SIEMENS

SICAM A8000 Series
CP-8031, CP-8050

Manual

DC8-026-2

NOTE

For your own safety, observe the warnings and safety instructions contained in this document, if available.

Disclaimer of Liability

Subject to changes and errors. The information given in this document only contains general descriptions and/or performance features which may not always specifically reflect those described, or which may undergo modification in the course of further development of the products. The requested performance features are binding only when they are expressly agreed upon in the concluded contract.

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Edition: 11.2022

Version of the product described:

Preface

Purpose of the Manual

This manual describes the characteristics and functions of the following products:

- CP-8031
- CP-8050

Target Audience

This manual is addressed to personnel and customers who are responsible for evaluation, conceptual design, configuration, and technical system maintenance.

It provides hints on how to get information or files via the website *https://support.industry.siemens.com*. If you do not have access to this website, contact your project manager at Siemens.

Scope

This manual is valid for the SICAM A8000 series.

Indication of Conformity

The product described conforms to the regulations of the following European Directives:

- 2014/30/EU
  Directive of the European Parliament and of the Council of 26 February 2014 on the harmonization of the laws of the Member States relating to electromagnetic compatibility; Official Journal of the EU L96, 29/03/2014, p. 79–106
- 2014/35/EU
  Directive of the European Parliament and of the Council of 26 February 2014 on the harmonization of the laws of the Member States relating to the making available on the market of electrical equipment designed for use within certain voltage limits; Official Journal of the EU L96, 29/03/2014, p. 357–374
- 2011/65/EU
  Directive of the European Parliament and of the Council of 8 June 2011 on the restriction of the use of certain hazardous substances in electrical and electronic equipment; Official Journal of the EU L174, 01/07/2011, p. 88-110

The conformity of the product with the above mentioned regulations is proven through the observance of the following harmonized standards:

- IEC/EN 60870-2-1 for 2014/30/EU
- IEC/EN 61010-1 and IEC/EN 61010-2-201 for 2014/35/EU;
  IEC/EN 61010-2-030 (only AI-8510, AI-8511, CM-8820, AI-8330, AI-8340)
- IEC/EN 63000 for 2011/65/EU

This declaration certifies the conformity with the specified directives, but is not an assurance of characteristics in the sense of the product liability law.

The product is intended exclusively for use in an industrial environment.

Standards

This product is UL-certified based on the Technical data:
UL 61010-2-201 incl. UL 61010-1; UL 61010-2-030
CAN/CSA-C22.2 No.61010-1 and CAN/CSA-C22.2 No.61010-2-201

IND. CONT. EQ.
E486146
E496940

For more information, see Product iQ on the Internet: *https://productiq.ulprospector.com/de*.
Log in (or use the option Search abridged site without login und search for UL File Nummer **E486146** or **E496940**.

Additional Support

For questions about the system, contact your Siemens sales partner.

Customer Support Center

Our Customer Support Center provides a 24-hour service.

Siemens AG	
Smart Infrastructure – Protection Automation	Tel.: +49 911 2155 4466
Customer Support Center	E-Mail: *energy.automation@siemens.com*

Training Courses

Inquiries regarding individual training courses should be addressed to our Training Center:

Siemens AG	
Siemens Power Academy TD	Phone: +49 911 9582 7100
Humboldtstraße 59	E-mail: *poweracademy@siemens.com*
90459 Nuremberg	Internet: *www.siemens.com/poweracademy*
Germany	

Notes on Safety

This document is not a complete index of all safety measures required for operation of the equipment (module or device). However, it comprises important information that must be followed for personal safety, as well as to avoid material damage. Information is highlighted and illustrated as follows according to the degree of danger:

DANGER

DANGER means that death or severe injury **will** result if the measures specified are not taken.

✧ Comply with all instructions, in order to avoid death or severe injuries.

WARNING

WARNING means that death or severe injury **may** result if the measures specified are not taken.

✧ Comply with all instructions, in order to avoid death or severe injuries.

CAUTION

CAUTION means that medium-severe or slight injuries **can** occur if the specified measures are not taken.

✧ Comply with all instructions, in order to avoid moderate or minor injuries.

NOTICE

NOTICE means that property damage **can** result if the measures specified are not taken.

✧ Comply with all instructions, in order to avoid property damage.

NOTE

Important information about the product, product handling or a certain section of the documentation which must be given attention.

Qualified Electrical Engineering Personnel

Only qualified electrical engineering personnel may commission and operate the equipment (module, device) described in this document. Qualified electrical engineering personnel in the sense of this document are people who can demonstrate technical qualifications as electrical technicians. These persons may commission, isolate, ground and label devices, systems and circuits according to the standards of safety engineering.

Proper Use

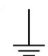
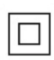
The equipment (device, module) may be used only for such applications as set out in the catalogs and the technical description, and only in combination with third-party equipment recommended and approved by Siemens.
Problem-free and safe operation of the product depends on the following:

- Proper transport
- Proper storage, setup and installation
- Proper operation and maintenance

When electrical equipment is operated, hazardous voltages are inevitably present in certain parts. If proper action is not taken, death, severe injury or property damage can result:

- The equipment must be grounded at the grounding terminal before any connections are made.
- All circuit components connected to the power supply may be subject to dangerous voltage.
- Hazardous voltages may be present in equipment even after the supply voltage has been disconnected (capacitors can still be charged).
- Operation of equipment with exposed current-transformer circuits is prohibited. Before disconnecting the equipment, ensure that the current-transformer circuits are short-circuited.
- The limiting values stated in the document must not be exceeded. This must also be considered during testing and commissioning.
- The device does not represent a safety-oriented application; it does not provide fault protection. Any fault protection must be provided by protection relays or other suitable means.

Selection of Used Symbols on the Device

No.	Symbol	Description
1		Direct current, IEC 60417, 5031
2		Alternating current, IEC 60417, 5032
3		Direct and alternating current, IEC 60417, 5033
4		Earth (ground) terminal, IEC 60417, 5017
5		Protective conductor terminal, IEC 60417, 5019
6		Caution, risk of electric shock
7		Caution, risk of danger, ISO 7000, 0434
8		Protective insulation, IEC 60417, 5172, safety class II devices
9		Guideline 2002/96/EC for electrical and electronic devices
10		Guideline for the Eurasian market
11		Mandatory conformity mark for electronics and electrotechnical products in Morocco

OpenSSL

This product includes software developed by the OpenSSL Project for use in OpenSSL Toolkit (*http://www.openssl.org/*).

This product includes software written by Tim Hudson (*tjh@cryptsoft.com*).

This product includes cryptographic software written by Eric Young (*eay@cryptsoft.com*).

Table of Contents

1 General Information

1.1 The Basic Units CP-8031, CP-8050

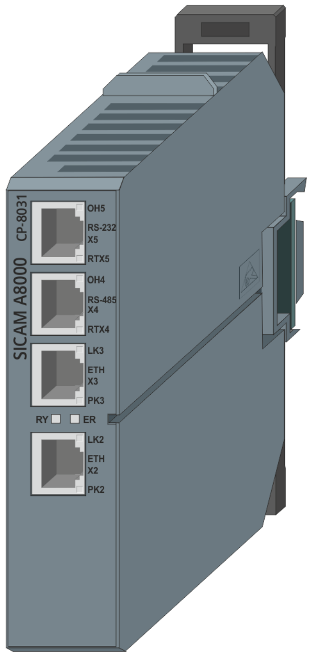


Figure 1-1 Master Module CP-8031

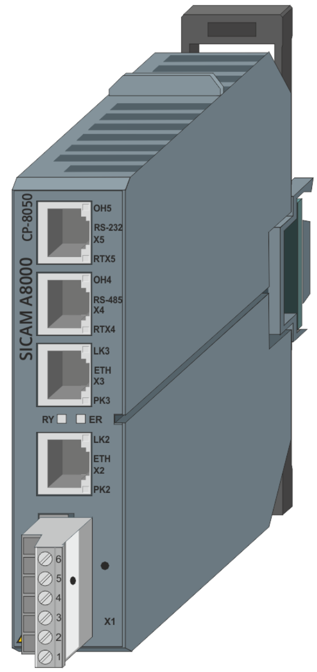


Figure 1-2 Master Module CP-8050

1.1.1 High Performing

With the SICAM A8000 Series you can implement different applications, depending on the requirements: telecontrol applications and automation solutions. Evidently all applications can be combined with each other.

The devices of the SICAM A8000 Series are universally usable. They are suitable for electrical distribution substations, gas distribution substations, hydro power plants, pipelines, railway power supplies, as well as in building protection or for alarm signaling.

Your advantages at a glance:

- Mechanical design for DIN-rail mounting and simple process connection.
- Versatile communication, integrated node functionality
- Expandable with external I/O modules (local and up to 15 remote I/O rows)
- Configuration, diagnostics and tests via SICAM Device Manager and SICAM TOOLBOX II; diagnostics and tests via SICAM WEB
- User-friendly through remote maintenance, remote diagnosis and remote parameterization
- Interlocking and local control in compliance with IEC 61131-3 thanks to smart user programs
- Optional data storage on SD card; plug-and-play for start-up and service
- Use of the devices of the SICAM A8000 Series under varied ambient conditions thanks to wide temperature range and extremely high degree of EMC

NOTE

Please consider the performance features of the systems and of its components in chapter 5, System Components and Technical Data

1.1.2 Different Fields of Application

Due to its node functionality, CP-8031/CP-8050 can be used in a variety of ways:

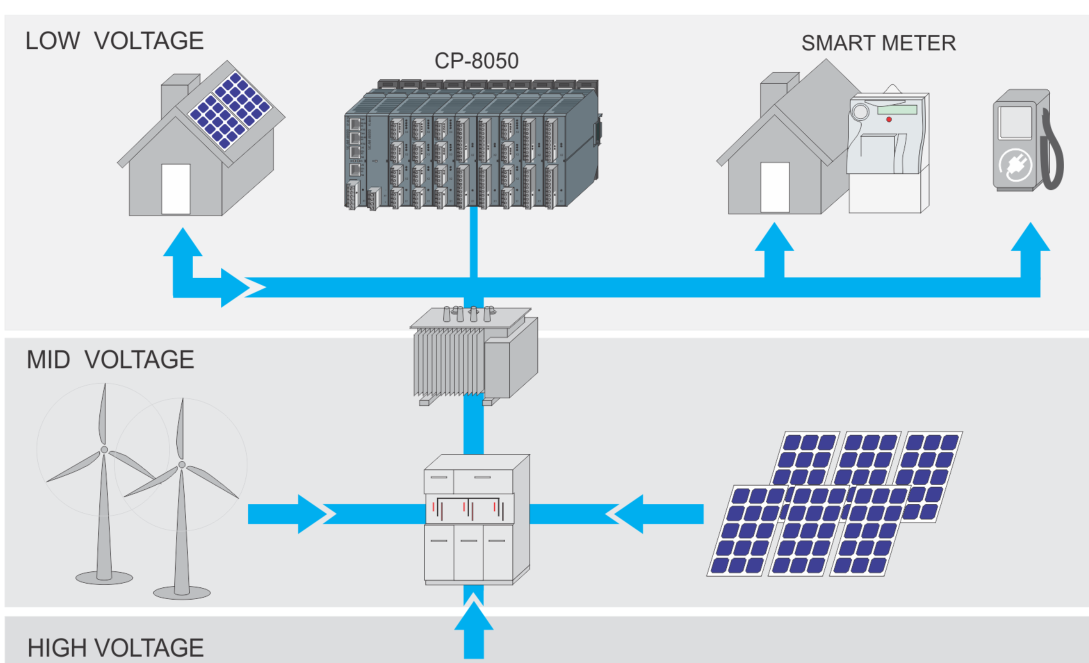
- Classical small telecontrol unit
- Remote terminal unit with manifold communication to the central station
- Automation and supervision of local network stations
- Transformer control
- Energy distribution and transmission
- Micro grids
- Traction power supply
- Communication gateway

In principle, for this all necessary functionalities are available. The actual application is defined simply through the corresponding configuration and parameterization.

Field of Application: Intelligent local network control

With this application CP-8031/CP-8050 enables a three-stage intelligence:

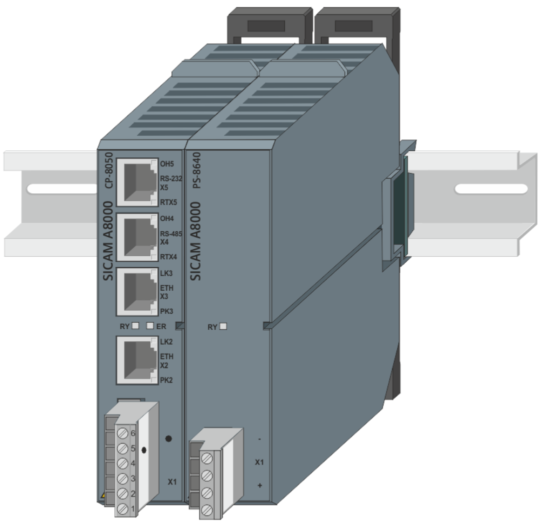
- Monitoring
  - High availability
  - Rapid fault location
- Telecontrol
  - Minimizing downtime
- Load flow control
  - Management of distributed infeeds
  - Minimizing losses



1.1.3 Mechanical Design

Assembly

The mechanical design is focused on achieving highest ease in handling. The installation of CP-8031/CP-8050 takes place on a DIN rail (TH35), which can be mounted horizontally. Remote I/O rows can also be mounted vertically.



[CP-8050_on_DIN_rail, 2, --_--]

Figure 1-3 CP-8050 and Power Supply mounted on DIN-rail

An essential feature of CP-8031/CP-8050 is the efficient and simple interfacing possibility of the process signals via removable screw terminals. This way of interfacing permits a direct sensor/actuator wiring without requiring the use of intermediate terminals. Where through the peripheral signals can be acquired very close to their point of origin, a wide cabling can be reduced to a minimum.

When the system is exchanged, no connections need to be detached, since the screw terminals carry the wiring. This reduces the assembly effort considerably.

With delivery, the screw terminals are plugged on the device.

1.1.4 Versatile communication, integrated node functionality

There are several possible means of communicating with the control center:

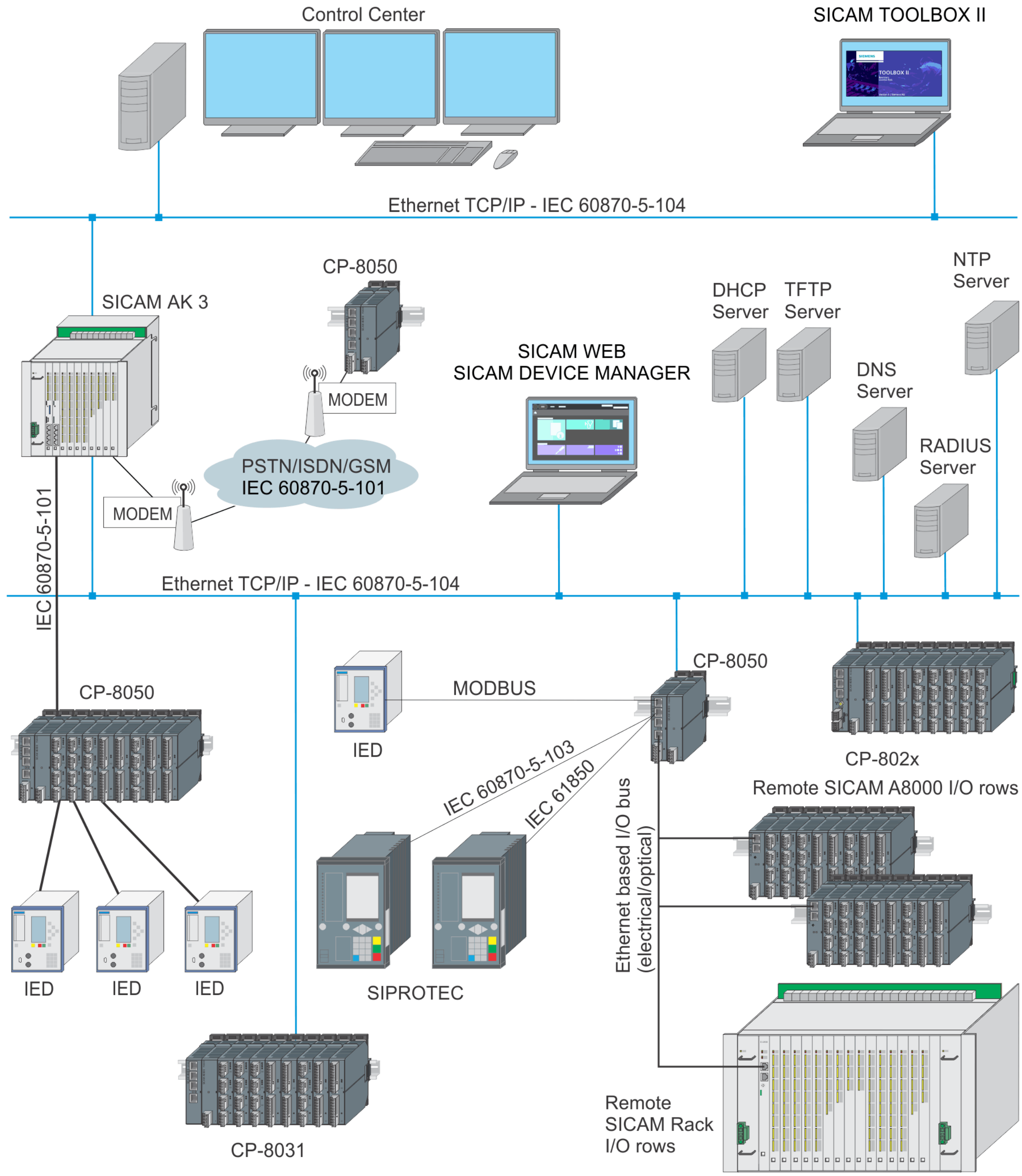
- Serial Communication

  You can connect external communications modules via the V.28 interface for transmission in point-to-point and mulit-point traffic. The standard protocols are freely selectable, as for example IEC 60870-5-101/-103 and Modbus RTU. Additional protocols are available on request.

- LAN/WAN

  In the case of communication via LAN/WAN networks, transmission is implemented for example in accordance with the IEC 60870-5-104 or IEC 61850 – based on Ethernet TCP/IP.

  Network services such as NTP, SNMP, PTP, Radius or Syslog are also available.



[dw_CP-8050_versatile_communication, 2, en_US]

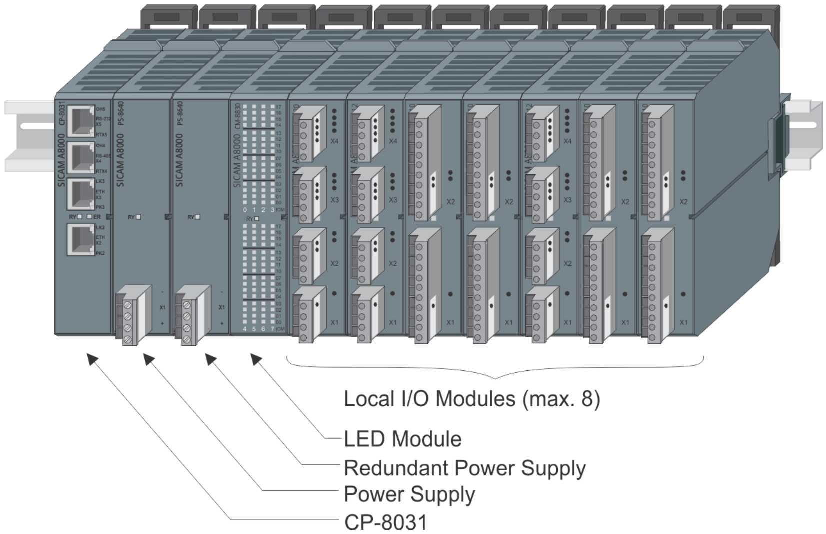
Further local devices can be connected in a very simple way via communication interfaces, in order to connect them to an entire unit.

1.1.5 Expandability

CP-8031

CP-8031 can be expanded with a local I/O row with up to 8 I/O modules. Further SICAM RTUs or other devices can be connected.

Freely programmable user programs for on-site control or regulating functions demonstrate the versatility of the CP-8031.



[dw_CP-8031_Expandibility, 1, en_US]

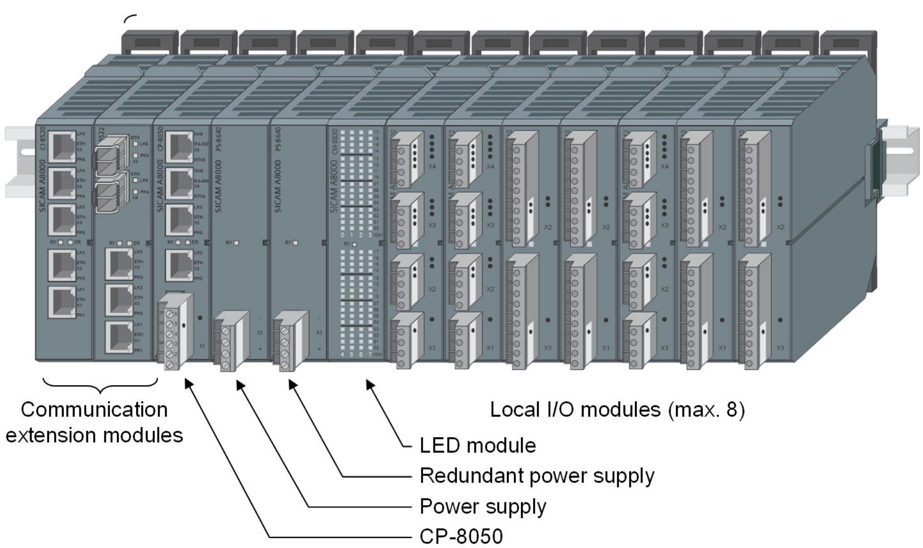
CP-8050

CP-8050 can be expanded with a local I/O row and up to 15 SICAM A8000 remote I/O rows or up to 4 SICAM A8000 racks. Further SICAM RTUs or other devices can be connected.

Freely programmable user programs for on-site control or regulating functions demonstrate the versatility of the CP-8050.

The local I/O modules always have the address PBA0. The remote I/O rows PBA1-15 (IO#1-15).

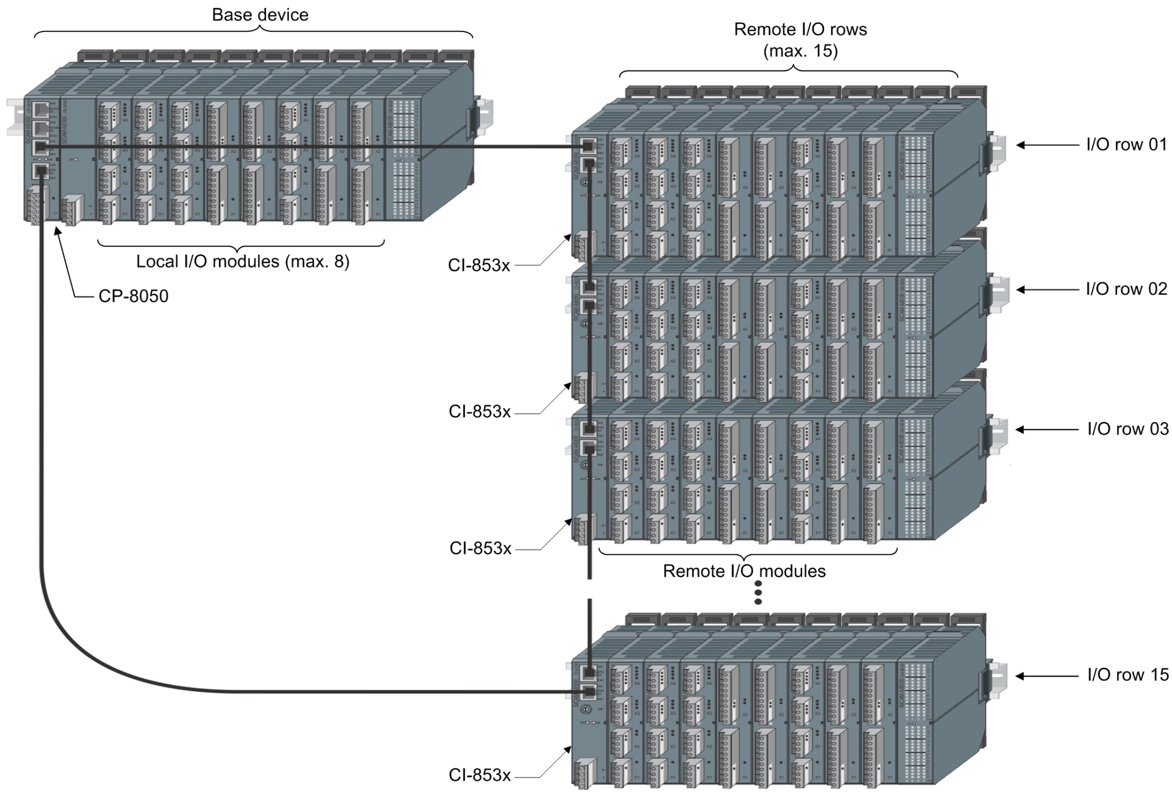
CP-8050 Basic Configuration with Local I/O Row



[dw_cp8050_cm8830first_expand, 3, en_US]

Figure 1-4 CP-8050 Basic Configuration with Local I/O Row

CP-8050 Basic Configuration with Local I/O Row and Remote I/O Rows (Ring Configuration)



[dw_cp8050_cm8830last_expand, 2, en_US]

Figure 1-5 CP-8050 Basic Configuration with Local I/O Row and Remote I/O Rows (Ring Configuration)

1.1.6 Spare Parts Concept

The optional usage of the SD card in CP-8031/CP-8050 enables a smooth exchange of all modules. The SD card which contains the data of the device to be replaced must only be inserted into the replacement device.

The replacement device must be in delivery status or the spare parts concept must be enabled in the loaded parameter (SD card mode). By default (after equipping) this concept is enabled, but it may be disabled due to security reasons.

1.1.7 Compatibility

The SICAM A8000 Series is in the range of IEC 60870 5 101/103/104, when using standard protocols, compatible with the hitherto existing SICAM RTUs system family (SICAM AK3 , SICAM AK, SICAM TM, SICAM EMIC, SICAM MIC, SICAM BC).

1.2 Performance Properties

	CP-8031	CP-8050
Maintenance-free, compact device for mounting on DIN rail	✓	✓
Expandable with SICAM A8000 I/O modules	16 (1 local I/O row, 1 remote I/O row[1])	128 (16 I/O rows, each 8)
Supported SICAM A8000 I/O Modules	all	all
Expandable with SICAM A8000 Rack I/O modules [1]	–	64 (4 I/O racks, each 16 I/Os)
Expandable with SICAM TM I/O modules	8 on local row	8 per I/O row
Combined automation and telecontrol function	✓	✓
Freely programmable application programs according to IEC 61131-3	✓	✓
Watchdog- and error-relais	–	✓
Function and error indication via LED	✓	✓
Communication		
RJ45 Ethernet interfaces 10/100Base-TX	2 on master module (up to 7 with CI-8520/22[1])	2 on Master Module (up to 12 with CI-Modules)
RS-232 interfaces with parameter-settable protocols according to IEC 60870-5-101/103/104, Modbus RTU and others	1 on master module (up to 5 with CI-8551[1])	1 on Master Module (up to 25 with CI-Modules)
RS-485 interfaces with parameter-settable protocols according to IEC 60870-5-101/103/104, Modbus RTU and others	1 on master module (up to 4 with CI-8551[1])	1 on Master Module (up to 19 with CI-Modules)
Number of protocols on firmware `Central processing (CPCI85)`	4	8
Number of protocols on firmware `Extended processing (EPCI85)` [1]	–	4
Number of firmware files `Extended processing (EPCI85)` [1]	–	4
Total number of protocols (`CPCI85 + EPCI85`) [1]	4	24
Multiple IP addresses per interface	✓	✓
Supported interface modules CI-8551/20/22	1/1/1 [1]	6/2/2[2]
Engineering, diagnosis and test via SICAM TOOLBOX II		
SICAM TOOLBOX II connection via LAN/WAN (remote connection)	✓	✓
Connection via proprietary TCP/IP protocol (one SICAM TOOLBOX II session can be served at the same time)	✓	✓
Simulation and logging of messages	✓	✓
Display of connection-, statistic- and developer information	✓	✓
Engineering, diagnosis and test via SICAM Device Manager		
SICAM Device Manager connection via LAN/WAN (remote connection)	✓	✓

1 License required; see chapter *14 Licenses*

2 Observe configuration rules. See *Configuration Rules for Communication Modules, Page 709*

	CP-8031	CP-8050
Simulation and logging of messages	✓	✓
Display of connection-, statistic- and developer information	✓	✓
Integrated web server for diagnosis via web browser (application SICAM WEB)		
Display of time, connection- and statistic information	✓	✓
Configuration of role based access control	✓	✓
Access to the web server with standard web browser via http(s)	✓	✓
Simulation and logging of messages	✓	✓
Dashboard for displaying data points and output of commands	✓	✓
Integrated protocol SNMP-Agent	✓	✓
Time synchronization via NTP server	✓	✓
Simplified maintenance operation by means of data storage on SD card	✓	✓
Authentication optional via RADIUS-Server	✓	✓
Secure password storage	✓	✓
Security[3]		
BDEW White Paper conformance statement	✓	✓
Firmware signature	✓	✓
Configurable firewall	✓	✓
Integrated Crypto-Chip	✓	✓
IPSec	✓	✓
802.1X - Network authorization supplicant	✓	✓
802.1Q - VLAN Tagging	✓	✓
Secure NTP	✓	✓
Service Forwarding (Port forwarding)	✓	✓
Security Logging	✓	✓
Role Based Access Control	✓	✓
Remote authentication via RADIUS or LDAP	✓	✓
HW based Application Firewall	✓	✓
X.509 certificate-based communication	✓	✓
Automatic certificate distribution using SICAM GridPass (EST)	✓	✓
SIAPP Container [1]	1	3
Maximum number of data points	20 000	400 000
Maximum number of stations	50	400 at CPCI85 + 200 per EPCI85
CFC resources of firmware *Central processing (CPCI85)*	1	1
CFC resources extension firmware *CPCI85 + EPCI85* [1]	–	4
Redundancy [1]	–	✓

3 Details see SICAM Administrator Security Manual (DC0-114-2)

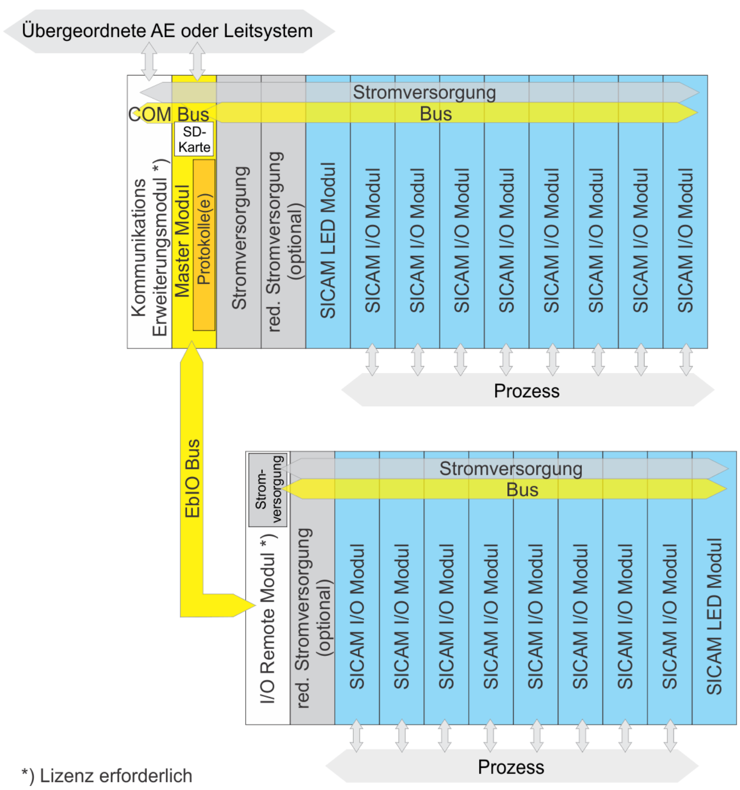
1.3 System Architecture

The basic configuration of a system consists of:

- A master module and a power supply module
  Based on the requirement, the basic configuration can be expanded with another power supply (optional for redundancy reasons).
- up to 8 local SICAM I/O modules
  The communication of the field process takes place via the extended SICAM I/O modules.
- The LED module
  The process data of 8 I/O modules are visualized by the LEDs on the LED module.

The communication to higher-level automation devices or to a control system takes place via the master module or additional extension modules. Up to 8 protocol elements can be loaded on the master module.

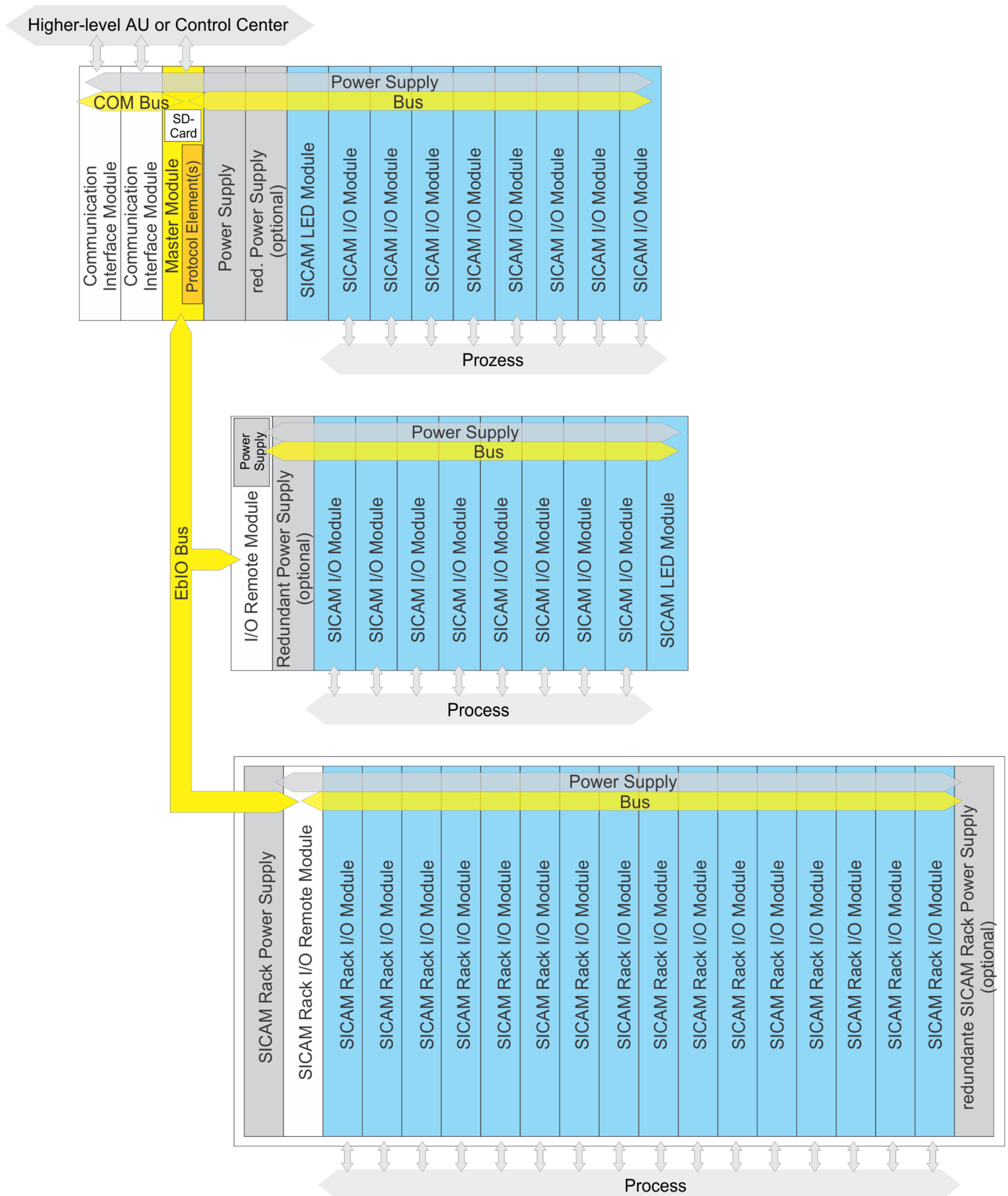
8 additional I/O modules can be connected to a CP-8031 system via a remote SICAM A8000 I/O row.



[dw_CP-8031_system_architecture, 2, en_US]

Figure 1-6 CP-8031 System Architecture

Further I/O modules can be connected via up to 15 remote SICAM A8000 I/O rows (each up to 8 I/O modules) or via up to 4 SICAM A8000 Racks.



[dw_CP-8050_system_architecture_with_rack, 2, en_US]

Figure 1-7 CP8050 System architecture

1.4 First Steps

Below you will find a chronological list of all the steps required to create a minimum configuration (master module with power supply) using the SICAM TOOLBOX II and a SD card.

Hardware

- Unpack the master module (CP-8031/CP-8050) and the power supply (PS-862x or PS-864x)
- Read carefully the product information for these devices
- Mount the master module on DIN rail as described in the PI
  For more information about mounting, see *6.5 Mounting/Removal of a SICAM A8000 Module*
- Mount the power supply to the right of the master module as described in the PI
- Read the following chapters:
  - *6.10 Memory card*
  - *6.11.6 Switching the Device On and Off*

Setup

- Read chapter *8.1.1 One Click to Connect*
  Necessary parameter settings via OPM II:
  - Definition of the interface, definition of the desired IP address, enable DHCP server:
    `System settings | Network settings | Interface`
  - Enable HTTP(S) WEB-Server:
    `System settings | Network settings | Services | Web server`
  - Enable SICAM WEB:
    `System settings | Network settings | Services | Web server | Applications`
  - Enable remote operation:
    `System settings | Network settings | Services | Web server | Applications | Remote operation`
- Configure firewall (OPM II, system technique, generate firewall)
- If necessary, obtain the latest firmware, e.g. via the live update in the SICAM TOOLBOX II
- Initialize the directly connected AE / load parameter
  or
- Generate flashcard (OPM II, system technique, flashcard, create files), insert flashcard into the device
  Note: The master module is delivered without SD card, the SD card must be ordered separately.
- Switch on power, automatic startup

2 System Overview

2.1 Power Supply

Base Device

The power supply of a CP-8031/CP-8050 base device takes place via one of the following power supply modules: PS-8620, PS-8622, PS-8640 or PS-8642. These provide the operating voltage for the master module, the transmission facilities with multi-point traffic and dial-up traffic (modem, interface converter) as well as for the local I/O modules.

To increase the availability a second power supply module can be used.

I/O row

The I/O remote rows are powered by the power supply that is integrated in the I/O remote modules (CI-8530, CI-8531, CI-8532 and CI-8533). To increase the availability of the I/O rows an additional power supply module (PS-8620, PS-8622, PS-8640 or PS-8642) can be used.

If the integrated power supply of the I/O remote module is not sufficient, it is possible to use up to two power supply modules instead. The integrated power supply must then not be wired.

I/O Rack

The power supply of the I/O racks takes place via the power supplies PS-2630 and PS-2632. To increase the availability in the I/O racks a second power supply module can be used.

Features of the Power Supply Modules

- Different input voltages
  - PS-862x: DC voltage input
  - PS-864x: AC or DC voltage input
  - CI-853x: DC voltage input (further information see *2.4 SICAM A8000 I/O Remote Modules*)
  - PS-2630: DC voltage input
  - PS-2632: AC or DC voltage input
- Input voltage
- Monitoring of the output voltages
- Monitoring of the input voltage
- Failure detection for redundancy
- Environmental conditions with enhanced electromagnetic compatibility
- Removable screw terminals
- Function indication via LED

Product Overview

Designation
PS-8620 Power Supply 24-60VDC 12W
PS-8622 Power Supply 110-220VDC 12W
PS-8640 Power Supply 24-60VDC 45W
PS-8642 Power S. 100-240VDC or VAC 45W
CI-8530 SICAM I/O Remote 24-60VDC el.
CI-8531 SICAM I/O Remote 24-60VDC F/O
CI-8532 SICAM I/O Remote 110-220VDC el.
CI-8533 SICAM I/O Remote 110-220VDC F/O

Designation
PS-2630 Power supply 24-60VDC
PS-2632 Power supply 110-220VDC, 230VAC

Configuration Rules for 2nd Power Supply

The 2nd power supply module must be plugged directly to the right of the first power supply module, or in the remote I/O row, just to the right of the I/O remote module.

2.2 Master module

The master module is the central processing unit. Its functionality is provided by means of a loadable and parameter-settable firmware.
The master module integrates the function packages for the telecontrol function (spontaneous processing and communication) and the open/closed-loop control function (periodical processing and peripheral functions) into one common device.
Additionally, it serves as centrally coordinating element for all system services.

Features

- Data node functionality
- Organization of the data flow from and to the communication interfaces
  - Ethernet (TCP/IP) for LAN/WAN connections according to IEC 60870-5-104 and IEC 61850
  - RS-232 for point-to-point or multi-point traffic according to IEC 60870-5-101 with supply for an external transmission facility
  - RS-485 for multi-point traffic according to IEC 60870-5-101 and interfacing of protective devices according to IEC 60870-5-103
- Time management and time synchronization via NTP
  - up to 4 different NTP servers (redundancy)
  - cyclically, adjustable in seconds, self-adapting
- Main focus in telecontrol
  - Parameter-settable telecontrol functions
  - Parameter-settable communication protocols
  - Monitoring and simulation of process signals
- Automation
  - Freely programmable open/closed-loop control function
- Autonomous behavior (for instance in the case of communication failure)
- Decentralized archive (DEAR) for the avoidance of data loss during communication fault
- Loadable firmware
- loadable SIAPP / LXC Container
- Optional storage of application data and firmware on SD card
- Watchdog- and Error-Relays (only CP-8050)
- Secure clock function
- Redundancy
- Network services (NTP, SNMP, Syslog, ...)
- Security

Product Overview

Designation	MLFB
CP-8031 Master Module (Bus connector CM-8813 is included; without SD card)	6MF28031AA00
CP-8050 Master Module (Bus connector CM-8813 is included; without SD card)	6MF28050AA00
CPCI85 Firmware Central processing and communication	

Designation	MLFB
EPCI85 Extended Processing	6MF27500EP00
SD-card 512 MB (optional) Temperature range - 40 to + 70 °C	6MF12132GA050AA0
SD-card 2 GB (optional) Temperature range - 25 to + 70 °C	6MF12131GA050AA0HH
CM-8813 Bus connector CP-8050 (this bus connector is part of CP-8031/CP-8050)	–

2.3 SICAM A8000 I/O Firmware

2.3.1 SICAM A8000 I/O Master Firmware

The SICAM A8000 I/O Master Firmware serves for the acquisition or output of process signals and performs the process-compliant adaptation, monitoring and processing of the process signals at each point of entrance or exit of the system. The functionality is provided by means of a loadable and parameter-settable firmware per SICAM A8000 row.

Features

- SICAM A8000 I/O Master firmwares can only be used on a basic firmware CPCI85
- Support of up to 8 SICAM I/O or SICAM TM I/O modules per I/O row
  Acquisition and preprocessing of process data according to IEC 60870-5-101/104 with and without time tag
  – Transmission of process information to the telecontrol function (for further distribution) and to the open-/closed-loop control function (for further processing)
    - Single-point and double-point information items
    - Count pulses
    - Measured values
  – Transmission of system information (example: diagnosis data)
- Postprocessing and output of process data according to IEC 60870-5-101/104
  – Reception of process information from the telecontrol function and from the open-/closed-loop control function
    - Single-point information
    - Single-point and double-point command items
    - Setpoint command
  – Reception of system information (example: Parameter)
- Secured data exchange with the SICAM I/O modules
- Supervision of the I/O modules and failure handling
- Error display via LED

Product Overview

Designation
IOMI85 Universal Signal Input and Output for SICAM A8000 I/O Modules
IOMI65 Universal Signal Input and Output for SICAM TM I/O Modules

2.3.2 SICAM A8000 Rack I/O Firmware

The SICAM A8000 Rack I/O Firmware serves for the acquisition or output of process signals and performs the process-compliant adaptation, monitoring and processing of the process signals at each point of entrance or exit of the system. The functionality is provided by means of a loadable and parameter-settable firmware per SICAM A8000 Rack I/O module.

Features

- SICAM A8000 rack I/O firmware can only be used on Expansion Processing firmware EPCI85
- A separate I/O firmware is required for each SICAM A8000 Rack I/O module
- The different firmware functions are listed in the Rack I/O modules

Product Overview

Designation	
BISI85	Digital input (8x8, 1 ms) (for DI-2100[4])
BISI86	Digital input (8x8, 1 ms) (for DI-2110[4], DI-2111[4])
BISIX86	Digital input (8x8, 1 ms) (for DI-2112, DI-2113, DI-2114, DI-2115)
BISO85	Digital output (Transistor, 40x1) (for DO-2201)
PASI85	Analog input (16x + opt. extension) (for AI-2300, AI-2302[4], AI-2303[4])
PCCO86	Command output (for DO-2210, DO-2211)
PCCO87	Command output with on/off rail (for DO-2210, DO-2211)
USIO86	Univ. input/output (32 DI, 16 CO, 2 DO, 2 AI, opt. extension) (for MX-2400)
USIO87	Univ. input/output (32 DI, 16 CO, with on/off rail, 2 DO, 2 AI, opt. extension) (for MX-2400[4])

4 Module state: termination of delivery

2.4 SICAM A8000 I/O Remote Modules

The SICAM A8000 I/O remote modules are used to couple remote SICAM A8000 I/O or SICAM TM I/O rows to a CP-8031[5]/CP-8050 base device via the Ethernet-based I/O bus (electrical or fiber optic). The integrated power supply supplies up to 8 SICAM A8000 I/O modules.

Features

- Support of up to 8 SICAM A8000 I/O or SICAM TM I/O modules
- Ring-, Star and Daisy Chain configurations are possible
- Optional redundant power supplies are supported
- Error display via LED

Product Overview

Designation	Power	MLFB
CI-8530 SICAM I/O Remote 24-60VDC el.	1.5 W	6MF28530AA00
CI-8531 SICAM I/O Remote 24-60VDC F/O[6]	4.5 W	6MF28531AA00
CI-8532 SICAM I/O Remote 110-220VDC el.	1.5 W	6MF28532AA00
CI-8533 SICAM I/O Remote 110-220VDC F/O[6]	4.5 W	6MF28533AA00
CM-8812 Bus Connector SICAM I/O [7]	–	–

5 License required

6 Power consumption is 4.5 W with factory supplied SFP modules. Power consumption is dependent on type of SFP mudule used. Refer to *5.5.1.2 Technical Data*.

7 Supplied with each I/O module

2.5 SICAM A8000 Rack I/O Remote Modules

The SICAM A8000 I/O remote module CI-2530 serves for coupling remote SICAM I/O Racks (CM-2846) to the CP-8050 base device via the Ethernet based I/O bus. A separate power supply (PS-2630/32) is required for each rack, which can supply up to 16 rack I/O modules.

Features

- Support for up to 4 racks
- Ring-, Star and Daisy Chain –configurations are possible
- Optional redundant power supplies are supported
- Error display via LED

Product Overview

Designation	MLFB
CI-2530 SICAM Rack I/O Remote	6MF22530AA00
CM-2846 Rack for 17 slots	6MF11130CJ460AA0
PS-2630 Power supply DC 24 to 60 V	6MF11130CG300AA0
PS-2632 Power supply DC 110 to 220 V, AC 230 V	6MF11130CG320AA0

2.6 SICAM A8000 I/O Modules

The SICAM A8000 I/O modules support the master module with the input and output of process signals.

The SICAM A8000 I/O modules communicate with the master module via an internal bus. This bus transmits data of different classes:

- Spontaneous data for the function package Telecontrol
  - Process information and system information that is transmitted acknowledged between the master module and the SICAM A8000 I/O modules within the acquisition and output grid
- Periodical data for the function package Automation
  - Information, which are transmitted between the master module and the SICAM A8000 I/O modules in the cycle of the open /closed-loop control function
- I/O Process data
  - I/O process status and I/O process errors that are transmitted from the SICAM A8000 I/O modules to the LED module for visualization

Features

- Acquisition of process signals and preprocessing by means of hardware
  - Digital inputs
  - Analog inputs (current, voltage, temperature)
- Output of process signals and postprocessing by means of hardware
  - Digital outputs
  - Analog outputs (current, voltage)
- Visualization of I/O process data via the LED module for each SICAM A8000 I/O row without any additional tool

Product Overview

Designation	MLFB
DI-8110 Digital Input 2x8, 24VDC	6MF28110AA00
DI-8111 Digital Input 2x8, 48/60VDC	6MF28111AA00
DI-8112 Digital Input 2x8, 110VDC	6MF28112AA00
DI-8113 Digital Input 2x8, 220VDC	6MF28113AA00
DO-8212 Dig Outp Rel 8x 24-220VDC/230VAC	6MF28212AA00
DO-8221 Secured Command Output[8]	6MF28221AA00
DO-8230 Dig Outp Transistor 16x 24-60VDC	6MF28230AA00
AI-8310 Analog Input 2x2 Pt100/Pt1000	6MF28310AA00
AI-8320 Analog Input 4x ±20mA/±10V	6MF28320AA00
AI-8330 Ana. Input 3xI(6A) for AI-8340	6MF28330AA00
AI-8340 Ana. Input (4xU(250V), 2xDO)	6MF28340AA00
AI-8510 Analog Inp.(3xU(240V),3xI(LoPo))[8]	6MF28510AA00
AI-8511 Analog Inp.(3xU(LoPo),3xI(LoPo))[8]	6MF28511AA00
AO-8380 Analog Output 4x ±20mA/±10V	6MF28380AA00
CM-8830 SICAM I/O Module LED Unit	6MF28830AA00
CM-8820 CT-Adapter 3xI 1A_5A/225mV	6MF28820AA00

8 Cannot be used for redundancy

Designation	MLFB
CM-8812 Bus connector SICAM I/O (this bus connector is part of all SICAM I/O modules)	–
CM-8816 Bus Connector AI-8340 (this bus connector is part of AI-8330)	–

2.7 SICAM A8000 Rack I/O Modules

The SICAM A8000 Rack I/O modules support the CP-8050 master module with the input and output of process signals.
The SICAM A8000 I/O modules communicate with the CP-8050 master module via an internal bus. This bus transmits data of different classes:

- Spontaneous data for the function package Telecontrol
  - Process information and system information that is transmitted acknowledged between the master module and the SICAM A8000 Rack I/O modules within the acquisition and output grid
- Periodical data for the function package Automation
  - Information, which are transmitted between the master module and the SICAM A8000 Rack I/O modules in the cycle of the open /closed-loop control function

Features

- Acquisition of process signals and preprocessing by means of hardware
  - Digital inputs
  - Analog inputs (current, voltage, temperature)
- Output of process signals and postprocessing by means of hardware
  - Digital outputs
  - Analog outputs (current, voltage)

Product Overview

Designation	MLFB
DI-2112 Digital Input 8x8, 24VDC,1ms	6MF10130CB120AA0
DI-2113 Digital Input 8x8, 48/60VDC,1ms	6MF10130CB130AA0
DI-2114 Digital Input 8x8, 110VDC,1ms	6MF10130CB140AA0
DI-2115 Digital Input 8x8, 220VDC,1ms	6MF10130CB150AA0
DO-2201 Dig. Outp.Trans 40x1,24-60VDC	6MF10110CC010AA0
DO-2210 Command Output 24-60VDC	6MF10110CC100AA0
DO-2211 Command Output 125VDC	6MF10110CC110AA0
AI-2300 Ana. Inp.16x ±20mA + 4x opt.IOM	6MF10110CD000AA0
SM-0570 Analog Input Extension (2x+/-20mA)	6MF10110AF700AA0
SM-0571 Analog Value Extension (2x Pt100)	6MF10110AF710AA0
SM-0572 Analog output extension (2x ±20 mA,±1/10 V)	6MF10110AF720AA0
SM-0574 Counter input (2x24-60VDC)	6MF10110AF740AA0
SM-2506 Measuring module for command output 24-60VDC	6MF10110CF060AA0

2.8 SICAM TM I/O Modules

The SICAM TM I/O modules support the I/O master module (IOMI65) with the input and output of process signals.

The SICAM TM I/O modules communicate with the master module via an internal bus. This bus transmits data of different classes:

- Spontaneous data for the function package Telecontrol
  - Process information and system information that is transmitted acknowledged between the master module and the SICAM TM I/O modules within the acquisition and output grid
- Periodical data for the function package Automation
  - Information, which are transmitted between the master module and the SICAM TM I/O modules in the cycle of the open /closed-loop control function

Features

- Acquisition of process signals and preprocessing by means of hardware
  - Digital inputs
  - Analog inputs (current, voltage, temperature)
- Output of process signals and postprocessing by means of hardware
  - Digital outputs
  - Analog outputs (current, voltage)

NOTE

The coupling module CM-6812 is required for the physical connection of SICAM TM I/O modules to a CP-8031/CP-8050 system.

Product Overview

Designation	MLFB
DI-6100 Binary input 2x8 DC 24 to 60 V	6MF11130GB000AA0
DI-6101 Binary input 2x8 DC 110/220 V	6MF11130GB010AA0
DI-6102 Binary input 2x8 DC 24 to 60 V, 1 ms	6MF11130GB020AA0
DI-6103 Binary input 2x8 DC 110/220 V, 1 ms	6MF11130GB030AA0
DI-6104 Binary input 2x8 DC 220 V	6MF11130GB040AA0
DO-6200 Binary output transistor 2x8 DC 24 to 60 V	6MF11130GC000AA0
DO-6212 Binary output relays 8x DC 24 to 220 V / AC 230 V	6MF11130GC120AA0
DO-6220 Secured command output basic module	6MF11130GC200AA0
DO-6221 Secured command output basic module measurement	6MF11130GC210AA0
DO-6230 Secured command output relay module	6MF11130GC300AA0
AI-6300 Analog input 2x2 ±20 mA/±10 V	6MF11130GD000AA0
AI-6307 Analog input 2x2 ±2.5 mA/±5 mA/±10 V	6MF11130GD070AA0
AI-6308 Analog input 2x2 ±1 mA/±2 mA/±10 V	6MF11130GD080AA0
AI-6310 Analog input 2x2 Pt100/Ni100	6MF11130GD100AA0
AO-6380 Analog output 4x ±20 mA/±10 mA/±10 V	6MF11130GD800AA0
TE-6420 Speed acquisition 2x2 DC 5/24V/NAMUR	6MF11130GE200AA0
TE-6430 Counting Pulse Inp. 2x DC 24 to 60 V	6MF11130GE300AA0

Designation	MLFB
TE-6450 Position acquisition 2x2 SSI/RS422	6MF11130GE500AA0
CM-6812 Coupling SICAM TM I/O modules	6MF11130GJ120AA0

NOTE

- As of version 4.20 of IOMI85, the module TE-6420 can also be used for redundancy
- To the right of the module TE-6420, only additional TE-6420 can be used
  (no other modules possible)

2.9 Devices with Conformal Coating

Product Overview

Designation	MLFB
CP-8050 Master Module	6MF28050AC00
CP-8031 Master Module	6MF28031AC00
PS-8620 Power supply DC 24 V to 60 V, 12 W	6MF28620AC00
PS-8622 Power supply DC 110 V to 220 V, 12 W	6MF28622AC00
CI-8520 Ethernet Interface	6MF28520AC00
CI-8530 SICAM I/O Remote 24-60VDC el.	6MF28530AC00
CI-8532 SICAM I/O Remote 110-220VDC el.	6MF28532AC00
DI-8110 Digital Input 2x8, 24 VDC	6MF28110AC00
DI-8111 Digital Input 2x8, 48/60VDC	6MF28111AC00
DI-8112 Digital Input 2x8, 110VDC	6MF28112AC00
DI-8113 Digital Input 2x8, 220VDC	6MF28113AC00
DO-8230 Digital output transistor 16x 24-60VDC	6MF28230AC00
DO-8212 Dig Outp Rel 8x 24-220VDC/230VAC	6MF28212AC00
AI-8310 Analog input 2x2 Pt100/Pt1000	6MF28310AC00
AI-8320 Analog output 4x ±20 mA/±10 V	6MF28320AC00
CM-8830 SICAM I/O Module LED Unit	6MF28830AC00

NOTE

The hardware of the MLFBs 6MF28xyzAA00 and 6MF28xyzAC00 is equal, but 6MF28xyzAC00 is conformal coated.

2.10 Configuration Rules for SICAM A8000 I/O Modules

If you use SICAM A8000 I/O modules, pay attention to the following rules:

- The total power consumption of the I/O modules must not exceed the following values:
  - 7 W (PS-862x, CI-853x)
  - 8 W (PS-864x)

  The total power consumption of all modules (I/O + CP + CI + LED module) must not exceed the power provided by the power-supply module.
- I/O modules with a power consumption > 800 mW must be mounted directly to the right of the power supply.
  Exception:
  - A LED module is mounted at the first slot.
  - If AI-8340 and PS-864x (with synchrocheck) are used, between these two modules a distance of 2 modules must be adhered.
- When using the LED module for each SICAM A8000 I/O row, the module can be mounted at any position on the right side from the power-supply module.
  The LED module can also be mounted before the I/O module which is having a power consumption > 800 mW.
- The combination of binary information and pulse commands on the single DO module is not possible, except with usage of the categories DO_SX and DO_DX (for details, refer to the manual SICAM RTUs Common Functions Peripheral Elements According to IEC 60870-5-101/104, chapter **Binary information and Command Output**).
  Following cases explain the mixing of binary information and pulse commands on a single module DO-820x, DO-821x or DO-823x:
  - Mixing of DO_SX, DO_DX, DO_SC_1.5POL and DO_DC_1.5POL is possible
  - Mixing of DO_SC_1POL and DO_DC_1POL is possible
  - Mixing of DO_SC_2POL and DO_DC_2POL is possible
  - Mixing of DO_SX and/or DO_DX with DO_SC_1POL and/or DO_DC_1POL is not possible
- For current measurement of each AI-8510 module, CM-8820 must be used; the CM-8820 must be always mounted at the end of an I/O row or at a separate I/O row.
- The current measuring module AI-8330 is only functional in combination with an analog voltage measuring module AI-8340 and the associated bus connector CM-8816. The voltage measuring module must always be plugged in to the left of the current measuring module.

Option “Assignment of Return Information to Pulse Command”

- With the parameter-settable assignment, the sequence of DI modules and DO modules is arbitrary.
- With the fixed assignment respectively after a DI-811x (DI-610x), a DO-82xx (DO-62xx) must be equipped.

2.11 Configuration Rules for SICAM TM Modules

If you use SICAM TM I/O modules, pay attention to the following rules:

- Up to 8 SICAM TM I/O modules can be used, as long as
  - the total power of the SICAM TM I/O modules do not exceed 7.0 W
  - the total load of all I/O modules and the peripheral control module does not exceed the power provided by the power supply module
    (with TE-6430 consider the startup power consumption of 0.6 W)
- AO modules must be installed on the first slots (max. 3 pieces possible; in the case of a 2-line arrangement, with the extension cable CM-6810, only allowed in the first line)
- The CM-6810 (TM I/O module extension cable) can also be used as an option
- The mixture of current and voltage on the same AI module is not possible
- It is not possible to mix binary information and pulse command on the same DO module, except when using the categories DO_EX and DO_DX
  (for details refer to manual **SICAM RTUs Common Functions Peripheral Elements According to IEC 60870-5-101/104**, chapter **Binary information and command output**)

2.12 Communication

2.12.1 Protocol Elements

A protocol element serves for the exchange of data – and thus for the transmission of messages – via a communication interface to other automation units or process control systems.

The hardware for the protocol elements is integrated on the master module and the communication modules, and their functionality is provided by means of loadable and parameter-settable firmware.

Via the communication interfaces the master module is able to communicate with an arbitrary superior or subordinate automation unit in point-to-point or multi-point traffic (with the aid of an external transmission facility), or via LAN/WAN.

Supported protocols

CP-8050 supports the following protocols and interfaces.

Protocol	Firmware	Designation	Interface		
			CP-8031/50	CI-852x	CI-8551
Integrated standard protocols					
DHCP	CPCI85	Dynamic Host Configuration Protocol	ETH (X2, X3)	ETH (X1 - X5)	
EST	CPCI85	"Enrollment over Secure Trans-port Protocol (EST)" for the remote request of certificates (Client)	ETH (X2, X3)	ETH (X1 - X5)	
http/https	CPCI85	TOOLBOX II remote operation	ETH (X2, X3)	ETH (X1 - X5)	
IPSec	CPCI85	Internet Protocol Security (IPsec)	ETH (X2, X3)	ETH (X1 - X5)	
IRIG-B	CPCI85	Inter Range Instrumentation Group Time Code Protocol	RS-232 (X5) RS-422 (X4)		
LDAP	CPCI85	"Lightweight Directory Access Protocol (LDAP)" – Internet protocol security (IPsec) for the role based administration of the authorized users	ETH (X2, X3)	ETH (X1 - X5)	
NTP	CPCI85	Network Time Protocol (Client + Server)	ETH (X2, X3)	ETH (X1 - X5)	
NTPsec	CPCI85	Secure Network Time Protocol (NTPsec) (Client + Server)	ETH (X2, X3)	ETH (X1 - X5)	
PTPmc	CPCI85	IEEE1588 "Precision Time Protocol" Master Clock (PTPmc)	ETH (X2, X3)	ETH (X1 - X5)	
PTPoc	CPCI85	IEEE1588 "Precision Time Protocol" Ordinary Clock (PTPoc)	ETH (X2, X3)	ETH (X1 - X5)	
RADIUS	CPCI85	"Remote Authentication Dial-In User Service" for administration of the authorized user (Client)	ETH (X2, X3)	ETH (X1 - X5)	
SNMP V3 Agent	CPCI85	Simple Network Management Protocol	ETH (X2, X3)	ETH (X1 - X5)	
SNTP	CPCI85	Simple Network Time Protocol (Client + Server)	ETH (X2, X3)	ETH (X1 - X5)	
Syslog	CPCI85	System Message Logging (Client)	ETH (X2, X3)	ETH (X1 - X5)	

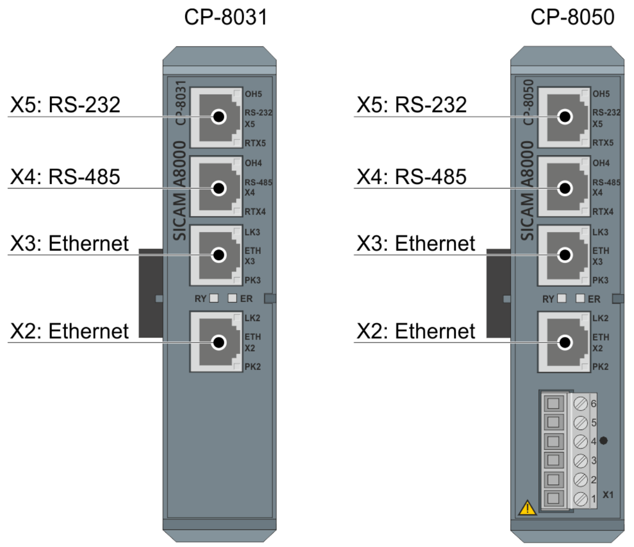
Protocol	Firmware	Designation	Interface		
			CP-8031/50	CI-852x	CI-8551
Equipable standard protocols					
DNP3	DNPII1	DNP3 TCP Slave	ETH (X2, X3)	ETH (X1 - X5)	
	DNPII2	DNP3 TCP Master	ETH (X2, X3)	ETH (X1 - X5)	
	DNPSI0	DNP3 Slave	RS-232 (X5) RS-485 (X4) RS-422 (X4)		RS-232 (X1, X2, X4, X5) RS-485 (X1, X2, X3) RS-422 (X1, X2, X3)
	DNPMI0	DNP3 Master	RS-232 (X5) RS-485 (X4) RS-422 (X4)		RS-232 (X1, X2, X4, X5) RS-485 (X1, X2, X3) RS-422 (X1, X2, X3)
DSfG	DSFGI0	DSfG-Bus Slave (Instance)	RS-485 (X4)		RS-485 (X1,X2, X3)
IEC 60870-5-101	BPPI0	Point-To-Point Traffic	RS-232 (X5) RS-422 (X4)		RS-232 (X1, X2, X4, X5) RS-422 (X1, X2, X3)
IEC 60870-5-101	UMPMI0	Multi-point traffic Master	RS-232 (X5) RS-485 (X4) RS-422 (X4)		RS-232 (X1, X2, X4, X5) RS-485 (X1, X2, X3) RS-422 (X1, X2, X3)
IEC 60870-5-101	UMPSI0	Multi-point traffic Slave	RS-232 (X5) RS-485 (X4) RS-422 (X4)		RS-232 (X1, X2, X4, X5) RS-485 (X1, X2, X3) RS-422 (X1, X2, X3)
IEC 60870-5-103	103MI0	Protective device interfacing Master	RS-232 (X5) RS-485 (X4) RS-422 (X4)		RS-232 (X1, X2, X4, X5) RS-485 (X1, X2, X3) RS-422 (X1, X2, X3)
IEC 60870-5-103	103SI0	Protection device interfacing Slave	RS-232 (X5) RS-485 (X4) RS-422 (X4)		RS-232 (X1, X2, X4, X5) RS-485 (X1, X2, X3) RS-422 (X1, X2, X3)
IEC 60870-5-104	ETI4	Ethernet TCP/IP	ETH (X2, X3)	ETH (X1 - X5)	
IEC 60870-5-104	FWI4	Ethernet TCP/IP with Application Layer Firewall	ETH (X2, X3)	ETH (X1 - X5)	
IEC 61850 Ed. 1+2	ETI5	Ethernet TCP/IP (Client)	ETH (X2, X3)	ETH (X1 - X5)	
IEC 61850 Ed. 2	ETI5	Ethernet TCP/IP (Server)	ETH (X2, X3)	ETH (X1 - X5)	
IEC 61850 Ed 2	ETI5	Ethernet TCP/IP (GOOSE)	ETH (X2, X3)	ETH (X1 - X5)	
IOT	OPUPI0	IOT Publisher (MQTT)	ETH (X2, X3)	ETH (X1 - X5)	
	OPUPI1	IOT Publisher (MindSphere)	ETH (X2, X3)	ETH (X1 - X5)	
Modbus RTU	MODMI0	Modbus RTU Master	RS-232 (X5) RS-485 (X4) RS-422 (X4)		RS-232 (X1, X2, X4, X5) RS-485 (X1, X2, X3) RS-422 (X1, X2, X3)
	MODSI0	Modbus RTU Slave	RS-232 (X5) RS-485 (X4) RS-422 (X4)		RS-232 (X1, X2, X4, X5) RS-485 (X1, X2, X3) RS-422 (X1, X2, X3)
Modbus TCP	MBCII0	Modbus TCP Master ("Client")	ETH (X2, X3)	ETH (X1 - X5)	
	MBSII0	Modbus TCP Slave ("Server")	ETH (X2, X3)	ETH (X1 - X5)	
PROFIBUS-DP	DPMI0	PROFIBUS-DP Master (DPV0) with ext. Gateway	ETH (X2, X3)	ETH (X1 - X5)	
PROFINET-IO	PNMI0	PROFINET-IO Master ("Controller") with ext. Gateway	ETH (X2, X3)	ETH (X1 - X5)	

Protocol	Firmware	Designation	Interface		
			CP-8031/50	CI-852x	CI-8551
Installable protocols (project-specific)					
AGP	AGPMI0	AGP Master for power distributor branch specific test equipment	RS-232 (X5)		RS-232 (X1, X2, X4, X5)
DLMS/COSEM	ETMCI9	DLMS Ethernet counter interfacing Master (Client)	ETH (X2, X3)	ETH (X1 - X5)	
EAW Ursatron 8000	U80ZI0	EAW Ursatron 8000 Master	RS-232 (X5) RS-485 (X4) RS-422 (X4)		RS-232 (X1, X2, X4, X5) RS-485 (X1, X2, X3) RS-422 (X1, X2, X3)
SAT SK 1703 GV	PCBMI0	SAT SK 1703 PCMBA Multi-point traffic Master for serial coupling of SK 1703, MK 1703, uK 1703, Ax 1703	RS-232 (X5) RS-485 (X4) RS-422 (X4)		RS-232 (X1, X2, X4, X5) RS-485 (X1, X2, X3) RS-422 (X1, X2, X3)
SAT SK 1703 Point-to-Point	SKEEI1	SAT SK 1703 PCMBA Point-to-Point for serial coupling of SK 1703, MK 1703, Ax 1703	RS-232 (X5) RS-422 (X4)		RS-232 (X1, X2, X4, X5) RS-422 (X1, X2, X3)
Siemens SINAUT 8	SA8MI0	Siemens SINAUT 8 Master Point-to-point or multi-point traffic Master	RS-232 (X5) RS-485 (X4) RS-422 (X4)		RS-232 (X1, X2, X4, X5) RS-485 (X1, X2, X3) RS-422 (X1, X2, X3)
	SA8SI0	Siemens SINAUT 8 Slave Point-to-point or multi-point traffic Slave	RS-232 (X5) RS-485 (X4) RS-422 (X4)		RS-232 (X1, X2, X4, X5) RS-485 (X1, X2, X3) RS-422 (X1, X2, X3)
ÖBB X.25	OX25I1	ÖBB X.25 with ext. "PAD" for railway control center information	RS-232 (X5)		RS-232 (X1, X2, X4, X5)
VLZ	VLZI0	ÖBB VLZ (PIPS1) for railway control center information	RS-232 (X5) RS-422 (X4)		RS-232 (X1, X2, X4, X5) RS-422 (X1, X2, X3)

Additional information on interfacing to third-party systems and further protocols is available on request.

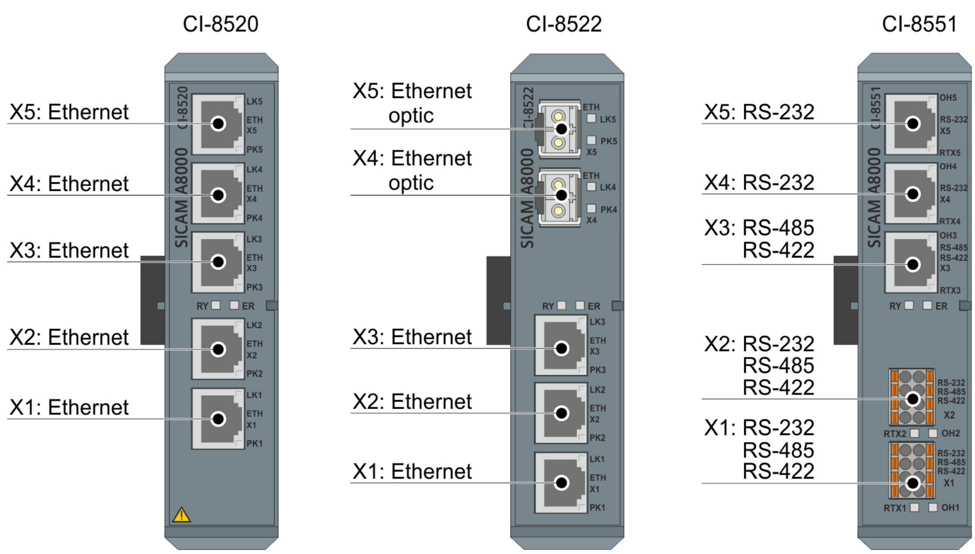
2.12.2 Communication Interfaces

In addition to the master modules, the communication modules CI-8520, CI-8522 and CI-8551 offer interfaces for serial, Ethernet or fiber optic communication.
All interfaces can be operated simultaneously.



[dw_communication_interfaces_master_modules, 1, --_--]

Figure 2-1 Communication interfaces of the master modules



[dw_communication_interfaces_extension_modules, 1, en_US]

Figure 2-2 Communication interfaces of the communication modules

NOTE

An additional license is required to use one of these communication modules with the CP-8031.

2.12.3 Transmission Facilities

Supported transmission facilities:

Connection	Transmission facility	Protocol-Firmware
Multi-point traffic Point-to-point traffic (serial)	CE-0700 V.23 Leased line modem[9]	UMPMI0, UMPSI0
	CE-0701 VFT Channel modem[9]	UMPMI0, UMPSI0
	CM-0847 fiber optical interface (electrical/FO)	103MI0, 103SI0, UMPMI0, UMPSI0, MODMI0, MODSI0, DNPSI0
	SIEMENS 7XV5450 Mini Starcoupler	103MI0, 103SI0, UMPMI0, UMPSI0
	SIEMENS 7XV5652 RS-232/LWL Converter	103MI0, 103SI0, UMPMI0, UMPSI0
	PHOENIX PSM-ME-RS232/RS485-P	103MI0, 103SI0, UMPMI0, UMPSI0, MODMI0, MODSI0, BPPI0
	Westermo TD-23 (analog)[10]	UMPMI0, UMPSI0
	SATELLINE 2ASxE	UMPMI0
	TP Radio WDM 8000	UMPSI0
	Radio digital	UMPMI0, UMPSI0
	Radio analog	UMPMI0, UMPSI0
	Direct connection RS-232 [11]	103MI0, 103SI0, UMPMI0, UMPSI0, MODMI0, MODSI0, BPPI0, DNPSI0, U80ZI0, VLZI0, PCBMI0, SKEEI1, SA8MI0, SA8SI0, OX25I1
	Direct connection RS-422	BPPI0, 103MI0, 103SI0, UMPMI0, UMPSI0, MODMI0, MODSI0, DNPSI0, U80ZI0, VLZI0, PCBMI0, SKEEI1, SA8MI0, SA8SI0
	Direct connection RS-485	103MI0, 103SI0, UMPMI0, UMPSI0, MODMI0, MODSI0, DNPSI0, DSFGI0, U80ZI0, PCBMI0, SA8MI0, SA8SI0
	AGP interface adapter UN1373BiS (optical/RS-232)	AGPMI0
GPRS	Siemens SCALANCE M874-2	ETI4, FWI4, OPUPI0, OPUPI1
	Siemens MD741-1	ETI4, FWI4, OPUPI0, OPUPI1
	Dr. Neuhaus Tainy EMOD-V2-IO	ETI4, FWI4, OPUPI0, OPUPI1
	Dr. Neuhaus Tainy EMOD-L1-IO [12]	ETI4, FWI4, OPUPI0, OPUPI1
	Welotech TK701G	ETI4, FWI4, OPUPI0, OPUPI1
	Welotech TK704G	ETI4, FWI4, OPUPI0, OPUPI1
Ethernet		ETI4, FWI4, ETI5, MBCII0, MBSII0, DNPII1, OPUPI0, OPUPI1, ETMCI9

9 5 V supply via modem cable for CE-070x
10 provides RS-232 and RS-485 interface
11 For multi-point traffic only possible with 1 substation
12 without IPsec VPN tunnel VPN-Tunnel

Connection	Transmission facility	Protocol-Firmware
Field bus (PROFIBUS-DP)	Hilscher netHOST NHST-T100-DP/DPM	DPMI0
Field bus (PROFINET-IO)	Hilscher netHOST NHST-T100-EN/PNM	PNMI0

All interfaces can be operated simultaneously.

2.13 Firmware Structure and Data Flow

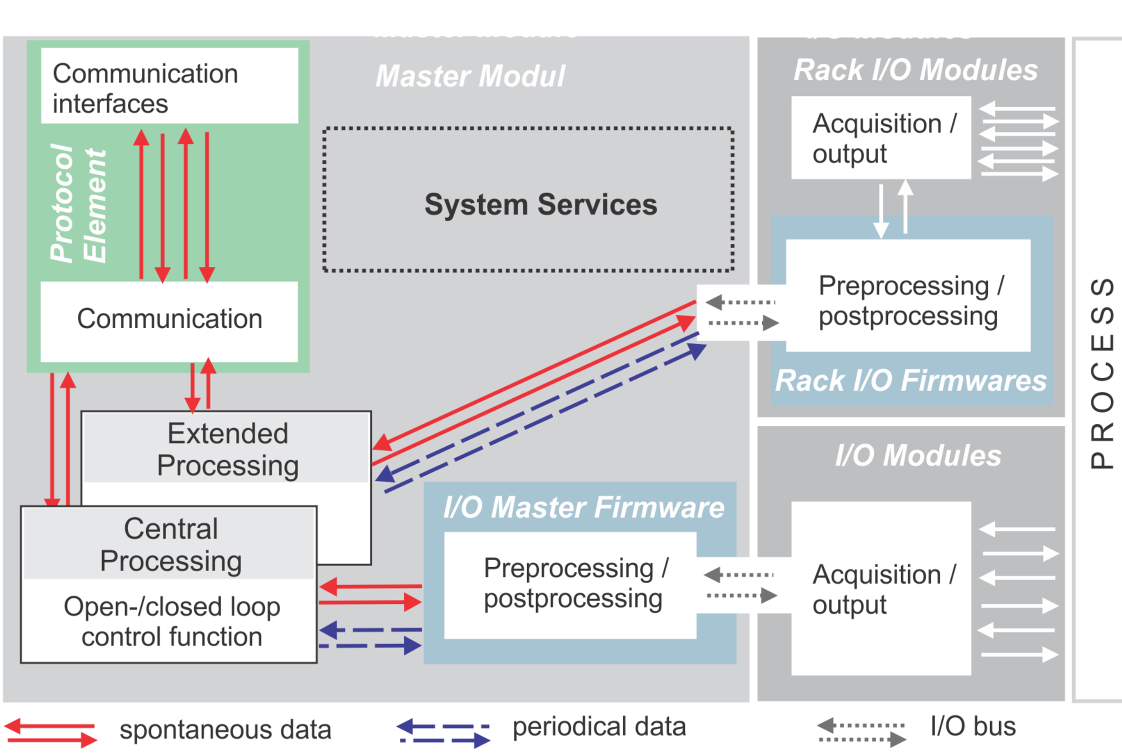
The basis for CP-8050 is a modular, open, and thus non-technology-dependent system architecture for processing, communication, and peripherals (single-processor system, firmware).

The adaptation to the specific needs of the application is accomplished by relying on an individual hardware configuration and by loading standard firmware and parameters. Within their defined limits, the parameters thereby not only influence the behavior of the firmware functions, but also that of the hardware functions. As a result, mechanical parameterizations such as the changing of jumpers or loads are no longer necessary on any of the module types. This permits not only online reconfiguration but also the gapless documentation of set parameters by the engineering system, as well as simplified inventory management.

Due to the different requirements in terms of functionality, also different data flow concepts are produced:

- Telecontrol. For telecontrol tasks and the distribution of user data in networked plants, the use of spontaneous transmission proves advantageous for optimizing the utilization of the in many cases limited communication bandwidth. This helps avoid constant burdening of the data sinks with unnecessary data.
- Automation. For the implementation of a freely definable open-/closed-loop control function a deterministic guaranteed reaction time is needed. This is achieved by using the consistently periodic concept with regard to data acquisition, execution of functions, and data transfer, regardless of the number of changing signals.

As interface to the process serve the I/O modules. The input/output and processing of the process signals is performed by means of the I/O master firmware or the rack I/O firmwares.



[dw_SICAM_A8000_data_flow, 1, en_US]

Figure 2-3 Internal Data Flow

2.14 Engineering

Depending on the master module, configuration, diagnostics and testing are alternatively carried out via

- CP-8031
  - SICAM TOOLBOX II (as of Version 7.00)
  - SICAM Device Manager (as of V03.50)
  - SICAM WEB (as of Version 4); only diagnostic!
- CP-8050
  - SICAM TOOLBOX II (as of Version 6.01)
  - SICAM Device Manager (as of V03.00)
  - SICAM WEB (as of Version 4); only diagnostic!

2.14.1 SICAM TOOLBOX II

Of course the SICAM TOOLBOX II, the integrated engineering system for SICAM RTUs, supports the SICAM A8000 Series. The SICAM TOOLBOX II comprises all stages of plant configuration and maintenance, this means data collection, configuring, parameter setting, expanding, changing, testing, system diagnosis, and documentation.

Object Orientation

The introduction of object orientation allows project engineers to describe real units and pieces of equipment in the configuration process (circuit breakers, feeders, etc.). Project engineers can take advantage of these structural advantages especially in cases where systems are constituted of a plurality of primary units and pieces of equipment of equal type (for example a transformer substation). This yields enormous streamlining effects for the engineering process.

Consistent Data Management

The SICAM TOOLBOX II stores all information in one central database. Once a piece of information has been entered, it will immediately and always be available in its latest updated form to all tools of the SICAM TOOLBOX II and to all people working on a project.

Networkability and shared-work operations

This reaches from stand-alone terminal solutions all the way to complex network solutions. In networks, several engineers may work on one or more projects at the same time. Whether on a standalone terminal or in a network, always the same SICAM TOOLBOX II is used.

Function Diagram for the Implementation of Application Programs

When configuring via the SICAM TOOLBOX II, application programs (open-/closed-loop control function) can be created as function diagram (FUD) with the tool CAEx plus. Optionally, also an existing instruction list can be imported into the SICAM TOOLBOX II.

In view of its conformity with IEC 61131-3, CAEx plus grants the user access to a well-established and generally acknowledged standard. This helps shorten staff training times considerably.

By means of the available standard-conformal module libraries and standard-conformal data types, the engineering becomes more transparent and is possible with high application quality.

2.14.2 SICAM Device Manager

Intuitive Engineering for SICAM A8000. Engineering is an important cost factor in the creation of new plants for energy generation, distribution and transmission. The maintenance of existing systems and the maintenance of the relevant databases also require high expenses. Configuration, parameterization, test and commissioning with the SICAM Device Manager solve these tasks and requirements in an intuitive manner and save time and money.

The current engineering software for the SICAM A8000 series supports project and device management for:

- CP-8031
- CP-8050
- CP-8000
- CP-8021
- CP-8022

The SICAM Device Manager is available in German and English language.

There are 3 licenses to choose from:

- 6MF7800-1FB00: SICAM Device Manager Basic
  Intuitive Engineering Tool for SICAM A8000 Series
- 6MF7800-1FS00: SICAM Device Manager Standard
  Intuitive Engineering Tool for SICAM A8000 Series incl. CFC
- 6MF7800-1GS00: SICAM Device Manager Upgrade Basic to Standard

Supported operating systems:

- Microsoft Windows 7
- Microsoft Windows 10
- Microsoft Windows 2012 Server R2
- Microsoft Windows 2016 Server R2

Cyber Security

In line with the SICAM A8000 series, the SICAM Device Manager also meets the cyber security requirements of tomorrow. In addition to the already known features, such as BDEW White Paper conformity, the SICAM Device Manager only supports digitally signed firmware.

2.14.3 SICAM WEB

Particular value was placed on simplest operation. SICAM WEB has an integrated web server that is operated with a standard web browser. By means of that, no special tools or additional licenses are needed.

Supported web browser:

- Google Chrome ®
- Microsoft Edge ®
- Mozilla Firefox ®

[sc_PIC1_DE, 1, en_US]

Figure 2-4 SICAM WEB dashboard

2.14.4 Differences with the Engineering Tools

	SICAM TOOLBOX II	SICAM WEB
License required	x	-
Interfacing	• direct point-to-point connection via serial interface (via patch cable and D-Sub/RJ45 Adapter) • Serial connection via telecommunications equipment • direct/remote LAN/WAN-connection via Ethernet interface • LAN/WAN-connection via serial interface and terminal server • remote via additional SICAM RTUs automation units	• direct point-to-point connection via Ethernet interface • LAN/WAN-connection via Ethernet interface
Addressing	Via region, component	Via IP address
Parameterization mode	Offline, subsequently transform parameters and load into target system	-
Remote Maintenance	x	-
HW Configuration	I/O modules must be configured in the OPM II after configuring the I/O master module	-
Process-technical parameterization	• Images can be created for the instancing of object types • Bulk edit for the values of the images possible	-
Application program	Based on IEC 61131-3, with restrictions from system limits (memory) • Function chart via CAEx plus • Instruction list	-

	SICAM TOOLBOX II	SICAM WEB
Test functions for telecontrol	• Data Flow Test • Topology Test • I/O test	• Process data Monitoring • Process data Simulation • I/O Test • I/O Simulation
Test of application program	• Online test • Offline simulation	
Sum diagnosis information	x	-
Role Based Access Control	-	x
Read security logbook	-	x

3 Function Packages

3.1 System Services

The function package System Services provides general functions and basic services that are required by other function packages. It contains

- Communication with the engineering system
- Integrated web server
- Time Management
- Monitoring Functions
- Failure Management
- Diagnostic and Signaling
- Autonomy
- Storage of application data
- Storage of firmware
- Role Based Access Control
- Remote Operation
- Factory Reset
- Configurable SD card usage
- Configurable Firewall (Whitelisting)
- Network management
- IPSec VPN
- Security Logging

3.1.1 Communication with the Engineering System (SICAM TOOLBOX II)

For the communication between the SIEMENS TOOLBOX II and CP-8050 exist different variants:

- Physical connection of the SICAM TOOLBOX II with the automation unit
  - Locally by means of a direct cable (RS-232 interface)
  - Remotely
    - Serial communication link via modems (RS-232 or RS-485 interface)
    - Ethernet connection (TCP/IP) and Terminal Server (RS-232 interface)
    - Ethernet connection (TCP/IP)
- Logical connection of the SICAM TOOLBOX II with that automation unit, that is the subject of the engineering task:
  - Local automation unit
    (that is that one, to which the physical connection exists, regardless in which of the previously mentioned forms)
  - Remote automation unit
    (automation unit that can be reached via the local automation unit; consistent remote communication according to IEC 60870-5-101 or -104 is required)

With the exception of the very first initialization procedures, all tasks are possible in each of the above mentioned variants, including for example:

- Parameter setting
- Diagnosis
- Test
- Firmwareloader
- Load parameters

3.1.2 Simplified Engineering via SICAM WEB

For restricted engineering tasks a web server resides on the master module. The web server provides the menus for maintenance designed as websites.
The following functions are supported:

- Diagnosis
- Read security logbook
- Configuration of role based access control
- Time synchronization command
- Load firmware
- Overview of installed and operating firmwares
- Read out of error information
- Monitoring & Simulation
- Dashboard
- Alarms & Events

3.1.3 Time Management

3.1.3.1 Clock

Generally, the SICAM A8000 Series supports automatical time tagging for all data. On the master module resides the central clock of the automation unit.
Time tagging takes place automatically at each point in the system where spontaneous data originates. The transfer of the data (priority-controlled) with standard protocols takes place with 7 octet date and time with 1ms resolution.

3.1.3.2 Time Setting and Synchronization

In CP-8031/CP-8050, the system time is either set automatic via time synchronization with external reference clocks or by usage of the internal RTC chip.
The configuration is done with parameter **`[Home] System settings | Time management | Synchronizing of the device`**.

- automatic
  Time synchronization takes place via external reference clocks
- No time synchronization (free running)
  The internal RTC chip is used; the system time can be set with the engineering tool.

NOTE

For CP-8031/CP-8050 the time setting source must be set. Therefor the manual time setting works only if it is parameterized. If "automatic" is set, manual time setting it is not possible. This is different to the legacy systems.

Automatic synchronization of the automation unit

Value of parameter **`[Home] System settings | Time management | Synchronizing of the device`** = **`Automatic`**.

Following methods of automatic time synchronization are supported and automatically recognized:

- Time synchronization via digital IRIG-B signal (highest priority)
- Time Synchronization via LAN/WAN (NTP)
- Time synchronization via IEEE 1588 Edition 2008 (PTP)
- Time synchronization via serial communication (z.B.: IEC 60870-5-101, third-party protocols)
- Time synchronization via RTC (Hardware clock, pulse per second, lowest priority)

Synchronization via IRIG-B

The CP-8031/CP-8050 system time can be synchronized via the digital IRIG-B signal received from external reference clocks.

The received message frame must include the information "Year" and the included time tag must be coded in UTC.

The IRIG-B signal has the highest priority of all external time references. Only if it fails, other kind of reference clocks are used to synchronize the internal system time.

The preferred format type is IRIG-B007.

Additional following formats are supported: IRIG-B004 – B006 and IEEE 1344

Supported plugs:

- X5 ... RS-232 (Wiring RXD, GND)
- X4 ... RS-485 (2-wire wiring: RX/TX+, RX/TX-, 4-wire wiring: TX+,TX-)

The plug must be selected via parameter **`[Home] System settings | Time management | Interface IRIG-B`** . The IRIG-B input can be inverted with the parameter **`[Home] System Settings | Time management | Inversion IRIG-B input`**. This parameters is only visible in the Device Manager with the function "Show all parameters".

NOTE

- SICAM A8000 supports the time synchronization of its own device with IRIG-B.
- max. accuracy: typical 1 ms
- SCAM A8000 cannot synchronize other devices with IRIG-B.

Synchronization via NTP (Client)

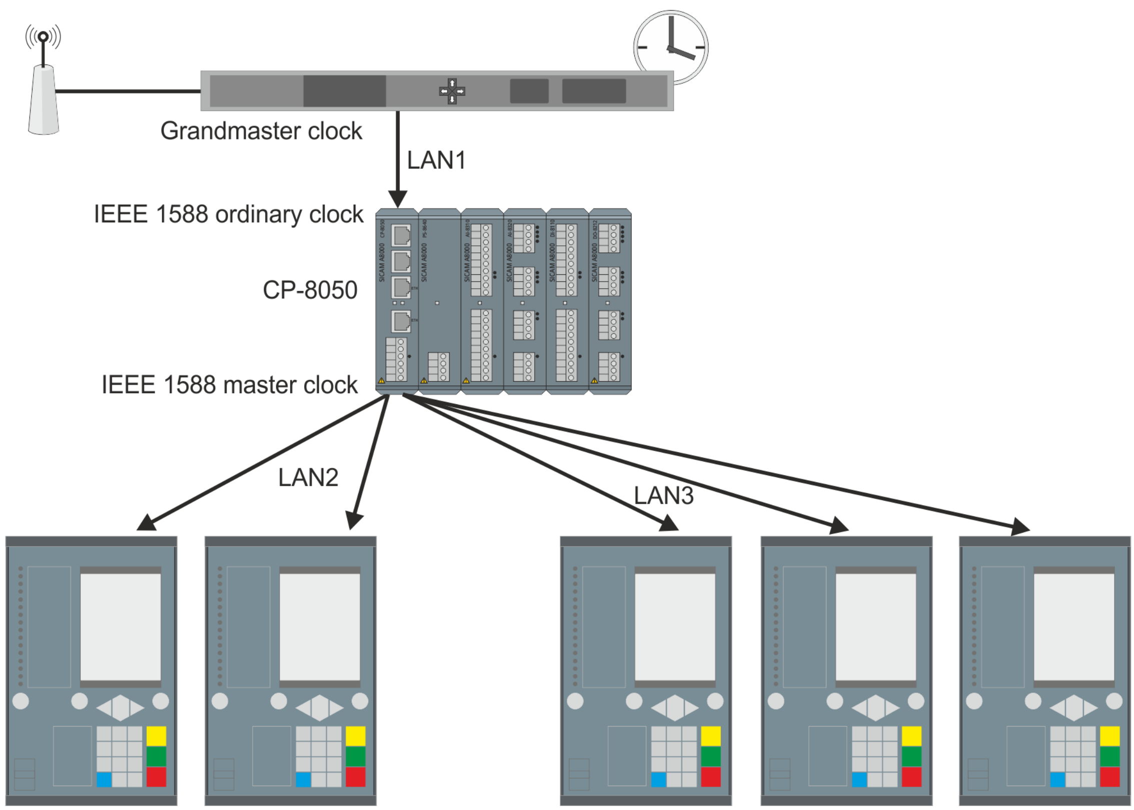
Up to 4 different NTP servers can be parameterized for the time synchronization. The selection of the NTP-servers used for time synchronization is done by the NTP-daemon by means of a predefined algorithm.

NOTE

If only 2 NTP servers are configured in **([Home] Communication | Client Services | Network Time Protocol Client (NTP) / Simple Network Time Protocol Client (SNTP) | Assigned LAN interfaces)**), the first configured NTP server is the preferred NTP server. The second is only used as backup.

Synchronization via IEEE 1588 Edition 2008 (PTP)

The IEEE 1588 protocol is used to synchronize clocks via network communication. IEEE 1588 is available as a time receiver in all Ethernet communication modules. Transfer and processing times in the components are also transferred within the protocol. These correction times can be taken into account in the terminal and improve the temporal synchronization of the terminals. A runtime measurement (IEEE Standard Profile for Use of IEEE 1588™ Precision Time Protocol in Power System Applications) is not supported. Time synchronization via IEEE 1588 Edition 2008 (PTP) is only supported in multicast mode. The reception of messages with IEEE 802.1Q marking (VLAN tag, single tagged only) is supported.



PTP is used in CP-8050 in 2 different ways:

- IEEE 1588 ordinary clock (slave)
  When used as “IEEE 1588 ordinary clock”, the system gets the time from an external time source, the “Grandmaster Clock” (e.g., Meinberg M600).
  The LAN interface to the Grandmaster Clock is selected with the parameter **`[Home] Communication | Client Services | IEEE 1588 Ordinary Clock (PTPoc) | assigned LAN interfaces`**.
  - max. accuracy: typical 1 ms

  For PTP Slave under **`[Home] Communication | Client Services | IEEE 1588 Ordinary Clock (PTPoc) | IEEE 1588 advanced parameters`**, the following parameters can be set:
  `Delay Mechanism:`
  - P2P (Peer-to-Peer)
  - E2E (End-to-End)

  This parameters is only visible in the Device Manager with the function “Show all parameters”.
- IEEE 1588 master clock
  When used as an “IEEE 1588 Master Clock”, the system time can be passed on to up to 4 freely selectable virtual networks.
  The LAN interfaces that are to be synchronized with CP-8031/CP-8050 as grandmaster clock are selected with the parameter **`[Home] Communication | Client Services | IEEE 1588 Ordinary Clock (PTPoc) | assigned LAN interfaces`**. If no LAN interfaces are assigned, the PTP master clock function will be disabled.
  - max. accuracy: typical 1 ms

  For PTP Master under **`[Home] Communication | Server Services | IEEE 1588 Master Clock (PTPmc) | IEEE 1588 advanced parameters`** the following parameters can be set:
  `Delay Mechanism:`
  - P2P (Peer-to-Peer)
  - E2E (End-to-End)

  `PTP Timescale:`
  - UTC (Coordinated Universal Time)
  - TAI (International Atomic Time)

  These parameters are only visible in the Device Manager with the function “Show all parameters”.

NOTE

- Delay Mechanism P2P with CI-852x is not supported!

Synchronization via serial communication

The time synchronization can also take place by means of serial communication protocols (e.g.: IEC 60870-5-101, third-party protocols)
This synchronization method is only used if IRIG-B and NTP are not configured or not working.

Synchronization via RTC

Time synchronization via the RTC chip (real-time clock) installed on the CP-8031/CP-8050 is only used if the methods described above are not available and the timeout **`[Home] System Settings | Time management | Monitoring time for synchroniz. event`** has expired.

The RTC-chip has a high accuracy of typical ± 2 ppm.

This synchronization method uses the clock of the RTC-chip to minimize deviations of the system time.

The time is read periodically (every 20 seconds) from the RTC-chip.

No synchronization of the automation unit

If time synchronization is not possible or required for the device, then the synchronization of the device is disabled with the parameter **[Home] System settings | Time management | Synchronization of the device** = **no synchronization (free running)**.

Synchronization via RTC

With this configuration the RTC-chip equipped on CP-8031/CP-8050 is used to synchronize the system time. Due to its high accuracy (typical ± 2 ppm), deviations of the system time can be limited.

The time is read periodically (every 20 seconds) from the RTC-chip.

Only in this configuration it is possible to use the engineering tools (SICAM TOOLBOX II, SICAM WEB) for time setting. This can be necessary for tests if no external reference clock is available, or if the system time differs more than the time defined in parameter **[Home] Communication | Client services | Network Time Protocol Client (NTP) / Simple Network Time Protocol Client (SNTP) | NTP/ SNTP | Advanced parameter | Panic threshold** (default = 15 min) from the reference time.

Then the system time must be adjusted manual to the reference time. After that, the synchronization can be set back to “automatic” in order to synchronize the system time with the reference time again.

NTP-daemon in CP-8031/CP-8050

For the time synchronization of the automation unit a NTP-daemon is installed. This NTP-daemon is responsible for setting the system time by synchronizing it with an external reference clock.

Additional to the standard time synchronization with NTP, the installed NTP-daemon offers the possibility to use other reference clocks, which use other methods of synchronization (e.g. IRIG-B, serial protocols, RTC).

Ideally the reference time is the same all over the world. Once synchronized, there should not be any unexpected deviations between the time on the system clock and the time of the reference clock, except the leap second.

The NTP-daemon evaluates the offset between system clock and reference clock. Under normal conditions the deviations are minimal and are corrected continuous from the NTP-daemon, without influencing the system or applications.

Individual, short-term deviations over 0.5 sec are discarded. If those deviations occur more than 300 seconds, the system time will be adjusted to the reference time.

Further the NTP-daemon monitors, if the deviations between system time and reference time exceed the panic threshold. This is set to the standard value of 15 minutes. Exceeding this value means a substantial deviation of the system time which points to a serious error. In this case the NTP-daemon stops working and displays an error message.

Then the user has to check the reference time or set the system time manually. The manual set time may maximum deviate from the reference time about the value of the “panic threshold”.

A value of “0” for the **Panic threshold** parameter means, that the monitoring of the deviation between the system time and the reference time is deactivated.

Time information items from reference clocks are only accepted as valid, if several have been received and checked. Data from reference clocks which are marked “invalid” cannot be used for time synchronization.

If case of time synchronization via NTP, the NTP-Daemon polls the time information using the “Clock Discipline Algorithm”. This poll process provides sufficient accuracy while minimizing network load.

The poll interval is configured with the parameter **[Home] Communication | Client services | Network Time Protocol Client (NTP) / Simple Network Time Protocol Client (SNTP)**

| NTP Minimal poll interval (16 s,**32 s**, 64 s, 128 s to 65536 s). After a restart of the NTP-daemon, the poll interval starts with the value of this parameter. If the time synchronization has reached sufficient accuracy, the poll interval is doubled until Max_poll (= **NTP min poll interval** * 2; but >= 128 s) is reached. If clock accuracy is insufficient, the poll interval is divided by 2 until **NTP min poll interval** is reached.

3.1.4 General Interrogation

On startup and after faults in the system (communication faults, FIFO overflows), the participating automation units ensure, that the operation is resumed automatically in a coordinated manner.

This means that the communication connection is established and all data concerned as well as relevant system information are transferred from their source all the way to their sink, in order to update the process images throughout the system (taking a multi-hierarchical network into account). This is done by prompting a general interrogation of the respective portion of the automation network where the error has occurred.

3.1.5 Monitoring Functions

Monitoring of an automation unit

- Functionality of processor and memory
  - periodical test of program, data and parameter memory, and watchdog function
  - permanent hardware based memory monitoring (ECC)
  - separated process frames with memory access protection
- Internal communication capability (periodical internal test messages with monitoring function)
- Data integrity (internally secured data transmission with parity, plausibility check at the internal interfaces, identification of data of failing modules)
- Information loss due to a buffer overflow
- Correctness of internal workflow sequences

Monitoring of system environment

- Plausibility of process states
- Plausibility of process sequences
- Availability of process circuits

Monitoring of communication

- Functionality (periodical call messages with monitoring function, monitoring of transmission quality)
- Data integrity (secured transmission, identification through failure of data concerned)

3.1.6 Failure Management

The failure management system concept implemented in CP-8050 ensures the individual identification of data of failing system components and the correct system and process behavior in disturbance events. For this purpose, the failure management function includes:

- a system function for failure detection (for instance for modules, communication)
- derived therefrom a system signaling in the form of status information in spontaneous messages and in the form of special data points for the open-/closed loop control function
- a parameter-settable behavior of digital outputs

This way, the state for each process information is available at all data sinks (peripheral outputs, open/closedloop control function, process control system), and it is possible - depending on the requirement and functionality - to elicit an appropriate counterreaction therefrom.

3.1.7 Diagnostics and signaling

The diagnostics function manages the system states and error information detected by the various functions and their watchdogs. It permits the indication of the internal system and error information, and of the process states by means of the engineering tool.

3.1.8 Storage of Application Data

With engineering via the SICAM TOOLBOX II, application data are stored in a data base on the engineering PC. From there they can be loaded into a target system, or else be written on a suitable SD card.

After the plug in of a configured SD card into the target system, this checks the user authorization (see Role Based Acces Control) and takes over the configuration (firmwares + parameter) during startup, if the validation was successful.

NOTE

If the user authorization (password) used when creating the SD card is not known on the target system, the SD card will not be accepted. Then the user and password must be configured beforehand on the target system via SICAM WEB.

3.1.9 Storage of Firmware

Current firmware revisions for CP-8031/CP-8050 can be loaded as binary files into a target system:

- online direct into a target system (with or without an equipped SD card)
- offline through storage on a suitable SD card

In both cases, the target system unpacks during startup the corresponding files and stores the firmwares permanent in the internal memory.

NOTE

All firmwares are signed. Only signed firmwares can be loaded. The signature is checked during each installation.

3.1.10 Autonomy

This system concept ensures that, if central parts succumb to a failure, as much of the functionality as possible will remain intact. CP-8050 is capable of functioning autonomously – this means, it will continue carrying out its defined local function even where the entire communication is disturbed.

In such events, the system invariably ensures that the failure is detected and signaled. Based thereon, a functional behavior may be defined, if necessary, that is adapted to the disturbance event at hand.

3.1.11 Role Based Access Control

The "Role Based Access Control" (RBAC) is a process to restrict the access to data or services in a multi user system. Therefore different roles with different access rights are assigned to the users. Each user is protected by a password.

In CP-8031/CP-8050 the configuration of the local role based access control is done with SICAM WEB (Administration - User). You have to create local user for each device. That activity can only be done by users which have the corresponding authorization (e.g. the standard user "administrator"). You can assign one or more of the predefined roles to each local user. Each of these roles has different rights/functions for working with CP-8031/CP-8050. The following chapter shows which roles are predefined and which rights each has.

NOTE

The local users must be configured for each CP-8031/CP-8050 device separately.

The authentication of the user can also be done via an external RADIUS server. But then the user can have only one role.

Roles

- Viewer
- Operator
- Engineer
- Installer
- Security Admin
- Security Auditor
- Role Based Access Manager
- Admin

NOTE

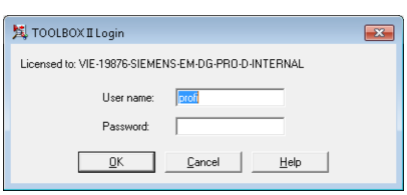
Which rights/functions these roles have in SICAM WEB and SICAM TOOLBOX II can be found in the *Administrator Security Manual; DC0-115-2*, section *Role Based Access Control in SICAM A8000 Series*.

Configuration of user/roles with SICAM WEB

See chapter *15.7.3 Creation of a local user*

Role based access control with SICAM TOOLBOX II

When you start SICAM TOOLBOX II you have to log on with the SICAM TOOLBOX II Login and can start working local.

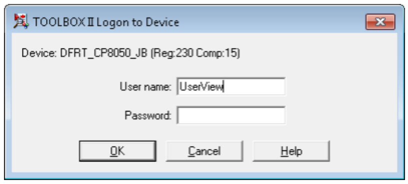


Only when you preform tasks which need online access to the connected CP-8050 (e.g. diagnosis), RBAC becomes active and you need to enter the required login credentials.

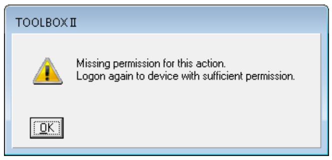
NOTE

This takes only place if a user role was already defined on the AU with SICAM WEB. If no role was assigned with SICAM WEB, there will be no question for a password.

Then you have to use a local user created with SICAM WEB.



Following warning will appear If the entered local user has not the required rights.



Now you can repeat the login with another user (with corresponding rights) to continue the login.
After the first successful login the user can perform all enabled actions on the device without another login.

NOTE

You have to login again, if the connection to the device is interrupted (e.g. caused by a reset during parameter loading) or no input was made within 2 minutes.

3.1.12 Secure Factory Reset

A Secure Factory Reset sets the device in the delivery status.
That means, that following security relevant information will be deleted, or set to delivery status (Factory Settings):

- all firmwares, except CPCI85, SWEB00
- all configurations (parameter, user management, user, passwords, keys, certificates)
- all logging- and diagnosis information (diagnosis logbook, security log)
- all data on the SD card

When is it necessary to make a Secure Factory Reset?:

- Your device is defect and must be sent back to factory.
- All interfaces are set to secure (no more access possible) and you have forgotten the admin password.

Procedure:

- Format the SD card
- Create in the root directory of the SD card a text file called: **`FactoryReset.txt`**.
- Content of the file: *`FactoryReset`*
- Insert the SD card in CP-8031/CP-8050 and switch on the device.
  Wait until the RY LED lights (can last up to 2 minutes)

NOTE

This method of Secure Factory Reset via SD card also works if the SD card is deactivated.

Comparison of Factory Settings with Default Settings

The following table shows the items affected by a Secure Factory Reset and their settings after the reset in column "Factory Settings". Additional you can see in the right column the "Default Settings" of a CP-8050.

Item	Factory Settings	Default Settings[13]
Firmwares	CPCI85, SWEB00 (Version according to time of production)	CPCI85, SWEB00 (Version according to latest loaded version)
Region number	249	is set during creation of the AU
Component number	254	is set during creation of the AU
X3 (LAN 1) TCP/IP address	172.16.0.3	172.16.0.3
8.1.1 One Click to Connect	enabled via X3 (LAN 1) DHCP	Disabled
Remote Operation	enabled via X3 (LAN 1)	Disabled
WEB browser for SICAM WEB (https)	enabled via X3 (LAN 1)	enabled via X3 (LAN 1)
serial connection with SICAM TOOLBOX II	enabled via X5	enabled via X5
Standard user	administrator (no password set)	administrator (no password set)
Mode of SD-Card	Spare Parts Concept	Spare Parts Concept

3.1.13 Configurable SD Card Usage

CP-8031/CP-8050 can be operated both with and without an SD card.
If an SD card is used during operation, the following functions are available:

- Spare parts concept, plug & play when replacing devices
  Details see *12.4 Replacement of the Hardware*, section “Master Module”

The usage of the SD card in CP-8031/CP-8050 can be set by parameter **CP-80xx/CPCI85 | System settings | Security | SD-Card Mode** .
The following settings are available for operation with an SD card:

- **Spare part concept active and updates via SC-Card allowed** (default)
  The spare part concept (simple device replacement) is activated in the CP-8031/CP-8050 delivery status. Thus the usage of the SD-Card is activated.

The following settings are available for operation without an SD card:

- **No data on SD card (factory reset possible)**
  This setting must be used if no SD-Card is used (e.g. due to security reasons).
- **Allow updates via tool generated SD-Card**
  The password of the target system must be entered during generation of the SC-Card.
- **No SD card (no factory reset possible)**
  This setting should be selected if no SD card is used and the factory reset should be deactivated. (e.g. due to security reasons).

3.1.14 Remote Operation with SICAM TOOLBOX II

The remote operation of SICAM RTUs components via LAN/WAN can be performed with the function "Remote Operation".
Parameters: **System settings | Network settings | Services | Web server | Applications | remote operation**

[13] State after configuration of CP-8050 with SICAM TOOLBOX II

Remote Operation via TCP/IP (http/https)

For the remote maintenance of SICAM RTUs components with "remote operation" a transparent connection is established over TCP/IP (http/https) between the SICAM TOOLBOX II and the SICAM RTUs component via the protocol element.

For “remote operation" with SICAM TOOLBOX II a proprietary Client-Server protocol is used for remote maintenance and remote diagnostics of SICAM RTUs components working through firewalls, NAT and Proxy-Server.

Remote Operation via Integrated Terminal Server

For the remote maintenance of SICAM RTUs components with "remote operation" a transparent connection is established over Ethernet between the SICAM TOOLBOX II and the integrated Terminal Server on the protocol element.

The Terminal Server protocol for the "remote operation" is based on TCP/IP and is a Client-Server protocol. The SICAM TOOLBOX II thereby always takes over the Client function, the SICAM RTUs component always the Server function. The connection for the "remote operation" is always set up by the SICAM TOOLBOX II.

Remote Operation via external Terminal Server

For the remote maintenance of SICAM RTUs components with "remote operation" via external Terminal Server the serial interface of the SICAM TOOLBOX II is connected with a selected SICAM RTUs component via Ethernet. Thereby an external Terminal Server (=Serial to Ethernet Converter) is used at the SICAM TOOLBOX II side and at the SICAM RTUs component side. At the SICAM RTUs side the serial interface of the external Terminal Server is connected with the M-CPU via TIAX00.

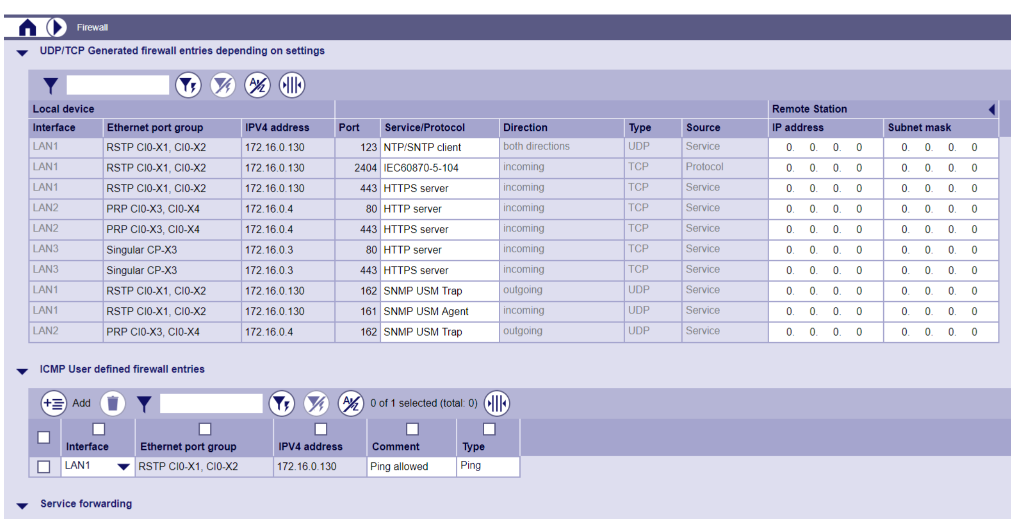
3.1.15 Firewall (Whitelisting)

General

CP-8031/CP-8050 offer the option of automatically generating and manually editing a firewall table with the engineering tools. The firewall table shows information of the incoming and outgoing network traffic. In detail these are data of the system-technical parameter (e.g. activated WEB server) and system-technical spreadsheets (e.g. connection definition, network parameter).

Display of the firewall table with SICAM Device Manager

- Click on the SICAM WEB dashboard in the **Systems** group on the **Firewall** tile.



Firewall

UDP/TCP Generated firewall entries depending on settings

Local device								Remote Station	
Interface	Ethernet port group	IPV4 address	Port	Service/Protocol	Direction	Type	Source	IP address	Subnet mask
LAN1	RSTP CI0-X1, CI0-X2	172.16.0.130	123	NTP/SNTP client	both directions	UDP	Service	0. 0. 0. 0	0. 0. 0. 0
LAN1	RSTP CI0-X1, CI0-X2	172.16.0.130	2404	IEC60870-5-104	incoming	TCP	Protocol	0. 0. 0. 0	0. 0. 0. 0
LAN1	RSTP CI0-X1, CI0-X2	172.16.0.130	443	HTTPS server	incoming	TCP	Service	0. 0. 0. 0	0. 0. 0. 0
LAN2	PRP CI0-X3, CI0-X4	172.16.0.4	80	HTTP server	incoming	TCP	Service	0. 0. 0. 0	0. 0. 0. 0
LAN2	PRP CI0-X3, CI0-X4	172.16.0.4	443	HTTPS server	incoming	TCP	Service	0. 0. 0. 0	0. 0. 0. 0
LAN3	Singular CP-X3	172.16.0.3	80	HTTP server	incoming	TCP	Service	0. 0. 0. 0	0. 0. 0. 0
LAN3	Singular CP-X3	172.16.0.3	443	HTTPS server	incoming	TCP	Service	0. 0. 0. 0	0. 0. 0. 0
LAN1	RSTP CI0-X1, CI0-X2	172.16.0.130	162	SNMP USM Trap	outgoing	UDP	Service	0. 0. 0. 0	0. 0. 0. 0
LAN1	RSTP CI0-X1, CI0-X2	172.16.0.130	161	SNMP USM Agent	incoming	UDP	Service	0. 0. 0. 0	0. 0. 0. 0
LAN2	PRP CI0-X3, CI0-X4	172.16.0.4	162	SNMP USM Trap	outgoing	UDP	Service	0. 0. 0. 0	0. 0. 0. 0

ICMP User defined firewall entries

Add 0 of 1 selected (total: 0)

Interface	Ethernet port group	IPV4 address	Comment	Type
LAN1	RSTP CI0-X1, CI0-X2	172.16.0.130	Ping allowed	Ping

Service forwarding

Global forwarding configuration

[sc_firewall_sdm_01, 1, en_US]

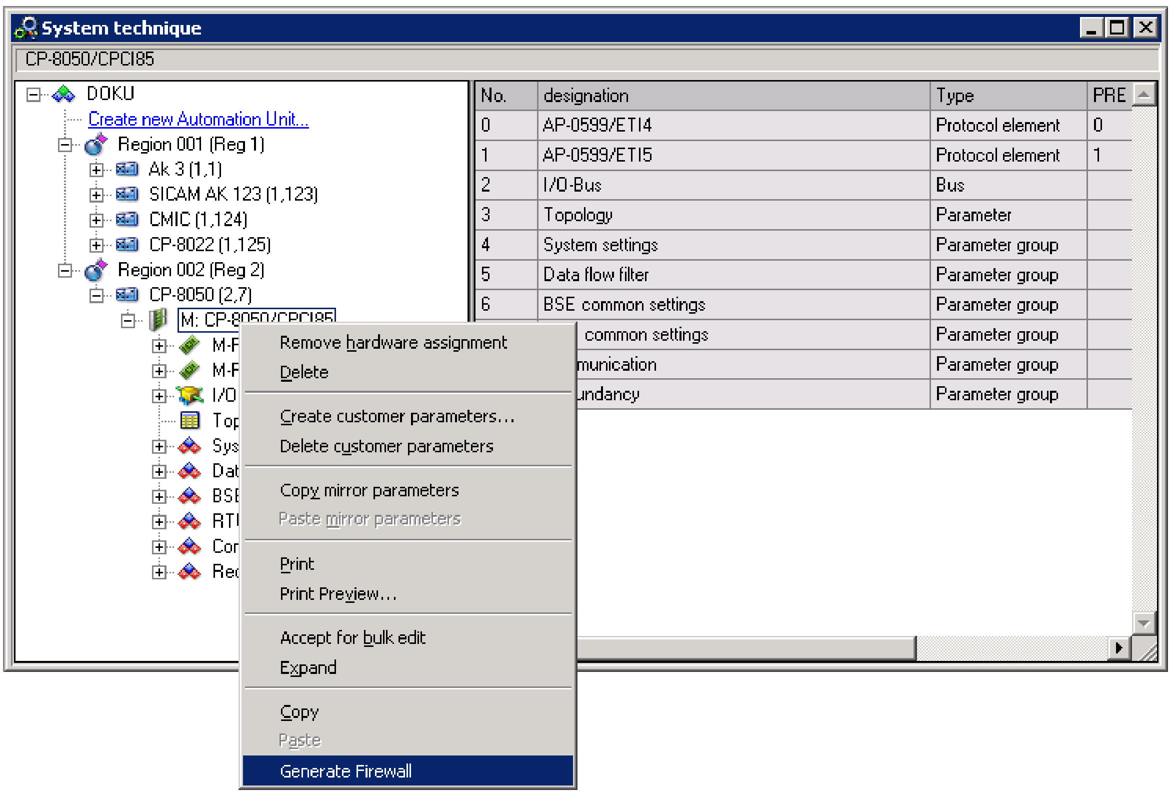
Generation of the firewall table with SICAM Toolbox II

The entries of the firewall table are generated automatically based on the configuration of the relevant parameter (e.g. NTP Client used, WEB Server http enabeld, ...) Already existing entries will be deleted during generation.

- Select the master module (CP-80xx/CPCI85) of the desired AU in the system technique of OPM.
- Choose **`Generate Firewall`** from the context menu.

NOTE

You get a note, that existing firewall entries will be lost. If you have manual entries which should be rescued, you need to save them before the automatic creation (select the entries and use the context menu "copy"). After generating the new firewall table you can enter the copied entries (use context menu "insert values").



[Firewall_generate_01, 1, en_US]

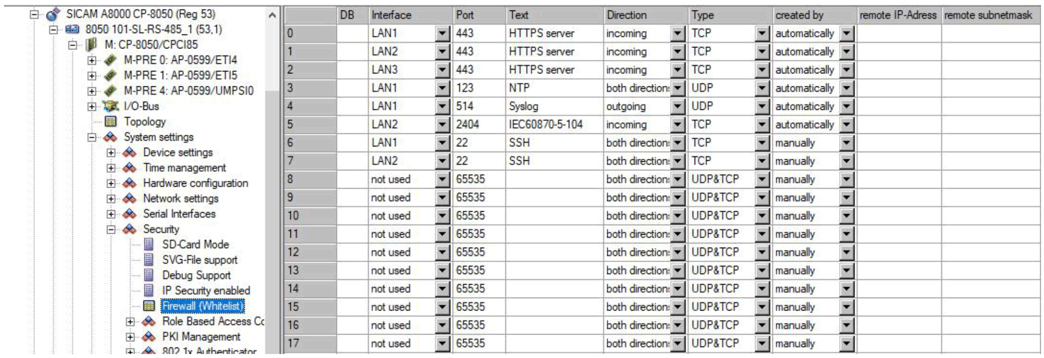
The generated table can be found in OPM under **`System settings | Security | Firewall (White-list)`**

Content of the Firewall Table

The firewall table shows following settings for each entry:

- DB
  Value "U" means, that the entry in this row was changed.
- Interface
- Port
- Text
- Direction

- Type
- created from
  indicates if the entry was created automatically or manual.
- IP address
- Subnet mask



[sc_Firewall_TBII_01, 1, en_US]

To disable an entry you have to set the interface value to "not used".

For all server services (NTP Server, WEB Server, ...) standard entries will be generated for all defined LAN interfaces.

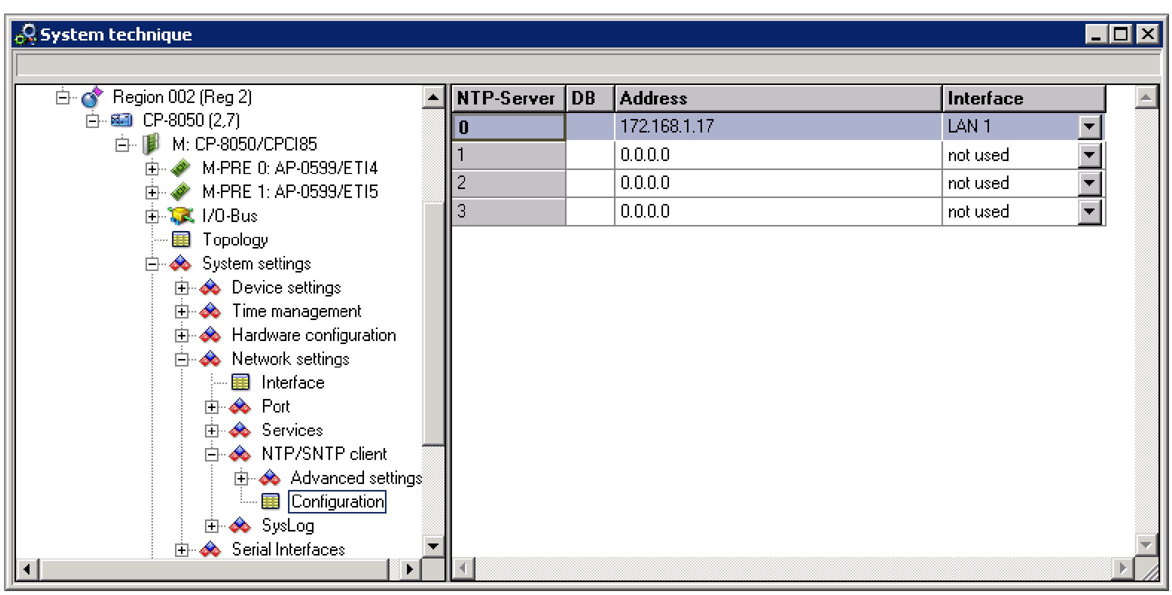
For all client services individual interface definitions can be made (direct via the enable / disable setting).

The firewall entries can be manually restricted to IP addresses or IP address ranges by editing the IP address and Subnet mask columns. The default values 0.0.0.0 for both columns result in access from anywhere.

NOTE

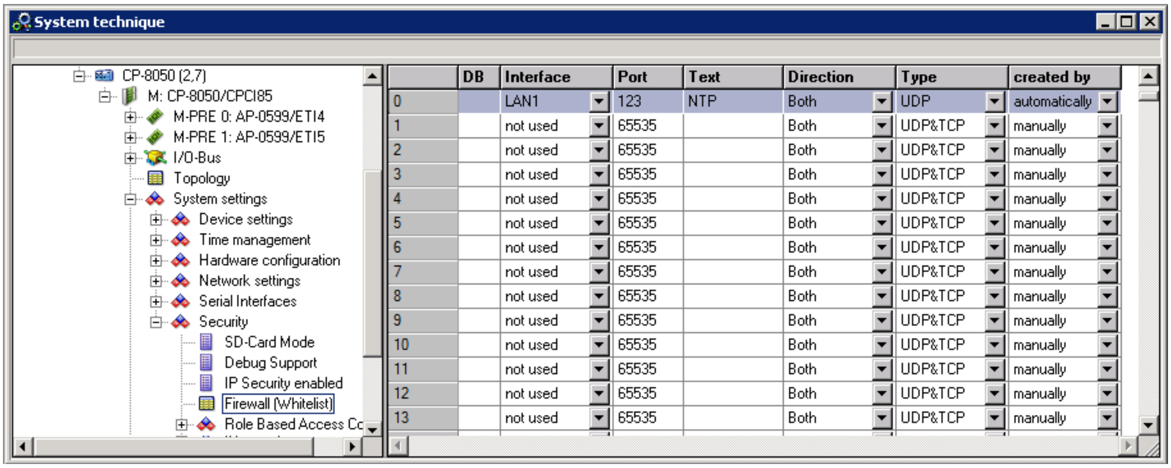
Each port that shall be used must be enabled in the firewall table!

For example: Configuration of a NTP client



[NTP_Client_Config_01, 1, en_US]

This configuration generates following entry in the firewall table.

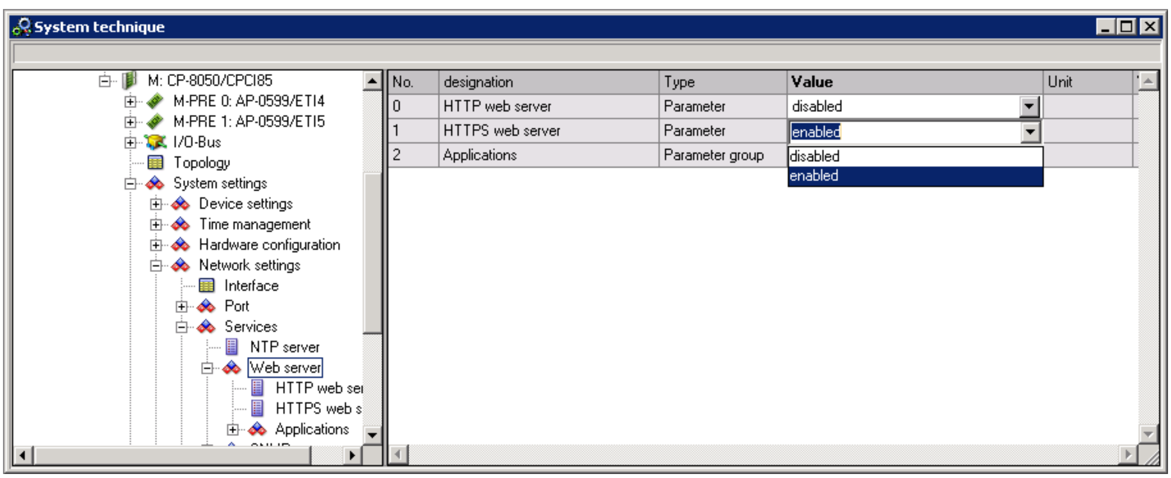


[Firewall_NTP, 1, en_US]

For example: Enabling SICAM WEB

To enable the SICAM WEB functionality you have to enable the protocol (http, https) for the Web Server before.

Enable the desired protocol under **`System settings | Network settings | Services | Web server`**.

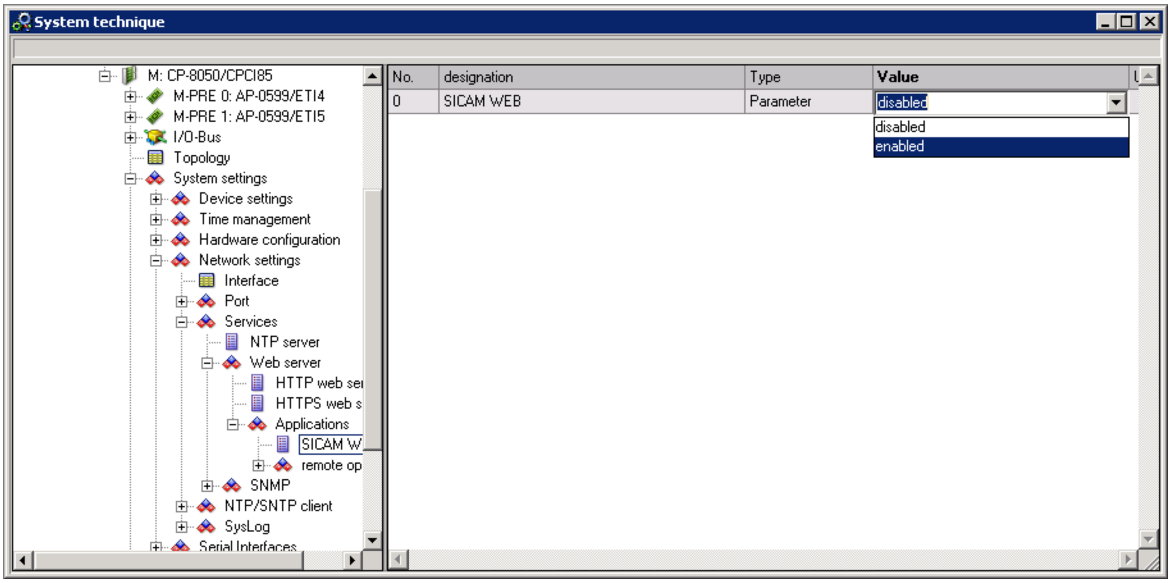


[Web_Server_Protocol_01, 1, en_US]

NOTE

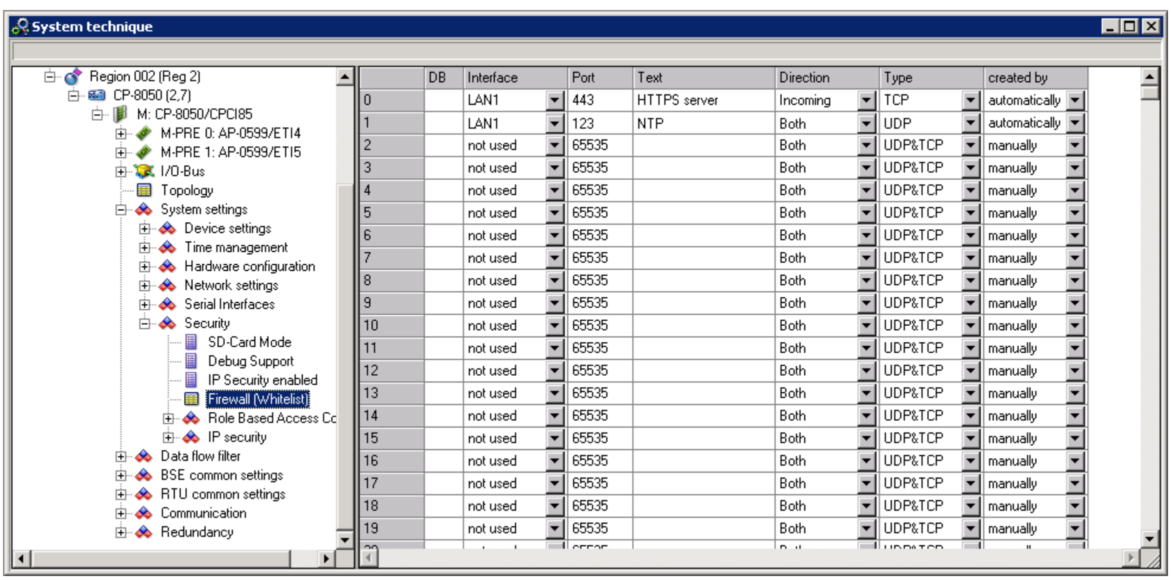
If on of these parameter is set, you can use the Web Server in CP-8031/CP-8050 and both protocols are available. The selection of the protocol is used for the automatic generation of the firewall table.

Enable afterwards the SICAM WEB application under **`System settings | Network settings | Services | Web server | Applications | SICAM WEB`**.



[SICAM_WEB_Enable, 1, en_US]

These configurations generate following entries in the firewall table.



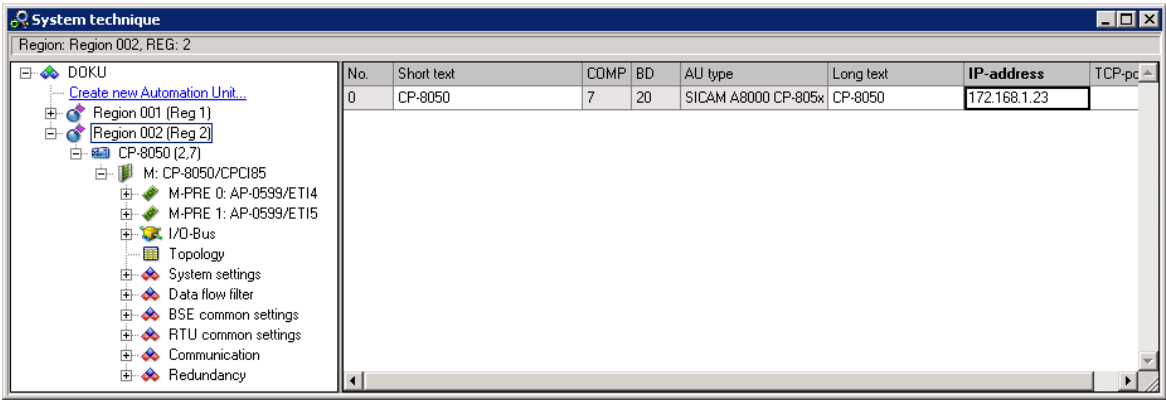
[Firewall_02, 1, en_US]

NOTE

If you want to prevent access to an interface, set it to "not used".

Start SICAM WEB from inside SICAM TOOLBOX II

To start SICAM WEB directly from the SICAM TOOLBOX II system technique, you need to enter the CP-8031/CP-8050 IP-address. You find the required input field when you select the corresponding region in the system technique.



[Region_01, 1, en_US]

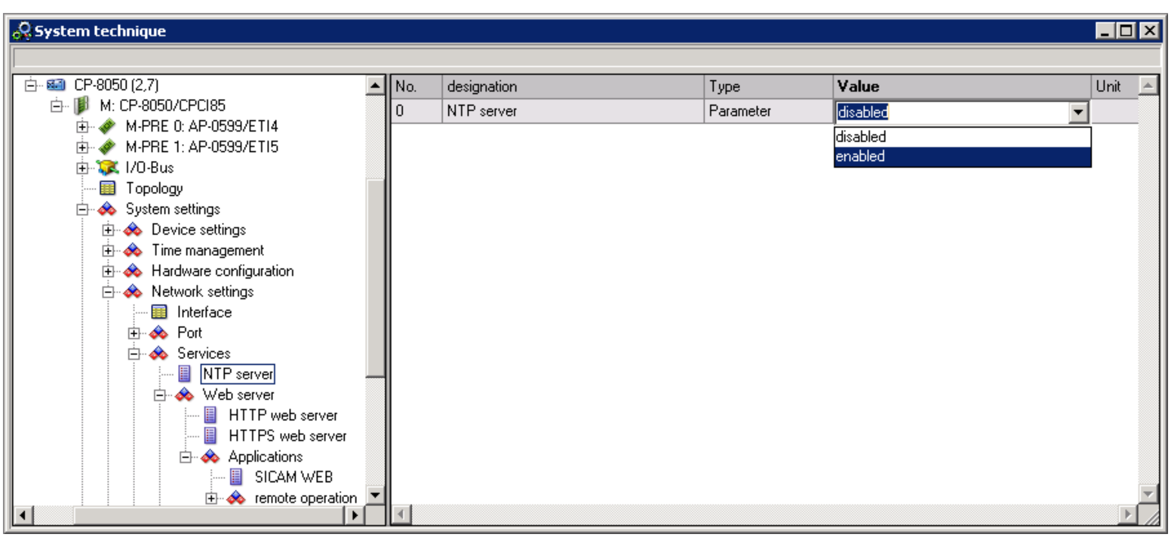
After entering the IP-address, click on the region and select "Start SICAM WEB..." from the popup menu.

NOTE

SICAM WEB requires a new password for the CP-8031/CP-8050 access. This is afterwards also valid for the SICAM TOOLBOX II.

For example: Enable NTP Server

Enable the NTP server under **`System settings | Network settings | Services | NTP server`**.



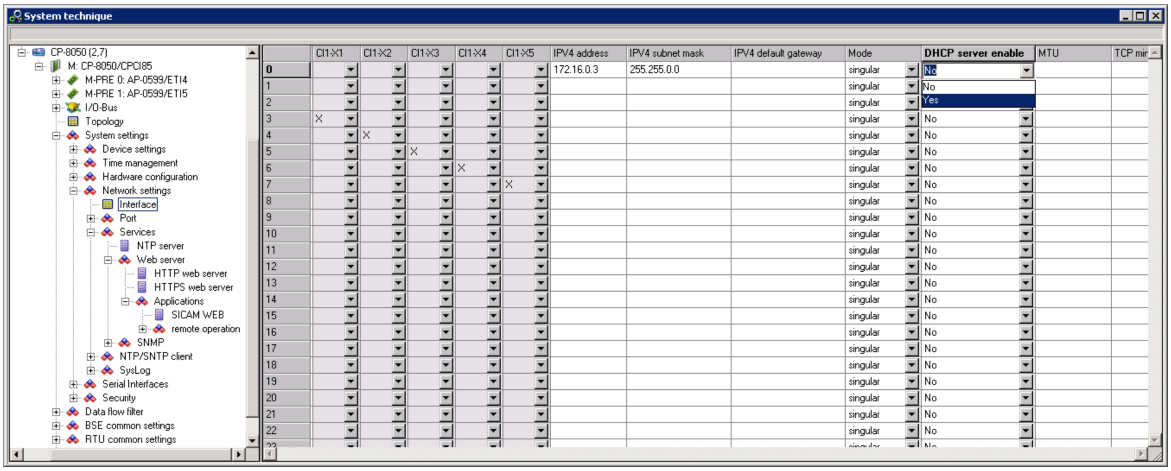
[NTP_Server_Enable, 1, en_US]

Each configured interface (see System settings | Network settings | Interface) generates an entry in the firewall table.

For example: Enable DHCP

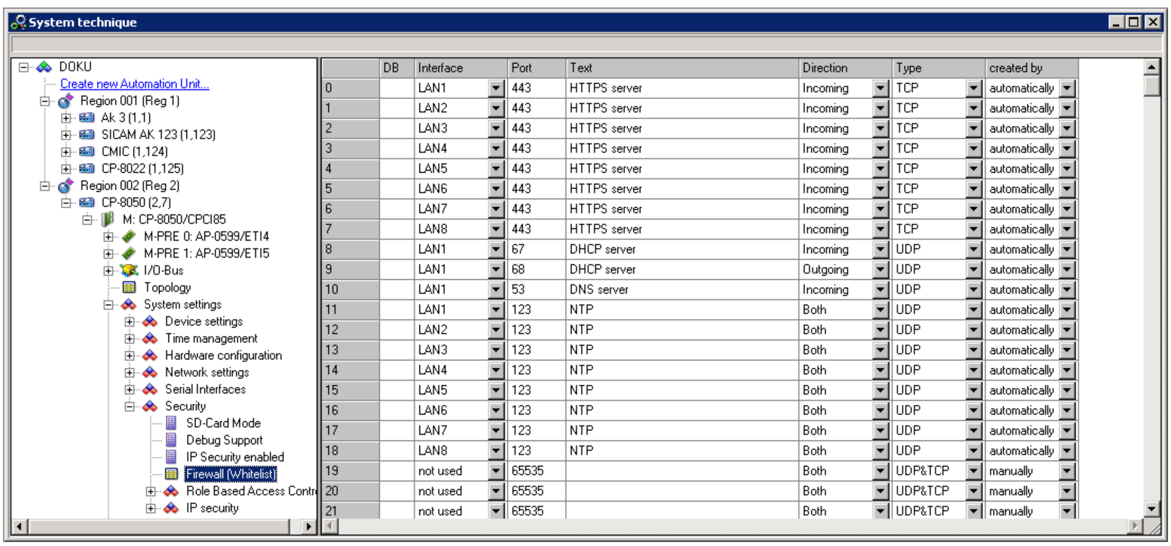
Enable DHCP under **`System settings | Network settings | Interface | DHCP server enable`**.

This configuration is required for *8.1.1 One Click to Connect*.



[DHCP_Server_Enable_01, 1, en_US]

This configuration generates following entry in the firewall table.

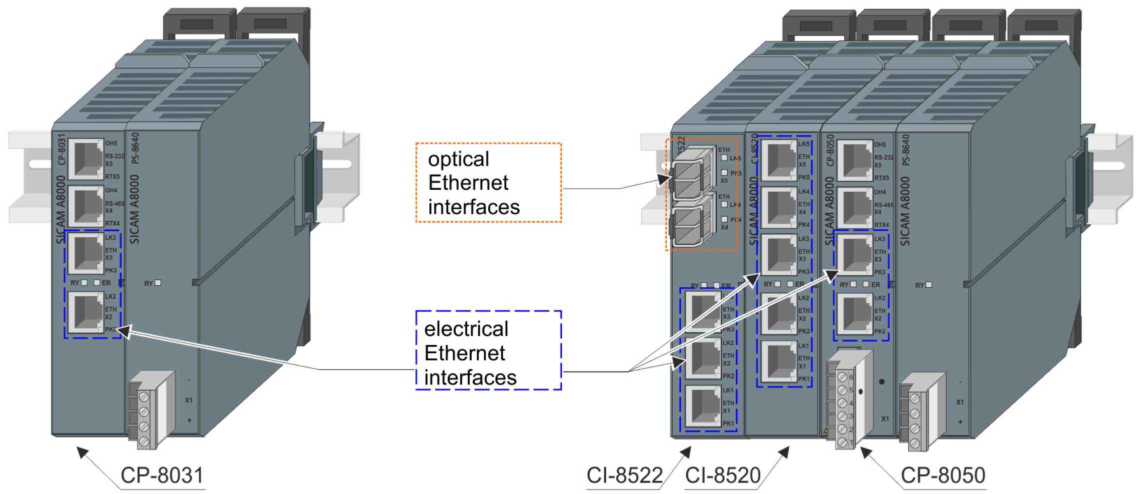


	DB	Interface	Port	Text	Direction	Type	created by
0		LAN1	443	HTTPS server	Incoming	TCP	automatically
1		LAN2	443	HTTPS server	Incoming	TCP	automatically
2		LAN3	443	HTTPS server	Incoming	TCP	automatically
3		LAN4	443	HTTPS server	Incoming	TCP	automatically
4		LAN5	443	HTTPS server	Incoming	TCP	automatically
5		LAN6	443	HTTPS server	Incoming	TCP	automatically
6		LAN7	443	HTTPS server	Incoming	TCP	automatically
7		LAN8	443	HTTPS server	Incoming	TCP	automatically
8		LAN1	67	DHCP server	Incoming	UDP	automatically
9		LAN1	68	DHCP server	Outgoing	UDP	automatically
10		LAN1	53	DNS server	Incoming	UDP	automatically
11		LAN1	123	NTP	Both	UDP	automatically
12		LAN2	123	NTP	Both	UDP	automatically
13		LAN3	123	NTP	Both	UDP	automatically
14		LAN4	123	NTP	Both	UDP	automatically
15		LAN5	123	NTP	Both	UDP	automatically
16		LAN6	123	NTP	Both	UDP	automatically
17		LAN7	123	NTP	Both	UDP	automatically
18		LAN8	123	NTP	Both	UDP	automatically
19		not used	65535		Both	UDP&TCP	manually
20		not used	65535		Both	UDP&TCP	manually
21		not used	65535		Both	UDP&TCP	manually

[DHCP_Server_in_Firewall_Table_01, 1, en_US]

3.1.16 Network management

All Ethernet interfaces in a SICAM A8000 system have their own MAC address. There are 2 Ethernet interfaces on the master module CP-8031/CP-8050. In addition, 2 CI modules (CI-8520 and CI-8522) with 5 Ethernet interfaces each can be connected to the CP-8050. CI-8520 provides 5 electrical Ethernet interfaces, whereas CI-8522 provides 2 optical and 3 electrical Ethernet interfaces each.

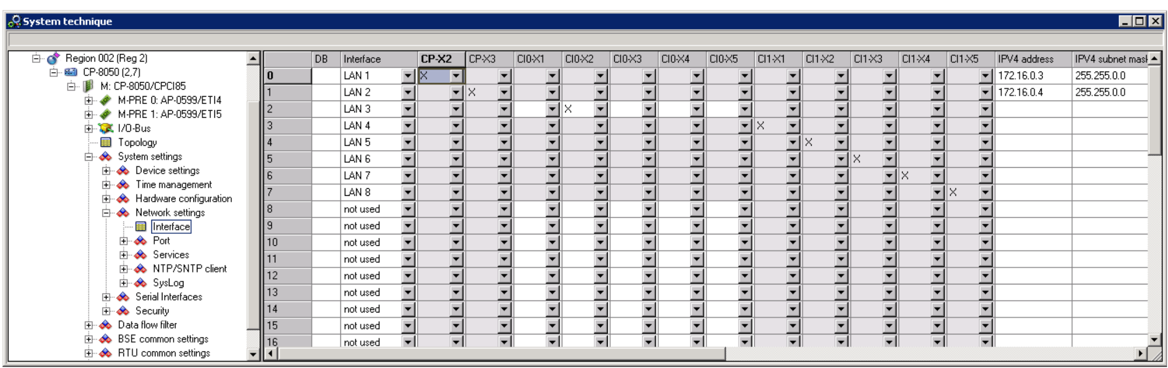


[dw_CP-8031_50_Ethernet_Interfaces, 1, en_US]

One or more LAN interfaces can be assigned to each physical Ethernet interface. Each of these LAN interfaces may be assigned with one or more Ethernet protocols (e.g. ETI4, ETI5).

The assignment of the LAN interface to the physical Ethernet interfaces is done with SICAM TOOLBOX II in the OPM system technique under **`System settings | Network settings | Interface`**.

It is also possible to add one or more VLANs (Virtual Local Area Network, according to the IEEE 802.1Q standard) to each physical Ethernet interface. Details about VLANs see *13.25 VLAN*. As described above, these VLANs can in turn be assigned one or more LAN interfaces.



[System_Network_Interface_Config_X2_X3, 1, en_US]

Table cells with gray background show parameter setting which cannot be changed. Red colored cells show errors and can be changed.

NOTE

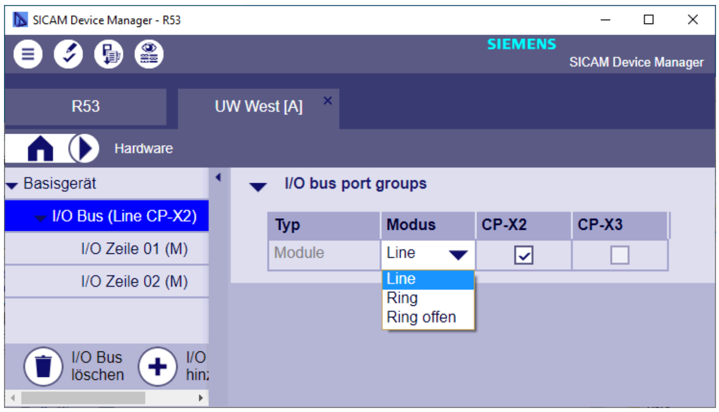
- Several interfaces on a CI-Module can be combined to a switching group.
- On the CP there are always 2 separated Ethernet. This means that no switching is possible on the CP.
- Also switching between modules is not possible.

Configuration of the Ethernet based I/O Port

The Ethernet interfaces on the master module can be used to connect remote I/O rows. Therefor you have to configure the Ethernet based I/O port. In the SICAM Device Manager under **`Hardware | Base device | I/O bus | I/O bus port groups | Mode`** the following options are available:

- **Line**
  The remote I/O rows will be connected in a line configuration.

- **Ring**
  The remote I/O rows will be connected in a ring configuration.
- **Ring open**
  This option is used when a ring configuration made up of separate I/O rows cannot be closed due to local conditions.



[sc_SDM_system_network_port_ethernet_based_IO, 1, en_US]

With the SICAM TOOLBOX II you will find these options under **`System Settings | Network Settings | Ports | Ethernet-based IO.`**. There is the additional option**not used**. This is to be used if no separate I/O rows are connected. X2 and X3 can be used for communication.

MAC addresses

MAC addresses for CP-8031/CP-8050

Each Ethernet port has its own MAC address

MAC addresses for CI-852x

For CI-8520, the MAC addresses depend on the mode of the interface:

- Singular
  Plug has its own MAC address
- Switch
  The group has one MAC address, the MAC address of the least significant connector (Example X2, X4, X5 → MAC address of X2)
- PRP
  The group has one MAC address, the MAC address of the least significant connector (Example X1, X3 → MAC address of X1), in addition, LAN A is the least significant connector and LAN B is the more significant connector.
- HSR
  The group has one MAC address, the MAC address of the least significant connector (Example X1, X3 → MAC address of X1)
- RSTP
  The group has one MAC address, the MAC address of the least significant connector (Example X1, X3 → MAC address of X1)
- Line
  (= like HSR) The group has one MAC address, the MAC address of the least significant connector (Example X1, X3 → MAC address of X1)

- External Switch

  The group has no MAC address. With "External Switch" several external devices can be connected to CI-852x which have an Ethernet connection among each other. The „external switch“ has no connection to CP-8050.

3.1.17 IPSec VPN

IPSec VPN (Internet Protocol Security – Virtual Private Network) is an extension of the Internet Protocol (IP) for encryption and authentication mechanisms. IPSec actively establishes a VPN tunnel (initiator), which guarantees the required confidentiality, authenticity and integrity of data transmission in IP networks. The termination of the IPSec VPN tunnel takes place in a router (e.g Siemens Scalance, Ruggedcom, Cisco, ...). CP-8050 supports up to 8 IPSec VPN tunnel.

Thus, it is e.g. possible, to secure the IEC 60870-104 communication completely between a CP-8050 and a higher-level control center, even if the connection is running over a public network.

CP-8031/CP-8050 uses the IKE-protocol (Internet key exchange) and the PSK-authentication process (pre-shared key). The used pre-shared key can be set by means of the engineering tool (e.g. SICAM TOOLBOX II) and is securely stored in SICAM TOOLBOX II and also in CP-8050.

3.1.18 Security Logging

CP-8031/CP-8050 provides a security logbook which acquires security-relevant events and transmits the events by means of a SysLog client to up to 2 configurable SysLog server.

The security logbook can also be read out with SICAM WEB.

3.2 Telecontrol

The function package *Telecontrol* includes the following functions:

- Communication with other stations via selectable protocols
  - Protocol Elements
  - Automatic or selective data flow routing
  - Data Storage
  - Priority control
  - Monitoring of the communication links upon failure
- Communication within the Automation Unit
- Protocol Element Control and Return Information
- Archiving of events (DEAR)
- Process Data Archive
- Online-Test
- Process Data Input and Output
- Data Flow Control
- Addressing
- General Interrogation

NOTE

The listed functions are described in detail in the document *SICAM SICAM RTUs Common Functions System and Basic System Elements*.

3.2.1 Communication with Other Stations

3.2.1.1 Protocol Elements

The communication function controls the transmission of messages via protocol elements to other automation units or control systems.

A protocol element is based on hardware integrated in the master module for serial or LAN/WAN communication, and supports protocols according to IEC 60870 5 101/103/104, as well as various protocols for the communication with third-party systems.

Communication Function in Transmit Direction

- The messages to be transmitted are learned through the automatic data flow routing and stored in the data storage.
- The transfer of the messages from the data storage to the protocol elements takes place via a priority controller in order to optimally utilize the transmission route.

Communication Function In Receive Direction

- *Messages with process information* are distributed to all functions within the automation unit
- *Messages with system information* are either processed directly (e.g. station interrogation) or distributed further based on their destination address (CASDU) (e.g. messages for remote maintenance)

3.2.1.2 Automatic or Selective Data Flow Routing

For the data flow routing, a routing of individual process information items is not necessary. Simply only the direction (monitor direction, control direction, both directions), in which the messages are to be transmitted, is to be parameterized.

The type identification of each message provides information about the class (refer to Messages with Process Information) to which a message belongs and with which methods it is to be distributed:

- *Messages with process information* in monitor direction
  - For simple applications, the messages can be distributed via an entry in the topology
  - For more complex applications, the messages can be distributed selectively by means of data flow filters For each communication interface, pass-through filters or blocking filters can be set; since wildcards can also be used for all address attributes of the message, it is possible to control the data flow very specifically with simple means
- *Messages with process information* in control direction
  - The messages are distributed to the destinations determined by their CASDU over interfaces that are defined in the topology; the CASDU is interpreted as destination address

3.2.1.3 Data Storage

The messages that are intended for transmission over communication interfaces, are in principle stored chronologically in rings. There is a process image both before and after a ring. The arrangement, consisting of one ring and two process images, is called a priority channel (priority channels for transparent data do not have any process images).

Depending on the data communication mode of the protocol element over which the communication is processed, priority channels are provided for every priority of the messages to be transmitted and for every station that can be reached via the protocol element:

- Data communication mode "Multi-Point" (e.g. multi-point traffic, LAN). One priority channel for every transmission priority, for every station and for every protocol element
- Data communication mode "Single-Point". One priority channel for every transmission priority and for every protocol element

With regard to the data that they transport, priority channels are distinguished as follows:

- Time synchronization
- System information
- Process information in control direction
- Process information in monitor direction Priority HIGH with class 1 data
- Process information in monitor direction Priority MEDIUM with class 2 data
- Process information in monitor direction Priority LOW with class 2 data
- Transparent information

Functions for priority channels:

- State compression for measured values (can be set using parameters) for the reduction of the flood of messages, that can continuously generate fluctuating measured values
- Behavior with a priority channel overload
- Behavior during a communication failure (transmit direction)
- Monitoring of the dwell time (parameter-settable) of messages with process information in control direction. Messages that are stored too long in the priority channel are discarded
- Answering of station interrogations

- Behavior during failure of I/O master modules, communication interfaces etc.
- Blocking (series of information elements)

3.2.1.4 Priority Control

The priority controller has the task of selecting messages recorded in the data memories independently and individually for each interface and station and to direct the transmission of the messages via the protocol elements in accordance with their priority. This ensures that even with continuously available higher-priority data, those of lower priority can also be transmitted.

The prioritization does not however represent an absolute priority status, but rather a measure for dividing up the channel capacity. This ensures, that even with continuously available higher-priority data, those of lower priority can also be transmitted.

3.2.2 Communication within the Automation Unit

Within the automation unit, the function package Telecontrol communicates with the function package Automation via its Telecontrol Interface.

3.2.3 Protocol Element Control and Return Information

The function for protocol element control/protocol element return information is different supported, depending on the protocol element:

- Protocol element control
  - Test if stations are reachable
    e.g.: Set control location
  - suppression of errors with intentionally switched-off stations
- Protocol element return information
  - Station failure
  - State of state line DTR, DSR

3.2.4 Decentralized Archive

In case of a communication fault, occurring events are stored in an archive (DEAR). After elimination of the fault the superior control system can demand the archive of the respective target system. By means of this function, a possible data loss will be prevented.

- Reconstruction of all process-relevant data during a communication fault
- Transmission of the archive to the control system
  - Automatic initiation by the control system
  - File transfer acc. to IEC 60870-5-5

- Data saving
  - Datapoint-specific (parameter-settable)
  - Number of files, memory size parameter-settable
  - Spontaneous for binary information items and integrated totals
  - Definable cycle for measured values
  - Non-volatile on flash card
    When parameter **`SD-Card Mode`** is set accordingly. If no SD-Card is parametrized, storage is done on the internal memory of CP-8050.
- Configuration acc. to IEC 60870-5-101/104 (point-to-point, multi-point traffic, Ethernet)
- Also multi-hierarchical configurations are possible
- Reading of the archive via SICAM TOOLBOX II possible

3.2.5 Process Data Archive

Binary information states, measured values and integrated totals can be recorded in a process data archive. This archive comprises up to 5.000.000 records over a maximal period of 3 months.

- Data saving
  - Datapoint-specific (parameter-settable)
  - Spontaneous for binary information items and integrated totals
  - Definable cycle for measured values
  - Non-volatile on flash card
- Reading of the archive via SICAM WEB by means of file download possible

3.2.6 Process Data Input and Output

The process data input and output comprises

- Acquisition and preprocessing of the process data from the process image of the I/O modules
- Generation and spontaneous transfer of messages with process information to the communication for further processing therein included are
  - time information (resolution 1 ms)
  - processed input signals
    - change-monitored conditioned values
    - change-monitored derived information
- Spontaneous reception of messages with process information from the communication
- Post processing and forwarding of the process data for the output via I/O modules

3.2.7 Data Flow Control

The data flow control is that system function which co-ordinates the communication of messages within the automation unit.

This function supports:

- Messages with Process Information
- Messages with System Information

For the tracking of messages within an automation unit the following test functions are available:

- Data Flow Test
- Message Simulation

3.2.7.1 Messages with Process Information

IEC 60870-5 distinguishes between the following classes of messages. The type identification of each message provides information about the class to which a message belongs and with which methods it is to be distributed:

- Messages with process information in monitor direction
  – binary information, measured values, integrated totals and bit patterns
- Messages with process information in control direction
  – commands, setpoint values and bit patterns

The distribution of messages with process information takes place by way of routing (telecontrol function) or assignment (open/closed-loop control function) based on the message address and type identification in the message.

Messages with process information, that are to be transmitted to other automation units via pro-tocol elements, are distributed with the help of the function Automatic Data Flow Routing.

For messages with process information that are to reach sinks within the automation unit (I/O modules, open-/closed-loop control function) the routing information or as-signments are automatically derived from parameters (datapoint address).

Predominantly used are message formats according to IEC 60870-5-101/104 in the public range with the exception of user data containers. Therefore, for their part the messages are compatible and interoperable with many other manufacturers. Therefore, for their part the messages are compatible and interoperable with many other manufacturers.

Messages with process information have a 5-stage message address. Message addresses must be parameterized at the sources (I/O modules, open-/closed-loop control function).

3.2.8 Addressing

3.2.8.1 Addressing of Automation Units

Each device of the SICAM A8000 Series forms an automation unit and is addressed with

- Region number (0...249)
- Component number (0...255)IEC 0 (255)

Within a system-technical plant, the automation unit must be uniquely addressed, which makes the maximum size of a system-technical plant 64000 automation units.

3.2.8.2 Addressing of the Process Information

The addressing and the structure of the process information to be passed on by an automation unit comply with the standard IEC 60870-5-101/104. Therefore, the information is in turn compatible and interoperable with many other vendors.

In the automation network, each data point is addressed by means of

CASDU 1..........Common address of ASDU, octet 1 (low octet "LSB")

CASDU 2..........Common address of ASDU, octet 2 (high octet "MSB")

IOA 1..............Information object address, octet 1 (low octet "LSB")

IOA 2..............Information object address, octet 2

IOA 3..............Information object address, octet 3 (high octet "MSB")
TI....................Type identification

3.2.9 General Interrogation

On startup and after faults in the system (communication faults, FIFO overflows), the participating automation units ensure, that the operation is resumed automatically in a coordinated manner.

This means that the communication connection is established and all data concerned as well as relevant system information are transferred from their source all the way to their sink, in order to update the process images throughout the system (taking a multi-hierarchical network into account). This is done by prompting a general interrogation of the respective portion of the automation network where the error has occurred.

3.3 Automation

The function package *Automation* contains the following functions:

- Telecontrol Interface
  - Reception of messages with process information
  - Treatment for commands according to IEC 60870-5-101/104
  - Change Monitoring and Generation of Messages with Time Tag
- Open/Closed-Loop Control Function
  - Online test
- Process Data Input and Output

3.3.1 Telecontrol Interface

3.3.1.1 Transfer of Messages with Process Information

Reception of *messages with process information* and transfer to the *open/closed-loop control function* for the purpose of further processing.

Messages with process information in monitoring direction:

- Single-point information, double-point information, step position information
- Measured values
- Integrated totals
- Bitstring of 32-bit

Messages with process information in control direction:

- Single commands, double commands, regulating step commands
- Setpoint commands
- Bitstring of 32-bit

Treatment for commands according to IEC 60870-5-101/104

The treatment for commands serves for the check of the spontaneous information objects to be processed with the help of the *open/closed-loop control function* and transmission of the confirmations for:

- Pulse commands (single commands, double commands, regulating step commands)
- Setpoint values (setpoint command)
- Bitstring of 32-bit

The data transfer of the spontaneous information objects to the *open/closed-loop control function* for further processing is dependent on the result of the checks.

The activation of the element or function to be controlled is the task of the *open/closed-loop control function*.

For the proper operation of this function, information is required by the open/closed-loop control function (e.g. from an interlocking logic) for the choice of a posi-tive or negative confirmation.

The treatment for commands can be activated individually for each command via a parameter.

The treatment for pulse command comprises the following processing functions:

- Prepare command output procedure
  - Formal check
  - Retry suppression
  - 1 out of n check
  - Direct command or
  - Select and execute command
  - Control location check
  - Command interlocking
- Initiate command output procedure
  - Command to application program
- Monitor pulse duration (only pulse commands)
  - Command output time
  - Return information monitoring
- Terminate command output procedure

3.3.1.2 Change Monitoring and Generation of Messages with Time Tag

For the generation of *Messages with process information*, the signals in the output process images that are assigned to an element of a spontaneous information object, are monitored for change.

The change monitoring takes place in the grid of the cycle time of the *open-/closed-loop control function*, in which the signal is assigned to a spontaneous information object.

On a change of the state in a corresponding element of the spontaneous information object, the generation of the message is initiated.

If a spontaneous information object has been activated for transmission due to a change, a *message with process information* is generated. The time tag corresponds either cycle-synchronous with the current time (resolution corresponds with the cycle time) or the time information from an assigned spontaneous information object.

3.3.2 Open/Closed-Loop Control Function

The *open-/closed-loop control function* is used for the management of automation tasks with the help of a freely programmable application program.

NOTE

The correct behavior of the open-/closed-loop control function created by the user must be ensured by means of suitable test scenarios by the user.

The application program is mainly created using function diagram technology in accordance with IEC 61131-3 with the following engineering tools:

- SICAM Device Manager with the logic editor CFC
- SICAM TOOLBOX II with the CAEx plus tool

The application program processes process information (so-called signals) from the connected I/O modules and/or from other system elements in the automation network of the specific process-technical plant.

Process images form the interface of the application program to the outside world. We distinguish between input process images and output process images.

The exchange of the process information can take place in two ways:

- Transmission of periodical information objects from and to the I/O master module (process data input and output)
- Transmission of spontaneous information objects from and to functions within the automation unit, other automation units or control systems via the telecontrol interface

3.3.2.1 Non-Volatile Storage

Variables, signals (input process images for spontaneous information objects) and function blocks can be saved non-volatile. That means, that after a power failure these variables and signals are immediately available again with their values before the power failure.

3.3.2.2 Task Management

The open-/closed-loop control function manages the application program in a periodically running task.

Coordination of the Sequences of a Task

- Periodical start in the selected cycle
- Programmable single-run upon change of a signal from the communication or from the I/O modules (no hardware interrupt)
- Input handling
- Program processing
- Output handling

Cycle Time

- Within the cycle time, the application programs must process the input handling and the output handling
- The cycle time can be set in the application program

Watchdog Timer

This function monitors the proper sequence of the task within its set cycle time. If the task is not finished with its input handling, program processing and its output handling within this time, the next cycle for this task is omitted and a time-out is signaled.

With serious time-outs, for example due to a malfunction, the reliability of the application program becomes questionable. A time scale can be defined for such cases, the exceeding of which leads to an error message and a controlled shutdown of parts or the entire application program as well as all I/O master modules connected.

3.3.2.3 Load Application Program

The initial loading of an application program is always associated with a startup.

Fundamentally however, the fault-free operation and consequently the availability of every control or controller depends on the quality of the program – in other words the measure of how free they are of formal and logical errors. The loading of error-burdened changes can always lead to interruptions to operation.

3.3.2.4 Online test

The entire functionality of the Online Test applies to

- the engineering tool ("CAEx plus Online Test" of the SICAM TOOLBOX II or SICAM WEB)
- the Online Test function of the *open-/closed-loop control function* of the automation unit

While in the engineering tool all functions of the user interface can be found, the *open-/closed-loop control function* provides functions for the execution of the operator inputs.

If for example a value is to be displayed, the selection of the value and its display takes place in the engineering tool. For this purpose, the *open-/closed-loop control function* is given the task of reading out the selected value and transmit it to the user interface.

In the following, those functions are listed that the Online Test function of the *open-/closed-loop control function* provides.

Display and setting of variables and signals

- Display of variables and signals
- Single setting of variables
  - The value of a variable can change again at any time after setting, due to the function of the program ("CAEx plus Online Test")
  - The value of a variable remains maintained until the test mode is active (SICAM WEB)

Blocking and enabling of messages with process information and periodical information

Blocking and Enabling of *Messages with Process Information* and Periodical Information

- in the input-side process images or
- from the output-side process images

can be blocked and enabled. This can take place with the following granularity:

- Per message
- All messages
- Per periodical information
- I/O master module

Changing the Execution Status of the Open-/Closed-Loop Control Function

- Program halt and continue
- Perform cold start or warm start of the program

Test means

The available test means are:

(a) Halting of the execution due to a trigger condition (breakpoint)

(b) Execution of the task in cycle steps

For each of the functions (a) a Trigger Condition is defined in the tool "CAEx plus Online Test". A trigger conditions consists of up to 4 conditions. The conditions of a trigger condition are linked equal-ranking with AND or OR.

A condition compares a variable with a constant value to be specified:

Variable of the Type	Operation	<operator>			
BOOL	*variable <operator> value*	=		<>	
INT or REAL	*variable <operator> value*	<	=	<>	>

The function "halting the execution due to a trigger condition" halts the task, if the trigger condition is satisfied. The trigger condition is evaluated at the end of the task.

Display Statistic Information

The following information on the application program is made available:

- Parameterized cycle time
- Current runtime
- Maximum run time
- Number of time-outs that the system has registered
- During the course of the interrogation, the current run time and the number of time-outs can be optionally reset (does not apply for SICAM WEB).

3.3.3 Process Data Input and Output

The process data input and output comprises

- Acquisition and preprocessing of the process data from the process image of the I/O modules
- Periodical transfer of the process information to the *open-/closed-loop control function* therein included are
  - Processed input signals
  - For processing, operations-relevant error information of the processed input signals (for instance "measured value faulty")
- Periodical reception of the process information from the *open-/closed-loop control function* therein included are
  - Derived information items
  - Processing results
  - Operations-relevant error information (for instance ”command output fault”)
- Postprocessing and forwarding of the process data for the output via I/O modules

4 Environmental Conditions

4.1 SICAM A8000

4.1.1 Protection type

Operational Equipment	Protection type acc. to IEC 60529	Protection type acc. to IEC 61140
CP-8031 CP-8050	Front: IP 40 Other housing sides: IP 20 (incl. terminals)	Class III Low voltage
PS-8620 PS-8622 PS-8640 PS-8642	Front: IP 40 Other housing sides: IP 20 (incl. terminals)	Class II Protection through double or reinforced insulation
CI-8520 CI-8522	Front: IP 40 Other housing sides: IP 20 (incl. terminals)	Class III (CI-8520) Class II (CI-8522) Low voltage
CI-8530 CI-8531 CI-8532 CI-8533 CI-8551	Front: IP 40 Other housing sides: IP 20 (incl. terminals)	Class II Protection through double or reinforced insulation
SICAM I/O-Module SICAM TM 1703 I/O-Modules	Front: IP 40 Other housing sides: IP 20 (incl. terminals)	Class II Protection through double or reinforced insulation
CM-8830	Front: IP 40 Other housing sides: IP 20	Class III Low voltage

4.1.2 Mechanical Ambient Conditions

Harmonic

Parameter	value	Testing Standard	Class	Product Standard	Class
Amplitude of the excursion 1...9 Hz Acceleration 9...200 Hz Acceleration 200...500 Hz	±3.0 mm 10 m/s² 15 m/s²	IEC 60068-2-6		IEC 60870-2-2	Bm
Amplitude 10 .. 60 Hz Acceleration 60 .. 150 Hz	±0.075 mm 1.0 g	IEC 60068-2-6		IEC 60255-21-1	2

Shock

Parameter	value	Testing Standard	Class	Product Standard	Class
Acceleration; 11 ms duration (functional capability)	100 m/s²	IEC 60068-2-27		IEC 60870-2-2	Bm
Acceleration; 11 ms duration (resistivity)	15 g	IEC 60068-2-27		IEC 60255-21-2	1

Continuous shock

Parameter	value	Testing Standard	Class	Product Standard	Class
Acceleration; 16 ms duration	10 g	IEC 60068-2-27		IEC 60255-21-2	1

Seismic harmonic

Parameter	value	Testing Standard	Class	Product Standard	Class
Oscillation 1...8 Hz (horizontal) Oscillation 1...8 Hz (vertical) Oscillation 8...35 Hz (horizontal) Oscillation 8...35 Hz (vertical)	±7.5 mm ±3.5 mm 2 g 1 g	IEC 60068-3-3		IEC 60255-21-3	2

The listed values cover or exceed the required seismic loading according to IEC 60870-2-2 Cl.S3 and IEC 60255-21-3 Cl.1. The values apply in operation and for storage.

The permitted mechanical stresses during transport depend on the transport packaging. The device packaging is not a transport packaging.

4.1.3 Climatic Ambient Conditions

Parameters	Range	Testing Standard	Product Standard	Class
Minimum air temperature (cold)	-25 °C/72 h [14] -40 °C/96 h [15]	IEC 60068-2-1 Ad	IEC 60870-2-2 IEC 60654-1	C2/C3 C2/C3
Maximum air temperature (dry heat)	70 °C/96 h [16] 50 °C/96 h [17] 10 % rH	IEC 60068-2-2 Bd	IEC 60870-2-2 IEC 60654-1	C3 C3
Maximum air temperature for safe operation [18]	70 °C [16] 55 °C [17][19]	IEC 61010-1	–	–
Moisture heat, cyclic	25 °C to 55 °C for 144 h 95 % rF	IEC 60068-2-30	–	–
Corrosive influences	25 °C for 504 h 75 % rF	DIN EN 60068-2-60 Method 4	–	–
Moisture heat, stationary	40 °C for 240 h[19] 93 % rF	IEC 60068-2-78	–	–
Temperature gradient	≤ 30 °C/h	–	IEC 60870-2-2 IEC 60654-1	C2 C2

14 valid for CP-8031/CP-8050, CI-852x, and CI-8551
15 valid for SICAM A8000 power supply, I/O remote modules and I/O modules; on request for CP-8031, CP-8050, and CI-8520
16 applies to horizontal mounting
17 applies to vertical mounting (I/O modules, remote I/O interface)
18 applies in the sense of personal and plant safety
19 not valid for DO-8221

Parameters	Range	Testing Standard	Product Standard	Class
Relative air humidity	5 % to 95 %	–	IEC 60870-2-2 IEC 60654-1	C1 C1
Absolute air humidity	≤35 g/m^3	–	IEC 60870-2-2 IEC 60654-1	C3 C3
Air pressure	70 kPa to 106 kPa (up to 3000 m) [20]	–	IEC 60870-2-2 IEC 60654-1	C2 C2
Temperature with storage and transport	-30 °C to +85 °C	–	–	–
Degree of pollution	2	IEC 61010-1	–	–

The listed values apply for the use in open-air cabinets for bay devices. The products can be exposed to sun and heat. They can be exposed to air flow caused by draught in buildings, e.g. by open windows or by the influences of technical processes.

Condensation is possible for a short time, e.g. during maintenance tasks (not in operation). Condensation, precipitations, water and icing are not permitted during operation.

Heating and cooling is used to maintain the necessary conditions, especially in case of great differences between indoor and outdoor climate.

The conditions of this class normally occur in living and working areas, as well as in production rooms for electronic and electrotechnical products, telecontrol rooms, in storage rooms for valuable and sensible devices.

4.1.4 Electromagnetic Compatibility

4.1.4.1 System Properties

Parameters	Value	Testing Standard	Product Standard	Class
Discharge of static electricity (ESD)	8 kV-Air discharge 6 kV-Contact discharge	IEC 61000-4-2	IEC 60870-2-1	3
Electromagnetic fields	30 V/m[21] (80 MHz to 6 GHz)	IEC 61000-4-3	IEC 60870-2-1	3
Electromagnetic fields (50 Hz)	100 A/m (cont.) 1000 A/m (3 s)	IEC 61000-4-8	IEC 60870-2-1	4
Pulse-shaped magnetic fields	1000 A/m	IEC 61000-4-9	–	–
Radio interference voltage approximate peak value	79 dBµV (0.15 MHz to 0.5 MHz) 60 dBµV (0.5 MHz to 30 MHz)	CISPR22 CISPR32[22]	IEC 60870-2-1 CISPR32	A
Radio interference voltage - mean value	66 dBµV (0.15 MHz to 0.5 MHz) 60 dBµV (0.5 MHz to 30 MHz)	CISPR22 CISPR32	IEC 60870-2-1 CISPR32	A

20 for DO-8221 with revision CC: 80 to 106 kPa (up to 2000 m)

21 CI-8522, AI-8330, AI-8340, DO-8221, AI-8510, and AI-8511 tested with 10 V/m

22 valid for PS-8640 and PS-8642

Parameters	Value	Testing Standard	Product Standard	Class
Radio interference field strength (10 m) approximate peak value	40 dBµV/m (30 MHz to 230 MHz)	CISPR22 CISPR32[23]	IEC 60870-2-1 CISPR32	A
	47 dBµV/m (0.23 MHz to 1 GHz)			
	56 dBµV/m average; 76 dBµV/m peak (1 GHz to 3 GHz)			
	60 dBµV/m average; 80 dBµV/m peak (3 GHz to 6 GHz)			

The characteristics required according to the standards IEC 61000-6-2, IEC 61000-6-4, and IEC 61000-6-5 are covered by the listed values.

WARNING

✧ This is a class A product. In a domestic environment this product may cause radio interference in which case the user may be required to take adequate measures.

4.1.4.2 Power Supply

Parameter	Value	Testing Standard	Product Standard	Class
Dielectrical test (50 Hz) U ≤ DC 60 V/AC 30 V	3.0 kV_{eff} 60 s	IEC 61010-1	IEC 61010-1	–
Dielectrical test (50 Hz) DC 60 V/AC 30 V < U < DC 286 V/AC 253 V (DC 220 V+30%/AC 230 V+10%)	3.0 kV_{eff} 60 s 3.8 kV_{eff} 5 s	IEC 61010-1	IEC 61010-1	–
Insulation resistance test	> 100 MΩ	IEC 60255-27	–	–
Impulse voltage test 1.2/50 µs, common	5.0 kV_p	IEC 60255-27	IEC 60870-2-1	VW3
Impulse voltage test 1.2/50 µs, normal	5.0 kV_p	IEC 60255-27	IEC 60870-2-1	VW3
Voltage tolerance DC	+30/-25%	–	IEC 60870-2-1 IEC 60654-2	DC3 DC4
Voltage tolerance AC	+10/-15%	–	IEC 60870-2-1 IEC 60654-2	AC2 AC3
Harmonic content	<20%	IEC 60870-2-1	IEC 60870-2-1 IEC 60654-2	>H2
Starting current	Class S1	IEC 60870-4	–	–
Harmonic current	-	IEC 61000-3-2	IEC 60870-2-1	A=B
Fast transient burst common	4.0 kV_p 5 kHz	IEC 61000-4-104	IEC 60870-2-1	4
Fast transient burst (fast repetition)	4.0 kV_p 100 kHz	IEC 61000-4-104	–	–
Fast transient burst common	4.0 kV	IEEE C37.90.1	–	–

23 valid for AO-8380, AI-8310, DO-8230, CI-8531, CI-8533, CM-8830, CI-8522, CI-8520, CI-8551,CI-8530, CI-8532, PS-8640, and PS-8642

Parameter	Value	Testing Standard	Product Standard	Class
Fast transient burst transverse	4.0 kV	IEEE C37.90.1	–	–
Surge 1.2/50 µs, common	4.0 kV_p	IEC 61000-5-104	IEC 60870-2-1	4
Surge 1.2/50 µs, normal	4.0 kV_p	IEC 61000-5-104	IEC 60870-2-1	>4
Conducted disturbance (induced HF)	10 V 0,15...80 MHz 80% AM (1 kHz)	IEC 61000-6-104	IEC 60870-2-1	3
Voltage dips, short-time interruption and voltage fluctuations on AC input connections	Dips: (ΔUn) 20% 5ms 30% 20ms 30% 500ms 40% 200ms 60% 200ms 60% 1s 70% 500ms Interruptions: (ΔUn) 100% 10ms 100% 20ms 100% 50ms 100% 100ms 100% 1s 100% 5s Fluctuations (ΔUn) ±8% 5s	IEC 61000-11-104	IEC 60870-2-1 IEC 61850-3 Ed.2	–
Frequency fluctuations AC	10 %	IEC 61000-11-104	IEC 60870-2-1	>F3
Ring waves 100 kHz common	2.0 kV_p	IEC 61000-12-104	IEC 60870-2-1	3
Ring waves 100 kHz normal	2.0 kV_p	IEC 61000-12-104	IEC 60870-2-1	>3
Conducted asymetrical disturbances (induced HF)	30...3 V, 15 Hz...150 kHz 30 V, 16 2/3 / 50 / 60 Hz 60 s 300 V 50/60 Hz 1 s	IEC 61000-4-16		–
Voltage ripple DC	10% U_N	IEC 61000-17-104	IEC 61850-3 Ed.2	>VR3
Damped oscillotory waves 1 MHz common	2.5 kV_p	IEC 61000-18-104	IEC 60870-2-1	4
Damped oscillatory waves 1 MHz normal	2.5 kV_p	IEC 61000-18-104	IEC 60870-2-1	>4
Damped oscillatory waves 10 MHz common[24]	2.5 kV_p	IEC 61000-18-104	–	–
Damped oscillatory waves 1 MHz common	2.5 kV_p	IEEE C37.90.1	–	–

24 valid for PS-8620, PS-8622, PS-8640, PS-8642, CI-8530, CI-8531, CI-8532 and CI-8533

Parameter	Value	Testing Standard	Product Standard	Class
Damped oscillatory waves 1 MHz transverse	2.5 kV_p	IEEE C37.90.1	–	–
Voltage dips, short voltage fluctuation on DC input connections [25]	Dips: (ΔUn) 30% 20ms 30% 500ms 60% 100ms 60% 500ms Interruptions: (ΔUn) 100% 10ms 100% 50ms 100% 100ms 100% 500ms 100% 5s	IEC 61000-29-104	IEC 60870-2-1 IEC 61850-3 Ed.2	–

4.1.4.3 Digital I/Os

Parameters	Value	Testing Standard	Product Standard	Class
Dielectric test (50 Hz) U < DC 60 V/AC 30 V	3,0 kV_{eff} 60 s[26]	IEC 61010-1	IEC 61010-1	
Dielectric test (50 Hz) DC 60 V/AC 30 V ≤ U ≤ DC 286 V/AC 253 V (DC 220 V + 30 %/AC 230 V + 10 %)	3.0 kV_{eff} 60 s 3.8 kV_{eff} 5 s	IEC 61010-1	IEC 61010-1	
Surge 1.2/50 µs, common	5.0 kV_p	IEC 60255-27	IEC 60870-2-1	VW3
Surge 1.2/50 µs, normal	5.0 kV_p	IEC 60255-27	IEC 60870-2-1	VW3
Fast transient burst common	4.0 kV_p 5 kHz	IEC 61000-4-104	IEC 60870-2-1	4
Fast transient burst (fast repetition)	4.0 kV_p 100 kHz	IEC 61000-4-104	–	–
Fast transient burst common	4.0 kV_p	IEEE C37.90.1	–	–
Fast transient burst transverse	4.0 kV_p	IEEE C37.90.1	–	–
Surge 1.2/50 µs, common	4.0 kV_p	IEC 61000-5-104	IEC 60870-2-1	4
Surge 1.2/50 µs, normal	4.0 kV_s[27]	IEC 61000-5-104	IEC 60870-2-1	>4
Conducted disturbances (induced HF)	10 V, 0.15 MHz to 80 MHz, 80% AM 1 kHz	IEC 61000-6-104	IEC 60870-2-1	3
Ring waves 100 kHz, common	2.0 kV_p	IEC 61000-12-104	IEC 60870-2-1	4
Ring waves 100 kHz, normal	2.0 kV_p	IEC 61000-12-104	IEC 60870-2-1	4

25 for interruptions/fluctuations > 50 ms applies criterion B: restart of the device allowed

26 DO-8230: 1.5 kV_p

27 DO-8221: 2.0 kV_p

Parameters	Value	Testing Standard	Product Standard	Class
Conducted asymetrical disturbances (induced HF)	30 V to 3 V, 15 Hz to 150 Hz 30 V, 16 2/3 / 50 / 60 Hz 60 s 300 V, 16 2/3 / 50 / 60 Hz 1 s	IEC 61000-16-104	–	–
Damped oscillatory waves 1 MHz, common	2.5 kV_p	IEC 61000-18-104	IEC 60870-2-1	4
Damped oscillatory waves 1 MHz, normal	2.5 kV_p	IEC 61000-18-104	IEC 60870-2-1	>4
Damped oscillatory waves 1 MHz, common	2.5 kV_p	IEEE C37.90.1	–	–
Damped oscillatory waves 1 MHz, transverse	2.5 kV_p	IEEE C37.90.1	–	–

4.1.4.4 Analog I/Os

Parameter	Value	Testing Standard	Product Standard	Class
Dielectrical test (50 Hz) U ≤ DC 60 V/ AC 30 V	1,6 kV_{eff} 60 s 1,8 kV_{eff} 5 s	IEC 61010-1	IEC 61010-1	
Surge 1.2/50 µs, common	2.5 kV_p	IEC 60255-27	IEC 60870-2-1	
Surge 1.2/50 µs, normal	2.5 kV_p	IEC 60255-27	IEC 60870-2-1	>VW 2
Fast transient burst common	4.0 kV_p 5 kHz	IEC 61000-4-104	IEC 60870-2-1	3
Fast transient burst (fast repetition)	4.0 kV_p 100 kHz	IEC 61000-4-104	–	–
Fast transient burst common	4.0 kV_p	IEEE C37.90.1	–	–
Surge 1.2/50 µs, common	2.0 kV_p	IEC 61000-5-104	IEC 60870-2-1	4
Surge 1.2/50 µs, normal	2.0 kV_p	IEC 61000-5-104	IEC 60870-2-1	4
Conducted disturbances (induced HF)	10 V, 0.15 to 80 MHz 80% AM 1 kHz	IEC 61000-6-104	–	
Ring waves 100 kHz common	2.0 kV_p	IEC 61000-12-104	IEC 60870-2-1	4
Ring waves 100 kHz normal	2.0 kV_p	IEC 61000-12-104	IEC 60870-2-1	4
Conducted asymetrical disturbances (NF)	30 to 3 V[28], 15 Hz to 150 kHz 30 V[29], 16 2/3 / 50 / 60 Hz 60 s 300 V[30], 50/60 Hz 1 s	IEC 61000-16-104	–	–
Damped oscillatory waves 1 MHz common	2.5 kV_p	IEC 61000-18-104	IEC 60870-2-1	4

28 AI-8310: tested with 10 to 1 V
29 AI-8310: tested with 10 V
30 AI-8310: tested with 100 V

Parameter	Value	Testing Standard	Product Standard	Class
Damped oscillatory waves 1 MHz normal	2.5 kV_p	IEC 61000-18-104	IEC 60870-2-1	4
Damped oscillatory waves 1 MHz common	2.5 kV_p	IEEE C37.90.1	–	–

4.1.4.5 Communication with Insulation: RS-485/RS-232

Parameters	Value	Testing Standard	Product Standard	Class
Dielectrical test (50 Hz) U ≤ DC 60 V/AC 30 V	1.5 kV_{eff} 60 s	IEC 60255-27	IEC 60870-2-1	–
Insulation resistance test	> 100 MΩ	IEC 60255-27	–	–
Impulse pulse voltage test 1.2/50 µs common	2.5 kV_p	IEC 60255-27	IEC 60870-2-1	–
Impulse voltage test 1.2/50 µs normal	2.5 kV_p	IEC 60255-27	IEC 60870-2-1	>VW2
Fast transient burst	4.0 kV_p 5 kHz	IEC 61000-4-104	IEC 60870-2-1	3
Fast transient burst common[31]	4.0 kV_p 100 kHz	IEC 61000-4-104	IEC 60870-2-1	3
Fast transient burst common	4.0 kV_p	IEEE C37.90.1	–	–
Fast transient burst normal	4.0 kVp	IEEE C37.90.1	–	–
Surge 1.2/50 µs common	4.0 kV_p	IEC 61000-5-104	IEC 60870-2-1	3
Surge 1.2/50 µs normal	4.0 kV_p	IEC 61000-5-104	IEC 60870-2-1	3
Surge 10/700 µs common[31]	4.0 kV_p	IEC 61000-5-104	IEC 60870-2-1	3
Conducted disturbances (induced HF)	10 V, 0.15 to 80 MHz 80% AM 1 kHz	IEC 61000-6-104	IEC 60870-2-1	3
Ring waves 100 kHz common	2.0 kV_p	IEC 61000-12-104	IEC 60870-2-1	4
Ring waves 100 kHz normal	2.0 kV_p	IEC 61000-12-104	IEC 60870-2-1	4
Conducted asymmetrical distur-bances (induced HF)	30 to 3 V, 15 Hz to 150 kHz 30 V, 16 2/3 / 50 / 60 Hz 60 s 300 V, 16 2/3 / 50 / 60 Hz 1 s	IEC 61000-16-104	–	–
Damped oscillatory waves 1 MHz common	2.5 kV_p	IEC 61000-18-104	IEC 60870-2-1	4
Damped oscillatory waves 1 MHz common	2.5 kV_p	IEEE C37.90.1	–	–

The listed values are valid for shielded cables.

4.1.4.6 Communication without Insulation: RS-232

The communication via RS-232 is designed only for distances ≤ 2.5 m. Therefore this interface does not need to show an immunity. The immunity and the galvanic insulation is assumed by the external data communica-tions equipment.

You can find the electrical ambient conditions of data transmission equipment in the related data sheets.

[31] valid for CI-8551

4.1.4.7 Communication with Insulation: LAN

Parameters	Value	Testing Standard	Product Standard	Class
Dielectrical test (50 Hz) U ≤ DC 60 V/AC 30 V	1.5 kV_{eff} 60 s	IEC 61010-1	IEC 61010-1	–
Insulation resistance test	> 100 MΩ	IEC 60255-27	–	–
Impulse voltage test 1.2/50 µs common	2.5 kV_p	IEC 61010-1	IEC 61010-1	–
Impulse voltage test 1.2/50 µs normal	2.5 kV_p	IEC 60255-27	IEC 60870-2-1	>VW2
Fast transient burst common	4.0 kV_p 5 kHz	IEC 61000-4-104	IEC 60870-2-1	3
Fast transient burst common[32]	4.0 kV_p 100 kHz	IEC 61000-4-104	IEC 60870-2-1	3
Fast transient burst	4.0 kV_p	IEEE C37.90.1	–	–
Surge 1.2/50 µs common	2.0 kV_p	IEC 61000-5-104	IEC 60870-2-1	3
Surge 1.2/50 µs normal	2.0 kV_p	IEC 61000-5-104	IEC 60870-2-1	3
Conducted disturbances (induced HF)	10 V 0,15...80 MHz 80% AM 1 kHz	IEC 61000-6-104	IEC 60870-2-1	–
Ring waves 100 kHz common	2.0 kV_p	IEC 61000-12-104	IEC 60870-2-1	4
Ring waves 100 kHz normal	2.0 kV_p	IEC 61000-12-104	IEC 60870-2-1	4
Conducted asymmetrical disturbances (induced HF)	30...3 V, 15 Hz... 150 kHz 30 V, 16 2/3 / 50 / 60 Hz 60 s 300 V, 16 2/3 / 50 / 60 Hz 1 s	IEC 61000-16-104	IEC 61850-3	–
Damped oscillatory waves 1 MHz common	2.5 kV_p	IEC 61000-18-104	IEC 60870-2-1	4
Damped oscillatory waves 1 MHz normal	2.5 kV_p	IEEE C37.90.1	–	–

The listed values are valid for shielded cables.

4.1.4.8 Storage and Transport

Storage

Store the device in dry and clean rooms. The relative humidity must not lead to the formation of either condensation water or ice.

For storage Siemens recommends that you maintain a limited temperature range of between +10°C and +35°C, in order to prevent premature ageing of the electrolytic capacitors used.

For a longer storage period Siemens also recommends connecting the device to the supply voltage once a year for 1 to 2 days, in order to form the electrolytic capacitors used. You should proceed likewise before a planned use of the device.

Transport

The transport packaging of the devices can be re-used for forwarding. If other packaging is used the observance of the transport requirements according to ISO 2248 must be ensured. Storage packaging of the individual devices is not adequate for transport.

32 valid for CI-8522 Ethernet-Port (X1, X2, X3): 4 kV 100 kHz; CI-8522 Ethernet SFP Module (X4, X5): 2 kV 100 kHz; CI-8531/CI-8533 Ethernet SFP Module: 2 kV 100 kHz. (CP-8050, CP-8031, CI-8520, CI-8530/CI-8532 are not tested with 100 kHz)

4.2 SICAM A8000 Rack

4.2.1 Protection type

Operational Equipment	Protection type acc. to IEC 60529
CM-2846	Rear panel installation with wall fastening kit IP 20
	19" (swing) frame installation with backside cover kit IP 20

4.2.2 Mechanical Ambient Conditions

Harmonic

Parameters	Value	Testing Standard	Clas s	Product Standard	Clas s
Amplitude of the excursion 1...9 Hz Acceleration 9...200 Hz Acceleration 200...500 Hz	±3.5 mm 10 m/s² 15 m/s²	IEC 60068-2-6		IEC 60870-2-2	Bm
Amplitude 10 ... 60 Hz Acceleration 60 ... 150 Hz	±0.075 mm 1.0 g	IEC 60068-2-6		IEC 60255-21-1	2

Shock

Parameters	Value	Testing Standard	Clas s	Product Standard	Clas s
Acceleration; 11 ms duration (functional capability)	100 m/s²	IEC 60068-2-27		IEC 60870-2-2	Bm
Acceleration; 11 ms duration (resistivity)	15 g	IEC 60068-2-27		IEC 60255-21-2	1

Continuous shock

Parameters	Value	Testing Standard	Clas s	Product Standard	Clas s
Acceleration; 16 ms duration	10 g	IEC 60068-2-27		IEC 60255-21-2	1

Seismic harmonic

Parameters	Value	Testing Standard	Clas s	Product Standard	Clas s
Amplitude 1 ... 8 Hz (horizontal) Acceleration 8 ... 35 Hz (horizontal) Amplitude 1 .. 8 Hz (vertical) Acceleration 8 ... 35 Hz (vertical)	±3.5 mm 1 g ±1.5 mm 0.5 g	IEC 60068-3-3		IEC 60255-21-3	1

The listed values apply in operation and for storage.

The permitted mechanical stresses during transport depend on the transport packaging. The device packaging is not a transport packaging.

4.2.3 Climatic Ambient Conditions

Parameters	Range	Testing Standard	Product Standard	Class
Minimum air temperature (cold)	-5 °C/72 h	IEC 60068-2-1 Ad	IEC 60870-2-2 IEC 60654-1	C1 C1
Maximum air temperature (dry heat)	55 °C/72 h [33]	IEC 60068-2-2 Bd	IEC 60870-2-2 IEC 60654-1	C2 C2
Temperature gradient	≤ 30 °C/h	–	IEC 60870-2-2 IEC 60654-1	C2 C2
Relative air humidity	5 % to 95 %	–	IEC 60870-2-2 IEC 60654-1	C1 C1
Absolute air humidity	≤35 g/m^3	–	IEC 60870-2-2 IEC 60654-1	C3 C3
Air pressure	70 kPa to 106 kPa (up to 3000 m)	–	IEC 60870-2-2 IEC 60654-1	C2 C2
Temperature with storage and transport	-30 °C to +85 °C	–	–	–

The listed values apply for indoor locations with temperature control and a wide range of relative humidity. The humidity is not controlled. The products can be exposed to sun and heat. They can be exposed as well to air flow caused by draught in buildings, e.g. by open windows or influences of technical processes.

Bedewing is possible for a short time, e.g. during the course of maintenance tasks (not in operation). Condensation, precipitations, water and icing are not permitted.

Heating and cooling is used to maintain the necessary conditions, especially in case of great differences between indoor and outdoor climate.

The conditions of this class normally occur in living and working areas, as well as in produc-tion rooms for electronic and electrotechnical products, telecontrol rooms, storage rooms for valuable and sensible devices.

33 max. 40°C allowed in case of a full equipped mounting rack

4.2.4 Electromagnetic Compatibility

4.2.4.1 System Properties

Parameters	Value	Testing Standard	Product Standard	Class
Discharge of static electricity (ESD)	8 kV-Air discharge 6 kV-Contact discharge	IEC 61000-4-2	IEC 60870-2-1	3
Electromagnetic fields	10 V/m (80 MHz to 1 GHz) 3 V/m 1 GHz to 2 GHz 1 V/m 2 GHz to 2.7 GHz	IEC 61000-4-3	IEC 60870-2-1	3
Induced HF voltage	10 V	IEC 61000-4-6	IEC 61000-6-2	-
50 Hz magnetic field	100 A/m (cont.) 1000 A/m (3 s)	IEC 61000-4-8	IEC 60870-2-1	4
Pulse-shaped magnetic fields	1000 A/m	IEC 61000-4-9	–	–
Radio interference voltage approximate peak value	79/73 dBµV	CISPR22	IEC 60870-2-1 CISPR22	A A
Radio interference voltage - mean value	66/60 dBµV	CISPR22	IEC 60870-2-1 CISPR22	A A
Radio interference field strength (10 m)	40/47 dBµV	CISPR22	IEC 60870-2-1 CISPR22	A A

WARNING

✧ This is a class A product. In this case the user may be required to take adequate measures.

4.2.4.2 Power Supply

Parameter	Value	Testing Standard	Product Standard	Class
Dielectric test U ≤ DC 60 V against SELV circuits	2,5 kV_{ms}	IEC 61010-1	IEC 61010-1	
Dielectric test U > DC 60 V against SELV circuits	3,0 kV_{ms}	IEC 61010-1	IEC 61010-1	
Surge 1.2/50 µs, common	5.0 kV_p	IEC 60255-27	IEC 60870-2-1	VW3
Surge 1.2/50 µs, normal	5.0 kV_p	IEC 60255-27	IEC 60870-2-1	VW3
Voltage tolerance DC [34]	+30/-25%	IEC 60870-2-1	IEC 60870-2-1 IEC 60654-2	>DC3 DC4
Voltage tolerance AC [35]	+10/-15%	IEC 60870-2-1	IEC 60870-2-1 IEC 60654-2	AC2 AC3
Frequency tolerance AC	±5%	IEC 60870-2-1	IEC 60870-2-1 IEC 60654-2	F3

34 referring to supply voltage rated values: 24/48/60 VDC, 110/220 VDC

35 referring to nominal values of the supply voltage: 115 V_{eff} AC / 230 V_{eff} AC

Parameter	Value	Testing Standard	Product Standard	Class
Harmonic content	<20%	IEC 60870-2-1	IEC 60870-2-1 IEC 60654-2	>H2
Starting current	S1	IEC 60870-4	IEC 60870-4	S1
Harmonic current	-	IEC 61000-3-2 D	IEC 60870-2-1	A=B
Fast transient burst common	4.0 kV_p	IEC 61000-4-104	IEC 60870-2-1 IEC 60255-26	-
Surge 1.2/50 µs, common	4.0 kV_p	IEC 61000-5-104	IEC 60870-2-1 IEC 60255-26	-
Surge 1.2/50 µs, normal	4.0 kV_p	IEC 61000-5-104	IEC 60870-2-1 IEC 60255-26	-
Interruption time AC (ΔU = 100%)	≤ 50 ms	IEC 61000-4-11	IEC 60870-2-1 IEC 60255-26	>1
Ring waves 100 kHz common	2.0 kV_p	IEC 61000-12-104	IEC 60870-2-1	3
Ring waves 100 kHz normal	2.0 kV_p	IEC 61000-12-104	IEC 60870-2-1	>3
Voltage ripple DC [34]	≤15%	IEC 61000-17-104	IEC 60870-2-1 IEC 60255-26	>VR3
Damped oscillatory waves 1 MHz normal	2.5 kV_p	IEC 61000-18-104	IEC 60870-2-1 IEC 60255-26	3-4
Damped oscillatory waves 1 MHz common	2.5 kV_p	IEC 61000-18-104	IEC 60870-2-1 IEC 60255-26	>3-4
Interruption time DC (ΔU = 100%)	≤50 ms	IEC 61000-4-29	IEC 60870-2-1 IEC 60255-26	>1

4.2.4.3 Digital and Analog I/O´s

Parameters	Value	Testing Standard	Product Standard	Class
Dielectric test	1,5 kV_{ms}	IEC 61010-1	IEC 61010-1	
Surge 1.2/50 µs, common	2.5 kV_p	IEC 60255-27	IEC 60870-2-1	>VW2
Surge 1.2/50 µs, normal	2.5 kV_p	IEC 60255-27	IEC 60870-2-1	>VW2
Fast transient burst common	2.0 kV_p	IEC 61000-4-104	IEC 60870-2-1 IEC 60255-26	-
Surge 1.2/50 µs, common	2.0 kV_p	IEC 61000-5-104	IEC 60870-2-1 IEC 60255-26	-
Surge 1.2/50 µs, normal	2.0 kV_p	IEC 61000-5-104	IEC 60870-2-1 IEC 60255-26	-
Conducted.common mode distur-bances common	10 V 0...150 kHz 100 V 50/60 Hz	IEC 61000-16-104	-	-
Damped oscillatory waves 1 MHz common	1.0 kV_p	IEC 61000-18-104	IEC 60870-2-1	2
Damped oscillatory waves 1 MHz normal	1.0 kV_p	IEC 61000-18-104	IEC 60870-2-1	>2

Deviating values for DO-2210 and DO-2211

Parameters	Value	Testing Standard	Product Standard	Class
Fast transient burst common	4.0 kV_p	IEC 61000-4-104	IEC 60870-2-1 IEC 60255-26	-
Damped oscillatory waves 1 MHz common	2.5 kV_p	IEC 61000-18-104	IEC 60870-2-1 IEC 60255-26	3-4
Conducted.common mode distur-bances common	1 V 0...150 kHz 10 V 50/60 Hz	IEC 61000-16-104	-	-

Deviating Values for DI-2112, DI-2113, DI-2114, DI-2115

Parameters	Value	Testing Standard	Product Standard	Class
Dielectric test $U_N \leq 60$ V against SELV circuits	2,5 kV_{ms}	IEC 60255-27	IEC 60870-2-1	VW3
Dielectric test $U_N > 60$ V against SELV circuits	3,0 kV_{ms}	IEC 60255-27	IEC 60950-2-1	2
Surge 1.2/50 µs, common	5.0 kV_p	IEC 60255-27	IEC 60870-2-1	VW3
Conducted.common mode distur-bances common	30 V 0...150 kHz 300 V 50/60 Hz	IEC 61000-16-104	-	-

4.2.4.4 Communikation LAN

Parameters	Value	Testing Standard	Product Standard	Class
Dielectric test (50 Hz)	1,5 kV_{ms}	IEC 60255-27	IEC 60870-2-1	>VW2
Surge 1.2/50 µs, common	2.5 kV_p	IEC 60255-27	IEC 60870-2-1	>VW2

The listed values are valid for CAT5 cables with a length of up to 3 m.

5 System Components and Technical Data

5.1 Power Consumption Total System

Depending on the power consumption of your system, suitable power supply modules are available. For the base device (master module as stand-alone or with expansion modules), these are external power supply modules with 12 W and 45 W power. In I/O rows, the power supply is integrated in the I/O remote modules (7 W output power). If required, the external power supply modules can also be used.

External power supply modules:

- PS-8620 Power Supply 24-60VDC 12W
- PS-8622 Power Supply 110-220VDC 12W
- PS-8640 Power Supply 24-60VDC 45W
- PS-8642 Power Supply 100-240VDC o. VAC 45W

I/O Remote modules with integrated power supply for I/O rows:

- CI-8530 SICAM I/O Remote 24-60VDC el.
- CI-8531 SICAM I/O Remote 24-60VDC F/O
- CI-8532 SICAM I/O Remote 110-220VDC el.
- CI-8533 SICAM I/O Remote 110-220VDC F/O

To select the appropriate power supply, you must determine the power requirement of the base device and, if applicable, each I/O row. To do this, add up the power consumption of all SICAM A8000 modules and any modems that may be included.

Modules	Available power for I/O modules	Available total power
PS-8620, PS-8622	7 W	12 W
PS-8640, PS-8642	8 W	45 W
CI-8530, CI-8531, CI-8532, CI-8533	7 W	7 W

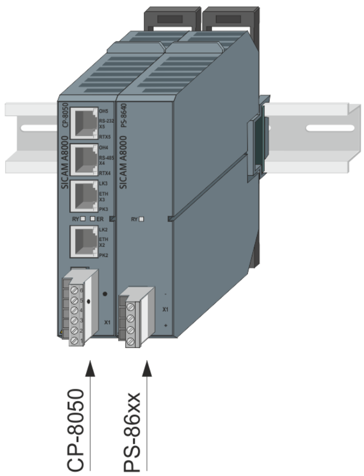
The values for the power consumption can be found in the section *5.1.2 Power Consumption of the SICAM A8000 Modules*. For the values of the used modems see the documentation of the respective modem.

NOTE

The efficiency factor of 80% (voltage transformer on CP-8031/CP-8050) must be considered if a modem is supplied via interface X5.

5.1.1 Example for the Calculation of the Power Consumption

CP-8050 as simple data node

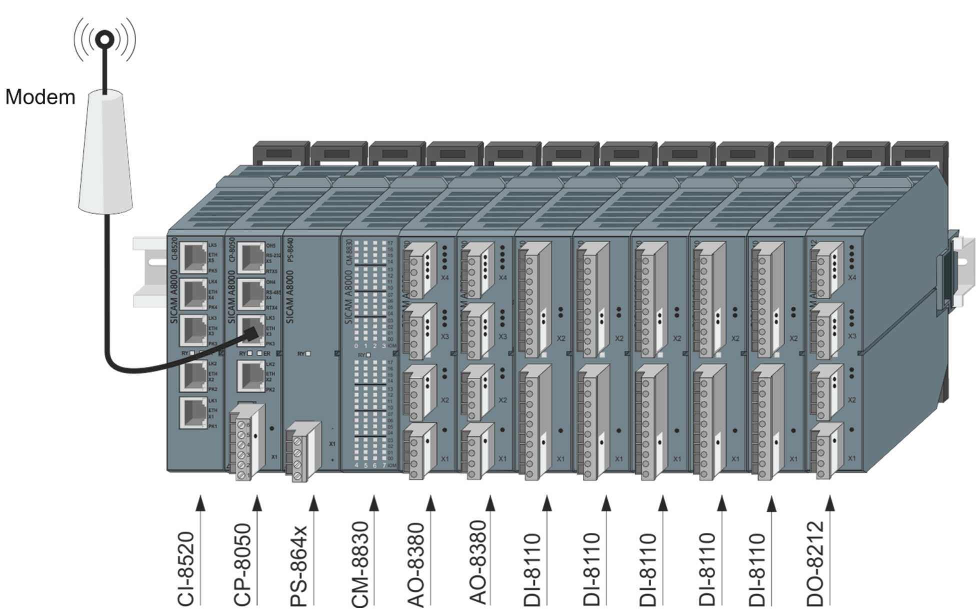


[CP-8050_Power_consumption_ex_01, 1, --_--]

Figure 5-1 CP-8050 as simple data node

Modules	Power consumption I/O Modules [W]; Σ max. 7	Power consumption of other modules [W]	Total power consumption [W]
CP-8050 Master-Module	–	4.50	
Sum	**–**	**4.50**	**4.50** → Recommended power supply unit: **PS-8620 or PS-8622**

CP-8050 as an automation device with local I/O-modules and modem



[dw_cp8050_powerconsum_int, 2, en_US]

Figure 5-2 CP-8050 as an automation device with local I/O-modules and modem

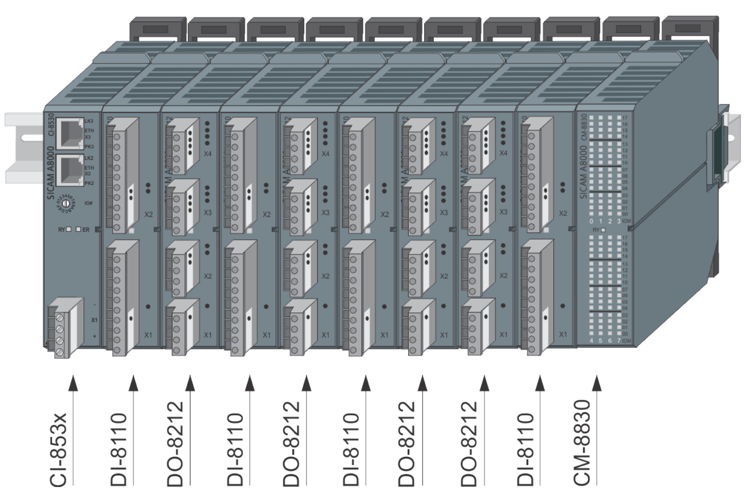
Modules	Power consumption I/O Modules [W]; Σ max. 7	Power consumption of other modules [W]	Total power consumption [W]
CI-8520 Ethernet Interface	–	2.50	
CP-8050 Master Module	–	4.50	
CM-8830 SICAM I/O Module LED Unit	0.50	–	
AO-8380 Analog output 4x ±20mA/±10V	2.20	–	
AO-8380 Analog output 4x ±20mA/±10V	2.20	–	
DI-8110 Digital input 2x8, 24VDC	0.13	–	
DI-8110 Digital input 2x8, 24VDC	0.13	–	
DI-8110 Digital input 2x8, 24VDC	0.13	–	
DI-8110 Digital input 2x8, 24VDC	0.13	–	
DI-8110 Digital input 2x8, 24VDC	0.13	–	
DO-8212 Dig Outp Rel 8x 24-220VDC/230VAC	0.80	–	
Modem	–	7.20[36]	
Sum	**6.35**	**14.20**	**20.55** → Required power supply unit: **PS-8640 or PS-8642**

NOTE

With PS-864x the available power increases to 8 W to I/O modules.

Calculation for an External I/O Row

The basis of each I/O row is a SICAM I/O remote module (CI-853x). This is connected to the CP-8050 base unit and supplies the connected I/O modules via an integrated power supply. The output power is 7 W.



[dw_cp8050_powerconsum_ext, 1, --_--]

Figure 5-3 Calculation for an External I/O Row

36 Power consumption of an external modem is 6 W. But due to 80 % efficiency of CP-8050, 7.20 W have to be considered.

Modules	Power consumption I/O Modules [W]; Σ max. 7	Power consumption of other modules [W]	Total power consumption [W]
DI-8110 Digital Input 2x8 DC 24 V	0.13	–	
DO-8212 Dig Outp Rel 8x 24-220VDC/ 230VAC	0.80	–	
DI-8110 Digital input 2x8, 24VDC	0.13	–	
DO-8212 Dig Outp Rel 8x 24-220VDC/ 230VAC	0.80	–	
DI-8110 Digital input 2x8, 24VDC	0.13	–	
DO-8212 Dig Outp Rel 8x 24-220VDC/ 230VAC	0.80	–	
DO-8212 Dig Outp Rel 8x 24-220VDC/ 230VAC	0.80	–	
DI-8110 Digital input 2x8, 24VDC	0.13	–	
CM-8830 SICAM I/O Module LED Unit	0.50	–	
Sum	**4.22**	**–**	**4.22** → no external power supply required; the power supply integrated in CI-853x is sufficient

5.1.2 Power Consumption of the SICAM A8000 Modules

Master Module

Module	Power consumption [W]
CP-8031 Master Module	4.20
CP-8050 Master Module	4.50

Communication Modules

Module	Power consumption [W]
CI-8520 Ethernet Interface	2.50
CI-8522 Network Interface F/O	4.50
CI-8551 Communication Interface serial	4.50

SICAM A8000 I/O-Module

Module	Power consumption [W]
AI-8310 Analog Input 2x2 Pt100/Pt1000	0.50
AI-8320 Analog Input 4x ±20mA/±10V	0.18
AI-8330 Ana. Input 3xI(6A) for AI-8340	0.30
AI-8340 Ana. Input (4xU(250V), 2xDO)	1.40
AI-8510 Analog Inp.(3xU(240V),3xI(LoPo))	0.80
AO-8380 Analog Output 4x ±20mA/±10V	2.20
DI-8110 Digital Input 2x8, 24VDC	0.13
DI-8111 Digital Input 2x8, 48/60VDC	0.13
DI-8112 Digital Input 2x8, 110VDC	0.13
DI-8113 Digital Input 2x8, 220VDC	0.13

Module	Power consumption [W]
DO-8212 Dig Outp Rel 8x 24-220VDC/230VAC	0.80
DO-8221 Secured Command Output	2.00 (during command output) 1,30 (at rest)
DO-8230 Dig Outp Transistor 16x 24-60VDC	0.50
CM-8830 SICAM I/O Module LED Unit	0.50
CM-8820 CT-Adapter 3xI 1A_5A/225mV	–

SICAM A8000 I/O Remote-Modules

Module	Power consumption [W]
CI-8530 SICAM I/O Remote 24-60VDC el.	1.5
CI-8531 SICAM I/O Remote 24-60VDC F/O	4.5
CI-8532 SICAM I/O Remote 110-220VDC el.	1.5
CI-8533 SICAM I/O Remote 110-220VDC F/O	4.5

5.1.3 Power Consumption of the SICAM TM Modules

SICAM TM I/O Modules

Module	Power consumption [W]
AI-6300 Analog input 2x2 ±20 mA/±10 V	0.48
AI-6307 Analog input 2x2 ±2.5 mA/±5 mA/±10 V	0.48
AI-6308 Analog input 2x2 ±1 mA/±2 mA/±10 V	0.48
AI-6310 Analog input 2x2 Pt100/Ni100	0.5
AO-6380 Analog output 4x ±20 mA/±10 mA/±10 V	1.9
DI-6100 Binary input 2x8 DC 24...60 V	0.17
DI-6101 Binary input 2x8 DC 110/220 V	0.17
DI-6102 Binary input 2x8 DC 24...60 V, 1 ms	0.19
DI-6103 Binary input 2x8 DC 110/220 V, 1 ms	0.19
DI-6104 Binary input 2x8 DC 220 V	0.17
DO-6200 Binary output transistor 2x8 DC 24...60 V	0.6
DO-6212 Binary output relays 8x DC 24...220 V / AC 230 V	0.8
DO-6220 Checked command output basic module	1.2
DO-6221 Checked command output basic module measurement	2.09
DO-6230 Checked command output relay module	0.33
TE-6420 Speed acquisition 2x2 5/24VDC/NAMUR	0.79
TE-6430 Counting Pulse Inp. 2x DC 24 to 60 V	0.6
TE-6450 Position acquisition 2x2 SSI/RS422	0.77

5.1.4 Power Consumption of the SICAM A8000 Rack Modules

SICAM A8000 Rack I/O Remote Modules

Module	Power consumption [W]
CI-2530 SICAM Rack I/O Remote	1.30

SICAM A8000 Rack I/O Modules

Module	Power consumption [W]
DI-2112 Digital Input 8x8, 24VDC,1ms	1.10
DI-2113 Digital Input 8x8, 48/60VDC,1ms	1.10
DI-2114 Digital Input 8x8, 110VDC,1ms	1.10
DI-2115 Digital Input 8x8, 220VDC,1ms	1.10
DO-2201 Dig. Outp.Trans 40x1,24-60VDC	0.60 + 0.03 W for each active output
DO-2210 Command Output 24-60VDC	1.00 without SM-2506 1.60 with SM-2506 + 0.60 W during command output
DO-2211 Command Output 125VDC	1.00 without SM-2506 1.60 with SM-2506 + 0.60 W during command output
AI-2300 Ana. Inp.16x ±20mA + 4x opt.IOM	2.50

SICAM A8000 Rack I/O Submodules

Module	Power consumption [W]
SM-0570 Analog Input Extension (2x+/-20mA)	0.60
SM-0571 Analog Value Extension (2x Pt100)	0.90
SM-0572 Analog output extension (2x ±20 mA,±1/10 V)	1.50

5.2 SICAM A8000 Master Modules

5.2.1 CP-8031, CP-8050

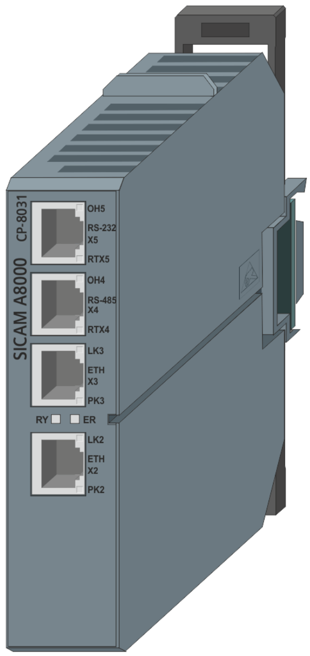


Figure 5-4 CP-8031

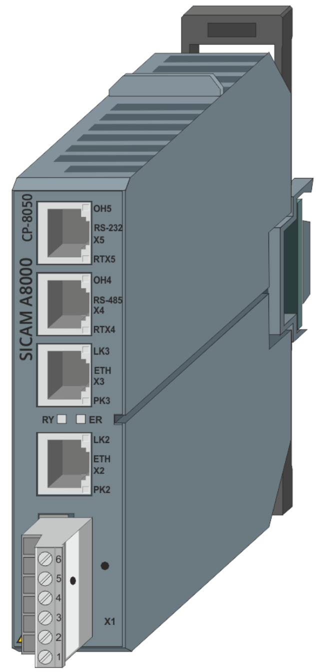


Figure 5-5 CP-8050

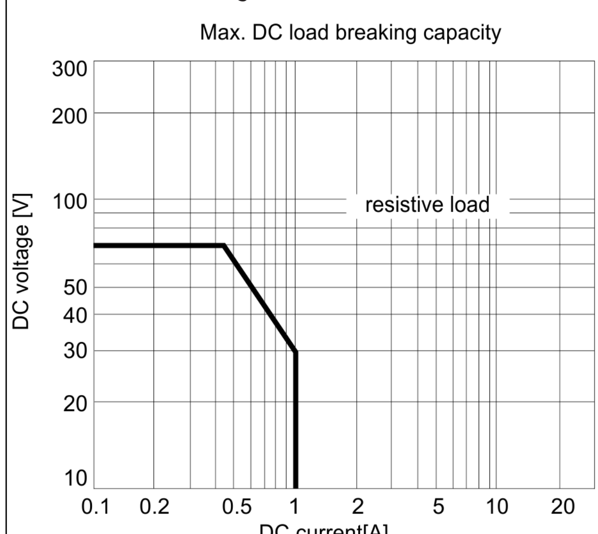
5.2.1.1 Technical Data

Processor and Memory

Processor	Altera Cyclon V SoC 5CSEB A4 Dual Core ARM Cortex A9 MPcore Processor
Clock frequency	Core clock: 800MHz System Clock: ca. 333 MHz
System/Core pulse	Quarz 50 Mhz, ± 50 ppm
Internal real time clock and external synchronization	• Buffered maintenance-free 72h • Automatical daylight-saving time/normal time change • External time synchronization via: – Digital IRIG-B signal – LAN/WAN (NTP) – IEEE 1588 (PTP) – Serial Communication
Accuracy clock pulse	Real Time Clock RTC ± 3.5 ppm (-40 °C to +80 °C), ± 2 ppm (0 °C to 40 °C)
Free run accuracy	12,6 ms/h
Program memory	QSPI Flash 64 MB – Boot Flash eMMC Flash 4GB
Main memory	DDR3 RAM 512 MB
Local non-volatile memory	NVRAM 256kBytes
Changeable non-volatile memory	SD card up to 2 GB
Application program max. size	3 MB

Number of variables for application program	200 000 binary or analog data types, thereof 5000 non-volatile
Memory for online test, real time archive	512kB
Program sampling	Cyclical 10 to 65520 ms (settable grid 10 ms)
Decentralized archive	• Recording raster for measured values 1, 2, 3, 5, 10, 15, 30, 60 min, settable • Max. message length of a segment 1 to 200 bytes, settable • Memory configuration, settable 10 files, each 1000 entries (= 10000 entries) 20 files, each 500 entries (= 10000 entries) 50 files, each 400 entries (= 20000 entries) 80 files, each 450 entries (= 36000 entries) 100 files, each 100 entries (= 10000 entries) 100 files, each 25 entries (= 2500 entries) 200 files, each 50 entries (= 10000 entries) 200 files, each 25 entries (= 5000 entries)

Binary Outputs (Watchdog, Error) - only CP-8050 !

2 Binary Outputs (Relays)	1 group with 2 outputs; galvanically insulated
Rated voltage:	DC 24 V / 48 V / 60 V
Max. operating voltage	• DC 60 V according to: – IEC 61010-1:2010/AMD1:2016 – UL 61010-1:2012 – CSA C22.2 No. 61010-1-12 • DC 70 V according to: – EN 61010-12010
Maximum continuous current	1 A
Switching capacity (DC voltage)	Max. 30 W acc. to diagram 
Switching cycles	$1 \cdot 10^5$
Rated impulse voltage	2.0kV

Response behavior of the watchdog/error relay:

	Error Relais	Watchdog Relais
Power Off	OFF	OFF
Startup	ON	OFF
Ready (no pending error)	OFF	ON
Ready (pending error)	ON	ON
CPCI85 Firmware shut down (Ready LED flashes)	ON	OFF

ON: Relay is energized

OFF: Relay has dropped

Communication

2 Ethernet/LAN interfaces (X2, X3)	• Ethernet acc. to IEEE 802.3 (10Base-T or 100Base-TX) • Galvanically insulated • ESD protection • Transmission rate max. 100 Mbit/s • Half duplex or full duplex • Auto-MDI(X) • Time synchronization via NTP server • Line length < 100 m • Rated impulse voltage 2.0 kV
1 serial interface (X4)	RS-485 Mode • Balanced interchange circuit RS-485 • Galvanically insulated • ESD protection • Configuration 4-wire/2-wire with/without terminating resistor (parameter-settable) • Transmission rate up to 115.2 kbit/s (depending on protocol) • Rated impulse voltage 2.0 kV • Line length ≤ 1200 m
1 serial interface (X5)	RS-232 Mode • Unbalanced interchange circuit RS 232/V.28 • Galvanically not insulated • ESD protection • Transmission rate up to 115.2 kbit/s (depending on protocol) • Transient over voltages 2 kVp • Line length < 2,5 m (cabinet internal)

Power Supply (from Internal Bus)

Operating voltage	Input DC 5 V: DC 4.75 V to 5.5 V; **CP-8031**: 0.2 W; **CP-8050**: 0.5 W Input DC 28 V: DC 25.2 to 30.8 V; 4 W + 3.0/7.2 W if an external modem is supplied (5 V / 12 V)
Internal operating voltages	Logic DC 3.3 V / 2.5 V / 1.35 V / 1.1 V / 0.675 V

Supply for external modem

takes place via X5	De-energized (for reset of modem) DC 5.2 V; ± 5 %; 2.5 W or DC 12 V; ± 5 %; 6 W

Connectors

Ethernet/LAN X2, X3	RJ45 socket 8-pole (IEC 60603-7)	
Serial RS-232 X5	RJ45 socket 8-pole (IEC 60603-7)	
Serial RS-485 X4	RJ45 socket 8-pole (IEC 60603-7)	
Watchdog/Error X1[37]	Removable screw terminal, 6-pole (grid size 5.08)	
Connection data X1[37]	Locking torque (PHOENIX terminal) [38] Locking torque (FCI terminal) [38]	0.5 Nm to 0.6 Nm 0.36 Nm to 0.44 Nm
	AWG	min. 22 max. 12
	Conductor cross section solid	min. 0.33 mm² max. 2.5 mm²
	Conductor cross section stranded	min. 0.33 mm² max. 2.5 mm²
	Conductor cross section stranded with ferrule without plastic sleeve	min. 0.33 mm² max. 2.5 mm²
	Conductor cross section stranded with ferrule with plastic sleeve	min. 0.33 mm² max. 2.5 mm²
	2 wires stranded with ferrule without plastic sleeve	min. 0.33 mm² max. 1 mm²
	2 wires stranded with ferrule with plastic sleeve	min. 0.5 mm² max. 1.31 mm²
	Wire strip length	min. 6 mm max. 7mm
	Length ferrule	10 mm

Mechanics

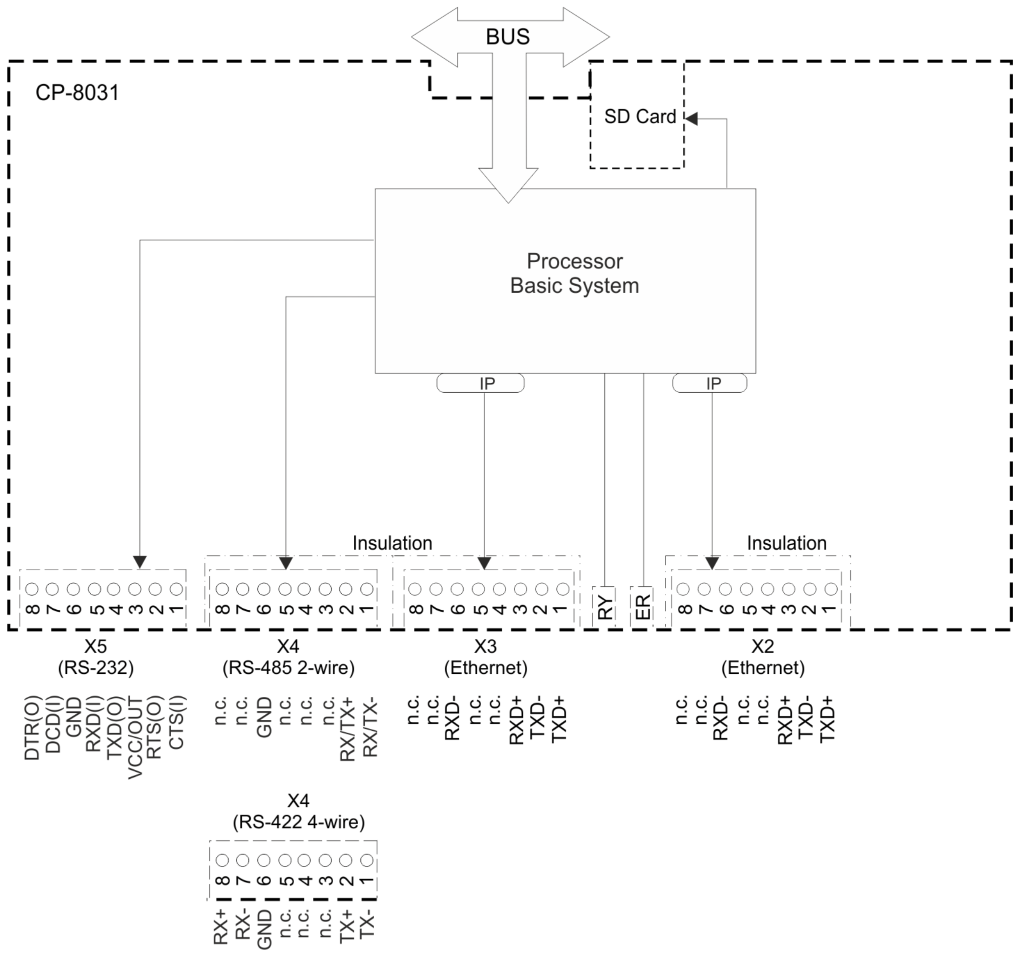
Structure	System for mounting on 35 mm DIN rail
Dimensions (W x H x D)	30 mm x 132 mm x 124 mm (without DIN rail, plug and terminal, locking hook closed); D 142 mm (with inserted terminal)
Weight	Approx. 235 g (incl. bus module 12 g)

37 only CP-8050

38 The respective manufacturer is imprinted at the terminal (see section *Types of screw terminals, Page 353*)

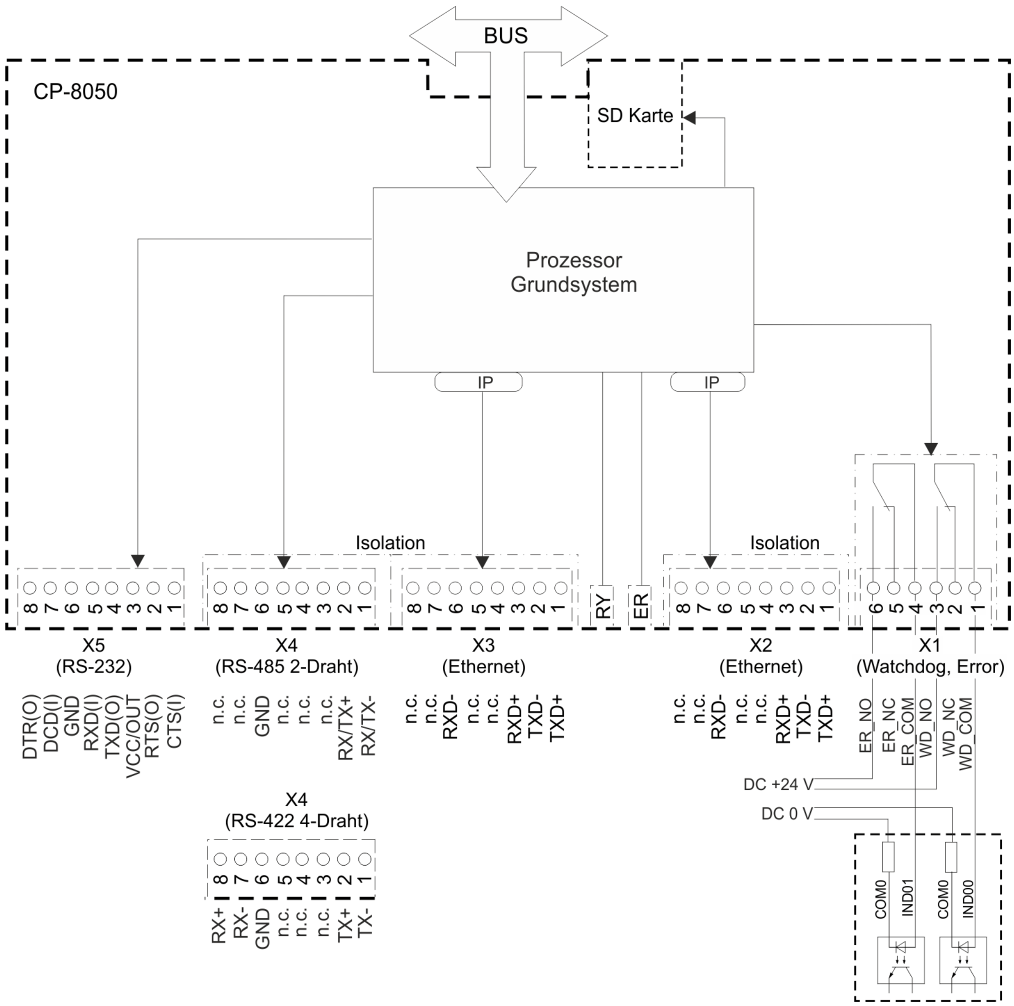
5.2.1.2 Block Diagram and External Circuitry

CP-8031



[dw_CP-8031_Block_Diagram_Circuitry_HB, 1, en_US]

CP-8050



[dw_CP-8050_Block_Diagram_Circuitry, 1, en_US]

NOTE

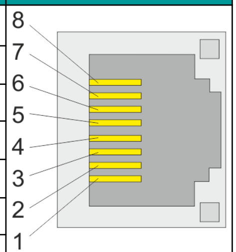
The meaning of the LED is described in chapter "Service" , Section *12.3.1 Master Modules* .

5.2.1.3 Pin Assignment

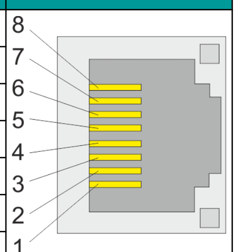
Connector X1 (Watchdog, Error) - only CP-8050 !

Pin	Signal
6	ER_NO
5	ER_NC
4	ER_COM
3	WD_NO
2	WD_NC
1	WD_COM

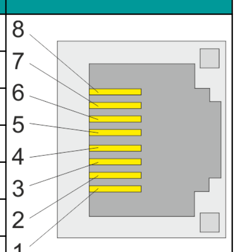
Connector X2, X3 (Ethernet)

Pin	Signal	
8	n.c. [39]	
7	n.c. [39]	
6	RXD-	
5	n.c. [39]	
4	n.c. [39]	
3	RXD+	
2	TXD-	
1	TXD+	

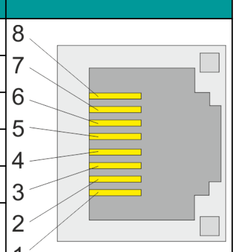
Connector X4 (RS-485 2-wire)

Pin	Signal	
8	n.c.	
7	n.c.	
6	GND	
5	n.c.	
4	n.c.	
3	n.c.	
2	TXD+/RXD+	
1	TXD-/RXD-	

Connector X4 (RS-422 4-wire)

Pin	Signal	
8	RXD+	
7	RXD-	
6	GND	
5	n.c.	
4	n.c.	
3	n.c.	
2	TXD+	
1	TXD-	

Connector X5 (RS-232)

Pin	Signal	
8	DTR (O)	
7	DCD (I)	
6	GND	
5	RXD (I)	
4	TXD (O)	
3	VCC/OUT 5V/12V	
2	RTS (O)	
1	CTS (I)	

39 terminated by terminating resistor

5.3 SICAM A8000 Power Supply Modules

5.3.1 PS-8620, PS-8622

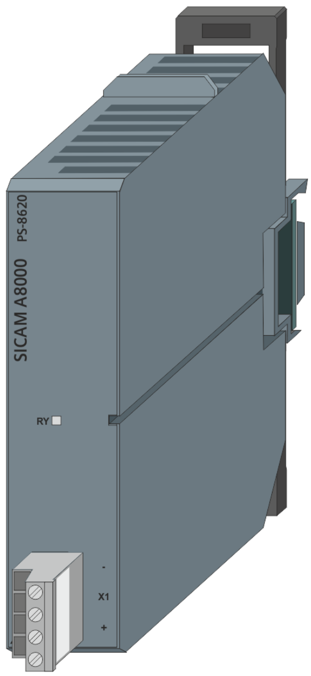


Figure 5-6 PS-8620

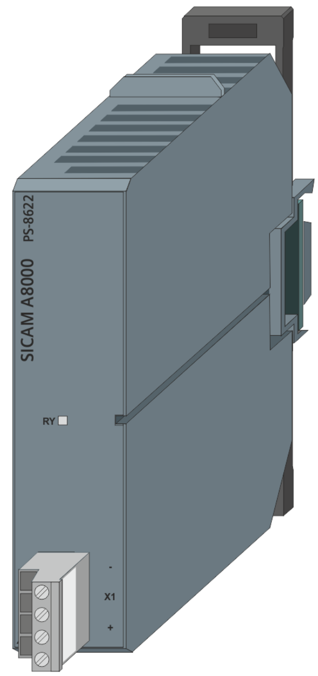


Figure 5-7 PS-8622

5.3.1.1 Features

- Input voltages
  - PS-8620: DC 24 to 60 V
  - PS-8622: DC 110 to 220 V
- The voltage is supplied on the front side
- The power supplies can be connected in parallel to increase the operation reliability (redundancy)
- Removable screw terminal
- Installation on 35 mm DIN rail
- Function indication via LED

5.3.1.2 Technical Data

Voltage Input

(The voltage is supplied via the terminal X1)	PS-8620	PS-8622
Input voltage	DC 24 to 60 V	DC 110 to 220 V
Operating voltage	DC 18 to 70 V (78 V [40])	DC 82.5 to 253 V (286 V [40])

[40] As of production level CC

Input current	0.8 A at DC 24 V 0.4 A at DC 48 V 0.3 A at DC 60 V	0.16 A at DC 110 V 0.08 A at DC 220 V
Reverse voltage protection	Yes	
Overload protection	Yes	
Short-circuit protection	Yes	
Can be connected in parallel	Yes (for redundancy, not for power enhancement) [40]	
Inrush peak current	Specified acc. to IEC 60870-4 (90) class S1	

Voltage Outputs

Output nominal voltage 1	DC 5.15 V ±2% static, ±3% dynamic
Output nominal current 1	0 to 1.8 A
Output nominal voltage 2	DC 28 V ±10 % static, ±3 % dynamic [41]
Output nominal current 2	0 to 0.43 A
Output power 1 ($P_{out\ 1}$)	9 W
Output power 2 ($P_{out\ 2}$)	12 W - $P_{out\ 1}$ (12 W if $P_{out\ 1}$ = 0 W)
Total output power	12 W
Guaranteed interruption time	50 ms
Startup time	< 2 s
Sustained short-circuit proof	Yes

Mechanics and Connectors

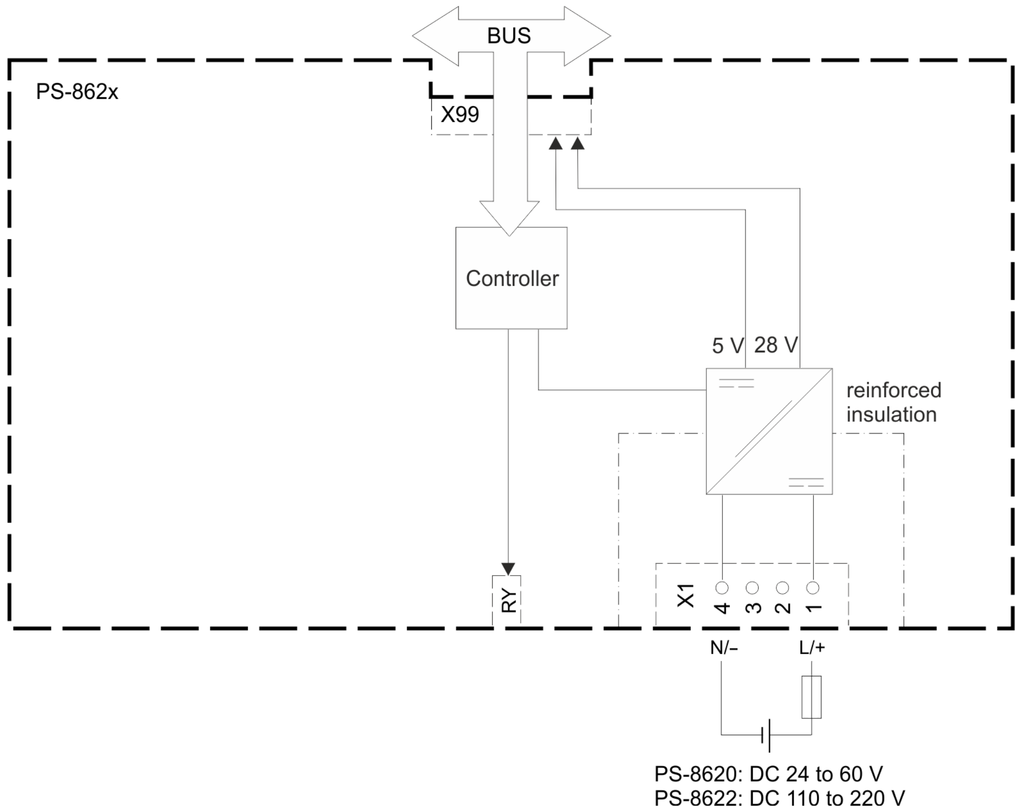
Connectors	Removable screw terminal (grid size 5.08 mm), 4-pole	
Connection data X1	Locking torque (PHOENIX terminal) [42] Locking torque (FCI terminal) [42]	0.5 Nm to 0.6 Nm 0.36 Nm to 0.44 Nm
	AWG	Min. 22 Max. 12
	Conductor cross section solid	Min. 0.33 mm² Max. 2.5 mm²
	Conductor cross section stranded	Min. 0.33 mm² Max. 2.5 mm²
	Conductor cross section stranded with ferrule without plastic sleeve	Min. 0.33 mm² Max. 2.5 mm²
	Conductor cross section stranded with ferrule with plastic sleeve	Min. 0.33 mm² Max. 2.5 mm²
	2 wires stranded with ferrule without plastic sleeve	Min. 0.33 mm² Max. 1 mm²
	2 wires stranded with TWIN ferrule with plastic sleeve	Min. 0.5 mm² Max. 1.31 mm²
	Wire strip length	Min. 6 mm Max. 7 mm
	Length ferrule	10 mm
Rated impulse voltage	4.0 kV	

41 For the generation of auxiliary voltage for specific transmission facilities

42 The respective manufacturer is imprinted at the terminal (see section *Types of screw terminals, Page 353*)

Dimensions (W x H x D)	30 mm x 132 mm x 124 mm (without DIN rail and terminal, locking hook closed); D 142 mm (with inserted terminal)
Weight	Approx. 240 g (incl. bus module 12 g)

5.3.1.3 Block Diagram and External Circuitry



[dw_PS-862x_block_diagram_ext_circuitry, 2, en_US]

Figure 5-8 PS-8620/PS-8622 – Block Diagram and External Circuitry

NOTE

The function of the RY LED is described in section *12.3.2 Power Supply Modules*.

5.3.1.4 Pin Assignment

Connector X1: Power Supply

Pin	Signal	Meaning
1	L/+	Input voltage PS-8620: DC 24 to 60 V PS-8622: DC 110 to 220 V
2	–	Do not connect
3	–	Do not connect
4	N/–	Input voltage

5.3.2 PS-8640, PS-8642

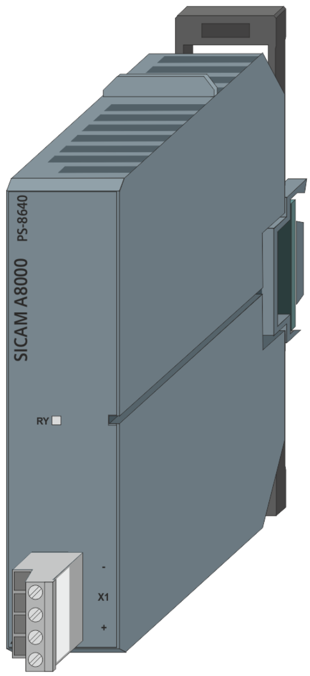


Figure 5-9 PS-8640

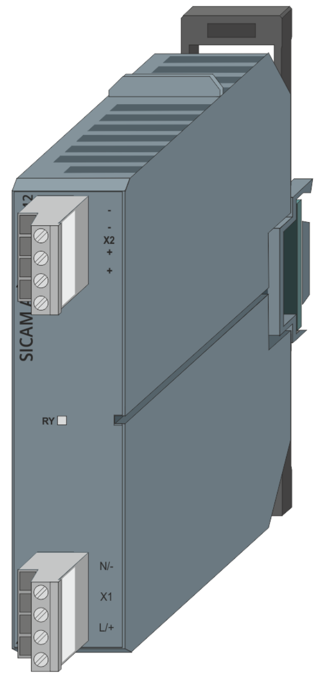


Figure 5-10 PS-8642

5.3.2.1 Features

- Input voltages
  - PS-8640: DC 24 to 60 V
  - PS-8642: DC 100 to 240 V, AC 100 to 240 V
- The voltage is supplied on the front side
- The power supplies can be connected in parallel to increase the operation reliability (redundancy)
- Removable screw terminal
- Installation on 35 mm DIN rail
- Function indication via LED

5.3.2.2 Technical Data

Voltage Input

(The voltage is supplied via the terminal X1)	PS-8640	PS-8642	
Input voltage	DC 24 to 60 V	DC 100 to 240 V	AC 100 to 240 V
Operating voltage	DC 18 to 78 V	DC 82.5 to 286 V	AC 85 to 264 V (45 to 66 Hz)
Temporary overvoltage	-	DC 300 V for 500 ms	-
Input current	3.05 A at DC 18 V 2.20 A at DC 24 V 0.90 A at DC 60 V 0.67 A at DC 78 V	0.68 A at DC 82.5 V 0.55 A at DC 100 V 0.24 A at DC 240 V 0.20 A at DC 286 V	0.66 A at AC 85 V 0.56 A at AC 100 V 0.26 A at AC 240 V 0.25 A at AC 264 V

Power consumption	55 W at DC 18 V 52.9 W at DC 48 V 52.5 W at DC 78 V	55.5 W at DC 82.5 V 55.1 W at DC 220 V 55.3 W at DC 286 V	55.2 W at AC 85 V 55.0 W at AC 100 V 54.8 W at AC 264 V
Reverse voltage protection	Yes		
Overload protection	Yes		
Short-circuit protection	Yes		
Can be connected in parallel	Yes (for redundancy, not to increase power)		
Inrush peak current	Specified acc. to IEC 60870-4 (90) class S1		

Voltage Outputs

Output nominal voltage 1	DC 5.15 V ±2% static, ±3% dynamic
Output nominal current 1	0 to 2 A
Output nominal voltage 2	DC 28 V ±10 % static, ±3 % dynamic [43]
Output nominal current 2	0 to 1.79 A
Output nominal voltage 3	DC 24 V +0 %/-15 % [44]
Output nominal current 3	0.42 A [44]
Output power 1 ($P_{out\ 1}$)	10 W
Output power 2 ($P_{out\ 2}$)	45 W - $P_{out\ 1}$ - P_{AUX} (45 W if $P_{out\ 1/AUX}$ = 0 W)
Output power 3 (P_{AUX})	10 W (30 W peak) [44]
Total output power	45 W
Guaranteed interruption time	50 ms
Startup time	< 2 s
Sustained short-circuit proof	Yes

43 For the generation of auxiliary voltage for specific transmission facilities

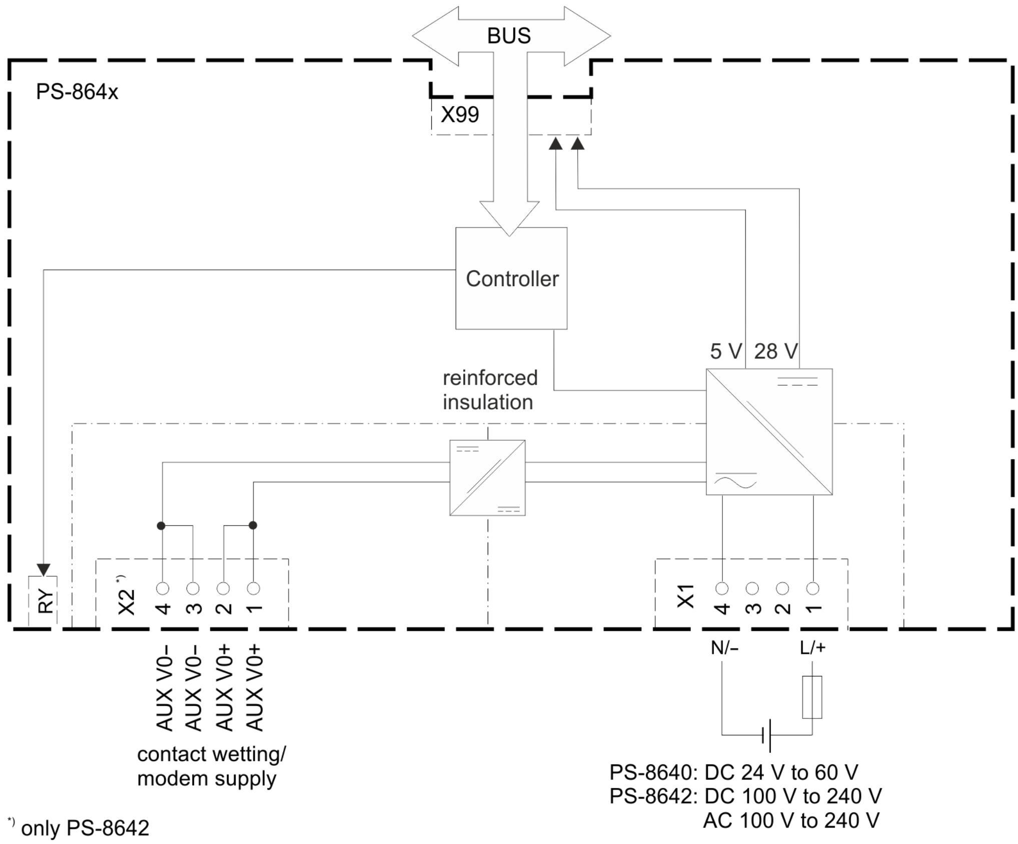
44 Applies only for PS-8642

Mechanics and Connectors

Connectors	Removable screw terminals (grid size 5.08 mm), 4-pole	
Connection data X1 (X2)	Locking torque (PHOENIX terminal) [45] Locking torque (FCI terminal) [45]	0.5 Nm to 0.6 Nm 0.36 Nm to 0.44 Nm
	AWG	Min. 22 Max. 12
	Conductor cross section solid	Min. 0.33 mm² Max. 2.5 mm²
	Conductor cross section stranded	Min. 0.33 mm² Max. 2.5 mm²
	Conductor cross section stranded with ferrule without plastic sleeve	Min. 0.33 mm² Max. 2.5 mm²
	Conductor cross section stranded with ferrule with plastic sleeve	Min. 0.33 mm² Max. 2.5 mm²
	2 wires stranded with ferrule without plastic sleeve	Min. 0.33 mm² Max. 1 mm²
	2 wires stranded with TWIN ferrule with plastic sleeve	Min. 0.5 mm² Max. 1.31 mm²
	Wire strip length	Min. 6 mm Max. 7 mm
	Length ferrule	10 mm
Rated impulse voltage	4.0 kV	
Dimensions (W x H x D)	30 mm x 132 mm x 124 mm (without DIN rail and terminal, locking hook closed); D 142 mm (with inserted terminal)	
Weight	Approx. 400 g (incl. bus module 12 g)	

45 The respective manufacturer is imprinted at the terminal (see section *Types of screw terminals, Page 353*)

5.3.2.3 Block Diagram and External Circuitry



[dw_PS-864x_block_diagram_ext_circuitry, 2, en_US]

Figure 5-11 PS-8640/PS-8642 – Block Diagram and External Circuitry

NOTE

The function of the RY LED is described in section *12.3.2 Power Supply Modules*.

5.3.2.4 Pin Assignment

Connector X1: Power Supply

Pin	Signal	Meaning
1	L/+	Input voltage PS-8640: DC 100 to 240 V PS-8642: DC 100 to 240 V, AC 100 to 240 V
2	–	Do not connect
3	–	Do not connect
4	N/–	Input voltage

Connector X2: Contact wetting

Pin	Signal	Meaning
1	AUXV0+	Contact wetting/modem supply
2	AUXV0+	Contact wetting/modem supply
3	AUXV0–	Contact wetting/modem supply
4	AUXV0–	Contact wetting/modem supply

5.4 SICAM A8000 Rack Power Supply Modules

5.4.1 PS-2630, PS-2632

Figure 5-12 PS-2630

Figure 5-13 PS-2632

5.4.1.1 Features and Functions

- Input voltages
  - PS-2630: 18...78 VDC
  - PS-2632: 82.5...286 VDC, 90...264 VAC
- The voltage is supplied on the front side of the housing
- The 5 V output is galvanically insulated and protected against continued short circuit
- The power supplies can be connected in parallel to increase the operation reliability (redundancy).
- Supervision and signaling
  - Power supply failure
  - Power supply not failure monitored
  - Temperature rise
  - Output voltage failure
- indication of the operating state by means of a LED on the front panel

5.4.1.2 Technical Data

Voltage input

	PS-2630	PS-2632	
operating voltage (incl. toler-ances)	DC 18 V to 78 V	DC 82.5 to 286 V	AC 90 to 264 V 45 to 66 Hz
Input current if Pout = 120 W	5.80 A (DC 24 V) 2.86 A (DC 48 V) 2.28 A (DC 60 V)	1.28 A (DC 110 V) 0.63 A (DC 220 V)	1.22 A (AC 115 V) 0.60 A (AC 230 V)
Power consumption if Pout = 120 W	139.5 W (DC 24 V) 137.5 W (DC 48 V) 137.0 W (DC 60 V)	140.0 W (DC 110 V) 138.0 W (DC 220 V)	140.0 W (AC 115 V) 138.0 W (AC 230 V)
Efficiency if Pout = 120 W	86.9 % (DC 24 V) 88.2 % (DC 48 V) 88.5 % (DC 60 V)	86.4 % (DC 110 V) 87.5 % (DC 220 V)	86.6 % (AC 115 V) 87.7 % (AC 230 V)
Inrush peak current	Inrush current limitation according to IEC 60870-4 (90) class S1		
Bridgeable interruption of the operating voltage (after 30s oper-ation)	min. 50 ms	min. 50 ms	
Reverse voltage protection	yes	can be operated with either polarity	
Overload protection	yes	yes	
Short-Circuit Protection	yes (max. 34 A)	yes (max. 34 A)	
Can be connected in parallel	yes (for redundancy)		

Voltage Output

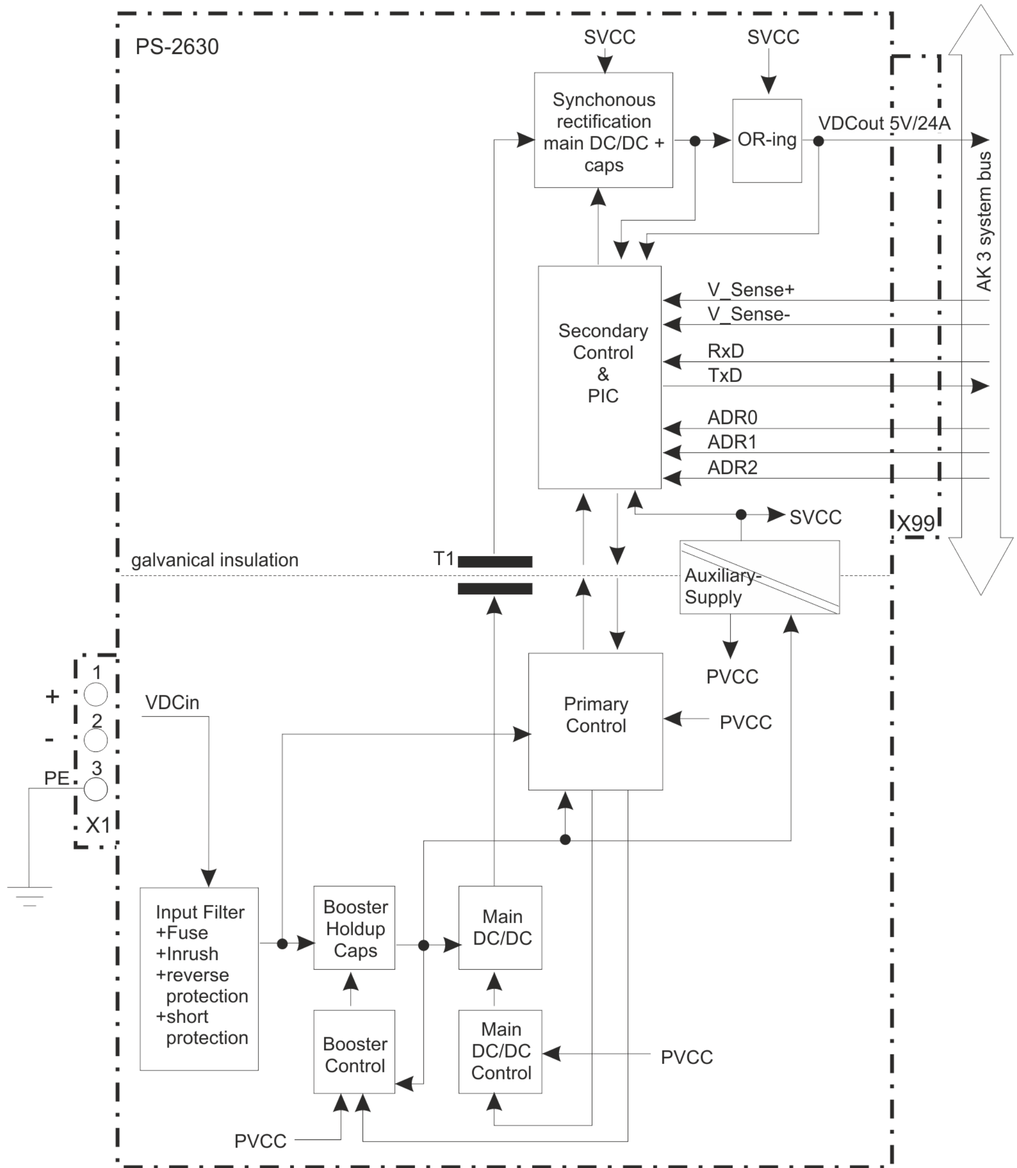
Output nominal voltage	DC 5.05 V (-1/+2 %)
Max. output voltage in case of error	DC 6 V
Output nominal current	0.5 to 24 A
Output nominal current (Pout)	• 120 W at - 5°C to + 55°C • 120 W at - 55°C to + 70°C from + 55°C derating: -10%/3°C • 60 W at + 70°C
Sustained short-circuit proof	yes

Mechanics and Connectors

Mechanics	Housing with front panel
Dimensions	Double euro format, 8 WU
Supply connector X1	• Screw terminals for direct conductor assembly • 3-pin removable screw terminal

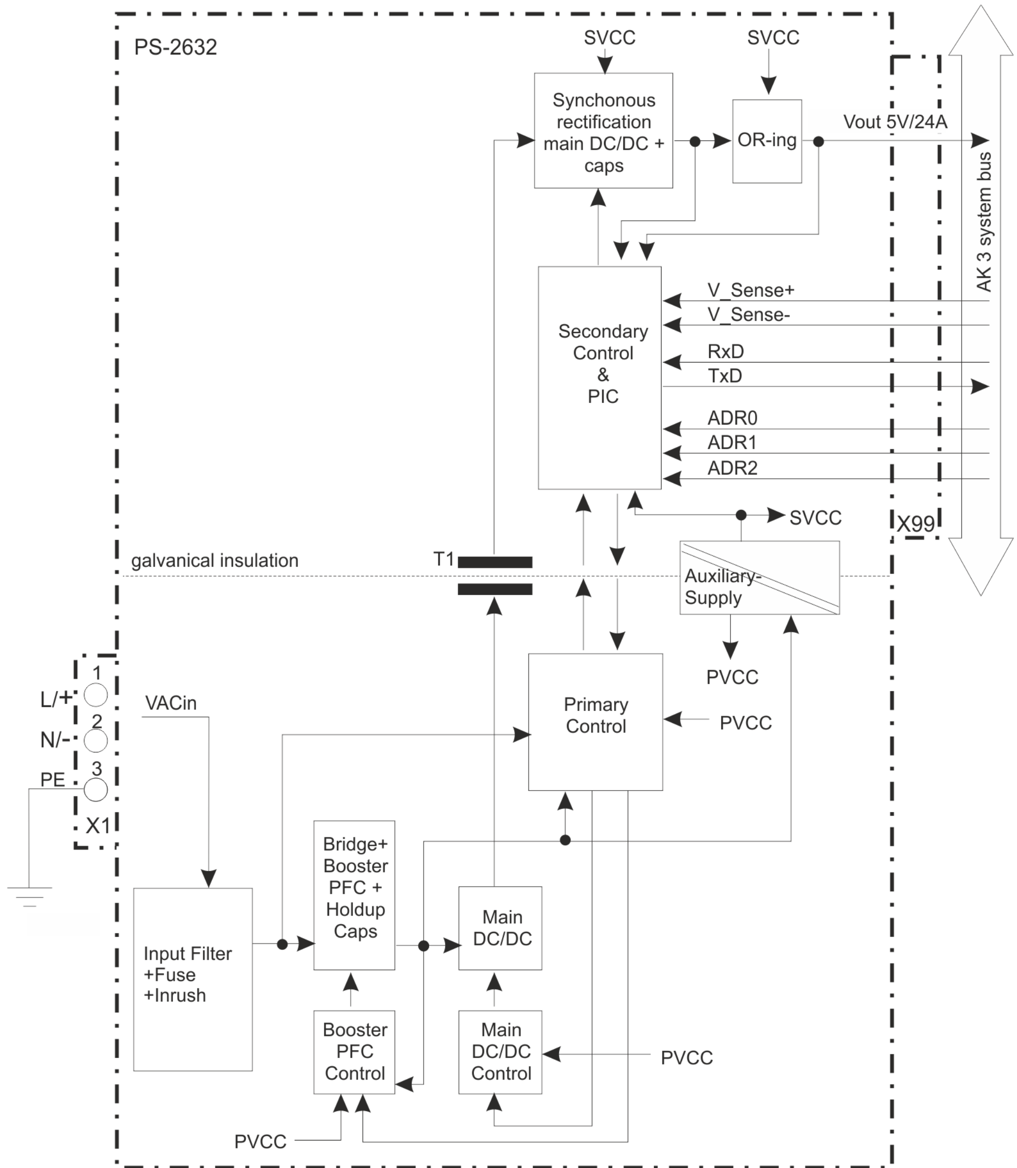
Connection data X1	Conductor cross section solid	min. 0.33 mm^2 max. 2.5 mm^2
	Conductor cross section stranded	min. 0.33 mm^2 max. 2.5 mm^2
	Conductor cross section stranded with ferrule without plastic sleeve	min. 0.33 mm^2 max. 2.5 mm^2
	Conductor cross section stranded with ferrule with plastic sleeve	min. 0.33 mm^2 max. 2.5 mm^2
	2 wires stranded with ferrule without plastic sleeve	min. 0.33 mm^2 max. 1 mm^2
	2 wires stranded with TWIN ferrule with plastic sleeve	min. 0.5 mm^2 max. 1.31 mm^2
	Wire strip length	min. 6 mm max. 7 mm
	Length ferrule	10 mm
Bus connector (X99)	• 96 pin according to DIN 41612 type C	
Rated impulse voltage	4.0 kV	
Weight	Approx. 1.3 kg	

5.4.1.3 Block Diagram and External Circuitry



[dw_PS-2630_Block_Diagram, 1, --_--]

Figure 5-14 PS-2630



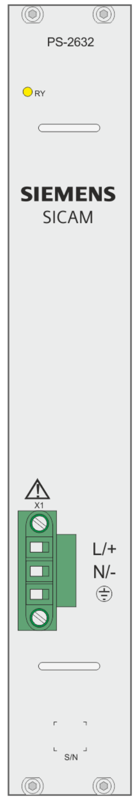
[dw_PS-2632_Block_Diagram, 1, --_--]

Figure 5-15 PS-2632

5.4.1.4 Display

The LEDs on the front panel indicate the operating state of the module.

PS-2630 Front



PS-2632 Front

LED	Meaning
RY	Readiness

5.4.1.5 Pin Assignment

PS-2630, Connector X1: Power Supply

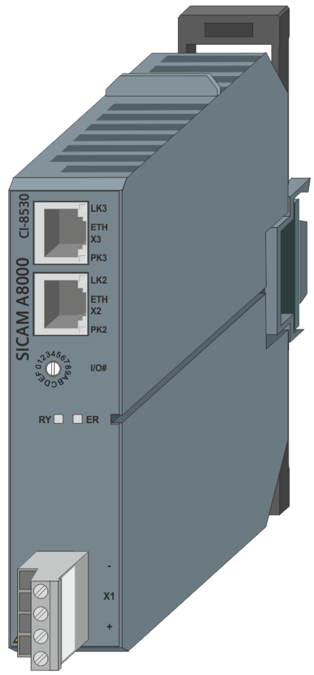
Pin	Signal	Meaning
1	+	Voltage supply + (24 to 60 VDC)
2	-	Voltage supply - (24 to 60 VDC)
3	PE	Protective earth

PS-2632, Connector X1: Power Supply

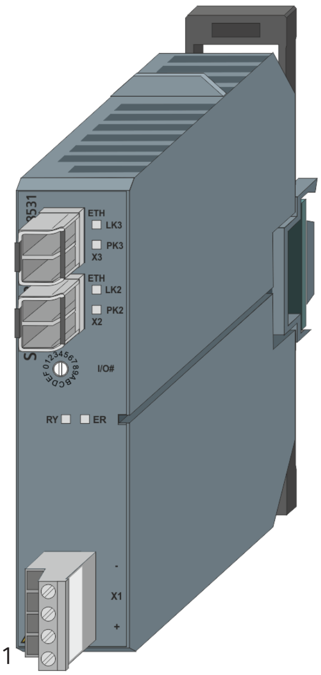
Pin	Signal	Meaning
1	L/+	Voltage supply + (110 to 220 VDC, 230 VAC)
2	N/-	Voltage supply - (110 to 220 VDC, 230 VAC)
3	PE	Protective earth

5.5 SICAM A8000 I/O Remote Modules

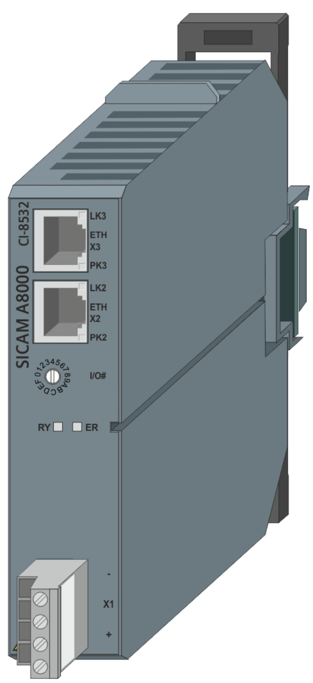
5.5.1 CI-8530, CI-8531, CI-8532, CI-8533



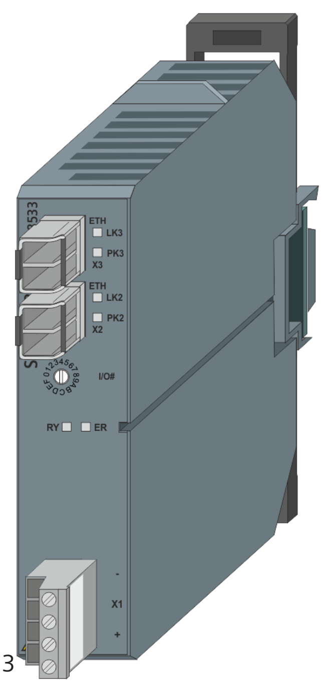
CI-8530



CI-8531



CI-8532



CI-8533

NOTE

For the operation of the I/O remote modules CI-8530 and CI-8532 revision CC (6MF28530AA00 CC, 6MF28532AA00 CC) firmware IOMI85 as of revision 4.20 is required.

5.5.1.1 Features

The SICAM A8000 I/O remote modules are used to connect remote SICAM A8000 I/O rows, each with up to 8 I/O modules. Up to 15 I/O rows can be connected to the CP-8050, with the CP-8031 one separate I/O row can be used with a license. Ring-, Star and Daisy Chain –configurations are possible. The integrated power supply supplies up to 8 I/O modules. Optional redundant power supplies are supported.

- **CI-8530, CI-8532**
  - 2 electrical Ethernet interfaces
- **CI-8531, CI-8533**
  - 2 optical Ethernet interfaces, based on the used SFP modules
  - can be used as a media converter with 1 electrical SFP and 1 optical SFP
- Device is used as I/O remote module
- Device is used as a repeater
- 1 rotary switch for address selection of the I/O row (I/O#)
- Communication to CP-8031/CP-8050 via Ethernet based I/O bus
- Status indication of the Ethernet connection via LED (LKx, PKx)
- Indication of the module via LED (RY, ER)
- Power supply via bus connector (if redundant power supply is used)
- Installation on 35 mm DIN rail

5.5.1.2 Technical Data

DC voltage input

(The voltage is supplied via the terminal X1)	CI-8530/CI-8531	CI-8532/CI-8533
Input voltage	DC 24 V to 60 V	DC 110 V to 220 V
Operating voltage	DC 18 V to 78 V	DC 82.5 V to 286 V
Input current	0.6/0.3/0.25 A (DC 24 V/48 V/60 V)	0.13/0.07 A (DC 110 V/DC 220 V)
Reverse voltage protection	yes	
Overload protection	yes	
Short-circuit protection	yes	
Can be connected in parallel	yes, with power supply PS-86xx (to increase the availability, not for power enhancement)	
	Operating voltage 1: DC 5.15 V 1.5 W (from bus)	Operating voltage 1: DC 5.15 V 1.5 W (from bus) Operating voltage 2: DC 28.0 V 3 W (from bus)
Inrush peak current	Specified acc. to IEC 60870-4 (90) class S1	

Voltage Outputs

	CI-8530/CI-8532	CI-8531/CI-8533
Output nominal voltage	DC 5.15 V ± 2 % static, ±3 % dynamic	
Output nominal current	0 A to 1.4 A	
Output power	7 W	

Guaranteed interruption time	• 50 ms • 100 ms with DC 220 V input voltage: CI-8532: for output powers up to 7 W and input voltage tolerance -25 %/+30 % CI-8533: for output powers up to 5.5 W and input voltage tolerance -25 %/+30 % CI-8533: for output powers up to 7 W and input voltage tolerance -10 %/+30 % These values also apply when using redundant power supplies (PS-86x2) on the remote I/O row.	
Startup time	< 2 s	
Sustained short-circuit proof	yes	
Power available on X2 and X3 ports for SFP modules	–	3.3 V, 1 W each 1.5 W in total [46]

Example: SFP module single port utilizes maximum of 1 W and when using 2 ports, total power is limited to 1.5 W.

Mechanics

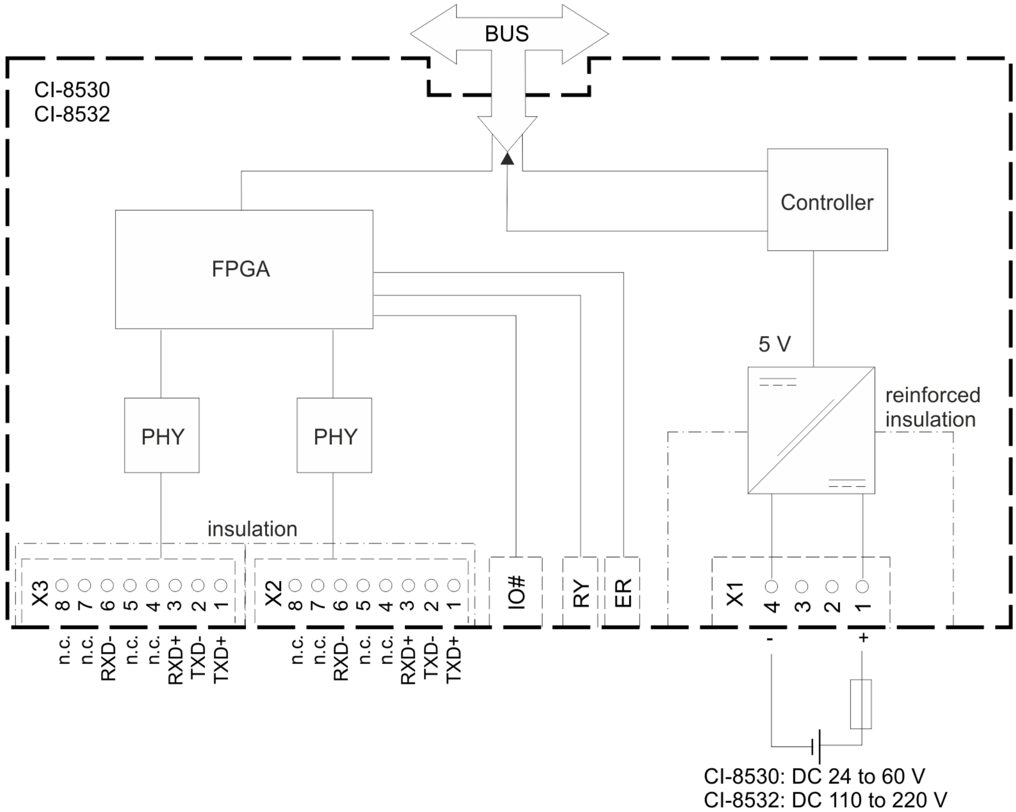
	CI-8530/CI-8532	CI-8531/CI-8533
Terminal (X1)	Removable screw terminals, 4-pole (grid size 5.08) wire cross sections up to 2.5 mm² Rated impulse voltage 4.0 kV	
Ethernet/LAN electrical (X2, X3)	RJ45 socket 8-pole (IEC 60603-7) Auto-MDI(X) Line length < 100 m Rated impulse voltage 2.0 kV	–
Ethernet or Fiber Optic (X2, X3)	–	2 x LC duplex optical interface Maximum line length≤2000 m at 62.5µm/125µm, Wavelength 1310 nm (with supplied multimode SFP)
IO# switch	Hex-switch for I/O module address	
Dimensions (W x H x D)	30 mm x 132 mm x 124 mm (without DIN rail, plug and terminal, locking hook closed); D 142 mm (with inserted terminal)	
Weight	Approx. 240 g (incl. bus module 12 g)	Approx. 290 g (incl. bus module 12 g)

NOTE

With factory supplied SFP modules, class 1 is maintained in compliance with EN 60825-1 when using optical fibers 62.5 µm/125 µm.

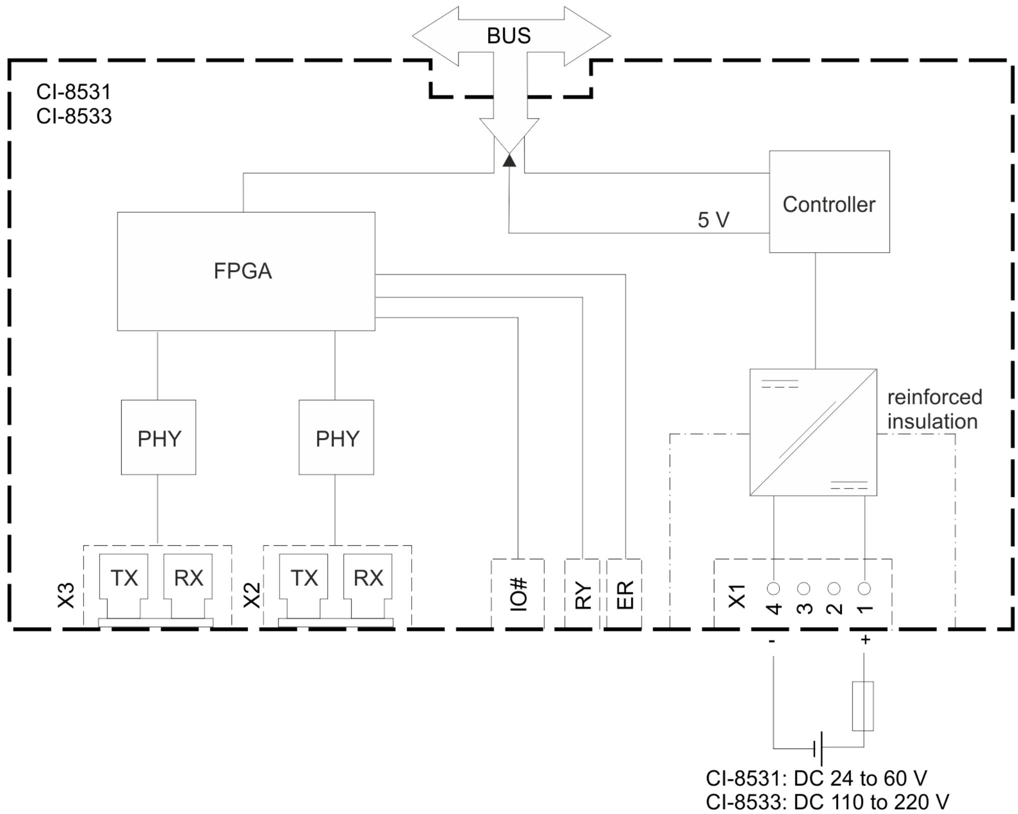
46 2 electrical SFP modules can be used, provided the power consumption is≤1.5 W

5.5.1.3 Block Diagram and External Circuitry (CI-8530, CI-8532)



[dw_CI-8530_32_Block_Diagram_Circuitry, 1, en_US]

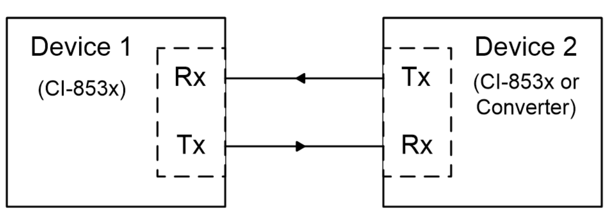
5.5.1.4 Block Diagram and External Circuitry (CI-8531, CI-8533)



[dw_CI-8531_33_Block_Diagram_Circuitry, 1, en_US]

Fiber Optic Interconnection (Tx, Rx) – Line and Ring I/O row Configurations

The fiber optic from device 1 Tx must be connected to device 2 Rx; and device 1 Rx must be connected to device 2 Tx.



[dw_CI-8531-33_TxRxCon, 1, --_--]

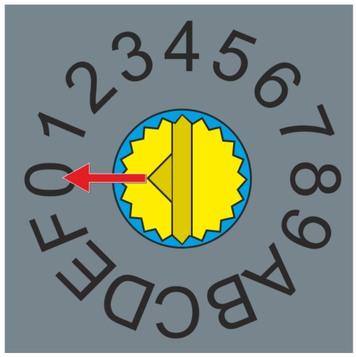
5.5.1.5 Pin Assignment

Connector X1: Power Supply

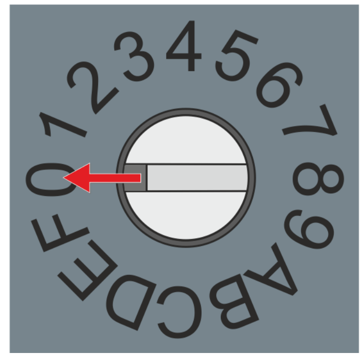
Pin	Signal	Meaning
1	+	Input voltage CI-8530/CI-8531: DC 24 to 60 V CI-8532/CI-8533: DC 110 to 220 V
2	n. c.	not connected
3	n. c.	not connected
4	-	Input voltage

5.5.1.6 IO# switch

Different versions of IO # switches are used. The following picture shows these types. Both hex switch indicate address 0.



The triangle on the yellow rotary switch points towards "0".

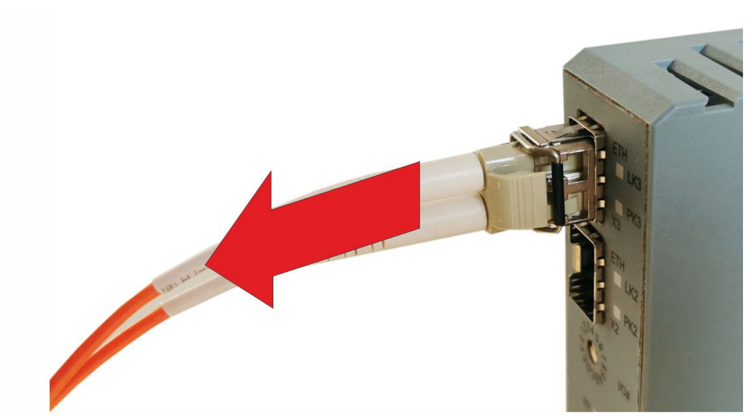


The lateral groove on the white rotary switch points towards "0".

5.5.1.7 Unplug the SFP module

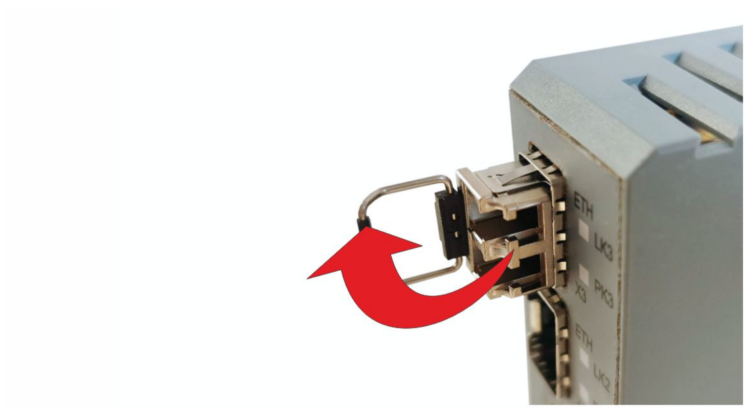
The modules CI-8531/CI-8533 have 2 slots that are equipped with optical SFP modules as standard. Please note the following when changing an SFP module (these also apply to electrical SFP modules):

- Unplug the cable from the SFP module



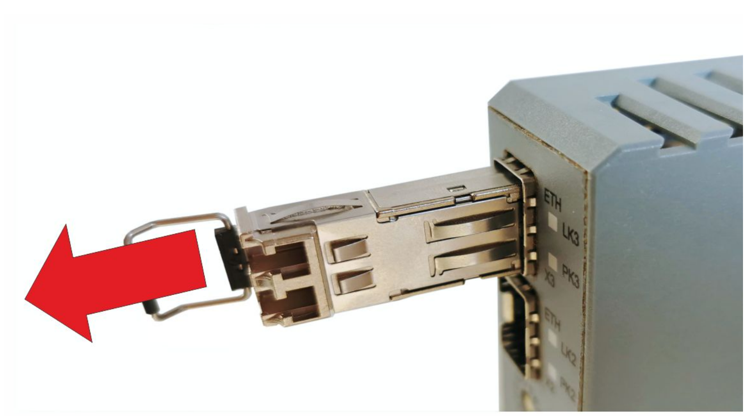
[dw_SFP_Module_unplug_01, 1, --_--]

- Open the handle on the SFP module



[dw_SFP_Module_unplug_02, 1, --_--]

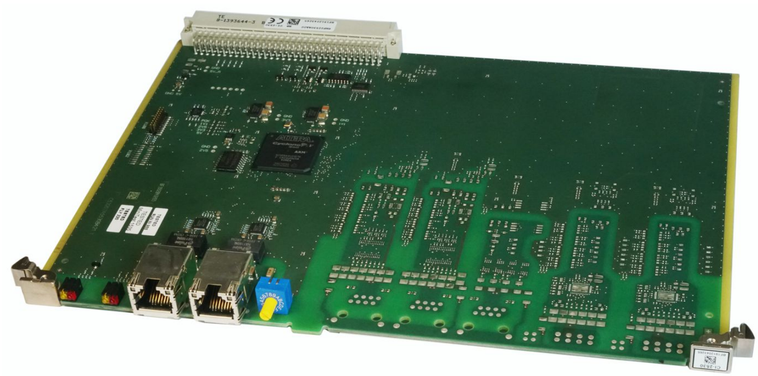
- Pull on the handle to open the locking mechanism of the SFP module and take the module out of the slot.



[dw_SFP_Module_unplug_03, 1, --_--]

5.6 SICAM A8000 Rack I/O Remote Modules

5.6.1 CI-2530



[ph_CI-2530_m, 1, --_--]

Figure 5-16 CI-2530

5.6.1.1 Features

CI-2530 is an Ethernet expansion module for connecting remote Rack I/Os. Up to 4 racks, each with up to 16 Rack I/Os, can be connected via the EbIO bus. Ring and line topology are possible.

Use cases see: *15.5 Configurations with SICAM A8000 Rack I/Os*

- Communication with Master Module CP-8050 via EbIO
- can be equipped in rack CM-2846
- Status indication of the Ethernet connection via LED (LKx, PKx)
- Power supply via bus connector
- Status indication of the module via LED (RY, ER)
- Status indication of the master module via LED (RY, ER)
- Assembly in Rack

NOTE

Use only in connection with CP-8050.

5.6.1.2 Technical Data

Power Supply

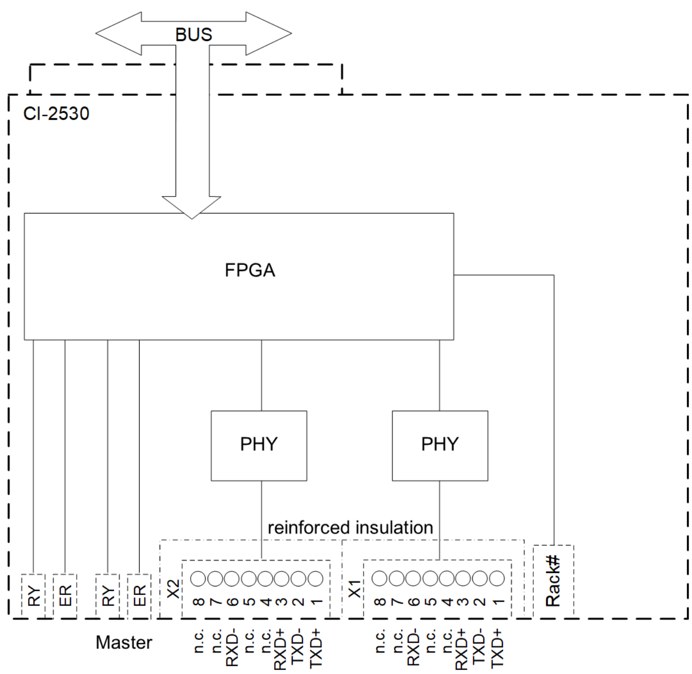
Operating voltage	DC 4.75 to DC 5.25 V The voltage is picked off from the bus of rack
Power Consumption	typ. 1.3 W

Mechanics and Connectors

Mechanics	Board without front plate
Rated impulse voltage	2 kV

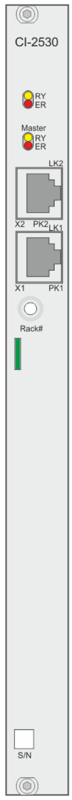
Dimensions	Suitable for 19” frame according to DIN 41494/IEC 60297 Height: Double euro format Width: 4 WU Depth: according to DIN 41494/IEC 60297
Bus connector X99	96 pin according to DIN 41612 type C
Ethernet/LAN X1, X2	• RJ45 socket 8-pole (IEC 60603-7) • Auto-MDI(X) • Line length < 3 m cabinet internal cabling
Rack# Switch	Hex-Switch for rack number
	Double euro format 233.4 x 160 mm, 4 WU
Weight	Approx. 190 g

5.6.1.3 Block Diagram and External Circuitry



[dw_CI-2530_block_diagram_circuitry, 1, en_US]

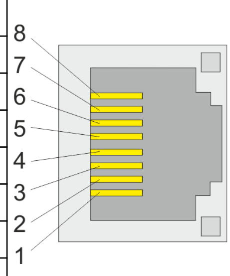
5.6.1.4 Pin Assignment and Display



[dw_CI-2530_Front, 1, --_--]

Figure 5-17 CI-2530 Front

Pin assignment X1, X2 (Ethernet)

Pin	Signal	
8	n.c.	
7	n.c.	
6	RXD-	
5	n.c.	
4	n.c.	
3	RXD+	
2	TXD-	
1	TXD+	

Status indication module

LED	Meaning
RY	Readiness
ER	Fault

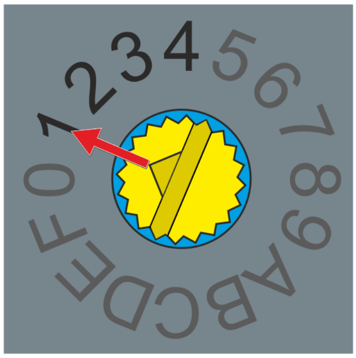
Status indication Master Module

LED	Meaning
RY	Readiness
ER	Fault

5.6.1.5 Rack Switch

The **Rack#** switch is used to define the number of the rack in which the CI-2530 module is equipped.

Since only a maximum of 4 racks can be coupled to a CP-8050, the switch may only be set to 1, 2, 3 or 4. The set value corresponds to the BSE number of the extended processing function.

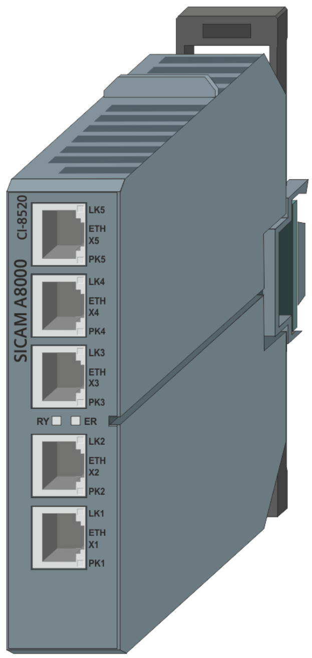


[dw_CI-2530_Rack-Switch, 1, --_--]

Figure 5-18 Rack# switch on position 1

5.7 SICAM A8000 Communication Modules

5.7.1 CI-8520 Ethernet Interface



NOTE

- For the operation of the communication module CI-8520 with revision CC (6MF28520AA00 CC) firmware CPCI85 from version 4.20 is required
- An additional license is required for use with CP-8031

5.7.1.1 Features

This module serves to expand CP-8031[47]/CP-8050 with 5 Ethernet interfaces. These interfaces serve for communication with Ethernet devices (e.g. Switch, Router, IEDs, redundancy operation HSR, PRP, RSTP and Line Mode). Also the engineering tools (SICAM TOOLBOX II and SICAM WEB) can be connected to parametrize CP-8031/CP-8050. A maximum of 2 of these modules can be connected directly to the left of a CP-8050, one with CP-8031.

- Communication to CP-8031/CP-8050 via bus connector (CM-8814)
- Status indication of the Ethernet connection via LED (LKx, PKx)
- Status indication of the module via LED (RY, ER)
- Power supply via bus connector
- Mounting on 35 mm DIN rail
- IEEE 1588 Delay Mechanism P2P (Peer To Peer) is not supported

47 License required

5.7.1.2 Technical Data

Communication

5 Ethernet/LAN interfaces (X1 - X5)	• Ethernet acc. to IEEE 802.3 (10Base-T or 100Base-TX) • Galvanically insulated • ESD protection • Transmission rate max. 100 Mbit/s • Half duplex or full duplex • Auto-MDI(X) • Line length < 100 m • Rated impulse voltage 2 kV

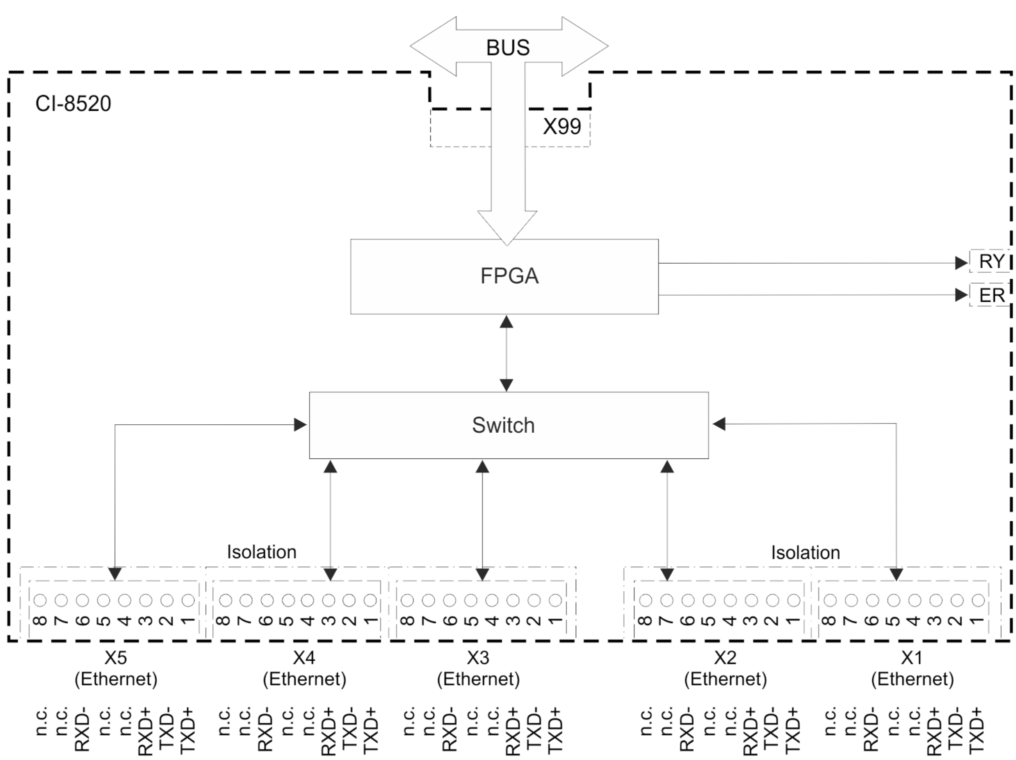
Power supply (from internal bus)

Operating voltage	Input DC 28 V: DC 25.2 to 30.8 V; 2.5 W
Internal operating voltages	Logik DC 3.3 V / 2.5 V / 1.1 V / 1.2 V

Mechanics and Connectors

Ethernet/LAN interfaces X1 - X5	RJ45 socket 8-pole (IEC 60603-7)
Dimensions (W x H x D)	30 mm x 132 mm x 124 mm (without DIN rail and plug, locking hook closed)
Weight	Approx. 210 g (inkl. bus module 12 g)

5.7.1.3 Block Diagram



[CI-8520_Block_Diagram, 1, en_US]

5.7.1.4 Pin Assignment

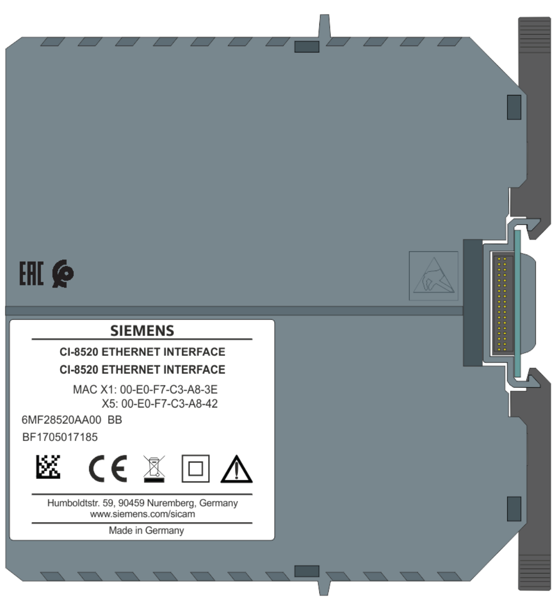
Connector X1 - X5 (Ethernet)

Pin	Signal
8	n.c. [48]
7	n.c. [48]
6	RXD-
5	n.c. [48]
4	n.c. [48]
3	RXD+
2	TXD-
1	TXD+

5.7.1.5 Type Plate

The MAC addresses of the Ethernet interfaces X1 and X5 are printed on the type plate. The MAC addresses of X2, X3 and X4 lie in between, for example:

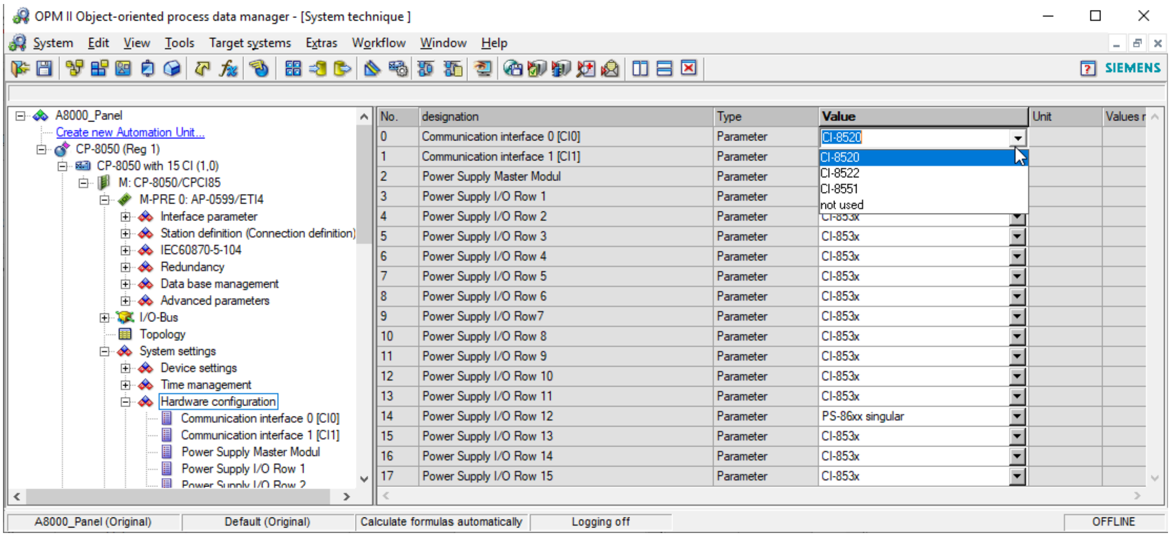
Connector	MAC Address
X1	**00-E0-F7-C3-A8-3E**
X2	00-E0-F7-C3-A8-3F
X3	00-E0-F7-C3-A8-40
X4	00-E0-F7-C3-A8-41
X5	**00-E0-F7-C3-A8-42**



5.7.1.6 Configuration

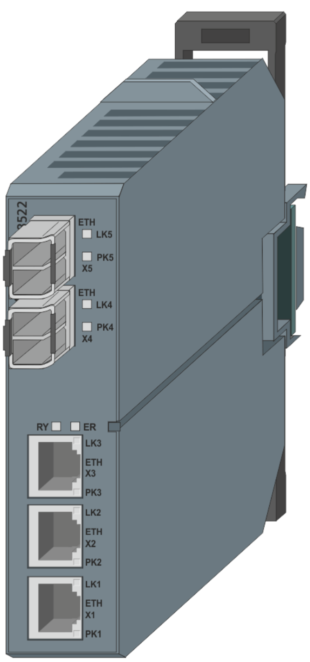
The configuration of a CI-8520 is done with the parameter **`CP-8050/CPCI85 | System settings | Hardware configuration`**.

48 terminated by terminating resistor



[sc_CI-8520_configuration_nov20, 1, en_US]

5.7.2 CI-8522 Network Interface Optical



NOTE

- Firmware CPCI85 V04.50 or higher is required to operate the communication module
- An additional license is required for use with CP-8031

5.7.2.1 Features

This module serves to expand CP-8031[49]/CP-8050 with 5 Ethernet interfaces having 2 slots for SFP modules (optical/electrical) and 3 sockets for electrical TP cables. These interfaces serve for communication with

49 License required

Ethernet devices (for example switch, router, IEDs, redundancy operation HSR, PRP, RSTP, and Line Mode) having electrical and optical interfaces. Also the engineering tools (SICAM TOOLBOX II and SICAM WEB) can be connected to parametrize CP-8031/CP-8050. A maximum of 2 of these modules can be connected directly to the left of a CP-8050, one with CP-8031.

- Communication to CP-8031/CP-8050 via bus connector (CM-8814)
- Status indication of the Ethernet connection via LED (LKx, PKx)
- Status indication of the module via LED (RY, ER)
- Power supply via bus connector
- Mounting on 35 mm DIN rail
- IEEE 1588 Delay Mechanism P2P (Peer To Peer) is not supported
- Supports single mode, multimode SFPs
- Equipped with 2 multimode optical SFP modules each supporting up to 2000 m for optical interfaces
- CI-8522 supports hot plug-in of SFP modules

NOTE

CI-8522 supports electrical and optical SFP modules at interface X4 and X5. Details about the modules see *A.9 SICAM A8000 I/O Remote Modules*.

Consider that purchased (spare) parts may have different EMC levels than SICAM A8000. This can influence the overall performance of the system.

2 electrical SFP modules can be used as long as the total power consumption for X4 and X5 is ≤ 2 W.

5.7.2.2 Technical Data

Communication

3 Ethernet interfaces (X1 - X3)	• Ethernet acc. to IEEE 802.3 (10Base-T or 100Base-TX) • Galvanically insulated • ESD protection • Transmission rate max. 100 Mbit/s • Half duplex or full duplex • Auto-MDI (X) • Line length < 100 m
2 Ethernet interfaces (X4, X5)	• Ethernet acc. to IEEE 802.3 • Galvanically insulated • Transmission rate max. 100 Mbit/s • 2 x LC duplex optical interface • Line length (MM) < 2000 m • Line length (MM) < 30 000 m

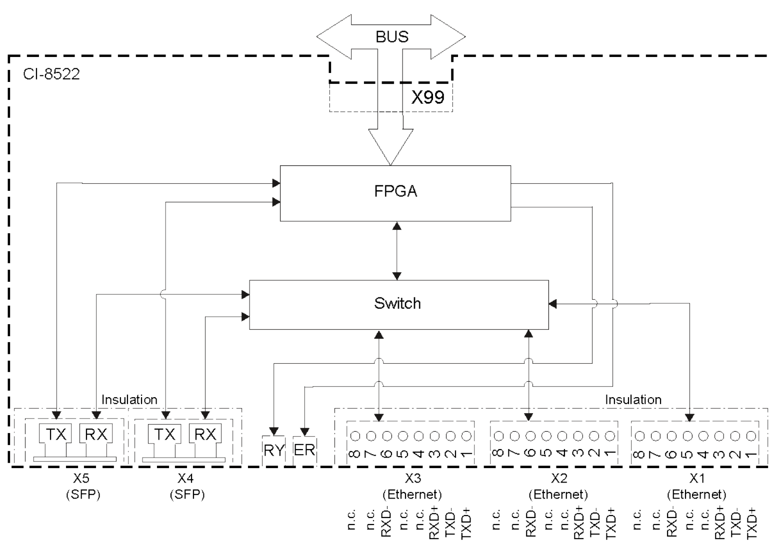
Power supply (from internal bus)

Operating voltage	Input DC 28 V: DC 25.2 to 30.8 V; 4.5 W
Internal operating voltages	Logik DC 3.3 V / 2.5 V / 1.1 V / 1.2 V

Mechanics and Connectors

Ethernet interfaces X1 - X3	RJ45 socket 8-pole (IEC 60603-7)
Ethernet interfaces X4, X5	Ethernet over fiber optic using SFP module 2 x LC duplex optical interface CI-8522 is supplied with 2 SFP modules operating with 50/125 µm or 62.5/125 µm wavelength 1310 nm multimode optical fibre (MM). If large distances have to be bridged, modules for single mode fibre (SM) are to be used.
Rated impulse voltage	2 kV (Category II / AC 230 V) (based on installation, Category II / AC 230 V & Category III / AC 150 V)
Powe available on X4, X5 port for SFP modules	1 W on each port, 2 W in total
Dimensions (W x H x D)	30 mm x 132 mm x 124 mm (without DIN rail, SFP module and plug, locking hook closed)
Weight	Approx. 246.5 g (incl. bus module 12 g)

5.7.2.3 Block Diagram



[CI-8522_Block_Diagram, 1, en_US]

Figure 5-19 CI-8522 Block Diagram

5.7.2.4 Pin Assignment

Connector X1 - X3 (Ethernet)

Pin	Signal
8	n.c. [50]
7	n.c. [50]
6	RXD-
5	n.c. [50]
4	n.c. [50]

50 terminated by terminating resistor

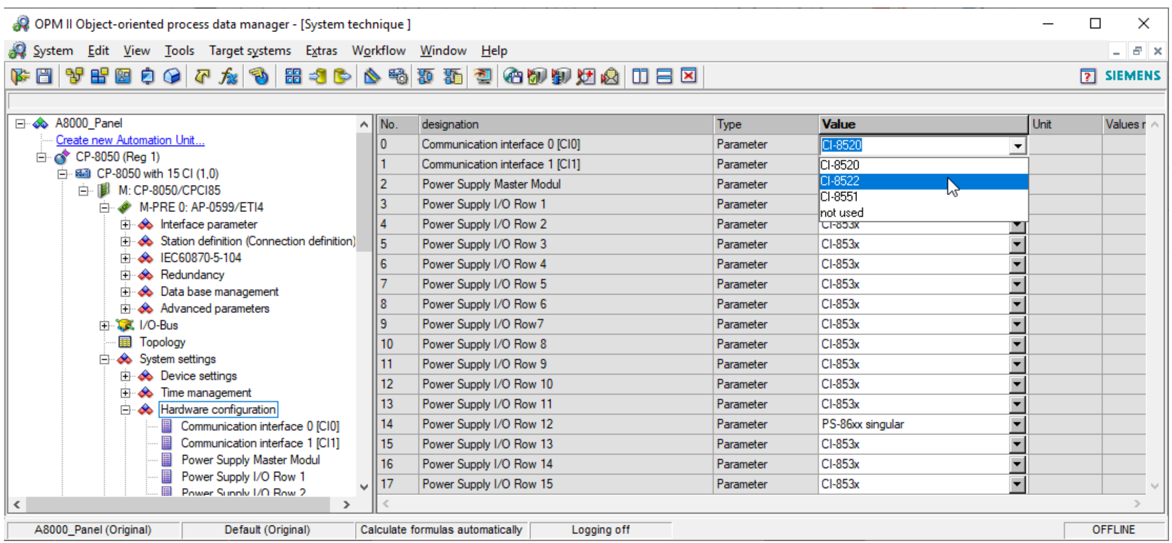
Pin	Signal
3	RXD+
2	TXD-
1	TXD+

Connector X4 - X5 (Ethernet over Fiber Optic Using SFP Module)

Pin	Signal
TX	Transmit
RX	Receive

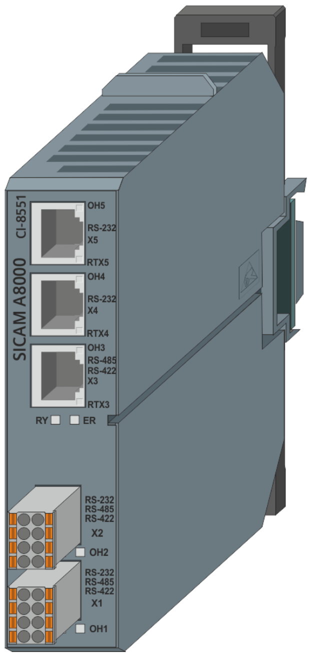
5.7.2.5 Configuration

The configuration of a CI-8522 is done with parameter **`CP-8050/CPCI85 | System settings | Hardware configuration`**.



[sc_CI-8522_configuration, 1, en_US]

5.7.3 CI-8551 Communication Interface Serial



NOTE

An additional license is required for use with CP-8031.

5.7.3.1 Features

A CI-8551 module is used to extend CP-8031[51]/CP-8050 systems with 5 serial ports. A maximum of 6 of these modules can be connected directly to the left of a CP-8050, one with CP-8031.

- 2 serial RS-232 interfaces (RJ45)
- 1 serial RS-485/422 interface (RJ45)
- 2 serial RS-232/485/422 interfaces (Push-in terminal)
- Communication to CP-8031/CP-8050 via bus connector (CM-8814)
- Status display of the serial connections via LED (OHx, RTXx)
- Status indication of the module via LED (RY, ER)
- Power supply via bus connector
- Mounting on 35 mm DIN rail

51 License required

5.7.3.2 Technical Data

Communication

2 serial interfaces (X4, X5)	RS-232 Mode • Unbalanced interchange circuit RS 232/V.28 • Galvanically insulated • ESD protection • Transmission rate up to 115.2 kbit/s (depending on protocol) • Rated impulse voltage 2 kVs • Line length ≤ 30 m • Supply of external modem / external converter
1 serial interface (X3)	RS-485/422 Mode • Balanced interchange circuit RS-485 • Galvanically insulated • ESD protection • Configuration 4-wire/2-wire with/without terminating resistor (parameter-settable) • Transmission rate up to 115.2 kbit/s (depending on protocol) • Rated impulse voltage 2 kV • Line length ≤ 1200 m
2 serial interfaces (X1, X2)	RS-232/485/422 Mode • Unbalanced interchange circuit RS 232/V.28 • Balanced interchange circuit RS-485 • Galvanically insulated • ESD protection • Transmission rate up to 115.2 kbit/s (depending on protocol) • Rated impulse voltage 2 kVs • line length – RS-232: ≤ 30 m – RS-485/422: ≤ 1200 m

Power supply (from internal bus)

Operating voltage	Input DC 28 V DC 25.2 to 30.8 V
Internal operating voltages	Logic DC 3.3 V / 2.5 V / 1.1 V
Power consumption	4.5 W + 1.5 W if 2 external converters (CM-0847) are supplied

Supply of external modem / external converter

Is done over X4 and X5	DC 5.0 V ± 10 %; 0.75 W

Connections

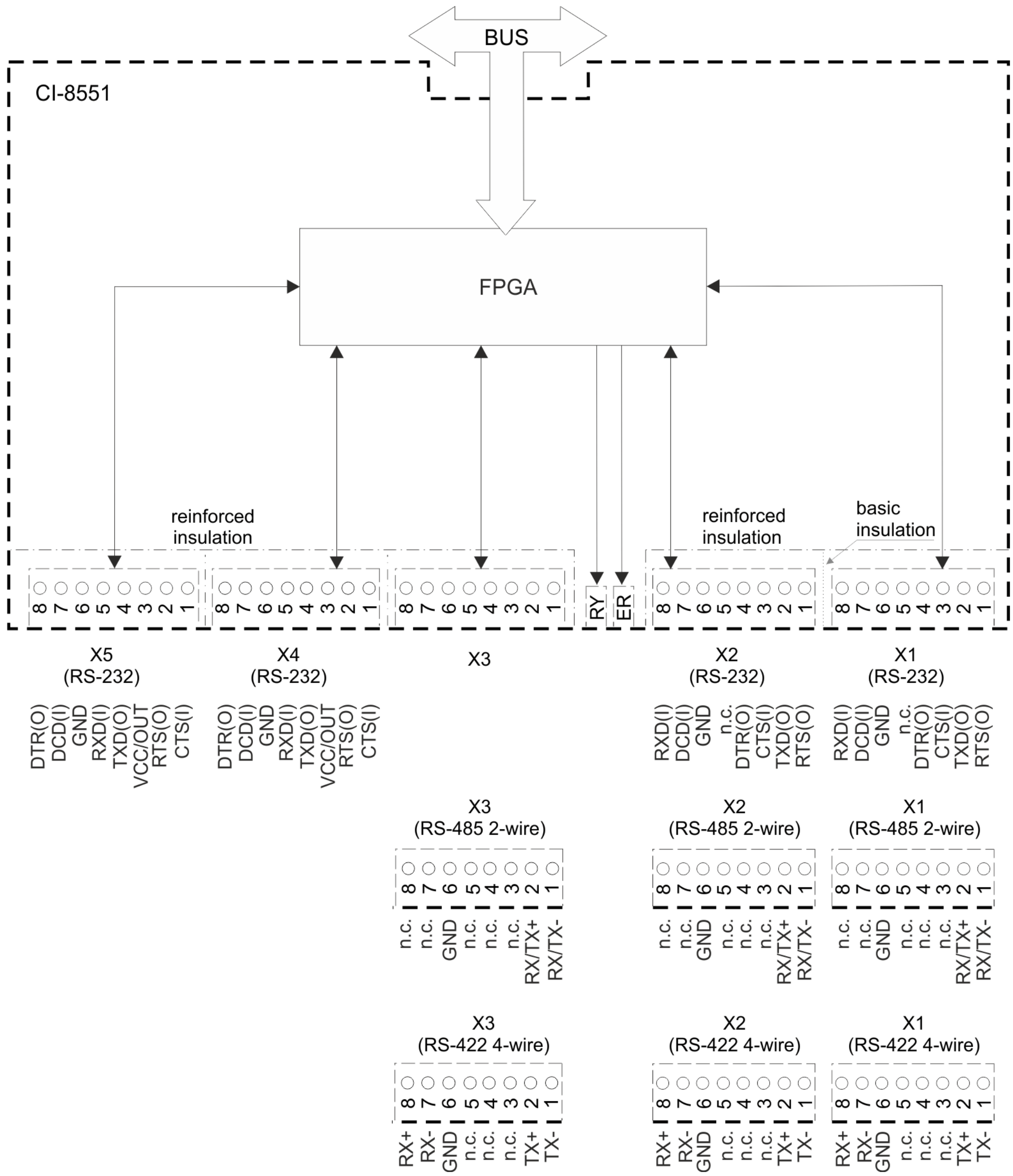
Serial RS-232 Interface (X4, X5)	RJ45 socket 8-pole (IEC 60603-7)
Serial RS-485/422 interface (X3)	RJ45 socket 8-pole (IEC 60603-7)

Serial RS-232/485/422 interface (X2, X1)	removable push-in terminal; 8-pole (no possibility for shielding)	
Connection data X1, X2	AWG	min. 24 max. 16
	Conductor cross section solid	min. 0.21 mm² max. 1.31 mm²
	Conductor cross section stranded	min. 0.21 mm² max. 1.31 mm²
	Conductor cross section stranded with ferrule without plastic sleeve	min. 0.25 mm² max. 1.31 mm²
	Conductor cross section stranded with ferrule with plastic sleeve	min. 0.21 mm² max. 0.75 mm²
	2 wires stranded with ferrule without plastic sleeve	min. 0.21 mm² max. 0.51 mm²
	2 wires stranded with ferrule with plastic sleeve	min. 0.21 mm² max. 0.51 mm²
	Wire strip length	min. 9 mm max. 10 mm
	Length ferrule	10 mm

Mechanics

Structure	System for mounting on 35 mm DIN rail
Dimensions (W x H x D)	30 mm x 132 mm x 124 mm (without DIN rail, plug and terminal, locking hook closed); D 142 mm (with inserted terminal)
Weight	Approx. 210 g (inkl. bus module 12 g)

5.7.3.3 Block Diagram

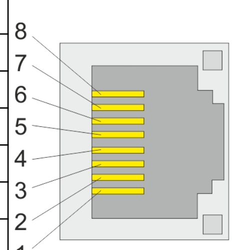


[dw_CI-8551_block_diagram, 2, en_US]

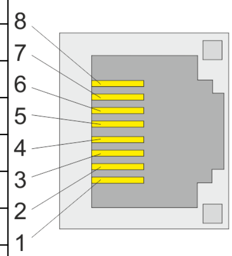
5.7.3.4 Pin Assignment

Connector X4, X5

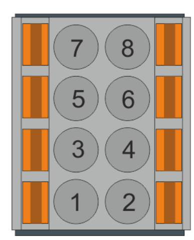
	RS-232	
Pin	**Signal**	
8	DTR (O)	
7	DCD (I)	
6	GND	
5	RXD (I)	
4	TXD (O)	
3	VCC/OUT 5V	
2	RTS (O)	
1	CTS (I)	



Connector X3

	RS-485 2-wire	RS-422 4-wire	
Pin	Signal	Signal	
8	n.c.	RXD+	
7	n.c.	RXD-	
6	GND	GND	
5	n.c.	n.c.	
4	n.c.	n.c.	
3	n.c.	n.c.	
2	TXD+/RXD+	TXD+	
1	TXD-/RXD-	TXD-	

Connector X1, X2

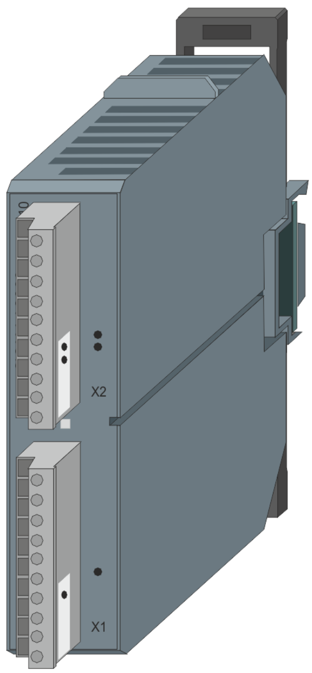
	RS-232	RS-485 2-wire	RS-422 4-wire	
Pin	Signal	Signal	Signal	
8	RXD (I)	n.c.	RXD+	
7	DCD (I)	n.c.	RXD-	
6	GND	GND	GND	
5	n.c.	n.c.	n.c.	
4	DTR (O)	n.c.	n.c.	
3	CTS (I)	n.c.	n.c.	
2	TXD (O)	TXD+/RXD+	TXD+	
1	RTS (O)	TXD-/RXD-	TXD-	

5.7.3.5 Configuration

- The configuration of a CI-8551 is done with parameter **`CP-8050/CPCI85 | System settings | Hardware configuration`**.
- For a system, consisting of a CP-8050 and a CI-8551 module, a PS-862x can be used for the power supply.
- For systems with more modules, the power consumption should be evaluated to select the power supply. See examples *5.1.1 Example for the Calculation of the Power Consumption*
- You find further configuration rules in section *Configuration Rules for Communication Modules, Page 709*

5.8 SICAM A8000 I/O Modules

5.8.1 DI-8110



[DI-8110_Oblique_View, 1, --_--]

Figure 5-20 DI-8110

5.8.1.1 Features

Digital input module

- Installation on 35 mm DIN rail
- 16 inputs (2 groups, 8 inputs each)
- Galvanically insulated by optocouplers
- Each group has a common return
- Signal voltage
  - DC 24 V
  - AC 24 V
- Removable screw terminals
- Function indication via LED

5.8.1.2 Functions

Single-Point Information

- Acquisition with a resolution of 1 ms [f]
- Update every 10 ms [a] (in the cycle of the open/closed-loop control function, if larger)
- Revision [fa]
- Power monitoring [fa]
- Inversion [fa]

- Firmware filter [f]
- Bounce suppression [f]
- Determination of the cause of transmission [f]
- Spontaneous transmission upon change [f]
- Periodical transmission [a]

Double-Point Information

- Acquisition with a resolution of 1 ms [f]
- Update every 10 ms [a] (in the cycle of the open/closed-loop control function, if larger)
- Revision [fa]
- Power monitoring [fa]
- Inversion [fa]
- Firmware filter [f]
- Bounce suppression [f]
- Monitoring intermediate and faulty positions [f]
- Determination of the cause of transmission [f]
- Reporting switching operations in progress [f]
- Breaker tripping detection [f]
- Breaker tripping suppression during automatic reclosure [f]
- Spontaneous transmission upon change [f]
- Periodical transmission [a]

Integrated Totals via Count Pulses [f1]

- Acquisition by firmware with a maximum count frequency of 20 Hz
  - Pulse length/pause >20 ms/>20 ms
  - Revision
  - Power monitoring
  - Inversion
  - Pulse counting
- Counter value formation
  - Count pulse evaluation
  - Set Counter
- Integrated total formation
  - Counter interrogation
  - Interval control
  - Frozen absolute value
  - Frozen relative value
- Not power-fail safe
- Integrated total transmission according to IEC 60870-5-101/104
- Spontaneous transmission

NOTE

The previously mentioned functions are described in detail in the document *SICAM RTUs Common Functions Peripheral Elements according to IEC 60870-5-101/104*.

5.8.1.3 Technical Data

Digital Inputs

16 digital inputs	• 2 groups 8 inputs each • Galvanical insulation • For each group one common return with selectable polarity
Filter time	3 ms (if the sensor voltage of a group of digital inputs is monitored for failures (parameter **`SVM_monitoring`**), there is a dedicated digital input for each group (IN D07 and IN D17); this input has a filter time of 2 ms)
Rated voltage:	• DC 24 V • AC 24 V at 50 Hz ± 10 %; 60 Hz ± 10 %
Operating points	≤ 12 V (logical “0”) ≥ 18 V (logical “1”)
Input circuits	• DC 18 to DC 31.2 V • AC 19 to AC 28 V The circuits are operated by means of an external voltage.
Current consumption	0,9 to 4,8 mA at 18 to 31.2 V

Power Supply

Operating voltage	DC 4.75 to DC 5.5 V The voltage is picked off from the system bus
Power consumption	130 mW

Mechanics and Connectors

Terminals	2 removable screw terminals (grid size 5.08 mm), 10-pole
Rated impulse voltage	4 kV (category III / AC 230 V)

Connection data X1, X2	Locking torque (PHOENIX terminal) [52] Locking torque (FCI terminal) [52]	0.5 Nm to 0.6 Nm 0.36 Nm to 0.44 Nm
	AWG	Min. 22 Max. 12
	Conductor cross section solid	Min. 0.33 mm² Max. 2.5 mm²
	Conductor cross section stranded	Min. 0.33 mm² Max. 2.5 mm²
	Conductor cross section stranded with ferrule without plastic sleeve	Min. 0.33 mm² Max. 2.5 mm²
	Conductor cross section stranded with ferrule with plastic sleeve	Min. 0.33 mm² Max. 2.5 mm²
	2 wires stranded with ferrule without plastic sleeve	Min. 0.33 mm² Max. 1 mm²
	2 wires stranded with ferrule with plastic sleeve	Min. 0.5 mm² Max. 1.31 mm²
	Wire strip length	Min. 6 mm Max. 7 mm
	Length ferrule	10 mm
Dimensions (W x H x D)	30 mm x 132 mm x 124 mm (without DIN rail and terminal, locking hook closed); D 142 mm (with inserted terminal)	
Weight	249 g (incl. bus module 12 g)	

5.8.1.4 Pin Assignment and Display

The process signals must be connected to two 10-pin screw terminals. The peripheral connectors are assigned according to the tables.

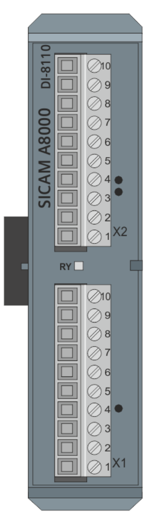


Figure 5-21 DI-8110 Front

Connector X1

Pin	Signal	Meaning
10	COM00	Common supply of group 0
9	COM00	Common supply of group 0

52 The respective manufacturer is imprinted at the terminal (see section *Types of screw terminals, Page 353*)

Pin	Signal	Meaning
8	IN D07	Digital input 7 of group 0
7	IN D06	Digital input 6 of group 0
6	IN D05	Digital input 5 of group 0
5	IN D04	Digital input 4 of group 0
4	IN D03	Digital input 3 of group 0
3	IN D02	Digital input 2 of group 0
2	IN D01	Digital input 1 of group 0
1	IN D00	Digital input 0 of group 0

Connector X2

Pin	Signal	Meaning
10	COM10	Common supply of group 1
9	COM10	Common supply of group 1
8	IN D17	Digital input 17 of group 1
7	IN D16	Digital input 16 of group 1
6	IN D15	Digital input 15 of group 1
5	IN D14	Digital input 14 of group 1
4	IN D13	Digital input 13 of group 1
3	IN D12	Digital input 12 of group 1
2	IN D11	Digital input 11 of group 1
1	IN D10	Digital input 10 of group 1

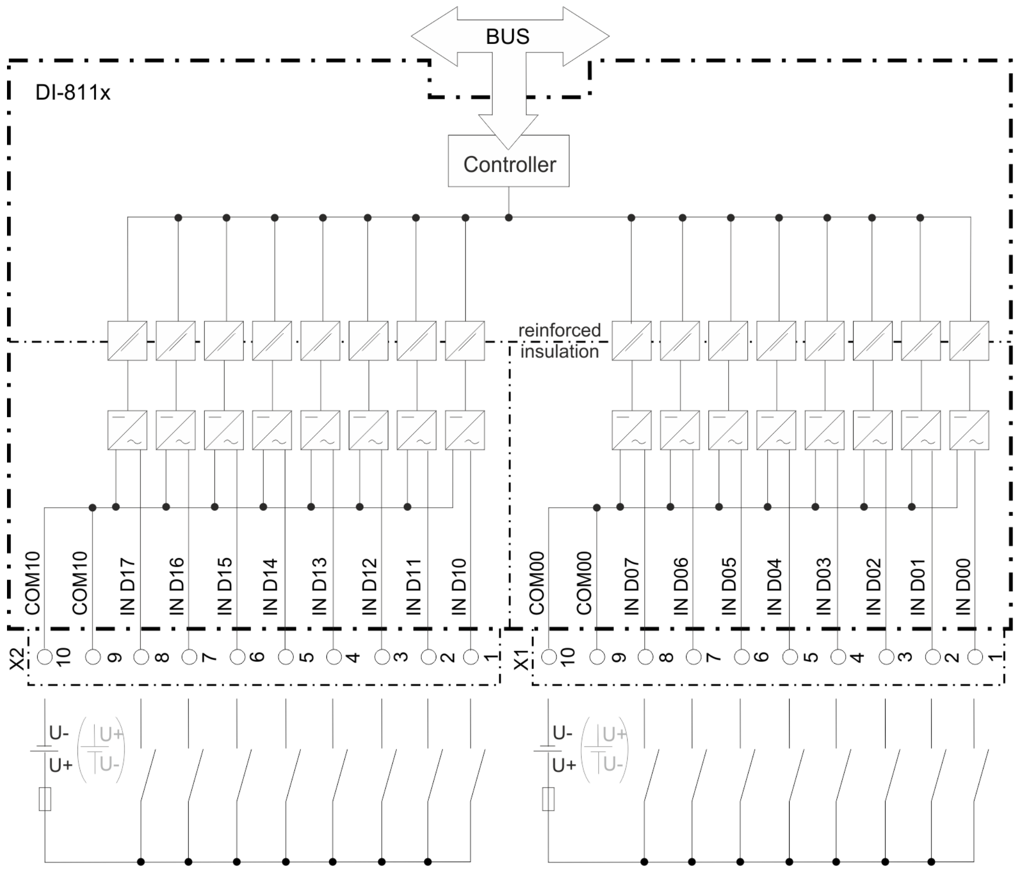
Display

LED	Meaning
RY	Readiness

5.8.1.5 Block Diagram and External Circuitry

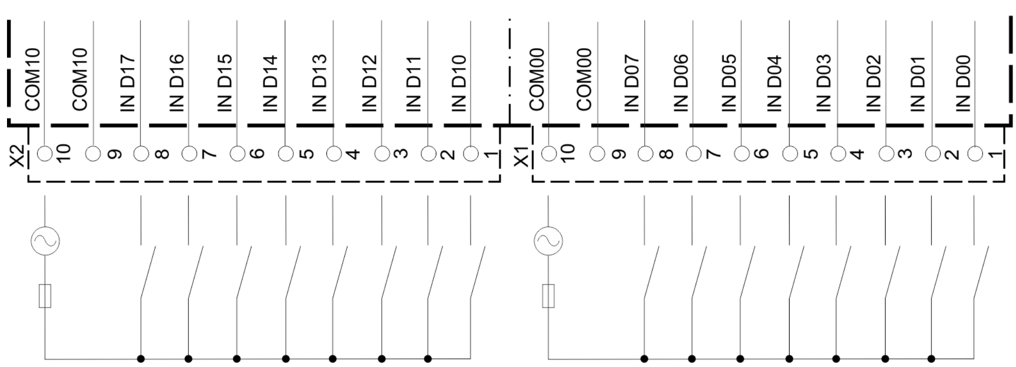
The following circuitry variants are examples, and do not relate exclusively to the depicted inputs/outputs.

Block diagram and external circuitry variant with DC voltage detection



[DI-811x_Block_Diagram_External_Circuitry, 1, en_US]

External circuitry variant with AC voltage detection

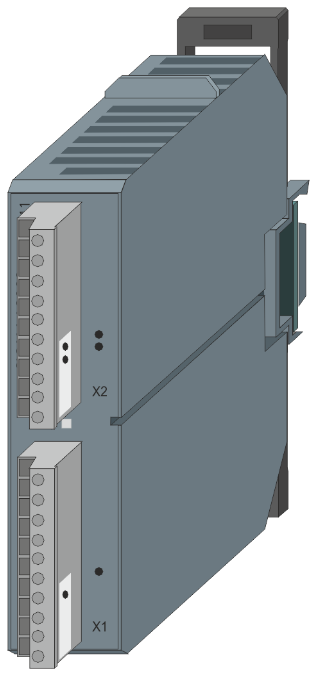


[dw_AI-8110-11-12_ext_circuitry, 1, --_--]

NOTE

- The use of different power networks (e.g. AC and DC voltage) within one input group is not permitted.

5.8.2 DI-8111



[DI-8111_Oblique_View, 1, --_--]

Figure 5-22 DI-8111

5.8.2.1 Features

Digital input module

- Installation on 35 mm DIN rail
- 16 inputs (2 groups, 8 inputs each)
- Galvanically insulated by optocouplers
- Each group has a common return
- Signal voltage
  - DC 48 V / 60 V
  - AC 48 V
- Removable screw terminals
- Function indication via LED

5.8.2.2 Functions

Single-Point Information

- Acquisition with a resolution of 1 ms [f]
- Update every 10 ms [a] (in the cycle of the open/closed-loop control function, if larger)
- Revision [fa]
- Power monitoring [fa]
- Inversion [fa]
- Firmware filter [f]
- Bounce suppression [f]

- Determination of the cause of transmission [f]
- Spontaneous transmission upon change [f]
- Periodical transmission [a]

Double-Point Information

- Acquisition with a resolution of 1 ms [f]
- Update every 10 ms [a] (in the cycle of the open/closed-loop control function, if larger)
- Revision [fa]
- Power monitoring [fa]
- Inversion [fa]
- Firmware filter [f]
- Bounce suppression [f]
- Monitoring intermediate and faulty positions [f]
- Determination of the cause of transmission [f]
- Reporting switching operations in progress [f]
- Breaker tripping detection [f]
- Breaker tripping suppression during automatic reclosure [f]
- Spontaneous transmission upon change [f]
- Periodical transmission [a]

Integrated Totals via Count Pulses [f1]

- Acquisition by firmware with a maximum count frequency of 20 Hz
  - Pulse length/pause >20 ms/>20 ms
  - Revision
  - Power monitoring
  - Inversion
  - Pulse counting
- Counter value formation
  - Count pulse evaluation
  - Set Counter
- Integrated total formation
  - Counter interrogation
  - Interval control
  - Frozen absolute value
  - Frozen relative value
- Not power-fail safe
- Integrated total transmission according to IEC 60870-5-101/104
- Spontaneous transmission

NOTE

The previously mentioned functions are described in detail in the document *SICAM RTUs Common Functions Peripheral Elements according to IEC 60870-5-101/104*.

5.8.2.3 Technical Data

Digital Inputs

16 digital inputs	• 2 groups 8 inputs each • Galvanical insulation • For each group one common return with selectable polarity
Filter time	3 ms (if the sensor voltage of a group of digital inputs is monitored for failures (parameter **`SVM_monitoring`**), there is a dedicated digital input for each group (IN D07 and IN D17); this input has a filter time of 2 ms)
Rated voltage:	• DC 48 V / 60 V • AC 48 V at 50 Hz ± 10 %; 60 Hz ± 10 %
Operating points	≤ 24 V (logical “0”) ≥ 36 V (logical “1”)
Input circuits	• DC 36 to DC 78 V • AC 38 to AC 57 V The circuits are operated by means of an external voltage.
Current consumption	0,5 to 2,5 mA at 36 to 78 V

Power Supply

Operating voltage	DC 4.75 to DC 5.5 V The voltage is picked off from the system bus
Power consumption	130 mW

Mechanics and Connectors

Terminals	2 removable screw terminals (grid size 5.08 mm), 10-pole
Rated impulse voltage	4 kV (category III / AC 230 V)

Connection data X1, X2	Locking torque (PHOENIX terminal) [53] Locking torque (FCI terminal) [53]	0.5 Nm to 0.6 Nm 0.36 Nm to 0.44 Nm
	AWG	Min. 22 Max. 12
	Conductor cross section solid	Min. 0.33 mm² Max. 2.5 mm²
	Conductor cross section stranded	Min. 0.33 mm² Max. 2.5 mm²
	Conductor cross section stranded with ferrule without plastic sleeve	Min. 0.33 mm² Max. 2.5 mm²
	Conductor cross section stranded with ferrule with plastic sleeve	Min. 0.33 mm² Max. 2.5 mm²
	2 wires stranded with ferrule without plastic sleeve	Min. 0.33 mm² Max. 1 mm²
	2 wires stranded with ferrule with plastic sleeve	Min. 0.5 mm² Max. 1.31 mm²
	Wire strip length	Min. 6 mm Max. 7 mm
	Length ferrule	10 mm
Dimensions (W x H x D)	30 mm x 132 mm x 124 mm (without DIN rail and terminal, locking hook closed); D 142 mm (with inserted terminal)	
Weight	249 g (incl. bus module 12 g)	

5.8.2.4 Pin Assignment and Display

The process signals must be connected to two 10-pin screw terminals. The peripheral connectors are assigned according to the tables.

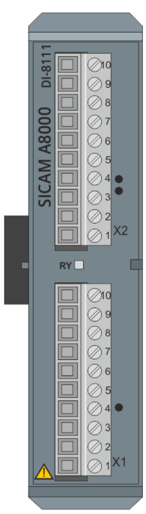


Figure 5-23 DI-8111 Front

Connector X1

Pin	Signal	Meaning
10	COM00	Common supply of group 0
9	COM00	Common supply of group 0

[53] The respective manufacturer is imprinted at the terminal (see section *Types of screw terminals, Page 353*)

Pin	Signal	Meaning
8	IN D07	Digital input 7 of group 0
7	IN D06	Digital input 6 of group 0
6	IN D05	Digital input 5 of group 0
5	IN D04	Digital input 4 of group 0
4	IN D03	Digital input 3 of group 0
3	IN D02	Digital input 2 of group 0
2	IN D01	Digital input 1 of group 0
1	IN D00	Digital input 0 of group 0

Connector X2

Pin	Signal	Meaning
10	COM10	Common supply of group 1
9	COM10	Common supply of group 1
8	IN D17	Digital input 17 of group 1
7	IN D16	Digital input 16 of group 1
6	IN D15	Digital input 15 of group 1
5	IN D14	Digital input 14 of group 1
4	IN D13	Digital input 13 of group 1
3	IN D12	Digital input 12 of group 1
2	IN D11	Digital input 11 of group 1
1	IN D10	Digital input 10 of group 1

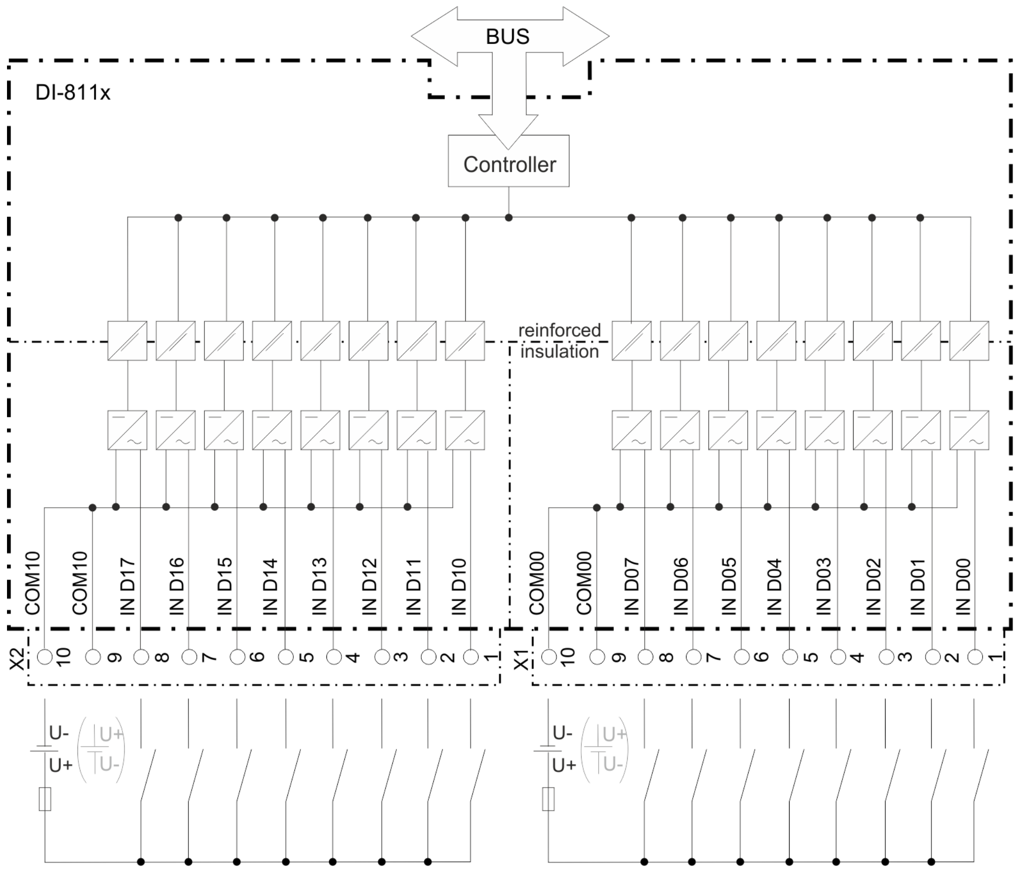
Display

LED	Meaning
RY	Readiness

5.8.2.5 Block Diagram and External Circuitry

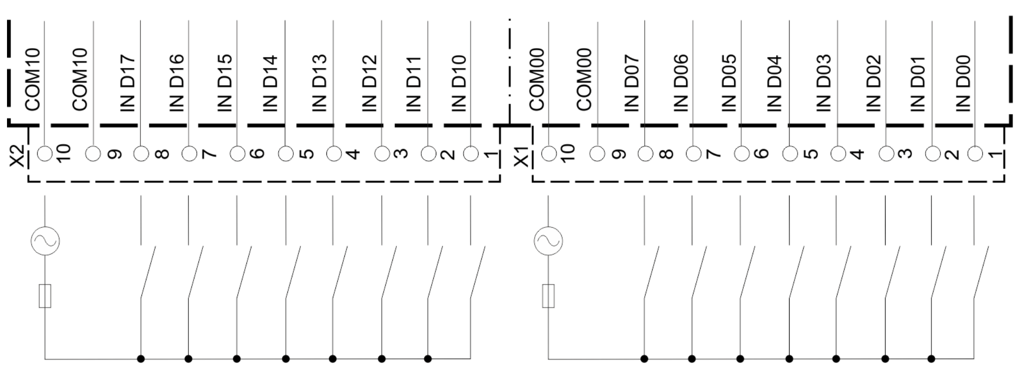
The following circuitry variants are examples, and do not relate exclusively to the depicted inputs/outputs.

Block diagram and external circuitry variant with DC voltage detection



[DI-811x_Block_Diagram_External_Circuitry, 1, en_US]

External circuitry variant with AC voltage detection

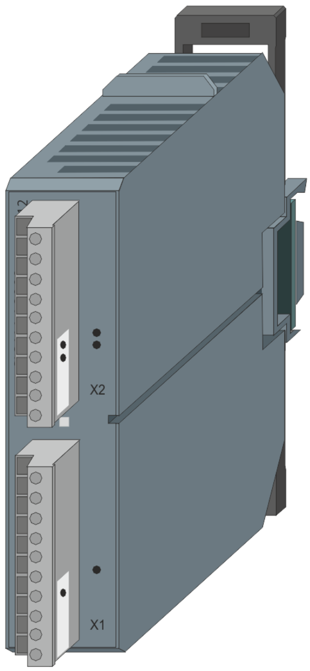


[dw_AI-8110-11-12_ext_circuitry, 1, --_--]

NOTE

- The use of different power networks (e.g. AC and DC voltage) within one input group is not permitted.

5.8.3 DI-8112



[DI-8112_Oblique_View, 1, --_--]

Figure 5-24 DI-8112

5.8.3.1 Features

Digital input module

- Installation on 35 mm DIN rail
- 16 inputs (2 groups, 8 inputs each)
- Galvanically insulated by optocouplers
- Each group has a common return
- Signal voltage
  – DC 110 V
  – AC 120 V
- Removable screw terminals
- Function indication via LED

5.8.3.2 Functions

Single-Point Information

- Acquisition with a resolution of 1 ms [f]
- Update every 10 ms [a] (in the cycle of the open/closed-loop control function, if larger)
- Revision [fa]
- Power monitoring [fa]
- Inversion [fa]
- Firmware filter [f]
- Bounce suppression [f]

- Determination of the cause of transmission [f]
- Spontaneous transmission upon change [f]
- Periodical transmission [a]

Double-Point Information

- Acquisition with a resolution of 1 ms [f]
- Update every 10 ms [a] (in the cycle of the open/closed-loop control function, if larger)
- Revision [fa]
- Power monitoring [fa]
- Inversion [fa]
- Firmware filter [f]
- Bounce suppression [f]
- Monitoring intermediate and faulty positions [f]
- Determination of the cause of transmission [f]
- Reporting switching operations in progress [f]
- Breaker tripping detection [f]
- Breaker tripping suppression during automatic reclosure [f]
- Spontaneous transmission upon change [f]
- Periodical transmission [a]

Integrated Totals via Count Pulses [f1]

- Acquisition by firmware with a maximum count frequency of 20 Hz
  - Pulse length/pause >20 ms/>20 ms
  - Revision
  - Power monitoring
  - Inversion
  - Pulse counting
- Counter value formation
  - Count pulse evaluation
  - Set Counter
- Integrated total formation
  - Counter interrogation
  - Interval control
  - Frozen absolute value
  - Frozen relative value
- Not power-fail safe
- Integrated total transmission according to IEC 60870-5-101/104
- Spontaneous transmission

NOTE

The previously mentioned functions are described in detail in the document *SICAM RTUs Common Functions Peripheral Elements according to IEC 60870-5-101/104*.

5.8.3.3 Technical Data

Digital Inputs

16 digital inputs	• 2 groups 8 inputs each • Galvanical insulation • For each group one common return with selectable polarity
Filter time	3 ms (if the sensor voltage of a group of digital inputs is monitored for failures (parameter **`SVM_monitoring`**), there is a dedicated digital input for each group (IN D07 and IN D17); this input has a filter time of 2 ms)
Rated voltage:	• DC 110 V • AC 120 V at 50 Hz ± 10 %; 60 Hz ± 10 %
Operating points	≤ 55 V (logical “0”) ≥ 82.5 V (logical “1”)
Input circuits	• DC 82.5 to DC 143 V • AC 96 to AC 144 V The circuits are operated by means of an external voltage.
Current consumption	0,4 to 1,4 mA at 82.5 to 143 V

Power Supply

Operating voltage	DC 4.75 to DC 5.5 V The voltage is picked off from the system bus
Power consumption	130 mW

Mechanics and Connectors

Terminals	2 removable screw terminals (grid size 5.08 mm), 10-pole
Rated impulse voltage	4 kV (category III / AC 230 V)

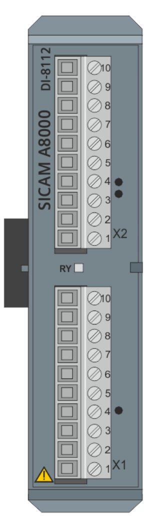
Connection data X1, X2	Locking torque (PHOENIX terminal) [54] Locking torque (FCI terminal) [54]	0.5 Nm to 0.6 Nm 0.36 Nm to 0.44 Nm
	AWG	Min. 22 Max. 12
	Conductor cross section solid	Min. 0.33 mm² Max. 2.5 mm²
	Conductor cross section stranded	Min. 0.33 mm² Max. 2.5 mm²
	Conductor cross section stranded with ferrule without plastic sleeve	Min. 0.33 mm² Max. 2.5 mm²
	Conductor cross section stranded with ferrule with plastic sleeve	Min. 0.33 mm² Max. 2.5 mm²
	2 wires stranded with ferrule without plastic sleeve	Min. 0.33 mm² Max. 1 mm²
	2 wires stranded with ferrule with plastic sleeve	Min. 0.5 mm² Max. 1.31 mm²
	Wire strip length	Min. 6 mm Max. 7 mm
	Length ferrule	10 mm
Dimensions (W x H x D)	30 mm x 132 mm x 124 mm (without DIN rail and terminal, locking hook closed); D 142 mm (with inserted terminal)	
Weight	249 g (incl. bus module 12 g)	

NOTE

Above an ambient temperature of +65 °C (horizontal mounting) / +45 °C (vertical mounting) a derating occurs. In this case, only a maximum of 13 inputs may be operated simultaneously.

5.8.3.4 Pin Assignment and Display

The process signals must be connected to two 10-pin screw terminals. The peripheral connectors are assigned according to the tables.



[DI-8112_Front, 1, --_--]

Figure 5-25 DI-8112 Front

54 The respective manufacturer is imprinted at the terminal (see section *Types of screw terminals, Page 353*)

Connector X1

Pin	Signal	Meaning
10	COM00	Common supply of group 0
9	COM00	Common supply of group 0
8	IN D07	Digital input 7 of group 0
7	IN D06	Digital input 6 of group 0
6	IN D05	Digital input 5 of group 0
5	IN D04	Digital input 4 of group 0
4	IN D03	Digital input 3 of group 0
3	IN D02	Digital input 2 of group 0
2	IN D01	Digital input 1 of group 0
1	IN D00	Digital input 0 of group 0

Connector X2

Pin	Signal	Meaning
10	COM10	Common supply of group 1
9	COM10	Common supply of group 1
8	IN D17	Digital input 17 of group 1
7	IN D16	Digital input 16 of group 1
6	IN D15	Digital input 15 of group 1
5	IN D14	Digital input 14 of group 1
4	IN D13	Digital input 13 of group 1
3	IN D12	Digital input 12 of group 1
2	IN D11	Digital input 11 of group 1
1	IN D10	Digital input 10 of group 1

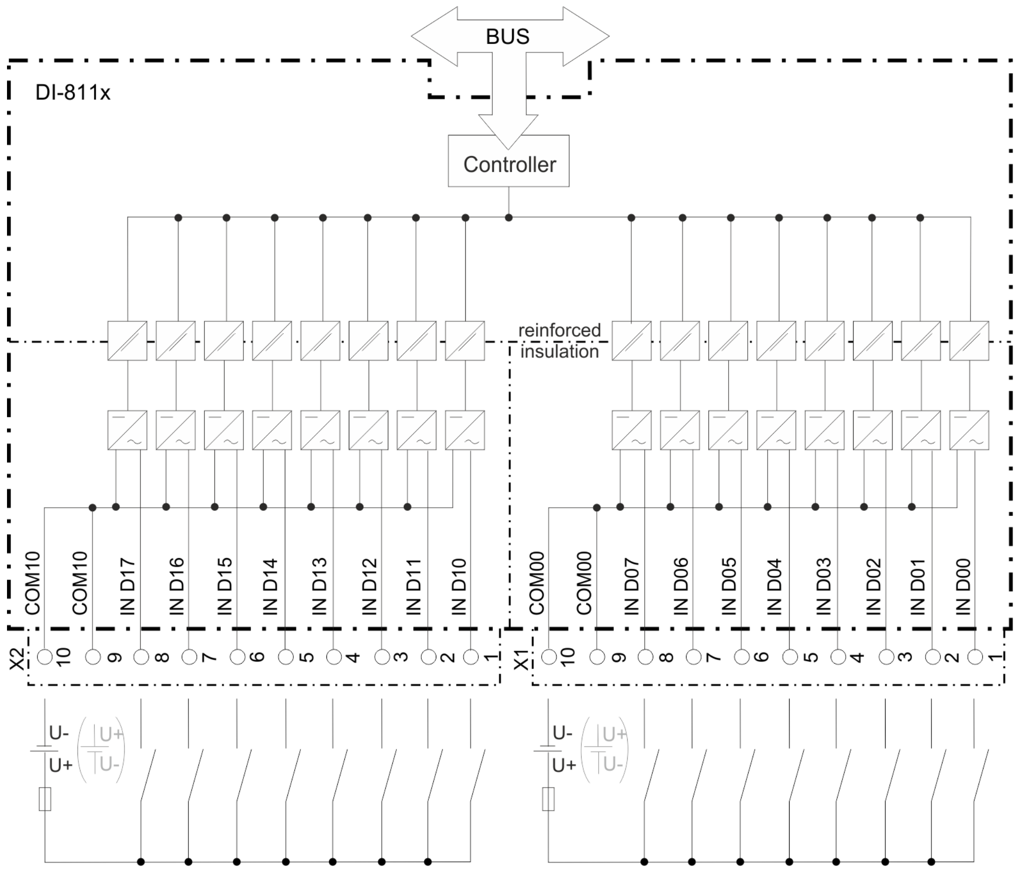
Display

LED	Meaning
RY	Readiness

5.8.3.5 Block Diagram and External Circuitry

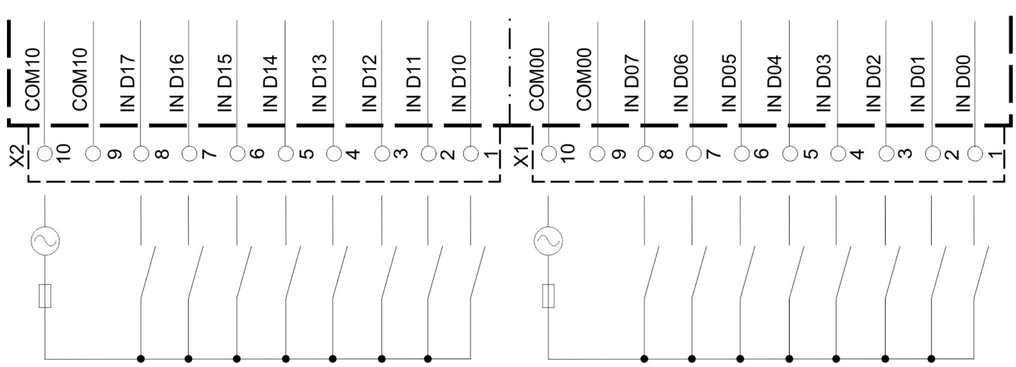
The following circuitry variants are examples, and do not relate exclusively to the depicted inputs/outputs.

Block diagram and external circuitry variant with DC voltage detection



[DI-811x_Block_Diagram_External_Circuitry, 1, en_US]

External circuitry variant with AC voltage detection

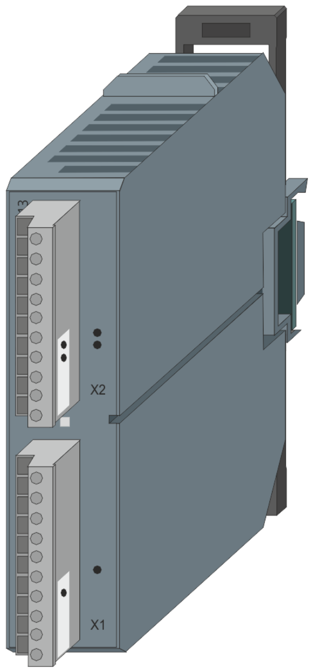


[dw_AI-8110-11-12_ext_circuitry, 1, --_--]

NOTE

- The use of different power networks (e.g. AC and DC voltage) within one input group is not permitted.

5.8.4 DI-8113



[DI-8113_Oblique_View, 1, --_--]

Figure 5-26 DI-8113

5.8.4.1 Features

Digital input module

- Installation on 35 mm DIN rail
- 16 inputs (2 groups, 8 inputs each)
- Galvanically insulated by optocouplers
- Each group has a common return
- Signal voltage
  - DC 220 V
  - AC 230 V
- Removable screw terminals
- Function indication via LED

5.8.4.2 Functions

Single-Point Information

- Acquisition with a resolution of 1 ms [f]
- Update every 10 ms [a] (in the cycle of the open/closed-loop control function, if larger)
- Revision [fa]
- Power monitoring [fa]
- Inversion [fa]
- Firmware filter [f]
- Bounce suppression [f]

- Determination of the cause of transmission [f]
- Spontaneous transmission upon change [f]
- Periodical transmission [a]

Double-Point Information

- Acquisition with a resolution of 1 ms [f]
- Update every 10 ms [a] (in the cycle of the open/closed-loop control function, if larger)
- Revision [fa]
- Power monitoring [fa]
- Inversion [fa]
- Firmware filter [f]
- Bounce suppression [f]
- Monitoring intermediate and faulty positions [f]
- Determination of the cause of transmission [f]
- Reporting switching operations in progress [f]
- Breaker tripping detection [f]
- Breaker tripping suppression during automatic reclosure [f]
- Spontaneous transmission upon change [f]
- Periodical transmission [a]

Integrated Totals via Count Pulses [f1]

- Acquisition by firmware with a maximum count frequency of 20 Hz
  - Pulse length/pause >20 ms/>20 ms
  - Revision
  - Power monitoring
  - Inversion
  - Pulse counting
- Counter value formation
  - Count pulse evaluation
  - Set Counter
- Integrated total formation
  - Counter interrogation
  - Interval control
  - Frozen absolute value
  - Frozen relative value
- Not power-fail safe
- Integrated total transmission according to IEC 60870-5-101/104
- Spontaneous transmission

NOTE

The previously mentioned functions are described in detail in the document *SICAM RTUs Common Functions Peripheral Elements according to IEC 60870-5-101/104*.

5.8.4.3 Technical Data

Digital Inputs

16 digital inputs	• 2 groups 8 inputs each • Galvanical insulation • For each group one common return with selectable polarity
Filter time	3 ms (if the sensor voltage of a group of digital inputs is monitored for failures (parameter **`SVM_monitoring`**), there is a dedicated digital input for each group (IN D07 and IN D17); this input has a filter time of 2 ms)
Rated voltage:	• DC 220 V • AC 230 V at 50 Hz ± 10 %; 60 Hz ± 10 %
Operating points	≤ 110 V (logical "0") ≥ 165 V (logical "1")
Input circuits	• DC 165 to DC 253 V • AC 184 to AC 253 V The circuits are operated by means of an external voltage.
Current consumption	0,3 to 0,7 mA at 165 to 253 V

Power Supply

Operating voltage	DC 4.75 to DC 5.5 V The voltage is picked off from the system bus
Power consumption	130 mW

Mechanics and Connectors

Terminals	2 removable screw terminals (grid size 5.08 mm), 10-pole
Rated impulse voltage	4 kV (category III / AC 230 V)

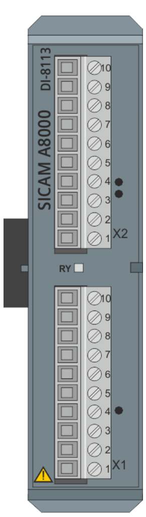
Connection data X1, X2	Locking torque (PHOENIX terminal) [55] Locking torque (FCI terminal) [55]	0.5 Nm to 0.6 Nm 0.36 Nm to 0.44 Nm
	AWG	Min. 22 Max. 12
	Conductor cross section solid	Min. 0.33 mm² Max. 2.5 mm²
	Conductor cross section stranded	Min. 0.33 mm² Max. 2.5 mm²
	Conductor cross section stranded with ferrule without plastic sleeve	Min. 0.33 mm² Max. 2.5 mm²
	Conductor cross section stranded with ferrule with plastic sleeve	Min. 0.33 mm² Max. 2.5 mm²
	2 wires stranded with ferrule without plastic sleeve	Min. 0.33 mm² Max. 1 mm²
	2 wires stranded with ferrule with plastic sleeve	Min. 0.5 mm² Max. 1.31 mm²
	Wire strip length	Min. 6 mm Max. 7 mm
	Length ferrule	10 mm
Dimensions (W x H x D)	30 mm x 132 mm x 124 mm (without DIN rail and terminal, locking hook closed); D 142 mm (with inserted terminal)	
Weight	249 g (incl. bus module 12 g)	

NOTE

Above an ambient temperature of +65 °C (horizontal mounting) / +45 °C (vertical mounting) a derating occurs. In this case, only a maximum of 13 inputs may be operated simultaneously.

5.8.4.4 Pin Assignment and Display

The process signals must be connected to two 10-pin screw terminals. The peripheral connectors are assigned according to the tables.



[DI-8113_Front, 1, --_--]

Figure 5-27 DI-8113 Front

55 The respective manufacturer is imprinted at the terminal (see section *Types of screw terminals, Page 353*)

Connector X1

Pin	Signal	Meaning
10	COM00	Common supply of group 0
9	COM00	Common supply of group 0
8	IN D07	Digital input 7 of group 0
7	IN D06	Digital input 6 of group 0
6	IN D05	Digital input 5 of group 0
5	IN D04	Digital input 4 of group 0
4	IN D03	Digital input 3 of group 0
3	IN D02	Digital input 2 of group 0
2	IN D01	Digital input 1 of group 0
1	IN D00	Digital input 0 of group 0

Connector X2

Pin	Signal	Meaning
10	COM10	Common supply of group 1
9	COM10	Common supply of group 1
8	IN D17	Digital input 17 of group 1
7	IN D16	Digital input 16 of group 1
6	IN D15	Digital input 15 of group 1
5	IN D14	Digital input 14 of group 1
4	IN D13	Digital input 13 of group 1
3	IN D12	Digital input 12 of group 1
2	IN D11	Digital input 11 of group 1
1	IN D10	Digital input 10 of group 1

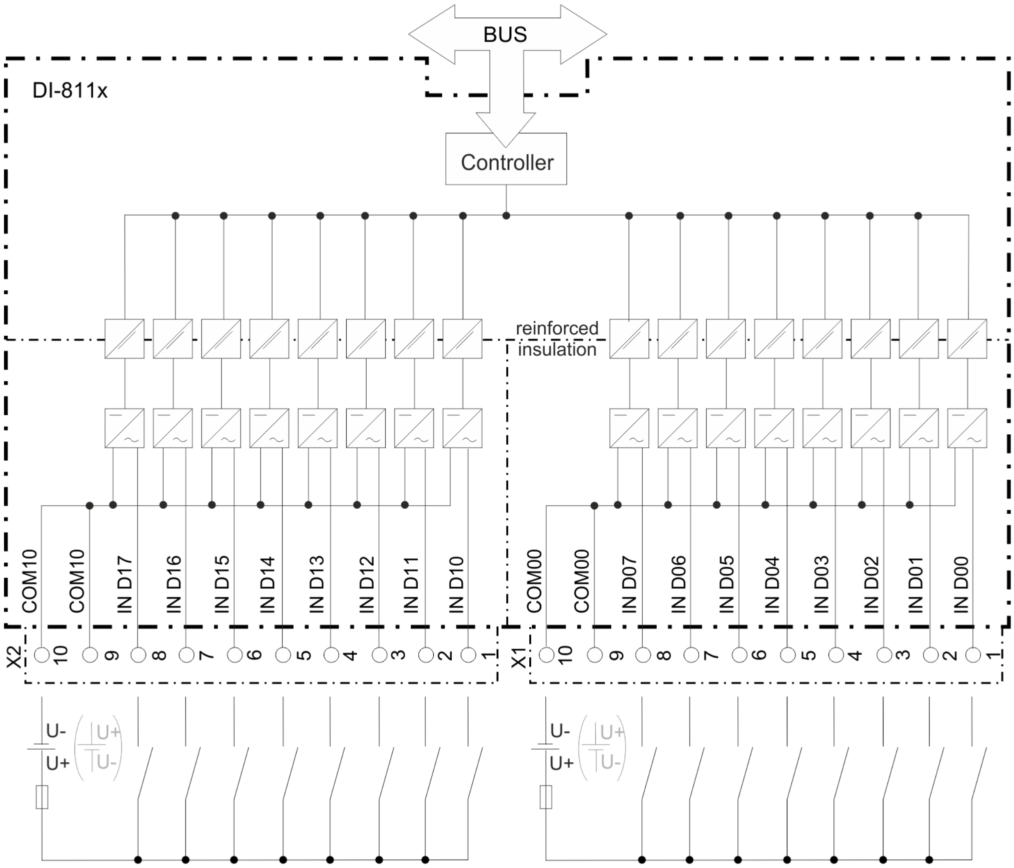
Display

LED	Meaning
RY	Readiness

5.8.4.5 Block Diagram and External Circuitry

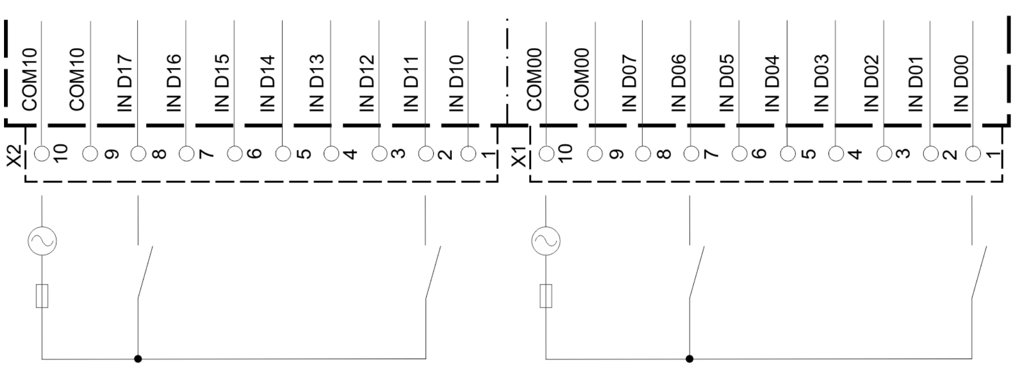
The following circuitry variants are examples, and do not relate exclusively to the depicted inputs/outputs.

Block diagram and external circuitry variant with DC voltage detection



[DI-811x_Block_Diagram_External_Circuitry, 1, en_US]

DI-8113 External circuitry variant with AC voltage detection

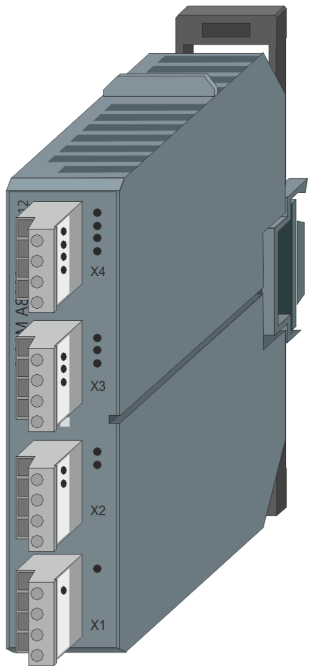


[dw_AI-8113_ext_circuitry, 1, --_--]

NOTE

- The use of different power networks (e.g. AC and DC voltage) within one input group is not permitted.
- Only two input channels per input group can be used on the DI-8113 (= max. 4 inputs for AC voltage detection on the DI-8113).
- Adjacent inputs on the DI-8113 must not be used for AC voltage monitoring. The binary inputs IN_D00, IN_D06 and IN_D11, IN_D17 are to be used.

5.8.5 DO-8212



[DO-8212_Oblique_View, 1, --_--]

Figure 5-28 DO-8212

5.8.5.1 Features

Digital output module

- Installation on 35 mm DIN rail
- 8 relay outputs (4 groups with 2 outputs each)
- Galvanical insulation
- Switching voltage DC 24 to 220 V / AC 230 V
- The outputs can switch both DC and AC voltages
- Removable screw terminals
- Function indication via LED

5.8.5.2 Functions

Pulse commands [f1]

- Secured output of pulse commands
  - 1-pole, 1½-pole, 2-pole
  - Cannot be mixed
- Single, double and regulating step commands
- Command output (OC)
- Basic application functions and procedures according to IEC 60870-5-101/104
  - Formal check
  - Direct command
  - Select and execute command

- Retry suppression
- 1-out-of-n Check
- Control location check
- Command interlocking
- Synchronization
- Revision
- Command output time
  - Can be set by parameter
  - Dependent on the process
- Return information monitoring
- Command prolongation
- Switching sequences
- Command output for the auto-reclose function
- If outputs of the module are used for pulse commands, no outputs of the same module can be used for binary information output

Binary Information

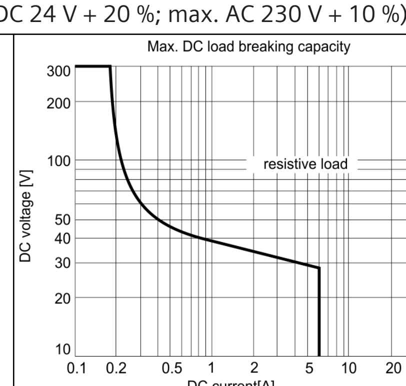
- Selectable behavior upon communication failure [fa] (deactivation or retention)
- Deactivation upon module failure [fa]
- Spontaneous transmission [f] or
- Periodical transmission [a]
- If outputs of the module are used for binary information output, no outputs of the same module can be used for pulse commands
- Use as watchdog realizable by means of application program (categories *DO_SX* and *DO_DX* must be used)

NOTE

The previously mentioned functions are described in detail in the document *SICAM RTUs Common Functions Peripheral Elements according to IEC 60870-5-101/104* (DC0-011-2).

5.8.5.3 Technical Data

Digital Outputs

8 digital outputs (relay)	• 4 groups, 2 outputs each • Each relay has a 1-pole normally-open contact • The outputs are galvanically insulated from logic circuits and ground by monostable relays with reinforced insulation • Each group is galvanically insulated from the other groups, logic circuits and ground with reinforced insulation • Within the groups, the outputs are galvanically insulated from each other with functional insulation of 250 V • The Outputs can be used for switching of direct voltage or also alternating voltage • Display of function and state of outputs via engineering tool or LED module
Nominal voltages	• DC 24 V / 48 V / 60 V / 110 V / 220 V • AC 110 V / 230 V
Maximum continuous current	Standard circuitry • 8 outputs max. 3 A each (5 A / 1 min) Circuitry with derating at 5 A • 2 outputs max. 5 A each • 6 outputs max. 2 A each or • 4 outputs max. 5 A each • 4 outputs max. 0 A each (relay must not be activated) Power augmentation [56] • 4 outputs max. 6 A each (max. DC 24 V + 20 %; max. AC 230 V + 10 %)
Switching capacity with DC	• Min. 50 mW at DC 5 V • Max. acc. to diagram 
Switching capacity with AC	• Max. 1250 VA at 5 A (AC 250 V), resistive load • Max. 500 VA at 2 A (AC 250 V) cosφ = 0.4
Switching cycles	$3 \cdot 10^4$
Output circuits	Max. DC 250 V / AC 253 V (operated with external voltage)
UL/CUL	DC 6 A / 24 V AC 6 A / 253 V resistive Pilot duty: R300, B300

56 With parallel connection within a group

Power Supply

Operating voltage	DC 4.75 to DC 5.5 V The voltage is picked off from the system bus
Power consumption	800 mW

Mechanics and Connectors

Terminals	4 removable screw terminals (grid size 5.08 mm), 4-pole	
Rated impulse voltage ⚠	4 kV < 2000 m: category III < 3000 m: Category II [57]	
Connection data X1, X2, X3, X4	Locking torque (PHOENIX terminal) [58] Locking torque (FCI terminal) [58]	0.5 Nm to 0.6 Nm 0.36 Nm to 0.44 Nm
	AWG	Min. 22 Max. 12
	Conductor cross section solid	Min. 0.33 mm² Max. 2.5 mm²
	Conductor cross section stranded	Min. 0.33 mm² Max. 2.5 mm²
	Conductor cross section stranded with ferrule without plastic sleeve	Min. 0.33 mm² Max. 2.5 mm²
	Conductor cross section stranded with ferrule with plastic sleeve	Min. 0.33 mm² Max. 2.5 mm²
	2 wires stranded with ferrule without plastic sleeve	Min. 0.33 mm² Max. 1 mm²
	2 wires stranded with ferrule with plastic sleeve	Min. 0.5 mm² Max. 1.31 mm²
	Wire strip length	Min. 6 mm Max. 7 mm
	Length ferrule	10 mm
Dimensions (W x H x D)	30 mm x 132 mm x 124 mm (without DIN rail and terminal, locking hook closed); D 142 mm (with inserted terminal)	
Weight	287 g (incl. bus module 12 g)	

NOTE

Within a group of outputs the wiring with different current circuits is not permissible since only functional insulation exists.

NOTE

- For power augmentation 2 relays may be connected parallel, this must happen within a group (applies only for I < 6 A → 2 · 3 A).
- Siemens recommends that outputs which are more heavily loaded should not be adjacent to each other. As a result, the stress on the device is distributed more evenly.

57 Category III - ONLY when connecting identical external voltage levels for each load on each contact of the groups X1 & X2 and X3 & X4 respectively

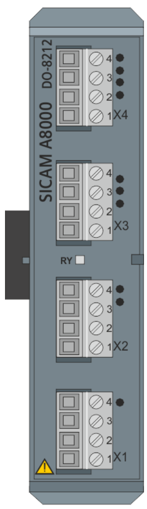
58 The respective manufacturer is imprinted at the terminal (see section *Types of screw terminals, Page 353*)

NOTE

The altitude at which DO-8212 is operated shall be considered applicable for all devices in the system.

5.8.5.4 Pin Assignment and Display

The process signals must be connected to four 4-pin screw terminals. The peripheral connectors are assigned according to the tables.



[DO-8212_Front, 1, --_--]

Figure 5-29 DO-8212 Front

Connector X1

Pin	Signal	Meaning
4	COM D01	Common supply output 1 of group 0
3	COM D00	Common supply output 0 of group 0
2	OUT D01	Digital output 1 of group 0
1	OUT D00	Digital output 0 of group 0

Connector X2

Pin	Signal	Meaning
4	COM D03	Common supply output 3 of group 1
3	COM D02	Common supply output 2 of group 1
2	OUT D03	Digital output 3 of group 1
1	OUT D02	Digital output 2 of group 1

Connector X3

Pin	Signal	Meaning
4	COM D05	Common supply output 5 of group 2
3	COM D04	Common supply output 4 of group 2
2	OUT D05	Digital output 5 of group 2
1	OUT D04	Digital output 4 of group 2

Connector X4

Pin	Signal	Meaning
4	COM D07	Common supply output 7 of group 3
3	COM D06	Common supply output 6 of group 3
2	OUT D07	Digital output 7 of group 3
1	OUT D06	Digital output 6 of group 3

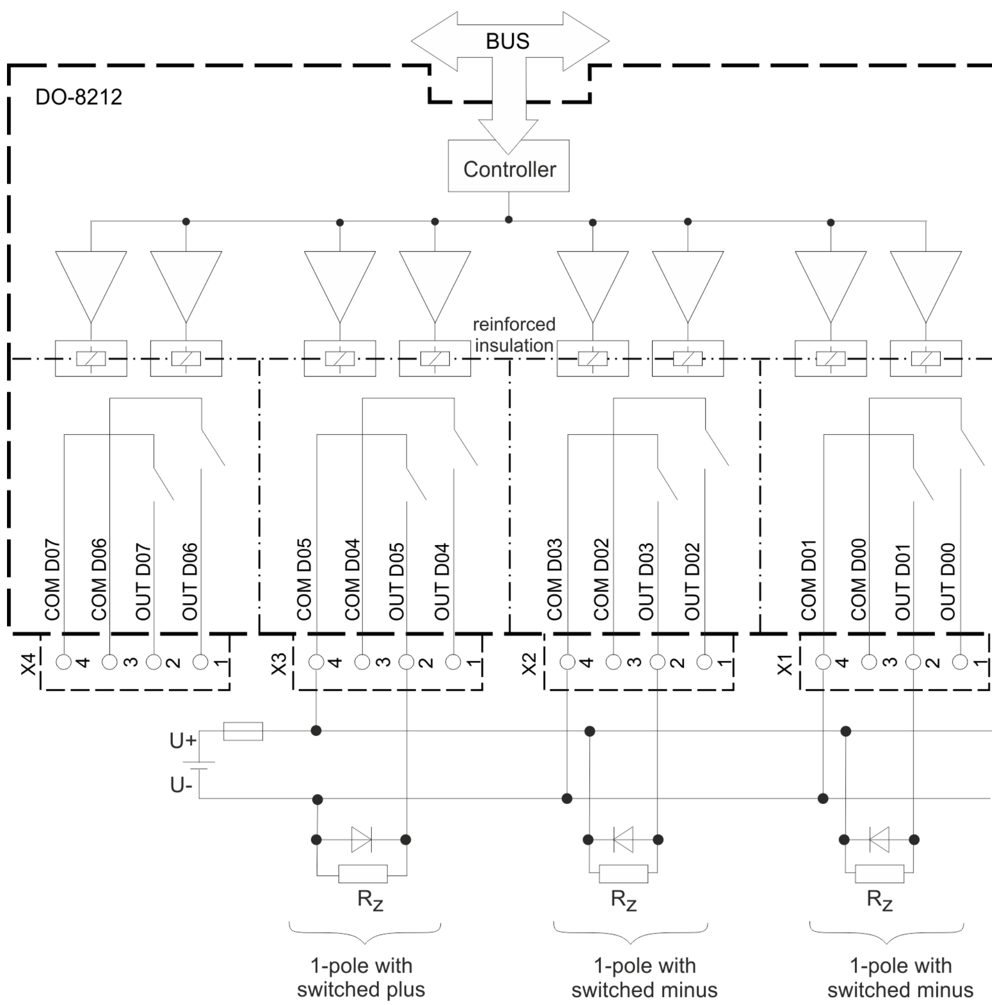
Display

LED	Meaning
RY	Readiness

5.8.5.5 Block Diagram and External Circuitry

The following circuit variants are exemplary and do not relate exclusively to the depicted inputs/outputs.

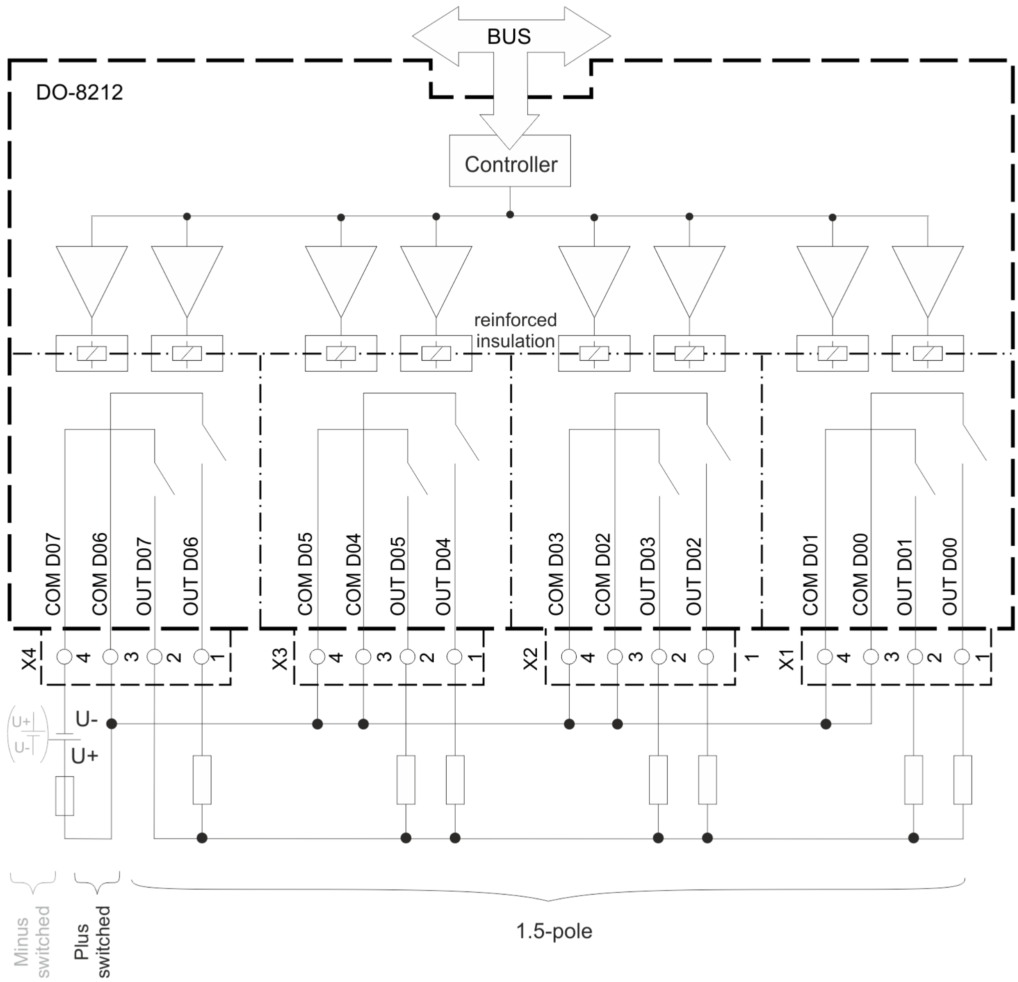
1-Pole Circuitry



[dw_DO-8212_block_diagram_and_external_circuitry_1pole, 1, en_US]

Figure 5-30 DO-8212 Block Diagram and External Circuitry 1-Pole

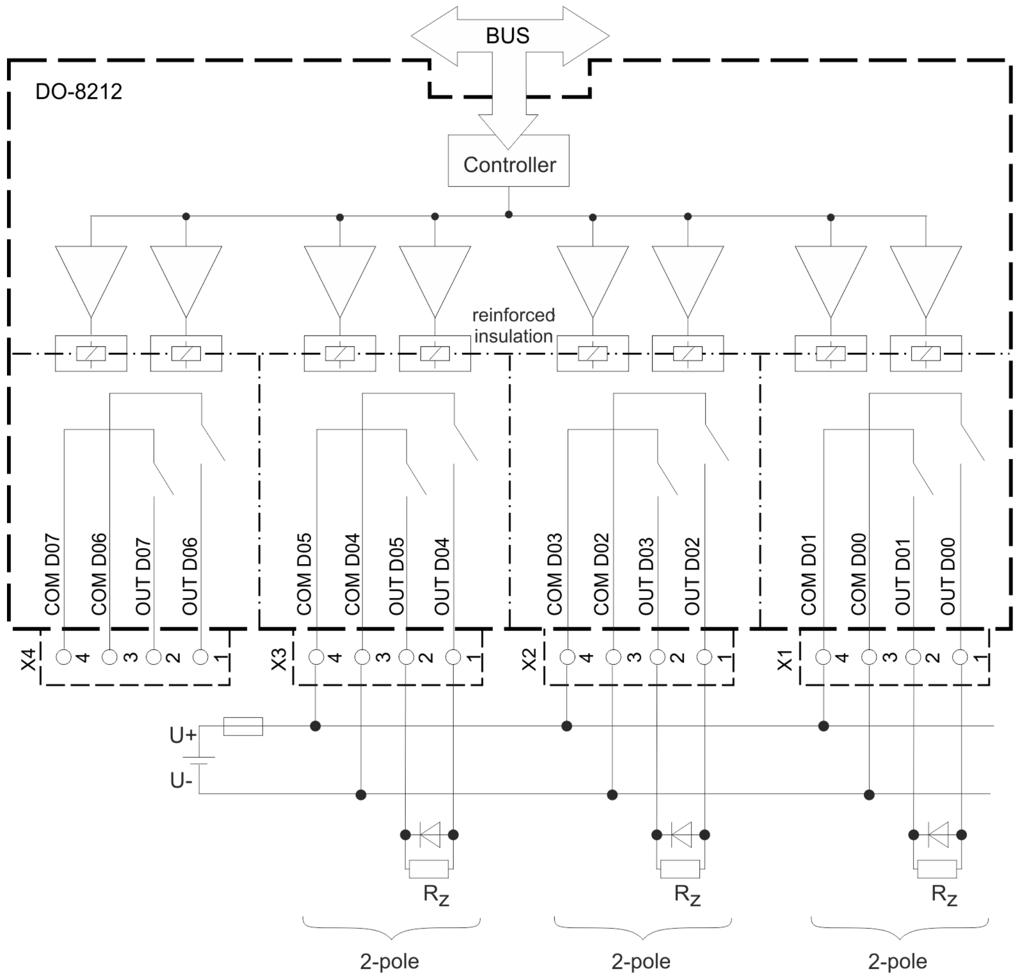
1.5-Pole Circuitry



[dw_DO-8212_block_diagram_and_external_circuitry_1-5_pole, 1, en_US]

Figure 5-31 DO-8212 Block Diagram and External Circuitry 1.5-Pole

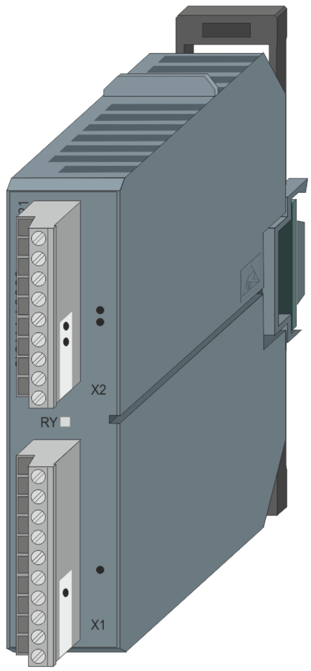
2-Pole Circuitry



[dw_DO-8212_block_diagram_and_external_circuitry_2pole, 2, en_US]

Figure 5-32 DO-8212 Block Diagram and External Circuitry 2-Pole

5.8.6 DO-8221



[dw_DO-8221_Oblique, 1, --_--]

Figure 5-33 DO-8221

5.8.6.1 Features

Digital output module for secured command output

- Installation on horizontal mounted 35 mm DIN rail only
- 12 relay-outputs (1 group)
- Galvanical insulation
- Switching voltage: DC up to 220 V and AC up to 230 V
- Removable screw terminals
- Function indication via LED

5.8.6.2 Functions

Pulse commands

- Secured output of pulse commands
  - 1-pole, 1½-pole, 2-pole
  - 1 and 2-pole double commands can be mixed
- Single, double and regulating step commands
- Command output with continuity check (CC1) [59]
  - Selective activation check
  - Idle check
  - Continuity check

59 Command output with current flow check is not supported for AC loads and must be disabled in the configuration.

- Basic application functions and procedures according to IEC 60870-5-101/104
  - Formal check
  - Direct command
  - Select and execute command
- Supports load usage categories for direct current and alternating current according to IEC 60947-4-1, table 10 (DC-1, 3, 5, 6 and AC-1, 2, 3/3e, 5b) [60]
- Retry suppression
- 1-out-of-n Check
- Control location check
- Command interlocking
- Synchronization
- Switching sequence
- Revision
- Command output time
  - Can be set by parameter
  - Dependent on the process
- Return information monitoring
- Command prolongation
- Periodical control circuit check
- Switching sequences
- Monitoring the Command Output Sequence
- Spontaneous transmission

NOTE

Siemens recommends return information monitoring by means of a DI/DO coupling.

Return Information to Pulse Command Assignment

Settable assignment for pulse commands that are acquired or output as follows:

- on the peripheral element itself
- on different peripheral elements of the same basic system element

NOTE

The previously mentioned functions are described in detail in the document *SICAM RTUs Common Functions Peripheral Elements according to IEC 60870-5-101/104* (DC0-011-2).

60 For AC load categories according to IEC 60947-4-1 table 10, the maximum switching current is (I_n) 2.5 A. For DC load categories according to IEC 60947-4-1 Table-10, DC-3 and DC-5, the maximum switching current is (I_n) 4 A.

5.8.6.3 Technical Data

Digital Outputs

NOTE

Operation with AC voltage is only permissible from production level DD onwards.

12 command outputs	1 Group (2 fused circuits)			
External circuit variants	12 x 1-pole, 12 x 1.5-pole or 6 x 2-pole command output			
Rated voltage:	BB version	CC version	DD version	EE version
	DC 24 V / 48 V / 60 V	DC 24 V / 48 V / 60 V / 110 V / 220 V	DC 24 V / 48 V / 60 V / 110 V / 220 V, AC 230 V	
Maximum switching current (I_{rated})	DC 4 A to 59 V (DC 2 A to 72 V)	DC 4 A	DC 4 A AC 3.25 A	DC 5 A AC 3.5 A
Maximum switching capacity, DC (L/R ≤ 40 ms), AC (cos φ ≤ 0.4)	DC 240 W	DC 1000 W	1000 W AC 800 VA	DC 1250 W AC 875 VA
Maximum continuous current	1 A			
Maximum supported inrush current	10 A for 200 ms			
Power augmentation			Command output cutoff	
	I_{max} (DC)/I_{peak} (AC)		$t_{active\ max}$	$t_{pause\ min}$
	1.5 A		60 s	t_{active}
	≤ 2.2A		60 s	3 x t_{active}
	≤ 2.6A		10 s	5 x t_{active}
	≤ 5A		10 s	20 x t_{active}
Overload proof	No If the current exceeds maximum I_{rated} > 200 ms, then overload is detected; the command is aborted and the command output block is activated			
Sustained short-circuit proof	Yes Short-circuit detection at 12 A with deactivation after 200 µs (above 72 V only with external limitation to I_{max} = 50 A); the current command is aborted			
Command output block	If an overload or short-circuit is detected, the commands following the overload of short circuit are discarded for 3 min			
Switching cycles (activate output)	• 10^7 (≤ 78 V) • 10^5 (> 78 V)			
Maximum switching frequency	30/min			
Output circuits	DC 18 V to 253 V; AC 195 V to 250 V (operated with external voltage)			
Test current	Max. 4.1 mA			
Output circuit voltage drop	• < 1.2 V at 1 A • < 6.5 V at 5 A			
line length	Max. 200 m			

Dimensioning of the load in the command circuit

NOTICE

- ✧ During the control circuit check, the internal and external command circuits are monitored by means of a test current. It must be ensured that this test current does not lead to an unintentional activation. Siemens recommends planning a sufficient reserve.
- ✧ It must be ensured that this test current can still flow over the load at the minimum working voltage.
- ✧ Control circuit check is not supported by AC motor loads.

- In order to enable the test current, the ohmic resistance of the load should be below the values for R_{max} given in the table.
  If necessary, a resistor must be connected in parallel.
- Since the test current must be reached within 50 ms, the series inductance must not exceed the value L_{max} given in the table.

V_n	$U_{min} = U_n - 25\ \%$	$R_{max} = (U_{min} - 12\ V) / 4\ mA$	L_{max}
DC 24 V	DC 18 V	1.5 kΩ	50 H
DC 48 V	DC 36 V	6 kΩ	200 H
DC 60 V	DC 45 V	8.2 kΩ	200 H
DC 110 V	DC 82.5 V	17.6 kΩ	200 H
DC 220 V	DC 165 V	38.2 kΩ	200 H

NOTICE

- ✧ An appropriate external surge suppressing component must be provided for inductive loads.
- ✧ In case of a DC Load, an external freewheeling diode must be connected across the load.
- ✧ In case of an AC Load, an external surge protector must be connected across the load.

- A possible inrush current (e.g. with a capacitive load) must drop below 12 A after 100 µs.
- Use only SF/UTP, SF/FTP or S/FTP cable (CAT 6A) for the EbIO-Bus to CI-853x. Siemens recommends the usage of 6XV1878-2A or 6XV1870-3QH or 6XV1870-3QN.
- Use only shielded RJ45 connectors. Consider a reliable and durable contacting of the cable shield with the RJ45 shield.
- Communication cables must be installed separately from the supply and peripheral cables.

Power Supply

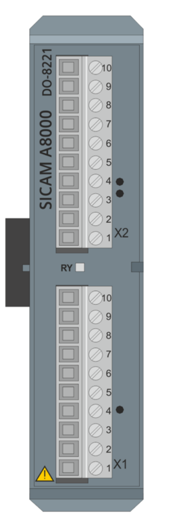
Operating voltage	DC 4.75 to DC 5.5 V The voltage is picked off from the system bus
Power consumption	• 2 W (during command output) • 1,3 W at rest

Mechanics and Connectors

Terminals	2 removable screw terminals (grid size 5.08 mm), 10-pole	
Rated impulse voltage	4 kV (category III / AC 230 V) [61]	
Connection data X1, X2	Locking torque (PHOENIX terminal) [62] Locking torque (FCI terminal) [62]	0.5 Nm to 0.6 Nm 0.36 Nm to 0.44 Nm
	AWG	Min. 22 Max. 12
	Conductor cross section solid	Min. 0.33 mm² Max. 2.5 mm²
	Conductor cross section stranded	Min. 0.33 mm² Max. 2.5 mm²
	Conductor cross section stranded with ferrule without plastic sleeve	Min. 0.33 mm² Max. 2.5 mm²
	Conductor cross section stranded with ferrule with plastic sleeve	Min. 0.33 mm² Max. 2.5 mm²
	2 wires stranded with ferrule without plastic sleeve	Min. 0.33 mm² Max. 1 mm²
	2 wires stranded with ferrule with plastic sleeve	Min. 0.5 mm² Max. 1.31 mm²
	Wire strip length	Min. 6 mm Max. 7 mm
	Length ferrule	10 mm
Dimensions (W x H x D)	30 mm x 132 mm x 124 mm (without DIN rail and terminal, locking hook closed); D 142 mm (with inserted terminal)	
Weight	343 g (incl. bus module 12 g)	

5.8.6.4 Pin Assignment and Display

The process signals must be connected to two 10-pin screw terminals. The peripheral connectors are assigned according to the tables.



[dw_DO-8221_Front, 1, --_--]

Figure 5-34 DO-8221 Front

61 Production level CC supports < 2000 m

62 The respective manufacturer is imprinted at the terminal (see section *Types of screw terminals, Page 353*)

Connector X1

Pin	Signal	Meaning
10	CB04	Command output 4 of common supply B
9	CA04	Command output 4 of common supply A
8	CB03	Command output 3 of common supply B
7	CA03	Command output 3 of common supply A
6	CB02	Command output 2 of common supply B
5	CA02	Command output 2 of common supply A
4	CB01	Command output 1 of common supply B
3	CA01	Command output 1 of common supply A
2	CB00	Command output 0 of common supply B
1	CA00	Command output 0 of common supply A

Connector X2

Pin	Signal	Meaning
10	OAY2	Battery voltage input Y (–/+)
9	OAY1	Battery voltage input Y (+/–)
8	OAX2	Battery voltage input X (–/+)
7	OAX1	Battery voltage input X (+/–)
6	COM2	Common supply 2
5	COM1	Common supply 1
4	COMB	Common supply B
3	COMA	Common supply A
2	CB05	Command output 5 of common supply B
1	CA05	Command output 5 of common supply A

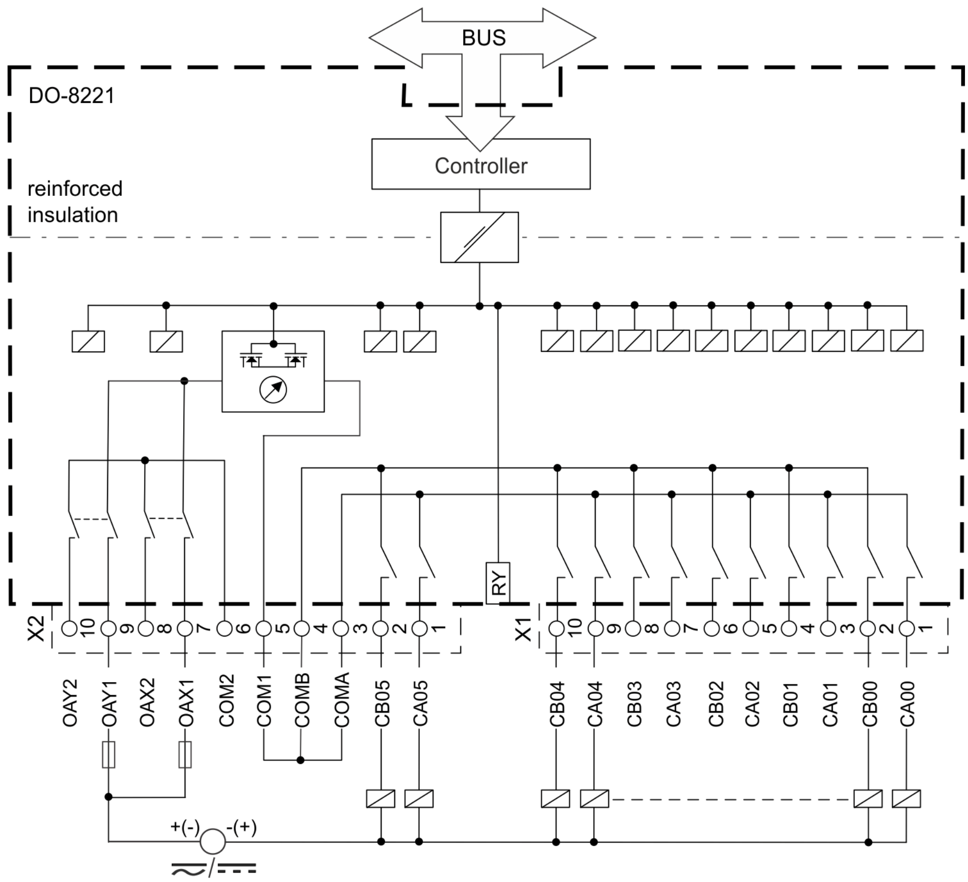
Display

LED	Meaning
RY	Readiness

5.8.6.5 Block Diagram and External Circuitry

The following circuit variants are examples, and do not relate exclusively to the depicted inputs/outputs.

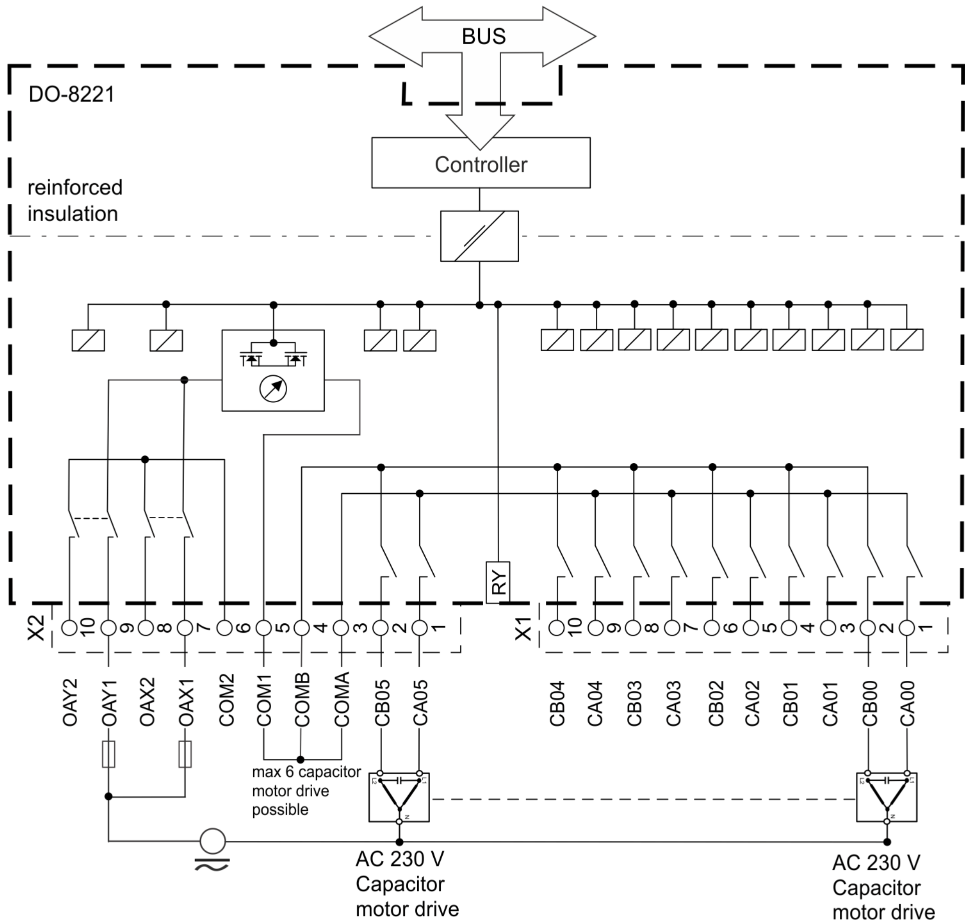
1-Pole Circuitry AC/DC



[dw_01_1-pole_circuit_ac-dc, 1, en_US]

Figure 5-35 DO-8221 Block Diagram and 1-Pole AC/DC External Circuit Variant

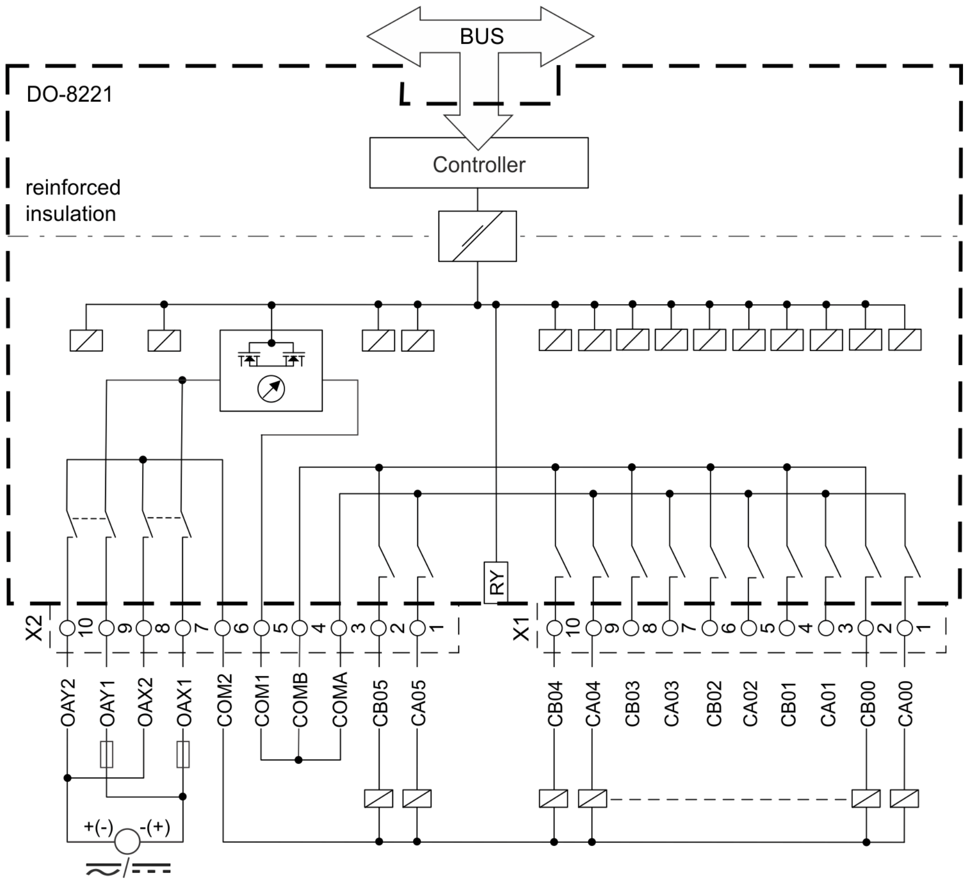
1-Pole Circuitry AC Motor Drive



[dw_01_1-pole_circuit_ac-dc_motor, 1, en_US]

Figure 5-36 DO-8221 Block Diagram and 1-Pole AC Motor Drive External Circuit Variant

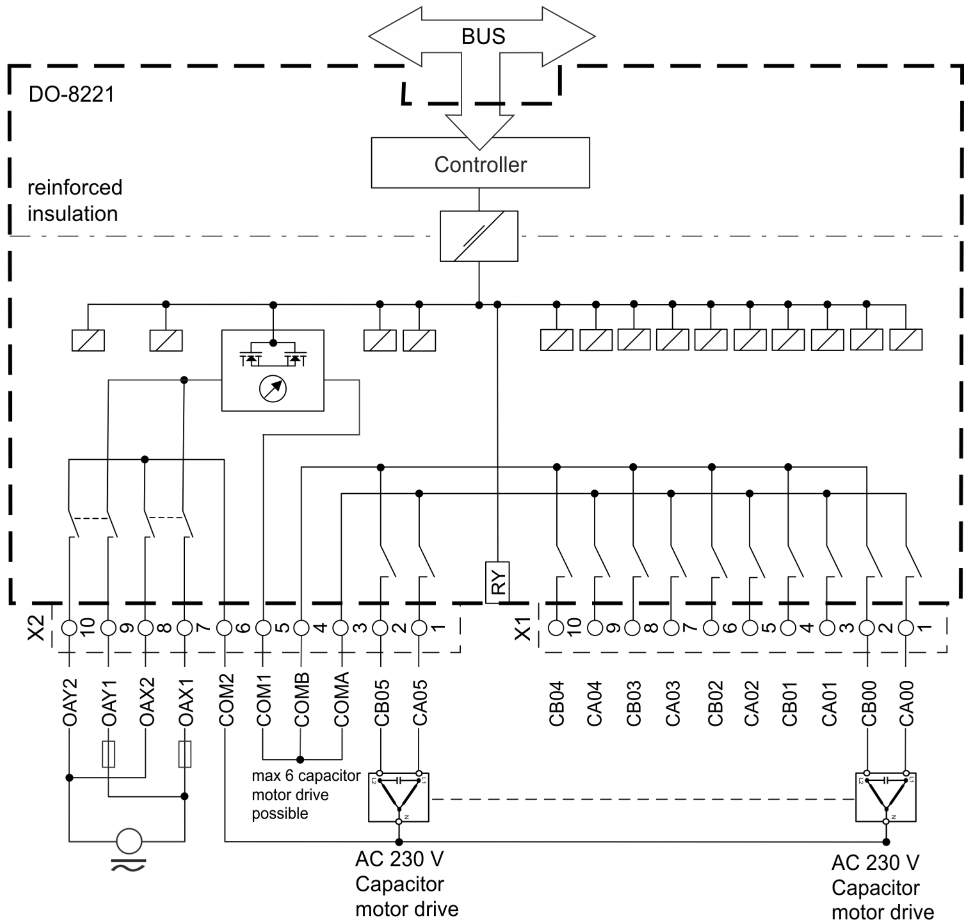
1.5-pole Circuitry AC/DC



[dw_02_1.5-pole_circuit_ac-dc, 1, en_US]

Figure 5-37 DO-8221 Block Diagram and 1.5-Pole AC/DC External Circuit Variant

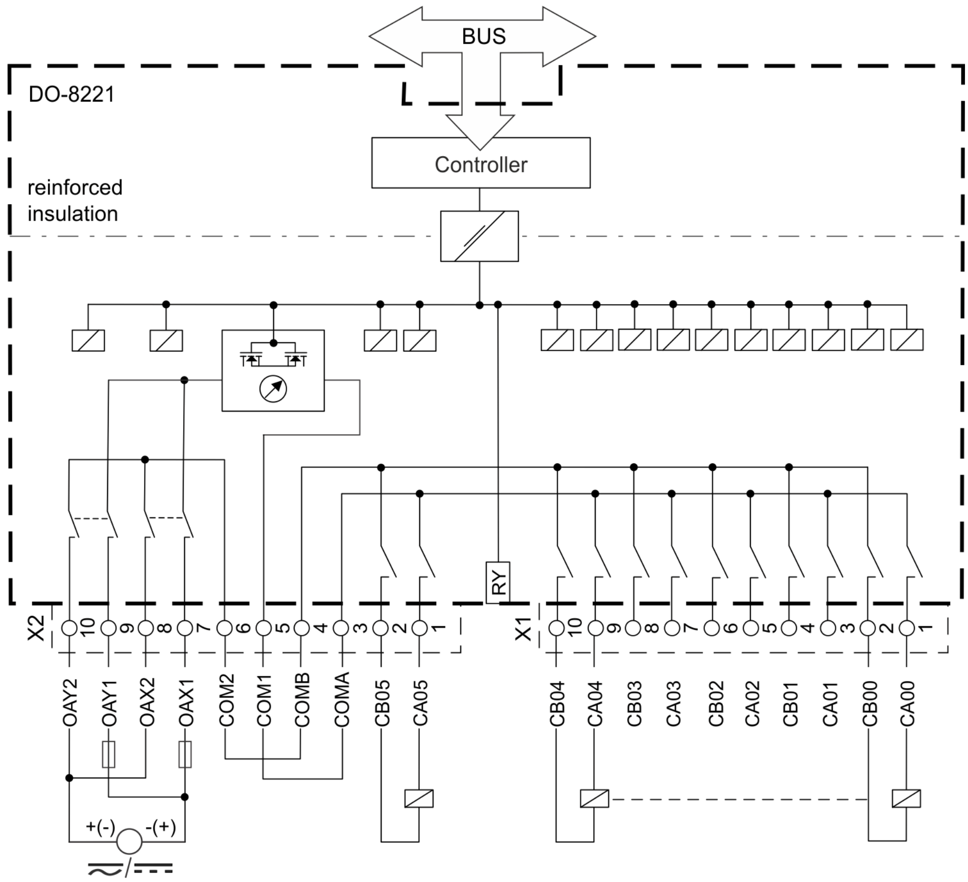
1.5-Pole Circuitry AC Motor Drive



[dw_02_1.5-pole_circuit_ac-dc_motor, 1, en_US]

Figure 5-38 DO-8221 Block Diagram and 1.5-Pole AC Motor Drive External Circuit Variant

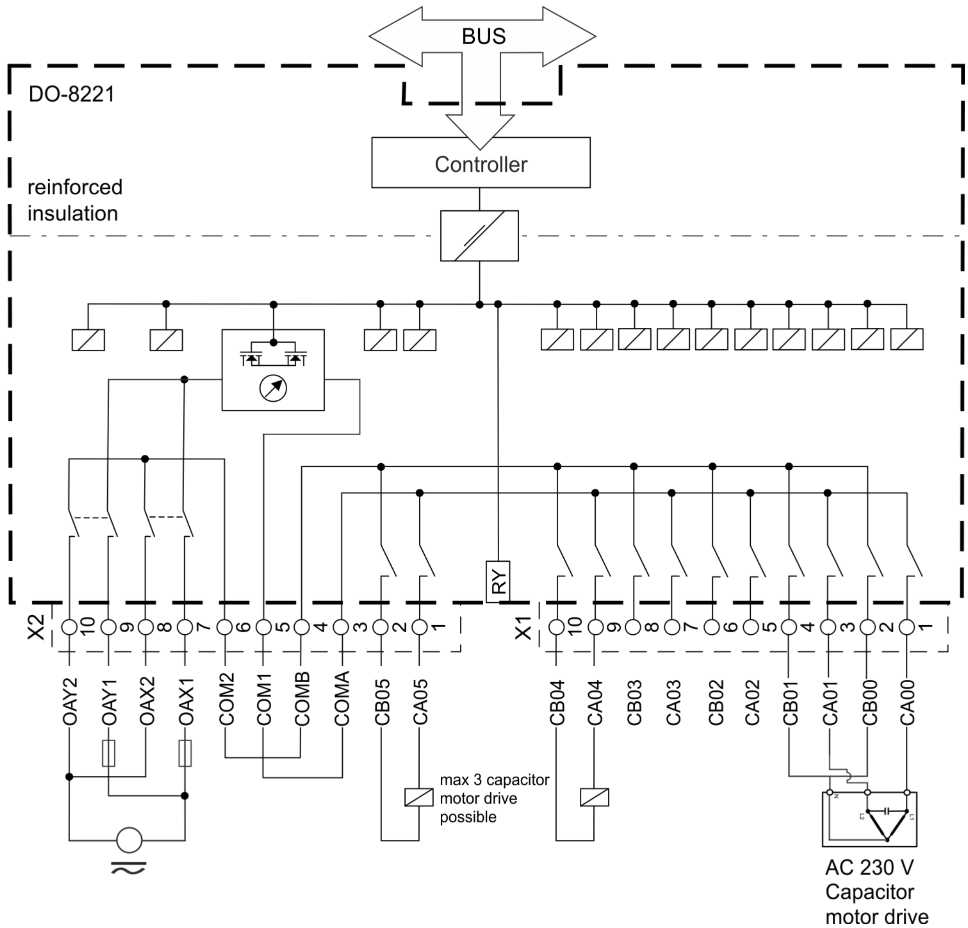
2-pole Circuitry AC/DC



[dw_03_2-pole_circuit_ac-dc, 1, en_US]

Figure 5-39 DO-8221 Block Diagram and 2-Pole AC/DC External Circuit Variant

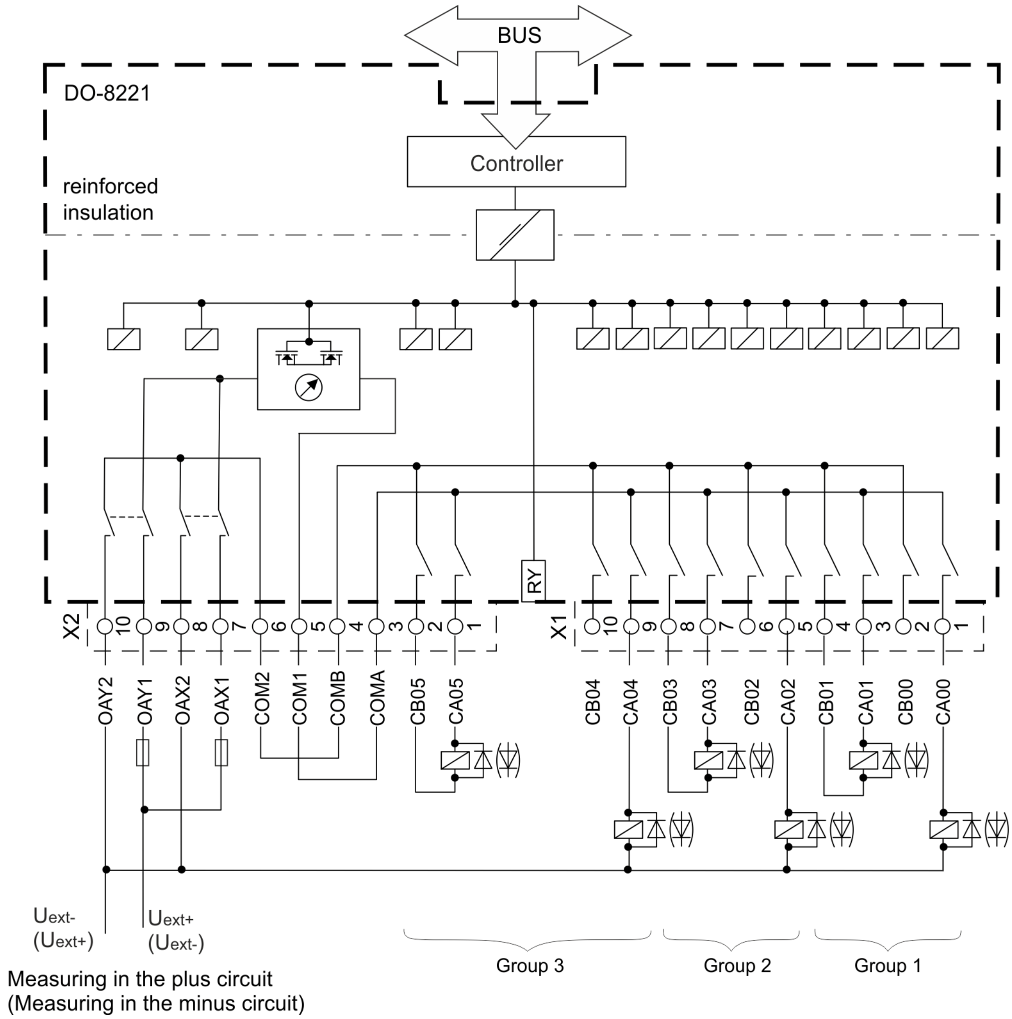
2-Pole Circuitry AC Motor Drive



[dw_03_2-pole_circuit_ac-dc_motor, 1, en_US]

Figure 5-40 DO-8221 Block Diagram and 2-Pole AC Motor Drive External Circuit Variant

1-pole Hybrid ON-Commands



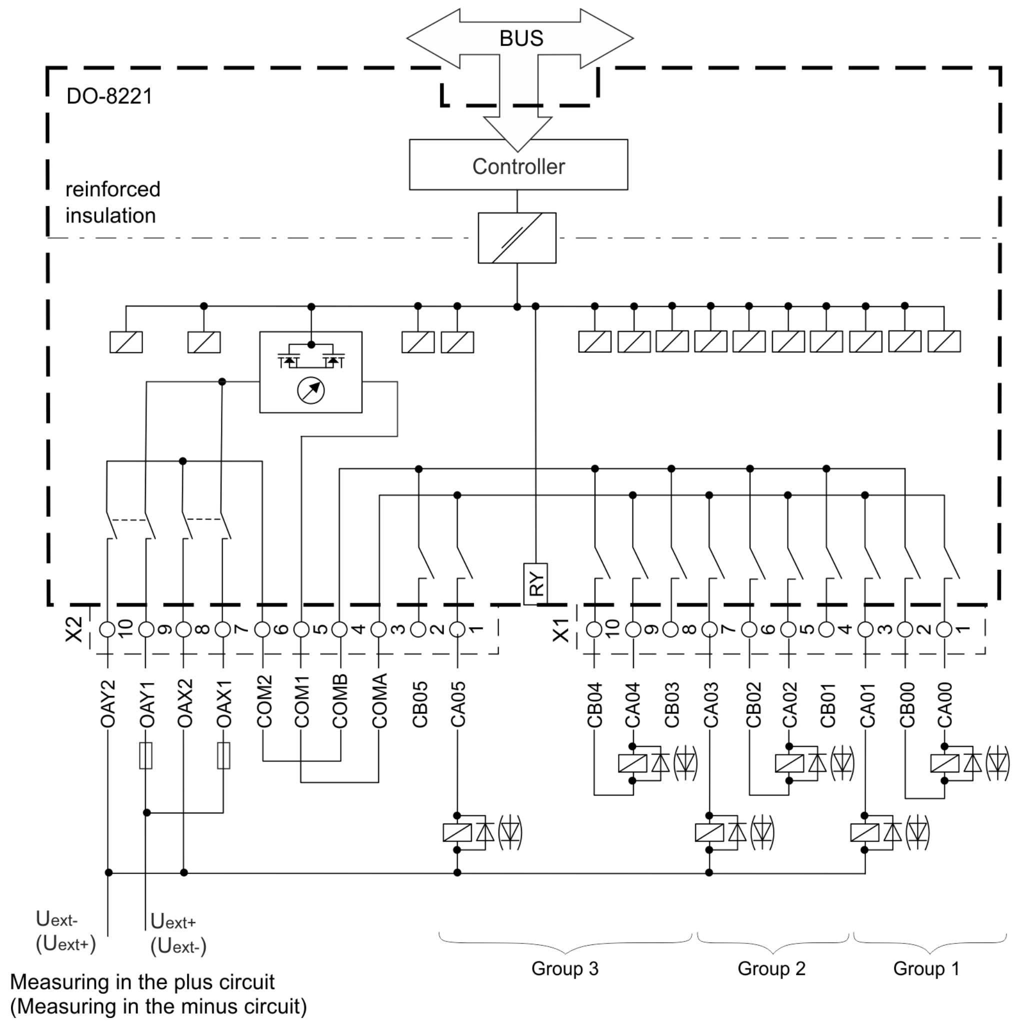
[dw_DO-8221_block_diagram_1_pole_Hybrid_ON_cmd, 1, en_US]

Figure 5-41 DO-8221 Block Diagram and 1-Pole Hybrid ON-Commands External Circuit Variant

NOTE

- All 1-pole commands must be output by the same common potential COMA. COMB must remain free.
- Any 1-pole command output can also remain free.
- Any group of the command outputs can also remain free.

1-pole Hybrid OFF-Commands



[dw_DO-8221_block_diagram_1_pole_Hybrid_OFF_cmd, 1, en_US]

Figure 5-42 DO-8221 Block Diagram and 1-Pole Hybrid OFF-Commands External Circuit Variant

NOTE

- All 1-pole commands must be output by the same common potential COMA. COMB must remain free.
- Any 1-pole command output can also remain free.
- Any group of the command outputs can also remain free.

WARNING

Danger due to improper operation of the device

Failure to observe the safety instructions means that death, severe injuries or considerable damage to property can occur.

✧ The 2 fuse circuits must be be supplied by one voltage source only. The use of different voltage sources is not permitted.

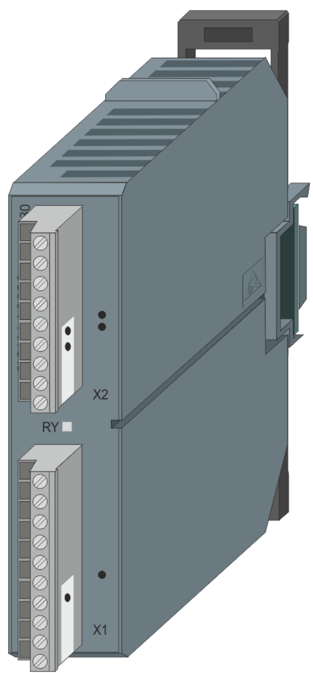
WARNING

Danger due to improper operation of the device

Failure to observe the safety instructions means that death, severe injuries or considerable damage to property can occur.

- ✧ The connectors X1 and X2 may be detached or attached in de-energized state only!
- ✧ Connector X1 must always be plugged in during operation even if no external loads are connected.

5.8.7 DO-8230



[dw_DO-8230_Oblique, 1, --_--]

Figure 5-43 DO-8230

5.8.7.1 Features

Digital output module

- Assembly on 35 mm DIN rail
- 16 transistor outputs (2 groups, each with 8 outputs)
- Galvanic insulation
- Nominal voltage DC 24 V to 60 V
- Removable screw terminals
- Function indication via LED

5.8.7.2 Functions

Pulse commands [f1]

- Secured output of pulse commands
  - 1-pole
- Single, double and regulating step commands
- Command output
- Basic application functions and procedures according to IEC 60870-5-101/104
  - Formal check
  - Direct command
  - Select and execute command
- Retry suppression
- 1-out-of-n check
- Control location check
- Command interlocking
- Synchronization
- Revision
- Command output time
  - Can be set by parameter
  - Dependent on the process
- Return information monitoring
- Command prolongation
- Switching sequences
- Command output for the auto-reclose function
- If module outputs are used for pulse commands, no outputs of the same module can be used for the output of binary informations

Binary information items

- Selectable behavior upon communication failure [fa] (deactivation or retention)
- Deactivation upon module failure [fa]
- Spontaneous transmission [f] or
- Periodical transmission [a]
- If outputs of the module are used for binary information output, no outputs of the same module can be used for pulse commands
- Use as watchdog realizable by means of application program (categories *DO_SX* and *DO_DX* must be used)
- Adjustable assignment of binary information items and pulse commands that are acquired or output on the I/O master module
- Predefined assignment for binary information items and pulse commands that are acquired or output on the I/O master module

NOTE

The previously mentioned functions are described in detail in the document *SICAM RTUs Common Functions Peripheral Elements according to IEC 60870-5-101/104* (DC0-011-2).

5.8.7.3 Technical Data

Digital Outputs

<table>
<tr><td>16 digital outputs</td><td colspan="4">• 2 groups, each with 8 outputs
• Each output has a 1-pole normally-open contact
• Each group is galvanically insulated from the other groups, logic circuits and earth by reinforced insulation
• Display of function and status of the outputs via engineering tool or LED module</td></tr>
<tr><td>Nominal voltages</td><td colspan="4">DC 24 V / 48 V / 60 V</td></tr>
<tr><td>Maximum continuous current</td><td colspan="4">Standard circuity
• 16 outputs, each max. 0.5 A</td></tr>
<tr><td rowspan="5">Power augmentation</td><td>Number of 1-A-outputs</td><td>Number of 0.5-A-outputs</td><td>Number of 0.25-A-outputs</td><td>Number of 0.1-A-outputs</td></tr>
<tr><td>1</td><td>15</td><td>0</td><td>0</td></tr>
<tr><td>2</td><td>12</td><td>2</td><td>0</td></tr>
<tr><td>3</td><td>8</td><td>3</td><td>2</td></tr>
<tr><td>4</td><td>4</td><td>2</td><td>6</td></tr>
<tr><td>Switching capacity (resistive load, U_N)</td><td colspan="4">• 78 W at DC 78 V (with power augmentation)
• 30 W at DC 60 V
• 24 W at DC 48 V
• 12 W at DC 24 V</td></tr>
<tr><td>Overload proof</td><td colspan="4">No</td></tr>
<tr><td rowspan="2">Proof against continued short circuit [63]</td><td colspan="4">Current limitation of 10 A (when current limitation is active, the current is switched off within 10 µs)</td></tr>
<tr><td colspan="4">Cyclic reclosing:
• Break time > 240 µs
• Make time < 10 µs</td></tr>
<tr><td>Switching cycles</td><td colspan="4">Unlimited</td></tr>
<tr><td>Output circuitry voltage drop</td><td colspan="4">< 0.25 V at 0.5 A
< 0.5 V at 1 A</td></tr>
<tr><td>Dynamic withstand capability</td><td colspan="4">• Capacitive load max. 100 nF at 60 V
• Inductive τ ≤ 500 ms (with external free wheeling diode)[64]
• Line Z ≥ 100 Ω, line length up to 3 km
• Lamp ≤ 500 mA [65]</td></tr>
<tr><td>Creepage</td><td colspan="4">< 200 µA at 70 °C[66]</td></tr>
<tr><td>Output circuits</td><td colspan="4">DC 18 V to 78 V (operated with external voltage)</td></tr>
</table>

63 This function is always supported on 1 channel only.
64 When DO-8230 is connected to an external mechanical relay, a free wheeling diode must be used across the relay coil.
65 A delay can occur during switch-on at higher lamp loads.
66 If DO-8230 is connected to an external mechanical relay, then use a 100 K Ω, ½ W resistor in series with the LED (if any) inside the external mechanical relay to avoid LED blinking due to leakage current.

NOTE

Parallel connections are not allowed in the case of switching load.

Power Supply

Operating voltage	DC 4.75 to 5.5 V The voltage is picked off from the system bus
Power consumption	500 mW

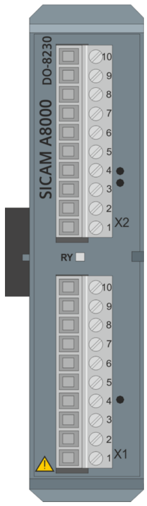
Mechanics and Connectors

Terminals	2 removable screw terminals (grid size 5.08 mm), 10-pole	
Rated impulse voltage	4 kV, category III / AC 230 V	
Protection type according to IEC 60529	IP 20	
Protection type according to IEC 61140	II	
Connection data X1, X2	Locking torque (PHOENIX terminal) [67] Locking torque (FCI terminal) [67]	0.5 Nm to 0.6 Nm 0.36 Nm to 0.44 Nm
	AWG	Min. 22 Max. 12
	Conductor cross section solid	Min. 0.33 mm² Max. 2.5 mm²
	Conductor cross section stranded	Min. 0.33 mm² Max. 2.5 mm²
	Conductor cross section stranded with ferrule without plastic sleeve	Min. 0.33 mm² Max. 2.5 mm²
	Conductor cross section stranded with ferrule with plastic sleeve	Min. 0.33 mm² Max. 2.5 mm²
	2 wires stranded with ferrule without plastic sleeve	Min. 0.33 mm² Max. 1 mm²
	2 wires stranded with ferrule with plastic sleeve	Min. 0.5 mm² Max. 1.31 mm²
	Wire strip length	Min. 6 mm Max. 7 mm
	Length ferrule	10 mm
Dimensions (W x H x D)	30 mm x 132 mm x 124 mm (without DIN rail and terminal, locking hook closed); D 142 mm (with inserted terminal)	
Weight	295 g (incl. bus module 12 g)	

67 The respective manufacturer is imprinted at the terminal (see section *Types of screw terminals, Page 353*)

5.8.7.4 Pin Assignment and Display

The process signals must be connected to two 10-pin screw terminals. The peripheral connectors are assigned according to the tables.



[dw_DO-8230_Front, 1, --_--]

Figure 5-44 DO-8230 Front

Connector X1

Pin	Signal	Meaning
10	COM 00+	Common supply of group 0
9	COM 00+	Common supply of group 0
8	OUT D07	Digital output 7 of group 0
7	OUT D06	Digital output 6 of group 0
6	OUT D05	Digital output 5 of group 0
5	OUT D04	Digital output 4 of group 0
4	OUT D03	Digital output 3 of group 0
3	OUT D02	Digital output 2 of group 0
2	OUT D01	Digital output 1 of group 0
1	OUT D00	Digital output 0 of group 0

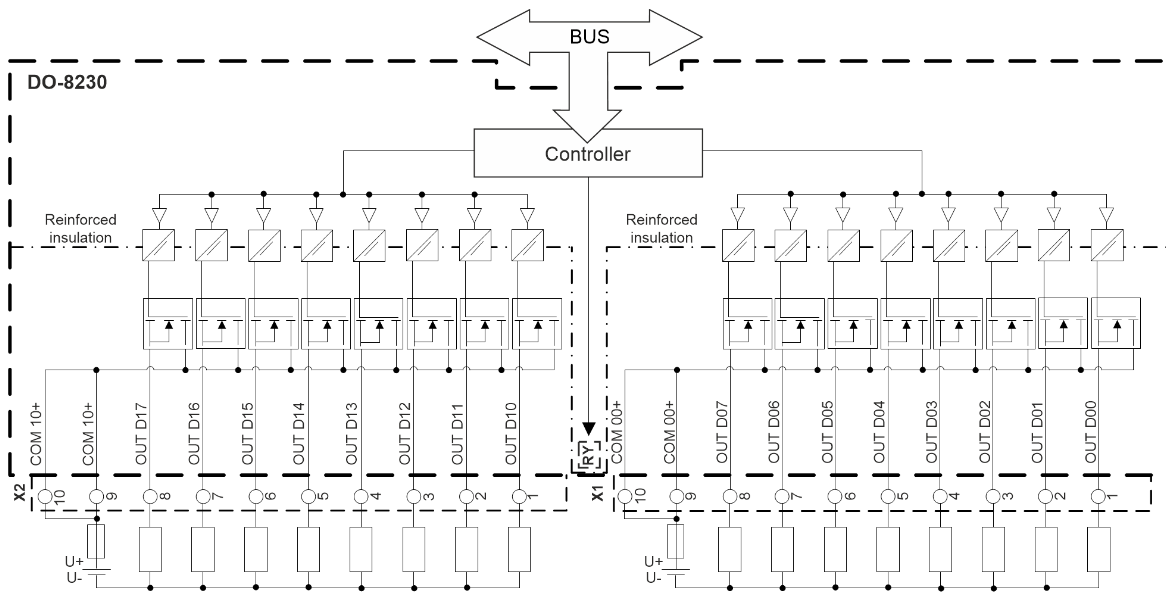
Connector X2

Pin	Signal	Meaning
10	COM 10+	Common supply of group 1
9	COM 10+	Common supply of group 1
8	OUT D17	Digital output 17 of group 1
7	OUT D16	Digital output 16 of group 1
6	OUT D15	Digital output 15 of group 1
5	OUT D14	Digital output 14 of group 1
4	OUT D13	Digital output 13 of group 1
3	OUT D12	Digital output 12 of group 1
2	OUT D11	Digital output 11 of group 1
1	OUT D10	Digital output 10 of group 1

Display

LED	Meaning
RY	Readiness

5.8.7.5 Block Diagram

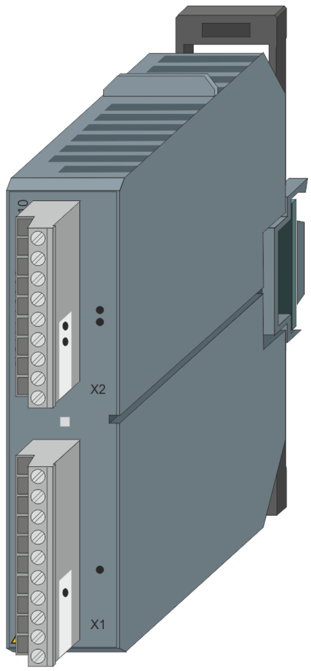


[DO-8230_Block-Diagram_Schematic, 1, --_--]

NOTE

- The connectors X1 and X2 are to be connected or disconnected in de-energized state only.
- The inputs of connector X1 and X2 must not be connected directly with a mains supply circuit.
- The insulation between the groups is provided as reinforced insulation.
- The connections from supply source to the connectors X1 and X2 must not be connected in reverse polarity.

5.8.8 AI-8310



[AI-8310_oblique_view_40x87, 1, --_--]

Figure 5-45 AI-8310

5.8.8.1 Features

Analog input module

- Installation on 35 mm DIN rail
- 4 inputs (2 groups, 2 inputs each)
- Galvanically insulated by optocouplers
- Acquisition of temperatures via Pt100/Pt1000/Ni100 resistance measurement in 2-wire, 3-wire and 4-wire technology.
- Noise rejection
- Removable screw terminals
- Function indication via LED

5.8.8.2 Functions

Temperatures

- Connection of the resistance thermometers: 2-, 3- or 4-wire technique
- Update every 400 ms

- Settable measuring ranges
  - Temperature values
    Input range
    Pt100: -50 to +350 °C / -58 to +662 °F / (≈80.31 to 229.67 Ω)
    Pt100: -100 to +700 °C / -148 to +1292 °F / (≈60.25 to 345.13 Ω)
    Ni100: -60 to +250 °C / -76 to +482 °F / (≈69.5 to 289.2 Ω)
    Pt1000: -100 to +700 °C / -148 to +1292 °F / (≈602.5 to 3451.3 Ω)
    Resolution
    Pt100: -50 to +350 °C 0.15 °C / 0.28 °F / (10 mΩ)
    Pt100: -100 to +700 °C 0.15 °C / 0.28 °F / (10 mΩ)
    Ni100: -60 to +250 °C 0.15 °C / 0.28 °F / (10 mΩ)
    Pt1000: -100 to +700 °C 0.15 °C / 0.28 °F / (100 mΩ)
    Response Time
    16⅔ Hz < 1.2 s
    50 Hz < 1.0 s
    60 Hz < 0.9 s
  - Resistance values
    Input range
    40 to 400 Ω, resolution: 10 mΩ
    400 to 4000 Ω, resolution: 100 mΩ
    Response time
    16⅔ Hz < 1.2 s
    50 Hz < 1.0 s
    60 Hz < 0.9 s
- Revision
- Noise rejection
- Calibration for 2-wire technique
- Smoothing
- Adaptation
  - Temperature value (°C, °F), conversion using implemented curves
  - Resistance (Ω)
- Change monitoring
- Spontaneous transmission of changes

NOTE

The above mentioned functions are described in detail in the document ***SICAM RTUs Common Functions Peripheral Elements according to IEC 60870-5-101/104***.

5.8.8.3 Technical Data

Analog Inputs

4 analog inputs	• 2 groups 2 inputs each • Galvanically insulated • Voltage between 2 inputs of a group max. DC 600 mV
Measuring ranges	• 40 to 400 Ω (Pt100, Ni100) • 400 to 4000 Ω (Pt1000)
Resolution	10 mΩ (Pt100, Ni100) 100 mΩ (Pt1000)
Noise rejection	16⅔ Hz, 50 Hz, 60 Hz
Conversion time	Noise rejection for 50 Hz, 200 ms Noise rejection for 60 Hz, 200 ms Noise rejection for 16⅔ Hz, 500 ms
Accuracy	0.19 % at 0 to +50 °C 0.4 % at -40 to +70 °C
Reference current	250 µA
Lead resistance	Sum of go-and-return line max. 300 Ω
Common mode rejection	16⅔ Hz, 50 Hz, 60 Hz to 20 kHz > 100 dB 10 Hz to 1 MHz > 70 dB
Normal mode rejection	16⅔ Hz > 106 dB 50 Hz > 98 dB 60 Hz > 91 dB
Input circuits	The circuits are operated with internal voltage (constant current source)

Power Supply

Operating voltage	DC 4.75 to DC 5.5 V The voltage is picked off from the system bus
Power consumption	Max. 500 mW

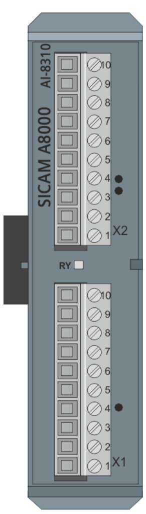
Mechanics and Connectors

Terminals	2 removable screw terminals (grid size 5.08 mm), 10-pole
Rated impulse voltage	2.0 kV

Connection data X1, X2	Locking torque (PHOENIX terminal) [68] Locking torque (FCI terminal) [68]	0.5 Nm to 0.6 Nm 0.36 Nm to 0.44 Nm
	AWG	Min. 22 Max. 12
	Conductor cross section solid	Min. 0.33 mm² Max. 2.5 mm²
	Conductor cross section stranded	Min. 0.33 mm² Max. 2.5 mm²
	Conductor cross section stranded with ferrule without plastic sleeve	Min. 0.33 mm² Max. 2.5 mm²
	Conductor cross section stranded with ferrule with plastic sleeve	Min. 0.33 mm² Max. 2.5 mm²
	2 wires stranded with ferrule without plastic sleeve	Min. 0.33 mm² Max. 1 mm²
	2 wires stranded with ferrule with plastic sleeve	Min. 0.5 mm² Max. 1.31 mm²
	Wire strip length	Min. 6 mm Max. 7 mm
	Length ferrule	10 mm
Dimensions (W x H x D)	30 mm x 132 mm x 124 mm (without DIN rail and terminal, locking hook closed); D 142 mm (with inserted terminal)	
Weight	241 g (incl. bus module 12 g)	

5.8.8.4 Pin Assignment and Display

The process signals must be connected to two 10-pin screw terminals. The peripheral connectors are assigned according to the tables.



[AI-8310_Front_ohne_Gefahrensymbol, 1, --_--]

Figure 5-46 AI-8310 Front

Connector X1

Pin	Signal	Meaning
10	IREF1-	Analog current output 1 of group 0
9	IN V1-	Analog voltage input 1 of group 0

68 The respective manufacturer is imprinted at the terminal (see section *Types of screw terminals, Page 353*)

Pin	Signal	Meaning
8	IN V1+	Analog voltage input 1 of group 0
7	IREF1+	Analog current output 1 of group 0
6	DNC	Do not connect
5	DNC	Do not connect
4	IREF0-	Analog current output 0 of group 0
3	IN V0-	Analog voltage input 0 of group 0
2	IN V0+	Analog voltage input 0 of group 0
1	IREF0+	Analog current output 0 of group 0

Connector X2

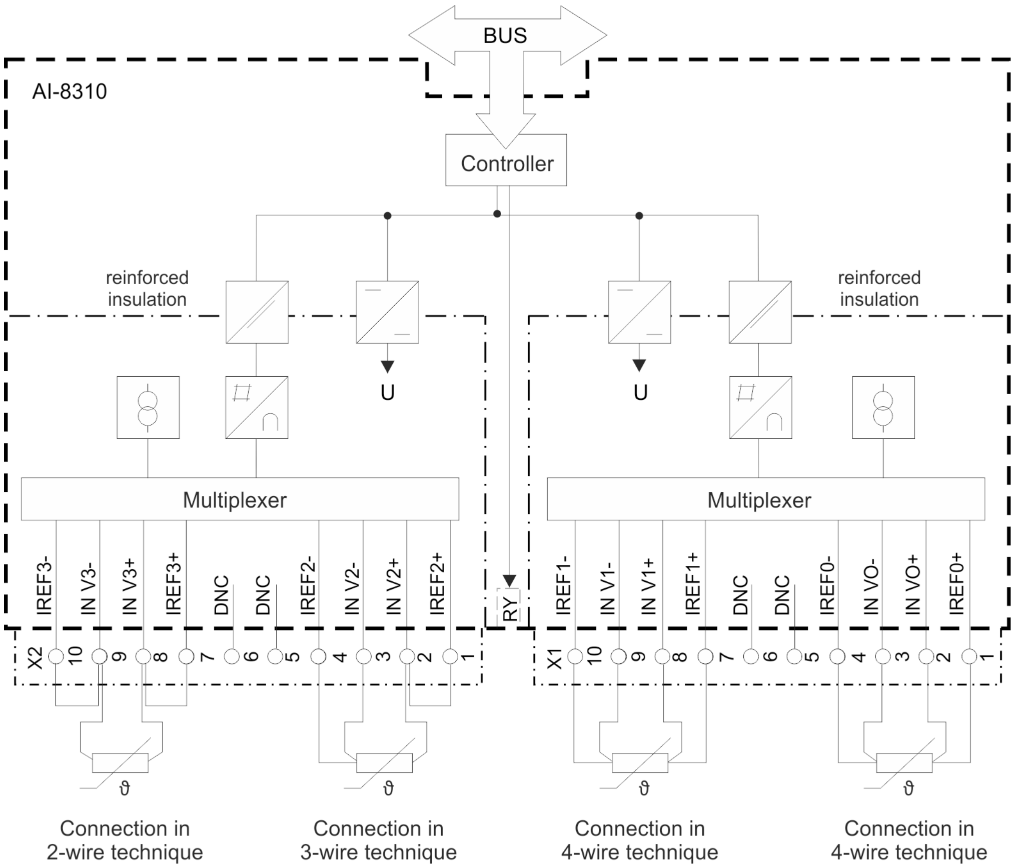
Pin	Signal	Meaning
10	IREF3-	Analog current output 3 of group 1
9	IN V3-	Analog voltage input 3 of group 1
8	IN V3+	Analog voltage input 3 of group 1
7	IREF3+	Analog current output 3 of group 1
6	DNC	Do not connect
5	DNC	Do not connect
4	IREF2-	Analog current output 2 of group 1
3	IN V2-	Analog voltage input 2 of group 1
2	IN V2+	Analog voltage input 2 of group 1
1	IREF2+	Analog current output 2 of group 1

Display

LED	Meaning
RY	Readiness

5.8.8.5 Block Diagram and External Circuitry

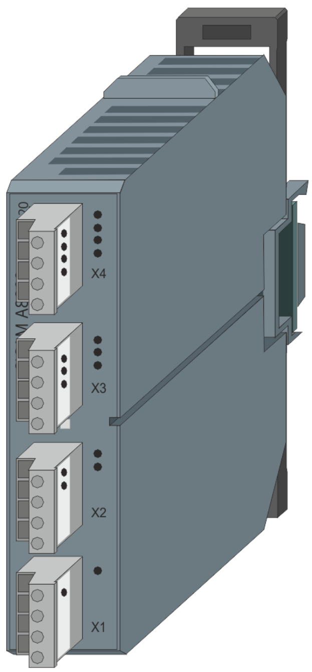
The following circuitry variants are examples, and do not relate exclusively to the depicted inputs/outputs.



[dw_AI-8310_Block_Diagram_External_Circuitry, 1, en_US]

Figure 5-47 AI-8310 Block Diagram and External Circuitry Variant

5.8.9 AI-8320



[AI-8320_Oblique_View, 1, --_--]

Figure 5-48 AI-8320

5.8.9.1 Features

Analog input module

- Installation on 35 mm DIN rail
- 4 inputs (4 groups, 1 input each)
- Galvanically insulated by transformer
- Acquisition of currents ±20 mA
- Acquisition of voltages ±10 V
- Removable screw terminals
- Function indication via LED

5.8.9.2 Functions

Currents and Voltages

- Settable acquisition grid n · 100 ms [f]
- Measurement range settable with a resloution of [f]
  - 16 bits (15 bits + sign) at full measurement range
  - Shrinking the range results in decreasing resolution
- Revision [f]
- Noise rejection [f]
- Automatic calibration [f]
- Smoothing [f]

- Adaptation [f]
  - Linear (normalized, technologically scaled or short floating-point)
  - Zero-range suppression
  - Plausibility check
- Change monitoring [f]
- Spontaneous transmission upon change [f]
- Currents and voltages can be mixed on the same module
  The category `AI_U_mix` – voltage value acquisition in conjunction with the category `AI_I` – current value acquisition allows to specify individually for each channel of the module whether voltage value acquisition or current value acquisition should be used.

NOTE

The above mentioned functions are described in detail in the document *SICAM RTUs Common Functions Peripheral Elements according to IEC 60870-5-101/104, chapter* ***Currents*** *and chapter* ***Voltages***.

5.8.9.3 Technical Data

Analog Inputs

4 analog inputs	• 4 groups,1 input each • Groups are galvanically insulated from one another
Measuring ranges	Current measurement –20 to 0 to +20 mA Voltage measurement –10 to 0 to +10 V Overrange current ~20 %, voltage ~30 %
Resolution	0.004 % at ±20 mA 0.004 % at ±10 V
Accuracy	0.15 % at 25 °C
Accuracy current inputs	0.2 % at 0 to 50 °C 0.3 % at –20 to 70 °C 0.4 % at –40 to 70 °C
Accuracy voltage inputs	0.4 % at 0 to 50 °C 0.5 % at –20 to 70 °C 0.6 % at –40 to 70 °C
Input impedance	52 Ω at ±20 mA 10.5 kΩ at ±10 V
Common mode rejection current inputs	Min. 90 dB (1 Hz to 1 MHz)
Common mode rejection voltage inputs	Min. 50 dB (1 Hz to 5 kHz) Min. 70 dB (5 kHz to 1 MHz)
Normal mode rejection	0 dB (10 Hz to 500 Hz) +30 dB/decade (500 Hz to 1 KHz) +50 dB/decade (1 kHz to 10 kHz) Min. 70 dB (10 kHz to 1 MHz)
Noise rejection	50 dB (50 Hz, 60 Hz, 16⅔ Hz)

Power Supply

Operating voltage	DC 4.75 to DC 5.5 V The voltage is picked off from the system bus
Power consumption	Max. 180 mW

Mechanics and Connectors

Terminals	4 removable screw terminals (grid size 5.08 mm), 4-pole	
Rated impulse voltage	2.0 kV	
Connection data X1, X2, X3, X4	Locking torque (PHOENIX terminal) [69] Locking torque (FCI terminal) [69]	0.5 Nm to 0.6 Nm 0.36 Nm to 0.44 Nm
	AWG	Min. 22 Max. 12
	Conductor cross section solid	Min. 0.33 mm² Max. 2.5 mm²
	Conductor cross section stranded	Min. 0.33 mm² Max. 2.5 mm²
	Conductor cross section stranded with ferrule without plastic sleeve	Min. 0.33 mm² Max. 2.5 mm²
	Conductor cross section stranded with ferrule with plastic sleeve	Min. 0.33 mm² Max. 2.5 mm²
	2 wires stranded with ferrule without plastic sleeve	Min. 0.33 mm² Max. 1 mm²
	2 wires stranded with ferrule with plastic sleeve	Min. 0.5 mm² Max. 1.31 mm²
	Wire strip length	Min. 6 mm Max. 7 mm
	Length ferrule	10 mm
Dimensions (W x H x D)	30 mm x 132 mm x 124 mm (without DIN rail and terminal, locking hook closed); D 142 mm (with inserted terminal)	
Weight	241 g (incl. bus module 12 g)	

69 The respective manufacturer is imprinted at the terminal (see section *Types of screw terminals, Page 353*)

5.8.9.4 Pin Assignment and Display

The process signals must be connected to four 4-pin screw terminals. The peripheral connectors are assigned according to the tables.

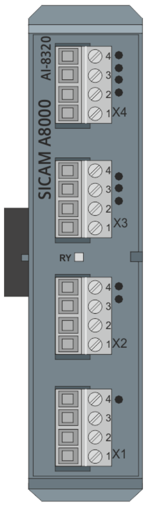


Figure 5-49 AI-8320 Front

Connector X1

Pin	Signal	Meaning
4	IN V0 U–	Analog voltage input of group 0 (–10 V)
3	IN V0 I–	Analog current input of group 0 (–20 mA)
2	IN V0 I+	Analog current input of group 0 (+20 mA)
1	IN V0 U+	Analog voltage input of group 0 (+10 V)

Connector X2

Pin	Signal	Meaning
4	IN V1 U–	Analog voltage input of group 1 (–10 V)
3	IN V1 I–	Analog current input of group 1 (–20 mA)
2	IN V1 I+	Analog current input of group 1 (+20 mA)
1	IN V1 U+	Analog voltage input of group 1 (+10 V)

Connector X3

Pin	Signal	Meaning
4	IN V2 U–	Analog voltage input of group 2 (–10 V)
3	IN V2 I–	Analog current input of group 2 (–20 mA)
2	IN V2 I+	Analog current input of group 2 (+20 mA)
1	IN V2 U+	Analog voltage input of group 2 (+10 V)

Connector X4

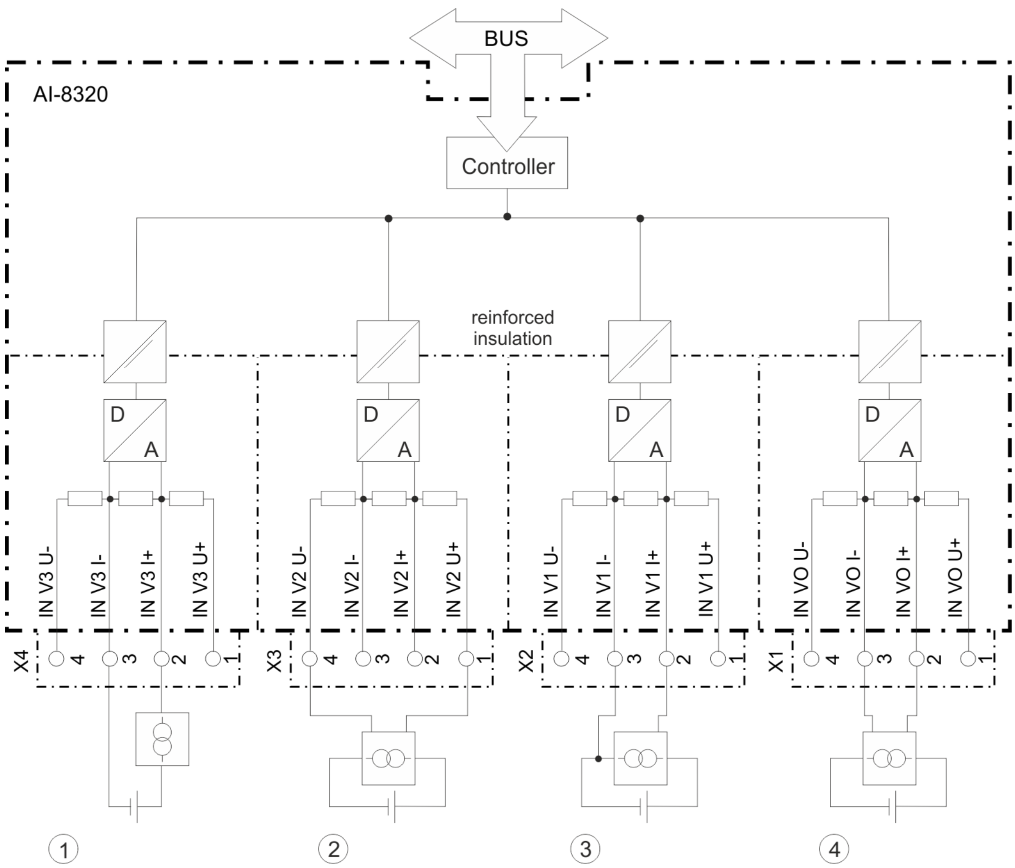
Pin	Signal	Meaning
4	IN V3 U–	Analog voltage input of group 3 (–10 V)
3	IN V3 I–	Analog current input of group 3 (–20 mA)
2	IN V3 I+	Analog current input of group 3 (+20 mA)
1	IN V3 U+	Analog voltage input of group 3 (+10 V)

Display

LED	Meaning
RY	Readiness

5.8.9.5 Block Diagram and External Circuitry

The following circuitry variants are examples, and do not relate exclusively to the depicted inputs/outputs.



[AI-8320_Block_Diagram_External_Circuitry, 1, en_US]

Figure 5-50 AI-8320 Block Diagram and External Circuitry Variants

(1) Connection of a 2-wire measuring transducer with current output

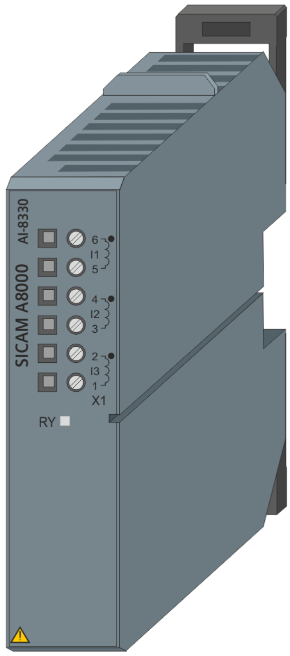
(2) Connection of a 4-wire measuring transducer with voltage output

(3) Connection of a 3-wire measuring transducer with current output

(4) Connection of a 4-wire measuring transducer with current output

5.8.10 AI-8330

The SICAM I/O module AI-8330 is the current measurement expansion module for the module AI-8340 for the measurement of voltages. It is used to expand SICAM A8000 systems with analog current measurement inputs. It can only be used in combination with the analog input module AI-8340.



[dw_AI-8330_Oblique, 1, --_--]

Figure 5-51 AI-8330

5.8.10.1 Features

- Installation on horizontal mounted 35 mm DIN rail
- 3 current measurement inputs
  The current inputs are galvanically insulated by transformers, from each other and from logic circuits
- Acquisition and processing according to IEC 60870-5-101/104
- Function indication via LED

5.8.10.2 Functions (only in combination with AI-8340)

Current inputs

- Acquisition of currents up to the 25th harmonic, with signal scanning 256 times per period
- Calculation of r.m.s. values over 25 harmonics by means of discret fourier transformation
- Acquisition of frequency and provision as:
  - Frequency instantaneous value
  - Frequency mean value
- Measuring range of the secondary quantities
  - Nominal current 6 A with 100% overrange and a resolution of 15 bits
  - Nominal frequency 16,7 Hz, 50 Hz oder 60 Hz ±15%
- Technological adaptation of currents
- Calculation of the zero phase system
- Calculation of active and reactive power value(s) according to the 1 , 2 or 3 wattmeter method

- Transfer of the acquired and calculated values using spontaneous information objects according to IEC 60870-5-101/104, in a selectable format
  - Measured value, short floating point number
  - Measured value, normalized value
  - Measured value, scaled value
- Smoothing, zero-range suppression and change monitoring can be set individually for each value
- Transfer of values to the higher-level open-/closed-loop control function, using periodical information objects
- Messages of voltage transformer MCB's are considered

NOTE

The previously mentioned functions are described in detail in the document ***SICAM RTUs Common Functions Peripheral Elements according to IEC 60870-5-101/104***, *chapter* ***Three-Phase Measurement on AI-8330/40*** .

5.8.10.3 Technical Data

Inputs for Transformer Currents

3 current inputs (X1)	The current inputs are galvanically insulated by transformers, from each other and from logic circuits
Nominal current I_N	0.2 A to 6 A (settable) typ. 1 A / 2 A / 5 A / 6 A
Max. measurement current	200 % I_N
Rated voltage	300 V
Nominal frequency	50 Hz, 60 Hz, 16⅔ Hz (settable)
Resolution	16 bits
Scanning	256 values per system period
Thermal withstand capability	25 A (continuously) 120 A (1 s)
Intrinsic consumption	< 0.1 W at I = 1 A < 0.3 W at I = 5 A

Power Supply

Operating voltage	DC 4.75 to DC 5.5 V The voltage is picked off from the system bus
Power consumption	300 mW

Mechanics and Connectors

Terminals	Integrated screw terminal for 3 transformer current inputs, 6-pole
Rated impulse voltage ⚠	4 kV, measurement category III

Connection data X1	Locking torque	0.5 Nm
	AWG	Min. 24 Max. 14
	Conductor cross section solid	Min. 0.2 mm² Max. 4.0 mm²
	Conductor cross section stranded	Min. 0.2 mm² Max. 2.5 mm²
	Conductor cross section stranded with ferrule without plastic sleeve	Min. 0.25 mm² Max. 1.5 mm²
	Conductor cross section stranded with ferrule with plastic sleeve	Min. 0.2 mm² Max. 1.5 mm²
	2 wires stranded with ferrule without plastic sleeve	Min. 0.33 mm² Max. 1 mm²
	2 wires stranded with ferrule with plastic sleeve	Min. 0.25 mm² Max. 0.34 mm²
	Wire strip length	Min. 9 mm
	Length ferrule	10 mm
Dimensions (W x H x D)	30 mm x 132 mm x 124 mm (without DIN rail, locking hook closed)	
Weight	252 g (incl. bus module 12 g)	

NOTE

The current carrying capacity of the connection cable is to be designed in relation to the maximum continuous current or overcurrent.

Accuracy of the measured values under reference conditions

	Nominal current $I_N \geq 0.5$ A	Nominal current $I_N < 0.5$ A
3 x current (r.m.s. value)	Class 0.2	• 1 % I_N (for $I \geq 5$ % I_N) • 2.5 % I_N (for $I < 5$ % I_N)
1 x zero current (r.m.s. value)	Class 0.5	-

Reference conditions

Reference factor	Reference value
Ambient temperature	23°C ± 2°C
Frequency	$F_N \pm 2\%$
Input current	$I_N \pm 2$ %, sinusoidal
Warm-up time	≥ 15 minutes

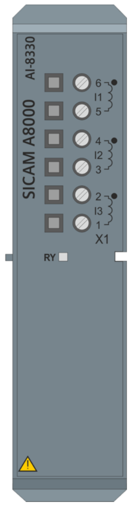
Influencing factors

Parameter	Nominal range of use	Additional error through influencing effects*)
Ambient temperature	-25°C...23°C...85°C	100 ppm/K
Curve form of the input current	Rectangular 1:1	2.5 %
	Sine phase control a=90°	2.5 %

*) Error to be added to accuracy under reference conditions

5.8.10.4 Pin Assignment and Display

The process signals must be connected to a 6-pin screw terminal. The peripheral connectors are assigned according to the tables.



[dw_AI-8330_Front, 1, --_--]

Figure 5-52 AI-8330 Front

Connector X1

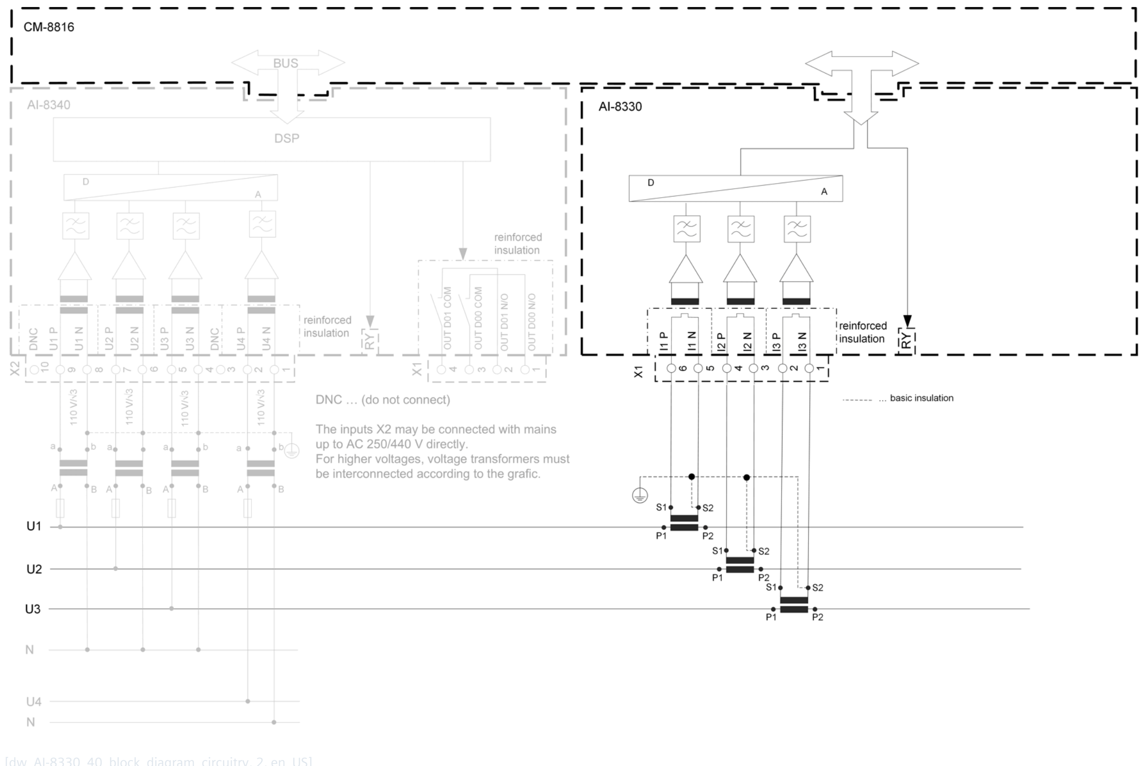
Pin	Signal	Meaning
6	I1 P	Current transformer input 1
5	I1 N	Current transformer input 1
4	I2 P	Current transformer input 2
3	I2 N	Current transformer input 2
2	I3 P	Current transformer input 3
1	I3 N	Current transformer input 3

Display

LED	Meaning
RY	Readiness

5.8.10.5 Block Diagram and External Circuitry

The following circuitry variants are examples, and do not relate exclusively to the depicted inputs/outputs.



NOTE

- The device is designed for connection of current transformers with secondary currents of 1 A / 2 A / 5 A / 6 A.
- Please take account of the direction of current flow when connecting the current measuring inputs. In the case of an inverse connection, the currents are measured in phase opposition and therefore direction-dependent variables are given a negative sign.

WARNING

The current transformer terminals may only be detached or attached in de-energized state! AI-8330 must not be connected directly with a mains supply circuit!

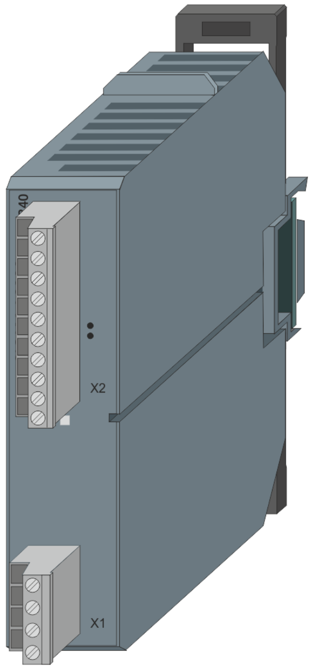
✧ Open current transformer circuits will result in electric shock and arc flashover.

✧ Will cause death, serious injury or considerable property damage.

✧ Only measure current with external current transformers. Do not use fuses for circuit protection. Do not open the secondary circuit under load. Short circuit the secondary current terminals of the current transformers before removing this device. The safety information for the current transformers used must be followed.

5.8.11 AI-8340

The SICAM I/O module AI-8340 is an analog input module for measuring alternating voltages.



[dw_AI-8340_Oblique, 1, --_--]

Figure 5-53 AI-8340

5.8.11.1 Features

- Installation on horizontal mounted 35 mm DIN rail
- 4 voltage inputs (250 V)
  The voltage inputs are galvanically insulated by transformers from each other and from logic circuits
- 2 digital outputs (relay)
  1 group with 2 outputs; galvanically insulated
- Acquisition and processing according to IEC 60870-5-101/104
- Removable screw terminals
- Function indication via LED

5.8.11.2 Functions

Voltage inputs

- Phase voltages or phase-to-phase voltages can be wired to the voltage inputs
- Acquisition of voltages up to the 25th harmonic, with signal scanning 256 times per period
- Calculation of r.m.s. values over 25 harmonics by means of discret fourier transformation
- Acquisition of frequency and provision as:
  - Frequency instantaneous value
  - Frequency mean value
- Measuring range of the secondary quantities
  - Nominal voltage 250 V with 50% overrange and a resolution of 15 bits
  - Nominal frequency 16,7 Hz, 50 Hz oder 60 Hz ±15%
- Technological adaptation
- Calculation of phase-to-phase voltages dependent on wiring

- Calculation of the zero phase system
- Calculation of voltage-, frequency- and phase difference for the synchrocheck function
- Transfer of the acquired and calculated values using spontaneous information objects according to IEC 60870-5-101/104, in a selectable format
  - Measured value, short floating point number
  - Measured value, normalized value
  - Measured value, scaled value
- Smoothing, zero-range suppression and change monitoring can be set individually for each value
- Transfer of values to the higher-level open-/closed-loop control function, using periodical information objects
- Messages of voltage transformer MCB's are considered
- Synchrocheck function with dynamic parameter switch-over, for up to 4 operating states
- Connecting a de-energized line/busbar
- Optional direct output of the synchronization status over relay contacts

NOTE

The previously mentioned functions are described in detail in the document ***SICAM RTUs Common Functions Peripheral Elements according to IEC 60870-5-101/104***, *chapter* ***Three-Phase Measurement on AI-8330/40*** .

5.8.11.3 Technical Data

Inputs for Transformer Voltages

4 voltage inputs (X2)	The voltage inputs are galvanically insulated by transformers from each other and from logic circuits
Nominal voltage U_N	AC 10 to 250 V (settable) Typ. 110 V,110 V/√3, 230 V
Max. measuring voltage	150 % U_N if $U_N \leq 110$ V 110 % U_N if $U_N \leq 250$ V
Rated voltage	300 V
Nominal frequency	50 Hz, 60 Hz, 16⅔ Hz (settable)
Resolution	16 bits
Scanning	256 values per system period
Thermal withstand capability	3 x 275 V continuously
Intrinsic consumption	< 0,44 VA at U = 230 V < 0,11 VA at U = 110 V < 0.04 VA at U = 110 V/√3

Digital outputs

2 digital outputs (relay) (X1)	• 1 group with 2 outputs; galvanically insulated • recognition of contact welding
Error_behavior	Command termination resp. command disable
Check	Activation of the relay winding by means of reading back the respective second contact

Switching cycles	• 10^5 AC 220 V (≤ 1 A) @ cos φ = 1 • 5 x 10^4 DC
Maximum switching current	AC or DC 1 A
Output circuits	Max. DC 250 V / AC 253 V (operated with external voltage)
Pilot duty	R300, B300
Switching capacity with DC	Min. 500 mW at DC 5 V Max. DC 250 V / 0.2 A
Switching capacity with AC	Max. 250 VA / 1 A / AC 250 V, resistive load

Power Supply

Operating voltage	DC 4.75 V to 5.5 V The voltage is picked off from the system bus
Power consumption	1400 mW

Mechanics and Connectors

Terminals	2 removable screw terminals (grid size 5.08 mm) • 4 measuring voltage inputs, 10-pole (X2) • 2 digital relay outputs, 4-pole (X1)	
Rated impulse voltage	• X1: 4 kV < 2000 m: Category III / AC 230 V < 3000 m: Category II / AC 230 V • X2: 4 kV < 2000 m: Measurement category III < 3000 m: Measurement category II	
Connection data X1, X2	Locking torque (PHOENIX terminal) [70] Locking torque (FCI terminal) [70]	0.5 Nm to 0.6 Nm 0.36 Nm to 0.44 Nm
	AWG	Min. 22 Max. 12
	Conductor cross section solid	Min. 0.33 mm² Max. 2.5 mm²
	Conductor cross section stranded	Min. 0.33 mm² Max. 2.5 mm²
	Conductor cross section stranded with ferrule without plastic sleeve	Min. 0.33 mm² Max. 2.5 mm²
	Conductor cross section stranded with ferrule with plastic sleeve	Min. 0.33 mm² Max. 2.5 mm²
	2 wires stranded with ferrule without plastic sleeve	Min. 0.33 mm² Max. 1 mm²
	2 wires stranded with ferrule with plastic sleeve	Min. 0.5 mm² Max. 1.31 mm²
	Wire strip length	Min. 6 mm Max. 7 mm
	Length ferrule	10 mm
Dimensions (W x H x D)	30 mm x 132 mm x 124 mm (without DIN rail and terminal, locking hook closed); D 142 mm (with inserted terminal)	
Weight	252 g (incl. bus module 12 g)	

70 The respective manufacturer is imprinted at the terminal (see section *Types of screw terminals, Page 353*)

Accuracy of the measured values under reference conditions

4 x voltage (r.m.s. value)	Class 0.2
1 x zero voltage (r.m.s. value)	Class 0.5
Power (active power, reactive power, power factor)	Class 0.5
Phase Angle	Class 0.5
Voltage difference	Class 0.5
Frequency mean value & frequency difference The frequency mean value is determined by means of a continuous mean value generation over 16 system periods respectively. The measuring range is the parameterized nominal frequency ±5Hz with a resolution and an accuracy of 1mHz.	1 mHz
Frequency instantaneous value	5 mHz

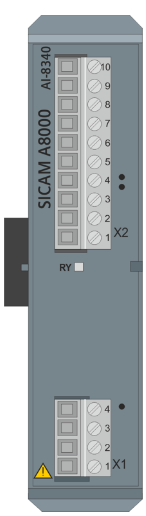
NOTICE

Siemens recommends adhering to the following assembly rules. If this is not possible, have your configuration checked by Customer Support Center.

- Use the AI-8340 only in configurations with the power supplies PS-862x or I/O remote modules CI-853x.
- AI-8340 and the power supplies PS-864x can only be used together, if the synchrocheck is not used.
- AI-8340, PS-864x and synchrocheck with a nominal voltage of the measuring transformer <200 V, can only be used together, if there is at least 2 modules distance between the PS and the AI module.

5.8.11.4 Pin Assignment and Display

The process signals must be connected to a 10-pin and a 4-pin screw terminal. The peripheral connectors are assigned according to the tables.



[dw_AI-8340_Front, 1, --_--]

Figure 5-54 AI-8340 Front

Connector X2

Pin	Signal	Meaning
10	DNC	do not connect
9	U1 P	measuring voltage input 1

Pin	Signal	Meaning
8	U1 N	measuring voltage input 1
7	U2 P	measuring voltage input 2
6	U2 N	measuring voltage input 2
5	U3 P	measuring voltage input 3
4	U3 N	measuring voltage input 3
3	DNC	do not connect
2	U4 P	measuring voltage input 4
1	U4 N	measuring voltage input 4

Connector X1

Pin	Signal	Meaning
4	OUT D01 COM	Common supply output 1
3	OUT D00 COM	Common supply output 0
2	OUT D01 N/O	Digital output 1
1	OUT D00 N/O	Digital output 0

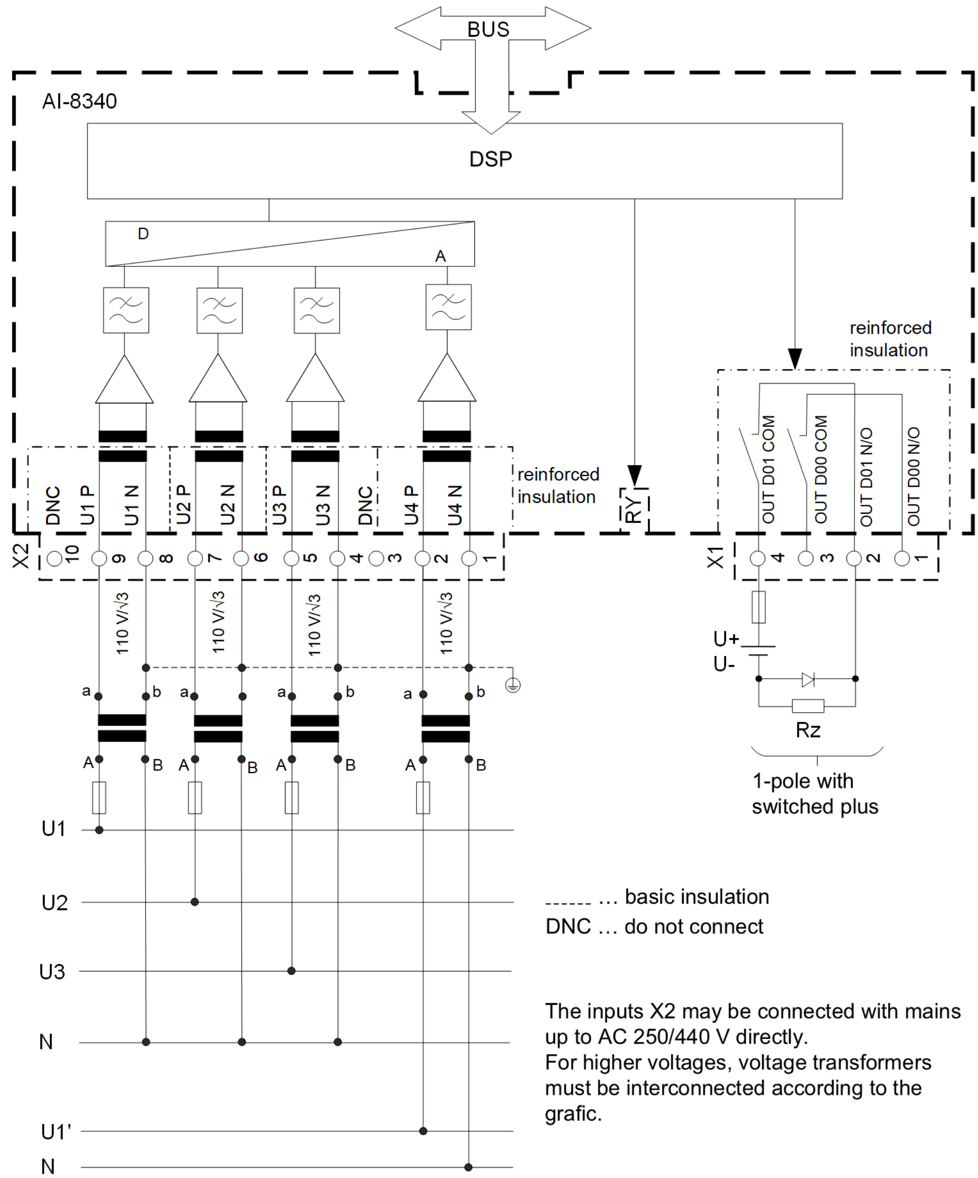
Display

LED	Meaning
RY	Readiness

5.8.11.5 Block Diagram and External Circuitry

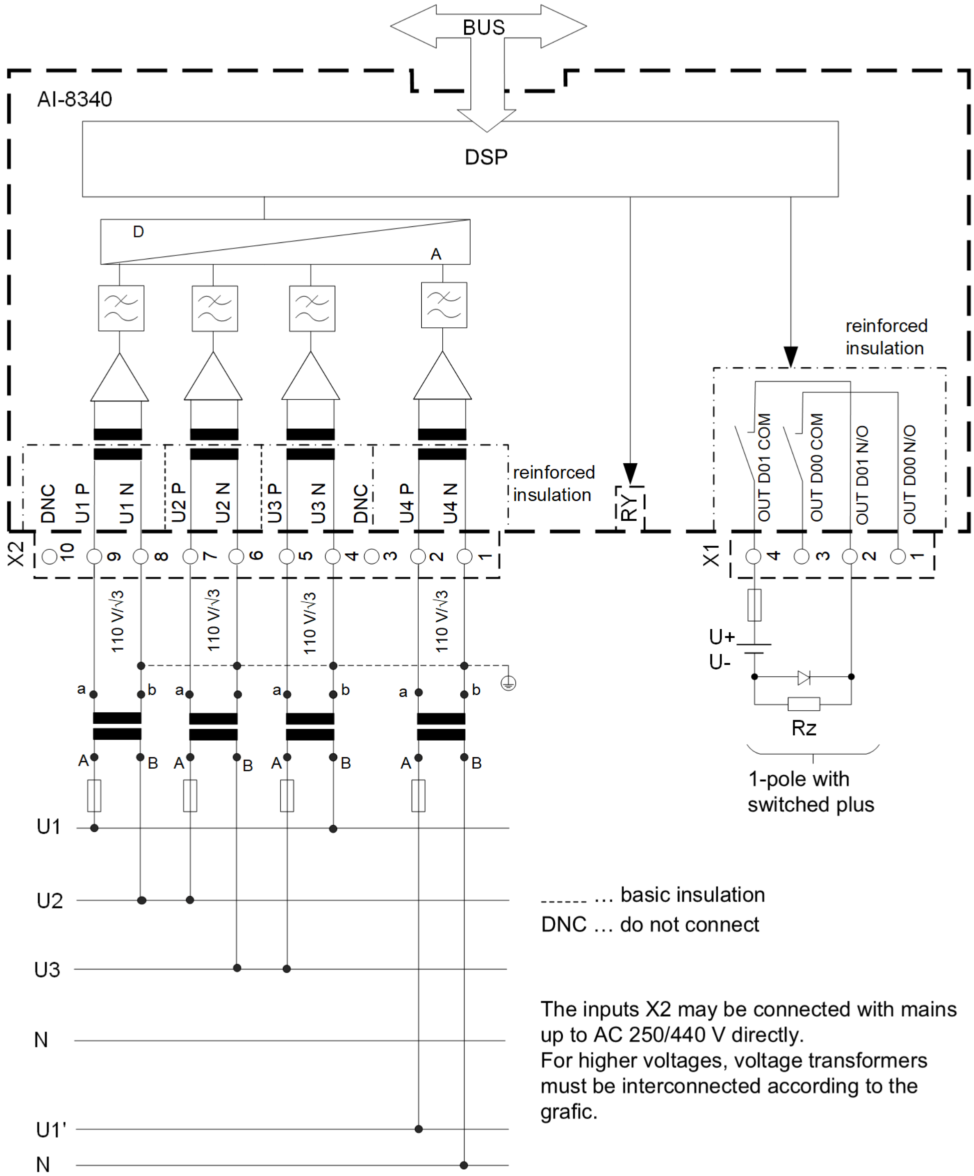
The following circuitry variants are examples, and do not relate exclusively to the depicted inputs/outputs.

Circuitry with phase Voltage



[dw_AI-8340_block_dia_circ_phase_volt, 1, en_US]

Circuitry with Phase-to-Phase Voltages



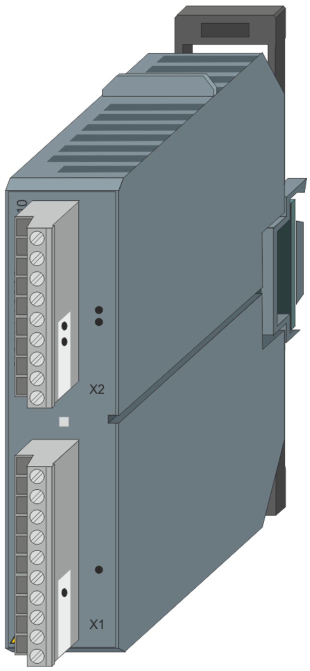
[dw_AI-8340_block_dia_circ_phase2phase_volt, 1, en_US]

NOTE

The connectors X1 and X2 may be detached or attached in de-energized state only!

Please note the direction of the voltage when connecting the voltage measurement inputs. With an inverse connection, direction-related measured values are inverted and given a negative sign.

5.8.12 AI-8510



[AI-8510_Oblique_View, 1, --_--]

Figure 5-55 AI-8510

5.8.12.1 Features

Analog input module

- Mounting on 35 mm DIN rail
- 3 low-power (LoPo) current measuring inputs in conjunction with adapter module CM-8820
- 3 voltage measuring inputs (settable 100 V/√3, 240 V, or 415 V/√3)
- Frequency acquisition (nominal frequency 45 to 65 Hz)
- Calculation of the r.m.s. values
  - Currents
  - Phase and phase-to-phase voltages
- Calculation of
  - Frequency
  - Active, reactive and apparent power
  - Zero-sequence voltage, zero-sequence current
  - Power factor
  - Phase angle
  - Fault current direction, power direction
- Acquisition and processing according to IEC 60870-5-101/104
- Removable screw terminals
- Function indication via LED

5.8.12.2 Functions

Acquisition Functions

- Measuring currents
  - Acquisition of currents through submodule CM-8820 using DFT algorithm, 1 signal sampling per millisecond
  - Nominal value 1 A/5 A with 16-bit resolution
- Measuring voltages
  - Acquisition of voltages through transformers or direct measurement using DFT algorithm, 1 signal sampling per millisecond
  - Circuitry of the voltage inputs with phase voltages
  - Nominal value 100 V/√3, 240 V, 415 V/√3 with 16-bit resolution
  - Supervision of the measuring voltage
- Frequency
  - Acquisition of frequency using signal zero crossing of voltage U1
  - Measuring range 45 Hz to 65 Hz (parameter-settable nominal frequencies of 50 Hz and 60 Hz) with a resolution of 100 mHz

Calculation Functions

- Calculation of values from acquired values
  - Current r.m.s. value I1 ^{fb}, I2 ^{fb}, I3 ^{fb}
  - Phase voltage r.m.s. value U1 ^{fb}, U2 ^{fb}, U3 ^{fb}
  - Phase-to-phase voltage r.m.s. value U12 ^{fb}, U23 ^{fb}, U31 ^{fb}
  - Frequency ^{fb}

  Voltage and current r.m.s. values undergo a linear (technological) adaptation ^{fb} and are the base for calculating further values
  - Zero current r.m.s. value I0 ^{f}
  - Zero voltage r.m.s. value U0 ^{f}
  - Active power P1 ^{f}, P2 ^{f} P3 ^{f}
  - Active power P (total value) ^{f}
  - Reactive power Q1 ^{f}, Q2 ^{f}, Q3 ^{f}
  - Reactive power Q (total value) ^{f}
  - Apparent power S1 ^{f}, S2 ^{f}, S3 ^{f}
  - Apparent power S (total value) ^{f}
  - Power factor 1 ^{f}, 2 ^{f}, 3 ^{f}
  - Power factor (total value) ^{f}
  - Phase angle I1 ^{f}, I2 ^{f}, I3 ^{f}, IN ^{f}
  - Phase angle ^{f}, U23 ^{f}, U31 ^{f}
  - Phase angle U1 ^{f}, U2 ^{f}, U3 ^{f}, U0 ^{f}

  To calculated values the following functions are applied:
  - Revision ^{fb}
  - Format conversion ^{f}
    - Normalized, technologically scaled or short floating-point number
    - Zero-range suppression
  - Change monitoring ^{f}
  - Fault detection
  - Spontaneous transmission upon change ^{f}

NOTE

The previously mentioned functions are described in detail in the document *SICAM RTUs Common Functions Peripheral Elements according to IEC 60870-5-101/104, chapter* ***Measurement in Three-Phase Systems – I/O Module***.

5.8.12.3 Technical Data

Inputs for Measuring Currents (Only Via Adapter Module CM-8820)

Nominal voltage at I_N	AC 225 mV following IEC 60044-8
Max. input voltage	AC 2.25 V

Nominal frequency	50 Hz, 60 Hz (range 45 to 65 Hz)
Resolution	16 bits
Scanning	1 value/ms

Inputs for Measuring Voltages

Nominal voltage U_N	AC 100 V/√3, AC 240 V, AC 415 V/√3 acc. to IEC 60044-7 (parameter-settable)
Max. measuring voltage	150% V_N (fault condition)
Rated voltage	300 V
Nominal frequency	50 Hz, 60 Hz (range 45 to 65 Hz)
Resolution	16 bits
Scanning	1 value/ms
Internal consumption [71]	< 0,3 VA at U_N = AC 240 V < 0,02 VA at U_N = AC 100 V/√3

Power Supply

Operating voltage	DC 4.75 to DC 5.5 V The voltage is picked off from the system bus
Power consumption	Max. 800 mW (typ. 625 mW)

Mechanics and Connectors

Terminals	2 removable screw terminals (grid size 5.08 mm) • 3 LoPo measuring current inputs, 10-pole (X1) • 3 measuring voltage inputs, 9-pole (X2)
Rated impulse voltage ⚠	4 kV (X2) < 2000 m: Measurement category III < 3000 m: Measurement category II

71 irrelevant for the power consumption

Connection data X1, X2	Locking torque (PHOENIX terminal) [72] Locking torque (FCI terminal) [72]	0.5 Nm to 0.6 Nm 0.36 Nm to 0.44 Nm
	AWG	Min. 22 Max. 12
	Conductor cross section solid	Min. 0.33 mm² Max. 2.5 mm²
	Conductor cross section stranded	Min. 0.33 mm² Max. 2.5 mm²
	Conductor cross section stranded with ferrule without plastic sleeve	Min. 0.33 mm² Max. 2.5 mm²
	Conductor cross section stranded with ferrule with plastic sleeve	Min. 0.33 mm² Max. 2.5 mm²
	2 wires stranded with ferrule without plastic sleeve	Min. 0.33 mm² Max. 1 mm²
	2 wires stranded with ferrule with plastic sleeve	Min. 0.5 mm² Max. 1.31 mm²
	Wire strip length	Min. 6 mm Max. 7 mm
	Length ferrule	10 mm
Dimensions (W x H x D)	30 mm x 132 mm x 124 mm (without DIN rail and terminal, locking hook closed); D 142 mm (with inserted terminal)	
Weight	252 g (incl. bus module 12 g)	

NOTE

The altitude at which AI-8510 is operated, shall be considered applicable for all modules in the system.

Accuracy of the Measured Values

Measured variable	Dependency of accuracy class acc. to IEC 61557-12:2007-08 (K55)
Voltage U	1 % (100/√3 up to 3 %)
Phase current I	1 % at nominal frequency
Power P	3 %
Reactive power Q	3 %
Apparent power S	3 %
Power factor	3 %
Frequency f (49 to 51/59 to 61 Hz)	1 %

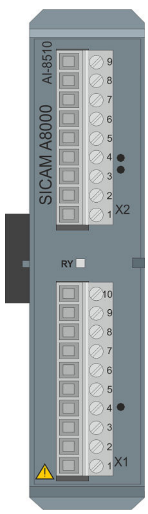
72 The respective manufacturer is imprinted at the terminal (see section *Types of screw terminals, Page 353*)

Accuracy of the Measured Ground Current with Isolated/Resonant Ground Connection

Measured variable	Dependency of accuracy class acc. to IEC 61557-12:2007-08 (K55)	
Ground current IN setting	0.4 to 1.9 A	2.0 to 2000 A
Measuring range	0.2 to 2.89 A at 50 Hz 0.2 to 2.99 A at 60 Hz	2.9 to 600 A at 50 Hz 3.0 to 600 A at 60 Hz
Accuracy	±0.19 A for measuring range 0.2 to 2.9 A	±0.19 A for measuring range 2.8 to 11.99 A ±1 % for measuring range 12 to 600 A

5.8.12.4 Pin Assignment and Display

The process signals must be connected to a 10-pin and a 9-pin screw terminal. The peripheral connectors are assigned according to the tables.



[AI-8510_Front, 2, --_--]

Figure 5-56 AI-8510 Front

Connector X1

Pin	Signal	Meaning
10	DNC	Do not connect
9	DNC	Do not connect
8	I1+	Measuring current input 1
7	I1-	Measuring current input 1
6	I2+/IN+	Measuring current input 2 / (sensitive) zero current
5	I2-/IN-	Measuring current input 2 / (sensitive) zero current
4	I3+	Measuring current input 3
3	I3-	Measuring current input 3
2	DNC	Do not connect
1	FE shield	Functional earth

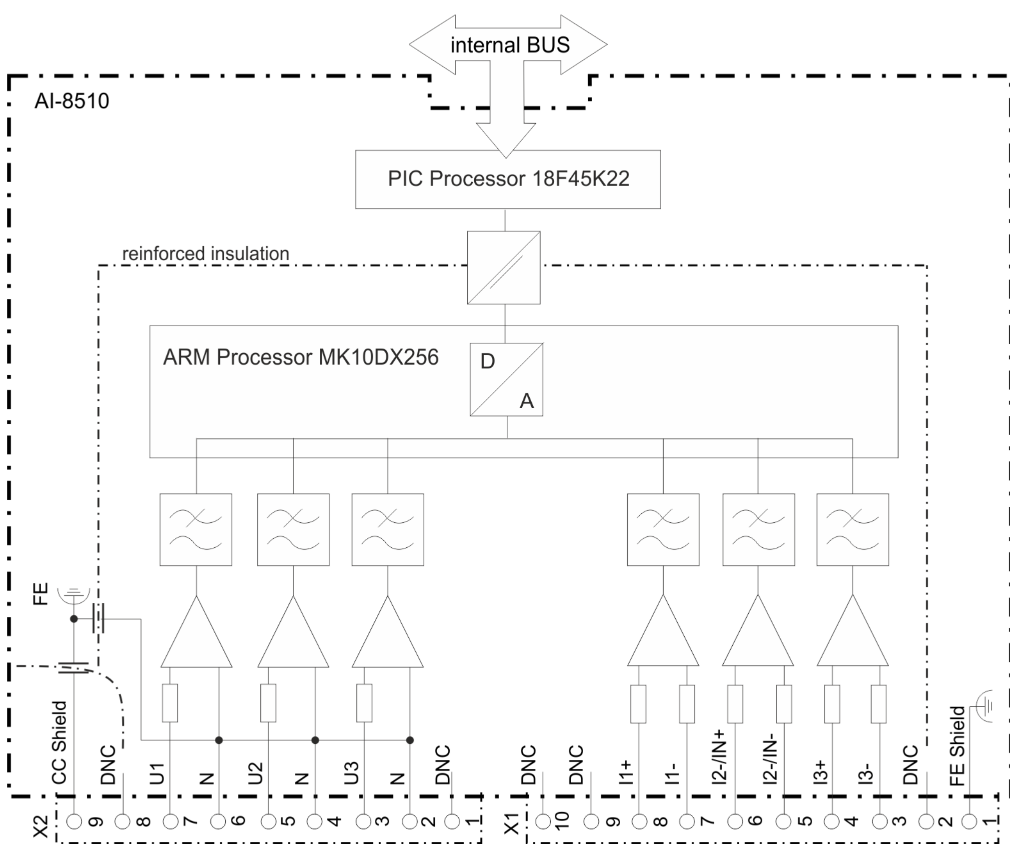
Connector X2

Pin	Signal	Meaning
9	CC shield	Capacitive coupled to protective earth
8	DNC	Do not connect
7	U1	Measuring voltage input 1
6	N	Measuring voltage input 1
5	U2	Measuring voltage input 2
4	N	Measuring voltage input 2
3	U3	Measuring voltage input 3
2	N	Measuring voltage input 3
1	DNC	Do not connect

Display

LED	Meaning
RY	Readiness

5.8.12.5 Block Diagram



[AI-8510_Block_Diagram, 2, en_US]

Figure 5-57 AI-8510 Block Diagram

NOTE

For the measurement of currents, the current transformer adaptor module CM-8820 must be connected via the X1 terminal. The specification for the connection cable is in section *5.8.14.3 Technical Data*.

DANGER

- The connectors X1 and X2 may be detached or attached in a de-energized state only!
- The connector X1 must always be plugged during operation (even if no current measurement is used)!

WARNING

- The inputs of connector X1 must not be directly connected with a mains supply circuit!
- The inputs of connector X2 may be directly connected with a mains supply current circuit up to AC 240/415 V. Higher voltages must be adapted via interconnected voltage transformers!

NOTE

Bear in mind the direction of the current flow when connecting the current measuring inputs. In the case of inverse connection, the measured values are inverted and are given a negative sign.

The same applies to the voltage measurement (direction and rotation angle) respectively.

5.8.12.6 External Circuitry

The following circuitry variants are examples and do not relate exclusively to the depicted values.

DANGER

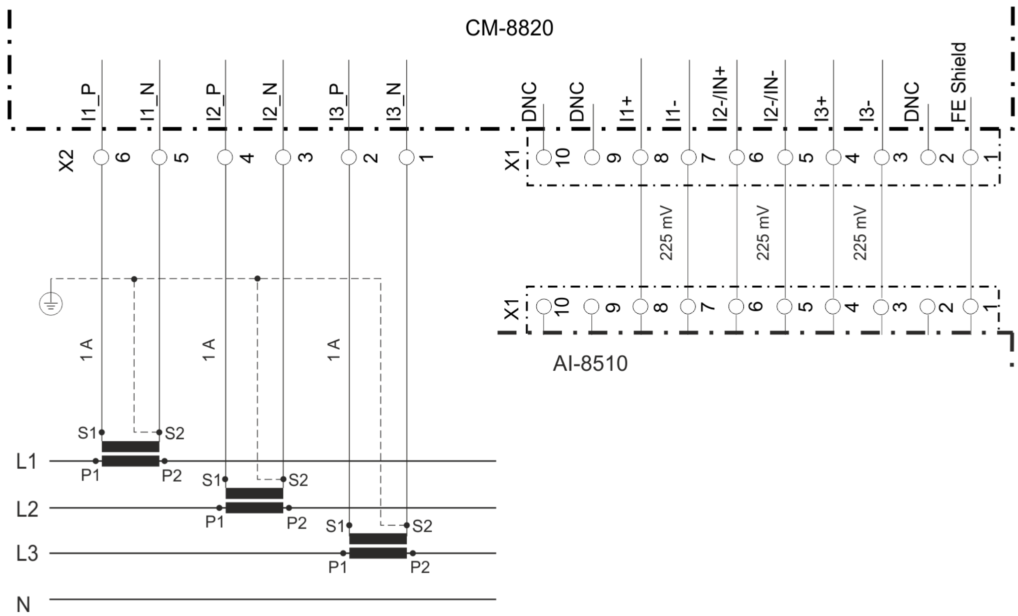
Work may be performed on the circuitry in a de-energized state only!

- During electrical installation, all the rules and regulations governing power systems must be observed.

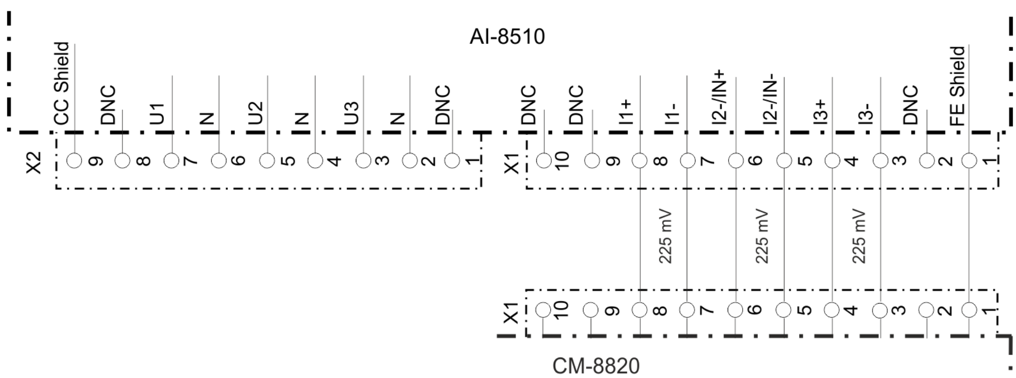
Short-Circuit Indicator

The current inputs I1, I2/IN, I3 are connected via the adaptor module CM-8820 with the measuring transformers of the corresponding phase currents.

In this configuration, the module functions as a short-circuit indicator. Fault information on the direction is not provided.



[dw_CM-8820_3xl, 1, en_US]



[dw_AI-8510_3xl, 1, en_US]

Figure 5-58 AI-8510 External Circuitry Variant for Short-Circuit Indicator

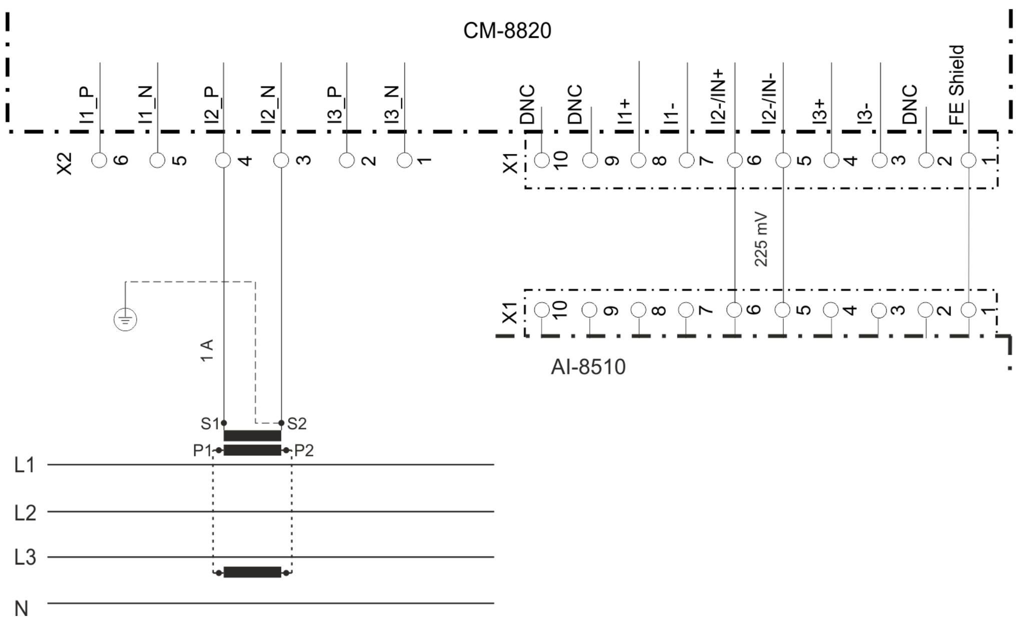
NOTE

With this connection scheme, the accuracy of ground current measurements for isolated/resonant ground connections cannot be guaranteed.

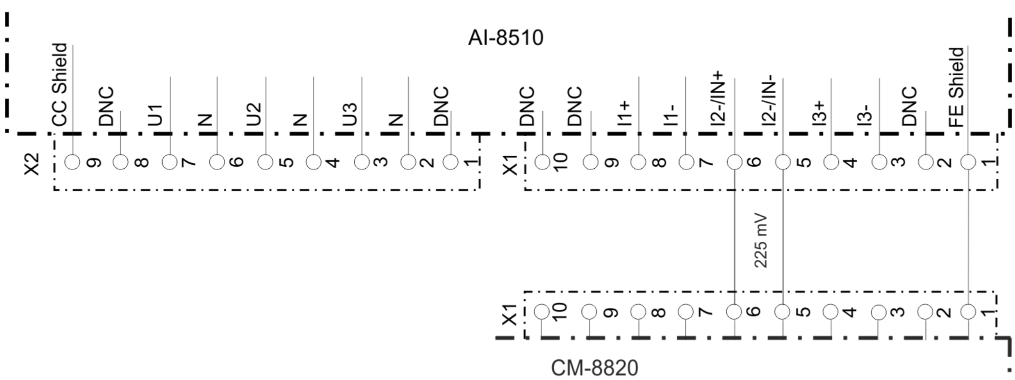
Ground-Fault Indicator

The current input I2/IN is connected via the adaptor module CM-8820 with the sum current measuring transformer.

In this configuration, the module functions as a non-directional ground-fault indicator.



[dw_CM-8820_IN, 1, en_US]



[dw_AI-8510_IN, 1, en_US]

Figure 5-59 AI-8510 External Circuitry Variant for Ground-Fault Indicator

Fault Detector

The current inputs I1, I2/IN, I3 are connected via the adaptor module CM-8820 with the corresponding measuring transformers. Additionally, the voltage inputs U1, U2, U3 are connected:

- through voltage transformers with 100 V/√3 to the middle-voltage network
- through voltage transformers with 415 V/√3 to the low-voltage network
- directly with 240 V to the low-voltage network

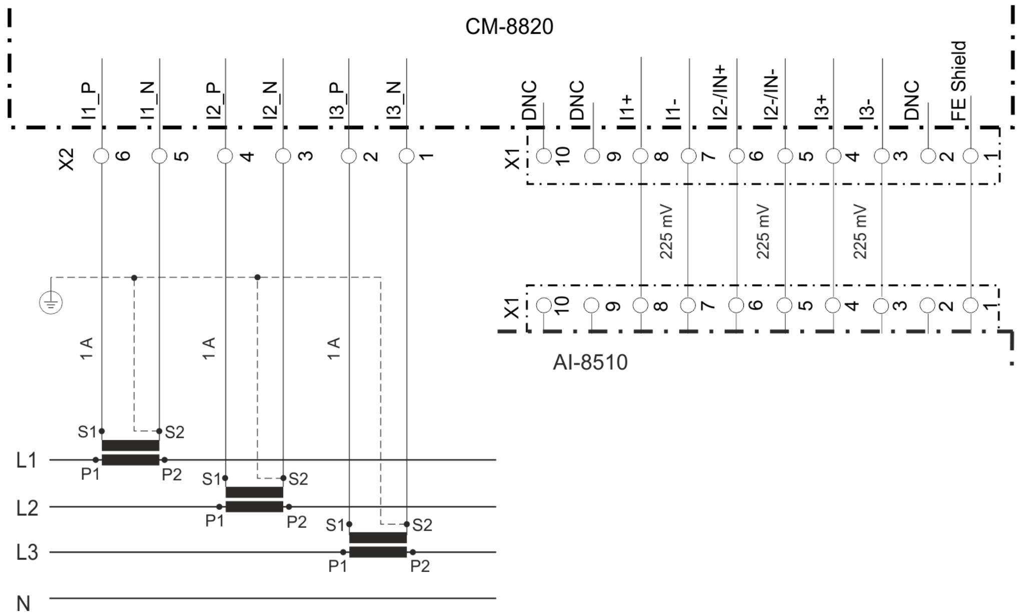
In this configuration, fault information with directional indication is output. All the measured and calculated measurands are thus also provided.

3-Phase Voltage, 3-Phase Current

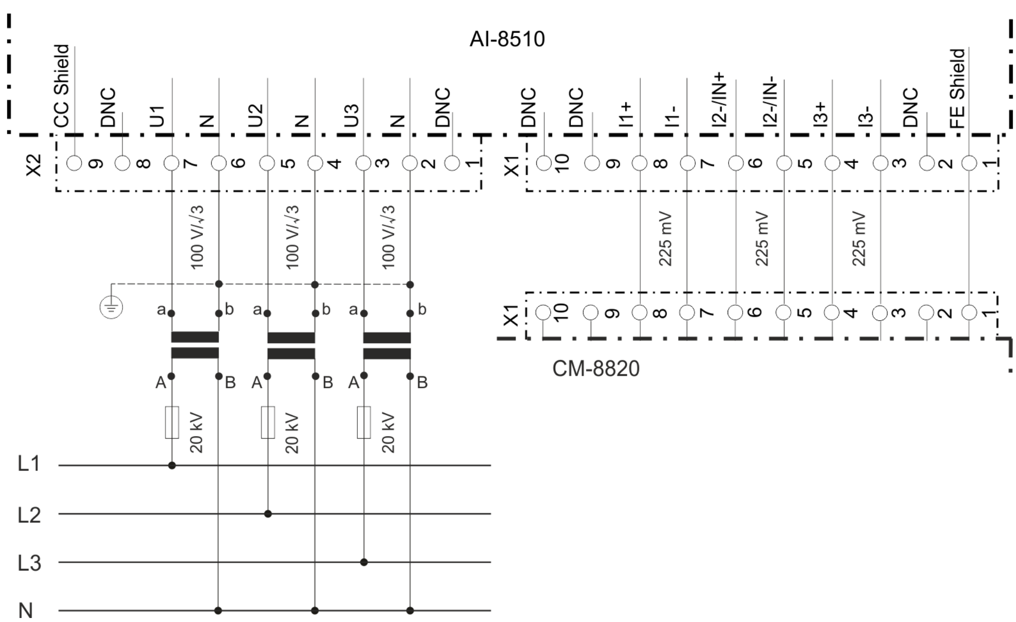
Through the current inputs I1, I2/IN, I3, the corresponding phase currents are measured. The value IN is calculated.

This configuration is used for solidly grounded networks. In this configuration, the module also works as a power meter.

Example: Middle-voltage network



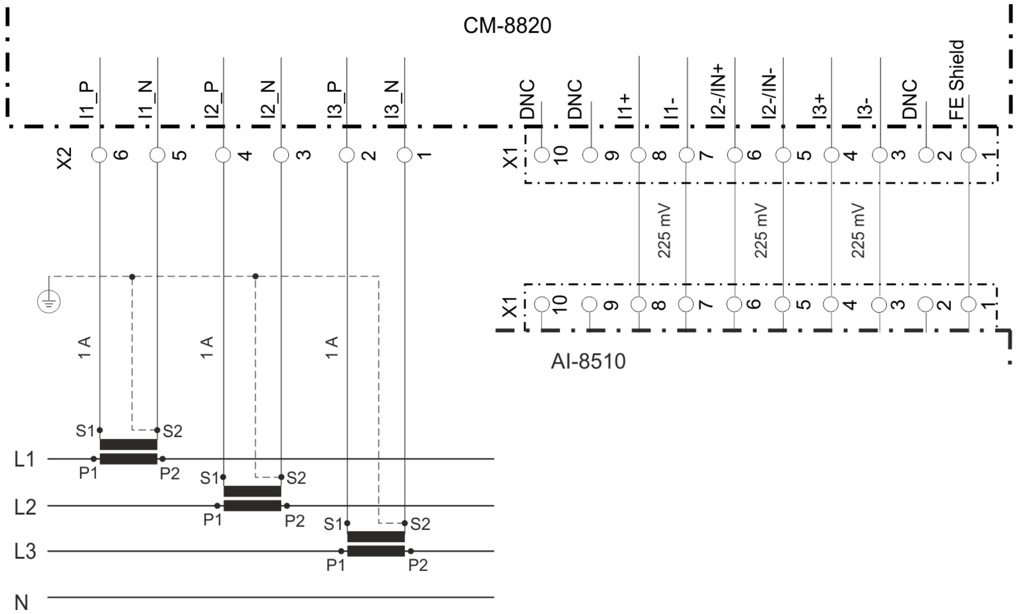
[dw_CM-8820_3xl, 1, en_US]



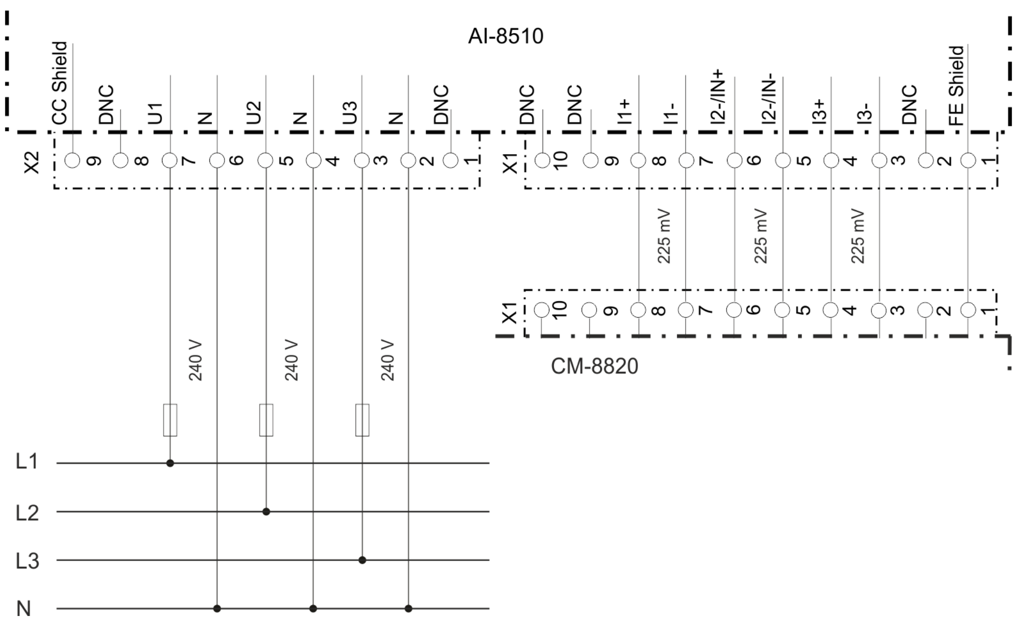
[dw_AI-8510_3xl_3xV_MV, 1, en_US]

Figure 5-60 AI-8510 External Circuitry Variant for 3-Phase Voltage, 3-Phase Current (MV)

Example: Low-voltage network



[dw_CM-8820_3xI, 1, en_US]



[dw_AI-8510_3xI_3xV_LV, 1, en_US]

Figure 5-61 AI-8510 External Circuitry Variant for 3-Phase Voltage, 3-Phase Current (LV)

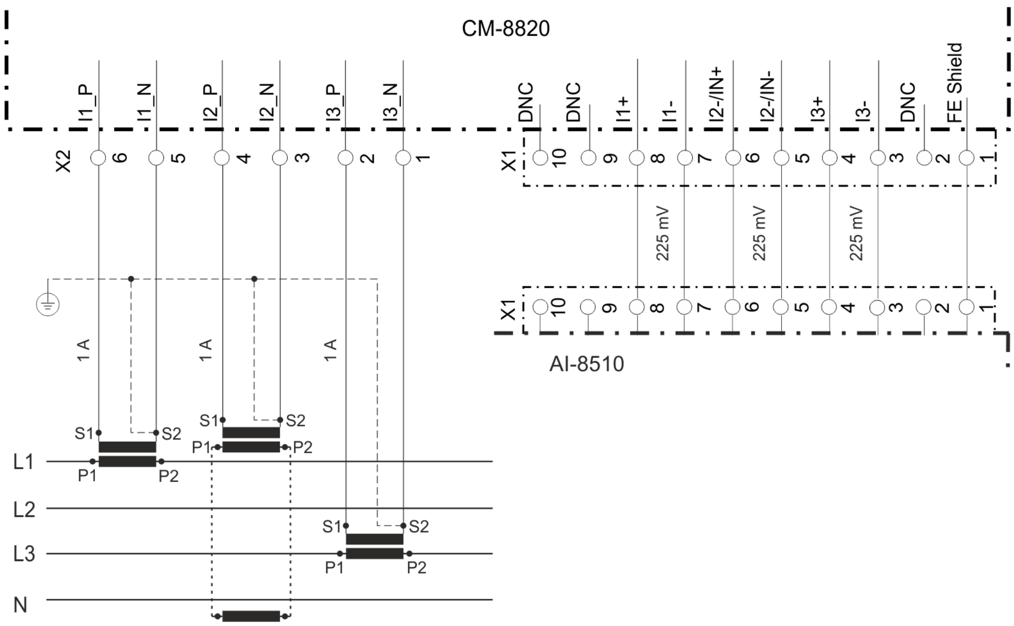
WARNING

✧ Miniature circuit breakers are mandatory (2 A recommended).

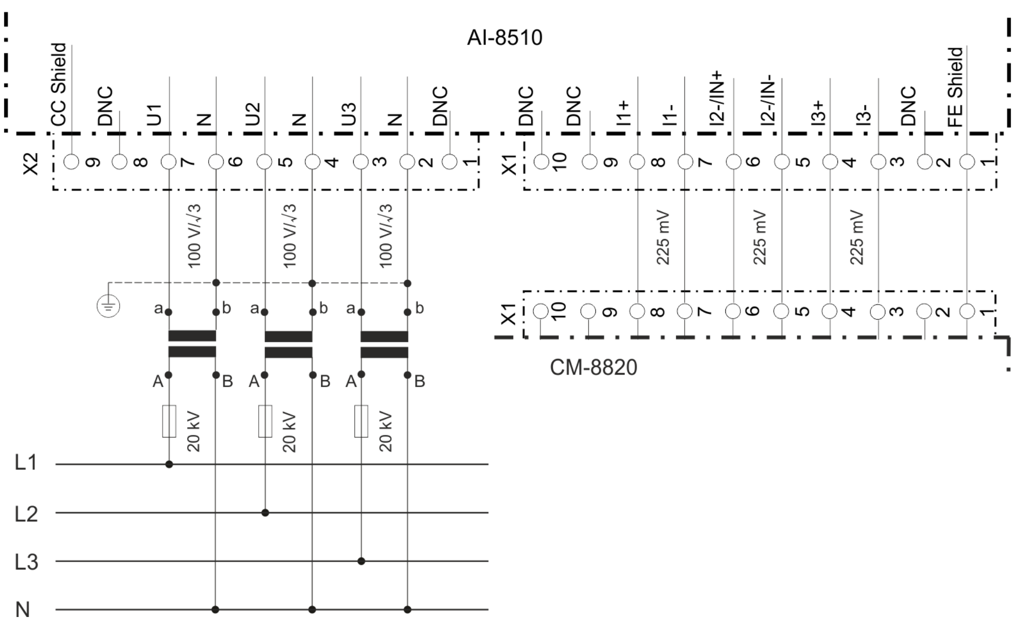
3-Phase Voltage, 2-Phase Current + Sensitive Zero-Sequence Current

Through the current inputs I1 and I3, the corresponding phase currents are measured, and through the input I2/IN, the sensitive zero-sequence current is measured. The value I2 is calculated.
This configuration is used for isolated and resonant grounded networks.

Example: Middle-voltage network



[dw_CM-8820_2xI_IN, 1, en_US]



[dw_AI-8510_3xI_3xV_MV, 1, en_US]

Figure 5-62 AI-8510 External Circuitry Variant for 3-Phase Voltage, 2-Phase Current, Sensitive Zero-Sequence Current

Medium Voltage/Low Voltage Measurement

The voltages in the middle-voltage network are determined by measuring the voltages from the low-voltage network (secondary side of the transformer).

The voltage inputs U1, U2, U3 are directly connected to 240 V in the low-voltage network. The current inputs I1, I2/IN, I3 are connected through the adaptor module CM-8820 with the corresponding measuring sensors in the middle-voltage network.

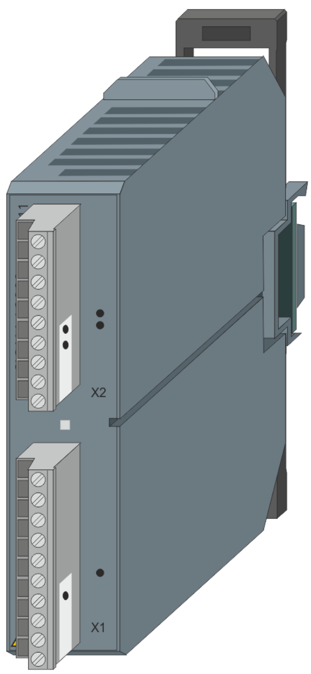
In this configuration, the module determines the direction of the phase fault and ground fault.

These connection diagrams are used for solidly grounded networks.

NOTE

The module supports the Dy-11 transformer type only. For this type, the secondary side of the transformer lags the primary side by a phase angle of 330°.

5.8.13 AI-8511



[AI-8511_Oblique_View, 1, --_--]

Figure 5-63 AI-8511

5.8.13.1 Features

Analog input module

- Mounting on 35 mm DIN rail
- 3 low-power (LoPo) current measuring inputs (225 mV)
- 3 low-power (LoPo) voltage measuring inputs (3.25 V/√3)
- Frequency acquisition (nominal frequency 45 to 65 Hz)
- Calculation of the r.m.s. values
  - Currents
  - Phase and phase-to-phase voltages

- Calculation of
  - Frequency
  - Active, reactive and apparent power
  - Zero-sequence voltage, zero-sequence current
  - Power factor
  - Phase angle
  - Fault current direction, power direction
- Acquisition and processing according to IEC 60870-5-101/104
- Removable screw terminals
- Function indication via LED

5.8.13.2 Functions

Acquisition Functions

- Measuring currents
  - Acquisition of currents through low-power measuring sensors using DFT algorithm, 1 signal sampling per millisecond
  - Nominal value 0 to 225 mV with 16-bit resolution
- Measuring voltages
  - Acquisition of voltages through low-power voltage transformers using DFT algorithm, 1 signal sampling per millisecond
  - Circuitry of the voltage inputs with phase voltages
  - Nominal value 3.25 V/√3 with 16-bit resolution
  - Supervision of the measuring voltage
- Frequency
  - Acquisition of frequency using signal zero crossing of voltage U1
  - Measuring range 45 Hz to 65 Hz (parameter-settable nominal frequencies of 50 Hz and 60 Hz) with a resolution of 100 mHz

Calculation Functions

- Calculation of values from acquired values
  - Current r.m.s. value I1 [fb], I2 [fb], I3 [fb]
  - Phase voltage r.m.s. value U1 [fb], U2 [fb], U3 [fb]
  - Phase-to-phase voltage r.m.s. value U12 [fb], U23 [fb], U31 [fb]
  - Frequency [fb]

  Voltage and current r.m.s. values undergo a linear (technological) adaptation [fb] and are the base for calculating further values

  - Zero current r.m.s. value I0 [f]
  - Zero voltage r.m.s. value U0 [f]
  - Active power P1 [f], P2 [f] P3 [f]
  - Active power P (total value) [f]
  - Reactive power Q1 [f], Q2 [f], Q3 [f]
  - Reactive power Q (total value) [f]
  - Apparent power S1 [f], S2 [f], S3 [f]
  - Apparent power S (total value) [f]
  - Power factor 1 [f], 2 [f], 3 [f]
  - Power factor (total value) [f]
  - Phase angle I1 [f], I2 [f], I3 [f], IN [f]
  - Phase angle [f], U23 [f], U31 [f]
  - Phase angle U1 [f], U2 [f], U3 [f], U0 [f]

  To calculated values the following functions are applied:

  - Revision [fb]
  - Format conversion [f]
    - Normalized, technologically scaled or short floating-point number
    - Zero-range suppression
  - Change monitoring [f]
  - Fault detection
  - Spontaneous transmission upon change [f]

NOTE

The previously mentioned functions are described in detail in the document *SICAM RTUs Common Functions Peripheral Elements according to IEC 60870-5-101/104, chapter* ***Measurement in Three-Phase Systems – I/O Module***.

5.8.13.3 Technical Data

Inputs for Measuring Currents

Nominal voltage at I_N	AC 225 mV following IEC 60044-8
Max. input voltage	AC 2.25 V

Nominal frequency	50 Hz, 60 Hz (range 45 to 65 Hz)
Resolution	16 bits
Scanning	1 value/ms
Internal resistance	22 kΩ

Inputs for Measuring Voltages

Nominal voltage U_N	AC 3.25 V/√3 acc. to IEC 60044-7
Max. measuring voltage	150 % V_N
Nominal frequency	50 Hz, 60 Hz (range 45 to 65 Hz)
Resolution	16 bits
Scanning	1 value/ms
Internal resistance	200 kΩ

Power Supply

Operating voltage	DC 4.75 to DC 5.5 V The voltage is picked off from the system bus
Power consumption	Max. 800 mW (typ. 625 mW)

Mechanics and Connectors

Terminals	2 removable screw terminals (grid size 5.08 mm) • 3 LoPo measuring current inputs, 10-pole (X1) • 3 LoPo measuring voltage inputs, 9-pole (X2)	
Rated impulse voltage	4 kV (X2) < 2000 m: Measurement category III < 3000 m: Measurement category II	
Connection data X1, X2	Locking torque (PHOENIX terminal) [73] Locking torque (FCI terminal) [73]	0.5 Nm to 0.6 Nm 0.36 Nm to 0.44 Nm
	AWG	Min. 22 Max. 12
	Conductor cross section solid	Min. 0.33 mm² Max. 2.5 mm²
	Conductor cross section stranded	Min. 0.33 mm² Max. 2.5 mm²
	Conductor cross section stranded with ferrule without plastic sleeve	Min. 0.33 mm² Max. 2.5 mm²
	Conductor cross section stranded with ferrule with plastic sleeve	Min. 0.33 mm² Max. 2.5 mm²
	2 wires stranded with ferrule without plastic sleeve	Min. 0.33 mm² Max. 1 mm²
	2 wires stranded with ferrule with plastic sleeve	Min. 0.5 mm² Max. 1.31 mm²
	Wire strip length	Min. 6 mm Max. 7 mm
	Length ferrule	10 mm

73 The respective manufacturer is imprinted at the terminal (see section *Types of screw terminals, Page 353*)

Dimensions (W x H x D)	30 mm x 132 mm x 124 mm (without DIN rail and terminal, locking hook closed); D 142 mm (with inserted terminal)
Weight	252 g (incl. bus module 12 g)

Accuracy of the Measured Values

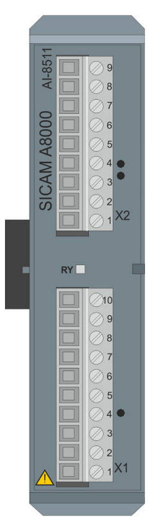
Measured variable	Dependency of accuracy class acc. to IEC 61557-12:2007-08 (K55)
Voltage U	1 %
Phase current I	1% at nominal frequency
Power P	3 %
Reactive power Q	3 %
Apparent power S	3 %
Power factor	3 %
Frequency f (49 to 51/59 to 61 Hz)	1 %

Accuracy of the Measured Ground Current with Isolated/Resonant Ground Connection

Measured variable	Dependency of accuracy class acc. to IEC 61557-12:2007-08 (K55)	
Ground current I_N setting	0.4 to 1.9 A	2.0 to 2000 A
Measuring range	0.2 to 2.43 A at 50/60 Hz	2.44 to 600 A at 50/60 Hz
Accuracy	±0.1 A for measuring range 0.2 to 2.43 A	±0.18 A for measuring range 2.44 to 11.99 A ±1 % for measuring range 12 to 600 A

5.8.13.4 Pin Assignment and Display

The process signals must be connected to a 10-pin and a 9-pin screw terminal. The peripheral connectors are assigned according to the tables.



[AI-8511_Front, 2, --_--]

Figure 5-64 AI-8511 Front

Connector X1

Pin	Signal	Meaning
10	DNC	Do not connect
9	DNC	Do not connect

Pin	Signal	Meaning
8	I1+	Measuring current input 1
7	I1-	Measuring current input 1
6	I2+/IN+	Measuring current input 2 / (sensitive) zero current
5	I2-/IN-	Measuring current input 2 / (sensitive) zero current
4	I3+	Measuring current input 3
3	I3-	Measuring current input 3
2	DNC	Do not connect
1	FE shield	Functional earth

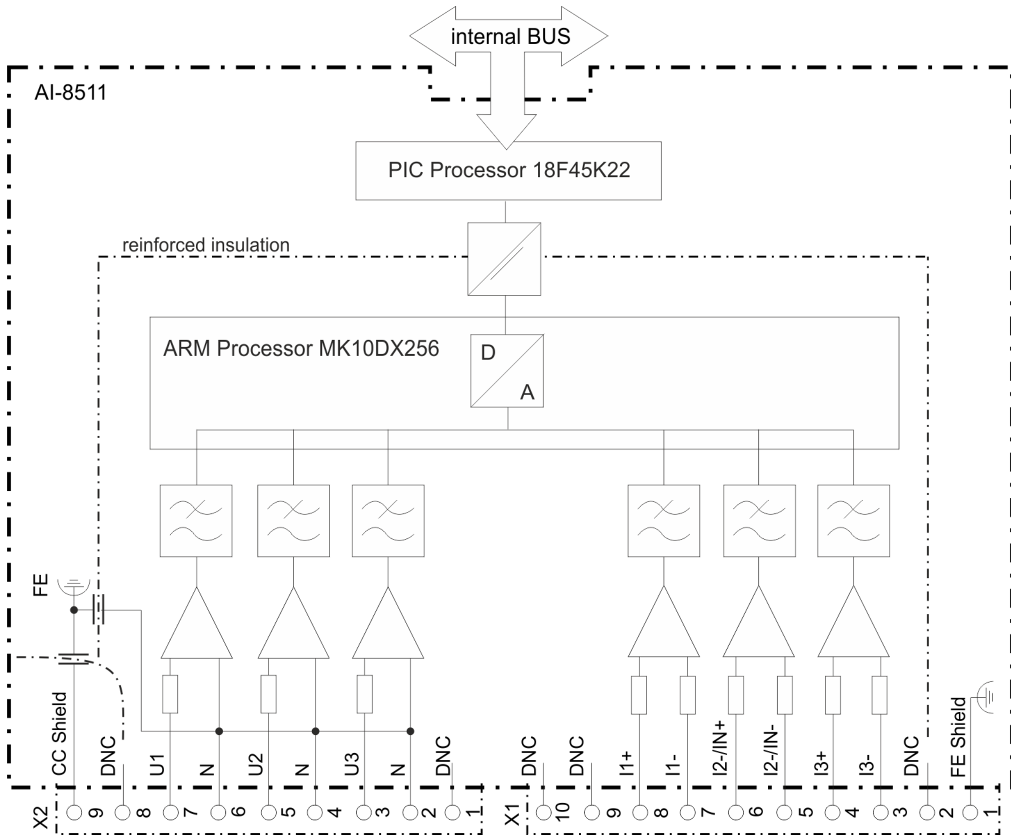
Connector X2

Pin	Signal	Meaning
9	CC shield	Capacitive coupled to protective earth
8	DNC	Do not connect
7	U1	Measuring voltage input 1
6	N	Measuring voltage input 1
5	U2	Measuring voltage input 2
4	N	Measuring voltage input 2
3	U3	Measuring voltage input 3
2	N	Measuring voltage input 3
1	DNC	Do not connect

Display

LED	Meaning
RY	Readiness

5.8.13.5 Block Diagram



[AI-8511_Block_Diagram, 1, en_US]

Figure 5-65 AI-8511 block diagram

DANGER

✧ The connectors X1 and X2 may be detached or attached in a de-energized state only!

WARNING

✧ The inputs for the connectors X1 and X2 must not be connected directly with a mains supply circuit!

NOTE

Bear in mind the direction of the current flow when connecting the current measuring inputs. In the case of inverse connection, the measured values are inverted and are given a negative sign.

The same applies to the voltage measurement (direction and rotation angle) respectively.

5.8.13.6 External Circuitry

The following circuitry variants are examples and do not relate exclusively to the depicted values.

DANGER

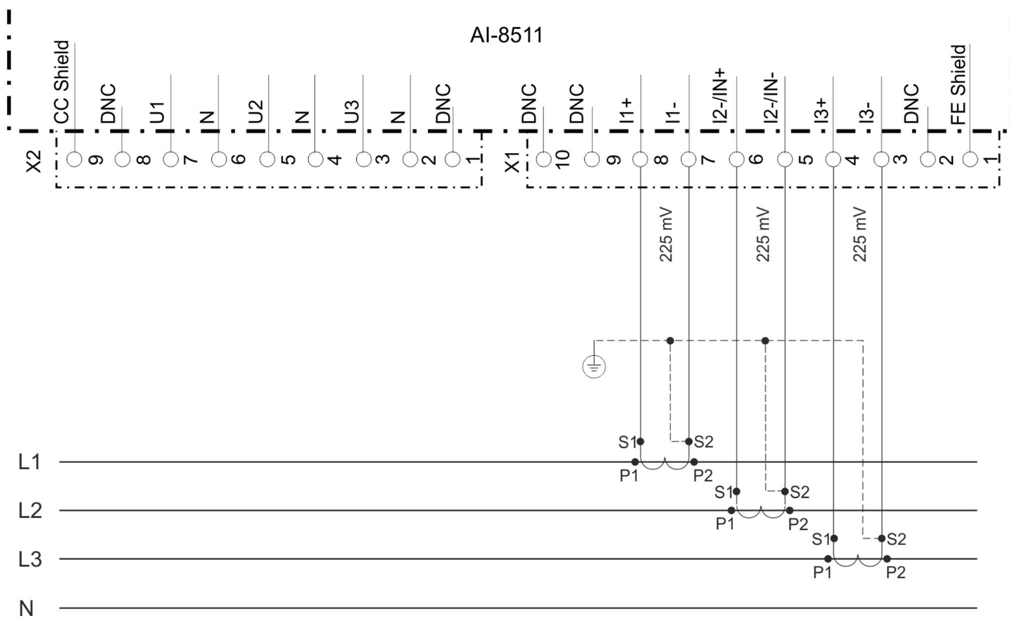
Work may be performed on the circuitry in a de-energized state only!

✧ During electrical installation, all the rules and regulations governing power systems must be observed.

Short-Circuit Indicator

The current inputs I1, I2/IN, I3 are connected with the LoPo measuring sensors of the corresponding phase currents.

In this configuration, the module functions as a short-circuit indicator. Fault information on the direction is not provided.



[dw_AI-8511_3xl, 1, en_US]

Figure 5-66 AI-8511 External Circuitry Variant for Short-Circuit Indicator

NOTE

With this connection scheme, the accuracy of zero-sequence current measurements for isolated/resonant ground connections cannot be guaranteed.

Ground-Fault Indicator

The current input I2/IN is connected with the LoPo sum current measuring sensor.
In this configuration, the module functions as a non-directional ground-fault indicator.

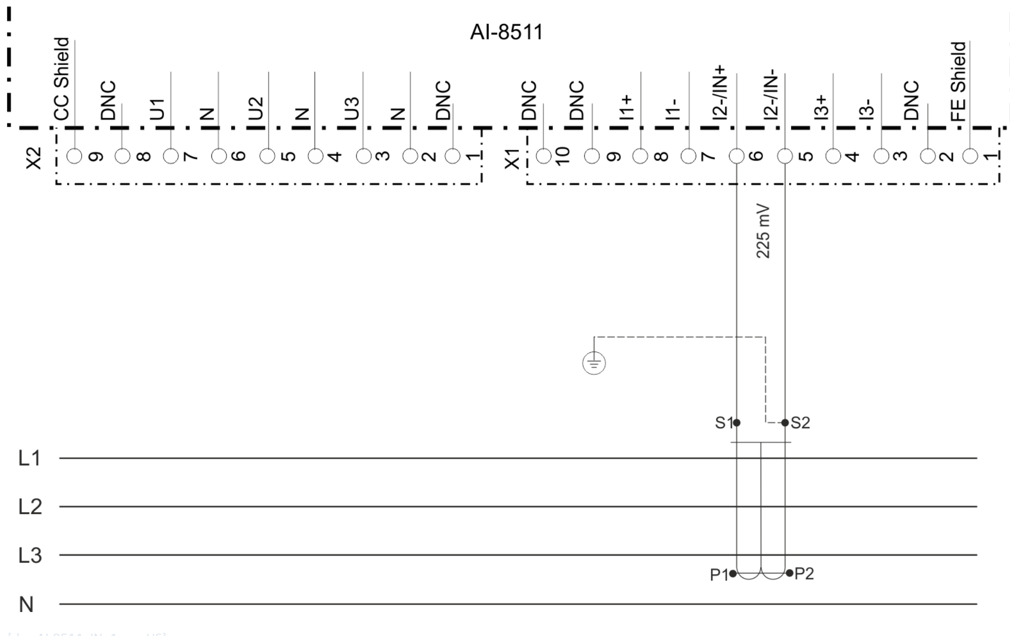


Figure 5-67 AI-8511 External Circuitry Variant for Ground-Fault Indicator

Fault Detector

The current inputs I1, I2/IN, I3 are connected to the corresponding LoPo measuring sensors. Additionally, the voltage inputs U1, U2, U3 are connected through LoPo voltage transformers with 3.25 V/√3 to the middle-voltage network.

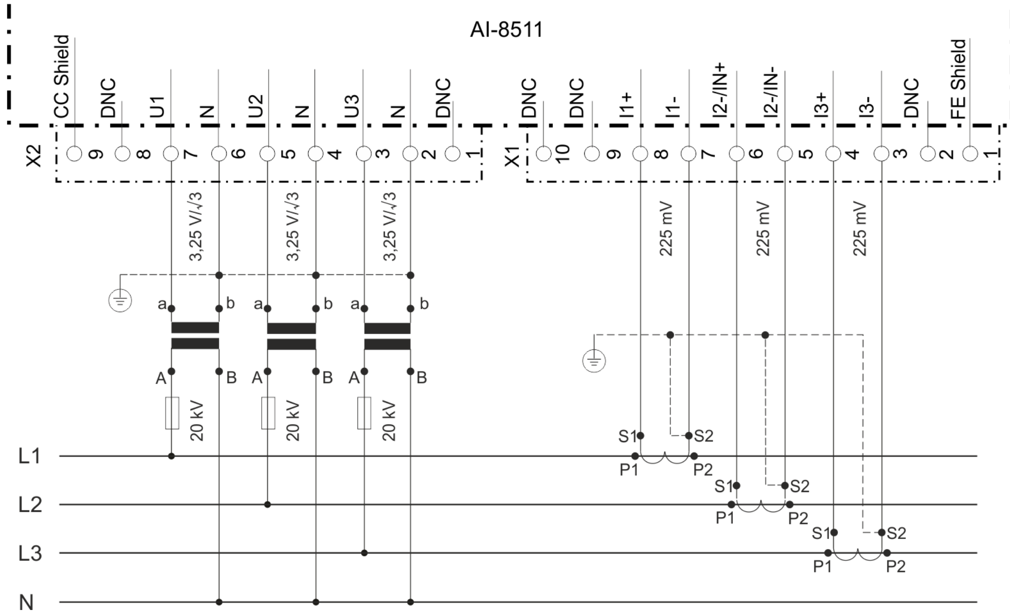
In this configuration, fault information with directional indication is output. All the measured and calculated measurands are thus also provided.

3-Phase Voltage, 3-Phase Current

Through the current inputs I1, I2/IN, I3, the corresponding phase currents are measured. The value IN is calculated. This configuration is used for solidly grounded networks.

In this configuration, the module also works as a power meter.

Example: Middle-voltage network



[dw_AI-8511_3xI_3xV, 1, en_US]

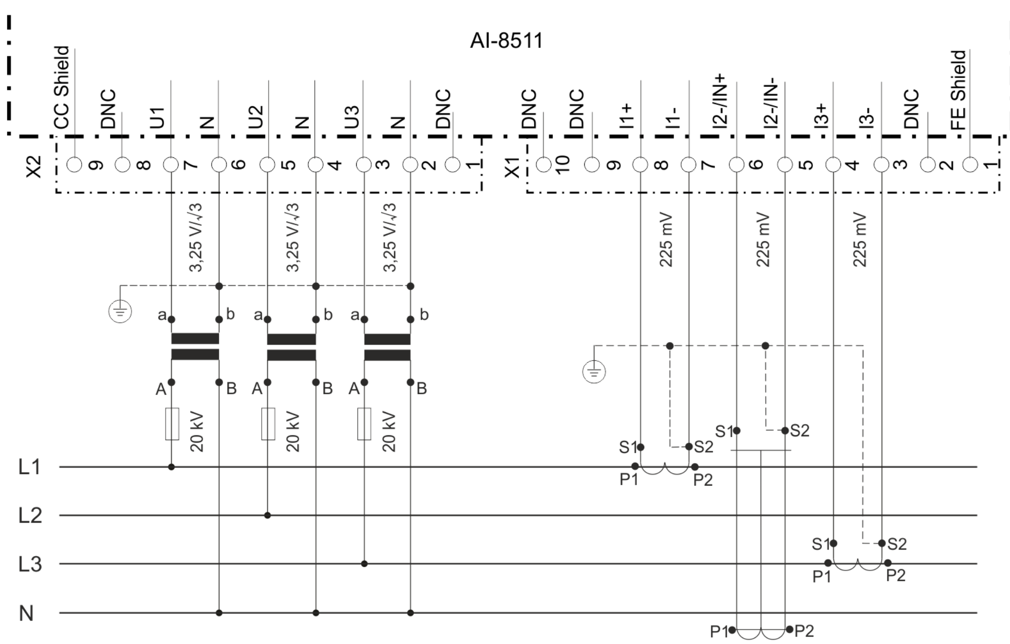
Figure 5-68 AI-8511 External Circuitry Variant for 3-Phase Voltage, 3-Phase Current

3-Phase Voltage, 2-Phase Current + Sensitive Ground Current

Through the current inputs I1 and I3, the corresponding phase currents are measured, and through the input I2/IN, the sensitive zero-sequence current is measured. The value I2 is calculated.

This configuration is used for isolated and resonant grounded networks.

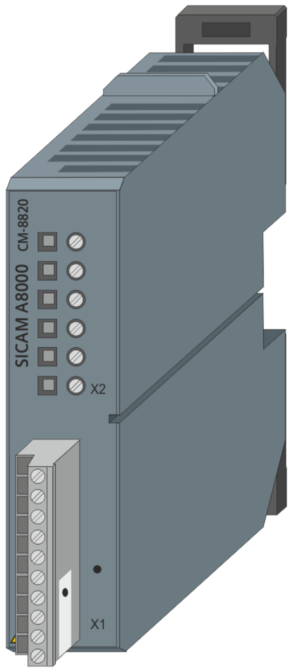
Example: Middle-voltage network



[dw_AI-8511_2xI_IN_3xV, 1, en_US]

Figure 5-69 AI-8511 External Circuitry Variant for 3-Phase Voltage, 2-Phase Current, Sensitive Zero-Sequence Current

5.8.14 CM-8820



[dw_CM-8820_Oblique, 1, --_--]

Figure 5-70 CM-8820

5.8.14.1 Features

- Mounting on DIN rail, at the last (right-most) slot of the I/O module line
- Current transformer adaptor for AI-8510
- 3 current transformer inputs
  - Nominal current max. 1 A or 5 A with 100% overrange
- LoPo voltage output 225 mV
  - Connection with AI-8510
  - Removable screw terminal for LoPo output

5.8.14.2 Functions

Acquisition Functions

- Measuring currents
  - Acquisition of currents via current measuring sensors
  - Measuring range 1 A or 5 A with 200% overrange

Output Functions

- Output through low-power outputs
  - Nominal voltage 225 mV
  - Measuring range 0 V to 450 mV

5.8.14.3 Technical Data

Inputs for Transformer Currents

Nominal current	1 A / 5 A (parameter-settable)
Max. measurement current	200 % I_N
nominal frequency	50 Hz, 60 Hz (range 45 to 65 Hz)
Internal consumption [74]	< 0.1 W at I_N = 1 A < 0.3 W at I_N = 5 A
Thermal withstand capability	10 A permanent 100 A 1 s

Outputs for measuring currents

Rated voltage:	AC 225 mV at I_N = 1 A following IEC 60044-8 1.125 V at I_N = 5 A
Max. voltage	2.25 V at I_N = 10 A
nominal frequency	50 Hz, 60 Hz (range 45 to 65 Hz)

Mechanics and Connectors

Terminals	• Removable screw terminal (grid size 5.08) mm) for 3 LoPo measuring current outputs, 10-pole (X1) • Integrated screw terminal for 3 transformer current inputs, 6-pole (X2)	
Rated impulse voltage ⚠	4 kV (measurement category III)	
Connection data X1	Locking torque (PHOENIX terminal) [75] Locking torque (FCI terminal) [75]	0.5 Nm to 0.6 Nm 0.36 Nm to 0.44 Nm
	AWG	min. 22 max. 12
	Conductor cross section solid	min. 0.33 mm² max. 2.5 mm²
	Conductor cross section stranded	min. 0.33 mm² max. 2.5 mm²
	Conductor cross section stranded with ferrule without plastic sleeve	min. 0.33 mm² max. 2.5 mm²
	Conductor cross section stranded with ferrule with plastic sleeve	min. 0.33 mm² max. 2.5 mm²
	2 wires stranded with ferrule without plastic sleeve	min. 0.33 mm² max. 1 mm²
	2 wires stranded with ferrule with plastic sleeve	min. 0.5 mm² max. 1.31 mm²
	Wire strip length	min. 6 mm max. 7mm
	Length ferrule	10 mm
	Max. cable length	0.5 m [76]

74 irrelevant for the power consumption (= 0 W)

75 The respective manufacturer is imprinted at the terminal (see section *Types of screw terminals, Page 353*)

76 plastic-insulated copper conductors (7 leads) with shield; up to 0.1 m (for side-by-side plugged AI-8510 and CM-8820) single wires without shield are possible Nominal voltage U_0/U = 300/500 V, Temperature range -40 to 80°C

Connection data X2	Locking torque	0.5 Nm
	AWG	min. 24 max. 14
	Conductor cross section solid	min. 0.2 mm² max. 2.5 mm²
	Conductor cross section stranded	min. 0.2 mm² max. 2.5 mm²
	Conductor cross section stranded with ferrule without plastic sleeve	min. 0.25 mm² max. 1.5 mm²
	Conductor cross section stranded with ferrule with plastic sleeve	min. 0.2 mm² max. 1.5 mm²
	2 wires stranded with ferrule without plastic sleeve	min. 0.33 mm² max. 1 mm²
	2 wires stranded with ferrule with plastic sleeve	min. 0.25 mm² max. 0.34 mm²
	Wire strip length	9 mm
	Length ferrule	10 mm
Dimensions (W x H x D)	30 mm x 132 mm x 124 mm (without DIN rail and terminal X1, locking hook closed); D 142 mm (with inserted terminal X1)	
Weight	303 g (incl. bus module 12 g)	

NOTE

For USA and Canada: NRTL/SCC certified current transformers are required. Use only UL listed energymonitoring current transformers.

NOTE

For each installed AI-8510 a CM-8820 must be connected ahead, if the current measurement is used. Thereby CM-8820 modules may only be installed at the end of a module line (right-most), else the internal system bus is interrupted.

CM-8820 modules may also be installed at a separate DIN rail, whereby the maximal cable length must be considered.

NOTE

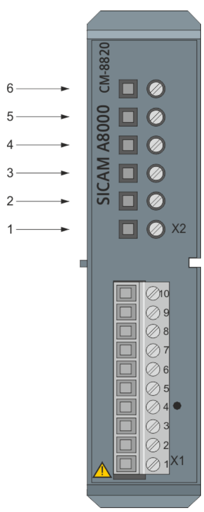
The current carrying capacity of the connection cable is to be designed in relation to the maximum continuous current or overcurrent.

Accuracy of the Measured Values

Measured variable	Dependency of accuracy class acc. to IEC 61557-12:2007-08 (K55)
Nominal current (input)	1 A 2 % at 50 Hz, max. angle deviation 3° 2 % at 60 Hz, max. angle deviation 3° 5 A 2 % at 50 Hz, max. angle deviation 3° 3 % at 60 Hz, max. angle deviation 3°
Nominal voltage (output)	3 %
nominal frequency	50 Hz 2 % at 0.2 to 10 A , max. angle deviation 3° 60 Hz 3 % at 0.2 to 10 A , max. angle deviation 3°

5.8.14.4 Pin Assignment

The process signals must be connected to 2 screw terminals. The peripheral connectors are assigned according to the tables.



[dw_CM-8820_Front_v2, 1, --_--]

Figure 5-71 CM-8820 Front

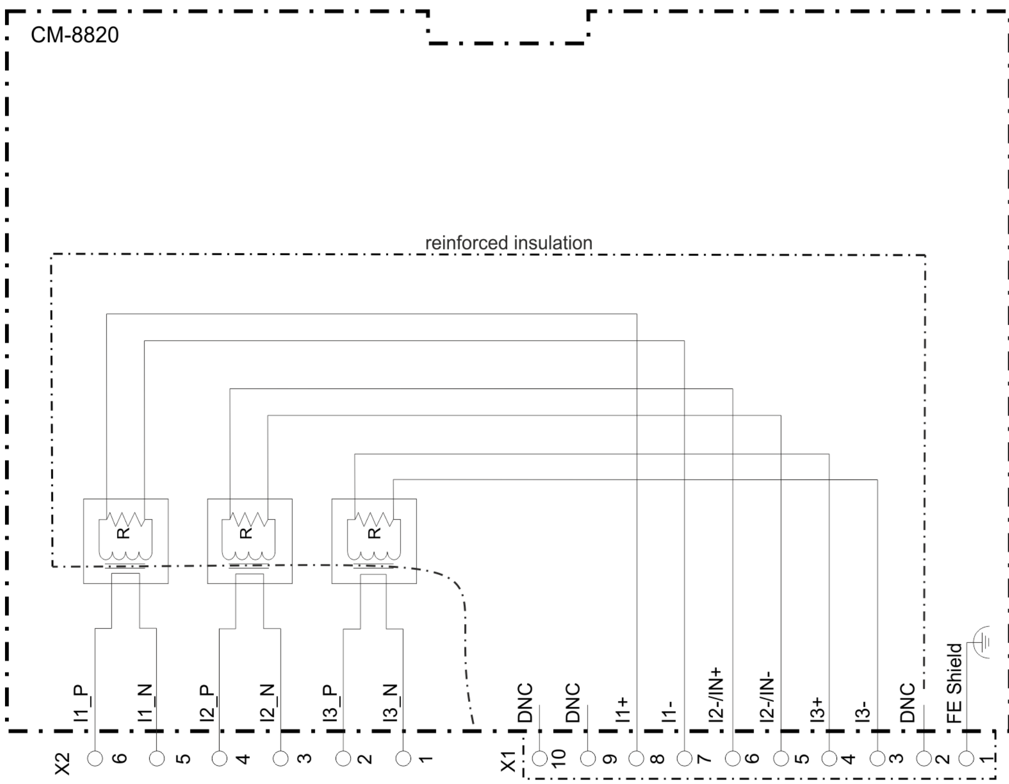
Connector X1

Pin	Signal	Meaning
10	DNC	do not connect
9	DNC	do not connect
8	I1+	measuring current output 1
7	I1-	measuring current output 1
6	I2+/IN+	measuring current output 2 / (sensitive) zero-sequence current
5	I2-/IN-	measuring current output 2 / (sensitive) zero-sequence current
4	I3+	measuring current output 3
3	I3-	measuring current output 3
2	DNC	do not connect
1	FE shield	functional earth

X2 current transformer terminals

Pin	Signal	Meaning
6	I1_P	current transformer input 1
5	I1_N	current transformer input 1
4	I2_P	current transformer input 2
3	I2_N	current transformer input 2
2	I3_P	current transformer input 3
1	I3_N	current transformer input 3

5.8.14.5 Block Diagram



[dw_CM-8820_Block_Diagram, 1, en_US]

Figure 5-72 CM-8820 block diagram

DANGER

✧ The connectors X1 and X2 may be detached or attached in de-energized state only!

WARNING

✧ The inputs of connector X1 and X2 must not be connected directly with a mains supply circuit!

NOTE

Within the signal inputs exists only functional insulation. Therefore, the use of different current circuits is not permitted.

CAUTION

✧ Direct currents cannot be measured with CM-8820.

NOTE

Please take account of the direction of current flow when connecting the current measuring inputs. With inverse connection, the measured values are inverted and receive a negative sign.

5.8.14.6 External Circuitry

The following circuitry variants are examples and not related exclusively to the shown values.

DANGER

Works on the circuitry may be performed in de-energized state only!

✧ During electrical installation, all the rules and regulations of power systems must be considered.

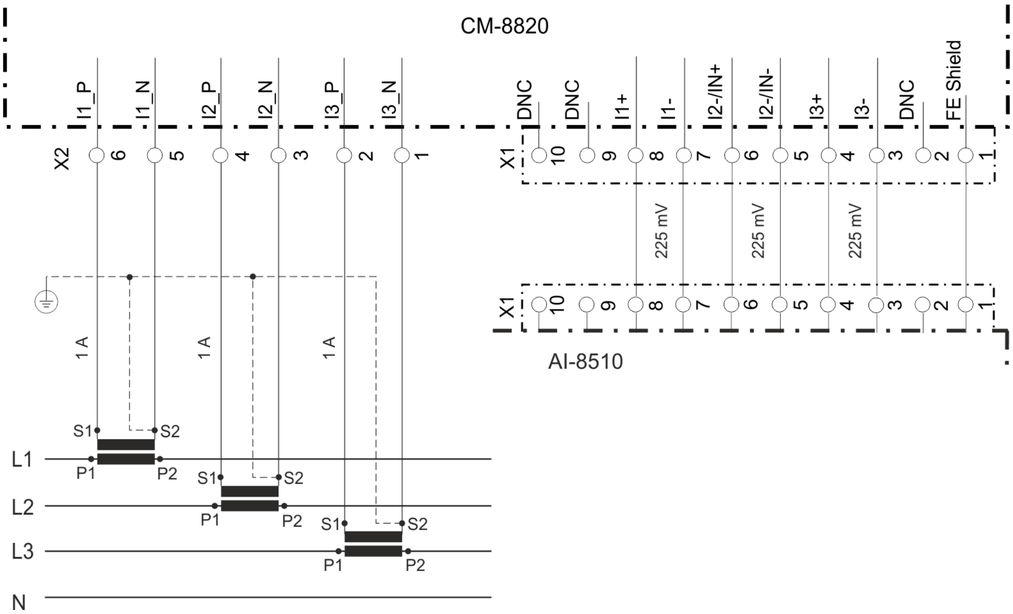
DANGER

Open transformer circuits will result in electric shock and arc flashover. Will cause death, serious injury or considerable property damage.

✧ Only measure current with external current transformers. Do not use fuses for circuit protection. Do not open the secondary circuit under load. Short circuit the secondary current terminals of the current transformers before removing this device. The safety information for the current transformers used must be followed.

3-Phase Current

Through the current inputs I1_P/I1_N, I2_P/I2_N, I3_P/I3_N the corresponding phase currents are measured.

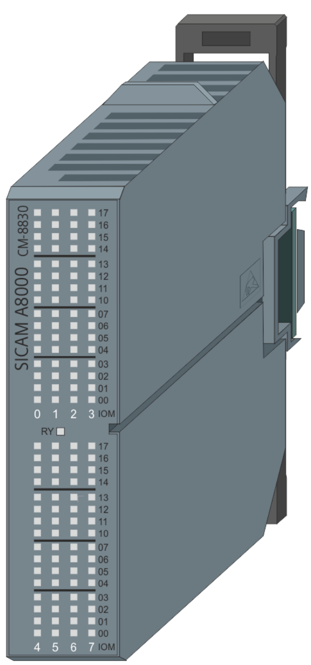


[dw_CM-8820_3xI, 1, en_US]

Figure 5-73 CM-8820 external circuitry for 3-phase current

Further options see *5.8.12.6 External Circuitry*.

5.8.15 CM-8830



[dw_CM-8830_Oblique, 1, --_--]

Figure 5-74 CM-8830

5.8.15.1 Features

LED Module for a SICAM A8000 I/O row

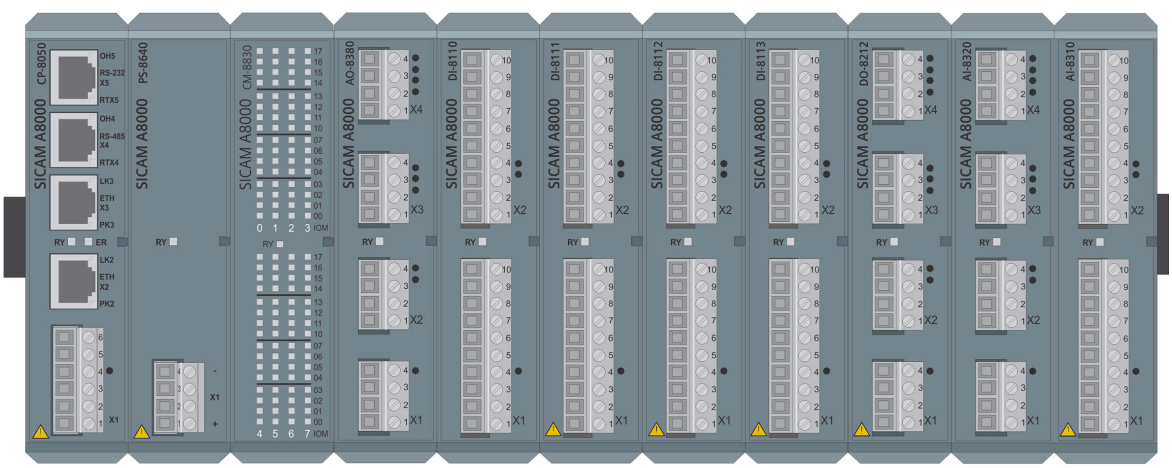
- Assembly on 35 mm DIN rail
- Indication of I/O module status (RY)
- Indication of I/O process status
- Indication of I/O process errors (ER)
- With a power consumption of less than 0.5 W, CM-8830 does not affect the power distribution of an existing SICAM A8000 I/O row

5.8.15.2 Functions

- CM-8830 is detected after mounting without project engineering from the Master Module.
- CM-8830 is ready (RY) only when the Master Module system startup has been completed.
- The I/O process status of the DI and AI modules is displayed without project engineering from the SICAM A8000 system.
- The LEDs provide actual status functions and status indications during system operation
- The LEDs also indicate correct wiring during commissioning
- CM-8830 updates the process data display every 100 ms

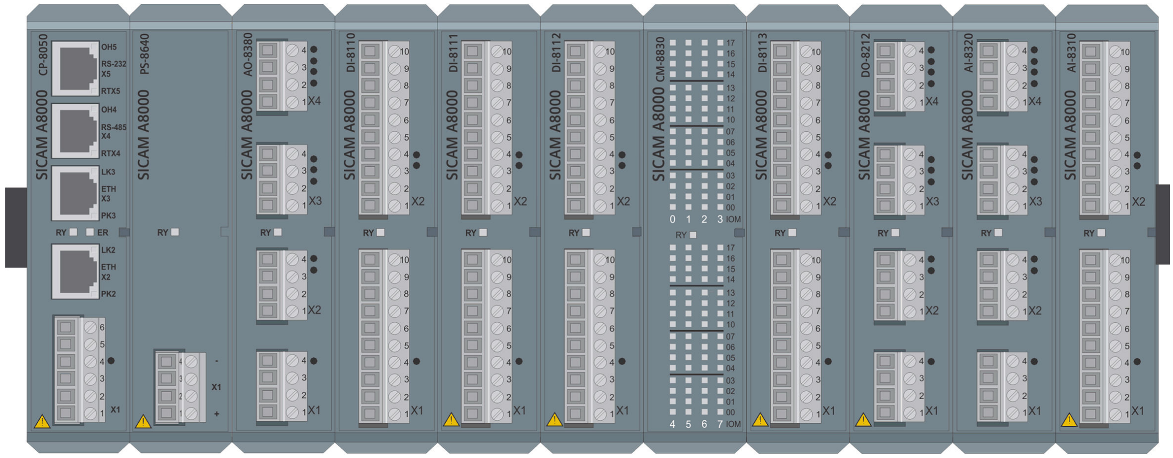
A detailed description of the visualization is provided in chapter *12.3.6 LED Module*

CM-8830 can be fitted in any position on the right side of the power supply on the SICAM A8000 I/O row, as shown in the following 3 figures.



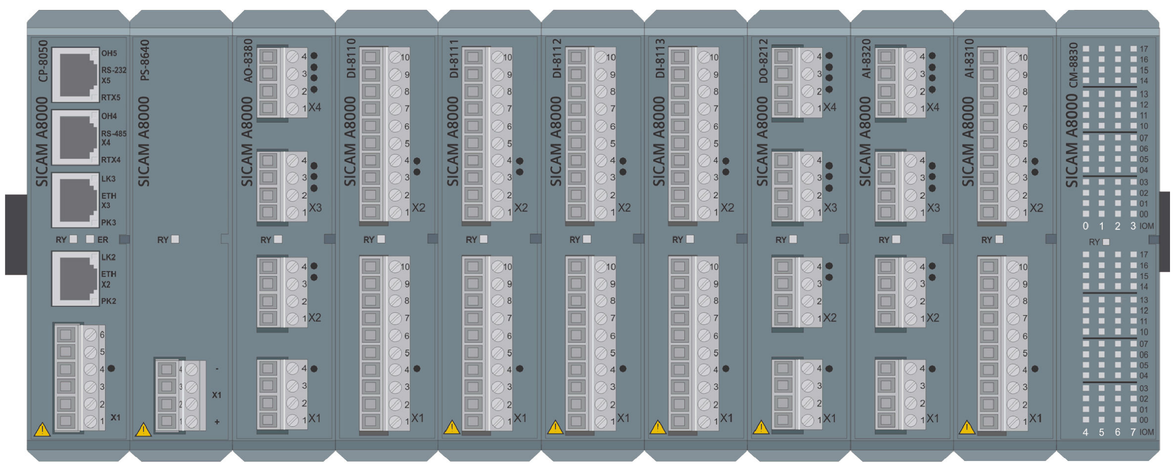
[dw_CM-8830_firstposition_8050, 1, --_--]

Figure 5-75 CM-8830 in the First Position



[dw_CM-8830_midposition_8050, 1, --_--]

Figure 5-76 CM-8830 in the Middle Position



[dw_CM-8830_lastposition_8050, 1, --_--]

Figure 5-77 CM-8830 in the Last Position

5.8.15.3 Technical Data

Power Supply

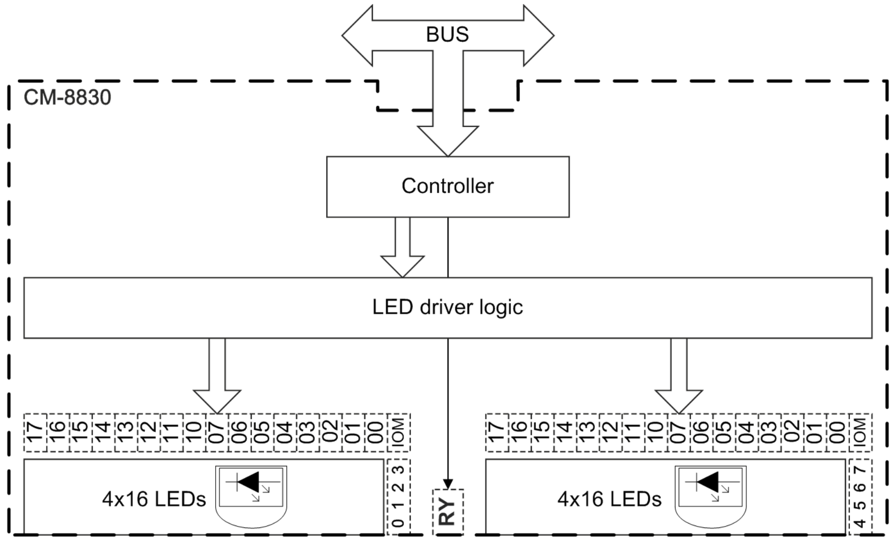
Operating voltage	DC 4.75 V to 5.5 V The voltage is picked off from the bus
Power consumption	500 mW

Mechanics

Dimensions (W x H x D)	30 mm x 132 mm x 124 mm (without DIN rail, locking hook closed)
Weight	185 g (inkl. bus module 12 g)
Protection type	Class III

5.8.15.4 Block Diagram

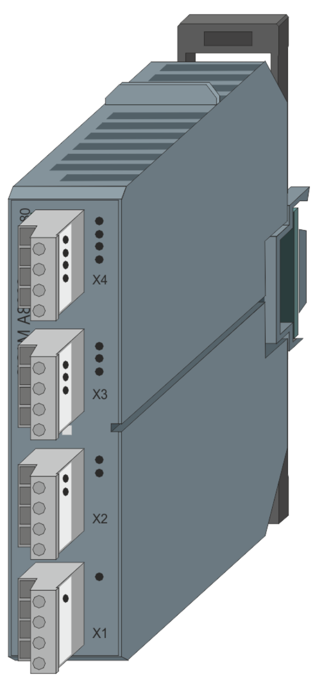
The following circuitry variant is an example, and does not relate exclusively to the depicted inputs/outputs.



[dw_cm8830_blockdiagram, 1, en_US]

Figure 5-78 LED Module Block Diagram

5.8.16 AO-8380



[AO-8380_Oblique_View, 1, --_--]

Figure 5-79 AO-8380

5.8.16.1 Features

Analog output module

- Installation on 35 mm DIN rail
- 4 outputs (4 groups with 1 output each)
- Galvanically insulated by optocouplers
- Output of currents ±20 mA, ±10 mA

- Output of voltages ±10 V
- Removable screw terminals
- Function indication via LED

5.8.16.2 Functions

Setpoint Values via Currents and Voltages

- Output range settable with a resolution of [fa]
  - 16 bits (15 bits + sign) at full output range
  - Shrinking the range results in decreasing resolution
- Basic application functions and procedures according to IEC 60870-5-101/104 [fa]
  - Formal check
  - Direct command
  - Select and execute command
- Adaptation [f]
  - Linear (normalized, technologically scaled or short floating-point) [f]
- Selectable behavior in case of communication failure and module failure [fa]
  (keep value, output substitute value)
- Spontaneous transmission [f] or
- Periodical transmission [a]

NOTE

The previously mentioned functions are described in detail in the document *SICAM RTUs Common Functions Peripheral Elements according to IEC 60870-5-101/104, chapter* ***Setpoint Values by means of Currents and Voltages***.

5.8.16.3 Technical Data

Analog Outputs

4 analog outputs	All outputs galvanically insulated
Current output	Max. ±20 mA on max. 500 Ω load Max. ±10 mA on max. 1 kΩ load
Voltage output	Max. ±10 V on min. 1 kΩ load
Resolution	0.025 % at ±20 mA, ±10 mA, ±10 V
Accuracy	0.3 % at 25 °C 0.4 % at 0 to 50 °C 0.7 % at –20 to 70 °C 0.8 % at –40 to 70 °C
Output circuits	The circuits are operated with internal voltage

Power Supply

Operating voltage	DC 4.75 to DC 5.5 V The voltage is picked off from the system bus
Power consumption	Max. 2200 mW

Mechanics and Connectors

Terminals	4 removable screw terminals (grid size 5.08 mm), 4-pole	
Rated impulse voltage	2.0 kV	
Connection data X1, X2, X3, X4	Locking torque (PHOENIX terminal) [77] Locking torque (FCI terminal) [77]	0.5 Nm to 0.6 Nm 0.36 Nm to 0.44 Nm
	AWG	Min. 22 Max. 12
	Conductor cross section solid	Min. 0.33 mm² Max. 2.5 mm²
	Conductor cross section stranded	Min. 0.33 mm² Max. 2.5 mm²
	Conductor cross section stranded with ferrule without plastic sleeve	Min. 0.33 mm² Max. 2.5 mm²
	Conductor cross section stranded with ferrule with plastic sleeve	Min. 0.33 mm² Max. 2.5 mm²
	2 wires stranded with ferrule without plastic sleeve	Min. 0.33 mm² Max. 1 mm²
	2 wires stranded with ferrule with plastic sleeve	Min. 0.5 mm² Max. 1.31 mm²
	Wire strip length	Min. 6 mm Max. 7 mm
	Length ferrule	10 mm
Dimensions (W x H x D)	30 mm x 132 mm x 124 mm (without DIN rail and terminal, locking hook closed); D 142 mm (with inserted terminal)	
Weight	300 g (incl. bus module 12 g)	

5.8.16.4 Pin Assignment and Display

The process signals must be connected to four 4-pin screw terminals. The peripheral connectors are assigned according to the tables.

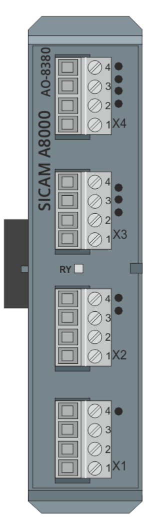


Figure 5-80 AO-8380 Front

[77] The respective manufacturer is imprinted at the terminal (see section *Types of screw terminals, Page 353*)

Connector X1

Pin	Signal	Meaning
4	DNC	Do not connect
3	OUT V0-	Analog output of group 0
2	OUT V0+	Analog output of group 0
1	DNC	Do not connect

Connector X2

Pin	Signal	Meaning
4	DNC	Do not connect
3	OUT V1-	Analog output of group 1
2	OUT V1+	Analog output of group 1
1	DNC	Do not connect

Connector X3

Pin	Signal	Meaning
4	DNC	Do not connect
3	OUT V2-	Analog output of group 2
2	OUT V2+	Analog output of group 2
1	DNC	Do not connect

Connector X4

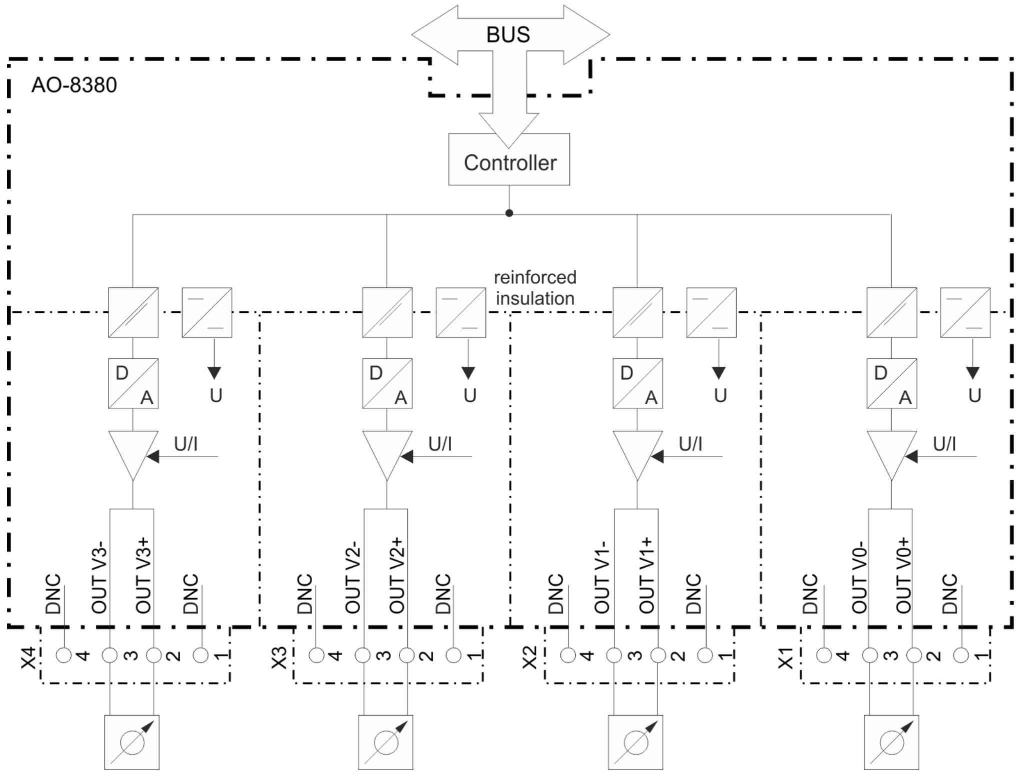
Pin	Signal	Meaning
4	DNC	Do not connect
3	OUT V3-	Analog output of group 3
2	OUT V3+	Analog output of group 3
1	DNC	Do not connect

Display

LED	Meaning
RY	Readiness

5.8.16.5 Block Diagram and External Circuitry

The following circuitry variant is an example, and does not relate exclusively to the depicted inputs/outputs.



[AO-8380_Block_Diagram_External_Circuitry, 2, en_US]

Figure 5-81 AO-8380 Block Diagram and External Circuitry Variant

5.9 SICAM A8000 Rack I/O Modules

5.9.1 DI-2112, DI-2113, DI-2114, DI-2115

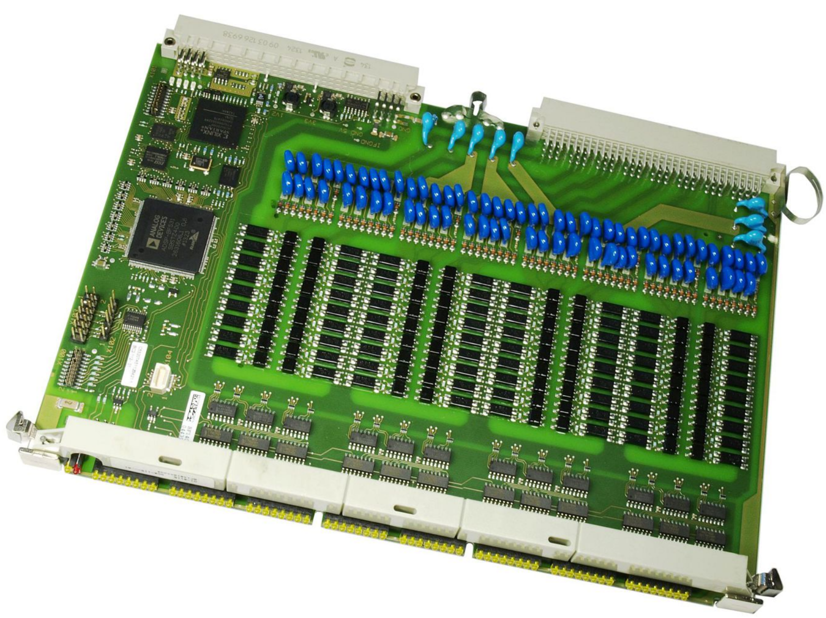
NOTE

Use only in connection with CP-8050.

The Rack I/O modules DI-2112/BISIX86, DI-2113/BISIX86, DI-2114/BISIX86 and DI-2115/BISIX86 are used for acquisition of digital input signals.

- DI-2112 Digital Input 8x8, 24VDC,1ms
- DI-2113 Digital Input 8x8, 48/60VDC,1ms
- DI-2114 Digital Input 8x8, 110VDC,1ms
- DI-2115 Digital Input 8x8, 220VDC,1ms

They consist of a module and loadable firmware (binary signal input).
(Firmware BISIX86 is firmware compatible to SICAM AK Firmware BISIX26)



[ph_DI-2115, 1, --_--]

5.9.1.1 Features

- Acquisition and processing according to IEC 60870-5-101/104
  - Up to 64 single-point information units, or
  - Up to 32 double-point information units, or
  - Up to 64 integrated totals via count pulses, or
  - A combination thereof
- 64 binary inputs (8 groups)
- 1 additional binary input for power monitoring for each group
- Galvanical insulation by optocouplers

- Common return for each group
- Signal voltage
  - **DI-2112**: DC 24 V
  - **DI-2113**: DC 48 V to 60 V
  - **DI-2114**: DC 110 V
  - **DI-2115**: DC 220 V
- Filter-equipped input circuit
- Integrated totals not power-fail safe
- Indication of function and state of the inputs via LEDs
- Installation in Rack

5.9.1.2 Functions

Single-point informations

- Acquisition with a resolution of 1 ms
- Update every 10 ms (or with the same cycle as the open-/closed-loop control function in the basic system element, depending on which cycle is larger)
- Revision
- Power monitoring
- Inversion
- Firmware Filter
- Bounce Suppression
- Determination of the cause of transmission
- Spontaneous transmission of changes
- periodical transmission

Double-point informations

- Acquisition with a resolution of 1 ms
- Update every 10 ms (or with the same cycle as the open-/closed-loop control function in the basic system element, depending on which cycle is larger)
- Revision
- Power monitoring
- Inversion
- Firmware Filter
- Bounce Suppression
- Monitoring intermediate- and faulty positions
- Determination of the cause of transmission
- Reporting switching operations in progress
- Breaker Tripping Detection
- Breaker Tripping Suppression during Auto-reclose
- Spontaneous transmission of changes
- periodical transmission

NOTE

The above mentioned functions are described in detail in the document *SICAM RTUs Common Functions Peripheral Elements according to IEC 60870-5-101/104*.

Integrated totals via count pulses

- Acquisition by firmware with a maximum count frequency of 20 Hz
  - Pulse length/pause >20 ms/>20 ms
  - Revision
  - Power monitoring
  - Inversion
  - Pulse counting
- Counter value formation
  - Count pulse evaluation
  - Set Counter
- Integrated total formation
  - Counter request
  - Interval control
  - Frozen absolute value
  - Frozen relative value
- Not power-fail safe
- Integrated total transmission according to IEC 60870-5-101/104
- Spontaneous transmission

Return Information to Pulse Command Assignment

- Settable assignment for messages and pulse commands, which
  - are acquired or output on the peripheral element itself or
  - on different peripheral elements of the same basic system element

.

5.9.1.3 Technical Data

Binary Inputs

64 binary inputs 8 auxiliary inputs	• 8 groups, each with 8 inputs and 1 auxiliary input • Galvanical insulation • Each group has a common return with settable polarity • Power monitoring using the auxiliary input of each group (optional)
Filter time	typ. 3.5 ms
Rated voltage:	• **DI-2112**: DC 24 V • **DI-2113**: DC 48 V to 60 V • **DI-2114**: DC 110 V • **DI-2115**: DC 220 V

Operating points	• **DI-2112**: ≤ 12 V (logical "0"); ≥ 18 V (logical "1") • **DI-2113**: ≤ 24 V (logical "0"); ≥ 36 V (logical "1") • **DI-2114**: ≤ 55 V (logical "0"); ≥ 82.5 V (logical "1") • **DI-2115**: ≤ 110 V (logical "0"); ≥ 165 V (logical "1")
Input circuits (operated by means of external voltage)	• **DI-2112**: DC 18 V to 31.2 V • **DI-2113** – DC 36 V to 70 V according to EN 61010-1:2010 – DC 36 V to 60 V according to IEC 61010-1:2010/AMD1:2016 • **DI-2114**: DC 82.5 to 143 V • **DI-2115**: DC 165 to 250 V
Rated current	• **DI-2112**: 1.4 to 5.2 mA (at 18 to 31.2 V) • **DI-2113**: 0.6 to 2.2 mA (at 36 to 78 V) • **DI-2114**: 0.4 to 1.1 mA (at 82.5 to 143 V) • **DI-2115**: 0.2 to 0.4 mA (at 165 to 250 V)

Power Supply

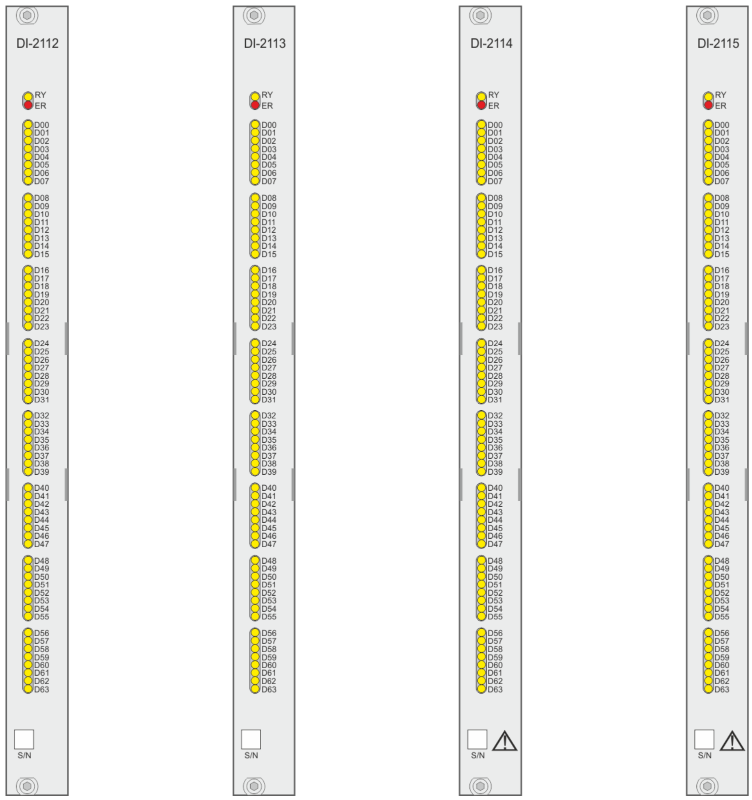
Operating voltage	DC 4.75 V to 5.25 V The voltage is picked off from the bus of rack
Power Consumption	typ. 1 W

Mechanics and Connectors

Ax 1703 Peripheral Bus	Transmission rate 16 Mbit/s
Peripheral connector	96 pin according to DIN 41612 type C
Rated impulse voltage	2.0 kV
Dimensions	Double euro format 233.4 x 160 mm, 4 WU
Weight	Approx. 300 g

5.9.1.4 Display

The LEDs on the front panel indicate the operating state of the module and the process state signals of the digital inputs.



DI-2112 DI-2113 DI-2114 DI-2115

LED	Meaning
RY	Readiness
ER	Fault
D00 to D63	Process status binary inputs

5.9.1.5 Pin Assignment

Connector X2

A 96-pin male connector according to DIN 41612 type C is used. The peripheral connector's pin assignment is described in the following table.

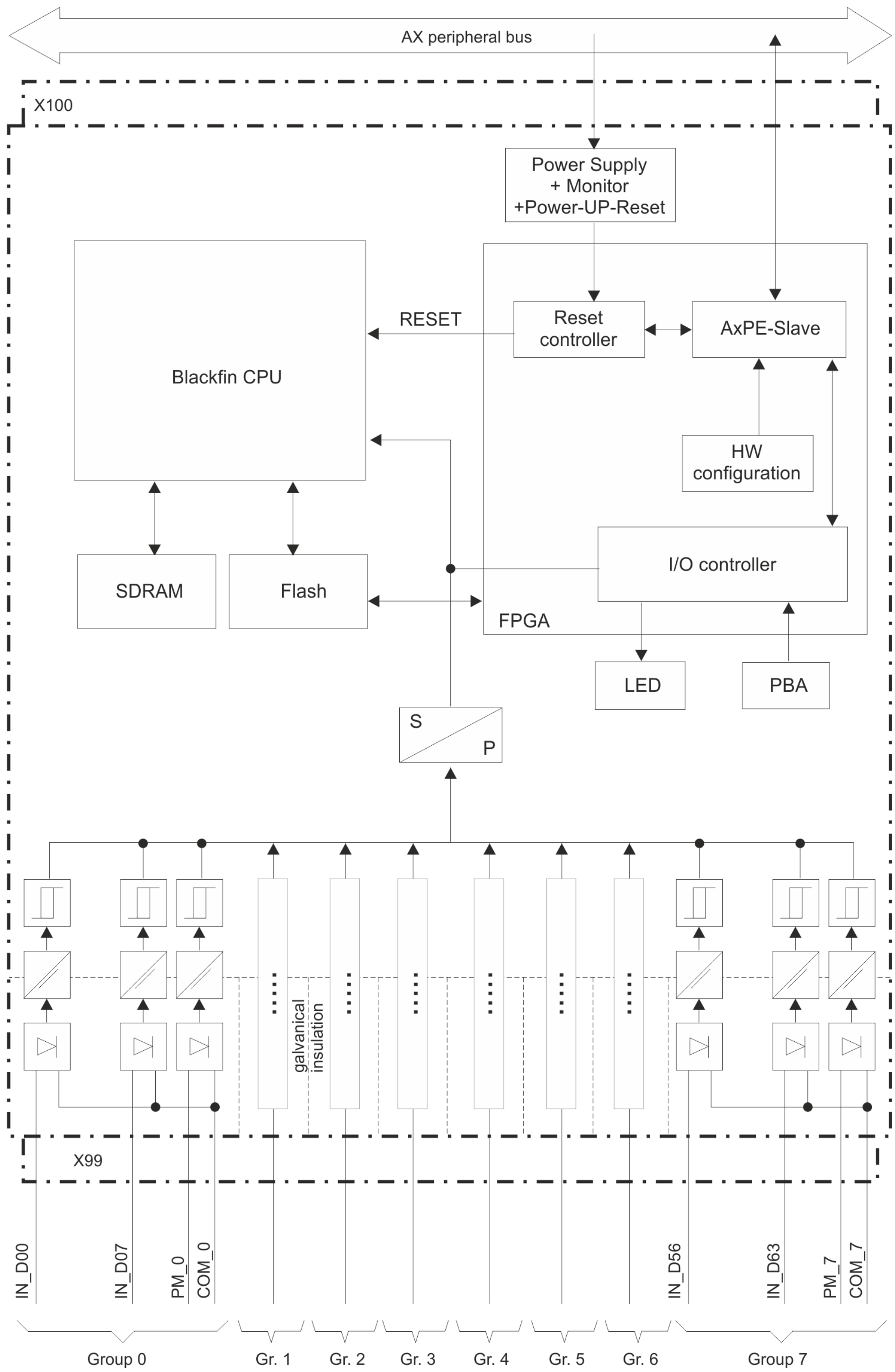
X2	Peripheral cable CM-2890		Signal	X2	Peripheral cable CM-2890		Signal	X2	Peripheral cable CM-2890		Signal
	Wire	Color			Wire	Color			Wire	Color	
c1	03	whbu/ye	IN D02	b1	02	bu/whbu	IN D01	a1	01	whbu/bu	IN D00
c2	06	gn/whbu	IN D05	b2	05	whbu/gn	IN D05	a2	04	ye/whbu	IN D03
c3	09	whbu/bk	IN PM0	b3	08	bn/whbu	IN D07	a3	07	whbu/bn	IN D06
c4	12	bu/whye		b4	11	whye/bu		a4	10	bk/whbu	COM0
c5	15	whye/gn	IN D10	b5	14	ye/whye	IN D09	a5	13	whye/ye	IN D08
c6	18	bn/whye	IN D13	b6	17	whye/bn	IN D12	a6	16	gn/whye	IN D11
c7	21	whgn/bu	IN PM1	b7	20	bk/whye	IN D15	a7	19	whye/bk	IN D14
c8	24	ye/whgn		b8	23	whgn/ye		a8	22	bu/whgn	COM1
c9	27	whgn/bn	IN D18	b9	26	gn/whgn	IN D17	a9	25	whgn/gn	IN D16
c10	30	bk/whgn	IN D21	b10	29	whgn/bk	IN D20	a10	28	bn/whgn	IN D19
c11	33	whbn/ye	IN PM2	b11	32	bu/whbn	IN D23	a11	31	whbn/bu	IN D22
c12	36	gn/whbn		b12	35	whbn/gn		a12	34	ye/whbn	COM2

X2	Peripheral cable CM-2890		Signal	X2	Peripheral cable CM-2890		Signal	X2	Peripheral cable CM-2890		Signal
	Wire	Color			Wire	Color			Wire	Color	
c13	39	whbn/bk	IN D26	b13	38	bn/whbn	IN D25	a13	37	whbn/bn	IN D24
c14	42	bu/whbk	IN D29	b14	41	whbk/bu	IN D28	a14	40	bk/whbn	IN D27
c15	45	whbk/gn	IN PM3	b15	44	ye/whbk	IN D31	a15	43	whbk/ye	IN D30
c16	48	bn/whbk		b16	47	whbk/bn		a16	46	gn/whbk	COM3
c17	51	rdbu/bu	IN D34	b17	50	bk/whbk	IN D33	a17	49	whbk/bk	IN D32
c18	54	ye/rdbu	IN D37	b18	53	rdbu/ye	IN D36	a18	52	bu/rdbu	IN D35
c19	57	rdbu/bn	IN PM4	b19	56	gn/rdbu	IN D39	a19	55	rdbu/gn	IN D38
c20	60	bl/rdbl		b20	59	rdbu/bk		a20	58	bn/rdbu	COM4
c21	63	rdye/ye	IN D42	b21	62	bu/rdye	IN D41	a21	61	rdye/bu	IN D40
c22	66	gn/rdye	IN D45	b22	65	rdye/gn	IN D44	a22	64	ye/rdye	IN D43
c23	69	rdye/bk	IN PM5	b23	68	bn/rdye	IN D47	a23	67	rdye/bn	IN D46
c24	72	bu/rdgn		b24	71	rdgn/bu		a24	70	bk/rdye	COM5
c25	75	rdgn/gn	IN D50	b25	74	ye/rdgn	IN D49	a25	73	rdgn/ye	IN D48
c26	78	bn/rdgn	IN D53	b26	77	rdgn/bn	IN D52	a26	76	gn/rdgn	IN D51
c27	81	rdbn/bu	IN PM6	b27	80	bk/rdgn	IN D55	a27	79	rdgn/bk	IN D54
c28	84	ye/rdbn		b28	83	rdbn/ye		a28	82	bu/rdbn	COM6
c29	87	rdbn/bn	IN D58	b29	86	gn/rdbn	IN D57	a29	85	rdbn/gn	IN D56
c30	90	bk/rdbn	IN D61	b30	89	rdbn/bk	IN D60	a30	88	bn/rdbn	IN D59
c31	93	rdbk/ye	IN PM7	b31	92	bu/rdbk	IN D63	a31	91	rdbk/bu	IN D62
c32	96	gn/rdbk		b32	95	rdbk/gn		a32	94	ye/rdbk	COM7

The "X2" column refers to the male connector of the peripheral connector.
The abbreviations have the following meaning:
IN D00 to IN D07 ... Digital inputs group 0, Bit0 to Bit7
IN D08 to IN D15 ... Digital inputs group 1, Bit0 to Bit7
IN D16 to IN D23 ... Digital inputs group 0, Bit0 to Bit7
IN D24 to IN D31 ... Digital inputs group 0, Bit0 to Bit7
IN D32 to IN D39 ... Digital inputs group 0, Bit0 to Bit7
IN D40 to IN D47 ... Digital inputs group 0, Bit0 to Bit7
IN D48 to IN D55 ... Digital inputs group 0, Bit0 to Bit7
IN D56 to IN D63 ... Digital inputs group 0, Bit0 to Bit7
IN PM0 to IN PM7 ... Digital inputs - Power monitoring 0 to 7
COM0 to COM7 ... Common group 0 to 7

5.9.1.6 Block Diagram and External Circuitry

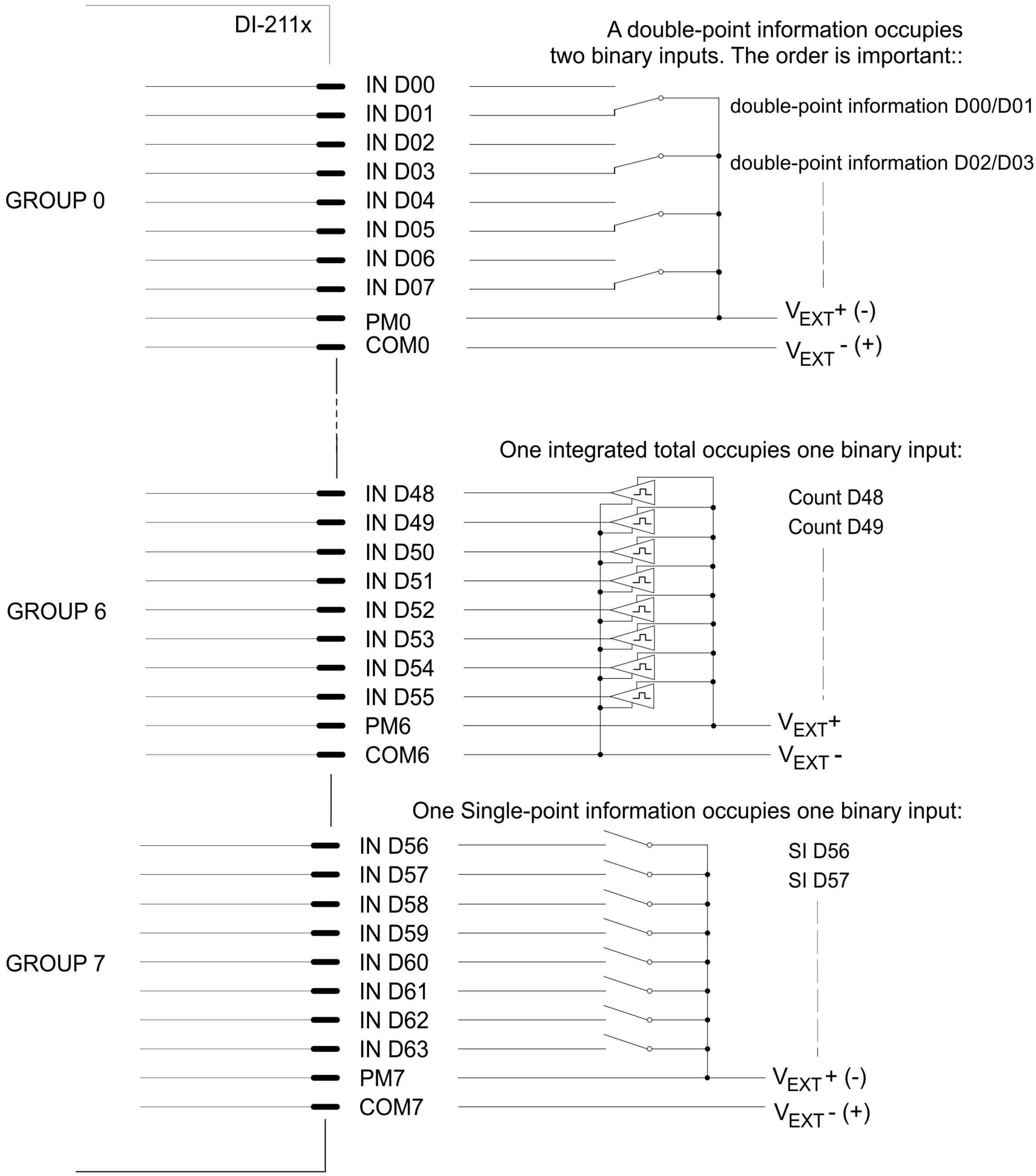
The following circuitry variants are examples, and do not relate exclusively to the depicted inputs/outputs.



[dw_DI-211x_BSB, 1, --_--]

Figure 5-82 DI-211x block diagram

External Circuitry: Input with switched plus or minus



[dw_DI-211x_E8, 1, en_US]

NOTE

The above figure shows one example of the assignment of inputs and/or outputs as well as their external circuitry. Rules, which must be considered for the assignment of the inputs and/or outputs, can be found in the following section.

5.9.1.7 I/O Assignment

The assignment of the HW pins to the data points is done according to the following scheme.

Inputs

HW pin	Data Point
Single-point informations	
IN D00 IN D01 : IN D63	Single-point information D00 Single-point information D01 : Single-point information D63
Double-point informations	
IN D00/IN D01 IN D02/IN D03 : IN D62/IN D63	Double-point information D00/D01 Double-point information D02/D03 : Double-point information D62/D63
Integrated totals	
IN D00 IN D01 : IN D63	Integrated total D00 Integrated total D01 : Integrated total D63

5.9.1.8 Return Information to Pulse Command Assignment

Predefined assignment to PCCO26 (assigning commands without building groups)

Type	Predefined assignment
Single-point information to single command (1-pole, 1.5-pole)	SI D00...command CA00 SI D01...command CA01 : SI D31...command CA31 SI D32...command CB00 SI D33...command CB01 : SI D63...command CB31
Single-point information to single command (2-pole)	SI D00...command CA00/CB00 SI D01...command CA01/CB01 : SI D31...command CA31/CB31
Double information to double command (1-pole, 1.5-pole)	DI D00/D01...command CA00/CA01 DI D02/D03...command CA02/CA03 : DI D30/D31...command CA30/CA31 DI D32/D33...command CB00/CB01 DI D34/D35...command CB02/CB03 : DI D62/D63...command CB30/CB31
Double information to double command (2-pole)	DI D00/D01...command CA00..CB01 DI D02/D03...command CA02..CB03 : DI D30/D31...command CA30..CB31

Predefined assignment to PCCO27 (assigning commands in groups)

Type	Predefined assignment
Single-point information to single command (1-pole, 1.5-pole)	SI D00...command CA00 SI D01...command CB00 SI D02...command CA01 SI D03...command CB01 : SI D62...command CA31 SI D63...command CB31
Single-point information to single command (2-pole)	SI D00...command CA00/CB00 SI D02...command CA01/CB01 : SI D60...command CA31/CB30 SI D62...command CA31/CB31
Double information to double command (1-pole, 1.5-pole)	DI D00/D01...command CA00/CB00 DI D02/D03...command CA01/CB01 : DI D62/D63...command CA31/CB31
Double information to double command (2-pole)	DI D00/D01...command CA00..CB01 DI D04/D05...command CA02..CB03 : DI D56/D57...command CA28..CB29 DI D60/D61...command CA30..CB31

5.9.1.9 Application Notes

WARNING

- An insulation plate must be installed left and right of the modules DI-2114 and DI-2115.
- One insulation plate is included to these boards. Further can be ordered with following number:
- Insulation plate double-Euro format........... T12-001 / 6MF13010CA010AA0
- Insulation plate holder................. TC2-099 / (4 pieces per insulation plate) 6MF13133CA000AA0
- There is no reinforced isolation between the peripheral circuits. It is therefore not permissible to protect these separately from one another.

5.9.2 DO-2201

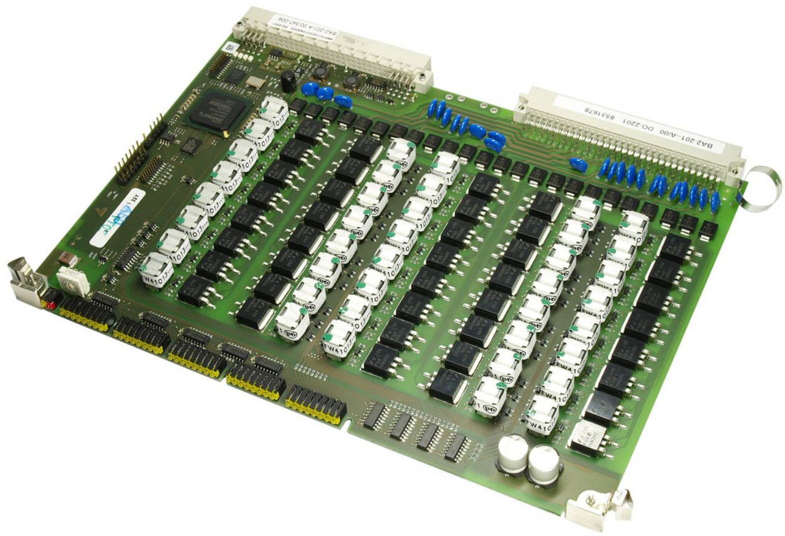
NOTE

Use only in connection with CP-8050.

The Rack I/O module DO-2201/BISO85 is used for output of single-point information.

It consists of the hardware DO-2201 (Binary Output Transistor 40x 1, 24...60 VDC) and the loadable firmware BISO85.

(Firmware BISO85 is firmware compatible to SICAM AK Firmware BISI25)



[ph_DO-2201, 1, --_--]

5.9.2.1 Features

- Processing and output according to IEC 60870-5-101/104
  - up to 40 single-point information units
- 40 binary outputs
- With regard to galvanic insulation, the outputs are partitioned into 8 groups with 2 outputs each, and 8 groups with 3 outputs each
- Galvanical insulation of the groups from each other and within a group 8
- The potential that shall be switched (plus or minus) can be determined for each output by external circuitry
- All outputs are overload-proof and proof against continued short-circuit
- Respectively 2 outputs can be connected in parallel to increase the switching capacity
- If an output short-circuits, it does not affect on other outputs
- Indication of function and state of the inputs via LEDs

5.9.2.2 Functions

Single-point informations

- Binary information output
  - Selectable behavior in case of communication failure
    (deactivation or retention)
  - Deactivation upon module failure
  - Spontaneous transmission or
  - periodical transmission

NOTE

The above mentioned functions are described in detail in the document *SICAM RTUs Common Functions Peripheral Elements according to IEC 60870-5-101/104*.

5.9.2.3 Technical Data

Binary Outputs

40 outputs (Transistor)	• With respect to insulation, the outputs form – 8 groups, 2 outputs each – 8 groups, 3 outputs each • Each group is galvanically insulated from the other groups, logic circuits and ground (1.5kVeff) • Within the groups, the outputs are galvanically insulated from each other with functional insulation of 80 V • The outputs are potential-free • The potential that shall be switched (plus or minus) can be determined for each output by external circuitry • All outputs are overload-proof and proof against continued short-circuit • Any 2 outputs can be connected in parallel to increase the switching capacity; in this case the outputs have to be switched simultaneously • If an output short-circuits, it does not affect on other outputs
Nominal current (for ohmic load)	• 0.7 A at 24, 48, 60 VDC • 1.0 A possible when connecting 2 outputs in parallel
Maximum sum of continuous current of all outputs	10 A
Nominal switching capacity (for ohmic load, UN +30%)	• 17 W (24 W) at 24 VDC • 34 W (48 W) at 48 VDC • 42 W (60 W) at 60 VDC Values in parenthesis apply when connecting 2 outputs in parallel
Maximum continuous current	0.9 A at DC 18 V to 78 V
Maximum switching voltage	• up tp DC 70 V according EN 61010-1:2010 • up to DC 60 V according IEC 61010-1:2010/AMD1:2016 Overvoltage protection: max. 1 mA leakage current up to 86 V
Maximum switching capacity	70 W at DC 78 V
Current limitation	10 A with over current cut-off, cyclic automatic reclosing with 300 μs
Switching cycles	Unlimited
Switching frequency	max. 50 Hz
Voltage drop in output circuit	< 1 V at 0.9 A
Dynamic load capability	• Capacitive load max. 100 nF at 60 V • Inductive load τ ≤ 1 ms (arbitrary with external free-wheeling diode) • Lines Z ≥ 100 Ω, length of line up to 3 km • Lamps IN ≤ 200 mA (IIn ≤ 3 A)

Power Supply

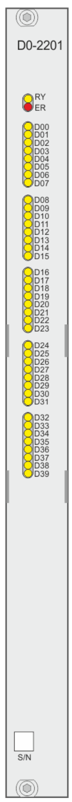
Operating voltage	DC 4.75 V to 5.25 V The voltage is picked off from the bus of rack
Power Consumption	typ. 0.6 W + 0.03 W for each active output

Mechanics and Connectors

Ax 1703 Peripheral Bus	Transmission rate 16 Mbit/s
Peripheral connector	96 pin according to DIN 41612 type C
Rated impulse voltage	2.0 kV
Dimensions	Double euro format 233.4 x 160 mm, 4 WU
Weight	Approx. 400 g

5.9.2.4 Display

The LEDs on the front panel indicate the operating state of the module and the process state signals of the digital inputs.



[dw_DO-2201_Front, 1, --_--]

LED	Meaning
RY	Readiness
ER	Fault
D00 to D39	Process state binary outputs

5.9.2.5 Pin Assignment

Connector X2

A 96-pin male connector according to DIN 41612 type C is used. The peripheral connector's pin assignment is described in the following table.

X2	Peripheral cable CM-2890		Signal	X2	Peripheral cable CM-2890		Signal	X2	Peripheral cable CM-2890		Signal
	Wire	Color			Wire	Color			Wire	Color	
c1	03	whbu/ye	OUT D01+	b1	02	bu/whbu	OUT D00-	a1	01	whbu/bu	OUT D00+
c2	06	gn/whbu	OUT D02-	b2	05	whbu/gn	OUT D02+	a2	04	ye/whbu	OUT D01-
c3	09	whbu/bk	OUT D04+	b3	08	bn/whbu	OUT D03-	a3	07	whbu/bn	OUT D03+
c4	12	bu/whye		b4	11	whye/bu		a4	10	bk/whbu	OUT D04-
c5	15	whye/gn	OUT D06+	b5	14	ye/whye	OUT D05-	a5	13	whye/ye	OUT D05+
c6	18	bn/whye	OUT D07-	b6	17	whye/bn	OUT D07+	a6	16	gn/whye	OUT D06-
c7	21	whgn/bu	OUT D09+	b7	20	bk/whye	OUT D08-	a7	19	whye/bk	OUT D08+
c8	24	ye/whgn		b8	23	whgn/ye		a8	22	bu/whgn	OUT D09-
c9	27	whgn/bn	OUT D11+	b9	26	gn/whgn	OUT D10-	a9	25	whgn/gn	OUT D10+
c10	30	bk/whgn	OUT D12-	b10	29	whgn/bk	OUT D12+	a10	28	bn/whgn	OUT D11-
c11	33	whbn/ye	OUT D14+	b11	32	bu/whbn	OUT D13-	a11	31	whbn/bu	OUT D13+
c12	36	gn/whbn		b12	35	whbn/gn		a12	34	ye/whbn	OUT D14-
c13	39	whbn/bk	OUT D16+	b13	38	bn/whbn	OUT D15-	a13	37	whbn/bn	OUT D15+
c14	42	bu/whbk	OUT D17-	b14	41	whbk/bu	OUT D17+	a14	40	bk/whbn	OUT D16-
c15	45	whbk/gn	OUT D19+	b15	44	ye/whbk	OUT D18-	a15	43	whbk/ye	OUT D18+
c16	48	bn/whbk		b16	47	whbk/bn		a16	46	gn/whbk	OUT D19-
c17	51	rdbu/bu	OUT D21+	b17	50	bk/whbk	OUT D20-	a17	49	whbk/bk	OUT D20+
c18	54	ye/rdbu	OUT D22-	b18	53	rdbu/ye	OUT D22+	a18	52	bu/rdbu	OUT D21-
c19	57	rdbu/bn	OUT D24+	b19	56	gn/rdbu	OUT D23-	a19	55	rdbu/gn	OUT D23+
c20	60	bl/rdbl		b20	59	rdbu/bk		a20	58	bn/rdbu	OUT D24-
c21	63	rdye/ye	OUT D26+	b21	62	bu/rdye	OUT D25-	a21	61	rdye/bu	OUT D25+
c22	66	gn/rdye	OUT D27-	b22	65	rdye/gn	OUT D27+	a22	64	ye/rdye	OUT D26-
c23	69	rdye/bk	OUT D29+	b23	68	bn/rdye	OUT D28-	a23	67	rdye/bn	OUT D28+
c24	72	bu/rdgn		b24	71	rdgn/bu		a24	70	bk/rdye	OUT D29-
c25	75	rdgn/gn	OUT D31+	b25	74	ye/rdgn	OUT D30-	a25	73	rdgn/ye	OUT D30+
c26	78	bn/rdgn	OUT D32-	b26	77	rdgn/bn	OUT D32+	a26	76	gn/rdgn	OUT D31-
c27	81	rdbn/bu	OUT D34+	b27	80	bk/rdgn	OUT D33-	a27	79	rdgn/bk	OUT D33+
c28	84	ye/rdbn		b28	83	rdbn/ye		a28	82	bu/rdbn	OUT D34-
c29	87	rdbn/bn	OUT D36+	b29	86	gn/rdbn	OUT D35-	a29	85	rdbn/gn	OUT D35+
c30	90	bk/rdbn	OUT D37-	b30	89	rdbn/bk	OUT D37+	a30	88	bn/rdbn	OUT D36-
c31	93	rdbk/ye	OUT D39+	b31	92	bu/rdbk	OUT D38-	a31	91	rdbk/bu	OUT D38+
c32	96	gn/rdbk		b32	95	rdbk/gn		a32	94	ye/rdbk	OUT D39-

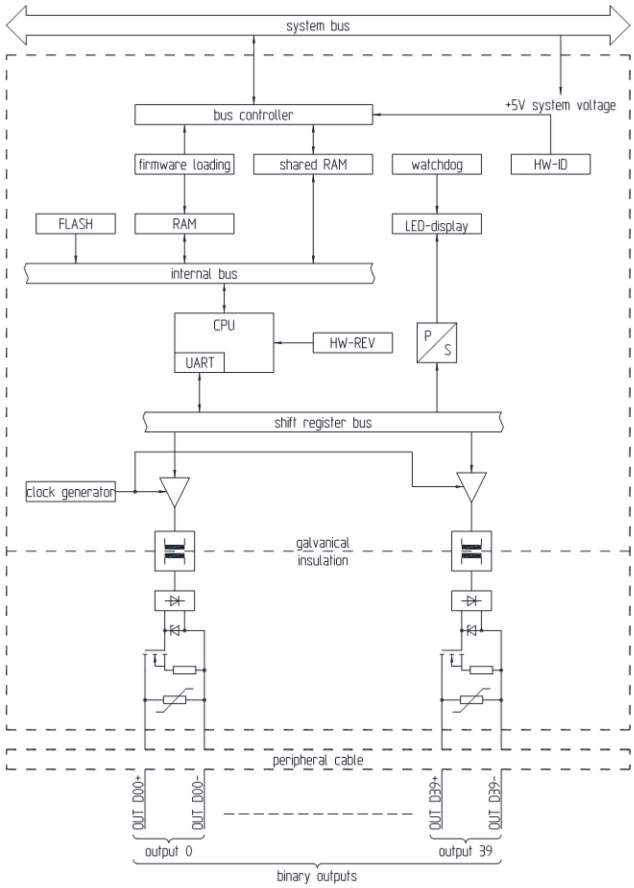
The "X2" column refers to the male connector of the peripheral connector.

The abbreviations have the following meaning:

OUT D00+(-) to OUT D39+(-) ... Digital outputs 0 to 39

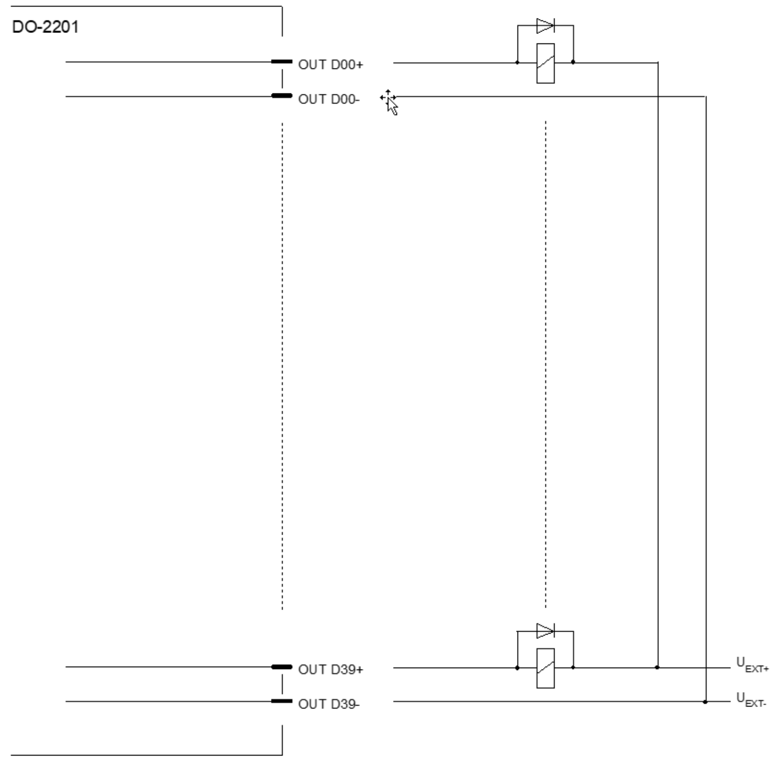
5.9.2.6 Block Diagram and External Circuitry

The following circuitry variants are examples, and do not relate exclusively to the depicted inputs/outputs.



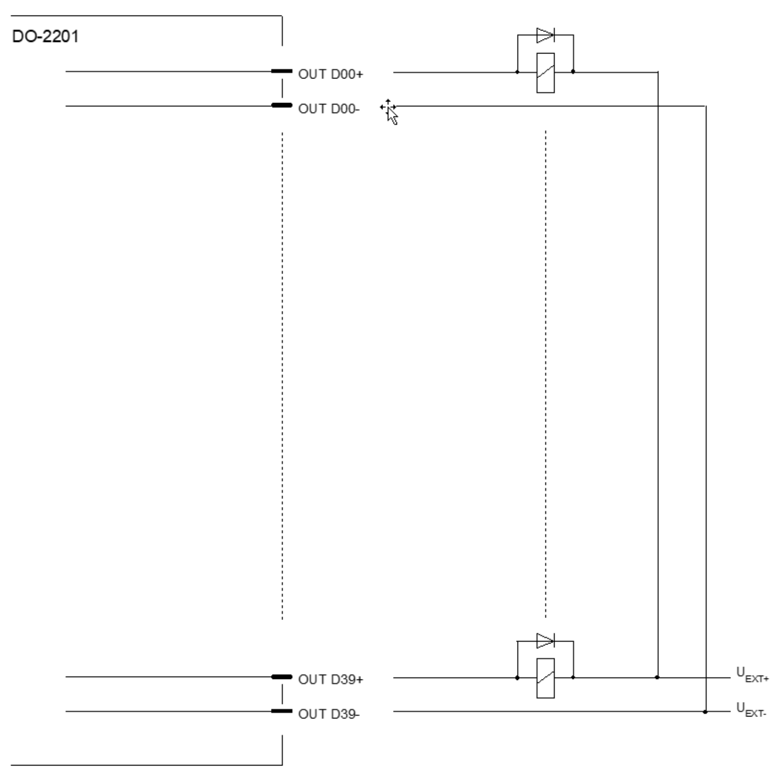
[dw_DO-2201_Block_Diagram, 1, en_US]

External Circuitry: 1-pole output, load on the plus pole



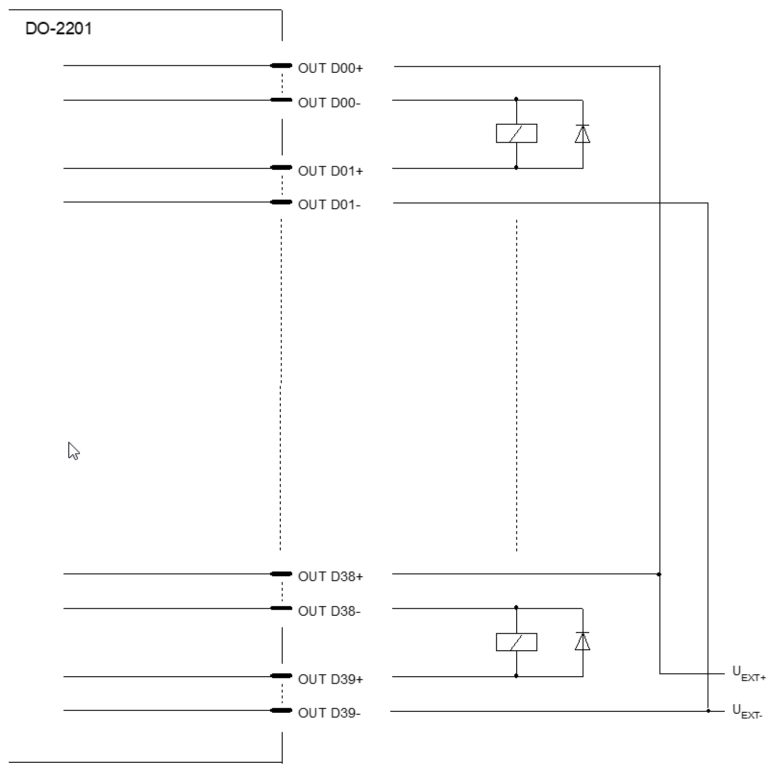
[dw_DO-2201_Ext_Circuitry_01, 1, --_--]

External Circuitry: 1-pole output, load on the plus pole



[dw_DO-2201_Ext_Circuitry_01, 1, --_--]

External Circuitry: 2-pole output



[dw_DO-2201_Ext_Circuitry_03, 1, --_--]

5.9.2.7 I/O Assignment

The assignment of the HW pins to the data points and the partitioning into groups is done according to the following scheme.

Outputs

HW pin	Data Point	Group
OUT DOO+ OUT DO1+ OUT DO2+	Binary information DOO Binary information DO1 Binary information DO2	0
OUT DO3+ OUT DO4+	Binary information DO3 Binary information DO4	1
OUT D05+ OUT D06+ OUT D07+	Binary information D05 Binary information D06 Binary information D07	2
OUT D08+ OUT D09+	Binary information D08 Binary information D09	3
OUT D10+ OUT D11+ OUT D12+	Binary information D10 Binary information D11 Binary information D12	4
OUT D13+ OUT D14+	Binary information D13 Binary information D14	5
OUT D15+ OUT D16+ OUT D17+	Binary information D15 Binary information D16 Binary information D17	6

HW pin	Data Point	Group
OUT D18+ OUT D19+	Binary information D18 Binary information D19	7
OUT D20+ OUT D21+ OUT D22+	Binary information D20 Binary information D21 Binary information D22	8
OUT D23+ OUT D24+	Binary information D23 Binary information D24	9
OUT D25+ OUT D26+ OUT D27+	Binary information D25 Binary information D26 Binary information D27	10
OUT D28+ OUT D29+	Binary information D28 Binary information D29	11
OUT D30+ OUT D31+ OUT D32+	Binary information D30 Binary information D31 Binary information D32	12
OUT D33+ OUT D34+	Binary information D33 Binary information D34	13
OUT D35+ OUT D36+ OUT D37+	Binary information D35 Binary information D36 Binary information D37	14
OUT D38+ OUT D39+	Binary information D38 Binary information D39	15

5.9.3 DO-2210, DO-2211

NOTE

Use only in connection with CP-8050.

The Rack I/O Module DO-221x/PCCO8x are used for checked output of pulse commands.
Each consist of the hardware:

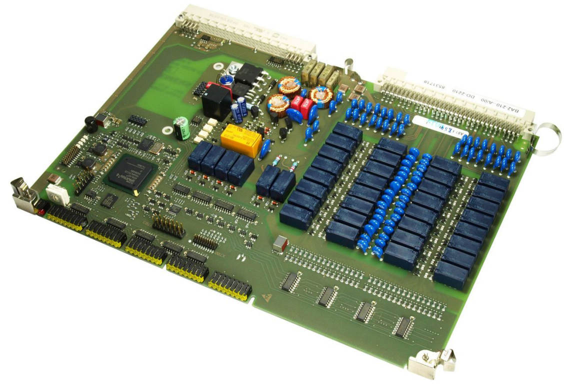
- DO-2210 (Checked command output 24...60 VDC)
- DO-2211 (Checked command output 125 VDC)

and the loadable firmware:

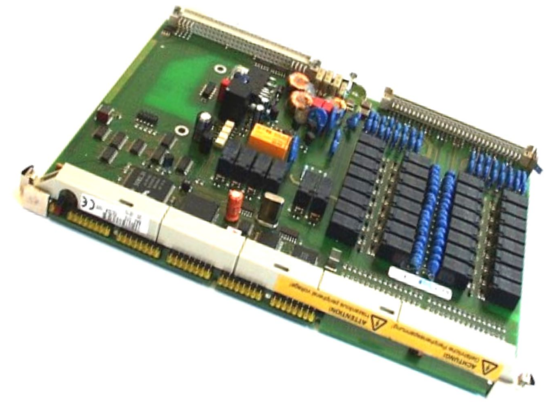
- PCCO86 Preprocessing and checked command output (Assignment of the commands without group formation)
  (Firmware PCCO86 is firmware compatible to SICAM AK Firmware PCCO26)
- PCCO87 Preprocessing and checked command output (Assignment of the commands in groups)
  (Firmware PCCO87 is firmware compatible to SICAM AK Firmware PCCO27)

A slot for an optional measuring circuit module for command output is available:

- SM-2506 Measuring module for command output via DO-2210 (24...60 VDC)



DO-2210



DO-2211

5.9.3.1 Features

- Processing and output according to IEC 60870-5-101/104
  - Up to 32 pulse commands (2-pole) or
  - Up to 64 pulse commands (1-pole or 1½-pole) or
  - A combination thereof
  - Checked command output
    - Internal checks (IC1)
    - Optional resistance check (RC1) via SM-2506/SM-2507
- 64 relay-outputs (2 groups) plus
  - 2 group outputs
  - 4 pulse outputs
- Common return for each group
- Switching voltage
  - **DO-2210**: DC 24 to 60 V
  - **DO-2211**: DC 125 V
- Each group may have an own fuse circuit
- Pulse outputs are current-limited electronically
- Indication of function and state of the inputs via LEDs

5.9.3.2 Functions

Pulse commands

- Checked output of pulse commands
  - 1-pole, 1½-pole, 2-pole (combinations are also possible)
- Single, double and regulating step commands

- Command Output with Internal Checks (IC1)
  - Selective activation check
  - Idle check

  Command output with resistance check (RC1) via SM-2506
  - Selective activation check
  - Current flow check in the external command circuit
  - Resistance check in the external command circuit
  - Interference voltage and earth fault check
  - Idle check
- Basic application functions and procedures according to IEC 60870-5-101/104
  - Formal Check
  - Direct Command
  - Select and Execute command
- Retry suppression
- 1-out-of-n Check
- Control Location Check
- Command interlocking
- Synchronization
- Revision
- Command output time
  - Parameter-settable
  - Dependent on the process
- Return information monitoring
- Command prolongation
- Periodical control circuit check
- Switching sequences
- Monitoring of command output sequence to prevent incorrect outputs
- Command output for the auto-reclose function
- Activation of command contactors with, or without, series-break contacts

NOTE

The above mentioned functions are described in detail in the document *SICAM RTUs Common Functions Peripheral Elements according to IEC 60870-5-101/104*.

Return Information to Pulse Command Assignment

- Settable assignment for messages and pulse commands, which
  - on the peripheral element itself
  - on different peripheral elements of the same basic system element

  .

5.9.3.3 Technical Data

Binary Outputs

<table>
<tr><td>2 x 32 command outputs
2 group outputs
2 pulse outputs</td><td colspan="2">• Every 32 outputs form a group (groups A, B)
• Each group has a common return
• Each group may have an own fuse circuit
• The outputs are galvanically insulated from logic circuits and ground by monostable relays
• The pulse outputs are current-limited electronically</td></tr>
<tr><td>Output current (+25°C)</td><td colspan="2">1.5 A continuous current
2 A 1 Minute</td></tr>
<tr><td>Switching voltage</td><td colspan="2">• DO-2210: DC 24 to 60 V
• DO-2211: DC 24 to 125 V</td></tr>
<tr><td>Maximum switching voltage</td><td colspan="2">• DO-2210: DC 60 V + 30%
• DO-2211: DC 125 V + 20%</td></tr>
<tr><td>Output circuits
(operated by means of external voltage)</td><td colspan="2">• DO-2210
– DC 18 V to 70 V according to EN 61010-1:2010
– DC 18 V to 60 V according to IEC 61010-1:2010/AMD1:2016
• DO-2211: DC 18 to 150 V</td></tr>
<tr><td>Switching cycles</td><td colspan="2">10^6</td></tr>
<tr><td>Switching capacity</td><td colspan="2">min. 1 mW
max. 120 W</td></tr>
<tr><td>Nominal switching capacity</td><td>DO-2210
• 48 W/DC 24 V
• 96 W/DC 48 V
• 120 W/DC 60 V</td><td>DO-2211
• 48 W/DC 24 V
• 96 W/DC 48 V
• 120 W/DC 60 V
• 250 W/DC 125 V</td></tr>
</table>

Optional measuring equipment for command outputs (SM-2506)

Resolution	12 Bit
Measuring range	30 Ω...44 kΩ
Accuracy	≤ 1 % at 30 Ω...22 kΩ ≤ 2 % at 22 kΩ...44 kΩ
Resistance measuring error due to inductive load	This depends on relay time constant L/R L...coil self inductance when fixing rail is open R...inner coil resistance • 0,1% 17 ms L/R • 0,3% 20 ms L/R • 1,9% 30 ms L/R • 5% 40 ms L/R • 9 % 50 ms L/R
Reference voltage source of resistance check	• Switchable between ±2.5 V and ±10 V • Resistance ranges at 2.5 V 30...5 kΩ at 10 V 5...44 kΩ

Power Supply

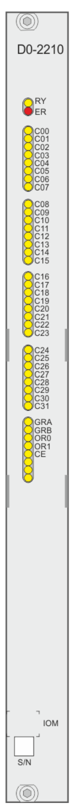
Operating voltage	5 VDC ± 5%, typ. 1.0 W without SM-2506 typ. 1.6 W with SM-2506 + 0.6 W during command output Voltage is picked off at the bus of rack

Mechanics and Connectors

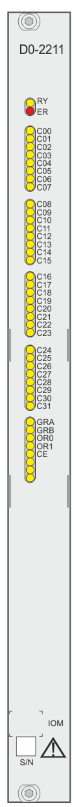
Ax 1703 Peripheral Bus	Transmission rate 16 Mbit/s
Peripheral connector	96 pin according to DIN 41612 type C
Rated impulse voltage	2.0 kV
Dimensions	Double euro format 233.4 x 160 mm, 4 WU
Weight	Approx. 340 g

5.9.3.4 Display

The LEDs on the front panel indicate the operating state of the module and the process state signals of the digital outputs.



DO-2210



DO-2211

LED	Meaning
RY	Readiness
ER	Fault
C00 to C31	Process state binary outputs

5.9.3.5 Pin Assignment

Connector X2

A 96-pin male connector according to DIN 41612 type C is used. The peripheral connector's pin assignment is described in the following table.

X2	Peripheral cable CM-2890		Signal	X2	Peripheral cable CM-2890		Signal	X2	Peripheral cable CM-2890		Signal
	Wire	Color			Wire	Color			Wire	Color	
c1	03	whbu/ye	CA02	b1	02	bu/whbu	CA01	a1	01	whbu/bu	CA00
c2	06	gn/whbu	CA05	b2	05	whbu/gn	CA04	a2	04	ye/whbu	CA03
c3	09	whbu/bk	COMA	b3	08	bn/whbu	CA07	a3	07	whbu/bn	CA06
c4	12	bu/whye		b4	11	whye/bu		a4	10	bk/whbu	GRA
c5	15	whye/gn	CB02	b5	14	ye/whye	CB01	a5	13	whye/ye	CB00
c6	18	bn/whye	CB05	b6	17	whye/bn	CB04	a6	16	gn/whye	CB03
c7	21	whgn/bu	COMB	b7	20	bk/whye	CB07	a7	19	whye/bk	CB06
c8	24	ye/whgn		b8	23	whgn/ye		a8	22	bu/whgn	GRB
c9	27	whgn/bn	CB10	b9	26	gn/whgn	CB09	a9	25	whgn/gn	CB08
c10	30	bk/whgn	CB13	b10	29	whgn/bk	CB12	a10	28	bn/whgn	CB11
c11	33	whbn/ye	COMB	b11	32	bu/whbn	CB15	a11	31	whbn/bu	CB14
c12	36	gn/whbn		b12	35	whbn/gn		a12	34	ye/whbn	
c13	39	whbn/bk	CA10	b13	38	bn/whbn	CA09	a13	37	whbn/bn	CA08
c14	42	bu/whbk	CA13	b14	41	whbk/bu	CA12	a14	40	bk/whbn	CA11
c15	45	whbk/gn	COMA	b15	44	ye/whbk	CA15	a15	43	whbk/ye	CA14
c16	48	bn/whbk		b16	47	whbk/bn		a16	46	gn/whbk	OA3
c17	51	rdbu/bu	CA18	b17	50	bk/whbk	CA17	a17	49	whbk/bk	CA16
c18	54	ye/rdbu	CA21	b18	53	rdbu/ye	CA20	a18	52	bu/rdbu	CA19
c19	57	rdbu/bn	COMA	b19	56	gn/rdbu	CA23	a19	55	rdbu/gn	CA22
c20	60	bl/rdbl		b20	59	rdbu/bk		a20	58	bn/rdbu	OA1
c21	63	rdye/ye	CB18	b21	62	bu/rdye	CB17	a21	61	rdye/bu	CB16
c22	66	gn/rdye	CB21	b22	65	rdye/gn	CB20	a22	64	ye/rdye	CB19
c23	69	rdye/bk	COMB	b23	68	bn/rdye	CB23	a23	67	rdye/bn	CB22
c24	72	bu/rdgn		b24	71	rdgn/bu		a24	70	bk/rdye	OA2
c25	75	rdgn/gn	CB26	b25	74	ye/rdgn	CB25	a25	73	rdgn/ye	CB24
c26	78	bn/rdgn	CB29	b26	77	rdgn/bn	CB28	a26	76	gn/rdgn	CB27
c27	81	rdbn/bu	COMB	b27	80	bk/rdgn	CB31	a27	79	rdgn/bk	CB30
c28	84	ye/rdbn		b28	83	rdbn/ye	VR	a28	82	bu/rdbn	OA0
c29	87	rdbn/bn	CA26	b29	86	gn/rdbn	CA25	a29	85	rdbn/gn	CA24
c30	90	bk/rdbn	CA29	b30	89	rdbn/bk	CA28	a30	88	bn/rdbn	CA27
c31	93	rdbk/ye	COMA	b31	92	bu/rdbk	CA31	a31	91	rdbk/bu	CA30
c32	96	gn/rdbk		b32	95	rdbk/gn		a32	94	ye/rdbk	

The "X2" column refers to the male connector of the peripheral connector.

The abbreviations have the following meaning:

CA00 to CA31 ... Command output group A, 0 to 31

CB00 to CB31 ... Command output group B, 0 to 31

COMA, COMB ... Common CA, CB

GRA, GRB ... 2 group outputs

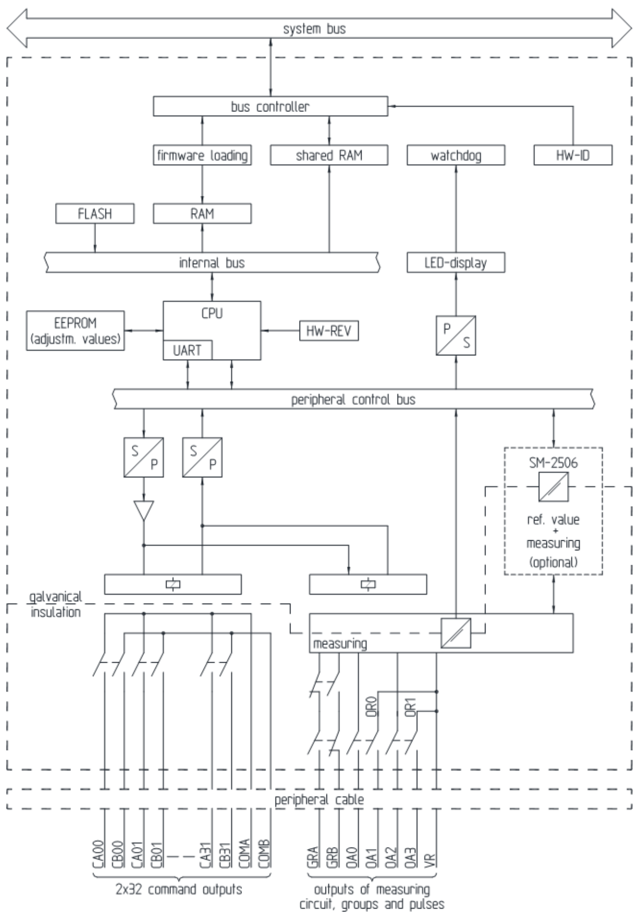
OA0 to OA3 ... 4 pulse outputs

OR0, OR1 ... Output relay 0, 1

VR ... Measuring circuit for command outputs

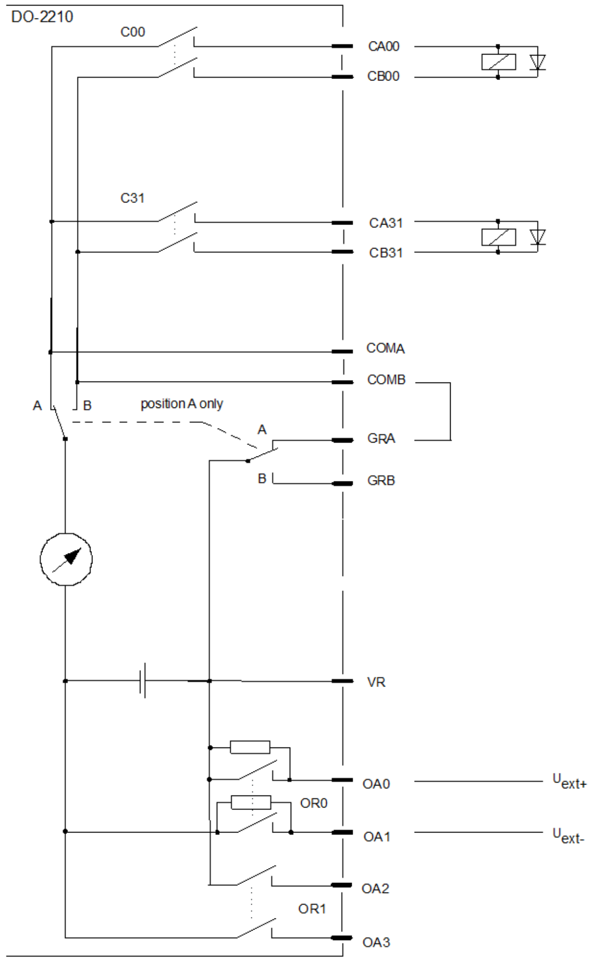
5.9.3.6 Block Diagram and External Circuitry

The following circuitry variants are examples, and do not relate exclusively to the depicted inputs/outputs.



[dw_DO-221x_Block_Diagram, 1, en_US]

External Circuitry: 32 2-pole commands, measuring in the minus circuit

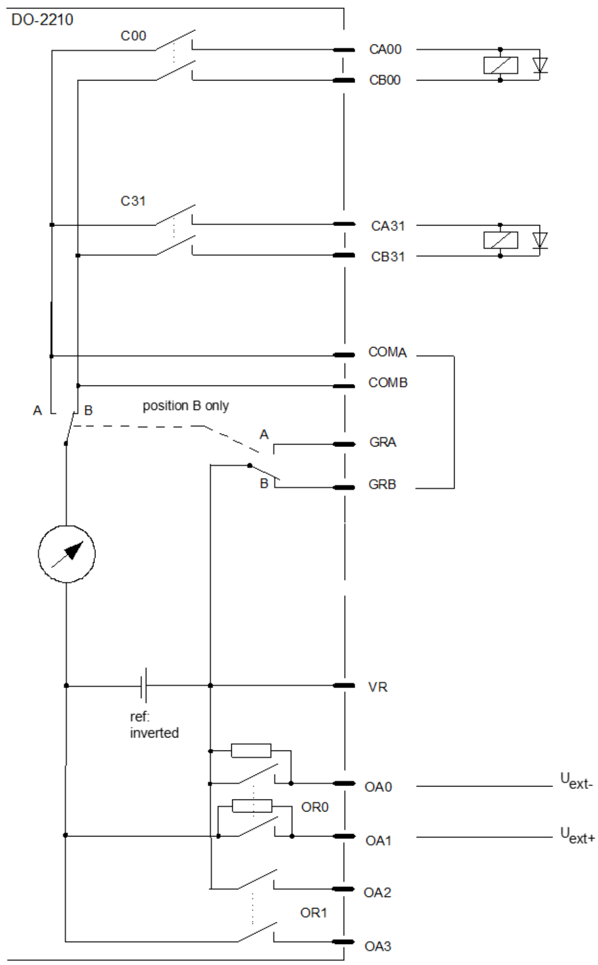


[dw_DO-221x_Ext_Circuitry_01, 1, en_US]

NOTE

The fused circuit with output relais OR0 must be used before the fused circuit with output relais OR1.

External Circuitry: 32 2-pole commands, measuring in the plus circuit

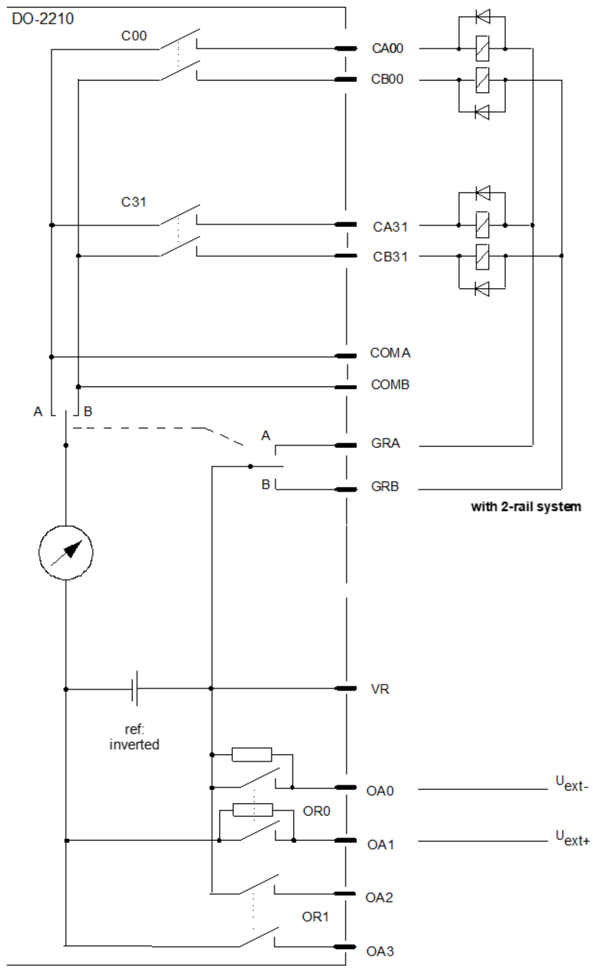


[dw_DO-221x_Ext_Circuitry_02, 1, en_US]

NOTE

The fused circuit with output relais OR0 must be used before the fused circuit with output relais OR1.

External Circuitry: 64 1½-pole commands, relay common return on minus pole with 2-rail system

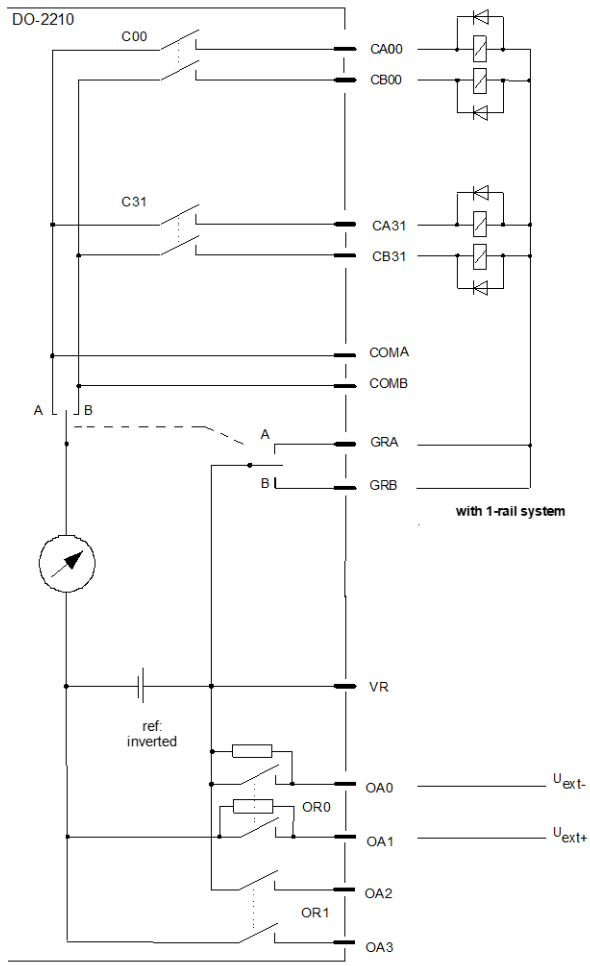


[dw_DO-221x_Ext_Circuitry_03, 1, en_US]

NOTE

The fused circuit with output relais OR0 must be used before the fused circuit with output relais OR1.

External Circuitry: 64 1½-pole commands, relay common return on minus pole with 1-rail system

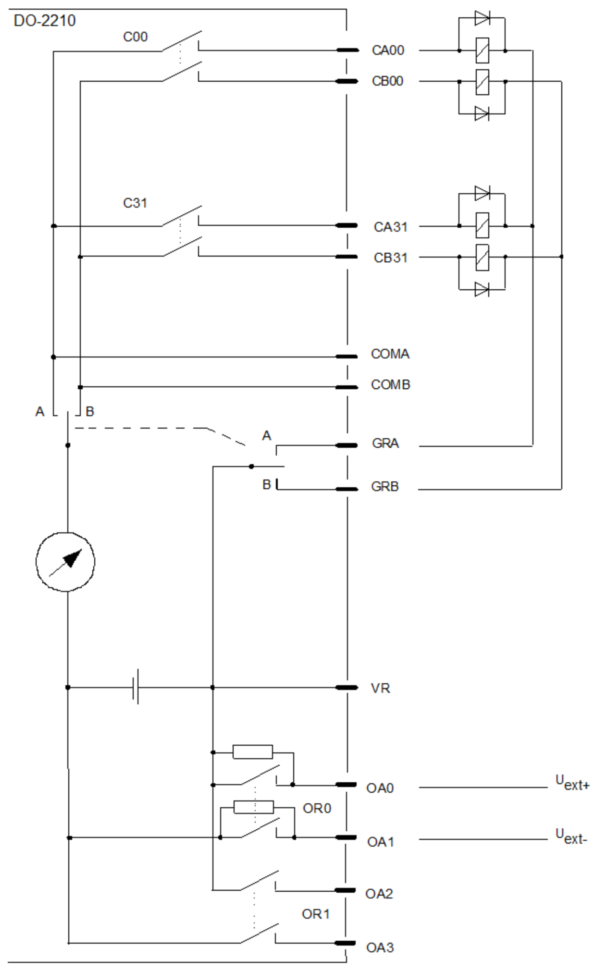


[dw_DO-221x_Ext_Circuitry_04, 1, en_US]

NOTE

The fused circuit with output relais OR0 must be used before the fused circuit with output relais OR1.

External Circuitry: 64 1½-pole commands, relay common return on plus pole with 2-rail system

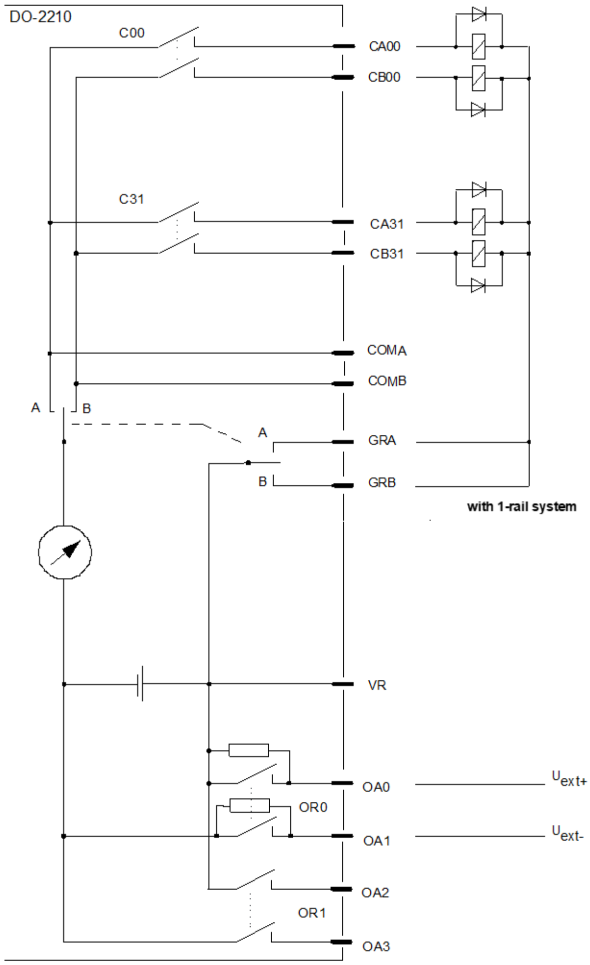


[dw_DO-221x_Ext_Circuitry_05, 1, en_US]

NOTE

The fused circuit with output relais OR0 must be used before the fused circuit with output relais OR1.

External Circuitry: 64 1½-pole commands, relay common return on plus pole with 1-rail system

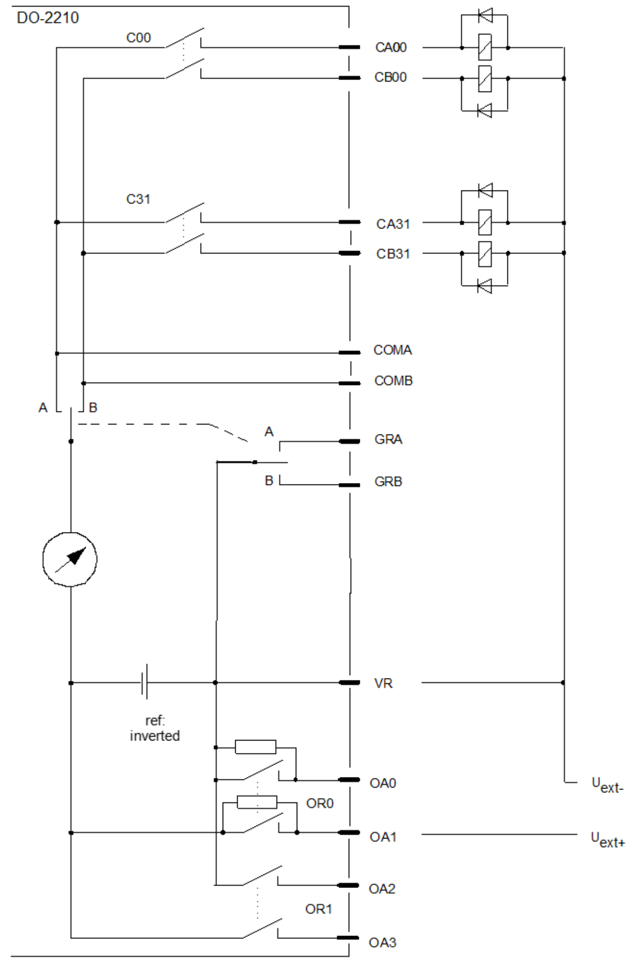


[dw_DO-221x_Ext_Circuitry_06, 1, en_US]

NOTE

The fused circuit with output relais OR0 must be used before the fused circuit with output relais OR1.

External Circuitry: 64 1-pole commands, relay common return on minus pole

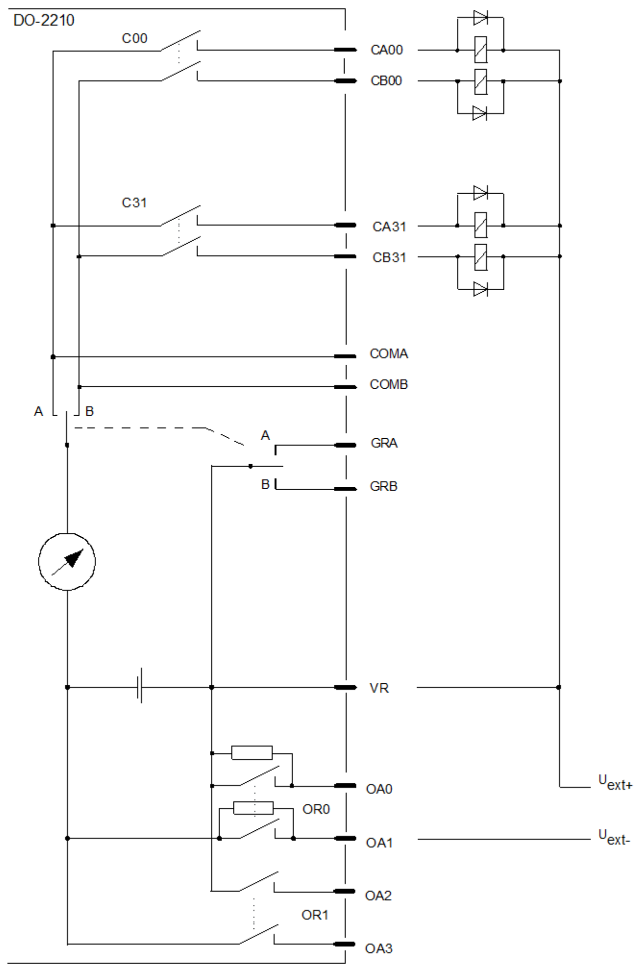


[dw_DO-221x_Ext_Circuitry_07, 1, en_US]

NOTE

The fused circuit with output relais OR0 must be used before the fused circuit with output relais OR1.

External Circuitry: 64 1-pole commands, relay common return on plus pole

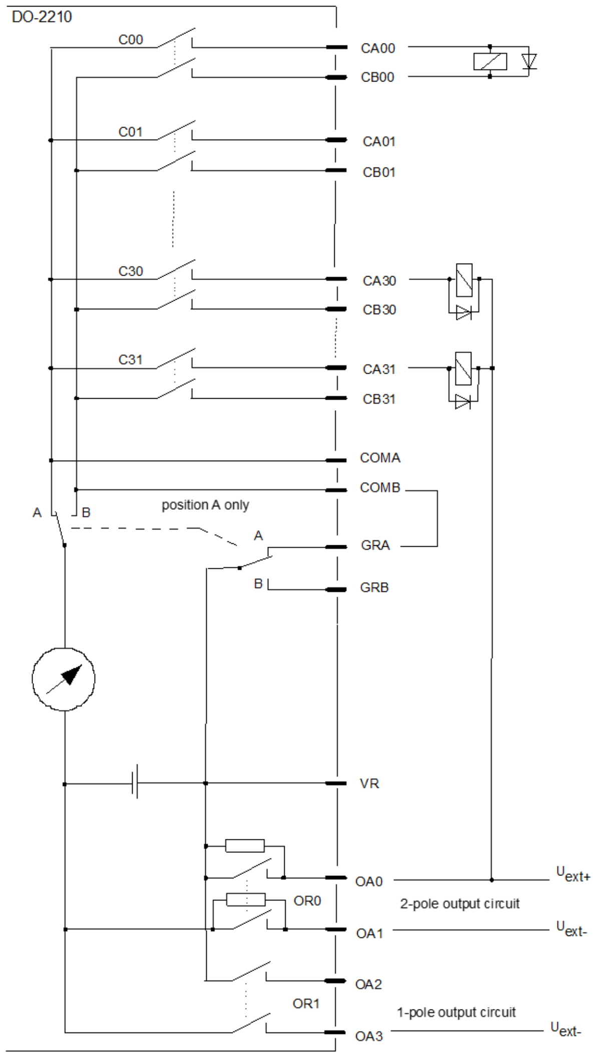


[dw_DO-221x_Ext_Circuitry_08, 1, en_US]

NOTE

The fused circuit with output relais OR0 must be used before the fused circuit with output relais OR1.

Mixed circuitry: 1-pole and 2-pole commands, with one fused circuit each, and measuring in the minus circuit

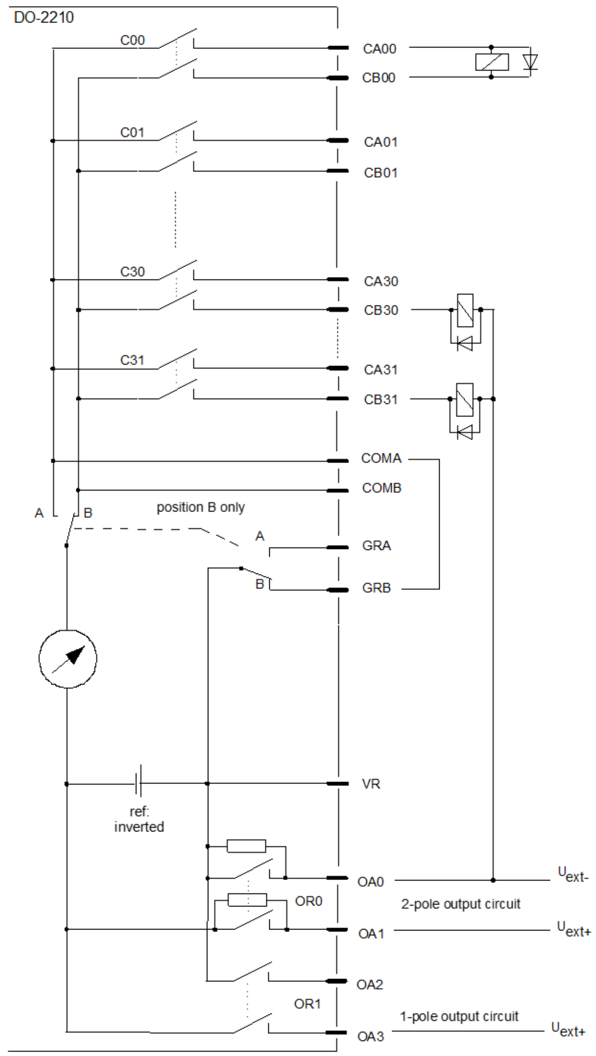


[dw_DO-221x_Ext_Circuitry_09, 1, en_US]

NOTE

The fused circuit with output relais OR0 must be used before the fused circuit with output relais OR1.

Mixed circuitry: 1-pole and 2-pole commands, with one fused circuit each, and measuring in the plus circuit



[dw_DO-221x_Ext_Circuitry_10, 1, en_US]

NOTE

The fused circuit with output relais OR0 must be used before the fused circuit with output relais OR1.

5.9.3.7 I/O Assignment

The assignment of the HW pins to the data points is done according to the following scheme.

Outputs

Pulse commands – PCCO86

HW pin	Data Point
Single commands 1-pole and 1 ½-pole	
CA00	Command CA00 (RI:SI D00)
CA01	Command CA01 (RI:SI D01)
:	:
CA31	Command CA31 (RI:SI D31)

HW pin	Data Point
CB00 CB01 : CB31	Command CB00 (RI:SI D32) Command CB01 (RI:SI D33) : Command CB31 (RI:SI D63)
Single commands 2 pole	
CA00 / CB00 CA01 / CB01 : CA31 / CB31	Command CA00/CB00 (RI:SI D00) Command CA01/CB01 (RI:SI D01) : Command CA31/CB31 (RI:SI D31)
Double command 1-pole and 1½-pole	
CA00, CA01 CA02, CA03 : CA30, CA31	command CA00/CA01 (RI:DI D00/D01) command CA02/CA03 (RI:DI D02/D03) : Command CA30/CA31 (RI:DI D30/D31)
CB00, CB01 CB02, CB03 : CB30, CB31	command CB00/CB01 (RI:DI D32/D33) command CB02/CB03 (RI:DI D34/D35) : Command CB30/CB31 (RI:DI D62/D63)
Double commands 2-pole	
CA00 / CB00, CA01 / CB01 CA02 / CB02, CA03 / CB03 : CA30 / CB30, CA31 / CB31	Command CA00..CB01 (RI:DI D00/D01) Command CA30..CB31 (RI:DI D30/D31) : Command CA30..CB31 (RI:DI D30/D31)

Pulse commands – PCCO87

HW pin	Data Point
Single commands 1-pole and 1 ½-pole	
CA00 CB00 CA01 CB01 : CA31 CB31	Command CA00 (RI:SI D00) Command CB00 (RI:SI D01) Command CA01 (RI:SI D02) Command CB01 (RI:SI D03) : Command CA31 (RI:SI D62) Command CB31 (RI:SI D63)
Single commands 2 pole	
CA00 / CB00 CA01 / CB01 : CA30 / CB30 CA31 / CB31	Command CA00/CB00 (RI:SI D00) Command CA01/CB01 (RI:SI D02) : Command CA30/CB30 (RI:SI D60) Command CA31/CB31 (RI:SI D62)
Double command 1-pole and 1½-pole	
CA00, CB00 CA01, CB01 : CA30, CB30 CA31, CB31	Command CA00/CB00 (RI:DI D00/D01) Command CA01/CB01 (RI:DI D02/D03) : Command CA30/CB30 (RI:DI D60/D61) Command CA31/CB31 (RI:DI D62/D63)

HW pin	Data Point
Double commands 2-pole	
CA00 / CB00, CA01 / CB01 CA02 / CB02, CA03 / CB03 CA04 / CB04, CA05 / CB05 : CA28 / CB28, CA29 / CB29 CA30 / CB30, CA31 / CB31	Command CA00..CB01 (RI:DI D00/D01) Command CA02..CB03 (RI:DI D04/D05) Command CA04..CB03 (RI:DI D08/D09) : Command CA28..CB29 (RI:DI D56/D57) Command CA30..CB31 (RI:DI D60/D61)

5.9.3.8 Return Information to Pulse Command Assignment

Assignment BISX86 to PCCO86 (assigning commands without building groups)

Type	Predefined assignment
Single-point information to single command (1-pole, 1.5-pole)	SI D00...command CA00 SI D01...command CA01 : SI D31...command CA31 SI D32...command CB00 SI D33...command CB01 : SI D63...command CB31
Single-point information to single command (2-pole)	SI D00...command CA00/CB00 SI D01...command CA01/CB01 : SI D31...command CA31/CB31
Double information to double command (1-pole, 1.5-pole)	DI D00/D01...command CA00/CA01 DI D02/D03...command CA02/CA03 : DI D30/D31...command CA30/CA31 DI D32/D33...command CB00/CB01 DI D34/D35...command CB02/CB03 : DI D62/D63...command CB30/CB31
Double information to double command (2-pole)	DI D00/D01...command CA00..CB01 DI D02/D03...command CA02..CB03 : DI D30/D31...command CA30..CB31

Assignment BISX86 to PCCO87 (assigning commands in groups)

Type	Predefined assignment
Single-point information to single command (1-pole, 1.5-pole)	SI D00...command CA00 SI D01...command CB00 SI D02...command CA01 SI D03...command CB01 : SI D62...command CA31 SI D63...command CB31
Single-point information to single command (2-pole)	SI D00...command CA00/CB00 SI D02...command CA01/CB01 : SI D60...command CA31/CB30 SI D62...command CA31/CB31
Double information to double command (1-pole, 1.5-pole)	DI D00/D01...command CA00/CB00 DI D02/D03...command CA01/CB01 : DI D62/D63...command CA31/CB31
Double information to double command (2-pole)	DI D00/D01...command CA00..CB01 DI D04/D05...command CA02..CB03 : DI D56/D57...command CA28..CB29 DI D60/D61...command CA30..CB31

5.9.4 AI-2300

NOTE

Use only in connection with CP-8050.

The rack I/O module AI-2300/PASI85 is used for the acquisition of analog values and counting pulses, as well as for the output of analog values.

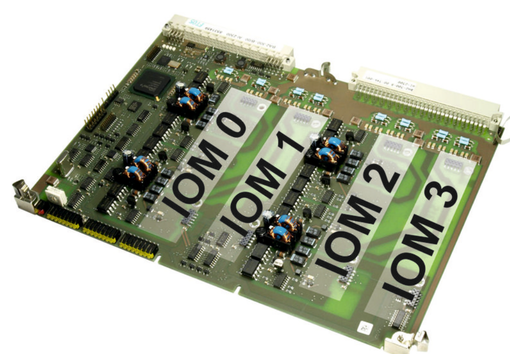
It consists of the hardware AI-2300 (Analog Inputs 16x ±20mA + 4x opt.IOM) and the loadable firmware PASI85.

(Firmware PASI85 is firmware compatible to SICAM AK Firmware PASI25)

[ph_AI-2300, 1, --_--]

Optional AI-2300 can be equipped with up to 4 input/output modules.

- SM-0570 Analog Input Extension (2x+/-20mA)
- SM-0571 Analog Value Extension (2x Pt100)
- SM-0572 Analog output extension (2x ±20 mA, ±1/10 V)
- SM-0574 Counter input (2x24-60VDC)



5.9.4.1 Features

- Acquisition and processing according to IEC 60870-5-101/104
  - Currents and voltages
  - Temperatures via SM-0571
  - Counting pulses via SM-0574
- Processing and output according to IEC 60870-5-101/104
  - Setpoint commands via currents and voltages via SM-0572
- 16 analog inputs (±20 mA), galvanically insulated from logic and ground
- Optionally expandable with up to 4 input/output modules, each 2 from the logic galvanically insulated
  - Analog inputs (±20 mA, ±10 VDC) via SM-0570
  - Analog inputs (Pt100; Ni100) via SM-0571
  - Analog outputs (±20 mA, DC ±10 V) via SM-0572
  - Pulse inputs (24...60 VDC) via SM-0574
- Indication of function and state of the inputs via LEDs

5.9.4.2 Functions

Acquisition of currents

- Settable acquisition grid n*100 ms
- Measurement range settable with a resolution of 12 bits + sign at ±20 mA
- Revision
- Noise rejection
- Automatic calibration
- Smoothing
- Adaptation
  - Linear (normalized, technologically scaled or short floating-point)
  - Zero-Range Suppression
  - Plausibility check
- Change Monitoring
- spontaneous transmission upon change

Acquisition of currents and voltages

- Acquisition via the analog inputs of a SM-0570
- Settable acquisition grid n*100 ms
- Measurement range settable with a resolution of
  - 12 bit + sign at ±20 mA
  - 12 bit + sign at ±10 V
  - shrinking the range results in decreasing resolution
- Revision
- Noise rejection
- Automatic calibration
- Smoothing
- Adaptation
  - Linear (normalized, technologically scaled or short floating-point)
  - Zero-Range Suppression
  - Plausibility check
- Change Monitoring
- spontaneous transmission upon change

Acquisition of temperatures

- Acquisition via the analog inputs of a SM-0571
- Connecting resistance thermometers: 2-, 3- or 4-wire technique
- Update every 400 ms

- Settable measuring ranges
  - When transferring temperatures
    - Pt100: -50...+350°C / -58...+662°F / (≈80.31...229.67 Ω)
    - Pt100: -100...+700°C / -148...+1292°F / (≈60.25...345.13 Ω)
    - Ni100: -60...+250°C / -76...+482°F / (≈74.18...295.52 Ω)
  - When transferring resistance values
    - Pt100: 0...230 Ω
    - Pt100: 0...346 Ω
    - Ni100: 0...346 Ω
- Resolution
  - When transferring temperatures
    - Pt100: 0.20 °C / 0.36 °F / (90 mΩ)
    - Pt100: 0.35 °C / 0.63 °F / (130 mΩ)
    - Ni100: 0.35 °C / 0.63 °F / (130 mΩ)
  - When transferring resistance values
    - (a) Pt100: 90 mΩ
    - (b) Pt100: 130 mΩ
    - (c) Ni100: 130 mΩ
- Revision
- Noise rejection
- Automatic calibration
- Calibration for 2-wire technique
- Smoothing
- Adaptation
  - Temperature value (°C, °F) calculation by means of implemented characteristics
  - Resistance (Ω)
- Change Monitoring
- spontaneous transmission upon change

Integrated totals via count pulses

- Acquisition via the binary inputs of a power-fail safe SM-0574
- Maximum pulse frequency 5 kHz
  - Pulse length/pause (see technical data SM-0574)
  - Revision
  - Bounce suppression
  - Inversion
  - Pulse counting
  - Measures for power-fail safety

- Counter value formation
  - Count pulse evaluation
  - Set counter
- Integrated total formation
  - Counter interrogation
  - Interval control
  - Frozen absolute value
  - Frozen relative value
- Integrated total transmission according to IEC 60870-5-101/104
- Spontaneous transmission

Output of Setpoint Values via Currents and Voltages

- Output via the analog inputs of a SM-0572
- Output range settable with a resolution of
  - 15 bit + sign at ±20 mA
  - 15 bit + sign at ±10 V
  - shrinking the range results in decreasing resolution
- Basic application functions and procedures according to IEC 60870-5-101/104
  - Formal check
  - Direct command
  - Select and Execute command
- Adaptation
  - Linear (normalized, technologically scaled or short floating-point)
- Selectable behavior upon communication failure and module failure (keep value, output substitute value)
- Spontaneous transmission or
- periodical transmission

NOTE

The previously mentioned functions are described in detail in the document *SICAM RTUs Common Functions Peripheral Elements according to IEC 60870-5-101/104* (DC0-011-2).

5.9.4.3 Technical Data

Analoge inputs of AI-2300

16 current inputs	• max. ±20 mA at 122.5 Ω load • Load voltage 2,45 V • Overrange typ. 2% • Voltage between the inputs of a group max. 4 VDC • Every 2 inputs form a group (8 groups) • All inputs are galvanically insulated from logic circuits and ground • The inputs of a group are not galvanically insulated from each other • The inputs of a group are galvanically insulated from those of the other groups and from the inputs/outputs of the input/output modules
Resolution	5 µV (12 bits + sign)
Sampling rate	Every 5 ms, free running
Accuracy	• 0/4...20 mA – 0.05 %; 25 °C – 0.1 %; 15 to 35 °C; class 0.1 – 0.15 %; 0 to 50 °C • -20 ... +20mA – 0.25 %; 25 °C – 0.30 %; 15 to 35 °C; class 0.3 – 0.40 %; 0 to 50 °C
CMRR	min. -70 dB
Noise rejection	16⅔, 50, 60 Hz -60dB

Inputs/outputs via input/output modules SM-0570, SM-0571, SM-0572, SM-0574

	see technical data of the respective submodule

Power Supply

Operating voltage	DC 4.75 V to 5.25 V The voltage is picked off from the bus of rack
Power consumption	typ. 2.5 W
Input circuits	Circuits are operated by means of an external voltage

Mechanics and Connectors

Ax 1703 Peripheral Bus	Transmission rate 16 Mbit/s
Peripheral connector	96 pin according to DIN 41612 type C
Rated impulse voltage	2.0 kV
Dimensions	Double euro format 233.4 x 160 mm, 4 WU
Weight	Approx. 270 g

5.9.4.4 Display

The LEDs on the front panel indicate the operating state of the module and the process state signals of the analog inputs.

[dw_AI-2300_Front, 1, --_--]

LED	Meaning
RY	Readiness
ER	Fault
V00 to V15	Analog inputs 0 to 15 (LED activation from 3 % of full scale value)
V16 to V23	Analog inputs 16 to 23 (LED activation from 3 % of full scale value) valid temperature value or setpoint value output)

	Meaning
IOM0	Position for label with serial number of submodule (IOM0)
IOM1	Position for label with serial number of submodule (IOM1)
IOM2	Position for label with serial number of submodule (IOM2)
IOM3	Position for label with serial number of submodule (IOM3)
S/N	Serial number

5.9.4.5 Pin Assignment

Connector X2

A 96-pin male connector according to DIN 41612 type C is used. The peripheral connector's pin assignment is described in the following table.

X2	Peripheral cable CM-2890		Signal	X2	Peripheral cable CM-2890		Signal	X2	Peripheral cable CM-2890		Signal
	Wire	Color			Wire	Color			Wire	Color	
c1	03	whbu/ye	IN V01+	b1	02	bu/whbu	IN V00-	a1	01	whbu/bu	IN V00+
c2	06	gn/whbu		b2	05	whbu/gn		a2	04	ye/whbu	IN V01-
c3	09	whbu/bk	IN V03+	b3	08	bn/whbu	IN V02-	a3	07	whbu/bn	IN V02+
c4	12	bu/whye		b4	11	whye/bu		a4	10	bk/whbu	IN V03-
c5	15	whye/gn	[IOM0] I/O 2	b5	14	ye/whye	[IOM0] I/O 1	a5	13	whye/ye	[IOM0] I/O 0
c6	18	bn/whye		b6	17	whye/bn		a6	16	gn/whye	[IOM0] I/O 3
c7	21	whgn/bu	[IOM0] I/O 6	b7	20	bk/whye	[IOM0] I/O 5	a7	19	whye/bk	[IOM0] I/O 4
c8	24	ye/whgn		b8	23	whgn/ye		a8	22	bu/whgn	[IOM0] I/O 7
c9	27	whgn/bn	IN V05+	b9	26	gn/whgn	IN V04-	a9	25	whgn/gn	IN V04+
c10	30	bk/whgn		b10	29	whgn/bk		a10	28	bn/whgn	IN V05-
c11	33	whbn/ye	IN V07+	b11	32	bu/whbn	IN V06-	a11	31	whbn/bu	IN V06+
c12	36	gn/whbn		b12	35	whbn/gn		a12	34	ye/whbn	IN V07-
c13	39	whbn/bk	[IOM1] I/O 2	b13	38	bn/whbn	[IOM1] I/O 1	a13	37	whbn/bn	[IOM1] I/O 0
c14	42	bu/whbk		b14	41	whbk/bu		a14	40	bk/whbn	[IOM1] I/O 3
c15	45	whbk/gn	[IOM1] I/O 6	b15	44	ye/whbk	[IOM1] I/O 5	a15	43	whbk/ye	[IOM1] I/O 4
c16	48	bn/whbk		b16	47	whbk/bn		a16	46	gn/whbk	[IOM1] I/O 7
c17	51	rdbu/bu	IN V09+	b17	50	bk/whbk	IN V09-	a17	49	whbk/bk	IN V08+
c18	54	ye/rdbu		b18	53	rdbu/ye		a18	52	bu/rdbu	IN V09-
c19	57	rdbu/bn	IN V11+	b19	56	gn/rdbu	IN V11-	a19	55	rdbu/gn	IN V10+
c20	60	bl/rdbl		b20	59	rdbu/bk		a20	58	bn/rdbu	IN V11-
c21	63	rdye/ye	[IOM2] I/O 2	b21	62	bu/rdye	[IOM2] I/O 1	a21	61	rdye/bu	[IOM2] I/O 0
c22	66	gn/rdye		b22	65	rdye/gn		a22	64	ye/rdye	[IOM2] I/O 3
c23	69	rdye/bk	[IOM2] I/O 6	b23	68	bn/rdye	[IOM2] I/O 5	a23	67	rdye/bn	[IOM2] I/O 4
c24	72	bu/rdgn		b24	71	rdgn/bu		a24	70	bk/rdye	[IOM2] I/O 7
c25	75	rdgn/gn	IN V13+	b25	74	ye/rdgn	IN V12-	a25	73	rdgn/ye	IN V12+
c26	78	bn/rdgn		b26	77	rdgn/bn		a26	76	gn/rdgn	IN V13-
c27	81	rdbn/bu	IN V15+	b27	80	bk/rdgn	IN V14-	a27	79	rdgn/bk	IN V14+
c28	84	ye/rdbn		b28	83	rdbn/ye		a28	82	bu/rdbn	IN V15-
c29	87	rdbn/bn	[IOM3] I/O 2	b29	86	gn/rdbn	[IOM3] I/O 1	a29	85	rdbn/gn	[IOM3] I/O 0
c30	90	bk/rdbn		b30	89	rdbn/bk		a30	88	bn/rdbn	[IOM3] I/O 3
c31	93	rdbk/ye	[IOM3] I/O 6	b31	92	bu/rdbk	[IOM3] I/O 5	a31	91	rdbk/bu	[IOM3] I/O 4
c32	96	gn/rdbk		b32	95	rdbk/gn		a32	94	ye/rdbk	[IOM3] I/O 7

The X2 column refers to the male connector of the peripheral connector.

The abbreviations have the following meaning:

IN V00+(-) to IN V15+(-) ... Analog inputs 0 to 15

[IOM0] I/O 0 to [IOM0] I/O 7 ... optional in-/outputs (in-/output module 0)

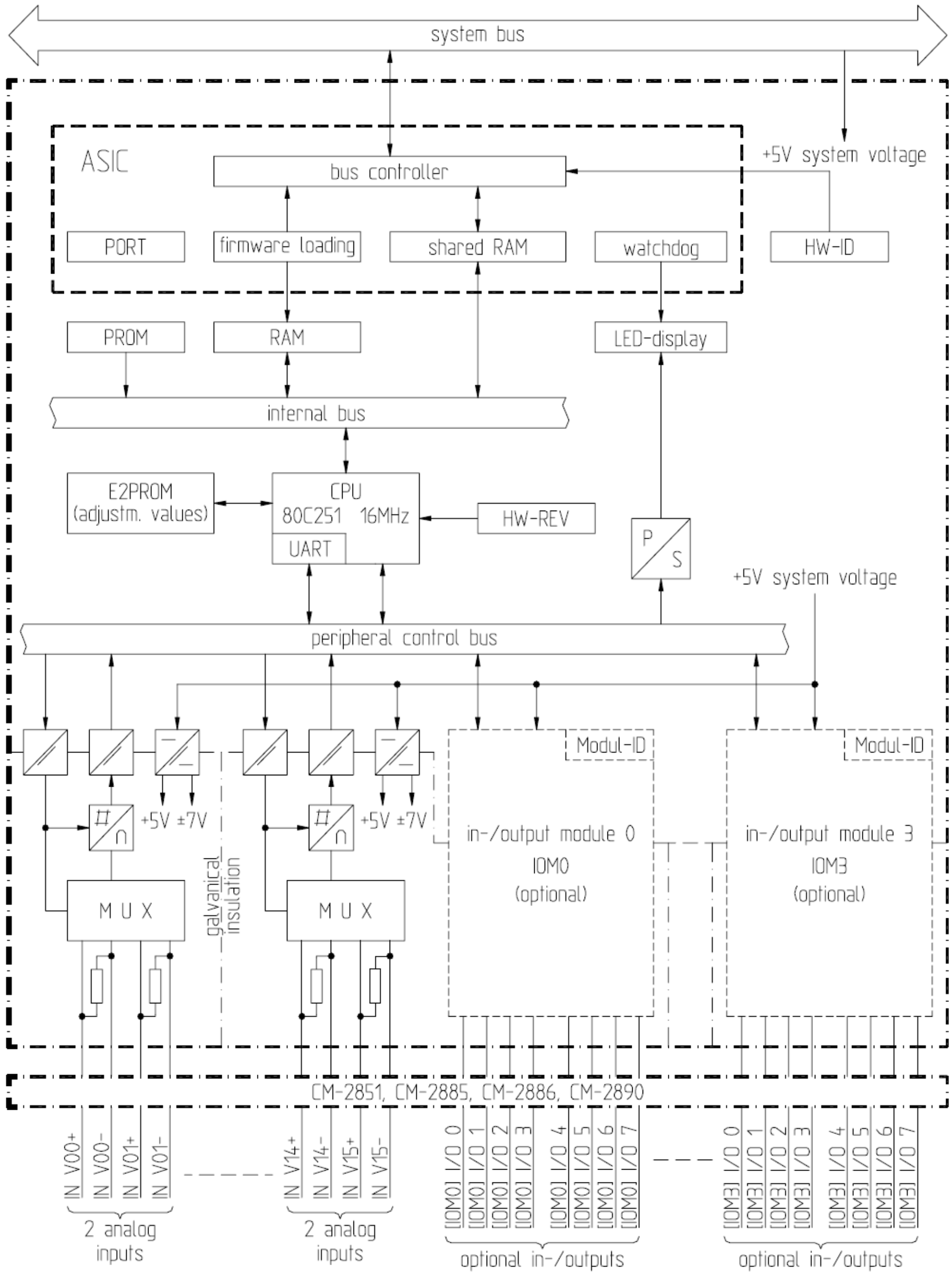
[IOM1] I/O 0 to [IOM1] I/O 7 ... optional in-/outputs (in-/output module 1)

[IOM2] I/O 0 to [IOM2] I/O 7 ... optional in-/outputs (in-/output module 2)

[IOM3] I/O 0 to [IOM3] I/O 7 ... optional in-/outputs (in-/output module 3)

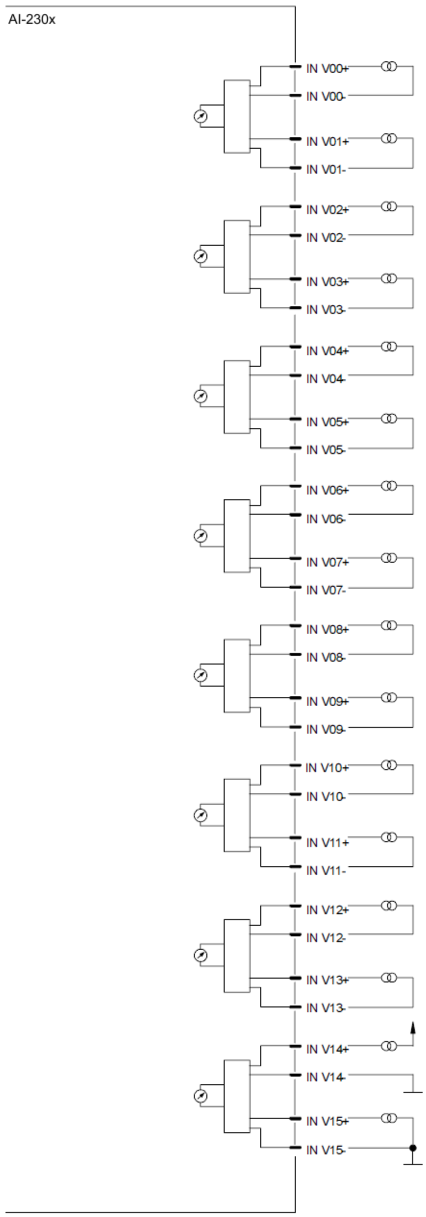
5.9.4.6 Block Diagram and External Circuitry

The following circuitry variants are examples, and do not relate exclusively to the depicted inputs/outputs.



[dw_AI-230x_Block_Diagram, 1, en_US]

External Circuitry



[dw_AI-230x_Ext_Circuitry, 1, --_--]

5.9.4.7 I/O Assignment

The assignment of the HW pins to the data points is done according to the following scheme.

Inputs

HW Pin	Data Point
Measured values on AI-2300 (±20 mA)	
IN V00+ / IN V00- IN V01+ / IN V01- : IN V15+ / IN V15-	Measured value V00 Measured value V01 : Measured value V15

HW Pin	Data Point
Optional measured values via SM-0570 (±20 mA)	
[IOMx] I/O 0 / [IOMx] I/O 1 [IOMx] I/O 4 / [IOMx] I/O 5	Measured value [IOMx] I/O 0-1 Measured value [IOMx] I/O 4-5
Optional measured values via SM-0570 (Pt100, Ni100)	
[IOMx] I/O 0 / [IOMx] I/O 1 / [IOMx] I/O 2 / [IOMx] I/O 3 [IOMx] I/O 4 / [IOMx] I/O 5 / [IOMx] I/O 6 / [IOMx] I/O 7	Measured value [IOMx] I/O 0-3 Measured value [IOMx] I/O 4-7
Optional integrated totals via SM-0574 (≤5 kHz, 24...60 VDC)	
[IOMx] I/O 0 / [IOMx] I/O 1 [IOMx] I/O 4 / [IOMx] I/O 5	Measured value [IOMx] I/O 0-1 Measured value [IOMx] I/O 4-5

(x = 0 to 3)

Outputs

HW Pin	Data Point
Optional setpoint values via SM-0572 (±20 mA, ±10 mA, ±5 mA; ±1 V, ±10 V)	
[IOMx] I/O 2 / [IOMx] I/O 3 [IOMx] I/O 6 / [IOMx] I/O 7	Measured value [IOMx] I/O 2-3 Measured value [IOMx] I/O 6-7

(x = 0 to 3)

NOTE

In the SICAM TOOLBOX II, always AI-2300/PASI85 has to be equipped. The following parameters must be set correspondingly:

	AI-2300
Default-load	yes
Bipolar acquisition	X_100%: 20 mA
	X_0%: 20 mA
Unipolar acquisition	X_100%: 20 mA
	X_0%: 0

5.9.5 SICAM Rack I/O Submodules

5.9.5.1 SM-0570 Analog Input Extension (2x+/-20mA)

The submodule SM-0570 (analog value module) is used for modular expansion of peripheral module AI-2300.

[ph_SM-0570_B, 1, --_--]

Overview

The submodule SM-0570 provides

- 2 analog inputs
  - Measuring range -20 mA ... +20 mA.
  - Other measuring ranges (e.g. ±5 mA, ±10 mA; ±1 V, ±10 V) are possible when changing load resistors and providing external circuitry

The function of this submodule is determined by the firmware of the basic module.

Value adaptation

In order to be able to carry out these different value adaptations, changes must be made to the module or the external circuitry. These are to be managed on a project-specific basis (attention when replacing!).

The load resistors and series resistors used must comply with the following specifications in order to comply with the specified accuracies:

Values:

123.5 Ohm for 1,3 % overrange (old modules)

122.5 Ohm for 2 % overrange (new modules)

Techn. Data: RM10mm; 0207; 0.1 %; 5 ppm

After the conversion a factory calibration must be carried out at full-scale for all measured values at the same time with a high-precision sensor, in order to comply with the specified accuracies. If only one sensor is available, the current values must be connected in series or the voltage values must be connected in parallel.

- Adaptation for 5 mA:
  The load resistance per measured value on the module must be exchanged for a 4 times value.
- Adaptation for 10 mA:
  The load resistance per measured value on the module must be exchanged for a double value.
- Adaptation for any current value:
  There must be a voltage of 2.468 V (1.3%) or 2.45 V (2%) at full load on the load resistor.

- Adaption for 10 V:

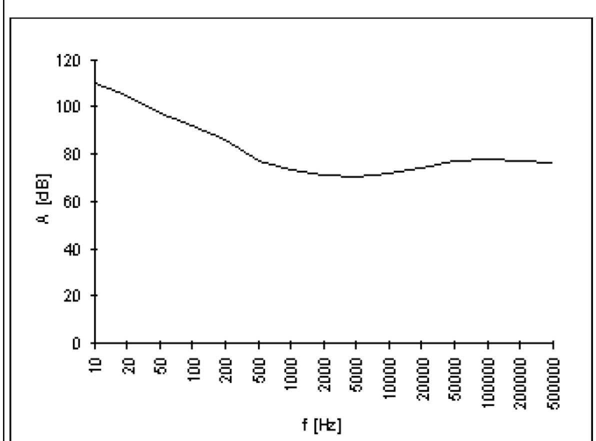
  The load resistance per measured value on the module must be exchanged for a 5 k ohm load resistor. Furthermore, an series resistor of 15k4 ohm must be set externally.

- Adaption for 1 V:

  The load resistance per measured value on the module must be exchanged for a 5 k ohm load resistor. The full-scale voltage for a 12-bit value is now 2.45 V, which means that a resolution of only 11 bits is available for a 1 V analog value. It must therefore be adapted to 12 bits in the CAEx.

Technical Data

Memory	
Parameter memory	EEPROM 24C01 (48 Byte)

Input circuits	
2 current inputs	• Max. ±20 mA at 122.5 Ω load • Load voltage 2,45 V • Overrange typ. 2% • Voltage between the inputs: max. 4 VDC • All inputs are galvanically insulated from logic circuits and ground • The inputs are not galvanically insulated from one another
Resolution	12 Bit + polarity sign
Accuracy	0/4 mA to + 20 mA • 0.05 % 25 °C • 0.1 % 15 to 35 °C class 0.1 • 0.15 % 0 to 50 °C • Long-term stability 0.1% for 5 years - 20 mA to + 20 mA • 0.25 % 25 °C • 0.3 % 15 to 35 °C class 0.3 • 0.4 % 0 to 50 °C
CMRR	Min. -70 dB 
Noise rejection	16 2/3 Hz, 50 Hz, 60 Hz: -60dB

Power Supply	
Operating voltage	5 VDC ± 5 %, typ. 0.6 W
Input circuits	Circuits are operated by means of an external voltage

Mechanics and Connectors	
Rated impulse voltage	2.0 kV
Dimensions	120 x 35 mm
Weight	Approx. 30 g

Pin Assignment

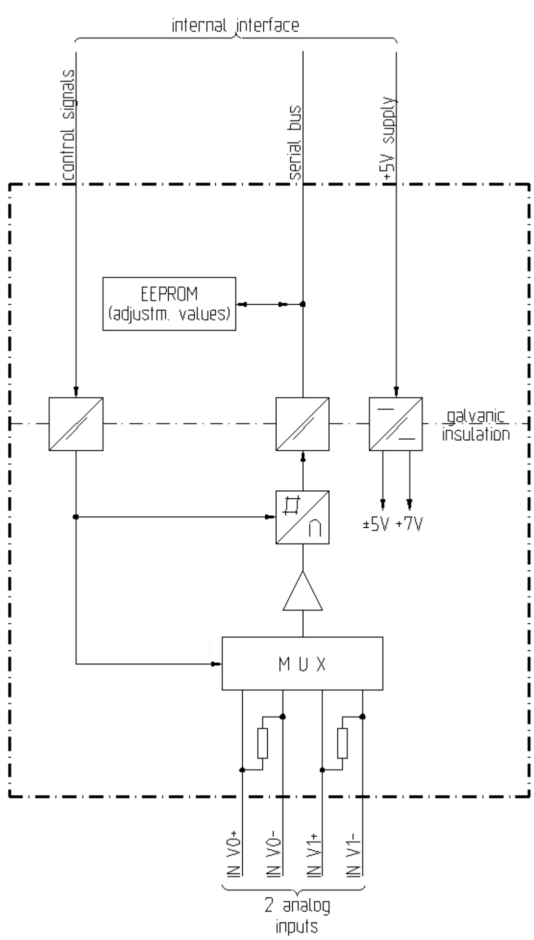
Connector to carrier module

The pin assignment of the connector is described as follows:

Pin	Alias	Signal	Pin	Alias	Signal
1	I/O 0	I/O V0+	2	I/O 1	I/O V0-
3	I/O 2		4	I/O 3	
5			6		
7	I/O 4	I/O V1+	8	I/O 5	I/O V1-
9	I/O 6		10	I/O 7	

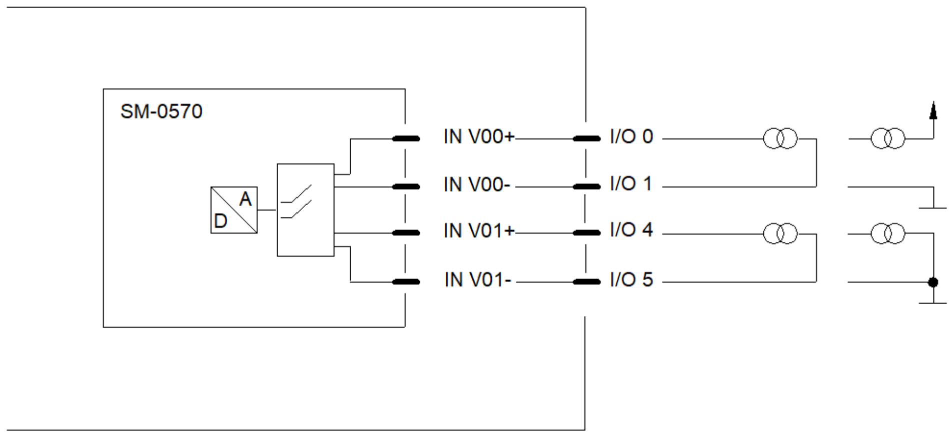
The abbreviations have the following meaning:
IN V0+, IN V0- = Analog input 0
IN V1+, IN V1- = Analog input 1

Block Diagram and External Circuitry



[dw_SM-0570_Block_Diagram, 1, en_US]

Figure 5-83 SM-0570 block diagram



[dw_SM-0570_Ext_Circuitry_01, 1, --_--]

Figure 5-84 External circuitry for current input

5.9.5.2 SM-0571 Analog Value Extension (2x Pt100)

The submodule SM-0571 (analog value module) is used for modular expansion of peripheral module AI-2300.

[ph_SM-0571_B, 1, --_--]

Overview

The submodule SM-0571 provides

- 2 resistance thermometer inputs
  - For Pt100- or Ni100-sensors
  - For 2-wire, 3-wire or 4-wire connection technology
  - The input signals are quantified by an integrated measurement method
  - Adjustable measuring range
  - Adjustable acquisition time and ripple rejection

The function of this submodule is determined by the firmware of the basic module.

Technical Data

Input circuits	
Resistance thermometer inputs	• Pt100, Ni100 • For 2-wire, 3-wire or 4-wire connection technology • The inputs are galvanically insulated from logic circuits and ground • The inputs are not galvanically insulated from one another
Measuring ranges	• Measuring range 1, 230 Ω • Measuring range 2, 346 Ω
Resolution	• Measuring range 1, 90 mΩ • Measuring range 2, 130 mΩ
Accuracy at 25°C	0.2 %
Reference current	• Measuring range 1, 2 mA ±6% • Measuring range 2, 1.33 mA ±6%
Maximum line resistance (in summary, go-and-return line)	max. 40 Ω for 2-, 3- and 4-wire-connection technology

Power Supply	
Operating voltage	5 VDC ± 5 %, typ. 0.9 W
Input circuits	Circuits are operated by means of an external voltage

Mechanics and Connectors	
Rated impulse voltage	2.0 kV
Dimensions	120 x 35 mm
Weight	Approx. 35 g

Pin Assignment

Connector to carrier module

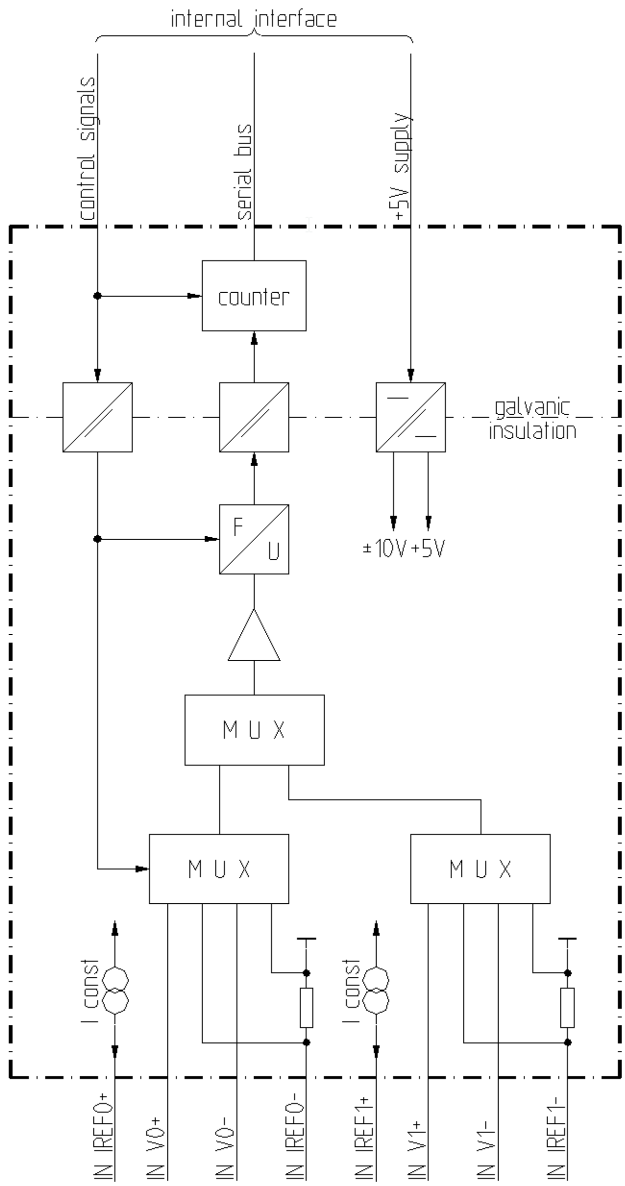
The pin assignment of the connector is described as follows:

Pin	Alias	Signal	Pin	Alias	Signal
1	I/O 0	IN IREF0-	2	I/O 1	IN IREF0+
3	I/O 2	IN V0-	4	I/O 3	IN V0+
5			6		
7	I/O 4	IN V1-	8	I/O 5	IN V1+
9	I/O 6	IN IREF1-	10	I/O 7	IN IREF1+

The abbreviations have the following meaning:
IN IREFx = reference current
IN Vx = measuring-circuit voltage

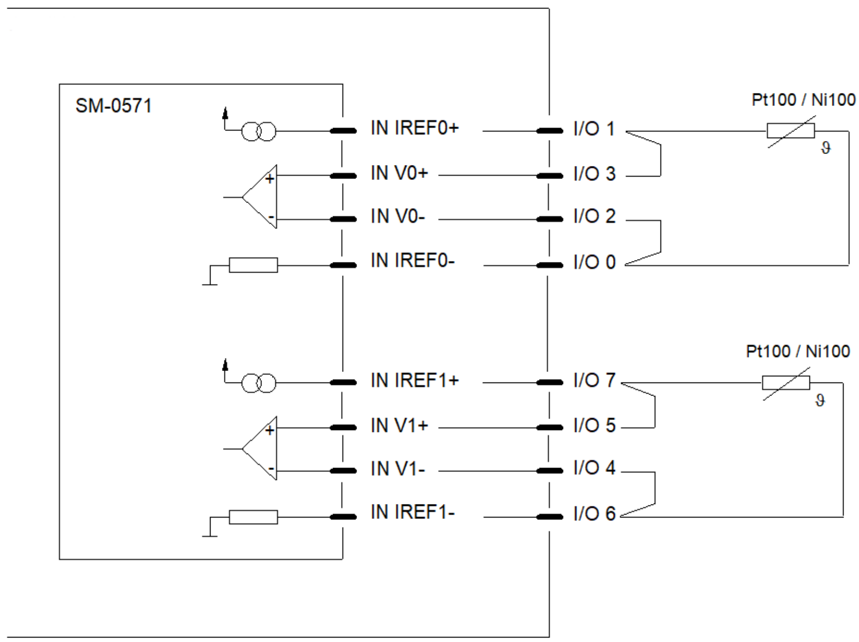
x...number of input 0...1

Block Diagram and External Circuitry



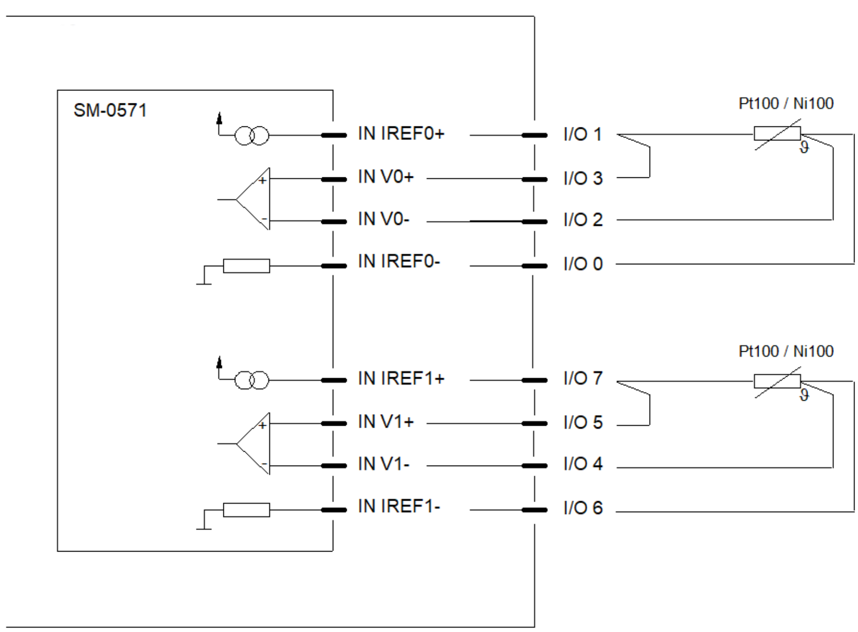
[dw_SM-0571_Block_Diagram, 1, en_US]

Figure 5-85 SM-0571 block diagram



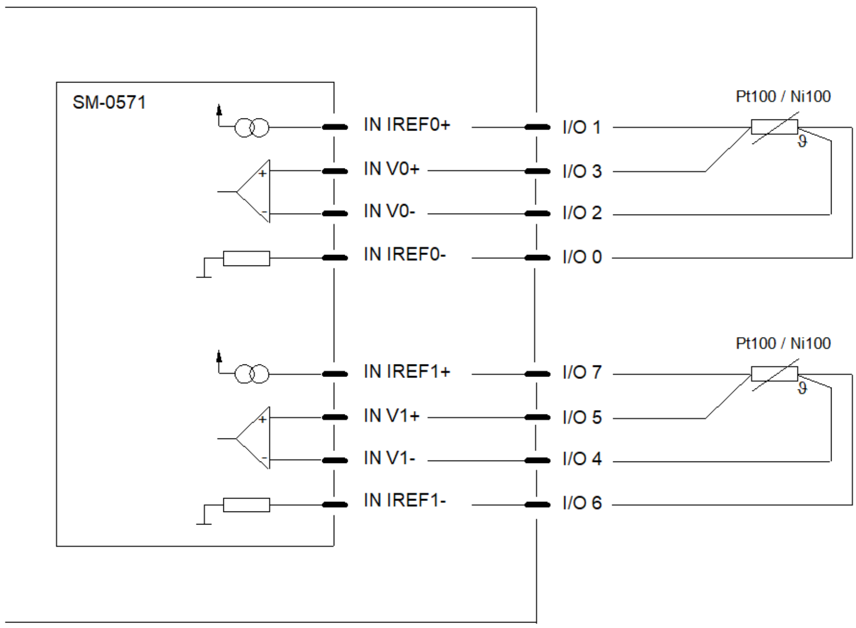
[dw_SM-0571_Ext_Circuitry_01, 1, --_--]

Figure 5-86 Connecting Resistance Thermometers in 2-Wire Technology



[dw_SM-0571_Ext_Circuitry_02, 1, --_--]

Figure 5-87 Connecting Resistance Thermometers in 3-Wire Technology

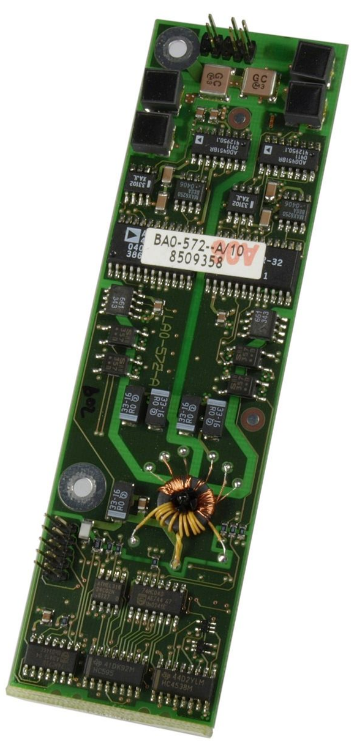


[dw_SM-0571_Ext_Circuitry_03, 1, --_--]

Figure 5-88 Connecting Resistance Thermometers in 4-Wire Technology

5.9.5.3 SM-0572 Analog output extension (2x ±20 mA,±1/10 V)

The submodule SM-0572 (analog value module) is used for modular expansion of peripheral module AI-2300.



[ph_SM-0572_8, 1, --_--]

Overview

The submodule SM-0572 provides

- 2 analog outputs
  - Current or voltage output can be selected for each submodule
  - Selectable current output range
    - -20 mA to +20 mA
    - -10 mA to +10 mA
    - -5 mA to +5 mA
  - Selectable voltage output range
    - -1 V to +1 V
    - -10 V to +10 V

The function of this submodule is determined by the firmware of the basic module.

Technical Data

Memory	
Parameter memory	EEPROM 96 Byte

<table>
<tr><th>Output circuits</th><th colspan="4"></th></tr>
<tr><td>Current outputs</td><td colspan="4">• max. ±20 mA on max. 500 Ω load
• max. ±10 mA on max. 500 Ω load
• max. ±5 mA on max. 500 Ω load
• The outputs are galvanically insulated from each other, from the carrier module, from the logic circuits and from ground
• The outputs are protected by EMC filters and fault protection equipment</td></tr>
<tr><td>Voltage Outputs</td><td colspan="4">• ±10 V at min. 1 kΩ load
• ±1 V at min. 1 kΩ load
• The outputs are galvanically insulated from each other, from the carrier module, from the logic circuits and from ground
• The outputs are protected by EMC filters and fault protection equipment</td></tr>
<tr><td>Resolution</td><td colspan="4">Current outputs
• 15 bit + sign at ±20 mA
• 14 bit + sign at ±10 mA
• 13 bit + sign at ±5 mA
Voltage Outputs
• 13 bit + sign at ±10 V
• 11 bit + sign at ±1 V</td></tr>
<tr><td>Setting time</td><td colspan="4">10 ms</td></tr>
<tr><td rowspan="8">Accuracy with fan operating (valid, if the ambient temperature is constant since 10 minutes)</td><td>Current outputs</td><td>±20 mA</td><td>±10 mA</td><td>±5 mA</td></tr>
<tr><td>+25°C</td><td>0.05 %</td><td>0.05 %</td><td>0.05 %</td></tr>
<tr><td>0 to +50°C</td><td>0.2 %</td><td>0.4 %</td><td>0.8 %</td></tr>
<tr><td>-25 to +70°C</td><td>0.35 %</td><td>0.7 %</td><td>1.4 %</td></tr>
<tr><td>Voltage Outputs</td><td>±10 V</td><td>±1 V</td><td></td></tr>
<tr><td>+25°C</td><td>0.05 %</td><td>0.5 % *)</td><td></td></tr>
<tr><td>0 to +50°C</td><td>0.4 %</td><td>4 % *)</td><td></td></tr>
<tr><td>-25 to +70°C</td><td>0.75 %</td><td>7.5 % *)</td><td></td></tr>
</table>

Output circuits				
Accuracy without fan operating (valid, if the ambient temperature is constant since 10 minutes)	Current outputs	±20 mA	±10 mA	
	+25°C	0.1 %	0.15 %	
	0 to +50°C	0.25 %	0.5 %	
	-25 to +70°C	0.4 %	0.6 %	
	Voltage Outputs	±10 V	±1 V	
	+25°C	0.2 %	2 % *)	
	0 to +50°C	0.55 %	5.5 % *)	
	-25 to +70°C	0.9 %	9 % *)	
Internal resistance with voltage output	max. 0.6 Ω			

*) if needed, accuracy is possible as for the 10 V range

Power Supply	
Operating voltage	5 VDC ± 5 %, typ. 1.5 W
Input circuits	Circuits are operated by means of an external voltage

Mechanics and Connectors	
Rated impulse voltage	2.0 kV
Dimensions	120 x 35 mm
Weight	Approx. 26 g

Pin Assignment

Connector to carrier module

The pin assignment of the connector is as follows:

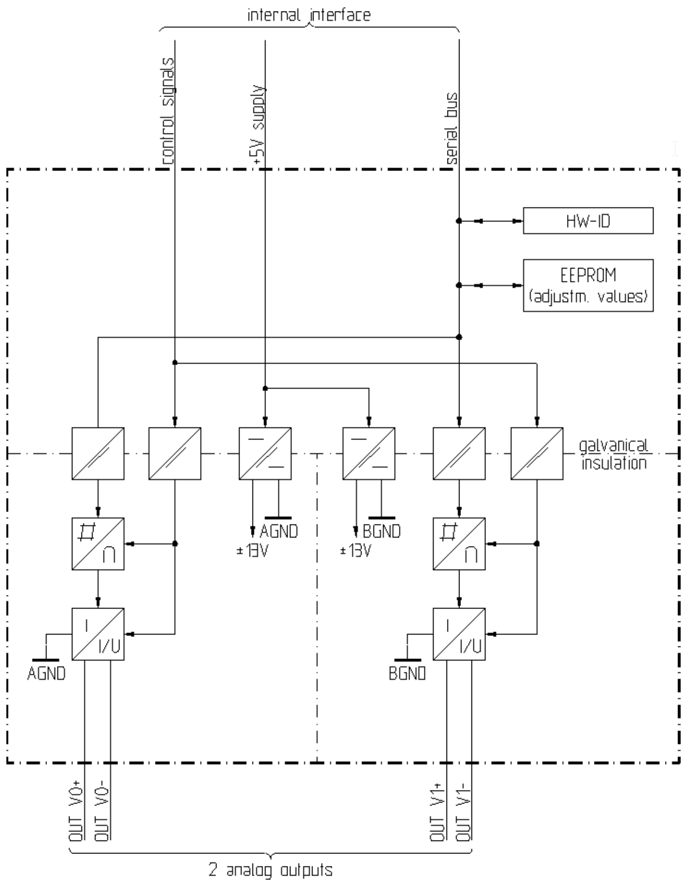
Pin	Alias	Signal	Pin	Alias	Signal
1	I/O 0		2	I/O 1	
3	I/O 2	OUT V0+	4	I/O 3	OUT V0-
5			6		
7	I/O 4		8	I/O 5	
9	I/O 6	OUT V1+	10	I/O 7	OUT V1-

The abbreviations have the following meaning:

OUT V0+, OUT V0- = Analog output 0

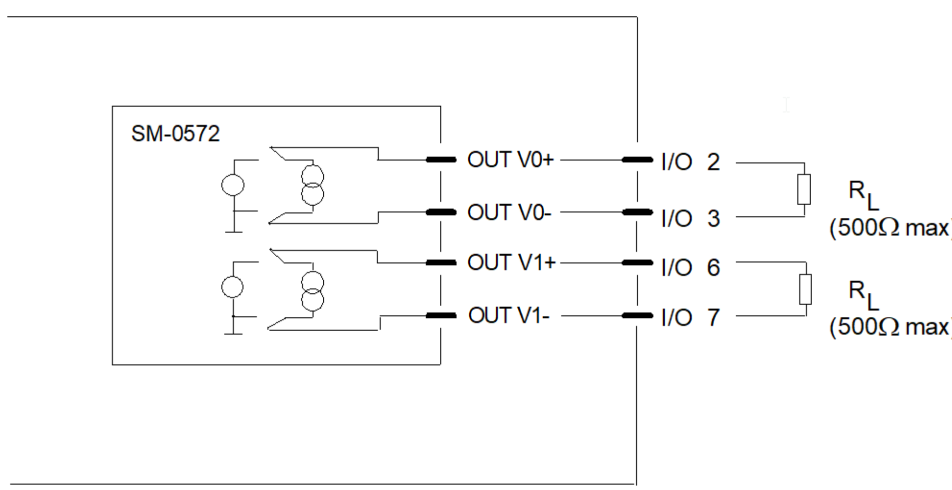
OUT V1+, OUT V1- = Analog output 1

Block Diagram and External Circuitry



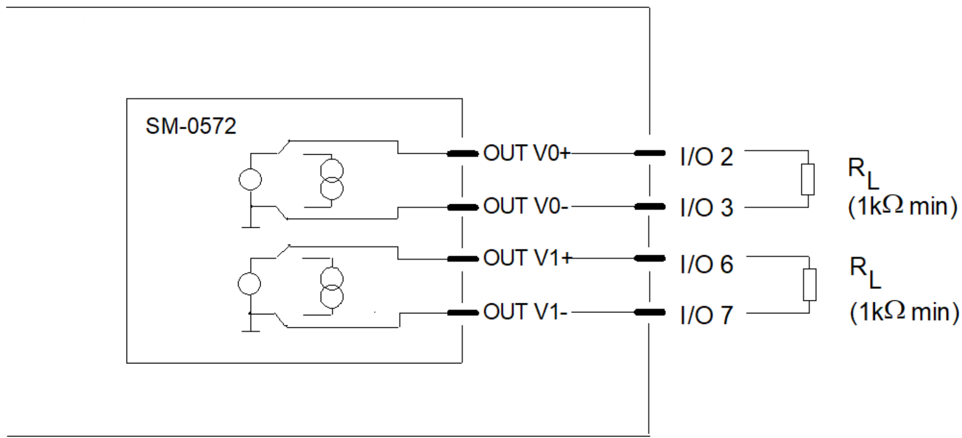
[dw_SM-0572_Block_Diagram, 1, en_US]

Figure 5-89 SM-0572 block diagram



[dw_SM-0572_Ext_Circuitry_01, 1, --_--]

Figure 5-90 External circuitry for current output

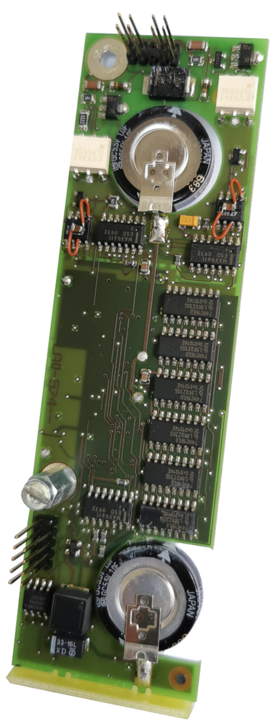


[dw_SM-0572_Ext_Circuitry_02, 1, --_--]

Figure 5-91 External circuitry for current output

5.9.5.4 SM-0574 Counter input (2x24-60VDC)

The submodule SM-0574 (counter input module) is used for modular expansion of peripheral module AI-2300.



[ph_SM-0574, 1, --_--]

Overview

The submodule SM-0574 provides

- 2 pulse inputs
  - Nominal voltage 24 to 60 VDC
  - The pulse inputs can be used alternatively as
    - 2 counter inputs
    - 1 counter input + 1 control input
  - 1 pulse input drives 1 counter (pulse counting)
    - The counter has a maximum count of 24 bits width
  - Submodule functions which can be operated autonomously are supplied by backup voltage
    - Because of this counting function and counts are preserved over a supply-outage of up to 72 hours (count pulse frequency ≤ 50 Hz)
    - In the case of a supply-outage of more than 72 hours the counts are either still correct or marked as "lost"

The function of this submodule is determined by the firmware of the basic module.

Technical Data

Memory	
Parameter and counter memory	FRAM 512 Byte

<table>
<tr><th>Input circuits and counters</th><th colspan="4"></th></tr>
<tr><td>2 pulse inputs</td><td colspan="4">• Rated voltage:
– DC 24 V to 70 V according to EN 61010-1:2010
– DC 24 V to 60 V according to IEC 61010-1:2010/AMD1:2016
• Maximum pulse frequency 5 kHz
• Level for logical "0" ≤ 12 VDC; Level for logical "1" ≥ 18 VDC
• Nominal power per input max. 170 mW at 24 VDC; max. 420 mW at 60 VDC
• The inputs are galvanically insulated from logic circuits and ground
• The inputs are operationally insulated from one another</td></tr>
<tr><td rowspan="5">Bounce suppression with counter frequency stage:</td><td></td><td>Pulse length</td><td>Pulse discontinuation</td><td></td></tr>
<tr><td>5 kHz</td><td>>10 µs</td><td>>100 µs</td><td></td></tr>
<tr><td>500 Hz</td><td>>150 µs</td><td>>1 ms</td><td></td></tr>
<tr><td>50 Hz</td><td>>1.5 ms</td><td>>10 ms</td><td></td></tr>
<tr><td>20 Hz</td><td>>3 ms</td><td>>25 ms</td><td></td></tr>
<tr><td>Backup devices</td><td colspan="4">4 pieces 1F electric double layer capacitors (Gold Caps). Backup devices can be changed</td></tr>
<tr><td>Calculated life time
(time after that 72 hours buffering is still ensured)</td><td colspan="4">• Raising the average ambient temperature by 10 °C will reduce expected life by 50 %
• A voltage >18 V (level for logical 1) fed to the input of a channel causes the channel's max. power consumption
• A voltage >12 V (level for logical 0) fed to the input of a channel causes the channel's max. power consumption
• Disturbance event means failure of the carrier module and autonomous buffered operation of the submodule</td></tr>
</table>

Input circuits and counters				
Life time	T_D	Case A[78]	Case B[79]	Case C[80]
	30	t_L = 14,6	t_L = 26,2	t_L = 29,2
	40	t_L = 7,3	t_L = 13,1	t_L = 14,6
	50	t_L = 3,6	t_L = 6,5	t_L = 7,3
	T_D	average ambient temperature in °C		
	t_L	calculated life in years		
Charging time for backup devices	Min. 12 h; during charging the power consumption decreases exponentially: at start 0.5 W (typ.) after 2 minutes 0.25 W (typ.) after 12 hours 50 mW (typ.)			
Backup supply for counting function and counts	72 h (count pulse frequency ≤ 50 Hz)			

Power Supply	
Operating voltage	5 VDC ± 5 %
Input circuits	Circuits are operated by means of an external voltage

Mechanics and Connectors	
Rated impulse voltage	2.0 kV
Dimensions	120 x 35 mm
Weight	Approx. 35 g

Pin Assignment

Connector to carrier module

The pin assignment of the connector is as follows:

Pin	Alias	Signal	Pin	Alias	Signal
1	I/O 0	IN IC0+	2	I/O 1	IN IC0-
3	I/O 2		4	I/O 3	
5			6		
7	I/O 4	IN IC1+	8	I/O 5	IN IC1-
9	I/O 6		10	I/O 7	

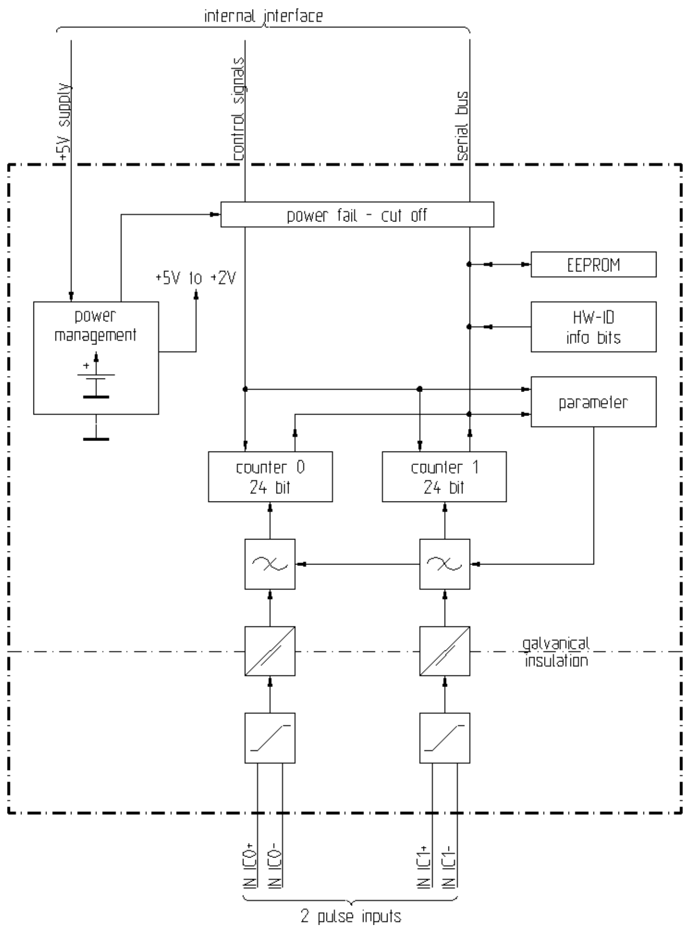
The abbreviations have the following meaning:
IN IC0+, IN IC0- = pulse input 0 (counter input)
IN IC1+, IN IC1- = pulse input 1 (counter input or control input)

78 during the disturbance event, a voltage ≥18 V (level for logical 1) is fed to both inputs (= worst case power consumption)

79 during the disturbance event, a 50 Hz pulse signal is fed to both inputs; bounce suppression is set to 50 Hz

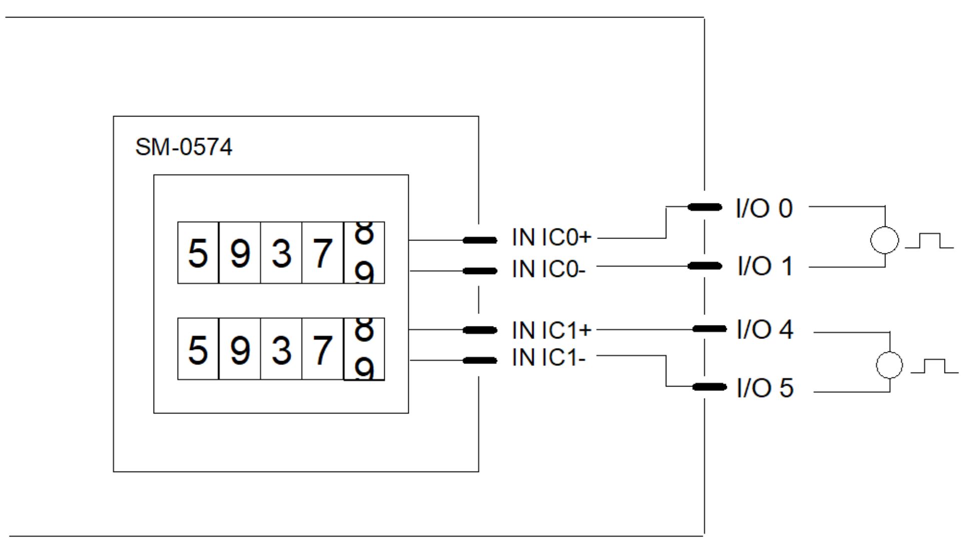
80 during the disturbance event, a 50 Hz pulse signal is fed to one of the inputs; bounce suppression is set to 50 Hz; the other input is open or a voltage ≤12 V (level for logic 0) fed to that input

Block Diagram and External Circuitry



[dw_SM-0574_Block_Diagram, 1, en_US]

Figure 5-92 SM-0574 block diagram



[dw_SM-0574_Ext_Circuitry_01, 1, --_--]

Figure 5-93 External circuitry for count pulse input

5.9.5.5 SM-2506 Measuring module for command output 24-60VDC

You find information on this submodule in the specification of the carrier module (DO-2210).

5.10 SICAM A8000 Racks

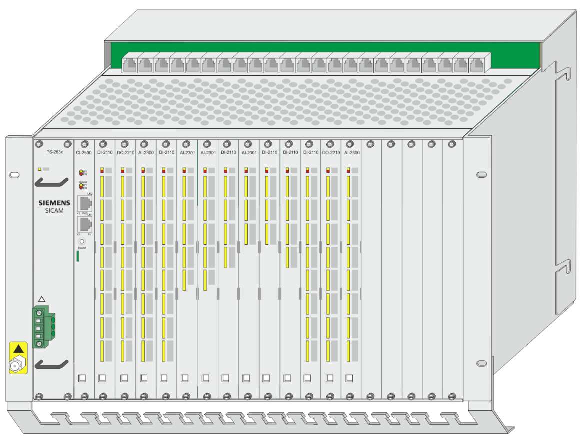
5.10.1 CM-2846

NOTE

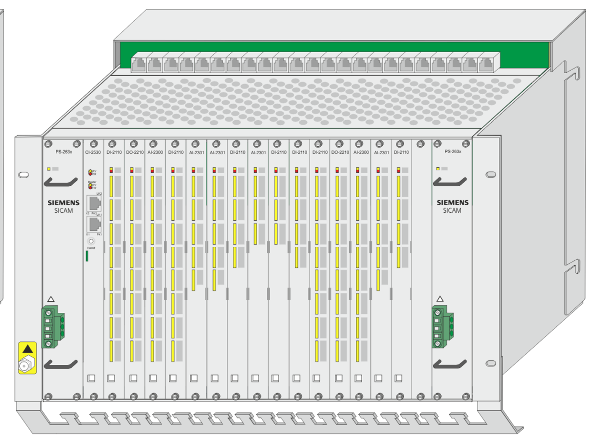
Use only in connection with CP-8050.

The mounting rack CM-2846 provides 17 slots for modules with double euro format.

The rack is primarily designed for 19" (swing) frame installation, but can also be used for rear panel installation with the optional wall mounting kit.



CM-2846 with single power supply



CM-2846 with redundant power supply

5.10.1.1 Overview

The mounting rack (84 TE, 9 HE) can be equipped as follows (these parts are not included in the scope of supply)

- SICAM A8000 Rack I/O Remote Module (CI-2530)
- up to 16 SICAM Rack I/O modules
  - DI-2112, DI-2113, DI-2114, DI-2115
  - DO-2201, DO-2210, DO-2211
  - AI-2300
- 1 to 2 power supply modules (PS-263x)

5.10.1.2 Features and Functions

- The installed rack I/O modules are connected to the EbIO, which is operated by exactly one - possibly redundant - master module (CP-8050/CPCi85)
- Wiring peripherals using prefabricated peripheral cables CM-2890
- 2 slots for power supply modules PS-263x
- ESD Earth Facility for connecting a ground strap when changing modules
- Unlocking tool for modules included

5.10.1.3 Technical Data

Backplane and Connectors

Slot for CI-2530	Slot 0
Slots for SICAM A8000 Rack I/O Modules	Slot for 1 - 17
Slots for PS-263x	• 1. Power supply module left • 2. Power supply module right

NOTE

The connections for redundancy and Ax 1703 peripheral bus (X1 to X23) are not used when the rack is connected to CP-8050.

Voltage output +5 VDC

	Voltage is taken from the power supply module, and provided current-limited using a PTC
Output nominal voltage[81]	1 A
PTC voltage drop[81]	≤ 100 mV at 1 A and +70°C
Proof against continued short-circuit[81]	yes

Supply of the mounting rack

Operating voltage	5,1 V; supplied by the installed power supply module PS-263x

Mechanical Design

Design	Compact metal housing for • rear panel installation • 19 inch (swing) frame installation
Peripheral connectors	Prefabricated peripheral cables CM-2890, 50x2x0.5, 5 m
Power supply connectors	Screw terminals for direct conductor assembly up to 2.5 mm² cross-section
Dimensions	Height: 320 mm Width: 483 mm Depth: 258 mm (power supply not installed) Depth: 280 mm (power supply installed)
Weight	Approx. 4.8 kg

81 applies additionally to the specification of the power supply

5.11 SICAM TM I/O Modules

Following SICAM TM I/O modules can be coupled to CP-8031/CP-8050 by means of the coupling module CM-6812:

Type	Designation	Power	MLFB
DI-6100	Binary input 2x8 DC 24-60 V	170 mW	6MF11130GB000AA0
DI-6101	Binary input 2x8 DC 110/220 V	170 mW	6MF11130GB010AA0
DI-6102	Binary input 2x8 DC 24-60 V, 1 ms	170 mW	6MF11130GB020AA0
DI-6103	Binary input 2x8 DC 110/220 V, 1 ms	170 mW	6MF11130GB030AA0
DI-6104	Binary input 2x8 DC 220 V	170 mW	6MF11130GB040AA0
DO-6200	Binary output transistor 2x8 DC 24-60 V	600 mW	6MF11130GC000AA0
DO-6212	Binary output relays 8x DC 24-220 V / AC 230 V	800 mW	6MF11130GC120AA0
DO-6220	Secured command output basic module	560 mW	6MF11130GC200AA0
DO-6221	Secured command output basic module measurement	1380 mW	6MF11130GC210AA0
DO-6230	Secured command output relay module	130 mW	6MF11130GC300AA0
AI-6300	Analog input 2x2 ±20 mA/±10 V	480 mW	6MF11130GD000AA0
AI-6307	Analog input 2x2 ±2.5 mA/±5 mA/±10 V	480 mW	6MF11130GD070AA0
AI-6308	Analog input 2x2 ±1 mA/±2 mA/±10 V	480 mW	6MF11130GD080AA0
AI-6310	Analog input 2x2 Pt100/Ni100	480 mW	6MF11130GD100AA0
AO-6380	Analog output 4x ±20 mA/±10 mA/±10 V	1900 mW	6MF11130GD800AA0
TE-6420	Speed acquisition 2x2 5/24VDC/NAMUR	790 mW	6MF11130GE200AA0
TE-6430	Counter input 2x DC 24 to 60 V	600 mW	6MF11130GE300AA0
TE-6450	Position acquisition2x2 SSI/RS422	770 mW	6MF11130GE500AA0
CM-6812	Coupling SICAM TM I/O Modules	–	6MF11130GJ120AA0

NOTE

- The modules DI-610x, DO-6212 and AI-6300 can also be used for redundancy from version 04.50 of the IOMI65.
- As of version 4.20 of IOMI85, the module TE-6420 can also be used for redundancy within an I/O line, together with SICAM A8000 I/Os
- To the right of the module TE-6420, only additional TE-6420 can be used
(no other modules possible)

NOTE

Details such as functions, technical data and external circuitry can be found in document **SICAM TM I/O Modules, DC6-041-2**.

5.12 MTBF Values

The MTBF values shown in this chapter were calculated according to Siemens standard SN29500.

All electrical and electromechanical components were considered. Not included are mechanical components (screws, housing, adhesive labels, ...).

The MTBF values are statistical values that serve only for the evaluation of maintenance and replacement needs. These values are not a guaranteed product feature.

The MTBF values were calculated for 40 °C ambient temperature.

5.12.1 MTBF values of the SICAM A8000 Modules

Master Module

Module	MTBF	
	[Hours]	[Years]
CP-8031 Master Module	428 796	48.95
CP-8050 Master Module	421 992	48.17

Power Supply Modules

Module	MTBF	
	[Hours]	[Years]
PS-8620 Power Supply 24-60VDC, 12 W	1 809 267	206.54
PS-8622 Power Supply 110-220VDC, 12 W	1 748 221	199.57
PS-8640 Power Supply 24-60VDC, 45 W	1 490 671	170.10
PS-8642 Power Supply 100-240VDC o. VAC 45W	1 014 243	115.80

Communication Modules

Module	MTBF	
	[Hours]	[Years]
CI-8520 Ethernet 'Interface	759 059	86.65
CI-8522 Network Interface Fiber Optic	646 914	73.85
CI-8551 Serial Communication Interface	436 215	49.80

SICAM A8000 I/O-Remote-Module

Module	MTBF	
	[Hours]	[Years]
CI-8530 SICAM I/O Remote 24-60VDC el.	772 308	88.16
CI-8531 SICAM I/O Remote 24-60VDC F/O	664 095	75.81
CI-8532 SICAM I/O Remote 110-220VDC el.	762 998	87.10
CI-8533 SICAM I/O Remote 110-220VDC F/O	643 795	73.47

SICAM I/O-Module

Module	MTBF	
	[Hours]	[Years]
AI-8310 Analog input 2x2 Pt100/Pt1000	1 293 929	147.71
AI-8320 Analog output 4x ±20mA/±10V	2 238 589	255.55
AI-8330 Ana. Input 3xI(6A) with AI-8340	3, 694, 809	421.78
AI-8340 Ana. Input (4xU(250V), 2xDO)	1, 122, 158	128.10

Module	MTBF	
	[Hours]	[Years]
AI-8510 Ana. Inp. (3xU(240V),3xI(LoPo))	1 354 169	154.59
AI-8510 Ana. Inp. (3xU(LoPo),3xI(LoPo))	1 408 352	160.77
AO-8380 Analog output 4x ±20mA/±10V	1 377 524	157.25
DI-8110 Digital input 2x8, 24VDC	1 617 914	184.69
DI-8111 Digital input 2x8, 48/60VDC	1 617 914	184.69
DI-8112 Digital input 2x8, 110VDC	1 617 914	184.69
DI-8113 Digital input 2x8, 220VDC	1 552 120	177.18
DO-8212 Dig Outp Rel 8x 24-220VDC/230VAC	2 362 056	269.64
DO-8230 Digital output transistor 16x 24-60VDC	1 019 432	116.37

Accessories

Module	MTBF	
	[Hours]	[Years]
CM-8820 CT-Adapter 3xI 1A_5A/225mV	11 993 284	1369.10
CM-8830 SICAM I/O Module LED Unit	1 659 916	189.00

5.12.2 MTBF Values of the SICAM A8000 Rack Modules

I/O Remote Module

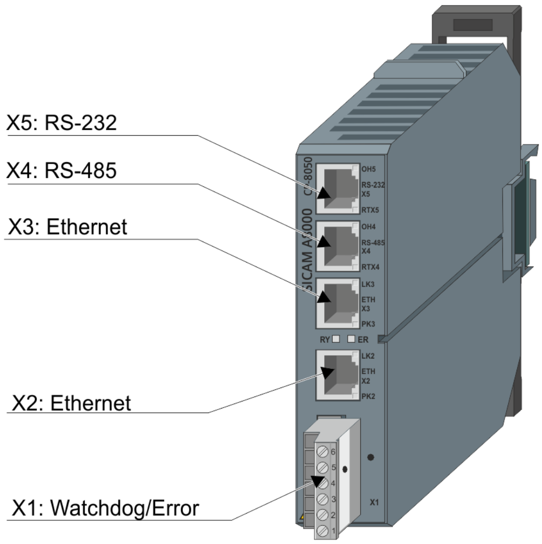
Module	MTBF	
	[Hours]	[Years]
CI-2530 SICAM Rack I/O Remote	1, 129, 637	128.95

6 Installation and Circuitry

6.1 Mechanical Design

The electrical components of the device are housed in a plastic casing with the dimensions 30 mm x 132 mm x 124 mm (W x H x D). The casing is designed for assembly on a DIN rail.

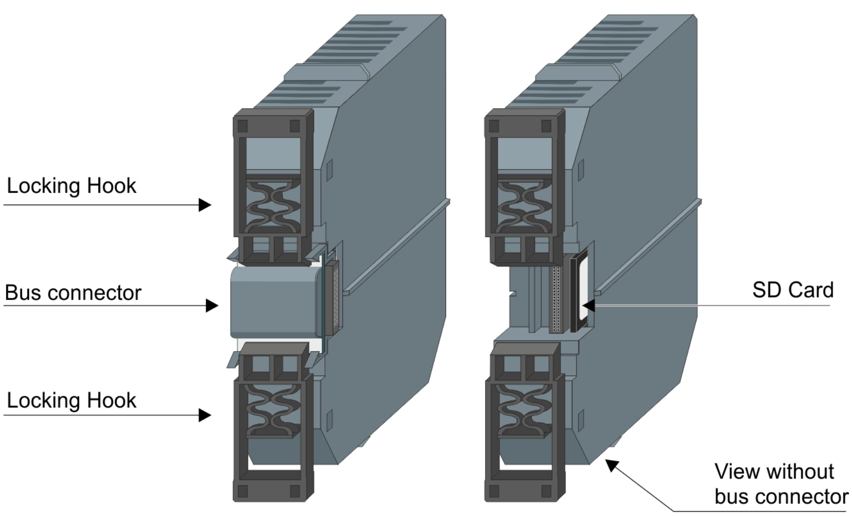
On the front are the LED display elements and the communication interfaces.



[CP-8050_mechanischer_aufbau_front, 1, en_US]

Figure 6-1 CP-8050 front view

At the back are the locking hooks, the bus connector and below the slot for the SD card.



[CP-8050_Mechanical_Design_Rear, 1, en_US]

NOTE

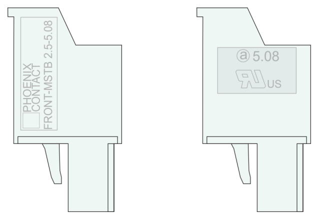
See *A Ordering Information* for compatible hardware versions of locking hook and bus connector with SICAM A8000 devices.

Locking Hook

The device is locked onto the DIN rail and also removed again using the locking hook. For details see *6.5 Mounting/Removal of a SICAM A8000 Module*

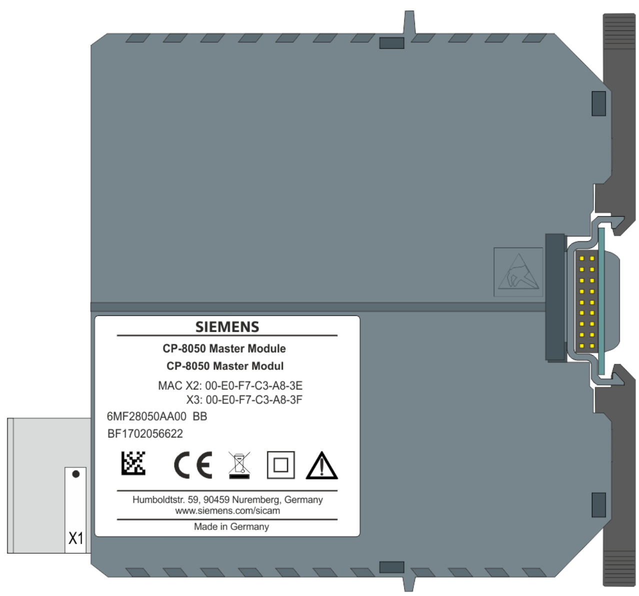
Types of screw terminals

Two different types of screw terminals are provided (manufacturer PHOENIX or FCI, see different impressions on the side of the terminal).



Type Plate

On the right side of the housing resides the type plate with specific information as type, order number, serial number, hardware address for the network operation (MAC address).

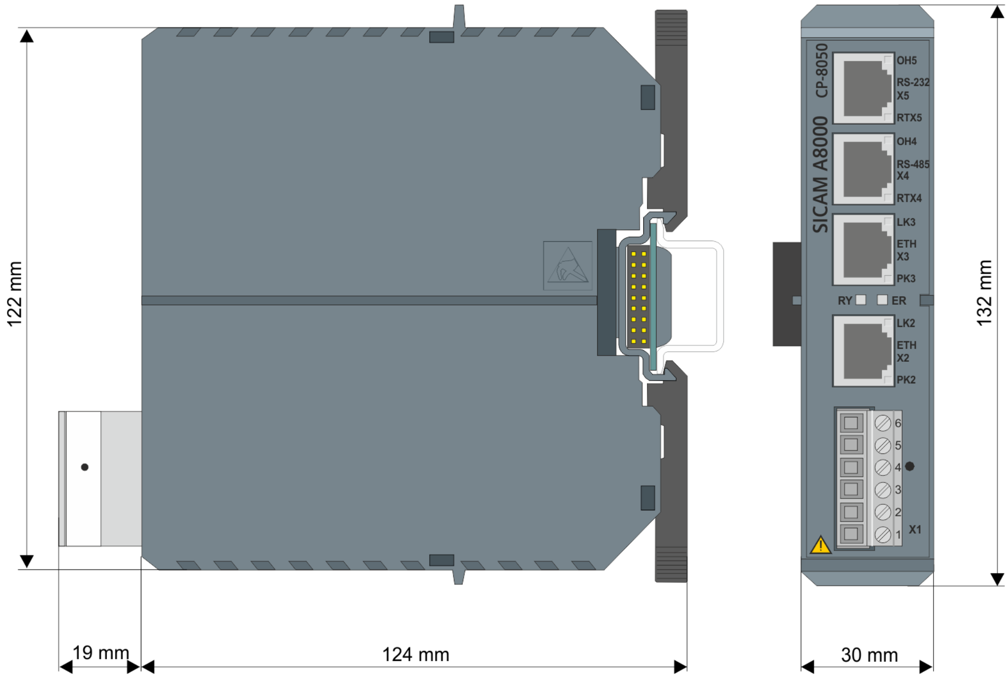


[CP-8050_with_type_plate, 2, --_--]

Figure 6-2 CP-8050 type plate

6.2 Dimensions

Front and side view



[CP-8050_housing_dimensions, 1, --_--]

Figure 6-3 CP-8050 Front and side view

6.3 Installation Location and Position

CP-8031/CP-8050 must be installed in a suitable cabinet with protection against fire and electrical hazard. Typically, this is an industrial control cabinet or a rack. For USA/Canada, NRTL/SCC certified cabinets are recommended.

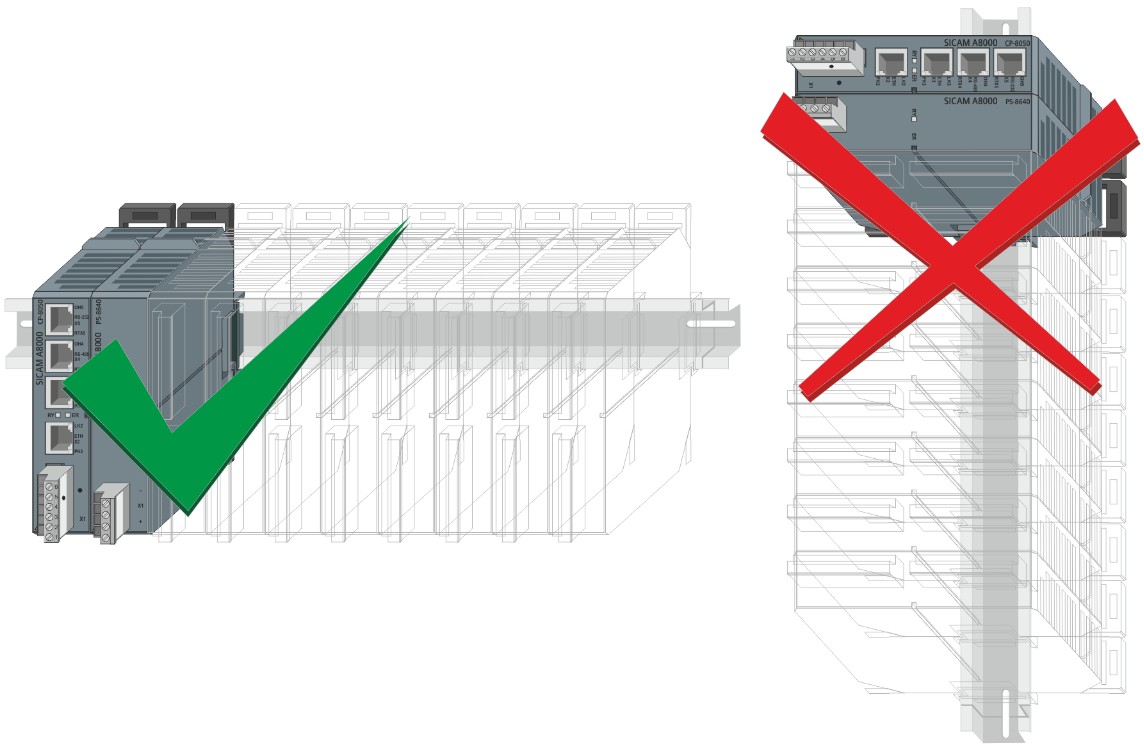
For information on the subject of environmental conditions, please refer to chapter *4 Environmental Conditions*.

NOTE

Not permissible are installations on the ceiling and on the floor (excessive temperature, dust load).

Base Device

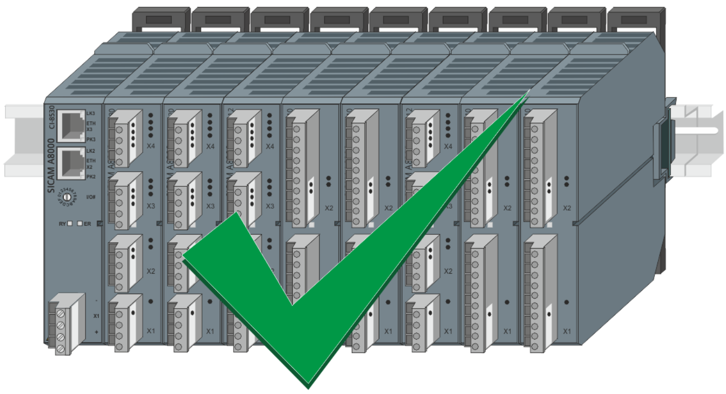
The base device (with or without communication modules, I/O-modules) may only be installed horizontally.

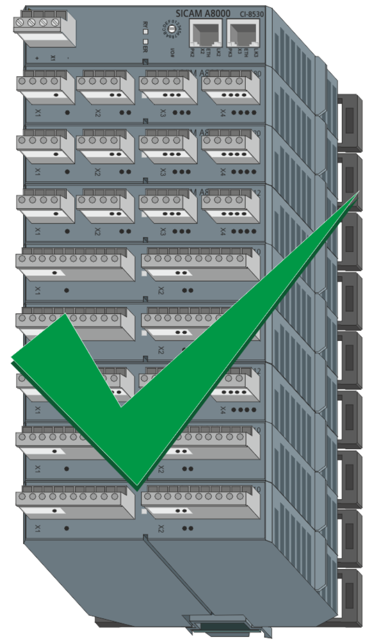


Remote I/O Row

Remote I/O rows can be mounted in horizontal and vertical position.

In the vertical installation position, a reduced maximum ambient temperature applies. Refer to *4.1.3 Climatic Ambient Conditions*.



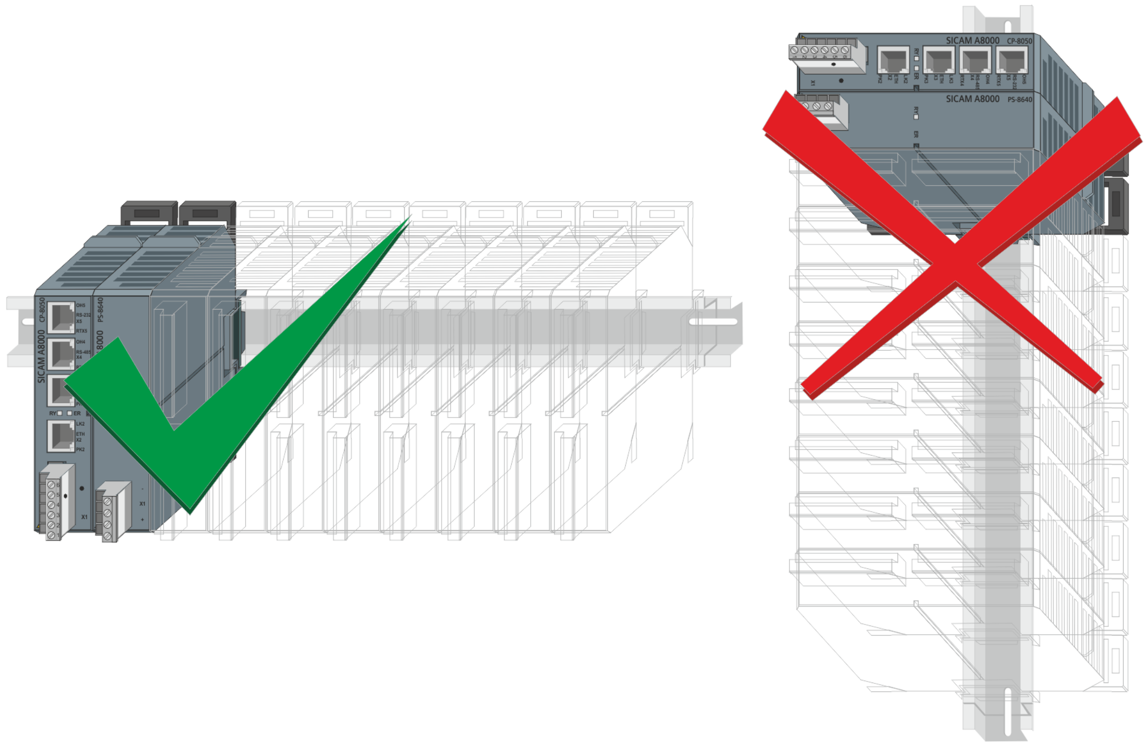


NOTE

Remote I/O rows with the Modules DO-8221, AI-8330 or AI-8340 may only be mounted horizontally.

6.3.1 Base Device

The base device (with or without communication modules, I/O-modules) may only be installed horizontally.



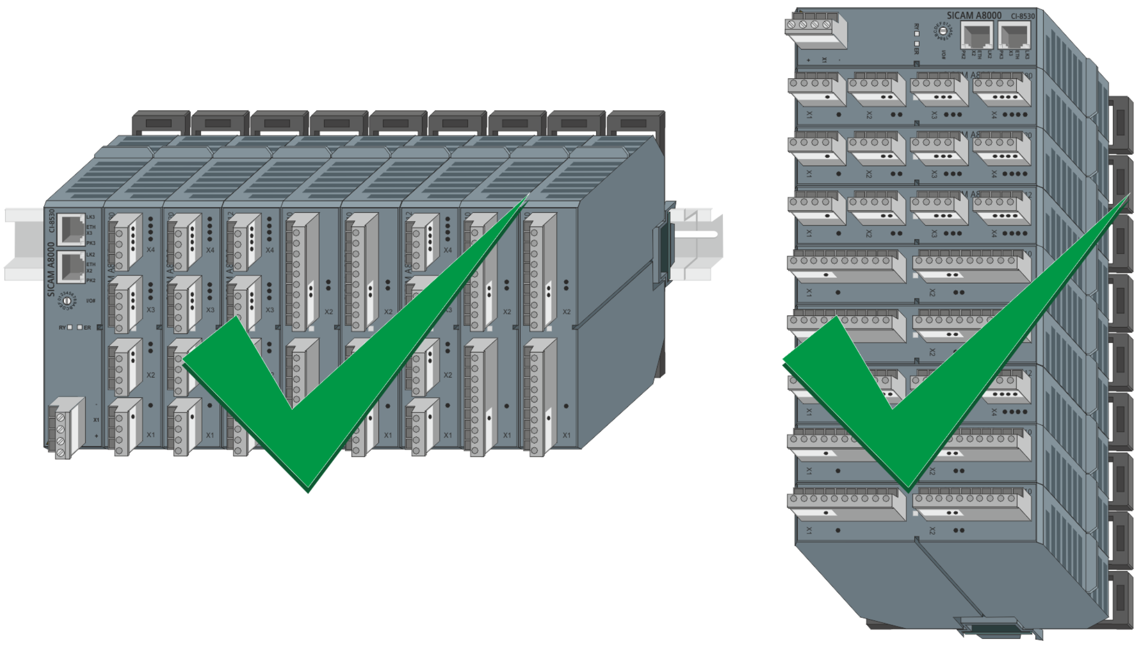
[CP-8050_Mounting_Position_Base_Device, 1, --_--]

Figure 6-4 CP-8031, CP-8050 - mounting position

6.3.2 Remote I/O Row

Remote I/O rows can be mounted in horizontal and vertical position.

In the vertical installation position, a reduced maximum ambient temperature applies. Refer to *4.1.3 Climatic Ambient Conditions*.



[CP-8050_Mounting_Position_IO_Row, 1, --_--]

Figure 6-5 Remote I/O Row - mounting position

NOTE

Remote I/O rows with the Modules DO-8221, AI-8330 or AI-8340 may only be mounted horizontally.

6.3.3 DIN Rail (TH35 Rail)

A DIN rail that conforms to the standard EN 60715 must be used for the installation of the modules. The orientation and position in which the DIN rail is to be installed must be determined locally.

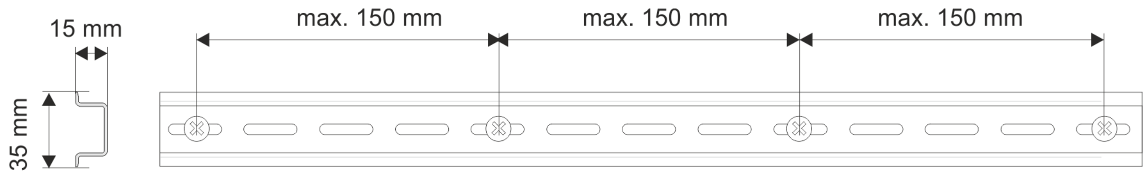
The DIN rail must be installed horizontally on a vertical wall.

WARNING

Danger due to improper operation of the device

Failure to observe the safety instructions means that death, severe injuries or considerable damage to property can occur.

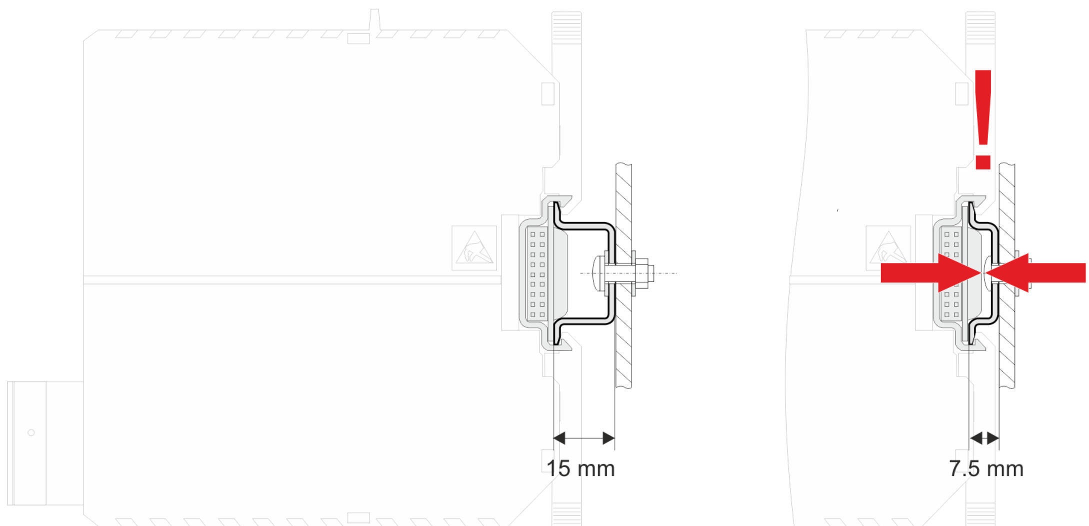
✧ The DIN rail must be screwed several times (distance between the screws: max. 150 mm) on an electrically conductive, metallic surface (cabinet/rack frame/mounting plate). This surface must be grounded properly. A mounting plate is recommended.



NOTE

Siemens recommends the use of a 15 mm deep DIN rail.

- With DIN rails with a smaller depth, there is a risk that the fastening screw will hit the bus connector. In such cases, screws with flat heads must be used.

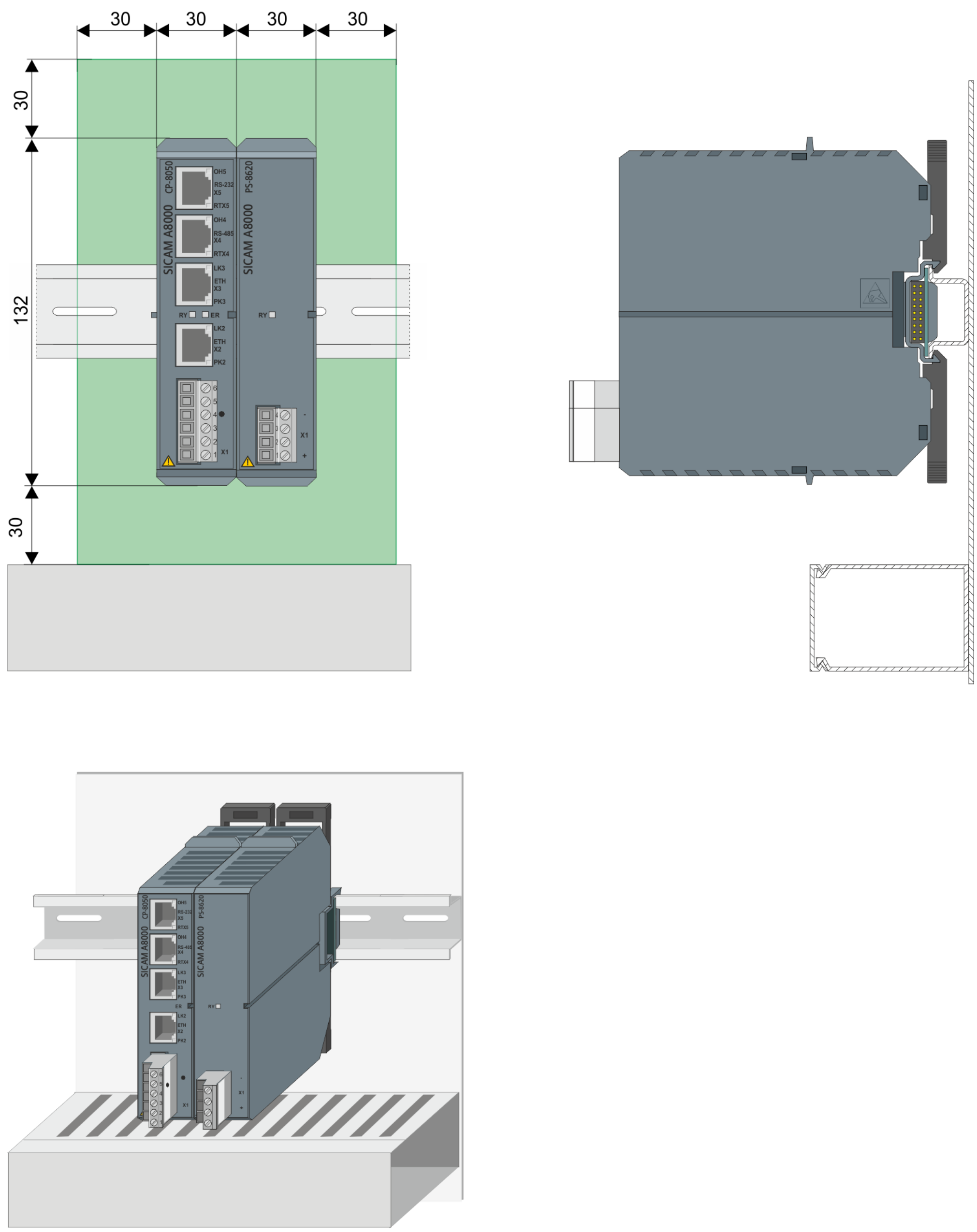


- Furthermore, in the case of DIN rails with a smaller depth the usability of the modules is restricted during assembly/disassembly.

6.4 Space Requirement

Space requirement for base device with power supply

To operate CP-8031/CP-8050, a power supply module is required. The dimensions and the minimum distance (30 mm) around the SICAM A8000 row (for thermal reasons) must be considered for the determination of the space requirement.



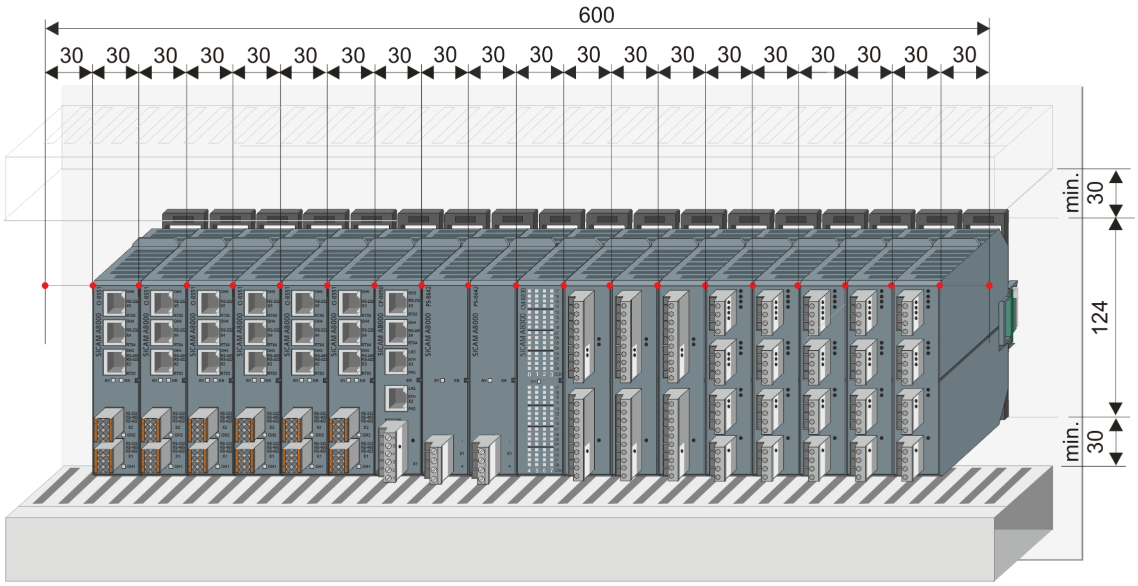
[CP-8050_Space_Requirement_Basic, 1, --_--]

Figure 6-6 CP-8050 Base Device with Power Supply Module

Space Requirement for a Maximum Configured CP-8050 Base Device

The maximum configuration consists of 6 CI modules, the CP module, 2 PS modules (for redundancy), 8 SICAM I/O modules and the LED module. Calculate 30 mm for each module. In addition, the thermal distance of 30 mm must be considered on the left and right.

Thermal distance on the left	30 mm
6 CI-Modules (6 x 30 mm)	180 mm
CP-Module	30 mm
2 PS-Modules (2 x 30 mm)	60 mm
LED Module	30 mm
8 SICAM I/O modules (8 x 30 mm)	240 mm
Thermal distance on the right	30 mm
Horizontal space requirement	**600 mm**



[dw_CP-8050_Space_Requirement_max, 1, --_--]

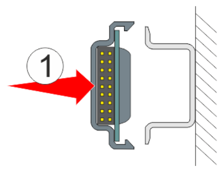
Figure 6-7 CP-8050 Base Device in Maximum Configuration

6.5 Mounting/Removal of a SICAM A8000 Module

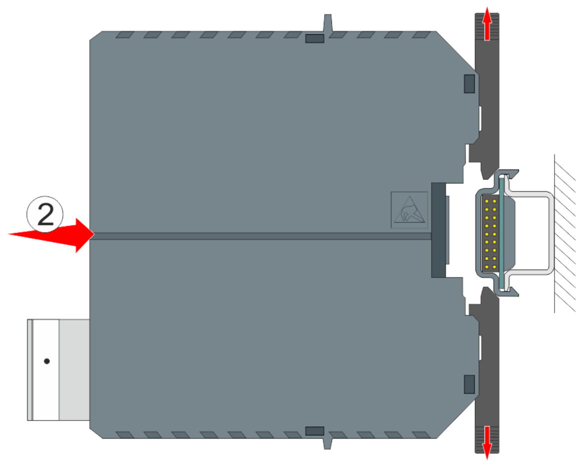
Assembly

- ✧ The modules of the SICAM A8000 Series are mounted by means of bus connector and locking hook on the DIN rail without using any tool.

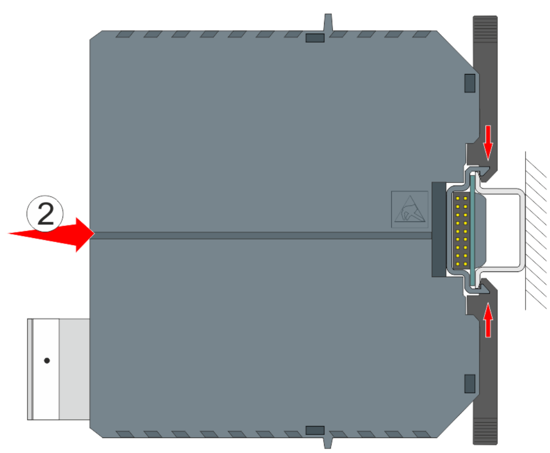
  Each module is equipped with a bus connector. Disconnect the bus connector from the I/O module and mount it on the DIN rail (1).



- ✧ Press the module on the bus connector (2). This opens the locking hooks.



- ✧ When module and bus connector are connected correctly, the locking hooks are latched on the DIN rail.



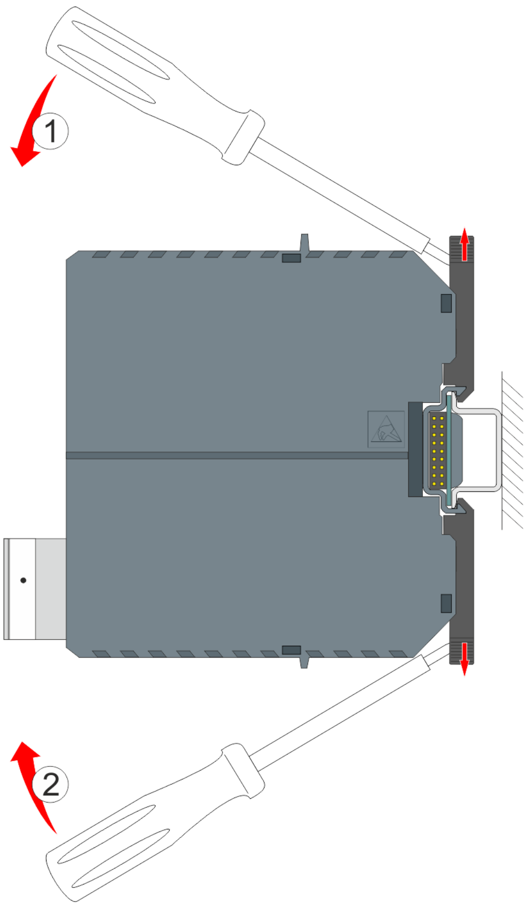
NOTE

You also can open and lock the locking hooks on the module, before you mount the module. They must be closed manually after assembly.

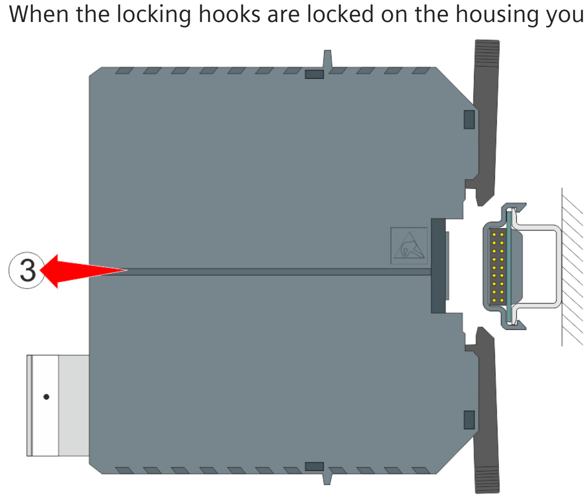
Check if the locking hooks are engaged in the DIN rail. This is essential for the safe attachment, as well as the correct function of the module and the other optionally mountable modules.

Removal

✧ To remove a module again, or to change its position on the DIN rail, the locking hooks must be opened again.
Insert a screwdriver suitable for slotted screws into the locking hook (shaft length at least 125 mm), as shown in the picture. The screw driver must have contact to the housing. The locking hooks are opened by carefully pushing the screwdriver downwards (1) resp. upwards (2).

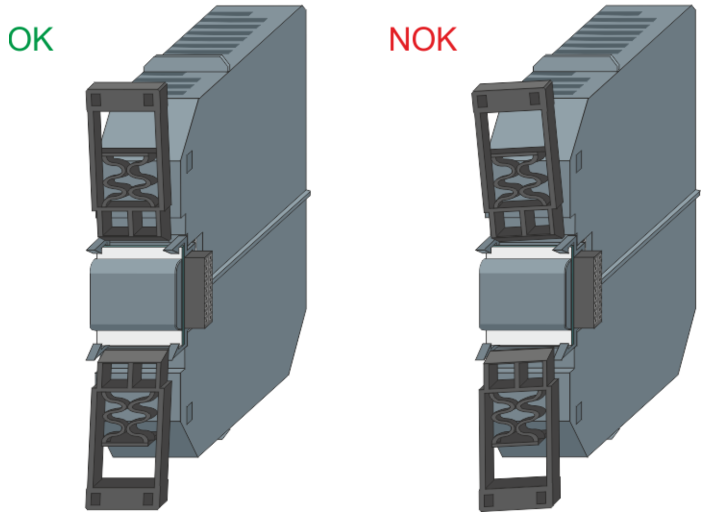


✧ When the locking hooks are locked on the housing you can pull the module off forward (3).



NOTE

Take care of the position of the locking hooks before removing the module from the DIN rail.



Make sure that the locking hooks are deflected exactly vertically, otherwise the module cannot be removed from the DIN rail or it could be damaged.

6.6 Mounting of SICAM A8000 I/O-modules

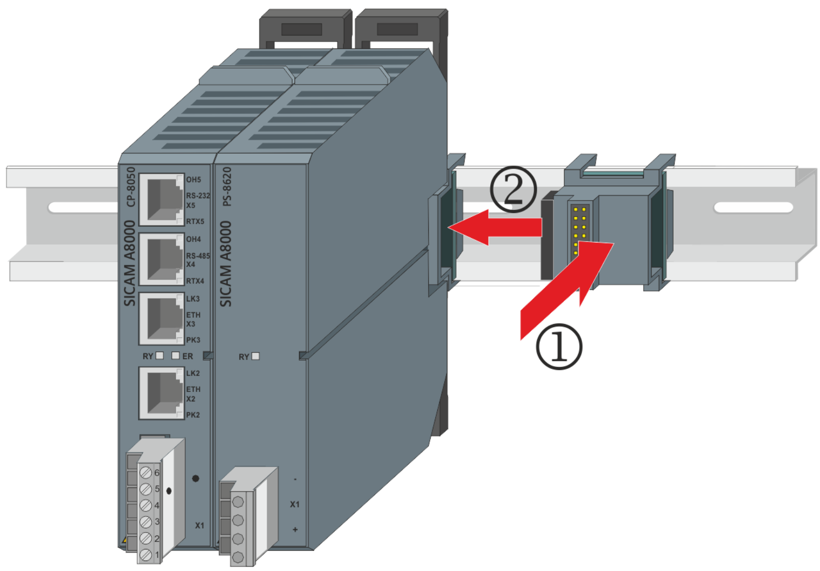
The SICAM I/O modules can either be installed locally on the CP-8031/CP-8050 base device or, in the case of CP-8050 systems, in remote I/O rows. Up to 8 SICAM I/O-modules can be connected in each case. The I/O-modules must be assembled to the right of the power supply. Thereto the following steps are essential:

- Mounting of the bus connector for SICAM I/O-modules
- Mounting of SICAM I/O-modules

Mounting of the bus connector for SICAM I/O-modules

Each SICAM I/O-module is equipped with a bus connector. These bus connectors must be equipped separated from the I/O-module. Hence you have to disconnect the bus connector from the I/O module before.

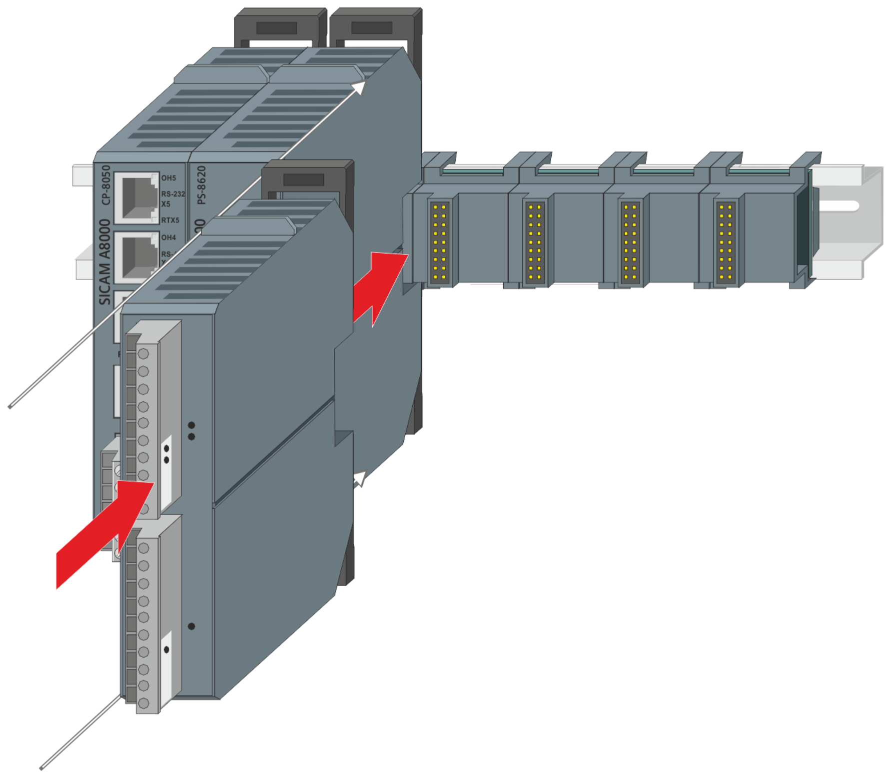
Mount the first bus connector right beside the power supply module on the DIN rail (1) and push it into the bus plug of the power supply module (2). Both elements must be aligned seamless.



Afterwards you can mount the bus connectors of further SICAM I/O-modules in the same way.

Mounting of SICAM I/O-modules

The SICAM I/O modules can be mounted as shown in following picture.



NOTE

The tongue and groove system integrated in the modules facilitates the correct combination. The module is only connected correctly when the locking hook is snapped onto the DIN rail.

NOTE

After transporting a CP-8031/CP-8050 system, Siemens recommends to check if the modules (bus connectors) are still in contact together.

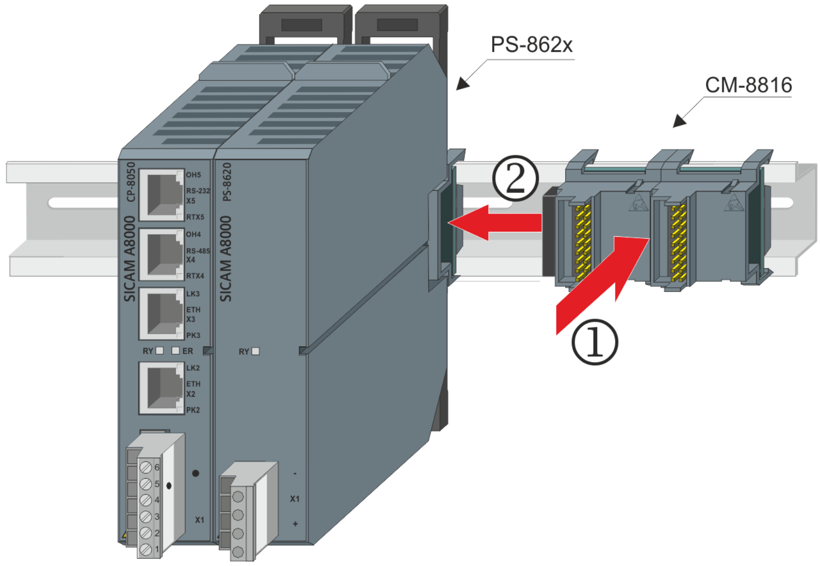
You can take information on the SICAM I/O-modules out of chapter *5.8 SICAM A8000 I/O Modules*

Please consider the notes in the section , . *2.10 Configuration Rules for SICAM A8000 I/O Modules*

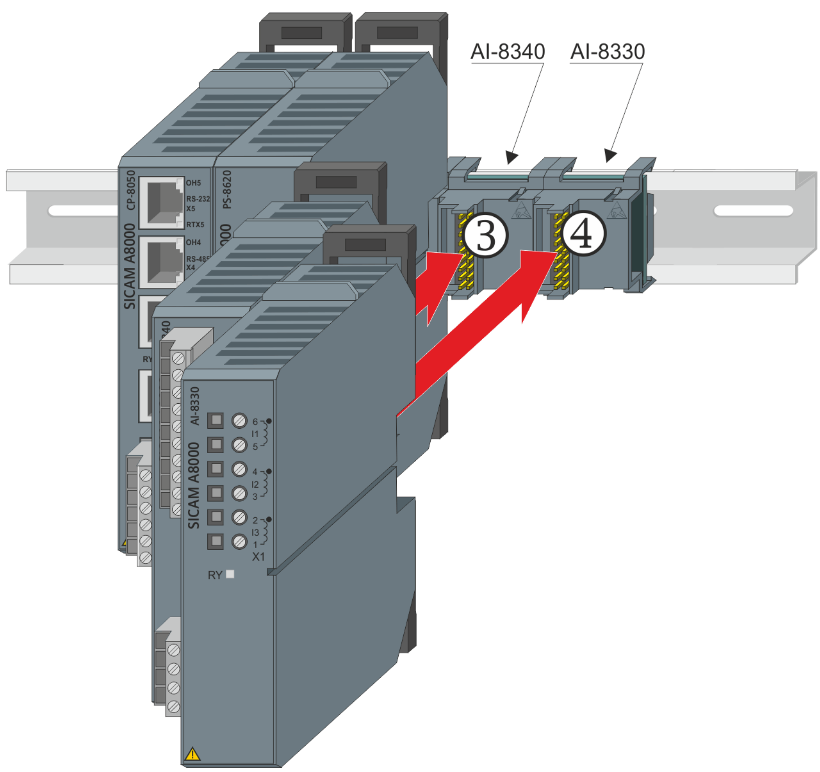
Mounting of the SICAM I/O modules AI-8330 and AI-8340

The prerequisite for installing the I/O module is that the SICAM A8000 system to be expanded has already been mounted on the DIN rail.

Then the bus connector (CM-8816), enclosed with the I/O module AI-8330, is clicked onto the DIN rail to the right of the installed system (1) and connected to the bus connector of the module on the left (2). Then the analog input module AI-8340 is plugged into the left bus connector (3) and the analog input module AI-8330 into the right bus connector.



[dw_AI-8330-40_Mounting_01, 1, --_--]



[dw_AI-8330-40_Mounting_02, 1, --_--]

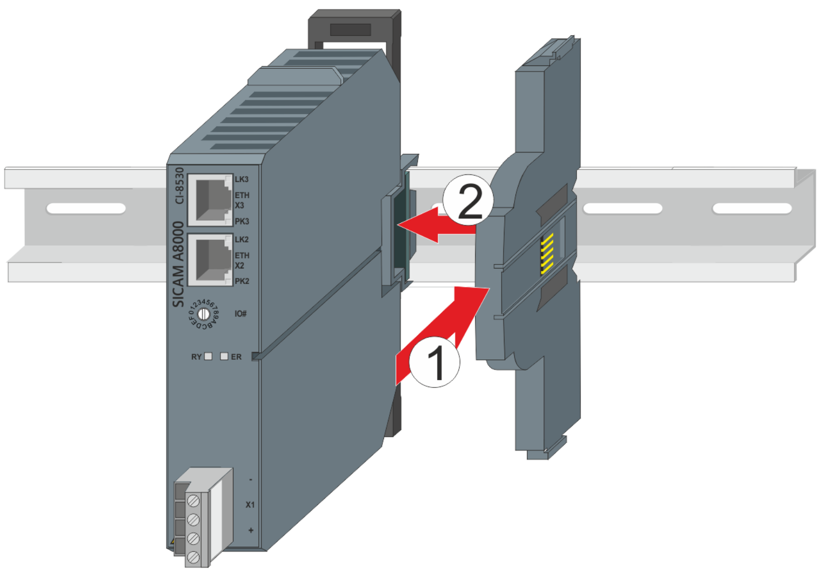
6.7 Mounting of SICAM TM I/O-modules

The SICAM TM I/O modules can either be installed locally on the CP-8031/CP-8050 base device or, in the case of CP-8050 systems, in remote I/O rows. Up to 8 SICAM TM I/O-modules can be connected in each case. At the base device the SICAM TM I/O modules must be assembled to the right of the master module and power supply. In a remote I/O row, install the I/O modules to the right of the CI-853x module, or if a redundant power supply is available, to the right of it. Thereto the following steps are essential:

- Mounting of the coupling module for SICAM TM I/O modules (CM-6812)
- Mounting of SICAM TM I/O-modules

Mounting of the coupling module for SICAM TM I/O modules (CM-6812)

This example shows the mounting of the adapter in a remote I/O row. This procedure is identical to the mounting of the adapter to a CP-8031/CP-8050 base device.

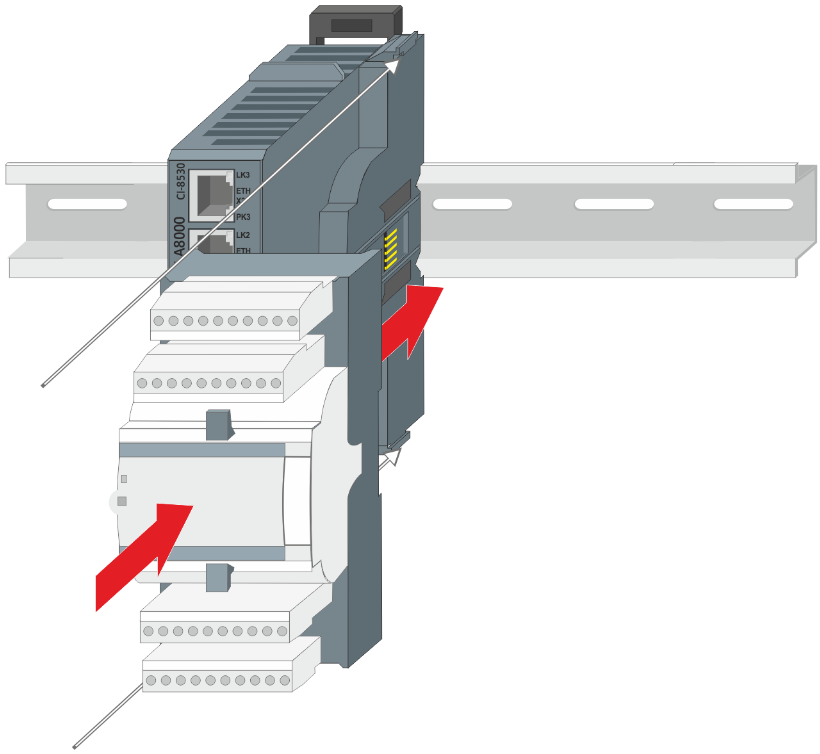


[CP-8050_Mounting_TM_IO-Modules_01, 1, --_--]

Place the adapter on the right of the remote I/O module (and, if present, to the right of the power supply module) on the rail (1) and slide it into the bus connector of the module adjacent to the left (2). Both elements must be aligned seamless.

Mounting of SICAM TM I/O-modules

Lead the first SICAM TM I/O module, as shown in the following picture, into the guides on the SICAM TM I/O coupling module and lock it on the DIN rail.



[CP-8050_Mounting_TM_IO-Modules_02, 1, --_--]

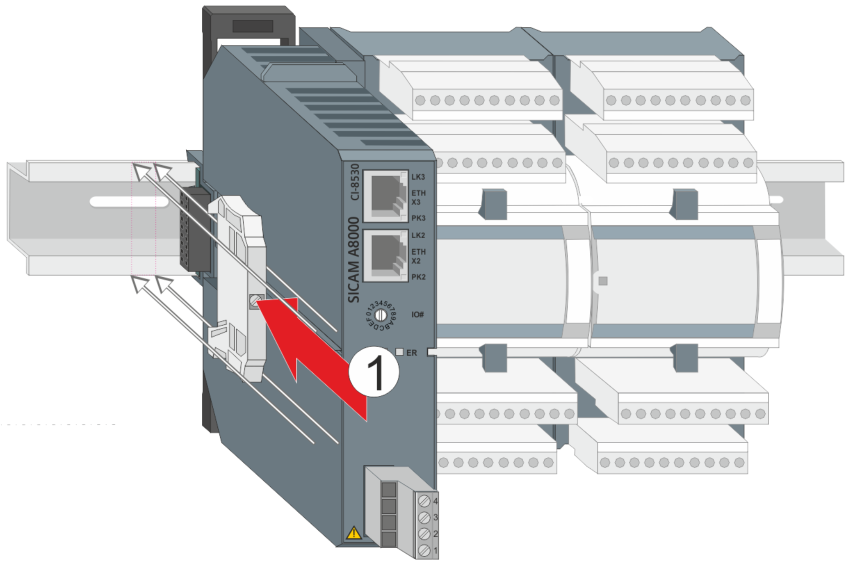
Then you can attach the further SICAM TM I/O modules.

NOTE

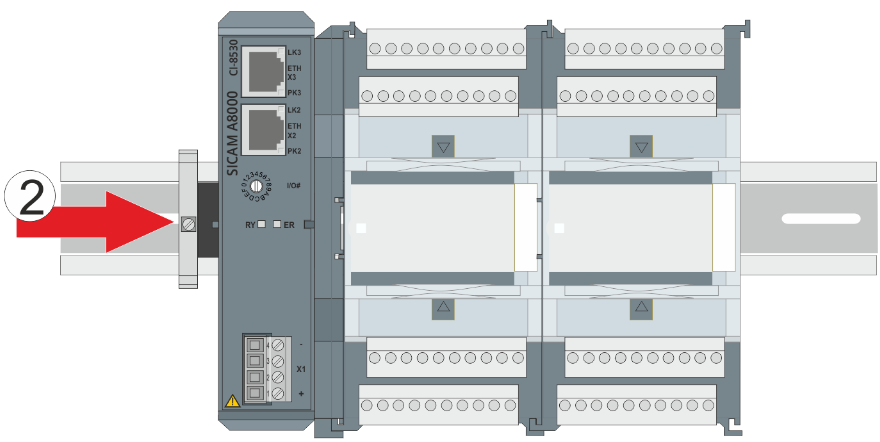
The last SICAM TM I/O module must be equipped with a protective cap to protect the bus. The appropriate cap is delivered with the coupling module.

Mounting end clamp

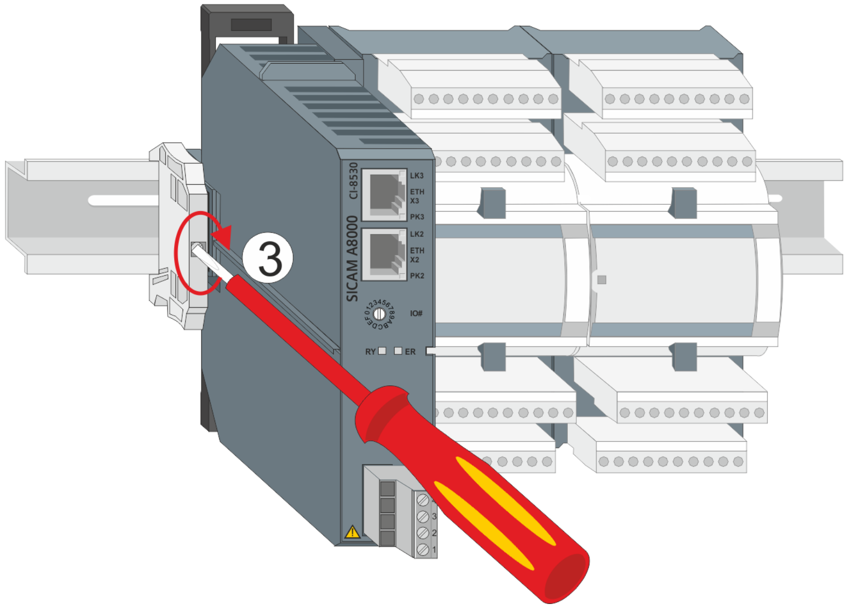
For reasons of stability, a screwable end clamp or earthing clamp must be installed flush on the left side of the CI-853x housing. Insert it onto the DIN rail (1), press it against the bus connector of the CI-853x module (2) and screw it tight (3).



[CP-8050_Mounting_TM_IO-Modules_03, 1, --_--]



[CP-8050_Mounting_TM_IO-Modules_04, 1, --_--]



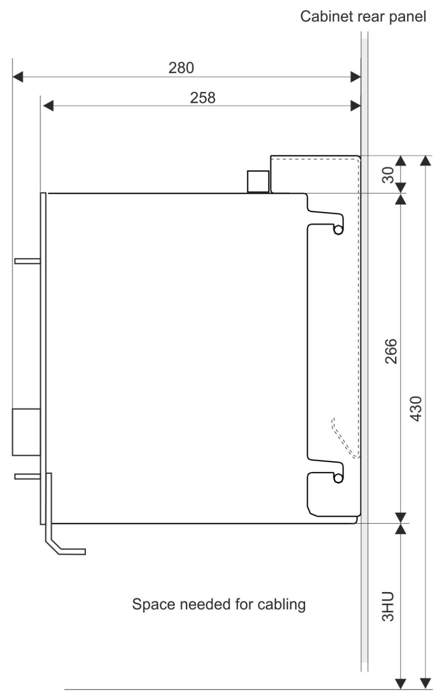
[CP-8050_Mounting_TM_IO-Modules_05, 1, --_--]

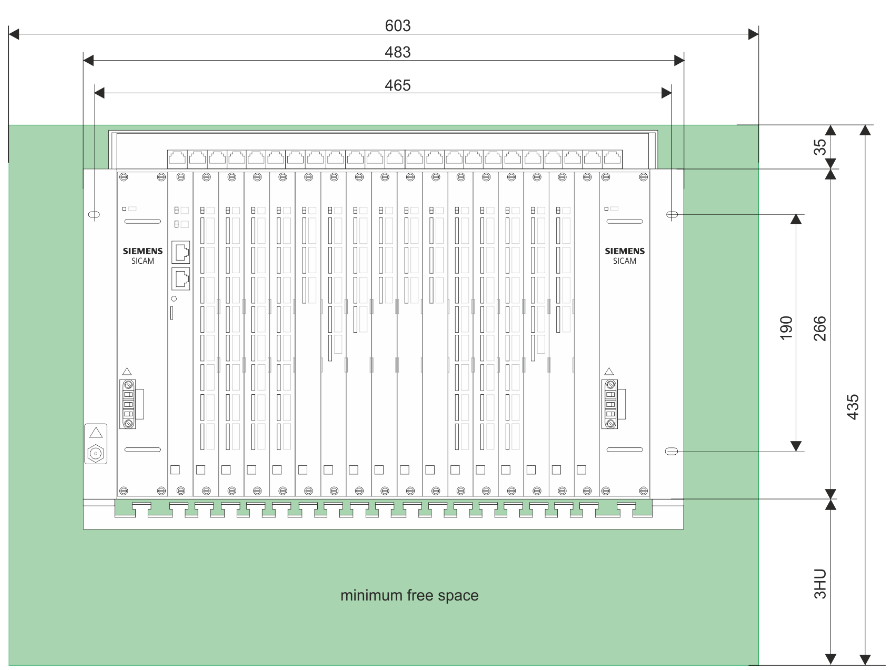
6.8 Mounting of SICAM A8000 Racks

6.8.1 Space Requirement

Certain minimum distances must be observed between rack and adjacent equipment. These minimum distances serve the installation and removal of components, the cabling and the ventilation of the device in operation.

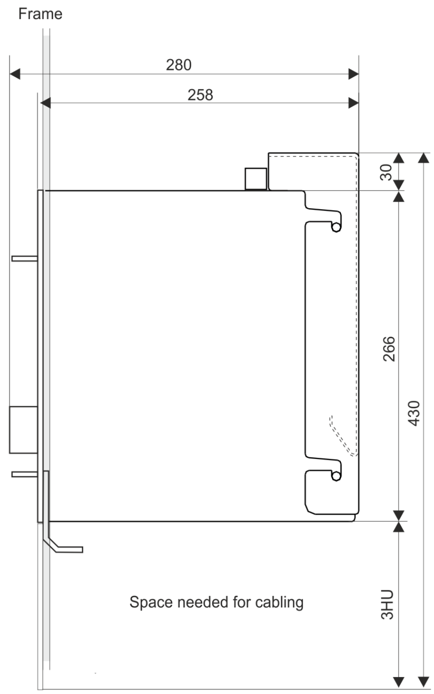
CM-2846 – rear panel installation

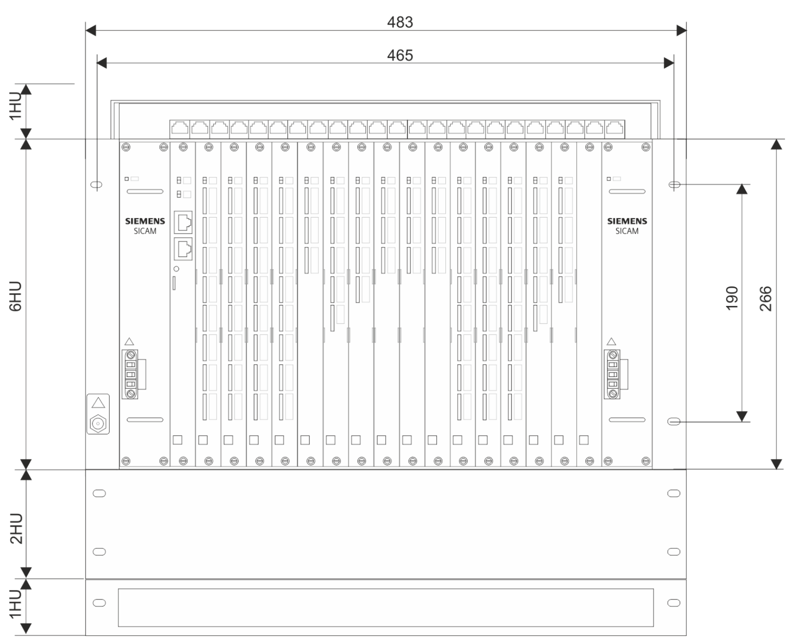




[SICAM_RACK_CM-2846_Rear_Panel_Installation, 2, en_US]

CM-2846 - 19" (Swing) Frame Installation





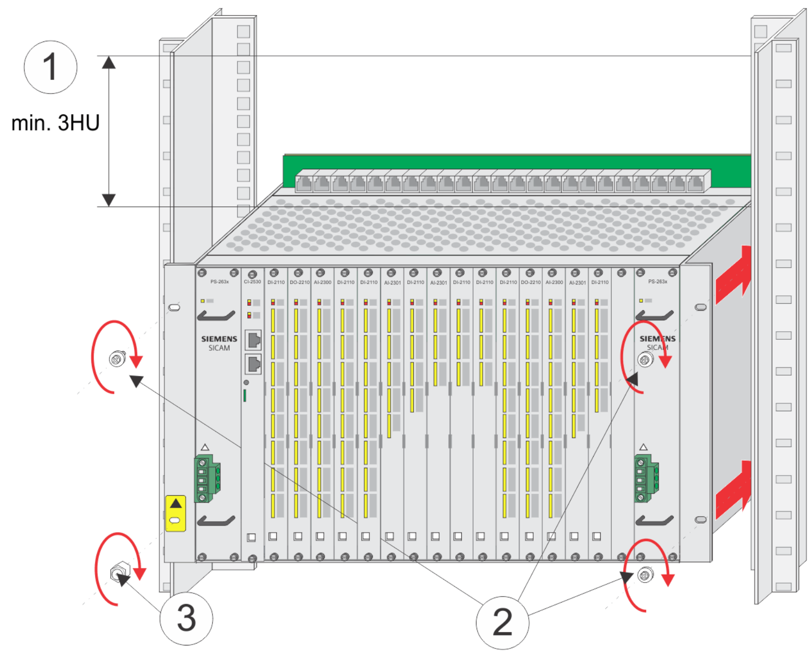
[SICAM_RACK_CM-2846_Swing_Frame_Installation, 2, en_US]

6.8.2 Assembly

CM-2846 19" (swing) frame installation

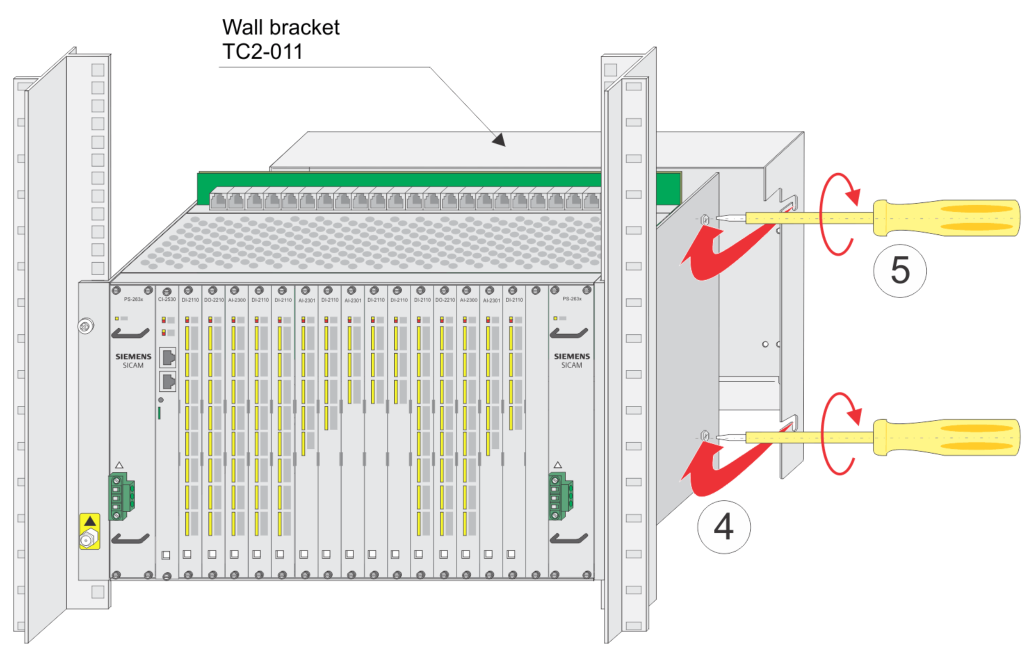
Proceed as follows:

- Determine the position at which the mounting rack is to be installed; please note thereby, that a space of 3HU must be maintained above the mounting rack ❶
- Screw the board rack to the 19" frame; use therefore the M6x16 (DIN 85) screws and the washers 6,4-KST (DIN 125) at position ❷, and the ESD-screw M6x14 at position ❸



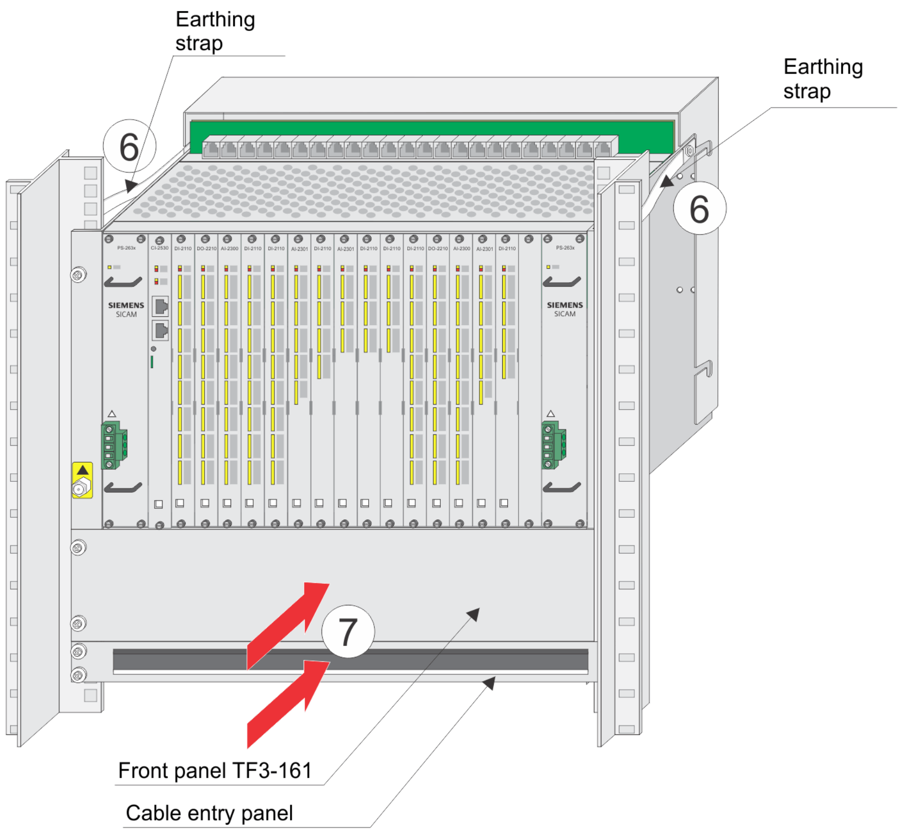
[dw_Rack_Frame_Installation_CM-2846_01, 2, en_US]

- To mount the optional wall bracket you have to screw the supplied screws (M6x12) half way into the board rack, hang the wall bracket on the board rack ❹ and tighten the fas-tening screws ❺.



[dw_Rack_Frame_Installation_CM-2846_02, 2, en_US]

- Attach the grounding straps to the cabinet/frame ❻
  Hint
  The earthing straps are not part of the board rack. They have to be ordered separately.
  EMC earthing strap 140/10/4.5-6.5 TF3-033 / 6MF13140DA330AA1
  EMC earthing strap 300/16/6.5-8.5 TF3-031 / 6MF13140DA310AA1
- Tighten front cover and cable entry panel ❼



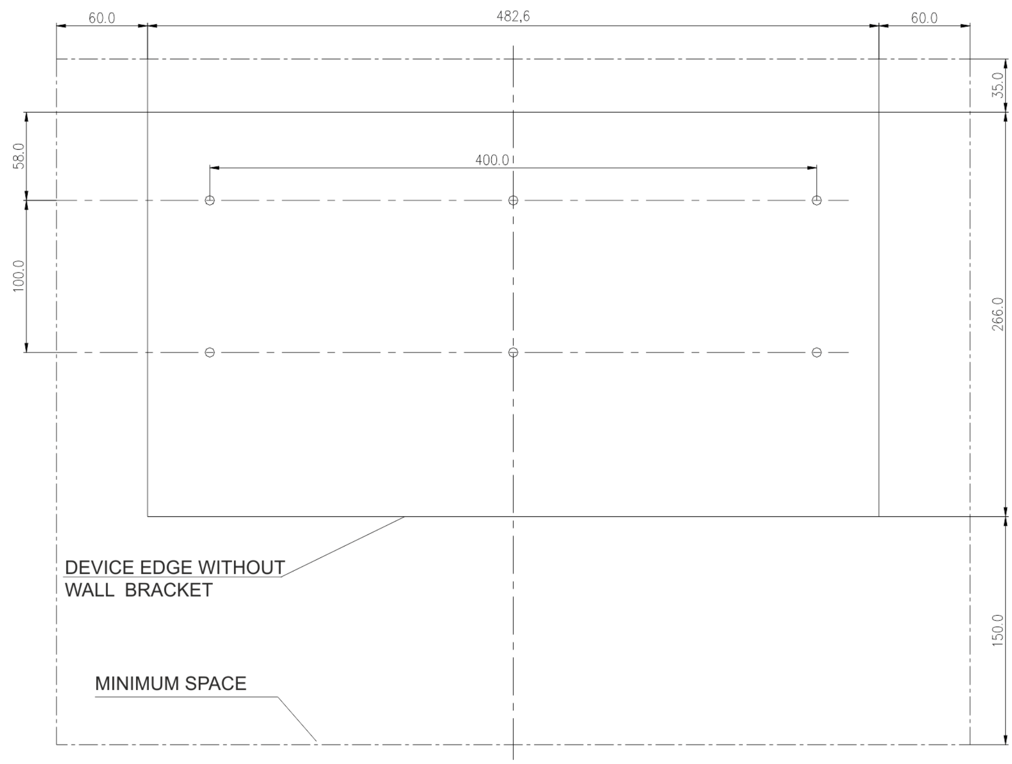
[dw_Rack_Frame_Installation_CM-2846_03, 2, en_US]

CM-2846 Rear Panel Assembly

The rack CM-2846 is designed for 19“ (swing) frame installation. The wall fastening kit (TC2-702 / 6MF13130CH020AA0) necessary for rear panel installation must be ordered separately.

Proceed as follows:

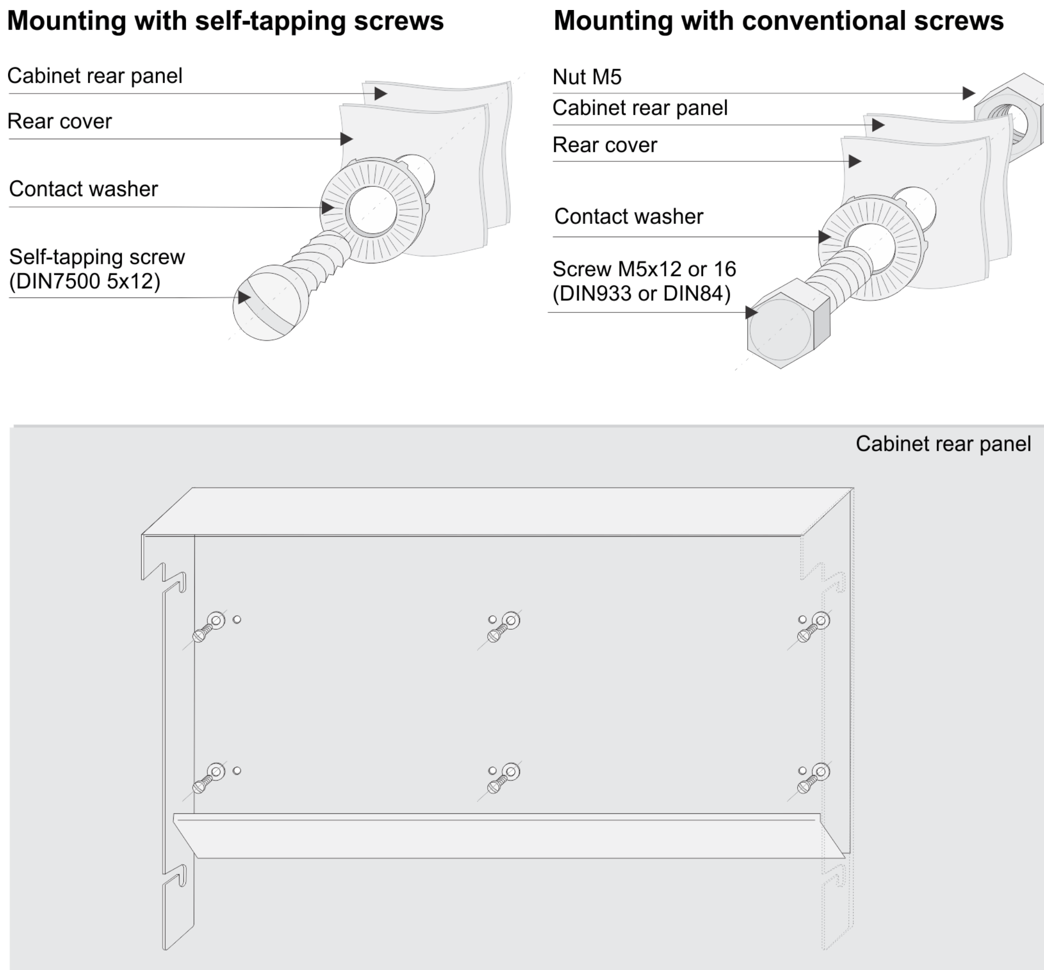
- Mark out the drill holes for the wall bracket on the rear panel of the cabinet according to the enclosed assembly instruction (C53207-A5703-E421-1A-7431)



[dw_Rack_Bohrplan_CM-2846, 1, en_US]

- Drill the holes according to the specifications on the drilling diagram

- fasten the wall bracket

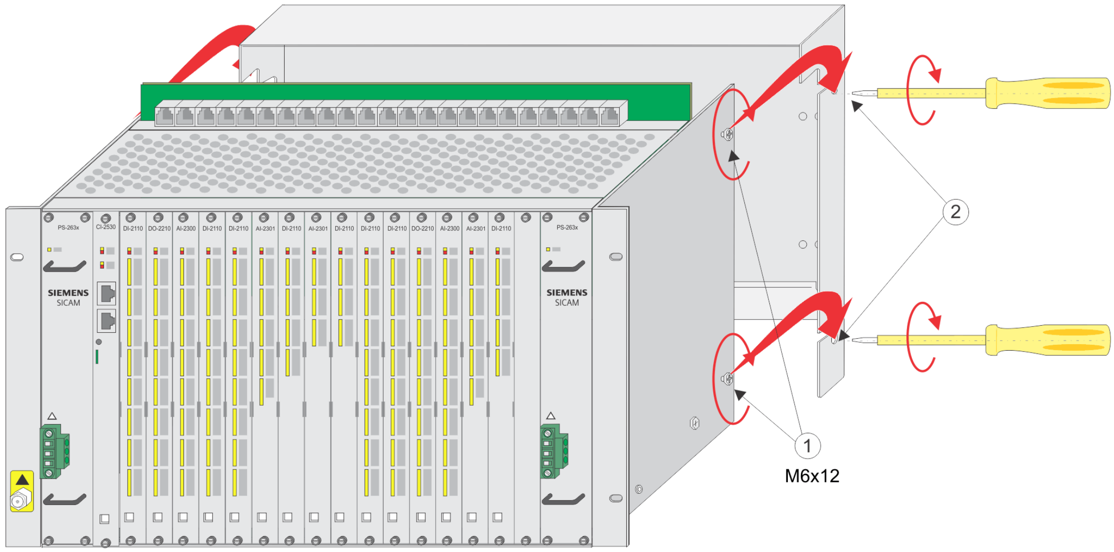


[dw_Rack_Wall_Installation_CM-2846_01, 1, en_US]

Caution

The mounting rack must be fastened with at least 6 screws.

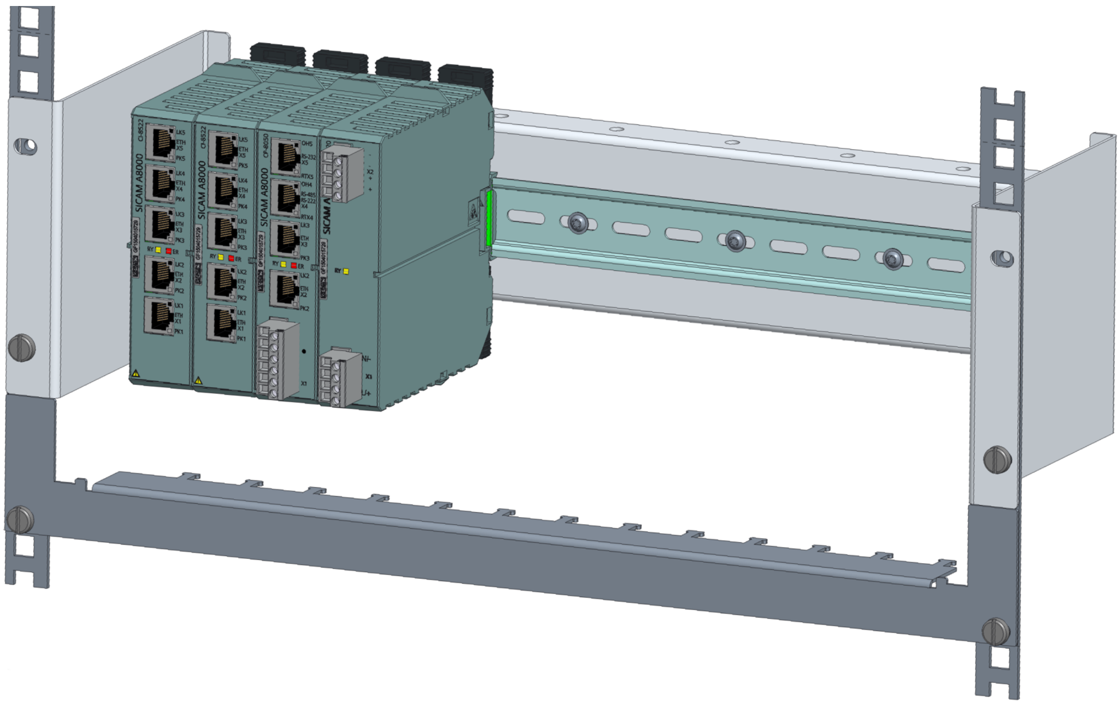
- Screw the supplied screws (M6x12) half way into the board rack ❶, hang the board rack in the wall bracket and tighten the fastening screws ❷.



[dw_Rack_Wall_Installation_CM-2846_02, 2, en_US]

6.9 Mounting of the SICAM A8000 Module Rack

The SICAM A8000 module rack CM-8846 enables the installation of up to 13 SICAM A8000 modules in a 19" rack.



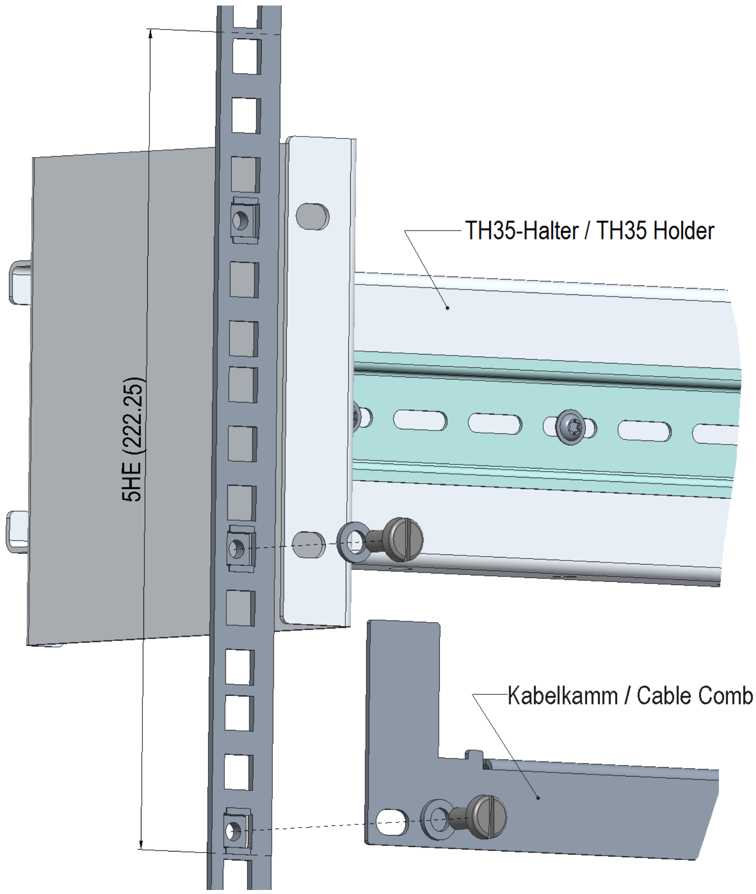
[dw_sicam_a8000_module-rack5, 1, --_--]

Scope of delivery:

- TH35 holder
- Front panel
- Cable comb

5 height units (222.25 mm) must be considered for the module rack

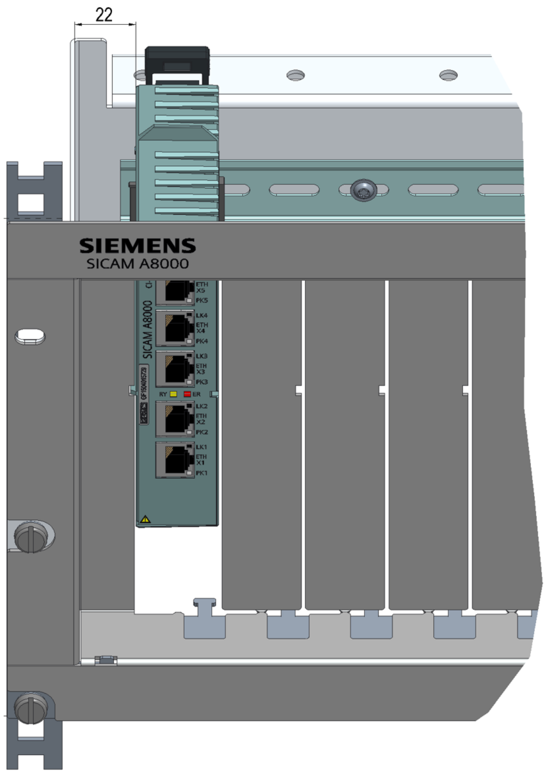
- Equip the cage nuts (6 pieces M6)
- Mount the TH35 holder with two suitable M6 screws and washers through the lower two mounting holes and ensure good grounding



[dw_sicam_a8000_module-rack2, 2, --_--]

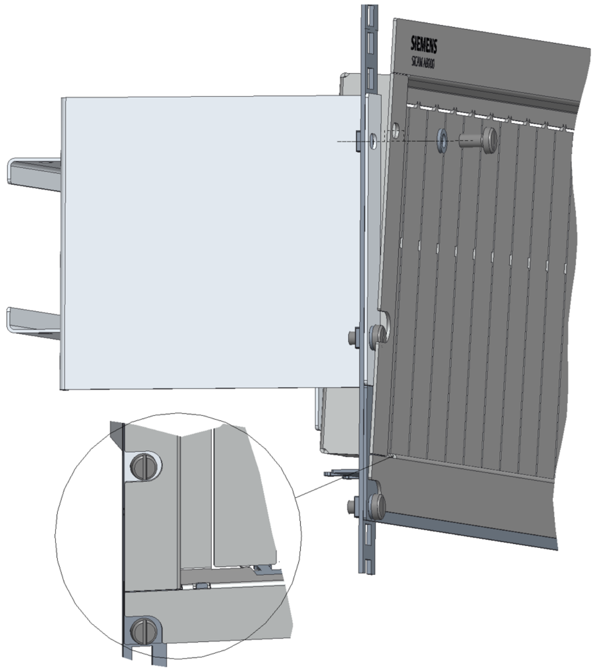
- Mount the cable comb with two suitable M6 screws and washers
- Break out the blank panels of the front panel by turning it several times, depending on the equipment. (Attention: the blank panels cannot be refitted!)

- Assemble the modules, either snapping the first 22 mm from the side wall or positioning it using the front panel



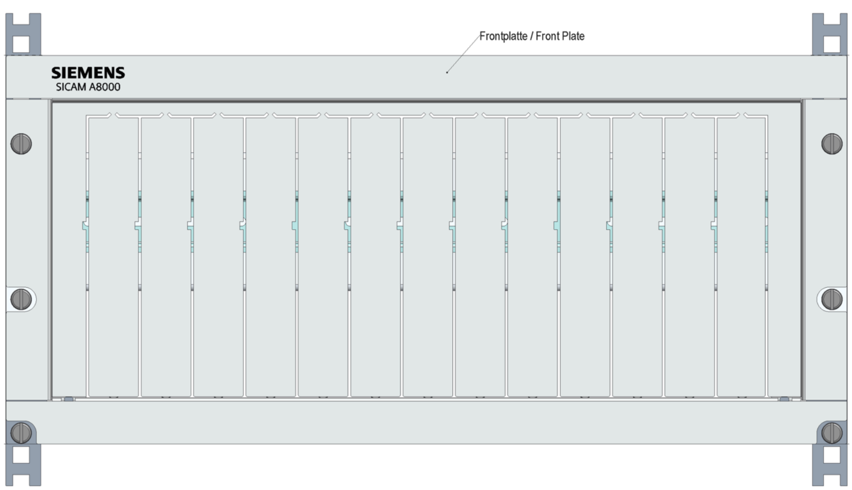
[dw_sicam_a8000_module-rack3, 1, --_--]

- Assemble the front plate by placing it at a small angle upwards in the lower area and then pressing it down. The extrusions from the cable comb need to come through the designated cutouts in the front panel.



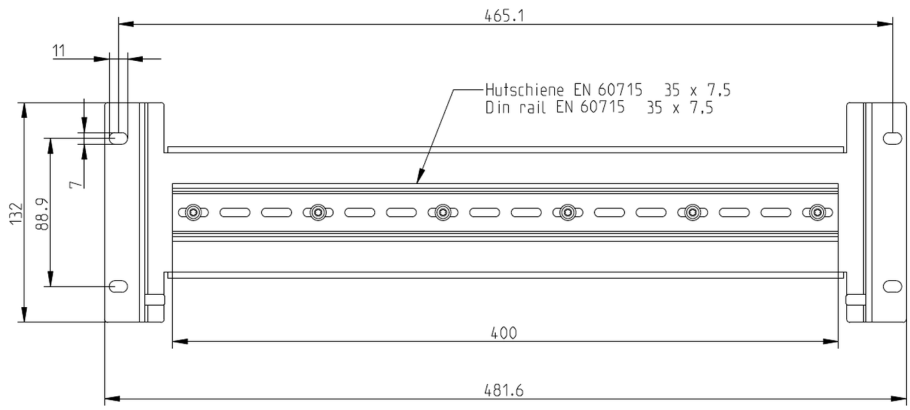
[dw_sicam_a8000_module-rack4, 1, --_--]

- Fix the front panel with two suitable M6 screws and washers



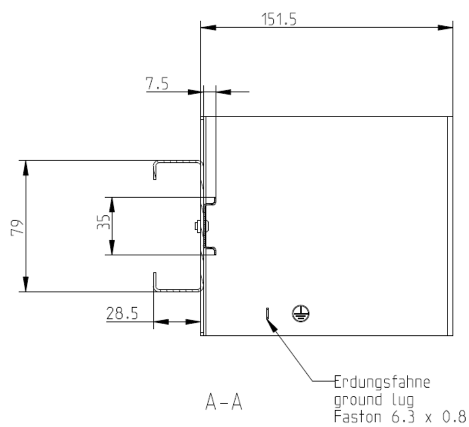
[dw_sicam_a8000_module-rack1, 1, --_--]

Dimensions



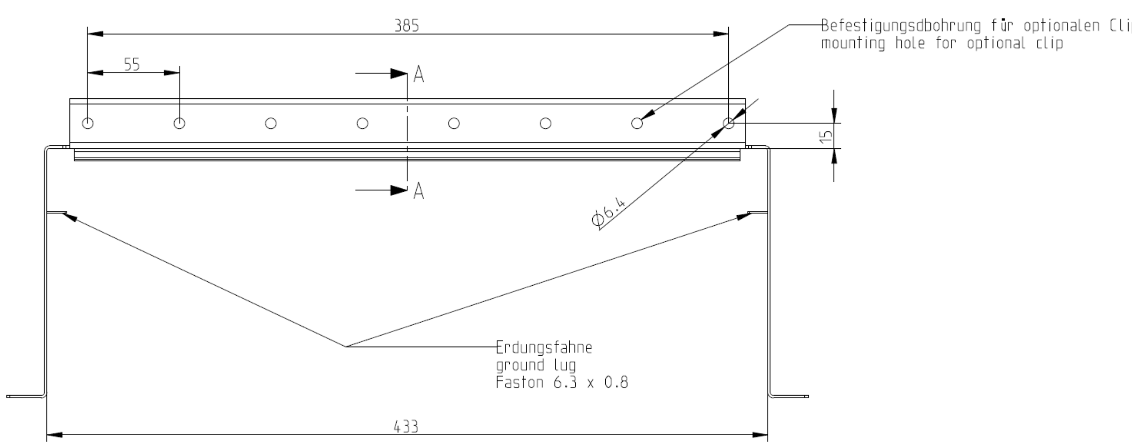
[dw_sicam_a8000_module-rack_dimensions_01, 2, --_--]

Figure 6-8 CM-8846 front view



[dw_sicam_a8000_module-rack_dimensions_02, 1, --_--]

Figure 6-9 CM-8846 side view



[dw_sicam_a8000_module-rack_dimensions_03, 1, --_--]

Figure 6-10 CM-8846 top view

6.10 Memory card

SD card

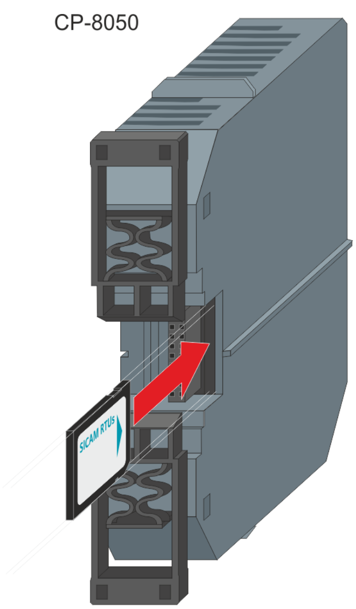
CP-8031/CP-8050 uses an SD card (Secure Digital) for the storage of firmware, application and diagnosis data. The master modules are delivered without SD card.

Product Overview

Designation	MLFB
SD card 512 MB Temperature range - 40 to + 70 °C (Spare Part)	6MF12132GA050AA0
SD card 2 GB Temperature range - 25 to + 70 °C (Spare Part)	6MF12131GA050AA0

Inserting the SD Card

With CP-8031/CP-8050 the SD card is inserted in the rear side, therefore the master module must be removed from the DIN rail when exchanging the SD card.



[CP-8050_SD-Card_Insertion, 1, --_--]

Figure 6-11 Insert SD card into CP-8050

Put the SD card in the slot and press carefully until it engages.

Removing the SD Card

Disconnect the device from the supply voltage and wait for at least 30 s.
Push the SD card carefully until it is disengaged and springs out of the slot. The SD card can now be removed.

6.11 Wiring

Cabinet-internal wiring is preferably carried out with plastic-insulated cables according to IEC 60364-5-52. Use only copper wires.

Due to the power dissipation in the device there is a higher temperature on the terminals than the device ambient temperature. This increase is maximum 15 °C with full load. For this reason the isolation of the wires must withstand a higher temperature than the device ambient temperature.

Example for process peripherals:

max. ambient temperature	max. operating temperature	Type
55°C	70°C	H05V-K, H07V-K
70°C	85°C	H05V2-K, H07V2-K

6.11.1 Power Supply

CP-8031/CP-8050 requires an external power supply module PS-862x or PS-864x.

- The supply can be performed via a station battery or via a series power unit.
- PS-8642 can be supplied optionally via the public low-voltage network.
- Furthermore, 2 redundant power supply modules can be used (PS-862x as of production level CC).
- For the fuse protection of PS-862x a circuit breaker 2-pole with 2 A, characteristic C is prescribed (standard type: Siemens 5SY5202-7).
- For the fuse protection of PS-864x a circuit breaker 2-pole with 10 A, characteristic C is prescribed (standard type: Siemens 5SY5210-7).
- The circuit breaker prescribed for switching on/off must be installed in a suitable location near the device, easily accessible for the user and marked as a disconnector for the device.

You can establish the supply with single leads of the type H07V-K (1.5 to 2.5 mm²) or a cable of the type LAYY-0 (2 x 1.5 to 2.5 mm²) or H05VV-F 3G (1.5 to 2.5 mm²).

Recommended and tested series power units (standard types) can be found in the Appendix *A.15 Recommended Upstream Power Supply Devices*.

6.11.2 Process Peripherals

You can establish the connections with single leads of the type H05V-K or H05V2-K (0.5 to 1 mm²), as well as H07V-K or H07V2-K (1.5 to 2.5 mm²).

If a wire bridge with 0.75 mm² is used or a bridged comb, the cable cross section is limited to 1.5 mm².

The construction of the peripheral connectors is designed for direct peripheral wiring. That means, that the wiring can be carried out without the use of a routing terminal or other additional screw terminals.

Removable screw terminals are used as peripheral connectors. These are attached to the device for delivery. Optionally spring-loaded or crimp terminals can be used.

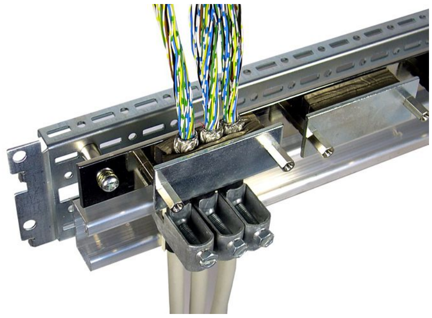
Preferably wire end sleeves are to be used.

A cable duct is to be provided for the wiring of the process signals.

6.11.3 Shielding - Process peripherals

Basically CP-8031/CP-8050 is designed in such a way that no shielded peripheral cables are required.

Normally, shielded cables are strain-relieved directly after the cabinet/rack entry and then grounded on a large-surface screening rail installed for this purpose. The device itself provides no possibility of shield clamping with peripheral I/Os.



[Shielded_Cable, 1, --_--]

Figure 6-12 Cable shield

6.11.4 Shielding - Communication

The connections of communication interfaces from/to the modules are to be made with (double) shielded patch cables of CAT 6A. These are to be laid separately from the supply and peripheral cables in separate cable shafts/channels and may only be crossed in short areas / transitions.

Recommended are cables with a combination of braided shield (S) and foil shield (F) such as SF/UTP, SF/FTP or S/FTP cables.

Designation scheme of the cables (XX/YZZ):

- XX stands for the overall shielding:
  - U = Unshielded
  - F = Foil Shield
  - S = Braided Shield
  - SF = Braided and Foil Shield
- Y stands for the wire pair shielding:
  - U = Unshielded
  - F = Foil Shield
  - S = Braided Shield
- ZZ stands for:
  - TP = Twisted Pair
  - QP = Quad Pair

Order information for cables see Appendix *A.16 Cables and Connectors*.

6.11.5 Protective Earth/Ground

When installing CP-8031/CP-8050, it is to be ensured that the cabinet or rack used has proper protective earth and ground. That means, that all electrical conducting parts must be connected large-surface and as short as possible with the existing grounding system.

If these preconditions exist, the grounding of the device takes place via the connection of the DIN rail with the cabinet spar. A reliable connection is achieved by using screws with contact washers.

6.11.6 Switching the Device On and Off

Before switching the device on it must be connected to the designated power supply. Switching on takes place by connecting the voltage, commonly for example by switching on a miniature circuit breaker.

Siemens recommends that the circuit breaker is located close to the device.

The device starts up automatically (startup after power-up). It is operational (without error display), as soon as all connected modules have concluded the startup. The startup may last up to 10 minutes.

Pay attention to the status display during and after startup.

The switching off of the device takes place by disconnecting the power supply.

CAUTION

✧ Switching off during writing operations to the SD card (load firmware, load parameters) is to be avoided without fail, since the data on the SD card could be destroyed as a result.

6.12 Installation of External Communication Connections

Via the communication interfaces of CP-8031/CP-8050 selected transmission facilities can be connected. Depending on the kind of the selected communication type, different connection cables are required for the connection of a data transmission facility.

Connection type	Communication type	Transmission facility	Connection cable
Serial	Multi-point traffic	• Leased line modem • VFT channel modem	Modem cable see section *6.12.1.4 Multi-Point Traffic via Leased Line Modem/VFT Channel Modem*
	Multi-Point Traffic via Fiber Optic	• RS-232/LWL Converter • Star coupler	D-Sub/RJ45 Adapter see section *6.12.1.6 Multi-Point Traffic via Fiber Optic*
	Point-to-point traffic	(direct connection)	See section *6.12.1.7 Direct RS-232 connection to other automation unit (AU)*
Ethernet TCP/IP	LAN/WAN		Patch cable
	GPRS	• MD741-1 GPRS router • Dr. Neuhaus Tainy EMOD-V2-IO • Dr. Neuhaus Tainy EMOD-L1-IO	Patch cable

Order information for transmission facilities and cables see appendix *A.13 Transmission Facilities* and *A.16 Cables and Connectors*.

NOTE

Communication cables are, if possible, to be installed separately from the supply and peripheral cables.

CAUTION

✧ It is not allowed to connect a serial interface to an Ethernet interface and vice versa.

NOTE

The examples shown in this chapter always show the master module CP-8050. The same configurations and circuits apply to CP-8031.

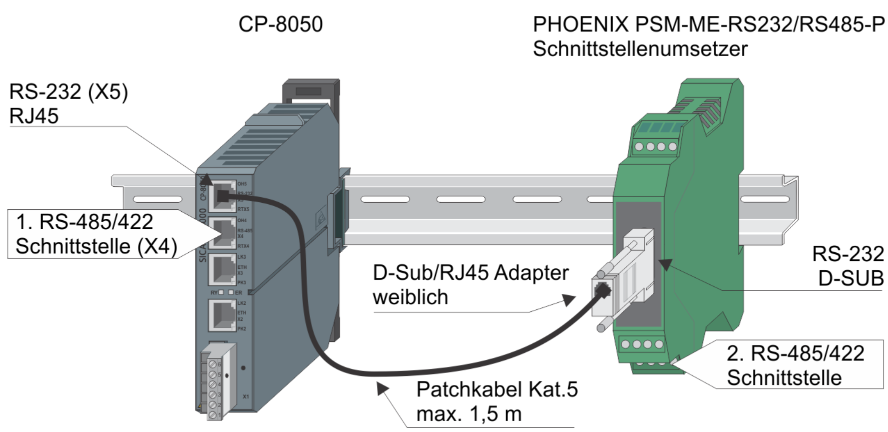
6.12.1 Serial Communication

6.12.1.1 CP-8050 with 2 serial RS-485/RS-422 interfaces

CP-8050 provides an RS-485/RS-422 interface with X4. If it is necessary to connect a second device via an RS-485/RS-422 interface, it is possible to use an external interface converter. This is connected via the RS-232 interface (X5). Siemens recommends using the Phoenix PSM-ME-RS232/RS485-P. For ordering information see *A.13 Transmission Facilities*

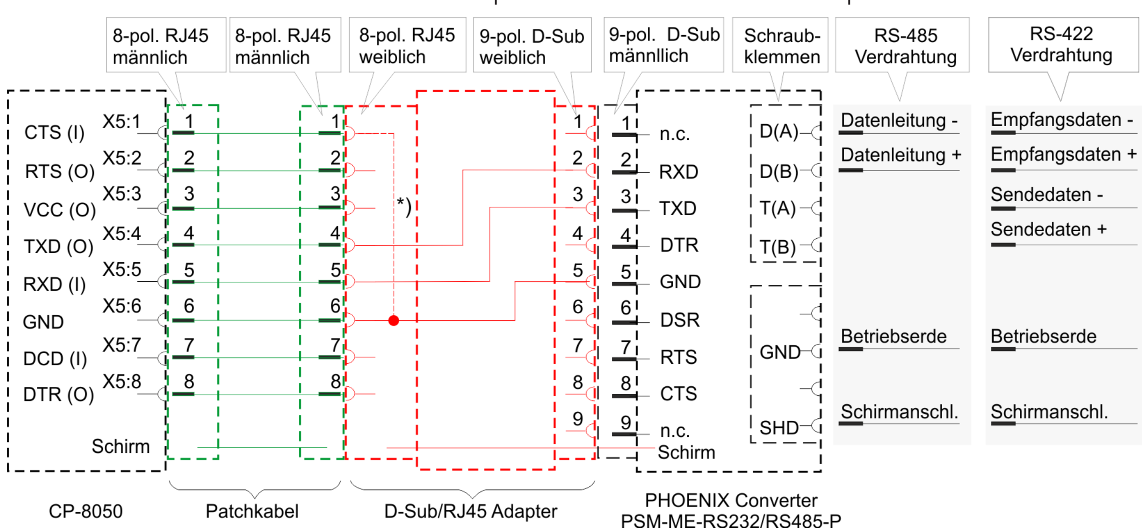
NOTE

As an alternative to using an external interface converter, it is also possible to use the serial interface module CI-8551.



Wiring for Connection CP-8050 – Interface converter

The connection is established with a standard patch cable and a D-Sub/RJ45 adapter.



NOTE

With a serial connection via X5 interface of CP-8031, CP-8050 a bridge between CTS and GND is required, as far as the interface shall also be used for the connection with the engineering PC.

The CTS status line cannot be used by the protocol!

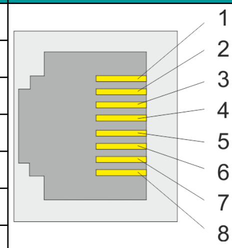
If the interface shall not be used as serial engineering interface, the function can be disabled with the parameter `Serial engineering interface = disabled`.

Thereby no connection between CTS and GND is required.

Recommended D-sub/RJ45 adapter: RS Pro Series MHDA D-Sub-Adapter for Sub-D plug, 9-polig

Order information see *Recommended third-party products, Page 2186*. This adapter provides a wired RJ45 socket and an unwired D-sub plug (female).

Wiring of the RJ45 socket:

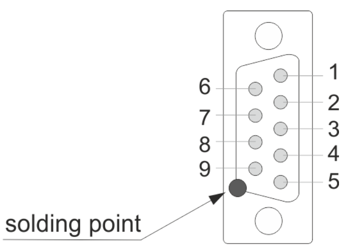
Pin	Wire color	
1	black	
2	yellow	
3	orange	
4	red	
5	green	
6	brown	
7	grey	
8	blue	
Shield	black	

NOTE

There are other similar converters on the market - the color of the wires can be different! (Check wire color and pin assignment!)

Wiring at the 9-pole D-sub plug:

The assignment of the pins at the D-sub plug (“backside” view of socket connector) can be made according to wiring diagram.



Unused wires must be isolated!

When using the shield, it must be soldered to the metal plate of the D-sub plug.

Configuration of Phoenix PSM-ME-RS232/RS485-P

The Phoenix interface converter must be configured for operation as an RS-485 interface. For instructions, see the package leaflet. This is also available via *https://www.phoenixcontact.com*.

NOTE

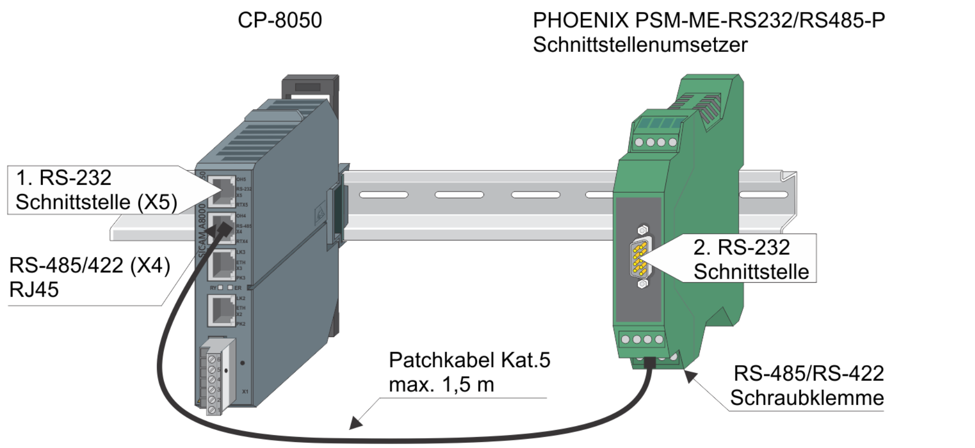
The Phoenix converter is to be used in**self-controlled mode**.

6.12.1.2 CP-8050 with 2 serial RS-232 interfaces

CP-8050 provides an RS-232 interface with X5. If it is necessary to connect a second device via an RS-232 interface, it is possible to use an external interface converter. This is connected via the RS-485/RS-422 interface (X5). Siemens recommends using the Phoenix PSM-ME-RS232/RS485-P. For ordering information see *A.13 Transmission Facilities*

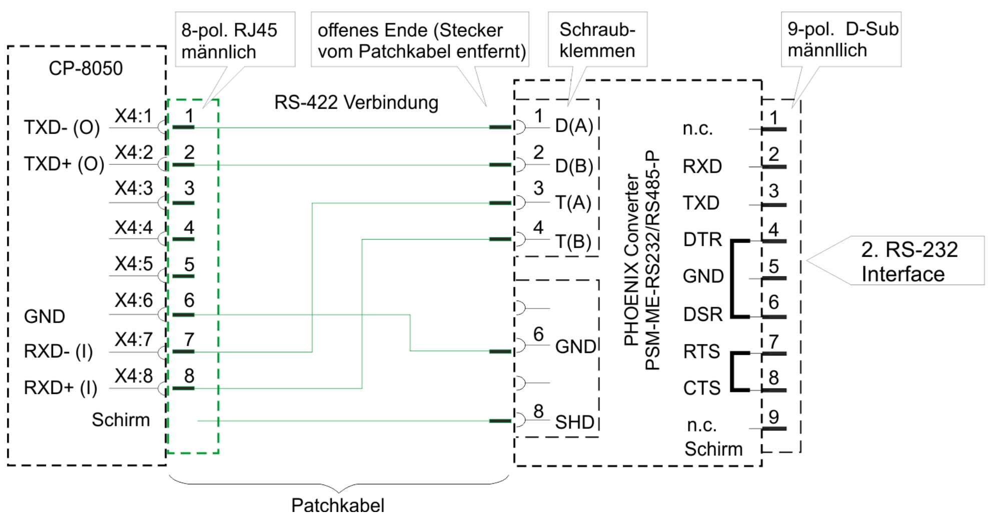
NOTE

As an alternative to using an external interface converter, it is also possible to use the serial interface module CI-8551.

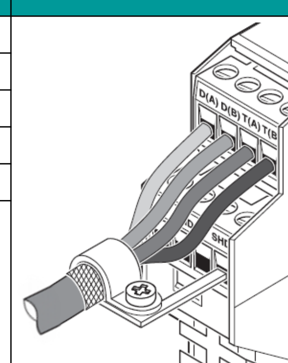


Wiring for Connection CP-8050 – Interface converter

The connection is established with a standard patch cable.

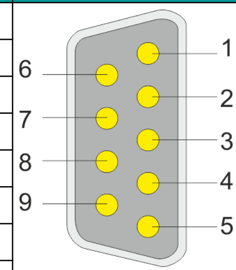


Pin assignment RS-485 4-wire at Phoenix PSM-ME-RS232/RS485-P (screw terminal)

Pin	Signal	Designation	
1	D(A)	Receive data -	
2	D(B)	Receive data +	
3	T(A)	Transmit data -	
4	T(B)	Transmit data +	
6	GND	Signal ground	
8	SHD	shield connection	

Pin assignment RS-232 interface at Phoenix PSM-ME-RS232/RS485-P (SUB-D 9)

Pin	Signal	Designation	
1	-		
2	RxD	Receive data	
3	TxD	Transmit data	
4	DTR	DEE ready	
5	GND	Signal ground	
6	DSR	Data set ready	
7	RTS	Request to send	
8	CTS	Clear to send	
9	-		



NOTE

- At the 9-pin SUB-D connector of the RS-232 interface of the PSM-ME-RS-232/RS485-P, there are no status lines (RTS, CTS, DTR, DSR) controlled by the CP-8050.
- RS-232 interface = half duplex / full duplex

Configuration of Phoenix PSM-ME-RS232/RS485-P

- DIP switch 1-4 (Transmission rate)
- Slide switch terminate = ON
- Slide switch S1 = DTE
- DIP-Switch 5 = OFF (Self Controlled)
- DIP-Switch 6 = OFF (RTS/CTS standard)
- DIP-Switch 7 = ON (RS-485 4-wire operation)
- DIP-Switch 8 = ON (RS-422)
- DTE/DCE depending on the desired connector assignment on the 9-pin SUB-D connector

The package insert of the Phoenix interface converter can be found via *https://www.phoenixcontact.com*.

Configuration of CP-8050

- `[BSE] System settings | Serial interfaces | Port | CP-X4 | Electrical interface | RS-422 with termination`

6.12.1.3 Communication via X.24/X.27 Interface (Isochronous) with Phoenix Interface Converter

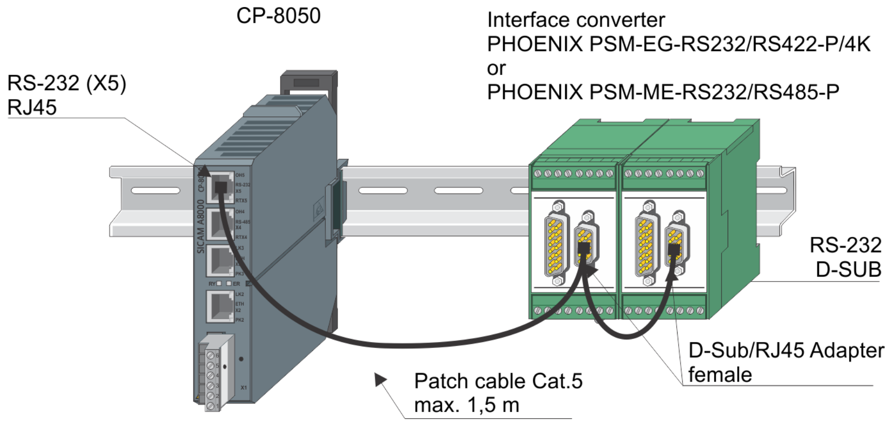
The modules CP-8050 with X5 (RS-232) and CI-8551 with X1, X2, X4 and X5 (RS-232) provide in conjunction with the Phoenix interface converter(s) PHOENIX PSM-EG-RS232/RS422-P/4K or PSM-ME RS232/RS485-P (“RS-232/RS-485/RS-422 converter”) a balanced interface X.24/X.27 (=balanced interchange circuit according to ITU-T X.24 or ITU-T X. 27) according to IEC 60870-5-101.

IEC 60870-5-101: For digital transmission methods with digital signal multiplexers, the ITU-T X.24 or ITU-T X.27 (X.24/X.27) interface may be used for channels up to 64 kbit/s by special agreement.

Order information see *A.14 Interface Modules*

NOTE

The structure of this type of communication is shown below using the example of a CP-8050. Analogously, these illustrations also apply for the use of a CI-8551 module.



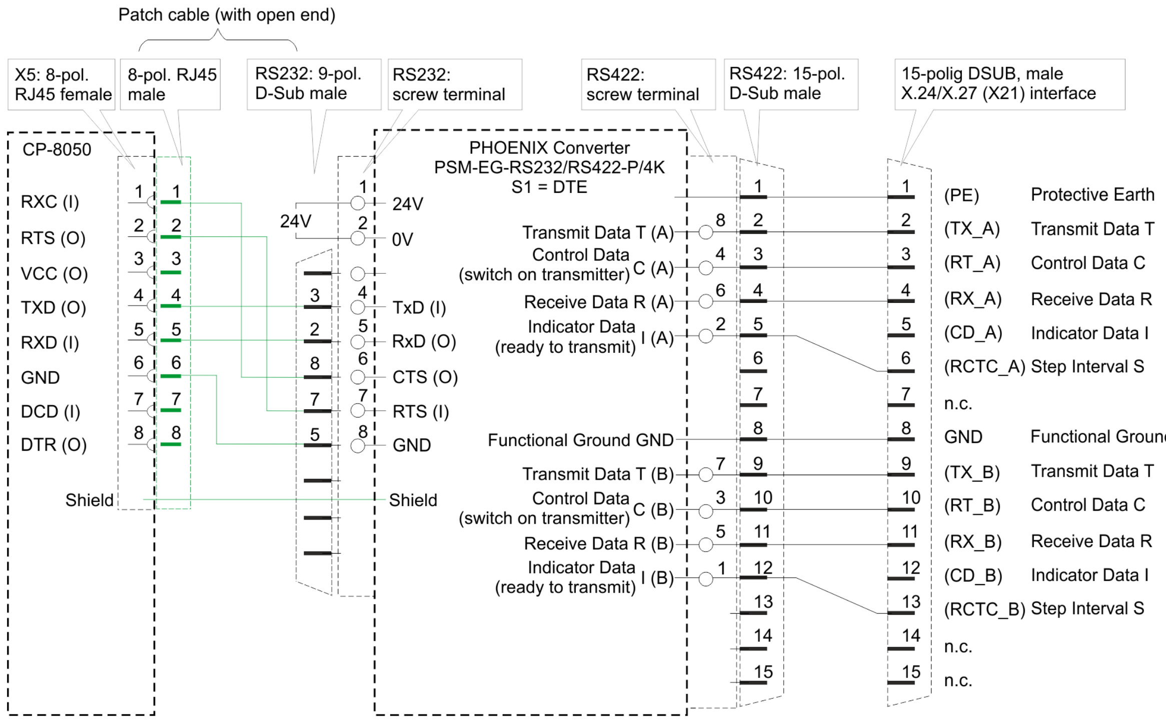
NOTE

- The X.24/X.27 interface is supported by the following protocols:
  – IEC 60870-5-101 (Point-to-point traffic, BPPI0)
  – IEC 60870-5-101 (Multi-point traffic Slave, UMPxI0)
- In mode X.24/X.27, the CP-8050/X5 interface cannot be used as a engineering interface for SICAM TOOLBOX II.
- The X.24/X.27 signal "Indicate" is signaled at the DCD signal.
  The state of the DCD signal can be evaluated as a protocol element return information.
- The X.24/X.27 signal "Control" is controlled by the RTS signal.
  The RTS signal is switched to "ON" by the protocol element firmware (after Ready).

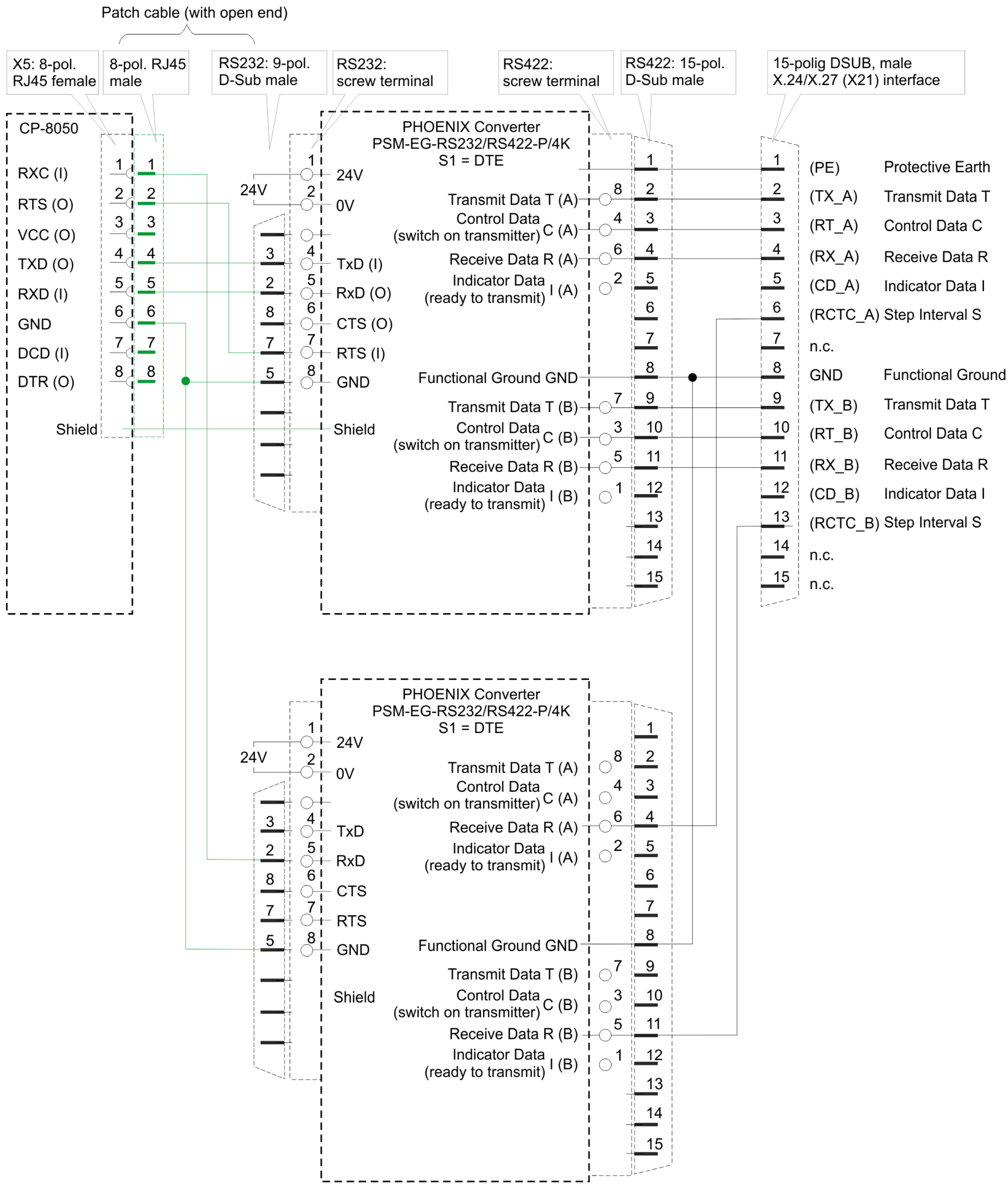
Required Settings

- Baud rate (set on PRE): 2400, 4800, 9600, 19200 38400, 56000, 64000 bit/s
- Mode of the interface:
  BSE] System settings | Serial interfaces | Port | CP-X5 | Mode | Isochron "X.24/X.27" (1-time bit clock internal) or
  [BSE] System settings | Serial interfaces | Port | CP-X5 | Mode | Isochron "X.24/X.27" (1-time bit clock external)
  Bit clock internal: the bit timing is generated by the CP-8050 interface and provided for connected systems
  Bit clock external: the bit clock is provided by the transmission system or by the remote station
- Disable X5 as engineering interface:
  [Home] Hardware | CP-X5 | Module properties | Serial engineering interface disable = yes

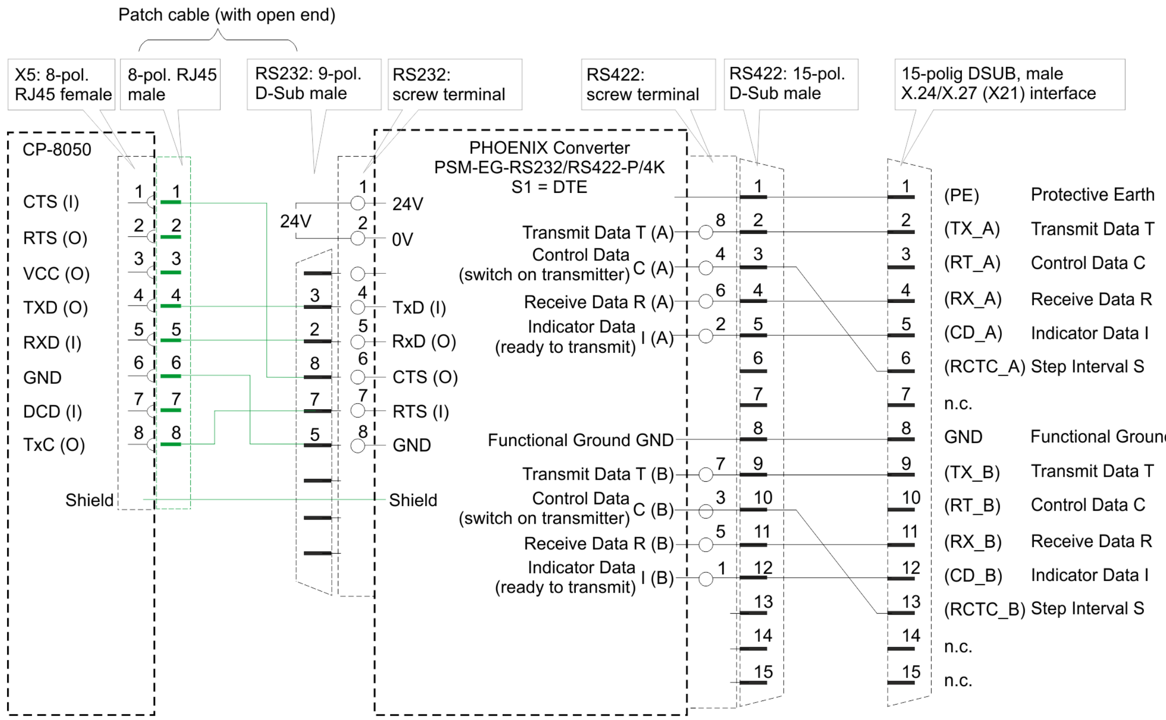
Wiring for connection CP-8050 - Interface converter (receive clock - Control used, Indicate not used)



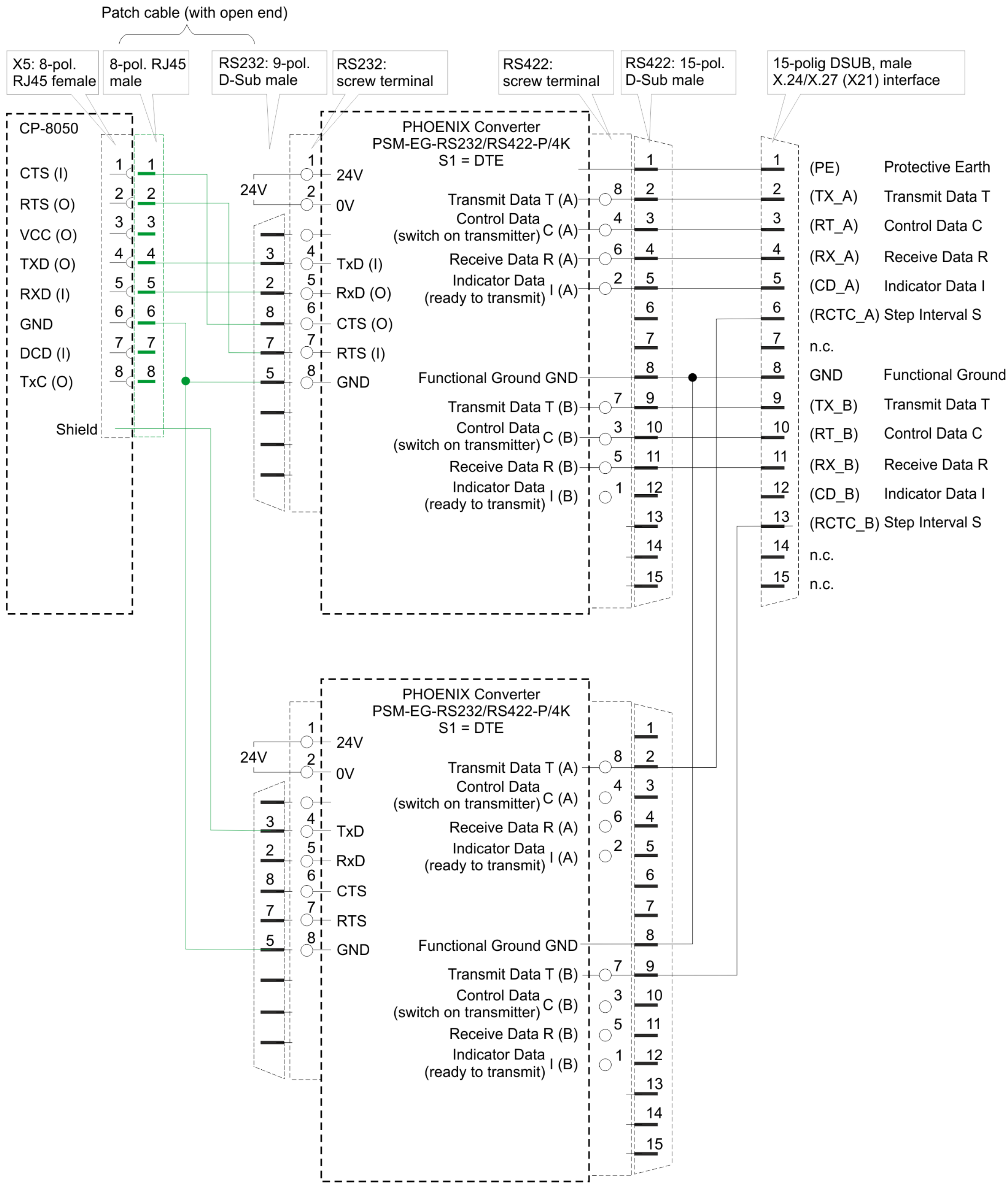
Wiring for connection CP-8050 - Interface converter (receive clock - Control & Indicate used)



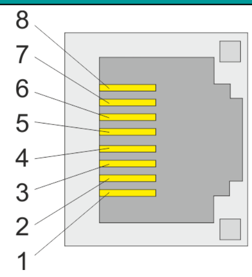
Wiring for connection CP-8050 - Interface converter (send clock - Control not used & Indicate used)



Wiring for connection CP-8050 - Interface converter (send clock - Control & Indicate used)



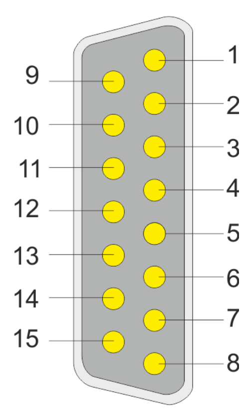
Connector assignment CP-8050 / X5 (RS-232) in mode Isochron 'X24/X.27'

RJ45	1...8	Signal	
		Pulse is transmitted	Pulse is received
	1	CTS (I)	RxC (I)
	2	RTS (O)	RTS (O)
	3	+5 V	+5 V
	4	TxD (O)	TxD (O)
	5	RxD (I)	RxD
	6	GND	GND
	7	DCD (I)	DCD (I)
	8	TxC (O)	DTR (O)

Legend:

CTS	... Clear to Send	RxD	... Receive data
RTS	... Request to Send	GND	... Signal Ground
DSR	... Data Set Ready	+5 V	... +5V Supply (output)
DCD	... Data Carrier Detect	TxC	... Pulse is transmitted
DTR	... Data Terminal Ready	RxC	... Pulse is received
TxD	... Transmit data	(O)	... Output
		(I)	... Input

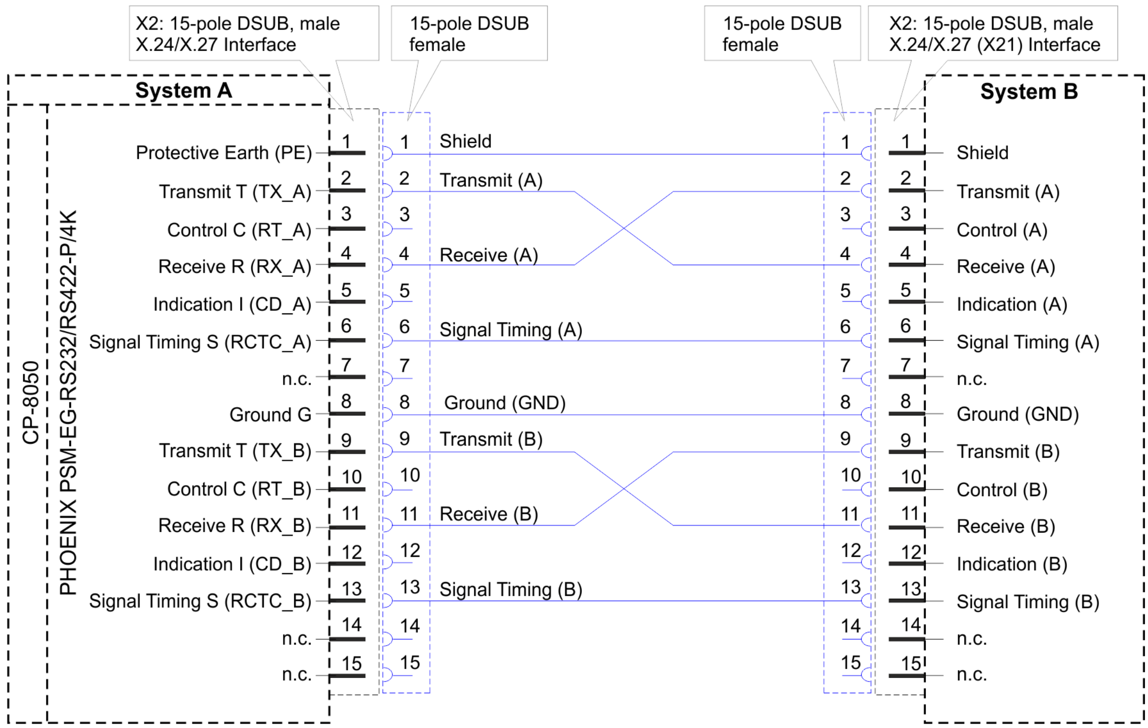
Connector pin assignment for X.24/X.27 interface

DSUB 15-pole	PIN	Signal
	1	PE
	2	TX_A
	3	RT_A
	4	RX_A
	5	CD_A
	6	RCTC_A
	7	n.c.
	8	GND
	9	TX_B
	10	RT_B
	11	RX_B
	12	CD_B
	13	RCTC_B
	14	n.c.
	15	n.c.

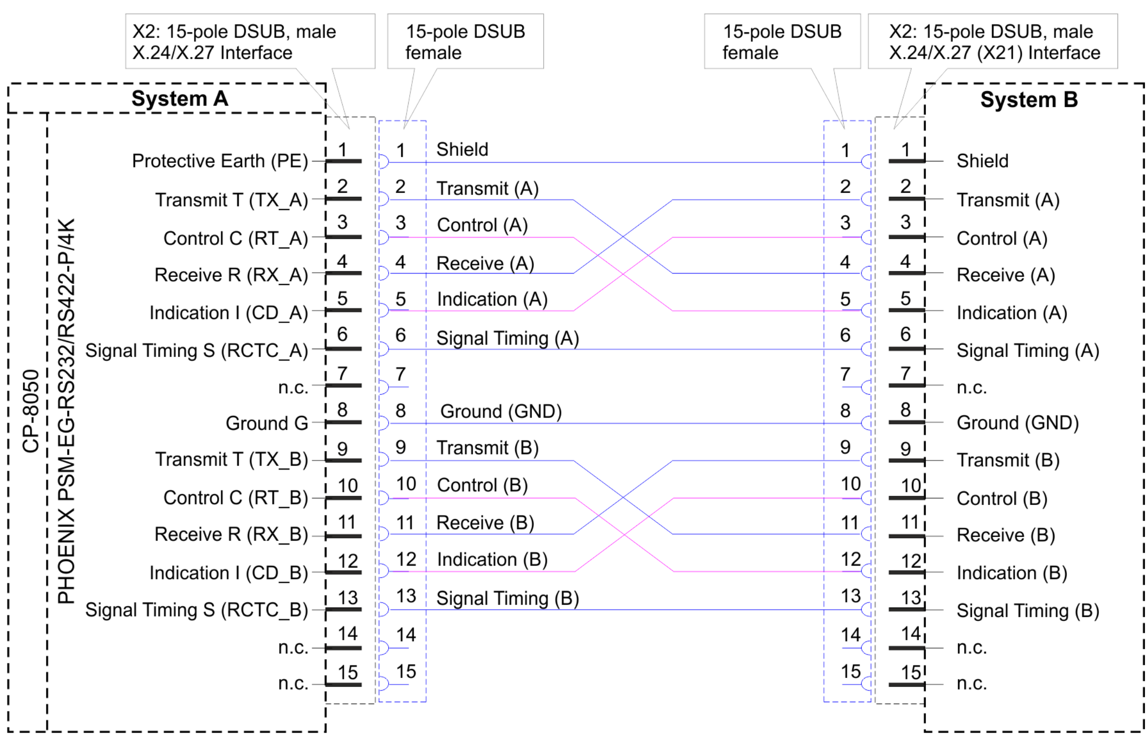
Legend:

PE	... Protective earth	GND	... Signal ground
TX_A	... Transmit data T	TX_B	... Transmit data T
RT_A	... Control C	RT_B	... Control C
RX_A	... Receive data R	RX_B	... Receive data R
CD_A	... Notify I	CD_B	... Notify I
RCTC_A	... Signal element timing S	RCTC_B	... Signal element timing S
n.c.	... not connected		

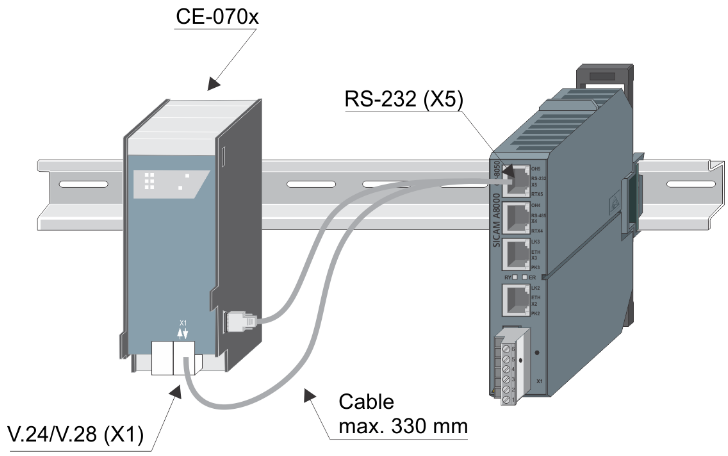
Wiring for connection cable if 2 systems are connected directly via the X.24/X.27 (X21) interface (Control & Indication not used)



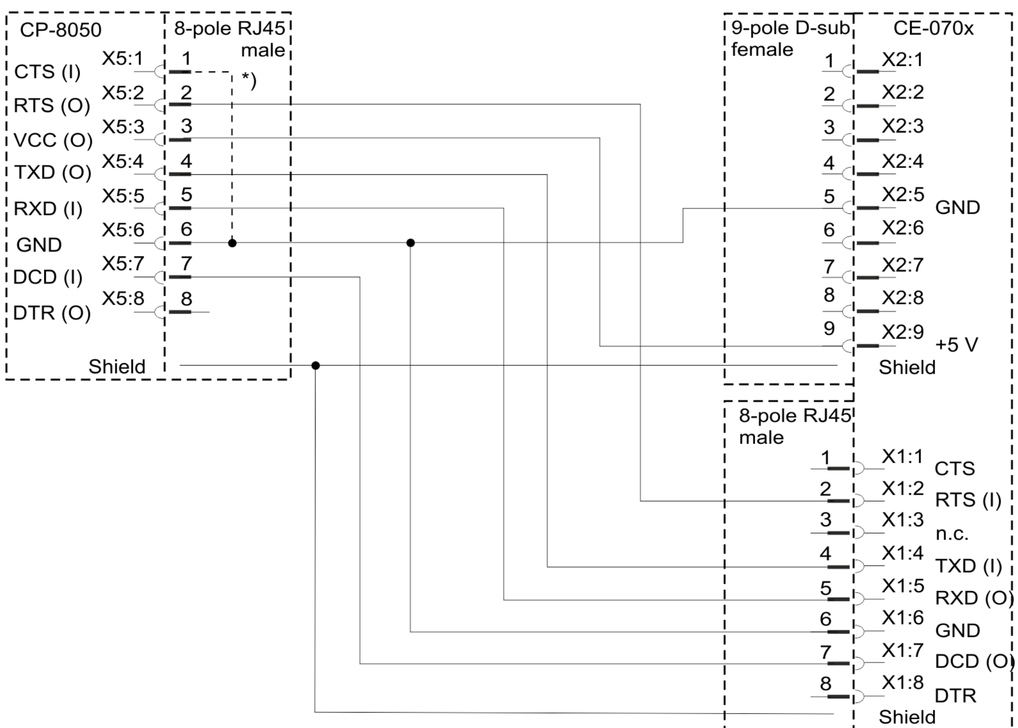
Wiring for connection cable if 2 systems are connected directly via the X.24/X.27 (X21) interface (Control & Indication used)



6.12.1.4 Multi-Point Traffic via Leased Line Modem/VFT Channel Modem



Wiring for Connection CP-8050 – CE-070x



NOTE

With a serial connection via X5 interface of CP-8031, CP-8050 a bridge between CTS and GND is required, as far as the interface shall also be used for the connection with the engineering PC.

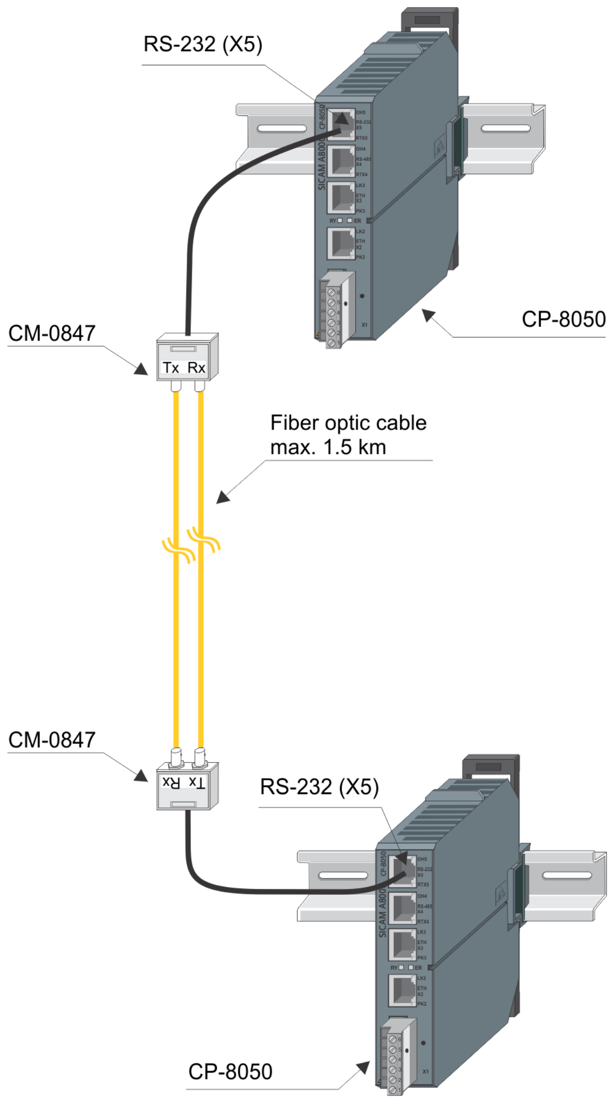
The CTS status line cannot be used by the protocol!

If the interface shall not be used as serial engineering interface, the function can be disabled with the parameter **`Serial engineering interface = disabled`**.

Thereby no connection between CTS and GND is required.

6.12.1.5 Point-to-point traffic via fiber optics

Point-to-point connection with CM-0847 converter (RS-232 ↔ FO)



[Communication_Setup_Serial_Multi-Point_Opt_P2P_CM-0847, 1, en_US]

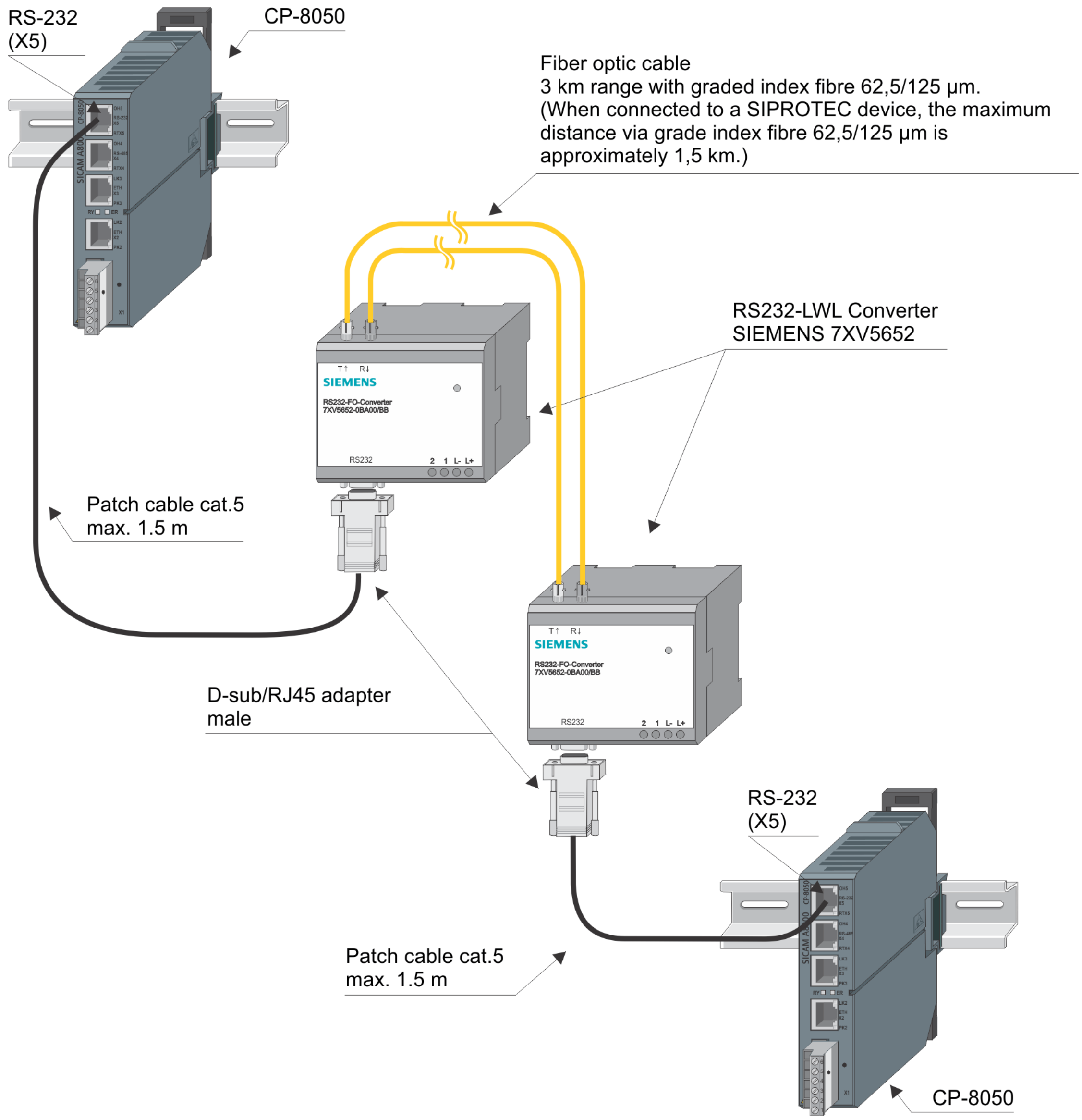
NOTE

The light idle state on the optical interface can be adjusted on the CM-0847 with the slide switch to set the optical line idle state.

The setting for the light idle state must be set the same on both sides of the optical cable!

Point-to-point connection with Siemens 7XV5652 converter (RS-232 ↔ FO)

Optical interface with CP-8050 (X5: RS-232) and RS-232/FO converter Siemens 7XV5650 (RS-232 / FO Converter).



[dw_com_setup_serial_multi-point_opt_P2P_conv_7XV5652_RS232, 1, en_US]

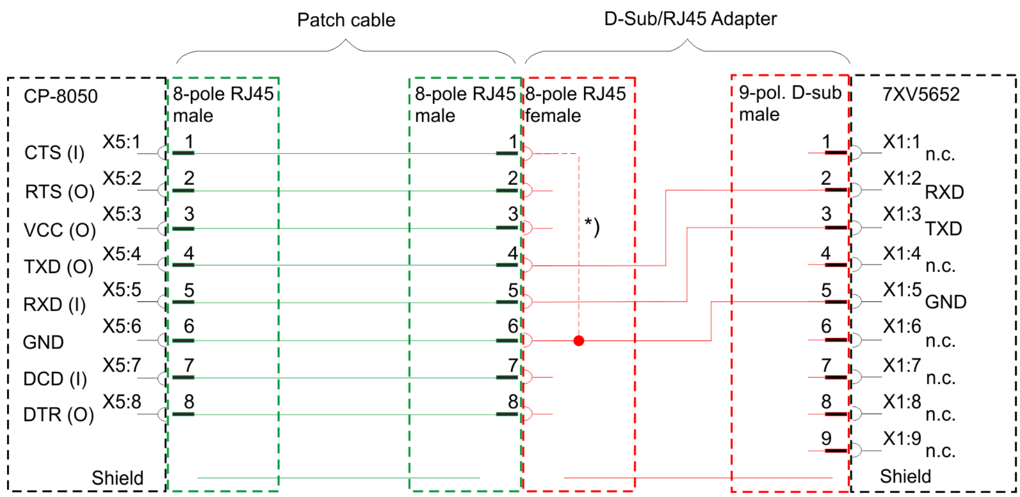
NOTE

The light idle state on the optical interface can be adjusted on the Siemens 7XV5652 converter with the DIP switch S1/8 (light idle state "ON" or light idle state "OFF").

The setting for the light idle state must be set the same on both sides of the optical cable!

Changing the light idle state has no effect on the wiring!

Wiring for Connection CP-8050 – Converter 7XV5652



NOTE

With a serial connection via X5 interface of CP-8031, CP-8050 a bridge between CTS and GND is required, as far as the interface shall also be used for the connection with the engineering PC.

The CTS status line cannot be used by the protocol!

If the interface shall not be used as serial engineering interface, the function can be disabled with the parameter **`Serial engineering interface = disabled`**.

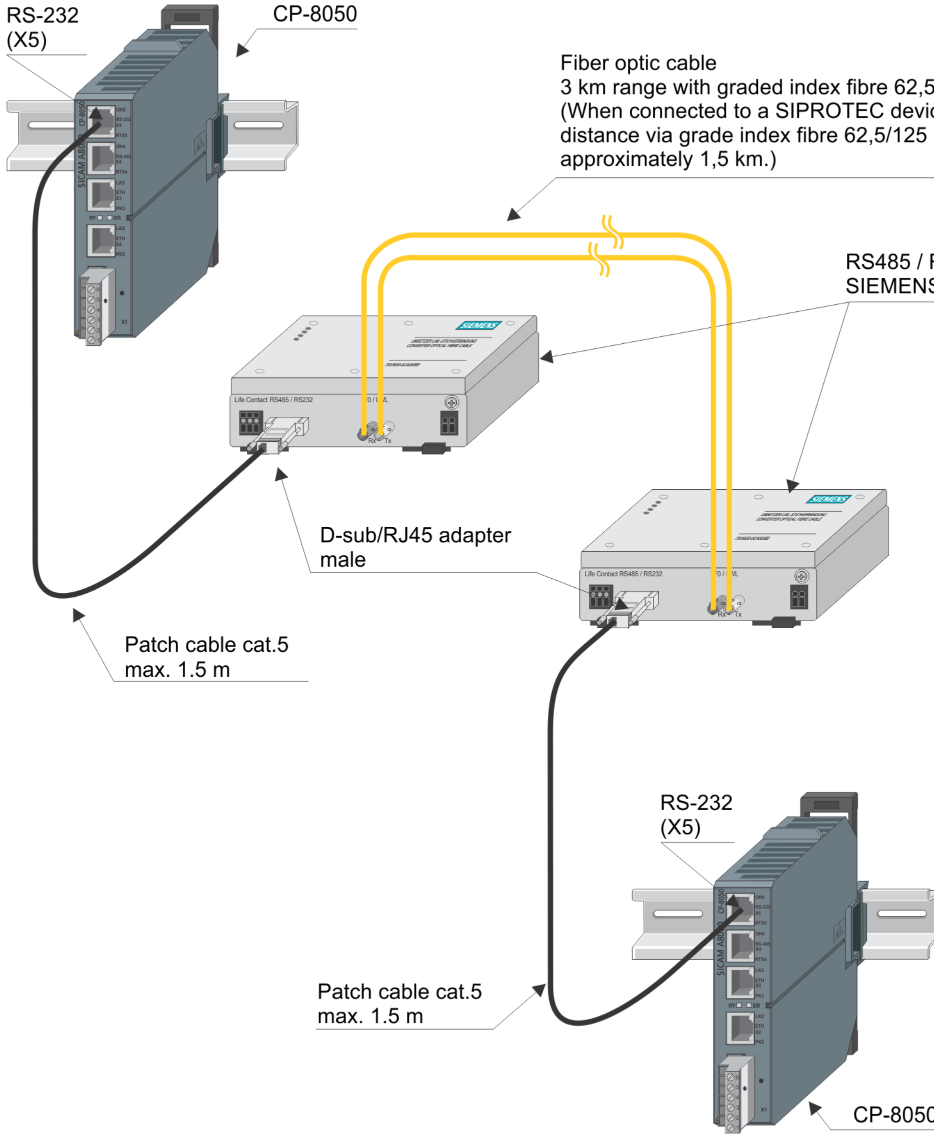
Thereby no connection between CTS and GND is required.

Recommended D-Sub/RJ45 Adapter

RS Pro MHDA9-PMJ8-M-K (see *Recommended third-party products, Page 2186*). This adapter provides a wired RJ45 socket and an unwired D-sub plug (male).

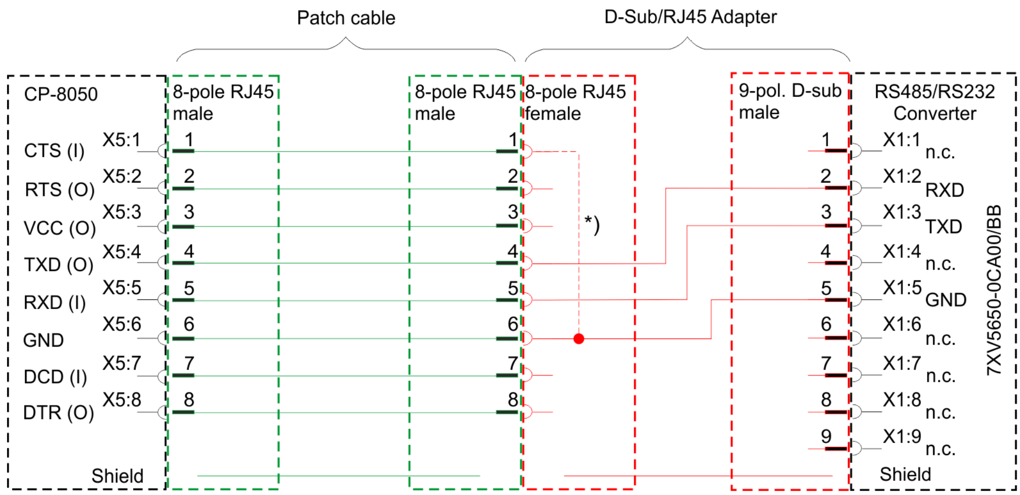
Point-to-point connection with Siemens 7XV5650 converter (RS-232 ↔ FO)

Optical interface with CP-8050 (X5: RS-232) and RS-232/FO converter Siemens 7XV5650 (RS-232 / FO Converter).



[dw_Comm_Setup_P2P_RS232_Conv_7XV5650, 2, en_US]

Wiring for Connection CP-8050 – Converter 7XV5650-0CA00/BB



[dw_Wiring_DSUB_RJ45_Adapter_for_7XV5650_0CA00_BB, 1, en_US]

NOTE

With a serial connection via X5 interface of CP-8031, CP-8050 a bridge between CTS and GND is required, as far as the interface shall also be used for the connection with the engineering PC.

The CTS status line cannot be used by the protocol!

If the interface shall not be used as serial engineering interface, the function can be disabled with the parameter **`Serial engineering interface = disabled`**.

Thereby no connection between CTS and GND is required.

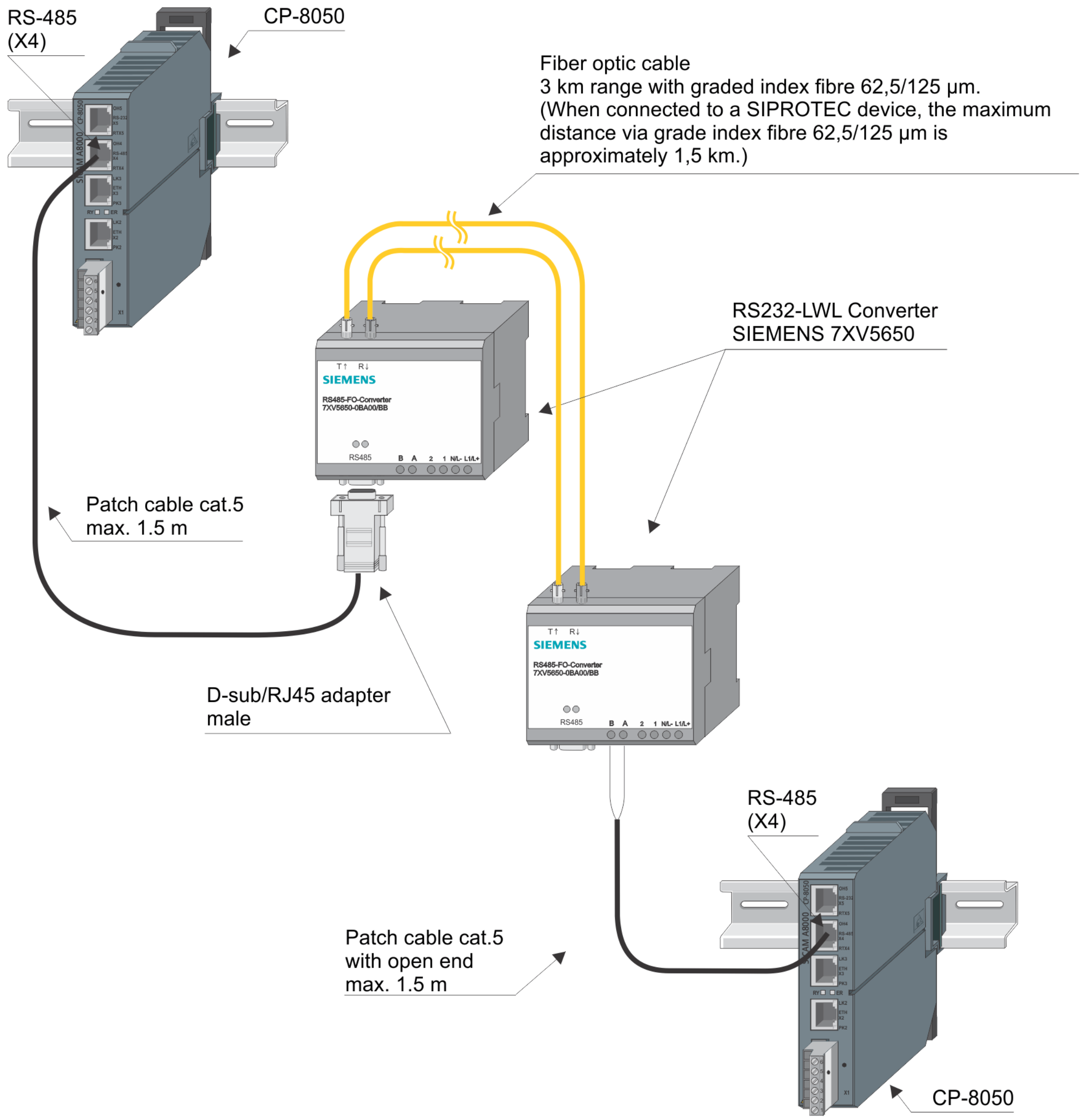
Recommended D-Sub/RJ45 Adapter

RS Pro MHDA9-PMJ8-M-K (see *Recommended third-party products, Page 2186*). This adapter provides a wired RJ45 socket and an unwired D-sub plug (male).

Point-to-point connection with Siemens 7XV5650 converter (RS-485 ↔ FO)

Optical interface with CP-8050 (X4: RS-485) and RS-485/FO converter Siemens 7XV5650 (RS-485 / FO Converter).

If the RS-232 interface of the CP-8050 [X5] is already in use, an optical connection to the remote station can be made via the RS-485 interface of the CP-8050 [X4] with an external converter RS-485 ↔ FO (e.g.: Siemens 7XV5650). For communication, only a half-duplex transmission protocol can be used (because of RS-485) (e.g.: IEC 60870-5-101 or IEC 60870-5-103 in multi-point traffic).



[dw_com_setup_serial_multi-point_opt_P2P_conv_7XV5650_RS485, 2, en_US]

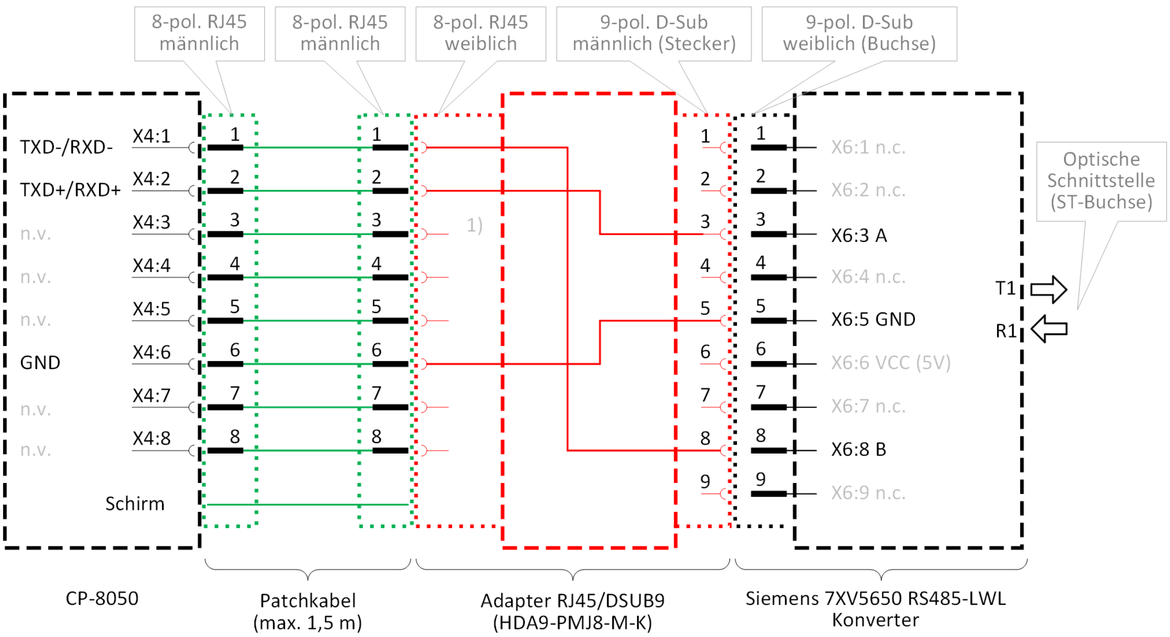
NOTE

The light idle state on the optical interface can be adjusted on the Siemens 7XV5650 converter with the DIP switch S1/8 (light idle state "ON" or light idle state "OFF").

The setting for the light idle state must be set the same on both sides of the optical cable!

Changing the light idle state has no effect on the wiring!

Circuitry for connection CP-8050 – Converter 7XV5650 (9 pol. Sub-D connector to 7XV5650)

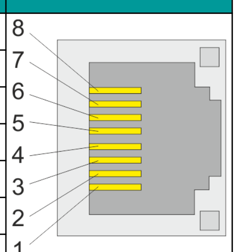


(1) nicht benutzte Adern müssen isoliert werden!

mandatory (erforderliche Verdrahtung im Adapter RJ45/DSUB9)

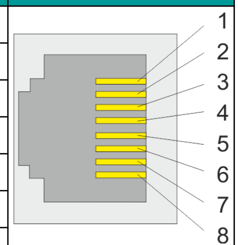
[dw_CP-8050_RS485_LWL_DSUB9_7XV5650, 1, en_US]

Connector pin assignment CP-8050 "X4" (RJ45 connector: RS-485 2-wire)

Pin	Signal	
8	n.c.	
7	n.c.	
6	GND	
5	n.c.	
4	n.c.	
3	n.c.	
2	TXD+/RXD+	
1	TXD-/RXD-	

Recommended D-sub/RJ45 adapter: RS Pro Series HDA D-Sub-Adapter for Sub-D terminal block, 9-pole (Order information see *Recommended third-party products, Page 2186*). The adapter RS Pro HDA9-SMJ8-M-K provides a wired RJ45 socket and an unwired D-sub plug (male).

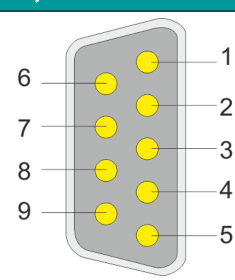
Wiring of the RJ45 socket on the adapter HDA9-SMJ8-M-K:

Pin	Wire color	
1	black	
2	yellow	
3	orange	
4	red	
5	green	
6	brown	
7	grey	
8	blue	
Shield	black	

NOTE

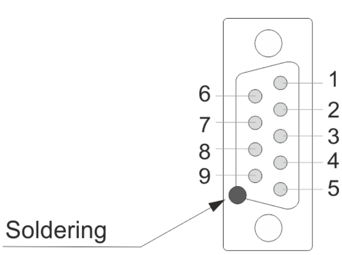
There are other similar converters on the market - the color of the wires can be different! (Check wire color and pin assignment!).

Pin assignment of the D-Sub connector on the adapter HDA9-SMJ8-M-K:

Pin	D-Sub9 (male) "connector"
1	
2	
3	
4	
5	
6	
7	
8	
9	

Wiring at the 9-pole D-sub plug: (Front view of plug)
Pins at the D-sub plug can be assigned according to the wiring diagram.

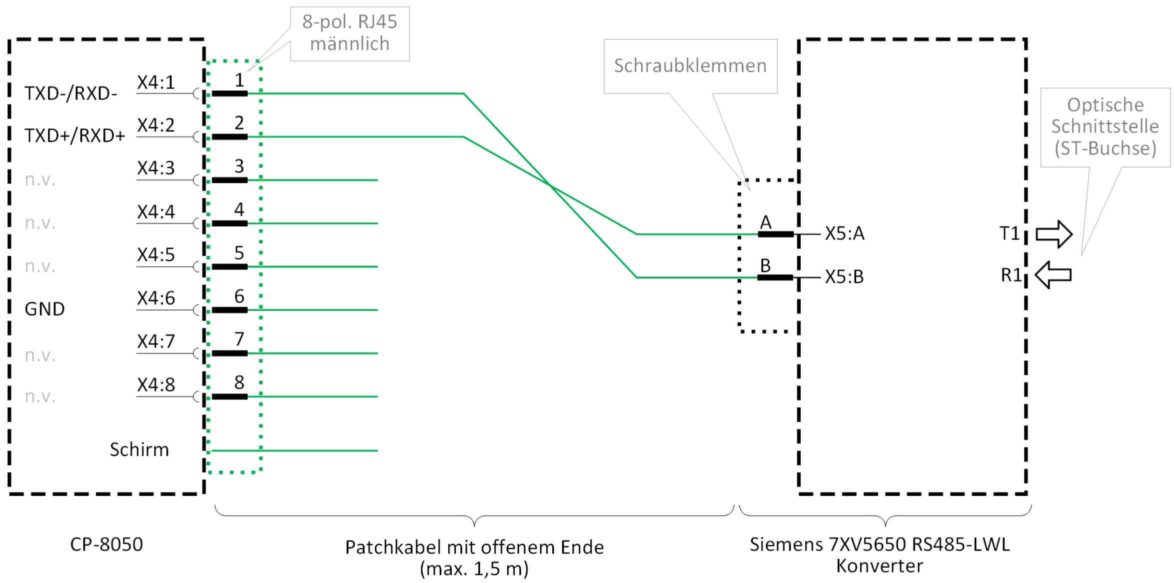
Unused wires must be isolated!



[dw_9-pole_DSUB_soldering, 1, en_US]

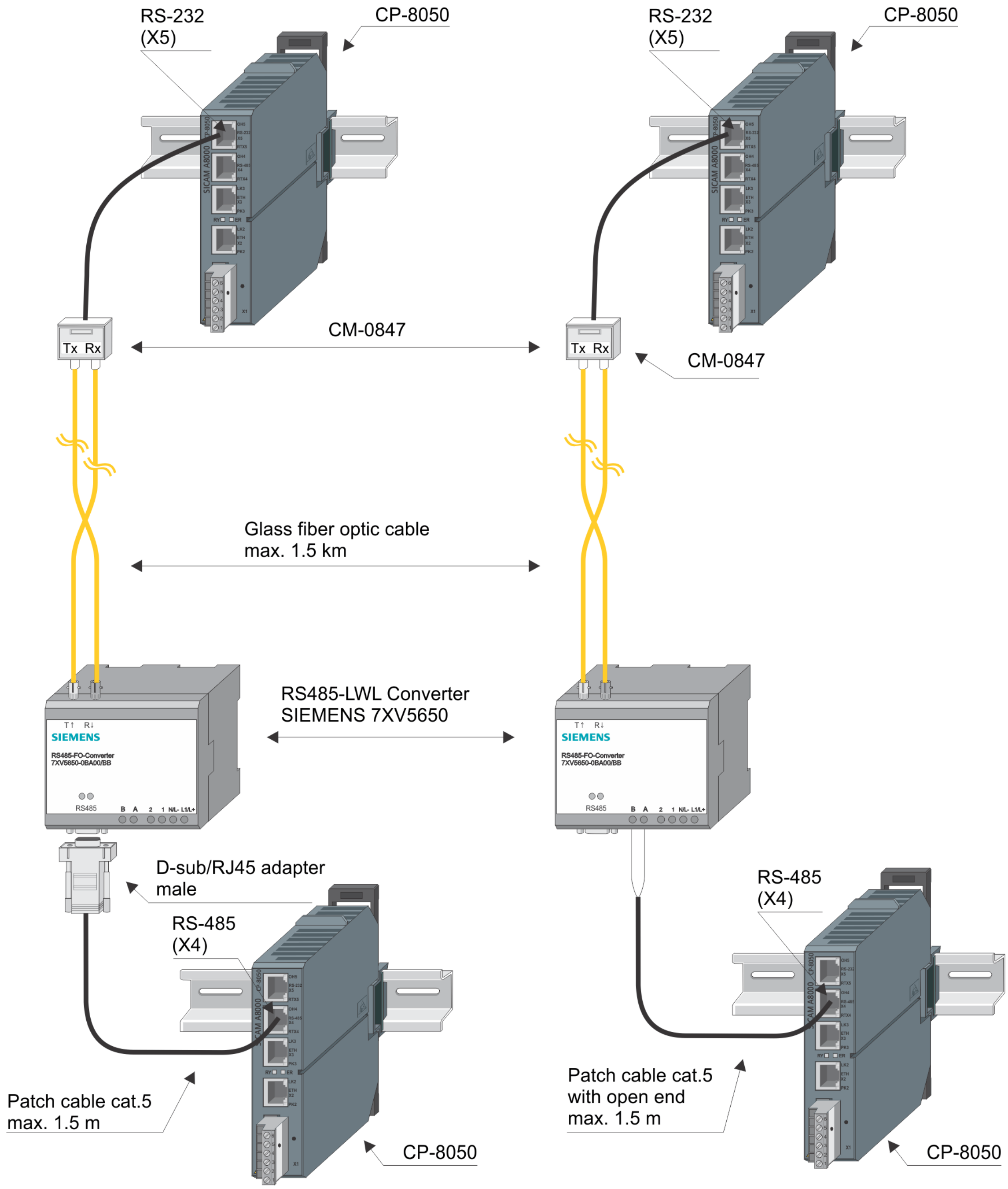
When using the shield, it must be soldered to the metal plate of the D-sub plug.

Circuitry for connection CP-8050 – Converter 7XV5650 (RS-485 A/B connetion to 7XV5650)



[dw_CP-8050_RS485_LWL_AB_7XV5650, 1, en_US]

Point-to-point connection with CM-0847 and Siemens 7XV5650 converter (RS-485 ↔ FO)



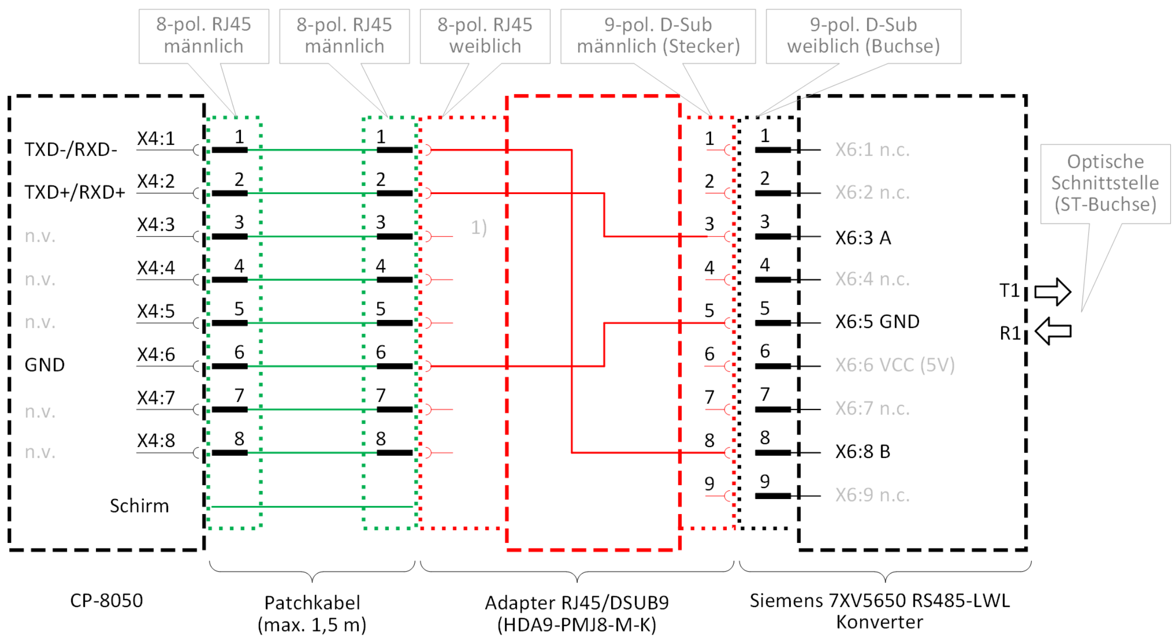
[dw_Comm_Setup_P2P_RS485_CM-0847_Conv_7XV5650, 2, en_US]

NOTE

The light idle state on the optical interface can be adjusted on the CM-0847 with the slide switch to set the optical line idle state and on the Siemens 7XV5650 converter with the DIP switch S1/8 (light idle state "ON" or light idle state "OFF").

The setting for the light idle state must be set the same on both sides of the optical cable.

Changing the light idle state has no effect on the wiring!

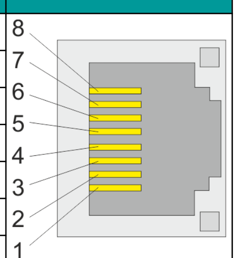


(1) nicht benutzte Adern müssen isoliert werden!

mandatory (erforderliche Verdrahtung im Adapter RJ45/DSUB9)

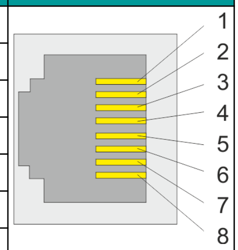
[dw_CP-8050_RS485_LWL_DSUB9_7XV5650, 1, en_US]

Connector pin assignment CP-8050 "X4" (RJ45 connector: RS-485 2-wire)

Pin	Signal	
8	n.c.	
7	n.c.	
6	GND	
5	n.c.	
4	n.c.	
3	n.c.	
2	TXD+/RXD+	
1	TXD-/RXD-	

Recommended D-sub/RJ45 adapter: RS Pro Series HDA D-Sub-Adapter for Sub-D terminal block, 9-pole (Order information see *Recommended third-party products, Page 2186*). The adapter RS Pro HDA9-SMJ8-M-K provides a wired RJ45 socket and an unwired D-sub plug (male).

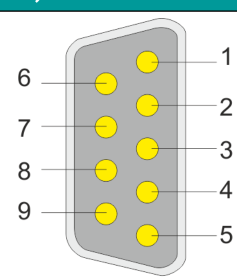
Wiring of the RJ45 socket on the adapter HDA9-SMJ8-M-K:

Pin	Wire color	
1	black	
2	yellow	
3	orange	
4	red	
5	green	
6	brown	
7	grey	
8	blue	
Shield	black	

NOTE

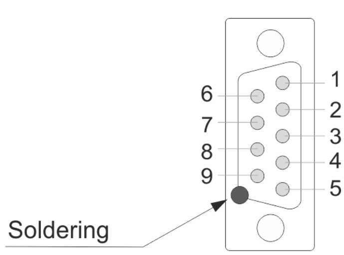
There are other similar converters on the market - the color of the wires can be different! (Check wire color and pin assignment!).

Pin assignment of the D-Sub connector on the adapter HDA9-SMJ8-M-K:

Pin	D-Sub9 (male) "connector"
1	
2	
3	
4	
5	
6	
7	
8	
9	

Wiring at the 9-pole D-sub plug: (Front view of plug)
Pins at the D-sub plug can be assigned according to the wiring diagram.

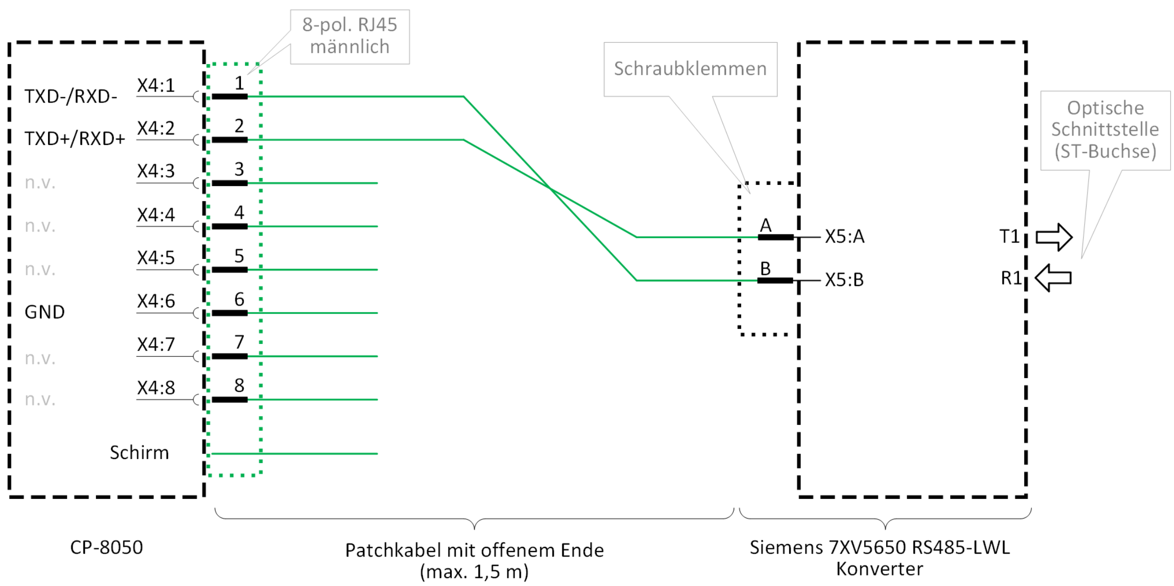
Unused wires must be isolated!



[dw_9-pole_DSUB_soldering, 1, en_US]

When using the shield, it must be soldered to the metal plate of the D-sub plug.

Circuitry for connection CP-8050 – Converter 7XV5650 (RS-485 A/B connetion to 7XV5650)

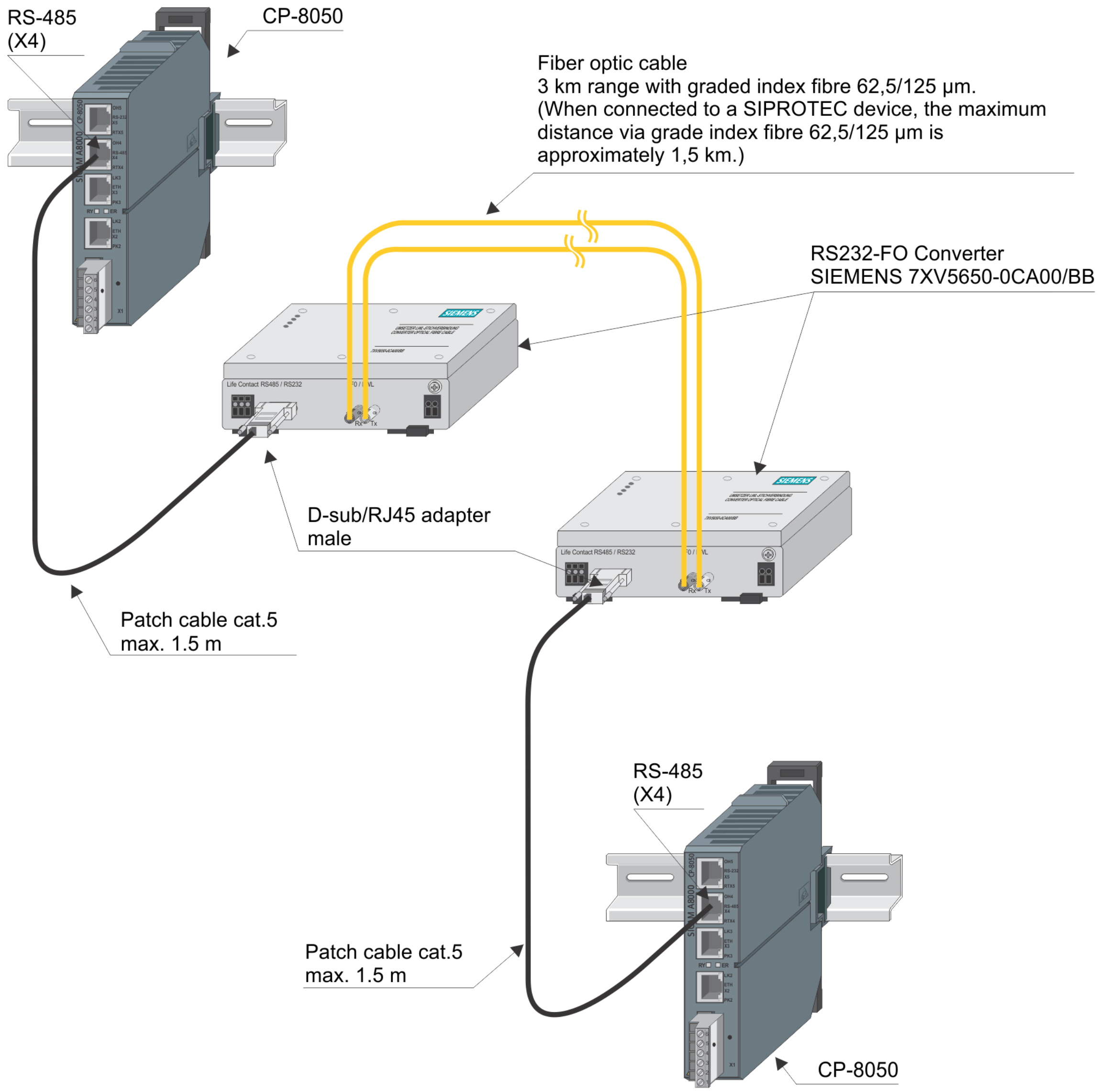


[dw_CP-8050_RS485_LWL_AB_7XV5650, 1, en_US]

Point-to-point connection with Siemens 7XV5650-0CA00/BB converter (RS-485 ↔ LWL)

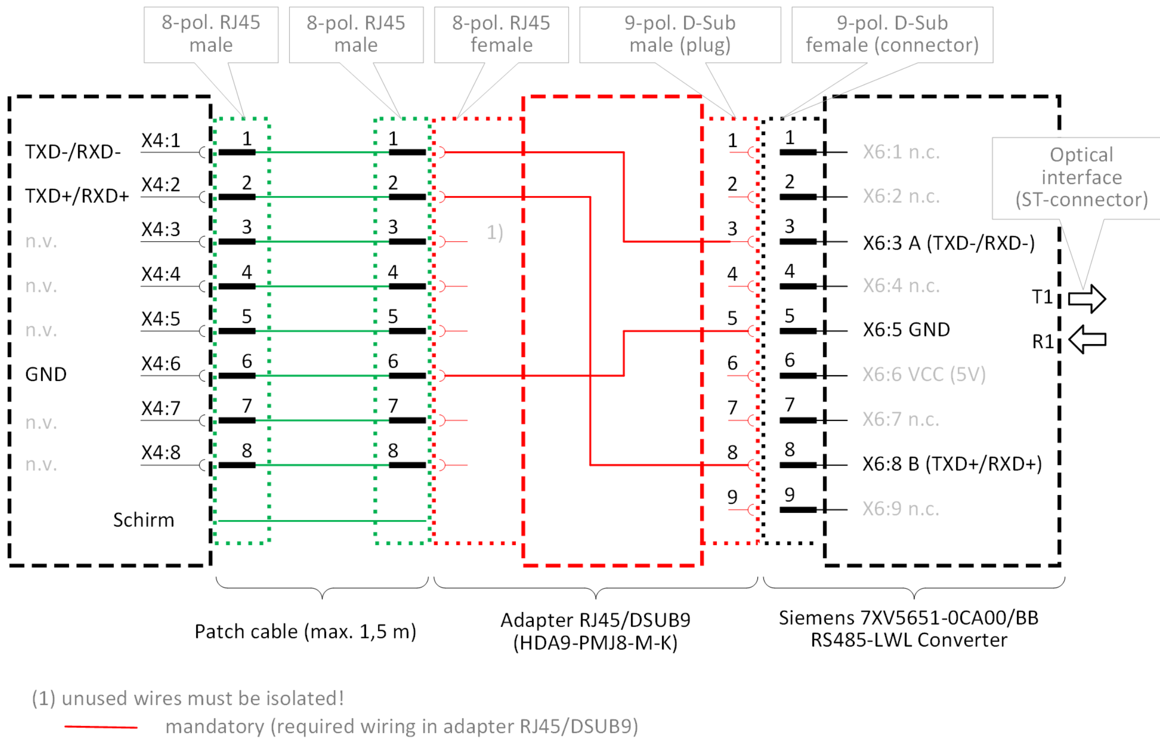
Optical interface with CP-8050 (X4: RS-485) and RS-485/FO converter Siemens 7XV5650-0CA00 (RS-485/FO Converter)

If the RS-232 interface of the CP-8050 [X5] is already in use, an optical connection to the remote station can be made via the RS-485 interface of the CP-8050 [X4] with an external converter RS-485 ↔ FO (e.g.: Siemens 7XV5650). For communication, only a half-duplex transmission protocol can be used (e.g.: IEC 60870-5-101 or IEC 60870-5-103 in multi-point traffic).



[dw_Comm_Setup_P2P_RS485_Conv_7XV5650, 1, en_US]

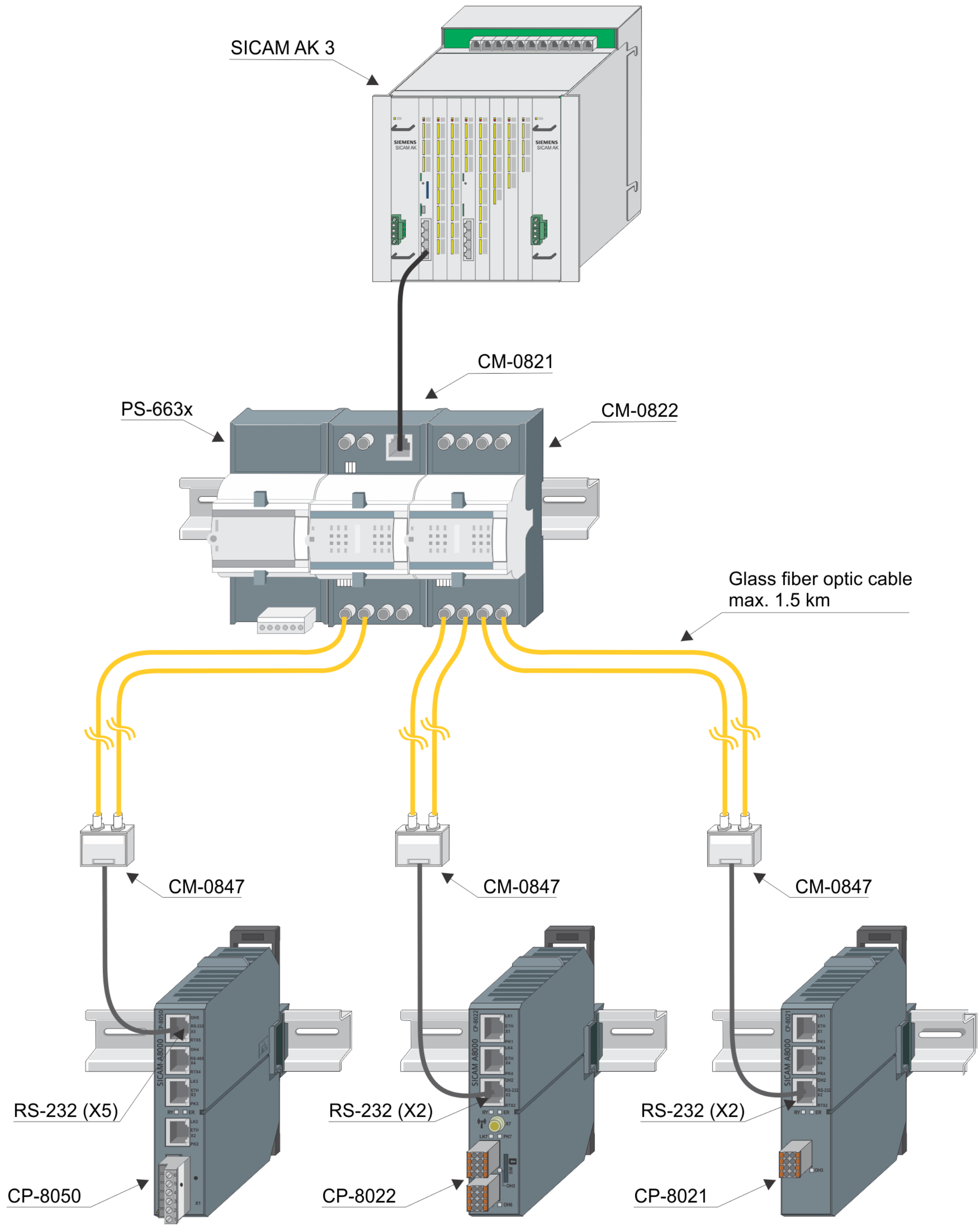
Circuitry for connection CP-8050 – Converter 7XV5650 (9 pol. Sub-D connector to 7XV5650-0CA00/BB)



[dw_CP-8050_RS485_LWL_DSUB9_7XV5650, 1, en_US]

6.12.1.6 Multi-Point Traffic via Fiber Optic

Star configuration with CM-0821, CM-0822 and CM-0847



[dw_Communication_Setup_Serial_Multi-Point_Opt_Star_CM-0847, 1, en_US]

NOTE

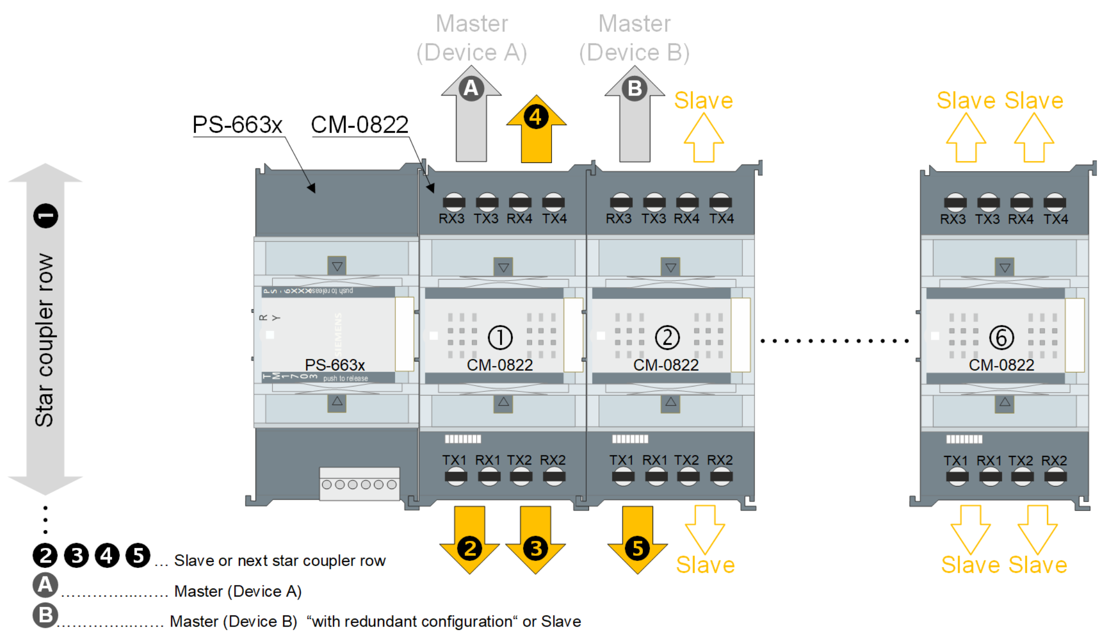
A maximum of 6 star coupler (CM-0822) may be attached next to each other.

Star configuration with CM-0822 star coupler

Star couplers with CM-0822 are used when "line idle state light = ON" is required on the optical line. The star couplers with CM-0822 can be supplied singularly or redundantly with the PS-663x power supply modules.

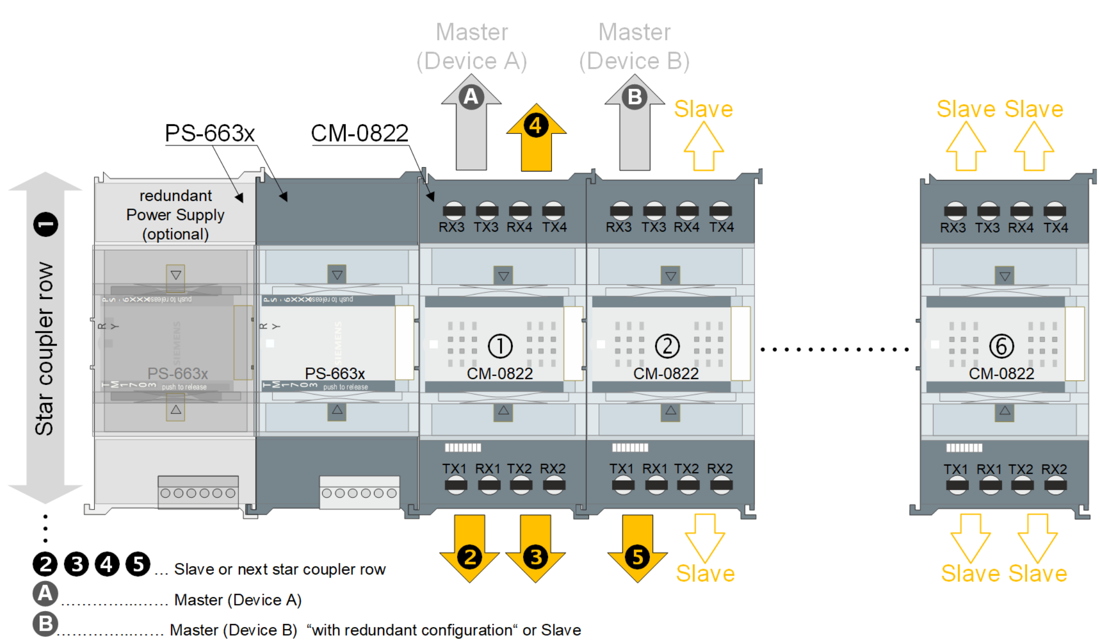
The following configuration drawings are shown with redundant PS-663x power supply modules.

Simple "singular" power supply module:



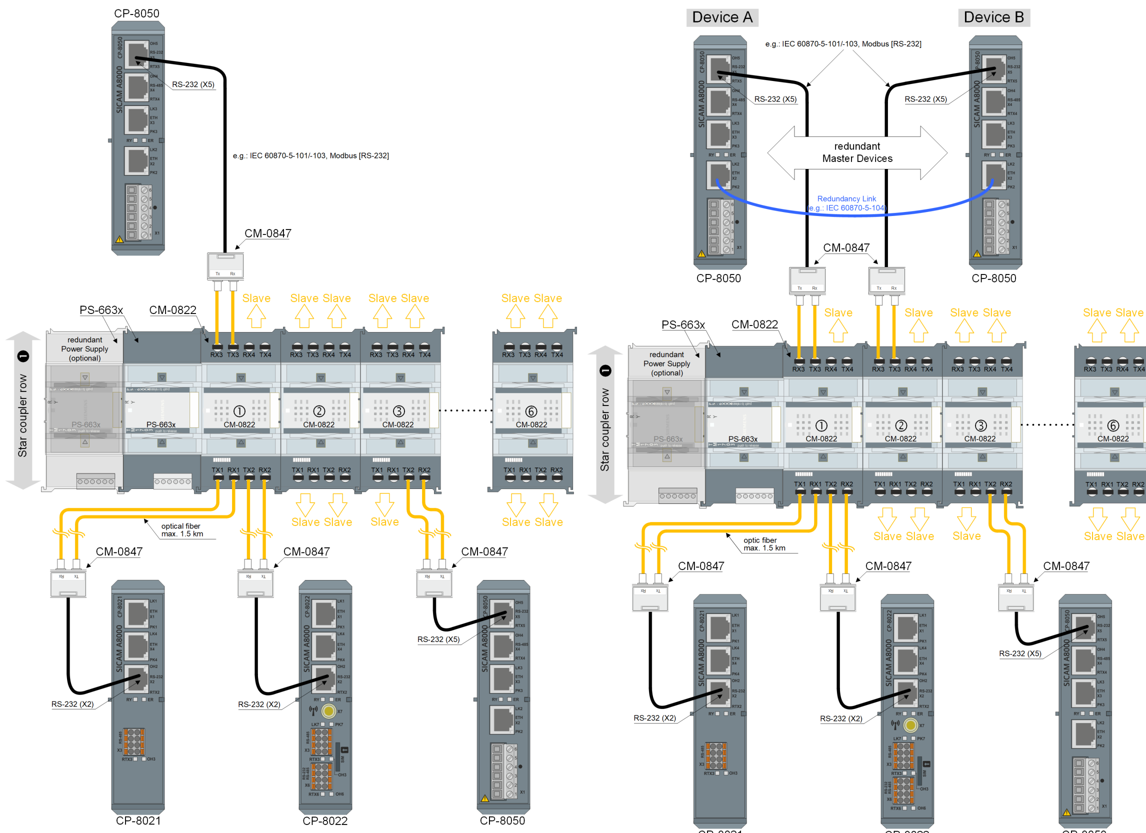
[dw_Communication_Setup_Serial_Multi_Point_Opt_Star_CM_0822_PS663x_PS-663x_a, 1, en_US]

Redundant power supply modules:



[dw_Communication_Setup_Serial_Multi_Point_Opt_Star_CM_0822_PS663x_PS-663x_b, 1, en_US]

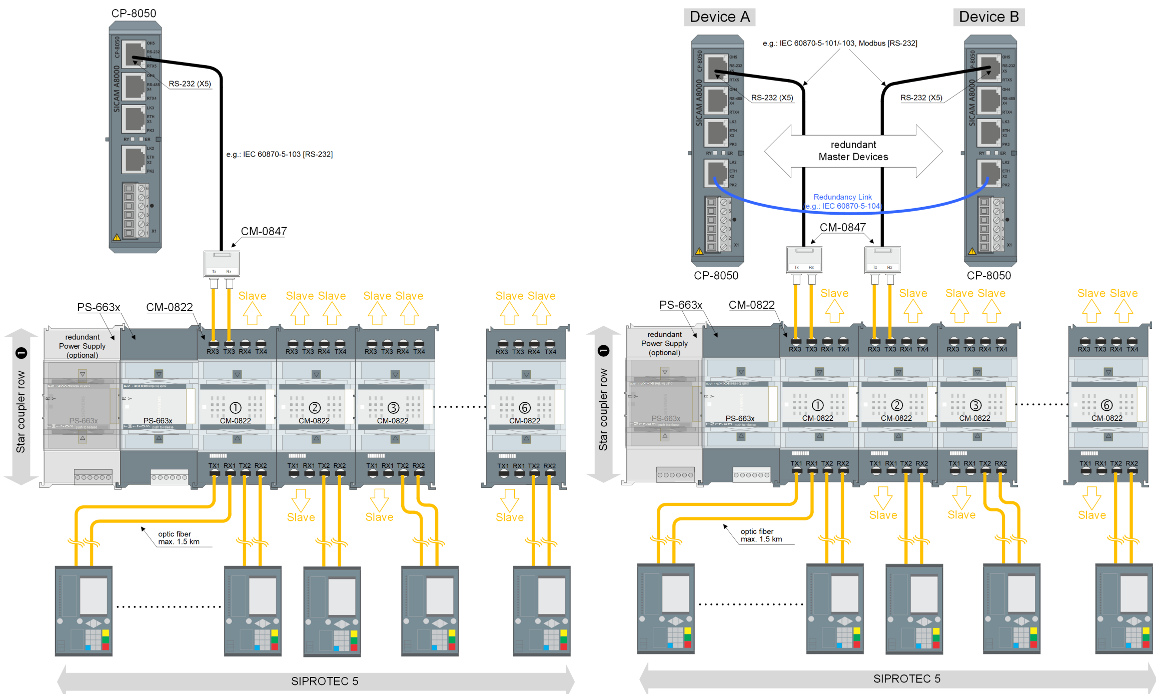
Star configuration with CM-0822 star coupler - singular / redundant master incl. "Redundant power supply for CM-0822"



NOTE

- Power supply of CM-0822 with PS-663x
  (redundant power supply possible)
- Line idle state can be set for each optical interface via DIP switch on the CM-0822.
- CM-0822 TX3/RX3 for connection to a master or slave.
  CM-0822 TX1/RX1, TX2/RX2, TX4/RX4 for connection to a slave.

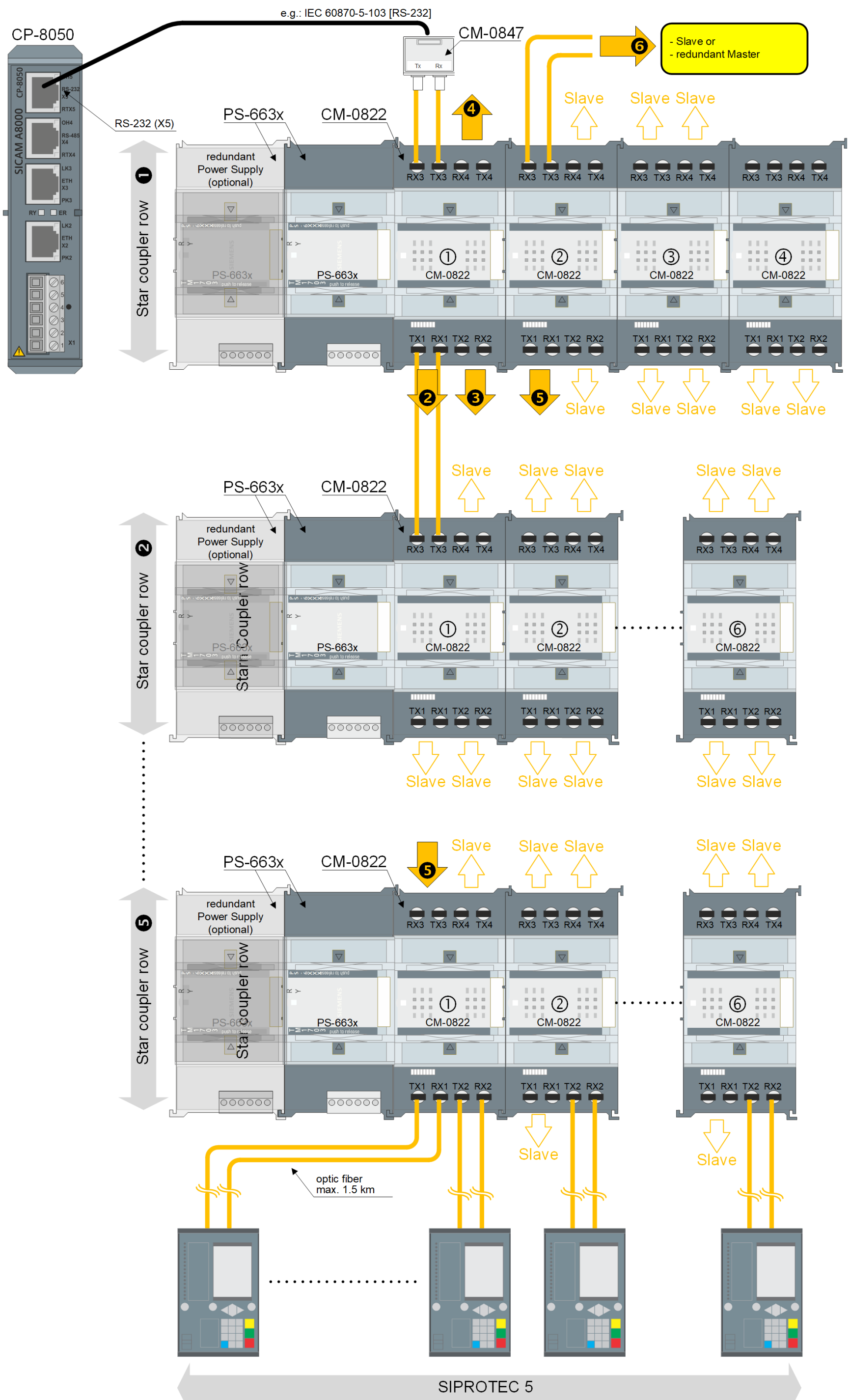
Star configuration with CM-0822 star coupler - singular / redundant master (max. 23/22 Slaves) ncl. "Redundant power supply for CM-0822"



NOTE

- Power supply of CM-0822 with PS-663x.
  (redundant power supply possible)
- A maximum of 6 star coupler (CM-0822) may be attached next to each other.
- Line idle state can be set for each optical interface via DIP switch on the CM-0822.
- CM-0822 TX3/RX3 for connection to a master or slave.
  CM-0822 TX1/RX1, TX2/RX2, TX4/RX4 for connection to a slave.

Star configuration with CM-0822 star coupler - singular master (max. 100 Slaves) incl. "Redundant power supply for CM-0822"



[dw_Communication_Setup_Serial_Multi_Point_Opt_Star_CM_0822_PS663x_b2, 1, en_US]

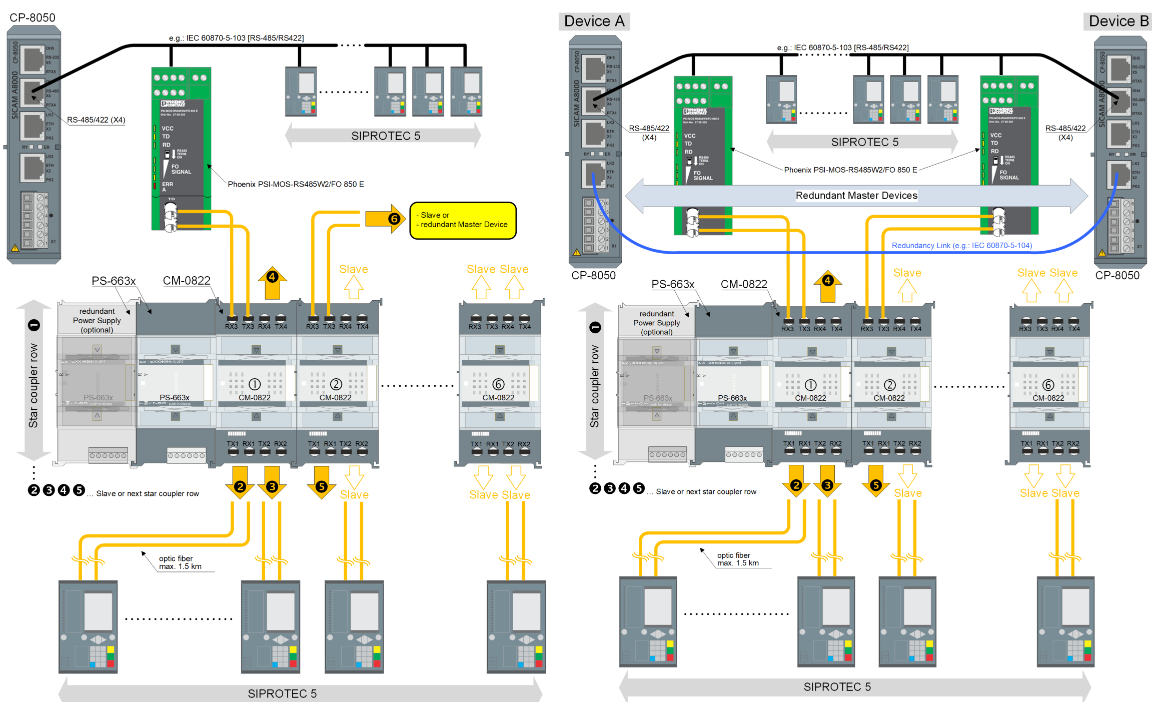
Star coupler row	Number CM-0822	Interfaces for slaves	Interfaces for masters	Interfaces for cascading
1	4	8	1	4
2	6	23		1
3	6	23		1

4	6	23		1
5	6	23		1
Sum	**28**	**100**		

NOTE

- Power supply of CM-0822 with PS-663x.
  (redundant power supply possible)
- A maximum of 6 star coupler (CM-0822) may be attached next to each other.
- Line idle state can be set for each optical interface via DIP switch on the CM-0822.
- CM-0822 TX3/RX3 for connection to a master or slave.
  CM-0822 TX1/RX1, TX2/RX2, TX4/RX4 for connection to a slave.
- For a star coupler for 100 protection devices: 28x CM-0822 are required.

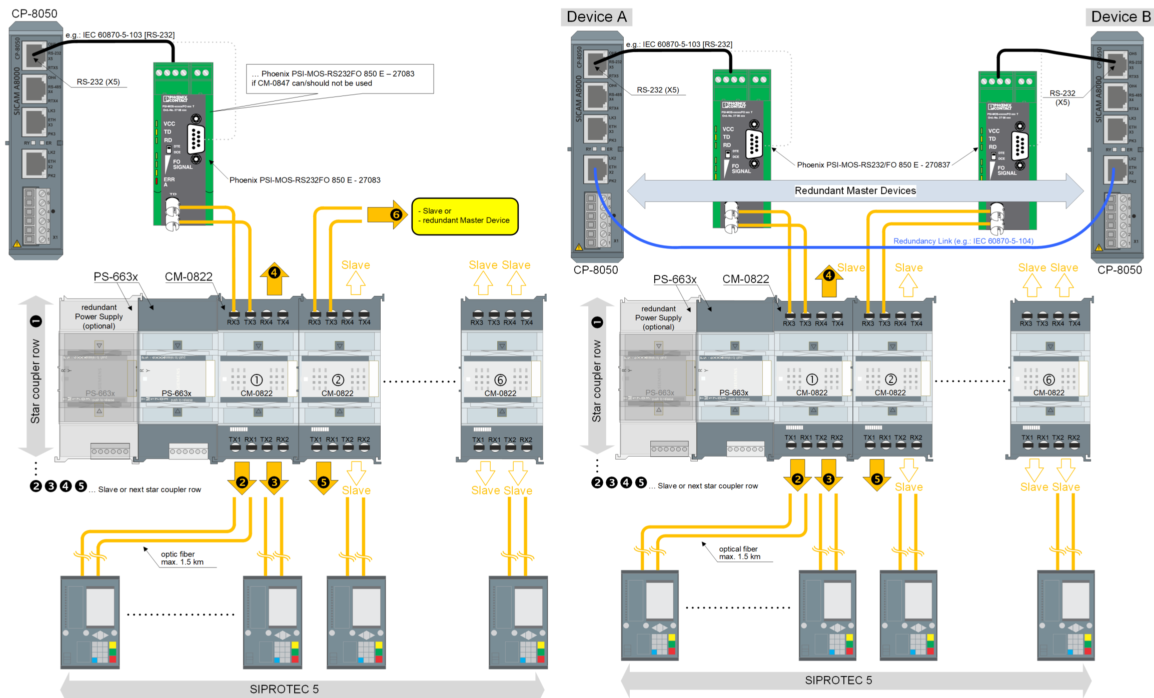
Star configuration with CM-0822 star coupler - singular / redundant master. CP-8050 ↔ CM-0822 optical with Phoenix RS-485/422 FO converter



NOTE

- Power supply of CM-0822 with PS-663x.
  (redundant power supply possible)
- A maximum of 6 star coupler (CM-0822) may be attached next to each other.
- Line idle state can be set for each optical interface via DIP switch on the CM-0822.
- Line idle state of the optical interface on the Phoenix PSI-MOS-RS485W2/FO 850 E can be set via DIP switches.
- CM-0822 TX3/RX3 for connection to a master or slave.
  CM-0822 TX1/RX1, TX2/RX2, TX4/RX4 for connection to a slave.

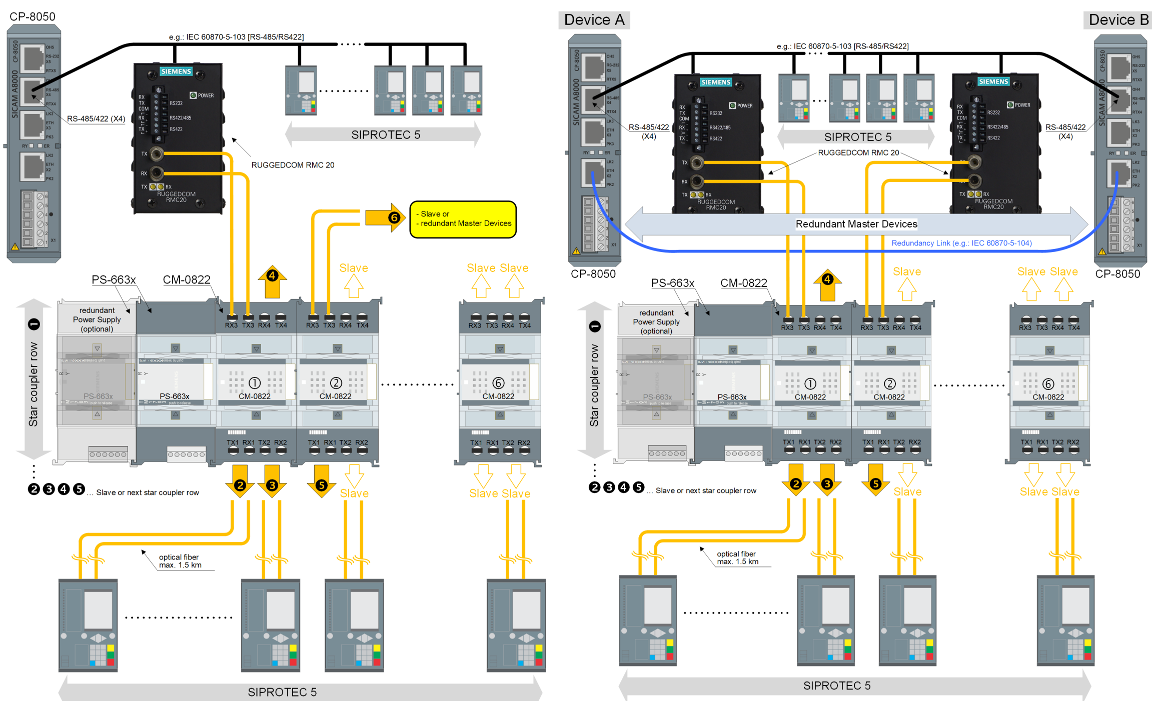
Star configuration with CM-0822 star coupler - single master CP-8050 ↔ CM-0822 optical with Phoenix RS-232/FO converter



NOTE

- Power supply of CM-0822 with PS-663x.
  (redundant power supply possible)
- A maximum of 6 star coupler (CM-0822) may be attached next to each other.
- Line idle state can be set on the CM-0822 for each optical interface via DIP switch.
- Line idle state of the optical interface on the Phoenix PSI-MOS-RS485/FO 850 E can be set via DIP switches.
- CM-0822 TX3/RX3 for connection to a master or slave.
  CM-0822 TX1/RX1, TX2/RX2, TX4/RX4 for connection to a slave.

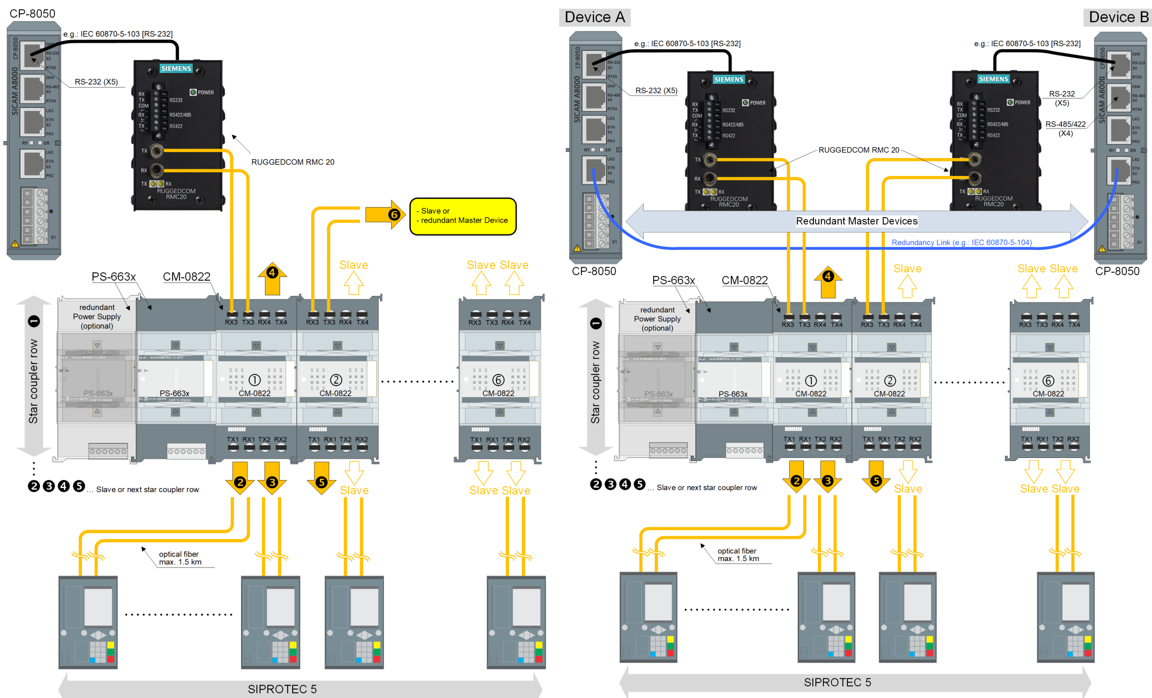
Star configuration with CM-0822 star coupler - singular / redundant master. CP-8050 ↔ CM-0822 optical with RMC 20 RS-485/422 FO converter



NOTE

- Power supply of CM-0822 with PS-663x.
  (redundant power supply possible)
- A maximum of 6 star coupler (CM-0822) may be attached next to each other.
- Line idle state can be set on the CM-0822 for each optical interface via DIP switch.
- Line idle state of the optical interface cannot be set on the RMC20!
- CM-0822 TX3/RX3 for connection to a master or slave.
  CM-0822 TX1/RX1, TX2/RX2, TX4/RX4 for connection to a slave.

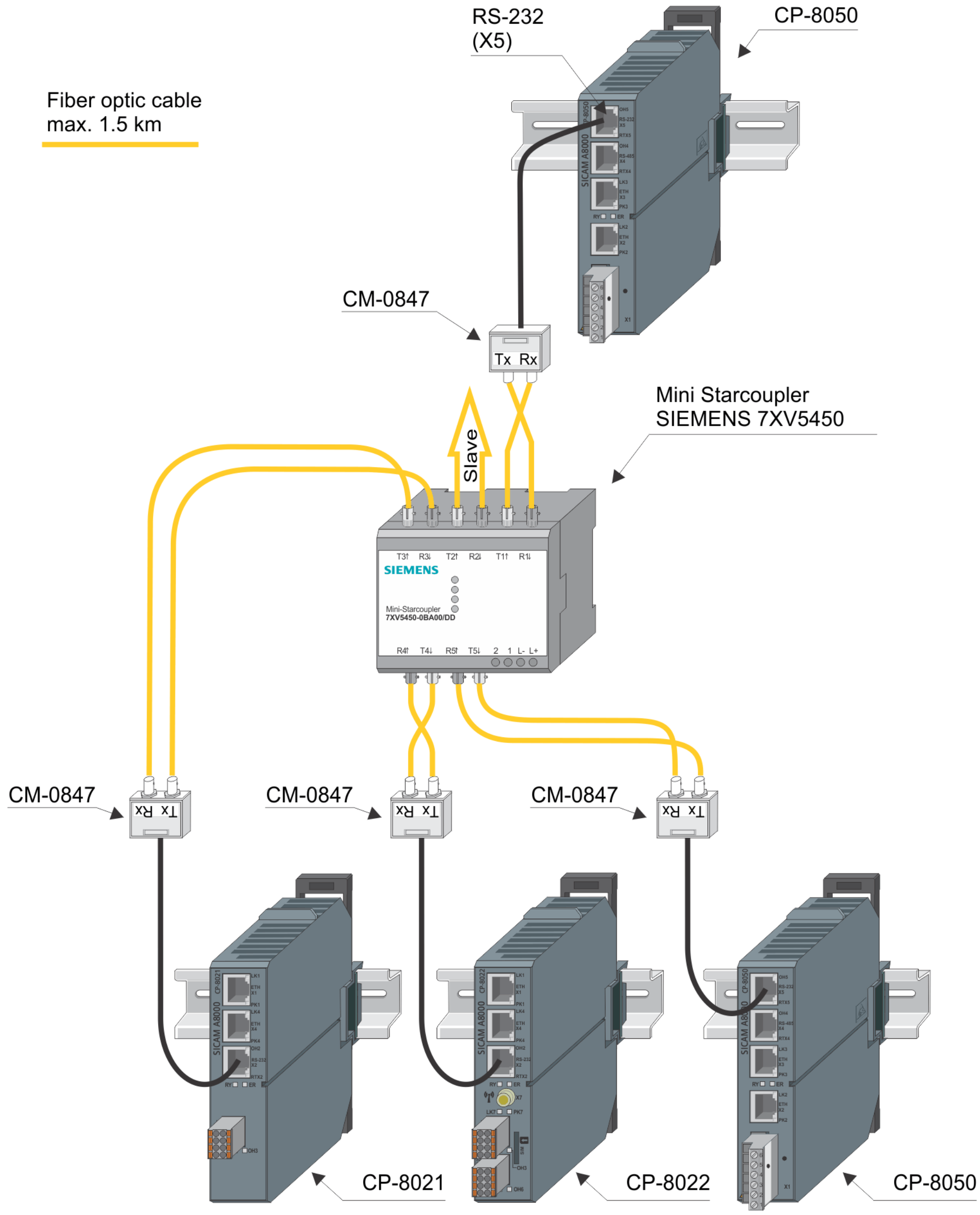
Star configuration with CM-0822 star coupler - singular / redundant master. CP-8050 ↔ CM-0822 optical with RMC 20 RS-232 FO converter



NOTE

- Power supply of CM-0822 with PS-663x.
  (redundant power supply possible)
- A maximum of 6 star coupler (CM-0822) may be attached next to each other.
- Line idle state can be set for each optical interface via DIP switch on the CM-0822.
- Line idle state of the optical interface cannot be set on the RMC20!
- CM-0822 TX3/RX3 for connection to a master or slave.
  CM-0822 TX1/RX1, TX2/RX2, TX4/RX4 for connection to a slave.

Star configuration with star coupler 7XV5450 and CM-0847 to another AE

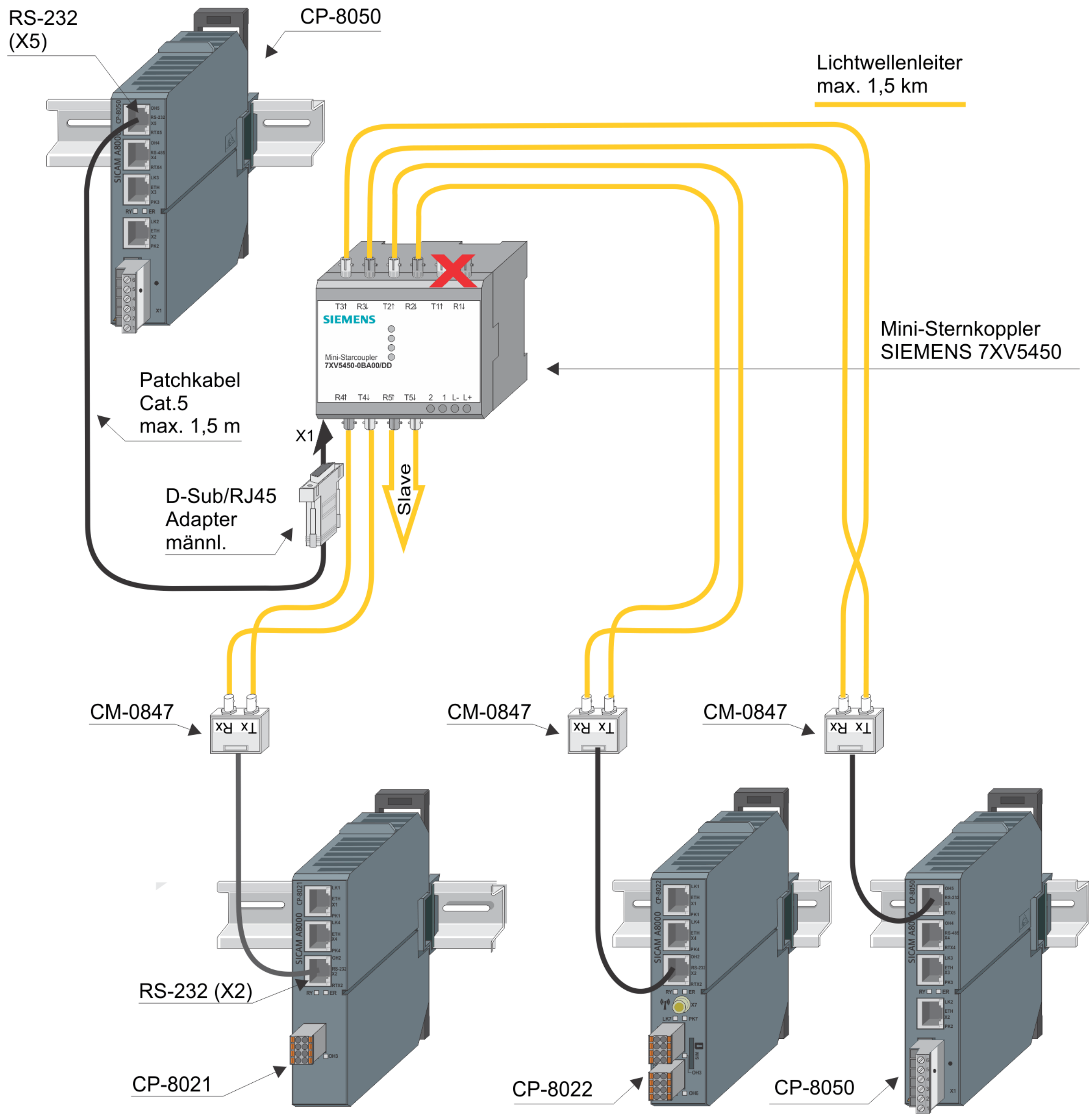


[dw_Com_Setup_Serial_Multi-Point_Opt_Star_Coupl_7XV5450, 2, en_US]

NOTE

- The the mini-star coupler SIEMENS 7XV5450 must be set on all channels to light idle state “OFF” (DIP-Switch), otherwise the communication is blocked for all channels in case of failure or restart of a sub station or defect FO.
- If a channel on of the mini-star coupler SIEMENS 7XV5450 is not used, the light idle state must be set to “OFF” (DIP-Switch), otherwise the communication via the mini star coupler will be blocked for all channels.

Star configuration with star coupler 7XV5450 to another AE

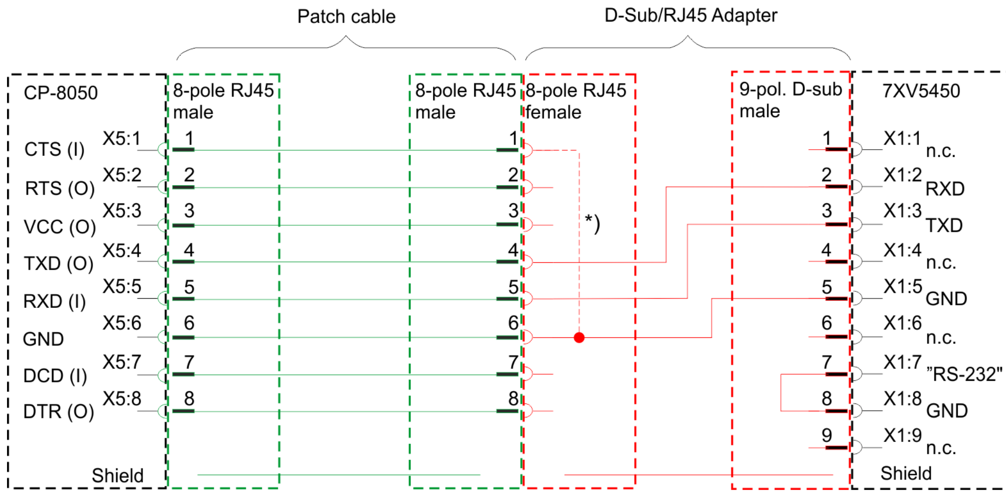


[dw_Com_Setup_Serial_Multi-Point_Opt_Star_Coupl_7XV5450_V2, 3, en_US]

NOTE

- The the mini-star coupler SIEMENS 7XV5450 must be set on all channels to light idle state "OFF" (DIP-Switch), otherwise the communication is blocked for all channels in case of failure or restart of a sub station or defect FO.
- If a channel on of the mini-star coupler SIEMENS 7XV5450 is not used, the light idle state must be set to "OFF" (DIP-Switch), otherwise the communication via the mini star coupler will be blocked for all channels.
- If the mini star coupler SIEMENS 7XV5450 is connected via the RS-232 interface, then the optical interface R1/T1 of the mini star coupler cannot be used.
  On the SIEMENS 7XV5450 mini star coupler, the operating mode must be set with DIP switch S1 to "Data transfer in enhanced mode", "Cascading star topology", "RS-232=ON" and pins 7-8 in the cable of RS-232 interface must be bridged.

Wiring for Connection CP-8050 – star coupler 7XV5450



[Wiring_DSUB_RJ45_Adapter_for_7XV5450, 2, en_US]

NOTE

With a serial connection via X5 interface of CP-8031, CP-8050 a bridge between CTS and GND is required, as far as the interface shall also be used for the connection with the engineering PC.

The CTS status line cannot be used by the protocol!

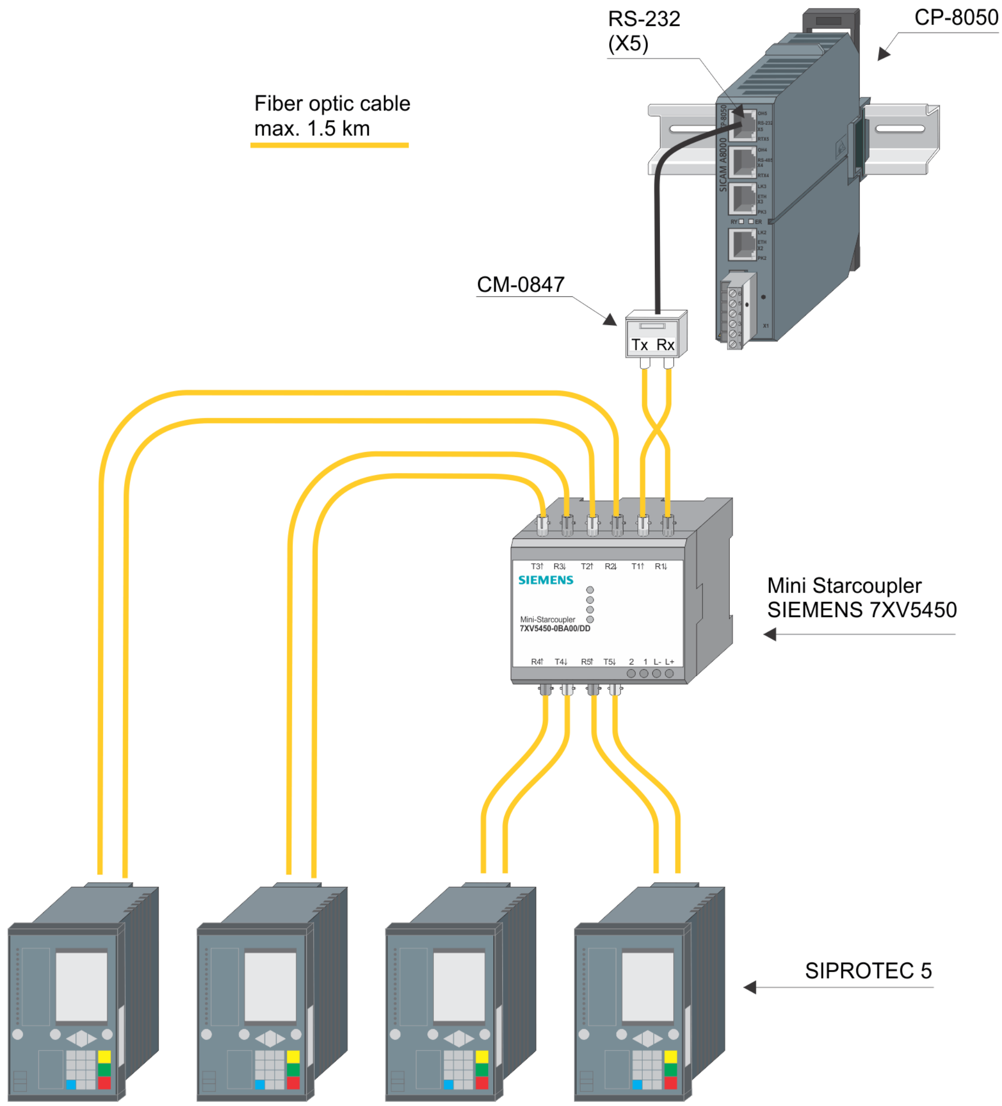
If the interface shall not be used as serial engineering interface, the function can be disabled with the parameter **`Serial engineering interface = disabled`**.

Thereby no connection between CTS and GND is required.

Recommended D-Sub/RJ45 Adapter

RS Pro MHDA9-PMJ8-M-K (see *Recommended third-party products, Page 2186*). This adapter provides a wired RJ45 socket and an unwired D-sub plug (male).

Star configuration with star coupler 7XV5450 to SIPROTEC 5

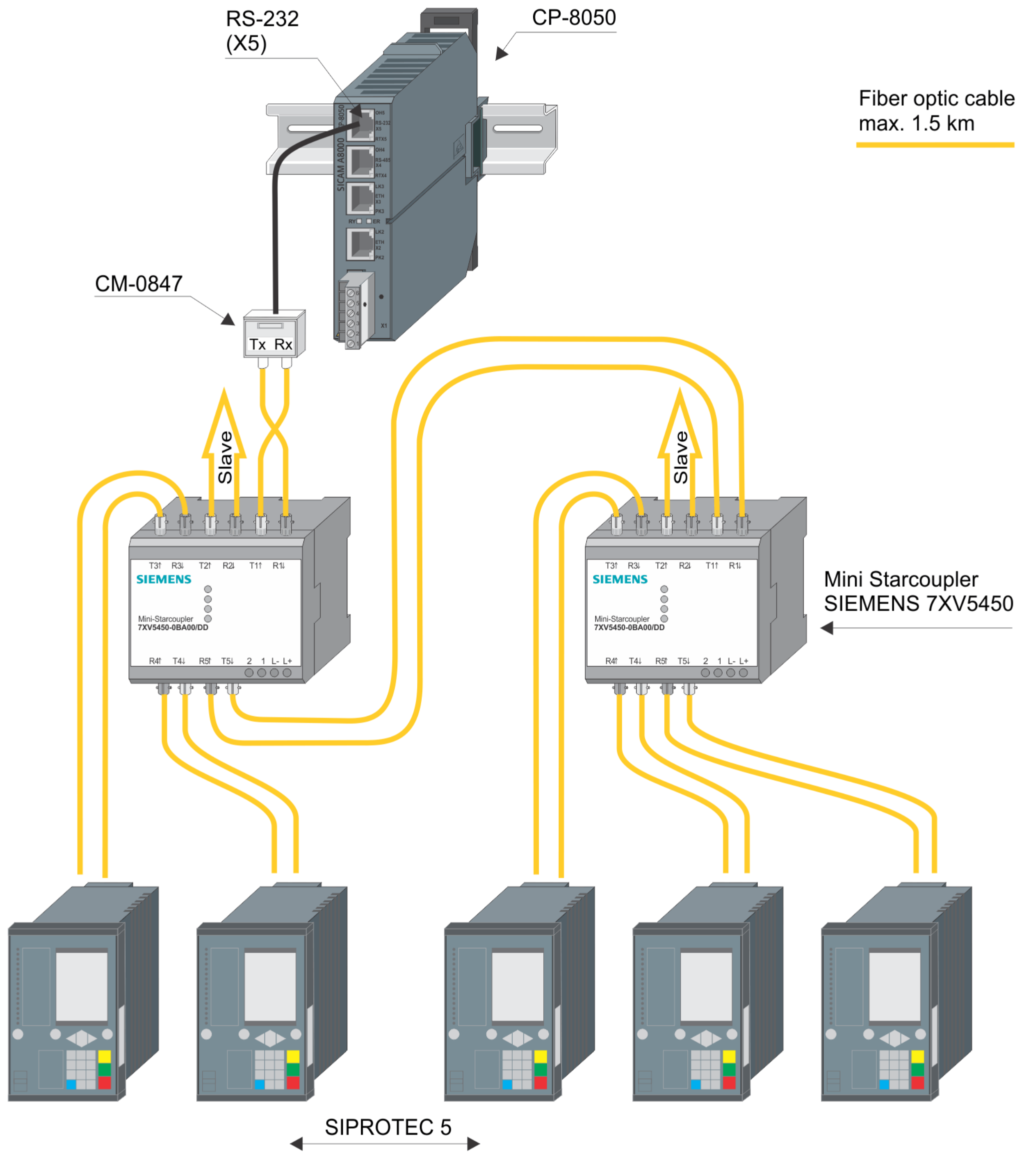


[dw_Com_Setup_Serial_Multi-Point_Opt_Star_Coupl_7XV5450_SIP5, 2, en_US]

NOTE

- No protective device slaves may be connected to the T1/R1 connector of the mini-star coupler Siemens 7XV5450 . T1/R1 is used for connection with the central station or to other star couplers in a star or ring structure.
- The the mini-star coupler SIEMENS 7XV5450 must be set on all channels to light idle state “OFF” (DIP-Switch), otherwise the communication is blocked for all channels in case of failure or restart of a sub station or defect FO.
- If a channel on of the mini-star coupler SIEMENS 7XV5450 is not used, the light idle state must be set to “OFF” (DIP-Switch), otherwise the communication via the mini star coupler will be blocked for all channels.

Connection with star coupler 7XV5450 to SIPROTEC 5 (cascaded in star structure)

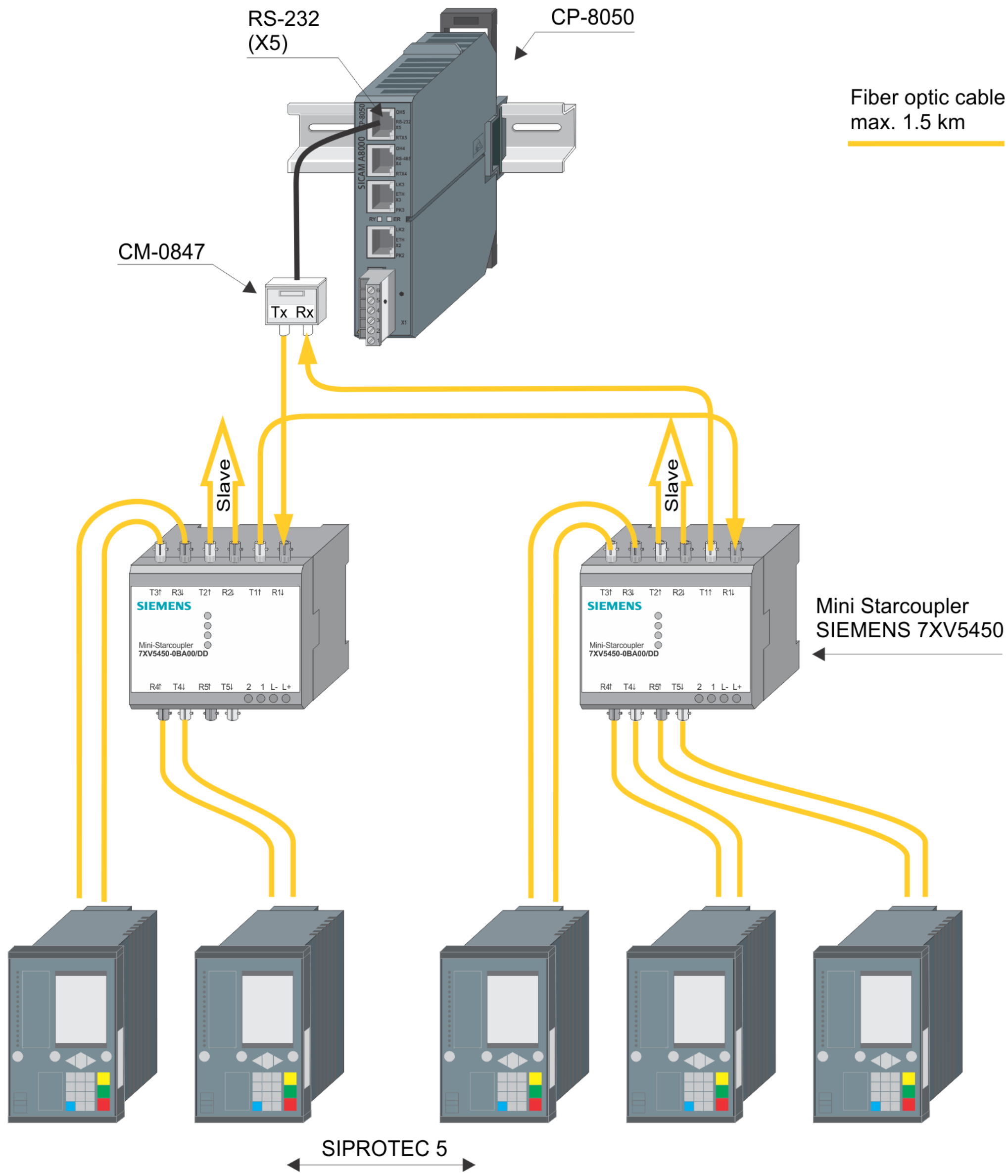


[dw_Com_Setup_Serial_Multi-Point_Opt_Star_Coupl_7XV5450_SIP5_Casc, 2, en_US]

NOTE

- To connect 100 protective devices with mini-star coupler SIEMENS 7XV5450 (cascaded in star structure) 33 mini-star coupler are needed.
  At each of 32 mini-star couplers 3 optical interfaces can be used and on the last mini-star coupler in the star structure 4 optical interfaces can be used to connect protective devices [32*3 + 1*4 = 100]. The other optical interfaces are used for cascading the mini-star coupler. It the master is connected with RS-232 to the mini-star coupler, then one optical interface remains unused.
- No protective device slaves may be connected to the T1/R1 connector of the mini-star coupler Siemens 7XV5450 . T1/R1 is used for connection with the central station or to other star couplers in a star or ring structure.
- The the mini-star coupler SIEMENS 7XV5450 must be set on all channels to light idle state “OFF” (DIP-Switch), otherwise the communication is blocked for all channels in case of failure or restart of a sub station or defect FO.
- If a channel on of the mini-star coupler SIEMENS 7XV5450 is not used, the light idle state must be set to “OFF” (DIP-Switch), otherwise the communication via the mini star coupler will be blocked for all channels.

Connection with star coupler 7XV5450 to SIPROTEC 5 (cascaded in ring structure)



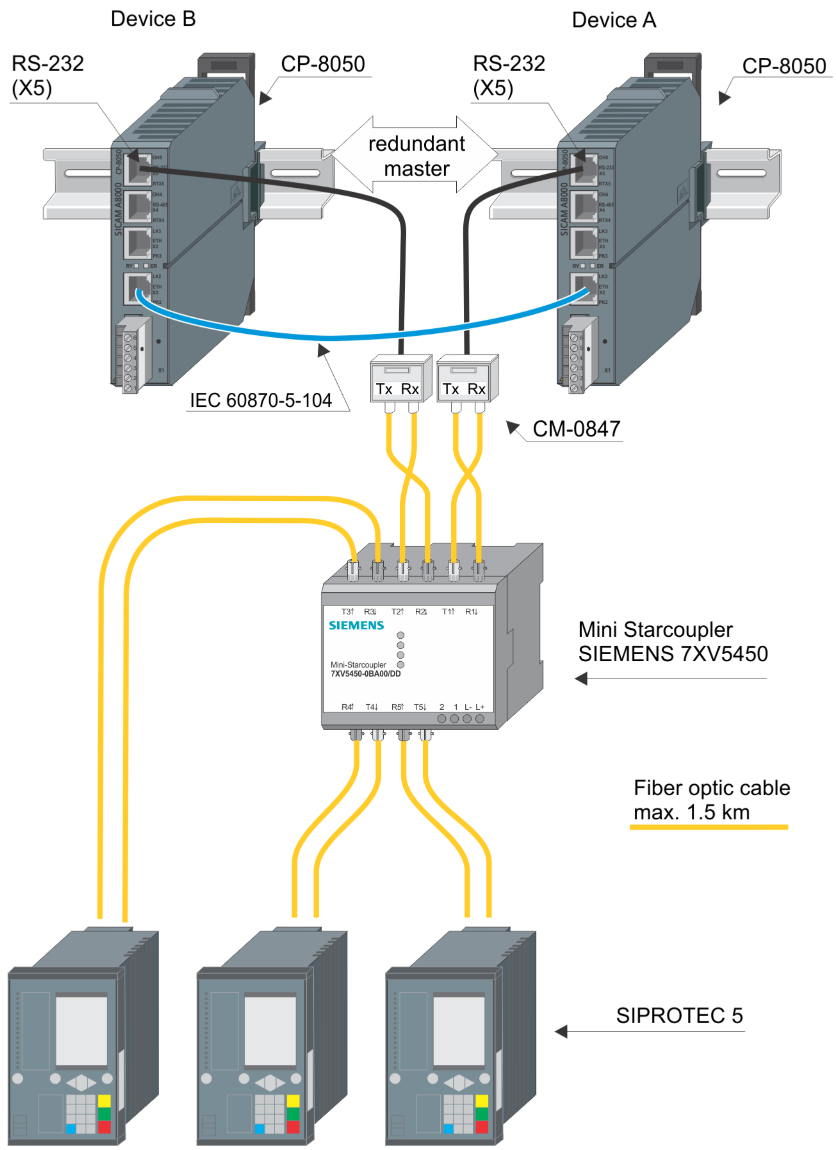
[dw_Com_Setup_Serial_Multi-Point_Opt_Star_Coupl_7XV5450_SIP5_Ring, 2, en_US]

NOTE

- To connect 100 protective devices with mini-star coupler SIEMENS 7XV5450 (cascaded in ring structure) 25 mini-star coupler are needed.

  At each mini-star coupler 4 optical interfaces can be used to connect protective devices [25*4 = 100] - per mini-star coupler one optical interface is used for cascading.
- No protective device slaves may be connected to the T1/R1 connector of the mini-star coupler Siemens 7XV5450 . T1/R1 is used for connection with the central station or to other star couplers in a star or ring structure.
- Redundant master are not supported with SIEMENS 7XV5450 in a cascaded ring structure.
- The the mini-star coupler SIEMENS 7XV5450 must be set on all channels to light idle state “OFF” (DIP-Switch), otherwise the communication is blocked for all channels in case of failure or restart of a sub station or defect FO.
- If a channel on of the mini-star coupler SIEMENS 7XV5450 is not used, the light idle state must be set to “OFF” (DIP-Switch), otherwise the communication via the mini star coupler will be blocked for all channels.

Star configuration with redundant master (2x optical) via star coupler 7XV5450 to SIPROTEC 5

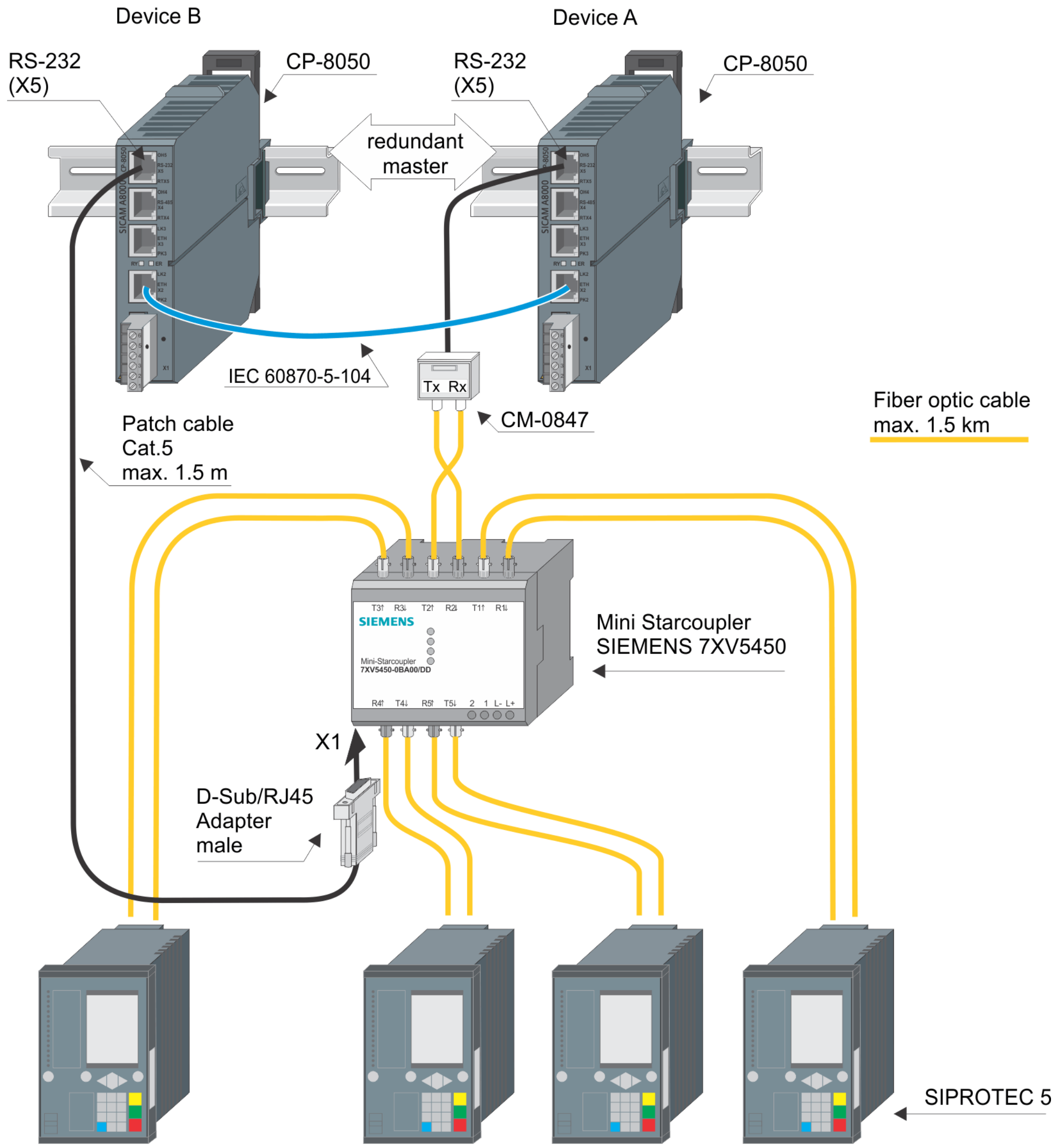


[dw_CP-8050_com_ex_2red_master_2opt_con_7XV5450_sip5, 2, en_US]

NOTE

- For redundant master, the mini star coupler SIEMENS 7XV5450 version 7XV5450-0BA00/**DD**or higher is required.
- The the mini-star coupler SIEMENS 7XV5450 must be set on all channels to light idle state “OFF” (DIP-Switch), otherwise the communication is blocked for all channels in case of failure or restart of a sub station or defect FO.
- If a channel on of the mini-star coupler SIEMENS 7XV5450 is not used, the light idle state must be set to “OFF” (DIP-Switch), otherwise the communication via the mini star coupler will be blocked for all channels.

Star configuration with redundant master (1x optical, 1x RS-232) via star coupler 7XV5450 to SIPROTEC 5

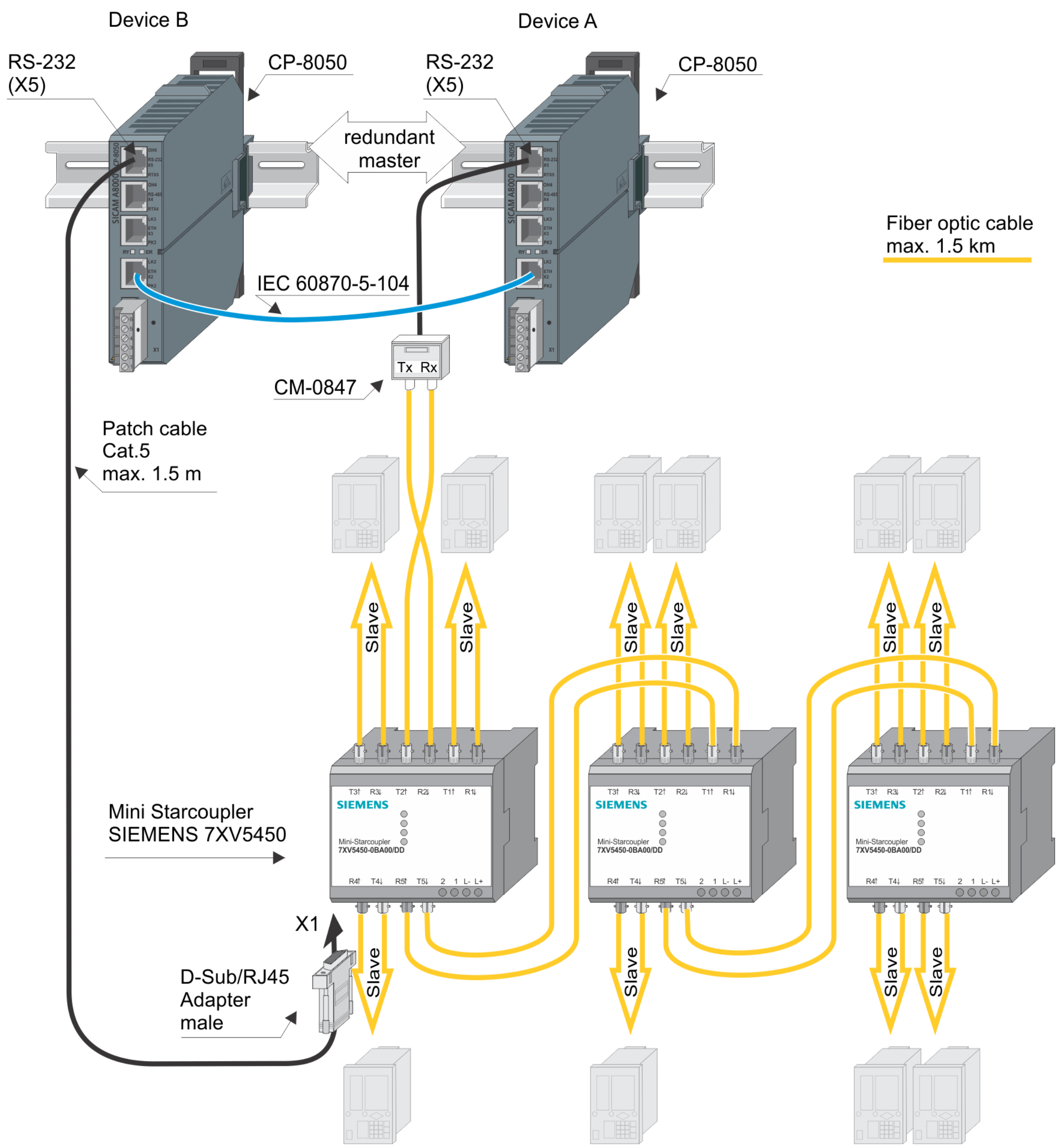


[dw_CP-8050_com_ex_2red_master_1opt_con_1rs232_con_7XV5450_sip5, 2, en_US]

NOTE

- For redundant master, the mini star coupler SIEMENS 7XV5450 version 7XV5450-0BA00/**DD**or higher is required.
- If the master is connected to the SIEMENS 7XV5450 mini star coupler via the RS-232 interface and the “Data transfer in enhanced mode” is set on the mini star coupler, the the optical interface R1/T1 of the mini Star coupler becomes a slave channel and can be used for protection device connection.
- On the SIEMENS 7XV5450 mini star coupler, the operating mode must be set with DIP switch S1 to “Data transfer in enhanced mode”, “Cascading star topology”, “RS-232=ON” and pins 7-8 in the cable of RS-232 interface must be bridged.
- The the mini-star coupler SIEMENS 7XV5450 must be set on all channels to light idle state “OFF” (DIP-Switch), otherwise the communication is blocked for all channels in case of failure or restart of a sub station or defect FO.
- If a channel on of the mini-star coupler SIEMENS 7XV5450 is not used, the light idle state must be set to “OFF” (DIP-Switch), otherwise the communication via the mini star coupler will be blocked for all channels.

Star configuration with redundant master (1x optical, 1x RS-232) via star coupler 7XV5450 to SIPROTEC 5 (cascaded in star structure)

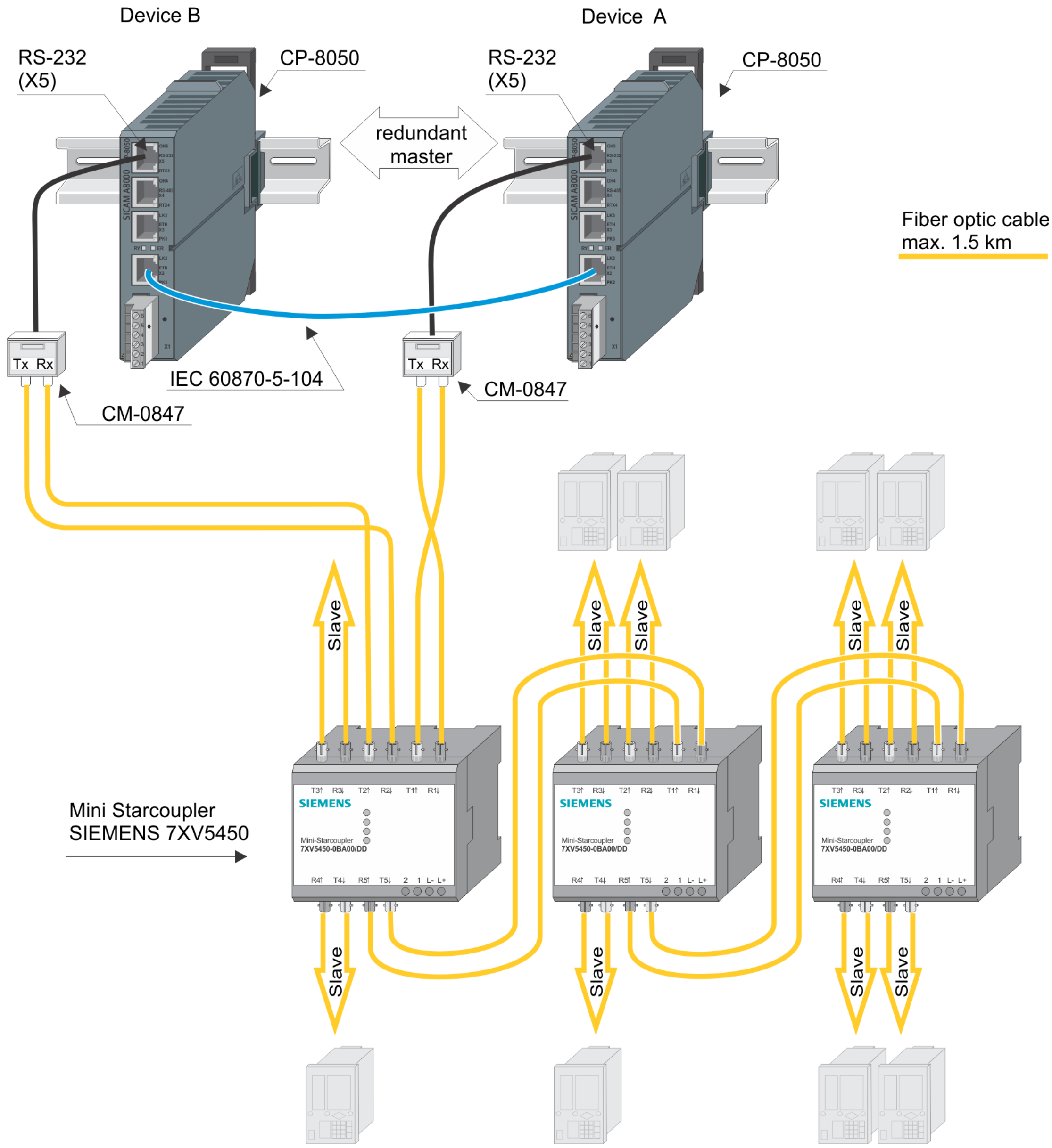


[dw_CP-8050_com_ex_2red_master_1opt_con_1rs232_con_7XV5450_sip5_casc_v1, 2, en_US]

NOTE

- For redundant master, the mini star coupler version 7XV5450-0BA00/**DD**or higher is required.
- The the mini-star coupler SIEMENS 7XV5450 must be set on all channels to light idle state “OFF” (DIP-Switch), otherwise the communication is blocked for all channels in case of failure or restart of a sub station or defect FO.
- If a channel on of the mini-star coupler SIEMENS 7XV5450 is not used, the light idle state must be set to “OFF” (DIP-Switch), otherwise the communication via the mini star coupler will be blocked for all channels.
- If the master is connected to the SIEMENS 7XV5450 mini star coupler via the RS-232 interface and the “Data transfer in enhanced mode” is set on the mini star coupler, the the optical interface R1/T1 of the mini Star coupler becomes a slave channel and can be used for protection device connection.
- Both masters (in Device A, B) must be connected to the same mini star coupler 7XV5450.
- On the mini star coupler 7XV5450 to which the masters are connected (RS-232 and LWL2 as master), the operating mode must be set to “Data transfer in enhanced mode”, “Cascading star topology”, “RS-232 = ON” with the DIP switch S1 and the pins 7-8 must be bridged in the cable of the RS-232 Interfaces interface. For the other 7XV5450 mini star couplers, the operating mode must be set to “Data transfer in compatibility mode (legacy mode)”.

Star configuration with redundant master (2x optical) via star coupler 7XV5450 to SIPROTEC 5 (cascaded in star structure)

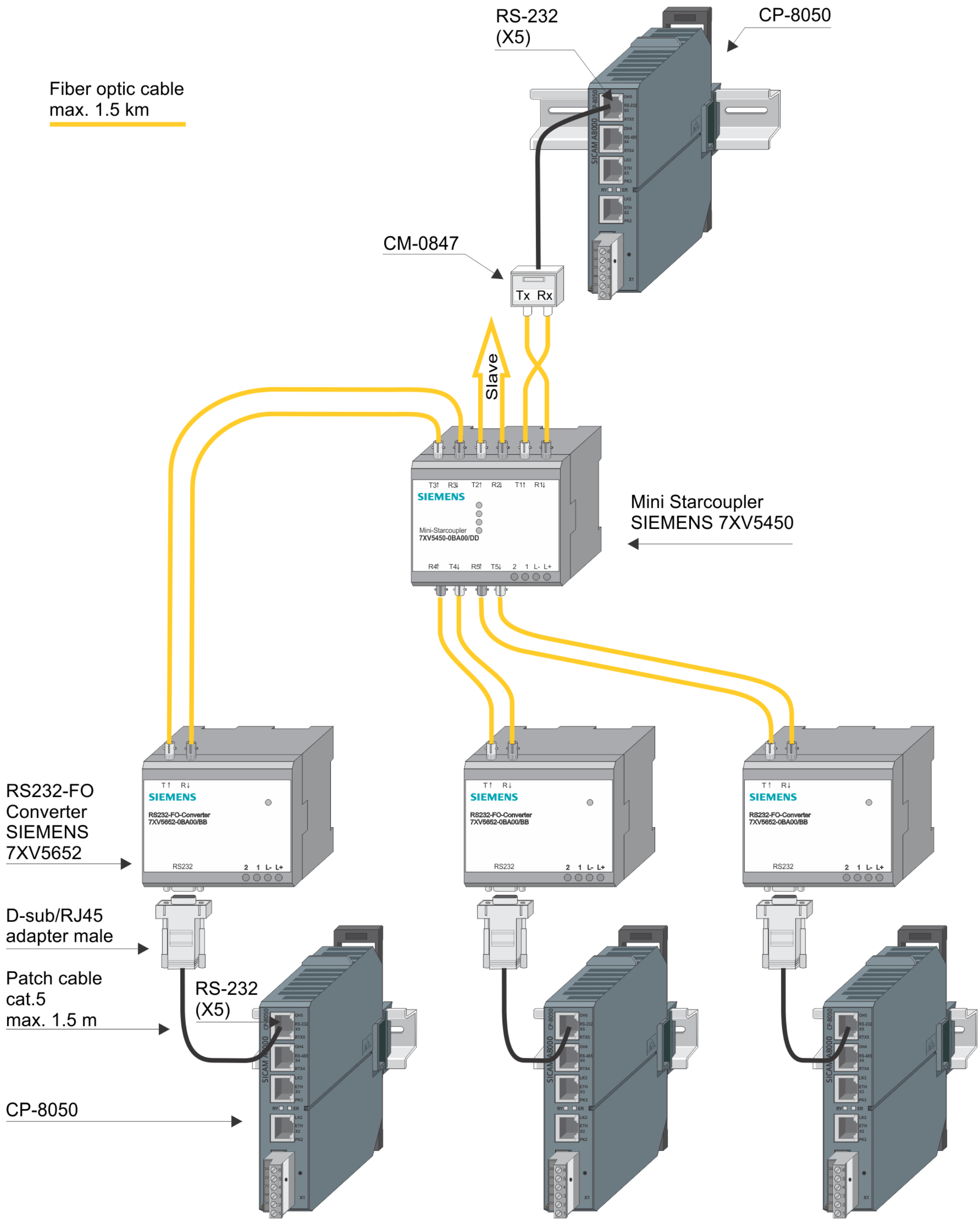


[dw_CP-8050_com_ex_2red_master_2opt_con_7XV5450_sip5_casc_v1, 3, en_US]

NOTE

- For redundant master, the mini star coupler SIEMENS 7XV5450 version 7XV5450-0BA00/**DD**or higher is required.
- The the mini-star coupler SIEMENS 7XV5450 must be set on all channels to light idle state “OFF” (DIP-Switch), otherwise the communication is blocked for all channels in case of failure or restart of a sub station or defect FO.
- If a channel on of the mini-star coupler SIEMENS 7XV5450 is not used, the light idle state must be set to “OFF” (DIP-Switch), otherwise the communication via the mini star coupler will be blocked for all channels.
- On the 7XV5450 mini star coupler to which the masters are connected (RS-232 and LWL2 as master), the operating mode must be set to ”Data transfer in enhanced mode” using DIP switch S1. For the other 7XV5450 mini star couplers, the operating mode must be set to “Compatibility mode (legacy mode)”.
- Both masters (in Device A, B) must be connected to the same mini star coupler 7XV5450.

Star configuration via star coupler 7XV5450 and converter 7XV5652 to another AE

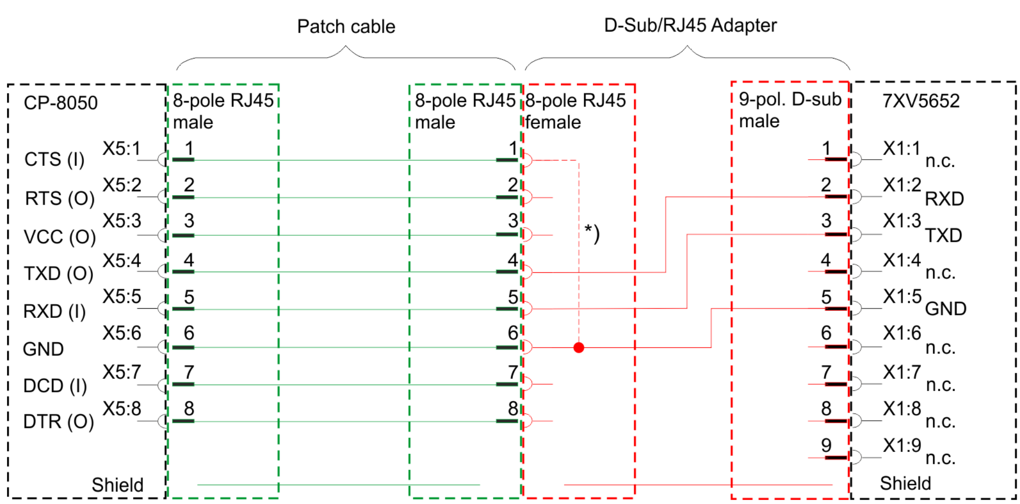


[dw_Com_Setup_Serial_Multi-Point_Opt_Star_Coupl_Converter, 2, en_US]

NOTE

- This configuration with converters is given when, for example, the customer provides the complete infrastructure for the communication. Alternatively, a CM-0847 can be used in the substations instead of the optical converter RS232/FO 7XV56529.
- The the mini-star coupler SIEMENS 7XV5450 must be set on all channels to light idle state “OFF” (DIP-Switch), otherwise the communication is blocked for all channels in case of failure or restart of a sub station or defect FO.
- If a channel on of the mini-star coupler SIEMENS 7XV5450 is not used, the light idle state must be set to “OFF” (DIP-Switch), otherwise the communication via the mini star coupler will be blocked for all channels.

Wiring for Connection CP-8050 – Converter 7XV5652



[Wiring_DSUB_RJ45_Adapter_for_7XV5652, 2, en_US]

NOTE

With a serial connection via X5 interface of CP-8031, CP-8050 a bridge between CTS and GND is required, as far as the interface shall also be used for the connection with the engineering PC.

The CTS status line cannot be used by the protocol!

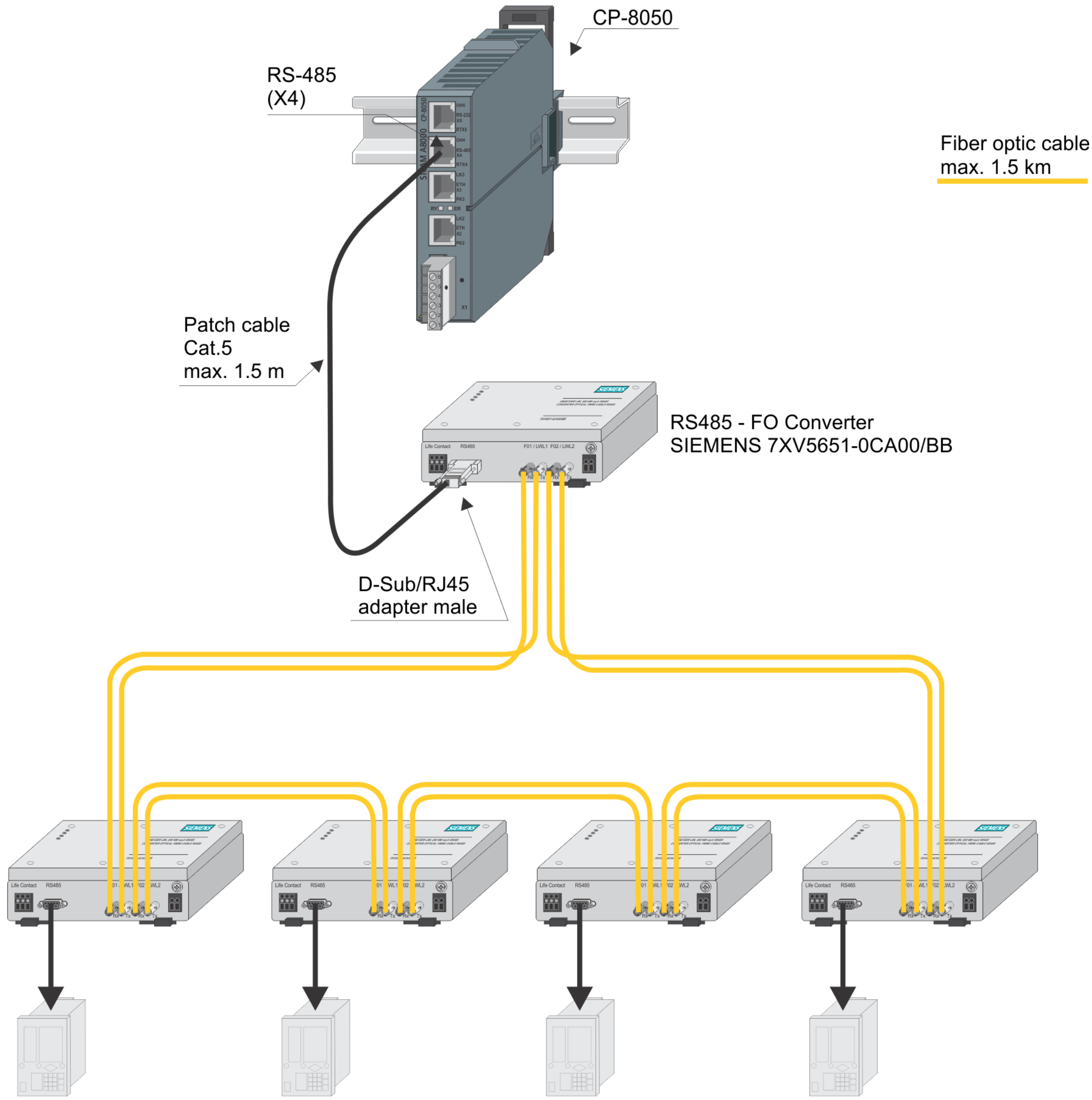
If the interface shall not be used as serial engineering interface, the function can be disabled with the parameter `Serial engineering interface = disabled`.

Thereby no connection between CTS and GND is required.

Recommended D-Sub/RJ45 Adapter

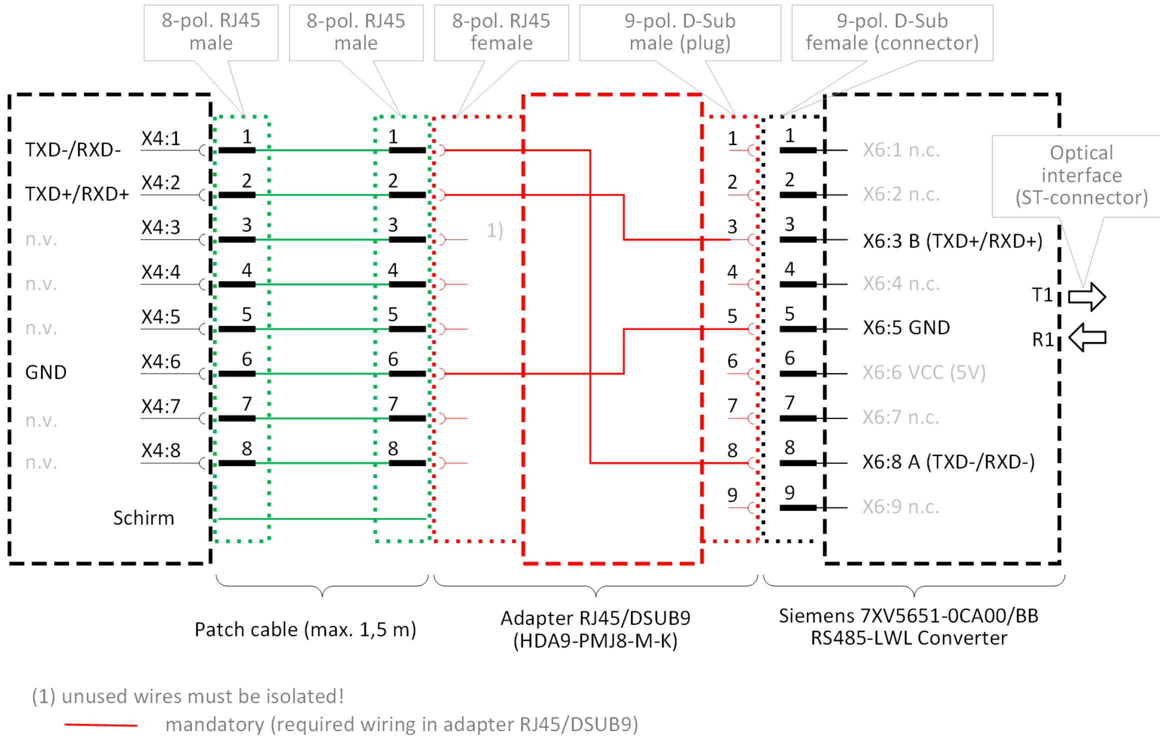
RS Pro MHDA9-PMJ8-M-K (see *Recommended third-party products, Page 2186*). This adapter provides a wired RJ45 socket and an unwired D-sub plug (male).

Ring configuration with converter 7XV5651-0CA00/BB to SIPROTEC 5



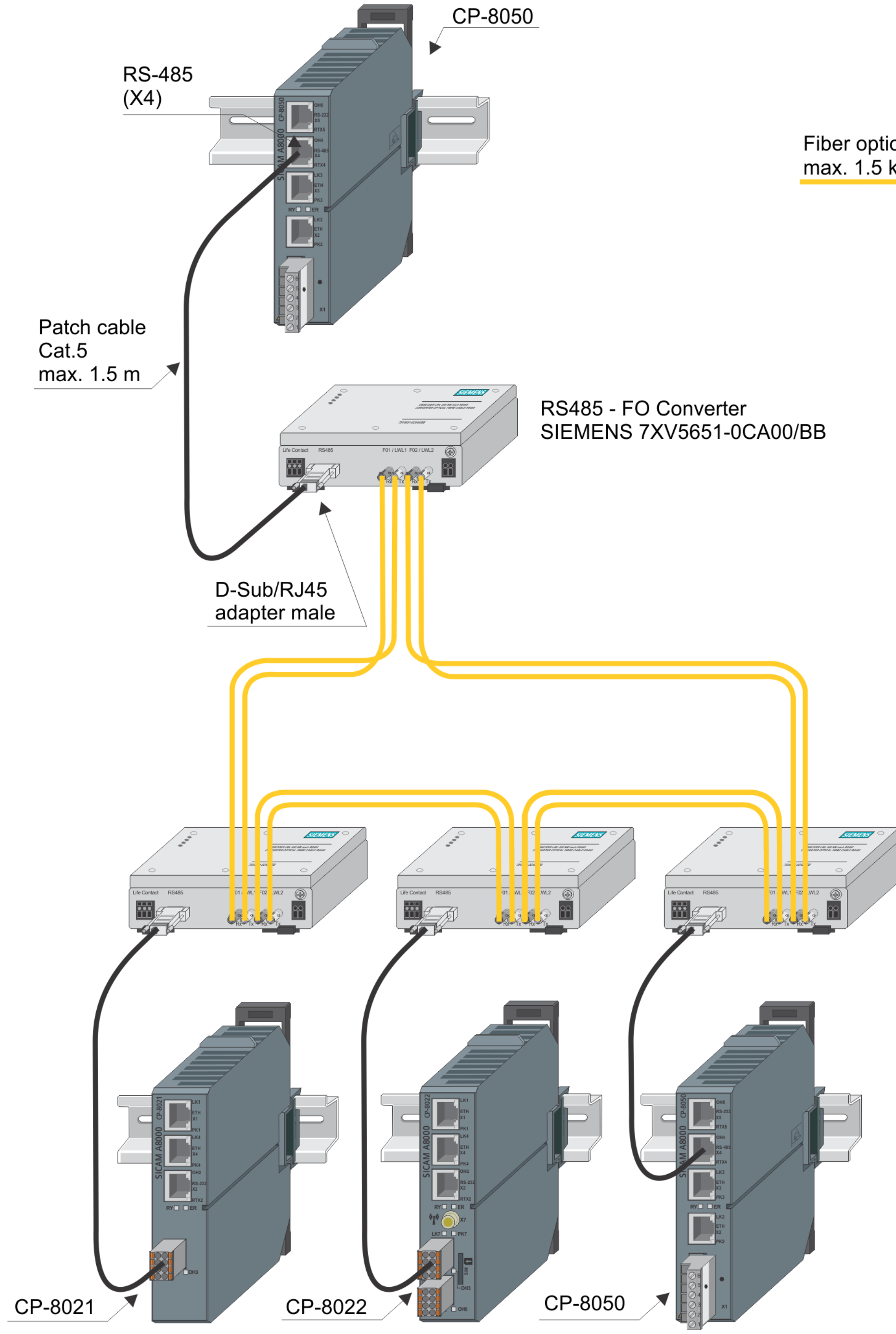
[dw_Comm_Setup_Ring_Conv_7XV5651_SIP5, 2, en_US]

Circuitry for connection CP-8050 – Converter 7XV5651-0CA00/BB (9 pol. Sub-D connector to 7XV5651)



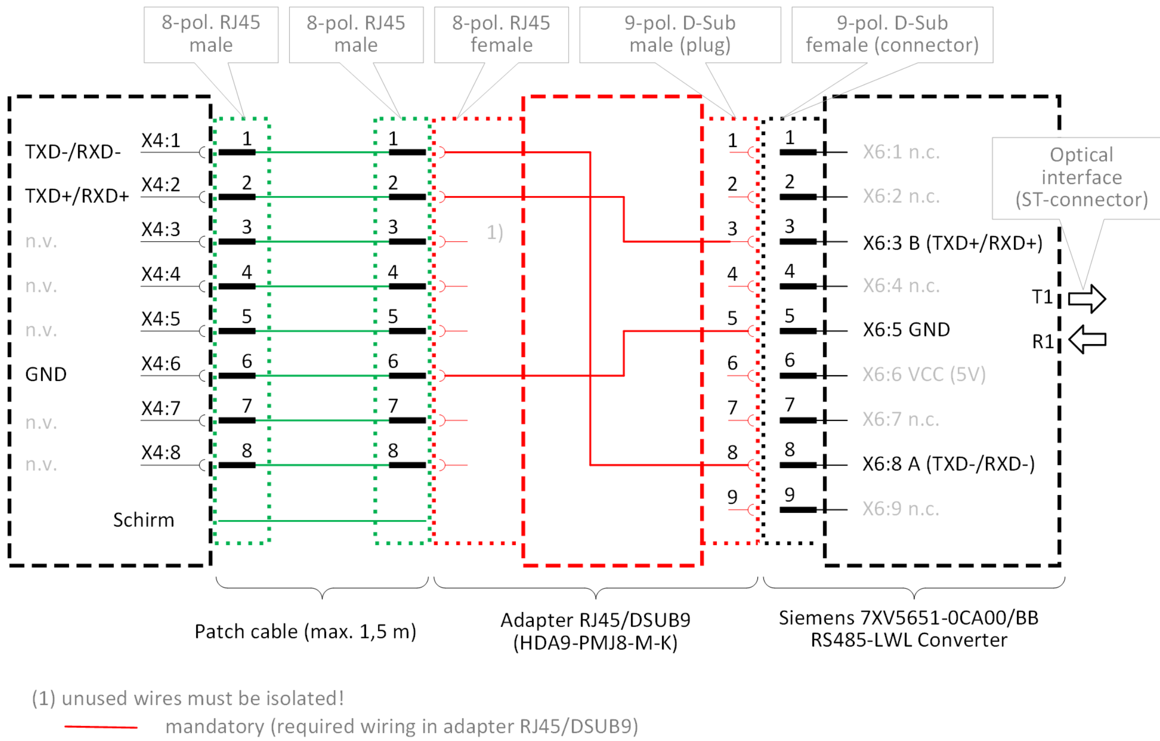
[dw_wiring_CP-8050_RS485_LWL_DSUB9_7XV5651, 2, en_US]

Ring configuration with converter 7XV5651-0CA00/BB to SICAM A8000



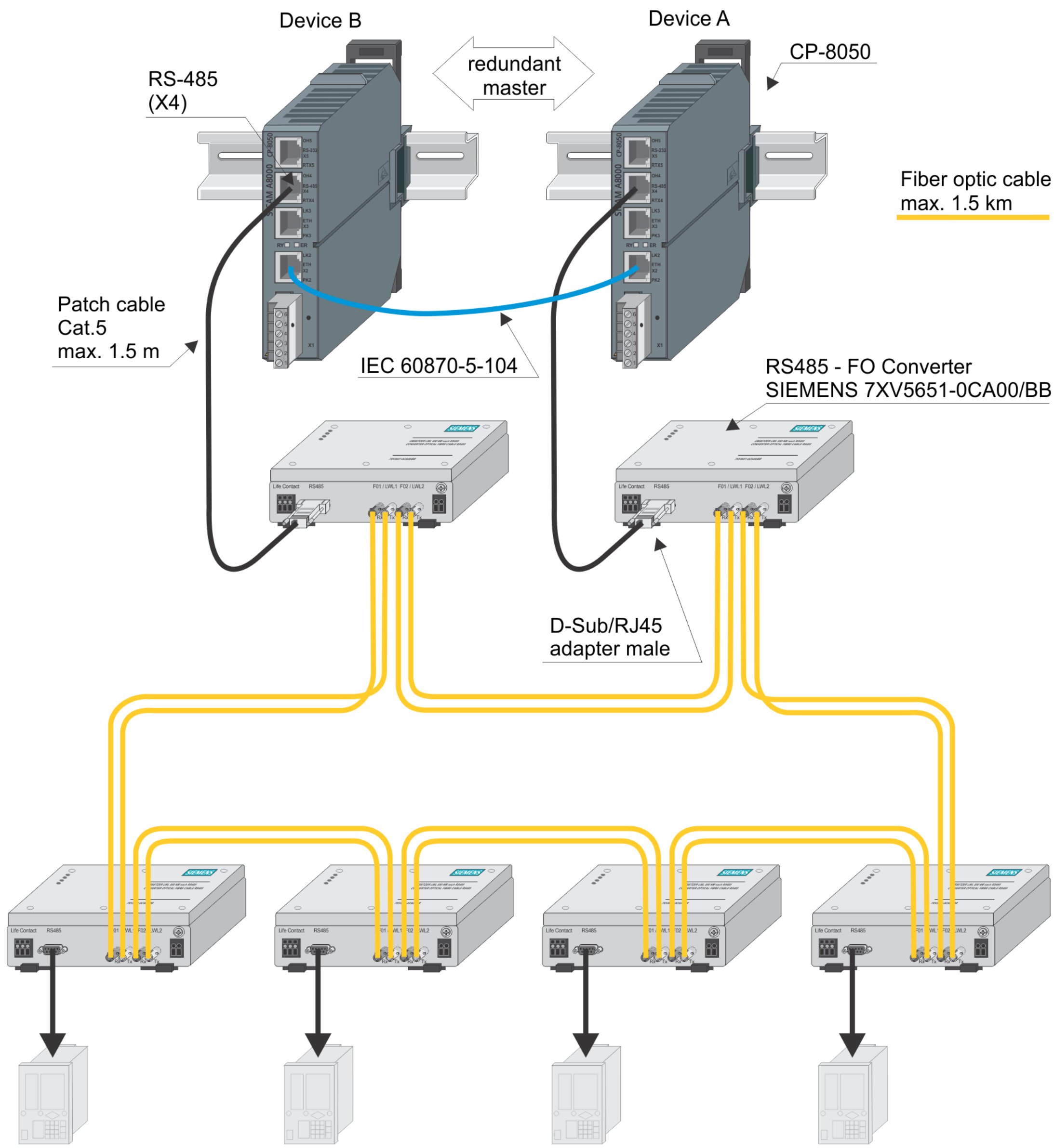
[dw_Comm_Setup_Ring_Conv_7XV5651_SIC_A8000, 2, en_US]

Wiring for Connection CP-8050 – Converter 7XV5651-0CA00/BB



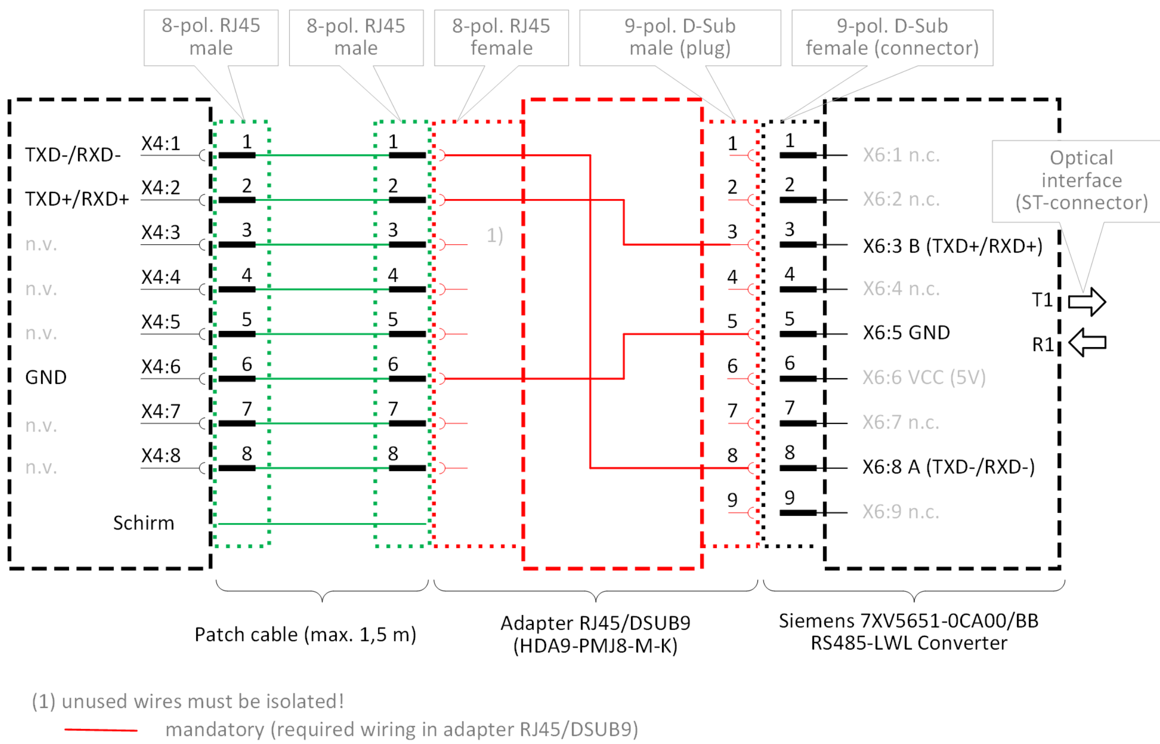
[dw_wiring_CP-8050_RS485_LWL_DSUB9_7XV5651, 2, en_US]

Ring configuration with redundant master with converter 7XV5651-0CA00/BB to SIPROTEC 5



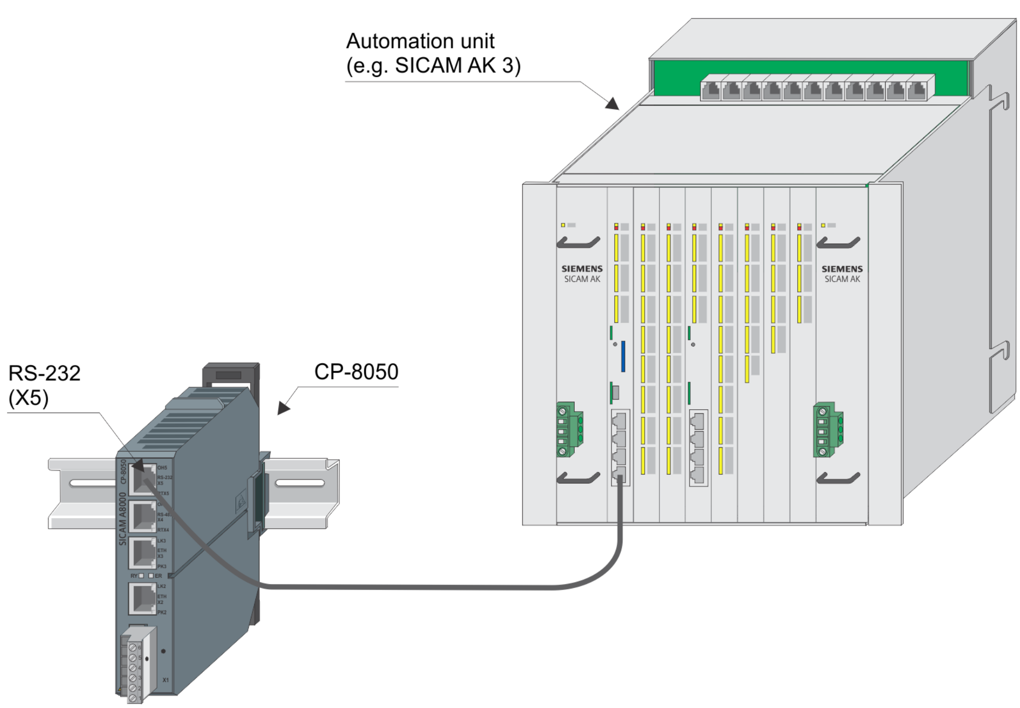
[dw_Comm_Setup_Ring_Red_Master_Conv_7XV5651_SIP5, 2, en_US]

Wiring for Connection CP-8050 – Converter 7XV5651-0CA00/BB



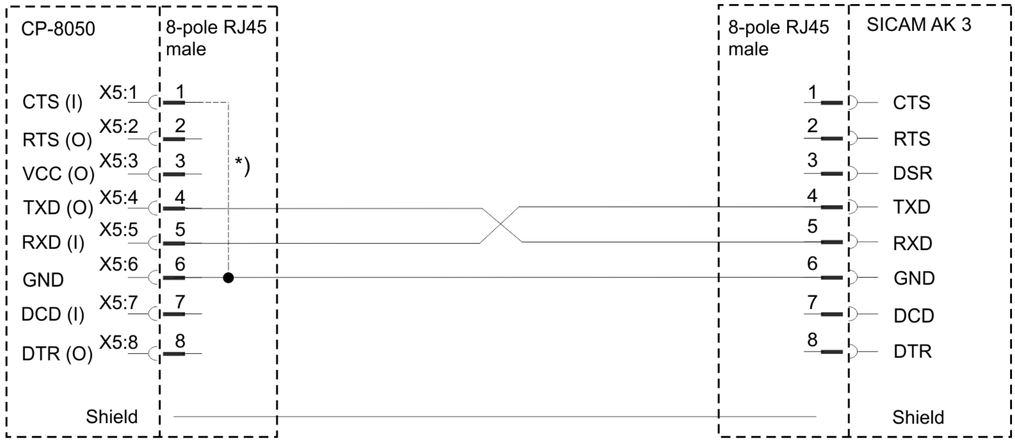
[dw_wiring_CP-8050_RS485_LWL_DSUB9_7XV5651, 2, en_US]

6.12.1.7 Direct RS-232 connection to other automation unit (AU)



[Communication_Setup_Serial_Direct_RS232_with_AU, 1, en_US]

Wiring for Connection with SICAM AK 3



[Wiring_P2P_with_AK3, 1, en_US]

NOTE

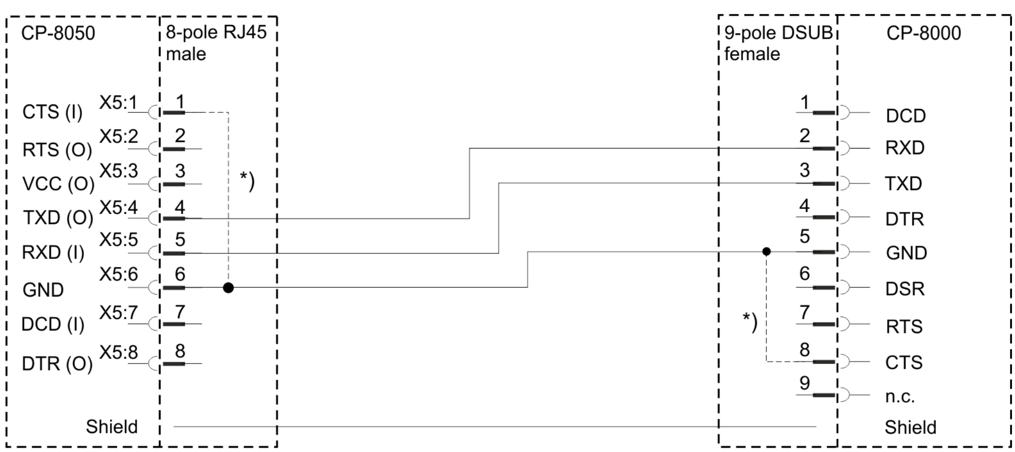
With a serial connection via X5 interface of CP-8031, CP-8050 a bridge between CTS and GND is required, as far as the interface shall also be used for the connection with the engineering PC.

The CTS status line cannot be used by the protocol!

If the interface shall not be used as serial engineering interface, the function can be disabled with the parameter **`Serial engineering interface = disabled`**.

Thereby no connection between CTS and GND is required.

Wiring for Connection with SICAM CP-8000



[Wiring_P2P_with_CP-8000, 1, en_US]

NOTE

With a serial connection via X5 interface of CP-8031, CP-8050 a bridge between CTS and GND is required, as far as the interface shall also be used for the connection with the engineering PC.

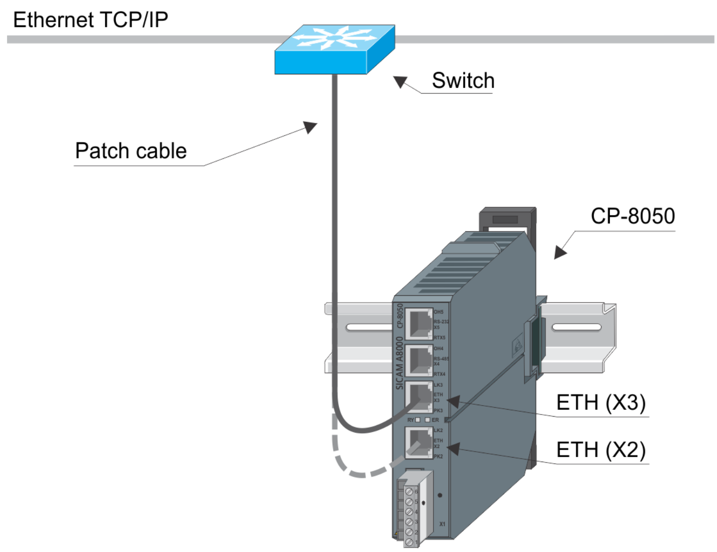
The CTS status line cannot be used by the protocol!

If the interface shall not be used as serial engineering interface, the function can be disabled with the parameter **`Serial engineering interface = disabled`**.

Thereby no connection between CTS and GND is required.

6.12.2 Ethernet TCP/IP

6.12.2.1 Communication via LAN/WAN

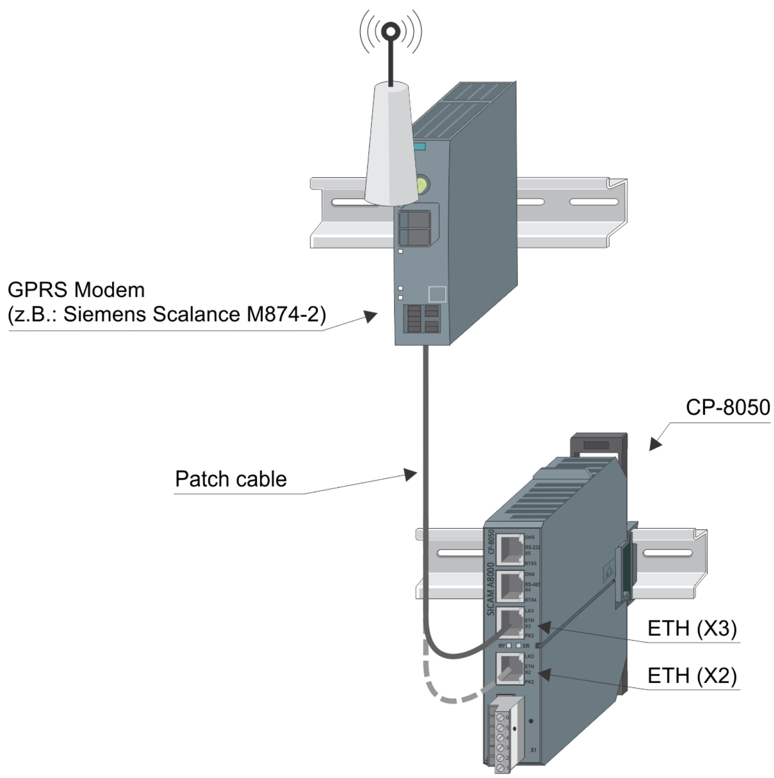


[Communication_Setup_Ethernet_LAN, 1, en_US]

NOTE

Depending whether a connection is done inside or outside of cabinets, different types of patch cables must be used.

6.12.2.2 Communicaton via GPRS



[Communication_Setup_Ethernet_GPRS, 1, en_US]

7 Redundancy

NOTE

Only CP-8050 devices can be implemented redundant. However, the CP-8031 can be used as an external voter.

7.1 Overview

To increase availability the CP-8050 system offers redundancy operation. The variety of use cases leads to lots of different configurations. This chapter gives an overview and shows their advantages and disadvantages.

CP-8050 supports device redundancy. In this case two devices with the same functionality exist. The following types are distinguished:

- Global Redundancy

  In this case a CP-8050 device pair is operated in the way, that one is active and the other one is passive. It is thereby possible to synchronize singular remote A8000 I/Os and/or redundant PLC applications via Ethernet based I/O bus ring (EbIO bus).

- Protocol-selective Redundancy

  With this type of redundancy, not all the devices are switched, but only individual protocols. Connections to substations or SCADA systems can be switched independently between the redundant devices. Especially in data node configurations the permanent reachability of the substations can be increased. An operation of singular A8000 I/Os is possible under certain preconditions but not recommended.

  (for example: When using the protocol-selective redundancy switch, singular I/Os may only be operated on CPCI85. This means that no SICAM A8000 Rack I/O modules are possible in this configuration.)

Each kind of redundant configuration is defined by two fundamental features, which can be applied in different ways. That's why they must be considered right from the beginning in the concept phase. The two features are:

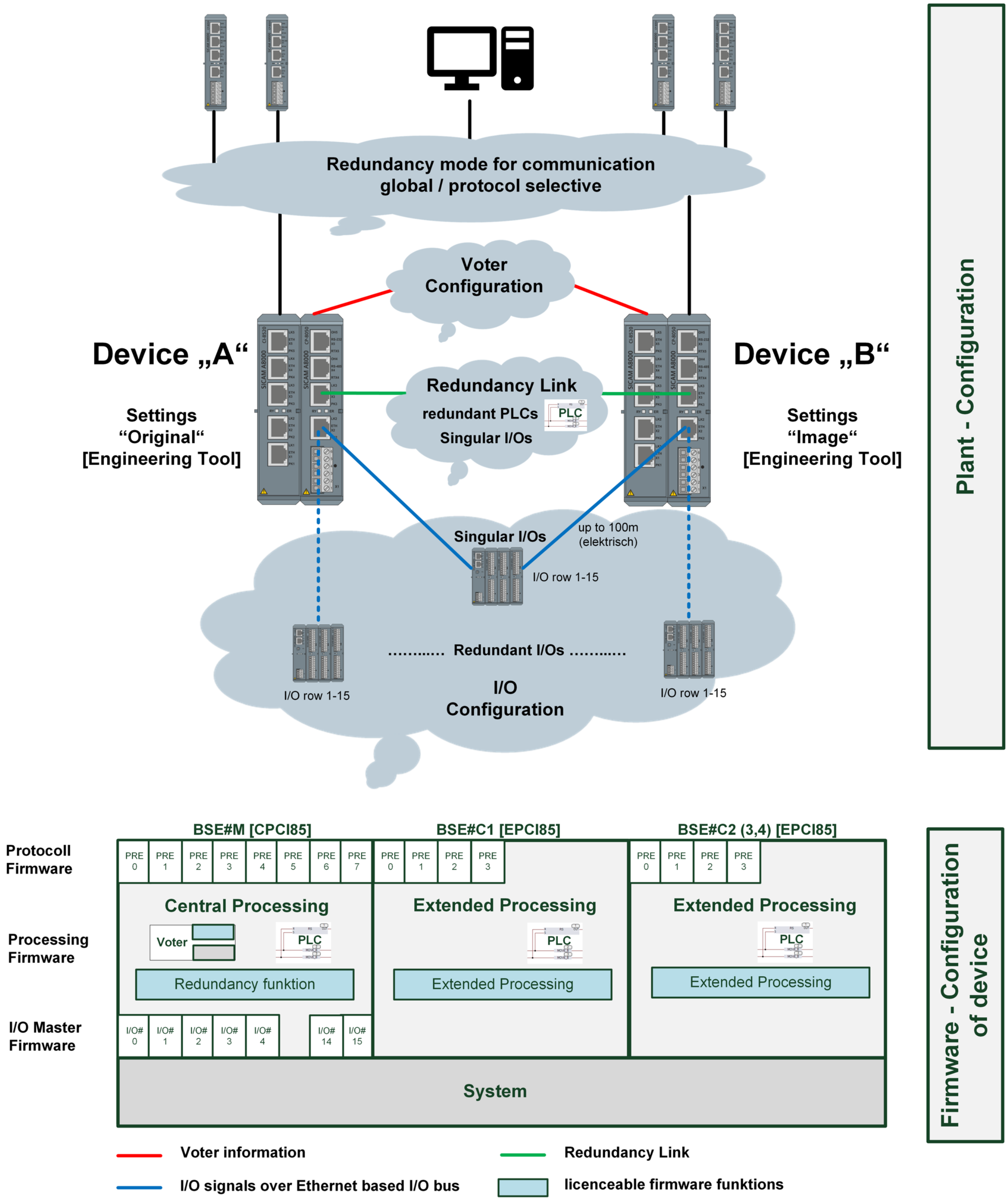
- Redundancy-switchover by voting function

  The voting function is integrated in the CP-8050 firmware. That means that the devices decide about a global active/passive switch-over (global redundancy) or protocol switch-over (protocol-selective Redundancy) based on a voter-table. You can choose between "internal" or "external" voting. If the redundant device-pair exchanges voting information among themselves and decides about switchover on their own, this is called "internal voting". This kind of voting is preferred if singular A8000 I/Os are operated in an EbIO-bus ring configuration. If, in addition to the redundant device pair, a third instance shall make the voting decision, a third CP-8050 can also be used. This occurs as an "external voter" to switch the device pair active/passive (global redundancy) or only individual protocols thereof (protocol-selective redundancy). The external voter can also be redundant, which requires a fourth CP-8050.

- The possible synchronization of the data via the redundancy link

  The redundancy link can either be established via the encrypted EbIO bus or via a routed network. Crucial for the type of medium is mainly whether singular A8000 I/Os shall be used or not. If this is the case, the I/O signals must be synchronized anyway via the EbIO bus. This also makes it possible to synchronize the PLC application and to exchange the voting information via the EbIO bus. The synchronization of data via routed IP network is mainly useful if there are large distances between the redundant devices and a dedicated synchronization link is not available or cannot be established. With large distances between the redundant devices, it should be noted that singular A8000 I/Os cannot be used due to the distances between the individual I/O rows. Here, a data supply from the substations to both redundant devices should be done, which may then be processed in a PLC application. This could in turn be synchronized over the network.

The following figure shows an overview of the possible system configurations or hardware and firmware configurations offered by the CP-8050 system.



[dw_Redundancy_Overview-Architecture, 1, en_US]

7.1.1 Basic Decisions

To provide a decision-making basis that makes it easier to select the appropriate configuration, here is a summary of the most important questions:

- Should individual connections to substations or SCADA systems be switched over or is the entire device always switched over? (global or protocol-selective redundancy?)
- Is a redundant PLC application required, which should also be synchronized between the devices? (Redundancy link or not?)

- Which I/O configuration is intended to be used? (singular or redundant SICAM A8000 I/Os?)
- Does a network connection exist between the redundant devices? (Redundancy link via IP network or EbIO bus)
- Should a third/fourth instance make the voting decision or should the function be covered by the redundant device pair. (internal or external voting?)

7.1.2 Preferred Configurations

Based on the answers to these questions it is easier to find your way through the related chapters. You will also notice, that not all combinations of possibilities do make sense. That's why the following chapters focus on preferred configurations.

Table 7-1 There are different requirements for the various fields of application and thus also different preferred configurations:

Preferred configuration for ...	Power plant & tunnel automation	Data nodes	
A8000 I/Os	Singular within EbIO Bus Ring	No or redundant	No or redundant
Redundancy Type	Global	Global	Protocol-Selective
Redundant PLC application	Yes	Yes	Not recommended [82]
Redundancy Link / Synchronization	EbIO-Bus Ring	IP network	No
Redundancy Switchover/ Voting	Internal	Internal/external	Internal/external

7.1.3 Redundancy Function

Function	Global Switch Over	Protocol-selective switch-over	Protocol-selective with applicative voting
Device redundancy	yes	yes	Applicative
Redundant PLC application	possible	limited possible	No
Synchronization singular I/Os	possible	limited possible[83]	No
Voting	automatic	automatic	Applicative
Engineering Tool Parameter update (Copy Mirror Parameters)	yes	yes	no

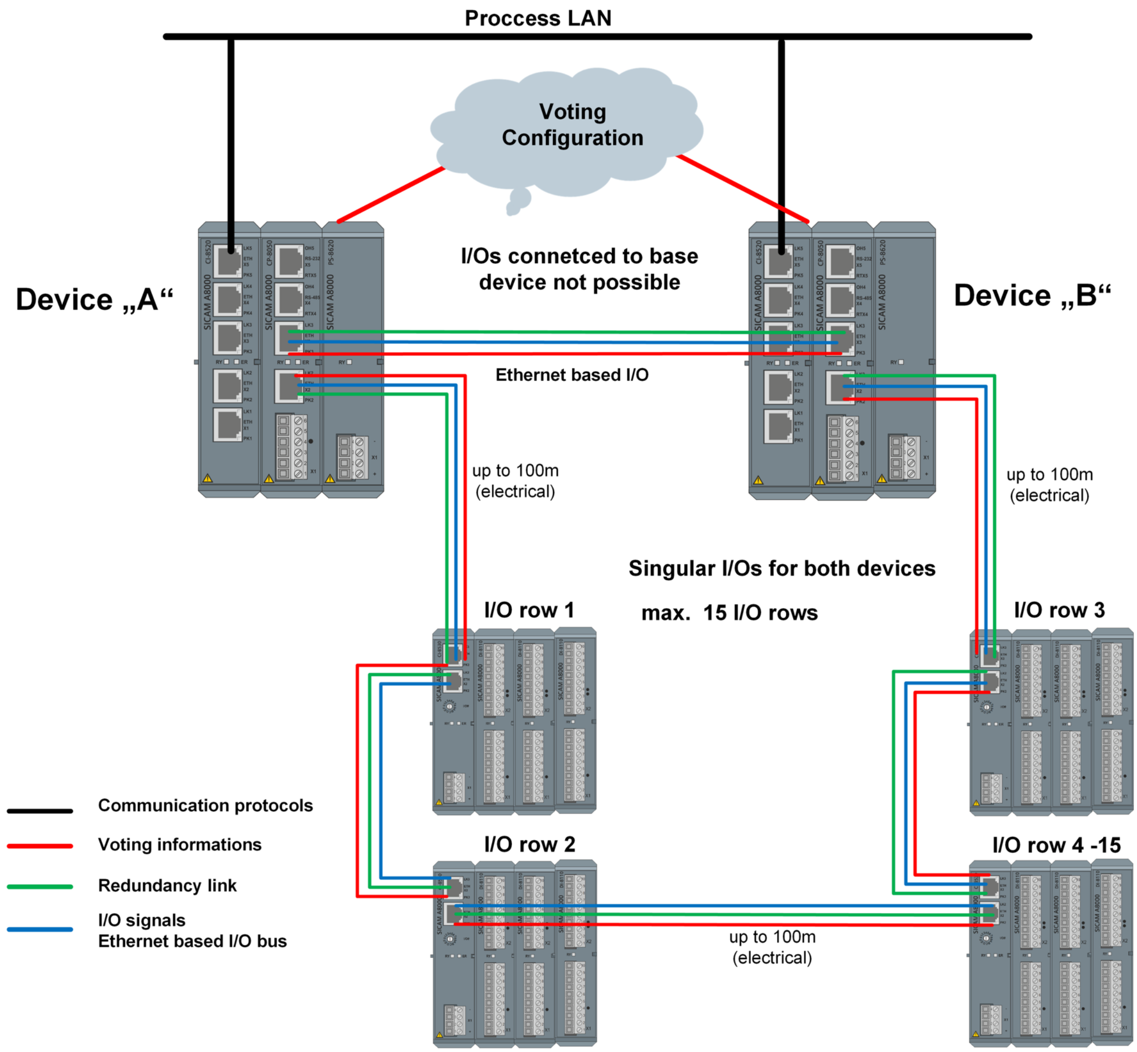
82 If it is ensured, that the PLC application does not use data points which are provided from protocols which shall be switched over selective, it can run on a redundant processing firmware. If this is not the case, it cannot be ensured that the PLC application is constantly supplied with all necessary data points via active connections.

83 When using the protocol-selective redundancy switch, singular I/Os may only be operated on CPCI85. This means that no SICAM A8000 Rack I/O modules are possible in this configuration.

7.2 I/O Configurations

7.2.1 Redundant Devices with singular "I/Os" [Ring configuration]

In this configuration, the I/O modules are physically installed only once and communicate with redundant devices via the EbIO bus. The active device communicates with the I/O rows and the installed I/O modules. The passive device receives the information via the EbIO bus in listening mode. The EbIO bus is in ring configuration what means that if a connection between the I/O rows fails (can also be between the two CP-8050 modules), full functionality is maintained.



[dw_Redundancy_Configurations-Red_sing_IO_ring, 1, en_US]

The following points should be noted with this configuration:

- Up to 15 remote I/O rows are possible
- The installation of I/O modules on the local row of the CP-8050 is not possible. However, the local row is needed to monitor the power supplies (that means, IOMI85 must be installed for row 0)
- The I/O modules AI-851x cannot be used with this type of I/O configuration
- Connector X2 of the CP-8050 device A must be connected to an I/O row. The ring must be closed across all I/O rows and then connected to connector X2 of the CP-8050 device B. The two CP-8050 must be connected via connector X3.

- The EbIO bus must be configured to ring
- If the redundancy link is configured to "Ethernet based I/O" and the "Internal Voter" is used, the I/O ring is also used automatically for the voter. Due to the ring topology, the voter has two communication channels in this case and no further voting connection needs to be defined.
- In the case of a redundant PLC application, redundant channels are also available for this synchronization
- The synchronization channel is encrypted as with the via Ethernet connected remote I/Os.
- The parameter **Redundancy | BSE settings | Priority I/O failure** should be set to **not used**, since a failure of a single I/O module is recognized in most cases on both devices and otherwise there may be an unnecessary redundancy switch.

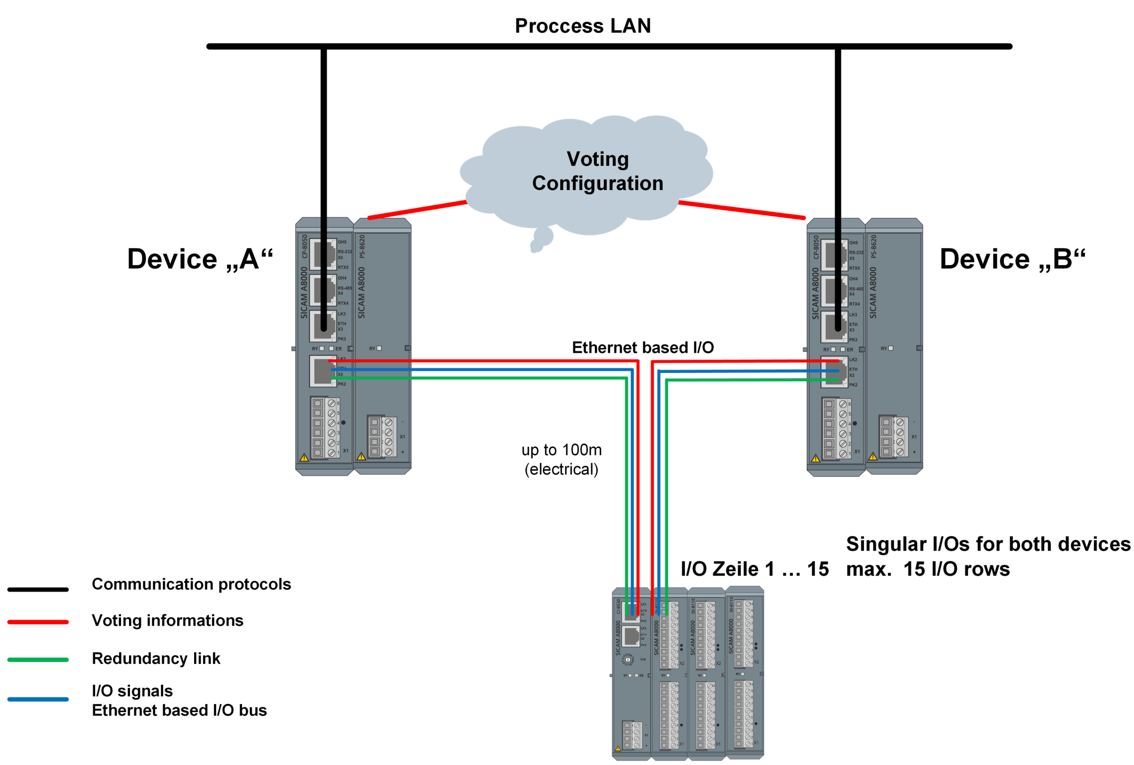
NOTE

With a redundant CP-8050 with EbIO bus ring (X2 & X3), the warning "Ring open" always comes up if no IOMI85 is equipped and loaded on the local I/O row, even if the ring is closed.

7.2.2 Redundant Devices with singular “I/Os” [Line Configuration]

This configuration is a special case and only makes sense in exceptional cases due to the limitations.

In this configuration, the I/O modules are physically installed only once and communicate with redundant devices via the EbIO bus. The active device communicates with the I/O rows and the installed I/O modules. The passive device receives the information via the EbIO bus in listening mode.



[dw_Redundancy_Configurations-Red_sing_IO_line, 1, en_US]

The following points should be noted in this configuration:

- Up to 15 remote I/O rows are possible
- The installation of I/O modules on the local row of the CP-8050 is not possible. However, the local row is needed to monitor the power supplies (that means, IOMI85 must be installed for row 0)
- The I/O modules AI-851x cannot be used with this type of I/O configuration

- Connector X2 of the CP-8050 device A must be connected to an I/O row. The connection must be closed across all I/O rows and then connected to connector X2 of the CP-8050 device B.
- The I/O bus must be configured to "Line"
- If the redundancy link is configured to "Ethernet based I/O" and the "Internal Voter" is used, the I/O line is also used automatically for the voter. That means, the voter already has a channel
- The voter needs a second communication channel, which means that the second connection has to be set up via an additional telecontrol protocol such as IEC 60870-104, IEC 60870-101 or IEC 61850.
- If the redundancy link is configured to "Ethernet based I/O", then in case of a PLC synchronization, the EbIO bus will be used for the synchronization
- The synchronization channel is encrypted as with the via Ethernet connected remote I/Os.
- The parameter **Redundancy | BSE settings | Priority I/O failure** should be set to **not used**, since a failure of a single I/O module is recognized in most cases on both devices and otherwise there may be an unnecessary redundancy switch.

NOTE

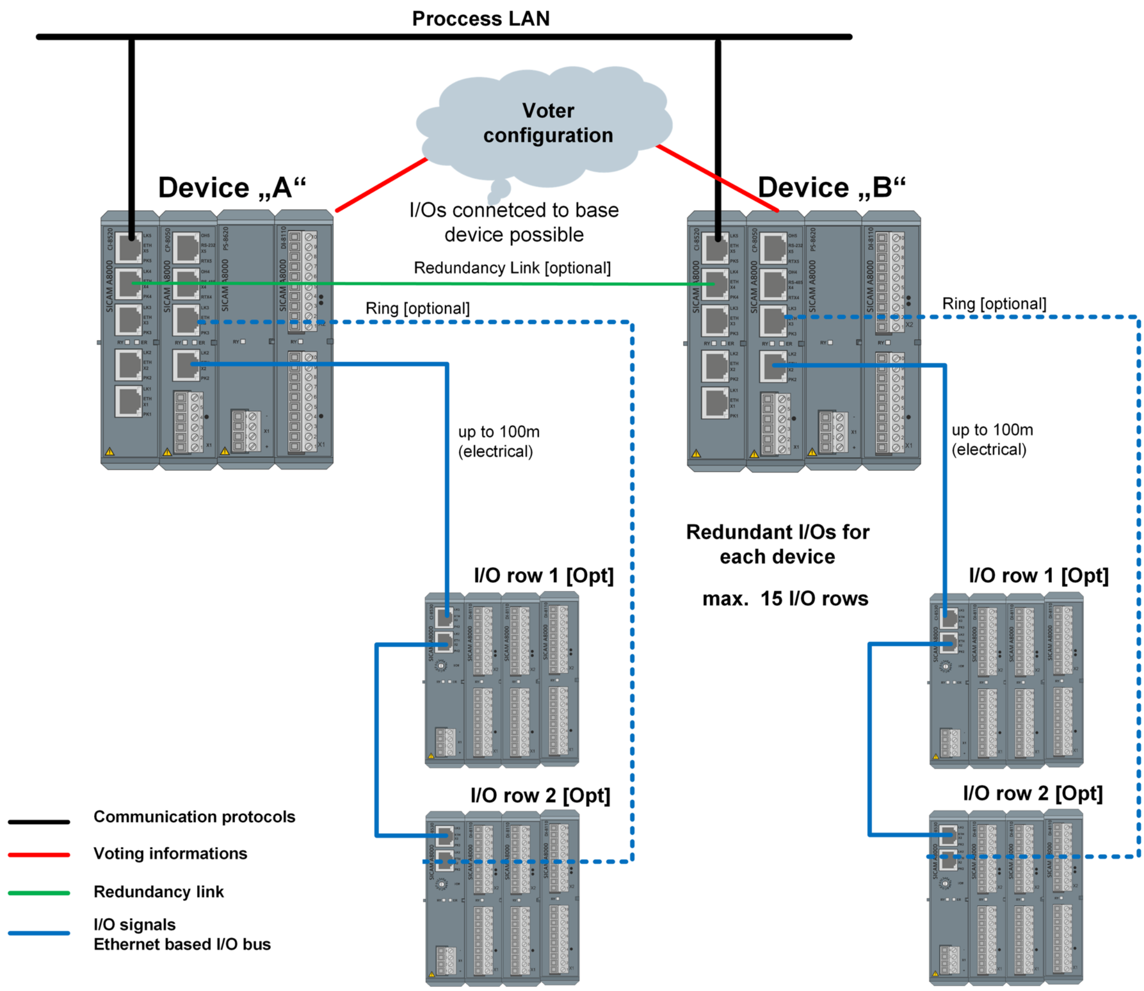
If a connection between the I/O lines fails, the following I/O lines can not be reached either.

In this case, device A reaches one part of the I/O rows and device B the other. Therefore, this configuration is only possible with one I/O row, if a single error occurs.

Synchronization of the redundant PLC application is no longer possible if a connection fails.

7.2.3 Redundant Devices with redundant “I/Os”

In this configuration, the I/O modules are physically installed twice (redundant) and communicate via their own EbIO bus with the redundant devices. The EbIO bus is actively driven in both devices, but the I/O Master firmware itself is switched active/passive.



[dw_Redundancy_Configurations-AU_Red_red_IO_line, 1, en_US]

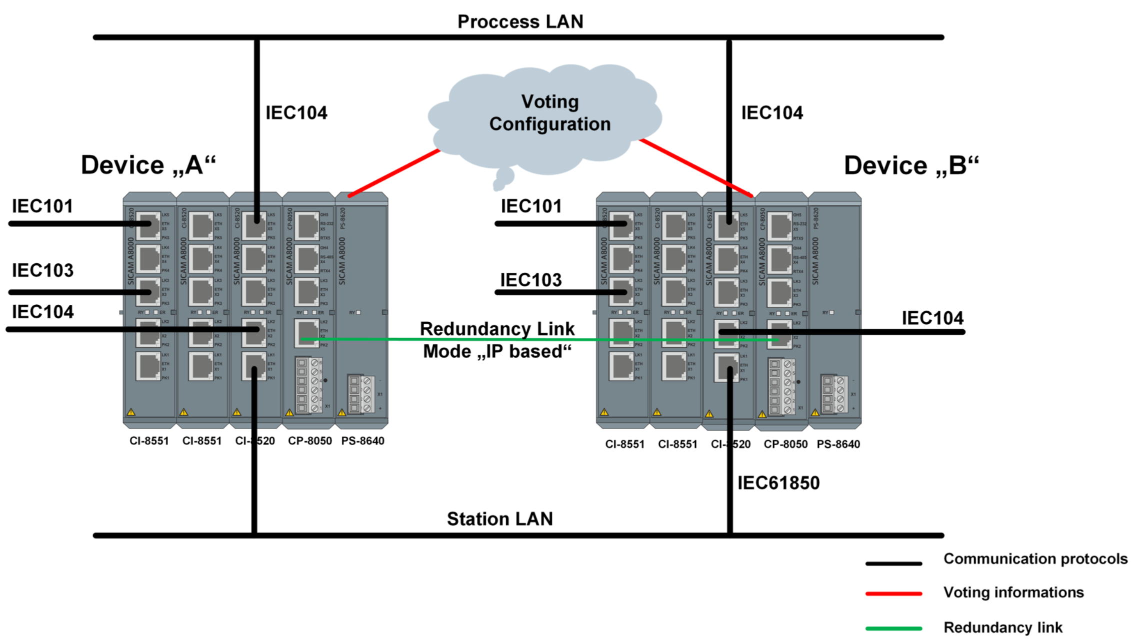
The following points should be noted in this configuration:

- Up to 15 remote I/O rows are possible
- It is possible to install I/O modules on the local CP-8050 row.
- The parameter "Redundancy/Settings for BSE/I/O mode" must be set to "redundant"
- The EbIO bus cannot be used for redundancy synchronization, i.e. there is no connection for the voter nor for the PLC synchronization
- For redundant PLC applications, an IP connection must exist for the redundancy link
- If outputs are to be switched on the passive device, then the parameter "Redundancy/Settings for BSEs / Data Filter to I/O" must be set to "Deactivate User Data Filter"

7.3 Communication Configuration

7.3.1 Redundant Data Nodes

In this configuration, you can choose between global and protocol-selective redundancy. With protocol-selective redundancy, connections to substations or SCADA systems can be switched as required between the redundant devices.



[dw_Redundancy_Configurations-RED_data_router, 1, en_US]

The following points should be noted in this configuration:

- No EbIO Bus in ring
- No or up to 15 I/O rows possible
- It is possible to install I/O modules on the local CP-8050 row.
- The parameter "Redundancy/Settings for BSE/I/O mode" must be set to "redundant"
- The EbIO bus cannot be used for redundancy synchronization, i.e. there is no connection for the voter nor for the PLC synchronization
- For redundant PLC applications, an IP connection must exist for the redundancy link
- If outputs are to be switched on the passive device, then the parameter "Redundancy/Settings for BSEs / Data Filter to I/O" must be set to "Deactivate User Data Filter"
- If you do not want to switch globally, but protocol-selective, the type of redundancy must be selected accordingly. On the other hand, a PLC may only work with data from I/O rows or only with data from protocols that are not switched over. (see *7.5.2.2 Protocol-selective Redundancy Switchover*)

7.4 Redundancy Link

7.4.1 General

The redundancy link is used to synchronize redundant PLC applications, singular I/O rows (I/O master firmware is available in both devices, but the I/O modules are only 1 x physical) and defined protocols. Synchronization assumes that both devices have the same parameter and firmware revision level loaded for each function.

The redundant device is monitored by periodic monitoring messages. These monitoring messages are generated and monitored by the devices on both sides of the interface.

With the redundancy link you can choose the following media:

- Ethernet based I/O Bus (EbIO) in line or ring configuration ... Mode „Ethernet based I/O"
  Advantages:
  - If singular I/O rows are coupled there is already this connection and this can also be used for the redundancy link (thus no further Ethernet connection between the two devices is necessary)
  - A redundant channel (ring) can be configured
  - Data is encrypted via the EbIO bus protocol

  Disadvantages:
  - Distance of the redundant devices electrically only up to 100 m or optically up to 6 km possible (depending on the media converter)
- via a "Raw IP" Ethernet connection ... Mode "IP based"
  Advantages:
  - An existing Ethernet connection can be used if no EbIO bus is configured (saving of Ethernet ports)
  - Distance between the two devices is only limited by the network architecture

  Disadvantages:
  - no redundant channel can be defined

7.4.2 Configuration of the Redundancy Link

Ethernet based I/O Bus (EbIO-Bus)

If remote I/O rows are connected to the device, it is also advisable to use the Ethernet based I/O bus for redundancy synchronization.

If the mode "Line" is selected for the EbIO bus, a singular point-to-point connection is established. If the mode "Ring" is selected, a redundant "point-to-point" connection is available. The EbIO bus can also be used if there are no I/O modules on the bus. In this case the bus is used exclusively for synchronization. (see *7.2 I/O Configurations*)

NOTE

- The Ethernet connection of the EbIO bus may only be a switched, multicast enabled and not routed network.
- With a redundant CP-8050 with EbIO bus ring (X2 & X3), the warning "Ring open" always comes up if no IOMI85 is equipped and loaded on the local I/O row, even if the ring is closed.

Raw IP Ethernet Connection

If synchronization takes place via a Raw-IP Ethernet connection, this can be done on any Ethernet port (except Ethernet ports which are used for the I/O bus). For synchronization via raw IP, only the IP address of the remote station must be parameterized.

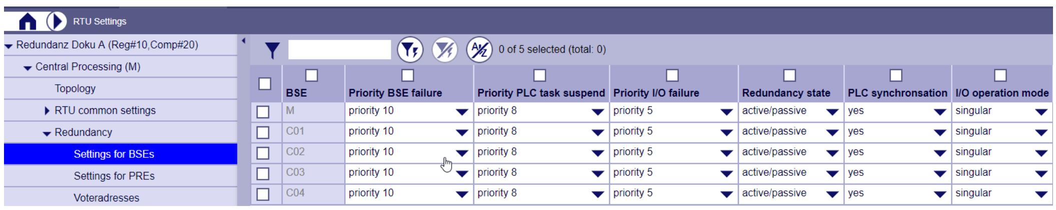
NOTE

If a router with a firewall is used between the devices, the IP packet Type 251 must be enabled in the router settings.

7.4.3 Synchronization of the Devices via Redundancy Link

7.4.3.1 Synchronization of redundant PLC Applications

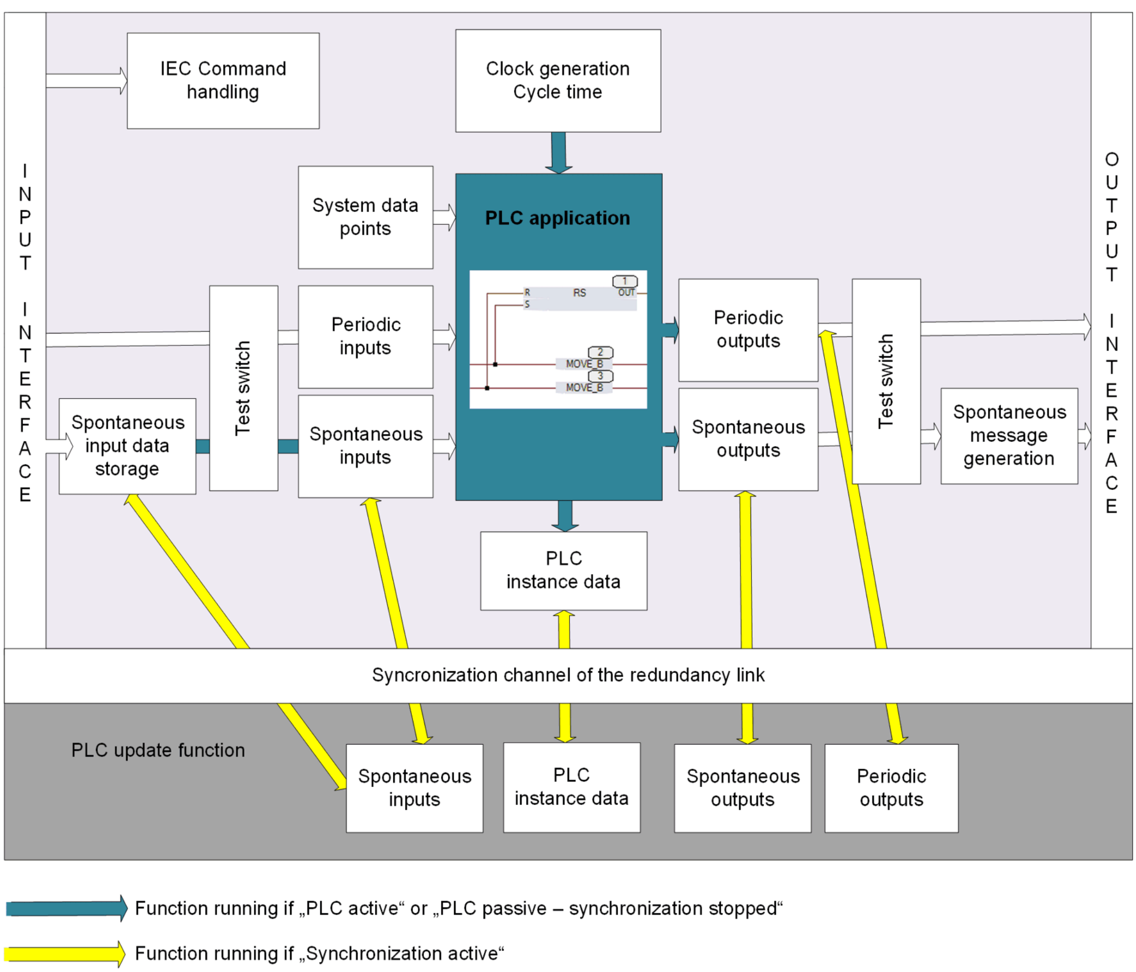
The redundancy function can be configured for each processing firmware via the parameter "Redundancy / Settings for BSEs / PLC synchronization", whether the redundant PLC application is synchronized via the redundancy link.



BSE	Priority BSE failure	Priority PLC task suspend	Priority I/O failure	Redundancy state	PLC synchronsation	I/O operation mode
M	priority 10	priority 8	priority 5	active/passive	yes	singular
C01	priority 10	priority 8	priority 5	active/passive	yes	singular
C02	priority 10	priority 8	priority 5	active/passive	yes	singular
C03	priority 10	priority 8	priority 5	active/passive	yes	singular
C04	priority 10	priority 8	priority 5	active/passive	yes	singular

[sc_SICAM_DM_RED_BSE_settings, 1, en_US]

If the "PLC synchronization" is enabled, the changed data of the PLC application are continuously transferred from the active PLC to the passive PLC.



[dw_Redundancy_PLC-PLC_Data, 1, en_US]

The active PLC updates all inputs in the parameterized grid of the cycle time, carries out the calculation of the PLC application and forwards the new output information spontaneously or periodically to the I/Os or communication. All changed spontaneous input information, PLC instance data and output information are sent via the redundancy link to the passive PLC.

The passive PLC itself does not carry out a calculation of the user program, but receives all the changed information via the update function of the active PLC if the synchronizing function is active. This ensures that the user program "seamless" continues to operate in the event of redundancy switching.

In opposite to SICAM AK, there is no need to install any applicative monitoring in the user program to ensure that the application programs are consistent.

The synchronization of the PLC data is stopped at:

- Failure of the redundancy link
- Failure of the redundant PLC
- Differently loaded firmware revisions of the redundant processing firmware
- In case of inconsistency of the control parameter of the corresponding processing firmware
  The check is carried out via a UUID for the application program and the associated input and output assignments. This ID is calculated by the engineering tool for the complete PLC application and concerns all tasks of the processing firmware
- When using the test switches for input/output information in the online test

If synchronization is stopped, also on the passive PLC all input telegrams are forwarded to the PLC application and the PLC application is calculated. Furthermore, an internal error with the exact cause is entered in the diagnosis.

The online test can be used on both, the active and the passive device. For details on the online test, see chapter Online test of the selected engineering tool.

NOTE

If calculations are carried out in the PLC application which do not access any common input information of the redundant PLCs (for example calculation of diagnostic information of the own device), these cannot be performed in a redundant PLC. In this case, another processing firmware is required in which PLC synchronization is disabled.

Synchronization Function of the PLC Application

The synchronizing function works in the transmission direction with a 2-buffer operation, what means that during the transmission of the changes of the 1st buffer to the passive PLC, the new changes are written to a 2nd buffer. As soon as the 1st buffer has been transferred to the passive PLC and acknowledged, the new changes to the 2nd buffer are transferred and the 1st buffer is used again for current changes.

As a result, the active PLC does not have to be stopped during the update.

During an update, the following data is transferred from the active to the passive control:

- Instance data of all program instances/charts
- Instance data of all global variable objects (CAEx plus)
- Spontaneous input signal process image
- Spontaneous output signal process image
- Periodic output signal process image
- IEC command treatment: Control location and 1 out of n interlock
- Status process image of the signals (CAEx plus)

NOTE

Note that redundant PLC applications require longer cycle times due to the synchronization function than singular PLC applications.

Excluded from the synchronization are:

- System data points (region number, component number)
- Periodic input signal process image
- IEC command handling: Select/Execute Timer
- Test switch for forcing the input-output signal images

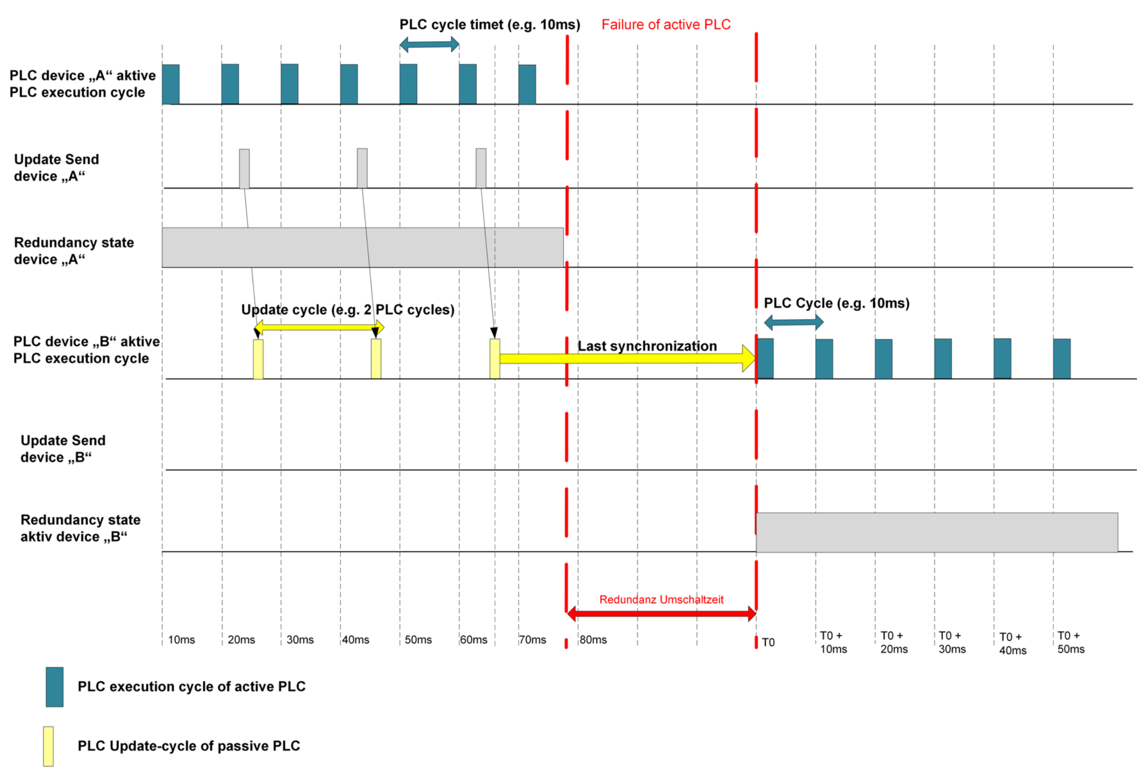
NOTE

For non-synchronized data, the current values of the own device are always displayed in the online test. If this information is used in links, the result can be displayed incorrectly on the passive PLC since all block outputs are synchronized by the active PLC.

When synchronizing, a distinction is made between a "delta" and a "full" update. With the delta update, only changes since the last synchronization cycle are transferred; during full update, all data is transferred.
A full update will be carried out at the following moments:

- In case of going failure of the redundancy link
- After restarting the passive PLC
- After parameter load when the parameters of the two PLCs are identical again (UUID of the user program is equal in both PLCs)
- When leaving the online test when the test switches of the input/output information are reset or during warm/cold start of the passive PLC
- During "Start synchronization" in the CFC online test (CFC only)

Timing of the update function



[dw_Redundancy_PLC-Update_Cycle, 1, en_US]

For fast cycle times, many changes or high load on the redundancy link due to further applications (e.g.: I/O synchronization or synchronization of other user programs) it is not guaranteed that all changes are transferred in the same control cycle to the passive PLC. In the case of redundancy switching, the previously passive PLC continues to calculate with the last cycle-consistent transmitted data image.

Via the redundancy link about 30 kB data change per 10 ms/bus cycle can be transmitted.

Design of the Application Program

As mentioned in the chapter "Synchronizing function", the synchronization requires performance, since all changes must be detected by a comparison function and transferred via the redundancy link.

The design of the user program has a significant influence on the utilization of the redundancy link.

If e.g. complex measured value processing is performed in a fast, high-priority task whose results are constantly changing, so the transmission of these measured values loads the transmission very often. If these values are not required with high priority, it would be useful to outsource them to a 2nd task, with a slower cycle time. This significantly reduces the load on the redundancy link.

7.4.3.2 Synchronization of singular I/O Modules

If the configuration "Redundant devices with singular remote I/Os" is required for the I/O connection, then the parameter "Redundancy | Settings for BSEs | IO mode" must be set to "singular".

In this case, the spontaneous data to the I/O modules is synchronized from the active I/O master firmware via the redundancy link to the passive I/O master firmware. A synchronization is done also during startup of the passive I/O master firmware. All relevant data of each I/O firmware instance is transferred from the active to the passive I/O function.

The synchronization of the I/O data per I/O master firmware is stopped at:

- Failure of the redundancy link
- Failure of the redundant I/O master firmware
- In case of different I/O master firmware revisions
- In case of inconsistency of the I/O parameters of the corresponding processing firmware

Redundancy switchover

In the case of a redundancy switchover, the active I/O master firmware is switched to passive in the first step and after a positive acknowledgment of this switchover the previously passive firmware becomes active. That means, there is a short time frame in which both are passive. During this time, the previously passive I/O master firmware takes over the operation of the bus, so that the I/O modules do not fail. If no active switching occurs during the next 20 seconds, the I/O modules will fail.

If synchronization is stopped, the passive I/O master firmware cannot take over operation during a redundancy switchover. In this case, the passive firmware is shut down. Furthermore, an internal error with the exact cause of the error is entered in the diagnosis.

If, nevertheless, a redundancy switchover takes place, then the firmware is automatically restarted when "switching active".

NOTE

The redundancy with singular I/O modules is only supported for SICAM I/O modules (IOMI85).

7.5 Automatic Voting

7.5.1 Basic Function of the Voter

The voting function is based on the definition of priorities in the voter table.
Voting between both devices is performed automatically by the voting function, regardless of the type of switching (global and protocol-selective redundancy switching).
For the device redundancy there are 2 possibilities of switching:

- Global redundancy switchover
  The entire device is either in the redundancy state active or passive. In this case, there is a voter table for the entire device.
- Protocol-selective redundancy switching
  Only defined processing or protocol firmwares of a device are switched to the passive state. Within one device some firmwares can be active, others passive.

The voter's decision is based on the redundancy voter tables of the two devices. Priorities are used to classify the pending errors. To each error that is used to determine the state of redundancy, a parameterizable priority is assigned.
A set error increases the counter of the parameterized priorities. The counters are sent to the voter in the case of protocol-selective or global switching. The voter compares the priorities of the two devices, calculates the redundancy state and communicates this to the two devices. The voter activates the device with the lower-priority errors.
There are 16 levels of priority where:

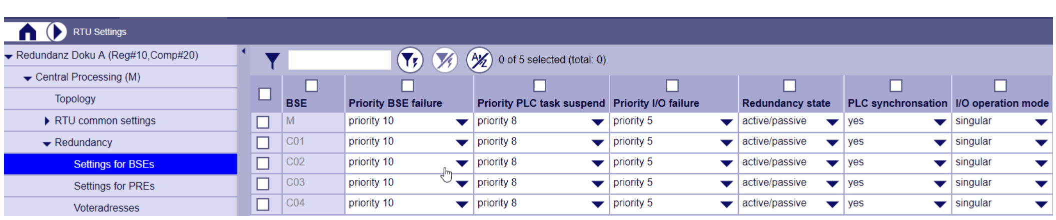
- Priority 15
  equates to the highest priority and is reserved by the system for the error of the redundant device
- Priority 0-14 (0 = lowest priority)
  can be freely assigned by the user to the types of errors

The function fix operating mode is higher-prior than the 16 priority levels. (see *7.5.1.3 Fixing Operating Mode*)

7.5.1.1 Assignment of Error Priorities to the Voter Table

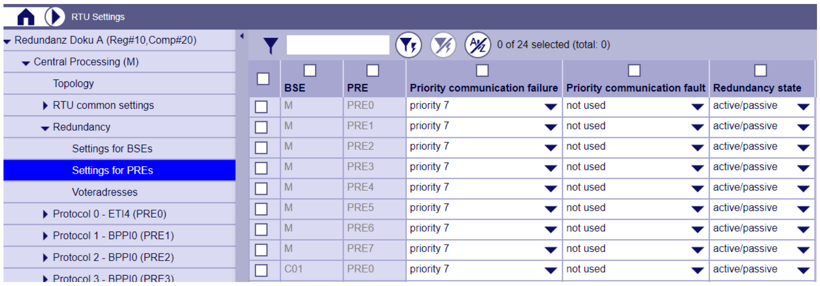
System error priorities

The system provides the redundancy voter with system errors (error types) that are already assigned in the default parameters error priorities. The user can change or deactivate these priorities.
The parameter table "Redundancy/Settings for BSEs" defines priorities for BSE errors:



[sc_SICAM_DM_RED_BSE_settings, 1, en_US]

The parameter table "Redundancy/Settings for PREs" defines priorities for protocol errors:



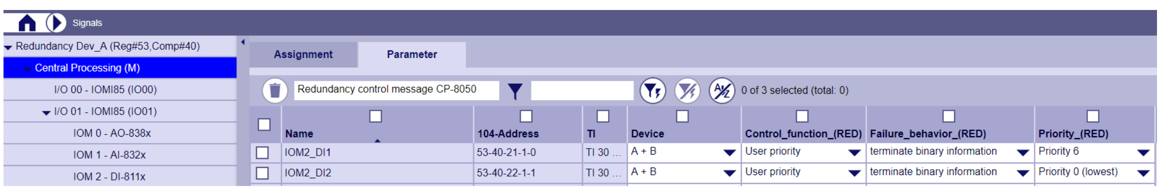
[sc_SICAM_DM_RED_PRE_settings, 1, en_US]

The two tables are always designed for the maximum number of processing firmwares and the maximum number of protocols. The real configuration is not considered here.

User Priorities

The system also offers the user the option of influencing the voter via so-called user priorities. For this purpose, signals can be assigned to the central processing firmware "BSE-M" via redundancy control messages with the control function "user priority".

The parameters BSE_RED and PRE_RED are not evaluated in the operating mode "global", these are only required for the operating mode "protocol-selective redundancy switchover".



[sc_SICAM_DM_RED_User_priority, 1, en_US]

If a single message with the address "53-40-21-1-0" and "On" is received, based on the configuration example shown in the last graphic, the priority 6 is set or reset in the corresponding voting table depending on the binary information state.

0 ... reset priority (counter = 0)

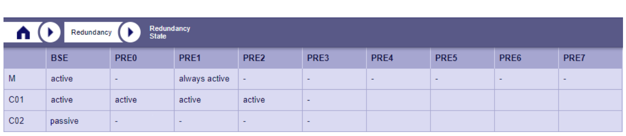
1 ... priority set (counter > 0)

If these single-point information are received with the NT bit set, either the state is maintained (parameterizable in response to failure) (counter remains unchanged) or possibly previously set messages are deleted (counter decremented if the information was set).

A single-point information, which e.g. sets user priority 14, can therefore be used to override individual station (priority 6) or communication (priority 7) failures in maintenance cases. (see *Fixing operating mode via user priorities, Page 470*)

7.5.1.2 Readout of the Redundancy State in SICAM WEB

With SICAM WEB, the redundancy state for all processing firmwares (BSE) and protocol firmwares (PRE) can be read from the device.



[sc_SICAM_WEB_Redundancy_State, 2, en_US]

The following states are displayed:

State	Description
active	the firmware has been switched to the "active" state
passive	the firmware has been switched to the "passive" state

State	Description
always active	Firmware is set to "always active" in „Redundancy | Settings for BSEs/PREs“
-	Firmware is not installed

7.5.1.3 Fixing Operating Mode

For test or maintenance purposes, it is often necessary to fix the redundancy state of the devices.

Fixing operating mode via redundancy control messages

The redundancy function provides the function "fixing operating mode", which can be operated via the following redundancy control telegrams:

- mode fix device A
- mode fix device B
- Operating mode fix automatic

By means of pushbuttons, key switches and control commands from the control system it is possible to fix the devices, this means switch device A or device B to fix. There is then again, the possibility to switch the redundancy function to automatic. These messages can be assigned both, to the voter (if configured externally) and to the redundant devices. The requirements for this function vary depending on the system.

This function always affects the entire device, even for protocol-selective switching, all protocols are switched to "fixed A" or "fixed B" either actively or passively.

If the redundancy function receives one of these 3 control messages, it switches to the selected operating mode. The function can be handled by multiple sources, that means used from different places.

All sources have the same priority, for example, if source 1 is switched to "fix A" then it can be switched from source 3 to "fix B". For this function, the time tag of the most recently received message is compared with the last received message, whereby the message with the younger time tag is valid.

The function "fix operating mode" has the highest priority for the voter and switches off the automatic voting. Even a failure of the fixed device causes no redundancy switchover. If this is not desired or if, in the case of protocol-selective switching, a different operating mode is to be fixed for individual protocols, then this function cannot be used.

Message Formats

The following type identifiers are supported for this function:

- TI 30 - Single-point information
  Only a positive edge of the single-point information (0 -> 1 edge) leads to a switch-over
- TI 45 - Single command
  For a switch-over, the status of the command must be "On" and "Execute". The command is answered in accordance with IEC command handling with confirmation and termination.

The selected operating mode can also be read back from the device via the following redundancy return information message:

- mode fix device A
- mode fix device B
- Operating mode fix automatic

NOTE

For correct function, all sources must be time synchronized.

Fixing operating mode via user priorities

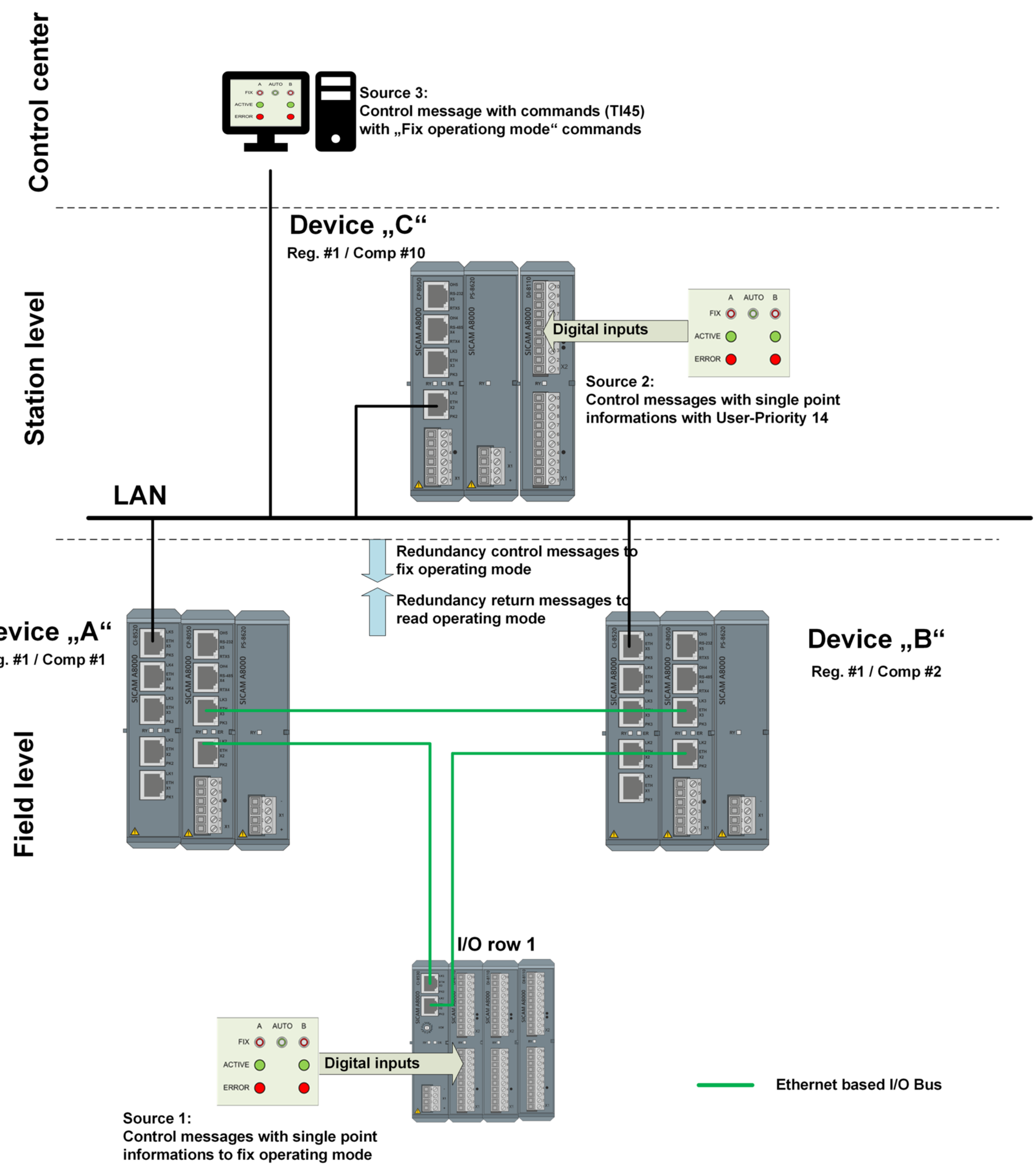
There is also the possibility by setting the user priorities to influence the voting and thus to realize a preferred position or a fixation. Here it is recommended to use the highest priority 14 for operating mode switch-over. If device "A" is to be active, user priority 14 must be set in device "B"; if device "B" is to be activated, user priority 14 must be set in device "A".

If now the fixed device "A" fails, the voter automatically switches to the device "B", since the failure information is permanently assigned to the higher priority 15.

For automatic mode, neither of the two devices may set a user priority for the "mode fix".

Applications with different operating mode sources

Based on the following figure, 3 different sources and the 2 different options are shown to fix the operating mode.

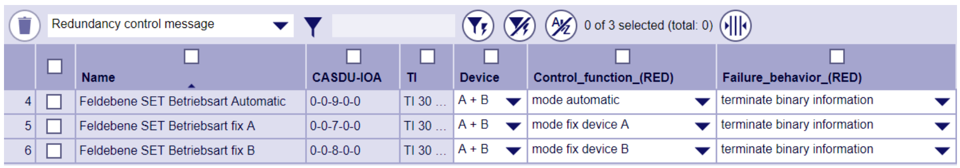


[dw_Redundancy_Voter-Switch_State, 1, en_US]

Source 1 - fixing the operating mode via the redundancy control message function

Source 1 is a digital input module in singular mode, connected to the redundant device pair via the EbIO bus. The 3 states (fix A, fix B, automatic) are read in via 3 digital inputs and sent to the voter via message format single-point information. As input medium, three buttons are recommended. The 3 single-point information messages of the pushbuttons can be used 1:1 as redundancy control messages for the voter.

If a key-operated switch is used, the 3 positions "A, B, Automatic" must be converted into 3 individual messages via the function diagram.



	Name	CASDU-IOA	TI	Device	Control_function_(RED)	Failure_behavior_(RED)
4	Feldebene SET Betriebsart Automatic	0-0-9-0-0	TI 30 ...	A + B	mode automatic	terminate binary information
5	Feldebene SET Betriebsart fix A	0-0-7-0-0	TI 30 ...	A + B	mode fix device A	terminate binary information
6	Feldebene SET Betriebsart fix B	0-0-8-0-0	TI 30 ...	A + B	mode fix device B	terminate binary information

[sc_SICAM_DM_fix_operation_mode_1, 1, en_US]

NOTE

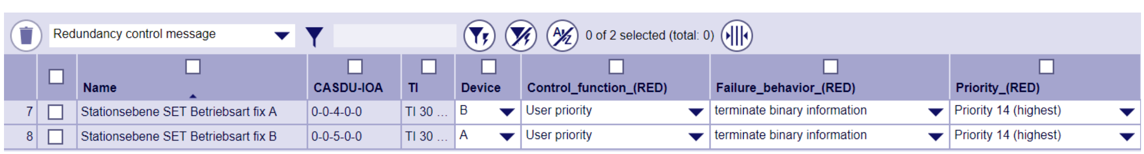
Attention: If the input module fails, e.g. both devices become passive due to an error or the input module is defective, so the operating mode can no longer be changed via this source. In this case it is recommended to enable a change of operating mode via another source (for example, source 3).

If the fixed device fails, it will not automatically be switched to the other device.

<u>Source 2 - fixing the operating mode via user priorities of the voting table</u>

This source uses the voting table via automatic voting. It is recommended to enter user priority 14 in the voting table.

The function "fix mode" with redundancy control messages, has highest priority in voting. If "fix A" or "fix B" is selected via source 1 or 3, it is not possible to switch via source 2 (user priority 14). If the mode "Automatic" is selected via source 1 or 3, automatic voting is active and the operating mode can also be selected via source 2.

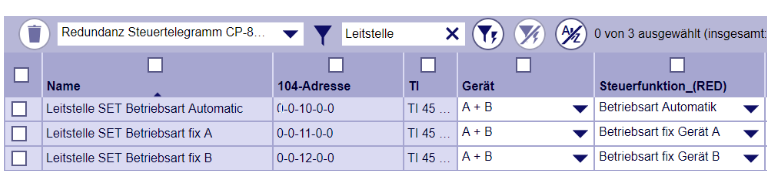


	Name	CASDU-IOA	TI	Device	Control_function_(RED)	Failure_behavior_(RED)	Priority_(RED)
7	Stationsebene SET Betriebsart fix A	0-0-4-0-0	TI 30 ...	B	User priority	terminate binary information	Priority 14 (highest)
8	Stationsebene SET Betriebsart fix B	0-0-5-0-0	TI 30 ...	A	User priority	terminate binary information	Priority 14 (highest)

[sc_SICAM_DM_fix_operation_mode_2, 1, en_US]

<u>Source 3 - fixing the operating mode via the function of the redundancy control messages</u>

Source 3 is, for example, a computer in a control center. Here, the function "Fix operating mode" can also be controlled via command messages. Source 1 and 3 have the same priority.

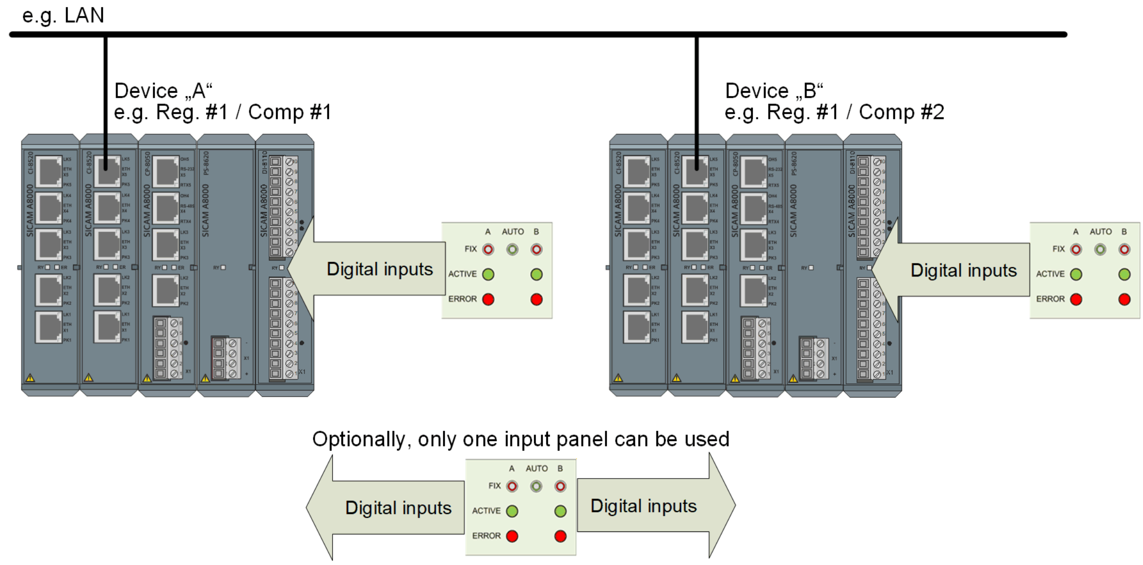


Name	104-Adresse	TI	Gerät	Steuerfunktion_(RED)
Leitstelle SET Betriebsart Automatic	0-0-10-0-0	TI 45 ...	A + B	Betriebsart Automatik
Leitstelle SET Betriebsart fix A	0-0-11-0-0	TI 45 ...	A + B	Betriebsart fix Gerät A
Leitstelle SET Betriebsart fix B	0-0-12-0-0	TI 45 ...	A + B	Betriebsart fix Gerät B

[sc_SICAM_DM_fix_operation_mode_3, 1, en_US]

Applications for data nodes without singular I/Os

In data nodes without singular I/Os, a separate input module can also be used for each device to read in the operating mode buttons.



[dw_Redundancy_Voter-Switch_lokalIO, 1, en_US]

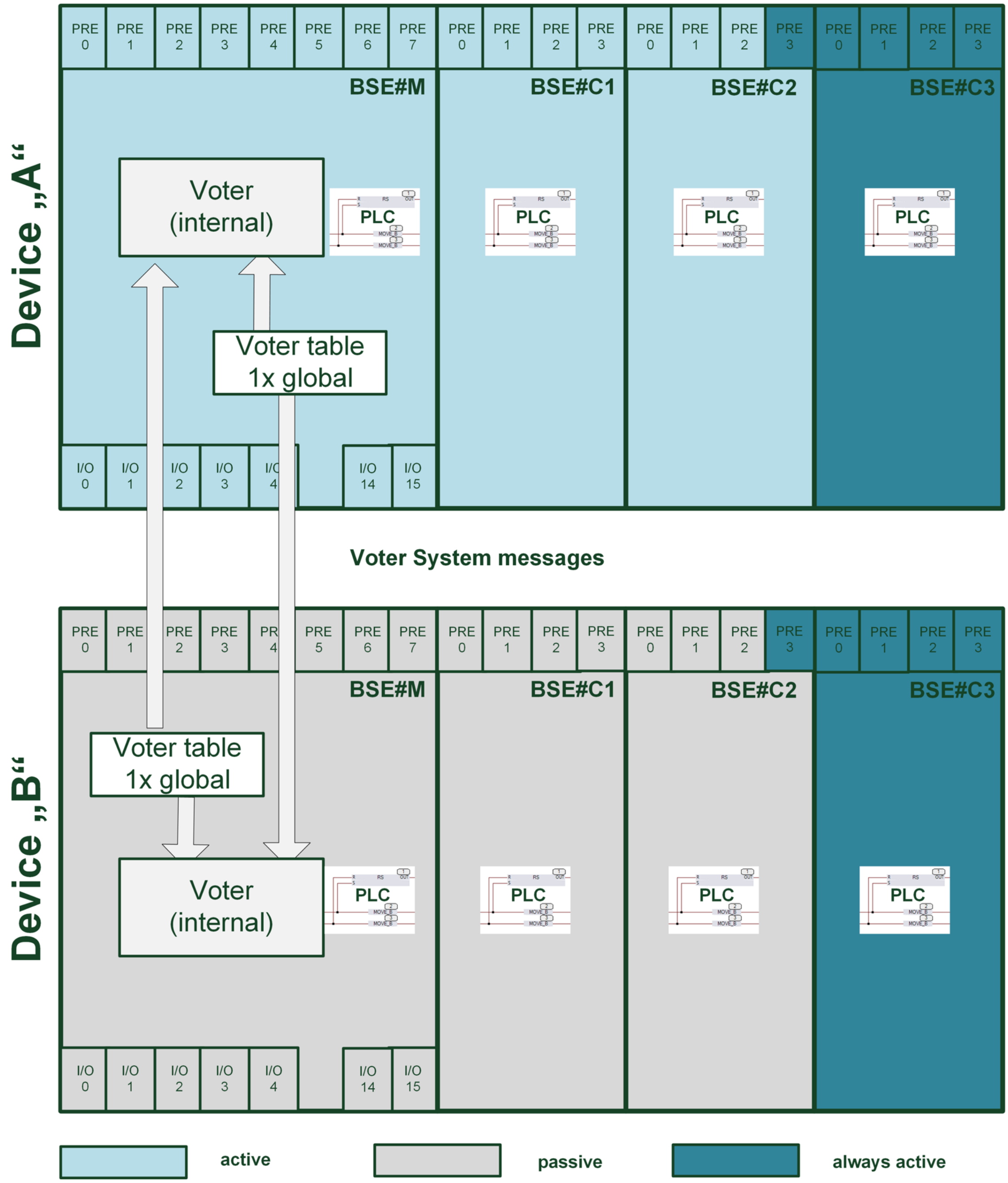
7.5.2 Redundancy Type

The redundancy type determines the behavior of the device for the communication protocols.
You can choose between the following modes:

- Global redundancy switchover and
- Protocol-selective Redundancy Switchover

7.5.2.1 Global Redundancy Switchover

This mode is active if the parameter "RTU general settings | Redundancy" is set to "global".
With global redundancy, there is only one voter table for the entire device. All firmwares are always switched to "active" or "passive". The I/O master firmwares are bound to the redundancy state of the higher-level processing firmware.
Certain processing firmwares can be excluded from global redundancy switching by the permanent activation in the menu item "Redundancy | Settings for BSEs or PREs".

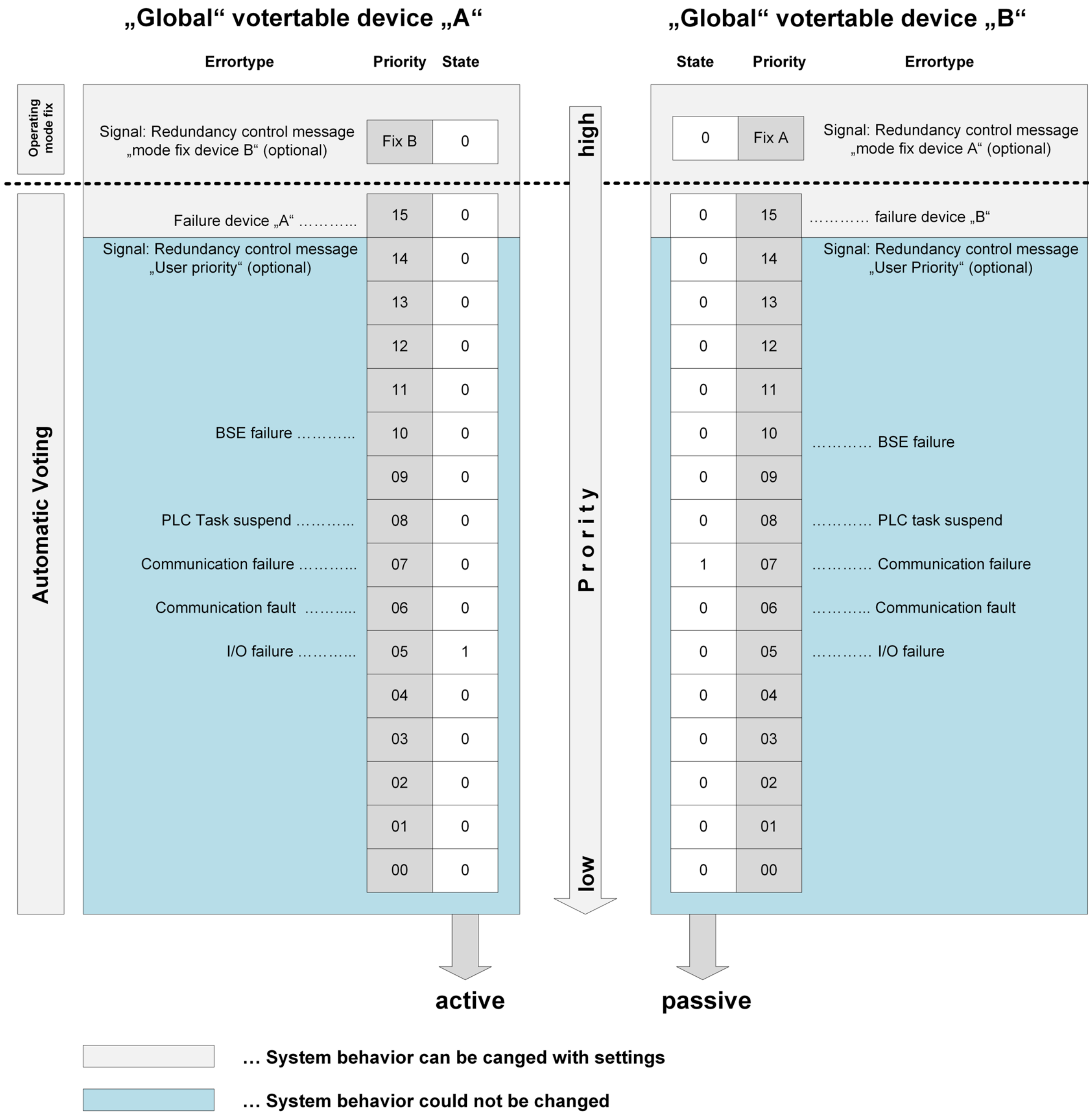


[dw_Redundancy_Voter-Globaler_Voter, 1, en_US]

Assignment of Error Priorities to the Voter Table of the Device

The following figure shows the default assignment of the error priorities due to the system errors for the global redundancy switchover. This default assignment can be changed via parameters.

Furthermore, the voter can be influenced via optional "redundancy control messages" (marked as optional). e.g. User priority 14 for "Fix operating mode" (see *7.5.1.3 Fixing Operating Mode*)



[dw_Redundancy_Voter-Global_Table, 1, en_US]

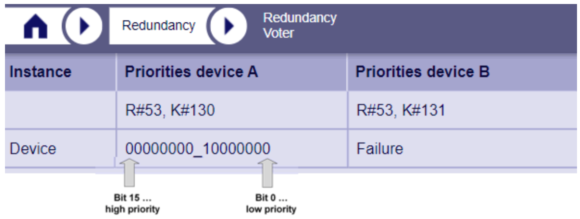
In order to illustrate the operation of the redundancy voter, the following assumption was made in the upper figure:

- In device A, an I/O module has failed
- Device B has lost communication with the control center

Since the communication error is assigned a higher error priority than the I/O module failure, the redundancy voter decides to switch device A to active.

Reading out the voter table from the device

With SICAM WEB, the error state of the voter table can be read from the device.



[dw_Redundancy_Voter-WEB_Global_Voter, 1, en_US]

The voter switches the device A to active in the picture above, as the error status of the device is better.

7.5.2.2 Protocol-selective Redundancy Switchover

This mode is active if the parameter "RTU general settings | Redundancy" is set to "protocol-selective". In the operating mode "protocol-selective redundancy switchover", there is a separate polling table for each processing firmware (BSE) and for each protocol firmware (PRE). The voter makes the decision per processing function and per protocol, whether the firmware is to switch active or passive. Exceptions are the firmwares that are set in "Redundancy | Settings for BSEs or PREs" to "always active".

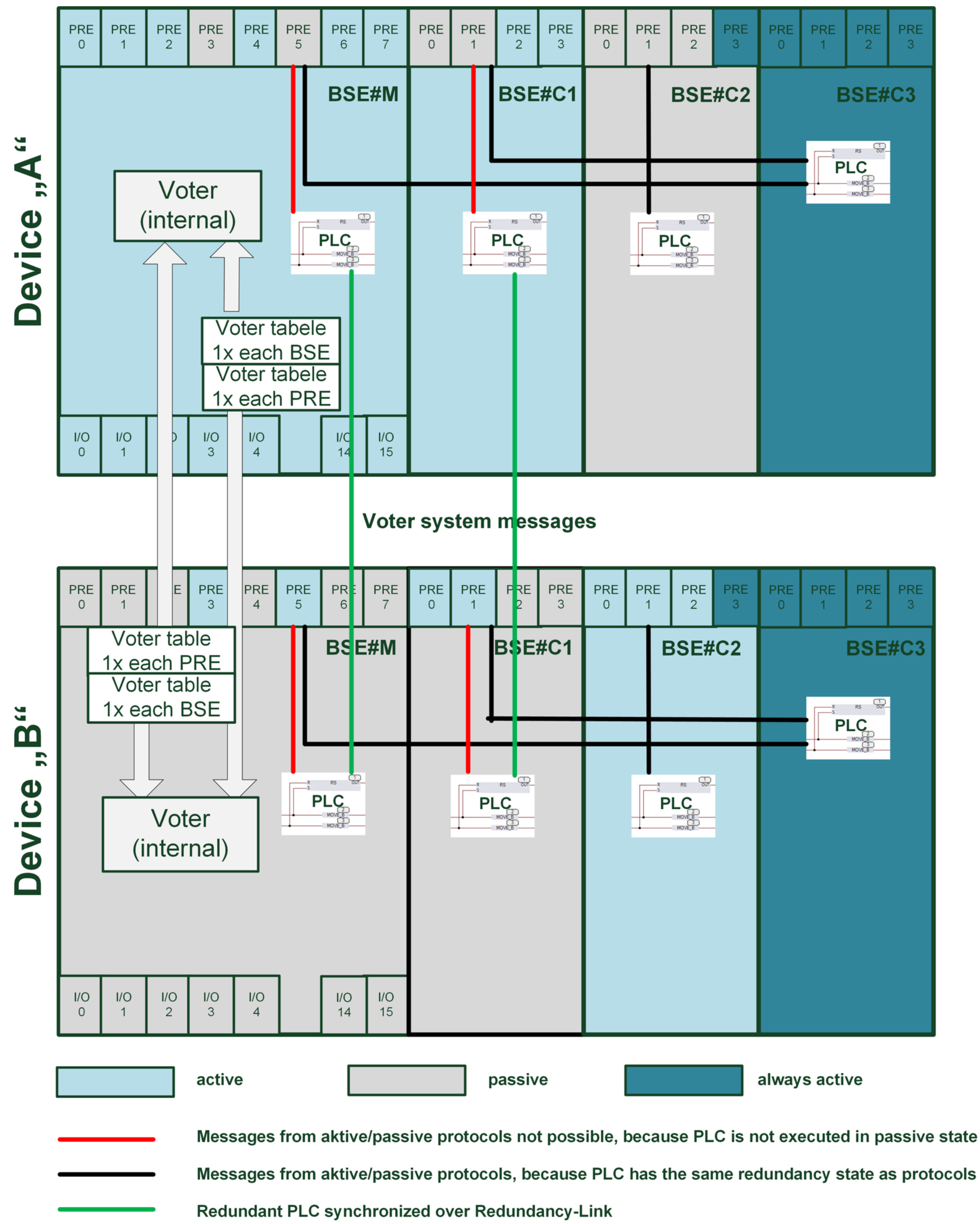
With this type of redundancy, not all the devices are switched, but only individual protocols. Connections to substations or SCADA systems can be switched independently between the redundant devices. Especially in data node configurations the permanent reachability of the substations can be increased.

The I/O master firmwares are always bound to the redundancy state of the higher-level processing firmware.

NOTE

If it is ensured, that the PLC application does not use data points which are provided from protocols which shall be switched over selective, it can run on a redundant processing firmware. If this is not the case, it cannot be ensured that the PLC application is constantly supplied with all necessary data points via active connections.

Messages of protocols, that can have a different active/passive state than the processing firmware, must be processed on a non-redundant PLC (in the example below on the BSE-C3)

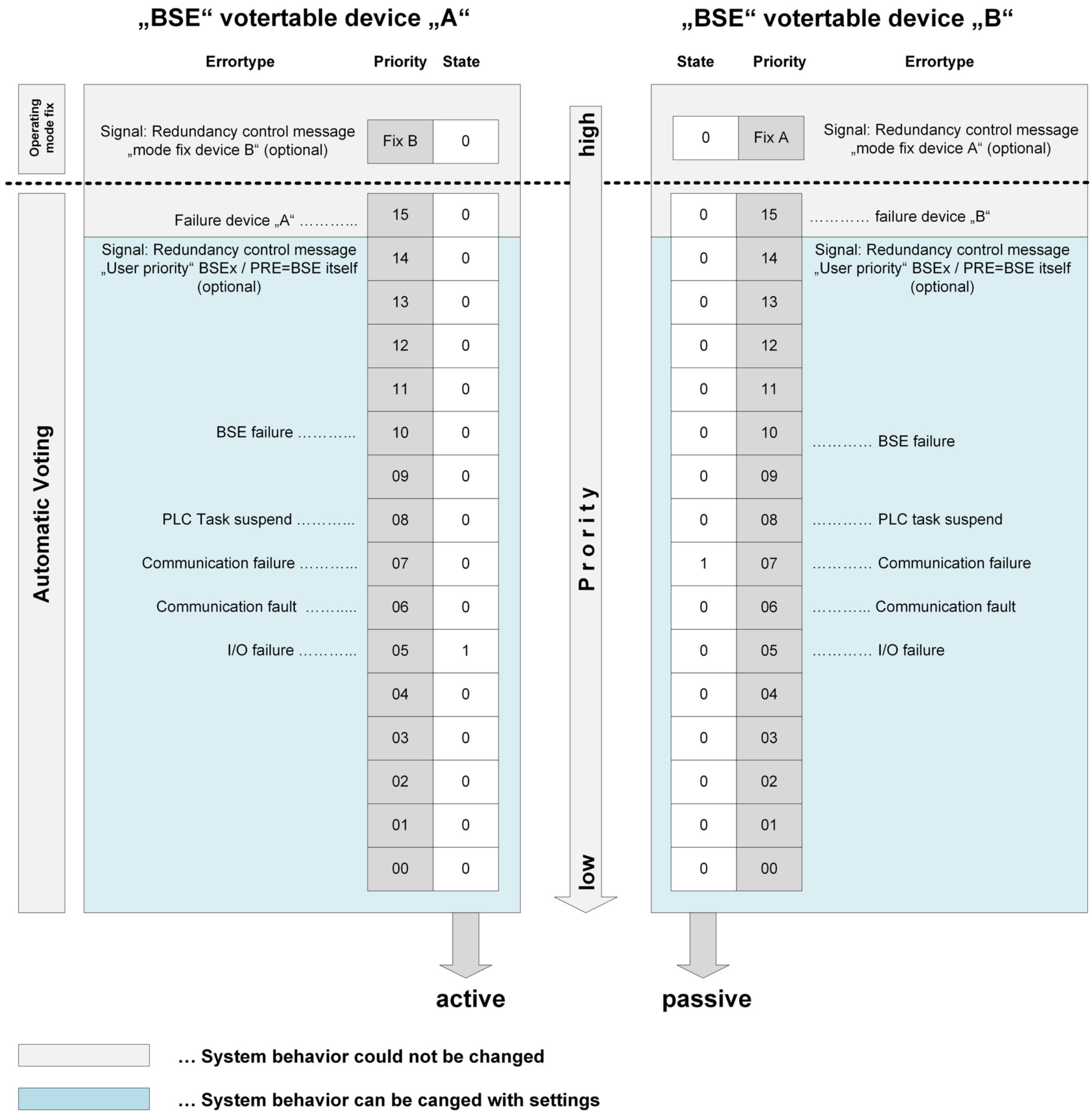


[dw_Redundancy_Voter-Protokoll_Voter, 1, en_US]

Assignment of Error Priorities to the Voter Table of the Firmwares

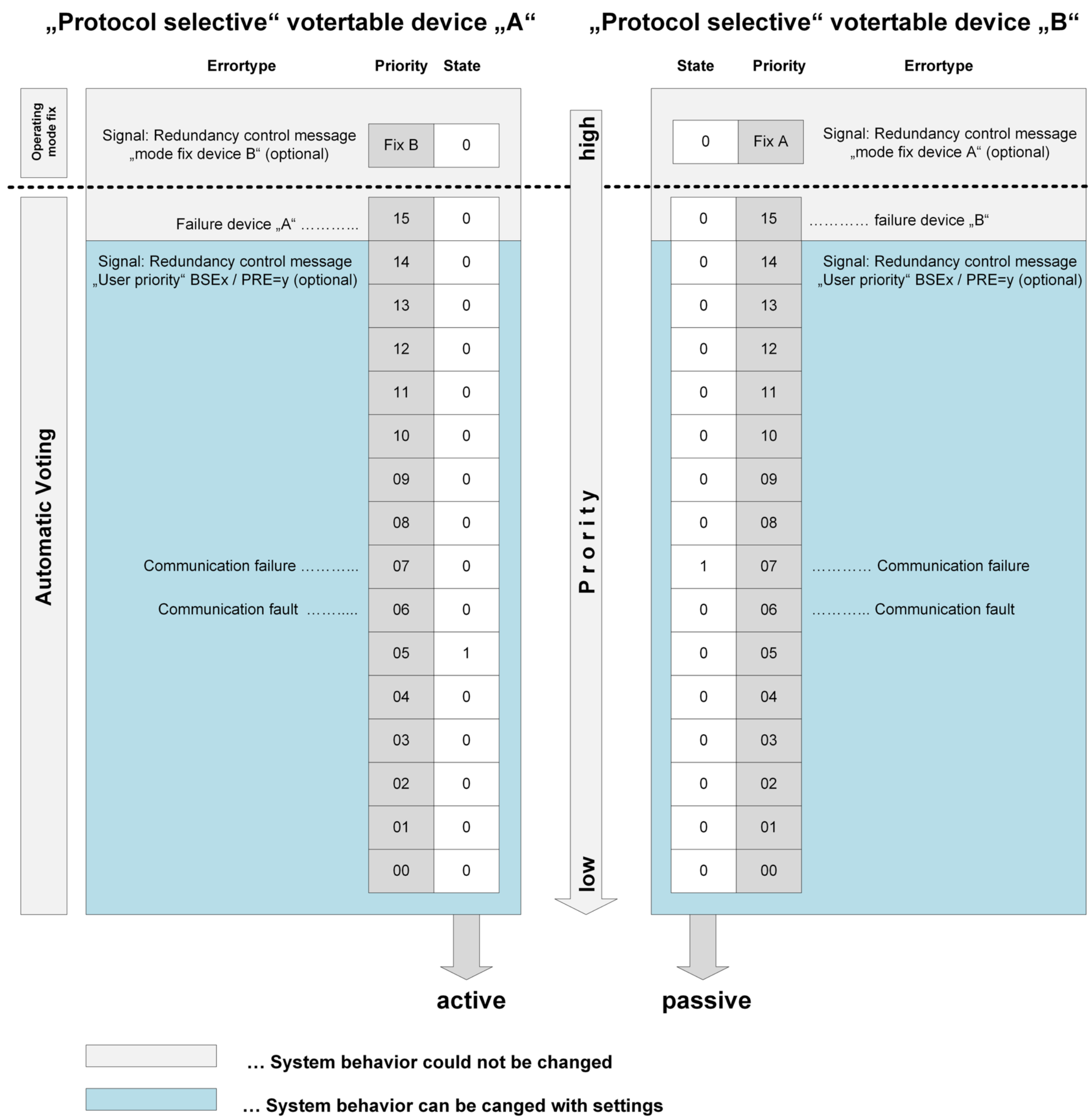
The system provides the redundancy voter with system errors (error types) that are already assigned in the default parameters error priorities. The user can change or deactivate these priorities.

The parameter table "Redundancy | Settings for BSEs" defines priorities for the processing firmwares (see *7.5.1.1 Assignment of Error Priorities to the Voter Table*). These errors always affect the voter table of the own processing firmware (BSE). e.g. If an error occurs in BSE#1, the error is entered in the voter table of BSE#1 and the protocol is switched to "Active" or "Passive" in the corresponding device.



[dw_Redundancy_Voter-BSE_Table, 1, en_US]

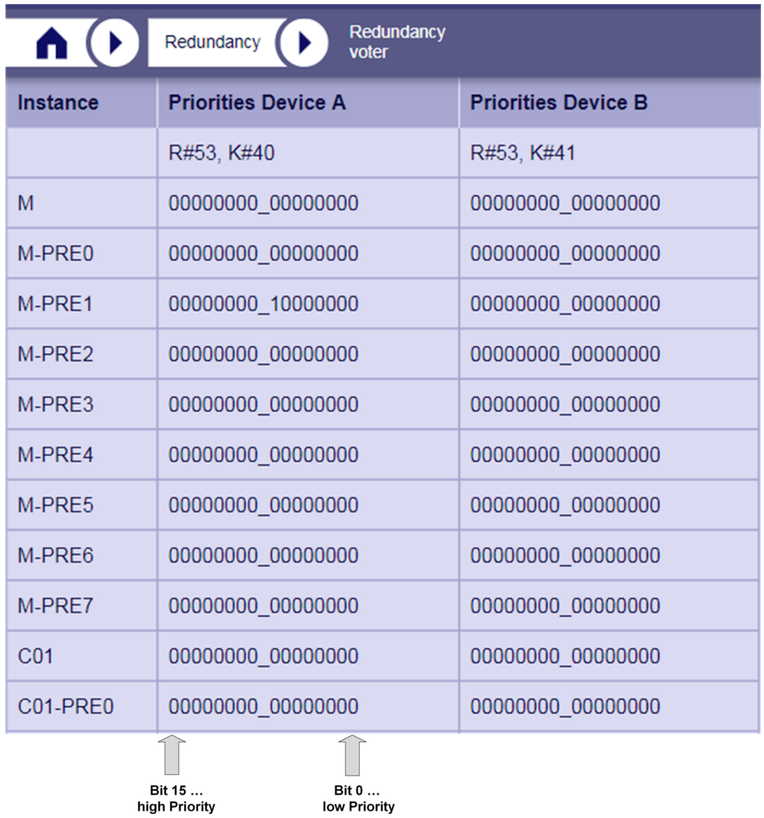
The parameter table "Redundancy | Settings for PREs" defines priorities for protocol firmwares (see *7.5.1.1 Assignment of Error Priorities to the Voter Table*). These errors always affect the voter table of the corresponding protocol. e.g. If an error occurs in BSE#1/Protocol#1, the error is entered in the voter table of BSE#1/Protocol#1 and the protocol is switched to "Active" or "Passive" in the corresponding BSE.



[dw_Redundancy_Voter-PRE_Table, 1, en_US]

Reading out the Voter Table from the Device

With SICAM WEB, the error status of all voting tables of the processing and protocol firmwares can be read out of the device.



Instance	Priorities Device A	Priorities Device B
	R#53, K#40	R#53, K#41
M	00000000_00000000	00000000_00000000
M-PRE0	00000000_00000000	00000000_00000000
M-PRE1	00000000_10000000	00000000_00000000
M-PRE2	00000000_00000000	00000000_00000000
M-PRE3	00000000_00000000	00000000_00000000
M-PRE4	00000000_00000000	00000000_00000000
M-PRE5	00000000_00000000	00000000_00000000
M-PRE6	00000000_00000000	00000000_00000000
M-PRE7	00000000_00000000	00000000_00000000
C01	00000000_00000000	00000000_00000000
C01-PRE0	00000000_00000000	00000000_00000000

[dw_Redundancy_Voter-WEB_protocol_Voter, 1, en_US]

In the picture shown above the voter switches the M-PRE1 of device B to active, because the error state of the device is better. For all other protocols and BSEs, the previous decision of the voter remains.

7.5.3 Voter Configurations

The voter mode can be set via the parameter "Redundancy | Voter".

The voting function runs either in the redundant devices (internal voter) or on additional CP-8031/CP-8050 which in turn can be designed redundantly (one or two external voters).

The communication between the devices and the voters must be redundant. That means, the voter must always be reachable via 2 communication channels (ways).

7.5.3.1 Mode “Internal Voter”

As already mentioned before, 2 channels must be available to the internal voter. The internal voter uses, if available, also the redundancy link.

Failure Behavior:

If the voter cannot reach the redundant device, the own device is switched to "active". The assumption here is that under normal circumstances the redundant device has failed.

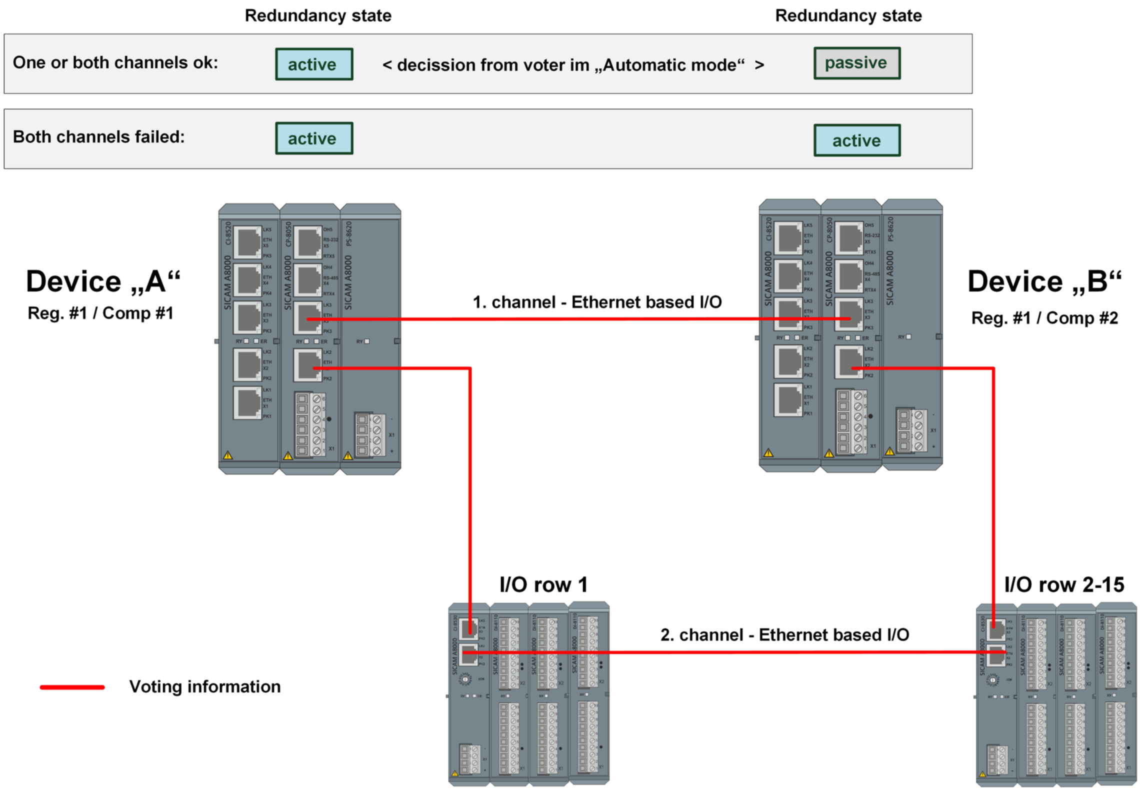
NOTE

If both of the voter's communication channels have failed, the voter can not distinguish whether there is a communication problem or the redundant device has failed. Therefore, both devices are switched to active in this case.

Depending on the configuration of the redundancy link, there are the following options:

Redundancy link is set to "Ethernet based I/O" and "Ring"

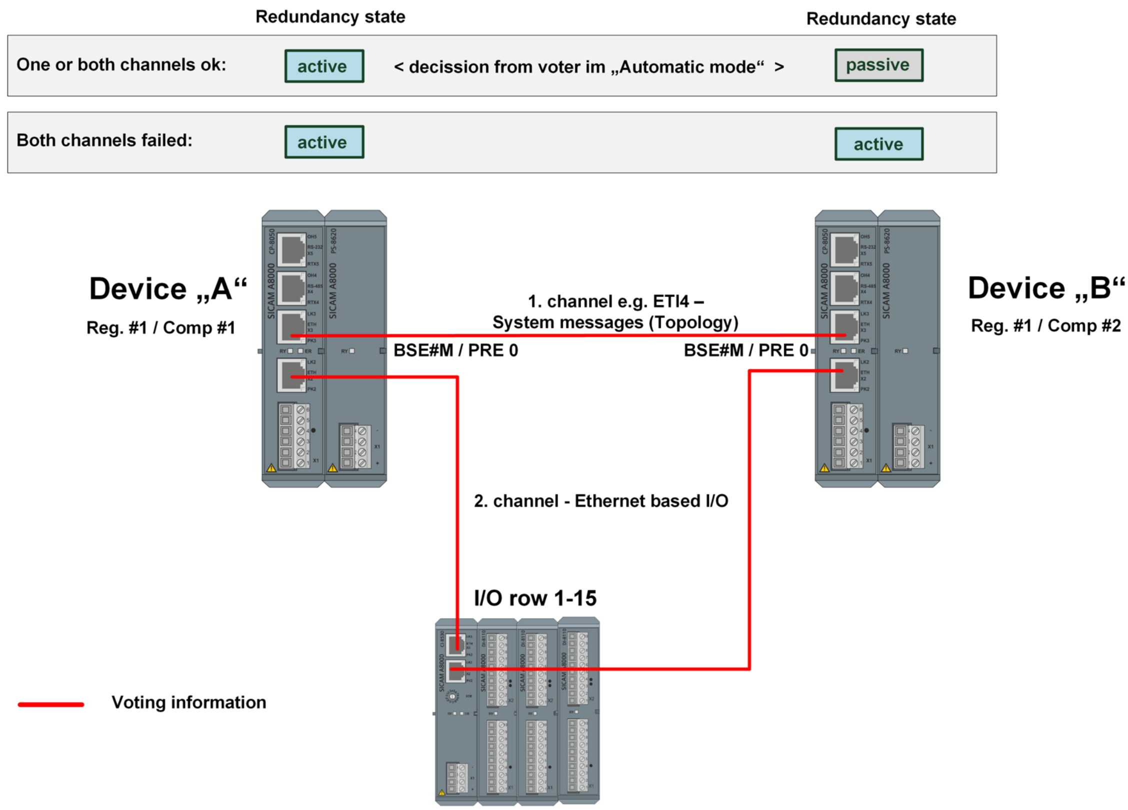
With this configuration, 2 channels are automatically available to the internal voter and there is nothing else to parameterize.



[dw_Redundancy_Voter-intVoter_2x_ebio, 1, en_US]

Redundancy link is set to "Ethernet based I/O" and "Line" or the redundancy link is set to "IP-based"

In this case, only 1 channel is automatically available to the voter, a second channel must be defined via a protocol and the RTU topology. Via this route, the voter exchanges the redundancy information via system messages.



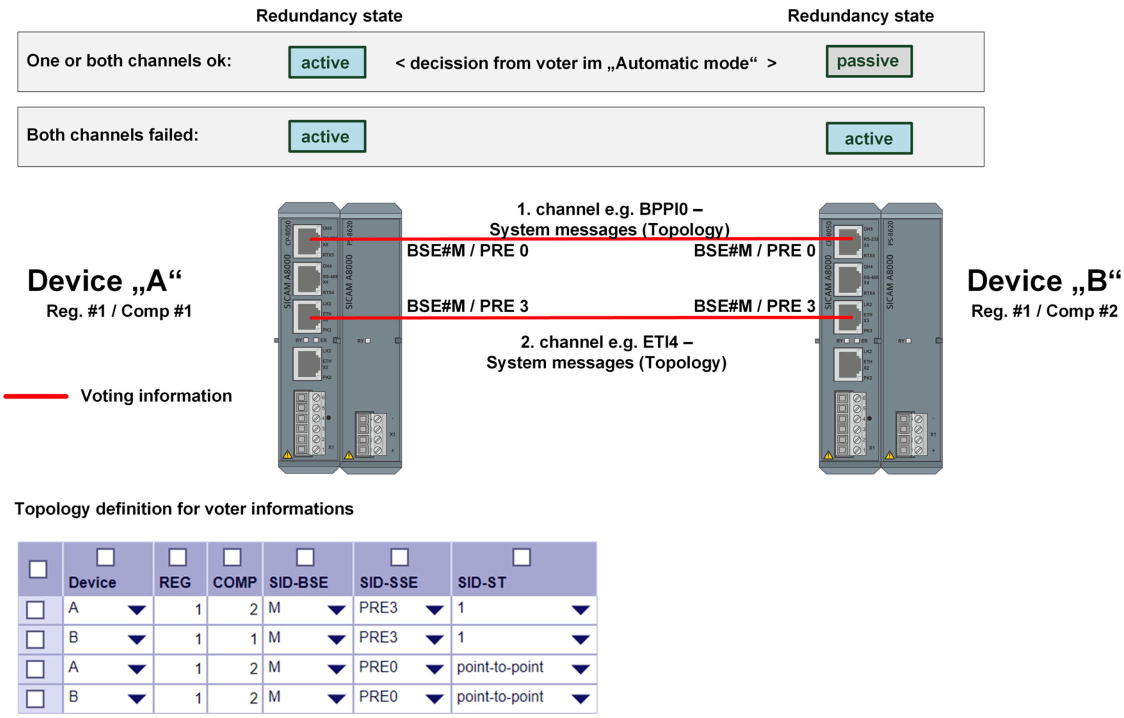
Topology definition for voter informations

☐	☐ Device	☐ REG	☐ COMP	☐ SID-BSE	☐ SID-SSE	☐ SID-ST
☐	A	1	2	M	PRE0	1
☐	B	1	1	M	PRE0	1

[dw_Redundancy_Voter-intVoter_1xebio_1xPRE, 1, en_US]

Redundancy link does not exist

In this case 2 channels for system messages must be defined via 2 protocols and the RTU topology.



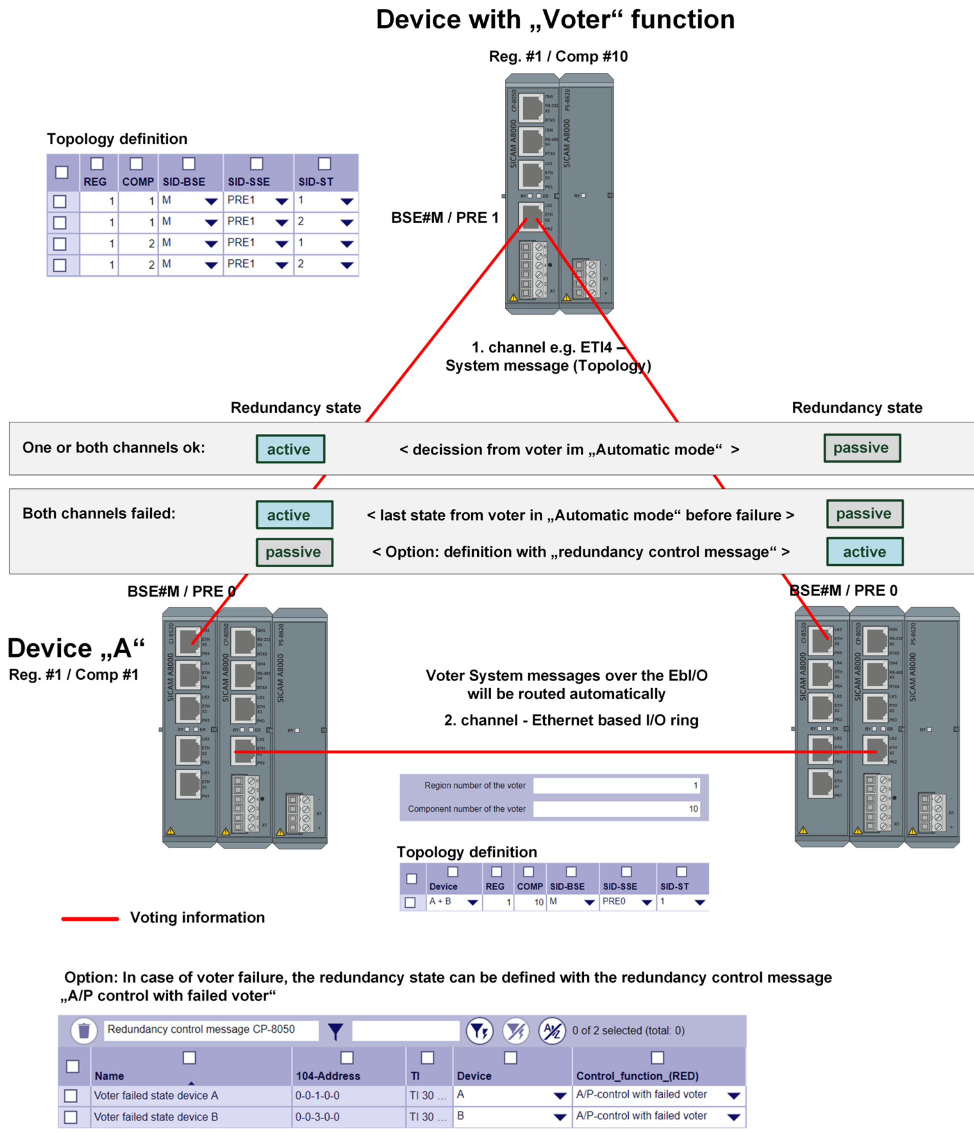
Device	REG	COMP	SID-BSE	SID-SSE	SID-ST
A	1	2	M	PRE3	1
B	1	1	M	PRE3	1
A	1	2	M	PRE0	point-to-point
B	1	2	M	PRE0	point-to-point

[dw_Redundancy_Voter-intVoter_2xPRE, 1, en_US]

7.5.3.2 Mode “1 external voter”

The 1 external voter solution consists of one SICAM CP-8031/CP-8050 voter and two (redundant) SICAM CP-8050 devices.

The communication between the devices takes place crosswise via standard communication protocols (e.g. via IEC 60870-5-104). The state functions send the voting information directly to the voter and also via the redundant CP-8050 to the voter. The topology must be defined in both, the redundant devices and in the external voter itself. The redundant path via which voting information is exchanged must either be established via a communication protocol (IEC101/104) via system messages, or, if available, via the redundancy link.



[dw_Redundancy_Voter-1extVoter, 1, en_US]

In this example, the redundancy link is used as redundant communication (2nd channel). If there is no redundancy link, a redundant connection via 2 protocols between the two devices can also be used as a redundant channel.

Failure Behavior

If the device A or B detects a failure of the voter device, the redundancy state is retained. In this case, the failure of the voter is assumed to be a single error, so the redundant device is still available. It is not switched to active, as with the internal voter.

Optionally, if the voter fails, the redundancy state can also be defined for both devices via the redundancy control message "A/P control on voter failure".

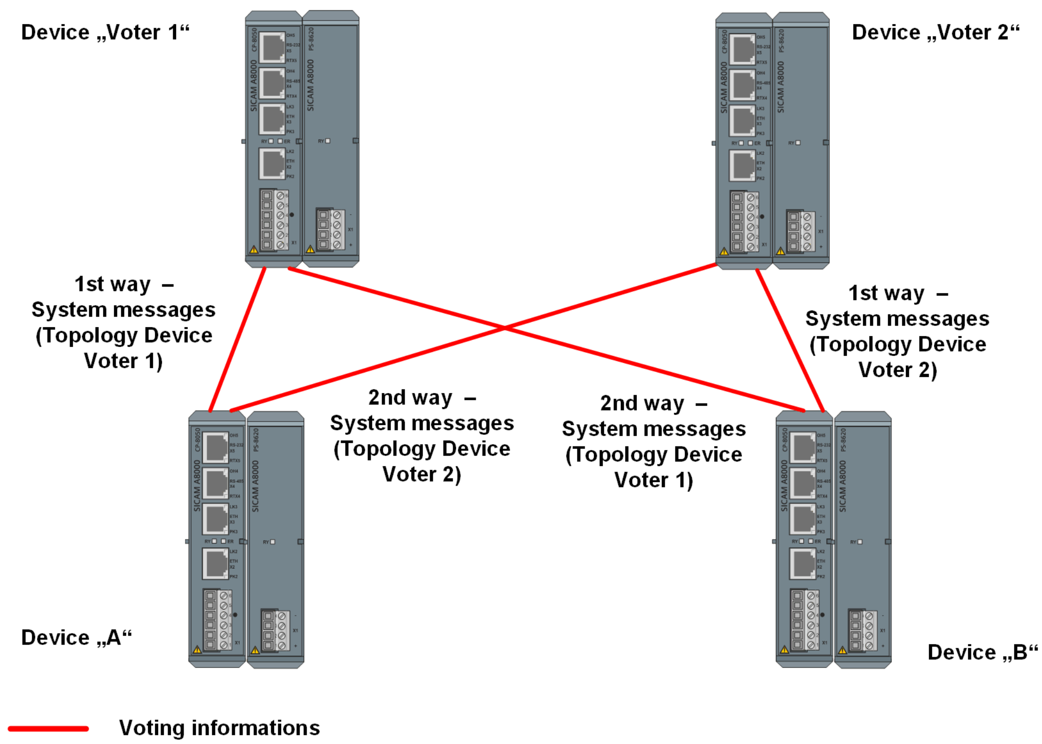
7.5.3.3 Mode ”2 external voter”

The 2 external voter solution consists of 2 redundant SICAM CP-8031/CP-8050 used as voters and the redundant CP-8050 device pair. The communication between the devices takes place crosswise via standard protocols and must be defined via the topology.

The redundant devices "A" and "B" always assume the redundancy states from the voter 1 in the error-free state. If the voter 1 cannot be reached, the states of voter 2 are used, but the redundancy function is retained in its entirety.

Only when both voters fail, the behavior for the voter failure comes into play and the redundancy state is maintained.

Optionally, if the voter fails, the redundancy state can also be defined for both devices via the redundancy control message "A/P control on voter failure". In this case, the redundant devices assume the status of the control telegram if this has been validly received.



[dw_Redundancy_Voter-2extVoter, 1, en_US]

7.5.3.4 Configuration of external Voters

Configuration of the redundant Devices

Basically, a functioning connection between the devices and the voters must be configured on all devices via a telecontrol protocol with support for system messages together with valid topology entries with system messages enabled.

In the case of redundant devices, the parameter "Voter" must be set to "1 external voter" or "2 external voters" for operation of external voters. Then the parameter group "Voter addresses" is displayed, where the system-technical addresses of the external voters must be entered.

Configuration of the Voter

The voter components must finally have a functioning connection together with valid topology entries with system messages enabled to the redundant components. The voting function is then automatically active in case of a valid configuration.

NOTE

The topology in the voters must be parameterized in such a way that the two redundant devices can be reached via both interfaces.

7.5.3.5 Supported Protocols

Any telecontrol protocol that implements the transmission of SICAM system messages can be used for communication with the external voters. These include the protocols listed below.

Protocol firmware	Protocol	Physical transmission
BPPI0	IEC 60870-101 Point to Point	RS-232, RS-422, RS-485
UMPSI0	IEC 60870-5-101 Multi-point traffic Slave	RS-232, RS-422, RS-485
UMPMI0	IEC 60870-5-101 Multi-point traffic Master	RS-232, RS-422, RS-485
ETI4	IEC 60870-5-104 (Client/Server)	TCP/IP Ethernet
ETI5	IEC 61850 (Ed2) Client/Server	TCP/IP Ethernet

7.6 Applicative Voting

The voting process is usually carried out by an external application based on the basis of received user data messages (more precisely: Redundancy return information messages). However, the voting is primarily applicative, where the voter also uses the error messages of the sum and detailed diagnostics to generate their own redundancy control messages for the switchover.

So, the behavior of the external application can be defined flexibly. The voting process is not based on the definition of priorities.

7.7 Data flow in the case of Redundancy

7.7.1 Redundancy Identifier R-Bit

In the case of redundant devices, the user data is almost always generated redundantly by the corresponding functions. In order to distinguish whether the user data telegram was generated by the active or passive function, the redundancy identifier, the R-Bit, is used. The R-Bit is part of the message and is transmitted in message status (bit 0).

R Redundancy Identifier

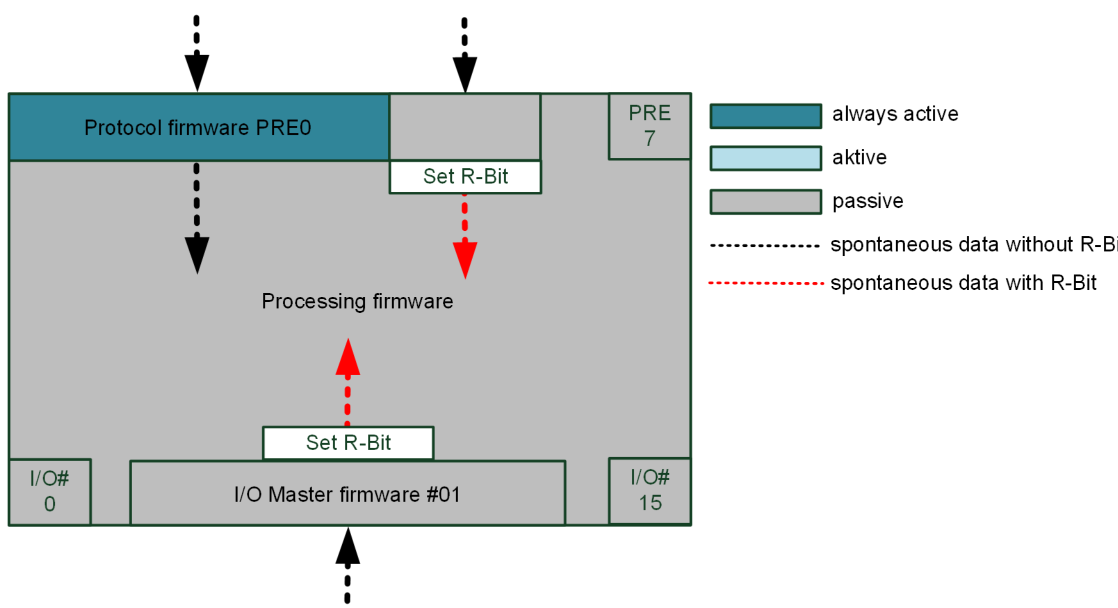
- 0 ... active or no redundancy
- 1 ... passive

The R-Bit is mainly evaluated, added and managed by functions in the passive processing firmware. So it is added on interfaces to passive protocol firmwares and I/O master firmwares and evaluated on the transmission side.

If the processing firmware is active, the R-Bit is not evaluated.

7.7.1.1 Set R-Bit when receiving from passive Firmware

If a message is received from a passive I/O master firmware or passive protocol firmware, the R-Bit is added to the message.



[dw_Redundancy_Overview-R_Bit_set, 1, en_US]

In the upper figure, the protocol firmware PRE0 is active, in which case no R-Bit will be added.

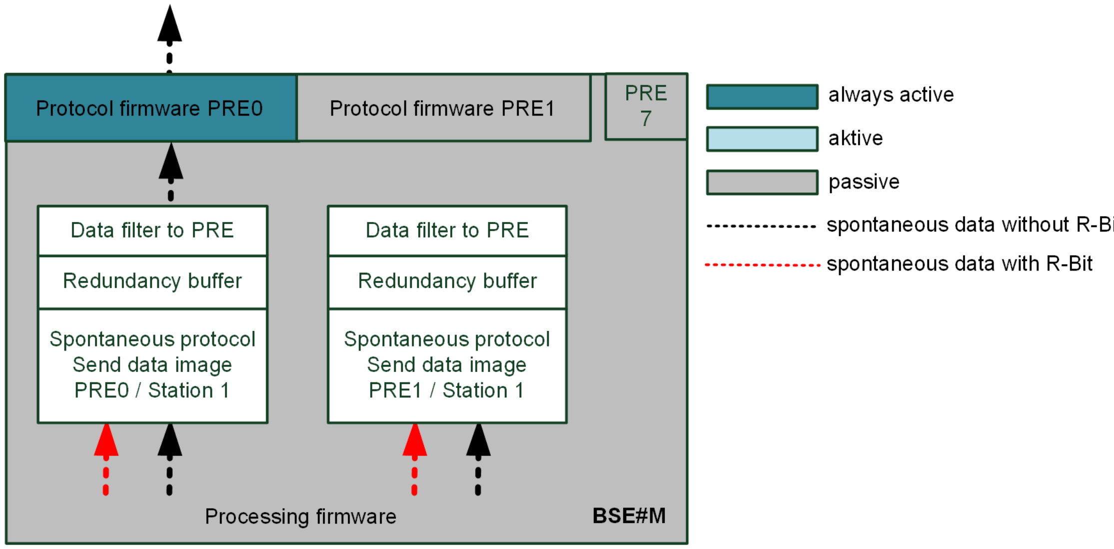
7.7.1.2 Data Filter to passive protocol Firmware

If data is sent to a passive protocol, the data transfer depends on the parameter **Redundancy | Settings for PREs | Data Filter to PRE**.

The following behavior can be defined for each protocol via this parameter:

if system element passive, filter user data (default)

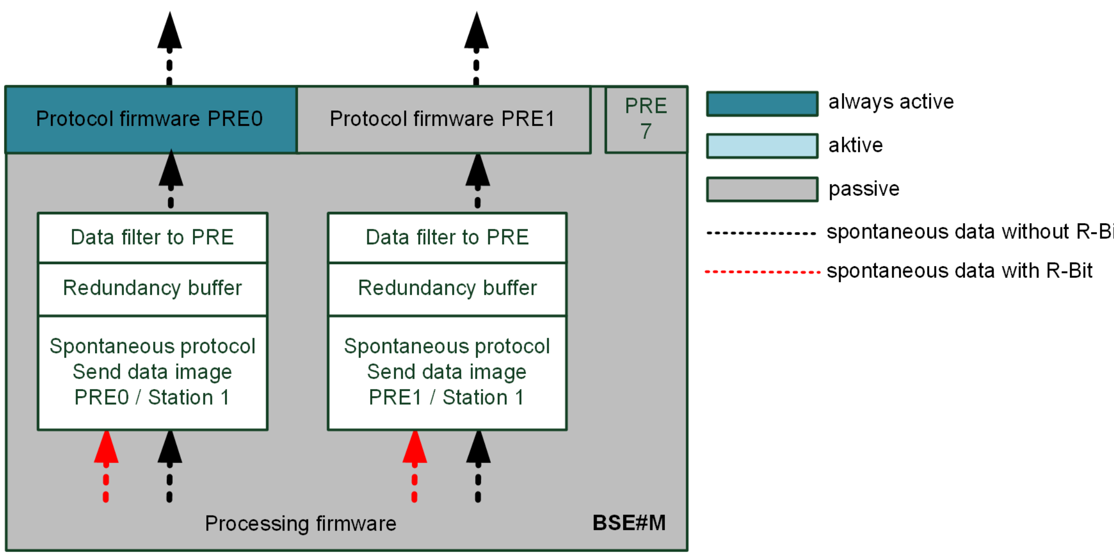
In this mode, all user data is discarded if the protocol firmware is passive or the R-Bit is set in the message.



[dw_Redundancy_Overview-PRE_Filter_all, 1, en_US]

filters only user data with status R

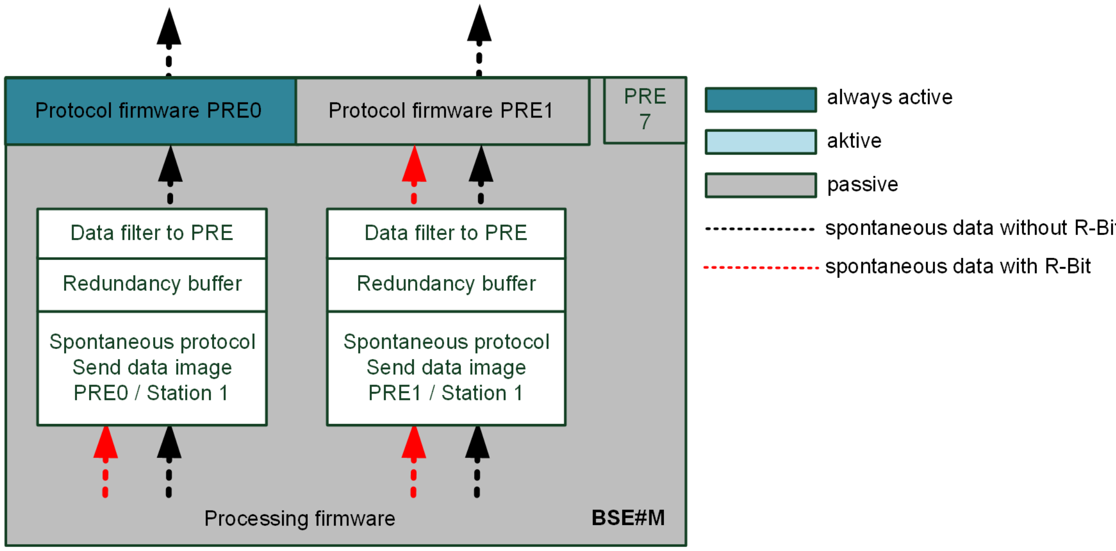
In this mode, all user data is discarded if the R-Bit is set in the message.



[dw_Redundancy_Overview-PRE_filter_only_R_Bit, 1, en_US]

User data filter deactivated

In this mode, all user data is passed on regardless of redundancy state and R-Bit.



[dw_Redundancy_Overview-PRE_filter_disable, 1, en_US]

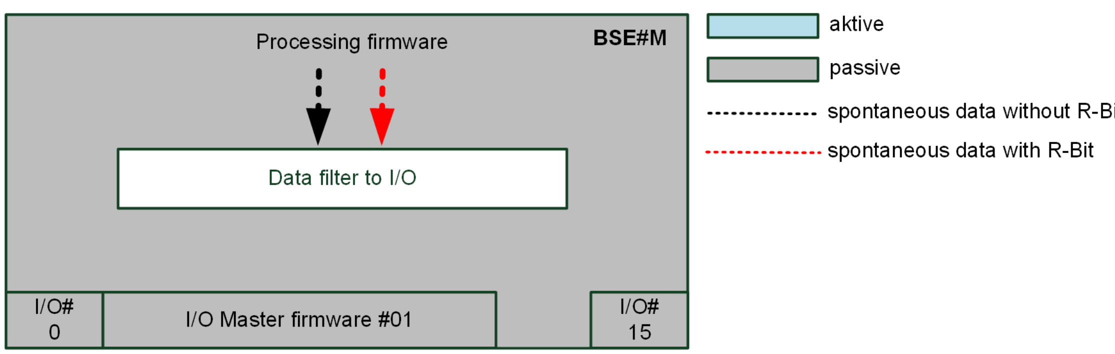
7.7.1.3 Data Filter to passive I/O Master Firmware

If data are sent to a passive I/O master firmware, the data transfer depends on the parameter "Redundancy | Settings for BSEs | Data Filter to I/O".

Using this parameter, the following behavior can be defined for all I/O master firmwares of the corresponding processing firmware:

"If system element passive, filter user data"

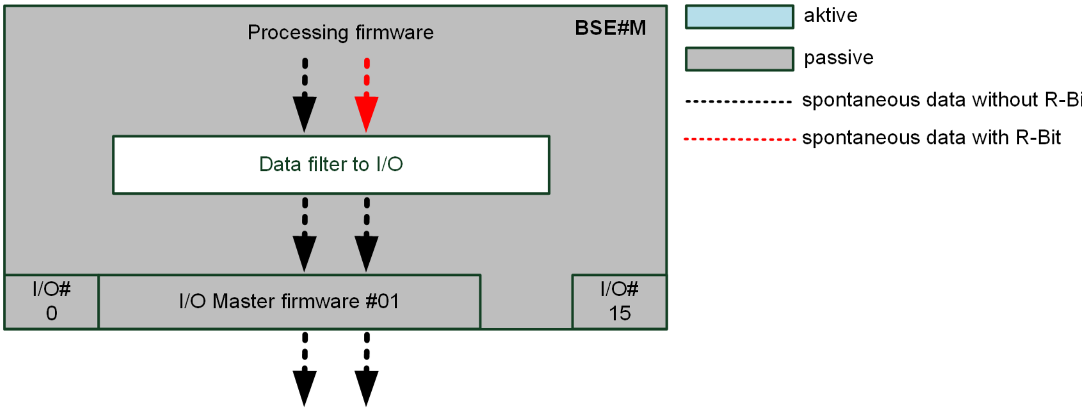
In this mode, all user data is discarded if the I/O master firmware is passive or the R-Bit is set in the message.



[dw_Redundancy_Overview-IO_filter_all, 1, en_US]

"User data filter deactivated"

In this mode, all user data is passed on to the I/O master firmware, in the case of spontaneous data with R-Bit, the R-Bit is deleted.



[dw_Redundancy_Overview-IO_filter_disable, 1, en_US]

7.7.1.4 Processing Functions "Singular Source"

The following processing functions are spontaneously transmitted "singularly" on both the active and passive processing firmware, i.e. there are no redundant data points with the same information.

- Error message detailed diagnostic table (CP-8050)
- Error message sum diagnostic table (CP-8050)
- Redundancy return information message (CP-8050)
- Protocol return information message (CP-8050)
- PLC output message with assigned R-Bit (see *7.7.1.6 R-Bit in the PLC Function*)

User data messages of these functions are also generated in the redundant state passively without R-Bits. If these messages are to be transferred, for example to protocol firmwares, the data filter for protocols must be set accordingly.

7.7.1.5 Processing Functions "Redundant Source"

The following processing functions are spontaneously transmitted both on the active without R bit and on the passive processing function with R-Bit.

- Special application output
- SIAPP output information

7.7.1.6 R-Bit in the PLC Function

The R-Bit can be used in the PLC application via the "R" attribute in the spontaneous message.

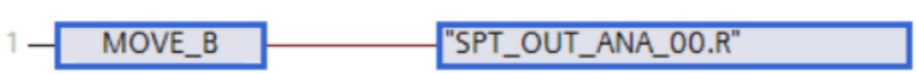
Input Signals

NOTE

If the PLC is synchronized in the case of a redundant processing firmware, then the R-Bit is always 0.

Output Signals

If data is generated by the PLC function in a passive processing firmware, the R-Bit is always automatically added when the message is generated. If the user uses the R-Bit of the output message in the PLC application, the state of the PLC application is transferred into the message.



[sc_signal_R-bit_in_PLC_Function, 1, --_--]

NOTE

If the PLC is synchronized in the case of redundant processing firmware, then the R-Bit must not be used because the data is always taken over by the active PLC.

7.7.1.7 General Interrogation with passive Firmware

If a general interrogation is received from another device on a passive processing firmware, only user data messages are sent without an R-Bit set.

7.7.2 Data flow with Redundancy Switchover

Turn processing firmware to active

If the processing firmware is switched to "active", a general interrogation (= "GI after active") will be performed or not due to the parameter "Redundancy | Settings for BSEs | General interrogation".

Turn processing firmware to passive

If the processing firmware is switched to "passive", the R-Bit is set for all functions that manage a message process image. For messages generated by "singular" processing functions, the R-Bit is not set.

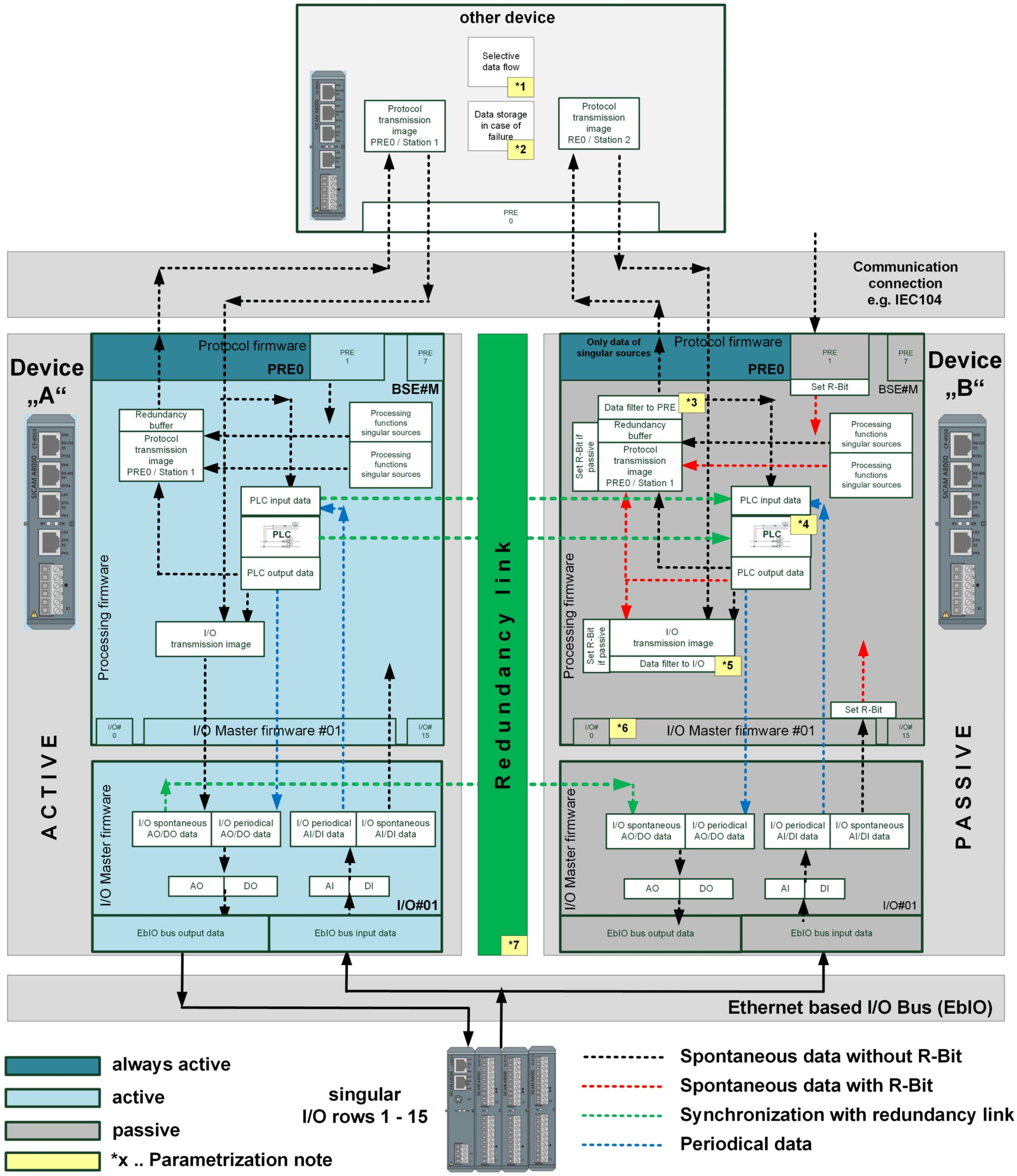
This concerns the following functions:

- Protocol transmission image
- I/O transmission image
- all other processing functions with a message process image

7.7.3 Data flow with synchronized PLC and singular I/Os

The following figure shows the data flow in the default configuration:

- Redundant synchronized PLC function
- I/O configuration "singular" I/Os
- Communication connection to another device via IEC104, whereby this interface is switched to "always active" in device "A" as well as in device "B".
  In this configuration, the data from the "other device" is always transferred to the two redundant devices.



[dw_Redundancy_Overview-Data_router_singIO, 1, en_US]

The redundant link is used to transfer the spontaneous PLC input information from the active PLC to the passive PLC. Furthermore, the spontaneous information to the I/O output modules is transferred directly from the active firmware to the passive firmware through the I/O master firmware.

7.7.3.1 PLC synchronization of spontaneous input process information

For spontaneous input signals, the control function has data storage in the receive direction. In this case, chronological information is temporarily stored during reception, on both the active and the passive PLC, possibly temporary stored in upstream rings, and change by change transferred to the control function.

As soon as information in the active PLC is copied into the process image of the controller, this information is also transmitted to the passive PLC and copied to the process image. When entering in the passive PLC, this information is also deleted from the receive rings of the passive PLC.

Due to this procedure, messages are not lost during redundancy switching (both passive).

Deleting the telegrams in the ring is timeout-monitored. If the messages are stored in the ring for more than 60 seconds without being synchronized by the active PLC, they are discarded.

7.7.3.2 Parameterization Notes

***1) Selective data flow – „Other device“**

In certain redundancy configurations, messages of the control direction (commands, setpoint values, etc.) are only transmitted to the active device after a startup, because the general interrogation was only answered from the active device and thus the distribution criterion (CASDU) was learned.

If a transfer to the passive devices is required in this case, there are the following solutions:

- Selective data flow
- Data flow filter

If you enter the data flow direction "both directions" in the topology for a communication interface, then the "Activation" will also be sent without any learned CASDU.

*** 2) Data storage in case of failure - "Other device"**

Since both interfaces of the other device are active to the "redundant device pair", the redundant devices are supplied with the "same data stream". The PLC input processing synchronizes these two data streams in order to enable lossless PLC switchover in the event of a device or communication line failure.

The protocol transmit image stores all data in rings until they are sent out to the stations. If the communication to one of the two devices fails, the data must no longer be stored in the rings, as the data are still sent to the redundant device and this data are synchronized again.

With going interface failure or if the failed device is present again (for example, after a reset), the stored data would be sent back to this device even though it has already been provided with this data by the redundant device.

To prevent this behavior, it is recommended in case of two active interfaces, to set the parameter "ETI4 | data management | data management in case of failure | Failure behavior for process information" to 0, i.e. clear data immediately in case of communication failure

***3) Data filter to PRE**

Set the parameter „Redundancy | Settings for PREs | Data filter to PRE“ for the protocol firmware BSE#M / PRE0 to „if firmware passive, filter user data“ (see *7.7.1.2 Data Filter to passive protocol Firmware*

***4) PLC synchronization for processing firmware**

Set the parameter „Redundancy | Settings for BSEs | PLC Synchronization“ for BSE#M to „Yes“.

***5) Data filter to I/O**

Set the parameter "Redundancy | Settings for BSEs | Data Filter to I/O" for BSE#M to "if passive firmware, filter user data". (see *7.7.1.3 Data Filter to passive I/O Master Firmware*)

***6) Singular I/O configuration**

Set the parameter „Redundancy | Settings for BSEs | I/O operating mode“ for BSE#M to „singular“. (see *7.7.1.2 Data Filter to passive protocol Firmware*

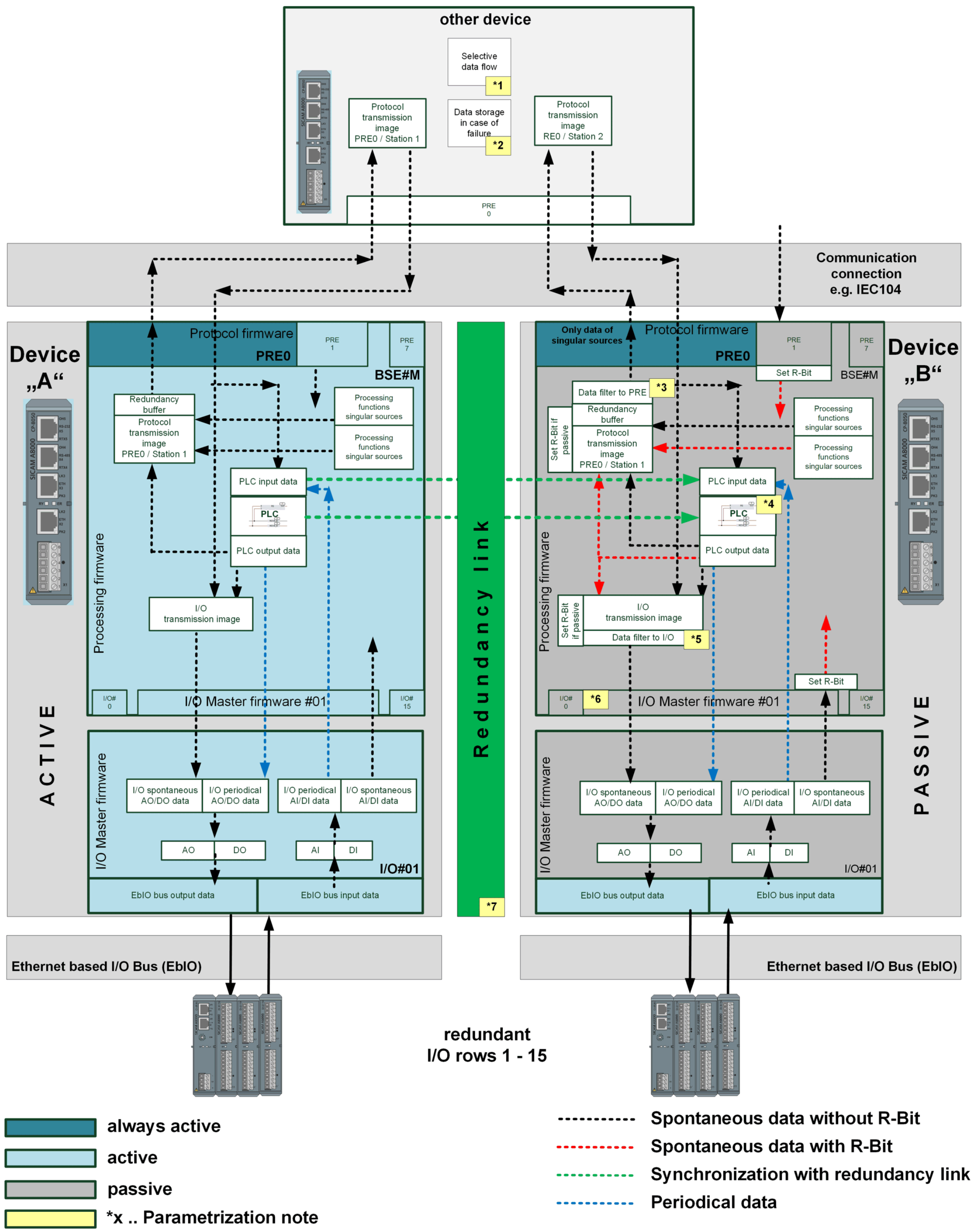
***7) Configuration of the Redundancy Link**

Since in this configuration both, the synchronized redundant PLC function and the singular I/O modules require a redundancy link, it is recommended to use the EbIO bus as a redundancy link. (see *7.4.2 Configuration of the Redundancy Link*)

7.7.3.3 Data flow with synchronized PLC and redundant I/Os

The following figure shows the data flow in the default configuration:

- Redundant synchronized PLC function
- I/O configuration "redundant" I/Os
- Communication connection to another device via IEC104, whereby this interface is switched to "always active" in device "A" as well as in device "B". In this configuration, the data from the "other device" is always transferred to the two redundant devices.



[dw_Redundancy_Overview-Data_router_redIO, 1, en_US]

The redundant link is used to transfer the spontaneous PLC input information from the active PLC to the passive PLC. The EbIO bus is available per device as the I/O modules are redundant.

Parameterization Notes

*1) Selective data flow – „Other device“

* 2) Data storage in case of failure - "Other device"

*3) Data filter to PRE

*4) PLC synchronization for processing firmware Parameterization notes *1 - *4 see *7.7.3.2 Parameterization Notes*

It is also possible to disable the synchronization of the PLC function, then no redundancy link is required.

*5) Data filter to I/O Set the parameter "Redundancy | Settings for BSEs | Data Filter to I/O" for BSE#M to "User data filter deactivated". (see *7.7.1.3 Data Filter to passive I/O Master Firmware*)

*6) Singular I/O configuration

Set the parameter „Redundancy | Settings for BSEs | I/O operating mode“ for BSE#M to „redundant“. (see *7.2.1 Redundant Devices with singular “I/Os” [Ring configuration]*)

*7) Configuration of the Redundancy Link

Since only the synchronized redundant PLC function and not the EbIO connect the two devices in this configuration, the "IP based" must be used as the redundancy link. (see *7.4.2 Configuration of the Redundancy Link*)

7.8 Engineering

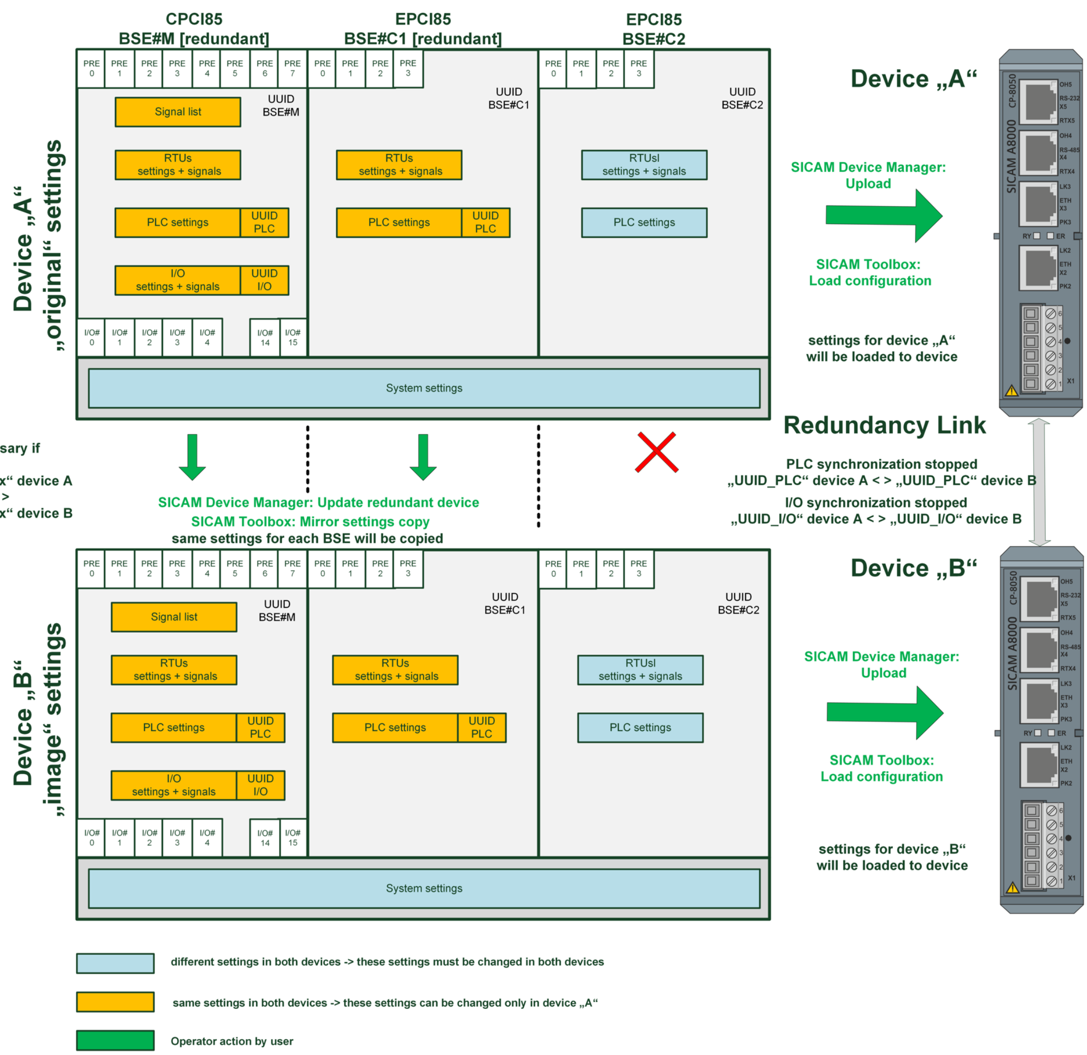
7.8.1 General

The engineering tool manages a separate parameter set for each device, which also has to be loaded for each device. However, the parameters are designed so that a large part of these parameters can be copied via redundancy copy functionality in the tool. Copying is always performed from device "A" (parameter original) to device "B" (parameter image).

However, there are also parameters that are not copied because they are different between device "A" and device "B".

The following architecture picture shows the different parameter types as well as the operator actions of the user with the following device setup:

- BSE#M (CPCI85) is redundantly defined, that means, same behavior in device A and B
- BSE# C1 (EPCI85) is redundantly defined, that means, same behavior in device A and B
- BSE#C2 (EPCI85) is not redundantly defined, that means, different behavior in device A and B



[dw_Redundancy_Engineering-Parameter_Architecture, 1, en_US]

As can be seen in the picture, it can be defined for each processing firmware whether the same behavior is needed in the redundant devices or not.

7.8.1.1 Select/Activate Redundancy

The first engineering step ist the activation and selection of the redundancy type. This is done with parameter **`RTU Settings | Central Processing (M) | RTU common settings | Redundancy type`**

7.8.1.2 Redundant Processing Firmware

The installation of processing firmwares must be the same on both devices, since the global installation is transferred to device "B" in the copy process.

Protocols for non-redundant processing firmware must then be parameterized and installed in both devices. Thus, in these a different protocol installation can be performed.

Redundant processing firmware (BSE)

Redundant BSEs always have identical parameters that are parameterized in device A and copied to device B. Unlike SICAM AK, SICAM CP-8050 copies all RTU settings for redundant BSEs.

The "Central processing (BSE#M)" must always be defined redundantly, in the "Extended processing (BSE#C1-4)" it depends on the functionality of the PLC application and the protocols used, whether a redundant BSE is required.

Not redundant processing firmware (BSE)

Should different user programs (for example: summations of diagnostic information of the own device) or different protocols run in the two devices so the parameters must not be copied.

The definition whether a processing firmware is redundant or not is different between SICAM TOOLBOX II (see *7.8.3.1 Generate Device „B"*) and SICAM Device Manager (see *7.8.2.1 Generate Device „B"*

7.8.1.3 Parameter „Device" – „A", „A+B" and „B"

This column was introduced for the redundancy function and represents a significant improvement for the redundancy engineering in contrast to the redundancy in SICAM AK. It is necessary in order to realize different device behavior and still carry out the engineering only in device "A".

For example: The two devices "A" (Reg#1/K#1) and "B" (Reg#1/K#2) have a common connection to another device (Reg#1/K#10)

A redundant device pair has a cross-connection via an end-end protocol (BPPI0)

The following selection box is available in the device column:

- "A + B" ... This parameter entry is valid in device "A" as well as in device "B" (default)
- "A" .... This parameter entry is only valid in device "A"
- "B" .... This parameter entry is only valid in device "B"

	Device	REG	COMP	SID-BSE	SID-SSE	SID-ST
	A + B	1	10	M	PRE0	1
	B	1	1	M	PRE1	point-to-point
	A	1	2	M	PRE1	point-to-point

[sc_A+B, 1, en_US]

Since the topology is copied from device "A" to device "B", 3 topology sets are loaded into the target system in both devices.

The firmware in the target system knows whether it is running in device A or B and activates the following topology entries:

- In device A, the 1 topology sets with the identifier "A + B" and the one with "A" are activated
- In device B, the 1 topology sets with the identifier "A + B" and the one with "B" are activated

Advantage to the SICAM AK

The user has all topology entries in one table and does not always have to enter the same topology entry in both devices.

This method is used in many parameter tables, such as station definition and signal engineering, and is always based on the same principle.

7.8.1.4 Properties of the Parameter Types for the Copy Function

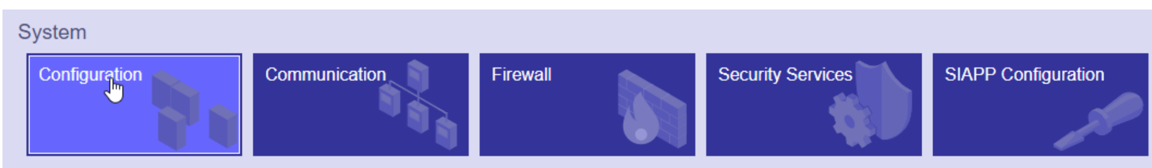
Parameters can be copied from device A (original) to device B (image) if the following requirements are met:

- The "global" or "protocol-selective" redundancy is set.
- SICAM TOOLBOX II
  For engineering with SICAM Toolbox II, the redundant processing firmwares of the devices must be defined (see *Define redundant processing firmware , Page 503*)
- SICAM Device Manager
  In the "Redundancy | Settings for BSEs" parameter group, the "Update" parameter defines the redundant processing firmwares.

System settings

The SICAM CP-8050 system is an open platform for applications that can be used to run customer applications in the future, not just the "RTU" function. Furthermore, there are many parameters that are different between device "A" and "B". These include, for example, all IPv4 addresses, security settings such as radius server, but also the firewall rules cannot be identical between the devices.

In order to be open for these different future requirements, the system settings are not copied by the copy function.



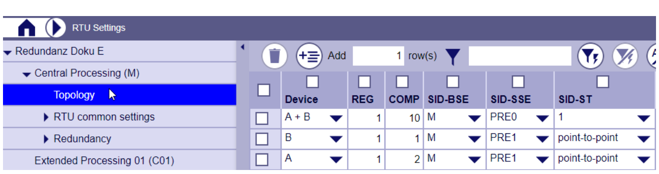
[sc_SICDM_Redundancy_System_Settings, 1, en_US]

When generating device "B" all parameters including system settings are copied. Each time the copy function is called again, the system settings are no longer copied. Then the parameters in device "A" and device "B" must be selectively changed.

It is recommended to set and, if possible, to test all system settings (such as configuration, Ethernet port and LAN interfaces, security settings ...) before the first copy

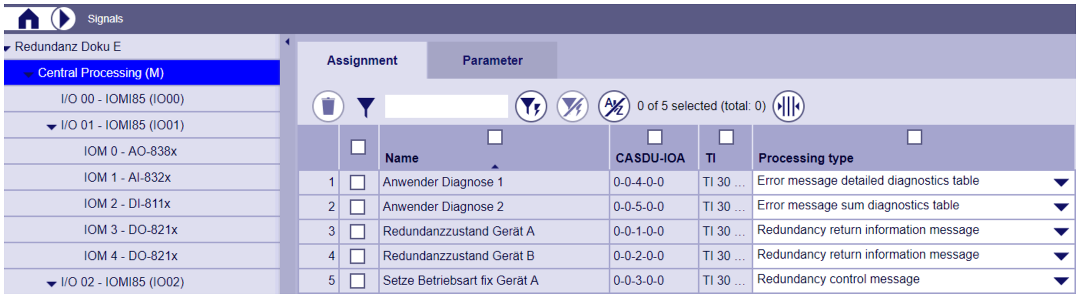
RTU Parameter

These parameters are essentially the RTU parameters as well as the protocol parameters and the protocol signals.



[sc_SICAM_DM_RED_Topology_A_B, 1, en_US]

Furthermore, the signals of the processing firmware and protocol firmware are also assigned to the RTU parameters.



[sc_eng_RTU_para_assign, 1, en_US]

PLC Parameter

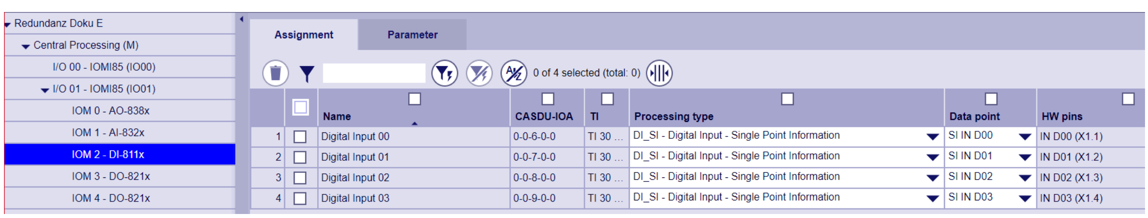
These parameters are the PLC application and its signal assignments. These parameters are always assigned to a processing firmware. If the processing firmware is defined as redundant, the PLC application is copied by the copy function, that means it can only be changed in device A.

These parameters are internally provided with the identifier "UUID-PLC", which is evaluated by the synchronization function in the target system. Each time these parameters are changed, the engineering tool calculates a new UUID and supplies it with the PLC parameters.

If PLC synchronization is enabled, both devices must have an identical "UUID-PLC" for synchronization to work. With different "UUID-PLC" the synchronization is stopped.

I/O Parameter & Signals

These parameters are all I/O parameters and their signal assignments for all I/O master firmwares of the associated processing firmware. If the processing firmware is defined as redundant, the parameters are copied by the copy function, that means they can only be changed in device A.



[sc_eng_IO_para_signals, 1, en_US]

These parameters are provided with the identifier "UUID-I/O". Each time you change these parameters, the engineering tool calculates a new UUID and adds it to the I/O parameters.

For singular I/Os, an identical "UUID-I/O" must be present in both devices for the function to work. With different "UUID-I/O" the synchronization is stopped for all I/O master firmwares of the processing firmware. When the active device is loaded, only those I/O master firmwares are reset for which parameters requiring reset are loaded.

UUID-BSE

Each of these above-mentioned parameter types is assigned to a processing firmware (BSE). As soon as a parameter is changed, a new "UUID-BSE" is calculated. This "UUID-BSE" is used by the copy function of the engineering tool for the parameter comparison between device "A" and device "B". The parameter comparison is performed per redundant processing firmware.

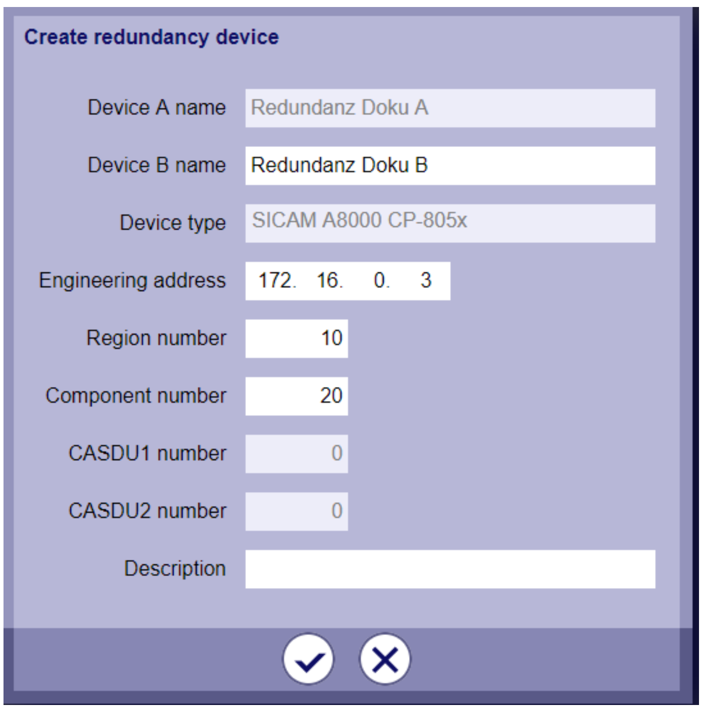
7.8.2 Engineering Tool - SICAM Device Manager

7.8.2.1 Generate Device „B“

To create a redundant device, a CP-8050 device must be selected in the device overview and the menu item "Create redundant device" must be executed.

[sc_SICAM_DM_RED_PRE_Create_Red_Device, 1, en_US]

After this action a dialog will appears, in which the properties of the redundant device are defined. The device being copied is automatically defined as device "A", the new redundant device is defined as device "B". This can also be seen on the icons.



[sc_SICAM_DM_RED_PRE_Create_Red_Device_dialog, 1, en_US]

Name, regions/component number and engineering IP address of device "B" must be defined. If the engineering IP address is found in the system settings "LAN interfaces", the IP address is changed automatically. When the redundant device is created, the SICAM Device Manager automatically generates a device ID with which the device is identified when "loading and reading back" the engineering data.

NOTE

It is recommended to set and, if possible, test all system settings (such as configuration, Ethernet port and LAN interfaces, security settings ...) before generating device "B".

When generating the "redundant device", all parameters, including system settings, are copied. Every time the copy function "Update redundant device" is called again, the system settings are no longer copied. Thereafter, the system settings in device "A" and device "B" must be selectively changed

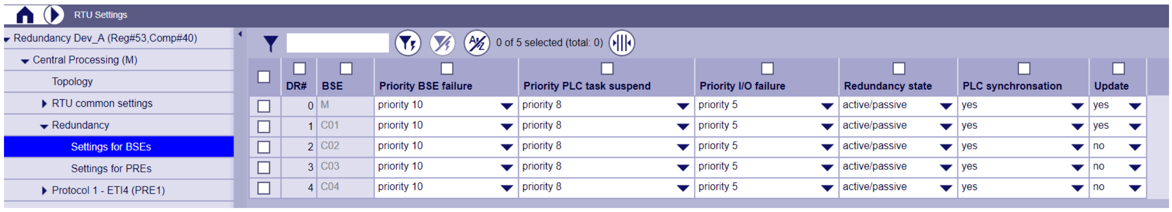
7.8.2.2 Copy function "Update redundant device"

If the device "B" is generated, all changes of the RTU settings and signals as well as all CFC plans of redundant processing firmwares always have to be done in device "A". Changes for signals and CFC plans are blocked in device "B". However, the changes can be transferred to device "B" using the "Update redundant device" operator action.

NOTE

The system settings are no longer accepted. Exception for hardware/firmware configuration: The I/O bus configuration and all protocol configuration and firmware versions are also copied for redundant BSEs.

In this copying process, only all redundant processing firmwares are adopted. This is derived from the parameter "RTU Settings | Redundancy | Settings for BSEs | Update". All BSEs marked with "Yes" will be copied.



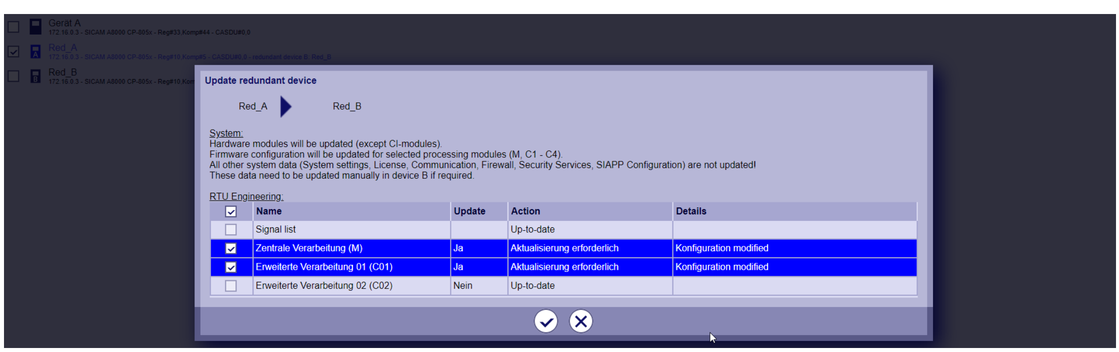
[sc_SICAM_DM_RED_BSE_settings_with_update, 1, en_US]

Update redundant device

- Select the original device A
- In the context menu, select the entry Update redundant device ......

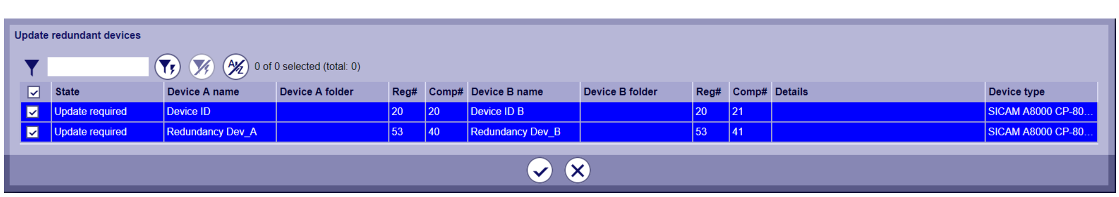
[sc_SICAM_DM_RED_PRE_Update_Red_Device, 1, en_US]

A dialog with all changes appears.



[sc_SICAM_DM_RED_PRE_Update_Red_Device_Dialog, 1, en_US]

The copying of all redundant devices "A" to the corresponding redundant devices "B" can also be done in the device overview.

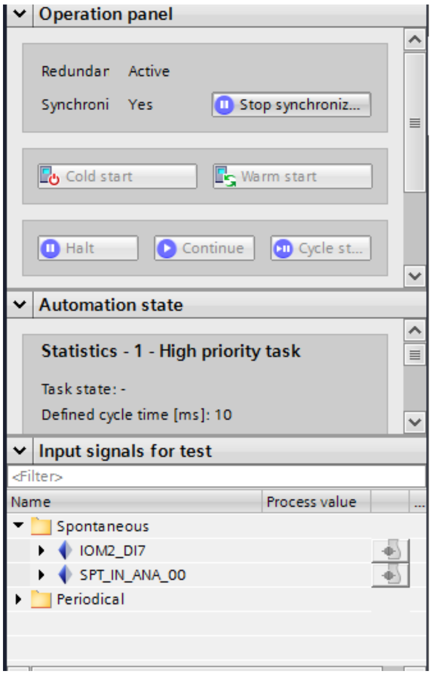


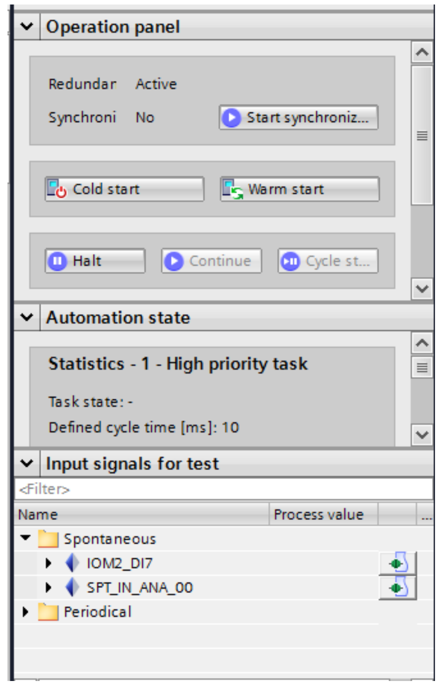
[sc_SICAM_DM_RED_PRE_Update_Red_Devices_Dialog, 1, en_US]

7.8.2.3 CFC Online test with redundant PLC function

The Online test works on both the active and the passive PLC. All values in the programs are displayed and also the trend function works.

If changes are to be made in the Online test by operator inputs of the user, the synchronizing function must first be stopped manually.





Then the following functions are activated in the Online test:

Test Switches

The test switches for spontaneous/periodic signal input/output images can be operated. Changes are not synchronized.

Cold start / warm start

Active PLC: If a cold start / warm restart is performed on the active PLC, the same procedure is used as for single PLCs. All instance data are initialized and the processing of the application program is restarted.

Passive PLC: A cold start / warm start on the passive PLC initializes all instance data and then requests a full update from the active PLC. If the synchronization was stopped during the Online test by operator actions of the user, then a FULL update is carried out automatically and the synchronization is restarted if possible. Leaving the Online test. If the synchronization was stopped during the Online test by operator actions of the user, a FULL update is automatically carried out when leaving the Online test and the synchronization is restarted if possible.

Leaving the Online test

If the synchronization was stopped during the Online test by operator actions of the user, a FULL update is automatically carried out when leaving the Online test and the synchronization is restarted if possible.

7.8.3 Engineering Tool - SICAM TOOLBOX II

7.8.3.1 Generate Device „B“

After device A has been completely parameterized and tested, device B can be generated.

Using the menu item "Create AE (Wizard)" and the selection "Copy existing automation unit", device B can be generated for the first time in the toolbox.

Thereafter, the copied device B must be defined as redundant device to A via the following steps:

- In the parameter set of device B set the parameter Device to "B (image)" (see *Define a redundant device , Page 503*)
- Define all required redundant processing firmware as "redundant" (see Chapter *Define redundant processing firmware , Page 503*)

NOTE

It is recommended to set and, if possible, to test all system settings (for example, configuration, Ethernet port and LAN interfaces, security settings ...) before copying the device.

Define a redundant device

With the parameter "Device" a distinction is made between the two redundant devices, in device "A" (parameter original) and device "B" (parameter image).

In the Value drop-down list, select one of the following entries:

- A (original)
- B (image)

NOTE

After the first call of the function "Copy mirror parameters to ...", this parameter is dimmed on device B and can no longer be edited.

Define redundant processing firmware

These parameters define the redundant processing firmwares in the device. By means of these settings (must match both in the device A and B), the "copy mirror parameters" function of the OPM is enabled for each processing firmware. The region and component number also define the redundant device address for the voter.

In both devices the address of the redundant device per processing firmware

- Region number of the redundant device
- Component number of the redundant device
- BSE number of the redundant device

must be set.

These parameters must be parameterized accordingly for all redundant processing firmwares.

Central processing: 20 [BSE#M]

Extended processing: 1-4 [BSE#C1–BSE#C4]

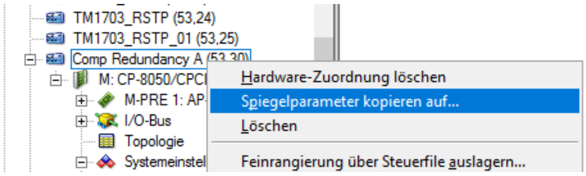
If "Copy mirror parameters to ..." has already been carried out, this parameter is dimmed on device B and can no longer be edited.

7.8.3.2 Copy function "Copy mirror parameters"

Copying device "A" to device "B" can be done per device, but also for the complete system technical plant.

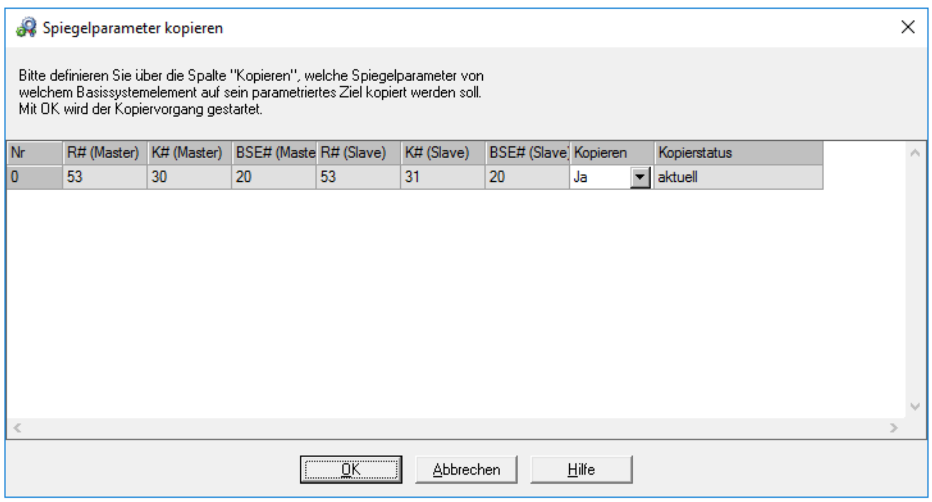
Copy mirror parameters per device:

- Select the original device A
- In the context menu, select Copy Mirror Parameters to ......



[sc_SICAM_TB_copy_mirror_para_1, 1, en_US]

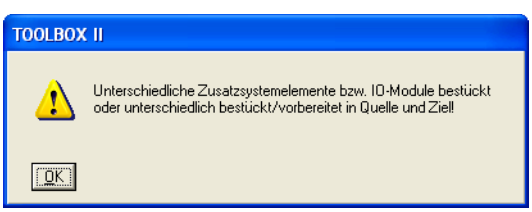
- A new window appears with the BSE pairs found



[sc_SICAM_TB_copy_mirror_para_2, 1, en_US]

- In the Copy column, select the processing firmware to be copied and press OK

If the elements of the redundancy pair are configured differently (one is for example equipped with an I/O master firmware and I/O modules, the other is not), the following message appears:



[sc_SICAM_TB_copy_mirror_para_3, 1, en_US]

In the case of an inconsistency, however, this must be done manually on device B.

NOTE

The copy function does not copy the system settings and firewall table. The system settings must be selectively changed in device "A" and device "B" and the firewall in each device must be regenerated if necessary

7.8.3.3 CAEx plus online test with redundant PLC function

The Online test works on both the active and the passive PLC. If changes are made in the Online test by operator actions of the user, however, due to the update function, the following must be observed:

Test Switches

The test switches for spontaneous/periodic signal input/output images are not synchronized by the update function. If an input or output is switched to test by the user, the synchronization is stopped.

Force Marker

Active PLC: If force markers are set on the active PLC, they are transferred to the passive PLC.

Passive PLC: If force markers are set on the passive PLC, the synchronization is stopped

Start/stop PLC

If PLC applications are stopped or started by operator actions, the synchronization is stopped.

Cold start / warm start

Active PLC: If a cold start / warm restart is performed on the active PLC, the same procedure is used as for single PLCs. All instance data are initialized and the processing of the application program is restarted. Changed data are automatically transferred via the update function to the passive PLC.

Passive PLC: A cold start / warm start on the passive PLC initializes all instance data and then requests a full update from the active PLC. If the synchronization was stopped during the Online test by operator actions of the user, then a FULL update is carried out automatically and the synchronization is restarted if possible.

Leaving the Online test

If the synchronization was stopped during the Online test by operator actions of the user, a FULL update is automatically carried out when leaving the Online test and the synchronization is restarted if possible.

7.8.3.4 Redundancy Control/Return Information Messages

Redundancy control messages are parameterizable user data messages in single-point information format (TI 30) or single commands (TI 45) that define the desired redundancy behavior in the CP-8050.

Redundancy return information messages are user data messages with a configurable 5-level address (CASDU1, CASDU2, IOA1, IOA2, IOA3) and a fixed type identifier (30 = single-point information), which provide e.g. information about the redundancy states of the individual firmwares or the set operating mode.

The messages can be parameterized in the OPM, menu Tools, menu item Type overview (Parameter tab Parameter: under SICAM 1703 + Ax 1703 + SICAM A8000 -> System functions -> Redundancy control messages CP-8050 or Redundancy return information message CP-8050).

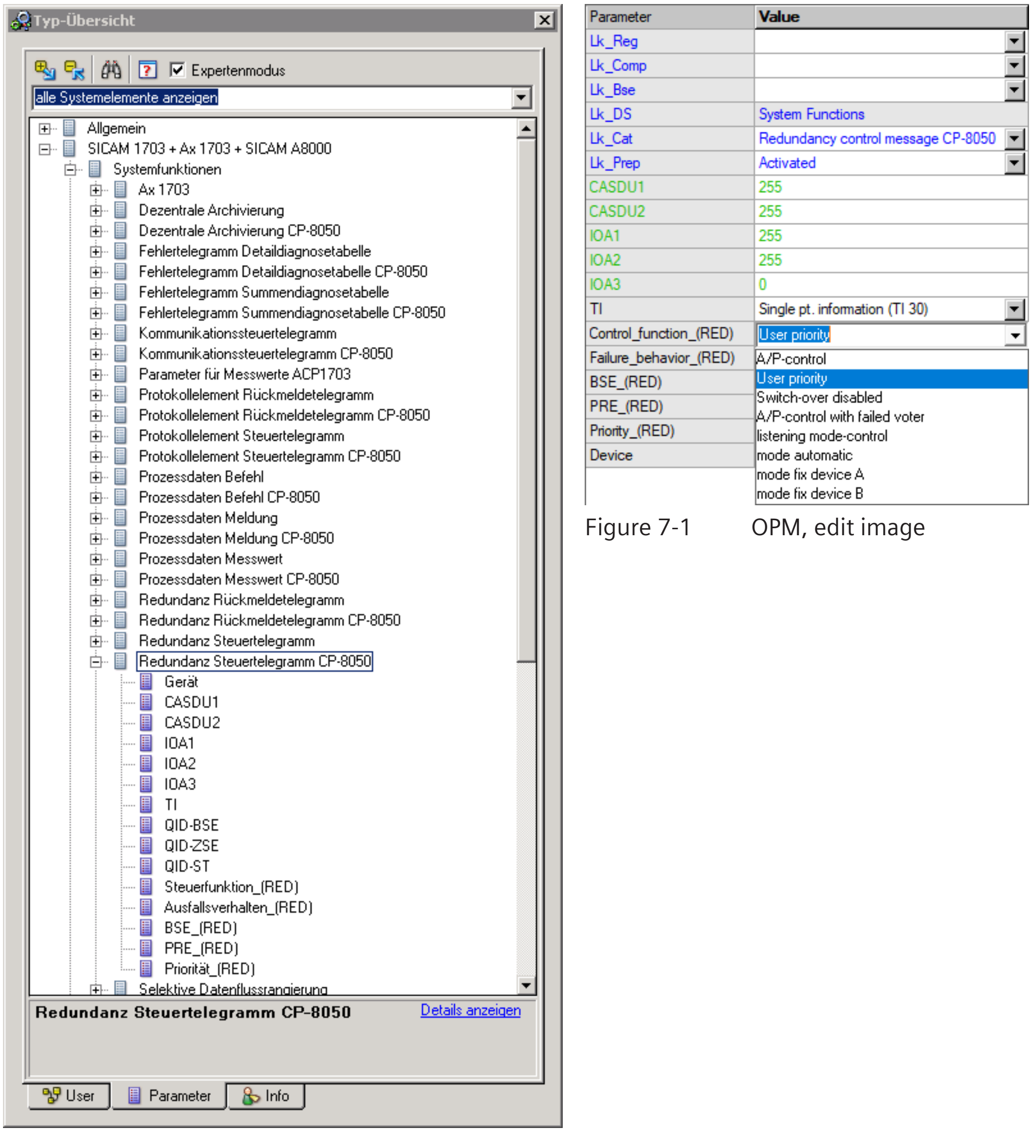


Figure 7-1 OPM, edit image

7.8.4 Parametrization of the Central Processing [CPCI85]

7.8.4.1 System settings

Redundancy Link

This parameter is used to select and set the medium for synchronization between the redundant devices.

- Select in the system technology of the OPM under the M-CPU the synchronization interface under the node System Settings | Redundancy Synchronization, or in the SICAM Device Manager under System | Configurations | System Settings | Redundancy Link the synchronization interface
- In the Value drop-down list, select one of the following entries:
  - Ethernet based I/O
  - IP based

  In the case of „IP based", two new parameters become visible to define the physical interface and the IP address of the remote station

- LAN interface
- remote IP address

7.8.4.2 RTU Setting

Redundancy Type

- In the system technique of the OPM or the Device Manager, under "Central Processing", select the Redundancy under the node RTU General Settings:
- In the Value drop-down list, select one of the following entries:
  – global
  – protocol-selective
  – protocol-selective with applicative voting
- A new folder Redundancy becomes visible in which the following parameters are available.

The following parameters apply only to the subtypes of device redundancy.
Most parameters are identical for all types of redundancy.

Voter

This parameter sets whether the voting function should run in the two redundant devices or whether there are one or two external devices (CP-8031/CP-8050).
In the Value drop-down list, select one of the following entries:

- Internal Voter
- External Voter
- 2 external Voter

If 1 or 2 external voters are parameterized, a group "Voter addresses" becomes visible in which a region and component number can be parameterized for the voters.
There are no parameters to be defined in the device in which the external voter is running.

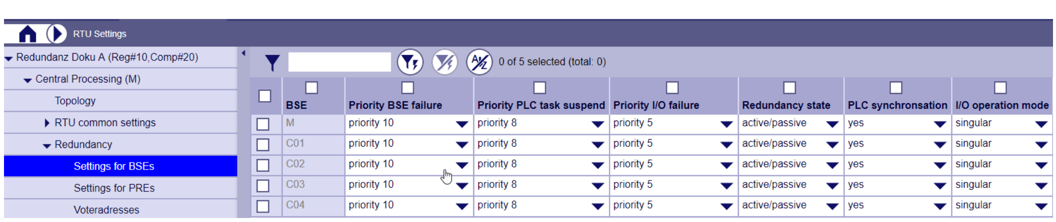
Cyclic Monitoring Voter

This parameter is used to set the grid in which the redundant devices send their priority messages to the voters (0.1 to 15 seconds in the 100 ms grid). The voters monitor reception twice the time.
Default: 1 second

Blocking time after a Switch-over

After a redundancy switch has been initiated, this parameter is used to prevent or delay the switchback for a certain time (1 to 255 seconds in the second grid).
Default: 3 seconds

Settings for BSEs (global, protocol-selective)

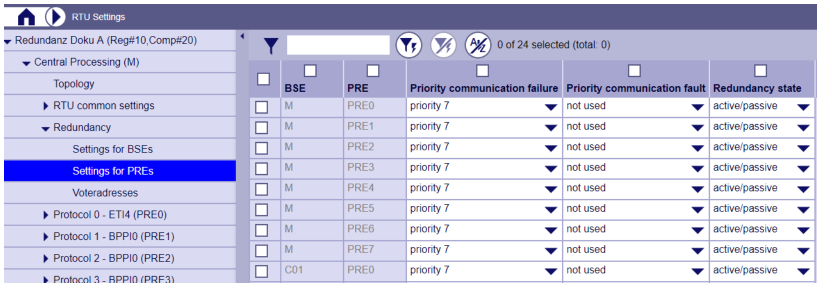


[sc_SICAM_DM_RED_BSE_settings, 1, en_US]

Some columns, which usually need not be changed, are hidden and can be selectively faded in.
Select **`Settings for BSEs`**:

Column Name / Parameter	Description / Value	Note
BSE	all BSEs (4 Cs, one M)	not editable
Priority BSE failure	Definition of the priority level for the failure of the relevant processing firmware (error type: Firmware, application shut down)	
Delay after BSE failure (Expert View)	Definition of the period after which the priority for a failure of the processing firmware is withdrawn after an going failure (in seconds)	Also applies to the priority of the BSE#M in a total startup
Priority PLC task suspended	Definition of the priority level when a PLC task is stopped	
Priority I/O failure	Definition of the priority level, if the • Firmware of the I/O Master Module • the CI-853x Hardware or • an I/O Module fails.	
Redundancy state	defines whether the voter should switch the defined processing firmware (active/passive) or not (always active)	The parameter applies to the selected processing firmware. The I/O master module (if any) takes over the state of the processing firmware. is switched indirectly to passive: the data of I/O modules are marked with R-Bit.
General Interrogation (Expert view)	defines whether, after the processing firmware has been switched over to active, a GI is to be sent (GI after active) or not (no GI after active)	
Data filter to I/O (Expert view)	defines the behavior of the processing firmware (if passive) for "user data to the I/O modules" if processing firmware is passive, filter user data User data filter deactivated	the passive processing firmware filters all user data messages passive processing firmware sends all data, including user data
PLC synchronization	Defines whether the PLC is to be synchronized on the passive processing firmware yes: the processing firmware uses the redundancy link to synchronize the PLC no: the PLC is not synchronized	
I/O operating mode	Singular: There are only singular I/O modules, which are used by both devices (EbIO bus necessary) Redundant: Each device uses its own I/O modules	With "Singular", no I/O modules must be connected directly to the local CP-8050.
Update	Defines whether it is a redundant processing firmware, that means the parameters of the processing firmware are copied via the copy function yes: Parameters are copied no: Parameters are not copied	This parameter is only relevant for engineering with SICAM Device Manager

Settings for PREs (global, protocol-selective)



[sc_SICAM_DM_RED_PRE_settings, 1, en_US]

Some columns, which usually need not be changed, are hidden and can be selectively faded in. (Expert parameter)

Select **`Settings for PREs`**:

Column Name / Parameter	Description/Value	Note
BSE	all processing firmwares (4 Cs, one M)	not editable
PRE	Eight protocol firmwares (0-7) of M four protocol firmwares each (0 – 3) pro C	not editable
Priority PRE failure (Expert view)	Definition of the priority level for the failure of the relevant protocol (firmware errors)	
Priority communication failure	Definition of the priority level for the communication failure of the concerned protocol	
Priority communication fault	Definition of the priority level for a communication fault of 1 ... (n-1) Connections on the affected protocol firmware	
Redundancy state	defines whether the voter should switch the defined protocol (active/passive) or not (always active)	For example: It is possible that not all firmwares are switched passively to continue to transmit information on redundancy statuses and diagnostic messages on the interface to the master computer
General Interrogation (Expert view)	defines whether, after the affected protocol has been switched over to active, a GI is to be sent (GI after active) or not (no GI after active)	
Data filter to PRE (Expert view)	defines the behavior of the protocol (if passive) filters only user data with status R if protocol firmware is passive, filter user data User data filter deactivated	the filter only refers to the transmission direction. Filtering means that the data point is not sent out the passive protocol only filters messages with the set status bit R (R bit = redundancy) the passive protocol filters all messages with user data the passive protocol sends all data, including user data
PRE synchronizing mode (Expert view)	yes: the protocol uses the synchronization interface to synchronize with its redundant protocol no: the protocol is not synchronized	Synchronization is only supported by special protocol firmwares

7.8.5 Settings for each Processing Firmware

The redundancy buffer serves to avoid data loss in the period from the occurrence of a fault/failure to a redundancy switchover. These parameters are once present for central processing as well as for all extended processing firmwares.

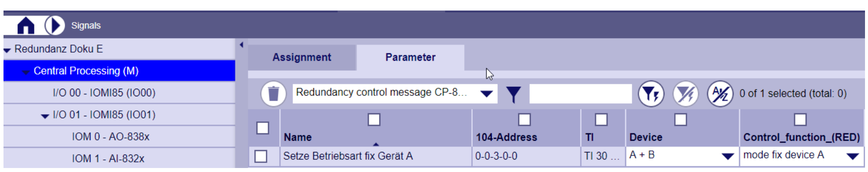
Column Name / Parameter	Description/Value	Note
Buffer size (Expert view)	maximum number of process information that can be additionally stored in the buffer time	Only valid for the communication function.
Buffer time (Expert view)	maximum time during which the process information has to be additionally stored	1-255 seconds Valid for communication and PLC function.

7.8.6 Signals

Signals must always be assigned to device "A" in both the Device Manager and the SICAM Toolbox II. It can be defined via the parameter "Device" in which device the signals are valid. (see *7.8.1.3 Parameter „Device" – „A", „A+B" and „B"*)

Example for the control direction:

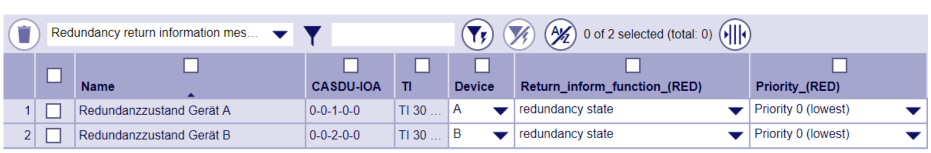
In the case of redundancy, control messages (e.g.: Operating mode fix device A ", the signal can be used in both devices. i.e. Device in this case be set to "A + B".



[sc_SICAM_DM_RED_Control_Message, 1, en_US]

Example for the return information direction:

As return information the redundancy state can be read out via the message "redundancy state" for device A as well as device B. For these two signals must be created and assigned once to the device A and once to the device B.



[sc_SICAM_DM_RED_Return_Message, 1, en_US]

7.8.6.1 Redundancy Control Messages CP-8050

Redundancy control messages are parameterizable user data messages in single-point information format (TI 30) or single commands (TI 45) that define the desired redundancy behavior in the CP-8050.

The redundancy control messages have the following parameters and can assume the following values (in brackets):

- Device (A+B, A, B)
- CASDU1 (0-255)
- CASDU2 (0-255)
- IOA1 (0-255)
- IOA2 (0-255)

- IOA3 (0-255)
- TI, Type identification (Single-point information TI=30, Single command TI=45)
- BSE_(RED) (C1 to C4, M, not used) ..... only relevant for protocol-selective switch over
- PRE_(RED) (PRE0 bis PRE7, BSE itself, not used) ..... only relevant for protocol-selective switching
- Control function_(RED) (A/P-control, User priority, Switch over lock, A/P-Control in case of voter failure, Listening mode, Operating mode automatic, Operating mode fix device A, Operating mode fix device B)
- Failure_behavior_(RED) (retain state, deactivate message)
- Priority_(RED) (Priority 0 (lowest) to Priority 14 (highest)) .... only relevant with user priority control function

Table 7-2 Overview of the different combinations of functions with possible redundancy and type identification

Control_function_(RED)	Redundancy	Type Identification
A/P-control	Protocol-selective with applicative voting	Single-point information TI=30
User-priority	Global Protocol-Selective	Single-point information TI=30
Switch over disabled	global	Single-point information TI=30
A/P-Control with failed voter	global Protocol-Selective	Single-point information TI=30
listening mode-control	Global Protocol-Selective Protocol-selective with applicative voting	Single-point information TI=30
mode automatic mode fix device A mode fix device B	Global Protocol-Selective	Single-point information TI=30 Single command TI=45

A/P control: only for protocol-selective with applicative voting

With the help of this message, the state (active or passive) of a single PRE (protocol-selective redundancy switching) is controlled.

In applicative voting, the voter (e.g., control center) forms the desired state itself (e.g., by comparing parameterized error messages). The desired state of the firmwares is communicated by means of user data messages of the central processing firmware.

The message can be parameterized in the OPM (SICAM 1703 + Ax 1703 system functions) under Redundancy control message with the attributes Control_function_ (RED) (A/P control message), Failure_behavior_ (RED), BSE_ (RED) and PRE_ (RED).

Routing destination in case of protocol selective switching is a selective firmware (BSE, ZSE).

A set message switches the selected firmware to active.

If these individual messages are received with the NT bit set, the state is either retained (parameterizable in the case of failure) or the affected firmwares are switched passively.

For protocol firmware, which belong to a function-related redundancy due to the parameterization, only the A/P control message to the least significant protocol firmware is required. However, this switches over all associated protocol firmwares.

User-priority (global, protocol-selective)

User priority messages can be routed in single-point information format to the central redundancy handling.

The messages can be parameterized under "Redundancy Control messages CP-8050" with the attributes Control_Function_ (RED) (User Priority), Failure_Behavior_ (RED), BSE_ (RED), PRE_ (RED) and Priority_RED.

The destination routing applies with protocol-selective switch over to

- a selective firmware (BSE, ZSE)

With global redundancy switch over, there are only once priorities that apply to the entire device, so BSE and ZSE are irrelevant. BSE and ZSE are only available in expert view.

A set message increases the counter of the parameterized priorities.

If these single-point information are received with the NT bit set, either the state is maintained (parameterizable in response to failure) (counter remains unchanged) or possibly previously set messages are deleted (counter decremented if the information was set).

The counters are sent to the voter in the case of protocol-selective or global switch over. The voter compares the priorities of the two devices, builds the redundancy state and communicates it to the devices.

Switch over disabled

This function is only available for the redundancy type "Global".

With this function it is possible to suppress the automatic switch over of the voter.

The message can be parameterized under "Redundancy Control Message CP-8050" with the attributes Control_Function_ (RED) (Switch over lock) and Failure_Behavior_(RED). The parameters BSE and ZSE are not evaluated. A set message locks the switch over.

If this single-point information is received with the NT bit set, either the message state is retained, or the lock is canceled (parameterizable in response to a failure).

The lock is displayed in the diagnostics with an error of diagnostic class Warning.

A/P-control with failed voter (global, protocol selective)

This function is only available in conjunction with 1 or 2 external voters. If a failure of the external voter is detected by the redundant devices, the redundancy state is maintained. In this case, it is possible to change the redundancy status of the devices with own user data messages in the single-point information format.

The message can be parameterized under "Redundancy control telegram CP-8050" with the attributes Control_function_ (RED) (A/P control in the case of voter failure) and Failure_behavior_ (RED). The message applies to the entire device.

A set message activates the entire device.

If this single-point information message is received with the NT bit set, the state of the message is either maintained (parameterizable in the case of failure) or the device is switched to passive.

listening mode-control

With the help of this message, the entire device is set to this mode. Listening mode means that the interfaces always receive the state passive, no matter which state the A/P control message assigns. This ensures that all interfaces do not switch their transmission lines to active and only listen to the data. Within the device, however, the data is still distributed or filtered based on the active/passive state.

The listening mode is controlled by means of a user data telegram in single-point information format.

The telegram can be parameterized under "Redundancy control telegram CP-8050" with the attributes Control_Function_ (RED) (monitoring operation) and FailureBehavior_ (RED).

There is only one message which applies to the entire device.

Due to the contents of the data, the entire device will be switched

- in normal operation (message = 1) or
- in the listening mode (message = 0)

.

If the user data message is received with the NT bit set, either the state is retained (parameterizable in the event of failure) or the device is switched to listening mode.

The state of the listening operation is also passed on as return information.

Fixing Operating Mode (Automatic, fix Device A, fix Device B)

In the case of redundancy configurations, it should be possible for a device or interfaces to be switched alternatively via pushbuttons or a key switch as follows:

- mode fix device A
- mode fix device B
- or automatic (desired state of the voter)

It is possible to read in this state via an input module or to determine it via communication from a higher-level point and to send it to the central redundancy treatment by means of a user data messages (single-point information or single command). Since this is only a status change, this happens (in contrast to the other control messages) with a command or a coming edge of the single-point information.

The message can be set under "Redundancy control telegram CP-8050" with the attributes Control_function_(RED) (Operating mode ....). The Failure_Behavior_(RED) is irrelevant because only the coming edge is evaluated. BSE_(RED) and PRE_(RED) are irrelevant even with protocol-selective switching since the state always applies to the entire device.

The message can be assigned either in one of the redundant devices or in the voters. The state is distributed to all involved devices. In order to be able to set the operating mode from several positions, several messages can also be assigned. Since the last valid state is detected by the acquisition time stamp, all devices must be timed.

7.8.6.2 Redundancy Return Information Messages CP-8050

Redundancy return information messages are user data messages with a configurable 5-level address (CASDU1, CASDU2, IOA1, IOA2, IOA3) and a fixed type identifier (30 = single-point information), which provide e.g. information about the redundancy states of the individual firmwares or the set operating mode.

The "Redundancy Return Information Messages CP-8050" have the following parameters and can assume the following values (in brackets):

- Device (A+B, A, B)
- CASDU1 (0-255)
- CASDU2 (0-255)
- IOA1 (0-255)
- IOA2 (0-255)
- IOA3 (0-255)
- TI, Type identification (Single-point information TI=30)
- Return_Information_Function_(RED) (redundancy state, switch over runs in global switching, operating mode automatic, operating mode fix device A, operating mode fixed device B, listening mode, priority)
- BSE_(RED), processing firmware (C1 to C4, M not used) ... .. only relevant for protocol-selective switch over
- PRE_(RED), protocol firmware (PRE0 to PRE7, BSE itself, not used) ... .. only relevant for protocol-selective switch over
- Priority_(RED)

Table 7-3 Overview of the different combinations of functions with possible redundancy:

Return_Information_function_(RED)	Redundancy
Redundancy state	Global Protocol-Selective Protocol-selective with applicative voting
Switch over runs at a global switch over	Global

Return_Information_function_(RED)	Redundancy
mode automatic mode fix device A mode fix device B	Global Protocol-Selective
listening mode-control	Global Protocol-Selective Protocol-selective with applicative voting
Priority	Global, Protocol-selective

Redundancy state

The message can be parameterized under "Redundancy return information message CP-8050" with the attributes Return_information_function_(RED) (redundancy state), BSE_(RED) and PRE_(RED).

With global redundancy switch over, there is only one return information message that applies to the entire device, therefore BSE and ZSE are irrelevant.

With protocol-selective switch over, a separate return information message is generated for each firmware (selected by BSE_(RED) and PRE_(RED)).

A set message means that the affected firmware or in the case of global switch over, at least one firmware is active.

Switch over runs at a global switch over

Applies only to global redundancy switch over.

The message can be parameterized under "Redundancy return information message CP-8050" with the attributes Return_Information_Function_(RED) (change over is active in the case of global switch over).

A set message means that the switch over has not yet been completed. This means that not all firmwares in the device have the same redundancy state.

Fixing Operating Mode (Automatic, fix Device A, fix Device B)

This message returns the set operating mode.

- mode fix device A
- mode fix device B
- or automatic (desired state of the voter)

The message can be set under "Redundancy return information message CP-8050" with the attribute Return_Information_Function_(RED) (Operating mode ....). BSE_(RED) and PRE_(RED) are irrelevant even with protocol-selective switch over since the state always applies to the entire device.

The message can be assigned either in one of the redundant devices or in the voters.

listening mode-control

The message can be set under "Redundancy return information message CP-8050" with the attribute Return_Information_Function_(RED) (Listening mode ....).

There is only one return information message, which applies to the entire device, since the listening mode is also only globally adjustable. Therefore, BSE and ZSE are irrelevant.

A set message means that the device is in normal operation.

Priority

The message can be parameterized under "Redundancy return information message CP-8050" with the attributes Return_information_function_(RED), (Priority), BSE_(RED), PRE_(RED) and Priority_(RED).

With global redundancy switching, there is only one return message per priority (selected by Priority_ (RED)), which applies to the entire device, therefore BSE and ZSE are irrelevant.

With protocol-selective switchover, a separate return message is generated for each firmware (selected by BSE_ (RED) and PRE_ (RED)) for each priority (selected by Priority_ (RED)).

A set message means that the parameterized priority (0-14) of the firmware concerned or, in the case of global switchover, the entire AE is set.

7.8.7 Parameterization of the Protocols

7.8.7.1 Parameters

The parameterization for protocols is also transferred by the copy function from device A to device B. Parameters that may be different in device A to device B are displayed twice. In the parameter set for device A, both the parameter values for the own device and for device B must be assigned.

For individual parameters, a suffix "_A" or "_B" is appended to the corresponding parameter text.

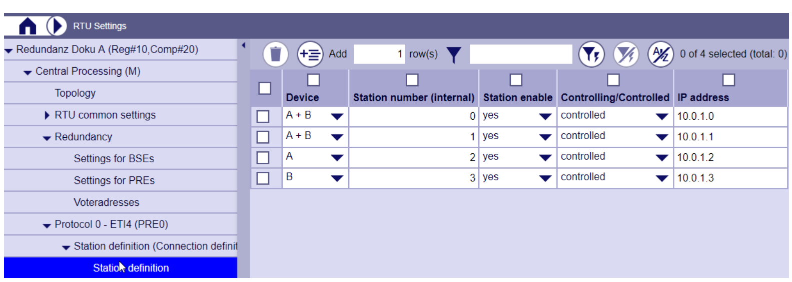
e.g. For the protocol BPPI0, a different baud rate can be defined in device A as well as in device B.

[sc_SICAM_DM_RED_BPPI0_System, 1, en_US]

7.8.7.2 Tables

If different parameters are required for device "A" and "B" in the tables, then the "Device" column can be used to define which lines are active in the individual devices.

e.g.: Station definition with IEC104 protocol



[sc_SICAM_DM_RED_ETI4_Topology, 1, en_US]

The number of entries is limited to 100.

7.9 Licensing of the Function

General

To operate CP-8050 systems redundant, the installation of a redundancy license is required.

The redundancy license includes the license for both devices, one license must be imported to device "A" and one to device "B".

Each CP-8050 license can only be used on one system. It is bound to the parameter set of the respective device. The licenses are delivered as USB sticks or OSD download. License Management requires the Automation License Manager (ALM).

The transfer of the licenses into the parameter set of a CP-8050 device takes place via the import function of your engineering tool (SICAM Device Manager as of V3.01 or SICAM TOOLBOX II as of 6.03)

Licensed features can be used on the CP-8050 system for up to 21 days without a valid license. Then you need a valid license to continue using the feature. After 21 days the function will be deactivated automatically.

A replacement of spare parts is possible because the license is bound to the parameter set.

CP-8050 Redundancy License

The redundancy license is required to enable the following functions for the redundancy pair "Device A" and Device "B":

- Enabling of the parameter "Redundancy type"
  "Global" ... for global redundancy switchover
  "Protocol-selective" ... protocol-selective redundancy switchover
- Enabling of the parameter "Redundancy Link"
  for the use of singular I/O modules
  redundant PLC synchronization via EbIO or via an IP network

For the permanent operation a redundancy license is needed - Order No. 6MF27500RE00

If CP-8031/CP-8050 is used as an external voter, no license is required.

NOTE

Licenses can no longer be returned if they have been imported into a CP-8050 device.

7.9.1 Requirements

7.9.1.1 Engineering Tools

Tool	From version
SICAM TOOLBOX II	6.03
SICAM Device Manager	3.10

7.10 Application Notes

7.10.1 Creation of a redundant device pair in the engineering tool

To perform the creation of the redundant device pair efficiently, the following steps should be followed:

Make definitions in device "A" before device "B" is generated

- Create device "A"
- Define hardware configuration and Ethernet port groups in device "A"
- I/O installation (rows and modules) and, if necessary, EbIO bus configuration
- Define LAN interfaces and IP addresses based on the Ethernet ports in device "A"
- Install processing firmwares in the system configuration
- Install protocol firmwares in the system configuration
- Define server/client functionalities in the system configuration
- Define the redundancy link in the system configuration (see *Redundancy Link, Page 506*)
- Define redundancy type in the RTU general settings (see *Redundancy Type, Page 507*)
- Set voter configuration (see *Voter, Page 507*)
- Perform settings for the redundancy function of the processing firmwares (BSEs) (see *Settings for BSEs (global, protocol-selective), Page 507*)
- Define redundant processing firmware (SICAM Device Manager - see *7.8.2.1 Generate Device „B“*) (SICAM TOOLBOX II - see *Define a redundant device , Page 503*
- Perform settings for the redundancy function of the protocol firmwares (PREs) (see *Settings for PREs (global, protocol-selective) , Page 509*)
- Create and assign signals for redundancy control messages / return information messages (for example, fix operation mode function)
- Create PLC application
- Load parameter set into device "A"
- Test device "A", e.g. System settings, LAN connections, PLC application

Only after a test of device "A" the redundant device "B" should be created.

Create device "B"

- Copy device „A“ to device „B“ (SICAM Device Manager - see *7.8.2.1 Generate Device „B“*) (SICAM TOOLBOX II - see *Define a redundant device , Page 503*)
- Define redundant processing firmwares (only necessary for SICAM TOOLBOX II in device B, see *Define a redundant device , Page 503*)
- Adjust different system parameters in device "B" e.g: IP addresses
- Load parameter set into device "B"
- Test device "B", e.g. System settings, LAN connections, PLC application
- Test the synchronization function in device "B"

7.10.2 Activation of the licenses of a redundant device pair

If the redundancy function of both devices has been tested and ensured, the licenses must be activated in both devices for permanent operation. To do this, the licenses must be assigned to the two devices in the engineering tool and then loaded into both devices. (see *7.9 Licensing of the Function*)

7.10.3 Function change of a redundant device pair

If the redundant device pair has already been created and changes are now to be made, the type of change must be taken into account.

Changes of system settings

System settings are not copied by the copy function and must be changed separately in both devices (if necessary).

Changes to signals and/or RTU settings

RTU parameters, signals and redundant PLC applications are transferred to device B by the copy function.

- Change RTU parameters in device A.
- Change user program in device "A" and generate code
- Call up the copy function (SICAM Device Manager - see *7.8.2.2 Copy function "Update redundant device"*) (SICAM TOOLBOX II - see *7.8.3.2 Copy function "Copy mirror parameters"*)
- Depending on the requirements and test strategy, both devices can now be loaded or the change can be tested in one device before

7.10.4 Functional change of a synchronized device pair during operation

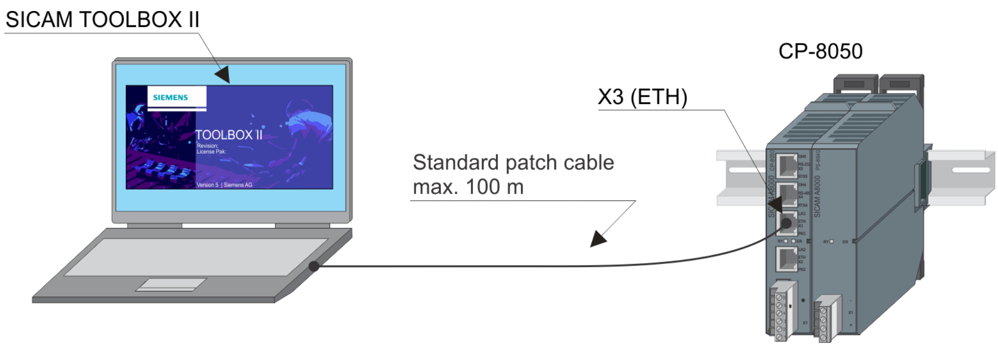
If a function change is to be carried out during operation and also the PLC application shall be changed "bumpless", then it depends on whether the change requires a reset of the processing firmware or not. This functionality is currently only available with the SICAM TOOLBOX II engineering tool.
If reset parameters (such as topology) are changed, the following steps must be carried out:

- Initial state: both devices must be synchronized
- Change all system settings and RTUs settings on device "A"
  In this step, the PLC application must not be changed.
- Set device "B" to active (fix redundancy state on device "B" - active)
- Load device "A" and perform a reset
  Since both PLC applications have the same status at this time, an update of the PLC application is performed after the device "A" has booted
- Change user program in device "A" and generate code
  In turn, no system settings and/or RTUs settings may be changed in this step
- Permanently switch device "A" to active (fix redundancy state to device "A" - active)
- Load device "A", a bumpless reload of the PLC application can be carried out
- Copy changed parameters in the engineering tool from device "A" to device "B"
- Load device "B", device "A" must be active at this time
- After the reset of device "B" both devices are synchronous again
- Set redundancy switchover back to "Automatic" (fix redundancy state to automatic)

8 Prepare Engineering

8.1 Connect Engineering PC with the Target System

8.1.1 One Click to Connect



[CP-8050_TB_Conn_Ethernet_One_Click_to_Connect, 2, en_US]

"One Click to Connect" is a simple and quick possibility to connect CP-8031/CP-8050 with an engineering PC (SICAM TOOLBOX II, SICAM WEB). You just have to connect PC and AU with a standard patch cable via the Ethernet interfaces. Take care that the AU is configured as DHCP Server (see *For example: Enable DHCP, Page 88*) and the PC as DHCP Client.

NOTE

- DHCP is enabled on CPCI85 during delivery. DHCP is disabled if SICAM TOOLBOX II is used to equip CPCI85.
- For a connection with SICAM TOOLBOX II, remote operation must also be enabled.

If these conditions are met, CP-8031/CP-8050 assigns automatically an IP address to the engineering PC. As a consequence SICAM TOOLBOX II or SICAM WEB can communicate with CP-8031/CP-8050. No further settings are necessary.

"One Click to Connect" supports all SICAM TOOLBOX II functions (incl. AE initialization).

If you use SICAM WEB to login to the AU, you can choose between two possibilities. Either you enter the IP address of the connected CP-8031/CP-8050 (standard is 172.16.0.3) in the Internet browser, or you enter on of the following addresses which create an automatic connection: *https://sicamrtulogin.com* or *https://www.sicamrtulogin.com*.

Details about the automatic address assignment

If the engineering PC is connected to the X3 Ethernet interface of CP-8031/CP-8050 and the DHCP settings are correct (AU = DHCP server, PC = DHCP client), then the engineering PC gets automatically an IP address from CP-8031/CP-8050. This IP address is 10 "above" the IP address of CP-8031/CP-8050. For instance, if the IP address of CP-8031/CP-8050 is 172.16.0.3 (=standard), then the engineering PC gets the IP address 172.16.0.13.

This increase is only valid, as long as the IP address of CP-8031/CP-8050 is below x.x.x.245, otherwise there will be a decrease of 10. E.g. if CP-8031/CP-8050 has the IP address 172.16.0.246, then the engineering PC gets the IP address 172.16.0.236.

When configuring the network mask on the CP-8031/CP-8050, take the ±10 range into account. If the network mask is too small, no connection is possible.

NOTE

- Only one LAN connection is allowed on the engineering PC.
- X3 is the default port for LAN on CP-8031/CP-8050. But you can also use any other LAN port on which DHCP is enabled.
- If parameters get loaded, on which DHCP is disabled, no more connection can be established. This results in a timeout after the reset of up to 10min, during which no connection setup is possible.
- The DHCP server assigns an address only once!

8.1.2 SICAM TOOLBOX II

Before parameters can be loaded via SICAM TOOLBOX II into CP-8031/CP-8050, the following steps must be performed:

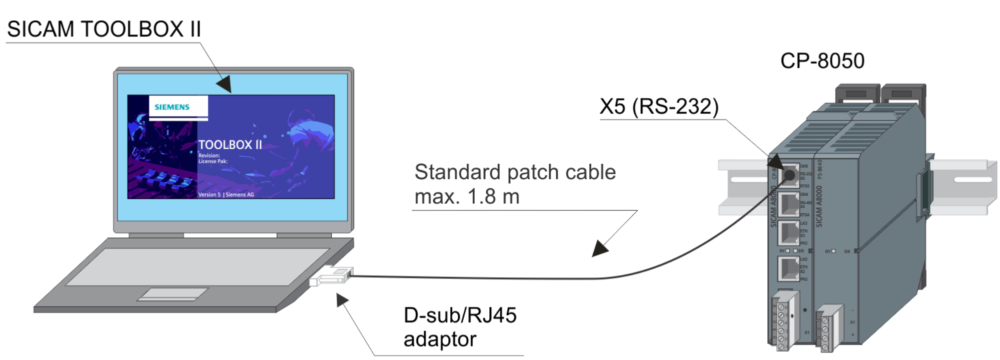
- Insert an appropriate SD card into the target device (optional)
- Store required TBII updates in the SICAM TOOLBOX II
- Switch on the target device
- Set up physical connection with the target device

The following connection options are available:

- Serial point-to-point connection
- Serial connection via telecommunications equipment
- LAN/WAN-connection via Ethernet interface
- LAN/WAN-connection via serial interface and terminal server
- Connection via further automation unit(s)

8.1.2.1 Serial point-to-point connection

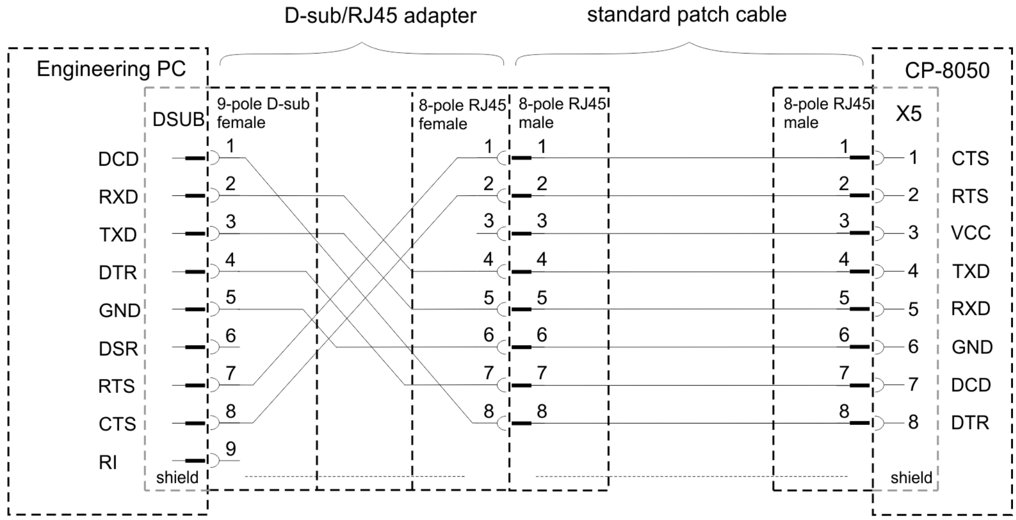
With CP-8031/CP-8050 a standard patch cable and a D-Sub/RJ45 adapter are necessary.



[CP-8050_TB_Conn_Serial_Point_to_Point, 1, en_US]

Figure 8-1 Serial point-to-point connection SICAM TOOLBOX II - CP-8050

Circuitry for connection CP-8031/CP-8050 – PC (D-Sub/RJ45 adapter + patch cable)

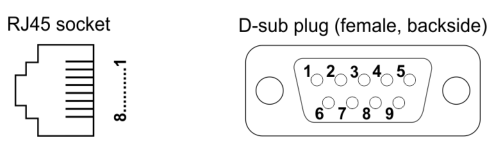


[Circuitry_CP-8050_RS232_with_Engineering_PC, 1, en_US]

Figure 8-2 Circuitry of the connection Engineering PC - CP-8050

Recommended D-Sub/RJ45 Adapter

RS Pro MHDA9-SMJ8-M-K (see *A.16 Cables and Connectors*). This adapter provides a wired RJ45 socket and an unwired D-sub plug (female).



[Dsub-RJ45_Adaper_PIN_Assignment, 1, en_US]

Table 8-1 Wiring of the RJ45 socket (wire color valid for MHDA9-SMJ8-M-K)

Pin	Wire color
1	black
2	yellow
3	orange (n.c.)
4	red
5	green
6	browne
7	grey
8	blue
Shield	black

The assignment of the pins at the D-sub plug can be made according to wiring diagram.

Not used wires must be isolated!

With use of the shield this must be soldered at the metal plate of the D-sub plug.

NOTE

If the engineering PC does not provide a serial COM port, additionally a USB/RS-232 converter is required (see *A.16 Cables and Connectors*).

8.2 Show Expert Parameters

For the most applications not all parameters are required. Therefore, only those parameters are displayed that are minimally necessary to configure a function. For special applications, additional parameters, so-called expert parameters, are available.

To simplify the engineering of the target device, the expert parameters are hidden by default. Thereby the directory tree has a reduced number of directories and parameter tables have a reduced number of columns (the parameter table of the signals page is not affected).

Depending on the used engineering tool, the expert parameters are displayed as follows:

- SICAM TOOLBOX II - System-technical parameter
  - Open the pop-up menu in the parameter table and select **unhide columns | all**
- SICAM TOOLBOX II - Process-technical parameter (signals)
  - Activate **View Expert Mode**
- SICAM Device Manager (System-technical parameter, Process-technical parameter = Signals)
  - Activate the checkbox **Show all parameters**

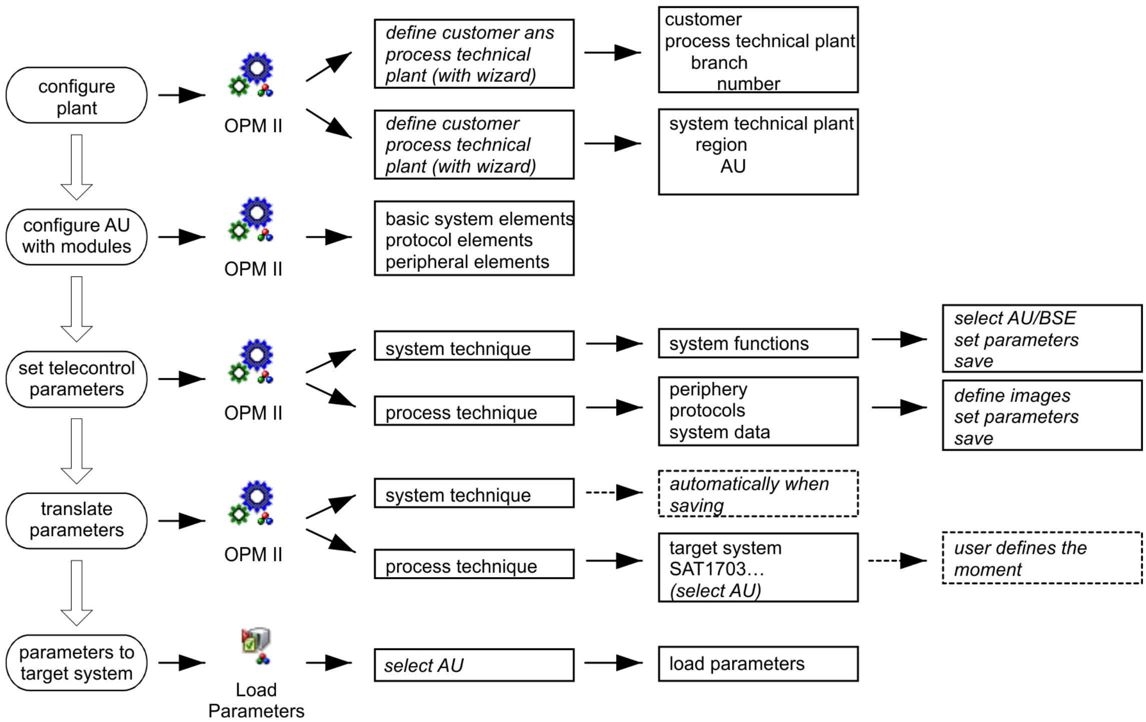
9 Engineering via SICAM TOOLBOX II

9.1 Telecontrol

Overview of the Tasks

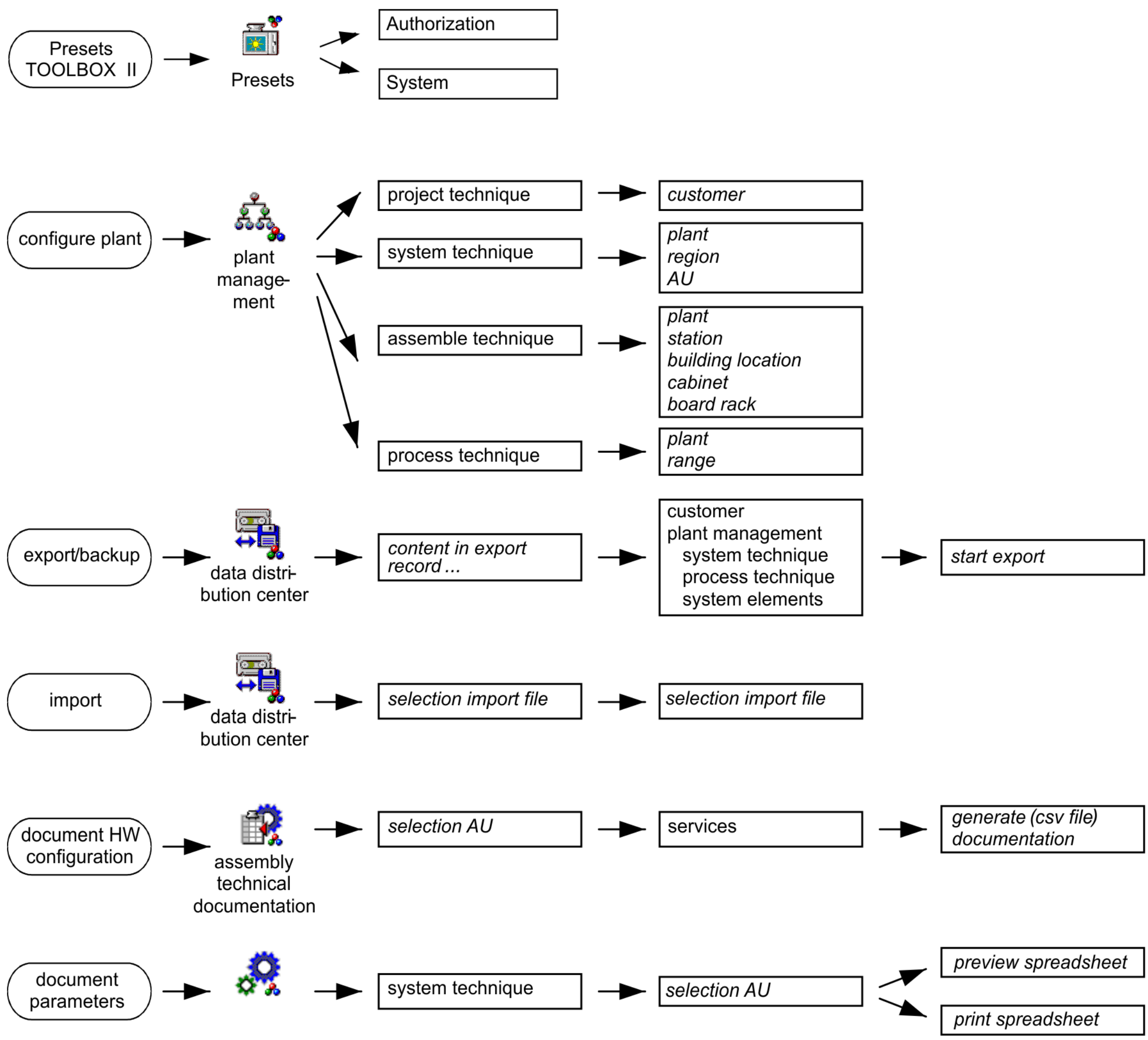
Task	Meaning
Presets	Define user and rights; language
Initialization of the plant data	Configure plant and automation unit
Import firmware	Load firmware into SICAM TOOLBOX II
HW configuration	Select installed system elements
Parameterization of the system technique	• Network Configuration • Security settings • Hardware configuration • Topology • Time management • Communication common • Protocol elements • Representation of data points assigned to hardware I/Os • Decentralized Archive
Parameterization of the process technique	• Create images • Assign process images to data points • Settings for configured process signals • Routing of send data and receive data
Bulk edit	Edit great amounts of image parameters
Transfer parameters	Translate parameters for the target system
SD card	• Write and read application data • Decentralized Archive
Import/Export	Generate and read backups of the application data
Documentation	Formatted spreadsheets for printing • Hardware (configuration, pin assignment) • Parameter
Load Parameters	Transfer parameters and function diagram to the target system
Parameter comparison	Compare settings between current project and target system
Data flow test	Record and store dataflow in the target system
Message simulation	Send messages from the SICAM TOOLBOX II to a target device
Service function online	Read and set time of target system
ST emulation	Execute system-internal functions (only for authorized users)
Topology test	Acqusition of physically connected automation units in a SICAM RTUs automation network
Diagnosis	Read detailed information generated by the self monitoring
Read decentralized archive	Chronological display of parameterized events

Fundamental Procedure of the Parameterization



[tbii_parameterize_new, 1, en_US]

Essential Administrative Functions



[tbii_parameterize_admin, 1, en_US]

9.1.1 Presets

Before you begin with the engineering of CP-8031/CP-8050, several basic settings are to be performed for the work with SICAM TOOLBOX II:

- User and rights
  - User-specific settings
- Password
- Workplace-specific settings
- Organization of the SICAM TOOLBOX II
- Speech

For the access to the SICAM TOOLBOX II a log on with user name and password is required.

The parameterization with the SICAM TOOLBOX II happens exclusively off line. Only the transfer of data (firmware, application data), as well as test and diagnosis are performed Online via a communication connection.

The globally valid configuration parameters in the SICAM TOOLBOX II are displayed and set with the tool "SICAM TOOLBOX II Presets". They can - dependent on the access rights - be changed at any optional time.

You find the details thereto in the *SICAM TOOLBOX II Online Help, chapter "SICAM TOOLBOX II Presets" and chapter "Administration of SICAM TOOLBOX II"*.

9.1.1.1 User and rights

The following user types are predefined and can be selected. For each user type different rights are predefined.

- Type **admin**
- Type **profi**
- Type **standard**

As user type **admin** you can freely assign new user names (max. 8 characters). For each user a special role (max. 20 characters) can be assigned.

For each role certain rights can be freely selected and assigned from a list. Depending on which role a user has been assigned, he may control determined functions. An exception are the unchangeable roles, that are reserved for the specialists for maintenance purposes.

You find the details thereto in the *SICAM TOOLBOX II Online Help, chapter "SICAM TOOLBOX II Presets", section "User/Role Administration"*.

NOTE

All operation and test functions of CP-8050 described in this manual are generally applicable for the SICAM TOOLBOX II role **admin**.

NOTE

From SICAM TOOLBOX II V5.11 it is possible to create domain users. Such a domain user does not use a specific SICAM TOOLBOX II user role to start SICAM TOOLBOX II, but he uses the user account for the log on on his workstation.

9.1.1.2 Password

The entrance into the SICAM TOOLBOX II is protected for each user by means of an individual password. The preset password is equal to the predefined user type.

NOTE

The presest password must be changed after the first login.

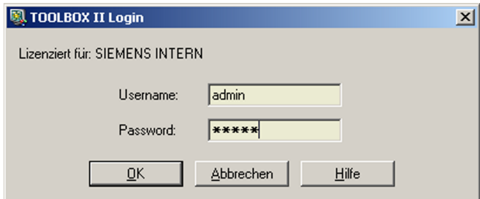
9.1.1.3 Language

The language **Deutsch** or **English** can be selected.

9.1.2 Entrance into the Project

9.1.2.1 Logon

With the initial start of a tool of the SICAM TOOLBOX II you must enter a user name and a password. After that you are able to begin the paramerization.



A user change is possible with the tool "TOOLBOX II Presets" (menu **Authorization | Login**).

9.1.2.2 Logoff

A user log off is possible with the tool "TOOLBOX II Presets" (menu Authorization | Logout). You can continue to operate tools that are still active, but the activation of tools requires another login.

If all tools are quit without logout, the user will remain logged in unless a logout from the SICAM TOOLBOX II PC or Toolbox Server takes place.

9.1.2.3 Change Password

As user type admin you can define a password for each newly added user.

Guidelines for the Assignment of Passwords:

- The password may consist of up to 8 characters
- No differentiation between upper case and lower case
- Special characters can be used
- Empty password possible (logon to the project without password)

NOTE

The presest password must be changed after the first login.

9.1.3 Plant Configuration

A plant is configured according to different views:

- Project technique
- System technique
- Process technique

The configuration data is in each case specifically parameterized for the different views.

With the initial creation of a plant you must enter the configuration data into the SICAM TOOLBOX II with the tool "OPM II" . The entry of the parameters is thereby supported by "Wizards" . The plant topology is determined based on the parameter setting of the configuration data.

After the initialization, the administration of the plant configuration can be carried out with the tool "Plant Management". With this tool the configuration data can be changed or deleted at any time.

You find the details thereto in the SICAM TOOLBOX II Online Help, chapter " Plant Management".

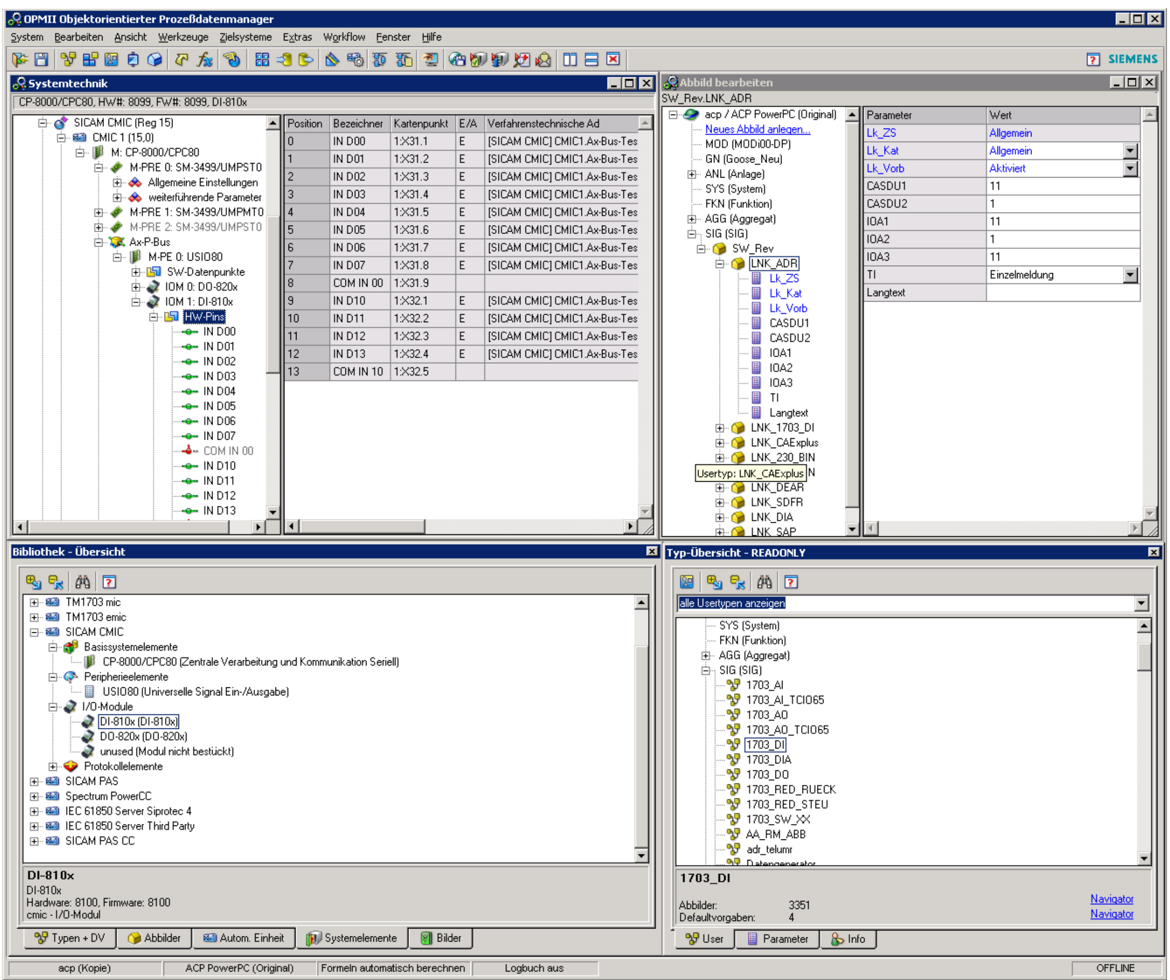
9.1.4 Import Firmware

For the parameterization of a target device the system elements to be used must be equipped, and the belonging firmwares must be present in the SICAM TOOLBOX II .

You can import the required firmwares - if not yet present - into the data base with the tool “Master Data Update” of SICAM TOOLBOX II . You find further information in section 11.5.1.2, Import Firmware into SICAM TOOLBOX II. You find information on firmware files in section 7.3, Loadable Firmwares.

9.1.5 Parameterization of the Firmware Functionality

The acquisition, parameter setting and documentation of the process-technical process and its associated data points is enabled in the SICAM TOOLBOX II mainly with the help of the tool “OPM II” (Object Orientated Process Data Manager). The user’s guide of the OPM II can be found in the SICAM TOOLBOX II Online-Help, chapter “OPM II”. The description of the system-technical and process-technical settings can be found in the manual “SICAM RTUs Common Functions System and Basic System Elements, chapter "Telecontrol"”.



9.1.5.1 Hardware Configuration

Before the parameterization of the functionality, the target system must be configured with the required system elements:

- Master Module (Details see *2.2 Master module*)
- Protocol elements (Details see *2.12.1 Protocol Elements*)

- Peripheral elements
  - SICAM I/O-modules (Details see *2.6 SICAM A8000 I/O Modules*)
  - SICAM TM I/O-modules (Details see *2.8 SICAM TM I/O Modules*)

NOTE

The firmware codes of the corresponding system elements must exist in the target system

You find an overview of the available system elements and I/O Modules and their technical specification chapter 5, System Components and Technical Data.

The configuration takes place with the tool “OPM II” via the menu items **Tools | System technique** and **Tools | Library Overview** .

By dragging the system elements of the master module CP-8031/CP-8050 from the Template Overview onto the respective target system in the system technique, the corresponding system elements are added with default parameters.

When deleting a system element, all the corresponding settings are rejected in the system technique.

With use of I/Os, the higher-level peripheral element (I/O-Master Module) must be configured at first. After that you can drag I/O-Modules onto the peripheral element (I/O-Master Module) and assign signals to the respective I/O-Module (system technique).

NOTE

The slots *IOM0*...*IOM7* are available for the I/O Modules.

When deleting an I/O-Module, all the assigned signals (hardware pins and software data points) are deleted from the plant tree.

The changed hardware configuration must be converted with the tool “OPM II” via the menu **Destination systems | SICAM 1703 transformer** . Subsequently it must be transmitted to the target device with the tool “Load parameters” to become effective.

During startup the target system checks if the mechanically installed system elements and I/O-modules match the parameterization.

NOTE

The configuration in the “OPM II” must match the mechanically installed I/O-modules.

If you remove an I/O module mechanically, you must delete it also in the “OPM II”.

If you do not adapt the configuration in the “OPM II”, the target system detects this I/O-module as failed (error indication). If you add an I/O-module mechanically without adapting the configuration in the “OPM II”, this has no effects. In this case, the added I/O module is ignored.

9.1.5.2 System-Technical Settings

The system-technical configuration of a target system can be opened via the menu item **Tools | System technique**.

The parameter setting is carried out in the directory tree, respectively below the selected Master Module:

- Common settings
- Time management

- Communication protocols
- Network settings
- Topology
- Dataflow filter
- Periphery
- Decentralized archiving

Communication

The protocol is determined by configuring a protocol element suitable for the existing application and its parameterization. For security-relevant information refer to the *SICAM RTUs / SICAM TOOLBOX II – Administrator Security* Manual (DC0-115-2).

Periphery

The peripheral functions are defined by means of configuring the peripheral element (I/O Master Firmware), the I/O modules suitable for the present application, as well as their parameters.

Below the level of the I/O bus the configured peripheral element with the configurable signals is displayed:

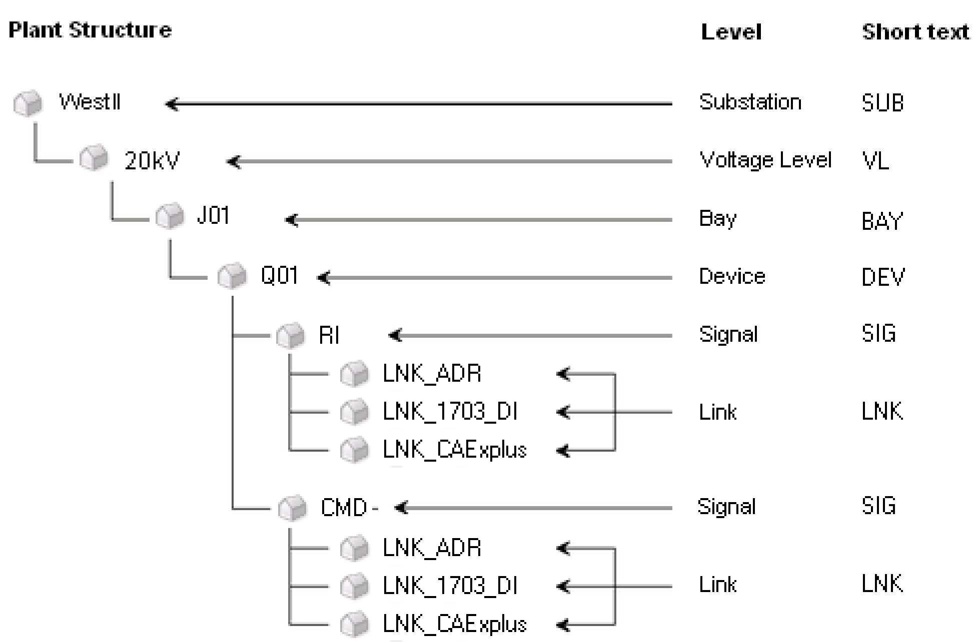
- Hardware pins
- Software data points

By means of the context menu of a hardware pin or software data point, selection **Edit image**, you get directly to the process-technical settings of the respective signal.

9.1.5.3 Process-Technical Settings

Levels

The process-technical plant can be structured in freely-definable hierarchy levels. The following graphic shows an example:



[tbii_levels, 1, en_US]

You find the instruction to create levels in the SICAM TOOLBOX II Online-Help, chapter "OPM II", section "Levels".

The process-technical settings of the system elements can be opened centrally via the menu item **Tools | Images** .

Types

Types form the template for the structure of a process-technical plant. They serve for the simplification with engineering of large quantities of objects, parameters and values.

Types of the following type categories can be defined below the levels:

- User types
- Link types
- Info types
- Parameter types

A type is defined respectively for objects, that have the same features (examples: feeder, circuit breaker, disconnector). You find the instruction to define the different types in the SICAM TOOLBOX II Online-Help, chapter "OPM II", section "Types".

Images

Images are real objects of the plant with parameters and signals (examples: feeder north, circuit breaker Q00, disconnector Q10).

- Typified images
  - Typified images can be created from the defined types, that means, each images is assigned to a type. The assigned type defines thereby the structure for the image. The structure defines which linktypes include a signal and which parameter includes a link. This structure can be changed only in the type of the belonging image. All images that are assigned to that type, adopt automatically the structure change (inheritance). The same behavior applies for default input.
  - The usage of typified images is the more efficient, the more identical images are present.
- Typeless images
  - Typeless images do not have a reference to the types, that means, no inheritance takes place. Typeless images are also created by structural changes of a typified image (since the image does not have the same structure as the type).
  - Typeless images are advantageous, if images are only uniquely existing.
  - Below typless images, typified images can be used (example: voltage level **20 kV** is typeless since it is only uniquely existing, all feeders thereunder are typified images).
- Link images
  - In the link images the parameters of the single target systems can be set.
  - The signals of the libraries include as first link a so-called common link (LNK_ADR). There reside parameters (example: longtext, LAN station...) that include **references** to other links of the same signal or are source of **formulas**.
- A reference causes that upon changes of an entry in the common link the change takes place automatically in the link of the specific target system. Message address CASDU(1,2), IOA(1,2,3) and TI are generated automatically with filling of the 1703 link address (Lk_Reg, Lk_Komp, Lk_BSE, Lk_ZSE, Lk_DP) by means of formulas and references and do not have to be entered.
- Parameter types

You find the instruction for the creation of images in the SICAM TOOLBOX II Online-Help, chapter “OPM II”, section “Images”.

Parameterization of the Process Signals and Assignment to the System Technique

The parameters for the technological processing of process signals reside in the directory tree below the link images:

The parameters for the technological processing of process signals reside in the directory tree below the link images:

- Addressing
- Signal preprocessing
- Signal post processing

You find the description of the parameters in the SICAM TOOLBOX II Online-Help, chapter “Parameter-Documentation”.

9.1.5.4 Decentralized Archive (DEAR)

The decentralized archive serves for the local storage of events of a substation, and - whenever necessary - for the transmission to the control system. By means of that, it is for instance possible to recover the archive of a control system after a communication fault.

In the decentralized archive all the data points used in the substation can be acquired.

You can configure the archive in the system technique of the “OPM II” (parameter group Decentralized archiving of the respective automation unit). In the images you can define the process-technical settings of the data points to be acquired. During operation, these data points are archived chronologically upon status change. This applies for all binary information items of the send and receive direction.

You find the detailed information on the settings in the manual SICAM RTUs Common Functions System and Basic System Elements, chapter “Telecontrol”, section “Decentralized Archiving”.

9.1.6 Transform Parameters

Before loading into the target system, the process-technical parameters of the plant must be transformed. This can be carried out with the tool "OPM II" through selection of the menu **Destination systems | SICAM RTUs... | SICAM RTUs Transformer**.

System-technical parameters are automatically transformed when saved.

You find the details thereto in the *SICAM TOOLBOX II Online Help, chapter "OPMII", section "Transform and Load", "SICAM RTUs"*.

9.1.7 Import, Export and Backup of Engineering Data

The tool "Data Distribution Center" enables the importing and exporting of parameters, as well as the creation of backup files.

You find the details thereto in the *SICAM TOOLBOX II Online Help, chapter "Data Distribution Center"*.

9.1.8 Documentation

With the tool "OPM II" you can generate and print the documentation of the engineering data:

- Hardware Configuration
- Assembly Technique
- Interface to Elcad
- Telecontrol Function
  - System-technical configuration
  - Process-technical settings

You find the details thereto in the *SICAM TOOLBOX II Online Help, chapter "OPM II", section "System Technique", section "Documentation"*.

9.1.8.1 Hardware Configuration

You can initiate the documentation of the system elements in the plant tree of the menu **System technique**, via the context menu of the automation unit.

The output takes place as a table in a file (format *.csv*) or to a printer.

With the tool "HW-FW Configuration" you can assign the required assembly-technical information to the system elements.

9.1.8.2 Assembly Technique

You can initiate the documentation of the assembly-technical configuration in the plant tree of the menu **System technique**, via the context menus of the peripheral elements.

The output takes place as a table with adjustable layout, optionally as preview on the screen or to a printer.

The documentation extends over the HW pins of the respective peripheral elements and contains:

- Slot and module type
- System-technical address of each pins within the message
- Process-technical address of each pins within the message
- Common information of a pin (long text)
- Assignment of the pins to a link image in the “OPM II”

9.1.8.3 Interface to ELCAD

For the coupling with the design tool ELCAD, it is possible to transfer images that are assigned to a system element via this defined interface.

The output takes place to a text file (format *asc*).

The generation of the file takes place via selection of the menu **Destination systems | SICAM RTUs... | SICAM RTUs Transformer**.

You find the details thereto in the *SICAM TOOLBOX II Online Help, chapter "OPMII", section "Elcad"*.

9.1.8.4 Telecontrol Function

System-Technical Configuration

You can initiate the documentation of the system-technical configuration in the menu **System technique**, via the context menu of an automation unit or of a specific system element.

The output takes place as a spreadsheet, optionally as preview on the screen or to a printer.

Process-Technical Settings

You can initiate the documentation of the process-technical settings in the tree of the menu **Edit image**, via the context menu of a selected hierarchical level.

The output takes place as a spreadsheet, optionally as preview on the screen or to a printer.

9.1.9 Commissioning and Test

For commissioning and test of the projected settings the following functions are available (online):

- Loading Engineering Data
- Parameter Comparison
- Test Functions
- Diagnosis

For these functions the engineering PC must be connected with the target system.

9.1.9.1 Loading Engineering Data

The loading of the parameters of a process-technical plant from the PC into the target system takes place with the tool "Load Parameters". You can launch it from the "OPM II" via the menu **Target systems | SICAM RTUs | Parameter loader** , or directly via the start menu of your PC.

With the tool "Parameter Loader" you can add and select automation units, and initiate the loading via the menu **Load | Selected AUs**.

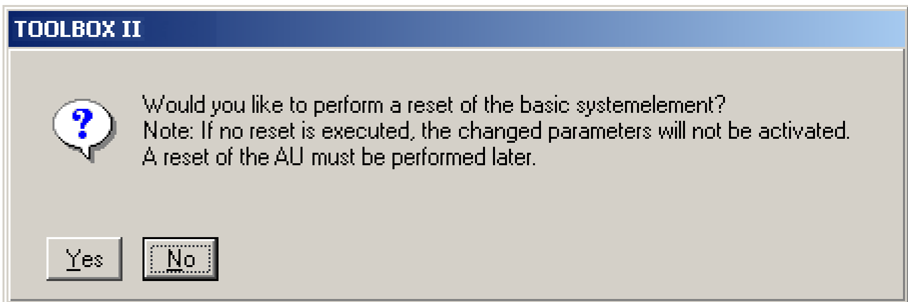
All settings that have been performed in the SICAM TOOLBOX II are thereby saved jointly on the SD card of the target system:

- Configuration parameters
- System-technical parameters
- Process-technical parameters (if they have been transformed previously)
- Application program (if code has been generated previously)

For the loading of the parameters there are different variants available:

- Load intelligent
  - only the changed parameters are loaded into the target system
  - can be applied locally or remotely
  - after the loading of the parameters an automatic startup of the target device is performed (for each selected automation unit a corresponding notification appears subsequently)
- Load unconditional
  - all parameters are loaded into the target system
  - can be applied locally or remotely
  - after the loading of the parameters an automatic startup of the target device is performed (for each selected automation unit a corresponding notification appears subsequently)

- Initialize
  - all parameters are deleted in the target system, and all parameters newly transferred
  - can be applied only with the locally connected automation unit
  - is used for the first loading of an automation unit or of a basic system element
  - if a changed parameter requires a startup of the Master Module, a notice appears after the loading, whether the startup is to be performed immediately or at a later time – for instance if further changed parameters are to be activated jointly



You find the details thereto in the *`SICAM TOOLBOX II Online Help, chapter "Service Programs", section "Parameter Loader"`*.

NOTE

"Load unconditional" and "Initialize" is only possible with user role Security Administrator or Administrator.

During a loading operation, the switching off of the target device is to be absolutely avoided, since the data on the flash card could be destroyed as a result.

9.1.9.2 Parameter Comparison

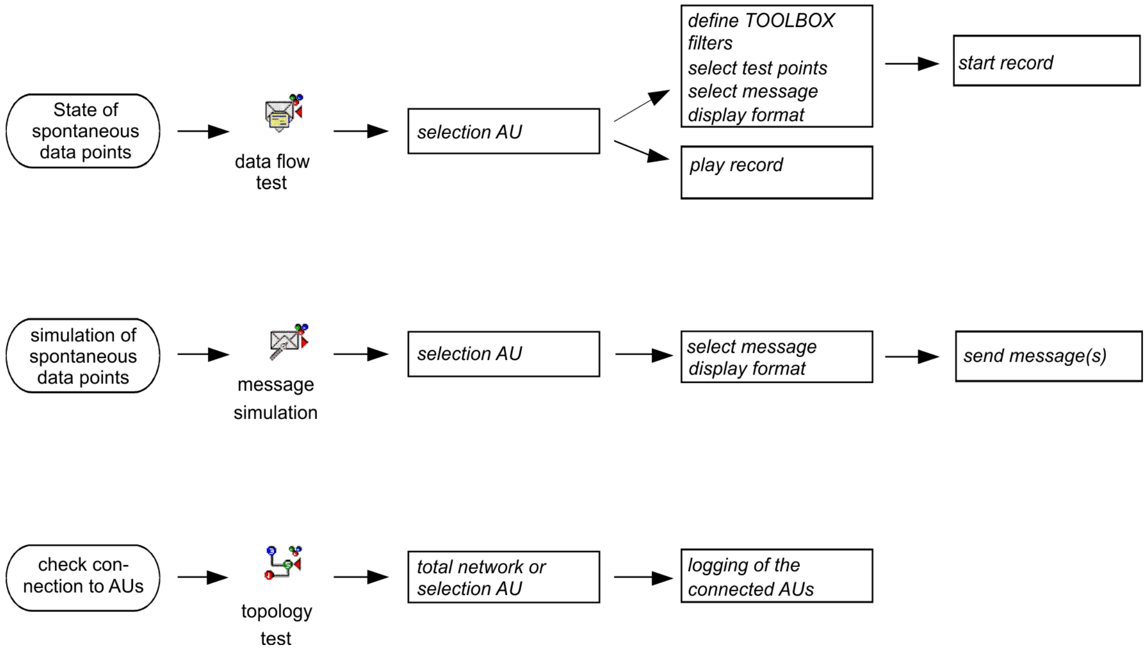
With tool "Parameter Loader" you can check whether the parameter status in the destination system is current. You can select an automation unit and start the comparison via the menu **`Parameter | Comparison AUs <-> Toolbox`**.

For each selected automation unit appears the indication whether the parameters are current or not current.

9.1.9.3 Test Functions

The following test functions are available:

- Data flow test
- Topology test
- Message simulation



[tbii_service_test, 1, en_US]

Status Of Spontaneous Data Points

With the tool "Data Flow Test" data streams (flow of messages) can be simultaneously logged and visualized. For a subsequent analysis - also at another location - a recording can take place with the Interface Recorder.

The function "Simultaneous log" serves for the recording of messages within the internal data flow of an automation unit. In protocol elements, the data flow from and to other automation units can also be acquired.

The following data can (with change of the spontaneous data) be simultaneously logged:

- Change of state of inputs/outputs
- Communication from and to protocol elements
- Data traffic from and to the application program
- Data traffic from and to special functions (for example set counters, set time)

By means of triggering a General Interrogation all spontaneous input signals can be simultaneously logged at any arbitrary time.

You find the instruction for this test function in the *SICAM TOOLBOX II Online Help, chapter "Service Programs", section "Data Flow Test"*.

You find further information in the manual *SICAM RTUs Common Functions System and Basic System Elements, chapter "System Services", section "Data Flow Test"*.

Simulation Of Spontaneous Data Points

With the tool "Message Simulation", messages can be transmitted from the SICAM TOOLBOX II to automation units. Just one message or up to 100 messages in succession can be transmitted; in addition sequential delays and message repetitions can be defined.

The messages can be passed in at defined points of the system. With this function the following possibilities exist:

- Setting of outputs
- Simulation of the communication from and to protocol elements
- Data traffic from and to the application program
- Data traffic from and to special functions (for example set counters, set time)

DANGER

Pay attention that due to the simulation the plant state can change.

The manual controlling of outputs with the plant running can lead to damage to persons and machines.

✧ Ensure that aggregates in the control area of the command output and those subsequent aggregates in the process chain are protected and that persons in the vicinity are warned!

You find the instruction for this test function in the *SICAM TOOLBOX II Online Help, chapter "Service Programs“, section "Message Simulation"*. You find further information in the manual *SICAM RTUs Common Functions System and Basic System Elements, chapter "System Services", section "Message Simulation"*.

Check The Connection To Automation Units

The tool "Topology Test" is used for the acquisition of all automation units in a SICAM RTUs automation network that are reachable or non-reachable from the automation unit momentarily physically connected.

You find the instruction for this test function in the *SICAM TOOLBOX II Online Help, chapter "Service Programs“, section "Topology Test*.

9.1.9.4 Displaying Decentral Archive (DEAR)

The current contents of DEAR can be displayed with the tool "OPM II".

Via the context menu of the automation unit, submenu **Display decentral archiving...**, you get to the file directory.

Then select a file and click on the button **Display archives** to display the respective records.

NOTE

The data records of the decentral archive are registered in configurable files. The files are stored on the SD card. The record of data points is therefore only possible with equipped SD card.

You can save the displayed records of DEAR in a file (Format *.csv*) on the engineering PC.

You find the information thereto in the *SICAM TOOLBOX II Online Help, chapter "OPM II", section "System Technique", "General", "SICAM RTUs", "Decentral Archive Display"*.

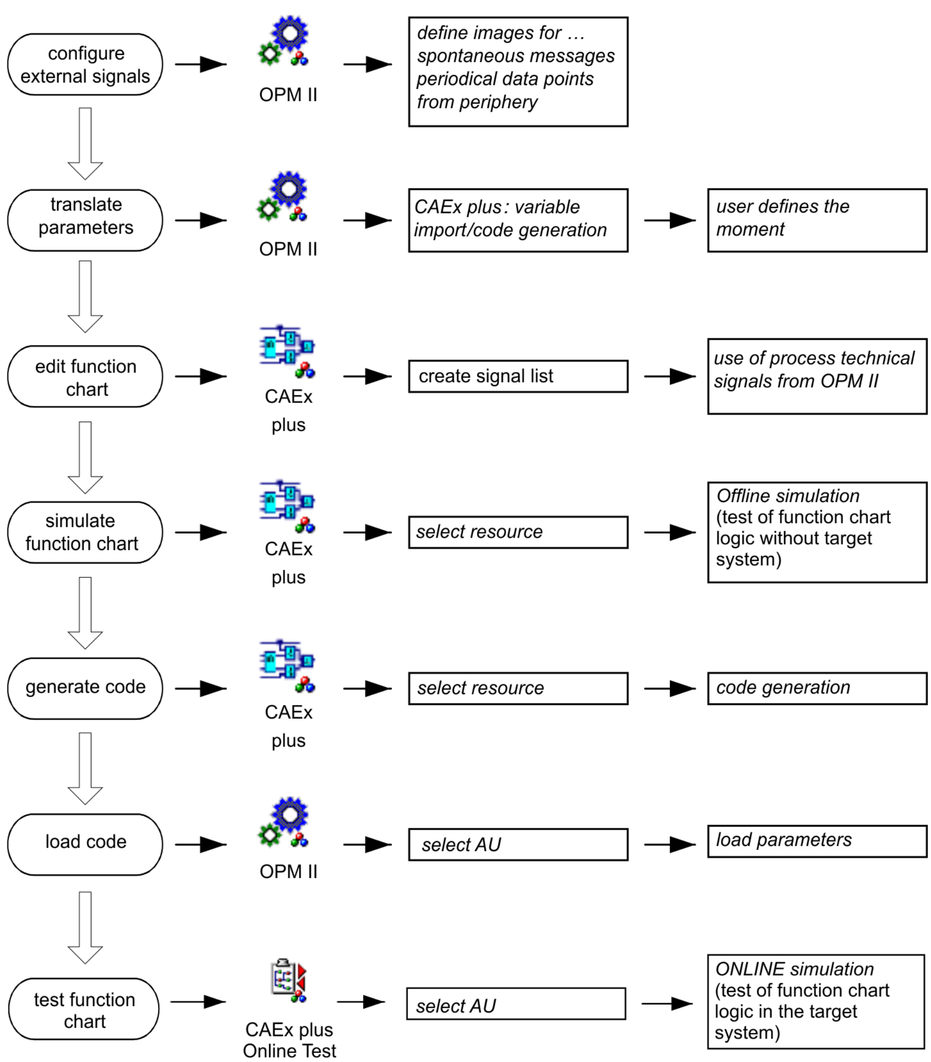
9.2 Automation

For the implementation of freely definable open-/closed-loop control functions you can optionally create an application program as function diagram.

Overview of the Tasks

Task	Meaning
Configure external signals	Create images for spontaneous and periodical data points
Create function diagram	Edit the application program
Simulate function diagram	Test application program offline
Generate program code	Compile application program
Load program code	Transfer application program into the target system
Perform startup	Initialize application program in the target system
Test function diagram	Test application program online
Documentation	Prepare application program for printing

Fundamental Procedure of the Programming



[tbii_automation, 1, en_US]

9.2.1 Creation of a Function Diagram with CAEx *plus*

For the creation of a function diagram (FUD) the tool "CAEx plus" is required. This provides various editors and standard libraries for the creation of the *open-/closed-loop control function*.

The process-technical functions of a plant are created with the function diagram editor (FBD-Editor). A function diagram is thereby created by the interconnection of

- predefined functions and function blocks
- functions and function blocks defined by the user

You find the description of the editor in the CAEx *plus Online Help, chapter "Editors"*. Additional Information can be found in the *SICAM TOOLBOX II Online Help, chapter "CAEx plus"*.

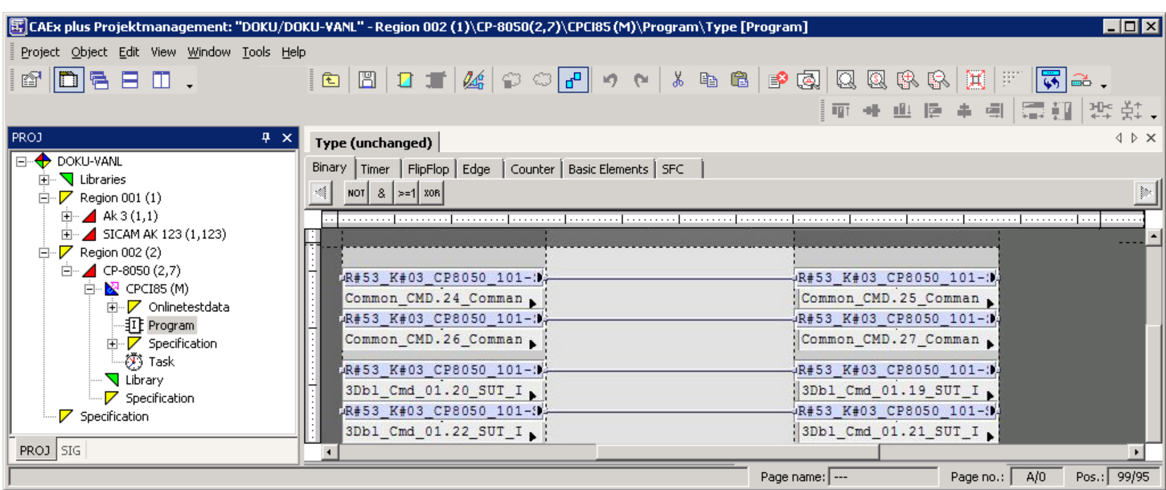
You find the most important characteristic values (limits) for the creation of the open-/closedloop control function in section **5.4.1, CP 8000** and **5.4.2, CP 8021 and CP 8022**.

You find the technical details for the processing of the *open-/closed-loop control function* and its partial functions in the manual *SICAM RTUs Common Functions System and Basic System Elements, chapter "Automation", section "Restricted Open-/Closed-Loop Control Function", "Application Program", "Function Diagram"*.

NOTE

Optionally to the creation of a function diagram, an instruction list (IL) with ASCII format can be imported in “CAEx plus” (tool “OPM II”, context menu of the CPU, **Instruction list | Import from file**).

Function Diagram Editor (Example)



9.2.1.1 Configuring External Signals

The I/O's are integrated into the Function Diagram via the Signal List. Dependent from the fact, whether the target system is engineered via SICAM TOOLBOX II or via SICAM WEB, the Signal List can be alternatively

- generated with the tool "OPM II"
- imported from a local parameterization *9.1.7 Import, Export and Backup of Engineering Data*

The signals of the process-technical plant can be used by “CAEx plus” after the transformation (see section *9.1.6 Transform Parameters*). The structure of the project tree automatically adapts to the structure from the "OPM II".

An introduction how to create a project can be found in the *CAEx plus Online Help chapter "First Steps" and chapter "Additional Products", section "Signal List (Optional)"*.

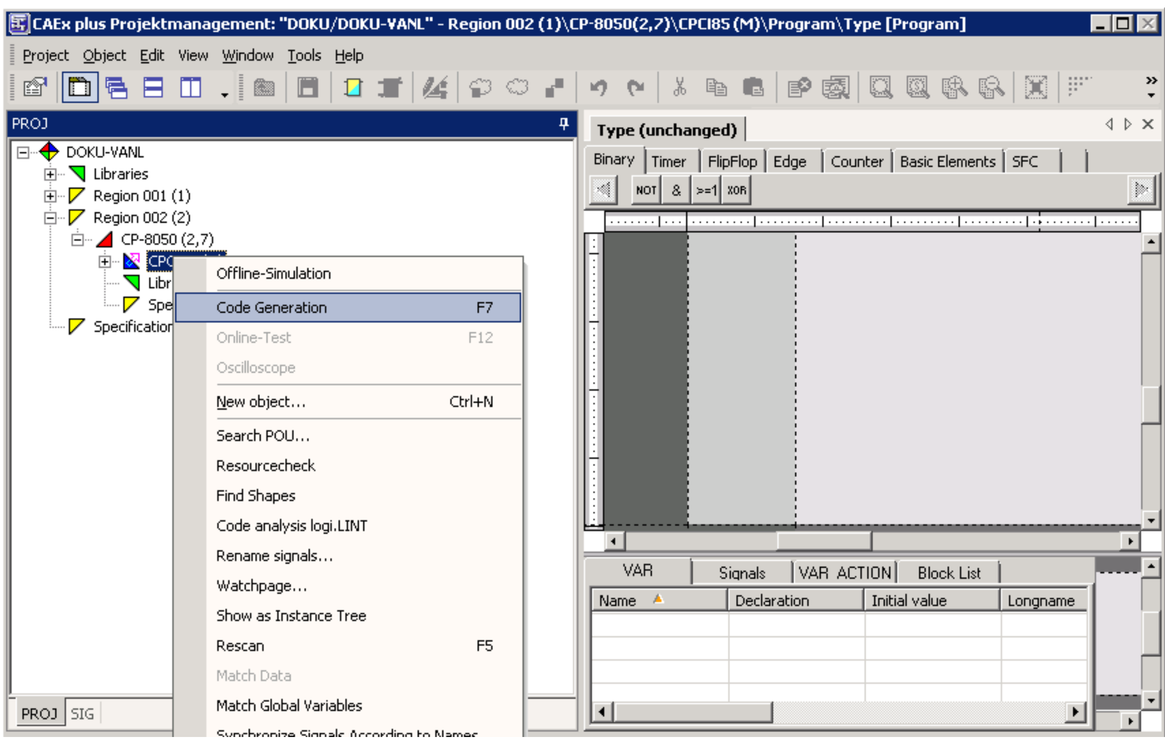
9.2.1.2 Program Code Generation

Before the loading of the *open-/closed-loop control function* into the target system, the application program code must be generated.

You can start the code generation via the following ways:

- CAEx *plus* Transformer
- CAEx *plus*, via the context menu of the Master Module (<firmware>)

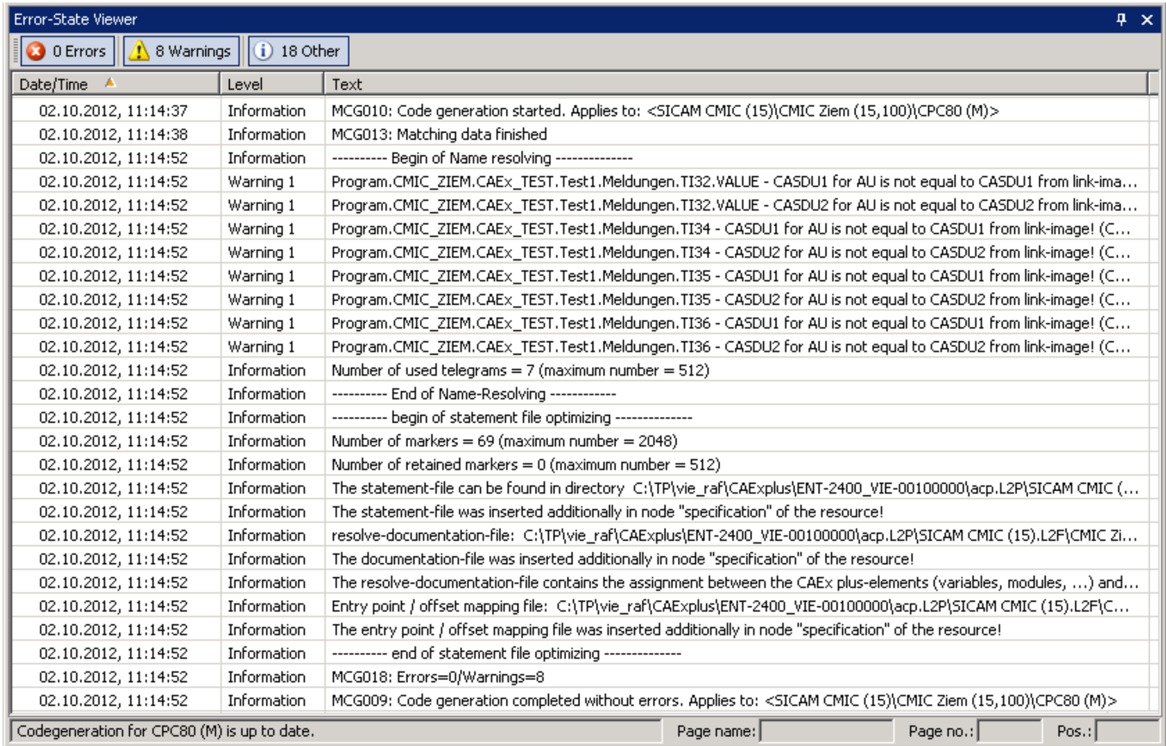
Start of the Program Code Generation



The function diagram is now translated and checked by a compiler. Simultaneously the program code is generated as instruction list (IL) in the folder “Specification”.

Via the menu **Tools | Error state viewer** the indication display of the code generation can be activated. There, common indications (as for instance information on occupied memory space for code and variables), as well as detected errors are recorded in detail.

Error State Viewer (Example)



Error-State Viewer

0 Errors | 8 Warnings | 18 Other

Date/Time	Level	Text
02.10.2012, 11:14:37	Information	MCG010: Code generation started. Applies to: <SICAM CMIC (15)\CMIC Ziem (15,100)\CPC80 (M)>
02.10.2012, 11:14:38	Information	MCG013: Matching data finished
02.10.2012, 11:14:52	Information	--------- Begin of Name resolving -------------
02.10.2012, 11:14:52	Warning 1	Program.CMIC_ZIEM.CAEx_TEST.Test1.Meldungen.TI32.VALUE - CASDU1 for AU is not equal to CASDU1 from link-ima...
02.10.2012, 11:14:52	Warning 1	Program.CMIC_ZIEM.CAEx_TEST.Test1.Meldungen.TI32.VALUE - CASDU2 for AU is not equal to CASDU2 from link-ima...
02.10.2012, 11:14:52	Warning 1	Program.CMIC_ZIEM.CAEx_TEST.Test1.Meldungen.TI34 - CASDU1 for AU is not equal to CASDU1 from link-image! (C...
02.10.2012, 11:14:52	Warning 1	Program.CMIC_ZIEM.CAEx_TEST.Test1.Meldungen.TI34 - CASDU2 for AU is not equal to CASDU2 from link-image! (C...
02.10.2012, 11:14:52	Warning 1	Program.CMIC_ZIEM.CAEx_TEST.Test1.Meldungen.TI35 - CASDU1 for AU is not equal to CASDU1 from link-image! (C...
02.10.2012, 11:14:52	Warning 1	Program.CMIC_ZIEM.CAEx_TEST.Test1.Meldungen.TI35 - CASDU2 for AU is not equal to CASDU2 from link-image! (C...
02.10.2012, 11:14:52	Warning 1	Program.CMIC_ZIEM.CAEx_TEST.Test1.Meldungen.TI36 - CASDU1 for AU is not equal to CASDU1 from link-image! (C...
02.10.2012, 11:14:52	Warning 1	Program.CMIC_ZIEM.CAEx_TEST.Test1.Meldungen.TI36 - CASDU2 for AU is not equal to CASDU2 from link-image! (C...
02.10.2012, 11:14:52	Information	Number of used telegrams = 7 (maximum number = 512)
02.10.2012, 11:14:52	Information	--------- End of Name-Resolving -----------
02.10.2012, 11:14:52	Information	--------- begin of statement file optimizing -------------
02.10.2012, 11:14:52	Information	Number of markers = 69 (maximum number = 2048)
02.10.2012, 11:14:52	Information	Number of retained markers = 0 (maximum number = 512)
02.10.2012, 11:14:52	Information	The statement-file can be found in directory C:\TP\vie_raf\CAExplus\ENT-2400_VIE-00100000\acp.L2P\SICAM CMIC (...
02.10.2012, 11:14:52	Information	The statement-file was inserted additionally in node "specification" of the resource!
02.10.2012, 11:14:52	Information	resolve-documentation-file: C:\TP\vie_raf\CAExplus\ENT-2400_VIE-00100000\acp.L2P\SICAM CMIC (15).L2F\CMIC Zi...
02.10.2012, 11:14:52	Information	The documentation-file was inserted additionally in node "specification" of the resource!
02.10.2012, 11:14:52	Information	The resolve-documentation-file contains the assignment between the CAEx plus-elements (variables, modules, ...) and...
02.10.2012, 11:14:52	Information	Entry point / offset mapping file: C:\TP\vie_raf\CAExplus\ENT-2400_VIE-00100000\acp.L2P\SICAM CMIC (15).L2F\C...
02.10.2012, 11:14:52	Information	The entry point / offset mapping file was inserted additionally in node "specification" of the resource!
02.10.2012, 11:14:52	Information	--------- end of statement file optimizing -------------
02.10.2012, 11:14:52	Information	MCG018: Errors=0/Warnings=8
02.10.2012, 11:14:52	Information	MCG009: Code generation completed without errors. Applies to: <SICAM CMIC (15)\CMIC Ziem (15,100)\CPC80 (M)>

Codegeneration for CPC80 (M) is up to date. Page name: Page no.: Pos.:

[tbii_caexplus_codegen_error_state, 1, en_US]

The exact description of this tool is included in the *CAEx plus Online Help, chapter "Target-System Connection", section "Functions for Target-System Connection", section "Code Generation"*.

The code generation can be started independently from "CAEx *plus*" with the tool "OPM II" through selection of the function **Destination systems | CAEx plus... | signal list/generate code**. Thereby a signal list is created for the processing of the parameterized signals in the *open-/closed loop control function* and read into CAEx *plus*.

Further details can be found in the *SICAM TOOLBOX II Online Help, chapter "OPM II", section "Transform and Load", "CAEx plus"*.

9.2.2 Documentation

9.2.2.1 Cross Reference List

With the tool "CAEx *plus*" a cross reference list over the project hierarchy can be generated, displayed on the screen, or printed.

The cross reference list refers alternatively to

- Basic system element
- Program organization unit

It is executed via the respective context menu **`Cross-references`**.

You find the instruction thereto in the *CAEx plus Online Help, chapter "Basics", section "Default Operating Elements", section "Commands of the Pop-Up Menus"*.

9.2.2.2 Open/Closed-Loop Control Function

In the project hierarchy of the tool "CAEx *plus*", by selecting each level the function **Print** can be executed, by means of pop-up menu. The print operation is started on the default printer of the PC.

You find the instruction thereto in the *CAEx plus Online Help, chapter "Basics", section "Default Operating Elements", section "Commands of the Pop-Up Menus", section "Print in Project Management"*.

Additional information can be found in the *CAEx plus Online Help, chapter "Basics", section "Default Properties" as well as chapter "Lists and References", section "Designing Printouts with DXF"*.

Further extensive possibilities for the documentation are provided by the optional function **Document Management** (additional product for CAEx *plus*).

You find the details thereto in the *CAEx plus Online Help, chapter "Additional Products", section "Documents Management (Optional)"*.

9.2.3 Commissioning and Test

9.2.3.1 Loading Program Code

To load the compiled program code into the target device, the engineering PC must be connected with the target device (see *8.1 Connect Engineering PC with the Target System*).

The loading of the program code into the target system takes place jointly with the parameters set in the "OPM II". Thereto the tool "Parameter Loader" must be used (see also section *9.1.9.1 Loading Engineering Data*).

NOTE

During a loading operation, the switching off of CP-8031/CP-8050 is to be absolutely avoided, since the data on the flash card could be destroyed as a result.

You find the technical description thereto in the manual *SICAM RTUs Common Functions System and Basic System Elements, chapter "Automation", section "Open-/Closed-Loop Control Function", "Loading of Application Program (Reload)"*.

You find the instruction for the operation in the *SICAM TOOLBOX II Online Help, chapter "Service Programs", section "Parameter Loader"*.

9.2.3.2 Test Functions

The following test functions are available:

- Simulate Function Diagram Offline
- Testing Function Diagram Online

Simulate Function Diagram Offline

The logic operations of a function diagram can be tested in "CAEx *plus*" with the “offline Simulation”.

This function can be called via the context menu of the basic system element, program instance or type instance (right mouse button). You can find the details thereto in the *CAEx plus User Manual, chapter "Additional Products", section "Offline Simulation"*.

Oscilloscope functions serve for the chronological representation of analog values and binary values during the “Offline-Simulation” of the function diagram.

You find exact details thereto in the *CAEx plus Online Help, chapter "Additional Products", section "Logic Analysis with Oscilloscope Functions"*.

Testing Function Diagram Online

With the tool "CAEx *plus*", all open- and closed-loop technical tasks in processing elements of the system can be tested online (selection of the basic system element, context menu **ONLINE Test**).

The following test functions are available:

- Display and force values
- Test switch input/output messages, input/output process images of the peripheral elements
- Changing the execution status of the open-/closed-loop control function
  - Stop controller
  - Start controller
  - Perform cold start of the resource
  - Perform warm start of the resource
  - Halt task
  - Continue task
  - Perform cold start of a task
  - Perform warm start of a task
  - Halt program
  - Continue program
- Setting breakpoints
- Real time archive
- Display status information
- Read and write variables

The technical description of the online test function can be found in the manual *SICAM RTUs Common Functions System and Basic System Elements, chapter "Automation", section "Online Test"*.

The details for operation can be found in the *CAEx plus User Manual, chapter "Target-System Connection", section "Functions for Target-System Connection"*.

NOTE

With user program running, the simulated value of a variable is statically overwritten. In contrast to this, inputs/outputs are not statically overwritten, rather only with a change to their process image (edge-triggered).

With application program stopped, simulated values are retained.

10 SICAM WEB

10.1 General Information

SICAM WEB provides the integrated online function for the devices of the SICAM A8000 Series WEB browser based on the HTML 5 standard. These online functions are also used by the SICAM Device Manager.

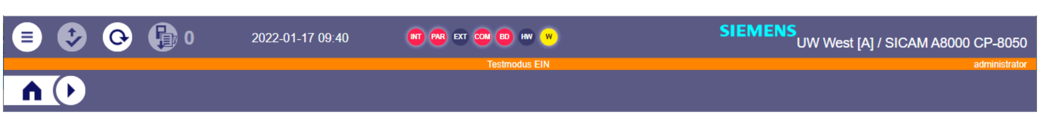
[sc_SICAM_WEB_dashboard, 5, en_US]

Figure 10-1 SICAM WEB Dashboard

10.1.1 Elements of the User Interface

Display of Test Modus

As soon as a function is switched to test in the device (e.g. data flow test, signals separated from the process, ...) an orange bar appears under the SICAM WEB header with a reference to the activated test mode.



[sc_sweb_dashboard_test_mode_active_new, 1, en_US]

Diagnosis Status LEDs in Header

LEDs are used in the SICAM WEB header to indicate whether diagnostic information (total information for each error class) is pending. Depending on the error class, the LEDs light up red (= restriction of the device function) or yellow (= warning according to the diagnosis).

[sc_sweb_diagnose_status_leds, 2, --_--]

Error class	Meaning	LED color
INT	Internal error	red
PAR	Parameter error / configuration error	red
EXT	External error	red
COM	Communication error	red
BD	(Break Down) Firmware failure	red
HW	Hardware error on an I/O module	red
V	Warning	yellow

The detailed information can be read out in the diagnosis function. See section *10.3 Diagnosis*

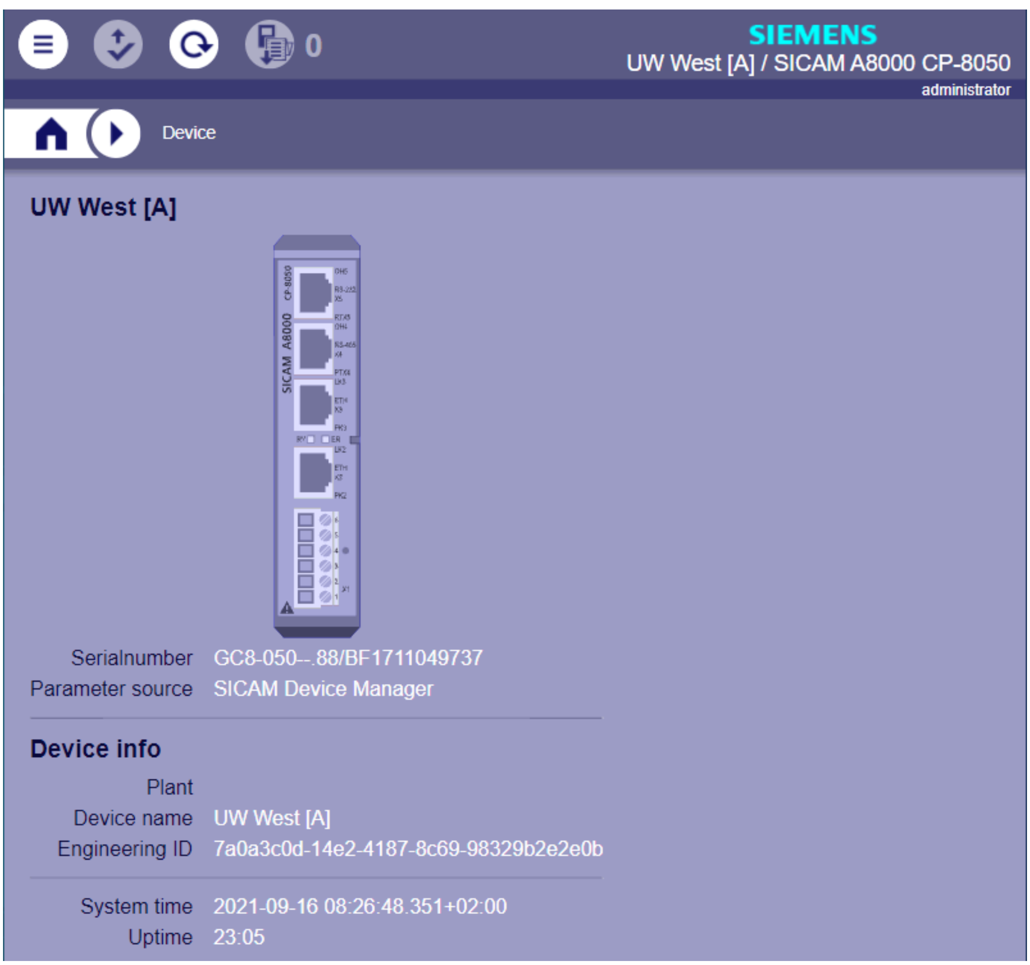
Date/time

The current device time is displayed.

10.2 Device

The following information can be called up from the target device via the **Device** tile on the SICAM WEB Dashboard.

- Device name
- View from the master module
- Serial number
- Parameter source
  e.g. SICAM Device Manager
- Plant
- Device name
- Engineering ID
- System time
- Operating time
  Shows the time since the device was last rebooted



[sc_sweb_device, 1, en_US]

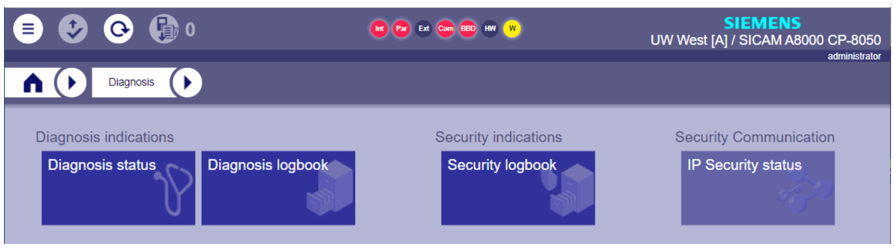
10.3 Diagnosis

General

The diagnostics function manages the system states and error information detected by the various functions and their watchdogs. It permits the indication of the internal system and error information, and of the process states by means of the engineering tool.

Currently pending diagnosis messages are signaled by LEDs in the SICAM WEB header and can be called up in detail via the **Status Diagnosis** tile. All diagnostic messages that have occurred in the device are recorded chronologically in the **Diagnosis Logbook**.

Via the **Diagnosis** tile on the SICAM WEB dashboard you can access the **Diagnosis** dashboard.



[sc_sweb_diagnose_dashboard, 1, en_US]

Diagnose Status LEDs

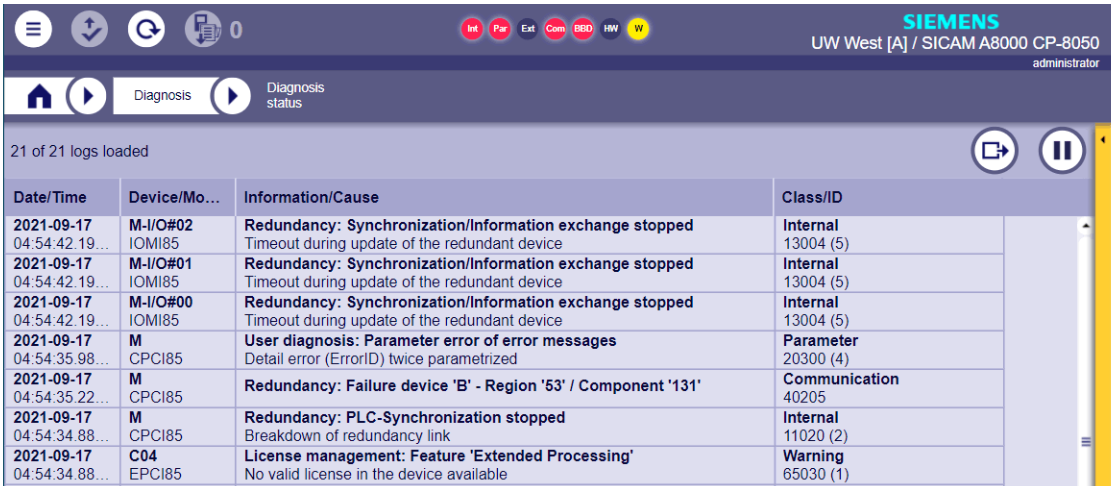
LEDs are used in the SICAM WEB header to indicate whether diagnostic information is pending. Depending on the error class, the LEDs light up red (= restriction of the device function) or yellow (= warning according to the diagnosis).

[sc_sweb_diagnose_status_leds, 2, --_--]

Error class	Meaning	LED color
INT	Internal error	red
PAR	Parameter error / configuration error	red
EXT	External error	red
COM	Communication error	red
BD	(Break Down) Firmware failure	red
HW	Hardware error on an I/O module	red
V	Warning	yellow

Diagnosis Status

After opening the **Diagnosis Status**, the currently pending errors are read out from the target device and displayed in a table.



[sc_sweb_diagnose_statusdiagnose, 1, en_US]

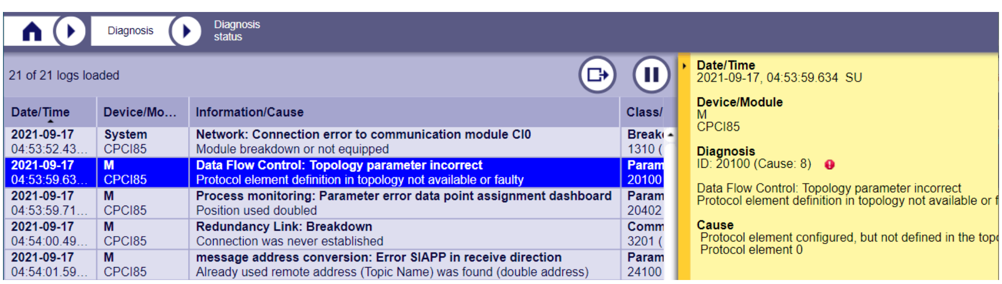
The status diagnosis shows all current errors in the target device.

The display is in chronological order. The contents of each column can be sorted in ascending or descending order.

NOTE

Reading out all diagnosis messages can take some time, depending on the communication connection. The process cannot be canceled.

When you select a row, an area with more detailed information opens on the right.



[sc_sweb_diagnose_statusdiagnose_detail, 1, en_US]

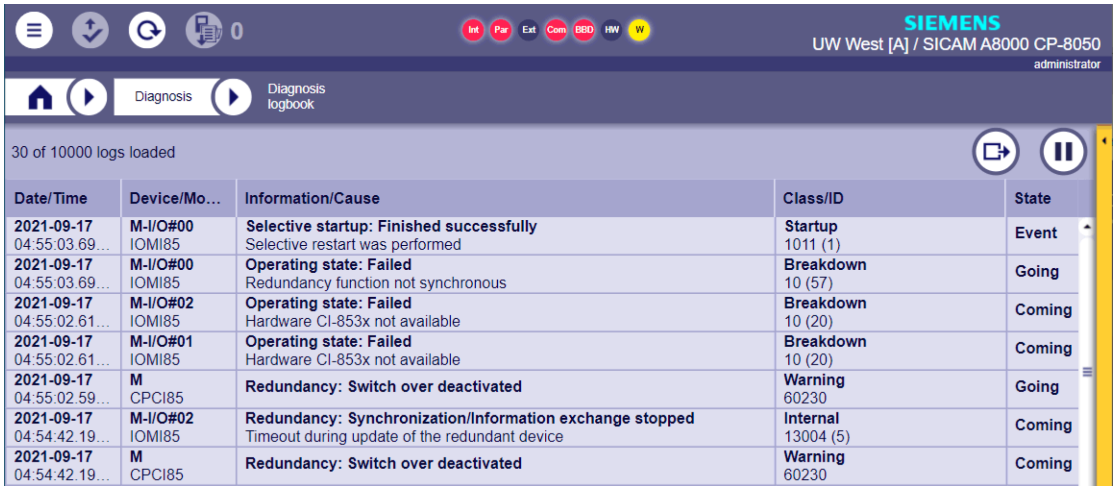
Export Diagnosis Status

With the export function you can save the recorded diagnosis status entries in a csv file on your PC.

- Start the process by clicking the button

Diagnosis Logbook

After opening the **Diagnosis logbook** the recorded diagnosis information is read out from the target device and displayed in a table.



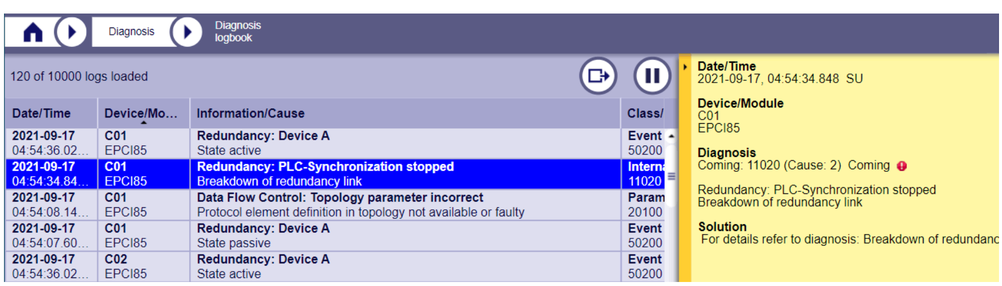
[sc_sweb_diagnose_diagnose_logbuch, 1, en_US]

The diagnosis logbook shows the chronological sequence of all incoming and outgoing errors in the target device.
The display is in chronological order (resolution 1 ms). The contents of each column can be sorted in ascending or descending order.

NOTE

Reading out all messages from the diagnosis logbook can take some time, depending on the communication connection. The process cannot be canceled.

The error table holds up to 10,000 entries and is saved in a non-volatile manner. When the error table is full, the oldest entry is overwritten with the newest one (ring buffer)
When you select a row, an area with more detailed information opens on the right.



[sc_sweb_diagnose_diagnose_logbuch_detail, 1, en_US]

Export Diagnosis Logbook

With the export function you can save the diagnosis events which are recorded in the ring buffer in a CSV file on your PC.

- Start the process by clicking the button

Clear Diagnosis logbook

[sc_Clear_Diagnosis_Loogbook, 1, en_US]

This function can be used to delete the diagnosis logbook.

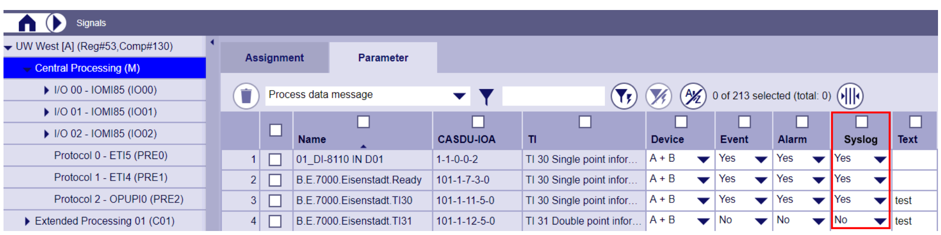
NOTE

As a result, information may be lost that is useful for subsequent troubleshooting.

Security logbook

This tile shows the latest security-related messages generated by the device.

It is also possible to enter changes of process data (single or double-point information items) in the security log (syslog). The assignment is made in the signal parameterization in the processing type**Process data message**in the **Syslog** column.



[sc_sdm_signal_syslog, 1, en_US]

This list can also be downloaded as a CSV file.

IP Security-Status

If the **IPSec** function has been activated, the current connection status of an IPSec tunnel can be displayed under this tile.

10.4 Alarms & Events

In operation, the occurring notifications from the system diagnosis and from the process are recorded upon a change of state.

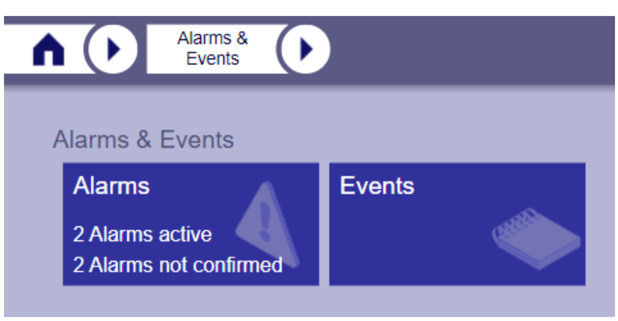
You can access the logs on the SICAM WEB Dashboard in the **RTUs** group with tile **Alarms & Events**. If there are alarms, their number and status are displayed on this tile.

The alarm list shows currently pending and unconfirmed alarms and no history. The event list shows event and alarms in chronological order.

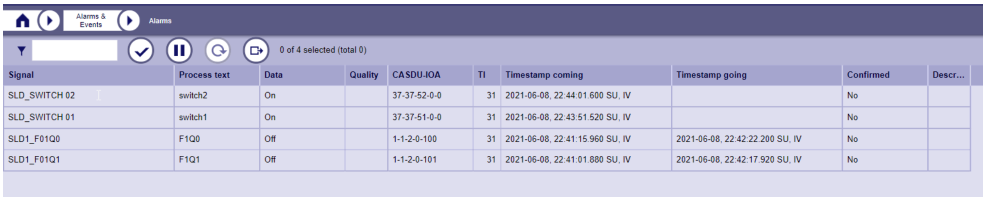
Signals can be assigned to both the event and the alarm list.

[sc_SICAM_WEB_dashboard, 5, en_US]

10.4.1 Show Alarm List



Selecting the tile **Alarms** will display the alarm list. It is displayed as a table. The table has read only rights.



Signal	Process text	Data	Quality	CASDU-IOA	TI	Timestamp coming	Timestamp going	Confirmed	Descr...
SLD_SWITCH 02	switch2	On		37-37-52-0-0	31	2021-06-08, 22:44:01.600 SU, IV		No	
SLD_SWITCH 01	switch1	On		37-37-51-0-0	31	2021-06-08, 22:43:51.520 SU, IV		No	
SLD1_F01Q0	F1Q0	Off		1-1-2-0-100	31	2021-06-08, 22:41:15.960 SU, IV	2021-06-08, 22:42:22.200 SU, IV	No	
SLD1_F01Q1	F1Q1	Off		1-1-2-0-101	31	2021-06-08, 22:41:01.880 SU, IV	2021-06-08, 22:42:17.920 SU, IV	No	

[sc_alarm_list, 1, en_US]

The process alarms (statuses of signals that are marked as alarms) are recorded in chronological order in an alarm buffer when the state changes.

Diagnostic alarms are no longer entered as of version 4.60.

The content of the alarm list depends on the confirmation of the alarm:

- Alarm is confirmed

  If the alarm is active, it is displayed with the time at which it first occurred. If it becomes inactive, it is automatically deleted from the list.

- Alarm is not confirmed

  If the alarm is active, it is in the list with the coming timestamp; the going timestamp is not entered. If it is no longer active, it is still in the list with coming and going timestamp.

  If the alarm list is confirmed, all inactive alarms are automatically removed from the list.

The table is sorted chronologically descending (latest alarm first, oldest alarm at last). If a new alarm occurs, this is automatically prepended at the first place of the table. The older alarms are moved down.

Only messages of type TI 30 and TI 31 can be assigned to the alarm list.

Confirm alarms

By clicking the **Confirm all alarms** button

all alarms with an **going timestamp** are deleted from the list.

- Active alarms are still displayed.
- The alarm list can also be confirmed in Viewer mode.
- A syslog entry is generated upon confirmation.
- The history can still be seen in the event list, if the data point is assigned to the alarm and event list.

Halt Function

By means of clicking on the button  you can halt the display of new alarms. If new alarms occur, then they are recorded furthermore in the alarms buffer, but not displayed in the table.

By means of clicking on the button  the alarm list is reloaded once. With activated halt function, this is thereby not canceled.

Structure of the alarm list

Column	Meaning / Note
Signal	Signal name from the signal list max. 99 characters; only if engineered with SICAM Device Manager or the signal list was imported from SICAM TOOLBOX II via SICAM WEB
Process text	Text from signal assignment parameter Max. 13 characters If the signal is also used in the dashboard, the name of the tile to which the signal is assigned is placed in front of the process text, separated by a '_'.
Data	On, Off actual status; text from assignment parameter Text_On, Text_Off, Text_Inter, Text_Fault
Quality	Status Bit (IV, NT, ...)
CASDU-IOA	parameterized CASDU1-CASDU2- IOA1-IOA2-IOA3
TI	Type identification (30, 31)
Timestamp coming	Time at which the alarm first occurred
Timestamp going	Time at which the alarm ended
confirmed	Yes, No
Description	Description column from the signal list of the Device Manager or long text from OPM

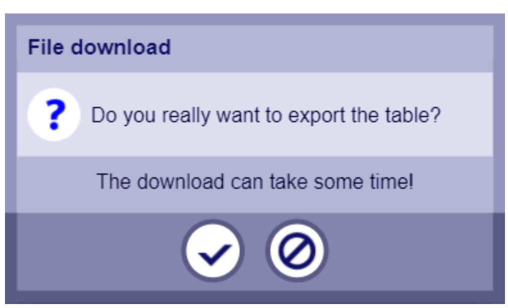
Export Alarm List

By means of clicking on the button  in the lower part of the alarm page the alarms can be exported to a file.
With the export function you can save all active (not confirmed) alarms in a file on your PC.

- Click on the button

  The target device saves the records in a file.

  [sc_alarms_export_01, 1, en_US]

- You can abort the procedure by clicking on

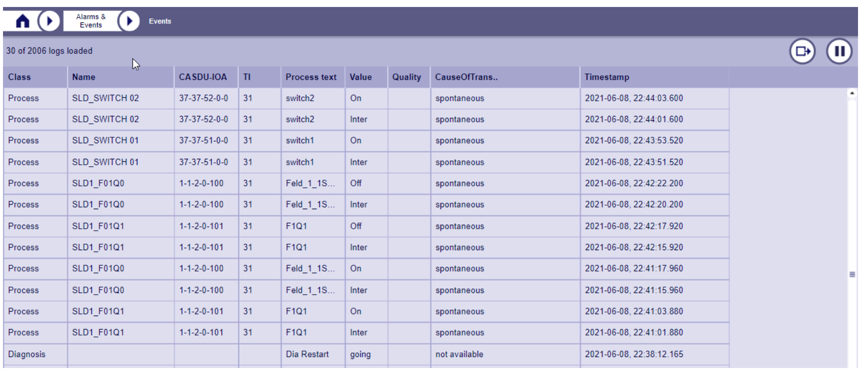
- Click on the button

  in order to start the export
  After the export, the file is provided for the download (format .csv).

10.4.2 Show Event List

Selecting the tile **Events** will display the event list. It is displayed as a table. The table has read only rights.



Class	Name	CASDU-IOA	TI	Process text	Value	Quality	CauseOfTrans..	Timestamp
Process	SLD_SWITCH 02	37-37-52-0-0	31	switch2	On		spontaneous	2021-06-08, 22:44:03.600
Process	SLD_SWITCH 02	37-37-52-0-0	31	switch2	Inter		spontaneous	2021-06-08, 22:44:01.600
Process	SLD_SWITCH 01	37-37-51-0-0	31	switch1	On		spontaneous	2021-06-08, 22:43:53.520
Process	SLD_SWITCH 01	37-37-51-0-0	31	switch1	Inter		spontaneous	2021-06-08, 22:43:51.520
Process	SLD1_F01Q0	1-1-2-0-100	31	Feld_1_1S...	Off		spontaneous	2021-06-08, 22:42:22.200
Process	SLD1_F01Q0	1-1-2-0-100	31	Feld_1_1S...	Inter		spontaneous	2021-06-08, 22:42:20.200
Process	SLD1_F01Q1	1-1-2-0-101	31	F1Q1	Off		spontaneous	2021-06-08, 22:42:17.920
Process	SLD1_F01Q1	1-1-2-0-101	31	F1Q1	Inter		spontaneous	2021-06-08, 22:42:15.920
Process	SLD1_F01Q0	1-1-2-0-100	31	Feld_1_1S...	On		spontaneous	2021-06-08, 22:41:17.960
Process	SLD1_F01Q0	1-1-2-0-100	31	Feld_1_1S...	Inter		spontaneous	2021-06-08, 22:41:15.960
Process	SLD1_F01Q1	1-1-2-0-101	31	F1Q1	On		spontaneous	2021-06-08, 22:41:03.880
Process	SLD1_F01Q1	1-1-2-0-101	31	F1Q1	Inter		spontaneous	2021-06-08, 22:41:01.880
Diagnosis				Dia Restart	going		not available	2021-06-08, 22:38:12.165

[sc_event_list, 1, en_US]

Events are recorded chronologically upon a change of state in an event buffer. The events are distinguished in 2 classes:

- Diagnosis events (notifications from the diagnosis function)
- Process events (states of signals that are marked as event)

When selecting the event list, the most current records (up to 50) are loaded. If more than 50 records are in the event buffer, when scrolling to the bottom the next 50 records will be loaded. The number of loaded records and the total number are displayed above the table.

The table is sorted chronologically descending (latest event first, oldest event at last), the time tagging has a resolution of 1 ms. If a new event occurs, this automatically prepended at the first place of the table. The older events are moved down.

The event buffer contains up to 4096 records and is managed as ring buffer. This means, if the event buffer has been fully written, the respective oldest record is overwritten by the most current.

The event buffer is stored non-volatile.

Are displayed:

- Messages of type TI 30 and TI 31
- Commands of the type TI 45, TI 46 and TI 47
- Command sequences

Halt Function

By means of clicking on the button you can halt the display of new events. If new events occur, then they are recorded furthermore in the event buffer, but not displayed in the table.

Events list items

The order and selection of the columns displayed in the list can be changed as required. See chapter *10.9.5 Configure WEB tables*)

Column	Meaning / Note
Class	Process Diagnosis
Name	Signal name from the signal list max. 99 characters; only if engineered with SICAM Device Manager or the signal list was imported from SICAM TOOLBOX II via SICAM WEB (applies for process events)
CASDU-IOA	IEC 60870-5-101/104 address parameterized CASDU1-CASDU2- IOA1-IOA2-IOA3
TI	Type identification (30, 31, 45, 46)
Process text	Text from signal assignment parameter Max. 13 characters If the signal is also used in the dashboard, the name of the tile to which the signal is assigned is placed in front of the process text, separated by a '_'.
Value	coming going On Off Fault Inter
Quality	Status bit (IV, NT, ...)
Cause of transmission	spontaneous, not available, activation, confirmation, execution, abort of activation, background interrogation, interrogated by GA, ...
Time tag	Date and time the event occurred YYYY-MM-DD, Thh:mm:ss:ms+hh:mm

NOTE

When selecting another menu within the session (e.g. settings, signals), the content of the table remains, but the polling for new events is stopped. If the event page is reopened again, all events since leaving the event page are automatically loaded.

If during the leaving of the event page a ring buffer overflow occurred, only the last 4096 events can be loaded.

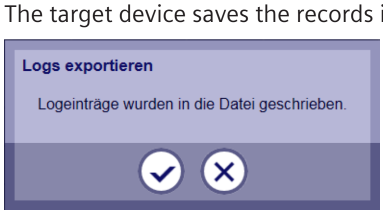
Export Event List

With the export function you can save the events which are recorded in the ring buffer in a file on your PC.

- Click the button

  The target device saves the records in a file.

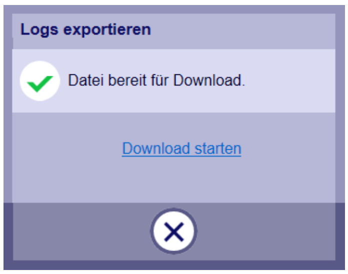
- You can abort the procedure by clicking on

- Click the button

  in order to start the export
  After the export, the file is provided for the download (format .csv). A dialog is opened with the link "Start download".

- Click with the right mouse button on the link
  A dialog for the selection of the saving path is opened. The default file name can be changed, if needed. Follow the instructions of your web browser.

- You can abort the procedure by clicking on

10.5 Process Data Archive

Binary information states, measured values and integrated totals can be recorded in a process data archive. This archive comprises up to 5.000.000 records over a maximal period of 3 months.

The data stored in the process data archive can be downloaded as a CSV file and saved on the configuration PC. This file can then be read out as a table.

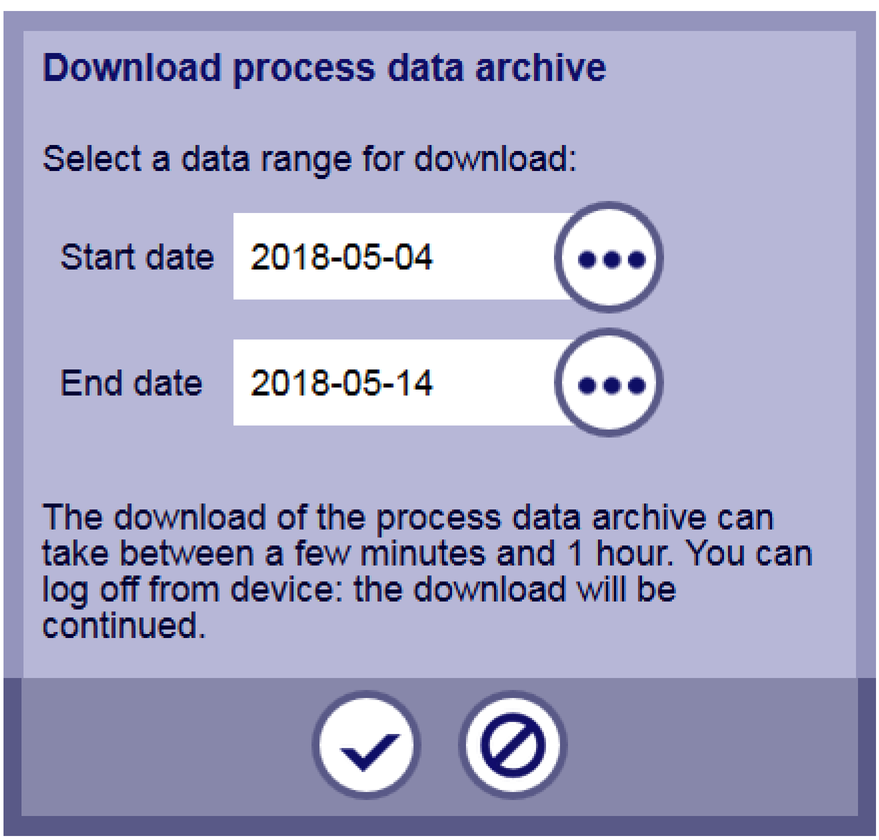
The file contains the binary information items, measured values and integrated totals that were parameterized for recording in the process data archive.

10.5.1 Download Process Data Archive

Standard Download

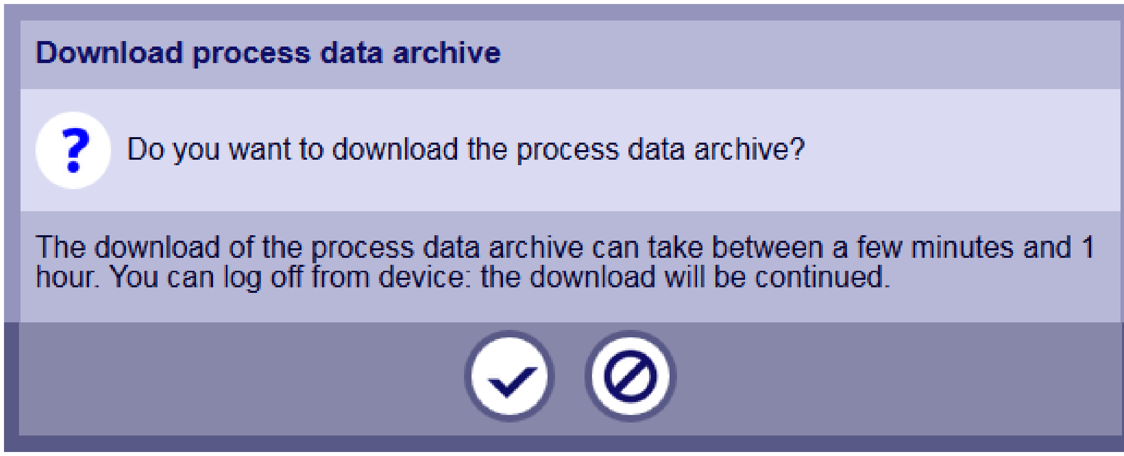
✧ Click on the SICAM WEB Dashboard in the **RTUs** group on the **Process Data Archive** tile.

The following dialog appears in which you can select a data range for download:



NOTE

If instead of the previous dialogue the following appears.



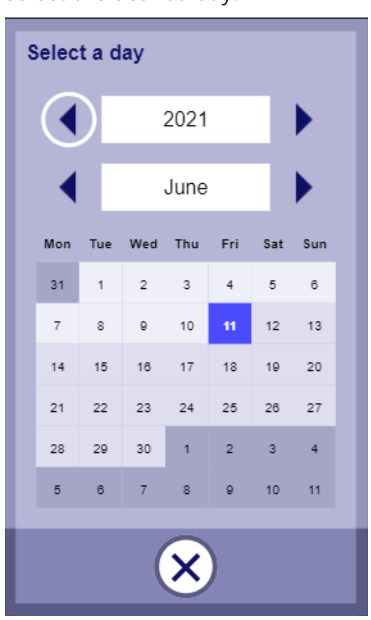
then you cannot select a data range due to missing dates in the process data. Then proceed as described under *Download of Data without Date, Page 565* .

✧ You can now start the download with the default data by clicking on or configuring a time period for which you want to download the data.

NOTE

The default start date comes from the oldest data element stored, the default end date from the last saved data element.

✧ For the configuration of start and end date click on. The following dialog appears in which you can select the desired day.



✧ End the date input for start and end dates by clicking on.

✧ You can now start the download by clicking on in the **Download process data archive** dialog.

The storing procedure may vary dependent on the used web browser and may take some time, depending on the file size (max. 1 GB) and transmission rate. Follow the instructions of your web browser. The file name is put together of: PROC_ARCHIVE<date>_<time>.csv.

Example for an Archive File

	A	B	C	D	E	F	G	H	I	J	K	L
1	Name	CASDU-IOA	TI	Process text	Value	Minimum	Maximum	Quality	Unit	Timestamp		
2	SLD_Panel_LED1	1-1-2-0-163	30	_Status	On					2021-08-29T03:53:21.470+02:00		
3	SLD_Panel_LED2	1-1-2-0-164	30	_Alarm	On					2021-08-29T03:53:21.470+02:00		
4	SLD_Panel_LED1	1-1-2-0-163	30	_Status	On					2021-08-29T03:53:14.690+02:00		
5	SLD_Panel_LED2	1-1-2-0-164	30	_Alarm	On					2021-08-29T03:53:14.690+02:00		
6	SLD_Panel_Fern_Ort	1-1-2-0-161	31	T E S T	Off			NT		2021-08-29T03:53:12.778+02:00		
7	SLD_Panel_Fern_Ort	1-1-2-0-161	31	T E S T	Off			NT		2021-08-29T03:53:12.738+02:00		
8	SLD_Panel_LED1	1-1-2-0-163	30	_Status	On					2021-07-06T09:17:53.840+02:00		
9	SLD_Panel_LED2	1-1-2-0-164	30	_Alarm	On					2021-07-06T09:17:53.840+02:00		
10	SLD_Panel_LED1	1-1-2-0-163	30	_Status	On					2021-07-06T09:17:47.040+02:00		

Due to the size (number of rows) of the download file there may be problems when opening it!

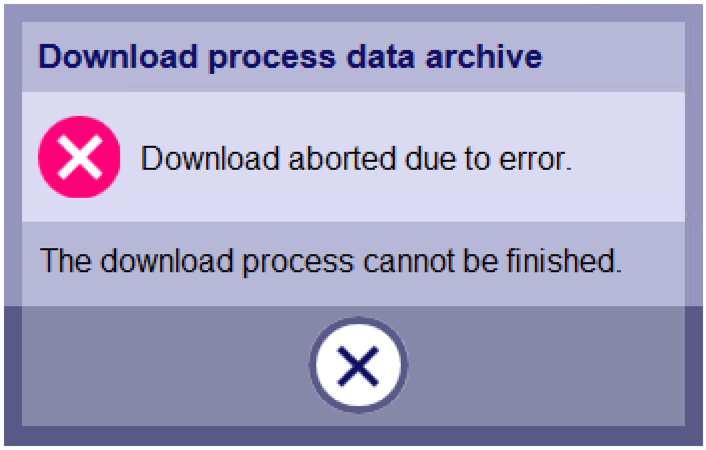
NOTE

If the download - possibly in another session - has already been started but not yet finished, the following dialog appears:

You must cancel the process and await the completion of the previous download.

NOTE

If the archive file cannot be generated due to errors, the following dialog appears:



One cause may be, for example, a poor communication connection or the memory usage in the target device.

Cancel the process and try again. If the error persists, check the communication connection and / or - if possible - trigger a startup of the target device.

NOTE

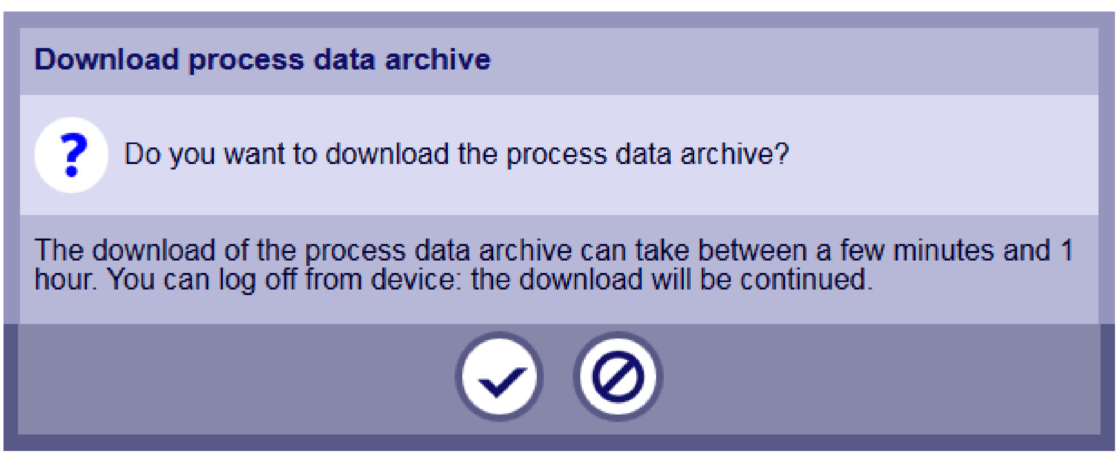
- If the **Process Data Archive** tile is grayed out, this is an indication of the missing configuration.
- If the error message `Unsupported Fearture` appears when clicking on the **Process Data Archive** tile, this is an indication of an outdated version of SICAM WEB.

Download of Data without Date

If your process archive has entries with no date (for example, if the date is not set), then the download is done as follows:

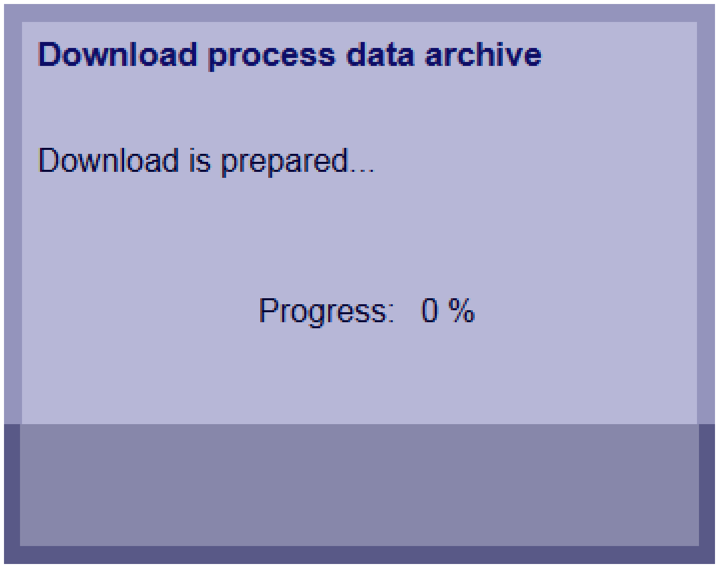
✧ Click on the SICAM WEB Dashboard in the **RTUs** group on the **Process Data Archive** tile.

The following dialog appears:

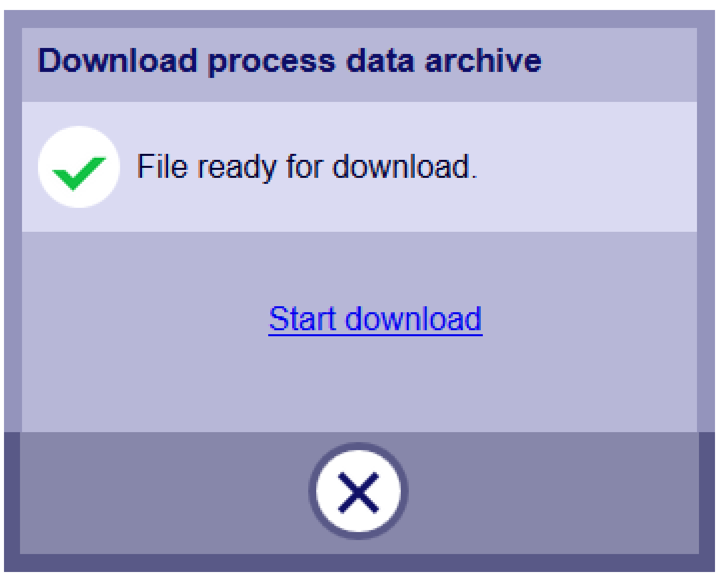


✧ Confirm the process with ✓.

The target device now starts generating the archive file. The progress is displayed by the web server. This process can take several minutes.



When the archive file has been successfully completed, the following dialog appears:



✧ Click on Start Download

The storing procedure may vary dependent on the used web browser and may take some time, depending on the file size (max. 1 GB) and transmission rate. Follow the instructions of your web browser. The file name is put together of: PROC_ARCHIVE<date>_<time>.csv.

NOTE

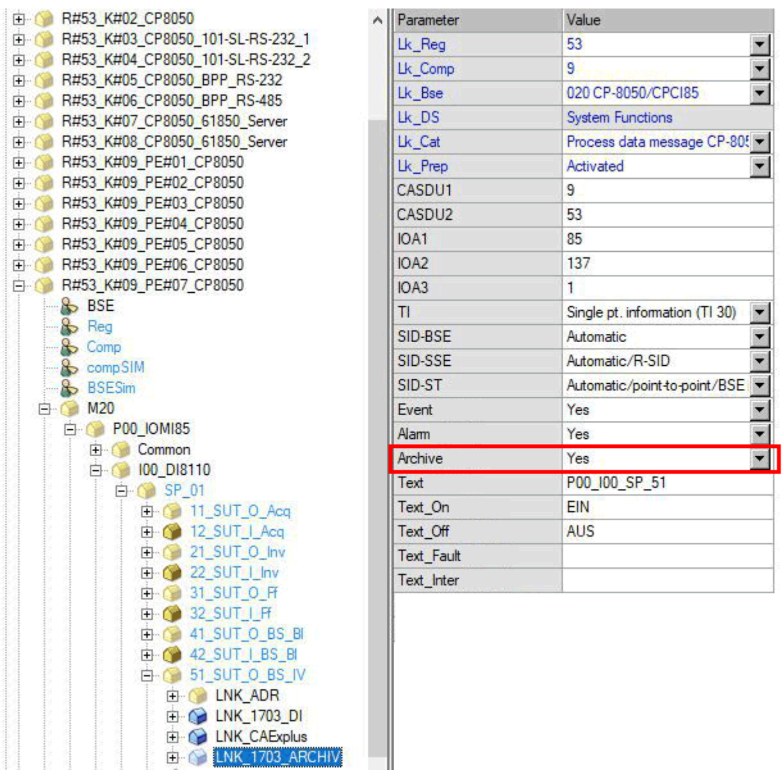
The download can be aborted at any time by means of:

- Cancel function via web browser
- Closing the web browser

10.5.2 Configuration of the Process Data Archive

The process data archive can be configured using the engineering tools SICAM Device Manager and SICAM TOOLBOX II.

Only those data points are recorded in the archive, which are parameterized for that. The assignment thereto can be performed in the signal parameterization.



[sc_TB_para_archive_de, 2, en_US]

Figure 10-2 Configuration with SICAM TOOLBOX II

The data points to be recorded are archived chronologically during operation. The archive captures up to 5.000.000 records over a maximal period of 3 months. The record happens for the following categories:

- Binary information items: upon status change (process data message)
- Measured values: according to parameter **`Recording grid for measured values`** (process data measured values)

NOTE

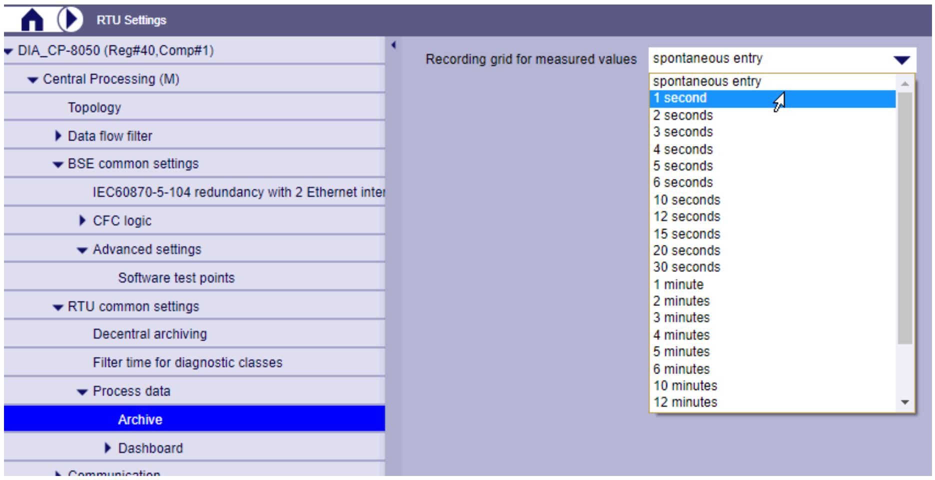
The contents of the process data archive is deleted with every change of the configuration of process data measured values and/or of process data message (for instance if a new signal is added). If needed, download the archive before such kind of change.

Change of a signal name affects the archive only after startup. Before startup the archive shows the previous signal name.

Recording Grid for Measured Values

This parameter defines whether the measured values are entered spontaneously when the status changes or periodically using the recording grid (cycle time) for measured values. It can be set from 1 second to 60 minutes.

The setttings are defined with SICAM Device Manager under **HOME | RTU Settings | Central Processing | RTU common settings | Process data | archive | Recording Grid for Measured Values**



[sc_PDA_config_mv_cycle, 1, en_US]

10.6 Dashboard

10.6.1 General

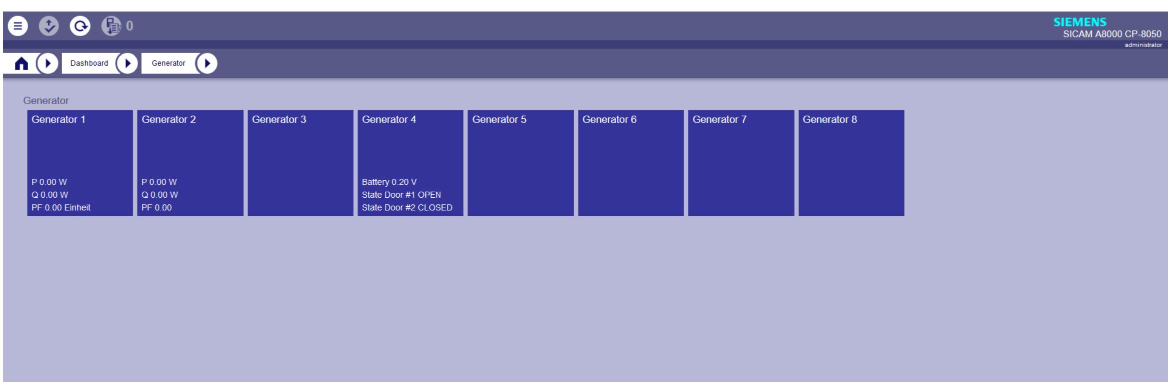
The dashboard function provides a simple, integrated HMI solution for CP-8031/CP-8050. Simple parameterization without a complex image editor offers the user a generic dashboard solution for the message and control direction.

You will find access to the dashboard after logging in to CP-8031/CP-8050 on the SICAM WEB main page in the **RTUs** area in the tile named **Dashboard**.

In the dashboard, the user can define up to 16 tiles with any name.

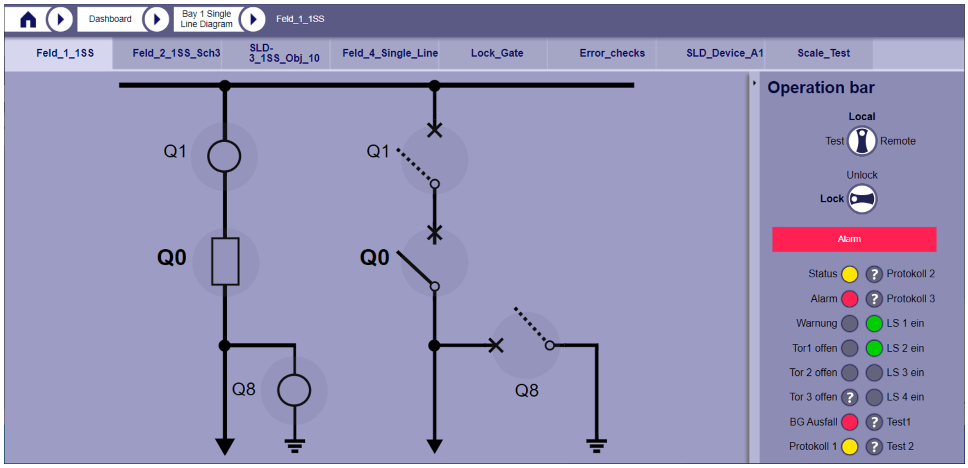
[sc_PIC2_DE, 1, en_US]

In each of these tiles up to 16 sub-tiles can be created.



[sc_PIC3_DE_EN, 1, en_US]

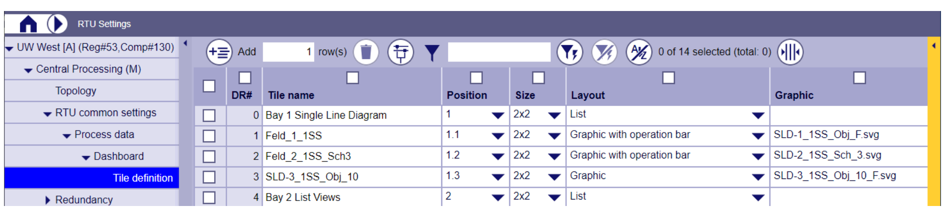
In addition to the tile view, it is also possible to display several pages in a tab layout:



[sc_SW_Graph_with_operation_bar_01, 2, en_US]

10.6.2 Configuration of the tile structure with the SICAM Device Manager

The tiles are defined with SICAM Device Manager under **HOME | RTU Settings | Central Processing (M) | RTU common settings | Process data | Dashboard | Tile definition**.

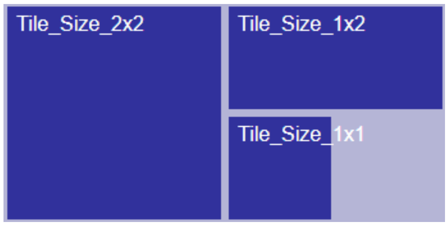


[sc_SDM_Tile_definition_01, 1, en_US]

Following settings are required:

- **Tile name**
  A maximum of 30 characters are allowed.
  (a-z, A-Z, 0-9, '_', '.', '-')
- **Position**
  16 positions (tiles) are possible. Position 1 is on the top left of the dashboard, position 2 on the right, and so on.
  Tiles of the first level are defined with values from 1 to 16 using the **Position** parameter.
  Sub-tiles of the second level are defined with values such as 1.1, 1.2, 1.3, 3.1, 3.2 etc. with the **Position** parameter.
  If a sub-tile is defined, without an existing corresponding tile on the first level, the device generates a diagnostic message with detailed information.
  If a tile position is configured twice, the device also generates a diagnostic message with detailed information.
  Are there gaps between the defined tiles (e.g .: 1,2,4,5) the position is not left blank, but the tiles are lined up.

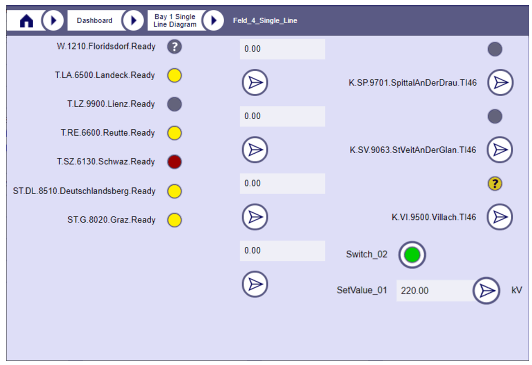
- **Size**
  There are 3 different sizes (2x2, 1x2 and 1x1) available for the tiles.

  [sc_SW_Tile_Size_01, 1, --_--]

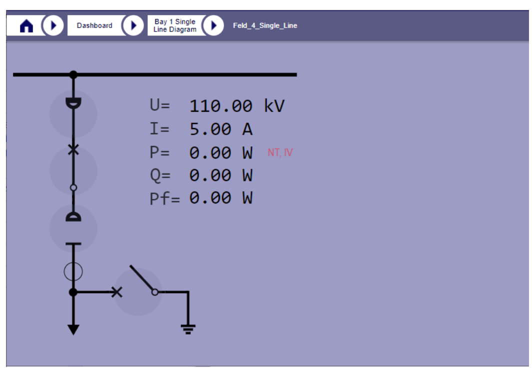
  This value is not relevant if the tab layout was selected for the SICAM WEB dashboard.

- **Layout**
  The following layout types can be used:
  - **List**
    In the list layout, up to 64 signals (commands, messages, setpoint- and measured values) can be displayed/output per tile.



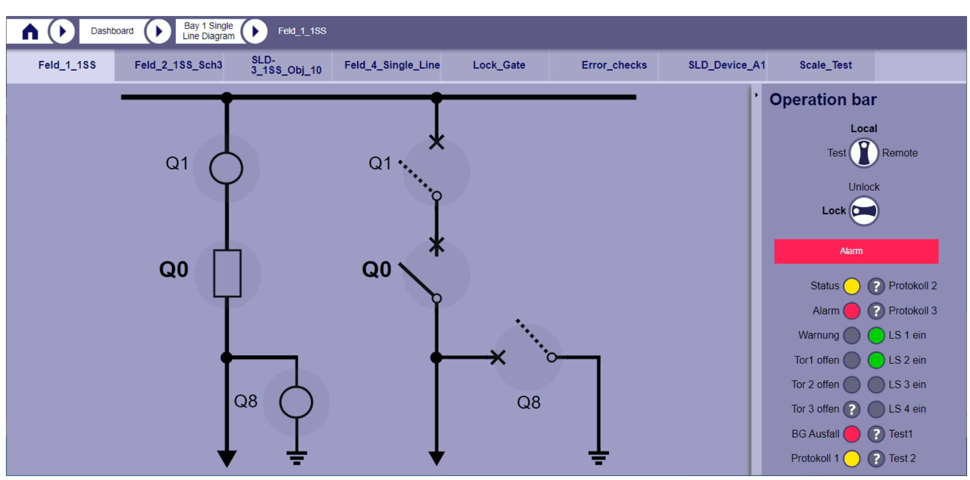
[sc_SW_Tile_Layout_List, 2, --_--]

  - **Graphic**
    The user defines and draws the content and layout of the graphic.



[sc_SW_Tile_Layout_Graphic_01, 1, --_--]

  - **Graphic with operation bar**
    The user defines and draws the content of the graphic window. The layout of the operation bar is fixed.

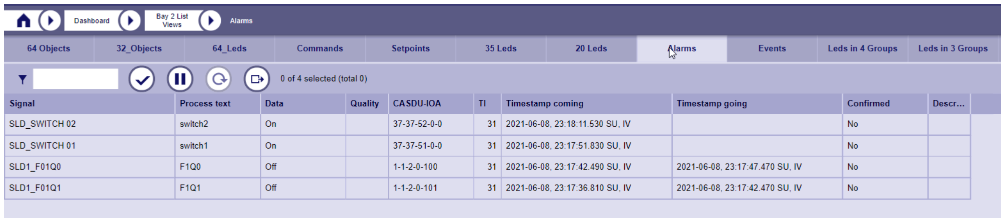


[sc_SW_Graph_with_operation_bar_01, 2, en_US]

  - **Alarms**

If this layout type is selected, the alarm list is displayed in the tile (or tab).

The content of this list is identical to that, which you can find via the SICAM WEB dashboard in group **RTUs** with the tile **Alarms & Events** .



[sc_db_tile_layout_alarms, 1, en_US]

– **Events**

  If this layout type is selected, the event list is displayed in the tile (or tab).

  The content of this list is identical to that, which you can find via the SICAM WEB dashboard in group **RTUs** with the tile **Alarms & Events** .

[sc_db_tile_layout_events, 1, en_US]

- **Graphic**

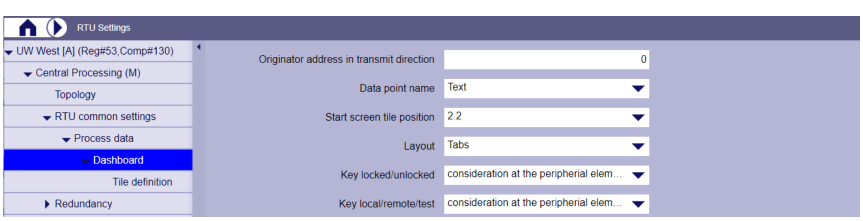
  The graphic (SVG) that is to be displayed in the tile is defined here.

  All SVG graphics are available that were loaded with the SICAM Device Manager.

  If the tiles are configured with the SICAM TOOLBOX II, the files must be loaded into SICAM WEB afterwards.

10.6.3 Dashboard Parameter

HOME | RTU Settings | Central Processing (M) | RTU common settings | Process data | Dashboard

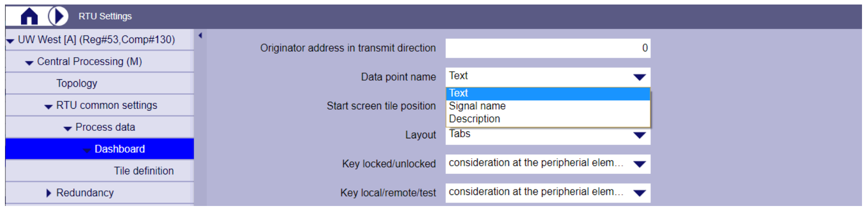


[sc_db_parameter_00, 3, en_US]

- **Originator address in transmit direction**

  All commands or setpoint values that are triggered by the user in the dashboard are provided with this originator address.

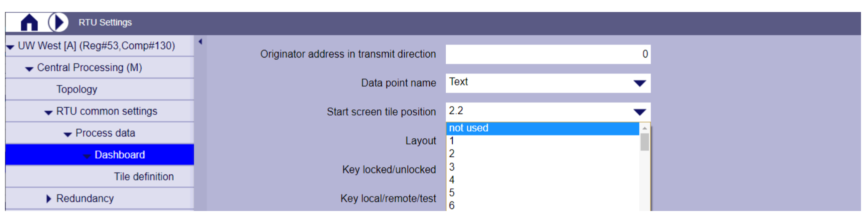
- **Data point designation**
  This parameter defines from which source the designation comes.
  It acts on the data point designation in the **List** layout and in the dialogs for command or setpoint output.



[sc_db_parameter_01, 3, en_US]

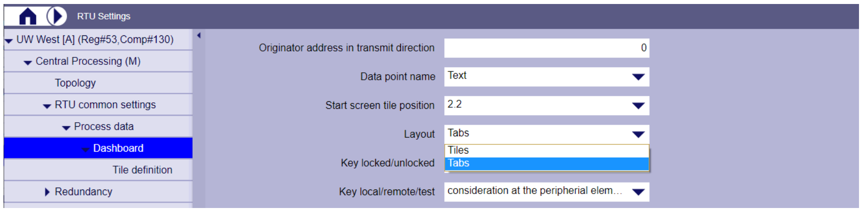
  – **Text**
    The value comes from the parameter list, column**Text**.
  – **Signal name**
    The value comes from the signal list, column**Name**.
  – **Description**
    The value comes from the signal list, column**Description**.

- **Start screen tile position**
  The SICAM WEB start screen can be configured with this parameter.
  If the parameter value is `not used`, the standard HOME desktop is shown.
  When selecting a tile position, the content of this tile is shown when SICAM WEB is opened.
  If you select a non-configured tile position, the SICAM WEB Standard HOME desktop is displayed and a diagnosis entry is made.



[sc_db_parameter_start_tile_pos, 2, en_US]

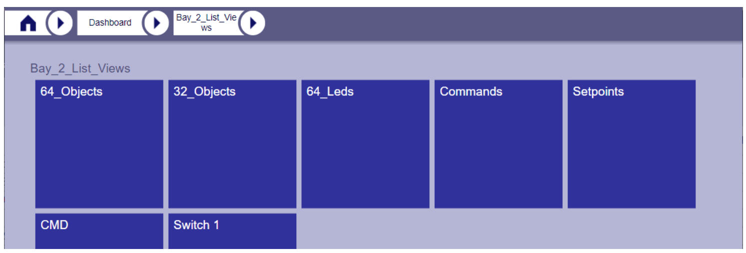
- **Layout**



[sc_db_parameter_layout, 2, en_US]

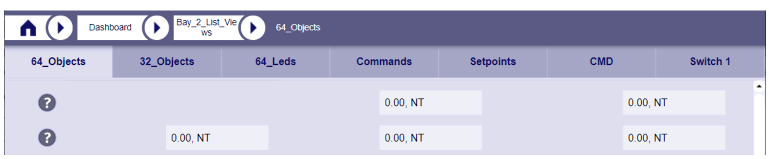
This parameter can be used to select the presentation of the display of the tiles in the dashboard. You can choose between:

– **Tiles**



[sc_db_layout_tile, 1, --_--]

– **Tabs**



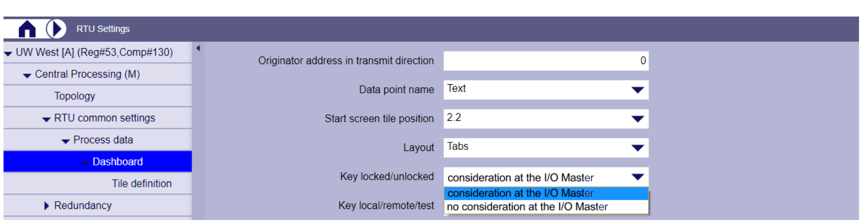
[sc_db_layout_tabs, 1, --_--]

This type of presentation enables you to switch between the individual tiles more quickly.

– The tab layout can only be used for tiles of the lowest level.

– Live values cannot be displayed in tabs.

- **Key locked/unlocked**
This parameter defines whether the status of the key switch should be evaluated directly on the I/O master.
The key switch is only available in the operation bar.

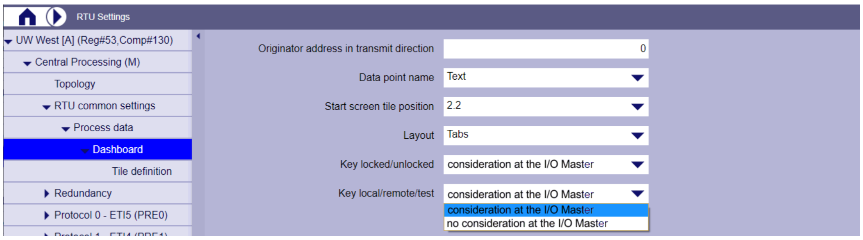


[sc_db_parameter_02, 4, en_US]

– **Consideration at the I/O master**
The key switch can be used to influence the checking of the locking conditions on the I/O master.

– **No consideration at the I/O master**
The I/O master checks the locking conditions independently of the key switch.

- **Key local/remote/test**
  This parameter defines whether the status of the key switch should be evaluated directly on the I/O master.
  The key switch is only available in the operation bar.



[sc_db_parameter_03, 3, en_US]

  – **Consideration at the I/O master**
    The key switch can be used to influence the checking of the locking conditions on the I/O master.
  – **No consideration at the I/O master**
    The I/O master checks the locking conditions independently of the key switch.

10.6.4 Display/Output of Signals in Lists

10.6.4.1 Indication of Messages, Measured Values, Commands and Setpoint Values

Messages, measured values, commands and setpoint values can be displayed in tiles with a list layout, each with its own symbol, or two functions (display and output) can be combined in a single symbol. This is possible with commands/messages and setpoint values/measured values.

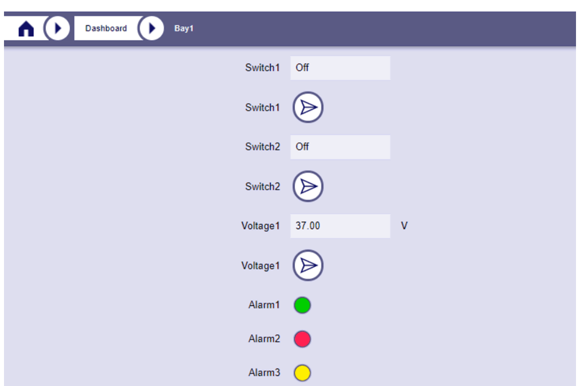


Figure 10-3 Symbols for the representation of individual signals

Figure 10-4 Symbols for displaying combined signals

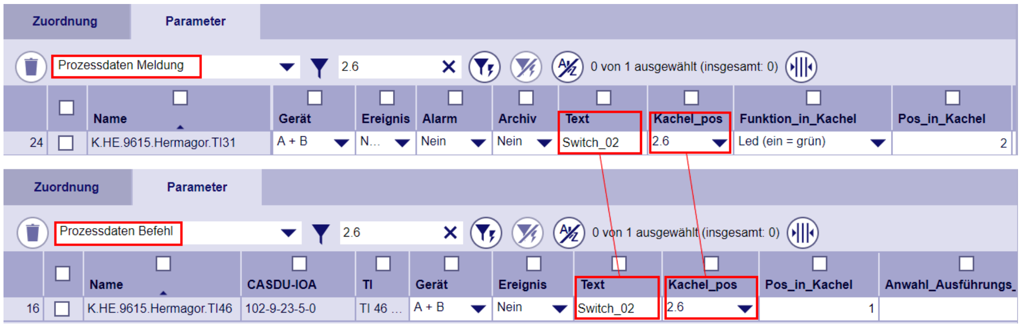
Combined representation of command/message

With the combination of command and message, an LED symbolizes the current switching status. If you want to change this, click on the LED and then get the dialog for the command output.

[sc_SDM_combined_symbol_02a, 1, --_--]

The linking of the signals that belong together takes place via the parameters **Text** and **Tile_pos**. These must be parameterized identically for both signals.

The **pos_in_tile** parameter must be unique. The same number for command and binary information must not be assigned.



[sc_SDM_combined_Mess_CMD_01, 2, en_US]

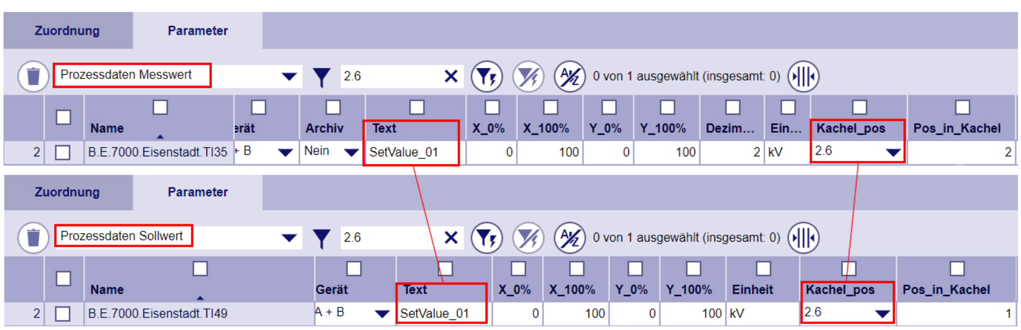
Combined representation of setpoint value/measured value

With the combination of setpoint value and measured value, the current measured value is displayed in a field. You can change this value with the attached **Send** button. When you click on **Send**, the dialog for the setpoint value output is called up. If the output is successful, the new value is displayed in the measured value field.

[sc_SDM_combined_symbol_02b, 1, --_--]

The signals that belong together are combined via the parameters **Text** and **Tile_pos**. These must be parameterized identically for both signals.

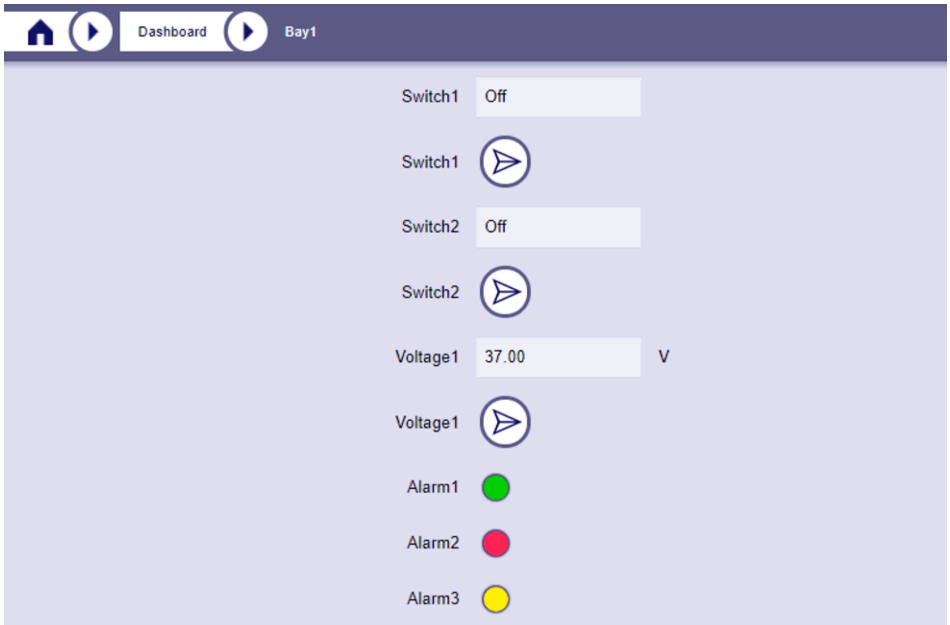
The **pos_in_tile** parameter must be unique. The same number for setpoint value and measured value must not be assigned.



[sc_SDM_combined_MV_SV_01, 2, en_US]

Representation of signals with their own symbol

Depending on the type of signal (message, measured value, command, setpoint value), it is displayed with its own symbol.



[sc_db_sinal_list_layouts, 1, --_--]

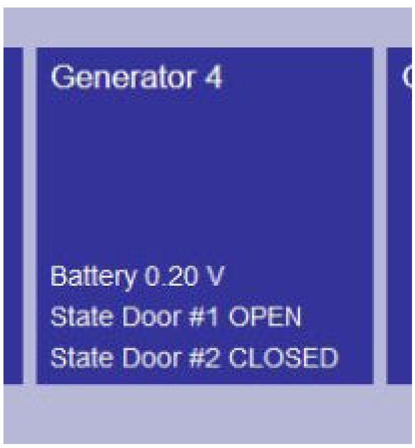
Figure 10-5 Symbols for the representation of individual signals

Parameterization of the signals

The selection of signals and the definition of their visualization on the tiles is done in the process data with following parameters:

- `Text` The signal is displayed with the value of this parameter, if parameter **Data point name** is set to **Text**.
- `Pos_in_tile` [1-16,1.1-1.16,2.1 ....16.16, Operation bar]
  The option **Operation bar** applies only to layout **Graphic with operation bar**.
- `Function_in_tile`
  This parameter is only available for messages and measured values. It determines the form in which the signal is displayed in tiles with a list layout.
  - `Measured value as graph (layout = list)`
    This type of display is only available with the **Extended SICAM WEB** license for measured values.
  - `Key local/remote/test operation bar`
    This option applies only to layout **Graphic with operation bar**.
  - `Key local/remote/test physical`
    This option applies only to layout **Graphic with operation bar**.
  - `Key locked operation bar`
    This option applies only to layout **Graphic with operation bar**.
  - `Key locked physical`
    This option applies only to layout **Graphic with operation bar**.
  - `Led (on = green)`
  - `Led (on = red)`
  - `Led (on = yellow)`

- **`Pos_in_tile`** [0 ... not used, 1-64]
  The order in which the signals are displayed in the list.
  The display order can also be used to group the signals. Up to 4 groups (4 columns) can be defined:
  - Group 1: Index 1-16
  - Group 2: Index 17-32
  - Group 3: Index 33-48
  - Group 4: Index 49-64
- **`Pos_on_tile`** [0 ... not used, 1-3]
  With this parameter **`Pos_on_tile`** you can define 3 signals per tile that are displayed directly on the tile. It is possible to display this information on all levels (tiles and sub-tiles).
  If the tiles are displayed as tabs (parameter layout = tabs), this parameter is not evaluated for the lowest level.



[sc_PIC8_DE_EN, 1, en_US]

The display of the signals in the dashboard tiles uses the existing options for event and alarm lists (Text, State_TextOn, ..., X_0%,... ..)

Parameter	Value
Lk_Reg	53
Lk_Comp	6
Lk_Bse	020 CP-8050/CPCI85
Lk_DS	System Functions
Lk_Cat	Process data message CP-8050
Lk_Prep	Activated
Device	A + B
CASDU1	6
CASDU2	53
IOA1	113
IOA2	185
IOA3	40
TI	Single pt. information (TI 30)
SID-BSE	Automatic
SID-SSE	Automatic/R-SID
SID-ST	Automatic/point-to-point/BSE itself
Event	No
Alarm	No
Archive	No
Text	State Door #1
Text_On	OPEN
Text_Off	CLOSED
Text_Fault	Faulty
Text_Inter	Interm
Cockpit_GroupNr	0
Cockpit_GroupPos	0
Tile_pos	1.4
Pos_in_tile	2
Pos_on_tile	2

Parameter	Value
Lk_Reg	53
Lk_Comp	6
Lk_Bse	020 CP-8050/CPCI85
Lk_DS	System Functions
Lk_Cat	Process data measured value CP-8050
Lk_Prep	Activated
Device	A + B
CASDU1	6
CASDU2	53
IOA1	68
IOA2	185
IOA3	40
TI	Measured val. 15 bit + sign normalized (TI 34)
SID-BSE	Automatic
SID-SSE	Automatic/R-SID
SID-ST	Automatic/point-to-point/BSE itself
Archive	No
Text	Battery
Cockpit_GroupNr	0
Cockpit_GroupPos	0
X_0%	-5
X_100%	5
Y_0%	-1
Y_100%	1
Decimal_places	2
Unit	V
Tile_pos	1.4
Pos_in_tile	1
Pos_on_tile	1

Signals

Assignment | Parameter

Process data measured value — 0 of 76 selected (total: 0)

	Name	CASDU-IOA	TI	Device	Archive_...	Text	X_0%...	X_100%...	Y_0%...	Y_100...	Decim...	Unit	Tile_pos	Pos_in_tile	Pos_on_tile
1	B.E.700...	101-1-15-5-0	TI 34 ...	A + B	No		0	1	0	1	2	Volt	2.5	1	0
2	B.E.700...	101-1-16-5-0	TI 35 ...	A + B	No		0	100	0	100	2		2.5	17	0
3	B.E.700...	101-1-17-5-0	TI 36 ...	A + B	No		0	1	0	1	2		1	0	0
4	B.JE.838...	101-3-15-5-0	TI 34 ...	A + B	No		0	1	0	1	2	Volt	2.5	3	0
5	B.JE.838...	101-3-16-5-0	TI 35 ...	A + B	No		0	100	0	100	2		2.5	19	0

[sc_dm_signal_parameter_meas_val_01, 2, en_US]

Signals

Assignment | Parameter

Process data message — 0 of 211 selected (total: 0)

	Name	CASDU-IOA	TI	Device	Event	Alarm	Archive...	Text	Tile_pos	Function_in_tile	Pos_in_tile	Pos_on_tile
1	B.E.7000.E...	101-1-7-3-0	TI 30 ...	A ...	No	No	No		2.3	Led (on = yellow)	1	0
2	B.E.7000.E...	101-1-11-5-0	TI 30 ...	A ...	No	No	No		2.4	Led (on = yellow)	1	0
3	B.E.7000.E...	101-1-12-5-0	TI 31 ...	A ...	No	No	No		2.4	Led (on = green)	33	0
4	B.JE.8380....	100-3-7-3-0	TI 30 ...	A ...	No	No	No		2.3	Led (on = yellow)	2	0
5	B.JE.8380....	101-3-11-5-0	TI 30 ...	A ...	No	No	No		2.4	Led (on = yellow)	3	0

[sc_dm_signal_parameter_message_01, 2, en_US]

Analog signals are displayed on the tile according to the sequence of parameter **`Pos_on_Tile`** with the name, the current value, the unit text and the quality descriptor.

Digital signals are displayed on the tile according to the sequence with parameter **`Pos_on_Tile`** with the name, the parameterized text for the current status and the quality descriptor.

NOTE

- If the tile number entered in the parameter **`Tile_pos_(...)`** has not been parameterized, the device generates a diagnostic entry with detailed information
- If the value entered in the parameter **`Pos_in_Tile`** is used twice in the same tile, the device generates a diagnostic entry with detailed information
- If **`Pos_in_Tile`** is 0, the data point is not shown.
- If there is a gap in **`Tile_pos`** (e.g. 1,2,4,5), the tiles are pushed together.
- If there is a gap in **`Pos_on_tile`** (e.g. 1,3,4,5), the signals are pushed together.

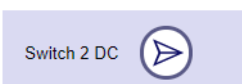
10.6.4.2 Output of Commands

General

Commands that have been parameterized with SICAM TOOLBOX II or SICAM Device Manager can be output via SICAM WEB.
Supported Type Identifications:

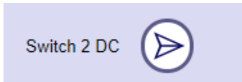
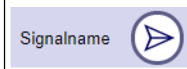
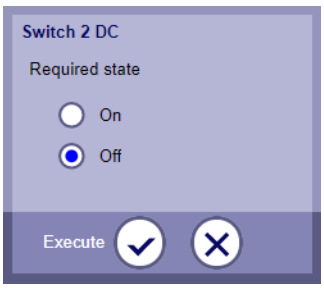
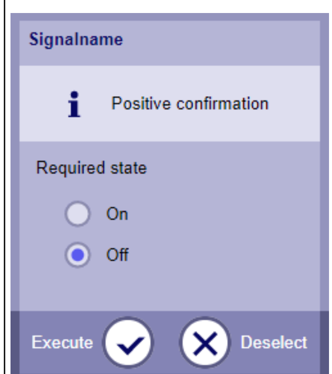
- Single command (TI 45)
- Double command (TI 46)

The logged on user needs the right **Operational activities** to be able to issue a command. If he does not have this right, the switching element cannot be used.
The command looks like this:



[sc_db_command_01, 1, --_--]

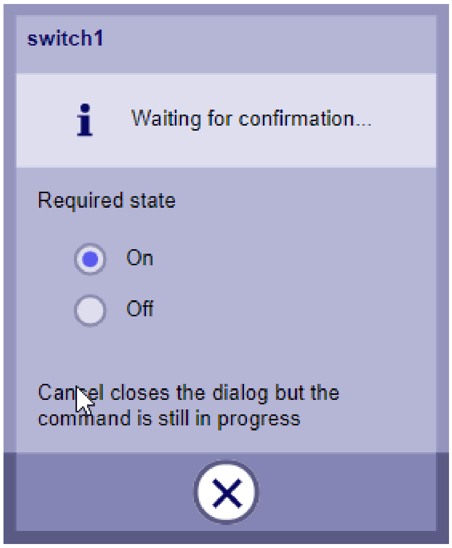
The name of the signal is displayed, followed by the **Send** button. Depending on the configuration, this designation contains the name of the signal, the value of the signal parameter **Text** or the value of the parameter **Description**.
After pressing the **Send** button, you can first select the desired switching operation and confirm with ✓. The sequence of the subsequent dialogues depends on whether a direct command (Execute) or a selection and execution command (Select/Execute) has been parameterized. This is done with the parameter **`Select_execute_t`**.

Sequense if `Select_execute_t` = 0	Sequence if `Slect_execute_t` = <value>
Click on **Send** 	Click on **Send** 
You now have the option of selecting the desired switching process and executing it immediately, or you can cancel the process. 	The current switching state is displayed. You can now select the desired state and continue with **Select** or cancel the process. 
	Now confirm the desired state with a click on **Execute** or cancel the process by **Deselect**. 

With the signal parameters **Text_off** and **Text_on** you can change the default values in the command dialog.

Negative confirmation of an execution command

If a command cannot be executed immediately, this can be indicated by the following dialog:



[sc_db_wait_for_confirm, 1, en_US]

This dialog is displayed as long as the confirmation for the execution of the command has not been received and the configured time (parameter **`Confirmation_excute_t`**) has not expired.

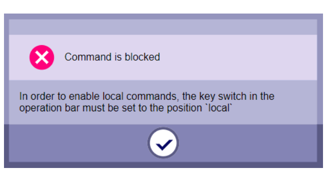
During this time this dialogue remains open. The user then has the option to close the dialog. An informational text indicates that this does not abort the command sequence but only closes the dialog. He can then start troubleshooting.

If a positive confirmation is received, this dialog is automatically closed.

In the event of a negative confirmation or expiry of the configured time, a window with details of the cause of the error is displayed.

Possible error causes:

- Command is blocked
  In order to enable local commands, the key switch in the operation bar must be set to the position 'local'

  [sc_neg_conf_local_remote_switch, 1, en_US]

- Command cannot be executed
  - No confirmation received
  - Negative confirmation received (for more information see the diagnosis)
  - Negative confirmation received (wrong control location)
  - Negative confirmation received (interlocking condition violated)
  - Negative confirmation received (sequence error select/execute)
  - Negative confirmation received (1-of-n negative, another command is "currently being executed)
  - Negative confirmation received (wrong state of return information)
  - Negative confirmation received (formal check of command)
  - Negative confirmation received (command output in revision)

Configuration

Once the structure of the tiles in the dashboard has been defined, you can configure which commands are to be displayed in the tiles. Up to 64 commands can be defined per sub-tile.

The selection of the commands and the configuration is done in the process data with the parameters:

- **`Pos_in_tile`** [1-16,1.1-1.16,2.1 ....16.16]
- **`Pos_in_tile`** [0 ... not used, 1-64]
  The order in which the commands are displayed in the list.
  The display order can also be used to group the commands. Up to 4 groups (4 columns) can be defined:
  - Group 1: Index 1-16
  - Group 2: Index 17-32
  - Group 3: Index 33-48
  - Group 4: Index 49-64
- **`Select_execute_t`**
  Maximum time between select and execute command. After the time has elapsed, a new selection is required.
  [in seconds, 0 = no monitoring time used; Execute command with the parameterized values is sent immediately]
- **`Confirmation_execute_t`**
  Maximum waiting time for confirmation of the execution of the command.
  [in seconds, 0 = no monitoring for confirmation]
- Qualifier of command **`IEC_qualifier_of_command`**
  - none
  - short
  - long
- **`Function_in_tile`**
  A single command with the status **`On`** can be sent without a command dialog via the **`Single command without dialog`** option. This option should only be used for non-critical commands (e.g. receipt of mosaics, dashboards). A parameter error is reported when using this option with double commands.

The display of the commands in the dashboard tiles uses the existing options for event and alarm lists (Text, State_TextOn, ...)

Parameter	Value
Lk_Reg	53
Lk_Comp	6
Lk_Bse	020 CP-8050/CPCI85
Lk_DS	System Functions
Lk_Cat	Process data command CP-8050
Lk_Prep	Activated
Device	A + B
CASDU1	6
CASDU2	53
IOA1	1
IOA2	1
IOA3	10
TI	Single command (TI 45)
SID-BSE	Automatic
SID-SSE	Automatic/R-SID
SID-ST	Automatic/point-to-point/BSE itself
Event	No
Text	SC direct no
Text_Off	OFF
Text_On	ON
Text_Fault	
Text_Int	
Tile_pos	4
Pos_in_tile	1
Select_execute_t	0
IEC_qualifier_of_command	no definition

[sc_TB_para_01_TI45_de, 2, en_US]

Assignment | Parameter

Process data command | 0 of 48 selected (total: 0)

	Name	CASDU-IOA	TI	Device	Event	Text	Tile_pos	Pos_in_tile	Select_execute_t	Confirmation_execute_t	IEC_qualifier_
1	02_DO-8212 OUT D07	1-1-0-0-22	TI 45 Single com...	A + B	No	DO-8212OUTD07	1.3	1	0	0	no definition
2	B.E.7000.Eisenstadt.TI45	100-1-22-5-0	TI 45 Single com...	A + B	No	Signalname	2.4	2	0	0	short
3	B.E.7000.Eisenstadt.TI46	101-1-23-5-0	TI 46 Double com...	A + B	No	Signalname	2.4	34	0	0	short
4	B.JE.8380.Jennersdorf.TI45	101-3-22-5-0	TI 45 Single com...	A + B	No	Signalname	2.4	4	5	0	short

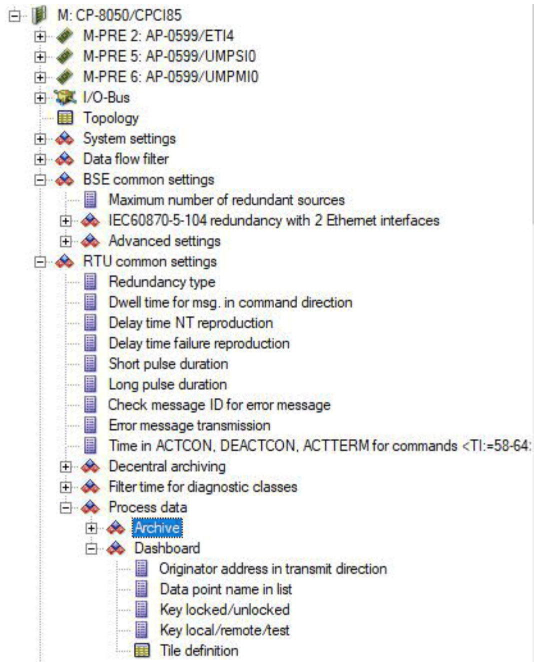
[sc_db_command_param_01, 2, en_US]

NOTE

- If the tile number entered in the parameter **Tile_pos** has not been parameterized, the device generates a diagnostic entry with detailed information
- If the value entered in the parameter **Pos_in_Tile** is used twice in the same tile, the device generates a diagnostic entry with detailed information
- If **Pos_in_Tile** is 0, the command is not shown.
- If there is a gap in the **Pos_in_tile** (e.g. 1,2,4,5), the signals are pushed together.

A select or a select/execute command is required to switch operational equipment. This option can therefore be parameterized for each command. It must also be parameterized with which command identifier (0 = no additional, 1 = short command output time, 2 = long command output time) the command is to be generated.

The source address, with which the commands are to be generated, is a system-technical parameter that applies to the entire device and is located in the tree under **Dashboard** (parallel to the tile definition).



[sc_TB_para_dashboard_de, 1, en_US]

10.6.4.3 Output of Setpoint Values

General

Setpoint values that have been parameterized with SICAM TOOLBOX II or SICAM Device Manager can be output via SICAM WEB.

Supported Type Identifications:

- Setpoint command, normalized value (TI=48)
- Setpoint command, scaled value (TI=49)
- Setpoint command, short floating point number (TI:=50)

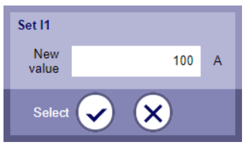
The logged on user needs the right **Operational activities** to be able to issue a setpoint value. If he does not have this right, the switching element cannot be used.

Representation of the setpoint values:

- Click the **Send** button to start the dialog

[sc_db_setpoint_01, 1, --_--]

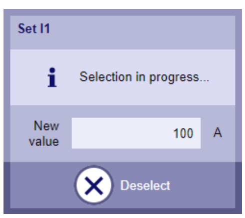
Enter the desired value and click ✓ to send the command.



[sc_db_setpoint_02, 1, en_US]

The entered value is converted according to the parameterized X and Y values and a setpoint value is generated. If the converted value is outside the value range, the OV bit is set in the data point quality descriptor.

If **Select_execute_t** has been parameterized, you can stop the execution of the command by clicking on ✗.

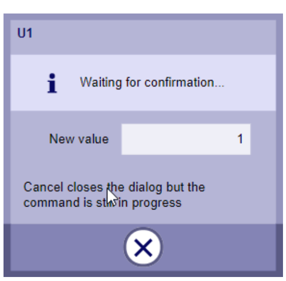


[sc_db_setpoint_03, 1, en_US]

If there is no cancellation within the configured time, the setpoint value is prepared.

Negative confirmation of a setpoint value output

If a setpoint value cannot be output immediately, this can be indicated by the following dialog:



[sc_db_wait_for_confirm_setpoint, 1, en_US]

This dialog is displayed as long as the confirmation for the output of the setpoint value has not been received and the configured time (parameter `Confirmation_excute_t`) has not expired.

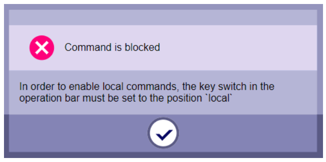
During this time this dialogue remains open. The user then has the option to close the dialog. An informational text indicates that this does not abort the command sequence but only closes the dialog. He can then start troubleshooting.

If a positive confirmation is received, this dialog is automatically closed.

In the event of a negative confirmation or expiry of the configured time, a window with details of the cause of the error is displayed.

Possible error causes:

- Command is blocked
  In order to enable local commands, the key switch in the operation bar must be set to the position 'local'



[sc_neg_conf_local_remote_switch, 1, en_US]

- Command cannot be executed
  - No confirmation received
  - Negative confirmation received (for more information see the diagnosis)
  - Negative confirmation received (wrong control location)
  - Negative confirmation received (sequence error select/execute)
  - Negative confirmation received (formal check of command)
  - Negative confirmation received (command output in revision)

Configuration

Once the structure of the tiles in the dashboard has been defined, you can configure which setpoint values are to be displayed in the tiles. Up to 64 setpoint values can be defined per sub-tile.

The selection of the setpoint value and the configuration is done in the process data with the parameters:

- **`Tile_pos`** [1-16,1.1-1.16,2.1 ....16.16]
- **`Pos_in_tile`** [0 ... not used, 1-64]
  Display order of the setpoint values in the list.
  The display order can also be used to group the setpoint values. Up to 4 groups (4 columns) can be defined:
  - Group 1: Index 1-16
  - Group 2: Index 17-32
  - Group 3: Index 33-48
  - Group 4: Index 49-64
- **`Select_execute_t`**
  Maximum time between select and execute command. After the time has elapsed, a new selection is required.
  [in seconds, 0 = no monitoring time used; Execute command with the parameterized values is sent immediately]
- **`Confirmation_execute_t`**
  Maximum waiting time for confirmation of the execution of the command.
  [in seconds, 0 = no monitoring for confirmation]

The display of the setpoint values in the dashboard tiles uses the existing options for event and alarm lists (text, X- and Y-values, Unit, ...)

Parameter	Value
Lk_Reg	53
Lk_Comp	6
Lk_Bse	020 CP-8050/CPCI85
Lk_DS	System Functions
Lk_Cat	Process data setpoint value CP-8050
Lk_Prep	Activated
Device	A + B
CASDU1	6
CASDU2	53
IOA1	1
IOA2	1
IOA3	16
TI	Setpoint val. positioning comm. stand. (TI 48)
SID-BSE	Automatic
SID-SSE	Automatic/R-SID
SID-ST	Automatic/point-to-point/BSE itself
Text	PD SW
X_0%	-1
X_100%	1
Y_0%	-2
Y_100%	2
Unit	TI48
Tile_pos	4
Pos_in_tile	7

[sc_TB_para_TI48_de, 2, en_US]

Assignment | Parameter

Process data setpoint value | 0 of 33 selected (total: 0)

	Name	CASDU-IOA	TI	Device	Text	X_0%	X_100%	Y_0%	Y_100%	Unit	Tile_pos	Pos_in_tile	select_execute_t	Confirmation_execute_t
1	B.E.7000.Eisenstadt.TI48	I01-1-25-5-0	TI 48 ...	A ...		0	1	0	1	Volt	2.5	2	0	
2	B.E.7000.Eisenstadt.TI49	I01-1-26-5-0	TI 49 ...	A ...		0	100	0	100		2.5	18	0	
3	B.E.7000.Eisenstadt.TI50	I00-1-27-5-0	TI 50 ...	A ...		0	1	0	1		1	0	0	
4	B.JE.8380.Jennersdorf.TI48	I01-3-25-5-0	TI 48 ...	A ...		0	1	0	1	Volt	2.5	4	5	

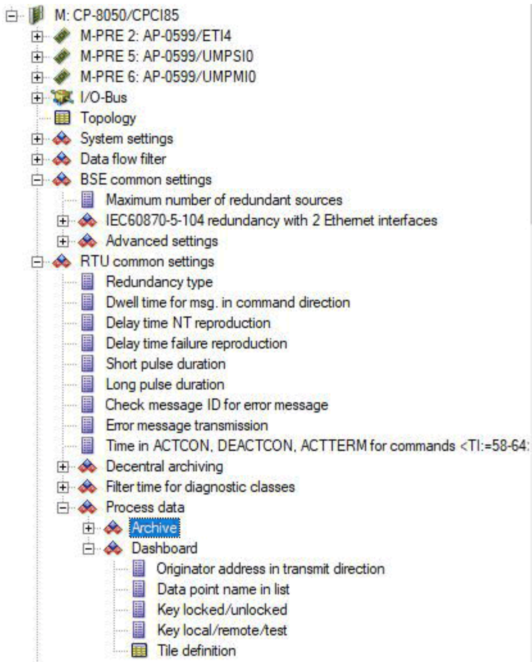
[sc_db_setpoint_para_01, 2, en_US]

Figure 10-6 Configuration with SICAM Device Manager

NOTE

- If the tile number entered in the parameter **`Tile_pos_(...)`** has not been parameterized, the device generates a diagnostic entry with detailed information
- If the value entered in the parameter **`Pos_in_Tile`** is used twice in the same tile, the device generates a diagnostic entry with detailed information
- If **`Pos_in_Tile`** is 0, the setpoint values is not shown.
- If there is a gap in the **`Pos_in_tile`** (e.g. 1,2,4,5), the signals are pushed together.

The source address, with which the setpoint values are to be generated, is a system-technical parameter that applies to the entire device and is located in the tree under **`Dashboard`** (parallel to the tile definition).



[sc_TB_para_dashboard_de, 1, en_US]

10.6.4.4 Display measured values as graph

NOTE

This type of display is only available with the **Extended SICAM WEB** license.

If you open a tile with graphs in the SICAM WEB dashboard, it shows the course of the configured measured value with a line. This line shows the last 200 stored measured values. The X-axis serves as a time axis and the measured values (voltage, current ...) are displayed on the Y-axis.

In addition to the graph, the current measured values can also be displayed in list form in the tile. The tile then contains 2 areas that can be opened and closed as required. The display in list form takes only place if the parameter **Pos_in_Tile** is set for the measured value.

[sc_SWEB_meas_value_as_graph_01, 1, en_US]

A maximum of 2 measured values can be displayed per tile. In total, a maximum of 16 tiles can contain measured value graphs. If these requirements are not met, a parameter error is diagnosed.

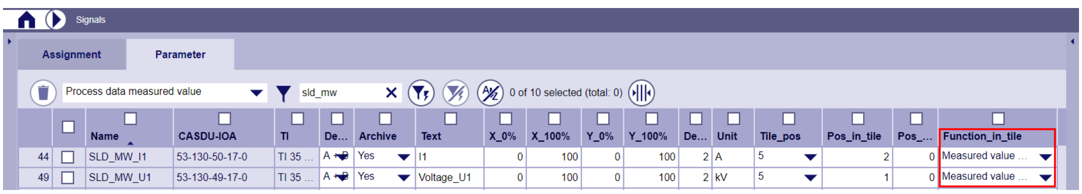
The time range shown depends on the frequency of the changes. During the view, the scaling of the time axis remains the same, i.e. if 10 minutes are visible, the last 10 minutes remain visible, even if it is updated every second. The graph pushes out to the left. With **Reset** (3 points in the graph menu) the time axis is expanded again to all existing values.

All measured values are saved during the view. This means that more than 200 values may be visible. In order to avoid memory problems, the view is automatically reduced to the last 200 values after one hour (as when it was first accessed).

A **Pause** button is also available for analyzing the graph. If this is activated, the graph is no longer updated every second. If it is pressed again, the graph is redrawn (the last 200 values are displayed again, as when it was first activated).

Assignment of the measured values to the graph

This is done in the parameter table of the engineering tool (**HOME | Signals | Central processing (M) | Parameter**).



[sc_SWEB_meas_value_as_graph_03, 1, en_US]

For the desired measured values, select the option **Measured value as Graph (Layout = List)** in the column **Function_in_Tile**.

Furthermore, the values from the columns **Text**, **Unit**, **Y_0%** and **Y_100%** are displayed in the graphic. Values > 100% are limited to 100%.

10.6.5 Display of Signals in Graphics

10.6.5.1 General

Graphics can also be integrated into the tiles of the SICAM WEB Dashboard, which serve as a graphical user interface. For example, states of switching devices can be displayed and switching can be carried out.

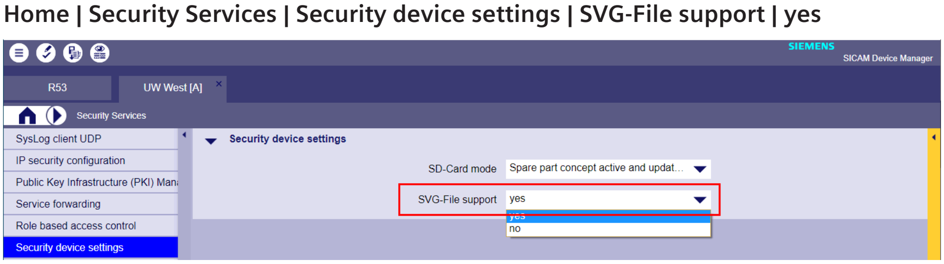
These graphics must be created and configured in SVG format. The SICAM Device Manager is used to load and assign the graphics to the dashboard tiles.

There are 2 user roles for using dashboard graphics. While the **Operator** role is allowed to perform switching operations, the **Viewer** role only has read rights.

NOTE

In order to work with SVG graphics, their support must be activated in the security parameters.

Home | Security Services | Security device settings | SVG-File support | yes



NOTE

The number of signals that can be integrated in an SVG graphic is limited to 200.

Each signal of the processing types process data command, process data message, process data measured value and process data setpoint that is assigned to a tile of type **Graphic** or **Graphic with operation bar** is counted. If a signal is assigned several times, each assignment counts separately.

Assignments to the operation bar (key switch and LEDs) or to the layout type **List** are not counted.

Via **Monitoring & Simulation | Central processing (M) | Processing functions | Process data (M)** you can check the number of assignments.

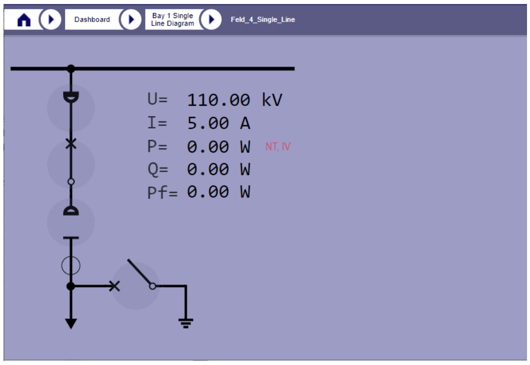
NOTE

If the industrial web panel SIMATIC IWP 900 is used, the web panel must be updated to version IWP V01.00.00.06 b001.

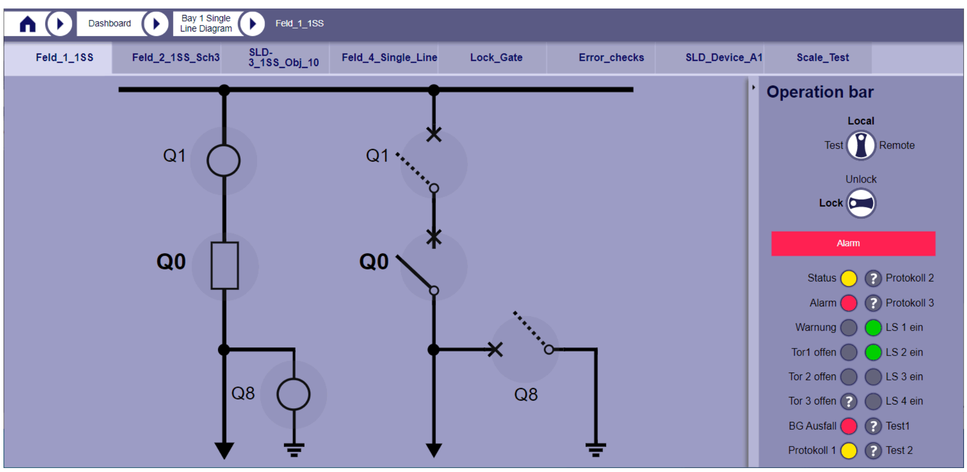
- Link to the Update-File:
  https://support.industry.siemens.com/cs/document/109781510/updates-f%C3%BCr-customized-industrial-web-panel%3A-iwp700-iwp900-und-iwp1200?dti=0&lc=de-DE
- Link to the Update-Description:
  https://support.industry.siemens.com/cs/mdm/109761220?c=114215991819&lc=de-DE

10.6.5.2 Sample Applications

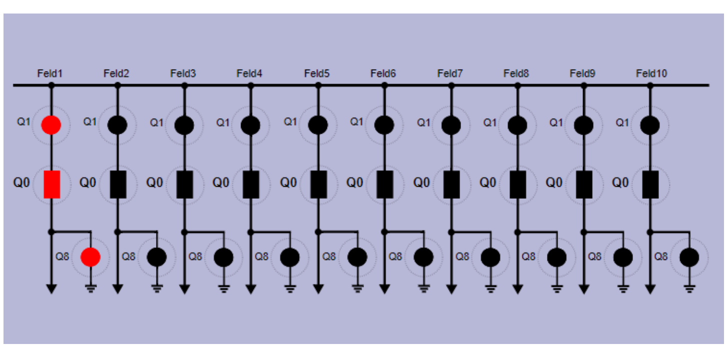
- Single Line Diagrams



[sc_SW_Tile_Layout_Graphic_01, 1, --_--]

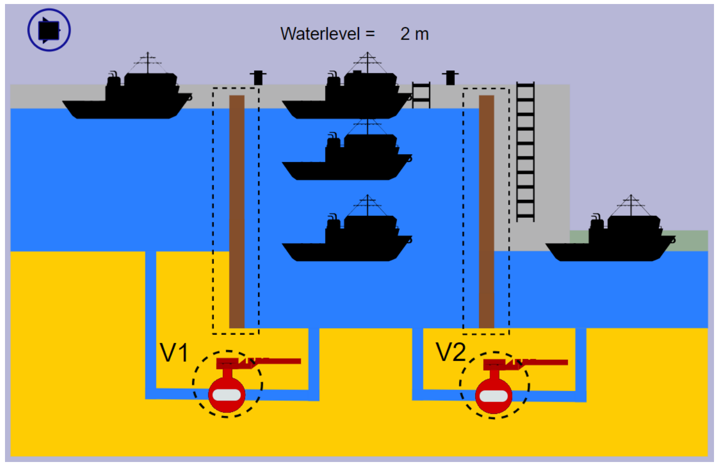


[sc_SW_Graph_with_operation_bar_01, 2, en_US]



[sc_DB_Graphic_example_03, 1, --_--]

- Topographies



[sc_D8_Graphic_example_01, 1, --_--]

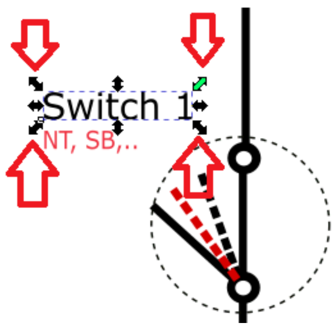
10.6.5.3 Creation of the SVG graphics for a single line diagram

The diagrams used in SICAM WEB are SVG graphics. You can create these with a tool of your choice. For this example the freeware tool **Inkscape** is used.

NOTE

Notes for the usage of Inkscape:

- **Scaling**
  The vaules for **Scaling** in the **Document properties** of the SVD file must be 1.00000. Other values cause problems with the display in SICAM WEB.
- **Change font size with "Drag"**
  If you want to change the size of a text in Inkscape, you must not change the font size simply by dragging it (see red arrows). This causes display problems in the SICAM WEB.



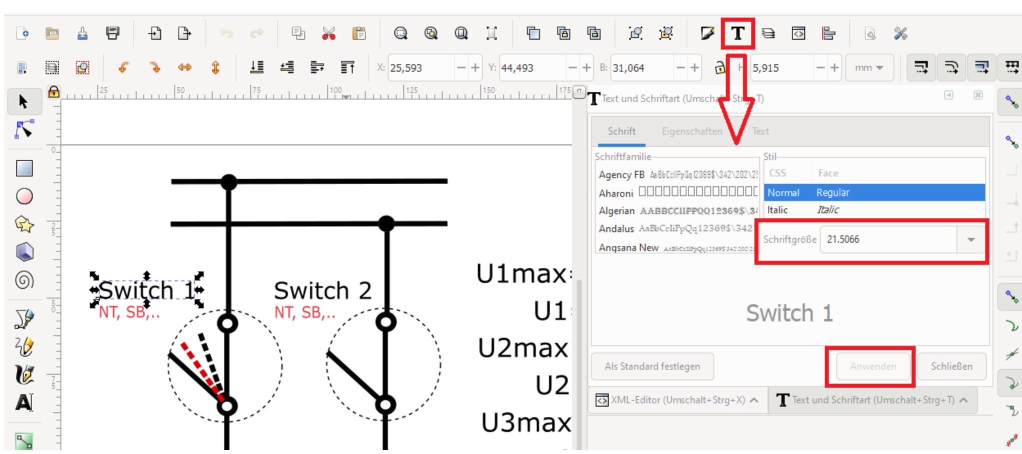
[sc_inkscape_text_size_01, 1, --_--]

Change the text size only via the **Text and Font** box as follows:

– Click on icon **T**
The box **Text and Font** opens

– Choose the appropriate font size

– Click on **Apply**

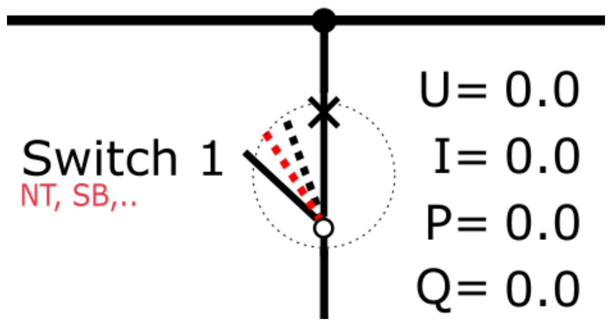


[sc_inkscape_text_size_02, 1, --_--]

- **Set font size explicitly**
  Set the font size of all text elements explicitly via the **Text and Font** box. Unwanted settings may occur when copying.
- **Font type**
  Siemens recommends using standard fonts (web-safe fonts).

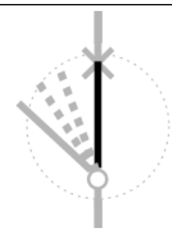
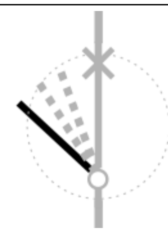
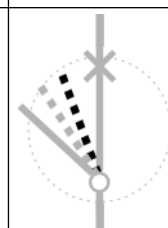
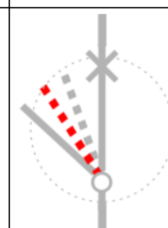
Draw switches for the display of switching states (messages) and the execution of switching operations

This example shows the graphic implementation of a double message using a switch. Since a double message can contain 4 states, 4 graphic elements are also necessary to represent these states.

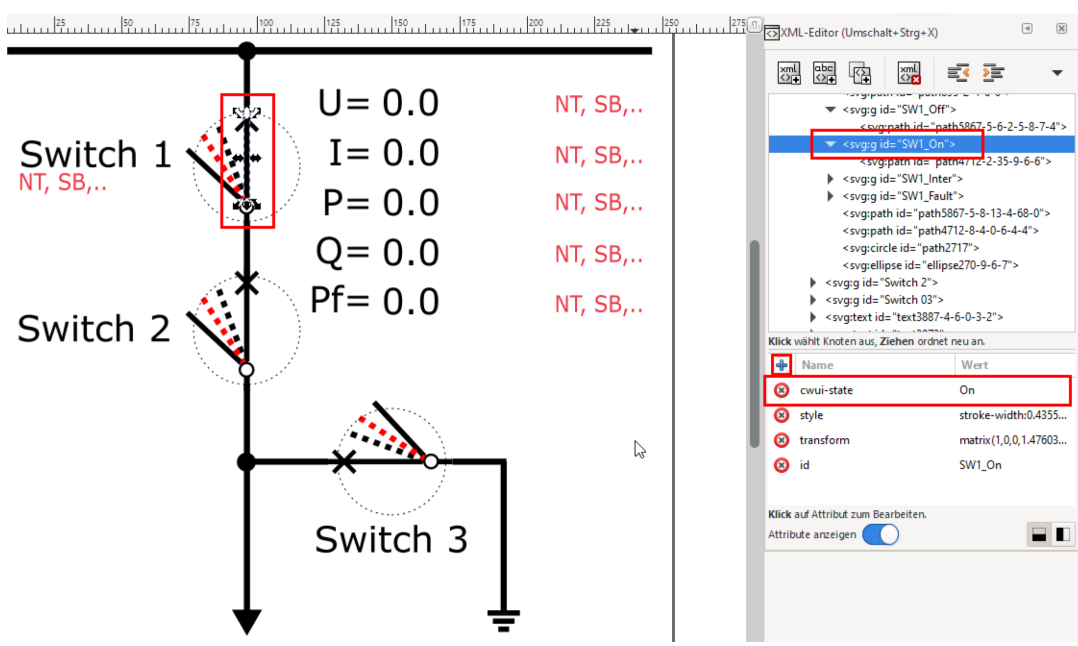


[dw_SLD_overview, 1, --_--]

The following lines (elements) are used to represent the switching states and must be configured accordingly.

Switching state:	On	Off	Intermediate position	Faulty position
Graphic representation:				
Attribute Name: **cwui-state**	Attribute-Value: **On**	Attribute-Value: **Off**	Attribute-Value: **Inter**	Attribute-Value: **Fault**

The configuration is done with the XML editor integrated in Inkscape.



[sc_Inkscape_overview_01, 1, --_--]

Figure 10-7 Configuration of the switching state "On"

Proceed as follows:

- Select the switching element in the drawing area.
  The selected element is displayed in the XML editor.

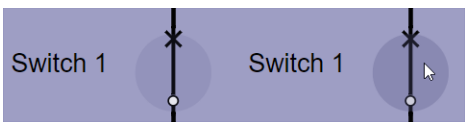
- Click in the **Attribute-window** to **+** to add a new attribute to the selected element.
  The name of the attribute must be: **cwui-state**
  The value of the attribute depends on the switching state shown: **On**, **Off**, **Inter** or **Fault**
- You can optionally add the attribute **id** to give the element a meaningful name. This makes working in the XML editor easier.

NOTE

Pay attention to the adherence of the name (cwui-state) and the values (On, Off, Inter, Fault) for the attributes. Deviations lead to faulty SVG graphics.

Define mouse area

The switch requires another graphic element for operation in SICAM WEB. This element defines the area in which the switch can be addressed with the computer mouse. When the mouse is in this area, the color of this element changes.

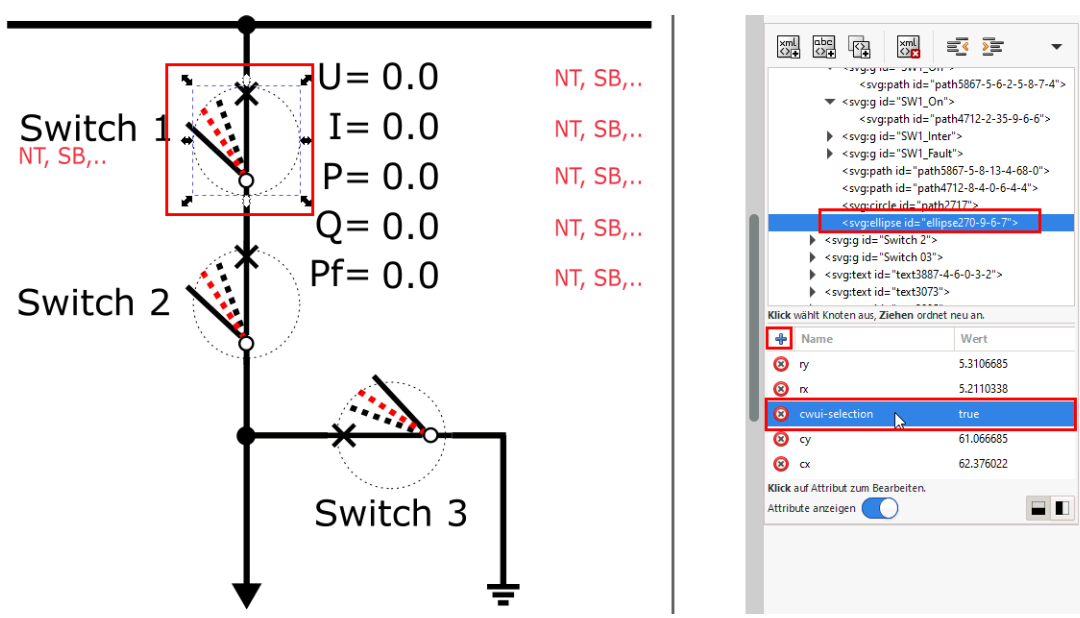


[sc_DB_SVG_Graphic_mouse_over, 1, --_--]

A dashed circle is used in this example. But you can also use other shapes. This graphic element must be the last element of the group in the XML editor.

Graphic representation:

Attribute name: **cwui-selection**   Attribute value: **true**



[sc_Inkscape_overview_mouse, 1, --_--]

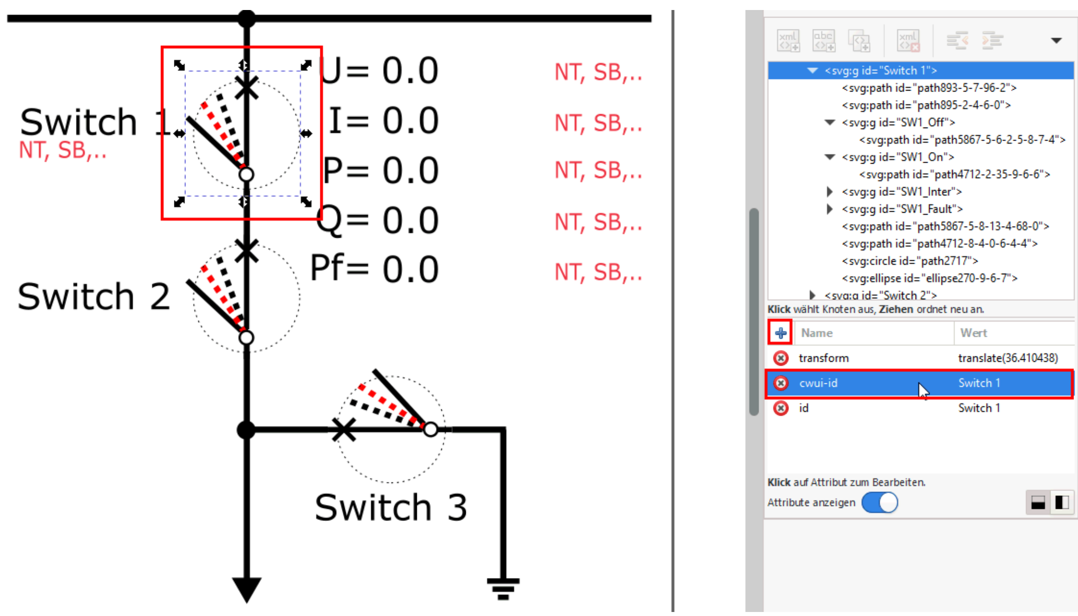
Figure 10-8 Configuration of the mouse area

Proceed as follows:

- Select the circle element in the drawing area.
  The selected element is displayed in the XML editor.
- Click in the **Attribute-window** to **+** to add a new attribute to the selected element.
  The name of the attribute must be: **cwui-selection**
  The value of the attribute is **true**
- You can optionally add the attribute **id** to give the element a meaningful name. This makes working in the XML editor easier.

Group all elements of the switch

Finally, all elements of the switch must be grouped together and named.
Then select the group and add in the XML editor the attribute **cwui-id**. You define a name for the switch as the value.



[sc_Inkscape_overview_group, 1, --_--]

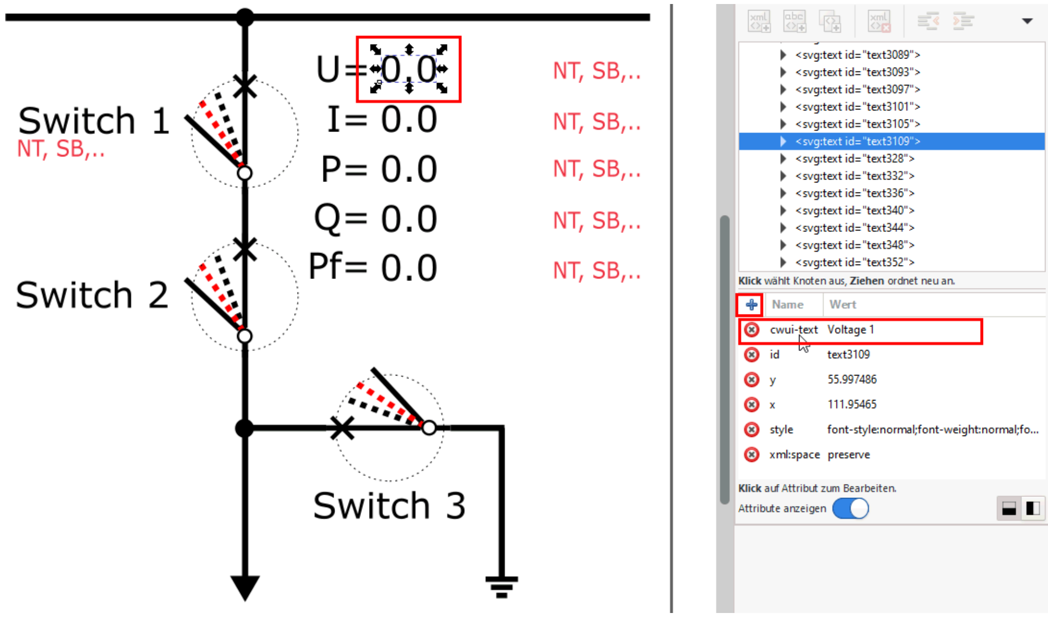
Figure 10-9 Configuration of the switch

Proceed as follows:

- Select all elements of the switch (switching states and mouse element) in the drawing area.
- Select **Object | Group**
- Then select the group and click in the **Attribute-window** to **+** to add a new attribute to the group.
  The name of the attribute must be: **cwui-id**
  Define the name of the switch as the value of the attribute.
  This name cannot have more than 13 characters. It is required when configuring the switch in the SICAM Device Manager.

Display measured values in text form

To display a measured value in a dashboard graphic in text form, it is assigned to a text element.
A measured value is a signal with type identifier TI 34 (measured value, normalized value), TI 35 (measured value, scaled value) or TI 36 (measured value, short floating point number).
When creating the dashboard graphic, the content/text of the text element can be freely selected. During operation, the content of this text element is replaced with the values of the assigned measured value.



[sc_Inkscape_overview_measured_value, 1, --_--]

Figure 10-10 Configurartion of a measured value

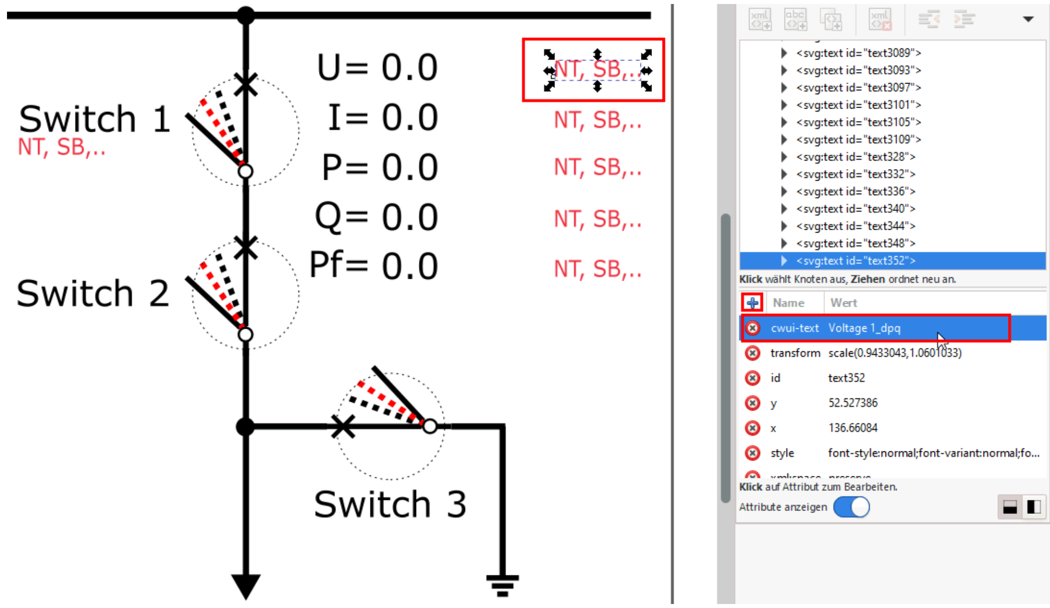
Proceed as follows:

- Select the text element in the drawing area.
  The selected element is displayed in the XML editor.
- Click in the **Attribute-window** to **+** to add a new attribute to the selected element.
  The name of the attribute must be: **cwui-text**
  The value of the attribute can be selected as required (e.g. **Voltage 1**).
  This name cannot have more than 13 characters. It is required when configuring the signal in the SICAM Device Manager.

Display the quality identifier of a data point

In addition to displaying messages and measured values, you can also display their quality identifier. For this you need a text element again.

When creating the graphic, the content/text of this element can be freely selected. During operation, the content of this text element is replaced with the quality identifier of the assigned measured value.



[sc_Inkscape_overview_data_point_quality, 1, --_--]

Figure 10-11 Configuration of the quality identifier of a data point

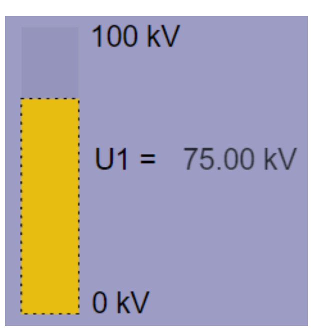
Proceed as follows:

- Select the text element in the drawing area.
  The selected element is displayed in the XML editor.
- Click in the **Attribute-window** to **+** to add a new attribute to the selected element.
  The name of the attribute must be: **cwui-text**
  The value of the attribute is made up of the name of the measured value and the appendix "_dpq" **Voltage 1_dpq**).

NOTE

Finished parts of a graphic (switches, measured values) can be copied as required if necessary. Make sure, however, that you have to change the values of the cwui attributes of these copies afterwards.

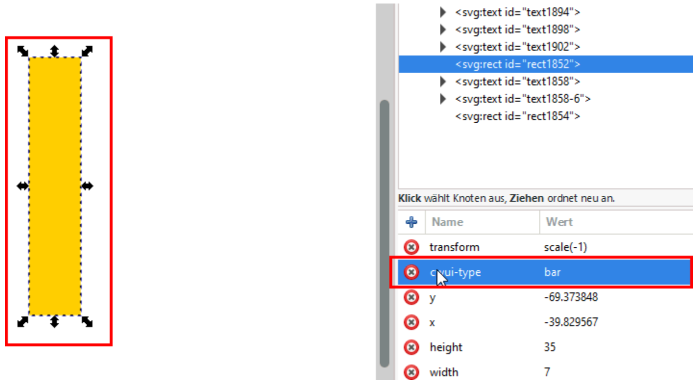
10.6.5.4 Display Measured Value as Bar



[sc_SWEB_meas_value_as_bar, 1, --_--]

To display a measured value as bar in a dashboard graphic, it is assigned to a graphic element which consists of the following parts:

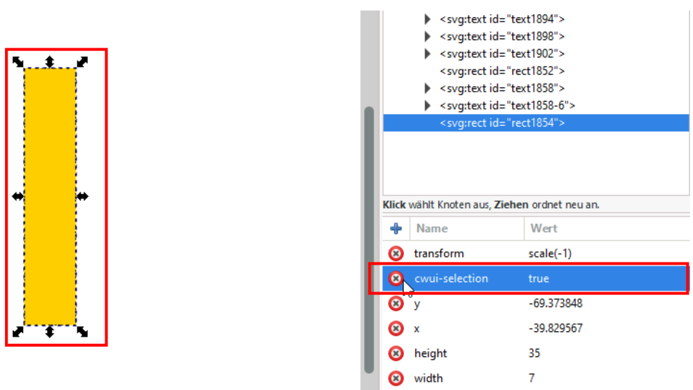
- A rectangle (bar) that is then filled in during operation depending on the measured value.



[sc_inkscape_meas_value_01, 1, --_--]

Add the **cwui-type** attribute to this element and enter **bar** as the value.

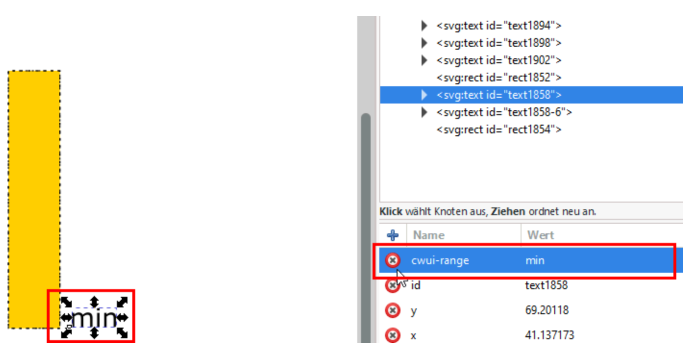
- Another rectangle which is placed over the first. This defines the mouse area with which the measured value bar in the dashboard graphic can be addressed.



[sc_inkscape_meas_value_02, 1, --_--]

Add the **cwui-selection** attribute to this element and enter **true** as the value.

- A text element to which the minimum value of the measuring range (value from column **Y_0%** of the signal) is assigned.

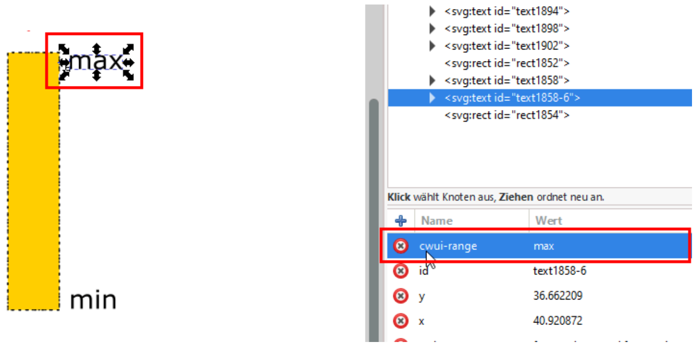


[sc_inkscape_meas_value_03, 1, --_--]

Add the **cwui-range** attribute to this element and enter **min** as the value.

The content/text of the text element can be freely selected. During operation, it is replaced with the values of the assigned measured value.

- A text element to which the maximum value of the measuring range (value from column **Y_100%** of the signal) is assigned.

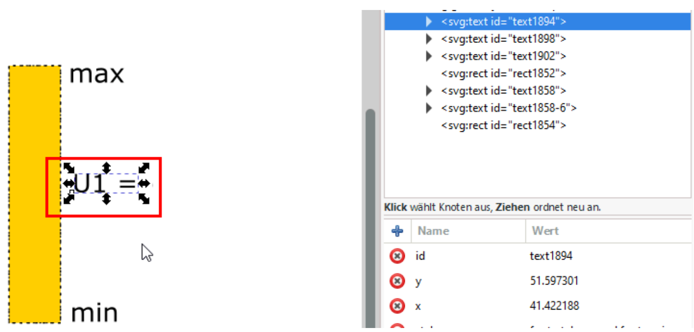


[sc_inkscape_meas_value_04, 1, --_--]

Add the **cwui-range** attribute to this element and enter **max** as the value.

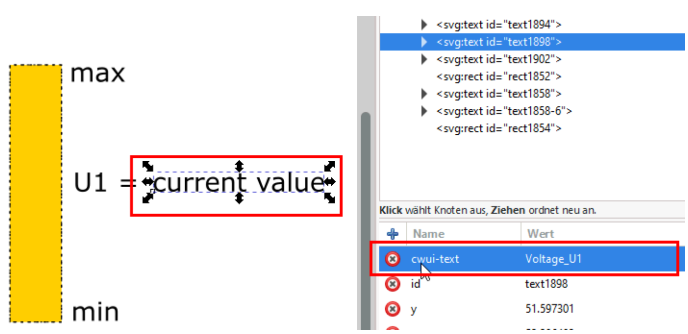
The content/text of the text element can be freely selected. During operation, it is replaced with the values of the assigned measured value.

- A text element with the name/designation of the measured value.



[sc_inkscape_meas_value_05, 1, --_--]

- A text element that shows the measured value in text form.

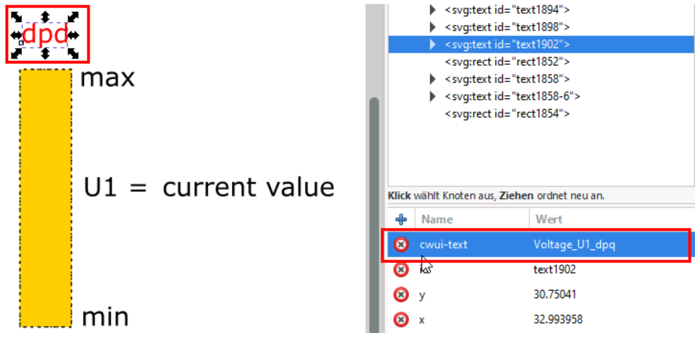


[sc_inkscape_meas_value_06, 1, --_--]

Add the **cwui-text** attribute to this element and enter the name of the measured value as the value (e.g. **Voltage_U1**).

The content/text of the text element can be freely selected. During operation, it is replaced with the values of the assigned measured value.

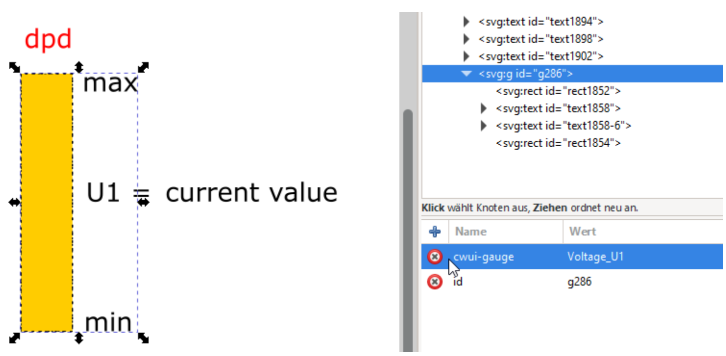
- A text element that shows the quality identifier of the data point in text form.



[sc_inkscape_meas_value_07, 1, --_--]

Add the **cwui-text** attribute to this element and enter the name of the measured value and the attachment "_dpq" (e.g. **Voltage_U1_dpq**) as the value.
The content/text of the text element can be freely selected. During operation, this is replaced with the quality identifier of the assigned measured value. If there is no quality identifier, the element remains empty and invisible.

After all elements have been created, the bar, the mouse area and the min/max texts must be combined into a group:

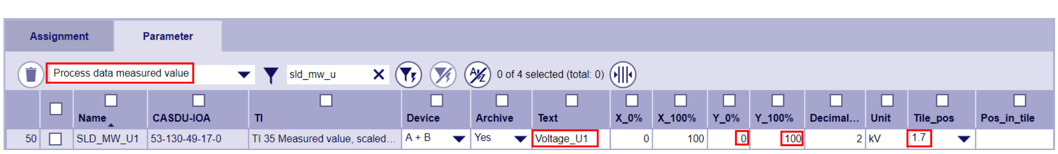


[sc_Inkscape_meas_value_10, 1, --_--]

Select the elements an select **Object | Group**
Add the **cwui-gauge** attribute to this group and enter the name of the measured value as the value (e.g. **Voltage_U1**).

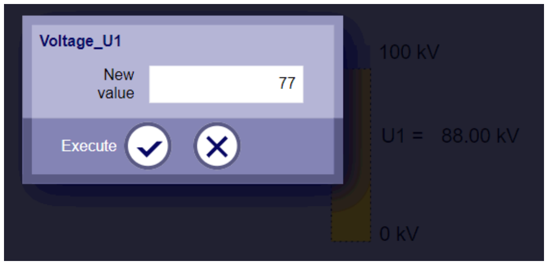
Assignment of the measured values to the elements in the graphic

This is done in the parameter table of the engineering tool. The main signal parameter is the one in the **Text** column.
Furthermore, the values from the columns **Y_0%** and **Y_100%** are displayed in the graphic.
The assignment to the position of the tile with the **Tile_pos** parameter is also important.



[sc_SDM_meas_value_parameter_01, 1, en_US]

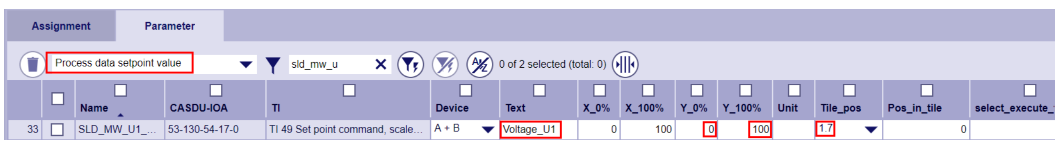
Output the setpoint value value by clicking on the measured value bar



[sc_SDM_meas_value_change_01, 1, en_US]

You can use the bar in the graphic to output a setpoint value if the corresponding setpoint value signal has been configured in the parameter table of the SICAM Device Manager.
Following settings are required:

- The value in the **Text** column must match the value of the measured value signal (e.g. **Voltage_U1**)
- The assignment to the tile in which the graphic is displayed must be made in the **Tile_pos** column



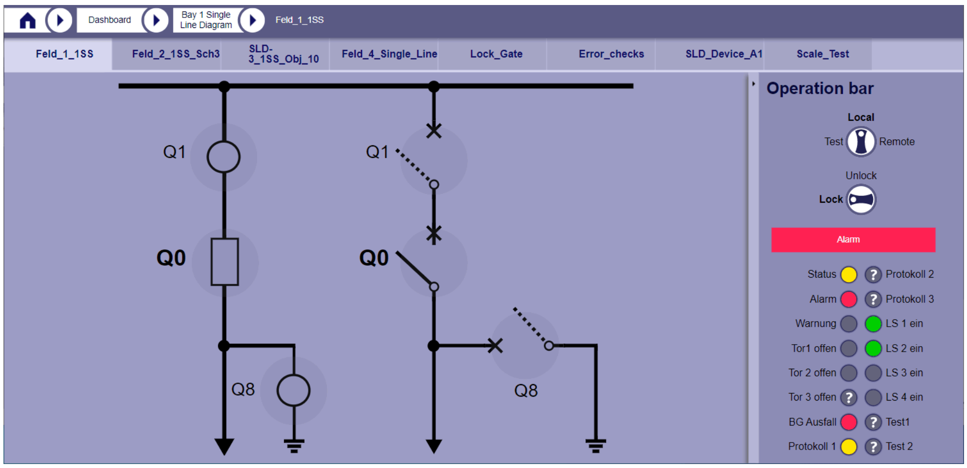
[sc_SDM_setpoint_value_parameter_01, 1, en_US]

10.6.5.5 Configuration of Dashboard Graphic with SICAM Device Manager

Create Tile

- Open the device in SICAM Device Manager
- Click on **RTU Settings**
- Select following node in the directory tree: **`RTU common settings | Process Data | Dashboard | Tile definition`**.
- Click on  to create a row for an new tile.

- Define the name, position, size and layout (graphic or graphic with operation bar) of the tile.
  You will need the position of the tile later to configure the signals.
  In the case of layout **Graphics with a operation bar**, an operation bar is displayed to the right of the graphic. This contains 2 key switches, the sum alarm bar and 16 LEDs. Only one global operation bar can be defined per device. This means, that every graphic to which an operation bar is assigned, shows the same operation bar.
  The signals (messages) are assigned to the operation bar in the parameter table in the column **Tile_pos** with value **Operation Bar**.



[sc_SW_Graph_with_operation_bar_01, 2, en_US]

- Choose the desired picture in column **Graphic**.

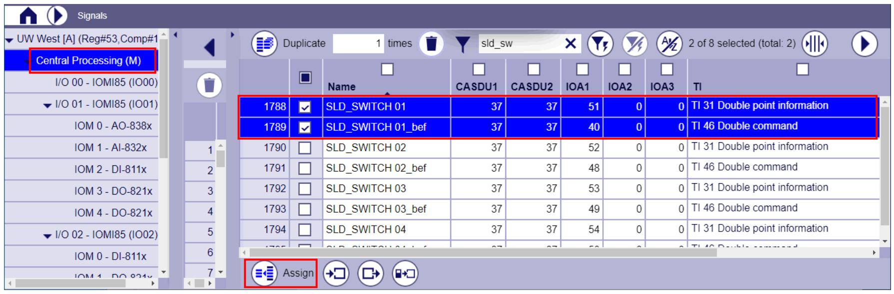
Parameterize Signals

The parameterization of the signals takes place in the signal list.
Following signal types can be used:

- Single-/Double commands (TI 45, TI 46) to change the switching state.
- Single-/Double point-information (TI 30, TI 31) to display the switching state.
- Setpoint commands (TI 48, TI 49, TI 50) to output/change voltage values
- Measured values (TI34, TI35, TI 36) to display voltage and current values.

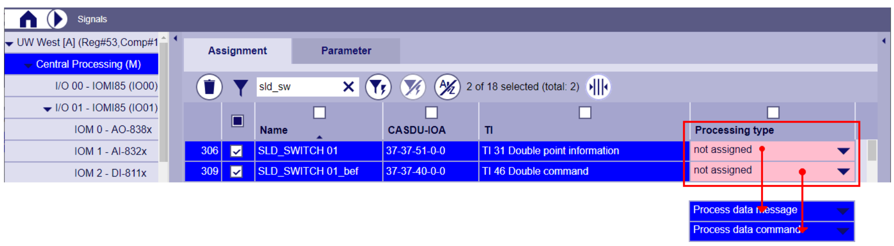
Assign double-point information and double command to the switch

- Select the desired signals in the signal list and assign these signals to the node **Central processing (M)**.



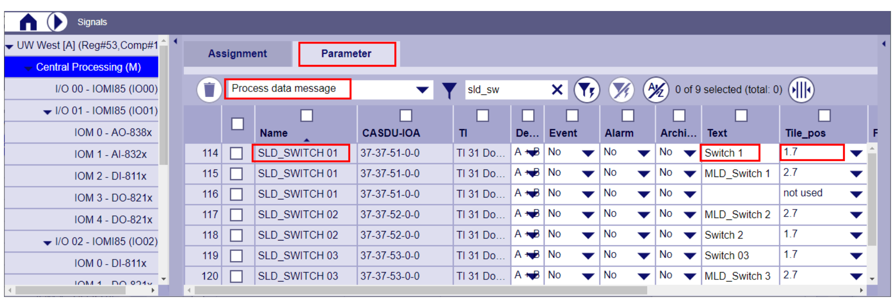
[sc_SDM_Signals_for_Graphic_02, 2, en_US]

- Select the appropriate processing type in the **Assignment** tab.



[sc_SDM_Signals_for_Graphic_04, 2, en_US]

- Select in tab **Parameter** the processing type **Process data message** and search the desired signal.

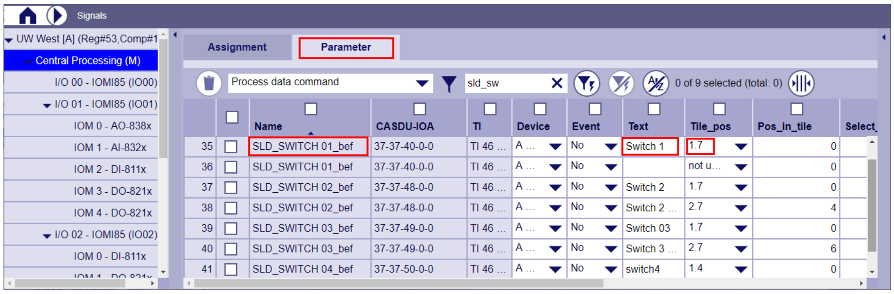


[sc_SDM_Signals_for_Graphic_11, 2, en_US]

  – Enter in column **Text** the name of the switch, which shall indicate this signal.
    This is the value which was assigned to the attribute **cwui-id** of the switch. In this example "Switch 1".

  – Enter the position of the tile in which the graphic shall be shown in column **Tile_pos**.

- Select in tab **Parameter** the processing type **Process data command** and search the desired signal.



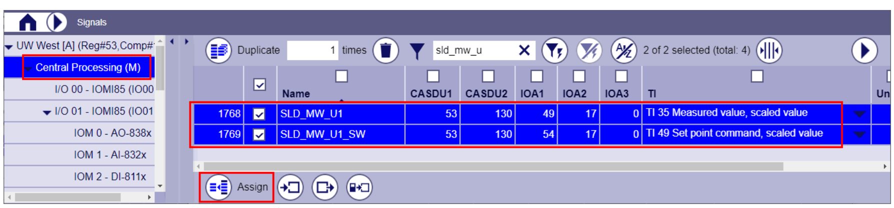
[sc_SDM_Signals_for_Graphic_05, 2, en_US]

  – Enter in column **Text** the name of the switch, which shall indicate this signal.
  This is the value which was assigned to the attribute **cwui-id** of the switch. In this example "Switch 1".

  – Enter the position of the tile in which the graphic shall be shown in column **Tile_pos**.

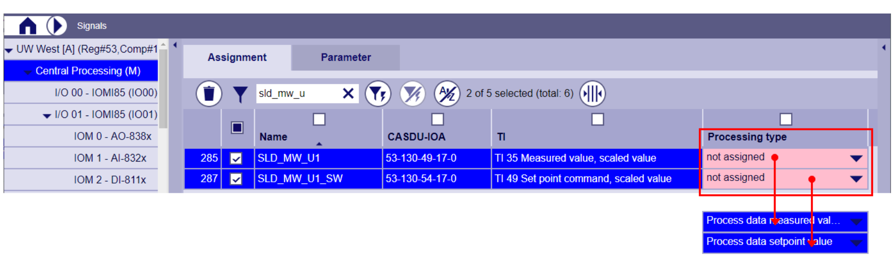
Assign measured value and setpoint command to a text element

- Select the desired signals in the signal list and assign these signals to the node **Central processing (M)**.



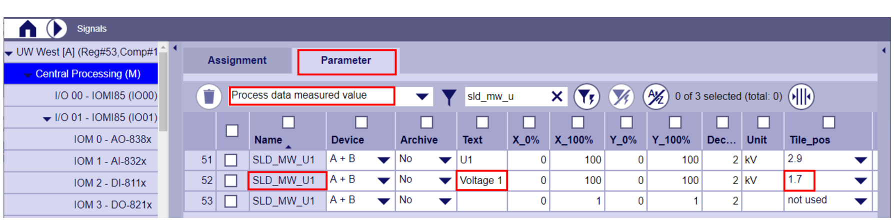
[sc_SDM_Signals_for_Graphic_01, 2, en_US]

- Select the appropriate processing type in the **Assignment** tab.



[sc_SDM_Signals_for_Graphic_06, 2, en_US]

- Select in tab **Parameter** the processing type **Process data measured value** and search the desired signal.

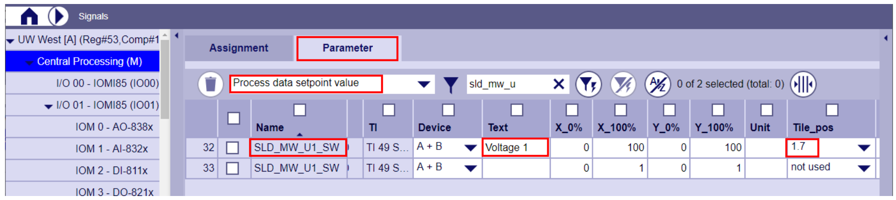


[sc_SDM_Signals_for_Graphic_08, 2, en_US]

  – Enter in column **Text** the name of the text element, which shall indicate this signal.
  This is the value which was assigned to the attribute **cwui-text** of the text element. In this example "Voltage 1".

  – Enter the position of the tile in which the graphic shall be shown in column **Tile_pos**.

- Select in tab **Parameter** the processing type **Process data setpoint value** and search the desired signal.



[sc_SDM_Signals_for_Graphic_09, 2, en_US]

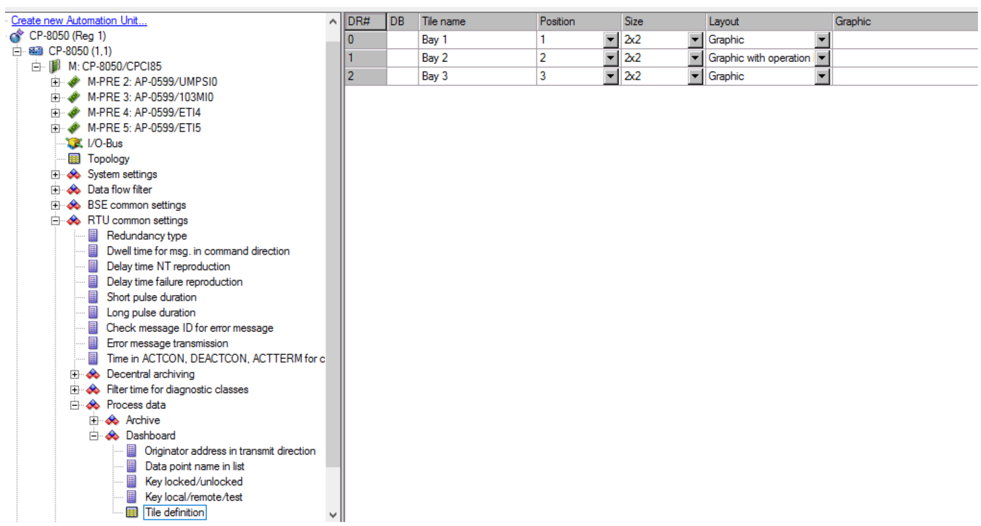
  – Enter in column **Text** the name of the text element, which shall indicate this signal.
    This is the value which was assigned to the attribute **cwui-text** of the text element. In this example "Voltage 1".

  – Enter the position of the tile in which the graphic shall be shown in column **Tile_pos**.

10.6.5.6 Configuration of the graphic with SICAM TOOLBOX II

Create Tile

- The configuration of the tiles for the dashboard graphics is done with the SICAM TOOLBOX II via the parameter **`RTU common settings | Process Data | Dashboard | Tile definition`**.



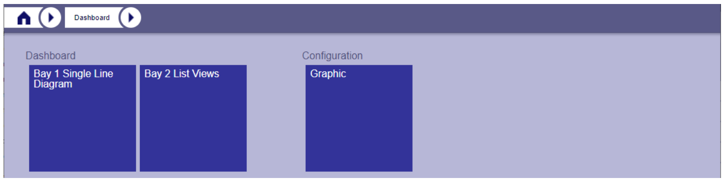
[sc_TBII_Tile_def_01, 1, en_US]

- Define the name (mandatory), position, size and layout of the tile.

Import graphics

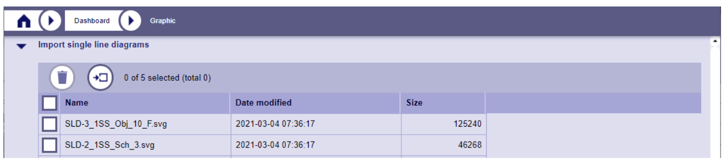
In contrast to the configuration with the SICAM Device Manager, with the SICAM TOOLBOX II the graphics for the tiles must be loaded into the device separately from the engineering data with SICAM WEB.

- Click on the **Dashboard** tile in SICAM WEB.



[sc_Dashboard_Conf_Grafic_01, 1, en_US]

- Click the **Graphic** tile.



[sc_Dashboard_Conf_Grafic_02, 1, en_US]

- Click **Import** to import the graphics.

NOTE

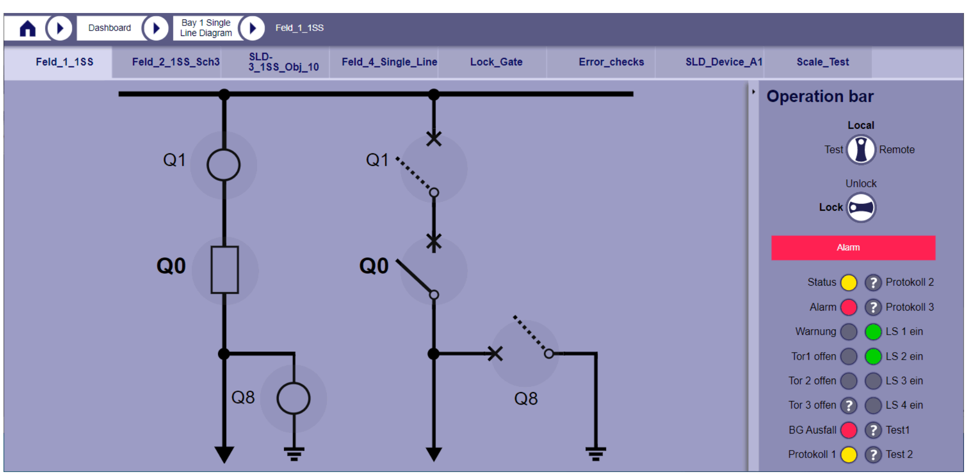
Graphics that are loaded via SICAM WEB, are saved on the SD card and are automatically transferred to the new device when the device is replaced.

10.6.5.7 Graphic with operation bar

This chapter shows how to configure the operation bar.

Only one operation bar can be configured per device. However, this will be displayed in all graphics with a control bar.

Only messages (TI 30, TI 31) can be displayed in a operation bar.



[sc_SW_Graph_with_operation_bar_01, 2, en_US]

Control bar elements:

- **Key switch for the control location**

  The state of switching device of the key switch is sent as system information to the I/O when the status changes (parameterizable).

  – Local (local operation)

    In position **Local** switching operations can only be carried out on site via the operation and display panel panel. Only commands are accepted whose source address matches the parameterized control location of the display.

  – Remote (Remote operation)

    In position **Remote** switching operations are only possible via a higher-level control center. The check of the source address is carried out in accordance with the control location check.

  – Test (test mode)

    In position **Test** the command output on the peripheral elements is suppressed (revision mode). If this is not desired, you can use the parameter **Keyswitch_test** to define a behavior on the peripheral element as like in local operation (commands are output).

- **Key switch for command interlocking**

  The key switch is used to switch between locked and unlocked command output in local operation.

  The state of switching device of the key switch is sent as system information to the I/O when the status changes (parameterizable).

  The unlocked command output can cause considerable damage. Operator inputs of this kind may only performed by specially trained personnel, and under the observance of special safety precautions!

  – Interlocked

  – Unlocked

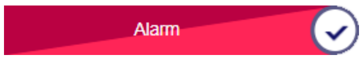
- **Sum alarm bar**

  The sum alarm bar shows the overall status of all alarms saved in the alarm list. The different states are represented by different colors and blinking rhythms.

  An alarm can either be **Active** or **Gone** . **Active** means, that the alarm has started but not yet ended. **Gone** means, that it has started and has already ended. In addition, you can confirm the alarms without having to switch to the alarm list.

  These different states are represented as follows:

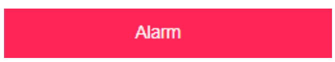
  – flashing red (status 1)

    In the alarm list there is at least one active alarm and at least one alarm that has not been confirmed.

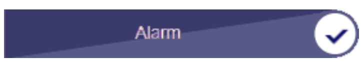
    The unacknowledged alarms can be confirmed by clicking on ✓.

  – static red (status 2)

    There is at least one active alarm in the alarm list and all alarms are confirmed.

  – flashing blue (status 3)

    There is no active alarm in the alarm list, but at least one alarm that has gone is not confirmed.

    The unacknowledged alarms can be confirmed by clicking on ✓.

  – static blue

    The alarm list is empty.

  If the sum alarm bar is not displayed, no signal is assigned to the alarm list.

- **LEDs**

  These LEDs are used to graphically display signals in the colors green, red or yellow.

Configuration of the tile

With the parameter **`RTU common settings | Process data | Dashboard | Tile definition | Layout`** you can define the appearance of the tile. Choose the option **Graphic with operation bar**.

You also have to define the name of the tile, its position and size and the associated graphic file.

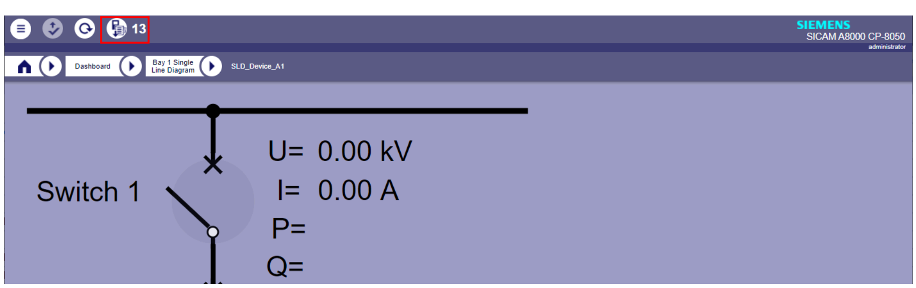
Configuration of the signals

Indicate in the parameter list all signals of type **`Process data message`**.

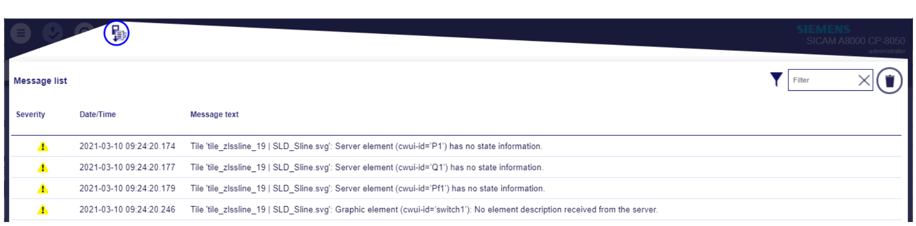
- Select in column **Tile_pos** the option **Operation bar** . With this you specify that the respective signal is displayed in the operation bar.
- In column **Function_in_tile** you can specify the form and function in which the respective message is displayed in the control bar.
  - **Key local/remote/test operation bar**
    The key switch in the operation bar is the source for selecting the control location.
    This option is only available for double-point informations (TI 31).
  - **Key local/remote/test physical**
    This option prevents, that the key switch is controlled via the display.
    The control location is selected using an external, physically available key switch (e.g. wired to a DI). The status is only displayed in the operation bar and cannot be changed there
    This option is only available for double-point informations (TI 31).
  - **Key locked operation bar**
    The key switch in the operation bar is the source for selecting the command interlocking.
    This option is only available for single-point information (TI 30).
  - **Key locked physical**
    This option prevents, that the key switch is controlled via the display.
    The selection of command interlocking is done by an external, physically available key switch (e.g. wired to a DI). The status is only displayed in the operation bar and cannot be changed there
    This option is only available for single-point information (TI 30).
  - **Led (on = green)**
    The signal is indicated as green LED.
  - **Led (on = red)**
    The signal is indicated as red LED.
  - **Led (on = yellow)**
    The signal is indicated as yellow LED.

10.6.5.8 Error Handling

If the graphic and the engineering of the signals are not compatible, corresponding messages are displayed in the SICAM WEB status log when the graphic is opened.



[sc_DB_SVG_Graphic_messages_01, 1, --_--]



[sc_DB_SVG_Graphic_messages_02, 1, --_--]

NOTE

These messages are only displayed once after each login, when the graphic is opened for the first time.

Multiple cwui-id

Warning: Tile <tile name>: Multiple elements with XML attribute "cwui-id = <value>" found in graphic

This occurs when the SVG graphic contains several elements with the same cwui-id.

Possible Cause: A switch was copied and the cwui-id for the copy was not adjusted.

Multiple cwui-text

Warning: Tile <tile name>: Multiple elements with XML attribute "cwui-text = <value>" found in graphic

This occurs when the SVG graphic contains several elements with the same cwui-text.

Possible Cause: An element with this attribute was copied and the value for the attribute was not adjusted in the copy.

Message signal not found in graphic

Warning: Tile <tile name>: No element found with XML attribute "cwui-id = <Text>"

This occurs if the SVG graphic does not have an element with the name parameterized in the signal (message) <parameter: Text>.

Measured value signal not found in graphic

Warning: Tile <tile name>: No element found with XML attribute "cwui-id = <Text>"

This occurs if the SVG graphic does not have an element with the name parameterized in the signal (measure value) <parameter: Text>.

State not found in element

Warning: Tile <tile name>: The state element (cwui-id = <value>) does not contain an element with XML attribute "cwui-state = <value>"

This occurs if there is no status element in the graphic for the status supplied by the device.

Missing selection in state element

Warning: Tile <tile name>: Graphic element for selection is missing (with the XML attribute "cwui-selection = 'true'.

This occurs if a state element is functional but does not contain an object with the XML attribute "cwui-selection = true".

No message signal received for state element

Warning: Tile <tile name>: Graphic element (cwui-id = <value>): No message signal received for state element.

This occurs if no message was received from the device for an existing status element in the graphic.

No message value signal received for text element

Warning: Tile <tile name>: Graphic element (cwui-id = <value>): No message signal received for state element.

This occurs when no measured value has been received from the device for an existing text element in the graphic.

10.6.6 Automatic Login

You can configure SICAM WEB in such a way that no login to the device is necessary when it is called and a certain dashboard tile is displayed as the start screen. This enables local emergency operation for access-secured plants.

This configuration can be done with the SICAM Device Manager or the SICAM Toolbox II.

The session timeout is deactivated for automatic login.

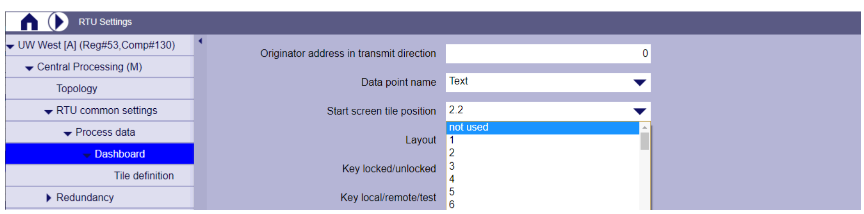
A syslog entry is generated with every automatic login.

NOTE

Siemens recommends only activating the automatic login on LAN interfaces that are used with local displays (devices that are located within a secure environment). An automatic login via remote would allow unauthorized remote device access.

Selection of the dashboard tile for the start screen

- In the SICAM Device Manager select the parameter **RTU common settings | Process Data | Dashboard | Start screen tile position**
- Select the tile you want from the drop-down list



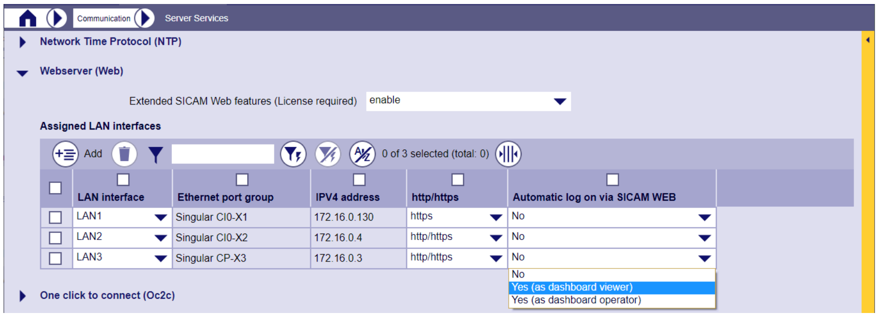
[sc_db_parameter_start_tile_pos, 2, en_US]

If you select a tile position that has not been configured, the SICAM WEB Standard HOME desktop with the tiles **Alarme & Events** and **Dashboard** is displayed instead.

Selection of the LAN interfaces for automatic login via SICAM WEB

- In the SICAM Device Manager select the tiles **Communication** and **Server Services**

- In the section **Webserver (Web)** you will find the column **Automatic log in via SICAM WEB** in the table **Assigned LAN interfaces** .



[sc_db_automatic_logon_01, 1, en_US]

Here you can configure for each LAN interface whether and with which authorization the automatic login should be implemented.

The following options are available:

– **No**

  Default setting. There is no automatic login. Username and password must be entered when starting SICAM WEB.

– **Yes (as dashboard viewer)**

  With this setting, the user name and password do not have to be entered. The user then has read rights for the tiles dashboard, alarms and events. No commands and setpoint values can be output.

  The **Dashboard Viewer** authorization is displayed at the top right of the SICAM WEB screen. A confirmation of the alarm list is possible.

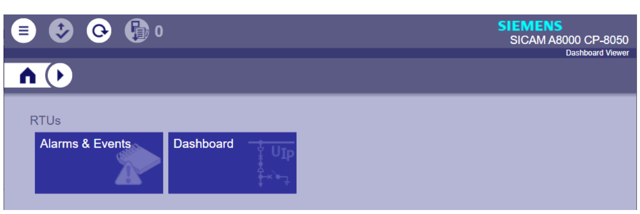
– **Yes (as dashboard operator)**

  With this setting, the user name and password do not have to be entered. The user then has operator rights on the dashboard. Commands and setpoint values can be output and both switches in the operation bar can be operated.

  The **Dashboard Operator** authorization is displayed at the top right of the SICAM WEB screen.

How do I exit the Dashboard Viewer/Operator mode?

After an automatic login on SICAM WEB you can only navigate within the tiles **Dashboard**, **Alarms** and **Events**.

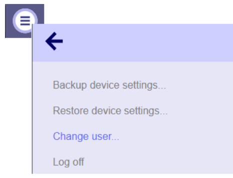


[sc_db_automatic_logon_02, 1, en_US]

In order to regain access to other areas, you must log in again with different user authorization.

Proceed as follows:

- Choose **Change User...** in the main menu.

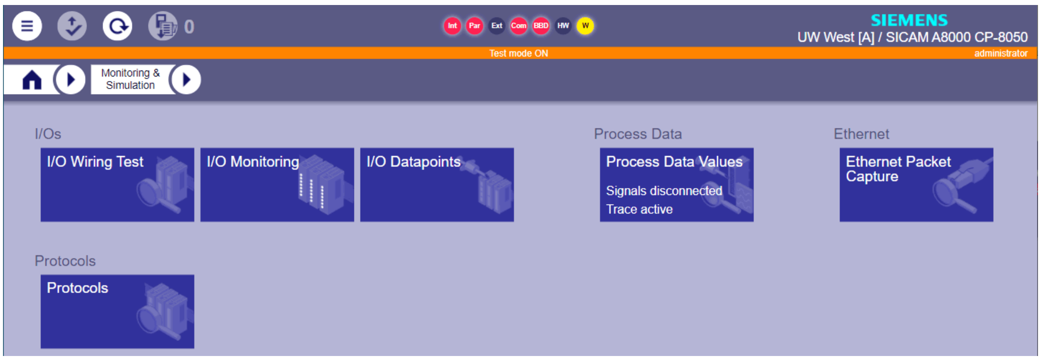


[sc_db_main_menu, 1, en_US]

- Confirm the question about changing users with **OK**.
- Log in with the desired user authorization.

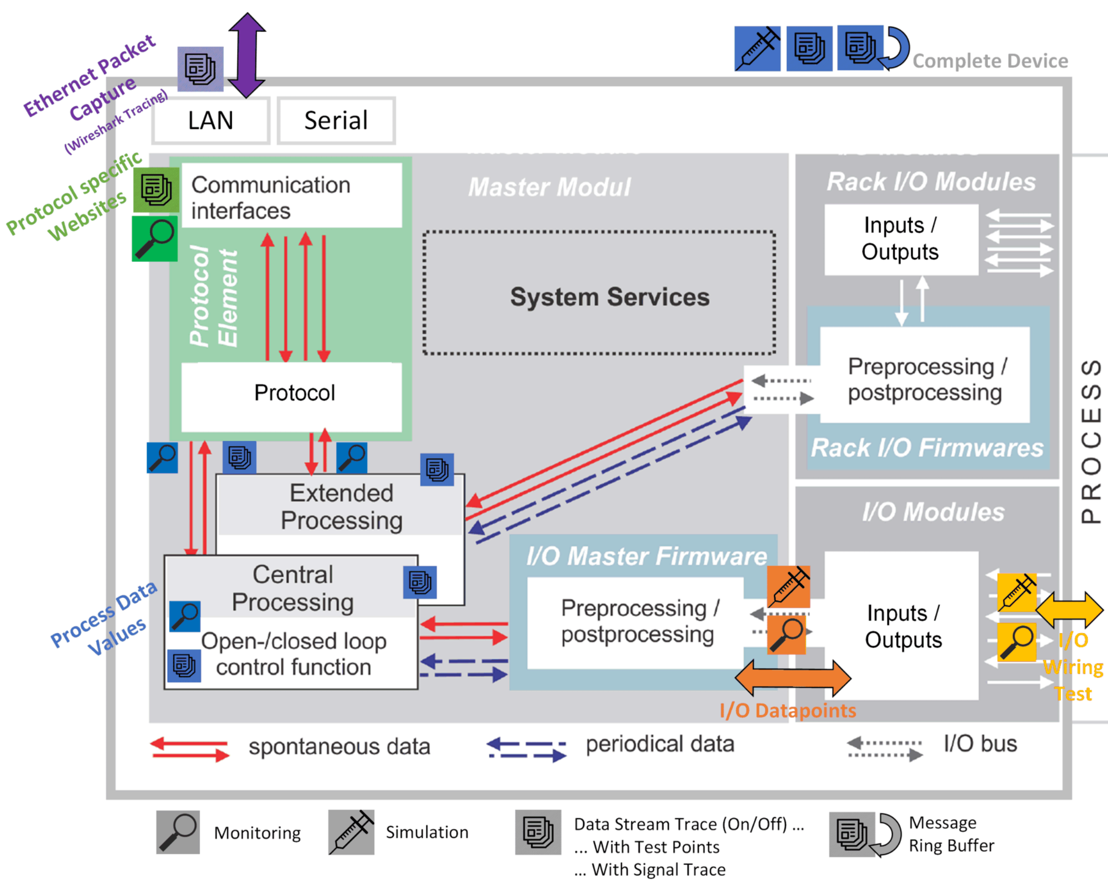
10.7 Monitoring & Simulation & Tracing

In order to monitor/test the system during the different phases of the plant life cycle, there are different possibilities for monitoring & simulation via SICAM WEB. In order to simplify the usability, the different applications are divided into several tiles.



[sc_WEB_Monitoring_Simulation, 3, en_US]

Here is an overview on which points in the system monitoring & simulation options are available.



[dw_Monitoring_Simulation_Overview_2011, 1, en_US]

I/O Wiring Test

Used to test the external cabling from/to the terminal of the SICAM A8000 I/O modules towards the process.

I/O Monitoring

Used to display the states of the inputs and outputs of the SICAM A8000 I/O modules.

I/O Datapoints

Serves to test the I/O data points from/for internal processing (e.g. function diagram) by specifying values or to decouple the outputs to prevent actual transmission to the process during the tests. Here internal values in the system can be compared with the actual values at the terminal/process.

Process Data Values

The process data values function is divided into 3 functions that can be selected via tabs:

- **Monitoring**

  The current status of all signals from the device including attributes, quality bits, etc. can be monitored here. Filtering on individual signals, protocols or devices/stations is also possible here to enable quick error diagnostic.

- **Simulation**

  Via the monitoring views signals can be assigned to the simulation view and simulated in this. The simulation of signals always applies within the complete device, i.e. in all functions to which the corresponding signal is assigned.

- **Trace**

  The signal sequence in the device can be followed using the trace function. Here there is the - message ring buffer which is always active (simple tracing) and the - data flow trace which can be configured and controlled via operating steps of the user.

Ethernet Packet Capture

Used for logging/tracing of TCP/IP packets which enter or leave the device via the various LAN connections. This offers the advantage that no additional ports have to be released in the system or no additional devices have to be installed in the system. The function logs before encryption or after decryption.

Protocols

Used to display protocol-specific web pages.

NOTE

Many of the monitoring & simulation functions offer an export button for tables, with which the contents of the table can be exported to a CSV file. This CSV file is written in UTF-8 format.

If you double-click this CSV file with Microsoft Excel, the umlauts will not be displayed correctly because Microsoft Excel opens CSV files with the Windows-specific character set Windows-1252.

The workaround for this problem is to open Microsoft Excel first and then import the data via **Data | From Text/CSV** with the UTF-8 character set.

10.7.1 I/O Wiring Test

With the help of the I/O wiring test, the mechanical/plant construction engineer can check whether the hardware wiring between the SICAM A8000 I/O module and the process is correct.
This test is mainly used when installing or expanding a system.
Preconditions:

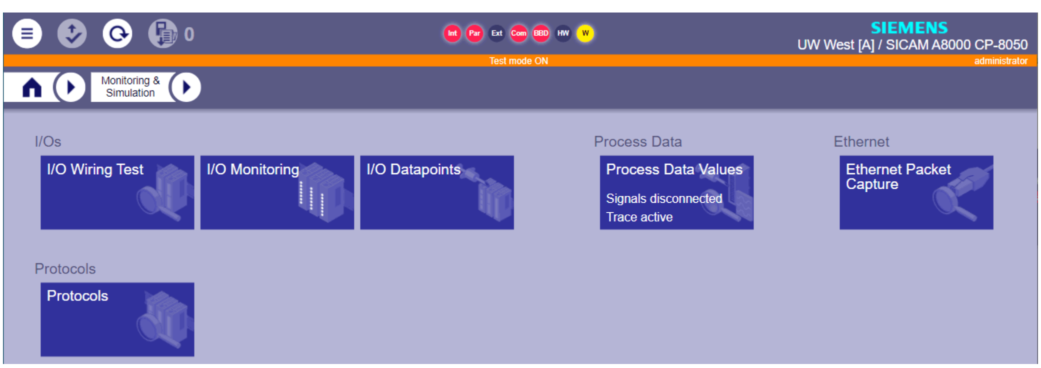
- The hardware/firmware configuration is available in the engineering data
- The physical sensors/actuators are connected to the SICAM A8000 I/O modules
- CP-8031/CP-8050 can be reached via SICAM WEB (IP address configuration is available)
- The SICAM WEB user has write access

NOTE

- Signal engineering is not required
- The following modules are currently not supported:
  - all SICAM TM I/O modules
  - all SICAM A8000 Rack I/O modules

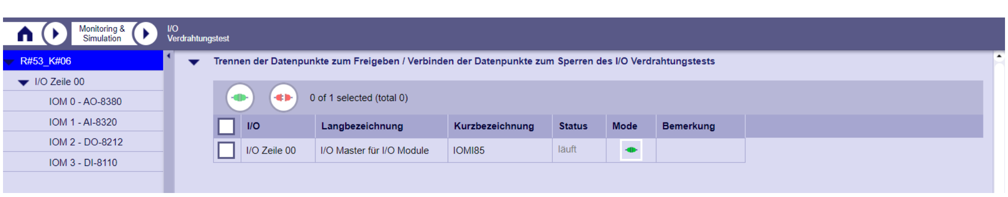
Prepare device for I/O wiring test / Disconnect connection

Before the test can be carried out, the inputs and especially the outputs must be separated from the internal processing functions.
The inputs and outputs are separated at the level of the I/O row.
Click on the SICAM WEB dashboard in the **RTUs** group on the **Monitoring & Simulation** tile.
Click in the **Monitoring & Simulation** dashboard in the **I/Os** group on the **I/O Wiring Test** tile.



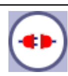
[sc_WEB_Monitoring_Simulation, 3, en_US]

The connected system with its I/O lines and I/O modules is displayed in the directory tree. Depending on the selection in the directory tree, the elements below are displayed in the window on the right. The respective connection status is shown in the **Mode** column with a plug symbol.



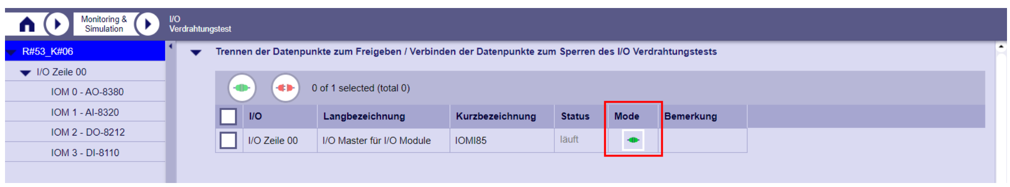
[sc_MS_WT_01a, 1, en_US]

Table 10-1 Symbols used for the function wiring test / device node

Symbol	Meaning
	All inputs/outputs of this I/O row are connected to the process. When this symbol is pressed, all inputs/outputs of this I/O row are separated from the process.
	All inputs/outputs of this I/O row are separated from the process. When this symbol is pressed, all input/output data points of this I/O row are connected to the process.
	Connect button in the action bar When this button is clicked, all I/O rows selected in the table are connected to the process.
	Disconnect button in the action bar When this button is clicked, all I/O rows selected in the table are disconnected from the process.

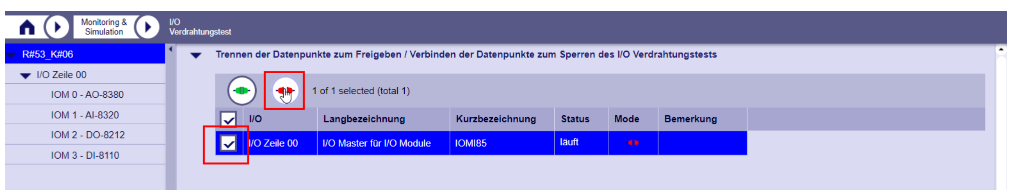
Disconnect/connect options:

- Click on the plug symbol in the **Mode** column



[sc_MS_WT_01a_m, 1, en_US]

- Select one or more I/O rows by clicking the checkbox in the left column and then use the disconnect/connect button in the action bar.



[sc_MS_WT_01c_m, 1, en_US]

To switch the entire device to I/O wiring test, all I/O rows must be selected and separated from the process.

NOTE

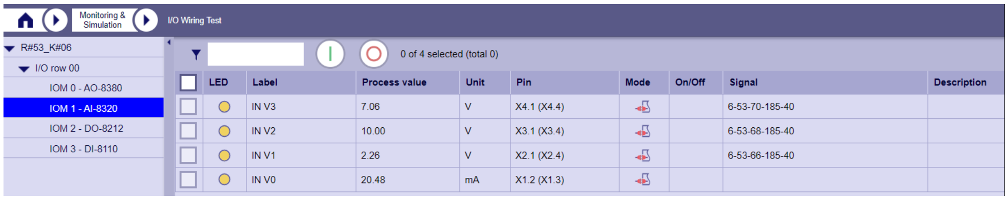
After the test has been carried out, the inputs and outputs must be reconnected to the process or the device must be reset/switched on.

Wiring test of SICAM A8000 input modules (AI, DI)

To check whether the hardware wiring between the SICAM A8000 input module and sensor/encoder is correct, I/O monitoring but also the I/O wiring test can be used. For the test of the inputs it is not necessary to switch the device to test mode, but it is recommended.

- The signals do not have to be, but can be assigned
- If the input module is separated from the system, the actual process value is not transferred to the system
- If the input module is not switched to test, the mechanical/plant construction engineer can also carry out this test, but the actual process value is transferred to the system
- With a digital input module, 0 or 1 is displayed for the current plug status, with an analog input module, the process value is displayed with the unit

Now simulate the process signals and check in SICAM WEB whether they are displayed.



[sc_WT_AI_01, 1, en_US]

Wiring test of a SICAM A8000 output module (AO, DO)

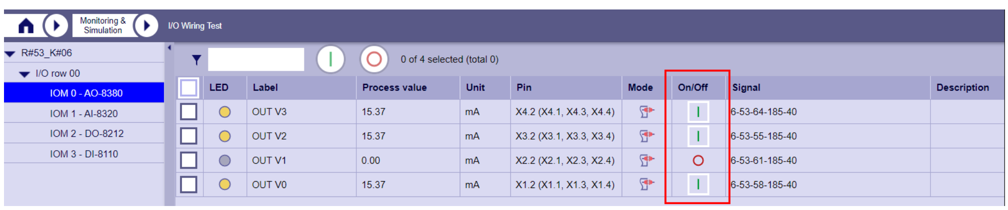
To check whether the hardware wiring between SICAM A8000 output module and e.g. a digital relay is correct, the I/O wiring test can be used to simulate the digital and analog outputs.

This application is only possible if the entire device or the complete I/O row is separated from the system. In this case, the system status is no longer transferred to the physical outputs.

Select the desired I/O row or the desired output module in the directory tree. All data points of the output module are displayed with detailed information.

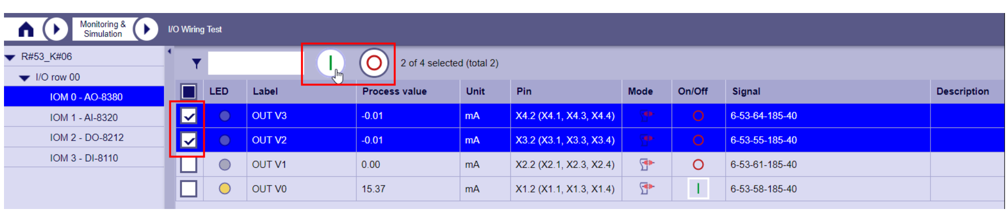
Testing options:

- In the **On/Off** column, click on the **Off** symbol for the respective output to activate the output.



[sc_WT_AO_01m, 1, en_US]

- Select one or more outputs by clicking on the checkbox in the left column and then use the **On** button in the action bar to activate the outputs.



[sc_WT_AO_02m, 1, en_US]

When the outputs are switched on, signals are output at the respective outputs. You can use a measuring device to check whether the simulated value is transferred to the physical power.

With analog outputs, 75% of the value range is output for the "On" state. (e.g. value range -10 to + +10 V, "On" corresponds to 7.5 V)

Table 10-2 Symbols used for the function wiring test / module node

Symbol	Meaning
	Mode "Input connected" The input signal is connected to the system. This is the default status after reset or switching on the system.
	Mode "Input not connected" The input signal is not connected to the system.
	Mode "Output connected" The output signal is connected to the process. This is the default status after reset or switching on the system.
	Mode "Output not connected" The output signal is not connected to the process.

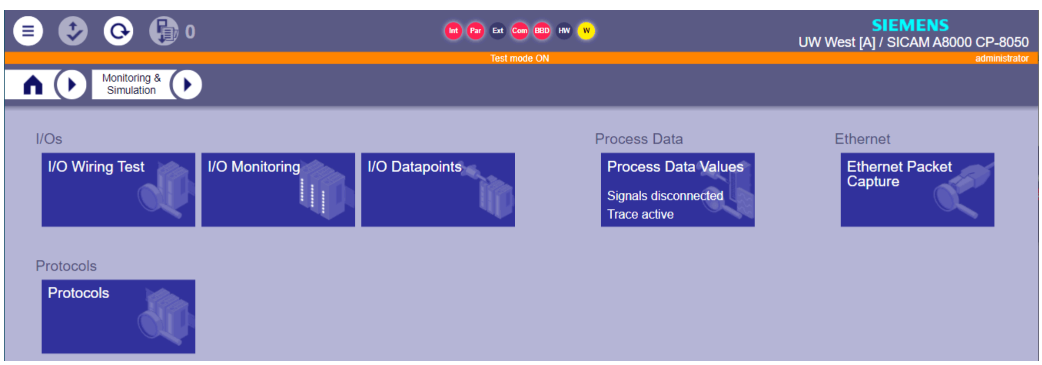
Symbol	Meaning
	Output is switched on. When this symbol is pressed, the output is switched off.
	Output is switched off. When this symbol is pressed, the output is switched on.
	ON button for outputs in the action bar When this button is pressed, all outputs selected in the table are switched on.
	OFF button for outputs in the action bar When this button is pressed, all outputs selected in the table are switched off.

10.7.2 I/O Monitoring

The SICAM A8000 I/O modules have no LEDs to indicate the states of the inputs and outputs.
For CP-8031/CP-8050 this task is performed by the I/O-monitoring function in SICAM WEB.
In addition to the digital values, analogue input and output values can also be displayed in the SICAM WEB.

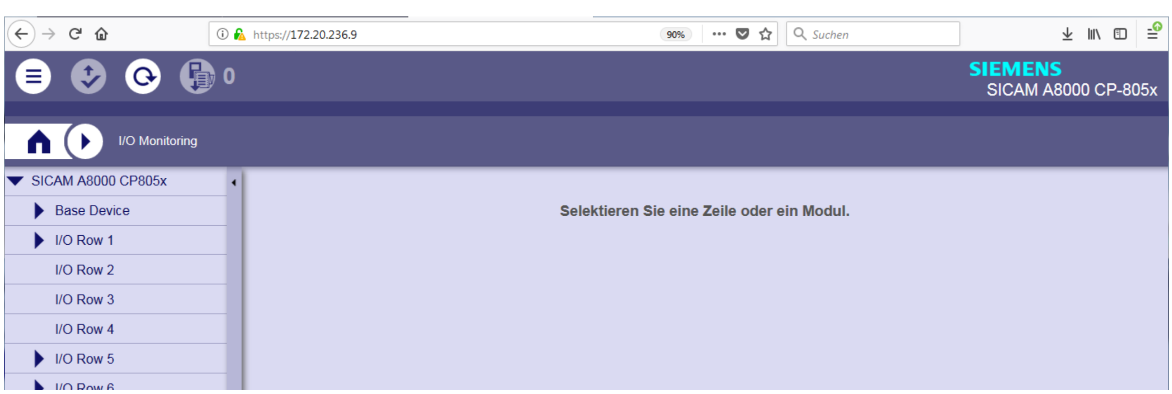
Start I/O Monitoring

Click on the SICAM WEB dashboard in the **RTUs** group on the **Monitoring & Simulation** tile.
Click in the Monitoring & Simulation dashboard in the **I/Os** group on the **I/O Monitoring** tile.

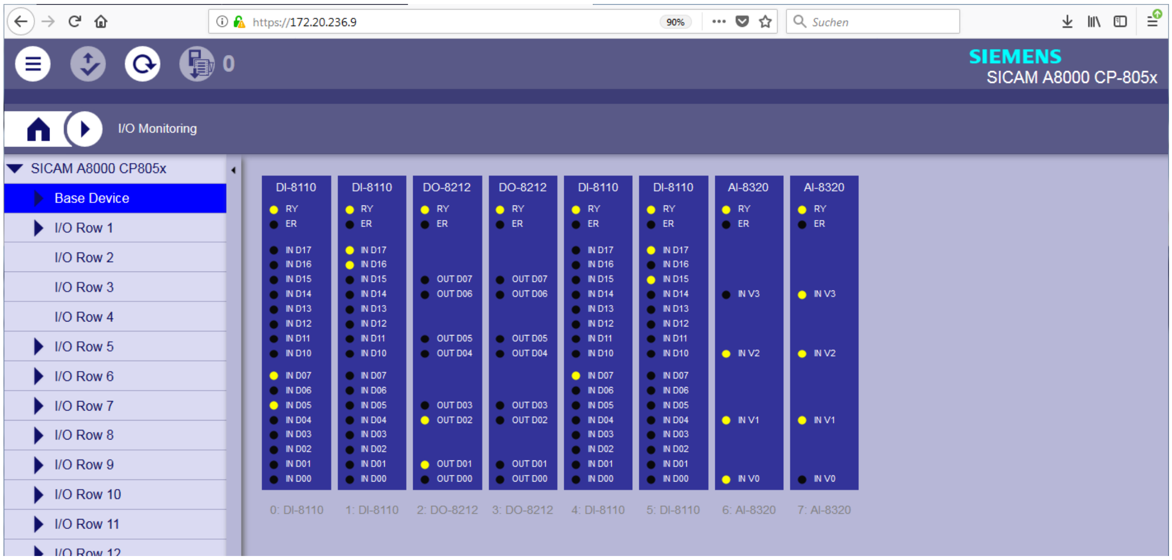


[sc_WEB_Monitoring_Simulation, 3, en_US]

The **I/O Monitoring** sub menu shows in the navigation area the structure of the plant (basic device + I/O lines) in a tree structure.



Click **Base Device** in the navigation area to display the I / O modules of the base device in the right-hand window.



For each I/O-module which is connected locally to the base device, a virtual display appears. The name of the I/O-module, LEDs for the system status and, per input/output, a status LED and the designation are shown.

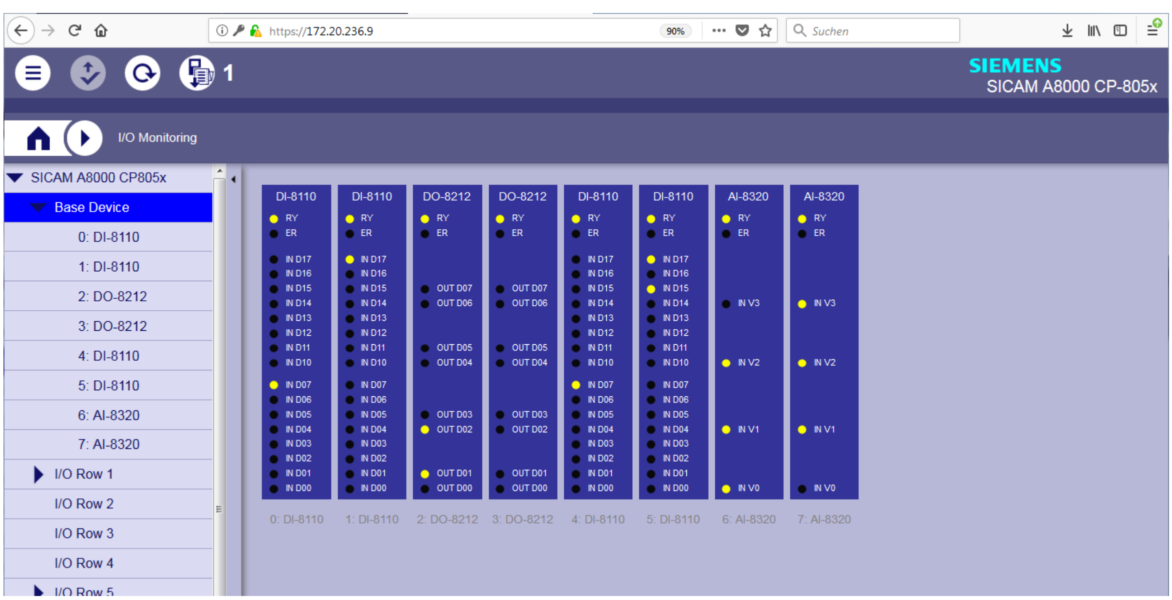
Both the order of the I/O-modules (from left to right) and the order of the PINs (top to bottom) are modeled on reality.

If an input/output is active, a yellow LED is displayed. When inactive, the LED is black.

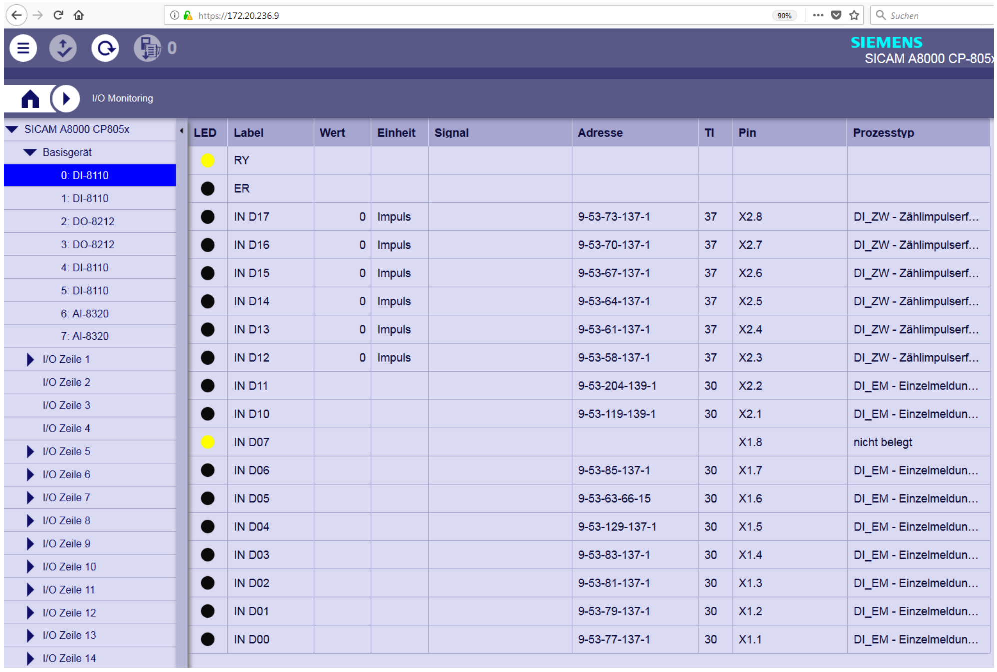
The status of the LED display is renewed every second.

Detail View of a I/O-Module

In the navigation area, display the I/O-Modules by clicking the button at **Base Device** or one of the I/O-rows.



In the extended navigation area, click on the I/O-Module from which you want to display the detailed information.



LED	Label	Wert	Einheit	Signal	Adresse	TI	Pin	Prozesstyp
	RY							
	ER							
	IN D17	0	Impuls		9-53-73-137-1	37	X2.8	DI_ZW - Zählimpulserf...
	IN D16	0	Impuls		9-53-70-137-1	37	X2.7	DI_ZW - Zählimpulserf...
	IN D15	0	Impuls		9-53-67-137-1	37	X2.6	DI_ZW - Zählimpulserf...
	IN D14	0	Impuls		9-53-64-137-1	37	X2.5	DI_ZW - Zählimpulserf...
	IN D13	0	Impuls		9-53-61-137-1	37	X2.4	DI_ZW - Zählimpulserf...
	IN D12	0	Impuls		9-53-58-137-1	37	X2.3	DI_ZW - Zählimpulserf...
	IN D11				9-53-204-139-1	30	X2.2	DI_EM - Einzelmeldun...
	IN D10				9-53-119-139-1	30	X2.1	DI_EM - Einzelmeldun...
	IN D07						X1.8	nicht belegt
	IN D06				9-53-85-137-1	30	X1.7	DI_EM - Einzelmeldun...
	IN D05				9-53-63-66-15	30	X1.6	DI_EM - Einzelmeldun...
	IN D04				9-53-129-137-1	30	X1.5	DI_EM - Einzelmeldun...
	IN D03				9-53-83-137-1	30	X1.4	DI_EM - Einzelmeldun...
	IN D02				9-53-81-137-1	30	X1.3	DI_EM - Einzelmeldun...
	IN D01				9-53-79-137-1	30	X1.2	DI_EM - Einzelmeldun...
	IN D00				9-53-77-137-1	30	X1.1	DI_EM - Einzelmeldun...

Structure of the table with the detailed information

Column	Meaning / Note
LED	Display if input/output is active/inactive. The display is renewed once per second.
Label	Name of the LED
Value	The shown value is renewed once per second.
Unit	Dependent on the I/O-Module • AI-8310: °C, °F, Ohm • AI-8320: V and mA (depending on the parameterization) • AO-8380: V and mA (depending on the parameterization) Digital I/O-Modules have no unit
Signal	Display of the signal name if the data point is used and the signal name is present in the device (e.g. device parameterized with Device Manager)
Address	Value only available with previous configuration
TI	Type Identification Value only available with previous configuration
Pin	Plug and PIN designation Value only available with previous configuration
Process type	Processing (U/I, EM/DM, ...)

NOTE

Currently, the details (except RY and ER) are not supported for the AI-8510 and AI-8511 boards.

10.7.3 I/O Datapoints

This function serves to test the I/O data points from or to internal processing (e.g. function diagram) by specifying values or to decouple the outputs to prevent actual transmission to the process during the tests. Here also internal values in the system can be compared with the actual values at the terminal/process.

The I/O simulation is suitable for the following applications:

- I/O data point tests in the system without physical encoders
- Simulation of periodic PLC data points for control loop functions

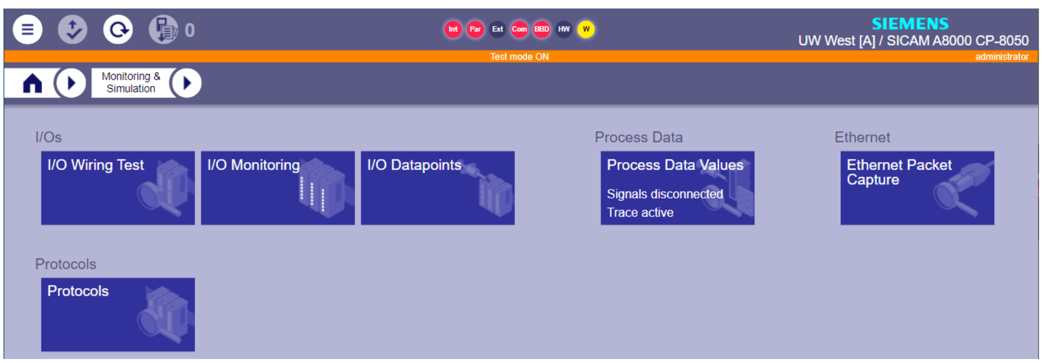
These functions are mainly used by the operating and maintenance engineer.

NOTE

- The following modules are currently not supported:
  - all SICAM TM I/O modules
  - all SICAM A8000 Rack I/O modules

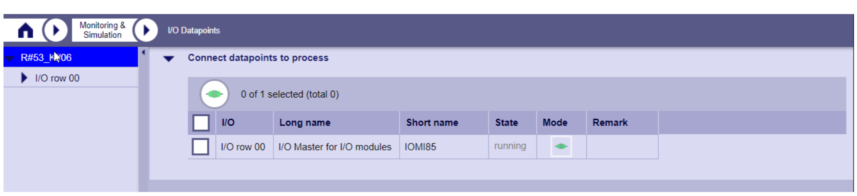
Open I/O Datapoints

Click on the **SICAM WEB** dashboard in the **RTUs** group on the **Monitoring & Simulation** tile.
Click in the **Monitoring & Simulation** dashboard in the **I/Os** group on the **I/O Datapoints** tile.



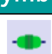
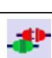
[sc_WEB_Monitoring_Simulation, 3, en_US]

The dashboard shows the I/O rows of the connected system.

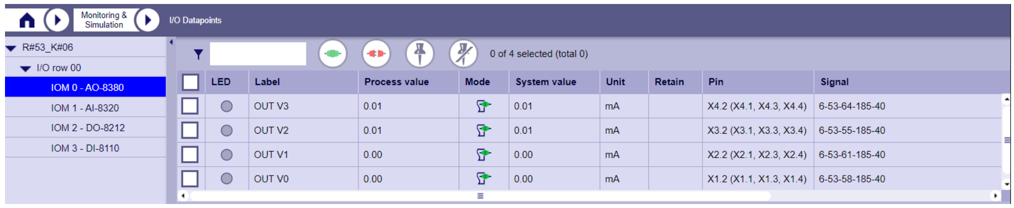


[sc_SIC_WEB_Datapoints_01, 1, en_US]

Table 10-3 Symbols used for the function I/O data points / node device

Symbol	Meaning
	All inputs/outputs of this I/O row are connected to the process.
	All inputs/outputs of this I/O row are separated from the process. When this symbol is pressed, all input/output data points of this I/O row are connected to the process.
	Within this I/O row there is a mix of disconnected and connected inputs/outputs. For details, see the row overview or on the modules. When this symbol is pressed, all inputs/outputs of this I/O row are connected to the process.

If you click on one of the I/O rows or I/O modules in the directory tree, all associated I/O data points are displayed.

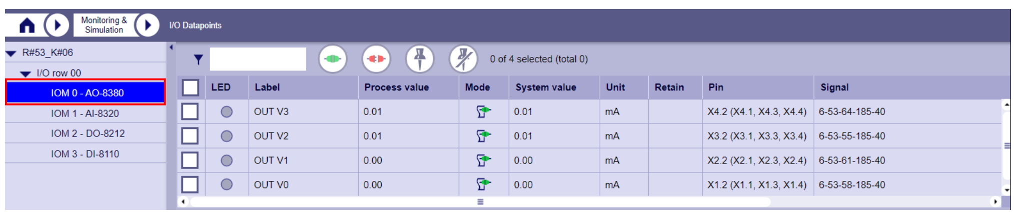


[sc_SIC_WEB_Datapoints_02, 1, en_US]

Simulate substitute values for SICAM A8000 input/output modules

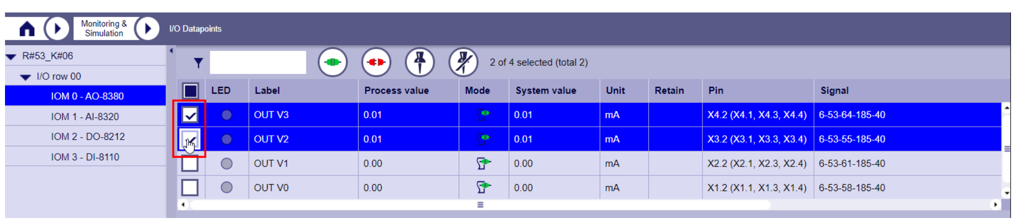
The value of each data point can be selectively simulated. To do this, the system value for the input/output must be separated from the physical input/output before. A substitute value can then be entered and the behavior of the system can be tested.

- Select the desired I/O module in the directory tree to display all associated I/O data points with detailed information.



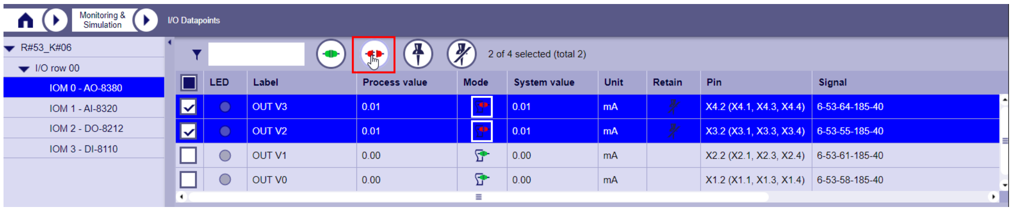
[sc_SIC_WEB_Datapoints_02_m, 1, en_US]

- Find the desired I/O data points and click on the check box in the left column.
  The data points selected in this way are highlighted in blue



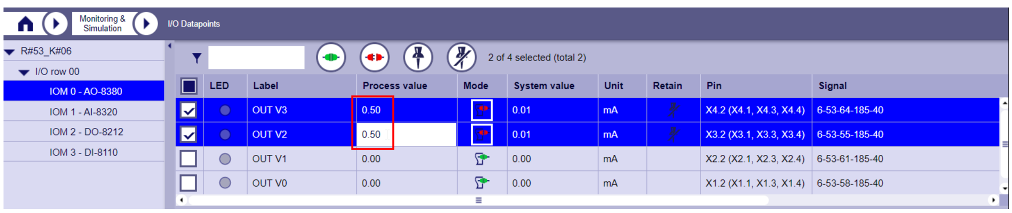
[sc_SIC_WEB_Datapoints_AO_sel_sel_01_m, 1, en_US]

- Now click on the Disconnect button in the action bar to disconnect the selected data points from the physical input/output.
  The plug symbol in column **Mode** turns red, indicating that the connection between the system and the process is disconnected.



[sc_SIC_WEB_Datapoints_AO_sel_sel_02_m, 1, en_US]

- Now enter the desired simulation value. For input modules in the **System value** column, for output modules in the **Process value** column. 0 or 1 for digital I/O modules and a value within the value range for analog I/O modules.



[sc_SIC_WEB_Datapoints_AO_sel_sel_03_m, 1, en_US]

Every simulated input value is processed in the system. Each simulated output is written to the physical I/O output.

Define substitute values for SICAM A8000 I/Os for restart - Retain

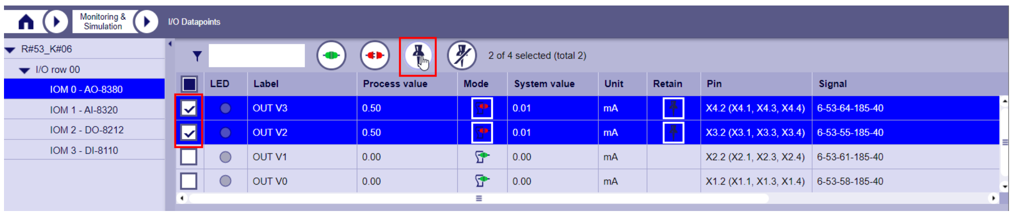
You can save the entered substitute values permanently / non-volatile.
This allows you to permanently overwrite values from damaged converters, for example.

Table 10-4 Symbols used for the function I/O data points / module nodes

Symbol	Meaning
	The substitute value of this data point is permanently saved. After pressing this symbol, the substitute value is no longer stored permanently.
	The substitute value of this data point is not saved permanently. After pressing this symbol, the substitute value is saved permanently.
	Retain button in the action bar When this button is clicked, the substitute values of all data points selected in the table are permanently saved.
	No Retain button in the action bar When this button is clicked, the substitute values of all data points selected in the table are no longer stored permanently.
	Mode "Input connected" The input signal is connected to the system. This is the default status after reset or switching on the system.
	Mode "Input not connected" The input signal is not connected to the system.

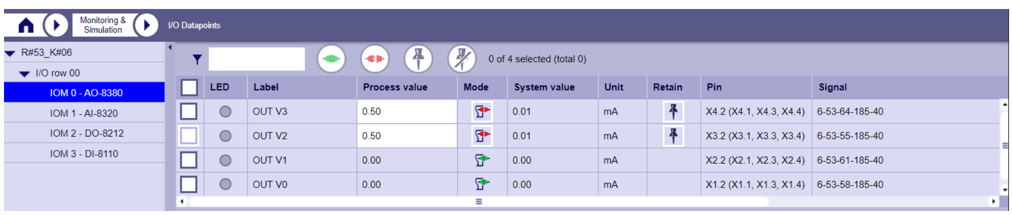
Symbol	Meaning
	Mode "Output connected" The output signal is connected to the process. This is the default status after reset or switching on the system.
	Mode "Output not connected" The output signal is not connected to the process.

- Select the desired I/O data points (for which a substitute value has been entered) by clicking on the check box in the left column and click on the **Retain** button in the action bar.



[sc_SIC_WEB_Datapoints_AO_sel_sel_retain_01_m, 1, en_US]

- The symbol in the **Retain** column now indicates that the substitute value is saved permanently.



[sc_SIC_WEB_Datapoints_AO_sel_sel_retain_02, 1, en_US]

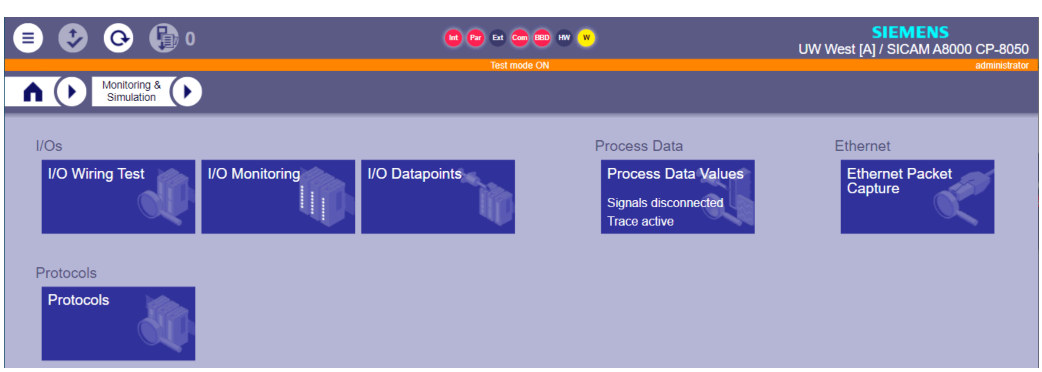
10.7.4 Process Data Values

10.7.4.1 General

The current status of all signals from the device including attributes, quality bits, etc. can be monitored, simulated and traced here. Filtering on individual signals, protocols or devices/stations is also possible here to enable quick error diagnostic.

Calling up the process data values

- Click on the SICAM WEB dashboard in the **RTUs** group on the **Monitoring & Simulation** tile.
- Click in the **Monitoring & Simulation** dashboard in the **Process Data** group on the **Process Data Values** tile.



[sc_WEB_Monitoring_Simulation, 3, en_US]

- In window **Process Data Values** the Tabs **Monitoring**, **Simulation** and **Trace** are available. At the first start, the **Monitoring** tab is displayed.

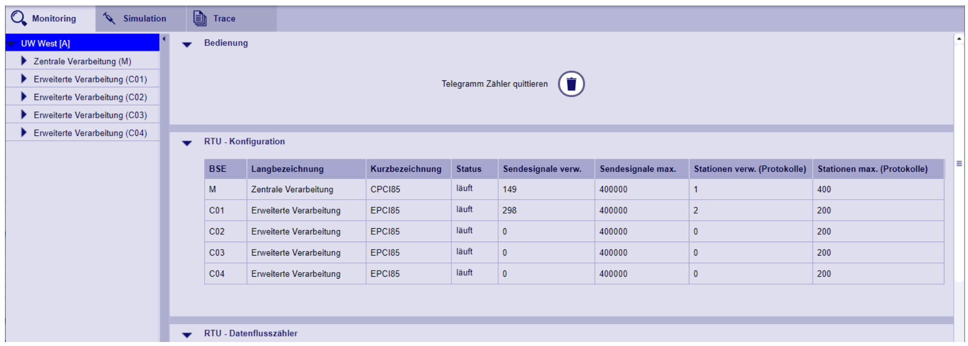
  In the directory tree on the left, the name of the connected device and all associated process modules (Central processing (M), Advanced processing (C1), etc.) are displayed.

[sc_MS_PD_Mon_01, 2, en_US]

10.7.4.2 Monitoring of Process Data

Introduction

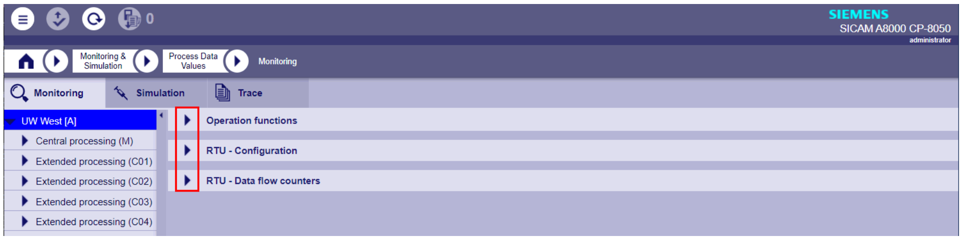
- Click on the device name in the directory tree in the **Monitoring** tab to display the following sections in the work area:



[sc_MS_PD_Mon_02, 2, en_US]

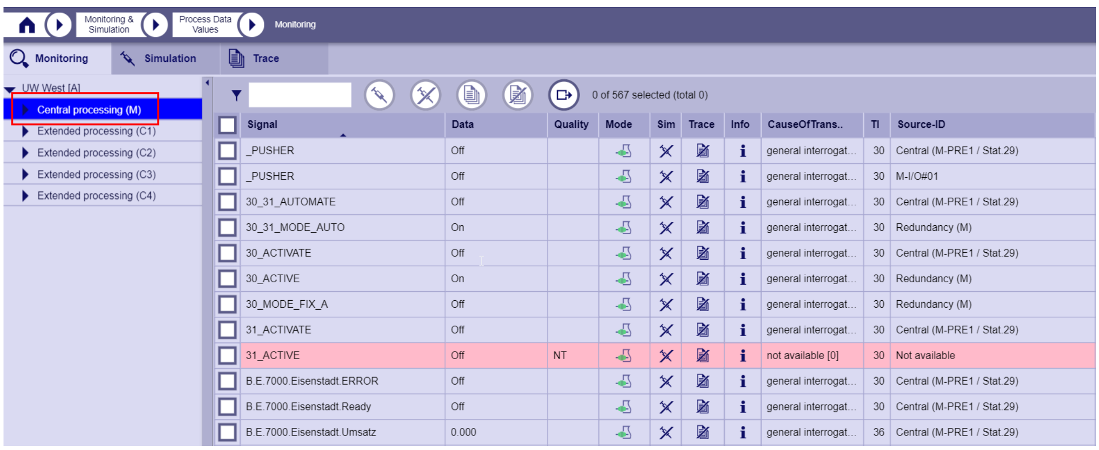
- **Operation functions**
  - **Quitt message counters**
    This button resets the following values:
    Change counter (column "MsgCounter")
    Maximum values per sec/min of the BSE/PRE data flow counter
- **RTU - Configuration**
  - **Used transmission signals**
    Sum of all signal images that are sent to other system parts via the protocols of the basic system element.
  - **Send signals max.**
    Maximum number of signal images that can be sent to other system parts via the protocols of the basic system element.
  - **Stations used (Protocols)**
  - **Stations max (Protocols)**
- **RTU - Data Flow Counter**
  - **Msg/sec**
    Number of spontaneous changes received by "Extended Processing Firmware" in the last second.
  - **Msg/min**
    Number of spontaneous changes received by "Extended Processing Firmware" in the last minute.
  - **Max. Msg/sec**
    Maximum number of spontaneous changes that can be received by "Extended Processing Firmware" per second.
  - **Max. Msg/min**
    Maximum number of spontaneous changes that can be received by "Extended Processing Firmware" per minute.

- You can close and open these areas by clicking on the arrow symbol.



[sc_MS_PD_Mon_03, 1, en_US]

- In the **Monitoring** tab in the directory tree, click on **Central Processing (M)**.
  All process data that are processed on this processing module are displayed.



[Bild1_Monitor_Zentrale_Verarbeitung, 1, en_US]

Figure 10-12 Process data for central processing

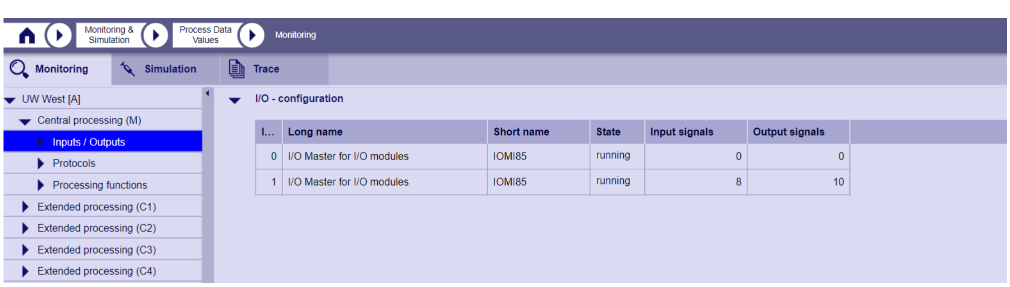
NOTE

The loading of the pages depends on the number of signals used.

At the time the page is launched, all signal images are loaded with the current status. Only the visible signals are updated during the monitoring. If a new message address is learned through automatic data flow during monitoring, this is not displayed. Call the page again to get the current status.

Inputs/Outputs

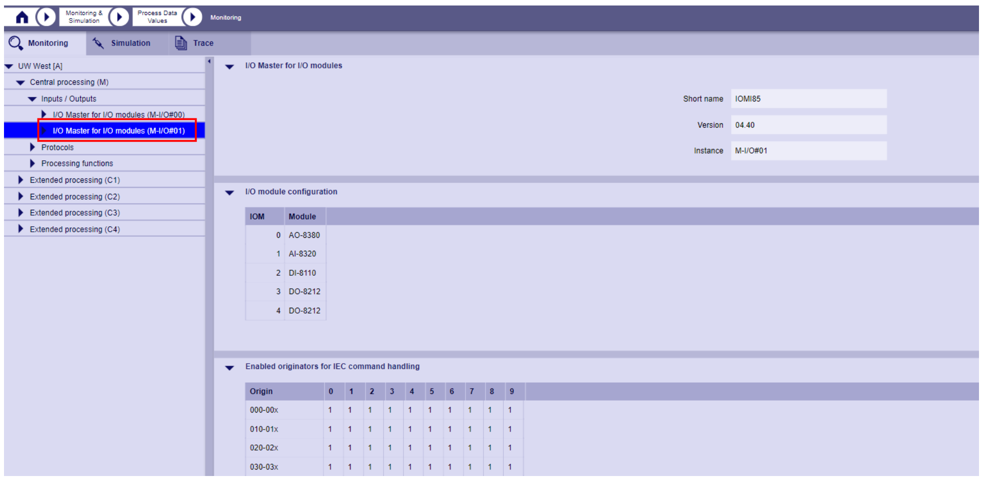
In this category all configured I/O master for I/O modules (e.g .: IOMI85 or IOMI65) are displayed with their current status.



[sc_mon_centproc_IO_01, 1, en_US]

Input Signals	Number of spontaneous signal images that are captured by the I/O master firmware and delivered to the system.
Output Signals	Number of spontaneous signal images that are captured by the I/O master firmware and delivered to the process.

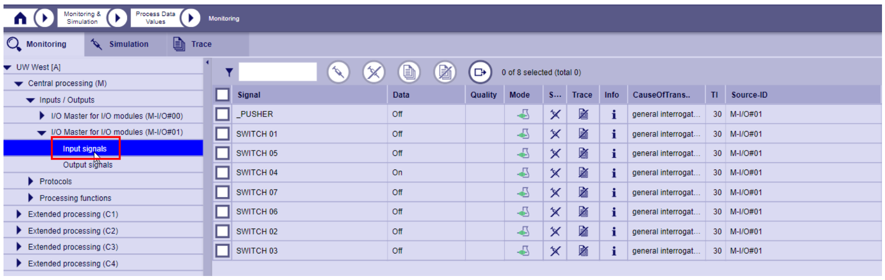
If you select an I/O master in the directory tree, the following information is displayed:



[sc_mon_centproc_IO_IOmaster_01_m, 1, en_US]

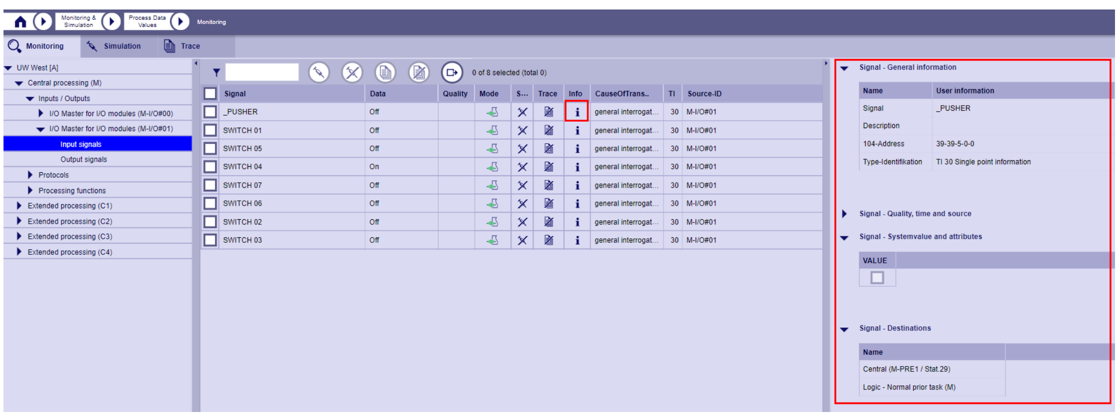
In the directory tree you will find the following information on the next level:

- **Input Signals**
  This table shows details of the signals that are recorded by the I/O master firmware and delivered to the system.
  The check boxes in the first column of the table are used to selectively select signals. Selected signals can be processed further using the buttons in the action bar.



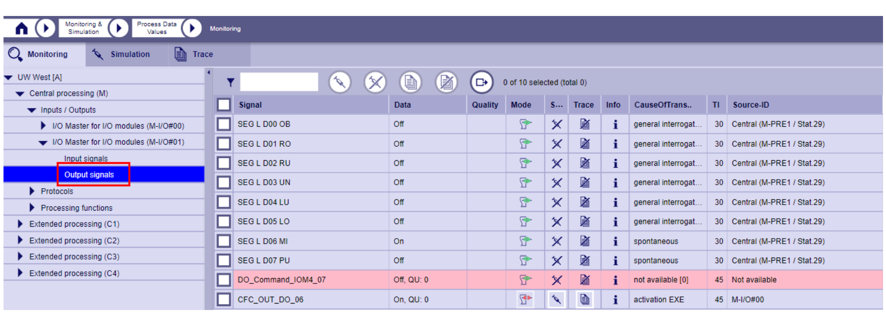
[Bild2_Monitor_IO_Inputs, 1, en_US]

  When the info symbol is pressed, a sidebar with detailed information about the signal is displayed. "Signal destinations" lists all destinations that are assigned to the signal



[Bild3_Monitor_Signal_detailinfo, 1, en_US]

- **Output Signals**
  This table shows details of the signals that are supplied by the system to the I/O master firmware and output to the process.



[Bild1_IO_Outputs, 1, en_US]

  Process values that have not yet been received are marked in red.
  The meaning of the symbols used in the table is identical to the description of the symbols in the section **Input Signals**.

Table 10-5 Symbols used for the function monitoring of process data

Symbol	Meaning
	Mode "Input connected" The input signal is connected to the system. This is the default status after reset or switching on the system.
	Mode "Input not connected" The input signal is <u>not</u> connected to the system.
	Mode "Output connected" The output signal is connected to the process. This is the default status after reset or switching on the system.
	Mode "Output not connected" The output signal is <u>not</u> connected to the process.
	The signal is available in the **Simulation** tab. If you click this button, the signal will be removed from the **Simulation** tab. This symbol is blocked if the simulation loop is activated in the simulation view. Attention: If the input signal is not connected to the system, it will be automatically reconnected by pressing this symbol.
	The signal is <u>not</u> available in the **Simulation** tab. If you click this button, the signal is inserted in the **Simulation** tab and can thus be simulated. This symbol is blocked if the simulation loop is activated in the simulation view.
	The signal is assigned to the data flow trace in the **Trace** tab for signal tracing. If you click this button, the signal will be removed from the **Trace** tab. This symbol is blocked when the data flow trace is activated.
	The signal is <u>not</u> available in the **Trace** tab. If you click this button, the signal is assigned for signal tracking to the data flow trace. The data flow trace must be started so that the signal is entered in the trace.
	When the info symbol is pressed, a sidebar with detailed information about the signal is displayed.

Table 10-6 Using the buttons in the Action Bar

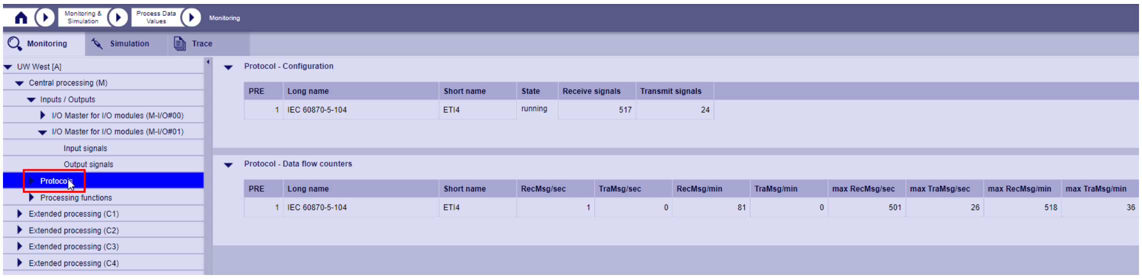
Symbol	Meaning
	The selected signals are shown in the **Simulation** tab. The symbols in **Sim** column are adjusted accordingly.
	The selected signals are removed from the **Simulation** tab. The symbols in the **Sim** column are adjusted accordingly.
	The selected signals are shown in the **Trace** tab. The symbols in the **Trace** column are adjusted accordingly.
	The selected signals are removed from the **Trace** tab. The symbols in the **Trace** column are adjusted accordingly.

Protocols

In this category, all protocols configured on the central processing module are displayed with their current state.
This category is only available if at least one protocol is configured.

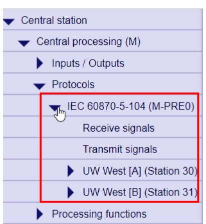
The following sections are displayed:

- Protocol - Configuration
- Protocol - Data flow counters
- Station definition of the protocol



[sc_mon_prot_01, 1, en_US]

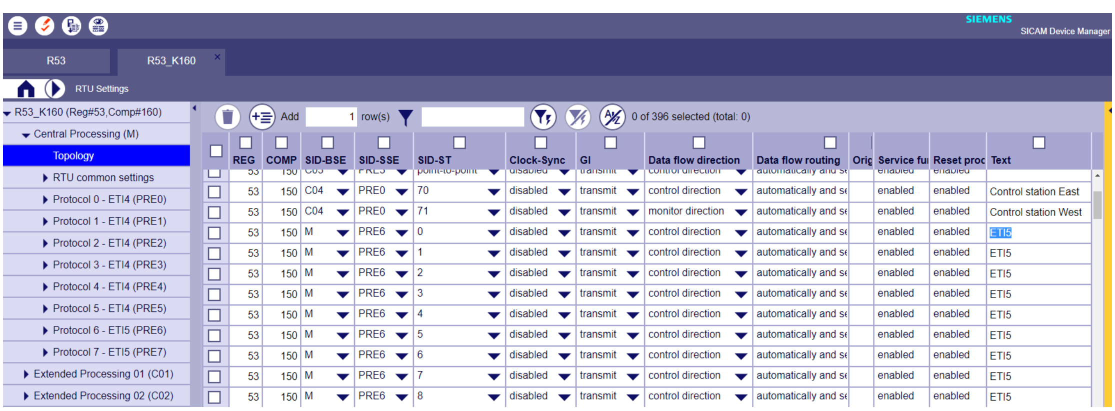
Each protocol has the sub-nodes **Receive signals** and **Transmit signals** and a sub-node for each **Station**. Each station has again the sub-nodes **Receive signals** and **Transmit signals**.



[Bild2_Knoten_Protokolle, 1, en_US]

Configuration hint:

The station name (e.g. UW West) displayed in the directory tree for the protocol, is defined with the engineering tool in the **Topology**, column **Text**.



[sc_SDM_Text_Topologie_Prozessdaten, 1, en_US]

Figure 10-13 Configuration with SICAM Device Manager

DR#	DB	REG	COMP	SID-BSE	SID-SSE	SID-ST	Originator	Text
11		53	170	C04	PRE0	70	0	Control station East
393		53	170	C04	PRE2	point-to-point	0	FBR
394		53	152	C04	PRE1	52	0	
395		53	170	C04	PRE0	71	0	Control station West

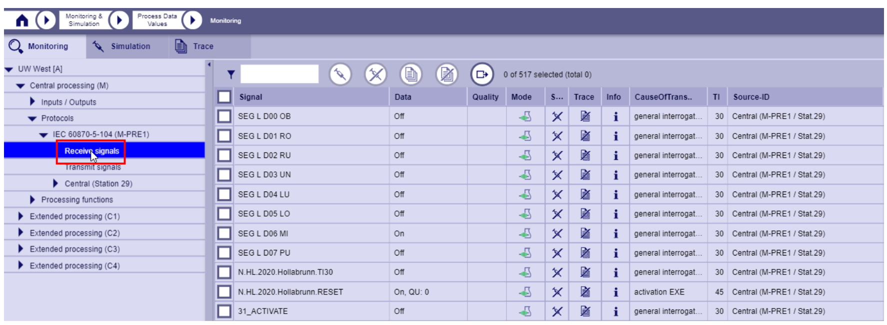
[sc_TBII_Text_Topologie_Prozessdaten_Sendertg_DE, 1, en_US]

Figure 10-14 Configuration with SICAM TOOLBOX II

- If you click on a protocol node, you will get the following information:

[Bild4_Monitor_Signal_Overview_Protocol, 1, en_US]

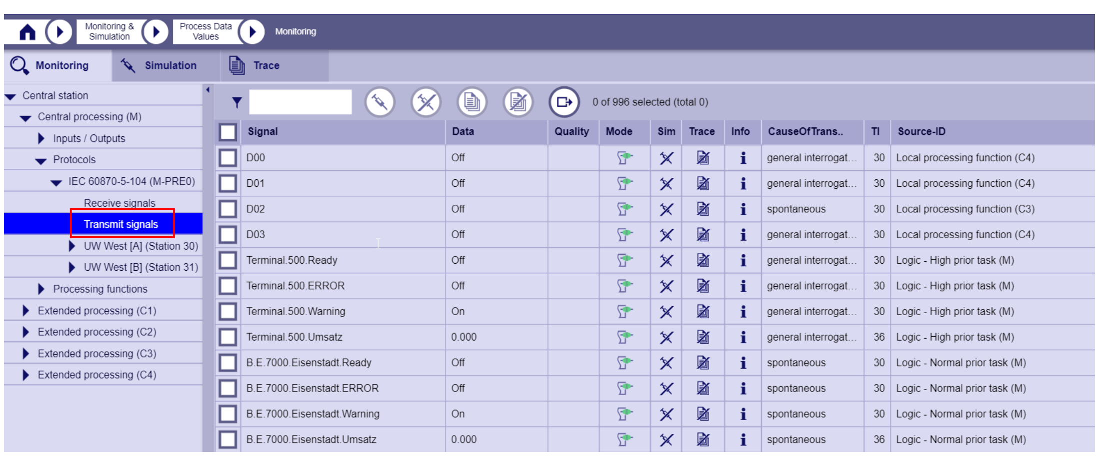
- If you click on the sub-node **Receive signals**, all signals that are received by the protocol are displayed:



[sc_mon_prot_04, 1, en_US]

The meaning of the symbols used in the table is identical to the description of the symbols for the I/O input/output signals.

- If you click on the sub-node **Transmit signals**, all signals that are sent by the protocol are displayed:



[Bild4_Protokolle_Sendesignale, 1, en_US]

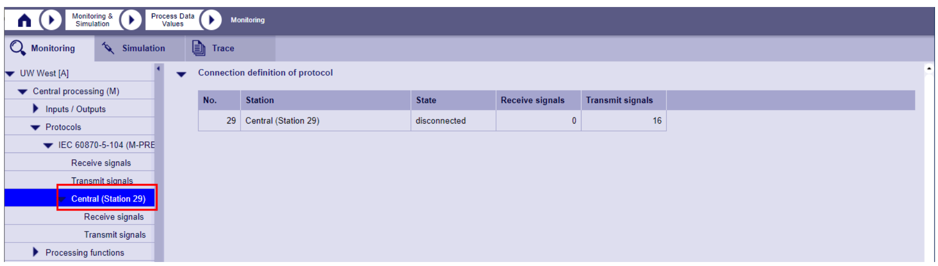
The meaning of the symbols used in the table is identical to the description of the symbols for the I/O input/output signals.

NOTE

Messages in control direction (e.g. commands, setpoint values, TI45-TI51) are not displayed on the protocols in the node **Transmit signals**, as these are signals that are not sent in the case of a general query and therefore there is no process image available on the send side. (Exception: Signals are assigned to the selective data flow)

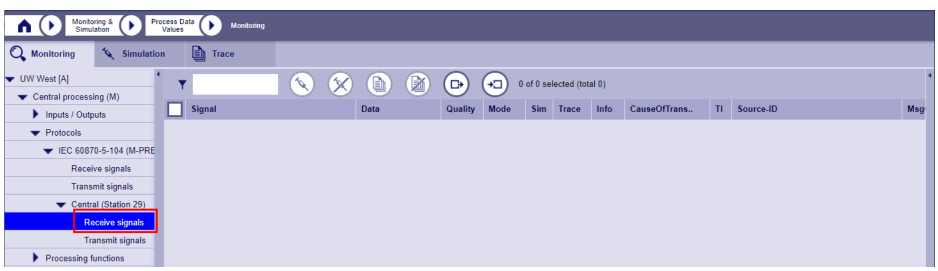
You can, however, query the current value of messages that have already been received or sent in the command direction in the node of the processing firmware. Only messages with status "Activation" are entered here. If you want to follow the complete sequence with activation, confirmation and termination, you have to access the trace functions.

- If you click on a **Station** node, you will get the following information:



[sc_mon_prot_06, 2, en_US]

- The respective signals are listed in the sub-nodes **Receive signals** and **Transmit signals**.



[sc_mon_prot_06a, 1, en_US]

Simulation of unavailable devices (test phase)

The **Import** button is available in the Action Bar in the sub-node **Receive signals** if the **Extended SICAM WEB** license has been activated (see *14.6 SICAM 8 Extended SICAM WEB*). This allows you to assign signals from other devices to the station that are not yet connected to your own system (e.g. the device does not yet exist).

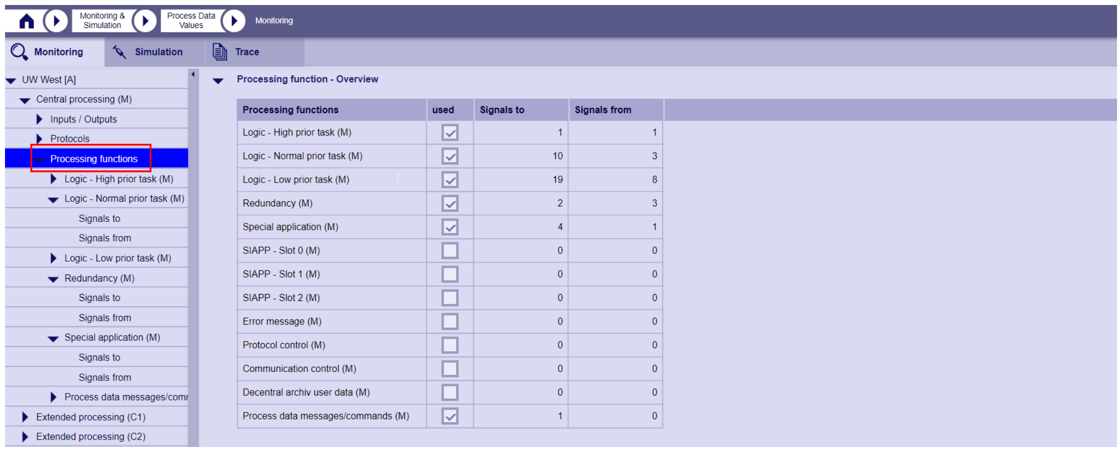
The import takes place via CSV files that have been generated using the SICAM Device Manager (HOME | Signals | Export ...) or with the SICAM TOOLBOX II (command line tool "signals2csv.exe"). But you can also send signals from non-SICAM A8000 devices (e.g .: SIPROTEC) if you manually generate a corresponding CSV file.

NOTE

After the simulation has been carried out, the signals imported into the station must be deleted by means of a reset.

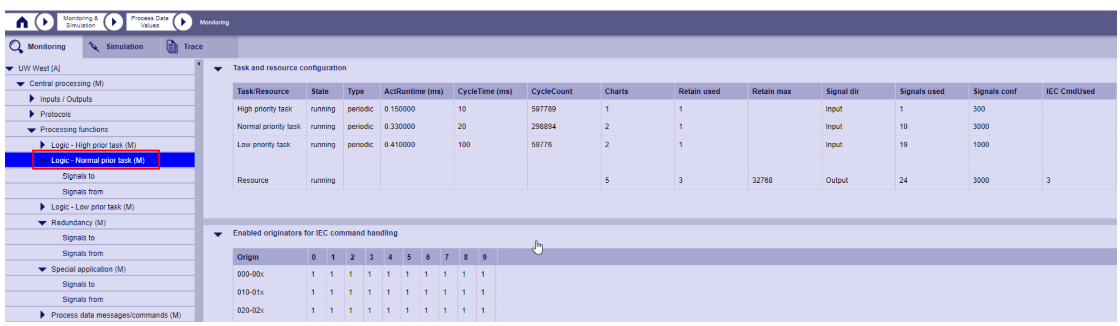
Processing functions

- If you click on the node **Processing functions**, you will get a table of all possible processing functions. A checkbox shows which are used and how many signals are received or sent by these functions.
  Only the functions used are displayed in the directory tree. Each processing function again has a sub node for **Signals to** and **Signals from**.



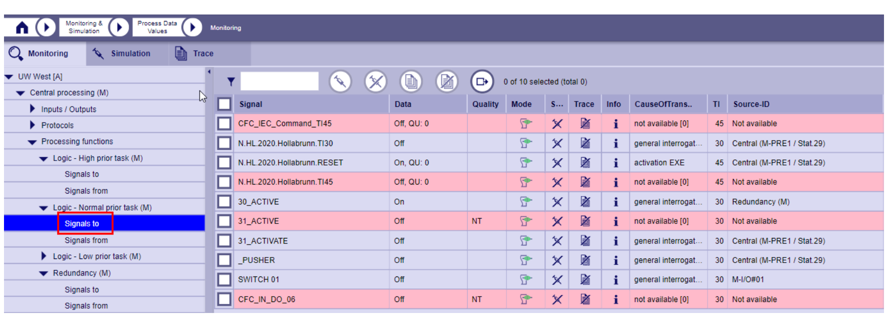
[sc_mon_procfunc_02, 1, en_US]

- If you click on the node of a processing function, you will receive more detailed information depending on the processing function (e.g. logic):



[Bild5_Monitor_Verarbeitungsfunktionen_Logic, 1, en_US]

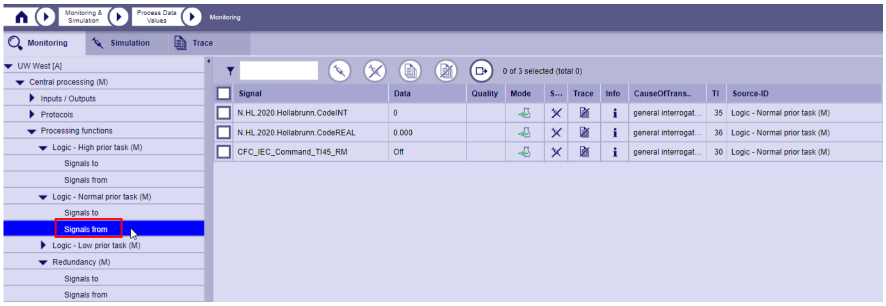
- If you click on the sub node **Signals to** or **Signals from**, you will get the following information:



[sc_mon_procfunc_04, 1, en_US]

NOTE

Signals marked in red are not valid. In the example above, the command signal has not yet been received.
If you select the red marked signal with the cursor, the cause is displayed in a tool tip.



[sc_mon_procfunc_05, 1, en_US]

In these tables you can select any signal to use it for simulation or tracing.

The meaning of the symbols used in the table is identical to the description of the symbols for the I/O input/output signals.

10.7.4.3 Simulation of Process Data Values

This function allows the user to simulate process data values for selected signals. For this purpose, it is possible to separate selected signals from the process and insert certain values into the process.

The selection of the signals for the simulation is only possible in the **Monitoring** tab.

NOTE

Simulated signals are always distributed throughout the device and are adopted in all functions (targets) used. i.e. they are also distributed via the communication interfaces.

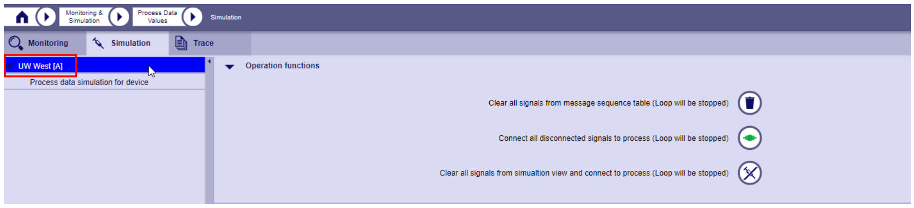
Since the signals are separated from the process during the simulation, the actual process values are discarded on the input side. This applies to signals in the signaling direction (single-point information...) as well as for signals in the command direction. If signals are reconnected to the process after the simulation via various control elements, a general interrogation is automatically triggered. i.e. For signals that are not transmitted during a general interrogation (e.g. commands, setpoint values), the simulated value remains active in the device.

As soon as a signal is separated from the process during the simulation, an entry of the class test is set in the diagnostic. Furthermore, this test status is displayed in the SICAM WEB header by means of an orange bar and on the **Monitoring & Simulation** and **Process data values** tiles. As soon as all signals are connected to the process again, this diagnostic bit is reset.

Furthermore, a syslog entry is made during the simulation of a signal. If the simulation loop is active, syslog entries are generated again and again. (every seconds)

[Bild6_Simulation, 1, en_US]

- When selecting the device node in the directory tree, the following functions are displayed:



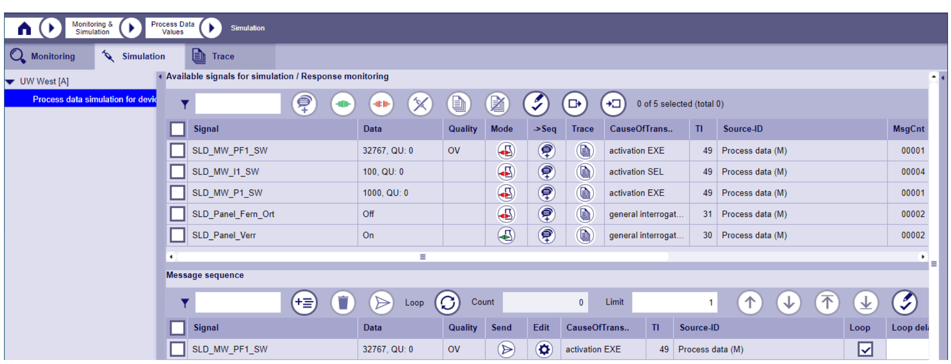
[Bild8_Simulation_Wurzel_Knoten, 1, en_US]

  – Clear all signals from the message sequence table (Loop will be stopped)
    If this symbol is clicked, all entries in the message sequence table are removed. If the simulation loop is active at this point, it is stopped automatically.
    Entries that have been stored reset-save are also deleted.

  – Connect all disconnected signals to process (Loop will be stopped)
    If this symbol is clicked, all disconnected signals are reconnected to the process. A simulation of signals is then no longer possible, therefore all signals in the message sequence table are marked as invalid (red). The message sequence table is not deleted. If the simulation loop is active at this point, it is stopped automatically.
    Reset-save entires are deleted.

  – Clear all signals from the simulation view and connect to process (Loop will be stopped)
    If this symbol is clicked, signals are removed from the simulation view and all disconnected signals are reconnected to the process. A simulation of signals is then no longer possible, therefore all signals in the message sequence table are marked as invalid (red). The message sequence table is not deleted. If the simulation loop is active at this point, it is stopped automatically.

- If you click on **Process data simulation (device)**, the table **Available signals for simulation** is displayed:

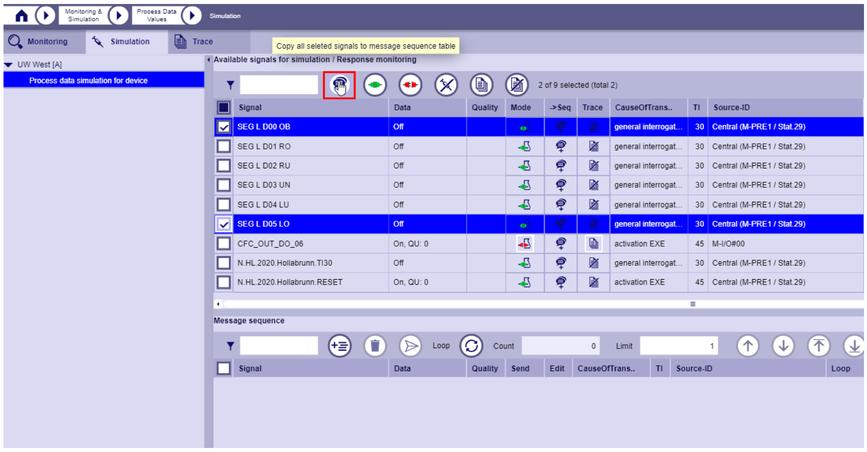


[sc_MS_Sim_01, 1, en_US]

This table shows only those signals which have been selected in the **Monitoring** Tab ( ).

- Here you can now select signals for the simulation. Select the desired signals using the check box and click to transfer them to the **Message sequence** table.

  If you want to select all signals at once, just click on Multiselect.



[Bild10_Simulation_Gerät_select, 1, en_US]

As soon as a signal is added to the **Message sequence** table, it is separated from the process and the test mode is activated. This status (signal separated) is displayed by means of an orange bar in the SICAM WEB header and on the **Process data values** and **Monitoring & Simulation** tiles.

Meaning / function of the symbols / buttons

Column	Meaning
Mode	The symbol in this column shows the connection status of the signal: - The input is connected to the process - The input is not connected to the process - The output is connected to the process - The output is not connected to the process If you click this button, the connection state takes on the opposite state (connected -> not connected, not connected -> connected).
-> Seq	- If you click on this button, an instance of the signal is added to the **Message sequence** table. Each time you click this button, another instance of the signal (= message) is added to the table. When adding, the signal is automatically disconnected from the process.
Trace	The icon in this column indicates whether the signal is being traced. - The signal is recorded and is available in the **Trace** tab. If you click this button, the signal will be removed from the **Trace** tab. - The signal is not recorded and is not available in the **Trace** tab. If you click this button, the signal will be added to the **Trace** tab.

Functions of the buttons in the action bar

Button	Meaning
	If you click this button, the selected signals will be removed from the **Simulation** tab.
	If you click this button, the selected signals will be shown in the **Trace** tab. The symbols in the **Trace** column are adjusted accordingly.
	If you click this button, the selected signals will be removed from the **Trace** tab. The symbols in the **Trace** column are adjusted accordingly.
	When you click this button, all signals selected in the table are connected to the process.
	When you click this button, all signals selected in the table are disconnected from the process.
	If you click on this button, instances (messages) of all signals selected in the table are added to the **Message sequence** table. Each time you click this button, additional instances of all selected signals are added. When adding, the signal is automatically disconnected from the process. This is indicated in the **Mode** column by a red symbol.
	If you click on this button, the table is loaded into the device in a non-volatile manner.
	If you click this button, all assignments in this table will be exported as a CSV file.
	If you click this button, you can import previously exported tables with mappings.

Allocation of message in the message sequence table

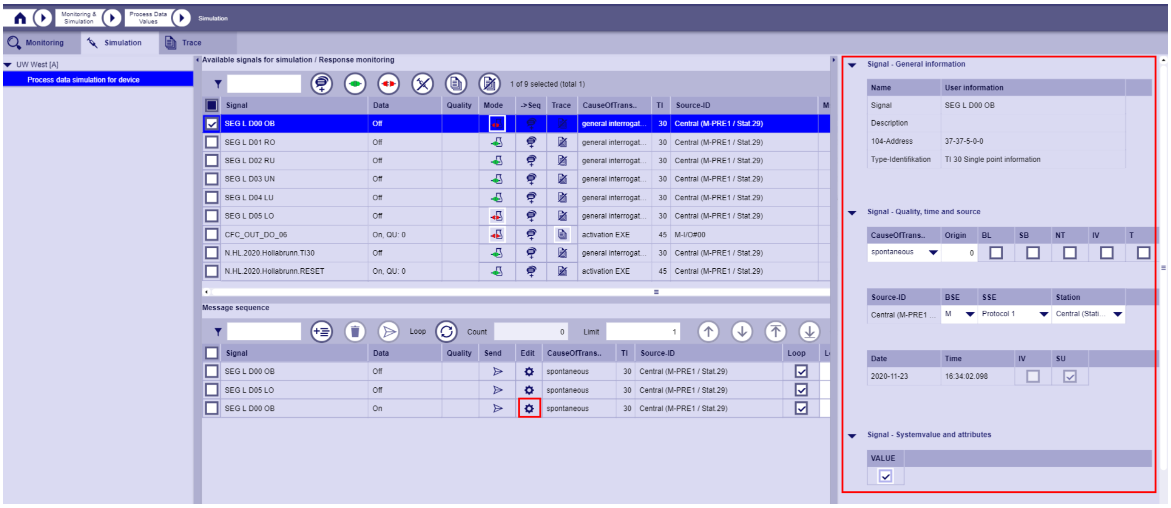
Instances of signals are copied by clicking on Copy in the table **Available signals for simulation / monitoring** with the current data, status and quality information in the table **Message sequence**. When assigning a process data signal, the loop attribute is automatically set and a loop delay of 10 ms is set.

System messages are added with **Add line** in the **Message sequence** table. When assigning a system message, the loop attribute is automatically set and a loop delay of 5 ms is set.

Modifications of messages

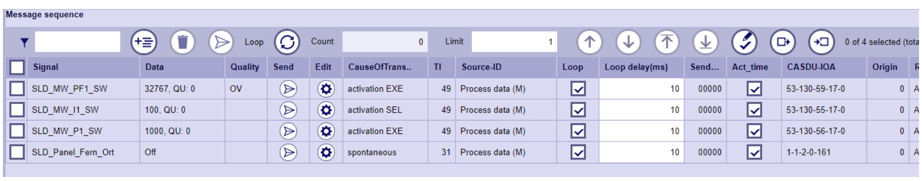
You have the option of changing various properties of messages before sending them. Select the message by clicking on the **Edit** symbol ( ).

This opens a window in which certain properties of the message can be displayed and changed.



[Bild7_Simulation_edit, 1, en_US]

Sending the messages from the message sequence table



[sc_MS_mess_sequ_table_01, 1, en_US]

The messages are ultimately sent from the **Message sequence** table.

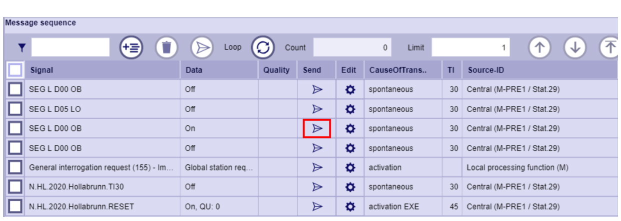
Sending is only possible if the message is valid. If the message to be sent is not separated from the process or the message is not correctly defined (e.g. no valid source ID), the message cannot be simulated. In this case the message is marked red.

Column	Meaning
Loop	Check box; shows all messages that are sent during loop mode
Loop Delay (ms)	Delay in ms, during the transmission between the messages
current time	activated -> the current time in the system is always added to the sent message not activated -> the time can be entered manually when modifying the message

- **Sending a single message**

  The following options are available:

  – Click on the **Send** symbol for the message concerned ( ) in the **Send** column. The message is sent once and without delay.

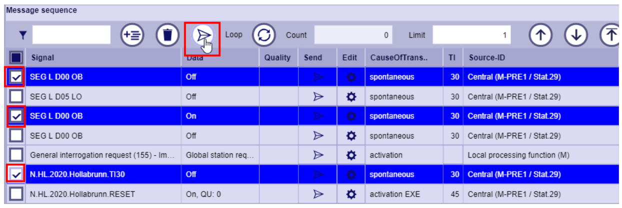
  

  [Bild8_Simulation_Send_with_row, 1, en_US]

  – Select the desired message by clicking on the check box and click on the **Send** button in the action bar. The message is sent once and without delay.

- **Send several messages**

  Select the desired messages by clicking on the respective check box. By clicking on the **Send** button in the action bar, the messages are sent once and without delay.

  [Bild9_Simulation_Send_multiselect, 1, en_US]

  The order in which the messages are sent, depends on the position (line) of the messages in the table. The top message selected is sent first, followed by the next lower one and so on. Using the **Up**, **Down**, **Top** and **Bottom** buttons in the action bar, you can change the order as you like.

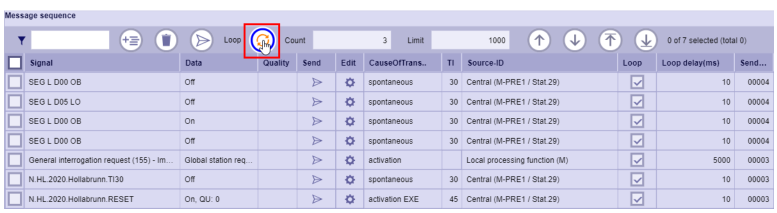
- **Sending messages in a loop**

  Select the desired messages by clicking on the respective loop check box and enter in the **Loop Delay(ms)** field for each messages how much time should pass before the next messages is sent.

  In the **Limit** field, specify in how many loops the selected messages are to be sent.

  The first **Loop** is started by clicking the loop button in the action bar.

  When starting, the **Send** counter for the messages assigned to the loop is reset.

  [Bild10_Simulation_Send_Loop, 1, en_US]

  The **Count** field shows how many loops have already been processed. You can stop the processing of the loops by clicking the **Loop** button. If you press **Loop** again, processing starts again with the first loop.

  After starting a loop, the following restrictions apply:

  – All selected messages in the message sequence are automatically switched to a "Read only" mode.

  – The columns **Mode** and **->Seq** in the table above are deactivated (no new messages can be added to the message sequence while a loop is being executed).

  – The color of the loop button changes to “orange”.

  – All messages that are executed in the loop are deactivated (no selection, no individual sending, no processing possible).

  – All messages that do not belong to the loop can be edited and the **Send** and **Edit** buttons remain activated. It is therefore possible to send individual messages during the loop that do not belong to the loop!

  – All buttons in the action bar, with the exception of the loop button, are deactivated.

Table 10-7 Function of the buttons in the **Message sequence** - table:

Button	Meaning
	If you click on this button, you can insert system messages into the table. An additional window opens in which you can configure the system messages.
	If you click on this button, the selected messages are deleted from the **Message sequence** table.

Button	Meaning
	If you click on this button, the selected messages are sent immediately.
	If you click on this button, the selected messages are sent immediately according to the loop configuration (number of loops, delay between loops).
	If you click on this button, the selected messages are shifted up one line in the table.
	If you click on this button, the selected messages are shifted down one line in the table.
	If you click on this button, the selected messages are moved to the top of the table.
	If you click on this button, the selected messages are moved to the very bottom in the table.
	If you click on this button, the table is loaded into the device in a non-volatile manner.
	If you click this button, all assignments in this table will be exported as a CSV file.
	If you click this button, you can import previously exported tables with mappings.

10.7.4.4 Tracing of Process Data

Introduction

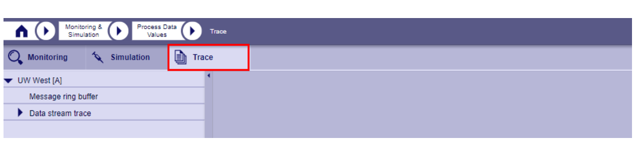
Tracing offers the possibility of following (recording) system values of selected signals. Every time a system value changes, a new record is added to the trace.

There are the following types of tracing:

- **Message ring buffer**
  The message ring buffer contains up to 5000 entries. All signals received from the device are automatically written to this trace.
  This trace is automatically activated after restarting the device.

- **Data stream trace**
  The data stream trace records signals that were previously selected in Tab**Monitoring**or in tab**Simulation**or signals that have passed configured simultaneous-logging points via**Wildcard trace configuration**.
  This trace is not active after restarting the device and must be configured and started by the user.
  This function cannot be used in parallel to the data stream test function of the SICAM TOOLBOX II.

You can find the**Trace**tab in window**Process Data Values**.



[sc_MS_PD_Trace_01, 1, en_US]

If you click in the**Trace**tab in the directory tree on the device name, you can start and stop the trace functions and delete the trace settings.

[Bild12_Trace_Geräte_Knoten, 1, en_US]

As soon as the trace function is started, an orange bar appears under the SICAM WEB header with a reference to the activated test mode.

[sc_sweb_dashboard_test_mode_active, 1, --_--]

Message ring buffer

- Click in the**Trace**tab in the directory tree on**Message ring buffer**.

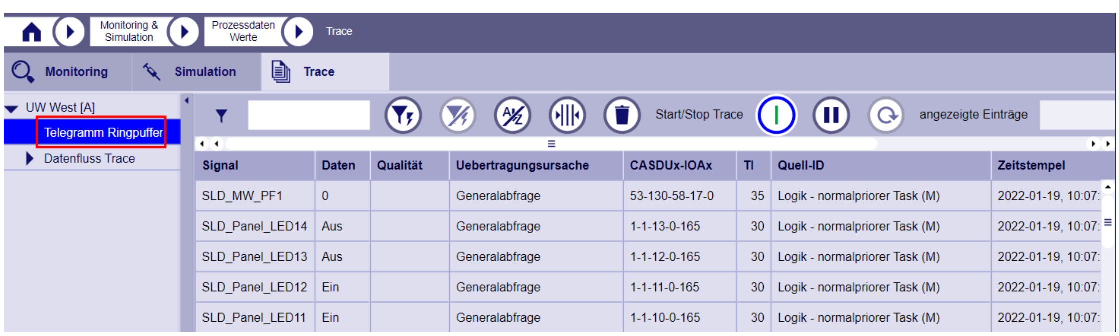
  The signals received last are always displayed here. New signals are inserted at the top of the table. All others are ranked down one position. When the memory is full (5000 signals) the oldest signal is deleted.

  The message ring buffer is switched on by default with every restart.

  In addition to signals (messages) of process data, the following system messages are also automatically recorded:

  – General interrogation

  – Counter interrogation



[sc_sweb_mon_sim_procdat_trace_01, 1, en_US]

The table content is automatically updated every second. By default, the last hundred signals are always displayed. You can change this value in the input field**Entries**.

The input field**Entries**can only be edited if the query is stopped with**Break**. Note that a higher number of displayed entries also means a longer retrieval time!

Table 10-8 Function of the buttons in the**Message ring buffer**action bar:

Button	Meaning
	Delete If you click on this button, all entries are deleted from the**Message ring buffer**.
 	Start/Stop Trace If you click on**Start**all new incoming messages are saved in the**Message ring buffer**in the target system and displayed in this table. If you click on**Stop**no more new incoming messages are saved in the**Message ring buffer**and therefore not shown in this table.
	Break If you click on**Break**the display of the newly incoming messages is stopped, but they are still recorded in the message ring buffer.
	Reload This button is only active, when the button**Break**was clicked. If you click on**Reload**the latest entries from the message ring buffer are displayed.
	Export If you click on**Export**all 5000 entries of the message ring buffer are exported to a CSV file.

Data stream trace

In contrast to the**Message ring buffer**the**Data stream trace**does not automatically record incoming signal changes, but the user has to define which signals are to be recorded.

NOTE

The data stream trace cannot be used simultaneously with SICAM WEB and SICAM TOOLBOX II. If the trace is running on the SICAM TOOLBOX II, you must first stop it and then you can start it manually in SICAM WEB.

The configuration is done by:

- **selective signal tracking**

  This is controlled by the trace symbol in the various monitoring views. The signals are assigned into this trace via the monitoring views and also in the process data simulation (table**Available signals for simulation / monitoring**).

  In the node**Signal trace configuration**all signals assigned to the trace are listed. These can also be switched off using the multi-select function. Switching on is not possible in this node. If a signal has been assigned, a selective entry is made in the data stream trace when the message is received for this signal and for each message routing to a destination.

  or

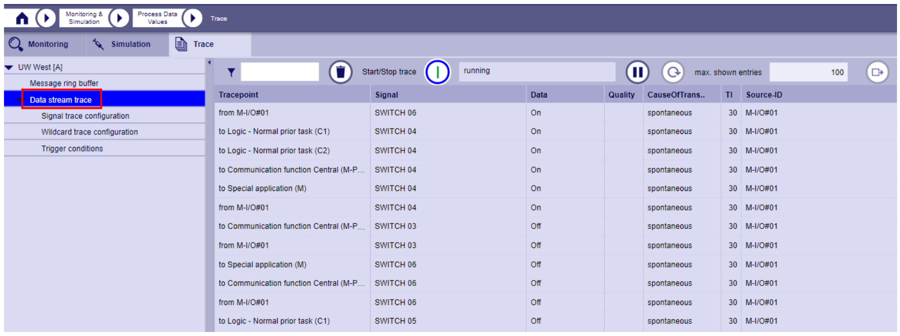
- **Wildcard trace configuration**

  With this function, the logging is controlled using test points (from/to input-outputs, protocols and processing functions) and message filters (analogous to the SICAM Toolbox data stream test).

  Furthermore, the data stream trace can be stopped when a diagnostic event occurs (e.g. interface failure) via configurable trigger events. These can be defined in node**Trigger conditions**.

  Reconfiguration is not possible while the trace is running, the corresponding test points are switched to "read mode".

The number of entries in the data stream trace is variable, since the messages of the recorded signals are of different size. Depending on the size of the messages, approx. 1000 are recorded.



[Bild14_Trace_datenfluss_trace, 1, en_US]

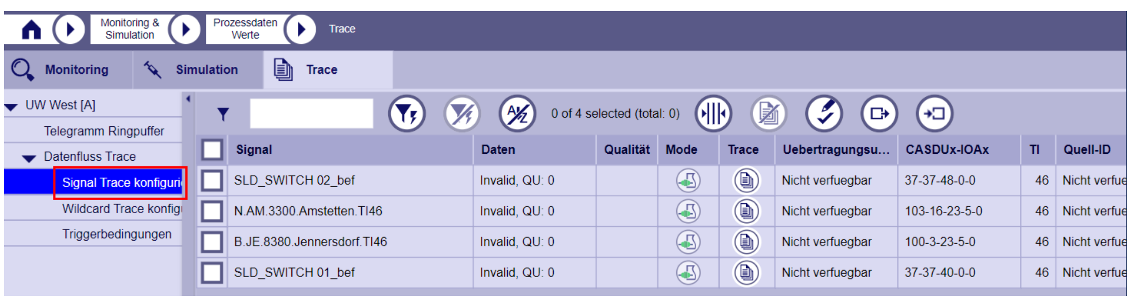
Signal trace configuration

Which signals are shonw in node**Signal trace configuration**is defined in the**Monitoring**and/or**Simulation**tab. There you have the option of selecting any signals by clicking on**Trace**( ).

NOTE

The**Trace**buttons can only be clicked when the data stream trace is stopped.

Display when signals are available for tracing:



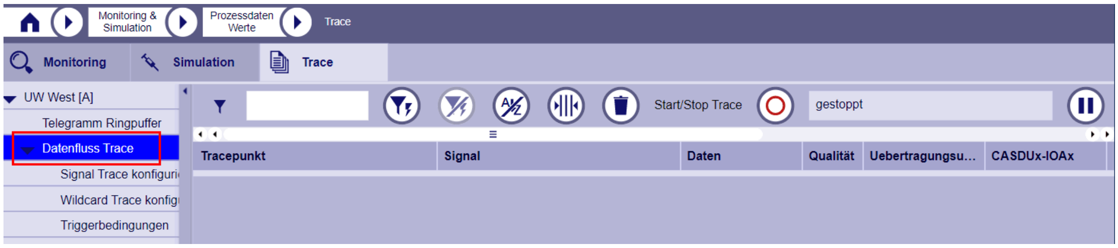
[sc_sweb_mon_sim_procdat_config_signal_trace_01, 1, en_US]

NOTE

The selective signal tracing (signal trace configuration) and the wildcard trace configuration are 2 parallel ways to add data to the data stream trace.
If the user assigns a signal to the signal trace (e.g. Switch 04) which is placed on an input of the I/O#01 firmware and a wildcard test point is also defined for I/O#01, then the message is entered 2x into the trace

The following steps are necessary:

- Click the node**Data stream trace**. This does not yet show any entries because the tracing has not yet started.



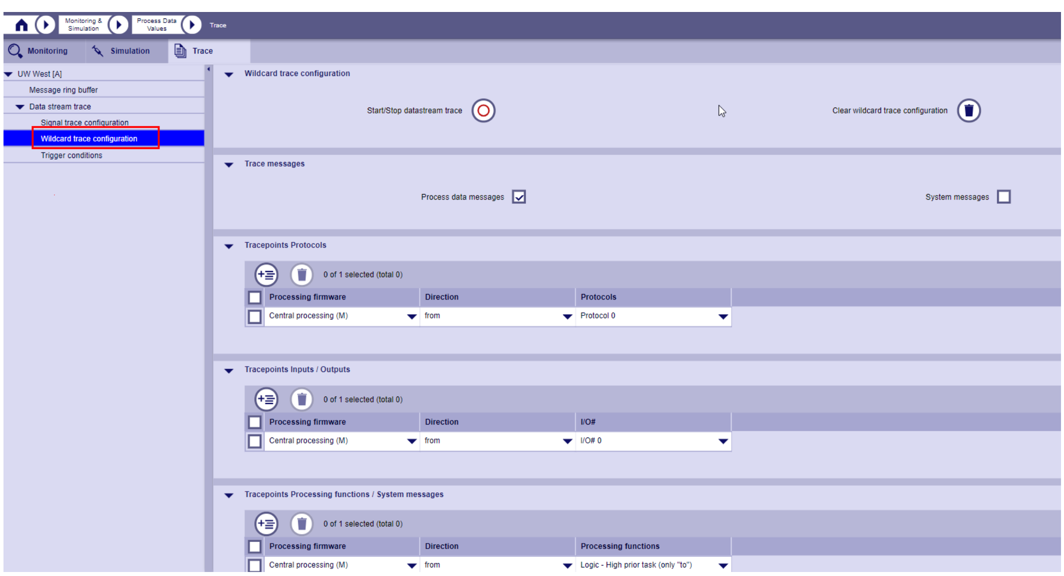
[sc_sweb_mon_sim_procdat_trace_datastream_01, 1, en_US]

- Click on the button**Start/Stop Trace**to start tracing.
  In the field to the right of the Start/Stop now the text**started**appears and if the system values of the signals configured for tracing change, these signals are listed.

Wildcard trace configuration

In addition to those explicitly in the node**Signal trace configuration**listed signals, the user can define several wildcards for the data stream trace.
Logging points and message filters are analogous to the SICAM TOOLBOX II data stream test
For example, if you only want to track signals from certain inputs/outputs of a central processing (M).
The following steps are necessary:

- Stop the data stream trace (otherwise the wildcard trace cannot be configured)
- Click in the**Trace**tab in the directory tree on**Wildcard trace configuration**.



[Bild13_Wildcard_testpunkte, 1, en_US]

- Click at**Tracepoints Inputs / Outputs**to**Add simultaneous-logging points**.
  Make the required configuration.

- Select the node**Data stream trace**and start tracing by a click on the**Start/Stop Trace**button.

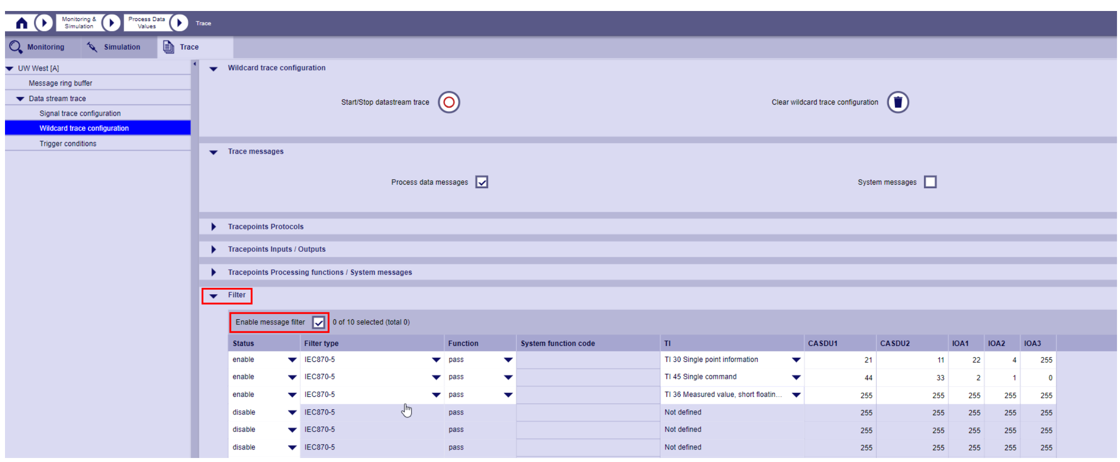
[Bild15_Trace_Datenfluss_Read, 1, en_US]

Now only system value changes from the previously configured input / output signals are traced.

You have the option to activate a message filter. Only those messages are then tracked that meet the defined filter criteria.

The following steps are necessary:

- Click at**Filter**to**Enable message filter**.

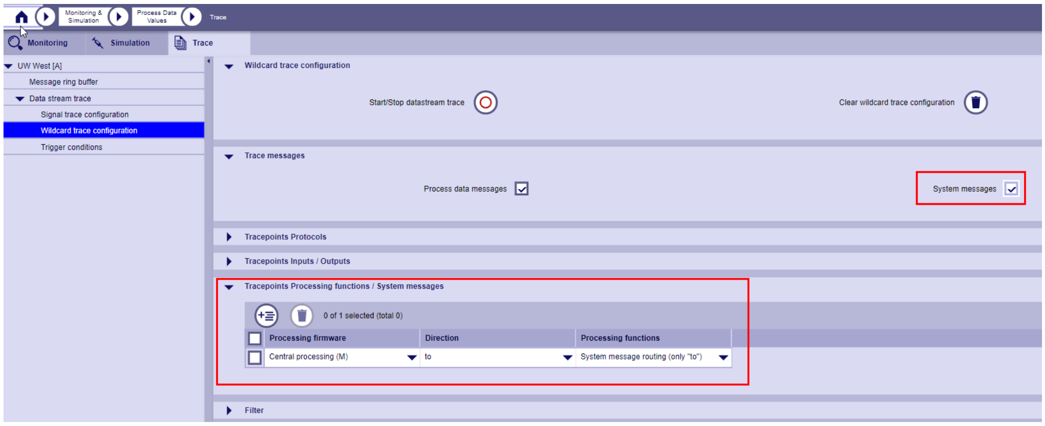


[Bild16_Trace_datenfluss_Filter, 1, en_US]

- Enter the desired filter conditions.
  The value**transfer**in column**Functions**means, that only messages are inserted that meet these conditions. If you select the value**suppress**, only messages are inserted that do NOT meet these conditions.

Tracing of system messages

Using the wildcard trace, it is also possible to record internal system messages in the device. To do this, in the wildcard trace the check box**System messages**and a test point for the system message router on the corresponding processing firmware must be enabled.



[Bild21_Trace_datenfluss_Systemtelegramme, 1, en_US]

Trigger conditions

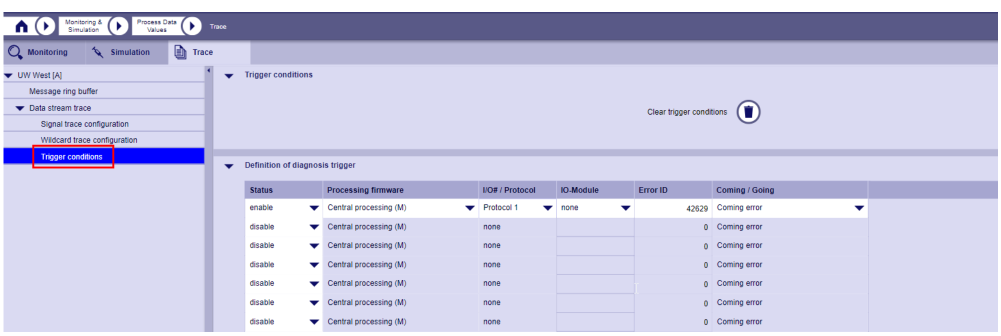
The user can define 1 to 10 trigger conditions. If one of these conditions is met, the entry in the data stream trace is automatically stopped.

Example:

A communication error in protocol 1 occurs sporadically in a system. To find this error, the user can define a trigger condition that stops recording in the data stream trace. Later, the user can view the events in the data stream trace that were recorded just before the error occurred and that may have led to this error.

The following steps are necessary:

- Click in the**Trace**tab in the directory tree on**Trigger conditions**.



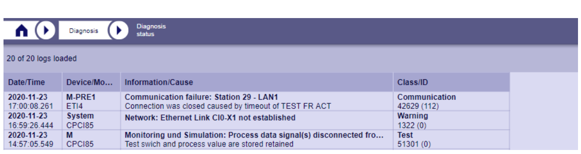
[Bild17_Trace_datenfluss_Trigger, 1, en_US]

- Make the settings you want

Example: Communication error for protocol 01 (IEC 60870-5-104, ETI4) for Station 29

A trigger for the central processing, protocol 01, with the error ID 42629 must be defined and released.

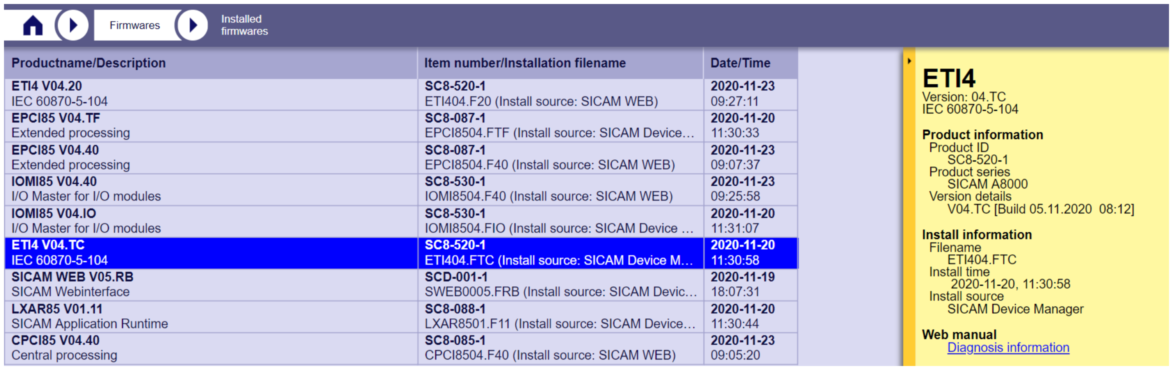
The error ID can be found in either the diagnosis:



[Bild18_Diagnose_ErrorID, 1, en_US]

or

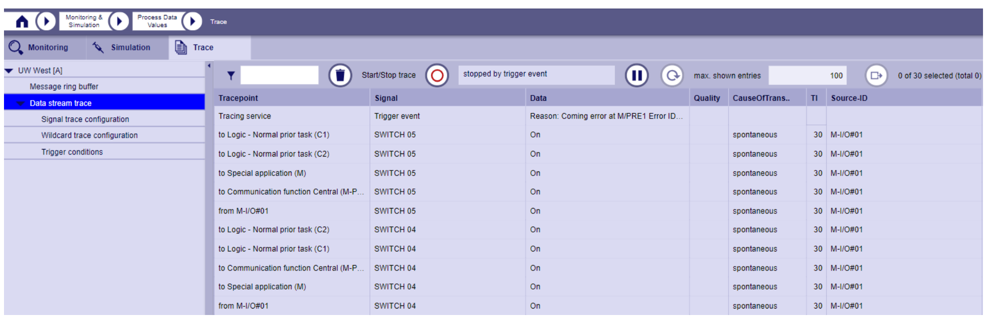
the diagnostic information in SICAM WEB under**Firmware | Installed firmwares**for the corresponding firmware:



[Bild19_Installed_firmwares_ErrorID, 1, en_US]

or also the diagnostic information in the firmware overview of the SICAM Device Manager.

If the entry in the trace is stopped due to a trigger event, the trigger event that has occurred is entered in the trace as the most recent line.



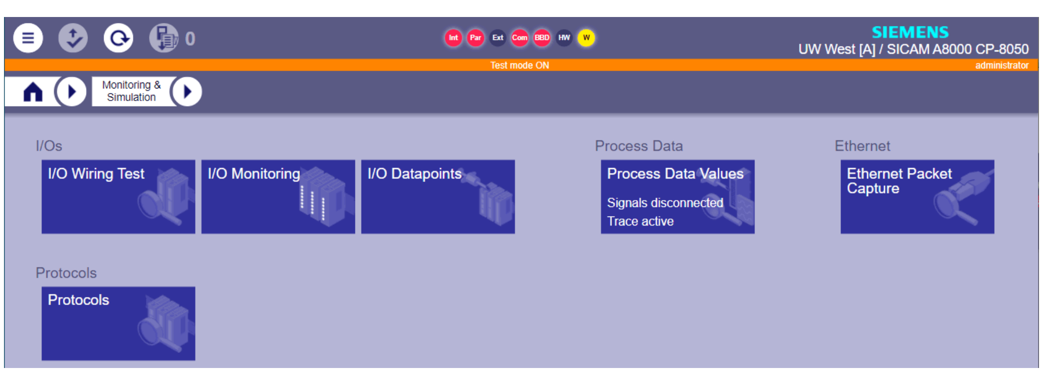
[Bild20_Trace_datenfluss_Trace_with_Trigger, 1, en_US]

10.7.5 Ethernet Packet Capture

Used for logging/tracing of TCP/IP packets which enter or leave the device via the various LAN connections. This offers the advantage that no additional ports have to be released in the system or no additional devices have to be installed in the system. The function logs before encryption or after decryption.

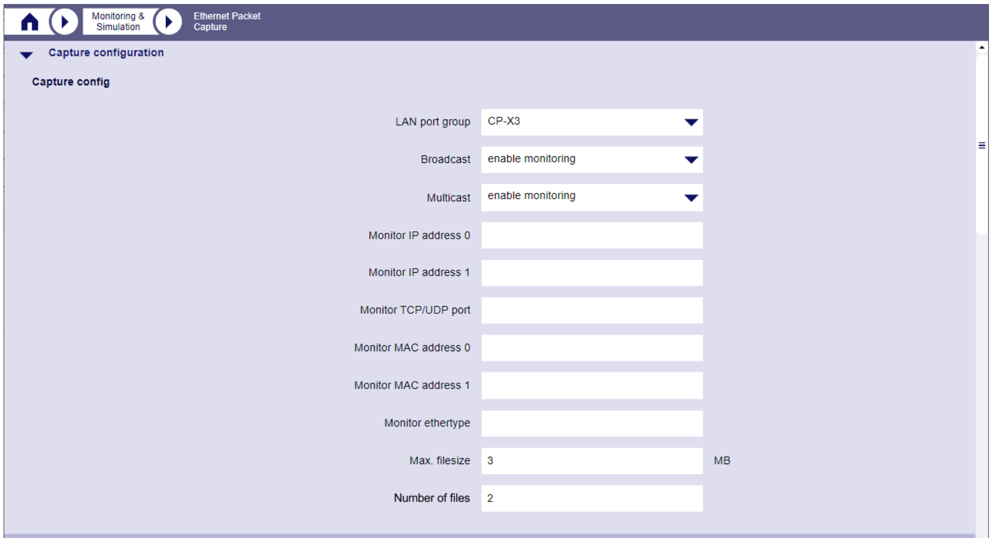
Start Ethernet Packet Capture

- Click on the SICAM WEB dashboard in the **RTUs** group on the **Monitoring & Simulation** tile.
- Click in the **Monitoring & Simulation** dashboard in the **Ethernet** group on the **Ethernet Packet Capture** tile.



[sc_WEB_Monitoring_Simulation, 3, en_US]

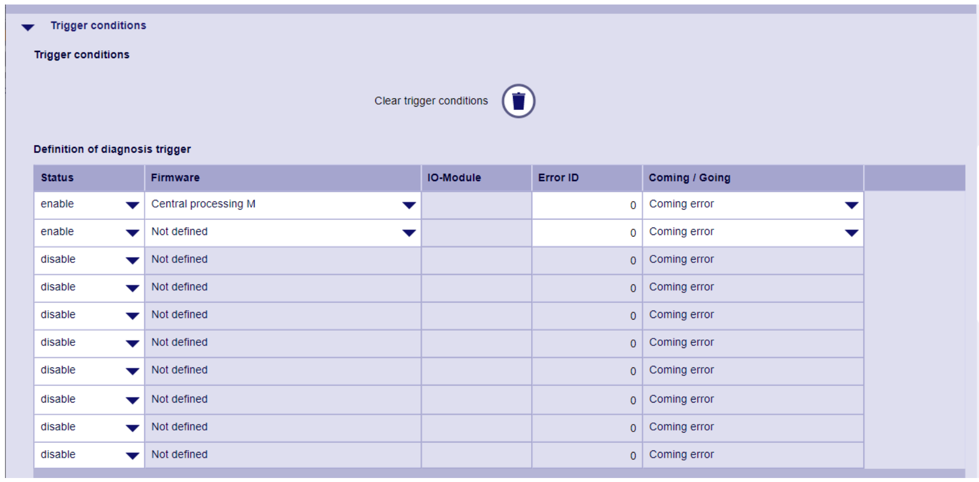
- In the **Capture configuration** section, make the desired selections.



[sc_sweb_mon_sim_eth_pack_01, 1, en_US]

- In the **Trigger Conditions** section, you have the option of defining up to 10 diagnosis triggers and 10 process data triggers via an IEC 104 address.
  The trigger conditions are saved in a non-volatile memory and are automatically reactivated after the start of the recording process.
  With the **Follow-up time** attribute, the tracing of the TCP/IP packets can remain active after the trigger condition has occurred. After the follow-up time has elapsed, tracing is stopped automatically.

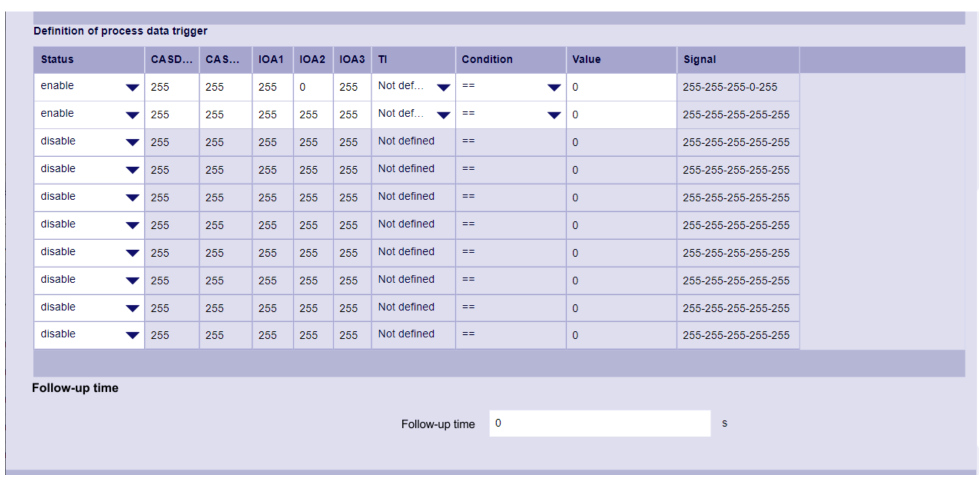
  – **Definition of diagnosis trigger**



Status	Firmware	IO-Module	Error ID	Coming / Going
enable	Central processing M		0	Coming error
enable	Not defined		0	Coming error
disable	Not defined		0	Coming error
disable	Not defined		0	Coming error
disable	Not defined		0	Coming error
disable	Not defined		0	Coming error
disable	Not defined		0	Coming error
disable	Not defined		0	Coming error
disable	Not defined		0	Coming error
disable	Not defined		0	Coming error

[sc_sweb_mon_sim_eth_pack_02, 1, en_US]

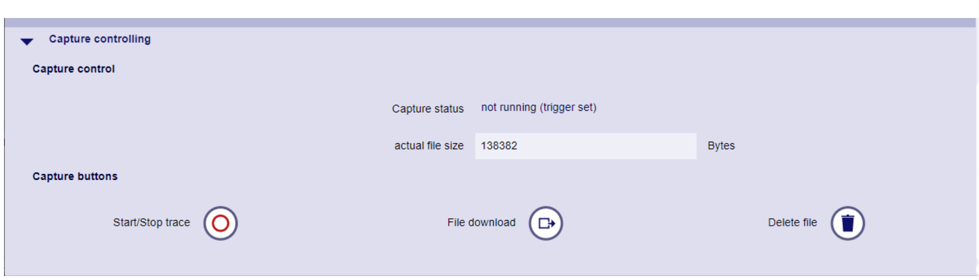
  – **Definition of process data trigger**



Status	CASD...	CAS...	IOA1	IOA2	IOA3	TI	Condition	Value	Signal
enable	255	255	255	0	255	Not def...	==	0	255-255-255-0-255
enable	255	255	255	255	255	Not def...	==	0	255-255-255-255-255
disable	255	255	255	255	255	Not defined	==	0	255-255-255-255-255
disable	255	255	255	255	255	Not defined	==	0	255-255-255-255-255
disable	255	255	255	255	255	Not defined	==	0	255-255-255-255-255
disable	255	255	255	255	255	Not defined	==	0	255-255-255-255-255
disable	255	255	255	255	255	Not defined	==	0	255-255-255-255-255
disable	255	255	255	255	255	Not defined	==	0	255-255-255-255-255
disable	255	255	255	255	255	Not defined	==	0	255-255-255-255-255
disable	255	255	255	255	255	Not defined	==	0	255-255-255-255-255

[sc_sweb_mon_sim_eth_pack_03, 1, en_US]

- Start recording in the **Capture controlling** section.

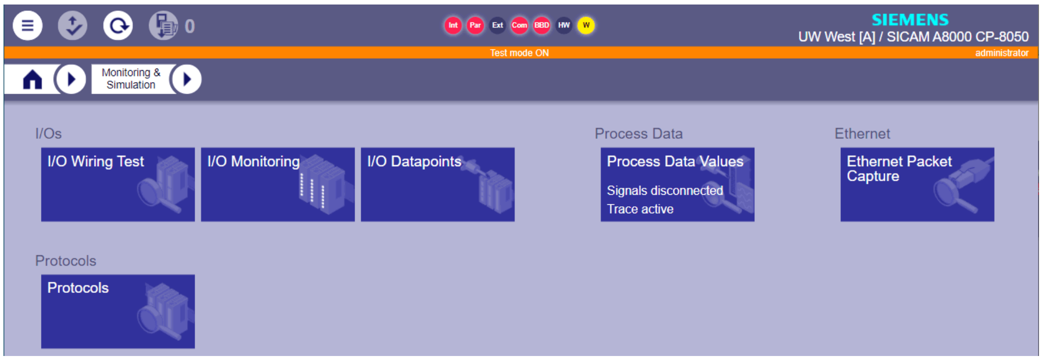


[sc_sweb_mon_sim_eth_pack_04, 1, en_US]

10.7.6 Protocols

Used to call up protocol-specific websites.

- Click on the SICAM WEB dashboard in the **RTUs** group on the **Monitoring & Simulation** tile.
- Click in the **Monitoring & Simulation** dashboard in the **Protocol** group on the **Protocol** tile.



[sc_WEB_Monitoring_Simulation, 3, en_US]

Details you can find in the chapter *13.1.4.12 Web server for protocol-specific web pages*

10.8 Redundancy

The current status of the components of a redundancy configuration can be displayed using the redundancy tiles.

You can access it on the SICAM WEB Dashboard in the **RTUs** group with tile **Redundancy**.

The **Redundancy** Dashboard contains the **Redundancy state** and **Redundancy voter** tiles to call up the relevant information.

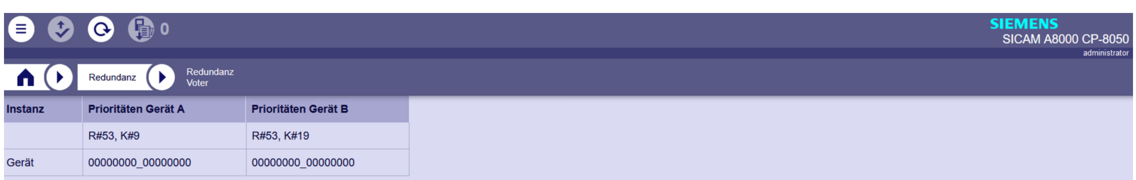
[sc_WEB_Redundanz, 2, en_US]

If device redundancy is used, the status (active/passive) is displayed on the **Redundancy States** and **Redundancy** tiles.

Redundancy state

[sc_WEB_Redundancy_State, 1, en_US]

Redundancy voter



[sc_WEB_Redundancy_Voter, 1, en_US]

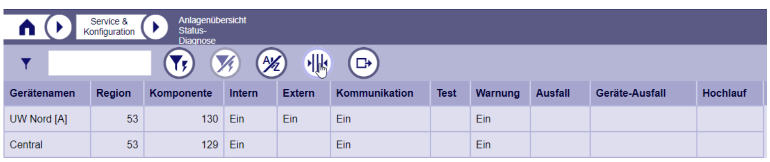
10.9 Services & Configuration

[sc_SWEB_Serv_Config_01, 1, en_US]

10.9.1 Plant Overview Diagnosis State

All devices defined in the topology that currently have diagnostic information listed in the device are listed in the **Plant overview diagnosis state** table.

Only sum information of the corresponding diagnosis classes are entered.



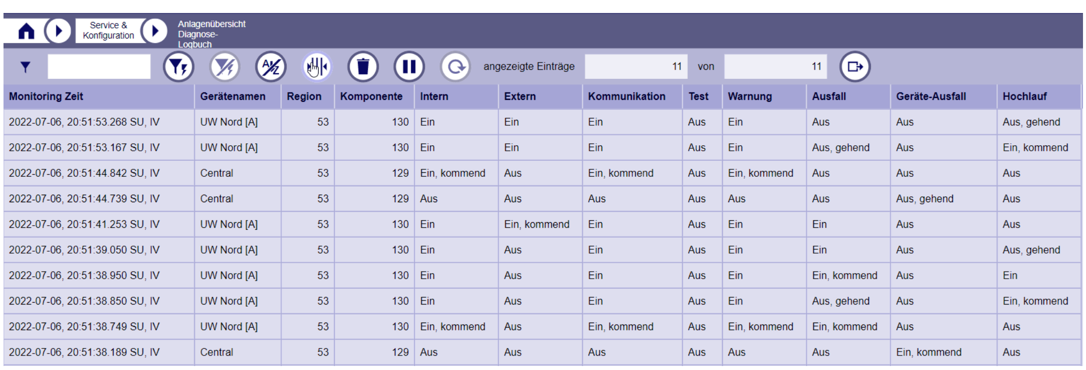
Gerätenamen	Region	Komponente	Intern	Extern	Kommunikation	Test	Warnung	Ausfall	Geräte-Ausfall	Hochlauf
UW Nord [A]	53	130	Ein	Ein	Ein		Ein			
Central	53	129	Ein		Ein		Ein			

[sc_sweb_serv_config_anlage_status_diagnose_01, 1, en_US]

10.9.2 Plant Overview Diagnosis Logbook

All changes of the sum diagnosis information are listed in chronological order in the **Plant overview diagnosis logbook** table since the device was reset.

All devices that are defined in the topology of your own device are entered.



Monitoring Zeit	Gerätenamen	Region	Komponente	Intern	Extern	Kommunikation	Test	Warnung	Ausfall	Geräte-Ausfall	Hochlauf
2022-07-06, 20:51:53.268 SU, IV	UW Nord [A]	53	130	Ein	Ein	Ein	Aus	Ein	Aus	Aus	Aus, gehend
2022-07-06, 20:51:53.167 SU, IV	UW Nord [A]	53	130	Ein	Ein	Ein	Aus	Ein	Aus, gehend	Aus	Ein, kommend
2022-07-06, 20:51:44.842 SU, IV	Central	53	129	Ein, kommend	Aus	Ein, kommend	Aus	Ein, kommend	Aus	Aus	Aus
2022-07-06, 20:51:44.739 SU, IV	Central	53	129	Aus	Aus	Aus	Aus	Aus	Aus	Aus, gehend	Aus
2022-07-06, 20:51:41.253 SU, IV	UW Nord [A]	53	130	Ein	Ein, kommend	Ein	Aus	Ein	Ein	Aus	Aus
2022-07-06, 20:51:39.050 SU, IV	UW Nord [A]	53	130	Ein	Aus	Ein	Aus	Ein	Ein	Aus	Aus, gehend
2022-07-06, 20:51:38.950 SU, IV	UW Nord [A]	53	130	Ein	Aus	Ein	Aus	Ein	Ein, kommend	Aus	Ein
2022-07-06, 20:51:38.850 SU, IV	UW Nord [A]	53	130	Ein	Aus	Ein	Aus	Ein	Aus, gehend	Aus	Ein, kommend
2022-07-06, 20:51:38.749 SU, IV	UW Nord [A]	53	130	Ein, kommend	Aus	Ein, kommend	Aus	Ein, kommend	Ein, kommend	Aus	Aus
2022-07-06, 20:51:38.189 SU, IV	Central	53	129	Aus	Aus	Aus	Aus	Aus	Aus	Ein, kommend	Aus

[sc_sweb_serv_config_anlage_diagnose_logbuch_01, 1, en_US]

The plant sum diagnosis information contains the summary diagnosis information of all diagnosis classes at the time of a change in a diagnosis class. If, for example, an error has been pending in the **Internal** diagnostics class for a long time and an error occurs for the first time in the **Communication** class, this can be recorded and filtered in the table.

Therefore, the following states are entered:

- **On**

  Diagnostic class was already **On** when the summary information was last entered.

- **On, coming**
  The diagnostic class is set for the first time in this summary entry
- **On, going**
  The class is **Off** for the first time in this entry, but was still **On** in the last entry
- **Off**
  The class was already **Off** or **Off, going** at the last entry

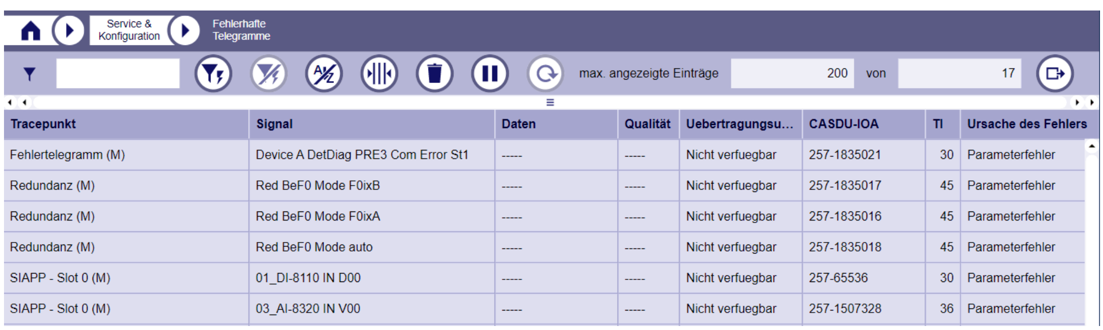
The table has a depth of 1000 entries in the device, but only the last 100 are read cyclically. If more are to be read, the **Pause** button can be pressed and then more entries can be requested via the field **max shown entries**. As soon as the pause mode is exited, only 100 entries are read again.

10.9.3 Faulty Message Trace

The faulty messages in the device are listed in this table.
Possible causes:

- Parameter error in processing firmware
- Packing/unpacking error in a protocol firmware

The **Tracepoint** column shows the location of the faulty message, the **Cause of fault** column shows the reason.
The trace can be exported to a CVS file and also deleted.



Tracepunkt	Signal	Daten	Qualität	Uebertragungsu...	CASDU-IOA	TI	Ursache des Fehlers
Fehlertelegramm (M)	Device A DetDiag PRE3 Com Error St1	-----	-----	Nicht verfuegbar	257-1835021	30	Parameterfehler
Redundanz (M)	Red BeF0 Mode F0ixB	-----	-----	Nicht verfuegbar	257-1835017	45	Parameterfehler
Redundanz (M)	Red BeF0 Mode F0ixA	-----	-----	Nicht verfuegbar	257-1835016	45	Parameterfehler
Redundanz (M)	Red BeF0 Mode auto	-----	-----	Nicht verfuegbar	257-1835018	45	Parameterfehler
SIAPP - Slot 0 (M)	01_DI-8110 IN D00	-----	-----	Nicht verfuegbar	257-65536	30	Parameterfehler
SIAPP - Slot 0 (M)	03_AI-8320 IN V00	-----	-----	Nicht verfuegbar	257-1507328	36	Parameterfehler

[sc_SWEB_Serv_Config_Faulty_Message_01, 1, en_US]

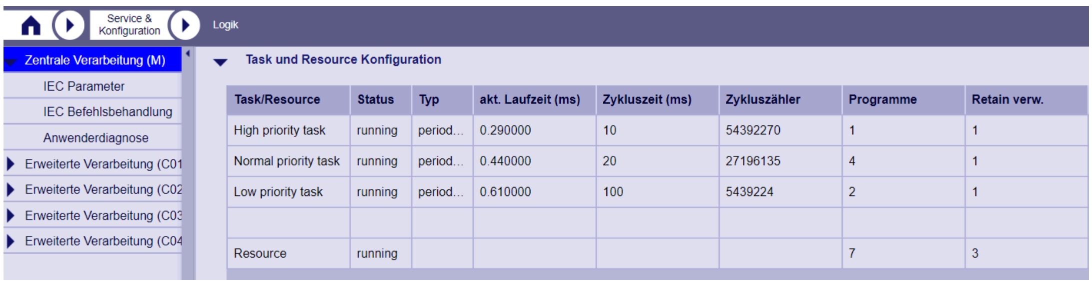
10.9.4 Logic

The logic function is available as an independent function on both the central processing function and the extended processing function.

On each main node there are the respective sub nodes with the corresponding functions:

- **Central processing (M) / Extended processing (C1-4)**
  - **IEC parameters**
  - **IEC command handling**
  - **User Diagnosis**

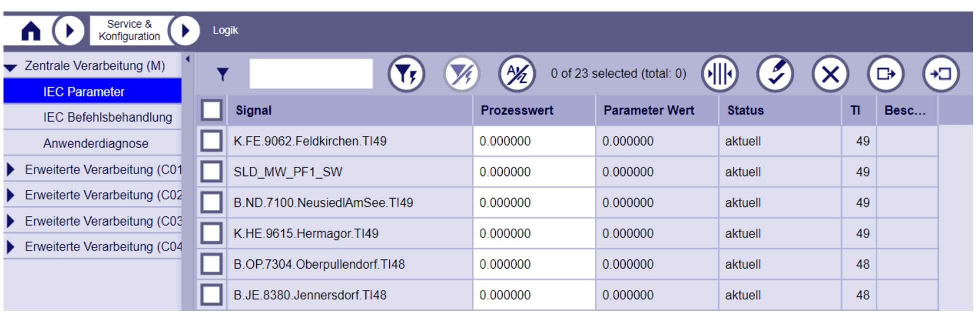
    The current task and resource configuration of the user program is displayed on the processing firmware node.



[sc_sweb_serv_config_conf_logic_zentr_verarb_01, 1, en_US]

IEC parameters

In the **IEC Parameters** node all signals are shown which have been assigned to the function**Logic IEC - Parameters**.



[sc_sweb_serv_config_conf_logic_iec_para_01, 1, en_US]

If the assigned parameter attributes are incorrect (e.g. TI not supported,**IEC_parameter_init_value**is outside the range), the signal is not accepted for the function, a diagnostic error is displayed and the signal is written to the **Faulty Message** trace. In this case, the corresponding signal is not displayed in the table.

The Logic IEC Parameters table supports the following symbols and columns:

Button	Meaning
	**Save** Button With the save button, all changed process values are saved/accepted in the engineering data set in the device. With this action, the changed process values are also saved on the SD card. The multi-select menu does not affect this button. Attention: Before pressing the save button, the parameter set between the device and SICAM Device Manager should be up to date. This button is also enabled without a **SICAM A8000 Extended SICAM WEB** license.
	Process value column This value is the value activated in the device. If this value is changed in the device, it is saved in the device and restored after a reset or power-up.

Button	Meaning
	Parameter value column This value is the actual parameter value in the device and on the SD card (if enabled). If one of these values in the device was changed with the save button, the engineering data set must be downloaded from the device to the SICAM Device Manager.
	Column **Status** This column shows the status of the process value compared to the parameter value. • changed, process value <> parameter value • up-to-date, process value = parameter value

Additional features with license: SICAM A8000 Extended SICAM WEB

By activating this license in the device, the signals can also be changed, changes can be discarded or the complete signal list can be exported as a CSV file, changed in Excel and then imported again. In this way, the user can manage several signal lists in CSV files in order to test and optimize the control function.

The Logic IEC Parameters table supports the following symbols and columns:

Button	Meaning
	Process value column This column allows the user to change the process value in the target system. The range of values depends on the type identifier of the signal. (See initial value) If the new value is out of range, an error message is displayed and the new value is not activated.
	**Restore** button The process values changed in the table are reset with the Restore button. Before pressing the Restore button, the changed rows must be selected with the multi-select bar. For these lines, the parameter value is reactivated in the target system.
	**Export** button With the Export button, all process values and the IEC addresses are exported to a CSV file. The process values can be changed in the CSV file and the file can be imported again.

	A	B	C	D	E	F	G	H
1	Fix::Signalname	Fix::PROCESS_VALUE	Fix::TI	Fix::CASDU1	Fix::CASDU2	Fix::IOA1	Fix::IOA2	Fix::IOA3
2	B.E.7000.Eisenstadt.TI48	0.500000	48	101	1	25	5	0
3	K.FE.9062.Feldkirchen.TI49	60.000000	49	102	8	26	5	0
4	B.MA.7210.Mattersburg.TI49	456.000000	49	101	4	26	5	0
5	B.OW.7400.Oberwart.TI50	600.000000	50	101	7	27	5	0
6	KW_Freudenau.turbine1.control.KP.TI48	0.219971	48	103	23	25	5	0
7	B.OW.7400.Oberwart.TI48	0.000000	48	101	7	25	5	0
8	B.OW.7400.Oberwart.TI49	0.000000	49	101	7	26	5	0

Button	Meaning
	**Import** button The process values can be changed by importing a CSV file. This feature allows the user to have different parameter settings in different files.

IEC command handling

With the instruction block**IECCMD_SET_CTRLLOC**the valid source addresses for the logic IEC command handling can be set from the user program. Four source addresses can be set simultaneously with one instruction block. This building block can be used multiple times.

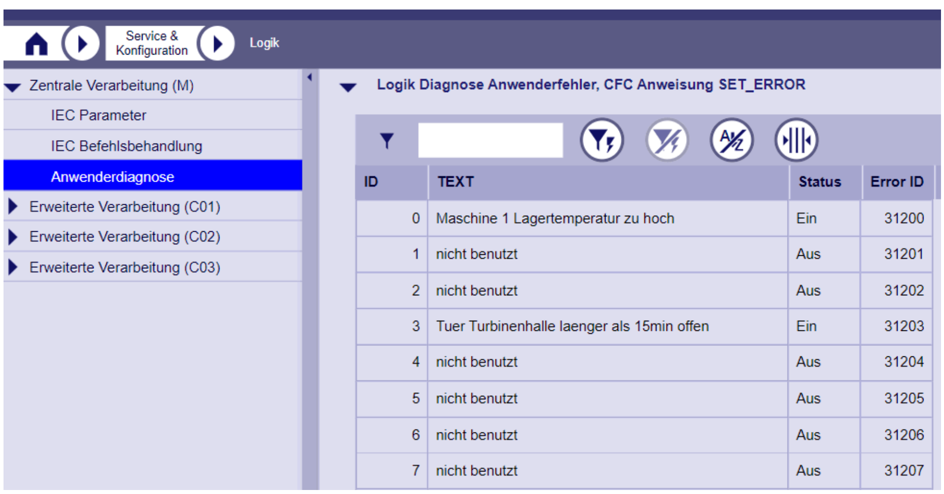
The table shows the source addresses that are validly set in the logic of the processing function. If the source address is not activated, the command is confirmed negatively.

[sc_sweb_serv_config_conf_logic_iec_befehl_01, 1, en_US]

User Diagnosis

On the sub node**User Diagnosis**an overview of the used logic diagnostic instructions**SET_ERROR**and**SET_WARNING**is shown. This makes sense for the customer, since the CFC editor cannot provide an overview of which IDs are used and which are free.

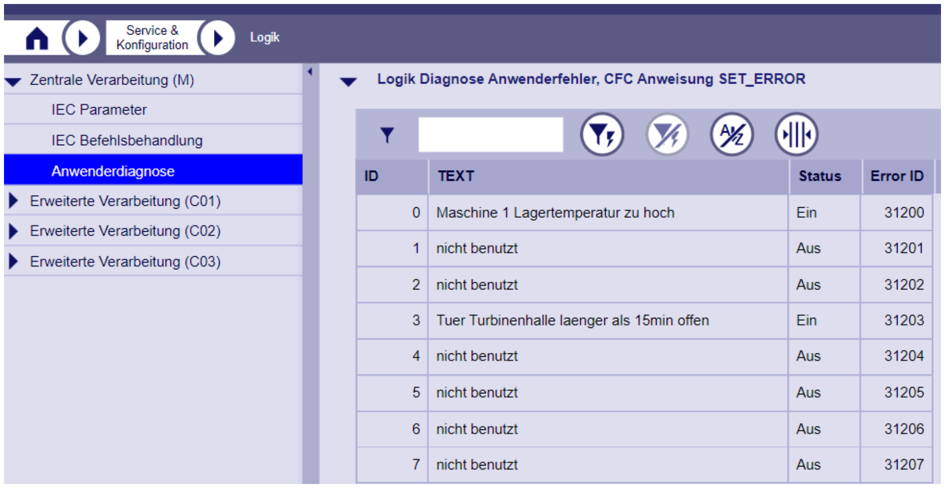
Also, the customer does not have the system diagnostics error ID for the error detail routing function because a system offset is added to the module's ID.



[Logic_Userdiagnosis_Error_GER, 1, en_US]

The following table gives an overview of the used**SET_ERROR**and**SET_WARNING**instructions with following columns:

- **ID**
  This is the ID that is the input value of the CFC module (range 0-31).
- **TEXT**
  User text that can be set in the CFC for the building block input text, 128 characters possible.
- **Status**
  Status of the diagnostic informations, On or Off
- **Error-ID**
  This is the error ID set in the target system
- Offset for SET_ERROR
  31200
- Offset for SET_WARNING
  61200

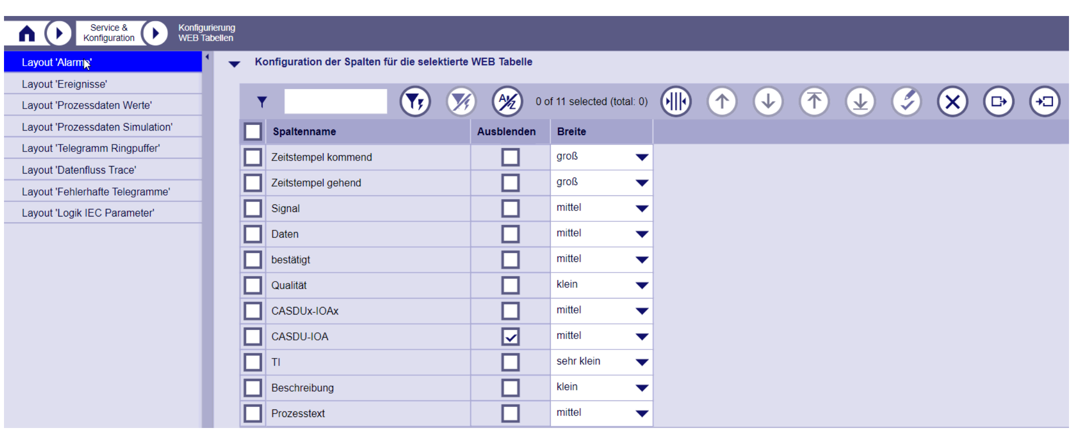


[Logic_Userdiagnosis_Error_GER, 1, en_US]

[Logic_Userdiagnosis_Warning_GER, 1, en_US]

10.9.5 Configure WEB tables

On this page you have the option of adapting the display of various WEB tables to your needs. You can determine in which order, which columns, in which column width, are displayed.



[Config_WEB_Table_GER, 1, en_US]

The columns can be configured for the following WEB tables:

- Alarms
- Events

- Process Data Values
- Process data Simulation
- Message ring buffer
- Data stream trace
- Faulty Message Trace
- Logic IEC Parameters

The table for configuring columns for WEB tables supports the following symbols and columns:

Button	Meaning
	Column **Hide** Here you can define which column (which parameter) should be displayed in the table. If you click the check box, the respective column will be hidden.
	Column **Width** Here you can define how wide a column is displayed in the table. The following levels are available: • very small = 1 character • small = 4 characters • medium = 14 characters • large = 32 characters • very large = 48 characters
	**Optimize Column Widths** With this button, the column widths of the displayed table are adapted to the content.
	**Move selected row(s) up 1 row** All selected rows are moved up one row in the table. The top row is then displayed in the table in the first (left) column of the WEB table.
	**Move selected row(s) down 1 line** All selected rows are moved down one row in the table.
	**Move selected row(s) to the top** All selected rows are moved to the top of the table.
	**Move selected row(s) all the way down** All selected rows are moved to the bottom of the table.
	**Save** With the Save button, all layout changes of the WEB table are saved in the device in a non-volatile manner. If an SD card is configured, the configuration is also stored on the SD card and taken over again when a module is exchanged. The configuration is lost during initialization and factory reset.
	**Restore default configuration** With this button all layout changes of the WEB table are discarded and set to standard.
	**Export** The export button exports the table configuration to a CSV file.
	**Import** button (extended SICAM WEB license required) You can use the import button to import exported table configurations back into the device. For example also in other devices after a factory reset.

10.9.6 Import Dashboard Grafic (TOOLBOX)

If the tiles are configured with the SICAM TOOLBOX II, the graphics (SVG files) must be loaded into SICAM WEB afterwards.

10.9.7 Import Signal Names

[sc_SWEB_Serv_Config_Import_Sign_01, 1, en_US]

Import signal names from other devices (CSV file)

This button can be used to import signal names that were previously exported from other devices. This export can be done with the SICAM Device Manager (HOME | Signals | Export ...) or with the SICAM TOOLBOX II (command line tool "signals2csv.exe"; option: `-sicdm`; see online help for more details).

This import function requires the license**Extended SICAM WEB**. For details see *14.6 SICAM 8 Extended SICAM WEB*

Delete imported signal names

If this button is pressed, all signal names that have been read in are deleted from the device.

Stored signal names

The number of signal names read in is displayed.

10.10 Serial Numbers

With the **Serial numbers** tile, all hardware modules belonging to a SICAM A8000 system can be displayed. You will find access to the serial numbers after registering with CP-8031/CP-8050 on the SICAM WEB main page in the **Hardware** area in the tile named **Serial Numbers**.

[sc_SICAM_WEB_dashboard, 5, en_US]

ID	Name	Klasse	Bestellnummer	Seriennummer	Version	Status
I/O Zeile 01 I/O Modul 05	DI-8110	Erweiterung	6MF28110AA00	GC8-110--.88/GF1601507831	--	Error
I/O Zeile 01 I/O Modul 06	DI-8110	Erweiterung	6MF28110AA00	GC8-110--.88/GF1601507864	--	Error
I/O Zeile 01 I/O Modul 07	DI-8110	Erweiterung	6MF28110AA00	GC8-110--.00/GF1507502350	--	Error
I/O Zeile 01 I/O Modul 12	CM-8830	Erweiterung	6MF28830AA00	GC8-830--.00/GF1912501133	--	OK
I/O Zeile 02 I/O Modul 00	AO-8380	Erweiterung	6MF28380AA00	GC8-380--.88/GF1904020467	--	OK
I/O Zeile 02 I/O Modul 01	AI-8320	Erweiterung	6MF28320AA00	GC8-320--.88/GF1702510468	--	OK
I/O Zeile 02 I/O Modul 02	DI-8110	Erweiterung	6MF28110AA00	GC8-110--.00/GF1904020809	--	Error
I/O Zeile 02 I/O Modul 03	DI-8110	Erweiterung	6MF28110AA00	GC8-110--.00/GF1904020920	--	Error
I/O Zeile 02 I/O Modul 04	DI-8110	Erweiterung	6MF28110AA00	GC8-110--.88/GF1903058288	--	Error
I/O Zeile 03 I/O Modul 00	AI-8340	Erweiterung	6MF28340AA00	GC8-340--.88/--12815378586	--	OK
I/O Zeile 03 I/O Modul 01	AI-8330	Erweiterung	6MF28330AA00	GC8-330--.88/BF1910004911	--	OK
I/O Zeile 03 I/O Modul 02	DO-8212	Erweiterung	6MF28212AA00	GC8-212-A.88/GF1701504857	-A	OK
I/O Zeile 03 I/O Modul 03	DI-8110	Erweiterung	6MF28110AA00	GC8-110--.88/GF1902041890	--	Error
I/O Zeile 03 I/O Modul 04	AI-8340	Erweiterung	6MF28340AA00	GC8-340--.88/BF1910004938	--	OK
I/O Zeile 03 I/O Modul 05	AI-8330	Erweiterung	6MF28330AA00	GC8-330--.88/BF1910004900	--	OK

[sc_SICAM_WEB_Hardware_Serial_Numbers, 1, en_US]

10.11 Applications

In order to have a better overview of the system status directly on the device, all firmware used including the status is shown in the **Applications** tile. It is also possible to restart applications individually, should a problem occur or for test purposes e.g., a failure/start-up can be simulated.

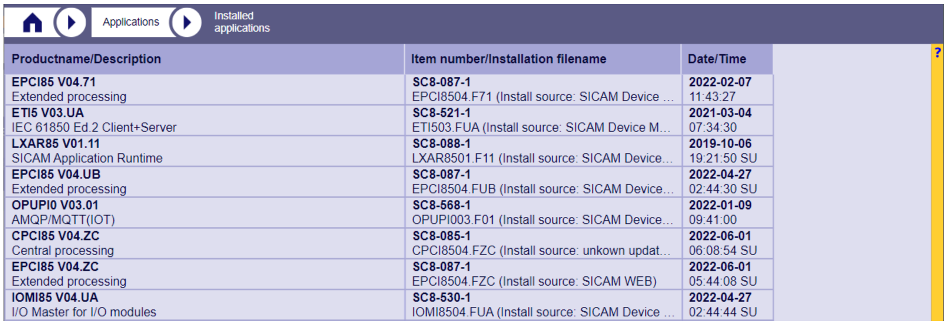
You can access it on the **SICAM WEB** Dashboard in the **Administration** group with the **Applications** tile.

[sc_SICAM_WEB_dashboard, 5, en_US]

[sc_sweb_applications_dashboard, 1, en_US]

On the **Applications** dashboard are tiles for:

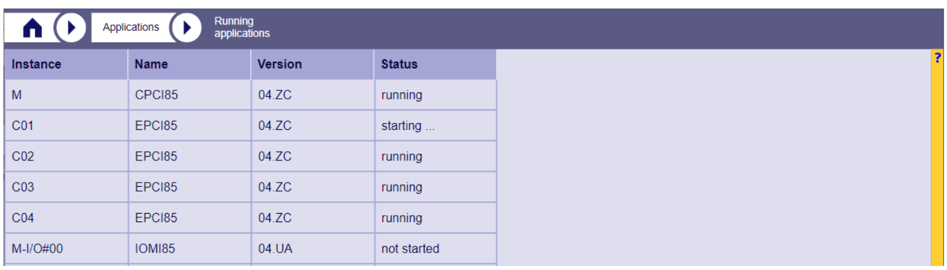
- **Installed applications**
  All Applications installed in the system are displayed.



Productname/Description	Item number/Installation filename	Date/Time
EPCI85 V04.71 Extended processing	**SC8-087-1** EPCI8504.F71 (Install source: SICAM Device ...	**2022-02-07** 11:43:27
ETI5 V03.UA IEC 61850 Ed.2 Client+Server	**SC8-521-1** ETI503.FUA (Install source: SICAM Device M...	**2021-03-04** 07:34:30
LXAR85 V01.11 SICAM Application Runtime	**SC8-088-1** LXAR8501.F11 (Install source: SICAM Device...	**2019-10-06** 19:21:50 SU
EPCI85 V04.UB Extended processing	**SC8-087-1** EPCI8504.FUB (Install source: SICAM Device...	**2022-04-27** 02:44:30 SU
OPUPI0 V03.01 AMQP/MQTT(IOT)	**SC8-568-1** OPUPI003.F01 (Install source: SICAM Device...	**2022-01-09** 09:41:00
CPCI85 V04.ZC Central processing	**SC8-085-1** CPCI8504.FZC (Install source: unkown updat...	**2022-06-01** 06:08:54 SU
EPCI85 V04.ZC Extended processing	**SC8-087-1** EPCI8504.FZC (Install source: SICAM WEB)	**2022-06-01** 05:44:08 SU
IOMI85 V04.UA I/O Master for I/O modules	**SC8-530-1** IOMI8504.FUA (Install source: SICAM Device ...	**2022-04-27** 02:44:44 SU

[sc_sweb_applications_installed, 1, en_US]

- **Running applications**
  All Applications in operation are displayed.



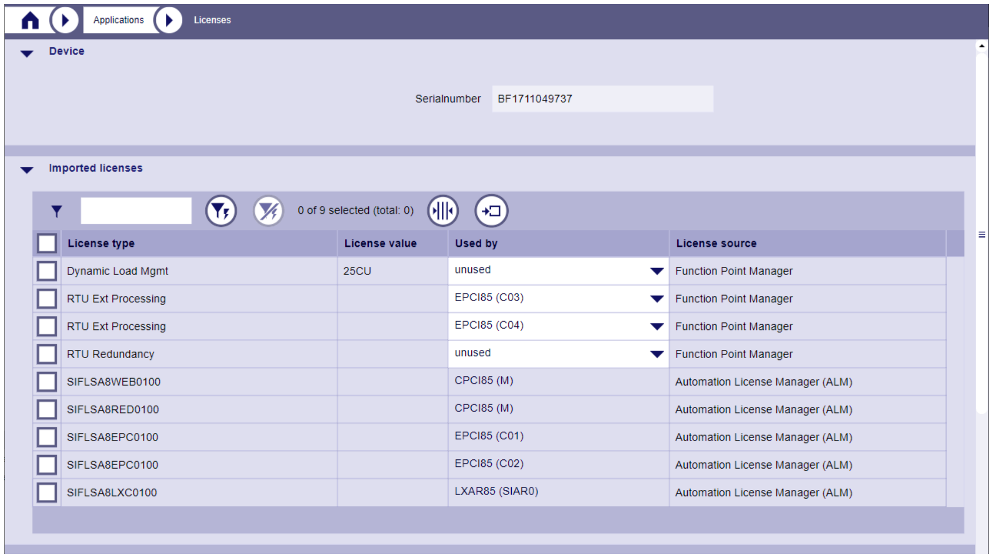
Instance	Name	Version	Status
M	CPCI85	04.ZC	running
C01	EPCI85	04.ZC	starting ...
C02	EPCI85	04.ZC	running
C03	EPCI85	04.ZC	running
C04	EPCI85	04.ZC	running
M-I/O#00	IOMI85	04.UA	not started

[sc_sweb_applications_running, 1, en_US]

- **Licenses**

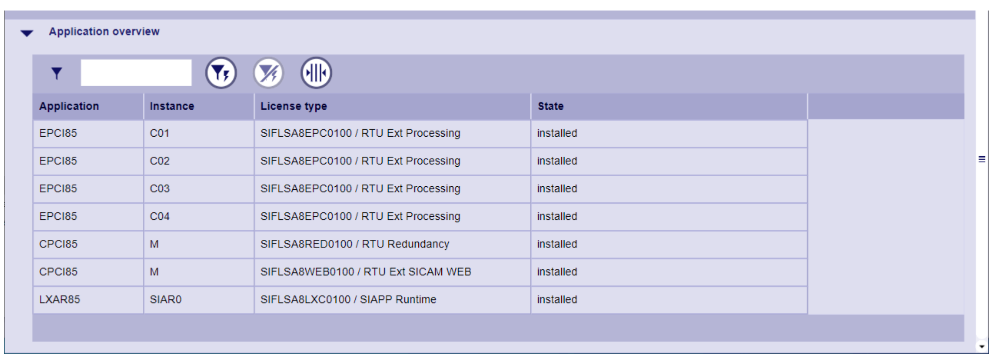
  All licenses imported into the device are displayed.

  The **License source** indicates the source of the license:



License type	License value	Used by	License source
Dynamic Load Mgmt	25CU	unused	Function Point Manager
RTU Ext Processing		EPCI85 (C03)	Function Point Manager
RTU Ext Processing		EPCI85 (C04)	Function Point Manager
RTU Redundancy		unused	Function Point Manager
SIFLSA8WEB0100		CPCI85 (M)	Automation License Manager (ALM)
SIFLSA8RED0100		CPCI85 (M)	Automation License Manager (ALM)
SIFLSA8EPC0100		EPCI85 (C01)	Automation License Manager (ALM)
SIFLSA8EPC0100		EPCI85 (C02)	Automation License Manager (ALM)
SIFLSA8LXC0100		LXAR85 (SIAR0)	Automation License Manager (ALM)

[sc_sweb_lic_01a, 1, en_US]



Application	Instance	License type	State
EPCI85	C01	SIFLSA8EPC0100 / RTU Ext Processing	installed
EPCI85	C02	SIFLSA8EPC0100 / RTU Ext Processing	installed
EPCI85	C03	SIFLSA8EPC0100 / RTU Ext Processing	installed
EPCI85	C04	SIFLSA8EPC0100 / RTU Ext Processing	installed
CPCI85	M	SIFLSA8RED0100 / RTU Redundancy	installed
CPCI85	M	SIFLSA8WEB0100 / RTU Ext SICAM WEB	installed
LXAR85	SIAR0	SIFLSA8LXC0100 / SIAPP Runtime	installed

[sc_sweb_lic_01b, 1, en_US]

Figure 10-15 Application overview

– Automation License Manager (ALM)

  The license was acquired via a license dongle or as an OSD download and assigned to the device via the Automation License Manager in the engineering tool (SICAM Device Manager or SICAM Toolbox). The license is loaded into the device via the parameter upload.

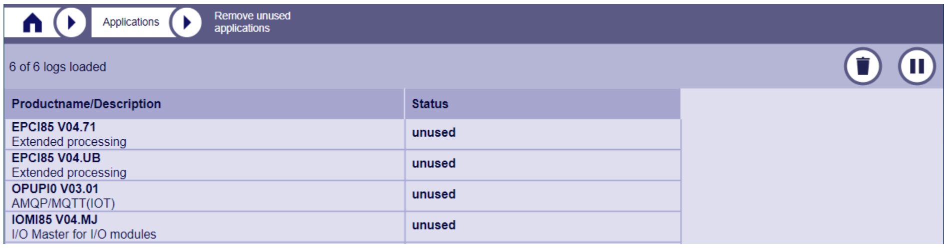
– Function Point Manager

  The license was acquired via the SICAM Function Point Manager for the corresponding device (via serial number and device type) and loaded into the device.

License files can be loaded into the device with the **Upload** button. Only license files that are assigned to the serial number of the device are accepted. When uploading, the licenses are assigned automatically as far as possible. The assignment can be edited via the **Used by** column.

- **Remove unused applications**

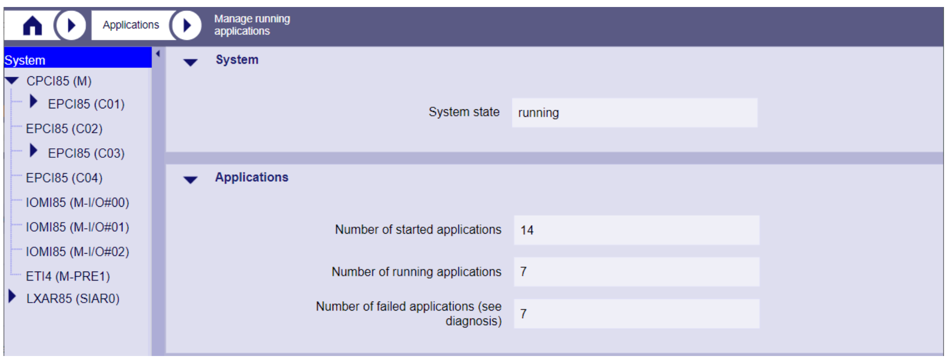
  All Applications that are not in operation are displayed. You can delete all with a single click.



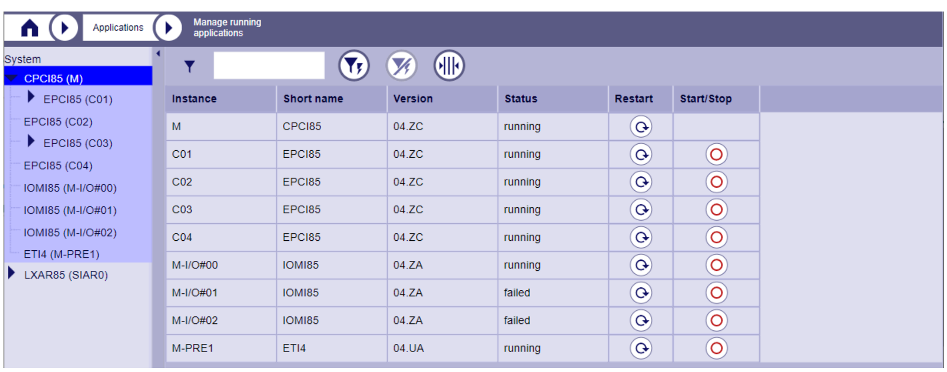
[sc_sweb_applications_remove_unused, 1, en_US]

- **Start/stop Applications**

  The Applications are displayed here in the directory tree. Depending on the selection, different information is displayed.



[sc_sweb_applications_manage_running, 1, en_US]



[sc_sweb_applications_manage_running_cpci85, 1, en_US]

Figure 10-16 Application overview

[sc_sweb_applications_manage_running_iomi85, 1, en_US]

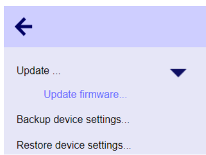
Figure 10-17 Dialog for starting/stopping/restarting a single Application

10.11.1 Update firmware

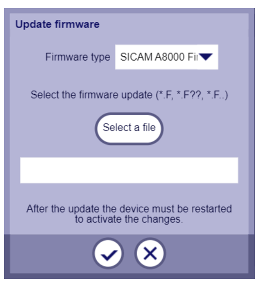
You can use this function to load the latest firmware into the target device.

- Click on the Menu button in the header and select **Update | Update firmware**.

[sc_menu_button, 1, --_--]



[sc_firmware_load_01, 1, en_US]



[sc_firmware_load_02, 1, en_US]

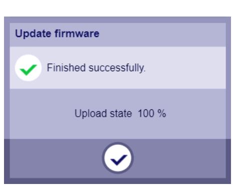
- Click on **Select file** to open the selection dialog
- Select the source file
- Click on the button 

The target device starts the import process. The duration of the import depends on the file size and the communication connection used.

NOTE

The menu must not be exited during the loading process. The selection of another website may lead to the occurrence of undefined states.

After a successful update, the following dialog appears:



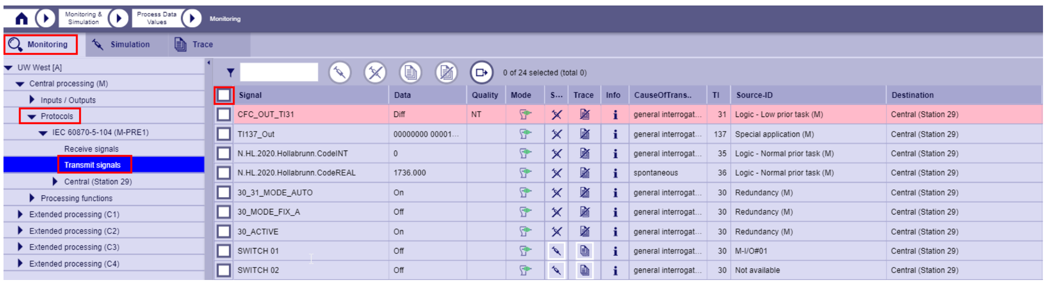
[sc_firmware_load_03, 1, en_US]

- Click on the button  , in order to close the dialog

10.12 Sample Applications

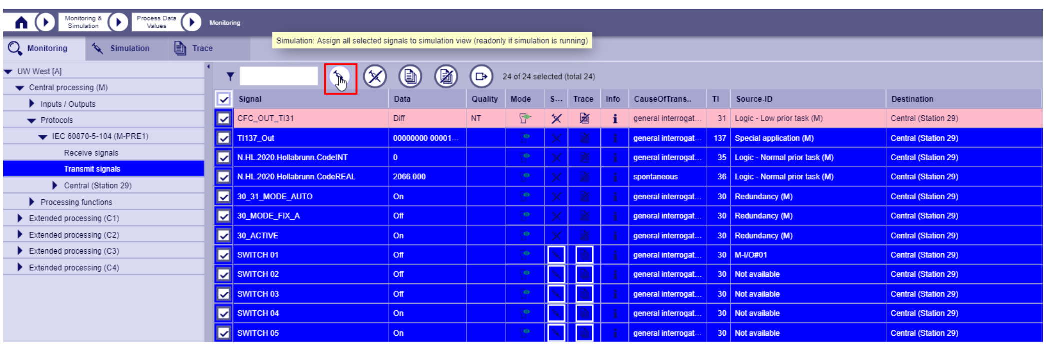
10.12.1 Data point test in the direction of another device / a control center

- In SICAM WEB, open the **Process Data Values** tile and select the **Monitoring** tab.
- Click the node **Output signals** in the directory tree and select all signals with the multiselect check box.



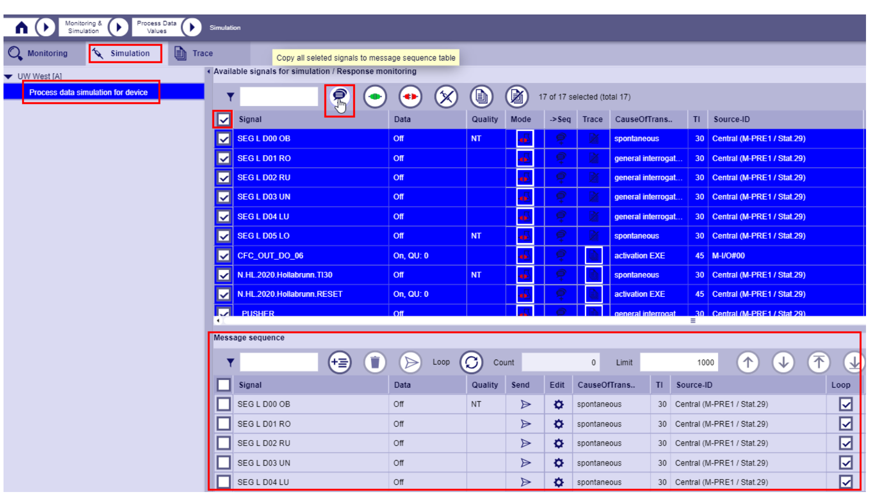
[sc_Use_Case_1_Bild4_Protokolle_Sendesignale_01, 1, en_US]

- Click the **Simulation** button in the action bar.



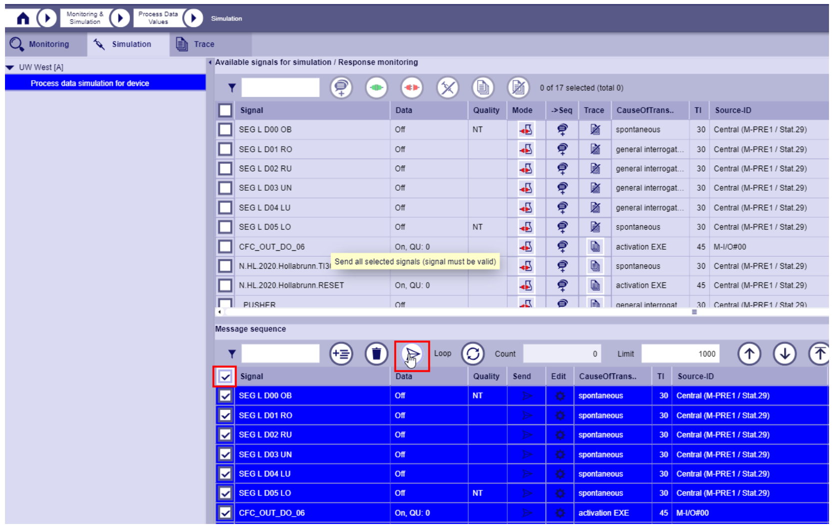
[sc_Use_Case_1_Bild4_Protokolle_Sendesignale_02, 1, en_US]

- Switch to the **Simulation** tab, select all signals again with multiselect and click the **Sequence** button in the action bar to transfer the signals to the **Message sequence** table.



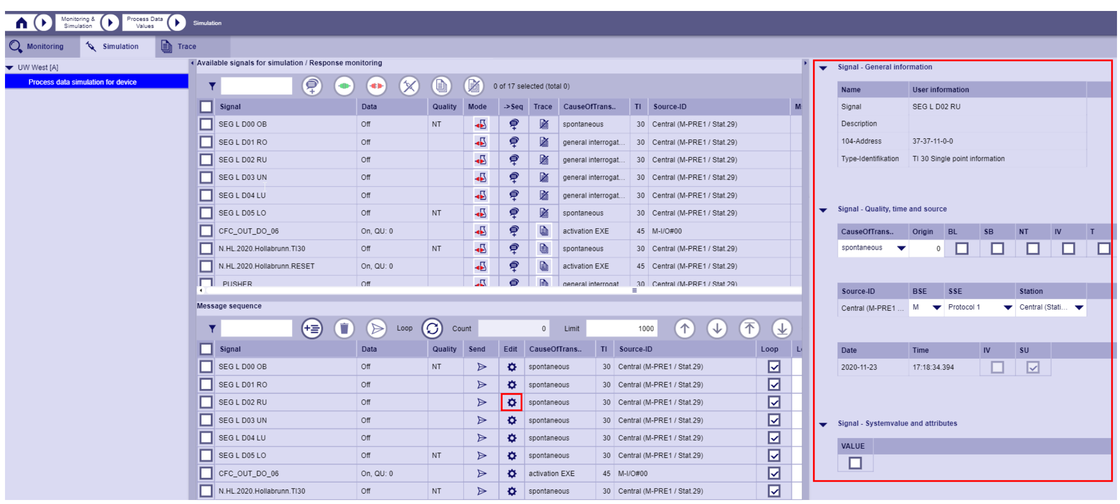
[Bild16_Simulation_Telegramm, 1, en_US]

- Use multiselect to select all signals in the **Message sequence** table and click on **Send** in the action bar to output all signals once.



[Bild17_Simulation_Telegramm_send, 1, en_US]

- Alternatively, you can send the signals several times in succession using a loop and/or change the properties of the messages.

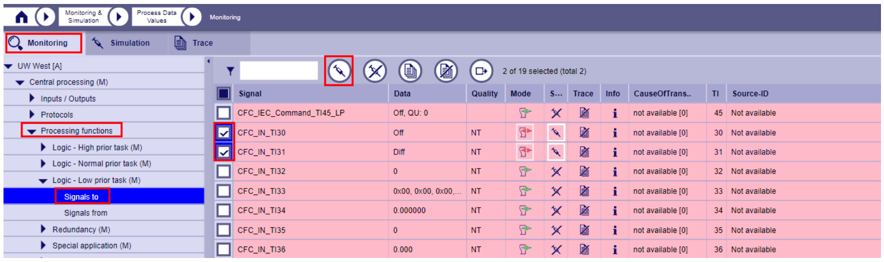


[sc_usecase_1_07, 1, en_US]

- If you switch to the **Trace** tab, you can follow the processes.

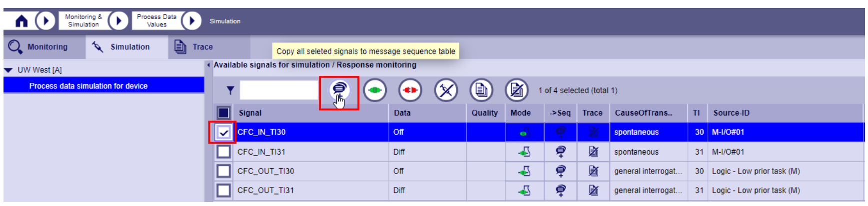
10.12.2 Testing the logic (CFC or CAEx Plus)

- In SICAM WEB, open the **Process Data Values** tile and select the **Monitoring** tab.
- In the directory tree click on the node **Device | Central processing (M) | Processing functions | Logic | Signals to**, select the desired signals with the check box and click on **Simulation** in the action bar.



[sc_usecase_2_01, 1, en_US]

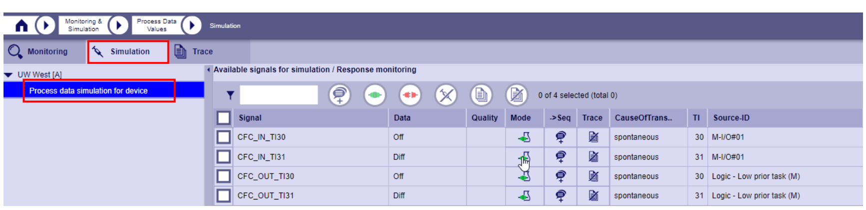
- Click on the **Signals from** node in the directory tree, select the desired signals with the check box and click on **Simulation** in the action bar.



[sc_usecase_2_02, 1, en_US]

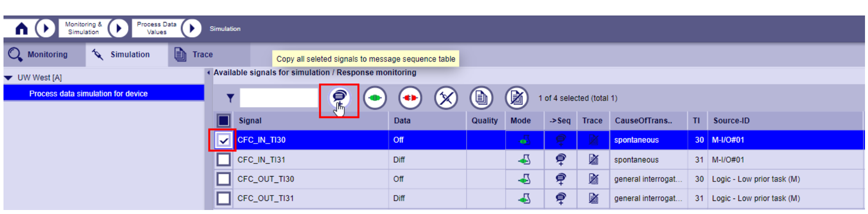
- Select the **Simulation** tab and click on the **Process data simulation** node in the directory tree.

  The previously selected signals are now available in the table **Available signals for simulation / Response monitoring** .



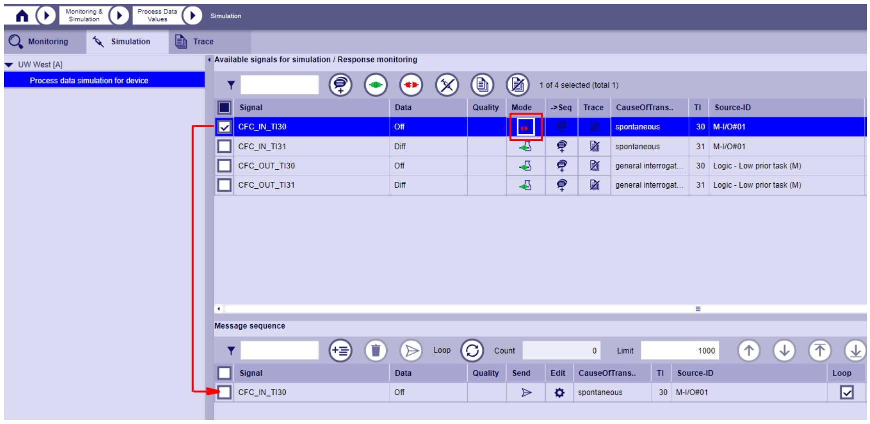
[sc_usecase_2_03, 1, en_US]

- Select the desired signals and click **-> Seq** to copy instances of these signals into the **Message sequence** table.



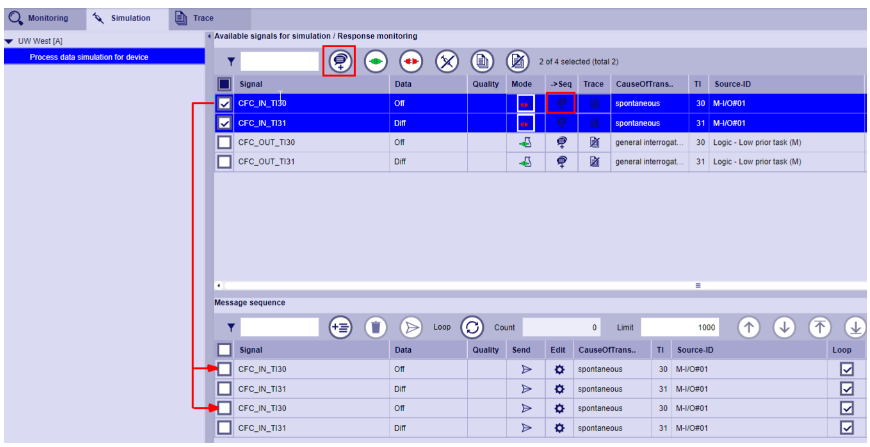
[sc_usecase_2_04, 1, en_US]

- As soon as a signal is in the **Message sequence** table, its connection to the system is interrupted (mode symbol shows red plug) and the message can be sent by clicking on the **Send** symbol.



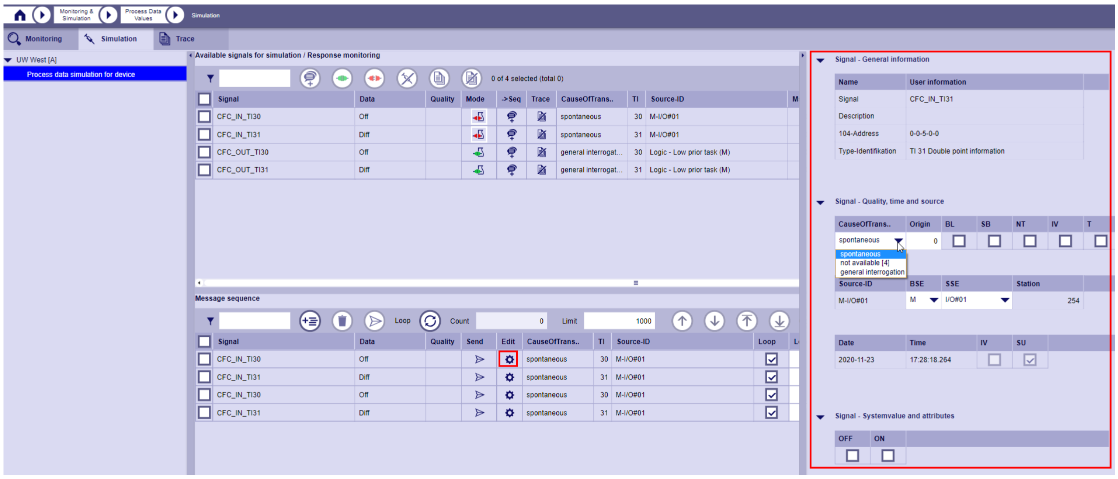
[sc_usecase_2_05, 1, en_US]

- It is also possible to include several instances of the same signal in the **Message sequence** table.



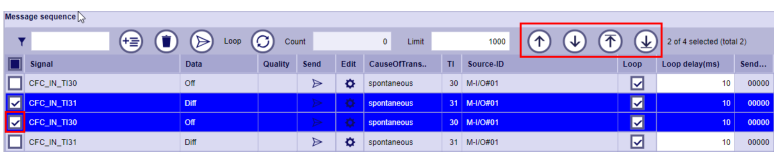
[sc_usecase_2_06, 1, en_US]

- You have the option of changing the properties of the messages in the **Message sequence** table. Click on the **Edit** symbol for the messages concerned. This opens a window in which the properties of the message can be displayed and changed.



[sc_usecase_2_07, 1, en_US]

- The order in which the messages are sent depends on the position (line) of the message in the table. The top message selected is sent first, followed by the next lower one and so on. Using the Up, Down, Top and Bottom buttons in the action bar, you can change the order as you like.



[sc_usecase_2_08, 1, en_US]

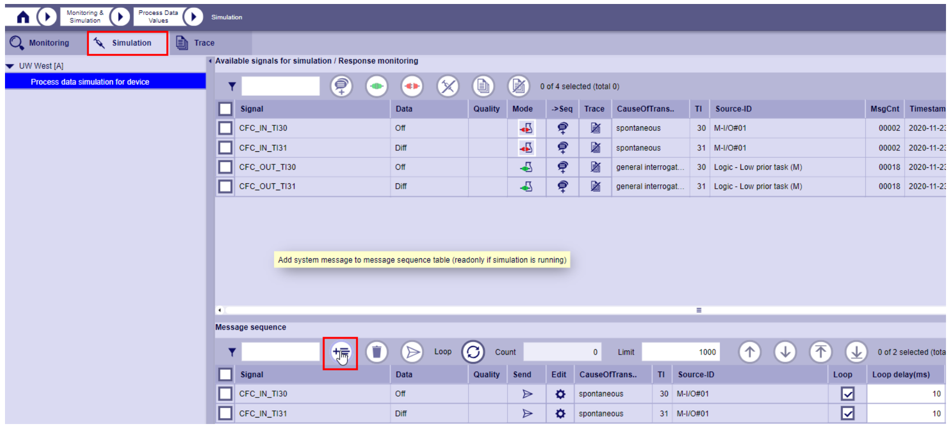
NOTE

Further options and details on sending messages can be found in the chapter *Sending the messages from the message sequence table, Page 644*.

10.12.3 Simulation of the general- and counter interrogation

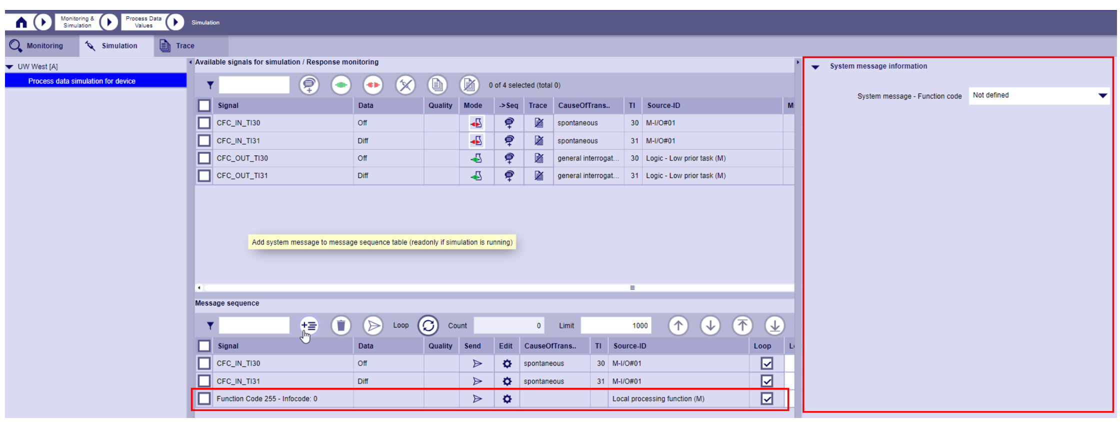
System messages can be generated and sent directly in the **Simulation** tab.

- In SICAM WEB, open the **Process Data Values** tile and select the **Simulation** tab.
- In the directory tree, click on the **Process data simulation** node to display the **Message sequence** table. Click the **Add system message** button in the action bar.



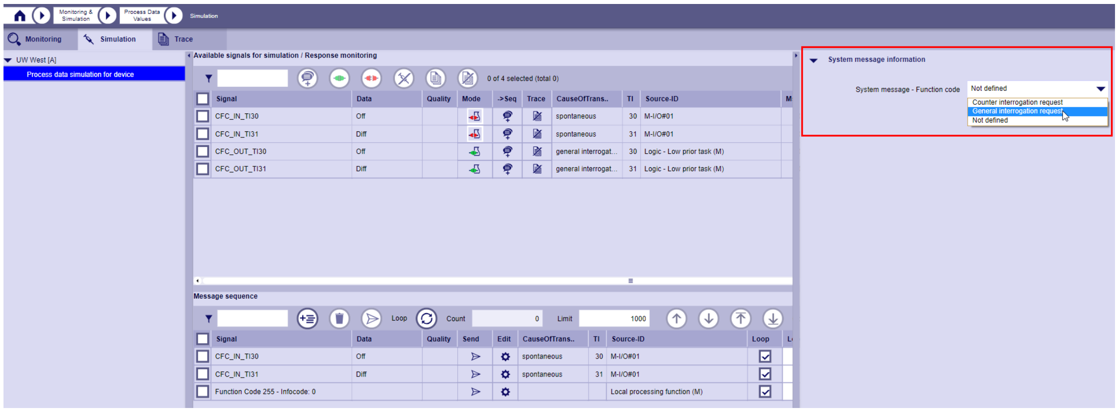
[sc_usecase_3_09, 1, en_US]

- A window appears in which the properties of the system message are displayed.



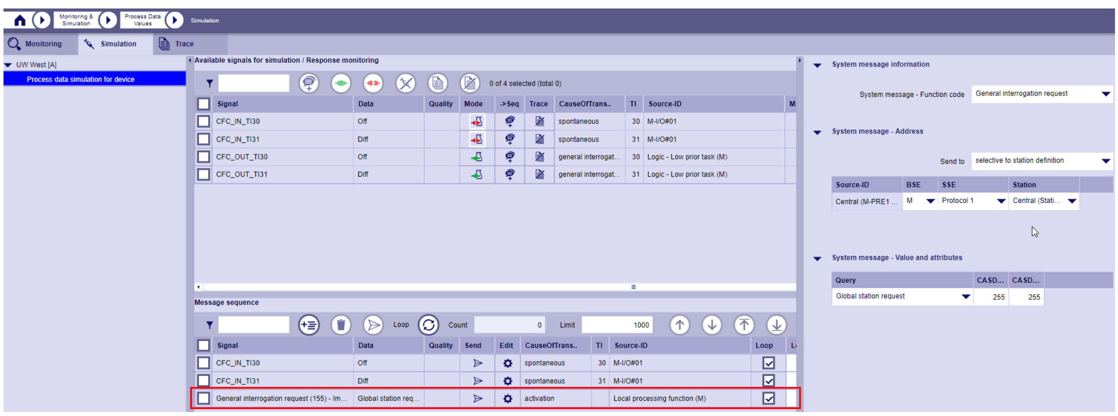
[sc_usecase_3_10, 1, en_US]

- You can now specify the type (e.g. general query) and address of the system message.



[sc_usecase_3_11, 1, en_US]

- The system messages generated in this way now appears in the **Message sequence** table and can be sent by clicking on **Send**.



[sc_usecase_3_12, 1, en_US]

11 Engineering via SICAM Device Manager

11.1 General Information

The SICAM Device Manager is the intuitive engineering software for SICAM A8000 Series.

- Clear project and device management
- Simple duplication of devices
- Online connection with the devices via SICAM WEB

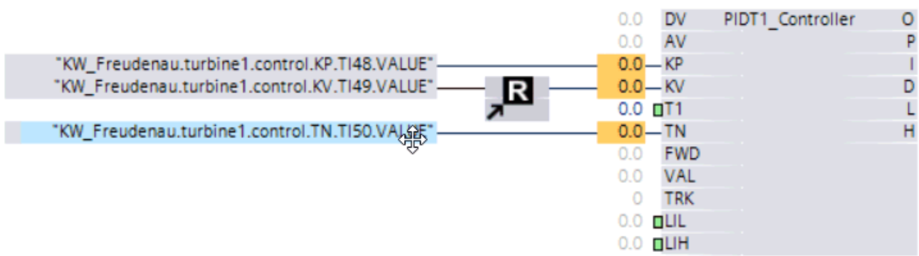
You will find the instructions for this tool in document *SICAM Device Manager User Manual (D51-003)*.

11.2 Logic IEC Parameters

11.2.1 Introduction

With this function it is possible to change parameters in the logic function diagram during operation without compiling the function diagram. This is used when the plant is commissioned or in real-time operation by a plant engineer.

An example of such a requirement is a controller application:



[sc_CFC_Logic_Para_01, 1, --_--]

In real operation, the controller input parameters **KP**, **KV** and **TN** should be changeable by an operator from one or more different sources. In this case it is not necessary to change and compile the function diagram, which means that the changes are made outside of the function diagram (e.g. by a control center). This requires an IEC signal to send the new value to the logic.

The controller input parameters **T1**, **LIL** and **LIH** should also be changeable during operation, but only during the commissioning phase of the system. This is necessary to optimize the controller quickly and easily.

This is done by a commissioning engineer with the logic editor CFC in the SICAM Device Manager, so this is possible with the "CFC Online Test". It is not necessary to define additional signals with input interfaces for this. These inputs only have to be activated with the force attribute on this module. After completing the optimization process with the "CFC Online Test", the changes in the logic editor must be saved, compiled and loaded into the device.

This chapter describes the first type of input parameters that can be changed by an operator without engineering tools.

As mentioned above, the operator wants to change parameter values in the application program from various sources outside the logic, during the operation of the device. For example using:

- Control system (e.g. SICAM SCC)
- SICAM WEB dashboard views (e.g. from your own or from another device)
- SICAM WEB Logic function (only on own device)
- other devices automatically (e.g. CP-8050 that works as a higher-level controller)

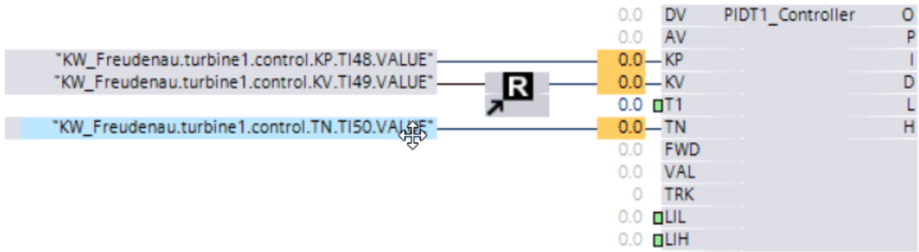
This means that these value changes are possible without the engineering tool SICAM Device Manager / Logic Editor.

For these entries, the user must define setpoint signals in the SICAM Device Manager (**IEC_Freigabe**), which must be assigned to the processing type **Logic function TI45-51**. The **IEC_Parameter** attributes must be set and an **IEC_Parameter_init_value** should be defined.

During operation, the user can change such parameters from one or more of the sources listed above. If the values are changed, the new values are automatically saved in the device.

Then, if all parameters are OK, the user can read the changed parameter values back into the SICAM Device Manager during operation. To do this, the user must trigger a "Save" operating command via SICAM WEB and then read the parameters back into the SICAM Device Manager using the download function. In this case, the **IEC_Parameter_Init_value** of all signals in the engineering data set of the SICAM Device Manager are overwritten. When saving, the parameters for the SD card spare part function are also saved on the SD card of the device (if enabled).

Example: Logic PIDT1_Controller; Parameter KP,KV,TN

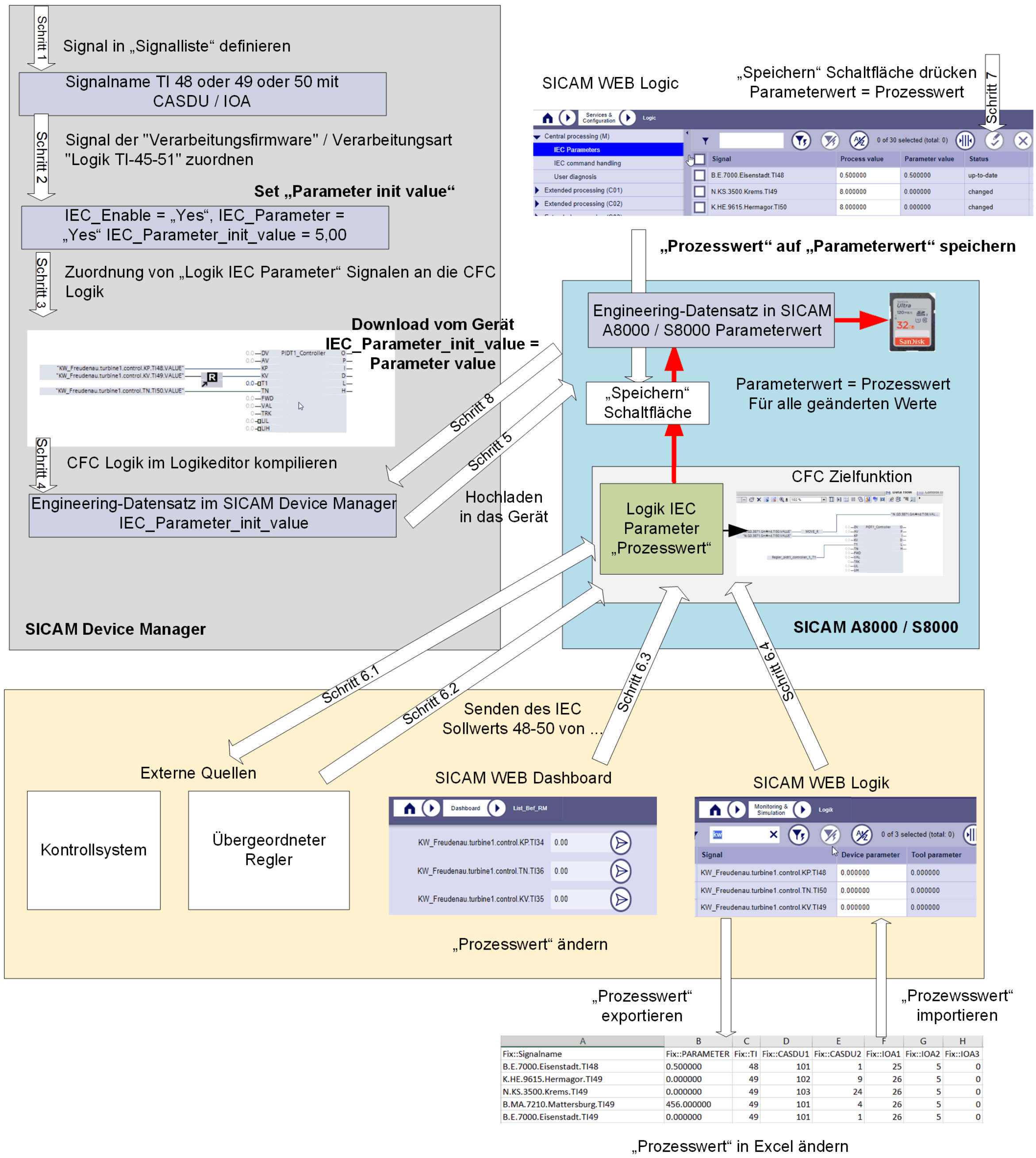


[sc_CFC_Logic_Para_01, 1, --_--]

Normally control systems can only send new values with setpoint commands (IEC 104 setpoint values). Therefore the interfaces to such parameter values are usually IEC104 signals defined in the signal list of the SICAM Device Manager.
The following IEC 104 setpoint type identifiers can be used to change the parameters:

- TI 48 Setpoint command, normalized value
- TI 49 Setpoint command, scaled value
- TI 49 Setpoint command, short floating-point number

The picture shows the tools for defining and changing "Logic IEC Parameters" in the device



[dw_Logic_IEC_Parameter, 1, en_US]

11.2.2 Engineering

The following steps provide guidance on how to define the "Logic IEC Parameters", upload them to the device with the SICAM Device Manager, how to change them from external sources and download them from the device to the SICAM Device Manager, and how to save them on the SD card in the device.

- **Step 1: Define signals in the signal list of the SICAM Device Manager**
  The IEC 104 signals must be defined with the following setpoint type identifiers and the CASDU/IOA attributes of the signal:
  – TI 48 Setpoint command, normalized value
  – TI 49 Setpoint command, scaled value
  – TI50 Setpoint command, short floating-point number
- **Step 2: Assign signals to the "Logic IEC parameters" function**
  The defined signals must be assigned to the **Central Processing (M) / Extended Processing** node in the signal list with the processing type **Logic Functions TI45-51**. The **IEC_Enable** and **IEC_Parameter** parameters must be set to **Yes**. Parameter **IEC_Parameter_Init_value** should be set to an expected initial value after initialization of the device.
  The value range of the parameter**IEC_parameter_init_value**depends on the type identifier of the signal:
  – TI 48 Setpoint command, normalized value (-1 to 1)
  – TI 49 Setpoint command, scaled value (-32768 to 32767)
  – TI 50 Setpoint command, short floating-point number (- 3.4028235×10^{38} to 3.4028235×10^{38})

NOTE

If the initial value is set outside the valid value range, the parameter is not activated in the target system. A parameter error is set.

- **Step 3: Assignment of "Logic IEC Parameter" signals to the CFC logic**
  The defined signals are automatically in the CFC signal list and can be assigned to the inputs of the logical instructions.
- **Step 4: Compile CFC logic in the logic editor**
  When the logic is finished, it needs to be compiled.
- **Step 5: Upload the engineering data set to the device with the SICAM Device Manager**
  When uploading a signal for the first time, the target system initializes the logic IEC parameter signals with the**IEC_parameter_init_value**.
  As long as the process value has not been changed in the target system, the **IEC_Parameter_init_value** can be changed in the tool and uploaded to the device. The new value is accepted when uploading.
  As soon as the process value in the target system has been changed once, the changed **IEC_Parameter_init_value** is no longer accepted from the tool. This means that changes in the target system have a higher priority than changes in the tool.
  If the changed value in the target system is read back into the Device Manager, this locking is canceled again. From this point in time, the value can also be changed again in the tool and will be adopted in the target system.

- **Step 6: Change the process value of the signal in the target system**
  - **Step 6.1: Change "process value" from control system**
    The control system can send an IEC setpoint command with a new value to the logic function. Input checks of the setpoint signal must be fulfilled (e.g. source address must be enabled, .. see IEC command handling) so that the setpoint command is accepted. If the setpoint command is accepted, the new value is automatically saved internally in the device and also adopted after a reset or power up.
  - **Step 6.2: Change parameters from another device**
    The parameters can also be changed from other devices, such as from a control system. e.g. superior controller
  - **Step 6.3: Change parameters from SICAM WEB Dashboard**
    If the parameters should be changed from the SICAM WEB Dashboard function, the signals must also be assigned to the processing type "Process data setpoint". The signals can be assigned to the list view or the graphical view. In this case it makes sense to assign a measurement value for the return information. Details see chapter *10.6 Dashboard*.
  - **Step 6.4: Change parameters from SICAM WEB Logic function**
    The parameters can also be changed from the SICAM WEB Logic function. All assigned signals that have the **IEC_Enable** and **IEC_Parameter** parameters enabled are automatically assigned to a parameter table view. The actual values in the target system can be displayed in this view.
    With license**SICAM A8000 Extended SICAM WEB**the signals can also be changed, changes discarded and the signals exported as a CSV file, changed in Excel and imported again. Details see chapter *10.9.4 Logic*
- **Step 7: Save changed process values in the parameter values of the engineering data set and on the SD card in the device**
  With the SICAM WEB Logic function, the changed process values can be saved by a user action and stored in the engineering data set in the target device.
  With this action, the parameters are also saved on the SD card if the security parameter **SD card mode** is set to **Spare parts concept active and updates via SD card allowed**.
- **Step 8: Download the engineering data set from the target device to the SICAM Device Manager**
  If the logic IEC parameters are changed and accepted in the target system, the user can download the complete parameter set from the target system. This is necessary in order to have the initial values for the parameters in the SICAM Device Manager when commissioning a new target hardware (spare part) for the first time.

11.2.3 Spare Part Concept with SD Card

If the target hardware needs to be replaced (spare part), the SD card can be plugged into the new hardware. If the parameters are passed correctly, the actual parameter values are active in the new target.

11.2.4 Diagnostic information when changing logic IEC parameters in the device

If the logic IEC parameters are changed in the device, the system sets diagnostic information. These parameters are changed and not transferred to the engineering data set of the SICAM Device Manager.

The behavior of the diagnostic information can be changed with the expert parameters

- Logic IEC parameter diagnostics with the following attributes:
  - Warning ... no error LED (default)
  - Internal error ... error LED
  - No diagnostic ... e.g. IEC parameters are automatically changed by other devices (no user action)

12 Service

12.1 Maintenance, Cleaning and Disposal

- Maintenance
  - The device is maintenance-free.
  - With handling on the bus – or its vicinity – a sufficient ESD protection must be considered.
- Cleaning
  - If necessary, wish the device with a clean, dry, soft and fluff-free cotton cloth.
  - Detergents may cause damage. Do not use a detergent.
  - Humidity and wetness may impair the functionality of the components. Make sure that humidity or wetness does not enter into the device.
- Disposal
  - For the disposal of the device it is necessary to observe the local and national directives.

NOTE

A device that is defective can be recognized by the fact, that after a restart of the target device the yellow RY-LED and the red ER-LED do not light up. An access with the SICAM TOOLBOX II is no longer possible in this case.

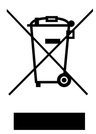
In this case please consult our Customer Support Center.

Modules must not be opened or repaired by the user!

12.2 Environmental Protection Hints

Disposal of Old Equipment and Batteries (Applicable only for European Union and Countries with a Recycling System)

The disposal of our products and possible recycling of their components after decommissioning has to be carried out by an accredited recycling company, or the products/components must be taken to applicable collection points. Such disposal activities must comply with all local laws, guidelines and environmental specifications of the country in which the disposal is done. For the European Union the sustainable disposal of electronic scrap is defined in the respective regulation for "waste electrical and electronic equipment" (WEEE).



The crossed-out wheelie bin on the products, packaging and/or accompanying documents means that used electrical and electronic products and batteries must not be mixed with normal household waste.

According to national legislation, penalties may be charged for incorrect disposal of such waste.

By disposing of these products correctly you will help to save valuable resources and prevent any potential negative effects on human health and the environment.

NOTE

Our products and batteries must not be disposed of as household waste. For disposing batteries it is necessary to observe the local national/international directives.

Disposal of Mobile Storage Devices (e.g. USB Sticks and Memory Cards)

When disposing of/transferring mobile storage devices, using the **format** or **delete** functions only changes the file management information and does not completely delete the data from your mobile storage device. When disposing of or transferring a mobile storage device, Siemens strongly recommends physically destroying it or completely deleting data from the mobile storage device by using a commercially available computer data erasing software.

REACH/RoHS Declaration

You can find our current **REACH/RoHS** declarations at:

https://www.siemens.com/global/en/home/products/energy/ecotransparency/ecotransparency-downloads.html

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NOTE

You can find more information about activities and programs to protect the climate at the EcoTransparency website:

https://www.siemens.com/global/en/home/products/energy/ecotransparency.html

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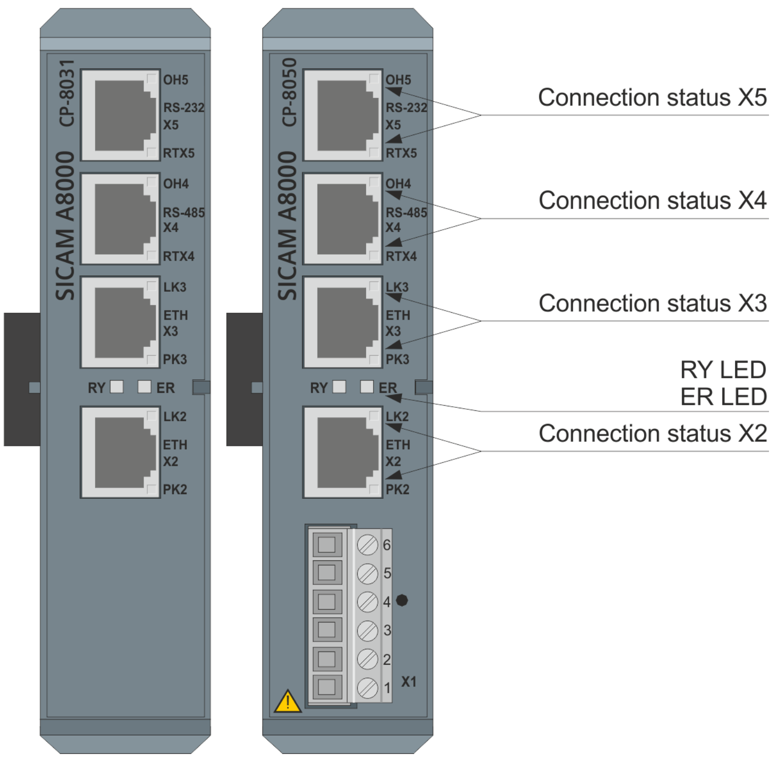
12.3 Display Elements

12.3.1 Master Modules

The master modules have

- 2 LEDs that indicate the operating state of the module
  - RY (Ready-LED, yellow)
  - ER (Error-LED, red)
- 8 LEDs (yellow) indicating the connection status of the communication interfaces X2 to X5 (depending on the loaded protocol elements)



[dw_Master_Modules_display_elements, 1, en_US]

Figure 12-1 CP-8031/CP-8050 display elements

NOTE

LEDs don't guarantee zero potential connectors.

Operation state

RY LED	ER LED	State of the system
dark	dark	OFF
dark	lightning	Boot
flashes irregularly	lightning	Startup or update
flashes regularly	lightning	Shut down
flashes	flashes	“Rescue Mode” after several exceptions
lightning	lightning	Ready with error
lightning	dark	Ready OK

Connection Status Connector X5 / RS-232

Name	Function	LED	Meaning
OH5	Off hook X5	Flickers (data exchange)	Sending message
		Active (lightning)	Connection with minimum one physical partner set up
		Inactive (dark)	Connection not established Startup
RTX5	Receive/ transmit data X5	Flickers (data exchange)	Activity on send/receive line
		Inactive (dark)	Startup

Connection Status Connector X4 / RS-485

Name	Function	LED	Meaning
OH4	Off hook X5	Flickers (data exchange)	Sending message
		Active (lightning)	Connection with minimum one physical partner set up
		Inactive (dark)	Connection not established Startup
RTX4	Receive/ transmit data X4	Flickers (data exchange)	Activity on send/receive line
		Inactive (dark)	Startup

Connection Status Connector X3 / ETH

Name	Function	LED	Meaning
LK3	Link X3	Active (lightning)	Physical connection to the Ethernet Hub
		Inactive (dark)	Connection not established Startup
PK3	Package X3	Flickers (data exchange)	Activity (TCP frame sent/received)
		Inactive (dark)	Startup

Connection Status Connector X2 / ETH

Name	Function	LED	Meaning
LK2	Link X2	Active (lightning)	Physical connection to the Ethernet Hub
		Inactive (dark)	Connection not established Startup
PK2	Package X2	Flickers (data exchange)	Activity (TCP frame sent/received)
		Inactive (dark)	Startup

12.3.2 Power Supply Modules

PS-862x and PS-864x provide the display element RY (Ready LED, yellow) that indicates the operating state of the module.

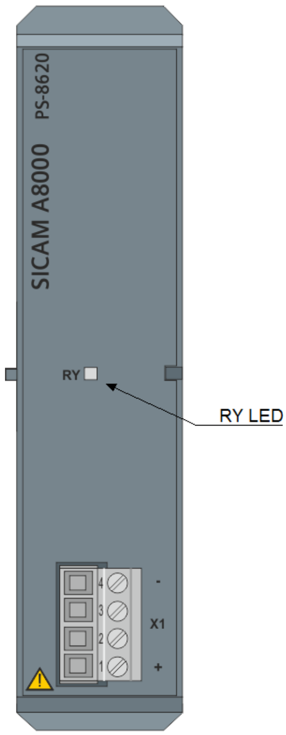


Figure 12-2 PS-8620

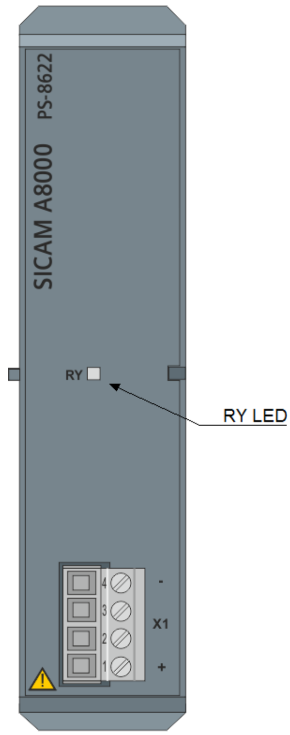


Figure 12-3 PS-8622

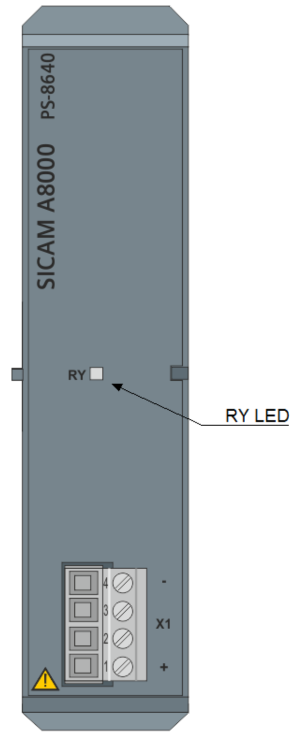


Figure 12-4 PS-8640

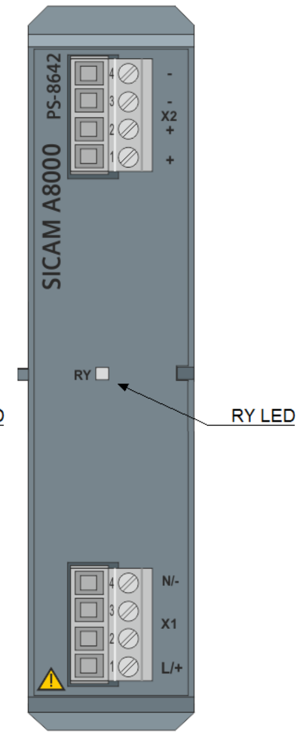


Figure 12-5 PS-8642

Operating state

Status of the RY LED	Meaning
Dark	Module not ready
Flashes	Module ready, monitoring not active
Lights up	Module ready, monitoring active (depending on parameter for the "power supply monitoring"

CAUTION

Risk of electric shock

Failure to observe these safety instructions may lead to injury.

- ✧ The output voltage may be available in the power supply module, even though the RY LED is in unlit status.
- ✧ The LED displays of the module cannot guarantee that the periphery connectors are de-energized!

Power Supply Monitoring

The operating state of the power supply modules is monitored from the master module. This function must therefore be activated, and an IOMI85 firmware must be configured on the I/O bus (even if no I/O modules are used). If these conditions are not met, the RY LED will flash.

The configuration of the power supply monitoring is performed with the SICAM TOOLBOX II settings: **`CP-8050/CPCI85 | System settings | Hardware configuration | Power Supply Master Module`**.

Possible settings:

- not monitored
- PS-86xx singular
- PS-86xx redundant

12.3.3 SICAM A8000 I/O Modules

The SICAM A8000 I/O modules provide one RY display element (Ready LED, yellow), which indicates the operating state of the module.

[dw_SICAM_IO_disp_elements_CP-8050, 1, --_--]

Figure 12-6 SICAM A8000 I/O Modules

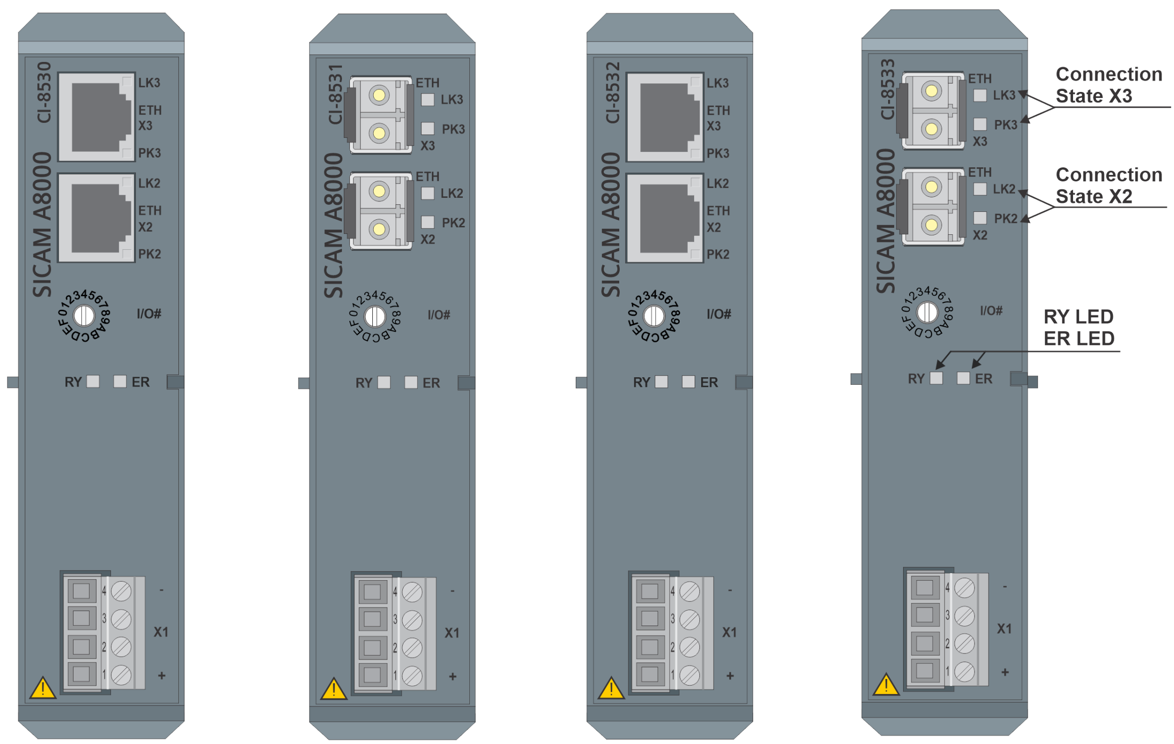
Operating State

Status of the RY LED	Meaning
Dark	• Sum error (voltage failure, defective) • System startup
Lights up	Module ready

12.3.4 SICAM I/O Remote Modules

The display elements of the SICAM I/O remote modules are on the front side of the housing.

- 2 LEDs that indicate the operating state of the module
  - RY (Ready LED, yellow)
  - ER (Error LED, red)
- 4 LEDs (yellow), which indicate the connection status of the communication interfaces X2 and X3
  - LK2-LED; PK2-LED
  - LK3-LED; PK3-LED



CI-8530 CI-8531 CI-8532 CI-8533

[sc_sicam_IO_remote_disp_elements, 1, --_--]

Operation state

RY-LED	ER-LED	Meaning
Dark	Dark	Module off
Dark	Lights up	Module is booting
Flashes regularly	Lights up	Update
Lights up	Dark	Module ready
Lights up	Lights up	Module ready with error

Operation state when CI-8531/CI-8533 is used as Repeater/Converter

State of the RY-LED	State of the ER-LED	Meaning
Dark	Dark	no power supply
Lights up	Dark	operating mode OK

Dark	Lights up	I/O# not 0
Lights up	Lights up	connection failure

Connection Status of X3 (Ethernet and F/O) LEDs

Name	Function	LED	Meaning
LK3	Link X3	Active (lights up)	Physical connection to the Ethernet Hub
		Inactive (dark)	Connection not established Startup
PK3	Package X3	Flickers (data exchange)	Activity (frame sent/received)
		Inactive (dark)	Startup

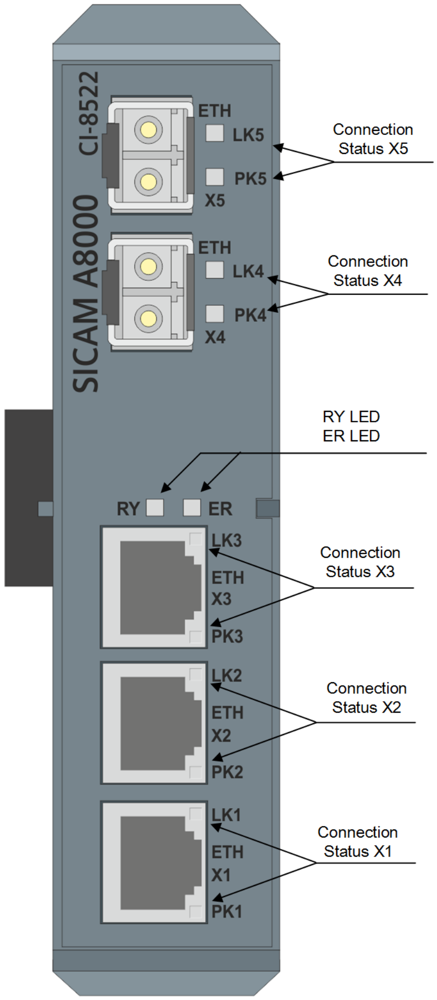
Connection Status of X2 (Ethernet and F/O) LEDs

Name	Function	LED	Meaning
LK2	Link X2	Active (lights up)	Physical connection to the Ethernet Hub
		Inactive (dark)	Connection not established Startup
PK2	Package X2	Flickers (data exchange)	Activity (frame sent/received)
		Inactive (dark)	Startup

12.3.5 Communication Modules

CI-852x has

- 2 LEDs that indicate the operating state of the module
  - RY (Ready-LED, yellow)
  - ER (Error-LED, red)
- 10 LEDs (yellow) indicating the connection status of the communication interfaces X1 to X5 (depending on the loaded protocol elements)



[sc_display-elements-ci-852x-modules, 1, en_US]

Figure 12-7 CI-8522 display elements

Operation state

RY LED	ER LED	State of the system
Dark	Dark	OFF
Dark	Lights up	Boot
Lights up	Lights up	Ready with error
Lights up	Dark	Ready OK
Flashes	Dark	Update

Connection Status of X5 (Ethernet and F/O) LEDs

Name	Function	LED	Meaning
LK5	Link X5	Active (lights up)	Physical connection to the Ethernet Hub
		Inactive (dark)	Connection not established Startup
PK5	Package X5	Flickers (data exchange)	Activity (TCP frame sent/received)
		Inactive (dark)	Startup

Connection Status of X4 (Ethernet and F/O) LEDs

Name	Function	LED	Meaning
LK4	Link X4	Active (lights up)	Physical connection to the Ethernet Hub
		Inactive (dark)	Connection not established Startup
PK4	Package X4	Flickers (data exchange)	Activity (TCP frame sent/received)
		Inactive (dark)	Startup

Connection Status of X3 (Ethernet) LEDs

Name	Function	LED	Meaning
LK3	Link X3	Active (lights up)	Physical connection to the Ethernet Hub
		Inactive (dark)	Connection not established Startup
PK3	Package X3	Flickers (data exchange)	Activity (TCP frame sent/received)
		Inactive (dark)	Startup

Connection Status of X2 (Ethernet) LEDs

Name	Function	LED	Meaning
LK2	Link X2	Active (lights up)	Physical connection to the Ethernet Hub
		Inactive (dark)	Connection not established Startup
PK2	Package X2	Flickers (data exchange)	Activity (TCP frame sent/received)
		Inactive (dark)	Startup

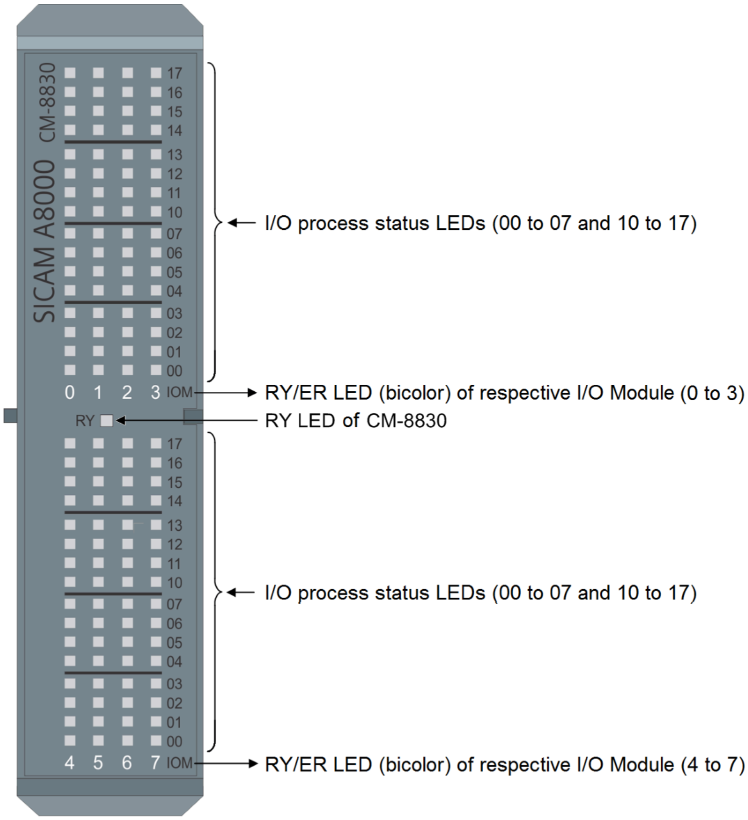
Connection Status of X1 (Ethernet) LEDs

Name	Function	LED	Meaning
LK1	Link X1	Active (lights up)	Physical connection to the Ethernet Hub
		Inactive (dark)	Connection not established Startup
PK1	Package X1	Flickers (data exchange)	Activity (TCP frame sent/received)
		Inactive (dark)	Startup

12.3.6 LED Module

The LED module provides:

- an RY display element (Ready LED, yellow), which indicates the operating state of the module
- 8 display elements (Ready/Error LED, bicolor) which indicate the process status of the respective SICAM I/O modules
- 128 display elements which indicate the process status of the I/Os of the respective SICAM I/O module



[dw_CM-8830_disp_elements, 1, en_US]

Figure 12-8 CM-8830 Display Elements

LED Module Operating State

Status of the RY LED	Meaning
Dark	Module not ready or failed
Lights up	Module ready

Operating States of the SICAM I/O Modules (RY/ER LED)

The IOM LEDs (IOM 0 to 3 and IOM 4 to 7) are bicolor LEDs that indicate the operating state and the process errors of the SICAM I/O modules in a SICAM A8000 I/O row.

Status of the I/O Module LEDs	Meaning	How to Read the LED Sequence
Dark	• Respective I/O module is not ready • Respective I/O module not detected or in error state	• Left to right (IOM 0 to 3) • Left to right (IOM 4 to 7)
Lights up (yellow)	• Respective I/O module is ready, monitoring is active • No process error	
Lights up (red)	• Respective I/O module monitoring is active and • I/O module process error indication	

I/O Process Status

The LEDs (00 to 07 and 10 to 17) indicate the process status of the digital and analog inputs/outputs of the respective SICAM I/O module.

Status of I/O Process Status LEDs	Meaning	How to Read the LED Sequence
Dark	Respective I/O module is not ready and/or channel is inactive	Bottom to top (00 to 07 and 10 to 17) of IOM 0 to 7
Lights up (yellow)	Respective I/O module is ready, channel is active	

- The I/O process status of the DI and AI is displayed without the project engineering of the SICAM A8000 system.
- The I/O process status (of the DO and AO) and the I/O process errors (of the DI and AI) are displayed only when the SICAM A8000 system has been engineered.
- The I/O process status for the AI-8320 and AO-8380 modules is displayed when the measured input is > 3 %. Accordingly, the LEDs do not light up when the measured input is < 3 %.
- The I/O process status of the AI-8310 module is displayed only when the measured input is between 20 Ω and 4075 Ω.

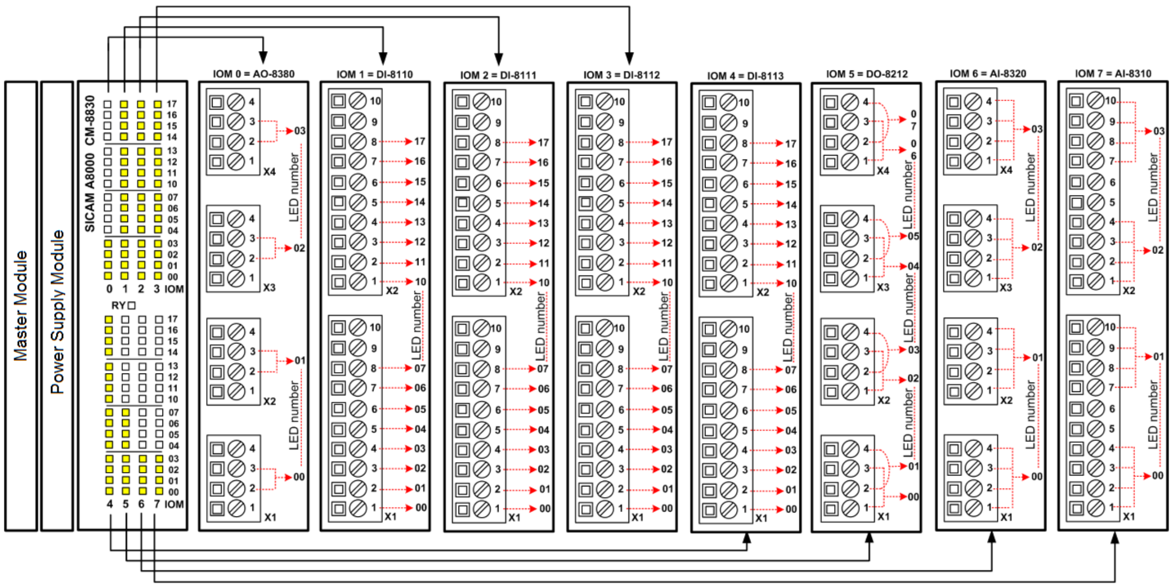
Process-Signal Assignment for Each SICAM I/O Module Type

Type	Process Signal	How to Read the LED Sequence
DI-811x	IN D00 to IN D07 and IN D10 to IN D17	Bottom to top (00 to 07 and 10 to 17)
DO-8212	OUT D00 to OUT D03 and OUT D04 to OUT D07	Bottom to top (00 to 03 and 04 to 07)
DO-8221	CA00/CB00 to CA03/CB03 and CA04/CB04 to CA05/CB05 OAX/OAY	Bottom to top (00/01 to 06/07 and 10/11 to 12/13 Bottom to top (16/17)
DO-8230	OUT D00 to OUT D07 and OUT D10 to OUT D17	Bottom to top (00 to 07 and 10 to 17)
AI-8310	IN V0 to IN V3	Bottom to top (00 to 03)
AI-8320	IN V0 to IN V3	Bottom to top (00 to 03)
AO-8380	OUT V00 to OUT V03	Bottom to top (00 to 03)

Process-Error Visualization

Name	Process Error Visualization
DI-811x	Power monitoring error
AI-8320	Zero-point suppression error

The following figure explains the mapping of the I/O module pin assignment and the mapping of the LED module displays:

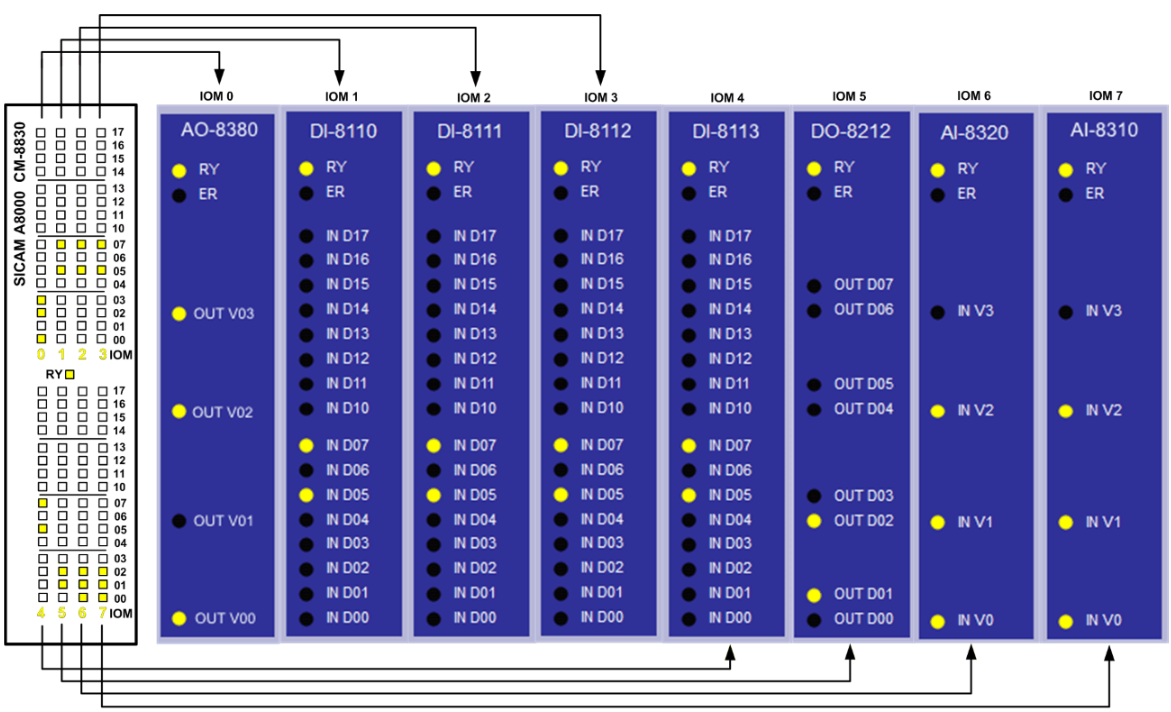


[dw_cm8830-display-mappi, 1, en_US]

Figure 12-9 Mapping of the I/O Module Pin Assignment and Mapping of the LED displays

The mapping shown above is for illustration purposes only. The actual display mapping and system setup can vary from configuration to configuration.

The following figure explains the I/O signal connection from SICAM A8000 to the LED module, compared to SICAM WEB I/O monitoring:



[dw_cm8830-display-sweb, 1, --_--]

Figure 12-10 I/O Signal Connection from SICAM A8000 to the LED Module

The mapping shown above is for illustration purposes only. The actual display mapping and system setup may vary from configuration to configuration.

12.4 Replacement of the Hardware

Master Module

If the use of the SD card is activated with CP-8031/CP-8050, the master module can be exchanged simply by plug & play.

When replacing the device, only the SD card with the data from the old device must be plugged into the replacement device.

Upon startup of the device, all required data are checked and - in case of differences to the settings stored in the device - automatically transferred from the SD card. Thus, when the device is exchanged with the same type, no subsequent loading process, this means, no engineering tool, will be required. The configuration is transferred directly to the replacement device.

The use of the SD card is released using the following parameter: **`CP-8050/CPCI85 | System settings | Security | SD-Card Mode = Spare part concept active and updates via SD-Card allowed`**.

I/O-Module

The process signals are connected by removable screw terminals. Since these screw terminals carry the circuitry, nothing needs to be disconnected when changing out a module.

The replacement of a module is achievable without a special tool.

WARNING

- The removal and insertion of I/O-Modules under voltage is not permitted.
- For modules that operate with voltages ≥ 60 V care must be taken, that manipulation on the peripheral connectors may only be carried out in a de-energized state.
- The displays (LED) of the modules do not guarantee that the peripheral plugs are de-energized!

Fiber Optic SFP Module

NOTICE

Exercise caution when handling the electrostatic sensitive devices.

Non-observance of the following specified measures means that material damage can occur.

- Fiber optic SFP module is an electrostatic sensitive device. Follow the ESD measures while installing and maintaining the device.
- Wear ESD gloves, wrist strap and clothes to avoid device damage.

Before replacing the fiber optic SFP module from CI-8531/CI-8533, press the push-pull LC latch and then remove optic fiber from the SFP module.

Release the SFP lever by more than 90° and hold the lever to pull out the SFP module from the CI-8531/CI-8533.

NOTE

If fiber optic cables are not connected to SFP module on CI-8531/CI-8533, then use factory supplied dust cap to protect the TX and RX ports from dust.

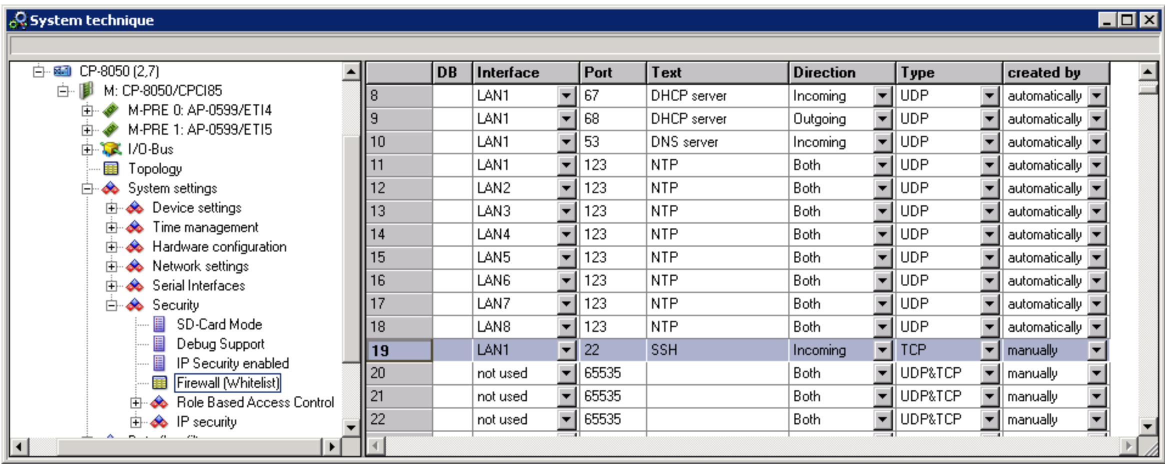
12.5 Debugging via SSH

If debugging a CP-8031/CP-8050 via LAN is required by Siemens experts, the operator of the CP-8031/CP-8050 can enable this access via SSH.

NOTE

This access is protected by a certificate. The certificate is only available to the Siemens Development Department.

The debug access is activated with parameter: **`CP-80xx/CPCI85 | System settings | Security | Debug Support`**. After this, the TCP port 22 in the firewall must be released. See the following example:



12.6 Rescue-Mode

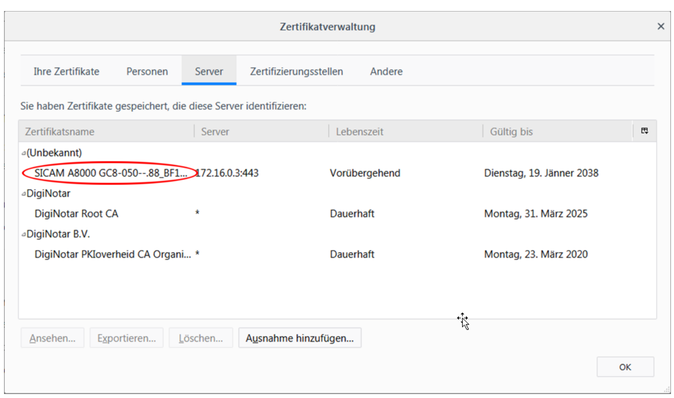
If a severe internal error occurs in the CP-8031/CP-8050 that does not allow an orderly shutdown of the automation component (for example, CPU Exception), then the automation component is automatically reset.
During startup after the exception, the parameter **`[BSE] System settings | Device settings | Failure behavior`** is evaluated.

- If this parameter is set to **`Firmware shutdown`**, the device remains shut down.
- If this parameter is set to **`Firmware restart`**, the device is switched back to normal operation.

However, if the exception occurs 3 more times within the next 30 minutes (for example due to parameters that cause a serious internal error), the device will be put into rescue mode.
The rescue mode temporarily uses the parameter configuration of the factory setting.
Rescue mode is indicated on the CP-8031/CP-8050 by flashing the RY LED and ER LED.

Further diagnostic steps

If the device is in rescue mode, a diagnosis via SICAM WEB can be carried out via the default IP address https://172.16.0.3. This requires a connection to the Ethernet interface X3.
If access is not possible, you must delete the certificates of the component in the browser. To do this, open **Privacy & Security -> Certificates -> Show Certificates**. Under the tab **Server** the certificates are listed and can be removed.



An access to the component (https://172.16.0.3) should then be possible again.
Now the diagnosis can be read out and a support file can be created.
The component can be returned to the operating state by performing a power-up. After a successful boot, the component can be reached again via the parameterized IP address.
If the error can not be corrected by a power-up, as the error recurs due to the loaded parameters, new parameters can be loaded in rescue mode.

13 Communication Protocols

13.1 Introduction

13.1.1 Overview

A communication protocol is used for the exchange of data – and thereby for the transmission of messages – over a communication interface to other automation units or devices of third-party manufacturers, for instance control systems.

The task of the communication protocol is:

- The processing of specific communication protocols for the communication of SICAM A8000 automation units with each other or with devices of other manufacturers.
- The adaptation of the internal message formats to the corresponding external message formats.
- The adaptation of system and addressing concepts of SICAM A8000 and the devices of other manufacturers.

Thereby a distinction is made between communication protocols with serial communication or with LAN/WAN communication.

Serial Communication

The following standard protocols are available for serial communication:

- IEC 60870-5-101 (Point-to-point traffic)
- IEC 60870-5-101 (Multi-point traffic Master)
- IEC 60870-5-101 (Multi-point traffic Slave)

Yet, there is still a whole series of other available protocols such as:

- IEC 60870-5-103 (Multi-point traffic Master for interfacing of protective devices)
- Modbus RTU

LAN/WAN Communication

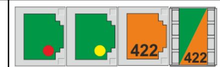
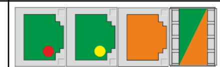
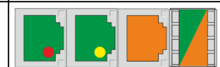
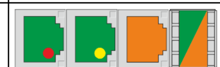
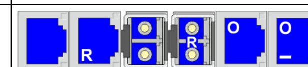
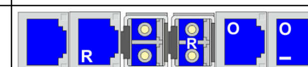
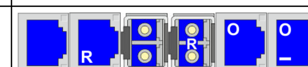
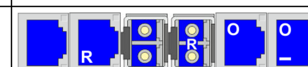
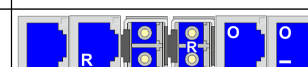
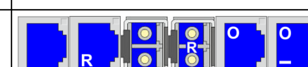
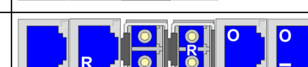
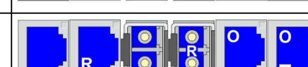
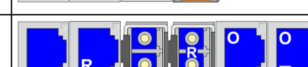
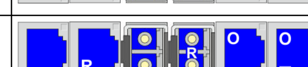
The following protocols are available for LAN/WAN communication:

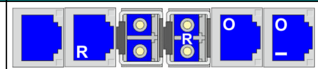
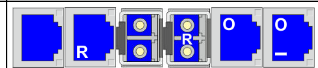
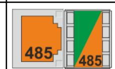
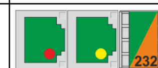
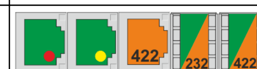
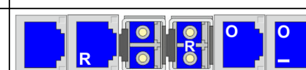
- IEC 60870-5-104
- IEC 61850 (Client, Server, GOOSE)
- Modbus TCP
- DNP3 via Ethernet (TCP/IP)

NOTE

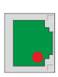
The hardware of the protocol elements is integrated on the master module and the communication modules. The related details are described in section ***Technical Data***.

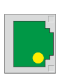
The following table shows via which interfaces the respective protocols are available.

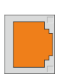
Protocol	Firmware	Interface	Interface symbol
IEC 60870-5-101 (Point-to-Point Traffic)	BPPI0	RS-232, RS-422	
IEC 60870-5-101 (Multi-point traffic Master)	UMPMI0	RS-232, RS-485, RS-422	
IEC 60870-5-101 (Multi-point traffic Slave)	UMPSI0	RS-232, RS-485, RS-422	
IEC 60870-5-103 (Protective device interfacing Master)	103MI0	RS-232, RS-485, RS-422	
IEC 60870-5-103 (Protection device interfacing Slave)	103SI0	RS-232, RS-485, RS-422	
IEC 60870-5-104	ETI4	ETH	
IEC 60870-5-104 with Application Layer Firewall	FWI4	ETH	
IEC 61850 Ed. 1+2 Client	ETI5	ETH	
IEC 61850 Ed. 2 Server (GOOSE)	ETI5	ETH	
Modbus RTU Master	MODMI0	RS-232, RS-485, RS-422	
Modbus RTU Slave	MODSI0	RS-232, RS-485, RS-422	
Modbus TCP Master ("Client")	MBCII0	ETH	
Modbus TCP Slave ("Server")	MBSII0	ETH	
DNP3 Master "serial"	DNPMI0	RS-232, RS-485, RS-422	
DNP3 Slave "serial"	DNPSI0	RS-232, RS-485, RS-422	
DNP3 TCP/IP Master	DNPII2	ETH	
DNP3 TCP/IP Slave	DNPII1	ETH	
ÖBB VLZ (PIPS1)	VLZI0	RS-232, RS-422	
PROFIBUS-DP	DPMI0	ETH	
PROFINET-IO	PNMI0	ETH	
AGP (Power Distributor Branch Specific Test Equipment)	AGPMI0	RS-232	

Protocol	Firmware	Interface	Interface symbol
IOT Publisher (MQTT)	OPUPI0	ETH	
IOT Publisher (MindSphere)	OPUPI1	ETH	
DSfG Bus Slave	DSFGI0	RS-485	
EAW Ursatron 8000 Master	U80ZI0	RS-232, RS-485, RS-422	
ÖBB X.25 "PAD"	OX25I1	RS-232	
SK 1703 PCMBA GV	PCBMI0	RS-232, RS-485, RS-422	
SK 1703 PCMBA End-End	SKEEI1	RS-232, RS-422	
Siemens SINAUT 8	SA8MI0	RS-232, RS-485, RS-422	
	SA8SI0	RS-232, RS-485, RS-422	
DLMS Ethernet counter interfacing Master (Client)	ETMCI9	ETH	

Legend:

 .... RS-232 (VCC 5 V or 12 V possible)

 .... RS-232 (VCC 5 V possible)

 RS-485/RS-422

 .... RS-485/RS-422 (RS-422 used)

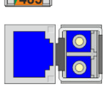
 ... RS-485/RS-422 (RS-485 used; VCC not possible!)

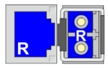
 .... RS-232 or RS-485/RS-422 (with RS-232 VCC not possible!)

 RS-232 or RS-485/RS-422 (RS-232 used; VCC not possible!)

 .... RS-232 or RS-485/RS-422 (RS-422 used; VCC not possible!)

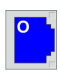
 ... RS-232 or RS-485/RS-422 (RS-485 used; VCC not possible!)

 .... Ethernet



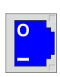
.... Ethernet port for HSR ring, PRP, RSTP ring or Line Mode

- 2 redundancy protocols are possible for each CI-852x module (HSR, PRP, RSTP or Line Mode).
- This means that a maximum of 4 redundancy rings are possible for each CP-8050.
- Either 2 identical or 2 different redundancy protocols can be used on a CI-852x module.
- For HSR, PRP, RSTP and Line Mode, 2 Ethernet connections are always required on a CI-852x module.
- The selection which 2 of the 5 Ethernet ports on the CI-852x module are used for HSR, PRP, RSTP or Line Mode is arbitrary.
- The two Ethernet ports for HSR, PRP, RSTP or Line Mode must always be on the same CI-852x module.
- If no redundancy protocol is used for Ethernet networks, then these Ethernet ports can be used as normal Ethernet ports.



.... Ethernet ports for I/O ring

- An I/O ring requires 2 Ethernet ports.
- If an I/O ring is used, then the 2 Ethernet ports cannot be used for other protocols.
- Either I/O line or I/O ring can be used (not both).
- If no I/O ring is used, then this Ethernet port can be used as a normal Ethernet port.
- Ethernet I/O ring and Ethernet I/O line may not be connected to other Ethernet networks.



.... Ethernet ports for I/O line

- An I/O line requires 1 Ethernet port.
- Either I/O line or I/O ring can be used (not both).
- If an I/O line is used, then this Ethernet port cannot be used for other protocols.
- If no I/O line is used, then this Ethernet port can be used as a normal Ethernet port.
- Ethernet I/O ring and Ethernet I/O line may not be connected to other Ethernet networks.

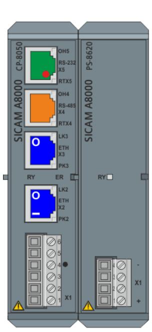
Configuration Rules for Communication Modules

NOTE

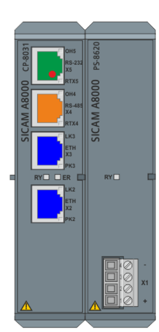
Additional communication modules can only be used with CP-8050.

With a license (see *14.8 SICAM A8000 CP-803x Extended CI-Module*), 1 communication module (CI-8551 or CI-852x) can be used additionally also with CP-8031.

Example 1a: Only CP-8050

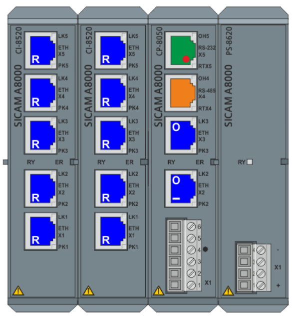


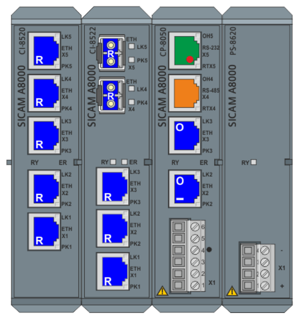
Example 1b: Only CP-8031



Example 2: CP-8050 + CI-852x

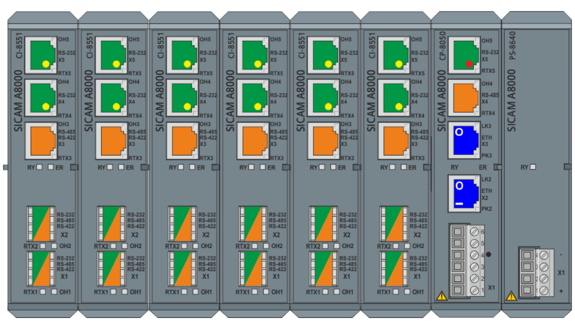
- PS-862x: max. 1x CI-8522
- PS-864x: max. 2x CI-852x
- If 2 CI-852x are connected, no more CI-8551 can be connected.
- CI-8520, CI-8522 can be combined as required





Example 3: CP-8050 + CI-8551

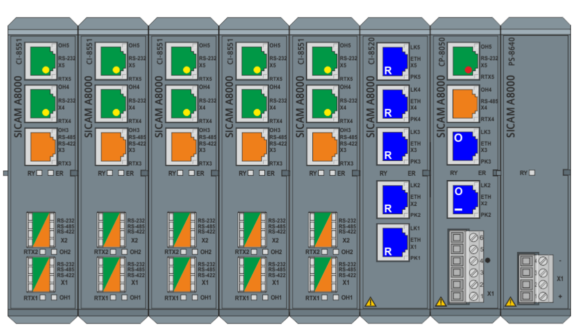
- Max. 6x CI-8551
- With CP-8050 + 6x CI-8551 no CI-852x can be connected
- PS-8640 or PS-8642 required

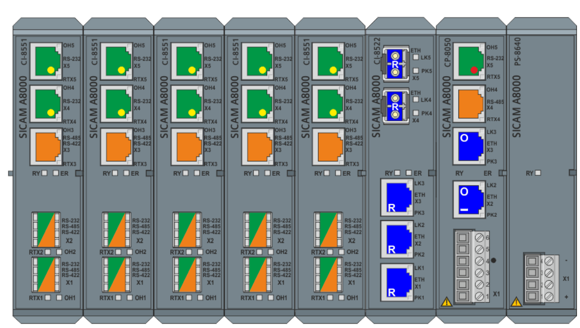


[dw_Usage_of_Communication_Interfaces_V3_6xCI-8551, 1, --_--]

Example 4: CP-8050 + CI-852x + CI-8551

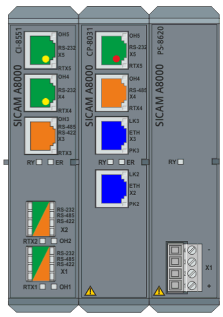
- Max. 1x CI-852x and max. 5x CI-8551
- PS-8640 or PS-8642 required
- CI-852x module must always be placed immediately to the left of the master module





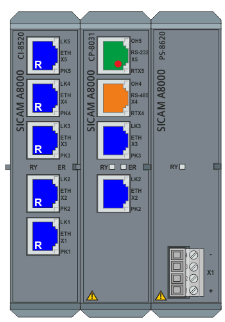
Example 5: CP-8031 + CI-8551 (license required!)

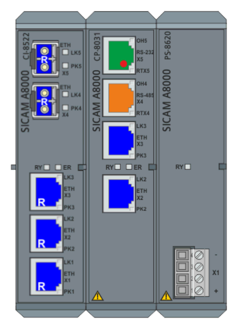
- Ps-862x or PS-864x: max. 1x CI-8551



Example 6: CP-8031 + CI-852x (license required!)

- Ps-862x or PS-864x: max. 1x CI-852x





13.1.2 Limits of the Communication Protocols

NOTE

The maximum number of stations on the CP-8031, regardless of which or how many protocols, is limited to 50.

The following limits apply for the basic system element and for each installed protocol element:

Firmware	Max. instal-lable proto-cols	Max. number of stations	Max. number of stations (recom-mended)	Max. number of data points	License
103MI0	–	100[84]	50	10000	–
AGPMI0	–	1	1	24	–
BPPI0	–	1	1	[85]	–
CPCI85	CP-8031: 4 CP-8050: 8	400[84]	200[84]	CP-8031: 20 000 CP-8050: 400 000	–
DNPII1	–	100[84]	8	10000	–
DNPII2	–	100[84]	50	10000	–
DNPMI0	–	20	50	10000	–
DNPSI0	–	1	1	10000	–

84 50 with CP-8031

85 Not limited (limited only by free memory)

Firmware	Max. instal-lable proto-cols	Max. number of stations	Max. number of stations (recom-mended)	Max. number of data points	License
DPMI0	–	100[84]	30 to 50	2000	–
DSFGI0	–	30	30	10000	–
EPCI85[86]	4	200	200	400000	✓
ETI4	–	100[84]	50 (25 with TLS)	[85]	–
ETI5 "Client"	–	100[84]	50	10000	–
ETI5 "Server"	–	6	6	10000[87]	–
ETMCI9 "Client"	–	20	20	10000	–
FWI4	–	100[84]	50	[85]	✓
MBCII0 "Client"	–	100[84]	50	10000	–
MBSII0 "Server"	–	50	8	10000	–
MODMI0	–	100[84]	50	10000	–
MODSI0	–	1	1	10000	–
OPUPI0	–	1	1	10000	–
OPUPI1	–	1	1	5000	–
OX25I1	–	1	1	10000	–
PCBMI0	–	100[84]	50	2000 (RX), 200 (TX)[88]	–
PNMI0	–	100[84]	30 to 50	2000	–
SA8MI0	–	16	16	2000	✓
SA8SI0	–	1	1	1000	✓
SKEEI1	–	1	1	2000 (RX), 200 (TX)[88]	✓
U80ZI0	–	100[84]	50	2000 (RX), 2000 (TX)[88]	–
UMPMI0	–	100[84]	50	[85]	–
UMPSI0	–	1	1	[85]	–
VLZI0	–	1	1	2048	–

13.1.3 LAN communications protocols with RSTP, PRP, HSR, Line Mode

SICAM A8000 CP-8050 supports the network redundancy protocols RSTP, PRP, HSR and Line Mode only in conjunction with the CI-852x module.

- 2 redundancy protocols for Ethernet networks (HSR, PRP, RSTP or Line Mode) are possible for each CI-852x module.
- for HSR, PRP, RSTP and Line Mode always 2 Ethernet ports are required on a CI-852x.
- The selection which 2 of the 5 Ethernet ports on the CI-852x module are used for HSR, PRP, RSTP or Line Mode is arbitrary
- The two Ethernet ports for HSR, PRP, RSTP or Line Mode must always be on the same CI-852x module.
- If no redundancy protocol is used for Ethernet networks, then these unused Ethernet ports can be used as normal Ethernet ports.

86 Is not supported with CP-8031

87 For more precise determination of the max. possible data point number depending on the number of LogicalDevices/Connections/ Data points see section *Formulas for the determination of the total number of data points (n), Page 1081*

88 (RX) = number of supported messages in receive direction, (TX) = number of supported messages in transmit direction. In the receive direction (RX), a message contains either 1 measured value up to 4 or 8 double-point information or up to 16 single-point information. In the transmit direction (TX), a message contains either 4 or 8 double-point information items or up to 16 single-point information items. The number of commands or measured values in the transmit direction is not limited (only limited by the free memory).

Protocol	Firmware	RSTP	PRP	HSR	Line Mode
IEC 60870-5-104	ETI4	✓	✓	✓	✓
IEC 61850 Ed. 1+2 Client	ETI5	✓	✓	✓	✓
IEC 61850 Ed. 2 Server (GOOSE)	ETI5	✓	✓	✓	✓
Modbus TCP Master ("Client")	MBCII0	✓	✓	✓	✓
Modbus TCP Slave ("Server")	MBSII0	✓	✓	✓	✓
DNP3 TCP/IP Slave	DNPII1	✓	✓	✓	✓
NTP/SNTP	CPCI85	✓	✓	✓	✓
Syslog	CPCI85	✓	✓	✓	✓
SNMP	CPCI85	✓	✓	✓	✓

13.1.4 Common Functions Communications Protocols

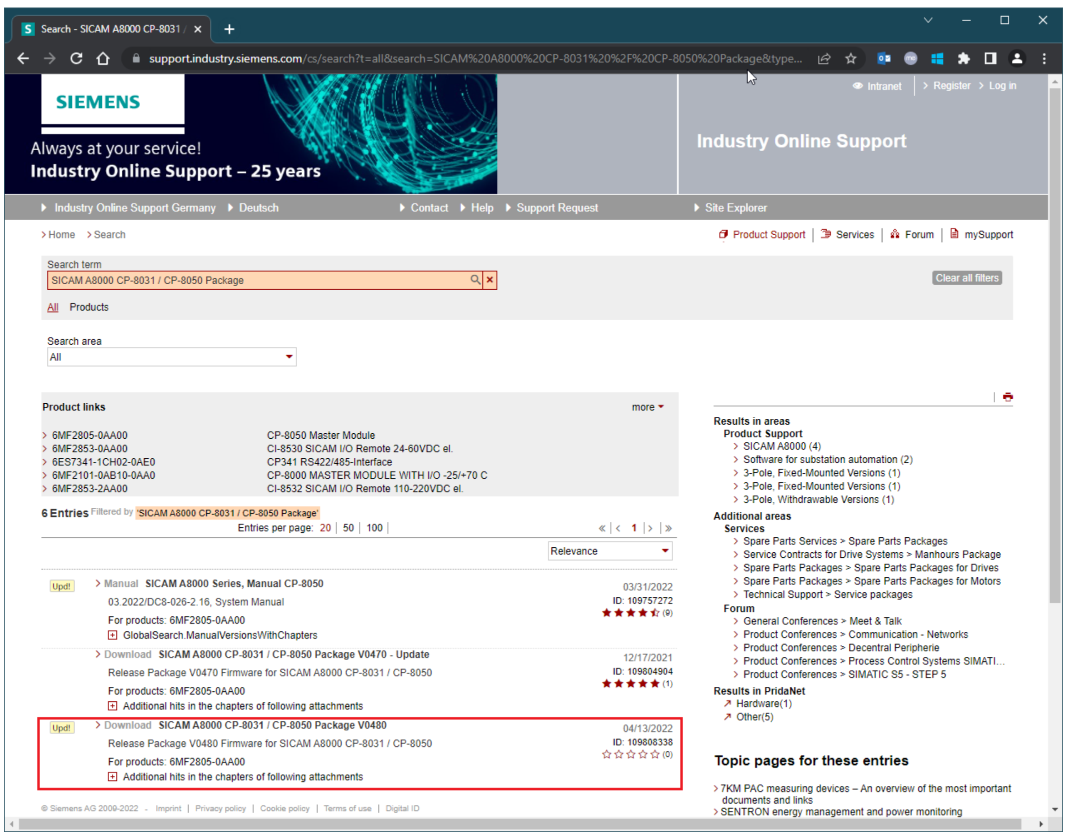
13.1.4.1 Import Firmware Files to SICAM Device Manager

Download Firmware

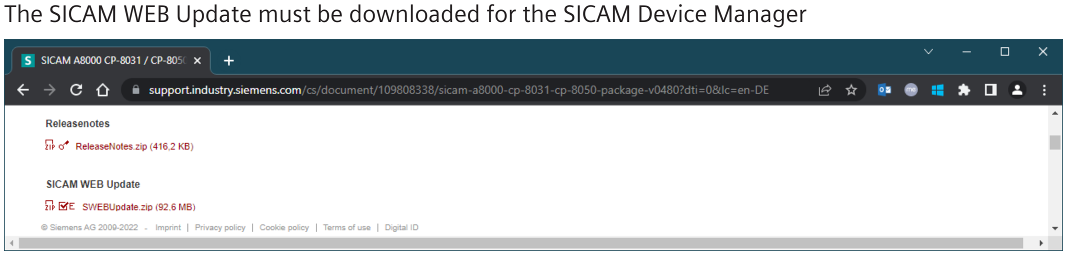
Firmwares for CP-8031, CP-8050 can be downloaded from the Internet from the Siemens Industry Online Support (SIOS portal).

- Download firmware package
  - search for the current package in the SIOS portal (WEB page: *https://support.industry.siemens.com/cs/start?lc=de-DE*)
    Search term: SICAM A8000 CP-8031 / CP-8050 Package

  - select the latest package (here in the example, the package is "V0480") and download it



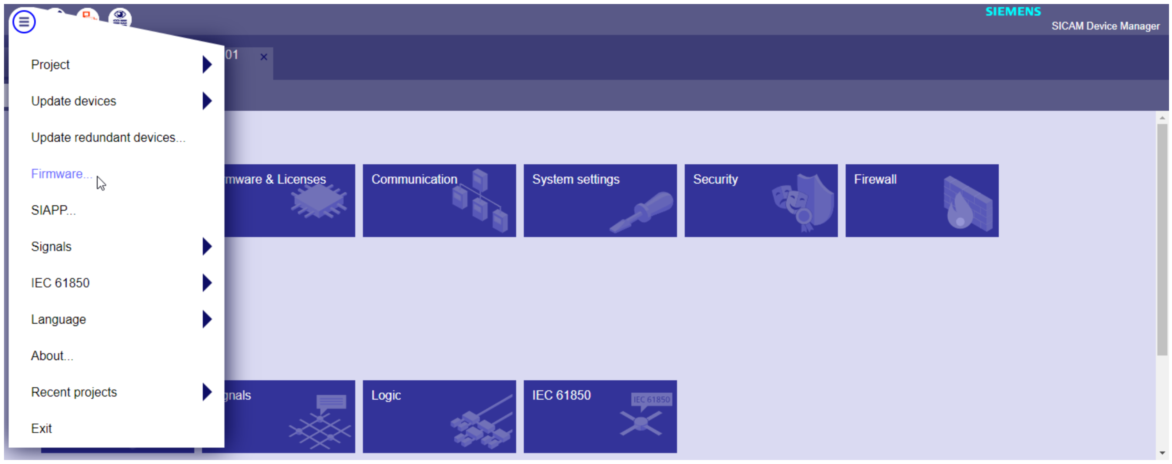
Note:
The SICAM WEB Update must be downloaded for the SICAM Device Manager



Import Firmware

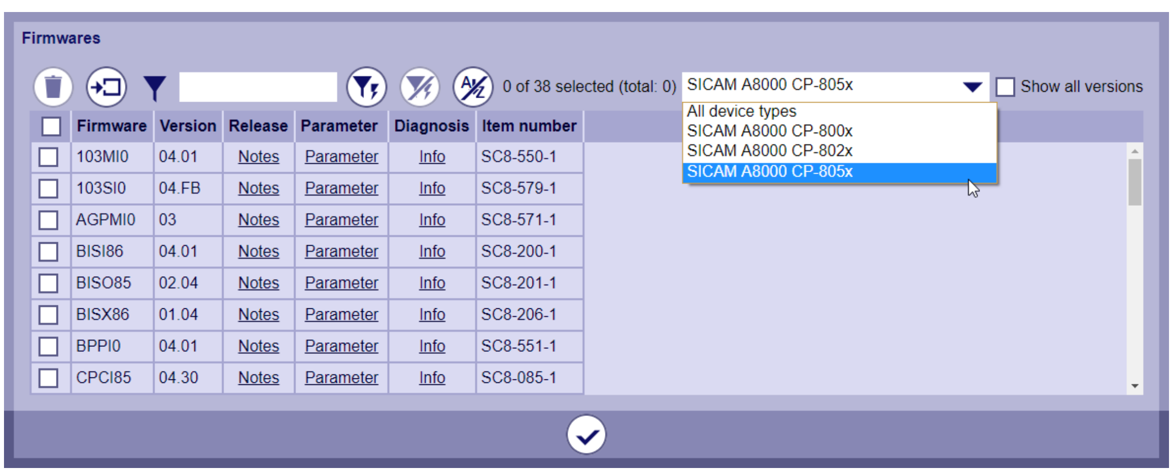
In order that new or selected older firmware versions can be used in devices, the corresponding firmware must be imported into the SICAM Device Manager.

- Firmware ...

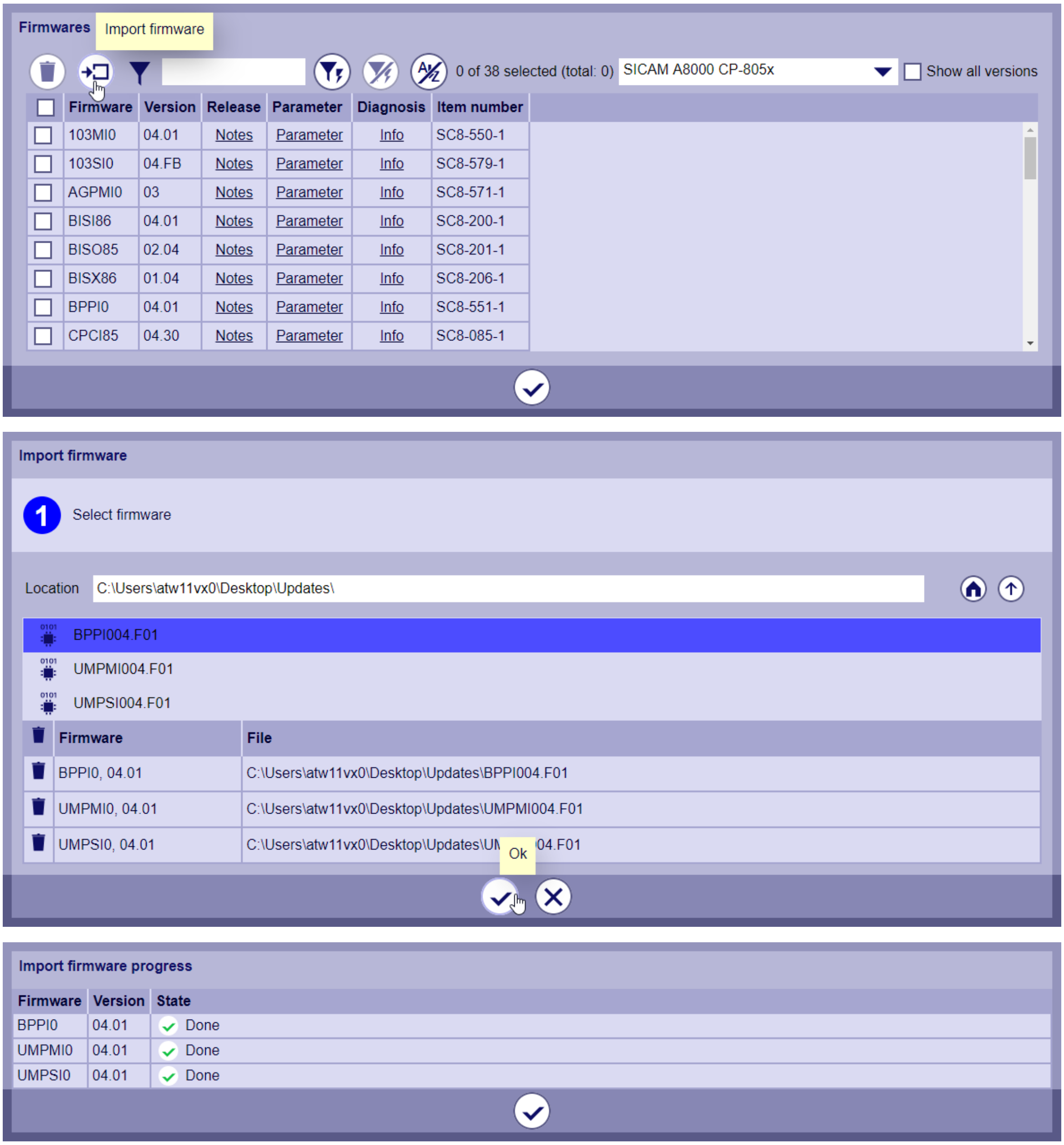


[DM_Firmware_01 [GER], 1, en_US]

- Firmware ... | Firmware overview
  – all imported firmware files are displayed
  – with <all device types> all firmware files for SICAM A8000 devices are displayed.
    with <SICAM A8000 CP-805x> only the firmware files for CP-8031, CP-8050 are displayed.
  – only the latest version of firmware is displayed
    (with <Show all versions> all versions of a firmware are displayed)



- Import Firmware
  – Seldt Firmware
    All firmware files stored in the selected folder are displayed for selection
  – the firmware files to be imported must be selected
  – with <OK> the selected firmware files (from the list "Firmware/File") are imported



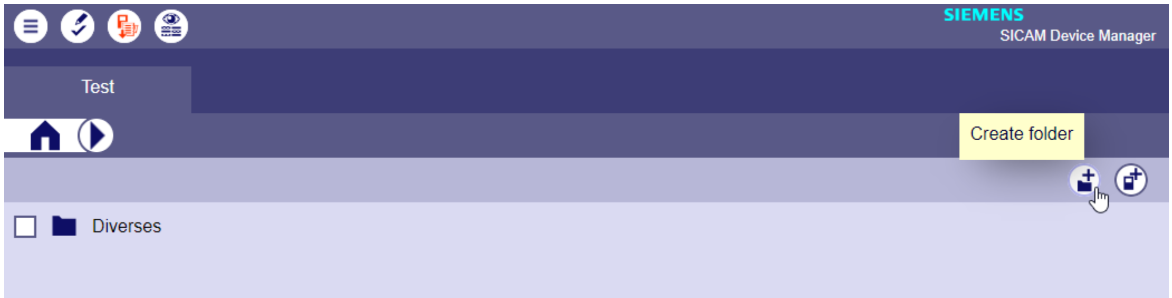
13.1.4.2 Load Protocols with the SICAM Device Manager

The loading of protocols with the SICAM Device Manager is shown here from scratch (including creation of folder and device). If a device has already been created, continue reading in the section "Configuration" .

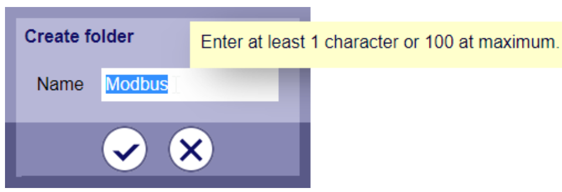
Create Folder

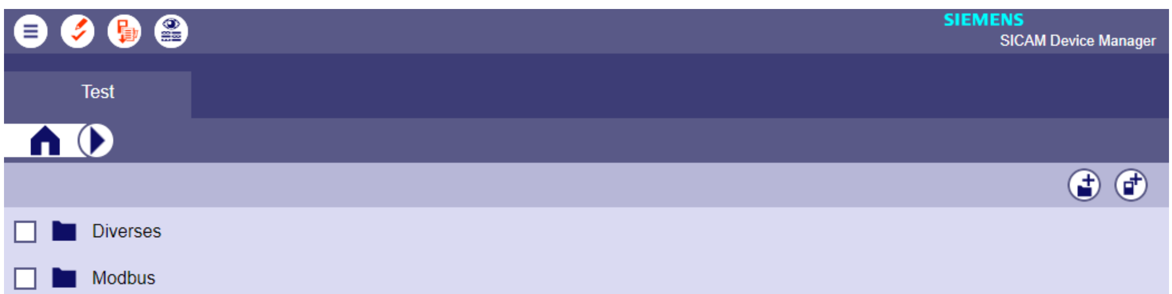
The parameters for the new device can be stored in a new folder within the project. The folder structure can also be created hierarchically (i.e. with sub-folder).

- Create Folder



[DM_Ordner_erzeugen1, 2, en_US]



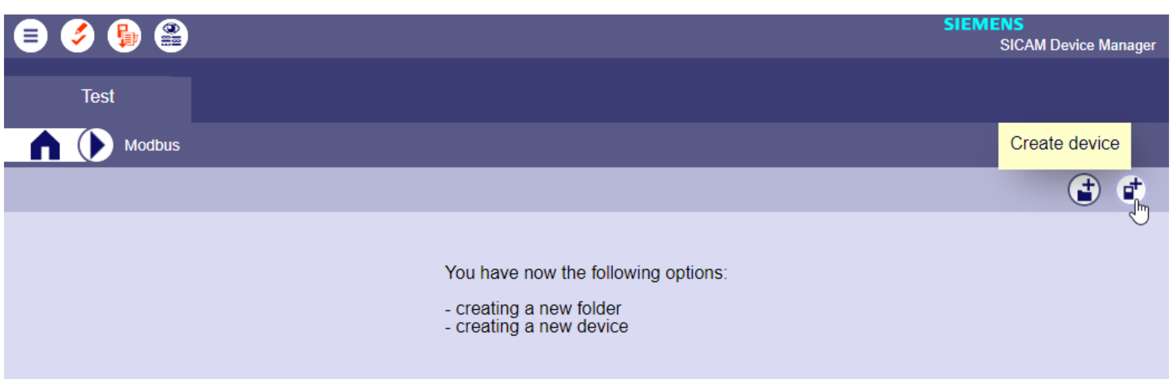


[DM_Ordner_erzeugen3, 2, en_US]

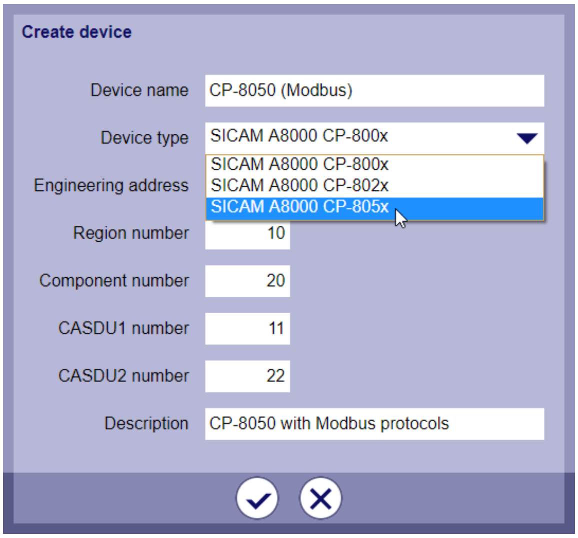
Create Device

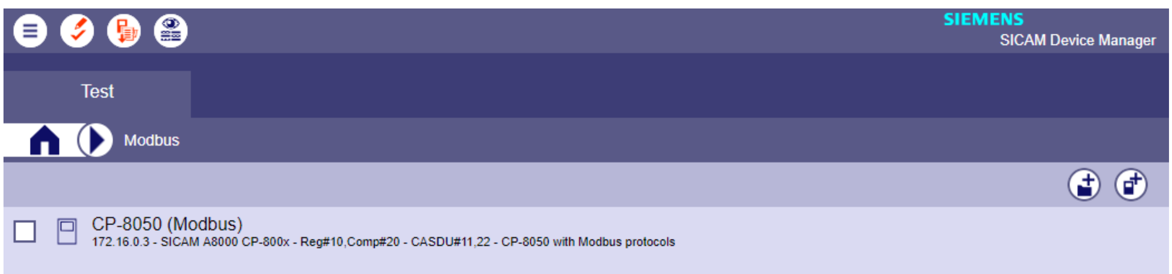
Create a new device within the folder structure.

- Create Device



[DM_Geraet_erzeugen1, 2, en_US]



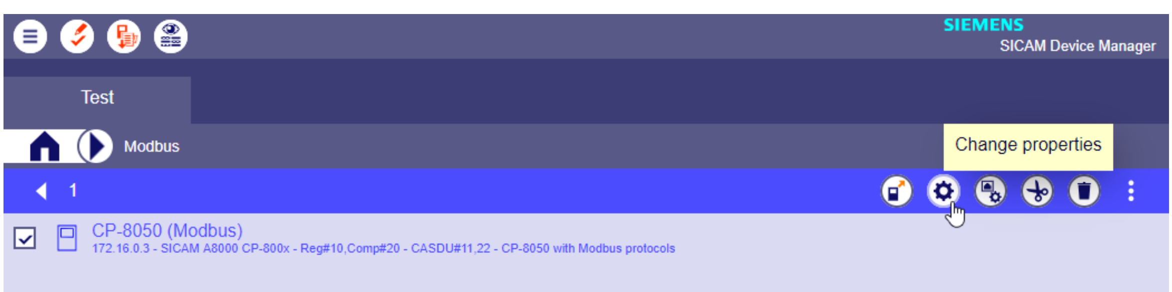


[DM_Geraet_erzeugen3, 2, en_US]

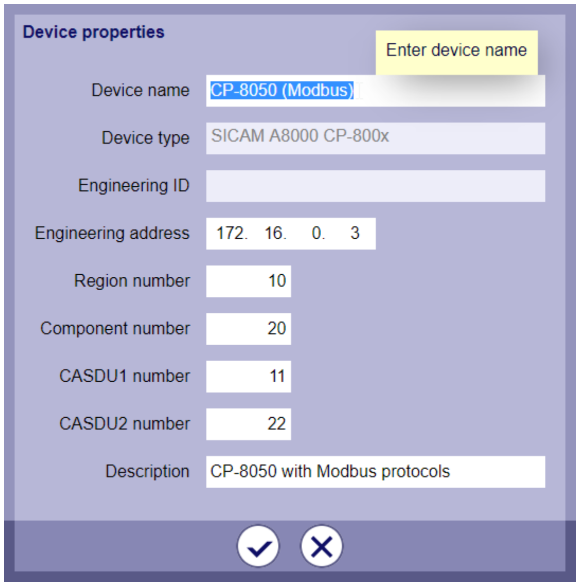
Change Properties for Device

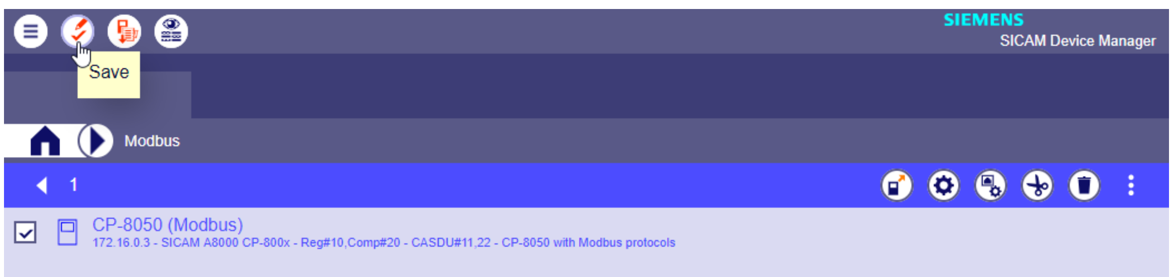
Selected properties can be changed after creation of the device.

- Change Properties



[DM_Geraet_Eigenschaften_aendern1, 2, en_US]



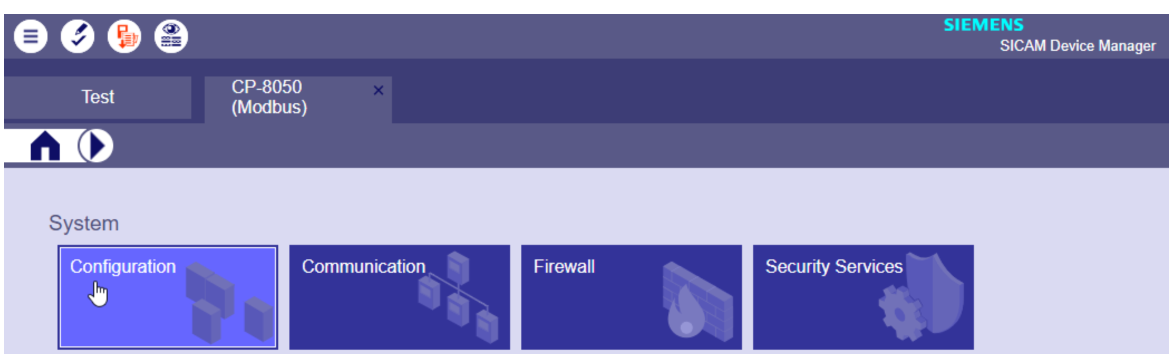


[DM_Geraet_Eigenschaften_aendern3, 2, en_US]

Configuration

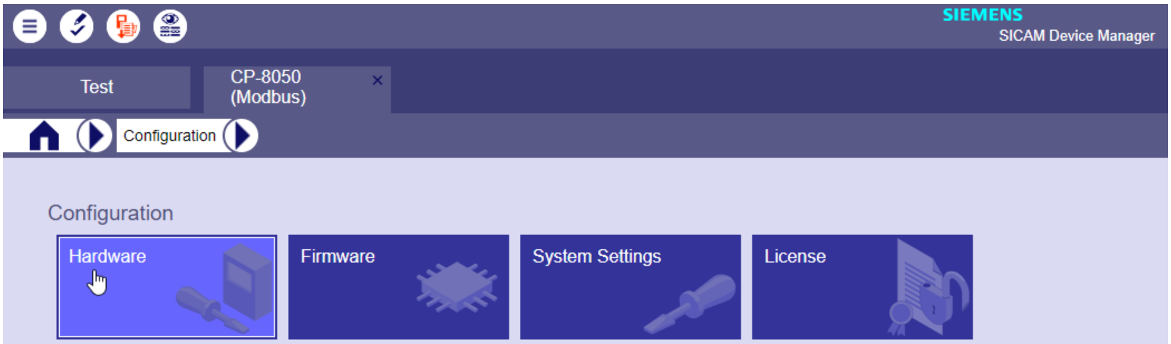
For a new device, at first the hardware must be configured .

- Configuration



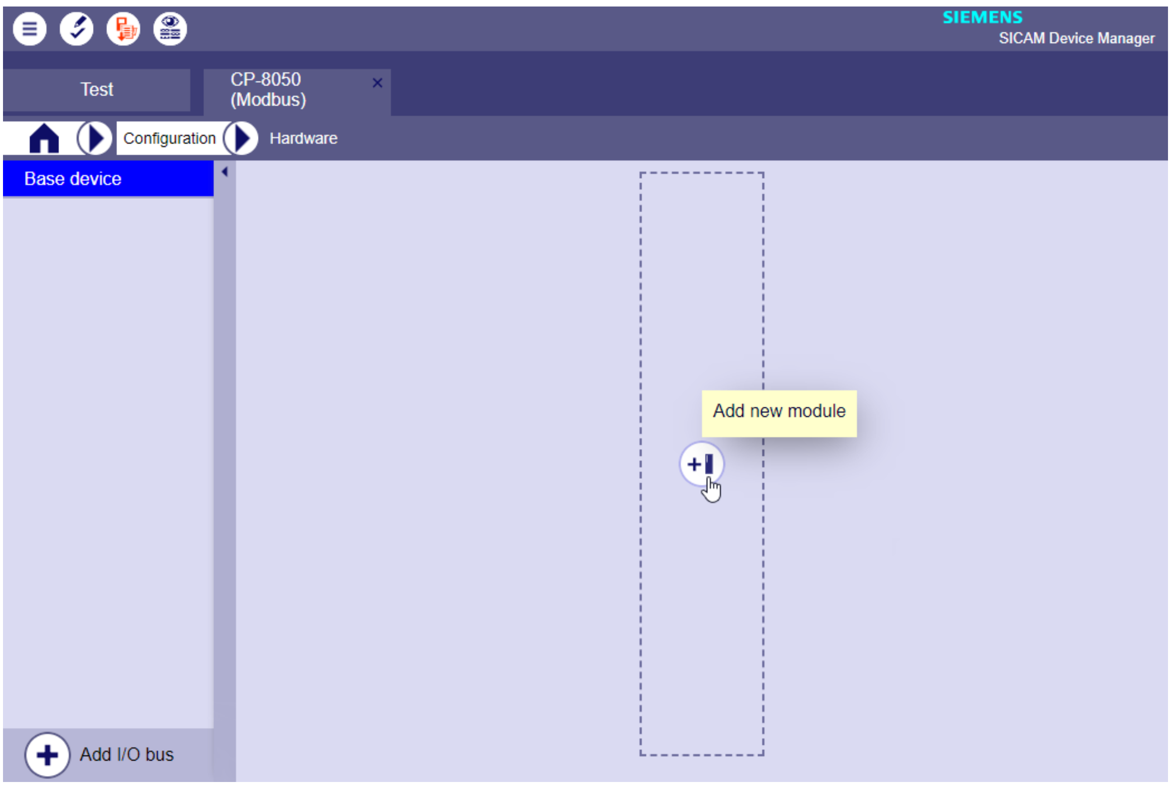
[DM_Konfiguration_b, 2, en_US]

- Configuration | Hardware



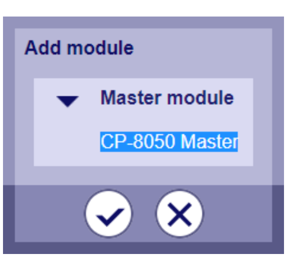
[DM_Konfiguration_Hardware1, 2, en_US]

- Configuration | Hardware | Add new Module (add basic devise "Master Module")

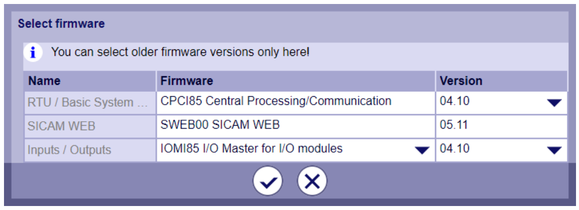


[DM_Konfiguration_Hardware2, 2, en_US]

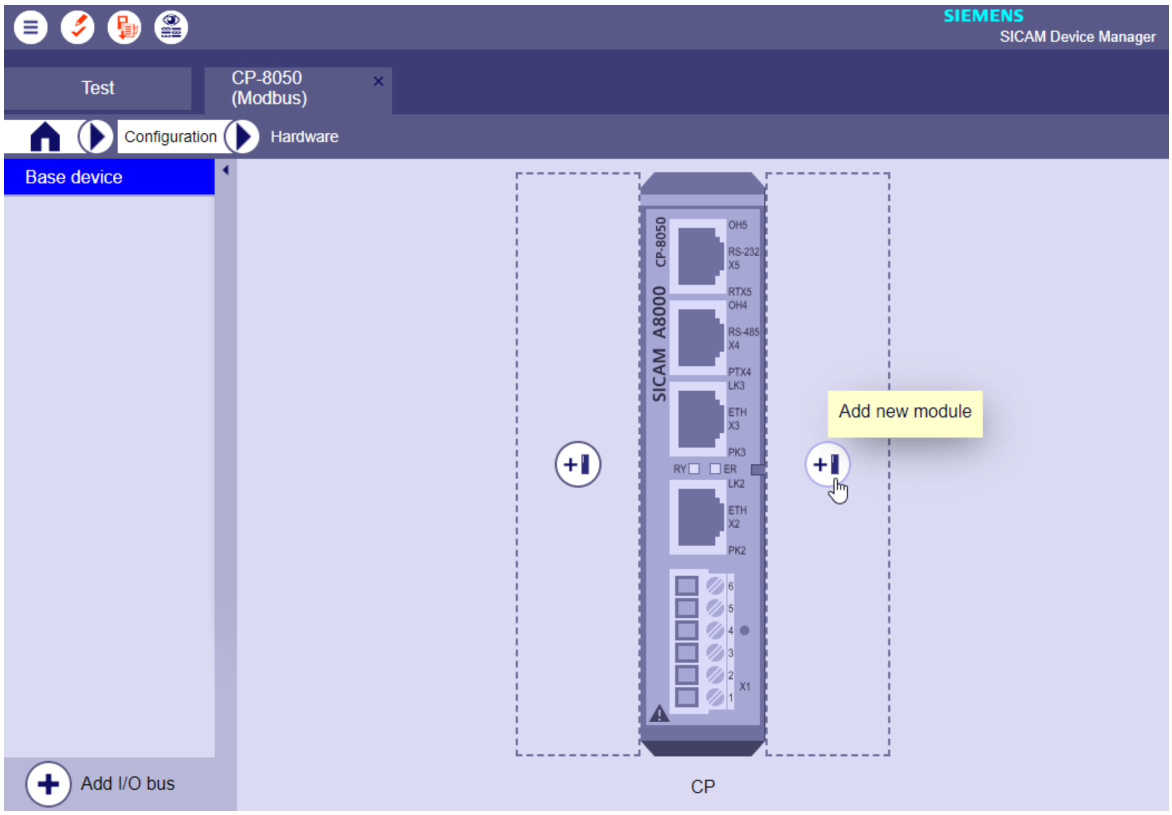
- Add Master Module



- Select Firmware and Firmware version

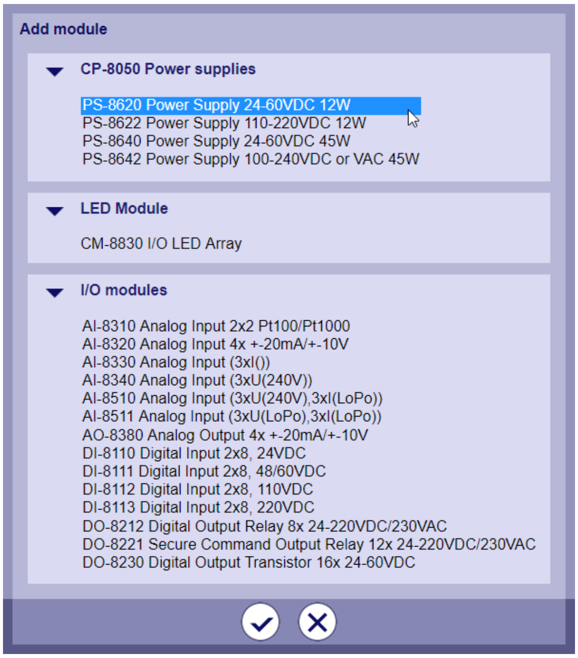


- Configuration | Hardware | Add new Module (equip power supply)

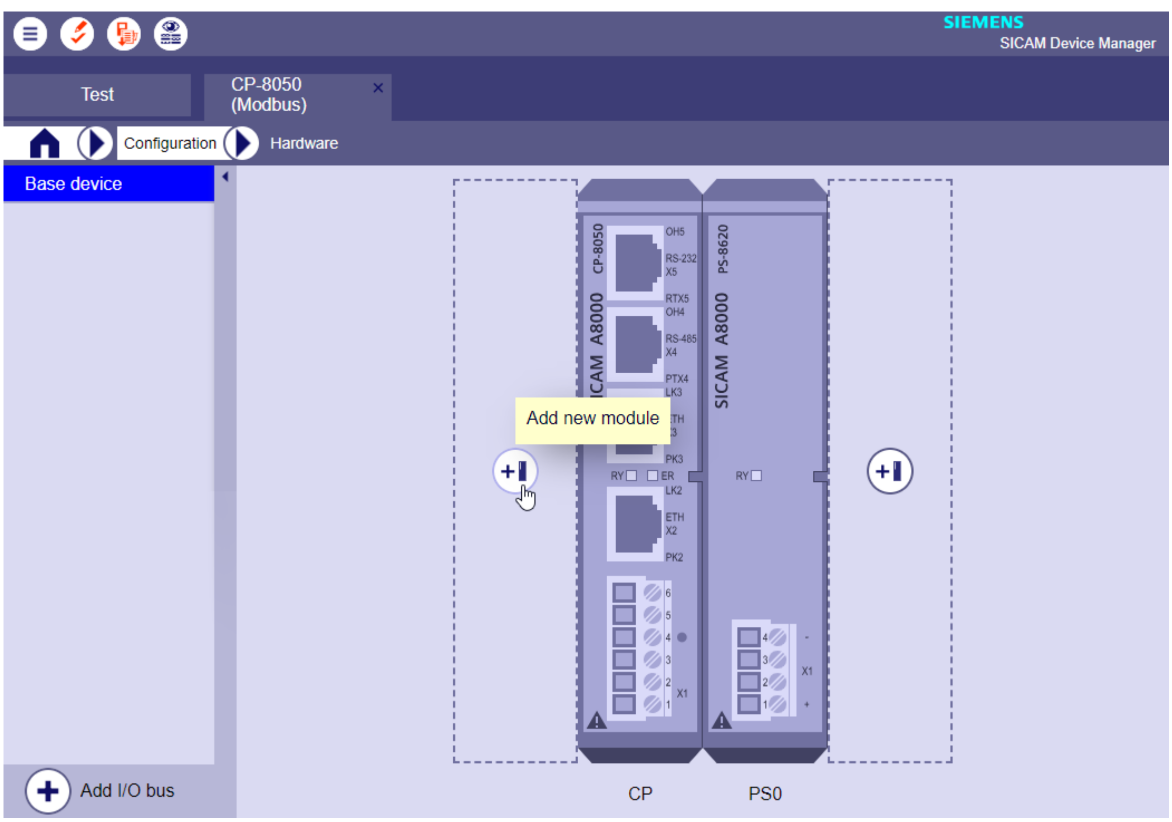


[DM_Konfiguration_Hardware6, 2, en_US]

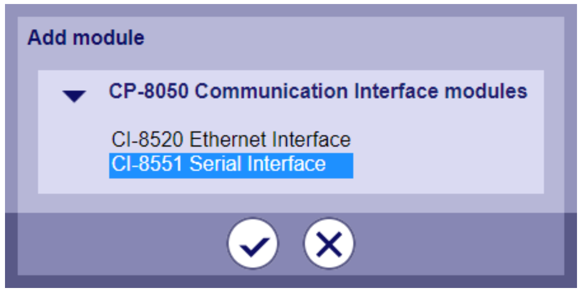
- Configuration | Hardware | Add new Module (select power supply)

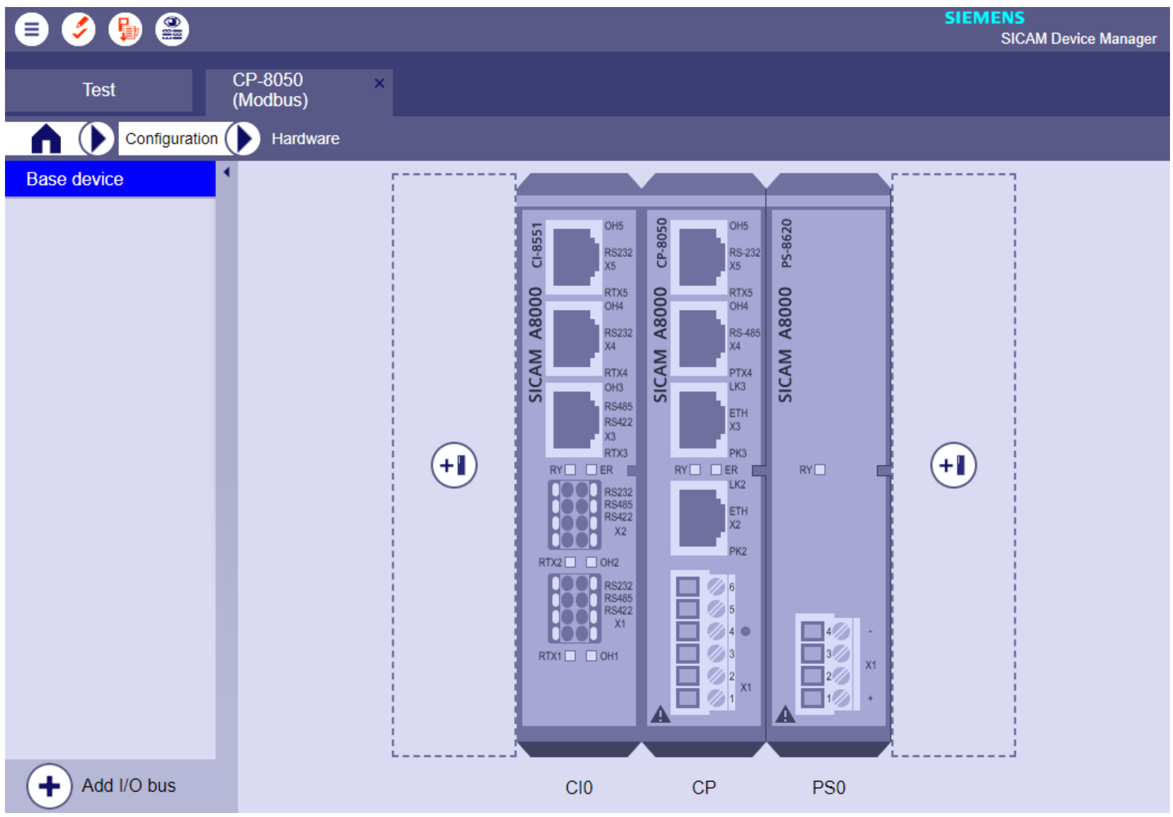


- Configuration | Hardware | Add new Module (e.g. equip CI-8551 Serial Interface)



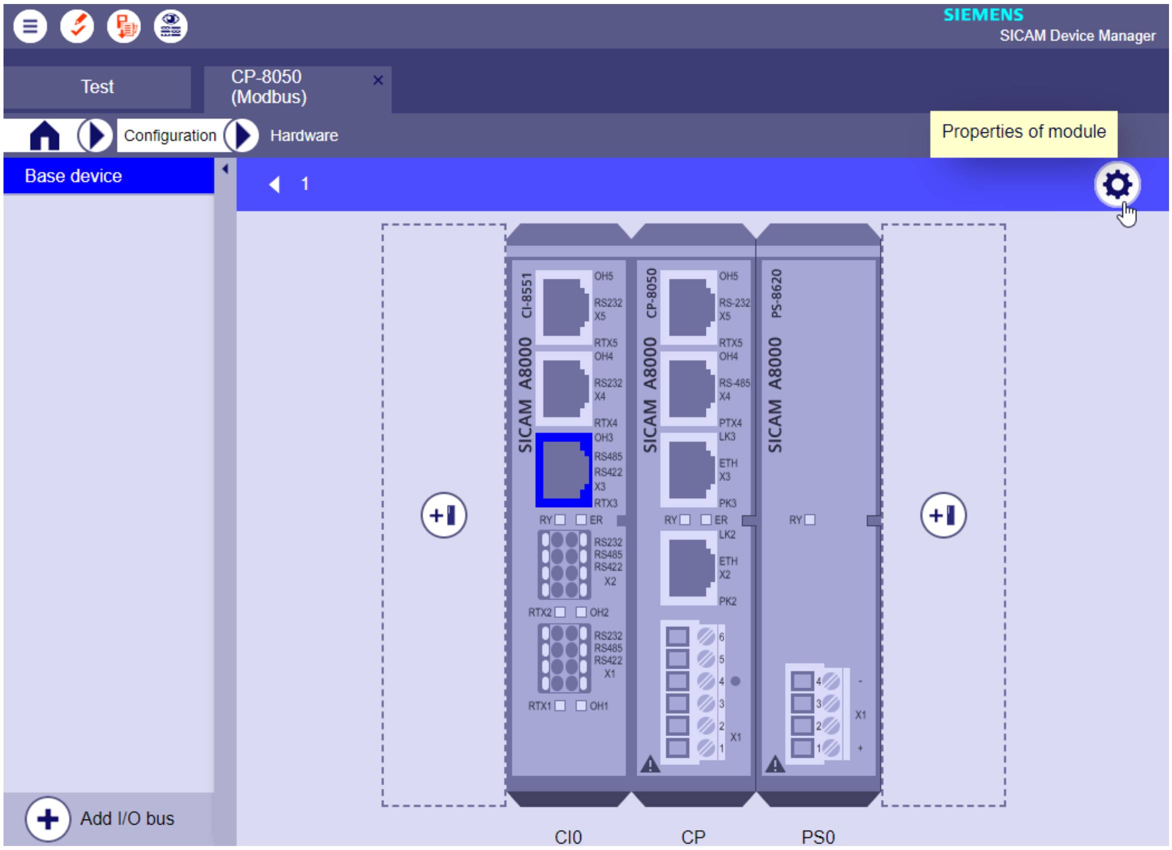
[DM_Konfiguration_Hardware8, 2, en_US]



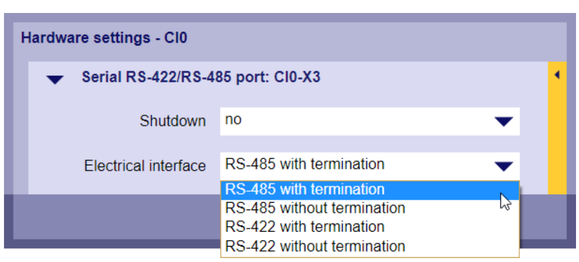


[DM_Konfiguration_Hardware10, 2, en_US]

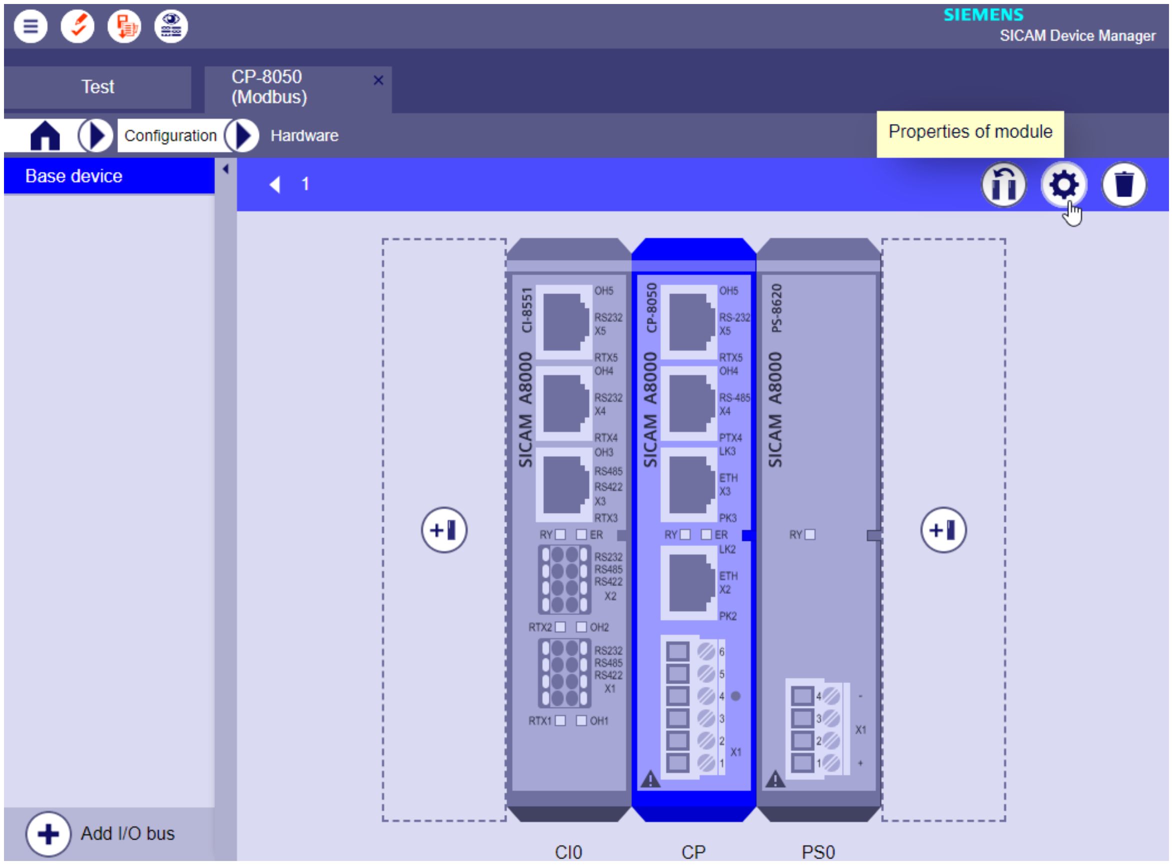
- Configuration | Hardware | Change Module Properties (change only selected interfaces)
  → Select connector
  → Module properties



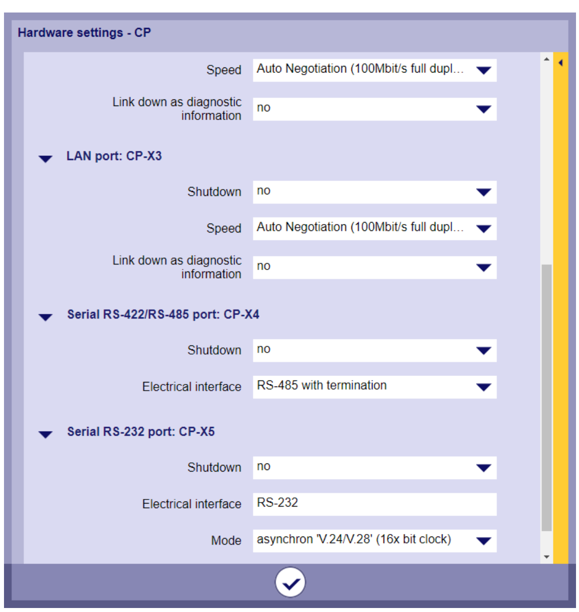
[DM_Konfiguration_Hardware11, 2, en_US]



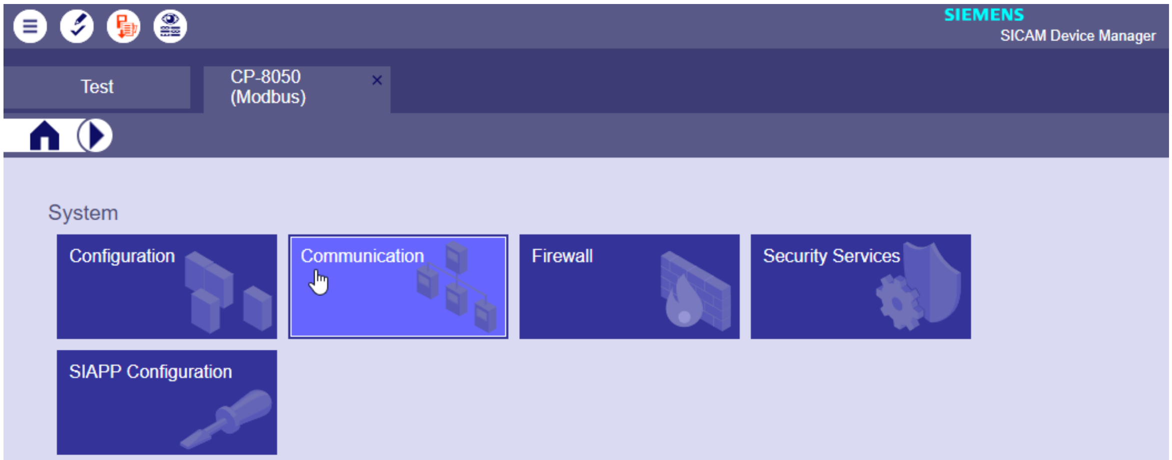
- Configuration | Hardware | Change Module Properties (change only selected modules)
  → Select Module (click on module with the mouse)
  → Module properties



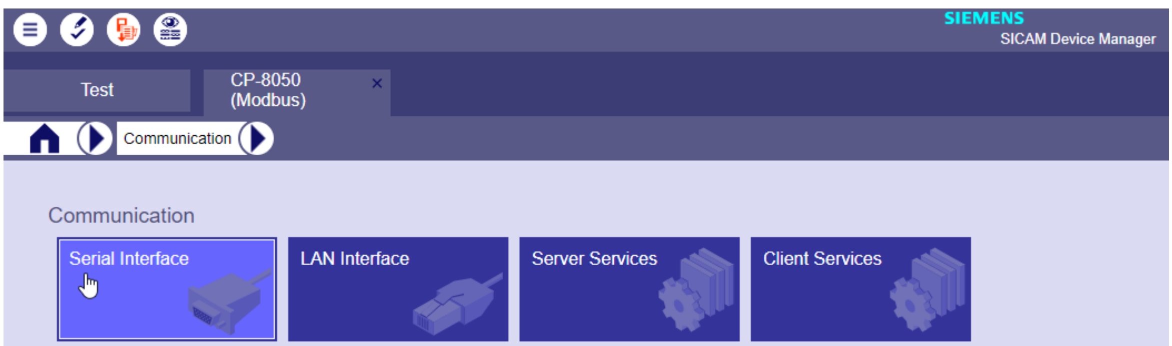
[DM_Konfiguration_Hardware13, 2, en_US]



- Communication | Serial interfaces

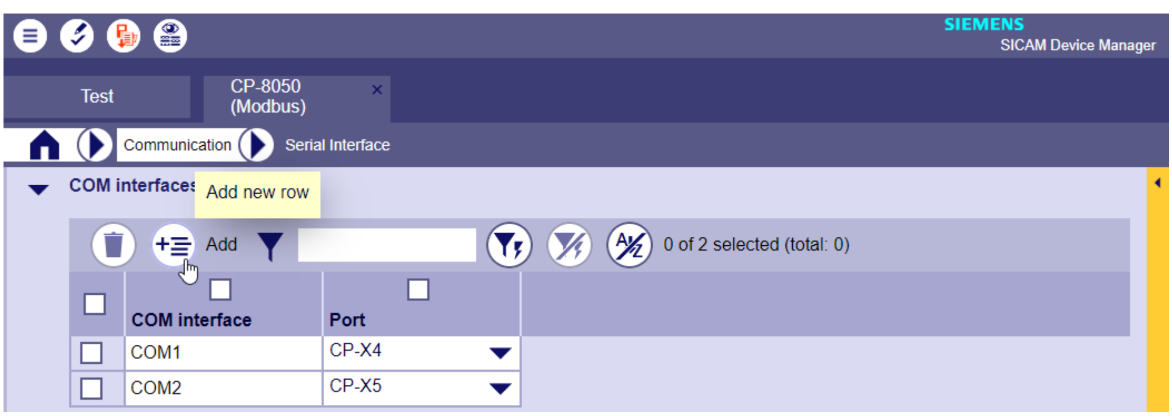


[DM_Kommunikation1, 2, en_US]



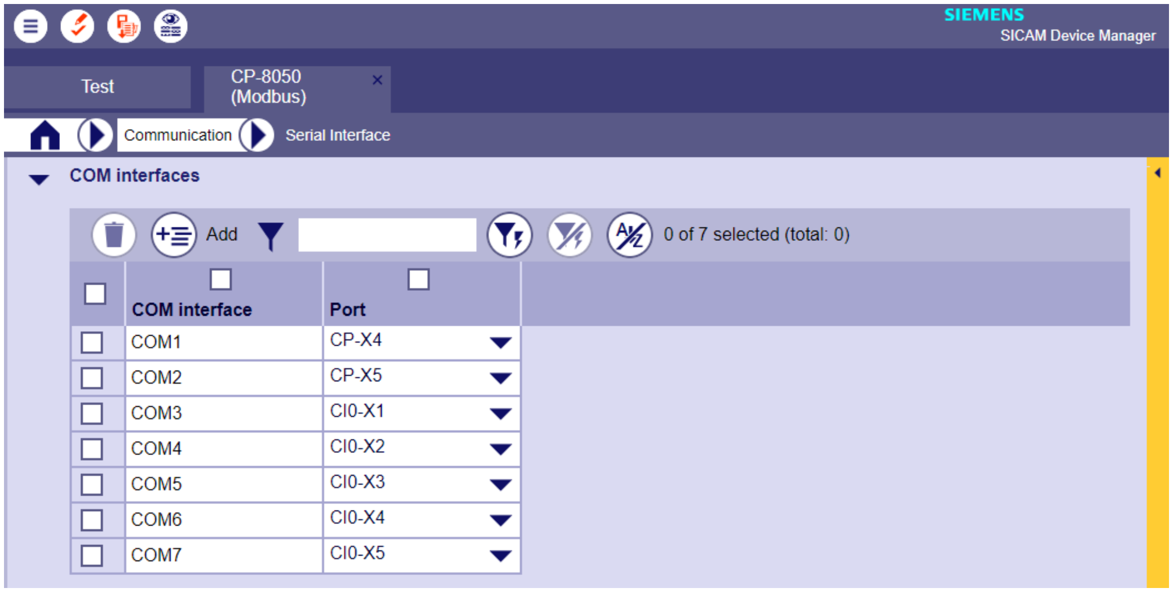
[DM_Kommunikation2, 2, en_US]

- Communication | Add serial interfaces



[DM_Kommunikation3, 2, en_US]

- Communication | Add serial interfaces | Select port for COM interface

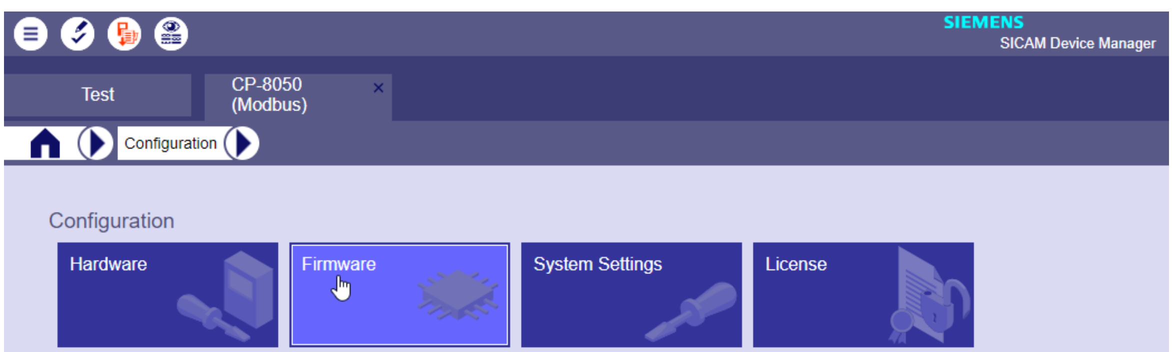


[DM_Kommunikation4, 2, en_US]

Configuration Firmware

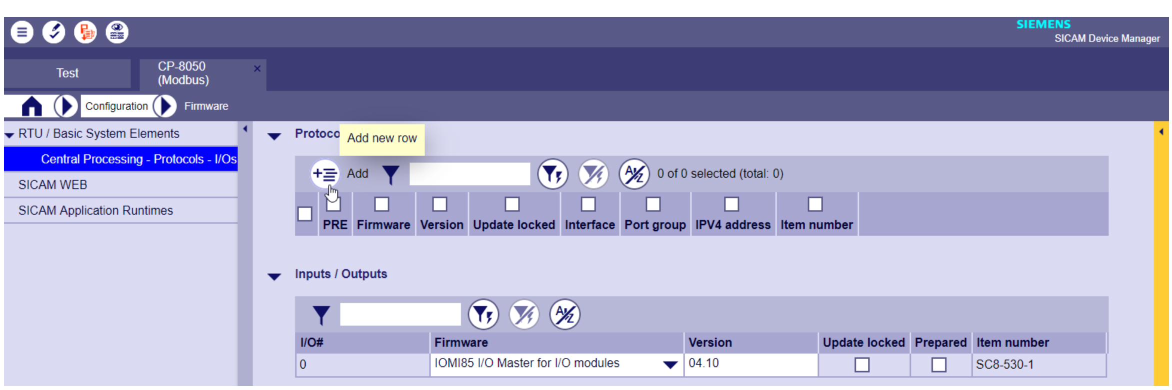
Select the desired communication protocol.

- Configuration | Firmware



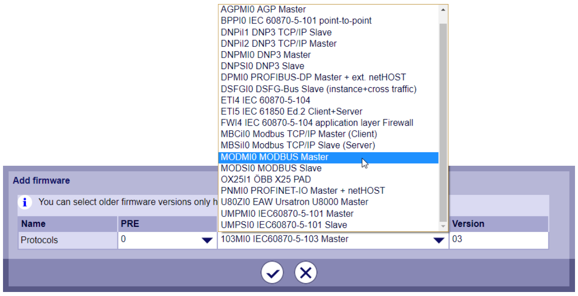
[DM_Konfiguration_Firmware1, 2, en_US]

- Configuration | Firmware: Add new line for protocols

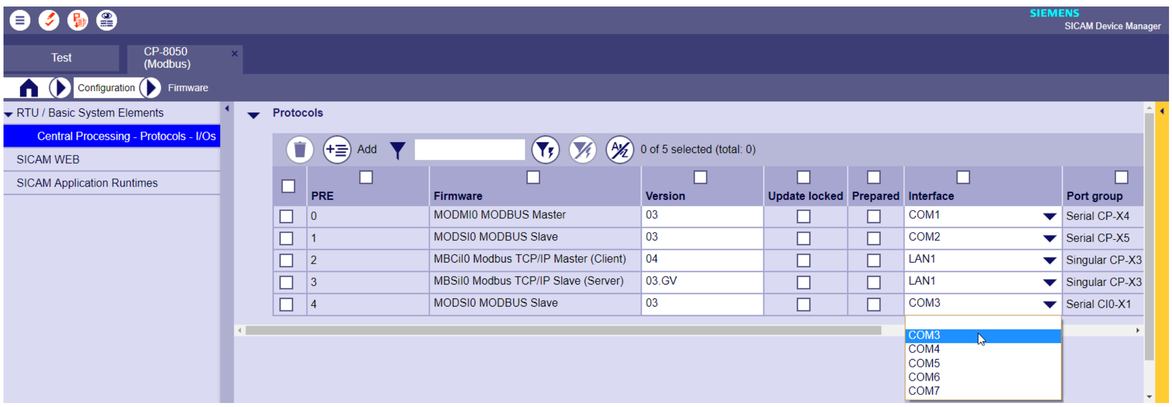


[DM_Konfiguration_Firmware2, 2, en_US]

- Configuration | Firmware: Select protocol



- Configuration | Firmware: Select interface for protocol



[DM_Konfiguration_Firmware6, 2, en_US]

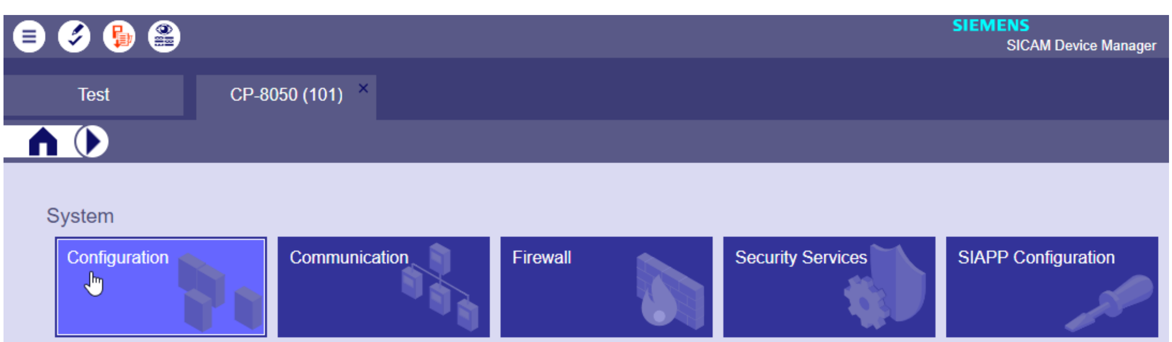
13.1.4.3 Change Firmware Version for Protocol in SICAM Device Manager

If a newer firmware version is available for a protocol and this is to be used, then this firmware must first be imported into the SICAM Device Manager and the new firmware assigned to the corresponding interface.

- Download Firmware - see *13.1.4.1 Import Firmware Files to SICAM Device Manager*
- Import Firmware - see *13.1.4.1 Import Firmware Files to SICAM Device Manager*

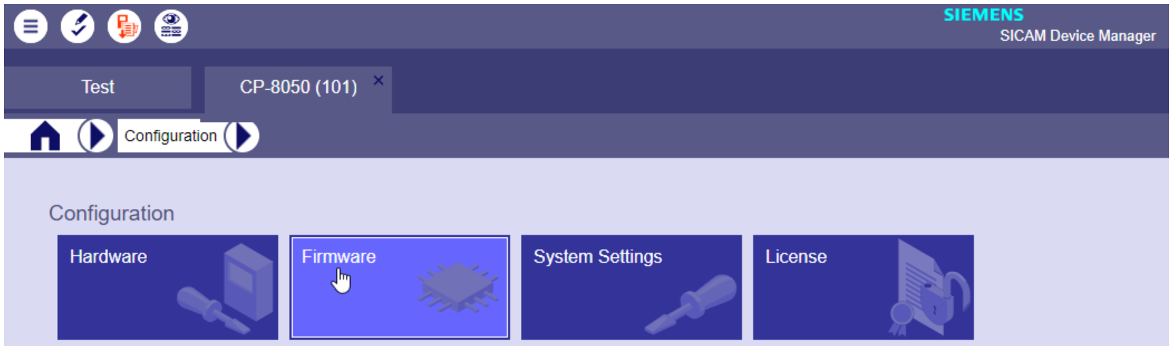
Change Firmware Version

- Configuration



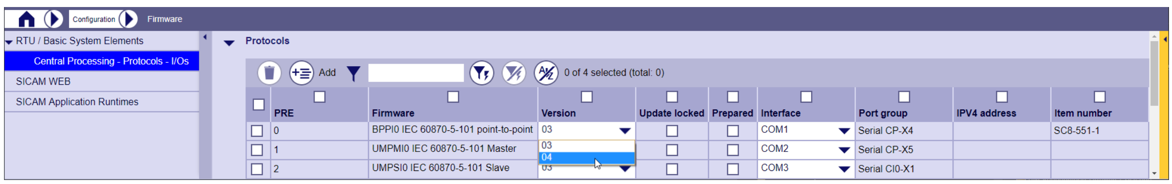
[DM_Konfiguration, 2, en_US]

- Configuration | Firmware

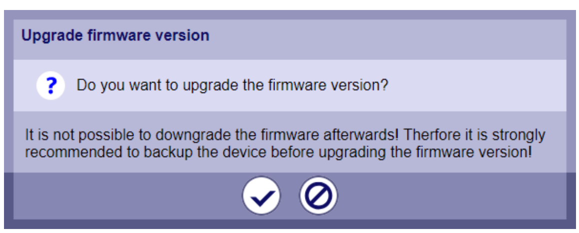


[DM_Konfiguration_Firmware, 2, en_US]

- Configuration | Firmware: select desired version of firmware



[DM_Konfiguration_Firmware_Version, 2, en_US]



- Store
- ... the new or changed firmware version still has to be loaded into the device (update device).

13.1.4.4 Selection of an Ethernet Interface for Communication Protocols

Ethernet interfaces are available on the master modules CP-8031, CP-8050 and on the communication modules CI-8520, CI-8522.

An interface must be assigned to each equipped Ethernet protocol.

Module	Interface (Port)	Interface
CP-8031 CP-8050	CP-X2, CP-X3	Ethernet (electrical) according to IEEE 802.3 (10Base-T or 100Base-TX)
CI-8520 [89]	CIn-X1 to CIn-X5	Ethernet (electrical) according to IEEE 802.3 (10Base-T or 100Base-TX)
CI-8522 [89]	CIn-X1 to CIn-X3	Ethernet (electrical) according to IEEE 802.3 (10Base-T or 100Base-TX)
CI-8522 [89]	CIn-X4, CIn-X5	Ethernet (optical) according to IEEE 802.3 (100 Mbit)

CIn: n = 0 to 1 (depending on component combinations with CI-8551 and CI-852x)

Electrical properties, pin assignment see *5.2 SICAM A8000 Master Modules* and *5.7.1 CI-8520 Ethernet Interface* and *5.7.2 CI-8522 Network Interface Optical*.

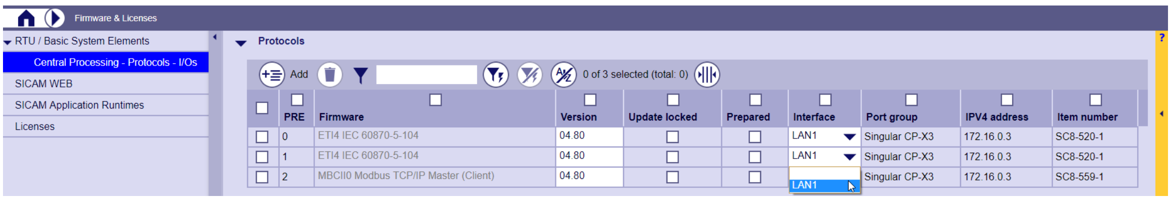
The selection of the Ethernet interface is shown here as an example for the IEC 60870-5-104 protocol (firmware: ETI4) and Modbus TCP/IP Master (Client) (Firmware: MBCII0) – but applies analogous to all serial protocols.

89 With CP-8031 not supported by default. With a license (see *14.8 SICAM A8000 CP-803x Extended CI-Module*) 1 communication module CI-8551 can be used additionally also with CP-8031.

Selection of the Ethernet Interface

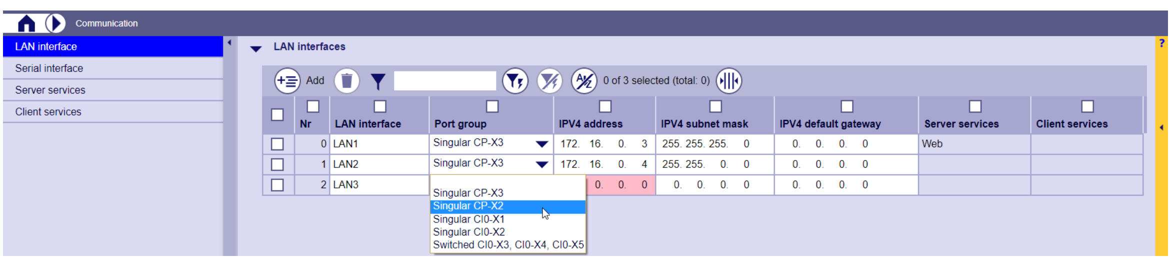
(Add protocols see *13.1.4.2 Load Protocols with the SICAM Device Manager*)

- Select LAN interface
  The LAN interface is selected per protocol with the parameter **`[Home] Firmware & Licenses | Central processing - Protocols - I/Os | Interface`**. Newly added Ethernet protocols are assigned the CP-X3 interface by default. If other LAN interfaces are to be selected, then the LAN interfaces must first be added under **`[Home] Communication | LAN interface`**. The IP address for the own device on the LAN interface can also be set under **`[Home] Communication | LAN interface`**.



[Zuordnung_Protokoll_LAN_Schnittstelle_CP [GER], 2, en_US]

- Add LAN interfaces
  A LAN interface is added in the parameters **`[Home] Communication | LAN interfaces`** and assigned to a port group. The IP address for your own device (0.0.0.0 is not permitted), subnet mask and default gateway must be configured for each LAN interface.



[LAN-Schnittstelle hinzufügen [GER], 2, en_US]

NOTE

So that a new port group can be selected for a LAN interface, the port group must first be set for each module in the module properties under **`[Home] Hardware | Module Properties | LAN port groups`**. . (see LAN port groups in chapter *13.1.4.6 Ethernet Interface – Module Properties*).

13.1.4.5 Selection of a serial interface for communication protocols

Serial interfaces are available on the master module CP-8031, CP-8050 and on the communication module CI-8551.
An interface must be assigned to each equipped Serial protocol.

Module	Interface (Port)	Interface	X.24 X.27	SICAM TOOLBOX II Engineering interface	Power supply of external converter/modem
CP-8031 CP-8050	CP-X4	RS-485, RS-422	–	–	–
CP-8031 CP-8050	CP-X5	direct link interface (RS-232)	✓[90]	✓	5 V or 12 V (optional)

90 X.24/X.27 interface only with RS-232 interface + external converter!

Module	Interface (Port)	Interface	X.24 X.27	SICAM TOOLBOX II Engineering interface	Power supply of external converter/modem
CP-8050 + CI-8551	CIn-X1	RS-232, RS-485, RS-422	✓[90]	–	–
	CIn-X2	RS-232, RS-485, RS-422	✓[90]	–	–
	CIn-X3	RS-485, RS-422	–	–	–
	CIn-X4	direct link interface (RS-232)	✓[90]	–	5V (optional)
	CIn-X5	direct link interface (RS-232)	✓[90]	–	5V (optional)

CIn: n = 0 to 5 (depending on component combinations with CI-852x)

Electrical properties, pin assignment see *5.2 SICAM A8000 Master Modules* and *5.7.3 CI-8551 Communication Interface Serial*.

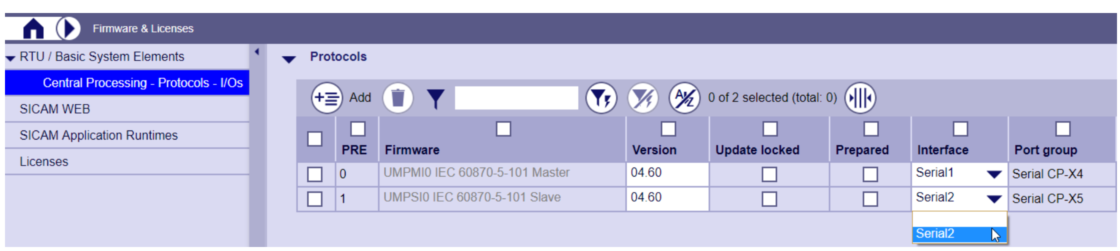
The selection of the serial interface is shown here as an example for the IEC 60870-5-101 protocol Multi-Point Traffic (firmware: UMPMI0, UMPSI0) – but applies analogous to all serial protocols.

Selection of the serial interface

(Add protocols see *13.1.4.2 Load Protocols with the SICAM Device Manager*)

- Select serial interface

  A serial interface is selected with the parameter **`[Home] Firmware & Licenses | Central processing - Protocols - I/Os | Interface`**.

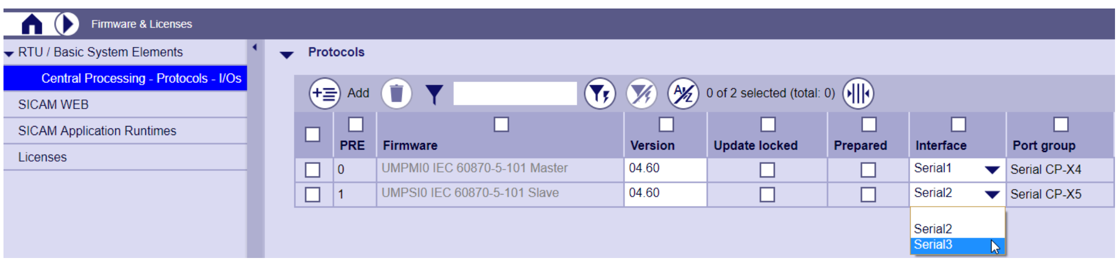


[Zuordnung_Protokoll_serielle_Schnittstelle_CP [GER], 1, en_US]

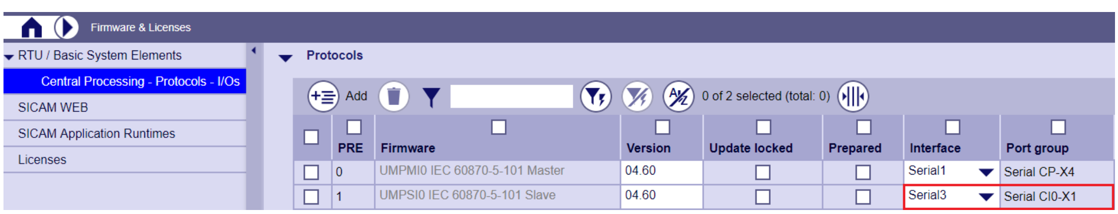
- Add serial interface (only CP-8050)
  If a CI-8551 module is newly equipped or if previously unused interfaces are to be used, then the interfaces must be added in the parameters **`[Home] Communication | Serial interfaces`** and assigned to a port.

[Zuordnung_Serielle-Schnittstelle_zu_Port_red [GER], 1, en_US]

After that, a newly added interface can be assigned to a protocol.



[Zuordnung_Protokoll_serielle_Schnittstelle_CI [GER], 1, en_US]



[Zuordnung_Protokoll_serielle_Schnittstelle_CI_b_red [GER], 1, en_US]

NOTE

Certain operating modes of the interfaces (RS-232, RS-422/RS-485, X.24/X.27, TOOLBOX II engineering interface, power supply of external converter) are only supported by certain interfaces and selected protocol firmware.
(see *13.1.4.7 Select Interface - Module Properties*)

13.1.4.6 Ethernet Interface – Module Properties

Function	CP-8050 CP-8031 [X2, X3]	CI-8520 [91] [X1 - X5]	CI-8522 [91] [X1 - X3]	CI-8522 [91] [X4, X5]
Speed				
Autonegotiation (100 Mbit/s full duplex), Auto-MDIX [92]	✓	✓	✓	–
Autonegotiation (100 Mbit/s half duplex), Auto-MDIX [92]	✓	✓	✓	–

91 With CP-8031 not supported by default. With a license (see *14.8 SICAM A8000 CP-803x Extended CI-Module*), 1 communication module (CI-8551 or CI-852x) can be used additionally also with CP-8031.
92 Auto-MDIX = Auto Medium Dependent Interface Crossover (automatic detection of the transmission and reception lines of the connected device)

Function	CP-8050 CP-8031 [X2, X3]	CI-8520 [91] [X1 - X5]	CI-8522 [91] [X1 - X3]	CI-8522 [91] [X4, X5]
Autonegotiation (10 Mbit/s full duplex), Auto-MDIX [92]	–	✓	✓	–
Autonegotiation (10 Mbit/s half duplex), Auto-MDIX [92]	–	✓	✓	–
Autonegotiation, Auto-MDIX [92]	✓	✓	✓	–
100 Mbit/s (full duplex), Auto-MDIX [92]	✓	✓	✓	–
100 Mbit/s (half duplex), Auto-MDIX [92]	✓	✓	✓	–
10 Mbit/s (full duplex), Auto-MDIX [92]	–	✓	✓	–
10 Mbit/s (half duplex), Auto-MDIX [92]	–	✓	✓	–
100 Mbit/s (Full duplex) [93]	–	–	–	✓
Physical interface				
Ethernet (electrical)	✓	✓	✓	–
Ethernet (optical)	–[94]	–[94]	–[94]	✓
Shut Down	✓	✓	✓	✓
Link Down as diagnostic information	✓	✓	✓	✓
LAN port groups				
Singular	✓	✓	✓	✓
Switched	–	✓	✓	✓
External Switch	–	✓	✓	✓
HSR	–	✓	✓	✓
Line	–	✓	✓	✓
PRP	–	✓	✓	✓
RSTP	–	✓	✓	✓
Parameters for port group[95]				
• TCP minimum expected acknowledgment time	0 to 3000 ms (standard setting = 250 ms)			
• Maximum transmission unit	68 to 9000 Bytes (standard setting = 1500 Bytes)			
• 802.1x Supplicant [96]	–		EAP-TLS	
Parameter for port group = RSTP				
• RSTP priority	–	0 to 61440		
• RSTP maximum age	–	6 to 40 (standard setting = 20)		
• RSTP hello time	–	1 s to 2 s (standard setting = 2 s)		
• RSTP forward delay	–	4 s to 30 s (standard setting = 15 s)		
• RSTP Transmit hold counter	–	1 to 10 (standard setting = 6)		

91 With CP-8031 not supported by default. With a license (see *14.8 SICAM A8000 CP-803x Extended CI-Module*), 1 communication module (CI-8551 or CI-852x) can be used additionally also with CP-8031.

93 Applies to CI-8522/Port X4, X5 only

94 An external "Ethernet ↔ LWL" media converter is also required for Ethernet (optical).

95 not for LAN port group = "External Switch"

96 Modus for IEEE 802.1x Supplicant service. IEEE 802.1X is a standard for authentication in computer networks. The standard recommends Extensible Authentication Protocol (EAP) or PPP-EAP-TLS Authentication Protocol

Function	CP-8050 CP-8031 [X2, X3]	CI-8520 [91] [X1 - X5]	CI-8522 [91] [X1 - X3]	CI-8522 [91] [X4, X5]
• RSTP Path Cost X1	–	2,000 to 2,000,000,000 (standard setting = 200,000)		
• RSTP Path Cost X2	–	2,000 to 2,000,000,000 (standard setting = 200,000)		

Speed

Ethernet speed – see possible settings per module and port *13.1.4.6 Ethernet Interface – Module Properties*.
Electrical properties, pin assignment see *5.2 SICAM A8000 Master Modules* and *5.7.1 CI-8520 Ethernet Interface* and *5.7.2 CI-8522 Network Interface Optical*.

Shut Down

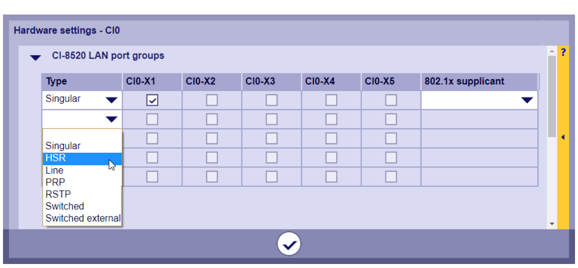
Prepared interfaces can be switched to shutdown for safety reasons.

Link Down as diagnostic information

If the link status of the Ethernet interface is "Down", (e.g.: LAN cable is unplugged or defective, or the switch/router/receiver is switched off or defective, or a directly connected Ethernet interface is defective), a diagnostic message can optionally be generated.

LAN port groups

LAN ports can be used individually, as a LAN port group for Ethernet redundancy or as a switch.
So that a port group can be selected for a LAN interface under **[Home] | communication | LAN interfaces**, the port group must first be configured for each module in the module properties under **[Home] Hardware | Module Properties | LAN port groups** (see *13.1.4.6 Ethernet Interface – Module Properties*, Changing hardware settings (module properties) for Ethernet interfaces).
After selecting the type for the LAN port group, the next free ports (if available) are assigned automatically - the assignment can be changed if required.



Type for LAN port group	CP-8050 CP-8031 [X2, X3]	CI-8520 [91] [X1 - X5]	CI-8522 [91] [X1 - X5]
Singular	✓	✓	✓
HSR	–	✓	✓
Line	–	✓	✓
PRP	–	✓	✓
RSTP	–	✓	✓

91 With CP-8031 not supported by default. With a license (see *14.8 SICAM A8000 CP-803x Extended CI-Module*), 1 communication module (CI-8551 or CI-852x) can be used additionally also with CP-8031.

Type for LAN port group	CP-8050 CP-8031 [X2, X3]	CI-8520 [91] [X1 - X5]	CI-8522 [91] [X1 - X5]
Switched	–	✓	✓
External Switch	–	✓	✓

NOTE

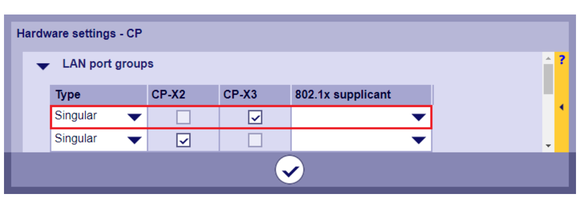
- LAN port groups can only be defined within a module and cannot be extended across other modules.
- Different types can be combined for LAN port groups on one module (including different Ethernet redundancy protocols) if the required number of ports is available.

Designation of the LAN port groups (selection of possible examples):

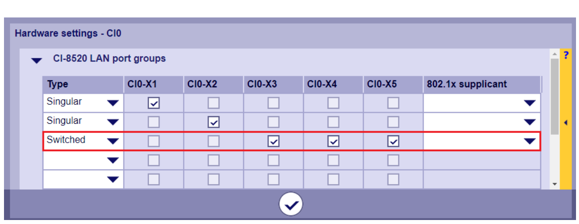
Designation of the LAN port groups	CP-8050 CP-8031 [X2, X3]	CI-8520 [91] [X1 - X5]	CI-8522 [91] [X1 - X5]
Singular CP-X2	✓	–	–
Singular CP-X3	✓	–	–
Singular CIn-X2	–	✓	✓
HSR CIn-X1, CIn-X2	–	✓	✓
HSR CIn-X4, CIn-X5	–	✓	✓
Line Mode CIn-X1, CIn-X2	–	✓	✓
PRP CIn-X1, CIn-X2	–	✓	✓
RSTP CIn-X1, CIn-X2	–	✓	✓
Switched CIn-X2, CIn-X3, CIn-X4, CIn-X5	–	✓	✓

CIn: n = 0 to 1 (depending on component combinations with CI-8551)

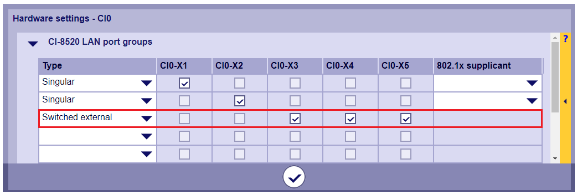
- Singular
  A singular LAN port is typically used for communication with a remote station. Several different protocols can share a singular LAN port.



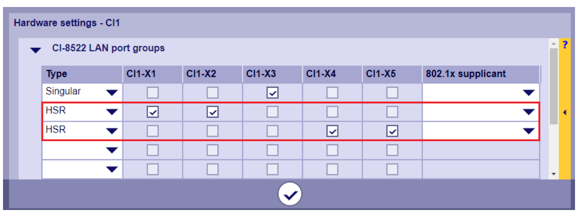
- Switched
  The allocated LAN ports are used as an integrated switch (max. 5 ports) with an internal connection to one or more protocols.



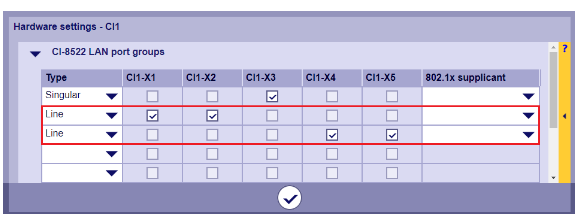
- External Switch
  The dedicated LAN ports serve as an integrated switch for external devices without internal connection to a protocol. This means that an externally required small switch (max. 5 ports) can be integrated into the CP-8050 with CI-852x.



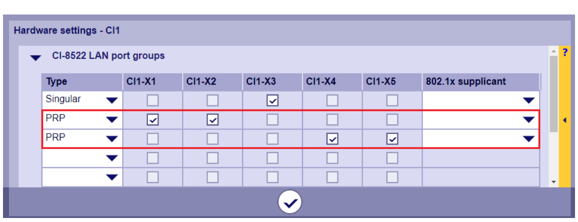
- HSR
  2 assigned LAN ports of a CI-852x module can be used for Ethernet redundancy with HSR (High Availability Seamless Redundancy) (see *13.21 HSR*). Max. 2 separate HSR rings per CI-852x module are possible.



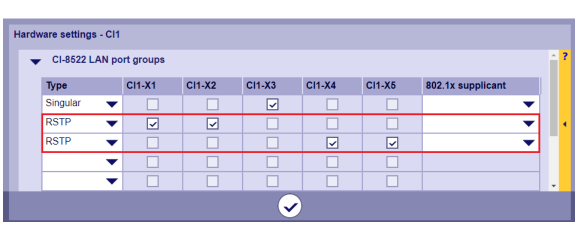
- Line
  2 assigned LAN ports of a CI-852x module can be used for Ethernet redundancy with line mode (see *13.24 Line Mode*). Max. 2 separate line configurations per CI-852x module are possible.



- PRP
  2 assigned LAN ports of a CI-852x module can be used for Ethernet redundancy with PRP (Parallel Redundancy Protocol) (see *13.23 PRP*). Max. 2 separate PRP configurations per CI-852x module are possible.

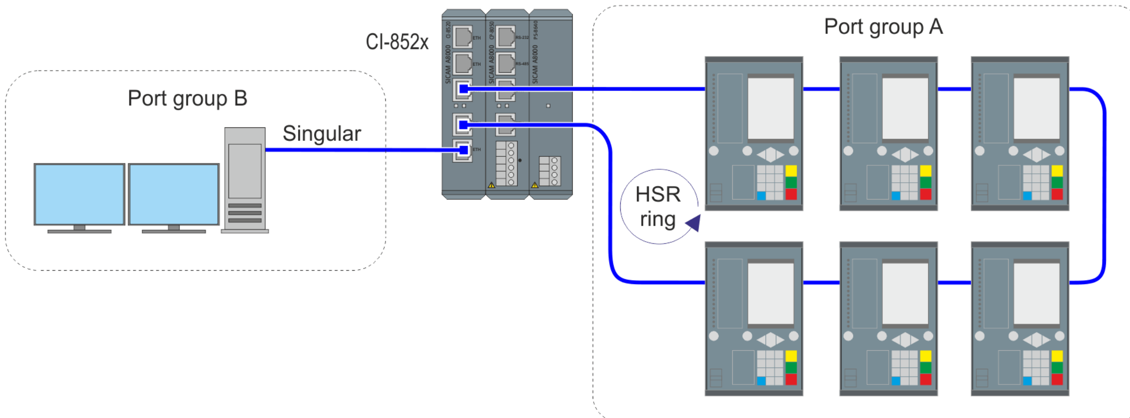


- RSTP
  2 assigned LAN ports of a CI-852x module can be used for Ethernet redundancy with RSTP (Rapid Spanning Tree Protocol) (see *13.22 RSTP*). Max. 2 separate RSTP rings per CI-852x module are possible.



Redbox

With the Redbox function, 2 LAN port groups can be connected to each other. Then traffic is transferred from one LAN port group to the other.



[dw_redbox_config_sing_hsr_01, 1, en_US]

Figure 13-1 Example: Redbox between singular and HSR port group

NOTE

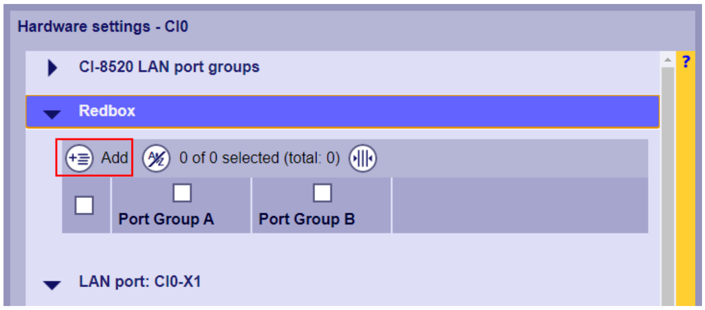
A RedBox license is required for this feature. Order informaton see *14.9 CI-852x RedBox*.

Limitations:

- Engineering only with SICAM Device Manager (not with SICAM Toolbox II)
- Only with CI-852x modules
- Only one RedBox configuration is possible per device
- The following types of LAN port groups can currently be combined:
  - Singular⇔PRP
  - Switched⇔PRP
  - Singular⇔HSR
  - Switched⇔HSR
  - Singular⇔RSTP
  - Switched⇔RSTP
  - Singular⇔Line Mode
  - Switched⇔Line Mode

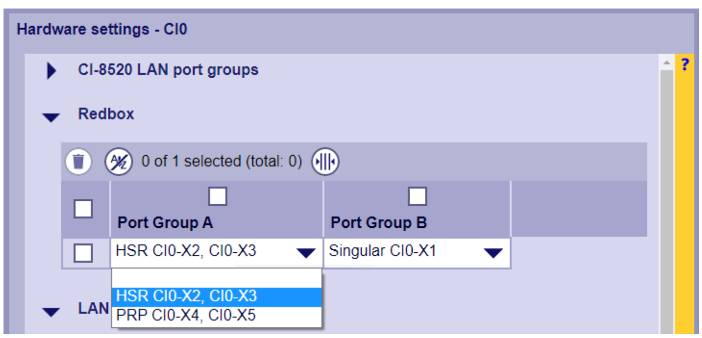
The configuration is done with the SICAM Device Manager in the module properties of the CI module under **`[Home] Hardware | Module Properties`**:

- In the **Redbox** section click **Add**



[sc_SDM_Redbox_01, 1, en_US]

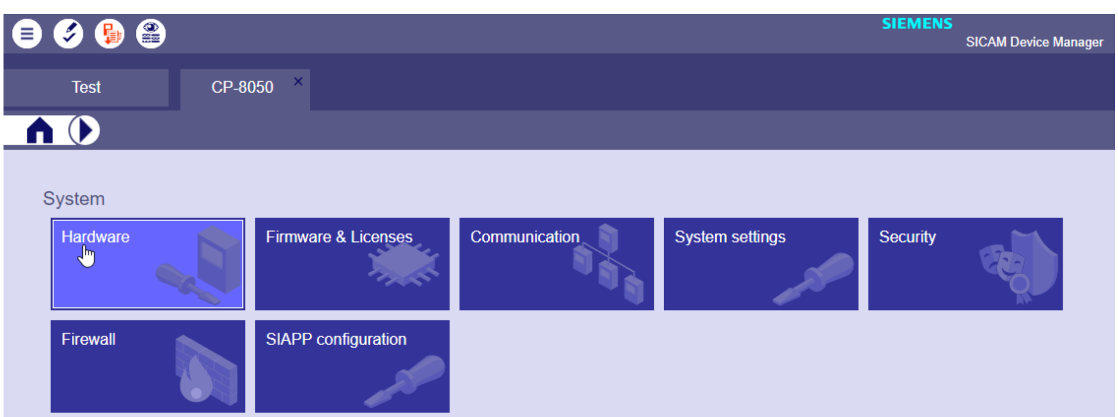
- Select the desired combination from the available LAN port groups



[sc_SDM_Redbox_02, 1, en_US]

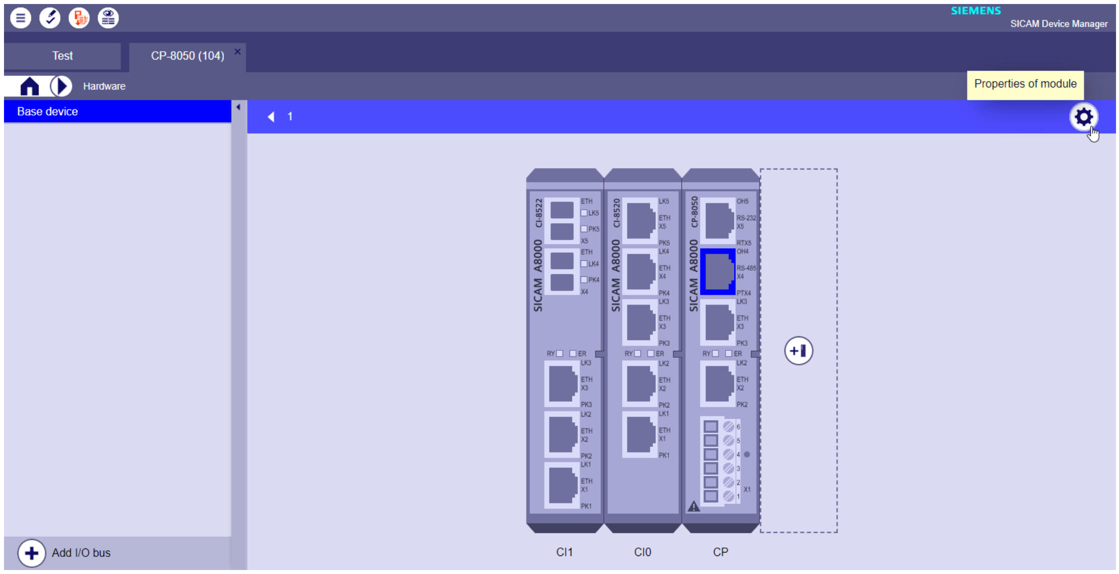
Change hardware settings (module properties) for Ethernet interfaces

- System | Hardware



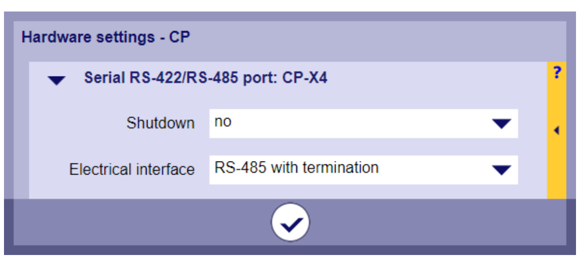
[System_Hardware (104) [GER], 2, en_US]

- Change parameters (module properties) of an Ethernet interface
  →Select Ethernet interface | Change module properties (e.g. CP-8050: X3)

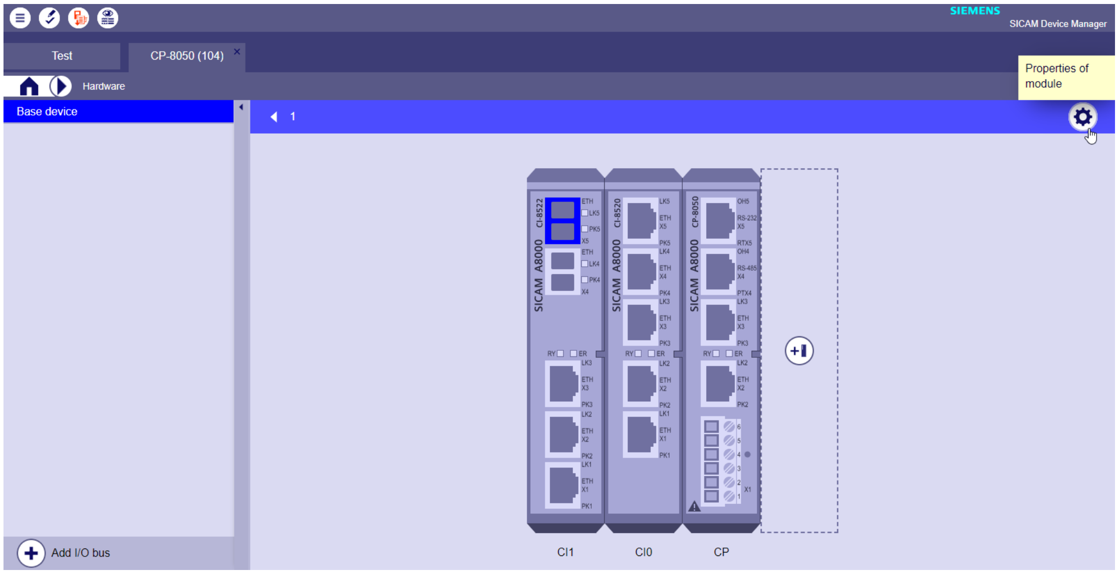


[System_Hardware_CP-8050_Moduleigenschaften_CP-X3 [GER], 2, en_US]

CP-8050: CP-X2, CP-X3
CI-8520: CI-X1 to CI-X5
CI-8522: CI-X1 to CI-X3

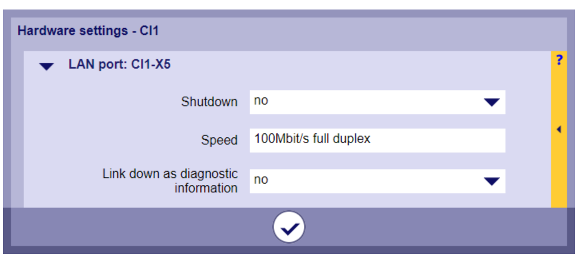


- Change parameters (module properties) of an Ethernet interface
  →Select Ethernet interface | Change module properties (e.g. CI-8522: X5)

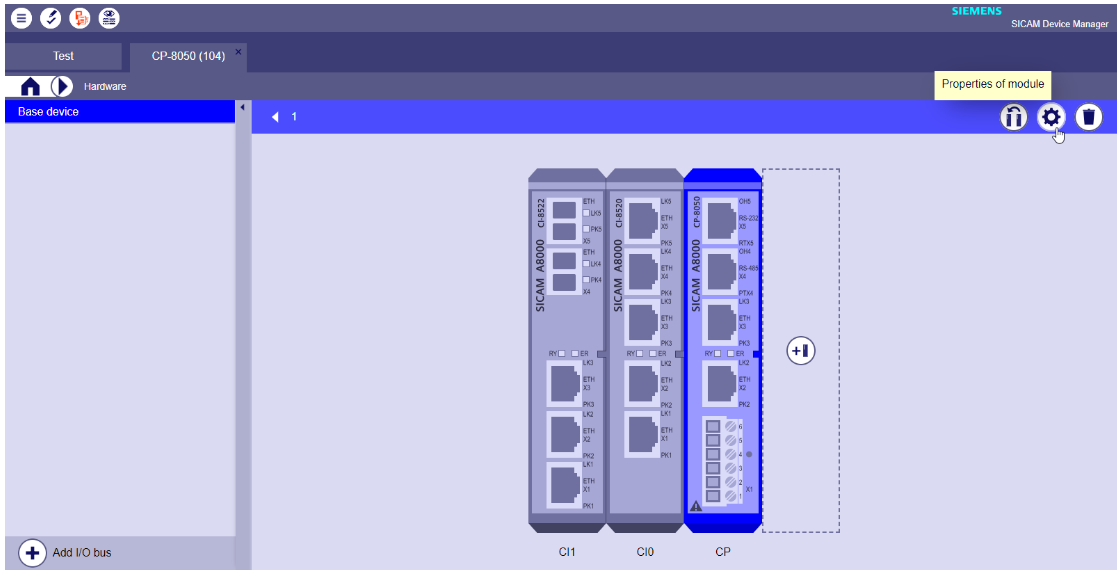


[System_Hardware_CI-8522_Moduleigenschaften_CI-X5 [GER], 1, en_US]

CI-8522: CI-X4, CI-X5

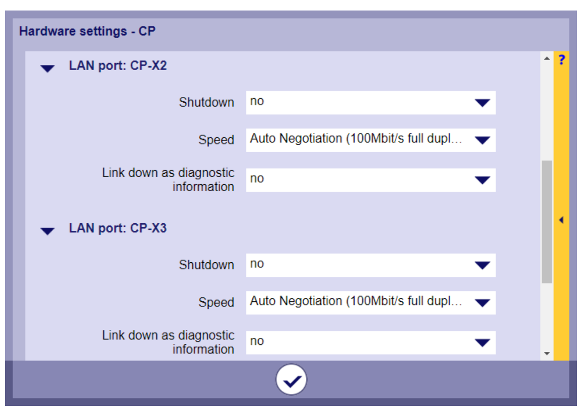


- Change parameters (module properties) for all LAN ports of a module (e.g. CP-8050).
  →select module | Change module properties

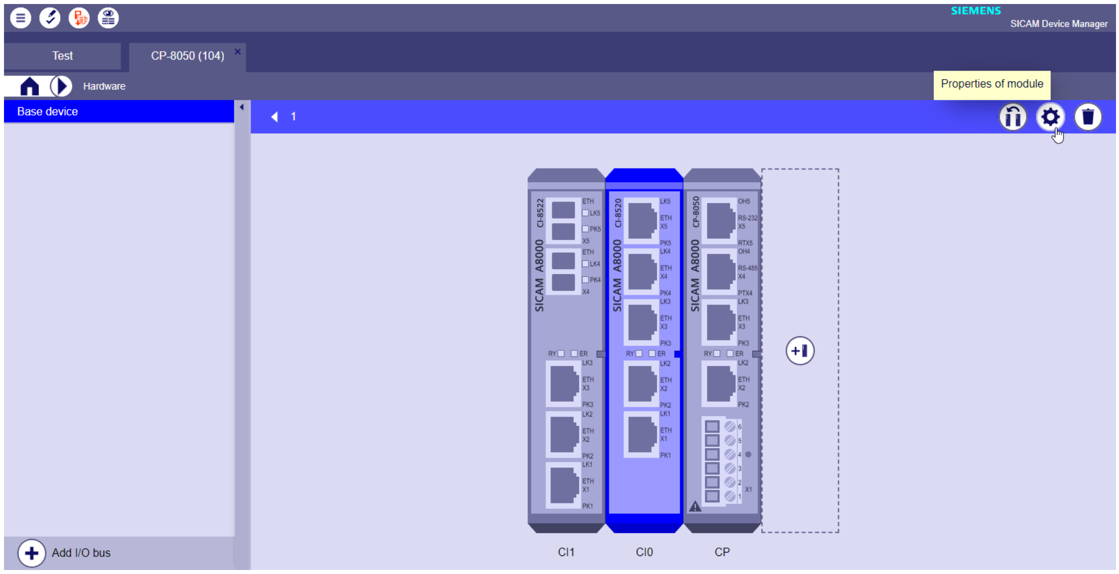


[System_Hardware_CP-8050_Moduleigenschaften [GER], 1, en_US]

CP-8050: CP-X2, CP-X3

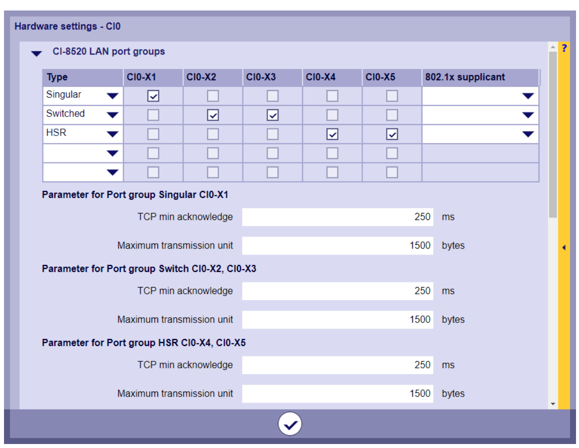


- Change parameters (module properties) for LAN port groups of a module (e.g. CI-8520).
  →select module | Change module properties



[System_Hardware_CP-8520_Moduleigenschaften [GER], 1, en_US]

CI-8520: CI-X1 to CI-X5



13.1.4.7 Select Interface - Module Properties

Function	CP-8050 CP-8031 [X4]	CP-8050 CP-8031 [X5]	CI-8551 [97] [X1, X2]	CI-8551 [97] [X3]	CI-8551 [97] [X4, X5]
Electrical Interface					
direct link interface (RS-232)	–	✓	✓	–	✓
RS-485	✓	–	✓	✓	–
• RS-485 with termination	✓	–	✓	✓	–
• RS-485 without termination	✓	–	✓	✓	–
RS-422	✓	–	✓	✓	–
• RS-422 with termination	✓	–	✓	✓	–

97 With CP-8031 not supported by default. With a license (see *14.8 SICAM A8000 CP-803x Extended CI-Module*), 1 communication module (CI-8551 or CI-852x) can be used additionally also with CP-8031.

Function	CP-8050 CP-8031 [X4]	CP-8050 CP-8031 [X5]	CI-8551 [97] [X1, X2]	CI-8551 [97] [X3]	CI-8551 [97] [X4, X5]
• RS-422 without termination	✓	–	✓	✓	–
Shut Down	✓	✓	✓	✓	✓
Mode					
asynchronous ‘V.24/V.28’ (16 times bit clock)	–	✓	✓	–	✓
isochronous ‘X.24/X.27 ‘(1 time bit clock internal)	–	✓	✓	–	✓
isochronous ‘X.24/X.27 ‘(1 time bit clock extern)	–	✓	✓	–	✓
DSR Power Supply					
none	–	✓	–	–	✓
5 V	–	✓	–	–	✓
12 V	–	✓	–	–	–
Deactivate serial engineering interface	–	✓	–	–	–

Electrical Interface

- RS-232
- RS-485 (with/without integrated bus termination)
- RS-422 (with/without integrated bus termination)

Electrical properties, pin assignment see *5.2 SICAM A8000 Master Modules* and *5.7.3 CI-8551 Communication Interface Serial*.

NOTE

- Certain operating modes of the interfaces (RS-232, RS-422/RS-485, X.24/X.27, TOOLBOX II engineering interface, power supply of external converter) are only supported by certain interfaces and selected protocol firmware.
- RS-485 is only supported by selected communication protocols (typical for multi-point traffic, for example IEC 60870-5-101, IEC 60870-5-103, Modbus, ...).

Shut Down

Prepared interfaces can be switched to shutdown (=Tristate) for safety reasons.

Mode

- asynchronous “V.24/V.28” (16 times bit clock)
- Isochronous “X.24/X.27” (1-time bit clock) [98]
  The bit clock is generated internally and provided to remote stations.

97 With CP-8031 not supported by default. With a license (see *14.8 SICAM A8000 CP-803x Extended CI-Module*), 1 communication module (CI-8551 or CI-852x) can be used additionally also with CP-8031.
98 Isochronous only with IEC 60870-5-101 (all other communication protocols only asynchronous). External converters are also required for the isochronous interface according to X.24/X.27!

- Isochronous "X.24/X.27" (1-time bit clock external) [98]
  The bit clock is provided by the external remote station or by the digital transmission system.

NOTE

The mode can only be selected with electrical interface = RS-232. With RS-485 and RS-422, a fixed "16-times bit clock internal" is used!

DSR power supply

For selected serial RS-232 interfaces externally connected transmission devices (interface converters / converters, modems) can be conditionally / optionally supplied with power via pin VCC (= DSR status line).

The voltage is output fixed by the central processing on the master module on CP-8031, CP-8050 or CI-8551 and is not controlled by the assigned communication protocol.

NOTE

Note the power consumption of the connected transmission device! (see *5.2 SICAM A8000 Master Modules* " and *5.7.3 CI-8551 Communication Interface Serial* "Supply of external modem / external converter".

Deactivate serial engineering interface

The serial interface X5 of the CP-8031, CP-8050 can optionally be used as an engineering interface (parameterization interface) with SICAM TOOLBOX II.

In the following cases, the use of the serial interface as engineering interface must be deactivated:

- for security reasons (if requested in the customer project)
- When the remote station is connected with a standard cable (i.e., wiring CTS = 0 is not possible) and the assigned status line for CTS is not controlled according to the engineering interface requirements.

If the interface is not used for a protocol, the configuration PC with SICAM TOOLBOX II can be connected to the interface if required.

If the interface is used for a protocol, the interface must be unplugged for the period of the engineering work and the configuration PC with SICAM TOOLBOX II must be connected to the interface. After the work is completed, the original connection of the interface must be restored.

The status line CTS indicates whether the serial interface CP-X5 is used for communication with a remote station or as a parameterization interface.

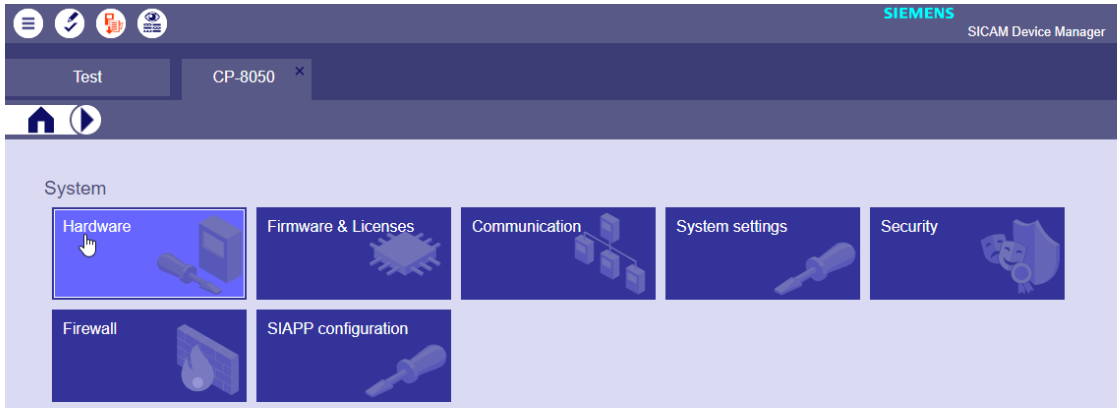
Status line CTS	Function of the serial interface
0 (GROUND)	Communication protocol →If the remote station is connected, a bridge must be placed between CTS and GND in the CP-X5 connector.
1	Engineering interface for SICAM TOOLBOX II (the cable for the communication protocol is disconnected and the cable for SICAM TOOLBOX II is plugged into the same connector) →The SICAM TOOLBOX II controls the status line CTS = 1.

NOTE

If the interface shall not be used as serial engineering interface, the function can be disabled with the parameter **`[Home] Hardware | CP-X5 | Module properties | Deactivate serial engineering interface = yes`**. Thereby no connection between CTS and GND is required.

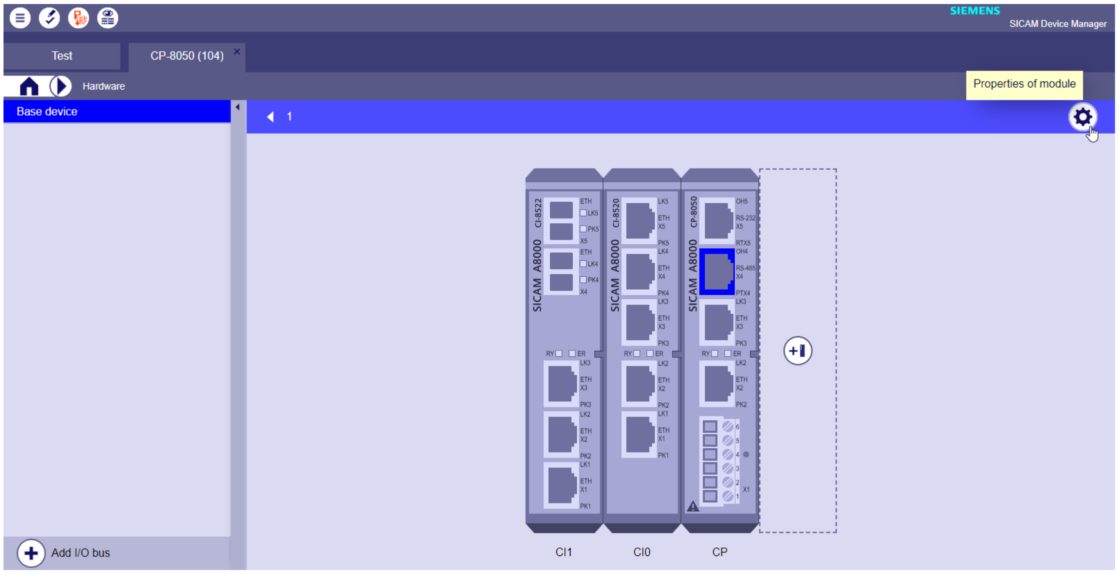
Change hardware settings (module properties) for Serial interfaces

- System | Hardware



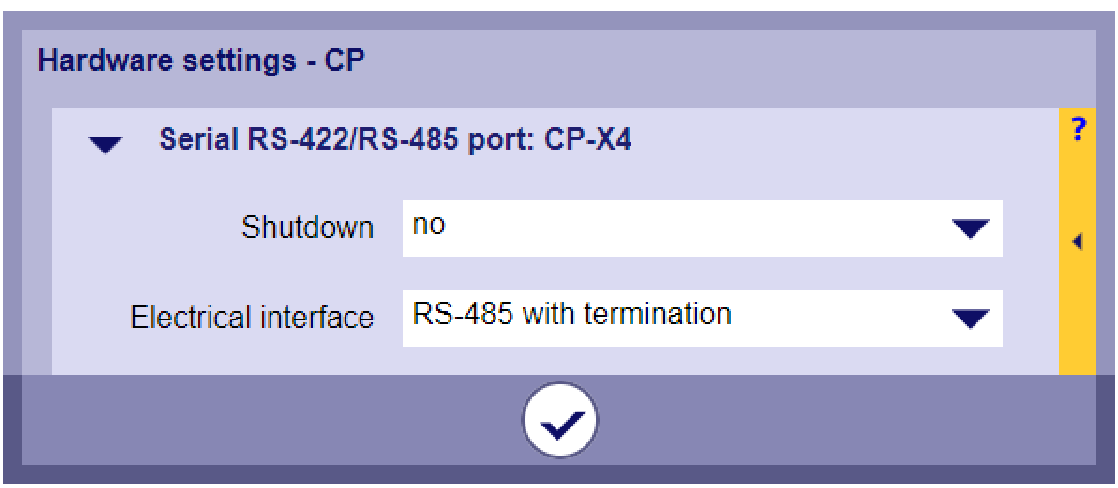
[System_Hardware [GER], 2, en_US]

- Change parameters (module properties) of an serial interface
  →Select serial interface | Change module properties (e.g. CP-8050: X4)



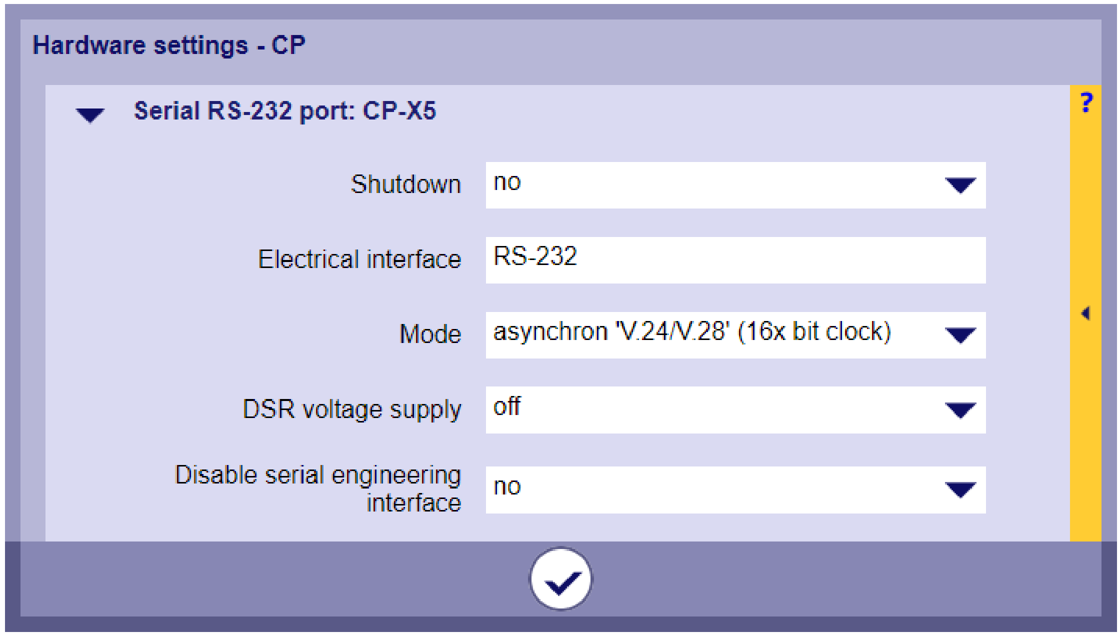
[System_Hardware_CP-8050_Moduleigenschaften_CP-X4 [GER], 2, en_US]

CP-8050 | CP-X4:



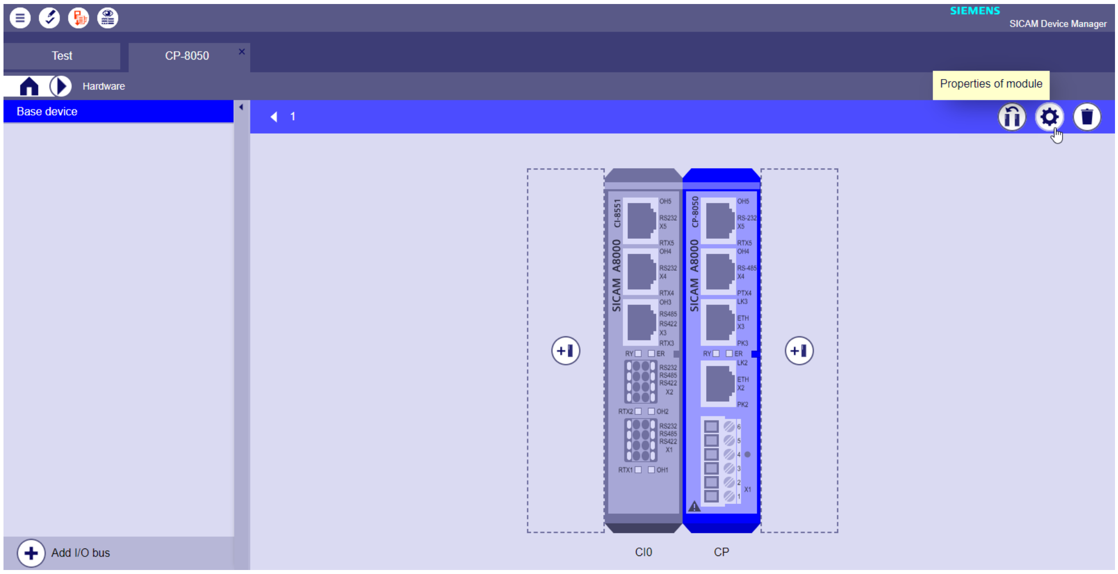
[System_Hardware_CP-8050_Moduleigenschaften_CP-X4b [GER], 2, en_US]

CP-8050 | CP-X5:



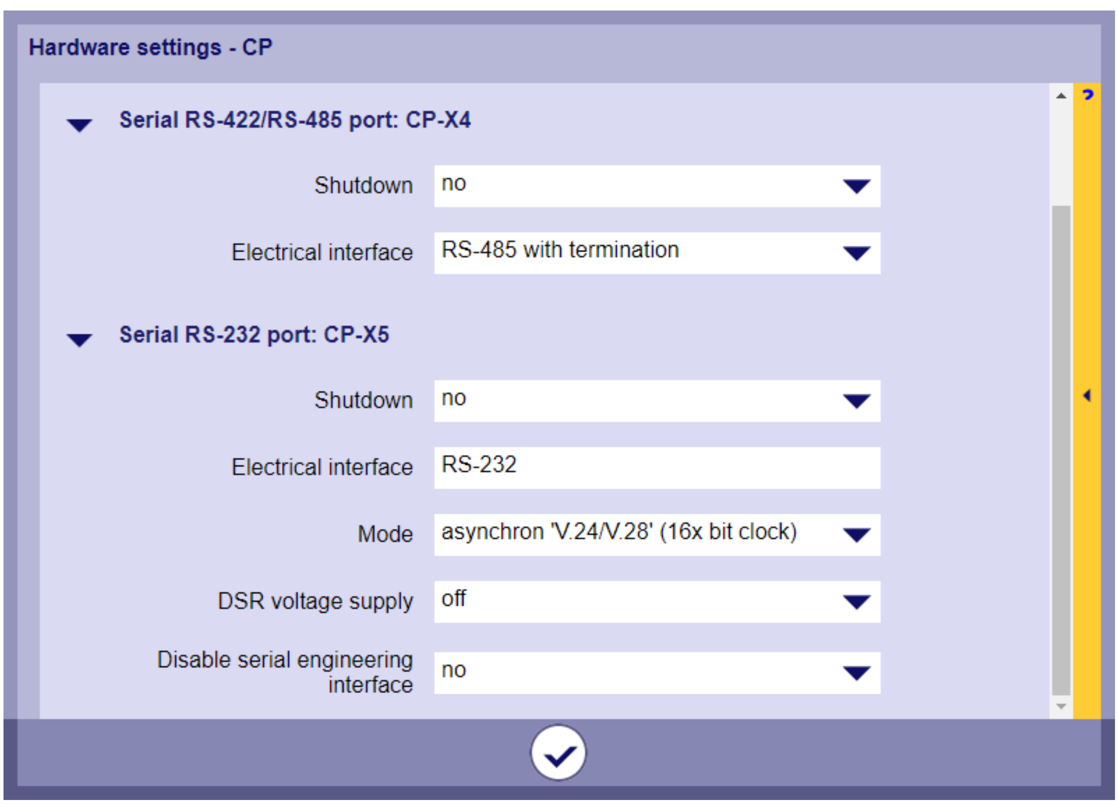
[System_Hardware_CP-8050_Moduleigenschaften_CP-X5b [GER], 2, en_US]

- Change parameters (module properties) for all interfaces of a module (e.g. CP-8050).
  →select module | Change module properties



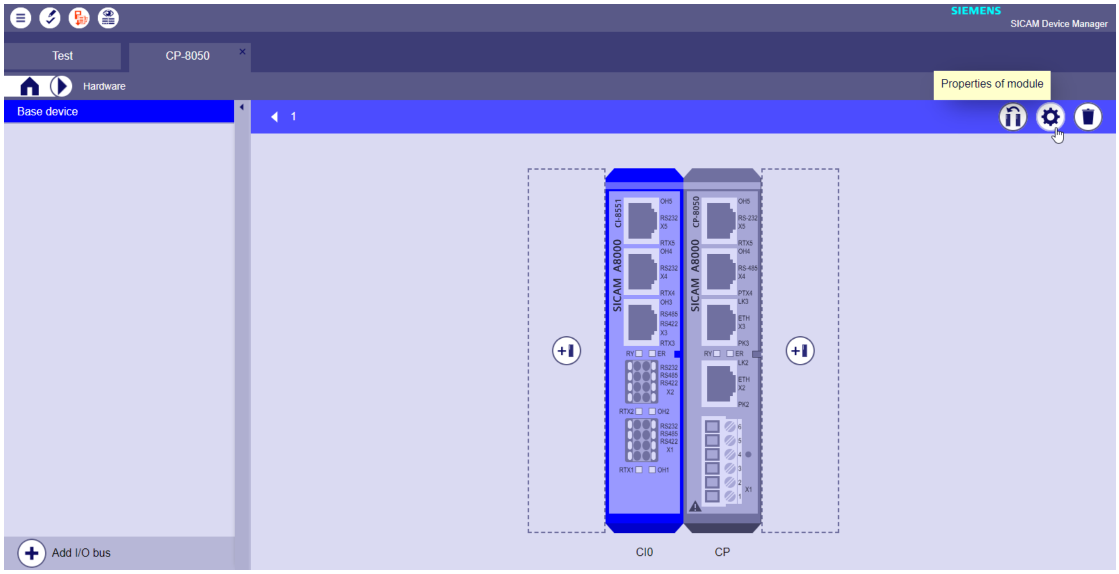
[System_Hardware_CP-8050_Moduleigenschaften [GER], 2, en_US]

CP-8050 | CP-X4, CP-X5:



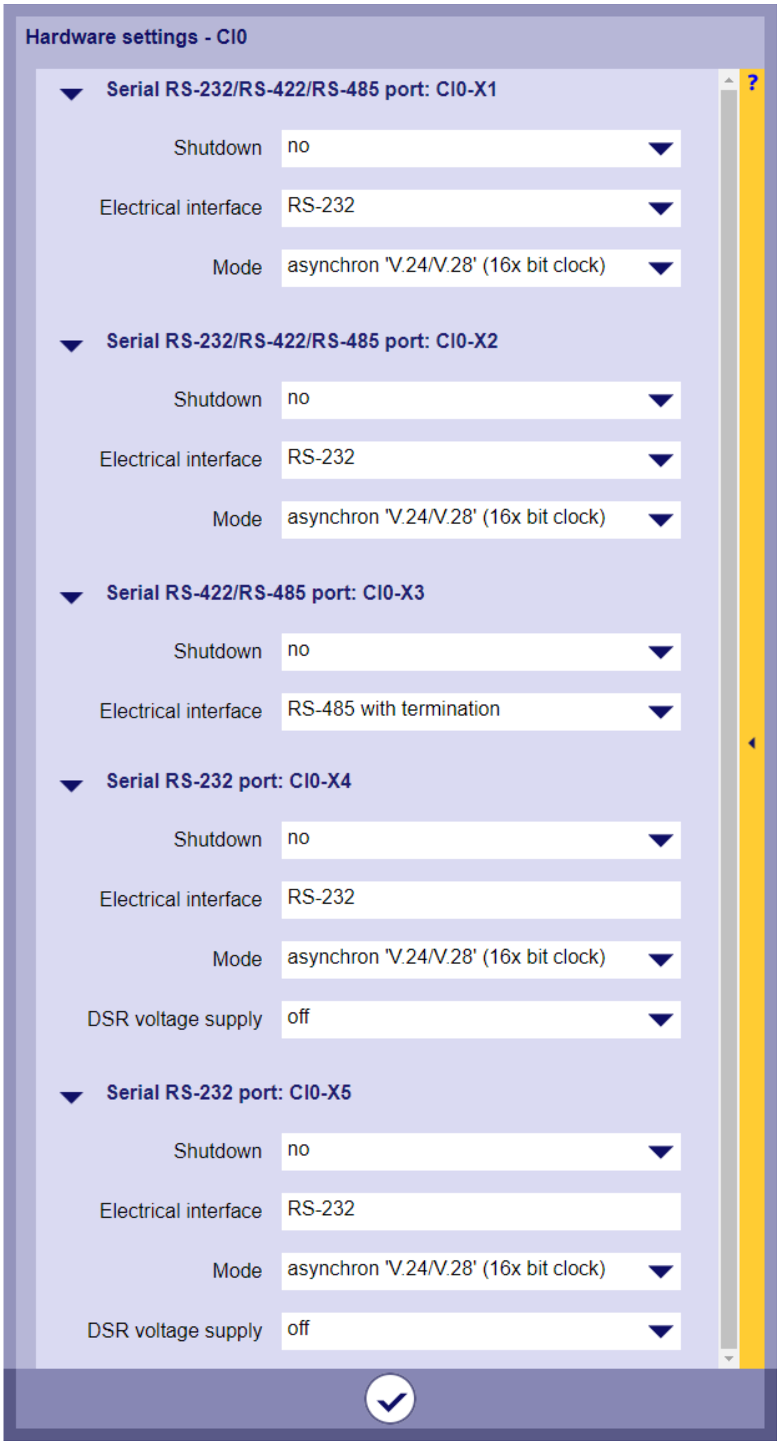
[System_Hardware_CP-8050_Moduleigenschaften_X4, X5 [GER], 2, en_US]

- Change parameters (module properties) for all interfaces of a module (e.g. CI-8551).
  →select module | Change module properties



[System_Hardware_CI-8551_Moduleigenschaften [GER], 2, en_US]

CI-8551 | CIn-X1, CIn-X2, CIn-X3, CIn-X4, CIn-X5:



[System_Hardware_CI-8551_Moduleigenschaften_X1-X5 [GER], 2, en_US]

13.1.4.8 Time settings for transmission facilities

The protocol element supports selected transmission facilities – the parameters for these are fixed. The selection of the transmission facility takes place with the parameter **`[PRE] Interface parameter | Time settings for interface modem`**. When the freely definable transmission facility is selected, certain parameters can be set individually under **`[PRE] Interface parameter | Time settings for free definable interface modem`**.

The control of the status lines RTS, DTR and the evaluation of the status line DCD is only supported with the RS-232 interface. With RS-485, RS-422, the transmission level of the interface is controlled internally with RTS.

NOTE

- Predefined transmission facilities are only supported by certain protocols.
- The standard settings can be different for the different protocols (the standard settings are documented for the protocol under 'Parameters and Properties').
- Some protocols only support some of the parameters from the time settings for free definable transmission

Refer to *13.1.4.5 Selection of a serial interface for communication protocols*.

Parameter name	Description	Settings
Time settings for transmission facilities	Time settings are predefined for selected transmission facilities - in addition, the time settings can be freely defined.	Permitted range = • Freely definable • Direct connection (RS-232) • direct link interface (RS-485) • direct link interface (RS-422) direct link interface (RS-485 with CM-08x9) • CM-0821 Ring • CM-0821 Star, CM-0847 Default setting = free definable
[PRE] Interface parameter | Time settings for free definable interface modem		
Pause time (tp)	Before a message transmission, a parameter-settable pause time “tp” is maintained before the transmission level is switched on with RTS.	Permitted range = 0 to 32767 ms 0 = no pause time Default setting = 5
Set-up time (tv)	After switching on the transmission level with RTS, the message transmission is started after the set-up time “tv” has expired.	Permitted range = 0 to 32767 ms 0 = no set-up time Default setting = 5 ms
Run out time (tn)	After the message transmission has ended the transmit signal level (RTS) is only switched off after expiry of the time “tn”.	Permitted range = 0 to 32767 ms 0 = no run-out time Default setting = 0 ms
DCD handling	The status line DCD “Data Carrier Detect” can be used for message synchronization in receive direction and for “Collision Detection”.	Permitted range = • disabled • enabled Default setting = disabled
Continuous level monitoring time (tcl)	If the DCD signal is active for longer than “tcl”, a "continuous level error" is signaled.	Permitted range = 0, 0.1 to 6553.5 s 0 = no continuous level monitoring Default setting = 10 s
Transmission delay at level (tcldly)	If a continuous level on the line has been detected (for example DCD signal “active”) and after the time “tcldly” has elapsed, it will be sent anyway so that a defective DCD input does not result in a blockade of the transmitter.	Permitted range = 0, 0.1 to 6553.5 s 0 = no transmit delay Default setting = 0.2 s

Parameter name	Description	Settings
`Bounce suppression time (tbounce)`	If the DCD signal is used by very old modems (usually relay output) then a "bouncing" of the DCD signal can be suppressed. The DCD signal is evaluated only after the bounce suppression time "tbounce".	Permitted range = 0 to 65535 ms Default setting = 10 ms
`Disable time (tdis)`	After receiving a message, the receiver can be disabled for the time "tdis" so that incorrect characters - caused by switching off the transmission level controlled by the remote station - are not processed.	Permitted range = 0 to 32767 ms Default setting = 0 ms

How the individual time settings are effective during the data transmission is shown in *`Picture 13-9`*.

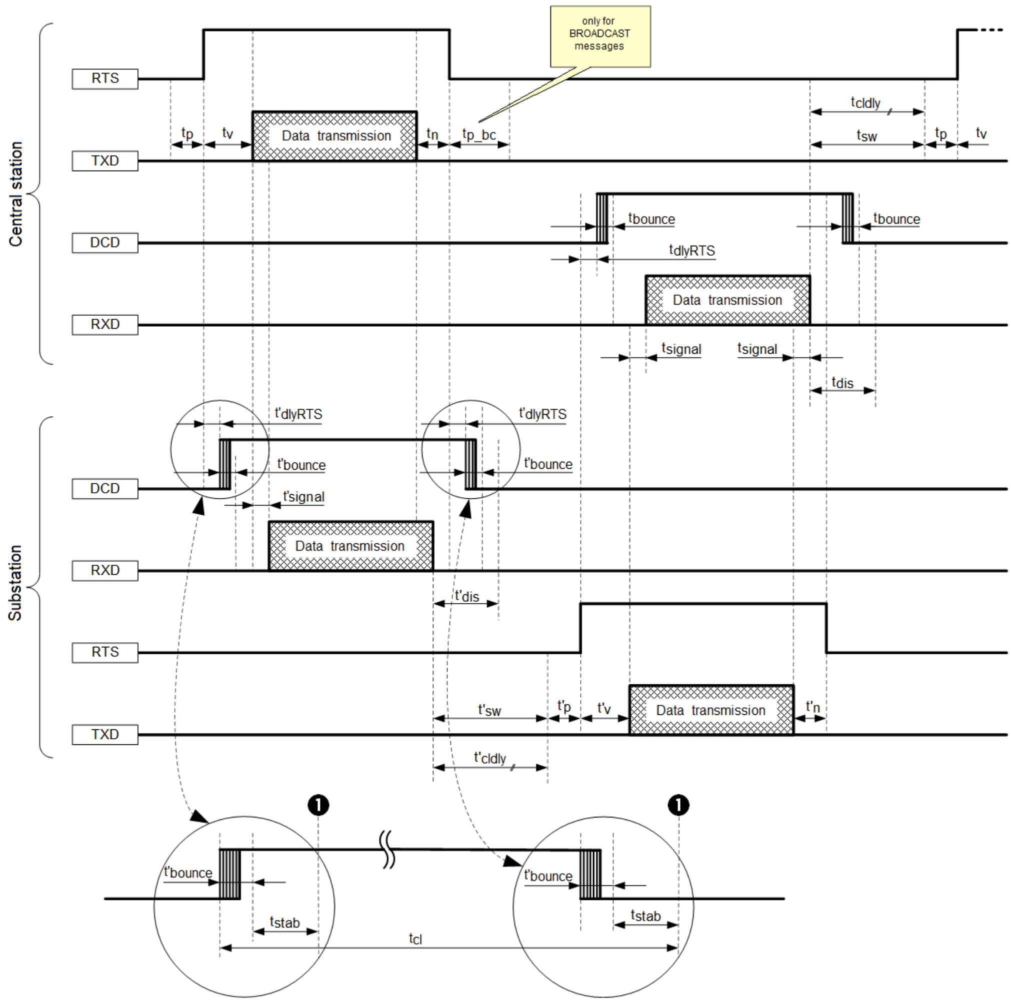
If necessary, the voltage supply of the transmission facility (5 V/12 V) – if this is enough – can be supplied over the status line DSR (VCC). The voltage supply is enabled with parameter **`[BSE] System settings | Serial Interfaces | Port | CP-X5 | DSR voltage supply`**. The voltage supply is only output to the DSR status line with corresponding parameter setting.

Then the DSR status line cannot be used by the protocol.

NOTE

- The interface parameters on the basic system element [BSE] are not automatically set by selecting the transmission facility on the protocol. These parameters must be set by the user!
- If the externally connected transmission facility is supplied with power via the RS-232 interface, the required supply voltage and maximum current consumption of the transmission facility must be observed!

Refer to *13.1.4.5 Selection of a serial interface for communication protocols*.



RTS .... Request to Send (switch on transmit part)
DCD .... Data Carrier Detect
TXD .... Transmit Data
RXD .... Receive Data
tdlyRTS .... Runtime of the transmission system (time difference between switch-on the transmit part (RTS ↑) and receiver ready (DCD ↑))
tp .... Pause time (delay before the transmit part is switched off with RTS)
tv .... Set-up time (transmit delay, after the transmit part has been switched on with RTS)
tn .... Run-out time (switch off transmit level with RTS after message transmission is delayed)
tp_bc .... Break time after broadcast messages (some systems require a longer break after the transmission of broadcast messages before the next message can be sent)
tsw .... Internal processing time
tsignal ...... Signal-transit time (depending on the transmission facility/transmission route used)
tbounce .... Detection time after a positive/negative DCD edge (DCD debouncing)
tstab .... Stability monitoring time - the new DCD status is only used once the stability monitoring time has elapsed for message synchronization
tcl .... Continuous level monitoring time
tcldly .... Transmit delay at continuous level - another message transmission is carried out at continuous level once the transmission delay has elapsed at the latest
tdis .... Disable time of the receiver after receiving a message (for suppressing the erroneous characters during level scanning)
t' .... Corresponding times in the substation
❶ DCD valid

[UMPxyy_Timing, 2, en_US]

Figure 13-2 Timing During Data Transmission

Predefined Parameter for Transmission Facilities

Transmission facility	RTS	tp [ms]	tv [ms]	tn [ms]	DCD	tcl [s]	tcldly [s]	tbounce [ms]	tdis [ms]
freely definable									
direct link interface (RS-232)	ON	0	0	0	No	0	0	0	0
direct link interface (RS-485)	-								
direct link interface (RS-422)	-								
Direct connection (RS-485 with CM-0829)	↑ ↓								
CM-0821 Ring	↑ ↓								
CM-0821 Star, CM-0847	↑ ↓								

RTS	↑ ↓ = RTS is for the control of the carrier switching of the modem scanned with each message (with tv=0: RTS = always ON ON = RTS always ON OFF = RTS always OFF
tp	Parameter Pause time (tp)
tv	Parameter Set-up time (tv)
tn	Parameter Run out time (tn)
tdis	Parameter Disable time (tdis)
DCD	Parameter DCD-Handling
tbounce	Parameter Bounce suppression time (tbounce)
tcl	Parameter Continuous level monitoring time (tcl)
tcldly	Parameter Transmission delay at level (tcldly)
A_I	BSE-Parameter Asynchron/Isochron (A = asynchron, I = isochron) (see *13.1.4.5 Selection of a serial interface for communication protocols*).
T	BSE Parameter Bittakt (only with isochron) (I = internal, E = external) (see *13.1.4.5 Selection of a serial interface for communication protocols*).

Preset parameters for time settings for freely definable transmission units (TU)

Protocol	RTS [99]	tp [ms]	tv [ms]	tn [ms]	DCD	tcl [s]	tcldly [s]	tbounce [ms]	tdis [ms]	A_I	T	5V/12V
103MI0	↑ ↓	30	100	0	No	10	0.2	10	0	A	I	No
103SI0	↑ ↓	30	100	0	No	10	0.2	10	0	A	I	No
AGPMI0	ON	0	0	0	No	–	–	–	0	A	I	No
BPPI0	ON	0	0	0	No	0	0	0	0	A	I	No
DNPMI0	↑ ↓	0	20	11	No	10	0.2	10	0	A	I	No
DNPSI0	↑ ↓	0	20	11	No	10	0.2	10	0	A	I	No
DSFGI0	↑ ↓	0	1	1	No	–	–	–	0	A	I	No
MODMI0	↑ ↓	5	5	0	No	10	0.2	10	0	A	I	No
MODSI0	↑ ↓	5	5	0	No	10	0.2	10	0	A	I	No
PCBMI0	↑ ↓	30	100	0	Yes	10	0.2	10	0	A	I	No
SA8MI0	↑ ↓	30	100	0	–	–	–	–	–	A	I	No
SA8SI0	↑ ↓	30	100	11	–	–	–	–	–	A	I	No

99 RTS=ON at tv=0. RTS is scanned at tv <> 0.

Protocol	RTS [99]	tp [ms]	tv [ms]	tn [ms]	DCD	tcl [s]	tcldly [s]	tbounce [ms]	tdis [ms]	A_I	T	5V/12V
SKEEI1	ON	–	–	–	–	–	–	–	–	A	I	No
U80ZI0	↑ ↓	30	100	0	No	10	0.2	10	0	A	I	No
UMPMI0	↑ ↓	30	100	0	No	10	0.2	10	0	A	I	No
UMPSI0	↑ ↓	30	100	0	No	10	0.2	10	0	A	I	No
VLZI0	ON	10	0	0	–	–	–	–	0	A	I	No

Time settings for external transmission device (connected via RS-232 interface)

Transmission device (=freely definable)	RTS	tp [ms]	tv [ms]	tn [ms/Bit] [100]	DCD	tcl [s]	tcldly [s]	tbounce [ms]	tdis [ms]	A_I	T	5V/12V
Settings for Master and Slave												
Radio digital	↑ ↓	30	100	11 bit	Yes	0	0.2	10	50	A	I	No
Radio analog	↑ ↓	50	300	50 ms	Yes	0	0.2	10	100	A	I	No
Direct connection (RS-485 with CM-0829)	↑ ↓	0	1	0	No	0	0	0	0	A	I	5 V
Direct connection “RS-485/RS-422 (optional with CM-0829) [101]	↑ ↓	5 [102]	5	0	No	0	0	0	0	A	I	5 V
RS-485/RS-422 interface with PHOENIX Interface converter PSM-ME-RS232/RS485-P [103]	↑ ↓	5 [102]	5	0	No	0	0	0	0	A	I	No
Optical	↑ ↓	0	1	0	No	0	0	0	0	A	I	5 V
Optical interface with Siemens RS-232/LWL Converter 7XV5652	ON	0	0	0	No	0	0	0	0	A	I	No
Optical interface/ Star coupler with Siemens mini-Star coupler 7XV5450 (via CM-0847)	ON	0	0	0	No	0	0	0	0	A	I	5 V

99 RTS=ON at tv=0. RTS is scanned at tv <> 0.

100 The run-out time must be set in [ms] and must be calculated as follows: Run-out time [ms] = (1/baud rate) * run-out time [Bit] * 1000

101 Recommended settings for retries or communication errors / communication failure with the setting “Direct “connection (RS-485 with CM-0829)”

102 recommended setting for baud rates < 9600 bit/s = 50 ms

103 Interface converter with activated function “Self-controlling send/receive switchover”

Transmission device (=freely definable)	RTS	tp [ms]	tv [ms]	tn [ms/ Bit] [100]	DCD	tcl [s]	tcldly [s]	tbounce [ms]	tdis [ms]	A_I	T	5V/12V
Optical interface/ Star coupler with Siemens mini- Star coupler 7XV5450 (direct via RS-232)	ON	0	0	0	No	0	0	0	0	A	I	No
Transmission devices "Legacy systems": Settings for Master and Slave ... for slave only valid, if under "Transmission devices Legacy systems: Settings for Slave" not otherwise specified.												
Modem for 4-wire transmission line (SAT-VFM,-WT,-WTK,-WTK-S,CE-0700)	ON	0	0	3 bit	Yes	60	0.2	5	35	A	I	No
Modem for 4-wire transmission line (CE–0701)	ON	0	0	3 bit	Yes	60	0.2	5	0	A	I	No
Modem for 2-wire transmission line (SAT-VFM,-WT,-WTK,-WTK-S,CE-0700)	↑ ↓	0	35	3 bit	Yes	60	0.2	5	35	A	I	No
Modem for 2-wire transmission line (CE–0701)	↑ ↓	22	30	3 bit	Yes	60	0.2	5	0	A	I	No
SAT-DMS (ring configuration)	ON	0	0	5 bit	No	0	0	0	0	A	I	No
SAT-DMS (Ring configuration (AE remotely with VFT)	↑ ↓	0	50	5 bit	Yes	60	0.2	5	35	A	I	No
DLC-Modem (CE-0740, CE-0741)	↑ ↓	0	0	0	No	0	0	0	0	A	I	No
Modem for "2-wire transmission line" (CE 0701 remote via further modems)	↑ ↓	0	60	5 bit	Yes	60	0.2	5	35	A	I	No
Modem for "2-wire transmission line" (CE 0701 remote via Westermo TD-32 Modem)	↑ ↓	0	1	0	No	0	0	0	0	A	I	No
Modem for "2-wire transmission line" (CE 0701 remote via Westermo GD-01 Modem)	↑ ↓	0	1	0	No	0	0	0	0	A	I	No
CM-0821 ring	ON	0	0	0	No	0	0	0	0	A	I	No

100 The run-out time must be set in [ms] and must be calculated as follows: Run-out time [ms] = (1/baud rate) * run-out time [Bit] * 1000

Transmission device (=freely definable)	RTS	tp [ms]	tv [ms]	tn [ms/Bit] [100]	DCD	tcl [s]	tcldly [s]	tbounce [ms]	tdis [ms]	A_I	T	5V/12V
CM-0821 Star, CM-0827	ON	0	0	0	No	0	0	0	0	A	I	5 V
SATTELLINE 2ASxE time slot radio-modem	↑ ↓	0	10	0	No	0	0	0	0	A	I	No
Transmission devices “Legacy systems”: Settings for slave												
Modem for 4-wire transmission line (SAT-VFM,-WT,-WTK,-WTK-S,CE-0700)	↑ ↓	0	30	3 bit	No	60	0.2	5	0	A	I	No
Modem for 4-wire transmission line (CE–0701)	↑ ↓	0	55	3 bit	No	0	0	0	0	A	I	No
Modem for 2-wire transmission line (SAT-VFM,-WT,-WTK,-WTK-S,CE-0700)	↑ ↓	3	30	3 bit	Yes	60	0.2	5	35	A	I	No
SAT-DMS (ring configuration)	ON	0	1	5 bit	No	0	0	0	0	A	I	No
SAT-DMS (Ring configuration (AE remotely with VFT)	↑ ↓	0	50	5 bit	Yes	60	0.2	5	35	A	I	No
Optical or SATTELLINE 2ASxE time slot radio-modem	↑ ↓	0	1	0	No	0	0	0	0	A	I	No
SATTELLINE 2ASxE time slot radio-modem	↑ ↓	0	1	0	No	0	0	0	0	A	I	No

13.1.4.9 Control location function for commands and setpoint values

The function “Control location” is used so that commands and setpoint values are only output from "authorized sources" to the substations.

Possible control location (Controlling authorized bodies):

- local command input
- local control
- local SCDA-System
- Command input in one of the higher-level central stations
- Command input in one of the higher-level control points (SCADA systems)
- ...

The control location function is a controllable filter on the protocol element which only allows commands and setpoint values to be passed on from enabled control locations to the substation. Commands and setpoint values at substations of control locations that are not released (i.e. not authorized) are rejected by the protocol element and confirmed with ACTCON-.

100 The run-out time must be set in [ms] and must be calculated as follows: Run-out time [ms] = (1/baud rate) * run-out time [Bit] * 1000

The authorized sources are addressed via the source address (control location) in the IEC 60870-5-101/104 command/setpoint telegram.

Activate control location function

The “Control location” function is activated on the protocol element as soon as a signal with the processing type “Protocol element control message CP-8050” with the parameter **`control function_(PRE)`** = ***`Set control location`*** is entered for the protocol element (PRE) on the basic system element (BSE). After startup of the PRE, the BSE sends a PRE control message *`Set control location`* to the PRE. As a result the function “control location” with control location check is activated on the PRE.

Enable/disable Control Location

The selection which origin addresses (control locations) may send commands/setpoint values to substations must be made either in the control system or in an application program of the open-/closed-loop control function of the central station.

Independent of the command or setpoint value that is to be transmitted, the control center is enabled/disabled with its own command message in the format single command <TI:=45> which is converted to a PRE control message *`set control location`* on the basic system element by the “Protocol control” function.

For the command message *`Enable/Disable control location`*, no acknowledgment of the activation (ACTCON) and no completion of the activation (ACTTERM) is emulated.

The control location is entered in the source address (origin) of the command message.

The command message *`Enable/Disable control location`* is only processed internally on the protocol element and is not transmitted to the remote station.

Originator address	Control Location
0	Not defined
1 to 127	Remote command
128 to 255	local command

NOTE

The released/locked control locations are to be transmitted to the protocol element with the control message defined for "control location".

If the control location function is activated, all control locations are blocked after the startup of the protocol element, i.e. all required control locations must be set again!

Enable/disable Control Location

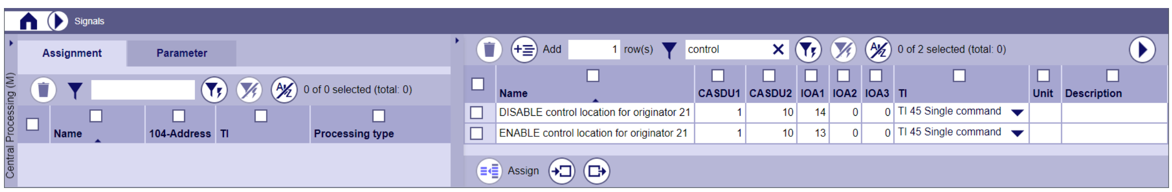
- Enable/disable control location with PRE-control message *`Set control location`*
- single command state ON = enable control location
- single command stat OFF = disable control location
- enable/disable selective control location for selective station
- enable selective control location for all stations
- all control locations are blocked for all stations
- the enabled/disabled control locations apply to all commands of a protocol element
- after startup of the protocol element all control locations are blocked

> **NOTE**
>
> The enable/disable of the control locations can either be performed globally for all stations or for selective stations.
>
> A mixed control of the control locations (enable control location selective - disable control location globally for all stations) is not supported!

protocol element control message

The command for enabling/disabling the control locations is converted to a PRE control telegram in the SICAM Device Manager using the “Signals” function and the processing type “protocol element control telegram CP-8050”.

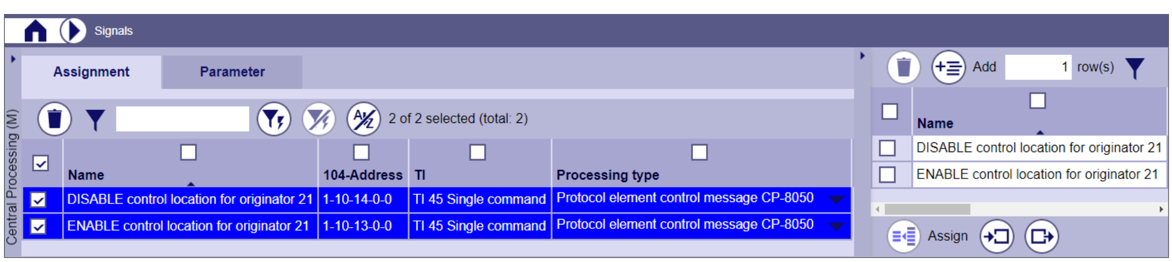
- Create signals for control location in SICAM Device Manager



[DM_PRE_Steuerort_a, 1, en_US]

Parameters	
Name	Name of the signal
CASDU1, CASDU2 **IOA1, IOA2, IOA3**	IEC 60870-5-101/104 message address (104-Adresse)
TI	Supported Type Identifications: • <TI:=45> ... Single command
Unit	... not used for -Protocol element control message CP-8050!
Description	Description of the signal

- Assign signals for the control location to central processing or the basic system element (BSE)

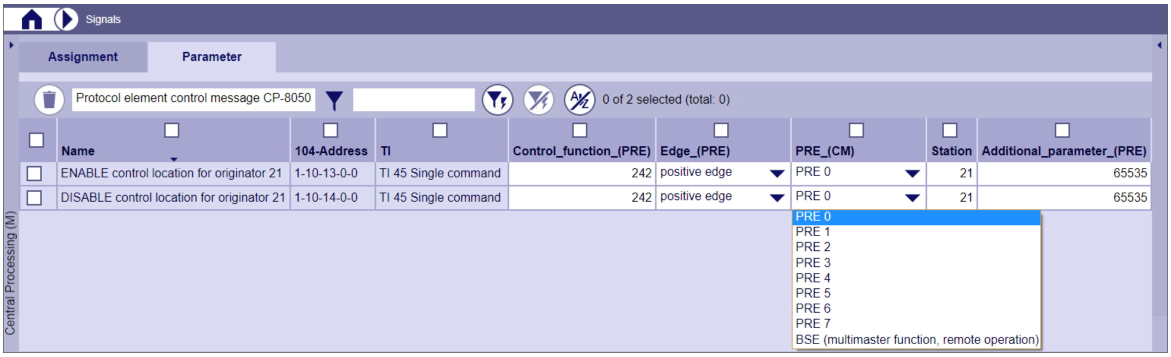


[DM_PRE_Steuerort_b, 1, en_US]

Parameters	
Name	Name of signal [104]
104-address	IEC 60870-5-101/104 message address [104]
TI .. Type Identification	Supported type identifications [104]
Processing type	Processing type • Protocol element control message CP-8050

[104] These parameter are determined during the definition of the signals.

- Parameter for protocol element control message CP-8050 (control function = set control location)



[DM_PRE_Steuerort_c2, 1, en_US]

Parameters	
Name	Name of signal [104]
104-address	IEC 60870-5-101/104 message address [104] (CASDU1, CASDU2, IOA1, IOA2, IOA3)
TI .. Type Identification	Supported Type Identifications: [104] • <TI:=45> ... Single command
Control function_(PRE)	Control function • 242 = Set control location
Edge_(PRE)	... not used for control function 242 (must be set to ***positive edge***)
PRE_(PST)	Assign control function to a protocol element (PRE): • PRE 0 to PRE 7
Station	Assignment of the control function for station (SICAM A8000 internal station number): • 125 ... alle Stations SCS=<ON>: Enable control location for all stations SCS=<OFF>: Disable all control locations for all stations • 0 to 99 ... Station 0 to 99 SCS=<ON>: Enable control location for station SCS=<OFF>: Block control location for station Note: • The enable/disable of the control location is determined by the command state <SCS> (Single Command State) • The control location is entered in the source address (origin) of the <TI:=45> command message.
Additional parameter_(PRE)	must be set to 65535.

Control Location Check

When the “control location” function is activated, commands and setpoint values are transmitted from the protocol element to the remote site only if the command or setpoint value is received from an authorized source, that means was sent from an enabled control location (Originator address). After startup of the protocol element, no control locations are enabled.

When the “control location” function is activated and the control location is not enabled,

- the command/setpoint value is not transmitted to the remote station
- a negative acknowledgment of the activation (ACTCON-) for the command/setpoint value is transmitted to the source address

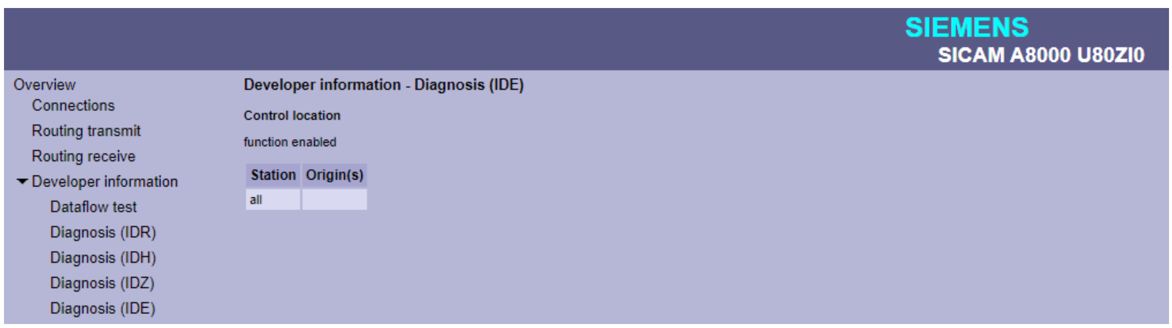
If the “control location” function is not activated, commands and setpoint values are transmitted to the remote station without control location check .

Display control location

Protocol elements which support the web server, show the enabled control locations on the protocol specific web page **Developer Information – Diagnosis (IDE)** under **Control location** .

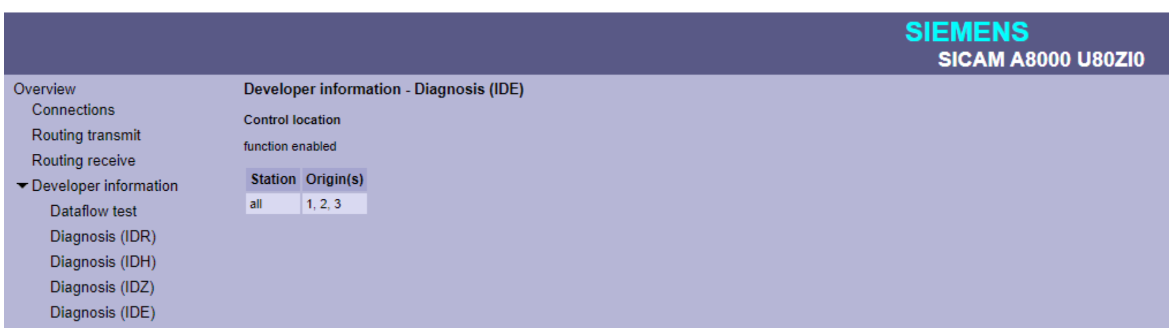
Examples:

- Function control location activated, no control location enabled on all stations



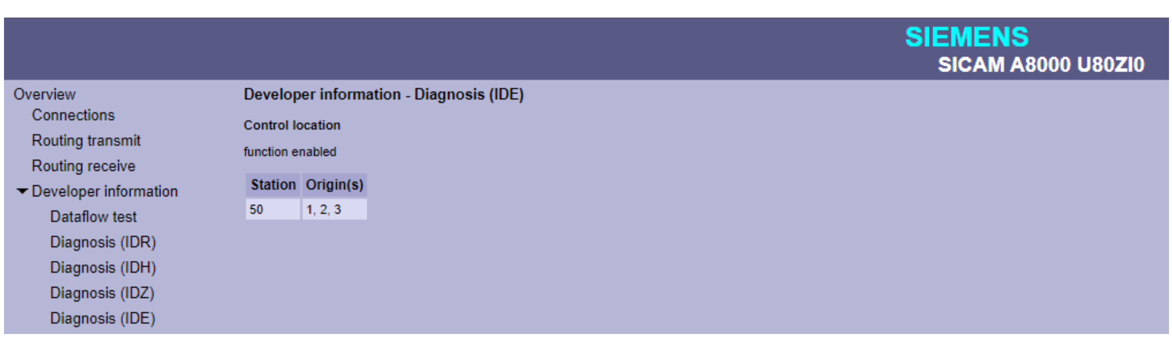
[U80ZI0_Web_IDE_Steuerort_Alle_HKA_gesperrt_, 1, --_--]

- Enable control location 1,2,3 for all stations



[U80ZI0_Web_IDE_Steuerort_Alle_Stationen_HKA_123_, 1, --_--]

- Enable control location only for station 50

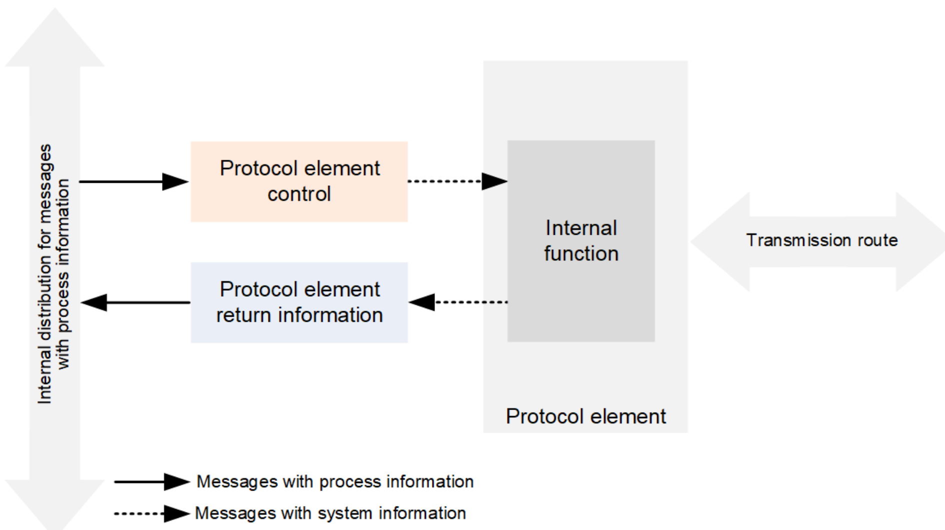


[U80ZI0_Web_IDE_Steuerort_Station_50_HKA_123_, 1, --_--]

13.1.4.10 Protocol Element Control Messages

Protocol element control messages can control protocol element internal functions.

On the basic system element, IEC 60870-5-101/104 `messages with process information in the control direction` are converted to protocol element control messages and transmitted to the selected protocol element.



[PRE_Steuerung, 1, en_US]

The parameterization of the address and message conversion for protocol element control messages is done for the basic system element ("Central processing (M)") with the SICAM Device Manager with the function "Signals" or with the SICAM TOOLBOX II, OPM with the processing type **Protocol element control message CP-8050**.

Protocol element Control messages are transmitted with "high priority" from the basic system element - regardless of the process information to be sent - immediately to the protocol element, only processed internally on the protocol element and not transmitted to the remote station.

An unused CASDU must be used for `messages with process information in the control direction` that are used as protocol element control messages (With automatic data flow routing, all data is transferred to the remote site with the data of the CASDU).

IEC 60870-5-101/104 message formats as protocol element control message

- <TI:=30> .. Single-point information
- <TI:=45> .. Single command

Protocol element control functions

- Applicational control of the station interrogation
- Set control location
- Testing the reachability of stations
- Suppression of errors with intentionally switched-off stations (Station Service)
- Data filter control

NOTE

- Depending on the protocol element, only selected protocol element control functions are supported (for details see the respective protocol).

Protocol element control functions

SF [105]	Protocol element control message `Control_function_(PRE)`	Station	Z-Par	FI	Description
	Point-to-point [Point-to-point] or multi-point traffic slave [Slave]				
0	I bit handling for time OFF	–	–		the protocol element stores the moment/state for the last received PRE control message *I bit handling for time ON/OFF* (=ti/e/a) from basic system element. For all messages with process information with time tag in transmit direction, the "Invalid" bit of the time tag is set by the protocol element, if the time in the message is the same or after the moment ti/e. For all messages with process information with time tag in transmit direction, the "Invalid" bit of the time tag is reset by the protocol element, if the time in the message is the same or after the moment ti/a.
1	I bit handling for time ON	–	–		the protocol element stores the moment/state for the last received PRE control message *I bit handling for time ON/OFF* (=ti/e/a) from basic system element. For all messages with process information with time tag in transmit direction, the "Invalid" bit of the time tag is set by the protocol element, if the time in the message is the same or after the moment ti/e. For all messages with process information with time tag in transmit direction, the "Invalid" bit of the time tag is reset by the protocol element, if the time in the message is the same or after the moment ti/a.
0	Data filter in transmit direction ON	255	–		Do not send all messages from BSE
1	Data filter in transmit direction OFF	255	–		Send all messages from BSE
2	Data filter in receive direction ON	255	–		All received messages not to BSE
3	Data filter in receive direction OFF	255	–		All received messages not to BSE

105 Some protocols use different numbers for the control function. The numbers specified in the protocol for the control function always apply.

SF [105]	Protocol element control message `Control_function_(PRE)`	Station	Z-Par	FI	Description
4	"Deactivate" interface	255	–		Reset interface failure • Do not send all messages from BSE • Received messages are discarded
5	"Activate" interface	255	–		
6	(General) interrogation command (image GI)	255	65535 0 to 65534		The PRE is forced to send a (general) interrogation command "image-GI" to own BSE. Z-Par: FFFF .. all CASDUs (BROADCAST) 0 to FFFE ... selective CASDU
20	"Deactivate" Interface + Protocol function	255	–		In the redundancy state PASSIVE and passive behavior = "Tristate interface", the interface + protocol function can be activated/deactivated with PST control message. (Preset = deactivated)
21	"Activate" Interface + Protocol function	255	–		In the redundancy state PASSIVE and passive behavior = "Tristate interface", the interface + protocol function can be activated/deactivated with PST control message.
242	Set control location [106]	255	65535		Set/delete control location global SCS = <ON>: set control location (HKA) SCS = <OFF>: delete control location (HKA)
	Multi point traffic master [Master]				
0	Call cycle START	125	–		
1	Call cycle STOP (disabling)	125	–		
2	Call cycle CONTINUE (enabling)	125	–		
3	Continuous call station x ON	0 to 99	0 to 65535		Z-Par = continuous call time (n·100 ms) Z-Par = 0: Continuous call without time input (stopped by other function)
4	Continuous call station x OFF	0 to 99	–		
5	Main transmission line ACTIVE	0 to 99	–		
6	Standby transmission line ACTIVE	0 to 99	–		
10	Master-Coordination (Token) With Main/Standby transmission line				Only used internal between PREs!
11	Connection set-up				reserved for internal use!
12	Connection closed				reserved for internal use!

105 Some protocols use different numbers for the control function. The numbers specified in the protocol for the control function always apply.
106 Point-to-point or Slave

SF [105]	Protocol element control message `Control_function_(PRE)`	Station	Z-Par	FI	Description
13	"Deactivate" interface	–	–		Switch interface to PASSIVE • interface = TRISTATE • redundancy bit in messages will not be set [107] • Reset interface failure • Do not send all messages from BSE • Received messages are discarded
14	"Activate" interface	–	–		Switch interface to ACTIVE [107]
20	"Deactivate" Interface + Protocol function	–	–		In the redundancy state PASSIVE and passive behavior = "Tristate interface", the interface + protocol function can be activated/deactivated with PST control message. (Preset = deactivated)
21	"Activate" Interface + Protocol function	–	–		In the redundancy state PASSIVE and passive behavior = "Tristate interface", the interface + protocol function can be activated/deactivated with PST control message.
128	Add station to station polling	0 to 99	–		only parameterized RTUs can be added to the station polling →otherwise error "faulty PST-control message"
129	Remove station from station polling	0 to 99	0, 1		only parameterized substations can be unhooked in the cycle →otherwise error "faulty PST-control message" Z-Par = 0: Reset present station fault Z-Par = 1: Do not change present station fault
242	Set control location [108][109]	125	65535		SCS = <ON>: Set control location (HKA) (all stations)
			65535		SCS = <OFF>: Reset control location (HKA) (all stations)
		0 to 99	65535		SCS = <ON>: Set control location (HKA) (selective stations)
			65535		SCS = <OFF>: Reset control location (HKA) (selective stations)
	[LAN]				

105 Some protocols use different numbers for the control function. The numbers specified in the protocol for the control function always apply.
107 nearly same function as with system internal redundancy control message, but controllable with protocol element control message
108 The control location can only be set by a single command TI 45.
109 Multi-point traffic or LAN with 100 connections

SF [105]	Protocol element control message `Control_function_(PRE)`	Station	Z-Par	FI	Description
0	"Activate" interface	–	–		ENABLE Ethernet interface = • Ethernet-Controller Chip will be enabled • Ethernet-connection (Link) is established. • assigned services of this Ethernet interface are activated. (e.g. IEC 60870-5-104, WEB, NTP, remote operation, ...)
1	"Deactivate" interface	–	–		DISABLE Ethernet interface = • Ethernet-Controller Chip will be disabled • Ethernet-connection (Link) is released • no services possible (IEC 60870-5-104, WEB, NTP, remote operation) • Warning: "interface DISABLED" (diagnostic message) • All connections will be released after 104 timeouts
2	Time sync. OK	–	–		
3	Time sync. NOK	–	–		With failure of the time synchronization for the local AU "Time mark (IV=1) with messages in send direction" can be used.
95	Link UP	-	-		
96	Link DOWN	-	-		
242	Set control location [110][111]	125	65535		SCS = <ON>: Set control location (HKA) (all stations)
			65535		SCS = <OFF>: Reset control location (HKA) (all stations)
		0 to 99	65535		SCS = <ON>: Set control location (HKA) (selective stations)
			65535		SCS = <OFF>: Reset control location (HKA) (selective stations)
	LAN [LAN], Point-to-point [Point-to-point] or Mulit-point traffic Master/Slave, [Master], [Slave]				
240	Send (general) interrogation command	0 to 99, 255	–		This function is processed on the BSE and sent to the protocol element as system message and not using PRE control message! CASDU = BROADCAST

105 Some protocols use different numbers for the control function. The numbers specified in the protocol for the control function always apply.

110 The control location can only be set by a single command TI 45.

111 Multi-point traffic or LAN with 100 connections

SF [105]	Protocol element control message `Control_function_(PRE)`	Station	Z-Par	FI	Description
243	Reset command	–	–		Not supported!
244	Send (general) interrogation command	0 to 99, 255	CASDU		This function is processed on the BSE and sent to the protocol element as system message and not using PRE control message! CASDU = selective

Legend:

SF	Control_function_(PRE)
Station	Station number (internal)
	0 to 99 = station 0 to 99 of the selected protocol element
	125 = all stations of the selected protocol element (=BROADCAST)
	255 = all stations of the selected protocol element (=BROADCAST) or station number not used (e.g., with point-to-point)
Z-Par	Additional parameter_(PRE)
FI	Edge
SCS	Single command state
HKA	Originator address “Control location” (HKA) = 0 to 255

Control location (see *13.1.4.9 Control location function for commands and setpoint values*):

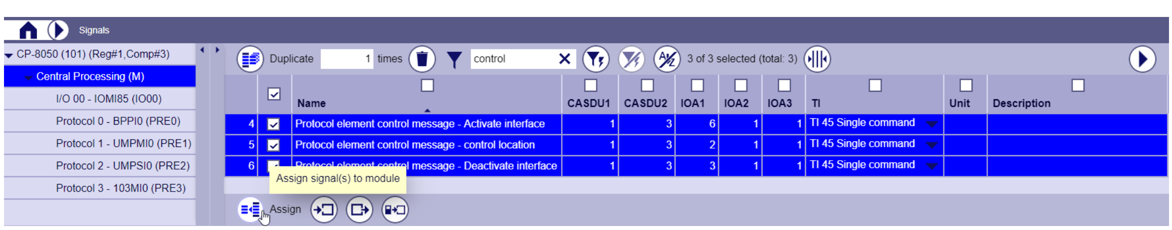
- For “Set control location”, “additional parameter_(PRE)” (Z-Par) = 65535 must be entered in the PST detailed routing on the BSE.
- If a PRE control message for “Set control location” is included in the PST detailed routing on the BSE, the BSE will send a PRE control message “Set control location” with additional parameter = 65535 after startup of the PRE to enable control location function on PRE.
- The control location (HKA) to be set is taken from the origin address “Origin”) of the command message which is used as the PRE control message and entered by the BSE in the PRE control message for the PRE in the additional parameters as follows:

  SCS = <ON> additional parameter in PRE control message = HKA

  SCS = <OFF> additional parameter in PRE control message = HKA + 256

Parameterization of the Protocol Element Control Messages

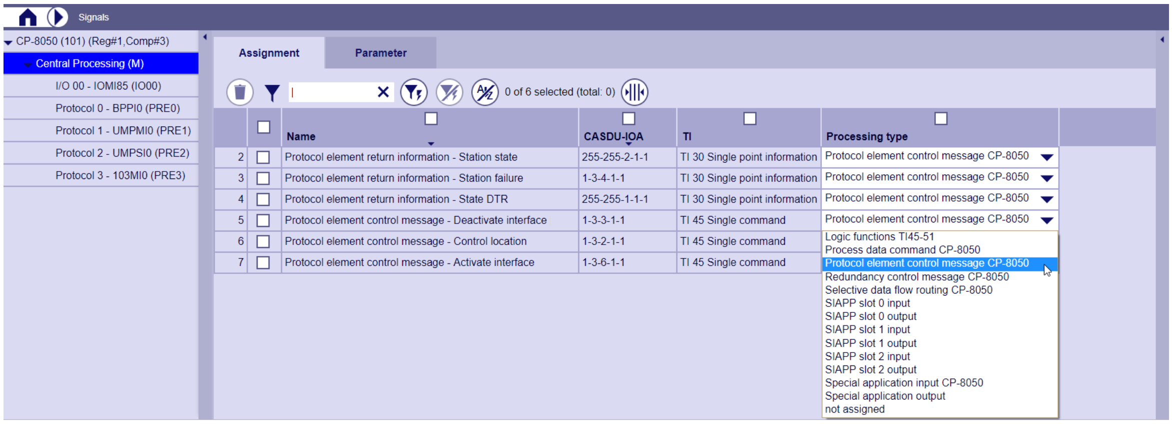
- Create & assign signals



[UMPMI0_DM_PRE_ST0, 2, en_US]

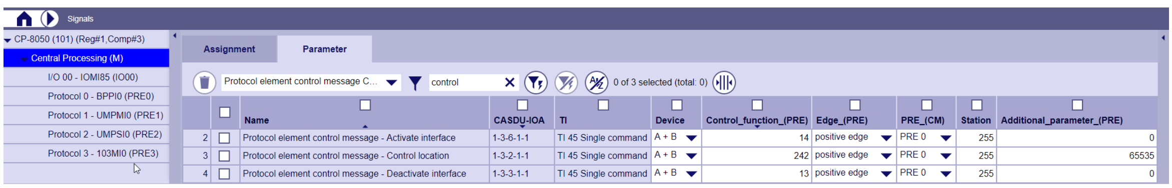
- Specify the processing type for signals

105 Some protocols use different numbers for the control function. The numbers specified in the protocol for the control function always apply.



[UMPMI0_DM_PRE_ST1, 2, en_US]

- Parameters for protocol element control message CP-8050



[UMPMI0_DM_PRE_ST2, 2, en_US]

Parameter name	Description	Settings
Name	Name of the signal	
104 address	SICAM A8000 internal IEC 60870-5-101/104 message address with which the protocol element control message is transmitted in the system as process information	Permitted range = • CASDU1 = 0 to 255 • CASDU2 = 0 to 255 • IOA1 = 0 to 255 • IOA2 = 0 to 255 • IOA3 = 0 to 255 Default setting = 255
TI	IEC 60870-5-101/104 type identification with which the protocol element control message is transmitted in the system as process information	Permitted range = • TI 45 .. Single command
SID-BSE	Source identification of the message with process information that is to be used as the protocol element control message (QID-BSE = Source ID BSE)	Permitted range = • C00 to C31 • M • R-QID • own BSE • Automatic Default setting = automatic

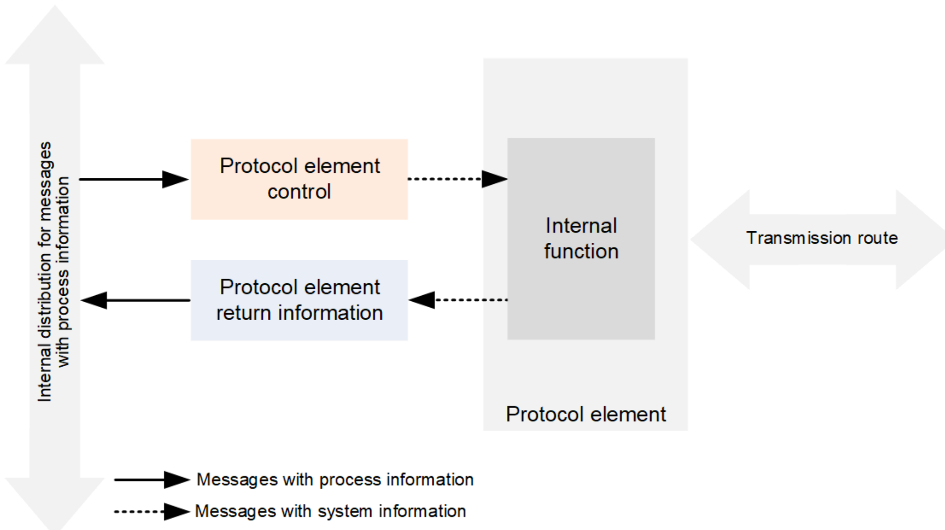
Parameter name	Description	Settings
SID-SSE	Source identification of the message with process information that is to be used as the protocol element control message (QID-ZSE = Source ID supplementary system element)	Permitted range = • IO00 to IO15 • PRE0 to PRE7 • BSE itself • Automatic/R-QID Default setting = Automatic/R-QID
SID-ST	Source identification of the message with process information that is to be used as the protocol element control message (QID-ST = Source ID Station number)	Permitted range = • 0 to 253 • 254/ZSE itself • Automatic/End-End/BSE itself Default setting = Automatic/End-End/BSE itself
Control_function_(PRE)	Protocol element control function (SF)	Permitted range = 0 to 255 Default setting = 0
Edge_(PRE)	Edge (FL)	Permitted range = • positive edge • negative edge • State (0 = Function, 1 = Function + 1) Default setting = positive edge
PRE_(CM)	Protocol element (PRE) [112].	Permitted range = • PRE 0 to PRE 7 • BSE (Multimaster function, remote operation) Standard setting = PRE 0
Station	Station number (internal) [112].	Permitted range = • 0 to 99 .. Station number (internal) • 125 .. to all stations • 255 .. Station number not used Default setting = 255
Additional parameter_(PRE)	Additional parameter (Z-Par) for protocol element control function	Permitted range = • 0 to 65535 Default setting = 0

13.1.4.11 Protocol Element Return Information

Protocol element return information is internal status information of the protocol elements which is transmitted spontaneously and in the event of a general interrogation with internal message formats from the protocol element to the basic system element.

112 To which PRE and with which station number a protocol element control message should be converted

On the basic system element, the protocol element return information is converted to IEC 60870-5-101/104 *messages with process information in the monitoring direction*.



[PRE_Steuerung, 1, en_US]

The parameterization of the address and message conversion for protocol element return information is done for the basic system element (“Central processing (M)”) with the SICAM Device Manager with the function “Signals” or with the SICAM TOOLBOX II, OPM II with the processing type **Protocol element return information CP-8050**.

Protocol Element Return Information

- Status of the state lines
- Protocol-specific return information (dependent on the protocol element used)
- Status of the stations

Protocol element return information `Return_information_function_(PRE)`	Station	Description	IEC 60870-5-101/104 Data format (TI) [113]
State RTS [114]	255	State of RS-232 state line 0 = status line inactive 1 = status line active	30
State CTS [114]	255	State of RS-232 state line 0 = status line inactive 1 = status line active	30

113 The internal protocol element responses are converted to the following type IDs on the basic system element.

114 States of the state lines are transmitted spontaneously from the protocol element for serial protocols to the basic system element with change or as reply to a general interrogation command; the spontaneous transmission of the current states takes place internally in a 100ms grid → state line changes shorter than 100ms are not guaranteed to be transmitted!

Protocol element return information `Return_information_function_(PRE)`	Station	Description	IEC 60870-5-101/104 Data format (TI) [113]
State DCD [114]	255	State of RS-232 state line 0 = status line inactive 1 = status line active	30
State DTR [114]	255	State of RS-232 state line 0 = status line inactive 1 = status line active	30
State DSR [114]	255	State of RS-232 state line 0 = status line inactive 1 = status line active	30
State RI [114]	255	State of RS-232 state line 0 = status line inactive 1 = status line active	30
Protocol-specific return information 0	0 to 99, 255		30
Protocol-specific return information 1	0 to 99, 255		30
Protocol-specific return information 2	0 to 99, 255		30
Protocol-specific return information 3	0 to 99, 255		30
Protocol-specific return information 4	0 to 99, 255		30
Protocol-specific return information 5	0 to 99, 255		30
Protocol-specific return information 6	0 to 99, 255		30
Protocol-specific return information 7	0 to 99, 255		30
Protocol-specific return information 8	0 to 99, 255		30
Protocol-specific return information 9	0 to 99, 255		30
Protocol-specific return information 10	0 to 99, 255		30
Protocol-specific return information 11	0 to 99, 255		30
Protocol-specific return information 12	0 to 99, 255		30
Protocol-specific return information 13	0 to 99, 255		30
Protocol-specific return information 14	0 to 99, 255		30

113 The internal protocol element responses are converted to the following type IDs on the basic system element.

Protocol element return information `Return_information_function_(PRE)`	Station	Description	IEC 60870-5-101/104 Data format (TI) [113]
Protocol-specific return information 15	0 to 99, 255		30
Protocol-specific return value	0 to 99, 255		36
Station status	0 to 99, 255		30
Station failure	0 to 99, 255	1 = Station failed [115]	30
Remote operation	0 to 99, 255	[116]	30

Legend: Station = station number (internal) 0 to 99; 255 = station number not used

<TI:=30> .. Single-point information with time tag CP56Time2a

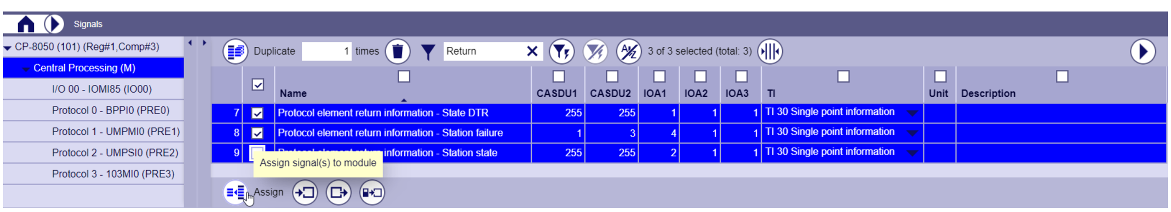
<TI:=36> .. Measured value, short floating-point number with time tag CP56Time2a

NOTE

- Depending on the protocol element, only selected protocol element return information items are supported!

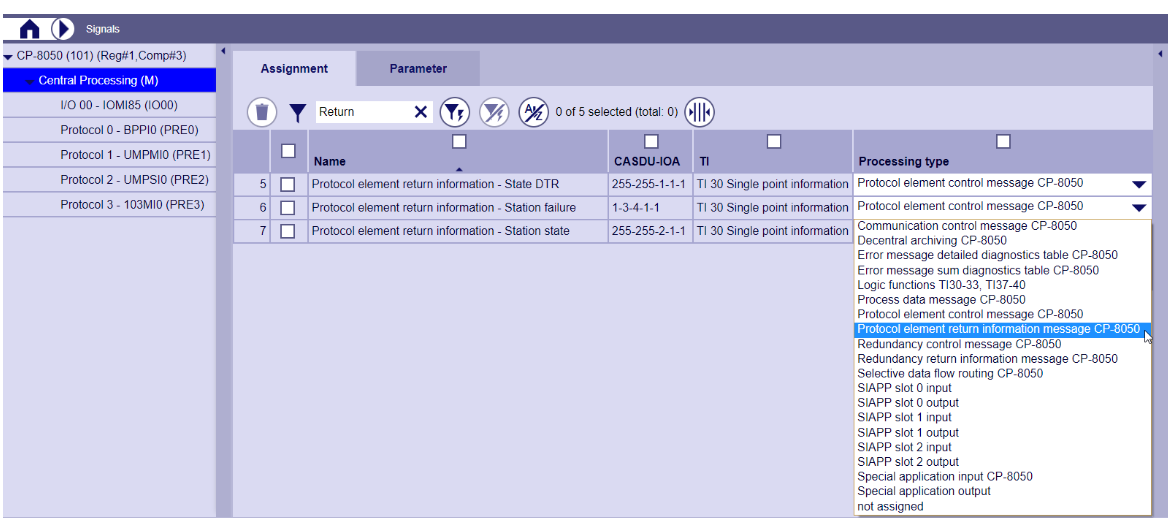
Parameterization of the Protocol Element Return Information

- Create & assign signals



[UMPMI0_DM_PRE_RM0, 2, en_US]

- Specify the processing type for signals



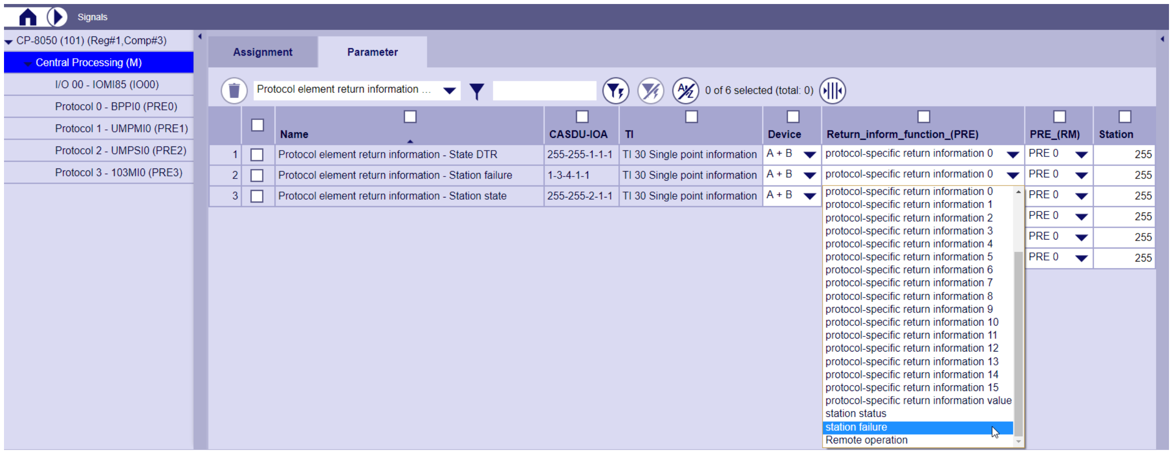
[UMPMI0_DM_PRE_RM1, 2, en_US]

113 The internal protocol element responses are converted to the following type IDs on the basic system element.

115 is currently not supported by basic system element!

116 This return information is generated directly on the BSE

- Parameters for protocol element return information message CP-8050



[UMPMI0_DM_PRE_RM2, 2, en_US]

Parameter name	Description	Settings
Name	Name of the signal	
104 address	SICAM A8000 internal IEC 60870-5-101/104 message address	Permitted range = • CASDU1 = 0 to 255 • CASDU2 = 0 to 255 • IOA1 = 0 to 255 • IOA2 = 0 to 255 • IOA3 = 0 to 255 Default setting = 255
TI	IEC 60870-5-101/104 type identification with which the protocol element feedback is transmitted further in the system (for permissible assignment of TI to protocol element feedback, see *13.1.4.11 Protocol Element Return Information*)	Permitted range = • TI 30 .. Single-point information • TI 36 .. Measured value, floating-point Standard setting = TI 30
Return_information_function_(PRE)	Protocol element return information	Permitted range = • Status RTS • Status CTS • Status DCD • Status DTR • Status DSR • Status RI • protocol-specific return information 0 to 15 • Protocol-specific return value • Station status • Station failure • Remote Operation Default setting = protocol-specific return information 0

Parameter name	Description	Settings
`PRE_(RM)`	Protocol element (PRE) [117]	Permitted range = • PRE 0 to PRE 7 • BSE (remote operation) Standard setting = PRE 0
`Station`	Station number (internal) [117]	Permitted range = • 0 to 99 .. Station number (internal) • 255 ... Station number not used Default setting = 255

13.1.4.12 Web server for protocol-specific web pages

A web server for internal diagnostic and statistic information is integrated in the protocol firmware. The web server itself is implemented on the basic system element (see *10 SICAM WEB*) – the protocol-specific web pages are provided by the protocol element.

Supported web browser:

- Google Chrome
- Microsoft Edge
- Mozilla Firefox

For the access to the web server the communication protocol HTTP (Hyper Text Transfer Protocol) is used with the port number 80 or the communication protocol HTTPS (Hyper Text Transfer Protocol over SSL/TLS) is used with the port number 443.

NOTE

- The integrated web server is activated by default.
- The integrated web server should be deactivated for security reasons.
- The values displayed on the web pages indicate the current status when the web page is started.
  The values of a web page are updated when they change.
  Some web pages require manual updating of the web page for certain functions ("refresh " or "reload this page" in the web browser).
- The web pages will be displayed only in English language!

The PRE-specific web pages supported by the protocol are documented for the respective protocol.

Supported protocol-specific web pages:

Protocol-Specific Web Page	Protocol "serial"	Protocol "LAN"
Developer Information	✓	✓
Dataflow test	✓	✓
Ethernet capture	–	✓
Diagnosis (IDH)	✓	–
Diagnosis (IDZ)	✓	–

117 from which PRE and from which station a protocol element return information shall be converted

Protocol-Specific Web Page	Protocol “serial”	Protocol “LAN”
Diagnosis (IDR)	✓	✓
Statistic (IDE)	✓	✓

The general protocol-specific web pages are largely independent of the protocol and are generally documented here.

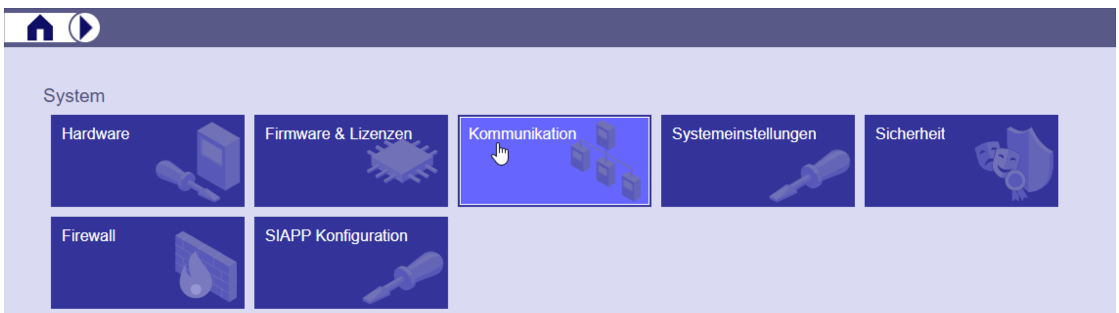
Enable web server

The web server can be enabled centrally for all protocols for a LAN interface.

NOTE

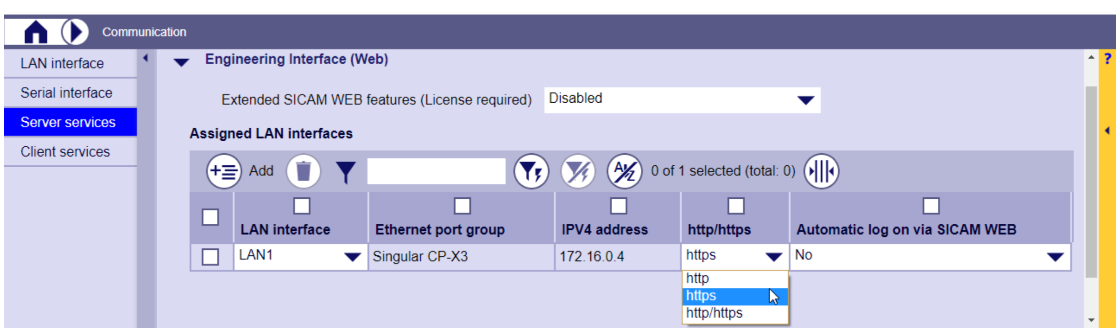
With some protocols, the web server must be enabled with an additional parameter!

- System: Communication



[DM_Kommunikation_WebServer1a_red, 3, en_US]

- System: Communication | Server Services | assigned LAN interfaces
  - Add line for assigned LAN interface
  - Select LAN interface
  - Allow http or https or both



[DM_Kommunikation_WebServer2a, 3, en_US]

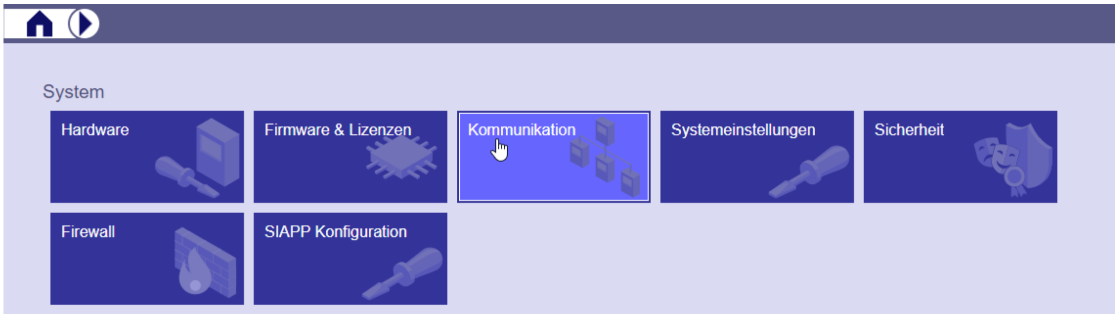
Disable web server

The web server can be disabled centrally for all protocols for a LAN interface.

NOTE

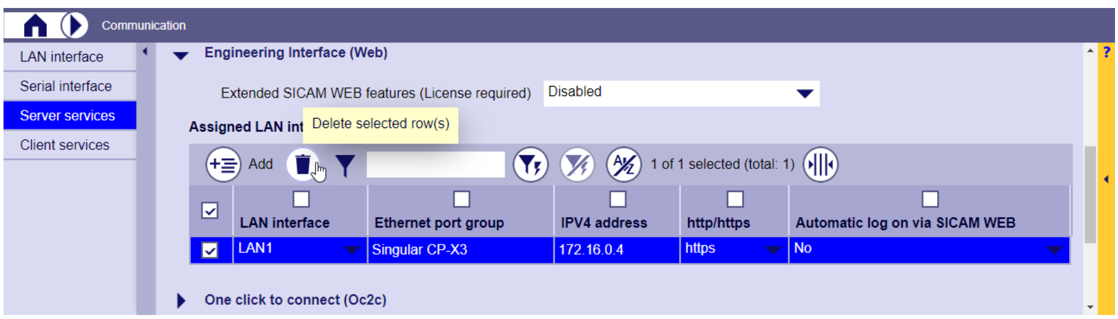
With some protocols, the web server can be disabled with a specific protocol parameter.

- System: Communication

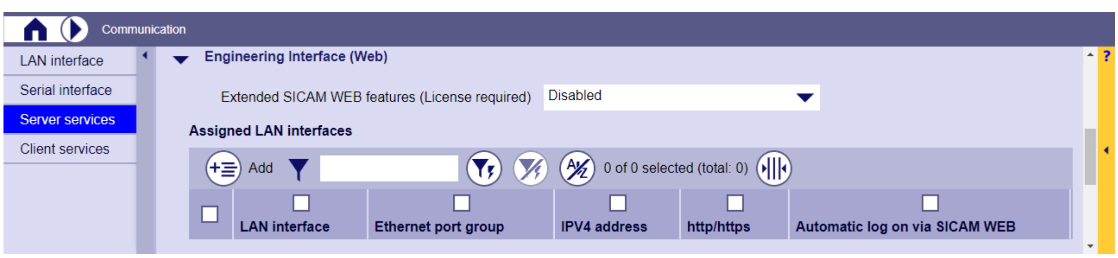


[DM_Kommunikation_WebServer1a_red, 3, en_US]

- System: Communication | Server Services | assigned LAN interfaces
  - Delete line (s) for assigned LAN interface (s)



[DM_Kommunikation_WebServer3a, 3, en_US]



[DM_Kommunikation_WebServer3b, 3, en_US]

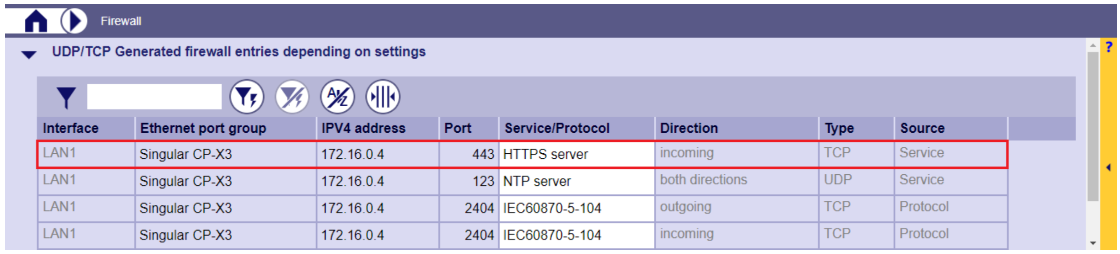
Enable/disable web server "Overview"

The firewall entries generated based on the device settings can be used to check on which LAN interfaces the web server can be used.

- System: Firewall

[DM_Kommunikation_WebServer4_red, 3, en_US]

- System: Firewall | UDP/TCP Generated firewall entries based on the device settings



Interface	Ethernet port group	IPV4 address	Port	Service/Protocol	Direction	Type	Source
LAN1	Singular CP-X3	172.16.0.4	443	HTTPS server	incoming	TCP	Service
LAN1	Singular CP-X3	172.16.0.4	123	NTP server	both directions	UDP	Service
LAN1	Singular CP-X3	172.16.0.4	2404	IEC60870-5-104	outgoing	TCP	Protocol
LAN1	Singular CP-X3	172.16.0.4	2404	IEC60870-5-104	incoming	TCP	Protocol

[DM_Kommunikation_WebServer5_red, 3, en_US]

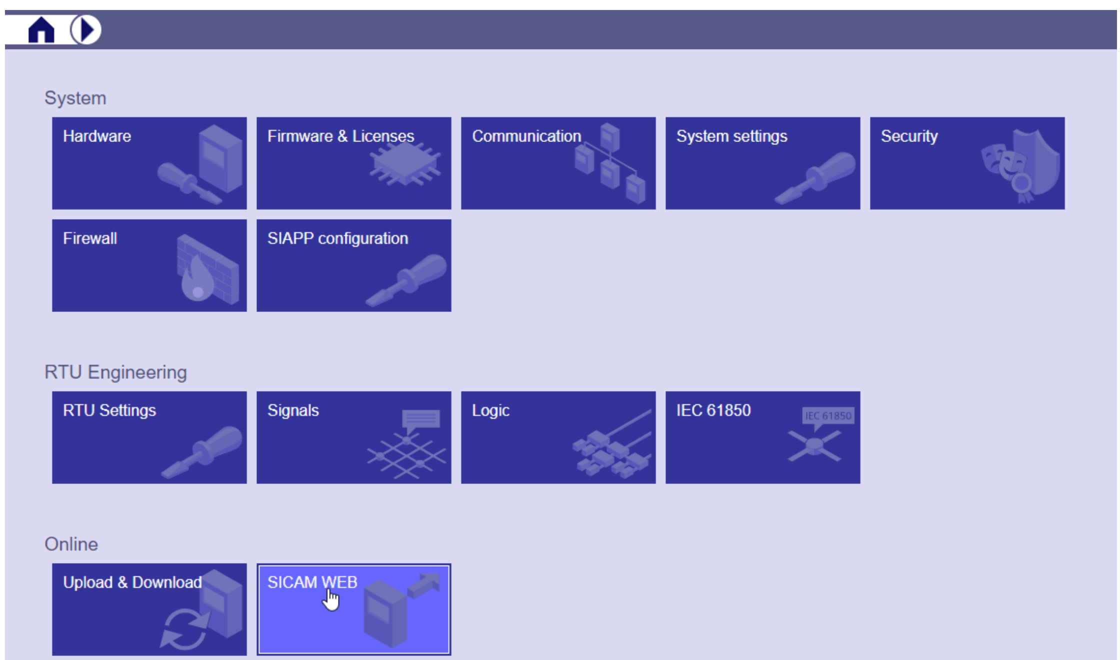
Start the web server via the SICAM Device Manager

With the SICAM Device Manager, the protocol-specific websites can be called up directly from the SICAM Device Manager with SICAM WEB.

NOTE

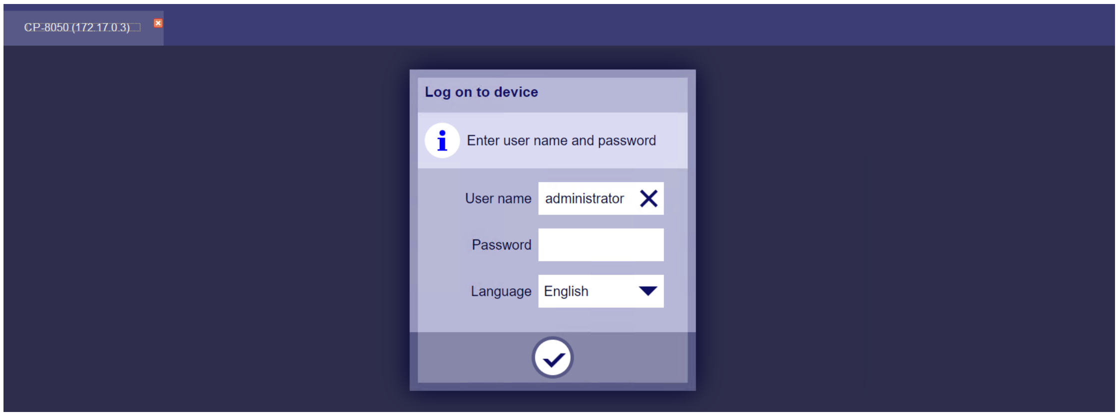
For SICAM WEB a connection to the CP-8050 must be established via LAN.

- Start SICAM WEB



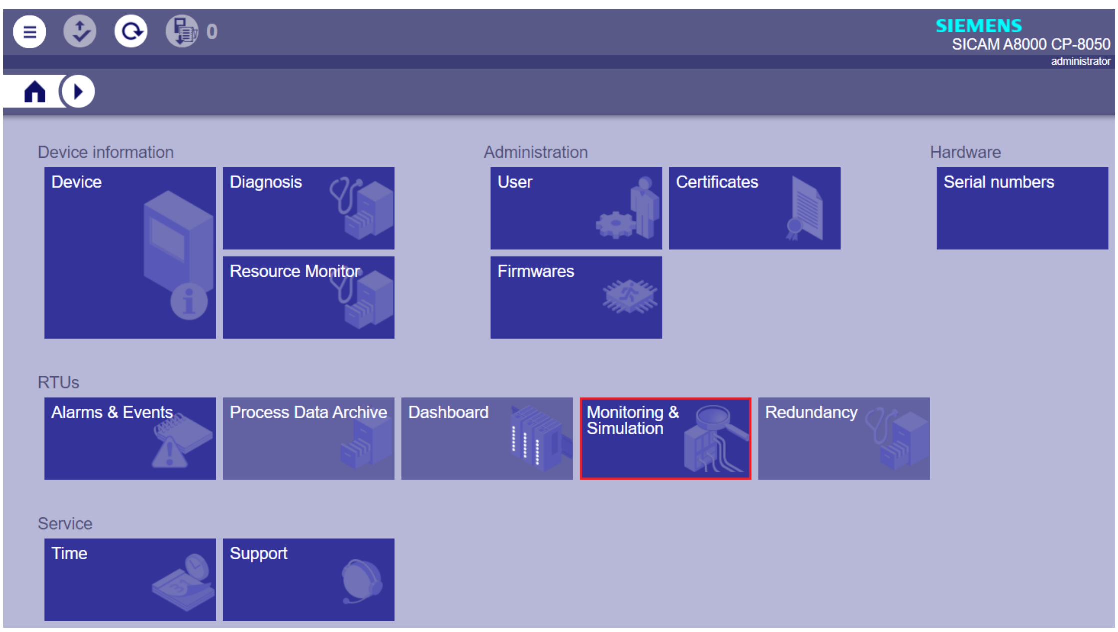
[DM_SICWEB_red, 2, en_US]

- SICAM WEB
  →the start page of SICAM WEB is displayed



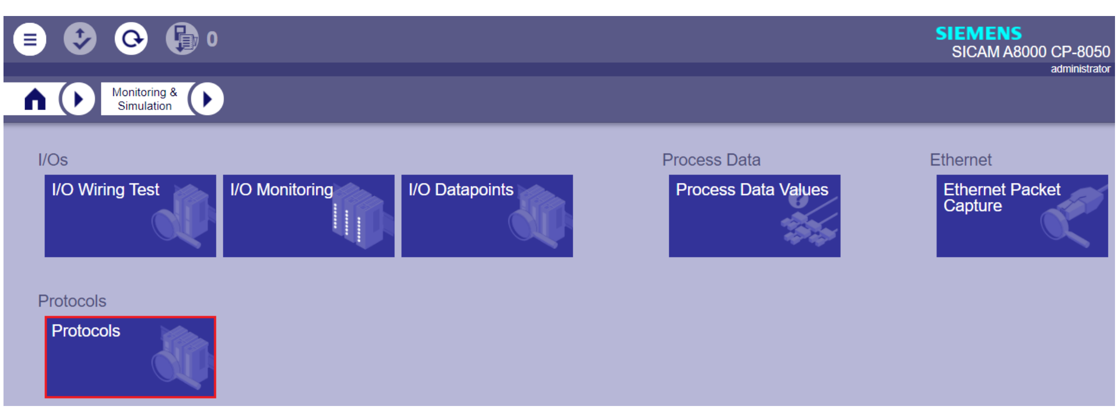
[DM_SICWEB_Logon_Screen, 1, en_US]

- select SICAM WEB | RTUs | Monitoring & Simulation



[SICWEB_Monitoring_Simulation, 1, en_US]

- select SICAM WEB | RTUs | Monitoring & Simulation | Protocols



[SICWEB_Monitoring_Simulation_Protokolle, 1, en_US]

- select protocol-specific web pages SICAM WEB | RTUs | Monitoring & Simulation | Protocols |

[SICWEB_Monitoring_Simulation_Protokolle_ETI4, 1, en_US]

Figure 13-3 start protocol-specific web page e.g. for ETI4

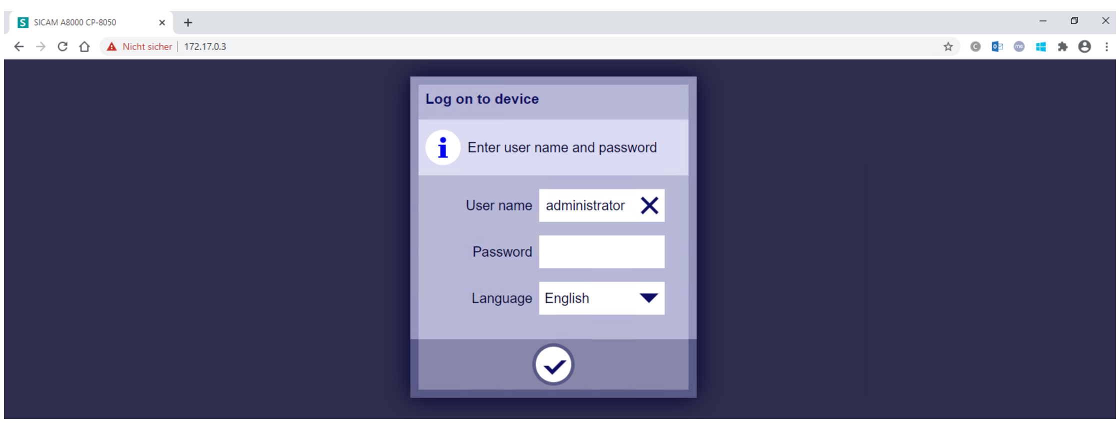
start web server via web browser

With SICAM TOOLBOX II or a PC with web browser, the protocol-specific web pages can be selected via the IP address of the CP-8050 (SICAM WEB).

NOTE

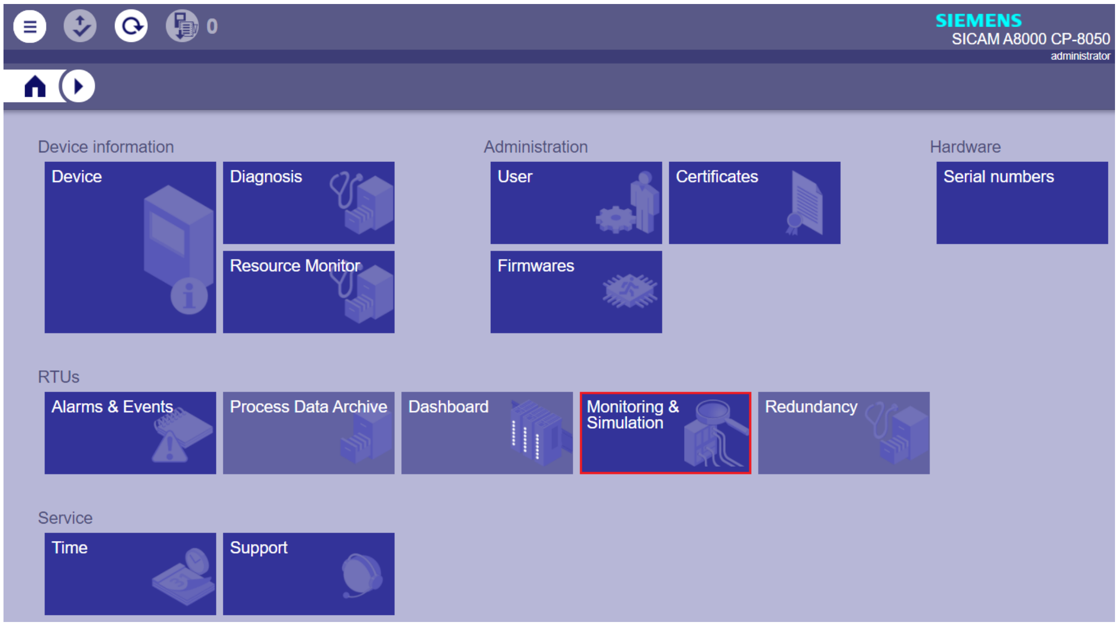
For SICAM WEB a connection to the CP-8050 must be established via LAN.

- Enter the IP address of the CP-8050 in the web browser.
  →the start page of SICAM WEB is displayed



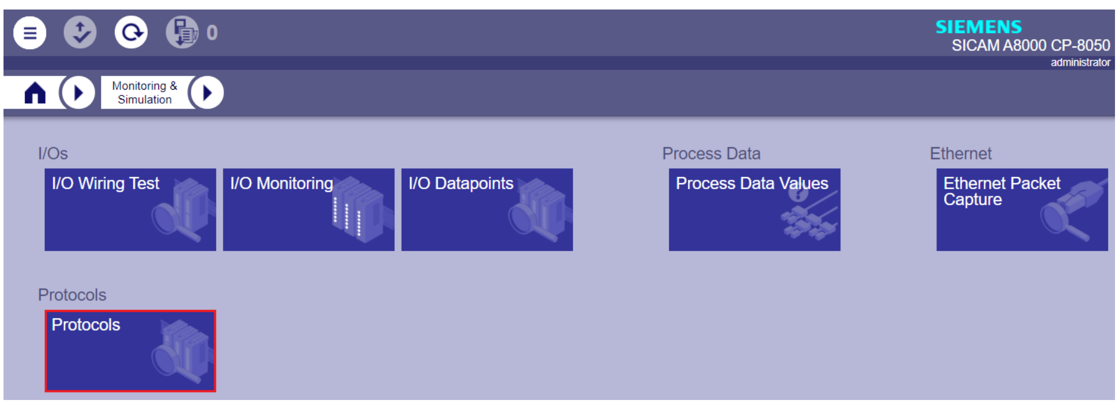
[SICWEB, 1, en_US]

- select SICAM WEB | RTUs | Monitoring & Simulation



[SICWEB_Monitoring_Simulation, 1, en_US]

- select SICAM WEB | RTUs | Monitoring & Simulation | Protocols



[SICWEB_Monitoring_Simulation_Protokolle, 1, en_US]

- select protocol-specific web pages SICAM WEB | RTUs | Monitoring & Simulation | Protocols |

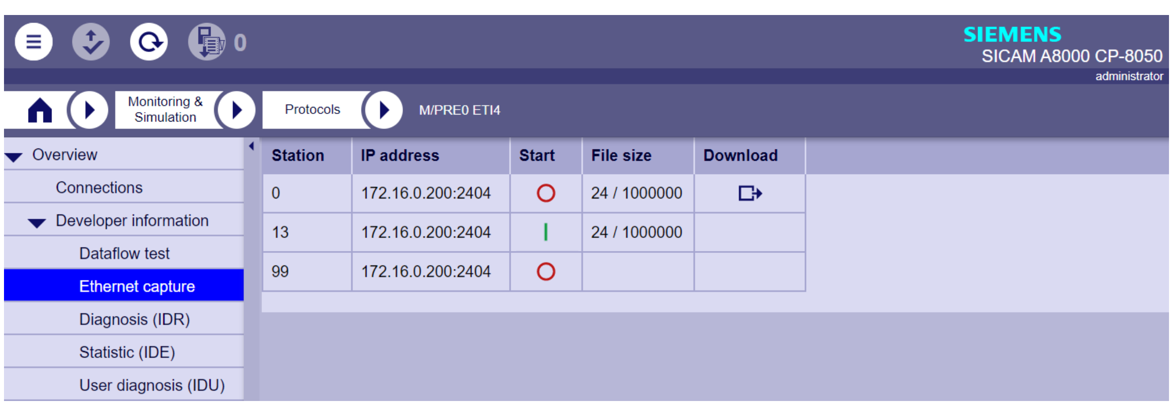
[SICWEB_Monitoring_Simulation_Protokolle_ETI4, 1, en_US]

Figure 13-4 start protocol-specific web page e.g. for ETI4

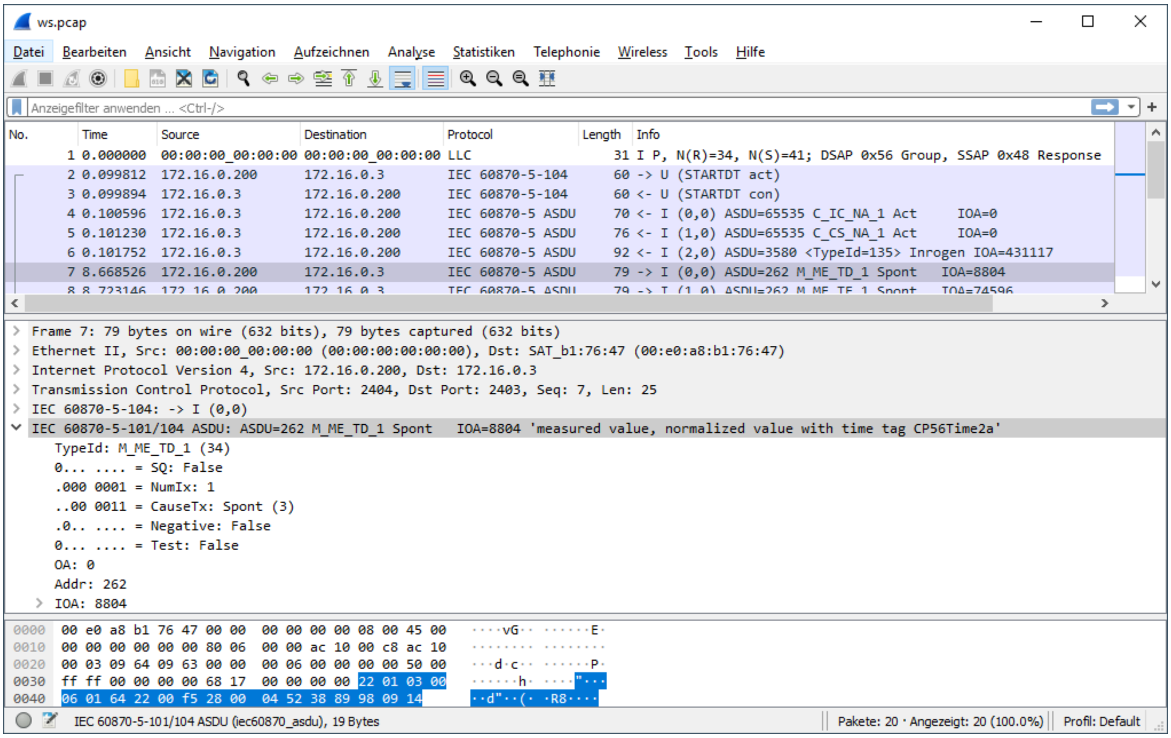
Protocol-specific web page Developer Information – Ethernet Capture

With the web page**Developer Information – Ethernet Capture**the data traffic on the LAN interface with the assigned TCP port number of the connection of the protocol (regardless of any TLS encryption used) can be recorded for diagnostic purposes and then saved for evaluation with Wireshark.

Field		Note
Station		CP-8050 internal station number for this connection
IP address		IP address of the remote station and port number of the connection
Start		Start/Stop Ethernet capture for this station • All TCP/IP messages are recorded via this connection (from/to remote station) with the configured TCP port number of the connection. • The recording can be started for different connections at the same time. • The max. number of recorded data is limited per connection (max. 1,000,000 bytes).
Start / Download		• Ethernet Capture stopped
		• Ethernet Capture started
		• Ethernet Capture stopped • Recorded data is available for download
File size		Number of bytes recorded • Example: 24/1000000 24 = Number of bytes currently recorded 1000000 = max. number of recorded bytes
Download		Download the recorded Ethernet capture data for this station from the CP-8050 and save it on a PC / notebook. • A running recording must be stopped before the download. • When downloading, the data is saved in the Wireshark ® file format (.pcap) in the “Download” folder on the PC (Windows ®). Default file name = ws.pcap. The file can be loaded into Wireshark ® for evaluation.



[ETI4_SICWEB_EthernetCapture, 1, en_US]



[ETI4_Wireshark, 1, en_US]

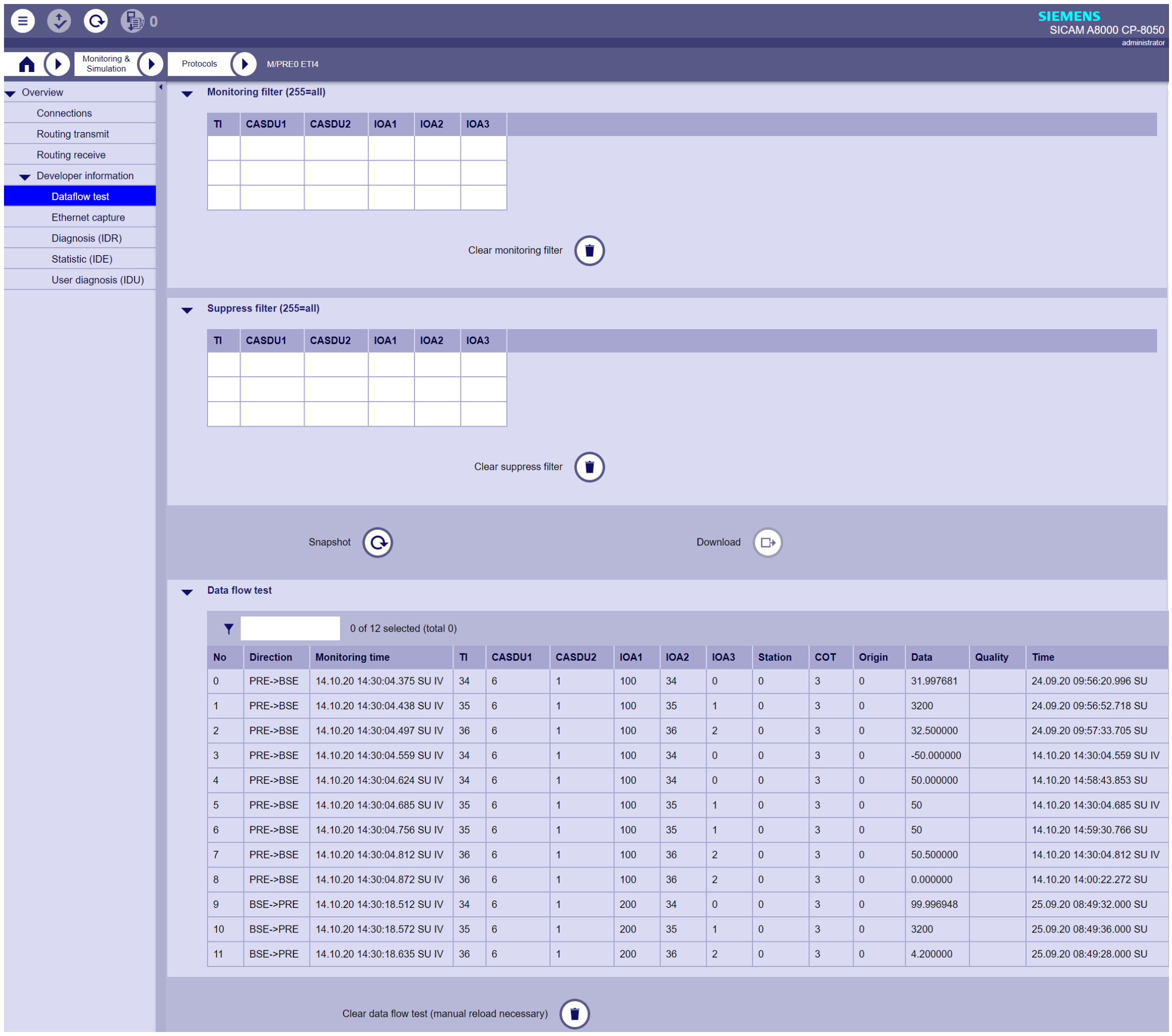
Figure 13-5 Example: Evaluation of an Ethernet capture file for IEC 60870-5-104 (ws.pcap) with Wireshark

Protocol specific web page: Developer Information – Dataflow Test

On the web page**Developer Information – Dataflow Test**the messages transmitted on the internal interface from PRE↔BSE are displayed.

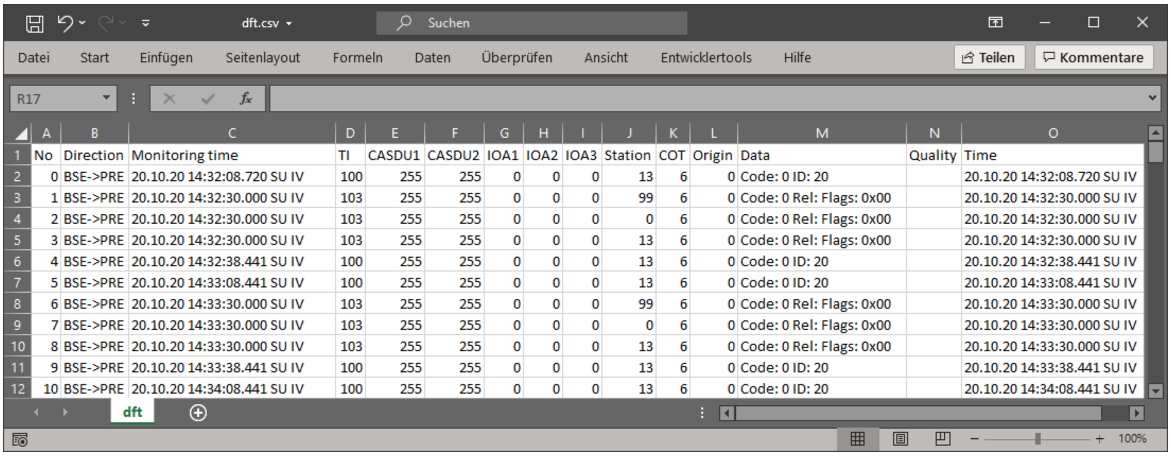
The last 1000 received or transmitted messages will be displayed.

Field	Note
No	Consecutive message number
Direction	Direction of the transmission • PRE→BSE: Received data • BSE→PRE: Transmitted data
Monitoring time	Logging time
TI	SICAM A8000 internal IEC 60870-5-101/104 type identification
CASDU1, CASDU2 IOA1, IOA2, IOA3	SICAM A8000 internal IEC 60870-5-101/104 Address of the data point
Station	SICAM A8000 internal station number of connection
COT	SICAM A8000 internal IEC 60870-5-101/104 cause of transmission (COT = Cause Of Transmission)
Origin	SICAM A8000 internal IEC 60870-5-101/104 originator address (origin = Originator)
Data	SICAM A8000 internal IEC 60870-5-101/104 Status of the data point
Quality	SICAM A8000 internal IEC 60870-5-101/104 quality identifier of the data point
Time	Receive time



[ETI4_SICWEB_DFT1, 1, en_US]

Symbol	Function
	• With **Clear data flow test (manual reload necessary)** the recorded messages are deleted from the Dataflow Test display (the web page must be updated manually to update the display).
	• With **Snapshot** the current logged messages are temporarily stored internally and are available for download.
	• With **Download** the internally cached and logged messages are downloaded from the CP-8050 and saved on the PC as a CSV file. →The CSV file can e.g. be opened and evaluated with Microsoft Excel.

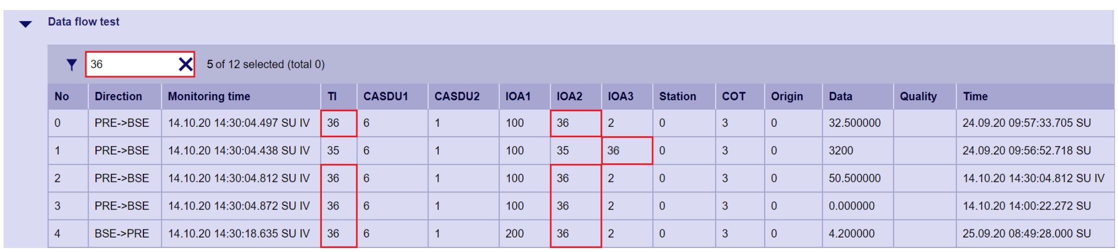


No	Direction	Monitoring time	TI	CASDU1	CASDU2	IOA1	IOA2	IOA3	Station	COT	Origin	Data	Quality	Time
0	BSE->PRE	20.10.20 14:32:08.720 SU IV	100	255	255	0	0	0	13	6	0	Code: 0 ID: 20		20.10.20 14:32:08.720 SU IV
1	BSE->PRE	20.10.20 14:32:30.000 SU IV	103	255	255	0	0	0	99	6	0	Code: 0 Rel: Flags: 0x00		20.10.20 14:32:30.000 SU IV
2	BSE->PRE	20.10.20 14:32:30.000 SU IV	103	255	255	0	0	0	0	6	0	Code: 0 Rel: Flags: 0x00		20.10.20 14:32:30.000 SU IV
3	BSE->PRE	20.10.20 14:32:30.000 SU IV	103	255	255	0	0	0	13	6	0	Code: 0 Rel: Flags: 0x00		20.10.20 14:32:30.000 SU IV
4	BSE->PRE	20.10.20 14:32:38.441 SU IV	100	255	255	0	0	0	13	6	0	Code: 0 ID: 20		20.10.20 14:32:38.441 SU IV
5	BSE->PRE	20.10.20 14:33:08.441 SU IV	100	255	255	0	0	0	13	6	0	Code: 0 ID: 20		20.10.20 14:33:08.441 SU IV
6	BSE->PRE	20.10.20 14:33:30.000 SU IV	103	255	255	0	0	0	99	6	0	Code: 0 Rel: Flags: 0x00		20.10.20 14:33:30.000 SU IV
7	BSE->PRE	20.10.20 14:33:30.000 SU IV	103	255	255	0	0	0	0	6	0	Code: 0 Rel: Flags: 0x00		20.10.20 14:33:30.000 SU IV
8	BSE->PRE	20.10.20 14:33:30.000 SU IV	103	255	255	0	0	0	13	6	0	Code: 0 Rel: Flags: 0x00		20.10.20 14:33:30.000 SU IV
9	BSE->PRE	20.10.20 14:33:38.441 SU IV	100	255	255	0	0	0	13	6	0	Code: 0 ID: 20		20.10.20 14:33:38.441 SU IV
10	BSE->PRE	20.10.20 14:34:08.441 SU IV	100	255	255	0	0	0	13	6	0	Code: 0 ID: 20		20.10.20 14:34:08.441 SU IV

[ETI4_SICWEB_DFT1_CSV, 1, en_US]

Dataflow test with text filter

- Messages that have already been recorded are displayed according to the filters set.
- The filter affects all fields of the table.
- The filter is activated with .
- The display is updated immediately when the filter is changed.



Data flow test

36 — 5 of 12 selected (total 0)

No	Direction	Monitoring time	TI	CASDU1	CASDU2	IOA1	IOA2	IOA3	Station	COT	Origin	Data	Quality	Time
0	PRE->BSE	14.10.20 14:30:04.497 SU IV	36	6	1	100	36	2	0	3	0	32.500000		24.09.20 09:57:33.705 SU
1	PRE->BSE	14.10.20 14:30:04.438 SU IV	35	6	1	100	35	36	0	3	0	3200		24.09.20 09:56:52.718 SU
2	PRE->BSE	14.10.20 14:30:04.812 SU IV	36	6	1	100	36	2	0	3	0	50.500000		14.10.20 14:30:04.812 SU IV
3	PRE->BSE	14.10.20 14:30:04.872 SU IV	36	6	1	100	36	2	0	3	0	0.000000		14.10.20 14:00:22.272 SU
4	BSE->PRE	14.10.20 14:30:18.635 SU IV	36	6	1	200	36	2	0	3	0	4.200000		25.09.20 08:49:28.000 SU

[ETI4_SICWEB_DFT2b, 1, en_US]

Message filter for simultaneous logging (“Monitoring Filter”)

With filter enabled, only messages will be logged which are selected by filter. If no filter is selected, all messages will be logged.

Symbol	Function
	• With **Clear monitoring filter** all filters are deleted.

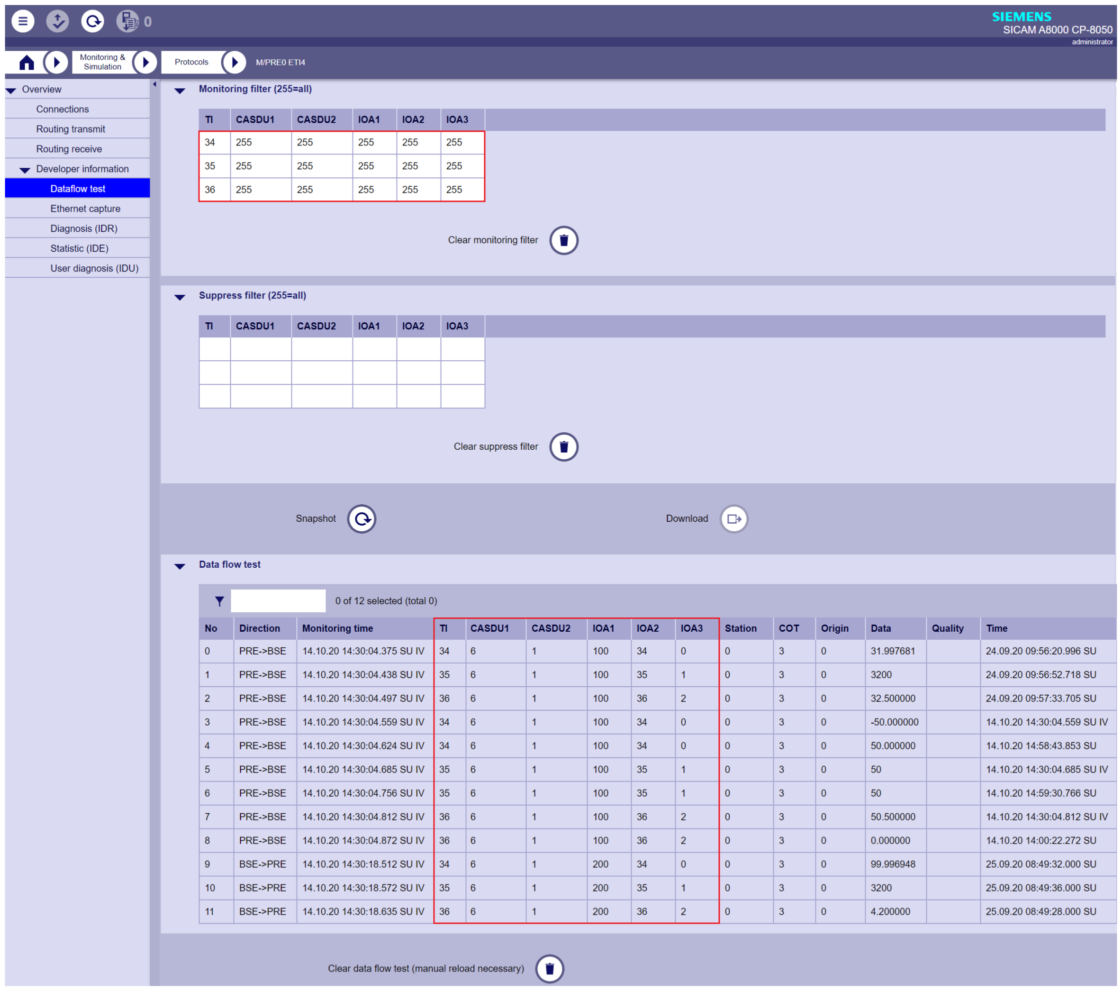
Message filter for logging - “Suppress Filter”

If a filter is selected, the messages selected by the filter are not logged (suppressed). If no filter is selected all messages will be logged.

Symbol	Function
	• With **Clear suppress filter** all filters are deleted.

- The filters are activated immediately by entering the filter values.
- With the value “255” “Wildcard” is set for this field. This means that all messages with this field (0 to 255) are logged/suppressed.

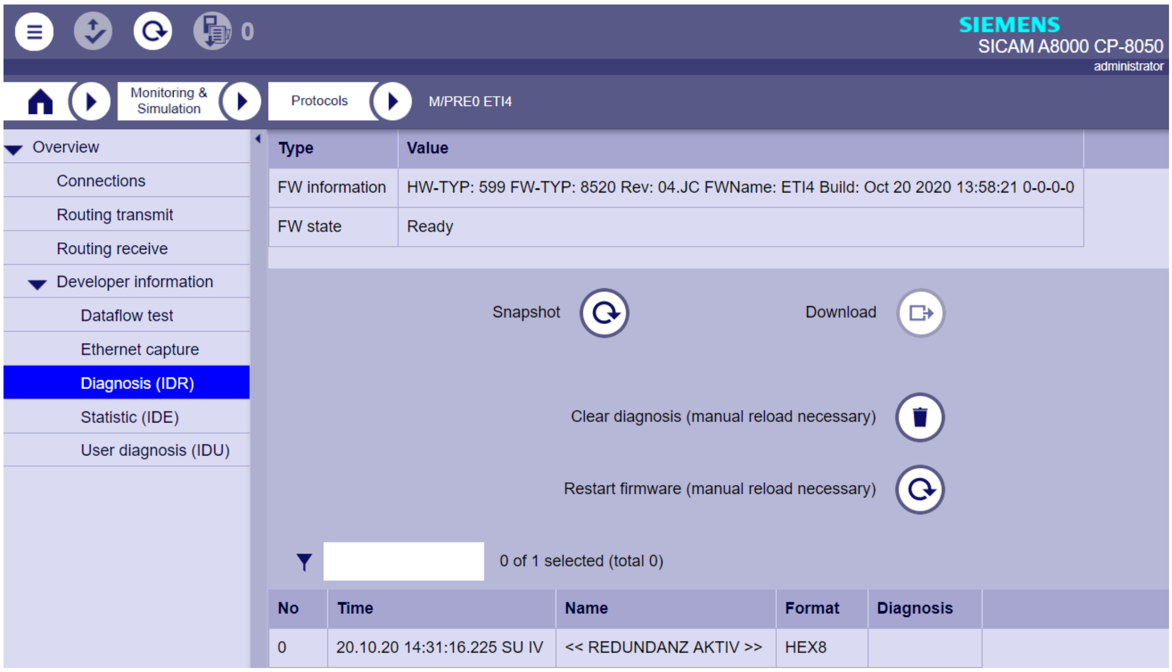
- The display of messages already recorded is not changed by changing the “Monitoring Filters” or “Suppress Filters”. The filters are effective immediately for new recorded messages.
- After changing the filter, the messages that have already been recorded should be deleted with **Clear data flow test (manual reload necessary)** .
- If the same values are entered in the “Monitoring Filter” and “Suppress Filter”, the “Suppress Filter” is effective.



[ETI4_SICWEB_DFT2_red, 1, en_US]

Developer Information – Diagnosis (IDR)

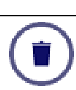
On the web page**Developer Information – Diagnosis (IDR)**protocol element-internal diagnostic information is displayed.

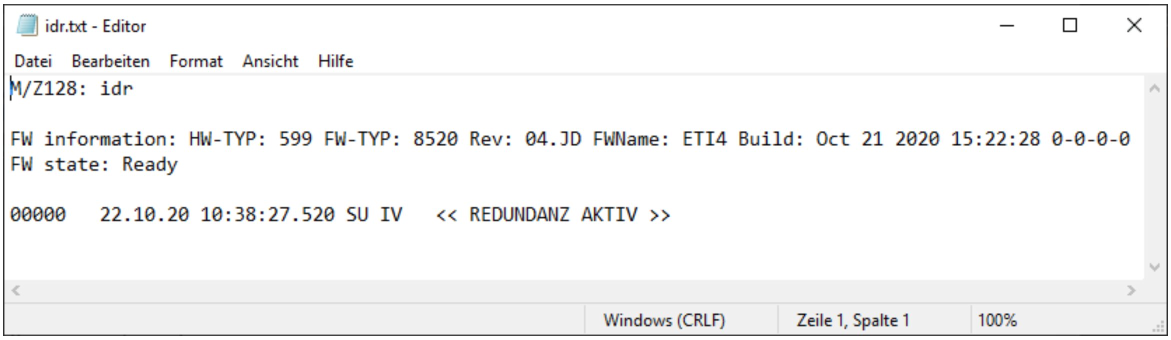


[ETI4_SICWEB_IDR, 1, en_US]

General information of the protocol firmware

Field (type)	Comment (Value)
FW information	Firmware information • HW-TYP .. Hardware type of protocol firmware • FW-TYP .. Firmware type of protocol firmware • Rev .. Revision of Firmware • Built .. Generation state of the firmware
FW state	State of the firmware: • ready • startup • KILL • not available

Symbol	Function
	• With**Snapshot**the current IDR diagnostic information are temporarily stored internally and are available for download.
	• With**Download**the internally cached IDR diagnostic information are downloaded from the CP-8050 and saved on the PC as a CSV file. →The text file can be opened with a text editor or sent by email for analysis.
	• With**Clear user diagnosis (manual reload necessary)**the recorded IDR diagnostic information is deleted (the web page must be updated manually to update the display).
	• With**Restart firmware (manual reload necesary)**the selected protocol firmware is restarted (the web page must be updated manually to update the display).



idr.txt - Editor

Datei Bearbeiten Format Ansicht Hilfe

```
M/Z128: idr

FW information: HW-TYP: 599 FW-TYP: 8520 Rev: 04.JD FWName: ETI4 Build: Oct 21 2020 15:22:28 0-0-0-0
FW state: Ready

00000   22.10.20 10:38:27.520 SU IV   << REDUNDANZ AKTIV >>
```

Windows (CRLF) Zeile 1, Spalte 1 100%

[idr, 1, en_US]

IDR diagnostic information of the protocol firmware (“PRE diagnosis information (IDR)”)

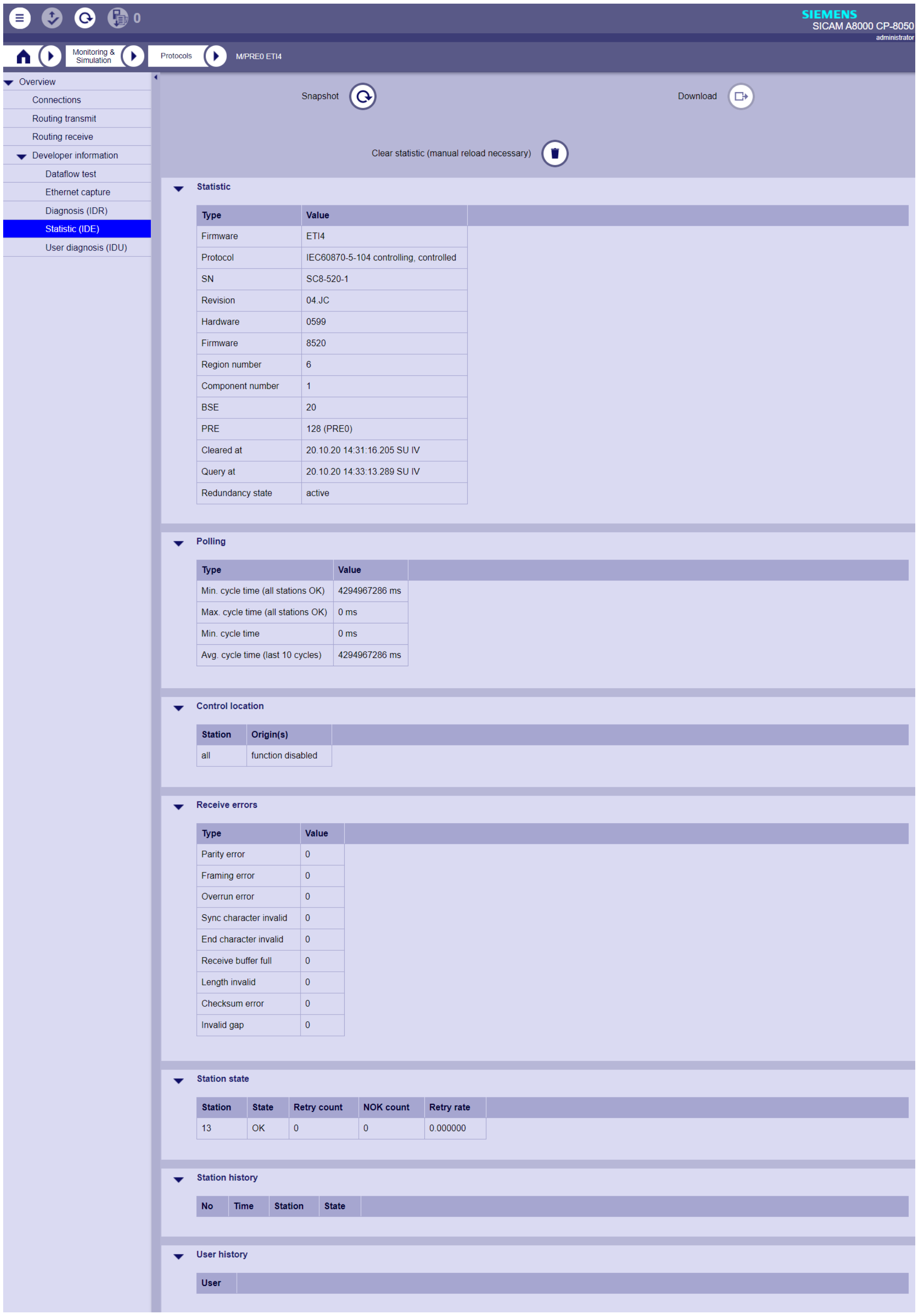
Field	Note
No	Consecutive number
Time	Date + time of IDR logging
Name	Diagnosis text
Format	Format of diagnosis information in next column • CHAR, HEX8, HEX16, HEX32, DEC8, DEC16, DEC32, FlOAT32
Diagnosis	Detail information for IDR diagnosis

Developer Information – Diagnosis (IDR) with text filter

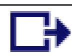
- The IDR diagnostic information in the list can be filtered using the text filter.
- The filter affects all fields of the table.
- The filter is activated with .
- The display is updated immediately when the filter is changed.

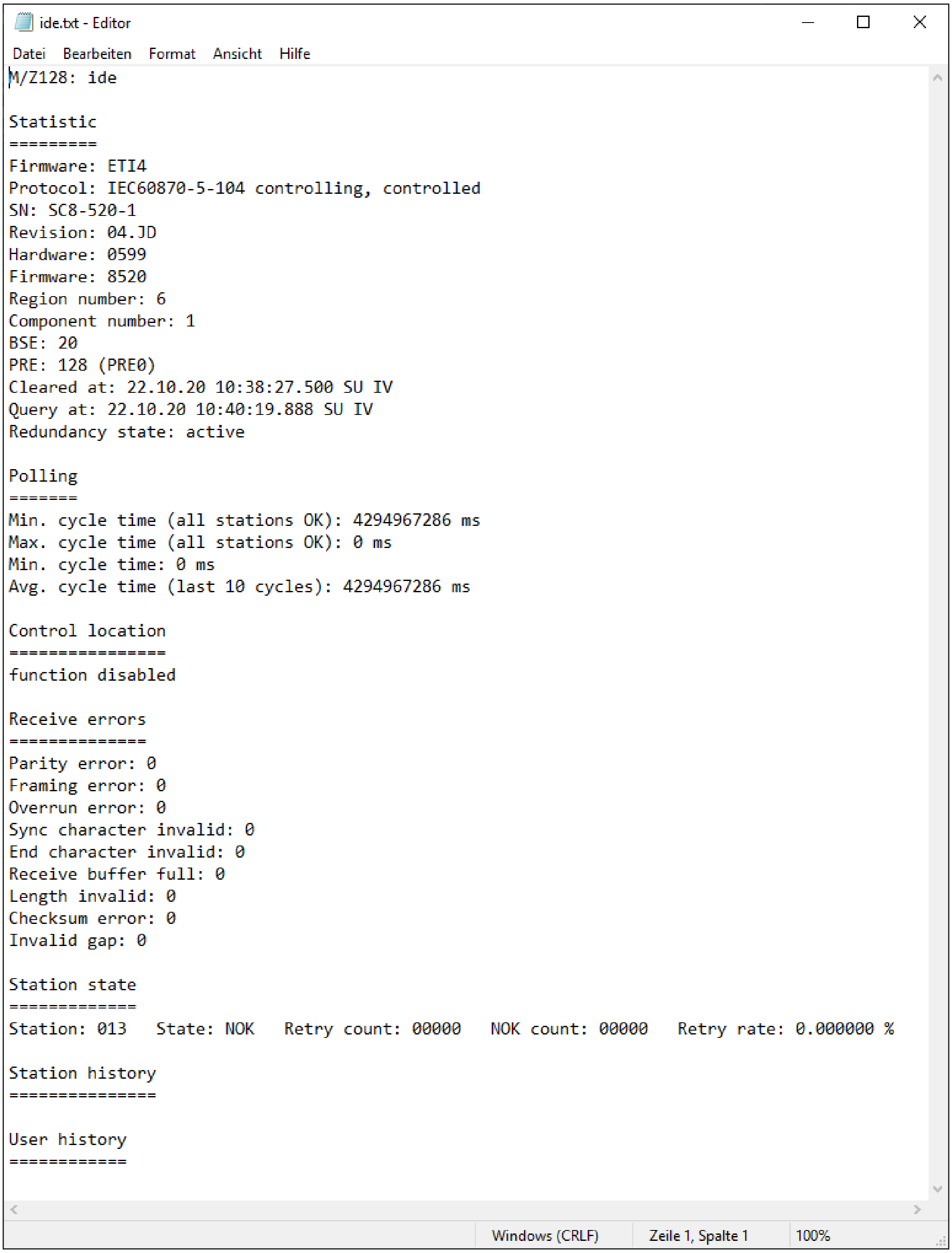
Protocol specific web page: Developer Information – Statistics (IDE)

On the web page**Developer Information – Statistics (IDE)**protocol-internal statistic information are displayed.



[ETI4_SICWEB_IDE, 1, en_US]

Symbol	Function
	• With**Clear statistics (manual reload necessary)**the recorded statistical information and error counters are deleted from the display (the web page must be updated manually to update the display).
	• With**Snapshot**the currently recorded statistical information is temporarily stored internally and is available for download.
	With**Download**the internally cached statistic information are downloaded from the CP-8050 and saved on the PC as a CSV file. →The text file can be opened with a text editor or sent by email for analysis.



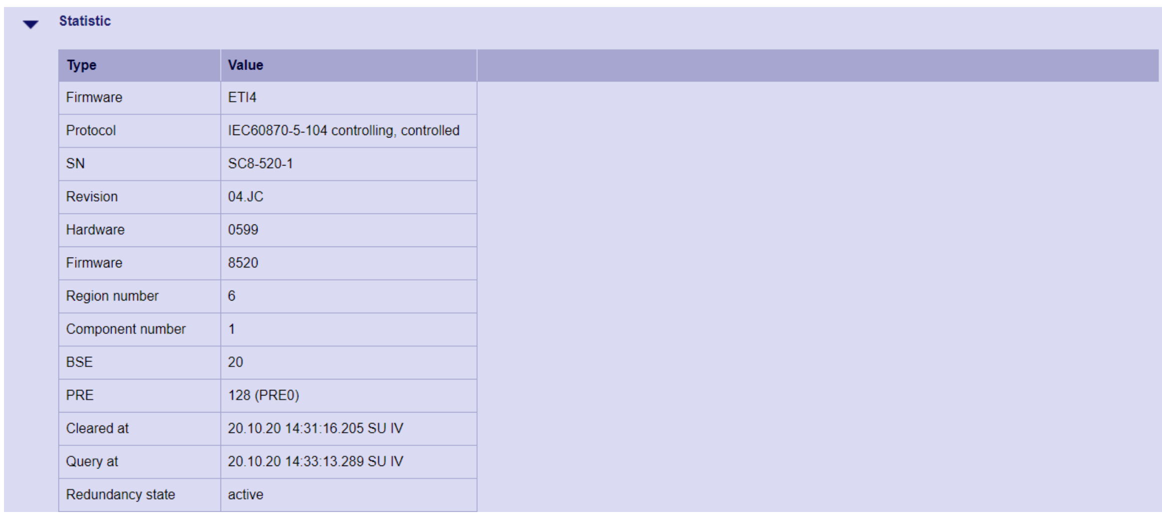
```
M/Z128: ide

Statistic
=========
Firmware: ETI4
Protocol: IEC60870-5-104 controlling, controlled
SN: SC8-520-1
Revision: 04.JD
Hardware: 0599
Firmware: 8520
Region number: 6
Component number: 1
BSE: 20
PRE: 128 (PRE0)
Cleared at: 22.10.20 10:38:27.500 SU IV
Query at: 22.10.20 10:40:19.888 SU IV
Redundancy state: active

Polling
=======
Min. cycle time (all stations OK): 4294967286 ms
Max. cycle time (all stations OK): 0 ms
Min. cycle time: 0 ms
Avg. cycle time (last 10 cycles): 4294967286 ms

Control location
================
function disabled

Receive errors
==============
Parity error: 0
Framing error: 0
Overrun error: 0
Sync character invalid: 0
End character invalid: 0
Receive buffer full: 0
Length invalid: 0
Checksum error: 0
Invalid gap: 0

Station state
=============
Station: 013   State: NOK   Retry count: 00000   NOK count: 00000   Retry rate: 0.000000 %

Station history
===============

User history
============
```

[ide, 1, en_US]

Statistic (en: “Statistic”)

Field (type)	Comment (Value)
Firmware	Name of firmware
Protocol	Protocol function
SN	Part number of the firmware
Revision	Revision of firmware

Field (type)	Comment (Value)
Hardware	Hardware number (system internal)
Firmware	Firmware number (system internal)
Region number	Region number (system internal)
Component number	Component number (system internal)
BSE	Basic system element number (system internal)
PRE	Protocol element number of the firmware (internal)
Cleared at	Time of IDE diagnosis information cleared
Query at	Last query time of IDE diagnosis information
Redundancy state	Current redundancy status of the firmware: • active • passive



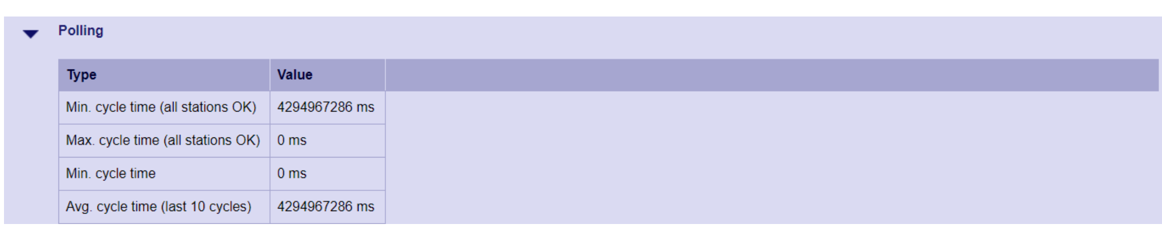
Statistic

Type	Value
Firmware	ETI4
Protocol	IEC60870-5-104 controlling, controlled
SN	SC8-520-1
Revision	04.JC
Hardware	0599
Firmware	8520
Region number	6
Component number	1
BSE	20
PRE	128 (PRE0)
Cleared at	20.10.20 14:31:16.205 SU IV
Query at	20.10.20 14:33:13.289 SU IV
Redundancy state	active

[ETI4_SICWEB_IDE_Statistic, 1, en_US]

Protocol station interrogation (“Polling”)

Field (type)	Comment (Value)
Min. cycle time (all stations OK)	protocol specific
Max. cycle time (all stations OK)	protocol specific
Min. cycle time	protocol specific
Avg. cycle time (last 10 cycles)	protocol specific



Polling

Type	Value
Min. cycle time (all stations OK)	4294967286 ms
Max. cycle time (all stations OK)	0 ms
Min. cycle time	0 ms
Avg. cycle time (last 10 cycles)	4294967286 ms

[ETI4_SICWEB_IDE_Polling, 1, en_US]

control location (en: “Control location”)

The activated control locations will be displayed when control location function is enabled.

Field	Note
Station	• all .. all stations • 0, 1, 2, to 99 .. internal station number
Origin(s)	Control location: • function disabled .. Control location not enabled • 0, 1, 2, to 255 .. enabled originator addresses [en: “Origin”]

Example:
The control location function is not enabled.
→Commands & setpoint values are transmitted to the remote station without evaluating the origin address.

Control location

Station	Origin(s)
all	function disabled

[ETI4_SICWEB_IDE_ControlLocation1, 1, en_US]

Example:
The control location function is enabled, but no control location is enabled.
→Commands & setpoint values are not transmitted to any of the stations and are negatively confirmed (ACTCON-).

Control location

Station	Origin(s)
all	

[ETI4_SICWEB_IDE_ControlLocation4, 1, en_US]

Example:
For station #13 the addresses of the origin (en: “Origin”) 0, 42 are enabled as control location.
For station #99 the originator address (en: “Origin”) 21 is enabled as control location.
→Commands & setpoint values are only transmitted to these stations only from these origin addresses
→Commands & setpoint values from other origin addresses are not transmitted and negatively confirmed (ACTCON-)

Control location

Station	Origin(s)
13	0, 42
99	21

[ETI4_SICWEB_IDE_ControlLocation2, 1, en_US]

Example:
For all stations the addresses of origin (en: “Origin”) 0, 42, 123 are enabled as control location.Origin)
→Commands & setpoint values are only transferred from these origin addresses to these stations
→Commands & setpoint values from other origin addresses are not transmitted and negatively confirmed (ACTCON-)

Control location

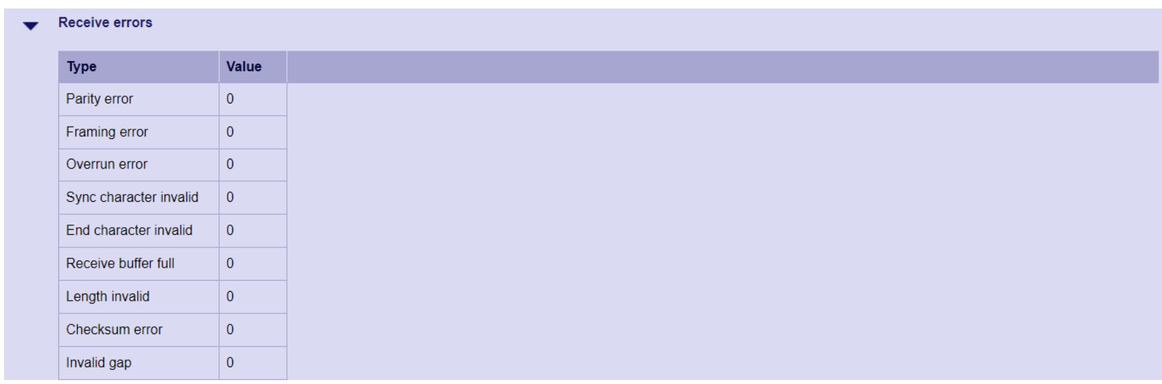
Station	Origin(s)
all	0, 42, 123

[ETI4_SICWEB_IDE_ControlLocation3, 1, en_US]

Reception error statistics (en: "Receive Errors")

The reception error statistics are protocol-specific (not used or used differently for LAN protocols).

Field (type)	Comment (Value)
Parity error	not used
Framing error	not used
Overrun error	Number of detected "Overflow errors" In case of overflow error the firmware load is too high - the received bytes can no longer be processed correctly.
Sync character invalid	Number of detected "Sync character errors"
End character invalid	Number of detected "End character errors"
Receive buffer full	Number of detected errors for "receive buffer full"
Length invalid	Number of detected "length invalid" errors
Checksum error	Number of detected "checksum errors"
Invalid gap	not used


Receive errors

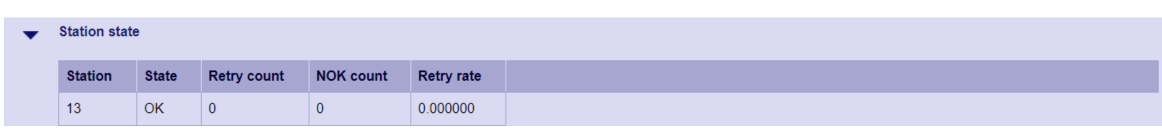
Type	Value
Parity error	0
Framing error	0
Overrun error	0
Sync character invalid	0
End character invalid	0
Receive buffer full	0
Length invalid	0
Checksum error	0
Invalid gap	0

[ETI4_SICWEB_IDE_ReceiveErrors, 1, en_US]

State of the communication link (en: "Station state")

For each station, the current status and statistics about the number of failures and retries are displayed.

Field	Note
Station	Station number (internal)
State	Status: • OK .... Communication link OK • NOK ..... Communication link NOK (failed)
Retry count	Number of retries since last Clear diagnosis
NOK count	Number of communication link NOK (failed) since last Clear diagnosis
Retry rate	Number of retries in % since last Clear diagnosis


Station state

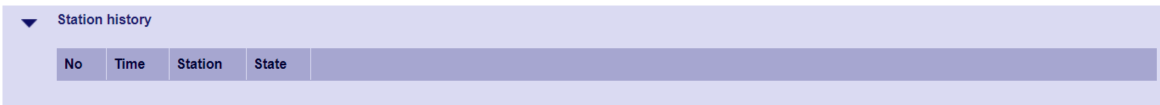
Station	State	Retry count	NOK count	Retry rate
13	OK	0	0	0.000000

[ETI4_SICWEB_IDE_StationState, 1, en_US]

Chronological list of retries and station failures (en: "Station History")

The "Station History" is partly protocol-specific (not used or used differently for LAN protocols).

Field	Note
No	Consecutive number
Time	Date + time of communication error (OK, NOK, retry)
Station	Station number (internal)
State	Status: • Retry no x ... Retry number x • Station OK • Station NOK



[ETI4_SICWEB_IDE_Station_History, 1, en_US]

Protocol specific logging (en: “User History”)

The “User History” is protocol specific.

Field	Note
User	

[ETI4_SICWEB_IDE_User_History, 1, en_US]

13.1.4.13 Additive Measured Value Change Monitoring

Due to the following reasons certain protocols have implemented a measured value change monitoring in the receive direction or also in the transmit direction:

- If measured values in the receiving direction come from cyclic protocols or from sources that have not implemented measured value change monitoring (e.g. 3rd-party devices), there may be a high data load SICAM A8000 internally.
- If measured values in the transmit direction come from sources that have not implemented measured value change monitoring (e.g. 3rd-party devices), then there can be impairments on the remote station – if it has to serve many connections – due to the high data load.

The number of measured values transmitted to the basic system element (for measured values in the receive direction) or to the remote station (for measured values in the transmit direction) can be reduced by the measured value change monitoring in the protocol, since measured values are only transmitted if the change in the measured values is correspondingly large.
In addition, a technological adaptation of the values (scaling) can be carried out on the protocol for measured values – also independently of the measured value change monitoring.

The measured value change monitoring is possible for the following type identifications:

TI	
<TI:=34>	Measured value, normalized value with time tag CP56Time2a
<TI:=35>	Measured value, scaled value with time tag CP56Time2a
<TI:=36>	Measured value, short floating-point number with time tag CP56Time2a

NOTE

The number of measured values for the measured value change monitoring is limited by the protocol.

Examples

Technological value Y_{100}	4000
Processing grid	1 s [118]
Thresh_uncond	40
Thresh_additive	400

Example 1:

After transmission due to the exceeding of the large threshold, the value has changed once by 39 (< the large threshold) and subsequently remains constant.
→ The measured value is transmitted after 11 seconds.

	0 s	1 s	2 s	3 s	4 s	5 s	6 s	7 s	8 s	9 s	10 s	11 s
Measured value	300	339	339	339	339	339	339	339	339	339	339	339
Difference	> 40	39	39	39	39	39	39	39	39	39	39	39
Additive total	0	39	78	117	156	195	234	273	312	351	390	429
Transmission	✓	–	–	–	–	–	–	–	–	–	–	✓

Example 2:

After transmission due to the exceeding of the large threshold, the value has changed once by 1 (< the large threshold) and subsequently remains constant.
→ The measured value is transmitted after 400 seconds (= 6 minutes and 40 seconds).

	0 s	1s	2 s	3 s	4 s	5 s	6 s	7 s	8 s	...	399 s	400 s
Measured value	300	301	301	301	301	301	301	301	301	...	301	301
Difference	> 80	1	1	1	1	1	1	1	1	...	1	1
Additive total	0	1	2	3	4	5	6	7	8	...	399	400
Transmission	✓	–	–	–	–	–	–	–	–	–	–	✓

Example 3:

After transmission due to the exceeding of the large threshold, the value continually changes by ±1.
→ The measured value is not transmitted.

	0 s	1s	2 s	3 s	4 s	5 s	6 s	7 s	8 s	...	...	...
Measured value	300	301	300	299	300	301	300	301	299	...	300	301
Difference	> 80	1	0	-1	0	1	0	1	-1	...	0	1
Additive total	0	1	0	1	0	1	0	1	1	...	0	1
Transmission	✓	–	–	–	–	–	–	–	–	–	–	–

118 The processing grid depends on the protocol. With cyclic protocols (e.g. Modbus), the processing grid is determined by the cyclic reception.

13.1.4.14 Data Management on the BSE for Communication Protocols

At the basic system element (BSE) a protocol-specific data management (process image, rings, ...) for the chronological or state storage of the data in the transmission direction is implemented for each communication protocol (PRE). In this data management, all data to be sent are stored independently of the protocol in the internal format IEC 60870-5-101/104.

The parameters for the protocol-specific data management are part of the protocol - the function of the data management is on the BSE.

The format conversion from the internal IEC 60870-5-101/104 format to the format of the respective protocol is carried out on the protocol element. Depending on requirements, a protocol-dependent process image is additionally implemented on the PRE.

In the receive direction, no protocol-specific data management is implemented at the BSE. Received telegrams are immediately distributed to the destination (peripheral element for data output, for transmission to another communication protocol, input process image for function diagram, etc.).

For details, see "Communication functions on the basic system element".

Parameters and properties for data management

Depending on the protocol element, some parameters may not be visible if not needed.

Parameter Name	Description	Settings
`[PRE] Data base management` Settings for the data base management on BSE (per PRE)		
`[PRE] Data base management | Messages in send direction`		
`TI 32 Step position information`		Permitted range = • state change stored • chronological Default setting = state change stored
`TI 34 Measured value, normalized value`		Permitted range = • state change stored • chronological Default setting = state change stored
`TI 35 Measured value, scaled value`		Permitted range = • state change stored • chronological Default setting = state change stored
`TI 36 Measured value, short floating point number`		Permitted range = • state change stored • chronological Default setting = state change stored
`[PRE] Data base management | Priority`		
`Priority messages`		Permitted range = • high priority • middle priority • low priority Default setting = high priority

Parameter Name	Description	Settings
`Priority measured values`		Permitted range = • high priority • middle priority • low priority Default setting = medium priority
`Priority integrated totals`		Permitted range = • high priority • middle priority • low priority Default setting = high priority
[PRE] Data base management | Data base management at failure		
`Failure behavior for process inform.`	Processing of stored process information in case of communication failure.	Permitted range = 0 to 65535 s 0 .. Delete data immediately 65535 .. Do not delete data 1-65534 .. Delete data after the set time Default setting = 65535 s
`Failure behavior for process inform (GI)`	Processing of stored process information (GI data) in case of communication failure.	Permitted range = • Do not delete • Delete Default setting = do not delete
`Failure behavior for transparent info.`	Processing of stored "transparent information" in case of communication failure.	Permitted range = • Do not delete • Delete Default setting = do not delete
[PRE] Data base management | Advanced parameters | Memory size		
`Buffer size priority channel high data class 1`		Permitted range = 0; 5 to 65535 0 .. automatic 5 - 65535 ... number of entries Standard setting = 0
`Buffer size priority channel middle data class 1`		Permitted range = 0; 5 to 65535 0 .. automatic 5 - 65535 ... number of entries Standard setting = 0
`Buffer size priority channel low data class 1`		Permitted range = 0; 5 to 65535 0 .. automatic 5 - 65535 ... number of entries Standard setting = 0
`Buffer size priority channel high data class 2`		Permitted range = 0; 5 to 65535 0 .. automatic 5 - 65535 ... number of entries Standard setting = 0
`Buffer size priority channel middle data class 2`		Permitted range = 0; 5 to 65535 0 .. automatic 5 - 65535 ... number of entries Standard setting = 0

Parameter Name	Description	Settings
Buffer size priority channel low data class 2		Permitted range = 0; 5 to 65535 0 .. automatic 5 - 65535 ... number of entries Standard setting = 0
[PRE] Data base management | Advanced parameters | Data base management at memory size error		
Storing of process informations if buffer overflow	Buffer overflow clears the selected process information.	Permitted range = • delete the oldest • delete the newest Default setting = delete the newest
Storing of measured values if buffer overflow	Buffer overflow clears the selected process information.	Permitted range = • delete the oldest • delete the newest Default setting = delete the newest
Reset of buffer overflow	The error "buffer overflow" is cleared at xx%.	Permitted range = • at 50% free • at 100% free Default setting = at 100% free
Suppress diagnostic info "ring overflow for data to PRE"		Permitted range = yes, no Default setting = no

13.2 IEC 60870-5-101 (Point-to-Point Traffic)

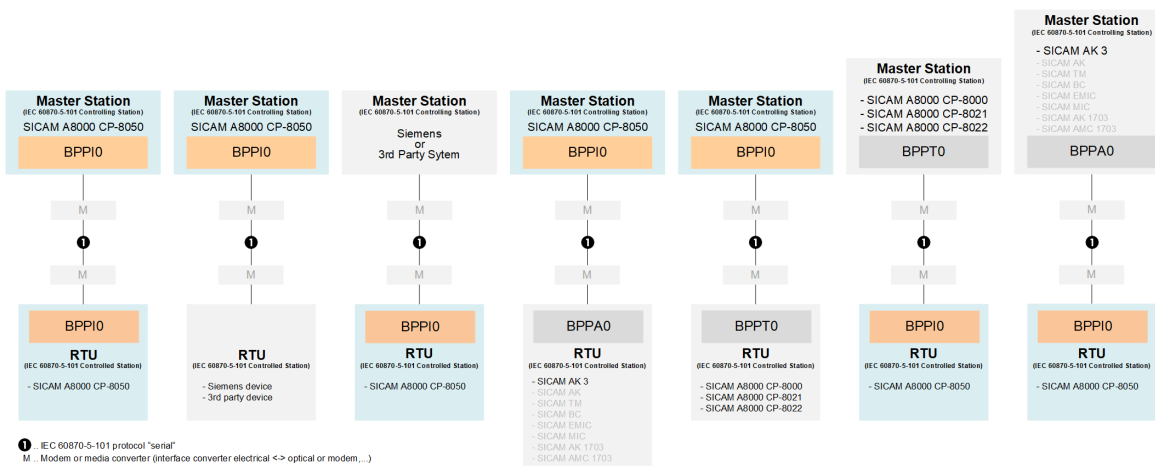
13.2.1 Introduction

The IEC 60870-5-101 protocol (point-to-point) is a standardized serial transmission protocol for communication with remote stations with point-to-point traffic.

Protocol firmware for IEC 60870-5-101 (point-to-point):

Firmware	System	Standard and function
BPPI0	CP-8031, CP-8050	IEC 60870-5-101 Balanced (point-to-point traffic)

Point-to-point traffic describes a serial communications protocol with which a central station is connected with a substation over a communication link in a point-to-point configuration. Each station has equal access and can spontaneously perform a data transmission.



[BPPI0_config, 1, en_US]

In point-to-point traffic a symmetric transmission procedure is used. That means, that every station can initiate message transmissions. As a result, every station in point-to-point traffic performs both the functions of the primary station as well as the functions of the secondary station. The function to be performed is determined through the initiation of the data transmission.
For point-to-point traffic a full-duplex transmission medium is required.

13.2.2 Functions

Function	BPPI0
IEC 60870-5-101	
Serial communication protocol according to IEC 60870-5-101	✓
Balanced transmission (Point-to-Point)	✓
System or device (application function):	
• “Controlling station”	✓
• “Controlled station”	✓
Max. connections	1
Max. number of supported data points	[119]

[119] The protocol firmware does not limit the number of data points.

Function	BPPI0
Interoperability	
IEC 60870-5-101 Ed.1 (Balanced)	✓
IEC 60870-5-101 Ed.2 (Balanced)	✓
Interoperability according to *13.2.10 Interoperability IEC 60870-5-101 (BPPI0)*	✓
Network configuration	
Point-to-point configuration	✓
Multiple point-to-point configuration (separate interface for each single point-to-point configuration required)	✓
Data concentrator	✓
Multi-hierarchical configurations (further components can be connected to substations)	✓
Physical interface	
direct link interface (RS-232)	✓
RS-422	✓
X.24/X.27 (external converters required)	✓
CP-8031, CP-8050: X4 (RS-422); X5 (RS-232)	✓
CI-8551[120]: X1, X2 (RS-232, RS-422); X3 (RS-422); X4, X5 (RS-232)	✓
Baud rates: 50, 75, 100, 134.5, 150, 200, 300, 600, 1050, 1200, 1800, 2000, 2400, 4800, 9600, 19200, 38400, 56000, 57600, 64000, 115200 bits/s	✓
Data transmission line (full duplex)	✓
Data transmission line (half duplex)	–
Bit transmission layer / message frame / data flow control	
Message formats according to IEC 60870-5-1/FT1.2	✓
Byte frame = 11 bits (8E1)	✓
Message protection d = 4:	
• Checksum (8 bits) + parity bit (even) + transmission rules	✓
Pulse code modulation, byte asynchronous	✓
Message length	1 to 255 bytes
Data flow control: Data flow control bit in receive direction used	✓
Data Flow Control: Data flow control bit in transmit direction used	–
IEC 60870-5-101 functions	
Acquisition of Events (Transmission of Data Ready to be Sent)	✓
Measured values:	
• Change monitoring for measured values (transmit and/or receive direction)	✓
• Value adaptation for measured values (transmit and/or receive direction)	✓
General Interrogation:	
• Non-Interruptible General Interrogation	✓
• Convert general interrogation command in receive direction to broadcast	✓

120 With CP-8031 not supported by default With a license (see*14.8 SICAM A8000 CP-803x Extended CI-Module*) 1 communication module CI-8551 can be used additionally also with CP-8031.

Function		BPPI0
Clock synchronization according to IEC 60870-5-101:		
•	Clock synchronization with <TI:=103> clock synchronization command	✓
•	Acquisition of transmission time (primary station) used for correction of clock synchronization with <TI:=106>	✓
•	Acquisition of transmission time (secondary station) used for correction of clock synchronization with <TI:=106>	✓
•	Correction of clock synchronization (via parameter)	–
•	Accuracy	±20 ms
Command transmission:		
•	Supervision of maximum transport time in control direction	–
•	Control location (set/check control location)	✓
Transmission of integrated totals		✓
File transfer		✓
Optimized parameters for selected transmission facilities		
Predefined parameters for selected transmission facilities		–
Adjustable parameters for free definable transmission facility		✓
Supply of connected transmission devices with 5 V/12 V(via VCC-Pin) ATTENTION: Check power consumption of the external transmission facility!		✓
Redundancy(functions for supporting redundant communication routes)		
NUC redundancy (Norwegian Users Conventions)		
•	NUC redundancy“Controlling station”	–
•	NUC redundancy“Controlled station”	✓
Protocol redundancy:		
•	“Tristate”Tristate of RS-232 interface when PASSIVE	✓
•	Listening mode when passive	–
•	Protocol function in redundancy state = PASSIVE – normal operation (RS-232 = ACTIVE)	✓
•	Protocol function in redundancy state = PASSIVE – listening mode (RS-232 = TRISTATE)	✓
Port redundancy:		
•	Deactivation of interface (with redundancy control message)	–
•	Deactivation of interface (with protocol element control message)	✓
Device redundancy:		
•	Device redundancy with the same PRE parameters	✓
•	Device redundancy with different PRE parameters (“A/B-Parameter”)	✓
•	Device redundancy with different PRE parameters (“A/B-Parameter”) for signals	–
Protocol element control and return information		
Protocol element control messages:		
•	Send (general) interrogation command to all	✓
•	Send (general) interrogation command to selective CASDU	✓
•	Send (general) interrogation command for image GI to own BSE	✓
•	Send (general) interrogation command for GI group to own BSE	–
•	Send reset command	–
•	Set control location	✓
•	Data filter in transmit direction ON/OFF (Filter out all messages in transmit direction - no sending)	✓

Function	BPPI0
• Data filter in receive direction ON/OFF (filter out all messages in receive direction - no forwarding to BSE)	✓
• Interface activate/deactivate	✓
• Interface + protocol activate/deactivate	✓
Protocol element return information:	
• Station status	✓
• Station failure	✓
• Protocol-specific return information 0: Interface activated/deactivated	✓
• Protocol-specific return information 1: Interface + protocol functions activated/deactivated	✓
Special Functions	
Summer time bit (SU) = 0 for all messages in transmit direction (time tag)	✓
Day of week (DOW) = 0 for all messages in transmit direction (time tag)	✓
Originator address = 0 for all messages in transmit direction	✓
WhiteList filter	✓
WhiteList filter"TI filter"	✓
Data throughput limit	✓
Convert general interrogation command in receive direction to broadcast	✓
Non Interruptible GI	✓
ACTCON for clock synchronization command	✓
Emulate ACTCON+/-	✓
Emulate ACTCON for commands with control message	✓
Special functions DBAG:	
• Breaker delay in transmit direction (DBAG-specific special message format <TI:=150>)	✓
• Send originator address with settable value	✓
Special functions RWE:	
• Bit by bit marking of the field	–
• Cyclic measured values	–
• Address of the return information for selection command 2	–
• NT bit, IV bit according to RWE requirements	✓
Transparent Mode (Tunneling, Container Mode)	–
Security	
WhiteList-Filter (predefined for all TIs + COTs)	✓
WhiteList filter"TI filter"(type identification-pass-through filter - parameter-settable)	✓
Web server	
Protocol-internal diagnostic and statistic information via protocol-specific web pages	–
Engineering	
SICAM Device Manager	✓
SICAM TOOLBOX II	✓
Remote maintenance with SICAM TOOLBOX II via serial interface	✓

13.2.3 Modes of Operation

The operating mode of the interface is determined by parameters of the protocol element and optional equipment.

Operating mode	Interface → optional DCE	Interface signals
Unbalanced interchange circuit (V.24/ V.28) RS-232 asynchronous	X5	RXD, TXD, CTS [121], RTS, DCD, DTR, DSR/ VCC, GND
Balanced interface (V.11) RS-422 (4 wire) asynchronous	X4	TXD+, TXD-, RXD+, RXD-, GND (4 wire)
Balanced interface (V.11) RS-422 (4 wire) asynchronous	X5 → PHOENIX PSM-ME-RS232/RS485-P interface converter	Interface signals at X5: (towards Phoenix PSM-ME-RS-232/RS-485-P) RXD, TXD, CTS, RTS, DCD, DTR, GND Interface signals at PHOENIX PSM-ME-RS232/RS485-P: RS-422 (4-wire): D(A), D(B), T(A), T(B), GND
Optical interface with CM-0847 (Multi-mode)	X5 → CM-0847	Interface at X5 towards CM-0847: RXD, TXD, CTS, RTS, DCD, DTR, DSR/ VCC, GND

13.2.4 Communication

For the stations to communicate with each other, suitable transmission facilities and/or network components may be needed in addition.

Own station

System	System element	Protocol Element	Remarks
SICAM A8000 Series	CP-8031/CPCI85 CP-8050/CPCI85 CP-8050/EPCI85	BPPI0	

Remote station

System	System element	Protocol Element	Remarks
SICAM A8000 Series	CP-8000/CPC80 CP-802x/CPC80	BPPT0	
	CP-8031/CPCI85 CP-8050/CPCI85 CP-8050/EPCI85	BPPI0	
SICAM AK 3	CP-2016/CPCX26 CP-2019/PCCX26	SM-2551/BPPA0 SM-0551/BPPA0	
Legacy systems (SICAM AK SICAM TM SICAM BC SICAM EMIC)	CP-20xx CP-60xx CP-50xx	SM-2551/BPPA0 SM-0551/BPPA0 BPPT0	

121 Not usable (reserved for SICAM TOOLBOX II)

System	System element	Protocol Element	Remarks
Siemens devices	–	–	according to *13.2.10 Interoperability IEC 60870-5-101 (BPPI0)*
Third-party system	–	–	according to *13.2.10 Interoperability IEC 60870-5-101 (BPPI0)*

13.2.5 Communication According to IEC 60870-5-101

13.2.5.1 Basic Configuration

For the communication with a remote station in point-to-point traffic according to IEC 60870-5-101 the following basic settings are required:

- Link layer address
- Number of octets for the link layer address
- Station type

For this, in the master / remote station the parameter **`[PRE] Station definition | Address of link`** and the parameter **`[PRE] IEC60870-5-101 | Link Layer | Address field of link (number)`** must be set according to the selected definition. The address of the link layer must be adjusted identically at both stations (master/substation) for communication with a remote partner as part of point-to-point traffic!

Setting the **`[PRE] Station definition | Station type`** parameter is also required for communication with a remote partner as part of point-to-point traffic according to IEC 60870-5-101. In this process, either "Station A" or "Station B" must be assigned to a station.

"Own station" station type	"Remote partner" station type
Station A	Station B
Station B	Station A

For the coupling of different systems with the IEC 60870-5-101 protocol, the setting of the variable elements of the message is required. These parameter can be found in the interoperability list (master station and remote station must be parametrized identically).
The variable elements of the message must be set at the protocol element.

IEC 60870-5-101 Parameter	Description
Link address byte number	Number of octets for the link layer address field
Cause of transmission (COT)	Number of octets for cause of transmission
Common address of ASDU (CASDU)	Number of octets for common address of the ASDU
Information object address (IOA)	Number of octets for the address of the information object
Acknowledgment on IEC 60870-5-2 layer	Single character or short message (ACK)
Maximum telegram length	
Time_marker	Number of octets for time marker

13.2.5.2 Data Transmission Procedure

The transmission of data from the remote station to the master and vice versa takes place spontaneous. The prioritization and blocking of the data takes place on the basic system element (BSE). The data transmission is started after startup or, with redundancy switchover after successful station initialization.

If a remote station (secondary station) can presently not process more data messages (messages), for the data flow control the DFC bit (Data Flow Control) is set in the control field of the message direction secondary station → primary station. From this moment the protocol firmware of the primary station sends no more data messages to the remote station, until the remote station resets the DFC-bit. In addition a warning is output by the protocol element of the primary station. The data is saved in the data storage of the communication function on the basic system element (BSE) until they are deleted by the dwell time monitoring or can be transmitted to the remote station.

The primary station also monitors whether the secondary station resets the DFC-bit within a time that can be set with the parameter **`[PRE] IEC60870-5-101 | Time settings, retries | Monitoring times | DFC-monitoring time`** . The state of the DFC-bit of the secondary station is interrogated by the primary station by means of cyclic messages "REQUEST STATUS OF LINK". The cycle time can be set with the parameter **`[PRE] IEC60870-5-103 | Communication functions | Data communication control | Polling cycle for stations with "DFC-bit = 1"`**. If the DFC-bit is present for longer than the set monitoring time, the interface is reported as failed.

Acknowledgment Procedure

All sent data messages must be acknowledged by the other station (secondary station). If, with non-faulty transmission line, the acknowledgment is missing for longer than the expected acknowledgment time, transmitted messages are repeated up to n-times (n can be parameterized). On expiry of the number of retries, the station is flagged as faulty.

The required expected acknowledgment time is determined automatically from the set parameters, but if necessary can be extended accordingly with the parameter **`[PRE] IEC60870-5-101 | Time settings, retries | Monitoring times | DFC-monitoring time | Expected_ack_time_corr_factor`** . This is then the case if additional signal propagation delays, delay times or slow processing times of the connected stations must be taken into consideration.

The number of retries for data messages is to be set with the parameter **`[PRE] IEC60870-5-101 | Time settings, retries | Monitoring times | Retries | Retries for data message SEND/CONFIRM (station selective)`** or for messages for station initialization with the parameter **`[PRE] IEC60870-5-101 | Time settings, retries | Monitoring times | Retries | Retries for INIT-messages SEND/CONFIRM (station selective)`** .

The acknowledgment can be transmitted optionally as single character (E5) or as message with fixed length (ACK). If no additional information is to be transmitted, as standard the single character (E5) is used for acknowledgment, however some third-party systems always expect the acknowledgment as message with fixed length.

The message type for the acknowledgment can be selected with the parameter **`[PRE] IEC60870-5-101 | Link layer | Acknowledgment IEC60870-5-2`** .

Failure monitoring

The monitoring of the interface by the active central station/substation takes place by means of cyclic transmitted (subject to acknowledgment) messages or by means of a cyclic executed "Test function of the link layer ".

The interface monitoring with "Test function of the link layer" can be parameterized with the parameter **`[PRE] IEC60870-5-101 | Communication functions | Test function | Test function cycle time`** . On expiry of the retry number the remote station is reported as failed.

No further data is sent to a failed remote station until successful station initialization. The data is stored in the data storage of the communication function on the basic system element (BSE) until these are deleted by the dwell time monitoring or can be transmitted to the re-reachable remote station.No further data is sent to a failed remote station until successful station initialization.

13.2.5.3 Station Initialization

After startup or redundancy switchover, the operation of the interface is begun after successful station initialization.

The initialization of the link layer of the remote terminal unit is performed by the master station with:

- Request for the status of the link layer (REQUEST STATUS OF LINK)
- Reset of the remote terminal unit link layer (RESET OF REMOTE LINK)

Reset Command	Function in the Remote Station
REQUEST STATUS OF LINK	• "STATUS OF LINK" is transmitted to the remote station
RESET OF REMOTE LINK	• FCB-Bit (Frame Count Bit) is initialized • Acknowledgment for RESET of REMOTE LINK is transmitted to remote station

NOTE

During faulty communication REQUEST STATUS OF LINK will be sent cyclic. The gap between the messages is the calculated acknowledged time including the parameterized time for **`[PRE] IEC60870-5-101 | Time settings, retries | Monitoring times | Expected_ack_time_corr_factor`**.

End of Initialization

If sending of "end of initialization" is enabled on the basic system element in the IEC 60870-5-101/104 parameter block, after the station initialization is performed, data is only sent from the protocol element if the "INIT-End" has been received from the basic system element for the corresponding ASDU. "<TI=70> End of Initialization" is also transmitted to the remote station. The clock synchronization command or general interrogation command may only be transmitted after "INIT-End".

13.2.5.4 Acquisition of events (transmission of data ready to be sent)

The transmission of data clear to send from the remote station to the master and vice versa takes place spontaneous. The prioritization and blocking of the data clear to send takes place on the basic system element (BSE). The data transmission is started after startup or in case of redundancy switchover after successful station initialization.
For further details, see to section "Data transmission procedure".

13.2.5.5 Change monitoring & value adaption (scaling) for measured values

All data, in particular measured values, are normally transmitted by the IEC 60870-5-101 protocol without further processing in the sending direction to the remote station or in the receiving direction - also without processing.
If measured values in the transmit direction come from sources that have not implemented measured value change monitoring (e.g.: 3rd party devices), then there can be impairments on the remote station - if it has to serve many connections - due to the high data load.

- The number of measured values transmitted to the remote station can be reduced by monitoring measured value changes in the protocol, since measured values are only transmitted if the change in the measured values is correspondingly large.
- Measured value change monitoring can also be used in the receive direction. This means that measured values from remote stations that have implemented no or only insufficient measured value change monitoring (e.g.: 3rd party devices) are already processed when they are received, thus reducing the SICAM A8000 internal data load.
- In addition, a technological adjustment of the values (scaling) on the log can be carried out for measured values - also independently of the measured value change monitoring.
- The number of measured values for change monitoring is not limited. A maximum of 300 measured values per second are processed in the transmission and/or reception direction. If there are more measured values to process, they will be processed in the next processing grid (in this case there may be delays in passing the measured values).

Measured value change monitoring possible for the following TIs:

TI	Designation
<TI:=34>	Measured value, normalized value with time tag CP56Time2a
<TI:=35>	Measured value, scaled value with time tag CP56Time2a
<TI:=36>	Measured value, short floating point number with time tag CP56Time2a

For details on the parameterization of the measured value change monitoring & value adjustment (scaling), see *13.2.8.2 Message conversion in transmit/receive direction for measured values*.

13.2.5.6 General Interrogation, Substation Interrogation

The general interrogation (outstation interrogation) function is used to update the central station after the internal station initialization or after the central station has detected a loss of information. The function general interrogation of the central station requests the substation to transmit the actual values of all its process variables.

Non-Interruptible General Interrogation

From the substation periodic and spontaneous data can also be transmitted during a running general interrogation.

With the parameter **`[PRE] IEC60870-5-101 | Communication functions | General interrogation | Non interrupted GI | Timeout for non interrupted GI`** the periodic or the periodic and spontaneous transmission of data can be disabled during a running general interrogation (monitoring time: "0" = GI is interruptible; "≠ 0" = GI is not interruptible).

The following parameter settings are necessary on the BSE for the non-interruptible GI:

- “Sending end of initialization” (INIT-End) must be enabled
- General interrogation must take place from the process image (Image-GI)

With the INIT-End, the protocol element detects all ASDUs used in transmit direction. This is required with general interrogation to all (broadcast) for GI end detection.

With non-interruptible general interrogation, from the moment of "General interrogation command received" all data of the cyclic or cyclic and spontaneous priority level from the basic system to the protocol element are inhibited. This block is then terminated by the protocol element, if the general interrogation is complete or the monitoring time **`Timeout for non-interruptible GI`** has expired.

The selection of the data which should be disabled for transmission during non-interruptible GI is to be done on the protocol element with the parameter **`[PRE] IEC60870-5-101 | Communication functions | General interrogation| Non interrupted GI | Disable data during non interrupted GI`** periodic data or periodic and spontaneous data.

The monitoring time is to be set on the protocol element with the parameter **`[PRE] IEC60870-5-101 | Communication functions | General interrogation | Non Interruptible GI | Timeout for GI-data`** and is used in transmit direction for all ASDUs together. The monitoring time is retriggered for messages with the causes of transmission COT = 2, 7, 20, 21 to 36. With general interrogation to a selective ASDU, the monitoring time is stopped when the general interrogation command is received with the cause of transmission COT = 10 "termination of activation", with general interrogation to all ASDUs (BROADCAST), the monitoring time is stopped when the general interrogation command is received for all ASDUs with the cause of transmission "termination of activation".

13.2.5.7 Clock Synchronization

The clock synchronization of the remote station can be performed over the serial communication line – controlled by the master station. The clock synchronization command is sent spontaneously at a change of the time and cyclic 1x per minute by the master station.

With clock synchronization 1x per minute a typical accuracy of +/- 20 ms can be achieved.

If the accuracy of the remote synchronization is insufficient, a local time signal receiver must be used in the remote station.

Messages, which are sent after a startup, but before the SICAM RTUs remote terminal unit has the correct time, contain the relative time from startup (reference day: 1.1.2001) with the flagging of the time tag as invalid.

The clock synchronization command is sent between the 20th and 50th second of minute. The time of transmission is determined based on the parameter settings (baud rate, message length, number of retries) and a possible presently running message transmission, so that the clock synchronization command arrives in the remote station in all cases before the minute change. The clock synchronization command is sent at the transmit moment, exactly synchronized to the internal 10ms cycle. The time in the message corresponds to the absolute time of the 1st bit during the transmission on the line.

In SICAM A8000 the cyclic transmission of the clock synchronization command for remote synchronization is initiated automatically by the basic system element.

In SICAM A8000 the cyclic transmission of the clock synchronization command for remote synchronization by the protocol element is to be activated with the parameter **[PRE] IEC60870-5-101 | Communication functions | Clock synchronization | Send clock synchronization command cyclic**.

The transmission of the clock synchronization command always takes place with high priority at the end of the running minute (in SICAM A8000 between the 50th and 59 second).

The clock synchronization command is sent at the transmit moment, exactly synchronized to the internal 10ms cycle. The time in the message corresponds to the absolute time of the 1st bit during the transmission on the line.

13.2.5.8 Command transmission

Data messages in command direction are always sent spontaneously by the master station to the remote station. The prioritization and blocking of the data to be sent already takes place on the basic system element (BSE).

For further details, refer to section *13.2.5.2 Data Transmission Procedure*.

Control location / Check control location

The “Control location” function is used to make sure that commands and setpoints are transferred from authorized sources only. Once the function has been activated, commands/set point adjusting commands are only transferred to the remote partner by the protocol element if the control location (originator address) has been enabled.

If the control location is not enabled, the protocol element immediately sends back a negative acknowledgment of activation (ACTCON) to the originator address (for more details on the control location, see section *13.1.4.9 Control location function for commands and setpoint values*).

13.2.5.9 Transmission of Integrated Totals

A counter interrogation command triggered in the system is transmitted acknowledged from the protocol element to the remote station.

The functionality implemented in the System SICAM RTUs concerning integrated totals is documented in the document "Common Functions of Peripheral Elements according to IEC 60870-5-101/104".

13.2.5.10 File Transfer

The protocol element sends all message formats received from the basic system element (BSE) that are defined for the transfer of files to the remote station. All message formats received from the remote station for the transfer of files are passed on by the protocol element to the basic system element.

The protocol element itself performs no functions for the transfer of files. Messages for the transfer of files are passed on "transparently".

Limitation:

For the transfer of files the System SICAM RTUs supports only max. 200 data bytes per segment!

13.2.5.11 Acquisition of Transmission Delay

The protocol element supports the function "Acquisition of transmission delay" and the time correction resulting from this with clock synchronization according to IEC 60870-5. With this procedure the transmission delay is determined with <TI=106> and the corrected time loaded in the remote station.

The correction of the time in the clock synchronization command is performed in the remote station.

The acquisition of the monitoring time is performed cyclic every "2 minutes".

The "Correction time for clock synchronization command" is produced from:

- Message delay
- Transmission delay

The clock synchronization command is transmitted cyclic 1x per minute to the remote station. The time in the clock synchronization command corresponds to the absolute moment of the 1st bit during the transmission on the line.

See also section "Clock Synchronization"!

13.2.6 Optimized Parameters for selected Transmission Facilities

The protocol element requires a full duplex transmission path, which means that the central station and the substation can transmit and receive at the same time.

The transmission facilities usually only support certain transmission speeds. These can be found in the respective specification of the transmission facility.

The transmission rate (Baud rate) is to be set for transmit/receive direction together with the parameter **[PRE] Interface parameter | Baud rate** .

In addition, the physical interface with the parameter **Common Settings | Interface**.

For the adaptation to various modems or time requirements of external systems, the following parameters can be set individually:

- **[BSE] System settings | Serial interfaces | Port | CP-X# | Electrical interface**
- **[BSE] System settings | Serial interfaces | Port | CP-X5 | Mode**
- **[BSE] System settings | Serial interfaces | Port | CP-X5 | DSR voltage supply**
- **[PRE] Interface Parameter | Time settings for interface modem | Pause time (tp)**
- **[PRE] Interface Parameter | Time settings for interface modem | Set up time (tv)**
- **[PRE] Interface Parameter | Time settings for interface modem | Run out time (tn)**
- **[PRE] Interface Parameter | Time settings for interface modem | DCD Handling**
- **[PRE] Interface Parameter | Time settings for interface modem | Continuous level monitoring time (tcl)**
- **[PRE] Interface Parameter | Time settings for interface modem | Transmission delay if continuous level (tcldly)**
- **[PRE] Interface Parameter | Time settings for interface modem | Bounce suppression time (tbounce)**
- **[PRE] Interface Parameter | Time settings for interface modem | Disable time (tdis)**

How the individual time settings are effective during the data transmission is shown in *Figure 13-6*.

If necessary the voltage supply of the transmission facility (5 V/12 V) – if this is enough – can be supplied over the status line DSR (VCC). The voltage supply is enabled with parameter **[BSE] System settings | Serial Interfaces | Port | CP-X5 | DSR voltage supply**. The voltage supply is only output to the DSR status line with corresponding parameter setting. The DSR status line cannot be used by the protocol.

NOTE

Required voltage supply and maximum current consumption of the transmission facility must be observed!

In addition, for the adaptation of the protocol to the transmission medium used or to the dynamic behavior of the connected remote station, the following parameters are available:

- **[PRE] IEC60870-5-101 | Time settings, retries | Monitoring times | Idle monitoring time**
- **[PRE] IEC60870-5-101 | Time settings, retries | Monitoring times | Expected_ack_time_corr_factor**
- **[PRE] IEC60870-5-101 | Time settings, retries | Monitoring times | Character monitoring time**

The character monitoring time and the idle monitoring time are used for message interruption monitoring and message resynchronization in the receive direction. A message interruption is detected when the time between 2 bytes of a message is greater than the set signal monitoring time. With message interruption the receive processing in progress is aborted and the message is discarded.

After a detected message interruption a new message is only accepted in receive direction after an idle time on the line (idle time). This idle time is monitored by the protocol element. After expiry of the monitoring time the receiver is resynchronized.

The protocol element – insofar as the transmission facility provides this signal receive-side – can evaluate the interface signal DCD and e.g. utilize it for monitoring functions.

Preset parameters for transmission equipment with BPPxx (RS-232 interface)

Transmission facility	RTS	tp [ms]	tv [ms]	tn [Bit]	tdis [ms]	DCD	Tbounce [ms]	tcl [s]	tverz [ms]	A_I	T	5V/12V
		0	0	0	0	No	0	0	0	A	I	No

Legend:

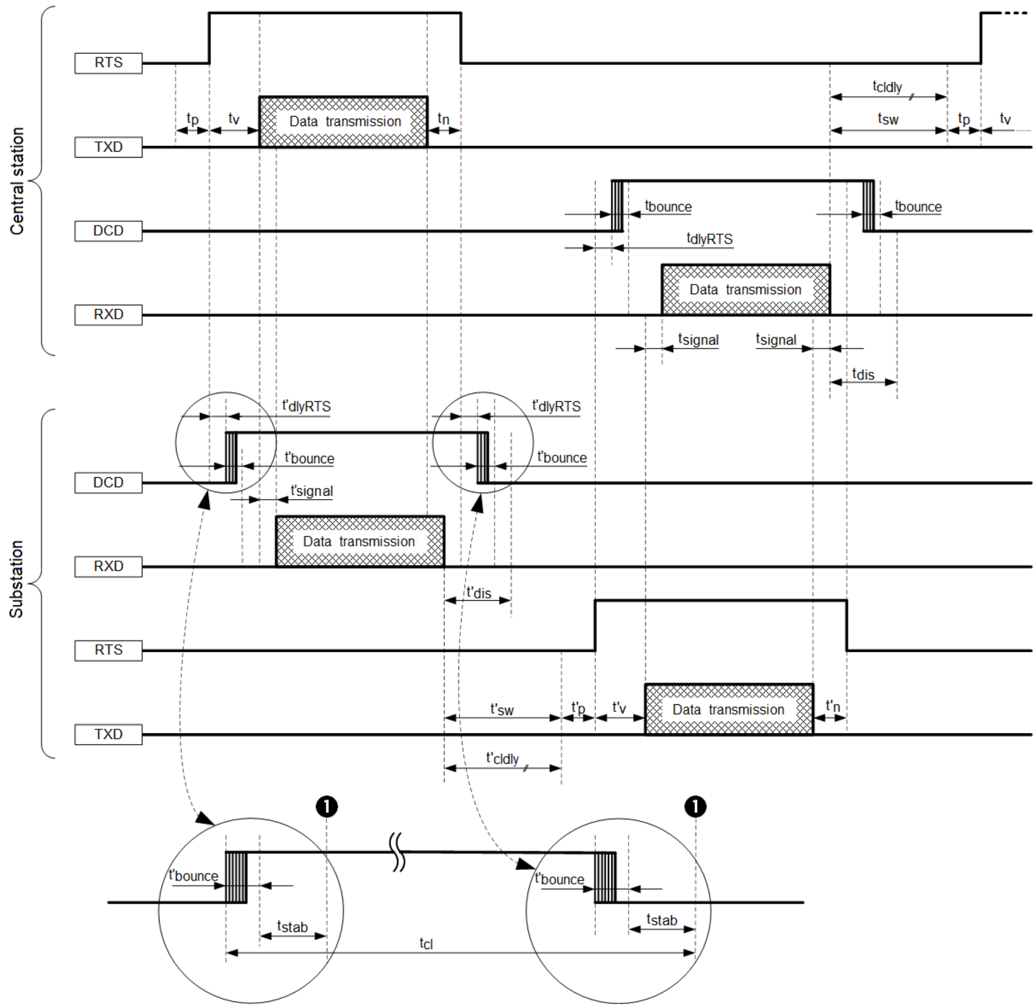
RTS	is used for the control of the carrier switching of the modem RTS = ON (if tv = 0), RTS = ↑ ↓ (if tv ≠ 0) Carrier switching (ON / OFF) for each message in the transmit direction
tp	Parameter **Pause time (tp)**
tv	Parameter **Set-up time (tv)**
tn	Parameter **Run out time (tn)**
tdis	Parameter **Disable time (tdis)**
DCD	Parameter **DCD-Handling**
tbs	Parameter **Bounce suppression time (tbounce)**
tduration	Parameter **Continuous level monitoring time (tcl)**
tdelay	Parameter **Transmission delay at level (tcldly)**
A_I	Parameter **Asynchron_Isochron** (A = asynchron, I = isochron) [BSE]
T	Parameter **Bittakt** (only with isochron) (I=internal, E=external) [BSE]
5V/12V	Parameter X2: **DSR Power Supply** [BSE]

NOTE

The parameter on the basic system element [BSE] are not selected automatically by the selection of the transmission facility.. These parameter must be set by the user!

The following diagram shows the timing for the data transmission when using transmission facilities with switched carrier.

For a better overview, the full duplex data transmission is not shown.



RTS .... Request to Send (switch on transmit part)
DCD .... Data Carrier Detect
TXD .... Transmit Data
RXD .... Receive Data
t_{dlyRTS} .... Runtime of the transmission system (time difference between switch-on the transmit part (RTS ↑) and receiver ready (DCD ↑))
t_p .... Pause time (delay before the transmit part is switched off with RTS)
t_v .... Set-up time (transmit delay, after the transmit part has been switched on with RTS)
t_n .... Run-out time (switch off transmit level with RTS after message transmission is delayed)
t_{sw} .... Internal processing time
t_{signal} ...... Signal-transit time (depending on the transmission facility/transmission route used)
t_{bounce} .... Detection time after a positive/negative DCD edge (DCD debouncing)
t_{stab} .... Stability monitoring time - the new DCD status is only used once the stability monitoring time has elapsed for message synchronization
t_{cl} .... Continuous level monitoring time
t_{cldly} .... Transmit delay at continuous level - another message transmission is carried out at continuous level once the transmission delay has elapsed at the latest
t_{dis} .... Disable time of the receiver after receiving a message (for suppressing the erroneous characters during level scanning)
t' .... Corresponding times in the substation

❶ DCD valid

[UMPxyy_Timing_ohne_broadcast, 2, en_US]

Figure 13-6 Timing during transmission

13.2.7 Redundancy

To increase the availability central stations as well as remote terminal units can be implemented redundantly. In the master station and remote station, with the parameter **[PRE] Redundancy | Redundancy control** one can select between the following redundancy controls:

- Protocol redundancy
- NUC-Redundancy
- Port-Redundancy (deactivation of Interface)

The switchover of the redundancy state takes place system-internal by means of redundancy control messages or protocol control messages .

In addition, in the central station and remote terminal unit a delay with the switchover of the redundancy state from PASSIVE (=STANDBY) to ACTIVE can be set with the parameter **Redundancy | Delay time passive⇒active**.

13.2.7.1 Protocol redundancy

The protocol-redundancy is selected with parameter **[PRE] Redundancy | Redundancy control** = "Standard".

In the STANDBY-station, for the synchronization of the FCB-Bit (Frame Count Bit) this is taken from a listened RESET OF REMOTE LINK or from a valid received message with variable block length.

The operating mode of the interface with redundancy state PASSIVE can be set according to redundancy configuration with the parameter **[PRE] Redundancy | Operation if passive** as follows:

- ***Transmitter tristate, listening mode***
- ***Transmitter active, listening mode***
- ***Transmitter active, normal mode***

From the redundant, not active master / remote terminal unit, listened messages are passed on to the basic system element (BSE) and forwarded by this in the system with the identifier “passive” in the state.

In redundant master/remote terminal units that are not active, a failure of the interface is monitored globally.

The failure of the interface is detected by the STANDBY station by monitoring for cyclic message reception. The monitoring time is set with the parameter **[PRE] Redundancy | Listening mode (failure monitoring time)** . The monitoring time is retriggered with a message received free of errors (except REQUEST STATUS OF LINK, RESET OF REMOTE LINK and positive acknowledgment message using single character E5H).

On receive timeout (active master / remote terminal unit or transmission facility has failed) the interface is signaled as failed.

The failure of the interface is reset in redundant STANDBY stations, if an error-free message (except REQUEST STATUS OF LINK and RESET OF REMOTE LINK) from the respective remote station is listened or if no failure monitoring is parameterized.

Activation / Deactivation of the interface in redundancy mode PASSIVE

For the implementation of project specific redundancy modes the interface and the operation of the protocol can be activated/deactivated with protocol element control message when redundancy mode is in PASSIVE and with parameter **operation if passive** is set to ***transmitter tristate*** .

The activation/deactivation of the interface can be used for supervision of redundant communication links to the remote station.

Behavior when interface is activated:

- The interface mode will be switched over from ***Transmitter tristate, listening mode*** to ***Transmitter active, normal mode*** .
- All data received from the remote stations are passed on to the basic system element; Due to the redundancy status PASSIVE, the received data on the basic system element is marked with R = 1 (data received from passive interface)
- All data ready for transmit sent from basis system element to protocol element will be sent to the remote station.

Behavior when interface is deactivated:

- The interface mode will be switched over from ***Transmitter active, normal mode*** to ***Transmitter tristate, listening mode*** .
- All data received from the remote station(listening mode) are passed on to the basic system element; Due to the redundancy status PASSIVE, the received data on the basic system element is marked with R = 1 (data received from passive interface)
- All data sent from basis system element to protocol element will be discarded by the protocol element.

Protocol control message for controlling the protocol mode will be accepted only in redundancy mode PASSIVE.

The status of the interface and the protocol function (activated / deactivated) is transmitted from the protocol element to the basic system element by protocol element return information in the event of a change or a general interrogation.

No general interrogation command will be initiated by the protocol element firmware after activation of the interface.

NOTE

the operating mode of the interface will be updated always by the AU internal protocol element control message (redundancy control message has higher priority than protocol control message).

13.2.7.2 NUC-Redundancy

The redundancy mode "Norwegian User Conventions (NUC)" uses 2 communications lines (main/stand-by transmission line) from the master station (Controlling Station) to the remote terminal unit (Controlled Station). Each of these communications lines is fixed activated to a specific interface in the master station and in the remote terminal unit. The data is only transmitted to the active interface. The passive interface is only monitored by the master / remote terminal unit.

The redundancy operation "Norwegian User Conventions (NUC)" is selected with parameter **[PRE] Redundancy | Redundancy control** = "Norwegian User Conventions (NUC)".

The protocol element only supports the functions of the slave station (="Controlled Station")!

The operating mode of the interface with redundancy state "PASSIVE" is not to be parameterized for this redundancy mode. The function is defined by the "Norwegian User Conventions (NUC)".

Redundancy function according to "Norwegian User Conventions (NUC)" for "balanced-Mode":

- After startup of the master station (Controlling Station) and the remote terminal unit (Controlled Station) both stations perform the initialization of the link layer.
- After startup of the remote terminal unit (Controlled Station) both interfaces are "PASSIVE". The remote terminal unit (Controlled Station) sends the message "Test function of the link layer" cyclic for monitoring the interfaces on both lines to the master station (Controlling Station). This message is acknowledged by the master station (Controlling Station) with NAK until this switches one of the two interfaces to "ACTIVE".

- The activation of an interface is always performed by the master station only – either manually or automatically on failure of one interface. The activation is performed either by a message sent from the master station (Controlling Station) on an interface to the remote station or with the acknowledgement of the message "Test function of the link layer" with ACK.
- The master station (Controlling Station) also sends the message "Test function of the link layer" cyclic for monitoring the interfaces on both lines to the remote terminal unit (Controlled Station). The "ACTIVE" interface acknowledges this message with ACK, the passive interface with NAK.
- During the switchover from main transmission line-stand-by transmission line, no data loss must occur in the Controlled Station. Transmitted data may only be deleted in the remote terminal unit if these have been explicitly acknowledged by the master station. With switchover, no general interrogation is necessary.

The passive line is monitored cyclic with the message "Test function of the link layer".

If a station no longer replies, on expiry of the number of retries this is reported as failed.

In the remote terminal unit, for the redundancy mode "Norwegian User Conventions (NUC)" the LOAD-SHARE-Mode of the communications function must be used on the basic system element. With this mode the basic system element uses 2 fixed assigned interfaces for the transmission of the data from a process image. With the redundancy mode "Norwegian User Conventions (NUC)", data is only transmitted over the active interface to the master station. Through the LOAD-SHARE-Mode a switchover without loss of data is ensured – a doubling of data can occur under certain circumstances.

In the remote terminal unit the assignment of the interfaces for main transmission line and stand-by transmission line is defined on a basic system element as follows:

Interface 1 Main/Standby transmission Line	Interface 2 Main/Standby transmission Line	Note
ZSE = 128	ZSE = 129	Redundant interface pair for NUC-Redundancy
ZSE = 130	ZSE = 131	Redundant interface pair for NUC-Redundancy

Legend:

SSE Supplementary system element (with serial interfaces, this is always configured with a PRE)

The CP-8050 remote terminal unit performs the following functions with redundancy state "PASSIVE":

- No data for emission are requested by the basic system element
- The "Test function of the link layer" message is send cyclic – with that a failure of the master station or a switchover of the redundancy state is detected.
- All data in signaling direction are transmitted over the active interface to the master station
- The interface is always electrically "ACTIVE" (and is not switched to "TRISTATE")

13.2.7.3 Port-Redundancy (deactivation of Interface)

When using mobile control systems the interface can be deactivated in order to suppress the interface failure if the control system is not connected.

With deactivated interface the transmitter of the interface is switched to "tristate" and the data for transmission are requested from the basic system element and discarded without error message. Received messages are discarded and not passed on to the basic system element.

The activation/deactivation of the interface takes place through PRE control messages. The actual state will be reported via PRE return information message. After startup of the protocol element the interface is activated by default.

With deactivation of the interface a possibly present failure of the interface is reset if no "listening mode (failure monitoring time)" is parameterized.

With deactivated interface, no monitoring of the interface takes place!

13.2.8 Message Conversion

Data in transmit direction is transferred from the basic system element to the protocol element in the SICAM A8000 internal IEC 60870-5-101/104 format. The data formats are converted to the IEC 60870-5-101 line format on the protocol element. The transmission of the data according to IEC 60870-5-101 is controlled by the protocol element.

In the transmit direction, the data to be sent is already blocked on the basic system element in accordance with IEC 60870-5-101/104. If the conditions for blocking the data are not met, the data is transmitted unblocked by the basic system element to the protocol element.

Data in receive direction is converted by the protocol element from the IEC 60870-5-101 format on the transmission line to a SICAM A8000 internal IEC 60870-5-101/104 format and transferred to the basic system element.

Blocked data in receive direction is transmitted by the protocol element to the basic system element and unblocked by it. Internally in SICAM A8000, the data is always transmitted unblocked.

With IEC 60870-5-101, no signal definition is required for the message conversion on the protocol - the data is forwarded unchanged. In addition, a measured value change monitoring or measured value adaptation (scaling) can be performed optionally on the protocol for measured values with <TI:=34, 35, 36> in transmit/receive direction. The parameterization of the measured values for the change monitoring or value adaptation takes place with the SICAM Device Manager with the function “Signals” or with the SICAM TOOLBOX II, OPM II using “SIP Message Address Conversion”.

Supported processing types for message conversion

Data	Direction	Processing type	BPPI0
Measured values	Receive direction	*firmware* / `Rec_value`	✓
Measured values	Transmit direction	*firmware* / `Trans_value`	✓

For details on the parameterization of the measured value change monitoring & value adaptation (scaling), see *13.2.8.2 Message conversion in transmit/receive direction for measured values*.

13.2.8.1 Blocking

For optimal use of the transmission paths, the data is transmitted with “blocking” in accordance with IEC 60870-5-101. Data to be sent is already blocked at the basic system element in accordance with the applicable rules and forwarded to the protocol element for sending.

Received data in blocked format is forwarded from the protocol element in blocked format to the basic system element. On the basic system element the blocked data is split up again into individual information objects by the “detailed routing” function and passed on as such to the further processing.

Due to the additionally required transport information, received messages with maximum length are transmitted SICAM A8000 internal in 2 blocks from the protocol element to the basic system element.

The parameters necessary for the blocking are to be set on the basic system element in the IEC 60870-5-101/104 parameter block.

NOTE

The blocking for data to be transmitted does not support the maximum possible message length according to IEC 60870-5-101!

13.2.8.2 Message conversion in transmit/receive direction for measured values

Message conversion in transmit/receive direction: IEC 60870-5-101 ↔ IEC 60870-5-101

SICAM A8000: IEC 60870-5-101/104 BSE ↔ PRE		ETI4, FWI4: IEC 60870-5-101 PRE ↔ remote station	
TI	Designation	TI	Designation
<TI:=34>	Measured value, normalized value with time tag CP56Time2a	<TI:=34>	Measured value, normalized value with time tag CP56Time2a

SICAM A8000: IEC 60870-5-101/104 BSE ↔ PRE		ETI4, FWI4: IEC 60870-5-101 PRE ↔ remote station	
<TI:=35>	Measured value, scaled value with time tag CP56Time2a	<TI:=35>	Measured value, scaled value with time tag CP56Time2a
<TI:=36>	Measured value, short floating-point number with time tag CP56Time2a	<TI:=36>	Measured value, short floating-point number with time tag CP56Time2a

Measured values

The parameterization of the measured values for change monitoring & value adaptation in the transmit/receive direction is carried out with the the SICAM Device Manager with the function "Signals" or with the SICAM TOOLBOX II, OPM II.

Processing type in transmit direction: *firmware* / `Trans_value`

BPPI0/Trans_value 0 of 3 selected (total: 0)

	Name	CASDU-IOA	TI	Thresh_uncond	Thresh_additive	X_0%	X_100%	Y_0%	Y_100%
1	MW Tx (1)	0-4-1-0-0	TI 34 Measured value, normalized value	0,1	0,05	-0,5	0,5	-1	1
2	MW Tx (2)	0-4-2-0-0	TI 35 Measured value, scaled value	20	5	0	2000	-1000	1000
3	MW Tx (3)	0-4-3-0-0	TI 36 Measured value, short floating point number	10	5	-2,5	2,5	-250	250

[BPPI0_DM_Sende_Wert_GER, 1, en_US]

Processing type in receive direction: *firmware* / `Rec_value`

BPPI0/Rec_value 0 of 3 selected (total: 0)

	Name	CASDU-IOA	TI	Thresh_uncond	Thresh_additive	X_0%	X_100%	Y_0%	Y_100%
1	MW Rx (1)	0-4-4-0-0	TI 34 Measured value, normalized value	0,1	0,05	-0,5	0,5	-1	1
2	MW Rx (2)	0-4-5-0-0	TI 35 Measured value, scaled value	20	5	0	2000	-1000	1000
3	MW Rx (3)	0-4-6-0-0	TI 36 Measured value, short floating point number	10	5	-2,5	2,5	-250	250

[BPPI0_DM_Empf_Wert_GER, 1, en_US]

Parameter	
`TI`	Supported type identifications: • <TI:=34> .. Measured value, normalized value with time tag CP56Time2a • <TI:=35> .. Measured value, scaled value with time tag CP56Time2a • <TI:=36> .. Measured value, short floating-point number with time tag CP56Time2a
`Name`	Name of the signal
`CASDU-IOA`	SICAM A8000 internal IEC 60870-5-101/104 message address (CASDU1, CASDU2, IOA1, IOA2, IOA3) [122]
`Thresh_uncond`	If the value changes > `Thres_uncond`, the values is transmitted immediately to the remote station or the received value is immediately forwarded to the BSE. Note: The change monitoring affects the raw value (before the value adaptation) (in the transmit direction on the SICAM A8000 internal value - in the receiving direction on the received value from the remote station)

122 If the common address of the ASDU (CASDU) is set to "1 octet" for IEC 60870-5-101, then CASDU2 = 0 must be parameterized. If the address of the information object (IOA) is set to "1 octet" for IEC 60870-5-101, then IOA2 = 0, IOA3 = 0 must be parameterized. If the address of the information objects (IOA) for IEC 60870-5-101 is set to "2 octet" , then IOA3 = 0 must be parameterized.

Parameter	
Thresh_additive	If the value changes ≤ **Thres_uncond**, the value to be sent is not transmitted immediately or, in the receive direction, the received value is not immediately forwarded to the BSE and the additive change monitoring is performed. Additive change monitoring: If the summed changes (= sign correct addition of changes since the last transfer) > **Thres_additive**, the value is passed on.
X_0%, X_100% **Y_0%, Y_100%**	Parameters for value adaptation (scaling): • Valid value range for **X_0%, X_100%** - see IEC 60870-5-101 data formats • **X_0%, X_100%** .. IEC60870-5-101 value range of remote station • **Y_0%, Y_100%** .. IEC 60870-5-101/104 Value Range SICAM A8000 (internal) • <TI:=34>.. **X_0%, X_100%** must not be greater or less than ±1 • <TI:=35> .. **Y_0%, Y_100%** must not be less than −32768 or greater than +32767. • Value adaptation inactive at **Y_0%** = 0 and **Y_100%** = 0

Supported Data Formats

TI		IEC 60870-5-101/104 Data format (TI)
34	Measured value, normalized value with time tag CP56Time2a	34
35	Measured value, scaled value with time tag CP56Time2a	35
36	Measured value, short floating-point number with time tag CP56Time2a	36

NOTE

Measured value change monitoring is not supported for the following TIs:

<TI:=9> .. Measured value, normalized value [123]

<TI:=10> .. Measured value, normalized value with time tag

<TI:=11> .. Measured value, scaled value [123]

<TI:=12> .. Measured value, scaled value with time tag

<TI:=13> .. Measured value, short floating-point number [123]

<TI:=14> .. Measured value, short floating-point number with time tag.

Measured Value Change Monitoring

See *13.2.5.4 Acquisition of events (transmission of data ready to be sent)* chapter *13.2.5.5 Change monitoring & value adaption (scaling) for measured values*.

Functionality of the measured value change monitoring:

- The measured value from <TI:=34>, <TI:=35>, <TI:=36> converted to FLOAT32 for change monitoring in the protocol.
- The change monitoring is performed based on the raw value before the value adaptation.
- The first value determined after startup is transmitted immediately.

[123] In the case of a general interrogation, the measured values are transmitted with the TIs without a time tag

- Each change of quality descriptor IV triggers an immediate transfer, the quality descriptor OV does not initiate a transfer.
- Change monitoring in accordance with the method of the additive threshold value procedure.
- The number of measured values for change monitoring is not limited.
- Changes are monitored every second, with a maximum of 300 measured values being processed at the same time. If there are more measured values to process they will be processed in the next processing grid (in this case there may be delays in passing the measured values).
- Change monitoring or value adaptation is only carried out for those measured values (signals) that are assigned to the PRE.
- Measured values that are not assigned to the change monitoring or the value adaptation on the protocol are transmitted without further processing.
- If measured values are transmitted blocked, the measured values assigned to the change monitoring or measured value adaptation are removed from the blocked message and transmitted after the change monitoring or value adaptation.
- In the case of a general interrogation, the last transmitted value is always transmitted. If a changed value is recognized during the general interrogation, then this new value is taken to the change monitoring and processed. With GA, measured values are transmitted with the TIs without a time tag <TI:=9, 11, 13> without blocking S = 0 (selective addressing per measured value) or with blocking S = 1 (ascending addressing for measured values).

Process Image

Measured values are entered in a process image for the change monitoring on the protocol. If a spontaneous transmission for a measured value is to be carried out by the additive measured value change monitoring, the measured value is transmitted spontaneously from the protocol from the process image.

Additive Measured Value Change Monitoring

The measured value is monitored for changes when it is received (from the remote station or from the BSE). If the deviation compared to the last measured value transmitted is greater than the configured **Thresh_uncond**, the new measured value is transmitted immediately. Otherwise, the deviation from the last spontaneously transmitted measured value is added with the correct sign in the processing grid. First when the amount of this total exceeds the parameterized **Thresh_additive** is the current measured value spontaneously transmitted.

Thresh uncond	Thresh additive	Processing
= 0	= 0	Value is transferred in the next processing grid when there is a change
= 0	≠ 0	
≠ 0	= 0	• Change greater **Thresh_uncond**: Value is transmitted • Change less than/equal **Thresh_uncond**: Additive threshold value procedure
≠ 0	≠ 0	• Change greater **Thresh_uncond**: Value is transmitted • Change less than/equal **Thresh_uncond**: Additive threshold value procedure

A transmission of the measured value due to a general interrogation does not influence the threshold value procedure.

The thresholds are to be set for every measured value in the parameters for signals with the parameter **Thresh_additive** and **Thresh_uncond**.

The values for the parameter **thresh additive** and **thresh uncond** are absolute values and always refer to the row value. [124] [125]

The following example shows a normal case, where the adaptation line goes through the zero point (origin) ($Y_{at\ X=0} = 0$).

Examples

Technological value Y_{100}	4000
Processing grid	1 s
Thresh_uncond	40
Thresh_additive	400

Example 1:

After transmission due to the exceeding of the large threshold, the value has changed once by 79 (< the large threshold) and subsequently remains constant.
The measured value is transmitted after 11 seconds.

	0s	SICAM 1s	2s	3s	4s	5s	6s	7s	8s	9s	10s	11s
Measured value	300	339	339	339	339	339	339	339	339	339	339	339
Difference	>40	39	39	39	39	39	39	39	39	39	39	39
Additive total	0	39	78	117	156	195	234	273	312	351	390	429
Transmission	✓	–	–	–	–	–	–	–	–	–	–	✓

Example 2:

After transmission due to the exceeding of the large threshold, the value has changed once by 1 (< the large threshold) and subsequently remains constant.
The measured value is transmitted after 400 seconds (= 6 minutes and 40 seconds).

	0s	SICAM 1s	2s	3s	4s	5s	6s	7s	8s	...	399s	400s
Measured value	300	301	301	301	301	301	301	301	301	...	301	301
Difference	>80	1	1	1	1	1	1	1	1	...	1	1
Additive total	0	1	2	3	4	5	6	7	8	...	399	400
Transmission	✓	–	–	–	–	–	–	–	–	–	–	✓

Example 3:

After transmission due to the exceeding of the large threshold, the value continually changes by ±1.
The measured value is not transmitted.

	0s	SICAM 1s	2s	3s	4s	5s	6s	7s	8s	...	...	...
Measured value	300	301	300	299	300	301	300	301	299	...	300	301
Difference	>80	1	0	-1	0	1	0	1	-1	...	0	1

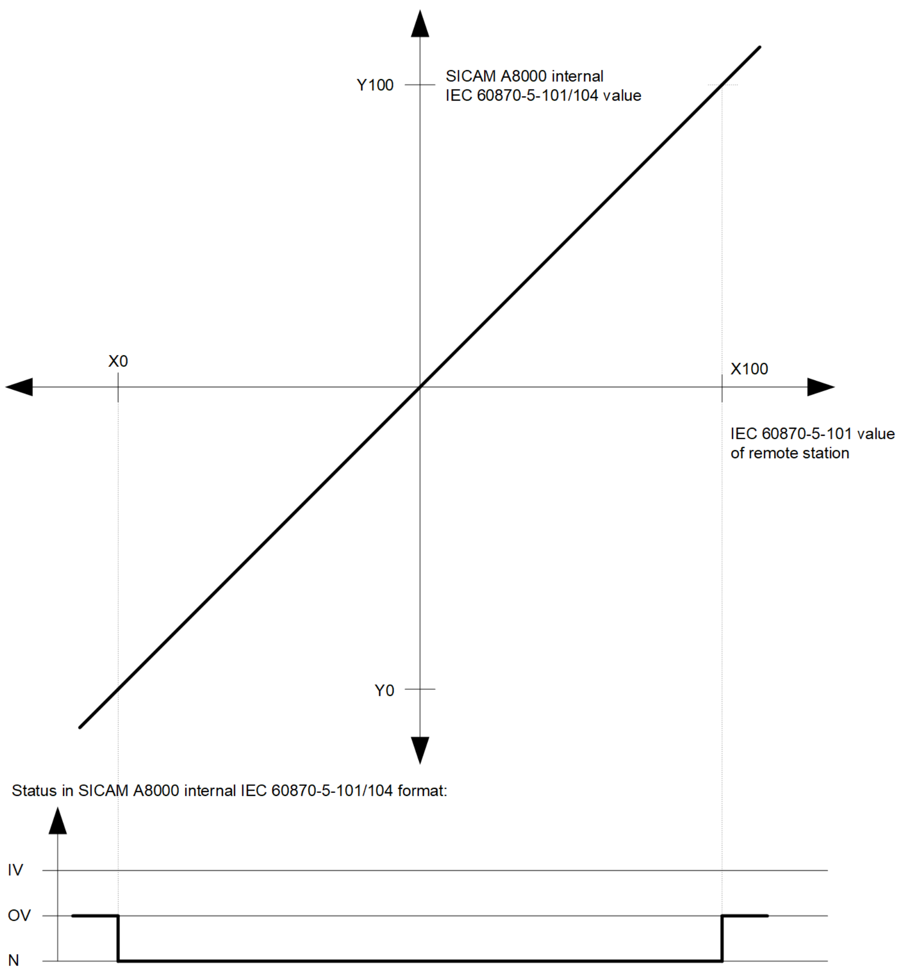
124 Value adaptation in transmit direction: Row value = $value_{intern}$ = IEC 60870-5-101/104 Wert (SICAM A8000 internal); $value_{external}$ = IEC 60870-5-101 value of the remote station

125 value adaption in receive direction: Row value = $value_{external}$ = IEC 60870-5-101 value of the remote station; $value_{internal}$ = IEC 60870-5-101/104 value (SICAM A8000 internal)

	0s	SICAM 1s	2s	3s	4s	5s	6s	7s	8s	...	...	...
Additive total	0	1	0	1	0	1	0	1	1	...	0	1
Transmission	✓	–	–	–	–	–	–	–	–	–	–	–

Value Adaptation

- The measured value adaptation (optional) takes place after the measured value change monitoring.
- The measured value adaptation can also be used independently of the measured value change monitoring.
- The value adaptation is defined by the parameters **`X_0%`**, **`X_100%`**, **`Y_0%`**, **`Y_100%`**.



[BPPI0_Anpassung_Messwerte_GER, 1, en_US]

Value Adaptation	
Transmit direction	$\text{Value}_{external} = k \cdot \text{value}_{internal} + d$ [124]
Receive direction	$\text{Value}_{internal} = k \cdot \text{value}_{external} + d$ [125]
Transmit direction, receive direction	$k = (Y100 - Y0) / (X100 - X0)$ $d = Y0 - k \cdot X0$

If the value adaptation is not activated (= direct transfer; **`X_0%`** = *0*, **`X_100%`** = *0*), the value is transferred unchanged.

The value adaptation is only performed if **`X_0%`** or **`X_100%`** ≠ *0* is parameterized.

If the value is less than `x_0%` or greater than `x_100%` when the value adaptation is activated, the value adaptation is carried out anyway, the OV bit is set and the value is transmitted.

If the value after the value adaptation is outside the value range of the data format, the value is set to the maximum value of the data format, the OV bit is set and the value is transmitted.

NOTE

Minor +/- rounding errors may occur when adjusting the values of <TI:=35>.

Message Conversion

The table describes the elements of the IEC 60870-5-101 message that are evaluated during message conversion.

Message elements	
TI .. Type identification	• <TI:=34> .. Measured value, normalized value with time tag CP56Time2a • <TI:=35> .. Measured value, scaled value with time tag CP56Time2a • <TI:=36> .. Measured value, short floating-point number with time tag CP56Time2a
CASDU, IOA .. Message address	Evaluated (will not be changed)
QDS .. Quality descriptor	
BL .. Blocked	Not evaluated (will not be changed)
SB .. Substituted	Not evaluated (will not be changed)
NT .. Not topical	Not evaluated (will not be changed)
IV .. Invalid	Not evaluated (will not be changed)
OV .. Overflow	OV = 1: If the value after the value adaptation is outside the value range of the data format of the corresponding TI.
Cause of transmission	
xx .. all COTs	Evaluated (will not be changed)
T .. Test	Evaluated (will not be changed)
Information	
Value.. S .. Sign	• Normalized value • Scaled value • IEEE STD 754 = short floating-point number
Time tag	
CP56Time2a .. Date + time	Supported (Time tag = time of transmission after change monitoring)

NOTE

Not listed elements of the IEC 60870-5-101 message are not evaluated/not supported!

13.2.8.3 Special Functions

For the coupling to external systems, if necessary the following special functions can be activated for the adaptation of the message conversion:

- Summer time bit (SU) = 0 for all messages in transmit direction (summer time bit in time tag)
- Day of week (DOW) = 0 for all messages in transmit direction (day of week time tag)
- Originator address = 0 for all messages in transmit direction
- WhiteList filter
- TI filter
- Data throughput limit
- Convert general interrogation command in receive direction to BROADCAST
- Non Interruptible GI
- ACTCON for clock synchronization command
- Emulate ACTCON+/-
- Emulate ACTCON, ACTTERM for commands
- Emulate ACTCON, ACTTERM for commands with commands
- Special functions DBAG
- Special Functions RWE

Summer Time Bit = 0 for all messages in transmit direction

With the parameter **[PRE] IEC60870-5-101 | Message Structure | Time tag | Summer-time bit (SU) = 0** = <yes>, the summer time bit (SU) in the time tag is always set to “0” for all messages with time tag in transmit direction.

Day of Week = 0 for all Messages in Transmit Direction

With the parameter **[PRE] IEC60870-5-101 | Message Structure | Time tag | Day of week (DOW) = 0** = <yes>, the day of week (DOW) in the time tag is always set to “0” for all messages with time tag in transmit direction.

NOTE

This function is only active for process information messages in transmit direction. The day of week in clock synchronization command message is not affected!

Originator address = 0 for all messages in transmit direction

With the parameter **[PRE] IEC60870-5-101 | Communication functions | Command transmission | Originator address in transmit direction = 0** = <yes>, the originator address is set to “0” for all messages in transmit direction.

NOTE

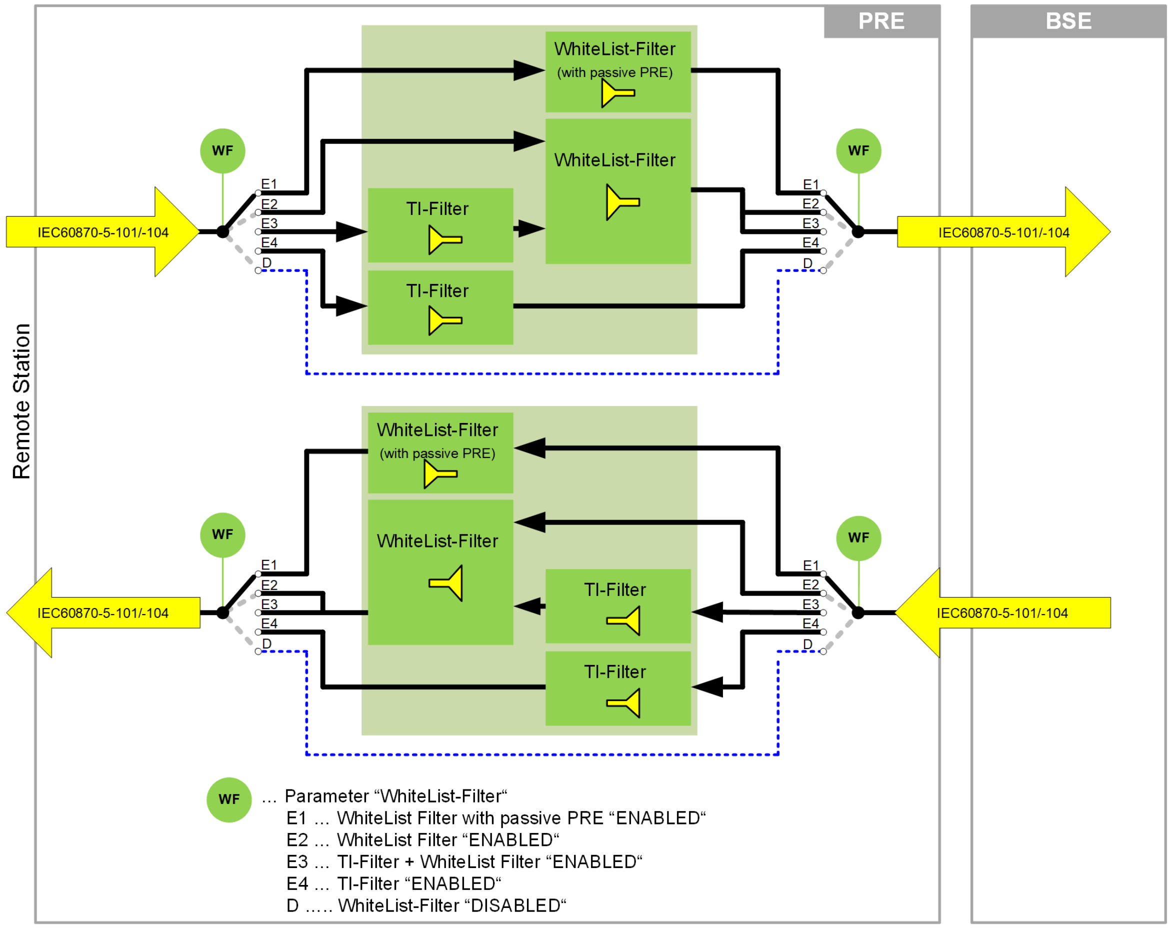
The originator address (2nd byte of the cause of transmission) is only then sent if the number of octets for cause of transmission (COT) is set on the basic system element to 2.

WhiteList filter

The IEC 60870-5-101 protocol is also frequently used for data exchange between telecontrol networks from different operators (network couplings).

Data traffic at such interfaces is reduced to a minimum in order primarily to protect one's own network, but also not to send unwanted telegrams to the foreign network.

Only defined messages (selected by type identification and cause of transmission) will be sent in transmit direction to the remote network and only defined messages will be taken in receive direction at WhiteList Filter enabled.



The WhiteList filter can be enabled with the parameter **[PRE] IEC60870-5-101 | WhiteList-Filter | WhiteList-Filter (type identification check)** .

Following WhiteList filters can be selected:

- WhiteList filter
  - This profile can be used on interfaces between different providers or regions within same provider.
  - From the predefined WhiteList filter only selected type identifications in transmit/receive direction are passed through (siehe *Profile Definition: "WhiteList Filter", Page 827*).
- WhiteList filter for passive PRE
  - This WhiteList filter is only active when the protocol element (PRE) is set to redundancy state PASSIVE with redundancy control message.
  - In this state the profile for "WhiteList filter" is used and additionally the system messages in the private range for SICAM RTUs <TI:=135> "SICAM RTUs system data container (TI:=135, FC=148, IC=04)" will be passed.
  - In redundancy state ACTIVE the profile "SICAM RTUs - IEC101" will be used.

- TI filter + WhiteList filter
  - From the predefined WhiteList filter only selected type identifications are passed through by the TI filter.
  - The TI-Filter can be parameterized separately in transmit-/receive direction.
  - IEC 60870-5-101 messages with type identifiers are already filtered out by the WhiteList filter cannot be passed through by the TI filter.
  - IEC 60870-5-101 messages with type identifiers that are filtered out by the TI-Filter are acknowledged to the remote station and then discarded (ACTCON / ACTTERM will not be sent).
- TI filter
  - Only the IEC 60870-5-101 messages with type identifiers selected in the TI flter will be passed in transmit/receive direction (the cause of transmission is not evaluated).
  - The TI-Filter can be parameterized separately in transmit-/receive direction.
  - IEC 60870-5-101 messages with type identifiers that are filtered out by the TI-Filter are acknowledged to the remote station and then discarded (ACTCON / ACTTERM will not be sent).
- SICAM RTUs - IEC 101 (SICAM RTUs Standard)
  - WhiteList filter switched off (preset).
  - This profile is typically used for interfacing SICAM RTUs systems within region of same provider.
  - All supported type identifications from interoperability of SICAM RTUs using balanced mode according to *13.2.10 Interoperability IEC 60870-5-101 (BPPI0)* incl. type identifications used by SICAM RTUs in private range (remote diagnostics, remote configuration,...) will be passed through in transmit-/receive direction.

WhiteList filter

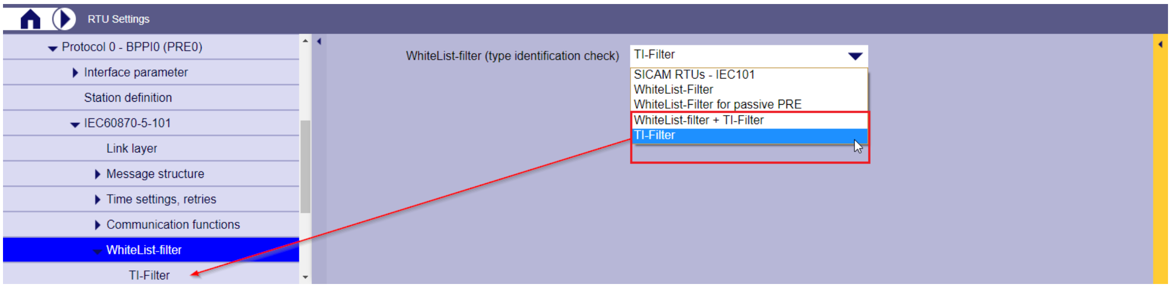
- The WhiteList filter is not an interoperability document!
- The WhiteList filter has the same definition in transmit/receive direction
- Filtered messages in transmit direction will be discarded without error [126]
  (message will be logged as normal in data flow test)
- Filtered messages in receive direction will be confirmed to remote station and discarded without error [126]
  (filtered messages cannot be logged in data flow test)
- Special functions for commands:
  Command messages with originator address = “0“ will be filtered in case of COT ≠ 6 or COT ≠ 8.
  For commands sent with COT=ACT/DEACT, the reply for the command in receive direction with COT=ACTCON (DEACTCON)/ACTTERM will be passed only in a time window when this command was sent before wit COT=ACT/DEACT via this interface.
  For commands received with COT=ACT/DEACT, the reply for the command in transmit direction with COT=ACTCON (DEACTCON)/ACTTERM will be passed only in a time window when this command was received before wit COT=ACT/DEACT via this interface.
  The time window is set to 600 seconds and cannot be parameterized.
  The WhiteList filter function stores for up to 200 commands running at the same time the address for the command, direction (receive/transmit) and the interface information. After termination of the command sequence according IEC 60870-5-101/104 standard (ACT→ACTCON→ACTTERM) the stored command information will be deleted. The stored command information is deleted at a faulty command sequence after expiry of the time window at the latest.

126 Error will be set for messages with type identifications not supported according WhiteList filter definition. No error will be set for messages with type identifications supported according WhiteList filter definition but with cause of transmission not supported according WhiteList filter definition.

TI-Filter (Type Identification Pass Filter)

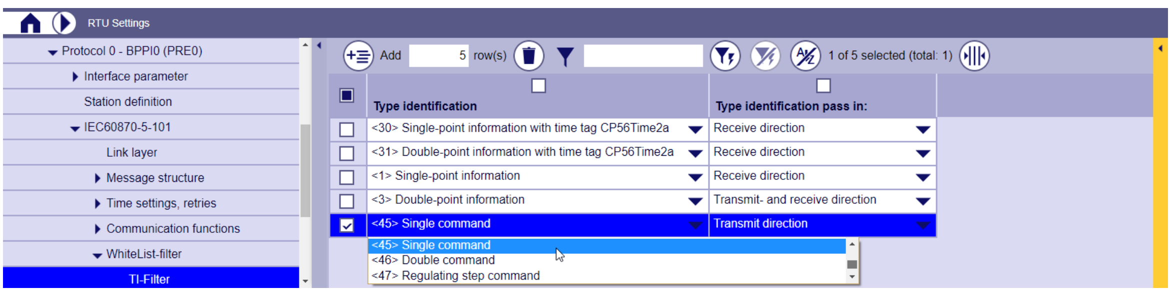
The TI-Filter (Type identification pass filter) will pass only IEC 60870-5-101/104 messages in transmit-/receive direction with type identifiers selected in the TI-Filter.

The TI filter can be enabled with the parameter **`[PRE] IEC60870-5-101 | WhiteList-Filter | WhiteList-Filter (type identification check)`** .



[sc_activate_ti_filter, 2, en_US]

After activating the TI-Filter, the detailed parameters for the type identifier pass filter will be displayed.



[sc_configurate_ti_filter, 2, en_US]

Settings:

- Up to 30 type IDs can be defined (type IDs for GI and type IDs for system information must also be defined)
- Each type identifier may only be entered once
- The transmission direction can be parameterized for each type identifier (column**pass type identification in**)
  - Transmit- and Receive direction
  - Transmit direction
  - Receive direction
- The TI-Filter can be parameterized separately in transmit-/receive direction.
- The TI filter can be used either selectively or in combination with the WhiteList filter.
- If the TI filter is used with the WhiteList filter, only the IEC60870-5-101/104 messages with type identifiers passed by the WhiteList filter and selected in the TI filter will be ***`passed`*** in transmit/receive direction (the cause of transmission is evaluated by the WhiteList filter). All type identifications that are not entered are not allowed through.
- If the TI filter is used without the WhiteList filter, only the IEC 60870-5-101 messages with type identifiers selected in the TI filter will be passed in transmit/receive direction (the cause of transmission will not be evaluated). All type identifications that are not entered in the TI filter are not allowed through.
- IEC 60870-5-101 messages, with type identifiers that are filtered out by the TI-Filter in receive direction, are acknowledged to the remote station and then discarded (ACTCON / ACTTERM will not be sent).

Profile Definition: “WhiteList Filter“

The following table below includes the profile definition for “WhiteList filter” and “WhiteList filter for passive PRE”.

- Messages with type identification will be passed through in transmit-/receive direction (CASDU “BROADCAST” not allowed)
- 1) Messages with type identification will be passed through in transmit-/receive direction (CASDU “BROADCAST” allowed)
- Special functions for commands
- 2) Messages with type identification will be passed through in transmit-/receive direction (CASDU “BROADCAST” allowed) – only when “WhiteList-Filter for passive PRE” is active
- Messages with type identification will not be passed through in transmit-/receive direction (messages filtered out)

Type Identification			COT Cause of Transmission																					
			0	1	2	3	4	5	6	7	8	9	10	11	12	13	14 to 19	20 to 36	37 to 41	42 to 43	44	45	46	47	48 to 63
<0>																									
<1>	Single-point information	M_SP_NA_1																							
<2>	Single-point information with time tag	M_SP_TA_1																							
<3>	Double-point information	M_DP_NA_1																							
<4>	Double-point information with time tag	M_DP_TA_1																							
<5>	Step position information	M_ST_NA_1																							
<6>	Step position information with time tag	M_ST_TA_1																							
<7>	Bitstring of 32 bit	M_BO_NA_1																							
<8>	Bitstring of 32 bit with time tag	M_BO_TA_1																							
<9>	Measured value, normalized value	M_ME_NA_1																							
<10>	Measured value, normalized value with time tag	M_ME_TA_1																							
<11>	Measured value, scaled value	M_ME_NB_1																							
<12>	Measured value, scaled value with time tag	M_ME_TB_1																							
<13>	Measured value, short floating point value	M_ME_NC_1																							
<14>	Measured value, short floating point value with time tag	M_ME_TC_1																							
<15>	Integrated totals	M_IT_NA_1																							
<16>	Integrated totals with time tag	M_IT_TA_1																							
<17>	Event of protection equipment with time tag	M_EP_TA_1																							
<18>	Packed start events of protection equipment with time tag	M_EP_TB_1																							
<19>	Packed output circuit information of protection equipment with time tag	M_EP_TC_1																							
<20>	Packed single-point information with status change detection	M_PS_NA_1																							
<21>	Measured value, normalized value without quality descriptor	M_ME_ND_1																							

Type Identification			COT Cause of Transmission																						
			0	1	2	3	4	5	6	7	8	9	10	11	12	13	14 to 19	20 to 36	37 to 41	42 to 43	44	45	46	47	48 to 63
<22-29>																									
<30>	Single-point information with time tag CP56Time2a	M_SP_TB_1																							
<31>	Double-point information with time tag CP56Time2a	M_DP_TB_1																							
<32>	Step position information with time tag CP56Time2a	M_ST_TB_1																							
<33>	Bitstring of 32 bit with time tag CP56Time2a	M_BO_TB_1																							
<34>	Measured value, normalized value with time tag CP56Time2a	M_ME_TD_1																							
<35>	Measured value, scaled value with time tag CP56Time2a	M_ME_TE_1																							
<36>	Measured value, short floating point value with time tag CP56Time2a	M_ME_TF_1																							
<37>	Integrated totals with time tag CP56Time2a	M_IT_TB_1																							
<38>	Event of protection equipment with time tag CP56Time2a	M_EP_TD_1																							
<39>	Packed start events of protection equipment with time tag CP56Time2a	M_EP_TE_1																							
<40>	Packed output circuit information of protection equipment with time tag CP56Time2a	M_EP_TF_1																							
<41-44>																									
<45>	Single command	C_SC_NA_1								*		*	*												
<46>	Double command	C_DC_NA_1								*		*	*												
<47>	Regulating step command	C_RC_NA_1								*		*	*												
<48>	Set point command, normalized value	C_SE_NA_1								*		*	*												
<49>	Set point command, scaled value	C_SE_NB_1								*		*	*												
<50>	Set point command, short floating point value	C_SE_NC_1								*		*	*												
<51>	Bitstring of 32 bit	C_BO_NA_1								*		*	*												
<52-55>																									
<58>	Single command with time tag CP56Time2a	C_SC_TC_1								*		*	*												
<59>	Double command with time tag CP56Time2a	C_DC_TC_1								*		*	*												
<60>	Regulating step command with time tag CP56Time2a	C_RC_TC_1								*		*	*												
<61>	Set point command, normalized value with time tag CP56Time2a	C_SE_TA_1								*		*	*												
<62>	Set point command, scaled value with time tag CP56Time2a	C_SE_TB_1								*		*	*												
<63>	Set point command, short floating point value with time tag CP56Time2a	C_SE_TC_1								*		*	*												
<64>	Bitstring of 32 bit with time tag CP56Time2a	C_BO_TA_1								*		*	*												
<65-69>																									
<70>	End of initialization	M_EI_NA_1																							
<71-99>																									
<100>	Interrogation command	C_IC_NA_1							1)																
<101>	Counter interrogation command	C_CI_NA_1																							
<102>	Read command	C_RD_NA_1																							
<103>	Clock synchronization command	C_CS_NA_1																							
<104>	Test command	C_TS_NA_1																							
<105>	Reset process command	C_RP_NA_1																							
<106>	Delay acquisition command	C_CD_NA_1																							
<107>	Test command with time tag CP56time2a	C_TS_TA_1																							
<108,109>																									
<110>	Parameter of measured value, normalized value	P_ME_NA_1																							
<111>	Parameter of measured value, scaled value	P_ME_NB_1																							
<112>	Parameter of measured value, short floating point value	P_ME_NC_1																							
<113>	Parameter activation	P_AC_NA_1																							
<114-119>																									
<120>	File ready	F_FR_NA_1																							
<121>	Section ready	F_SR_NA_1																							
<122>	Call directory, select file, call file, call section	F_SC_NA_1																							
<123>	Last section, last segment	F_LS_NA_1																							
<124>	Ack file, ack section	F_AF_NA_1																							
<125>	Segment	F_SG_NA_1																							
<126>	Directory	F_DR_TA_1*																							
<127>																									
<128-134>																									
<135>	SICAM RTUs: System data container (TI:=135, FC=148, IC=04)		2)	2)	2)	2)	2)	2)	2)	2)	2)	2)	2)	2)	2)	2)	2)	2)	2)	2)	2)	2)	2)	2)	2)
<136>	SICAM RTUs: Double-point information with command state information																								
<137>	SICAM RTUs: 16 single-point information																								
<138>	SICAM RTUs: 8 double-point information																								
<139>	SICAM RTUs: 4 double-point information with command state information																								
<140>	SICAM RTUs: Measured value - 31 Bit + sign																								
<141>	SICAM RTUs: 32 binary information																								
<142>	SICAM RTUs: User data container (TI:=142, message type = 128)																								
<143>	SICAM RTUs: Realtime system information																								
<144>	SICAM RTUs: File transfer																								
<145-146>																									
<147>	SICAM RTUs: User data container in monitoring direction (TC)																								
<148-159>																									
<160>	SICAM RTUs: Single command with output time																								
<161>	SICAM RTUs: User data container in command direction (TC)																								
<162>	SICAM RTUs: User data container in command direction (SHP)																								
<163-255>																									

Semantics of cause of transmission:

<0>	:=	not used
<1>	:=	periodic, cyclic
<2>	:=	Background scan
<3>	:=	spontaneous

<4>	:=	initialized
<5>	:=	request or requested
<6>	:=	Activation
<7>	:=	Confirmation of activation
<8>	:=	Abortion of activation
<9>	:=	Confirmation of the abortion of activation
<10>	:=	Activation termination
<11>	:=	Return information, caused by a remote command
<12>	:=	Return information, caused by a local command
<13>	:=	File transfer
<14..19>	:=	reserved for further compatible definitions (not used)
<20>	:=	interrogated by station interrogation
<21..36>	:=	interrogated by group 1..16 interrogation
<37>	:=	requested by general counter request
<38..41>	:=	requested by group 1..4 counter request
<42, 43>	:=	reserved for further compatible definitions (not used)
<44>	:=	unknown type identification
<45>	:=	unknown cause of transmission
<46>	:=	unknown common address of ASDU
<47>	:=	unknown information object address
<48, 63>	:=	for special use (private range - not used)

Profile Definition: "SICAM RTUs – IEC 101"

The profile “SICAM RTUs - IEC 101” (SICAM RTUs Standard) defines functionality according *13.2.10 Interoperability IEC 60870-5-101 (BPPI0)*. This profile will be used as standard for interfacing SICAM RTUs components.

Messages will be supported (B=both directions, X=standard direction)
Messages will not be supported (valid according IEC 60870-5-101 standard)
Messages will not be supported

Type Identification			COT Cause of Transmission																						
			0	1	2	3	4	5	6	7	8	9	10	11	12	13	14 to 19	20 to 36	37 to 41	42 to 43	44	45	46	47	48 to 63
<0>																									
<1>	Single-point information	M_SP_NA_1																							
<2>	Single-point information with time tag	M_SP_TA_1				B																			
<3>	Double-point information	M_DP_NA_1																							
<4>	Double-point information with time tag	M_DP_TA_1				B																			
<5>	Step position information	M_ST_NA_1			B	B*								B*	B*			B*							
<6>	Step position information with time tag	M_ST_TA_1				B*								B*	B*										
<7>	Bitstring of 32 bit	M_BO_NA_1			B	B*												B*							
<8>	Bitstring of 32 bit with time tag	M_BO_TA_1				B*																			
<9>	Measured value, normalized value	M_ME_NA_1																							
<10>	Measured value, normalized value with time tag	M_ME_TA_1																							
<11>	Measured value, scaled value	M_ME_NB_1																							
<12>	Measured value, scaled value with time tag	M_ME_TB_1																							
<13>	Measured value, short floating point value	M_ME_NC_1																							
<14>	Measured value, short floating point value with time tag	M_ME_TC_1																							
<15>	Integrated totals	M_IT_NA_1																							
<16>	Integrated totals with time tag	M_IT_TA_1																							
<17>	Event of protection equipment with time tag	M_EP_TA_1																							
<18>	Packed start events of protection equipment with time tag	M_EP_TB_1																							
<19>	Packed output circuit information of protection equipment with time tag	M_EP_TC_1																							
<20>	Packed single-point information with status change detection	M_PS_NA_1			6)													6)							
<21>	Measured value, normalized value without quality descriptor	M_ME_ND_1																							

Type Identification			COT Cause of Transmission																						
			0	1	2	3	4	5	6	7	8	9	10	11	12	13	14 to 19	20 to 36	37 to 41	42 to 43	44	45	46	47	48 to 63
<22-29>																									
<30>	Single-point information with time tag CP56Time2a	M_SP_TB_1																							
<31>	Double-point information with time tag CP56Time2a	M_DP_TB_1				B																			
<32>	Step position information with time tag CP56Time2a	M_ST_TB_1				B*								B*	B*										
<33>	Bitstring of 32 bit with time tag CP56Time2a	M_BO_TB_1				B*																			
<34>	Measured value, normalized value with time tag CP56Time2a	M_ME_TD_1																							
<35>	Measured value, scaled value with time tag CP56Time2a	M_ME_TE_1				B																			
<36>	Measured value, short floating point value with time tag CP56Time2a	M_ME_TF_1																							
<37>	Integrated totals with time tag CP56Time2a	M_IT_TB_1				B																			
<38>	Event of protection equipment with time tag CP56Time2a	M_EP_TD_1																							
<39>	Packed start events of protection equipment with time tag CP56Time2a	M_EP_TE_1																							
<40>	Packed output circuit information of protection equipment with time tag CP56Time2a	M_EP_TF_1				B																			
<41-44>																									
<45>	Single command	C_SC_NA_1							B	B	B	B	B								B	B	B	B	
<46>	Double command	C_DC_NA_1							B	B	B	B	B								B	B	B	B	
<47>	Regulating step command	C_RC_NA_1							B	B	B	B	B								B	B	B	B	
<48>	Set point command, normalized value	C_SE_NA_1							B	B	B	B	B*								B	B	B	B	
<49>	Set point command, scaled value	C_SE_NB_1							B	B	B	B	B*								B	B	B	B	
<50>	Set point command, short floating point value	C_SE_NC_1							B	B	B	B	B*								B	B	B	B	
<51>	Bitstring of 32 bit	C_BO_NA_1							B*	B*	B*	B*	B*								B	B	B	B	
<52-55>																									
<58>	Single command with time tag CP56Time2a	C_SC_TC_1							B	B	B	B	B								B	B		B	
<59>	Double command with time tag CP56Time2a	C_DC_TC_1							B	B	B	B	B								B	B		B	
<60>	Regulating step command with time tag CP56Time2a	C_RC_TC_1							B	B	B	B	B								B	B		B	
<61>	Set point command, normalized value with time tag CP56Time2a	C_SE_TA_1							B	B	B	B	B*								B	B		B	
<62>	Set point command, scaled value with time tag CP56Time2a	C_SE_TB_1							B	B	B	B	B*								B	B		B	
<63>	Set point command, short floating point value with time tag CP56Time2a	C_SE_TC_1							B	B	B	B	B*								B	B		B	
<64>	Bitstring of 32 bit with time tag CP56Time2a	C_BO_TA_1							B*	B*	B*	B*	B*								B	B		B	
<65-69>																									
<70>	End of initialization	M_EI_NA_1					B																		
<71-99>																									
<100>	Interrogation command	C_IC_NA_1							B	B			B								B	B	B	B	
<101>	Counter interrogation command	C_CI_NA_1							B	B			B								B	B	B	B	
<102>	Read command	C_RD_NA_1																							
<103>	Clock synchronization command	C_CS_NA_1							B	B											B	X	X	X	
<104>	Test command	C_TS_NA_1							B	B											B	X	X	X	
<105>	Reset process command	C_RP_NA_1							X*	X*											B	X	X	X	
<106>	Delay acquisition command	C_CD_NA_1				B			B	B											B	X	X	X	
<107>	Test command with time tag CP56time2a	C_TS_TA_1																							
<108,109>																									
<110>	Parameter of measured value, normalized value	P_ME_NA_1							X	X								X			B	X	X	X	
<111>	Parameter of measured value, scaled value	P_ME_NB_1							X	X								X			B	X	X	X	
<112>	Parameter of measured value, short floating point value	P_ME_NC_1							X	X								X			B	X	X	X	
<113>	Parameter activation	P_AC_NA_1																							
<114-119>																									
<120>	File ready	F_FR_NA_1														B					B	5)	5)	5)	
<121>	Section ready	F_SR_NA_1														B					B	5)	5)	5)	
<122>	Call directory, select file, call file, call section	F_SC_NA_1						B								B					B	5)	5)	5)	
<123>	Last section, last segment	F_LS_NA_1														B					B	5)	5)	5)	
<124>	Ack file, ack section	F_AF_NA_1														B					B	5)	5)	5)	
<125>	Segment	F_SG_NA_1														B					B	5)	5)	5)	
<126>	Directory {blank or X, only available in monitor (standard) direction}	F_DR_TA_1*				X		X																	
<127>																									
<128-134>																									
<135>	SICAM RTUs: System data container (TI:=135, FC=148, IC=04)		B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B
<136>	SICAM RTUs: Double-point information with command state information		B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B
<137>	SICAM RTUs: 16 single-point information		B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B
<138>	SICAM RTUs: 8 double-point information		B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B
<139>	SICAM RTUs: 4 double-point information with command state information		B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B
<140>	SICAM RTUs: Measured value - 31 Bit + sign		B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B
<141>	SICAM RTUs: 32 binary information		B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B
<142>	SICAM RTUs: User data container (TI:=142, message type = 128)		B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B
<143>	SICAM RTUs: Realtime system information		B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B
<144>	SICAM RTUs: Filetransfer		B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B
<145-146>																									
<147>	SICAM RTUs: User data container in monitoring direction (TC)		B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B
<148-159>																									
<160>	SICAM RTUs: Single command with output time		B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B
<161>	SICAM RTUs: User data container in command direction (TC)		B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B
<162>	SICAM RTUs: User data container in command direction (SHP)		B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B
<163-255>																									

*) ... blank or “X” only

+ ... secondary application function only

B* ... can be generated by the PLC

5) ... transparent transmission by system

6) ... Reception possible, thereby the blocked single-point information is deblocked and further individually processed as TI = 30 (address translation occurs algorithmic).

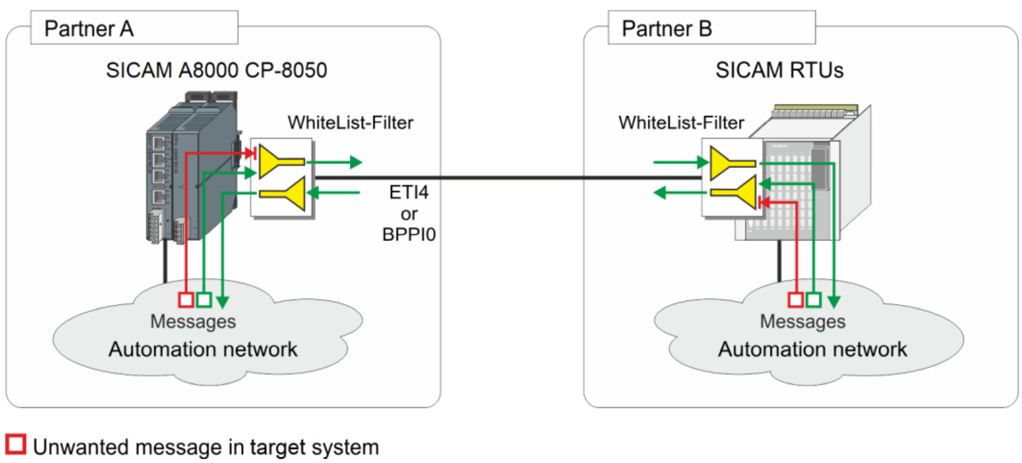
Sample Applications

Following function is the same for different sample applications.
When WhiteList filter is enabled:

- routing of unwanted message within the system will be stopped
- unwanted messages will not be transmitted
- unwanted messages in receive direction will not be passed through
- ACTCON/ACTTERM for commands will be sent only if this command was received before via this interface

Partner Interface between SICAM A8000 and SICAM RTUs System

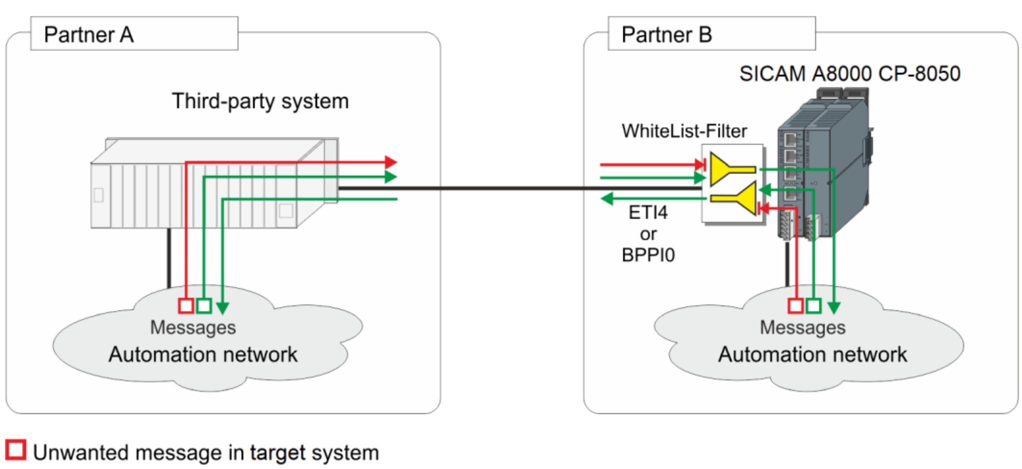
Data exchange via interface (LAN, serial) between different partners. One partner uses a SICAM A8000 system, the other partner uses a SICAM RTUs system.



[whitelist_partnerkopplung_sic_rtus, 2, en_US]

Partner Interface between SICAM RTUs System and 3rd Party System

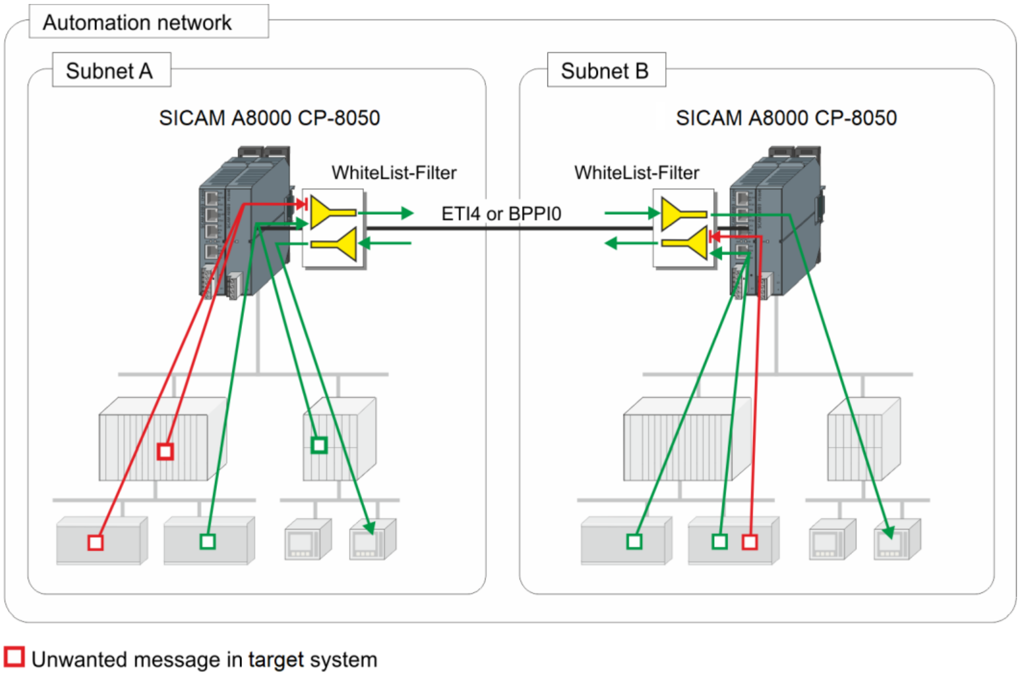
Data exchange via interface (LAN, serial) between different partners. One partner uses a SICAM A8000 system, the other partner uses a 3rd party system.



[whitelist_partnerkopplung_sic_rtus_fremdsys, 3, en_US]

Internal Segmentation between SICAM RTUs Systems

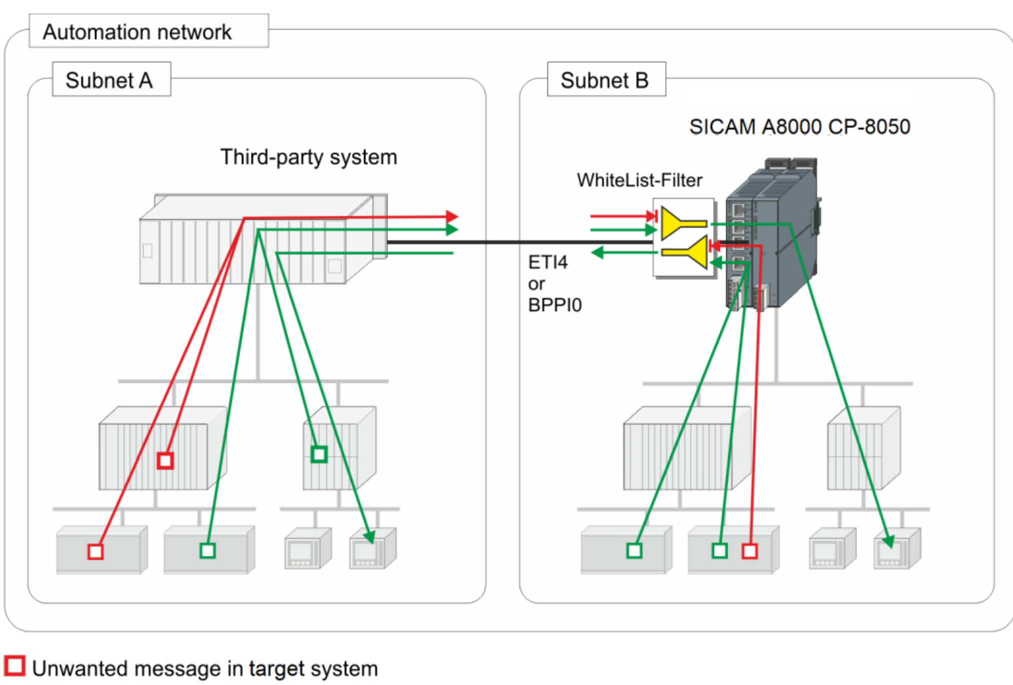
Data exchange via interface (LAN, serial) between different divisions within the same partner. Both divisions are using SICAM A8000 systems.



[whitelist_intern_segm_sic_rtus, 2, en_US]

Internal Segmentation between SICAM RTUs Systems and 3rd Party Systems

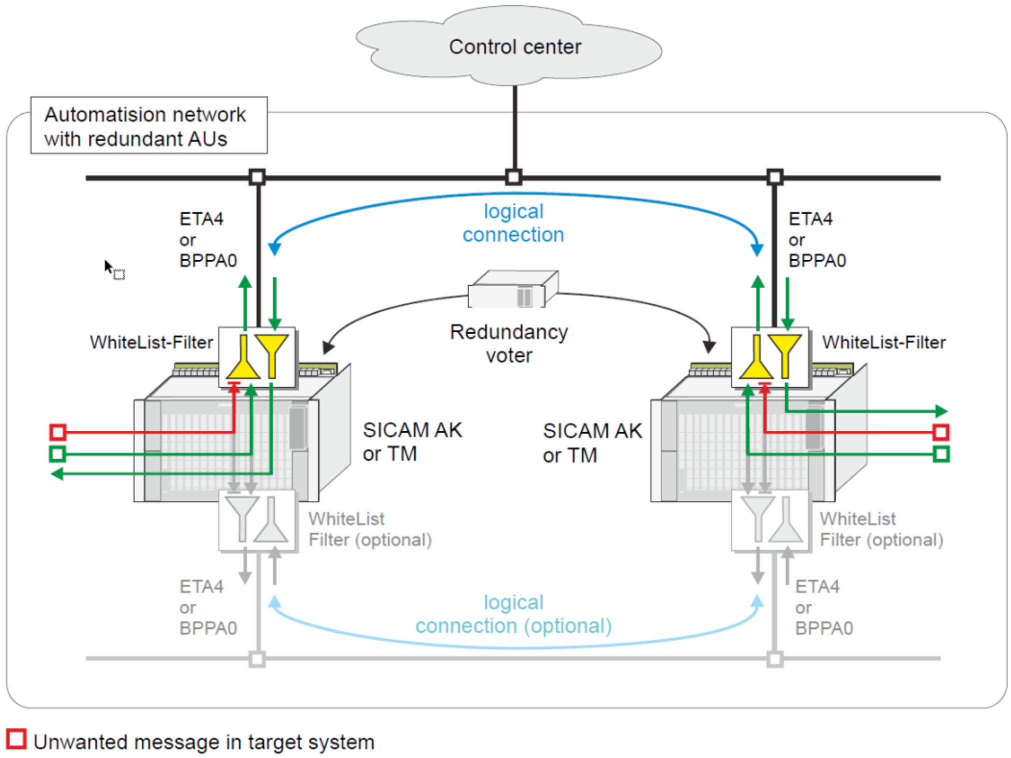
Data exchange via interface (LAN, serial) between different divisions within the same partner. One division uses a SICAM A8000 system, the other division uses a 3rd party system.



[whitelist_intern_segm_sic_rtus_fremdsys, 3, en_US]

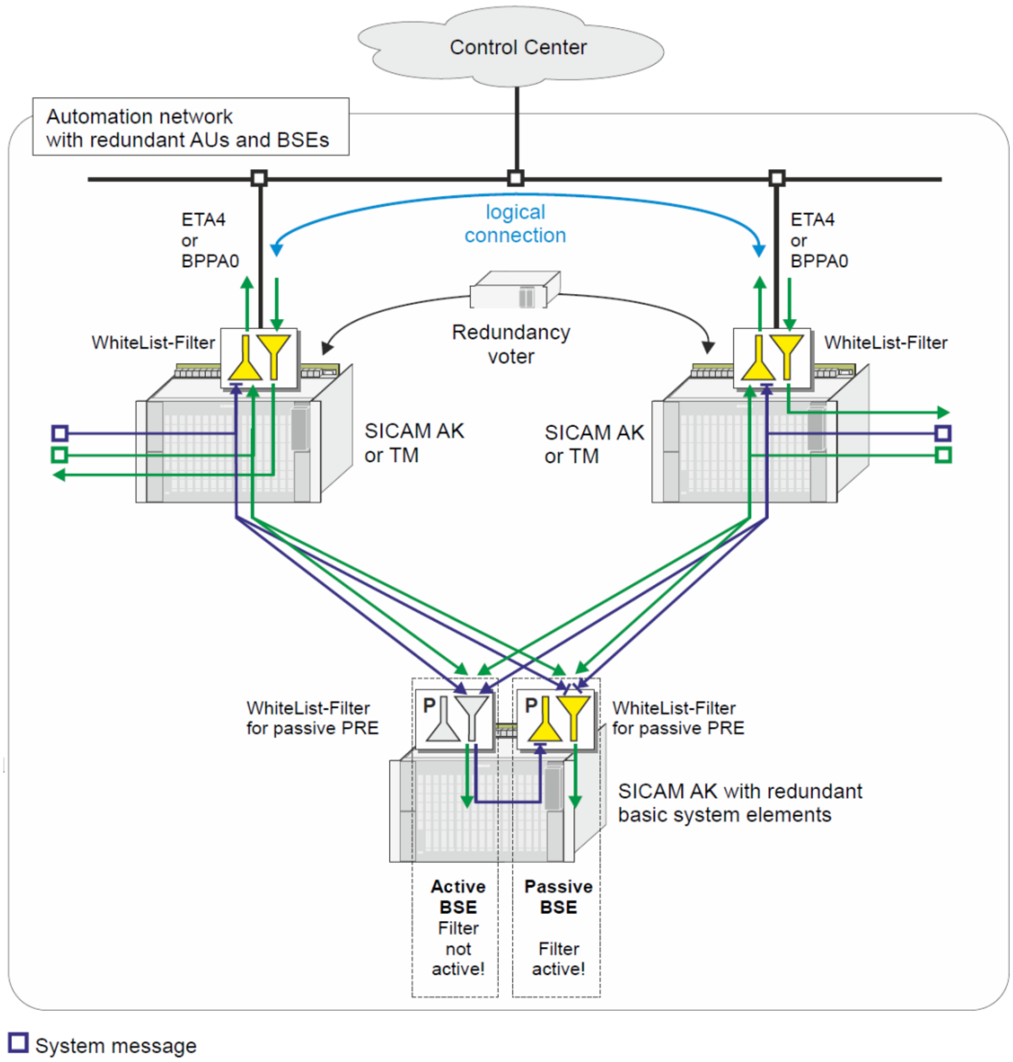
Redundant SICAM RTUs Automation Units

The WhiteList filter is only enabled on the interfaces between the redundant systems. All other interfaces are not affected.



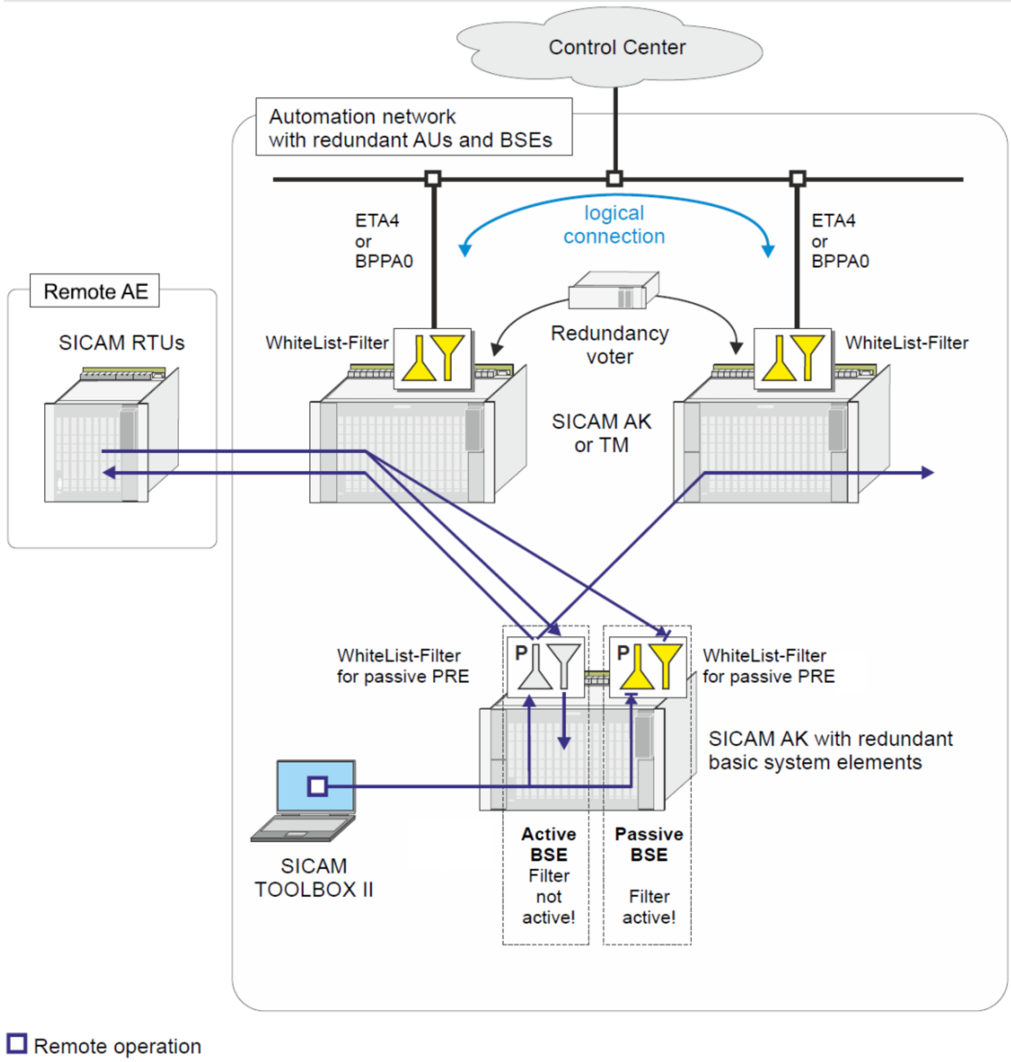
Redundant SICAM RTUs Basic System Elements (BSE)

- The WhiteList filter disables possible unwanted routing of system messages or messages in the private range via possible communication loops in redundancy configuration for redundant BSE
  Note: A routing of data messages to redundant BSE will be suppressed per standard by passive BSE.
- The parameter ***WhiteList-Filter for passive PRE*** must be applied to both BSE.
- The WhiteList filter is only activated on passive BSE and deactivated on active BSE.



Redundant SICAM RTUs Basic System Elements (BSE) – Remote Operation

- The WhiteList filter disables possible unwanted routing of system messages via communication loops in this redundancy BSE
- The parameter ***`WhiteList-Filter for passive PRE`*** must be applied to both BSE.
- The WhiteList filter is only activated on passive BSE.
- The messages of the SICAM TOOLBOX II are blocked by the active filter of the passive BSE, but let through by the active BSE because the filter is deactivated there



Data throughput limit

The protocol element for IEC 60870-5-101 balanced point-to-point does not support specific functions for reduction of data throughput. Data throughput can be reduced as follows:

- reducing the baud rate
  (change of baud rate must be done also in remote system)
- delay before sending
  (example: Pause time **tp**)
  by increasing the pause time (for data throughput reduction) a change of acknowledge timeout monitoring time in the remote system may be necessary.

Convert general interrogation command in receive direction to BROADCAST

With function enabled with the parameter **[PRE] IEC60870-5-101 | Communication functions | General interrogation | advanced parameters | GI command "broadcast"** , all general interrogation commands <TI:=100> received by the protocol element of the substation are passed on from the transmission line with the cause of transmission “activation” to the basic system element with the address CASDU = Broadcast.

Non Interruptible GI

According IEC 60870-5-101, spontaneous or periodic data can be sent during general interrogation and thus the general interrogation can be interrupted. When interfacing to third-party systems it can be necessary to disable the spontaneous or periodic data transmission during general interrogation.

Note: A detailed description of the function "Non Interruptible GI" can be found in section *13.2.5.6 General Interrogation, Substation Interrogation* .

Emulate ACTCON+ for Clock Synchronization Command

The transmission of ACTCON+ by the protocol element for clock synchronization can be set with the parameter **`[PRE] IEC60870-5-101 | Communication functions | Clock synchronization | ACTCON for clock synchronization command`** as follows:

- not send (default)
- immediately send
- Send after minute change and internal transfer of the time (preset)

Emulate ACTCON+/- for Commands

If ACTCON is not supported by the basic system element or by the peripheral element used, then the emulation of ACTCON can be performed by the protocol element (PRE) as follows:

Emulation of	Note
ACTCON-	for: <TI:=45> Single command <TI:=46> Double command <TI:=47> Regulating step command <TI:=48> Setpoint command, normalized value <TI:=49> Setpoint command, scaled value <TI:=50> Setpoint command, short floating-point number • ACTCON- send immediately from PRE if – CASDU is not known to the PRE • ACTCON+/- from BSE or PE is sent from PRE
ACTCON-	for: <TI:=100> Interrogation command • ACTCON- send immediately from PRE if – CASDU is not known to the PRE and – CASDU ≠ FFFF (broadcast) • ACTCON+/- from BSE is sent from PRE

Emulation of	Note
ACTCON+/-	for: <TI:=101> Counter interrogation command • ACTCON+ send immediately from PRE if – CASDU is known to the PRE or – CASDU = FFFF (broadcast) • ACTCON- send immediately from PRE if – CASDU is not known to the PRE
ACTCON+/-	for: <TI:=103> Clock synchronization command if • ACTCON+ send from PRE if – CASDU = FFFF (broadcast) the moment for the transmission of ACTCON+ can be parameterized with the parameter **[PRE] IEC60870-5-101 | Communication functions | Clock synchronization | ACTCON for clock synchronization command** . • ACTCON- send immediately from PRE if – CASDU ≠ FFFF (broadcast)

Legend:

BSE	...	Basic system element
PRE	...	Protocol element
PE	...	Peripheral Element

The emulation of ACTCON by the protocol element (PRE) can be activated with the parameter **[PRE] IEC60870-5-101 | Communication functions | Command transmission | Advanced parameters | ACTCON +/- emulation**. So that the emulation can be performed by the protocol element, it must be ensured that the INIT-End messages are passed on from the basic system element to the protocol element (required because of the known CASDU addresses).

The parameter setting necessary is to be performed on the basic system element (BSE) in the IEC 60870-5-101/104 parameter block.

Emulate ACTCON+ for Commands

If ACTCON for commands is not supported by the peripherals element used, then the emulation of ACTCON messages can be performed by the protocol element of the substation as follows:

Emulation of	Note
ACTCON+	for: <TI:=45> Single command <TI:=46> Double command <TI:=47> Regulating step command • ACTCON+ from PRE send immediately (for SELECT and EXECUTE command) • ACTCON+/- from BSE is filtered out by PRE and not sent! • ACTTERM+/- from BSE is sent from PRE

The emulation of ACTCON by the protocol element (PRE) for commands can be activated with the parameter **[PRE] IEC60870-5-101 | Communication functions | Command transmission | Advanced parameters | ACTCON +/- emulation**.

With function activated, ACTCON messages are emulated by the protocol element as shown in the table. All ACTCON+/- messages that are transferred from the basic system element to the protocol element are filtered out by the protocol element and therefore not transmitted.

ACTTERM messages that are transferred from the basic system element to the protocol element are transmitted by the protocol element.

With function not activated ACTCON and ACTTERM messages that are transferred from the basic system element to the protocol element are transmitted by the protocol element, no emulation of any kind by the protocol element takes place.

NOTE

This function is not required in SICAM A8000 if this function is supported by the peripheral elements used!

For the emulation of ACTCON- with unknown CASDU, the parameter **`[PRE] IEC60870-5-101 | Communication functions | Command transmission | Advanced parameters | ACTCON +/- emulation`** is to be enabled.

Emulate ACTCON, ACTTERM for Commands with Control Messages

If ACTCON and ACTTERM for commands are not supported by the system, then the emulation of ACTCON and ACTTERM – controlled by control messages – can be emulated by the protocol element (PRE) for a previously received command.

This emulation for ACTCON, ACTTERM is often used when a protocol element for the interfacing of external systems or one external system itself does not support this function.

The emulation of ACTCON, ACTTERM is activated on the protocol element, if the type identification in the parameter **`[PRE] Advanced parameters | Project specific settings | ACTCON, ACTTERM for commands controlled by control messages | TI`** and the monitoring times for ACTCON, ACTTERM are parameterized ≠ 0.

The control can be performed by an application program of the open/closed-loop control function.

Due to the control messages the emulation of the messages ACTCON+/- and ACTTERM+/- of a previously received command (TI:=45, TI:=46, TI:=47 - Select or Execute) to the remote station is triggered.

A message with optional type identification can be used as control message – the data content of the control messages is not evaluated by the protocol element. The identification of the control message takes place based only on the parameterized address.

In addition the protocol element performs a "1 out of n" check for commands. If a further command is received from the remote station, although the previously received command has not yet been terminated, a negative confirmation (ACTCON-) is transmitted immediately by the protocol element to the remote station.

The control of the emulation of the messages ACTCON+/-, ACTTERM+/- by the application program of the open/closed-loop control function is monitored by the protocol firmware. If the corresponding control message is not received by the protocol element within the monitoring time, the protocol element itself sends an ACTCON- or ACTTERM- to the remote station.

The monitoring time for the reception of the confirmation of activation is to be set on the protocol element with the parameter **`[PRE] Advanced parameters | Project specific settings | ACTCON, ACTTERM for commands controlled by control messages | Monitoring time ACTCON (after ACT)`**.

The monitoring time for the reception of the termination of activation is to be set on the protocol element with the parameter **`[PRE] Advanced parameters | Project specific settings | ACTCON, ACTTERM for commands controlled by control messages | Monitoring time ACTTERM (after ACTCON)`**.

The IEC 60870-5-101/104 address of the control message (TI, CASDU1, CASDU2, IOA1, IOA2, IOA3) for the emulation of ACTCON+ is to be parameterized with the parameter **`[PRE] Advanced parameters | Project specific settings | ACTCON, ACTTERM for commands controlled by control messages | *`**. The addresses of the other control messages are defined.

Address for Control Message [127]	Control Message
Parameterized address	Control message for emulation ACTCON+
Parameterized address, IOA+ 1	Control message for emulation ACTCON-
Parameterized address, IOA+ 2	Control message for emulation ACTTERM+
Parameterized address, IOA+ 3	Control message for emulation ACTTERM-

Special functions DBAG

For the implementation of the protocol firmware in DBAG projects the following special functions can be activated:

- Breaker delay in transmit direction (DBAG-specific special message format <TI:=150>)
- Send originator address with settable value

These special functions can be activated with the parameter **`[PRE] Advanced parameters | Project specific settings | DBAG functions`**.

With function activated, messages in the format <TI:=33> “Bitstring of 32 bits” in the direction basic system element → protocol element are converted by the protocol element to the DBAG-specific message format <TI:=150> and transmitted.

Messages received in the format <TI:=150> are converted by the protocol element to the format <TI:=33> “Bitstring of 32bits” and passed on to the basic system element.

In transmit direction <TI:=33> “32-bit bitstring” is converted as follows:

Cause of transmission	IEC-Parameter	Type Identification for Transmission to the Remote Station
spontaneous	-	<TI=150> DBAG-specific format
GI	with time (3 octets)	<TI:=4> Double-point information with time tag
GI	with time (7 octets)	<TI:=31> Double-point information with time tag CP56Time2a
GI	without time	<TI:=3> Double-point information

In receive direction <TI=150> is converted as follows:

Cause of transmission	Time Format	Type Identification for Transmission to Basic System Element
spontaneous, GI	with time (7 octets)	<TI:=33> Bitstring of 32 bits with time tag CP56Time2a

NOTE

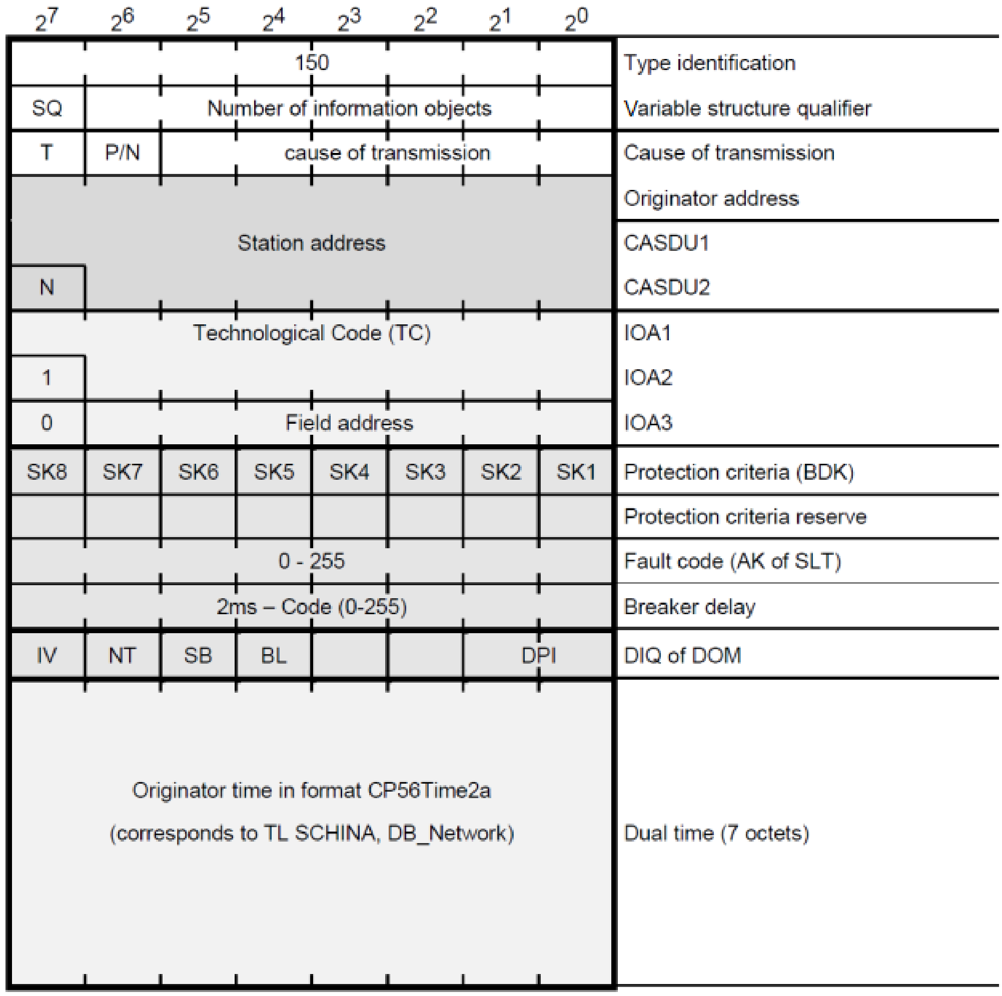
The format <TI:=150> is only defined with 7 bytes time, 3 bytes IOA, 2 bytes CASDU and 2 bytes COT! For the format <TI=150> in addition no double transmission is defined as format without time tag!

Breaker delay in transmit direction

If the delay of the circuit breaker or the time of the fault current is not available, this time can be added by the protocol element in messages in transmit direction with the parameter **`[PRE] Advanced parameters | Project specific settings | DBAG functions | Switch transfer time in transmit direction`** .

127 if TI=0 is parameterized, no emulation by the protocol element takes place; ACTCON, ACTTERM messages are transferred from the basic system element to the remote station

Message structure <TI:=150> "Railway-specific Format" (in the private range)



[Telegrammaufbau_TI150, 1, en_US]

Send originator address with settable value

In DBAG projects the originator address in transmit direction is always transferred with a fixed parameterized value. The originator address is to be set with the parameter **[PRE] Advanced parameters | Project specific settings | DBAG functions | Originator address in transmit direction** . For this function the setting of the number of octets for cause of transmission to "2 octets" is necessary (see IEC 60870-5-101/104 Parameters on the Basic System Element).

Special Functions RWE

For the implementation of the protocol firmware in RWE projects the following special functions can be activated:

- NT bit, IV bit according to RWE requirements

These special functions can be activated with the parameter **[PRE] Advanced parameters | Project specific settings | RWE functions**.

NT bit, IV bit according to RWE requirements

For projects for the customer RWE, a special handling can be activated for the NT bit and the IV bit of the quality descriptor of the messages in transmit direction.

If the RWE-specific functions are not activated, the NT bit and the IV bit in the messages are transferred to the remote station unchanged.

If the RWE-specific functions are activated, the special handling for the NT bit and the IV bit can be selected with the parameter **[PRE] Advanced parameters | Project specific settings | RWE functions | Convert of the NT bits to the IV bit in transmit direction** from the following options:

- Variant a: (selection = **<disabled>**)
  NT bit is set to "0", IV bit is not changed
- Variant b: (selection = **<enabled>**)
  NT bit is set to "0", IV bit is set if NT bit (internal) or IV bit (internal) is set

SICAM A8000 internal		To Remote Station (Variant a)		To Remote Station (Variant b)	
NT bit	IV bit	NT bit	IV bit	NT bit	IV bit
0	x	0	x	0	x
1	x	0	x	0	1
0	0	0	0	0	0
0	1	0	1	0	1
1	0	0	0	0	1
1	1	0	1	0	1

x = optional state, or state is not changed!

13.2.9 Protocol Element Control and Return Information

13.2.9.1 Protocol element control messages

Protocol element control messages can control protocol element internal functions. On the basic system element, IEC 60870-5-101/104 *messages with process information in the control direction* are converted to protocol element control messages and transmitted to the selected protocol element (see *13.1.4.10 Protocol Element Control Messages*).

Supported Protocol element control functions

SF	Protocol element control function Control function_(PRE)	BPPI0 [Point-to-Point]
0	Data filter in transmit direction ON	✓
1	Data filter in transmit direction OFF	✓
2	Data filter in receive direction ON	✓
3	Data filter in receive direction OFF	✓
4	“Deactivate” interface	✓
5	“Activate” interface	✓
6	(General) interrogation command (image GI)	✓
20	“Deactivate” Interface + Protocol function	✓
21	“Activate” Interface + Protocol function	✓
240	Send (General)-interrogation command (CASDU=All)	✓
242	Set control location	✓
243	Reset command	–
244	Send (General)-interrogation command (CASDU = selective)	✓

Legend:

SF .. Control function_(PRE)

13.2.9.2 Protocol element - Return information

Protocol element return information are internal status information of the protocol elements which are transmitted spontaneously and in the event of a general interrogation with internal message formats from the protocol element to the basic system element. On the basic system element, the protocol element return information (see *13.1.4.11 Protocol Element Return Information*) are converted to IEC 60870-5-101/104 `messages with process information in the monitoring direction`.

Supported protocol element return information

Protocol element return information `Return information function_(PRE)`	Station	BPPI0 [Point-to-Point]
Status DTR	255	✓
Status DSR	255	✓
Station failure	255	✓
protocol-specific return information 0: • Interface “activated/deactivated” Return information for PRE control message interface “activate/deactivate”. <0> = interface “activated” <1> = interface “deactivated”	255	✓
protocol-specific return information 1 • Interface + protocol functions “activate/deactivate” Return information for PRE control message interface + protocol function “activate/deactivate”. <0> = interface + protocol function “deactivate” <1> = interface + protocol function “activate”	255	✓

13.2.10 Interoperability IEC 60870-5-101 (BPPI0)

This companion standard presents sets of parameters and alternatives from which subsets must be selected to implement particular telecontrol systems. Certain parameter values, such as the number of octets in the COMMON ADDRESS of ASDUs represent mutually exclusive alternatives. This means that only one value of the defined parameters is admitted per system. Other parameters, such as the listed set of different process information in command and in monitor direction, allow the specification of the complete set or subsets, as appropriate for given applications. This clause summarizes the parameters of the previous clauses to facilitate a suitable selection for a specific application. If a system is composed of equipment stemming from different manufacturers it is necessary that all partners agree on the selected parameters.

The selected parameters should be marked in the white boxes as follows:

[ ] Function or ASDU is not used

[X] Function or ASDU is used as standardized (default)

[R] Function or ASDU is used in reverse mode

[B] Function or ASDU is used in standard and reverse mode

The possible selection (blank, X, R, or B) is specified for each specific clause or parameter.

NOTE In addition, the full specification of a system may require individual selection of certain parameters for certain parts of the system, such as the individual selection of scaling factors for individually addressable measured values.

13.2.10.1 System or device function

(system-specific parameter, indicate the system's or station's function by marking one of the following with „**X**")

- [X] System definition
- [ ] Controlling Station (Master)
- [ ] Controlled Station (Slave)

13.2.10.2 Network configuration

(network-specific parameter, all configurations that are used are to be marked „**X**"

X	Point-to-Point		Multipoint-partyline
X	Multiple Point-to-Point		Multipoint-star

13.2.10.3 Physical layer

(network-specific parameter, all used interfaces and data rates must be marked wirth „**X**"

Transmission speed (control direction)

Unbalanced Interface V.24/V.28 Standard		Unbalanced Interface V.24/V.28 Recommended if >1200 bit/s		Balanced Interface X.24/X.27			
X	100 bit/s	X	2 400 bit/s	X	2 400 bit/s	X	56 000 bit/s
X	200 bit/s	X	4 800 bit/s	X	4 800 bit/s	X	64 000 bit/s
X	300 bit/s	X	9 600 bit/s	X	9 600 bit/s		
X	600 bit/s	X	19 200 bit/s	X	19 200 bit/s		
X	1 200 bit/s	X	38 400 bit/s	X	38 400 bit/s		

Transmission speed (monitor direction)

Unbalanced Interface V.24/V.28 Standard	Unbalanced Interface V.24/V.28 Recommended if >1200 bit/s	Balanced Interface X.24/X.27	
X 100 bit/s	X 2 400 bit/s	X 2 400 bit/s	X 56 000 bit/s
X 200 bit/s	X 4 800 bit/s	X 4 800 bit/s	X 64 000 bit/s
X 300 bit/s	X 9 600 bit/s	X 9 600 bit/s	
X 600 bit/s	X 19 200 bit/s	X 19 200 bit/s	
X 1 200 bit/s	X 38 400 bit/s	X 38 400 bit/s	

13.2.10.4 Link Layer

(network-specific parameter, all configurations that are used are to be marked „**X**“ Specify the maximum frame length. If a non-standard assignment of class 2 messages is implemented for unbalanced transmission, indicate the Type ID and COT of all messages assigned to class 2.)

Frame format FT 1.2, single character 1 and the fixed time out interval are used exclusively in this companion standard.

Link transmission procedure	Address filed of the link
X Balanced transmission	X not present (balanced transmission only)
☐ Unbalanced transmission	X 1 Octet
	X 2 Octets
	X structured
	X unstructured

Frame length

☐ Maximum length L (control direction)

☐ Maximum length L (monitor direction)

☐ Time interval in which repetitions are allowed *(Trp)* or number of repetitions

When using an unbalanced link layer, the following ASDU types are returned in class 2 messages (low priority) with the indicated causes of transmission:

☐ The standard assignment of ASDUs to class 2 messages is used as follows:

Type Identification	Cause of transmission
9, 11, 13, 21	<1>

☐ A special assignment of ASDUs to class 2 messages is used as follows:

Type identification	Cause of transmission

NOTE:
In response to a class 2 poll, a controlled station may respond with class 1 data when there is no class 2 data available.

13.2.10.5 Application Layer

Transmission mode for application data

Mode 1 (Least significant octet first), as defined in clause 4.10 of IEC 60870-5-4, is used exclusively in this companion standard.

Common address of ASDU

(system-specific parameter, all configurations that are used are to be marked "**X**")

[X] 1 Octet

[X] 2 Octets

Address of the information object

(system-specific parameter, all configurations that are used are to be marked "**X**")

[X] 1 Octet

[X] structured

[X] 2 Octets

[X] unstructured

[X] 3 Octets

Cause of transmission

(system-specific parameter, all configurations that are used are to be marked "**X**")

[X] 1 Octet

[X] 2 Octets (with originator address)
Only originator address not used (=0) is used

Selection of standard ASDUs

Process information in monitor direction

(station-specific parameter, mark each Type ID "**X**" if it is only used in the standard direction, "**R**" if only used in the reverse direction, and "**B**" if used in both directions)

[B] <1> := Single-point information M_SP_NA_1

[B] <2> := Single-point information with time tag M_SP_TA_1

B	<3> := Double-point information	M_DP_NA_1
B	<4> := Double-point information with time tag	M_DP_TA_1
B	<5> := Step position information	M_ST_NA_1
B	<6> := Step position information with time tag	M_ST_TA_1
B	<7> := Bitstring of 32 bit	M_BO_NA_1
B	<8> := Bitstring of 32 bit with time tag	M_BO_TA_1
B	<9> := Measured value, normalized value	M_ME_NA_1
B	<10> := Measured value, normalized value with time tag	M_ME_TA_1
B	<11> := Measured value, scaled value	M_ME_NB_1
B	<12> = Measured value, scaled value with time tag	M_ME_TB_1
B	<13> := Measured value, short floating point number	M_ME_NC_1
B	<14> := Measured value, short floating point number with time tag	M_ME_TC_1
B	<15> := Integrated totals	M_IT_NA_1
B	<16> := Integrated totals with time tag	M_IT_TA_1
B	<17> := Event of protection equipment with time tag	M_EP_TA_1
B	<18> := Packed start events of protection equipment with time tag	M_EP_TB_1
B	<19> := Packed output circuit information of protection equipment with time tag	M_EP_TC_1
6)	<20> := Packed single-point information with status change detection M_PS_NA_1	M_PS_NA_1
	<21> := Measured value, normalized value without quality descriptor	M_ME_ND_1
B	<30> := Single-point information with time tag CP56Time2a	M_SP_TB_1
B	<31> := Double-point information with time tag CP56Time2a	M_DP_TB_1
B	<32> := Step position information with time tag CP56Time2a	M_ST_TB_1
B	<33> := Bitstring of 32 bits with time tag CP56Time2a	M_BO_TB_1
B	<34> := Measured value, normalized value with time tag CP56Time2a	M_ME_TD_1
B	<35> := Measured value, scaled value with time tag CP56Time2a	M_ME_TE_1
B	<36> := Measured value, short floating point number with time tag CP56Time2a	M_ME_TF_1
B	<37> := Integrated totals with time tag CP56Time2a	M_IT_TB_1
B	<38> := Event of protection equipment with time tag CP56Time2a	M_EP_TD_1

B	<39> := Packed start events of protection equipment with time tag CP56Time2a	M_EP_TE_1
B	<40> := Packed output circuit information of protection equipment with time tag CP56Time2a	M_EP_TF_1

Either ASDUs of the set <2>, <4>, <6>, <8>, <10>, <12>, <14>, <16>, <17>, <18>, <19> or of the set <30 – 40> are used.

6) Reception possible, thereby the blocked single-point information is deblocked and further individually processed as TI = 30 (address translation occurs algorithmic).

Process information in control direction

(station-specific parameter, mark each Type ID "**X**" if it is only used in the standard direction, "**R**" if only used in the reverse direction, and "**B**" if used in both directions)

B	<45> := Single command	C_SC_NA_1
B	<46> := Double command	C_DC_NA_1
B	<47> := Regulating step command	C_RC_NA_1
B	<48> := Set point command, normalized value	C_SE_NA_1
B	<49> := Set point command, scaled value	C_SE_NB_1
B	<50> := Set point command, short floating point number	C_SE_NC_1
B	<51> := Bitstring of 32 bit	C_BO_NA_1
B	<58> := Single command with time tag CP56Time2a	C_SC_TA_1
B	<59> := Double command with time tag CP56Time2a	C_DC_TA_1
B	<60> := Regulating step command with time tag CP56Time2a	C_RC_TA_1
B	<61> := Set point command, normalized value with time tag CP56Time2a	C_SE_TA_1
B	<62> := Set point command, scaled value with time tag CP56Time2a	C_SE_TB_1
B	<63> := Set point command, short floating point with time tag CP56Time2a	C_SE_TC_1
B	<64> := Bitstring of 32 bits with time tag CP56Time2a	C_BO_TA_1

Either the ASDUs of the set <45> - <51> or of the set <58> - <64> are used.

System information in monitoring direction

(station-specific parameter, mark each Type ID "**X**" if it is only used in the standard direction, "**R**" if only used in the reverse direction, and "**B**" if used in both directions)

X	<70> := End of initialization	M_EI_NA_1

System information in control direction

(station-specific parameter, mark each Type ID "**X**" if it is only used in the standard direction, "**R**" if only used in the reverse direction, and "**B**" if used in both directions)

B	<100> := Interrogation command	C_IC_NA_1
B	<101> := Counter interrogation command	C_CI_NA_1
	<102> := Read command	C_RD_NA_1
B	<103> := Clock synchronization command	C_CS_NA_1
B	<104> := Test command	C_TS_NA_1
X+	<105> := Reset process command	C_RP_NA_1
B+	<106> := Delay acquisition command	C_CD_NA_1

Parameter in control direction

(station-specific parameter, mark each Type ID "**X**" if it is only used in the standard direction, "**R**" if only used in the reverse direction, and "**B**" if used in both directions)

X+	<110> := Parameter of measured value, normalized value	P_ME_NA_1
X+	<111> := Parameter of measured value, scaled value	P_ME_NB_1
X+	<112> := Parameter of measured value, short floating	P_ME_NC_1
4)	<113> := Parameter activation	P_AC_NA_1

+ ... secondary application function only
4) ... Not used in IEC 60870-5-101 Edition 2. No use case.

File transfer

(station-specific parameter, mark each Type ID "**X**" if it is only used in the standard direction, "**R**" if only used in the reverse direction, and "**B**" if used in both directions)

B	<120> := File ready	F_FR_NA_1
B	<121> := section ready	F_SR_NA_1
B	<122> := Call directory, select file, call file, call section	F_SC_NA_1
B	<123> := last section, last segment	F_LS_NA_1
B	<124> := Ack file, ack section	F_AF_NA_1
B	<125> := Segment	F_SG_NA_1
X	<126> := Directory {blank or X, only available in monitor (standard) direction}	F_DR_TA_1

Type identifier and Cause of Transmission Assignments

(station-specific parameter)
Shaded boxes are not required.
Black boxes are not permitted in this companion standard
Blank = Function or ASDU is not used.
Mark Type Identification/Cause of transmission combinations:
"**X**" if only used in the standard direction,

"**R**" if only used in the reverse direction,
"**B**" if used in both directions.

Type Identification		Cause of transmission																		
		1	2	3	4	5	6	7	8	9	10	11	12	13	20 to 36	37 to 41	44	45	46	47
<1>	M_SP_NA_1		B	B								B	B		B					
<2>	M_SP_TA_1			B								B	B							
<3>	M_DP_NA_1		B	B								B	B		B					
<4>	M_DP_TA_1			B								B	B							
<5>	M_ST_NA_1		B	B*								B*	B*		B*					
<6>	M_ST_TA_1			B*								B*	B*							
<7>	M_BO_NA_1		B	B*											B*					
<8>	M_BO_TA_1			B*																
<9>	M_ME_NA_1	B	B	B											B					
<10>	M_ME_TA_1			B																
<11>	M_ME_NB_1	B	B	B											B					
<12>	M_ME_TB_1			B																
<13>	M_ME_NC_1	B	B	B											B					
<14>	M_ME_TC_1			B																
<15>	M_IT_NA_1			B												B				
<16>	M_IT_TA_1			B												B				
<17>	M_EP_TA_1			B																
<18>	M_EP_TB_1			B																
<19>	M_EP_TC_1			B																
<20>	M_PS_NA_1		6)												6)					
<21>	M_ME_ND_1																			
<30>	M_SP_TB_1			B								B	B							
<31>	M_DP_TB_1			B								B	B							
<32>	M_ST_TB_1			B*								B*	B*							
<33>	M_BO_TB_1			B*																
<34>	M_ME_TD_1			B																
<35>	M_ME_TE_1			B																
<36>	M_ME_TF_1			B																
<37>	M_IT_TB_1			B												B				
<38>	M_EP_TD_1			B																
<39>	M_EP_TE_1			B																
<40>	M_EP_TF_1			B																
<45>	C_SC_NA_1						B	B	B	B	B						B	B	B	B
<46>	C_DC_NA_1						B	B	B	B	B						B	B	B	B
<47>	C_RC_NA_1						B	B	B	B	B						B	B	B	B
<48>	C_SE_NA_1						B	B	B	B	B*						B	B	B	B
<49>	C_SE_NB_1						B	B	B	B	B*						B	B	B	B

B* … can be generated by the PLC

6) Reception possible, thereby the blocked single-point information is deblocked and further individually processed as TI = 30 (address translation occurs algorithmic).

[Typ_Identification_101_1, 2, en_US]

Type Identification		Cause of transmission																		
		1	2	3	4	5	6	7	8	9	10	11	12	13	20 to 36	37 to 41	44	45	46	47
<50>	C_SE_NC_1						B	B	B	B	B*						B	B	B	B
<51>	C_BO_NA_1						B*	B*	B*	B*	B*						B	B	B	B
<58>	C_SC_TC_1						B	B	B	B	B						B	B		B
<59>	C_DC_TC_1						B	B	B	B	B						B	B		B
<60>	C_RC_TC_1						B	B	B	B	B						B	B		B
<61>	C_SE_TA_1						B	B	B	B	B*						B	B		B
<62>	C_SE_TB_1						B	B	B	B	B*						B	B		B
<63>	C_SE_TC_1						B	B	B	B	B*						B	B		B
<64>	C_BO_TA_1						B*	B*	B*	B*	B*						B	B		B
<70>	M_EI_NA_1*)				B															
<100>	C_IC_NA_1						B	B			B						B	B	B	B
<101>	C_CI_NA_1						B	B			B						B	B	B	B
<102>	C_RD_NA_1																			
<103>	C_CS_NA_1						B	B									B	X	X	X
<104>	C_TS_NA_1						B	B									B	X	X	X
<105>	C_RP_NA_1						X+	X+									B	X	X	X
<106>	C_CD_NA_1			B			B	B									B	X	X	X
<110>	P_ME_NA_1						X	X							X		B	X	X	X
<111>	P_ME_NB_1						X	X							X		B	X	X	X
<112>	P_ME_NC_1						X	X							X		B	X	X	X
<113>	P_AC_NA_1																			
<120>	F_FR_NA_1													B			B	5)	5)	5)
<121>	F_SR_NA_1													B			B	5)	5)	5)
<122>	F_SC_NA_1					B								B			B	5)	5)	5)
<123>	F_LS_NA_1													B			B	5)	5)	5)
<124>	F_AF_NA_1													B			B	5)	5)	5)
<125>	F_SG_NA_1													B			B	5)	5)	5)
<126>	F_DR_TA_1*)			X		X														

*) … blank or X only
B* … can begenerated by the PLC
5) … transparent transmission by system

+ … secondary application function only

[Type_Identification_101_2, 2, en_US]

Semantics of cause of transmission:

<0>	:=	not used
<1>	:=	periodic, cyclic (optional)
<2>	:=	background scan (optional)
<3>	:=	spontaneous
<4>	:=	initialized
<5>	:=	request or requested
<6>	:=	activation
<7>	:=	activation confirmation
<8>	:=	deactivation
<9>	:=	deactivation confirmation
<10>	:=	activation termination
<11>	:=	return information caused by a remote command
<12>	:=	return information caused by a local command
<13>	:=	file transfer
<14..19>	:=	not used
<20>	:=	interrogated by station interrogation
<21..36>	:=	interrogated by interrogation of the group 1..16
<37>	:=	requested by general counter request
<38..41>	:=	requested by counter interrogation of the group 1..4
<42, 43>	:=	not used
<44>	:=	unknown type identification
<45>	:=	unknown cause of transmission
<46>	:=	unknown common address of ASDU
<47>	:=	unknown information object address
<48, 63>	:=	not used

[Type_Identification_101_3, 2, en_US]

13.2.10.6 Basic application functions

Station Initialization

(station-specific parameter, mark "**X**" if function is used)

X	Remote initialization

Cyclic data transmission

(station-specific parameter, mark each Type ID "**X**" if function is only used in the standard direction, "**R**" if only used in the reverse direction, and "**B**" if used in both directions)

X'	Cyclic data transmission

' ... secondary application function only

Read procedure

(station-specific parameter, mark each Type ID "**X**" if function is only used in the standard direction, "**R**" if only used in the reverse direction, and "**B**" if used in both directions)

	Read procedure

Spontaneous transmission

(station-specific parameter, mark each Type ID "**X**" if function is only used in the standard direction, "**R**" if only used in the reverse direction, and "**B**" if used in both directions)

B	Spontaneous transmission

Double transmission of information objects with cause of transmission spontaneous

(station-specific parameter, mark each information type "**X**" where both a Type ID without time and corresponding Type ID with time are issued in response to a single spontaneous change of a monitored object)

The following type identifications may be transmitted in succession caused by a single status change of an information object. The particular information object addresses for which double transmission is enabled are defined in a project-specific list.

☐ Single-point information M_SP_NA_1, M_SP_TA_1, M_SP_TB_1 and M_PS_NA_1

☐ Double-point information M_DP_NA_1, M_DP_TA_1 and M_DP_TB_1

☐ Step position information M_ST_NA_1, M_ST_TA_1 and M_ST_TB_1

☐ Bitstring of 32 bit M_BO_NA_1, M_BO_TA_1 and M_BO_TB_1 (if defined for a specific project)

☐ Measured value, normalized value M_ME_NA_1, M_ME_TA_1, M_ME_ND_1 and M_ME_TD_1

☐ Measured value, scaled value M_ME_NB_1, M_ME_TB_1 and M_ME_TE_1

☐ Measured value, short floating point value M_ME_NC_1, M_ME_TC_1 and M_ME_TF_1

Station Interrogation

(station-specific parameter, mark "**X**" if function is only used in the standard direction, "**R**" if only used in the reverse direction, and "**B**" if used in both directions)

[B] Global

B	group 1	B	group 7	B	group 13
B	group 2	B	group 8	B	group 14
B	group 3	B	group 9	B	group 15
B	group 4	B	group 10	B	group 16
B	group 5	B	group 11		
B	group 6	B	group 12		Information Object Addresses assigned to each group must be shown in a separate table.

Clock synchronization

(station-specific parameter, mark "**X**" if function is only used in the standard direction, "**R**" if only used in the reverse direction, and "**B**" if used in both directions)

[B] Clock synchronization

[B] Day of week used

☐ RES1, GEN (time tag substituted/ not substituted) used

[B] SU-bit (summertime) used

Command transmission

(object-specific parameter, mark "**X**" if function is only used in the standard direction, "**R**" if only used in the reverse direction, and "**B**" if used in both directions)

B	Direct command transmission
B	Direct set point command transmission
B	"Select and execute" command
B	"Select and execute" set point command
B	C_SE ACTTERM used
B	No additional definition
B	Short pulse duration (duration determined by a system parameter in the outstation)
B	Long pulse duration (duration determined by a system parameter in the outstation)
B*	Persistent output

B* can be generated by the PLC

Transmission of integrated totals

(station- or object-specific parameter, mark "**X**" if function is only used in the standard direction, "**R**" if only used in the reverse direction, and "**B**" if used in both directions)

B	Mode A: Local freeze with spontaneous transmission
B	Mode B: Local freeze with counter interrogation
B	Mode C: Freeze and transmit by counter interrogation commands
	Mode D: Freeze by counter interrogation command, frozen values reported spontaneously
B	Counter read
B	counter freeze without reset
B	Counter freeze with reset
B	counter reset
B	General request counter
B	counter interrogation group 1
B	counter interrogation group 2
B	counter interrogation group 3
B	counter interrogation group 4

Parameter loading [128]

(object-specific parameter, mark "**X**" if function is only used in the standard direction, "**R**" if only used in the reverse direction, and "**B**" if used in both directions)

X	Threshold value
X	Smoothing factor
X	Low limit for transmission of measured value
X	High limit for transmission of measured value

Parameter activation

(object-specific parameter, mark "**X**" if function is only used in the standard direction, "**R**" if only used in the reverse direction, and "**B**" if used in both directions)

	act/deact of persistent cyclic or periodic transmission of the addressed object

Test procedure

(station-specific parameter, mark "X" if function only used in standard direction, "R" if only used in the reverse direction, and "B" if used in both directions)

B	Test procedure

file transfer

(station-specific parameter, mark "**X**" if function is used)

File transfer in monitor direction

X*	Transparent file
X*	Transmission of disturbance data of protection equipment
X	Transmission of sequences of events
X*	Transmission of sequences of recorded analog values

File transfer in control direction

	Transparent file

X* Data can be transparently transported by the system but not generated or evaluated. A maximum of 220 bytes of user data can be transported in a segment telegram for file transfer.

Background scan

(station-specific parameter, mark "**X**" if function is only used in the standard direction, "**R**" if only used in the reverse direction, and "**B**" if used in both directions)

B	Background scan

Note: used for data which are transmitted caused by a self-initiated general interrogation

[128] Not supported with "Controlled Function"

Acquisition of transmission delay

(station-specific parameter, mark "**X**" if function is only used in the standard direction, "**R**" if only used in the reverse direction, and "**B**" if used in both directions)

B	Acquisition of transmission delay

13.3 IEC 60870-5-101 (Multi-Point Traffic)

13.3.1 Introduction

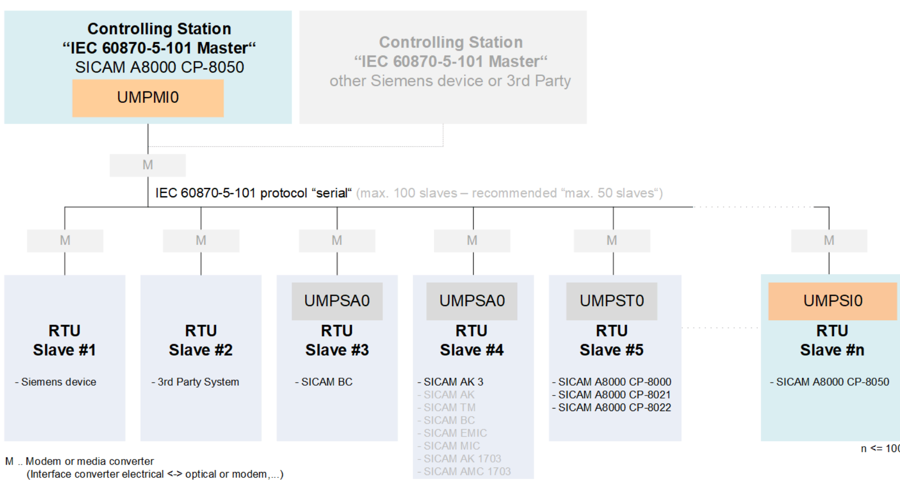
The IEC 60870-5-101 protocol (multi-point traffic) is a standardized serial transmission protocol for communication with remote stations with multi-point traffic (master/slave principle; “Partyline”).

Protocol firmware for IEC 60870-5-101 (multi-point traffic):

Firmware	System	Standard and function
UMPMI0	CP-8031, CP-8050	IEC 60870-5-101 Unbalanced (Multi point Master)
UMPSI0	CP-8031, CP-8050	IEC 60870-5-101 Unbalanced (Multi point Slave)

Multi-point traffic describes a serial communications protocol with which a central station is connected with one or several substations over a communications link in a line or star configuration. The data traffic is controlled by the central station.

Either data messages or station interrogation messages are transmitted from the central station. Data from the substation to the central station can only be transmitted as reply to a station interrogation.



[UMPxI0_config, 1, en_US]

In multi-point traffic an unbalanced transmission procedure is used. That means, that as primary station the central station initiates all message transmissions, while the substations, which are secondary stations, may only transmit when they are called.

The multi-point traffic only requires a half-duplex transmission medium and can be used in multiple point-to-point, star or line structure.

The central station and the substations in multi-point traffic operate with a communications protocol according to IEC 60870-5-101. The supported functionality (interoperability) is described in section *13.3.13 Interoperability IEC 60870-5-101 (UMPMI0, UMPSI0)*.

13.3.2 Functions

Function	UMPMI0	UMPSI0
IEC 60870-5-101		
Serial communication protocol according to IEC 60870-5-101	✓	✓
Unbalanced transmission Master	✓	–
Unbalanced transmission Slave	–	✓

Function	UMPMI0	UMPSI0
System or device (application function):		
• "Controlling station"	✓	–
• "Controlled station"	–	✓
Max. connections (number of substations per master)	100	–
Max. connections (number of masters per slave)	–	1
Max. number of supported data points	[129]	[129]
Interoperability		
IEC 60870-5-101 Ed.1 (Unbalanced)	✓	✓
IEC 60870-5-101 Ed.2 (Unbalanced)	✓	✓
Interoperability according to *13.3.13 Interoperability IEC 60870-5-101 (UMPMI0, UMPSI0)*	✓	✓
Network configuration		
Point-to-point configuration (Master + 1 Slave)	✓	✓
Multiple point-to-point configuration (a separate interface with 1 master + 1 slave is required for each point-to-point configuration)	✓	✓
Data concentrator	✓	✓
Line configuration	✓	✓
Star configuration	✓	✓
Multi-hierarchical configurations (further components can be connected to substations)	✓	✓
Physical interface		
direct link interface (RS-232)	✓	✓
RS-485	✓	✓
RS-422	✓	✓
X.24/X.27 (external converters required)	✓[130]	✓[130]
CP-8031, CP-8050: X4 (RS-485, RS-422); X5 (RS-232)	✓	✓
CI-8551[131]: X1,X2 (RS-232, RS-485, RS-422); X3 (RS-485, RS-422); X4, X5 (RS-232)	✓	✓
Baud rates: 50, 75, 100, 134.5, 150, 200, 300, 600, 1050, 1200, 1800, 2000, 2400, 4800, 9600, 19200, 38400, 56000, 57600, 64000, 115200 bits/s	✓	✓
Data transmission line (full duplex)	–	–
Data transmission line (half duplex)	✓	✓
Bit transmission layer / message frame / data flow control		
Message formats according to IEC 60870-5-1/FT1.2	✓	✓
Byte frame = 11 bits (8E1)	✓	✓
Message protection d = 4:		
• Checksum (8 bits) + parity bit (even) + transmission rules	✓	✓
Pulse code modulation, byte asynchronous	✓	✓

129 The protocol firmware does not limit the number of data points.

130 External interface converter required.

131 With CP-8031 not supported by default With a license (see*14.8 SICAM A8000 CP-803x Extended CI-Module*) 1 communication module CI-8551 can be used additionally also with CP-8031.

Function	UMPMI0	UMPSI0
Message length	1 to 255 bytes	1 to 255 bytes
Data flow control: Data flow control bit in receive direction used	✓	–
Data Flow Control: Data flow control bit in transmit direction used	–	–
Data flow control bit supervision	✓	–
IEC 60870-5-101 functions		
Data acquisition by polling (station interrogation):		
• Continuous interrogation of a substation	✓	–
• Station failure delay	✓	–
• Quick-Check-Procedure	–	–
Acquisition of events (transmission of data ready to be sent)	✓	✓
General interrogation, substation interrogation		
• Non-interruptible general interrogation	–	✓
• Send GI data as class 1 data	–	✓
• Convert general interrogation command in receive direction to broadcast	–	✓
• Do not store general interrogation commands in receive direction	–	✓
• Timeout monitoring for GI data	–	–
Clock synchronization according to IEC 60870-5-101:		
• Clock synchronization with <TI:=103> clock synchronization command	✓	✓
• Acquisition of the transmission time (primary station) to correct the time synchronization with <TI:=106>	–	–
• Acquisition of the transmission time (primary station) used for correction of clock synchronization (with"Request Status Of Link"= proprietary)	✓	–
• Acquisition of the transmission time (secondary station) to correct the time synchronization with <TI:=106>	–	✓
• Correction of clock synchronization (via parameter)	–	✓
• Accuracy	–	±20 ms
• Relay operation accuracy (per routing station)[132]	–	±20 ms
Command transmission:		
• Demand	✓	–
• Supervision of maximum transport time in control direction	–	–
• Control location (set/check control location)	✓	–
Transmission of integrated totals	✓	✓
File transfer	✓	✓
Optimized parameters for selected transmission facilities		
Predefined parameters for selected transmission facilities	✓	✓
Freely definable parameters for transmission facility	✓	✓
Supply of connected transmission devices with 5 V/12 V(via VCC-Pin) ATTENTION: Check power consumption of the external transmission facility!	✓	✓
Standby transmission line over the public telephone network (PSTN)	✓	–
Data transmission using time slot radio	✓	✓

132 In case of relay operation additional 10 ms for each routing station.

Function	UMPMI0	UMPSI0
Coordination of several central stations	✓	–
Relay operation (multi-point traffic wirth routing)		
Main/Standby transmission line	✓	✓
Redundancy(functions for supporting redundant communication routes)		
NUC redundancy (Norwegian Users Conventions)		
• NUC redundancy“Controlling station”	✓	–
• NUC redundancy“Controlled station”	–	✓
Protocol redundancy:		
• Call operation when passive	✓	–
• Tristate of RS-232 interface if passive	✓	✓
• Listening mode when passive	✓	✓
• Protocol function in redundancy state = passive – normal operation (RS-232 = active)	✓	✓
• Protocol function in redundancy state = PASSIVE – listening mode (RS-232 = TRISTATE)	✓	✓
Port redundancy:		
• Deactivation of interface (with redundancy control message)	–	–
• Activation/Deactivation of interface when passive with protocol element control message	✓	–
Device redundancy:		
• Device redundancy with the same PRE parameters	✓	✓
• Device redundancy with different PRE parameters (“A/B-Parameter”)	✓	✓
• Device redundancy with different PRE parameters (“A/B-Parameter”) for signals	–	–
Protocol element control and return information		
Protocol element control messages:		
• Send (general) interrogation command to all	✓	✓
• Send (general) interrogation command to selective CASDU	✓	–
• Send (general) interrogation command for image GI to own BSE	–	–
• Send (general) interrogation command for GI group to own BSE	–	–
• Send reset command	–	–
• Set control location	✓	–
• Data filter in transmit direction ON/OFF (Filter out all messages in transmit direction - no sending)	✓	–
• Data filter in receive direction ON/OFF (filter out all messages in receive direction - no forwarding to BSE)	✓	–
• Interface activate/deactivate	✓	–
• Interface + Protocol activate/deactivate	✓	–
• Add/remove station to station polling	✓	–
• Call cycle START/STOP/CONTINUE	✓	–
• Continuous call station x ON / OFF	✓	–
• Main / Standby transmission line ACTIVE	✓	–
• I bit handling for time ON/OFF	–	✓

Function	UMPMI0	UMPSI0
Protocol element return information:		
• Station status	✓	–
• Station failure	✓	–
• Status DTR	✓	✓
• Status DSR	✓	✓
• Protocol-specific return information 0 to 3, 6, 7, 8 to 11	✓	–
• Protocol-specific return information value (retries in % of the last hour)	✓	–
Special functions		
Summer time bit (SU) = 0 for all messages in transmit direction (time tag)	✓	✓
Day of week (DOW) = 0 for all messages in transmit direction (time tag)	✓	✓
Originator address = 0 for all messages in transmit direction	✓	✓
Data throughput limit	–	–
Send End of init message as class 1 data	–	✓
Send ACTCON, ACTTERM as class 1 data	–	✓
ACTCON for clock synchronization command	–	✓
ACTCON±emulate	–	✓
Emulate ACTCON, ACTTERM for commands (with control message)	–	✓
Message Synchronization	–	✓
Filtering of Measured Values in Transmit Direction	–	✓
Transparent Mode (Tunneling)	✓	–
Security		
WhiteList filter	–	–
WhiteList filter (predefined for all TIs + COTs)	–	–
WhiteList filter"TI filter"(type identification-pass-through filter - parameter-settable)	–	–
Web server		
Protocol-internal diagnostic and statistic information via protocol-specific web pages	–	–
Engineering		
SICAM Device Manager	✓	✓
SICAM TOOLBOX II	✓	✓
Remote maintenance with SICAM TOOLBOX II via serial interface	✓	✓

13.3.3 Modes of Operation

The operating mode of the interface is determined by parameters of the protocol element and optional equipment.

Operating mode	Interface → optional DTE	Interface signals
Unbalanced interchange circuit (V.24/V.28) RS-232 asynchronous	X5	RXD, TXD, CTS [133], RTS, DCD, DTR, DSR/VCC, GND
Balanced interface (V.11) RS-485 (2-wire)/ RS-422 (4-wire) asynchronous	X4	TXD+, TXD-, RXD+, RXD- (4-wire)
Balanced interface (V.11) RS-485 (2-wire)/ RS-422 (4-wire) asynchronous	X5 → PHOENIX PSM-ME-RS232/ RS485-P interface converter	Interface signals at X5: (towards PHOENIX PSM-ME-RS232/RS485-P) RXD, TXD, CTS, RTS, DCD, DTR, GND Interface signals at PHOENIX PSM-ME-RS232/RS485-P: • RS-485 2-wire D(A), D(B), GND • RS-422 (4-wire): D(A), D(B), T(A), T(B), GND
Optical interface with CM-0847 (Multimode)	X5 → CM-0847	Interface at X5 towards CM-0847: RXD, TXD, CTS, RTS, DCD, DTR, DSR/ VCC, GND

13.3.4 Communication

For the stations to communicate with each other, suitable transmission facilities and/or network components may be needed in addition.

Own Station (Central Station, IEC60870-5-101 Master)

System	System element	Protocol Element	Remarks
SICAM A8000 Series	CP-8031/CPCI85 CP-8050/CPCI85 CP-8050/EPCI85	UMPMI0	max. 100 Slaves

Remote Station (Substation, IEC60870-5-101 Slave)

System	System element	Protocol Element	Remarks
SICAM A8000 Series	CP-8000/CPC80 CP-802x/CPC80	UMPST0	max. 1 Master
	CP-8031/CPCI85 CP-8050/CPCI85 CP-8050/EPCI85	UMPSI0	max. 1 Master
SICAM AK 3	CP-2016/CPCX26 CP-2019/PCCX26	SM-2551/UMPSA0 SM-0551/UMPSA0	max. 1 Master
Legacy systems (SICAM AK, SICAM TM, SICAM BC, SICAM EMIC, SICAM MIC)	CP-20xx CP-60xx CP-50xx	SM-2551/UMPSA0 SM-0551/UMPSA0 UMPST0	max. 1 Master

133 not usable (reserved for SICAM TOOLBOX II)

System	System element	Protocol Element	Remarks
Siemens devices	–	–	according to *13.3.13 Interoperability IEC 60870-5-101 (UMPMI0, UMPSI0)*
Third-party system	–	–	according to *13.3.13 Interoperability IEC 60870-5-101 (UMPMI0, UMPSI0)*

Own Station (Substation, IEC60870-5-101 Slave)

System	System element	Protocol Element	Remarks
SICAM A8000 Series	CP-8031/CPCI85 CP-8050/CPCI85 CP-8050/EPCI85	UMPSI0	max. 1 Master

Remote station (Central Station, IEC60870-5-101 Master)

System	System element	Protocol Element	Remarks
SICAM A8000 Series	CP-8000/CPC80 CP-802x/CPC80	UMPMT0	max. 100 Slaves
	CP-8031/CPCI85 CP-8050/CPCI85 CP-8050/EPCI85	UMPMI0	max. 100 Slaves
SICAM AK 3	CP-2016/CPCX26 CP-2019/PCCX26	SM-2551/UMPMA0 SM-0551/UMPMA0	max. 100 Slaves
Legacy systems (SICAM AK, SICAM TM, SICAM BC, SICAM EMIC)	CP-20xx CP-60xx CP-50xx	SM-2551/UMPMA0 SM-0551/UMPMA0 UMPMT0	max. 100 Slaves
Siemens devices	–	–	according to *13.3.13 Interoperability IEC 60870-5-101 (UMPMI0, UMPSI0)*
Third-party system	–	–	according to *13.3.13 Interoperability IEC 60870-5-101 (UMPMI0, UMPSI0)*

13.3.5 Communication According to IEC 60870-5-101

13.3.5.1 Data Acquisition by Polling (Station Interrogation)

The transmission of the data from the substations to the central station takes place by means of station-selective station interrogations (interrogation procedure, polling), controlled by the central station; that changed data is stored in the substation and transmitted to the central station with the interrogation of this substation. The interrogation procedure of the central station ensures, that substations are interrogated sequentially, whereby substations with important data can be interrogated more often. Substations may only transmit when they are called.

The interrogation procedure can be influenced with the following parameters:

- Continuous cycle
- Existing stations
- Number of calls until station change

- Number of stations to be called until change of priority level
- Priority level assignment (each station is assigned one of the 4 priority levels: high priority, medium priority, low priority-A, low priority-B)

The interrogation procedure can be performed either continuously (continuous cycle) or only on request. The continuous interrogation of the substations by the central station interrogation procedure is to be performed by enabling the parameter **`[PRE] IEC60870-5-101 | Communication functions | Data communication control | Continuous cycle`** .

The station-selective parameters of the central station for the interrogation cycle such as "Stat No", "Link Address", "Station Enabling", "Station failure", "Priority Level" and "Number of calls" are to be set in the parameter **`[PRE] IEC60870-5-101 | Station definition`** .

In every substation, the station-selective address must be set with the parameter **`[PRE] Station definition | Address of the link`** . This address must be unambiguous for each multi-point traffic line.

In the central station and in the substation, the number of octets is to be parameterized with which the address field is transmitted on the line with the parameter **`[PRE] IEC60870-5-101 | Link-Layer | Address field of the link (number of octets)`** .

The prioritization of the station interrogation can be parameterized by means of corresponding parameter setting of the number of stations called until level change with the following parameters:

- **`[PRE] IEC60870-5-101 | Communication funktions | Data communication control | Station call prioritization | No. of stat. calls in high priority lvl`**
- **`[PRE] IEC60870-5-101 | Communication funktions | Data communication control | Station call prioritization | No. of stat. calls in mid priority lvl`**
- **`[PRE] IEC60870-5-101 | Communication funktions | Data communication control | Station call prioritization | No. of stat. calls in low priority lvl (A)`**
- **`[PRE] IEC60870-5-101 | Communication funktions | Data communication control | Station call prioritization | No. of stat. calls in low priority lvl (B)`**

Through parameterization of the interrogation procedure the following characteristics can be achieved:

- A substation which has a lot of data to send – as for instance continuously changing measured values – does not impair the disposal of the data of the other substations.
- Each substation is interrogated within a determinable time (deterministic).
- Substations with important data, those with a large volume of data to be transmitted can be interrogated more frequently than the others.

The interrogation procedure can be performed either continuously (continuous cycle) or only on request. The control of the interrogation procedure on request can be realized with protocol control messages in the function diagram.

In the running interrogation cycle, data and system messages are transmitted spontaneously from the central station according to the parameter setting as follows:

- One substation selectively (acknowledged)
- All substations (unacknowledged)

If the interrogation cycle has been stopped by protocol control messages or the listening mode is switched on, no station interrogation takes place. With the interrogation cycle stopped, spontaneous data messages continue to be transmitted to the substations. With listening mode switched on, the messages are normally not transmitted from the central station to the substations, rather discarded directly on the basic system element (BSE) by the function "User data filter".

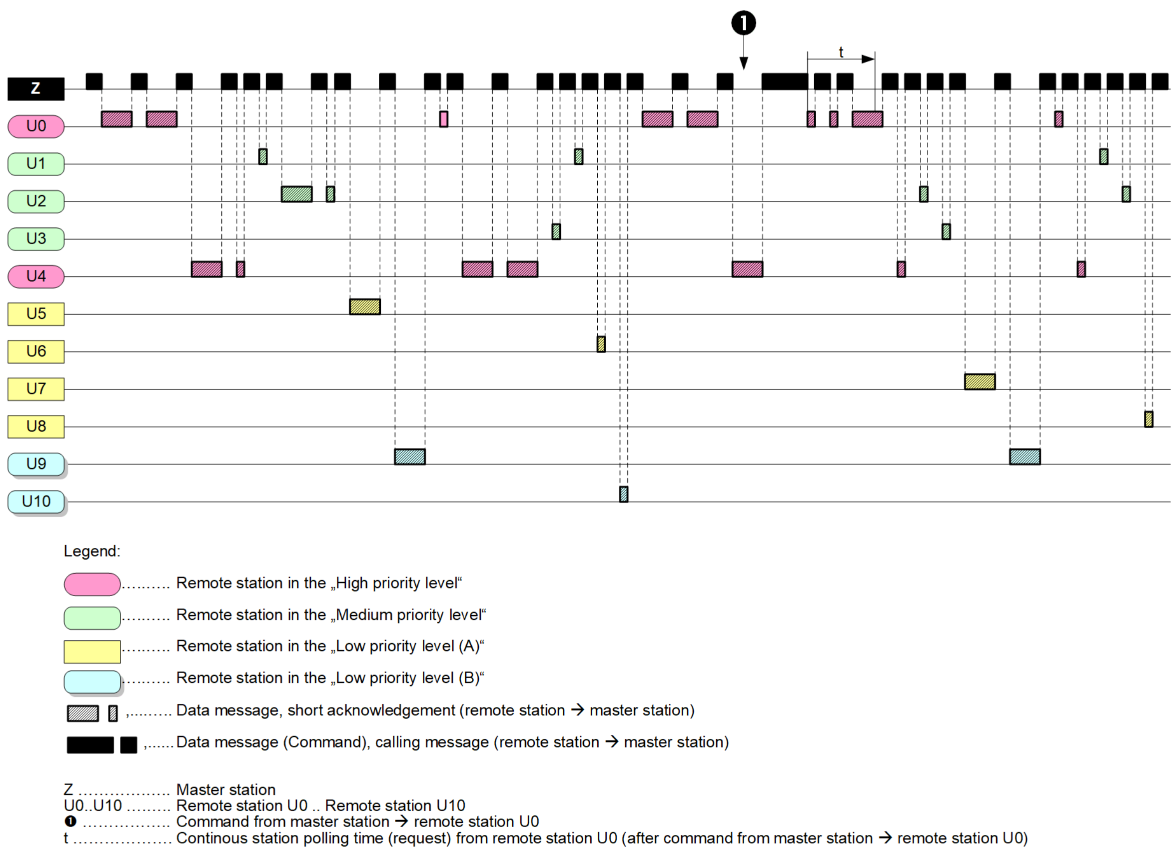
For example: Prioritization of the station interrogation

Below the prioritization of the station interrogation for continuous cycle is shown based on the specified parameters as an example.

Parameter for "Station call prioritization":

High priority level	Number of stations called until level change = 2
Medium priority level	Number of stations called until level change = 2
Low priority level (A)	Number of stations called until level change = 1
Low priority level (B)	Number of stations called until level change = 1

Station U0, U4	High priority level / Number of calls until station change = 2
Station U1,U2,U3	Medium priority level / Number of calls until station change = 2
Station U5,U6,U7,U8	Low priority level (A) / Number of calls until station change = 1
Station U9,U10	Low priority level (B) / Number of calls until station change = 1



For the coupling of different systems with the IEC 60870-5-101 protocol, the setting of the variable elements of the message is required. These parameter can be found in the interoperability list (central station and all substations must be parametrized identically).

The variable elements of the message must be set at the protocol element.

IEC 60870-5-101 parameters	Description	System element
Byte number link address	Number of octets for the address field of the link layer	PRE
Cause of transmission (COT)	Number of octets for cause of transmission	BSE
Common address of ASDU (CASDU)	Number of octets for common address of the ASDU	BSE
Information object address (IOA)	Number of octets for the address of the information object	BSE
Acknowledgment on IEC 60870-5-2 layer	Single character or short message (ACK)	PRE

IEC 60870-5-101 parameters	Description	System element
Maximum message length		BSE
Time tag	Number of octets for time tag	BSE

Legend:

PRE ... Protocol element
BSE ... Basic system element

Continuous interrogation of a substation

The "continuous interrogation of a substation" can be activated automatically in the central station with the function "Demand" or spontaneously with protocol control messages. With function activated, a station interrogation is always executed by the central station to only one selected station. Data messages ready for sending to same remote station will be sent during demand in progress.

During the demand, user data messages continue to be transmitted to this substation.

Through a demand, following a message transmission (e. g., command, setpoint value) the central station can quickly fetch changed data from the substation (e. g., measured values after command or setpoint value). With demand, the continuous interrogation of a substation is terminated after timeout or a message to another substation. With control of the demand using protocol control messages, the continuous interrogation of a substation can be terminated spontaneously through a corresponding protocol control message.

Acknowledgment Procedure

All data messages transmitted selectively to a substation must be acknowledged by this substation. If, with non-faulty transmission line, the acknowledgment is missing for longer than the expected acknowledgment time, transmitted messages are repeated up to n-times (n can be parameterized). On expiry of the number of retries, the station is flagged as faulty.

The acknowledgment from the substation to the central station can be transmitted as single character (E5), if no additional information (such as DCF bit or ACD bit) is to be transmitted. If additional information is to be transmitted, the acknowledgment is transmitted as message with fixed length (ACK).

Instead of the acknowledgment with single character (E5H) the acknowledgment can be transmitted as message with fixed length (ACK).

The message type for the acknowledgment can be selected with the parameter **[PRE] IEC60870-5-101 | Link layer | Acknowledgment IEC60870-5-2** .

The required expected acknowledgment time is determined automatically from the set parameters, but if necessary can be extended accordingly with the parameter **[PRE] IEC60870-5-101 | Time settings, retries | Monitoring times | DFC-monitoring time | Expected_ack_time_corr_factor** . This is then the case if additional signal propagation delays, delay times or slow processing times of the connected substations must be taken into consideration.

The number of retries for data messages is to be set with the parameter **[PRE] IEC60870-5-101 | Time settings, retries | Monitoring times | Retries | Retries for data message SEND/CONFIRM (station selective)** or for messages for station initialization with the parameter **[PRE] IEC60870-5-101 | Time settings, retries | Monitoring times | Retries | Retries for INIT-messages SEND/CONFIRM (station selective)** .

The number of retries is to be set in the substation for data messages with the parameter **[PRE] IEC60870-5-101 | Time settings, retries | Retries | Retries for data message (remote station → master station)** . On expiry of the number of retries (e.g., if the central station keeps the FCB bit unchanged for a number of times when FCV = 1), the interface will be marked as faulty in the substation and the protocol element of the substation is waiting for new station initialization.

Failure Monitoring in the Central Station

The monitoring of the interface by the active central station takes place by means of the cyclic running interrogation procedure (station interrogation). A substation is reported as failed by the central station after expiry of the number of retries. Retries to a substation are thereby always sent in succession immediately after expiry of the expected acknowledgment time i.e. no other substations are interrogated during a running retry handling. For failed substations, a communication fault is only then reported if this is parameterized accordingly in the parameter **`Station failure`** of the **`[PRE] [PRE] Station definition`** .

The failure of substations is thus detected by the central station during the normal interrogation cycle. Failed substations continue to be interrogated by the central station with the interrogation procedure, however, no message retry is performed for such substations during the station interrogation.

The interrogation cycle for failed stations can be set with the parameter **`[PRE] IEC60870-5-103 | Communication function | Data communication control | Faulty stations | Polling cycle for faulty stations`** . As a result, failed substations are removed from the running interrogation procedure for a certain time and from then are only interrogated in the parameterized grid.

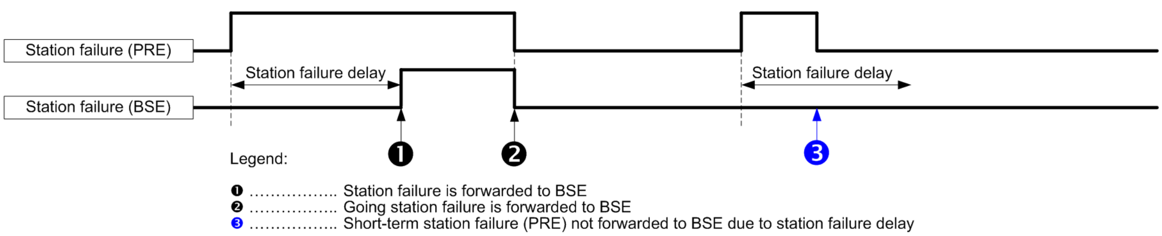
No data is transmitted from the central station to failed substations. The data is saved in the data storage of the communication function on the basic system element (BSE) until they are deleted by the dwell time monitoring or are transmitted to the non-failed substation.

Station Failure Delay

If short-term communication faults lead again and again to station failures, and the number of retries in the central station is not to be increased further, then the transfer of the fault can be delayed.

Through the station failure delay, short-term communication faults no longer lead to a station failure.

With station failure delay, the failure of a substation (after expiry of the number of retries) is not immediately reported as failed, rather only after expiry of a settable delay time. The delay time can be parameterized with the parameter **`[PRE] IEC60870-5-101 | Communication function | Data communication control | Faulty stations | Station failure delay`**.



The station failure delay is performed by the protocol firmware of the central station station-selective. With station failure delay only the "coming" fault is delayed – a "going" fault is passed on immediately to the basic system element.

NOTE

During the station failure delay, no data is transmitted to the affected substations.

Due to the dwell time monitoring on the BSE, certain data is deleted after expiry of the monitoring time if these could not be transmitted!

Failure Monitoring in the Substation

The monitoring of the interface in the substation is performed by monitoring for "cyclic message reception with station interrogation or station-selective data messages". The monitoring time is to be set in the substation with the parameter **`[PRE] IEC60870-5-101 | Time settings, retries | Monitoring times | Call monitoring time`** .

The monitoring timeout is normally only retriggered in the substation with station-selective call messages or station-selective data messages.

The parameter **`[PRE] IEC60870-5-101 | Time settings, retries | Monitoring times | Call timeout retrigger also with "request status of link" retriggern`** is only to be used if this function is explicitly required (special functionality or due to downward compatibility). The message "Request Status of Link" is transmitted from the central station during the initialization phase, with the "acquisition time of the transmission time" and with station failure.

If during failure of the communication line (e. g., signaling direction only) in the substation a failure of the communication link is also to be detected, then the call timeout in the substation must not be retriggered with "Request Status of Link"!

The monitoring time in the substation must be set sufficiently high, so that this does not expire unintentionally during the transmission of larger quantities of data from other substations (e. g., during general interrogation).

As an additional function the remote station can set the interface as faulty on expiry of retries for data messages. The number of retries is to be set in the substation for data messages with the parameter **`[PRE] IEC60870-5-101 | Time settings, retries | Retries | Retries for data message (remote station → master station)`** . On expiry of the number of retries (e.g., if the central station keeps the FCB bit unchanged for a number of times when FCV = 1), the interface will be marked as faulty in the substation and the protocol element of the substation is waiting for new station initialization.

With failed interface, data to be transmitted is stored in the data storage on the basic system element (BSE) of the substation until this is deleted by the dwell time monitoring or can be transmitted to the central station.

13.3.5.2 Station Initialization

After startup, redundancy switchover or after communication error the operation of the interface is started after successful station initialization. The failure of the interface will be detected by the master station and remote station with the failure monitoring function.

The initialization of the link layer of the remote terminal unit is performed by the master station with:

- Request for the status of the link layer (REQUEST STATUS OF LINK)
- Reset of the remote terminal unit link layer (RESET OF REMOTE LINK)

Reset Command	Function in the Remote Terminal Unit
REQUEST STATUS OF LINK	• "STATUS OF LINK" is transmitted to the master station
RESET OF REMOTE LINK	• FCB-Bit (Frame Count Bit) is initialized • Acknowledgment for RESET of REMOTE LINK is transmitted to master station

End of Initialization

If sending of "end of initialization" is enabled on the basic system element in the IEC 60870-5-101/104 parameter block, after the station initialization is performed, data is only sent from the protocol element if the "INIT-End" has been received from the basic system element for the corresponding ASDU. "<TI=70> End of Initialization" is also transmitted to the remote station.

The clock synchronization command or general interrogation command may only be transmitted after "INIT-End".

13.3.5.3 Acquisition of events (transmission of data ready to be sent)

Data of the remote terminal unit ready to be sent are stored on the basic system element (BSE) in the remote terminal unit until transmission.

See also section "Data Acquisition by Polling (Station Interrogation)".

Message from the Remote Terminal Unit to the Master Station

Messages from the remote terminal unit to the master station are only transmitted with station interrogation. A quick-check procedure for speeding up the transmission of data is not implemented.

Coarse Time Message

When transmission of messages with short time format (ms, sec, min) is used, the protocol element of the remote terminal unit can send the missing time information (date + hour) with clock synchronization command in monitoring direction.A Quick-Check procedure for accelerating the transmission of data is not implemented.

Note:

- CP24Time2a ... short time format (3 octet time information including ms and sec)
- CP56Time2a ... long time format (7 octet time information including full date + time)

The transmission of the coarse time message can be activated with the parameter **[PRE] IEC60870-5-101 | Communication functions | Clock synchronization | Coarse time in transmit direction (TK103 COT3)** .

Transmission of Coarse Time:

- do not send coarse time
- send coarse time always before message with short time tag
- send coarse time only when changed before message with short time tag

The coarse time will be sent using <TI=103> clock synchronization command in monitoring direction with same CASDU, IOA of following message with time tag and cause of transmission "spontaneous".

The coarse time will be sent automatically 1x after restart / redundancy switchover / RESET of remote Link before following 1st message with time tag.

13.3.5.4 General Interrogation, Substation Interrogation

The general interrogation function (RTU interrogation) is used for updating the central station after the internal station-initialization or after the central station has detected a loss of information. The function general interrogation of the central station requests the substation to transmit the actual values of all its process variables.

A general interrogation command "to all" triggered in the system is always transferred by the communications function on the basic system element (BSE) station-selective to the protocol element of the central station and also transmitted station-selective by this to the substations.

Non-Interruptible General Interrogation

Spontaneous data is also transmitted from the substation during a running general interrogation. With the parameter **[PRE] IEC60870-5-101 | Communication functions | General interrogation | Timeout for non interrupted GI** the spontaneous transmission of data can be disabled in the remote station during a running general interrogation (monitoring time: "0" = GI is interruptible; "≠ 0" = GI is not interruptible).

The following parameter settings are necessary on the BSE for the non-interruptible GI:

- “Sending end of initialization” (INIT-End) must be enabled
- General interrogation must take place from the process image (Image-GI)

With the INIT-End, the protocol element detects all ASDUs used in transmit direction. This is required with general interrogation to all (BROADCAST) for GI end detection.

With non-interruptible general interrogation, from the moment of "General interrogation command received" all data of the spontaneous priority level from the basic system to the protocol element are inhibited. This block is then terminated by the protocol element, if the general interrogation is complete or the monitoring time **Timeout for non-interruptible GI** has expired.

The monitoring time is to be set on the protocol element with the parameter **[PRE] IEC60870-5-101 | Communication functions | General interrogation | Timeout for GI-data** and is used in transmit direction for all ASDUs together. The monitoring time is retriggered for messages with the causes of transmission COT = 2, 7, 20, 21 to 36. With general interrogation to a selective ASDU, the monitoring time is stopped when the general interrogation command is received with the cause of transmission COT = 10 "termination of activation", with general interrogation to all ASDUs (BROADCAST), the monitoring time is stopped when the general interrogation command is received for all ASDUs with the cause of transmission "termination of activation".

13.3.5.5 Clock Synchronization

The clock synchronization of the substations can be performed over the serial communication line – controlled by the central station. The clock synchronization command is sent by the central station spontaneously at change of time or cyclically.

The period for cyclic clock synchronization can be set with the parameter **[PRE] IEC60870-5-101 | Communication functions | Clock synchronization | Cycle time for sending clock synchronization command**.

Accuracy:	typical +/- 20 ms	(clock synchronization 1x per minute)
		(with relay operation accuracy will be reduced 10 ms per routing station)

If the accuracy of the remote synchronization is insufficient, a local time signal receiver must be used in the substation.

Messages, which are sent after a startup, but before the substation has the correct time, contain the relative time from startup (reference day: 1.1.2001) with the flagging of the time tag as invalid.

The clock synchronization command is sent from the protocol element of the central station to the substations either station-selective or broadcast depending on the selected transmission facility.

When using the freely definable transmission facility, the type of transmission of the clock synchronization command can be selected with the parameter **[PRE] IEC60870-5-101 | Communication functions | Clock synchronization | Send clock synchronization command to each station selective**.

With clock synchronization the time can be corrected by the remote station. The correction time is either calculated by the central station using transmission procedure <TI:=106> “delay acquisition command” and sent to the substation, or optionally configured in the substation with the parameter **[PRE] IEC60870-5-101 | Communication functions | Clock synchronization | Correction time for time synchronization command (T_Delay)**.

- t_delay = 0:
  The correction time (t_delay) can be set by the central station using <TI:=106> “delay acquisition command” (otherwise t_delay = 0)
  New time of substation; time in ACTCON for <TI:=103> = $t_{<TI:=103>}$ + $t\_delay_{<TI:=106>}$ – t_delay_{tel}
- t_delay ≠ 0:
  New time of substation; time in ACTCON for <TI:=103> = $t_{<TI:=103>}$ + t_delay

t_delay_{tel}	Message delay
$t_{<TI:=103>}$	new time of substation from <TI:=103>
$t\_delay_{<TI:=106>}$	correction time from <TI:=106>

If required, the protocol element of the substation can send the message *confirmation of the activation* (ACTCON+) for the clock synchronization command. This function can be enabled with the parameter **[PRE] IEC60870-5-101 | Communication functions | Clock synchronization | ACTCON for clock synchronization command** as follows (see also section *13.3.11.3 Special Functions*):

- Do not send (default)
- Send immediately
- Send after minute change and internal transfer of the time
- Send immediately and ignore (do not accept clock synchronization command)

With relay operation, the clock synchronization command is only transmitted via selected routing paths “to all” (broadcast). Only a few parameterized routing paths are used, with which all stations (substations and routing stations) can be reached. All stations which receive or forward a clock synchronization command use this for the synchronization of their own clock.

Due to this necessary procedure a time setting operation with relay operation can also take several minutes. During the transmission it is ensured, that the time in the clock synchronization command is updated with each new emission. Delay times due to the transmission facility are acquired automatically by the protocol element and taken into consideration during the updating of the time.

13.3.5.6 Command transmission

Message from the Central Station selectively to a Remote Terminal Unit

Station-selective data messages in command direction are always inserted by the central station with high priority into the running interrogation procedure (station interrogation) after completion of the data transmission in progress. Data to be sent from the base system element (BSE) is always prioritized at a ratio of 1:1 compared with station queries.

Inquiry

If the reaction of the substation to a transmitted telegram is to be acquired quickly by the master station, an inquiry (configurable station-selective continuous query) can be performed by the master station. This station-selective inquiry is retriggered by further telegrams to the same station (telegram configured with inquiry) or canceled by telegrams to other stations.

Run type identification selection and adjustment of the continuous access time for type identification with the **`[PRE] IEC60870-5-101 | Communication functions | Data transmission control | Access procedure per type identification | *`** parameters to enable this inquiry.

Data-Flow Control

If a substation is unable to process additional data telegrams (messages), the DFC bit (data flow control) is set in the telegram control field towards substation → master station. From this moment onwards, the protocol firmware of the master station no longer sends data telegrams to the corresponding substation until the substation once again resets the DFC bit. The protocol firmware also monitors whether the substation resets the DFC bit within a time that can be adjusted using the **`[PRE] IEC60870-5-101 | Time settings, retries | Monitoring times | DFC continuous monitoring time`** parameter.

If the DFC bit applies for longer than the set monitoring time, the *`DFC bit timeout to station no. xx`* warning is output.

Control location / Control location check

The “Control location” function is used to make sure that commands and setpoints are transferred from authorized sources only. Once the function has been activated, commands/set point adjusting commands are only transferred to the remote partner by the protocol element if the control location (originator address) has been enabled.

If the control location is not enabled, the protocol element immediately sends back a negative acknowledgment of activation (ACTCON) to the originator address (for more details on the control location, see section *13.1.4.9 Control location function for commands and setpoint values*).

Message from the Master Station to all Remote Terminal Units (unacknowledged)

“Unacknowledged” telegrams from the multi-point traffic master station to all are inserted into an on-going polling cycle (station query) after having completed the on-going data transmission. In this process, the telegram is sent several times from the master station with the configurable number of telegram retries according to the **`[PRE] IEC60870-5-101 | Time settings, retries | Retries | Retries for SEND/NO REPLY (broadcast) data telegram`** parameter. Afterwards the interrupted interrogation cycle is resumed.

13.3.5.7 Transmission of integrated totals

A counter interrogation command triggered in the system is transmitted from the protocol element of the master station either station-selective or “to all” (=BROADCAST) according to the parameter **`[PRE] IEC60870-5-101 | Communication functions | Transmission of integrated totals | Send counter interrogation command as "Broadcast`** . This parameter is transferred to the basic system element after startup of the protocol element.

A counter interrogation command to be sent is then already made available to the protocol element by the basic system element, station-selective or BROADCAST.

The functionality implemented in the System SICAM RTUs concerning integrated totals is documented in the document Common Functions of Peripheral Elements according to IEC 60870-5-101/104.

13.3.5.8 Acquisition of transmission delay

The protocol element of the remote terminal unit supports the "Acquisition of transmission delay" and the time correction resulting from this with clock synchronization according to IEC 60870-5. With this procedure the transmission delay is determined with <TI=106> and the corrected time loaded in the remote station. The correction of the time in the clock synchronization command is performed in the remote station.

The protocol element of the master station uses a SICAM RTUs specific method for the "acquisition of transmission delay". With this method the transmission delay per remote terminal unit is determined by the protocol firmware of the master station with the sequence "Request Status Of Link" and the reply from the remote terminal unit "Status of Link" and from this an automatically determined correction value is derived.

The acquisition of the monitoring time can be carried out cyclic. The cycle time can be set with the parameter **[PRE] IEC60870-5-101 | Communication functions | Clock synchronization | Cycle time for sending clock synchronization command**.

With the parameter **[PRE] IEC60870-5-101 | Communication functions | Clock synchronization | Correction time for clock synchronization command** an additional correction value can be parameterized.

The clock synchronization command is transmitted station-selective. The time in the time-synchronization command is already corrected by the protocol firmware of the master station with the automatically determined correction value and the parameterized correction value.

13.3.6 Optimized Parameters for selected Transmission Facilities

The protocol element supports selected transmission facilities – for which the parameters are set fixed. The selection of the transmission facility takes place with the parameter **[PRE] Interface parameter | Time setting for interface modem**. With the selection of a free definable transmission facility certain parameters can be set individually.

The transmission facilities usually only support certain transmission speeds. These can be found in the respective specification of the transmission facility.

The transmission rate (Baud rate) is to be set for transmit/receive direction together with the parameter **[PRE] Interface parameter | Baud rate** .

In addition, the physical interface with the parameter **Common Settings | Interface** .

When using the transmission facility DLC-Modem (CE-0740, CE-0741) you need to set on the protocol element additional the settings of the DLC-Modems like **DIP-Switch S1/1 .. S1/4** and the used **Frequency range** (=actual DIP-switch settings from DLC-Modem) with parameters **Common settings | DLC-Modem (CE-0740, CE-0741) | ***. These parameters are used to optimize data transmission via DCL modem (CE-0740, CE-0741) and to automatically set the required time settings in the protocol firmware.

When using the transmission facility SATTELLINE 2ASxE Time slot radio modem you must additional set the parameter **[PRE] Interface Parameter | Time slot radio modem (SATTELLINE 2ASxE) | Failure monitoring**, the parameter **[PRE] Interface Parameter | Time slot radio modem (SATTELLINE 2ASxE) | Length of the time slot** and the parameter **[PRE] Interfaces | Time slot radio modem (SATTELLINE 2ASxE) | start second of time slot** . These parameters are used for the optimization of the data transmission with "time slot radio technique".

After the transmission of broadcast messages an extra pause can be inserted regardless of the transmission facility used. This pause is required for remote terminal units of third-party manufacturers, if these can only process further messages after a transmission pause following the reception of broadcast messages.

The pause after broadcast messages can be set in the master station with the parameter **[PRE] IEC61870-5-101 | Time settings, Retries | Pause time after broadcast message (tp_bc)** . If the pause time is set to ***0***, a minimum pause of 33 bit is maintained by the protocol element.

With the free definable transmission device, all available parameters can be set individually. This is necessary when transmission facilities are to be used that are not predefined or if modified parameters are to be used for predefined transmission facilities.

For the selection of the freely definable transmission facility the parameter **[PRE] Interface Parameter | Time settings for interface modem** must be set to ***free definable***. Only then all supported parameters are displayed and can be parameterized with the required values (refer to table with preset parameters for transmission facilities).

For the adaptation to various modems or time requirements of external systems, the following parameters can be set individually:

- **[BSE] System settings | Serial interfaces | Port | CP-X# | Electrical interface**
- **[BSE] System settings | Serial interfaces | Port | CP-X5 | Mode**
- **[BSE] System settings | Serial interfaces | Port | CP-X5 | DSR voltage supply**
- **[PRE] Interface Parameter | Time settings for free definable interface modem | Pause time (tp)**
- **[PRE] Interface Parameter | Time settings for free definable interface modem | Set up time (tv)**
- **[PRE] Interface Parameter | Time settings for free definable interface modem | Run out time (tn)**
- **[PRE] Interface Parameter | Time settings for free definable interface modem | DCD Handling**
- **[PRE] Interface Parameter | Time settings for free definable interface modem | Continuous level monitoring time (tcl)**
- **[PRE] Interface Parameter | Time settings for free definable interface modem | Transmission delay if continuous level (tcldly)**
- **[PRE] Interface Parameter | Time settings for free definable interface modem | Bounce suppression time (tbounce)**
- **[PRE] Interface Parameter | Time settings for free definable interface modem | Disable time (tdis)**

How the individual time settings are effective during the data transmission is shown in *Figure 13-7*.

If necessary the voltage supply of the transmission facility (5 V/12 V) – if this is enough – can be supplied over the status line DSR (VCC). The voltage supply is enabled with parameter **[BSE] System settings | Serial Interfaces | Port | CP-X5 | DSR voltage supply**. The voltage supply is only output to the DSR status line with corresponding parameter setting. The DSR status line cannot be used by the protocol.

NOTE

Required voltage supply and maximum current consumption of the transmission facility must be observed!

In addition, for the adaptation of the protocol to the transmission medium used or to the dynamic behavior of the connected remote station, the following parameters are available:

- **`[PRE] IEC60870-5-101 | Time settings, retries | Monitoring times | Idle monitoring time`**
- **`[PRE] IEC60870-5-101 | Time settings, retries | Monitoring times | Expected_ack_time_corr_factor`** (see acknowledgment procedure in the master station)
- **`[PRE] IEC60870-5-101 | Time settings, retries | Monitoring times | Character monitoring time`**

The character monitoring time and the idle monitoring time are used for message interruption monitoring and message resynchronization in the receive direction. A message interruption is detected when the time between 2 bytes of a message is greater than the set signal monitoring time. With message interruption the receive processing in progress is aborted and the message is discarded.

After a detected message interruption a new message is only accepted in receive direction after an idle time on the line (idle time). This idle time is monitored by the protocol element. After expiry of the monitoring time the receiver is resynchronized.

The protocol element – insofar as the transmission facility (example: VFT-Channel) provides this signal receive-side – can evaluate the interface signal DCD and utilize it for monitoring functions.

Preset parameters for transmission equipment with UMPMI0 (RS-232 interface)

Transmission facility	RTS	tp [ms]	tv [ms]	tn [ms]	tp_bc [ms]	tdis [ms]	DCD	Tbounce [ms]	tcl [s]	tcldly [s]	A_I	T	Z	5V/ 12V
Modem for 4-wire transmission line (CE–0700)	ON	0	0	3	0	35	Yes	5	60	0.2	A	I	B	No
Modem for 2-wire transmission line (CE–0700)	↑↓	0	35	3	0	35	Yes	5	60	0.2	A	I	B	No
Radio digital	↑↓ ↑↓	30	100	11	0	50	Yes	10	0	0.2	A	I	B	No
Radio analog	↑↓	50	300	50	0	100	Yes	10	0	0.2	A	I	B	No
Modem for 4-wire transmission line (CE–0701)	ON	0	0	3	0	0	Yes	5	60	0.2	A	I	B	No
Modem for 2-wire transmission line (CE–0701)	↑↓	22	30	3	0	0	Yes	5	60	0.2	A	I	B	No
direct connection	ON	0	0	0	0	0	No	0	0	0	A	I	B	No
SATTELLINE 2ASxE time slot radio-modem	↑↓	0	10	0	0	0	No	0	0	0	A	I	B	No
freely definable	↑↓ ↑↓	30	100	11	0	0	No	10	10	0.2	A	I	B	No

Time settings "free definable" for selected converters/modems with UMPMI0, UMPSI0 (RS-232 interface)

Transmission facility	RTS	tp [ms]	tv [ms]	tn [ms]	tp_bc [ms]	tdis [ms]	DCD	Tbounce [ms]	tcl [s]	tcldly [s]	A_I	T	Z	5V/ 12V
RS-485/RS-422 interface with PHOENIX interface converter PSM-ME-RS232/RS485-p [134]	↑↓	5 [135]	5	0	0	0	No	0	0	0	A	I	B	No
Optical interface with Siemens RS-232/LWL Converter 7XV5652	ON	0	0	0	0	0	No	0	0	0	A	I	B	No
Optical interface/star coupler with mini-star coupler 7XV5450 (via CM-0847)	ON	0	0	0	0	0	No	0	0	0	A	I	B	5 V
Optical interface/star coupler with mini-star coupler 7XV5450 (direct via RS-232)	ON	0	0	0	0	0	No	0	0	0	A	I	B	5 V

Preset parameters for transmission equipment with UMPSI0 (RS-232 interface)

Transmission facility	RTS	tp [ms]	tv [ms]	tn [ms]	tdis [ms]	DCD	Tbounce [ms]	tcl [s]	tcldly [s]	A_I	T	5V/ 12V
Modem for 4-wire transmission line (CE–0700)	↑↓	0	30	3	0	No	5	60	0.2	A	I	No
Modem for 2-wire transmission line (CE–0700)	↑↓	3	30	3	35	Yes	5	60	0.2	A	I	No
Radio digital	↑↓	30	100	11	50	Yes	10	0	0.2	A	I	No
Radio analog	↑↓	50	300	50	100	Yes	10	0	0.2	A	I	No
Modem for 4-wire transmission line (CE–0701)	↑↓	0	55	3	0	No	0	0	0	A	I	No
Modem for 2-wire transmission line (CE–0701)	↑↓	22	30	3	0	Yes	5	60	0.2	A	I	No
Direct connection (RS-232)	ON	0	0	0	0	No	0	0	0	A	I	No
TP Radio Modem WDM8000	↑↓	22	30	3	0	No	5	60	0	A	I	No
freely definable	↑↓	30	100	11	0	No	10	10	0.2	A	I	No

Legend:

RTS	↑↓ = RTS is for the control of the carrier switching of the modem scanned with each message (ON / OFF)
tp	Parameter `Pause time (tp)`
tv	Parameter `Set-up time (tv)`
tn	Parameter `Run out time (tn)`

134 interface converter with activated function "Self-controlling send/receive switchover"

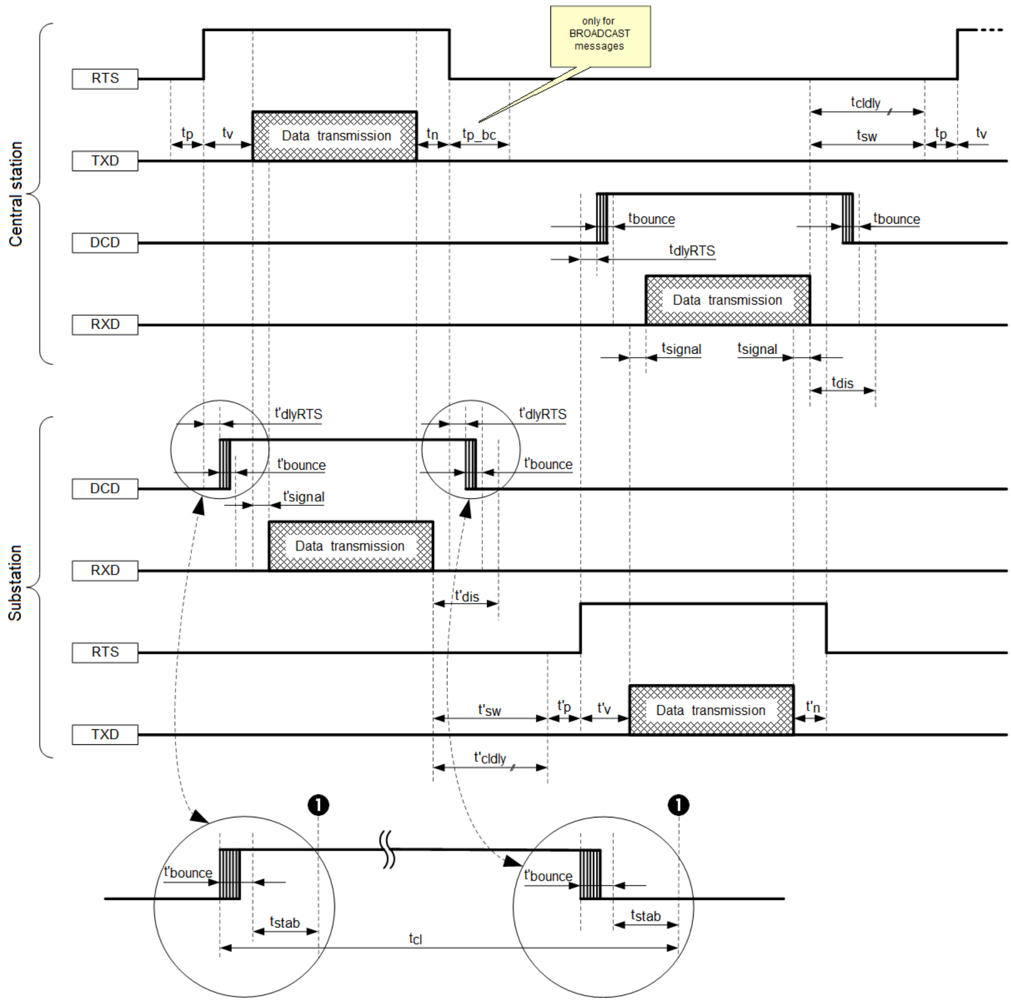
135 recommended setting for baud rates < 9600 Bit/s: 50 ms

tp_bc	Parameter **Pause time after Broadcast message (tp_bc)** (valid only for MASTER station!)
tdis	Parameter **Disable time (tdis)**
DCD	Parameter **DCD-Handling**
tbs	Parameter **Bounce suppression time (tbounce)**
tduration	Parameter **Continuous level monitoring time (tcl)**
tdelay	Parameter **Transmission delay at level (tcldly)**
A_I	Parameter**Asynchron_Isochron** (A = asynchron, I = isochron) [BSE]
T	Parameter **Bittakt** (only with isochron) (I=internal, E=external) [BSE]
Z	Parameter **Send clock synchronization command station-selective** (s=selective, B=BROADCAST) – valid only for MASTER station!
5V/12V	Parameter **DSR Power Supply** [BSE]

NOTE

The parameter on the basic system element [BSE] are not selected automatically by the selection of the transmission facility.. These parameter must be set by the user!

The following diagram shows the timing for the data transmission when using transmission facilities with switched carrier.



RTS .... Request to Send (switch on transmit part)
DCD .... Data Carrier Detect
TXD .... Transmit Data
RXD .... Receive Data
tdlyRTS .... Runtime of the transmission system (time difference between switch-on the transmit part (RTS ↑) and receiver ready (DCD ↑))
tp .... Pause time (delay before the transmit part is switched off with RTS)
tv .... Set-up time (transmit delay, after the transmit part has been switched on with RTS)
tn .... Run-out time (switch off transmit level with RTS after message transmission is delayed)
tp_bc .... Break time after broadcast messages (some systems require a longer break after the transmission of broadcast messages before the next message can be sent)
tsw .... Internal processing time
tsignal ...... Signal-transit time (depending on the transmission facility/transmission route used)
tbounce .... Detection time after a positive/negative DCD edge (DCD debouncing)
tstab .... Stability monitoring time - the new DCD status is only used once the stability monitoring time has elapsed for message synchronization
tcl .... Continuous level monitoring time
tcldly .... Transmit delay at continuous level - another message transmission is carried out at continuous level once the transmission delay has elapsed at the latest
tdis .... Disable time of the receiver after receiving a message (for suppressing the erroneous characters during level scanning)
t' .... Corresponding times in the substation

❶ DCD valid

[UMPxyy_Timing, 2, en_US]

Figure 13-7 Timing during transmission

13.3.7 Standby transmission line over the public telephone network (PSTN)

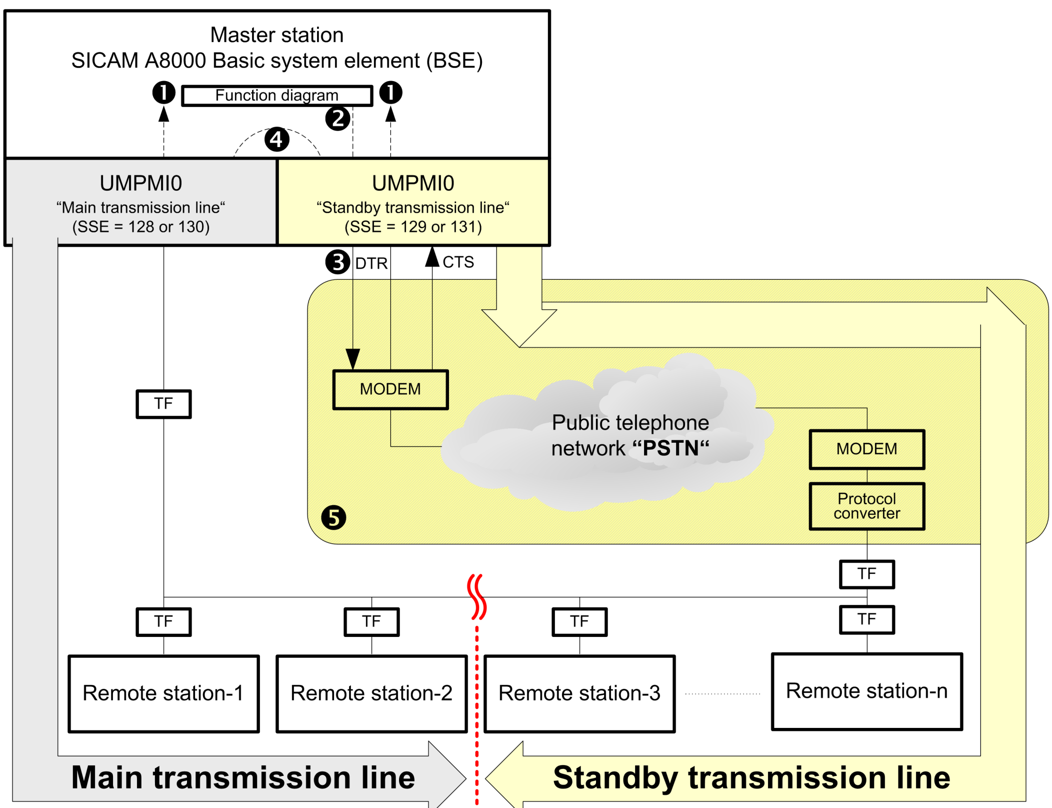
The data transmission between master station and the remote terminal units during fault-free operation takes place over the main transmission line. Failed remote terminal units can be interrogated on the standby transmission line over the public telephone network (PSTN).

For this, a connection is established from the interface for standby transmission line over the public telephone network (PSTN), which establishes a transparent communications link to a transmission facility (TF), for multi-point traffic preferably at the other end of the transmission line. The connection setup is thereby initiated with the state line DTR – the telephone number is fixed programmed in the modem.

Presently, for the standby transmission line operation over the public telephone network (PSTN) at master station end only the dial-up modem WESTERMO TD32 is supported and at remote terminal units end, the modems WESTERMO TD32 (analog) and WESTERMO GD01 (GSM).

At the remote terminal unit end, in addition a protocol converter WESTERMO MD54 is required. The protocol converter WESTERMO MD54 is required for the conversion of different used baud rates and for "removing" of gaps in messages received via GSM (gaps caused by transmission in telephone network).

Configuration for standby transmission line operation over telephone network:



Legend:

TF .... Transmission Facility
❶ .... Failed remote stations are signaled to the basic system element as failed.
❷ .... Failed remote stations must be signaled to the standby protocol element with the protocol element control message "standby transmission line ACTIVE"
❸ .... The standby transmission line via dial-up traffic is established with status line DTR (modem configuration must be done „offline“; telephone number is stored in the modem). The build-up connection will be signaled with CTS status line.
❹ .... The coordination of main-/standby transmission lines takes place with internal protocol control messages
❺ .... The transmission path for standby must guarantee a transparent connection (no gaps in messages, baud rate and byte frame to TF on standby transmission line must be identical with the baud rate and byte frame used on the main transmission line)
.... Example for conductor interruption and hence split in remote stations accessible on main and standby transmission line.

[dw_UMPMyy_Ersatzweg_ueber_WV, 1, en_US]

The standby transmission line operation over public telephone network (PSTN) is activated on the protocol element of the interface for standby transmission line with the parameter **`[PRE] IEC60870-5-101 |`**

Communication functions | Data Communication control | Master for stand-by transmission line (PSTN) .

The assignment of the interface for main transmission line and standby transmission line is defined as follows:

Main Line	Backup Line	Note
ZSE = 128	ZSE = 129	
ZSE = 130	ZSE = 131	

Legend:

SSE ... Supplementary system element (with serial interfaces, this is always configured with a PRE)
PRE ... Protocol Element
BSE ... Basic System Element

The remote terminal units are interrogated by the master station predominantly on the main transmission line. If the protocol element of the master station detects a remote terminal unit on the interface of the main transmission line as failed, then this is reported to the basic system element (BSE) as failed. The station failure is to be transferred as protocol control message to the interface for standby transmission line by using the function diagram on the basic system element (BSE). The testing of the standby transmission line is also to be realized with the function diagram.

With the parameter **[PRE] IEC60870-5-101 | Communication functions | Data Communication control | Master for stand-by transmission line via PSTN | Delay time for activation of stand-by transmission line** the protocol element for standby transmission line performs a station-selective delayed selection of the standby transmission line. If a remote terminal unit reported as failed on the main transmission line is reported as OK again during the delay time, no standby transmission line is established for this remote terminal unit..

After expiry of the delay time the standby transmission line is set-up. If the connection setup is not successful, after a pause that can be set with the parameter **[PRE] IEC60870-5-101 | Communication functions | Data Communication control | Master for stand-by transmission line via PSTN | Pause between not successful dial-up sequence** a new connection setup is initiated. If the connection cannot be established over the public telephone network (PSTN) after max. 4 dialing attempts, the corresponding remote terminal units are also reported as failed by the interface for standby transmission line.

The established standby transmission line is reported to the protocol element for main transmission line by an internal protocol control message. From this moment, the protocol elements of the interfaces for main and standby transmission line coordinate themselves with internal protocol control messages in such a way, that the remote terminal units of the multi-point traffic line are always only interrogated by one interface (main or standby transmission line) at one time.

After a completed message transmission including receipt of the acknowledgment, the control is transferred to the other interface with the internal protocol control message ("send next message"). Station interrogations on the standby transmission line are always started after a delay time. This delay time prevents of processing of possibly delayed messages received from the remote terminal unit on the standby transmission line caused by station interrogation on the main line.

Failed remote terminal units also continue to be interrogated on the main transmission line (but from now on every 10th time). If a failed remote terminal unit can be reached again on the main transmission line, the standby transmission line handling is terminated for this RTU. If all remote terminal units can be reached again on the main transmission line, the connection for standby transmission line is terminated after a delay time of 1 minute.

The parameter setting of main-/standby transmission line is carried out in the topology. From this parameter setting the routing of the internal protocol control messages necessary for the coordination is also derived.

Functions of the protocol converter for standby transmission line:

- Adaptation of the baud rate
  The baud rate from/to transmission facility (ÜE) on the standby transmission line must be identical with the baud rate from/to transmission facility (ÜE) on the main transmission line.

- Adaptation of the byte frame
  The byte frame from/to transmission facility (ÜE) on the standby transmission line must be identical with the byte frame from/to transmission facility (ÜE) on the main transmission line.
- Removal of message gaps
  Messages to the transmission facility (ÜE) on the standby transmission line must not contain any gaps (pauses).

NOTE

- The "Standby Transmission Line over the Public Telephone Network (PSTN)" will be supported in the master station only for following transmission facilities (Data transmission with "no Parity"):
  – Modem for "2-wire circuit transmission line" (CE-0701 via remote modem Westermo TD-32)
  – Modem for "2-wire circuit transmission line" (CE-0701 via remote modem Westermo GD-01)
- On the protocol element for standby transmission line, in addition a greater time for the message interruption monitoring is to be set with the parameter **`[PRE] IEC60870-5-101 | Time settings, retries | Monitoring times | Character monitoring time`** .

13.3.8 Data Transmission using Time Slot Radio

With time slot radio the radio transmission may only be utilized during a particular time (typically max. 6 seconds per minute). The remaining time is utilized for the radio transmission of other systems – this transmission method is called “Time Slot Technique”.

In Germany, for example, 5 frequencies for exclusively professional radio data transmission using the time slot method are approved for the use of time slot technology. In this method, in each case 10 users can utilize a common frequency for 6 seconds each within 1 minute. The synchronization of the time slot takes place by means of a DCF-77 signal (atomic clock), so that overlaps are excluded.

This method can be used everywhere, where there are no time-critical data or where data is collected over a certain period before the transmission, in order to then send these in a packet. Since no station needs to be mobile, fixed installed local radio data networks can be established.

The applications can be seen in the areas of measurement data transmission between fixed stations, power utilities, water, waste water, meteorology, control data to fixed stations, packet-orientated control tasks, alarm transmissions and many more.

As a result the user has other benefits:

- high ranges
- free point-to-point data transmission
- free point-to-multipoint data transfer
- free data transfer in master-slave operation
- free data transmission for multi master networks
- low interferences from neighboring disturbance emitters

Through the use of suitable additional devices in the master station and the implementation of suitable procedures, it is ensured, that no time slot violation occurs during the data transmission. The SATELLINE-TSU (Time Slot Unit) is a device with an integrated DCF-77 receiver. This device switches the transmission lines between the transmitting station and the connected time slot radio modem for the set time slot.

The TSU is normally used in each station, that cannot manage the time slot in a highly precise manner. In master-slave configurations, the TSU is usually only used in the central station. A time slot violation by the substation must be prevented by suitable measures in the communication protocol used (especially by a message sent by the substation at the end of the time slot).

For this purpose, the status line input CTS (Clear to Send) in the central station is connected to the CTS signal from the TSU. This signal is active for the respective station during the assigned time slot. The central station sends data only during the assigned time slot, but only until the response from the substation is completely transmitted within the time slot. The CTS-signal from the TSU is also monitored for plausibility. If the CTS-signal from the TSU switches to inactive during a running message transmission before expiry of the parameterized **Length of the time slot** , the interface of the master station is switched immediately to “Tristate”. In addition the CTS-signal of the TSU is monitored for failure.

The data transmission using the time slot method is selected by selecting the transmission facility SATTELLINE 2ASxE time slot radio modem with the parameter **[PRE] Interface parameter | Time settings for interface modem** . When using this transmission facility, in the remote terminal unit additionally the parameter **[PRE] Interface parameter | Time slot radio modem (SATTELLINE 2ASxE) | failure monitoring**, the parameter **[PRE] Interface parameter | Time slot radio modem (SATTELLINE 2ASxE) | length of time slot** and the parameter **[PRE] Interface parameter | Time slot radio modem (SATTELLINE 2ASxE) | start second of time slot** must be parameterized. These parameters are used for the optimization of the data transmission with time slot radio technique.

13.3.9 Data transmission in relay operation mode "multi-point traffic with routing"

In relay operation, messages transmitted from the master station can also reach the remote terminal unit indirectly (and vice versa), namely by way of intermediate stations along the transmission path, that can always communicate directly with their respective adjacent station. Such stations lying along the path between source and destination of a message transmission "only" provide a routing function for the transmission in question (namely reception and forwarding of messages). In this sense, such stations are routing stations. Remote terminal units themselves can also be used as routing stations for other remote terminal units.

All stations participating in the multi-point traffic are equipped with protocol elements for relay operation and through this possess the capability of routing – in general besides their process-related tasks and independent from these. The routing paths are defined through parameterization in the master station. The routing can take place via up to 7 routing stations. For each station a primary path and a secondary path can be defined.

With wired communication, the relay operation can be used for regenerating the signal: if for example a very remote station can only be reached with great difficulty, error-free communication is often only possible with a very high number of retries. By routing the messages over a routing station, the attainability can be improved considerably.

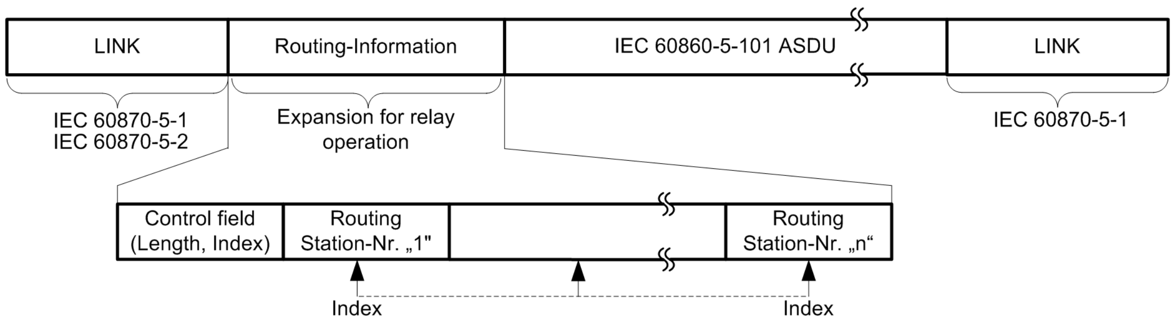
With radio communication, it can happen, that due to the geographical location or the limited transmission power and an insufficient number of transmission frequencies, not all stations can be reached with just one transmitter installed in the master station. With the communication procedure of the relay operation, despite the use of the most simple of radio devices (even with low transmitting power), the required communication tasks are resolved with just one single radio frequency in the entire automation range.

The function "Relay Operation" is a SICAM A8000-specific expansion of the IEC 60870-5-101 protocol in multi-point traffic.

The function Relay Operation is activated by enabling the parameter **[PRE] IEC60870-5-101 | Communication function| Data communication control | Repeater function (Routing)** . By enabling this parameter, the parameters required for relay operation such as "Routing method", "Retries until path change" and "Routing paths" are first displayed.

If the relay function is not enabled, the protocol functions according to IEC 60870-5-101.

With function enabled, the protocol no longer corresponds with the IEC 60870-5-101 standard, since an extra block is used in the message for the routing information for the relay function. The user data formats themselves continue to be used according to IEC 60870-5-101.



Parameters for relay operation:

- Enabling of the relay function with the parameter **[PRE] IEC60870-5-101 | Communication function | Data communication control | Repeater function (Routing)**
- Switchover main-/standby transmission line with the parameter **[PRE] IEC60870-5-101 | Communication function | Data communication control | Repeater function (Routing) | Retries until switchover to stand-by line**
- Routing method (optimized/not optimized) with the parameter **[PRE] IEC60870-5-101 | Communication function | Data communication control | Repeater function (Routing) | Routing Method**
- "Radio circuit identifier/master number" with the parameter **[PRE] IEC60870-5-101 | Communication function | Data communication control | Radio area identifier/master number**
- "Routing paths" (path-type, destination station number, routing station number) with the parameters **[PRE] IEC60870-5-101 | Communication function | Data communication control | Repeater function (Routing) | Routing-paths | Path type, Destination station number, routing station nr. #**

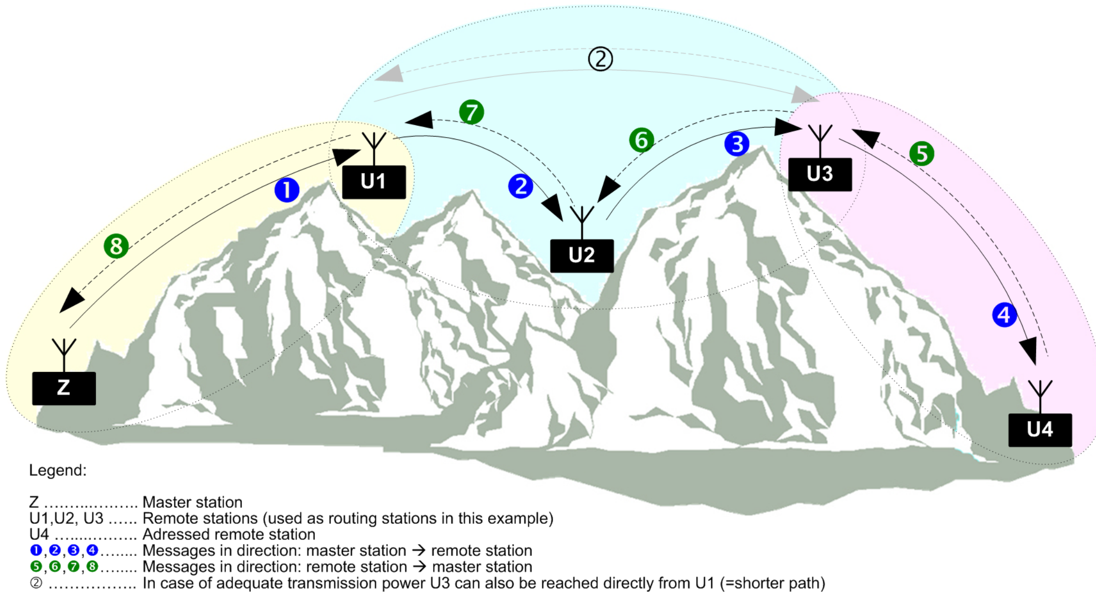
Multi-point traffic with relay operation over radio

In utilities, many small and medium size stations fail to become automated because of communication problems. Where dedicated lines or, because of poor infrastructure, dial-up traffic cannot be used, one often has to fall back on radio communication. Thereby it can happen, that due to the geographical location or the limited transmitting power and an insufficient number of transmission frequencies, not all stations can be reached with just one transmitter installed in the master station.

Relay operation solves this problem despite the fact that only most simple radio communication units, even of low transmission power, with only one single frequency are used in the entire automation area.

Functioning principle of the radio relay operation

In particular in mountainous regions, where even the highest elevation is in most cases insufficient for a radio transmitter, in order to reach every individual valley the radio relay operation provides the solution to the problem. Up to 7 routing stations can be used for the data transfer (with regard to routing and fulfilling process-related tasks - e.g. telecontrol functionality - see above). A chronological coordination of all transmitter up-switching operations in the entire network thereby takes place.



A message is transported via radio by means of multi-point traffic (half duplex) over a predefined path from the source (master station or RTU depending on the direction) to the destination (RTU or master station depending on the direction). The path leads

- either from the source directly to the destination, or – if that is not possible -
- Indirectly from the source – via one or more routing stations, which only forward messages – to the destination.

  From the example in the picture above it can be seen, that individual stations cannot reach others directly via radio because of the mountains situated in between. Stations which are capable of communicating with one another directly via radio communication are located within one "radio region": the example shown includes the following radio regions: (Z, U1), (U1, U2, U3) and (U3, U4).

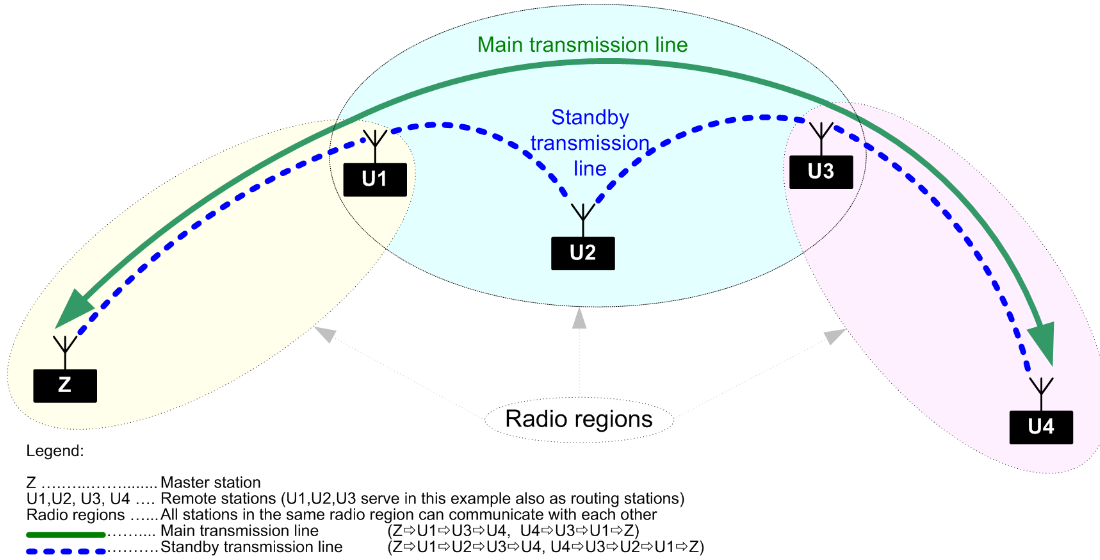
For the transmission of a message from the master station Z to the remote stations U1, U2, U3, and U4, the following routes are possible (reverse direction along the same route):

Source	Destina-tion	Route	Note
Z	U1	Z → U1	
Z	U2	Z → *u1* → U2	
Z	U3	Z → *u1* → U3	shorter route → advantageous
Z	U3	Z → *u1* → *u2* → U3	longer route → disadvantageous
Z	U4	Z → *u1* → *u3* → U4	

Legend:

Z, Ux ... source, destination
ux ... Routing-Station

Legend:
In the following picture, radio regions are represented by closed curves.



The shortest route along which an outstation can be reached is determined by parameter setting. This route is also contained in the message transmitted. All stations within reach of the respective transmitter will receive the message. However, it will be retransmitted only by the routing station that is next in the routing order and thus be passed on in the relay operation - until it arrives at its destination.

The function of the routing stations can be taken over by remote terminal units with process-related tasks. If remote terminal units cannot be reached directly or without gaps over other remote terminal units due to the local circumstances, additional stations must be used for routing (data relay stations).

All remote terminal units – even those which only have routing tasks – are interrogated by the master station in a configurable interrogation cycle. Stations with important data can be called several times in one interrogation cycle. The transmission of the data from the remote terminal units to the master station take place by means of a relay-wise forwarded, selective station interrogation (Polling). The remote terminal unit stores changed data and transmits these back to the master station in the same manner with a station interrogation of this station.

To increase the availability, besides the main transmission line a redundant route (standby transmission line) can be defined.

Transmit time limitation of the radio equipment

So that remote terminal units or radio equipment that are functionally impaired do not lead to a blocking of the link, it is advisable to equip the radio equipment used with a transmit time limit (e.g. external equipment connected between remote terminal unit and radio equipment, which monitors the RTS signal). This unit should switch the radio equipment off after a settable maximum time. After this protection device has responded in a disturbance event, the interrogation cycle to the remaining stations can continue to be carried out by the master station.

Speech

The utilization of the radio equipment for telephony cannot be enabled with intermediate routing stations and because of the use of only one radio frequency (speech must be buffered in the routing stations).

In this case a separate radio channel is to be used for the transmission of speech (e.g. mobile radio).

For remote terminal units that can be reached directly from the master station, the radio equipment of the master station and the remote terminal unit can however be used for speech transmission. So that an interface fault signaling in the master station does not occur with speech transmission (data transmission not possible due to activated speech connection), on switchover of the radio equipment the master station is provided with a binary information, through which the interrogation cycle is stopped. On termination of the speech transmission the interrogation cycle is resumed.

Time tagging, clock synchronization

The routing often over several routing stations causes longer total transmission times. Here it is particularly advisable to perform the time tagging for process information directly at the point of origin. The management of a real-time clock necessary in each of the remote terminal units for time tagging must often manage without decentral time signal receiver for reasons of cost and poor reception locations in many cases.

The clock synchronization of the remote terminal units can also be carried out over the serial communication line. The clock synchronization is typically carried out once per minute by the master station. The typical accuracy that can be achieved through this is 20 ms and with relay operation an additional 10 ms per routing station (see also section Clock Synchronization).

Radio circuit identifier

When using the same radio frequencies in different, local and geographically separated regions, due to over-ranges in the radio communication, a remote terminal unit could receive station interrogations or even commands from a third-party master station.

If, for example, several multi-point traffic areas – each with a master station - are formed in one automation network, then a mutual influencing (over-ranges) and an undesirable system behavior caused as a result can be prevented, by

- assigning a different radio frequency to every multi-point traffic area or/and
- performing a station number assignment unambiguous over all areas or/and
- an unambiguous assignment (in the framework of the configuration options) of all stations to their respective own master station with the help of the radio circuit identifier.

The radio circuit identifier must be configured in the master station and in every remote terminal unit. The assignment of the remote terminal units to the associated master (=interface of the master station) is defined with the parameter **`[PRE] IEC60870-5-101 | Communication function | Data communication control | Repeater function (Routing) | Radio area identifier/master number`** . The master number is transmitted in the message on the line in the 2nd octet of the link address.

All messages from the master station are sent with the configured radio circuit identifier.

Messages are only then evaluated by the routing stations, if the radio circuit identifier contained in the message corresponds with that configured. As a result, messages that are received from third-party master stations / remote terminal units (due to over-ranges in the radio communication) are ignored.

13.3.9.1 [PRE] Main and Standby Transmission Line

For every remote terminal unit that cannot be reached directly, but only via routing stations, the main transmission line must be configured in the master station (Routing Information: series of RTU-addresses, over which a remote terminal unit can be reached from the master station over the shortest route). In addition, for every remote terminal unit a standby transmission line can be configured (Routing Information: series of RTU-addresses, over which a remote terminal unit can also be reached from the master station).

The parameters for "Routing" are only displayed by enabling the parameter **`[PRE] EC60870-5-101 | Communication function | Data communication control | Repeater function (Routing) | Repeater function (Routing)`** . For every routing-path (main or standby transmission line) to a remote terminal unit (destination station number) a new row must be parameterized in the spreadsheet with the parameters for "Destination station No.", "Path type" and "Routing station No.1...7". Every remote terminal unit in multi-point traffic (directly reachable remote terminal unit and routing station) is to be recorded in the parameter **`Station definition`** . Thereby a new row is appended in the spreadsheet for every remote terminal unit and the corresponding station-specific parameter entered.

With fault-free station interrogation, all remote terminal units are interrogated directly, respectively over the configured main transmission line.

If remote terminal units cannot be reached from the master station over the main transmission line (failure/fault of transmit/receive systems, of routing stations, the RTU itself, etc.), communication is attempted over the configured standby transmission line. With the arameter **`[PRE] IEC60870-5-101 | Communication function | Data communication control | Repeater function (Routing) | Repeater function (Routing) | Retries until switchover to stand-by line`** the moment for the switchover from main to standby transmission line can be defined. If this attempt to obtain an acknowledgment also fails (expiry of number of retries) or if no standby transmission line has been configured, the remote terminal unit is flagged as faulty.

Configured standby transmission lines are checked in the background at configurable intervals. If stations are only reachable over the standby transmission line, the main transmission line is monitored in the background.

With fault-free communication, a standby transmission line configured for a station is checked after every 20 station interrogations (default). With faulty main transmission line, with configured standby transmission line this is checked after every 10 station interrogations.

With faulty main or standby transmission line, a warning is generated by the master station in the form of "station-selective binary information".

Quality assessment of main and standby transmission line

A quality assessment is carried out for the main and standby transmission line. The quality of a route is derived from the message retries required. If the quality of a route is no longer provided, a warning is also derived from the master station.

For the quality assessment, the last 16 messages per route are assessed. If from the last 16 messages, more than a configurable number have not been acknowledged, a warning is output.

13.3.9.2 Routing Method

Received messages are re-transmitted immediately after complete reception by "data relay stations", if these are determined for further transmission based on the "Routing Information" (in the message) and with own radio circuit identifier.

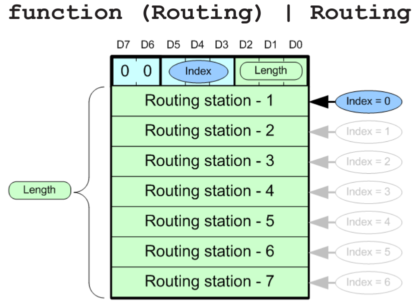
Messages received by stations that are not defined as "End station" (= addressed remote terminal unit) or "data relay station" (station is not or not yet provided in the routing information of the message), are not processed further.

The received routing information is entered in the reverse order by the addressed "End station" for the reply message to be transmitted. Consequently, the reply message is transmitted through the network over the route specified by the master station.

In relay operation, stations can be reached through the "Routing method" implemented over a maximum of 7 "data relay stations" (routing stations).

For stations that can be reached directly from the master station, the configuration of routing information is not necessary.

The structure of the routing information used in the message is defined with the parameter **`[PRE] IEC60870-5-101 | Communication function | Data communication control | Repeater function (Routing) | Routing procedure`** .



Legend:

Length ....Number of registered routing stations (1..7)
- The length of the routing field is dynamically administrated in case of an „optimized routing method“. That means that only those routing stations are registered in the routing fields which are actually required.
- „Non-optimized routing methods“ transmit the routing field always in „maximal length“ (8 Bytes) In the routing field „Length“ only the actual number of used fields for routing stations must be entered. Unused routing fields are initialized with „FF“.

Index .... Information about the processed routing fields (0..6).

Non-optimized Routing Method

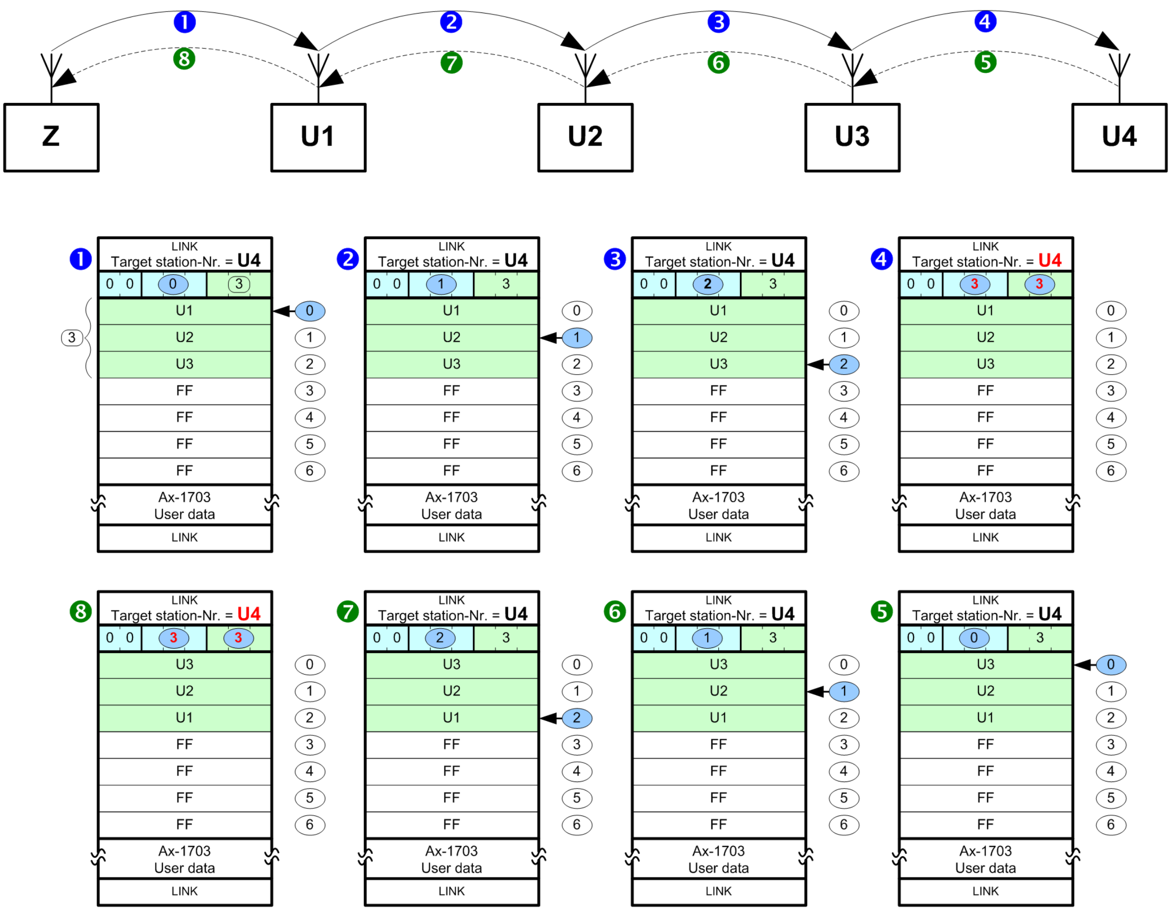
With the "non-optimized routing method" the routing information in messages is managed "statically". In messages formats with fixed block length the routing information is always available with maximum length.

In messages formats with variable block length the routing information is always available with variable length (same as used for "optimized routing method").

Station interrogations / acknowledgements are generally transmitted with the "message format with fixed block length", user data is transmitted with the "message format variable block length".

Single characters are not used!

Example: Management of the routing information with 3 routing stations for "non-optimized routing method" (e.g. for REQUEST STATUS OF LINK).



Legende:

Z .... Master station
U1,U2, U3 ... Remote stations (serve as routing stations in this example)
U4 .... Adressed remote station
❶,❷,❸,❹..... Message direction: Master station → Remote station
❺,❻,❼,❽..... Message direction: Remote station → Master station

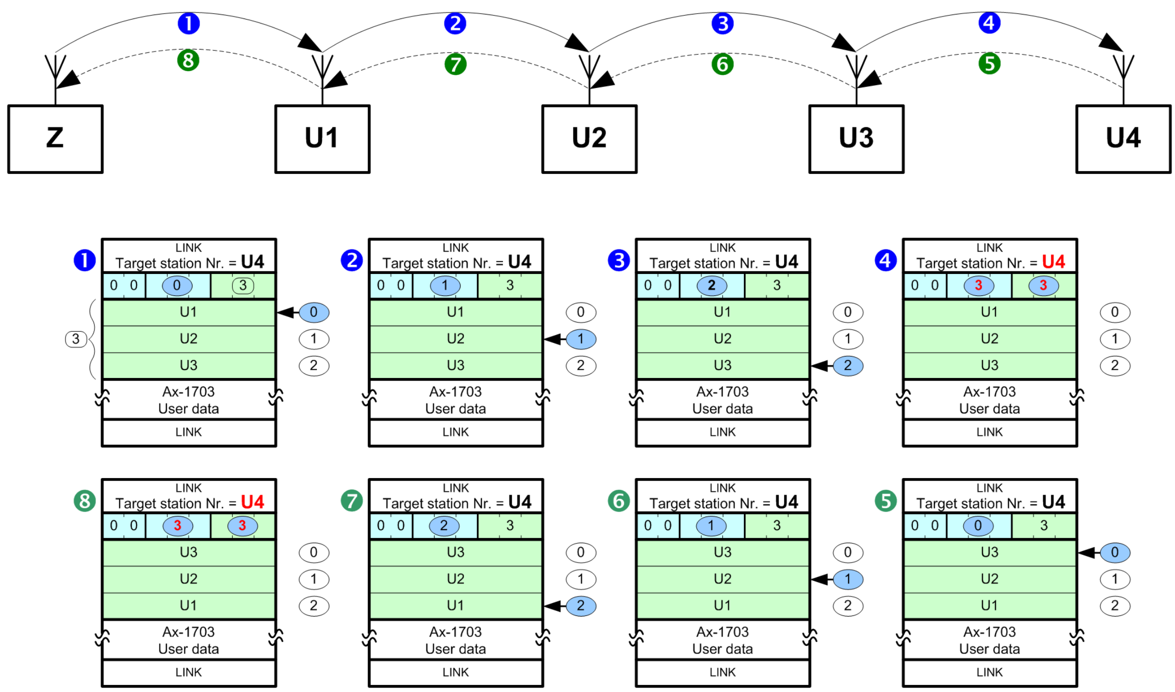
Optimized Routing Method

With the "optimized routing method for relay operation" the routing information in messages is managed "dynamically".

Station interrogations to remote terminal units that can be reached directly from the master station, contain no routing information (= message format with fixed block length). Such remote terminal units, if there are no data to be transmitted, reply with a single character or a short acknowledgement (no routing¬ information in the message). Data is transmitted with the "message format with variable block length" and a "0-Routing Information".

Station interrogations to remote terminal units that cannot be reached directly from the master station, contain only the routing information necessary (message format with variable block length). Such remote terminal units, if there are no data to be transmitted, reply with an acknowledgement message and the necessary routing information (message format with variable block length). Data is generally transmitted with the "message format with variable block length" and the necessary routing information.

Example: Management of the routing information with 3 routing stations for "optimized routing method"



Legend:

Z .... Master station
U1,U2, U3 ... Remote stations (serve as routing stations in this example)
U4 .... Adressed remote station
❶,❷,❸,❹..... Message direction: Master station → Remote station
❺,❻,❼,❽..... Message direction: Remote station → Master station

13.3.10 Redundancy

To increase the availability central stations as well as remote terminal units can be implemented redundantly.

In this section, the possible redundancy concepts themselves that can be realized are not described, rather only those functions supported by the protocol element for the support of redundant communication routes.

In the master station and remote station, with the parameter **`[PRE] Redundancy | Redundancy control`** one can select between the following redundancy controls:

- Protocol redundancy
- NUC-Redundancy

13.3.10.1 Protocol redundancy

The protocol redundancy is selected with the parameter **`[PRE] Redundancy | Redundancy control`** = "Standard".

The switchover of the redundancy state takes place system-internal by means of redundancy control messages.

In addition, in the central station and remote terminal unit a delay with the switchover of the redundancy state from PASSIVE (=STANDBY) to ACTIVE can be set with the parameter **`[PRE] Redundancy | Delay time passive⇒aktiv`**.

The operating mode of the interface with redundancy state "PASSIVE" can be set according to redundancy configuration with the parameter **`[PRE] Redundancy | Operation if passive`** as follows:

- Interface "tristate" – only listening mode
- Interface "active" – only listening mode
- Interface "active" – interrogation mode

From the redundant, not active master / remote terminal unit, listened messages are passed on to the basic system element (BSE) and forwarded by this in the system with the identifier "passive" in the state.

In redundant master stations that are not active, a failure of the interface is monitored globally and the failure of remote terminal units monitored station-selective.

The failure of the interface is detected by the STANDBY master station by monitoring for cyclic message reception. The monitoring time is set with the parameter **`[PRE] Redundancy | Listening mode (failure monitoring time)`** . On receive timeout (active central station or transmission facility of the central station has failed) the interface is signaled as failed.

The failure of a remote terminal unit is detected by the STANDBY master station through station-selective monitoring for cyclic message reception. On station-selective receive timeout (remote terminal unit or transmission facility of the remote terminal unit has failed) the remote terminal unit is signaled as failed.

Station-specific faults present are reset in a redundant STANDBY master station, if a faultless message from the respective station is “listened”.

In case of redundancy switchover from "PASSIV → AKTIV", the substation forces a station initializtion by not answering any telegrams until the "REQUEST STATUS OF LINK" message is received. This means that the central station detects a failure of the interface and, after successful station initialization, a general query is carried out and the current status of the data is transferred from the now active redundant substation (a redundancy switchover always leads to a brief station failure).

Activation / Deactivation of the interface in redundancy mode "passive"

For the implementation of project specific redundancy modes the interface and the operation of the protocol can be activated/deactivated with protocol element control message when redundancy mode is in "passive" and with parameter "operation if passive" is set to "transmitter tristate".

The activation/deactivation of the interface can be used for supervision of redundant communication links to the remote station.

Behavior when interface is "activated":

- the interface mode will be switched over from
  - transmitter "tristate", listening mode
  - to transmitter "active", normal operation
- all date received from remote station (listening mode) will be forwarded to basis system element. By redundancy mode "passive" enabled the received data will be marked on basis system element with "R=1" (data received from "passive" interface).
- all data ready for transmit sent from basis system element to protocol element will be sent to the remote station.

Behavior when interface is "deactivated":

- the interface mode will be switched over from
  - transmitter "active", normal operation
  - to transmitter "tristate", listening mode
- all date received from remote station (listening mode) will be forwarded to basis system element. By redundancy mode "passive" enabled the received data will be marked on basis system element with "R=1" (data received from "passive" interface).
- all data sent from basis system element to protocol element will be discarded by the protocol element.

PRE control message for controlling the protocol mode will be accepted only in redundancy mode "passive".

The actual state of the interface and the protocol mode (activated/deactivated) will be sent from protocol element to basis system element spontaneous after change of event and during general interrogation.

No general interrogation command will be initiated by the protocol element firmware after activation of the interface.

NOTE

The operating mode of the interface will be updated always by the AU internal protocol element control message (redundancy control message has higher priority than PRE control message).

13.3.10.2 NUC redundancy

The redundancy mode NUC (Norwegian User Conventions) uses 2 communications lines (main/stand-by transmission line) from the central station to the substation. Each of these communications lines is fixed activated to a specific interface in the central station and in the substation. The data is only transmitted to the active interface. The passive interface is only monitored by the master.

The NUC redundancy is supported in the central station and substation and is selected with the parameter **[PRE] Redundancy | Redundancy control** = ***Norwegian User Conventions (NUC)***.

The switchover of the redundancy state in the central station takes place system-internal through redundancy control messages.

In addition, in the central station a delay with the switchover of the redundancy state from PASSIVE (=STANDBY) to ACTIVE can be set with the parameter **[PRE] Redundancy | Delay time passive⇒active** .

The operating mode of the interface with redundancy state PASSIVE is not to be parameterized for this redundancy mode. The function is defined by Norwegian User Conventions.

Redundancy function according to Norwegian User Conventions for unbalanced operation mode:

- After startup of the Central station, this starts the communication on both interfaces with the message *Request Status of Link*. The Central station decides which of the interfaces is to be switched to ACTIVE for the data transmission as main transmission line (Primary Line). The other interface is used as standby transmission line and remains at PASSIVE.
- After startup of the substation, this waits for the initialization of the interfaces by the central station for the redundancy mode. After startup both interfaces are PASSIVE. The substation activates that interface on which the message *Reset of Remote Link* is received from the central station as main transmission line (primary line).
- For monitoring the standby transmission line (Backup Line) the central station sends the message *Request Status of Link* cyclic.
- With a communication failure on the main transmission line or with unintentional switchover to the standby transmission line, the Central station sends a message *Reset of Remote Link* on the previous standby transmission line. With that the previous standby transmission line is now used as main transmission line (Primary Line). From now on, the Controlled station is interrogated by the Central station on the previous main transmission line with *Request Status of Link* and as a result monitored for failure (with *Request Status of Link* switchover to the standby transmission line takes place).
- During the switchover from main transmission line-stand-by transmission line, no data loss must occur in the substation. Transmitted data may only be deleted in the substation, if these have been explicitly acknowledged by the central station. With switchover, no general interrogation is necessary.

The central station performs the following functions in the PASSIVE redundancy state:

- Only *Request Status of Link* is sent – with that the failure of the substations is detected
- All data in command directions are discarded and not transmitted
- The interface is always electrically ACTIVE (and is not switched TRISTATE)

The central station monitors the standby transmission line by means of cyclic *Request Status of Link* messages.

If a substation no longer replies, on expiry of the number of retries this is reported as failed. As a result, a failure of the interface is monitored globally and the failure of substations is monitored station-selective.

In the substation, for the redundancy mode NUC the "Load-share" mode of the communications function must be used on the basic system element. With this mode the basic system element uses 2 fixed assigned interfaces for the transmission of the data from a process image. With the redundancy mode NUC data is only interrogated by the central station over the active interface. Through the "Load-share" mode a switchover without loss of data is ensured – a doubling of data can occur under certain circumstances.

In the substation the assignment of the interfaces for main transmission line and stand-by transmission line is defined on a basic system element as follows:

Interface 1 Main/Standby transmission line	Interface 2 Main/Standby transmission line	Note
ZSE = 128	ZSE = 129	Redundant interface pair for NUC-Redundancy
ZSE = 130	ZSE = 131	Redundant interface pair for NUC-Redundancy

Legend:

SSE ... Supplementary system element (with serial interfaces, this is always configured with a PRE)

The SICAM A8000 substation performs the following functions with redundancy state PASSIVE:

- No data for emission are requested by the basic system element
- All data in signaling direction are transmitted over the active interface to the central station
- The interface is always electrically ACTIVE (and is not switched TRISTATE

After a restart of the substation, for the redundancy mode NUC by default both interfaces are switched to PASSIVE.
The central station decides which interface of the substation is to be operated as ACTIVE.
The switchover to ACTIVE takes place with the message *Reset of Remote Link*.
The switchover to PASSIVE takes place with the message *Request Status of Link*.

NOTE

- In the substation the parameter **[PRE] IEC60870-5-101 | Time settings, Retries | Monitoring times | Call timeout retrigger also with "request status of link"** must be activated!
- The message *Request Status of Link* from the central station on the ACTIVE interface may only be transmitted to failed substations. This message is used with NUC-Redundancy for the switchover to PASSIVE.
  The message *Request Status of Link* is used with the station-selective clock synchronization of the central station for the acquisition of the transmission time.
  In the case of NUC redundancy, the time synchronization command may only be sent to all (broadcast) and not station-selectively!

13.3.11 Message Conversion

Data in transmit direction is transferred from the basic system element to the protocol element in the SICAM A8000 internal IEC 60870-5-101/104 format. The data formats are converted to the IEC 60870-5-101 line format on the protocol element. The transmission of the data according to IEC 60870-5-101 is controlled by the protocol element.
Data in receive direction is converted by the protocol element from the IEC 60870-5-101 format on the transmission line to a SICAM A8000 internal IEC 60870-5-101/104 format and transferred to the basic system element.
With IEC 60870-5-101, no signal definition is required for the message conversion on the protocol – the data is forwarded unchanged.

13.3.11.1 Blocking

For the optimum utilization of the transmission paths, for the data transmission with IEC 60870-5-101 protocols the "Blocking" according to IEC 60870-5-101 is implemented. This function is performed on the basic system element (BSE) according to the rules applicable for this. Data to be transmitted are thereby already blocked on the basic system element and passed on to the protocol element for transmission. The blocking for data to be transmitted does not support the maximum possible message length according to IEC 60870-5-101!

Received data in blocked format according to IEC 60870-5-101 are passed on from the protocol element to the basic system element in blocked format. On the basic system element the blocked data is split up again into individual information objects by the detailed routing function and passed on as such to the further processing. Received messages with maximum length are transmitted SICAM RTUs internal in 2 blocks to the basic system element (BSE) because of the additionally required transport information.

The parameters necessary for the blocking are to be set in the IEC 60870-5-101/104 parameter block **`[PRE] IEC60870-5-101 | Message structure | Variable elements of the message`** and the parameter **`[PRE] IEC60870-5-101 | Message structure | Blocking with SQ=1`** .

13.3.11.2 Class 1, 2 Data

According IEC 60870-5-101, data can be sent in multipoint configurations using unbalanced transmission mode from remote station to master station as data class 1 or as data class 2.

The default operation of the master station is polling the remote stations with request data class 2.

The remote station reports to the master station with the ACD-Bit=1 in the control field of the message, that class 1 data is stored in the remote station for transmission. For this, a class 1 message is buffered on the protocol element until this is requested by the master station.

The assignment of the data as data class 1 or data class 2 has to be done on the basic system element (BSE).

The prioritization of data (class 1, 2) can be selected in the remote station with the parameter **`[PRE] IEC60870-5-101 | Communication functions | Data communication control | Prioritization of data`** .

Prioritization of data (Class 1, 2):

- Class 2 (=default) From the remote terminal unit in multi-point traffic, data is normally always transmitted for SICAM A8000 master stations as class 2 data. SICAM A8000 internal mechanisms for the prioritization of the data to be sent provide extensive options in order to be able to transmit important data to the master station.
- Class 1, 2 Transmission of "data class 1" and "data class 2" according IEC 60870-5-101.
  Note:
  Data class 1 can be sent by the remote station as reply for data class 2 request if there is no data class 2 stored for transmission at specific time.
- Class 1, 2 (ARCC – project specific)
  Data class 1 will be sent only as reply for data class 1 requests. Data class 2 will be sent only as reply for data class 2 requests.

Send ACTCON, ACTTERM, INIT-End as class 1 data

The assignment of the messages ACTCON, ACTTERM and INIT-End to the data class 1 takes place by special function of the protocol element.

The enabling of the function is carried out on the protocol element by setting the parameter **`[PRE] IEC60870-5-101 | Communication functions | Data communication control | Prioritization of data`** to "Class 1,2". The other parameters for the assignment of the messages ACTCON, ACTTERM and INIT-End to the data class 1 are displayed on enabling the function.

The detailed description is included in the section special functions.

Required parameter settings on the basic system element:

- Sending of "end of initialization" must be enabled

13.3.11.3 Special Functions

For the coupling to external systems, if necessary the following special functions can be activated for the adaptation of the message conversion:

- Summer time bit (SU)=0 for all messages in transmit direction
(summer time bit in the time tag)
- Day of week (DOW)=0 for all messages in transmit direction
(day of week in the time tag)
- Originator address = 0 for all messages in transmit direction
- Send GI data as class 1 data
- Send End of init message as class 1 data
- Send ACTCON, ACTTERM as class 1 data
- Non Interruptible GI
- Timeout monitoring for GI-data
- Convert general interrogation command to broadcast in receive direction
- Do not store General Interrogation Commands in Receive Direction
- ACTCON for clock synchronization command
- Emulate ACTCON+/-
- Emulate ACTCON, ACTTERM for commands
- Message Synchronization
- Filtering of Measured Values in Transmit Direction

Summer Time Bit = 0 for all Messages in Transmit Direction

With the parameter **[PRE] IEC60870-5-101 | Message Structure | Time tag | Summer-time bit (SU) = 0** = <yes>, the summer time bit (SU) in the time tag is always set to "0" for all messages with time tag in transmit direction.

Day of Week = 0 for all Messages in Transmit Direction

With the parameter **[PRE] IEC60870-5-101 | Message Structure | Time tag | Day of week (DOW) = 0** = <yes>, the day of week (DOW) in the time tag is always set to "0" for all messages with time tag in transmit direction.

NOTE

This function is only active for process information messages in transmit direction. The day of week in clock synchronization command message is not affected!

Originator address = 0 for all messages in transmit direction

With the parameter **[PRE] IEC60870-5-101 | Communication functions | Command transmission | Command concept for third party coupling | Originator address in transmit direction = 0** = <yes>, the originator address is set to "0" for all messages in transmit direction.

NOTE

The originator address (= 2nd byte of the cause of transmission) is only then sent if the number of octets for cause of transmission (COT) is set in parameter **[PRE] IEC60870-5-101 | Message structure | Variable elements of the message | Cause of transmission (COT)** to 2.

Send GI data as class 1 data

When interfacing substations to third-party central stations, it can be necessary to transmit all GI data to the central station as class 1 data. For SICAM A8000 stations, GI data is always transmitted as class 2 data. With the parameter **[PRE] IEC60870-5-101 | General interrogation | Prioritization of data (GI-data)** the protocol element of the substation is instructed to transmit GI data that is to be transmitted to the central station as reply to a general interrogation command with the set priority (class 1 or class 2), regardless of the SICAM A8000 internal parameter setting.

Send End of init message as class 1 data

When interfacing substations to third-party central stations it can be necessary to transmit the end of initialization message to the central station as class 1 data.

For SICAM A8000 stations, the end of initialization message is always transmitted as class 2 data. The enabling of the function is carried out on the protocol element by setting the parameter **[PRE] IEC60870-5-101 | Communication functions | Data communication control | Prioritization of data** to "Class 1,2". With the parameter **[PRE] IEC60870-5-101 | Communication functions | Data communication control | Advance parameters (prioritization of data) | Prioritization of data INIT-END (TI 70)** the protocol element of the substation will be instructed to transmit the end of initialization message with the selected data class (class 1 or class 2), regardless of the SICAM A8000 internal parameter setting.

Send ACTCON, ACTTERM Message as Class 1 Data

When interfacing substations to third-party central stations it can be necessary to transmit the messages for "activation confirmation" (ACTCON) and "activation termination" (ACTTERM) to the central station as class 1 data.

For SICAM A8000 stations, this messages will be sent as default with the same data class priority as used for the associated indication.

The enabling of the function is carried out on the protocol element by setting the parameter **[PRE] IEC60870-5-101 | Communication functions | Data communication control | Prioritization of data** to ***Class 1,2***. With the parameter **[PRE] IEC60870-5-101 | Communication functions | Data communication control | Advance parameters (prioritization of data) | Prioritization of data ACTCON, ACTTERM (TK45-51, TK101-107)** the protocol element of the substation will be instructed to transmit the end of initialization message with the selected data class (class 1 or class 2), regardless of the SICAM A8000 internal parameter setting.

Non Interruptible GI

According IEC 60870-5-101, spontaneous or periodic data can be sent during general interrogation and thus the general interrogation can be interrupted. When interfacing to third-party systems it can be necessary to disable the spontaneous or periodic data transmission during general interrogation.

NOTE

A detailed description of the function “Non Interruptible GI” can be found in section *13.3.5.4 General Interrogation, Substation Interrogation* .

Timeout Monitoring for GI data

With function enabled with the parameter **[PRE] IEC60870-5-101 | Communication functions | General interrogation | Monitoring time for GI-data** enabled, all data following a general interrogation command are to be transmitted from the protocol element of the substation to the central station as class 1 data. A timeout is thereby started with the message "ACTCON for general interrogation command" and retriggered with each message with the cause of transmission "interrogated by station interrogation" or "background scan". As long as the timeout is running, all data is transmitted to the central station as class 1 data regardless of their cause of transmission.

This procedure for class 1 data does not conform to IEC 60870-5-101 and is thus only to be implemented when coupling to central stations which specifically require this procedure!

Convert general interrogation command in receive direction to "broadcast

With function enabled with the parameter **`[PRE] IEC60870-5-101 | Communication functions | General interrogation | GI command "broadcast"`** , all general interrogation commands <TI:=100> received by the protocol element of the substation are passed on from the transmission line with the cause of transmission "activation" to the basic system element with the address CASDU = Broadcast.

Do not store General Interrogation Commands in Receive Direction

When a general interrogation is in progress, further in SICAM A8000 received general interrogation commands will be stored on basic system element (BSE) (for each CASDU and each group) and processed after termination of general interrogation in progress. When interfacing remote stations to third-party central stations it can be necessary that general interrogation commands should not be stored (only the currently requested GI data should be sent).

The enabling of the function is carried out on the protocol element of the substation by setting the parameter **`[PRE] IEC60870-5-101 | Communication functions | General interrogation | GI-handling to "ARCC (project specific)"`** to ***`ARCC (project specific)`***. With this parameter setting, only the current general interrogation command from the remote station is executed; a stored or currently running GI is aborted and discarded by the protocol element.

Only that GI data that was queried with the last received general interrogation command is transmitted to the remote station.

Emulate ACTCON+ for Clock Synchronization Command

The transmission of ACTCON+ by the substation for the clock synchronization can be set with the parameter **`[PRE] IEC60870-5-101 | Communication functions | Clock synchronization | ACTCON for clock synchronization command`** as follows:

- Do not send (default)
- Send immediately
- Send after minute change and internal transfer of the time
- Send immediately and ignore (do not accept clock synchronization command)

More details for clock synchronization command can be found in section *13.3.5.5 Clock Synchronization*.

Emulate ACTCON+/- for Commands

If ACTCON is not supported by the basic system element or by the peripheral element used, then the emulation of ACTCON can be performed by the protocol element (PRE) of the substation as follows:

Emulation of	Note
ACTCON-	at <TI:=45> Single command <TI:=46> Double command <TI:=47> Regulating step command <TI:=48> Setpoint command, normalized value <TI:=49> Setpoint command, scaled value <TI:=50> Setpoint command, short floating-point number → ACTCON- send immediately from PRE if * CASDU is not known to the PRE → ACTCON+/- from BSE or PE is sent from PRE
ACTCON-	for <TI:=100> (General-) Interrogation command → ACTCON- send immediately from PRE if * CASDU is not known to the PRE and * CASDU ≠ FFFF (broadcast) → ACTCON+/- from BSE is sent from PRE

Emulation of	Note
ACTCON+/-	for <TI:=101> Counter interrogation command → ACTCON+ send immediately from PRE if * CASDU is known to the PRE or * CASDU = FFFF (broadcast) → ACTCON- send immediately from PRE if * CASDU is not known to the PRE
ACTCON+/-	for <TI=103> Clock synchronization command if → ACTCON+ send from PRE if * CASDU = FFFF (broadcast) *) → ACTCON- send immediately from PRE if * CASDU ≠ FFFF (broadcast)

*) The moment for the transmission of ACTCON+ in the substation can be parameterized with the parameter **`[PRE] IEC60870-5-101 | Communication functions | Clock synchronization | ACTCON for clock synchronization command`**.

Legend:

BSE ... Basic system element
PRE ... Protocol element
PE Peripheral Element

The emulation of ACTCON in the substation can be activated on the protocol element with the parameter **`[PRE] IEC60870-5-101 | Communication functions | Command transmission | ACTCON emulation`** . So that the emulation can be performed by the protocol element, it must be ensured that the INIT-End messages are passed on from the basic system element to the protocol element (required because of the known CASDU addresses).

The INIT-End message must be released with parameter **`[PRE] IEC60870-5-101 | Communication functions | Data transmission control | Station initialization | End of initialization`** .

Emulate ACTCON+ for Commands

If ACTCON for commands is not supported by the peripherals element used, then the emulation of ACTCON messages can be performed by the protocol element of the substation as follows:

Emulation of	Note
ACTCON+	at <TI:=45> Single command <TI:=46> Double command <TI:=47> Regulating step command → ACTCON+ from PRE send immediately (for SELECT and EXECUTE command) → ACTCON+/- from BSE is filtered out by PRE and not sent! → ACTTERM+/- from BSE is sent from PRE

The emulation of ACTCON for commands in the substation can be activated on the protocol element with the parameter **`[PRE] IEC60870-5-101 | Communication functions | Command transmission | ACTCON emulation`** .

With function activated, ACTCON messages are emulated by the protocol element as shown in the table. All ACTCON+/- messages that are transferred from the basic system element to the protocol element are filtered out by the protocol element and therefore not transmitted.

ACTTERM messages that are transferred from the basic system element to the protocol element are transmitted by the protocol element.

With function not activated, ACTCON and ACTTERM messages that are transferred from the basic system element to the protocol element are transmitted by the protocol element, no emulation of any kind by the protocol element takes place.

NOTE

This function is not required in SICAM A8000 or if the this function is supported by the peripheral elements used!

For the emulation of ACTCON- with unknown CASDU, the parameter **`[PRE] IEC60870-5-101 | Communication functions | Command transmission | Advanced parameters | ACTCON +/- emulation`** is to be enabled.

Message Synchronization

With the parameter **`[PRE] IEC60870-5-101 | Link-layer | Message synchronization`** one can select between the following methods of synchronization for disturbed reception:

Message synchronization	Description
Standard (IEC 60870-5-1)	Received byte sequences "68,X,Y" (without gaps between the bytes): If X ≠ Y ist → Message synchronization after a pause (> 33 bit Idle)
Mode-A (68 xx yy)	Received byte sequences "68,X,Y" (without gaps between the bytes): If X ≠ Y ist → The receiver must discard 68 and begin with the IEC message check from X (without pause > 33 bit Idle)

Filtering of Measured Values in Transmit Direction

When interfacing substations to third-party central stations, it can be necessary to suppress (filtering) measured values with cause of transmission "spontaneous". These measured values will be requested by central station using general interrogation command with groups or transmitted cyclic.

The filter for transmission of spontaneous measured values can be activated on protocol element with the parameter **`[PRE] Advanced parameters | IEC60870-5-101 | Filtering of measured values with COT=3 in transmit direct.`** .

Following messages with measured values and cause of transmission "spontaneous" will be filtered out when function is enabled:

- <TI:=9> Measured value, normalized value
- <TI:=10> Measured value, normalized value with time tag
- <TI:=11> Measured value, scaled value
- <TI:=12> Measured value, scaled value with time tag
- <TI:=13> Measured value, short floating-point number
- <TI:=14> Measured value, short floating-point value with time tag
- <TI:=34> Measured value, normalized value with time tag CP56Time2a
- <TI:=35> Measured value, scaled value with time tag CP56Time2a
- <TI:=36> Measured value, short floating-point number with time tag CP56Time2a

NOTE

Only measured values with <TI:=34,35,36> will be sent from basic system element (BSE) to protocol element (PRE). The different formats for transmission on the line to the remote station are generated by the protocol element according to the IEC60870-5-101 parameter settings **`[PRE] IEC60870-5-101 | Message structure | Time tag | Transmission with/without time tag [BSE] Communication | PREx | IEC60870-5-101/104 | transmission with/without time tag`**.

The suppressed (filtered out) measured values will not be sent by the protocol element to the central station and deleted without any error or warning.

13.3.12 Protocol Element Control and Return Information

13.3.12.1 Protocol element control messages

Protocol element control messages can control protocol element internal functions. On the basic system element, IEC 60870-5-101/104 `messages with process information in the control direction` are converted to protocol element control messages and transmitted to the selected protocol element (see *13.1.4.10 Protocol Element Control Messages*).

Supported Protocol element control functions

SF	Protocol element control function `Control function_(PRE)`	UMPMI0 [Master]	UMPSI0 [Slave]
0	I – Bit handling for time OFF	–	✓
1	I – Bit handling for time ON	–	✓
0	Call cycle START	✓	–
1	Call cycle STOP (disabling)	✓	–
2	Call cycle CONTINUE (enabling)	✓	–
3	Continuous call station x ON	✓	–
4	Continuous call station x OFF	✓	–
5	Main transmission line ACTIVE	✓	–
6	Standby transmission line ACTIVE	✓	–
10	Master coordination (Token) for Main-/Standby line	✓	–
11	Connection set-up	✓	–
12	Connection closed	✓	–
13	“Deactivate” interface	✓	–
14	“Activate” interface	✓	–
20	“Deactivate” Interface + Protocol function	✓	–
21	“Activate” Interface + Protocol function	✓	–
128	Add station to station polling	✓	–
129	Remove station from station polling	✓	–
240	Send (General)-interrogation command (CASDU=All)	✓	✓
242	Set control location	✓	–
243	Reset command	–	–
244	Send (General)-interrogation command (CASDU = selective)	✓	–

Legend:
SF .. Control function_(PRE)

13.3.12.2 Protocol element - Return information

Protocol element return information are internal status information of the protocol elements which are transmitted spontaneously and in the event of a general interrogation with internal message formats from the protocol element to the basic system element. On the basic system element, the protocol element return information (see *13.1.4.11 Protocol Element Return Information*) are converted to IEC 60870-5-101/104 `messages with process information in the monitoring direction`.

Supported protocol element return information

Protocol element return information `Return information function_(PRE)`	Station	UMPMI0 [Master]	UMPSI0 [Slave]
Status DTR	255	✓	✓
Status DSR	255	✓	✓
Station status	0 to 99	✓	–
Station failure	0 to 99	✓	✓ [136]
protocol-specific return information 0: • Interface activated/deactivated": Return information for PRE control message interface "activate/deactivate" <0> = interface "activated" <1> = interface "deactivated"	255	✓	–
protocol-specific return information 1: • Interface + protocol functions "activate/deactivate": Return information for PRE control message interface + protocol function "activate/deactivate" <0> = interface + protocol function "deactivate" <1> = interface + protocol function "activate"	255	✓	–
protocol-specific return information 0: • Main transmission line parameterized	0 to 99	✓	–
protocol-specific return information 1: • Main transmission line OK	0 to 99	✓	–
protocol-specific return information 2: • Main transmission line faulty	0 to 99	✓	–
protocol-specific return information 3: • Main transmission line NOK	0 to 99	✓	–
protocol-specific return information 4: • Standby transmission line parameterized	0 to 99	✓	–
protocol-specific return information 5: • Secondary path OK	0 to 99	✓	–
protocol-specific return information 6: • Secondary path faulty	0 to 99	✓	–
protocol-specific return information 7: • Secondary path NOK	0 to 99	✓	–
protocol-specific return information 0: • Cycle IDLE – Station polling is stopped – User data messages will be sent furthermore.	255	✓	–

136 Station = 0

Protocol element return information `Return information function_(PRE)`	Station	UMPMI0 [Master]	UMPSI0 [Slave]
protocol-specific return information 1: • Cycle NORMAL MODE – cycle control running in normal mode (cyclic RTU interrogation)	255	✓	–
protocol-specific return information 2: • Continous station polling – Continous station polling of a specific station is in progress.	255	✓	–
protocol-specific return information 3: • Station polling stopped – Station polling was stopped by PST-control message.	255	✓	–
protocol-specific return information 6: • Sending “Data to all” – User data message Data “to all” (BROADCAST) is now being transmitted	255	✓	–
protocol-specific return information 7: • “Send Data message” – station-selective user data message is now being transmitted	255	✓	–
protocol-specific return information value: • retries in % (of the last full hour) – The return information value can be selected via parameter – “IEEE 754 Floating Point” format will be used for return information value	0 to 99	✓	–

13.3.13 Interoperability IEC 60870-5-101 (UMPMI0, UMPSI0)

This companion standard IEC 60870-5-101 presents sets of parameters and alternatives from which subsets must be selected to implement particular telecontrol systems. Certain parameter values, such as the number of octets in the COMMON ADDRESS of ASDUs represent mutually exclusive alternatives. This means that only one value of the defined parameters is admitted per system. Other parameters, such as the listed set of different process information in command and in monitor direction, allow the specification of the complete set or subsets, as appropriate for given applications. This clause summarizes the parameters of the previous clauses to facilitate a suitable selection for a specific application. If a system is composed of equipment stemming from different manufacturers it is necessary that all partners agree on the selected parameters.

Note:
In addition, the full specification of a system may require individual selection of certain parameters for certain parts of the system, such as the individual selection of scaling factors for individually addressable measured values.
The selected parameters should be crossed in the white boxes.

☐ Function or ASDU is not used

☒ Function or ASDU is used as standardized (default)

[R] Function or ASDU is used in reverse mode

[B] Function or ASDU is used in standard and reverse mode

The possible selection (blank, X, R, or B) is specified for each specific clause or parameter.

13.3.13.1 System or device function

(system-specific parameter, indicate the system's or station's function by marking one of the following with "**X**")

☐ System definition

☒ Controlling Station (Master)

☒ Controlled Station (Slave)

13.3.13.2 Network configuration

(network-specific parameter, all configurations that are used are to be marked "**X**")

☐ Point-to-Point	☒ Multipoint-partyline
☐ Multiple Point-to-Point	☒ Multipoint-star

13.3.13.3 Physical layer

(network-specific parameter, all interfaces and data rates that are used are to be marked "**X**")

Transmission speed (control direction)

Unbalanced Interface V.24/V.28 Standard	Unbalanced Interface V.24/V.28 Recommended if >1200 bit/s	Balanced Interface X.24/X.27	
☒ 100 bit/s	☒ 2 400 bit/s	☒ 2 400 bit/s	☒ 56 000 bit/s
☒ 200 bit/s	☒ 4 800 bit/s	☒ 4 800 bit/s	☒ 64 000 bit/s
☒ 300 bit/s	☒ 9 600 bit/s	☒ 9 600 bit/s	

X 600 bit/s	X 19 200 bit/s	X 19 200 bit/s
X 1 200 bit/s	X 38 400 bit/s	X 38 400 bit/s

Transmission speed (monitor direction)

Unbalanced Interface V.24/V.28 Standard	Unbalanced Interface V.24/V.28 Recommended if >1200 bit/s	Balanced Interface X.24/X.27	
X 100 bit/s	X 2 400 bit/s	X 2 400 bit/s	X 56 000 bit/s
X 200 bit/s	X 4 800 bit/s	X 4 800 bit/s	X 64 000 bit/s
X 300 bit/s	X 9 600 bit/s	X 9 600 bit/s	
X 600 bit/s	X 19 200 bit/s	X 19 200 bit/s	
X 1 200 bit/s	X 38 400 bit/s	X 38 400 bit/s	

13.3.13.4 Link Layer

(network-specific parameter, all options that are used are to be marked "**X**") Specify the maximum frame length.
If a non-standard assignment of class 2 messages is implemented for unbalanced transmission, indicate the Type ID and COT of all messages assigned to class 2.)
Frame format FT 1.2, single character 1 and the fixed time out interval are used exclusively in this companion standard.

Link transmission procedure	Address filed of the link
☐ Balanced transmission	☐ not present (balanced transmission only)
X Unbalanced transmission	X 1 Octet
	X 2 Octets
	X structured
	X unstructured

Frame length

☐ Maximum length L (control direction)

☐ Maximum length L (monitor direction)

☐ Time interval in which repetitions are allowed *(Trp)* or number of repetitions

When using an unbalanced link layer, the following ASDU types are returned in class 2 messages (low priority) with the indicated causes of transmission:

☐ The standard assignment of ASDUs to class 2 messages is used as follows:

Type Identification	Cause of transmission
9, 11, 13, 21	<1>

☒ A special assignment of ASDUs to class 2 messages is used as follows:

Type identification	Cause of transmission
not dependent on parameterization	all

NOTE:
In response to a class 2 poll, a controlled station may respond with class 1 data when there is no class 2 data available.

13.3.13.5 Application Layer

Transmission mode for application data

Mode 1 (Least significant octet first), as defined in clause 4.10 of IEC 60870-5-4, is used exclusively in this companion standard.

Common address of ASDU

(system-specific parameter, all configurations that are used are to be marked "**X**")

☒ 1 Octet

☒ 2 Octets

Address of the information object

(system-specific parameter, all configurations that are used are to be marked "**X**")

☒ 1 Octet

☒ structured

☒ 2 Octets

☒ unstructured

☒ 3 Octets

Cause of transmission

(system-specific parameter, all configurations that are used are to be marked "**X**")

☒ 1 Octet

☒ 2 Octets (with originator address)
Only originator address not used (=0) is used

Selection of standard ASDUs

Process information in monitor direction

(station-specific parameter, mark each Type ID "**X**" if it is only used in the standard direction, "**R**" if only used in the reverse direction, and "**B**" if used in both directions)

B	<1> := Single-point information	M_SP_NA_1
B	<2> := Single-point information with time tag	M_SP_TA_1
B	<3> := Double-point information	M_DP_NA_1
B	<4> := Double-point information with time tag	M_DP_TA_1
B	<5> := Step position information	M_ST_NA_1
B	<6> := Step position information with time tag	M_ST_TA_1
B	<7> := Bitstring of 32 bit	M_BO_NA_1
B	<8> := Bitstring of 32 bit with time tag	M_BO_TA_1
B	<9> := Measured value, normalized value	M_ME_NA_1
B	<10> := Measured value, normalized value with time tag	M_ME_TA_1
B	<11> := Measured value, scaled value	M_ME_NB_1
B	<12> = Measured value, scaled value with time tag	M_ME_TB_1
B	<13> := Measured value, short floating point number	M_ME_NC_1
B	<14> := Measured value, short floating point number with time tag	M_ME_TC_1
B	<15> := Integrated totals	M_IT_NA_1
B	<16> := Integrated totals with time tag	M_IT_TA_1
B	<17> := Event of protection equipment with time tag	M_EP_TA_1
B	<18> := Packed start events of protection equipment with time tag	M_EP_TB_1
B	<19> := Packed output circuit information of protection equipment with time tag	M_EP_TC_1
6)	<20> := Packed single-point information with status change detection M_PS_NA_1	M_PS_NA_1
	<21> := Measured value, normalized value without quality descriptor	M_ME_ND_1
B	<30> := Single-point information with time tag CP56Time2a	M_SP_TB_1
B	<31> := Double-point information with time tag CP56Time2a	M_DP_TB_1
B	<32> := Step position information with time tag CP56Time2a	M_ST_TB_1
B	<33> := Bitstring of 32 bits with time tag CP56Time2a	M_BO_TB_1
B	<34> := Measured value, normalized value with time tag CP56Time2a	M_ME_TD_1

B	<35> := Measured value, scaled value with time tag CP56Time2a	M_ME_TE_1
B	<36> := Measured value, short floating point number with time tag CP56Time2a	M_ME_TF_1
B	<37> := Integrated totals with time tag CP56Time2a	M_IT_TB_1
B	<38> := Event of protection equipment with time tag CP56Time2a	M_EP_TD_1
B	<39> := Packed start events of protection equipment with time tag CP56Time2a	M_EP_TE_1
B	<40> := Packed output circuit information of protection equipment with time tag CP56Time2a	M_EP_TF_1

Either ASDUs of the set <2>, <4>, <6>, <8>, <10>, <12>, <14>, <16>, <17>, <18>, <19> or of the set <30 – 40> are used.

6) Reception possible, thereby the blocked single-point information is deblocked and further individually processed as TI = 30 (address translation occurs algorithmic).

Process information in control direction

(station-specific parameter, mark each Type ID "**X**" if it is only used in the standard direction, "**R**" if only used in the reverse direction, and "**B**" if used in both directions)

B	<45> := Single command	C_SC_NA_1
B	<46> := Double command	C_DC_NA_1
B	<47> := Regulating step command	C_RC_NA_1
B	<48> := Set point command, normalized value	C_SE_NA_1
B	<49> := Set point command, scaled value	C_SE_NB_1
B	<50> := Set point command, short floating point number	C_SE_NC_1
B	<51> := Bitstring of 32 bit	C_BO_NA_1
B	<58> := Single command with time tag CP56Time2a	C_SC_TA_1
B	<59> := Double command with time tag CP56Time2a	C_DC_TA_1
B	<60> := Regulating step command with time tag CP56Time2a	C_RC_TA_1
B	<61> := Set point command, normalized value with time tag CP56Time2a	C_SE_TA_1
B	<62> := Set point command, scaled value with time tag CP56Time2a	C_SE_TB_1
B	<63> := Set point command, short floating point with time tag CP56Time2a	C_SE_TC_1
B	<64> := Bitstring of 32 bits with time tag CP56Time2a	C_BO_TA_1

Either the ASDUs of the set <45> - <51> or of the set <58> - <64> are used.

System information in monitoring direction

(station-specific parameter, mark each Type ID "**X**" if it is only used in the standard direction, "**R**" if only used in the reverse direction, and "**B**" if used in both directions)

X	<70> := End of initialization	M_EI_NA_1

System information in control direction

(station-specific parameter, mark each Type ID "**X**" if it is only used in the standard direction, "**R**" if only used in the reverse direction, and "**B**" if used in both directions)

B	<100> := Interrogation command	C_IC_NA_1
B	<101> := Counter interrogation command	C_CI_NA_1
	<102> := Read command	C_RD_NA_1
X	<103> := Clock synchronization command	C_CS_NA_1
X	<104> := Test command	C_TS_NA_1
X+	<105> := Reset process command	C_RP_NA_1
X+	<106> := Delay acquisition command	C_CD_NA_1

+ .... UMPSI0 only; only secondary application function

Parameter in control direction

(station-specific parameter, mark each Type ID "**X**" if it is only used in the standard direction, "**R**" if only used in the reverse direction, and "**B**" if used in both directions)

X	<110> := Parameter of measured value, normalized value	P_ME_NA_1
X	<111> := Parameter of measured value, scaled value	P_ME_NB_1
X	<112> := Parameter of measured value, short floating	P_ME_NC_1
4)	<113> := Parameter activation	P_AC_NA_1

4) ... Not used in IEC 60870-5-101 Edition 2. No use case.

File transfer

(station-specific parameter, mark each Type ID "**X**" if it is only used in the standard direction, "**R**" if only used in the reverse direction, and "**B**" if used in both directions)

X	<120> := File ready	F_FR_NA_1
X	<121> := section ready	F_SR_NA_1
X	<122> := Call directory, select file, call file, call section	F_SC_NA_1
X	<123> := last section, last segment	F_LS_NA_1
X	<124> := Ack file, ack section	F_AF_NA_1
X	<125> := Segment	F_SG_NA_1
X	<126> := Directory {blank or X, only available in monitor (standard) direction}	F_DR_TA_1

Type identifier and Cause of Transmission Assignments

(station-specific parameter)
Shaded boxes are not required.
Black boxes are not permitted in this companion standard
Blank = Function or ASDU is not used.
Mark Type Identification/Cause of transmission combinations:
"**X**" if only used in the standard direction,
"**R**" if only used in the reverse direction,
"**B**" if used in both directions.

Type Identification		Cause of transmission																		
		1	2	3	4	5	6	7	8	9	10	11	12	13	20 to 36	37 to 41	44	45	46	47
<1>	M_SP_NA_1		B	B								B	B		B					
<2>	M_SP_TA_1			B								B	B							
<3>	M_DP_NA_1		B	B								B	B		B					
<4>	M_DP_TA_1			B								B	B							
<5>	M_ST_NA_1		B	B*								B*	B*		B*					
<6>	M_ST_TA_1			B*								B*	B*							
<7>	M_BO_NA_1		B	B*											B*					
<8>	M_BO_TA_1			B*																
<9>	M_ME_NA_1	B	B	B											B					
<10>	M_ME_TA_1			B																
<11>	M_ME_NB_1	B	B	B											B					
<12>	M_ME_TB_1			B																
<13>	M_ME_NC_1	B	B	B											B					
<14>	M_ME_TC_1			B																
<15>	M_IT_NA_1			B												B				
<16>	M_IT_TA_1			B												B				
<17>	M_EP_TA_1			B																
<18>	M_EP_TB_1			B																
<19>	M_EP_TC_1			B																
<20>	M_PS_NA_1		6)												6)					
<21>	M_ME_ND_1																			
<30>	M_SP_TB_1			B								B	B							
<31>	M_DP_TB_1			B								B	B							
<32>	M_ST_TB_1			B*								B*	B*							
<33>	M_BO_TB_1			B*																
<34>	M_ME_TD_1			B																
<35>	M_ME_TE_1			B																
<36>	M_ME_TF_1			B																
<37>	M_IT_TB_1			B												B				
<38>	M_EP_TD_1			B																
<39>	M_EP_TE_1			B																
<40>	M_EP_TF_1			B																
<45>	C_SC_NA_1						B	B	B	B	B						B	B	B+	B
<46>	C_DC_NA_1						B	B	B	B	B						B	B	B+	B
<47>	C_RC_NA_1						B	B	B	B	B						B	B	B+	B
<48>	C_SE_NA_1						B	B	B	B	B*						B	B	B+	B
<49>	C_SE_NB_1						B	B	B	B	B*						B	B	B+	B

B* can be used only when the COT is generated via a function-plan application (CAEx)

\+ only UMPS

6) reception possible, thereby the blocked single-point information is deblocked and further individually processed as TI = 30 (address translation occurs algorithmic)

[Typ_Identification_UMP, 2, en_US]

Type Identification		Cause of transmission																		
		1	2	3	4	5	6	7	8	9	10	11	12	13	20 to 36	37 to 41	44	45	46	47
<50>	C_SE_NC_1						B	B	B	B	B*						B	B	B+	B
<51>	C_BO_NA_1						B*	B*	B*	B*	B*						B	B	B+	B
<58>	C_SC_TC_1						B	B	B	B	B						B	B		B
<59>	C_DC_TC_1						B	B	B	B	B						B	B		B
<60>	C_RC_TC_1						B	B	B	B	B						B	B		B
<61>	C_SE_TA_1						B	B	B	B	B*						B	B		B
<62>	C_SE_TB_1						B	B	B	B	B*						B	B		B
<63>	C_SE_TC_1						B	B	B	B	B*						B	B		B
<64>	C_BO_TA_1						B*	B*	B*	B*	B*						B	B		B
<70>	M_EI_NA_1*)				B															
<100>	C_IC_NA_1						B	B			B						B	B+	B+	B+
<101>	C_CI_NA_1						B	B			B						B	B+	B+	B+
<102>	C_RD_NA_1																			
<103>	C_CS_NA_1						X	X									B	X+	X+	X+
<104>	C_TS_NA_1						X	X									B	X+	X+	X+
<105>	C_RP_NA_1						X+	X+									B	X	X+	X+
<106>	C_CD_NA_1			B			X+	X+									B	X+	X+	X+
<110>	P_ME_NA_1						X	X							X		B	X	X+	X
<111>	P_ME_NB_1						X	X							X		B	X	X+	X
<112>	P_ME_NC_1						X	X							X		B	X	X+	X
<113>	P_AC_NA_1																			
<120>	F_FR_NA_1													X			B	5)	5)	5)
<121>	F_SR_NA_1													X			B	5)	5)	5)
<122>	F_SC_NA_1					X								X			B	5)	5)	5)
<123>	F_LS_NA_1													X			B	5)	5)	5)
<124>	F_AF_NA_1													X			B	5)	5)	5)
<125>	F_SG_NA_1													X			B	5)	5)	5)
<126>	F_DR_TA_1*)			X		X														

*) blank or X only

\+ UMPS only

5) … transparent transmission by system

[Type_Identification_UMP_1, 2, en_US]

Semantics of cause of transmission:

<0>	:=	not used
<1>	:=	periodic, cyclic (optional)
<2>	:=	background scan (optional)
<3>	:=	spontaneous
<4>	:=	initialized
<5>	:=	request or requested
<6>	:=	activation
<7>	:=	activation confirmation
<8>	:=	deactivation
<9>	:=	deactivation confirmation
<10>	:=	activation termination
<11>	:=	return information caused by a remote command
<12>	:=	return information caused by a local command
<13>	:=	file transfer
<14..19>	:=	not used
<20>	:=	interrogated by station interrogation
<21..36>	:=	interrogated by interrogation of the group 1..16
<37>	:=	requested by general counter request
<38..41>	:=	requested by counter interrogation of the group 1..4
<42, 43>	:=	not used
<44>	:=	unknown type identification
<45>	:=	unknown cause of transmission
<46>	:=	unknown common address of ASDU
<47>	:=	unknown information object address
<48, 63>	:=	not used

[Type_Identification_UMP_2, 2, en_US]

13.3.13.6 Basic application functions

Station Initialization

(station-specific parameter, mark "**X**" if function is used)

X+ Remote initialization

+ ... only UMPS

Cyclic data transmission

(station-specific parameter, mark each Type ID "**X**" if function is only used in the standard direction, "**R**" if only used in the reverse direction, and "**B**" if used in both directions)

B Cyclic data transmission

' ... secondary application function only

Read procedure

(station-specific parameter, mark each Type ID "**X**" if function is only used in the standard direction, "**R**" if only used in the reverse direction, and "**B**" if used in both directions)

Read procedure

Spontaneous transmission

(station-specific parameter, mark each Type ID "**X**" if function is only used in the standard direction, "**R**" if only used in the reverse direction, and "**B**" if used in both directions)

B Spontaneous transmission

Note: No spontaneous transmission (blank field) is not supported

Double transmission of information objects with cause of transmission spontaneous

(station-specific parameter, mark each information type "**X**" where both a Type ID without time and corresponding Type ID with time are issued in response to a single spontaneous change of a monitored object)

The following type identifications may be transmitted in succession caused by a single status change of an information object. The particular information object addresses for which double transmission is enabled are defined in a project-specific list.

	Single-point information M_SP_NA_1, M_SP_TA_1, M_SP_TB_1 and M_PS_NA_1
	Double-point information M_DP_NA_1, M_DP_TA_1 and M_DP_TB_1
	Step position information M_ST_NA_1, M_ST_TA_1 and M_ST_TB_1
	Bitstring of 32 bit M_BO_NA_1, M_BO_TA_1 and M_BO_TB_1 (if defined for a specific project)
	Measured value, normalized value M_ME_NA_1, M_ME_TA_1, M_ME_ND_1 and M_ME_TD_1
	Measured value, scaled value M_ME_NB_1, M_ME_TB_1 and M_ME_TE_1
	Measured value, short floating point value M_ME_NC_1, M_ME_TC_1 and M_ME_TF_1

Station Interrogation

(station-specific parameter, mark "**X**" if function is only used in the standard direction, "**R**" if only used in the reverse direction, and "**B**" if used in both directions)

B	Global				
B	group 1	B	group 7	B	group 13
B	group 2	B	group 8	B	group 14
B	group 3	B	group 9	B	group 15
B	group 4	B	group 10	B	group 16
B	group 5	B	group 11		
B	group 6	B	group 12		Information Object Addresses assigned to each group must be shown in a separate table.

Clock synchronization

(station-specific parameter, mark "**X**" if function is only used in the standard direction, "**R**" if only used in the reverse direction, and "**B**" if used in both directions)

B	Clock synchronization
B	Day of week used
	RES1, GEN (time tag substituted/ not substituted) used
B	SU-bit (summertime) used

Command transmission

(object-specific parameter, mark "**X**" if function is only used in the standard direction, "**R**" if only used in the reverse direction, and "**B**" if used in both directions)

B	Direct command transmission
B	Direct set point command transmission
B	"Select and execute" command
B	"Select and execute" set point command
B	C_SE ACTTERM used

B	No additional definition
B	Short pulse duration (duration determined by a system parameter in the outstation)
B	Long pulse duration (duration determined by a system parameter in the outstation)
B*	Persistent output

B* can be generated by the PLC

Transmission of integrated totals

(station- or object-specific parameter, mark "**X**" if function is only used in the standard direction, "**R**" if only used in the reverse direction, and "**B**" if used in both directions)

B	Mode A: Local freeze with spontaneous transmission
B	Mode B: Local freeze with counter interrogation
B	Mode C: Freeze and transmit by counter interrogation commands
	Mode D: Freeze by counter interrogation command, frozen values reported spontaneously

B	Counter read
B	counter freeze without reset
B	Counter freeze with reset
B	counter reset

B	General request counter
B	counter interrogation group 1
B	counter interrogation group 2
B	counter interrogation group 3
B	counter interrogation group 4

Parameter loading [137]

(object-specific parameter, mark "**X**" if function is only used in the standard direction, "**R**" if only used in the reverse direction, and "**B**" if used in both directions)

X	Threshold value
X	Smoothing factor
X	Low limit for transmission of measured value
X	High limit for transmission of measured value

Parameter activation

(object-specific parameter, mark "**X**" if function is only used in the standard direction, "**R**" if only used in the reverse direction, and "**B**" if used in both directions)

	act/deact of persistent cyclic or periodic transmission of the addressed object

Test procedure

(station-specific parameter, mark "**X**" if function is only used in the standard direction, "**R**" if only used in the reverse direction, and "**B**" if used in both directions)

X	Test procedure

file transfer

(station-specific parameter, mark "**X**" if function is used)

File transfer in monitor direction

X*	Transparent file
X*	Transmission of disturbance data of protection equipment
X	Transmission of sequences of events
X*	Transmission of sequences of recorded analog values

File transfer in control direction

	Transparent file

X* Data can be transparently transported by the system but not generated or evaluated. A maximum of 220 bytes of user data can be transported in a segment telegram for file transfer.

Background scan

(station-specific parameter, mark "**X**" if function is only used in the standard direction, "**R**" if only used in the reverse direction, and "**B**" if used in both directions)

B	Background scan

137 Not supported with "Controlled Function"

Note: used for data which are transmitted caused by a self-initiated general interrogation

Acquisition of transmission delay

(station-specific parameter, mark "**X**" if function is only used in the standard direction, "**R**" if only used in the reverse direction, and "**B**" if used in both directions)

X+	Acquisition of transmission delay

+ ... only UMPS

13.4 IEC 60870-5-103

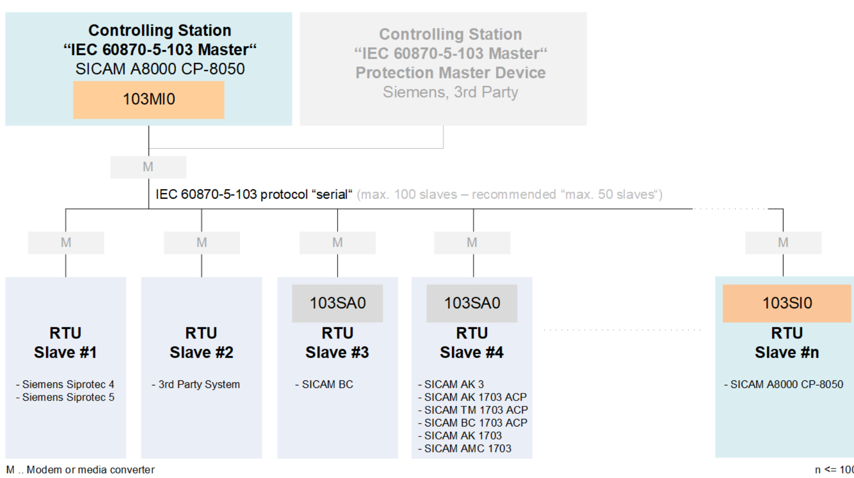
13.4.1 Introduction

The IEC 60870-5-103 protocol is a standardized serial transmission protocol for communication with digital protective devices with multi-point traffic (master/slave principle; "Partyline").

Protocol firmwares for IEC 60870-5-103 (multi-point traffic):

Firmware	System	Standard and function
103MI0	CP-8031, CP-8050	IEC 60870-5-103 multi-point traffic Master (interfacing of protective devices)
103SI0	CP-8031, CP-8050	IEC 60870-5-103 multi-point traffic SLAVE (interfacing of protective devices)

For the interfacing of digital protective devices or protective devices according to IEC 60870-5-103, a serial communications protocol is implemented for multi-point traffic, with which one master station is connected with one or several protective devices (remote terminal units) over a communication link in a linear or star configuration.



[103MI0_config, 1, en_US]

Figure 13-8 IEC 60870-5-103 Configuration

In multi-point traffic an unbalanced transmission procedure is used. This means that the master station initiates all message transmissions, while the substations are only allowed to transmit when they are called.

The supported functionality of the communication protocol according to IEC 60870-5-103 is determined in section *13.4.11 Interoperability IEC 60870-5-103 (103MI0)*.

13.4.2 Functions

Function	103MI0	103SI0
IEC 60870-5-103		
Serial communications protocol according to IEC 60870-5-103	✓	✓
Unbalanced transmission "Master"	✓	–
Unbalanced transmission "Slave"	–	✓
System or device (application function):		
• Controlling station	✓	–
• Controlled station	–	✓

Function	103MI0	103SI0
Max. connections (number of substations per master)	100 [138]	–
Max. number of supported data points	10000	10000
Interoperability		
IEC 60870-5-103 Compatibility level 1 (VDEW/ZVEI recommendation)	✓	✓
IEC 60870-5-103 Compatibility level 2 (disturbance record)	✓	–
Interoperability according to *13.4.11 Interoperability IEC 60870-5-103 (103MI0)*	✓	–
Interoperability according to *13.4.12 Interoperability IEC 60870-5-103 (103SI0)*	–	✓
Network configuration		
Point-to-point configuration (Master + 1 Slave)	✓	✓
Multiple point-to-point configuration (a separate interface with 1 master + 1 slave is required for each point-to-point configuration)	✓	–
Data concentrator	✓	✓
Line configuration	✓	✓
Star configuration	✓	✓
Physical interface		
RS-232	✓	✓
RS-485	✓	✓
RS-422	✓	✓
CP-8031, CP-8050: X4 (RS-485, RS-422); X5 (RS-232)	✓	✓
CI-8551 [139]: X1, X2 (RS-232, RS-485, RS-422); X3 (RS-485, RS-422); X4, X5 (RS-232)	✓	✓
Optical interface (external converter/star coupler required)	✓	✓
Baud rates: 50, 75, 100, 134.5, 150, 200, 300, 600, 1050, 1200, 1800, 2000, 2400, 4800, 9600, 19200, 38400, 56000, 57600, 64000, 115200 Bit/s	✓	✓
Data transmission line (full duplex)	–	–
Data transmission line (half duplex)	✓	✓
Bit transmission layer / message frame / data flow control		
Message formats according to IEC 60870-5-1/FT1.2	✓	✓
Byte frame = 11 bit (8E1)	✓	✓
Message protection d = 4:		
• Checksum (8 bits) + parity bit (even) + transmission rules	✓	✓
Pulse code modulation, byte asynchronous	✓	✓
Message length	1 to 255 bytes	1 to 255 bytes
Data flow control: Data flow control bit in receive direction used	✓	–
Data flow control: Data flow control bit in transmit direction used	–	–
Data flow control bit supervision	✓	–

138 Recommended: 50

139 With CP-8031 not supported by default. With a license (see *14.8 SICAM A8000 CP-803x Extended CI-Module*) 1 communication module CI-8551 can be used additionally also with CP-8031.

Function	103MI0	103SI0
IEC 60870-5-103 functions		
Data acquisition by polling (station interrogation):	✓	✓
• Continuous interrogation of a substation	✓	–
Acquisition of events (transmission of data ready to be sent):	✓	✓
• Test mode	✓	–
General interrogation, substation interrogation	✓	✓
• Delayed transmission of general interrogation command	✓	–
• Transmit non-updated process images	✓	–
• Emulation of ACTCON/ACTTERM for general interrogation (according IEC 60870-5-101/104)	✓	–
Clock synchronization according to IEC 60870-5-103:	✓	✓
• Cyclic clock synchronization (parameterizable)	✓	–
• Correction of clock synchronization (via parameter)	✓	–
• Accuracy	±20 ms	±20 ms
Command transmission:		
• Demand	✓	–
• Control location (set/check control location)	✓	–
• Emulation of ACTCON for commands, setpoint values (according IEC 60870-5-101/104)	✓	–
• Emulation of ACTCON- for commands, setpoint values (according IEC 60870-5-101/104), when a command/setpoint value is discarded from an unreleased control location.	✓	–
• Emulation of ACTTERM for commands, setpoint values (according IEC 60870-5-101/104)	✓	–
Transmission of integrated totals	✓	–
File transfer:		
• Transmission disturbance records according to IEC 60870-5-103	✓	–
• Disturbance records to SICAM DISTO	✓	–
• Disturbance records to control center systems according to IEC 60870-5-101/104	✓	–
Information processing:		
• Signaling/measured value disabling	✓	–
• Emulation of the going binary information	✓	–
• Transfer of the Information “Blocked Activation/Tripping of the Protection”	✓	–
• Monitoring intermediate and faulty positions of double-point information	✓	–
Measured value processing:		
• Technological adaptation for measured values (scaling of measured values)	✓	–
• Measured value change monitoring	✓	–
• Signaling/measured value disabling	✓	–
Fault location values:		
• Reset fault location values automatically	✓	–
• Reset fault location values with command	–	–
• Send fault location value with GI	✓	–
Optimized parameters for selected transmission facilities		
Predefined parameters for selected transmission facilities	✓	✓
Freely definable parameters for transmission facility	✓	✓

Function	103MI0	103SI0
Supply of connected transmission facilities with 5 V/12 V (via VCC pin) ATTENTION: Check power consumption of the external transmission facility!	✓	✓
Supported IEC 60870-5-103 message formats in transmit direction (PRE→IEC 60870-5-103) "public range"		
<TI:=1> .. Binary Information with time tag	–	✓
<TI:=2> .. Binary information with relative time	–	–
<TI:=3> .. Measured value I	–	✓
<TI:=4> .. Real-time measured values with relative time	–	✓
<TI:=5> .. Identification information	–	✓
<TI:=6> .. Time synchronization	✓	–
<TI:=6> .. Time synchronization, binary information	–	✓
<TI:=7> .. General interrogation	✓	–
<TI:=8> .. General interrogation termination	–	✓
<TI:=9> .. Measured value II	–	✓
<TI:=10> .. Generic data (setpoint command)	✓	–
<TI:=11> .. Generic identification	–	–
<TI:=20> .. General command	✓	–
<TI:=21> .. Generic command (general interrogation command) [140]	✓	–
<TI:=23> .. List of recorded disturbances	–	–
<TI:=24> .. Order to transmit disturbance data	✓	–
<TI:=25> .. Acknowledgment for disturbance data transmission	✓	–
<TI:=26> .. Ready for transmission of disturbance data	–	–
<TI:=27> .. Ready for transmission of a channel	–	–
<TI:=28> .. Ready for transmission of tags	–	–
<TI:=29> .. Transmission of tags	–	–
<TI:=30> .. Transmission of disturbance values	–	–
<TI:=31> .. End of transmission	–	–
Supported IEC 60870-5-103 message formats in transmit direction (PRE→IEC 60870-5-103) "private range"		
<TI:=45> .. Command with SELECT/EXECUTE ALSTOM	✓	–
<TI:=46> .. Command with SELECT/EXECUTE ALSTOM	✓	–
<TI:=232> .. Command to protective device ALSTOM	✓	–
<TI:=253> .. REYDISP termination of private data response frame	–	–
<TI:=254> .. REYDISP parameter frame	✓	–
<TI:=255> .. REYDISP parameter "last frame"	✓	–
Supported IEC 60870-5-103 message formats in receive direction (PRE←IEC 60870-5-103) "public range"		
<TI:=1> .. Binary Information with time tag	✓	–
<TI:=2> .. Binary information with relative time	✓	–
<TI:=3> .. Measured value I	✓	–
<TI:=4> .. Real-time measured values with relative time	✓	–
<TI:=5> .. Identification information	✓	–
<TI:=6> .. Time synchronization	–	✓

140 Only general interrogation command for generic data is supported!

Function	103MI0	103SI0
<TI:=7> .. General interrogation	–	✓
<TI:=9> .. Measured value II	✓	–
<TI:=10> .. Generic data (measured value) [141]	✓	–
<TI:=11> .. Generic identification	–	–
<TI:=20> .. General command	–	✓
<TI:=23> .. Disturbance event overview	✓	–
<TI:=24> .. Order to transmit disturbance data	–	–
<TI:=25> .. Acknowledgment for disturbance data transmission	–	–
<TI:=26> .. Ready for transmission of disturbance data	✓	–
<TI:=27> .. Ready for transmission of a channel	✓	–
<TI:=28> .. Ready for transmission of tags	✓	–
<TI:=29> .. Transmission of tags	✓	–
<TI:=30> .. Transmission of disturbance values	✓	–
<TI:=31> .. End of transmission	✓	–
Supported IEC 60870-5-103 message formats in receive direction (PRE←IEC 60870-5-103) “private range”		
<TI:=33> .. Real-time information (SEG protective devices)	✓	–
<TI:=65> .. Single-point information with time ALSTOM	✓	–
<TI:=66> .. Single-point information without time ALSTOM	✓	–
<TI:=67> .. Double-point information with time ALSTOM	✓	–
<TI:=68> .. Double-point information without time ALSTOM	✓	–
<TI:=71> .. 32-bit binary value ALSTOM	✓	–
<TI:=72> ..	–	–
<TI:=140> .. Measured values SIEMENS	✓	–
<TI:=204> .. Measured value, short floating-point number (Reinhausen TAPCON 240)	✓	–
<TI:=205> .. Measured value 28-bit (SIPROTEC)	✓	–
<TI:=253> .. REYDISP termination of private data response frame	✓	–
<TI:=254> .. REYDISP parameter frame	✓	–
<TI:=255> .. REYDISP parameter “last frame”	✓	–
Supported IEC60870-5-101/-104 message formats in transmit direction (BSE→PRE)		
<TI:=30> .. Single-point information with time tag CP56Time2a	–	✓
<TI:=31> .. Double-point information with time tag CP56Time2a	–	✓
<TI:=34> .. Measured value, normalized value with time tag CP56Time2a	–	✓
<TI:=36> .. Measured value, floating-point number with time tag CP56Time2a	–	✓
<TI:=45> .. Single command	✓	–
<TI:=46> .. Double command	✓	–
<TI:=47> .. Regulating step command	✓	–
<TI:=50> .. Setpoint command, short floating-point number	✓	–
<TI:=120> .. File ready	–	–
<TI:=121> .. Section ready	–	–
<TI:=122> .. File directory interrogation, file selection, file interrogation, section interrogation	✓	–
<TI:=123> .. Last section, last segment	–	–

141 Only data in the format GDD [DATATYPE] = 7 (Short Real IEEE STD 754) is supported!

Function	103MI0	103SI0
<TI:=124> .. File confirmation, section confirmation	✓	–
<TI:=125> .. Segment	–	–
<TI:=126> .. File directory	–	–
<TI:=142> .. User data container “Disturbance record transmission to SICAM DISTO”	✓	–
<TI:=142> .. User data container “Parameter messages to Reyrolle protective devices”	✓	–
Supported IEC60870-5-101/-104 message formats in receive direction (BSE←PRE)		
<TI:=30> .. Single-point information with time tag CP56Time2a	✓	–
<TI:=31> .. Double-point information with time tag CP56Time2a	✓	–
<TI:=33> .. Bitstring of 32 bits with time tag CP56Time2a	✓	–
<TI:=34> .. Measured value, normalized value with time tag CP56Time2a	✓	–
<TI:=35> .. Measured value, scaled value with time tag CP56Time2a	✓	–
<TI:=36> .. Measured value, short floating-point number with time tag CP56Time2a	✓	–
<TI:=37> .. Integrated total with time tag CP56Time2a	✓	–
<TI:=38> .. Protection event with CP56Time2a time tag	✓	–
<TI:=39> .. Blocked activation of the protection with time tag CP56Time2a	✓	–
<TI:=40> .. Blocked trip of the protection with time tag CP56Time2a	✓	–
<TI:=45> .. Single command	–	✓
<TI:=46> .. Double command	–	✓
<TI:=120> .. File ready	✓	–
<TI:=121> .. Section ready	✓	–
<TI:=122> .. File directory interrogation, file selection, file interrogation, section interrogation	–	–
<TI:=123> .. Last section, last segment	✓	–
<TI:=124> .. File confirmation, section confirmation	–	–
<TI:=125> .. Segment	✓	–
<TI:=126> .. File directory	✓	–
<TI:=142> .. User data container “Disturbance record transmission to SICAM DISTO”	✓	–
<TI:=142> .. User data container “Parameter messages to Reyrolle protective devices”	✓	–
Redundancy(functions for supporting redundant communication routes)		
Protocol redundancy:		
• Tristate of RS-232 interface if passive	✓	–
• Listening mode when passive	✓	–
Port redundancy:		
• Deactivation of interface (with redundancy control message)	✓	–
• Activation/Deactivation of interface when passive with protocol element control message	✓	–
Device redundancy:		
• Device redundancy with the same PRE parameters	✓	✓
• Device redundancy with different PRE parameters (“A/B parameters”)	✓	✓
• Device redundancy with different PRE parameters (“A/B parameters”) for signals	✓	–
Protocol element control and return information		
Protocol element control messages:		
• Send (general) interrogation command to all	✓	–
• Send (general) interrogation command to selective CASDU	✓	–

Function	103MI0	103SI0
• Set control location	✓	–
• Interface “activate/deactivate”	✓	–
• Call cycle “START/STOP/CONTINUE”	✓	–
Protocol element return information:		
• Station status	✓	✓
• Station failure	✓	✓
• Status DTR	✓	✓
• Status DSR	✓	✓
Web server		
Protocol-internal diagnostic and statistic information via protocol-specific web pages	–	–
Engineering		
SICAM Device Manager	✓	✓
SICAM TOOLBOX II	✓	✓
Remote-configuration of Reyrolle relays (tunneling)	✓	–

13.4.3 Modes of Operation

The operating mode of the interface is determined by parameters of the protocol element and optional equipment.

Operating mode	Interface → optional DCE	Interface signals
Unbalanced interchange circuit (V.24/V.28) RS-232 asynchronous	CP-8031, CP-8050: X5 CI-8551: X1, X2, X4, X5	RXD, TXD, CTS*), RTS, DCD, DTR, DSR/VCC, GND
Balanced interface (V.11) RS-485 (2-wire)/ RS-422 (4-wire) asynchronous	CP-8031, CP-8050: X4 CI-8551: X1, X2, X3	• RS-485 2-wire TXD+/RXD+, - TXD-/RXD-, GND • RS-422 (4-wire): TXD+, TXD-, RXD+, RXD-, GND
Balanced interface (V.11) RS-485 (2-wire)/ RS-422 (4-wire) asynchronous	CP-8031, CP-8050: X5 CI-8551: X1, X2, X4, X5 → PHOENIX PSM-ME-RS232/ RS485-P Interface converter	Interface signals (RS-232) to CP-8031, CP-8050: X5, CI-8551: X1, X2, X4, X5 zu PHOENIX PSM-ME-RS232/RS485-P: RXD, TXD, CTS, RTS, DCD, DTR, GND Interface signals at PHOENIX PSM-ME-RS232/RS485-P: • RS-485 2-wire D(A), D(B), GND • RS-422 (4-wire): D(A), D(B), T(A), T(B), GND
Optical interface with CM-0847 (Multimode)	CP-8031, CP-8050: X5 CI-8551: X1, X2, X4, X5 → CM-0847	Interface signals (RS-232) to CP-8031, CP-8050: X5, CI-8551: X1, X2, X4, X5 to CM-0847: RXD, TXD, CTS, RTS, DCD, DTR, DSR/VCC, GND

NOTE

The serial interface X5 of the CP-8031, CP-8050 can optionally be used by the SICAM TOOLBOX II for engineering.
In order to use the serial interface with the CTS signal by the communication protocol, the serial engineering interface must be disabled with the parameter **`[Home] Hardware | CP-X5 | Module properties | Serial engineering interface disabled`** = yes.

13.4.4 Communication

For the stations to communicate with each other, suitable transmission facilities and/or network components may be needed in addition.

Own Station (Central station, IEC 60870-5-103 Master)

System	System element	Protocol Element	Remarks
SICAM A8000 Series	CP-8031/CPCI85 CP-8050/CPCI85 CP-8050/EPCI85	103MI0	max. 100 Slaves (recommendation max. 30)

Remote Station (Substation, IEC60870-5-103 Slave)

System	System element	Protocol Element	Remarks
Legacy systems:			
SICAM BC	CP-5000/CPC55 CP-5014/CPCX55	SM-2551/103SA0 SM-0551/103SA0	
Digital protective devices:			
Siemens protective devices of serial 4 and 5 (SIP4, SIP5)	–	–	
Third-party system	–	–	according to *13.4.11 Interoperability IEC 60870-5-103 (103MI0)*

Own Station (Substation, IEC60870-5-103 Slave)

System	System element	Protocol Element	Remarks
SICAM A8000 Series	CP-8031/CPCI85 CP-8050/CPCI85 CP-8050/EPCI85	103SI0	

Remote station (Central Station, IEC60870-5-103 Master)

System	System element	Protocol Element	Remarks
SICAM A8000 Series	CP-8031/CPCI85 CP-8050/CPCI85 CP-8050/EPCI85	103MI0	max. 100 Slaves (recommendation max. 30)
SICAM AK 3	CP-2016/CPCX26 CP-2019/PCCX26	SM-2551/103MA0 SM-0551/103MA0	max. 100 Slaves (recommendation max. 30)
Legacy systems:			

System	System element	Protocol Element	Remarks
(SICAM AK, SICAM TM, SICAM BC, SICAM EMIC, SICAM MIC)	CP-20xx CP-60xx CP-50xx	SM-2551/103MA0 SM-0551/103MA0 103MT0 ✓	max. 100 Slaves (recommendation max. 30)
Protection central device:			
Siemens	–	–	according to *13.4.11 Interoperability IEC 60870-5-103 (103MI0)*
Third-party system	–	–	according to *13.4.11 Interoperability IEC 60870-5-103 (103MI0)*

13.4.5 Communication According to IEC 60870-5-103

13.4.5.1 Data Acquisition by Polling (Station Interrogation)

The transmission of the data from the substations to the central station takes place by means of station-selective station interrogations (interrogation procedure, polling), controlled by the central station; that changed data is stored in the substation and transmitted to the central station with the interrogation of this substation. The interrogation procedure of the central station ensures, that substations are interrogated sequentially, whereby substations with important data can be interrogated more often. Substations may only transmit when they are called.

The interrogation procedure can be influenced with the following parameters:

- Continuous cycle
- Existing stations
- Number of calls until station change
- Number of stations to be called until change of priority level
- Priority level assignment (each station is assigned one of the 4 priority levels: high priority, medium priority, low priority-A, low priority-B)

The interrogation procedure can be performed either continuously (continuous cycle) or only on request. The continuous interrogation of the substations by the central station interrogation procedure is to be performed by enabling the parameter **`[PRE] IEC60870-5-103 | Communication functions | Data communication control | Continuous cycle`** .

The station-selective parameters of the central station for the interrogation cycle such as "Stat No", "Link Address", "Station Enabling", "Station failure", "Priority Level", "Number of calls", “Block of class 2 data” are to be set in the parameter **`[PRE] Station definition`** .

In each substation, the station-selective address must be set with the parameter **`Common settings | Station definition | Address of the link`** .

In each substation an unambiguous station address (address of link layer) must be set. This address must be unambiguous for each multi-point traffic line. For IEC 60870-5-103 the number of octets for the "Address field of the link layer" is defined with 1 octet.

The prioritization of the station interrogation can be parameterized by means of corresponding parameter setting of the number of stations called until level change with the following parameters:

- **`[PRE] IEC60870-5-103 | Communication functions | Data communication control | Station call prioritization | No. of stat. calls in high priority lvl`**
- **`[PRE] IEC60870-5-103 | Communication funktions | Data communication control | Station call prioritization | No. of stat. calls in mid. priority lvl`**

- **[PRE] IEC60870-5-103 | Communication funktions | Data communication control | Station call prioritization | No. of stat. calls in low priority lvl (A)**
- **[PRE] IEC60870-5-103 | Communication funktions | Data communication control | Station call prioritization | No. of stat. calls in low priority lvl (B)**

Through parameterization of the interrogation procedure the following characteristics can be achieved:

- A substation which has a lot of data to send – as for instance continuously changing measured values – does not impair the disposal of the data of the other substations.
- Each substation is interrogated within a determinable time (deterministic).
- Substations with important data or those with a large volume of data to be transmitted can be interrogated more frequently than the others.

The interrogation procedure can be performed either continuously (continuous cycle) or only on request. The control of the interrogation procedure on request can be realized with protocol control messages in the function diagram.
In the running interrogation cycle, data and system messages are transmitted spontaneously from the central station according to the parameter setting as follows:

- One substation selectively (acknowledged)
- All substations (unacknowledged)

If the interrogation cycle has been stopped by protocol control messages or the listening mode is switched on, no station interrogation takes place. With the interrogation cycle stopped, spontaneous data messages continue to be transmitted to the substations. With listening mode switched on, the messages are normally not transmitted from the central station to the substations, rather discarded directly on the basic system element (BSE) by the function "User data filter".

Interrogation Procedure of Central Station - Station Change

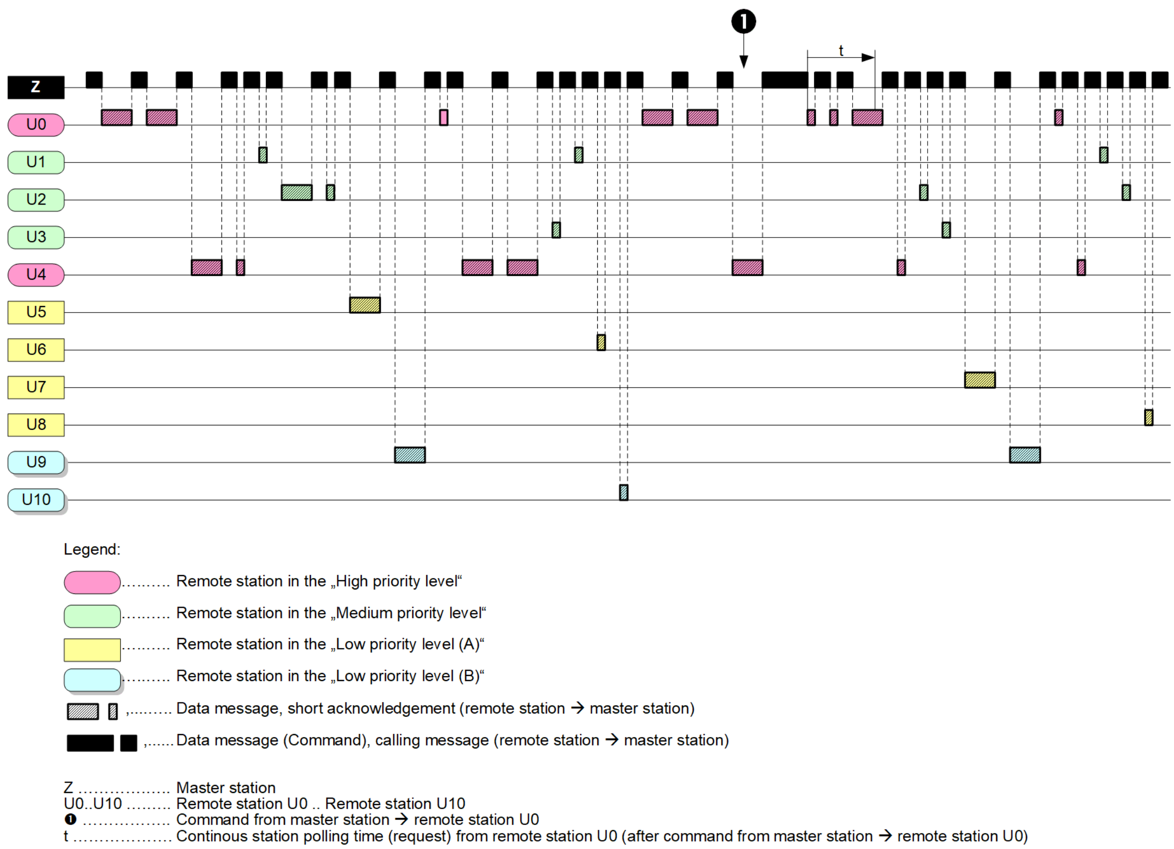
The central station will do a station change when:

- “requested data not available” message received from remote station
- “data class 2“ message received with “ACD=0“ from remote station
  (ACD=0: remote station has no “data class 2“ stored for sending)
- limit for number of consecutive station calls reached
  (e.g. remote station has permanent “data class 2” ready for sending)
- “NAK confirmation“ message received from remote station
- no answer from remote station received (e.g. in case of error – after retries)
- remote station failed and no answer received after 1x retry

For example: Prioritization of the station interrogation
Below the prioritization of the station interrogation for continuous cycle is shown based on the specified parameters as an example.
Parameter for "Station call prioritization"

High priority level	Number of stations called until level change = 2
Medium priority level	Number of stations called until level change = 2
Low priority level (A)	Number of stations called until level change = 1
Low priority level (B)	Number of stations called until level change = 1

Station U0, U4	High priority level / Number of calls until station change = 2
Station U1,U2,U3	Medium priority level / Number of calls until station change = 2
Station U5,U6,U7,U8	Low priority level (A) / Number of calls until station change = 1
Station U9,U10	Low priority level (B) / Number of calls until station change = 1



For the interfacing of protection equipment with the protocol IEC 60870-5-103, no variable elements of the message are provided.

Description	IEC 60870-5-103	Note
Number of octets for the address field of the link layer	1 Octet	
Number of octets for cause of transmission	1 Octet	
Number of octets for common address of the ASDU	1 Octet	ASDU is identical with address of link layer (station address)
Number of octets for the address of the information object	2 Octets	IOA1 = Function type IOA2 = Information number
Acknowledgment message	Single character or short message (ACK)	
Number of octets for time tag	4 Octets	

Continuous Interrogation of a substation

The "continuous interrogation of a substation" can be activated automatically in the central station with the function "Demand" or spontaneously with protocol control messages. With function activated, a station interrogation is always executed by the central station to only one selected station. Data messages ready for sending to same remote station will be sent during demand in progress.

During the demand, user data messages continue to be transmitted to this substation.

Through a demand, following a message transmission (e.g., command, setpoint value) the central station can quickly fetch changed data from the substation (e.g., measured values after command or setpoint value). With demand, the continuous interrogation of a substation is terminated after timeout or a message to another substation. With control of the demand using protocol control messages, the continuous interrogation of a substation can be terminated spontaneously through a corresponding protocol control message.

Acknowledgment Procedure

All data messages transmitted selectively to a substation must be acknowledged by this substation. If, with non-faulty transmission line, the acknowledgment is missing for longer than the expected acknowledgment time, transmitted messages are repeated up to n-times (n can be parameterized). On expiry of the number of retries, the station is flagged as faulty.

The required expected acknowledgment time is determined automatically from the set parameters, but if necessary can be extended accordingly with the parameter **`[PRE] IEC60870-5-103 | Time settings, retries | Monitoring times | Expected_ack_time_corr_factor`** . This is then the case if additional signal propagation delays, delay times or slow processing times of the connected substations must be taken into consideration.

The number of retries is to be set in the central station for messages for station interrogation and data messages with the parameter **`[PRE] IEC60870-5-103 | Time settings, retries | Retries | Retries for data message SEND/CONFIRM (station selective)`** or for messages for station initialization with the parameter **`[PRE] IEC60870-5-103 | Time settings, retries | Retries | Retries for INIT-messages SEND/CONFIRM (station selective)`** .

The acknowledgment from the substation to the central station is transmitted as single character (E5), if no additional information (DCF/ACD bit) is to be transmitted. If additional information is to be transmitted, the acknowledgment is transmitted as message with fixed length (ACK).

Failure Monitoring in the Central Station

The monitoring of the interface by the active central station takes place by means of the cyclic running interrogation procedure (station interrogation). A substation is reported as failed by the central station after expiry of the number of retries. Retries to a substation are thereby always sent in succession immediately after expiry of the expected acknowledgment time i.e. no other substations are interrogated during a running retry handling. For failed substations, a communication fault is only then reported if this is parameterized accordingly in the parameter **`Station failure`** of the **`[PRE] Station definition`** .

The failure of substations is thus detected by the central station during the normal interrogation cycle. Failed substations continue to be interrogated by the central station with the interrogation procedure, however, no message retry is performed for such substations during the station interrogation.

The interrogation cycle for failed stations can be set with the parameter **`[PRE] IEC60870-5-103 | Communication function | Data communication control | Faulty stations | Polling cycle for faulty stations`**. As a result, failed substations are removed from the running interrogation procedure for a certain time and from then are only interrogated in the parameterized grid.

No data is transmitted from the central station to failed substations. The data is saved in the data storage of the communication function on the basic system element (BSE) until they are deleted by the dwell time monitoring or are transmitted to the non-failed substation.

Fault Monitoring in Redundant Central Stations

In redundant configurations the failure monitoring in the PASSIVE (STANDBY) central station is done globally for the failure of the interface and station-selective for the failure of substations.

The failure of the interface is detected by the STANDBY central station by monitoring for cyclic message reception (receive timeout). The monitoring time is set with the parameter **`[PRE] Redundancy | Listening mode (failure monitoring time)`**.

The failure monitoring (station-selective or global) will be retriggered with each error free received message. On receive timeout (active central station or transmission facility of the central station has failed) the interface is signaled as failed.

To enable a station selective fault monitoring in the PASSIVE central station even if there is less or no user data to be sent from the substations to the central station, the ACTIVE central station will send (if failure monitoring time ≠ 0) cyclic a "Reset FCB" or "Request Status of Link" message to each single substation. The cyclic sending of these messages will be done in following time raster: failure monitoring time / 2. This message will be confirmed by the substation with an ACK message (station address or link address is part of the ACK message – this enables station selective failure monitoring).

If the substation will provide cyclic data for sending, a cyclic sending of "Reset FCB" or "Request Status of Link" message to each single substation is not necessary.

The message type for cyclic sending to enable station selective failure monitoring (Reset FCB or Request Status of Link) is to be set in the central station with the parameter **`[PRE] Redundancy | Cyclic message for station selective failure monitoring`**.

13.4.5.2 Station Initialization

The communication with a protective device (remote terminal unit) can only be started after successfully executed station initialization.

A distinction is made between a reset of the protection equipment itself and a reset of the communications function of the protective device.

A reset of the communications function in the protective device (remote terminal unit) is triggered from the master station by sending a Reset-command. This is generally sent from the master station if,

- the master station is being initialized (reset or redundancy switchover)
- the protective device (remote terminal unit) does not reply within a defined time (reset or interface fault)

The reset command does not influence the protection function itself, rather only resets the communications part of the protective device. The reset command can be transmitted as,

- Reset of frame count bit (FCB) or
- Reset of communications unit (KE)

After a reset of the master station, the station initialization is always performed with the reset command "Reset of KE". After redundancy switchover or with station failure, remote terminal units are initialized with the reset command "Reset FCB". If the remote terminal unit does not react within a settable time, then the corresponding remote terminal unit is initialized with the reset command "Reset KE". The time for the switchover of the station initialization can be set with the parameter **`[PRE] IEC60870-5-103 | Time settings, retries | Monitoring times | Station initialization timeout`** .

Reset Command	Function in the Remote Terminal Unit
Reset KE [FC=0]	• FCB-Bit (Frame Count Bit) is initialized • Transmit buffer + process image (SSE+BSE) is deleted
Reset FCB [FC=7] (Reset FCB) *)	• FCB-Bit (Frame Count Bit) is initialized

in redundant configurations "Reset FCB" or "Request Status of Link" can be sent cyclic to enable station-selective failure monitoring in STANDBY master station

End of Initialization

If sending of "end of initialization" is enabled on the basic system element in the IEC 60870-5-101/104 parameter block, after the station initialization is performed, data is only sent from the protocol element if the "INIT-End" has been received from the basic system element for the corresponding ASDU. "<TI=70> End of Initialization" is also transmitted to the remote station.

The clock synchronization command or general interrogation command may only be transmitted after "INIT-End".

13.4.5.3 Acquisition of Events (Transmission of Data Ready to be Sent)

Message from the substation to the Central Station

Messages from the substation to the central station are only transmitted with station interrogation. A quick-check procedure for speeding up the transmission of data is not defined for Modbus protocol and therefore not implemented.

Test Mode

In the mode “Test Mode” spontaneous binary information and cyclic measured values are identified in the protective device for the further processing in the control system by means of the cause of transmission “Test Mode”. That means that message that are normally transmitted with cause of transmission “spontaneous” or “cyclic” are transmitted with the cause of transmission “Test Mode”.

Messages that are transmitted from the substation to the central station with cause of transmission “Test Mode” can be discarded (filtered out) by the protocol element of the central function or – if conversion for specific message is supported – converted and transferred to the basic system element for further distribution/processing.

Possible selections for test mode in receive direction:

- test mode = NO

  All received indications from the protection devices with cause of transmission “Test Mode” (COT = 7) will be discarded (filtered out) and not forwarded to BSE.

  All other messages received from the protection devices with cause of transmission “Test Mode” (COT = 7) will be converted to IEC 60870-5-101/104 and forwarded to BSE with cause of transmission “spontaneous” (COT = 3) and T = 0.

- test mode = YES

  All received messages from the protection devices with cause of transmission “Test Mode” (COT = 7) will be converted to IEC 60870-5-101/104 and forwarded to BSE with cause of transmission “spontaneous” (COT = 3) and T = 1.

- test mode = YES (T=0)

  All received messages from the protection devices with cause of transmission “Test Mode” (COT = 7) will be converted to IEC 60870-5-101/104 and forwarded to BSE with cause of transmission “spontaneous” (COT = 3) and T = 0.

Data with test-bit set (T = 1) will be routed SICAM A8000 internally without any evaluation and sent out via IEC 60870-5-101/104.

The handling of the data with cause of transmission “Test Mode” can be set on the protocol element of the central station with the parameter **`[PRE] Station definition | Test mode`** .

13.4.5.4 General Interrogation, Outstation Interrogation

The general interrogation function (RTU interrogation) is used for updating the central station after the internal station-initialization or after the central station has detected a loss of information. The general interrogation function of the master station requests the remote terminal unit to transmit the actual values of the process variables subject to GI.

A general interrogation command "to all" triggered in the system is always transferred from the communications function on the basic system element (BSE) station-selective to the protocol element of the master station and also transmitted station-selective by this to the remote terminal units with "CASDU = BROADCAST".

Some protective devices cannot immediately process a general interrogation command in certain situations (e.g. after startup, going interface fault or station initialization). Often, the general interrogation command is then only received by the protection equipment after the transmission of the identification information or after successful clock synchronization. For configurations with such protection equipment, a solution for this problem can be offered with the parameter **`[PRE] IEC60870-5-103 | Communication functions | General interrogation | Send initiation of general interrogation after delay`** .

If generic data is used, this function is to be enabled with the parameter **`[PRE] IEC60870-5-103 | Communication functions | Generic data`** . With function enabled, a "general interrogation command" triggered in the system is also transmitted as "GI-command for Generic Data" to the corresponding remote terminal unit. (See also in section Message Conversion "Generic Data".)

13.4.5.5 Clock Synchronization

The clock synchronization of the substations can be performed over the serial communication line – controlled by the central station. The time synchronization is carried out spontaneously and cyclically by the central station.

The period for cyclic clock synchronization can be set with the parameter **[PRE] IEC60870-5-101 | Communication functions | Clock synchronization | Cycle time for sending clock synchronization command**.

The accuracy (typical) is ± 10 ms (clock synchronization 1x per minute). If the accuracy of the remote synchronization is insufficient, a local time signal receiver must be used in the substation.

Messages, which are sent after a startup, but before the substation has the correct time, contain the relative time from startup (reference day: 1.1.2001) with the flagging of the time tag as invalid.

The clock synchronization command will be sent by the protocol element of the central station (either spontaneously after startup/at change of time or cyclic) as broadcast message (send/no response service) to the substations. The cyclic clock synchronization of the substations will be done by the protocol element itself.

If the clock synchronization of the central station fails, the protocol element of the central station can stop the clock synchronization of the substations over the serial communication line. The remote stations will detect a failure of the clock synchronization and data with time tag will be sent including "IV-bit of time = 1".

This function can be enabled in the central station with the parameter **[PRE] IEC60870-5-103 | Communication functions | Clock synchronization | Synchronization also with invalid time** .

Default: "Synchronization also with invalid time" = YES.

NOTE

IEC 60870-5-103 does not define procedures for acquisition of transmission delay and therefore no correction of the time for clock synchronization!

13.4.5.6 Command transmission

Message from the Central Station selectively to a Remote Terminal Unit

Station-selective data messages in command direction are always inserted by the central station with high priority into the running interrogation procedure (station interrogation) after completion of the data transmission in progress. Data to be sent from the base system element (BSE) is always prioritized at a ratio of 1:1 compared with station queries.

Inquiry

If the reaction of the substation to a transmitted telegram is to be acquired quickly by the master station, an inquiry (configurable station-selective continuous query) can be performed by the master station. This station-selective inquiry is retriggered by further telegrams to the same station (telegram configured with inquiry) or canceled by telegrams to other stations.

Run type identification selection and adjustment of the continuous access time for type identification with the **[PRE] IEC60870-5-103 | Communication functions | Data transmission control | Access procedure per type identification | *** parameters.

Data-Flow Control

If a substation is unable to process additional data telegrams (messages), the DFC bit (data flow control) is set in the telegram control field towards substation → master station. From this moment onwards, the protocol firmware of the master station no longer sends data telegrams to the corresponding substation until the substation once again resets the DFC bit.

The status of the DFC bit for the corresponding substations is requested cyclically by the master station with REQUEST STATUS OF LINK. The protocol firmware of the master station also monitors whether the substation resets the DFC bit within an adjustable time specified with the **[PRE] IEC60870-5-103 | Communication functions | Data transmission control | Access procedure for stations with "DFC bit = 1" | DFC continuous monitoring time** parameter. If the DFC-bit is set for longer than the set monitoring time, an station specific diagnostic information will be set (external error).

Remote terminal units with set DFC-Bit can be interrogated with low priority and consequently less often by the master station during the station interrogation. Use the **[PRE] IEC60870-5-103 | Communication functions | Data transmission control | Access procedure for stations with "DFC bit = 1" | Response with "DFC bit = 1"** parameter to select whether the substation must be requested in the polling cycle or in a slower polling cycle with lower priority. The cycle time can be configured with the **[PRE] IEC60870-5-103 | Communication functions | Data transmission control | Access procedure for stations with "DFC bit = 1" | Polling cycle for stations with "DFC-bit = 1"** parameter.

Control location / Check control location

The “Control location” function is used to make sure that commands and setpoints are transferred from authorized sources only. Once the function has been activated, commands/set point adjusting commands are only transferred to the remote partner by the protocol element if the control location (originator address) has been enabled.

If the control location is not enabled, the protocol element immediately sends back a negative acknowledgment of activation (ACTCON) to the originator address (for more details on the control location, see section *13.1.4.9 Control location function for commands and setpoint values*).

Message from the Master Station to all Remote Terminal Units (unacknowledged)

“Unacknowledged” telegrams from the multi-point traffic master station to all are inserted into an on-going polling cycle (station query) after having completed the on-going data transmission. In this process, the telegram is sent several times from the master station with the configurable number of telegram retries according to the **[PRE] IEC60870-5-101 | Time settings, retries | Retries | Retries for SEND/NO REPLY (broadcast) data telegram** parameter. Afterwards the interrupted interrogation cycle is resumed.

The protocol element for IEC 60870-5-103 master function exclusively sends the time synchronization command as telegram that is “not acknowledged to all”. All other messages are transmitted station-selective.

13.4.5.7 Transmission of Integrated Totals

A counter interrogation command triggered in the system is transmitted from the protocol element of the master station either station-selective or “to all” (=BROADCAST) according to the parameter **[PRE] IEC60870-5-103 | Communication functions | Transmission of integrated totals | Send counter interrogation command as "Broadcast** . This parameter is transferred to the basic system element after startup of the protocol element.

A counter interrogation command to be sent is then already made available to the protocol element by the basic system element, station-selective or BROADCAST.

A station-selective counter interrogation command is however only then sent by the protocol element, if an identification message has been received from the corresponding remote terminal unit during startup with the ASCII text "BC1703ACP".

13.4.5.8 File Transfer

Disturbance records are recorded and stored in protection equipment. These can be read out by the master station with the procedures defined in IEC 60870-5-103 for the transfer of files.

The protocol element of the master function supports the following possibilities for reading out and transferring disturbance records:

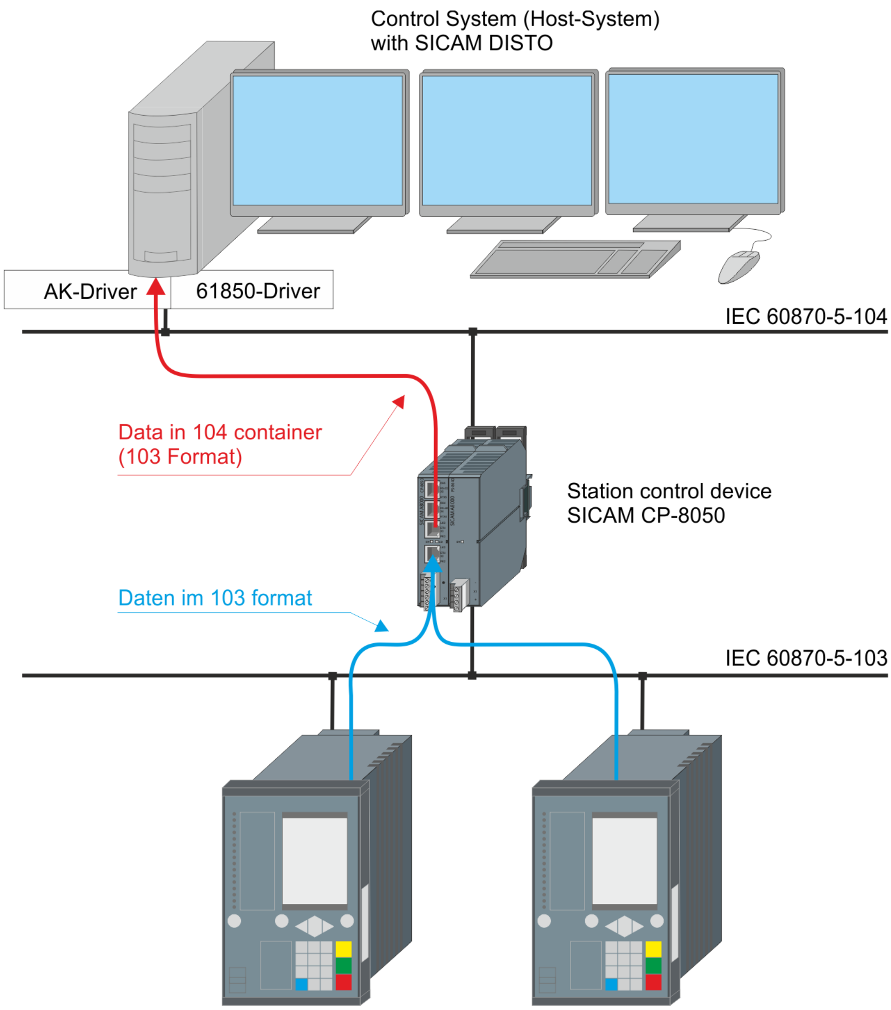
- Transfer of Disturbance Records to SICAM DISTO
- Transfer of disturbance records to IEC 60870-5-101/104 systems

Transfer of Disturbance Records to SICAM DISTO

The transfer of disturbance records from protection equipment is controlled by SICAM DISTO (SICAM SCC Application). Disturbance records are read out from the protection equipment by SICAM DISTO according to IEC 60870-5-103 and saved as file in IEEE Comtrade format.

The data transmission between SICAM DISTO and the protocol element with protection equipment connected is carried out with the user data containers provided for this purpose.

The protocol element itself performs no special sequences for the transmission of disturbance records (except cyclic requests of disturbance records overview from protection equipment).



Disturbance Records Container

All IEC 60870-5-103 message formats necessary for the transfer of disturbance records from protection equipment are transmitted from the protocol element of the master station between SICAM DISTO and the protocol element of the master function in a user data container (=”disturbance records container”) defined for SICAM RTUs in the private range of IEC 60870-5-101/104. Only the IEC 60870-5-103 message format included in the user data container will be transmitted to the protection equipment, and not the data container itself.

The transmission of the user data container within SICAM RTUs takes place with type identification <TI=142> in the private range of IEC 104-5-104. SICAM RTUs internal, several modes are provided for the use of the user data container. For the transfer of disturbance records, the user data container is used with message type = 128 (=1703 Standard-Format).

IEC 60870-5-101/104		IEC 60870-5-103	
<TI:=142>	User data container	<TI:=23> <TI:=26> <TI:=27> <TI:=28> <TI:=29> <TI:=30> <TI:=31>	Disturbance event overview Ready for transmission of disturbance data Ready for transmission of a channel Ready for transmission of tags Transmission of tags Transmission of disturbance values end of transmission
<TI:=142>	User data container	<TI:=24> <TI:=25>	Order to Transmit Disturbance Data Acknowledgment for Disturbance Data Transmission

For each interface with protection equipment connected, a user data container (=”disturbance records container”) must be parameterized in SIP message address conversion for transmit and receive direction with unambiguous address and not used station address (e.g. “99” = “virtual station address”).

The assignment of the message address for the spontaneous information object "User data container" is carried out in the OPM II with the category `firmware / Trans_container` and the category `firmware / Rec_Container`. The "container type" has to be set to `"disturb. data container"` with the parameter `Containtertype_Rec` and the parameter `Containtertype_Tra` .

In SICAM RTUs the addresses of all user data containers for the transfer of disturbance records are to be entered in the data flow filter.

In Ax 1703 the addresses of the user data containers are to be entered in the corresponding Ax 1703-PRE detailed routings PDS (QID-ST = 254 ... SSE as source).

With the parameterization of the message addresses for the disturbance records container, the transfer of disturbance records to SICAM DISTO will be enabled.

Sequence of the Disturbance Record Transmission (Protection Device ↔ SICAM DISTO)

The protocol element of the master station will send a cyclic request (every 5 minutes) for transmission of disturbance records directory to connected protection equipment. With this procedure the disturbance record overview will be sent cyclic from the protection equipment to SICAM DISTO. During disturbance record transmission in progress cyclic request will be retriggered with each single disturbance record message.

Cyclic Request for Disturbance Records Overview:

- the cycle time for requests of disturbance records is fixed and cannot be changed via parameter.
- the cycle time (5 minutes) for requests of disturbance records will be retriggered with following messages:
  - disturbance records container message BSE ↔ PRE

  Note:
  if a disturbance record transmission is running in forever loop (e.g. caused by error detected by SICAM DISTO and restart of disturbance transmission) the cycle time for request of disturbance records overview will be retriggered permanently.
  - in this case no disturbance records directories will be requested (even not from other protection equipment)!
  - this behavior is as defined because SICAM DISTO will initiate a request for disturbance records overview in case of successful/failed disturbance record transmission via positive/negative confirmation by SICAM DISTO.

- the request for the disturbance record overview will be sent as broadcast (send/no reply) for each function type with station number 255.

  Note:

  – function type of all connected protection devices (e.g.: function type 128 = “distance protection“, 160 = “over current protection“, ...) will be learned from list of recorded disturbance records if sent spontaneous or during general interrogation and with min. 1x disturbance record included.

  – if only protection devices are connected without recorded disturbance record then no function code will be learned and no cyclic request for disturbance records overview will be started.

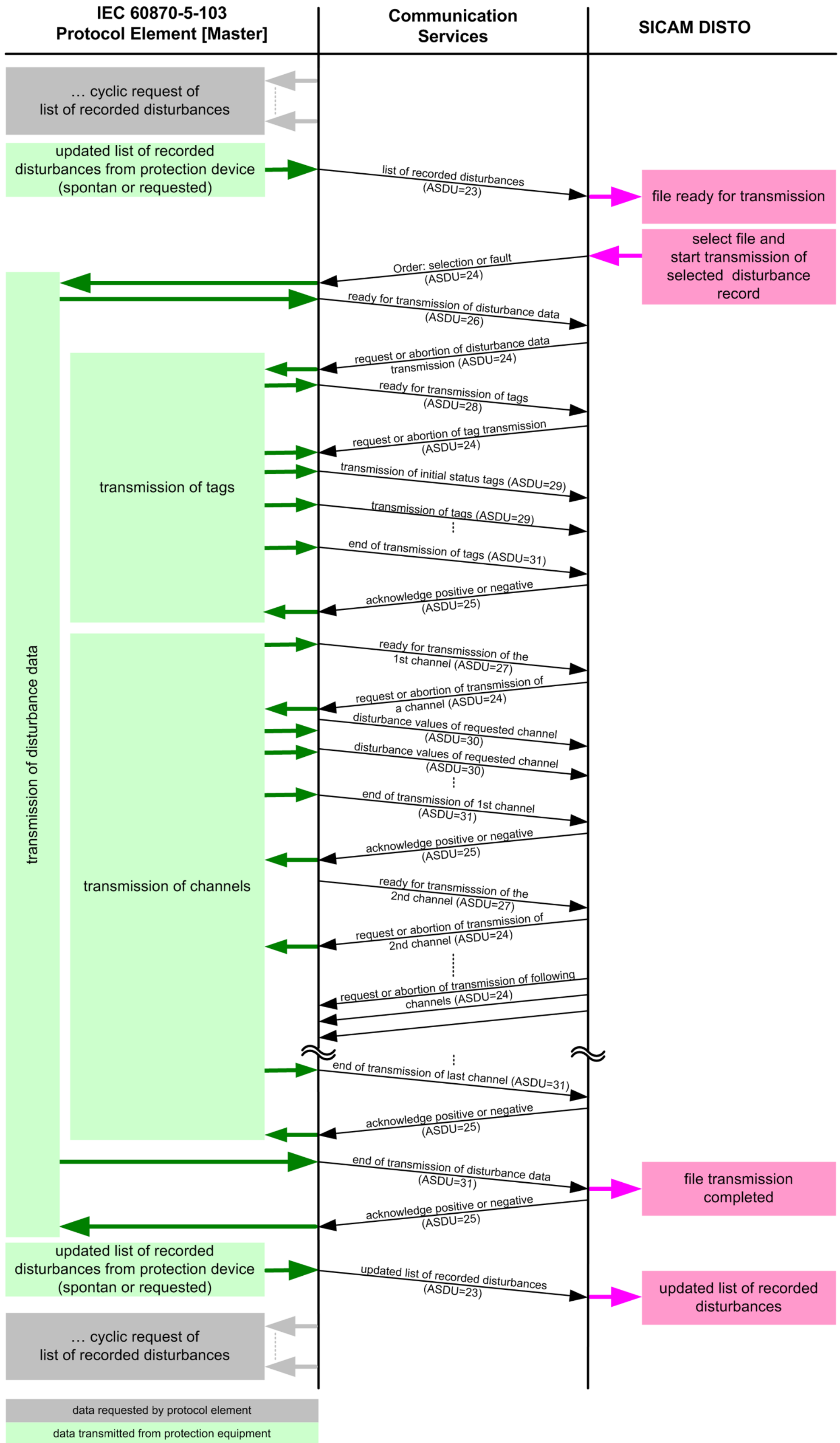
- a correct disturbance record container address must be parameterized in SIP message address conversion.

  – in transmit-and receive direction (**`Containtertype_Rec`** and **`Containertype_Tra`**).

- the “virtual station address” used for transmission of disturbance records container must be added in topology and (if used) in data flow filters (pass through filters) but this “virtual station address” must not be included in the station definition.

- a disturbance records overview (also empty directories) will be always sent to SICAM DISTO.

File Transfer between Protocol Element and SICAM DISTO



Segmentation

With user data containers a maximum of 180 bytes of transparent message data can be transmitted.

Longer parameter messages from REYDISP (max. 256 bytes) are thus to be transmitted in several part segments and grouped together again before transmission/processing. With missing segments the partially transmitted parameter message is discarded.

The transparent mode only utilizes part segments with a max. length of 50 bytes of message data!

User data container <TI=142> for transmission of disturbance records

2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0	
142								Type identification
1								variable structure qualifier
								Cause of transmission
								Originator address
								CASDU1
								CASDU2
								IOA1
								IOA2
								IOA3
⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	7 octets dual time in CP56Time2a format
								Length of user data in bytes 1)
128								Message type = 128 (SICAM RTUs standard format)
45								UEK = 45
						S = 1	I = 0	Status = 0x02
1 - 255								Number of bytes IEC 60870-5-103 message + segment info 2)
R	Number of segments			Segment number				Segment information
TI								Message data (0) IEC 60870-5-103 Format
⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮
								Message data (n) IEC 60870-5-103 Format max. 50 Bytes

1) Length of the user data from the field UEK up to the last byte of the message data (n)

2) Length of the user data from the field segment information up to the last byte of the message data (n)

NOTE

The user data container is described here in the internal format of the protocol element with the essential information fields.

Elements of the Message	
TI .. Type Identification	<TI:=142> Single command
CASDU, IOA .. Message address	
CASDU1 = LSB of the CASDU	CASDU = CASDU of the remote terminal unit
CASDU2 = MSB of the CASDU	CASDU = CASDU of the remote terminal unit
IOA1	
IOA2	
IOA3	
Cause of transmission	
03 .. spontaneous	... in monitoring direction
06 .. activation	... in control direction
Time	
7 octet dual time	Earliest possible acquisition moment of a message in AK 1703, time tag on the basic system element (BSE)
Message type = 128	
Length of the user data part in octets	Length of the user data in octets (exclusive message type)
Number of bytes	Number of bytes for message data incl. segmentation field
Segmentation field	
Number of segments	Total number of segments
Segment number	Current number of the transmitted segment ... the 1st segment has segment number 1
Direction bit (R)	0 = control direction (SICAM DISTO → PRE) 1 = monitoring direction (PRE → SICAM DISTO)

Transfer of disturbance records to control systems according to IEC 60870-5-101/104

Disturbance records (fault data) from protection equipment can be transmitted from the protocol element of the master station to a central control system according to IEC 60870-5-101/104 "Transmission of Files in Monitoring Direction (disturbance record transmission of a protective device)". In the control system the disturbance records are displayed for evaluation and saved to data carrier.

After the order to transmit the fault data by the higher-level master station has taken place, the selected file is read out from the protective device by the protocol element of the master station according to IEC 60870-5-103 and buffered in the memory of the protocol element.

After the transmission of the file from the protective device has concluded, this is transmitted to the higher-level master station according to IEC 60870-5-101/104 "Transfer of Files in Monitoring Direction (disturbance record transmission of a protective device)". The file is only deleted in the protective device after the complete transmission of the file to the higher-level master station.

The protocol element only supports the transmission of one file at one time.

For the transmission of the file to the higher-level master station, the corresponding IEC 60870-5-101/104 type identifications are processed or generated by the protocol element. SICAM A8000 internal, presently IEC 60870-5-101/104 messages for the transmission of files can only be transported with a maximum length of 200 bytes (a SICAM RTUs internal "Segmentation" of these messages is presently not yet supported). For the transmission to the higher-level control system, if necessary the message length can be parameterized with the parameter **`[PRE] IEC60870-5-103 | Communication functions | File transfer | Maximum message length for one segment`** and thus be set "shorter" (concerns "Segment" and "File Directory").

IEC 60870-5-101/104 Messages in Control Direction for the Transmission of Files	
<TI:=122>	File directory interrogation, file selection, file interrogation, section interrogation
<TI:=124>	File confirmation, section confirmation

IEC 60870-5-101/104 Messages in Monitoring Direction for the Transmission of Files	
<TI:=120>	File ready
<TI:=121>	Section ready
<TI:=123>	Last section, last segment
<TI:=125>	Segment
<TI:=128>	File directory

The assignment of the IEC 60870-5-101/104 message address for the spontaneous information object "disturbance record container" is carried out in the OPM II in the master station in the process-technical parameterization in transmit direction (to SCADA system) with the category **`firmware / Tra_container`** and in receive direction (from SCADA system) with the category **`firmware / Rec_container`** (container type = disturbance data container).

For each single protective device, the address for the sub-directory and the address for each disturbance record are to be parameterized in the process technique.

The protocol element monitors a running transmission of a file both in the direction of the higher-level master station (SCADA system) as well as in the direction of the protective device. A failure during a running transmission of a file is detected by the protocol element by means of a monitoring time (Timeout). Wit the parameter **`[PRE] IEC60870-5-103 | Communication functions | File transfer | Timeout for file transfer`** this monitoring time can be parameterized.

With a failure of a running transmission, the disturbance file stored in the memory of the protocol element is deleted and the current file directory transmitted to the higher-level master station. Since the disturbance file is only deleted in the protective device after successful transmission to the higher-level master station, in the event of an error this can be transmitted again.

The spontaneous transmission of the file directory can be deactivated with the parameter **`[PRE] IEC60870-5-103 | Communication functions | File transfer | spontaneous transmission of directory list`** . If the spontaneous transmission is deactivated, the higher-level master station must request the transmission of the file directory.

For the transmission of disturbance files to the higher-level master station, the messages of several protective devices can be used with the same CASDU or also per protective device with one unambiguous CASDU.

13.4.6 Transfer of Parameters for Reyrolle Protection Equipment

If digital protective devices from the firm Reyrolle are used in combination with a control centre system SICAM SCC, REYDISP – the Engineering Tool for Reyrolle Protective Devices – can be implemented directly on the control centre system SICAM SCC "Embedded REYDISP".

The transfer of parameters from/to Reyrolle protection equipment is controlled by REYDISP. REYDISP is thereby used on the control centre system (SICAM SCC, SAT 250 SCALA) under Windows. Parameters are transmitted from REYDISP to the protection equipment in the private range of IEC 60870-5-103.

The data transmission between REYDISP and the protocol element to which the protection equipment are connected, is carried out in the System SICAM A8000 with the user data containers provided for this purpose. REYDISP does not require its own interface to SICAM A8000 – the communication takes place over the interface of the control centre system (REYDISP is coupled to the software of the control centre system over a software interface).

The protocol element itself performs no special sequences for the transmission of parameters. All IEC 60870-5-103 message formats necessary for the transfer of parameters from/to Reyrolle protection equipment are transmitted from the protocol element of the master station between REYDISP and the protocol element of the master function in a user data container defined for SICAM A8000 in the private range of IEC 60870-5-101/104. Only the IEC 60870-5-103 message format included in the user data container will be transmitted to the protection equipment, and not the data container itself.

The transmission of the user data container within SICAM A8000 takes place with type identification <TI=142> in the private range of IEC 104-5-104. SICAM A8000 internal, several modes are provided for the use of the user data container. For the transmission of parameters, the user data container is used with message type = 132 (=REYDISP parameter container).

All data sent from REYDISP via user data container are transmitted to the remote terminal units by the protocol firmware on conclusion of the running message transmission sequence. User data containers to non-parameterized remote terminal units are not transmitted by the protocol firmware and are discarded! With station-selective addressing, in addition the reply from the protective device following this is transmitted back to REYDISP via user data container. In addition, all message formats received from the protective devices with unknown type identification are also passed on to REYDISP via user data container.

For each interface with protection equipment connected, an unambiguous address must be parameterized for a user data container in transmit and receive direction. The assignment of the message address for the spontaneous information object "User data container" is carried out in the OPM II with the category **`firmware / Trans_container`** and the category **`firmware / Rec_Container`**. The "container type" has to be set to **`"Reydisp container"`** with the parameter **`Containtertype_Rec`** and the parameter **`Containtertype_Tra`** . With the parameterization of the message addresses, the transfer of parameters to REYDISP is also activated.

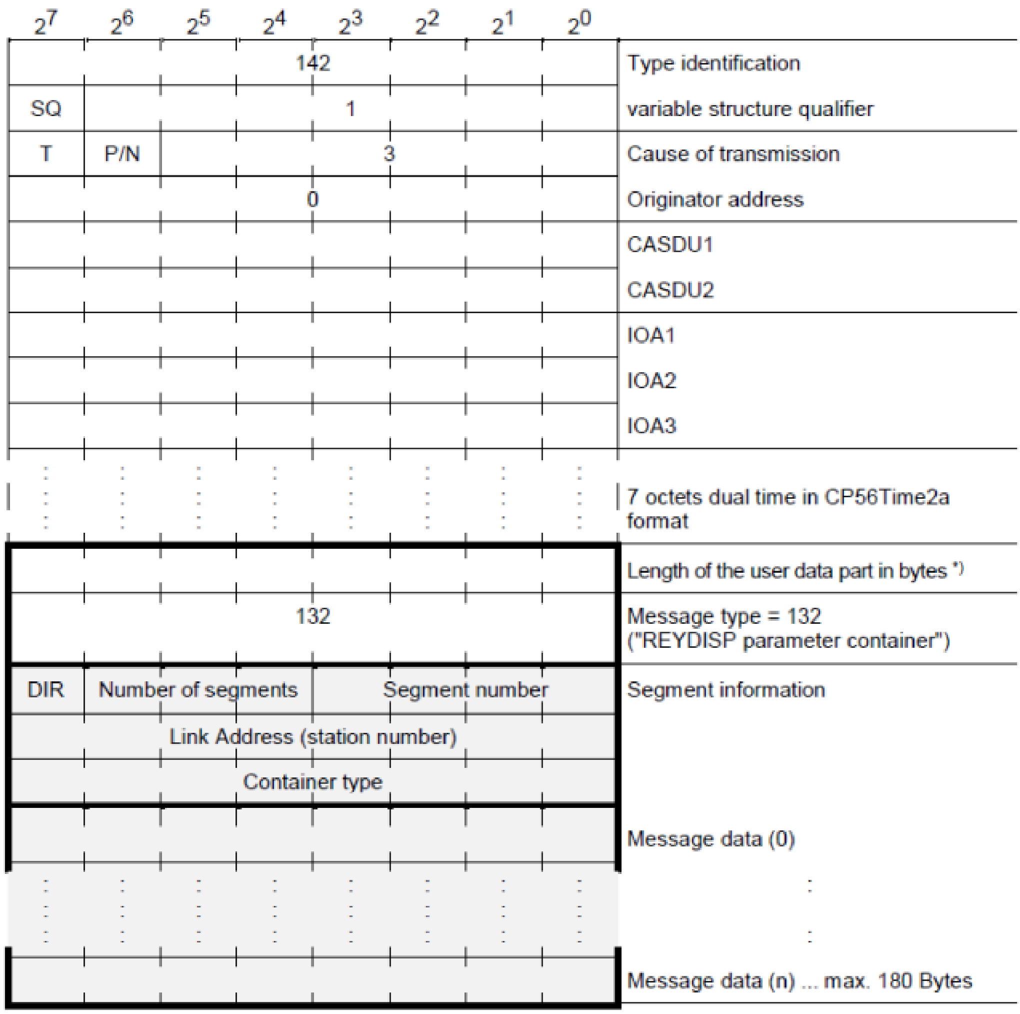
In SICAM A8000 the addresses of all user data containers for the transfer of disturbance records are to be entered in the data flow filter. In Ax 1703 the addresses of the user data containers are to be entered in the corresponding Ax 1703-PRE detailed routings PDS (QID-ST = 254 ... SSE as source).

Segmentation

With user data containers a maximum of 180 bytes of transparent message data can be transmitted.

Longer parameter messages from REYDISP (max. 256 bytes) are thus to be transmitted in several part segments and grouped together again before transmission/processing. With missing segments the partially transmitted parameter message is discarded.

User data container <TI=142> "REYDISP parameter container"



*) Number of bytes from segment information up to and including the last byte of the message data

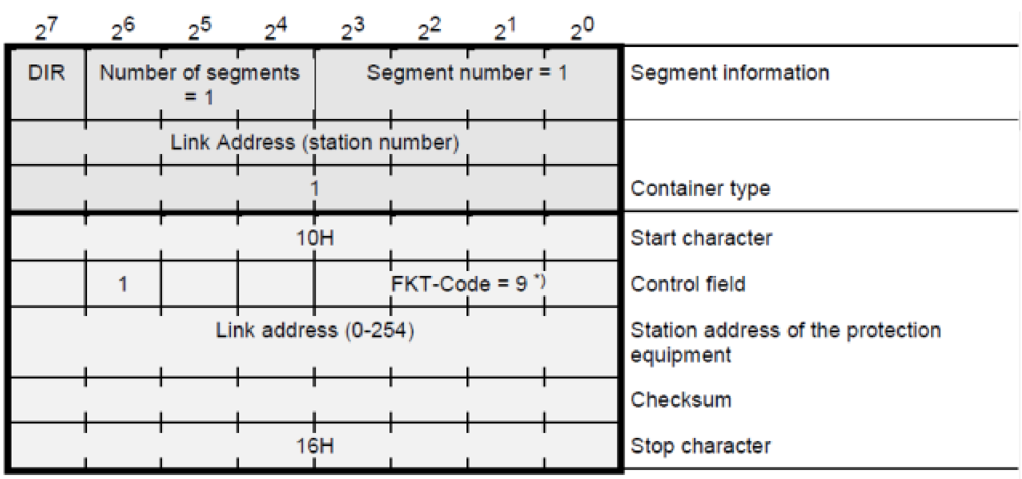
NOTE

The user data container is described here in the internal format of the protocol element with the essential information fields.

Elements of the Message	
TI .. Type Identification	<TI:=142> Single command
CASDU, IOA .. Message address	
CASDU1 = LSB of the CASDU	CASDU = CASDU of the remote terminal unit
CASDU2 = MSB of the CASDU	CASDU = CASDU of the remote terminal unit
IOA1	
IOA2	
IOA3	
Cause of transmission	
03 .. spontaneous	... in control direction and monitoring direction
Time	
7 octet dual time	
Message type = 132	REYDISP parameter container

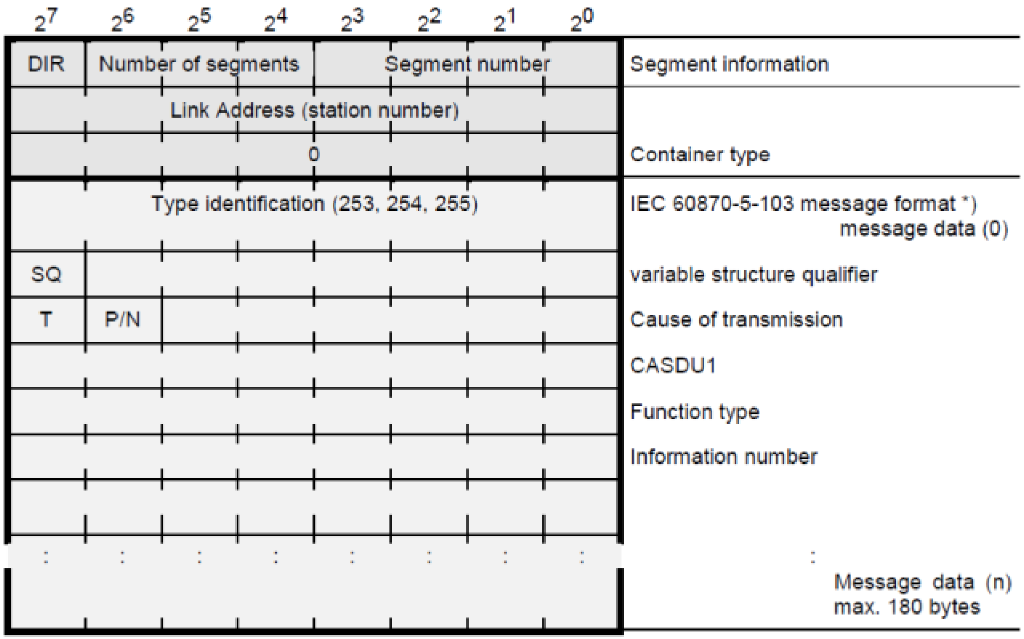
Elements of the Message	
Length of the user data part in octets	Number of the user data in octets (exclusive message type)
Segmentation field	
Number of segments	Total number of segments
Segment number	Current number of the transmitted segment ... the 1st segment has segment number 1
Direction bit (DIR)	0 = control direction (REYDISP → PRE) 1 = monitoring direction (PRE → REYDISP)
Link address	Station number of the protection equipment
Container type	0 = "IEC 60870-5-103" message 1 = "IEC 60870-5-1/FT1.2" message with fixed block length 2 = "IEC 60870-5-1/FT1.2" single character

Container type "1" IEC 60870-5-1/FT1.2 "Message with fixed block length"



*) For the transparent transmission of IEC 60870-5-101/FT1.2 message formats, presently only function code < FKT = 9 > "Request Status of Link" is supported!

Container type "0" IEC 60870-5-103 message "Message with variable block length"



*) The IEC 60870-5-101, IEC 60870-5-103 frame is not transmitted in the REYDISP parameter container; this is regenerated by the protocol element during transmission.

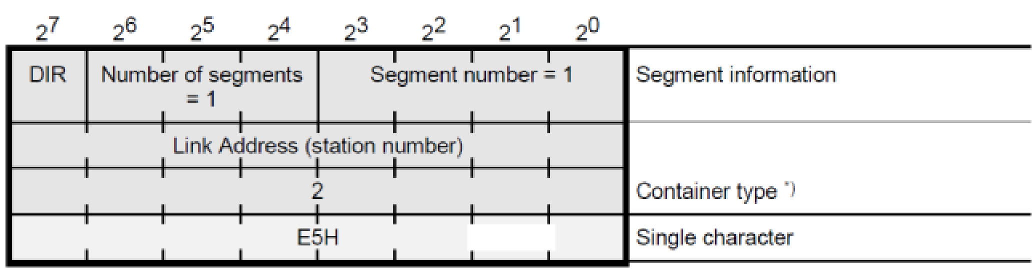
Control direction:

<TI=254>	REYDISP parameter frames
<TI=255>	REYDISP parameter "last frame"

Monitoring direction:

<TI=253>	REYDISP termination of private data response frame
<TI=254>	REYDISP parameter frames
<TI=255>	REYDISP parameter "last frame"

Container type "2" IEC 60870-5-1/FT1.2 "Single character"



*) The transparent transmission of IEC 60870-5-101/FT1.2 message formats for single character is only supported in monitoring direction (SICAM RTUs ⇨ REYDISP)!

13.4.7 Optimized Parameters for selected Transmission Facilities

The protocol element supports selected transmission facilities – for which the parameters are set fixed. The selection of the transmission facility takes place with the parameter **`[PRE] Interface parameter | Time setting for interface modem`**. With the selection of a free definable transmission facility certain parameters can be set individually.

The transmission facilities usually only support certain transmission speeds. These can be found in the respective specification of the transmission facility.

The transmission rate (Baud rate) is to be set for transmit/receive direction together with the parameter **`[PRE] Interface parameter | Baud rate`**.

In addition, the physical interface with the parameter **Common Settings | Interface**.

After the transmission of broadcast messages an extra pause can be inserted regardless of the transmission facility used. This pause is required for remote terminal units of third-party manufacturers, if these can only process further messages after a transmission pause following the reception of broadcast messages.

The pause after broadcast messages can be set in the master station with the parameter **[PRE] IEC61870-5-101 | Time settings, Retries | Pause time after broadcast message (tp_bc)** . If the pause time is set to ***0***, a minimum pause of 33 bit is maintained by the protocol element.

With the free definable transmission device, all available parameters can be set individually. This is necessary when transmission facilities are to be used that are not predefined or if modified parameters are to be used for predefined transmission facilities.

For the selection of the freely definable transmission facility the parameter **[PRE] Interface Parameter | Time settings for interface modem** must be set to ***free definable*** . Only then all supported parameters are displayed and can be parameterized with the required values (refer to table with preset parameters for transmission facilities).

For the adaptation to various modems or time requirements of external systems, the following parameters can be set individually:

- **[BSE] System settings | Serial interfaces | Port | CP-X# | Electrical interface**
- **[BSE] System settings | Serial interfaces | Port | CP-X5 | Mode**
- **[BSE] System settings | Serial interfaces | Port | CP-X5 | DSR voltage supply**
- **[PRE] Interface Parameter | Time settings for free definable interface modem | Pause time (tp)**
- **[PRE] Interface Parameter | Time settings for free definable interface modem | Set up time (tv)**
- **[PRE] Interface Parameter | Time settings for free definable interface modem | Run out time (tn)**
- **[PRE] Interface Parameter | Time settings for free definable interface modem | DCD Handling**
- **[PRE] Interface Parameter | Time settings for free definable interface modem | Continuous level monitoring time (tcl)**
- **[PRE] Interface Parameter | Time settings for free definable interface modem | Transmission delay if continuous level (tcldly)**
- **[PRE] Interface Parameter | Time settings for free definable interface modem | Bounce suppression time (tbounce)**
- **[PRE] Interface Parameter | Time settings for free definable interface modem | Disable time (tdis)**

How the individual time settings are effective during the data transmission is shown in *Figure 13-9*.

If necessary the voltage supply of the transmission facility (5 V/12 V) – if this is enough – can be supplied over the status line DSR (VCC). The voltage supply is enabled with parameter **[BSE] System settings | Serial Interfaces | Port | CP-X5 | DSR voltage supply**. The voltage supply is only output to the DSR status line with corresponding parameter setting. The DSR status line cannot be used by the protocol.

NOTE

Required voltage supply and maximum current consumption of the transmission facility must be observed!

In addition, for the adaptation of the protocol to the transmission medium used or to the dynamic behavior of the connected remote station, the following parameters are available:

- **`[PRE] IEC60870-5-103 | Time settings, retries | monitoring times | Call monitoring time`** (only remote terminal unit)
- **`[PRE] IEC60870-5-101 | Time settings, retries | Monitoring times | Idle monitoring time`**
- **`[PRE] IEC60870-5-101 | Time settings, retries | Monitoring times | Character monitoring time`**
- **`[PRE] IEC60870-5-103 | Time settings, retries | monitoring times | expected acknowledgment time correction`** (only master station, see acknowledgment procedure)

The character monitoring time and the idle monitoring time are used for message interruption monitoring and message resynchronization in the receive direction. A message interruption is detected when the time between 2 bytes of a message is greater than the set signal monitoring time. With message interruption the receive processing in progress is aborted and the message is discarded.

After a detected message interruption a new message is only accepted in receive direction after an idle time on the line (idle time). This idle time is monitored by the protocol element. After expiry of the monitoring time the receiver is resynchronized.

The protocol element – insofar as the transmission facility provides this signal receive-side – can evaluate the interface signal DCD and e.g. use it for monitoring functions.

Preset parameters for transmission equipment with 103xx0 (RS-232 interface)

Transmission facility	RTS	tp [ms]	tv [ms]	tn [ms]	tp_bc [ms]	tdis [ms]	DCD	Tbounce [ms]	tcl [s]	tcldly [s]	A_I	T	5V/ 12V
Optical with CM-0847	ON	0	0	0	0	0	No	0	0	0	A	I	5 V
Direct connection (RS-485)	↑↓	0	1	0	0	0	No	0	0	0	A	I	No
Direct connection RS-232	ON	0	0	0	0	0	No	0	0	0	A	I	No
freely definable													

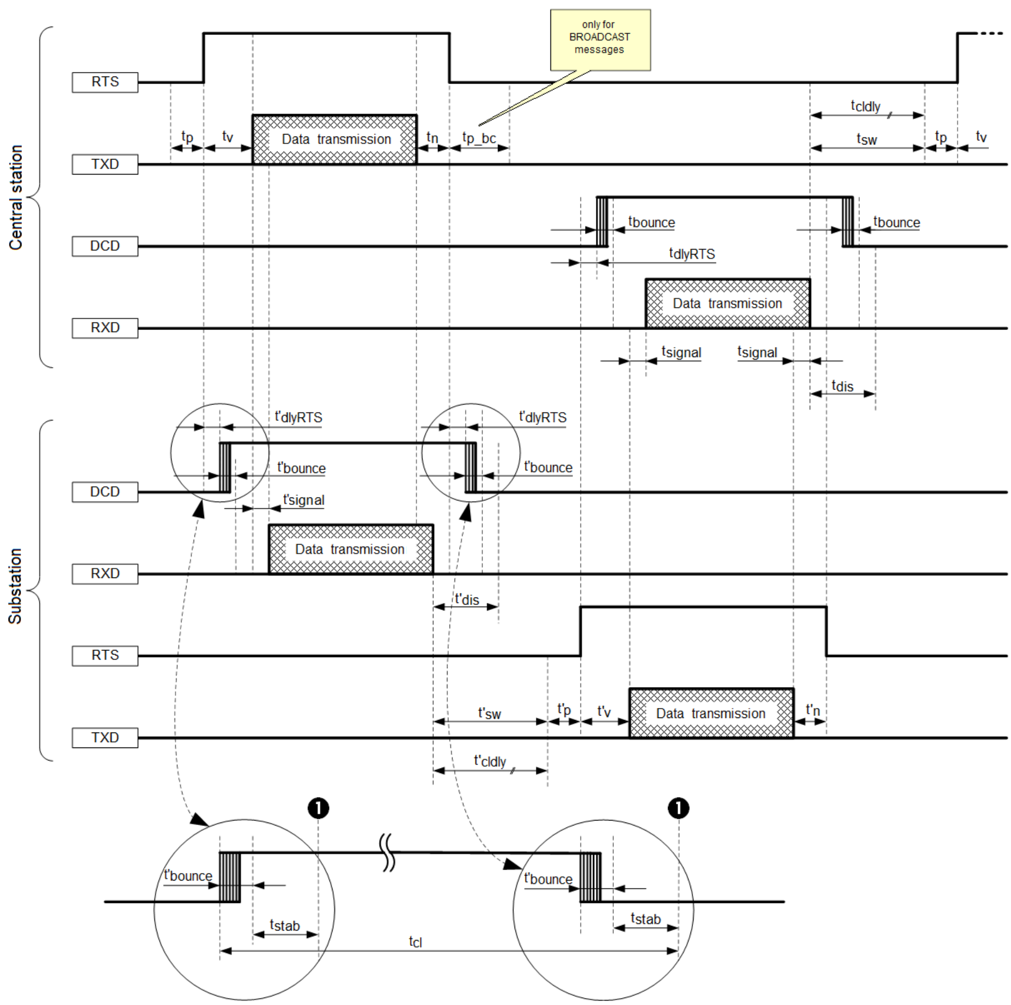
Legend:

RTS	↑↓ = RTS is for the control of the carrier switching of the modem scanned with each message (ON / OFF)
tp	Parameter **`Pause time (tp)`**
tv	Parameter **`Set-up time (tv)`**
tn	Parameter **`Run out time (tn)`**
tp_bc	Parameter **`Pause time after Broadcast message (tp_bc)`** (valid only for MASTER station!)
tdis	Parameter **`Disable time (tdis)`**
DCD	Parameter **`DCD-Handling`**
tbs	Parameter **`Bounce suppression time (tbounce)`**
tduration	Parameter **`Continuous level monitoring time (tcl)`**
tdelay	Parameter **`Transmission delay at level (tcldly)`**
~~A_I~~	~~Parameters **Asynchronous_Isochronous**, (A=asynchron, I=isochron) [BSE]~~
~~T~~	~~Parameters **Bit timing** (only with isochron) (I=internal, E=external) [BSE]~~
5V/12V	Parameter **`DSR Power Supply`** [BSE]

NOTE

The parameter on the basic system element [BSE] are not selected automatically by the selection of the transmission facility.. These parameter must be set by the user!

The following diagram shows the timing for the data transmission when using transmission facilities with switched carrier.



RTS .... Request to Send (switch on transmit part)
DCD .... Data Carrier Detect
TXD .... Transmit Data
RXD .... Receive Data
tdlyRTS .... Runtime of the transmission system (time difference between switch-on the transmit part (RTS ↑) and receiver ready (DCD ↑))
tp .... Pause time (delay before the transmit part is switched off with RTS)
tv .... Set-up time (transmit delay, after the transmit part has been switched on with RTS)
tn .... Run-out time (switch off transmit level with RTS after message transmission is delayed)
tp_bc .... Break time after broadcast messages (some systems require a longer break after the transmission of broadcast messages before the next message can be sent)
tsw .... Internal processing time
tsignal ...... Signal-transit time (depending on the transmission facility/transmission route used)
tbounce .... Detection time after a positive/negative DCD edge (DCD debouncing)
tstab .... Stability monitoring time - the new DCD status is only used once the stability monitoring time has elapsed for message synchronization
tcl .... Continuous level monitoring time
tcldly .... Transmit delay at continuous level - another message transmission is carried out at continuous level once the transmission delay has elapsed at the latest
tdis .... Disable time of the receiver after receiving a message (for suppressing the erroneous characters during level scanning)
t' .... Corresponding times in the substation
❶ DCD valid

[UMPxyy_Timing, 2, en_US]

Figure 13-9 Timing during transmission

13.4.8 Redundancy

To increase the availability of the master station, these units can be designed redundant.

In this section, the possible redundancy concepts themselves that can be realized are not described, rather only those functions supported by the protocol element for the support of redundant communication routes.

In the master station one of the following redundancy controls can be selected:

- Protocol redundancy
- Ring-Redundancy (Main-/Backup line with 2 interfaces)
- Deactivation of Interface

13.4.8.1 Protocol redundancy

The switchover of the redundancy state takes place system-internal by means of redundancy control messages.

In the master station, in addition a delay for the switchover of the redundancy state from PASSIVE (=STANDBY) to ACTIVE can be set with the parameter **`[PRE] Redundancy | Delay time passive=>active`** .

The operating mode of the interface with redundancy state "PASSIVE" can be set according to redundancy configuration with the parameter **`[PRE] Redundancy | Operation if passive`** as follows:

- Interface "tristate" – only listening mode
- Interface "active" – only listening mode
- Interface "active" – interrogation mode

From the redundant, not active master / remote terminal unit, listened messages are passed on to the basic system element (BSE) and forwarded by this in the system with the identifier "passive" in the state.

In redundant master stations that are not active, a failure of the interface is monitored globally and the failure of remote terminal units monitored station-selective.

The failure of the interface is detected by the STANDBY master station by monitoring for cyclic message reception. The monitoring time is set with the parameter **`[PRE] Redundancy | Listening mode (failure monitoring time)`** . On receive timeout (active central station or transmission facility of the central station has failed) the interface is signaled as failed.

The failure of a remote terminal unit is detected by the STANDBY master station through station-selective monitoring for cyclic message reception. On station-selective receive timeout (remote terminal unit or transmission facility of the remote terminal unit has failed) the remote terminal unit is signaled as failed.

Station-specific faults present are reset in a redundant STANDBY master station, if a faultless message from the respective station is “listened”.

13.4.8.2 Ring Redundancy

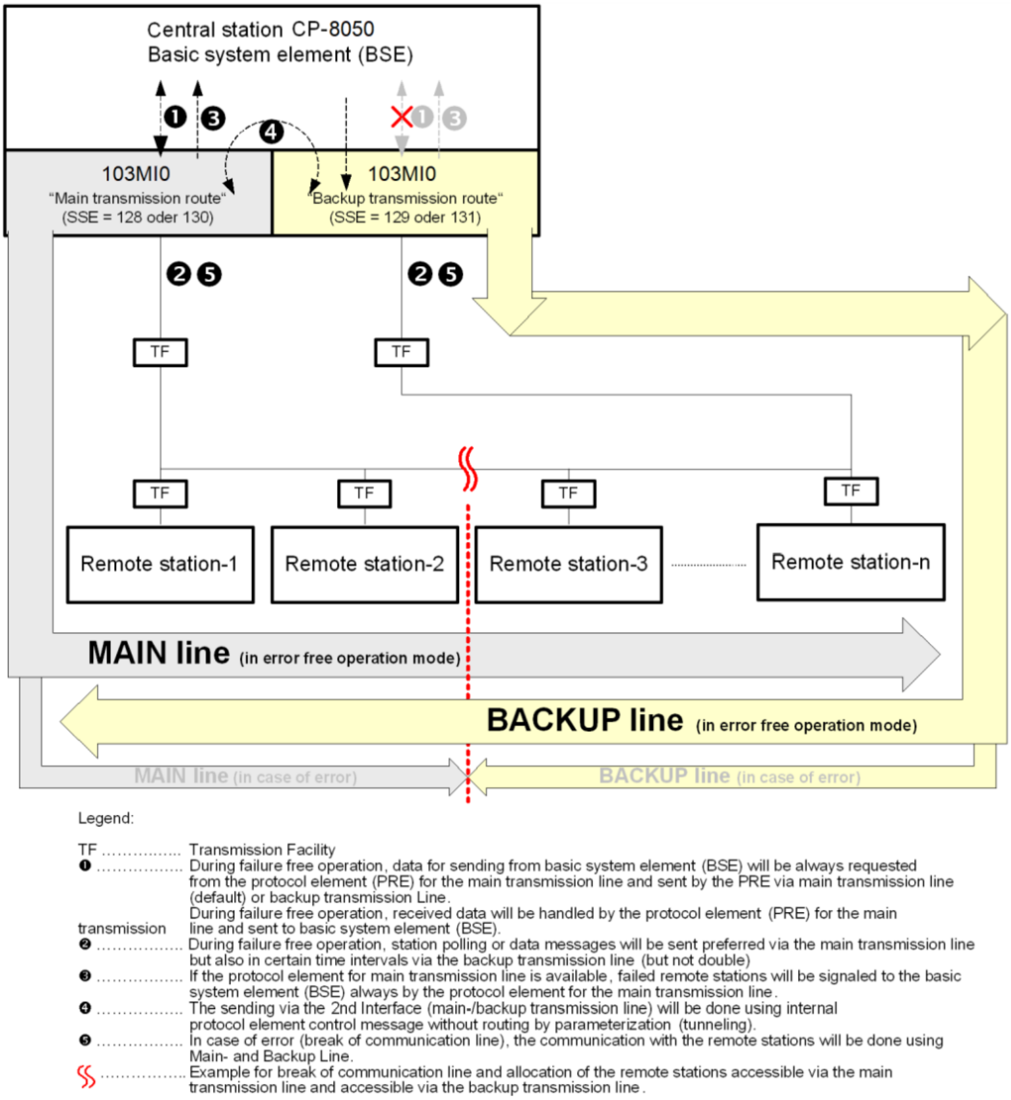
With redundancy mode “Ring-Redundancy” (Main-/Backup transmission line with 2 interfaces) the data transmission between the master station (controlling station) and the remote terminal units (controlled stations) takes place via the main transmission line or via the backup transmission line (stand-by transmission route).

The standby transmission line operation is activated with parameter **`Redundancy | stand-by transmission line`**.

In the error free operation mode the protocol element (PRE) for the main transmission line will control the data transmission from the basic system element (BSE), the data transmission to the remote terminal units preferred via the main transmission line but also (for monitoring) via the backup transmission line. Received data from the remote terminal units will also be handled and transmitted to the basic system element (BSE) by the protocol element for the main transmission line.

The data transmission via the backup transmission line is also controlled by the protocol element for the main transmission line. The data exchange between the assigned protocol elements will be done using a tunneling mechanism.

Schematic configuration for Main-/Standby transmission line operation with 2 interfaces:



[103MI0_Ring_Redundanz, 2, en_US]

A feature of this redundancy mode is supporting a switch over from main transmission line to backup transmission line without loss of data in case of failure of a transmission modem of the master station or break of the communication line in a way that enables communication to the remote stations either via main transmission line or backup transmission line.

In case of failure of a protocol element for main/- or backup line, data can be lost in transmit direction during redundancy switchover between the assigned protocol elements.

The assignment of the interface for main transmission line and standby transmission line is defined as follows:

Main Line	Backup Line	Note
ZSE = 128	ZSE = 129	The SSEs for Main-/Backup transmission line must be on the same BSE
ZSE = 130	ZSE = 131	The SSEs for Main-/Backup transmission line must be on the same BSE

Legend:

SSE ... Supplementary system element (with serial interfaces, this is always configured with a PRE)
PRE ... Protocol Element
BSE ... Basic System Element

In the error free operation mode the data communication from/to the remote stations will be done preferred via the main transmission line controlled by the protocol element for the main transmission line. The time synchronization control message will be sent 1st always via the main transmission line and also via the backup transmission line. The backup transmission line will be checked cyclically by the protocol element for the main transmission line. During check cycle the protocol element polls all remote stations once via the stand-by transmission line. Data to be sent via the protocol element for backup transmission line will be requested by the protocol element for backup transmission line and deleted without generating error and without sending.

If a communication error to a remote station on the communication line (main- or stand-by transmission line) will be detected by the protocol element for the main transmission line, an alarm information will be sent to the basic system (BSE). A remote station will be signaled as faulty if no communication to this station is possible via main transmission line and backup transmission line. Faulty remote stations will be polled further in the basic cycle but without retries. If communication to a faulty remote station is possible again via main- or backup transmission line the error for this station will be reset.

In case of communication errors from the master station to the remote station, retries will be sent by the master station via backup transmission line. Following retries will be transmitted alternately via main transmission line or via backup transmission line.

Both protocol elements perform a cyclic monitoring of the assigned partner protocol element for this redundancy mode. If the active protocol element fails, the previously passive protocol element takes over the function. When switching over, a general query is triggered by the active protocol element. The data is then only transmitted via the interface of its own protocol element. The assigned partner protocol element for this redundancy mode will be supervised further on. When the failed protocol element is available again, the redundancy via main-/stand-by transmission line is also available again.

If the protocol element for backup transmission line is actually "Active" and the protocol element for main transmission line becomes available again no redundancy switchover will be initiated and the protocol element for backup transmission line and the protocol element will be further "Active". The data pick-up from the basic system element, data transmission, fault signaling is then carried out by the protocol element for the alternative route.

A cyclic switchover between the assigned protocol elements is not supported! The passive protocol element only takes over the protocol functions if the active protocol element fails.

NOTE

Notes for parameter settings

- All data to the remote stations must be routed in the master station to both assigned interfaces
- Stand-by transmission line parameter in topology parameters must be deactivated for this redundancy mode.
- The line-by-line redundancy will not be supported by the protocol element in this redundancy mode.
- The simulation of measured values during general interrogation must be delayed by the protocol element using the parameter **`Advanced parameters | Imitation from measured values of GI`**
- The simulation of data with NT-bit (not topical) in case of failure must be delayed on the basic system element.

13.4.8.3 Port-Redundancy

Deactivation of interface with protocol element control message

With the possibility of deactivation of interface by a PRE control messages, simple redundancy solutions can be realized.

With deactivated interface the transmitter of the interface is switched to "tristate" and the data for transmission are requested from the basic system element and discarded without error message. Received messages are discarded and not passed on to the basic system element.

The activation/deactivation of the interface takes place through PRE control messages. With function enabled with the parameter `Redundancy | Interface deactivation` the interface is deactivated after startup of the protocol element.

With deactivation of the interface a possibly present failure of the interface is reset if no "listening mode (failure monitoring time)" is parameterized.

With activation of the interface, a general interrogation message is transmitted to the remote station by the protocol element.

With deactivated interface, no monitoring of the interface takes place!

13.4.9 Message Conversion

Data in transmit direction are transferred from the basic system element to the protocol element in the SICAM A8000 internal IEC 60870-5-101-/104 format. These are converted by the protocol element to the IEC 60870-5-103 message format on the line and transmitted according to the transmission procedure of the protocol.

Data in monitoring direction is received from the protocol element according to the transmission procedure according to IEC 60870-5-103, converted by the protocol element to the internal IEC 60870-5-101/104 format and then transferred to the basic system element.

The supported functionality (interoperability) is described in section *13.4.11 Interoperability IEC 60870-5-103 (103MI0)*.

NOTE

Generic data is only partially supported!

The parameter setting of the address conversion from IEC 60870-5-101 ⇔ IEC 60870-5-103 address and message format takes place with the “SIP-Message Address Conversion”.

IEC 60870-5-101/104 →		← IEC 60870-5-103	
Station No.	SICAM A8000 internal station number (0 to 99)	Link-address	SICAM A8000 internal station number (0 to 99)
CASDU1 CASDU2 IOA1 IOA2 IOA3	CASDU IOA	CASDU FUN INF	Station address of the protection equipment Function type Information number
TI	Type identification [142]	TI	Function type (type identification) [142]
Diverse	Additional info per category		

Message Conversion in Control Direction (Public Range of IEC 60870-5-103)

IEC 60870-5-101/104		IEC 60870-5-103		C
–	–	<TI:=6>	Time synchronization [143]	✓
–	General interrogation command (SICAM A8000 internal)	<TI:=7>	General interrogation	✓
<TI:=50>	Setpoint command, short floating-point number	<TI:=10>	Generic Data (Setpoint Command)	✓

[142] See Message Conversion in Send/Receive Direction

[143] Is generated from the protocol element; SICAM A8000 internally the time management message (function code 156) is used

IEC 60870-5-101/104		IEC 60870-5-103		C
<TI:=45> <TI:=46>	Single command Double command	<TI:=20>	General command	✓
<TI:=47>	Regulating step command	<TI:=20>	General command	✓
–	General interrogation command (SICAM A8000 internal)	<TI:=21>	Generic command (general interrogation command) [144]	✓
<TI:=142>	User data container "Disturbance record transmission to SICAM DISTO"	<TI:=24> <TI:=25>	Order to transmit disturbance data Acknowledgment for disturbance data transmission	✓ ✓
<TI:=45> <TI:=46>	Single command Double command	–	Reset of the fault locations (acts only protocol element internal) [145]	✓
<TI:=122>	Interrogation of file directory, [146] File selection, file interrogation, section interrogation			✓
<TI:=124>	File confirmation, section confirmation			✓

Message Conversion in Control Direction (Private Range of IEC 60870-5-103)

IEC 60870-5-101/104		IEC 60870-5-103		C
<TI:=45> <TI:=46>	Single command Double command	<TI:=232> <TI:=45, 46> <TI:=45, 46>	Command to protective device ALSTOM Command with SELECT/EXECUTE ALSTOM Command without SELECT/ EXECUTE ALSTOM	✓ ✓ ✓
<TI:=142>	User data container “Parameter messages to Reyrolle protective devices”	<TI:=254> <TI:=255>	REYDISP parameter frame REYDISP parameter “last frame”	✓ ✓

Message Conversion in Monitoring Direction (Public Range of IEC 60870-5-103)

IEC 60870-5-101/104 [147]		IEC 60870-5-103		C
<TI:=30>	Single-point information with time tag	<TI:=1>	Binary information with time tag	✓
<TI:=31>	Double-point information with time tag			
<TI:=38>	Events of protection equipment with time tag			
<TI:=39>	Blocked activation of the protection with time tag			
<TI:=40>	Blocked trip of the protection equipment with time tag			

144 Only general interrogation command for generic data is supported!
145 This command is not transmitted → the fault locations of the parameterized link address are reset to the corresponding initial value!
146 Is generated by the protocol element (only 103Mx0); Transmission of files in monitoring direction (disturbance record transmission of a protective device) according to IEC 60870-5-101/104
147 All with time tag format CP56Time2a

IEC 60870-5-101/104 [147]		IEC 60870-5-103		C
<TI:=30>	Single-point information with time tag	<TI:=2>	Binary information with relative time	✓
<TI:=31>	Double-point information with time tag			
<TI:=36>	Measured value, short floating-point number with time tag			
<TI:=38>	Events of protection equipment with time tag			
<TI:=39>	Blocked activation of the protection with time tag			
<TI:=40>	Blocked trip of the protection equipment with time tag			
<TI:=34>	Measured value, normalized value with time tag	<TI:=3>	Measured value I	✓
<TI:=35> [148]	Measured value, scaled value with time tag			
<TI:=36> [148]	Measured value, short floating-point number with time tag			
<TI:=34>	Measured value, normalized value with time tag	<TI:=4>	Real-time measured values with relative time	✓
<TI:=35> [148]	Measured value, scaled value with time tag			
<TI:=36> [148]	Measured value, short floating-point number with time tag			
<TI:=30>	Single-point information with time tag	<TI:=5>	Identification information [149]	✓
<TI:=31>	Double-point information with time tag			
–	–	<TI:=6>	Time synchronization, binary information [149]	
–	–	<TI:=8>	General interrogation end [149]	
<TI:=34>	Measured value, normalized value with time tag	<TI:=9>	Measured value II	✓
<TI:=35> [148]	Measured value, scaled value with time tag			
<TI:=36> [148]	Measured value, short floating-point number with time tag			
<TI:=36>	Measured value, short floating-point number with time tag	<TI:=10>	Generic data (measured value) [150]	✓
–	–	<TI:=11>	Generic identification	
<TI:=126>	File directory	<TI:=23>	List of recorded disturbances	✓
<TI:=120>	File ready [151]	<TI:=26>	Ready for transmission of disturbance data	✓

147 All with time tag format CP56Time2a

148 Not supported by protocol element for IEC 60870-5-103 substation in SICAM A8000 (103Sx0)

149 Is generated in the substation directly by the protocol element!

150 Only data in the format GDD [DATATYPE] = 7 (Short Real IEEE STD 754) is supported!

151 Is generated by the protocol element (only 103Mx0); Transmission of files in monitoring direction (disturbance record transmission of a protective device) according to IEC 60870-5-101/104

IEC 60870-5-101/104 [147]		IEC 60870-5-103		C
<TI:=121>	Section ready	<TI:=27>	Ready for transmission of a channel	✓
		<TI:=28>	Ready for transmission of tags	✓
<TI:=125>	Segment	<TI:=29>	Transmission of tags	✓
		<TI:=30>	Transmission of disturbance values	✓
<TI:=123>	Last section, last segment	<TI:=31>	End of transmission	✓
<TI:=142>	User data container "Disturbance record transmission to SICAM DISTO"	<TI:=23>	List of recorded disturbances	✓
		<TI:=26>	Ready for transmission of disturbance data	✓
		<TI:=27>	Ready for transmission of a channel	✓
		<TI:=28>	Ready for transmission of tags	✓
		<TI:=29>	Transmission of tags	✓
		<TI:=30>	Transmission of disturbance values	✓
		<TI:=31>	End of transmission	✓

Message Conversion in Monitoring Direction (Private Range of IEC 60870-5-103)

IEC 60870-5-101/104 [152]		IEC 60870-5-103		C
<TI:=30> <TI:=31>	Single-point information with time tag Double-point information with time tag	<TI:=33>	Real-time information (SEG protective devices)	✓
<TI:=30>	Single-point information with time tag	<TI:=65>	Single-point information with time ALSTOM	✓
		<TI:=66>	Single-point information without time ALSTOM	✓
<TI:=31>	Double-point information with time tag	<TI:=67>	Double-point information with time ALSTOM	✓
		<TI:=68>	Double-point information without time ALSTOM	✓
<TI:=33>	Bitstring of 32 bits with time tag	<TI:=71>	32-bit binary value ALSTOM	✓
		<TI:=72>		
<TI:=34>	Measured value, normalized value with time tag	<TI:=140>	Measured values SIEMENS	✓
<TI:=35>	Measured value, scaled value with time tag			
<TI:=36>	Measured value, short floating-point number with time tag			
<TI:=36>	Measured value, short floating-point number with time tag	<TI:=204>	Measured value, short floating-point number (Reinhausen TAPCON 240)	✓
<TI:=36>	Measured value, short floating-point number with time tag	<TI:=205>	Measured value 28-bit (SIPROTEC)	✓
<TI:=37>	Integrated totals with time tag			

147 All with time tag format CP56Time2a
152 All with time tag format CP56Time2a

IEC 60870-5-101/104 [152]		IEC 60870-5-103		C
<TI:=142>	User data container “Parameter messages to Reyrolle protective devices”	<TI:=253>	REYDISP termination of private data response frame	✓
		<TI:=254>	REYDISP parameter frame	✓
		<TI:=255>	REYDISP parameter “last frame”	✓

Causes of Transmission in Control Direction

IEC 60870-5-101/103		103MI0 [Central station]	103SI0 [Substation]
COT	Cause of transmission		
8	Time synchronization, command	✓	✓
9	GI initiation	✓	✓
19	ALSTOM command <TI:=232> [153]	✓	–
20	General command	✓	✓
31	Disturbance data transmission	✓	✓
40	Generic write command	✓	–
42	Generic read command	–	–

Causes of Transmission in Monitoring Direction

IEC 60870-5-101/103		103MI0 [Central station]	103SI0 [Substation]
COT	Cause of transmission		
1	Spontaneous	✓	✓
2	Cyclic	✓	✓
3	Reset information FCB	✓	✓
4	Reset information KE	✓	✓
5	Startup/restart information	✓	✓
6	First start information	✓	–
7	Test mode	✓	✓
8	Time synchronization, binary information	✓	✓
9	General interrogation	✓	✓
10	GI end information	✓	✓
11	Local operation	–	–
12	Remote operation	✓	✓
13	Remote operation negative [154]	✓	–
20	Return information to remote command positive	✓	✓
21	Return information to remote command negative	–	✓
31	Disturbance data transmission	✓	✓
40	Return information to generic write command positive	–	–
41	Return information to generic write command negative	–	–
42	Generic reading; data valid	✓	–
43	Generic reading; data invalid	–	–
44	Confirmation of a generic write command	–	–

152 All with time tag format CP56Time2a
153 Only for ALSTOM protection equipment!
154 Only for ALSTOM protection equipment!

Type identification 6: Time synchronization

The assignment of the IEC 60870-5-103 message address for the spontaneous information object “time synchronization” takes place without parameter setting by the protocol element of the central station.

The time synchronization is sent spontaneously when the time changes and cyclically in a parameterizable grid, always as “Broadcast” (send/no response) from the protocol element of the central station to the protective devices.

Elements of the Message (SICAM A8000 internal) BSE → PRE		Elements of the Message (IEC 60870-5-103) C → S	
Function code = 156 Information code = 0 .. Clock synchronization	Time management (SICAM A8000 internal) not evaluated	Type identification <TI:=6> .. Time synchronization	
		Message address CASDU = 255 .. Station address of the protection equipment (broadcast) FUN = 255 .. Global function type INF = 0 .. Information number	System function (time synchronization)
		Cause of transmission (COT) COT = 8 .. Time synchronization	
Time CP56Time2a ... Dual time with 7 octets	with this SICAM A8000 internal message, the internal clock of the protocol element is set and a time synchronization of the protection equipment connected in initiated.	Time CP56Time2a ... Dual time with 7 octets	In the message the time of the 1st bit is entered on the line

Type identification 7: General interrogation command

The assignment of the IEC 60870-5-103 message address for the spontaneous information object “general interrogation command” takes place without parameter setting by the protocol element of the central station. The general interrogation command is transmitted from the protocol element of the central station selectively for every CASDU per Link-Address (station address of the protection equipment).

Elements of the Message (SICAM A8000 internal) BSE → PRE		Elements of the Message (IEC 60870-5-103) C → S	
Function code = 155 Information code = 1 .. Source-GI request	General interrogation request (SICAM A8000 internal) not evaluated	Type identification	
		<TI:=7> .. General interrogation	
Message address		Message address	
CASDU .. Station address of the protection equipment		CASDU .. Station address of the protection equipment	
		FUN = 255 .. Global function type	
		INF = 0 .. Information number	System function
Cause of transmission (COT)		Cause of transmission (COT)	
<6> .. Activation		<9> .. Initiation of general interrogation	
Qualifier of interrogation	Not evaluated		

Elements of the Message (SICAM A8000 internal) BSE → PRE		Elements of the Message (IEC 60870-5-103) C → S	
		Cycle number (SCN)	
		SCN = 0 to 255 .. Cycle number	Beginning from 0, the cycle number is increased by 1 with each transmitted general interrogation command (per protective device). All data of a protective device subject to GI that is transmitted following a general interrogation command is transmitted with the cycle number of the general interrogation command. The cycle number is not evaluated in the central station.

NOTE

The IEC 60870-5-103 message in monitoring direction “General interrogation end” is not evaluated by the protocol element of the central station! ACTCON and ACTTERM for general interrogation request are not emulated by the protocol element of the central station!

Type identification 20: General command

Type Identification 45, 46, 232: General Command (in the private range)

The assignment of the message address for the spontaneous information object “general command” is carried out in the OPM II in the central station with the category**firmware / Trans_command**and in the substation with the category**firmware / Rec_command**.

Elements of the Message (IEC 60870-5-101/104) BSE ↔ PRE		Elements of the Message (IEC 60870-5-103) C → S	
Type identification		Type identification [155]	
<TI:=45> .. Single command		<TI:=20> .. General command	
		<TI:=232> .. Command to protective device	
		<TI:=45> .. Command with SEL / EXE	
		<TI:=45> .. Command without SEL / EXE	Private range [156]

155 TI is defined with the additional information in the OPM II (see Special Functions)

156 Command message in the private range of IEC 60870-5-103 to ALSTOM protection equipment (qualifier of command as for IEC 60870-5-101) ← only supported by central station!

Elements of the Message (IEC 60870-5-101/104) BSE ↔ PRE		Elements of the Message (IEC 60870-5-103) C → S	
<TI:=46> .. Double command		<TI:=20> .. General command	
		<TI:=232> .. Command to protective device	Private range [156]
		<TI:=46> .. Command with SEL / EXE	
		<TI:=46> .. Command without SEL / EXE	
<TI:=47> .. Regulating step command		<TI:=20> .. General command	
Message address		Message address	
CASDU (CASDU1, CASDU2)	Can be set by parameter	CASDU .. Station address of the protection equipment	Can be set by parameter
IOA (IOA1, IOA2, IOA3)	Can be set by parameter	FUN .. Function type	
		INF .. Information number	
		Return information identification (RII)	
Cause of transmission (COT)		Cause of transmission (COT)	
<6> .. Activation		<20> .. General command	Only for ALSTOM <TI:=232> [156]
<7> .. Confirmation of activation	PRE → BSE (after reception of return information or timeout)	<19> .. ALSTOM Command	
<8> .. Abortion of activation	Not supported		
<9> .. Confirmation of the abortion of activation	Not supported		
<10> .. Activation termination	PRE → BSE (after reception of return information or timeout)		
P/N .. positive/negative confirmation	PRE → BSE (after reception of return information or timeout)		
T ..Test	Not evaluated		
Originator address	See Set Control Location!		
Command qualifier		Command qualifier	
QU <0> .. No additional definitions		QU <0> .. No additional definitions	Only for <TI:=45>, <TI:=46> [156]
QU <1> .. Short command execution time		QU <1> .. Short command execution time	
QU <2> .. Long command execution time		QU <2> .. Long command execution time	
QU <3> .. Persistent command	Not supported	QU <3> .. Persistent command	
S/E <0> .. Execute	Only for IEC 60870-5-103 <TI:=45>, <TI:=46> [155]	S/E <0> .. Execute	
S/E <1> .. Select		S/E <1> .. Select	

Elements of the Message (IEC 60870-5-101/104) BSE ↔ PRE		Elements of the Message (IEC 60870-5-103) C → S	
Single command (SCO) <0> ..**OFF** <1> ..**ON**		Double command (DCO) <0> .. Not permitted <1> ..**OFF** <2> ..**ON** <3> .. Not permitted	
Double command (DCO) <0> .. Not permitted <1> ..**OFF** <2> ..**ON** <3> .. Not permitted			

Special functions (SIP-message address conversion of the central station):

- Additional info

<0> =	General command <TI:=20>	According to IEC 60870-5-103
<1> =	General command <TI:=232>	To ALSTOM protective device in the private range (COT = 19)
<2> =	General command <TI:=45>, <TI:=46>	To ALSTOM protective device in the private range with SELECT / EXECUTE
<3> =	General command <TI:=45>, <TI:=46>	To ALSTOM protective device in the private range without SELECT / EXECUTE
<4> =	General command <TI:=20>	According to IEC 60870-5-103 to substation (protection equipment) and emulation of SELECT / EXECUTE according to IEC 60870-5-101/104 in direction basic system element (BSE).

  The max. delay between SELECT / EXECUTE is monitored by the protocol element and must be set with the parameter **`[PRE] IEC60870-5-103 | Communication functions | Command transmission | Select/Execute command emulation | Timeout Execute`**.

<5> =	General command <TI:=232>	To ALSTOM protective device in the private range (COT = 20)

- Cross-over (exchange) of the double command states ON ↔ OFF during the message conversion IEC 60870-5-101 → IEC 60870-5-103
- Return information monitoring time

  The central station monitors whether the return information for a command is received within a settable time from the substation.

  With IEC 60870-5-103, the return information for the command is always transmitted with the address of the command.

Emulation of	Condition
ACTCON+	• Return information is received from the protection equipment with COT = 12 (remote operation) or COT = 20 (positive acknowledgment of command) or return information monitoring time = "0" → ACTCON+ emulate from PRE to BSE
ACTCON-	• No return information received (return information monitoring time expired) • Return information is received from the protection equipment with COT = 21 (negative acknowledgment of command) → ACTCON- emulate from PRE to BSE
ACTTERM+	• Return information is received from the protection equipment with COT = 20 (positive acknowledgment of command) or return information monitoring time = "0" → ACTTERM+ emulate from PRE to BSE
ACTTERM-	• No return information received (return information monitoring timeout) but ACTCON+ already transferred • Return information is received from the protection equipment with COT = 13 (negative acknowledgment of command) → ACTTERM- emulate from PRE to BSE

Legend:

BSE ... Basic system element
PRE ... Protocol element

Type identification 10: Generic Data (Setpoint Command)

The assignment of the message address for the spontaneous information object “Generic data (setpoint command)” is carried out in the OPM II with the category**firmware / Trans_generic_setpoint command(GDD=7)**..

Elements of the Message (IEC 60870-5-101/104) BSE → PRE		Elements of the Message (IEC 60870-5-103) C → S	
Type identification		Type identification	
<TI:=50> .. Setpoint command, short floating-point number		<TI:=10> .. Generic data	Setpoint command
Message address		Message address	
CASDU (CASDU1, CASDU2)	Can be set by parameter	CASDU .. Station address of the protection equipment	Can be set by parameter
IOA (IOA1, IOA2, IOA3)	Can be set by parameter	FUN = 254 .. Generic function type	
		INF = 250 .. Information number	Generic function
Cause of transmission (COT)		Cause of transmission (COT)	
<6> .. Activation		<40> .. Generic write command	
<7> .. Confirmation of activation	PRE → BSE (immediately by PRE)		
<8> .. Abortion of activation	Not supported		
<9> .. Confirmation of the abortion of activation	Not supported		
<10> .. Activation termination	Not supported		
P/N .. Positive/negative confirmation	Positive		
T ..Test	Not evaluated		
Originator address	Not evaluated		
		Generic data description (data record)	
		RII = 0 .. Return information identification	Not supported
		NGD = 1 .. Number of generic data records	
		GIN .. Generic identification number	Parameter-settable GIN [group, entry]
		KOD = 1 .. Actual Value	
		GDD [DATATYPE] = 7 .. IEEE STD 754	Short real IEEE STD 754
		GDD [DATASIZE] = 4 .. 4 Octets	
		GDD [NUMBER] = 1	Number of data elements
		GDD [CONT] = 0	No following data elements
Data		Generic data	

Elements of the Message (IEC 60870-5-101/104) BSE → PRE		Elements of the Message (IEC 60870-5-103) C → S	
Short floating-point number IEEE STD 754	32-bit floating-point number	GID = short floating-point number (IEEE STD 754)	32-bit floating-point number
Identifier for setpoint command (QOS)			
QL <0> .. Not defined	Not supported		
QL <1 to 127>	Not supported		
S/E <0> .. Execute	Not supported		
S/E <1> .. Select	Not supported		

Type identification 21: Generic Command (general interrogation command for generic data)

The assignment of the message address for the spontaneous information object “Generic command (general interrogation command for generic data)” is carried out without parameter setting by the protocol element of the central station.

The general interrogation command is transmitted selectively for each CASDU per Link Address (station address of the protection equipment).

Elements of the Message (SICAM A8000 internal) BSE → PRE		Elements of the Message (IEC 60870-5-103) C → S	
Function code = 155	General interrogation request (SICAM A8000 internal) not evaluated	Type identification	
Information code = 1 .. Source-GI request		<TI:=21> .. Genenic command	General interrogation command for generic data
Message address		Message address	
CASDU .. Station address of the protection equipment		CASDU .. Station address of the protection equipment	
		FUN = 254 .. Generic function type	
		INF = 245 .. Information number	Generic function
Cause of transmission (COT)		Cause of transmission (COT)	
<6> .. Activation		<9> .. Initiation of general interrogation	
T .. Test	Not evaluated		
P/N .. Positive/negative confirmation	Not evaluated		
Originator address	Not evaluated		

Elements of the Message (SICAM A8000 internal) BSE → PRE		Elements of the Message (IEC 60870-5-103) C → S	
qualifier of interrogation	Not evaluated	Generic data description (data record)	
		RII = 0 .. Return information identification (= cycle number)	Beginning from 0, the cycle number is increased by 1 with each transmitted general interrogation command (per protective device). All data of a protective device subject to GI that is transmitted following a general interrogation command is transmitted with the cycle number of the general interrogation command. The cycle number is not evaluated in the central station.
		NOG = 0 .. Number of generic identifications	

NOTE

ACTCON and ACTTERM for general interrogation request are not emulated by the protocol element of the central station!

Type identification 253: REYDISP termination of private data response frame

Type identification 254: REYDISP parameter frame

Type identification 255: REYDISP parameter "last frame"

The assignment of the message address for the spontaneous information object “user data container” is carried out in the OPM II with the category**firmware / Trans_container**and the category**firmware / Rec_container**. The parameters `Containertype_Rec` and `Containertype_Tra` must be set to ***Reydisp container*** (see also section *13.4.6 Transfer of Parameters for Reyrolle Protection Equipment*).

Elements of the Message (IEC 60870-5-101/104) BSE ↔ PRE		Elements of the Message (IEC 60870-5-103) C ↔ S	
Type identification		Type identification	
<TI:=142> .. User data container	User data container for REYDISP parameter data	<TI:=253> .. REYDISP termination of private data response frame	Monitoring direction
		<TI:=254> .. REYDISP parameter frame	control/monitoring direction
		<TI:=255> .. REYDISP parameter last frame	
Message address		Message address	
CASDU (CASDU1, CASDU2)	Can be set by parameter	CASDU .. Station address of the protection equipment	Can be set by parameter

Elements of the Message (IEC 60870-5-101/104) BSE ↔ PRE		Elements of the Message (IEC 60870-5-103) C ↔ S	
IOA (IOA1, IOA2, IOA3)	Can be set by parameter	FUN = xx .. Is not evaluated! [157]	
		INF = xx .. Is not evaluated! [157]	
Cause of transmission (COT)		Cause of transmission (COT)	
<3> .. Spontaneous		<xx> .. Is not evaluated! [157]	
T .. Test	Not evaluated		
P/N .. Positive/negative confirmation	Not evaluated		
Originator address	Not evaluated		
User data part	IEC 60870-5-103 message formats for the transmission of REYDISP parameter data are transmitted in the user data part of the user data container.		

Type identification 23: List of recorded disturbances

Type identification 24: Order to transmit disturbance data

Type identification 25: Acknowledgment for disturbance data transmission

Type identification 26: ready for transmission of disturbance data

Type identification 27: ready for transmission of a channel

Type identification 28: ready for transmission of tags

Type identification 29: transmission of tags

Type identification 30: transmission of disturbance values

Type identification 31: End of transmission

The assignment of the message address for the spontaneous information object “user data container” is carried out in the OPM II with the category**firmware / Trans_container**and the category**firmware / Rec_container**. The parameters **`Containertype_Rec`** and **`Containertype_Tra`** must be set to ***`Reydisp container`*** (see also section *13.4.5.8 File Transfer*).

Elements of the Message (IEC 60870-5-101/104) BSE ↔ PRE		Elements of the Message (IEC 60870-5-103) C ↔ S	
Type identification		Type identification	
<TI:=142> .. User data container	User data container for disturbance record transmission	<TI:=23> .. List of recorded disturbances	Monitoring direction
		<TI:=24> .. Order to transmit disturbance data	Control direction
		<TI:=25> .. Acknowledgment for disturbance data transmission	

157 These information items are copied 1:1 from the user data container into the IEC 60870-5-103 format without assessment

Elements of the Message (IEC 60870-5-101/104) BSE ↔ PRE		Elements of the Message (IEC 60870-5-103) C ↔ S	
		<TI:=26> .. Ready for transmission of disturbance data	Monitor direction
		<TI:=27> .. Ready for transmission of a channel	
		<TI:=28> .. Ready for transmission of tags	
		<TI:=29> .. Transmission of tags	
		<TI:=30> .. Transmission of disturbance values	
		<TI:=31> .. End of transmission	
Message address		Message address	
CASDU (CASDU1, CASDU2)	Can be set by parameter	CASDU .. Station address of the protection equipment	Can be set by parameter
IOA (IOA1, IOA2, IOA3)	Can be set by parameter	FUN = 255 .. Only for <TI:=24> [158]	
		INF = 0 .. Only for <TI:=24> [158]	
Cause of transmission (COT)		Cause of transmission (COT)	
<3> .. Spontaneous	In monitoring direction	<31> .. Only with <TI:=24> [158]	
<6> .. Activation	In control direction		
T .. Test	Not evaluated		
P/N .. Positive/negative confirmation	Not evaluated		
Originator address	Not evaluated		
User data part	[159]		

Type identification 1: Binary information with time tag

Type identification 2: Binary information with relative time

The assignment of the message address for the spontaneous information object “binary information” is carried out in the OPM II in the central station with the category**firmware / Rec_binary**and in the substation with the category**firmware / Trans_binary_information**.

Elements of the Message (IEC 60870-5-101/104) BSE ← PRE		Elements of the Message (IEC 60870-5-103) C ← S	
Type identification (all with time tag CP56Time2a)		Type identification	
<TI:=30> .. Single-point information		<TI:=1> .. Binary information with time tag	

158 These information items only have the specified values with <TI:=24> – with all other TIs these information items are copied 1:1 from the user data container into the IEC 60870-5-103 format without assessment

159 IEC 60870-5-103 message formats for the transmission of files are transmitted in the user data part of the user data container

Elements of the Message (IEC 60870-5-101/104) BSE ← PRE		Elements of the Message (IEC 60870-5-103) C ← S	
<TI:=31> .. Double-point information		<TI:=2> .. Time-tagged message with relative time [160]	
<TI:=32> .. Measured value, short floating-point number	Only for relative time as measured value		
<TI:=38> .. Event of protection equipment			
< TI := 39 >.. Blocked activation of the protection			
< TI := 40 >.. Blocked trip of the protection			
Message address		Message address	
CASDU (CASDU1, CASDU2)	Can be set by parameter	CASDU .. Common address of ASDU	Can be set by parameter
IOA (IOA1, IOA2, IOA3)	Can be set by parameter	FUN .. Function type	
		INF .. Information number	
Cause of transmission (COT)		Cause of transmission (COT) [161]	
<3> .. Spontaneous		<1> .. Spontaneous	
<20> .. Interrogated by station interrogation		<9> .. General interrogation	
<12> .. Return information, caused by a local command		<11> .. Local operation	
<11> .. Return information, caused by a remote command		<12> .. Remote operation	
T .. Test		<7> .. Test mode [162]	
P/N .. Positive/negative confirmation			
Originator address	Not defined		
Quality descriptor			
BL = 0 .. Blocked	Not used		
SB = 0 .. Substituted	Not used		
NT .. Not topical	Emulated by the basic system element on failure of the protocol element or the substation		
IV = x .. Invalid	Only for <TI:=39>, <TI:=40>		
EI = 0 .. Elapsed time (0/1 = valid/invalid)	Not used		
• Double-point information state (DPI)	Only <TI:=31>	Double-point information (DPI)	
• Binary information state (ES)	Only <TI:=38>		
<0> .. Undetermined state	Intermediate position	<0> .. Not used	
<1> .. OFF		<1> .. OFF	
<2> .. ON		<2> .. ON	
<3> .. Undetermined state	Faulty position	<3> .. Not used	

160 Binary information items with relative time are not supported by the SICAM A8000 substation!

161 Binary information items with other causes of transmission are discarded!

162 See section *Test Mode, Page 927*

Elements of the Message (IEC 60870-5-101/104) BSE ← PRE		Elements of the Message (IEC 60870-5-103) C ← S	
Time		Time	
CP56Time2a .. Dual time with 7 octets		CP32Time2a .. Dual time with 4 octets	
Start events of protection equipment	Only <TI:=39>		
SRD .. Start of operation in reverse direction	The IEC 60870-5-103 binary information state can be assigned to one of these binary information items		
SIE .. Start of operation IE (earth current)			
SL3 .. Start of operation phase L3			
SL2 .. Start of operation phase L2			
SL1 .. Start of operation phase L1			
GS .. General start of operation			
Binary information to the output current circuit of the protection equipment	Only <TI:=40>		
CL3 .. Binary information phase L3 OFF	The IEC 60870-5-103 binary information state can be assigned to one of these binary information items		
CL2 .. Binary information phase L2 OFF			
CL1 .. Command to output circuit phase L1			
GC .. Binary information General OFF			
Measured value, short floating-point number	Only <TI:=36> (relative time as measured value)	Relative time (CP16Time2a)	
Elapsed time (CP16Time2a)	Only <TI:=38>		
Relay duration time (CP16Time2a)	Only <TI:=39>		
Relay operation time (CP16Time2a)	Only <TI:=40>		
Measured value, short floating-point number	Only <TI:=36>	Fault number	
		Additional information (SIN) [163]	

The additional information (SIN) is used in the substation in monitoring direction as follows:

- Cause of transmission = general interrogation → SIN = cycle number of the GI command
- Cause of transmission = command acknowledgment → SIN = return information identification of the command
- Cause of transmission = other → SIN = not used

163 In central station not evaluated

Suggestions for the SIP message address conversion of the central station:

- Type information (selection of the data to be converted from the IEC 60870-5-103 message)
  From IEC 60870-5-103 messages in the format "Binary information with time tag", the state of the double-point information can be converted to a IEC 60870-5-101/104 message format. The correct type identification (TI) is to be parameterized for the selected data.
  From IEC 60870-5-103 messages in the format "Binary information with relative time", the state of the double-point information or the relative time or the fault number can be converted to IEC 60870-5-101/104 message format. The correct type identification (TI) is to be parameterized for the selected data. For each selective data type, a routing record must be entered in the SIP message address conversion.
- Additional info ... Binary information type
  With additional info "only coming binary information", after the transfer of the received binary information "coming", the binary information "going" is emulated by the protocol element with the "received time + 10 ms".
- GI initiation ... Initiation of a general interrogation command on reception of this binary information item
- Double-point information assignment
  With this function, 2 received single-point information items can be converted to 1 double-point information item.
  Note: For both single-point information items, the same SICAM A8000 address of the double-point information item must be parameterized!
- Intermediate/faulty position suppression_t: (intermediate/faulty position suppression time)
  If no intermediate/faulty position suppression time is parameterized, then a received double-point information item is transferred immediately to the basic system element. With intermediate/faulty position suppression time parameterized, a received double-point information item with intermediate or faulty position is not transferred to the basic system element. The double-point information item is buffered on the protocol element and an intermediate or faulty state position suppression is performed. If a valid switching state (ON or OFF) is received during the suppression time, then this double-point information state is transferred immediately to the basic system element and the intermediate/faulty position suppression handling is terminated. After expiry of the suppression time, the intermediate/faulty position of the double-point information is transmitted to the basic system element.

Type identification 33: Binary information with time tag

Type identification 65: Single-point information

Type identification 66: Single-point information with time tag

Type identification 67: Double-point information

Type identification 68: Double-point information with time tag

The assignment of the message address for the spontaneous information object "binary information" is carried out in the OPM II in the central station with the category**firmware / Rec_binary**.

Elements of the Message (IEC 60870-5-101/104) BSE ← PRE		Elements of the Message (IEC 60870-5-103) C ← S	
Type identification (all with time tag CP56Time2a)		Type identification	
<TI:=30> .. Single-point information		<TI:=33> .. Binary information with time tag	Private range [164]
<TI:=31> .. Double-point information		<TI:=65> .. Single-point information without time tag	Private range [165]
		<TI:=66> .. Single-point information with time tag	
		<TI:=67> .. Double-point information without time tag	
		<TI:=68> .. Double-point information with time tag	
Message address		Message address	
CASDU (CASDU1, CASDU2)	Can be set by parameter	CASDU .. Common address of ASDU	Can be set by parameter
IOA (IOA1, IOA2, IOA3)	Can be set by parameter	FUN .. Function type	
		INF .. Information number	

Type identification 3: Measured value I

Type identification 4: Real-time measured values with relative time

Type identification 9: Measured value II

The assignment of the message address for the spontaneous information object “measured value” in receive direction is carried out in the OPM II in the central station with the category**firmware / Rec_measured_value**.

The assignment of the message address for the spontaneous information object “Messwert” in transmit direction is carried out in the OPM II in the substation with the category**firmware / Trans_measured value**.

Elements of the Message (IEC 60870-5-101/104) BSE ← PRE		Elements of the Message (IEC 60870-5-103) C ← S	
Type identification (all with time tag CP56Time2a)		Type identification	
<TI:=34> .. Measured value, normalized value		<TI:=3> .. Measured value I	
<TI:=35> .. Measured value, scaled value [166] [167]		<TI:=4> .. Real-time measured value with relative time	Fault location values
<TI:=36> .. Measured value, short floating-point number [167]		<TI:=9> .. Measured value II	
Message address		Message address	
CASDU (CASDU1, CASDU2)	Can be set by parameter	CASDU .. Common address of ASDU	Can be set by parameter
IOA (IOA1, IOA2, IOA3)	Can be set by parameter	FUN .. Function type	
		INF .. Information number	
		Subvalue ... Number of the measured value in message	

164 Binary information with time tag SEG protective device

165 Binary information with time tag ALSTOM protective device

166 Fault location values that are converted to the IEC 60870-5-101/104 message format “<TI:=35> measured value, scaled value with time tag” can, if necessary, be multiplied by a parameter-settable factor in the master station before the conversion – as a result, the places after the decimal point that are otherwise truncated can be shown in the new format, the factor can be set with the parameter**Advanced parameters | Multiplication factor for fault location value (fract.digit)**.

167 supported by protocol element for IEC 60870-5-103 substation in SICAM A8000 103Sx0)

Elements of the Message (IEC 60870-5-101/104) BSE ← PRE		Elements of the Message (IEC 60870-5-103) C ← S	
Cause of transmission (COT)		Cause of transmission (COT)	
<3> .. Spontaneous		<1> .. Spontaneous	
		<2> .. Cyclic	
<20> .. Interrogated by station interrogation		<9> .. General interrogation	
Originator address	Not defined		
Quality descriptor			
BL = 0 .. Blocked	Not used		
SB = 0 .. Substituted	Not used		
NT .. Not topical	NT = ER [168]	ER = x .. Error <0> .. If NT = 0 and IV = 0 [169] <1> .. wenn NT = 1 or IV = 1 [169]	
IV = x .. Invalid			
OV = x .. Overflow		OV = x .. Overflow	
Value [166]	Converted and scaled 103 measured value	MEA ... Measured value type 103 measured value Only for <TI:=3>, <TI:=9>	Can be set by parameter
Value [166]	Converted and scaled 103 measured value	SCL ... Short circuit location Only <TI:=4>	Can be set by parameter
–	–	FAN (fault number) Only <TI:=4>	The fault number (FAN) is incremented with each general start of operation received from BSE → PRE
–	–	RET ... Relative time Only <TI:=4>	= 0

Suggestions for the SIP message address conversion of the central station:

- Type of measured values (selection of the measure value data format in IEC 60870-5-103 Message)
  <0> = Measured value I or measured value II
  <1> = Measured value at real-time value with relative time
  <2> = Relative time at real-time value with relative time
  <3> = Disturbance record number at real-time value with relative time

NOTE

- For type identification 3 (measured value I) or type identification 9 (measured value II) or type identification 140 (measured values SIEMENS) only type of measured value = "0" (measured value I or measured value II) is valid.
- When parameterizing measured values, it should be noted that the sub-value starts counting at "0". Regardless of what is configured on the remote station.

13.4.9.1 Blocking

The data transmission according to IEC 60870-5-103 defines no blocking!

168 Only receive direction central station
169 Only transmit direction substation

13.4.9.2 Class 1, 2 Data

Measured values are normally transmitted from the protection equipment (remote terminal units) as "Class 2 data" and all other information as "Class 1 data". If protection equipment only supply "Class 1 data", then the master station can omit an interrogation for "Class 2 data" for these stations. For this the type of data interrogation can be determined selectively for every remote terminal unit in the master station in the parameters for the **`[PRE] Station definition`** with the parameter **`[PRE] Station definition | Prioritization of data`** .

Class 1 data stored for transmission are indicated to the master station with ACD-Bit=1 in the control field of every message.

13.4.9.3 Special Functions

For the coupling of protection equipment, if necessary, the following special functions can be activated for the adaptation of the message conversion:

- Send fault location value with GI
- Reset fault location values
- Signaling / measured value disabling
- Technological adaptation for measured values
- Measured value change monitoring
- Monitoring intermediate and faulty positions of double-point information
- Transfer of the information “Blocked activation/tripping of the protection”
- Transmit non-updated process images
- Emulation of the going binary information

Send Fault Location Values with GI

With general interrogation, fault location values are not transmitted from the protection equipment. If the fault location values are also expected with general interrogation in higher-level control center systems, then with a general interrogation these can be emulated by the protocol element from the internal process image.

This function is activated with the parameter **`PRE] IEC60870-5-103 | Communication functions | General interrogation | Send fault location values within GI`**.

Reset fault location values

Fault location values are transmitted from the protection equipment in monitoring direction with the type identification “<TI:=4> real-time measured values with relative time”. Fault location values are not reset by the protection equipment!

For the processing of the fault location values in the control center system, the protocol element provides the following special functions:

- Reset fault location value with command
- Reset fault location value automatically

The fault location values are reset in the internal process image of the protocol element and from this emulated spontaneously to the BSE with the parameterized initial values.

A large number of fault location values to be emulated with initial value can lead to a high data load in the system for a short time, which can lead to problems with the further distribution in the system.

The reset of the fault location values can be slowed down. Thereby, a parameterized pause is always maintained after 5 fault location values emulated with initial value (measured value messages). The pause is set with parameter **`[PRE] IEC60870-5-103 | Communication functions | Fault location values | Send initial values with delay`**.

Reset Fault Location Values with Command

After the spontaneous transmission of the fault location values from the protective devices, these can be reset on the protocol element with a special command message. The reset fault location values are transmitted spontaneously from the protocol element with the parameterized initial value.

The assignment of the message address for the spontaneous information object “Command to reset the fault location values” is carried out in the OPM II with the category *firmware*/**Trans_command_reset_error_location**.

With an IEC 60870-5-101/104 command message, all fault location values received from one protection device (“<TI:=4> real-time measured values with relative time”) can be reset in the process image of the protocol element of the central station. A specific command message must be used for each protective device (per Link address).

This command is not transmitted, rather only processed "protocol element internal". The fault location values are reset to the parameter-settable initial value.

The initial values for the fault location values can be parameterized for the various IEC 60870-5-101/104 measured value formats with the parameters **[PRE] IEC60870-5-103 |Communication functions | Fault location values | Initialization value 16 bit normalized (TI 34)**, dem Parameter **[PRE] IEC60870-5-103 | Communication functions | Fault location values | Initialization value 16 bit scaled (TI 35)** and parameter **[PRE] IEC60870-5-103 | Communication functions | Fault location values | Initialization value Floating Point (TI 36)**.

Reset fault location values automatically

After the spontaneous transmission of the fault location values from the protective devices, these can be reset by the protocol element after a parameter-settable time. The reset fault location values are transmitted spontaneously from the protocol element with the parameterized initial value.

This function is activated with parameter **[PRE] IEC60870-5-103 | Communication functions | Fault location values | Reset fault location values automatically** and parameter **[PRE] IEC60870-5-103 | Communication functions | Fault location values | Imitate initialization values**. In addition, with the parameter **[PRE] IEC60870-5-103 | Communication functions | Fault location values | automatic Reset fault location values** the delay time is also set.

The initial values for the fault location values can be parameterized for the various IEC 60870-5-101/104 measured value formats with the parameters **[PRE] IEC60870-5-103 |Communication functions | Fault location values | Initialization value 16 bit normalized (TI 34)**, dem Parameter **[PRE] IEC60870-5-103 | Communication functions | Fault location values | Initialization value 16 bit scaled (TI 35)** and parameter **[PRE] IEC60870-5-103 | Communication functions | Fault location values | Initialization value Floating Point (TI 36)**.

The IEC 60870-5-101/104 format for every fault location value is parameterized in OPM II in the “SIP message address conversion”.

Signaling / measured value disabling

The signaling/measured value disabling is a function of the protection equipment and can be activated globally (for binary information and measured values together) for example by means of a key lock switch or by means of a control input in the protection equipment. Through the signaling / measured value disabling function, the spontaneous transmission of the data from the protection equipment to the central station is deactivated.

With activation/deactivation of the signaling/measured value disabling, the binary information *signaling/ measured value disabling* is transmitted spontaneously to the central station. The signaling / measured value disabling is transmitted as last binary information with activation and as first binary information with deactivation.

With activation of the signaling/measured value disabling, the data concerned are not emulated to the basic system element by the protocol element of the central station with the status ”blocked” in the IEC 60870-5-101/104 format.

With deactivation of the signaling / measured value disabling, to update the data a general interrogation can be triggered to the protection equipment by the protocol element of the master function.

So that the general interrogation can be triggered with deactivation of the signaling/measured value disabling, the information *signaling/measured value disabling* of the protection equipment must be entered in the SIP message address conversion in receive direction with the category *firmware***Rec_binary_information**. In addition, in the category the setting **initiate GI with going edge** must be selected in the field **GI-initiation**.

Technological Adaptation for Measured Values

The technological adaptation enables the measured value supplied by the protection equipment to be transformed into a technological or normalized value. Into which value can be converted, is dependent on the format of the spontaneous information object "Measured value" to be transferred.

Spontaneous information object	Value range	Meaning
Measured value, normalized value	-1 to $+1-2^{-15}$	Normalized, percentage representation
Measured value, scaled value	–32768 to +32767	Technological, integer
Measured value, short floating-point number	$-8.43 \cdot 10^{-37}$ to $+3.37 \cdot 10^{38}$	Technological, floating point

Depending on the protocol element, the parameters for the technological adaptation are parameterized per measured value as adaptation line with 2 interpolation points. The received measured value is adapted linear according to the parameter setting by the protocol element before transfer to the basic system element.

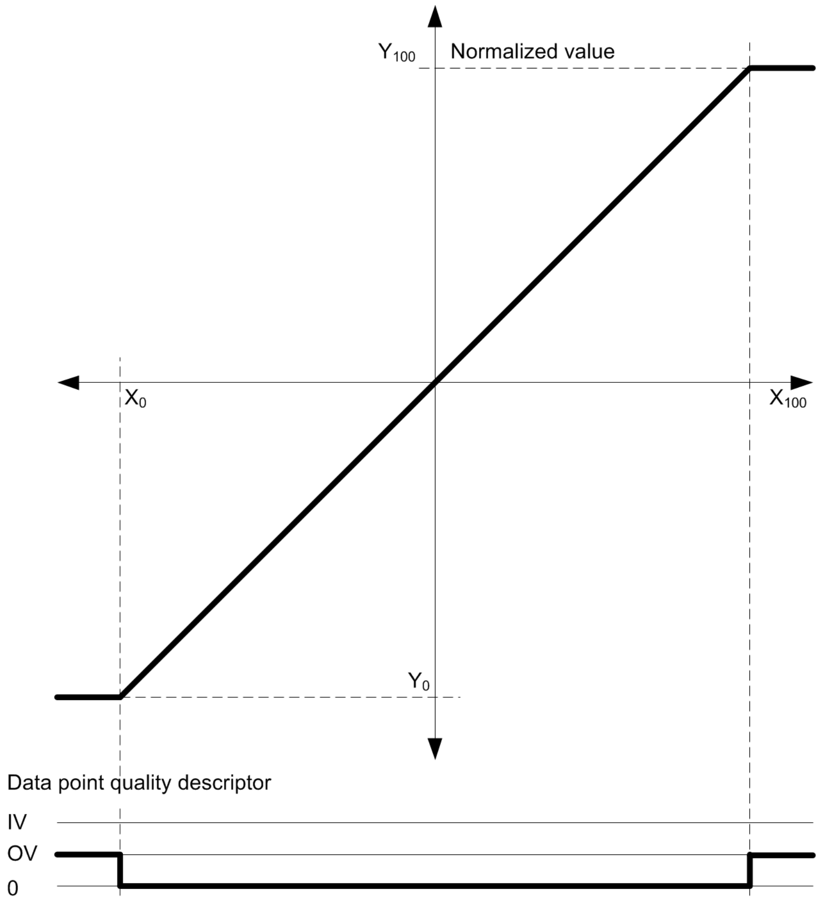
The adaptation line with 2 interpolation points is to be parameterized for each measured value with the parameters **X_0%**, **X_100%**, **Y_0%** und **Y_100%**. For this, the technological value Y0 is parameterized for the lower limit of the measuring range X0 and the technological value Y100 for the upper limit of the measuring range X100.

The adaptation line with "kx + d" is to be parameterized for each measured value with the parameters **Factor_k** and **Offset_d**.

Bipolar measured values without zero-range suppression and plausibility check

Example for <TI:= 3, 9>

	Value	Meaning	Parameter
X0	-1	Lower boundary of the measuring range (set by parameter)	X_0%
X100	+1	Upper boundary of the measuring range (set by parameter)	X_100%
Y0		Technological value at X0	Y_0%
Y100		Technological value at X100	Y_100%



Measured value change monitoring

Measured values are transmitted from some protection equipment with the smallest changes in measured value or even cyclic.

So as not to load the following transmission facilities unnecessarily, the measured value is monitored for change in accordance with the following rules:

- The first value received after startup is transmitted immediately.
- Every change of the quality descriptors blocked, invalid or overflow triggers an immediate transmission.
- Change monitoring in accordance with the method of the additive threshold value procedure.

Additive Threshold Value Procedure

In the parameterized processing grid the measured value is monitored for change. In the parameterized processing grid the measured value is monitored for change. If the deviation from the last spontaneously transmitted measured value is greater than the parameterized **`Threshold_absolute`**, the new measured value is transmitted immediately. Otherwise, in the parameterized processing grid the deviations from the last spontaneously transmitted measured value are totalled according to the polarity sign. First when the amount of this total exceeds the parameterized **`Thresh_additive`** is the current measured value spontaneously transmitted.

Thresh uncond	Thresh additive	Processing
0	0	Value is sent to BSE in the next processing grid upon change
0	≠ 0	
≠ 0	0	Value will not be sent to BSE (only with status change)
≠ 0	≠ 0	• Change ≥ **thresh_uncond**: Value will be sent to BSE in the next processing grid • Change < **thresh_uncond**: Additive Threshold Value Procedure

A transmission of the measured value due to a general interrogation does not influence the threshold value procedure.

Parameterization defines:

- Processing grid: 1 s to 25.5 s
- Threshold_Unit (optional): % or absolute
- Thresh_uncond: 0.00 % to 103.00 % or 0.0 to 999.9
- Thresh_additive: 0.0 % to 1000.0 % or 0.0 to 999.9

The percentages given refer to the parameterized value for Y_{100} - $Y_{at\ X=0}$.

The values for the parameter **Thresh_additive** and **Thresh_uncond** are absolute values and refer to the value after the technological adaptation.

The processing grid is to be parameterized for all measured values with the parameter **[PRE] IEC60870-5-103 | Communication function | Measured values | Measured value thresholds | Cycle time for measured change monitoring**.

The following example shows a normal case, where the adaptation line goes through the zero point (origin) ($Y_{at\ X=0}$ = 0).

Examples

Technological value Y_{100} 4000

Processing grid 0,1 s

Thresh_uncond 2 % represents a change of 80

Thresh_additive 150 % represents an additive total of 6000

Example 1:

After transmission due to the exceeding of the large threshold, the value has changed once by 79 (< the large threshold) and subsequently remains constant.

→ The measured value is transmitted after 7.5 seconds.

	0.0 s	0.1 s	0.2 s	0.3 s	0.4 s	0.5 s	0.6 s	0.7 s	0.8 s	...	7.4 s	7.5 s
Measured value	300	379	379	379	379	379	379	379	379	...	379	379
Difference	>80	79	79	79	79	79	79	79	79	...	79	79
Additive total	0	79	158	237	316	395	474	553	632	...	5925	6004
Transmission	x											x

Example 2:

After transmission due to the exceeding of the large threshold, the value has changed once by 1 (< the large threshold) and subsequently remains constant.

→ The measured value is transmitted after 10 minutes.

	0.0 s	0.1 s	0.2 s	0.3 s	0.4 s	0.5 s	0.6 s	0.7 s	0.8 s	...	599.9	600 s
Measured value	300	301	301	301	301	301	301	301	301	...	301	301
Difference	>80	1	1	1	1	1	1	1	1	...	1	1
Additive total	0	1	2	3	4	5	6	7	8	...	5999	6000
Transmission	x											x

Example 3:

After transmission due to the exceeding of the large threshold, the value continually changes by ±1.
→ The measured value is not transmitted.

	0.0 s	0.1 s	0.2 s	0.3 s	0.4 s	0.5 s	0.6 s	0.7 s	0.8 s	...	7.4 s	7.5 s
Measured value	300	301	300	299	300	301	300	301	299	...	300	301
Difference	>80	1	0	-1	0	1	0	1	-1	...	0	1
Additive total	0	1	0	1	0	1	0	1	1	...	0	1
Transmission	x											

Monitoring intermediate and faulty positions of double-point information

Double-point information items that are transmitted from the protection equipment, or single-point information items that are transmitted from protection equipment and converted to double-point information items on the protocol element, can be monitored by the protocol element for intermediate and faulty position (in most cases protection equipment do not have any monitoring for intermediate and faulty position implemented).

Thereby, the transfer of an intermediate position (neither ON- nor OFF binary information exists) or a faulty position (both ON- as well as OFF binary information exists) is suppressed by the protocol element for a parameter-settable time.

On reception of a double-point information with intermediate or faulty position, a monitoring time is started and the double-point information is not transferred. If the double-point information is received during the monitoring time with valid binary information state (ON or OFF), the monitoring time is stopped and the double-point information with the valid binary information state is transferred.

On expiry of the monitoring time, the double-point information with the state “intermediate or faulty position” is forwarded with the received time.

The assignment of the message address for the spontaneous information object “Double-point information” is carried out in the OPM II with the category **`firmware / Rec_binary information`**.

A suppression time can be parameterized for the suppression of intermediate and faulty position for each double-point information (parameter **`inter-/faulty_t)`**).

Transfer of the Information "Blocked Activation/Tripping of the Protection"

Disturbance information from protection equipment can be transferred in the direction IEC 60870-5-101/104 with the message formats provided especially for this *`Blocked activation of the protection`* and *`Blocked trip of the protection`*.

With the message *`Blocked activation of the protection`* several protection activation information items and the relay duration time are transmitted.

With the message *`Blocked trip of the protection`* several binary information items are transmitted to the output current circuit of the protective device and the relay operation time is transmitted.

IEC 60870-5-101/104		IEC 60870-5-103	
<TI:=39>	Blocked activation of the protection with time tag CP56Time2a	<TI:=2>	Binary information with relative time
<TI:=40>	Blocked trip of the protection with time tag CP56Time2a	<TI:=2>	Binary information with relative time

<TI:=39> blocked activation of the protection with time tag CP56Time2a		IEC 60870-5-103 disturbance information [170].	
GS	General start of operation	<INF=84>	General start of operation
SL1	Start of operation phase L1	<INF=64>	Activation L1
SL2	Start of operation phase L2	<INF=65>	Activation L2
SL3	Start of operation phase L3	<INF=66>	Activation L3
SIE	Start of operation IE (earth current)	<INF= >	–
SRD	Start of operation in reverse direction	<INF= >	–

<TI:=40> blocked trip of the protection with time tag CP56Time2a		IEC 60870-5-103 disturbance information IEC	
GC	General command to output circuit	<INF=68>	General trip
CL1	Command to output circuit phase L1	<INF=69>	Trip L1
CL2	Command to output circuit phase L2	<INF=70>	Trip L2
CL3	Binary information phase L3 OFF	<INF=71>	Trip L3

The assignment of the message address for the spontaneous information object “Blocked activation/triggering of protection” is carried out in the OPM II with the category *firmware* / **Rec_packed_start_event_output_circuit**.

The disturbance information items are always transmitted from the protection equipment as single binary information messages. For the transfer with the IEC 60870-5-101/104 message format, the binary information state of several start events of protection equipment and a relay duration time/relay operation time (relative time) are transmitted in one message.

The moment of transfer of the IEC 60870-5-101/104 message can be determined with the parameter **[PRE] IEC60870-5-103 | Communication functions | Protection indications IEC60870-5-101 (TI=38,39) | Blocked activation/trip of the protection**.

- Transfer with change of a binary information state.
- Transfer only with going general start of operation or trip information (time from PRE).
  The message is time-tagged again by the protocol element with the transfer.
- Transfer only with going general start of operation or trip information (time from protection equipment).
  With the transfer, the message is time-tagged by the protocol element with the time of the coming general start of operation or trip information.

Transfer with Change of a Binary Information State

The message *Blocked activation of the protection* or *Blocked trip of the protection* is transferred with each binary information change in the message. As relay duration time/relay operation time the relative time of the changed disturbance information is entered.

Transfer only with Going General Start of Operation or Trip Information (Time from PRE)

IEC 60870-5-103 disturbance information items are only received by the protocol element after coming disturbance information for general start of operation/tripping and buffered until transfer of the IEC 60870-5-101/104 message *Blocked activation/trip of the protection*.

The message *Blocked activation of the protection* or *Blocked trip of the protection* is only transferred after reception of the going disturbance information for general start of operation/trip. As relay duration time/relay operation time the relative time of the going disturbance information is entered.

If no going disturbance information arrives within 60 seconds after a coming disturbance information for general start of operation/trip, then the message *Blocked activation of the protection* or *Blocked trip of the protection* is transferred by the protocol element.

As relay duration time/relay operation time the relative time of the last changed disturbance information is entered.

170 The specified information number represents the default values according to IEC 60870-5-103 (protection equipment can also transmit these disturbance information items with different address)

Transfer only with Going General Start of Operation or Trip Information (Time from Protection Equipment)

The function is identical as for "Transfer only with Going General Start of Operation or Trip Information (Time from PRE)", but with the transfer the message is time-tagged by the protocol element with the time of the coming general start of operation or trip information (time from the protection equipment).

Transmit Non-Updated Process Images

After a general interrogation, the protocol firmware of the central station sends all non-received but parameterized data points for binary information with status "interrogated by station interrogation". The quality descriptor of the data points of failed substations is transmitted with "not topical".

The emulation of these data points will be started after a parameterizable delay time (default = number of stations · 5 s) – from transmission of the general interrogation interrogation command. The delay time for the emulation of the data points can be parameterized with the parameter **`[PRE] IEC60870-5-103 | Communication functions | General interrogation | Emulation of not updated process data after GI | Timeout for emulation of not updated process data after GI`**.

The emulation of these data points can be deactivated with the parameter **`[PRE] IEC60870-5-103 | Communication functions | General interrogation | Emulation of not updated process data after GI | Not updated process data base`**.

The emulation of the data not received for GI must then be deactivated, if in combination with the automatic data flow routing in SICAM A8000 a general parameter setting (surplus) for the data of protection equipment is used. The reason is, that the protective devices are not always configured the same, i.e. they do not always supply the same volume of data.

In this case, data points have been emulated by the protocol element following a general interrogation, which are possibly not transferred at all by the protection equipment.

If in the central station a surplus quantity of the data model is parameterized, emulated but not received data points would always be signaled as *`faulty`*.

Emulation of the going binary information

With IEC 60870-5-103, protection signals are only transmitted with the state ON (coming). For IEC 60870-5-101/104, the "coming/going state" is always required for every binary information item.

The protocol element with IEC 60870-5-103 central function can emulate the going binary information item automatically for selected binary information items in receive direction. The going binary information item is emulated immediately after sending the coming binary information with the time of the coming binary information + 10 ms.

The emulation of the going signal can be parameterized in the SIP message address conversion in receive direction in the category **`firmware / Rec_binary information`** for each signal in the field "type_of_binary_information".

With additional info "type of binary information = only coming binary information", after the transfer of the received binary information "coming" the binary information *`going`* is emulated by the protocol element with the received time + 10 ms.

13.4.10 Protocol Element Control and Return Information

13.4.10.1 Protocol Element Control Messages

Protocol element control messages can control protocol element internal functions. On the basic system element, IEC 60870-5-101/104 *`messages with process information in the control direction`* are converted to protocol element control messages and transmitted to the selected protocol element (see *13.1.4.10 Protocol Element Control Messages*).

Supported Protocol Element Control Functions

SF	Protocol element control function `Control_function_(PRE)`	103MI0 [Master]	103SI0 [Slave]
0	Call cycle START	✓	–
1	Call cycle STOP (disabling)	✓	–
2	Call cycle CONTINUE (enabling)	✓	–
3	Continuous call station x ON	✓	–
4	Continuous call station x OFF	✓	–
5	Interface “Deactivate” [171] • Substations are no longer queried • Interface is switched to tristate • Messages to be sent are discarded • Received messages are discarded • Interface deactivation/activation controlled via protocol element control messages	✓	–
6	“Activate” interface	✓	–
128	Add station to station polling	✓	–
129	Remove station from station polling	✓	–
240	Send (general) interrogation command	✓	–
242	Setting control location	✓	–
243	Reset command	–	–
244	Send (general) interrogation command	✓	–

13.4.10.2 Protocol Element Return Information

Protocol element return information is internal status information of the protocol elements which is transmitted spontaneously and in the event of a general interrogation with internal message formats from the protocol element to the basic system element. On the basic system element, the protocol element return information items (see *13.1.4.11 Protocol Element Return Information*) are converted to IEC 60870-5-101/104 *messages with process information in monitoring direction*.

Supported Protocol Element Return Information

Protocol element return information `Return information function_(PRE)`	Station	103MI0 [Master]	103SI0 [Slave]
Status DTR	255	✓	✓
Status DSR	255	✓	✓
Station status	0 to 99	✓	–
Station failure	0 to 99	✓	✓
protocol-specific return information 0 • Cycle IDLE – Station polling is stopped – User data messages will be sent furthermore.	255	✓	–

[171] For the redundancy control "Deactivating/activating the interface" the parameter**[PRE] Redundancy \| Always passive (independent of BSE redundancy control)**must be enabled.

Protocol element return information `Return information function_(PRE)`	Station	103MI0 [Master]	103SI0 [Slave]
protocol-specific return information 1 ● Station polling STANDARD MODE – cycle control running in normal mode (cyclic RTU interrogation)	255	✓	–
protocol-specific return information 2 ● Continous station polling – Continous station polling of a specific station is in progress.	255	✓	–
protocol-specific return information 3 ● Station polling stopped – Station polling was stopped by PST-control message.	255	✓	–
protocol-specific return information 6 ● Sending “Data to all” – User data message “to all” (broadcast) is now being transmitted	255	✓	–
protocol-specific return information 7 ● Sedn “Data message” – station-selective user data message is now being transmitted	255	✓	–

13.4.11 Interoperability IEC 60870-5-103 (103MI0)

13.4.11.1 Physical layer

Electrical Interface

[X] EIA RS-485

[ ] Number of loads .... for one protection equipment

NOTE:
EIA RS-485 standard defines unit loads so that 32 of them can be operated on one line. For detailed information refer to clause 3 of EIA RS-485 standard.

Optical interface

[X] Glass fiber *)

[X] Plastic fiber *)

[X] F-SMA type connector *)

[X] BFOC/2,5 type connector *)

*) For optical interfaces suitable converter (RS-232 ↔ optical) must be used!

Transmission rate

- [x] 9600 bit/s
- [x] 19200 bit/s

13.4.11.2 Link Layer

There are no choices for the link layer.

13.4.11.3 Application Layer

Transmission mode for application data

Mode 1 (least significant octet first), as defined in 4.10 of IEC 870-5-4, is used exclusively in this companion standard.

Common address of ASDU

- [x] One Common Address of ASDU (identical with station address)
- [ ] More than one Common Address of ASDU

13.4.11.4 Selection of standard-ASDU in monitor direction

X	ASDU 1	Binary Information with time tag
X	ASDU 2	Binary information with relative time
X	ASDU 3	measurands I
X	ASDU 4	time-tagged measurands with relative time
X	ASDU 5	identification
	ASDU 6	time synchronization
	ASDU 8	general interrogation termination
X	ASDU 9	measurands II
X	ASDU 10	generic data
	ASDU 11	generic identification
X	ASDU 23	Disturbance event overview
X	ASDU 26	Ready for transmission of disturbance data

X	ASDU 27	Ready for transmission of a channel
X	ASDU 28	Ready for transmission of tags
X	ASDU 29	Transmission of tags
X	ASDU 30	Transmission of disturbance values
X	ASDU 31	end of transmission

NOTE:
For full compatibility, the INFORMATION NUMBERS should also be specified with the ASDU.

13.4.11.5 Selection of standard-ASDU in control direction

X	ASDU 6	time synchronization
X	ASDU 7	General interrogation command
X	ASDU 10	generic data
X	ASDU 20	General command
X	ASDU 21	genenc command
X	ASDU 24	Order to Transmit Disturbance Data
X	ASDU 25	Acknowledgment for Disturbance Data Transmission

NOTE:
For full compatibility, the INFORMATION NUMBERS should also be specified with the ASDU.

13.4.11.6 Selection of standard information numbers in monitor direction

System functions in monitor direction

	INF	**Description**
X	<0>	End of general interrogation
X	<0>	Time Synchronization
X	<2>	Reset FCB
X	<3>	Reset KE

X	<4>	Start/restart
X	<5>	Power on

Status indications in monitor direction

	INF	Semantics
X	<16>	Auto-recloser acitve
X	<17>	Teleprotection active
X	<18>	Protection active
X	<19>	LED reset
X	<20>	Monitor direction blocked
X	<21>	Test Mode
X	<22>	Local parameter setting
X	<23>	Characteristic 1
X	<24>	Characteristic 2
X	<25>	Characteristic 3
X	<26>	Characteristic 4
X	<27>	Auxiliary input 1
X	<28>	Auxiliary input 2
X	<29>	Auxiliary input 3
X	<30>	Auxiliary input 4

Supervision indications in monitor direction

	INF	Semantics
X	<32>	Measurand supervision I
X	<33>	Measurand supervision V
X	<35>	Phase sequence supervision
X	<36>	Trip circuit supervision

X	<37>	I>> back-up operation
X	<38>	VT fuse failure
X	<39>	Teleprotection disturbed
X	<46>	Group warning
X	<47>	Group alarm

Earth fault indications in monitor direction

	INF	Semantics
X	<48>	Earth fault L1
X	<49>	Earth fault L2
X	<50>	Earth fault L3
X	<51>	Earth fault forward, i.e. line
X	<52>	Earth fault reserve, i.e. busbar

Fault indications in monitor direction

	INF	Semantics
X	<64>	Start/pick-up L1
X	<65>	Start/pick-up L2
X	<66>	Start/pick-up L3
X	<67>	Start/pick-up N
X	<68>	General trip
X	<69>	Trip L1
X	<70>	Trip L2
X	<71>	Trip L3
X	<72>	Trip I>> (back-up operation)
X	<73>	Fault location X in ohms
X	<74>	Fault forward/line

X	<75>	Fault reverse/busbar
X	<76>	Teleprotection signal transmitted
X	<77>	Teleprotection signal received
X	<78>	Zone 1
X	<79>	Zone 2
X	<80>	Zone 3
X	<81>	Zone 4
X	<82>	Zone 5
X	<83>	Zone 6
X	<84>	General start/pick-up
X	<85>	Breaker failure
X	<86>	Trip measuring system L1
X	<87>	Trip measuring system L2
X	<88>	Trip measuring system L3
X	<89>	Trip measuring system E
X	<90>	Trip I>
X	<91>	Trip I>>
X	<92>	Trip IN>
X	<93>	Trip IN>>

Auto-reclosure indications in monitor direction

	INF	Semantics
X	<128>	CB ‘on’ by AR
X	<129>	CB ‘on’ by long-time AR
X	<130>	AR blocked

Measurands in monitor direction

	INF	Semantics
X	<144>	Measurand I
X	<145>	Measurand I, V
X	<146>	Measurand I, V, P, Q
X	<147>	Measurands IN, VEN
X	<148>	Measurands IL1,2,3, VL1,2,3, P, Q, f

Generic functions in monitor direction

	INF	Semantics
	<240>	Read headings of all defined groups
	<241>	Read values or attributes of all entries of one group
	<243>	Read directory of a single entry
	<244>	Read value or attribute of a single entry
	<245>	End of general interrogation of generic data
	<249>	Write entry with confirmation
	<250>	Write entry with execution
	<251>	Write entry aborted

13.4.11.7 Selection of standard information numbers in control direction

System functions in control direction

	INF	Semantics
X	<0>	Initiation of general interrogation
X	<0>	Time synchronization

General commands in control direction

	INF	Semantics
X	<16>	Auto-recloser on/off
X	<17>	Teleprotection on/off

- [X] <18> Protection on/off
- [X] <19> LED reset
- [X] <23> Activate characteristic 1
- [X] <24> Activate characteristic 2
- [X] <25> Activate characteristic 3
- [X] <26> Activate characteristic 4

Generic functions in control direction

	INF	Semantics
[ ]	<240>	Read headings of all defined groups
[ ]	<241>	Read values or attributes of all entries of one group
[ ]	<243>	Read directory of a single entry
[ ]	<244>	Read value or attribute of a single entry
[ ]	<245>	General interrogation of generic data
[ ]	<248>	Write entry
[ ]	<249>	Write entry with confirmation
[ ]	<250>	Write entry with execution
[ ]	<251>	Write entry abort

13.4.11.8 Basic application functions

- [X] Test Mode
- [X] Blocking of monitor direction
- [X] Disturbance data
- [ ] Generic services
- [X] Private data

13.4.11.9 Miscellaneous

Measurands are transmitted with ASDU 3 as well as with ASDU 9. As defined in 7.2.6.8, the maximum MVAL can either be 1,2 or 2,4 times the rated value. No different rating shall be used in ASDU 3 and ASDU 9, i.e. for each measurand there is only one choice.

Measurand	Max. MVAL = times rated value		
	1.2	or	2.4
Current L1	X		X
Current L2	X		X
Current L3	X		X
Voltage L1-E	X		X
Voltage L2-E	X		X
Voltage L3-E	X		X
Active power P	X		X
Reactive power Q	X		X
Frequency f	X		X
Voltage L1 – L2	X		X

13.4.12 Interoperability IEC 60870-5-103 (103SI0)

13.4.12.1 Physical layer

Electrical Interface

[X] EIA RS-485

[ ] Number of loads .... for one protection equipment

NOTE:
EIA RS-485 standard defines unit loads so that 32 of them can be operated on one line. For detailed information refer to clause 3 of EIA RS-485 standard.

Optical interface

[X] Glass fiber *)

[X] Plastic fiber *)

- [x] F-SMA type connector *)
- [x] BFOC/2,5 type connector *)

*) For optical interfaces suitable converter (RS-232 ↔ optical) must be used!

Transmission rate

- [x] 9600 bit/s
- [x] 19200 bit/s

13.4.12.2 Link Layer

There are no choices for the link layer.

13.4.12.3 Application Layer

Transmission mode for application data

Mode 1 (least significant octet first), as defined in 4.10 of IEC 870-5-4, is used exclusively in this companion standard.

Common address of ASDU

- [x] One Common Address of ASDU (identical with station address)
- [ ] More than one Common Address of ASDU

13.4.12.4 Selection of standard-ASDU in monitor direction

X	ASDU 1	Binary Information with time tag
	ASDU 2	Binary information with relative time
X	ASDU 3	measurands I
X	ASDU 4	time-tagged measurands with relative time
X	ASDU 5	identification
	ASDU 6	time synchronization
X	ASDU 8	general interrogation termination
X	ASDU 9	measurands II

- [ ] ASDU 10 generic data
- [ ] ASDU 11 generic identification
- [ ] ASDU 23 Disturbance event overview
- [ ] ASDU 26 Ready for transmission of disturbance data
- [ ] ASDU 27 Ready for transmission of a channel
- [ ] ASDU 28 Ready for transmission of tags
- [ ] ASDU 29 Transmission of tags
- [ ] ASDU 30 Transmission of disturbance values
- [ ] ASDU 31 end of transmission

NOTE:
For full compatibility, the INFORMATION NUMBERS should also be specified with the ASDU.

13.4.12.5 Selection of standard-ASDU in control direction

- [X] ASDU 6 time synchronization
- [X] ASDU 7 General interrogation command
- [ ] ASDU 10 generic data
- [X] ASDU 20 General command
- [ ] ASDU 21 genenc command
- [ ] ASDU 24 Order to Transmit Disturbance Data
- [ ] ASDU 25 Acknowledgment for Disturbance Data Transmission

NOTE:
For full compatibility, the INFORMATION NUMBERS should also be specified with the ASDU.

13.4.12.6 Selection of standard information numbers in monitor direction

System functions in monitor direction

	INF	Description
[X]	<0>	End of general interrogation
[X]	<0>	Time Synchronization

X	<2>	Reset FCB
X	<3>	Reset KE
X	<4>	Start/restart
X	<5>	Power on

Status indications in monitor direction

	INF	Description
X	<16>	Auto-recloser acitve
X	<17>	Teleprotection active
X	<18>	Protection active
X	<19>	LED reset
X	<20>	Monitor direction blocked
X	<21>	Test Mode
X	<22>	Local parameter setting
X	<23>	Characteristic 1
X	<24>	Characteristic 2
X	<25>	Characteristic 3
X	<26>	Characteristic 4
X	<27>	Auxiliary input 1
X	<28>	Auxiliary input 2
X	<29>	Auxiliary input 3
X	<30>	Auxiliary input 4

Supervision indications in monitor direction

	INF	Description
X	<32>	Measurand supervision I
X	<33>	Measurand supervision V

X	<35>	Phase sequence supervision
X	<36>	Trip circuit supervision
X	<37>	I>> back-up operation
X	<38>	VT fuse failure
X	<39>	Teleprotection disturbed
X	<46>	Group warning
X	<47>	Group alarm

Earth fault indications in monitor direction

	INF	Description
X	<48>	Earth fault L1
X	<49>	Earth fault L2
X	<50>	Earth fault L3
X	<51>	Earth fault forward, i.e. line
X	<52>	Earth fault reserve, i.e. busbar

Fault indications in monitor direction

	INF	Description
X	<64>	Start/pick-up L1
X	<65>	Activation L2
X	<66>	Activation L3
X	<67>	Start/pick-up N
X	<68>	General trip
X	<69>	Trip L1
X	<70>	Trip L2
X	<71>	Trip L3
X	<72>	Trip I>> (back-up operation)

X	<73>	Fault location X in ohms
X	<74>	Fault forward/line
X	<75>	Fault reverse/busbar
X	<76>	Teleprotection signal transmitted
X	<77>	Teleprotection signal received
X	<78>	Zone 1
X	<79>	Zone 2
X	<80>	Zone 3
X	<81>	Zone 4
X	<82>	Zone 5
X	<83>	Zone 6
X	<84>	General start of operation
X	<85>	Breaker failure
X	<86>	Trip measuring system L1
X	<87>	Trip measuring system L2
X	<88>	Trip measuring system L3
X	<89>	Trip measuring system E
X	<90>	Trip I>
X	<91>	Trip I>>
X	<92>	Trip IN>
X	<93>	Trip IN>>

Auto-reclosure indications in monitor direction

	INF	Description
X	<128>	CB 'on' by AR

	INF	Description
X	<129>	CB 'on' by long-time AR
X	<130>	AR blocked

Measurands in monitor direction

	INF	Description
X	<144>	Measurand I
X	<145>	Measurand I, V
X	<146>	Measurand I, V, P, Q
X	<147>	Measurands IN, VEN
X	<148>	Measurands IL1,2,3, VL1,2,3, P, Q, f

Generic functions in monitor direction

	INF	Description
☐	<240>	Read headings of all defined groups
☐	<241>	Read values or attributes of all entries of one group
☐	<243>	Read directory of a single entry
☐	<244>	Read value or attribute of a single entry
☐	<245>	End of general interrogation of generic data
☐	<249>	Write entry with confirmation
☐	<250>	Write entry with execution
☐	<251>	Write entry aborted

13.4.12.7 Selection of standard information numbers in control direction

System functions in control direction

	INF	Description
X	<0>	Initiation of general interrogation
X	<0>	Time Synchronization

General commands in control direction

	INF	Description
X	<16>	Auto-recloser on/off
X	<17>	Teleprotection on/off
X	<18>	Protection on/off
X	<19>	LED reset
X	<23>	Characteristic 1
X	<24>	Characteristic 2
X	<25>	Characteristic 3
X	<26>	Characteristic 4

Generic functions in control direction

	INF	Description
	<240>	Read headings of all defined groups
	<241>	Read values or attributes of all entries of one group
	<243>	Read directory of a single entry
	<244>	Read value or attribute of a single entry
	<245>	General interrogation of generic data
	<248>	Write entry
	<249>	Write entry with confirmation
	<250>	Write entry with execution
	<251>	Write entry abort

13.4.12.8 Basic application functions

	Description
X	Test Mode
	Blocking of monitor direction
	Disturbance data

☐ Generic services

☐ Private data

13.4.12.9 Miscellaneous

Measurands are transmitted with ASDU 3 as well as with ASDU 9. As defined in 7.2.6.8, the maximum MVAL can either be 1,2 or 2,4 times the rated value. No different rating shall be used in ASDU 3 and ASDU 9, i.e. for each measurand there is only one choice.

Measurand		Max. MVAL = times rated value	
	1.2	**or**	**2.4**
Current L1	X		X
Current L2	X		X
Current L3	X		X
Voltage L1-E	X		X
Voltage L2-E	X		X
Voltage L3-E	X		X
Active power P	X		X
Reactive power Q	X		X
Frequency f	X		X
Voltage L1 – L2	X		X

13.5 IEC 60870-5-104

13.5.1 Introduction

The IEC 60870-5-104 protocol is a standardized transmission protocol (TCP/IP) for communication with remote stations in the network (LAN, WAN).

Protocol firmware for IEC 60870-5-104:

Firmware	System	Standard and function
ETI4	CP-8031, CP-8050	IEC 60870-5-104 for central station (controlling station)
ETI4	CP-8031, CP-8050	IEC 60870-5-104 for remote station (controlled station)
FWI4	CP-8031, CP-8050	IEC 60870-5-104 for central station (controlling station) with Application Layer Firewall (TCP/IP Stack separation)
FWI4	CP-8031, CP-8050	IEC 60870-5-104 for remote station (controlled station) with Application Layer Firewall (TCP/IP Stack separation)

The IEC 60870-5-104 protocol is a transmission protocol on OSI layer 5-7 for the communication between control systems or between central stations and substations. For OSI-layer 3+4 the TCP/IP protocol is implemented.

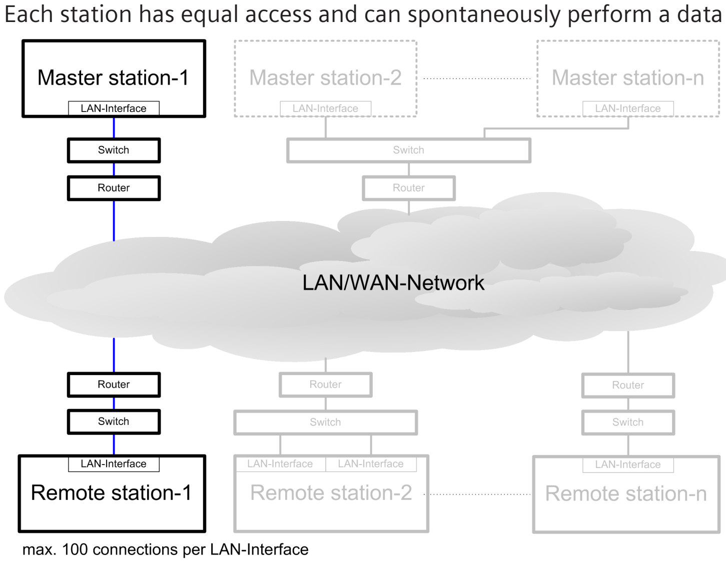
The protocol is especially suitable for SCADA applications.

In contrast to the IEC 60870-5-101 protocol, which establishes connections over serial interfaces, the IEC 60870-5-104 interface enables the communication over networks (Local Area Network "LAN" and Wide Area Network "WAN"). Thereby common network components such as switches and routers can be used.

The IEC 60870-5-104 protocol uses a signal-orientated data model. Every message represents one data point, such as e.g. one measured value, setpoint value, command or alarm. This message is thereby defined by an address and a data type. The address then determines which signal is concerned, i.e. transmitter and receiver must know the meaning of the address.

For the transmission of data, a "TCP-Connection" is established between 2 participating stations. One station can establish an independent connection to several different stations.

Each station has equal access and can spontaneously perform a data transmission.



Application Layer Firewall (TCP/IP Stack separation)

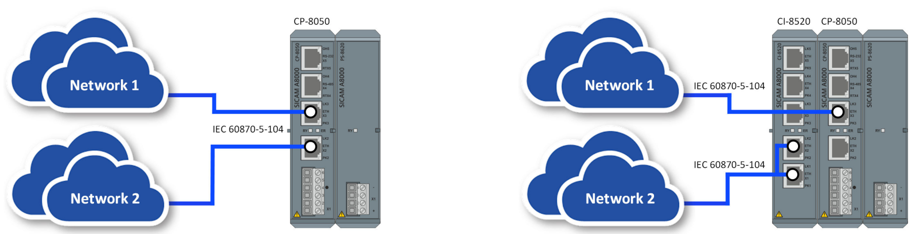
The firmware FWI4 uses in contrast to the firmware ETI4 its own embedded TCP/IP stack.

When using both firmware files in CP-8031, CP-8050 - ETI4 with Linux TCP/IP Stack and FWI4 with Embedded TCP/IP Stack - a separation of the networks through the Application Layer Firewall (realized via "TCP/IP Stack Separation") is achieved.

NOTE

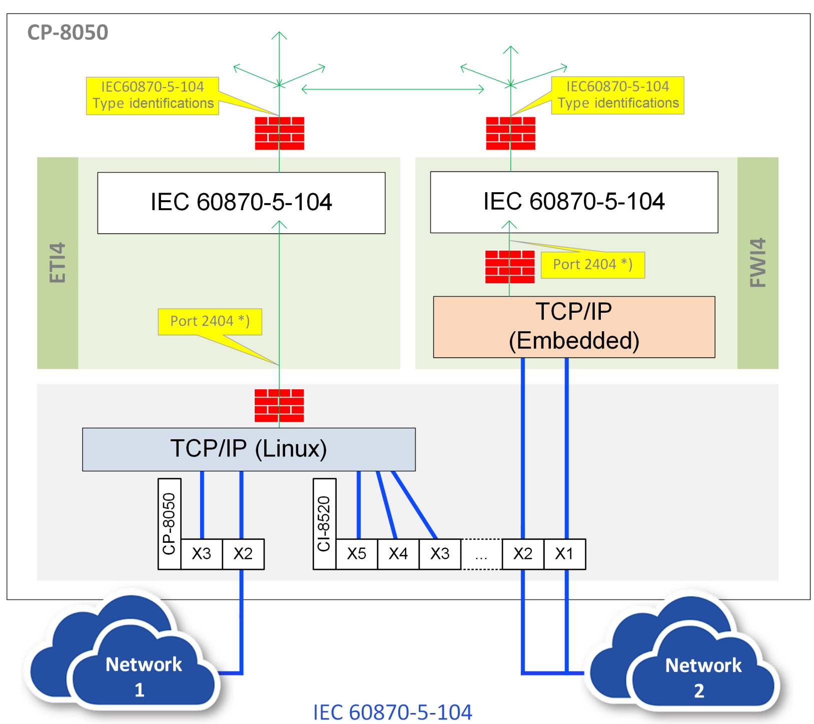
- With the CP-8031, it is not possible to separate the networks into different modules (CP-8031 + CI-852x)! [172]
- The LAN connector for Ethernet used for FWI4 cannot be used for other protocols/protocol firmware!

Schematic representation:



For example:

- ETI4 firmware: assigned LAN connector on CP-8050 [X2]
- FWI4 firmware: assigned LAN connector on CI-852x [X1, X2]



*) Port 2404 = IEC 60870-5-104 standard or parameter-settable

172 With a license (see *14.8 SICAM A8000 CP-803x Extended CI-Module*), 1 communication module CI-852x can be used additionally also with CP-8031.

13.5.2 Functions

Function	ETI4	FWI4
IEC 60870-5-104	✓	✓
Controlling station	✓	✓
Controlled station	✓	✓
Max. connections:	100	100
Max. connections without TLS (recommended)	50	50
Max. connections with TLS (recommended)	25	–
Port number (TCP)	2404	2404
Port number (TCP) parameter-settable (1024 to 65535)	✓	✓
Port number (TLS)	19998	–
Application layer firewall (TCP/IP stack separation)	–	✓
Interoperability		
IEC 60870-5-104 Ed.2	✓	✓
Interoperability according to *13.5.10 Interoperability IEC 60870-5-104 (ETI4, FWI4)*	✓	✓
License		
License required to use the firmware in CP-8031, CP-8050	–	✓
License management with Siemens ALM (Automation License Manager)	–	✓
Engineering: Import license from ALM	–	✓
Ethernet interface (properties)		
Ethernet interface (*13.1.4.6 Ethernet Interface – Module Properties*)	✓	✓
TCP/IP optimization parameters	✓	✓
TCP/IP keep alive	✓	✓
IEC 60870-5-104 Functions		
Acquisition of events (transmission of data ready to be sent)	✓	✓
Measured values:		
• Change monitoring for measured values (transmit and/or receive direction)	✓	✓
• Value adaptation for measured values (transmit and/or receive direction)	✓	✓
General Interrogation	✓	✓
Clock synchronization according to IEC 60870-5-104 (synchronization via NTP is recommended)	✓	✓
Command transmission:		
• Supervision of maximum transport time in control direction	✓	✓
• Control location function (set/check control location)	✓	✓
Transmission of integrated totals	✓	✓
File transfer	✓	✓
Protocol element control and return information		
Protocol element control messages:		
• Interface enable, disable	✓	✓
• Send (general) interrogation command	✓	✓
• Setting control location	✓	✓
• Remote operation enable, disable	–	–
Protocol element return information:		
• Protocol-specific return information 0: Status DATA TRANSFER (BSE)	✓	✓
• Protocol-specific return information 1: Status DATA TRANSFER (104)	✓	✓
• Protocol specific return information 2: Remote operation enable/disable	–	–

Function	ETI4	FWI4
Redundancy(functions for supporting redundant communication routes)		
104 redundancy according to IEC 60870-5-104 Edition 2:		
• 104 redundancy "controlling station"[173]	✓	✓
• 104 redundancy "controlled station (with 1 Ethernet interface)"	✓	✓
• 104 redundancy "controlled station (with 2 Ethernet interfaces)"	✓	✓
Protocol redundancy:		
PSI redundancy (synchronous connections)	✓	✓
Port redundancy:		
• Deactivation of interface (with protocol element control message)	✓	✓
• Deactivation of interface (with redundancy control message)	✓	✓
Device redundancy:		
• Device redundancy with the same PRE parameters	✓	✓
• Device redundancy with different PRE parameters ("A/B parameters")	✓	✓
• Device redundancy with different PRE parameters ("A/B parameters") for signals	–	–
Special functions		
Time tag (IV = 1) in messages in transmit direction	✓	✓
Originator address = 0 for all messages in transmit direction	✓	✓
Summer time bit (SU) = 0 for all messages in transmit direction (time tag)	✓	✓
Day of week (DOW) = 0 for all messages in transmit direction (time tag)	✓	✓
Special functions DBAG:		
• Breaker delay in transmit direction (<TI:=150>)	✓	✓
• Send originator address with settable value	✓	✓
Special functions RWE:		
• Bit by bit marking of the field	✓	✓
• Cyclic measured values	✓	✓
• Address of the return information for selection command 2	✓	✓
• NT bit, IV bit according to RWE requirements	✓	✓
Suppress error in case of connection failure	✓	✓
Error handling for connection with failure = suppress:		
• NT bit emulation for received data	✓	✓
• General interrogation after connection is OK	✓	✓
Security		
TLS (IEC 62351-3 "Transport Layer Security")		
• Max. Connections with TLS	25	–
• Mixture of connections with/without TLS	✓	–
• Portnumber (TCP) for TLS	19998	–
• Port number (TCP) for TLS parameter-settable (1024 to 65535)	✓	–
• PKI certificate management	✓	–
Whitelist filter:		
• WhiteList filter (predefined for all TIs + COTs)	✓	✓
• WhiteList filter "TI filter" (type identification pass-through filter – parameter-settable)	✓	✓
• Extended diagnostic messages for WhiteList filter	✓	–
Data throughput limit:		
• Data throughput limitation in receive direction	✓	✓

173 This function is not supported with CP-8031!

Function	ETI4	FWI4
• Data throughput limitation in transmit direction	✓	✓
Web server		
Protocol-internal diagnostic and statistic information via protocol-specific web pages	✓	✓
Engineering		
SICAM Device Manager	✓	✓
SICAM TOOLBOX II	✓	✓
Remote operation:		
• Remote operation with SICAM TOOLBOX II based on HTTP/HTTPS	✓[174]	–
• Remote operation via control message enable/disable	✓[174]	–
• Warning for "remote operation" active	✓[174]	–

13.5.3 Modes of Operation

Standard operating mode	Optional equipment	Interface signals (X2, X3)
Electrical ethernet-interface (twisted pair)	-	TXD+, TXD-, RXD+, RXD-
Optical interface	e.g.: Siemens SCALANCE Type: X101-1 or Phoenix FO converter Type: FL MC 2000E LC	

13.5.4 Communication

For the stations to communicate with each other, suitable transmission facilities and/or network components may be needed in addition.

Own Station (Central Station or Substation)

System	System element	Protocol element	Remarks
SICAM A8000 Series	CP-8031/CPCI85 CP-8050/CPCI85 CP-8050/EPCI85	ETI4, FWI4	

Remote Station (Substation or Central Station)

System	System element	Protocol element	Remarks
SICAM A8000 Series	CP-8031/CPCI85 CP-8050/CPCI85 CP-8050/EPCI85	ETI4, FWI4	
SICAM A8000 Series	CP-8000/CPC80 CP-8021/CPC80 CP-8022/CPC80	ET84	
SICAM AK3	CP-2016/CPCX26 CP-2019/PCCX26	SM-2558/ETA4 ET24	
Legacy systems (SICAM AK, SICAM TM, SICAM EMIC, SICAM MIC, SICAM BC)	CP-20xx CP-50xx CP-60xx	SM-2556/ETA2 SM-2557/ETA2 SM-2558/ETA4 ETT0	

174 This function is implemented on the basic system element!

System	System element	Protocol element	Remarks
Other Siemens devices	–	–	according to *13.5.10 Interoperability IEC 60870-5-104 (ETI4, FWI4)*
Third-party system	–	–	according to *13.5.10 Interoperability IEC 60870-5-104 (ETI4, FWI4)*

13.5.5 LAN/WAN communication according to IEC 60870-5-104

13.5.5.1 Ethernet Interface

The Ethernet interface is implemented on the basic system element.

The interface is selected in 2 steps (see *13.1.4.4 Selection of an Ethernet Interface for Communication Protocols*) :

- Selection of a LAN interface on the PRE
- Assignment of the LAN interface to the connector on BSE

13.5.5.2 Definition of the Connections

IP addresses

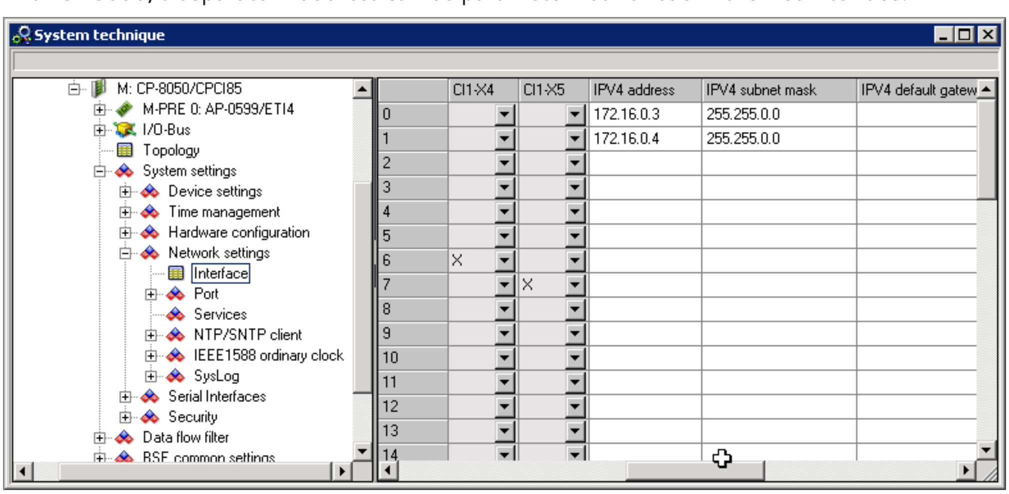
Every device connected to a TCP/IP network has an unique IP address.

The protocol firmware supports only IP addresses in the format IPv4 (32-bit). With that 2^{32}, therefore 4,294,967,296 addresses can be represented. The IP address is mostly represented in the “dotted decimal notation” .

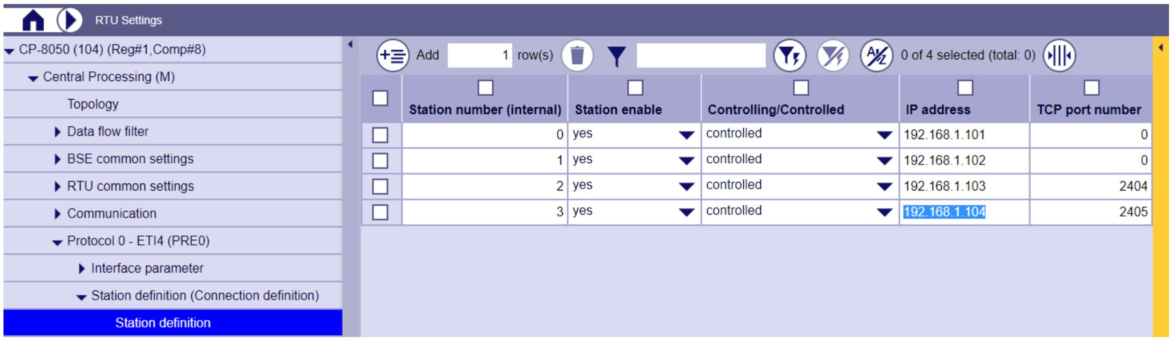
For example: 192168122195

The IP address of the own station is to be parameterized with parameter **`[BSE] System settings | Network settings | Interface | IPV4 address`**.

With CP-8050, a separate IP address can be parameterized for each Ethernet interface.



The IP addresses of the connected remote stations are to be configured in the protocol in the parameters **`[PRE] station definition (connection definitions)`**.



Port Numbers

Every IP connection is defined by the IP address of the own station and the remote station and the port number. The port numbers are determined by the IANA (Internet Assigned Numbers Authority).

Used port numbers:

Port Number	Protocol	Standard
2404	IEC 60870-5-104	IEC 60870-5-104 Edition 2.0
19998	IEC 60870-5-104 + TLS	IEC 62351-3 Transport Layer Security
1024 to 65535	IEC 60870-5-104, IEC 60870-5-104 + TLS	project specific

Default-Router (Default-Gateway) [175]

If one’s own network is connected by means of a router, then the IP address of the Default Router is to be set with the parameter **`[BSE] System settings | Network settings | Interface | IPV4 default gateway`**.

Subnet mask [175]

The subnet mask is a bit mask, that separates an IP address into a network- and a device part (Host part). It is used in IP networks to make routing decisions.

The subnet mask is to be set with the parameter **`[BSE] System settings | Network settings | Interface | IPV4 subnet mask`**.

The subnet mask is exactly as long as the IP address, to which it is applied (therefore 32 bits for IPv4). All bits of the network part are set to “1” and all bits of the device part are set to “0”.

In most cases the notation of a network mask is not carried out binary, rather (as with IP address also) frequently in decimal notation (dotted decimal notation).

Therefore the IPv4 network mask for a 27 bit network part reads 255.255.255.224.

The usable address space of a network is defined by the subnet mask. For a 27 bit network the first 27 places of the IP address of the network part and for all hosts of the network are identical. In all practical cases of application the network part is continuous (without zeros in between).

175 Function is implemented on the basic system element

```
Example: Calculation of Network- and Host portion
         IPv4-Address = 192.168.122.195
         Network part = 27 Bit → Subnet-Mask = 255   .   255   .   255   .   224
                                               11111111 11111111 11111111 11100000

             Decimal          Binary                                Calculation
IP Address   192.168.122.195  11000000 10101000 01111010 11000011         IP Address
Net mask     255.255.255.224  11111111 11111111 11111111 11100000     AND Subnet Mask
Network part 192.168.122.192  11000000 10101000 01111010 11000000      = Network part

IP Address   192.168.122.195  11000010 10101000 01111010 11000011         IP Address
Net mask~    255.255.255.224  00000000 00000000 00000000 00011111  AND (NOT Subnet-Mask)
Device part                3  00000000 00000000 00000000 00000011       = Device part
```

A network mask with 27 set bits produces a network part of 192.168.122.192. 5 bits and therefore 32 addresses are left over for the device part.

In the above example the smallest host address ends with 11000000 (decimal: 192), the greatest possible host address with the octet 11011111 (decimal: 223). The address range for the subnet in the example is therefore 192.168.122.192 to 192.168.122.223.

The greatest address is by definition reserved for the IP broadcast and the smallest address describes the network itself. They are therefore not included in the freely usable addresses.

In practice the Default Gateway is often assigned to the smallest (binary in the example: 11000001, decimal: 193) or largest (binary in the example: 11011110, decimal: 222) usable IP address in the network.

Connection-Specific Parameters

In the central station and in the substation(s), the required settings are to be carried out for each "Connection" in the parameters of the **`Station definition (Connection definition)`**.

The following parameters can be set for each connection:

- Station number (internal)

  The station number is used SICAM A8000 internal for the routing of the data, diagnostic treatment and failure management. The station number is the SICAM A8000 internal reference for the connection that is assigned to an IP address. During the data transmission, only the IP address assigned to the station number is transmitted, the station number is not transmitted.

  During the data flow routing the data is routed for transmission to a "Station number" (Connection number = destination station number).

  The station number is to be entered in the parameter **`[PRE] Station definition (Connection definition) | Connection definition | Station number (internal)`** for each connection.

- Station enable

  A parameterized connection can be activated/deactivated with the parameter **`[PRE] Station definition (Connection definition) | Connection definition | Station Enabling`** ; this way connections can be prepared, which are activated at a later time by means of parameterization.

- Controlling/Controlled

  Through the plant configuration, it is determined for every connection whether a station according to IEC 60870-5-104 is a "Controlling Station" or a "Controlled Station". Therefore for every connection one party is to be parameterized either as "Controlling Station" or as "Controlled Station". The IEC 60870-5-104 data flow is started/stopped by the "Controlling Station". With the parameter **`[PRE] Station definition (Connection definition) | Connection definition | Controlling/Controlled`** the role of the own station is to be parameterized for every connection.

- IP-address
  For every connection the IP address of the remote station is to be parameterized.
  The IP address (Internet Protocol) is a number, which permits the addressing of parties in LAN/WAN IP networks. This address must always be unambiguous in a network.
  The IP address is to be parameterized as follows (example): 192.168.122.195. The IP address of the remote station is to be parameterized for every connection with the parameters **[PRE] Station definition (Connection definition) | Connection definition | IP address** .
- Redundancy
  For every connection, its redundancy function is to be determined for the selected redundancy control:
  - no redundancy (default) [176]
  - Real connection
  - Virtual connection
  - 104-Contr-Red
    Connection has IEC 60870-5-104 Controlling functionality

  For further details, see section *13.5.6 Redundancy*.
  With the parameter **[PRE] Station definition (Connection definition) | Connection definition | Redundancy** the function of the own station is to be parameterized for every connection.
- RedGroup
  When using the redundancy for controlled station according to IEC 60870-5-104, every connection can be assigned to one of several redundancy groups.
  For further details refer to section “Functions for the support of redundant communication routes”.
  With the parameter **[PRE] Station definition (Connection definition) | Connection definition | RedGroup** the redundancy group number is parameterized for the connection.
- Stop behavior
  If the own station is parameterized as “Controlled Station” and the IEC 60870-5-104 data transfer has been stopped by the “Controlling Station” with “STOP DataTransfer activation)”, with the parameter **[PRE] Station definition (Connection definition) | Connection definition | Stop behaviour** it can be selected, if in state “STOP” all messages in transmit direction (including End of Init) will be saved or discarded.
  Note: With “stop behavior = discard” a buffer overflow is avoided in the state “STOP”.
- Network connection
  Optimized IEC 60870-5-104 parameters for network connection: [177]
  - LAN (IEC 104 default)
  - WAN
  - LAN (fast dropout detection)
  - GPRS
  - Satellite
  - free definable 1
  - free definable 2
  - free definable 3

176 Non-redundant IEC 60870-5-104 connection.
177 A "freely definable network connection" should be used for project-specific settings. The optimized parameters for other network connections should not be changed.

- Station failure

  For certain redundancy configurations or operating modes, for the SICAM A8000 internal diagnostics, the failure of a connection can be suppressed with the parameter **[PRE] Station definition (Connection definition) | Connection definition | Station failure**.

  If the failure is suppressed, the connection is never signaled in the diagnostic as failed and all messages in transmit direction (also INIT-End) are discarded until the connection is established!

  Note: As a result a ring overflow is avoided with non-connected remote stations.

- day of week

  With parameter **[PRE] Station definition (Connection definition) | Connection definition | Day of week** = <suppress> the day of week (DOW field of the time tag) is always set to "0" for all messages with time tag in transmit direction.

- Daylight saving time

  With parameter **[PRE] Station definition (Connection definition) | Connection definition | Summertime** = <suppress> the summer time bit (SU bit of the time tag) is always set to "0" for all messages with time tag in transmit direction.

- Originator address

  With parameter **[PRE] Station definition (Connection definition) | Connection definition | Originator address** = <suppress> the originator address is set to "0" for all messages in transmit direction.

- Clear Ring Buffer

  At failure of connection the protocol element can read data from the ring buffer from the basic system element (BSE) after timeout and delete data without error. This function can avoid ring buffer overflow on basic system element (BSE).

  The function can be enabled with the parameter **[PRE] Station definition (Connection definition) | Connection definition | Clear ring buffer** .

  The delay time can be parameterized with the parameter **Advanced parameters | Timeout clear ring buffer** .

- Profile (type identification check)

  The selected profile defines the type identifications to be supported for communication with remote system.

  Depending on selected profile, enhanced checks for fields of IEC 60870-5-104 message will be executed.

  Supported Profiles:

  – SICAM RTUs - IEC104 ("SICAM RTUs Standard")
  – IEC 60870-5-104 Ed.2 ("KEMA Conformance tested")
  – WhiteList filter
  – WhiteList-Filter for passive PRE
  – WhiteList-Filter + TI-Filter
  – TI-Filter

  The required profile can be selected with the parameter **[PRE] Station definition (Connection definition) | Connection definition | Profile (type identification check)** .

- Data throughput limit in receive direction (msg/s)

- Data throughput limit in transmit direction (msg/s)
  The protocol element for IEC 60870-5-104 supports a limitation of data throughput separately in transmit and receive direction for IEC 60870-5-104 data messages.
  The “number of messages/second” in transmit direction can be parameterized with the parameter **[PRE] Station definition (Connection definition) | Connection definition | Data throughput limit in transmit direction (msg/s)** (0 = no data throughput limitation).
  The “number of messages/second” in receive direction can be parameterized with the parameter **[PRE] Station definition (Connection definition) | Connection definition | Data throughput limit in receive direction (msg/s)** (0 = no data throughput limitation).

IEC 60870-5-104 Parameters

For the coupling of different systems with the IEC 60870-5-104 protocol, the setting of the variable elements of the message according to IEC 60870-5-104 to the following defined values is required:

IEC 60870-5-101 Parameter	Description	System Element
Cause of transmission (COT)	Number of octets for cause of transmission = 2	BSE
Common address of ASDU (CASDU)	Number of octets for common address of the ASDU = 2	BSE
Information object address (IOA)	Number of octets for the address of the information object = 3	BSE
Maximum message length	max. 253	BSE
Time tag	Number of octets for time tag = 7	BSE

NOTE

If one parameter does not correspond to the required setting, a parameter error is reported!

IEC 60870-5-104 Parameters / TCP Parameters

The IEC 60870-5-104 specific parameters for “Definition of monitoring times” and “Maximum number of unacknowledged I-format frames k and acknowledgment w” are grouped into parameter groups. One of these parameter groups (104 parameter, network connection) can be selected for every connection.

NOTE

The modifying of the 104 specific parameters requires detailed knowledge of the IEC 60870-5-104 protocol and should therefore only be performed by communications experts or after consultation!

Supported IEC 60870-5-104 / TCP Parameters

	Network connection								
Parameter	LAN (IEC 104 default)	WAN	LAN (fast dropout detection)	GPRS	Satellite	Free definable 1	Free definable 2	Free definable 3	
IEC 104 Parameter									
Timeout connection setup t0	5	5	5	60	5	5	5	5	
Timeout transmit t1	15	60	7	250	60	15	15	15	
Timeout transmit acknowledgment t2	10	10	2	10	10	10	10	10	

	Network connection								
Timeout connection check t3	20	20	10	250	20	20	20	20	
Max. number of APDUs unacknowledged (k)	12	12	12	12	60	12	12	12	
Number of APDUs until acknowledgment (w)	8	8	8	8	8	8	8	8	
TCP parameters	*)			*)					
Transmission optimization	**)	**)	**)	**)	**)	**)	**)	**)	
Initial value TCP expected acknowledgment time	2500	2500	100	2500	2500	2500	2500	2500	
Minimum TCP expected acknowledgment time	250	250	100	1000	250	250	250	250	
Maximum TCP expected acknowledgment time	5000	5000	200	10000	5000	5000	5000	5000	
MSS (maximum segment size) transmit direction	1460	1460	1460	512	1460	1460	1460	1460	
TCP connection close	***)	***)	***)	***)	***)	***)	***)	***)	

*) ... The settings for TCP parameters cannot be changed in CP-8000/CP-802x (ET84)

**) ... Possible selections:

- default (ack delay, no nagle)
- bandwith (ack delay, nagle)
- throughput (no ack delay, nagle)
- response time (no ack delay, no nagle)

***) ... Possible selections:

- close with FIN or RST (default)
- close with RST

The following IEC 60870-5-104 parameters can be set per parameter group:

- Timeout connection setup t0
  Timeout for connection setup.
  Note:
  The parameter **`[PRE] Interface parameter | Network connection | LAN (IEC 104 default) | IEC 104-Parameter | Timeout connection setup t0`** is not evaluated by the protocol!

- Timeout transmit t1
  Timeout for transmit or test frames.
  Transmitted data (Information/Transmit-/Test frames) must be acknowledged by the remote station at the latest before expiry of the Timeout t1 with a transmit or test frame. On timeout the connection is terminated and then re-established.
  The Timeout t1 is to be parameterized with the parameter **`[PRE] Interface parameter | Network connection | LAN (IEC 104 default) | IEC 104-Parameter | Timeout transmit t1`**.

- Timeout transmit acknowledgment t2
  Timeout for acknowledgment, if no data is transmitted t2<t1.
  With the simultaneous transmission of user data (I-Frames) in both directions, acknowledgments are sent together in the user data messages. For the data transmission of user data in only one direction, an acknowledgment (S-frame) is sent after Timeout t2 at the latest.
  The Timeout t2 is to be parameterized with the parameter **[PRE] Interface parameter | Network connection | LAN (IEC 104 default) | IEC 104-Parameter | Timeout transmit acknowledge t2**.
- Timeout connection check t3
  Timeout for the transmission of Test-Frames, if no data traffic t3>t1.
  If no data is transmitted with connection established, then a test frame (TESTFR act) is sent after t3 at the latest. This must be replied to by the remote station, also with a Test-Frame (TESTFR con). This test procedure can be performed independently by both sides of a connection. The Timeout t2 is retriggered by the reception of Information/Transmit/Test frames.
  The Timeout t3 is to be parameterized with the parameter **[PRE] Interface parameter | Network connection | LAN (IEC 104 default) | IEC 104-Parameter | Timeout connection check t3** .

The following parameters can be set for each parameter group for “Maximum number of unacknowledged I-format frames k and acknowledgment w”:

- Maximum number of unacknowledged APDUs (k)
  Greatest difference between receive sequence number and transmit status variable. User data is transmitted from one station to the remote station without needing to receive an immediate acknowledgment for the transmitted user data. However, if after a max. number (k) of transmitted but not yet acknowledged ASDUs no acknowledgment has been received, no further data is sent until the reception of the acknowledgment.
  An acknowledgment must now be sent by the remote station before expiry of t1.
  For IEC 60870-5-104 a sum acknowledgment is used i.e. all consecutively numbered messages received without error up to a moment in time are acknowledged with an acknowledgment message.
  The maximum number of unacknowledged APDUs (k) is to be parameterized with the parameter **[PRE] Interface parameter | Network connection | LAN (IEC 104 default) | IEC 104-Parameter | Max. no. of APDUs until acknowledgment (k)**.
- Number of APDUs until acknowledgment (w)
  Acknowledgment at the latest after reception of “w” I-format APDUs.
  User data is transmitted from one station to the remote station without needing to receive an immediate acknowledgment for the transmitted user data. An acknowledgment is sent after the reception of a max. number (w) of user data messages (APDUs).
  “Recommendation: w” should not exceed 2/3 of the “k”-value.
  The number of APDUs until acknowledgment (w) is to be parameterized with the parameter **[PRE] Interface parameter | Network connection | LAN (IEC 104 default) | IEC 104-Parameter | Number of APDUs until acknowledgment (w)**.

The following TCP/IP parameters are supported by the protocol firmware:

- Transmission optimization
  The data transmission over TCP/IP can be optimized with the parameter **[PRE] Interface Parameter | Network connection | LAN (IEC 104 default) | TCP-Parameter | Transmission optimization** for the following requirements:
  – default (ack delay, no nagle)
  – bandwith (ack delay, no nagle)
  – throughput (no ack delay, nagle)
  – Response time (no ack delay, no nagle) (For details see chapter “Data Transmission Procedure”)

- Maximum segment size in transmission direction "MTU" (Maximum Transmission Unit)
  In rare cases transmission systems support only a limited maximum segment size (MSS) for ethernet packets (MSSmax = 1460 bytes); e.g., there are GPRS systems that only support a max. segment size of 512 bytes. The maximum segment size (MTU) can be set with parameter **[BSE] System settings | Network settings | Interface | * | MTU**.
- Minimum TCP expected acknowledgment time
  The minimum TCP expected acknowledgment time can be modified with the parameter **[BSE] System settings | Network settings | Interface | * | Minimum TCP retransmission timeout**.
- TCP connection close
  The mode for closing a TCP /IP connection ca be set with parameter **[PRE] Network connection | LAN (IEC 104 default) | TCP-Parameter | TCP connection close**:
  - close with FIN or RST (default)
  - close with RST

  (for further details, see to section "Data Transmission Procedure")

By default the parameters are set so that no modification is required.

Data Transmission Procedure

The transmission of the data from the substation to the central station as well as from the central station to the substation takes place spontaneously for each LAN connection. For each LAN connection, the data transmission is comparable with that between 2 stations over a virtual point-to-point connection.

Data Transmission Procedure

The prioritization and 104-blocking of the data to be sent takes place on the basic system element (BSE). The data transmission is started after a startup or with redundancy switchover after establishment of the TCP/IP connection and after "STARTDTact".

The data storage on the basic system element is managed individually for each LAN connection (excluded from this are special redundancy modes such as e.g. "synchronous connections").

Data messages "to all" are already split up selectively for every LAN connection by the communications function on the basic system element (BSE).

Data messages to "prepared connections" will be requested by the protocol element but not sent and discarded without error message. The protocol element will send a positive activation confirmation (ACTCON +) for general interrogation command and test command to the basic system element.

The data processing of the TCP packets can be influenced by the parameter **[PRE] Network connection | LAN (IEC 104 default) | TCP-Parameter | Transmission optimization** – the moment for the transmission of a TCP packet is controlled by the Nagle algorithm. The Nagle algorithm is applied with the TCP protocol and should prevent too small packets, for which the additional overhead due to header etc. is considerably larger than the actual user data.

Nagle algorithm for the transmission of TCP packets:

- If a TCP packet is full, then send immediately
- If a TCP packet is not full, then this is first sent when a TCP acknowledgment is received.

The data pick-up from the basic system element is performed in such a way, that on the one hand the blocking per connection is optimally utilized, and on the other, one connection with a lot of data does not block others unnecessarily long. With the data pick-up for transmission, the connections are processed in ascending order. The communications function on the basic system element performs the prioritization of the data per connection. During the data pick-up, the highest priority data object is always offered for transmission.

Note: For the optimum prioritization and blocking of the data with LAN/WAN communication, only 1 priority level is to be used.

→ As a result a more favorable prioritization for LAN is achieved, since the data for transmission for each connection (destination station) are requested in groups (blocked) by the LAN/WAN protocol element. In addition, through the blocking at TCP/IP level, several messages for this connection are transmitted.

→ Due to this the processing of the connections according to the Round-Robin principle is ensured (Connections are processed in ascending order).

System data is processed with high priority by the communications function on the basic system element and transferred to the LAN/WAN protocol element for transmission as fast as possible.

Data transmission control with Start/Stop (data flow block)

For every TCP connection, one station is either “Listener (Server)” or “Connector (Client)”.

After startup, redundancy switchover or after a failure of the connection, every connection on TCP level is established by that station defined as “Connector (Client)”.

For IEC 60870-5-104 the data transfer is controlled by the Controlling-Station with the messages Start/Stop data transfer. After establishment of a connection at TCP/IP level, the transmission of the data according to IEC 60870-5-104 is stopped.

The data transfer according to IEC 60870-5-104 is started by that station defined as “Controlling Station” with STARTDTact (Start Data Transfer Activation).

After reception of the confirmation from the remote station (STARTDTcon = Start Data Transfer Confirmation) the connection is ready for the transmission of the data.

According to IEC 60870-5-104 the data transmission must be started by the Controlling Station with STARTDTact (Start Data Transfer ACTIVATION). The start must be confirmed by the remote station (Controlled Station) with STARTDTcon (Start Data Transfer CONFIRMATION). If no STARTDTcon has been received within t1 after sending STARTDTact, the connection is terminated again. User data may only be transmitted after successful connection establishment.

The data transmission is stopped by the Controlling Station with STOPDTact (Stop Data Transfer ACTIVATION). STOPDTact is confirmed by the remote station (Controlled Station) with STOPDTcon (Stop Data Transfer CONFIRMATION).

After start of the IEC 60870-104 data transfer with the message STARTDTact by the controlling station, a general interrogation command can be sent to the controlling station if required (for update of the process data base). The function “GI after Start Data Transfer” can be enabled with the parameter **`[PRE] IEC60870-5-104 | Communication functions | General interrogation | GI after START DT`** for all connections of the protocol element.

With function enabled, the protocol element will send an internal system message to the basic system element; this will initiate a sending of a general interrogation command to the controlling station.

Start-/Stop data transfer messages are transmitted with U-Frames “Unnumbered Control Functions” and are used by the Controlling Station in order to control the data transfer from a Controlled Station. Stop Data Transfer is used especially when several connections are established to one station but one connection e.g. due to redundancy, is not used. Start/Stop Data Transfer is intended to prevent a possible loss of data during the switchover to another connection.

The duration of the stopped data transfer is not monitored!

If, as Controlling Station, one remote station blocks the data transfer for a longer period, an overflow of the data storage (rings) on the basic system element (BSE) can occur and through this a fault in the system is signaled. The handling of the user data with stopped "Data Transfer" can be parameterized for each connection with the parameter **`[PRE] Station definition (Connection definition) | Connection definition | Stop behaviour`**.

Handling of the user data if the data transmission is stopped with STOPDTact:

- “Save” [Default]

  The data is saved in the data storage of the communication function on the basic system element (BSE) until they are deleted by the dwell time monitoring or can be transmitted to the remote station.

  Advantage: Storage of the data with stopped data transfer

  Disadvantage: Ring overflow possible

- "Discard"
  All data in transmit direction are read out immediately from the basic system element (BSE) by the protocol firmware, not transmitted and discarded without error message. As a result an overflow of the data storage (rings) is prevented.
  Advantage: Ring overflow is prevented
  Disadvantage: Data loss

Connection Termination

The following possibilities for closing a TCP/IP connection are available:

- Close with FIN or RST (default)
  – "4-Way Handshake" (FIN, ACK, FIN, ACK) for all "known IP addresses" (configured in the parameters of the Connection definition).
    Such a termination occurs for instance if a IEC 60870-5-104 timeout expires or when a IEC 60870-5-104 message with an illegal frame format is received. If the remote station cannot be reached or does not respond to the FIN, the socket will only be deleted after a TCP timeout (3 minutes). During this time the socket and its resources are occupied and this can cause resource problems with the result that no new connections can be established. Possible reasons: Possible reasons:
    – "Denial-of-service attack"
    – Faulty remote station
  – "1-Way Handshake" (RST)
    Such a termination occurs for instance if
    – the IP address of the remote station is not included in the connection definition
    – a connection to a remote station is already established, and the remote station tries to establish further connection.
- Close with RST
  IEC 60870-5-104 defines the termination of a connection with "4-Way Handshake". The closing of a connection with "1-Way Handshake" (RST) only can be used for the following cases:
  – Robust interface required (Example: insecure WAN or Internet)
  – Downward compatible applications

Acknowledgment Procedure

All data messages sent per connection must be acknowledged by the remote station at IEC 60870-5-104 level. Thereby, not every individual IEC 60870-5-104 packet that can contain several IEC 60870-5-104 message objects must be acknowledged, rather several consecutively numbered messages received without error up to a moment in time can also be acknowledged in one operation with one acknowledgment message (sum acknowledgment procedure)

With this sum acknowledgment procedure, user data is transmitted from a station to the remote station, without an acknowledgment needing to be received immediately for the transmitted user data. If no acknowledgment has been received after a maximum number (k) of transmitted but not yet acknowledged IEC 60870-5-104 packets (ASDUs), no further data is sent until reception of the acknowledgment.

The max. number (k) of messages is to be set with the parameter **`[PRE] Interface parameter | Network connection | LAN (IEC 104 default) | IEC 104-Parameter | Max. no. of APDUs until acknowledgment (k)`**.

An acknowledgment must now be sent by the remote station before expiry of t1. With the simultaneous transmission of user data (I-Frames) in both directions, acknowledgments are sent together in the user data messages. For the data transmission of user data in only one direction, an acknowledgment (S-frame) is sent after Timeout t2 at the latest.

On reception of IEC 60870-5-104 packets (APDUs) with user data, an acknowledgment must be sent at the latest after reception of a settable maximum number of messages. The maximum number (w) of messages must be set with parameter **[PRE] Interface Parameter | Network connection | LAN (IEC 104 default) | IEC 104 Parameter | Number of APDUs until acknowledgment (w)** einzustellen.

The retries are (insofar as necessary) performed automatically by the TCP/IP layer of the protocol until the termination of the connection and can only be influenced indirectly with the parameter **[BSE] System settings | Network settings | Interface | TCP min. acknowledge time**.

The data transmission at TCP level starts the data transmission with the settable initial value for the expected acknowledgment time. Depending on the quality of the connection the expected acknowledgment time is adapted dynamically between the parameterized minimum or maximum TCP expected acknowledgment time.

If, with connection established, the IEC 60870-5-104 acknowledgment for transmitted data (information/transmit/test frames) is missing for longer than the set 104 expected acknowledgment time (timeout t1), all IEC 60870-5-104 messages already sent but not yet acknowledged are negatively acknowledged to the basic system element (BSE), the TCP connection is terminated with RST and the remote station flagged as failed.

The connection will be reestablished after a delay of**t0**(=timeout connection setup).

The error message for the failed connection is reset after successfully established connection at TCP level.

Failure Monitoring

The monitoring of every established connection is carried out by the active central station/substation either by means of (subject to acknowledgment) spontaneously transmitted user data messages or by means of cyclic transmitted messages (test frames). The failure monitoring can be carried out independently by both participating stations of a connection.

The Test-Frames are generated by the protocol firmware itself and are not transferred to the basic system element.

If no user data is transmitted with a connection established and activated data transfer, a Test-Frame (TESTFR act) is sent at the latest after expiry of the time t3 (Timeout Connection Test). This Test-Frame must be replied (acknowledged) by the remote station with a Test-Frame (TESTFR con) at the latest before expiry of the timeout t1.

The “Test function of the link layer” (test command) also enables a cyclic message transmission and monitoring controlled by the basic system element. This test function can be set with the parameter **[PRE] IEC60870-5-104 | Communication functions | Test functions (test procedure) | Cycle time of the check command**.

The timeout t3 is retriggered with the transmission of user data messages or test frames. After a message transmission, the remote station is signaled as failed after expiry of the monitoring time t1 (Timeout) and the TCP connection is terminated with RST or FIN. For further details, refer to section *Acknowledgment Procedure, Page 1007*“Acknowledgment Procedure”.

No further data is sent to failed remote stations until successful establishment of the connection.

The data is stored in the data storage of the communication function on the basic system element (BSE) until these are deleted by the dwell time monitoring or can be transmitted to the re-reachable remote station.No further data is sent to a failed remote station until successful station initialization.

Error Handling for “Failed” Connections

The failure of a connection can be suppressed with the parameter **[PRE] Station definition (Connection definition) | Connection definition | Station failure**.

The error handling for faulty connections with “failure = suppress” can be set with the parameter **[PRE] Station definition (Connection definition) | Connection definitions | Error handling for connections with ”failure = suppress“** .

<u>Error handling for faulty connection if ”failure = suppressed” – Mode-0“:</u>(Presets)

- no error in diagnostics
- no NT-Bit emulation for received data by BSE
- no general interrogation command initiated by BSE after connection error

Error handling for faulty connections if "failure = suppressed – Mode-1":

- no error in diagnostics
- NT bit emulation for received data by BSE
- general interrogation command initiated by BSE after connection error

During connection failure all data messages in transmit direction (including "End of Init") will be discarded. As a result a ring overflow is avoided with non-connected remote stations.

Connection Failure "notify/suppress" with 104-Redundancy with 1 Ethernet Interface

Supported settings for "failure = notify/suppress" (each redundancy group):

Failure for "virtual connection"	Failure for "real connection(s)" [178]	supported
notify	notify	✓
notify	suppress	✓
suppress	notify	–
suppress	suppress	–

13.5.5.3 Station Initialization

After startup, the connection is first established on the TCP/IP level. Then the Controlling Station starts the connection on the 104-level by means of STARTDTact (Start Data Transfer Activation). Afterwards the transmission of user data and other system messages to the remote station is started either immediately or only after the transmission of the INIT-End message.

End of Initialization

The INIT-End message "<TI=70> End of Initialization" is only transmitted to the remote station for each ASDU after startup of the component or the basic system element, if the following preconditions are fulfilled:

- Connection is established at TCP/IP level
- Connection with STARTDTact on IEC 60870-5-104 level is started
- Sending of „end of initialization" must be enabled on the basic system element in the IEC 60870-5-101/104 parameter block
- "INIT-End" has been received by the basic system
- Parameter **`[PRE] Station definition (Connection definition) | Connection definition | Stop behaviour`** = "save"
- Parameter **`[PRE] Station definition (Connection definition) | Connection definition | Station failure`** = "notify"

13.5.5.4 Acquisition of Events (transmission of data ready to be sent)

The transmission of the data from the remote terminal unit to the master station as well as from the master station to the remote terminal unit takes place spontaneously with connection established and for each connection. The prioritization and 104-blocking of the data ready to be sent takes place on the basic system element (BSE). The data transmission is started after a startup or, with redundancy switchover, after successful establishment of the connection.
For further details, see to section "Data Transmission Procedure".

178 Parameter settings for all real connections of a redundancy group must be the same!

13.5.5.5 Change monitoring & value adaption (scaling) for measured values

All data, in particular measured values, are normally transmitted by the IEC 60870-5-104 protocol without further processing in the sending direction to the remote station or in the receiving direction - also without processing.

If measured values in the transmit direction come from sources that have not implemented measured value change monitoring (e.g.: 3rd party devices), then there can be impairments on the remote station - if it has to serve many connections - due to the high data load.

- The number of measured values transmitted to the remote station can be reduced by monitoring measured value changes in the protocol, since measured values are only transmitted if the change in the measured values is correspondingly large.
- Measured value change monitoring can also be used in the receive direction. This means that measured values from remote stations that have implemented no or only insufficient measured value change monitoring (e.g.: 3rd party devices) are already processed when they are received, thus reducing the SICAM A8000 internal data load.
- In addition, a technological adjustment of the values (scaling) on the log can be carried out for measured values - also independently of the measured value change monitoring.
- The number of measured values for change monitoring is not limited. A maximum of 300 measured values per second are processed in the transmission and/or reception direction. If there are more measured values to process, they will be processed in the next processing grid (in this case there may be delays in passing the measured values).

Measured value change monitoring possible for the following TIs:

TI	Designation
<TI:=34>	Measured value, normalized value with time tag CP56Time2a
<TI:=35>	Measured value, scaled value with time tag CP56Time2a
<TI:=36>	Measured value, short floating point number with time tag CP56Time2a

For details on the parameterization of the measured value change monitoring & value adjustment (scaling), see *13.5.7.3 Message conversion in transmit/receive direction for measured values*.

13.5.5.6 General interrogation, Outstation interrogation

The general interrogation (outstation interrogation) function is used to update the master station after the internal connection initialization or after the master station has detected a loss of information. The general interrogation function <TI:=100> of the master station requests the remote terminal unit connected over one connection to transmit the current values of all its process variables.

A general interrogation command "to all" triggered in the system is always transferred by the communications function on the basic system element (BSE) station-selective (per connection) to the protocol element of the master station and transmitted by this to the remote terminal units.

A general interrogation command to a "prepared connection" will not be transmitted but positive confirmed (ACTCON+) by the protocol element.

After start of the IEC 60870-104 data transfer with the message STARTDTact by the controlling station, a general interrogation command can be sent to the controlling station if required (for update of the process data base). For further details, refer to section *"Data Transmission Procedure" | "Data transmission control with Start/Stop (data flow block)"*.

If the IEC 60870-104 data transfer will be stopped by the controlling station using STOPDTact during running general interrogation, the not sent general interrogation data stored on BSE can be discarded or continued with sending after STARTDTact.

This function can be enabled on BSE with the parameter **[PRE] Data base management | Data base management at failure | Failure behavior for process inform (GI)** . With selection “Delete” all process information with cause of transmission “interrogated by station interrogation” including ACTCON and ACTTERM will be deleted in case of communication failure or STOPDTact.

The deactivation of a general interrogation <COT:= 8> (DEACT) is not supported. If a deactivation is received, the protocol element responds with DEACTCON- with <COT:=45> (unknown cause of transmission).

13.5.5.7 Clock Synchronization

In networks and in systems with time-critical tasks a precise time is essential.

The clock synchronization for IEC 60870-5-104 can be performed in the following ways:

- Clock synchronization command <TI:=103>
- Network Time Protocol (NTP) according to RFC 1305 [179]

For SICAM A8000 a clock synchronization using NTP is recommended!

Messages that are transmitted after a startup contain the

- current time, if the automation unit already has been synchronized previously
- relative time from startup (reference date), if the automation unit already has never been synchronized
  Reference date for SICAM A8000 (SICAM RTUs): 1.1.2001
  Reference date for Ax1703: 1.1.1997 1.1.1997

In both cases, the time tag is marked as invalid until the first reception of the synchronizing event.

Clock Synchronization Command

The time synchronization of the remote station with the time synchronization command can also be carried out via the network if the requirements for the accuracy of the time synchronization are lower.

The procedure defined in IEC 60870-5-5 for time synchronization with the time synchronization command is not recommended in networks, since the runtime cannot be determined with IEC 60870-5-104 and a runtime correction is therefore not possible.

Time synchronization with the time synchronization command can be used in configurations with networks if the "max. network delay" is less than the required accuracy for time synchronization.

If for instance the network provider guarantees, that the maximum delay for the transmission in the network is never greater than 400 milliseconds and the accuracy required for the time synchronization is only 1 second, then this procedure can be used for clock synchronization.

If the accuracy of clock synchronization via network is insufficient, a local time signal receiver or clock synchronization via NTP must be used by the remote station.

SICAM A8000 as Sender of Clock Synchronization Command

The time synchronization command <TI:=103> is sent with the current time spontaneously when the time changes and cyclically 1x per minute (at the 30th second).

The transmission of the time synchronization command is controlled by the basic system element.

Before switchover of daylight saving time the clock synchronization command will be sent (in advance) with new time.

SICAM A8000 as Receiver of Clock Synchronization Command

With SICAM A8000 correct setting of time is only ensured if the clock synchronization command will be received between 10th and 50th second. The new time is adopted at the next minute change.

NOTE

With SICAM A8000 the new time must be sent in (advance) at change of daylight saving time, otherwise the time is not correct for up to 1 minute.

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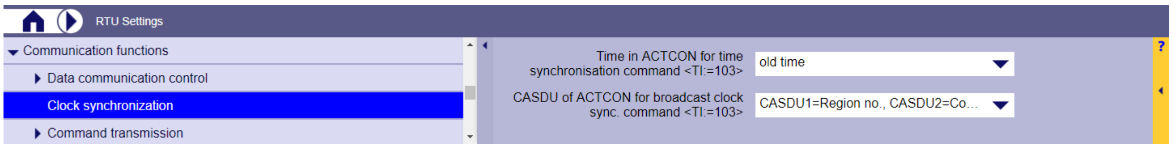
[179] Function integrated on the basic system element

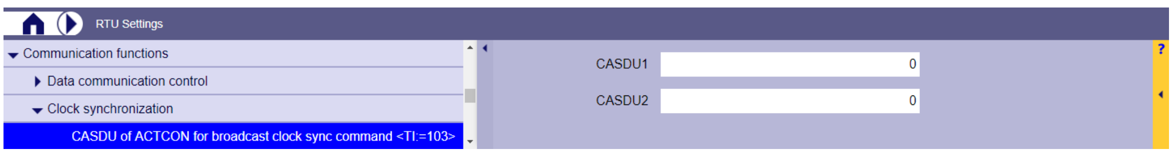
Acknowledgment (ACTCON) for time synchronization command

The following parameters are available in the SICAM A8000 substation to adapt to requirements for time synchronization by the central station that deviate from the IEC 60870-5-104 standard:

- Time in ACTCON for time setting command <TI:=103>
- CASDU of ACTCON for broadcast time setting command <TI:=103>



[ETI4_DM_Zeitsync_ZEIT_in_ACTCON_GER_, 1, en_US]



[ETI4_DM_Zeitsync_CASDU_in_ACTCON_GER, 1, en_US]

Parameter	Description	Settings
[PRE] IEC60870-5-104 | Communication functions | Clock synchronisation		
Time in ACTCON for time setting command <TI:=103>	The selected time is transmitted in the acknowledgment (ACTCON) for time set command <TI:=103>. • <Old time> Time in ACTCON = old time before time synchronization. (= according to IEC 60870-5-104 Standard) • <New time> Time in ACTCON = new time from the time setting command <TI:=103>	Permitted range = • old time • new time default setting = old time
CASDU of ACTCON for broadcast time setting command <TI:=103>	If the time setting command <TI:=103> was transmitted with CASDU=Broadcast (=FFFF), then the confirmation (ACTCON) is transmitted with the following CASDU: • <CASDU1=Regionnr, CASDU2=Componentnr> ACTCON is transmitted with the CASDU of its own component (R#, K#). • <freely definable> ACTCON is transferred with the freely parameterized**CASDU1**,**CASDU2**.	Permitted range = • CASDU1=Regionnr, CASDU2=Componentnr • freely definable Default setting = CASDU1=Regionnr, C ASDU2=Componentnr

Parameter	Description	Settings
[PRE] IEC60870-5-104 | Communication functions | Clock synchronisation | CASDU of ACTCON for broadcast time setting command <TI:=103>		
CASDU1 **CASDU2**	The confirmation (ACTCON) is sent with this CASDU if the time synchronization command <TI:=103> with CASDU = BROADCAST (FFFF) was received and the parameter **[PRE] IEC60870-5-104 | Communication functions | Clock synchronisation | CASDU of ACTCON for broadcast time setting command <TI:=103>** is set to "**freely definable**.	Permitted range = • CASDU1: 0 to 255 • CASDU2: 0 to 255 Standard setting = 0

13.5.5.8 Command Transmission

With connection established (data transfer must be started and the number of unacknowledged APDUs must not be reached) data messages in command direction are always transmitted spontaneously from the central station to the remote station. The prioritization and 104-blocking of the data to be sent already takes place on the basic system element (BSE).

For commands in transmit direction the function "control location check" can be enabled optionally. If control location check is enabled, commands will be sent to remote station only if the originator address of the command was enabled before by PRE control message.

A check command <TI:=107> with cause of transmission <COT=6> (activation) can be sent by the basic system element for each connection.

The check command must be confirmed by the remote station with cause of transmission <COT=7> (activation confirmation) and P/N=1 (ACTCON+). The check of the correct confirmation of the test commend will be done on the basic system element.

A check command sent from the basic system element a prepared connection will not be transmitted but positive confirmed (ACTCON+) by the protocol element.

More details are in the sections *Data Transmission Procedure, Page 1005* and *13.5.7 Message Conversion*.

Command Transfer Monitoring (Dwell Time Monitoring)

During the transmission of data in networks, unwanted delays can occur. So that no unwanted process behavior is triggered due to a delayed output of commands, the LAN/WAN protocol element can monitor the transmission time (dwell time) of the data in the network for selected process information in control direction. This monitoring prevents the output of old commands.

If the command delay monitoring is activated and a command message arrives via the LAN interface, then the time tag of the message is compared with the current time of the component.

If the evaluated command delay time (transmission time of the data in the network) is longer than the parametrized command delay monitoring the command message is discarded without an error message.

If the time of the component is not yet set while dwell time monitoring is activated, the behavior to handle received command messages can be selected with the parameter **IEC60870-5-104 | Communication functions | Command transmission | Discard command when local time not set** whether a received command message should be passed on for further processing or deleted.

The controlling station detects the failed command output through the missing of the confirmation of activation (ACTCON).

The time for the command delay monitoring is to be parameterized on the basic system element (BSE) in the IEC 60870-5-101/104 parameters per protocol element. The command delay monitoring can also be deactivated (**Command delay monitoring** = 0).

Error signalization To localize the error, the number of commands discarded by the command delay monitoring since RESET is summed and the last discarded command messages are additionally saved in a diagnostic ring. The counters and the diagnostic ring can be read out with the SICAM TOOLBOX II (ST-Emulation).

Monitoring of the command delay time for the following message types (TI's):

- <TI:=58> Single command with time tag CP56Time2a
- <TI:=59> Double command with time tag CP56Time2a
- <TI:=60> Regulating step command with time tag CP56Time2a
- <TI:=61> Setpoint command, normalized value with time tag CP56Time2a
- <TI:=62> Setpoint command, scaled value with time tag CP56Time2a
- <TI:=63> Setpoint command, short floating-point number value with time tag CP56Time2a
- <TI:=64> Bitstring of 32 bits with time tag CP56Time2a
- <TI:=107> Check command with time tag CP56Time2a

NOTE

- The message conversion in receive direction can also generate the assigned message types without time tag. As a result, indirectly the internal type identifications <TI=45, 46, 47, 48, 59, 50, 51 and 104> are also affected.
- The command delay monitoring is only carried out for command messages with the cause of transmission ACT (Activation)!

Control Location / Control Location Check

The function “Control location” is used so that commands and setpoint values are only output from "authorized sources". If the function is activated, commands/setpoint commands from the protocol element are only transmitted to the remote station, when the control location (originator address) is enabled.

If the control location is not enabled, the protocol element immediately sends back a negative acknowledgment of activation (ACTCON) to the originator address (further details about control location see section *13.1.4.9 Control location function for commands and setpoint values*).

13.5.5.9 Transmission of Integrated Totals

A counter interrogation command "to all" triggered in the system is always transferred by the communications function on the basic system element (BSE) station-selectively (per connection) to the protocol element of the central station and transmitted by this to the substations.

The functionality implemented in SICAM A8000 concerning integrated totals is described in the document *SICAM RTUs Common Functions Peripheral Elements according to IEC 60870-5-101/104*.

13.5.6 Redundancy

To increase the availability central stations as well as remote terminal units can be implemented redundantly.

In this section, not the possible redundancy concepts themselves that can be realized are described, rather only those functions supported by the protocol element (PRE) for the support of redundant systems or communication routes.

The following redundancy modes are supported:

- 104-Redundancy
  - 104-Redundancy “Controlled” with 1 Ethernet Interface
  - 104-Redundancy “Controlled” with 2 Ethernet Interfaces
  - 104 redundancy “Controlled” [180]
- Protocol redundancy
- Port-Redundancy (deactivation of Interface)

[180] This function is not supported with CP-8031!

- PSI-Redundancy (Synchronous Connections)
- Device redundancy

NOTE

Only 1 redundancy mode can be used per protocol element!

13.5.6.1 104-Redundancy

The redundancy mode “104-Redundancy” is defined in the IEC 60870-5-104 standard.

With 104-redundancy, one or more substations (Controlled Station) are connected to one or more redundant master stations (Controlling Stations) via several logical connections. The data transfer always takes place via only 1 started connection per redundancy group.

Redundancy Function according to IEC 60870-5-104:

- The master station (Controlling Station) and the remote terminal unit (Controlled Station) support multiple logical connections
- Multiple logical connections are grouped to form one redundancy group
- Within a redundancy group only 1 logical connection may be started
- Only the master station (Controlling Station) decides which logical connection within a redundancy group is started
- All logical connections of a redundancy group are monitored by test frames
- One redundancy group is only supplied by one process image (data base)

There is a TCP connection for each redundant Ethernet interface of the remote station and these redundant connections are combined into a redundancy group. Only one of the redundant connections may be started by the controlling station and transmit data. At the NIP, the 104-redundancy group can be described like a switch which controls the sending of data to the started connection.

The 104-redundancy with 2 Ethernet interfaces uses an additional logical switch on the BSE which selects to which NIP the data to be sent is forwarded, and thus the redundancy group extends over both NIPs and the BSE.

NOTE

The 104-redundancy "Controlled with 2 Ethernet interfaces" can only be used within one basic system element (BSE).

A distribution of 104-redundancy over several BSE's is not supported!

The controlling station switches between the redundant connections. There are two types of redundancy switching, the **soft switchover** and the **hard switchover**.

The **soft switchover** is applied, e.g. during tests or when a part of the controlling station is to be decommissioned. First, the previously started connection is stopped with a STOPDTact. Only when STOPDTcon has been received by the controlling station a STARTDTact will be sent from the controlling station to another connection. This then becomes the new started connection.

The **hard switchover** occurs primarily when the controlling station detects a connection failure (for example, a 104 timeout). The controlling station will immediately send a STARTDTact to another connection. This then becomes the new started connection. If the previously started connection in the controlled station is still established at this time (because the controlled station has not yet detected a connection failure), it is immediately closed.

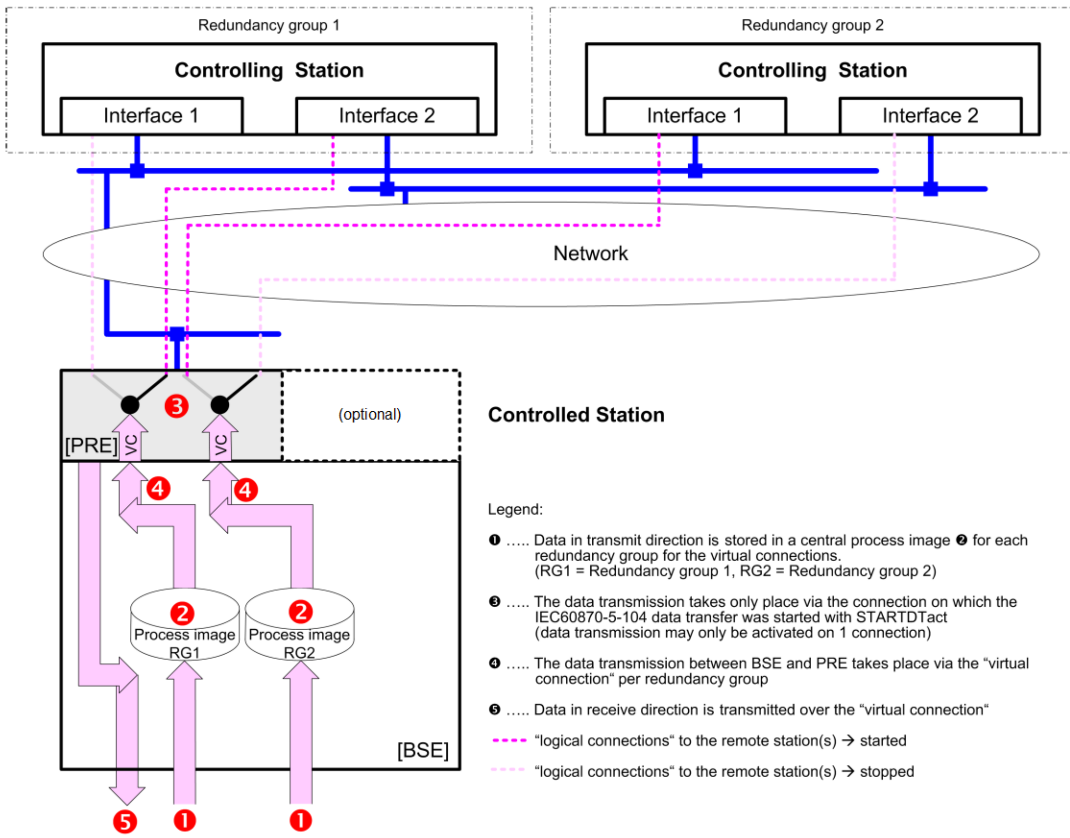
Several independent redundancy groups are possible. Each connection can be assigned to exactly one redundancy group.

The connection parameterization, the connection state and the redundancy state can be read out from PRE in the ST emulation with the command “idh”.

13.5.6.2 104-Redundancy “Controlled” with 1 Ethernet Interface

The 104-redundancy “Controlled” with 1 Ethernet interface allows the interfacing of a remote station with redundant Ethernet interfaces over 1 Ethernet network to redundant master stations.

Example for a remote station with redundant interfaces is e.g. one system with two Ethernet interfaces or two systems that are operated redundantly or a combination of both.



Operating Mode of the 104-Redundancy with 1 Ethernet Interface in the Controlled Station:

- Several redundancy groups can be defined for each PRE
- Each redundancy group consists of one or more "real" connections and exactly 1 "virtual connection" for the communication to the BSE. The connections of a redundancy group in transmit direction are handled as one connection (=virtual connection) from the point of view of the communication function on the BSE.
- A redundancy group may only have a max. of 4 real connections assigned
- The data is transferred from the BSE to the PRE via the "virtual connection" assigned to the redundancy group. As a result, the connections of a 104 redundancy group for 1 Ethernet interface are supplied from only one process image (data base).
- The 104 data transmission is controlled by the controlling station with STARTDT / STOPDT act - only 1 Connection may be started per redundancy group.
- The data is transmitted to the remote station only over the started "real connection" of the 104-redundancy group.
- All stopped connections are established at the TCP level.

- Each connection is monitored with test frames.
- Each connection (and therefore the 104 sequence numbers) is managed independently.
- In receive direction, the data of a 104-redundancy group are transmitted to the BSE with the station number assigned to the "virtual connection".
- Connections for 104 redundancy and normal connections (without redundancy) can be mixed on the same PRE.

Parameter settings for the 104-Redundancy with 1 Ethernet Interface in the Controlled Station:

- The parameter **[PRE] Redundancy | Redundancy mode** must be set to ***"104-Redundancy"*** .
- The parameters of the connection definitions **[PRE] Station definition (Connection definition) | Station definition | Station enable** must be set to ***yes*** .
- For all connections of the 104 redundancy group, the parameter **[PRE] Station definition (Connection definition) | Station definition | Controlling/Controlled** must be set to ***"controlled"*** .
- For each 104 redundancy group, a connection must be defined with the parameter **[PRE] Station definition (Connection definition) | Station definition | Redundancy** as ***"virtual Connection"*** .

  The virtual connection is used only for internal communication with the BSE. This connection is not present on the LAN (the IP address of the virtual connection is not relevant and will not be used).

  Notes:
  - "suppress station failure" must not be set for virtual connections!
  - only the virtual connection must be included in the topology definition. (including a real connection of a 104-redundancy group in topology definition will cause buffer overflow)
- All connections of the 104 redundancy groups to the remote stations must be defined with the parameter **[PRE] Station definition (Connection definition) | Station definition | Redundancy** as ***"real Connection"*** .

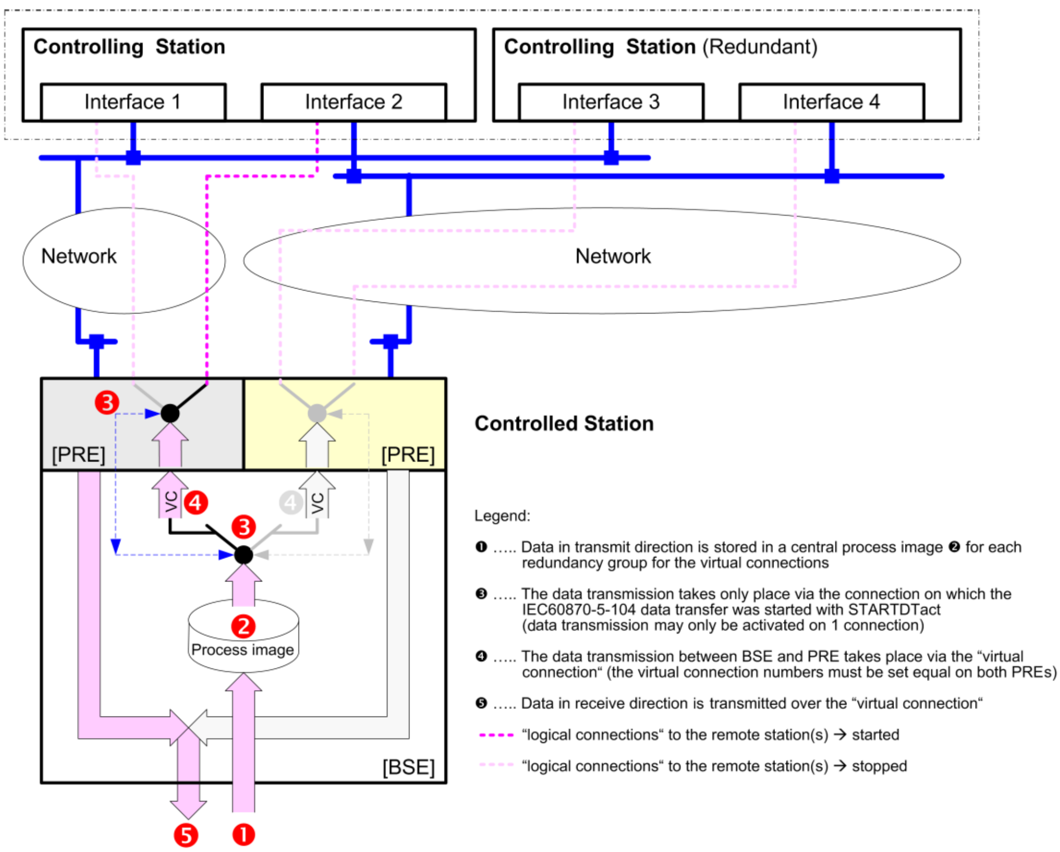
  For the real connections additionally all necessary parameters like IP address of the remote station, ... must be defined in the parameters of the **[PRE] Station definition (Connection definition) | Station definition** .
- With 104-redundancy, a connection can be assigned to one of several redundancy groups. Each redundancy group can be controlled independently of the other 104-redundancy groups. For each 104-redundancy group, the data transmission can be started via 1 of the assigned connections. The redundancy group is set with parameter **[PRE] Station definition (Connection definition) | Station definition | RedGroup** .
- The Stop behavior must be set with parameter **[PRE] Station definition (Connection definition) | Station definition | Stop behavior** to ***"store"***.
- The function "Clear ring buffer" must be set with parameter **[PRE] Station definition (Connection definition) | Station definition | Clear ring buffer** to ***"no"***.
- The parameter **[PRE] | Redundancy | Station number for received telegrams** is not evaluated.
- If the PRE is switched to "passive" by the redundancy control of the BSE, the transmission of the telegram "<TI:=103> Clock synchronization command“ can be suppressed with parameter **[PRE] | Redundancy | Send time setting (TI103) if passive** .
- If the PRE is switched to "passive" by the redundancy control of the BSE, the transmission of the telegram "<TI:=107> Check command with time tag CP56Time2a“ can be suppressed with parameter **[PRE] | Redundancy | Send test command (TI107) if passive** .
- The parameter **[PRE] | Redundancy | Disable Ethernet-Port if passive** must be set to "no".

13.5.6.3 104-Redundancy “Controlled” with 2 Ethernet Interfaces

The 104-redundancy "Controlled" with 2 Ethernet interfaces enables the redundant interfacing of a component as substation to remote stations with redundant Ethernet interfaces via 2 Ethernet networks. Example for a remote station with redundant interfaces is e.g. one system with two Ethernet interfaces or two systems that are operated redundantly or a combination of both. This type of redundancy requires two PRE’s on the same BSE.

In addition to the two redundancy groups on the PRE's there is a "switch" on the BSE, which switches between the two PRE redundancy groups. The two PRE redundancy groups and the BSE switch work as a single redundancy group.

The CP-8050 internal redundancy control telegrams are not used in the controlled station.



[ETxx_Redundanz_mit_2_Schnittstellen, 2, en_US]

Operating Mode of the 104-Redundancy “Controlled” with 2 Ethernet Interfaces” in the Controlled Station.

Only the differences or extensions compared to the functionality of the 104-redundancy with 1 Ethernet interface are described here:

- The data transfer is started by the controlling station with the telegram STARTDTact. For each redundancy group (which is assigned to two PRE's and the BSE) only 1 connection may be started. i.e. either a real connection has been started on the Ethernet interface 1 or on the Ethernet interface 2. The data transfer from the BSE to the PRE takes place only via the "virtualConnection" of the started Ethernet interface. This supplies the connections of a redundancy group for 2 Ethernet interfaces from only one process image.

- The data transmission to the remote station is done only via the real connection with data transmission started with STARTDTact.

Parameter settings for the 104-Redundancy “Controlled” with 2 Ethernet Interface in the Controlled Station.

Only the differences or extensions compared to the functionality of the 104-redundancy with 1 Ethernet interface are described here:

- The virtual connections must be configured identically on both PRE’s (same number of virtual connections, same assignment to station numbers, same redundancy groups).
- The number of real connections and the station numbers of the real connections may be different on both PRE's.
- On the PRE, connections for 104-redundancy and normal connections (without redundancy) can only be parameterized mixed on the primary protocol element.
- For the remaining parameters in 104-redundancy with 2 Ethernet interfaces the same rules apply to parameter settings as with 104-redundancy with 1 Ethernet interface.

13.5.6.4 104 redundancy „Controlling“

The 104 redundancy “Controlling” enables the interfacing of a central station to one or more remote stations. One PRE in the central station works as a controlling station. The number of controlling stations depends on the redundancy configuration and the PREs can be equipped as required (mixed configurations are also possible):

- on one BSE
- on various BSEs within one component
- on various BSEs in different components

NOTE

This function is not supported with CP-8031!

Redundancy switching is controlled by the BSE with the redundancy A/P control message (FC 159, IC 1) - the entire PRE is switched to passive or active. With redundancy switching, all redundant connections of a PRE are switched together with STARTDT or STOPDT. It is not possible to switch some connections as started (with STARTDT) and other connections as stopped (with STOPDT).

The redundancy control logic (active/passive switching) controls all connections that are parameterized as “104-redundancy controlling”:

- PRE is set active:
  - 104 data transfer is started with STARTDTact when connection is established.
  - should be confirmed by the remote station with STARTDTcon.
- PRE is set passive:
  - 104 data transfer is stopped with STOPDTact when connection is established.
  - should be confirmed by the remote station with STOPDTcon.

When the START/STOP switchover has been acknowledged with "STARTDTcon / STOPDTcon" from all connections, a redundancy A/P control acknowledgment message (FC 159, IC 2) is returned to the BSE.

In the following cases, a connection is not taken into account during redundancy switching and the handling of the A/P control message acknowledgment (FC 159, IC 2):

- the connection fails (remote device close the connection → IEC 104 Timeout) before a STARTDTcon / STOPDTcon is received. The A/P control acknowledgment message will be delayed until the remote station is detected as failed.
- The connection is established during redundancy switchover and started if necessary.

Operating Mode of the 104-Redundancy "Controlling":

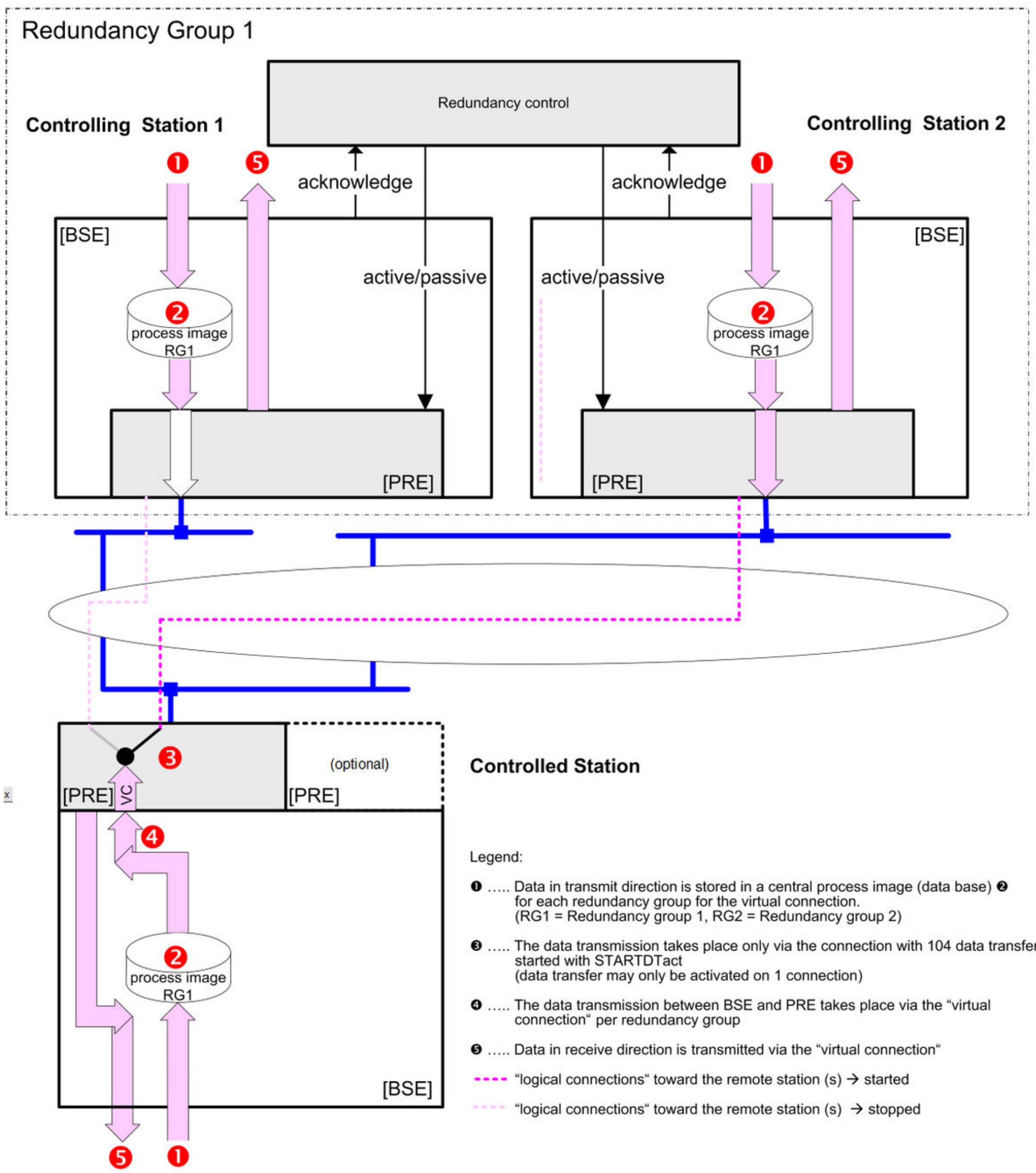
The redundancy control evaluates the criteria for a redundancy switchover and sets the controlling stations used in the redundancy configuration to started or stopped. Depending on the redundancy group, two to four controlling stations are possible. A maximum of one controlling station may be started.

After a redundancy switchover the redundancy control logic must wait for the A/P control acknowledgment message from the PRE before initiating another switchover, otherwise the following behavior may occur:

- Hard switchovers and connection terminations
- Non-IEC 104 compliant behavior

The redundancy control requires additional functionality, which can be implemented as follows:

- SICAM RTUs Redundancy or
- recundancy controlled by logic (CAEx plus)



[ETxx_Redundanz_Controlling, 2, en_US]

Prosess data message handling between BSE and PRE depends on the redundancy and connection state.

Process data messages to the PRE are, depending on the operating state, fetched and sent, fetched up and discarded or piled up.

PRE active/passive 104-data transfer	Connection	Handling of Data (Data BSE → PRE)	Note
passive/STOPDT	down	fetched and discarded	loss of data on this PRE
passive/STOPDT	up	fetched and discarded	loss of data on this PRE
aktive/STARTDT	down	piled up	• ring overflow possible (loss of data) • confirmation time-outs
aktive/STARTDT	up	fetched and discarded	

Process data messages received from the remote station are forwarded without change to the BSE.

Parameter settings for the 104-Redundancy “Controlling”

(valid for all connections with controlling functionality of the 104-redundancy)

The number of connections with controlling redundancy on one NIP is functionally unlimited, all 100 connections of one NIP can be operated with controlling redundancy (see recommendations in the function overview).

- The parameter **[PRE] Redundancy | Redundancy mode** must be set to ***104-Redundancy*** .
- The parameters of the connection definitions **[PRE] Station definition (Connection definition) | Station definition | Station enable** must be set to ***yes*** .
- The IEC 60870-5-104 data flow control of the own station (Controlling / Controlled) must be set in the parameters of the connection definitions with the parameter **[PRE] Station definition (Connection definition) | Station definition | Controlling/Controlled** must be set to ***controlling***.
- The “redundancy” mode must be set in the parameters of the connection definitions with the parameter **[PRE] Station definition (Connection definition) | Station definition | Redundancy** to ***104-Contr-Red***.
- In the parameters of the connection definitions the parameter **[PRE] Station definition (Connection definition) | Station definition | RedGroup** is not relevant.
- In the parameters of the connection definitions, set the parameter **[PRE] Station definition (Connection definition) | Station definition | Stop behavior** to ***store***.
- In the parameters of the connection definitions, set the parameter **[PRE] Station definition (Connection definition) | Station definition | Station failure** to ***notify***.
- In the parameters of the connection definitions, set the parameter **[PRE] Station definition (Connection definition) | Station definition | Clear ring buffer** to ***No***.
- In addition, all required parameters such as the IP address of the remote station, ... must be parameterized for the connections in the parameters of the **[PRE] Station definition (Connection definition) | Station definition** .
- The parameter **[PRE] | Redundancy | Station number for received telegrams** is not evaluated.
- If the PRE is switched to "passive" by the redundancy control of the BSE, the transmission of the telegram "<TI:=103> Clock synchronization command“ can be suppressed with parameter **[PRE] | Redundancy | Send time setting (TI103) if passive** .

- If the PRE is switched to "passive" by the redundancy control of the BSE, the transmission of the telegram "<TI:=107> Check command with time tag CP56Time2a“ can be suppressed with parameter **[PRE] | Redundancy | Send test command (TI107) if passive** .
- The parameter **[PRE] | Redundancy | Disable Ethernet-Port if passive** must be set to "no".

13.5.6.5 Protocol redundancy

With protocol redundancy one remote terminal unit (Controlled Station) is connected with one or several master stations (Controlling Stations) over several logical connections. The data transmission takes place over all connections.

The switchover of the redundancy state (ACTIVE ↔ PASSIVE) takes place system-internal through redundancy control messages.

Operating mode of the redundancy control for protocol redundancy

- There is no difference between redundancy state ACTIVE/PASSIVE on the IEC 60870-5-104 interface.
- The data transmission is started by the controlling station for every connection with STARTDTact but not stopped with redundancy state PASSIVE.
- The data transmission is carried out on all connections independent of the other connections
- All data transferred from the BSE to the PRE for transmission are transmitted to the remote station even with the redundancy state PASSIVE.
- The data transmission is controlled from one specific process image for each connection.
- The switchover to PASSIVE takes place globally per PRE and not selectively per connection.

Parameter settings for protocol redundancy:

- The protocol redundancy is selected by setting the parameter **[PRE] Station definition (Connection definition) | Station definition | Redundancy** to ***none***.
- The parameter **[PRE] Redundancy | Redundancy mode** must be set to ***104-Redundancy*** .
- The parameter **[PRE] | Redundancy | Station number for received messages** is not evaluated.
- For all connections of the 104 redundancy group, the parameter **[PRE] Station definition (Connection definition) | Station definition | Controlling/Controlled** must be set to ***controlled*** .
- In the redundancy state PASSIVE, the message *<TI=107> check command with time tag CP56Time2a* can be disabled for transmission by the PRE with the parameter **[PRE] | Redundancy | Redundancy | Send test command (TI107) if passive** .
- In the redundancy state PASSIVE, the message *<TI:=103> Clock synchronization command* can be disabled for transmission by the PRE with the parameter **[PRE] | Redundancy | Redundancy | Send time setting (TI103) if passive** .
- In the redundancy state PASSIVE, the Ethernet interface can be deactivated with the parameter **[PRE] Redundancy | Disable Ethernet-Port if passive** .

NOTE

There is no difference between redundancy state ACTIVE/PASSIVE on the IEC 60870-5-104 interface.

When using IEC 104 redundancy “Controlled” and “Protocol Redundancy” at the same time, the following must be observed with the following configuration:
Configuration:

- Two telecontrol front ends where at a certain point in time one is ACTIVE and one is PASSIVE.
  On each telecontrol front end, 104 redundancy “Controlled” is parameterized.
- 2 SCADA systems with 104 redundancy “Controlling” parameterized.
  Each SCADA system has a connection to each telecontrol front end.

What is to be considered:

- In total there are two IEC 104 redundancy groups with two connections each.
  For each redundancy group, a connection has been started.
- The IEC 104 redundancy control in the SCADA system must recognize, which telecontrol front-end is active.
  (Example: only the active telecontrol front end send <TI:=103> or <TI:=107> messages).
  With this the SCADA system can recognize the active telecontrol front-end.
- In the SICAM A8000 telecontrol front-end the sending of messages with <TI:=103> or <TI:=107> can be disabled in redundancy state PASSIVE.

13.5.6.6 Port-Redundancy (deactivation of Interface)

For specific redundancy configurations the Ethernet interface can be deactivated.
Activation/deactivation of the Ethernet interface with:

- PST control message
- Redundancy control message

The function “Activation/deactivation of the Ethernet interface with redundancy control message” can be enabled with the parameter **`[PRE] Redundancy | Disable Ethernet-Port if passive`** . If the activation/deactivation of the Ethernet interface is enabled with the redundancy control message, the PST control message cannot be used.
After restart of the PRE the Ethernet-interface is activated per default.
Behavior at “Interface DISABLED”:

- Ethernet Port will be disabled
  (disconnect Ethernet connection; TCP/IP connection will be released)
- no services possible (IEC 60870-5-104, WEB, NTP, remote operation)
  Note: behavior is the same as with disconnected LAN cable.
- Warning: “Interface DISABLED” is output as a diagnostic message
- all IEC 60870-5-104 connections will be released after 104 timeouts

13.5.6.7 PSI Redundancy (Synchronous Connections)

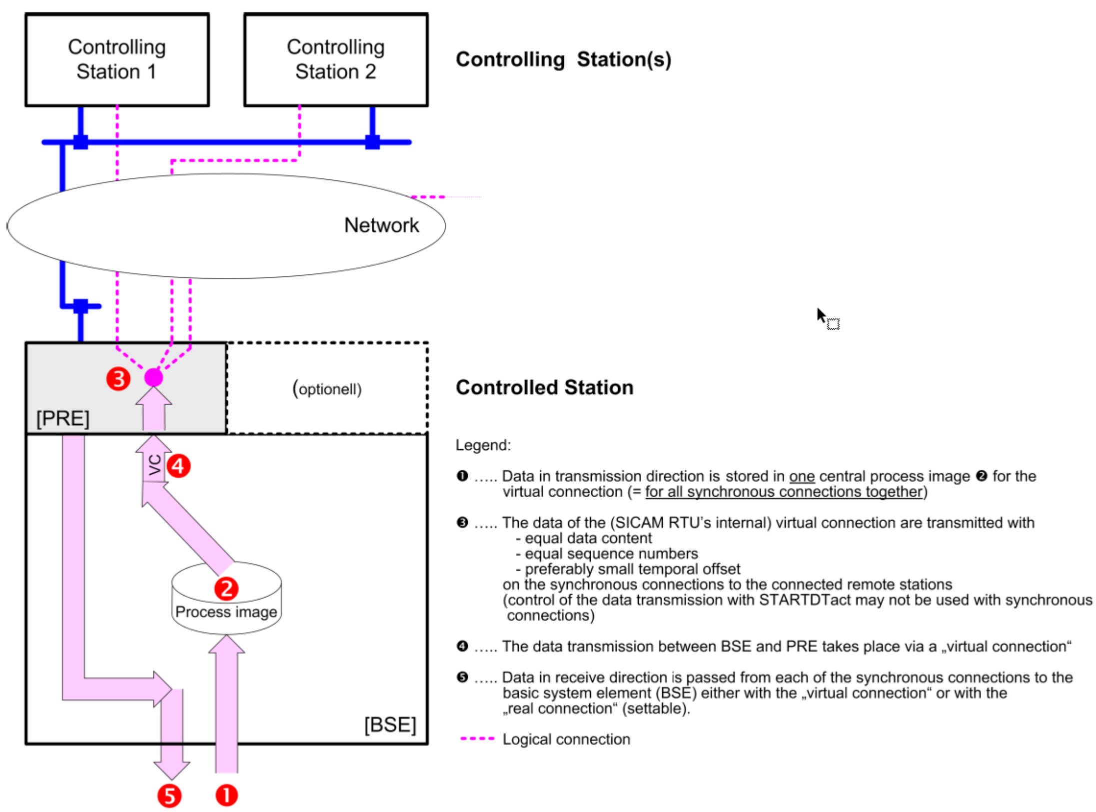
The redundancy mode "PSI-Redundancy (synchronous connections)" is a proprietary function and is only implemented in plants with a control system (Controlling Station) from the manufacturer "PSI".
This redundancy function is not defined in the IEC 60870-5-104 standard! This redundancy mode is selected by setting the parameter **`[PRE] Redundancy | Redundancy mode`** to PSI-Redundancy and with that is continuously activated.

A switchover/control of the redundancy through system-internal redundancy control messages as well as the redundancy functions of the Controlling Station are not supported for this redundancy mode!

Functioning method of synchronous connections:

- The data is sent over the synchronous connections with the same data content.
- The data is sent over the synchronous connections in the same order.
- The data is sent over the synchronous connections with the same IEC 60870-5-104 sequence number.

  The data to the first synchronous connection established is transmitted beginning with the sequence number "0". The data to other synchronous connections established later is transmitted with the current consecutive sequence number (the sequence number for received data is individual for each synchronous connection).
- The data is transmitted over the synchronous connections with as little chronological offset as possible.
- In receive direction, there is no specific function for synchronous connections – received data is transferred to the BSE for each synchronous connection.



On the LAN/WAN-protocol element, synchronous connections for PSI redundancy and normal connections (without redundancy) can be used mixed.

For synchronous connections, system internally only 1 virtual connection may be parameterized and at least 2 or more real connections. The synchronous connections form a group – these are handled as one connection in transmit direction from the perspective of the communications function on the BSE.

The synchronism of the connections is controlled directly by the LAN/WAN-protocol element. The data transferred from the BSE for transmission to the synchronous connections are duplicated by the LAN/WAN-protocol element to the assigned connections. Due to the synchronism of the connections during transmission, the data throughput is defined by the slowest remote station. With acknowledgment required, a further transmission can only then take place when all remote stations have acknowledged.

In transmit direction, on the BSE the data is only routed to the "virtual connection" and passed on immediately to the remote station by the LAN/WAN-protocol element without TCP/IP blocking. If the control of the data transmission is stopped for one connection, the data for this connection are discarded.

In receive direction, the data is passed on to the BSE either with the station number of the virtual connection or with the station number of the real connection. The selection of the station number is performed with the parameter **[PRE] | Redundancy | Station number for received messages** .

On failure of one real connection, this is signaled as failed. On failure of all real connections, in addition the virtual connection is signaled as failed.

Necessary parameter settings for synchronous connection on the LAN/WAN-protocol element:

- Virtual connection

  A selected connection is to be defined as virtual connection in the parameters **[PRE] Station definition (Connection definition) | Station definition | Redundancy** .

  The virtual connection is used only for internal communication with the BSE. This connection is not present on the LAN (the IP address of the virtual connection is not relevant and will not be used).

  Note:

  For connections that are operated without redundancy, the parameter **Connection definition | Redundancy** is to be set to "none".

- Synchronous Connections (real connections)

  All connections to the connected remote stations that are to be handled as synchronous connections are to be defined as real connections in the parameters **[PRE] Station definition (Connection definition) | Connection definition | Redundancy** .

  For the real connections, in addition all necessary parameters of the Connection definition (such as IP address of the remote station,...) must be parameterized in **[PRE] Station definition (Connection definition) | Connection definition** .

- IEC 60870-5-104 Data Flow Control of the own station (Controlling/Controlled)

  The data flow control is defined for all synchronous connections together with the parameter **[PRE] Station definition (Connection definition) | Connection definition | Controlling/Controlled** for the virtual connection!

Necessary parameter settings of the communications function/topology on the BSE for synchronous connections in transmit direction:

- Deactivation of the state compression.
- All user data must be assigned to one priority level.
- For the failure management, the real connections must be entered in the topology.
- For the real connections the disabling of system data must be activated in the topology.
- For the failure management of the data in receive direction, the parameter setting of the topology and the source ID is required.
- The virtual connection and all real connections must be parameterized as "Controlled".
- No data may be routed to a real connection.

Restrictions:

- A special handling for synchronous connections is only implemented in transmit direction!
- Synchronous connections to one SICAM A8000 component must not be used!
- With synchronous connections the remote station may not use Start/Stop for the control of the data transmission!
- The formation of redundancy groups for synchronous connections is not supported!
- Data in transmit directions must not be routed "to all"!

13.5.7 Message Conversion

Data in transmit direction is transferred from the basic system element to the protocol element in SICAM A8000 internal IEC 60870-5-101/104 (without 101/104 blocking) format. The data formats are converted to the IEC 60870-5-104 line format on the protocol element. The transmission of data at the Ethernet interface according to IEC 60870-5-104 is controlled by the protocol element.

In the transmit direction, the data to be sent is already blocked on the basic system element in accordance with IEC 60870-5-101/104. If the conditions for blocking the data are not met, the data is transmitted unblocked by the basic system element to the protocol element.

Data in receive direction is converted by the protocol element from the IEC 60870-5-104 format on the transmission line to a SICAM A8000 internal IEC 60870-5-101/104 format and transferred to the basic system element (with/without 101/104 blocking).

Blocked data in receive direction is transmitted by the protocol element to the basic system element and unblocked by it. Internally in SICAM A8000, the data is always transmitted unblocked.

With IEC 60870-5-104, no signal definition is required for the message conversion on the protocol - the data is forwarded unchanged. In addition, measured values with <TI:=34, 35, 36> in transmit/receive direction can optionally be monitored for measured value changes or adjusted (scaling) to the protocol. The parameterization of the measured values for the change monitoring or value adaptation takes place with the SICAM Device Manager with the function “Signals” or with the SICAM TOOLBOX II, OPM II using “SIP Message Address Conversion”.

Supported processing types for message conversion

Data	Direction	Processing type	ETI4	FWI4
Measured values	Receive direction	*firmware* /**Rec_values**	✓	✓
Measured values	Transmit direction	*firmware* /**Trans_values**	✓	✓

For details on the parameterization of the measured value change monitoring & value adjustment (scaling), see *13.5.7.3 Message conversion in transmit/receive direction for measured values*.

13.5.7.1 Object Numbering

All IEC 60870-5-104 message objects are transmitted with an unambiguous IEC 60870-5-104 sequence number. Several IEC 60870-5-104 message objects can be transmitted in one TCP packet. A packed IEC 60870-5-104 message (with several individual messages) is handled as one message object.

The sequence number is managed for each connection and is an ascending number in the range 0 to 32767 (modulo 32768). The sequence number is used for the acknowledgment procedure defined for IEC 60870-5-104.

13.5.7.2 Blocking

For optimal use of the transmission paths, the data is transmitted with “blocking” in accordance with IEC 60870-5-104. Data to be sent is already blocked at the basic system element in accordance with the applicable rules and forwarded to the protocol element for sending.

When communicating on Ethernet, several blocked IEC 60870-5-104 messages can be transmitted in one TCP packet.

Received data in blocked format is forwarded from the protocol element in blocked format to the basic system element. On the basic system element the blocked data is split up again into individual information objects by the “detailed routing” function and passed on as such to the further processing.

Due to the additionally required transport information, received messages with maximum length are transmitted SICAM A8000 internal in several blocks from the protocol element to the basic system element.

The parameters necessary for the blocking are to be set on the basic system element in the IEC 60870-5-101/104 parameter block.

13.5.7.3 Message conversion in transmit/receive direction for measured values

Message conversion in transmit/receive direction: IEC 60870-5-101/104 ↔ IEC 60870-5-104

SICAM A8000: IEC 60870-5-101/104 BSE ↔ PRE		ETI4, FWI4: IEC 60870-5-104 PRE ↔ remote station	
TI	Designation	TI	Designation
<TI:=34>	Measured value, normalized value with time tag CP56Time2a	<TI:=34>	Measured value, normalized value with time tag CP56Time2a
<TI:=35>	Measured value, scaled value with time tag CP56Time2a	<TI:=35>	Measured value, scaled value with time tag CP56Time2a
<TI:=36>	Measured value, short floating-point number with time tag CP56Time2a	<TI:=36>	Measured value, short floating-point number with time tag CP56Time2a

Measured values

The parameterization of the measured values for change monitoring & value adaptation in the transmit/receive direction is carried out with the the SICAM Device Manager with the function "Signals" or with the SICAM TOOLBOX II, OPM II.

Processing type in transmit direction: *firmware* / **`Trans_value`**

ETI4/Trans_value 0 of 3 selected (total: 0)

	Name	CASDU-IOA	TI	Station_number	Thresh_uncond	Thresh_additive	X_0%	X_100%	Y_0%	Y_100%
1	MW MTx (1)	88-1-1-0-0	TI 34 Measured value, normalized value	1	0,1	0,05	-0,5	0,5	-1	1
2	MW MTx (2)	88-1-2-0-0	TI 35 Measured value, scaled value	3	20	5	0	2000	-1000	1000
3	MW MTx (3)	88-1-3-0-0	TI 36 Measured value, short floating point number	5	10	5	-2,5	2,5	-250	250

[ETI4_DM_Sende_Wert_GER, 1, en_US]

Processing type in receive direction: *firmware* / **`Rec_value`**

ETI4/Rec_value 0 of 3 selected (total: 0)

	Name	CASDU-IOA	TI	Station_number	Thresh_uncond	Thresh_additive	X_0%	X_100%	Y_0%	Y_100%
1	MW MRx (1)	88-1-4-0-0	TI 34 Measured value, normalized value	1	0,1	0,05	-0,5	0,5	-1	1
2	MW MRx (2)	88-1-5-0-0	TI 35 Measured value, scaled value	3	20	5	0	2000	-1000	1000
3	MW MRx (3)	88-1-6-0-0	TI 36 Measured value, short floating point number	5	10	5	-2,5	2,5	-250	250

[ETI4_DM_Empf_Wert_GER, 1, en_US]

Parameter	
`TI`	Supported type identifications: • <TI:=34> .. Measured value, normalized value with time tag CP56Time2a • <TI:=35> .. Measured value, scaled value with time tag CP56Time2a • <TI:=36> .. Measured value, short floating-point number with time tag CP56Time2a
`Name`	Name of the signal
`CASDU-IOA`	SICAM A8000 internal IEC 60870-5-101/104 message address (CASDU1, CASDU2, IOA1, IOA2, IOA3)
`Station number`	SICAM A8000 internal station number of the connection from the station definition: • 0 to 99

Parameter	
`Thresh_uncond`	If the value changes > `Thres_uncond`, the values is transmitted immediately to the remote station or the received value is immediately forwarded to the BSE. Note: The change monitoring affects the raw value (before the value adaptation) (in the transmit direction on the SICAM A8000 internal value - in the receiving direction on the received value from the remote station)
`Thresh_additive`	If the value changes ≤ `Thres_uncond`, the value to be sent is not transmitted immediately or, in the receive direction, the received value is not immediately forwarded to the BSE and the additive change monitoring is performed.
`X_0%, X_100%` `Y_0%, Y_100%`	Parameters for value adaptation (scaling): • Valid value range for `X_0%` , `X_100%` - see IEC 60870-5-104 data formats • `X_0%`, `X_100%` .. IEC60870-5-104 value range of remote station • `Y_0%`, `Y_100%` .. IEC 60870-5-101/104 Value Range SICAM A8000 (internal) • <TI:=34>.. `X_0%`, `X_100%` must not be greater or less than ±1 • <TI:=35> .. `Y_0%`, `Y_100%` must not be less than –32768 or greater than +32767. • Value adaptation inactive at `Y_0%` = 0 and `Y_100%` = 0

Supported Data Formats

TI		IEC 60870-5-101/104 Data format (TI)
34	Measured value, normalized value with time tag CP56Time2a	34
35	Measured value, scaled value with time tag CP56Time2a	35
36	Measured value, short floating-point number with time tag CP56Time2a	36

NOTE

Measured value change monitoring is not supported for the following TIs:

<TI:=9> .. Measured value, normalized value [181]

<TI:=10> .. Measured value, normalized value with time tag

<TI:=11> .. Measured value, scaled value [181]

<TI:=12> .. Measured value, scaled value with time tag

<TI:=13> .. Measured value, short floating-point number [181]

<TI:=14> .. Measured value, short floating-point number with time tag.

Measured Value Change Monitoring

Refer to *13.5.5.5 Change monitoring & value adaption (scaling) for measured values*.

Functionality of the measured value change monitoring:

- The measured value from <TI:=34>, <TI:=35>, <TI:=36> converted to FLOAT32 for change monitoring in the protocol.
- The change monitoring is performed based on the raw value before the value adaptation.

[181] In the case of a general interrogation, the measured values are transmitted with the TIs without a time tag

- The first value determined after startup is transmitted immediately.
- Each change of quality descriptor IV triggers an immediate transfer, the quality descriptor OV does not initiate a transfer.
- Change monitoring in accordance with the method of the additive threshold value procedure.
- The number of measured values for change monitoring is not limited.
- Changes are monitored every second, with a maximum of 300 measured values being processed at the same time.
  If there are more measured values to process they will be processed in the next processing grid (in this case there may be delays in passing the measured values).
- Change monitoring or value adaptation is only carried out for those measured values (signals) that are assigned to the PRE.
- Measured values that are not assigned to the change monitoring or the value adaptation on the protocol are transmitted without further processing.
- If measured values are transmitted blocked, the measured values assigned to the change monitoring or measured value adaptation are removed from the blocked message and transmitted after the change monitoring or value adaptation.
- In the case of a general interrogation, the last transmitted value is always transmitted. If a changed value is recognized during the general interrogation, then this new value is taken to the change monitoring and processed.
  With GA, measured values are transmitted with the TIs without a time tag <TI:=9>, <TI:= 11>, <TI:=13> without blocking S = 0 (selective addressing per measured value) or with blocking S = 1 (ascending addressing for measured values).
- Change monitoring or value adaptation is carried out on the protocol for each measured value, taking into account the station number.
  This means, if the measured value is transmitted with the same address on several connections, the change monitoring or value adaptation for this measured value can be carried out separately for each connection.

Process Image

Measured values are entered in a process image for the change monitoring on the protocol. If a spontaneous transmission for a measured value is to be carried out by the additive measured value change monitoring, the measured value is transmitted spontaneously from the protocol from the process image.

Additive Measured Value Change Monitoring

The measured value is monitored for changes when it is received (from the remote station or from the BSE).

If the deviation compared to the last measured value transmitted is greater than the configured **`Thresh_uncond`**, the new measured value is transmitted immediately. Otherwise, the deviation from the last spontaneously transmitted measured value is added with the correct sign in the processing grid. First when the amount of this total exceeds the parameterized **`Thresh_additive`** is the current measured value spontaneously transmitted.

Thresh uncond	Thresh additive	Processing
= 0	= 0	Value is transferred in the next processing grid when there is a change
= 0	≠ 0	

Thresh uncond	Thresh additive	Processing
≠ 0	= 0	• Change greater **Thresh_uncond**: Value is transmitted • Change less than/equal **Thresh_uncond**: Additive threshold value procedure
≠ 0	≠ 0	• Change greater **Thresh_uncond**: Value is transmitted • Change less than/equal **Thresh_uncond**: Additive threshold value procedure

A transmission of the measured value due to a general interrogation does not influence the threshold value procedure.

The thresholds are to be set for every measured value in the parameters for signals with the parameter **Thresh_additive** and **Thresh_uncond**.

The values for the parameter **thresh additive** and **thresh uncond** are absolute values and always refer to the row value. [182] [183]

The following example shows a normal case, where the adaptation line goes through the zero point (origin) ($Y_{at\ X=0} = 0$).

Examples

Technological value Y_{100}	4000
Processing grid	1 s
Thresh_uncond	40
Thresh_additive	400

Example 1:

After transmission due to the exceeding of the large threshold, the value has changed once by 79 (< the large threshold) and subsequently remains constant.

The measured value is transmitted after 11 seconds.

	0s	1s	2s	3s	4s	5s	6s	7s	8s	9s	10s	11s
Measured value	300	339	339	339	339	339	339	339	339	339	339	339
Difference	>40	39	39	39	39	39	39	39	39	39	39	39
Additive total	0	39	78	117	156	195	234	273	312	351	390	429
Transmission	✓	–	–	–	–	–	–	–	–	–	–	✓

Example 2:

After transmission due to the exceeding of the large threshold, the value has changed once by 1 (< the large threshold) and subsequently remains constant.

The measured value is transmitted after 400 seconds (= 6 minutes and 40 seconds).

182 Value adaptation in transmit direction: Row value = $value_{intern}$ = IEC 60870-5-101/104 Wert (SICAM A8000 internal); $value_{external}$ = IEC 60870-5-104 value of the remote station

183 value adaption in receive direction: Row value = $value_{external}$ = IEC 60870-5-104 value of the remote station; $value_{internal}$ = IEC 60870-5-101/104 value (SICAM A8000 internal)

	0s	1s	2s	3s	4s	5s	6s	7s	8s	...	399s	400s
Measured value	300	301	301	301	301	301	301	301	301	...	301	301
Difference	>80	1	1	1	1	1	1	1	1	...	1	1
Additive total	0	1	2	3	4	5	6	7	8	...	399	400
Transmission	✓	–	–	–	–	–	–	–	–	–	–	✓

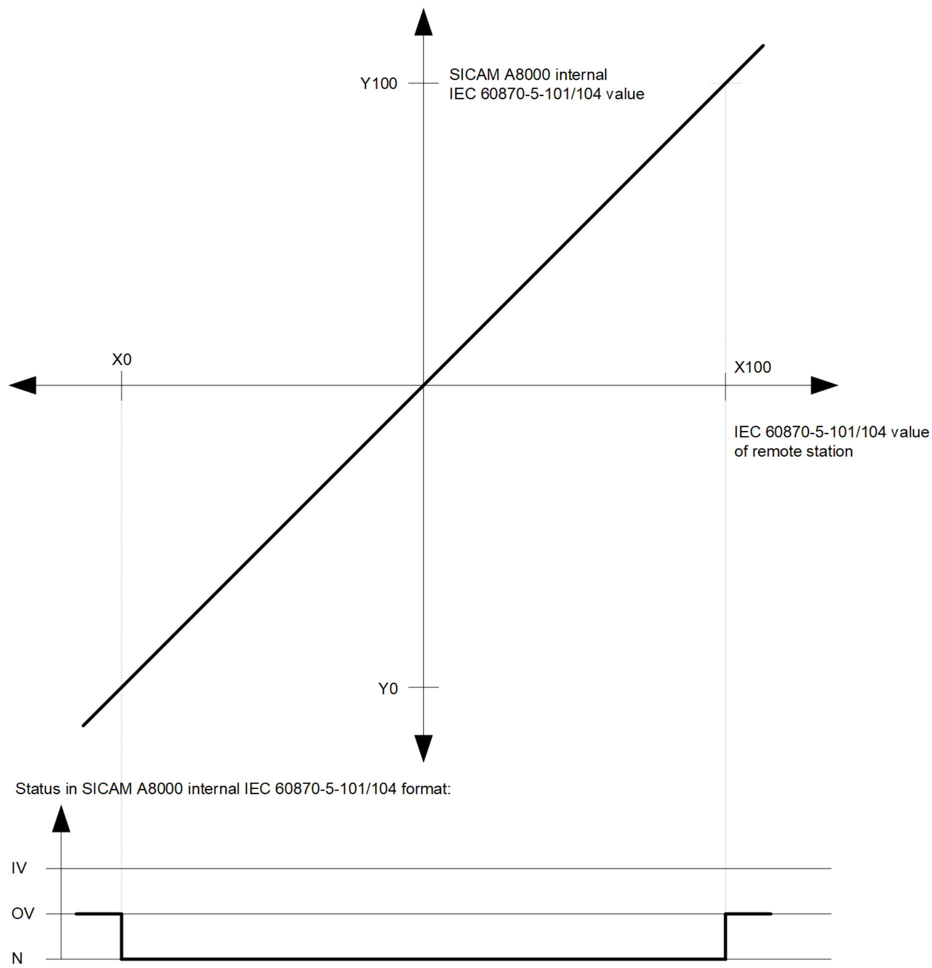
Example 3:

After transmission due to the exceeding of the large threshold, the value continually changes by ±1. The measured value is not transmitted.

	0s	1s	2s	3s	4s	5s	6s	7s	8s	...	...	...
Measured value	300	301	300	299	300	301	300	301	299	...	300	301
Difference	>80	1	0	-1	0	1	0	1	-1	...	0	1
Additive total	0	1	0	1	0	1	0	1	1	...	0	1
Transmission	✓	–	–	–	–	–	–	–	–	–	–	–

Value Adaptation

- The measured value adaptation (optional) takes place after the measured value change monitoring.
- The measured value adaptation can also be used independently of the measured value change monitoring.
- The value adaptation is defined by the parameters **`X_0%`**, **`X_100%`**, **`Y_0%`**, **`Y_100%`**.



[ETI4_Anpassung_Messwerte_GER, 1, en_US]

Value Adaptation	
Transmit direction	$Value_{external} = k \cdot value_{internal} + d$ [184]
Receive direction	$Value_{internal} = k \cdot value_{external} + d$ [185]
Transmit direction, receive direction	k = (Y100 - Y0) / (X100 - X0) d = Y0 - k · X0

If the value adaptation is not activated (= direct transfer; **X_0%** = *0*, **X_100%** = *0*), the value is transferred unchanged.

The value adaptation is only performed if **X_0%** or **X_100%** ≠ *0* is parameterized.

If the value is less than **X_0%** or greater than **X_100%** when the value adaptation is activated, the value adaptation is carried out anyway, the OV bit is set and the value is transmitted.

If the value after the value adaptation is outside the value range of the data format, the value is set to the maximum value of the data format, the OV bit is set and the value is transmitted.

184 value adaption in transmit direction: Row value = $value_{intern}$ = IEC 60870-5-101/104 value (SICAM A8000 internal); $value_{external}$ = IEC 60870-5-104 value of the remote station

185 value adaption in receive direction: Row value = $value_{external}$ = IEC 60870-5-104 value of the remote station; $value_{internal}$ = IEC 60870-5-101/104 value (SICAM A8000 internal)

NOTE

Minor +/- rounding errors may occur when adjusting the values of <TI:=35>.

Message Conversion

The table describes the evaluated elements of the IEC 60870-5-101/104 message during message conversion.

Elements of the message	
TI .. Type identification	• <TI:=34> .. Measured value, normalized value with time tag CP56Time2a • <TI:=35> .. Measured value, scaled value with time tag CP56Time2a • <TI:=36> .. Measured value, short floating-point number with time tag CP56Time2a
CASDU, IOA .. Message address	Evaluated (will not be changed)
QDS .. Quality descriptor	
BL .. Blocked	Not evaluated (will not be changed)
SB .. Substituted	Not evaluated (will not be changed)
NT .. Not topical	Not evaluated (will not be changed)
IV .. Invalid	Not evaluated (will not be changed)
OV .. Overflow	OV = 1: If the value after the value adaptation is outside the value range of the data format of the corresponding TI.
Cause of transmission	
xx .. Other COTs	Evaluated (will not be changed)
T .. Test	Evaluated (will not be changed)
Information	
Value.. S .. Sign	• Normalized value • Scaled value • IEEE STD 754 = short floating-point number
Time tag	
CP56Time2a .. Date + time	Supported (Time tag = time of transmission after change monitoring)

NOTE

Not listed elements of the IEC 60870-5-101 message are not evaluated/not supported!

13.5.7.4 Special Functions

The following functions for adapting the message conversion can be activated for coupling to third-party systems:

- Summer time bit (SU)=0 for all messages in transmit direction
  (summer time bit in the time tag)
- Day of week (DOW)=0 for all messages in transmit direction
  (day of week in the time tag)

- Time tag (IV = 1) in messages in transmit direction
- Originator address = 0 for all messages in transmit direction
- WhiteList filter
- Data throughput limit
- Special functions DBAG
- Special Functions RWE

Summer Time Bit = 0 for all Messages in Transmit Direction

With the setting of the parameter **`Connection definition | Summertime`** to ***suppress***, the summer time bit (SU) in the time tag is always set to "0" by the protocol element for all messages with time tag in transmit direction.

Day of Week = 0 for all Messages in Transmit Direction

With the setting of the parameter **`Connection definition | Day of week`** to ***suppress***, the day of the week (DOW) in the time tag is always set to "0" by the protocol for all messages with time tag in transmit direction.

NOTE

This function is only active for process information messages in transmit direction.

The day of week in clock synchronization command message is not affected!

Time tag (IV = 1) in messages in transmit direction

If the time synchronization of the own AU fails (i.e. after timeout of free running time or monitoring time for sync. event), the I bit of the internal system clock will be set. All signals with time stamp acquired directly in the own component (via own PE) will then be sent with IV bit of the time = 1. All data with time stamp received from connected devices via serial or LAN based interfaces will be passed on with the IV bit of the time from the remote station.

With the setting of the parameter **`[PRE] Advanced parameters | Time stamp (IV=1) in messages in transmit direction`** , and if the time synchronization of the own AU fails, the protocol element will send all messages with <TI:=30, 31, 32, ...40> in transmit direction with IV=1 for time tag.

NOTE

In Ax 1703 the I bit of the internal system clock will not be set.

In the case of Ax 1703, the failure of the time synchronization of an own component must be sent to the protocol element with a protocol element control message (i.e. failure of time synchronization as user error word → message conversion → protocol element control message).

Originator address = 0 for all messages in transmit direction

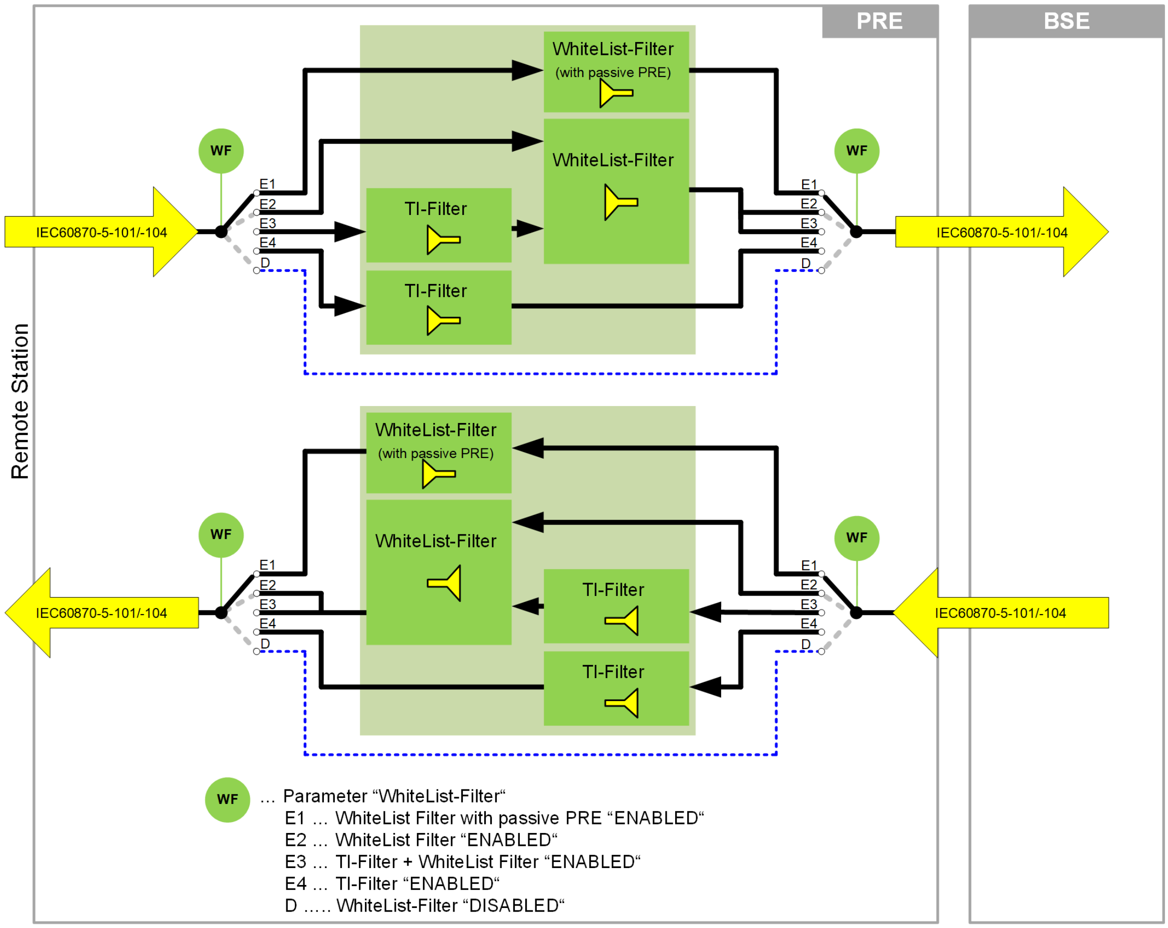
With the setting of the parameter **`[PRE] Station definition (Connection definition) | Connection definition | Originator address`** to ***suppress***, for all messages in transmit direction the originator address is always set to "0" by the protocol element.

WhiteList filter

The IEC 60870-5-104 protocol is also frequently used for data exchange between telecontrol networks from different operators (network couplings).

Data traffic at such interfaces is reduced to a minimum in order primarily to protect one's own network, but also not to send unwanted telegrams to the foreign network.

Only defined messages (selected by type identification and cause of transmission) will be sent in transmit direction to the remote network and only defined messages will be taken in receive direction at WhiteList Filter enabled.



The WhiteList filter can be enabled for each single connection with the parameter **[PRE] Station definition (Connection definition) | Connection definition | Profile (type identification check)** .

Following WhiteList filters can be selected: [186]

- WhiteList filter
  - This profile can be used on interfaces between different providers or regions within same provider.
  - From the predefined WhiteList filter only selected type identifications in transmit/receive direction are passed through (siehe *Profile Definition: "WhiteList Filter", Page 1038*).
- TI filter + WhiteList filter
  - From the predefined WhiteList filter only selected type identifications are passed through by the TI filter.
  - The TI-Filter can be parameterized separately in transmit-/receive direction.
  - IEC 60870-5-104 messages with type identifiers are already filtered out by the WhiteList filter cannot be passed through by the TI filter.
  - IEC 60870-5-104 messages with type identifiers that are filtered out by the TI-Filter are acknowledged to the remote station and then discarded (ACTCON / ACTTERM will not be sent).

186 For profiles additional parameter settings (BSE + PRE) are required! (Profile definitions later in this chapter)

- TI filter
  - Only the IEC 60870-5-104 messages with type identifiers selected in the TI flter will be passed in transmit/receive direction (the cause of transmission is not evaluated).
  - The TI-Filter can be parameterized separately in transmit-/receive direction.
  - IEC 60870-5-104 messages with type identifiers that are filtered out by the TI-Filter are acknowl-edged to the remote station and then discarded (ACTCON / ACTTERM will not be sent).
- SICAM RTUs - IEC104 (“SICAM RTUs Standard”)
  - WhiteList filter switched off (preset).
  - This profile is typically used for interfacing SICAM RTUs systems within region of same provider.
  - All supported type identifications from interoperability *13.5.10 Interoperability IEC 60870-5-104 (ETI4, FWI4)* incl. type identifications used by SICAM RTUs in private range (remote diagnostics, remote configuration, ...) will be passed through in transmit-/receive direction.
- IEC 60870-5-104 Ed.2 (“KEMA Conformance tested”)
  - WhiteList filter disabled and data in private range are disabled. This profile will be used if interface should be used as conformance tested according IEC 60870-5-104 by KEMA.
  - Only the supported type identifications from interoperability for SICAM RTUs (Document *Protocol Implementation Conformance Statement (PICS) - Interoperability of SICAM AK, SICAM TM according to IEC 60870-5-104 (ETA4) as Controlled Station*) will be passed through in transmit-/receive irection.
  - Type identifications in private range (Example: remote diagnostics, remote parameterization,...) will not be supported! Spontaneous tasks are not supported.

WhiteList filter

- The WhiteList filter is not an interoperability document!
- The WhiteList filter has the same definition in transmit/receive direction
- Filtered messages in transmit direction are displayed in the data flow, are not transmitted to the remote station and, if necessary, are reported with diagnostic or syslog messages.
- Filtered messages in receive direction will be confirmed to remote station, are not displayed in the data flow and, if necessary, are reported with diagnostic or syslog messages.
- Special functions for commands:

  Command messages with originator address = “0“ will be filtered in case of “COT ≠ 6” or “COT ≠ 8”.

  For commands sent with COT=ACT/DEACT, the reply for the command in receive direction with COT=ACTCON (DEACTCON)/ACTTERM will be passed only in a time window when this command was sent before wit COT=ACT/DEACT via this interface/connection.

  For commands received with COT=ACT/DEACT, the reply for the command in transmit direction with COT=ACTCON (DEACTCON)/ACTTERM will be passed only in a time window when this command was received before wit COT=ACT/DEACT via this interface/connection.

  The time window is set to 600 seconds and cannot be parameterized.

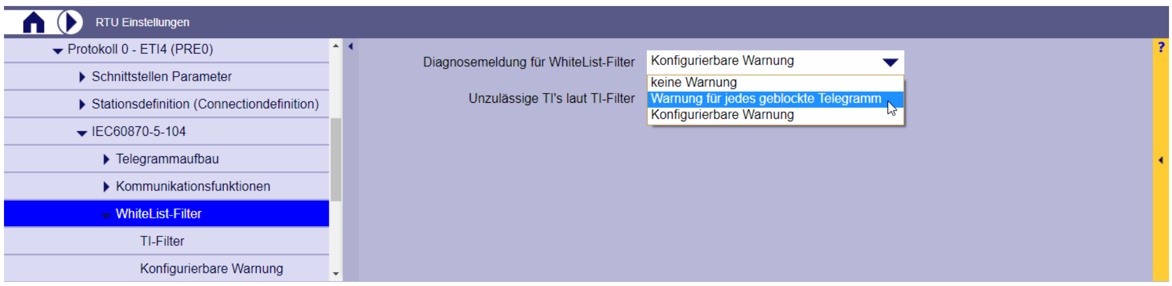
  The WhiteList filter function stores for up to 200 commands running at the same time the address for the command, direction (transmit/receive) and the interface/connection information. After termination of the command sequence according IEC 60870-5-101/104 standard (ACT→ACTCON→ACTTERM) the stored command information will be deleted. The stored command information is deleted at a faulty command sequence after expiry of the time window at the latest.

Diagnostic messages for WhiteList filter

The diagnostic message for WhiteList filter can be selected as follows:

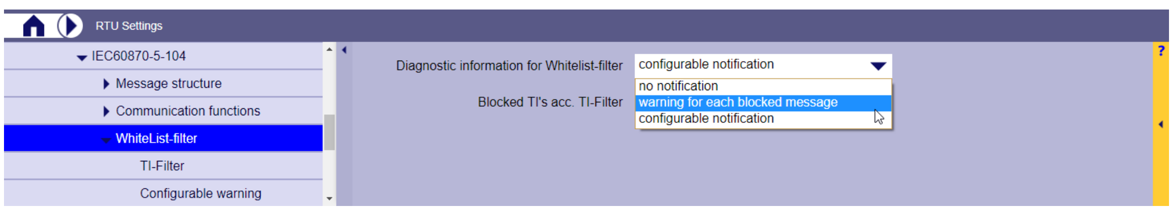
- No warning
- Warning for each blocked message
- Configurable warning

In addition, a syslog message is generated for each filtered message. The distribution of the syslog message can be delayed with the configurable warning.



[WhiteList-Filter_Diagnosemeldung [GER], 1, en_US]

Example:

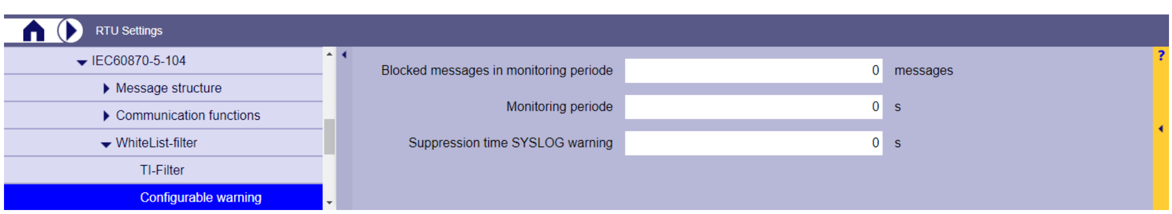


[WhiteList-Filter_Diagnosemeldung_Beispiel, 1, en_US]

Configurable warning

A diagnostic message is not forwarded immediately, but only when the number of blocked messages in the monitoring period exceeds a parameterizable value.

A syslog message is not forwarded immediately, but only after a parameterizable suppression time. This avoids an unnecessarily large number of syslog messages in the case of many blocked messages within a short time.

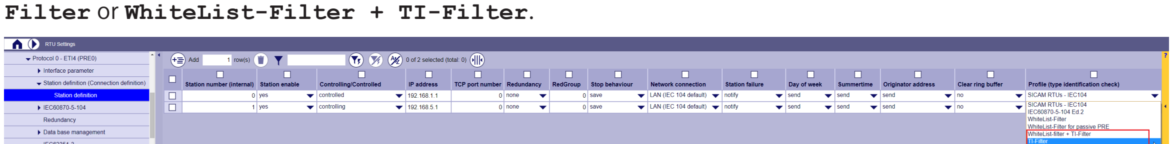


[WhiteList-Filter_Konfigurierbare Warnung [GER], 1, en_US]

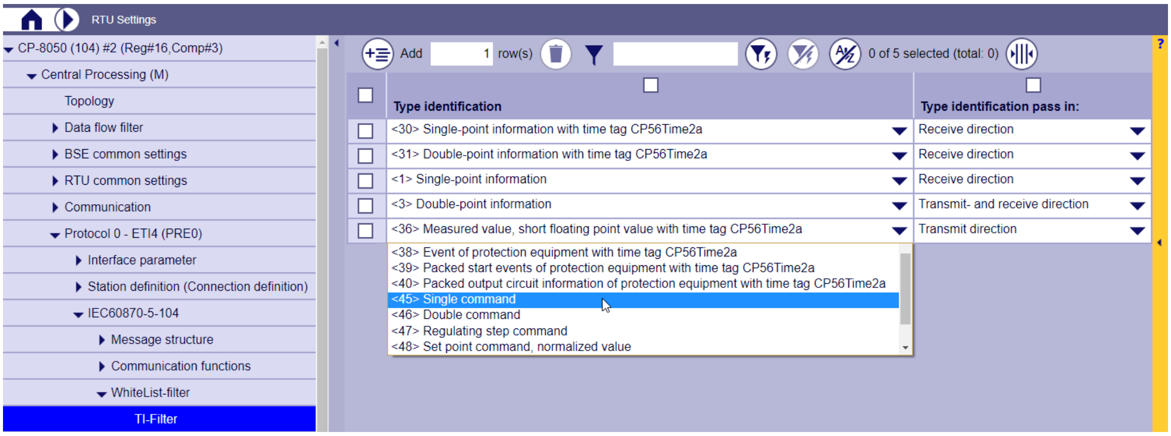
TI-Filter (“Type Identification Pass Filter”)

The TI-Filter will pass only IEC 60870-5-101/104 messages in transmit-/receive direction with type identifiers selected in the TI-Filter.

The TI filter can be activated with the parameter **`[PRE] Station definition (Connection definition) | Station definition | Profile (type identification check)`** by selecting **`TI-Filter`** or **`WhiteList-Filter + TI-Filter`**.



The type identifiers which shall be passed through by the TI filter in the send/receive direction are set with the parameters **`[PRE] IEC60870-5-104 | WhiteList-Filter | TI-Filter`**.



- A maximum of 30 type identifications can be defined in the TI filter (type identifications for GA and type identifications for system information must also be defined)
- Each type identifier may only be entered once in the TI-Filter
- For each type identification, you can select in TI-Filter “Type identification pass” in
  - Transmit- and Receive direction
  - Transmit direction
  - Receive direction

  .
- The TI-Filter can be parameterized separately in transmit-/receive direction.
- The TI filter can be used either selectively or in combination with the WhiteList filter.
- If the TI filter is used with the WhiteList filter, only the IEC60870-5-101/104 messages with type identifiers passsed by the WhiteList filter and selected in the TI filter will be passed in transmit/receive direction (the cause of transmission is evaluated by the WhiteList filter). Not selected TIs in TI-Filter will be discarded.
- If the TI filter is used without the WhiteList filter, only the IEC 60870-5-101 messages with type identifiers selected in the TI filter will be passed in transmit/receive direction (the cause of transmission will not be evaluated). All type identifications that are not entered in the TI filter are not allowed through.
- IEC 60870-5-101 messages, with type identifiers that are filtered out by the TI-Filter in receive direction, are acknowledged to the remote station and then discarded (ACTCON / ACTTERM will not be sent).

Profile Definition: “WhiteList Filter”

The following table below includes the profile definition for “WhiteList filter” and “WhiteList filter for passive PRE”.

	Messages with type identification will be pass through in transmit-/receive direction (CASDU "BROADCAST" not allowed)
1)	Messages with type identification will be pass through in transmit-/receive direction (CASDU "BROADCAST" allowed)
	Special functions for commands
2)	Messages with type identification will be pass through in transmit-/receive direction (CASDU "BROADCAST" allowed) – only when "WhiteList-Filter for passive PRE" is active
	Messages with type identification will not be passed through in transmit-/receive direction (messages filtered out)

Type Identification			COT Cause of Transmission																						
			0	1	2	3	4	5	6	7	8	9	10	11	12	13	14 to 19	20 to 36	37 to 41	42 to 43	44	45	46	47	48 to 63
<0>																									
<1>	Single-point information	M_SP_NA_1																							
<2>	Single-point information with time tag	M_SP_TA_1																							
<3>	Double-point information	M_DP_NA_1																							
<4>	Double-point information with time tag	M_DP_TA_1																							
<5>	Step position information	M_ST_NA_1																							
<6>	Step position information with time tag	M_ST_TA_1																							
<7>	Bitstring of 32 bit	M_BO_NA_1																							
<8>	Bitstring of 32 bit with time tag	M_BO_TA_1																							
<9>	Measured value, normalized value	M_ME_NA_1																							
<10>	Measured value, normalized value with time tag	M_ME_TA_1																							
<11>	Measured value, scaled value	M_ME_NB_1																							
<12>	Measured value, scaled value with time tag	M_ME_TB_1																							
<13>	Measured value, short floating point value	M_ME_NC_1																							
<14>	Measured value, short floating point value with time tag	M_ME_TC_1																							
<15>	Integrated totals	M_IT_NA_1																							
<16>	Integrated totals with time tag	M_IT_TA_1																							
<17>	Event of protection equipment with time tag	M_EP_TA_1																							
<18>	Packed start events of protection equipment with time tag	M_EP_TB_1																							
<19>	Packed output circuit information of protection equipment with time tag	M_EP_TC_1																							
<20>	Packed single-point information with status change detection	M_PS_NA_1																							
<21>	Measured value, normalized value without quality descriptor	M_ME_ND_1																							

[sc_WhiteList-Filter-ger1, 1, en_US]

Type Identification			COT Cause of Transmission																						
			0	1	2	3	4	5	6	7	8	9	10	11	12	13	14 to 19	20 to 36	37 to 41	42 to 43	44	45	46	47	48 to 63
<22-29>																									
<30>	Single-point information with time tag CP56Time2a	M_SP_TB_1																							
<31>	Double-point information with time tag CP56Time2a	M_DP_TB_1																							
<32>	Step position information with time tag CP56Time2a	M_ST_TB_1																							
<33>	Bitstring of 32 bit with time tag CP56Time2a	M_BO_TB_1																							
<34>	Measured value, normalized value with time tag CP56Time2a	M_ME_TD_1																							
<35>	Measured value, scaled value with time tag CP56Time2a	M_ME_TE_1																							
<36>	Measured value, short floating point value with time tag CP56Time2a	M_ME_TF_1																							
<37>	Integrated totals with time tag CP56Time2a	M_IT_TB_1																							
<38>	Event of protection equipment with time tag CP56Time2a	M_EP_TD_1																							
<39>	Packed start events of protection equipment with time tag CP56Time2a	M_EP_TE_1																							
<40>	Packed output circuit information of protection equipment with time tag CP56Time2a	M_EP_TF_1																							
<41-44>																									
<45>	Single command	C_SC_NA_1								*		*	*												
<46>	Double command	C_DC_NA_1								*		*	*												
<47>	Regulating step command	C_RC_NA_1								*		*	*												
<48>	Set point command, normalized value	C_SE_NA_1								*		*	*												
<49>	Set point command, scaled value	C_SE_NB_1								*		*	*												
<50>	Set point command, short floating point value	C_SE_NC_1								*		*	*												
<51>	Bitstring of 32 bit	C_BO_NA_1								*		*	*												
<52-55>																									
<58>	Single command with time tag CP56Time2a	C_SC_TC_1								*		*	*												
<59>	Double command with time tag CP56Time2a	C_DC_TC_1								*		*	*												
<60>	Regulating step command with time tag CP56Time2a	C_RC_TC_1								*		*	*												
<61>	Set point command, normalized value with time tag CP56Time2a	C_SE_TA_1								*		*	*												
<62>	Set point command, scaled value with time tag CP56Time2a	C_SE_TB_1								*		*	*												
<63>	Set point command, short floating point value with time tag CP56Time2a	C_SE_TC_1								*		*	*												
<64>	Bitstring of 32 bit with time tag CP56Time2a	C_BO_TA_1								*		*	*												
<65-69>																									
<70>	End of initialization	M_EI_NA_1																							
<71-99>																									
<100>	Interrogation command	C_IC_NA_1							1)																
<101>	Counter interrogation command	C_CI_NA_1																							

[sc_WhiteList-Filter-ger2, 1, en_US]

Type Identification			COT Cause of Transmission																						
			0	1	2	3	4	5	6	7	8	9	10	11	12	13	14 to 19	20 to 36	37 to 41	42 to 43	44	45	46	47	48 to 63
<102>	Read command	C_RD_NA_1																							
<103>	Clock synchronization command	C_CS_NA_1																							
<104>	Test command	C_TS_NA_1																							
<105>	Reset process command	C_RP_NA_1																							
<106>	Delay acquisition command	C_CD_NA_1																							
<107>	Test command with time tag CP56time2a	C_TS_TA_1																							
<108,109>																									
<110>	Parameter of measured value, normalized value	P_ME_NA_1																							
<111>	Parameter of measured value, scaled value	P_ME_NB_1																							
<112>	Parameter of measured value, short floating point value	P_ME_NC_1																							
<113>	Parameter activation	P_AC_NA_1																							
<114-119>																									
<120>	File ready	F_FR_NA_1																							
<121>	Section ready	F_SR_NA_1																							
<122>	Call directory, select file, call file, call section	F_SC_NA_1						1)																	
<123>	Last section, last segment	F_LS_NA_1																							
<124>	Ack file, ack section	F_AF_NA_1																							
<125>	Segment	F_SG_NA_1																							
<126>	Directory {blank or X, only available in monitor (standard) direction}	F_DR_TA_1*																							
<127>																									
<128-134>																									
<135>	SICAM RTUs: System data container (TI:=135, FC=148, IC=04)		2)	2)	2)	2)	2)	2)	2)	2)	2)	2)	2)	2)	2)	2)	2)	2)	2)	2)	2)	2)	2)	2)	2)
<136>	SICAM RTUs: Double-point information with command state information																								
<137>	SICAM RTUs: 16 single-point information																								
<138>	SICAM RTUs: 8 double-point information																								
<139>	SICAM RTUs: 4 double-point information with command state information																								
<140>	SICAM RTUs: Measured value - 31 Bit + sign																								
<141>	SICAM RTUs: 32 binary information																								
<142>	SICAM RTUs: User data container (TI:=142, message type = 128)																								
<143>	SICAM RTUs: Realtime system information																								
<144>	SICAM RTUs: File transfer																								
<145-146>																									
<147>	SICAM RTUs: User data container in monitoring direction (TC)																								
<148-159>																									
<160>	SICAM RTUs: Single command with output time																								
<161>	SICAM RTUs: User data container in command direction (TC)																								
<162>	SICAM RTUs: User data container in command direction (SHP)																								
<163-255>																									

[sc_WhiteList-Filter-ger3, 1, en_US]

Semantics of cause of transmission:

<0>	:=	not used
<1>	:=	periodic, cyclic
<2>	:=	Background scan
<3>	:=	spontaneous
<4>	:=	initialized
<5>	:=	request or requested
<6>	:=	Activation
<7>	:=	Confirmation of activation
<8>	:=	Abortion of activation
<9>	:=	Confirmation of the abortion of activation
<10>	:=	Activation termination
<11>	:=	Return information, caused by a remote command
<12>	:=	Return information, caused by a local command
<13>	:=	File transfer
<14..19>	:=	reserved for further compatible definitions (not used)
<20>	:=	interrogated by station interrogation
<21..36>	:=	interrogated by group 1..16 interrogation
<37>	:=	requested by general counter request
<38..41>	:=	requested by group 1..4 counter request
<42, 43>	:=	reserved for further compatible definitions (not used)
<44>	:=	unknown type identification
<45>	:=	unknown cause of transmission
<46>	:=	unknown common address of ASDU

<47>	:=	unknown information object address
<48, 63>	:=	for special use (private range - not used)

Profile Definition "SICAM RTUs – IEC104"

The profile**SICAM RTUs – IEC104**(“SICAM RTUs Standard”) defines the functionality according to *13.5.10 Interoperability IEC 60870-5-104 (ETI4, FWI4)*. This profile will be used as standard for interfacing SICAM RTUs components.

- Messages will be supported (B=both directions, X=standard direction)
- Messages will not be supported (valid according IEC 60870-5-104 standard)
- Messages will not be supported

Type Identification			COT Cause of Transmission																						
			0	1	2	3	4	5	6	7	8	9	10	11	12	13	14 to 19	20 to 36	37 to 41	42 to 43	44	45	46	47	48 to 63
<0>																									
<1>	Single-point information	M_SP_NA_1																							
~~<2>~~	~~Single-point information with time tag~~	~~M_SP_TA_1~~																							
<3>	Double-point information	M_DP_NA_1																							
~~<4>~~	~~Double-point information with time tag~~	~~M_DP_TA_1~~																							
<5>	Step position information	M_ST_NA_1			B	B*								B*	B*			B*							
~~<6>~~	~~Step position information with time tag~~	~~M_ST_TA_1~~																							
<7>	Bitstring of 32 bit	M_BO_NA_1			B	B*												B*							
~~<8>~~	~~Bitstring of 32 bit with time tag~~	~~M_BO_TA_1~~																							
<9>	Measured value, normalized value	M_ME_NA_1																							
~~<10>~~	~~Measured value, normalized value with time tag~~	~~M_ME_TA_1~~																							
<11>	Measured value, scaled value	M_ME_NB_1																							
~~<12>~~	~~Measured value, scaled value with time tag~~	~~M_ME_TB_1~~																							
<13>	Measured value, short floating point value	M_ME_NC_1																							
~~<14>~~	~~Measured value, short floating point value with time tag~~	~~M_ME_TC_1~~																							
<15>	Integrated totals	M_IT_NA_1																							
~~<16>~~	~~Integrated totals with time tag~~	~~M_IT_TA_1~~																							
~~<17>~~	~~Event of protection equipment with time tag~~	~~M_EP_TA_1~~																							
~~<18>~~	~~Packed start events of protection equipment with time tag~~	~~M_EP_TB_1~~																							
~~<19>~~	~~Packed output circuit information of protection equipment with time tag~~	~~M_EP_TC_1~~																							
<20>	Packed single-point information with status change detection	M_PS_NA_1			6)													6)							
<21>	Measured value, normalized value without quality descriptor	M_ME_ND_1																							
<22-29>																									
<30>	Single-point information with time tag CP56Time2a	M_SP_TB_1																							

[sc_SICAM_RTUs-IEC104-ger1, 1, en_US]

Type Identification			COT Cause of Transmission																						
			0	1	2	3	4	5	6	7	8	9	10	11	12	13	14 to 19	20 to 36	37 to 41	42 to 43	44	45	46	47	48 to 63
<31>	Double-point information with time tag CP56Time2a	M_DP_TB_1				B																			
<32>	Step position information with time tag CP56Time2a	M_ST_TB_1				B*								B*	B*										
<33>	Bitstring of 32 bit with time tag CP56Time2a	M_BO_TB_1				B*																			
<34>	Measured value, normalized value with time tag CP56Time2a	M_ME_TD_1																							
<35>	Measured value, scaled value with time tag CP56Time2a	M_ME_TE_1				B																			
<36>	Measured value, short floating point value with time tag CP56Time2a	M_ME_TF_1																							
<37>	Integrated totals with time tag CP56Time2a	M_IT_TB_1				B																			
<38>	Event of protection equipment with time tag CP56Time2a	M_EP_TD_1																							
<39>	Packed start events of protection equipment with time tag CP56Time2a	M_EP_TE_1																							
<40>	Packed output circuit information of protection equipment with time tag CP56Time2a	M_EP_TF_1				B																			
<41-44>																									
<45>	Single command	C_SC_NA_1							B	B	B	B	B								B	B	B	B	
<46>	Double command	C_DC_NA_1							B	B	B	B	B								B	B	B	B	
<47>	Regulating step command	C_RC_NA_1							B	B	B	B	B								B	B	B	B	
<48>	Set point command, normalized value	C_SE_NA_1							B	B	B	B	B*								B	B	B	B	
<49>	Set point command, scaled value	C_SE_NB_1							B	B	B	B	B*								B	B	B	B	
<50>	Set point command, short floating point value	C_SE_NC_1							B	B	B	B	B*								B	B	B	B	
<51>	Bitstring of 32 bit	C_BO_NA_1							B*	B*	B*	B*	B*								B	B	B	B	
<52-55>																									
<58>	Single command with time tag CP56Time2a	C_SC_TC_1							B	B	B	B	B								B	B	B	B	
<59>	Double command with time tag CP56Time2a	C_DC_TC_1							B	B	B	B	B								B	B	B	B	
<60>	Regulating step command with time tag CP56Time2a	C_RC_TC_1							B	B	B	B	B								B	B	B	B	
<61>	Set point command, normalized value with time tag CP56Time2a	C_SE_TA_1							B	B	B	B	B*								B	B	B	B	
<62>	Set point command, scaled value with time tag CP56Time2a	C_SE_TB_1							B	B	B	B	B*								B	B	B	B	
<63>	Set point command, short floating point value with time tag CP56Time2a	C_SE_TC_1							B	B	B	B	B*								B	B	B	B	
<64>	Bitstring of 32 bit with time tag CP56Time2a	C_BO_TA_1							B*	B*	B*	B*	B*								B	B	B	B	
<65-69>																									
<70>	End of initialization	M_EI_NA_1					B																		
<71-99>																									
<100>	Interrogation command	C_IC_NA_1							B	B	7)	7)	B								B	B	B	B	
<101>	Counter interrogation command	C_CI_NA_1							B	B			B								B	B	B	B	
<102>	Read command	C_RD_NA_1																							
<103>	Clock synchronization command	C_CS_NA_1							X	X											B	B	B	B	

[sc_SICAM_RTUs-IEC104-ger2, 1, en_US]

Type Identification			COT Cause of Transmission																						
			0	1	2	3	4	5	6	7	8	9	10	11	12	13	14 to 19	20 to 36	37 to 41	42 to 43	44	45	46	47	48 to 63
~~<104>~~	~~Test command~~	~~C_TS_NA_1~~																							
<105>	Reset process command	C_RP_NA_1							X+	X+											B	X	X	X	
~~<106>~~	~~Delay acquisition command~~	~~C_CD_NA_1~~																							
<107>	Test command with time tag CP56time2a	C_TS_TA_1							B	B											B	B	B	B	
<108,109>																									
<110>	Parameter of measured value, normalized value	P_ME_NA_1							X	X								X			B	B	B	B	
<111>	Parameter of measured value, scaled value	P_ME_NB_1							X	X								X			B	B	B	B	
<112>	Parameter of measured value, short floating point value	P_ME_NC_1							X	X								X			B	B	B	B	
<113>	Parameter activation	P_AC_NA_1																							
<114-119>																									
<120>	File ready	F_FR_NA_1														B					B	5)	5)	5)	
<121>	Section ready	F_SR_NA_1														B					B	5)	5)	5)	
<122>	Call directory, select file, call file, call section	F_SC_NA_1						B								B					B	5)	5)	5)	
<123>	Last section, last segment	F_LS_NA_1														B					B	5)	5)	5)	
<124>	Ack file, ack section	F_AF_NA_1														B					B	5)	5)	5)	
<125>	Segment	F_SG_NA_1														B					B	5)	5)	5)	
<126>	Directory	F_DR_TA_1*				X		X																	
<127>																									
<128-134>																									
<135>	SICAM RTUs: System data container (TI:=135, FC=148, IC=04)		B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B
<136>	SICAM RTUs: Double-point information with command state information		B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B
<137>	SICAM RTUs: 16 single-point information		B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B
<138>	SICAM RTUs: 8 double-point information		B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B
<139>	SICAM RTUs: 4 double-point information with command state information		B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B
<140>	SICAM RTUs: Measured value - 31 Bit + sign		B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B
<141>	SICAM RTUs: 32 binary information		B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B
<142>	SICAM RTUs: User data container (TI:=142, message type = 128)		B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B
<143>	SICAM RTUs: Realtime system information		B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B
<144>	SICAM RTUs: Filetransfer		B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B
<145-146>																									
<147>	SICAM RTUs: User data container in monitoring direction (TC)		B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B
<148-159>																									
<160>	SICAM RTUs: Single command with output time		B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B
<161>	SICAM RTUs: User data container in command direction (TC)		B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B
<162>	SICAM RTUs: User data container in command direction (SHP)		B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B
<163-255>																									

[sc_SICAM_RTUs-IEC104-ger3, 1, en_US]

*)	blank or “X“ only
+	secondary application function only
B*	can be generated by the PLC
5)	transparent transmission by system
6)	Reception possible, thereby the blocked single-point information is deblocked and further individually processed as TI = 30 (address translation occurs algorithmic)
7)	Not supported; reply sent with COT = 45 „unknown cause of transmission“

Profile Definition "IEC 60870-5-104 Ed.2"

The profile IEC 60870-5-104 Ed.2 (“KEMA Conformance tested”) defines IEC 60870-5-104 Ed. 2 functionality as conformance tested by KEMA. This profile is used at interfaces required functionality as conformance tested according IEC 60870-5-104 Ed. 2 by KEMA.

Details see document *Protocol Implementation Conformance Statement (PICS) - Interoperability of SICAM AK, SICAM TM according to IEC 60870-5-104 (ETA4) as Controlled Station*.

Messages will be supported (B=both directions, X=standard direction)
Messages will not be supported (valid according IEC 60870-5-104 standard)
Messages will not be supported

Type Identification			COT Cause of Transmission																					
			0	1	2	3	4	5	6	7	8	9	10	11	12	13	14 to 19	20 to 36	37 to 41	42 to 43	44	45	46	47	48 to 63
<0>																									
<1>	Single-point information	M_SP_NA_1																							
~~<2>~~	~~Single-point information with time tag~~	~~M_SP_TA_1~~																							
<3>	Double-point information	M_DP_NA_1																							
~~<4>~~	~~Double-point information with time tag~~	~~M_DP_TA_1~~																							
<5>	Step position information	M_ST_NA_1			X	B*								B*	B*			B*							
~~<6>~~	~~Step position information with time tag~~	~~M_ST_TA_1~~																							
<7>	Bitstring of 32 bit	M_BO_NA_1			X	B*												B*							
~~<8>~~	~~Bitstring of 32 bit with time tag~~	~~M_BO_TA_1~~																							
<9>	Measured value, normalized value	M_ME_NA_1																							
~~<10>~~	~~Measured value, normalized value with time tag~~	~~M_ME_TA_1~~																							
<11>	Measured value, scaled value	M_ME_NB_1																							
~~<12>~~	~~Measured value, scaled value with time tag~~	~~M_ME_TB_1~~																							
<13>	Measured value, short floating point value	M_ME_NC_1																							
~~<14>~~	~~Measured value, short floating point value with time tag~~	~~M_ME_TC_1~~																							
<15>	Integrated totals	M_IT_NA_1																							
~~<16>~~	~~Integrated totals with time tag~~	~~M_IT_TA_1~~																							
~~<17>~~	~~Event of protection equipment with time tag~~	~~M_EP_TA_1~~																							
~~<18>~~	~~Packed start events of protection equipment with time tag~~	~~M_EP_TB_1~~																							
~~<19>~~	~~Packed output circuit information of protection equipment with time tag~~	~~M_EP_TC_1~~																							
<20>	Packed single-point information with status change detection	M_PS_NA_1																							
<21>	Measured value, normalized value without quality descriptor	M_ME_ND_1																							
<22-29>																									
<30>	Single-point information with time tag CP56Time2a	M_SP_TB_1																							

[sc_IEC_60870-5-104_Ed2-ger1, 1, en_US]

Type Identification			COT Cause of Transmission																					
			0	1	2	3	4	5	6	7	8	9	10	11	12	13	14 to 19	20 to 36	37 to 41	42 to 43	44	45	46	47	48 to 63
<31>	Double-point information with time tag CP56Time2a	M_DP_TB_1				B																			
<32>	Step position information with time tag CP56Time2a	M_ST_TB_1				B*								B*	B*										
<33>	Bitstring of 32 bit with time tag CP56Time2a	M_BO_TB_1				B*																			
<34>	Measured value, normalized value with time tag CP56Time2a	M_ME_TD_1																							
<35>	Measured value, scaled value with time tag CP56Time2a	M_ME_TE_1				B																			
<36>	Measured value, short floating point value with time tag CP56Time2a	M_ME_TF_1																							
<37>	Integrated totals with time tag CP56Time2a	M_IT_TB_1				B																			
<38>	Event of protection equipment with time tag CP56Time2a	M_EP_TD_1																							
<39>	Packed start events of protection equipment with time tag CP56Time2a	M_EP_TE_1																							
<40>	Packed output circuit information of protection equipment with time tag CP56Time2a	M_EP_TF_1				B																			
<41-44>																									
<45>	Single command	C_SC_NA_1							B	B	B	B	B								B	B	B	B	
<46>	Double command	C_DC_NA_1							B	B	B	B	B								B	B	B	B	
<47>	Regulating step command	C_RC_NA_1							B	B	B	B	B								B	B	B	B	
<48>	Set point command, normalized value	C_SE_NA_1							B	B	B	B	B								B	B	B	B	
<49>	Set point command, scaled value	C_SE_NB_1							B	B	B	B	B								B	B	B	B	
<50>	Set point command, short floating point value	C_SE_NC_1							B	B	B	B	B								B	B	B	B	
<51>	Bitstring of 32 bit	C_BO_NA_1																							
<52-55>																									
<58>	Single command with time tag CP56Time2a	C_SC_TC_1							B	B	B	B	B								B	B	B	B	
<59>	Double command with time tag CP56Time2a	C_DC_TC_1							B	B	B	B	B								B	B	B	B	
<60>	Regulating step command with time tag CP56Time2a	C_RC_TC_1							B	B	B	B	B								B	B	B	B	
<61>	Set point command, normalized value with time tag CP56Time2a	C_SE_TA_1							B	B	B	B	B								B	B	B	B	
<62>	Set point command, scaled value with time tag CP56Time2a	C_SE_TB_1							B	B	B	B	B								B	B	B	B	
<63>	Set point command, short floating point value with time tag CP56Time2a	C_SE_TC_1							B	B	B	B	B								B	B	B	B	
<64>	Bitstring of 32 bit with time tag CP56Time2a	C_BO_TA_1																							
<65-69>																									
<70>	End of initialization	M_EI_NA_1					B																		
<71-99>																									
<100>	Interrogation command	C_IC_NA_1							B	B			B								B	B	B	B	
<101>	Counter interrogation command	C_CI_NA_1							X	X			X								X	X	X	X	
<102>	Read command	C_RD_NA_1																							
<103>	Clock synchronization command	C_CS_NA_1																							

[sc_IEC_60870-5-104_Ed2-ger2, 1, en_US]

Type Identification			COT Cause of Transmission																						
			0	1	2	3	4	5	6	7	8	9	10	11	12	13	14 to 19	20 to 36	37 to 41	42 to 43	44	45	46	47	48 to 63
~~<104>~~	~~Test command~~	~~C_TS_NA_1~~																							
<105>	Reset process command	C_RP_NA_1							X+	X+											X	X	X	X	
~~<106>~~	~~Delay acquisition command~~	~~C_CD_NA_1~~																							
<107>	Test command with time tag CP56time2a	C_TS_TA_1							B	B											B	B	B	B	
<108,109>																									
<110>	Parameter of measured value, normalized value	P_ME_NA_1							X	X								X			X				
<111>	Parameter of measured value, scaled value	P_ME_NB_1							X	X								X			X				
<112>	Parameter of measured value, short floating point value	P_ME_NC_1							X	X								X			X				
<113>	Parameter activation	P_AC_NA_1																							
<114-119>																									
<120>	File ready	F_FR_NA_1														X					X	1)	1)	1)	
<121>	Section ready	F_SR_NA_1														X					X	1)	1)	1)	
<122>	Call directory, select file, call file, call section	F_SC_NA_1						X								X					X	1)	1)	1)	
<123>	Last section, last segment	F_LS_NA_1														X					X	1)	1)	1)	
<124>	Ack file, ack section	F_AF_NA_1														X					X	1)	1)	1)	
<125>	Segment	F_SG_NA_1														X					X	1)	1)	1)	
<126>	Directory {blank or X, only available in monitor (standard) direction}	F_DR_TA_1*				X		X																	
<127>																									
<128-134>																									
<135>	SICAM RTUs: System data container (TI:=135, FC=148, IC=04)																								
<136>	SICAM RTUs: Double-point information with command state information																								
<137>	SICAM RTUs: 16 single-point information																								
<138>	SICAM RTUs: 8 double-point information																								
<139>	SICAM RTUs: 4 double-point information with command state information																								
<140>	SICAM RTUs: Measured value - 31 Bit + sign																								
<141>	SICAM RTUs: 32 binary information																								
<142>	SICAM RTUs: User data container (TI:=142, message type = 128)																								
<143>	SICAM RTUs: Realtime system information																								
<144>	SICAM RTUs: Filetransfer																								
<145-146>																									
<147>	SICAM RTUs: User data container in monitoring direction (TC)																								
<148-159>																									
<160>	SICAM RTUs: Single command with output time																								
<161>	SICAM RTUs: User data container in command direction (TC)																								
<162>	SICAM RTUs: User data container in command direction (SHP)																								
<163-255>																									

[sc_IEC_60870-5-104_Ed2-ger3, 1, en_US]

*)	blank or "X" only
+	secondary application function only
X*	can be generated by the PLC
1)	transparent transmission by system

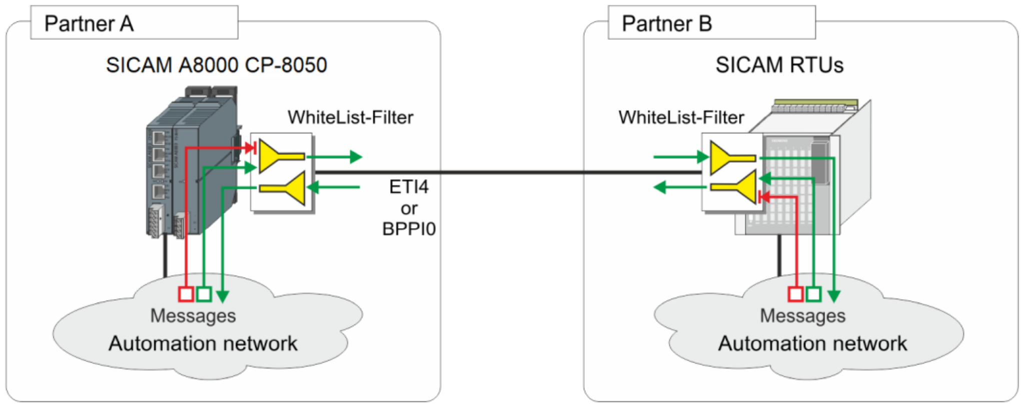
Sample Applications

Following function is the same for different sample applications.
When WhiteList filter is enabled:

- routing of unwanted message within the system will be stopped
- unwanted messages will not be transmitted
- unwanted messages in receive direction will not be passed through
- ACTCON/ACTTERM for commands will be sent only if this command was received before via this interface

Partner Interface between SICAM RTUs Systems

Data exchange via interface (LAN, serial) between different partners. One partner uses a SICAM A8000 system, the other partner uses a SICAM RTUs system.

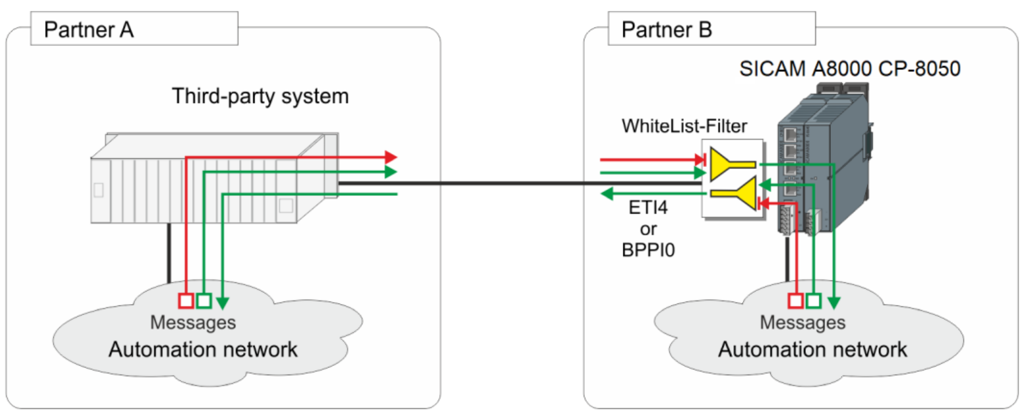


Unwanted message in target system

[whitelist_partnerkopplung_sic_rtus, 2, en_US]

Partner Interface between SICAM RTUs System and 3rd Party System

Data exchange via interface (LAN, serial) between different partners. One partner uses a SICAM A8000 system, the other partner uses a 3rd party system.

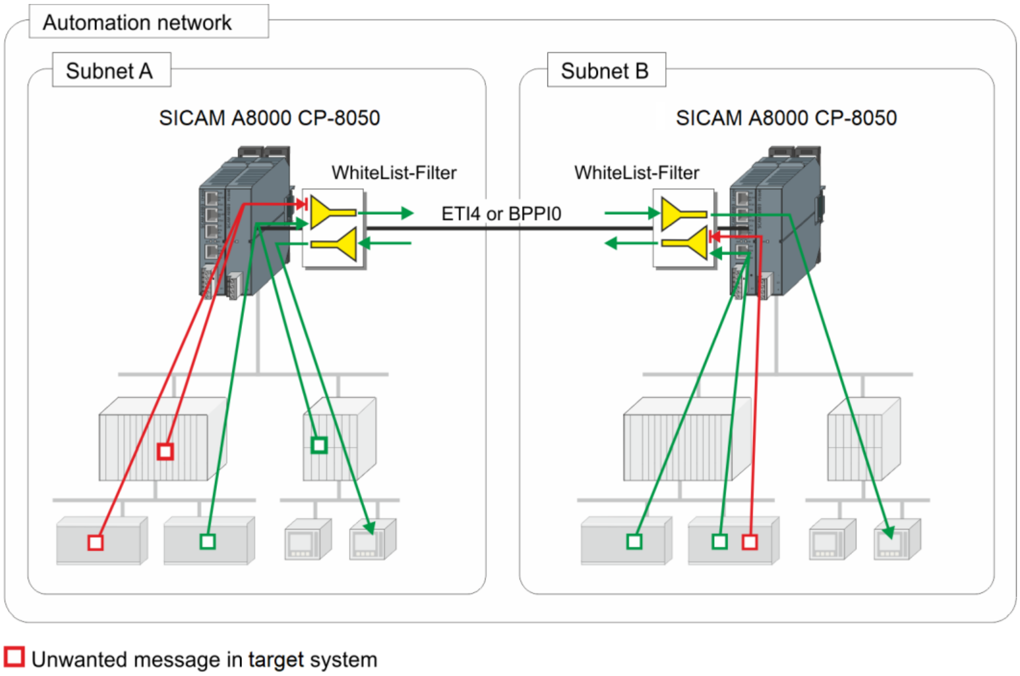


Unwanted message in target system

[whitelist_partnerkopplung_sic_rtus_fremdsys, 3, en_US]

Internal Segmentation between SICAM RTUs Systems

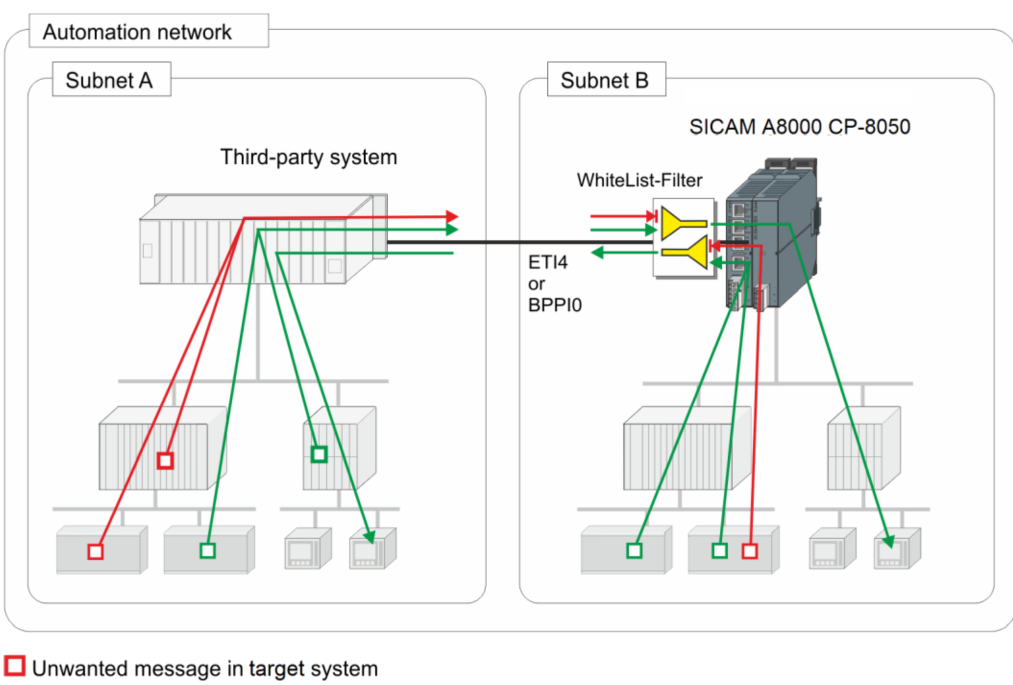
Data exchange via interface (LAN, serial) between different divisions within the same partner. Both divisions are using SICAM A8000 systems.



[whitelist_intern_segm_sic_rtus, 2, en_US]

Internal Segmentation between SICAM RTUs Systems and 3rd Party Systems

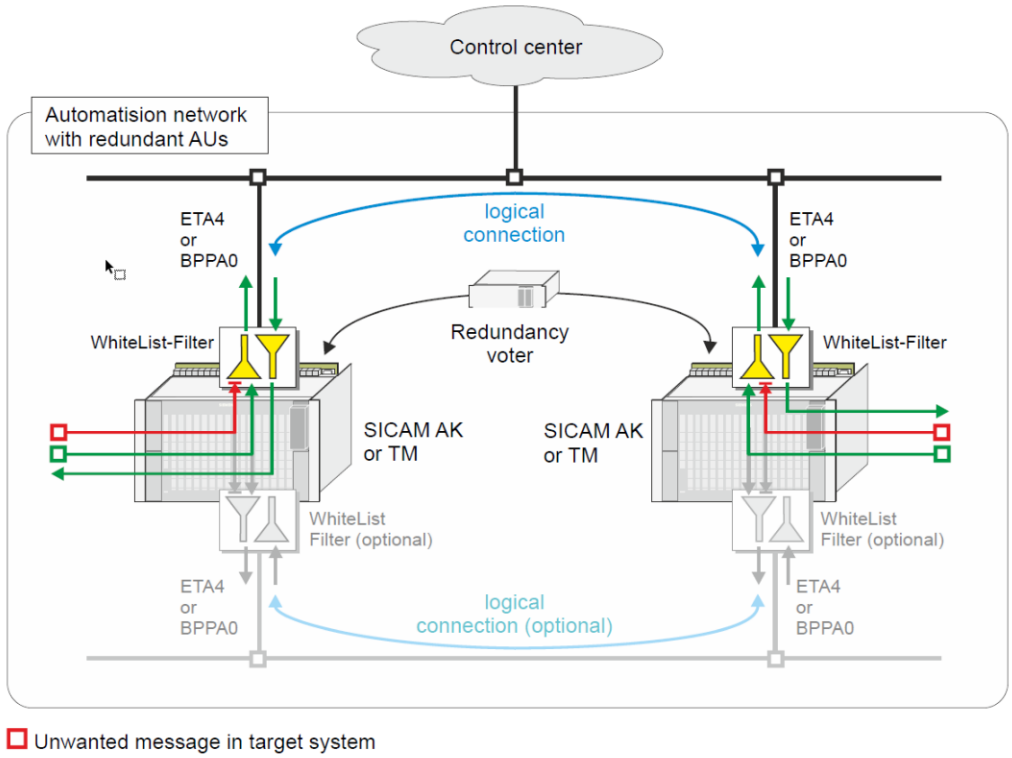
Data exchange via interface (LAN, serial) between different divisions within the same partner. One division uses a SICAM A8000 system, the other division uses a 3rd party system.



[whitelist_intern_segm_sic_rtus_fremdsys, 3, en_US]

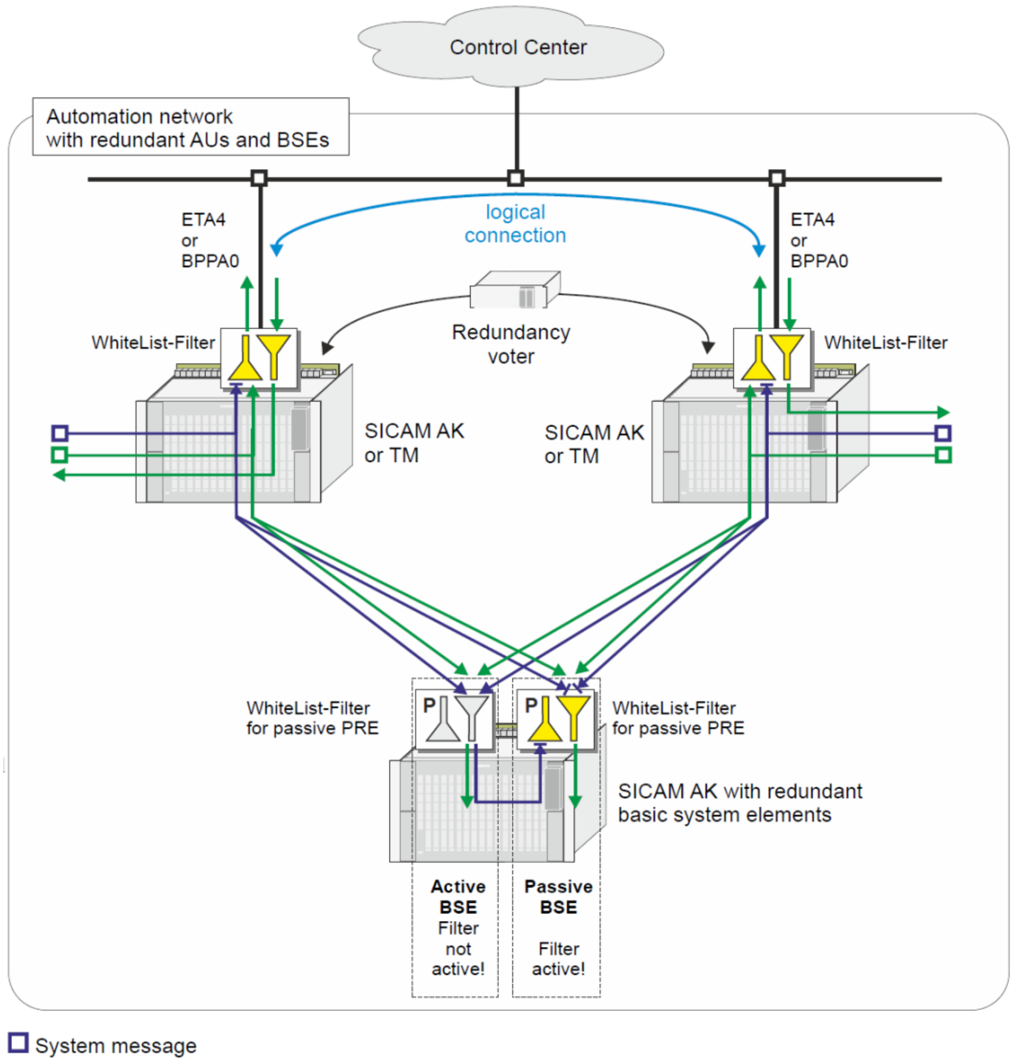
Redundant SICAM RTUs Automation Units

The WhiteList filter is only enabled on the interfaces between the redundant systems. All other interfaces are not affected.



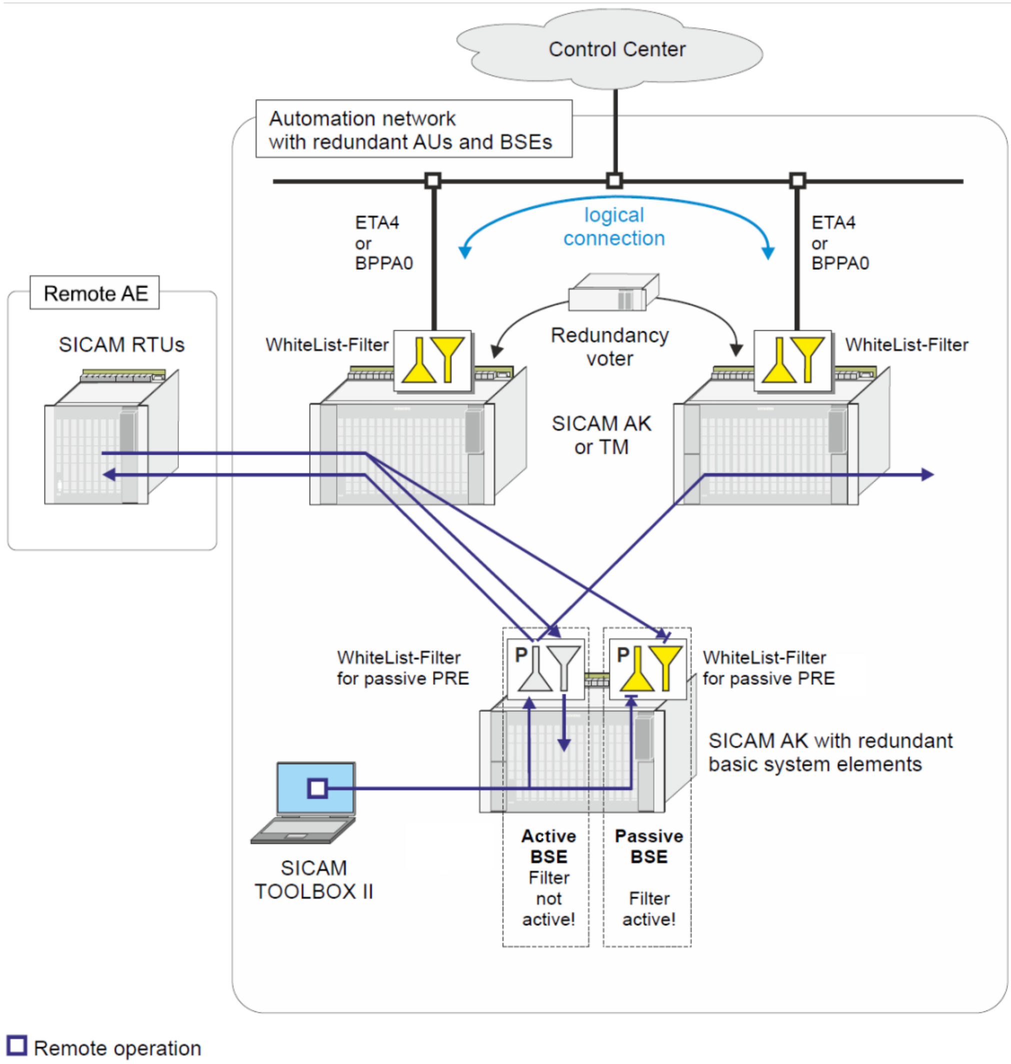
Redundant SICAM RTUs Basic System Elements (BSE)

- The WhiteList filter disables possible unwanted routing of system messages or messages in the private range via possible communication loops in redundancy configuration for redundant BSE
  Note: A routing of data messages to redundant BSE will be suppressed per standard by passive BSE.
- The parameter "WhiteList-Filter for passive PRE" must be applied to both BSE.
- The WhiteList filter is only activated on passive BSE and deactivated on active BSE.



Redundant SICAM RTUs Basic System Elements (BSE) – Remote Operation

- The WhiteList filter disables possible unwanted routing of system messages via communication loops in this redundancy BSE
- The parameter "WhiteList-Filter for passive PRE" must be applied to both BSE.
- The WhiteList filter is only activated on passive BSE.
- The messages of the SICAM TOOLBOX II are blocked by the active filter of the passive BSE, but let through by the active BSE because the filter is deactivated there



Data throughput limit

With the data throughput limitation, an overload of the subsequent communication infrastructure or systems can be avoided or the data traffic on partner interfaces or interfaces to selected areas can be restricted. The protocol in SICAM A8000 supports a limitation of data throughput separately in transmit and receive direction for IEC 60870-5-104 data messages.

Data throughput limit:

- can be parameterized for each connection
- separate parameters for number of messages/second in transmit-/receive direction
- a message is a selective or blocked IEC 60870-5-104 message (APDU)
- no delay in communication if data throughput is below limit
- Data throughput limitation in receive direction in case of exceeded limit by delay of acknowledge message according IEC 60870-5-104
- Data throughput limitation in transmit direction in case of exceeded limit by delay of transmission of IEC 60870-5-104 data messages

NOTE

The data throughput limitation works properly only if the IEC 60870-5-104 parameters are set to the same values on both sides.

Data throughput limitation in transmit direction

The number of messages per second in transmit direction can be parameterized per connection with the of the **`[PRE] Station definition (Connection definition) | Connection definition | Data throughput limit in transmit direction (msg/s)`** (0 = no data throughput limitation).

If the number of messages/second for a single connection exceeds the parameterized limit then the data transmission is stopped for this connection until next second.

A communication error “data throughput in transmit direction” is set if the data throughput has reached permanently 90 % of the parameterized limit within the last 10 minute window.

Data throughput limitation in receive direction

The number of messages/second in receive direction can be parameterized per connection with the parameters of the **`[PRE] Station definition (Connection definition) | Connection definition | Data throughput limit in receive direction (msg/s)`** (0 = no data throughput limitation).

If the number of messages/second for a single connection reaches the parameterized limit, the transmission of the confirmation for the received message will be delayed in a way that limit the number of received messages in middle at the parameterized limit.

If the delay would cause in exceeding timeout t2 (Example: “k” parameter in the remote system is set to a very high value in relation to parameterized limit) the data throughput limitation will be stopped to avoid connection failure caused by delayed IEC 60870-5-104 confirmation.

Limitation:

In worst case the number of messages /second in receive direction can be higher by “k” of the remote system (k = max. number of not confirmed messages = IEC 60870-5-104 parameter).

If the number of messages/second for a single connection exceeds the parameterized limit within a time slot (1 second) then the number of messages/second for the next time slot(s) will be reduced by the exceeded number of messages.

A communication error “data throughput limit in receive direction” is set if the data throughput has reached permanently 90 % of the parameterized limit within the last 10 minutes.

Special functions DBAG

For the implementation of the protocol firmware in DBAG projects the following special functions can be activated:

- Breaker delay in transmit direction
  (DBAG-specific special message format <TI=150>)
- Send originator address with settable value

These special functions can be activated with the parameter **`[PRE] advanced parameters | Project specific settings | DBAG functions`**.

With function activated, messages in the format <TI:=33> "32-bit bitstring" in the direction basic system element * protocol element are converted by the protocol element to the DBAG-specific message format <TI:=150> and transmitted.

Messages received in the format <TI:=150> are converted by the protocol element to the format <TI:=33> "32-bit bitstring" and passed on to the basic system element.

In transmit direction <TI:=33> "32-bit bitstring" is converted as follows:

Cause of Transmission	IEC-Parameter	Type Identification for Transmission to the Remote Station
spontaneous	-	<TI=150> DBAG-specific format
GI	with time (3 octets)	<TI:=4> Double-point information with time tag

Cause of Transmission	IEC-Parameter	Type Identification for Transmission to the Remote Station
GI	with time (7 octets)	<TI:=31> Double-point information with time tag CP56Time2a
GI	without time	<TI:=3> Double-point information

In receive direction <TI=150> is converted as follows:

Cause of Transmission	Time Format	Type Identification for Transmission to Basic System Element
spontaneous, GI	with time (7 octets)	<TI:=33> Bitstring of 32 bits with time tag CP56Time2a

NOTE

The format <TI:=150> is only defined with 7 bytes time, 3 bytes IOA, 2 bytes CASDU and 2 bytes COT! For this format no double transmission is defined as format without time tag!

Breaker delay in transmit direction

If the delay of the circuit breaker or the time of the fault current is not available, this time can be added by the protocol element in messages in transmit direction with the parameter **`[PRE] Advanced parameters | Project specific settings | parameter settings for DBAG/PSI | Switch transfer time in transmit direction`**.

Message structure <TI=150> "Railway-specific Format" (in the private range)

2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0	
150								Type identification
SQ	Number of information objects							Variable structure qualifier
T	P/N	cause of transmission						Cause of transmission
Station address								Originator address
								CASDU1
N								CASDU2
Technological Code (TC)								IOA1
1								IOA2
0	Field address							IOA3
SK8	SK7	SK6	SK5	SK4	SK3	SK2	SK1	Protection criteria (BDK)
								Protection criteria reserve
0 - 255								Fault code (AK of SLT)
2ms – Code (0-255)								Breaker delay
IV	NT	SB	BL			DPI		DIQ of DOM
Originator time in format CP56Time2a (corresponds to TL SCHINA, DB_Network)								Dual time (7 octets)

Send originator address with settable value

In DBAG projects the originator address in transmit direction is always transferred with a fixed parameterized value. The originator address is to be set with the parameter **`[PRE] Advanced parameters | Project specific settings | parameter settings for DBAG/PSI | Originator address in transmit direction`**.
For this function the setting of the **`number of octets for cause of transmission`** to *`2 octets`* is necessary (see IEC 60870-5-101/104 Parameters on the Basic System Element).

Special Functions RWE

For the implementation of the protocol firmware in RWE projects the following special functions can be activated:

- Bit by bit marking of the field
- Cyclic measured values
- Address of the return information for selection command 2
- NT bit, IV bit according to RWE requirements

These special functions can be activated with the parameter **`[PRE] [PRE] Advanced parameters | Project specific settings | RWE functions`** and are effective for all connections of the LAN/WAN protocol element.

Bit by bit marking of the field

For RWE switchgear projects, the configuration of the plants is divided into “voltage level”, “station number” and “field”.

This structuring is represented on the 5-stage IEC 60870-5-101/104 address of the data.

The definition of which part of the address (CASDU, IOA) the field addresses is carried out in the parameters **`[PRE] [PRE] Advanced parameters | Project specific settings | RWE functions | Bit-level flag of bay | *`**.

All set bits in the bit by bit marking of the field define the range of the address of the field. All reset bits in the mask define the range of the addresses for data points within the fields.

The assignment of the measured values to the fields is determined by the structuring of the address.

For cyclic group 0 measured values, no field-specific functions are implemented on the LAN/WAN protocol element.

The transmission of cyclic group 2 measured values is activated by field-specific selection commands. On the LAN/WAN protocol element the cyclic measured values are not activated/deactivated by the selection command itself, rather indirectly by the return information for the selection command.

With the return information for selection command 2, those cyclic group 2 measured values whose address for the field after masking matches the mask for bit by bit marking of the field are activated/deactivated for transmission.

	Bit by Bit marking of the Field "Mask"		Address Range for Fields
	[HEX]	BIN	Dec [HEX]
CASDU1	FF	11111111	0 to 255 [00 to FF]
CASDU2	FF	11111111	0 to 255 [00 to FF]
IOA1	00	00000000	--
IOA2	00	00000000	--
IOA3	FC	11111100	252 to 255 [FC to FF]

NOTE

- All bits with "1" in the mask declare the address range of the field
- All bits with "0" in the mask declare the address range of the data points within the field
- The bit by bit marking of the field is always the same for RWE projects!

Example:

	Parameterized Return Information Address		Bit by Bit marking of the Field "Mask"		Addresses of the Return Information determined by this
	[HEX]	[BIN]	[HEX]	BIN	Dec [HEX]
CASDU1	00	00000000	FF	11111111	0 to 255 [00 to FF]
CASDU2	00	00000000	FF	11111111	0 to 255 [00 to FF]
IOA1	21	00100001	00	00000000	21
IOA2	56	01010110	00	00000000	56
IOA3	03	00000011	FC	11111100	3, 7, 11, 15, 19, ..., 255 [03, 07, 0F, 13, ..., FF]

Cyclic measured values

Measured values can be transmitted cyclic to the remote station from the internal process image by the protocol element itself. For this special function, the activation of the RWE-specific functions and the use of the selective data flow in SICAM A8000 is required.

For cyclic measured values the following groups are supported:

- Group 0: cyclic measured values with a parameter-settable cycle time (default cycle time)
- Group 2: cyclic measured values – are only transmitted for selection 2 (high priority cycle time)

Group 2 measured values (PSG measured values) are first transmitted cyclic after activation with the selection command 2.

The selection of the measured values for the cyclic transmission and the assignment of the measured values to the group is carried out in the process-technical parameter setting for the selective data flow in SICAM RTUs in the field “Function group”.

Function Group	Group	Note
0 to 249	---	No cyclic measured value! (measured value is transmitted spontaneous)
250	0	Cyclic measured value with a parameter-settable cycle time (default cycle time; typically 3 sec)
251	1	Cyclic measured value – is only transmitted for activation with selection command 1; not used with LAN/WAN protocol element!
252	2	Cyclic measured value – is only transmitted for activation with selection command 2 (high priority cycle time; typically 0.5 s)

NOTE

The functional groups required for cyclic measured values must not be used for other functions!

The updating of the process image for cyclic measured values takes place during the transmission of spontaneous measured values or during general interrogation to the LAN/WAN protocol element – from now on these measured values are transmitted cyclic (not spontaneous and not with GI) to the remote station.

For the transmission of the cyclic measured values, SICAM RTUs internal (between basic system element and LAN/WAN protocol element) the message format “<TI:=35> measured value, scaled value with time tag CP56Time2a” is used.

Cyclic measured values are always transmitted from the LAN/WAN protocol element to the remote station without time tag with the message format “<TI:=11> measured value, scaled value” and with the cause of transmission “cyclic”.

The cycle time for the transmission of cyclic measured values can be set with the parameter **`[PRE] Advanced parameters | Project specific settings | RWE functions | Cyclic measured value | Base cycle time`** and the parameter **`[PRE] Advanced parameters | Project specific settings | RWE functions | Cyclic measured value | High priority cycle time`** .

The transmission of the cyclic measured values to the remote station takes place with maximum possible blocking according to IEC 60870-5-104. The blocking for cyclic measured values is performed by the LAN/WAN communications element itself. The parameters provided for the blocking on the basic system element (BSE) in the IEC 60870-5-101/104 parameter block are not evaluated.

During the transmission of the cyclic measured values, the transmission of spontaneous data is disabled. All cyclic measured values are prepared for transmission in one operation at the respective cycle moment.

Limitations:

- Maximum 2000 cyclic measured values
- Cyclic measured values are only supported in Systems with selective data flow
- An address conversion for cyclic measured values is not supported
- Cyclic measured values are only supported for 1 connection (only to the 1. connection in the detailed routing)
- Cyclic measured values must not be routed to a redundant connection

NOTE

So that the process data is transmitted with the latest values as fast as possible after a going interface fault, the function "delete ring with communication failure" is to be deactivated in the communications function on the basic system element.

This setting is therefore necessary, because the general interrogation in the system is only triggered later and consequently, until the updating of the cyclic measured values, due to the general interrogation, old values are transmitted to the remote station.

Group 0 measured values

With function enabled, group 0 measured values are always transmitted cyclic. The cycle time can be set with the parameter **[PRE]Advanced parameters | Project specific settings | RWE functions | Cyclic measured value | Base cycle time** .

Group 1 measured values (selection command 1)

Group 1 measured values are not supported!

Group 2 measured values (selection command 2)

Group 2 measured values (PSG measured values) are first transmitted cyclic after activation with the selection command 2. If the transmission of the measured values is not activated with the selection command 2, these measured values are not transmitted.

After startup, by default these measured values are not transmitted.

The activation of the group 2 measured values takes place on the LAN/WAN protocol element not directly with the selection command 2, rather with the return information for the selection command 2.

The cycle time can be set with the parameter **[PRE] Advanced parameters | Project specific settings | RWE functions | Cyclic measured value | High priority cycle time** .

Address of the Return Information for Selection Command

The activation of the group 2 measured values does not take place on the LAN/WAN protocol element with the selection command 2 itself, rather with the return information for the selection command 2. The selection command is processed in the function diagram of the component according to the RWE requirements and with successful selection the return information is generated for the selection command 2.

The selection of the group 2 measured values is supported for all fields, whose address range has been determined by the bit by bit marking of the field.

The address of the return information for the selection command 2 is to be parameterized with the parameters **[PRE] [PRE] Advanced parameters | Project specific settings | RWE functions | Cyclic measured value | Address of the return information of select command 2 | ***.

As return information address, only those sections of the address are to be parameterized that are not part of the address range for the field. Consequently, as return information address only the field-internal address is to be parameterized. The bits of the address which identify the field in the return information address for selection command 2 are not evaluated by the LAN/WAN protocol element.

For the return information of the selection command 2, SICAM RTUs internal only the message format "<TI:=30> single-point information with time tag CP56Time2a" is used.

The cyclic transmission of the group 2 measured values is activated with the single-point information state "ON" and deactivated with the state OFF.

The selection of the group 2 measured values can be carried out either Locally or Remotely. The return information for the selection command 2 is only transmitted spontaneously to the remote station with the cause of transmission "Return information, caused by a remote command" or "Return information, caused by a local command".

With general interrogation, the return information for the selection command is not transmitted to the remote station!

The assignment of the measured values to the fields is determined by the structuring of the address for RWE.

With the return information for selection command 2, those cyclic group 2 measured values whose address for the field after masking matches the mask for bit by bit marking of the field are activated/deactivated for transmission.

NT bit, IV bit according to RWE requirements

For projects for the customer RWE, a special handling can be activated for the NT bit and the IV bit of the quality descriptor of the messages in transmit direction.
If the RWE-specific functions are not activated, the NT bit and the IV bit in the messages are transferred to the remote station unchanged.
If the RWE-specific functions are activated, the special handling for the NT bit and the IV bit can be selected with the parameter **[PRE] Advanced parameters | Project specific settings | RWE functions | Convert of the NT bits to the IV bit in transmit direction** from the following options:

- Variant a: (selection = **<disabled>**)
  NT bit is set to "0", IV bit is not changed
- Variant b: (selection = ***<enabled>***)
  NT bit is set to "0", IV bit is set if
  NT bit (internal) or IV bit (internal) is set

SICAM RTUs internal		To Remote Station (Variant a)		To Remote Station (Variant b)	
NT bit	IV bit	NT bit	IV bit	NT bit	IV bit
0	x	0	x	0	x
1	x	0	x	0	1
0	0	0	0	0	0
0	1	0	1	0	1
1	0	0	0	0	1
1	1	0	1	0	1

x = optional state, or state is not changed!

13.5.8 Protocol Element Control and Return Information

13.5.8.1 Protocol element control messages

Protocol element control messages can control protocol element internal functions. On the basic system element, IEC 60870-5-101/104 *messages with process information in the control direction* are converted to protocol element control messages and transmitted to the selected protocol element (see *13.1.4.10 Protocol Element Control Messages*).

Supported Protocol element control functions

SF	Protocol element control function **Control function_(PRE)**	ETI4 [LAN]	FWI4 [LAN]
0	Activate interface	✓	✓
1	Deactivate interface	✓	✓
2	Time sync, OK	✓	✓
3	Time sync, NOK	✓	✓
240	Send (General)-interrogation command (CASDU=All)	✓	✓
242	Set control location	✓	✓

SF	Protocol element control function `Control function_(PRE)`	ETI4 [LAN]	FWI4 [LAN]
243	Reset command	–	–
244	Send (General)-interrogation command (CASDU = selective)	✓	✓

Legend:
SF .. Control function_(PRE)

13.5.8.2 Protocol element - Return information

Protocol element return information are internal status information of the protocol elements which are transmitted spontaneously and in the event of a general interrogation with internal message formats from the protocol element to the basic system element. On the basic system element, the protocol element return information (see *13.1.4.11 Protocol Element Return Information*) are converted to IEC 60870-5-101/104 *`messages with process information in the monitoring direction`*.

Supported protocol element return information

Protocol element - return information `Return information function_(PRE)`	Station	ETI4 [LAN]	FWI4 [LAN]
Station Failure	0 to 99	✓	✓
protocol-specific return information 0: • Status DATA TRANSFER (BSE) [187] <0> = data transfer from/to BSE is stopped <1> = data transfer from/to BSE is started	0 to 99	✓	✓
protocol-specific return information 1: • Status DATA TRANSFER (104-Connection) [188] <0> = IEC 60870-5-104 data transfer is stopped (STOPDTact) <1> = IEC 60870-5-104 data transfer is started (STARTDTact)	0 to 99	✓	✓

13.5.9 Web server

A web server for internal diagnostic and statistical information is integrated in the protocol firmware. The web server itself is implemented on the basic system element - the protocol-specific websites are provided by the protocol element.

System	Firmware	Protocol function	Protocol-specific web pages
CP-8031, CP-8050	ETI4	IEC 60870-5-104	✓
	FWI4	IEC 60870-5-104	✓

Enable/disable web server or start web server via SICAM Device Manager or web browser see *13.1.4.12 Web server for protocol-specific web pages*

Supported protocol-specific web pages:

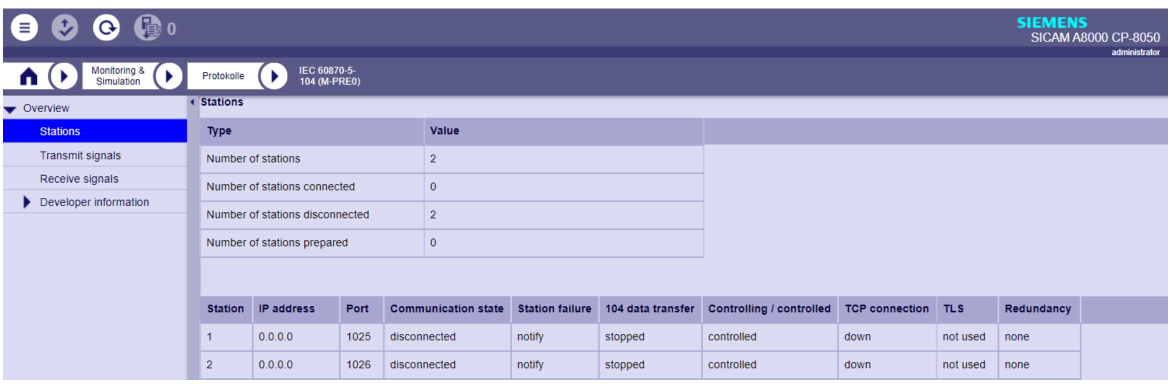
187 the state “DATA TRANSFER (BSE)” can be changed by the parameter “Stop behavior” and “Failure”” (see connection specific parameters) and und can be different to the state of “DATA TRANSFER (104 Connection)”.
188 Actual state “DATA TRANSFER (104 Connection)”.

Protocol specific web page	ETI4	FWI4
Overview [189]	✓	✓
Stations	✓	✓
Transmit signals	✓	✓
Receive signals	✓	✓
Developer Information [189]		
Datastream trace [189]	✓	✓
Ethernet capture [189]	✓	✓
Diagnosis (IDR) [189]	✓	✓
Statistics (IDE) [189]	✓	✓
User diagnosis (IDU) [189]	✓	✓

13.5.9.1 Protocol specific web page: Stations

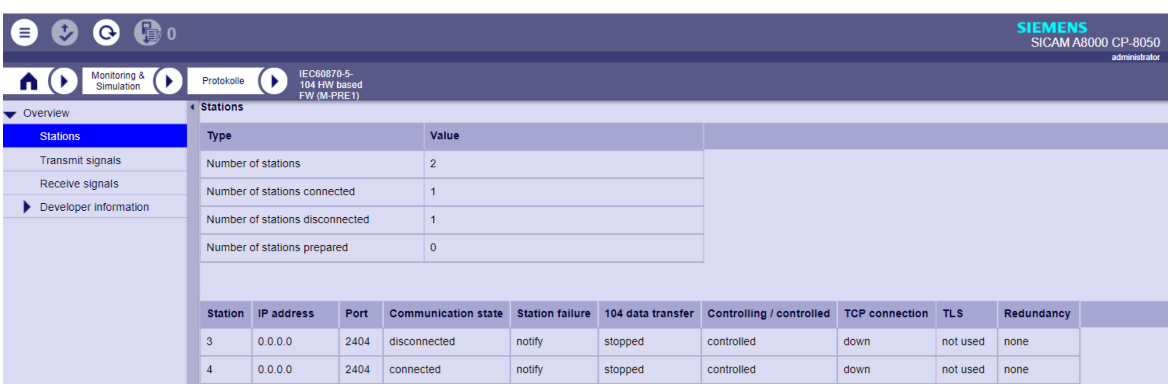
With web page **Stations** detailed information about the status of the connection to each connected remote station will be displayed.

ETI4:



[ETI4_WEB_stations, 1, --_--]

FWI4:



[FWI4_WEB_stations, 1, --_--]

Field	Note
Number of stations	Number of parameterized stations (connections)
Number of stations connected	Number of established connections to stations

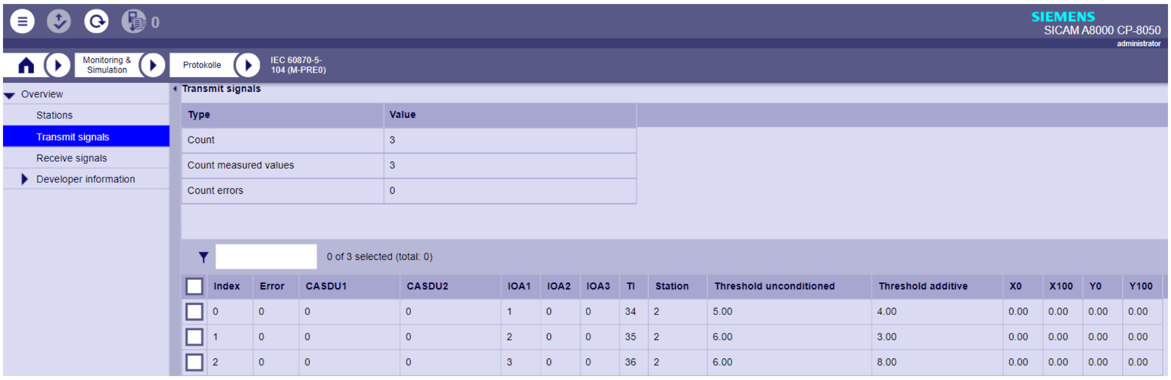
189 see *13.1.4.12 Web server for protocol-specific web pages*.

Field	Note
Number of stations disconnected	Number of cleared connections to stations
Number of stations prepared	Number of prepared connections to stations
Station	Internal station number for this connection
IP address	IP-Address of remote station
Port	Used TCP port number for this connection. (2404 = Standard Port Number for IEC 60870-5-104)
Communication state	State of the connection to this station • connected • disconnected • prepared
Station failure	report station failure • notify • suppress
104 data transfer	Status IEC 60870-5-104 data transfer: • started • stopped
Controlling / controlled	IEC 60870-5-104 function of the own station for this connection: • controlling • controlled
TCP connection	State of the TCP connection: • up • down
TLS	Encryption of the connection with TLS: • not used • encrypted • null chiper
Redundancy	Used redundancy mode for this connection: • not used • real connection • virtual connection • 104 controlling redundancy

13.5.9.2 Protocol specific web page: Transmit signals

On the **Transmit signals** web page, information on the configured signals for monitoring of measured value changes and measured value adaption (scaling) in transmit direction is displayed.

Signals that are sent by the protocol element but are not monitored for change or are not scaled are not displayed here.



[ETI4_WEB_transmit_signals, 1, --_--]

Field	Note
Count	Number of parameterized data points in transmit direction (total for all stations)
Count measured values	Number of parameterized data points in transmit direction for “monitoring of measured value changes/measured value scaling” (total for all stations)
Count error	Number of faulty parameterized data points in transmit direction (total number for all stations)
Index	Internal index in the detailed routing of the message conversion
Error	Error number (the last detected error is displayed in the diagnostic)
CASDU1, CASDU2 IOA1, IOA2, IOA3	Internal IEC 60870-5-101/104 address of the data point
TI	Internal IEC 60870-5-101/104 type identification
Station	Internal station number for this connection
Threshold additive	Additive threshold for change monitoring
Threshold unconditioned	Unconditioned threshold for change monitoring
X0	X_0% for value adaptation
X100	X_100% for value adaptation
Y0	X_0% for value adaptation
Y100	Y_100% for value adaptation

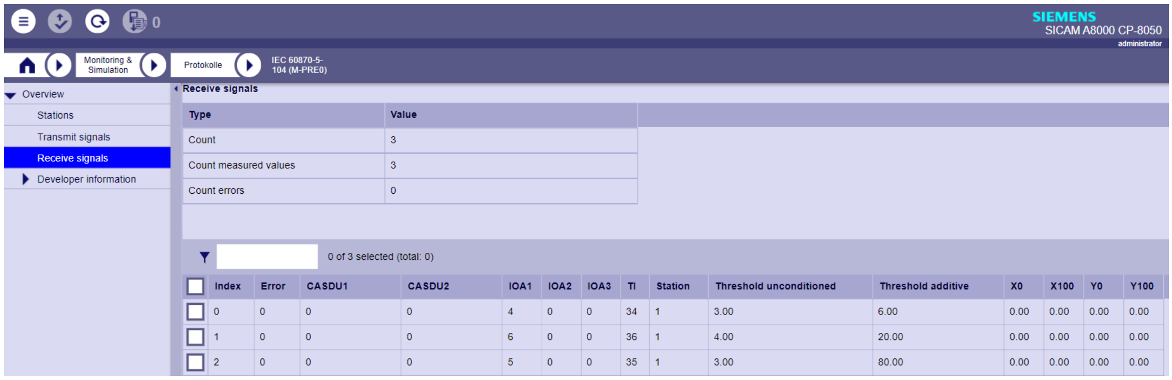
The filter 

affects all fields in the table (see *13.1.4.12 Web server for protocol-specific web pages*).

13.5.9.3 Protocol specific web page: Receive signals

On the **Receive signals** web page, information on the configured signals for monitoring of measured value changes and measured value adaption (scaling) in receive direction is displayed.

Signals that are received by the protocol element but are not monitored for change or are not scaled are not displayed here.



[ETI4_WEB_receive_signals, 1, --_--]

Field	Note
Count	Number of parameterized data points in receive direction (total for all stations)
Count measured values	Number of parameterized data points in receive direction for “monitoring of measured value changes/measured value scaling” (total for all stations)
Count error	Number of faulty parameterized data points in receive direction (total number for all stations)
Index	Internal index in the detailed routing
Error	Error number (the last detected error is displayed in the diagnostic)
CASDU1, CASDU2 IOA1, IOA2, IOA3	Internal IEC 60870-5-101/104 address of the data point
TI	Internal IEC 60870-5-101/104 type identification
Station	Internal station number for this connection
Threshold additive	Additive threshold for change monitoring
Threshold unconditioned	Unconditioned threshold for change monitoring
X0	X_0% for value adaptation
X100	X_100% for value adaptation
Y0	X_0% for value adaptation
Y100	Y_100% for value adaptation

The filter 

affects all fields in the table (see *13.1.4.12 Web server for protocol-specific web pages*).

13.5.10 Interoperability IEC 60870-5-104 (ETI4, FWI4)

This companion standard presents sets of parameters and alternatives from which subsets must be selected to implement particular telecontrol systems. Certain parameter values, such as the choice of “structured“ or “unstructured“ fields of the INFORMATION OBJECT ADDRESS of ASDUs represent mutually exclusive alternatives. This means that only one value of the defined parameters is admitted per system. Other parameters, such as the listed set of different process information in command and in monitor direction allow the specification of the complete set or subsets, as appropriate for given applications. This clause summarizes the parameters of the previous clauses to facilitate a suitable selection for a specific application. If a system is composed of equipment stemming from different manufacturers it is necessary that all partners agree on the selected parameters.

The interoperability list is defined as in IEC 60870-5-101 and extended with parameters used in this standard. The text descriptions of parameters which are not applicable to this companion standard are strike-through (corresponding check box is marked black).

NOTE: In addition, the full specification of a system may require individual selection of certain parameters for certain parts of the system, such as the individual selection of scaling factors for individually addressable measured values.

The selected parameters should be marked in the white boxes as follows:

☐ Function or ASDU is not used

X Function or ASDU is used as standardized (default)

R Function or ASDU is used in reverse mode

B Function or ASDU is used in standard and reverse mode

The possible selection (blank, X, R, or B) is specified for each specific clause or parameter.

A black check box indicates that the option cannot be selected in this companion standard.

13.5.10.1 System or device function

(system-specific parameter, indicate the system’s or station’s function by marking one of the following with "**X**")

X System definition

X Controlling Station (Master)

X Controlled Station (Slave)

13.5.10.2 Network configuration

(network-specific parameter, all configurations that are used are to be marked "**X**")

■ ~~Point-to-Point~~

■ ~~Multipoint-partyline~~

■ ~~Multiple Point-to-Point~~

■ ~~Multipoint-star~~

13.5.10.3 Physical layer

(network-specific parameter, all interfaces and data rates that are used are to be marked "**X**")

Transmission speed (control direction)

Unbalanced interchange Circuit V.24/ V.28 Standard	Unbalanced interchange Circuit V.24/ V.28 Recommended if >1200 bit/s	Balanced interchange CircuitX.24/ X.27	
■ ~~100 bit/s~~	■ ~~2 400 bit/s~~	■ ~~2 400 bit/s~~	■ ~~56 000 bit/s~~
■ ~~200 bit/s~~	■ ~~4 800 bit/s~~	■ ~~4 800 bit/s~~	■ ~~64 000 bit/s~~
■ ~~300 bit/s~~	■ ~~9 600 bit/s~~	■ ~~9 600 bit/s~~	
■ ~~600 bit/s~~		■ ~~19 200 bit/s~~	
■ ~~1 200 bit/s~~		■ ~~38 400 bit/s~~	

Transmission speed (monitor direction)

Unbalanced interchange Circuit V.24/ V.28 Standard	Unbalanced interchange Circuit V.24/ V.28 Recommended if >1200 bit/s	Balanced interchange Circuit X.24/ X.27	
■ ~~100 bit/s~~	■ ~~2 400 bit/s~~	■ ~~2 400 bit/s~~	■ ~~56 000 bit/s~~
■ ~~200 bit/s~~	■ ~~4 800 bit/s~~	■ ~~4 800 bit/s~~	■ ~~64 000 bit/s~~
■ ~~300 bit/s~~	■ ~~9 600 bit/s~~	■ ~~9 600 bit/s~~	
■ ~~600 bit/s~~		■ ~~19 200 bit/s~~	
■ ~~1 200 bit/s~~		■ ~~38 400 bit/s~~	

13.5.10.4 Link Layer

(network-specific parameter, all options that are used are to be marked "**X**") Specify the maximum frame length. If a non-standard assignment of class 2 messages is implemented for unbalanced transmission, indicate the Type ID and COT of all messages assigned to class 2.)

~~Frame format FT 1.2, single character 1 and the fixed time out interval are used exclusively in this companion standard.~~

Link transmission procedure	Address filed of the link
■ ~~Balanced transmission~~	■ ~~not present (balanced transmission only)~~
■ ~~Unbalanced transmission~~	■ ~~1 Octet~~
	■ ~~2 Octets~~

■ ~~structured~~

■ ~~unstructured~~

Frame length

■ ~~Maximum length L (control direction)~~

■ ~~Maximum length L (monitor direction)~~

■ ~~Time period in which repetitions are allowed (*Trp*) or number of repetitions~~

When using an unbalanced link layer, the following ASDU types are returned in class 2 messages (low priority) with the indicated causes of transmission:

■ ~~The standard assignment of ASDUs to class 2 messages is used as follows:~~

Type Identification	Cause of transmission
9, 11, 13, 21	<1>

■ ~~A special assignment of ASDUs to class 2 messages is used as follows:~~

Type identification	Cause of transmission

~~NOTE: In response to a class 2 poll, a controlled station may respond with class 1 data when there is no class 2 data available.~~

13.5.10.5 Application Layer

Transmission mode for application data

Mode 1 (Least significant octet first), as defined in clause 4.10 of IEC 60870-5-4, is used exclusively in this companion standard.

Common address of ASDU

(system-specific parameter, all configurations that are used are to be marked "**X**")

■ ~~1 Octet~~

☒ 2 Octets

Address of the information object

(system-specific parameter, all configurations that are used are to be marked "**X**")

■ ~~1 Octet~~

☒ structured

■ ~~2 Octets~~

☒ unstructured

☒ 3 Octets

Cause of transmission

(system-specific parameter, all configurations that are used are to be marked "**X**")

■	~~1 Octet~~	X	2 Octets (with originator address) Only originator address not used (=0) is used

Length of APDU

(system-specific parameter, specify the maximum length of the APDU per system)
The maximum length of the APDU in both transmission directions is 253. This is a fixed system parameter.

Length of APDU

■ ~~Maximum length of APDU per system in control direction~~

■ ~~Maximum length of APDU per system in monitoring direction~~

Selection of standard ASDUs

Process information in monitor direction

(station-specific parameter, mark each Type ID "**X**" if it is only used in the standard direction, "**R**" if only used in the reverse direction, and "**B**" if used in both directions)

B	<1> := Single-point information	M_SP_NA_1
■	~~<2> := Single-point information with time tag~~	M_SP_TA_1
B	<3> := Double-point information	M_DP_NA_1
■	~~<4> := Double-point information with time tag~~	M_DP_TA_1
B	<5> := Step position information	M_ST_NA_1
■	~~<6> := Step position information with time tag~~	M_ST_TA_1
B	<7> := Bitstring of 32 bit	M_BO_NA_1
■	~~<8> := Bitstring of 32 bit with time tag~~	M_BO_TA_1
B	<9> := Measured value, normalized value	M_ME_NA_1
■	~~<10> := Measured value, normalized value with time tag~~	M_ME_TA_1
B	<11> := Measured value, scaled value	M_ME_NB_1
■	~~<12> = Measured value, scaled value with time tag~~	M_ME_TB_1
B	<13> := Measured value, short floating point number	M_ME_NC_1
■	~~<14> := Measured value, short floating point number with time tag~~	M_ME_TC_1
B	<15> := Integrated totals	M_IT_NA_1
■	~~<16> := Integrated totals with time tag~~	M_IT_TA_1
■	~~<17> := Event of protection equipment with time tag~~	M_EP_TA_1

	~~<18> := Packed start events of protection equipment with time tag~~	M_EP_TB_1
	~~<19> := Packed output circuit information of protection equipment with time tag~~	M_EP_TC_1
6)	<20> := Packed single-point information with status change detection M_PS_NA_1	M_PS_NA_1
	<21> := Measured value, normalized value without quality descriptor	M_ME_ND_1
B	<30> := Single-point information with time tag CP56Time2a	M_SP_TB_1
B	<31> := Double-point information with time tag CP56Time2a	M_DP_TB_1
B	<32> := Step position information with time tag CP56Time2a	M_ST_TB_1
B	<33> := Bitstring of 32 bits with time tag CP56Time2a	M_BO_TB_1
B	<34> := Measured value, normalized value with time tag CP56Time2a	M_ME_TD_1
B	<35> := Measured value, scaled value with time tag CP56Time2a	M_ME_TE_1
B	<36> := Measured value, short floating point number with time tag CP56Time2a	M_ME_TF_1
B	<37> := Integrated totals with time tag CP56Time2a	M_IT_TB_1
B	<38> := Event of protection equipment with time tag CP56Time2a	M_EP_TD_1
B	<39> := Packed start events of protection equipment with time tag CP56Time2a	M_EP_TE_1
B	<40> := Packed output circuit information of protection equipment with time tag CP56Time2a	M_EP_TF_1

In this companion standard only the use of the set <30> – <40> for ASDUs with time tag is permitted.

6) Reception possible, thereby the blocked single-point information is deblocked and further individually processed as TI = 30 (address translation occurs algorithmic).

Process information in control direction

(station-specific parameter, mark each Type ID "**X**" if it is only used in the standard direction, "**R**" if only used in the reverse direction, and "**B**" if used in both directions)

B	<45> := Single command	C_SC_NA_1
B	<46> := Double command	C_DC_NA_1
B	<47> := Regulating step command	C_RC_NA_1
B	<48> := Set point command, normalized value	C_SE_NA_1
B	<49> := Set point command, scaled value	C_SE_NB_1
B	<50> := Set point command, short floating point number	C_SE_NC_1
B	<51> := Bitstring of 32 bit	C_BO_NA_1
B	<58> := Single command with time tag CP56Time2a	C_SC_TA_1

B	<59> := Double command with time tag CP56Time2a	C_DC_TA_1
B	<60> := Regulating step command with time tag CP56Time2a	C_RC_TA_1
B	<61> := Set point command, normalized value with time tag CP56Time2a	C_SE_TA_1
B	<62> := Set point command, scaled value with time tag CP56Time2a	C_SE_TB_1
B	<63> := Set point command, short floating point with time tag CP56Time2a	C_SE_TC_1
B	<64> := Bitstring of 32 bits with time tag CP56Time2a	C_BO_TA_1

Either the ASDUs of the set <45> - <51> or of the set <58> - <64> are used.

System information in monitoring direction

(station-specific parameter, mark each Type ID "**X**" if it is only used in the standard direction, "**R**" if only used in the reverse direction, and "**B**" if used in both directions)

X	<70> := End of initialization	M_EI_NA_1

System information in control direction

(station-specific parameter, mark each Type ID "**X**" if it is only used in the standard direction, "**R**" if only used in the reverse direction, and "**B**" if used in both directions)

B	<100> := Interrogation command	C_IC_NA_1
B	<101> := Counter interrogation command	C_CI_NA_1
	<102> := Read command	C_RD_NA_1
X**	<103> := Clock synchronization command	C_CS_NA_1
	~~<104> := Test command~~	C_TS_NA_1
X	<105> := Reset process command	C_RP_NA_1
	~~<106> := Delay acquisition command~~	C_CD_NA_1
B	<107> := Test command with time tag CP56time2a	C_CD_NA_1

X** ... supported but not recommended (bad accuracy)

Parameter in control direction

(station-specific parameter, mark each Type ID "**X**" if it is only used in the standard direction, "**R**" if only used in the reverse direction, and "**B**" if used in both directions)

X	<110> := Parameter of measured value, normalized value	P_ME_NA_1
X	<111> := Parameter of measured value, scaled value	P_ME_NB_1
X	<112> := Parameter of measured value, short floating	P_ME_NC_1
4)	<113> := Parameter activation	P_AC_NA_1

4) ... Not used in IEC 60870-5-104 Edition 2. No use case.

File transfer

(station-specific parameter, mark each Type ID "**X**" if it is only used in the standard direction, "**R**" if only used in the reverse direction, and "**B**" if used in both directions)

B	<120> := File ready	F_FR_NA_1
B	<121> := section ready	F_SR_NA_1
B	<122> := Call directory, select file, call file, call section	F_SC_NA_1
B	<123> := last section, last segment	F_LS_NA_1
B	<124> := Ack file, ack section	F_AF_NA_1
B	<125> := Segment	F_SG_NA_1
X	<126> := Directory {blank or X, only available in monitor (standard) direction}	F_DR_TA_1
	<127>:= QueryLog – Request for an archive file	F_SC_NB_1

Type identifier and Cause of Transmission Assignments

(station-specific parameter)
Shaded boxes are not required.
Black boxes are not permitted in this companion standard
Blank = Function or ASDU is not used.
Mark Type Identification/Cause of transmission combinations:
"**X**" if only used in the standard direction,
"**R**" if only used in the reverse direction,
"**B**" if used in both directions.

Type Identification		Cause of transmission																		
		1	2	3	4	5	6	7	8	9	10	11	12	13	20 to 36	37 to 41	44	45	46	47
<1>	M_SP_NA_1		B	B								B	B		B					
~~<2>~~	~~M_SP_TA_1~~																			
<3>	M_DP_NA_1		B	B								B	B		B					
~~<4>~~	~~M_DP_TA_1~~																			
<5>	M_ST_NA_1		B	B*								B*	B*		B*					
~~<6>~~	~~M_ST_TA_1~~																			
<7>	M_BO_NA_1		B	B*											B*					
~~<8>~~	~~M_BO_TA_1~~																			
<9>	M_ME_NA_1	B	B	B											B					
~~<10>~~	~~M_ME_TA_1~~																			
<11>	M_ME_NB_1	B	B	B											B					
~~<12>~~	~~M_ME_TB_1~~																			
<13>	M_ME_NC_1	B	B	B											B					
~~<14>~~	~~M_ME_TC_1~~																			
<15>	M_IT_NA_1			B												B				
~~<16>~~	~~M_IT_TA_1~~																			
~~<17>~~	~~M_EP_TA_1~~																			
~~<18>~~	~~M_EP_TB_1~~																			
~~<19>~~	~~M_EP_TC_1~~																			
<20>	M_PS_NA_1		6)												6)					
<21>	M_ME_ND_1																			
<30>	M_SP_TB_1			B								B	B							
<31>	M_DP_TB_1			B								B	B							
<32>	M_ST_TB_1			B*								B*	B*							
<33>	M_BO_TB_1			B*																
<34>	M_ME_TD_1			B																
<35>	M_ME_TE_1			B																
<36>	M_ME_TF_1			B																
<37>	M_IT_TB_1			B												B				
<38>	M_EP_TD_1			B																
<39>	M_EP_TE_1			B																
<40>	M_EP_TF_1			B																
<45>	C_SC_NA_1						B	B	B	B	B						B	B	B	B
<46>	C_DC_NA_1						B	B	B	B	B						B	B	B	B
<47>	C_RC_NA_1						B	B	B	B	B						B	B	B	B
<48>	C_SE_NA_1						B	B	B	B	B*						B	B	B	B
<49>	C_SE_NB_1						B	B	B	B	B*						B	B	B	B

B* can be generated by the PLC

6) Reception possible, thereby the blocked single-point information is deblocked and further individually processed as TI = 30 (address translation occurs algorithmic).

[Type_Identification_1, 2, en_US]

Type Identification		Cause of transmission																		
		1	2	3	4	5	6	7	8	9	10	11	12	13	20 to 36	37 to 41	44	45	46	47
<50>	C_SE_NC_1						B	B	B	B	B*						B	B	B	B
<51>	C_BO_NA_1						B*	B*	B*	B*	B*						B	B	B	B
<58>	C_SC_TC_1						B	B	B	B	B						B	B	B	B
<59>	C_DC_TC_1						B	B	B	B	B						B	B	B	B
<60>	C_RC_TC_1						B	B	B	B	B						B	B	B	B
<61>	C_SE_TA_1						B	B	B	B	B*						B	B	B	B
<62>	C_SE_TB_1						B	B	B	B	B*						B	B	B	B
<63>	C_SE_TC_1						B	B	B	B	B*						B	B	B	B
<64>	C_BO_TA_1						B*	B*	B*	B*	B*						B	B	B	B
<70>	M_EI_NA_1*)				X															
<100>	C_IC_NA_1						B	B	7)	7)	B						B	B	B	B
<101>	C_CI_NA_1						B	B			B						B	B	B	B
<102>	C_RD_NA_1																			
<103>	C_CS_NA_1			B			X	X									B	B	B	B
~~<104>~~	~~C_TS_NA_1~~																			
<105>	C_RP_NA_1						X	X									B	B	B	B
~~<106>~~	~~C_CD_NA_1~~																			
<107>	C_TS_TA_1						B	B									B	B	B	B
<110>	P_ME_NA_1						X	X							X		B	B	B	B
<111>	P_ME_NB_1						X	X							X		B	B	B	B
<112>	P_ME_NC_1						X	X							X		B	B	B	B
<113>	P_AC_NA_1																			
<120>	F_FR_NA_1													B			B	5)	5)	5)
<121>	F_SR_NA_1													B			B	5)	5)	5)
<122>	F_SC_NA_1					B								B			B	5)	5)	5)
<123>	F_LS_NA_1													B			B	5)	5)	5)
<124>	F_AF_NA_1													B			B	5)	5)	5)
<125>	F_SG_NA_1													B			B	5)	5)	5)
<126>	F_DR_TA_1*)			X		X														

*) blank or X only
B* can be generated by the PLC
5) transparent transmission by system
7) not supported; reply sent with COT=45 „unknown cause of transmission“

[Type_Identification_2, 2, en_US]

Semantics of cause of transmission:

<0>	:=	not used
<1>	:=	periodic, zyclic (optional)
<2>	:=	background scan (optional)
<3>	:=	spontaneous
<4>	:=	initialized
<5>	:=	request or requested
<6>	:=	activation
<7>	:=	Confirmation of activation
<8>	:=	Abortion of activation
<9>	:=	Confirmation of the abortion of activation
<10>	:=	Activation termination
<11>	:=	Return information, caused by a remote command
<12>	:=	Return information, caused by a local command

<13>	:=	File transfer
<14..19>	:=	reserved for further compatible definitions (not used)
<20>	:=	interrogated by station interrogation
<21..36>	:=	interrogated by group 1..16 interrogation
<37>	:=	requested by general counter request
<38..41>	:=	requested by group 1..4 counter request
<42, 43>	:=	not used
<44>	:=	unknown type identification
<45>	:=	unknown cause of transmission
<46>	:=	unknown common address of ASDU
<47>	:=	unknown information object address
<48, 63>	:=	not used

13.5.10.6 Basic Application Functions

Station initialization

(station-specific parameter, mark “**X**”)

[X] Station initialization

Cyclic data transmission

(station-specific parameter, mark each Type ID “**X**” if function is only used in the standard direction, “**R**” if only used in the reverse direction, and “**B**” if used in both directions)

[B] Cyclic data transmission

Read procedure

(station-specific parameter, mark each Type ID “**X**” if function is only used in the standard direction, “**R**” if only used in the reverse direction, and “**B**” if used in both directions)

[ ] Read procedure

Spontaneous transmission

(station-specific parameter, mark each Type ID “**X**” if function is only used in the standard direction, “**R**” if only used in the reverse direction, and “**B**” if used in both directions)

[B] Spontaneous transmission

Double transmission of information objects with cause of transmission spontaneous

(station-specific parameter, mark each information type “**X**” where both a Type ID without time and corresponding Type ID with time are issued in response to a single spontaneous change of a monitored object)

The following type identifications may be transmitted in succession caused by a single status change of an information object. The particular information object addresses for which double transmission is enabled are defined in a project-specific list.

[ ] Single-point information M_SP_NA_1, M_SP_TA_1, M_SP_TB_1 and M_PS_NA_1

[ ] Double-point information M_DP_NA_1, M_DP_TA_1 and M_DP_TB_1

- [ ] Step position information M_ST_NA_1, M_ST_TA_1 and M_ST_TB_1
- [ ] Bitstring of 32 bits M_BO_NA_1, M_BO_TA_1 and M_BO_TB_1 (if defined for a specific project)
- [ ] Measured value, normalized value M_ME_NA_1, M_ME_TA_1, M_ME_ND_1 and M_ME_TD_1
- [ ] Measured value, scaled value M_ME_NB_1, M_ME_TB_1 and M_ME_TE_1
- [ ] Measured value, short floating-point value M_ME_NC_1, M_ME_TC_1 and M_ME_TF_1

Station interrogation

(station-specific parameter, mark “**X**” if function is only used in the standard direction, “**R**” if only used in the reverse direction, and “**B**” if used in both directions)

B	Global				
B	Group 1	B	Group 7	B	Group 13
B	Group 2	B	Group 8	B	Group 14
B	Group 3	B	Group 9	B	Group 15
B	group 4	B	Group 10	B	Group 16
B	Group 5	B	Group 11		
B	Group 6	B	Group 12		Information Object Addresses assigned to each group must be shown in a separate table.

Clock synchronization

(station-specific parameter, mark “**X**” if function is only used in the standard direction, “**R**” if only used in the reverse direction, and “**B**” if used in both directions)

B**	Clock synchronization
B	Day of week used
	RES1, GEN (time tag substituted/ not substituted) used
B	SU-bit (summertime) used

B** supported but not recommended (bad accuracy); by default time synchronization is done by NTP/SNTP

Command transmission

(object-specific parameter, mark “**X**” if function is only used in the standard direction, “**R**” if only used in the reverse direction, and “**B**” if used in both directions)

B	Direct command transmission
B	Direct setpoint command transmission
B	“Select and execute” command

B "Select and execute" setpoint command

B C_SE ACTTERM used

B No additional definition

B Short pulse duration (duration determined by a system parameter in the outstation)

B Long pulse duration (duration determined by a system parameter in the outstation)

B* Persistent command

B* Can be used only when the COT is generated via a function plan application (CAEx *plus*)

X Supervision of maximum delay of commands and setpoint commands in command direction

0-65535s Maximum allowable delay of commands and setpoint commands

Transmission of integrated totals

(station- or object-specific parameter, mark "**X**" if function is only used in the standard direction, "**R**" if only used in the reverse direction, and "**B**" if used in both directions)

B Mode A: Local freeze with spontaneous transmission

B Mode B: Local freeze with counter interrogation

B Mode C: Freeze and transmit by counter interrogation commands

☐ Mode D: Freeze by counter interrogation command, frozen values reported spontaneously

B Counter interrogation

B Counter freeze without reset

B Counter freeze with reset

B Reset counter

B General request counter

B Counter interrogation group 1

B Counter interrogation group 2

B Counter interrogation group 3

B Counter interrogation group 4

Parameter loading[190]

(object-specific parameter, mark "**X**" if function is only used in the standard direction, "**R**" if only used in the reverse direction, and "**B**" if used in both directions)

190 Only supported with "Controlled Function"

[X] Threshold

[X] Smoothing factor

[X] Low limit for transmission of measured value

[X] High limit for transmission of measured value

Parameter for activation

(object-specific parameter, mark "**X**" if function is only used in the standard direction, "**R**" if only used in the reverse direction, and "**B**" if used in both directions)

[ ] Activation/deactivation of persistent cyclic or periodic transmission of the addressed object

Test procedure

(station-specific parameter, mark "**X**" if function is only used in the standard direction, "**R**" if only used in the reverse direction, and "**B**" if used in both directions)

[B] Test procedure

File transfer

(station-specific parameter, mark "**X**" if function is used)

File transfer in monitoring direction

[X*] Transparent file

[X*] Transmission of disturbance data of protection equipment

[X] Transmission of sequences of events

[X*] Transmission of sequences of recorded analog values

File transfer in control direction

[ ] Transparent file

X* Data can be transparently transported by the system but not generated or evaluated. A maximum of 220 bytes of user data can be transported in a segment message for file transfer.

Background scan

(station-specific parameter, mark "**X**" if function is only used in the standard direction, "**R**" if only used in the reverse direction, and "**B**" if used in both directions)

[B] Background scan

Note: used for data which are transmitted caused by a self-initiated general interrogation

Acquisition of transmission delay

(station-specific parameter, mark "**X**" if function is only used in the standard direction, "**R**" if only used in the reverse direction, and "**B**" if used in both directions)

■ ~~Acquisition of transmission delay~~

Definition of time-outs

Parameter	Default Value	Note	Selected value
t_0	30 s	Time-out of connection establishment	
t_1	15 s	Time-out of send or test APDUs	
t_2	10 s	Time-out for acknowledges in case of no data messages $t_2 < t_1$	
t_3	20 s	Time-out for sent test frames in case of long idle states	

Maximum range of values t_0 to t_2: 1 to 255 s, accuracy 1 s

Recommended range of values t_3: 0 s to 48 h, accuracy 1 s

Large time monitoring values t_3 are needed in special cases, where satellite or dial-up connections are used (for example, with only daily or weekly connection setup for data transmission).

Maximum numbers of outstanding I format frames k and latest acknowledge

Parameter	Default Value	Note	Selected value
k	12 APDUs	Maximum difference receive sequence number to send state variable	
w	8 APDUs	Latest acknowledge after receiving w I-format APDUs	

Maximum range of value k: 1 to 32 767 ($2^{15} - 1$) APDU, accuracy 1 APDU.[191]

Maximum range of value w: 1 to 32 767 APDU, accuracy 1 APDU (Recommendation: w should not exceed 2/3 of k).[191]

Port number

Parameter	Value	Note
Port number	2404	In all cases

Redundant connections

$\boxed{4}$ Number N connections used in redundancy group

RFC 2200 suite

RFC 2200 is an official Internet Standard which describes the state of standardization of protocols used in the Internet as determined by the Internet Architecture Board (IAB). It offers a broad spectrum of actual standards used in the Internet. The suitable selection of documents from RFC 2200 defined in this standard for given projects has to be chosen by the user of this standard.

[191] SICAM A8000 supports only 1 to 128 APDUs

- [x] Ethernet 802.3
- [ ] Serial X.21 interface
- [ ] Other selection from RFC 2200

List of valid documents from RFC 2200:

1. ....
2. ....
3. ....
4. ....
5. ....
6. ....
7. etc.

13.6 IEC 61850

13.6.1 Introduction

The IEC 61850 protocol is a standardized transmission protocol (TCP/IP) for communication with remote stations in protection and control in the network (LAN, WAN).

Protocol firmwares for IEC 61850:

Firmware	System	Standard and function
ETI5	CP-8031, CP-8050	IEC 61850 Client (Edition 1, Edition 2, Edition 2.1)
ETI5	CP-8031, CP-8050	IEC 61850 Server (Edition 2, Edition 2.1)
ETI5	CP-8031, CP-8050	IEC 61850 GOOSE (Edition 2)

The standard series mainly defines:

- General definitions for switchgear
- The most important information for functions and devices,
- The exchange of information for protection, monitoring, control and measurement
- A digital interface for primary data
- A configuration language

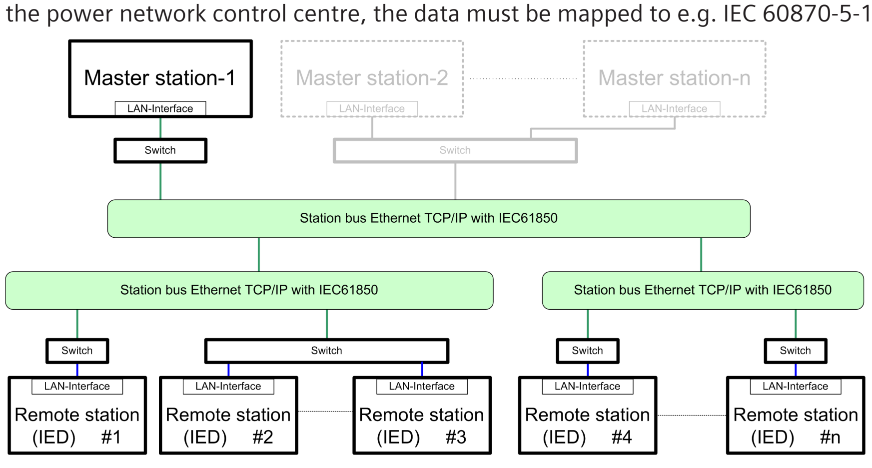
The protocol uses TCP/IP as basic transmission protocol and the MMS protocol (Manufacturing Messaging Specification) as classic Client-Server communication (defined in the standard part IEC 61850-8-1). In addition, two so-called Peer-to-Peer services are described for the real time capable communication, which sit directly on the Ethernet protocol:

- Transmission of fast samples according to standard IEC 61850-9-1
  (is currently not supported by the protocol element Server + Client!)
- Transmission of GOOSE messages according to standard part IEC 61850-8-1

The IEC 61850 Client actively establishes the connection and fetches data from a IEC 61850 Server or sends data to a IEC 61850 Server. The IEC 61850 Server waits passively for a connection established by a IEC 61850 Client and is data source and data recipient.

In contrast to IEC 60870-5-104, which is based on a signal-orientated data model, the data model of the IEC 61850 interface is strictly object-orientated. The name of the object in plain text serves as identification. The objects are self-descriptive, i.e. the structure of the objects is transmitted with the object itself in the message.

In contrast to IEC 60870-5-104, IEC 61850 is only defined for the station bus within the switch gear and not for the process data transmission between the stations and the power control system. For the interfacing of the power network control centre, the data must be mapped to e.g. IEC 60870-5-101/104.



One major peculiarity of the IEC 61850 protocol is the decoupling of the object-orientated technological representation of the data from the communication. The IEC 61850 defines the appearance of the functions based on the data to outside. The functions are indeed described but not defined. For each connection, the SICAM A8000 protocol element supports either IEC 61850-Server function or IEC 61850-Client function.

13.6.2 Functions

Function	ETI5 [Client]	ETI5 [Server]
IEC 61850		
Client	✓	–
Server	–	✓
GOOSE [192]	–	✓
Max. number of servers (max. connections)	100 [193]	–
Max. number of clients (max. connections)	–	6
Max. number of logical devices (including all servers)	–	500
Max. number of logical devices (per connection)	[194]	–
Max. number of logical nodes (including all servers)	–	[194]
Max. number of logical nodes (per connection)	[194]	–
Max. number of supported data points	10000	10000 [195]
ACSI services	[196]	–
Common Data Classes (CDCs)	[196]	–
Attributes	[196]	–
Supported TCP port numbers:		
• Port 102: MMS (Manufacturing Message Specification)	✓	✓
• Port 3782: MMS (Manufacturing Message Specification) TLS	✓	✓
• Port 80: HTTP (Hypertext Transfer Protocol) – Web server	✓	✓[197]
• Port 443: HTTPS (Hypertext Transfer Protocol over SSL/TLS) – Web server	✓	✓[197]
Interoperability		
IEC 61850 Edition 1	✓	–
IEC 61850 Edition 2	✓	✓
IEC 61850 Edition 2.1	✓	✓[198]
Supported functionality according to		
• PICS (Protocol Implementation Conformance Statement)	✓	✓
• PIXIT (Protocol Implementation Extra Information)	✓	✓
• Supported logical nodes and their attributes	✓	✓

192 With GOOSE-Publish and GOOSE-Subscribe only data attributes are supported with IEC 61850 Ed.1 (no data objects)! With GOOSE-Publish and GOOSE-Subscribe, IEC 61850 Ed.2 supports data attributes and data objects (data structures) for the following CDCs: (FC = ST): SPC, DPC, ENC, INC, SPS, DPS, ENS

193 Recommended: 50 (the connection number can be increased to max. 100 with use of the firmware without server)

194 Not limited (limited only by free memory)

195 See *Formulas for the determination of the total number of data points (n), Page 1081*

196 Supported only to a limited extent (for details see section *13.6.5.1 Objects and Data* |**Basic data types**and section *13.6.8.2 Conversion IEC 60870-5-101/104 ↔ IEC 61850*

197 Function is integrated in the master module

198 Edition 2.1 only supported with SICAM Device Manager

Function	ETI5 [Client]	ETI5 [Server]
Certificate ("AoC" Attestation of Conformity)		
IEC 61850 certificate level A for the client system: SICAM A8000 CP-8050 Telecontrol and Automation System with CI-8520 Module Software version: ETI5 rev. 03.09 issued by DNVGL (KEMA) No. 10087389-INC 18-2590	✓	–
UCA: IEC 61850 certificate level A for the server product: SICAM A8000 CP-8050 Telecontrol and Automation System with CI-8520 Module. Software version: ETI5 rev. 03.09 issued by DNVGL (KEMA) No. 10087389-INC 18-2647	–	✓
License		
License required to use the firmware in CP-8031, CP-8050	–	–
Security IEC 62351-3,4 (2006)		
Application security:		
• None	–	–
• A-security profile	✓	✓
• E2E security without encryption	–	–
• E2E security with encryption	–	–
Transport security:		
• None	–	–
• TLS	✓	✓
Network configuration		
LAN/WAN	✓	✓
Transmission rate		
10 Mbit/s	✓	✓
100 Mbit/s	✓	✓
Ethernet interface (properties)		
Ethernet interface (*13.1.4.6 Ethernet Interface – Module Properties*)	✓	✓
TCP/IP optimization parameters	✓	✓
TCP/IP keep alive	✓	✓
Physical interface		
Ethernet	✓	✓
CP-8031, CP-8050: X2, X3	✓	✓
CI-852x [199]: X1, X2, X3, X4, X5	✓	✓
IEC 61850 firmware functions		
Acquisition of events		
• Static data sets	✓	✓
• Dynamic data sets	✓	–
• Buffered reports	✓	✓
• Unbuffered reports	✓	✓
• Emulation of the data on reception of the attribute Beh.stVal = OFF and Beh.stVal = BLOCKED	✓	–
Transmission of files ("file transfer"):		
• Disturbance records to SICAM DISTO	✓	✓
Transmission of integrated totals	✓	✓

199 With CP-8031 not supported by default. With a license (see *14.8 SICAM A8000 CP-803x Extended CI-Module*) 1 communication module CI-852x can be used additionally also with CP-8031.

Function	ETI5 [Client]	ETI5 [Server]
General interrogation	✓	✓
Command transmission: ""		
• Direct control with normal security	✓	✓
• Direct control with enhanced security	✓	✓
• SBO control with enhanced security	✓	✓
• Logging of the remote commands at the local control center	–	✓
• Command locking	✓	–
• Control location (set/check control location)	✓	–
• Information processing	–	–
• Information locking	✓	–
• Emulation of the going binary information	✓	–
• Monitoring intermediate and faulty positions of double-point information	✓	–
Measured value processing:		
• Technological adaptation for measured values	✓	✓
• Measured value change monitoring	✓	✓
• Measured value disabling	✓	–
Setting groups ""	✓	✓
Time management:		
• Conversion of the time information (UTC; local time with/without summer-winter-time)	✓	✓
Redundancy(functions for supporting redundant communication routes)		
Protocol redundancy	✓	–
Server redundancy	–	✓
GOOSE redundancy	–	✓
Protocol element control and return information		
Protocol element control messages:		
• Send (general) interrogation command	✓	✓
• Set control location	✓	–
• Start connection to server ("Initiate")	✓	–
• Start connection to server ("Conclude")	✓	–
• Start GOOSE application	✓	✓
• Stop GOOSE application	✓	✓
Protocol element return information:		
• Station status	✓	✓
• Station failure	✓	✓
Web server		
Protocol-internal diagnostic and statistic information via protocol-specific web pages	✓	✓
Engineering		
SICAM Device Manager	✓	✓
SICAM TOOLBOX II	✓	✓
Remote parameterization/diagnostic of SICAM RTUs with SICAM TOOLBOX II via IEC 61850	✓[200]	✓[200]

200 Function is integrated in the master module

Formulas for the determination of the total number of data points (n)

Unbuffered reports:	(#LD • 54) + (#CON • (13 • (#LD + #DP/60) • 2)) + (#DP • 14) = n
Buffered Reports:	(#LD • 54) + (#CON • (19 • (#LD + #DP/60) • 2)) + (#DP • 14) = n
Unbuffered + buffered Reports:	(#LD • 54) + (#CON • (32 • (#LD + #DP/60) • 2)) + (#DP • 14) = n

Meaning:
#LD Number of Logical Devices
#CON Number of connections
#DP Number of data points
The following maximum value applies: n = 80000

13.6.3 Modes of Operation

Standard Operation Mode	Optional equipment	Interface signals (X2, X3)
Electrical ethernet-interface (twisted pair)	-	TXD+, TXD-, RXD+, RXD-

13.6.4 Communication

For the stations to communicate with each other, suitable transmission facilities and/or network components may be needed in addition.

Own Station (IEC 61850, electrical)

System	System element	Protocol Element	Remarks
SICAM A8000 Series	CP-8031/CPCI85 CP-8050/CPCI85 CP-8050/EPCI85	ETI5	Edition 1, Edition 2

Remote station (IEC 61850 Server)

System	System element	Protocol Element	Remarks
SICAM A8000 Series	CP-8031/CPCI85 CP-8050/CPCI85 CP-8050/EPCI85	ETI5	Edition 2, Edition 2.1
SICAM A8000 Series	CP-8000/CPC80 CP-802x/CPC80	ET85	Edition 2
SICAM AK 3	CP-2016/CPCX26 CP-2019/PCCX26	ET25 SM-2558/ETA5	Edition 2 Edition 2
Legacy systems (SICAM AK, SICAM TM, SICAM BC)	CP-20xx CP-60xx CP-50xx	SM-2558/ETA5 SM-2558/ETA3 SM-2557/ET03	Edition 2 Edition 1 Edition 1 IEC 61850 interoperability
Third-party system	–	–	IEC 61850 interoperability

Own Station (IEC 61850 Server)

System	System element	Protocol Element	Remarks
SICAM A8000 Series	CP-8031/CPCI85 CP-8050/CPCI85 CP-8050/EPCI85	ETI5	Edition 2, Edition 2.1

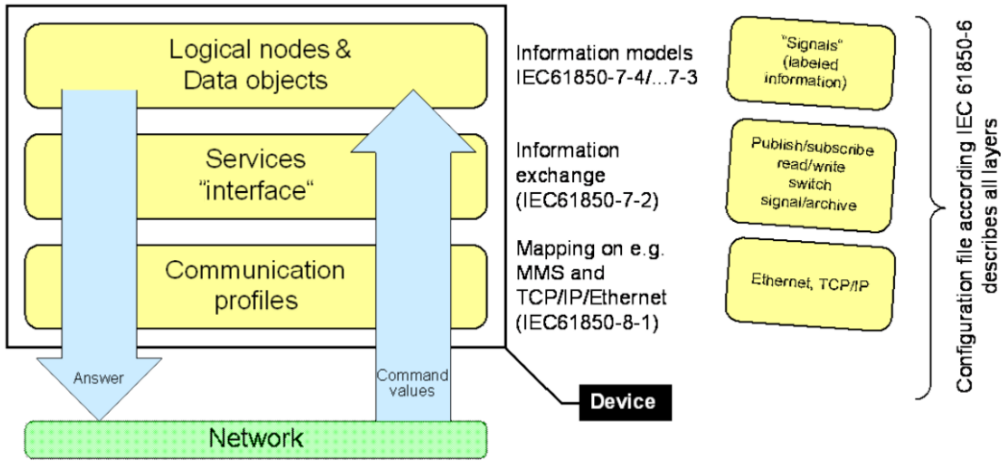
Remote station (IEC 61850 Client)

System	System element	Protocol Element	Remarks
SICAM A8000 Series	CP-8031/CPCI85 CP-8050/CPCI85 CP-8050/EPCI85	ETI5	Edition 2, Edition 2.1
SICAM A8000 Series	CP-8000/CPC80 CP-802x/CPC80	ET85	Edition 2, Edition 2.1
SICAM AK 3	CP-2016/CPCX26 CP-2019/PCCX26	ET25 SM-2558/ETA5	Edition 2, Edition 2.1 Edition 2, Edition 2.1
Legacy systems (SICAM AK, SICAM TM, SICAM BC)	CP-20xx CP-60xx CP-50xx	SM-2558/ETA5 SM-2558/ETA3 SM-2557/ET03	Edition 2, Edition 2.1 Edition 1 Edition 1 IEC 61850 interoperability
Third-party system	–	–	IEC 61850 interoperability

13.6.5 LAN Communication over Ethernet TCP/IP according to IEC 61850

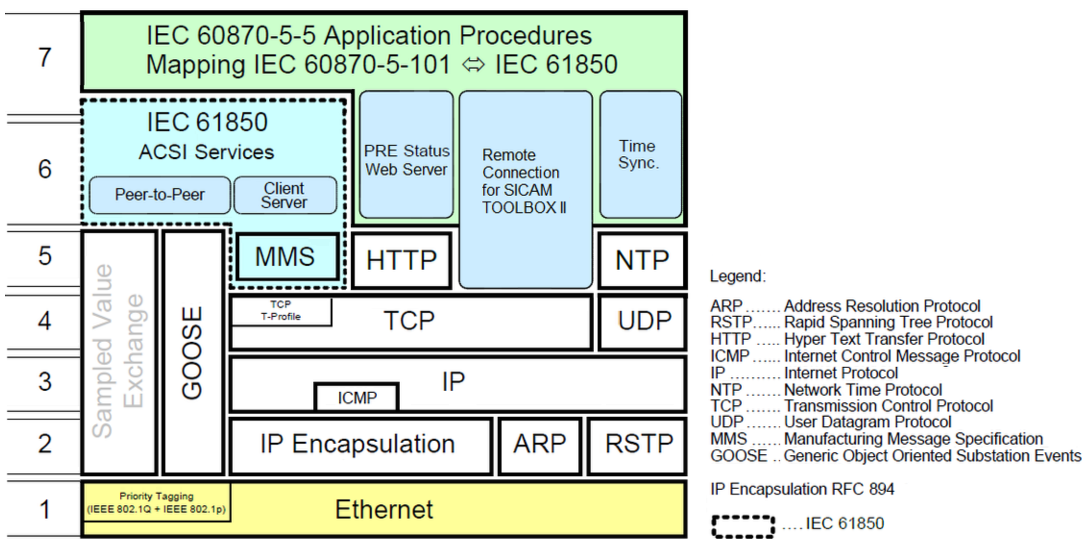
The IEC 61850 standard series essentially defines:

- Standardized Information
  - Standardized Information for circuit breakers, measured value unit, measured values, status, control, Meta data etc. with self-description (IEC 61850-7-4)
  - Standardized information are based on a set of about 20 general basic types (CDC = Common Data Classes) like status, measured value, count,... (IEC 61850-7-3)
  - Some of the standardized information are switchgear-specific, others are general
  - The definition of new information models by reusing the standardized information is explicitly supported
- Standardized Services
  - Standardized Services for unrestricted access to values, signaling of values and archiving/interrogation of values, ..., controlling of devices (IEC 61850-7-2)
  - The standardized services can be applied both to the standardized information (IEC 61850-7-4) as well as to any expanded or new information models
- Standardized Networks
  - For the exchange of messages in a narrower sense, suitable standards are selected
  - The standardized services, the standardized information and all other information are communicated over standardized communication systems (IEC 61850-8-1/-9-1/-9-2)
- Standardized Configurations
  - devices and the entire switchgear are described completely formal
  - The IEC 61850-6 standard provides an XML-based system description language (SCL = Substation Configuration Language) with which the standardized configuration files are created



[ET03_61850_Ebenen, 2, en_US]

Protocols according to the IEC 61870-5 standard are based on the OSI layer model



[ET03_osi, 3, en_US]

Layer	Task	Functions, Characteristics, Comments
7 - Application	Application	• Transmission Handling • Reception Handling • Management of multiple connections
6 - Presentation	Data format	• IEC 61850 ACSI to Ax 1703/SICAM RTUs and compatible systems In the "private range" according to IEC 60870-5-104, SICAM A8000 specific system messages and some user data is implemented (e.g. transmission of disturbance records to SICAM DISTO)

Layer	Task	Functions, Characteristics, Comments
5 - Session	Interface between data format and communication protocol	• GOOSE • MMS • HTTP • Remote operation for SICAM TOOLBOX II • NTP according to RFC 1305
4 - Transport 3 - Network	Communication protocol	• TCP/IP according to RFC 791 and RFC 793; GOOSE • ICMP according to RFC 792; GOOSE
2 - Data Link 1 - Physical	LAN interface	• Ethernet 10/100 Mbps according to IEEE 802.3; GOOSE • Medium and transmission rate can be selected with SICAM TOOLBOX II • Connection technique (on the master control or communication element) RJ45 for copper and MT-RJ connector for FO • ARP according to RFC 826 • IP Encapsulation according to RFC 894

Relevant Standards

Standard	Application
IEC 61850-1	Introduction and Overview • Introduction and overview of the standards of the IEC 61850 series
IEC 61850-2	Dictionary • Collection of terms
IEC 61850-3	General Requirements (especially on the network components) • Quality requirements (reliability), maintainability, system availability, portability, IT security) • Environmental conditions • Auxiliary services • Other standards and other rules of engineering
IEC 61850-4	System and Project Management • Engineering service requirements (classification of parameters, technical work tools, documentation) • System utilization cycle (product versions, production setting, support after production setting) • Quality control (responsibilities, test equipment, type tests, system tests, factory acceptance tests (FAT) and location acceptance tests (SAT))
IEC 61850-5	Communication Requirements for Functions and Device Models • Principle of the logical nodes • Logical communication links • Concept of assigned information elements for the communication (PICOM) • Logical nodes and assigned PICOM • Functions • Performance requirements (response times etc.) • Dynamic Scenarios (requirements on the information flow under various operating conditions)

Standard	Application
IEC 61850-6	Language for the configuration of station automation systems ("Engineering") • Formal description of the single-pole scheme, of devices and system structure and their assignment to the single-pole scheme
IEC 61850-7-1	Basic communication structure for station and bay-related secondary technology equipment – principles and models • Introduction in IEC 61850-7 • Communication principles and models
IEC 61850-7-2	Basic communication structure for station and bay-related secondary technology equipment – Abstract Communication Services Interface (ACSI) • Description of the abstract communication service interface (ACSI) • Specification of the abstract communication services • Model of the server database
IEC 61850-7-3	Basic communication structure for station and bay-related secondary technology equipment – Common Data Classes • Abstract common data classes and attribute definitions
IEC 61850-7-4	Basic communication structure for station and bay-related secondary technology equipment – Compatible Logic Nodes and Data Classes • Definition of logical nodes, data objects and their logical addressing
IEC 61850-8-1	Specific Communication Services Modeling (SCSM) – Modeling on MMS (acc. to ISO/IEC 9501-1 and -2) and ISO/IEC 9501-3 • Illustration for the communication within the entire station (Client-Server communication and GOOSE-messages)
IEC 61850-9-1	Specific Communication Services Modeling (SCSM) – Scanned values over serial Simplex-Multiple-Point-to-Point connection • Model for the Point-to-Point-like, unidirectional communication of scanned values of the transformer (with and without Merging Unit)
IEC 61850-9-2	Specific Communication Services Modeling (SCSM) – Scanned values over ISO/IEC 8802-3 • Model for the bus-type, flexible communication of scanned values of the transformer (with and without Merging Unit)
IEC 61850-10	Conformity Check • Procedure for the conformity check
IEC 60255-24	IEEE COMTRADE

NOTE

The underlined standards contain essential information for the implementation of the IEC 61850 functions in the protocol element.

IEC 61850 Definition of Terms

Designation	Abbrevi-ation	Note
ACSI	ACSI	Abstract Communication Service Interface. The protocol-independent user interface ACSI decouples the applications from the underlying communication protocols and bus physics.
Common Data Class	CDC	The IEC 61850 defines different Common Data Classes. Common Data Classes are single-point information, double-point information, single command (incl. the return information), double command (incl. the return information), setpoint value, ...
Data	D	Data are commands, binary information, status, time, ...
Data Class		Data Class is also called Common Data Class (CDC)
Data Set	DS	Selection from the object-orientated data model (selective data of the hierarchical attributes)
Dynamic Data Set		Dynamic data sets are generated (created) by the client per runtime. Different Data Sets are created for each Physical Device.
Functional Constraint	FC	Functional Constraint (FC) divides data into structural groups such as measured values, spontaneous events, command objects, etc..
Static Data Set		The static data set is predefined and is either automatically determined by the device (for each functional constraint (fix) ← in the SICAM A8000 server), or specified by parameterization (example: for third-party devices, the static data set is generated by a configurator and loaded in the Device)
Directory	DIR	The Directory (MMS Directory) of the server contains all data that can be sent in transmit direction or receive direction.
GOOSE		Generic Object Oriented Substation Events GOOSE is a transmission service of IEC 61850 for generic status events, that can be sent simultaneously per Multicast to multiple devices in order to satisfy high real-time requirements. Typical cases of application are the spontaneous transmission of switching device settings in the decentral interlocking of switching commands in substations. GOOSE messages use the ether-type specification for VLAN / prioritization and are represented directly on the Ethernet layer.
Logical Device	LD	A Logical Device is one function in a device (Physical Device) A Physical Device can contain several Logical Devices. Logical Devices are protection functions, control functions, disturbance recording, measured value acquisition, ... The designation of the Logical Devices is not fixed and can therefore be freely defined
Logical Node	LN	A logical node is a sub function of a logical device. Every sub function is represented by data objects, which essentially represent the process information Logical Nodes are switches, protection functions (KU, DTL, distance calculation), ...
LOG		Archive function (similar to the decentral archive DEAR) - is presently not supported!
MMS	MMS	Manufacturing Message Specification MMS standardizes the exchange of messages in the production area. MMS provides functions that can be used for the observation, inspection and control of device operations and technical processes

Designation	Abbrevi-ation	Note
Physical Device	IED	The Physical Device (also called IED; IED = Intelligent Electronic Device) is a device usually with 1 Ethernet interface – but can also be equipped for redundant configurations with several Ethernet interfaces
Report		Spontaneous transmission from Server → Client takes place by means of reports • Buffered Reports [FC = BR]: Spontaneous data remain stored with interface fault • Unbuffered Reports [FC = RP]: Spontaneous data is deleted with interface fault
Report Control Block		Each report (in the server) has its own report control block. The characteristics of the respective report are entered in the Report Control Block. as for example • Reference to the Data Set • Trigger for the transmission (spontaneous, general interrogation, ...) • Data Set Name (optional) The Report Control Block can be read and written by the client
ICD	ICD	IED Capability Description ICD defines all the possibilities of an IED type and serves as a template for the system or IED configurator
CID	CID	Configured IED Description Description file of a selective Intelligent Electronic Device (IED) EXT in SIPROTEC stands for "Extended"
SCD	SCD	Substation Configuration Description SCD describes a whole substation – this is normally created with a system configurator and contains the Engineering for the entire plant
SCL	SCL	Substation Configuration Language
PICS	PICS	Protocol Implementation Conformance Statement [201]
PIXIT	PIXIT	Protocol Implementation eXtra Information for Testing [201]
MICS	MICS	Model Implementation Conformance Statement
SCSM	SCSM	Specific Communication Service Mapping
PICOM	PICOM	Pieces of Communication

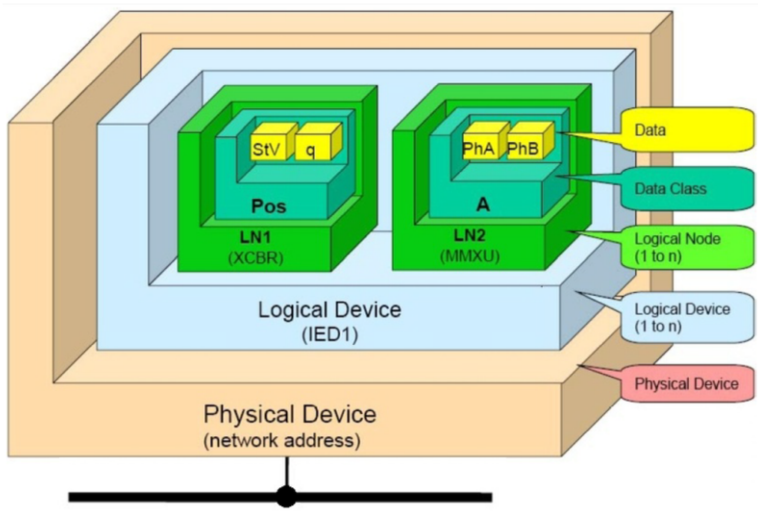
201 The IEC 61850 Interoperability is documented in the documents PICS and PIXIT

13.6.5.1 Objects and Data

Data Models

The data models for IEC 61850 describe the real data of a device, that can be read or written over the communication.

The data models are strictly object-oriented. The objects are functions that the user of the substation requires and knows. Every object defines mandatory or optional data objects.



[ET03_Object_Model, 2, en_US]

Physical Device [IED]

The physical device is also called IED [Intelligent Electronical Device].

The physical device is a device normally with 1 Ethernet interface. For redundant configurations the physical device can also be equipped with several Ethernet interfaces.

The IED-Name can be parameterized with the parameter **IEC61850 | Server | IED Name**. However, this IED-Name is not used by the protocol firmware and is only displayed on the main page of the web server. The IED-Name required for IEC 61850 is only taken by the protocol element from the data of the SIP message address conversion in transmit/receive direction.

Physical Device [LD]

A logical device is one function in a physical device. A physical device can contain several functions (logical devices). Logical devices are for instance protection functions, control functions, disturbance recording, measured value acquisition.

The designation of the logical devices is not fixed and can thus be freely defined.

For SIPROTEC the following designations for logical devices will be used:

CTRL ... Control Control]

DR ... Disturbance Recording Disturbance Recording]

EXT ... Extras

MEAS ... Measurement Measurement]

PROT ... Protection Function: . .

Logical Node [LN]

A logical node is a sub function of a logical device. Every sub function is represented by data objects, which essentially represent the process information.

IEC 61850-7-4 currently defines 92 logical features - these cover most of the areas of a modern substation.

Group (initial letter)	Logical Node Categories	Number of defined logical nodes
A	Automatic Functions .	4
C	Supervisory Control .	5
G	Generic References .	3
I	Interfacing and Archiving [en: .	4
L	System Logical Node .	3
M	Metering and Measurement .	8
P	Protection Functions .	28
R	Protection Related Functions [en: .	10
S	Supervision and Monitoring [en: .	4
T	Instrument Transformer and Sensors .	2
X	Switchgear .	2
Y	Power Transformer and Related Functions .	4
Z	Further substation specific devices [en: Further Power System Equipment]	15

The IEC 61850 standard series also contains clear rules for the expansion of the information models. Included among these are supplements to the logical nodes, new logical nodes, expanded and new data and new data attributes.

Following Logical Nodes are supported from SICAM RTUs **C**lient/**S**(valid for IEC 61850 Edition 1).

NOTE

SICAM RTU's IEC 61850 client (Ed.1 and Ed.2) supports all logical nodes based on the supported CDC's.

Logical Nodes	Description	S	C
A	**Automatic Functions .**		
ANCR	Neutral Current Regulator	✓	✓
ARCO	Relative Power Control	–	–
ATCC	Automatic Tap Changer Controller	✓	✓
AVCO	Voltage Control	–	–
C	**Supervisory Control .**		
CALH	Alarm Handling	✓	✓
CCGR	Cooling Group Control	✓	✓
CILO	Interlocking	✓	✓
CPOW	Point-On-Wave Switching	–	–
CSWI	Switch Controller	✓	✓
G	**Generic References .**		
GAPC	Generic Automatic Process Control	✓	✓
GGIO	Generic Process I/O	✓	✓
GSAL	Generic Security Application	–	–
I	**Generic References .**		
IARC	Archiving	–	–
IHMI	Human Machine Interface	✓	✓
ITCI	Telecontrol Interface	–	–

Logical Nodes	Description	S	C
ITMI	Telemonitoring Interface	–	–
L	**System Logical Node .**		
LLN0	Logical Node Zero	✓	✓
LPHD	Physical Device Information	✓	✓
M	**Metering and Measurement .**		
MDIF	Differential Measurements	✓	✓
MHAI	Harmonics Or Interharmonics	–	–
MHAN	Non Phase Related Harmonics Or Interharmonics	–	–
MMTR	Metering	✓	✓
MMXN	Non Phase Related Measurement	✓	✓
MMXU	Measurement	✓	✓
MSQI	Sequence & Imbalance	✓	✓
MSTA	Metering Statistics	✓	✓
P	**Protection Functions .**		
PDIF	Differential	✓	✓
PDIR	Direction Comparsion	✓	✓
PDIS	Distance	✓	✓
PDOP	Directional Overpower	✓	✓
PDUP	Directional Underpower	✓	✓
PFRC	Rate Of Change Of Frequency	✓	✓
PHAR	Harmonic Restraint	✓	✓
PHIZ	Ground Detector	✓	✓
PIOC	Instantaneous Overcurrent	✓	✓
PMRI	Motor Restart Inhibition	✓	✓
PMSS	Motor Starting Time Supervision	✓	✓
POPF	Over Power Factor	✓	✓
PPAM	Phase Angle Measuring	✓	✓
PSCH	Protection Scheme	✓	✓
PSDE	Sensitive Directional Earthfault	✓	✓
PTEF	Transient Eart Fault	✓	✓
P	**Protection Functions .**		
PTOC	Time Overcurrent	✓	✓
PTOF	Over Frequency	✓	✓
PTOV	Overvoltage	✓	✓
PTRC	Protection Trip Conditioning	✓	✓
PTTR	Thermal Overload	✓	✓
PTUC	Undercurrent	✓	✓
PTUF	Under Frequency	✓	✓
PTUV	Undervoltage	✓	✓
PUPF	Under Power Factor	✓	✓
PVOC	Voltage Controlled Time Overcurrent	✓	✓
PVPH	Volts per Hz	✓	✓
PZSU	Zero Speed Or Underspeed	✓	✓
R	**Protection Related Functions .**		
RADR	Disturbance Recorder Channel Analog	✓	–
RBDR	Disturbance Recorder Channel Binary	✓	–
RBRF	Breaker Failure	✓	✓

Logical Nodes	Description	S	C
RDIR	Directional Element	✓	✓
RDRE	Disturbance Recorder Function	✓	✓
RDRS	Disturbance Record handling	–	–
RFLO	Fault Locator	✓	✓
RPSB	Power Swing Detection / Blocking	✓	✓
RREC	Autoreclosing	✓	✓
RSYN	Synchronism-Check or Synchronising	✓	✓
S	**Supervision and Monitoring .**		
SARC	Monitoring And Disgnostic For Arcs	–	–
SIMG	Insulation Medium Supervision (Gas)	✓	✓
SIML	Insulation Medium Supervision (Liquid)	✓	✓
SPDC	Monitoring And Diagnostics For Partial Discharges	–	–
T	**Instrument Transformer and Sensors .**		
TCTR	Current Transformer	✓	✓
TVTR	Voltage Transformer	✓	✓
X	**Switchgear .**		
XCBR	Circuit Breaker	✓	✓
XSWI	Circuit Switch	✓	✓
Y	**Power Transformer and Related Functions .**		
YEFN	Earth Fault Neutralizer (Petersen Oil)	–	–
YLTC	Tap Changer	✓	✓
YPSH	Power Shunt	–	–
YPTR	Power Transformer	✓	✓
Z	**Further (Power System) Equipment .**		
ZAXN	Auxiliary Network	✓	✓
ZBAT	Battery	✓	✓
ZBSH	Bushing	–	–
ZCAB	Power Cable	–	–
ZCAP	Capacitor Bank	–	–
ZCON	Converter	–	–
ZGEN	Generator	–	–
ZGIL	Gas Insulated Line	–	–
ZLIN	Power Overhead Line	–	–
ZMOT	Motor	–	–
ZREA	Reactor	–	–
ZRRC	Rotating Reactive Component	–	–
ZSAR	Surge Arrestor	✓	✓
ZTCF	Thyristor Controlled Frequency Converter	–	–
ZTCR	Thyristor Controlled Reactive Component	–	–

The logical nodes "LLN0" and "LPHD0" must always be present in every logical device. The logical nodes "LLN0" and "LPHD1" are created automatically by the protocol element for every logical device, insofar as these have not already been defined through the parameterization (SIP message address conversion).

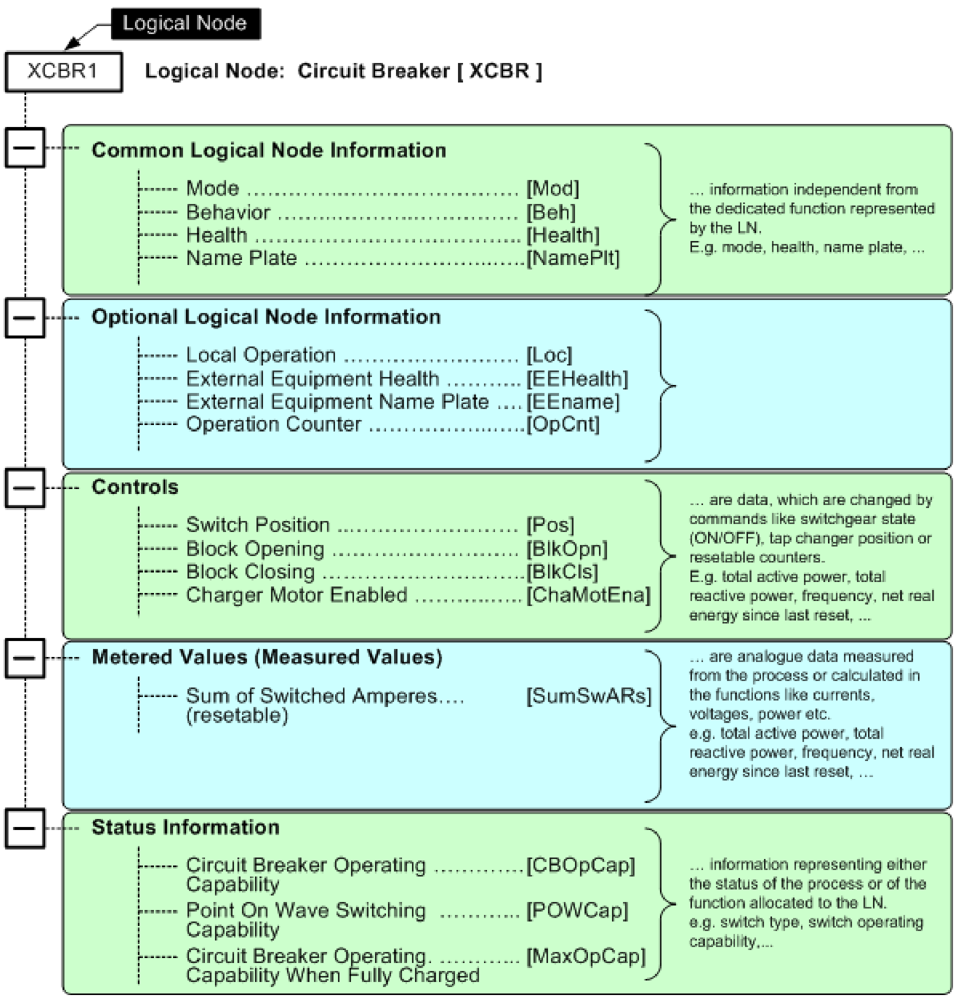
The logical node "LLN0" contains data which apply for all logical nodes of the logical device (e.g. revision status of the parameters).

The logical node LPHD1 contains data of the IEDs [Intelligent Electronical Device = Physical Device] – these are applicable for all logical nodes of the physical device (e.g. rating plate).

Logical nodes are structured hierarchically and contain different groups of information:

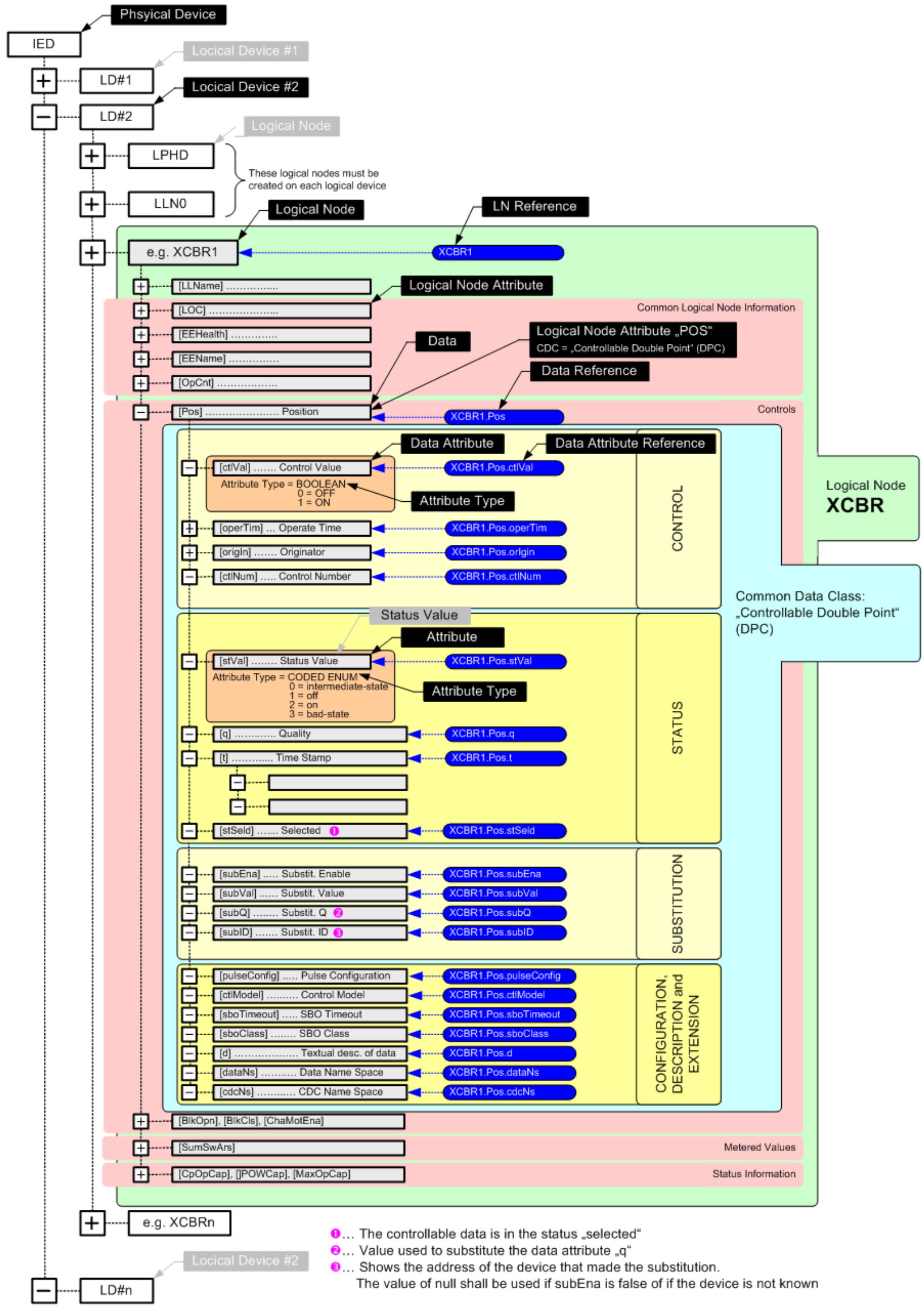
- Common Logical Node Information .
- Common Logical Node Information .
- Status Information .
- Settings .
- Measured Values .
- Controls .

Example:



[ET03_LN_XCBR, 1, en_US]

The precise structure of the logical nodes is documented in the IEC 61850-7-4 standard. In the following example, the structure of the logical node for the circuit breaker [XCBR] is documented schematically with designation of the fields.



[ET03_LD_LN_CDC, 1, en_US]

The following example shows the representation of the logical node in the IEC 61850-7-4 standard for the circuit breaker (XCBR).

5.12 Logical Nodes for switchgear LN Group: X

5.12.1 LN: Circuit breaker Name: XCBR

This LN is used for modelling switches with short circuit breaking capability. Additional LNs for example SIMS, etc. may be required to complete the logical modelling for the breaker being represented. The closing and opening commands shall be subscribed from CSWI or CPOW if applicable. If no services with real-time capability are available between CSWI or CPOW and XCBR, the opening and closing commands are performed with a GSE-message (see IEC 61850-7-2).

XCBR class				
Attribute Name	**Attr. Type**	**Explanation**	**T**	**M/O**
LNName		Shall be inherited from Logical-Node Class (see IEC 61850-7-2)		
Data				
Common Logical Node Information				
		LN shall inherit all Mandatory Data from Common Logical Node Class		M
Loc	SPS	Local operation (local means without substation automation communication, hardwired direct control)		M
EEHealth	INS	External equipment health		O
EEName	DPL	External equipment name plate		O
OpCnt	INS	Operation counter		M
Controls				
Pos	DPC	Switch position		M
BlkOpn	SPC	Block opening		M
BlkCls	SPC	Block closing		M
ChaMotEna	SPC	Charger motor enabled		O
Metered Values				
SumSwARs	BCR	Sum of Switched Amperes, resetable		O
Status Information				
CBOpCap	INS	Circuit breaker operating capability		M
POWCap	INS	Point On Wave switching capability		O
MaxOpCap	INS	Circuit breaker operating capability when fully charged		O

[ET03_XCBR_Norm, 1, en_US]

Legend: M...Mandatory (these attributes must be supported)
O...Optional (these attributes can optionally be supported)

In field "Attr. Type" is the CDC = Common Data Class .

The following example shows the representation of the basic data types [CDC] in the IEC 61850-7-3 standard for the Common Data Class "Controllable Double Point (DPC)".

7.5.3 Controllable double point (DPC)

Table 33 defines the common data class “controllable double point”.

Table 33 – Controllable double point

DPC class					
Attribute Name	**Attribute Type**	**FC**	**TrgOp**	**Value/Value Range**	**M/O/C**
DataName	Inherited from Data Class (see IEC 61850-7-2)				
DataAttribute					
control and status					
ctlVal	BOOLEAN	CO		off (FALSE) | on (TRUE)	AC_CO_M
operTm	TimeStamp	CO			AC_CO_O
origin	Originator	CO, ST			AC_CO_O
ctlNum	INT8U	CO, ST		0..255	AC_CO_O
stVal	CODED ENUM	ST	dchg	intermediate-state | off | on | bad-state	M
q	Quality	ST	qchg		M
t	TimeStamp	ST			M
stSeld	BOOLEAN	ST	dchg		AC_CO_O
substitution					
subEna	BOOLEAN	SV			PICS_SUBST
subVal	CODED ENUM	SV		intermediate-state | off | on | bad-state	PICS_SUBST
subQ	Quality	SV			PICS_SUBST
subID	VISIBLE STRING64	SV			PICS_SUBST
configuration, description and extension					
pulseConfig	PulseConfig	CF			AC_CO_O
ctlModel	CtlModels	CF			M
sboTimeout	INT32U	CF			AC_CO_O
sboClass	SboClasses	CF			AC_CO_O
d	VISIBLE STRING255	DC		Text	O
dU	UNICODE STRING255	DC			O
cdcNs	VISIBLE STRING255	EX			AC_DLNDA_M
cdcName	VISIBLE STRING255	EX			AC_DLNDA_M
dataNs	VISIBLE STRING255	EX			AC_DLN_M
Services					
As defined in Table 31					

[ET03_DPC, 1, en_US]

IEC 61850 Address

The IEC 61850 address is represented as readable text (ASCII-characters) and is presently limited to max. 62 characters. The syntax of the IEC 61850 variable names [Data Attribute Reference] is defined by the IEC 61850 standard.

Every object is unambiguously identified by its address (name of the object) in plain text. Due to the address, the objects are self-descriptive.

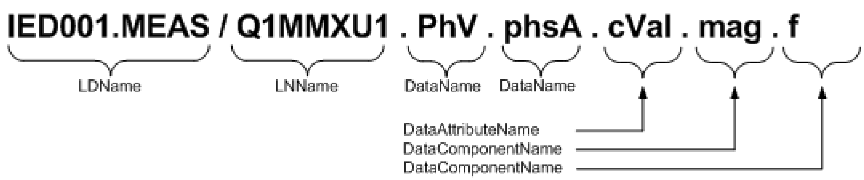
Structure (principle):

$$\underbrace{\text{IED001\_CTRL}}_{\text{LDName}}/\underbrace{\text{Q0CSWI1}}_{\text{LNName}}.\underbrace{\text{Pos}}_{\text{DataName}}.\underbrace{\text{ctlVal}}_{\text{DataAttributeName}}$$

LDName/LNName.DataName.DataAttributeName

LDName .... Logical Device Name

LNName .... Logical Node Name



Edition 1:

61850 address:	**LDName** + "/" + **FCD** = 32 + 1 + 29 = max. 62 characters
FCD:	**LNName** + **DataName** + **DataAttributeName** + **DataComponentName** = max. 29 characters
LDName:	**IEDName** + **LDName** = max. 32 characters
LNName:	**LN_prefix** + **LN_classname** + **LN_instanceID** = max. 11 characters
Lnclassname:	= max. 4 characters
DataName:	= max. 10 characters

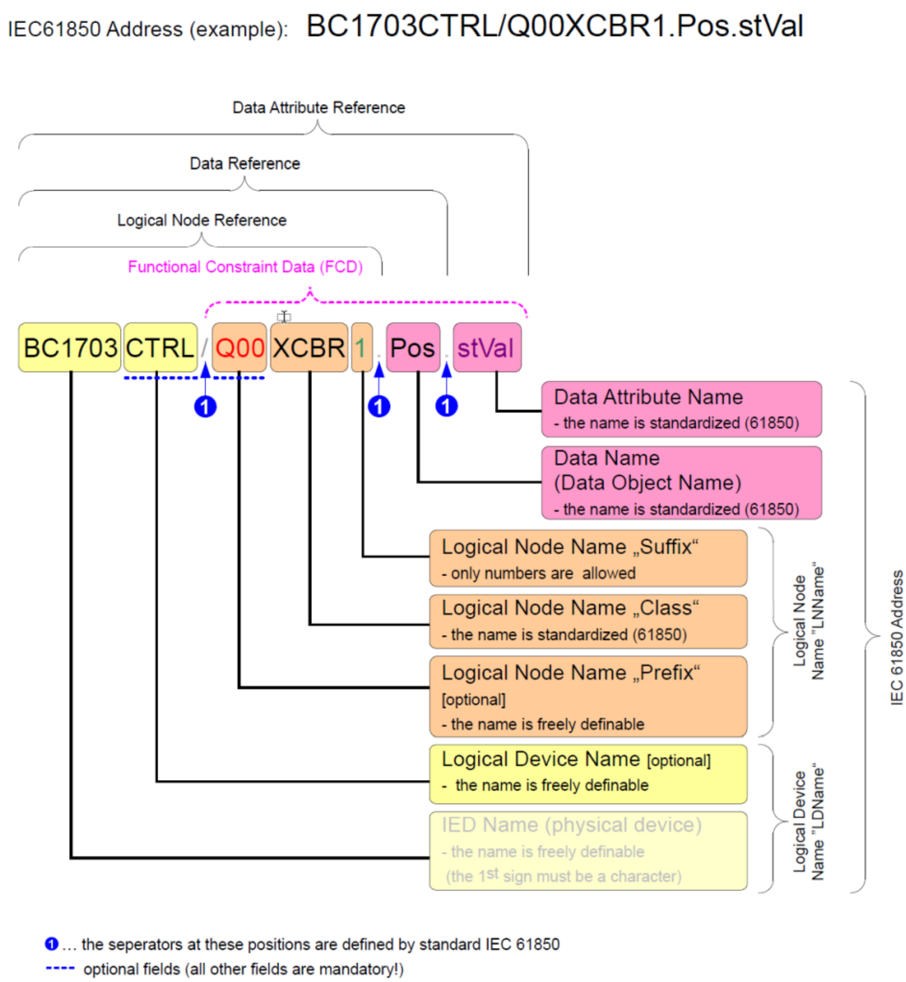
Edition 2:

61850 address:	**LDName** + "/" + **FCD** = 64 + 1 + 64 = max. 129 characters
FCD:	**LNName** + **DataName** + **DataAttributeName** + **DataComponentName** = max. 64 characters
LDName:	**IEDName** + **LDName** = max. 64 characters
LNName:	**LN_prefix** + **LN_classname** + **LN_instanceID** = max. 11 characters
Lnclassname:	= max. 4 characters
DataName:	= max. 10 characters

NOTE

The address must not contain any special characters (excluded from this are the established separating characters "/" and ".") and no umlauts.
In Edition 2 there may also be no more "." In the Logical Device Name.

The structure of the IEC 61850 address is explained with the help of the following example.



[etxx_61850_address, 1, en_US]

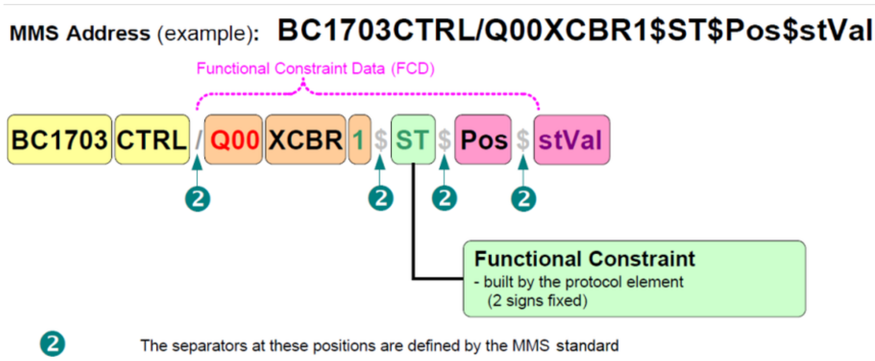
<u>Examples for the valid syntax of 61650 addresses:</u>
BC1703CTRL/Q00XCBR1.Pos.stVal
VLC01/Q0XCBR1.Mod.stVal
T403B1CTRL/GGIO10.SPCSO0.ctlVal
IED001MEAS/Q1MMXU1.Mod.ctlVal
System message module failed: BC1703CTRL/SYSGGIO1.SPCSO1.stVal
Reference voltage U4: BC1703MEAS/GGIO1.AnInU4.mag.f

<u>Examples for a IEC 61850 address with max. recursion depth:</u>
IED001MEAS/Q1MMXU1.PhV.phsA.cVal.mag.f
BC1703_E17CTRL/GO_E07GGIO1.DPCSOQ1.stVal

MMS Address

For the transmission the IEC 61850 address is converted by the protocol element on the line to the defined format of the MMS address.

The MMS address is presently used with max. 65 characters. Of the 65 bytes, 3 characters are fixed reserved through the FCD (Functional Constraint Data) and 1 separating character by the MMS address structure. As a result, the present implementation produces a max. possible length for the IEC 61850 address of 62 characters.



Functional Constraint

The field "Functional Constraint [FC]" of the MMS address is inserted by the protocol element itself.

One IEC 61850 Common Data Class [CDC] consists of various Functional Constraints (a Common Data Class is e.g. single-point information, double-point information, ...)

FC	Functional Constraint
CF	Attribute used for configuration
CO	Control
DC	Attribute used for description
EX	Attribute used for extensions of common data classes
MX	Measurands (analog values)
SE	Attribute used for edit parameter group
SG	Attribute used for active parameter group
SP	Setpoint
ST	Status Information
SV	Attribute used for substitution

<u>Examples for the valid syntax of MMS addresses:</u>

BC1703CTRL/Q00XCBR1STPos$stVal

VLC01/q=XCBR1STMod$stVal

T403B1CTRL$GGIO10$CO$SPCSO0$ctlVal

BC1703_E17CTRL/GO_E07GGIO1STDPCSOQ1$stVal

<u>Examples for MMS addresses with max. recursion depth:</u>

VLC01/MMXU1MXA$phsA$cValmagf

Data Class, Data

Attributes are those data objects which contain real information.

The attributes are assigned to the common data classes . The common data classes [CDC's] are documented in the IEC 61850-7-3 standard.

The elements "Physical Device", "Logical Device", "Logical Node" and "Data Class" are only used for the structuring of the data.

The CDC's are structural elements with attribute-types that contain (apart from a few exceptions) no further sub-structures.

Attribute types (without SUB-structure): e.g.: BOOLEAN, INT8U, INT32U, ...

Attribut-Type (with SUB structure): e.g.: TimeStamp, Quality, Originator, ...

SUB-structures defined in IEC 61850 will be mapped to MMS SUB-structures (if supported by MMS) or mapped to common data classes.

NOTE

Attribute types in upper case / lower case (e.g. TimeStamp) have a further sub-structure.
Attribute types in upper case (e.g. BOOLEAN) have no further sub-structure.

Basic data types [CDC = Common Data Class].

All standardized information according to IEC 61850-7-4 (e.g. circuit breaker, measured value unit, measured values, status, control, meta data) are based on a set of about 30 general basic data types (status, measured value, count).

The basic data types are known as Common Data Classes [CDC] and are defined in the IEC 61850-7-3 standard.

CDC [abbrev.][202]		Common Data Class Specification for	Ss	Se	Ss_G	Sr_G	Cs 203	Ce 203
		Status Information						
SPS		Single Point Status	✓	-	✓	✓	-	✓
DPS		Double Point Status	✓	-	✓	✓	-	✓
INS		Integer Status	✓	-	✓	✓ 204	-	✓
ENS		Enumerated Status	✓ 204	-	✓ 204	✓ 204	-	✓ 204
ACT		Protection Activation Information	✓	-	✓	✓	-	✓
ACD		Directional Protection Activation Information	✓	-	✓	✓	-	✓
SEC		Security Violation Counting	-	-	-	-	-	-
BCR		Binary Counter Reading	✓	-	-	-	-	✓
		Measurand Information						
MV		Measured Value	✓	-	✓	✓	-	✓
CMV		Complex Measured Value	✓	-	✓	✓	-	✓
SAV		Sampled Value	✓	-	✓	✓	-	✓
WYE		Collection Of Measurands (Phase to ground related measured value of a three phase system)	✓	-	✓	✓	-	✓
DEL		Delta (phase to phase related measured value of a three phase system)	✓	-	✓	✓	-	✓
SEQ		Sequence	✓	-	✓	✓	-	✓
HMV		Harmonic Value	-	-	-	-	-	-
HWYE		Harmonic Value for WYE	-	-	-	-	-	-
HDEL		Harmonic Value for DEL	-	-	-	-	-	-
		Controllable Status Information						
SPC	[ST|CO]	Controllable Single Point	✓|-	✓|-	✓|-	✓|-	✓|-	✓|-
DPC	[ST|CO]	Controllable Double Point	✓|-	✓|-	✓|-	✓|-	✓|-	✓|-

202 Common Data Classes with the additional designation [ST|CO] are supported differently by the Server/Client for the Functional Constraints "ST" (Status Information) and "CO" (Control)

203 in the protocol element with IEC 61850 Client function, for data (attributes) in transmit/receive direction that are not contained in the IEC 61850 standard, the Common Data Class (CDC) can be parameterized Devices of different manufacturers utilize the possibility in order to expand the logical nodes defined in the standard with additional attributes for data in the private range. For the expansion in the private range, only Common Data Classes can be selected that are already defined in the standard and are supported by the protocol element. The expansions are only supported at the logical node level and with the parameterization the highest value Common Data Class in the hierarchy must be parameterized. Examples: VLC01/CSWI1.SPos.ctlVal (SPos = DPC) VLC01/XCBR1.SPos.ctlVal (SPos = DPC) VLC01/MMXU1.STotW.mag.f (STotW = MV) VLC01/MMXU1.AS.phsA.cVal.mag.f (AS = WYE)

204 applies only for IEC 61850 Edition 2

CDC [abbrev.][202]		Common Data Class Specification for	Ss	Se	Ss_G	Sr_G	Cs 203	Ce 203
INC	[ST|CO]	Controllable Integer Status	✓|-	✓|-	✓|-	✓|- 204	✓|-	✓|-
ENC	[ST|CO]	Controllable Enumerated Status	✓|- 204	✓|- 204	✓|- 204	✓|- 204	✓|- 204	✓|- 204
BSC	[ST|CO]	Binary Controlled Step Position Information	✓|-	✓|-	-	-	✓|-	✓|-
ISC	[ST|CO]	Integer Controlled Step Position Information	✓|-	✓|-	-	-	✓|-	✓|-
		Controllable Analog Information						
APC		Controllable analog set point information	✓|- 204	✓|- 204	-	-	✓|- 204	✓|- 204
		Status Settings						
ENG	[SP]	Enumerated Status Setting	✓ 205	✓ 205	-	-	✓ 205	✓ 205
SPG	[SP]	Single Point Setting	✓|- 206	✓|- 206	-	-	✓	✓|- 206
ING	[SP]	Integer Status Setting	✓|- 204	✓|- 204	-	-	✓	✓
		Analog Settings						
ASG	[SP]	Analog Setting	✓|- 204	✓|- 204	-	-	✓	✓
CURVE		Setting Curve	-	-	-	-	-	-
		Description Information						
DPL		Device Name Plate	✓ 206	-	-	-	-	-
LPL		Logical Node Name Plate	✓ 206	-	-	-	-	-
CSD		Curve Shape Description	-	-	-	-	-	-
SGCB		Setting Group Control Block [207]	✓	✓	-	-	✓	✓

For commands, the “Extended Common Data Classes” defined in the IEC 61850-8-1 standard are used . These "Extended Common Data Classes" consist of several attributes that are used differently according to IEC 61850 Control Model.

CDC [abbrev.][208]		Extended Common Data Class Specification for	Ss	Se	Ss_G	Sr_G	Cs 203	Ce 203
		Controllable Status Information						
SPC	[ST|CO]	Extended Common Data Class Controllable Single Point	✓|-	✓|-	✓|-	✓|-	✓|-	✓|-

202 Common Data Classes with the additional designation [ST|CO] are supported differently by the Server/Client for the Functional Constraints "ST" (Status Information) and "CO" (Control)

203 in the protocol element with IEC 61850 Client function, for data (attributes) in transmit/receive direction that are not contained in the IEC 61850 standard, the Common Data Class (CDC) can be parameterized Devices of different manufacturers utilize the possibility in order to expand the logical nodes defined in the standard with additional attributes for data in the private range. For the expansion in the private range, only Common Data Classes can be selected that are already defined in the standard and are supported by the protocol element. The expansions are only supported at the logical node level and with the parameterization the highest value Common Data Class in the hierarchy must be parameterized. Examples: VLC01/CSWI1.SPos.ctlVal (SPos = DPC) VLC01/XCBR1.SPos.ctlVal (SPos = DPC) VLC01/MMXU1.STotW.mag.f (STotW = MV) VLC01/MMXU1.AS.phsA.cVal.mag.f (AS = WYE)

205 applies only for IEC61850 Edition 2 and Edition 2.1

206 this information is generated by PRE

207 SGCB is a Control Block and not a Common Data Class, but is handled as a CDC by the protocol element

208 Common Data Classes with the additional designation [ST|CO] are supported differently by the Server/Client for the Functional Constraints "ST" (Status Information) and "CO" (Control)

CDC [abbrev.][208]		Extended Common Data Class Specification for	Ss	Se	Ss_G	Sr_G	Cs 203	Ce 203
DPC	[ST|CO]	Extended Common Data ClassControllable Double Point	✓|-	✓|-	✓|-	✓|-	✓|-	✓|-
INC	[ST|CO]	Extended Common Data Class Controllable Integer Status	✓|-	✓|-	✓|-	✓|- 204	✓|-	✓|-
BSC	[ST|CO]	Extended Common Data Class Binary Controlled Step Position Information	✓|-	✓|-	-	-	✓|-	✓|-
ISC	[ST|CO]	Extended Common Data Class Integer Controlled Step Position Information	✓|-	✓|-	-	-	✓|-	✓|-
		Controllable Analog Information						
APC	[ST|CO]	Extended Common Data Class Controllable Analog Set Point Information	✓|- 204	✓|- 204	-	-	✓|- 204	✓|- 204

Legend:

- Ss Server transmitting
- Se Server receiving
- Cs Client transmitting
- Ce Client receiving
- Ss_G Server senden GOOSE (publish)
- Sr_G Server receiving GOOSE (subscribe)

13.6.5.2 Definition of the Connections

IP addresses

Every device which is connected to a TCP/IP network has an unambiguous IP address. The protocol firmware supports only IP addresses in the format IPv4 (32 bits). With that 2^{32}, therefore 4,294,967,296 addresses can be represented. The IP address is mostly represented in the *dotted decimal notation*. Definition of the Connections

Example: *192168122195*

The IP address of the own station is to be parameterized with the parameter **IP address | own IP address**.

The IP address(es) of the remote station(s) is(are) to be parameterized for each connection with the parameters of the **Connection definition**.

Port number

Every IP connection is defined by the IP address of the own station and the remote station and the port number. The port numbers are determined by the IANA (Internet Assigned Numbers Authority).

Port numbers used in the LAN/WAN protocol firmware:

Port number	Protocol	Standard
102	MMS (Manufacturing Message Specification)	ISO/IEC 9506
3782	MMS (Manufacturing Message Sepcification) TLS	ISO/IEC 9506
80	HTTP (Hypertext Transfer Protocol)	RFC 2616 (HTTP/1.1)
443	HTTPS (Hypertext Transfer Protocol over SSL/TLS)	Web server

208 Common Data Classes with the additional designation [ST|CO] are supported differently by the Server/Client for the Functional Constraints "ST" (Status Information) and "CO" (Control)

RFC .... Request for Comments

Default Router (Default Gateway)

If one's own network is connected by means of a router, then the IP address of the Default Router is to be set in the parameters of the protocol firmware with the parameter **`IP address | Default router (default gateway)`**.

Subnet Mask

The subnet mask is a bit mask, that separates an IP address into a network- and a device part (Host part). It is used in IP networks to make routing decisions.

The subnet mask is to be set in the parameters of the protocol firmware with the parameter **`IP address | Subnet mask`**.

The subnet mask is exactly as long as the IP address, to which it is applied (therefore 32 bits for IPv4). All bits of the network part are set to "1" and all bits of the device part are set to "0".

In most cases the notation of a network mask is not carried out binary, rather (as with IP address also) frequently in decimal notation (dotted decimal notation).

Therefore the IPv4 network mask for a 27 bit network part reads 255.255.255.224.

The usable address space of a network is defined by the subnet mask. For a 27 bit network the first 27 places of the IP address of the network part and for all hosts of the network are identical. In all practical cases of application the network part is continuous (without zeros in between).

```
Example: Calculation of Network- and Host portion
         IPv4-Address = 192.168.122.195
         Network part = 27 Bit → Subnet-Mask =  255   .  255  .  255  .  224
                                            11111111 11111111 11111111 11100000

             Decimal         Binary                                       Calculation
IP Address   192.168.122.195 11000000 10101000 01111010 11000011             IP Address
Net mask     255.255.255.224 11111111 11111111 11111111 11100000         AND Subnet Mask
Network part 192.168.122.192 11000000 10101000 01111010 11000000          = Network part

IP Address   192.168.122.195 11000010 10101000 01111010 11000011             IP Address
Net mask~    255.255.255.224 00000000 00000000 00000000 00011111 AND (NOT Subnet-Mask)
Device part                3 00000000 00000000 00000000 00000011           = Device part
```

A network mask with 27 set bits produces a network part of 192.168.122.192. 5 bits and therefore 32 addresses are left over for the device part.

In the above example the smallest host address ends with 11000000 (decimal: 192), the greatest possible host address with the octet 11011111 (decimal: 223).

The address range for the subnet in the example is therefore 192.168.122.192 to 192.168.122.223.

The greatest address is by definition reserved for the IP broadcast and the smallest address describes the network itself. They are therefore not included in the freely usable addresses.

In practice the Default Gateway is often assigned to the smallest (binary in the example: 11000001, decimal: 193) or largest (binary in the example: 11011110, decimal: 222) usable IP address in the network.

Connection-Specific Parameters

In the central station and in the substation(s) for each "Connection", the required settings must be made in the parameters of the **`Connectiondefinitionen`** .

The following parameters can be set for each connection:

- "Station number"

  The station number is used SICAM RTUs internal for the routing of the data, diagnostic treatment and failure management. The station number is the SICAM RTUs internal reference for the connection that is assigned to an IP address. During the data transmission, only the IP address assigned to the station number is transmitted, the station number is not transmitted.

  During the data flow routing the data is routed for transmission to a "Station number" (Connection number = destination station number).

  The station number is to be entered for each connection in the parameters **Connection definition | Stationsnummer** .

- "Enable"

  A parameterized connection can be activated/deactivated with the parameter **Connection definition | Enable** .

  Thus, connections can be prepared that are activated only at a later moment by means of parameterization.

- "Station failure"

  For certain redundancy configurations or operating modes, for the SICAM RTUs internal diagnostics, the failure of a connection can be suppressed with the parameter **Station definition | Station failure**.

  If the failure is suppressed, the connection is never signaled in the diagnostic as failed and all messages in transmit direction are discarded until the connection is established!

  As a result a ring overflow is avoided with non-connected remote stations.

- "Own Mode"

  For every TCP/IP connection one party is either "Server (Listener)" or "Client (Connector)". The TCP/IP connection is always only established by the "Client (Connector)".

  With the parameter **Connection definition | Own mode** the role of the own station is to be parameterized for every connection.

- "IP-addr"

  For every connection the IP address of the remote station is to be parameterized. The IP address (Internet-Protocol) is a number, which permits the addressing of parties in LAN IP networks. This address must always be unambiguous in a network.

  The IP address is to be parameterized as follows (example): 192168122195

  The IP address of the remote station is to be parameterized for every connection with the parameters **Connection definition | IP-addr.** .

- "AE Qualifier"

  This parameter applies for a connected server, if that requires resp. checks the corresponding AE Qualifier for the connection setup. The value of the AE Qualifier is in the ICD file of the corresponding server.

  The AE Qualifier is to be parameterized for every connection with the parameters **Connection definition | AE qualifier**.

The settings of the variable elements of the message in the IEC 60870-5-101/104 parameter block of the basic system element are not evaluated by the IEC 61850 protocol element.

In the IEC 61850 Client as of Edition 2, the following parameters can be set per connection:

- "Timeout IEC61850 connection setup"

  Timeout for the cyclic connection reestablishment to the connected device (default 10 s).

- "Timeout IEC 61850 Services"

  Timeout for IEC 61850 services, every service must be confirmed within this timeout. This timeout is increased during command transmission to the Timeout ACT→CON (default 7 s).

- “Reports”
  Selection of reports. With “unbuffered, buffered” and “buffered, unbuffered” both are used with priority to the first selection. With “unbuffered” and “buffered” only the parameterized reports are used (“unbuffered, buffered”/”buffered, unbuffered”/”unbuffered/buffered/single read requests”).
- “Timeout buffered reports”
  After a communication breakdown, the Buffered Report will not be flushed during this time (default 0).
- "cbName dynamic"
  Values of reports writable (dynamic).
- "dataSet dynamic "
  Values of reports writable (dynamic).
- "rpID dynamic "
  Values of reports writable (dynamic).
- "optFields dynamic"
  Values of reports writable (dynamic).
- "bufTime dynamic"
  Values of reports writable (dynamic).
- "trgOps dynamic"
  Values of reports writable (dynamic).
- "intgPd dynamic"
  Values of reports writable (dynamic).
- "DynamicDatasets"
  Server supports dynamic datasets.
- "Elements for dataset"
  Count of elements for dynamic datasets (typical = default 60).
- "Beh.stVal = 2 (blocked)"
  If the attribute "Beh.stVal" changes to blocked, all hierarchical data points from the connected device are generated with the parametrized status. If "LLN0.Beh.stVal" is used, all data points from the logical device are generated.
- "Beh.stVal = 5 (off)"
  If the attribute "Beh.stVal" changes to off, all hierarchical data points from the connected device are generated with the parametrized status. If "LLN0.Beh.stVal" is used, all data points from the logical device are generated.
- "Convert commands EXE -> SEL/EXE"
  Automatic conversion of execute commands to IEC 61850 select/execute commands.
- "Delay SEL -> EXE (ms)"
- With automatic conversion of execute commands this time is used between SEL and EXE (default 0).
- "Termination"
  Derive Termination for commands from the IEC 61850 Termination or from the return information, if the IEC 61850 Termination is before the return information. A received neg. Termination will always be generated (IEC 61850 command termination/ IEC 61850 return information).
- "Timeout SEL -> EXE (s)"
  Max. time between Select and Execute for commands (default 20 s).
- "Timeout ACT -> CON (s)"
  Max. time between Activation and Confirmation for commands (default 20 s).
- "Timeout CON-> TERM (s)"
  Max. time between Confirmation and Termination for commands (default 20 s).

- "Intermediate position suppression time (s)"
  Intermediate state suppression time for double-point information (default 0).
- "Faulty state suppression time (s)"
  Faulty state suppression time for double-point information (default 0).
- "IED name"
  IED name for ICD file import. This parameter should not be changed manually.
- "ICD/SCD File"
  ICD file name for ICD import. This parameter should not be changed manually.
- "Filetransfer"
  File transfer in connected Server supported.
- "TrgOps data change"
  Trigger Op value in connected Server supported.
- "TrgOps quality change"
  Trigger Op value in connected Server supported.
- "TrgOps data update"
  Trigger Op value in connected Server supported.
- "TrgOps integrity"
  Trigger Op value in connected Server supported.
- "TrgOps general interrogation"
  Trigger Op value in connected Server supported.

Data Transmission Procedure

The transmission of data ready to be sent from the central station (IEC 61850 Client) to the substation (IEC 61850 Server) takes place spontaneously with connection established and for each connection.

The transmission of data ready to be sent from the substation (IEC 61850 Server) to the central station (IEC 61850 Client) takes place either spontaneous by means of IEC 61850 Reports or interrogated by the central station.

For each LAN connection, the Client-Server data transmission is comparable with that between 2 stations over a virtual point-to-point connection.

In addition, with IEC 61850, for the transmission of data between servers the multicast transmission procedure GOOSE (Generic Object Oriented Substation Events) is used.

The transmission speed (10/100 Mbit/s) and the transmission type (full duplex/half duplex) on the Ethernet are specified separately for each port separated on the basic system element by the parameter **System settings | Network settings | Port | CI#-X# | Speed**, **System settings | Network settings | Port | CP-X# | Speed** In the default setting this parameter is set to ***Auto negotiation*** and only needs to be specifically adjusted in exceptional cases.

"Autonegotiation" or "Auto-Sensing" is an Ethernet procedure by which two connected devices (e.g. a network port of a computer and the network port of a Router, Hub or Switch) choose common transmission parameters, such as speed, duplex mode, and flow control. The procedure only applies to multi-wire connections (twisted pair cable) – but not for WLAN-, fiber optic- or coaxial cables.

NOTE

If problems arise with the direct connection of other systems with crossover cables or when using hubs or other network components with the presetting, ***half duplex*** should be used here.

The data storage on the basic system element is managed individually for each LAN connection. Data messages "to all" are already split up selectively for every LAN connection by the communications function on the basic system element.

The prioritization of the data to be sent to the protocol element takes place on the basic system element. System data is processed with high priority by the communications function on the basic system element and transferred to the protocol element for transmission as fast as possible.

This prioritization is of no significance for the protocol element with IEC 61850 Server function. The data is received from the basic system element by the protocol element, entered in the IEC 61850 organized process image on the protocol element and prepared for transmission according to IEC 61850.

The possible 104-blocking for the data transmission between basic system element ⇔ protocol element is not used.

In the SICAM A8000 protocol element with IEC 61850 Client function, with the parameter **IEC61850 | Client | Timeout IEC61850 Services** the monitoring time for IEC 61850 Services (e.g.: Read/Write) can be set. For commands, this monitoring time is extended to the time that can be set with the parameter **IEC61850 | Timeout Confirmation → Termination** (as of IEC 61850 Edition 2: **Connectiondefinitionen | Timeout CON → TERM**).

Failure monitoring

The monitoring of every connection by the central station (Client) and by the substation (Server) is carried out by means of cyclically transmitted messages (TCP keep alive frames). The failure monitoring can be carried out independently by both participating stations of a connection.

The “TCP Keep-Alive Frames” are generated and monitored by the TCP/IP stack of the protocol firmware itself and are not transferred to the basic system element.

The time grid for the cyclic transmission of the "TCP Keep Alive Frames" is determined with the parameter **Advanced parameters | monitoring time | TCP keep alive time**.

If with connection established, the cyclic reception of the "TCP Keep Alive Frames" is missing, the failure of the connection is signaled by the TCP/IP stack of the protocol firmware. The failure of a connection is signaled immediately by the protocol element to the basic system element, insofar as this is not disabled in the parameters of the **Connection definition** with the parameter **Station failure** .

With connection failed, the client attempts to re-establish a connection to the assigned server in a cyclic time grid. The time grid can be set with the parameter **IEC61850 | Client | Timeout IEC61850 connection setup** (as of IEC 61850 Edition 2: **Connection definitions | Connection establishment (s)**).

No further data is sent from the connections with Client-functionality to failed remote stations until successful establishment of the connection and the initialization of the connection.

The data is stored in the data storage of the communication function on the basic system element until this is deleted by the dwell time monitoring or can be transmitted to the re-reachable remote station.

From the connections with Server-functionality, further data is requested from the basic system element and stored in the protocol element internal IEC 61850 data model, even with failed connection to the remote station.

13.6.5.3 Station Initialization

Initialization of the Connections [Client]

After startup, all parameterized connections with IEC 61850 Client function are reported by the protocol element as failed (insofar as this is not disabled in the parameters of the connection definitions) and afterwards the connection is established for every single connection at TCP/IP level by the IEC 61850 Client.

For failed or unreachable remote stations, a connection setup (attempt) for the connection is performed cyclic by the IEC 61850 Client.

After complete initialization of a connection, the protocol element with IEC 61850 Client function will reset the connection failure and starts requesting the data from the basic system element and initiates a general interrogation to the basic system element.

Initialization of the Connections [Server]

For each connection with IEC 61850 Server function, the protocol element waits for an establishment of the connection at TCP/IP level by the IEC 61850 Client.

13.6.5.4 Acquisition of Events (Transmission of Data Ready to be Sent)

With connection established, the transmission from the central station (client) to the substation (server) takes place spontaneously. The transmission from the substation (server) to the central station (client) takes place either spontaneous by means of reports or interrogated by the central station.

For the transmission of data between servers, the GOOSE transmission procedure can be implemented.

Data Transmission Server ↔ Client

The transmission of data ready to be sent from the central station (IEC 61850 Client) to the substation (IEC 61850 Server) takes place spontaneously with connection established and for each connection.

The transmission of data ready to be sent from the substation (IEC 61850 Server) to the central station (IEC 61850 Client) takes place either spontaneous by means of IEC 61850 Reports or interrogated by the central station.

With the parameter **`IEC61850 | Client | Advanced parameters | IEC61850 service for request`** it is determined, whether the transmission of the data from the substation (61850 Server) to the central station (61850 Client) is carried out spontaneously by means of reports or through cyclic interrogation by the central station.

With spontaneous transmission using reports, the spontaneous transmission is activated in the Report Control Block of the IEC 61850 Server by the protocol element with IEC 61850 Client function.

With transmission of the data through cyclic interrogation, the data attributes are interrogated selectively by the protocol element with IEC 61850 Client function (Report Control Block, Reports and Data Sets are not used here).

The time grid for the cyclic interrogation of the individual values can be parameterized with the parameter **`IEC61850 | Client | Advanced parameters | Acquisition grid for "single read requests"`**.

The possible 104-blocking for the data transmission between basic system element and protocol element is not used.

The prioritization of the data ready to be sent by the basic system element (BSE) is of no significance for the protocol element with IEC 61850 Server function. The data is transferred from the basic system element, entered in the IEC 61850 organized process image on the protocol element and prepared for transmission according to IEC 61850.

The prioritization of the data ready to be sent by the basic system element (BSE) is only of significance for the protocol element with IEC 61850 Client function.

Reports/Report Control Block

The spontaneous transmission of data from the IEC 61850 Server to the IEC 61850 Client takes place by means of reports. The reports are created permanently in the servers and every report has its own Report Control Block. The characteristics of the respective report are entered in the Report Control Block. The Report Control Block can be read as well as written by the IEC 61850 Client.

The following information is stored in the Report Control Block (extract-wise):

- Reference to the associated DataSet
- Trigger for the transmission (spontaneous, general interrogation, etc.)
- DataSet Name
- ...

Unbuffered/Buffered Reports

For the reports, a distinction is made between Buffered Reports and Unbuffered Reports. This function is determined by the IEC 61850 device. With the Buffered Reports, changes are stored after a connection failure.

After startup or going connection fault all the present Unbuffered/Buffered Control Blocks are interrogated and the belonging Dataset is read (attribute ”DatSet”). Predominantly, the Unbuffered Control Block is used, only if no Unbuffered Control Blocks are present, Buffered Control Blocks are used.

In the handling of the reports, on reception no distinction is made between Buffered reports and Unbuffered reports by the SICAM RTUs protocol element with IEC 61850 client function.

As of IEC 61850 Edition 2 the selection of reports can be defined with the parameter **Connection definitions | Reports**. With "unbuffered, buffered" and "buffered, unbuffered" both are used with priority to the first selection. With "unbuffered", "buffered" and "single read requests" only the parameterized reports are used.

With the parameter **Connection definitions | Timeout buffered reports (s)** a time can be defined during that the Buffered Report will not be deleted after a connection failure.

As of IEC 61850 Edition 2, the automatic search of reports will be overruled with the table **IEC61850 | Client | Advanced parameters | Report definition**.

Parameter	Description
Station	0 to 99 (internal SICAM station)
Report name	Name of the report (e. g., IEDPROT/LLN0RPurcb01

Static/Dynamic Datasets

In the datasets, all information is contained that can be transmitted spontaneously from the IEC 61850 Server to the IEC 61850 Client. Required values that are not contained in the datasets, must be read out from the IEC 61850 Client by cyclic interrogation of the attributes.

Static datasets are predefined by the IEC 61850 device and are created in the device by the IEC 61850 Server function itself.

In SICAM RTUs devices, the static datasets are generated by the protocol element with IEC 61850 Server function from the data of the SIP message address conversion in transmit direction.

Dynamic datasets must be created by the IEC 61850 Client in the IEC 61850 Server. In the initialization phase, the protocol element with IEC 61850 Client function reads out the information from those devices with IEC 61850 Server function, whether dynamic datasets are supported. Dynamic datasets are generated by the protocol element with IEC 61850 Server function from the data of the SIP message address conversion in receive direction and created in the devices with IEC 61850 Server function.

With the parameter **IEC61850 | Client | Advanced parameters | Dataset** it is determined how the dynamic datasets are to be created.

The datasets can be created as follows:

- For each logical node
- For each logical device

As of IEC 61850 edition 2, the parameter **Connection definitions | Dynamic datasets** defines whether the IEC 61850 Server supports dynamic datasets. With this parameter it is determined whether dynamic datasets are created by the IEC 61850 Client or not. This parameter is created with the SCD import by the SICAM TOOLBOX II, in dependence whether the device supports dynamic datasets or not.

The count of elements for dynamic datasets is defined with the parameter **Connection definitions | Elements for datasets** (typical: 60).

In order to use dynamic datasets, the parameters **dataSet dynamic** and **dynamic datasets** must be set to ***YES***, and in addition, the device must notify upon connection setup that it supports dynamic datasets.

With usage of the SICAM TOOLBOX II SCD import, these parameters are set automatically. A typical use case is for instance the import of a SIPROTEC5 device (this supports dynamic datasets), whereby both parameters are set to ***YES***. If predefined datasets are to be used in the Sysconf instead of dynamic datasets, the parameter **dynamic datasets** must be set to ***NO***.

The report attributes (**dataSet dynamic**, **cbName dynamic**, **rpId dynamic**, etc.) are with SICAM TOOLBOX II import automatically taken from the SCD file and reflect the possibilities of the device whether the corresponding report attributes are dynamic (i.e. changeable by the client).

NOTE

Siemens protection devices of the SIPROTEC series support only dynamic datasets. Protection devices of other manufacturers mostly support only static datasets.

Setting Group Control Model

Only with Logical Device "Protection" and Logical Node "LLN0" setting groups are supported.

Values of a SGCB are not transmitted spontaneously, but interrogated cyclically.

NOTE

Only a group switchover is possible (SelectActiveSG), no parameter settings.

Data Transmission Server ↔ Server with GOOSE (Server only)

The Generic Object Oriented Substation Events (GOOSE) is a transmission service of IEC 61850 for generic status events, that can be sent simultaneously per multicast to multiple devices in order to satisfy high real-time requirements. Typical cases of application are the spontaneous transmission of state of switching device in the decentral interlocking of switching commands in substations. GOOSE messages use the Ether type specification for VLAN, the prioritization and are represented directly on the Ethernet layer.

With GOOSE messages according to standard part IEC 61850-8-1, data is exchanged between IEC 61850 devices (servers).

Range for the multicast address for GOOSE:

	of	to
MAC address	01-0C-CD-01-00-00	01-0C-CD-01-01-FF

Max. 100 different GOOSE messages can be supported, whereby the number applies conjointly in send and receive direction.

For the GOOSE data transmission, the IEC 61850 protocol element supports only basic types (single elements) – data structures are supported only for edition 2 with following CDCs: (FC= ST): SPC, DPC, ENC, INC, SPS, DPS, ENS, INS.

The GOOSE data transmission is supported by the server function of the protocol element in transmit direction “Publisher” (transmitter) and also in receive direction “Subscriber” (receiver).

The datasets to be transmitted are defined with the process-technical parameterization of the SIP message address conversion. The datasets must consist of data of the MMS directories.

The internal station number (from SSE to BSE) of the received GOOSE messages is 254 (own SSE). Hence results that Publish messages must be included in the send routing, and Subscribe message in the receive routing.

GOOSE messages are transmitted with high priority by the switches implemented in IEC 61850 networks. For this the switches must support the standard IEEE802.1Q (prioritization of messages).

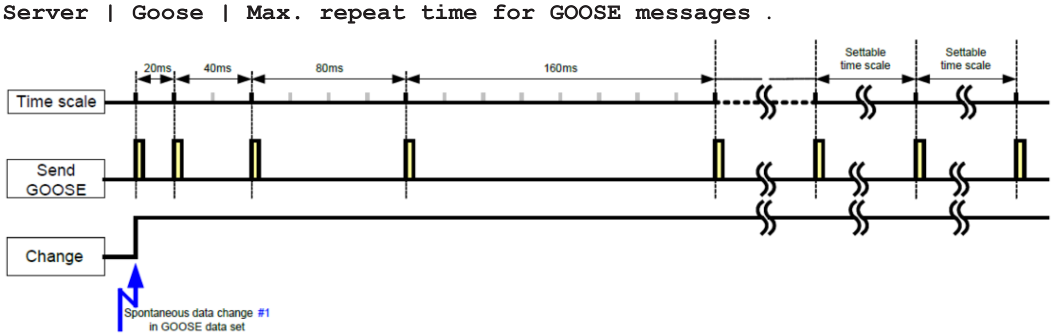
GOOSE Transmission Procedure

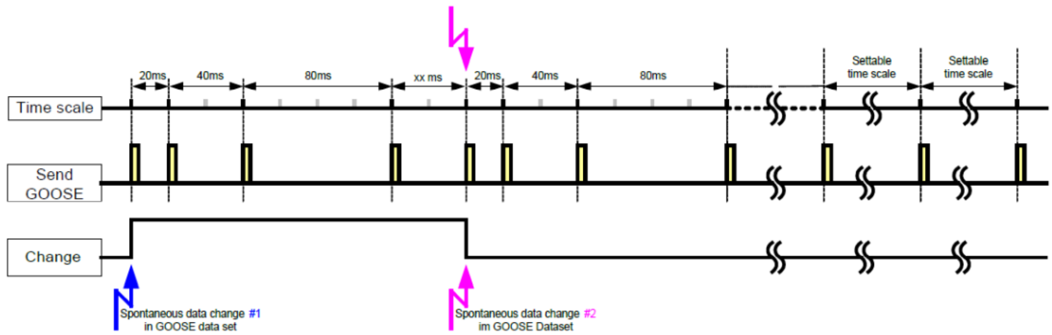
The GOOSE data transmission is a cyclic multicast transmission. A GOOSE message is thereby transmitted from one device as “Publisher” (transmitter) and received by multiple devices “Subscriber” (receivers).

With the GOOSE data transmission, the GOOSE message is transmitted spontaneously immediately with change and then cyclic with changed cycle time (repeat time). The data transmission is not acknowledged, the reception of the current state is ensured through the repeat procedure.

The initial repeat time after a spontaneous GOOSE data transmission is 20 ms. This time is doubled with each transmission until the parameterized maximum repeat time is reached.

The maximum repeat time for GOOSE messages is to be parameterized with the parameter **`IEC61850 Server | Goose | Max. repeat time for GOOSE messages`** .





Failure monitoring

The failure monitoring for GOOSE messages in receive direction (Subscriber) is derived from the current HOLD time (repeat time) per GOOSE application. The current HOLD time is also included in every message of a GOOSE message.

The time for the failure monitoring is the current HOLD time multiplied by the parameterized maximum number of retries for GOOSE. The maximum number of retries for GOOSE messages is to be parameterized with the parameter **IEC61850 Server | Goose | Retry count for GOOSE**.

After a failure is detected, the data concerned can be emulated by the protocol element to the basic system element as failed ("not topical"). The selection of whether the data is to be emulated as failed, is set with the parameter **IEC61850 Server | Goose | Mark data invalid after GOOSE failure**.

NOTE

If the emulation of the data concerned is deactivated on failure, the monitoring by the user function must be ensured.

Parameters for GOOSE Data

The configuration of GOOSE data must be done exclusively using SICAM TOOLBOX II. Only existing projects using GOOSE data should be configured using process-technical parameter setting of protocol element.

Data of the process-technical parameter setting (SIP message address conversion in transmit/receive direction) can be selected for the GOOSE data transmission. All data with the same GOOSE index is assigned to one GOOSE application.

The detail parameters for each GOOSE application (GOOSE index) are to be parameterized in the parameters in the spreadsheet **IEC61850 | Server | Goose | Goose definition**.

All data of a GOOSE application are transmitted with the parameterized multicast address.

The following parameters can be set in the GOOSE definitions:

- "Enable"
  A parameterized GOOSE application can be activated/deactivated with the parameter **IEC61850 | Server | Goose | Goose definition | Enable**; e.g., this way GOOSE applications can be prepared, that are first activated at a later time by means of parameterization.
- "GOOSE Index"
  With the GOOSE index, the data of the SIP message address conversion is assigned to the GOOSE application.
  The GOOSE index is only used SICAM RTUs internal and is parameterized for each GOOSE application with the parameter **IEC61850 | Server | Goose | Goose definition | Goose Index**.
- "GOOSE Control Block (gocbref)"
  With the parameter **IEC61850 | Server | Goose | Goose definition | Goose Control Block (gocbref)** the reference to the GOOSE Control Block is parameterized.
  The GOOSE Control Block is generated by the protocol element for each GOOSE application from the parameters of the GOOSE definitions and can be read by the Client.
  With the integrated web server, the GOOSE Control Block can be read out in the directory of the server under the functional constraint "GO".

- “GOOSE Id (goid)”
  With the parameter **IEC61850 | Server | Goose | Goose definition | Goose Id (goid)** an unambiguous GOOSE identification is parameterized. The GOOSE identification must be unambiguous in the network and is transmitted with the GOOSE message.
- "Dataset Reference"
  For every GOOSE application a specific dataset is created in the SICAM RTUs Server. With the parameter **IEC61850 | Server | Goose | Goose definition | Dataset Reference** the reference to the dataset is to be parameterized for each GOOSE application.
- “MAC address”
  Every GOOSE application is transmitted with multicast to multiple devices as GOOSE message. With the parameter **IEC61850 | Server | Goose | Goose definition | MAC Address** the multicast address (= MAC address) is to be parameterized for each GOOSE application.
  The MAC address is to be parameterized as character string without separating character.
  Example: The multicast address 01-0C-CD-01-0<u>1-FF</u> is to be parameterized with the character string 010CCD010<u>1FF</u>.
- “AppId”
  With the parameter **IEC61850 | Server | Goose | Goose definition | AppId** the application identification (AppId) of the GOOSE application is to be parameterized.
- “configRev”
  With the parameter **IEC61850 | Server | Goose | Goose definition | configRev** an unambiguous revision identifier of the GOOSE application is to be parameterized.
  This revision identifier should be changed when the dataset of the GOOSE application changes, so that no malfunction occurs in connected devices with incompatible parameter setting.
  Note: The check of the revision identifier can be switched on and off with a parameter.
- “VLAN Vid”
  With the parameter **IEC61850 | Server | Goose | Goose definition | VLAN** the VLAN ID (unambiguous number of the virtual LAN) is to be parameterized.
  Details about VLAN see *13.25 VLAN*.
- “VLAN Priority”
  With the parameter **IEC61850 | Server | Goose | Goose definition | VLAN priority** the priority for the data packets in the VLAN is to be parameterized.
  Details about VLAN see *13.25 VLAN*.

General Notes on GOOSE

Attribute	unambigous per	
	Network	Device
GoCBRef	✓	✓
GoId	✓	✓
Dataset	–	✓
MAC address	–	✓
AppId	–	✓
configRev	–	–
VLAN Vid	–	–
VLAN priority	–	–

The combination GoCBRef and GoId must be unambigous in the network.

The Logical Nodes of the GOOSE receiver should be of the type GGIO:

GOOSE-Publish:

VLC01/Q0CSWI1.Pos.stVal

VLC01/Q0CSWI1.Pos.q

GOOSE-Subscribe:

VLC02/Q0GGIO1.DPCSO1.stVal

VLC02/Q0GGIO1.DPCSO1.q

Q0CSWI.Pos.stVal and Q0GGIO1.DPCSO1.stVal are both of the typa double-point information.

At the receiver (subscribe) a new data point is created (VLC02). The quality should be always transmitted.

Example of a valid GOOSE parameter setting:

GoCBReg	Go Id	Dataset	MAC	AppId	config Rev	VLAN Vid	VLAN priority
VLC01/LLN0GOgcb01	1	VLC01/LLN0$ds1	010CCD010000	1	1	1	4
VLC01/LLN0GOgcb02	2	VLC01/LLN0$ds2	010CCD010001	2	1	1	4

By means of this parameterization, in the VLC01/LLN0 Logical Node a respective GOOSE Control Block with the name gcb01 and gcb02 is created automatically, as far as they are publish. Write accesses to the GOOSE Control Block do not have effect on the function of the GOOSE messages. As well the created dataset is not readable.

According to the following table the attributes of the GGIOs must be assigned:

Basic Type	Used as	GGIO Attribut
BOOLEAN	Single-point information	SPCSO.stVal
BOOLEAN	Double-point information	DPCSO.stVal
FLOAT32	Measured value	AnIn.mag.f
Quality	Quality [209]	
TimeStamp	Real time [210]	

Manual Updating GOOSE

In commissioning or conversion phases or in the event of a failure of a field control device, there is a requirement to be able to update the switch position information of this field from the local control.

General range of functions:

- The server in the gateway that is configured for manual updating reproduces the GOOSE applications of the failed field on request from the local control.
- In addition, the server sets the SB bit for each manually updated switching device in the status of the correspondingly configured spontaneous double-point information/single-point information.

  If the "original" GOOSE of the field is detected on the network when the failed field returns, the transmission of the manual updating GOOSE is immediately stopped.

209 additional attribute to single-point information, double-point information, measured value

210 additional attribute to single-point information, double-point information, measured value

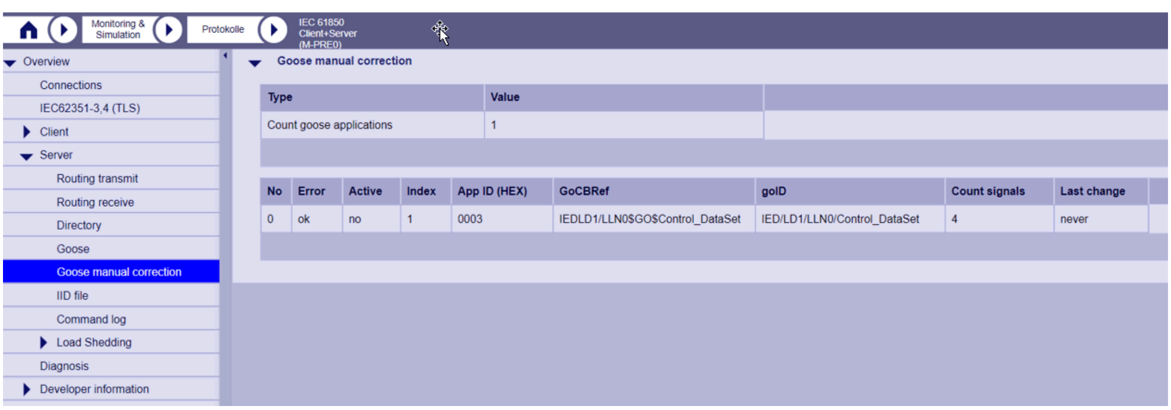
Parameterization:

- The GOOSE application, which is to be used for manual updating, must be parameterized as a GOOSE "Subscribe" application in the 61850 server. Here there is no difference in the parameterization to other servers, which also receive this GOOSE application.
- In order to parameterize a GOOSE application for manual updating, the following settings must be made:
  - Enter return information of the manual updating in the server receive detailed routing [RI_manual_corrected_CASDU1 **|RI_manual_corrected_CASDU2 | RI_manual_corrected_IOA1 | RI_manual_corrected_IOA2 | RI_manual_corrected_IOA3 | RI_manual_corrected_TI].**

    Attention! There must be no gaps in the Goose_AttrX_Datasetpos!
  - In the corresponding server receive detailed routing, correct the parameter **Manual_corrected_Goose**. Either on **send** to update the GOOSE application or on **do not send** to only update the corresponding return information.
  - The updating of the GOOSE application is started by a command. The value of the command is used as the status for updating. The quality is set to SB. For the assignment of the command to the GOOSE application, the server must receive the command of the**Goose_Idx**of the application and the**Goose_AttrX_Datasetpos**Parameters are set in the same way as with the GOOSE data points (server receive detailed routing).

Web Page

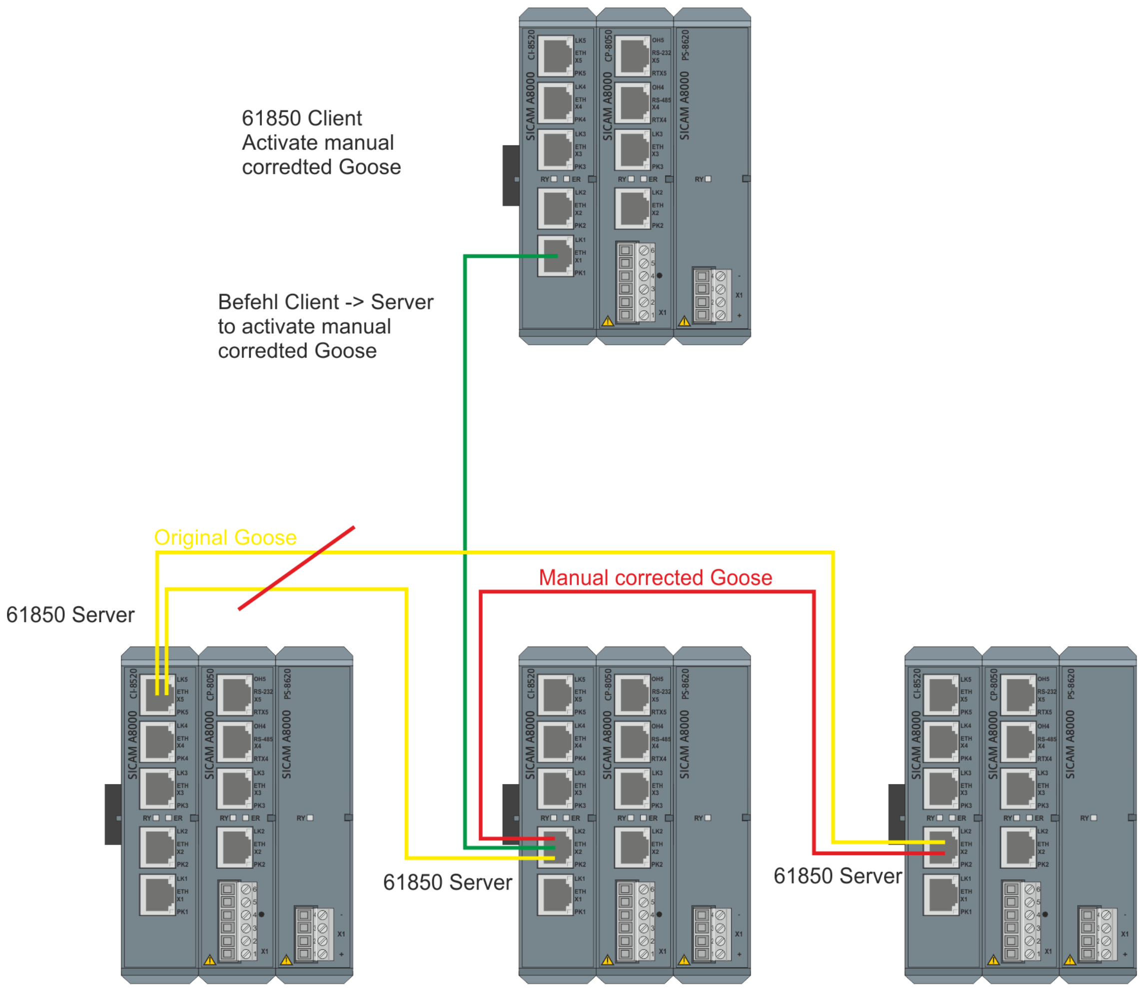
In SICAM WEB you can view the current status of the parameterization or the status of the manual updating via the **Goose manual correction** web page.



[sc_61850_Goose_Handnachfuehrung_sweb, 1, en_US]

Schematic Representation of the Function

If the original GOOSE is no longer available on the line, it can be started on the CP-8050 with the parameterized manual updating. This is reproduced until the original GOOSE is back on the line.



[dw_61850_Goose_Handnachfuehrung, 1, en_US]

13.6.5.5 General interrogation, Outstation interrogation

The general interrogation (outstation interrogation) function is used to update the master station after the initialization of the connection or after the master station has detected a loss of information.

A general interrogation command "to all" triggered in the system is always transferred by the communications function on the basic system element (BSE) station-selective (per connection) to the protocol element (server or client) and replied to by this directly from the internal process image of the protocol element with the current time.

Handling of the General Interrogation in the IEC 61850 Client

A general interrogation is only sent to the server by the protocol element with IEC 61850 Client function after startup or after going communication failure (connection failure) (GI-Bits in the "Unbuffered Control Blocks").

Handling of the General Interrogation in the IEC 61850 Server

The protocol element with IEC 61850 Server function does not perform any general interrogation towards the basic system element. A general interrogation triggered by the IEC 61850 Client is replied to by the protocol element with IEC 61850 Server function directly from the internal process image of the protocol element by means of "Unbuffered Reports".

13.6.5.6 Clock synchronization

In networks and in systems with time-critical tasks a precise time is essential.

The clock synchronization for IEC 61850 can be performed in the following ways:

- Network Time Protocol (NTP V3) according to RFC 1305
- Simple Network Time Protocol (SNTP V3, V4)

Messages that are transmitted after a startup contain the

- current time, if the automation unit already has been synchronized previously
- relative time from startup (reference date), if the automation unit already has never been synchronized
  Reference date for SICAM RTUs: 1.1.2001 1/1/2001
  Reference date for Ax1703: 1.1.1997 1/1/1997

In both cases, the time tag is marked as invalid until the first reception of the synchronizing event.

Network Time Protocol (NTP)

For further details refer to chapter *12, NTP*.

13.6.5.7 Command Transmission

For the transmission of commands, the Common Data Classes expanded in the IEC 6185081 standard are used. These expanded Common Data Classes consist of several attributes that are all transmitted in one IEC 61850 message.
The protocol element with IEC 61850 Client function describes the attribute “Check” as last attribute during the preparation of the command. The protocol element with IEC 61850 Server function only then processes the command further if the attribute “Check” is set.
Exception: With abortion of the command (“Cancel”), instead of the attribute “Check” the attribute “Test” is used.
Number of different commands that can be executed at the same time from the protocol:

- ETI5 as Server = max. 20 (recommended 10)
- ETI5 as Client = max. 40 (recommended 20)

The transmission of commands for IEC 61850 is defined in the “Control Models” (settable in the detailed routing):

IEC 61850 Control Model	Data Attributes without TimeActivatedOperate [211]	Note
Direct with normal security	Oper	Only EXECUTE-command
Direct with enhanced security	Oper	Only EXECUTE-command
Select Before Operate with normal security [212]	Select Before Operate (SBO) Oper Cancel	Only SELECT/EXECUTE-commands
Select before operate with enhanced security	Select Before Operate (SBOw) Oper Cancel	Only SELECT/EXECUTE-commands

The “Control Model” (ctlmodel) is determined by the IEC 61850 Server and read out by the IEC 61850 Client in the startup phase.
With the control models “Direct with enhanced security” and “Select before operate with enhanced security” the termination is also transmitted and the termination for IEC 60870-5-101/104 is derived from this. With the other control models the termination for IEC 60870-5-101/104 is derived from the return information.

211 "Data Attributes with Time Activated Operate" are not supported by the protocol element!
212 is not supported by the SICAM A8000 protocol element!

IEC 61850-7-2 Model/Services:

IEC 61850-7-2 Model	IEC 61850-7-2 Service	Note
Control	Select	
	SelectWithValue	
	Cancel	
	Operate	
	CommandTermination	
	TimeActivatedOperate [213]	

The SICAM A8000 protocol element for IEC 61850 performs the adaptation ("Mapping") of the various command modes from IEC 60870-5-101/104 ⇔ IEC 61850.

SICAM A8000 internal, the protocol element with IEC 61850 server function requests the information ACTCON, ACTTERM and the return information with the cause of transmission = “Return information caused by a remote command” (COT = 11) for every command.

A command is sent with the following attributes and sequence:

IEC 61850 Attribut	Description
ctlVal	Command state
origin.orCat	see “cause of transmission”
origin.orIdent	
ctlNum	Ascending number
T	current time
Test	depending on Test-Bit IEC 60870-5-101/104
Check	Refer to the following table

Control Model

Command Output Time (QU)

Client

IEC 60870-5-101/104 QU	IEC 61850 Check	Meaning
9	00	
0, all others	01	interlocking
10	10	synchrocheck
11	11	synchrocheck + interlocking

All commands with short, long and without definition are sent with “interlocking”. Commands that are generated from return information items are always sent without “interlocking” and without “synchrocheck” ("00").

Optionally, the following transfer table can be implemented with the parameter **`Advanced parameters | Compatibility mode`** = ***RWE***:

IEC 60870-5-101/104 QU	IEC 61850 Check	Meaning
11	00	
10, all others	01	interlocking
9	10	synchrocheck
0	11	synchrocheck + interlocking

213 is not supported by the SICAM A8000 protocol element!

Server

IEC 61850 Check	IEC 60870-5-101/104 QU	Meaning
00	9	
01	0	interlocking [214]
10	10	synchrocheck
11	11	synchrocheck + interlocking

Optionally, the following transfer table can be implemented with the parameter **`Advanced parameters | Compatibility mode`** = ***`RWE`***:

IEC 61850 Check	IEC 60870-5-101/104 QU	Meaning
00	11	
01	10	interlocking
10	9	synchrocheck
11	0	synchrocheck + interlocking

Causes of Transmission (origin)

Client

The causes of transmission are derived according to the following table.

IEC 61850 origin.orCat	IEC 60870-5-101/104 COT
Not supported	Spontaneous (3)
Bay control	Local (12)
Station control	Remote (11), Local (12) [215]
Remote control	Remote (11)
Automatic bay	Spontaneous (3)
Automatic station	Spontaneous (3)
Automatic remote	Spontaneous (3)
Process	Spontaneous (3)

If a return information is transmitted without origin.orCat and if this is in a running command sequence, even though the cause “Remote” (COT = 11) is enclosed.

Edition 1: Commands from Client to the Server are sent with “remote control”.

Edition 2: Commands from Client to the Server are sent with “remote control”, if the origin address is < 128 and with “station control”, if the origin address is >= 128.

The attribute orIdent is sent with the value “ETI5: nnn.nnn.nnn.nnn Rxxx Kyyy Origin:zzz”.

nnn.nnn.nnn.nnn = IP address

Rxxx = region number

Kyyy = component number

zzz = origin address from IEC 60870-5-101/104

The IEC 60870-5-101/104 origin address in receive direction is then set, if the orIdent attribute contains the string “ETI5” or “SAT 200” (value of Origin).

Server

If a command was transmitted in direction SICAM A8000 system, a timeout is started (parameter-settable), and with arrival of the corresponding return information, the cause of transmission (origin) is copied from CO to ST. With the next information report this is reported to the Client.

214 this is the typical command; the meaning of QU = 0 corresponds "without additional definition"

215 With the parameter**[PRE] IEC 61850 Client | Command transmission | Cause of transmission of the retrun information (orCat=station control)**can be set whether the return information of the source address ≥ 128 should be sent with “Remote” (11) or “Local” (12).

For this function a correlation between command and return information is created via the IEC 61850 address (detailed routing).

State	Behaviour
Command running (no timeout) and return information has the cause 11 (remote)	Copying of ctlNum, origin.orCat, origin.orIdent
Return information has not the cause 11 (remote) and not the cause 12 (local)	origin.orCat = process origin.orIdent
Return information has the cause 12 (local)	origin.orCat = bay-control origin.orIdent

The IEC 60870-5-101/104 origin address is taken in receive direction from the origin.orIdent, as far as this corresponds to the firmware of the IEC 61850 protocol element (see *IEC 61850: Common Data Attribute Types, Page 1138*, IEC 61850: Originator).

Command Termination

Client

For commands with "Enhanced Security", for the transmission of the information "Command Termination" of the temporary information report "Command Termination" is used.

In the SICAM A8000 protocol element with IEC 61850 client function, with the parameter **IEC61850 | Client | Advanced parameters | Terminations for commands** (as of IEC 61850 Edition 2: **Connection definitions | Termination**) it can be selected whether the "Termination of Activation" is to be derived from the "Command Termination" of IEC 61850 or from the return information itself for the conversion to IEC 60870-5-101/104.

For the evaluation/generation of the termination, a correlation is established by the protocol element between command and return information via the IEC 61850 address from the parameters of the SIP message address conversion (ctlVal, stVal).

In the SICAM A8000 protocol element with IEC 61850 Client function, the parameter **IEC61850 | Client | Timeout IEC61850 Services** (from IEC 61850 Edition 2: **Connection definitions | Timeout IEC61850 Services**) the monitoring time for 61850 services (e.g.: Read/Write) can be set. For commands, this monitoring time is extended to the time that can be set with the parameter **IEC61850 | Timeout Confirmation → Termination** (as of IEC 61850 Edition 2: **Connection definition | Timeout CON → TERM (s)**).

Server

For commands with "Enhanced Security" for "Command Termination-" the temporary information report "Command Termination" is used.

The elements of the "Command Termination-" are "LastApplError" and "Oper". A "Command Termination+" contains only the element "Oper".

1-Out-Of-n Check [Server only]

With 1-out-of-n check activated, only 1 command output procedure may be performed at one time.

The SICAM A8000 protocol element with IEC 61850 server function can perform a 1- out-of-n check either per connection (station-selective) or per LAN interface (globally for the LAN interface).

The 1-out-of-n check is activated on the protocol element with IEC 61850 Server function with the parameter **IEC61850 Server | Command transmission**.

Converting EXECUTE (104) → SELECT/EXECUTE (61850) [Client only]

The protocol element with IEC 61850 Client function can convert IEC 60870-5-101/104 commands with "direct command transmission" (EXECUTE only) for the transmission to the IEC 61850 remote station to a "Select before operate with enhanced security" command. This is necessary if no Select/Execute commands can be sent by the control system.

This function is activated on the protocol element with the parameter **IEC61850 | Client | Convert commands EXE to SEL/EXE** (as of IEC 61850 Edition 2: **Connection definition | Convert commands EXE to SEL/EXE**).

With function activated the SELECT-command is transmitted immediately to the remote station. After reception of the confirmation for the SELECT-command, the EXECUTE-command is transmitted to the remote station after a settable delay. The delay time can be set with the parameter **IEC61850 | Client | Delay between SEL CON - EXE ACT** (as of IEC 61850 Edition 2: **Connection definition | Delay SEL/EXE (ms)**).

NOTE

SELECT/EXECUTE-commands (IEC 60870-5-101/104) cannot be converted to "Direct with normal security" or "Direct with enhanced security" by the protocol element for the transmission to IEC 61850!

Step	IEC 60870-5-101/104	Direction	IEC 61850 ASCI Service
1	Execute Activation	→	Select
1		←	Select Confirmation
3		→	Execute
4	Execute Confirmation	←	Execute Confirmation
5	Execute Termination	←	Execute Termination

Between step 2 and 3 a delay time can be parameterized (default = 0).

LastApplError [Server only]

For commands with enhanced security for Res- a temporary information report “LastApplError” is used. This information report is sent before the actual Res-.

Attribute Name	Type	Values
CntrlObj	STRING65	[216]
Error	ENUMERATED	• No Error • Unknown • Timeout Test Not OK • Operator Test Not OK
Origin	Originator	

[216] MMS name of the Control Object (e.g.: VLC01/XCBR1ModOper)

Attribute Name	Type	Values
ctlNum	INT8U	
AddCause	ENUMERATED	• Unknown • Not supported (Service Error) • Blocked by switching hierarchy • Select failed • Invalid position • Position reached • Parameter change in execution • Step limit • Blocked by mode • Blocked by process • Blocked by interlocking • Blocked by synchrocheck • Command already in execution • Blocked by health • 1 of n control • Abortion by cancel • Time limit over • Abortion by trip • Object not selected

Monitoring

Client

The protocol element with IEC 61850 Client function performs the following checks and monitoring during the conversion of the commands from IEC 60870-5-101/104 ⇔ IEC 61850.

- Timeout SELECT – EXECUTE

  For SELECT/EXECUTE-commands, the protocol element with IEC 61850 Client function monitors the time between IEC 60870-5-101/104 SELECT-command and the IEC 60870-5-101/104 EXECUTE-command at the interface from the basic system element.

  The monitoring time can be set with the parameter **`IEC61850 | Timeout Select→ Execute`** (as of 61850 Ed.2: **`Connection definition | Timeout SEL → EXE (s)`**).

  If the monitoring time expires, a "negative confirmation of activation" (ACTCON-) is transmitted to the basic system element by the protocol element for the IEC 60870-5-101/104 EXECUTE-command and the command is not transmitted.

- Timeout ACTIVATION – CONFIRMATION

  For commands, the protocol element with IEC 61850 Client function monitors the time between the command transmitted to the IEC 61850 remote station [Server] and the CONFIRMATION received from the IEC 61850 remote station.

  The monitoring time can be set with the parameter **`IEC61850 | Timeout Activation → Confirmation`** (as of IEC 61850 Edition 2: **`Connection definition | Timeout ACT -> CON (s)`**).

  If the monitoring time expires, a "negative confirmation of activation" (ACTCON-) is transmitted to the basic system element by the protocol element.

- Timeout CONFIRMATION – TERMINATION

  For commands, the protocol element with IEC 61850 Client function monitors the time between the CONFIRMATION received from the IEC 61850 remote station [Server] for the transmitted command and the TERMINATION received from the 61850 remote station.

  The monitoring time can be set with the parameter **`IEC61850 | Timeout Confirmation → Termination`** (as of IEC 61850 Edition 2: **`Connection definition | Timeout CON → TERM`**).

  If the monitoring time expires, a "negative termination of activation" (ACTTERM-) is transmitted to the basic system element by the protocol element.

Server

The protocol element with IEC 61850 Server function performs the following checks and monitoring during the conversion of the commands from IEC 61850 ⇔ IEC 60870-5-101/104.

- Timeout SELECT – EXECUTE

  For "Select Before Operate" commands, the protocol element with IEC 61850 Server function monitors the time between the SELECT-command received via IEC 61850 and converted to IEC 60870-5-101/104 and the IEC 60870-5-101/104 EXECUTE (Operate)-command.

  The monitoring time can be set with the parameter **`IEC61850 | Timeout Select→ Execute`** (as of 61850 Ed.2: **`Connection definition | Timeout SEL → EXE (s)`**).

  If the monitoring time expires, the EXECUTE-command is discarded by the protocol element and a "negative confirmation of activation" (ACTCON-) is transmitted to the IEC 61850 Client.

- Timeout ACTIVATION – CONFIRMATION

  For commands that have been converted from IEC 61850 to IEC 60870-5-101/104, the protocol element with IEC 61850 Server function monitors that time between the "Activation" (ACT) and the "Confirmation of Activation" (ACTCON) at the interface to/from the basic system element.

  The monitoring time can be set with the parameter **`IEC61850 | Timeout Activation → Confirmation`** (as of IEC 61850 Edition 2: **`Connection definition | Timeout ACT -> CON (s)`**).

  If the monitoring time expires, a "negative confirmation of activation" (ACTCON-) is transmitted to the IEC 61850 Client by the protocol element.

- Timeout CONFIRMATION – TERMINATION

  For commands that have been converted from IEC 61850 to IEC 60870-5-101/104, the protocol element with IEC 61850 Server function monitors that time between the "Confirmation of Activation" (ACTCON+) and the "Termination of Activation" (ACTTERM) at the interface from the basic system element.

  The monitoring time can be set with the parameter **`IEC61850 | Timeout Confirmation → Termination`** (as of IEC 61850 Edition 2: **`Connection definition | Timeout CON → TERM`**).

  If the monitoring time expires, a "negative termination of activation" (ACTTERM-) is transmitted to the IEC 61850 Client by the protocol element.

Direct control with normal security

Client

Step	IEC 60870-5-101	Direction	IEC 61850 ASCI Service
1	Command Execute, COT = 6	→	Operate Req.
2	Command Execute, COT = 7, PN = 0,1	←	Operate Res±
3	Command Execute, COT = 10		

The following steps are performed:
With reception of the command (COT = 6) on the protocol a timeout is started.

Check	Behaviour
More than 10 commands simultaneously	Confirmation neg. (COT = 7, PN = 1)
Command already running	Confirmation neg. (COT = 7, PN = 1)

Check	Behaviour
“ctlModel” unequal 1, 3	Confirmation neg. (COT = 7, PN = 1)
No Execute command	Confirmation neg. (COT = 7, PN = 1)

If all checks are successful, the command is sent and a timeout for the Confirmation is started.

Evaluation for the Confirmation:

Check	Behaviour
Operate Res+	Confirmation pos. (COT = 7, PN = 0)
Operate Res-	Confirmation neg. (COT = 7, PN = 1)
Timeout	Confirmation neg. (COT = 7, PN = 1)

If a pos. Confirmation was generated, a timeout for the Termination is started.
If a return information was not parameterized, a pos. Termination is sent instantly after the pos. Confirmation.

Evaluation for the Termination:

Check	Behaviour
belonging “stVal” changes	Termination pos. (COT = 10, PN = 0)
Timeout	Termination neg. (COT = 10, PN = 1)

Server

Step	IEC 61850 ASCI Service	Direction	IEC 60870-5-101/104
1	Operate Req	→	Command Execute, COT = 6
2	Operate Res±	←	

The following steps are performed:

Check	Behaviour
Attribute not “Oper”	Operate Res-
Command already running	Operate Res-
1-out-of-n check	Operate Res-
More than 10 commands simultaneously	Operate Res-
xxx.Beh.stVal unequal 1, 3, 5	Operate Res-

The “Access Result” with Operate Res- is always "object-access-denied".
If all checks are successful, an Operate Res+ is sent and the command is forwarded (COT:=6). The transmission of the actual command return information takes place after step 2.

Direct control with enhanced security

Step	IEC 60870-5-101	Direction	IEC 61850 ASCI Service
1	Command Execute, COT = 6	→	Operate Req.
2	Command Execute, COT = 7, PN = 0, 1	←	Operate Res±
3	Command Execute, COT = 10, PN = 0, 1	←	Command Termination

Client

The following steps are performed:

Check	Behaviour
More than 10 commands simultaneously	Confirmation neg. (COT = 7, PN = 1)
Command already running	Confirmation neg. (COT = 7, PN = 1)
“ctlModel” unequal 1, 3	Confirmation neg. (COT = 7, PN = 1)
No Execute command	Confirmation neg. (COT = 7, PN = 1)

If all checks are successful, the command is sent and a timeout for the Confirmation is started.

Evaluation for the Confirmation:

Check	Behaviour
Operate Res+	Confirmation pos. (COT = 7, PN = 0)
Operate Res-	Confirmation neg. (COT = 7, PN = 1)
Timeout	Confirmation neg. (COT = 7, PN = 1)

If a pos. Confirmation was generated, a timeout for the Termination is started.

Evaluation for the Termination:

Check	Behaviour
Command Termination+	Termination pos. (COT = 10, PN = 0)
Command Termination-	Termination neg. (COT = 10, PN = 1)
Timeout	Termination neg. (COT = 10, PN = 1)

Some devices do not send the Command Termination and the command return information in the correct sequence, what results in a wrong command sequence according to IEC 60870-5-101/104 (Termination, return information). To prevent this, by means of a parameter can be defined that the Termination is generated by the command return information and not by the Command Termination.

Server

Step	IEC 60870-5-101	Direction	IEC 61850 ASCI Service
1	Operate Req	→	Command Execute, COT = 6
2	Operate Res±	←	Command Execute, COT = 7, PN = 0, 1
3	Command Termination±	←	Command Execute, COT = 10, PN = 0, 1

The Confirmation and Termination is monitored in each case with a parameter-settable timeout.

The following steps are performed:

Check	Behaviour
Attribute not "Oper"	LastApplError Error = Operator Test Not OK AddCause = Service Error Operate Res-
1-out-of-n check	LastApplError Error = Operator Test Not OK AddCause = 1 of n control Operate Res-
More than 10 commands simultaneously	LastApplError Error = Unknown AddCause = Service Error Operate Res-
Command already running	LastApplError Error = Operator Test Not OK AddCause = Command already in execution Operate Res-
xxx.Beh.stVal unequal 1, 3, 5	LastApplError Error = Operator Test Not OK AddCause = Blocked by Mode Operate Res-

The "Access Result" with Operate Res- is always "Object-access-denied".

If all checks are successful, the command is forwarded (COT = 6).

For the evaluation of the Confirmation the entire MMS packet is temporarily stored and held back as long as a pos. or neg. Confirmation is received from the BSE or a parameter-settable timeout expires.

Check	Behaviour
Confirmation neg. (COT = 7, PN = 1)	LastApplError Error = Operator Test Not OK AddCause = Blocked by process Operate Res-
Timeout	LastApplError Error = Operator Test Not OK AddCause = Time Limit Over Operate Res-
Confirmation pos. (COT = 7, PN = 0)	Operate Res+

The “Access Result” with Operate Res- is always “Object-access-denied”.

The Command Termination± is created by the Termination (COT = 10):

Check	Behaviour
Termination neg. (COT = 10, PN = 1)	LastApplError Error = Operator Test Not OK AddCause = Blocked by process
Timeout	LastApplError Error = Operator Test Not OK AddCause = Time Limit Over
Termination pos. (COT = 10, PN = 0)	Command Termination+

The transmission of the actual command return information takes place between step 2 and 3.

SBO control with enhanced security

Client

Step	IEC 60870-5-101	Direction	IEC 61850 ASCI Service
1	Command Select, COT = 6	→	Select with Value Req.
2	Command Select, COT = 7, PN = 0, 1	←	Select with Value Res±
3	Command Execute, COT = 6	→	Operate Req.
4	Command Execute, COT = 7, PN = 0, 1	←	Operate Res±
5	Command Execute, COT = 10, PN = 0, 1	←	Command Termination±

The following steps are performed:

Check	Behaviour
More than 10 commands simultaneously	Confirmation neg. (COT = 7, PN = 1)
Command already running	Confirmation neg. (COT = 7, PN = 1)
"ctlModel" unequal 4	Confirmation neg. (COT = 7, PN = 1)
No Execute command	Confirmation neg. (COT = 7, PN = 1)

If all checks are successful, the command is sent and a timeout for the Confirmation is started.

Evaluation for the Confirmation:

Check	Behaviour
Select with Value Res+	Confirmation pos. (COT = 7, PN = 0)
Select with Value Res-	Confirmation neg. (COT = 7, PN = 1)
Timeout	Confirmation neg. (COT = 7, PN = 1)

If a pos. Confirmation was generated, a timeout for the Execute command is started.

Evaluation for the Execute command:

Check	Behaviour
Execute command has unequal address as the Select command	Confirmation neg. (COT = 7, PN = 1)
Timeout	Enable command in the memory

If all checks are successful, the command is sent and a timeout for the Confirmation is started.

Check	Behaviour
Operate Res+	Confirmation pos. (COT = 7, PN = 0)
Operate Res-	Confirmation neg. (COT = 7, PN = 1)
Timeout	Confirmation neg. (COT = 7, PN = 1)

If a pos. Confirmation was generated, a timeout for the Termination is started.

Evaluation for the Termination:

Check	Behaviour
Command Termination+	Termination pos. (COT = 10, PN = 0)
Command Termination-	Termination neg. (COT = 10, PN = 1)
Timeout	Termination neg. (COT = 10, PN = 1)

Some devices do not send the Command Termination and the command return information in the correct sequence, what results in a wrong command sequence according to IEC 60870-5-101/104 (Termination, return information). To prevent this, by means of a parameter can be defined that the Termination is generated by the command return information and not by the Command Termination.

Termination of the Command (Deactivation COT = 8)

Check	Behaviour
Command is not running	Deactivate Confirmation neg. (COT = 9, PN = 1)

Server

Only one SBO with value (SBOw) is supported.

Step	IEC 61850 ASCI Service	Direction	IEC 60870-5-101/104
1	Select with Value Req	→	Command Select, COT = 6
2	Select with Value Res±	←	Command Select, COT = 7, PN = 0, 1
3	Operate Req	→	Command Execute, COT = 6
4	Operate Res±	←	Command Execute, COT = 7, PN = 0, 1
5	Command Termination±	←	Command Execute, COT = 10, PN = 0, 1

The Confirmation and Termination is monitored in each case with a parameter-settable timeout. For Cancel exist an own Timeout+ counter.

The following steps are performed, if the written attribute is "SBOw":

Check	Behaviour
1-out-of-n check	LastApplError Error = Operator Test Not OK AddCause = 1 of n control Operate Res-
More than 10 commands simultaneously	LastApplError Error = Unknown AddCause = Service Error Operate Res-

Check	Behaviour
Command already running	LastApplError Error = Operator Test Not OK AddCause = Command already in execution Operate Res-
xxx.Beh.stVal unequal 1, 3, 5	LastApplError Error = Operator Test Not OK AddCause = Blocked by Mode Operate Res-

The “Access Result” with Operate Res- is always “Object-access-denied”.
If all checks are successful, the command (Select) is forwarded (COT = 6).

For the evaluation of the Confirmation the entire MMS packet is temporarily stored and held back as long as a pos. or neg. Confirmation is received from the BSE or a parameter-settable timeout expires.

Check	Behaviour
Confirmation neg. (COT = 7, PN = 1)	LastApplError Error = Operator Test Not OK AddCause = Select Failed Operate Res-
Timeout	LastApplError Error = Operator Test Not OK AddCause = Time Limit Over Operate Res-
Confirmation pos. (COT = 7, PN = 0)	Operate Res+

The “Access Result” with Operate Res- is always “Object-access-denied”.

The following steps are performed, if the written attribute is "Oper":

Check	Behaviour
More than 10 commands simultaneously	LastApplError Error = Unknown AddCause = Service Error Operate Res-
Command is not running	LastApplError Error = Operator Test Not OK AddCause = Object not selected Operate Res-
Select forwarded and also already the Execute	LastApplError Error = Operator Test Not OK AddCause = Command already in execution Operate Res-
xxx.Beh.stVal unequal 1, 3, 5	LastApplError Error = Operator Test Not OK AddCause = Blocked by Mode Operate Res-
SBOw.ctlVal and Oper.ctlVal not equal	LastApplError Error = Operator Test Not OK AddCause = Service Error Operate Res-

The “Access Result” with Operate Res- is always “Object-access-denied”.
If all checks are successful, the command (Execute) is forwarded (COT = 6).

For the evaluation of the Confirmation the entire MMS packet is temporarily stored and held back as long as a pos. or neg. Confirmation is received from the BSE or a parameter-settable timeout expires.

Check	Behaviour
Confirmation neg. (COT = 7, PN = 1)	LastApplError Error = Operator Test Not OK AddCause = Blocked by process Operate Res-
Timeout	LastApplError Error = Operator Test Not OK AddCause = Time Limit Over Operate Res-
Confirmation pos. (COT = 7, PN = 0)	Operate Res+

The "Access Result" with Operate Res- is always "Oject-access-denied".

The Command Termination± is created by the Termination (COT = 10):

Check	Behaviour
Termination neg. (COT = 10, PN = 1)	LastApplError Error = Operator Test Not OK AddCause = Blocked by process
Timeout	LastApplError Error = Operator Test Not OK AddCause = Time Limit Over
Termination pos. (COT = 10, PN = 0)	Command Termination+

The transmission of the actual command return information takes place between step 4 and 5.

The following steps are performed, if the written attribute is "Cancel":

Check	Behaviour
More than 10 commands simultaneously	LastApplError Error = Unknown AddCause = Service Error Operate Res-
Command is not running	LastApplError Error = Operator Test Not OK AddCause = Object not selected Operate Res-
xxx.Beh.stVal unequal 1, 3, 5	LastApplError Error = Operator Test Not OK AddCause = Blocked by Mode Operate Res-

The "Access Result" with Operate Res- is always "Object-access-denied".
If all checks are successful, the command "Deactivate Select" is forwarded (COT = 8).

For the evaluation of the Confirmation the entire MMS packet is temporarily stored and held back as long as a pos. or neg. Confirmation is received from the BSE or a parameter-settable timeout expires.

Check	Behaviour
Confirmation neg. (COT = 7, PN = 1)	LastApplError Error = Operator Test Not OK AddCause = Blocked by process Operate Res-
Timeout	LastApplError Error = Operator Test Not OK AddCause = Time Limit Over Operate Res-
Confirmation pos. (COT = 7, PN = 0)	Operate Res+

The "Access Result" with Operate Res- is always "Object-access-denied".

Control Location [Client only]

If the function “control location” is activated, commands from the protocol element of the central station are only then transmitted to the substation (remote station) if the command has been sent from an enabled control location (originator address).

The setting of the control location itself takes place with a command message in single command format <TI:=45> which is converted on the basic system element to a PRE control message (function 242: set control location). The control location to be enabled/disabled is taken from the originator of the command message.

A command received with an originator address not enabled as control location is not transmitted from the protocol element of the central station and is discarded. For these commands a negative confirmation of activation (ACTCON-) is sent back immediately by the protocol element to the originator address.

Control Location Check

The control location check is used to check whether the control location, specified with the originator address in the spontaneous information object “Command”, has command authority.

The originator address specified in the spontaneous information object “Command” must correspond with the control location previously set.

If the originator address in the spontaneous information object “Command” does not match the control location previously set or if no control location has been preset:

- the command is rejected
- a negative confirmation of the activation is transmitted (ACTCON-)

The control location check is activated as soon as a PRE control message of the type “Set control location” is entered in the PST detailed routing on the basic system element (BSE) for a protocol element (PRE). After startup of the PRE, the BSE sends a PRE control message "Set control location" to the PRE. As a result the control location check function is activated on the PRE.

Set control location

The control location is set on the PRE with a PRE control message (Function = set control location) either globally for all stations or station-selective. The control location can be set or deleted and is applicable for all commands of a protocol element.

On the BSE the control location is set by the spontaneous information object “control location” and is valid for all commands of a protocol element. The assignment of this message takes place in the OPM II of the SICAM TOOLBOX II with the category **`SICAM 1703 + AX 1703 + SICAM A8000 | System functions | Protocol element control message`**.

For the derivation of the control location, the following values in the spontaneous information object “Command” signify the originator address:

Originator address	Control Location
0	Not defined
1 to 127	Remote command
128 to 255	local command

NOTE

The selection of the control location and the generation of the spontaneous information object “Control location” must be programmed in an application program of the open /closed-loop control function.

With the spontaneous information object “Control location” in “single command” format, up to 256 control locations can be set at the same time. The information object “Control location” is converted on the basic system element (BSE) to a PRE control message and passed on to the protocol element.

Due to an information object Control location with the single command state "ON", the originator address is added to the list of enabled control locations (= “Control location enabled”).

Due to an information object "Control location" with the single command state OFF, the originator address is deleted from the list of enabled control locations (= "Control location not enable").

The deleting of the control locations can be carried out either station-selective for each control location individually or globally for all stations and all control locations.

No confirmation (ACTCON) and no termination (ACTTERM) of the command initiation is created for the information object "Control location".

With each startup of the protocol element, all enabled control locations are reset. The control locations are to be set again after every startup of the protocol element.

13.6.5.8 Transmission of Integrated Totals

IEC 61850 does not define any counter concepts like IEC 60870-5-101/104. With IEC 61850 integrated totals can be transmitted as measured values. The transmission can be performed either spontaneously with reports or through interrogation of the selective attributes.

13.6.5.9 File Transfer (Disturbance Records)

In IEC 61850 protection equipment [Server] disturbance records are recorded and stored in the protection equipment as files in IEEE-Comtrade format.

These files can be read out by the protocol element of the master station [Client] with the procedures defined in IEC 61850 (ASCI-Service: File Transfer Model) and transferred to SICAM DISTO for storage/evaluation.

The definition is done with the with the parameter **`IEC 61850 | Server | Disturbance record | Disturbance record type`** (default IEC 61850).

In the system SICAM BC this parameter must be set to "IEC 60870-5-103".

The transmission of disturbance records can be blocked, if the connected Server does not support a file transfer (as of IEC 61850 Edition 2: Parameter **`Connection definition | File transfer`**).

NOTE

A transmission of the disturbance records from the protocol element of the master station to a central control system according to IEC 60870-5-101/104 "Transmission of files in monitoring direction (disturbance record transmission of one protective device)" is presently not supported!

According to IEC 61850 the disturbance records are stored in the server in the file directory "COMTRADE".

For each disturbance record the following files are created in this directory:

- Header-File (File-Extension .HDR) general information about the station (ASCII)
- Configuration-File (File-Extension .CFG) general info about the disturbance record (ASCII)
- Data-File (File-Extension .DAT) Information of analog, digital channels (BINARY)

or optionally

- ZIP-File (File-Extension .ZIP) all files of a disturbance record as ZIP-File (for each disturbance event a separate ZIP-file)

The filename of the disturbance record file is not fixed, but normally contains the fault number and possibly additional information for the identification of the fault or the station.

IEC 61850-7-2 Model	IEC 61850-7-2 Service	Note
FILE transfer	GetFile	
	SetFile	
	DeleteFile	
	GetFileAttributeValues	

Transfer of Disturbance Records to SICAM DISTO

With the IEC 61850 protocol element [Client] disturbance records can be read out from IEC 61850 devices [Server] and transferred to SICAM DISTO for storage/evaluation. Disturbance records are stored by SICAM DISTO in the format transmitted by the protocol element either as single files in IEEE Comtrade format (**.HDR, *,CFG, *.DAT*) or as file in zipped format (**.ZIP*).

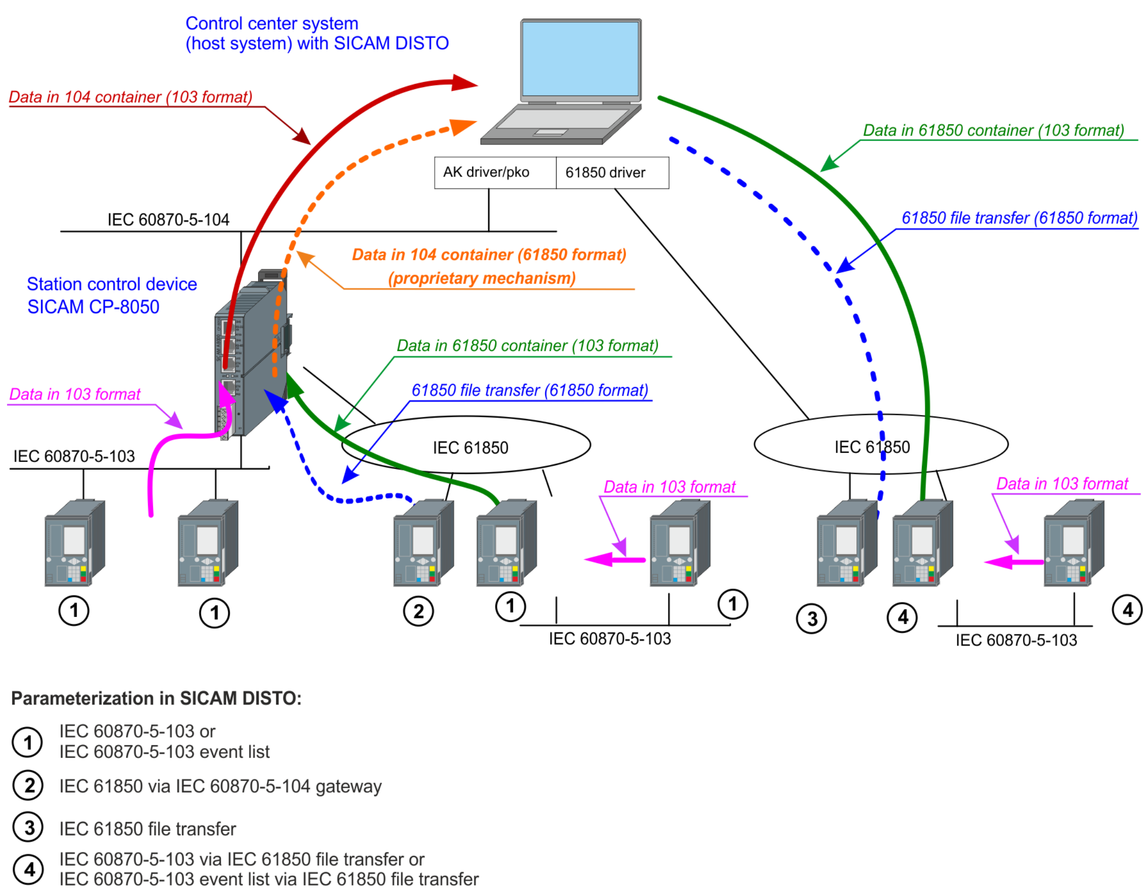
The data transmission between the protocol element and SICAM DISTO is carried out with a proprietary procedure for the transmission of files. The transmission of all necessary information takes place with SICAM RTUs user data containers <TI:=142> in the private range of IEC 60870-5-101/104.

For the transmission of disturbance records, a separate "channel" is defined between the protocol element and SICAM DISTO for every client with SICAM RTUs user data containers (="disturbance record containers"). For each channel a SICAM RTUs user data container (disturbance record container) in transmit direction (to SICAM DISTO) and a SICAM RTUs user data container (disturbance record container) in receive direction (from SICAM DISTO) is to be defined.

The assignment of the IEC 60870-5-101/104 message address for the spontaneous information object "disturbance record container" is carried out in the OPM II in the master station in the process-technical parameterization in transmit direction (to SICAM DISTO) with the category **`firmware/ ET03/ Fault_record_Trans_IEC61850`** and in receive direction (from SICAM_DISTO) with the category **`firmware/ ET03/Fault_record_Trans_IEC61850`**.

NOTE

Redundant configurations with SICAM DISTO are not supported!



[dw_61850_disto_configuration, 1, en_US]

Figure 13-10 Configurations with SICAM DISTO

Sequence of the Disturbance Record Transmission (between Client and Server)

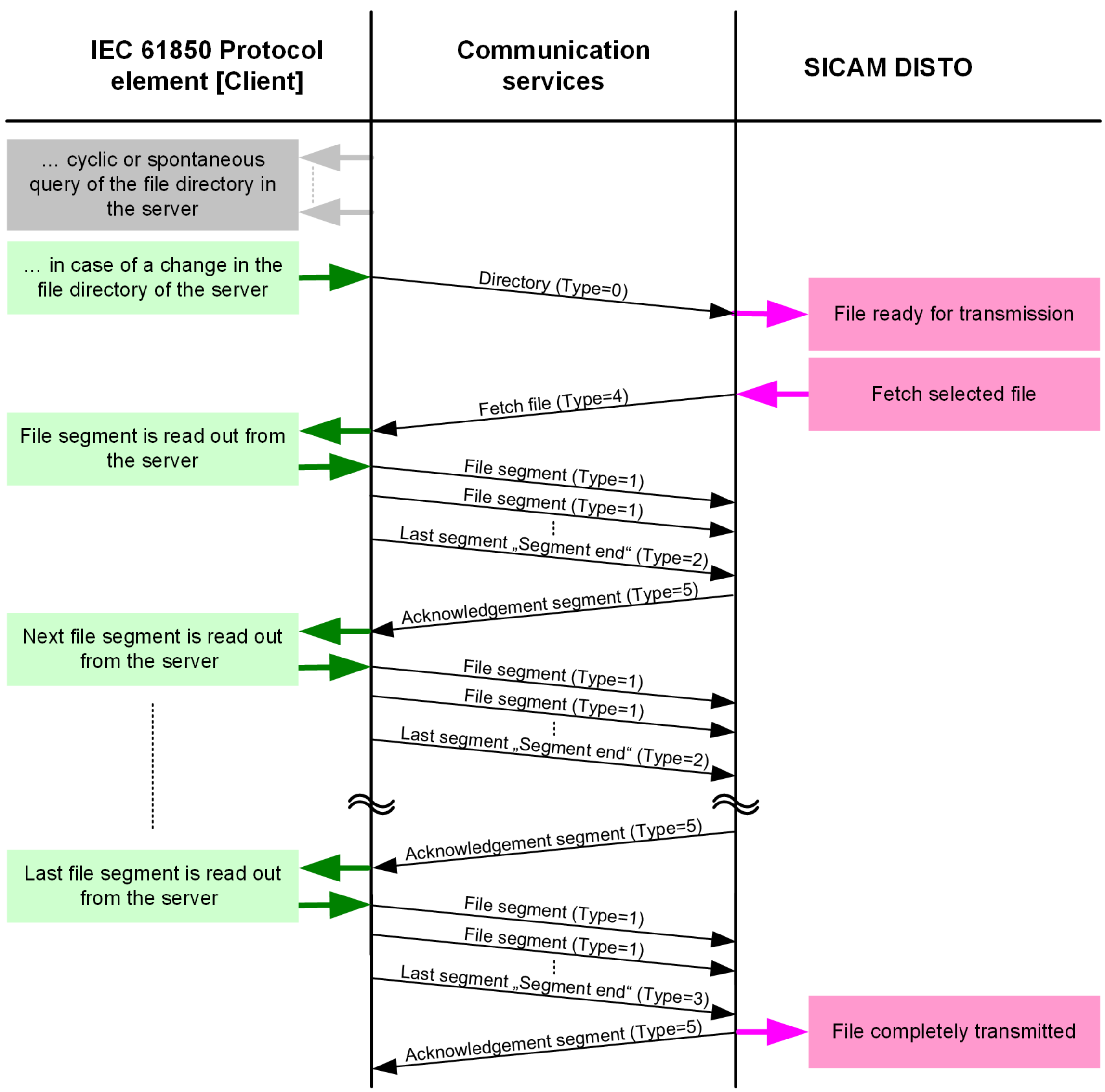
The file directory in the server is interrogated cyclic (every 3 minutes) by the protocol element [Client] or spontaneously with a request from SICAM DISTO (e.g. with restart of SICAM DISTO).

If the attribute "RcdMade" (RecordMade = "disturbance record has been created") of the Logical Node "RDRE" (Disturbance Recorder Function) is available in the server, this can be entered in the SIP message address conversion in receive direction.

With a change of the attribute to "TRUE" or with a change of the time, the protocol element spontaneously executes an interrogation of the file directories of the server – as a result newly stored disturbance records can be interrogated quickly and transmitted.

So that the transmission of spontaneous information is not delayed during a fault by the transmission of disturbances records, the interrogation of the file directories by the protocol element first takes place after a delay of 10 seconds.

After the transmission of a disturbance record has concluded or with cancelation of the disturbance record transmission to SICAM DISTO, a renewed interrogation of the file directories is performed automatically by the protocol element.



File transfer between protocol element and SICAM DISTO

[dw_ET03_Ablauf_zu_DISTO, 1, en_US]

Transmission of Disturbance Records [SICAM RTUs = Server]

NOTE

The protocol element for IEC 61850 [Server] does not presently support any transfer of disturbance records according to IEC 61850!

13.6.6 Function for the Support of Redundant Communication Routes

To increase the availability central stations as well as remote terminal units can be implemented redundantly.

In this section, not the possible redundancy concepts themselves that can be realized are described, rather only those functions supported by the protocol element for the support of redundant systems or communication routes.

The following redundancy modes are supported:

- Protocol redundancy (Client only)
- Server redundancy (Server only)
- GOOSE redundancy (Server only)

13.6.6.1 Protocol redundancy

With the redundancy mode protocol redundancy, one remote terminal unit is connected with one or several master stations over several logical connections. The data transmission takes place over all connections.

The switchover of the redundancy state (ACTIVE ⇔ PASSIVE) takes place system-internal through redundancy control messages.

Redundancy function of the standard redundancy mode:

- When using GOOSE in transmit direction (Publisher) special functions will be executed during redundancy switchover to avoid failures in the connected devices (Subscriber) (see section GOOSE data transmission (server only) / GOOSE redundancy).
- All data received from the LAN protocol element in the redundancy state PASSIVE are marked by the basic system element in the message status with the redundancy status PASSIVE.
- The switchover to PASSIVE takes place globally per LAN protocol element and not selectively per connection

NOTE

Redundant configurations with SICAM DISTO are not supported!

13.6.6.2 Server Redundancy

Special functions are implemented in the protocol element for the support of redundant configurations of SICAM RTUs devices with IEC 61850 Server function.

So that a fast switchover between the servers can be performed during redundancy switchover from PASSIVE → ACTIVE, the connection to both Servers must be established and the IEC 61850 communication must be completely initialized.

The IEC 61850 Client has no information which Server is ACTIVE. The transmission of spontaneous data (Reports) is only carried out by the active server.

After initialization is complete, the spontaneous transmission of data (Reports) is deactivated by the protocol element of the passive server.

The switchover of the redundancy state ACTIVE ↔ PASSIVE takes place system-internal through redundancy control messages.

Functions in the redundancy state PASSIVE:

- Data in transmit direction continue to be received from the basic system and are entered into the internal process image of the protocol element.
- Spontaneous data and GI-data in transmit direction (Reports) are no longer transmitted by the protocol element
- Data in receive direction continue to be passed on from the protocol element to the basic system element and identified by this with the PASSIVE-Bit.

Functions during the switchover from the redundancy state PASSIVE → ACTIVE:

- The spontaneous transmission of data in transmit direction (Reports) is activated.
- A general interrogation is carried out to the basic system element.

NOTE

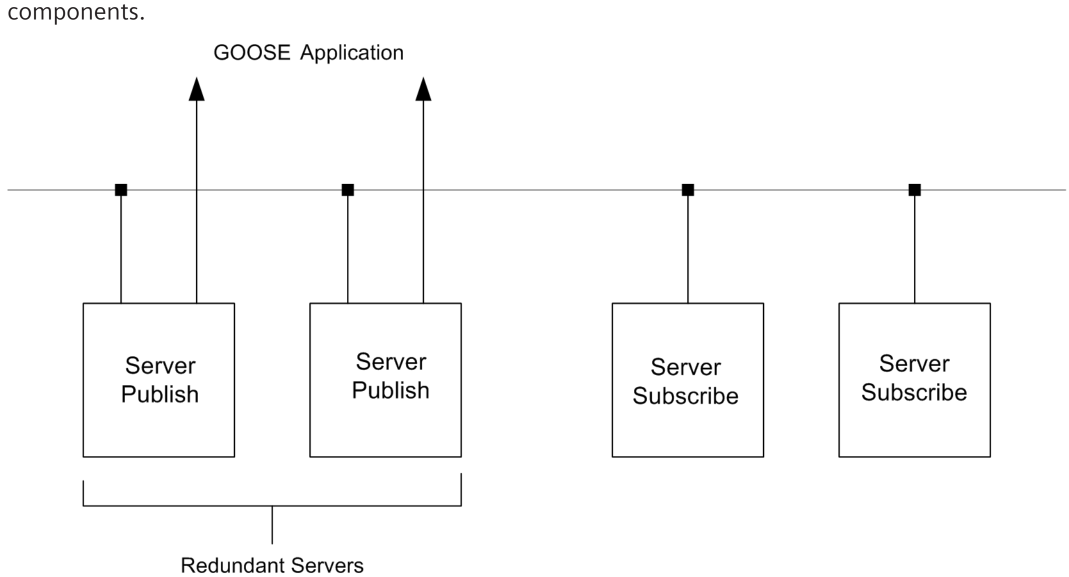
The cyclic interrogation of attributes must not be used with server redundancy (this can lead to inconsistent states in the client)!

The server redundancy is to be activated in the protocol element with IEC 61850 Server function with the parameter **`IEC61850 | Server | Redundancy for Server`**.

13.6.6.3 GOOSE Redundancy

For the support of redundant configurations of SICAM RTUs components with IEC 61850 Server function, special functions are implemented in the protocol element for the GOOSE message transfer during transmission (Publisher), which prevent a possible failure of the GOOSE messages at the receivers (Subscriber) in the connected devices during redundancy switchover.

These functions are then required, if the same GOOSE applications are sent in the redundant SICAM RTUs components.



For redundant devices with GOOSE publisher function and the same parameterized GOOSE applications (i.e. same MAC-address is used by different devices) always only 1 device may be active at one time. The passive device stops the transmission of GOOSE messages.

The special functions for GOOSE redundancy are to be enabled with the parameter **`IEC61850 | Server | Goose | Redundancy for goose (Publish)`** .

The switchover of the redundancy state takes place system-internal by means of redundancy control messages.

Functions during the switchover from the redundancy state ACTIVE → PASSIVE:

- All GOOSE applications are transmitted again by the server becoming passive (Publisher) before the switchover with the "hold time in the message" (= 10 seconds), in order that all Subscribe Servers do not detect a failure during a switchover. After that, the GOOSE applications are switched off (Publish). As a result the failure monitoring time for GOOSE applications is retriggered again in the connected devices before the switchover.

Functions in the redundancy state PASSIVE:

- Transmission of GOOSE messages is stopped.
- 61850 Server + Client functions continue to be executed.

Functions during the switchover from the redundancy state PASSIVE → ACTIVE:

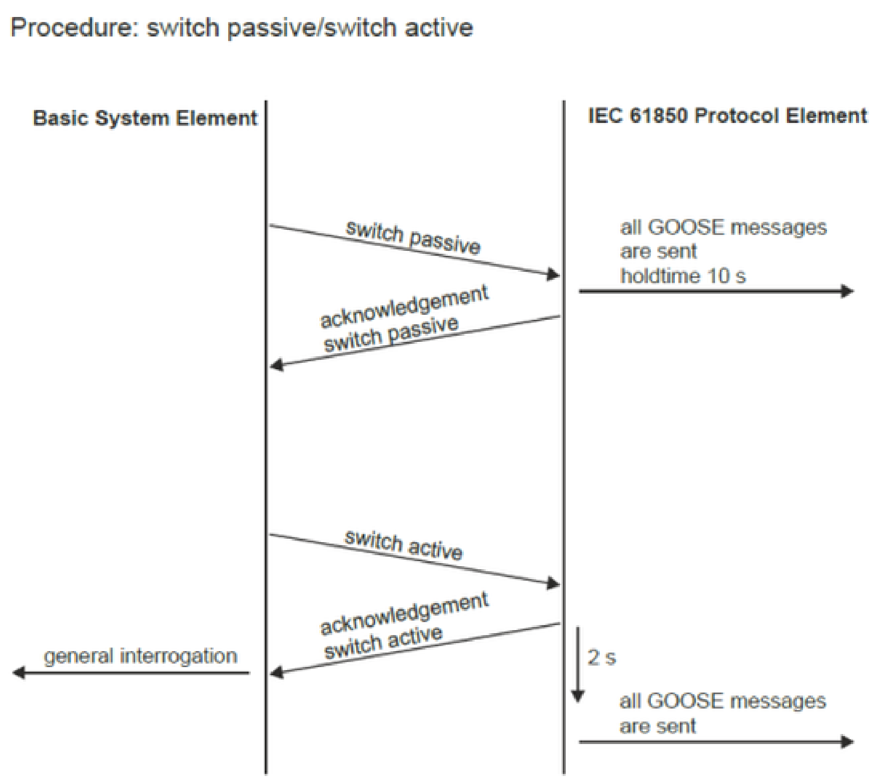
- After switchover, all GOOSE applications are only transmitted by the ACTIVE Server (Publisher) after a delay time of 2 seconds.

NOTE

IEC 61850 Ed.1: The “State Number” in the GOOSE message (change counter) is not synchronized between the redundant devices. As a result, during redundancy switchover (without change of the data state) a change in connected devices can be detected.

The “State Number” is not evaluated by the protocol element!

IEC 61850 Ed.1: The “State Number” in the GOOSE message (change counter) is synchronized between the redundant devices. This enables a faultless switching over without detection of additional changed data.



13.6.7 Protocol element control and return information

13.6.7.1 Protocol Element Control Messages

Protocol element control messages can control protocol element internal functions. On the basic system element, IEC 60870-5-101/104 `messages with process information in the control direc-`

tion are converted to protocol element control messages and transmitted to the selected protocol element (see *13.1.4.10 Protocol Element Control Messages*).

Possible Client functions

Function	PST Detail Routing				Note
	SF	Station	Z-Par	FI	
Start connection to server ("Initiate")	128	0 to 99	–		Connection Setup Start connection to server controlled from 61850 Client→61850 Server
Start connection to server ("Conclude")	129	0 to 99	–		Link Disconnection Stop connection to server controlled from 61850 Client→61850 Server A pending station fault is not changed when the connection is terminated
Start GOOSE application	130	0 to 99	GOOSE-Index 0 to 99		The station number must be a server station.
Stop GOOSE application	131	0 to 99	GOOSE-Index 0 to 99		The station number must be a server station.
Send (general) interrogation command	240	–	–		This function is processed on the BSE and sent to the protocol element as system message and not using PRE control message! CASDU = BROADCAST
Set control location [217]	242	125	65535		SCS = <ON>: set control location (HKA) (all stations)
			65535		SCS = <OFF>: set control location (HKA) (all stations)
		0 to 99	65535		SCS = <ON>: set control location (HKA) (selective station)
			65535		SCS = <OFF>: set control location (HKA) (selective station)
Send (general) interrogation command	244		CASDU		This function is processed on the BSE and sent to the protocol element as system message and not using PRE control message! CASDU = selective

Legend:

SF	Control_function_(PRE)
Station	Station number
	0 to 99 ... Station 0 to 99 of the selected protocol element
	125 ... all stations of the selected protocol element (global)
Z-Par	Additional parameter_(PRE)
FI	Edge

217 The control location can only be set by a single command <TI:=45>.

SCS Single command state
HKA Originator address Control location (HKA) = 0 to 255

Set control location:

- For "Set control location" in PST detailed routing in filed **`additional parameter_(PRE)`** (Z-Par) = ***65535*** must be entered.
- If a PRE control message for "Set control location" is included in the PST detailed routing on the BSE, the BSE will send a PRE control message "Set control location" with additional parameter = ***65535*** after startup of the PRE to enable control location function on PRE.
- The control location (HKA) to be enabled/disabled is taken by the BSE firmware from the originator of the command message used as PST control message and sent to PRE as PRE control message with additional parameter set as follows:
  SCS = <ON> additional parameter in PRE control message = HKA
  SCS = <OFF> additional parameter in PRE control message = HKA + 256

13.6.7.2 Protocol element return information

Protocol element return information is internal status information of the protocol elements which is transmitted spontaneously and in the event of a general interrogation with internal message formats from the protocol element to the basic system element. On the basic system element, the protocol element return information items (see 13.1.4.11 Protocol Element Return Information) are converted to IEC 60870-5-101/104 messages with process information in the monitoring direction.

Supported Protocol Element Return Information

Protocol element return information `Return_information_function_(PRE)`	Station	ETI5 [Client]	ETI5 [Server]
Station status	0 to 99	✓	✓
Station failure	0 to 99	✓	✓

13.6.8 Message Conversion

13.6.8.1 General

Data in control direction is transferred from the basic system element to the protocol element in the SICAM A8000 internal IEC 60870-5-101/104 IEC 60870-5-101/104 format (unblocked). These data points are entered by the protocol element in the internal IEC 61850 data model. The data transmission from this data model takes place according to IEC 61850.

Data in monitoring direction is received from the protocol element according to the transmission procedure according to IEC 61850 converted by the protocol element to the internal IEC 60870-5-101/104 format and then transferred to the basic system element.

The address conversion from IEC 60870-5-101/104 ↔ IEC 61850 (address and message format) takes place in the SICAM TOOLBOX II, OPM II with the "SIP Message Address Conversion". The "mapping" of IEC 61850 attributes to IEC 60870-5-101/104 type identifications takes place through the parameterization of the address conversion.

In the SIP message address conversion the following categories are available:

Protocol Element with IEC 61850 Client Function
firmware /Client_Trans_IEC61850
firmware /Client_Rec_IEC61850
firmware /Fault_record_Trans_IEC61850
firmware /Fault_record_Rec_IEC61850

Protocol Element with IEC 61850 Server Function
firmware /Server_Trans_IEC61850
firmware /Server_Rec_IEC61850
firmware /Server_Trans_Goose_IEC61850 [218]
firmware /Server_Rec_Goose_IEC61850 [218]
firmware /Server_Trans_default_value_IEC61850 [218]

Protocol Element with IEC 61850 Client Function

In receive direction, with a change of state/time/quality, data is converted from IEC 61850 to IEC 60870-5-101/104 and transferred to the basic system element.

On reception of data, the following time information is taken for the message conversion:

- Time of the ".t" attribute has changed since the last transmission
  → Time of the ".t" attribute is applied
- Time of the ".t" attribute has not changed since the last transmission, time of the report is available (= time of the creation of the report in the server)
  → Time of the report is applied
- Time of the ".t" attribute has not changed since the last transmission, time of the report is not available (= time of the creation of the report in the server)
  → Current time is applied

NOTE

A general interrogation is always replied to by the protocol element from the internal process image of the protocol element with the actual time.

Protocol Element with IEC 61850 Server Function

When data change, with IEC 61850 all attributes of the same "Functional Constraint" group are always transmitted. If for instance the binary information state ***stVal*** changes from Pos, then the other data attributes of the same Functional Constraint (ST = status information) such as for instance "q" and "t" are also transmitted, even if these have not changed.

13.6.8.2 Conversion IEC 60870-5-101/104 ↔ IEC 61850

IEC 61850: Basic Types

Name	Range
BOOLEAN	TRUE (1), FALSE (0)
INT8	–128 to +127
INT16	-32768 to + 32767
INT24	–8388608 to +8388607
INT32	–2147483648 to +2147483647
INT128	-2127 bis +2127 - 1
INT8U	0 to 255
INT16U	0 to 65535
INT24U	0 to 16777215
INT32U	0 to 4294967295
FLOAT32	IEEE 754

[218] Edition 1 only

Name	Range
FLOAT64	IEEE 754
ENUMERATED	Enumeration
BOOLEAN	Enumeration
OCTET STRING	String
VISIBLE STRING	String

IEC 61850: Common ACSI Types

IEC 61850: Time Quality

IEC 61850			IEC 60870-5-101/104	supported	
Attribute Name	**Type**	**Values**		**Ed.1**	**Ed.2**
LeapSecondsKnown	BOOLEAN			[219]	–
ClockFailure	BOOLEAN		CP56Time2a IV	✓	✓
ClockNot Synchronized	BOOLEAN		CP56Time2a IV	✓	✓[220]
TimeAccuracy	BOOLEAN	significant bits in FractionOfSeconds	1 ms resolution matches approx. 10 bits	✓	✓

Edition 2: applies only for Client

IEC 61850: Time Stamp

IEC 61850			IEC 60870-5-101/104	supported	
Attribute Name	**Type**	**Values**		**Ed.1**	**Ed.2**
SecondsSinceEpoch	INT32	Seconds since 01.01.1970 00:00	CP56Time2a	✓	✓
FractionOfSeconds	INT24U	1 / 16777215 second fraction	CP56Time2a	✓	✓
TimeQuality	TimeQuality			✓	✓

Edition 2: applies only for Client

The time format is UTC time. Weekday and daylight-saving time flag (SU) are not considered.

IEC 61850: Common Data Attribute Types

IEC 61850: Quality

Conversion of quality from IEC 61850 ↔ IEC 60870-5-101/104 at: Parameter **`[PRE] advanced parameters | conversion of quality identifier`** = ***`SICAM RTUs`***

IEC 61850			IEC 60870-5-101/104	supported	
Attribute Name	**Type**	**Values**		**Ed.1**	**Ed.2**
validity	BOOLEAN	good invalid reserved questionable	NT = 0 NT = 1 IV	✓	✓

[219] applies only for Server

[220] applies only in receive direction

IEC 61850			IEC 60870-5-101/104	supported	
detailQual overflow	PACKED LIST BOOLEAN		 OV[221][222]	✓	✓
outOfRange badReference oscillatory failure oldData inconsistent inaccurate	BOOLEAN BOOLEAN BOOLEAN BOOLEAN BOOLEAN BOOLEAN BOOLEAN		[223]	✓	✓
source	BOOLEAN	process substituted	SB = 0 SB = 1	✓	✓
test	BOOLEAN		T	✓	✓
operatorBlocked	BOOLEAN		BL	✓	✓

Conversion of quality from IEC 61850 ↔ IEC 60870-5-101/104 at: Parameter **[PRE] advanced parameters | conversion of quality identifier** = ***according to IEC61850-80-1/2016***

IEC 61850			IEC 60870-5-101/104	supported	
Attribute Name	**Type**	**Values**		**Ed.1**	**Ed.2**
validity	BOOLEAN	good invalid reserved questionable	IV = 0 IV = 1 NT	✓	✓
detailQual overflow	PACKED LIST BOOLEAN		 OV[224], IV	✓	✓
outOfRange badReference oscillatory failure oldData inconsistent inaccurate	BOOLEAN BOOLEAN BOOLEAN BOOLEAN BOOLEAN BOOLEAN BOOLEAN		IV, NT[225] IV, NT[225] IV, NT[225] IV[225] NT[225] NT[225] NT[225]	✓	✓
source	BOOLEAN	process substituted	SB = 0 SB = 1	✓	✓
test	BOOLEAN		T	✓	✓
operatorBlocked	BOOLEAN		BL	✓	✓

221 applies only for Client: CY with TI 37; if only the OV bit of “detailQuality” is set, then the NT resp. IV bit is reset; further the OV bit is set with TI 34, TI 35, if the value is out of the valid range of the respective type identification (TI 34: -1 to +1, TI 35: -32768 to +32767)

222 Server: with OV = 1 “validity” is set to invalid additionally

223 applies only for Client: all these bits are ORed to the IV bit

224 applies only for Client: CY with TI 37; if only the OV bit of “detailQuality” is set, then the NT resp. IV bit is reset; further the OV bit is set with TI 34, TI 35, if the value is out of the valid range of the respective type identification (TI 34: -1 to +1, TI 35: -32768 to +32767)

225 applies only for Client

IEC 61850: AnalogueValue

IEC 61850			IEC 60870-5-101/104	supported	
Attribute Name	**Type**	**Values**		**Ed.1**	**Ed.2**
i	INT32			–	✓
f	FLOAT32			✓	✓

Edition 2: applies only for Client

IEC 61850: Vector

IEC 61850			IEC 60870-5-101/104	supported	
Attribute Name	**Type**	**Values**		**Ed.1**	**Ed.2**
mag	AnalogueValue			✓	✓
ang	AnalogueValue			–	✓

Edition 2: applies only for Client

IEC 61850: Originator

IEC 61850			IEC 60870-5-101/104	supported	
Attribute Name	**Type**	**Values**		**Ed.1**	**Ed.2**
orCat	ENUMERATED	not-supported bay-control station-control remote-control automatic-bay automatic-station automatic-remote process	See *IEC 61850: Common Data Classes, Page 1142*	✓	✓
orIndent	STRING64			✓[226] D[227]	✓[226]

Description of the originator: refer to *Control Model, Page 1116*, Causes of Transmission (origin).

Server

The attribute “orIndent” is set to the fixed value “ETI5: nnn.nnn.nnn.nnn Rxxx Kyyy Origin:zzz” upon change of the datapoint due to a event (spontaneous).

nnn.nnn.nnn.nnn = IP address

Rxxx = region number

Kyyy = component number

zzz = origin address from IEC 60870-5-101/104

Logging of the Remote Commands in the Local Control:

In order to log remote commands in the local control, all remote commands must be sent additionally to the local control. However, this is according to IEC 61850 (Client/Server) not possible.

To be able to use this function anyway, the “orIndent” attribute of the return information is used thereto. This function is only then possible, if commands have a return information (coherence between ctlVal and stVal).

Example:

VLC01/XCBR1.Pos.ctlVal (command)

VLC01/XCBR1.Pos.stVal (return information)

[226] applies only for Client: all these bits are ORed to the IV bit

[227] applies only for Server

All Activation, Confirmation, Termination messages are indirectly via a change of the orIdent attribute spontaneous transmitted, whereby the state, the quality and the time of the return information do not change (no change of the information state).

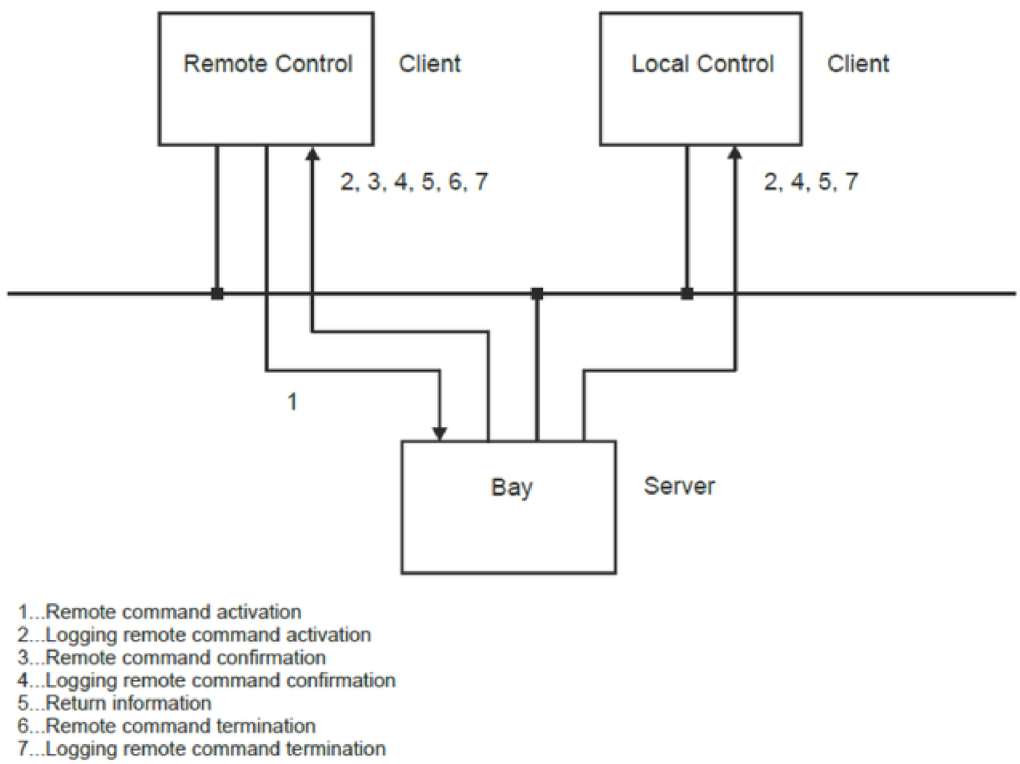
ETI5LOG: COT:cccb Value:d Origin:zzz

ccc	Cause of transmission (6, 7, 10)		
b	"P" for positive, "N" for negative		
d	Data	TI 45, 46:	"0" = OFF ", 1" = ON
		TI 47:	"0" = LOWER, "1"= HIGHER
		TI 49, 50:	decimal value (-12, 12.3, 1.2E-2)
zzz	Origin address of the command		

NOTE

This function is for CDCs of the type INC (Ed.1) or ENC (Ed.2) (e. g., Mod.ctlVal) not available if the single states are not splitted to different single resp. double commands. In this case the first found command is used in the SIP message address conversion for the logging.

Example:



[goose_command_logging, 2, en_US]

IEC 61850: Step position with transient indication

IEC 61850			IEC 60870-5-101/104	supported	
Attribute Name	Type	Values		Ed.1	Ed.2
posVal	INT8	−64 to +63	VTI	✓	✓
transInd	BOOLEAN		VTI	✓	✓[228]

228 for transInd a single-point information (TI 30) can be generated in the Client

IEC 61850: Common Data Classes

Client Transmit Direction → Server Receive Direction Server Transmit Direction → Client Receive Direction

The IEC 60870-5-101/104 cause of transmission (COT) is not considered with the conversion to Common Data lasses. Controllable Common Data Classes are thereby an exception and the conversion is described there. Controllable Common Data Classes are thereby an exception and the conversion is described there.

In the column "Rout" (routing SICAM TOOLBOX II) is marked which attribute must be used for the routing. Thereby, upon ambiguousness the corresponding IEC 60870-5-101/104 type identifications are given.

Client Receive Direction ← Server Transmit Direction

All messages in direction IEC 61850 → IEC 60870-5-101/104 are transmitted to the the basic system element with COT = 3 (SPONTANEOUS). The origin address is set to 0.

If data is received, with that the time is not written, this data is time tagged with the SICAM RTUs time.

Server Receive Direction ← Client Transmit Direction

All messages in direction IEC 61850 → IEC 60870-5-101/104 are transmitted to the Ax 1703 system with COT = 6 (ACT), as far as they are CO (otherwise COT = 3). The origin address is set to 0, except the Client runs the same firmware.

If data is received, with that the time is not written, this data is time tagged with the SICAM RTUs time.

Overview of the supported Common Data Classes [CDC]

IEC 61850 Common Data Class [CDC]		FC	IEC 60870-5-101/104[229]		Cs	Se	Ce	Ss	Ss_G	Se_G
SPC	Controllable Single Point	CO	<TI:=30> <TI:=31>	Single-point information Double-point information	✓	✓	–	–	–	–
			<TI:=45> <TI:=46>	Single command Double command	✓	✓	–	–	–	–
		ST	<TI:=30> <TI:=31>	Single-point information Double-point information	–	–	✓	✓	✓	✓
DPC	Controllable Double Point	CO	<TI:=30> <TI:=31>	Single-point information Double-point information	✓	✓	–	–	–	–
			<TI:=45> <TI:=46>	Single command Double command	✓	✓	–	–	–	–
		ST	<TI:=30> <TI:=31>	Single-point information Double-point information	–	–	✓	✓	✓	✓

229 all with time mark CP56Time2a; only TI 30 and TI 31 are GI capable

IEC 61850 Common Data Class [CDC]		FC	IEC 60870-5-101/104[229]		Cs	Se	Ce	Ss	Ss_G	Se_G
INC	Controllable Integer Status	CO	<TI:=30> <TI:=31>	Single-point information Double-point information	✓	–	–	–	–	–
			<TI:=45> <TI:=46>	Single command Double command	✓	✓	–	–	–	–
			<TI:=49> <TI:=50>	Setpoint command, scaled[230] setpoint command, floating point[230]	✓	✓	–	–	–	–
		ST	<TI:=30> <TI:=31>	Single-point information Double-point information	–	–	✓	✓	✓	✓[231]
			<TI:=35> <TI:=36>	measured value, scaled[230] measured value, floating point[230]	–	–	✓	✓	✓	✓[231]
ENC	Controllable Enumerated Status	CO	<TI:=30> <TI:=31>	Single-point information Double-point information	✓[231]	–	–	–	–	–
			<TI:=45> <TI:=46>	Single command Double command	✓[231]	✓[231]	–	–	–	–
			<TI:=49> <TI:=50>	Setpoint command, scaled[230] setpoint command, floating point[230]	✓[231]	✓[231]	–	–	–	–
		ST	<TI:=30> <TI:=31>	Single-point information Double-point information	–	–	✓[231]		✓[231]	✓[231]
			<TI:=35> <TI:=36>	measured value, scaled[230] measured value, floating point[230]	–	–	✓[231]		✓[231]	✓[231]
APC	Controllable Analog Set	CO	<TI:=49> <TI:=50>	Setpoint command, scaled[230] setpoint command, floating point[230]	✓[231]	✓[231]	–	–	–	–
		ST	<TI:=35> <TI:=36>	measured value, scaled[230] measured value, floating point[230]	–	–	✓[231]	✓[231]	–	–
SPS	Single-Point Status	ST	<TI:=30>	Single-point information	–	–	✓	✓	✓	✓
DPS	Double-Point status	ST	<TI:=31>	Double-point information	–	–	✓	✓	✓	✓
INS	Integer Status	ST	<TI:=30> <TI:=31>	Single-point information Double-point information	–	–	✓	✓	✓	✓[231]
			<TI:=35> <TI:=36>	measured value, scaled[230] measured value, floating point[230]	–	–	✓	✓	✓	✓[231]
ENS	Enumerated Status	ST	<TI:=30> <TI:=31>	Single-point information Double-point information	–	–	✓[231]	✓[231]	✓[231]	✓[231]
			<TI:=35> <TI:=36>	measured value, scaled[230] measured value, floating point[230]	–	–	✓[231]	✓[231]	✓[231]	✓[231]

229 all with time mark CP56Time2a; only TI 30 and TI 31 are GI capable

IEC 61850 Common Data Class [CDC]		FC	IEC 60870-5-101/104[229]		Cs	Se	Ce	Ss	Ss_G	Se_G
ACT	Protection Activation Information	ST	<TI:=30>	Single-point information	–	–	✓	✓	✓	✓
			<TI:=38> <TI:=39> <TI:=40>	Event of protection equipment Blocked activation of the protection Blocked triggering of the protection	–	–	✓	✓	✓	✓
ACD	Directional Protection Activation Information	ST	<TI:=30>	Single-point information	–	–	✓	✓	✓	✓
			<TI:=31>	Double-point information	–	–	✓	–	–	–
			<TI:=38> <TI:=39> <TI:=40>	Event of protection equipment Blocked activation of the protection Blocked triggering of the protection	–	–	✓	✓	✓	✓
SGCB	Setting Group Control Block	SP	<TI:=30> <TI:=31>	Single-point information Double-point information	✓	–	✓	✓	–	–
			<TI:=35> <TI:=36>	Measured value, scaled value[230] measured value, floating point[230]	–	–	✓	✓	–	–
			<TI:=45> <TI:=46>	Single command Double command	✓	✓	–	–	–	–
			<TI:=49> <TI:=50>	Setpoint command, scaled[230] setpoint command, floating point[230]	✓	✓	–	–	–	–
BCR	Binary Counter Reading	ST	<TI:=37>	Integrated total	–	–	✓	✓	–	–
BSC	Binary Controlled Step Position	ST	<TI:=30> <TI:=32>	Single-point information Step position information[230]	–	–	✓	✓	–	–
		CO	<TI:=47>	Regulating step command	✓	✓	–	–	–	–
ISC	Integer Controlled Step Position	ST	<TI:=30> <TI:=32>	Single-point information Step position information[230]	–	–	✓	✓	–	–
		CO	<TI:=49> <TI:=50>	Setpoint command, scaled[230] setpoint command, floating point[230]	✓	✓	–	–	–	–
ASG	Analogue Setting	SP	<TI:=35> <TI:=36>	measured value, scaled measured value, floating point	–	–	✓	✓[231]	–	–
			<TI:=49> <TI:=50>	Setpoint command, scaled[230] setpoint command, floating point[230]	✓	✓[231]	–	–	–	–
ING	Integer Setting	SP	<TI:=35> <TI:=36>	measured value, scaled measured value, floating point	–	–	✓	✓[231]	–	–
			<TI:=49> <TI:=50>	Setpoint command, scaled[230] setpoint command, floating point[230]	✓	✓[231]	–	–	–	–

229 all with time mark CP56Time2a; only TI 30 and TI 31 are GI capable

IEC 61850 Common Data Class [CDC]		FC	IEC 60870-5-101/104[229]		Cs	Se	Ce	Ss	Ss_G	Se_G
MV	Measured Value	MX	<TI:=34>	measured value, normalized	–	–	✓	✓	✓	✓
			<TI:=35>	measured value, scaled						
			<TI:=36>	Measured value Floatingpoint						
CMV	Complex Measured Value	MX	<TI:=34>	measured value, normalized	–	–	✓	✓	✓	✓
			<TI:=35>	measured value, scaled						
			<TI:=36>	measured value, floating point						
SAV	Sampled Value	MX	<TI:=34>	measured value, normalized	–	–	✓	✓	✓	✓
			<TI:=35>	measured value, scaled						
			<TI:=36>	measured value, floating point						
WYE	Collection Of Measurands	MX	<TI:=34>	measured value, normalized	–	–	✓	✓	✓	✓
			<TI:=35>	measured value, scaled						
			<TI:=36>	measured value, floating point						
DEL	Delta	MX	<TI:=34>	measured value, normalized	–	–	✓	✓	✓	✓
			<TI:=35>	measured value, scaled						
			<TI:=36>	measured value, floating point						
SEQ	Sequence	MX	<TI:=34>	measured value, normalized	–	–	✓	✓	✓	✓
			<TI:=35>	measured value, scaled						
			<TI:=36>	measured value, floating point						
DPL	Device Name Plate		only used on the protocol firmware		–	–	–	✓	–	–
LPL	Logical Node Name Plate		only used on the protocol firmware		–	–	–	✓	–	–
SPG	Single Point Setting	SP	<TI:=30>	Single-point information	–	–	✓	✓	–	–
			<TI:=45>	Single command	✓	✓	–	–	–	–
ENG	Enumerated Status Setting	SP	<TI:=30>	Single-point information	–	–	✓	✓	–	–
			<TI:=45>	Single command	✓	✓	–	–	–	–

Legend:

FC	Functional Constraint
Cs	Client in Transmit Direction
Se	Server in Receive Direction
Ce	Client in Receive Direction
Ss	Server in Transmit Direction
Ss_G	GOOSE-Server in Transmit Direction
Se_G	GOOSE-Server in Receive Direction

NOTE

As shown in the following tables, edition 2 applies only for the IEC 61850 Client.

229 all with time mark CP56Time2a; only TI 30 and TI 31 are GI capable
230 for this values a measured value adaptation (scaling) is not supported
231 applies only for Edition 2

IEC 61850: Controllable Single Point (SPC)

IEC 61850				IEC 60870-5-101/104	supported			Rout
Attribute Name	**Type**	**FC**	**Values**		**Ed.1**	**Ed.2**	**Ed.2.1**	
ctlVal	BOOLEAN	CO		TI 30: SPI[232] TI 31: DPI[232] TI 45: SCS[232] TI 46: DCS[232]	✓	✓	✓	TI 30 TI 31 TI 45 TI 46
operTim	TimeStamp	CO			–	–	–	
origin	Originator	CO ST		see *Control Model, Page 1116*, Cause of transmission (origin)	✓	✓	✓	
ctlNum	INT8U	CO ST			✓	✓	✓	
stVal	BOOLEAN	ST		TI 30: SPI[233][234] TI 31: DPI[233][234]	✓	✓	✓	TI 30 TI 31
q	Quality	ST		TI 30: SIQ[233][234] TI 31: DIQ[233][234]	✓	✓	✓	
t	TimeStamp	ST		CP56Time2a[233][234]	✓	✓	✓	
stSeld	BOOLEAN	ST		TI 30: SPI[233]	✓	–	–	TI 30
subEna	BOOLEAN	SV			–	–	–	
subVal	BOOLEAN	SV			–	–	–	
subQ	Quality	SV			–	–	–	
subID	STRING64	SV			–	–	–	
pulseConfig	PulseConfig	CF			–	–	–	
ctlModel	ENUMERATED	CF	status-only[235] direct-with-normal-security direct-with-enhanced-sec. sbo-with-enhanced-sec.	settable in the detailed routing[236]	✓	–	–	
sboTimeout	INT32U	CF			–	–	–	
sboClass	STRING256	CF			–	–	–	
d	STRING256	DC			–	–	–	
dU	USTRING256	DC			–	–	–	
cdcNs	STRING256	EX			–	–	–	
cdcName	STRING256	EX			–	–	–	
dataNs	STRING256	EX			–	–	–	

232 applies only for Client in transmit direction and Server in receive direction

233 applies only for Client in receive direction and Server in transmit direction

234 receive direction: from these attributes a single-point information (TI 30) or double-point information (TI 31) can be generated; the double-point information has only the state ON or OFF

235 Server in transmit direction: status only is only then set, if no CO is present

236 applies only for Server

IEC 61850: Controllable Double Point (DPC)

IEC 61850				IEC 60870-5-101/104	supported			Rout
Attribute Name	**Type**	**FC**	**Values**		**Ed.1**	**Ed.2**	**Ed.2.1**	
ctlVal	BOOLEAN	CO		TI 30: SPI[232] TI 31: DPI[232] TI 45: SCS[232] TI 46: DCS[232]	✓	✓	✓	TI 30 TI 31 TI 45 TI 46
operTim	TimeStamp	CO			–	–	–	
origin	Originator	CO ST		see *Control Model, Page 1116*, Cause of transmission (origin)	✓	✓	✓	
ctlNum	INT8U	CO ST			✓	✓	✓	
stVal	BOOLEAN	ST		TI 30: SPI[233,237,238] TI 31: DPI[233,237]	✓	✓	✓	TI 30 TI 31
q	Quality	ST		TI 30: SIQ[233,237] TI 31: DIQ[233,237]	✓	✓	✓	
t	TimeStamp	ST		CP56Time2a[233,237]	✓	✓	✓	
stSeld	BOOLEAN	ST		TI 30: SPI[233]	✓	–	–	TI 30
subEna	BOOLEAN	SV			–	–	–	
subVal	BOOLEAN	SV			–	–	–	
subQ	Quality	SV			–	–	–	
subID	STRING64	SV			–	–	–	
pulseConfig	PulseConfig	CF			–	–	–	
ctlModel	ENUMERATED	CF	status-only[239] direct-with-normal-security direct-with-enhanced-sec. sbo-with-enhanced-sec.	settable in the detailed routing[240]	✓	–	–	
sboTimeout	INT32U	CF			–	–	–	
sboClass	STRING256	CF			–	–	–	
d	STRING256	DC			–	–	–	
dU	USTRING256	DC			–	–	–	
cdcNs	STRING256	EX			–	–	–	
cdcName	STRING256	EX			–	–	–	
dataNs	STRING256	EX			–	–	–	

237 receive direction: from these attributes a single-point information (TI 30) or double-point information (TI 31) can be generated; with a single-point information the status INT and FLT is not converted

238 with the parameter**IEC61850 value**from the AddCauses included in the neg. command termination, single-point information items (TI 30) can be generated (only "coming" information);**IEC61850 value**= 100 + AddCause

239 Server in transmit direction: status only is only then set, if no CO is present

240 applies only for Server

IEC 61850: Controllable Integer Status (INC)

IEC 61850				IEC 60870-5-101/104	supported			Rout
Attribute Name	Type	FC	Values		Ed.1	Ed.2	Ed.2.1	
ctlVal	INT32	CO		TI 30: SPI[241] TI 31: DPI[241]	✓	✓	✓	TI 30 TI 31
				TI 45: SCS[232,242,243] TI 46: DCS[232,242,243] TI 49: SVA[232] TI 50: R32-IEEE[232]	✓	✓	✓	TI 45 TI 46 TI 49 TI 50
operTim	TimeStamp	CO			–	–	–	
origin	Originator	CO ST		see *Control Model, Page 1116*, Cause of transmission (origin)	✓	✓	✓	
ctlNum	INT8U	CO ST			✓	✓	✓	
stVal	INT32	ST		TI 30: SPI[233,242,243] TI 31: DPI[233,242,243] TI 33: BSI TI 35: SVA[233] TI 36: R32-IEEE[233]	✓	✓	✓	TI 30 TI 31 TI 33 TI 35 TI 36
q	Quality	ST		TI 30: SIQ[233] TI 31: DIQ[233] TI 33: QDS[233] TI 35: QDS[233] TI 36: QDS[233]	✓	✓	✓	
t	TimeStamp	ST		CP56Time2a[233]	✓	✓	✓	
stSeld	BOOLEAN	ST		TI 30: SPI[233]	✓	–	–	TI 30
subEna	BOOLEAN	SV			–	–	–	
subVal	BOOLEAN	SV			–	–	–	
subQ	Quality	SV			–	–	–	
subID	STRING64	SV			–	–	–	
pulseConfig	PulseConfig	CF			–	–	–	
ctlModel	ENUMERATED	CF	status-only[244] direct-with-normal-security direct-with-enhanced-sec. sbo-with-enhanced-sec.	settable in the detailed routing[245]	✓	–	–	
sboTimeout	INT32U	CF			–	–	–	
sboClass	STRING256	CF			–	–	–	
minVal	INT32	CF			–	–	–	
maxVal	INT32	CF			–	–	–	

241 applies only for Client in transmit direction

242 transmit direction: for the ON state the parameterized IEC 61850 value is used

243 receive direction: for the parameterized IEC 61850 value the ON command is generated

244 Server in transmit direction: status only is only then set, if no CO is present

245 applies only for Server

IEC 61850				IEC 60870-5-101/104	supported			Rout
stepSize	INT32U	CF			–	–	–	
d	STRING256	DC			–	–	–	
dU	USTRING256	DC			–	–	–	
cdcNs	STRING256	EX			–	–	–	
cdcName	STRING256	EX			–	–	–	
dataNs	STRING256	EX			–	–	–	

IEC 61850: Controllable Integer Status (ENC)

IEC 61850				IEC 60870-5-101/104	supported			Rout
Attribute Name	**Type**	**FC**	**Values**		**Ed.1**	**Ed.2**	**Ed.2.1**	
ctlVal	INT32	CO		TI 30: SPI[241] TI 31: DPI[241]	✓	✓	✓	TI 30 TI 31
				TI 45: SCS[232][242][243] TI 46: DCS[232][242][243] TI 49: SVA[232] TI 50: R32-IEEE[232]	✓	✓	✓	TI 45 TI 46 TI 49 TI 50
operTim	TimeStamp	CO			–	–	–	
origin	Originator	CO ST		see *Control Model, Page 1116*, Cause of transmission (origin)	✓	✓	✓	
ctlNum	INT8U	CO ST			✓	✓	✓	
stVal	INT32	ST		TI 30: SPI[233][242][243] TI 31: DPI[233][242][243] TI 33: BSI TI 35: SVA[233] TI 36: R32-IEEE[233]	✓	✓	✓	TI 30 TI 31 TI 33 TI 35 TI 36
q	Quality	ST		TI 30: SIQ[233] TI 31: DIQ[233] TI 33: QDS[233] TI 35: QDS[233] TI 36: QDS[233]	✓	✓	✓	
t	TimeStamp	ST		CP56Time2a[233]	✓	✓	✓	
stSeld	BOOLEAN	ST		TI 30: SPI[233]	✓	–	–	TI 30
subEna	BOOLEAN	SV			–	–	–	
subVal	BOOLEAN	SV			–	–	–	
subQ	Quality	SV			–	–	–	
subID	STRING64	SV			–	–	–	

IEC 61850				IEC 60870-5-101/104	supported			Rout
ctlModel	ENUMERATED	CF	status-only[246] direct-with-normal-security direct-with-enhanced-sec. sbo-with-enhanced-sec.	settable in the detailed routing[247]	✓	–	–	
sboTimeout	INT32U	CF			–	–	–	
sboClass	STRING256	CF			–	–	–	
minVal	INT32	CF			–	–	–	
maxVal	INT32	CF			–	–	–	
stepSize	INT32U	CF			–	–	–	
d	STRING256	DC			–	–	–	
dU	USTRING256	DC			–	–	–	
cdcNs	STRING256	EX			–	–	–	
cdcName	STRING256	EX			–	–	–	
dataNs	STRING256	EX			–	–	–	

IEC 61850: Controllable Integer Status (APC)

IEC 61850				IEC 60870-5-101/104	supported			Rout
Attribute Name	**Type**	**FC**	**Values**		**Ed.1**	**Ed.2**	**Ed.2.1**	
ctlVal	AnalogueValue	CO		TI 49: SVA[232] TI 50: R32-IEEE[232]	–	✓	✓	TI 49 TI 50
operTim	TimeStamp	CO			–	–	–	
origin	Originator	CO ST		see *Control Model, Page 1116*, Cause of transmission (origin)	–	✓	✓	
ctlNum	INT8U	CO ST			–	✓	✓	
mxVal	AnalogueValue	ST		TI 35: SVA[233] TI 36: R32-IEEE[233]	–	✓	✓	TI 35 TI 36
q	Quality	ST		TI 30: SIQ[233] TI 31: DIQ[233] TI 35: QDS[233] TI 36: QDS[233]	–	✓	✓	
t	TimeStamp	ST		CP56Time2a[233]	–	✓	✓	
stSeld	BOOLEAN	ST		TI 30: SPI[233]	–	–	–	TI 30
subEna	BOOLEAN	SV			–	–	–	
subVal	AnalogueValue	SV			–	–	–	
subQ	Quality	SV			–	–	–	
subID	STRING64	SV			–	–	–	

246 Server in transmit direction: status only is only then set, if no CO is present

247 applies only for Server

IEC 61850				IEC 60870-5-101/104	supported			Rout
ctlModel	ENUMERATED	CF	status-only[248] direct-with-normal-security direct-with-enhanced-sec. sbo-with-enhanced-sec.	settable in the detailed routing[249]	–	✓	✓	
sboTimeout	INT32U	CF			–	–	–	
sboClass	STRING256	CF			–	–	–	
minVal	INT32	CF			–	–	–	
maxVal	INT32	CF			–	–	–	
stepSize	INT32U	CF			–	–	–	
dbRef	FLOAT32	CF			–	–	✓	
d	STRING256	DC			–	–	–	
dU	USTRING256	DC			–	–	–	
cdcNs	STRING256	EX			–	–	–	
cdcName	STRING256	EX			–	–	–	
dataNs	STRING256	EX			–	–	–	

IEC 61850: Single Point Status (SPS)

IEC 61850				IEC 60870-5-101/104	supported			Rout
Attribute Name	**Type**	**FC**	**Values**		**Ed.1**	**Ed.2**	**Ed.2.1**	
stVal	BOOLEAN	ST		TI 30: SPI	✓	✓	✓	TI 30
q	Quality	ST		TI 30: SIQ	✓	✓	✓	
t	TimeStamp	ST		CP56Time2a	✓	✓	✓	
subEna	BOOLEAN	SV			–	–	–	
subVal	BOOLEAN	SV			–	–	–	
subQ	Quality	SV			–	–	–	
subID	STRING64	SV			–	–	–	
d	STRING256	DC			–	–	–	
dU	USTRING256	DC			–	–	–	
cdcNs	STRING256	EX			–	–	–	
cdcName	STRING256	EX			–	–	–	
dataNs	STRING256	EX			–	–	–	

Server in Receive Direction:

The cause of transmission is fixed set to 3 (SPONTANEOUS).
Binary information is forwarded only upon change of stVal or q.

248 Server in transmit direction: status only is only then set, if no CO is present
249 applies only for Server

IEC 61850: Double Point Status (DPS)

IEC 61850				IEC 60870-5-101/104	supported			Rout
Attribute Name	**Type**	**FC**	**Values**		**Ed.1**	**Ed.2**	**Ed.2.1**	
stVal	BOOLEAN	ST	intermediate-state off on bad-state	TI 31: SPI	✓	✓	✓	TI 31
q	Quality	ST		TI 31: SIQ	✓	✓	✓	
t	TimeStamp	ST		CP56Time2a	✓	✓	✓	
subEna	BOOLEAN	SV			–	–	–	
subVal	BOOLEAN	SV			–	–	–	
subQ	Quality	SV			–	–	–	
subID	STRING64	SV			–	–	–	
d	STRING256	DC			–	–	–	
dU	USTRING256	DC			–	–	–	
cdcNs	STRING256	EX			–	–	–	
cdcName	STRING256	EX			–	–	–	
dataNs	STRING256	EX			–	–	–	

Server in Receive Direction:

The cause of transmission is fixed set to 3 (SPONTANEOUS).
Binary information is forwarded only upon change of stVal or q.

IEC 61850: Integer Status (INS)

IEC 61850				IEC 60870-5-101/104	supported			Rout
Attribute Name	**Type**	**FC**	**Values**		**Ed.1**	**Ed.2**	**Ed.2.1**	
stVal	INT32	ST		TI 30: SPI[250] TI 31: DPI[250] TI 33: BSI TI 35: SVA TI 36: R32-IEEE	✓	✓	✓	TI 30 TI 31 TI 33 TI 35 TI 36
q	Quality	ST		TI 30: SIQ TI 31: DIQ TI 33: QDS TI 35: QDS TI 36: QDS	✓	✓	✓	
t	TimeStamp	ST		CP56Time2a	✓	✓	✓	
subEna	BOOLEAN	SV			–	–	–	
subVal	INT32	SV			–	–	–	
subQ	Quality	SV			–	–	–	
subID	STRING64	SV			–	–	–	
d	STRING256	DC			–	–	–	
dU	USTRING256	DC			–	–	–	

250 for the respective ON state the parameterized IEC 61850 value is used

IEC 61850				IEC 60870-5-101/104	supported			Rout
cdcNs	STRING256	EX			–	–	–	
cdcName	STRING256	EX			–	–	–	
dataNs	STRING256	EX			–	–	–	

IEC 61850: Integer Status (ENS)

IEC 61850				IEC 60870-5-101/104	supported			Rout
Attribute Name	**Type**	**FC**	**Values**		**Ed.1**	**Ed.2**	**Ed.2.1**	
stVal	INT32	ST		TI 30: SPI[250] TI 31: DPI[250] TI 33: BSI TI 35: SVA TI 36: R32-IEEE	–	✓	✓	TI 30 TI 31 TI 33 TI 35 TI 36
q	Quality	ST		TI 30: SIQ TI 31: DIQ TI 33: QDS TI 35: QDS TI 36: QDS	–	✓	✓	
t	TimeStamp	ST		CP56Time2a	–	✓	✓	
subEna	BOOLEAN	SV			–	–	–	
subVal	INT32	SV			–	–	–	
subQ	Quality	SV			–	–	–	
subID	STRING64	SV			–	–	–	
d	STRING256	DC			–	–	–	
dU	USTRING256	DC			–	–	–	
cdcNs	STRING256	EX			–	–	–	
cdcName	STRING256	EX			–	–	–	
dataNs	STRING256	EX			–	–	–	

IEC 61850: Protection Activation Information (ACT)

IEC 61850				IEC 60870-5-101/104	supported			Rout
Attribute Name	**Type**	**FC**	**Values**		**Ed.1**	**Ed.2**	**Ed.2.1**	
General	BOOLEAN	ST		TI 30: SPI TI 38: ES TI 39: GS TI 40: GC	✓	✓	✓	TI 30 TI 38 TI 39 TI 40
phsA	BOOLEAN	ST		TI 30: SPI TI 38: ES TI 39: SL1 TI 40: CL1	✓	✓	✓	TI 30 TI 38
phsB	BOOLEAN	ST		TI 30: SPI TI 38: ES TI 39: SL2 TI 40: CL2	✓	✓	✓	TI 30 TI 38

IEC 61850				IEC 60870-5-101/104	supported			Rout
phsC	BOOLEAN	ST		TI 30: SPI TI 38: ES TI 39: SL3 TI 40: CL3	✓	✓	✓	TI 30 TI 38
neut	BOOLEAN	ST		TI 30: SPI TI 38: ES TI 39: SIE	✓	✓	✓	TI 30 TI 38
q	Quality	ST		TI 30: SIQ TI 38: SEP TI 39: QDP TI 40: QDP	✓	✓	✓	
t	TimeStamp	ST		CP56Time2a	✓	✓	✓	
operTim	STRING256	CF			–	–	–	
d	STRING256	DC			–	–	–	
dU	USTRING256	DC			–	–	–	
cdcNs	STRING256	EX			–	–	–	
cdcName	STRING256	EX			–	–	–	
dataNs	STRING256	EX			–	–	–	

Client in Receive Direction:

With TI 38 the runtime is 0.

Server in Transmit Direction:

If single-point information (TI 30) or protection event (TI 38) is used, then in the detailed routing must be also the attribute name specified. The quality (q) is then generated from an OR logic of all single messages.

Server in Receive Direction:

Binary information is forwarded only upon change of general, phsA, phsB, phsC, neut and q.

IEC 61850: Directional Protection Activation Information (ACD)

IEC 61850				IEC 60870-5-101/104	supported			Rout
Attribute Name	**Type**	**FC**	**Values**		**Ed.1**	**Ed.2**	**Ed.2.1**	
General	BOOLEAN	ST		TI 30: SPI TI 31: DPI[233] TI 38: ES TI 39: GS TI 40: GC	✓	✓	✓	TI 30 TI 31 TI 38 TI 39 TI 40
dirGeneral	ENUMERATED	ST	unknown forward backward both	fixed "unknown"[251]	✓[252]	✓[252]	✓[252]	

251 applies only for Server in transmit direction

252 applies for Client in receive direction: if TI 31 is used

IEC 61850				IEC 60870-5-101/104	supported			Rout
phsA	BOOLEAN	ST		TI 30: SPI TI 31: DPI[233] TI 38: ES TI 39: SL1 TI 40: CL1	✓	✓	✓	TI 30 TI 31 TI 38
dirPhsA	ENUMERATED	ST	unknown forward backward both	fixed "unknown"[251]	✓[252]	✓[252]	✓[252]	
phsB	BOOLEAN	ST		TI 30: SPI TI 31: DPI[233] TI 38: ES TI 39: SL2 TI 40: CL2	✓	✓	✓	TI 30 TI 31 TI 38
dirPhsB	ENUMERATED	ST	unknown forward backward both	fixed "unknown"[251]	✓[252]	✓[252]	✓[252]	
phsC	BOOLEAN	ST		TI 30: SPI TI 31: DPI[233] TI 38: ES TI 39: SL3 TI 40: CL3	✓	✓	✓	TI 30 TI 31 TI 38
dirPhsC	ENUMERATED	ST	unknown forward backward both	fixed "unknown"[251]	✓[252]	✓[252]	✓[252]	
neut	BOOLEAN	ST		TI 30: SPI TI 31: DPI[233] TI 38: ES TI 39: SIE	✓[253]	✓[254]	✓[255]	TI 30 TI 31 TI 38
dirNeut	ENUMERATED	ST	unknown forward backward both	fixed "unknown"[251]	✓[252]	✓[252]	✓[252]	
q	Quality	ST		TI 30: SIQ TI 31: DIQ[233] TI 38: SEP TI 39: QDP TI 40: QDP	✓	✓	✓	
t	TimeStamp	ST		CP56Time2a	✓	✓	✓	
operTim	STRING256	CF			–	–	–	
d	STRING256	DC			–	–	–	
dU	USTRING256	DC			–	–	–	

253 does not apply for TI 31
254 does not apply for TI 31
255 does not apply for TI 31

IEC 61850				IEC 60870-5-101/104	supported			Rout
cdcNs	STRING256	EX			–	–	–	
cdcName	STRING256	EX			–	–	–	
dataNs	STRING256	EX			–	–	–	

Client in Receive Direction:

With TI 38, TI 39, TI 40 the runtime is 0.

The status (general, phsA, phsB, phsC, neut) and the direction information (dirGeneral, dirPhsA, dirPhsB, dirPhsC, dirNeut) is converted according tot he following table:

IEC 61850		IEC 60870-5-101/104
State	**Direction information**	**TI 31: DPI**
OFF (0)	unknown (0)	INT (00)
	forward (1)	INT (00)
	backward (2)	INT (00)
	both (3)	INT (00)
ON (1)	unknown (0)	ON (10)
	forward (1)	ON (10)
	backward (2)	OFF (01)
	both (3)	FLT (11)

An intermediate resp. faulty position suppression is not performed.

If TI 30, TI 38 is used:

By means use of the field **`ON_info_on_IEC61850_value`** that is included in the detailed routing, in each case a separate single-point information can be derived from the status + direction information (max. 4 single-point information items).

By means of the option "transient" in the message address conversion the following behavior can be adjusted:

- without "transient"
  If the information is ON and an additional ON information with different direction occurs, then both IEC 60870-5-104 information items are set to ON
- with "transient"
  If the information is ON and an additional ON information with different direction occurs, then the previous IEC 60870-5-104 information is set to OFF and the new information is set to ON; thereby always only 1 information item out of the possible 4 information items is ON

IEC 61850 direction information	ON info on IEC 61850 value
unknown (0)	2
forward (1)	3
backward (2)	4
both (3)	5

Server in Transmit Direction:

If single-point information (TI 30) or protection event (TI 38) is used, then in the detailed routing must be also the attribute name specified. The quality (q) is then generated from an OR logic of all single messages.

The respective direction attributes are only then present, if also the belonging states are present.

Server in Receive Direction:

Binary information is forwarded only upon change of general, phsA, phsB, phsC, neut and q.

IEC 61850: Setting Group (SGCB)

IEC 61850				IEC 60870-5-101/104	supported			Rout
Attribute Name	**Type**	**FC**	**Values**		**Ed.1**	**Ed.2**	**Ed.2.1**	
NumOfSG	INT8U			TI 35: SVA[233] TI 36: R32-IEEE[233]	✓	✓	✓	TI 35 TI 36
ActSG	INT8U			TI 30: SPI[233,256,242] TI 31: DPI[233,256,242] TI 35: SVA[233] TI 36: R32-IEEE[233]	✓	✓	✓	TI 30 TI 31 TI 35 TI 36
				TI 45: SCS[232,242,257] TI 46: DCS[232,242,257] TI 49: SVA[232] TI 50: R32-IEEE[232]	✓[258]	✓[258]	✓[258]	TI 45 TI 46 TI 49 TI 50
EditSG	INT8U				–	–	–	
CnfEdit	BOOLEAN				–	–	–	
LActTm	TimeStamp			CP56Time2a[233]	✓	✓	✓	

For further details refer to section *Data Transmission Server ↔ Client, Page 1107*, Setting Group Control Model.

Server in Transmit Direction:

The Setting Group Control Block (SGCB) exists only if it is parameterized in the detailed routing. It can appear only with LLN0 (e.g.: VLC01/LLN0.SGCB).

Values of the SGCB are not assigned to a dataset resp. Unbuffered Control Block (no spontaneous transmission).

Server in Receive Direction:

Command output time (QU): 0 = without additional definition.

For Setting Groups no Confirmation, Termination messages are required. Also on the IEC 61850 side the Write command is instantly confirmed positive.

IEC 61850: Binary Counter Reading (BCR)

IEC 61850				IEC 60870-5-101/104	supported			Rout
Attribute Name	**Type**	**FC**	**Values**		**Ed.1**	**Ed.2**	**Ed.2.1**	
actVal	INT128	ST		TI 37: BCR[259]	✓	✓	✓	TI 37
frVal	INT128	ST		TI 37: BCR[260]	✓	✓	✓	TI 37
frTm	TimeStamp	ST		CP56Time2a[260]	✓	✓	✓	
q	Quality	ST		IV[259,260]	✓	✓	✓	
t	TimeStamp	ST		CP56Time2a[259]	✓	✓	✓	
units	Unit	CF			–	–	–	

256 applies also for Client in transmit direction
257 receive direction: for the parameterized IEC 61850 value the ON command is generated
258 transmit direction: no SEL/EXE permissible, but only EXE
259 is used with use of the attribute "actVal"
260 is used with use of the attribute "frVal"

IEC 61850				IEC 60870-5-101/104	supported			Rout
pulsQty	FLOAT 32	CF			–	✓[261]	✓[261]	
frEna	BOOLEAN	CF			–	–	–	
strTm	TimeStamp	CF			–	–	–	
frPd	INT32	CF			–	–	–	
frRs	BOOLEAN	CF			–	–	–	
d	STRING 256	CF			–	–	–	
dU	USTRING 256	CF			–	–	–	
cdcNs	STRING 256	CF			–	–	–	
cdcName	STRING 256	CF			–	–	–	
dataNs	STRING 256	CF			–	–	–	

Client in Receive Direction:

In the IEC 60870-5-101/104 message only a 31 bit binary value + sign can be represented. An initial overflow of the value causes the CY bit which is reset afterwards. Only the less significant 31 bits are used. The sequence number is 0.

Integrated totals are always transmitted spontaneous upon change. Counter interrogations are not possible.

IEC 61850: Binary Controlled Step Position Information (BSC)

IEC 61850				IEC 60870-5-101/104	supported			Rout
Attribute Name	**Type**	**FC**	**Values**		**Ed.1**	**Ed.2**	**Ed.2.1**	
ctlVal	CODED_ENUM	CO	stop lower higher	TI 47: RCO[232][262]	✓	✓	✓	TI 47
operTim	TimeStamp	CO			–	–	–	
origin	Originator	CO ST		see *Control Model, Page 1116*, Cause of transmission (origin)	✓	✓	✓	
ctlNum	INT8U	CO ST			✓	✓	✓	
valWTr	INT8U	ST		TI 32: VTI[233]	✓	✓	✓	TI 32
q	Quality	ST		QDS[233]	✓	✓	✓	
t	TimeStamp	ST		CP56Time2a[233]	✓	✓	✓	
stSeld	BOOLEAN	ST			–	–	–	
subEna	BOOLEAN	SV			–	–	–	
subVal	BOOLEAN	SV			–	–	–	
subQ	Quality	SV			–	–	–	
subID	STRING64	SV			–	–	–	
persistent	BOOLEAN	CF			–	–	–	

261 for Client Ed.2 only; can be enabled for each data point, value = Value * pulsQty

262 the status "stop" is generated with the not permissible value "00" acc. to IEC 60870-5-101/104

IEC 61850				IEC 60870-5-101/104	supported			Rout
ctlModel	ENUMERATED	CF	status-only[263]direct-with-normal-security direct-with-enhanced-sec. sbo-with-enhanced-sec.	settable in the detailed routing[264]	✓	–	–	
sboTimeout	INT32U	CF			–	–	–	
sboClass	STRING256	CF			–	–	–	
minVal	INT8	CF			–	–	–	
maxVal	INT8	CF			–	–	–	
stepSize	INT8U	CF			–	–	–	
d	STRING256	DC			–	–	–	
dU	USTRING256	DC			–	–	–	
cdcNs	STRING256	EX			–	–	–	
cdcName	STRING256	EX			–	–	–	
dataNs	STRING256	EX			–	–	–	

IEC 61850: Integer Controlled Step Position Information (ISC)

IEC 61850				IEC 60870-5-101/104	supported			Rout
Attribute Name	**Type**	**FC**	**Values**		**Ed.1**	**Ed.2**	**Ed.2.1**	
ctlVal	INT8	CO	-64...+63	TI 49: SVA[232,265] TI 50: R32 – IEEE[232,266]	✓	✓	✓	TI 49 TI 50
operTim	TimeStamp	CO			–	–	–	
origin	Originator	CO ST		see *Control Model, Page 1116*, Cause of transmission (origin)	✓	✓	✓	
ctlNum	INT8U	CO ST			✓	✓	✓	
valWTr	ValWithTrans	ST		TI 32: VTI[233]	✓	✓	✓	TI 32
q	Quality	ST		QDS[233]	✓	✓	✓	
t	TimeStamp	ST		CP56Time2a[233]	✓	✓	✓	
stSeld	BOOLEAN	ST			–	–	–	
subEna	BOOLEAN	SV			–	–	–	
subVal	BOOLEAN	SV			–	–	–	
subQ	Quality	SV			–	–	–	
subID	STRING64	SV			–	–	–	
persistent	BOOLEAN	CF			–	–	–	

263 Server in transmit direction: status only is only then set, if no CO is present
264 applies only for Server
265 in contrast to the standard the maximum values can be in the range -128... +127
266 Server in transmit direction: status only is only then set, if no CO is present

IEC 61850				IEC 60870-5-101/104	supported			Rout
ctlModel	ENUMERATED	CF	status-only[267]direct-with-normal-security direct-with-enhanced-sec. sbo-with-enhanced-sec.	settable in the detailed routing[268]	✓	–	–	
sboTimeout	INT32U	CF			–	–	–	
sboClass	STRING256	CF			–	–	–	
minVal	INT8	CF			–	–	–	
maxVal	INT8	CF			–	–	–	
stepSize	INT8U	CF			–	–	–	
d	STRING256	DC			–	–	–	
dU	USTRING256	DC			–	–	–	
cdcNs	STRING256	EX			–	–	–	
cdcName	STRING256	EX			–	–	–	
dataNs	STRING256	EX			–	–	–	

IEC 61850: Analogue Setting (ASG)

IEC 61850				IEC 60870-5-101/104	supported			Rout
Attribute Name	**Type**	**FC**	**Values**		**Ed.1**	**Ed.2**	**Ed.2.1**	
setMag	Analogue Value	SP		TI 49: SVA[232] TI 50: R32-IEEE[232]	✓	✓	✓	TI 49 TI 50
				TI 35: SVA[233] TI 36: R32-IEEE[233]	✓	✓	✓	TI 35 TI 36
units	Unit	CF			–	–	–	
sVC	Select Value Config	CF			–	–	–	
minVal	Analogue Value	CF			–	–	–	
maxVal	Analogue Value	CF			–	–	–	
stepSize	Analogue Value	CF			–	–	–	
d	STRING256	DC			–	–	–	
dU	USTRING256	DC			–	–	–	
cdcNs	STRING256	EX			–	–	–	
cdcName	STRING256	EX			–	–	–	
dataNs	STRING256	EX			–	–	–	

Client in Receive Direction:

With writing of the value no Setting Group setting is performed, however, a simple write process.

267 Server in transmit direction: status only is only then set, if no CO is present

268 applies only for Server

IEC 61850: Integer Setting (ING)

IEC 61850				IEC 60870-5-101/104	supported			Rout
Attribute Name	Type	FC	Values		Ed.1	Ed.2	Ed.2.1	
setVal	INT32	SP		TI 49: SVA[232] TI 50: R32-IEEE[232]	✓	✓	✓	TI 49 TI 50
				TI 35: SVA[233] TI 36: R32-IEEE[233]	✓	✓	✓	TI 35 TI 36
setVal	INT32	SG, SE			–	–	–	
minVal	INT32	CF			–	–	–	
maxVal	INT32	CF			–	–	–	
stepSize	INT32	CF			–	–	–	
d	STRING256	DC			–	–	–	
dU	USTRING256	DC			–	–	–	
cdcNs	STRING256	EX			–	–	–	
cdcName	STRING256	EX			–	–	–	
dataNs	STRING256	EX			–	–	–	

Client in in Transmit direction:

With writing of the value no Setting Group setting is performed, however, a simple write process.

IEC 61850: Measured Value (MV)

IEC 61850				IEC 60870-5-101/104	supported			Rout
Attribute Name	Type	FC	Values		Ed.1	Ed.2	Ed.2.1	
instMag	AnalogueValue	MX			–	✓	✓	TI 34 TI 35 TI 36
mag	AnalogueValue	MX		TI 34: NVA TI 35: SVA TI 36: R32-IEEE	✓	✓	✓	TI 34 TI 35 TI 36
range	ENUMERATED	MX	- normal - high - ...		–	–	–	
q	Quality	MX		QDS	✓	✓	✓	
t	TimeStamp	MX		CP56Time2a	✓	✓	✓	
subEna	BOOLEAN	SV			–	–	–	
subMag	AnalogueValue	SV			–	–	–	
subQ	Quality	SV			–	–	–	
subID	STRING64	SV			–	–	–	
units	Unit	CF			–	–	–	
db	INT32U	CF			–	–	–	
zeroDb	INT32U	CF			–	–	–	
sVC	ScaledValue-Config	CF			–	–	–	
rangeC	RangeConfig	CF			–	–	–	
smpRate	INT32U	CF			–	–	–	
dbRef	FLOAT32	CF			–	–	✓	

IEC 61850				IEC 60870-5-101/104	supported			Rout
zeroDbRef	FLOAT32	CF			–	–	✓	
d	STRING256	DC			–	–	–	
dU	USTRING256	DC			–	–	–	
cdcNs	STRING256	EX			–	–	–	
cdcName	STRING256	EX			–	–	–	
dataNs	STRING256	EX			–	–	–	

IEC 61850: Complex Measured Value (CMV)

IEC 61850				IEC 60870-5-101/104	supported			Rout
Attribute Name	**Type**	**FC**	**Values**		**Ed.1**	**Ed.2**	**Ed.2.1**	
instCVal	Vector	MX			–	✓	✓	TI 34 TI 35 TI 36
cVal	Vector	MX		TI 34: NVA TI 35: SVA TI 36: R32-IEEE	✓	✓	✓	TI 34 TI 35 TI 36
range	ENUMERATED	MX	- normal - high - ...		–	–	–	
q	Quality	MX		QDS	✓	✓	✓	
t	TimeStamp	MX		CP56Time2a	✓	✓	✓	
subEna	BOOLEAN	SV			–	–	–	
subCVal	Vector	SV			–	–	–	
subQ	Quality	SV			–	–	–	
subID	STRING64	SV			–	–	–	
units	Unit	CF			–	–	–	
db	INT32U	CF			–	–	–	
zeroDb	INT32U	CF			–	–	–	
rangeC	RangeConfig	CF			–	–	–	
magSVC	ScaledValue-Config	CF			–	–	–	
angSVC	ScaledValue-Config	CF			–	–	–	
angRef	ENUMERATED	CF	- V - A - ...		–	–	–	
smpRate	INT32U	CF			–	–	–	
dbRef	FLOAT32	CF			–	–	✓	
zeroDbRef	FLOAT32	CF			–	–	✓	
d	STRING256	DC			–	–	–	
dU	USTRING256	DC			–	–	–	
cdcNs	STRING256	EX			–	–	–	
cdcName	STRING256	EX			–	–	–	
dataNs	STRING256	EX			–	–	–	

IEC 61850: Sampled Value (SAV)

IEC 61850				IEC 60870-5-101/104	supported			Rout
Attribute Name	**Type**	**FC**	**Values**		**Ed.1**	**Ed.2**	**Ed.2.1**	
instMag	AnalogueValue	MX		TI 34: NVA TI 35: SVA TI 36: R32-IEEE	✓	✓	✓	TI 34 TI 35 TI 36
q	Quality	MX		QDS	✓	✓	✓	
t	TimeStamp	MX		CP56Time2a	✓	✓	✓	
units	Unit	CF			–	–	–	
sVC	ScaledValue-Config	CF			–	–	–	
min	AnalogueValue	CF			–	–	–	
max	AnalogueValue	CF			–	–	–	
d	STRING256	DC			–	–	–	
dU	USTRING256	DC			–	–	–	
cdcNs	STRING256	EX			–	–	–	
cdcName	STRING256	EX			–	–	–	
dataNs	STRING256	EX			–	–	–	

IEC 61850: Collection Of Measurands (WYE)

IEC 61850				IEC 60870-5-101/104	supported			Rout
Attribute Name	**Type**	**FC**	**Values**		**Ed.1**	**Ed.2**	**Ed.2.1**	
phsA	CMV			TI 34: NVA TI 35: SVA TI 36: R32-IEEE	✓	✓	✓	TI 34 TI 35 TI 36
phsB	CMV			TI 34: NVA TI 35: SVA TI 36: R32-IEEE	✓	✓	✓	TI 34 TI 35 TI 36
phsC	CMV			TI 34: NVA TI 35: SVA TI 36: R32-IEEE	✓	✓	✓	TI 34 TI 35 TI 36
neut	CMV			TI 34: NVA TI 35: SVA TI 36: R32-IEEE	✓	✓	✓	TI 34 TI 35 TI 36
net	CMV			TI 34: NVA TI 35: SVA TI 36: R32-IEEE	✓	✓	✓	TI 34 TI 35 TI 36
res	CMV			TI 34: NVA TI 35: SVA TI 36: R32-IEEE	✓	✓	✓	TI 34 TI 35 TI 36
angRef	ENUMERATED	CF			–	–	–	
d	STRING256	DC			–	–	–	
dU	USTRING256	DC			–	–	–	
cdcNs	STRING256	EX			–	–	–	
cdcName	STRING256	EX			–	–	–	
dataNs	STRING256	EX			–	–	–	

IEC 61850: Delta (DEL)

IEC 61850				IEC 60870-5-101/104	supported			Rout
Attribute Name	**Type**	**FC**	**Values**		**Ed.1**	**Ed.2**	**Ed.2.1**	
phsAB	CMV			TI 34: NVA TI 35: SVA TI 36: R32-IEEE	✓	✓	✓	TI 34 TI 35 TI 36
phsBC	CMV			TI 34: NVA TI 35: SVA TI 36: R32-IEEE	✓	✓	✓	TI 34 TI 35 TI 36
phsCA	CMV			TI 34: NVA TI 35: SVA TI 36: R32-IEEE	✓	✓	✓	TI 34 TI 35 TI 36
angRef	ENUMERATED	CF			–	–	–	
d	STRING256	DC			–	–	–	
dU	USTRING256	DC			–	–	–	
cdcNs	STRING256	EX			–	–	–	
cdcName	STRING256	EX			–	–	–	
dataNs	STRING256	EX			–	–	–	

IEC 61850: Sequence (SEQ)

IEC 61850				IEC 60870-5-101/104	supported			Rout
Attribute Name	**Type**	**FC**	**Values**		**Ed.1**	**Ed.2**	**Ed.2.1**	
c1	CMV			TI 34: NVA TI 35: SVA TI 36: R32-IEEE	✓	✓	✓	TI 34 TI 35 TI 36
c2	CMV			TI 34: NVA TI 35: SVA TI 36: R32-IEEE	✓	✓	✓	TI 34 TI 35 TI 36
c3	CMV			TI 34: NVA TI 35: SVA TI 36: R32-IEEE	✓	✓	✓	TI 34 TI 35 TI 36
seqT	ENUMERATED	MX	- pos-neg-zero - dir-quad-zero	fix pos-neg-zero	✓	–	–	
phsRef	ENUMERATED	CF	- A - B - C - ...		–	–	–	
d	STRING256	DC			–	–	–	
dU	USTRING256	DC			–	–	–	
cdcNs	STRING256	EX			–	–	–	
cdcName	STRING256	EX			–	–	–	
dataNs	STRING256	EX			–	–	–	

IEC 61850: Device Name Plate (DPL)

IEC 61850				IEC 60870-5-101/104	supported			Rout
Attribute Name	**Type**	**FC**	**Values**		**Ed.1**	**Ed.2**	**Ed.2.1**	
vendor	STRING256	DC		fix "SIEMENS"	✓	–	–	
hwRev	STRING256	DC			✓	–	–	
swRev	STRING256	DC		Revision ETxx[269]	✓	–	–	
serNum	STRING256	DC			–	–	–	
model	STRING256	DC			–	–	–	
location	STRING256	DC			–	–	–	
cdcNs	STRING256	EX			–	–	–	
cdcName	STRING256	EX			–	–	–	
dataNs	STRING256	EX			–	–	–	

IEC 61850: Logical Node Name Plate (LPL)

IEC 61850				IEC 60870-5-101/104	supported			Rout
Attribute Name	**Type**	**FC**	**Values**		**Ed.1**	**Ed.2**	**Ed.2.1**	
vendor	STRING256	DC		fix "SIEMENS"	✓	–	–	
swRev	STRING256	DC		Revision ETxx[269]	✓	–	–	
d	STRING256	DC		[270]	✓	–	–	
dU	USTRING256	DC			–	–	–	
configRev	STRING256	DC		fix 0[271]	✓	–	–	
ldNs	STRING256	EX		fix "IEC 61850-7-4: 2002"[271]	✓	–	–	
lnNs	STRING256	EX			–	–	–	
cdcNs	STRING256	EX			–	–	–	
cdcName	STRING256	EX			–	–	–	
dataNs	STRING256	EX			–	–	–	

IEC 61850: Single Point Setting (SPG)

IEC 61850				IEC 60870-5-101/104	supported			Rout
Attribute Name	**Type**	**FC**	**Values**		**Ed.1**	**Ed.2**	**Ed.2.1**	
setVal	Boolean	SP		TI 45: SPC	–	✓	✓	
				TI 30: SPI	–	✓	✓	
setVal	Boolean	SG, SE			–	–	–	
d	STRING256	DC			–	–	–	
dU	USTRING256	DC			–	–	–	
cdcNs	STRING256	EX			–	–	–	
cdcName	STRING256	EX			–	–	–	
dataNs	STRING256	EX			–	–	–	

269 xx = 03, 83 (dependent on the respective firmware)

270 this value is taken from the detailed routing "Logical Node Name Description"; if there is no Logical Node Name Description included in the detailed routing, then the Logical Node Name is entered here (e.g. VLC01/Q0XCBR1)

271 only with LNN0

IEC 61850: Enumerated Status Setting (ENG)

IEC 61850				IEC 60870-5-101/104	supported			Rout
Attribute Name	**Type**	**FC**	**Values**		**Ed.1**	**Ed.2**	**Ed.2.1**	
setVal	INT32	SP		TI 30: SPI[272]	–	✓	✓	TI 30
				TI 45: SC[272]	–	✓	✓	TI 45
d	STRING256	DC			–	–	–	
dU	USTRING256	DC			–	–	–	
cdcNs	STRING256	EX			–	–	–	
cdcName	STRING256	EX			–	–	–	
dataNs	STRING256	EX			–	–	–	

Mapping IEC 61850 → MMS

By means of the mapping from IEC 61850 to MMS, new “Extended Common Data Classes” result.

NOTE

The “Extended Common” Data Classes serve only for the transmission on the line.

Extended Common Data Classes

Select with Value (SBOw), Operate (Oper), Cancel (Cancel)

Attribute Name	Type	supported	
		Ed.1	**Ed.2**
ctlVal	[273]	✓	✓
setMag		–	–
operTm	TimeStamp	–	–
origin	Originator	✓	✓
ctlNum	INT8U	✓	✓
T	TimeStamp[274]	✓	✓
Test	BOOLEAN	✓	✓
Check	PACKED LIST[274][275]	✓	✓

13.6.8.3 Datapoint Settings in the Detailed Routing

All detailed routings in the process technique are “SIP Message Address Conversion”. The category is seperate for send direction and receive direction.

It is necessary that in the OPM II the detailed routing is filled out including data attribute. Thereby it is to be considered that for CDCs always only one certain attribute can/must be routed. Certain attributes (e.g. q, t) are added automatically. The attributes that must be routed are listed with the CDCs.

Further, there are CDCs that consist of several IEC 60870-5-101/104 messages (unambiguous/ambiguous).

272 applies only for Client in transmit direction
273 is adopted from the Basis Common Data Class
274 is not evaluated
275 for Cancel not present

Client in Transmit Direction

Routing element	Description	Expert parameter
CASDU1 CASDU2 IOA1 IOA2 IOA3	Address of the datapoint	
IEC61850_Address	68 bytes ASCII characters (as of IEC 61850 Ed.2: 128 byte)	
IEC61850_Station	Station 0...99, 255 = not used	
Measured value adaptation_X_0% Measured value adaptation_X_100% Measured value adaptation_Y_0% Measured value adaptation_Y_100%	Value adaptation limits	
TI	30 = Single-point information 31 = Double-point information 45 = Single command 46 = Double command 47 = Regulating step command 49 = Setpoint command, scaled 50 = Setpoint command, floating point	
CDC	Common Data Class [276] 12 = SPC 13 = DPC 14 = INC 20 = SGCB 21 = BSC 22 = ISC 23 = ASG 24 = ING 25 = APC 27 = ENC 28 = ENG 29 = SPG	

276 The belonging CDC must be parameterized here. Always the hierarchical most significant CDC must be parameterized. Example: VLC01/CSWI1.Pos.ctlVal = DPC (Pos = DPC), VLC01/MMXU1.A.phsA.cVal.mag.f (A = WYE)

Routing element	Description	Expert parameter
IEC61850_command_qualifier	0 = via IEC 60870-5-101/104 qualifier of command [277] 1 = without interlocking/without synchro check 2 = with interlocking/without synchro check 3 = without interlocking/with synchro check 4 = with interlocking/with synchro check 5 = without interlocking/with synchro check only with ON 6 = with interlocking/with synchro check only with ON	✓
IEC61850_value_at_TI45/46_ON	[278]	✓
IEC61850_value_at_TI45/46_OFF	[278]	✓
Tio_CON_TERM_wo_synchro-check(s)	[279]	✓
Tio_CON_TERM_with_synchro-check(s)	[279]	✓
IM_CASDU1_ON IM_CASDU2_ON IM_IOA1_ON IM_IOA2_ON IM_IOA3_ON	Address of the interlocking information for the ON command [280]	✓
IM_CASDU1_OFF IM_CASDU2_OFF IM_IOA1_OFF IM_IOA2_OFF IM_IOA3_OFF	Address of the interlocking information for the OFF command [280]	✓

IEC 60870-5-101/104	Interlocking information check
TI 45 Single command	ON
TI 46 Double command	ON, OFF
TI 47 Regulating step command	ON (matches HIGHER),OFF (matches LOWER)
TI 49 Setpoint command, scaled	ON
TI 50 Setpoint command, floating point	ON

277 The attribute “Check” is affected by means of that. The default entry is 0 (control by the IEC 60870 -5 -101/104 qualifier of command, refer to *Control Model, Page 1116*, Command Output Time (QU)).

278 This value is transmitted instead of ON (1) or OFF (0) and can be used for the CDCs “INS”, “INC” and “SGCB”; as of IEC 61850 Ed. 2: “ENS”, “ENC”. By means of that, e.g. for the activation of the health state (value range 1...3) respectively one single-point information can be used, whereby the respective ON state of the command is converted to the corresponding value.

279 The station-selective timeout for confirmation -> termination can be substituted with a command-selective timeout for with and without syncrocheck. At value “0” the station-selective timeout applies.

280 By means of respectively one single-point information (TI 30) for the ON resp. the OFF command an overlapping interlocking operation can be implemented by means of a CAExplus project. If the corresponding information is ON, the command is locked and is rejected with a neg. Confirmation. By means of this function the same procedure of interlocking as to SICAM RTUs peripheral elements can be applied. Note: The interlock only works if the signals are also sent to the PRE (pass-through filter/selective routing).

Client in Receive Direction

Routing element	Description	Expert parameter
CASDU1 CASDU2 IOA1 IOA2 IOA3	Address of the datapoint	
IEC61850_Address	68 bytes ASCII characters (as of IEC 61850 Ed.2: 128 byte)	
IEC61850_Station	Station 0...99, 255 = not used	
Measured value adaptation_X_0% Measured value adaptation_X_100% Measured value adaptation_Y_0% Measured value adaptation_Y_100%	Value adaptation limits	
thresh_uncond thresh_additive	Absolute value [281] Absolute value [281]	
TI	30 = Single-point information 31 = Double-point information 45 = Single command 46 = Double command 47 = Regulating step command 49 = Setpoint command, scaled 50 = Setpoint command, floating point	

281 The measured value change monitoring occurs on the raw value (= received value from the Server).

Routing element	Description	Expert parameter
CDC	Common Data Class [282] 0 = Standard 1 = SPS 2 = DPS 3 = INS 4 = ACT 5 = ACD 6 = MV 7 = CMV 8 = SAV 9 = WYE 10 = DEL 11 = SEQ 12 = SPC 13 = DPC 14 = INC 19 = BCR 20 = SGCB 21 = BSC 22 = ISC 23 = ASG 24 = ING 25 = APC 26 = ENS 27 = ENC 28 = ENG 29 = SPG	
ON-info_on_IEC61850_value	[283]	✓
Usage_on_informa-tion_IEC61850_	0 = event 1 = IEC61850 value bit 0 2 = IEC61850 value bit 1 3 = IEC61850 value bit 2	✓
type_of_binary_information	coming/going [284] Coming	✓

282 The belonging CDC must be parameterized here. Always the hierarchical most significant CDC must be parameterized. Example: VLC01 / XCBR1.Pos.stVal = DPC (Pos = DPC), VLC01 / MMXU1.TotW.mag.f = MV (TotW = MV), VLC01 / MMXU1.A.phsA.cVal.mag.f = WYE (A = WYE)

283 With the value for TI 30/31 can be parameterized, at which IEC 61850 value the ON info is to be generated. The corresponding OFF info is generated automatically by the firmware as soon as another value is received (applies only for the CDCs "INC", "INS", "SGCB"; as of IEC 61850 Ed. 2: "ENS", "ENC"). For the CDC "ACD" the direction information can be evaluated with the values 2, 3, 4, 5 (*IEC 61850: Common Data Classes, Page 1142*, IEC 61850: Directional Protection Activation Information (ACD)

284 This applies only for single-point information items (TI 30). By means of the setting "coming" is the going edge automatically emulated (1 ms time difference to the comin edge).

Client – Disturbance Record in Transmit Direction

Routing element	Description	Expert parameter
CASDU1 CASDU2 IOA1 IOA2 IOA3	Address of the datapoint	
TI	142 = user data container	
File transfer mode	Client	

Client – Disturbance Record in Receive Direction

Routing element	Description	Expert parameter
CASDU1 CASDU2 IOA1 IOA2 IOA3	Address of the datapoint	
TI	142 = user data container	
File transfer mode	Client	

Server in Transmit Direction

Routing element	Description	Expert parameter
CASDU1 CASDU2 IOA1 IOA2 IOA3	Address of the datapoint	
IEC61850_Address	68 bytes ASCII characters	
Measured value adaptation_X_0% Measured value adaptation_X_100% Measured value adaptation_Y_0% Measured value adaptation_Y_100%	Value adaptation limits	
Selectivity	To all remote stations/selective	
TI	30 = Single-point information 31 = Double-point information 34 = Measured value, normalized 35 = Measured value, scaled 36 = Measured value, floating point 38 = Protection event 39 = Blocked start events of protection 40 = Blocked tripping of protection	

Routing element	Description	Expert parameter
CDC	0 = Standard 1 = SPS 2 = DPS 3 = INS 4 = ACT 5 = ACD 6 = MV 7 = CMV 8 = SAV 9 = WYE 10 = DEL 11 = SEQ 12 = SPC 13 = DPC 14 = INC 19 = BCR 20 = SGCB 21 = BSC 22 = ISC 23 = ASG 24 = ING 25 = APC 26 = ENS 28 = ENG 29 = SPG	
IEC61850_value_at_TI30/31_ON	[285]	✓
IEC61850_value_at_TI30/31_OFF	[286]	✓
Usage_IEC61850_value_off	0 = IEC61850 value at TI30/31 OFF not used 1 = IEC61850 value at TI30/31 OFF used 2 = IEC61850 value bit 0 3 = IEC61850 value bit 1 4 = IEC61850 value bit 2	✓
Goose_Attr1_Datasetpos [287] Goose_Attr2_Datasetpos [287] Goose_Attr3_Datasetpos [287] Goose_Attr4_Datasetpos [287] Goose_Attr5_Datasetpos [287]	Selection 0...255	✓

285 This value is transmitted instead of ON and can be used for the CDCs “INC”, “INS” (Ed. 1) resp. “ENC”, “ENS” (Ed. 2) and “SGCB” . By means of that, e.g. for the health status (value range 1...3) a single-point information can be used respectively for the activation, whereby the respective ON status of the information is converted to the corresponding value. The OFF information is not evaluated.

286 This value is transmitted instead of OFF and can be used for the CDCs “INC”, “INS” (Ed. 1) resp. “ENC”, “ENS” (Ed. 2) and “SGCB” . This value is only then used, if all information items that have the same IEC 61850 address have the status OFF.

287 only Edition 2

Routing element	Description	Expert parameter
Goose_Attrib1 [287] Goose_Attrib2 [287] Goose_Attrib3 [287] Goose_Attrib4 [287] Goose_Attrib5 [287]	GOOSE Attribute (see *GOOSE-Attributes, Page 1179*)	✓
Goose_Idx [287]	Selection 0...255	✓

Server in Receive Direction

Routing element	Description	Expert parameter
CASDU1 CASDU2 IOA1 IOA2 IOA3	Address of the datapoint	
Controltype	- Direct Control With Normal Security - Direct Control With Enhanced Security - SBO Control With Enhanced Security	
IEC61850_Address	68 bytes ASCII characters	
Measured value adaptation_X_0% Measured value adaptation_X_100% Measured value adaptation_Y_0% Measured value adaptation_Y_100%	Value adaptation limits	
Selectivity	To all remote stations/selective	
TI	30 = Single-point information 31 = Double-point information 34 = Measured value, normalized 35 = Measured value, scaled 36 = Measured value, floating point 38 = Protection event 39 = Blocked start events of protection 40 = Blocked tripping of protection 45 = Single command 46 = Double command 49 = Setpoint command, scaled 50 = Setpoint command, floating point	

Routing element	Description	Expert parameter
CDC	0 = Standard 12 = SPC 13 = DPC 14 = INC 21 = BSC 22 = ISC 23 = ASG 24 = ING 25 = APC 27 = ENC 28 = ENG 29 = SPG	
ON-command_on_IEC61850_value	[288]	✓
Goose_Attr1_Datasetpos [287] Goose_Attr2_Datasetpos [287] Goose_Attr3_Datasetpos [287] Goose_Attr4_Datasetpos [287] Goose_Attr5_Datasetpos [287]	Selection 0...255	✓
Goose_Attrib1 [287] Goose_Attrib2 [287] Goose_Attrib3 [287] Goose_Attrib4 [287] Goose_Attrib5 [287]	GOOSE Attribute (see *GOOSE-Attributes, Page 1179*)	✓
Goose_Idx [287]	Selection 0...255	

Server in Transmit Direction + Goose [only Edition 1]

Routing element	Description	Expert parameter
CASDU1 CASDU2 IOA1 IOA2 IOA3	Address of the datapoint	
IEC61850_Address	68 bytes ASCII characters	
Measured value adaptation_X_0% Measured value adaptation_X_100% Measured value adaptation_Y_0% Measured value adaptation_Y_100%	Value adaptation limits	
Selectivity	To all remote stations/selective	

288 With the value for TI 45/46 can be parameterized, at which IEC 61850 value the ON command is to be generated. The corresponding OFF command is generated automatically by the firmware as soon as another value is received (applies only for the CDCs "INC", "INS", "SGCB"; as of IEC 61850 Ed. 1) resp. “ENC“, “ENS“ (Ed. 2), "SGCB"). By means of this function can be derived a command from each status e.g. due to a Controllable Integer Status (INC/ENC), whereby the current status result in an ON command and all other with the same IEC 61850 address in an OFF command. The originator address iss et fixed to 0.

Routing element	Description	Expert parameter
TI	30 = Single-point information 31 = Double-point information 34 = Measured value, normalized 35 = Measured value, scaled 36 = Measured value, floating point 38 = Protection event 39 = Blocked start events of protection 40 = Blocked tripping of protection	
CDC	0 = Standard 1 = SPS 2 = DPS 3 = INS 4 = ACT 5 = ACD 6 = MV 7 = CMV 8 = SAV 9 = WYE 10 = DEL 11 = SEQ 12 = SPC 13 = DPC 14 = INC 19 = BCR 21 = BSC 22 = ISC 23 = ASG 24 = ING 25 = APC 26 = ENS 27 = ENC	
IEC61850_value_at_TI30/31_ON	[289]	✓
IEC61850_value_at_TI30/31_OFF	[290]	✓
Goose_Attrib1 [287] Goose_Attrib2 [287] Goose_Attrib3 [287] Goose_Attrib4 [287] Goose_Attrib5 [287]	GOOSE Attribute (see *GOOSE-Attributes, Page 1179*)	
Goose_Index_A Goose_Index_B Goose_Index_C	GOOSE Index in the system technique 0...255	

289 This value is transmitted instead of ON (1) and can be used for the CDCs "INC", "INS" (Ed. 1) resp. “ENC“, “ENS“ (Ed. 2) and "SGCB". By means of that, e.g. for the health status (value range 1...3) a single-point information can be used respectively for the activation, whereby the respective ON status of the information is converted to the corresponding value. The OFF information is not evaluated.

290 This value is transmitted instead of OFF and can be used for the CDCs "INC", "INS" (Ed. 1) resp. “ENC“, “ENS“ (Ed. 2) and "SGCB". This value is only then used, if all information items that have the same IEC 61850 address have the status OFF.

Routing element	Description	Expert parameter
Goose_Attr1_Datasetpos_Index_A Goose_Attr1_Datasetpos_Index_B Goose_Attr1_Datasetpos_Index_C Goose_Attr2_Datasetpos_Index_A Goose_Attr2_Datasetpos_Index_B Goose_Attr2_Datasetpos_Index_C Goose_Attr3_Datasetpos_Index_A Goose_Attr3_Datasetpos_Index_B Goose_Attr3_Datasetpos_Index_C Goose_Attr4_Datasetpos_Index_A Goose_Attr4_Datasetpos_Index_B Goose_Attr4_Datasetpos_Index_C Goose_Attr5_Datasetpos_Index_A Goose_Attr5_Datasetpos_Index_B Goose_Attr5_Datasetpos_Index_C	Dataset Position 0...255 [291]	✓
Station_A Station_B Station_C Station_D Station_E Station_F Station_G Station_H Station_I Station_J	Selection station 0...99 255 = to all stations	✓
Usage_IEC61850_value_off	0 = IEC61850 value at TI30/31 OFF not used 1 = IEC61850 value at TI30/31 OFF used 2 = IEC61850 value bit 0 3 = IEC61850 value bit 1 4 = IEC61850 value bit 2	✓

291 The dataset position must be parameterized ascending from 0 and must not have breaks.

Server in Receive Direction + Goose [only Edition 1]

Routing element	Description	Expert parameter
CASDU1 CASDU2 IOA1 IOA2 IOA3	Address of the datapoint	
Controltype	- Direct Control With Normal Security - Direct Control With Enhanced Security - SBO Control With Enhanced Security	
IEC61850_Address	68 bytes ASCII characters	
Measured value adaptation_X_0% Measured value adaptation_X_100% Measured value adaptation_Y_0% Measured value adaptation_Y_100%	Value adaptation limits	
Thresh_uncond Thresh_additive	Absolute value [292] Absolute value [292]	
Selectivity	To all remote stations/selective	
TI	30 = Single-point information 31 = Double-point information 34 = Measured value, normalized 35 = Measured value, scaled 36 = Measured value, floating point 38 = Protection event 39 = Blocked start events of protection 40 = Blocked tripping of protection 45 = Single command 46 = Double command 49 = Setpoint command, scaled 50 = Setpoint command, floating point	
CDC	0 = Standard 12 = SPC 13 = DPC 14 = INC 21 = BSC 22 = ISC 23 = ASG 24 = ING 25 = APC 27 = ENC	
ON-command_on_IEC61850_value	[293]	✓

292 The measured value change monitoring occurs on the raw value (= received value).

293 With the value for TI 45, TI46 can be parameterized, at which IEC 61850 value the ON command is to be generated. The corresponding OFF command is generated automatically by the firmware as soon as another value is received (applies only for the CDCs "INC", "INS", "SGCB"; as of IEC 61850 Ed. 1) resp. “ENC“, “ENS“ (Ed. 2) and "SGCB").

Routing element	Description	Expert parameter
Goose_Attrib1 [287] Goose_Attrib2 [287] Goose_Attrib3 [287] Goose_Attrib4 [287] Goose_Attrib5 [287]	GOOSE Attribute (see *GOOSE-Attributes, Page 1179*)	
Goose_Index_A	GOOSE Index in the system technique 0...255	
Goose_Attr1_Data-setpos_Index_A Goose_Attr2_Data-setpos_Index_A Goose_Attr3_Data-setpos_Index_A Goose_Attr4_Data-setpos_Index_A Goose_Attr5_Data-setpos_Index_A	Dataset Position 0...255 [294]	✓
Station_A Station_B Station_C Station_D Station_E Station_F Station_G Station_H Station_I Station_J	Selection station 0...99 255 = to all stations	✓

294 The dataset position must be parameterized ascending from 0 and must not have breaks.

GOOSE-Attributes

GOOSE-Attribute	Common Data Class (CDC)
stVal	SPS, DPS, INS, SPC, DPC, INC
q	SPS, DPS, INS, ACT, ACD, MV, CMV, SAV, SPC, DPC, INC
t	SPS, DPS, INS, ACT, ACD, MV, CMV, SAV, SPC, DPC, INC
General	ACT, ACD
phsA	ACT, ACD
phsB	ACT, ACD
phsC	ACT, ACD
neut	ACT, ACD
mag.f	MV
mag.i	MV
cVal.mag.f	CMV
cVal.mag.i	CMV
instMag.f	SAV
phsA.cVal.mag.f	WYE
phsA.cVal.mag.i	WYE
phsB.cVal.mag.f	WYE
phsB.cVal.mag.i	WYE
phsC.cVal.mag.f	WYE
phsC.cVal.mag.i	WYE
neut.cVal.mag.f	WYE
neut.cVal.mag.i	WYE
net.cVal.mag.f	WYE
net.cVal.mag.i	WYE
res.cVal.mag.f	WYE
res.cVal.mag.i	WYE
phsA.q	WYE
phsA.t	WYE
phsB.q	WYE
phsB.t	WYE
phsC.q	WYE
phsC.t	WYE
neut.q	WYE
neut.t	WYE
net.q	WYE
net.t	WYE
res.q	WYE
res.t	WYE

GOOSE-Attribute	Common Data Class (CDC)
phsAB.cVal.mag.f	DEL
phsAB.cVal.mag.i	DEL
phsBC.cVal.mag.f	DEL
phsBC.cVal.mag.i	DEL
phsCA.cVal.mag.f	DEL
phsCA.cVal.mag.i	DEL
phsAB.q	DEL
phsAB.t	DEL
phsBC.q	DEL
phsBC.t	DEL
phsCA.q	DEL
phsCA.t	DEL
c1.cVal.mag.f	SEQ
c1.cVal.mag.i	SEQ
c2.cVal.mag.f	SEQ
c2.cVal.mag.i	SEQ
c3.cVal.mag.f	SEQ
c3.cVal.mag.i	SEQ
c1.q	SEQ
c1.t	SEQ
c2.q	SEQ
c2.t	SEQ
c3.q	SEQ
c3.t	SEQ
Pos.origin.orCat	DPC
Pos.origin.orIdent	DPC
stSeld	DPC
Pos.Oper.origin.orCat	DPC
Pos.Oper.origin.orIdent	DPC
SPC (stVal, q, t)	SPC [295]
DPC (stVal, q, t)	DPC [295]
ENC (stVal, q, t)	ENC [295]
INC (stVal, q, t)	INC [295]
SPS (stVal, q, t)	SPS [295]
DPS (stVal, q, t)	DPS [295]
ENS (stVal, q, t)	ENS [295]
INS (stVal, q, t)	INS [295]

Server in Transmit Direction – Default Values

Routing element	Description	Expert parameter
IEC61850_Address	68 bytes ASCII characters	
Selectivity	To all remote stations/selective	

295 In Ed. 2 these attributes can be received/sent as data structures in GOOSE

Routing element	Description	Expert parameter
Station_A Station_B Station_C Station_D Station_E Station_F Station_G Station_H Station_I Station_J	Selection station 0...99 255 = to all stations	✓
Value	Default value (30 characters)	

With this routing the Data Attribute Name must be named always.

For the following Basic Types (refer to *IEC 61850: Basic Types, Page 1137*) a default value can be parameterized, whereby the values must be parameterized in ASCII:

Basic type
BOOLEAN
INT 8
INT 16
INT 24
INT 32
INT 128
INT 8U
INT 16U
INT 24U
INT 32U
FLOAT 32
FLOAT 64
VISIBLE STRING

GOOSE properties (system technique)

Routing element	Edition 1	Edition 2
GOOSE Index	0...99	0...99
GoCBRef	65 Byte ASCII [296]	128 Byte ASCII [296]
GoID	65 Byte ASCII [297]	129 Byte ASCII [297]
DataSet	68 Byte ASCII [298]	128 Byte ASCII [298]
MAC Address	12 Byte ASCII [299]	12 Byte ASCII [299]
AppID	0...3FFF [300]	0...3FFF [300]
configRev	0...4294967295 [301]	0...4294967295 [301]

296 reference to the GOOSE Control Block, e.g.: VLC01/LLN0.gcST

297 unambiguous identification of the GOOSE message

298 name of the Data Set, e.g.:VLC01/ds2

299 see section *Data Transmission Server ↔ Server with GOOSE (Server only), Page 1109*

300 should be unambiguous over all GOOSE messages and unequally 0 (attention: HEX)

301 32 bit value, the SICAM TOOLBOX II supports only a 16 bit value (0...65535)

Routing element	Edition 1	Edition 2
VLAN Vid	0...4096 [302]	0...4096 [302]
VLAN Priority	0...7 [303]	0...7 [303]

13.6.8.4 Special Functions

For the coupling of devices with the IEC 61850 protocol, if necessary the following special functions can be activated for the adaptation of the message conversion:

- Conversion of the Time Information
- Signaling/measured value disabling
- Emulation of the going binary information
- Emulation of the data on reception of the attribute “Beh.stVal” = OFF and “Beh.stVal” = BLOCKED
- Technological Adaptation for Measured Values
- Measured value change monitoring
- Monitoring intermediate and faulty positions of double-point information
- Logging of the remote commands at the local control center
- Remote parameterization/diagnostic of SICAM A8000 components via IEC 61850
- Automatic Load Shedding

Conversion of the Time Information

As time format, as standard IEC 61850 defines the UTC-Format (Universal Time Coordinated = coordinated universal time).

For the message conversion, the SICAM A8000 internal time format can be determined with the parameter **Advanced parameters | Time format in transmit direction** and the parameter **Advanced parameters | Time format in receive direction**.

Possible time formats:

IEC 61850 time format (on the line)	IEC 60870-5-101/104 Time Format (SICAM A8000 internal)
UTC (Universal Time Coordinated)	Local time with daylight-saving / normal time
UTC (Universal Time Coordinated)	Local time with normal time (winter time)
UTC (Universal Time Coordinated)	UTC (Universal Time Coordinated)
Local time	Local time

Signaling/Measured Value Disabling [Client only]

The signaling/measured value disabling is a function of the protection equipment and can be activated globally (for binary information and measured values together) for example by means of a key lock switch or by means of a control input in the protection equipment. Through the signaling/measured value disabling function the spontaneous transmission (Reporting) is deactivated.

With activation/deactivation of the signaling/measured value disabling, for each logical device the binary information *Behavior* is transmitted spontaneously to the client. The signaling / measured value disabling is transmitted as last signal with activation and as first signal with deactivation.

So that the functions for the emulation of the data can be executed by the protocol element with signaling/measured value disabling, the attribute “Beh.stVal” for signaling/measured value disabling of the affected logical node or the logical node LLN0 must be entered in the SIP message address conversion in receive direction. The protocol element evaluates the attribute of the respective logical node with higher priority than the attribute of the logical node LLN0.

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302 should be unequally 0

303 default 4

If only the attribute "Beh.stVal" of the logical node LLN0 is entered, on reception of the attribute "Beh.stVal" = BLOCKED the data of all affected logical nodes is emulated.

If the attribute "Beh.stVal" of a selective logical node is entered, on reception of the attribute "Beh.stVal" = BLOCKED only the data of the selective logical node is emulated.

The emulation of the data concerned (with activation of the signaling/measured value disabling) by the protocol element with IEC 61850 Server function to the internal IEC 60870-5-101/104 format can be selected with the parameter **`IEC61850 | Client | Advanced parameters | Behavior of Beh.stVal=2 (blocked)`** as of IEC 61850 Edition 2: **`Connection definition | Beh.stVal=2 (blocked)`**).

Possible emulation of the data with "Beh.stVal" = BLOCKED:

- No emulation
- Emulation of the data with BL = 1 (blocked)

On deactivation of the signaling/measured value disabling, in the following cases all data concerned are read out again by the protocol element with IEC 61850 Server function from the IEC 61850 Clients and the data transferred spontaneously:

- Change of the attribute "Beh.StVal" from BLOCKED → ON
- Change of the attribute "Beh.StVal" from BLOCKED → TEST
- Change of the attribute "Beh.StVal" from BLOCKED → TEST-BLOCKED

NOTE

- In the protocol element with IEC 61850 Server function, no special functionality is implemented for the signaling/measured value disabling!
- For counts that are transmitted as measured values, no emulation is performed!
- With signaling/measured value disabling activated, also no (possible) parameterized cyclic interrogation of the data points concerned is performed.
- SICAM A8000 internal, on activation of the signaling/measured value disabling, all signals/measured values are generated with the status "spontaneous + blocked" and transmitted via IEC 61850 to the Client. On deactivation of the signaling/measured value disabling, all signals/measured values are transmitted spontaneously with the status "spontaneous".

Emulation of the Going Binary Information [Client only]

With IEC 61850, protection signals are only transmitted with the state ON (coming). For IEC 60870-5-101/104, the "coming/going state" is always required for every signal.

The protocol element with IEC 61850 Client function can emulate the "Going Signal" automatically for selected signals in receive direction. The "Going Signal" is fixed emulated with the time of the coming signal + 10 milliseconds.

The emulation of the going signal can be parameterized in the SIP message address conversion in receive direction in the category *`firmware /`* **`Client_Rec_IEC61850`** for each signal in the field **type_of_binary_information**.

Emulation of the Data on Reception of the Attribute Beh.stVal = OFF [Client only]

On reception of the attribute "Beh.stVal" with the state "OFF" for a selective logical node or the logical node LLN0 (per logical device), the emulation of the data concerned by the protocol element with IEC 61850 Server function to the internal IEC 60870-5-101/104 format can be selected with the parameter **`IEC 61850 | Client | Advanced parameters | Behavior of Beh.stVal=5 (OFF)`** (as of IEC 61850 Edition 2: **`Connection definition | Beh.stVal=5 (OFF)`**).

Possible emulation of the data with Beh.stVal = OFF:

- No emulation
- Emulation of the data with NT = 1 (not topical)
- Emulation of the data with IV = 1 (invalid)

So that the functions for the emulation of the data can be performed by the protocol element, the attribute "Beh.stVal" must be entered in the SIP message address conversion in receive direction. The protocol element evaluates the attribute of the respective logical node with higher priority than the attribute of the logical node LLN0.

If only the attribute "Beh.stVal" of the logical node LLN0 is entered, on reception of the attribute "Beh.stVal" = OFF the data of all affected logical nodes is emulated.

If the attribute "Beh.stVal" of a selective logical node is entered, on reception of the attribute "Beh.stVal" = OFF only the data of the selective logical node is emulated.

NOTE

For counts that are transmitted as measured values, no emulation is performed!

On reception of the attribute Behavior (Beh.stVal) with the state ≠ OFF, in the following cases all affected data points are read out again by the protocol element with IEC 61850 Server function from the IEC 61850 Clients and the data transferred spontaneously:

- Change of the attribute "Beh.StVal" form OFF → ON
- Change of the attribute "Beh.StVal" form OFF → TEST
- Change of the attribute "Beh.StVal" form OFF → TEST-BLOCKED

Technological Adaptation for Measured Values

The technological adaptation enables the measured value supplied by the connected devices to be transformed into a technological or normalized value. Which value can be transformed into depends on the format of the spontaneous information object to be transferred.

Type Identification (IEC 60870-5-104)	Spontaneous information object	Value range	Meaning
<TI:=34>	Measured value, normalized value	-1 to +1-2^{-15}	Normalized, percentage representation
<TI:=35>	Measured value, scaled value	-32768 to +32767	Technological, integer
<TI:=36>	Measured value, short floating-point number	$-8.43 \cdot 10^{-37}$ to $+3.37 \cdot 10^{38}$	Technological, floating point

The technological adaption is set for each measured value as an adaption line with 2 support points: Parameter **`Measured_value_adaptation_X_0%`**, **`Measured_value_adaptation_X_100%`**, **`Measured_value_adaptation_Y_0%`**, **`Measured_value_adaptation_Y_100%`** in the technological parameters of the protocol element.

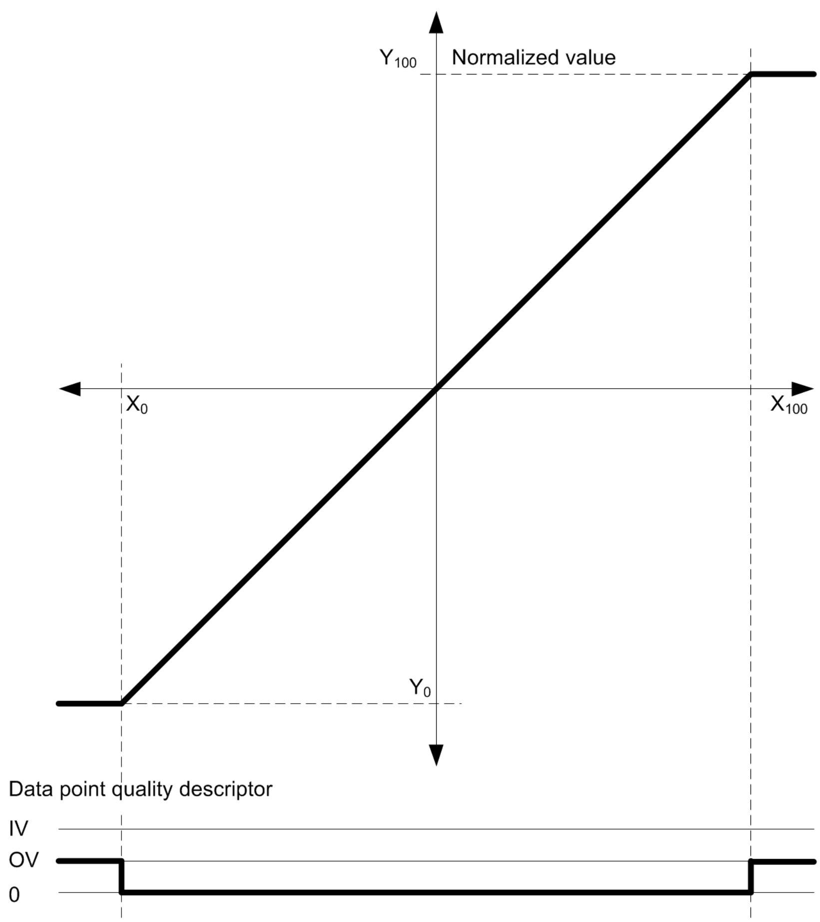
For this, the technological value Y0 is parameterized for the lower limit of the measuring range X0 and the technological value Y100 for the upper limit of the measuring range X100.

The received measured value is adapted linear according to the parameter setting by the protocol element before transfer to the basic system element.

Bipolar measured values without zero-range suppression and plausibility check (Example)

Pin	Value	Meaning	Parameter
X_0	-2000	Lower boundary of the measuring range (set by parameter)	Measured value adaptation_X_0%
X_{100}	+2000	Upper boundary of the measuring range (set by parameter)	Measured value adaptation_X_100%

Pin	Value	Meaning	Parameter
Y_0	-1	Technological value at X0	Measured value adapta-tion_Y_0%
Y_{100}	+1	Technological value at X100	Measured value adapta-tion_Y_100%



Measured value change monitoring

Measured values are transmitted from some protection equipment with the smallest changes in measured value or even cyclic.
So as not to load the following transmission facilities unnecessarily, the measured value is monitored for change in accordance with the following rules:

- The first value received after startup is transmitted immediately.
- Every change of the quality descriptors "blocked", "invalid" or "overflow" triggers an immediate transmission.
- Change monitoring in accordance with the method of the additive threshold value procedure.

Additive Threshold Value Procedure

In the parameterized processing grid the measured value is monitored for change. If the deviation from the last spontaneously transmitted measured value is greater than the parameterized **thresh_uncond** , the new measured value is transmitted immediately. Otherwise, the deviations from the last spontaneously transmitted measured value are added with the correct sign in the processing grid (**grid for additive measured value monitoring**). First when the amount of this total exceeds the parameterized **Thresh_additive** is the current measured value spontaneously transmitted.

Thresh uncond	Thresh additive	Processing
0	0	Value is sent immediately to BSE upon change
0	≠ 0	
≠ 0	0	Value is sent to BSE in the next processing grid upon change
≠ 0	≠ 0	• Change ≥ **thresh_uncond** – Value will be sent to BSE in the next processing grid • Change <**thresh_uncond** – Additive Threshold Value Procedure

A transmission of the measured value due to a general interrogation does not influence the threshold value procedure.

By means of parameterization it is established:

- **Grid for additive measured value monitoring** 0.1 s to 25.5 s
- **Thresh_uncond** $1.17 \cdot 10^{-38}$ to $3.40 \cdot 10^{+38}$
- **Thresh_additive** $1.17 \cdot 10^{-38}$ to $3.40 \cdot 10^{+38}$

The values for the parameters **thresh additive** and **thresh uncond** are absolute values and always refer to the received non-linearized value.

The processing grid is parameterized for all measured values together with the parameter **IEC61850 | Grid for measurands change monitoring** . The thresholds are to be parameterized for every measured value with the parameter **Thresh_additive** and the parameter **Thresh_uncond** in the technological parameters of the protocol element.

The following example shows a normal case, where the adaptation line goes through the zero point (origin) ($Y_{\text{at } X=0} = 0$).

Examples

Technological value Y_{100}	4000
Processing grid	0.1 s
Thresh_uncond	80.00 (represents a change of the received value by 80)
Thresh_additive	6000.00 (represents an additive sum of 6000)

Example 1:

After transmission due to the exceeding of the large threshold, the value has changed once by 79 (< the large threshold) and subsequently remains constant. The measured value is transmitted after 7.5 seconds.

	0.0 s	0.1 s	0.2 s	0.3 s	0.4 s	0.5 s	0.6 s	0.7 s	0.8 s	...	7.4 s	7.5 s
Measured value	300	379	379	379	379	379	379	379	379	...	379	379
Difference	>80	79	79	79	79	79	79	79	79	...	79	79
Additive total	0	79	158	237	316	395	474	553	632	...	5925	6004
Transmission	x											x

Example 2:

After transmission due to the exceeding of the large threshold, the value has changed once by 1 (< the large threshold) and subsequently remains constant. The measured value is transmitted after 10 minutes.

	0.0 s	0.1 s	0.2 s	0.3 s	0.4 s	0.5 s	0.6 s	0.7 s	0.8 s	...	599.9	600 s
Measured value	300	301	301	301	301	301	301	301	301	...	301	301
Difference	>80	1	1	1	1	1	1	1	1	...	1	1
Additive total	0	1	2	3	4	5	6	7	8	...	5999	6000
Transmission	x											x

Example 3:

After transmission due to the exceeding of the large threshold, the value continually changes by ±1. The measured value is not transmitted.

	0.0 s	0.1 s	0.2 s	0.3 s	0.4 s	0.5 s	0.6 s	0.7 s	0.8 s	...	7.4 s	7.5 s
Measured value	300	301	300	299	300	301	300	301	299	...	300	301
Difference	>80	1	0	-1	0	1	0	1	-1	...	0	1
Additive total	0	1	0	1	0	1	0	1	1	...	0	1
Transmission	x											

Monitoring Intermediate and Faulty Positions of Double Point Information [Client only]

Double-point information that are transmitted from the connected IEC 61850 devices, can be monitored by the protocol element for intermediate and faulty position (in most cases protection equipment do not have any monitoring for intermediate and faulty position implemented).

Thereby, the transfer of an intermediate position (neither ON- nor OFF binary information exists) or a faulty position (both ON- as well as OFF binary information exists) is suppressed by the protocol element for a parameter-settable time.

On reception of a double-point information with intermediate or faulty position, the suppression time is started and the double-point information is not transferred. If during the monitoring time the double-point information is received with valid binary information state (ON or OFF), the suppression time is stopped and the double-point information is transferred with the valid binary information state.

The time tag after suppression of intermediate and faulty position corresponds to the original time tag+ the parameterized suppression time (Example: Intermediate position at 12:01:02.123 with 10 seconds suppression time, message transfer after 10 seconds with time 12:01:12.123).

The suppression time for the intermediate position must be parameterized for all double-point information items jointly with the parameter **`IEC61850 | Client | Intermediate position suppression time`** (as of IEC 61850 Edition 2: **`Connection definition | Intermediate position suppression time (s)`**).

The suppression time for the faulty position must be parameterized for all double-point information items jointly with the parameter **`IEC61850 | Client | faulty state suppression time`** (as of IEC 61850 Edition 2: **`Connection definition | Faulty position suppression time (s)`**).

The assignment of the message address for the spontaneous information object "Double-point information" is carried out in the OPM II with the category *`SIP message address conversion /... /firmware/ ...`*.

Logging of the Remote Commands at the Local Control Center [Server only]

For documentation or traceability, a logging of operator inputs to an existing local control center is often required.

So that remote commands can be logged at a local control center connected in the IEC 61850 network, the remote commands must also be sent to the local control center. However with IEC 61850, due to the Server/Client communication this is not possible without additional measures!

For configurations with SICAM A8000 components as IEC 61850 Client and the control center system SICAM SCC as local control center, the logging of remote commands via IEC 61850 is possible by means of a proprietary (non-compatible) procedure, if an unambiguously assigned return information is available for every remote command (assignment: ctlVal ⇔ stVal).

With function activated, the protocol element with IEC 61850 Server function sends the return information to the control point and to the local control centre with the information required for the logging in the attribute "orIdent" (Originator Identification).

The following items of information are entered in the attribute “orIdent” as ASCII-Text (max. 64 characters):

- IP-address
- Region number
- Component number
- Cause of transmission
- Positive/Negative identifier
- Data (On/Off, Higher/Lower,...)
- Originator address

The function can be activated with the parameter **`IEC61850 | Server | Advanced parameters | Log remote commands on local SCADA system`** .

Remote parameterization/diagnostic of SICAM A8000 components via IEC 61850

If SICAM A8000 components are used as IEC 61850 Client and as IEC 61850 Server, then a remote parameterization/diagnostic of the SICAM A8000 components can be performed over the LAN connection and the IEC 61850 protocol element.

The remote parameterization/diagnostic is activated automatically by the IEC 61850 protocol element, as soon as the connection is established and a SICAM A8000 component with IEC 61850 protocol element has been detected as remote station.

For this a proprietary procedure is implemented over the TCP/IP connection of the LAN-link, which can only be used between SICAM A8000 components and is not defined in IEC 61850 or IEC 60870-5-104 respectively.

The automatic detection/activation and the transmission of all messages required for the remote parameterization/diagnostic takes place over TCP/IP with messages defined especially for this purpose.

Automatic Load Shedding

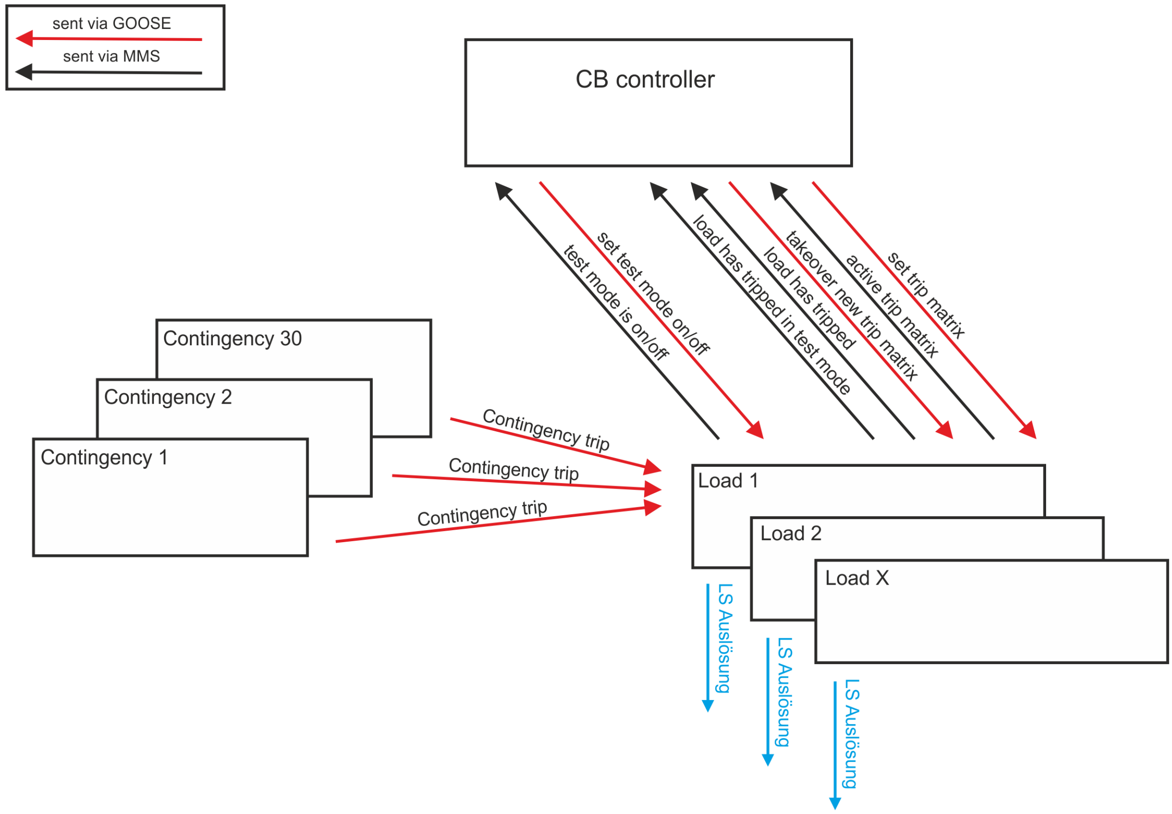
Critical events with sudden significant loss of generated power are a serious threat for the stability of industry grids. Such disturbance of the balance between generated power and load typically results in a frequency drop and the risk of activation of generator protection relays. As these relays protect running generators their trip causes even more decline of frequency and finally resulting in a total blackout. This so called “domino-effect” has to be avoided to make sure, that at least the main production works uninterrupted.

The only way to prevent deep drops in system frequency and a frequency collapse following a large disturbance is to employ automatic fast shedding of low priority loads.

The function Automatic Load Shedding aims to maintain stability of electrical grids in industry, especially in critical situations like a generator trip or loss of the tie-line to an external utility. Thereby consumer feeders with low priority will be switched off in order to establish the balance of generated and consumed loads.

Set Loads

Up to 300 loads (Load 1 to Load X) can be configured, each load has a trip matrix.



[dw_ETx5_load_shedding, 1, en_US]

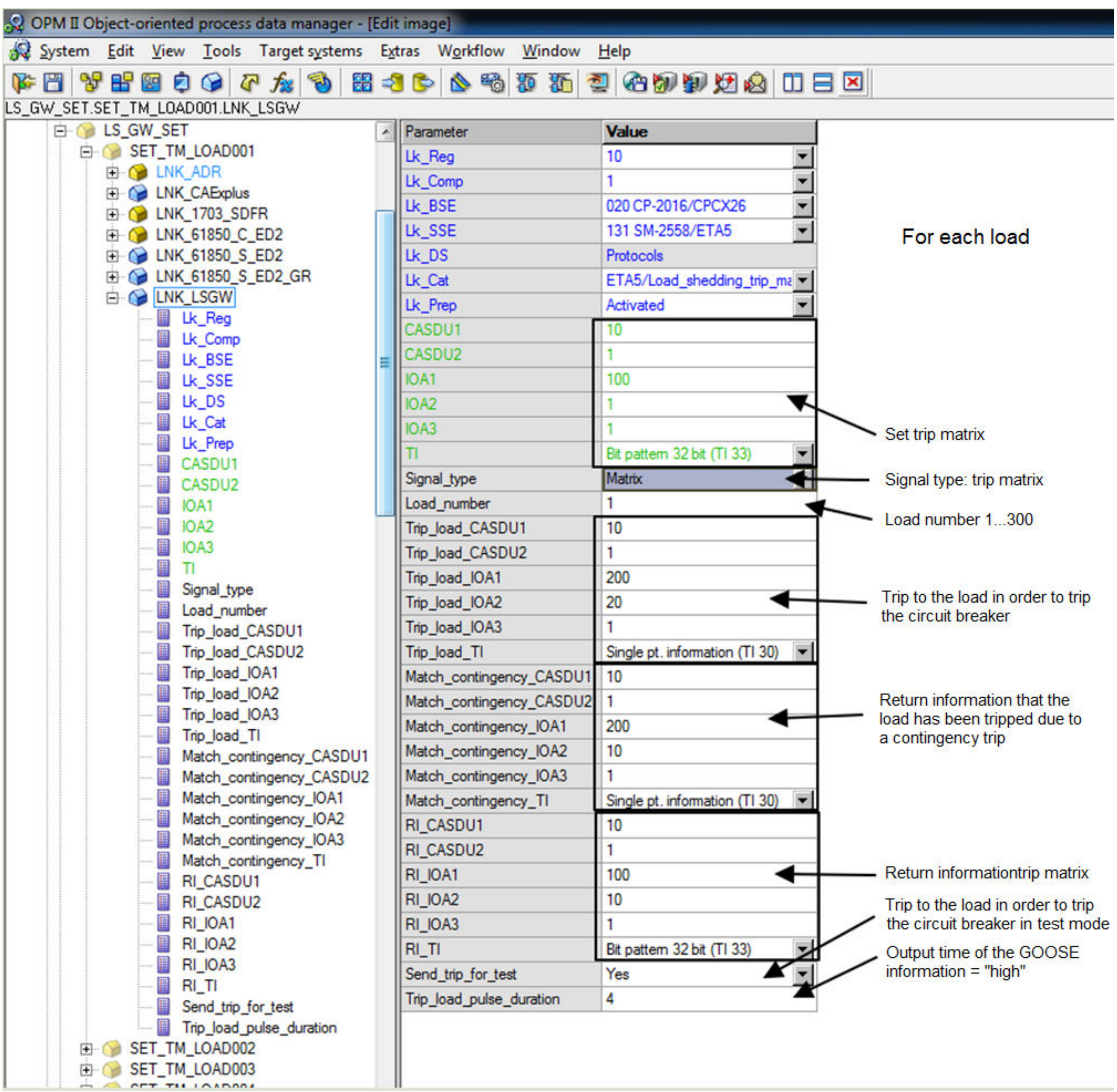
Required Settings

- **CASDU1**, **CASDU2**
  IOA1, **IOA2**, **IOA3**
  IEC 60870-5-101/104 address that adjusts the bitmask resp. takeover information, test information
- **TI**
  30 for the takeover information, test information (load number, GOOSE information is not evaluated)
  33 for the bitmask
- **Signal_type**
  Matrix, enable, test
- **Load_Number**
  1bis 300
- **Rückmeldung_CASDU1**, **Rückmeldung_CASDU2**
  Rückmeldung_IOA1, **Rückmeldung_IOA2**, **Rückmeldung_IOA3**
  Address of the return information for trip matrix resp. trip matrix takeover (if desired) resp. test mode
- **RI_TI**
  30 for the takeover information, test information
  33 for the bitmask
- **Load_Trip_CASDU1**, **Load_Trip_CASDU2**
  Load_Trip_IOA1, **Load_Trip_IOA2**, **Load_Trip_IOA3**
  IEC 60870-5-101/104 address of the trip to the load in order to trip the circuit breaker
- **Trip_load_TI**
  30 for the trip in direction BSE

- **`Match_contingency_CASDU1`**, **`Match_contingency_CASDU2`**
  `Match_contingency_IOA1`, **`Match_contingency_IOA2`**, **`Match_contingency_IOA3`**
  IEC 60870-5-101/104 address of the return information load tripped through contingency trip
- **`Match_contingency_TI`**
  30 for the trip in direction GOOSE
- **`Send_trip_for_test`**
  Trip to the load in order to trip the circuit breaker in test mode
- **`Trip_load_pulse_duration`**
  Output time for GOOSE message
- **`Contingency_number`**
  1 to 30

Set Trip Matrix

The trip matrix can be set with a TI 33 information. The information can be received by the BSE (application program) or by GOOSE (CDC = INC, INS).

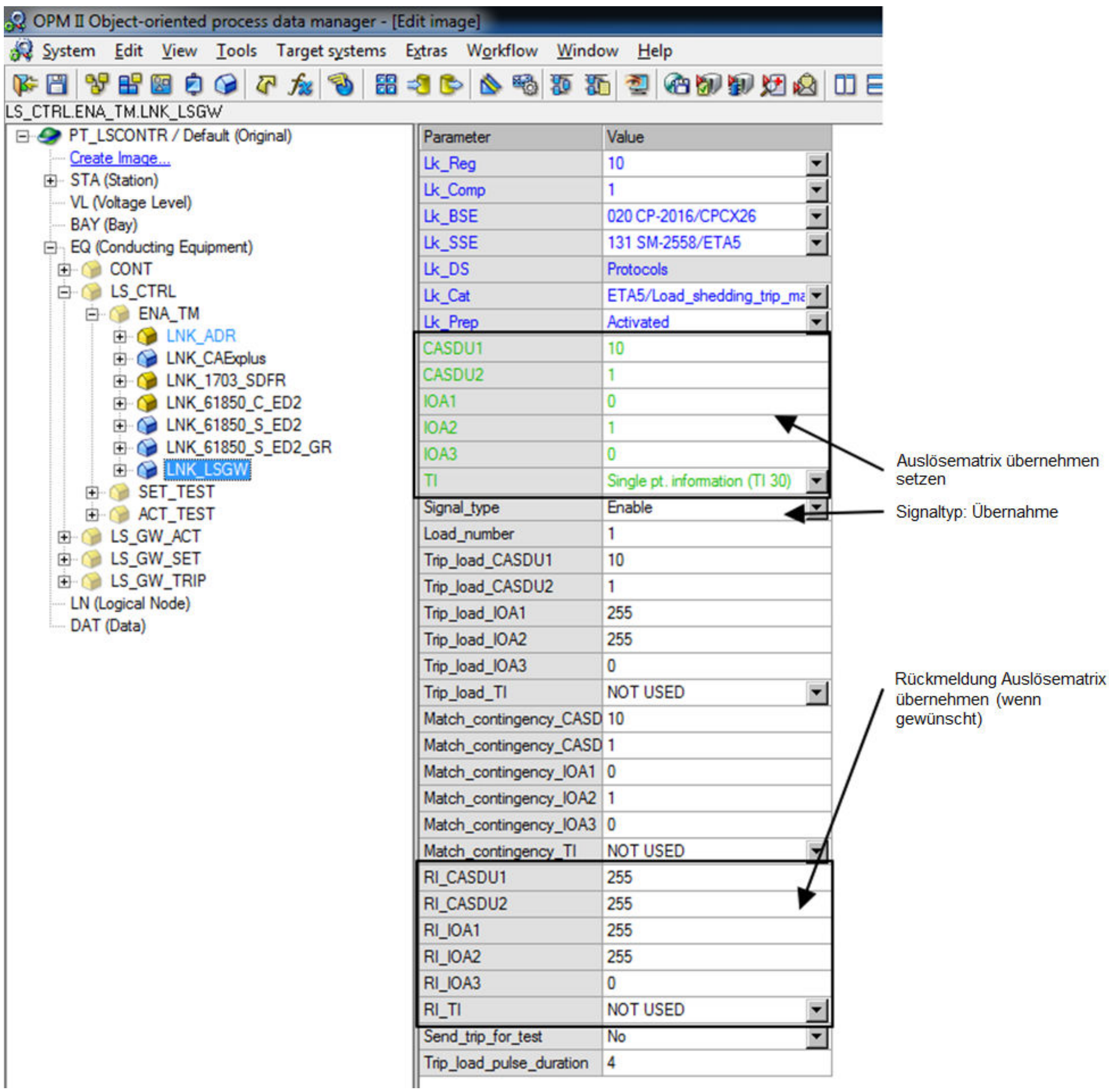


[sc_ETx5_load_shedding_01, 1, en_US]

Trip Matrix Enable

The setting of the bit combination for each load is only active, if a coming edge of a load-overlapping enable information of the BSE or by GOOSE was received (the new bit combinations are written into the memory as prepared and copied with the enable information for all loads in the active memory. Thereby it is assured that all loads have the correct state simultaneously).

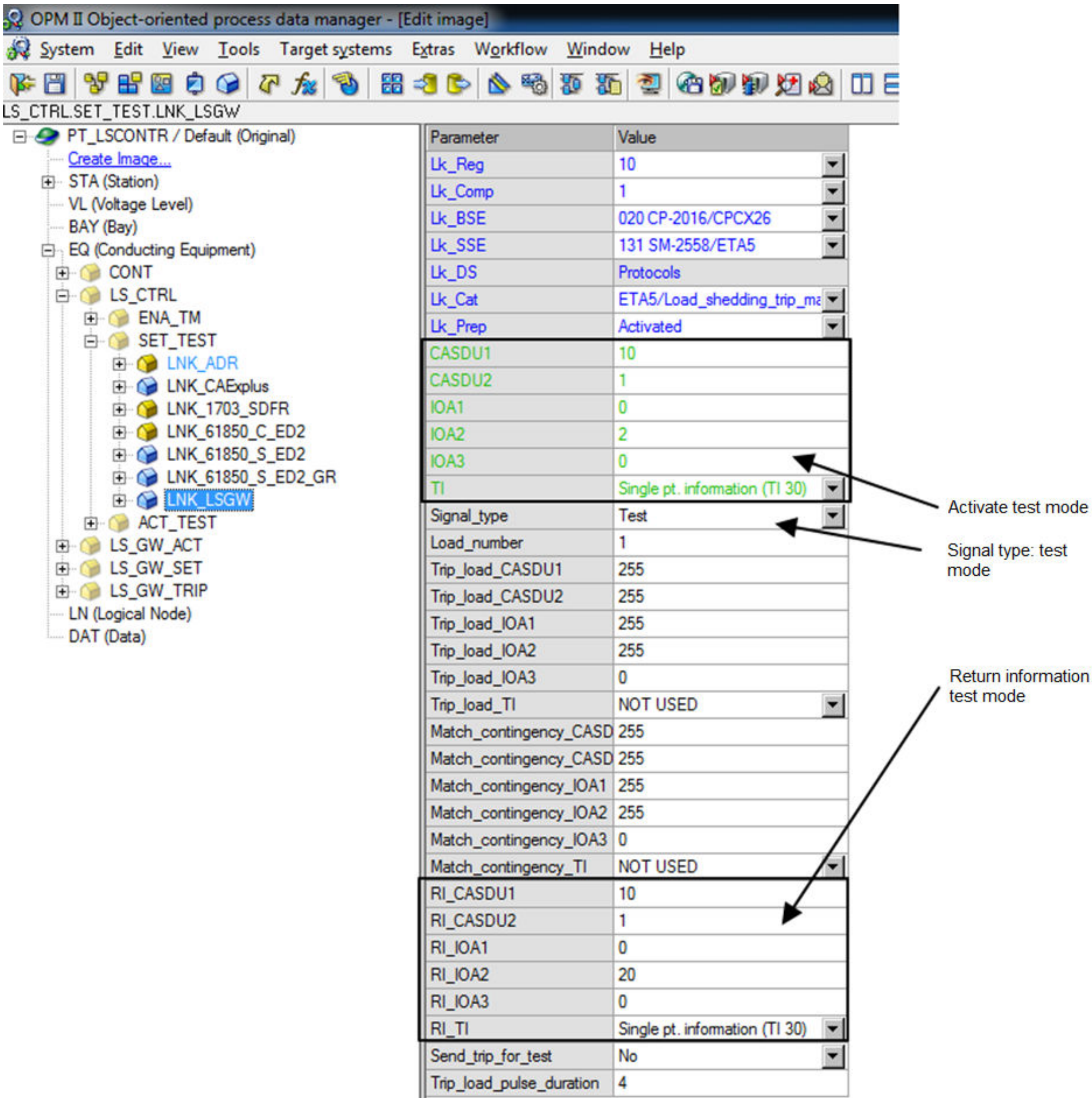
With the coming enable information (takeover new trip matrix) all current set new bit combinations will be sent as return information <TI:=33> spontaneously in direction BSE, these return information items are GI-capable. The enable information will be sent spontaneously as return information in direction BSE and is GI-capable.



[sc_ETx5_load_shedding_02, 1, en_US]

Test Mode

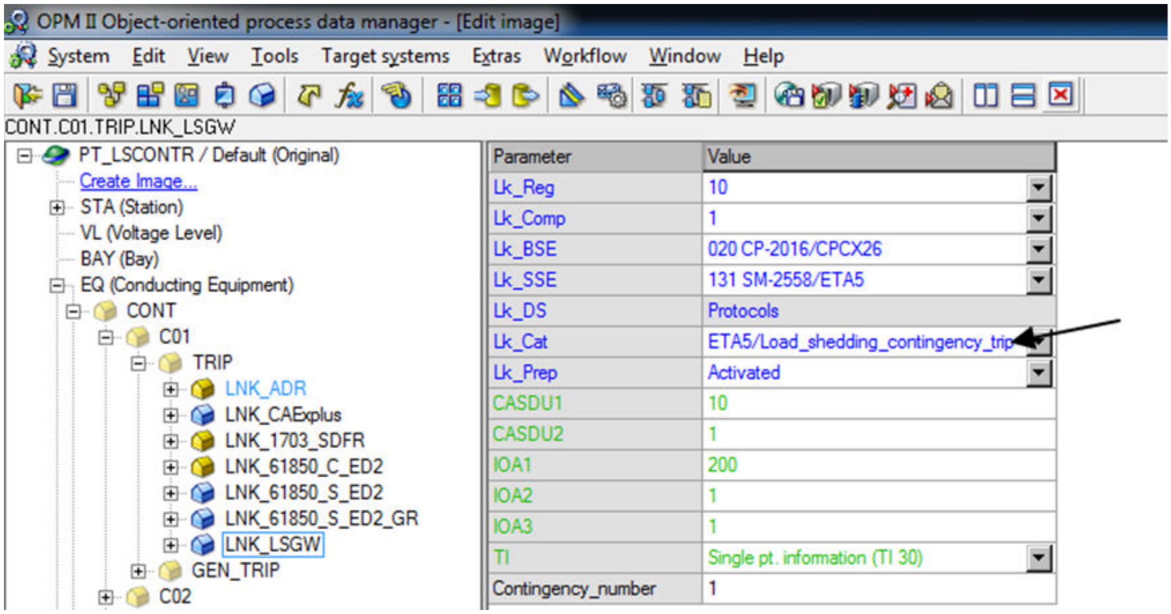
A load-overlapping test information is sent spontaneously as return information in direction BSE.



[sc_ETx5_load_shedding_03, 1, en_US]

Contingency Trip

Per contingency a trip impulse is received by GOOSE. If a corresponding bit for each load is set to 1, a GOOSE message is generated and also an information in direction BSE. The GOOSE message (CB Trip) is only generated, if the Test bit is set to 0 or if the GOOSE trigger was parameterized to ***Yes*** with Test (for each load). The information in direction BSE is always generated (if the status TEST is active, the coming information is provided with the Test bit, this can be evaluated in the application program).



[sc_ETx5_load_shedding_04, 1, en_US]

The GOOSE applications and information items must be configured via the normal way of the Server parameterization (SICAM TOOLBOX II and Sysconf).

The information in direction BSE will be generated with ON and OFF, whereby the time tag is +10 ms between the both information items.

The GOOSE message is set to ON for the adjustable time **`Trip_load_pulse_duration`** (n·100 ms) and thereafter to OFF again (minimal time 200 ms).

Quality Bit Handling

- If the bitmask is provided with the NT or IV bit, the status will be taken over anyway
- If the Test information is provided with the NT or IV bit, the status will be taken over anyway
- If the enable information is provided with the NT or IV bit, all bitmasks (actual and prepared) are set to 0

Time Supervision

If the enable information does not have a rising edge per all 5 seconds, all active bitmasks will be set to 0, the prepared bitmasks will be maintained.

Example: Bitmasks are set per IEC 60870-5-104

Type	104 address	Load	IEC 61850 binary information "trip"	104 address trip	104 address return information
Bit Mask	TI = 33, CASDU, IOA	1	IED1CTRL/GGIO1.SPCSO1.stVal	TI = 30, CASDU, IOA	TI = 33, CASDU, IOA
Bit Mask	TI = 33, CASDU, IOA	2	IED2CTRL/GGIO1.SPCSO2.stVal	TI = 30, CASDU, IOA	TI = 33, CASDU, IOA
Bit Mask	TI = 33, CASDU, IOA	3	IED4CTRL/GGIO1.SPCSO3.stVal	TI = 30, CASDU, IOA	TI = 33, CASDU, IOA
Takeover	TI = 30, CASDU, IOA	-	-	-	TI = 30, CASDU, IOA
Test	TI = 30, CASDU, IOA	-	-	-	TI = 30, CASDU, IOA

IEC 61850 trigger	Load
IED1CTRL/GGIO1.SPCSO88.stVal	1
IED2CTRL/GGIO1.SPCSO88.stVal	2
IED7CTRL/GGIO1.SPCSO88.stVal	3

Sequence:

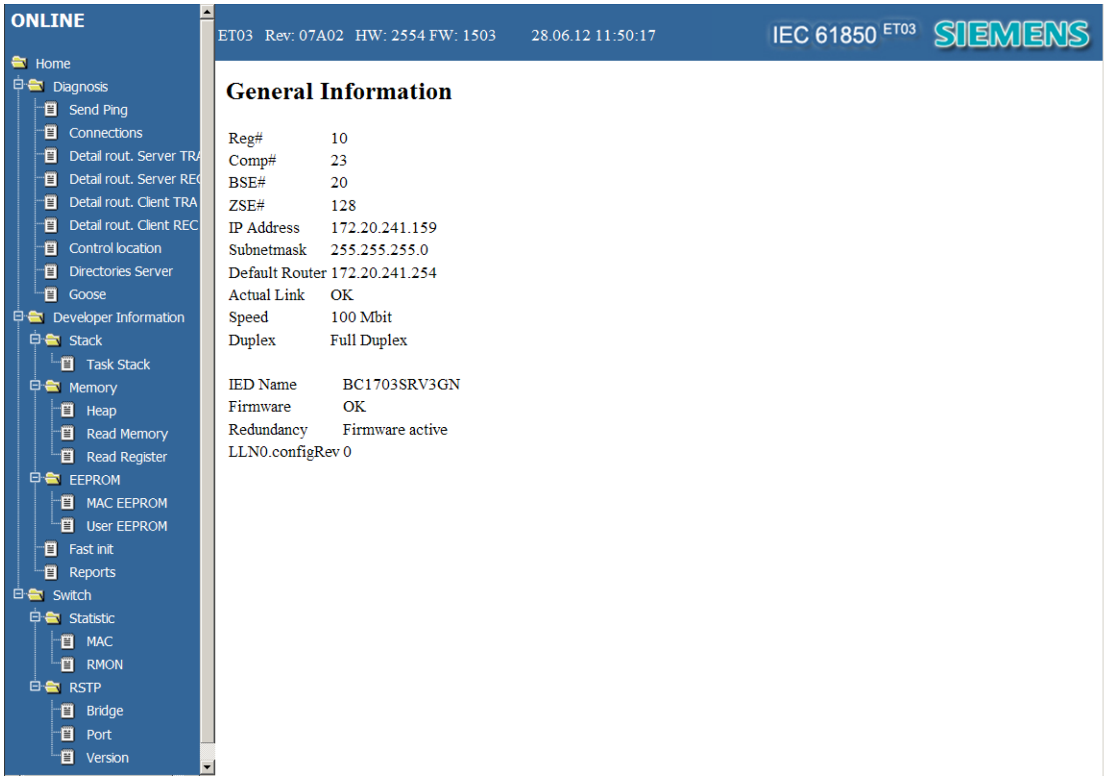
Direction	
BSE → PRE	Setting bitmask load 1 (is copied into prepared memory without test bit)
BSE → PRE	Setting bitmask load 2 (is copied into prepared memory without test bit)
BSE → PRE	Setting bitmask load 3 (is copied into prepared memory without test bit)
BSE → PRE	Takeover ON (all loads are copied from the prepared memory into the active memory)
PRE → BSE	Return information takeover ON (spontaneous)
PRE → BSE	Return information bitmask load 1 (spontaneous)
PRE → BSE	Return information bitmask load 2 (spontaneous)
PRE → BSE	Return information bitmask load 3 (spontaneous)
BSE → PRE	Takeover OFF
PRE → BSE	Return information takeover OFF (spontaneous)
GOOSE → PRE	Trigger 1 (load 1 triggers)
PRE → GOOSE	Trip load 1
PRE → BSE	Trip load 1 (spontaneous) (test bit = 0)
BSE → PRE	Test ON (all test bits of all loads are set to 1)
PRE → BSE	Return information Test ON (spontaneous)
GOOSE → PRE	Trigger 1 (load 1 triggers)
PRE → BSE	Trip load 1 (spontaneous) (test bit = 1)
BSE → PRE	Test OFF (all test bits of all loads are set to 0)
PRE → BSE	Return information Test OFF (spontaneous)

13.6.9 Web Server

13.6.9.1 IEC 61850 Edition 1 [Client]

A web server for internal diagnostic and statistical information is integrated in the protocol firmware. The web server itself is implemented on the basic system element - the protocol-specific web pages are provided by the protocol element.

Enable/disable web server or start web server via SICAM Device Manager or web browser see *13.1.4.12 Web server for protocol-specific web pages*.



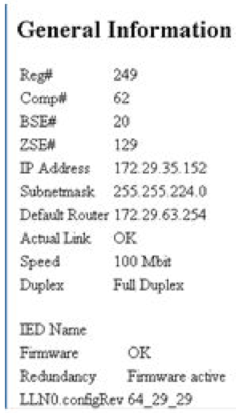
[sc_ET03_webserver_overview, 1, --_--]

Via the integrated web server the following information can be read out:

- General information (Home)
- Diagnostic Information
  - Triggering a Ping command (**Diagnosis | Send Ping**)
  - Display of the connection information (**Diagnosis | Connections**)
  - Display of the Detail Routing Parameters for the client function in transmit direction (**Diagnosis | Detail rout. Client TRA**)
  - Display of the Detail Routing Parameters for the client function in receive direction (**Diagnosis | Detail rout. Client REC**)
  - Display of the control locations with command authority (**Diagnosis | Control location**)
- System-internal data for development specialists
- Switch (DNIP only)
  - Display statistic information (**Switch | Statistic**)
  - Display RSTP information (**Switch | RSTP**)

General Information

On the start page of the web server, general information about the protocol element and the network-specific settings is displayed.



General Information:

- Reg#, Comp#, BSE#, SSE#, IP Address, Subnet Mask, Default Router, Actual Link, Speed, Duplex
  The parameterized or current values are displayed next to the respective fields.
- IED Name [Server only]
  The displayed "IED Name" (= Intelligent Electronical Device Name or Physical Device Name) is parameterized with the parameter **IEC61850 | Server | IED Name** . This IED Name is only used for the ICD file import (as of IEC 61850 Edition 2). The IED Name required for IEC 61850 is only taken by the protocol element from the data of the SIP message address conversion in transmit/receive direction.
- Firmware
  The status of the firmware is displayed next to the field "Firmware".
  OK .... Firmware is running error-free
  KILL, No: #### (0x####)...... A serious error has occurred → notify manufacturer! The number displayed (decimal and HEX) supply the developer with more specific information about the cause of the error.
- Redundancy
  The current redundancy state of the protocol element is displayed next to the field "Redundancy".
  Firmware active ....The redundancy state of the protocol element is "ACTIVE"
  Firmware passive .... The redundancy state of the protocol element is "PASSIVE"
- LLN0.configRev
  The current revision of the SICAM RTUs internal IEC 61850 specific parameters is displayed here. This revision can parameterized either with the parameter **IEC61850 | Server | Advanced parameters | LLN0.configRev** or with corresponding setting of the parameter **IEC61850 | Server | Advanced parameters | LLN0.configRev** the parameter revision generated automatically by the SICAM TOOLBOX II is displayed for the relevant parameter blocks.

NOTE

The "configRev" is the unambiguous identifier of the parameter status of a IEC 61850 device and for SICAM RTUs components is listed for each Physical Device (all logical devices of a physical device have the same revision).

NOTE

61850 devices of some manufacturers check that revision of the parameter status (configRev) imported from the ICD file for connected IEC 61850 devices with that parameter status used in the connected IEC 61850 device (configRev is read out and compared).

→ IEC 61850 devices of some manufacturers terminate the complete function if the configRev no longer corresponds!

NOTE

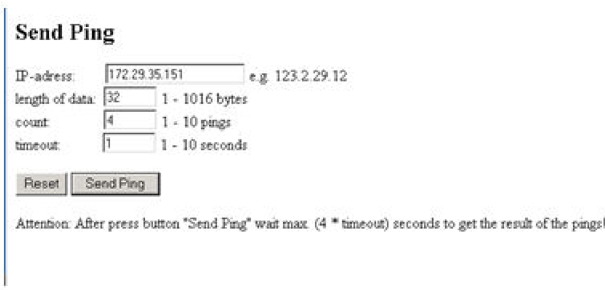
The SICAM RTUs protocol element for IEC 61850 does not terminate the function with different configRevs – correctly parameterized data is converted, the remaining data is not converted.

Triggering a Ping command ("Send Ping")

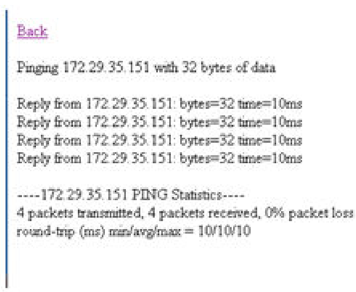
On the web page **Diagnosis | Send Ping** a PING command can be transmitted from the LAN protocol element to the remote station.

This function can be used by the user in order to be able to check the reachability of a connected IEC 61850 remote station.

The advantage of this function is that the PING command is really transmitted from the protocol element, thus from the source.

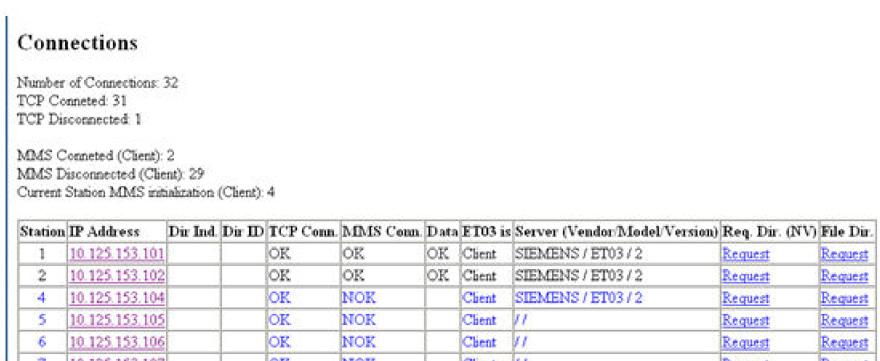


The results of the PING command are displayed in a separate window.



Connection Information ("Connections")

On the web page **Diagnosis | Connections** the status information of the parameterized connections is displayed.



Connections

Number of Connections: 32
TCP Conneted: 31
TCP Disconnected: 1

MMS Conneted (Client): 2
MMS Disconnected (Client): 29
Current Station MMS initialization (Client): 4

Station	IP Address	Dir Ind.	Dir ID	TCP Conn.	MMS Conn.	Data	ET03 is	Server (Vendor/Model/Version)	Req. Dir. (NV)	File Dir.
1	10.125.153.101			OK	OK	OK	Client	SIEMENS / ET03 / 2	Request	Request
2	10.125.153.102			OK	OK	OK	Client	SIEMENS / ET03 / 2	Request	Request
4	10.125.153.104			OK	NOK		Client	SIEMENS / ET03 / 2	Request	Request
5	10.125.153.105			OK	NOK		Client	/ /	Request	Request
6	10.125.153.106			OK	NOK		Client	/ /	Request	Request
7	10.125.153.107			OK	NOK		Client	/ /	Request	Request

Connection-specific status information:

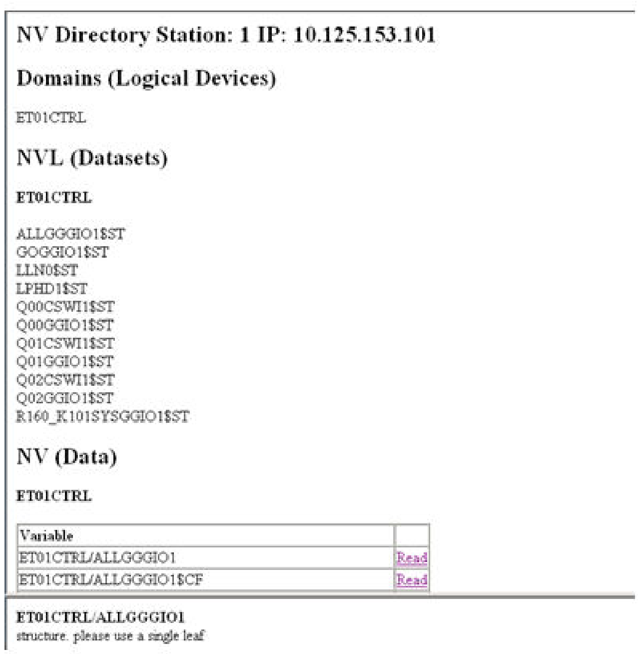
- Station (SICAM RTUs internal station number)
  The station number is used SICAM RTUs internal for the routing of the data, diagnostic treatment and failure management. The station number is the SICAM RTUs internal reference for the connection that is assigned to an IP address.
- IP address
  The field "IP Address" displays the IP address of the remote station parameterized in the parameters for **`Connectiondefinitionen`**. An IP address marked red signifies that this is presently not reachable.
  By clicking the mouse button on the IP address, via a link the web page of a web server possibly implemented in the remote station is displayed.
- Dir Ind. [Server only]
  The field "Dir Ind." is only used for SICAM RTUs components with IEC 61850 Server function and is an index number for a directory created in the server (data model). The "Dir Ind" is unambiguous within a device.
  By clicking the mouse button on the registered "Dir Ind." of a station, the assigned data model of the IEC 61850 station (remote station) is displayed.
- Dir ID [Server only]
  The field "Dir ID" (Directory ID) is only used for SICAM RTUs components with IEC 61850 Server function and is an unambiguous identification number for a directory created in the server (data model).
  By clicking the mouse button on the registered "Dir ID" of a station, the assigned data model of the IEC 61850 station (remote station) is displayed.
- TCP Conn. [Client only]
  The field "TCP Conn." (TCP connection) indicates the status of the connected at TCP level (OK = Connected established at TCP level).
- MMS Conn. [Client only]
  This field indicates the status of the connection at MMS level (OK = Connection is established at TCP level and MMS level, datasets are created and spontaneous transmission is possible).
- Data [Client only]
  The field "Data" is OK if all IEC 61850 data (transmit/receive direction) parameterized in the SIP message address conversion also exist in the remote station.
  If NOK, this link can be used to display the missing data.
- ETI5 is
  This field displays the set parameters **`Connection definition | Own mode`** as the role of the own station for every connection.
- Server (Vendor/Model/Version)" [Client only]
  This field displays the manufacturer information of the connected IEC 61850 device (Server) read out by the Client.
- Req. Dir. (NV) (Request Directory Named Variables) [Client only]
  By clicking the mouse button on the link "Request’ registered in the field, the Directory (data model) of all "Named Variables" is read out and displayed.
- File Dir. [Client only]
  By clicking the mouse button on the link "Request" registered in the field "File Dir.", the File Directory is read out and displayed.
  Displayed are e.g. files of recorded disturbance records in IEEE Comtrade format.

Named Variables Directory of the Station

Via the web page **Diagnosis | Connections | Req. Dir. (NV)** of the IEC 61850 Client, the Named Variables Directory of the IEC 61850 remote station (Server) can be read out and displayed.

The NV Directory contains the following information:

- “Domains (Logical Devices)”
  Listing of all Logical Devices of the IEC 61850 station.
  Example:
  CTRL Control
  DR Disturbance Recording
  EXT Extras
  MEAS Measured value acquisition
  PROT Protection
- “NVL (Datasets)”
  Listing of the NVL (Named Variable Lists) per Logical Device.
- “NV (Data)”
  Listing of all NV (Named Variables) per Logical Device.


NV Directory Station: 1 IP: 10.125.153.101

Domains (Logical Devices)

ET01CTRL

NVL (Datasets)

ET01CTRL

ALLGGGIO1$ST
GOGGIO1$ST
LLN0$ST
LPHD1$ST
Q00CSWI1$ST
Q00GGIO1$ST
Q01CSWI1$ST
Q01GGIO1$ST
Q02CSWI1$ST
Q02GGIO1$ST
R160_K101SYSGGIO1$ST

NV (Data)

ET01CTRL

Variable	
ET01CTRL/ALLGGGIO1	Read
ET01CTRL/ALLGGGIO1$CF	Read

ET01CTRL/ALLGGGIO1
structure. please use a single leaf

The current states of the data attributes of the Named Variables ("Data Attribute Reference") can be read out directly from the IEC 61850 remote station (Server) with "Read" via the web page in the IEC 61850 Client.

The readout is only supported for basic types! The readout of higher-level structures "Data References" is not supported. With an attempt to read out a higher-level structure, the error message "structure. Please use a single leaf" is displayed!

The current state of the selected data attribute is displayed in the window (below). Through the readout, data in the IEC 61850 device cannot be deleted unintentionally.

File Directory of the Station

On the web page *Diagnosis / Connections / File Dir.* the File Directory of the IEC 61850 remote station (Server) can be displayed in the IEC 61850 Client.

A file can be displayed by clicking the left mouse button on the link stored in the filename or saved on the local PC by clicking the right mouse button and selecting the function "Save file as...". The readout and saving of the file is controlled by the protocol firmware.

The files read out via the web server are not deleted in the IEC 61850 remote station.

File Directory Station: 0 IP: 172.29.35.29

To save a file right click on the file -> Save Target As.
After saving the file, please rename it to the correct extension.

Filename	Time	Size
/COMTRADE/00020002.cfg	20060828073733Z	0
/COMTRADE/00020002.dat	20060828073733Z	0
/COMTRADE/00020002.txt	20060828073733Z	0
/COMTRADE/00010001.cfg	20060817154336Z	0
/COMTRADE/00010001.dat	20060817154336Z	0
/COMTRADE/00010001.txt	20060817154336Z	0

Detail Routing Client TRA, Detail Routing Client REC

The address conversion from SICAM RTUs internal IEC 60870-5-101/104 format to the IEC 61850 format in transmit direction and the address conversion from IEC 61850 format to the SICAM RTUs internal IEC 60870-5-101/104 format in receive direction is parameterized with the SICAM TOOLBOX II in the OPM II and generated with the function SIP message address conversion.

On the web page **Diagnosis | Detail Routing Client TRA** all routing information generated for the protocol element in transmit direction is displayed.

Detail routing Client TRA

Type 3: Detail routing transmit

Count: 163
Errors: 0
Not in the Server Directory: 61

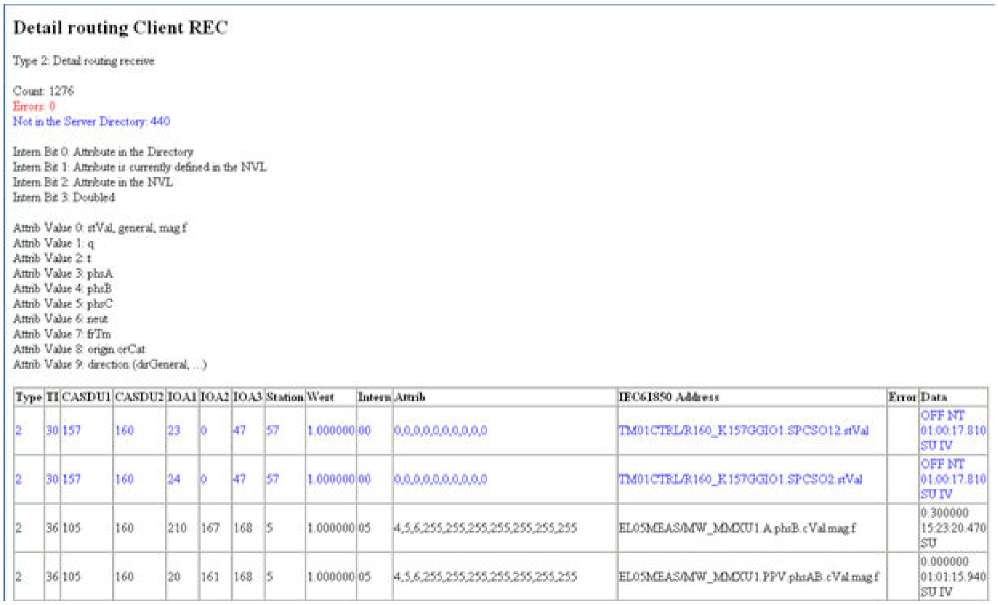
Ctrltype (ctlModel) 0 = Status only
Ctrltype (ctlModel) 1 = Direct with normal security (= EXE)
Ctrltype (ctlModel) 2 = SBO with normal security (= not supported by ET03)
Ctrltype (ctlModel) 3 = Direct with enhanced security (= EXE)
Ctrltype (ctlModel) 4 = SBO with enhanced security (= SEL/EXE)

Intern Bit 0: Attribute in the Directory
Intern Bit 1: Attribute is currently defined in the NVL
Intern Bit 2: Attribute in the NVL
Intern Bit 3: Doubled

IM Bit 0: ON (HIGHER) blocked
IM Bit 1: OFF (LOWER) blocked

Type	TI	CASDU1	CASDU2	IOA1	IOA2	IOA3	Station	Wert	Ctrltype Srv	Intern	IM	IEC61850 Address	Error	Data
3	45	105	160	7	0	175	5	1.000000	1	01	00	EL05CTRL/SYNGGIO1.SPCSO8.ctlVal		OFF
3	45	105	160	5	0	175	5	1.000000	1	01	00	EL05CTRL/SYNGGIO1.SPCSO6.ctlVal		OFF
3	45	105	160	5	192	175	5	1.000000	1	01	00	EL05CTRL/SYNGGIO1.SPCSO5.ctlVal		OFF
3	45	105	160	6	0	175	5	1.000000	1	01	00	EL05CTRL/SYNGGIO1.SPCSO7.ctlVal		OFF
3	46	105	160	222	103	168	5	1.000000	1	01	00	EL05CTRL/Q00CSWI1.Pos.ctlVal		DIFF
3	46	105	160	228	103	168	5	1.000000	1	01	00	EL05CTRL/Q08CSWI1.Pos.ctlVal		DIFF
3	46	105	160	223	103	168	5	1.000000	1	01	00	EL05CTRL/Q01CSWI1.Pos.ctlVal		DIFF
3	46	105	160	224	103	168	5	1.000000	1	01	00	EL05CTRL/Q02CSWI1.Pos.ctlVal		DIFF
3	46	105	160	226	103	168	5	1.000000	1	01	00	EL05CTRL/Q09CSWI1.Pos.ctlVal		DIFF
3	46	127	160	222	103	168	27	1.000000	255	00	00	EC17CTRL/Q00CSWI1.Pos.ctlVal		DIFF
3	46	127	160	223	103	168	27	1.000000	255	00	00	EC17CTRL/Q01CSWI1.Pos.ctlVal		DIFF
3	46	127	160	224	103	168	27	1.000000	255	00	00	EC17CTRL/Q02CSWI1.Pos.ctlVal		DIFF
3	46	165	160	0	131	4	65	1.000000	255	00	00	EL5HCTRL/GAPC255.SPCSO.ctlVal		DIFF

On the web page **Diagnosis | Detail Routing Client REC** all routing information converted for the protocol element in receive direction is displayed.



Detail routing Client REC

Type 2: Detail routing receive

Count: 1276
Errors: 0
Not in the Server Directory: 440

Intern Bit 0: Attribute in the Directory
Intern Bit 1: Attribute is currently defined in the NVL
Intern Bit 2: Attribute in the NVL
Intern Bit 3: Doubled

Attrib Value 0: stVal, general, mag.f
Attrib Value 1: q
Attrib Value 2: t
Attrib Value 3: phsA
Attrib Value 4: phsB
Attrib Value 5: phsC
Attrib Value 6: neut
Attrib Value 7: frTm
Attrib Value 8: origin.orCat
Attrib Value 9: direction (dirGeneral, ...)

Type	TI	CASDU1	CASDU2	IOA1	IOA2	IOA3	Station	Wert	Intern	Attrib	IEC61850 Address	Error	Data
2	30	157	160	23	0	47	57	1.000000	00	0,0,0,0,0,0,0,0,0,0	TM01CTRL/R160_K157GGIO1.SPCSO12.stVal		OFF NT 01:00:17.810 SU IV
2	30	157	160	24	0	47	57	1.000000	00	0,0,0,0,0,0,0,0,0,0	TM01CTRL/R160_K157GGIO1.SPCSO2.stVal		OFF NT 01:00:17.810 SU IV
2	36	105	160	210	167	168	5	1.000000	05	4,5,6,255,255,255,255,255,255,255	EL05MEAS/MW_MMXU1.A.phsB.cVal.mag.f		0.300000 15:23:20.470 SU
2	36	105	160	20	161	168	5	1.000000	05	4,5,6,255,255,255,255,255,255,255	EL05MEAS/MW_MMXU1.PPV.phsAB.cVal.mag.f		0.000000 01:01:15.940 SU IV

A separate line is created in the routing information for every IEC 60870-5-101/104 data point.

Entries with incorrect parameter setting are indicated red (e.g. wrong TI, ...). **Entries with data points that do not exist in the server are indicated blue.**

With incorrect IEC 61850 address an error message is displayed in the field "Error". The IEC 61850 address is checked by the protocol firmware after startup for all routing information from the designation "Logical Node" on.

Connection-specific status information:

- Type

  SICAM RTUs internal defined/unambiguous number for the detailed routing record type.

- TI, CASDU1, CASDU2, IOA1, IOA2, IOA3

  5-stage address and type identification according to IEC 60870-5-101/104.

- Station (SICAM RTUs internal station number)

  The station number is used SICAM RTUs internal for the routing of the data, diagnostic treatment and failure management. The station number is the SICAM RTUs internal reference for the connection that is assigned to an IP address.

- Value

  Additional attribute for the differentiation of multiple equal IEC 61850 addresses with different IEC 60870-5-101/104 addresses (e.g., Mod.ctlVal from single commands).

- Ctrltype [Client only]

  In this field, the Control Type (Ctrltype) for the data point read out from the IEC 61850 Server is displayed. The possible Control Types are also displayed on the web page.

- Internal

  In the field "Internal" a internal status information is displayed for every data point.

  The internal status information is formed from individual internal binary states and displayed as a number.

  The following status numbers are of significance for the user:

  01...Data point exists in directory / no spontaneous transmission (is interrogated cyclic)

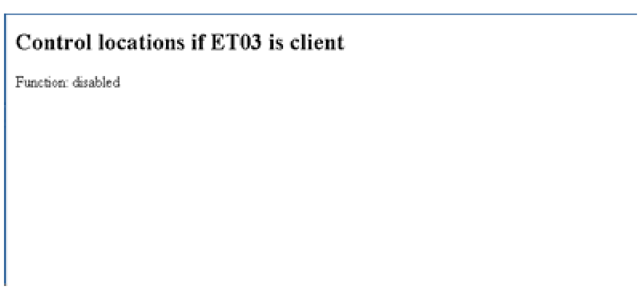
  05...Data point exists in directory / spontaneous transmission

  09...Data point exists in directory / spontaneous transmission

- IM
  In the field "IM" (Interlocking Messaging) the current state of the command enabling for this data point is displayed. The command enabling can be controlled by binary information and is used for "overlapping command interlocks".
- Attrib
  In the field "Attrib", internal information is displayed which is only of significance for the development experts.
- IEC 61850 Address
  In this field the parameterized IEC 61850 address of the data point is displayed. A basic type ("Data Attribute Reference") must always be specified as IEC 61850 address.
- Error
  In the field "Error" an error information is displayed for incorrectly parameterized IEC 61850 address.
- Data
  In this field the current status of the IEC 60870-5-101/104 data point including the quality bits and the time information is displayed.

Control location

On this web page the control locations set for the client are displayed. If the function "control location" is activated, commands from the protocol element with the “Client” function are only then transmitted to the addressed station (61850 remote station) if the command has been sent from an enabled control location (originator address).
The control location can be set globally for all connections or selectively per connection by means of protocol control messages.
The control location (originator address) is a definition according to IEC 60870-5-101/104 and is supported by the protocol element. For details about the function "Control Location" refer to section "Command Transmission/Control Location".



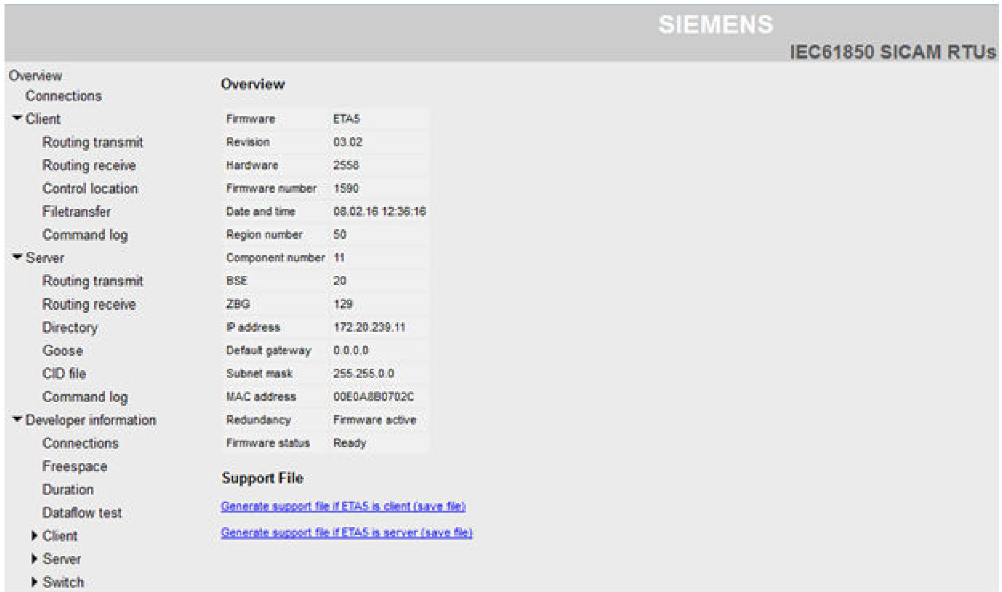
Developer Information

System-internal data of the protocol firmware can be read out on these web pages. This information is helpful in isolating the error and must be sent to Siemens support if required.
The description of these sites is not subject to this manual.

13.6.9.2 IEC 61850 Edition 2 [Client + Server, GOOSE]

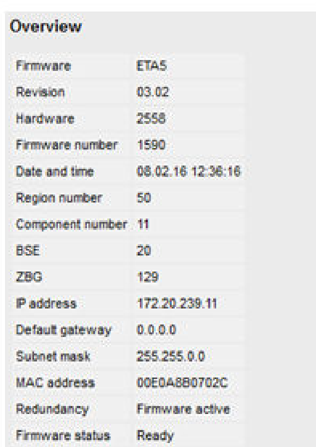
A web server for internal diagnostic and statistical information is integrated in the protocol firmware. The web server itself is implemented on the basic system element - the protocol-specific web pages are provided by the protocol element.

Enable/disable web server or start web server via SICAM Device Manager or web browser see *13.1.4.12 Web server for protocol-specific web pages*.



Overview

This web page is the start page of the web server.


Overview

Firmware	ETA5
Revision	03.02
Hardware	2558
Firmware number	1590
Date and time	08.02.16 12:36:16
Region number	50
Component number	11
BSE	20
ZBG	129
IP address	172.20.239.11
Default gateway	0.0.0.0
Subnet mask	255.255.0.0
MAC address	00E0A8B0702C
Redundancy	Firmware active
Firmware status	Ready

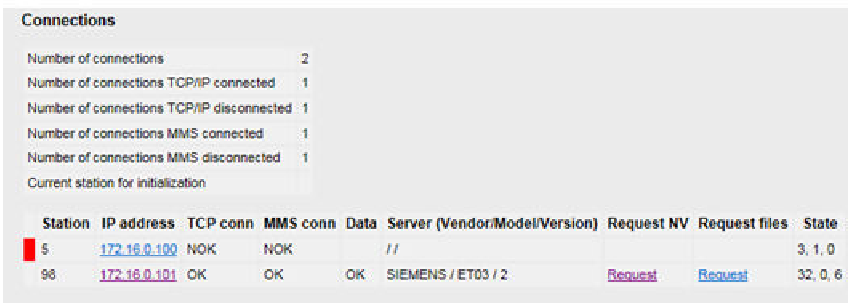
In the Overview the following information is displayed:

- Firmware
  Designation of the used firmware
- Revision
  Current revision level
- Hardware
  Name of the interface module
- Firmware number
  Number of the used firmware
- Date and Time
  System time in the BSE

- Region number,Component number,BSE,SSE,IP address,Default gateway,Subnetmask,MAC address
  The parameterized or current values are displayed next to the respective fields.
- Redundancy
  The current redundancy state of the protocol element is displayed next to the field "Redundancy".
  Firmware active ....The redundancy state of the protocol element is "ACTIVE"
  Firmware passive ....The redundancy state of the protocol element is "PASSIVE"
- Firmware status
  The status of the firmware is displayed next to the field "Firmware".
  READY ....Firmware is running error-free
  KILL, No: #### (0x####)......A serious error has occurred → notify manufacturer! The number displayed (decimal and HEX) supply the developer with more specific information about the cause of the error.

Connections

On this web page the status information of the parameterized connections is displayed.


Connections

Number of connections	2
Number of connections TCP/IP connected	1
Number of connections TCP/IP disconnected	1
Number of connections MMS connected	1
Number of connections MMS disconnected	1
Current station for initialization	

Station	IP address	TCP conn	MMS conn	Data	Server (Vendor/Model/Version)	Request NV	Request files	State
5	172.16.0.100	NOK	NOK		/ /			3, 1, 0
98	172.16.0.101	OK	OK	OK	SIEMENS / ET03 / 2	Request	Request	32, 0, 6

Connection-specific status information:

- Station(SICAM A8000 internal station number)
  The station number is used SICAM A8000 internal for the routing of the data, diagnostic treatment and failure management. The station number is the SICAM A8000 internal reference for the connection that is assigned to an IP address.
- IP address
  The field "IP Address" displays the IP address of the remote station parameterized in the parameters for Connection definition .
  By clicking the mouse button on the IP address, via a link the web page of a web server possibly implemented in the remote station is displayed.
- conn
  The field "conn" indicates the status of the connection (OK = connection established at TCP level).
- TCP conn[Client only]
  The field "TCP Conn." (TCP connection) indicates the status of the connected at TCP level (OK = Connected established at TCP level)
- MMS conn[Client only]
  Indicates the status of the connection at MMS level (OK = Connection is established at TCP level and MMS level, datasets are created and spontaneous transmission is possible)
- Data[Client only]
  The field "Data" is OK if all IEC 61850 data (transmit/receive direction) parameterized in the SIP message address conversion also exist in the remote station.
  If NOK, then the corresponding missing addresses can be filtered in the web page “Client – Routing transmit”/”Client – Routing receive”.

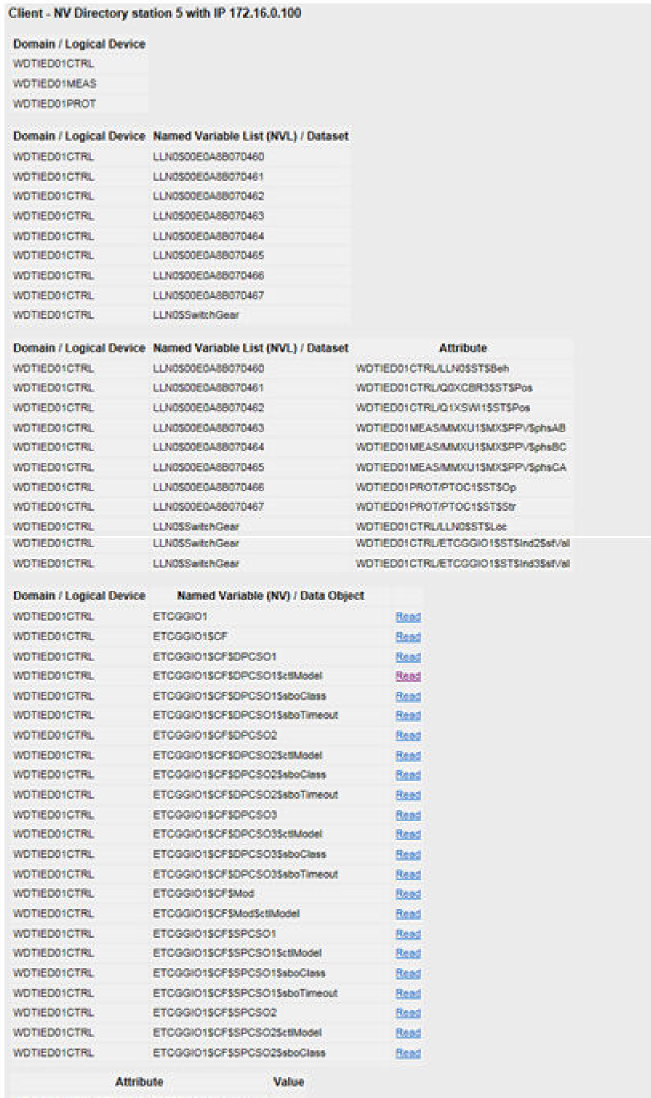
- Server (Vendor/Model/Version)[Client only]
  This field displays the manufacturer information of the connected IEC 61850 device (Server) read out by the Client.
- Request NV(Request Directory Named Variables) [Client only]
  By clicking the mouse button on the link "Request' registered in the field, the Directory (data model) of all "Named Variables" is read out and displayed.
- Request files[Client only]
  By clicking the mouse button on the link "Request" registered in the field, the File Directory is read out and displayed.
  Displayed are for example files of recorded disturbance records.

Entries of failed connections (MMS and TCP level) are indicated with red color. If the connection is established on TCP level, but not on MMS level, then these entries are indicated with blue color.

Client - Named Variables Directory of the Station

Via this web page of the IEC 61850 Client, the Named Variables Directory of the IEC 61850 remote station (Server) can be read out and displayed.
The NV Directory contains the following information:

- "Domain / Logical Device"
  Listing of all Logical Devices of the IEC 61850 station, fpr example:
  – CTRL Control
  – DR Disturbance Recording
  – MEAS Measured Value Acquisition
  – PROT Protection
- "Named Variable List (NVL) / Dataset"
  Listing of the NVL per Logical Device
- "Named Variable (NV) / Data Object"
  Listing of all NV per Logical Device



Client - NV Directory station 5 with IP 172.16.0.100

Domain / Logical Device
WDTIED01CTRL
WDTIED01MEAS
WDTIED01PROT

Domain / Logical Device	Named Variable List (NVL) / Dataset
WDTIED01CTRL	LLN0$00E0A8B070460
WDTIED01CTRL	LLN0$00E0A8B070461
WDTIED01CTRL	LLN0$00E0A8B070462
WDTIED01CTRL	LLN0$00E0A8B070463
WDTIED01CTRL	LLN0$00E0A8B070464
WDTIED01CTRL	LLN0$00E0A8B070465
WDTIED01CTRL	LLN0$00E0A8B070466
WDTIED01CTRL	LLN0$00E0A8B070467
WDTIED01CTRL	LLN0$SwitchGear

Domain / Logical Device	Named Variable List (NVL) / Dataset	Attribute
WDTIED01CTRL	LLN0$00E0A8B070460	WDTIED01CTRL/LLN0STBeh
WDTIED01CTRL	LLN0$00E0A8B070461	WDTIED01CTRL/Q0XCBR3STPos
WDTIED01CTRL	LLN0$00E0A8B070462	WDTIED01CTRL/Q1XSWI1STPos
WDTIED01CTRL	LLN0$00E0A8B070463	WDTIED01MEAS/MMXU1MXPPV$phsAB
WDTIED01CTRL	LLN0$00E0A8B070464	WDTIED01MEAS/MMXU1MXPPV$phsBC
WDTIED01CTRL	LLN0$00E0A8B070465	WDTIED01MEAS/MMXU1MXPPV$phsCA
WDTIED01CTRL	LLN0$00E0A8B070466	WDTIED01PROT/PTOC1STOp
WDTIED01CTRL	LLN0$00E0A8B070467	WDTIED01PROT/PTOC1STStr
WDTIED01CTRL	LLN0$SwitchGear	WDTIED01CTRL/LLN0STLoc
WDTIED01CTRL	LLN0$SwitchGear	WDTIED01CTRL/ETCGGIO1STInd2$stVal
WDTIED01CTRL	LLN0$SwitchGear	WDTIED01CTRL/ETCGGIO1STInd3$stVal

Domain / Logical Device	Named Variable (NV) / Data Object	
WDTIED01CTRL	ETCGGIO1	Read
WDTIED01CTRL	ETCGGIO1$CF	Read
WDTIED01CTRL	ETCGGIO1CFDPCSO1	Read
WDTIED01CTRL	ETCGGIO1CFDPCSO1$ctlModel	Read
WDTIED01CTRL	ETCGGIO1CFDPCSO1$sboClass	Read
WDTIED01CTRL	ETCGGIO1CFDPCSO1$sboTimeout	Read
WDTIED01CTRL	ETCGGIO1CFDPCSO2	Read
WDTIED01CTRL	ETCGGIO1CFDPCSO2$ctlModel	Read
WDTIED01CTRL	ETCGGIO1CFDPCSO2$sboClass	Read
WDTIED01CTRL	ETCGGIO1CFDPCSO2$sboTimeout	Read
WDTIED01CTRL	ETCGGIO1CFDPCSO3	Read
WDTIED01CTRL	ETCGGIO1CFDPCSO3$ctlModel	Read
WDTIED01CTRL	ETCGGIO1CFDPCSO3$sboClass	Read
WDTIED01CTRL	ETCGGIO1CFDPCSO3$sboTimeout	Read
WDTIED01CTRL	ETCGGIO1CFMod	Read
WDTIED01CTRL	ETCGGIO1CFMod$ctlModel	Read
WDTIED01CTRL	ETCGGIO1CFSPCSO1	Read
WDTIED01CTRL	ETCGGIO1CFSPCSO1$ctlModel	Read
WDTIED01CTRL	ETCGGIO1CFSPCSO1$sboClass	Read
WDTIED01CTRL	ETCGGIO1CFSPCSO1$sboTimeout	Read
WDTIED01CTRL	ETCGGIO1CFSPCSO2	Read
WDTIED01CTRL	ETCGGIO1CFSPCSO2$ctlModel	Read
WDTIED01CTRL	ETCGGIO1CFSPCSO2$sboClass	Read

Attribute	Value
WDTIED01CTRL/ETCGGIO1CFDPCSO1$ctlModel	1

The current states of the data attributes of the Named Variables ("Data Attribute Reference") can be read out directly from the IEC 61850 remote station (Server) with *Read* via the web page in the IEC 61850 Client.

The readout is only supported for basic types! The readout of higher-level structures "Data References" is not supported. With an attempt to read out a higher-level structure, the error message "structure. Please use a single leaf" is displayed!

The current state of the selected data attribute is displayed in the window at the bottom. Through the readout, data in the IEC 61850 device cannot be deleted unintentionally.

Client - File Directory of the Station

On this web page the File Directory of the IEC 61850 remote station (Server) can be displayed in the IEC 61850 Client.

A file can be displayed by clicking the left mouse button on the link stored in the filename or saved on the local PC by clicking the right mouse button and selecting the function “Save target as...”. The readout and saving of the file is controlled by the protocol firmware.

The files read out via the web server are not deleted in the IEC 61850 remote station.

Client - File directory station 5 with IP 172.16.0.100

To save a file right click on the file -> Save target as.
After saving the file, please rename it to the correct extension.

Filename	Date and Time	Size
103\	20130911141129	0
AX1703QA.TAD	20021210134104	784
cap.bvt	20120806133635	94
cap.tim	20120806133635	8
cap.txt	20120806133636	709
CodeMeterRuntime.exe	20130903123902	20531584
debser.txt	20140401065622	678
default.tpa	20130618144620	418533
default.tam	20130618144620	414390
drivers\	20120219091145	0
fls160.tmp	20021210134104	256
haspds_windows.dll	20120125162130	2158267
HIDrv32.exe	20120125162202	10794776
hlvdd.dll	20120125162120	191488
iec60870-5-101.csv	20120807145052	63542
iec60870-5-101.tb	20021210134126	25251
iec60870-5-103.tb	20021210134126	9590
iec60870-5-104.tb	20021210134126	35752
IEC61850\	20120219091146	0
importicd.out	20140401065641	1005
INSTALL.LOG	20130911141218	350804
LcVcWrapperNative.dll	20120125162148	4064256
loadlan.exe	20130911133220	79360
msvcp100.dll	20110219220312	421200
msvcr100.dll	20110218234050	773968

Client - Routing Transmit, Client - Routing Receive

The address conversion from SICAM A8000 internal IEC 60870-5-101/104 format to the IEC 61850 format in transmit direction and the address conversion from IEC 61850 format to the SICAM A8000 internal IEC 60870-5-101/104 format in receive direction is parameterized with the SICAM TOOLBOX II in the OPM and generated with the function SIP message address conversion.

On the web page **Client - Routing transmit** all routing information generated for the protocol element in transmit direction is displayed.

Client - Routing transmit

Count	20
Count in server database	20
Count not in server database	0
Count error	0

◉ all ○ in server database ○ not in server database ○ error

Error	TI	CASDU1	CASDU2	IOA1	IOA2	IOA3	Station	Value	IEC61850 address	CDC	Ctrl type	Blocked	Data	Quality	Time
	45	13	50	103	252	1	13	1	SICAM_CMIC_IEC_61850/USERCSWI11.Pos.ctlVal	SPC	direct enhanced		never sent		
	46	13	50	45	252	1	13	1	SICAM_cmic_IEC_61850/CSWI1101.Pos.ctlVal	DPC	direct enhanced		never sent		
	46	13	50	55	252	1	13	1	SICAM_cmic_IEC_61850/CSWI1102.Pos.ctlVal	SPC	direct enhanced		never sent		
	30	13	50	71	252	1	13	1	SICAM_cmic_IEC_61850/USRGAPC2002.SPCSO1.ctlVal	SPC	direct normal		OFF		08.02.16 12:34:47.047
	45	13	50	73	252	1	13	1	SICAM_cmic_IEC_61850/GAPC1103.SPCSO1.ctlVal	SPC	sel/exe enhanced		never sent		
	30	13	50	81	252	1	13	1	SICAM_cmic_IEC_61850/USRGAPC2003.SPCSO1.ctlVal	SPC	direct normal		OFF		08.02.16 12:34:47.047
	30	13	50	123	252	1	13	1	SICAM_cmic_IEC_61850/RevisGAPC1.SPCSO1.ctlVal	SPC	direct normal		OFF		08.02.16 12:34:47.048
	30	13	50	69	252	1	13	1	SICAM_cmic_IEC_61850/USRGAPC1902.SPCSO1.ctlVal	SPC	direct normal		OFF		08.02.16 12:34:47.047
	45	11	50	41	174	1	11	1	TM1703_ACP_LAN/USERCSWI11.Pos.ctlVal	SPC	direct enhanced		OFF		23.12.15 09:43:37.070
	46	11	50	234	173	1	11	1	TM1703_ACP_LAN/CSWI1102.Pos.ctlVal	DPC	direct enhanced		OFF		23.12.15 09:34:24.640
	46	11	50	221	173	1	11	1	TM1703_ACP_LAN/CSWI1101.Pos.ctlVal	DPC	sel/exe enhanced		OFF		23.12.15 09:35:49.840
	45	11	50	5	174	1	11	1	TM1703_ACP_LAN/CSWI1103.Pos.ctlVal	SPC	sel/exe enhanced		ON		23.12.15 09:43:16.990
	30	11	50	68	174	1	11	1	TM1703_ACP_LAN/RevGGIO1.SPCSO1.ctlVal	SPC	direct normal		OFF		08.02.16 13:46:01.340
	30	11	50	254	173	1	11	1	TM1703_ACP_LAN/USRGAPC1902.SPCSO1.ctlVal	SPC	direct normal		OFF		23.12.15 09:33:15.590
	30	11	50	3	174	1	11	1	TM1703_ACP_LAN/USRGAPC2002.SPCSO1.ctlVal	SPC	direct normal		OFF		23.12.15 09:33:26.490
	30	11	50	235	174	1	11	1	TM1703_ACP_LAN/GGIO000000.SPCSO4.ctlVal	SPC	direct normal		ON		23.12.15 09:50:44.390
	30	11	50	214	174	1	11	1	TM1703_ACP_LAN/GGIO000000.SPCSO1.ctlVal	SPC	direct normal		ON		23.12.15 09:50:51.440
	30	11	50	221	174	1	11	1	TM1703_ACP_LAN/GGIO000000.SPCSO2.ctlVal	SPC	direct normal		OFF		23.12.15 09:50:51.440
	30	11	50	228	174	1	11	1	TM1703_ACP_LAN/GGIO000000.SPCSO3.ctlVal	SPC	direct normal		OFF		23.12.15 09:50:51.440
	30	11	50	19	174	1	11	1	TM1703_ACP_LAN/USRGAPC2003.SPCSO1.ctlVal	SPC	direct normal		OFF		23.12.15 09:30:08.240

On the web page **Client - Routing receive** all routing information converted for the protocol element in receive direction is displayed.

Client - Routing receive

Count	72
Count in server database	72
Count not in server database	0
Count error	0

(•) all ( ) in server database ( ) not in server database ( ) error

Error	TI	CASDU1	CASDU2	IOA1	IOA2	IOA3	Station	Value	IEC61850 address	CDC	Type	Kind	Data	Quality	Time
	30	11	50	176	173	1	11	1	TM1703_ACP_LAN/SP_CGGIO01.SPCSO11.stVal	SPC		spont	OFF		08.02.16 13:47:32.340
	30	11	50	179	173	1	11	1	TM1703_ACP_LAN/SP_CGGIO01.SPCSO21.stVal	SPC		spont	ON		08.02.16 13:47:32.340
	30	11	50	182	173	1	11	1	TM1703_ACP_LAN/SP_CGGIO01.SPCSO31.stVal	SPC		spont	OFF		08.02.16 13:47:32.890
	30	11	50	185	173	1	11	1	TM1703_ACP_LAN/SP_CGGIO01.SPCSO41.stVal	SPC		spont	OFF		08.02.16 13:47:13.440
	30	11	50	188	173	1	11	1	TM1703_ACP_LAN/SP_CGGIO01.SPCSO51.stVal	SPC		spont	OFF		08.02.16 13:47:13.440
	31	11	50	193	173	1	11	1	TM1703_ACP_LAN/DP_CGGIO01.DPCSO11.stVal	DPC		spont	DIFF		08.02.16 13:46:11.484
	31	11	50	197	173	1	11	1	TM1703_ACP_LAN/DP_CGGIO01.DPCSO21.stVal	DPC		spont	DIFF		08.02.16 13:46:01.390
	31	11	50	203	173	1	11	1	TM1703_ACP_LAN/DP_CGGIO01.DPCSO31.stVal	DPC		spont	FAULTY		08.02.16 13:46:01.390
	31	11	50	207	173	1	11	1	TM1703_ACP_LAN/DP_CGGIO01.DPCSO41.stVal	DPC		spont	DIFF		08.02.16 13:46:01.390
	31	11	50	211	173	1	11	1	TM1703_ACP_LAN/DP_CGGIO01.DPCSO51.stVal	DPC		spont	DIFF		08.02.16 13:46:01.390
	31	11	50	215	173	1	11	1	TM1703_ACP_LAN/DP_CGGIO01.DPCSO61.stVal	DPC		spont	DIFF		08.02.16 13:46:01.390
	30	11	50	201	173	1	11	1	TM1703_ACP_LAN/DP_CGGIO01.DPCSO24.stVal	DPC		spont	OFF		08.02.16 13:46:01.390
	30	11	50	63	174	1	11	1	TM1703_ACP_LAN/ExtraTestsGGIO01.SPCSO11.stVal	SPC		spont	OFF		08.02.16 13:46:01.390
	30	11	50	65	174	1	11	1	TM1703_ACP_LAN/ExtraTestsGGIO01.SPCSO21.stVal	SPC		spont	OFF		08.02.16 13:46:01.390
	30	13	50	0	252	1	13	1	SICAM_cmic_IEC_61850/SP_CGGIO01.SPCSO11.stVal	SPS		spont	OFF		08.02.16 12:34:46.924
	30	13	50	3	252	1	13	1	SICAM_cmic_IEC_61850/SP_CGGIO01.SPCSO21.stVal	SPS		spont	ON		08.02.16 12:34:46.924
	30	13	50	6	252	1	13	1	SICAM_cmic_IEC_61850/SP_CGGIO01.SPCSO31.stVal	SPS		spont	OFF		08.02.16 12:34:46.924
	30	13	50	9	252	1	13	1	SICAM_cmic_IEC_61850/SP_CGGIO01.SPCSO41.stVal	SPS		spont	OFF		08.02.16 12:34:46.924
	30	13	50	12	252	1	13	1	SICAM_cmic_IEC_61850/SP_CGGIO01.SPCSO51.stVal	SPS		spont	OFF		08.02.16 12:34:46.924
	31	13	50	17	252	1	13	1	SICAM_cmic_IEC_61850/DP_CGGIO01.DPCSO11.stVal	DPS		spont	DIFF		08.02.16 12:34:46.321
	31	13	50	21	252	1	13	1	SICAM_cmic_IEC_61850/DP_CGGIO01.DPCSO21.stVal	DPS		spont	DIFF		08.02.16 12:34:46.321
	31	13	50	27	252	1	13	1	SICAM_cmic_IEC_61850/DP_CGGIO01.DPCSO31.stVal	DPS		spont	FAULTY		08.02.16 12:34:46.321

A separate line is created in the routing information for every IEC 60870-5-101/104 data point.
Entries with incorrect parameter setting are marked red (Example: wrong TI, ...).
Entries with data points that do not exist in the server are marked blue.
With incorrect IEC 61850 address an error message is displayed in the field "Error".
If needed, the display can be filtered by means of selection

- All
- In server database
- Not in server database
- Faulty

Connection-specific status information:

- Error
  In this field an error information is displayed for incorrectly parameterized IEC 61850 address.
- TI, CASDU1, CASDU2, IOA1, IOA2, IOA3
  5-stage address and type identification according to IEC 60870-5-101/104.
- Station(SICAM A8000 internal station number)
  The station number is used SICAM A8000 internal for the routing of the data, diagnostic treatment and failure management. The station number is the SICAM A8000 internal reference for the connection that is assigned to an IP address.
- Value
  Additional attribute for the differentiation of multiple equal IEC 61850 addresses with different IEC 60870 -5 -101/104 addresses (for example Mod.ctlVal from single commands).
- IEC61850 Address
  In this field the parameterized IEC 61850 address of the data point is displayed. A basic type ("Data Attribute Reference") must always be specified as IEC 61850 address.
- CDC
  In this field the parameterized IEC 61850 Common Data Class of the data point is displayed.

- Kind
  In this field the kind of transmission is displayed:
  spont ... data point is transmitted spontaneously per Report
  poll ...... data point is interrogated cyclically
- Ctrltype
  In this field, the Control Type (Ctrltype) for the data point read out from the IEC 61850 Server is displayed.
- Blocked
  In this field the current state of the command enabling for this data point is displayed. The command enabling can be controlled by binary information and is used for "overlapping command interlocks" (interlocking information for the ON/OFF state: BL_ON, BL_OFF).
- Data
  In this field the current status of the IEC 60870-5-101/104 data point is displayed.
- Quality
  In this field the quality identification is displayed (NT, IV, BL, SB, EI, OV).
- Time
  In this field the time tag of the data point is displayed.

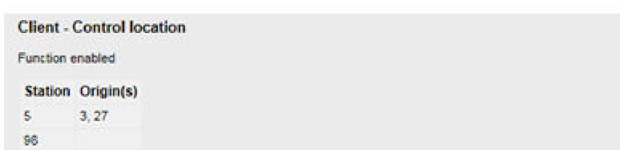
Client - Control Location

On this web page the control locations set for the client are displayed.

If the function "control location" is activated, commands from the protocol element with the “Client” function are only then transmitted to the addressed station (61850 remote station) if the command has been sent from an enabled control location (originator address).

The control location (originator address) is a definition according to IEC 60870-5-101/104 and is supported by the protocol element. The control location can be set globally for all connections or selectively per connection by means of protocol control messages.

For details on the function "Control Location" refer to section *Control Location [Client only], Page 1128*.



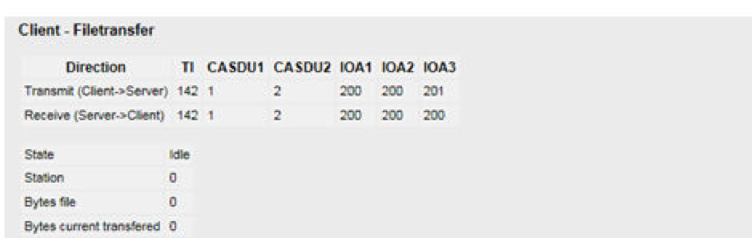
Client - Control location

Function enabled

Station	Origin(s)
5	3, 27
98	

Client - File Transfer

On this web page the information for the disturbance record transmission to SICAM DISTO is displayed, if this is parameterized.



Client - Filetransfer

Direction	TI	CASDU1	CASDU2	IOA1	IOA2	IOA3
Transmit (Client->Server)	142	1	2	200	200	201
Receive (Server->Client)	142	1	2	200	200	200

State	Idle
Station	0
Bytes file	0
Bytes current transfered	0

Information on the transmitted user data containers:

- Direction
  In this field the transmission direction of the container is displayed.
- TI,CASDU1,CASDU2,IOA1,IOA2,IOA3
  5-stage address and type identification according to IEC 60870-5-101/104.

The display below describes the state of the last/current data transmission.

For details on the function "File Transfer" refer to section *13.6.5.9 File Transfer (Disturbance Records)*.

Client - Command Log

On this web page the record of the respective last commands (ACT, CON, TERM) in context with IEC 60870-5-101/104 and IEC 61850 is displayed.

Client - Command log

Time	Direction	Reason	TI	CASDU1	CASDU2	IOA1	IOA2	IOA3	Station	IEC61850 address	Origin	Addcause	Data	QU
23.12.15 09:33:12.388	Server->Client EXE CON	neg	46	11	50	234	173	1	11	TM1703_ACP_LAN/CSWI1102.Pos.ctlVal	0		OFF	0
23.12.15 09:33:12.702	Server->Client INFO TERM	pos							11	TM1703_ACP_LAN/USERCSWI11.Pos.ctlVal				
23.12.15 09:33:12.702	Server->Client EXE TERM	pos	45	11	50	41	174	1	11	TM1703_ACP_LAN/USERCSWI11.Pos.ctlVal	0		ON	0
23.12.15 09:33:16.198	Client->Server EXE ACT		46	11	50	234	173	1	11	TM1703_ACP_LAN/CSWI1102.Pos.ctlVal	0		OFF	0
23.12.15 09:33:16.314	Server->Client EXE CON	pos	46	11	50	234	173	1	11	TM1703_ACP_LAN/CSWI1102.Pos.ctlVal	0		OFF	0
23.12.15 09:33:19.687	Server->Client INFO TERM	pos							11	TM1703_ACP_LAN/CSWI1102.Pos.ctlVal				
23.12.15 09:33:19.687	Server->Client EXE TERM	pos	46	11	50	234	173	1	11	TM1703_ACP_LAN/CSWI1102.Pos.ctlVal	0		OFF	0
23.12.15 09:33:22.864	Client->Server EXE ACT		46	11	50	234	173	1	11	TM1703_ACP_LAN/CSWI1102.Pos.ctlVal	0		ON	0
23.12.15 09:33:23.284	Server->Client INFO TERM	neg							11	TM1703_ACP_LAN/CSWI1102.Pos.ctlVal		blocked by process (9)		
23.12.15 09:33:23.284	Server->Client EXE CON	neg	46	11	50	234	173	1	11	TM1703_ACP_LAN/CSWI1102.Pos.ctlVal	0		ON	0
23.12.15 09:33:27.092	Client->Server EXE ACT		46	11	50	234	173	1	11	TM1703_ACP_LAN/CSWI1102.Pos.ctlVal	0		OFF	0
23.12.15 09:33:27.287	Server->Client EXE CON	pos	46	11	50	234	173	1	11	TM1703_ACP_LAN/CSWI1102.Pos.ctlVal	0		OFF	0
23.12.15 09:33:30.607	Server->Client INFO TERM	pos							11	TM1703_ACP_LAN/CSWI1102.Pos.ctlVal				
23.12.15 09:33:30.607	Server->Client EXE TERM	pos	46	11	50	234	173	1	11	TM1703_ACP_LAN/CSWI1102.Pos.ctlVal	0		OFF	0
23.12.15 09:33:33.754	Client->Server EXE ACT		46	11	50	234	173	1	11	TM1703_ACP_LAN/CSWI1102.Pos.ctlVal	0		ON	0
23.12.15 09:33:33.987	Server->Client EXE CON	pos	46	11	50	234	173	1	11	TM1703_ACP_LAN/CSWI1102.Pos.ctlVal	0		ON	0
23.12.15 09:33:37.347	Server->Client INFO TERM	pos							11	TM1703_ACP_LAN/CSWI1102.Pos.ctlVal				
23.12.15 09:33:37.347	Server->Client EXE TERM	pos	46	11	50	234	173	1	11	TM1703_ACP_LAN/CSWI1102.Pos.ctlVal	0		ON	0
23.12.15 09:33:37.503	Client->Server EXE ACT		45	11	50	41	174	1	11	TM1703_ACP_LAN/USERCSWI11.Pos.ctlVal	0		OFF	0
23.12.15 09:33:37.535	Server->Client EXE CON	pos	45	11	50	41	174	1	11	TM1703_ACP_LAN/USERCSWI11.Pos.ctlVal	0		OFF	0
23.12.15 09:33:42.502	Server->Client INFO TERM	pos							11	TM1703_ACP_LAN/USERCSWI11.Pos.ctlVal				
23.12.15 09:33:42.502	Server->Client EXE TERM	pos	45	11	50	41	174	1	11	TM1703_ACP_LAN/USERCSWI11.Pos.ctlVal	0		OFF	0
23.12.15 09:34:09.052	Client->Server EXE ACT		45	11	50	41	174	1	11	TM1703_ACP_LAN/USERCSWI11.Pos.ctlVal	0		ON	0
23.12.15 09:34:09.082	Server->Client EXE CON	pos	45	11	50	41	174	1	11	TM1703_ACP_LAN/USERCSWI11.Pos.ctlVal	0		ON	0
23.12.15 09:34:09.602	Client->Server EXE ACT		46	11	50	234	173	1	11	TM1703_ACP_LAN/CSWI1102.Pos.ctlVal	0		OFF	0
23.12.15 09:34:09.722	Server->Client INFO TERM	pos							11	TM1703_ACP_LAN/USERCSWI11.Pos.ctlVal				
23.12.15 09:34:09.722	Server->Client EXE TERM	pos	45	11	50	41	174	1	11	TM1703_ACP_LAN/USERCSWI11.Pos.ctlVal	0		ON	0
23.12.15 09:34:09.917	Server->Client EXE CON	pos	46	11	50	234	173	1	11	TM1703_ACP_LAN/CSWI1102.Pos.ctlVal	0		OFF	0
23.12.15 09:34:10.056	Client->Server	neg: command already running	46	11	50	234	173	1	11	TM1703_ACP_LAN/CSWI1102.Pos.ctlVal	0		ON	0
23.12.15 09:34:24.187	Server->Client INFO TERM	neg							11	TM1703_ACP_LAN/CSWI1102.Pos.ctlVal		blocked by process (9)		

Command-specific status information:

- Time

  In this field the time tag of the command is displayed.
- Direction

  In this field the command direction and the command kind are displayed.
- Reason

  In this field the identification "pos"/"neg" of the command is displayed.
- TI,CASDU1,CASDU2,IOA1,IOA2,IOA3

  5-stage address and type identification according to IEC 60870-5-101/104.
- Station(SICAM A8000 internal station number)

  The station number is used SICAM A8000 internal for the routing of the data, diagnostic treatment and failure management. The station number is the SICAM A8000 internal reference for the connection that is assigned to an IP address.
- IEC 61850 Address

  In this field the parameterized IEC 61850 address of the data point is displayed.
- Origin

  In this field the control location (originator address) acc. to IEC 60870-5-101/104 is displayed.
- AddCause

  In this field the cause for a negative command termination is displayed.
- Data

  In this field the current status of the IEC 60870-5-101/104 data point is displayed.
- QU

  In this field the command output qualifier is displayed.

Server - Routing Transmit, Server - Routing Receive

The address conversion from SICAM A8000 internal IEC 60870-5-101/104 format to the IEC 61850 format in transmit direction and the address conversion from IEC 61850 format to the SICAM A8000 internal IEC 60870-5-101/104 format in receive direction is parameterized with the SICAM TOOLBOX II in the OPM II and generated with the function SIP message address conversion.

On the web page **Server - Routing transmit** all routing information generated for the protocol element in transmit direction is displayed.

Server - Routing transmit

Count	45
Count client/server	45
Count goose	0
Count error	0

(•) all ( ) error

Error	TI	CASDU1	CASDU2	IOA1	IOA2	IOA3	Val OFF	Val ON	IEC61850 address	CDC	Goose	Data	Quality	Time
	30	11	50	176	173	1	0	1	TM1703_ACP_LAN/SP_CGGIO01.SPCSO11.stVal	SPC		OFF		08.02.16 12:51:32.340
	30	11	50	182	173	1	0	1	TM1703_ACP_LAN/SP_CGGIO01.SPCSO31.stVal	SPC		OFF		08.02.16 12:51:32.890
	30	11	50	185	173	1	0	1	TM1703_ACP_LAN/SP_CGGIO01.SPCSO41.stVal	SPC		OFF		08.02.16 12:51:13.440
	30	11	50	188	173	1	0	1	TM1703_ACP_LAN/SP_CGGIO01.SPCSO51.stVal	SPC		OFF		08.02.16 12:51:13.440
	31	11	50	193	173	1	0	1	TM1703_ACP_LAN/DP_CGGIO01.DPCSO11.stVal	DPC		DIFF		08.02.16 12:52:00.385
	31	11	50	197	173	1	0	1	TM1703_ACP_LAN/DP_CGGIO01.DPCSO21.stVal	DPC		DIFF		08.02.16 12:51:57.985
	31	11	50	203	173	1	0	1	TM1703_ACP_LAN/DP_CGGIO01.DPCSO31.stVal	DPC		FAULTY		08.02.16 12:52:00.385
	31	11	50	207	173	1	0	1	TM1703_ACP_LAN/DP_CGGIO01.DPCSO41.stVal	DPC		DIFF		08.02.16 12:52:00.885
	31	11	50	211	173	1	0	1	TM1703_ACP_LAN/DP_CGGIO01.DPCSO51.stVal	DPC		ON		08.02.16 12:52:00.532
	31	11	50	215	173	1	0	1	TM1703_ACP_LAN/DP_CGGIO01.DPCSO61.stVal	DPC		ON		08.02.16 12:52:00.532
	30	11	50	201	173	1	0	1	TM1703_ACP_LAN/DP_CGGIO01.DPCSO24.stVal	DPC		OFF		08.02.16 12:51:57.985
	30	11	50	63	174	1	0	1	TM1703_ACP_LAN/ExtraTestsGGIO01.SPCSO11.stVal	SPC		OFF		08.02.16 12:50:01.380
	30	11	50	65	174	1	0	1	TM1703_ACP_LAN/ExtraTestsGGIO01.SPCSO21.stVal	SPC		OFF		08.02.16 12:50:01.380
	36	11	50	51	174	1	0	1	TM1703_ACP_LAN/MMXU1.A.phsA.cVal.mag.f	WYE		13.738281		08.02.16 12:51:41.140
	34	11	50	55	174	1	0	1	TM1703_ACP_LAN/MMXU2.A.phsA.cVal.mag.f	WYE		79.974365 %		08.02.16 12:51:08.270
	35	11	50	59	174	1	0	1	TM1703_ACP_LAN/MMXU3.A.phsA.cVal.mag.f	WYE		10002		08.02.16 12:50:01.600
	30	11	50	21	174	1	0	1	TM1703_ACP_LAN/USERGGIO1.SPCSO1.stVal	SPC		OFF		23.12.15 09:35:15.150
	30	11	50	23	174	1	0	1	TM1703_ACP_LAN/USERGGIO2.SPCSO1.stVal	SPC		OFF		23.12.15 09:35:44.522
	30	11	50	25	174	1	0	1	TM1703_ACP_LAN/USERGGIO3.SPCSO1.stVal	SPC		OFF		22.12.15 15:38:55.716
	30	11	50	27	174	1	0	1	TM1703_ACP_LAN/USERGGIO4.SPCSO1.stVal	SPC		OFF		23.12.15 09:32:34.682
	30	11	50	29	174	1	0	1	TM1703_ACP_LAN/USERGGIO5.SPCSO1.stVal	SPC		OFF		23.12.15 09:43:17.262
	30	11	50	31	174	1	0	1	TM1703_ACP_LAN/USERGGIO6.SPCSO1.stVal	SPC		OFF		22.12.15 15:38:55.717
	30	11	50	33	174	1	0	1	TM1703_ACP_LAN/USERGGIO7.SPCSO1.stVal	SPC		OFF		22.12.15 15:38:55.717
	30	11	50	35	174	1	0	1	TM1703_ACP_LAN/USERGGIO8.SPCSO1.stVal	SPC		OFF		23.12.15 09:33:23.150

On the web page **Server - Routing receive** all routing information converted for the protocol element in receive direction is displayed.

Server - Routing receive

Count	12
Count client/server	12
Count goose	0
Count error	0

(•) all ( ) error

Error	TI	CASDU1	CASDU2	IOA1	IOA2	IOA3	Value	IEC61850 address	CDC	Ctrl type	Goose	Data	Quality	Time
	30	11	50	214	174	1	1	TM1703_ACP_LAN/GGIO000000.SPCSO1.ctlVal	SPC	direct normal		ON		23.12.15 09:50:51.499
	30	11	50	68	174	1	1	TM1703_ACP_LAN/RevGGIO1.SPCSO1.ctlVal	SPC	direct normal		OFF		08.02.16 12:50:01.385
	30	11	50	235	174	1	1	TM1703_ACP_LAN/GGIO000000.SPCSO4.ctlVal	SPC	direct normal		ON		23.12.15 09:50:44.446
	46	11	50	221	173	1	1	TM1703_ACP_LAN/CSWI1101.Pos.ctlVal	DPC	sel/exe enhanced		OFF		23.12.15 09:35:35.135
	45	11	50	41	174	1	1	TM1703_ACP_LAN/USERCSWI11.Pos.ctlVal	DPC	direct enhanced		OFF		23.12.15 09:43:37.072
	46	11	50	234	173	1	1	TM1703_ACP_LAN/CSWI1102.Pos.ctlVal	DPC	direct enhanced		ON		23.12.15 09:34:24.344
	30	11	50	254	173	1	1	TM1703_ACP_LAN/USRGAPC1902.SPCSO1.ctlVal	SPC	direct normal		OFF		23.12.15 09:33:15.625
	30	11	50	3	174	1	1	TM1703_ACP_LAN/USRGAPC2002.SPCSO1.ctlVal	SPC	direct normal		OFF		23.12.15 09:33:26.541
	45	11	50	5	174	1	1	TM1703_ACP_LAN/CSWI1103.Pos.ctlVal	DPC	sel/exe enhanced		ON		23.12.15 09:43:17.012
	30	11	50	19	174	1	1	TM1703_ACP_LAN/USRGAPC2003.SPCSO1.ctlVal	SPC	direct normal		OFF		23.12.15 09:30:08.294
	30	11	50	228	174	1	1	TM1703_ACP_LAN/GGIO000000.SPCSO3.ctlVal	SPC	direct normal		OFF		23.12.15 09:50:51.501
	30	11	50	221	174	1	1	TM1703_ACP_LAN/GGIO000000.SPCSO2.ctlVal	SPC	direct normal		OFF		23.12.15 09:50:51.501

A separate line is created in the routing information for every IEC 60870-5-101/104 data point.

Entries with incorrect parameter setting are marked red (Example: wrong TI, ...).

Entries with data points that do not exist in the server are marked blue.

With incorrect IEC 61850 address an error message is displayed in the field "Error".

If needed, the display can be filtered by means of selection

- All
- Faulty

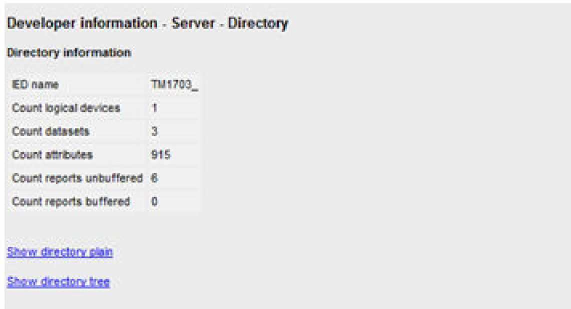
Connection-specific status information:

- Error
  In this field an error information is displayed for incorrectly parameterized IEC 61850 address.
- TI,CASDU1,CASDU2,IOA1,IOA2,IOA3
  5-stage address and type identification according to IEC 60870-5-101/104.
- Station(SICAM A8000 internal station number)
  The station number is used SICAM A8000 internal for the routing of the data, diagnostic treatment and failure management. The station number is the SICAM A8000 internal reference for the connection that is assigned to an IP address.
- ValOFF
  Value for the binary information state OFF
- ValON
  Value for the binary information state ON
- Value
  Additional attribute for the differentiation of multiple equal IEC 61850 addresses with different IEC 60870-5-101/104 addresses (for example Mod.ctlVal from single commands).
- IEC 61850 Address
  In this field the parameterized IEC 61850 address of the data point is displayed. A basic type ("Data Attribute Reference") must always be specified as IEC 61850 address.
- CDC
  In this field the parameterized IEC 61850 Common Data Class of the data point is displayed.
- Ctrltype
  In this field, the Control Type (Ctrltype) for the data point read out from the IEC 61850 Server is displayed.
- GOOSE
  In this field the GOOSE index is displayed.
- Data
  In this field the current status of the IEC 60870-5-101/104 data point is displayed.
- Quality
  In this field the quality identification is displayed (NT, IV, BL, SB, EI, OV).
- Time
  In this field the time tag of the data point is displayed.

Server - Directory

On this web page, detailed information of the data model generated for the selected directory of the IEC 61850 Server is displayed.

The data model is generated during startup by the protocol element from the process-technical parameters (SIP message address conversion). The data model forms the directory for the communication according to IEC 61850.



The following information is displayed:

- IED name
  In this field the Logical Device created in the directory of the Server is displayed.
- Count logical devices
  In this field the number of Logical Nodes generated per Logical Device is displayed.
- Count datasets
  In this field the number of Named Variable Lists (Dataset) generated per Logical Device is displayed.
- Count attributes
  In this field the number of Attributes generated per Logical Device is displayed.
- Count reports unbufferd
  In this field the number of Unbuffered Reports generated per Logical Device is displayed.
- Count reports bufferd
  In this field the number of Buffered Reports generated per Logical Device is displayed.

The data in the directories can be displayed in the following ways:

- Show directory plain
  In this directory all data is displayed in alphabetical order.
- Show directory tree
  In this directory all data is displayed in hierarchically structured form.

Server - Directory plain view

On this web page the selected directory of the server is displayed in alphabetical order.

Server - Directory - plain view

Datasets

Nr	Nr LD	Logical Device	Nr DS	Dataset	Nr DO	Data object
0	0	TM1703_ACP_LAN	0	LLN0$DS_MX_AA	0	TM1703_ACP_LAN/MMXU1MXA
1	0	TM1703_ACP_LAN	0	LLN0$DS_MX_AA	1	TM1703_ACP_LAN/MMXU2MXA
2	0	TM1703_ACP_LAN	0	LLN0$DS_MX_AA	2	TM1703_ACP_LAN/MMXU3MXA
3	0	TM1703_ACP_LAN	0	LLN0$DS_MX_AA	3	TM1703_ACP_LAN/MMXU4MXA
4	0	TM1703_ACP_LAN	0	LLN0$DS_MX_AA	4	TM1703_ACP_LAN/MMXU5MXA
5	0	TM1703_ACP_LAN	0	LLN0$DS_MX_AA	5	TM1703_ACP_LAN/MMXU6MXA
6	0	TM1703_ACP_LAN	1	LLN0$DS_STAT_AA	0	TM1703_ACP_LAN/BTDGGIO1802STBeh
7	0	TM1703_ACP_LAN	1	LLN0$DS_STAT_AA	1	TM1703_ACP_LAN/CSWI1101STBeh
8	0	TM1703_ACP_LAN	1	LLN0$DS_STAT_AA	2	TM1703_ACP_LAN/CSWI1102STBeh
9	0	TM1703_ACP_LAN	1	LLN0$DS_STAT_AA	3	TM1703_ACP_LAN/CSWI1103STBeh
10	0	TM1703_ACP_LAN	1	LLN0$DS_STAT_AA	4	TM1703_ACP_LAN/CSWI1601STBeh
11	0	TM1703_ACP_LAN	1	LLN0$DS_STAT_AA	5	TM1703_ACP_LAN/CSWI1602STBeh
12	0	TM1703_ACP_LAN	1	LLN0$DS_STAT_AA	6	TM1703_ACP_LAN/DP_CGGIO01STBeh
13	0	TM1703_ACP_LAN	1	LLN0$DS_STAT_AA	7	TM1703_ACP_LAN/ExtraTestsGGIO01STBeh
14	0	TM1703_ACP_LAN	1	LLN0$DS_STAT_AA	8	TM1703_ACP_LAN/GGIO000000STBeh
15	0	TM1703_ACP_LAN	1	LLN0$DS_STAT_AA	9	TM1703_ACP_LAN/MMXU1STBeh
16	0	TM1703_ACP_LAN	1	LLN0$DS_STAT_AA	10	TM1703_ACP_LAN/MMXU2STBeh
17	0	TM1703_ACP_LAN	1	LLN0$DS_STAT_AA	11	TM1703_ACP_LAN/MMXU3STBeh
18	0	TM1703_ACP_LAN	1	LLN0$DS_STAT_AA	12	TM1703_ACP_LAN/MMXU4STBeh
19	0	TM1703_ACP_LAN	1	LLN0$DS_STAT_AA	13	TM1703_ACP_LAN/MMXU5STBeh
20	0	TM1703_ACP_LAN	1	LLN0$DS_STAT_AA	14	TM1703_ACP_LAN/MMXU6STBeh
21	0	TM1703_ACP_LAN	1	LLN0$DS_STAT_AA	15	TM1703_ACP_LAN/RI_GGIO1603STBeh
22	0	TM1703_ACP_LAN	1	LLN0$DS_STAT_AA	16	TM1703_ACP_LAN/RevGGIO1STBeh
23	0	TM1703_ACP_LAN	1	LLN0$DS_STAT_AA	17	TM1703_ACP_LAN/SORGGIO1702STBeh
24	0	TM1703_ACP_LAN	1	LLN0$DS_STAT_AA	18	TM1703_ACP_LAN/SP_CGGIO01STBeh
25	0	TM1703_ACP_LAN	1	LLN0$DS_STAT_AA	19	TM1703_ACP_LAN/USERCSWI1STBeh
26	0	TM1703_ACP_LAN	1	LLN0$DS_STAT_AA	20	TM1703_ACP_LAN/USERGGIO1STBeh
27	0	TM1703_ACP_LAN	1	LLN0$DS_STAT_AA	21	TM1703_ACP_LAN/USERGGIO10STBeh
28	0	TM1703_ACP_LAN	1	LLN0$DS_STAT_AA	22	TM1703_ACP_LAN/USERGGIO14STBeh
29	0	TM1703_ACP_LAN	1	LLN0$DS_STAT_AA	23	TM1703_ACP_LAN/USERGGIO15STBeh
30	0	TM1703_ACP_LAN	1	LLN0$DS_STAT_AA	24	TM1703_ACP_LAN/USERGGIO2STBeh
31	0	TM1703_ACP_LAN	1	LLN0$DS_STAT_AA	25	TM1703_ACP_LAN/USERGGIO3STBeh
32	0	TM1703_ACP_LAN	1	LLN0$DS_STAT_AA	26	TM1703_ACP_LAN/USERGGIO4STBeh

In the list "Datasets" all datasets generated for the selected server directory are displayed.

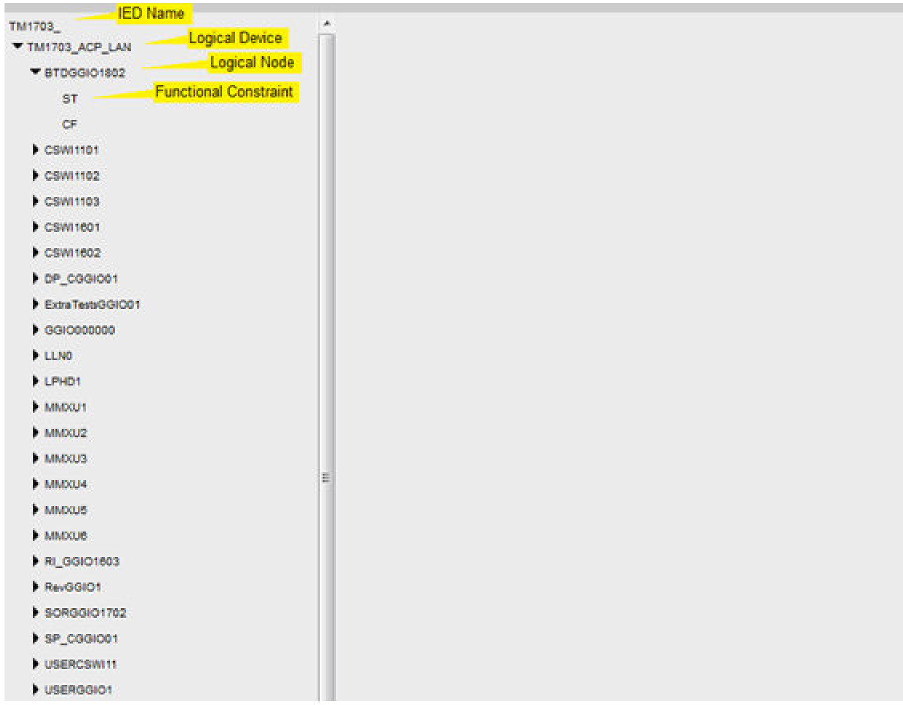
Datasets are only created for those data, that are to be transmitted from one IEC 61850 Server to one IEC 61850 Client. For data in the direction IEC 61850 Server → IEC 61850 Client, no data sets are created.

The following information is displayed:

- Nr
  In this field the consecutive number created in the directory of the Server is displayed.
- Nr LD
  In this field the number of the Logical Device is displayed.
- Logical Device
  In this field the parameterized name of the Logical Device is displayed.
- Nr DS
  In this field the number of Datasets is displayed.
- Dataset
  In this field the parameterized name of the Dataset is displayed.
- Nr DO
  In this field the number of Data Object is displayed.
- Data object
  In this field the parameterized name of the Data Object is displayed.

Server - Directory tree view

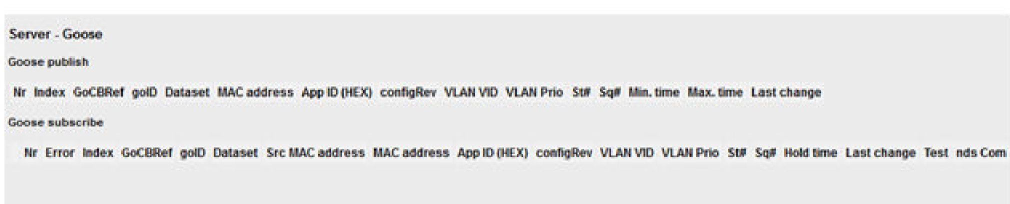
On this web page, the selected server directory is displayed in hierarchically structured form.



Server - GOOSE

On this web page, details of the GOOSE header information are displayed. The datasets for the GOOSE applications are generated from the process-technical parameters (SIP message address conversion) during startup.

- "GOOSE publish"
  In the list “GOOSE publish” the sum of transmitted GOOSE applications since startup of the protocol element is displayed
- "GOOSE subscribe"
  In the list “GOOSE subscribe” the sum of received GOOSE applications since startup of the protocol element is displayed



The following information is displayed for each GOOSE application:

- Index
  The field "Index" displays the parameterized number for the respective GOOSE application. This index is only required for the SICAM A8000 protocol element and is not transmitted.

- Error
  In the field "Error" a detailed error information is displayed for each GOOSE application (since startup of the own device). Possible error information:
  Blank field .... OK
  Timeout .... GOOSE application has already been received once, but presently this is no longer received.
  Data Set Wrong ... The structure of the dataset received for the GOOSE application does not correspond with the parameter setting in the own device.
  Never Received ... The dataset for the parameterized GOOSE application has never been received.
- GoCBRef
  In the field "GoCBref" the GOOSE Control Block Reference is displayed. This is unambiguous in the device and the network.
- goID
  In the field "goID" an unambiguous GOOSE identification reference is displayed. This identifier is unambiguous for each device and for each network and is also transmitted with GOOSE.
- MAC address
  In the field "MAC address" the parameterized MAC address of the GOOSE application is displayed. The MAC address is a "Multicast MAC address" – several different remote stations can receive data from one MAC address.
- Src MAC address
  In the field "Src MAC address" the unambiguous MAC address of that device which has transmitted the GOOSE application is displayed.
  Note:
  If due to an incorrect parameter setting, an unambiguous GOOSE application is to be transmitted from several devices (for example through the copying of parameters), the MAC addresses of the devices are displayed alternating in the field "MAC Source".
- AppID (HEX)
  In the field "AppID" the parameterized identification of the GOOSE application is displayed.
- configRev
  In the field "configRev" an unambiguous revision identifier of the GOOSE application is entered.
  Note: The revision identifier is generally not used presently and is assigned by default with "1" !
- VLAN_VID
  In the field "VLAN_VID" the parameterized VLAN identification is displayed.
- VLAN_Prio
  In the field "VLAN-Prio" the parameterized VLAN priority is displayed.
- St#
  In the field "St#" the state number is displayed.
- Sq#
  In the field "Sq#" the sequence number is displayed.
- Min. time
  In the field "Min. time" the minimal repetition time is displayed.
- Max. time
  In the field "Max. time" the maximal repetition time is displayed.
- Hold time
  In the field "Hold time" the current repetition time is displayed.
- Last change
  In the field "Last change" the time of the latest change of the GOOSE application is displayed.

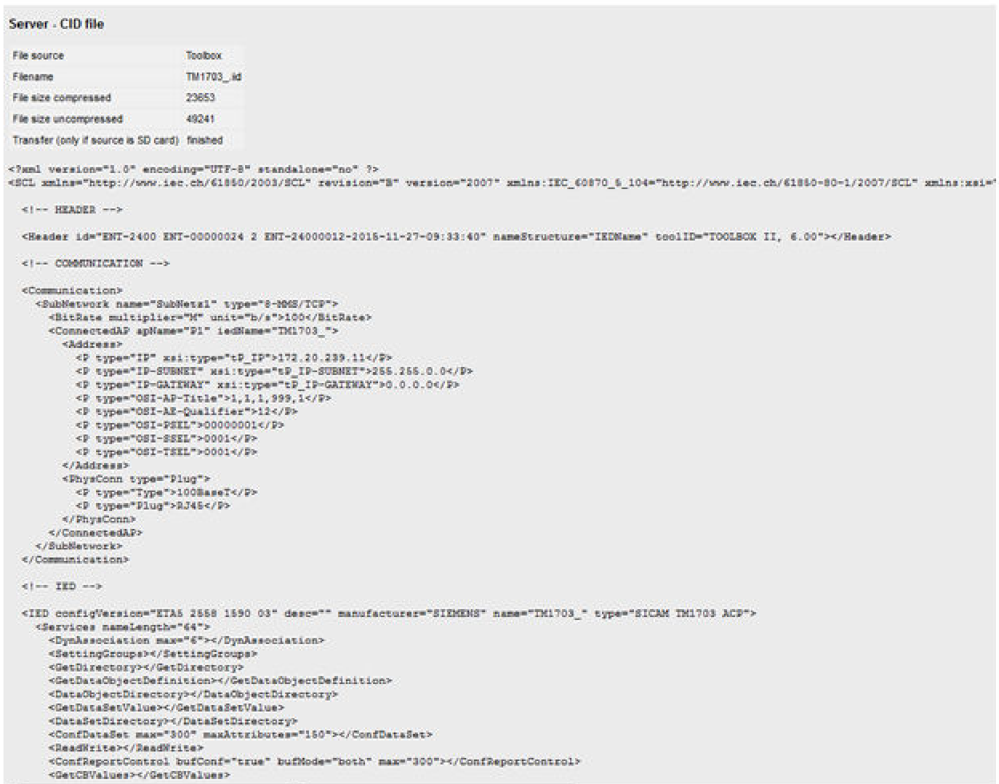
- Test

  In the field "Test" the additional attribute “GOOSE generated by means of test” is displayed.
- nds Com

  In the field "nds Com" the additional attribute “GOOSE generated by means of commissioning” is displayed.

Server – CID File

On this web page the own CID file is displayed.



Server - CID file

File source	Toolbox
Filename	TM1703_.id
File size compressed	23653
File size uncompressed	49241
Transfer (only if source is SD card)	finished


```
<?xml version="1.0" encoding="UTF-8" standalone="no" ?>
<SCL xmlns="http://www.iec.ch/61850/2003/SCL" revision="B" version="2007" xmlns:IEC_60870_5_104="http://www.iec.ch/61850-80-1/2007/SCL" xmlns:xsi="

  <!-- HEADER -->

  <Header id="ENT-2400 ENT-00000024 2 ENT-24000012-2016-11-27-09:33:40" nameStructure="IEDName" toolID="TOOLBOX II, 6.00"></Header>

  <!-- COMMUNICATION -->

  <Communication>
    <SubNetwork name="SubNetz1" type="8-MMS/TCP">
      <BitRate multiplier="M" unit="b/s">100</BitRate>
      <ConnectedAP apName="P1" iedName="TM1703_">
        <Address>
          <P type="IP" xsi:type="tP_IP">172.20.239.11</P>
          <P type="IP-SUBNET" xsi:type="tP_IP-SUBNET">255.255.0.0</P>
          <P type="IP-GATEWAY" xsi:type="tP_IP-GATEWAY">0.0.0.0</P>
          <P type="OSI-AP-Title">1,1,1,999,1</P>
          <P type="OSI-AE-Qualifier">12</P>
          <P type="OSI-PSEL">00000001</P>
          <P type="OSI-SSEL">0001</P>
          <P type="OSI-TSEL">0001</P>
        </Address>
        <PhysConn type="Plug">
          <P type="Type">100BaseT</P>
          <P type="Plug">RJ45</P>
        </PhysConn>
      </ConnectedAP>
    </SubNetwork>
  </Communication>

  <!-- IED -->

  <IED configVersion="ETA5 2558 1590 03" desc="" manufacturer="SIEMENS" name="TM1703_" type="SICAM TM1703 ACP">
    <Services nameLength="64">
      <DynAssociation max="6"></DynAssociation>
      <SettingGroups></SettingGroups>
      <GetDirectory></GetDirectory>
      <GetDataObjectDefinition></GetDataObjectDefinition>
      <DataObjectDirectory></DataObjectDirectory>
      <GetDataSetValue></GetDataSetValue>
      <DataSetDirectory></DataSetDirectory>
      <ConfDataSet max="300" maxAttributes="150"></ConfDataSet>
      <ReadWrite></ReadWrite>
      <ConfReportControl bufConf="true" bufMode="both" max="300"></ConfReportControl>
      <GetCBValues></GetCBValues>
```


Server – Command log

On this web page the record of the respective last commands (ACT, CON, TERM) in context with IEC 60870-5-101/104 and IEC 61850 is displayed.

Server - Command log

Time	Direction	Reason	TI	CASDU1	CASDU2	IOA1	IOA2	IOA3	Station	IEC61850 address	Origin	Addcause	Data
23.12.15 09:32:19.791	Server->Client INFO TERM	neg	46	11	50	234	173	1	1	TM1703_ACP_LAN/CSWI1102.Pos.ctlVal	0	blocked by process (9)	ON
23.12.15 09:32:20.135	Client->Server EXE ACT		46	11	50	234	173	1	1	TM1703_ACP_LAN/CSWI1102.Pos.ctlVal	47	no synch., with interl., no test	ON
23.12.15 09:32:20.251	Server->Client EXE CON	pos	46	11	50	234	173	1	1	TM1703_ACP_LAN/CSWI1102.Pos.ctlVal	47		ON
23.12.15 09:32:20.571	Server->Client EXE TERM	pos	46	11	50	234	173	1	1	TM1703_ACP_LAN/CSWI1102.Pos.ctlVal	47		ON
23.12.15 09:32:20.884	Client->Server EXE ACT		45	11	50	41	174	1	1	TM1703_ACP_LAN/USERCSWI11.Pos.ctlVal	0	no synch., with interl., no test	ON
23.12.15 09:32:20.911	Server->Client EXE CON	pos	45	11	50	41	174	1	1	TM1703_ACP_LAN/USERCSWI11.Pos.ctlVal	0		ON
23.12.15 09:32:25.891	Server->Client EXE TERM	pos	45	11	50	41	174	1	1	TM1703_ACP_LAN/USERCSWI11.Pos.ctlVal	0		ON
23.12.15 09:32:26.188	Client->Server EXE ACT		46	11	50	234	173	1	1	TM1703_ACP_LAN/CSWI1102.Pos.ctlVal	0	no synch., with interl., no test	OFF
23.12.15 09:32:26.363	Server->Client EXE CON	pos	46	11	50	234	173	1	1	TM1703_ACP_LAN/CSWI1102.Pos.ctlVal	0		OFF
23.12.15 09:32:26.771	Server->Client EXE TERM	pos	46	11	50	234	173	1	1	TM1703_ACP_LAN/CSWI1102.Pos.ctlVal	0		OFF
23.12.15 09:32:27.041	Client->Server EXE ACT		46	11	50	234	173	1	1	TM1703_ACP_LAN/CSWI1102.Pos.ctlVal	69	no synch., with interl., no test	ON
23.12.15 09:32:27.424	Server->Client INFO TERM	neg	46	11	50	234	173	1	1	TM1703_ACP_LAN/CSWI1102.Pos.ctlVal	69	blocked by process (9)	ON
23.12.15 09:32:27.732	Client->Server EXE ACT		46	11	50	234	173	1	1	TM1703_ACP_LAN/CSWI1102.Pos.ctlVal	47	no synch., with interl., no test	ON
23.12.15 09:32:27.871	Server->Client EXE CON	pos	46	11	50	234	173	1	1	TM1703_ACP_LAN/CSWI1102.Pos.ctlVal	47		ON
23.12.15 09:32:28.223	Server->Client EXE TERM	pos	46	11	50	234	173	1	1	TM1703_ACP_LAN/CSWI1102.Pos.ctlVal	47		ON
23.12.15 09:32:28.506	Client->Server EXE ACT		45	11	50	41	174	1	1	TM1703_ACP_LAN/USERCSWI11.Pos.ctlVal	0	no synch., with interl., no test	OFF
23.12.15 09:32:28.531	Server->Client EXE CON	pos	45	11	50	41	174	1	1	TM1703_ACP_LAN/USERCSWI11.Pos.ctlVal	0		OFF
23.12.15 09:32:33.491	Server->Client EXE TERM	pos	45	11	50	41	174	1	1	TM1703_ACP_LAN/USERCSWI11.Pos.ctlVal	0		OFF
23.12.15 09:32:33.686	Client->Server EXE ACT		46	11	50	234	173	1	1	TM1703_ACP_LAN/CSWI1102.Pos.ctlVal	0	no synch., with interl., no test	ON
23.12.15 09:32:34.043	Server->Client INFO TERM	neg	46	11	50	234	173	1	1	TM1703_ACP_LAN/CSWI1102.Pos.ctlVal	0	blocked by process (9)	ON
23.12.15 09:32:34.385	Client->Server EXE ACT		46	11	50	234	173	1	1	TM1703_ACP_LAN/CSWI1102.Pos.ctlVal	47	no synch., with interl., no test	ON
23.12.15 09:32:34.743	Server->Client INFO TERM	neg	46	11	50	234	173	1	1	TM1703_ACP_LAN/CSWI1102.Pos.ctlVal	47	blocked by process (9)	ON
23.12.15 09:32:36.143	Client->Server EXE ACT		45	11	50	41	174	1	1	TM1703_ACP_LAN/USERCSWI11.Pos.ctlVal	0	no synch., with interl., no test	OFF
23.12.15 09:32:36.171	Server->Client EXE CON	pos	45	11	50	41	174	1	1	TM1703_ACP_LAN/USERCSWI11.Pos.ctlVal	0		OFF
23.12.15 09:32:41.191	Server->Client EXE TERM	pos	45	11	50	41	174	1	1	TM1703_ACP_LAN/USERCSWI11.Pos.ctlVal	0		OFF
23.12.15 09:33:07.695	Client->Server EXE ACT		45	11	50	41	174	1	1	TM1703_ACP_LAN/USERCSWI11.Pos.ctlVal	0	no synch., with interl., no test	ON
23.12.15 09:33:07.724	Server->Client EXE CON	pos	45	11	50	41	174	1	1	TM1703_ACP_LAN/USERCSWI11.Pos.ctlVal	0		ON
23.12.15 09:33:08.231	Client->Server EXE ACT		46	11	50	234	173	1	1	TM1703_ACP_LAN/CSWI1102.Pos.ctlVal	0	no synch., with interl., no test	ON
23.12.15 09:33:08.591	Server->Client INFO TERM	neg	46	11	50	234	173	1	1	TM1703_ACP_LAN/CSWI1102.Pos.ctlVal	0	blocked by process (9)	ON
23.12.15 09:33:11.959	Client->Server EXE ACT		46	11	50	234	173	1	1	TM1703_ACP_LAN/CSWI1102.Pos.ctlVal	0	no synch., with interl., no test	OFF
23.12.15 09:33:12.331	Server->Client INFO TERM	neg	46	11	50	234	173	1	1	TM1703_ACP_LAN/CSWI1102.Pos.ctlVal	0	blocked by process (9)	OFF
23.12.15 09:33:12.691	Server->Client EXE TERM	pos	45	11	50	41	174	1	1	TM1703_ACP_LAN/USERCSWI11.Pos.ctlVal	0		ON
23.12.15 09:33:16.188	Client->Server EXE ACT		46	11	50	234	173	1	1	TM1703_ACP_LAN/CSWI1102.Pos.ctlVal	0	no synch., with interl., no test	OFF
23.12.15 09:33:16.304	Server->Client EXE CON	pos	46	11	50	234	173	1	1	TM1703_ACP_LAN/CSWI1102.Pos.ctlVal	0		OFF
23.12.15 09:33:19.571	Server->Client EXE TERM	pos	46	11	50	234	173	1	1	TM1703_ACP_LAN/CSWI1102.Pos.ctlVal	0		OFF

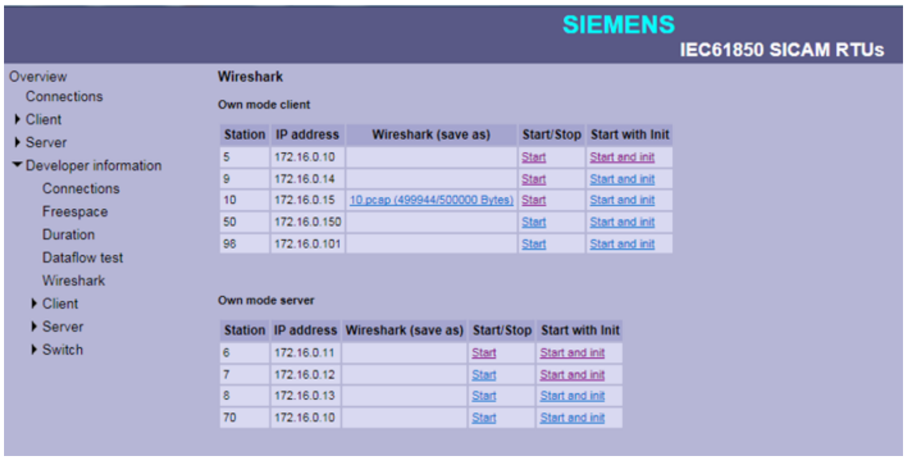
Command-specific status information:

- Time
  In this field the time tag of the command is displayed.
- Direction
  In this field the command direction and the command kind are displayed.
- Reason
  In this field the identification "pos"/"neg" of the command is displayed.
- TI,CASDU1,CASDU2,IOA1,IOA2,IOA3
  5-stage address and type identification according to IEC 60870-5-101/104.
- Station(SICAM A8000 internal station number)
  The station number is used SICAM A8000 internal for the routing of the data, diagnostic treatment and failure management. The station number is the SICAM A8000 internal reference for the connection that is assigned to an IP address.
- IEC 61850 Address
  In this field the parameterized IEC 61850 address of the data point is displayed.
- Origin
  In this field the control location (originator address) acc. to IEC 60870-5-101/104 is displayed.
- AddCause
  In this field the cause for a negative command termination is displayed.
- Data
  In this field the current status of the IEC 60870-5-101/104 data point is displayed.

Developer Information – Wireshark

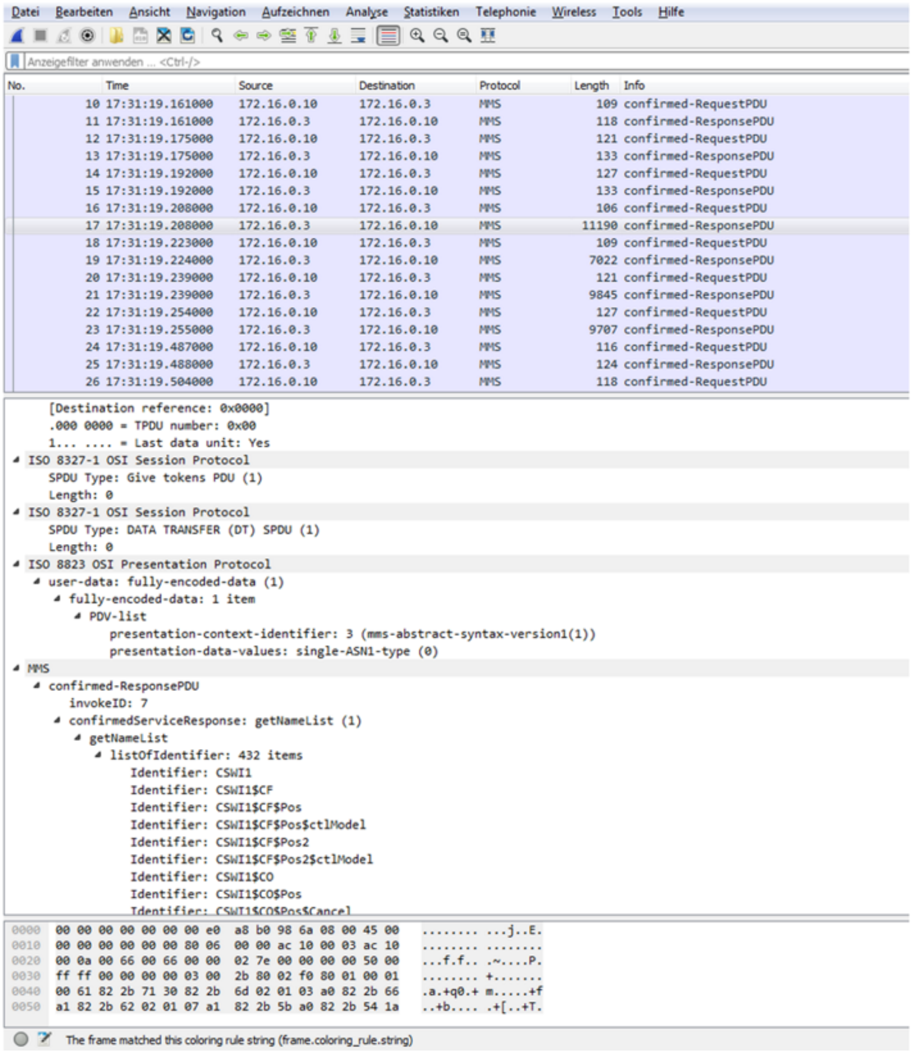
Upon problems with the communication via IEC 61850 it is necessary that a Wireshark recording will be performed. It can be operated remotely via the web server of the affected firmware without having to disconnect a cable or a restart. A recording on site is not required.

The recording can be started for each parameterized station, if needed also the initialization procedure can be recorded. The recorded data will be stored in a Wireshark compatible file which can be downloaded via the web server.



[sc_Wireshark_01, 1, --_--]

Function in Wireshark:



[sc_Wireshark_02, 1, --_--]

13.7 Modbus RTU

13.7.1 Introduction

The Modbus RTU protocol is a standardized serial transmission protocol for communication with remote stations with multi-point traffic (master/slave principle; “Partyline”).

Protocol firmware for Modbus RTU:

Firmware	System	Standard and function
MODMI0	CP-8031, CP-8050	Modbus RTU Master (serial)
MODSI0	CP-8031, CP-8050	Modbus RTU Slave (serial)

The Modbus RTU protocol defines the data exchange of 16-bit register values or of coils (binary information) between systems via a serial communication connection.

The Modbus RTU protocol is standardized by the user organization *www.modbus.org*.

The Modbus protocol was originally defined for serial transmission, later Modbus TCP was defined for the transmission of data via LAN/WAN (Ethernet).

The message structure is very similar between “Modbus RTU” and “Modbus TCP”.

The protocol element MODMI0 enables the serial communication of a component as central station with up to 100 substations (= Slaves) with the Modbus RTU protocol on a common line.

The protocol element MODSI0 enables the serial communication of a component as substation (= Slave) with a central station (= Master) with the Modbus RTU protocol on a common line with up to a maximum of 247 substations.

In multi-point traffic the central station and the substations operate with a serial communication protocol according to Modicon Modbus (RTU mode).

The supported functionality (interoperability) is determined in the chapter *13.7.12 Interoperability*.

Multi-point traffic describes a serial communication protocol with which a central station is connected with one or several substations over a communications link in a line or star configuration. The data traffic is controlled by the central station.

An unambiguous station number in the range 1 to 247 is assigned to each substation. The station number "0" is used for the simultaneous addressing of all stations (broadcast-addressing). With broadcast addressing no reply (response message) is transmitted from the substations to the central station.

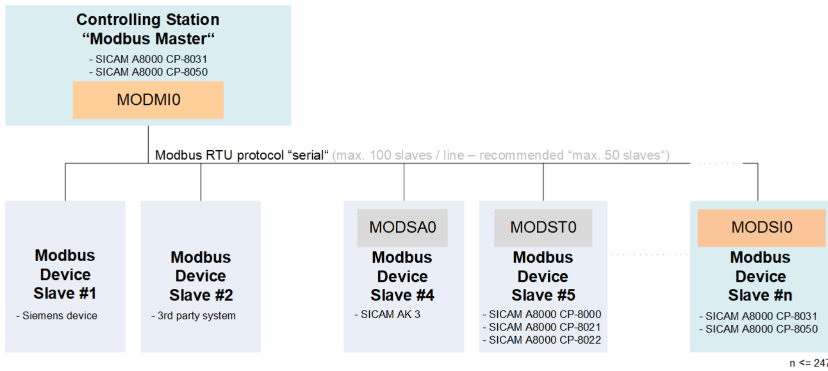
NOTE

The Modbus RTU Master does not support broadcast addressing!

A transmission of data can always only be initiated by the central station. A data transmission consists either of a “request/response sequence” (query/response) to selectively addressed substations or of a simultaneous addressing of all connected substations (broadcast/no response).

Depending on the case of application the central station can transmit a further message immediately following reception of a valid reply message from a substation or with “lack of a response” after a configurable timeout.

The requests (Read Registers/Read Coils) or data messages (Write Registers/Write Coils) provided for the Modbus communication protocol are transmitted from the central station. Data from the substation to the central station can only be transmitted as a response to a request.



[Modbus_RTU_config, 2, en_US]

Figure 13-11 Modbus RTU Configuration

In multi-point traffic an “unbalanced transmission procedure” is used. That means, that as primary station the central station initiates all message transmissions, while the substations, which are secondary stations, may only transmit when they are called.

The multi-point traffic only requires a half-duplex transmission medium and can be used in a star or line structure.

13.7.2 Functions

Function	MODMI0	MODSI0
Modbus RTU		
Serial communication protocol according to Modbus RTU	✓	✓
Serial communication protocol according to Modbus ASCII	–	–
Modbus RTU Master	✓	–
Modbus RTU Slave	–	✓
Max. number of remote stations	100 [304]	1
Modbus slave addresses	1 to 247	1 to 247
Max. number of supported data points	10000	10000
Modbus RTU broadcast addressing (broadcast slave address = 0 only with clock synchronization)	–	✓
Network configuration		
Point-to-point configuration (Modbus master + 1 Modbus slave)	✓	✓
Multiple point-to-point configuration (Modbus master + 1 Modbus slave) Separate interface for each single point-to-point configuration required!	✓	✓
Multi-point traffic – line configuration	✓	✓
Multi-point traffic – star configuration	✓	✓
Data concentrator	✓	✓
Multi-point traffic – ring	–	–
Dial-up traffic (dial in)	–	–
Dial-up traffic (dial out)	–	–
Modem bank	–	–

304 Recommended: 50

Function	MODMI0	MODSI0
Physical interface		
direct link interface (RS-232)	✓	✓
RS-485	✓	✓
RS-422	✓	✓
CP-8031, CP-8050: X4 (RS-485/RS-422); X5 (RS-232)	✓	✓
CI-8551 [305]: X1, X2 (RS-232, RS-485/RS-422); X3 (RS-485/RS-422); X4, X5 (RS-232)	✓	✓
Baud rates: 50, 75, 100,134.5, 150, 200, 300, 600, 1050, 1200, 1800, 2000, 2400, 4800, 9600, 19200, 38400,5600057600, 64000, 115200 bits/s	✓	✓
Transmission line (half duplex)	✓	✓
Bit transmission layer		
Modbus message frame according to Modbus standard (*www.modbus.org*)		
Byte frame: 8N1, 8E1, 8O1, 8N2, 8E2, 8O2 [306]	✓	✓
Modbus ASCII message frame according to Modbus standard (*www.modbus.org*)		
7N1, 7E1, 7O1, 7N1.5, 7E1.5, 7O1.5, 7N2, 7E2, 7O2 [307]	–	–
Message protection d = 4:		
• CRC16	✓	✓
• LRC	–	–
• Parity bit “optional”	✓	✓
Interoperability		
Interoperability according to *13.7.12.1 Interoperability Modbus RTU Master*	✓	–
Interoperability according to *13.7.12.2 Interoperability Modbus RTU Slave*	–	✓
Modbus register/coil addressing		
Modbus register 16 bits	✓	✓
Modbus register addresses: 1 (0) bis 65535	✓	✓
Modbus coil addresses: 1 (0) bis 65535	✓	✓
Modbus register addressing – according to Modbus standard (YES/NO) – station-selective	✓	✓
Modbus register addressing – according to Modbus standard (YES/NO) – global for all stations	–	–
Modbus function codes[308]		
01 = Read Coils	✓	✓
02 = Read Discrete Inputs	✓	✓
03 = Read Holding Registers	✓	✓
04 = Read Input Registers	✓	✓

305 With CP-8031 not supported by default. With a license (see *14.8 SICAM A8000 CP-803x Extended CI-Module*) 1 communication module CI-8551 can be used additionally also with CP-8031.

306 Byte frame according Modbus Standard for RTU mode: 8E1 (1 start bit, 8 data bits, 1 parity bit (even parity), 1 stop bit) If**no parity**2 stop bits must be used In old configurations byte frame "8N2" (8 data bits, no parity, 2 stop bits) is used typically for Modbus RTU mode.

307 Byte frame according Modbus standard for ASCII mode: 7E1 (1 start bit, 7 data bits, 1 parity bit (even parity), 1 stop bit) If**no parity**2 stop bits must be used In old configurations byte frame "7N2" (7 data bits, no parity, 2 stop bits) is used typically for Modbus ASCII mode.

308 In addition to the supported Modbus function codes the supported data formats in the Modbus registers are also relevant!

Function	MODMI0	MODSI0
05 = Write Single Coil	✓	✓
06 = Write Single Register	✓	✓
08 = Diagnostics (subcode 00 bis 18, 20) "Return Query Data" (loopback check)	–	–
15 = Write Multiple Coils	✓	✓
16 = Write Multiple Registers	✓	✓
Modbus exception codes[309]		
01 = Illegal Function	✓	✓
02 = Illegal Data Address	✓	✓
03 = Illegal Data Value	✓	✓
04 = Server Device Failure	✓	✓
05 = Acknowledge	✓	–
06 = Server Device Busy	✓	–
08 = Memory Parity Error	✓	–
10 (0x0A) = Gateway Path Unavailable	✓	–
11 (0x0B) = Gateway Target Device Failed To Respond	✓	–
Modbus data formats		
INT16: Signed integer 16-bit	✓	✓
UINT16: Unsigned integer 16-bit	✓	✓
INT32 (H/L): Signed integer 32-bit ("HIGH before LOW")	✓	✓
UINT32 (H/L): Unsigned integer 32-bit ("HIGH before LOW")	✓	✓
INT32 (L/H): Signed integer 32-bit ("LOW before HIGH")	✓	✓
UINT32 (L/H): Unsigned integer 32-bit ("LOW before HIGH")	✓	✓
FLOAT32: Short floating-point (IEEE 754)	✓	✓
FLOAT32 (swapped): Short floating-point (IEEE 754) "swapped"	✓	✓
FLOAT32 (little endian) Short floating-point (IEEE 754) "little endian"	✓	✓
32BIT/OMVZ: OMV counter value format	–	✓
BS16: Bitstring 16-bit	✓	✓
SPI: Single-point information	✓	✓
DPI: Double-point information (OFF before ON)	✓	✓
DPI: Double-point information (ON before OFF)	✓	✓
SC: Single command	✓	✓
SC (pulse): Single command pulse	✓	✓
SC1n16R: Single command - 1 of 16 (register)	–	–
DC: Double command (2 bits)	✓	✓
DC1: Double command (1 bit)	–	–
DC1 (pulse): Double command pulse (1 bit)	–	–
DC2 (pulse): Double command pulse (2 bits)	✓	✓
DC1n16R: Double command - 1 of 16 (register)	–	–
SPI + IV: Single-point information with invalid identifier	✓	✓
DPI + IV: Double-point information (OFF before ON) with invalid identifier	✓	✓
DPI + IV: Double-point information (ON before OFF) with invalid identifier	✓	✓
INT16 + IV: Signed integer 16-bit + "invalid" identifier	✓	✓

309 Exception codes are not specially evaluated by the Modbus RTU master. A received exception code is rated as negative acknowledgment.

Function	MODMI0	MODSI0
UINT16 + IV: Unsigned integer 16-bit + "invalid" identifier	✓	✓
DTx: Date + time format free configurable	✓	–
DTFCM: Date + time (SICAM FCM) [310]	–	–
DT10BCD: Date + time (BCD) “OMV” [310]	–	–
DT10BCDr: Date + time (BCD swapped) “OMV” [310]	–	–
IEC60870-5-101/-104 data formats in transmit direction		
TI 30 .. Single-point information with time tag CP56Time2a	✓	✓
TI 31 .. Double-point information with time tag CP56Time2a	–	✓
TI 33 .. Bitstring of 32 bits with time tag CP56Time2a	✓	✓
TI 34 .. Measured value, normalized value with time tag CP56Time2a	✓	✓
TI 35 .. Measured value, scaled value with time tag CP56Time2a	✓	✓
TI 36 .. Measured value, short floating-point number with time tag CP56Time2a	✓	✓
TI 37 .. Integrated total with time tag CP56Time2a	–	✓
TI 45 .. Single command	✓	–
TI 46 .. Double command	✓	–
TI 47 .. Regulating step command	✓	–
TI 48 .. Setpoint command, normalized value	✓	–
TI 49 .. Setpoint command, scaled value	✓	–
TI 50 .. Setpoint command, short floating-point number	✓	–
TI 51 .. Bitstring of 32-bit	✓	–
IEC60870-5-101/-104 data formats in receive direction		
TI 30 .. Single-point information with time tag CP56Time2a	✓	✓
TI 31 .. Double-point information with time tag CP56Time2a	✓	✓
TI 33 .. Bitstring of 32 bits with time tag CP56Time2a	✓	–
TI 34 .. Measured value, normalized value with time tag CP56Time2a	✓	✓
TI 35 .. Measured value, scaled value with time tag CP56Time2a	✓	✓
TI 36 .. Measured value, short floating-point number with time tag CP56Time2a	✓	✓
TI 37 .. Integrated total with time tag CP56Time2a	✓	✓
TI 45 .. Single command	–	✓
TI 46 .. Double command	–	✓
TI 48 .. Setpoint command, normalized value	–	✓
TI 49 .. Setpoint command, scaled value	–	✓
TI 50 .. Setpoint command, short floating-point number	–	✓
Data acquisition by querying		
Read out of the Modbus registers/coils - in the base cycle	✓	–
Read out of the Modbus registers/coils - time-controlled	✓	–
Data is made available for query by the Modbus master in Modbus registers or coils	–	✓
Conversion of the Modbus register/coil data ↔ IEC 60870-5-101/104 Data formats	✓	–
Measured value change monitoring (receive direction)	✓	✓
Value adaptation for measured values (transmit and receive direction)	✓	✓
Suppression of intermediate and faulty position for double-point information	✓	–

310 Only in transmit direction for setting the time of the remote station. Time-tagged user data is not supported (except Alarm Panel)!

Function	MODMI0	MODSI0
General interrogation		
SICAM A8000 internal emulation of the ICE 60870-5-101/104 general interrogation (the current values of the Modbus Registers/Coils are read and passed on in general interrogations)	✓	–
SICAM A8000 internal emulation of the ICE 60870-5-1/104 general interrogation with the actual values from the Modbus Register/Coils	–	✓
Emulation of ACTCON, ACTTERM (according IEC 60870-5-101/104) general interrogation	–	–
Clock synchronization		
Clock synchronization of the substations via Modbus with FC = 16 (WRITE MULTIPLE REGISTER)	✓	–
Clock synchronization - selectable for each Modbus slave	✓	–
Clock synchronization always station selective	✓	–
Clock synchronization with “free definable time format” in Modbus message	✓	–
Clock synchronization of the CP-8031, CP-8050 substation via NTP	–	✓
Clock synchronization of the CP-8031, CP-8050 substation via NTP	–	–
Command Transmission		
Conversion of IEC 60870-5-101/104 commands→Modbus register/bits or coils	✓	–
Conversion of commands from the Modbus registers/coils→IEC 60870-5-101/104 commands	–	✓
Control location (set control location, check)	✓	–
Emulation of ACTCON for commands/setpoint values according IEC 60870-5-101/104	✓	–
Emulation of ACTCON- for commands (according IEC 60870-5-101/104), when a command is discarded from an unreleased control location.	✓	–
Emulation of ACTTERM for commands/setpoint values (according IEC 60870-5-101/104)	–	–
Transmission of integrated totals		
With counter interrogation command (Modbus interrogation of counter - in basic cycle)	✓	–
Spontaneous (Modbus interrogation - cyclic/time-controlled)	✓	–
Conversion of the Modbus register data→IEC 60870-5-101/104 integrated totals	✓	–
Integrated totals are provided in Modbus registers for polling by the Modbus master	–	✓
Redundancy		
Protocol redundancy:		
• Call operation when PASSIVE	✓	–
• Tristate of RS-232 interface when PASSIVE	✓	✓
• Listening mode (for global/selective station failure handling)	✓	✓
• Listening mode (for data)	–	–
Ring redundancy (“loop redundancy”):		
• Ring redundancy with redundant devices (via redundancy link)	✓	–
• Ring redundancy in own device	–	–

Function	MODMI0	MODSI0
Device redundancy:		
• Device redundancy with the same PRE parameters	✓	✓
• Device redundancy with different PRE parameters (“A/B parameters”)	–	–
• Device redundancy with different PRE parameters (“A/B parameters”) for signals	✓	–
Optimized parameters for selected transmission facilities		
• Predefined parameters for selectable transmission facility	✓	✓
• Freely definable parameters for transmission facility	✓	✓
• 5 V power supply for connected transmission facility (via RS-232 status line) ATTENTION: Check power consumption of the external transmission facility!	✓	✓
Protocol element control and return information		
Protocol element control messages:		
• Set control location	✓	–
• Disable/enable SICAM FCM parameter loading	–	–
Protocol element return information:		
• Station status	✓	✓
• Station failure	✓	✓
• SICAM FCM parameter loading disabled/enabled	–	–
	✓	–
Web server		
Protocol-internal diagnostic and statistic information via protocol-specific web pages	✓	✓
Engineering		
SICAM Device Manager	✓	✓
SICAM TOOLBOX II	✓	✓

NOTE

Real-time data via Modbus RTU is not supported!

The Modbus RTU protocol in SICAM A8000 does not support full functionality according to Modbus RTU.

The Modbus RTU protocol defines only the transmission of coils and 16-bit register values, but not the data formats in the Modbus registers!

The Modbus RTU protocol in SICAM A8000 supports many of the commonly used data formats (see section *13.7.13 Modbus Data Formats*).

For the coupling of devices with Modbus RTU protocol it is always necessary to check first whether the required functionality and the required data formats are supported in the central station and in the substation!

13.7.3 Modes of Operation

The operating mode of the interface is determined by parameters of the protocol element and optional equipment.

Operating mode	Interface → optional DTE	Interface signals
Unbalanced interchange circuit (V.24/V.28) RS-232 asynchronous	X5	RXD, TXD, CTS [311], RTS, DCD, DTR, DSR/VCC, GND
Balanced interface (V.11) RS-485 (2-wire)/ RS-422 (4-wire) asynchronous	X4	TXD+, TXD-, RXD+, RXD- (4-wire)
Balanced interface (V.11) RS-485 (2-wire)/ RS-422 (4-wire) asynchronous	X5 → PHOENIX PSM-ME-RS232/ RS485-P interface converter	Interface signals at X5: (towards PHOENIX PSM-ME-RS232/RS485-P) RXD, TXD, CTS, RTS, DCD, DTR, GND Interface signals at PHOENIX PSM-ME-RS232/RS485-P: • RS-485 2-wire D(A), D(B), GND • RS-422 (4-wire): D(A), D(B), T(A), T(B), GND

13.7.4 Communication

For the stations to communicate with each other, suitable transmission facilities and/or network components may be needed in addition.

Own Station (Central Station – Modbus RTU Master)

System	System element	Protocol Element	Remarks
SICAM A8000 Series	CP-8031/CPCI85 CP-8050/CPCI85 CP-8050/EPCI85	MODMI0	max. 100 Slaves

Remote Station (Substation – Modbus RTU Slave)

System	System element	Protocol Element	Remarks
SICAM A8000 Series	CP-8031/CPCI85 CP-8050/CPCI85 CP-8050/EPCI85	MODSI0	
SICAM A8000 Series	CP-8000/CPC80 CP-8021/CPC80 CP-8022/CPC80	MODST0	
SICAM AK 3	CP-2016/CPCX26 CP-2019/PCCX26	SM-2551/MODSA0 SM-0551/MODSA0	
Legacy systems (SICAM AK, SICAM TM, SICAM BC, SICAM EMIC)	CP-20xx CP-60xx CP-50xx	SM-2551/MODSA0 SM-0551/MODSA0 MODST0	
Siemens devices	–	–	according to *13.7.12.1 Interoperability Modbus RTU Master*
Third-party system	–	–	according to *13.7.12.1 Interoperability Modbus RTU Master*

[311] not usable (reserved for SICAM TOOLBOX II)

Own Station (Substation – Modbus RTU Slave)

System	System element	Protocol Element	Remarks
SICAM A8000 Series	CP-8031/CPCI85 CP-8050/CPCI85 CP-8050/EPCI85	MODSI0	

Remote Station (Central station – Modbus RTU Master)

System	System element	Protocol Element	Remarks
SICAM A8000 Series	CP-8031/CPCI85 CP-8050/CPCI85 CP-8050/EPCI85	MODMI0	max. 100 Slaves
SICAM A8000 Series	CP-8000/CPC80 CP-8021/CPC80 CP-8022/CPC80	MODMT2	
SICAM AK 3	CP-2016/CPCX26 CP-2019/PCCX26	SM-2551/MODMA0 SM-0551/MODMA0	
Legacy systems (SICAM AK, SICAM TM, SICAM BC, SICAM EMIC)	CP-20xx CP-60xx CP-50xx	SM-2551/MODMA0 SM-0551/MODMA0 MODMT2	
Siemens devices	–	–	Interoperability according to *13.7.12.2 Interoperability Modbus RTU Slave*
Third-party system	–	–	Interoperability according to *13.7.12.2 Interoperability Modbus RTU Slave*

13.7.5 Communication According to Modbus RTU

Overview

The Modbus protocol defines the data exchange of 16 bit register values or of coils (binary information) between systems.

Message formats for Modbus “serial”:

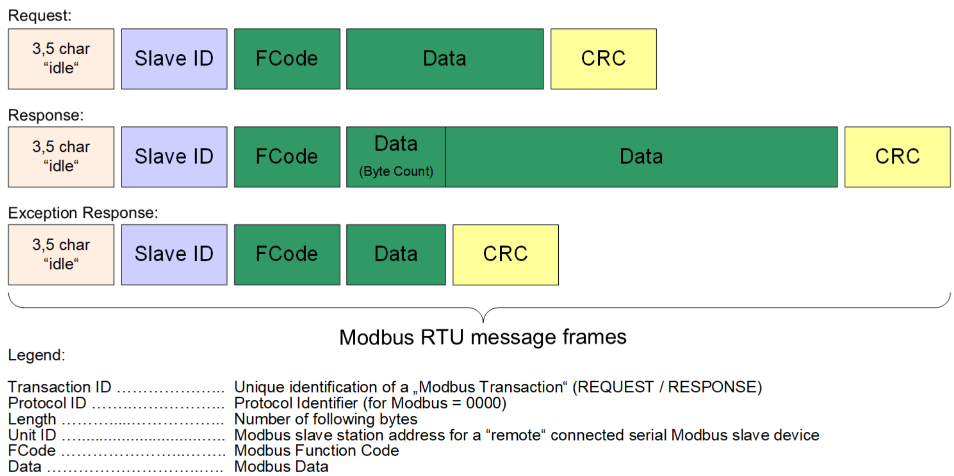
- RTU Mode
- ASCII-Modenot supported by CP-8050)

The message format on the line is ”determined by agreement”. For the communication with Modbus all participants must use the same message format.

With Modbus "serial" the message protection takes place by means of the CRC/LRC at the end of the message and optionally with the Parity-Bit for each byte in the message.

13.7.5.1 Message Description

Structure of the message



[Modbus_RTU_message_frame, 1, en_US]

Figure 13-12 Modbus RTU message structure

Field	Length [bytes]	Description	Note
Slave ID	1	Modbus slave address	1 to 247 (0 = broadcast)
FCode	1	Modbus function code	
Data	n	Data bytes	Max. 253 Bytes
Byte Count	1	Length of answer bytes	
CRC	2	CRC16	

Used Interface Lines (Modbus serial)

With RS-232 following V.24 interface lines are used:

	Number of the interface line	Designation	Use
TxD	<103>	Transmit data	Transmit data
RxD	<104>	Receive data	Receive data
GND	<102>	Signal Ground	
RTS	<105>	Request to Send	Switching on the transmit signal level of the transmission facility
DCD	<109>	Data Carrier Detect	Detecting the receive signal level of the transmission facility

If Modbus devices with RS-485 are to be connected to the serial RS-232 interface, then external converters must also be used!

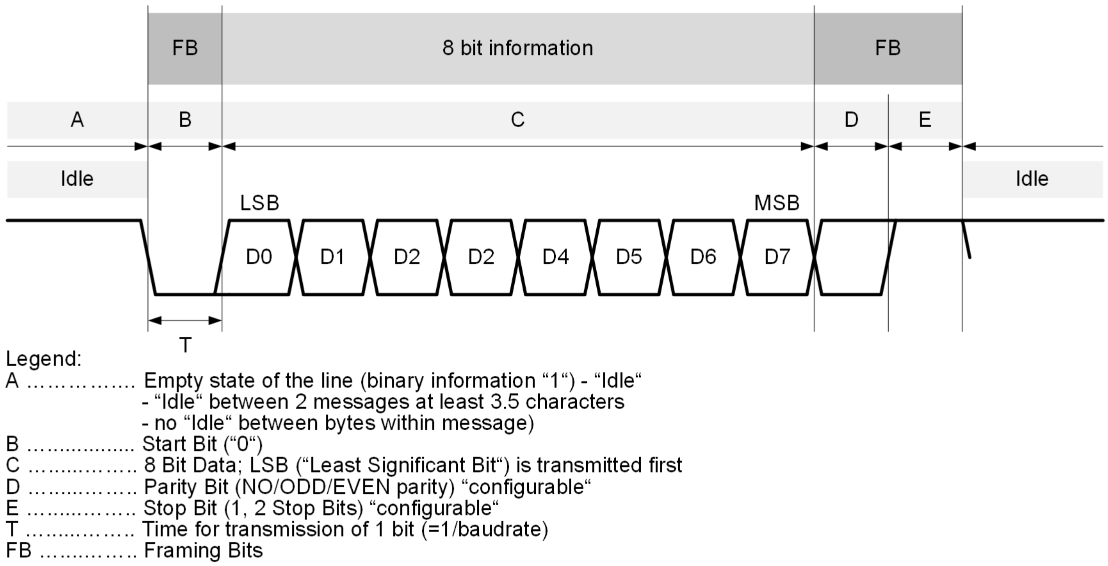
Byte Frame (Modbus serial)

The byte frame can be parameterized.

This byte frame contains:

1	Start bit
8	Data bits
1/NO	parity bit (even, odd, no parity)
1/2	Stop bits

Because of start- and stop bits of the byte frame the synchronization of the receiver happens new with each byte.



[Modbus_RTU_Byte_Framing, 3, en_US]

Figure 13-13 Modbus RTU byte frame

Message transmission in Modbus RTU Mode

In RTU Mode all items of information are transmitted in 8-bit binary encoded characters.

- Modbus message must be transmitted as a continuous stream (without gaps between the bytes).
- The pause time (“silent interval”) between two Modbus messages must be at least 3.5 UART characters.
  The minimum required pause time is generated by protocol firmware automatically and can be extended by user with the parameter **`Interface parameter | Time settings for free definable interface modem | Pause time (tp)`**.
- If a silent interval of more than 1.5 UART character times occurs between 2 UART characters of a Modbus message, the message frame is declared as incomplete and will be discarded by the receiver.
  Note:
  The message gap monitoring (“silent interval between two characters of a Modbus message frame”) is set with the parameter **`Modbus | Time settings, retries | Monitoring times | Character monitoring time`**.
  With message interruption the receive processing in progress is aborted and the message is discarded.

Modbus slave address

For Modbus “serial”, the individual slave address (“Slave Node Address”) is set in the range 1 to 247. The slave address "0" is defined as a broadcast address.
Limitation: Broadcast addressing is not supported in SICAM A8000!

Modbus Function Codes (FC)

The Modbus message formats are differentiated by the Modbus Function Code (FC).

Supported Modbus function codes:

Function code	Function	Description
01	Read Coils	Read binary marker
02	Read Discrete Inputs	Read binary inputs
03	Read Holding Registers	Read internal register
04	Read Input Registers	Read input register
05	Write Single Coil	Write binary outputs
06	Write Single Register	Write register
15	Write Multiple Coils	Write binary outputs
16	Write Multiple Registers	Write register

Modbus Address (Register/Coils)

Addressing according to Modbus for register values:

- One Modbus register address addresses one 16-bit register
- The Modbus register address begins with 1 (or 0)
- For each Modbus register the MSB is transmitted first and then the LSB
- Address range for Modbus register address: (0),1 to 65535
  With the protocol firmware for SICAM A8000 the address range for Modbus registers is organized separately per Modbus function code and limited only by free internal memory. Some third-party systems have only one common address range, common for all Modbus function codes – thereby an offset is defined per function code for the Modbus register address.

Addressing according to Modbus for “Coils”:

- One Modbus coil address addresses one coil “Binary states” (ON/OFF)
- The Modbus coil address begins with 1 (or 0)
- Address range for coils: (0),1 to 65535

According to the Modbus definition, the addressing of the Modbus registers begins from address 1, but on the line the address 0 is transmitted for Modbus register address 1.

Modbus register addressing (typical):

Function code	Function	Register address (address list) [dec]	Register address (in message) [dec]
01	Read Coils	00001 to 10000	0000 to 9999
02	Read Discrete Inputs	10001 to 20000	0000 to 9999
03	Read Holding Registers	40001 to 50000	0000 to 9999
04	Read Input Registers	30001 to 40000	0000 to 9999
05	Write Single Coil	00001 to 10000	0000 to 9999
06	Write Single Register	40001 to 50000	0000 to 9999
15	Write Multiple Coils	00001 to 10000	0000 to 9999
16	Write Multiple Registers	40001 to 50000	0000 to 9999

NOTE

The addressing of the Modbus registers is implemented differently depending on manufacturer and must be looked up in the device descriptions!
Some manufacturers also specify the Modbus register address on the line in the address list!

Deviating from the definition for the Modbus protocol, some substations use the Modbus register start address in the Modbus message on the line starting from 1 instead of starting from 0.

The addressing according to Modbus standard can be set in the parameters of the **`Station definition`** in the field **`Addressing MODBUS Standard`** per station.

	Station number (internal)	MODBUS_Station	Station enable	Station failure	Station type	Addressing MODBUS standard	Diagnostics (FC=08)	FCM parameter	FCM Active group
	0	10	yes	notify	general	yes	no	selective	acc. FCM parameter
	1	11	yes	notify	general	yes	no	selective	acc. FCM parameter
	2	12	yes	notify	general	yes	no	selective	acc. FCM parameter
	3	13	yes	notify	general	yes	no	selective	acc. FCM parameter
	5	14	yes	notify	general	yes	no	selective	acc. FCM parameter

For example:

Modbus address	Modbus address in message	
	Addressing Modbus standard = <yes>	Addressing Modbus standard = <no>
1	0	1
75	74	75
1000	999	1000
1374	1373	1374

Modbus Data (Register/Coils)

The Modbus data essentially contain the contents of the Modbus registers or the contents of the Modbus Coils.

The supported Modbus data formats are described in chapter *13.7.13 Modbus Data Formats*, *13.7.12.1 Interoperability Modbus RTU Master* and *13.7.12.2 Interoperability Modbus RTU Slave*.

The Modbus data format is defined for each data point in the message conversion at the protocol element.

Modbus REQUEST or RESPONSE messages typically contain slave address, function code, coil / register address, number of bytes and data.

The exact Modbus message structure is documented for each function code in the section “Modbus Request/ Response Services”.

NOTE

The Modbus protocol does not define the data formats in the Modbus registers!

The addressing of the Modbus registers is implemented differently depending on manufacturer and must be looked up in the device descriptions!

Some manufacturers also specify the Modbus register address on the line in the address list!

Message Protection

In the case of Modbus RTU, the message protection is carried out by a CRC16 at the message end and optionally by one parity bit per message byte.

13.7.5.2 Modbus Request/Response Services

For the supported Modbus function codes, the message formats are shown schematically in the following description for Modbus RTU.

Supported Modbus function codes:

Function-code	Designation	Description
01	Read Coils	Read binary marker
02	Read Discrete Inputs	Read binary inputs

Function-code	Designation	Description
03	Read Holding Registers	Read internal register
04	Read Input Registers	Read input register
05	Write Single Coil	Write binary outputs
06	Write Single Register	Write register
15	Write Multiple Coils	Write binary outputs
16	Write Multiple Registers	Write register

Read Coils, Read Discrete Inputs [FC = 01, 02]

In the query message of the central station (Modbus RTU Master) the starting address and the number of data points to be transmitted is specified.

Station address [Slave Address]	1 to 247 (broadcast not supported)
Function code [Function Code]	01 (Read Coils)
	02 (Read Discrete Inputs)
Start address [Starting Address]	0 to 65535
Number of queried data points	1 to 127
Byte count [Byte Count]	1 to 16
Data [Data Coil Status]	8 states (binary information) per byte

Request (Query Message, Read Request) Example: Request of Bits 20 to 56 from the slave 17 with function code 01 or 02.			
Field name	**Example [HEX]**	**Example [DEC]**	**Description**
Slave Address	11	17	
Function Code	01 / 02	1 / 2	
Starting Address Hi	00	0	
Starting Address Lo	13	19	
Number of Points Hi	00	0	
Number of Points Lo	25	37	
Error Check (CRC16)	xx,xx	xx,xx	

Response (Response Message) Example: Response to the request of Bits 20 to 56 from the slave 17 with function code 01 or 02.			
Field name	**Example [HEX]**	**Example [DEC]**	**Description**
Slave Address	11	17	
Function Code	01 / 02	1 / 2	
Byte Count	05	5	
Data (Coils 27 to 20)	CD	205	1100 1101
Data (Coils 35 to 28)	6 B	107	0110 1011
Data (Coils 43 to 36)	B2	178	1011 0010
Data (Coils 51 to 44)	0E	14	0000 1110
Data (Coils 56 to 52)	1 B	27	0001 1011
Error Check (CRC16)	xx,xx	xx,xx	

In the response message each binary information is transmitted with 1 Bit. (0 = binary information OFF; 1 = binary information ON)

The number of data points requested refers to the individual items of binary information. The least significant bit in the 1st data byte contains the status of the addressed binary information.

Read Holding Registers / Read Input Registers [FC = 03, 04]

In the query message of the central station (Modbus RTU Master) the starting address and the number of data points to be transmitted is specified.

Station address [Slave Address]	1 to 247 (broadcast not supported)
Function code [Function Code]	03 (Read Holding Registers)
	04 (Read Input Registers)
Start address [Starting Address]	0 to 65535
Number of queried data points	1 to 127
Byte count [Byte Count]	2 to 254

Request (Query Message, Read Request) **Example: Request of Register 108 to 110 from the slave 17 with function code 03 or 04.**			
Field name	**Example [HEX]**	**Example [DEC]**	**Description**
Slave Address	11	17	
Function Code	03 / 04	3 / 4	
Starting Address Hi	00	0	
Starting Address Lo	6 B	107	
Number of Points Hi	00	0	
Number of Points Lo	03	3	
Error Check (CRC16)	xx,xx	xx,xx	

Response (Response Message) **Example: Response to the request of the Register 108 to 110 from the slave 17 with function code 03 or 04.**			
Field name	**Example [HEX]**	**Example [DEC]**	**Description**
Slave Address	11	17	
Function Code	03 / 04	3 / 4	
Byte Count	06	6	
Data Hi (Register 108)	02	2	0000 0010
Data Lo (Register 108)	2 B	43	0010 1011
Data Hi (Register 109)	00	0	0000 0000
Data Lo (Register 109)	00	0	0000 0000
Data Hi (Register 110)	00	0	0000 0000
Data Lo (Register 110)	64	100	0110 0100
Error Check (CRC16)	xx,xx	xx,xx	

Write Single Coil [FC = 05]

Binary information, commands from the central station are only transmitted to the substations as “single point information”. The query message contains the data point address and the state.

Station address [Slave Address]	1 to 247 (broadcast not supported)
Function code [Function Code]	05 (Write Single Coil)
Data point address [Coil Address]	0 to 65535
State [Write Data]	0x00 = OFF; 0xFF = ON

Write (Write Request) Example: Writing of the address 173 in slave 17 with function code 05.			
Field name	**Example [HEX]**	**Example [DEC]**	**Description**
Slave Address	11	17	
Function Code	05	05	
Coil Address Hi	00	00	
Coil Address Lo	AC	172	
Write Data Hi	FF	255	ON
Write Data Lo	00	00	
Error Check (CRC16)	xx,xx	xx,xx	

Response (Response Message) Example: Response to the writing of the address 173 in slave 17 with function code 05.			
Field name	**Example [HEX]**	**Example [DEC]**	**Description**
Slave Address	11	17	
Function Code	05	5	
Coil Address Hi	00	0	
Coil Address Lo	AC	172	
Write Data Hi	FF	255	ON
Write Data Lo	00	0	
Error Check (CRC16)	xx,xx	xx,xx	

With station-selective addressing the content of the query message is sent back by the substation as response to the central station.

Write Single Register [FC = 06]

Measured values and setpoint values are transmitted from the central station (Modbus RTU Master) to the substations with the message Write Single Register. The query message contains the data point address and the state. A maximum of 1 value is transmitted per message.

Station address [Slave Address]	1 to 247 (broadcast not supported)
Function code [Function Code]	06 (Write Single Register)
Data point address [Register Address]	0 to 65535

Write (Write Request) Example: Write the value 0003 into the register 0x0002 of the substation 17 with function code 06.			
Field name	**Example [HEX]**	**Example [DEC]**	**Description**
Slave Address	11	17	
Function Code	06	6	
Register Address Hi	00	0	
Register Address Lo	01	1	
Preset Data Hi	00	0	
Preset Data Lo	03	3	
Error Check (CRC16)	xx,xx	xx,xx	

Response (Response Message) **Example: Response to writing the value 0003 into the register 0x0002 of the substation 17 with function code 06.**			
Field name	**Example [HEX]**	**Example [DEC]**	**Description**
Slave Address	11	17	
Function Code	06	6	
Register Address Hi	00	0	
Register Address Lo	01	1	
Preset Data Hi	00	0	
Preset Data Lo	03	3	
Error Check (CRC16)	xx,xx	xx,xx	

With station-selective addressing the content of the query message is sent back by the substation as response to the central station.

NOTE

Modbus RTU (Master, Slave) in SICAM A8000 does not support double register values (as e.g. FLOAT32, INT32, UINT32) with function code = 06 Write Single Register!

Write Multiple Coils [FC = 15]

Multiple binary information / command states can be transmitted from the central station (Modbus RTU Master) to the substations with one message. Specified in the query message is the 1st data point address, the number of coils to be written and the status of every individual coil.
(Coil 1 is addressed with "0").

Station address [Slave Address]	1 to 247 (broadcast not supported)
Function code [Function Code]	15 (Write Multiple Coils)
Data point address [Coil Address]	0 to 65535
Number of Coils [Quantity of Coils]	1 to 2 Restriction with Modbus RTU Master: With FC = 15 only 1 single command (= 1 coil) resp. 1 double command (= 2 coils) can be transmitted!
State [Write Data]	0 = OFF; 1 = ON (1 bit per coil state)

Write (Write Request) **For example: Write 10 coils with the data 0xCD01 from coil address 20 in the slave 17 with function code 15.**			
Field name	**Example [HEX]**	**Example [DEC]**	**Description**
Slave Address	11	17	
Function Code	0F	15	
Coil Address Hi	00	0	
Coil Address Lo	13	19	
Quantity of Coils Hi	00	0	
Quantity of Coils Lo	0 A	10	
Byte Count	02	2	
Write Data Hi (Coils 27-20)	CD	205	`Bit:  1  1  0  0  1  1  0  1 | 0  0  0  0  0  0  0  1` `Coil: 27 26 25 24 23 22 21 20 | -- -- -- -- -- -- 29 28`

Write (Write Request) For example: Write 10 coils with the data 0xCD01 from coil address 20 in the slave 17 with function code 15.			
Field name	**Example [HEX]**	**Example [DEC]**	**Description**
Write Data Lo (Coils 29-28)	01	1	
Error Check (CRC16)	xx,xx	xx,xx	

Response (Response Message) Example: Response for write request of 10 coils with the data 0xCD01 from coil address 20 in the slave 17 with function code 15.			
Field name	**Example [HEX]**	**Example [DEC]**	**Description**
Slave Address	11	17	
Function Code	0F	15	
Coil Address Hi	00	0	
Coil Address Lo	13	19	
Quantity of Coils Hi	00	0	
Quantity of Coils Lo	0 A	10	
Error Check (CRC16)	xx,xx	xx,xx	

Write Multiple Registers [FC = 16]

Multiple consecutive 16-bit register values can be transmitted from the central station (Modbus RTU Master) to the substations with one message. Specified in the query message is the 1st Data point address (Number of location), the number of registers to be written and the register status.

Station address [Slave Address]	1 to 247 (broadcast only with time synchronization)
Function code [Function Code]	16 (Write Multiple Registers)
Start address [Starting Address]	0 to 65535
Number of registers [No. of Registers]	1 to 2 Restriction with Modbus RTU Master: With FC=16 only 1 value can be transmitted (e.g. 1 Register with INT16/UINT16 or 2 Register with Float, INT32/UINT32). Exception: With time synchronization via Modbus, all required registers are transmitted in one message with FC = 16.

Write (Write Request) Example: Write 2 registers in slave 17 with function code 16 from register address 0x0002 with 00 0A and 01 02.			
Field name	**Example [HEX]**	**Example [DEC]**	**Description**
Slave Address	11	17	
Function Code	10	16	
Starting Address Hi	00	0	
Starting Address Lo	01	1	
Number of Registers Hi	00	0	
Number of Registers Lo	02	2	
Byte Count	04	4	
Data Hi	00	0	
Data Lo	0 A	10	
Data Hi	01	1	

Write (Write Request) Example: Write 2 registers in slave 17 with function code 16 from register address 0x0002 with 00 0A and 01 02.			
Field name	**Example [HEX]**	**Example [DEC]**	**Description**
Data Lo	02	2	
Error Check (CRC16)	xx,xx	xx,xx	

Response (Response Message) Example: Respones to writing 2 registers in slave 17 with 00 0A and 01 0" from register address 0x0002.			
Field name	**Example [HEX]**	**Example [DEC]**	**Description**
Slave Address	11	17	
Function Code	10	16	
Starting Address Hi	00	0	
Starting Address Lo	01	1	
Number of Registers Hi	00	0	
Number of Registers Lo	02	2	
Error Check (CRC16)	xx,xx	xx,xx	

Exception Response

If a substation has not implemented the query data from the central station or the queried data is not available, an exception code (exception response) is transmitted instead of the data (response message).

Supported Modbus Exception Codes:

Exception code	Modbus designation	Description	MODMI0 [312]	MODSI0
01	Illegal Function Code	The function code is not known to the computer.	✓	✓
02	Illegal Data Address	Modbus register/coil address not supported.	✓	✓
03	Illegal Data Value	Illegal data for the Modbus register.	✓	–
04	Server failure	The server failed during execution.	✓	✓[313]
05	Acknowledge	The Server has accepted the service call, but the service takes a relatively long time to execute. The Server therefore only sends back a confirmation of the service call confirmation.	✓	–
06	Server busy	The Server could not accept the requests. The Client must decide if and when the request should be sent again.	✓	–
08	Memory Parity Error	Parity error detected in memory.	–	–

312 The exception codes are not specially evaluated by the Modbus RTU master - a received exception code is rated as negative acknowledgment.

313 Only with activated parameter for data points marked faulty

Exception code	Modbus designation	Description	MODMI0 [312]	MODSI0
10	Gateway problem	Gateway path not available.	✓	–
11	Gateway problem	The addressed substation does not respond. This exception is generated by the gateway.	✓	–

NOTE

- If the query of the Modbus TCP Master is answered with an Exception Response, then the queried data is emulated by the Modbus RTU Master as invalid (NT = 1 "not topical").
- The Modbus RTU Master does not do any retries.
- The exception codes are not specially evaluated by the Modbus RTU master - a received exception code is rated as negative acknowledgment.

13.7.5.3 Data acquisition by querying

The transmission of the data from the remote terminal units to the master station takes place by means of station-selective station interrogations (interrogation procedure, polling) of the parameterized Modbus addresses, controlled by the master station.

The master station performs a cyclic interrogation of the data (Modbus coils/register values) from the remote terminal units (Query/Response Cycle).

Call Procedure (Query/Response Cycle)

A Modbus TCP data transmission sequence will be initiated by the master station. A data transmission sequence consists either of a "Request/Response Service" or of a "Send/Confirm Service" to a selective addressed remote terminal unit (Slave) by IP-address/unit identifier.

The Protocol element for Modbus TCP master does not support broadcast addressing!

The requests (Read Registers/Read Coils) or data messages (Write Registers/Write Coils) provided for the Modbus communication protocol are transmitted from the master station. Data from the remote terminal unit to the master station can only be transmitted as a response to a request.

In contrast to the protocol Modbus "serial"- that establishes connections over serial interfaces - the protocol Modbus TCP enables the communication over networks (Local Area Network "LAN" and Wide Area Network "WAN"). Thereby common network components such as switches and routers can be used.

The Modbus protocol element uses a Modbus oriented data base (Registers, Coils). Every message represents one or multiple data points, such as e.g. one/multiple measured value(s), setpoint value(s), command(s) or alarm(s). Thereby the data are addressed with the Modbus function code, Modbus register address, bit position in the Modbus register or with the Coil address.

The address then determines which signal is concerned, i.e. transmitter and receiver must know the meaning of the address.

The Modbus protocol does not define the data formats in the Modbus registers!

For the transmission of data a "TCP Connection" is established between 2 participating stations.

With Modbus TCP the master is the"Connector" (... the connector establishes a TCP/IP connection) and the Slave is "Listener".

Prioritization of the data transmission with Modbus

The prioritization of the data to be sent or interrogated is only carried out by the master station. The remote terminal unit (Slave) receives the data written in the Modbus register or Coils and answers the interrogations by the master station with the data stored in the Modbus registers or Coils.

[312] The exception codes are not specially evaluated by the Modbus RTU master - a received exception code is rated as negative acknowledgment.

With Modbus normally the interrogation of the data is always performed sequentially i.e. a further Request/Response interrogation sequence is only started when the previous Request/Response sequence is concluded.

Depending on the case of application the master station can transmit a further message immediately following reception of a valid response message from a remote terminal unit or with “lack of a response” after a configurable TIMEOUT.

Parallel Polling (number of max. Server polled at the same time)

The protocol element for Modbus TCP master uses a so-called parallel polling for querying Modbus registers/coils for real Modbus TCP slaves (i.e. Modbus slaves with integrated TCP/IP interface). With this procedure, Modbus queries are sent to several substations immediately one after the other and the responses from the slaves are then waited for. This considerably increases the performance of the data query of the Modbus master.

The parallel polling is only carried out for Modbus stations with a unique IP address. Up to a maximum of 5 requests (one request each) are sent to the next 5 Modbus TCP slaves. Then the response is waited for.

As soon as a response is received, the next request is sent (i.e. a maximum of 5 responses are pending).

Parallel polling is not used for Modbus stations with the same IP address, as several serial Modbus slave devices are usually connected to the Modbus TCP via a serial Ethernet converter.

Delay between 2 queries (Polling Delay)

Some Modbus devices only allow a limited number of queries within a specified time. This limitation is typically indicated by “polling delay between 2 query”.

The Modbus master sends a new interrogation or a new message to a Modbus substation only after the expiry of the set “Polling Delay” time.

The delay time must be parameterized in the **`Polling Delay`** field in the parameter **`Connection definition`** for each station. This does not affect the query of other stations.

Device	MODBUS station (internal)	Station enable	Station failure	Remote IP address	TCP port number	Station type	MODBUS unit-ID	Addressing MODBUS standard	Network connection	Polling delay	Redundancy
A + B	0	yes	notify	192.168.1.1	0	general	255	yes	LAN (MODBUS default)	0	redundant connection
A + B	1	yes	notify	192.168.1.2	0	general	255	yes	LAN (MODBUS default)	0	redundant connection
A + B	2	yes	notify	192.168.1.3	0	general	255	yes	LAN (MODBUS default)	0	redundant connection
A + B	3	yes	notify	192.168.1.4	502	general	200	yes	LAN (MODBUS default)	1	redundant connection
A + B	5	yes	notify	192.168.1.4	503	general	201	no	LAN (MODBUS default)	1	redundant connection

[DM_MBCiI0_Polling_Delay, 2, en_US]

Data exchange with Modbus TCP

- Data in the transmit direction (Master → Slave) are transmitted spontaneously. Prioritization of the data: 1:1 to the request of the data from the Register-/Coils
- Data in receive direction (Master ← Slave) are only transmitted in case of interrogation. The query of the register data/coils from the slaves is controlled by the master.

Possible selection for query cycle:

`<Basic cycle>` .... Query of the data in the basic cycle

`<Query cycle-1>` .... Query of the data in the query cycle 1

`<Query cycle 2>` .... Query of the data in the query cycle 2

`<Query cycle 3>` .... Query of the data in the query cycle 3

`<Query cycle 4>` .... Query of the data in the query cycle 4

The query cycle is defined for each data point in the message conversion.

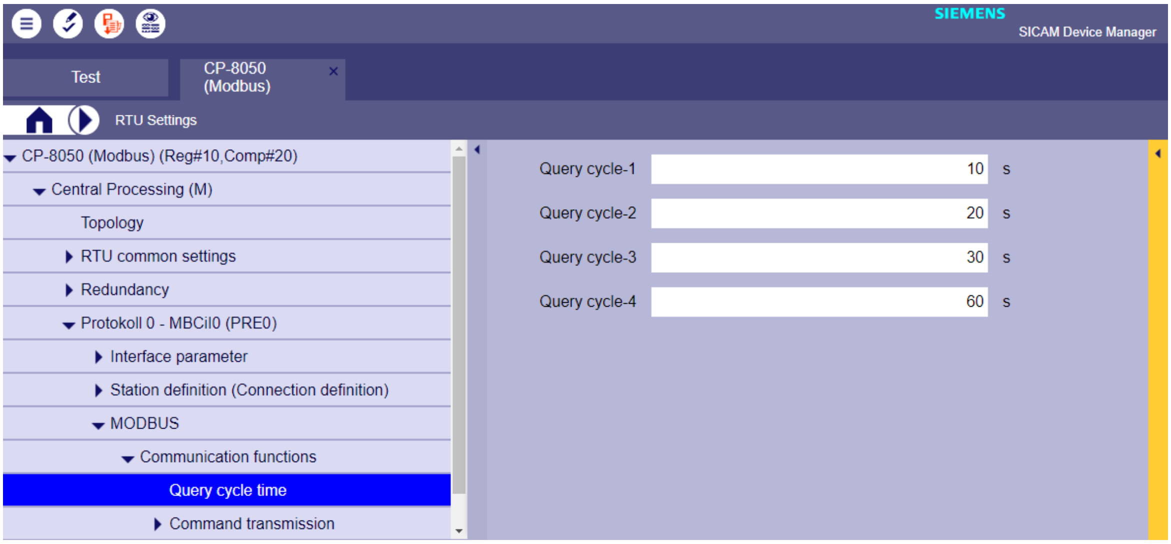
<u>Basic cycle</u>

In the basic cycle, the important data are queried that should be updated as quickly as possible. If it is not necessary to continuously query important data in the basic cycle, the data can be queried in slower query cycles (query cycle 1-4).

Query cycle-1..4

Query of the parameterized data in the adjustable time frame. The time grid for querying cycle times 1-4 must be set with the parameters **`[PRE] MODBUS | Communication functions | Cycle time query | Parameterize cycle 1..4`**.

Possible: 10 Sec – 3600 Sec.



[MBCil0_DM_Abfrage_Zykluszeit, 1, en_US]

If several data are to be queried at a query cycle, these are queried one after the other.

With the different times of the query cycles 1-4, unimportant data can be queried less often (e.g .: Query of certain data only 1x per minute or 1x / hour). This means that the important data - if available - can be queried more often in the basic cycle.

Modbus master - polling cycle control

- The Modbus master controls the query of the Modbus data.
- If data is assigned to the basic cycle, the query is carried out permanently.
- If no data are assigned to the basic cycle, the query is only carried out if a query of the data is triggered by query cycle 1-4.
- Only one Modbus query is carried out per Modbus station; the next query is sent to the next higher Modbus station number.
- For each Modbus query, several Modbus registers/coils are queried if the Modbus addresses are in ascending order and there is no address gap between them.
- The Modbus addresses are processed in ascending order for each station.
- Modbus addresses that are not assigned to the basic cycle are only queried in the basic cycle if the query of the data is triggered by the query cycle 1-4. The Modbus registers/coils are always queried in ascending order of the Modbus addresses. Modbus addresses that were activated by query cycle 1-4 are not placed in front, but rather queried when it is the turn of the Modbus address in the basic cycle.

Example: *"Modbus master - polling cycle control"*

The following Modbus register addresses should be queried:

Modbus Register/Coil	Modbus Station #1		Modbus Station #2		Modbus Station #3	
Modbus Register Address	40000	B	50000	B	40000	B
	40001	B	50001	B	40001	B
	40002	B	50002	B	40002	B
	40003	B	50003	B	40003	B
	40004	B	50004	B	40004	B
	40005	Z1	50005	B	40005	Z1
	40010	Z1			40010	Z1
	40011	Z1			40011	Z1
	40100	Z2			40100	Z2
	40500	B			40500	B

Query sequence by Master:

		Query by Master:	Note
1.	1	Station#1: Modbus Address [40000 - 40004]	
2.		Station#2: Modbus Address [50000 - 50005]	
3.		Station#3: Modbus Address [40000 - 40004]	
4.	2	Station#1: Modbus Address (40500)	
5.		Station#2: Modbus Address [50000 - 50005]	
6.		Station#3: Modbus Address (40500)	Station#1: Query cycle Z2 is triggerd
7.	3	Station#1: Modbus Address [40000 - 40004]	Station#3: Query cycle Z1 is triggerd
8.		Station#2: Modbus Address [50000 - 50005]	
9.		Station#3: Modbus Address [40000 - 40004]	
10.	4	Station#1: Modbus Address (40100)	
11.		Station#2: Modbus Address [50000 - 50005]	
12.		Station#3: Modbus Address (40005)	
13.	5	Station#1: Modbus Address (40500)	
14.		Station#2: Modbus Address [50000 - 50005]	
15.		Station#3: Modbus Address [40010 - 40011]	
16.	6	Station#1: Modbus Address [40000 - 40004]	
17.		Station#2: Modbus Address [50000 - 50005]	
18.		Station#3: Modbus Address (40500)	
19.	7	Station#1: Modbus Address (40500)	
20.		Station#2: Modbus Address [50000 - 50005]	
21.		Station#3: Modbus Address [40000 - 40004]	
22.	8	Station#1: Modbus Address [40000 - 40004]	
23.		Station#2: Modbus Address [50000 - 50005]	
24.		Station#3: Modbus Address (40500)	

Continuous Interrogation of a Remote Terminal Unit

The “Continuous interrogation of a remote terminal unit” by the master station following the transmission of certain data (e.g. commands or setpoint values) to the remote terminal unit is not supported.

13.7.5.4 Acknowledgment Procedure

All query or data messages that are selectively sent to a substation must be answered by the substation with a response message.

If the response message is not received for longer than the response timeout when the transmission line is not disturbed, then the station is marked as failed in the Modbus TCP stations, or retries are performed in the case of serial substations which are connected to Modbus TCP via a serial Ethernet converter. With retries, the telegrams sent by the master are repeated up to n times (can be parameterized) (= number of retries). After expiry of the Retry number the station is marked as failed.

Retries to a remote terminal unit are transmitted immediately one after the other after expiry of the expected acknowledgement time. I.e. no other remote terminal units are interrogated while a Retry handling is in progress.

Messages transmitted from a remote terminal unit are not acknowledged by the master station.

The “Response Timeout” is set on the protocol element of the central station with the parameter **`[PRE] interface parameter | Network connection | * | MODBUS parameters | Response timeout`**.

The number of retries is set on the protocol element of the central station with the parameter **`[PRE] interface parameter | Network connection | LAN (serial converter #) | MODBUS parameters | Number of retries`**.

Failure Monitoring

The monitoring of the interface by the active master station takes place by means of the cyclic interrogation procedure of the parameterized Modbus register. A communication fault is only reported for failed remote terminal units if this is parameterized accordingly in the parameter “station failure” of the station definition.

Failed remote terminal units continue to be interrogated by the central station by means of the interrogation procedure, however no message repetition (Retry) is carried out during the station interrogation for such remote terminal units.

When the remote terminal unit replies again with the requested register values, the station failure is reset.

Station Initialization

The Modbus protocol does not define any special procedure for station initialization. After startup or redundancy switchover the polling cycle will be started.

Device-specific initialization sequences are not supported by the Modbus master station in SICAM A8000!

13.7.5.5 Acquisition of events (transmission of data ready to be sent)

Data ready to be sent in the master station can either be transmitted to the remote terminal unit spontaneously when they occur or cyclically (or cyclic + spontaneous).

With spontaneous transmission the data are prioritized 1:1 to the cyclic interrogation of the configured Modbus addresses. I.e. after spontaneous transmission the polling cycle will be continued.

With cyclic transmission the data to be transmitted are stored temporarily in the process image on the protocol element of the central station. The transmission takes place cyclically in the interrogation cycle.

The transmission takes place cyclically in the interrogation cycle.

Spontaneous data for sending are not stored in protocol element internal data base for Modbus.

With a failure of the communication to a remote terminal unit, on the protocol element of the master station the fetching of data from the basic system element is disabled but the cyclic transmission of data to the failed RTU is not stopped.

The data are saved in the data storage of the communication function on the basic system element (BSE) until they are deleted by the dwell time monitoring or can be transmitted to the remote station.

After a going interface fault the fetching of data from the basic system element is enabled again and the saved data transmitted by the protocol element according to the prioritization.

NOTE

The protocol element for Modbus TCP master in SICAM A8000 does not support procedures for the transmission of events (event queues)!

Message from the Remote Terminal Unit to the Master Station

Messages from the remote terminal unit to the master station are only transmitted with station interrogation.

A quick-check procedure for speeding up the transmission of data is not implemented.

13.7.5.6 General interrogation, substation interrogation

The general interrogation function (RTU interrogation) is used for updating the master station after startup, redundancy switchover or after communication error.

The Modbus protocol does not define any GI concept!

With a general interrogation within SICAM A8000, all parameterized data are queried by the Modbus TCP master from the connected Modbus slaves.

The received data is handled without change monitoring and the current status of the data is queried with the cause of transmission <COT=20> "by station query " and passed on to the basic system element.

The general interrogation command is always internally transmitted to the PRE by the BSE in SICAM A8000 on a "station specific" basis.

- The protocol element for Modbus TCP master only supports the general interrogation command "global".
- A general interrogation command for GA groups is not supported!
- The protocol element for Modbus TCP does not send ACTCON / ACTTERM for the general interrogation command!
- The protocol element does not reproduce any GA data for failed stations.

13.7.5.7 Clock Synchronization

The Modbus TCP protocol does not define any procedures for clock synchronization.

The Modbus TCP master ("Client") in SICAM A8000 supports time synchronization of the connected Modbus slaves via:

- Time synchronization via Modbus register

Time synchronization via Modbus register

The clock synchronization of Modbus Slaves devices is performed spontaneous or cyclic controlled by the Modbus master station with station selective Modbus message using FC = 16 (WRITE MULTIPLE REGISTERS).

The message format for clock synchronization is free definable (with supported time elements) via parameter for each single MODBUIS Slave.

Clock Synchronization can be done at following Time:

- spontaneous (initiated by command <TI:=45>)
- cyclic every 1 minute (offset = 0 s)
- cyclic every 1 minute (offset = 30 s)
- cyclic each 5th Minute (offset = 0 s)
- cyclic each 10th Minute (offset = 0 s)
- cyclic each 30th Minute (offset = 0 s)
- cyclic each 60th Minute (offset = 0 s)

- after AU internal clock synchronization
- after going communication failure

Supported time elements:

Time element [Byte]	Value Range	Example
Not used	Dummy: UI8 [7 to 0] <0>	
year (high)	year (high) [7 to 0] <0 to 255>	year = 2016 = 07E0 [HEX] → year (high) = 0x07 [HEX]
year (low)	year (low) [7 to 0] <0 to 255>	year = 2016 = 07E0 [HEX] → year (low) = 0xEX [HEX]
year - 2000 (high)	year 2000 (high) [7 to 0] <0 to 255>	year = 2016 → 2016 - 2000 = 16 = 0x0010 [HEX] → year - 2000 (high) = 0x00 [HEX]
year - 2000 (low)	year 2000 (high) [7 to 0] <0 to 255>	year = 2016 → 2016 - 2000 = 16 = 0x0010 [HEX] → year - 2000 (low) = 0x10 [HEX]
Month	Month [7 to 0] <1 to 12>	month = 12 (december) → month = 0x0C [HEX]
Day	Day [7 to 0] <1 to 31>	day = 23 → day = 0x17 [HEX]
Day of week	Day of week [7 to 0] <1 to 7> <1> = Monday; <2> = Tuesday; ... <7> = Sunday	Day of week = Tuesday → Day of week = 0x02 [HEX]
day + day of week	Day [4 to 0] <1 to 31> Day of week [7 to 5] <1 to 7> <1> = Monday; <2> = Tuesday; ... <7> = Sunday	
Hour	Hour [7 to 0] <0 to 23>	hour = 21 = 0x15 [HEX]
hour + SU	Hour [4 to 0] <0 to 23> summer time (SU) [7] <0, 1> SU <0> = standard time (winter time) SU <1> = summer time	
Minute	Minute [5 to 0] <0 to 59>	minute = 59 = 0x3B [HEX]
minute + IV	Minute [6 to 0] <0 to 59> Invalid (IV) [7] <0, 1> IV <0> = valid IV <1> = invalid	
second	second [7 to 0] <0 to 59>	second = 32 = 0x20 [HEX]
millisecond (high)	millisecond n * 1 ms (high) [7 to 0] <0 to 255> n <0 to 59999> = range including seconds	milliseconds = 998 = 03E6 [HEX] → millisecond (high) = 0x03 [HEX]
millisecond (low)	millisecond n * 1 ms (low) [7 to 0] <0 to 255> n <0 to 59999> = range including seconds	milliseconds = 998 = 03E6 [HEX] → millisecond (low) = 0xE6 [HEX]
ticks (10ms)	millisecond n * 10 ms [7 to 0] <0 to 99>	milliseconds = 998 → Ticks (10 ms) = 99 = 0x63 [HEX]

Time element [Byte]	Value Range	Example
ticks (100ms)	millisecond n * 100 ms [7 to 0] <0 to 99>	milliseconds = 998 → Ticks (100 ms) = 9 = 0x09 [HEX]
EOF (End of Frame)		Note: This time element defines the end of the freely configurable time format - this data byte is no longer sent!

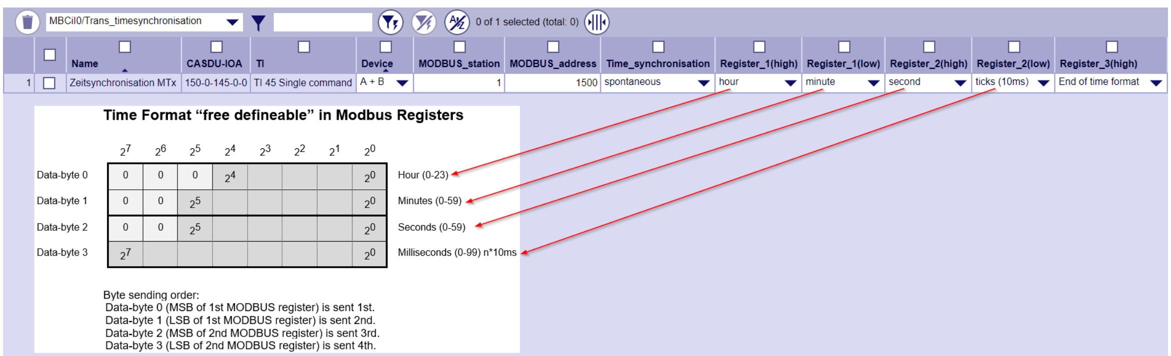
Legend:

[ ] .. Values in square brackets = bit position of the value in the byte

<> .. Values in angle brackets = value range

Free definable Time Synchronization Format (Example)

Time synchronization controlled by <TI:= 5> single command with the address CASDU=150, IOA=145 on the Modbus address 1500.



[MBCiI0_DM_Modbus_Zeitformat, 1, en_US]

13.7.5.8 Command Transmission

Control Location / Check Control Location

The function “Control location” is used so that commands are only output from authorized sources.

If the “control location” function is activated, commands from the protocol element are only transmitted to the substation, when the control location (originator address) is enabled. If the control location is not enabled, the protocol element immediately sends back a negative acknowledgment of activation (ACTCON) to the originator address (further details about setting control location / check control location see section *13.1.4.9 Control location function for commands and setpoint values*).

Messages "To All"

Messages “to all” (acknowledged or unacknowledged) are not supported by the Modbus TCP central station!

13.7.5.9 Transmission of Integrated Totals

The Modbus protocol itself does not define any procedures for counter interrogation.

A counter interrogation command triggered in the SICAM A8000 system is not sent to the Modbus slaves by the protocol element.

The integrated totals are updated cyclically due to the cyclic data exchange between the protocol element and the Modbus TCP slaves.

Forwarding of integrated totals to the basic system element:

- Counter Interrogation
  After a counter interrogation command (SICAM A8000 internal) the integrated totals will be forwarded to the basic system element directly from the protocol element internal process image.

- Cyclic in the parameterized time grid
  After the time grid for cyclic counter values (SICAM A8000 internal) has expired, the counter values are forwarded to the basic system element with the next time they are received.

The sequence number in the counter message is incremented with every counter interrogation message, or with cyclic counter interrogation in the parameterized time grid.
Restrictions:

- The protocol element for Modbus TCP does not send ACTCON / ACTTERM for the SICAM A8000 internal counter interrogation command.
- The protocol element does not reproduce any integrated totals for failed stations.

13.7.6 Parameters and Settings

13.7.6.1 Modbus RTU Master

Parameter Name	Description	Settings
`[PRE] Interface parameter` Note: • The serial interface for the protocol is selected in the SICAM Device Manager under**`Configuration | Firmware`**(see *13.1.4.5 Selection of a serial interface for communication protocols*). • Some parameters may not be displayed until the interface is selected.		
`Baud rate`	Transmission rate in send and receive direction.	Permitted range = 50, 75, 100, 134.5, 150, 200, 300, 600, 1050, 1200, 1800, 2000, 2400, 4800, 9600, 19200, 38400, 56000, 57600, 64000, 115200 bit/s Default setting = 9600
`Data bits`	Number of data bits per byte. [314]	Permitted range = • 7 bits • 8 bits Default setting = 8 bits
`Stop bits`	Number of stop bits per byte. [314]	Permitted range = • 1 bit • 2 bits Default setting = 1 bit
`Parity`	Paritybit per Byte. [314]	Permitted range = • even Parity • odd Parity • no Parity Default setting = even parity

[314] Byte frame for Modbus RTU mode according Modbus standard: 8E1 (1 start bit, 8 data bits, 1 parity bit “even parity”, 1 stop bit) For maximum compatibility with other devices “odd parity”, “no parity” and “2 stop bits” is also supported. With “no parity” 2 stop bits must be used! In old configurations with Modbus RTU mode typically the byte frame 8N2 (8 data bits, no parity, 2 stop bits) is used.

Parameter Name	Description	Settings
`Time settings for transmission facilities`	Selection of the transmission facility. Connection of the transmission facilities as described (additional adapters / cables are sometimes required)	Permitted range = • free definable • direct link interface (RS-232) • direct link interface (RS-485) • direct link interface (RS-422) • direct link interface (RS-485 with CM-08x9) • CM-0821 Ring • CM-0821 Star, CM-0847 Default setting = free definable
`[PRE] Interface parameter | Time settings for free definable interface modem` The time settings are predefined for selected transmission facilities - in addition, the time settings can be freely defined (see *13.1.4.8 Time settings for transmission facilities*).		
`Pause time (tp)`		Default setting = 5 ms
`Set-up time (tv)`		Default setting = 5 ms
`Run out time (tn)`		Default setting = 0 ms
`DCD handling`		Default setting = disabled
`Continuous level monitoring time (tcl)`		Default setting = 10 s
`Transmission delay at level (tcldly)`		Default setting = 0.2 s
`Bounce suppression time (tbounce)`		Default setting = 10 ms
`Disable time (tdis)`		Default setting = 0 ms
`[PRE] Station definition | Station definition`		
`Station number (internal)`	SICAM A8000 internal station number of the remote station. Internally the same station number is used for diagnosis and data routing. Each substation must be assigned a unique station number.	Permitted range = • 0 to 99 • 255 (= not used) Default setting = 255
`MODBUS_Station`	Modbus slave address for communication in accordance with Modbus RTU on the transmission line.	Permitted range = • 0 to 99 • 255 (= not used) Default setting = 255
`Station enable`	Selective remote stations can be prepared or deactivated with setting ***`no`***. Data to "prepared" stations are fetched by the PRE and discarded without an error message (data is not transferred).	Permitted range = • yes • no Default setting = yes
`Station failure`	If a substation fails, the forwarding of the error message can be suppressed with the setting ***`do not report`*** (may be required for special redundancy configurations).	Permitted range = • notify • suppress Default setting = notify

Parameter Name	Description	Settings
Station type	Device-specific special treatments are activated with the station type.	Permitted range = • General • SICAM FCM Default setting = general
Addressing MODBUS standard	Addressing of the Modbus Register/coils during the transmission on the line: • Modbus Address from 0x0000 (Standard) • Modbus Address from 0x0001 Note: The addressing of the Modbus registers is implemented differently depending on manufacturer and must be looked up in the device descriptions! Some manufacturers also specify the Modbus register address on the line in the address list!	Permitted range = • yes • no Default setting = yes
[PRE] MODBUS | Time settings, retries | Retries		
Retries for data message SEND/CONFIRM (station selective)	Retries for data messages (not for acknowledgment message)	Permitted range = 0 to 255 Default setting = 2
[PRE] MODBUS | Time settings, retries | Time settings		
Pause time after broadcast message (tp_bc)	After a broadcast message has been sent, the set pause time is also observed before the transmit signal level (RTS) is switched on again.	Permitted range = 0 to 2.55 s Default setting = 0.1 s
[PRE] MODBUS | Time settings, retries | Monitoring times		
Expected acknowledgment time	After sending a Modbus request message, the Modbus RTU master waits to see whether the response is received within the parameter-ized response timeout (= expected acknowledgment time).	Permitted range = 0 to 655.35 s Default setting = 2 s
Idle monitoring time	After transmission disturbances or message interruption the idle state is monitored. After expiry of the monitoring time the receiver is resynchronized.	Permitted range = 0 to 32767 bits Default setting = 33 bits
Character monitoring time	Message gap monitoring Maximum pause between succes-sive bytes of a message Idle moni-toring time is started after detec-tion of message interruption.	Permitted range = 0 to 32767 Bit Default setting = 33 Bit

Parameter Name	Description	Settings
[PRE] MODBUS | Communication functions | Query cycle time		
Query cycle time-1	The Modbus RTU master can query data in a parameterizable cycle time. The query cycle time is assigned to the data point when parameterizing the data point.	Permitted range = 10 to 3600 s Default setting = 10 s
Query cycle time-2		Default setting = 20 s
Query cycle time-3		Default setting = 30 s
Query cycle time-4		Default setting = 60 s
[PRE] MODBUS | Communication functions | Max. number Register/Coils per request		
Function code 1 (Read Coil Status)	Maximum number of Modbus coils in a Modbus RTU request.	Permitted range = 1 to 127 Default setting = 127
Function code 2 (Read Input Status)	Maximum number of Modbus coils in a Modbus RTU request.	Permitted range = 1 to 127 Default setting = 127
Function code 3 (Read Holding Registers)	Maximum number of Modbus register in a Modbus RTU request.	Permitted range = 1 to 125 Default setting = 125
Function code 4 (Read Input Register)	Maximum number of Modbus register in a Modbus RTU request.	Permitted range = 1 to 125 Default setting = 125
[PRE] MODBUS | Communication functions | Command transmission | Command output time		
Commands without identifier (sek)	Command output time (pulse duration) for commands in transmit direction	Permitted range = 0.1 to 6553.5 s Default setting = 0.5 s
Commands with short output time (sek)	Command output time (pulse duration) for commands in transmit direction	Permitted range = 0.1 to 6553.5 s Default setting = 2 s
Commands with long output time (sek)	Command output time (pulse duration) for commands in transmit direction	Permitted range = 0.1 to 6553.5 s Default setting = 10 s

<table>
<tr><th>Parameter Name</th><th>Description</th><th>Settings</th></tr>
<tr><td colspan="3"><code>[PRE] Data base management</code>
Settings for the data base management on BSE (per PRE) see 13.1.4.14 Data Management on the BSE for Communication Protocols</td></tr>
<tr><td colspan="3"><code>[PRE] Redundancy</code></td></tr>
<tr><td><code>Operation if passive</code></td><td>Behavior of the protocol element in the redundancy state “passive”:
• <code>Interface "ACTIVE"</code>:
– Same behavior as in redundancy state “active”
– The passive master continues to send Modbus requests to the Modbus devices. Received messages are passed on to the BSE and marked with R = 1 by the BSE
• <code>Interface "TRISTATE"</code>:
– The passive master does not send any Modbus data or Modbus request messages
– Received (listened) data is not passed on to the BSE
– Listening mode for global/station selective station failure handling
The redundancy control (active/passive) takes place via the internal redundancy control message.</td><td>Permitted range =
• interface "ACTIVE"
• interface "TRISTATE"
• Default setting = interface "ACTIVE"</td></tr>
<tr><td><code>Delay time passive ⇒ aktive</code></td><td>With redundancy switching from passive → active, the protocol element is switched to active with delay.</td><td>Permitted range =
• 1 to 2000 s
• 0 (= no delay)
Default setting = 0</td></tr>
<tr><td colspan="3"><code>[PRE] Advanced parameters | Software test points</code></td></tr>
<tr><td>...</td><td>The software test points may only be used under the guidance of experts for error detection!
Once the fault isolation is completed, software checkpoints must always be turned off.</td><td>Permitted range =
• yes
• no
Default setting = no</td></tr>
</table>

13.7.6.2 Modbus RTU Slave

Parameter Name	Description	Settings
[PRE] Interface parameter Note: • The serial interface for the protocol is selected in the SICAM Device Manager under**Configuration | Firmware**(see *13.1.4.5 Selection of a serial interface for communication protocols*). • Some parameters may not be displayed until the interface is selected.		
Baud rate	Transmission rate in send and receive direction.	Permitted range = 50, 75, 100, 134.5, 150, 200, 300, 600, 1050, 1200, 1800, 2000, 2400, 4800, 9600, 19200, 38400, 56000, 57600, 64000, 115200 bit/s Default setting = 9600
Data bits	Number of data bits per byte. [315]	Permitted range = • 7 bits • 8 bits Default setting = 8 bits
Stop bits	Number of stop bits per byte. [315]	Permitted range = • 1 bit • 2 bits Default setting = 1 bit
Parity	Paritybit per Byte. [315]	Permitted range = • even Parity • odd Parity • no Parity Default setting = even parity
Time settings for transmission facilities	Selection of the transmission facility. Connection of the transmission facilities as described (additional adapters / cables are sometimes required)	Permitted range = • free definable • direct link interface (RS-232) • direct link interface (RS-485) • direct link interface (RS-422) • direct link interface (RS-485 with CM-08x9) • CM-0821 Ring • CM-0821 Star, CM-0847 Default setting = free definable
[PRE] Interface parameter | Time settings for free definable interface modem Time settings are predefined for selected transmission facilities - in addition, the time settings can be freely defined (see *13.1.4.8 Time settings for transmission facilities*).		
Pause time (tp)		Standard setting = 5 ms
Set-up time (tv)		Standard setting = 5 ms
Run out time (tn)		Default setting = 0 ms
DCD-evaluation		Default setting = disabled

315 Byte frame for Modbus RTU mode according Modbus standard: 8E1 (1 start bit, 8 data bits, 1 parity bit “even parity”, 1 stop bit) For maximum compatibility with other devices “odd parity”, “no parity” and “2 stop bits” is also supported. With “no parity” 2 stop bits must be used! In old configurations with Modbus RTU mode typically the byte frame 8N2 (8 data bits, no parity, 2 stop bits) is used.

Parameter Name	Description	Settings
`Continuous level moni-toring time (tcl)`		Default setting = 10 s
`Transmission delay at level (tcldly)`		Default setting = 0.2 s
`Bounce suppression time (tbounce)`		Default setting = 10 ms
`Disable time (tdis)`		Default setting = 0 ms
`[PRE] Station definition | Station definition`		
`Modbus Slave Address`	Modbus slave address for communication in accordance with Modbus RTU on the transmission line.	Permitted range = 1 to 247 Default setting = 1
`MODBUS-exception code 4`	In the case of disturbed values in the sending direction with NT = 1 or IV = 1, the query can be answered with exception code = 4 (SLAVE DEVICE ERROR) instead of the value-specific identification of disturbed values (last valid status, disturbed value, NAN, ...).	Permitted range = • yes • no Default setting = yes
`Addressing MODBUS standard`	Addressing of the Modbus Register/coils during the transmission on the line. • Modbus Address from 0x0000 (Standard) • Modbus Address from 0x0001 Note: The addressing of the Modbus registers is implemented differently depending on manufacturer and must be looked up in the device descriptions! Some manufacturers also specify the Modbus register address on the line in the address list!	Permitted range = • yes • no Default setting = yes
`[PRE] MODBUS | Communication functions | Initialisation`		
`Startup Delay`	When the BSE is restarted (from Ready), Modbus communication from the Modbus RTU slave is only started after the start-up delay has expired. During the startup delay, the process image for Modbus on the protocol element is updated.	Permitted range = 10 to 65535 s Default setting = 10 s
`[PRE] MODBUS | Communication functions | Command transmission | Command output time`		
`Commands without identi-fier (sek)`	Command output time (pulse duration) for commands in transmit direction	Permitted range = 0.1 to 6553.5 s Default setting = 0.5 s
`Commands with short output time (sek)`	Command output time (pulse duration) for commands in transmit direction	Permitted range = 0.1 to 6553.5 s Default setting = 2 s

Parameter Name	Description	Settings
`Commands with long output time (sek)`	Command output time (pulse duration) for commands in transmit direction	Permitted range = 0.1 to 6553.5 s Default setting = 10 s
`[PRE] MODBUS | Time settings, retries | Monitoring times`		
`Monitoring timeout`	If the Modbus slave is not called by the Modbus master within the call monitoring time, a failure of the interface is signaled in the Modbus slave.	Permitted range = 0 to 255 s Default setting = 30 s
`Idle monitoring time`	After transmission disturbances or message interruption the idle state is monitored. After expiry of the monitoring time the receiver is resynchronized.	Permitted range = 0 to 32767 Bit Default setting = 33 bit
`Character monitoring time`	Message gap monitoring Maximum pause between successive bytes of a message Idle monitoring time is started after detection of message interruption.	Permitted range = 0 to 32767 Bit Default setting = 33 bit
`[PRE] Data base management` Settings for the data base management on BSE (per PRE) see *13.1.4.14 Data Management on the BSE for Communication Protocols*		
`Operation if passive`	Behavior of the protocol element in the redundancy state “passive”. • ***`Interface "active", normal operation`***: – Same behavior as in redundancy state “= active” – Modbus requests are further answered – Received data is passed on to the BSE and marked with R = 1 by the BSE. • ***`Interface "standby"`***: – The electrical interface is switched to “tristate” – Modbus requests are not answered The redundancy control (active/passive) takes place via the internal redundancy control message.	Permitted range = • interface “active”, normal operation • interface “standby” Default setting = interface “active” normal operation
`Delay time passive ⇒ active`	With redundancy switching from passive → active, the protocol element is switched to active with delay.	Permitted range = • 1 to 2000 s • 0 (= no delay) Default setting = 0

Parameter Name	Description	Settings
`[PRE] Advanced parameters | Software test points`		
...	The software test points may only be used under the guidance of experts for error detection! Once the fault isolation is completed, software checkpoints must always be turned off.	Permitted range = • yes • no Default setting = no

13.7.7 Redundancy

To increase availability, devices (control center, substation) can be designed redundantly. In this section, the possible redundancy concepts themselves that can be realized are not described, rather only those functions supported by the protocol for the support of redundant communication routes.

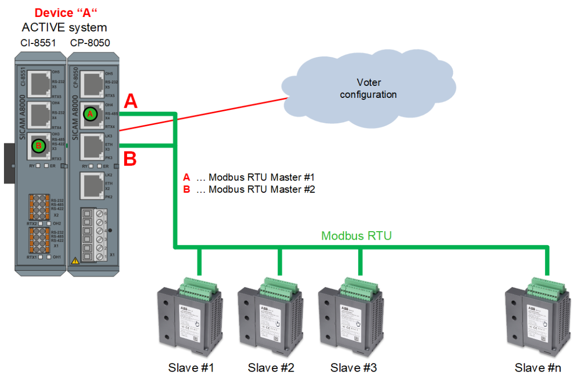
The redundancy control is implemented on the basic system element and is controlled by system functions or a user program.

The function with redundancy is determined by different parameters.

Redundancy	MODMI0	MODSI0
Protocol redundancy	✓	✓
Call operation when passive	✓	–
Tristate of RS-232 interface if passive	✓	✓
Listening mode (for global/selective station failure handling)	✓	–
Listening mode (for Data)	–	–
Protocol function in redundancy state “passive” – normal operation (RS-232 = “active”)	✓	✓
Protocol function in redundancy state “passive” – listening mode (RS-232 = “Tristate”)	✓	✓
Device redundancy	✓	✓
Device redundancy with the same PRE parameters	✓	✓
Device Redundancy with different PRE-Parameter (“A/B-Parameter”)	–	–
Device Redundancy with different PRE-Parameter (“A/B-Parameter”) for signals	✓	✓

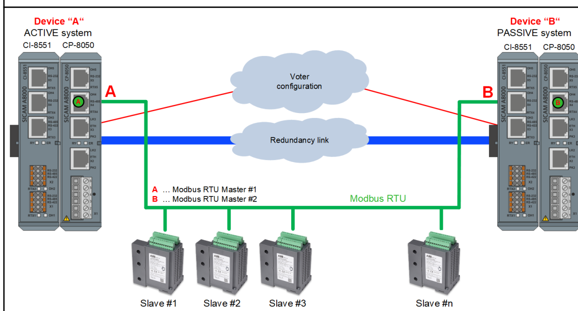
13.7.7.1 Modbus RTU Master: Protocol redundancy

The protocol redundancy increases the availability in the event of failure of a CP-8050 interface or failure of a CP-8050 device.

<table>
<tr><th>Supported configurations</th><th>Description</th></tr>
<tr><td>


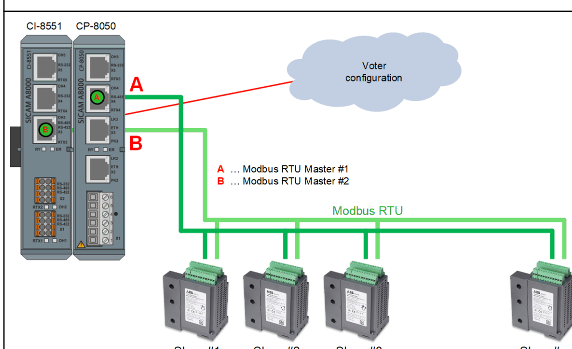
</td><td>
Redundant interfaces in the central station

Modbus devices (slaves) have a Modbus interface.
Interfaces in the central station are redundant.
The Modbus master protocol sends the Modbus requests via the active interface.
The passive Modbus master monitors the Modbus devices (slaves) for failure in listening mode.
The passive Modbus master does not support listening mode for Modbus data.
If the active interface fails, the redundant interface becomes active.
Only 1 interface may be active for proper function - the redundant interface must be passive.

</td></tr>
<tr><td>


</td><td>
Redundant devices in the central station

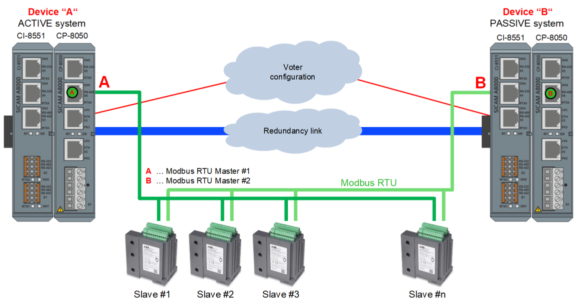
Modbus devices (slaves) have one Modbus interface.
Devices in the central station are redundant.
The Modbus master protocol in the active device sends the Modbus requests via the active interface.
The Modbus master in the passive device monitors the Modbus devices (slaves) for failure in listening mode.
The passive Modbus master does not support listening mode for Modbus data.
If the active interface or the active device fails, the redundant device becomes active.
Only 1 device may be active for proper function - the redundant device must be passive.

</td></tr>
<tr><td>


</td><td>
Redundant interfaces in the central station

Modbus devices (slaves) have 2 independent Modbus interfaces.
Interfaces in the central station are redundant.
Both Modbus master protocols are active.
Received data on the passive interface are marked with R=1 on the BSE.

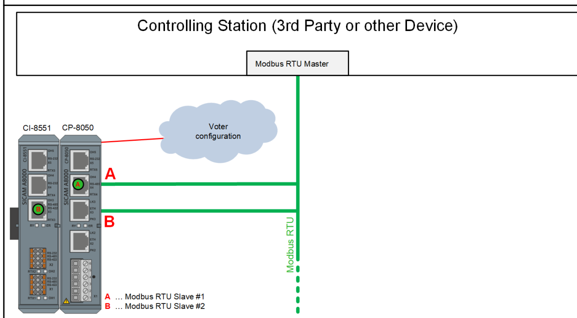
</td></tr>
</table>

<table>
<tr><th>Supported configurations</th><th>Description</th></tr>
<tr><td>


</td><td>

Redundant devices in the central station

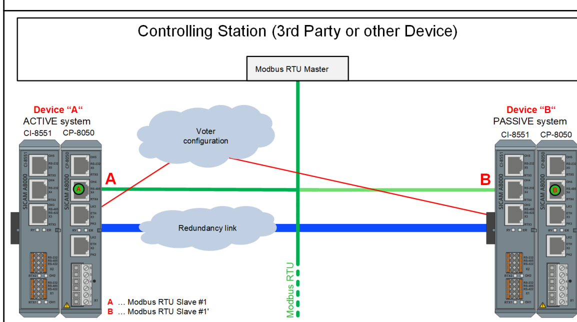
- Modbus devices (slaves) have 2 independent Modbus interfaces.
- Devices in the central station are redundant.
- Both Modbus master protocols are active.
- Received data from the redundant device are marked with R = 1 on the BSE.

</td></tr>
<tr><td>


</td><td>

Redundant interfaces in the remote station

- Central station with Modbus master only has 1 interface.
- Modbus interfaces in CP-8050 as Modbus device (slave) are redundant. (= 2 independent Modbus interfaces).
- Both Modbus slave interfaces have the same Modbus station address.
- The redundancy control (voter) in the CP-8050 as Modbus device (slave) decides, which interface is active.
- Modbus requests from the master are only answered by the active interface.
- Only 1 interface may be active for proper function - the redundant interface must be passive.
- Received data from the passive interface are marked with R=1 on the BSE.

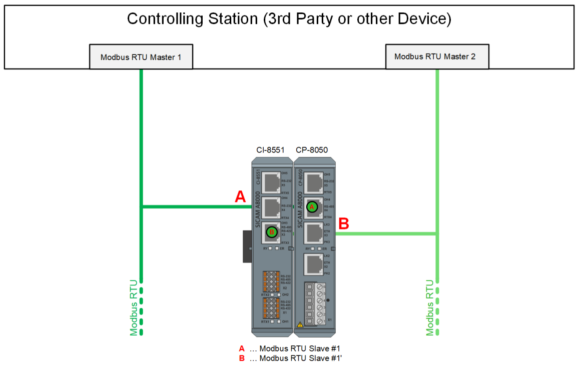
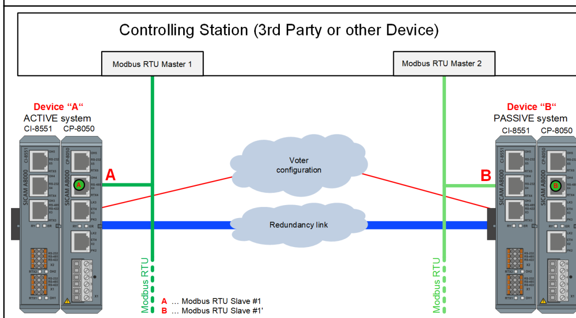
</td></tr>
<tr><td>


</td><td>

Redundant devices in the substation

- Central station with Modbus master only has 1 interface.
- CP-8050 as Modbus device (slave) are redundant (= 2 independent Modbus interfaces).
- Both Modbus slave interfaces have the same Modbus station address.
- Redundancy control (voter) in the CP-8050 as Modbus device (slave) decides which device is active.
- Modbus requests from the master are only answered by the active Modbus device (slave).
- For a properly function, only 1 device may be active - the interface in the redundant device must be passive.
- Received data from the passive interface are marked with R=1 on the BSE.

</td></tr>
</table>

Supported configurations	Description
	**Redundant interfaces in the remote station** • Central station with Modbus master has 2 independent interfaces. • CP-8050 as Modbus device (slave) has 2 independent Modbus interfaces. • Depending on the functionality of the central station, both or only one Modbus master interface can be active. • Modbus requests are only answered at the interface where the request was received.
	**Redundant devices in the substation** • Central station with Modbus master has 2 independent interfaces. • Devices in the remote station are redundant. • Modbus interfaces in CP-8050 as Modbus device (slave) are independent. • Depending on the functionality of the central station, both or only one Modbus master interface can be active. • Modbus requests are only answered at the interface where the request was received.

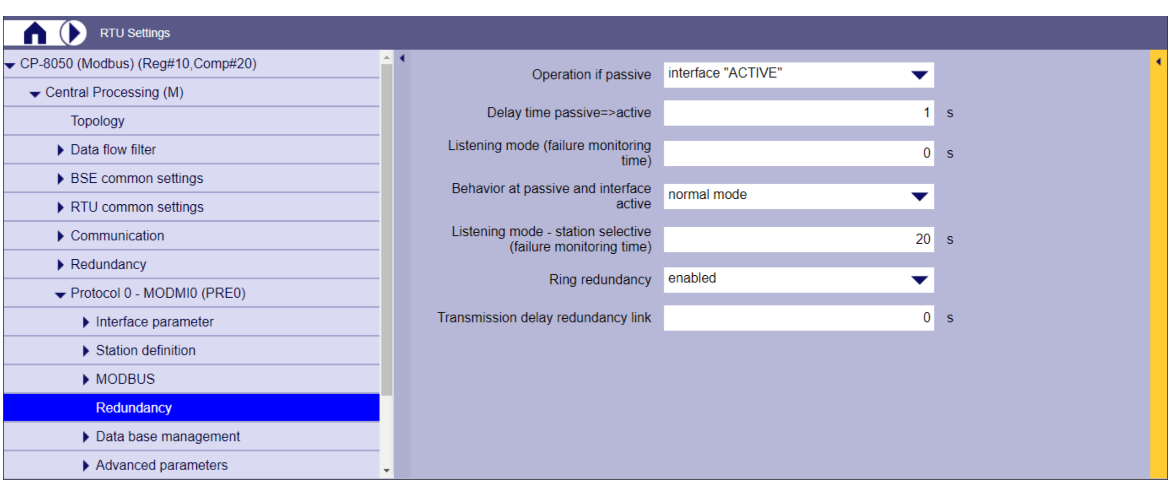
The switchover of the redundancy status takes place within the device by means of redundancy control telegrams.

With parameter **`[PRE] Redundancy | delay time passie ⇒ aktive`** a delay in switching the redundancy state from PASSIVE (= STANDBY) to ACTIVE can be set.

During the delay time the previously active station can perform an orderly termination of the active state.

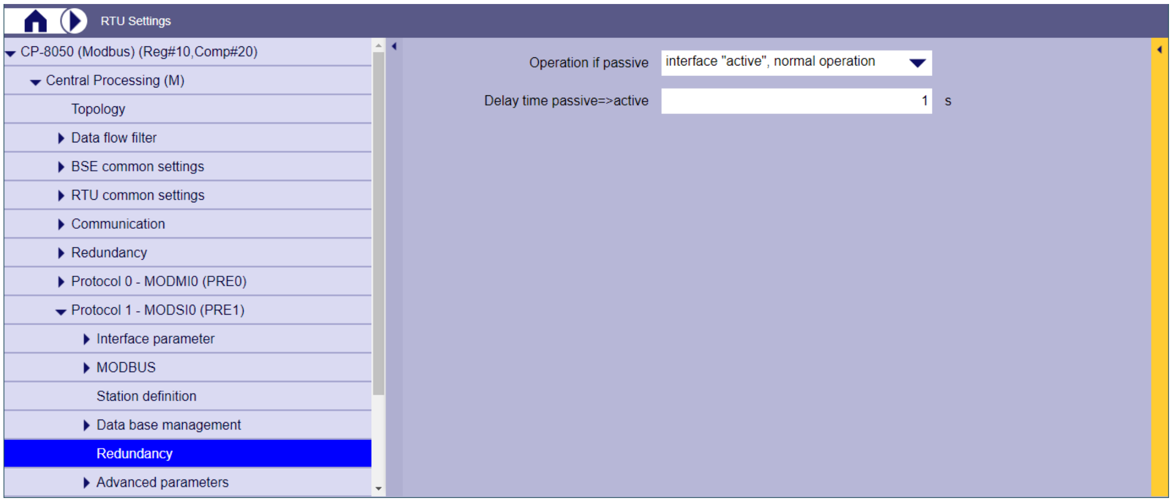
The operating mode of the interface with redundancy state PASSIVE can be set according to redundancy configuration with the parameter **`[PRE] Redundancy | Operation if passive`** as follows:

- Interface TRISTATE
- Interface ACTIVE



[MODMI0_DM_Redundanz, 1, en_US]

Figure 13-14 Modbus RTU Master: Redundancy Parameter



[MODSI0_DM_Redundanz, 2, en_US]

Figure 13-15 Modbus RTU Slave: Redundancy Parameter

Behavior of the master station/remote terminal unit with PASSIVE and interface = TRISTATE

- No messages are sent from the master station/remote terminal unit.
- Listened messages are not forwarded to the basic system element (BSE).
- The failure of the interface is detected by the master station globally or station-selective by monitoring for cyclic message reception.

The monitoring time for the station-selective failure monitoring is set with the parameter **`[PRE] Redundancy | listening mode (failure monitoring time)`**.

With reception timeout (active master station, RTU or a transmission facility has failed) the entire interface or the selective station is signaled as failed.

The reception timeout is retriggered by faultless Modbus messages with function code 1,2, 3, 4 if the message is unambiguously a response message from the remote terminal unit (evaluation of the message length).

Note:

Modbus messages have no direction identifier; consequently there are response messages that cannot be distinguished from call messages.

Station-specific faults present are reset in a redundant STANDBY master station, if a faultless message from the respective station is “listened”.

Behavior of the master station with PASSIVE and interface = ACTIVE

- The function of the master station with redundancy state PASSIVE and interface = ACTIVE is determined with the parameter **`[PRE] Redundancy | behaviour at passive and interface active`**.
  Possible settings:
  - Loopback Check
    The master station permanently checks all connected remote terminal units with the function Loopback Check (Function code 8, Sub-Function = 0000).
  - Normal Operation
    The central unit polls the parameterized data points (same function as with redundancy status = ACTIVE).
- Received messages are marked on the basic system element with “R = 1” (data received from passive interface)
- Data in transmit direction are forwarded from the basic system element (assuming corresponding parameter setting on the BSE) to the protocol element (otherwise discarded), stored in the protocol element internal data base and transmitted to the selected remote station.

NOTE

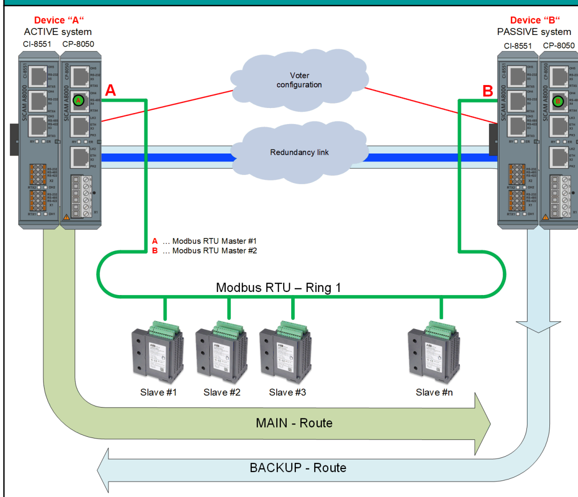
In the redundancy state PASSIVE (= STANDBY) no listened data are passed on! The listening mode is not implemented due to the missing information in the response message for the complete interpretation of the messages.

The information required is only contained in the call message of the active master, which cannot (or not always) be listened.

13.7.7.2 Modbus RTU Master: Ring Redundancy ("LOOP Redundancy")

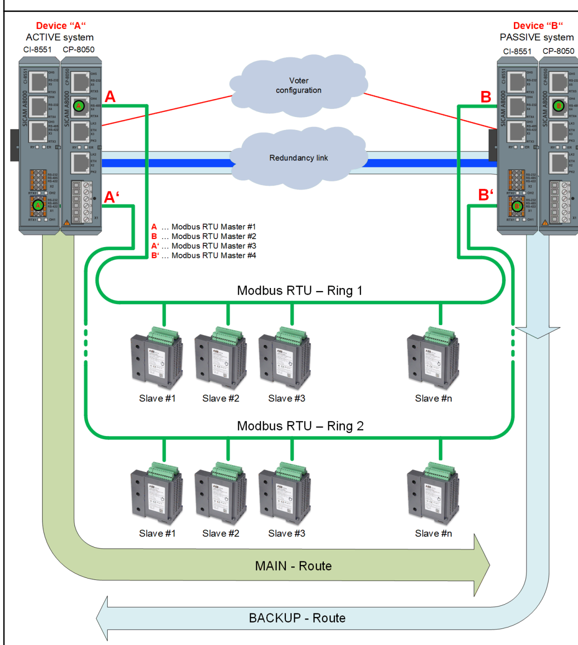
The ring redundancy increases the availability of serial connected Modbus devices with RS-485 line interruption.

In the case of line interruption (ring interruption), the Modbus devices are polled via “main transmission line” and “Backup-Route”.

<table>
<tr><th>Supported configurations</th><th>Description</th></tr>
<tr><td>
</td><td>

Ring redundancy (1 Ring) in redundant devices

- Modbus-Ring (Loop) via 2 redundant devices.
- The protocol in the active device sends the Modbus requests in an error-free state via its own interface (A) - in the event of an error via the interface of the redundant device (B).
- The message to the redundant device are transmitted via the redundancy link.
- For the ring redundancy to function properly, only 1 device may be active - the redundant device must be passive.

</td></tr>
<tr><td>
</td><td>

Ring redundancy (2 Rings) in redundant devices

- ... The same functionality as with ring redundancy (1 ring)
- The Modbus protocols of the interfaces (A, A’) work independently of each other
- Pay attention to the performance of the redundancy link when using it!

</td></tr>
</table>

Ring-Redundancy ("Loop-Redundancy")

- With ring redundancy, the RS-485 communication line is connected to a master interface at both ends.
- The interface of the active master is referred as the "Main-Route" and the interface of the redundant master is referred as the "Backup-Route".
- The redundant master interfaces are installed in redundant devices.
- The redundant devices are connected by a redundancy link.
- If a Modbus device (slave) no longer responds on the "Main-Route", the Modbus device is queried on the "Backup-Route".
- All RS-485 interfaces of the CP-8050 and CI-8551 can be used for ring redundancy.
- For ring redundancy, the same interfaces must be used in the redundant devices.
- Several independent ring configurations are possible between redundant devices.

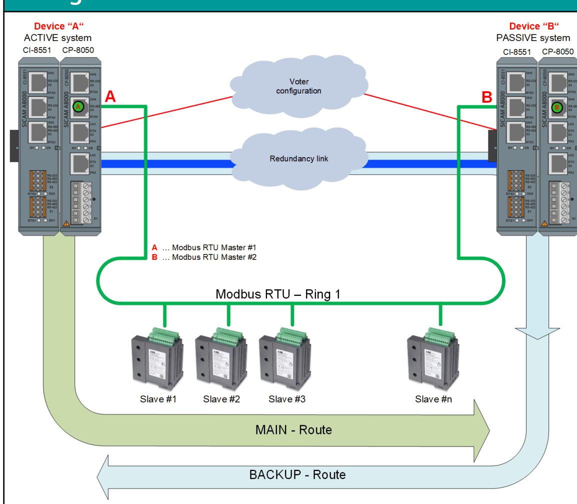
NOTE

- Ring redundancy ("Loop Redundancy") within a device is not supported!
- The signal parameterization (images) in the send and receive directions must be the same in both devices.

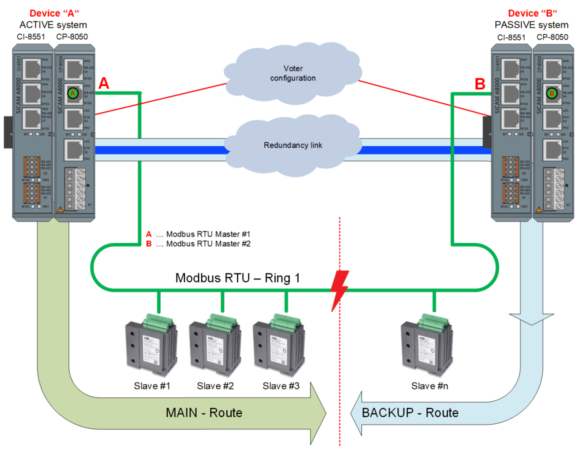
Internal monitoring

- Every Modbus master sends an internal monitoring message to the redundant master every 20 seconds. Each Modbus master checks whether at least one monitoring message has been received from the redundant master within 60 seconds. If there are no monitoring messages, the warning " Connection to the redundant master interrupted in case of ring redundancy" is set.
- If the connection to the redundant master is recognized as having failed, the active Modbus master only sends all calls via the main transmission line.

Ring-Redundancy ("Loop-Redundancy") – Functionality with undisturbed transmission:

Configurations	Description
	**Modbus Ring-Redundancy in Redundant Devices** • With undisturbed transmission, Modbus messages from the active modbus master will be transmitted via the "Main-Route" and the associated received responses from the Modbus devices (slaves) will be processed from the "Main-Route". The Modbus master in the redundant device does not send any message itself. • Monitored messages on the "Backup-Route" are discarded by the redundant master and used to detect the failure of the Modbus devices. • The "Backup-Route" is tested each 60 seconds. To do this, the active Modbus master transmits a Modbus request via the redundancy link to the redundant master interface, where it is transmitted via the "Backup-Route" and the associated response is sent back to the active master via the redundancy link.

Ring-Redundancy ("Loop-Redundancy") – Functionality with undisturbed transmission:

<table>
<tr><th>Configurations</th><th>Description</th></tr>
<tr><td>
</td>
<td>Modbus Ring-Redundancy in Redundant Devices

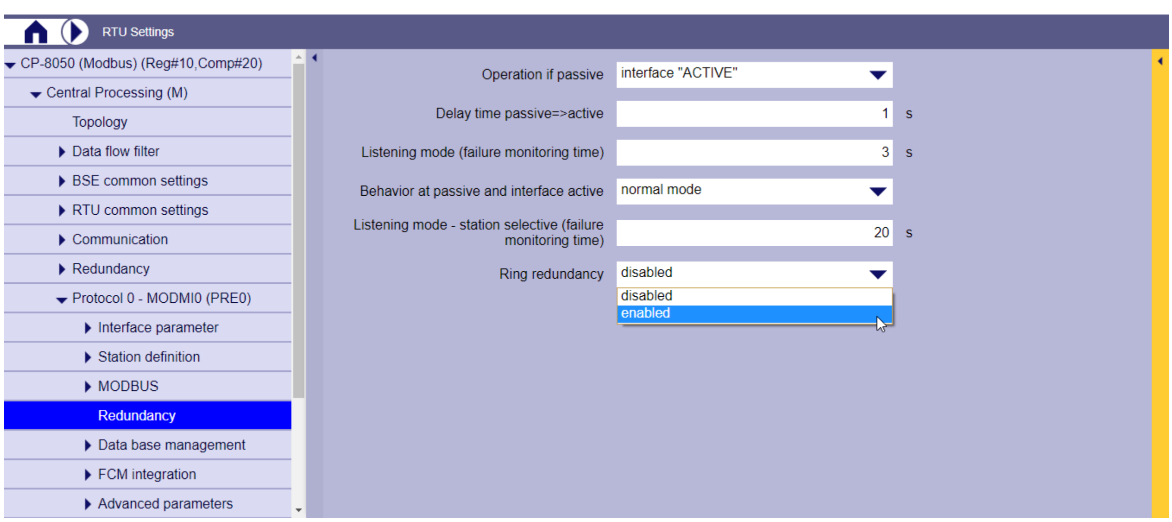
During interruption of ring - as far as the Modbus communication on the RS-485 bus is physically possible - the Modbus devices are queried via the “Main-Route” or the “Backup-Route”.
If a Modbus device (slave) does not respond on “Main-Route” the “last retry of the request” will be transmitted via the “Backup-Route”.
Diagnostics:

With ring interrupted, Modbus devices will not be handled as faulty by active master if Modbus slaves can be reached either via “main-route” or “backup-route”.
The active master sends the number of Modbus devices which are currently polled via “backup-route” as protocol element return information to the BSE. This information can be used for redundancy control.
The passive master detects via failure monitoring in listening mode those Modbus devices as having failed, that can only be reached via the main route of the active master .

Every 60 seconds the active Modbus master checks whether a Modbus device can be reached again via the “Main-Route”.
</td></tr>
</table>

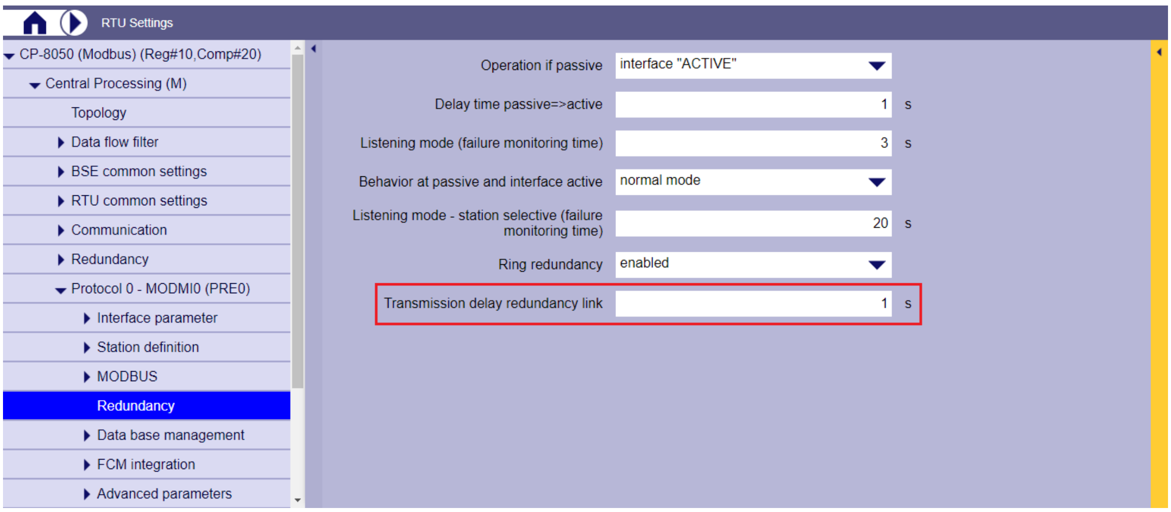
Parameter in Modbus RTU Master for Ring-Redundancy

- The ring redundancy will be enabled with parameter **`[PRE] Redundancy | Ring redundancy`**.



[MODMI0_DM_Ringredundanz, 3, en_US]

- For ring redundancy the parameter **`[PRE] Redundancy | Operation if passive`** must be set to **<Interface “TRISTATE”>** .
- Transmission delay redundancy link:
  If a Modbus request is sent out via the redundant Modbus master interface in the case of ring redundancy (i.e. the Modbus request and the associated response are transmitted via the redundancy link), the expected acknowledgement time is extended by the configured value.
  With the parameter “Transmission delay redundancy link” the internal delay times / processing times and the delay times of the selected transmission path for the redundancy link must be taken into account.
  The transmission delay is set with the parameter **`[PRE] Redundancy | Transmission delay redundancy link`**.

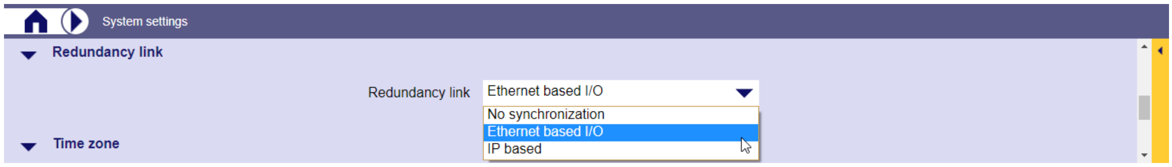


[MODMI0_DM_Sendeverzoegerung_Redundanzlink, 3, en_US]

- Number of Retries (re-transmissions)
  With ring redundancy the parameter **`[PRE] MODBUS | Time settings, Retries | Retries | Retries for data message SEND/CONFIRM`** (station selective) must be set to ≥ 2 in Modbus master.
- listening mode-control
  For ring redundancy the parameter **`[PRE] Redundancy | Listening mode (failure monitoring time)`** should be set >0 (recommendation = 15 sec.) and the parameter **`[PRE] Redundancy | Listening mode -station selective (failure monitoring time)`** should be set >0 (recommendation = 20 sec.).
- Character Monitoring Time
  With a freely definable transmission facility, the character monitoring time must be set with the parameter **`[PRE] MODBUS | Time settings, retries | Monitoring times | Character monitoring time`** can be set to 33 bits according to the Modbus standard.

Parameter for redundancy link via Ethernet based I/O bus (as an example) (see *7.4 Redundancy Link*)

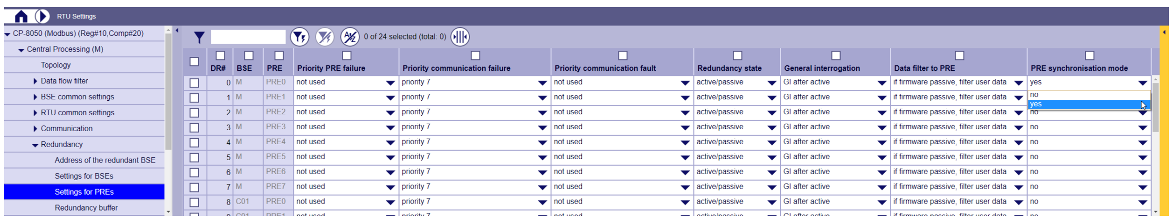
- select type of redundancy (see *7 Redundancy*)
- Enable redundancy link
  The desired type of redundancy must be enabled for the redundancy link.



[DM_Redundanz_link_via_Ehternet_Based_IO, 2, en_US]

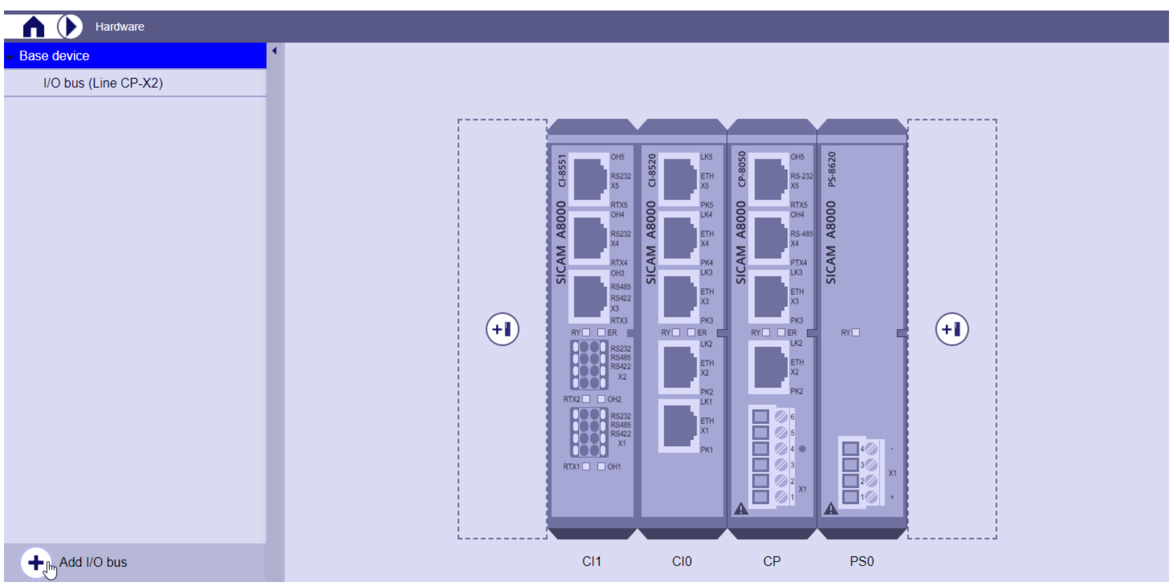
Figure 13-16 Example: Redundancy link via I/O Bus.

- PRE synchronizing mode
  For the Modbus RTU master protocol with ring redundancy, the parameter **`[BSE] Central processing (M) | Redundancy | Settings for PREs | Set PRE synchronization mode`** must be set to <yes>.



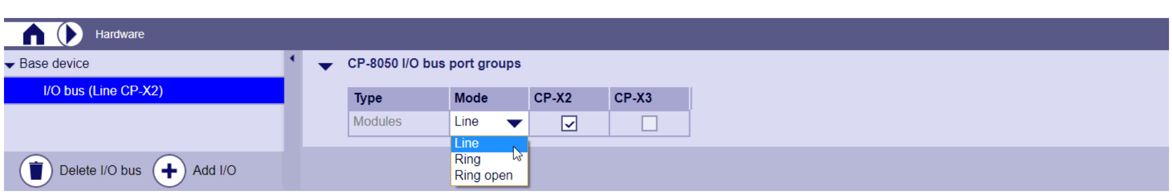
[DM_Einstellungen_fuer_PRE_Synchronisierungsmode, 3, en_US]

- Redundancy link via I/O Bus: Add I/O Bus



[DM_IO_BUS_hinzufuegen, 3, en_US]

- Redundancy link via I/O Bus: Set “CP-8050 I/O Bus Port Groups”.



[DM_IO-BUS_Linie_fuer_Redundanzlink, 3, en_US]

Parameter in Modbus device (Slave) for Ring-Redundancy

- No parameterization is required in the Modbus device (slave) for ring redundancy!

NOTE

The Modbus master interfaces for ring redundancy (Loop redundancy) must - except for the address of the redundant master - be parameterized completely identically!

The signal parameterization (images) in the send and receive directions must be the same in both devices.

13.7.7.3 Modbus RTU (Master+Slave): Device redundancy

With device redundancy (see *7 Redundancy*), the parameters for device-A and device-B are parameterized together in one device. The device-specific parameters are distinguished by _A and _B. The parameters for the redundant device B are generated in the SICAM Device Manager using the “Update redundant devices ...” function.

The information on whether the protocol is currently running in device-A or device-B is made known to the protocol when it is started up by the basic system element.

The protocol in device-A uses the device-specific parameters _A and the protocol in device-B uses the device-specific parameters _B.

Non-device-specific parameters are used by the protocol in device-A and device-B.

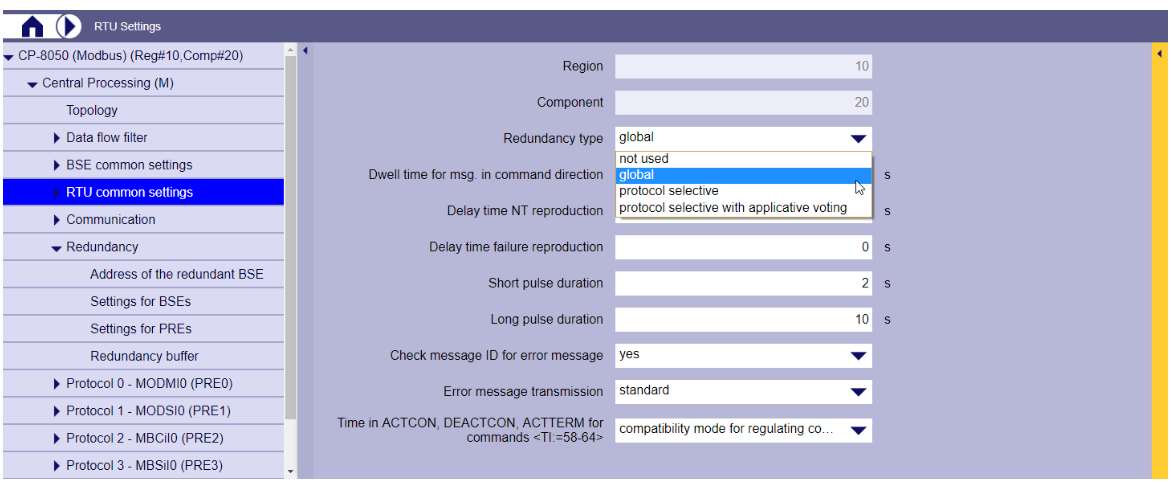
- Redundancy type

  The device redundancy is set with the parameter **`[BSE] Central processing (M) | RTU general settings | Type of redundancy`**.

  Supported device redundancy types: (see *7 Redundancy*)

  - Global Redundancy

  - Protocol-selective Redundancy



[DM_RTU-allgemeine_Einstellungen_Redundanzart, 2, en_US]

- With device redundancy the parameters for device-A and device-B are parameterized together in one device. The device-specific parameters are distinguished by _A and _B. The parameters for the redundant device B are generated in the SICAM Device Manager using the “Update redundant devices ...” function.

- The function of the protocol when the redundancy status is active or passive is determined by further parameters. (see *13.7.7 Redundancy*)

Parameters for device-A, device-B

For device redundancy, the Modbus RTU protocol does not provide different parameters for the redundant devices (device-A, device-B). The protocol uses the same parameters in device-A and in device-B.

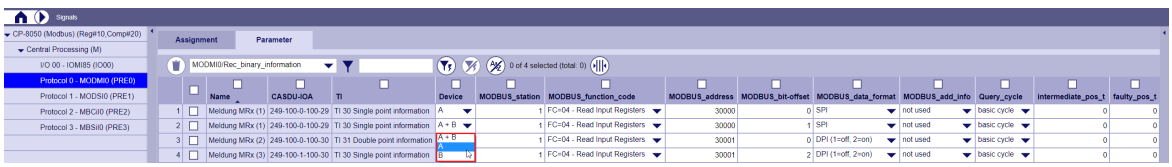
Signals for device-A, device-B

With device redundancy the signals for device A and device B are parameterized together in one device. Device-specific signals are parameterized by assigning them to device **A** and/or device **B**. The parameters for the redundant device B are generated in the SICAM Device Manager using the “Update redundant devices ...” function.

For device redundancy, the signals can be assigned separately for device-A and device-B if required. In the case of redundant devices with Modbus RTU master, all signals are usually always required in both devices.

Different signals in redundant devices may be required if the Modbus device (slave) supports Modbus RTU via 2 independent interfaces and the same signals are not available at these interfaces.

- Each signal can be assigned individually to the devices:
  - **A** .. Device-A
  - **B** .. Device-B
  - **A+B** .. Device-A + Device-B



[MODMI0_DM_Signale_A_B_red, 2, en_US]

13.7.8 Device Specific Functions

13.7.8.1 SICAM FCM

The protocol firmware for Modbus RTU Master (MODMI0) supports the following device-specific functions for SICAM FCM:

- Firmware load for SICAM FCM
- Parameter load for SICAM FCM
- Clock synchronization for SICAM FCM

Firmware load for SICAM FCM

The protocol element for Modbus RTU master supports firmware update (load) for connected SICAM FCM devices with selected SICAM FCM firmware versions via serial Modbus interface.

Table 13-1 Firmware load for SICAM FCM devices:

SICAM FCM hardware	SICAM FCM MLFB	SICAM FCM firmware version
SICAM FCM version 1 	6MD2320-xxxxx-xxxx/xx	Not supported!
SICAM FCM version 2 	6MD2321-xxxxx-xxxx/xx 6MD2322-xxxxx-xxxx/xx	✓ (V2.xx) “ALT“
SICAM FCM Version 3 	6MD2321-xxxxx-xxxx/xx 6MD2322-xxxxx-xxxx/xx	✓ (V3.xx)

Firmware loading for SICAM FCM with:

- SICAM Device Manager | SICAM WEB

The loading of the firmware for SICAM FCM devices can be carried out via the protocol-specific web page “SICAM FCM”, if in the parameter **`[PRE] station definition in the field station type = FCM`** is entered.

FCM Firmware Loading - “Intelligent / anyway”

The mode for SICAM FCM firmware loading (“intelligent/anyway”) is set with the parameter **`[PRE] FCM Integration | Load FCM firmware | load firmware`** (recommendation/default: FCM Firmware loading = “intelligent”).

- “Intelligent” loading
  Before start of firmware loading actual loaded firmware revision will be read from SICAM FCM devices. Firmware loading will be started to SICAM FCM devices having other firmware revision loaded as included in firmware file.

- "Unconditional" loading

  Before start of firmware loading actual loaded firmware revision will be read from SICAM FCM devices. Firmware loading will be started to all SICAM FCM devices supporting this range of firmware revision.

  → Firmware loading takes more time

NOTE

SICAM FCM firmware revision 2.xx can be loaded only in SICAM FCM "Version 2" devices!

SICAM FCM firmware revision 3.xx can be loaded only in SICAM FCM "Version 3" devices!

SICAM FCM Firmware Loading – Priority

The priority for SICAM FCM firmware loading ("normal/high") is set with the parameter **`[PRE] FCM Integration | Load FCM firmware | Priority`** (recommendation/default: Priority = "high").

- Priority = "high".

  During firmware loading to specific SICAM FCM devices, process data from other Modbus devices will not be updated.

- Priority = "normal"

  During firmware loading to specific SICAM FCM devices, data from other Modbus slave devices will be polled and so process data will be updated with low priority.

NOTE

Certain SICAM FCM versions support firmware loading only with max. 19.2 kBit/s!

If SICAM FCM is used with baud rates > 19.2 kBit/s, SICAM FCM will switch over to 19.2 kBit/s firmware loading start (→ baud rate in CP-8031, CP-8000 must be also changed to 19.2 kBit/s during firmware loading). After firmware loading baud rate will be still 19.2 kBit/s! Changing the baud rate of SICAM FCM is only possible via local display!

Recommendation: Configurations with SICAM FCM only with 19.2 kBit/s!

Load firmware with SICAM Device Manager or SICAM WEB

With the SICAM Device Manager / SICAM WEB, the firmware of the SICAM FCM devices that are serially connected to the CP-8031, CP-8050 with the Modbus RTU protocol, can be updated.

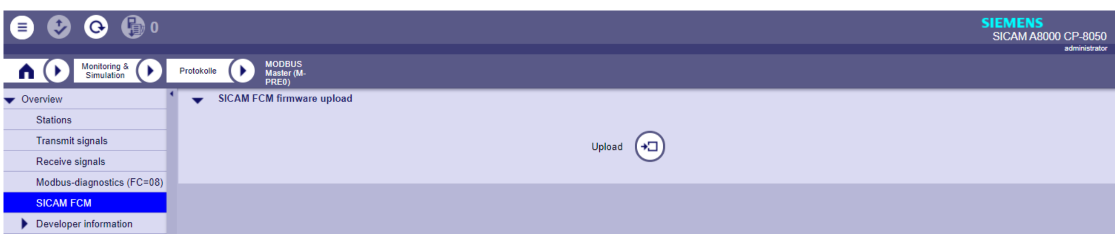
- Connect PC / Notebook with CP-8031, CP-8050 via Ethernet
- Start SICAM WEB from SICAM Device Manager or open the web browser and enter the IP address of the connected CP-8031, CP-8050

- SICAM FCM Firmware load via protocol specific web page “SICAM FCM” (see also *13.7.10 Web server*)

[MODMI0-WEB_01, 1, en_US]

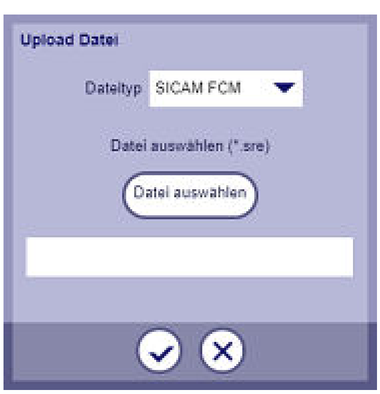
[MODMI0-WEB_02, 1, en_US]

[MODMI0-WEB_03, 1, en_US]



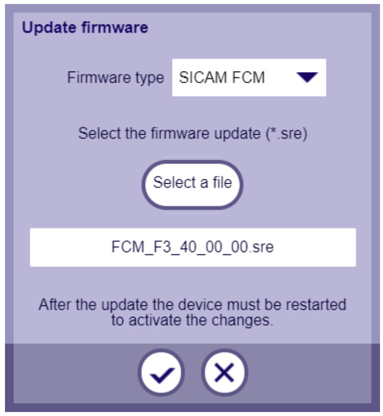
[MODMI0_WEB_SICAM_FCM_Firmware_Upload_1, 1, --_--]

- SICAM FCM firmware upload



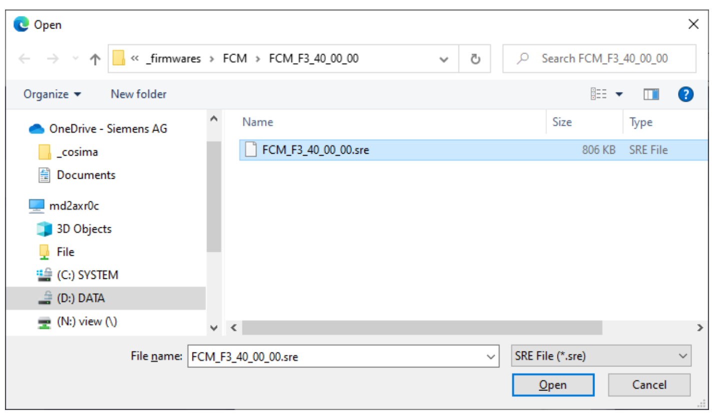
[MODMI0_WEB_SICAM_FCM_Firmware_Upload_2, 2, en_US]

- Upload File | File type + select File
  - SICAM FCM Firmware File (Data type = SICAM FCM)
    Note: here the firmware file as an example <FCM_F3_40_00_00.sre>



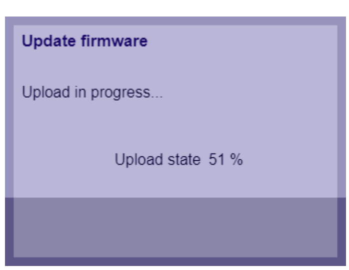
[sc_MODMT2_sweb_update_fw_fcm_select, 3, en_US]

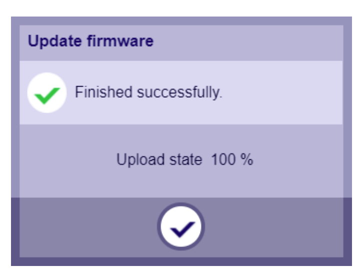
Select SICAM FCM firmware file
File extension: .SRE "SICAM FCM SREC-File Type"
Note: If the SICAM FCM Firmware file has the extension**.srec**, the file must be renamed to**.sre**.



[sc_MODMT2_sweb_update_fw_fcm_browse, 1, en_US]

- Upload File
  After selecting the file, the SICAM FCM firmware file is loaded into the CP-8031, CP-8050.





- After the successful upload of the SICAM FCM firmware file to the memory of the CP-8031, CP-8050, the Modbus RTU master protocol firmware MODMI0 starts automatically with the transfer of the firmware to the SICAM FCM devices.
- The loading of the firmware for several SICAM FCM devices connected on a line is carried out selectively for each device.

  i.e. after completion of the firmware loading for one device, the firmware loading is started for the next device.
- Errors during firmware loading will be displayed in history diagnostics.

Parameter load for SICAM FCM

The protocol element for Modbus RTU master in CP-8031, CP-8050 supports the loading of parameters from connected SICAM FCM devices with selected SICAM FCM firmware versions via the serial Modbus interface.

Table 13-2 Parameter loading will be supported for following SICAM FCM versions:

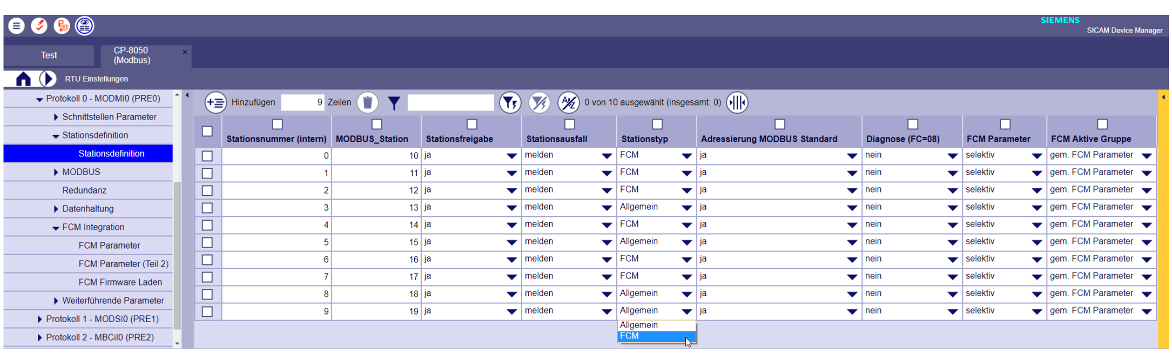
SICAM FCM hardware	SICAM FCM MLFB	SICAM FCM firmware version
SICAM FCM version 1	6MD2320-xxxxx-xxxx/xx	V1.xx is not supported!
SICAM FCM Version 2	6MD2321-xxxxx-xxxx/xx 6MD2322-xxxxx-xxxx/xx	✓ V2.00, V2.10, V2.20, V2.30 ✓ V2.40, V2.50, V2.60, V2.61
SICAM FCM Version 3	6MD2321-xxxxx-xxxx/xx 6MD2322-xxxxx-xxxx/xx	✓ V3.10, V3.20, V3.30, V3.40

SICAM FCM parameters for a maximum of 10 SICAM FCM devices or for a maximum of 5 SICAM FCM device groups are integrated in the RTU settings in the protocol element MODMI0 under **`[PRE] FCM Integration | FCM Parameter`** and **`[PRE] FCM Integration | FCM Parameter (part 2)`**.

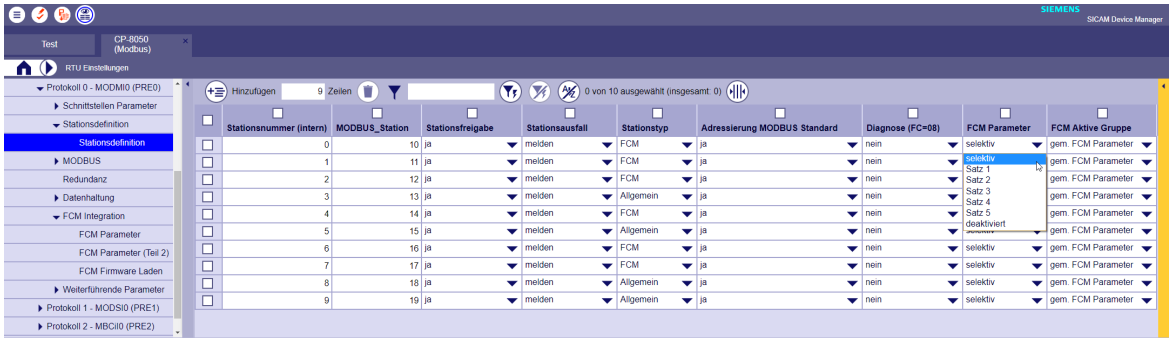
All SICAM FCM parameters are always displayed regardless of the firmware revision of the connected SICAM FCM devices.

The SICAM FCM parameters are transmitted from the protocol element for Modbus master with Modbus function code = 16 (WRITE MULTIPLE REGISTERS) station-selectively to the SICAM FCM devices.

The parameters for SICAM FCM devices are loaded if the parameters for **`[PRE] Station definition`** in field station type = "**`FCM`**" and in field **`FCM parameter "station selective"`** or FCM parameter set "Set 1-5" is selected.



[MODMI0_DM_Stationsdefinition_a, 1, en_US]



[MODMI0_DM_Stationsdefinition_b, 1, en_US]

Assignment of FCM Parameters to FCM Devices

The SICAM FCM parameter will be assigned to specific SICAM FCM device with the parameter FCM parameter loading in the parameters of the [PRE] station definition as follows:

- selective

The parameters **`[PRE] FCM Integration | FCM Parameter`** and **`[PRE] FCM Integration | FCM Parameter (Part 2)`** are assigned to the SICAM FCM device with the same Modbus_Station/parameter set.

`[PRE] Station definition`		**`[PRE] FCM Ingtegration	FCM Parameter, [PRE] FCM Ingtegration	FCM Parameter (Part 2)`**
MODBUS_Station	FCM Parameters	Modbus_Station/Parameter set
1 to 247	selective	1 to 247

- Set 1 to 5

The SICAM FCM device receives in the station definition the parameter set with the same set # from **`[PRE] FCM Integration | FCM Parameter`** and **`[PRE] FCM Integration | FCM Parameter (Teil 2)`**.

`[PRE] Station definition`		**`[PRE] FCM Ingtegration	FCM Parameter, [PRE] FCM Ingtegration	FCM Parameter (Part 2)`**
MODBUS_Station	FCM Parameters	Modbus_Station/Parameter set
1 to 247	set 1	248 (= set 1)
1 to 247	set 2	249 (= set 2)
1 to 247	set 3	250 (= set 3)
1 to 247	set 4	251 (= set 4)
1 to 247	set 5	252 (= set 5)

- disabled
  - no parameters are assigned to SICAM FCM device
  - no parameters will be loaded into SICAM FCM device

Supported SICAM FCM Parameters

Table 13-3 Supported SICAM FCM Parameters

Modbus Address	SICAM FCM Parameter	SICAM FCM Firmware Revision 2.0x	2.1x	2.2x	2.3x	2.4x	2.5x	2.60	2.61	3.1x 3.2x	3.3x	3.40	3.41 [316]	3.44 [316]
0009	Grid frequency	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	–	–
0010	Primary voltage	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	–	–
0011	Overcurrent trip value (I>>), high-set	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	–	–
0012	Overcurrent response time (tI>>)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	–	–
0013	Ground-fault trip value (IN>) (Group 1)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	–	–
0014	Ground-fault response time (tIN>) (Group 1)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	–	–
0015	Transformer Type	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	–	–
0016	Neutral-point treat-ment	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	–	–
0017	Language	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	–	–
0018	Voltage transformer secondary/low-power voltage transformer	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	–	–
0019	Date type	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	–	–
0020	Time type	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	–	–
0021	Vmax alarm	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	–	–
0022	Vmax warning	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	–	–
0023	Vmin alarm	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	–	–
0024	Vmin warning	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	–	–
0025	Neutral-point displace-ment voltage VNE> (Group 1)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	–	–
0026	Neutral displacement time tVNE> (Group 1)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	–	–
0027	Auto reset time	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	–	–
0028	Rated primary current	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	–	–
0029	Overcurrent trip value I>, low-set	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	–	–
0030	Overcurrent response time (tI>), low-set	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	–	–
0031	T1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	–	–
0032	T2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	–	–
0033	T3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	–	–
0034	Imax alarm setting	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	–	–
0035	Imax warning setting	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	–	–
0036	Imax alarm time setting	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	–	–

316 ... is currently not supported in CP-8031, CP-8050!

Modbus Address	SICAM FCM Parameter	SICAM FCM Firmware Revision 2.0x	2.1x	2.2x	2.3x	2.4x	2.5x	2.60	2.61	3.1x 3.2x	3.3x	3.40	3.41 [316]	3.44 [316]
0037	Imax warning time setting	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	–	–
0038	Primary voltage correction	–	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	–	–
0039	Transformer angle	–	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	–	–
0040	Idir (Group 1)	–	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	–	–
0041	Sensor voltage	–	–	✓	✓	✓	✓	✓	✓	✓	✓	✓	–	–
0042	Active group	–	–	✓	✓	✓	✓	✓	✓	✓	✓	✓	–	–
0043	Ground-fault trip value (IN>) (Group 2)	–	–	✓	✓	✓	✓	✓	✓	✓	✓	✓	–	–
0044	Ground-fault response time (tIN>) (Group 2)	–	–	✓	✓	✓	✓	✓	✓	✓	✓	✓	–	–
0045	Neutral-point displacement voltage VNE> (Group 2)	–	–	✓	✓	✓	✓	✓	✓	✓	✓	✓	–	–
0046	Neutral displacement time tVNE> (Group 2)	–	–	✓	✓	✓	✓	✓	✓	✓	✓	✓	–	–
0047	Idir (Group 2)	–	–	✓	✓	✓	✓	✓	✓	✓	✓	✓	–	–
0048	V-measurement (reserved for further use)	–	–	✓	✓	✓	✓	✓	✓	✓	✓	✓	–	–
0049	Auto Calibration Voltage (reserved for further use)	–	–	✓	✓	✓	✓	✓	✓	✓	✓	✓	–	–
0050	Ground current acquisition	–	–		✓	✓	✓	✓	✓	✓	✓	✓	–	–
0051	DO configuration	–	–	–	–	✓	✓	✓	✓	✓	✓	✓	–	–
:														
0054	C Crossblocktimer	–	–	–	–	✓	✓	✓	✓	✓	✓	✓	–	–
0055	Ground sensor	–	–	–	–	✓	✓	✓	✓	✓	✓	✓	–	–
0056	I1 power-flow direction	–	–	–	–	–	✓	✓	✓	✓	✓	✓	–	–
0057	I2/IN power-flow direction	–	–	–	–	–	–	✓	✓	✓	✓	✓	–	–
0058	I3 power-flow direction	–	–	–	–	–	–	✓	✓	✓	✓	✓	–	–
0059	P, Q sign	–	–	–	–	–	–	✓	✓	✓	✓	✓	–	–
0060	Neutral-point treatment (Group 2)	–	–	–	–	–	–	–	✓	✓	✓	✓	–	–
:														
0070	Undervoltage phase threshold for ground V<	–	–	–	–	–	–	–	–	✓	✓	✓	–	–
0071	Overvoltage phase threshold for ground V>	–	–	–	–	–	–	–	–	✓	✓	✓	–	–

316 ... is currently not supported in CP-8031, CP-8050!

Modbus Address	SICAM FCM Parameter	SICAM FCM Firmware Revision												
		2.0x	2.1x	2.2x	2.3x	2.4x	2.5x	2.60	2.61	3.1x 3.2x	3.3x	3.40	3.41 [316]	3.44 [316]
0072	3I0 delta pulse off-on	–	–	–	–	–	–	–	–	✓	✓	✓	–	–
0073	Pulse-on duration	–	–	–	–	–	–	–	–	✓	✓	✓	–	–
0074	Pulse-off duration	–	–	–	–	–	–	–	–	✓	✓	✓	–	–
0075	Nos Number of pulses for operate	–	–	–	–	–	–	–	–	✓	✓	✓	–	–
0076	Nos Number of pulses for monitoring	–	–	–	–	–	–	–	–	✓	✓	✓	–	–
0077	Nos det.	–	–	–	–	–	–	–	–	✓	✓	✓	–	–
0078	T-det. ext.	–	–	–	–	–	–	–	–	✓	✓	✓	–	–
0079	Correction factors	–	–	–	–	–	–	–	–	–	✓	✓	–	–
0080	V1 magnitude factor	–	–	–	–	–	–	–	–	–	✓	✓	–	–
0081	V1 angle offset	–	–	–	–	–	–	–	–	–	✓	✓	–	–
0082	V2 magnitude factor	–	–	–	–	–	–	–	–	–	✓	✓	–	–
0083	V2 angle offset	–	–	–	–	–	–	–	–	–	✓	✓	–	–
0084	V3 magnitude factor	–	–	–	–	–	–	–	–	–	✓	✓	–	–
0085	V3 angle offset	–	–	–	–	–	–	–	–	–	✓	✓	–	–
0086	I1 magnitude factor	–	–	–	–	–	–	–	–	–	✓	✓	–	–
0087	I1 angle offset	–	–	–	–	–	–	–	–	–	✓	✓	–	–
0088	I2/IN magnitude factor	–	–	–	–	–	–	–	–	–	✓	✓	–	–
0089	I2/IN angle offset	–	–	–	–	–	–	–	–	–	✓	✓	–	–
0090	I3 magnitude factor	–	–	–	–	–	–	–	–	–	✓	✓	–	–
0091	I3 angle offset	–	–	–	–	–	–	–	–	–	✓	✓	–	–
0092	Integrated battery pack	–	–	–	–	–	–	–	–	–	–	✓	–	–
0093	I2/I1 Ratio	–	–	–	–	–	–	–	–	–	–	✓	–	–
0094	Time delay	–	–	–	–	–	–	–	–	–	–	✓	–	–
0095	U/C guard	–	–	–	–	–	–	–	–	–	–	✓	–	–
0096	Threshold	–	–	–	–	–	–	–	–	–	–	✓	–	–
0097	Maximum operation	–	–	–	–	–	–	–	–	–	–	✓	–	–
0098	3I0 threshold	–	–	–	–	–	–	–	–	–	–	✓	–	–
0099	3I0 threshold operate	–	–	–	–	–	–	–	–	–	–	✓	–	–
0100	Operate delay	–	–	–	–	–	–	–	–	–	–	✓	–	–
0101	Dropout delay	–	–	–	–	–	–	–	–	–	–	✓	–	–
0102	Ring/Meshed network	–	–	–	–	–	–	–	–	–	–	✓	–	–

More details for SICAM FCM parameters can be found in SICAM FCM documentation.

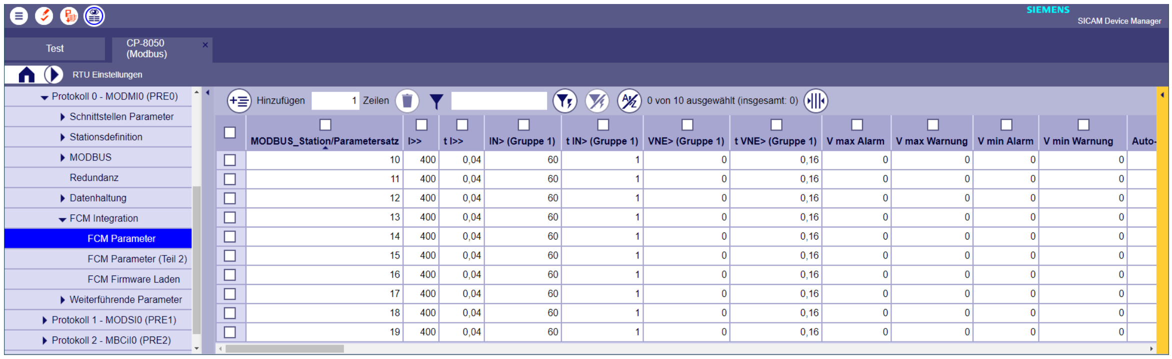
SICAM FCM Parameter in SICAM CP-8031, CP-8050

The parameters of the SICAM FCM devices are integrated in the RTU settings of the protocol element MODMI0 under `[PRE] FCM Integration | FCM Parameter` and `[PRE] FCM Integration | FCM Parameter (part 2)`.

In the SICAM Device Manager, only the most important SICAM FCM parameters are displayed with the basic settings. The “Show all parameters” button shows all parameters.

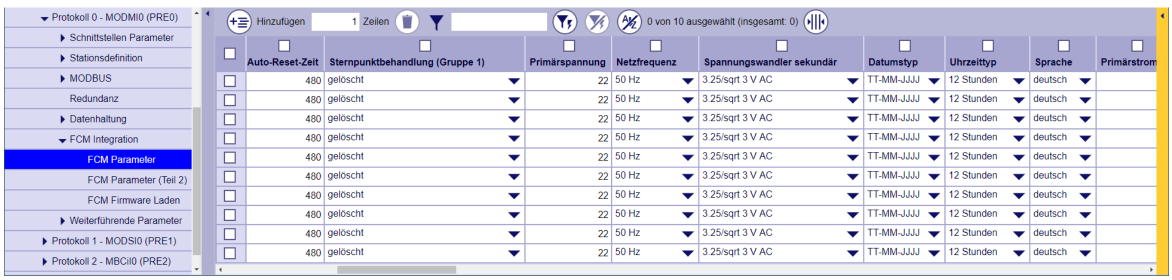
316 ... is currently not supported in CP-8031, CP-8050!

FCM Parameter (Part 1):



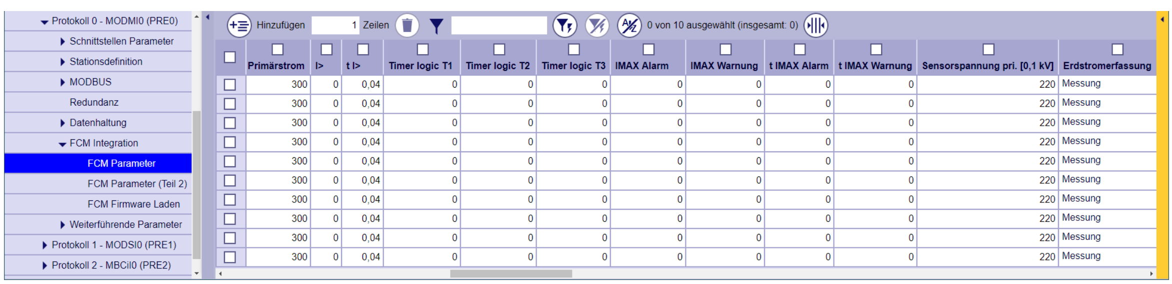
MODBUS_Station/Parametersatz	I>>	t I>>	IN> (Gruppe 1)	t IN> (Gruppe 1)	VNE> (Gruppe 1)	t VNE> (Gruppe 1)	V max Alarm	V max Warnung	V min Alarm	V min Warnung	Auto-
10	400	0,04	60	1	0	0,16	0	0	0	0	
11	400	0,04	60	1	0	0,16	0	0	0	0	
12	400	0,04	60	1	0	0,16	0	0	0	0	
13	400	0,04	60	1	0	0,16	0	0	0	0	
14	400	0,04	60	1	0	0,16	0	0	0	0	
15	400	0,04	60	1	0	0,16	0	0	0	0	
16	400	0,04	60	1	0	0,16	0	0	0	0	
17	400	0,04	60	1	0	0,16	0	0	0	0	
18	400	0,04	60	1	0	0,16	0	0	0	0	
19	400	0,04	60	1	0	0,16	0	0	0	0	

[MODMI0_FCM_Parameter_1a, 1, en_US]



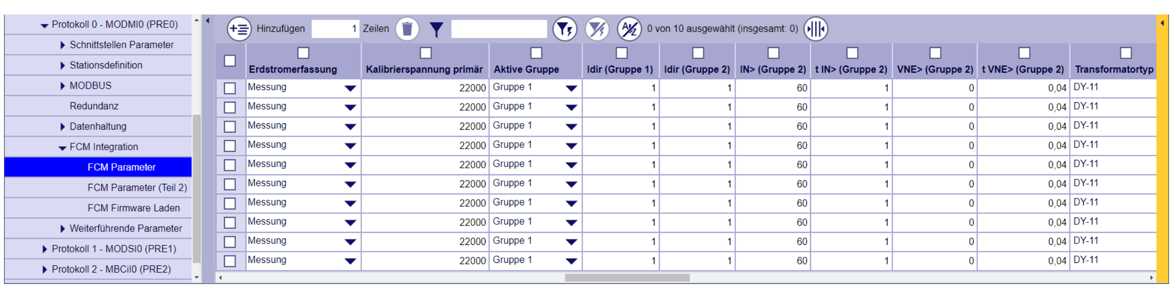
Auto-Reset-Zeit	Sternpunktbehandlung (Gruppe 1)	Primärspannung	Netzfrequenz	Spannungswandler sekundär	Datumstyp	Uhrzeittyp	Sprache	Primärstrom
480	gelöscht	22	50 Hz	3.25/sqrt 3 V AC	TT-MM-JJJJ	12 Stunden	deutsch	
480	gelöscht	22	50 Hz	3.25/sqrt 3 V AC	TT-MM-JJJJ	12 Stunden	deutsch	
480	gelöscht	22	50 Hz	3.25/sqrt 3 V AC	TT-MM-JJJJ	12 Stunden	deutsch	
480	gelöscht	22	50 Hz	3.25/sqrt 3 V AC	TT-MM-JJJJ	12 Stunden	deutsch	
480	gelöscht	22	50 Hz	3.25/sqrt 3 V AC	TT-MM-JJJJ	12 Stunden	deutsch	
480	gelöscht	22	50 Hz	3.25/sqrt 3 V AC	TT-MM-JJJJ	12 Stunden	deutsch	
480	gelöscht	22	50 Hz	3.25/sqrt 3 V AC	TT-MM-JJJJ	12 Stunden	deutsch	
480	gelöscht	22	50 Hz	3.25/sqrt 3 V AC	TT-MM-JJJJ	12 Stunden	deutsch	
480	gelöscht	22	50 Hz	3.25/sqrt 3 V AC	TT-MM-JJJJ	12 Stunden	deutsch	
480	gelöscht	22	50 Hz	3.25/sqrt 3 V AC	TT-MM-JJJJ	12 Stunden	deutsch	

[MODMI0_FCM_Parameter_1b, 1, en_US]



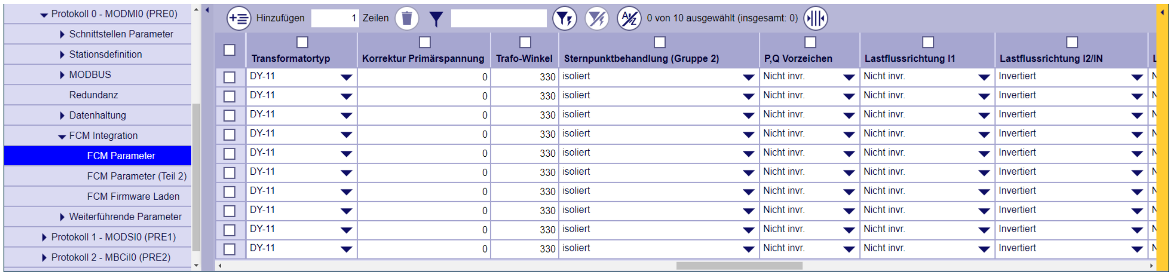
Primärstrom	I>	t I>	Timer logic T1	Timer logic T2	Timer logic T3	IMAX Alarm	IMAX Warnung	t IMAX Alarm	t IMAX Warnung	Sensorspannung pri. [0,1 kV]	Erdstromerfassung
300	0	0,04	0	0	0	0	0	0	0	220	Messung
300	0	0,04	0	0	0	0	0	0	0	220	Messung
300	0	0,04	0	0	0	0	0	0	0	220	Messung
300	0	0,04	0	0	0	0	0	0	0	220	Messung
300	0	0,04	0	0	0	0	0	0	0	220	Messung
300	0	0,04	0	0	0	0	0	0	0	220	Messung
300	0	0,04	0	0	0	0	0	0	0	220	Messung
300	0	0,04	0	0	0	0	0	0	0	220	Messung
300	0	0,04	0	0	0	0	0	0	0	220	Messung
300	0	0,04	0	0	0	0	0	0	0	220	Messung

[MODMI0_FCM_Parameter_1c, 1, en_US]

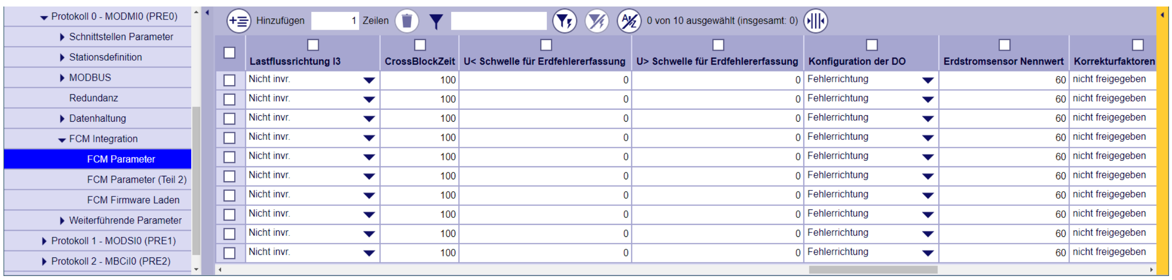


Erdstromerfassung	Kalibrierspannung primär	Aktive Gruppe	Idir (Gruppe 1)	Idir (Gruppe 2)	IN> (Gruppe 2)	t IN> (Gruppe 2)	VNE> (Gruppe 2)	t VNE> (Gruppe 2)	Transformatortyp
Messung	22000	Gruppe 1	1	1	60	1	0	0,04	DY-11
Messung	22000	Gruppe 1	1	1	60	1	0	0,04	DY-11
Messung	22000	Gruppe 1	1	1	60	1	0	0,04	DY-11
Messung	22000	Gruppe 1	1	1	60	1	0	0,04	DY-11
Messung	22000	Gruppe 1	1	1	60	1	0	0,04	DY-11
Messung	22000	Gruppe 1	1	1	60	1	0	0,04	DY-11
Messung	22000	Gruppe 1	1	1	60	1	0	0,04	DY-11
Messung	22000	Gruppe 1	1	1	60	1	0	0,04	DY-11
Messung	22000	Gruppe 1	1	1	60	1	0	0,04	DY-11
Messung	22000	Gruppe 1	1	1	60	1	0	0,04	DY-11

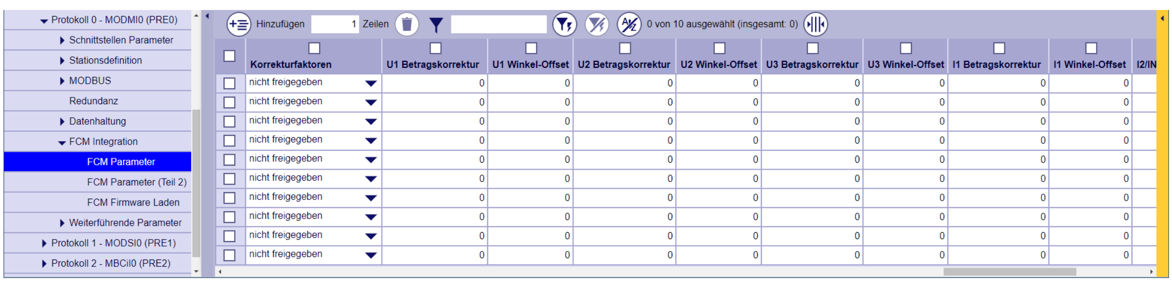
[MODMI0_FCM_Parameter_1d, 1, en_US]



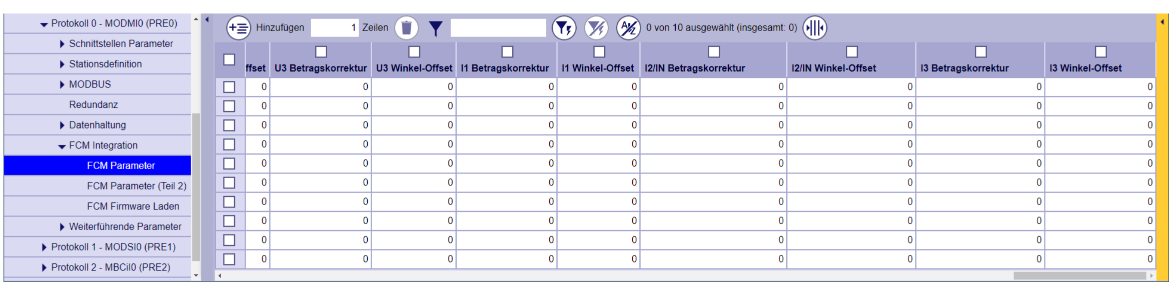
[MODMI0_FCM_Parameter_1e, 1, en_US]



[MODMI0_FCM_Parameter_1f, 1, en_US]

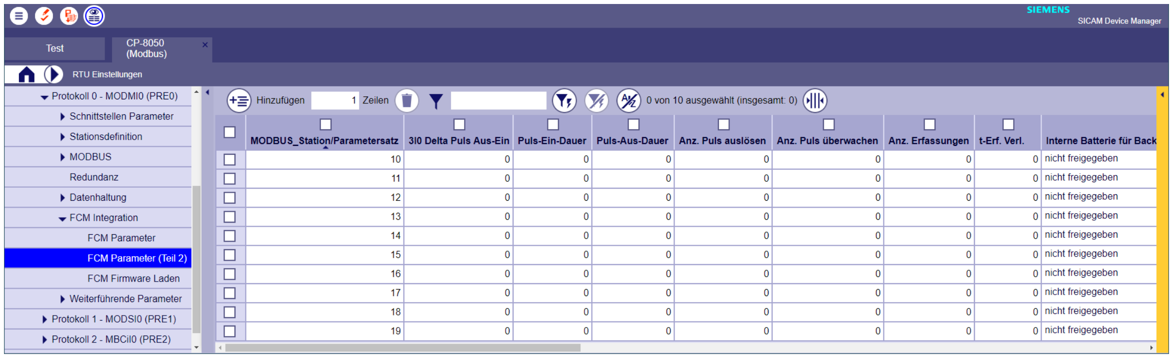


[MODMI0_FCM_Parameter_1g, 1, en_US]



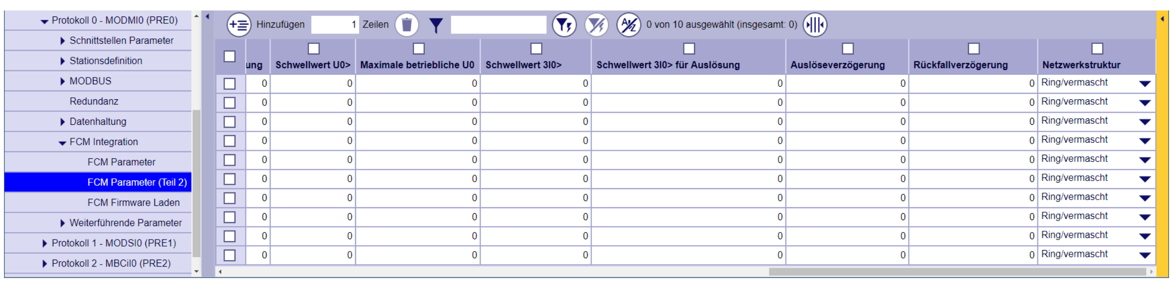
[MODMI0_FCM_Parameter_1h, 1, en_US]

FCM Parameter (Part 2):



[MODMI0_FCM_Parameter_2a, 1, en_US]

[MODMI0_FCM_Parameter_2b, 1, en_US]



[MODMI0_FCM_Parameter_2c, 1, en_US]

Parameter Loading

The SICAM FCM firmware revision will be read by the protocol element for Modbus RTU master in CP-8031, CP-8050 (MODMI0) before start of parameter loading. Only parameters assigned to SICAM FCM firmware revision will be included in parameter loading procedure (see *Table 13-3*).

The protocol element for Modbus RTU master (MODMI0) then always checks whether there is a parameter difference. For this purpose, the parameters are read from the SICAM FCM device with Modbus function code = 3 (Read Holding Registers) and compared with the SICAM FCM parameters stored in SICAM CP-8031, CP-8050. If there is a parameter difference, all parameters are loaded into the SICAM FCM device with Modbus function code = 16 (Write Multiple Registers).

Parameter loading will be done in case of differences in parameters after:

- Power up/Reset of CP-8031, CP-8050
- Change of parameters for SICAM FCM in CP-8031, CP-8050
- Communication error
- Cyclic parameter check

  Parameter check will be done every 30 sec for one SICAM FCM device. This means that when parameters are changed locally on the SICAM FCM control unit, they are updated in the background with the parameters saved in CP-8031, CP-8050 → SICAM FCM.

Parameter load “activate/deactivate”

If SICAM FCM parameters should be modified via SICAM FCM operating panel or by application via setpoint values, “SICAM FCM load parameters” must be disabled with one of the following methods:

- **`[PRE] Station definition | FCM Parameter = deactivated`**
- With the protocol element control message “FCM parameter loading”
  - After power up, the “SICAM FCM parameter loading” function is activated.
  - If the “SICAM FCM parameter loading” function is deactivated with a protocol element control message, the warning “Parameter upload to FCM deactivated ” is set!

NOTE

The “SICAM FCM parameter loading” function cyclically checks whether the parameters in the SICAM FCM devices are still identical to the parameters for SICAM FCM stored in SICAM A8000 CP-8031, CP-8050. If a difference is recognized, the parameters in the SICAM FCM device are updated again.

SICAM FCM Parameter: Active group

Selected SICAM FCM parameters are organized in parameter groups (group 1, 2). At any time, only one selected group of settings is active.

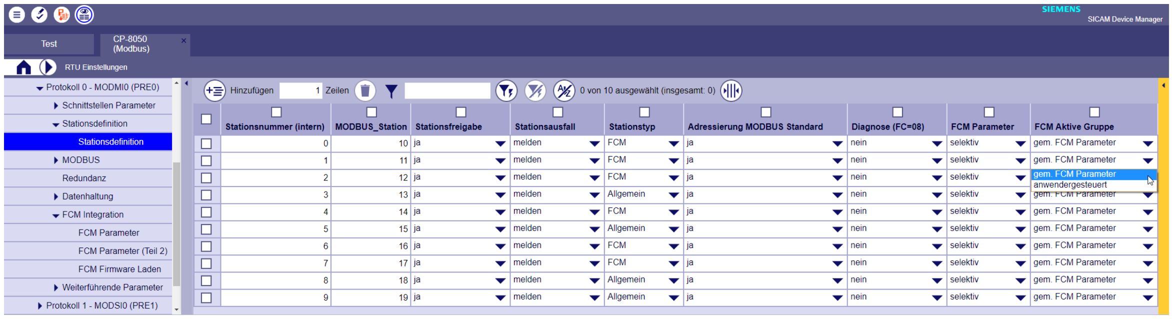
Modbus Address	SICAM FCM Parameter	Group 1	Group 2
0042	Active group		
0013	Ground-fault trip value (IN>) (Group 1)	✓	
0014	Ground-fault response time (tIN>) (Group 1)	✓	
0025	Neutral-point displacement voltage VNE> (Group 1)	✓	
0026	Neutral displacement time tVNE> (Group 1)	✓	
0040	Idir (Group 1)	✓	
0016	Neutral-point treatment	✓	
0043	Ground-fault trip value (IN>) (Group 2)		✓
0044	Ground-fault response time (tIN>) (Group 2)		✓
0045	Neutral-point displacement voltage VNE> (Group 2)		✓
0046	Neutral displacement time tVNE> (Group 2)		✓
0047	Idir (Group 2)		✓
0060	Neutral-point treatment (Group 2)		✓

The “active group” can be selected with:

- with parameter **`[PRE] FCM Integration | FCM Parameter | Active group = <Group 1>`** or **`<Group 2>`**
- using Modbus command (Coil) 0012 “Active Group Switching” (Toggles the active group between group 1 and group 2)
- with the Modbus setpoint value: Modbus Address = 0042
  <0> ... active group = group 1
  <1> ... active group = group 2

Required parameter settings, if the “Active group” is selected with parameter **`[PRE] FCM Integration | FCM Parameter | Aktive Gruppe`**:

- In the parameters for **`[PRE] Station definition`**, the value ***`acc. FCM parameter`*** must be selected in the **`FCM Active group`** field.



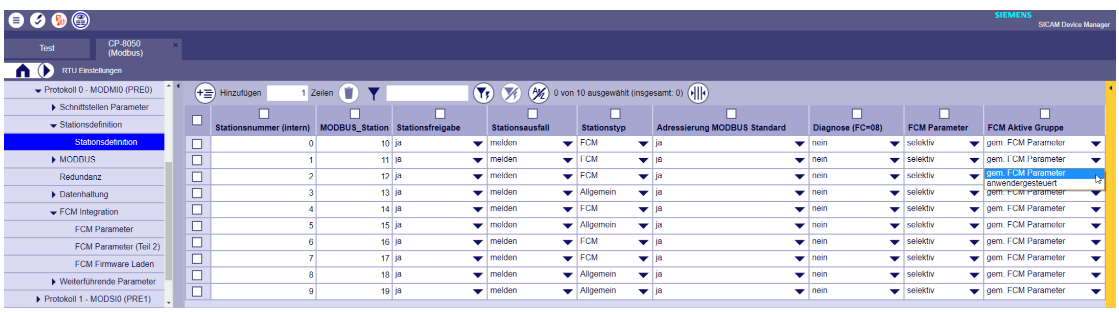
[MODMI0_DM_Stationsdefinition_FCM, 1, en_US]

→ The active group <**Group 1**> or <**Group 2**> has to be set with **[PRE] FCM Integration | FCM Parameter | Active group**.

→ All SICAM FCM parameters are loaded into the SICAM FCM and checked cyclically.

Required parameter settings when the active group is selected with a command / setpoint:

- In the parameters for **[PRE] Station definition** the field **FCM Active group** must be set to value <***user controlled***>.



[MODMI0_DM_Stationsdefinition_FCM, 1, en_US]

→ with <***user controlled***> the SICAM FCM parameter “Active group” can be set via Modbus command/setpoint.

→ The parameter **[PRE] FCM Integration | FCM parameters | Active group** is not effective (this parameter is no longer transferred to the SICAM FCM device).

SICAM FCM Parameter: Calibration voltage

If the parameter “calibration voltage primary” (Modbus register address 0049) is defined in the signal definition for measured values / setpoint values in the sending direction, then this parameter is no longer taken into account in the periodic parameter check!

If the parameters of the SICAM FCM devices are set via the protocol element MODMI0, a periodic parameter check is carried out in order to identify changes to the parameter settings (example: via the local operating unit of the SICAM FCM).

If a difference in the parameter settings between the protocol element and SICAM FCM is recognized, the parameter settings of the protocol element are transferred back to the SICAM FCM.

With “Auto calibration”, the parameter **calibration voltage primary** (Modbus register address 0049) is set by means of a setpoint or measured value (controlled by an application such as CAEx plus), via the Modbus protocol in SICAM FCM (only 6MD2322). After the calibration voltage primary has been transmitted, the calibration process is started by the application with the “initiate auto-adjustment” command (coil 9).

If a parameter of the SICAM FCM is changed in “FCM Parameter” or “FCM Parameter (Part 2)”, the parameter **calibration voltage primary** is reset to the parameterized value - defined in “FCM Parameter”. The parameter **Calibration voltage primary** must then be set again before the next “auto calibration” is started.

Clock synchronization for SICAM FCM

The time of the SICAM FCM devices is synchronized by the Modbus RTU master. The time synchronization for SICAM FCM is activated with the parameter **`[PRE] station definition | Station type = FCM`**.

The time synchronization of the SICAM FCM takes place station-selectively - cyclically 1x per minute.

At the 30th second, the Modbus RTU master sends the time information in the specified format with Modbus function code FC = 16 to the SICAM FCM devices.

Clock synchronization for SICAM FCM:

	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0	
Data byte 0	2^{15}							2^8	millisecond (0 to 59999) n • 1 ms (HIGH)
Data byte 1	2^7							2^0	millisecond (0 to 59999) n • 1 ms (LOW)
Data byte 2	0	0	0	2^4				2^0	hour (0 to 23)
Data byte 3	0	0	2^5					2^0	minute (0 to 59)
Data byte 4	0	0	0	0	2^3			2^0	month (1 to 12)
Data byte 5	2^2	WD	2^0	2^4		D		2^0	day of week + day
Data byte 6	0								year (0) (HIGH)
Data byte 7	2^7							2^0	year (12 to 99) (LOW)

[dw_MODMT2_format_104_dtfcm, 1, en_US]

Byte sending order:
Data byte 0 (MSB of 1st Modbus Register)
Data byte 1 (LSB of 1st Modbus register)
Data byte 2 (MSB of 2nd Modbus register)
:
Data byte 7 (LSB of 4th Modbus register).
Year: 12 to 99 = 2012 to 2099
Note: Date + Time is transmitted in binary coding.

13.7.9 Protocol Element Control and Return Information

13.7.9.1 Protocol element control messages

Protocol element control messages can control protocol element internal functions. On the basic system element, IEC 60870-5-101/104 *`messages with process information in the control direction`* are converted to protocol element control messages and transmitted to the selected protocol element (see *13.1.4.10 Protocol Element Control Messages*).

Supported Protocol element control functions

SF	Protocol element control function `Control function_(PRE)`	MODMI0 [Master]	MODSI0 [Slave]
240	Send (General)-interrogation command (CASDU=All) [317]	✓	✓
242	Set control location	✓	–
244	Send (General)-interrogation command (CASDU = selective) [317]	✓	✓

13.7.9.2 Protocol Element Return Information

Protocol element return information is internal status information of the protocol elements which is transmitted spontaneously and in the event of a general interrogation with internal message formats from the protocol element to the basic system element. On the basic system element, the protocol element return information items (see *13.1.4.11 Protocol Element Return Information*) are converted to IEC 60870-5-101/104 *messages with process information in monitoring direction*.

Supported Protocol Element Return Information

Protocol element return information `Return information function_(PRE)`	Station	MODMI0 [Master]	MODSI0 [Slave]
• Station status	0 to 99	✓	✓
• Station failure	0 to 99	✓	✓

13.7.10 Web server

A web server for internal diagnostic and statistical information is integrated in the protocol firmware. The web server itself is implemented on the basic system element - the protocol-specific web pages are provided by the protocol element.

System	Firmware	Designation	Protocol-specific web pages
CP-8031, CP-8050	MODMI0	Modbus RTU Master (serial)	✓
	MODSI0	Modbus RTU Slave (serial)	✓

Enable/disable web server or start web server via SICAM Device Manager or web browser see *13.1.4.12 Web server for protocol-specific web pages*.

Supported protocol-specific web pages

Web page	Modbus RTU Master [MODMI0]	Modbus RTU Slave [MODSI0]
Overview[318]	✓	✓
Stations	✓	✓
Transmit signals	✓	✓
Receive signals	✓	✓
Modbus-diagnostics (FC=08)	✓	–
SICAM FCM	✓	–

317 This function is processed on the BSE

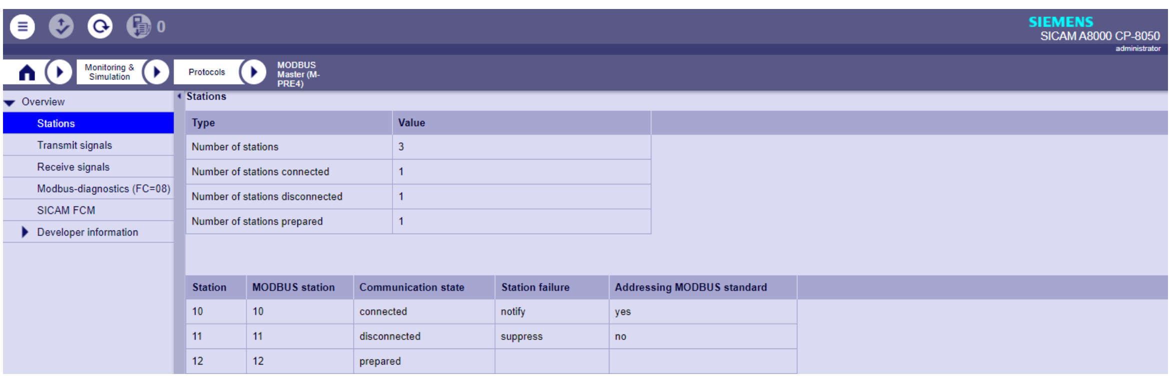
318 See *13.1.4.12 Web server for protocol-specific web pages*

Web page	Modbus RTU Master [MODMI0]	Modbus RTU Slave [MODSI0]
Developer Information[318]		
Datastream trace[318]	✓	✓
Diagnosis (IDR)[318]	✓	✓
Serialtest (IDH)[318]	✓	✓
Serialtest (IDZ)[318]	✓	✓
Statistic (IDE)[318]	✓	✓
User diagnosis (IDU)[318]	–	✓

13.7.10.1 Protocol specific web page: Stations

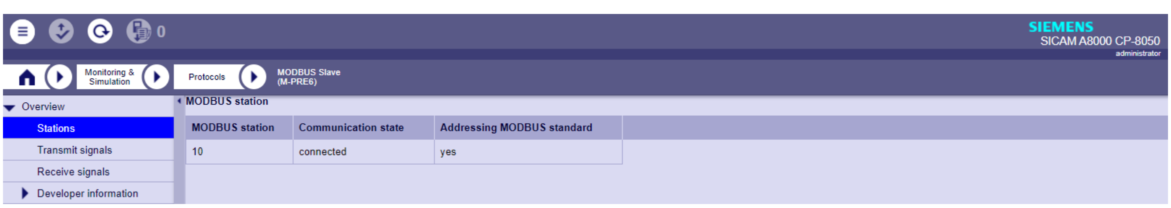
With web page **Stations** detailed information about the status of the connection to each connected station will be displayed.

Modbus RTU Master (MODMI0):



[MODMI0_WEB_Stations, 1, --_--]

Modbus RTU Slave (MODSI0):



[MODSI0_WEB_Stations, 1, --_--]

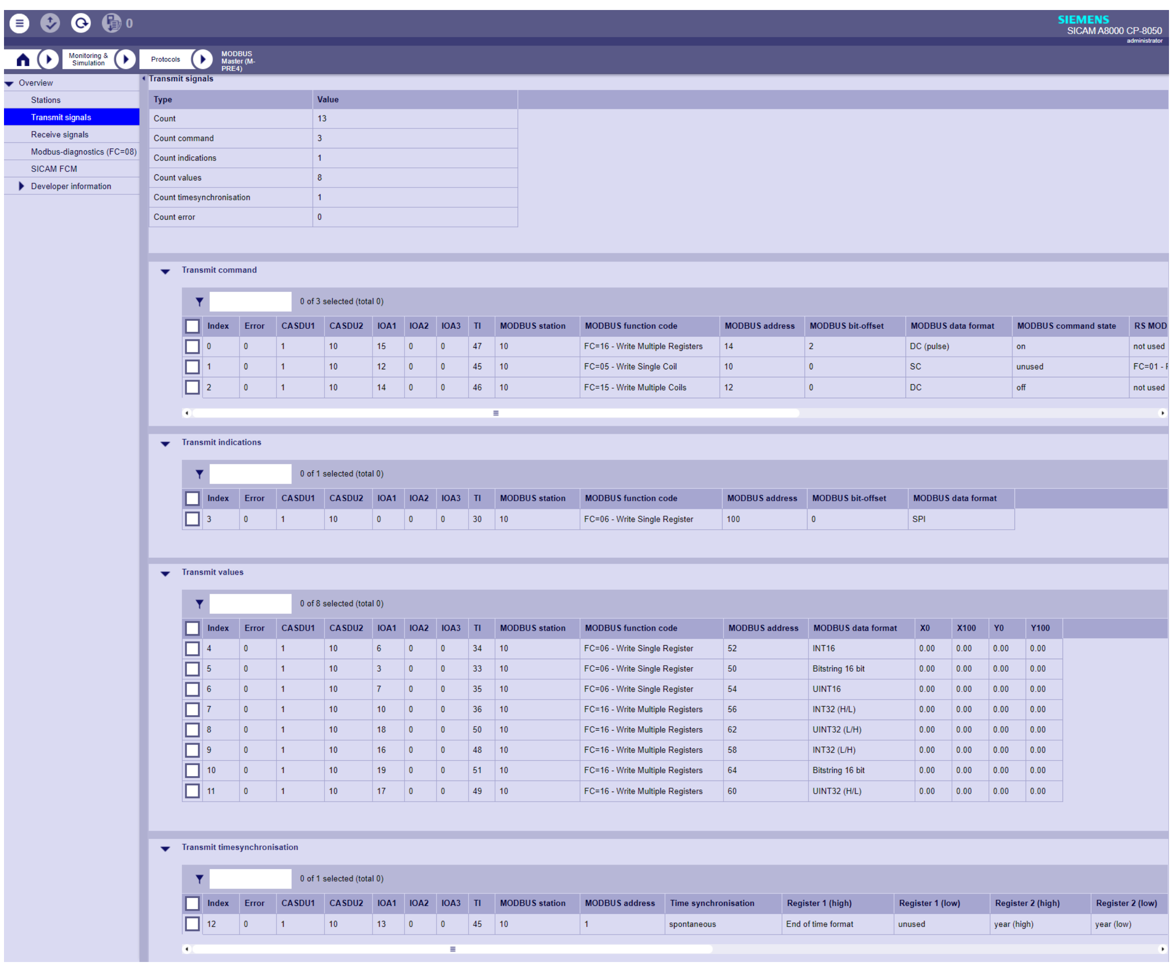
Field	Note
Number of stations	Number of parameterized stations
Number of stations connected	Number of established connections to stations
Number of stations disconnected	Number of cleared connections to stations
Number of stations prepared	Number of prepared connections to stations
Station	Internal station number for this connection
Modbus station	Modbus station address

Field	Note
Communication state	State of the connection to this station: • connected • disconnected • prepared
Station failure	report station failure • notify • suppress
Addressing Modbus standard	Addressing of the Modbus Register-/Coils according Modbus Standard: • yes • no

13.7.10.2 Protocol specific web page: Transmit signals

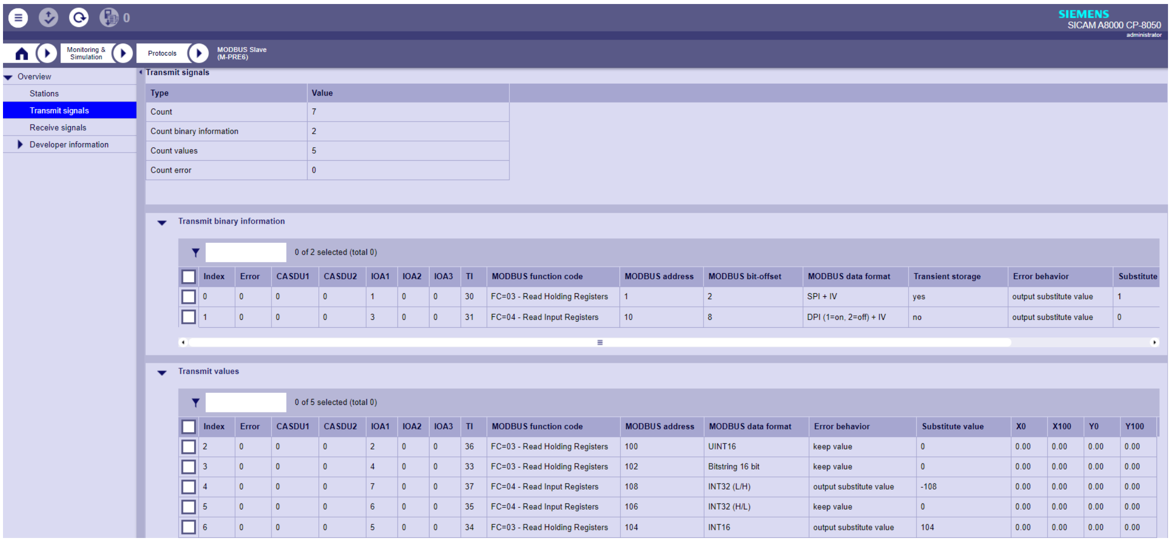
The **Transmit signals** web page displays information of the parameterized and by the protocol processed signals in transmit direction.

Modbus RTU Master (MODMI0):



[MODMI0_WEB_Transmit_Signals, 1, --_--]

Modbus RTU Slave (MODSI0):



[MODSI0_WEB_Transmit_Signals, 1, --_--]

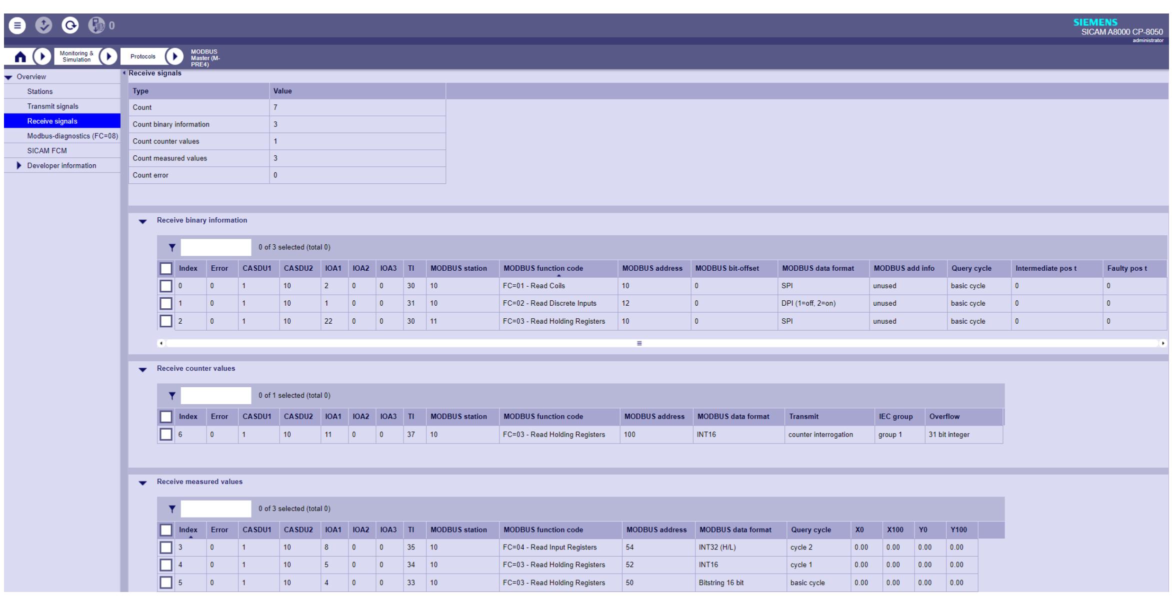
Field	Note
Count	Number of parameterized data points in transmit direction (total number for all stations)
Count command	Number of parameterized data points for “Commands” in transmission direction (total for all stations)
Count indications Count binary indications	Number of parameterized data points for “binary information” in transmit direction (total for all stations)
Count values	Number of parameterized data points for “values” in transmission direction (total for all stations)
Count timesynchronization	Number of parameterized data points for “time synchronization” in transmission direction (total for all stations)
Count error	Number of faulty parameterized data points in transmit direction (total number for all stations)
Transmit command	Parameterized data points for “commands” in transmit direction (total for all stations)
Transmit indications **Transmit binary information**	Parameterized data points for “indications/binary information” in transmit direction (total for all stations)
Transmit values	Parameterized data points for “values” in transmit direction (total for all stations)
Transmit timesynchronisation	Parameterized data points for “time synchronization” in transmit direction (total for all stations)
Index	Internal index in the detailed routing of the message conversion
Error	Error number (the last detected error is displayed in the diagnostic)
CASDU1, CASDU2 IOA1, IOA2, IOA3	Internal IEC 60870-5-101/104 address of the data point
TI	Internal IEC 60870-5-101/104 type identification
Modbus station	Modbus station address
Modbus function code	Modbus function code
Modbus address	Modbus register- or coil-address
Modbus bit-offset	Modbus bit position for the value in Modbus register
Modbus data format	Modbus Data Format

Field	Note
Modbus command state	Modbus command state
RS Modbus function code	Modbus function code of the return information
RS Modbus address	Modbus address of the return information
RS Modbus bit-offset	Modbus bit position of the return information in Modbus register
RS Modbus monitoring time	Return information monitoring time
RS Modbus state check	Status check of the return information in the case of return information monitoring
X0	X_0% for value adaptation
X100	X_100% for value adaptation
Y0	Y_0% for value adaptation
Y100	Y_100% for value adaptation
Transient_storage	Transient storage for binary information
Error behaviour	Selection of which value is transferred to Modbus if the internal value is faulty.
Substitute value	Substitute_value
Time synchronization	Trigger for transmitting the time synchronization
Register 1 (high)	Selected time element for time synchronization in the register
Register 1 (low)	Selected time element for time synchronization in the register
:	:
Register n (high)	Selected time element for time synchronization in the register
Register n (low)	Selected time element for time synchronization in the register

13.7.10.3 Protocol specific web page: Receive signals

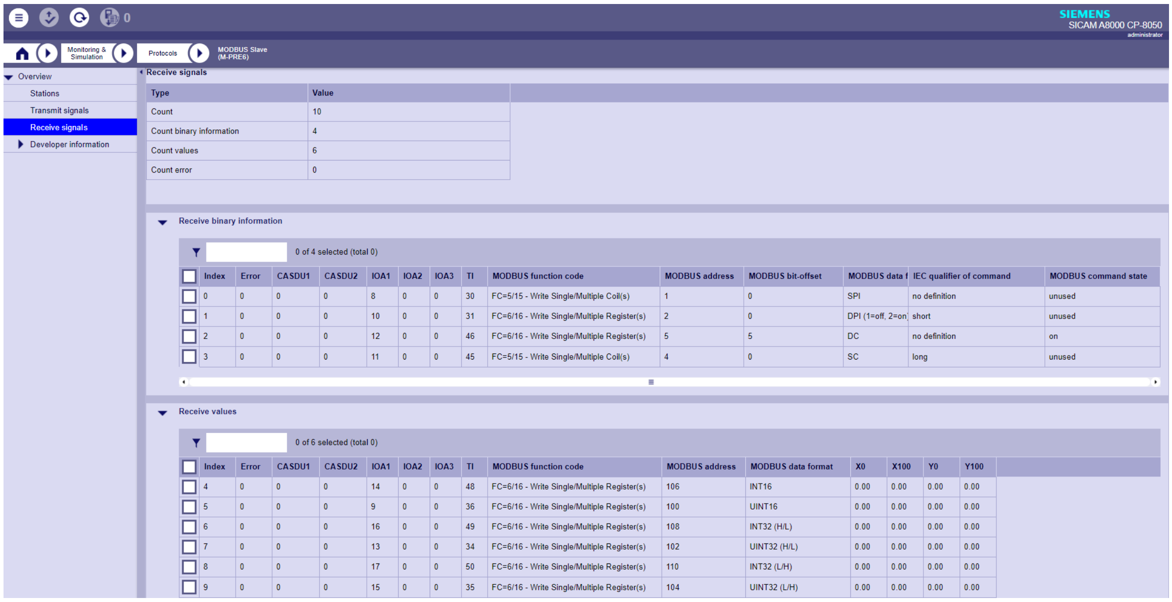
The **Receive signals** web page displays information of the parameterized and by the protocol processed signals in receive direction.

Modbus Master (MODMI0):



[MODMI0_Web_Receive_Signals, 1, --_--]

Modbus Slave (MODSI0):



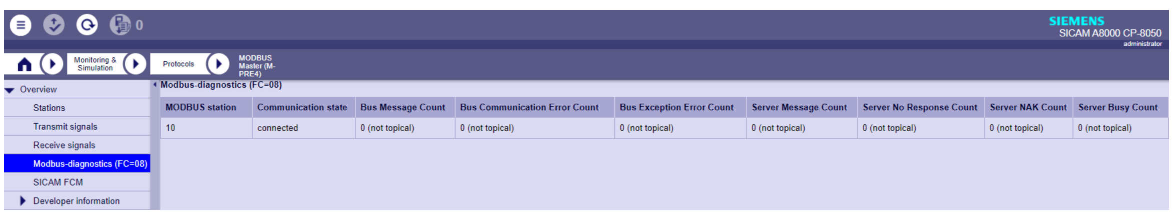
[MODSI0_WEB_Receive_Signals, 1, --_--]

Field	Note
Count	Number of parameterized data points in receive direction (total number for all stations)
Count binary indications	Number of parameterized data points for “binary information” in receive direction (total for all stations)
Count values	Number of parameterized data points for “values” in receive direction (total for all stations)
Count counter values	Number of parameterized data points for “integrated totals” in receive direction (total for all stations)
Count measured values	Number of parameterized data points for “measured values” in receive direction (total for all stations)
Count error	Number of faulty parameterized data points in receive direction (total number for all stations)
Receive binary information	Parameterized data points for “binary information” in receive direction (total for all stations)
Receive counter values	Parameterized data points for “integrated totals” in receive direction (total for all stations)
Receive measured values	Parameterized data points for “measured values” in receive direction (total for all stations)
Index	Internal index in the detailed routing of the message conversion
Error	Error number (the last detected error is displayed in the diagnostic)
CASDU1, CASDU2 IOA1, IOA2, IOA3	Internal IEC 60870-5-101/104 address of the data point
TI	Internal IEC 60870-5-101/104 type identification
Modbus station	Modbus station address
Modbus function code	Modbus function code
Modbus address	Modbus register- or coil-address
Modbus bit-offset	Modbus bit position for the value in Modbus register
Modbus data format	Modbus Data Format

Field	Note
Modbus add info	Trigger for querying the data points tripped by a trigger
Query cycle	Query cycle for Modbus data
Intermediate pos t	Intermediate position suppression time for double-point information
Faulty pos t	Suppression time for faulty state for double-point information
Transmit	Transmission time of the integrated total
IEC group	IEC 60870-5-101/104 counter group
Overflow	Value format for counter overflow
X0	X_0% for value adaptation
X100	X_100% for value adaptation
Y0	Y_0% for value adaptation
Y100	Y_100% for value adaptation

13.7.10.4 Protocol specific web page: Modbus-diagnostics (FC=08)

On the **Modbus-diagnostics (FC=08)** web page, the last queried diagnostic counters of the connected stations are displayed according to the Modbus standard. This diagnostic information is read out by the Modbus master with function code = 08 (=Diagnostics) from the connected Modbus devices.



[MODMI0_WEB_FC08, 1, --_--]

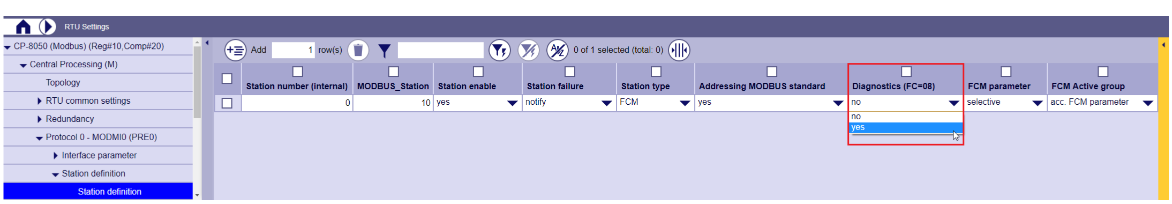
Field	Note
Modbus station	Modbus station address
Communication state	State of the connection to this station: • connected • disconnected
Bus Message Count	Number of messages that the Modbus device has recognized since its last power-up, restart or clearing of the counter. • 0 to 65535 • 0 (not topical) .. Information not available
Bus Communication Error Count	Number of CRC faults that the Modbus device has recognized since the last power-up, restart or clearing of the counter. • 0 to 65535 • 0 (not topical) .. Information not available
Bus Exception Error Count	Number of Modbus exception codes that the Modbus device has sent since the last power-up, restart or clearing of the counter. • 0 to 65535 • 0 (not topical) .. Information not available

Field	Note
Server Message Count	Number of Modbus messages that the addressed Modbus device has received since the last power-up, restart or clearing of the counter. • 0 to 65535 • 0 (not topical) .. Information not available
Server No Response Count	Number of Modbus messages to the addressed Modbus device that have not been answered by it since the last power-up, restart or clearing of the counter (neither exception response nor normal response). • 0 to 65535 • 0 (not topical) .. Information not available
Server NAK Count	Number of Modbus messages to the addressed Modbus device that have been answered with a negative acknowledgment (NAK) since the last power-up, restart or clearing of the counter. • 0 to 65535 • 0 (not topical) .. Information not available
Server Busy Count	Number of Modbus messages to the addressed Modbus device that have been replied to with an exception code (BUSY) since the last power-up, restart or clearing of the counter. • 0 to 65535 • 0 (not topical) .. Information not available

NOTE

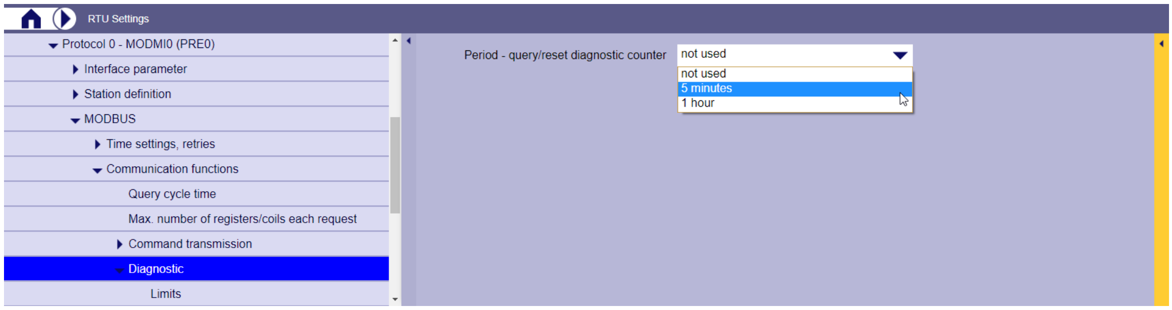
- Many Modbus devices do not support the function code=08 “Diagnostics”. Some devices do not answer the telegrams from the master. A communication failure occurs here. The function must be deactivated in the Modbus master for these devices!
- For Modbus devices that do not support Modbus diagnostics with FC = 08 or the diagnostic counters have not yet been queried after startup, the counters are displayed with “0 (not topical)” (= information not available).
- The Modbus master only supports diagnosis counters with 16 bits (0 to 65535)!

The diagnosis (FC = 08) must be enabled selectively for each station in the Modbus master in the station definition.



[MODMI0_DM_Stationsdefinition_Diagnose_FC08, 2, en_US]

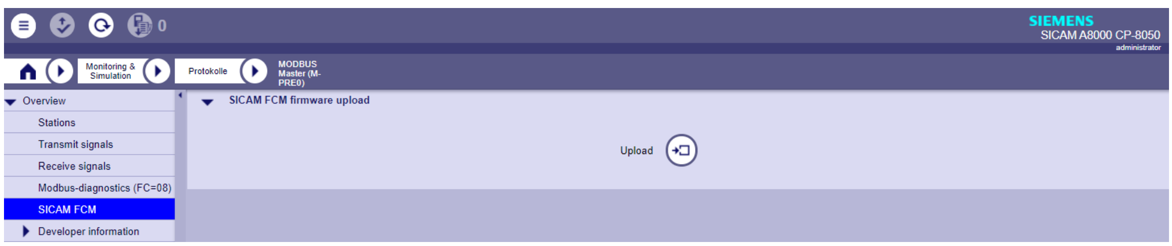
The Modbus master polls the diagnostic values (FC=08) from the Modbus devices cyclically in the selected time grid.
After querying the diagnostic values, these are reset in the Modbus devices.



[MODMI0_DM_Diagnose_FC08, 2, en_US]

13.7.10.5 Protocol specific web page: SICAM FCM firmware upload

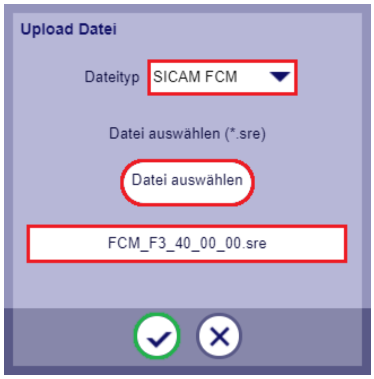
The update of the firmware in the SICAM FCM devices - controlled by the CP-8050 - is initiated via the **SICAM FCM firmware upload** web page.



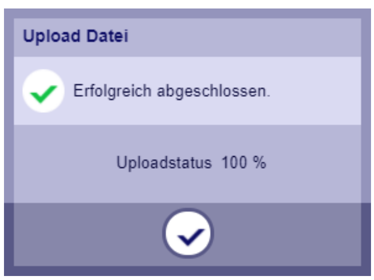
[MODMI0_WEB_SICAM_FCM_Firmware_Upload_1, 1, --_--]

- Start upload

- Select file
  - SICAM FCM Firmware File (Data type = SICAM FCM)
    Note: here the firmware file as an example <FCM_F3_40_00_00.sre>



... after selecting the file, the SICAM FCM firmware file is copied to the SD card of the CP-8050; then the firmware is loaded into the connected SICAM FCM devices via the serial interface - controlled by the Modbus RTU master protocol.



13.7.11 Message Conversion

Data in transmit direction are transferred from the basic system element to the protocol element in SICAM A8000 internal IEC 60870-5-101/104 (without 101/104 blocking) format. The data formats are converted to the Modbus RTU line format on the protocol element. The transmission of the data according to Modbus RTU is controlled by the protocol element.

Data in receive direction is converted by the protocol element from the Modbus RTU format to a SICAM A8000 internal IEC 60870-5-101/104 format and transferred to the basic system element (no 101/104 blocking). The transmission of the data according to Modbus RTU is controlled by the protocol element.

The conversion of the SICAM A8000 internal IEC 60870-5-101/104 message format ↔ Modbus RTU data format and the conversion of the address information are called message conversion.

The parameterization of the conversion from IEC 60870-5-101/104 ↔ Modbus RTU (address and message format) is to be done with the SICAM Device Manager with function “Signals” or with the SICAM TOOLBOX II, OPM II using “SIP Message Address Conversion”.

Supported processing types for message conversion

Data	Direction	Processing type	MODMI0	MODSI0
Binary information	Receive direction	firmware / **`Rec_binary_information`**	✓	✓
Commands	Receive direction	firmware / **`Rec_binary_information`**	–	✓
Measured values	Receive direction	firmware / **`Rec_measured_values`**	✓	–
Measured values	Receive direction	firmware / **`Rec_values`**	–	✓
Setpoint values	Receive direction	firmware / **`Rec_values`**	–	✓
Integrated totals	Receive direction	firmware / **`Rec_counter_value`**	✓	✓
Binary information	Transmit direction	firmware / **`Trans_binary_information`**	✓	–
Binary information	Transmit direction	firmware / **`Trans_binary_information`**	–	✓

Data	Direction	Processing type	MODMI0	MODSI0
Commands	Transmit direction	firmware / **`Trans_binary_information`**	–	✓
Commands	Transmit direction	firmware / **`Trans_command`**	✓	–
Measured values	Transmit direction	firmware / **`Trans_values`**	✓	✓
Setpoint values	Transmit direction	firmware / **`Trans_values`**	✓	–
Bitstring	Transmit direction	firmware / **`Trans_value`**	✓	✓
Integrated totals	Transmit direction	firmware / **`Trans_value`**	–	✓
Time synchronization	Transmit direction	firmware / **`Trans_timesynchronisation`**	✓	–

General description of the parameters and properties (valid for each type of processing)

Parameter	
`MODBUS_Station`	Address of the Modbus Slave (SICAM A8000 internal): 0 to 99 Note: This Modbus station number is only used internally by SICAM A8000 for message conversion and internal system functions. This Modbus station number is not transmitted on the line!
`MODBUS_address`	Modbus Address (Coil- or Register Address): 1 to 65534 (65535) Note: • The Modbus address (= coil or register address) which is specified in the device descriptions in the Register-MAP is always parameterized. • According to the Modbus standard, the Modbus register address on the line is always transmitted with offset –1. Example: parameterized Modbus register address = 0001 → Modbus register address = 0000 on the line • Some device manufacturers do not always adhere to the standard on this point and require "parameterized Modbus address" = "Modbus address on the line". In the parameters of the connection definition the Modbus addressing on the line per Modbus station can be set. – Addressing Modbus Standard = yes (default) – Addressing Modbus Standard = no

13.7.11.1 Message Conversion in Transmit Direction – Modbus RTU Master

Message conversion in transmit direction: IEC 60870-5-101/104 → Modbus RTU

SICAM A8000: IEC 60870-5-101/104 →		Modbus RTU Format	
TI	**Designation**	**FC**	**Data format**
<TI:=30>	Single-point information with time tag CP56Time2a	05, 06, 15, 16	SPI
<TI:=33>	Bitstring of 32 bits with time tag CP56Time2a	06, 16	BS16
<TI:=34>	Measured value, normalized value with time tag CP56Time2a	06	INT16, UINT16
		16	INT16, INT32 (H/L), INT32 (L/H), UINT16, UINT32 (H/L), UINT32 (L/H), FLOAT32, FLOAT32 (swapped), FLOAT32 (little endian)

SICAM A8000: IEC 60870-5-101/104 →		Modbus RTU Format	
<TI:=35>	Measured value, scaled value with time tag CP56Time2a	06	INT16, UINT16
		16	INT16, INT32 (H/L), INT32 (L/H), UINT16, UINT32 (H/L), UINT32 (L/H), FLOAT32, FLOAT32 (swapped), FLOAT32 (little endian)
<TI:=36>	Measured value, floating-point number with time tag CP56Time2a	06	INT16, UINT16
		16	INT16, INT32 (H/L), INT32 (L/H), UINT16, UINT32 (H/L), UINT32 (L/H), FLOAT32, FLOAT32 (swapped), FLOAT32 (little endian)
<TI:=45>	Single command	05, 06, 15, 16	SC, SC (pulse)
<TI:=46>	Double command	05, 06, 15, 16	DC, DC (pulse), SC
<TI:=47>	Regulating step command	05, 06, 15, 16	DC, DC (pulse), SC
<TI:=48>	Setpoint command, normalized value	06	INT16, UINT16
		16	INT16, INT32 (H/L), INT32 (L/H), UINT16, UINT32 (H/L), UINT32 (L/H), FLOAT32, FLOAT32 (swapped), FLOAT32 (little endian)
<TI:=49>	Setpoint command, scaled value	06	INT16, UINT16
		16	INT16, INT32 (H/L), INT32 (L/H), UINT16, UINT32 (H/L), UINT32 (L/H), FLOAT32, FLOAT32 (swapped), FLOAT32 (little endian)
<TI:=50>	Setpoint command, short floating-point number	06	INT16, UINT16
		16	INT16, INT32 (H/L), INT32 (L/H), UINT16, UINT32 (H/L), UINT32 (L/H), FLOAT32, FLOAT32 (swapped), FLOAT32 (little endian)
<TI:=51>	Bitstring 32-bit	06, 16	BS16
<TI:=100>	Interrogation command [319]	-	-
<TI:=101>	Counter interrogation command	-	-
<TI:=45>	Single command "Time synchronization"	16	DTx

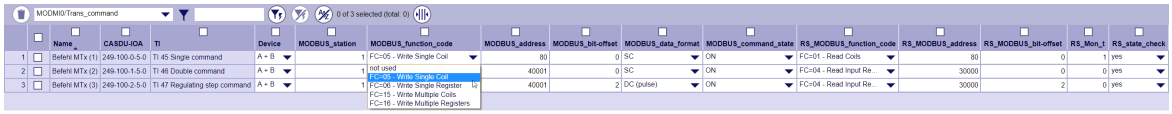
Modbus Function Codes (FC):
05 .. Write Single Coil
06 .. Write Single Register
15 .. Write Multiple Coils
16 .. Write Multiple Registers

Commands

The parameterization of the address and message conversion for commands from Modbus RTU Master in transmit direction is to be done with the SICAM Device Manager with the function "Signals" or with the SICAM TOOLBOX II, OPM II.

[319] The Modbus protocol does not define a general interrogation procedure. With SICAM A8000 internal general interrogation the data requested by the central station are forwarded to the basic system element during the next interrogation with the cause of transmission COT=20 (interrogated by station interrogation).

Processing type: *firmware* / `Trans_command`



[MODMI0_DM_Sende_Befehl, 2, en_US]

Parameter	
TI	Supported type identifications: • <TI:=45> .. Single command • <TI:=46> .. Double command • <TI:=47> .. Regulating step command
Name	Name of the signal
CASDU-IOA	SICAM A8000 internal IEC 60870-5-101/104 message address (CASDU1, CASDU2, IOA1, IOA2, IOA3)
MODBUS_Station	Modbus Slave station address: • 1 to 247
MODBUS_function_code	Supported Modbus function codes: • FC = 05 .. Write Single Coil • FC = 06 .. Write Single Register [320] • FC = 15 .. Write Multiple Coils • FC = 16 .. Write Multiple Register [320]
MODBUS_address	Modbus address (register or coil address): • 1 to 65535 (single command; double command with FC = 06, 16) • 1 to 65534 (double command with FC = 05, 15) The bits of a double command are always next to each other.
MODBUS_bit-offset	Bit number in the corresponding Modbus register: • 0 .. Single command, double command [with FC = 05, 15] • 0 to 15 .. Single command [only FC = 06, 16] • 0 to 14 .. Double command [only FC = 06, 16] Double commands use 2 contiguous bits in the same Modbus register. With the Modbus bit offset always the 1st bit of the double command specified.
MODBUS_data_format	Data format on the Modbus: • SC .. Single command • DC .. Double command [only FC = 15; 06, 16] • SC (pulse) .. Single command pulse • DC (pulse) .. Double command pulse
MODBUS_command_state	Modbus command state: <only for double commands> • OFF • ON On the parameterized Modbus_address / Modbus_bit-offset the parameterized selected Modbus_command_state is output (possible inversion of the command output)

320 Only 1 data point is supported per Modbus register!

NOTE

With function code FC = 06 (WRITE SINGLE REGISTER) and function code FC = 16 (WRITE MULTIPLE REGISTERS), only 1 data point is supported per Modbus register!

Supported Data Formats

Format	Modbus data format	IEC 60870-5-101/104 data format (TI)
SC	Single command	45, 46, 47
SC (pulse)	Single command pulse	45
DC	Double command	46, 47
DC (pulse)	Double command pulse	46, 47

NOTE

Since the Modbus protocol does not define how the data is represented in the coils/registers, the Modbus format must be specified for the message conversion. Supported Modbus data formats see *13.7.13 Modbus Data Formats*.

Control Location / Check Control Location

The function "Control location" is used so that commands are only output from authorized sources. If the function is activated, commands from the protocol element are only transmitted to the remote station, when the control location (originator address) is enabled.

If the control location is not enabled, the protocol element immediately sends back a negative acknowledgment of activation (ACTCON) to the originator address (further details about control location see section *13.1.4.9 Control location function for commands and setpoint values*).

Command Output Time for Single-/Double Commands

Commands can be transmitted on the Modbus as pulses (1 or 2 bits). The protocol element maps the command output as a pulse to 1 or 2 bits in the Modbus register or 1 or 2 coil addresses of the Modbus slave with the associated command output time.

The command output time (duration of the pulse) is set for commands with qualifier of command = <0> "no additional definition" with the parameter **`[PRE] MODBUS | Communication functions | Command transmission | command pulse duration | Command with no addt'l def. (sec)`** .

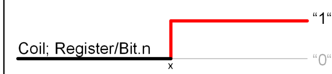
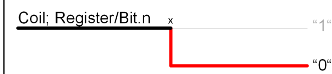
The pulse duration of commands with qualifier of command = <1> "short pulse duration" must be set on the protocol element with the parameter **`[PRE] MODBUS | Communication functions | Command transmission | command output time | Command with short pulse duration (sec)`** .

The pulse duration of commands with qualifier of command = <2> "long pulse duration" must be set with the parameter **`[PRE] MODBUS | Communication functions | Command transmission | command output time | Command with long pulse duration (sec)`** .

Max. 10 commands pulse commands (single-, double -, regulating stepcommands) will be executed at the same time.

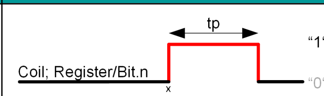
Single Command SC

A single command with the status SCS = ON or SCS = OFF is transmitted on the Modbus with the current status.

Modbus data format	Command state	Command output 1 bit as coil or 1 bit in Modbus register
SC	SCS = ON	 x ... command = ON
	SCS = OFF	 x ... command = OFF

Single Command SC (Pulse)

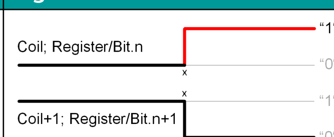
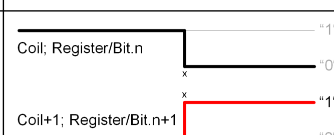
A single command with command state SCS = ON will be output on the Modbus as pulse with parametrized command output time.

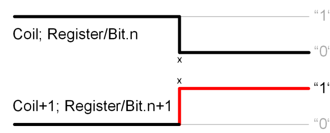
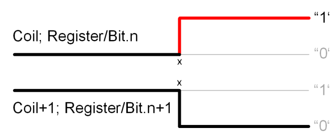
Modbus data format	Command state	Command output 1 bit as coil or 1 bit in Modbus register
SC (pulse)	SCS = ON	 tp ... command output time (pulse duration) x ... command = ON
	SCS = OFF	The OFF state is not evaluated!

If a further command with the same IEC 60870-5-101/104 address is initiated during command output in progress, this one will be discarded with a negative confirmation to the BSE (ACTCON-). The current pulse output of the command is not affected.

Double Command DC

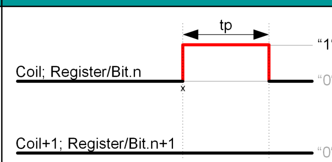
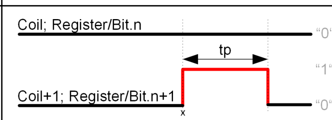
A double command or regulating step command with the status DCS = ON/OFF or RCS = HIGHER/LOWER is output as a state on the Modbus.

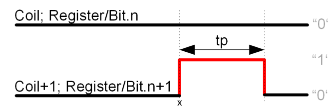
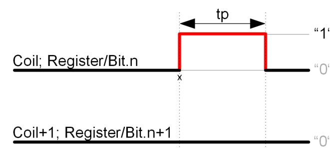
Modbus data format	Command state	Command output 2 bits as coil or 2 bits in Modbus register
DC `Modbus_command_state` = ON	DCS = ON RCS = HIGHER	 x ... command = ON
	DCS = OFF RCS = LOWER	 x ... command = OFF

Modbus data format	Command state	Command output 2 bits as coil or 2 bits in Modbus register
DC **Modbus_command_state** = OFF	DCS = ON RCS = HIGHER	 x ... command = ON
	DCS = OFF RCS = LOWER	 x ... command = OFF

Double Command DC (Pulse)

A double command or regulating step command with the status DCS = ON/OFF or RCS = HIGHER/LOWER is output on the Modbus as pulse with the set command output time.

Modbus data format	Command state	Command output 2 bits as coil or 2 bits in Modbus register
DC (pulse) **Modbus_command_state** = ON	DCS = ON RCS = HIGHER	 tp ... command output time (pulse duration) x ... command = ON
	DCS = OFF RCS = LOWER	 tp ... command output time (pulse duration) x ... command = OFF

Modbus data format	Command state	Command output 2 bits as coil or 2 bits in Modbus register
DC (pulse) **`Modbus_command_state`** = OFF	DCS = ON RCS = HIGHER	 tp ... command output time (pulse duration) x ... command = ON
	DCS = OFF RCS = LOWER	 tp ... command output time (pulse duration) x ... command = OFF

If a further command with the same IEC 60870-5-101/104 address is initiated during command output in progress, this one will be discarded with a negative confirmation to the BSE (ACTCON-).

The current pulse output of the command is not affected.

Message Conversion

The table describes the evaluated elements of the IEC 60870-5-101/104 message during message conversion.

Elements of the message		
TI .. Type identification		• <TI:=45> .. Single command • <TI:=46> .. Double command • <TI:=47> .. Regulating step command
CASDU, IOA .. Message address		Parameter-settable
Cause of transmission		
06 .. Activation		BSE→PRE: evaluated an the PRE (only "activation" accepted)
07 .. Confirmation of activation		PRE→BSE:
08 .. Abortion of activation		BSE→PRE: not supported. Is confirmed negative (ACTCON-)
09 .. Confirmation of the abortion of activation		PRE→BSE: Abortion of the activation is confirmed negative (ACTCON-)
10 .. Activation termination		Not supported
xx .. Other COTs		Not supported
T .. Test		Not supported
Information		
SCO/DCO/RCO		
SCS	Single command state	[only <TI:=45>]
	0 .. OFF	Evaluated
	1 .. ON	Evaluated

Elements of the message		
DCS	Double command state	[only <TI:=46>]
	0 .. Not allowed	Not supported
	1 .. OFF	Evaluated
	2 .. ON	Evaluated
	3 .. Not allowed	Not supported
RCS	Regulating step command state	[only <TI:=47>]
	0 .. Not allowed	Not supported
	1 .. Next step lower	Evaluated
	2 .. Next step higher	Evaluated
	3 .. Not allowed	Not supported
QOC	S/E	
	0 .. Execute	Is checked for "execute"
	1 .. Select	Not supported; is confirmed negative (ACTCON-)
QU	0 .. No additional definitions	Evaluated
	1 .. Short pulse duration	Evaluated
	2 .. Long pulse duration	Evaluated
	3 .. Persistent command	Not supported

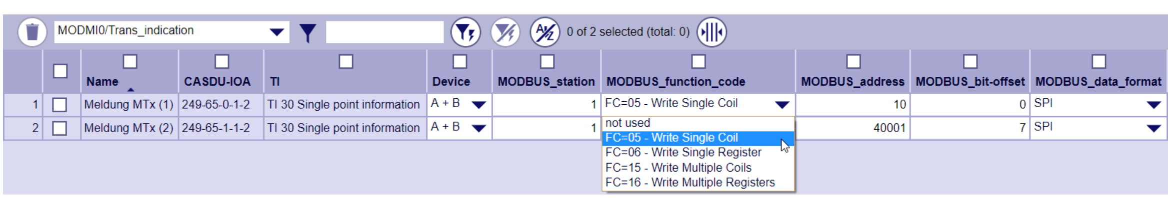
NOTE

Not listed elements of the IEC 60870-5-101/104 message are not rated/not supported!

Binary Information

The parameterization of the address and message conversion for binary information from Modbus RTU Master in transmit direction is to be done with the SICAM Device Manager with the function "Signals" or with the SICAM TOOLBOX II, OPM II.

Processing type: *firmware* / `Trans_binary_information`



[MODMI0_DM_Sende_Meldung, 2, en_US]

Parameter	
TI	Supported type identifications: • <TI:=30> .. Single-point information with time tag CP56Time2a
Name	Name of the signal
CASDU-IOA	SICAM A8000 internal IEC 60870-5-101/104 message address (CASDU1, CASDU2, IOA1, IOA2, IOA3)
MODBUS_Station	Modbus Slave station address: • 1 to 247

Parameter	
MODBUS_func-tion_code	Supported Modbus function codes: • FC = 05 .. Write Single Coil • FC = 06 .. Write Single Register [321] • FC = 15 .. Write Multiple Coils • FC = 16 .. Write Multiple Register [321]
MODBUS_address	Modbus address (register or coil address): • 1 to 65535
MODBUS_bit-offset	Bit number in the corresponding Modbus register: • 0 .. Single command [only FC = 05, 15] • 0 to 15 .. Single command [only FC = 06, 16]
MODBUS_data_format	Data format on the Modbus: SPI .. Single-point information

NOTE

With function code FC = 06 (Write Single Register) and function code FC = 16 (Write Multiple Register), only 1 data point is supported per Modbus register!

Binary information items are only transmitted by the Modbus master if NT = 0 and IV = 0.

Supported Data Formats

Format	Modbus data format	IEC 60870-5-101/104 data format (TI)
SPI	Single-point information	30

NOTE

Since the Modbus protocol does not define how the data is represented in the coils/registers, the Modbus format must be specified for the message conversion. Supported Modbus data formats see *13.7.13 Modbus Data Formats*.

Message Conversion

The table describes the evaluated elements of the IEC 60870-5-101/104 message during message conversion.

Elements of the message	
TI .. Type identification	<TI:=30> .. Single-point information with time tag CP56Time2a
CASDU, IOA .. Message address	Parameter-settable
QDS .. Quality descriptor	
BL .. Blocked	Not evaluated
SB .. Substituted	Not evaluated
NT .. Not topical	NT = 1: Binary information is not transmitted!
IV .. Invalid	IV = 1: Binary information is not transmitted!
Cause of transmission	

321 Only 1 data point is supported per Modbus register!

Elements of the message		
xx ..		Not evaluated
T .. Test		Not evaluated
Information		
Single-point information status		
SPI	0 .. OFF	Evaluated
	1 .. ON	Evaluated
Time tag		
CP56Time2a .. Date + time		Not rated

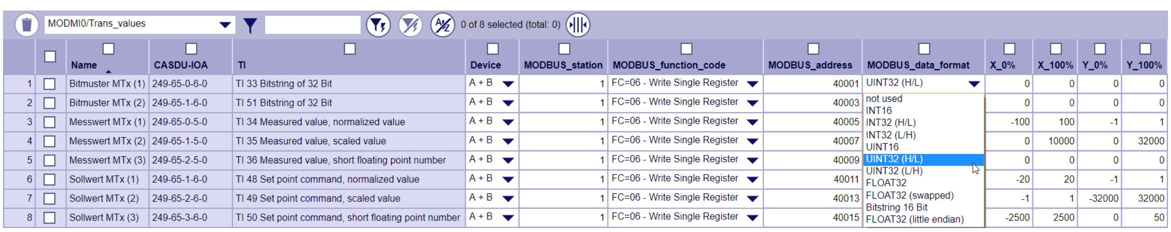
NOTE

Not listed elements of the IEC 60870-5-101/104 message are not rated / not supported!

Measured values, Setpoint values, Bitstrings

The parameterization of the address and message conversion for measured values, setpoint values, bitstrings from Modbus RTU Master in transmit direction is to be done with the SICAM Device Manager with the function “Signals” or with the SICAM TOOLBOX II, OPM II.

Processing type: *firmware* / **`Trans_values`**



[MODMI0_DM_Sende_Werte, 1, en_US]

Parameter	
`TI`	Supported type identifications: • <TI:=33> .. Bitstring of 32 bits with time tag CP56Time2a • <TI:=34> .. Measured value, normalized value with time tag CP56Time2a • <TI:=35> .. Measured value, scaled value with time tag CP56Time2a • <TI:=36> .. Measured value, short floating-point number with time tag CP56Time2a • <TI:=48> .. Setpoint command, normalized value • <TI:=49> .. Setpoint command, scaled value • <TI:=50> .. Setpoint command, short floating-point number • <TI:=51> .. Bitstring 32-bit
`Name`	Name of the signal
`CASDU-IOA`	SICAM A8000 internal IEC 60870-5-101/104 message address (CASDU1, CASDU2, IOA1, IOA2, IOA3)
`MODBUS_Station`	Modbus Slave station address: • 1 to 247

Parameter	
MODBUS_function_code	Supported Modbus function codes: • FC = 06 .. Write Single Register • FC = 16 .. Write Multiple Register
MODBUS_address	Modbus address (register address): • 1 to 65535
MODBUS_data_format	Data format on the Modbus: • INT16 • INT32 (H/L) [only FC = 16] • INT32 (L/H) [only FC = 16] • UINT16 • UINT32 (H/L) [only FC = 16] • UINT32 (L/H) [only FC = 16] • FLOAT32 [only FC = 16] • FLOAT32 (swapped) [only FC = 16] • FLOAT32 (little endian) [only FC = 16] • BS16
X_0%, X_100% **Y_0%, Y_100%**	Parameters for value adaptation (scaling): • Valid range of value for X_0% and X_100% see *13.7.13 Modbus Data Formats* • <TI:=34, 48> .. **Y_0%** and **Y_100%** must not be greater or less than ± 1 • <TI:=35, 49> .. **Y_0%** and **Y_100%** must not be less than −32768 or greater than +32767. • Value adaptation inactive at **Y_0%** = 0 and **Y_100%** = 0

NOTE

Measured values/setpoint values/bitstrings are only transmitted by the Modbus RTU master if NT = 0 and IV = 0.

Supported Data Formats

Format	Modbus data format	IEC 60870-5-101/104 data format (TI)
INT16	Signed integer 16-bit	34, 35, 36, 48, 49, 50
INT32 (H/L)	Signed integer 32-bit (HIGH before LOW)	34, 35, 36, 48, 49, 50
INT32 (L/H)	Signed integer 32-bit (LOW before HIGH)	34, 35, 36, 48, 49, 50
UINT16	Unsigned integer 16-bit	34, 35, 36, 48, 49, 50
UINT32 (H/L)	Unsigned integer 32-bit (HIGH before LOW)	34, 35, 36, 48, 49, 50
UINT32 (L/H)	Unsigned integer 32-bit (LOW before HIGH)	34, 35, 36, 48, 49, 50
FLOAT32	Short floating-point (IEEE 754)	34, 35, 36, 48, 49, 50
FLOAT32 (swapped)	Short floating-point (IEEE 754) “swapped”	34, 35, 36, 48, 49, 50
FLOAT32 (little endian)	Short floating-point (IEEE 754) “little endian”	34, 35, 36, 48, 49, 50
BS16	Bitstring of 16 bits	33, 51

NOTE

Since the Modbus protocol does not define how the data is represented in the coils/registers, the Modbus format must be specified for the message conversion. Supported Modbus data formats see *13.7.13 Modbus Data Formats*.

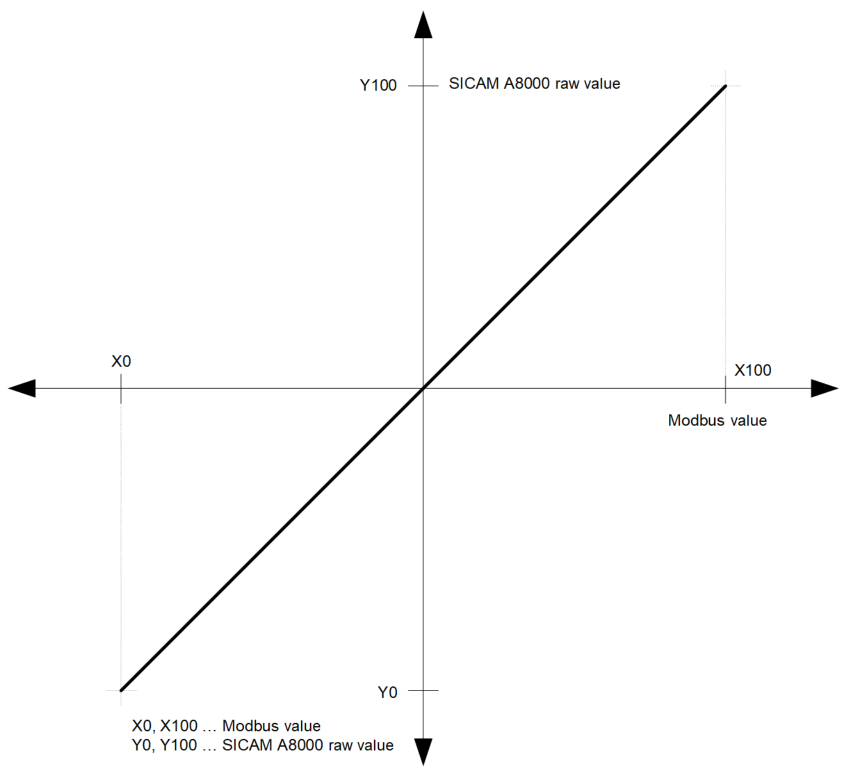
Control Location / Check Control Location

The function “Control location” is used so that setpoint values are only output from authorized sources. If the function is activated, setpoint commands from the protocol element are only transmitted to the remote station, when the control location (originator address) is enabled.

If the control location is not enabled, the protocol element immediately sends back a negative acknowledgment of activation (ACTCON) to the originator address (further details about control location see section *13.1.4.9 Control location function for commands and setpoint values*).

Value Adaptation[not for <TI:=33, 51>]

The value adaptation is defined by the parameters **X_0%**, **X_100%**, **Y_0%**, **Y_100%**.



The value adaptation is only performed if **Y_0%** or **Y_100%** ≠ *0* is parameterized.

- If adaptation is activated and the raw value of the SICAM A8000 is smaller than **Y_0%** or greater than **Y_100%**, then the value is limited on **X_0%** or **X_100%** and also transferred.
- If adaptation is not activated (= direct transfer, **Y_0%** = *0*, **Y_100%** = *0*) and the SICAM A8000 raw value is outside the value range of the selected Modbus data format, then the message conversion is aborted and the error message *Error of format conversion in transmit direction* is set.

Message Conversion

The table describes the evaluated elements of the IEC 60870-5-101/104 message during message conversion.

Elements of the message	
TI .. Type identification	• <TI:=33> .. Bitstring of 32 bits with time tag CP56Time2a • <TI:=34> .. Measured value, normalized value with time tag CP56Time2a • <TI:=35> .. Measured value, scaled value with time tag CP56Time2a • <TI:=36> .. Measured value, short floating-point number with time tag CP56Time2a • <TI:=48> .. Setpoint command, normalized value • <TI:=49> .. Setpoint command, scaled value • <TI:=50> .. Setpoint command, short floating-point number • <TI:=51> .. Bitstring 32 bit
CASDU, IOA .. Message address	Parameter-settable
QDS .. Quality descriptor	
BL .. Blocked	Not evaluated
SB .. Substituted	Not evaluated
NT .. Not topical	NT = 1: Value is not transmitted!
IV .. Invalid	IV = 1: Value is not transmitted!
OV .. Overflow	Not evaluated
Cause of transmission	
06 .. Activation	Is evaluated (only “activation” allowed) [only <TI:=48, 49, 50, 51>]
07 .. Confirmation of activation	PRE→BSE:
08 .. Abortion of activation	BSE→PRE: not supported. Is confirmed negative (ACTCON-)
09 .. Confirmation of the abortion of activation	PRE→BSE: Abortion of the activation is confirmed negative (ACTCON-)
10 .. Activation termination	Not supported
xx .. Other COTs	Not evaluated [only <TI:=33, 34, 35, 36, 37>]
T .. Test	Not evaluated
Information	
Value.. S .. Sign	• Normalized value • Scaled value • IEEE STD 754 = short floating-point number • Dual meter reading • Bitstring 32 bit (only bits 0 to 15 used, bits 16 to 31 are not evaluated)
QOS S/E	[only <TI:=48, 49, 50>]
QOS 0 .. Execute	Is checked for “execute”
QOS 1 .. Select	Not supported; is confirmed negative (ACTCON-)
Time tag	
CP56Time2a .. Date + time	Not evaluated

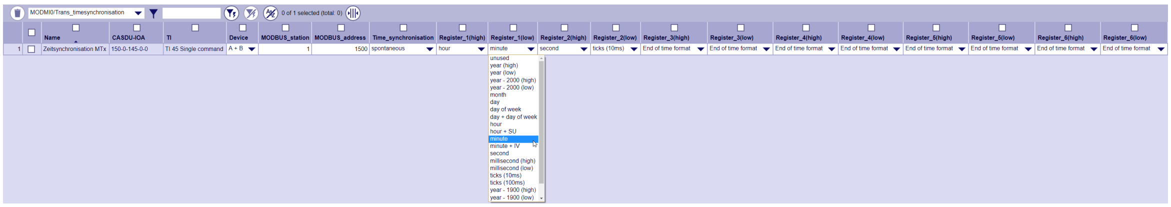
NOTE

Not listed elements of the IEC 60870-5-101/104 message are not rated/not supported!

Time Synchronization

The parameterization of the address and message conversion for time synchronization from Modbus RTU Master in transmit direction is to be done with the SICAM Device Manager with the function “Signals” or with the SICAM TOOLBOX II, OPM II.

Processing type: *firmware* / **`Trans_timesynchronisation`**



[MODMI0_DM_Sende_Zeitsynchronisation, 2, en_US]

Parameter	
`TI`	Supported type identifications: • <TI:=45> .. Single command
`Name`	Name of the signal
`CASDU-IOA`	SICAM A8000 internal IEC 60870-5-101/104 message address (CASDU1, CASDU2, IOA1, IOA2, IOA3)
`MODBUS_Station`	Modbus Slave station address • 1 to 247 For each Modbus station, a different message format for time synchronization can be defined. The transmission of the Modbus time synchronization message always takes place station-selective.
`MODBUS_address`	Modbus address (register address): • 1 to 65535

Parameter	
`Time synchronization`	Clock synchronization at: • Immediately spontaneous • Cyclically every 1 minute (offset = 0 s) • Cyclically every 1 minute (offset = 30 s) • Cyclically every 5th minute (offset = 0 s) • Cyclically every 10th minute (offset = 0 s) • Cyclic every 30. minute (offset = 0 s) • Cyclic every 60. minute (offset = 0 s) Spontaneous .. Transmission is spontaneously controlled by the single command <TI:=45> Offset = 0 s .. Transmission after minute change at 0th Second Offset = 30 s .. Transmission after minute change at 30th Second
`Register_1 (high)` **`Register_1 (low)`** **`Register_2 (high)`** **`Register_2 (low)`** **`Register_3 (high)`** **`Register_3 (low)`** **`Register_4 (high)`** **`Register_4 (low)`** **`Register_5 (high)`** **`Register_5 (low)`** **`Register_6 (high)`** **`Register_6 (low)`**	Modbus time element: • Year (high) • Year (low) • Year - 2000 (high) • Year - 2000 (low) • Year - 1900 (high) • Year - 1900 (low) • Month • Day • Weekday • Day + day of week • Hour • Hour + SU • Minute • Minute + IV • Second • Millisecond (high) • Millisecond (low) • Ticks (10 ms) • Ticks (100 ms) • End of time format • Status (SICAM T)

NOTE

Details for “Modbus time element” see *13.7.13 Modbus Data Formats*.

The freely definable Modbus time synchronization message is sent out excluding the end identifier. If the end identifier is in a Register_n (low), then this part of the Modbus register is transferred with the value 0.

Supported Data Formats

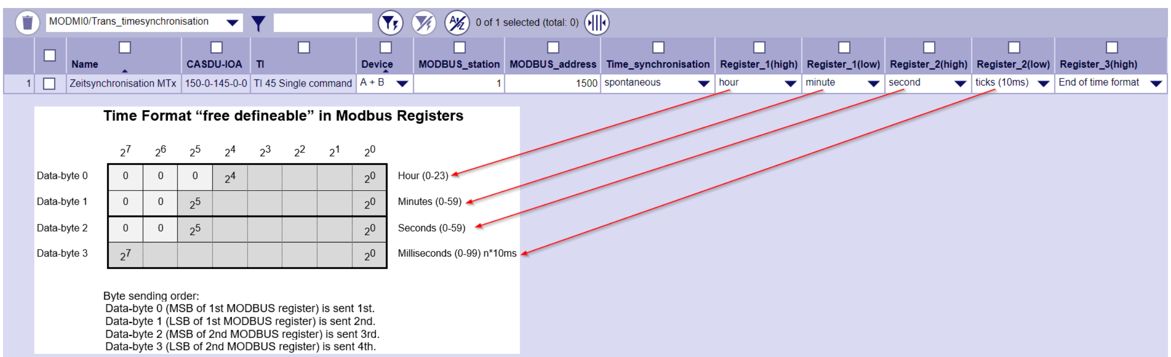
Format	Modbus data format	IEC 60870-5-101/104 data format (TI)
DTx	Date and time (freely definable)	45

NOTE

Since the Modbus protocol does not define how the data is represented in the coils/registers, the Modbus format must be specified for the message conversion. Supported Modbus data formats see *13.7.13 Modbus Data Formats*.

Free Definable Time Synchronization Format (Example)

- Time synchronization controlled by <TI:= 5> single command with the address CASDU=150, IOA=145 on the Modbus address 1500.



[MODMI0_DM_Modbus_Zeitformat, 1, en_US]

Message Conversion

The table describes the evaluated elements of the IEC 60870-5-101/104 message during message conversion.

Elements of the message		
TI .. Type identification		<TI:=45> .. Single command
CASDU, IOA .. Message address		Parameter-settable
Cause of transmission		
06 .. Activation		Is evaluated (only “activation” allowed)
xx .. Other COTs		Not accepted (only “activation” allowed)
T .. Test		Not supported
Information		
SCO		
SCS	Single command state	
	0 .. OFF	Not evaluated
	1 .. ON	Not evaluated
QOC	S/E	
	0 .. Execute	Is checked for “execute”
	1 .. Select	Not supported

Elements of the message		
QU	Command qualifier	
	0 .. No additional definitions	Evaluated
	1 .. Short pulse duration	Evaluated
	2 .. Long pulse duration	Evaluated
	3 .. Persistent command	Not supported

NOTE

Not listed elements of the IEC 60870-5-101/104 message are not rated/not supported!

13.7.11.2 Message Conversion in Receive Direction – Modbus RTU Master

Message conversion in receive direction: IEC 60870-5-101/104 ← Modbus RTU

SICAM A8000: IEC 60870-5-101/104 ←		Modbus RTU Format	
TI	**Designation**	**FC**	**Data format**
<TI:=30>	Single-point information with time tag CP56Time2a	01, 02, 03, 04	SPI
		03, 04	SPI + IV
<TI:=31>	Double-point information with time tag CP56Time2a	01, 02, 03, 04	DPI (1 = off, 2 = on) , DPI (1 = on, 2 = off), SPI
		03, 04	DPI (1 = off, 2 = on) + IV, DPI (1 = on, 2 = off) + IV
<TI:=33>	Bitstring of 32 bits with time tag CP56Time2a	03, 04	BS16
<TI:=34>	Measured value, normalized value with time tag CP56Time2a	03, 04	INT16, INT16 + IV, INT32 (H/L), INT32 (L/H), UINT16, UINT16 + IV, UINT32 (H/L), UINT32 (L/H), FLOAT32, FLOAT32 (swapped), FLOAT32 (little endian)
<TI:=35>	Measured value, scaled value with time tag CP56Time2a	03, 04	INT16, INT16 + IV, INT32 (H/L), INT32 (L/H), UINT16, UINT16 + IV, UINT32 (H/L), UINT32 (L/H), FLOAT32, FLOAT32 (swapped), FLOAT32 (little endian)
<TI:=36>	Measured value, floating-point number with time tag CP56Time2a	03, 04	INT16, INT16 + IV, INT32 (H/L), INT32 (L/H), UINT16, UINT16 + IV, UINT32 (H/L), UINT32 (L/H), FLOAT32, FLOAT32 (swapped), FLOAT32 (little endian)
<TI:=37>	Integrated total with time tag CP56Time2a	03, 04	INT16, INT32 (H/L), INT32 (L/H), UINT16, UINT32 (H/L), UINT32 (L/H) FLOAT32, FLOAT32 (swapped), FLOAT32 (little endian)

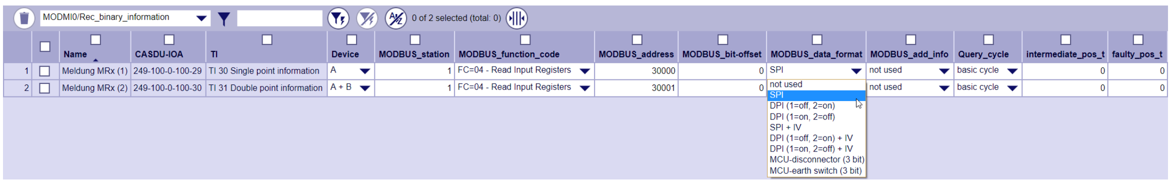
Modbus Function Codes (FC):

01 .. Read Coils
02 .. Read Discrete Inputs
03 .. Read Holding Registers
04 .. Read Input Registers

Binary information items

The parameterization of the address and message conversion for binary information from Modbus RTU Master in receive direction is to be done with the SICAM Device Manager with the function “Signals” or with the SICAM TOOLBOX II, OPM II.

Processing type: *firmware* / **`Rec_binary_information`**



[MODMI0_DM_Empf_Binäre_Information, 2, en_US]

Parameter	
`TI`	Supported type identifications: • <TI:=30> .. Single-point information with time tag CP56Time2a • <TI:=31> .. Double-point information with time tag CP56Time2a
`Name`	Name of the signal
`CASDU-IOA`	SICAM A8000 internal IEC 60870-5-101/104 message address (CASDU1, CASDU2, IOA1, IOA2, IOA3)
`MODBUS_Station`	Modbus Slave station address: • 1 to 247
`MODBUS_function_code`	Supported Modbus function codes: • FC = 01 .. Read Coils • FC = 02 .. Read Discrete Inputs • FC = 03 .. Read Holding Registers • FC = 04 .. Read Input Registers
`MODBUS_address`	Modbus address (register address): • 1 to 65535 • 1 to 65534 [only for double-point information with FC = 01, 02] Note: The bits of a double-point information are always next to each other.
`MODBUS_bit-offset`	Bit number in the corresponding Modbus register: • 0 to 15 .. Single command [only FC = 03, 04] • 0 to 14 .. Double-point information [only FC = 03, 04] • 0 to 14 .. Single-point information + IV [only FC = 03, 04] • 0 to 13 .. Double-point information + IV [only FC = 03, 04] Both bits of a double-point information must always be in the same Modbus register! With the Modbus bit offset always the 1st bit of the double-point information is specified.

Parameter	
`MODBUS_data_format`	Data format on the Modbus: • SPI • DPI (1 = off, 2 = on) • DPI (1 = on, 2 = off) • SPI + IV • DPI (1 = off, 2 = on) + IV • DPI (1 = on, 2 = off) + IV
`Query_cycle`	Query cycle: • Basic cycle • Query cycle 1 • Query cycle 2 • Query cycle 3 • Query cycle 4 Basic cycle: continuous query of all parameterized data. Query cycle 1 to 4: Query of the parameterized data in the adjustable time grid. The time grid for query cycles 1 to 4 can be parameterized.
`Intermediate_pos_t`	Intermediate position suppression time 0 to 255 s
`Faulty_pos_t`	Faulty position suppression time: 0 to 255 s

Supported Data Formats

Format	Modbus data format	IEC 60870-5-101/104 data format (TI)
SPI	Single-point information	30, 31
SPI + IV	Single-point information + invalid identifier	30
DPI (1 = off, 2 = on)	Double-point information (OFF before ON)	31
DPI (1 = on, 2 = off)	Double-point information (ON before OFF)	31
DPI (1 = off, 2 = on) + IV	Double-point information (OFF before ON) + "invalid" Identifier	31
DPI (1 = on, 2 = off) + IV	Double-point information (ON before OFF) + "invalid" identifier	31
3BIT/MCU	3-bit-binary information - Siemens MCU ("Motor Control Unit") [only with FC = 01, 02]	31

NOTE

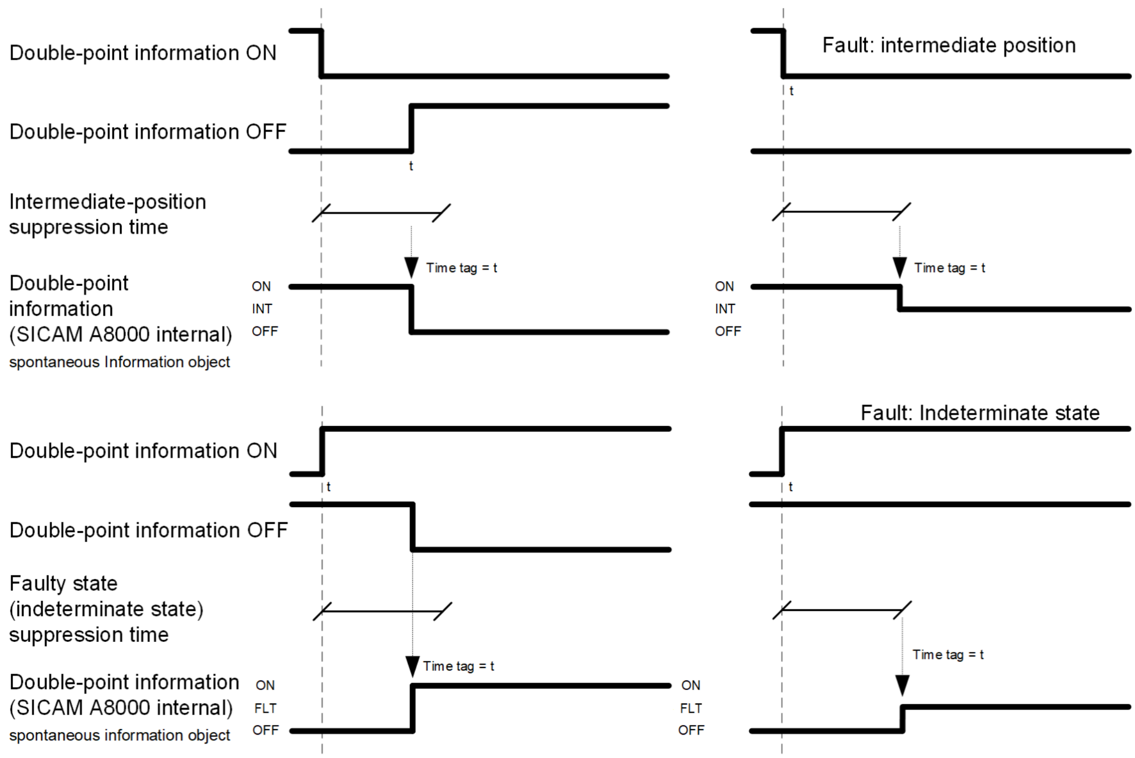
Since the Modbus protocol does not define how the data is represented in the coils/registers, the Modbus format must be specified for the message conversion. Supported Modbus data formats see *13.7.13 Modbus Data Formats*.

Monitoring for intermediate and faulty positions

The transfer of an intermediate position (neither ON- nor OFF binary information exists) or a faulty position (both ON- as well as OFF binary information exists) from PRE → BSE is suppressed for a parameterizable time.

For the suppression of the intermediate position an intermediate-position suppression time (parameter **Intermediate_pos_t**) can be parameterized for each double-point information.

For the suppression of the faulty position a faulty position suppression time (parameter **Faulty_pos_t**) can be parameterized for each double-point information.



Message Conversion

The table describes the evaluated elements of the IEC 60870-5-101/104 message during message conversion.

Elements of the message		
TI .. Type identification		• TI 30 .. Single-point information with time tag CP56Time2a • TI 31 .. Double-point information with time tag CP56Time2a
CASDU, IOA .. Message address		Parameter-settable
QDS .. Quality descriptor		
BL .. Blocked		Not supported (BL = 0)
SB .. Substituted		Not supported (SB = 0)
NT .. not topical		with SPI + IV = 1 or with DPI + IV = 1 (otherwise NT = 0) or on reception of Exception Response NT = 1
IV .. Invalid		Not supported (IV = 0)
Cause of transmission		
03 .. Spontaneous		Upon change of information state or quality descriptor
20 .. Interrogated by station interrogation		Upon reception of a GI request
xx .. Other COTs		Not supported
T .. Test		Not supported
Information		
Single-point information status		
SPI	0 .. OFF	Supported
	1 .. ON	Supported

Elements of the message		
Double-point information state		
DPI	0 .. Indeterminate or intermediate state	Supported
	1 .. OFF	Supported
	2 .. ON	Supported
	3 .. Indeterminate state	Supported
Time tag		
CP56Time2a .. Date + time		PRE internal time (receive time)

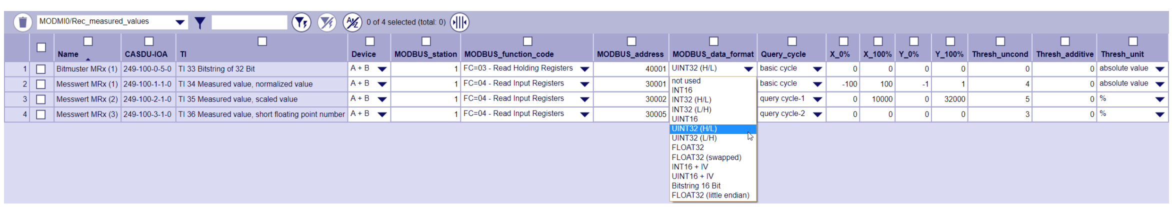
NOTE

Not listed elements of the IEC 60870-5-101/104 message are not rated/not supported!

Measured Values, Bitstrings

The parameterization of the address and message conversion for measured values, bitstrings from Modbus RTU Master in receive direction is to be done with the SICAM Device Manager with the function "Signals" or with the SICAM TOOLBOX II, OPM II.

Processing type: *firmware* / **`Rec_measured_values`**



[MODMI0_DM_Empf_Messwerte, 2, en_US]

Parameter	
`TI`	Supported type identifications: • <TI:=33> .. Bitstring of 32 bits with time tag CP56Time2a • <TI:=34> .. Measured value, normalized value with time tag CP56Time2a • <TI:=35> .. Measured value, scaled value with time tag CP56Time2a • <TI:=36> .. Measured value, short floating-point number with time tag CP56Time2a
`Name`	Name of the signal
`CASDU-IOA`	SICAM A8000 internal IEC 60870-5-101/104 message address (CASDU1, CASDU2, IOA1, IOA2, IOA3)
`MODBUS_Station`	Modbus Slave station address: • 1 to 127
`MODBUS_function_code`	Supported Modbus function codes: • FC = 03 .. Read Holding Registers • FC = 04 .. Read Input Registers
`MODBUS_address`	Modbus address (register address): • 1 to 65535

Parameter	
MODBUS_data_format	Data format on the Modbus: • INT16 • INT32 (H/L) • INT32 (L/H) • UINT16 • UINT32 (H/L) • UINT32 (L/H) • FLOAT32 • FLOAT32 (swapped) • FLOAT32 (little endian) • INT16 + IV • UINT16 + IV • BS16
Query_cycle	Query cycle: • Basic cycle • Query cycle 1 • Query cycle 2 • Query cycle 3 • Query cycle 4 Basic cycle: Continuous query of all parameterized data. Query cycle 1 to 4: Query of the parameterized data in the adjustable time grid. The time grid for query cycle 1 to 4 can be set in the system-technical parameters.
X_0%, X_100% **Y_0%, Y_100%**	Parameters for value adaptation (scaling): • Valid range of value for X_0% and X_100% see *13.7.13 Modbus Data Formats* • <TI:=34> .. **Y_0%** and **Y_100%** must not be greater or less than ± 1 • <TI:= 35> .. **Y_0%** and **Y_100%** must not be less than −32768 or greater than +32767. • Value adaptation inactive at **X_0%** = 0 and **X_100%** = 0
Thresh_uncond	If the value changes > **Thres_uncond**, the received value is immediately forwarded to the BSE.
Thresh_additive	If the value changes ≤ **Thres_uncond**, the received value is not immediately forwarded to the BSE and the additive measured value change monitoring is performed.
Thresh_unit	• Absolute value [received value from Modbus] • %

Supported Data Formats

Format	Modbus data format	IEC 60870-5-101/104 data format (TI)
INT16	Signed integer 16-bit	34, 35, 36
INT16 + IV	Signed integer 16 bit + "invalid" identifier	34, 35, 36
INT32 (H/L)	Signed integer 32-bit (HIGH before LOW)	34, 35, 36
INT32 (L/H)	Signed integer 32-bit (LOW before HIGH)	34, 35, 36

Format	Modbus data format	IEC 60870-5-101/104 data format (TI)
UINT16	Unsigned integer 16-bit	34, 35, 36
UINT16 + IV	Unsigned integer 16-bit + "invalid" identifier	34, 35, 36
UINT32 (H/L)	Unsigned integer 32-bit (HIGH before LOW)	34, 35, 36
UINT32 (L/H)	Unsigned integer 32-bit (LOW before HIGH)	34, 35, 36
FLOAT32	Short floating-point (IEEE 754)	34, 35, 36
FLOAT32 (swapped)	Short floating-point (IEEE 754) “swapped”	34, 35, 36
FLOAT32 (little endian)	Short floating-point (IEEE 754) "little endian"	34, 35, 36
BS16	Bitstring of 16 bits	33

NOTE

Since the Modbus protocol does not define how the data is represented in the coils/registers, the Modbus format must be specified for the message conversion. Supported Modbus data formats see *13.7.13 Modbus Data Formats*.

Additive Measured Value Change Monitoring

In order to avoid unnecessarily burdening the SICAM A8000 internal and further communication, the received measured value is monitored for changes according to the following rules:

- The first value determined after startup is transmitted immediately
- Each change of quality descriptor IV triggers an immediate transfer, the quality descriptor OV does not initiate a transfer
- Change monitoring in accordance with the method of the additive threshold value procedure:
  The measured value is monitored for changes when it is received. If the deviation compared to the last measured value transmitted to BSE is greater than the configured **thresh_uncond** , the new measured value is transmitted immediately. Otherwise, the deviation is added to the last spontaneously transmitted measured value, with the correct sign. Only when the amount of this sum exceeds the parameterizable **Thresh_additive**, the current measured value is spontaneously transmitted to the BSE.

Thresh uncond	Thresh additive	Processing
= 0	= 0	Value is transmitted to the BSE upon each status change in the next processing grid
= 0	≠ 0	
≠ 0	= 0	• Change greater **Thresh_uncond**: → value is transmitted • Change less than/equal **Thresh_uncond**: → Additive threshold value procedure
≠ 0	≠ 0	• Change greater **Thresh_uncond**: → value is transmitted • Change less than/equal **Thresh_uncond**: → Additive threshold value procedure

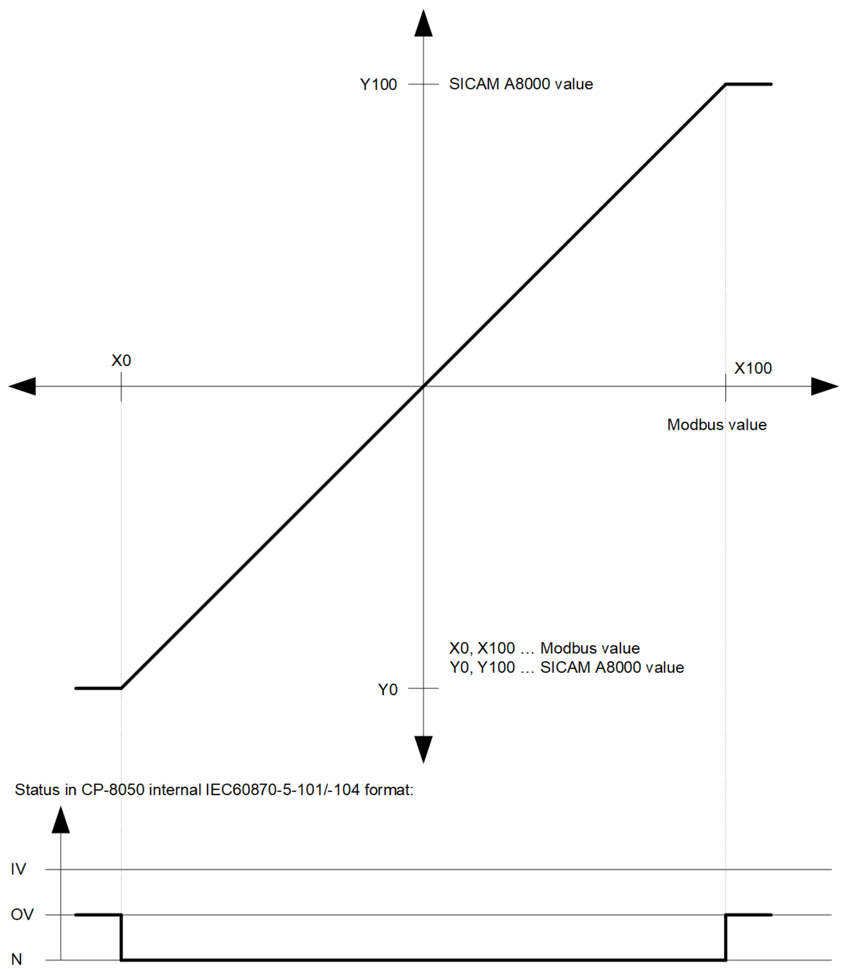
A transmission of the measured value due to a general interrogation does not influence the threshold value procedure.

The thresholds are to be parameterized for every measured value with the parameter **Thresh_additive** and the parameter **Thresh_uncond** .

For more details and examples of additive monitoring of measured value changes, see*13.1.4.13 Additive Measured Value Change Monitoring*.

Value Adaptation[not for <TI:=33>]

The value adaptation is defined by the parameters **`X_0%`**, **`X_100%`**, **`Y_0%`**, **`Y_100%`**.



The value adaptation is only performed if **`X_0%`** or **`X_100%`** ≠ *0* is parameterized.

If the Modbus value is outside the value range of the selected IEC 60870-5-101/104 type identifier when the value adoption (= direct transfer) is not activated, then OV = 1 is set.

NOTE

The value adaptation in MODMI0 is different compared to other Modbus protocols (e.g.: MODMA0 in SICAM RTUs or MODMT2 in SICAM A8000 CP8000, CP802x).

When replacing by SICAM A8000 with MODMI0, special attention must be paid if the parameterization of the signals is taken over 1:1 from the systems mentioned and the value adaptation was previously parameterized with **`X_0%`** = *0*, **`X_100%`** = *1*, **`Y_0%`** = *0* and **`Y_100%`** = *1*.

With this parameterization, only values in the range 0 to 1 are implemented as valid. Values greater than 1 are no longer converted and marked with OV = 1.

Message Conversion

The table describes the evaluated elements of the IEC 60870-5-101/104 message during message conversion.

Elements of the message	
TI .. Type identification	• TI 33 .. Bitstring of 32 bits with time tag CP56Time2a • TI 34 .. Measured value, normalized value with time tag CP56Time2a • TI 35 .. Measured value, scaled value with time tag CP56Time2a • TI 36 .. Measured value, short floating-point number with time tag CP56Time2a
CASDU, IOA .. Message address	Parameter-settable
QDS .. Quality descriptor	
BL .. Blocked	Not supported (BL = 0)
SB .. Substituted	Not supported (SB = 0)
NT .. not topical	NT = 1 • at Modbus Format INT16+IV, UINT16+IV if IV=1 • FLOAT32 format with the value = NAN (Not A Number) • Reception of Exception Response
IV .. Invalid	IV = 0
OV .. Overflow	OV = 1: • Without value adaptation: Modbus value outside the range of the selected type identi-fication • With value adaptation: Modbus value less than X_0% or greater X_100%
Cause of transmission	
03 .. Spontaneous	Alteration of the measured value depending on the thresholds or alteration of the quality descriptor
20 .. Interrogated by station interrogation	Upon reception of a GI request
xx .. Other COTs	Not supported
T .. Test	Not supported
Information	
Value.. S .. Sign	• Normalized value • Scaled value • IEEE STD 754 = short floating-point number • Bitstring 32 bit (only bits 0 to 15 used, bits 16 to 31 are not evaluated)
Time tag	
CP56Time2a .. Date + time	PRE internal time (receive time)

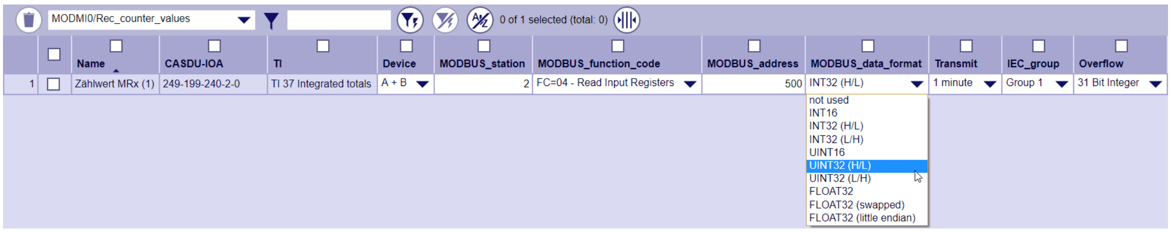
NOTE

Not listed elements of the IEC 60870-5-101/104 message are not rated/not supported!

Integrated Totals

The parameterization of the address and message conversion for integrated totals from Modbus RTU Master in receive direction is to be done with the SICAM Device Manager with the function “Signals” or with the SICAM TOOLBOX II, OPM II.

Processing type: *firmware* / `Rec_counter value`



[MODMI0_DM_Empf_Zaehlwert, 1, en_US]

Parameter	
TI	Supported type identifications: • <TI:=37> .. Integrated total with time tag CP56Time2a
Name	Name of the signal
CASDU-IOA	SICAM A8000 internal IEC 60870-5-101/104 message address (CASDU1, CASDU2, IOA1, IOA2, IOA3)
MODBUS_Station	Modbus Slave station address: • 1 to 247
MODBUS_function_code	Supported Modbus function codes: • FC = 03 .. Read Holding Registers • FC = 04 .. Read Input Registers
MODBUS_address	Modbus address (register address): • 1 to 65535
MODBUS_data_format	Data format on the Modbus: • INT16 • INT32 (H/L) • INT32 (L/H) • UINT16 • UINT32 (H/L) • UINT32 (L/H) • FLOAT32 • FLOAT32 (swapped) • FLOAT32 (little endian)
Transmit	Counter transmission at: • Counter interrogation • Cyclically every 1, 2, 3, 5, 10, 15, 30, 60 minutes
IEC-Group	IEC 60870-5-101/104 counter group: • Group 1 to 4
Overflow	Overflow treatment at: • 24, 31 bit integer • 2, 3, 4, 5, 6, 7, 8, 9 decades BCD

Supported Data Formats

Format	Modbus data format	IEC 60870-5-101/104 data format (TI)
INT16	Signed integer 16-bit	37
INT32 (H/L)	Signed integer 32-bit (HIGH before LOW)	37
INT32 (L/H)	Signed integer 32-bit (LOW before HIGH)	37
UINT16	Unsigned integer 16-bit	37
UINT32 (H/L)	Unsigned integer 16-bit (HIGH before LOW)	37
UINT32 (L/H)	Unsigned integer 32-bit (LOW before HIGH)	37
FLOAT32	Short floating-point (IEEE 754)	37
FLOAT32 (swapped)	Short floating-point (IEEE 754) “swapped”	37
FLOAT32 (little endian)	Short floating-point (IEEE 754) “little endian”	37

NOTE

Since the Modbus protocol does not define how the data is represented in the coils/registers, the Modbus format must be specified for the message conversion. Supported Modbus data formats see *13.7.13 Modbus Data Formats*.

Message Conversion

The table describes the evaluated elements of the IEC 60870-5-101/104 message during message conversion.

Elements of the message	
TI .. Type identification	<TI:=37> .. Integrated total with time tag CP56Time2a
CASDU, IOA .. Message address	Parameter-settable
Data point quality descriptor	
Sequence number	With each trigger for latching for a group the sequence number is increased in the range from 1 to 31.
CY .. Carry	On overflow of the count in the associated count period
CA .. Presets	Not supported
IV .. Invalid	IV = 1 • FLOAT32 format with the value = NAN (“Not A Number”) • Reception of Exception Response
Cause of transmission	
03 .. Spontaneous	When transmitting = periodical data transfer (cyclically every 1, 2, 3, 5, 10, 15, 30, 60 minutes)
37 .. Requested by general counter interrogation	For general counter interrogation
38 to 41 .. Interrogated by group 1 to 4 interrogation	For request counter group (1 to 4)
T .. Test	Not supported
Information	
Value.. S .. Sign	Dual meter reading
Time tag	
CP56Time2a .. Date + time	PRE internal time

NOTE

Not listed elements of the IEC 60870-5-101/104 message are not rated / not supported!

Message Conversion Counter Interrogation Command (SICAM A8000 internal only)

The table describes the evaluated elements of the IEC 60870-5-101/104 message during message conversion.

Elements of the message		
TI .. Type identification		<TI:=101> .. Counter interrogation command
CASDU, IOA .. Message address		Defined
QCC .. Identifier counter interrogation		
FRZ	RQT	FRZ .. Freeze (= latch) RQT .. Request (= requirement)
0	1 to 4	Read (no freeze or reset) Counter interrogation (1 to 4)
	5	Read (no freeze or reset) General counter interrogation
1	1 to 4	Counter freeze without reset Counter interrogation group (1 to 4)
	5	Counter freeze without reset All counter groups
2	1 to 4	Counter freeze with reset Counter interrogation group (1 to 4)
	5	Counter freeze without reset All counter groups
3	1 to 4	Reset counter Counter interrogation group (1 to 4)
	5	Reset counter All counter groups
x	0; 6 to 63	Not supported
Cause of transmission		
06 .. Activation		Must be set
xx .. Other COTs		Not supported
T .. Test		Not supported

NOTE

Not listed elements of the IEC 60870-5-101/104 message are not rated/not supported!

13.7.11.3 Message Conversion in Transmit Direction – Modbus RTU Slave

Message conversion in transmit direction: IEC 60870-5-101/104 → Modbus RTU

SICAM A8000: IEC 60870-5-101/104 →		Modbus RTU Format	
TI	**Designation**	**FC**	**Data format**
<TI:=30>	Single-point information with time tag CP56Time2a	01, 02, 03, 04	SPI SPI + IV

SICAM A8000: IEC 60870-5-101/104 →		Modbus RTU Format	
<TI:=31>	Double-point information with time tag CP56Time2a	01, 02, 03, 04	DPI (1 = off, 2 = on) , DPI (1 = on, 2 = off) DPI (1 = off, 2 = on) + IV, DPI (1 = on, 2 = off) + IV
<TI:=33>	Bitstring of 32 bits with time tag CP56Time2a	03, 04	Bitstring 16-bit
<TI:=34>	Measured value, normalized value with time tag CP56Time2a	03, 04	INT16, INT16 + IV, INT32 (H/L), INT32 (L/H), UINT16, UINT16 + IV, UINT32 (H/L), UINT32 (L/H), FLOAT32, FLOAT32 (swapped), FLOAT32 (little endian)
<TI:=35>	Measured value, scaled value with time tag CP56Time2a	03, 04	INT16, INT16 + IV, INT32 (H/L), INT32 (L/H), UINT16, UINT16 + IV, UINT32 (H/L), UINT32 (L/H), FLOAT32, FLOAT32 (swapped), FLOAT32 (little endian)
<TI:=36>	Measured value, floating-point number with time tag CP56Time2a	03, 04	INT16, INT16 + IV, INT32 (H/L), INT32 (L/H), UINT16, UINT16 + IV, UINT32 (H/L), UINT32 (L/H), FLOAT32, FLOAT32 (swapped), FLOAT32 (little endian)
<TI:=37>	Integrated total with time tag CP56Time2a	03, 04	INT16, INT16 + IV, INT32 (H/L), INT32 (L/H), UINT16, UINT16 + IV, UINT32 (H/L), UINT32 (L/H), FLOAT32, FLOAT32 (swapped), FLOAT32 (little endian)
<TI:=45>	Single command	01, 02, 03, 04	SC (pulse)
<TI:=46>	Double command	01, 02, 03, 04	DC (pulse)
<TI:=47>	Regulating step command	01, 02, 03, 04	DC (pulse)
<TI:=48>	Setpoint command, normalized value	03, 04	INT16, INT32 (H/L), INT32 (L/H), UINT16, UINT32 (H/L), UINT32 (L/H), FLOAT32, FLOAT32 (swapped), FLOAT32 (little endian)
<TI:=49>	Setpoint command, scaled value	03, 04	INT16, INT32 (H/L), INT32 (L/H), UINT16, UINT32 (H/L), UINT32 (L/H), FLOAT32, FLOAT32 (swapped), FLOAT32 (little endian)

SICAM A8000: IEC 60870-5-101/104 →		Modbus RTU Format	
<TI:=50>	Setpoint command, short floating-point number	03, 04	INT16, INT32 (H/L), INT32 (L/H), UINT16, UINT32 (H/L), UINT32 (L/H), FLOAT32, FLOAT32 (swapped), FLOAT32 (little endian)
<TI:=100>	(General-) interrogation command [322]	-	-

Modbus Function Codes (FC):

01 .. Read Coils

02 .. Read Discrete Inputs

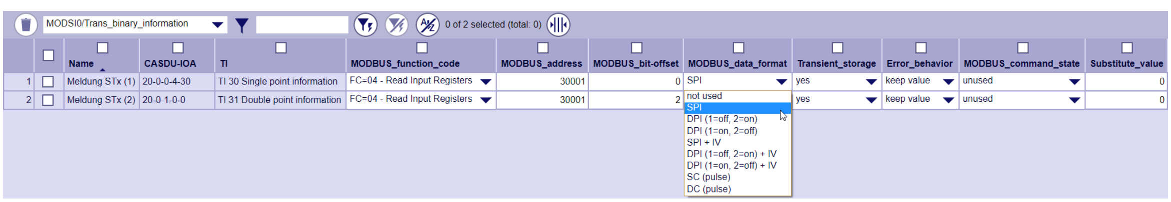
03 .. Read Holding Registers

04 .. Read Input Registers

Binary information items

The parameterization of the address and message conversion for binary information from Modbus RTU Slave in transmit direction is to be done with the SICAM Device Manager with the function “Signals” or with the SICAM TOOLBOX II, OPM II.

Processing type: *firmware* | **`Trans_binary_information`**



[MODSI0_DM_Sende_Binäre_Information_Meldungen, 2, en_US]

Parameter	
`TI`	Supported type identifications: • <TI:=30> .. Single-point information with time tag CP56Time2a • <TI:=31> .. Double-point information with time tag CP56Time2a
`Name`	Name of the signal
`CASDU-IOA`	SICAM A8000 internal IEC 60870-5-101/104 message address (CASDU1, CASDU2, IOA1, IOA2, IOA3)
`MODBUS_function_code`	Supported Modbus function codes: • FC = 01 .. Read Coils • FC = 02 .. Read Discrete Inputs • FC = 03 .. Read Holding Registers • FC = 04 .. Read Input Registers
`MODBUS_address`	Modbus address (register or coil address): • 1 to 65535 (single-point information; double-point information with FC = 03, 04) • 1 to 65534 (double-point information with FC = 01, 02) The bits of a double-point information are always next to each other.

322 The general interrogation command is processed internally on the protocol element and not transmitted to the remote station. The next time the data is received on the Modbus interface, they are transmitted in response to the general interrogation command from PRE → BSE.

Parameter	
MODBUS_bit-offset	Bit number in the corresponding Modbus register: • 0 .. Single-point information, double-point information [with FC = 01 02] • 0 to 15 .. Single command [only FC = 03, 04] • 0 to 14 .. Double-point information [only FC = 03, 04] Both bits of a double-point information are in the same Modbus register! With the Modbus bit offset always the 1st bit of the double-point information is specified.
MODBUS_data_format	Data format on the Modbus: • SPI • SPI + IV [only FC = 03, 04] • DPI (1 = off, 2 = on) • DPI (1 = on, 2 = off) • DPI (1 = off, 2 = on) + IV [only FC = 03, 04] • DPI (1 = on, 2 = off) + IV [only FC = 03, 04]
Transient storage	Transient storage: • Yes [only single-point information] • No With transient storage, a message change is saved until transfer (with multiple changes up to transfer only 1 change is transferred)
Error_behavior	Output on Modbus if NT = 1 or IV = 1: • Keep value • Output substitute value
Substitute_value	Substitute value if **error_behavior** is set to ***output substitute value***. • Valid range of values see appendix *13.7.13 Modbus Data Formats* • The parameterized substitute value is also used as the initial value.
MODBUS_command_state	Not used!

NOTE

The parameters **substitute_value** and **error_behavior** must be adapted to the requirements of the application!

Supported Data Formats

Format	Modbus data format	IEC 60870-5-101/104 data format (TI)
SPI	Single-point information	30
SPI + IV	Single-point information + invalid identifier	30
DPI (1 = off, 2 = on)	Double-point information (OFF before ON)	31
DPI (1 = on, 2 = off)	Double-point information (ON before OFF)	31

Format	Modbus data format	IEC 60870-5-101/104 data format (TI)
DPI (1 = off, 2 = on) + IV	Double-point information (OFF before ON) + "invalid" identifier	31
DPI (1 = on, 2 = off) + IV	Double-point information (ON before OFF) + “invalid” identifier	31

NOTE

Since the Modbus protocol does not define how the data is represented in the coils/registers, the Modbus format must be specified for the message conversion. Supported Modbus data formats see *13.7.13 Modbus Data Formats*.

Message Conversion

The table describes the evaluated elements of the IEC 60870-5-101/104 message during message conversion.

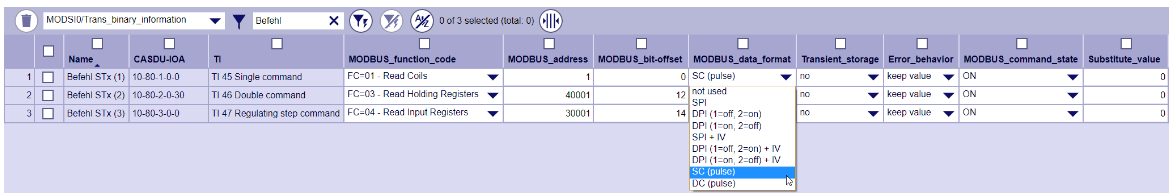
Elements of the message		
TI .. Type identification		• <TI:=30> .. Single-point information with time tag CP56Time2a • <TI:=31> .. Double-point information with time tag CP56Time2a
CASDU, IOA .. Message address		Parameter-settable
QDS .. Quality descriptor		
BL .. Blocked		Not evaluated
SB .. Substituted		Not evaluated
NT .. Not topical		NT = 1: Depending on the parameter error behavior, either the current state is kept or the parameterized substitute value is output.
IV .. Invalid		IV = 1: Depending on the parameter error behavior, either the current state is kept or the parameterized substitute value is output.
Cause of transmission		
xx ..		Not rated
T .. Test		Not evaluated
Information		
Single-point information status		
SPI	0 .. OFF	Evaluated
	1 .. ON	Evaluated
Double point information state		
DPI	0 .. Indeterminate or intermediate state	Not supported
	1 .. OFF	Evaluated
	2 .. ON	Evaluated
	3 .. Indeterminate state	Evaluated
Time tag		
CP56Time2a .. Date + time		Not rated

> **NOTE**
>
> Not listed elements of the IEC 60870-5-101/104 message are not rated / not supported!

Commands

The parameterization of the address and message conversion for commands from Modbus RTU Slave in transmit direction is to be done with the SICAM Device Manager with the function “Signals” or with the SICAM TOOLBOX II, OPM II.

Processing type: *firmware* / **`Trans_binary_information`**



[MODSI0_DM_Sende_Binäre_Information_Befehl, 2, en_US]

Parameter	
`TI`	Supported type identifications: • <TI:=45> .. Single command • <TI:=46> .. Double command • <TI:=47> .. Regulating step command
`Name`	Name of the signal
`CASDU-IOA`	SICAM A8000 internal IEC 60870-5-101/104 message address (CASDU1, CASDU2, IOA1, IOA2, IOA3)
`MODBUS_function_code`	Supported Modbus function codes: • FC = 01 .. Read Coils • FC = 02 .. Read Discrete Inputs • FC = 03 .. Read Holding Registers • FC = 04 .. Read Input Registers
`MODBUS_address`	Modbus address (register or coil address): • 1 to 65535 (single command; double command with FC = 3, 4) • 1 to 65534 (double command with FC = 1, 2) The bits of a double command are always next to each other.
`MODBUS_bit-offset`	Bit number in the corresponding Modbus register: • 0 .. Single command, double command [with FC = 1, 2] • 0 to 15 .. Single command [only FC = 3, 4] • 0 to 14 .. Double command [only FC = 3, 4] Both bits of a double command must always be in the same Modbus register! With the Modbus bit offset always the 1st bit of the double command specified.
`MODBUS_data_format`	Data format on the Modbus: • SC (pulse) .. Single command pulse • DC (pulse) .. Double command pulse

Parameter	
Transient_storage	Not used!
Error_behavior	Not used!
Substitute_value	Not used!
MODBUS_command_state	Modbus command state: <only double commands> • OFF • ON On the parameterized Modbus_address / Modbus_bit-offset the parameterized selected Modbus command state is output (possible inversion of the command output)

Supported Data Formats

Format	Modbus data format	IEC 60870-5-101/104 data format (TI)
SC (pulse)	Single command pulse	45
DC (pulse)	Double command pulse	46, 47

NOTE

Since the Modbus protocol does not define how the data is represented in the coils/registers, the Modbus format must be specified for the message conversion. Supported data formats see *13.7.13 Modbus Data Formats*.

Command Output Time for Single/Double Commands

Commands can be transmitted on the Modbus as pulses (1 or 2 bits). The protocol element maps the command output to 1 or 2 bits in the Modbus register of the Modbus slave with the assigned command output time.

The pulse duration of commands with qualifier of command = <0> "no additional definition" must be set on the protocol with the parameter **advanced parameters | command pulse duration | Command with no addt'l def. (sec)**.

The pulse duration of commands with qualifier of command = <1> "short pulse duration" must be set on the protocol with the parameter **advanced parameters | command pulse duration | Command with short pulse duration (sec)**.

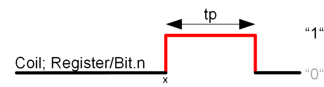
The pulse duration of commands with qualifier of command = <2> "short pulse duration" must be set on the protocol with the parameter **advanced parameters | command pulse duration | Command with short pulse duration (sec)**.

Max. 10 commands as pulse command (single-, double commands) executed at the same time will be supported.

Single Command SC (Pulse)

A single command with command state SCS = ON will be output on the Modbus register (or coil) as pulse with the parametrized command output time.

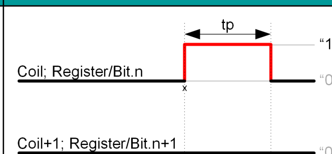
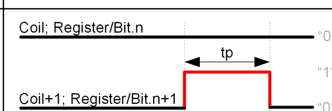
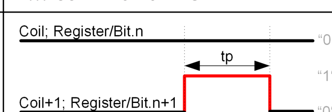
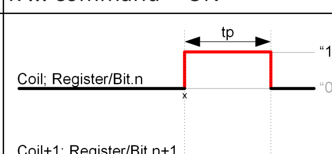
The command output time must be set so that the command pulse in the Modbus register (or coil) is read out at least once from the central station (Modbus master) (depending on the interrogation cycle of the Modbus master).

Modbus data format	Command state	Command output 1 bit as coil or 1 bit in Modbus register
SC (pulse)	SCS = ON	 tp ... command output time (pulse duration) x ... command = ON
	SCS = OFF	The OFF state is not evaluated!

If a further command with the same IEC 60870-5-101/104 address is initiated during command output in progress, this one will be discarded with a negative confirmation to the BSE (ACTCON-).
The current pulse output of the command is not affected.

Double Command DC (Pulse)

A double command or regulating step command with the status DCS = ON/OFF or RCS = HIGHER/LOWER is output on the parameterized Modbus register (or coil) as pulse with the set command output time.
The command output time must be set so that the command pulse in the Modbus register (or coil) is read out at least once from the central station (Modbus master) (depending on the interrogation cycle of the Modbus master).

Modbus data format	Command state	Command output 2 bit as coil or 2 bit in Modbus register
DC (pulse) Modbus_command_state = ON	DCS = ON RCS = HIGHER	 tp ... command output time (pulse duration) x ... command = ON
DC (pulse) Modbus_command_state = ON	DCS = OFF RCS = LOWER	 tp ... command output time (pulse duration) x ... command = OFF
DC (pulse) Modbus_command_state = OFF	DCS = ON RCS = HIGHER	 tp ... command output time (pulse duration) x ... command = ON
DC (pulse) Modbus_command_state = OFF	DCS = OFF RCS = LOWER	 tp ... command output time (pulse duration) x ... command = OFF

If a further command with the same IEC 60870-5-101/104 address is initiated during command output in progress, this one will be discarded with a negative confirmation to the BSE (ACTCON-).

The current pulse output of the command is not affected.

Message Conversion

The table describes the evaluated elements of the IEC 60870-5-101/104 message during message conversion.

Elements of the message		
TI .. Type identification		• <TI:=45> .. Single command • <TI:=46> .. Double command • <TI:=47> .. Regulating step command
CASDU, IOA .. Message address		Parameter-settable
Cause of transmission		
06 .. Activation		BSE→PRE: is evaluated on the BSE (only “activation” allowed)
07 .. Confirmation of activation		PRE→BSE: • ACTCON+ when the Modbus register/coil is read by the master during the pulse duration. • ACTCON- if the Modbus register/coil is not read by the master during the pulse duration.
08 .. Abortion of activation		BSE→PRE: not supported
09 .. Confirmation of the abortion of activation		PRE→PRE: Abortion of the activation is confirmed negative (ACTCON-)
10 .. Activation termination		Not supported
xx .. Other COTs		Not supported
T .. Test		Not supported
Information		
SCO/DCO/RCO		
SCS	Single command state	[only <TI:=45>]
	0 .. OFF	Not evaluated
	1 .. ON	Evaluated
DCS	Double command state	[only <TI:=46>]
	0 .. Not allowed	Not supported
	1 .. OFF	Evaluated
	2 .. ON	Evaluated
	3 .. Not allowed	Not supported
RCS	Regulating step command state	[only <TI:=47>]
	0 .. Not allowed	Not supported
	1 .. Next step lower	Evaluated
	2 .. Next step higher	Evaluated
	3 .. Not allowed	Not supported
QOC	S/E	
	0 .. Execute	Is checked for “execute”
	1 .. Select	Not supported; is confirmed negative (ACTCON-)

Elements of the message		
QU	Command qualifier	
	0 .. No additional definitions	Evaluated
	1 .. Short pulse duration	Evaluated
	2 .. Long pulse duration	Evaluated
	3 .. Persistent command	Not supported

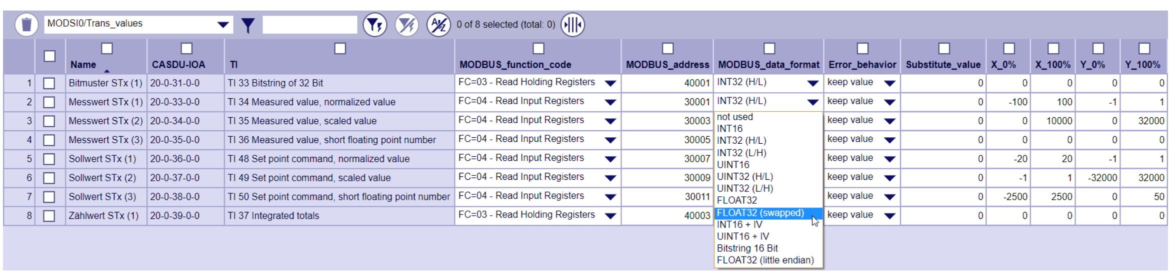
NOTE

Not listed elements of the IEC 60870-5-101/104 message are not rated/not supported!

Measured values, Setpoint values, Integrated Totals, Bitstrings

The parameterization of the address and message conversion for measured values, setpoint values, integrated totals, bitstrings from Modbus RTU Slave in transmit direction is to be done with the SICAM Device Manager with the function “Signals” or with the SICAM TOOLBOX II, OPM II.

Processing type: *firmware* / **`Trans_values`**



	Name	CASDU-IOA	TI	MODBUS_function_code	MODBUS_address	MODBUS_data_format	Error_behavior	Substitute_value	X_0%	X_100%	Y_0%	Y_100%
1	Bitmuster STx (1)	20-0-31-0-0	TI 33 Bitstring of 32 Bit	FC=03 - Read Holding Registers	40001	INT32 (H/L)	keep value	0	0	0	0	0
2	Messwert STx (1)	20-0-33-0-0	TI 34 Measured value, normalized value	FC=04 - Read Input Registers	30001	INT32 (H/L)	keep value	0	-100	100	-1	1
3	Messwert STx (2)	20-0-34-0-0	TI 35 Measured value, scaled value	FC=04 - Read Input Registers	30003		keep value	0	0	10000	0	32000
4	Messwert STx (3)	20-0-35-0-0	TI 36 Measured value, short floating point number	FC=04 - Read Input Registers	30005		keep value	0	0	0	0	0
5	Sollwert STx (1)	20-0-36-0-0	TI 48 Set point command, normalized value	FC=04 - Read Input Registers	30007		keep value	0	-20	20	-1	1
6	Sollwert STx (2)	20-0-37-0-0	TI 49 Set point command, scaled value	FC=04 - Read Input Registers	30009		keep value	0	-1	1	-32000	32000
7	Sollwert STx (3)	20-0-38-0-0	TI 50 Set point command, short floating point number	FC=04 - Read Input Registers	30011		keep value	0	-2500	2500	0	50
8	Zählwert STx (1)	20-0-39-0-0	TI 37 Integrated totals	FC=03 - Read Holding Registers	40003		keep value	0	0	0	0	0

[MODSI0_DM_Sende_Werte, 2, en_US]

Parameter	
`TI`	Supported type identifications: • <TI:=33> .. Bitstring of 32 bits with time tag CP56Time2a • <TI:=34> .. Measured value, normalized value with time tag CP56Time2a • <TI:=35> .. Measured value, scaled value with time tag CP56Time2a • <TI:=36> .. Measured value, short floating-point number with time tag CP56Time2a • <TI:=37> .. Integrated total with time tag CP56Time2a • <TI:=48> .. Setpoint command, normalized value • <TI:=49> .. Setpoint command, scaled value • <TI:=50> .. Setpoint command, short floating-point number
`Name`	Name of the signal
`CASDU-IOA`	SICAM A8000 internal IEC 60870-5-101/104 message address (CASDU1, CASDU2, IOA1, IOA2, IOA3)
`MODBUS_function_code`	Supported Modbus function codes: • FC = 03 .. Read Holding Registers • FC = 04 .. Read Input Registers

Parameter	
`MODBUS_address`	Modbus address (register or coil address): • 1 to 65535 • 1 to 65534 [for all Modbus “Double register formats” (e.g.: FLOAT32)]
`MODBUS_data_format`	Data format on the Modbus: • INT16 • INT16 + IV [only <TI:=34, 35, 36, 37>] • INT32 (H/L) • INT32 (L/H) • UINT16 • UINT16 + IV [only <TI:=34, 35, 36, 37>] • UINT32 (H/L) • UINT32 (L/H) • FLOAT32 • FLOAT32 (swapped) • FLOAT32 (little endian) • Bitstring 16-bit
`Error_behavior`	Output on Modbus if NT = 1 or IV = 1: • Keep value • Output substitute value
`Substitute_value`	Substitute value if error behavior is set to ***`output substitute value`***. Valid range of values see appendix *13.7.13 Modbus Data Formats*.
`X_0%, X_100%` **`Y_0%, Y_100%`**	Parameters for value adaptation (scaling): • Valid range of value for X_0% and X_100% see *13.7.13 Modbus Data Formats* • <TI:=34> .. Y_0% and Y_100% must not be greater or less than ±1 • <TI:=35> .. Y_0% and Y_100% must not be less than −32768 or greater than +32767. • Value adaptation inactive at Y_0% = 0 and Y_100% = 0

NOTE

The parameters **`substitute_value`** and **`error_behavior`** must be adapted to the requirements of the application!

Supported Data Formats

Format	Modbus data format	IEC 60870-5-101/104 data format (TI)
INT16	Signed integer 16-bit	34, 35, 36, 37, 48, 49, 50
UINT16	Unsigned integer 16-bit	34, 35, 36, 37, 48, 49, 50
INT16 + IV	Signed integer 16 bit + "invalid" identifier	34, 35, 36, 37
UINT16 + IV	Unsigned integer 16-bit + "invalid" identifier	34, 35, 36, 37
INT32 (H/L)	Signed integer 32-bit (HIGH before LOW)	34, 35, 36, 37, 48, 49, 50
INT32 (L/H)	Signed integer 32-bit (LOW before HIGH)	34, 35, 36, 37, 48, 49, 50

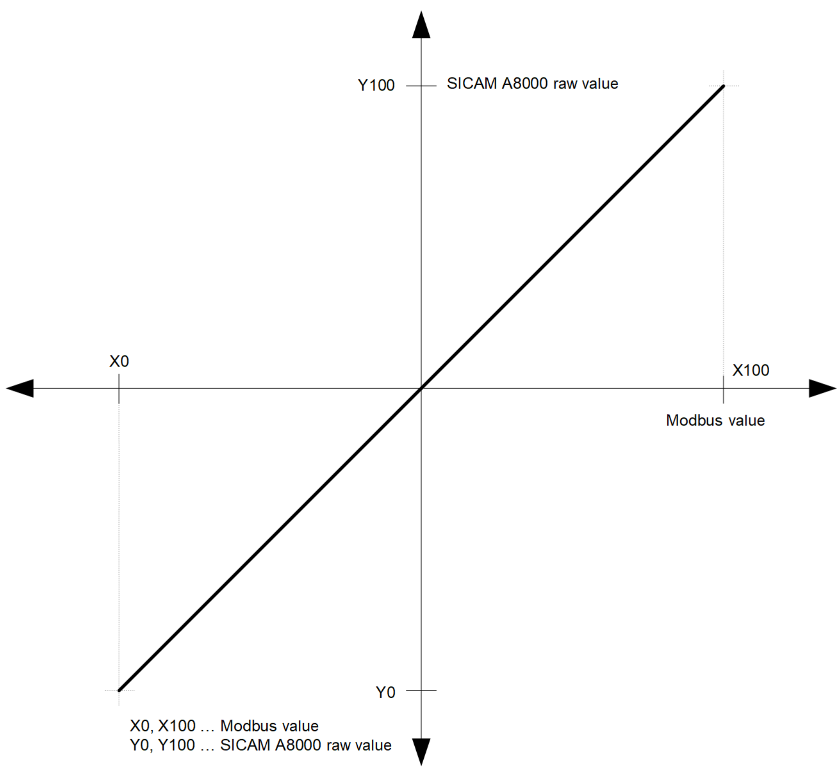
Format	Modbus data format	IEC 60870-5-101/104 data format (TI)
UINT32 (H/L)	Unsigned integer 16-bit (HIGH before LOW)	34, 35, 36, 37, 48, 49, 50
UINT32 (L/H)	Unsigned integer 32-bit (LOW before HIGH)	34, 35, 36, 37, 48, 49, 50
FLOAT32	Short floating-point (IEEE 754)	34, 35, 36, 37, 48, 49, 50
FLOAT32 (swapped)	Short floating-point (IEEE 754) "swapped"	34, 35, 36, 37, 48, 49, 50
FLOAT32 (little endian)	Short floating-point (IEEE 754) "little endian"	34, 35, 36, 37, 48, 49, 50
Bitstring 16-bit	Bitstring of 16 bits	33

NOTE

Since the Modbus protocol does not define how the data is represented in the coils/registers, the Modbus format must be specified for the message conversion. Supported Modbus data formats see *13.7.13 Modbus Data Formats*.

Value Adaptation[not for <TI:=33, 37>]

The value adaptation is defined by the parameters **X_0%**, **X_100%**, **Y_0%**, **Y_100%**.



The value adaptation is only performed if **Y_0%** or **Y_100%** ≠ *0* is parameterized.

- If, when the value adaptation is active, the SICAM A8000 raw value is smaller than **Y_0%** or greater **Y_100%**, then
  - no conversion is carried out
  - the error message *Format conversion error in transmit direction* is set
  - on the Modbus, either the parameterized substitute value or, for Modbus RTU, data formats with IV: → IV = 1; X_0% or X_100% is output.

- If, when the value adaptation is not active (= direct transfer), the SICAM A8000 raw value is outside of the value range of the selected Modbus RTU data format, then
  - no conversion is carried out
  - the error message `Format conversion error in transmit direction` is set
  - on the Modbus, either the parameterized substitute value or, for Modbus RTU, data formats with IV: → IV = 1; min. or max. Modbus value for the selected Modbus RTU data format is output.
- Modbus formats with IV:
  Regardless of the value adaptation, the NT/IV bit is taken over into the IV bit of the Modbus format.

Message Conversion

The table describes the evaluated elements of the IEC 60870-5-101/104 message during message conversion.

Elements of the message	
TI .. Type identification	• <TI:=33> .. Bitstring of 32 bits with time tag CP56Time2a • <TI:=34> .. Measured value, normalized value with time tag CP56Time2a • <TI:=35> .. Measured value, scaled value with time tag CP56Time2a • <TI:=36> .. Measured value, short floating-point number with time tag CP56Time2a • <TI:=37> .. Integrated total with time tag CP56Time2a
CASDU, IOA .. Message address	Parameter-settable
QDS .. Quality descriptor	
BL .. Blocked	Not evaluated
SB .. Substituted	Not evaluated
NT .. Not topical	NT = 1: Depending on the parameter error behavior, either the current state is kept or the parameterized substitute value is output.
IV .. Invalid	IV = 1: Depending on the parameter error behavior, either the current state is kept or the parameterized substitute value is output.
OV .. Overflow	Not evaluated
Cause of transmission	
xx .. Other COTs	Not evaluated
T .. Test	Not evaluated
Information	
Value.. S .. Sign	• Normalized value • Scaled value • IEEE STD 754 = short floating-point number • Dual meter reading • Bitstring 32 bit
Time tag	
CP56Time2a .. Date + time	Not evaluated

NOTE

Not listed elements of the IEC 60870-5-101/104 message are not rated/not supported!

Message elements		
TI .. Type identification		• <TI:=48> .. Setpoint command, normalized value • <TI:=49> .. Setpoint command, scaled value • <TI:=50> .. Setpoint command, short floating-point number
CASDU, IOA .. Message address		Parameter-settable
QOS .. Qualifier of setpoint command		
S/E	0 .. Execute	Is checked for “execute”
	1 .. Select	Not supported; is confirmed negative (ACTCON-)
QL ..		Not evaluated
Cause of transmission		
06 .. Activation		BSE→PRE: Is evaluated on the PRE (only "activation" allowed)
07 .. Confirmation of activation		PRE→BSE: • ACTCON+ if the Modbus register is read by the master within 60 seconds. • ACTCON- if the Modbus register is not read by the master within 60 seconds.
08 .. Abortion of activation		BSE→PRE: not supported
09 .. Confirmation of the abortion of activation		PRE→PRE: Abortion of the activation is confirmed negative (ACTCON-)
10 .. Activation termination		Not supported
xx .. Other COTs		Not supported
T .. Test		Not supported
Information		
Value.. S .. Sign		• Normalized value • Scaled value • IEEE STD 754 = short floating-point number • Bitstring 32 bit (only bits 0 to 15 used, bits 16 to 31 are not evaluated)
Time tag		
CP56Time2a .. Date + time		Not evaluated

NOTE

Not listed elements of the IEC 60870-5-101/104 message are not rated/not supported!

13.7.11.4 Message Conversion in Receive Direction – Modbus RTU Slave

Message conversion in receive direction: IEC 60870-5-101/104 ← Modbus RTU

SICAM A8000 IEC 60870-5-101/104 ←		Modbus RTU Format	
TI	**Designation**	**FC**	**Data format**
<TI:=30>	Single-point information with time tag CP56Time2a	05, 06, 15, 16	SPI
<TI:=31>	Double-point information with time tag CP56Time2a	05, 06, 15, 16	SPI DPI (1 = off, 2 = on) DPI (1 = on, 2 = off)

SICAM A8000 IEC 60870-5-101/104 ←		Modbus RTU Format	
<TI:=34>	Measured value, normalized value with time tag CP56Time2a	06, 16	INT16, INT32 (H/L), INT32 (L/H), UINT16, UINT32 (H/L), UINT32 (L/H), FLOAT32, FLOAT32 (swapped), FLOAT32 (little endian)
<TI:=35>	Measured value, scaled value with time tag CP56Time2a	06, 16	INT16, INT32 (H/L), INT32 (L/H), UINT16, UINT32 (H/L), UINT32 (L/H), FLOAT32, FLOAT32 (swapped), FLOAT32 (little endian)
<TI:=36>	Measured value, floating-point number with time tag CP56Time2a	06, 16	INT16, INT32 (H/L), INT32 (L/H), UINT16, UINT32 (H/L), UINT32 (L/H), FLOAT32, FLOAT32 (swapped), FLOAT32 (little endian)
<TI:=37>	Integrated total with time tag CP56Time2a	06, 16	INT16, INT32 (H/L), INT32 (L/H), UINT16, UINT32 (H/L), UINT32 (L/H) FLOAT32, FLOAT32 (swapped), FLOAT32 (little endian), 32BIT/OMVZ
<TI:=45>	Single command	05, 06, 15, 16	SC, SC (pulse)
<TI:=46>	Double command	05, 06, 15, 16	DC, DC (pulse)
<TI:=48>	Setpoint command, normalized value	06, 16	INT16, INT32 (H/L), INT32 (L/H), UINT16, UINT32 (H/L), UINT32 (L/H), FLOAT32, FLOAT32 (swapped), FLOAT32 (little endian)
<TI:=49>	Setpoint command, scaled value	06, 16	INT16, INT32 (H/L), INT32 (L/H), UINT16, UINT32 (H/L), UINT32 (L/H), FLOAT32, FLOAT32 (swapped), FLOAT32 (little endian)
<TI:=50>	Setpoint command, short floating-point number	06, 16	INT16, INT32 (H/L), INT32 (L/H), UINT16, UINT32 (H/L), UINT32 (L/H), FLOAT32, FLOAT32 (swapped), FLOAT32 (little endian)
-	Time synchronization [323]	-	-

Modbus Function Codes (FC):

05 .. Write Single Coil

06 .. Write Single Register

15 .. Write Multiple Coils

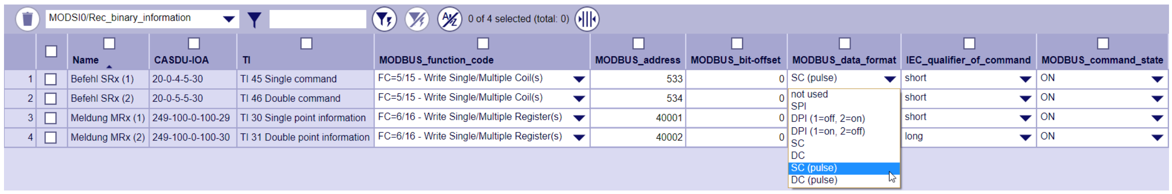
16 .. Write Multiple Registers

Indications, Commands

The parameterization of the address and message conversion for binary information, commands from Modbus RTU Slave in receive direction is to be done with the SICAM Device Manager with the function “Signals” or with the SICAM TOOLBOX II, OPM II.

323 Time synchronization of the SICAM A8000 component via NTP-Server (time synchronization internal with int. system messages)

Processing type: *firmware* | `Rec_binary_information`



[MODSI0_DM_Empf_Binäre_Information, 3, en_US]

Parameter	
`TI`	Supported type identifications: • <TI:=30> .. Single-point information with time tag CP56Time2a • <TI:=31> .. Double-point information with time tag CP56Time2a • <TI:=45> .. Single command • <TI:=46> .. Double command
`Name`	Name of the signal
`CASDU-IOA`	SICAM A8000 internal IEC 60870-5-101/104 message address (CASDU1, CASDU2, IOA1, IOA2, IOA3)
`MODBUS_function_code`	Supported Modbus function codes: • FC = 05 .. Write Single Coil • FC = 06 .. Write Single Register • FC = 15 .. Write Multiple Coils [max. 2 coils possible] • FC = 16 .. Write Multiple Registers [max. 2 register possible]
`MODBUS_address`	Modbus address (register or coil address): • 1 to 65535 (FC = 06, 16; single-point information, single command with FC = 05, 15) • 1 to 65534 (double-point information; double command with FC = 05, 15) The bits of a double-point information/double command are always next to each other.
`MODBUS_bit-offset`	Bit number in the corresponding Modbus register: • 0 .. With FC = 05, 15 • 0 to 15 .. Single-point information/single command [only FC = 06, 16] • 0 to 14 .. Double-point information/double command [only FC = 06, 16] Both bits of a double-point information/double command are in the same Modbus register! With the Modbus bit offset always the 1st bit of the double-point information/double command is specified.
`MODBUS_data_format`	Data format on the Modbus: • SPI .. Single-point information • DPI (1 = off, 2 = on) .. Double-point information [only FC = 06, 16] • DPI (1 = on, 2 = off) .. Double-point information [only FC = 06, 16] • SC .. Single command • DC .. Double command • SC (pulse) .. Single command (pulse) • DC (pulse) .. Double command (pulse)

Parameter	
IEC_qualifier_of_command	IEC qualifier of command: [only <TI:=45, 46>] • none • short • long
MODBUS_command_state	Modbus command state: [only double command <TI:=46>] • OFF • ON On the parameterized Modbus_address / Modbus_bit-offset the parameterized selected Modbus command state is output (possible inversion of the command output)

Supported Data Formats

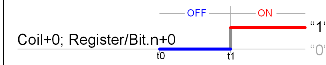
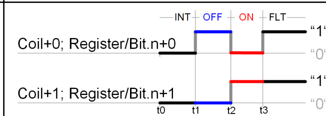
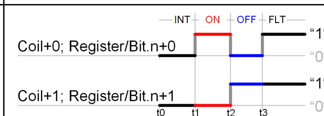
Format	Modbus data format	IEC 60870-5-101/104 data format (TI)
SPI	Single-point information	30
DPI (1 = off, 2 = on)	Double-point information (OFF before ON)	31
DPI (1 = on, 2 = off)	Double-point information (ON before OFF)	31
SC	Single command	45
DC	Double command	46
SC (pulse)	Single command pulse	45
DC (pulse)	Double command pulse	46

NOTE

Since the Modbus protocol does not define how the data is represented in the coils/registers, the Modbus format must be specified for the message conversion. Supported Modbus data formats see *13.7.13 Modbus Data Formats*.

Single-Point Information SPI, Double-Point Information DPI

In receive direction, each binary information state is forwarded 1:1 to the BSE on change. For double-point information, no intermediate position suppression and no suppression time for faulty state is performed in the receive direction!

Modbus data format	Modbus binary information state	Binary information state in Modbus coil/register	IEC 60870-5-101/104
SPI	SPI: Bit n+0 <0>: 0 .. OFF <1>: 1 .. ON		SPI: <0> ... OFF <1> ... ON
DPI (1 = off, 2 = on)	DPI: Coding "OFF before ON" (IEC 60870-5-101/104) Bit n+1 | n+0 <0>: 0 | 0 .. INT [324] <1>: 0 | 1 .. OFF <2>: 1 | 0 .. ON <3>: 1 | 1 .. FLT[325]	 DPI ... 2 bits as coils or 2 bits in Modbus register	DPI: <0>: ... INT [324] <1>: ... OFF <2>: ... ON <3>: ... FLT [325]
DPI (1 = on, 2 = off)	DPI: Coding "ON before OFF" (IEC 60870-5-101/104) Bit n+1 | n+0 <0>: 0 | 0 .. INT [324] <1>: 0 | 1 .. ON <2>: 1 | 0 .. OFF <3>: 1 | 1 .. FLT[325]	 DPI ... 2 bits as coils or 2 bit in Modbus register	DPI: <0>: ... INT [324] <1>: ... OFF <2>: ... ON <3>: ... FLT [325]

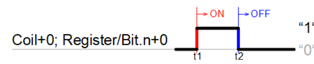
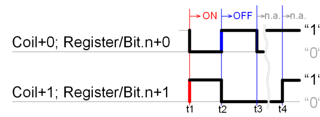
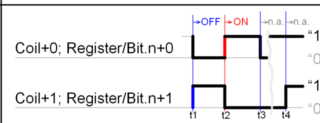
Single Command SC, Double Command DC

In receive direction, the command state is always forwarded to the BSE on receipt 1:1 without change comparison.

Commands are not forwarded during general interrogation!

324 intermediate position (undefined state or intermediate state)

325 Faulty position (indeterminate state)

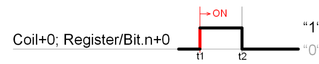
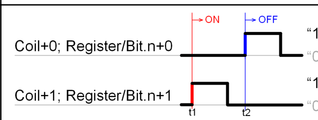
Modbus data format	Modbus binary information state	Binary information state in Modbus coil/register	IEC 60870-5-101/104
SC	SC: Bit n+0 <0>: 0 .. OFF <1>: 1 .. ON	 SC ... 1 bit as coil or 1 bit in Modbus register t1 .. ON command is forwarded t2 .. OFF command is forwarded	SCS: <0> ... OFF <1> ... ON
DC	Modbus_command_state = OFF DC: Bit n+1 | n+0 <0>: 0 | 0 .. n.a. [326] <1>: 0 | 1 .. OFF <2>: 1 | 0 .. ON <3>: 1 | 1 .. n.a. [326]	 DPI ... 2 bits as coils or 2 bit in Modbus register t1 .. <2> ON command is forwarded t2 .. <1> OFF command is forwarded t3 .. <0> n.a. is forwarded t4 .. <3> n.a. is forwarded	DCS/RCS: <0>: ... n.a. [326] <1>: ... OFF/LOWER <2>: ... ON/HIGHER <3>: ... n.a. [326]
DC	Modbus_command_state = ON DC: Bit n+1 | n+0 <0>: 0 | 0 .. n.a. [326] <1>: 0 | 1 .. ON <2>: 1 | 0 .. OFF <3>: 1 | 1 .. n.a. [326]	 DPI ... 2 bits as coils or 2 bit in Modbus register t1 .. <1> OFF command is forwarded t2 .. <2> ON command is forwarded t3 .. <0> n.a. is forwarded t4 .. <3> n.a. is forwarded	DCS/RCS: <0>: ... n.a. [326] <1>: ... OFF/LOWER <2>: ... ON/HIGHER <3>: ... n.a. [326]

Single command SC (Pulse), Double command DC (Pulse)

In receive direction, the ON command state is always transferred to the BSE 1:1 without change comparison. The OFF command state is not transferred.

Commands are not forwarded during general interrogation.

326 Not permitted!

Modbus data format	Modbus binary information state	Binary information state in Modbus coil/register	IEC 60870-5-101/104
SC (pulse)	SC (pulse): Bit n+0 <0>: 0 .. OFF <1>: 1 .. ON	 SC ... 1 bit as coil or 1 bit in Modbus register t1 .. ON command is forwarded t2 .. OFF command is not forwarded	SCS: <1> ... ON
DC (pulse)	DC (pulse): Bit n+1 | n+0 <0>: 0 | 0 .. n.a. [326] <1>: 0 | 1 .. OFF <2>: 1 | 0 .. ON <3>: 1 | 1 .. n.a. [326]	 SC ... 1 bit as coil or 1 bit in Modbus register t1 .. ON command is forwarded t2 .. OFF command is forwarded	DCS/RCS: <0>: ... n.a. [326] <1>: ... OFF/LOWER <2>: ... ON/HIGHER <3>: ... n.a. [326]

Message Conversion

The table describes the evaluated elements of the IEC 60870-5-101/104 message during message conversion.

Elements of the message		
TI .. Type identification		• <TI:=30> .. Single-point information with time tag CP56Time2a • <TI:=31> .. Double-point information with time tag CP56Time2a
CASDU, IOA .. Message address		Parameter-settable
QDS ..Quality descriptor		
BL .. Blocked		Not supported (BL = 0)
SB .. Substituted		Not supported (SB = 0)
NT .. Not topical		Not supported (NT = 0)
IV .. Invalid		Not supported (IV = 0)
Cause of transmission		
03 .. Spontaneous		upon change of information state
20 .. Interrogated by station interrogation		Upon reception of a GI request
xx .. Other COTs		Not supported
T ..Test		Not supported
Information		
Single-point information status		
SPI	0 .. OFF	Supported
	1 .. ON	Supported
Double-point information state		
DPI	0 .. Indeterminate or intermediate state	Supported
	1 .. OFF	Supported
	2 .. ON	Supported
	3 .. Indeterminate state	Supported

Elements of the message	
Time tag	
CP56Time2a .. Date + time	PRE internal time (receive time)

NOTE

Not listed elements of the IEC 60870-5-101/104 message are not rated / not supported!

Message elements		
TI .. Type identification		• <TI:=45> .. Single command • <TI:=46> .. Double command
CASDU, IOA .. Message address		Parameter-settable
Cause of transmission		
06 .. Activation		Supported
xx .. Other COTs		Not supported
T ..Test		Not supported
Information		
(SCO/DCO)		
SCS	Single command state	[only <TI:=45>]
	0 .. OFF	Supported
	1 .. ON	Supported
DCS	Double command state	[only <TI:=46>]
	0 .. Not allowed	Supported
	1 .. OFF	Supported
	2 .. ON	Supported
	3 .. Not allowed	Supported Not supported
QOC	S/E	
	0 = Execute	Supported
	1 = Select	Not supported
QU	Command qualifier	
	0 .. No additional defini-tions	Supported
	1 .. Short pulse duration	Supported
	2 .. Long pulse duration	Supported
	3 .. Persistent command	Not supported

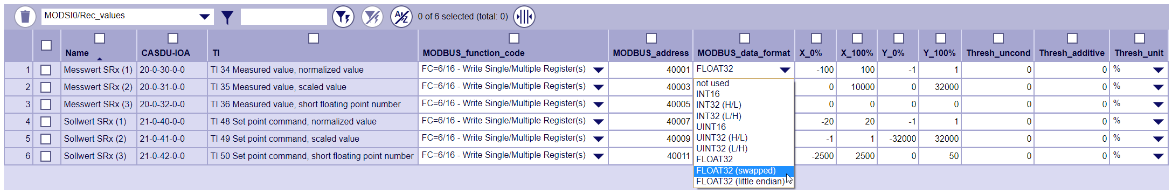
NOTE

Not listed elements of the IEC 60870-5-101/104 message are not rated / not supported!

Measured Values, Setpoint Values

The parameterization of the address and message conversion for measured values, setpoint values from Modbus RTU Slave in receive direction is to be done with the SICAM Device Manager with the function “Signals” or with the SICAM TOOLBOX II, OPM II.

Processing type: *firmware* | **`Rec_values`**



MODSI0/Rec_values — 0 of 6 selected (total: 0)

	Name	CASDU-IOA	TI	MODBUS_function_code	MODBUS_address	MODBUS_data_format	X_0%	X_100%	Y_0%	Y_100%	Thresh_uncond	Thresh_additive	Thresh_unit
1	Messwert SRx (1)	20-0-30-0-0	TI 34 Measured value, normalized value	FC=6/16 - Write Single/Multiple Register(s)	40001	FLOAT32	-100	100	-1	1	0	0	%
2	Messwert SRx (2)	20-0-31-0-0	TI 35 Measured value, scaled value	FC=6/16 - Write Single/Multiple Register(s)	40003		0	10000	0	32000	0	0	%
3	Messwert SRx (3)	20-0-32-0-0	TI 36 Measured value, short floating point number	FC=6/16 - Write Single/Multiple Register(s)	40005		0	0	0	0	0	0	%
4	Sollwert SRx (1)	21-0-40-0-0	TI 48 Set point command, normalized value	FC=6/16 - Write Single/Multiple Register(s)	40007		-20	20	-1	1	0	0	%
5	Sollwert SRx (2)	21-0-41-0-0	TI 49 Set point command, scaled value	FC=6/16 - Write Single/Multiple Register(s)	40009		-1	1	-32000	32000	0	0	%
6	Sollwert SRx (3)	21-0-42-0-0	TI 50 Set point command, short floating point number	FC=6/16 - Write Single/Multiple Register(s)	40011		-2500	2500	0	50	0	0	%

[MODSI0_DM_Empf_Werte, 2, en_US]

Parameters	
`TI`	Supported type identifications: • <TI:=34> .. Measured value, normalized value with time tag CP56Time2a • <TI:=35> .. Measured value, scaled value with time tag CP56Time2a • <TI:=36> .. Measured value, short floating-point number with time tag CP56Time2a • <TI:=48> .. Setpoint command, normalized value with time tag CP56Time2a • <TI:=49> .. Setpoint command, scaled value • <TI:=50> .. Setpoint command, short floating-point number
`Name`	Name of the signal
`CASDU-IOA`	SICAM A8000 internal IEC 60870-5-101/104 message address (CASDU1, CASDU2, IOA1, IOA2, IOA3)
`MODBUS_function_code`	Supported Modbus function codes: • FC = 06 .. Write Single Register • FC = 16 .. Write Multiple Registers [max. 2 register possible]
`MODBUS_address`	Modbus address (register address): • 1 to 65535 • 1 to 65534 [for all Modbus “Double register formats“ (e.g.: FLOAT32)]
`MODBUS_data_format`	Data format on the Modbus: • INT16 • INT32 (H/L) [only FC = 16] • INT32 (L/H) [only FC = 16] • UINT16 • UINT32 (H/L) [only FC = 16] • UINT32 (L/H) [only FC = 16] • FLOAT32 [only FC = 16] • FLOAT32 (swapped) [only FC = 16] • FLOAT32 (little endian) [only FC = 16]
`X_0%`, `X_100%` **`Y_0%`, `Y_100%`**	Parameters for value adaptation (scaling) • Valid range of value for X_0% and X_100% see *13.7.13 Modbus Data Formats* • <TI:=34> .. **`Y_0%`** and **`Y_100%`** must not be greater or less than ±1 • <TI:= 35> .. **`Y_0%`** and **`Y_100%`** must not be less than –32768 or greater than +32767. • Value adoption inactive at **`X_0%`** = *0* and **`X_100%`** = *0*
`Thresh_uncond`	If the value changes > **`Thres_uncond`**, the received value is immediately forwarded to the BSE.

Parameters	
Thresh_additive	When changing the value ≤ **thres_ uncond**, the received value is not immediately forwarded to the BSE and the additive measured value change monitoring is performed.
Thresh_unit	• Absolute value [received value from Modbus] • %

Supported Data Formats

Format	Modbus data format	IEC 60870-5-101/104 data format (TI)
INT16	Signed integer 16-bit	34, 35, 36, 48, 49, 50
INT32 (H/L)	Signed integer 32-bit (HIGH before LOW)	34, 35, 36, 48, 49, 50
INT32 (L/H)	Signed integer 32-bit (LOW before HIGH)	34, 35, 36, 48, 49, 50
UINT16	Unsigned integer 16-bit	34, 35, 36, 48, 49, 50
UINT32 (H/L)	Unsigned integer 16-bit (HIGH before LOW)	34, 35, 36, 48, 49, 50
UINT32 (L/H)	Unsigned integer 32-bit (LOW before HIGH)	34, 35, 36, 48, 49, 50
FLOAT32	Short floating-point (IEEE 754)	34, 35, 36, 48, 49, 50
FLOAT32 (swapped)	Short floating-point (IEEE 754) “swapped”	34, 35, 36, 48, 49, 50
FLOAT32 (little endian)	Short floating-point (IEEE 754) “little endian”	34, 35, 36, 37, 48, 49, 50

NOTE

Since the Modbus protocol does not define how the data is represented in the coils/registers, the Modbus format must be specified for the message conversion. Supported Modbus data formats see *13.7.13 Modbus Data Formats*.

Modbus data formats that require multiple registers (e.g., FLOAT32) must always be transmitted in the same Modbus message!

Measured Value Change Monitoring

In order to avoid unnecessarily burdening the SICAM A8000 internal and further communication, the received measured value is monitored for changes according to the following rules:

- The first value determined after startup is transmitted immediately
- Each change of quality descriptor IV triggers an immediate transfer, the quality descriptor OV does not initiate a transfer
- Change monitoring in accordance with the method of the additive threshold value procedure:

  The measured value is monitored for changes when it is received. If the deviation compared to the last measured value transmitted to BSE is greater than the configured **thresh_uncond** , the new measured value is transmitted immediately. Otherwise, the deviation is added to the last spontaneously transmitted measured value, with the correct sign. Only when the amount of this sum exceeds the parameterizable **thresh_additive**, the current measured value is spontaneously transmitted to the BSE.

Thresh uncond	Thresh additive	Processing
= 0	= 0	Value is transmitted to the BSE upon each status change in the next processing grid
= 0	≠ 0	

Thresh uncond	Thresh additive	Processing
≠ 0	= 0	• Change greater **Thresh_uncond**: Value is transmitted • Change less than/equal **Thresh_uncond**: Additive threshold value procedure
≠ 0	≠ 0	• Change greater **Thresh_uncond**: Value is transmitted • Change less than/equal **Thresh_uncond**: Additive threshold value procedure

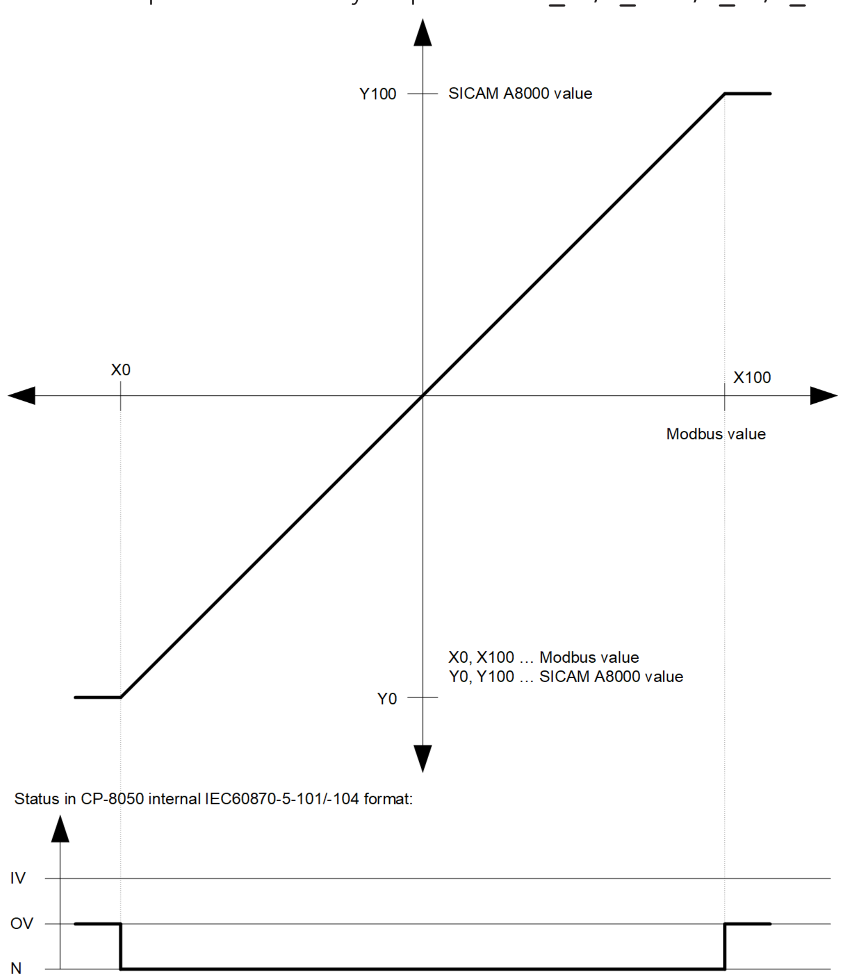
A transmission of the measured value due to a general interrogation does not influence the threshold value procedure.

The thresholds are to be parameterized for every measured value with the parameter **Thresh_additive** and the parameter **Thresh_uncond** .

For more details and examples of additive monitoring of measured value changes, see *13.1.4.13 Additive Measured Value Change Monitoring*.

Value Adaptation

The value adaptation is defined by the parameters **X_0%**, **X_100%**, **Y_0%**, **Y_100%**.



The value adaptation is only performed if **X_0%** or **X_100%** ≠ *0* is parameterized.

If the Modbus value is outside the value range of the selected IEC 60870-5-101/104 type identifier when the value adoption (= direct transfer) is not activated, then OV = 1 is set.

NOTE

The value adaptation in MODSI0 is different compared to other Modbus protocols (e.g.: MODSA0 in SICAM or MODST0 in SICAM A8000 CP-8000, CP- 802x).

When replacing by SICAM A8000 with MODSI0, special attention must be paid if the parameterization of the signals is taken over 1:1 from the systems mentioned and the value adaptation was previously parameterized with **`X_0%`** = *0*, **`X_100%`** = *1*, **`Y_0%`** = *0* and **`Y_100%`** = *1*.

With this parameterization, only values in the range 0 to 1 are implemented as valid. Values greater than 1 are no longer converted and marked with OV = 1.

Change Handling

Received values are only transferred on to the basic system element, by the protocol element for Modbus RTU Slave, if they are changed.

Since measured values from the Modbus RTU Master -> Slave with FC = 06, 16 are usually only transmitted spontaneously when changed, a measured value change handling with additive threshold value procedure with **`Thres_uncond`** and **`Thres_additive`** is not implemented in Modbus RTU Slave for SICAM A8000.

Message Conversion

The table describes the evaluated elements of the IEC 60870-5-101/104 message during message conversion.

Elements of the message	
TI .. Type identification	• <TI:=34> .. Measured value, normalized value with time tag CP56Time2a • <TI:=35> .. Measured value, scaled value with time tag CP56Time2a • <TI:=36> .. Measured value, short floating-point number with time tag CP56Time2a • <TI:=48> .. Setpoint command, normalized value • <TI:=49> .. Setpoint command, scaled value • <TI:=50> .. Setpoint command, short floating-point number
CASDU, IOA .. Message address	Parameter-settable
QDS .. Quality descriptor	
BL .. Blocked	Not supported (BL = 0)
SB .. Substituted	Not supported (SB = 0)
NT .. Not topical	NT = 1 if FLOAT32 format with the value = NAN (Not A Number) or with the value = ∞ (the last received valid value is passed with NT = 1)
IV .. Invalid	Not supported (IV = 0)
OV .. Overflow	OV = 1: • Without value adaptation: Modbus value outside the range of the selected type identification • With value adaptation: Modbus value **`X_0%`** or **`X_100%`**
Cause of transmission	

Elements of the message	
03 .. Spontaneous	Alteration of the measured value depending on the thresholds or alteration of the quality descriptor [only <TI:=34, 35, 36>]
06 .. Activation	Supported [only <TI:=48, 49, 50>]
20 .. Interrogated by station interrogation	After receipt of a GI request [only <TI:=34, 35, 36>]
xx .. Other COTs	Not supported
T .. Test	Not supported
Information	
Single-point information status	
Value.. S .. Sign	• Normalized value • Scaled value • IEEE STD 754 = short floating-point number
Time tag	
CP56Time2a .. Date + time	PRE internal time (receive time)

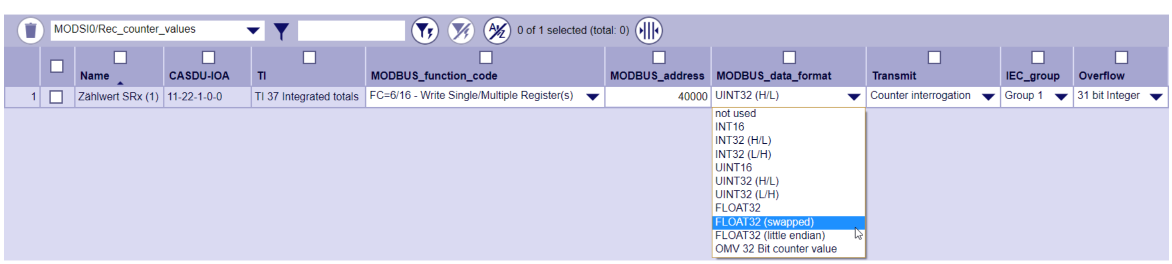
NOTE

Not listed elements of the IEC 60870-5-101/104 message are not rated / not supported!

Integrated Totals

The parameterization of the address and message conversion for integrated totals from Modbus RTU Slave in receive direction is to be done with the SICAM Device Manager with the function “Signals” or with the SICAM TOOLBOX II, OPM II.

Processing type: *firmware* / `Rec_counter value`



[MODSI0_Empf_Zählwerte, 2, en_US]

Parameter	
`TI`	Supported type identifications: • <TI:=37> .. Integrated totals with time tag CP56Time2a
`Name`	Name of the signal
`CASDU-IOA`	SICAM A8000 internal IEC 60870-5-101/104 message address (CASDU1, CASDU2, IOA1, IOA2, IOA3)
`MODBUS_Station`	Address of the Modbus Slave (SICAM A8000 internal): • 0 to 99
`MODBUS_func-tion_code`	Supported Modbus function codes: • FC = 06 .. Write Single Register • FC = 16 .. Write Multiple Registers

Parameter	
`MODBUS_address`	Modbus address (register address): • 1 to 65535
`MODBUS_data_format`	Data format on the Modbus: • INT16 • INT32 (H/L) • INT32 (L/H) • UINT16 • UINT32 (H/L) • UINT32 (L/H) • FLOAT32 • FLOAT32 (swapped) • FLOAT32 (little endian) • OMV 32-Bit counter format
`Transmit`	Counter transmission at: • Counter interrogation • Cyclically every 1, 2, 3, 5, 10, 15, 30, 60 minutes
`IEC_group`	IEC 60870-5-101/104 counter group: • Group 1 to 4
`Overflow`	Overflow treatment at: • 24, 31 bit integer • 2, 3, 4, 5, 6, 7, 8, 9 decades BCD

Transfer of the received integrated totals

Received integrated totals are not passed on spontaneously to the BSE, but rather if the following criteria are met:

- Counter interrogation
- Cyclically every 1, 2, 3, 5, 10, 15, 30, 60 minutes
  Note:
  If “cyclic” is selected, the integrated totals are not forwarded immediately in the selected time grid, but only when the integrated totals is next received after the cycle time has expired.

Supported Data Formats

Format	Modbus data format	IEC 60870-5-101/104 Data format (TI)
INT16	Signed integer 16-bit	37
INT32 (H/L)	Signed integer 32-bit (HIGH before LOW)	37
INT32 (L/H)	Signed integer 32-bit (LOW before HIGH)	37
UINT16	Unsigned integer 16-bit	37
UINT32 (H/L)	Unsigned integer 16-bit (HIGH before LOW)	37
UINT32 (L/H)	Unsigned integer 32-bit (LOW before HIGH)	37
FLOAT32	Short floating-point (IEEE 754)	37
FLOAT32 (swapped)	Short floating-point (IEEE 754) “swapped”	37

Format	Modbus data format	IEC 60870-5-101/104 Data format (TI)
FLOAT32 (little endian)	Short floating-point (IEEE 754) "little endian"	37
32BIT/OMVZ	OMV counter value format	37

Legend: <TI:=37> Integrated totals with time tag CP56Time2a

NOTE

Since the Modbus protocol does not define how the data is represented in the coils/registers, the Modbus format must be specified for the message conversion. Supported Modbus data formats see *13.7.13 Modbus Data Formats*.

Message Conversion

The table describes the evaluated elements of the IEC 60870-5-101/104 message during message conversion.

Elements of the message	
TI .. Type identification	<TI:=37> .. Integrated totals with time tag CP56Time2a
CASDU, IOA .. Message address	Parameter-settable
Data point quality descriptor	
Sequence number	With each trigger for latching for a group the sequence number is increased in the range from 1 to 31.
CY .. Carry	On overflow of the count in the associated count period
CA .. Presets	Not supported
IV .. Invalid	IV = 1 • FLOAT32 format with the value = NAN ("Not A Number") • I bit from the OMV 32-Bit counter interrogation format
Cause of transmission	
03 .. Spontaneous	When transmitting = periodical data transfer (cyclic each 1, 2, 3, 5, 10, 15, 30, 60 minutes)
37 .. requested by general counter interrogation	For general request counter (all counter groups)
38 to 41 .. interrogated by group 1 to 4 interrogation	For request counter group (1 to 4)
T .. Test	Not supported
Information	
Value.. S .. Sign	• Binary counter reading
Time tag	
CP56Time2a .. Date + time	PRE internal time

NOTE

Not listed elements of the IEC 60870-5-101/104 message are not rated / not supported!

Message Conversion "Counter Interrogation Command" (SICAM A8000 internal only)

The table describes the evaluated elements of the IEC 60870-5-101/104 message during message conversion.

Elements of the message		
TI .. Type identification		<TI:=101> .. Counter interrogation command
CASDU, IOA .. Message address		Defined
QCC .. Identifier counter interrogation		
FRZ	RQT	FRZ .. Freeze (= latch) RQT .. Request (= requirement)
0	1 to 4	Read (no freeze or reset) Counter interrogation (1 to 4)
	5	Read (no freeze or reset) General counter interrogation
1	1 to 4	Counter freeze without reset Counter interrogation (1 to 4)
	5	Counter freeze without reset All counter groups
2	1 to 4	Counter freeze with reset Counter interrogation (1 to 4)
	5	Counter freeze without reset All counter groups
3	1 to 4	Reset counter Counter interrogation group (1 to 4)
	5	Reset counter All counter groups
x	0; 6 to 63	Not supported
Cause of transmission		
06 .. Activation		Must be set
xx .. Other COTs		Not supported
T .. Test		Not supported

NOTE

Not listed elements of the IEC 60870-5-101/104 message are not rated / not supported!

13.7.12 Interoperability

13.7.12.1 Interoperability Modbus RTU Master

The companion standard defined presents sets of parameters and alternatives from which subsets have to be selected to implement particular telecontrol systems. Other parameters, such as the listed set of different Modbus Function Codes or Modbus Data Formats in command and in monitoring direction allow the specification of the complete set or subsets, as appropriate for given applications. This clause summarizes the parameters of the previous clauses to facilitate a suitable selection for a specific application. If a system is composed of equipment stemming from different manufacturers it is necessary that all partners agree on the selected parameters.

The selected parameters should be crossed in the white boxes.

☐	Function is not supported
X	Function is supported
■	Function not defined for this application!

Note:
In addition, the full specification of a system may require individual selection of certain parameters for certain parts of the system, such as the individual selection of scaling factors for individually addressable measured values.

Network Configuration

	Configuration	Note
X	Point-to-point configuration	Multi-point traffic – line configuration (half duplex) with only one slave RS-232 or RS-485 (or RS-422)
X	Multiple point-to-point configuration	RS-232 or RS-485 (or RS-422)
X	Multi-point traffic – line configuration	RS-485 or RS-422
X	Multi-point traffic – star configuration	RS-232 or RS-485 (or RS-422)
X	Data concentrator	
☐	Multi-point traffic – ring	
☐	Dial-up traffic (dial in)	
☐	Dial-up traffic (dial out)	
☐	Modem bank	

Physical layer

Electrical interface

	Selection	Note
X	direct link interface (RS-232)	• Point-to-point configuration (master with 1 slave)
X	RS-422	RS-422 (4-Wire) • Multi-point traffic (master with n slaves) • Point-to-point configuration (master with 1 slave)
X	RS-485	RS-485 (2-wire) • Multi-point traffic (master with n slaves) • Point-to-point configuration (master with 1 slave)

Transmission speed

- The Modbus protocol uses only an unbalanced communication procedure
- The transmission speed is same for both directions (transmit/receive)

	Transmission speed	Note		Transmission speed	Note
X	50 bits/s		X	1800 bits/s	
X	75 bits/s		X	2000 bits/s	
X	100 bits/s		X	2400 bits/s	
	110 bits/s		X	4800 bits/s	
X	134.5 bits/s		X	9600 bits/s	
X	150 bits/s		X	19200 bits/s	
X	200 bits/s		X	38400 bits/s	
X	300 bit/s		X	56000 bits/s	
X	600 bits/s		X	57600 bits/s	
X	1050 bits/s		X	64000 bits/s	
X	1200 bits/s		X	115200 bits/s	

Link Layer

	Transmission mode
X	RTU mode
	ASCII mode

RTU mode

Byte asynchronous data transmission is used in in RTU mode (least significant bit is sent first for each byte).

	Byte frame	Note
X	1 start bit	
X	8 data bits	
X	Parity bit “even”	
X	Parity bit “odd”	
X	No parity bit	
X	1 stop bit	
X	2 stop bits	

Note:

- Byte frame for Modbus RTU mode according Modbus standard: 8E1 (1 start bit, 8 data bits, 1 parity bit (even parity), 1 stop bit)
- For maximum compatibility with other devices “odd parity”, “no parity” and “2 stop bits” is also supported.
- With “no parity” 2 stop bits must be used!
- In old configurations with Modbus RTU mode typically the byte frame 8N2 (8 data bits, no parity, 2 stop bits) is used.

	Modbus settings	Note
X	Modbus slave address (8 bits)	
X	Modbus function code (8 bits)	
X	Modbus register address (16 bits)	The Modbus address addresses a 16-bit Modbus register
X	Cyclical redundancy check (CRC) (16 bits)	

~~ASCII Mode~~

~~Byte asynchronous data transmission is used in in ASCII mode (least significant bit is sent first for each byte).~~

	~~Byte frame~~	~~Note~~
☐	~~1 start bit~~	
☐	~~7 data bits~~	
☐	~~Parity bit "even"~~	
☐	~~Parity bit "odd"~~	
☐	~~No parity bit~~	
☐	~~1 stop bit~~	
☐	~~2 stop bits~~	

~~Note:~~

- ~~Byte frame for Modbus ASCII mode according Modbus standard: 7E1 (1 start bit, 7 data bits, 1 parity bit (even parity), 1 stop bit)~~
- ~~For maximum compatibility with other devices "odd parity", "no parity" and "2 stop bits" are also supported.~~
- ~~With "no parity" 2 stop bits must be used!~~
- ~~In old configurations with Modbus ASCII mode typically the byte frame 7N2 (7 data bits, no parity, 2 stop bits) is used.~~

	~~Modbus settings~~	~~Note~~
☐	~~Modbus slave address - 2 characters (8 bits)~~	
☐	~~Modbus function code - 2 characters (8 bits)~~	
☐	~~Modbus register address - 4 characters (16 bits)~~	~~The Modbus address addresses a 16-bit Modbus register~~
☐	~~Longitudinal redundancy check (LRC) - 2 characters (8 bits)~~	

Link Layer

	Description	Note
X	Unbalanced transmission Master/Slave	
X	Modbus Master (half duplex)	
☐	Modbus Slave	

Message Length

	Description	Note
X	RTU mode: Maximum message length 253 bytes (without address and CRC bytes)	
	ASCII mode: Maximum message length 0 up to 2*252 characters (without start, address, function, LRC and end characters)	Max. message length is configurable

Address of the Link Layer

	Description	Note
X	1 octet (8 bits) ... RTU Mode	Modbus slave address (1 to 247)
	2 characters .... ASCII mode	Modbus slave address (1 to 247)
	Broadcast addressing	Modbus slave address (0)

Application Layer

Modbus Function Codes

	Modbus function code	Data formats
	Data access (read/write bit)	
X	01 = Read Coils	<20> SPI <21> DPI (1 = off, 2 = on) <22> DPI (1 = on, 2 = off)
X	02 = Read Discrete Inputs	<20> SPI <21> DPI (1 = off, 2 = on) <22> DPI (1 = on, 2 = off)
X	05 = Write Single Coil	<20> SPI <30> SC <31> SC (pulse) <35> DC2 (pulse)
X	15 = Write Multiple Coils	<20> SPI <30> SC <31> SC (pulse) <32> DC <35> DC2 (pulse)
	Data access (16-bit read/write)	

	Modbus function code	Data formats
X	03 = Read Holding Registers	<01> INT16 <02> UINT16 <03> INT32 (H/L) <04> UINT32 (H/L) <05> INT32 (L/H) <06> UINT32 (L/H) <7a> FLOAT32 <7b> FLOAT32 (swapped) <16> BS16 <20> SPI <21> DPI (1 = off, 2 = on) <22> DPI (1 = on, 2 = off) <23> INT16 + IV <24> UINT16 + IV <50> SPI + IV <51> DPI (1 = off, 2 = on) + IV <52> DPI (1 = on, 2 = off) + IV
X	04 = Read Input Registers	<01> INT16 <02> UINT16 <03> INT32 (H/L) <04> UINT32 (H/L) <05> INT32 (L/H) <06> UINT32 (L/H) <7a> FLOAT32 <7b> FLOAT32 (swapped) <7c> FLOAT32 (little endian) <16> BS16 <20> SPI <21> DPI (1 = off, 2 = on) <22> DPI (1 = on, 2 = off) <23> INT16 + IV <24> UINT16 + IV <50> SPI + IV <51> DPI (1 = off, 2 = on) + IV <52> DPI (1 = on, 2 = off) + IV
X	06 = Write Single Register	<01> INT16 <02> UINT16 <16> BS16 <20> SPI [327] <30> SC [327] <31> SC (pulse) [327] <32> DC [327] <35> DC2 (pulse) [327]

327 Only 1 data point is supported per Modbus register!

	Modbus function code	Data formats
X	16 = Write Multiple Registers	<01> INT16 <02> UINT16 <03> INT32 (H/L) <04> UINT32 (H/L) <05> INT32 (L/H) <06> UINT32 (L/H) <7a> FLOAT32 <7b> FLOAT32 (swapped) <7c> FLOAT32 (little endian) <16> BS16 <20> SPI [327] <30> SC [327] <31> SC (pulse) [327] <32> DC [327] <35> DC2 (pulse) [327] <1xx> DTx
	22 = Mask Write Register	
	23 = Read / Write Multiple Registers	
	24 = Read FIFO Queue	
	Data access (read/write file)	
	20 = Read File Record	
	21 = Write File Record	
	Diagnosis	
	07 = Read Exception Status	
	08 = Diagnostics (Sub-Code 00 to 18, 20)	
	11 = Get Com Event Counter	
	12 = Get Com Event Log	
	17 = Report Slave ID	
	43 = Read Device Identification (Sub-Code = 14)	
	Other	
	43 = Encapsulated Interface Transport (Sub-Code = 13, 14)	

Modbus Exception Status

	Modbus exception code[328]	Note
X	01 = Illegal Function	Function code not supported
X	02 = Illegal Data Address	Requested data not present
X	03 = Illegal Data Value	Illegal data
X	04 = Server Device Failure	An error has occurred during the request
X	05 = Acknowledge	The substation acknowledges, but cannot reply to the request immediately
X	06 = Server Device Busy	The substation is busy
X	08 = Memory Parity Error	Parity error detected in memory
X	10 (0x0A) = Gateway Path Unavailable	Gateway path not available.
X	11 (0x0B) = Gateway Target Device Failed To Respond	The addressed substation does not respond. This exception is generated by the gateway.

Note:

- If the query of the Modbus TCP Master is answered with an Exception Response, then the queried data is emulated by the Modbus RTU Master as invalid (NT = 1 “not topical”).
- The Modbus RTU Master does not do any retries.
- The exception codes are not specially evaluated by the Modbus RTU master - a received exception code is rated as negative acknowledgment.

13.7.12.2 Interoperability Modbus RTU Slave

The companion standard defined presents sets of parameters and alternatives from which subsets have to be selected to implement particular telecontrol systems. Other parameters, such as the listed set of different Modbus Function Codes or Modbus Data Formats in command and in monitoring direction allow the specification of the complete set or subsets, as appropriate for given applications. This clause summarizes the parameters of the previous clauses to facilitate a suitable selection for a specific application. If a system is composed of equipment stemming from different manufacturers it is necessary that all partners agree on the selected parameters.

The selected parameters should be crossed in the white boxes.

☐	Function is not supported
X	Function is supported
■	Function not defined for this application!

Note:

328 The exception codes are not specially evaluated by the Modbus TCP master - a received exception code is rated as negative acknowledgment.

In addition, the full specification of a system may require individual selection of certain parameters for certain parts of the system, such as the individual selection of scaling factors for individually addressable measured values.

Network configuration

	Configuration	Note
X	Point-to-point configuration	Multi-point traffic – line configuration (half duplex) with only one slave RS-232 or RS-485 (or RS-422)
X	Multiple point-to-point configuration	RS-232 or RS-485 (or RS-422)
X	Multi-point traffic – line configuration	RS-485 or RS-422
X	Multi-point traffic – star configuration	RS-232 or RS-485 (or RS-422)
X	Data concentrator	
	Multi-point traffic – ring	
	Dial-up traffic (dial in)	
	Dial-up traffic (dial out)	
	Modem bank	

Physical Layer

Electrical interface

	Selection	Note
X	direct link interface (RS-232)	• Point-to-point configuration (master with 1 slave)
X	RS-422	• Multi-point traffic (master with n slaves) • Point-to-point configuration (master with 1 slave)
X	RS-485	• Multi-point traffic (master with n slaves) • Point-to-point configuration (master with 1 slave)

Transmission speed

- The Modbus protocol uses only an unbalanced communication procedure
- The transmission speed is same for both directions (transmit/receive)

	Transmission speed	Note		Transmission speed	Note
X	50 bits/s		X	1800 bits/s	
X	75 bits/s		X	2000 bits/s	
X	100 bits/s		X	2400 bits/s	
	110 bits/s		X	4800 bits/s	
X	134.5 bits/s		X	9600 bits/s	
X	150 bits/s		X	19200 bits/s	
X	200 bits/s		X	38400 bits/s	
X	300 bit/s		X	56000 bits/s	
X	600 bits/s		X	57600 bits/s	
X	1050 bits/s		X	64000 bits/s	
X	1200 bits/s		X	115200 bits/s	

Link Layer

	Transmission mode
X	RTU mode
	ASCII mode

RTU mode

Byte asynchronous data transmission is used in in RTU mode (least significant bit is sent first for each byte).

	Byte frame	Note
X	1 start bit	
X	8 data bits	
X	Parity bit “even”	
X	Parity bit “odd”	
X	No parity bit	

	Byte frame	Note
X	1 stop bit	
X	2 stop bits	

Note:

- Byte frame for Modbus RTU mode according Modbus standard: 8E1 (1 start bit, 8 data bits, 1 parity bit "even", 1 stop bit)
- For maximum compatibility with other devices "odd parity", "no parity" and "2 stop bits" is also supported.
- With "no parity" 2 stop bits must be used!
- In old configurations with Modbus RTU mode typically the byte frame 8N2 (8 data bits, no parity, 2 stop bits) is used.

	Modbus settings	Note
X	Modbus slave address (8 bits)	
X	Modbus function code (8 bits)	
X	Modbus register address (16 bits)	The Modbus address addresses a 16-bit Modbus register
X	Cyclical redundancy check (CRC) (16 bits)	

~~ASCII Mode~~

~~Byte asynchronous data transmission is used in in ASCII mode (least significant bit is sent first for each byte).~~

	~~Byte frame~~	~~Note~~
	~~1 start bit~~	
	~~7 data bits~~	
	~~Parity bit "even"~~	
	~~Parity bit "odd"~~	
	~~No parity bit~~	
	~~1 stop bit~~	
	~~2 stop bits~~	

~~Note:~~

- ~~Byte frame for Modbus ASCII mode according Modbus standard: 7E1 (1 start bit, 7 data bits, 1 parity bit (even parity), 1 stop bit)~~
- ~~For maximum compatibility with other devices "odd parity", "no parity" and "2 stop bits" are also supported.~~

- ~~With "no parity" 2 stop bits must be used!~~
- ~~In old configurations with Modbus ASCII mode typically the byte frame 7N2 (7 data bits, no parity, 2 stop bits) is used.~~

	~~Modbus settings~~	~~Note~~
	~~Modbus slave address - 2 characters (8 bits)~~	
	~~Modbus function code - 2 characters (8 bits)~~	
	~~Modbus register address - 4 characters (16 bits)~~	~~The Modbus address addresses a 16-bit Modbus register~~
	~~Longitudinal redundancy check (LRC) - 2 characters (8 bits)~~	

Link Layer

	Description	Note
X	Unbalanced transmission Master/Slave	
	Modbus Master (half duplex)	
X	Modbus Slave	

Message Length

	Description	Note
X	<u>RTU mode:</u> Maximum message length 253 bytes (without address and CRC bytes)	
	<u>ASCII mode:</u> Maximum message length 0 up to 2*252 characters (without start, address, function, LRC and end characters)	Max. message length is configurable

Address of the Link Layer

	Description	Note
X	1 octet (8 bits) ... RTU Mode	Modbus slave address (1 to 247)
	2 characters .... ASCII mode	Modbus slave address (1 to 247)
	Broadcast addressing	Modbus slave address (0)

Application Layer

Modbus Function Codes

	Modbus function code	Data formats
	Data access (read/write bit)	
X	01 = Read Coils	<20> SPI <21> DPI (1 = off, 2 = on) <22> DPI (1 = on, 2 = off)

	Modbus function code	Data formats
X	02 = Read Discrete Inputs	<20> SPI <21> DPI (1 = off, 2 = on) <22> DPI (1 = on, 2 = off)
X	05 = Write Single Coil	<20> SPI <30> SC <31> SC (pulse) <35> DC2 (pulse)
X	15 = Write Multiple Coils	<20> SPI <21> DPI (1 = off, 2 = on) <22> DPI (1 = on, 2 = off) <30> SC <31> SC (pulse) <32> DC <35> DC2 (pulse)
	Data access (16-bit read/write)	
X	03 = Read Holding Registers	<01> INT16 <02> UINT16 <03> INT32 (H/L) <04> UINT32 (H/L) <05> INT32 (L/H) <06> UINT32 (L/H) <7a> FLOAT32 <7b> FLOAT32 (swapped) <7c> FLOAT32 (little endian) <16> BS16 <20> SPI <21> DPI (1 = off, 2 = on) <22> DPI (1 = on, 2 = off) <23> INT16 + IV <24> UINT16 + IV <50> SPI + IV <51> DPI (1 = off, 2 = on) + IV <52> DPI (1 = on, 2 = off) + IV

	Modbus function code	Data formats
X	04 = Read Input Registers	<01> INT16 <02> UINT16 <03> INT32 (H/L) <04> UINT32 (H/L) <05> INT32 (L/H) <06> UINT32 (L/H) <7a> FLOAT32 <7b> FLOAT32 (swapped) <7c> FLOAT32 (little endian) <16> BS16 <20> SPI <21> DPI (1 = off, 2 = on) <22> DPI (1 = on, 2 = off) <23> INT16 + IV <24> UINT16 + IV <50> SPI + IV <51> DPI (1 = off, 2 = on) + IV <52> DPI (1 = on, 2 = off) + IV
X	06 = Write Single Register	<01> INT16 <02> UINT16 <03> INT32 (H/L) <04> UINT32 (H/L) <05> INT32 (L/H) <06> UINT32 (L/H) <7a> FLOAT32 <7b> FLOAT32 (swapped) <7c> FLOAT32 (little endian) <12> 32Bit/OMVZ <20> SPI [329] <21> DPI (1 = off, 2 = on) [329] <22> DPI (1 = on, 2 = off) [329] <30> SC [329] <31> SC (pulse) [329] <32> DC [329] <35> DC2 (pulse) [329]

329 Per Modbus register several data points are supported!

	Modbus function code	Data formats
X	16 = Write Multiple Registers	<01> INT16 <02> UINT16 <03> INT32 (H/L) <04> UINT32 (H/L) <05> INT32 (L/H) <06> UINT32 (L/H) <7a> FLOAT32 <7b> FLOAT32 (swapped) <7c> FLOAT32 (little endian) <12> 32Bit/OMVZ <20> SPI [329] <21> DPI (1 = off, 2 = on) [329] <22> DPI (1 = on, 2 = off) [329] <30> SC [329] <31> SC (pulse) [329] <32> DC [329] <35> DC2 (pulse) [329]
☐	22 = Mask Write Register	
☐	23 = Read / Write Multiple Registers	
☐	24 = Read FIFO Queue	
	Data access (read/write file)	
☐	20 = Read File Record	
☐	21 = Write File Record	
	Diagnosis	
☐	07 = Read Exception Status	
☐	08 = Diagnostics (Sub-Code 00 to 18, 20)	
☐	11 = Get Com Event Counter	
☐	12 = Get Com Event Log	
☐	17 = Report Slave ID	
☐	43 = Read Device Identification (Sub-Code = 14)	
	Other	
☐	43 = Encapsulated Interface Transport (Sub-Code = 13, 14)	

Modbus exception status

	Modbus exception codes	Note
X	01 = Illegal Function	Function code not supported
X	02 = Illegal Data Address	Requested data not present
X	03 = Illegal Data Value	Illegal data
☐	04 = Server Device Failure	An error has occurred during the request
☐	05 = Acknowledge	The substation acknowledges, but cannot reply to the request immediately
☐	06 = Server Device Busy	The substation is busy
☐	08 = Memory Parity Error	Parity error detected in memory
☐	10 (0x0A) = Gateway Path Unavailable	Gateway path not available.
☐	11 (0x0B) = Gateway Target Device Failed To Respond	The addressed substation does not respond. This exception is generated by the gateway.

Note: Not supported exception codes are handled as “no response”.

13.7.13 Modbus Data Formats

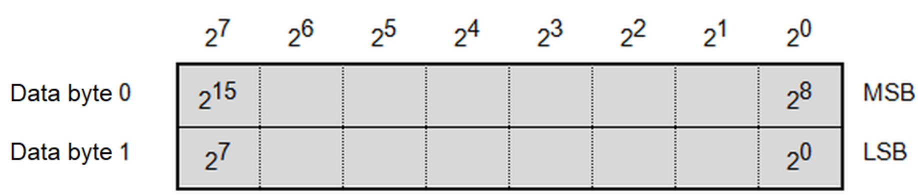
Supported Modbus data formats:

Format #	Format	Designation	Register	Coil
General formats				
1	INT16	Signed integer 16-bit	✓	–
2	UINT16	Unsigned integer 16-bit	✓	–
3	INT32 (H/L)	Signed integer 32-bit (HIGH before LOW)	✓	–
4	UINT32 (H/L)	Unsigned integer 32-bit (HIGH before LOW)	✓	–
5	INT32 (L/H)	Signed integer 32-bit (LOW before HIGH)	✓	–
6	UINT32 (L/H)	Unsigned integer 32-bit (LOW before HIGH)	✓	–
7a	FLOAT32	Short floating-point (IEEE 754)	✓	–
7b	FLOAT32 (swapped)	Short floating-point (IEEE 754) “swapped”	✓	–
7c	FLOAT32 (little endian)	Short floating-point (IEEE 754) “little endian”	✓	–
12	32BIT/OMVZ	OMV counter value format	✓	–
16	Bitstring 16-bit	Bitstring of 16 bit	✓	–
20	SPI	Single-point information	✓	✓
21	DPI (1 = off, 2 = on)	Double-point information (OFF before ON)	✓	✓
22	DPI (1 = on, 2 = off)	Double-point information (ON before OFF)	✓	✓
30	SC	Single command	✓	✓
31	SC (pulse)	Single command “pulse”	✓	✓
32	DC	Double command	✓	✓

Format #	Format	Designation	Register	Coil
33	DC1	Double command (1 bit)	✓	✓
35	DC2 (pulse)	Double command “pulse”	✓	✓
Device specific formats				
50	SPI + IV	Single-point information + invalid identifier	✓	–
51	DPI (1 = off, 2 = on) + IV	Double-point information (OFF before ON) + invalid identifier	✓	–
52	DPI (1 = on, 2 = off) + IV	Double-point information (ON before OFF) + invalid identifier	✓	–
53	INT16 + IV	Signed integer 16-bit + invalid identifier	✓	–
54	UINT16 + IV	Unsigned integer 16-bit + invalid identifier	✓	–
1xx	DTx	Date & time (free parameter-settable)	✓	–

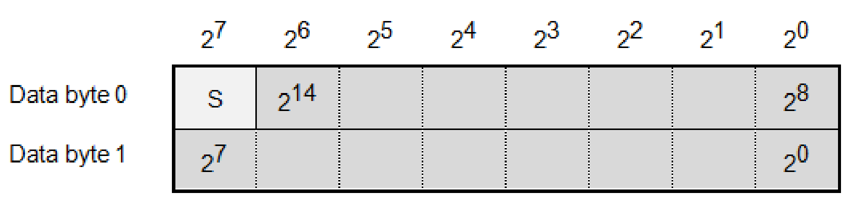
Data formats in a Modbus register are always displayed/transmitted in “big endian” (HIGH before LOW order).

Data in Modbus Register:



The most significant bit (MSB) is transmitted first!

Format-1: INT16 – Signed Integer 16-Bit

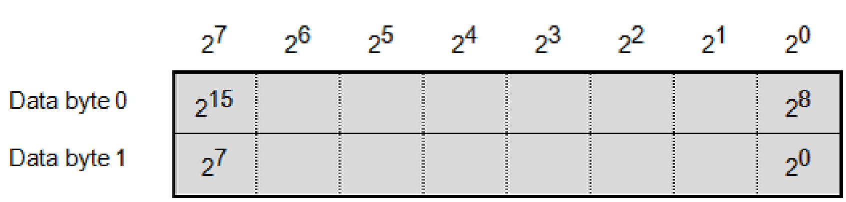


S (sign): <0> = "+"; <1> = "-"

Value range: -32768 0 to +32767

Note: Negative values will be stored in two's complement.

Format-2: UINT16 – Unsigned Integer 16 Bit



Value range: 0 to 65535

Format-3: INT32 (H/L) – Signed Integer 32 Bit (HIGH before LOW)

	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
Data byte 0	S	2^{30}						2^{24}
Data byte 1	2^{23}							2^{16}
Data byte 2	2^{15}							2^8
Data byte 3	2^7							2^0

S (sign): <0> = "+"; <1> = "-"
Value range: -2 147 483 648 to 0 to +2 147 483 647
Note: Negative values will be stored in two's complement.

Format-4: UINT32 (H/L) – Unsigned Integer 32 Bit (HIGH before LOW)

	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
Data byte 0	2^{31}							2^{24}
Data byte 1	2^{23}							2^{16}
Data byte 2	2^{15}							2^8
Data byte 3	2^7							2^0

Value range: 0 to 4 294 967 295

Format-5: INT32 (L/H) – Signed Integer 32 Bit (LOW before HIGH)

	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
Data byte 0	2^{15}							2^8
Data byte 1	2^7							2^0
Data byte 2	S	2^{30}						2^{24}
Data byte 3	2^{23}							2^{16}

S (sign): <0> = "+"; <1> = "-"
Value range: -2 147 483 648 to 0 to +2 147 483 647
Note: Negative values will be stored in two's complement.

Format-6: UINT32 (L/H) – Unsigned Integer 32 Bit (LOW before HIGH)

	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
Data byte 0	2^{15}							2^8
Data byte 1	2^7							2^0
Data byte 2	2^{31}							2^{24}
Data byte 3	2^{23}							2^{16}

Value range: 0 to 4 294 967 295

Format-7a: FLOAT32 – Short Floating-Point (IEEE 754)

	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0	
Data byte 0	2^{-8}							2^{-15}	Mantissa
Data byte 1	2^{-16}							2^{-23}	Mantissa
Data byte 2	S	2^7						2^1	Exponent, S
Data byte 3	2^0	2^{-1}						2^{-7}	Mantissa

Value range:~$1.1 \cdot 10^{-38}$ bis~$3.4 \cdot 10^{38}$
S (sign): <0> = "+"; <1> = "-"
Exponent: <255> = "NaN" (not a number) or∞

Format-7b: FLOAT32 (swapped) – Short Floating-Point (IEEE 754) "Swapped"

	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0	
Data byte 0	S	2^7						2^1	Exponent, S
Data byte 1	2^0	2^{-1}						2^{-7}	Mantissa
Data byte 2	2^{-8}							2^{-15}	Mantissa
Data byte 3	2^{-16}							2^{-23}	Mantissa

Value range:~$1.1 \cdot 10^{-38}$ bis~$3.4 \cdot 10^{38}$
S (sign): <0> = "+"; <1> = "-"
Exponent: <255> = "NaN" (not a number) or∞

Format-7c: FLOAT32 (little endian) – Short Floating-Point (IEEE 754) "Little Endian"

	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0	
Data byte 0	2^{-16}							2^{-23}	Mantissa
Data byte 1	2^{-8}							2^{-15}	Mantissa
Data byte 2	2^0	2^{-1}						2^{-7}	Mantissa
Data byte 3	S	2^7						2^1	Exponent, S

Value range:~$1.1·10^{\-38}$ to~$3.4·10^{38}$
S (sign): <0> = "+"; <1> = "\-"
Exponent: <255> = "NaN" (not a number) or∞

Format-12: 32Bit/OMVZ – OMV Counter Interrogation Format(device specific data format)

	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0	
Data byte 0	I	T	T	I	S	2^{26}	2^{25}	2^{24}	S (=sign)
Data byte 1	2^{23}							2^{16}	
Data byte 2	2^{15}							2^8	
Data byte 3	2^7							2^0	

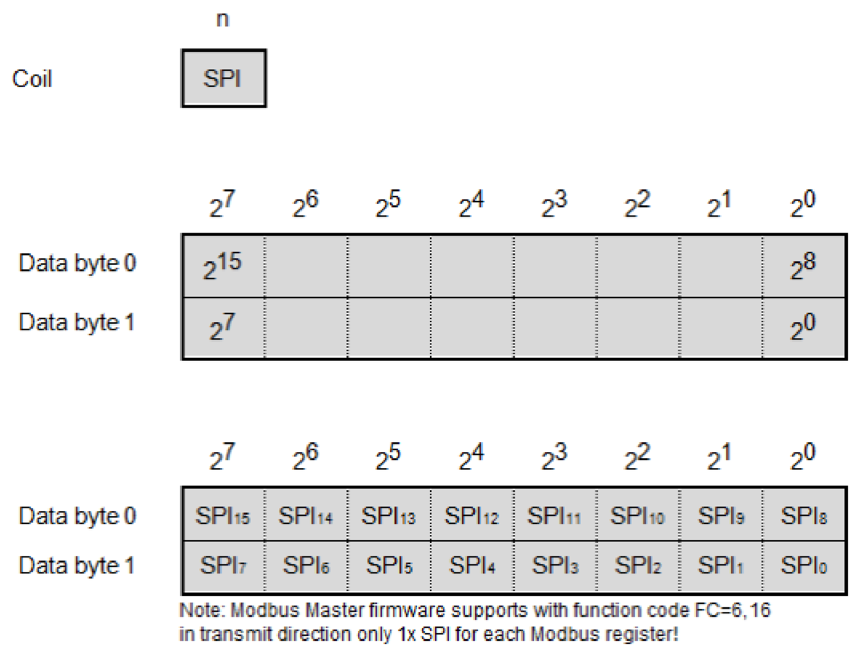
Value range: 0 to 134217727
I (invalid bit): <0> valid; <1> invalid
T (tendency bit): is not evaluated
S (sign): is not evaluated

Format-16: Bitstring 16-Bit

	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
Data byte 0	2^{15}							2^8
Data byte 1	2^7							2^0

Format-20: SPI – Single-Point Information

Single-point information as coil or 1 bit in Modbus register.



Value range: 0, 1

SPI – Single-Point Information

<0> = OFF

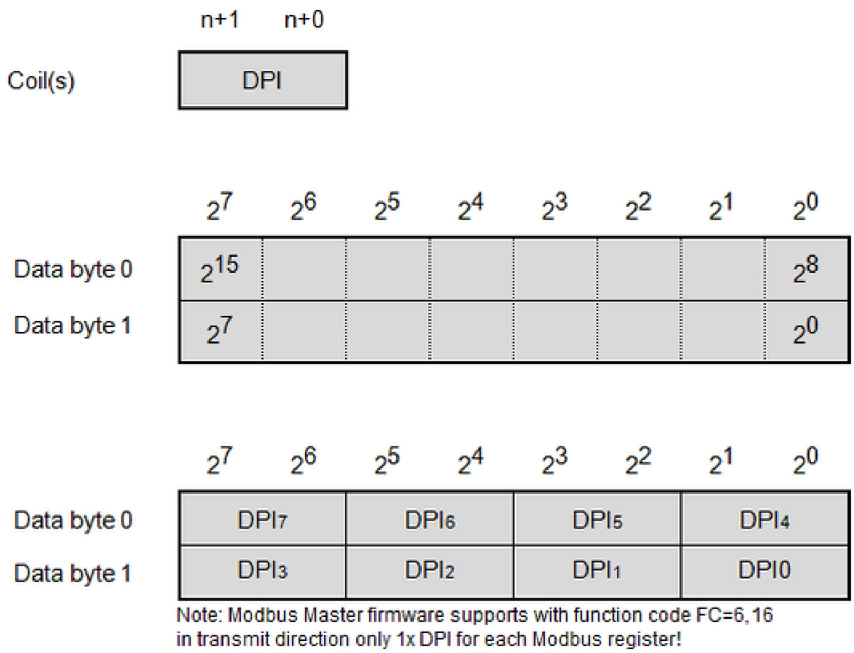
<1> = ON

Bit (n+0)	Coding (IEC 60870-5-101/104)
0	**OFF**
1	**ON**

Format-21: DPI (1 = off, 2 = on) – Double-Point Information (OFF before ON)

Format-22: DPI (1 = on, 2 = off) – Double-Point Information (ON before OFF)

Double-point information in 2 adjacent bits in the Modbus register or as 2 adjacent bits as coil.
Note:
The 2 bits of DPI must be located always in same byte of a Modbus register.



Value range: 0 to 3

DPI – Double-Point Information (OFF before ON)- DPI (1 = off, 2 = on)
<0> = Indeterminate or intermediate state
<1> = OFF
<2> = ON
<3> = Indeterminate state

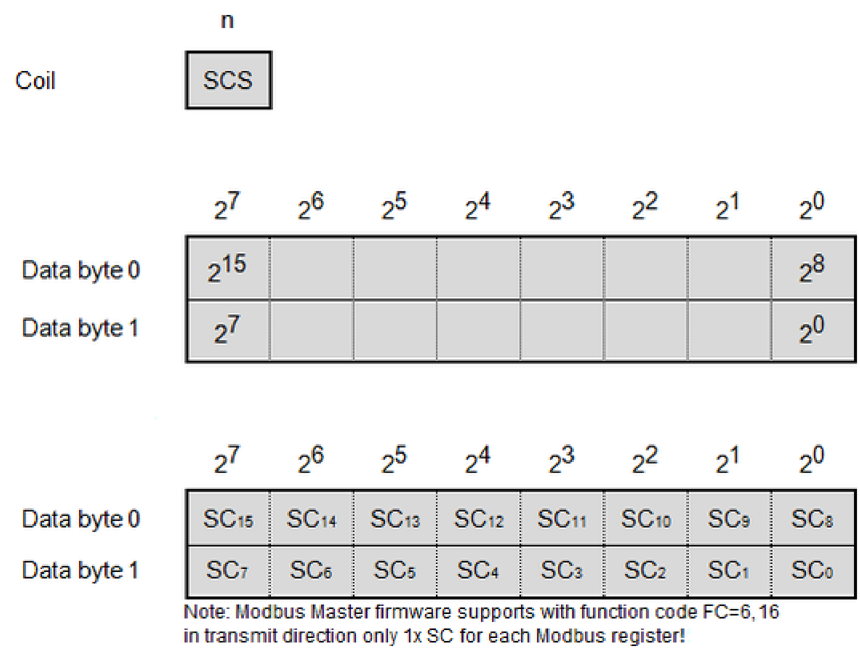
DPI – Double-Point Information (ON before OFF)- DPI (1 = on, 2 = off)
<0> = Indeterminate or intermediate state
<1> = ON
<2> = OFF
<3> = Indeterminate state

	Bit (n+1)	Bit (n+0)	Coding OFF before ON (IEC 60870-5-101/104)	Coding ON before OFF
0	0	0	INT	INT
1	**0**	**1**	**OFF**	**ON**
2	**1**	**0**	**ON**	**OFF**
3	1	1	FLT	FLT

INT .. Intermediate position (indeterminate or intermediate state)
FLT .. Faulty position (indeterminate state)

Format-30: SC – Single Command

A single command with command state ON or OFF can be sent as coil (1 bit) or as 1 bit Modbus register.



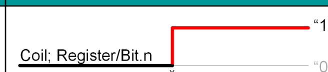
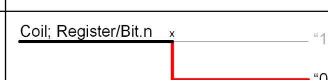
Value range: 0, 1

SCS – Single Command State

<0> = OFF

<1> = ON

Command	Modbus format	Command Transmission
Single command ON	SC	COIL (n); register/bit (n) = ON
Single command OFF	SC	COIL (n); register/bit (n) = "OFF"

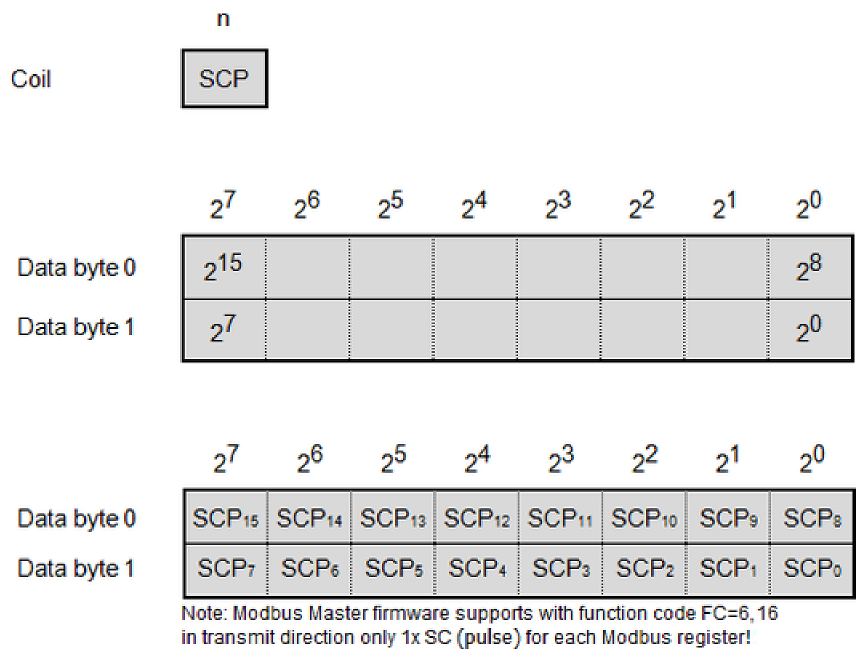
Modbus format	Command state	Command output SC as Coil or 1 Bit in Modbus Register
SC	SCS = ON	 x ... command = ON
	SCS = OFF	 x ... command = OFF

Format-31: SC (pulse) – Single Command (Pulse)

A single command with command state ON can be sent as pulse with the parametrized command output time as coil (1 bit) or as bit in the Modbus register .

The command state OFF is not evaluated.

The command state will be set to INACTIVE after command output time.



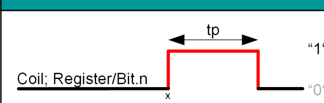
Value range: 0, 1

SCP – Command State (Pulse)

<0> = inactive

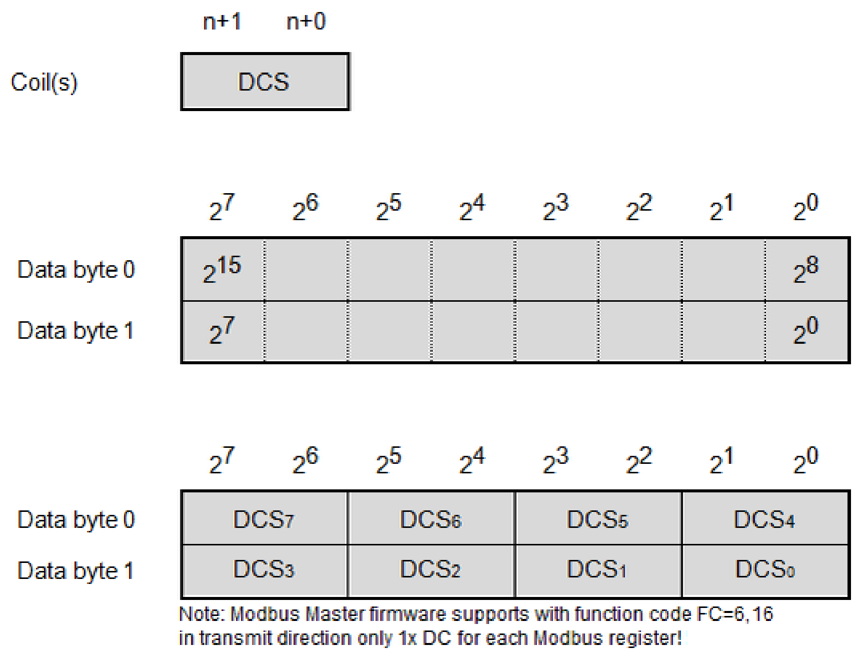
<1> = active

Command	Modbus format	Command Transmission
Single command ON	SC (pulse)	COIL (n); register/bit (n) = pulse

Modbus format	Command state	Command output SC as Coil or 1 Bit in Modbus Register
SC (pulse)	SCS = ON	 tp ... command output time (pulse duration) x ... command = ON
	SCS = OFF	The OFF state is not evaluated!

Format-32: DC – Double Command (2-Bit)

The command state of a double command resp. regulating step command (2 bit) is transferred with 2 consecutive bits as coils or bits in the Modbus register.

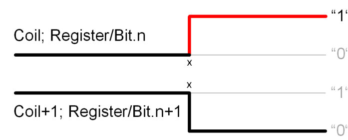
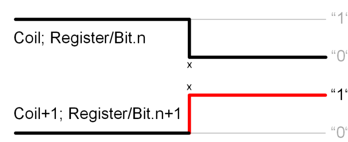
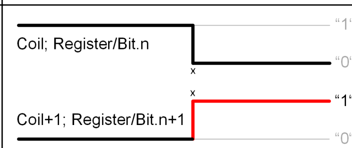
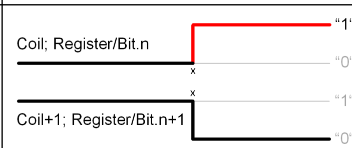


Value range: 0 to 3

DCS – Double Command State[Modbus_command_state = OFF]
<1> = OFF
<2> = ON

DCS – Double Command State[Modbus_command_state = ON]
<1> = ON
<2> = OFF

	Bit (n+1)	Bit (n+0)	Coding OFF before ON (IEC 60870-5-101/104) [Modbus_command_state = OFF]	Coding ON before OFF [Modbus_command_state = ON]
0	0	0	Not permitted	Not permitted
1	**0**	**1**	**OFF**	**ON**
2	**1**	**0**	**ON**	**OFF**
3	1	1	Not permitted	Not permitted

Modbus format	Command state	Command output 2 bits as coil or 2 bits in Modbus register
DC Modbus_command_state = ON	DCS = ON RCS = HIGHER	 x ... command = ON
	DCS = OFF RCS = LOWER	 x ... command = OFF
DC Modbus_command_state = OFF	DCS = ON RCS = HIGHER	 x ... command = ON
	DCS = OFF RCS = LOWER	 x ... command = OFF

Format-33: DC1 – Double Command (1 Bit)

A double command with command state ON or OFF can be sent as coil (1 bit) with coil address (n) or as 1 bit Modbus register.

	n
Coil	DCS

	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
Data byte 0	2^{15}							2^8
Data byte 1	2^7							2^0

	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
Data byte 0	DCS_{15}	DCS_{14}	DCS_{13}	DCS_{12}	DCS_{11}	DCS_{10}	DCS_9	DCS_8
Data byte 1	DCS_7	DCS_6	DCS_5	DCS_4	DCS_3	DCS_2	DCS_1	DCS_0

Note: Modbus Master firmware supports with function code FC=6, 16
in transmit direction only 1x DC (1 bit) for each Modbus register!

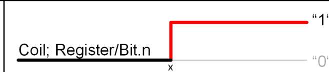
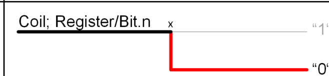
Value range: 0, 1

DCS – Double Command State (1 Bit)

<0> = OFF

<1> = ON

Command	Modbus format	Command Transmission
Double command ON	DC1	COIL (n); register/bit (n) = ON
Double command OFF	DC1	COIL (n); register/bit (n) = “OFF”

Modbus format	Command state	Command output DC as coil or 1 bit in Modbus register
DC1	DCS = ON	 x ... command = ON
	DCS = OFF	 x ... command = OFF

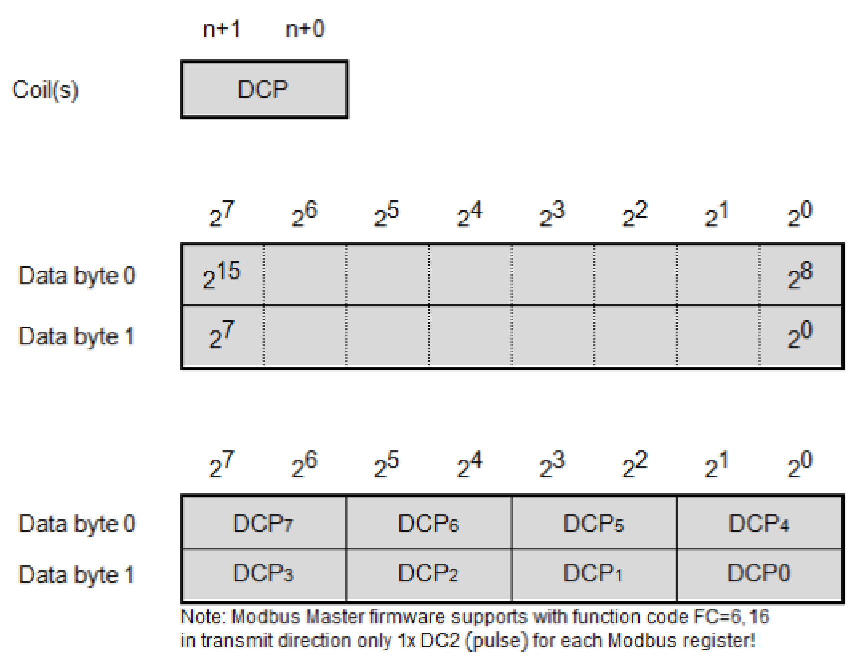
Format-35: DC2 (pulse) – Double Command (Pulse)

A double command or regulating step command with the command state DCS = ON/OFF or RCS = HIGHER/ LOWER is transferred on Modbus with the set command output time as pulse (2 bits) with 2 coils or 2 bits in the Modbus register.

The command state ON or HIGH is transmitted as 1-bit pulse on coil address (n+0 or n+1) or in register address/bit (n+0 or n+1).

The command state OFF or LOWER is transmitted as 1-bit pulse on coil address (n+1 or n+0) or in register address/bit (n+1 or n+0).

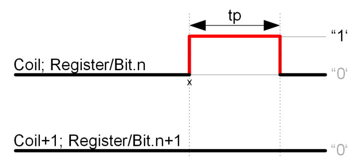
The command state will be set to INACTIVE after command output time.

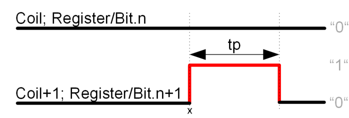


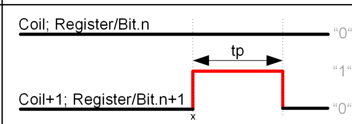
Value range: 0 to 3

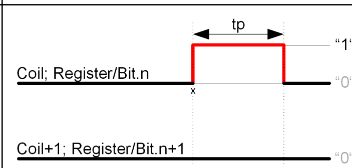
DCP – Double Command (Pulse) – per Bit

<0> = INACTIVE
<1> = ACTIVE

<table>
<tr><th>Modbus format</th><th>Command state</th><th>Command output
2 bits as coil or 2 bits in Modbus register</th></tr>
<tr><td>DC2 (pulse)
Modbus_command_state = ON</td><td>DCS = ON
RCS = HIGHER</td><td>

tp ... command output time (pulse duration)
x ... command = ON</td></tr>
<tr><td>DC2 (pulse)
Modbus_command_state = ON</td><td>DCS = OFF
RCS = LOWER</td><td>

tp ... command output time (pulse duration)
x ... command = OFF</td></tr>
<tr><td>DC2 (pulse)
Modbus_command_state = OFF</td><td>DCS = ON
RCS = HIGHER</td><td>

tp ... command output time (pulse duration)
x ... command = ON</td></tr>
<tr><td>DC2 (pulse)
Modbus_command_state = OFF</td><td>DCS = OFF
RCS = LOWER</td><td>

tp ... command output time (pulse duration)
x ... command = OFF</td></tr>
</table>

Format-50: SPI + IV – Single-Point Information + Invalid Identifier

	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
Data byte 0	IV	SPI14	SPI13	SPI12	SPI11	SPI10	SPI09	SPI08
Data byte 1	SPI07	SPI06	SPI05	SPI04	SPI03	SPI02	SPI01	SPI00

IV (invalid identifier):
<0> = Valid
<1> = Invalid

SPI (Single-Point Information)

<0> = OFF
<1> = ON

Note:

- IV bit applies to all binary information in the Modbus register.
- Unused SPIs/bits are transferred with <0>.
- In a Modbus register several single- and double-point information can be transmitted mixed.

Format-51: DPI (1 = off, 2 = on) + IV – Double-Point Information (OFF before ON) + Invalid Identifier

Format-52: DPI (1 = on, 2 = off) + IV – Double-Point Information (ON before OFF) + Invalid Identifier

	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
Databyte 0	IV		DPI$_6$		DPI$_5$		DPI$_4$	
Databyte 1	DPI$_3$		DPI$_2$		DPI$_1$		DPI0	

IV (invalid identifier):
<0> = Valid
<1> = Invalid

Double-Point Information (OFF before ON)DPI (1 = off, 2 = on)
<0> = Indeterminate or intermediate state
<1> = OFF
<2> = ON
<3> = Indeterminate state

Double-Point Information (ON before OFF)DPI (1 = on, 2 = off)
<0> = Indeterminate or intermediate state
<1> = ON
<2> = OFF
<3> = Indeterminate state

	Bit (n+1)	Bit (n+0)	Coding OFF before ON (IEC 60870-5-101/104)	Coding ON before OFF
0	0	0	INT	INT
1	**0**	**1**	**OFF**	**ON**
2	**1**	**0**	**ON**	**OFF**
3	1	1	FLT	FLT

INT .. Intermediate position (indeterminate or intermediate state)
FLT .. Faulty position (indeterminate state)

Note:

- IV bit applies to all binary information in the Modbus register.
- Unused DPIs/bits are transferred with <0>.
- In a Modbus register several single-point and double-point information items can be transmitted mixed.
- Double-point information items must always be transferred completely in a Modbus register byte.

Format-53: INT16 + IV – Signed Integer 16-Bit + Invalid Identifier

	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
Databyte 0	IV	S	2^{13}					2^8
Databyte 1	2^7							2^0

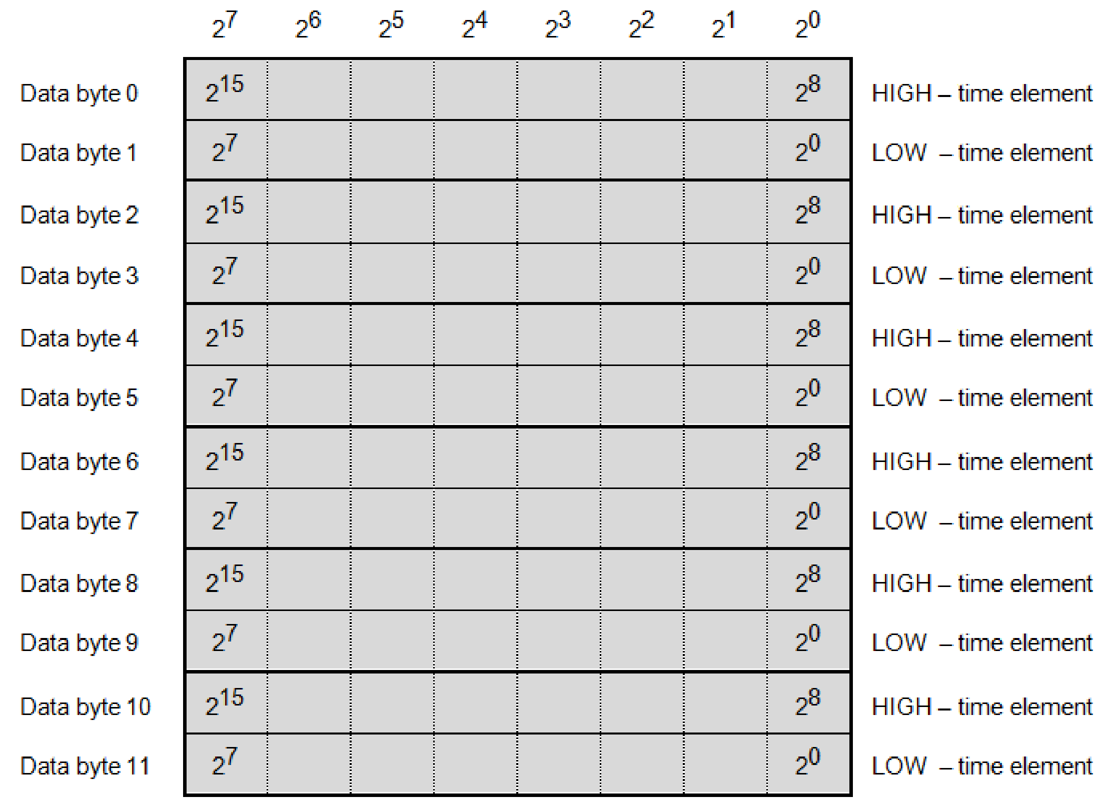
IV (invalid identifier):
<0> = Valid
<1> = Invalid
S (sign):
<0> = "+"
<1> = "–"
Value range: -16384 0 to +16383
Note: Negative values will be stored in two's complement.

Format-54: UINT16 + IV – Unsigned Integer 16-Bit + Invalid Identifier

	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
Databyte 0	IV	2^{14}						2^8
Databyte 1	2^7							2^0

IV (invalid identifier):
<0> = Valid
<1> = Invalid
Value range: 0 to 32767

Format-1xx: DTx – Date + Time (free configurable)



Byte sending order:
Data byte 0 (MSB of 1st Modbus register) is sent as 1st Data byte sent
Data byte 1 (LSB of 1st Modbus register) is sent as 2nd Data byte sent
Data byte 2 (MSB of 2nd Modbus register) is sent as 3rd Data byte sent
:
Data byte n will be sent as last byte.

Note:

- Only the configured number of bytes will be sent.
- If "End of Frame" is in the HIGH data byte, then the Modbus register will not be sent.
- If "End of Frame" is in the LOW data byte, then the Modbus register will be sent and in the LOW data byte "0" will be sent.

Time element	Value range	Example
Not used	Dummy: UI8 [7 to 0] <0>	
Year (high)	Year (high) [7 to 0] <0 to 255>	Year = 2016 = 07E0 [HEX] →Year (high) = 0x07 [HEX]
Year (low)	Year (low) [7 to 0] <0 to 255>	Year = 2016 = 07E0 [HEX] →Year (low) = 0xEX [HEX]
Year - 2000 (high)	Year 2000 (high) [7 to 0] <0 to 255>	Year = 2016→2016 - 2000 = 16 = 0x0010 [HEX] →Year - 2000 (high) = 0x00 [HEX]
Year - 2000 (low)	Year 2000 (high) [7 to 0] <0 to 255>	Year = 2016→2016 - 2000 = 16 = 0x0010 [HEX] →Year - 2000 (low) = 0x10 [HEX]

Time element	Value range	Example
Month	Month [7 to 0] <1 to 12>	Month = 12 (December) → Month = 0x0C [HEX]
Day	Day [7 to 0] <1 to 31>	Day = 23 → Day = 0x17 [HEX]
Day of week	Day of week [7 to 0] <1 to 7> <1> = Monday; <2> = Tuesday; ... <7> = Sunday	Day of week = Tuesday → Day of week = 0x02 [HEX]
Day + day of week	Day [4 to 0] <1 to 31> Day of week [7 to 5] <1 to 7> <1> = Monday; <2> = Tuesday; ... <7> = Sunday	
Hour	Hour [7 to 0] <0 to 23>	Hour = 21 = 0x15 [HEX]
Hour + SU	Hour [4 to 0] <0 to 23> Summer time (SU) [7] <0, 1> SU <0> = standard time (winter time) SU <1> = summer time	
Minute	Minute [5 to 0] <0 to 59>	Minute = 59 = 0x3B [HEX]
Minute + IV	Minute [6 to 0] <0 to 59> Invalid (IV) [7] <0, 1> IV <0> = valid IV <1> = invalid	
Second	Second [7 to 0] <0 to 59>	Second = 32 = 0x20 [HEX]
Millisecond (high)	Millisecond n·1 ms (high) [7 to 0] <0 to 255> n <0 to 59999> = range including seconds	Milliseconds = 998 = 03E6 [HEX] → Millisecond (high) = 0x03 [HEX]
Millisecond (low)	Milliseconds n·1 ms (low) [7 to 0] <0 to 255> n <0 to 59999> = range including seconds	Milliseconds = 998 = 03E6 [HEX] → Millisecond (low) = 0xE6 [HEX]
Ticks (10 ms)	Milliseconds n·10 ms [7 to 0] <0 to 99>	Milliseconds = 998 → Ticks (10 ms) = 99 = 0x63 [HEX]
Ticks (100 ms)	Milliseconds n·100 ms [7 to 0] <0 to 9>	Milliseconds = 998 → Ticks (100 ms) = 9 = 0x09 [HEX]
EOF (End of Frame)		Note: This time element defines the end of the freely configurable time format - this data byte is no longer sent!

Legend: [7 to 0] = bit position in data byte of Modbus register
< > = valid range of value

13.8 Modbus TCP

13.8.1 Introduction

The Modbus TCP protocol is a standardized transmission protocol (TCP/IP) for communication with devices in the network (LAN, WAN).

Protocol firmwares for Modbus TCP:

Firmware	System	Standard and function
MBCII0	CP-8031, CP-8050	Modbus TCP Master ("Client")
MBSII0	CP-8031, CP-8050	Modbus TCP Slave ("Server")

The Modbus TCP protocol defines the data exchange of 16 bit register values or of coils (binary information) between systems via a LAN/WAN communication connection.

The Modbus TCP protocol is standardized by the user organization *www.modbus.org* and by IEC 61158 Digital data communication for measurement and control - Fieldbus for use in industrial control systems (CFP15/1 Modbus/TCP).

The Modbus protocol was originally defined for serial transmission, later Modbus TCP was defined for the transmission of data via LAN/WAN (Ethernet).

The message structure is very similar between "Modbus seriell" and "Modbus TCP". With Modbus TCP in addition to the Modbus data (PDU) the Modbus TCP specific MBAP-Header is transmitted.

The protocol element MBCII0 enables the LAN/WAN communication of one component as central station (=Master/Client) with up to 100 remote terminal units (=Slaves/Server).

The protocol element MBSII0 enables the LAN/WAN communication of one component as substation (=Slave/Server) with up to 100 central stations (=Master/Clients).

The master station and the remote terminal units operate with the Ethernet based LAN/WAN communication protocol according to Modbus TCP.

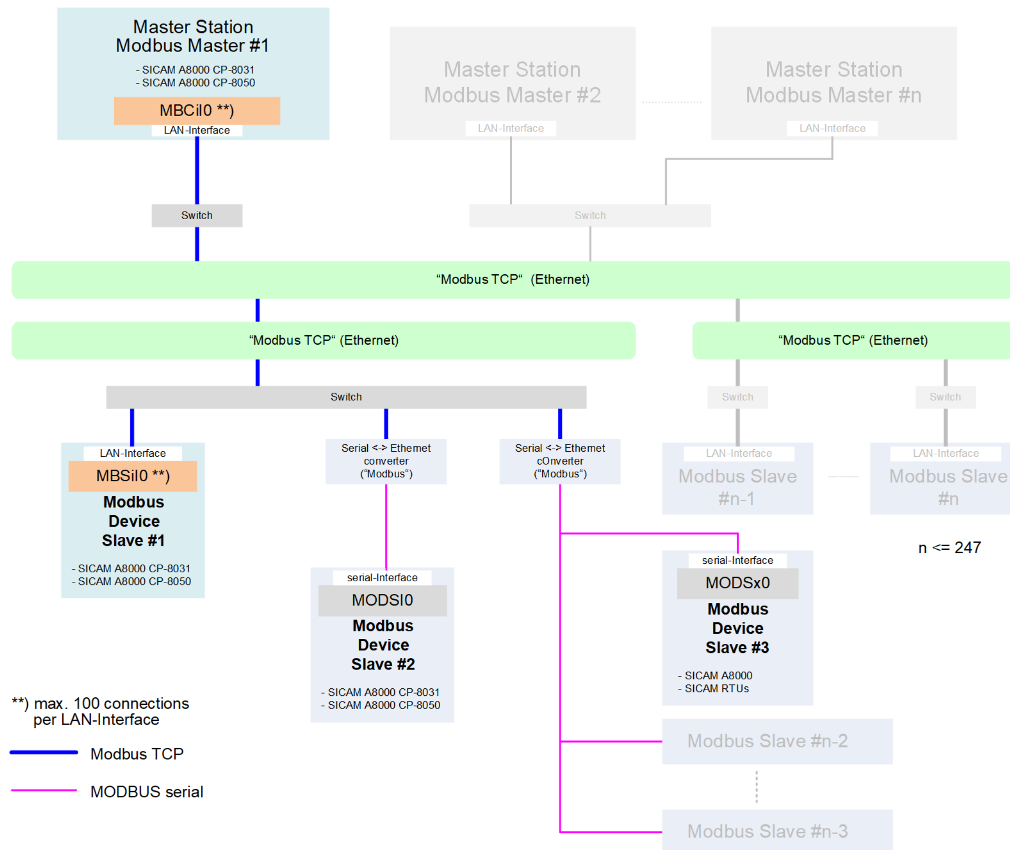
The supported functionality (interoperability) is described in section *13.8.11 Interoperability*. With Modbus TCP the data transfer is controlled by the central station (master).

With Modbus TCP every RTU is assigned an unambiguous IP address.

Substations can only transfer data if the data is requested by the central station (Read Register, Read Coils).

Sub-stations with serial interface can be connected to a Modbus TCP master via a serial Ethernet converter (with Modbus TCP functionality).

Schematic configuration with Modbus TCP:



[Modbus_TCP_config, 2, en_US]

13.8.2 Functions

Function	MBCII0	MBSII0
Modbus TCP		
LAN/WAN communication protocol according to Modbus TCP	✓	✓
Modbus TCP Master (“Client”)	✓	–
Modbus TCP Slave (“Server”)	–	✓
Modbus TCP Port number (Standard)	502	502
Modbus TCP Port number “parameter-settable”	1 to 65535	1 to 65535
Max. number of connections	100	50
Max. number of supported data points (all connections)	10000	10000
Modbus Unit Identifier	1 to 247, 255	1 to 247, 255
Maximal number of buffered Modbus requests	–	16
Maximum number of servers that are queried at the same time (parallel polling) [330]	5	–
Modbus TCP message protection by TCP/IP Layer	✓	✓

330 Polling is carried out simultaneously for a maximum of n Modbus devices with different IP addresses. A further Modbus device (Server) will only be polled, if an already running Request/Response sequence is finished. The polling will slow down by e.g. slowly answering Modbus devices or by data in transmit direction.

Function	MBCII0	MBSII0
Network configuration		
LAN/WAN	✓	✓
Ethernet interface (properties)		
Ethernet interface (*13.1.4.6 Ethernet Interface – Module Properties*)	✓	✓
Parameter for TCP/IP optimization: MTU-Size (Maximum Transmission Unit)	✓	✓
Parameter for TCP/IP optimization: TCP expected acknowledgment time	✓	✓
Interoperability		
Interoperability according to*13.8.11.1 Interoperability Modbus TCP Master "Client"*	✓	–
Interoperability according to*13.8.11.2 Interoperability Modbus TCP Slave "Server"*	–	✓
Modbus register/coil addressing		
Modbus Register "16 Bits"	✓	✓
Modbus register addresses: 1 (0) bis 65535	✓	✓
Modbus coil addresses: 1 (0) bis 65535	✓	✓
Modbus register addressing according Modbus standard (YES/NO - station selective)	✓	✓
Modbus function codes		
01 = Read Coils	✓	✓
02 = Read Discrete Inputs	✓	✓
03 = Read Holding Registers	✓	✓
04 = Read Input Registers	✓	✓
05 = Write Single Coil	✓	✓
06 = Write Single Register	✓	✓
15 = Write Multiple Coils	✓	✓
16 = Write Multiple Registers	✓	✓
Modbus exception codes[331]		
01 = Illegal Function	✓	✓
02 = Illegal Data Address	✓	✓
03 = Illegal Data Value	✓	✓
04 = Server Failure	✓	✓
05 = Acknowledge	✓	–
06 = Server Busy	✓	–
10 (0x0A) = Gateway Problem (Gateway paths not available)	✓	–
11 (0x0B) = Gateway Problem (The targeted device failed to respond)	✓	–
Modbus data formats		
INT16: Signed integer 16-bit	✓	✓
UINT16: Unsigned integer 16-bit	✓	✓
INT32 (H/L): Signed integer 32-bit ("HIGH before LOW")	✓	✓
UINT32 (H/L): Unsigned integer 32-bit ("HIGH before LOW")	✓	✓

[331] Exception codes are not specially evaluated by the Modbus TCP master; a received exception code is rated as negative acknowledgment.

Function	MBCII0	MBSII0
INT32 (L/H): Signed integer 32-bit (“LOW before HIGH”)	✓	✓
UINT32 (L/H): Unsigned integer 32-bit (“LOW before HIGH”)	✓	✓
FLOAT32: Short floating-point (IEEE 754)	✓	✓
FLOAT32 (swapped): Short floating-point (IEEE 754) “swapped”	✓	✓
FLOAT32 (little endian) Short floating-point (IEEE 754) “little endian”	✓	✓
BS16: Bitstring 16-bit	✓	✓
SPI: Single-point information	✓	✓
DPI: Double-point information (OFF before ON)	✓	✓
DPI: Double-point information (ON before OFF)	✓	✓
SC: Single command	✓	✓
SC: Single command “pulse”	✓	✓
DC: Double command	✓	✓
DC: Double command “pulse”	✓	✓
SPI + IV: Single-point information with invalid identifier	–	✓
DPI + IV: Double-point information (OFF before ON) with invalid identifier	–	✓
DPI + IV: Double-point information (ON before OFF) with invalid identifier	–	✓
Status 2B: Status - 2-bit	✓	–
Status 3B: Status - 3-bit	✓	–
Status 4B: Status - 4-bit	✓	–
Date + time “Format free configurable”	✓	–
IEC60870-5-101/104 Data formats in transmit direction		
TI 30 .. Single-point information with time tag CP56Time2a	✓	✓
TI 31 .. Double-point information with time tag CP56Time2a	–	✓
TI 33 .. Bitstring of 32 bits with time tag CP56Time2a	✓	✓
TI 34 .. Measured value, normalized value with time tag CP56Time2a	✓	✓
TI 35 .. Measured value, scaled value with time tag CP56Time2a	✓	✓
TI 36 .. Measured value, short floating-point number with time tag CP56Time2a	✓	✓
TI 37 .. Integrated total with time tag CP56Time2a	–	✓
TI 45 .. Single command	✓	✓
TI 46 .. Double command	✓	✓
TI 47 .. Regulating step command	✓	✓
TI 48 .. Setpoint command, normalized value	✓	✓
TI 49 .. Setpoint command, scaled value	✓	✓
TI 50 .. Setpoint command, short floating-point number	✓	✓
TI 51 .. Bitstring of 32-bit	✓	–
IEC60870-5-101/104 data formats in receive direction		
TI 30 .. Single-point information with time tag CP56Time2a	✓	✓
TI 31 .. Double-point information with time tag CP56Time2a	✓	✓
TI 33 .. Bitstring of 32 bits with time tag CP56Time2a	✓	–
TI 34 .. Measured value, normalized value with time tag CP56Time2a	✓	✓
TI 35 .. Measured value, scaled value with time tag CP56Time2a	✓	✓
TI 36 .. Measured value, short floating-point number with time tag CP56Time2a	✓	✓
TI 37 .. Integrated total with time tag CP56Time2a	✓	–
TI 45 .. Single command	–	✓
TI 46 .. Double command	–	✓

Function	MBCII0	MBSII0
TI 48 .. Setpoint command, normalized value	–	✓
TI 49 .. Setpoint command, scaled value	–	✓
TI 50 .. Setpoint command, short floating-point number	–	✓
Data acquisition by querying		
Read out of the Modbus registers/coils - in the base cycle	✓	–
Read out of the Modbus registers/coils - time-controlled	✓	–
Modbus Response Re-Assembling (if the response is sent by the Modbus TCP slave in several TCP messages)	✓	–
Data is made available for query by the Modbus master in Modbus registers or coils	–	✓
Conversion Modbus register/coil data ↔ IEC 60870-5-101/104 Data formats	✓	✓
Scaling of values	✓	✓
Suppression of intermediate and faulty position for double-point information	✓	–
General interrogation		
Emulation of the IEC 60870-5-101/104 general interrogation (the current values of the Modbus registers/coils are read and forwarded in general interrogations)	✓	✓
Emulation of ACTCON, ACTTERM (according IEC 60870-5-101/104) general interroga-tion	–	–
Clock synchronization		
Clock synchronization of the substations via Modbus with FC 16 (Write Multiple Registers)	✓	–
Clock synchronization - selectable for each Modbus TCP Slave	✓	–
Clock synchronization always station selective	✓	–
Clock synchronization with “free definable time format” in Modbus message	✓	–
Clock synchronization of theCP-8050remote station via NTP	–	✓
Clock synchronization of theCP-8050remote station via Modbus	–	–
Command transmission		
Conversion of IEC 60870-5-101/104 commands → Modbus register/bits or coils	✓	–
Conversion of commands from Modbus register/coils → IEC60870-5-101/104 commands	–	✓
Control location (set control location, check)	✓	–
Emulation of ACTCON for commands/setpoint values according IEC 60870-5-101/104	✓	–
Emulation of ACTCON- for commands (according IEC 60870-5-101/104), when a command is discarded from an unreleased control location.	✓	–
Emulation of ACTTERM for commands/setpoint values (according IEC 60870-5-101/104)	–	–
Transmission of integrated totals		
With counter interrogation command (Modbus interrogation of counter - in basic cycle)	✓	–
Spontaneous (Modbus interrogation - cyclic/time controlled)	✓	–
Conversion of the Modbus register data → IEC 60870-5-101/104 integrated totals	✓	–
Integrated totals are provided in Modbus registers for polling by the Modbus master	–	✓
Redundancy		
Protocol redundancy	✓	✓

Function	MBCII0	MBSII0
Redundant connections	✓	✓
listening mode-control	–	–
Device redundancy	–	–
Protocol element control and return information		
Protocol element control messages:		
• Setting control location	✓	–
Protocol element return information:		
• Station status	✓	✓
• Station failure	✓	✓
Web server		
Protocol-internal diagnostic and statistic information via protocol-specific web pages	–	–
Engineering		
SICAM Device Manager	✓	✓
SICAM TOOLBOX II	✓	✓

Restrictions

- UDP-Modbus is not supported
- Real-time data via Modbus TCP are not supported
- Broadcast addressing at TCP/IP level is not supported
- Broadcast addressing with unit identifier (station address = 0) is not supported

NOTE

The Modbus TCP protocol in SICAM A8000 does not support full functionality according to Modbus TCP.

The Modbus TCP protocol defines only the transmission of coils and 16 Bit register values, but not the data formats in the Modbus registers.

The Modbus TCP protocol in SICAM A8000 supports many of the commonly used data formats (see section *13.8.12 Modbus Data Formats*).

For the coupling of devices with Modbus TCP protocol it is always necessary to check first whether the required functionality and the required data formats are supported in the central station and in the substation!

13.8.3 Modes of Operation

Standard Operation Mode	Optional equipment	Interface signals (X2, X3)
Electrical Ethernet interface (Twisted Pair)	–	TXD+, TXD-, RXD+, RXD-

13.8.4 Communication

For the stations to communicate with each other, suitable transmission facilities and/or network components may be needed in addition.

Own Station (Central Station – Modbus TCP Master "Client")

System	System element	Protocol Element	Remarks
SICAM A8000 Series	CP-8031/CPCI85 CP-8050/CPCI85 CP-8050/EPCI85	MBCII0	max. 100 Slaves

Remote Station (Substation – Modbus TCP Slave "Server")

System	System element	Protocol Element	Remarks
SICAM A8000 Series	CP-8031/CPCI85 CP-8050/CPCI85 CP-8050/EPCI85	MBSII0	max. 100 Master
SICAM A8000 Series	CP-8000/CPC80 CP-8021/CPC80 CP-8022/CPC80	MBSiT0	max. 100 Master
SICAM AK 3	CP-2016/CPCX26 CP-2019/PCCX26	SM-2558/MBSiA0	max. 100 Master
Legacy systems (SICAM AK, SICAM TM, SICAM BC)	CP-20xx CP-60xx CP-50xx	SM-2558/MBSiA0	max. 100 Master
Siemens devices	–	–	according to *13.8.11.1 Interoperability Modbus TCP Master "Client"*
Third-party system	–	–	according to *13.8.11.1 Interoperability Modbus TCP Master "Client"*

Own Station (Substation – Modbus TCP Slave "Server")

System	System element	Protocol Element	Remarks
SICAM A8000 Series	CP-8031/CPCI85 CP-8050/CPCI85 CP-8050/EPCI85	MBSII0	max. 100 Master

Remote Station (Central Station – Modbus TCP Master "Client")

System	System element	Protocol Element	Remarks
SICAM A8000 Series	CP-8031/CPCI85 CP-8050/CPCI85 CP-8050/EPCI85	MBCII0	max. 100 Slaves
SICAM A8000 Series	CP-8000/CPC80 CP-8021/CPC80 CP-8022/CPC80	MBCiT0	max. 100 Slaves
SICAM AK 3	CP-2016/CPCX26 CP-2019/PCCX26	SM-2558/MBCiA0	max. 100 Master
Legacy systems (SICAM AK, SICAM TM, SICAM BC)	CP-20xx CP-60xx CP-50xx	SM-2558/MBCiA0	max. 100 Master

System	System element	Protocol Element	Remarks
Siemens devices	–	–	Interoperability according to *13.8.11.2 Interoperability Modbus TCP Slave "Server"*
Third-party system	–	–	Interoperability according to *13.8.11.2 Interoperability Modbus TCP Slave "Server"*

13.8.5 Communication According to Modbus TCP

Station Definition

Station definition for Modbus TCP Master ("Client")

All connected Modbus TCP slave ("Server") devices must be entered in the station definition.

Device	MODBUS station (internal)	Station enable	Station failure	Remote IP address	TCP port number	Station type	MODBUS unit-ID	Addressing MODBUS standard	Network connection	Polling delay	Redundancy
A + B	0	yes	notify	192.168.1.1	0	general	255	yes	LAN (MODBUS default)	0	redundant connection
A + B	1	yes	notify	192.168.1.2	0	general	255	yes	LAN (MODBUS default)	0	redundant connection
A + B	2	yes	notify	192.168.1.3	0	general	255	yes	LAN (MODBUS default)	0	redundant connection
A + B	3	yes	notify	192.168.1.4	502	general Sentron 3VA via COM-module	200	yes	LAN (MODBUS default)	1	redundant connection
A + B	5	yes	notify	192.168.1.4	503	general	201	no	LAN (MODBUS default)	1	redundant connection

[MBCiI0_DM_Stationsdefinition, 1, en_US]

Station definition for Modbus TCP Slave ("Server")

All connected Modbus TCP master ("Client") devices must be entered in the station definition.

Device	MODBUS station (internal)	Station enable	Station failure	Remote IP address	TCP port number	MODBUS unit-ID	Addressing MODBUS standard	Network connection	MODBUS-exception code 4
A + B	50	yes	notify	192.168.1.50	0	255	yes	LAN (MODBUS default)	no
A + B	51	yes	notify	192.168.1.51	0	255	yes	LAN (MODBUS default)	no
A + B	52	yes	notify	192.168.1.52	0	255	yes	LAN (MODBUS default)	no

[MBSiI0_DM_Stationsdefinition, 1, en_US]

Parameter and Properties see *13.8.6.1 Modbus TCP Master*.

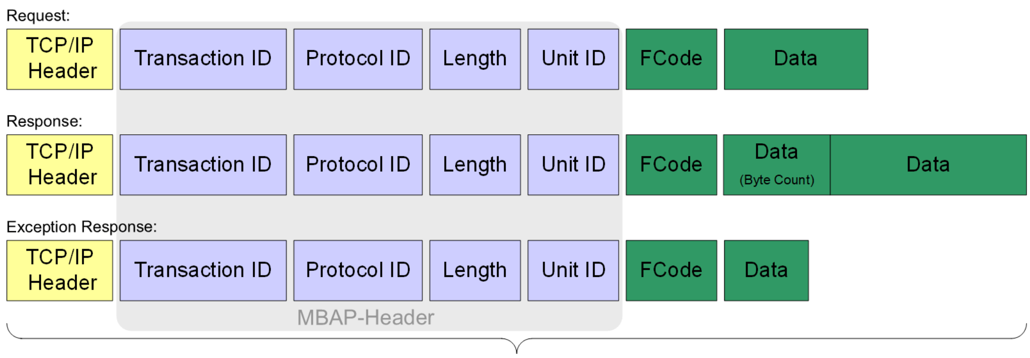
TCP connection, TCP port number

- The Modbus TCP master in CP-8050 establishes a TCP connection to the configured IP address with the configured TCP port number for each configured Modbus TCP slave (if data is configured in the send or receive direction).
- After startup, the Modbus TCP slave in CP-8050 waits for a TCP connection to be established by the Modbus TCP master with the configured IP address and the configured TCP port number.
- By default, the port number = 502 is used for Modbus TCP (With default parameter = 0 for TCP the port number 502 is used). The port number for Modbus TCP can be parameterized for special applications.
- The parameters for the TCP port number are displayed in the SICAM Device Manager with the setting "Show all parameters".

13.8.5.1 Message Description

Structure of the Message

A Modbus TCP message consists of the MBAP header, the Modbus function code and the Modbus data.



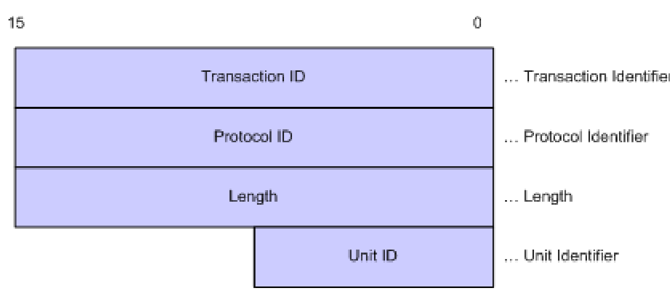
Modbus TCP/IP message frames

Legend:

Transaction ID .... Unique identification of a „Modbus Transaction“ (REQUEST / RESPONSE)
Protocol ID .... Protocol Identifier (for Modbus = 0000)
Length .... Number of following bytes
Unit ID .... Modbus slave station address for a “remote“ connected serial Modbus slave device
FCode .... Modbus Function Code
Data .... Modbus Data

Field	Length [Bytes]	Description	
FCode	1	Modbus function code	
Data	n	Data bytes	Max. 253
Byte Count	1	Length of answer bytes	

MBAP Header



Field	Length [bytes]	Description	Client	Server
Transaction identifier	2	Unambiguous identification of a Modbus Request/Response Transaction [332]	Initialized by the Client	Mirrored back transaction number of request
Protocol identifier	2	= 0000 (Modbus protocol)	Initialized by the Client	Mirrored back protocol identifier of request
Length	2	Number of following bytes	Initialized by the Client (Request)	Initialized by the Server (Response)
Unit Identifier [333]	1	Modbus Slave address for serial connected device	Initialized by the Client	Mirrored back unit identifier of request

332 permissible implementation of the transaction identifier: REQUESTs from the MASTER are numbered in ascending order (selectively per RTU), identical REQUESTs from the MASTER are always sent with the same Transaction-ID.
333 Modbus TCP central stations usually use "Unit Identifier = 255 (0xFF)" for end-end configurations (Master + 1 Slave).

Modbus Slave Address ("Slave Node Address", "Unit Identifier")

With Modbus TCP, a Modbus Slave is addressed only by the unique IP address.
The "Modbus Unit Identifier" (Unit-ID) in the Modbus TCP message format is usually not used.
Possible use of the Unit Identifier (Unit-ID):

Modbus Unit ID	Note
255	Used in case of single Modbus TCP device (Slave) is connected to Modbus TCP Master ("End-End") and the connected Modbus TCP Slave supports addressing via IP address.
1 to 247 [334]	Used in case of single Modbus TCP device (Slave) is connected to Modbus TCP Master ("End-End") and the connected Modbus Slave does not support addressing only via IP address.
255	Used when several Modbus TCP devices (Slaves) are connected to a Modbus TCP master and the connected Modbus Slaves only support addressing via the IP address.
1 to 247 [334]	Used if several Modbus TCP devices (Slaves) are connected to a Modbus TCP master and the connected Modbus Slaves do not support addressing only via the IP address.
1 to 247 [334]	Used when serial Modbus devices are connected to a Modbus TCP Master via a Serial-Ethernet converter.

NOTE

- Broadcast addressing with unicast/multicast addressing at TCP/IP level is not supported!
- Broadcast addressing with unit identifier = 0 is not supported!
  The protocol element for Modbus TCP slave supports max. 1 station address per connection.
  With Unit ID = 255 the Modbus station address assigned to the connection will be used.

Modbus Function Codes (FC)

The Modbus message formats are differentiated by the Modbus Function Code (FC).
Supported Modbus function codes:

Function code	Designation	Description
01	Read Coils	Read binary marker
02	Read Discrete Inputs	Read binary inputs
03	Read Holding Registers	Read internal register
04	Read Input Registers	Read input register
05	Write Single Coil	Write binary outputs
06	Write Single Register	Write register
15	Write Multiple Coils	Write binary outputs
16	Write Multiple Registers	Write register

Modbus register/coil address

Addressing according to Modbus for register values:

- One Modbus register address addresses one 16 Bit register
- The Modbus register address begins with 1 (or 0)
- For each Modbus register the MSB is transmitted first and then the LSB

334 Modbus slave station address

- Address range for Modbus register address: (0),1 to 65535
  With the protocol firmware for SICAM A8000 the address range for Modbus registers is organized separately per Modbus function code and limited only by free internal memory. Some third-party systems have only one common address range, common for all Modbus function codes. Thereby an offset is defined per function code for the Modbus register address.

Addressing according to Modbus for “Coils”:

- One Modbus coil address addresses one coil “Binary states” (ON/OFF)
- The Modbus coil address begins with 1 (or 0)
- Address range for coils: (0),1 to 65535

According to the Modbus definition, the addressing of the Modbus registers begins from address 1, but on the line the address “0” is transmitted for Modbus register address 1.

Modbus Register Addressing (typical):

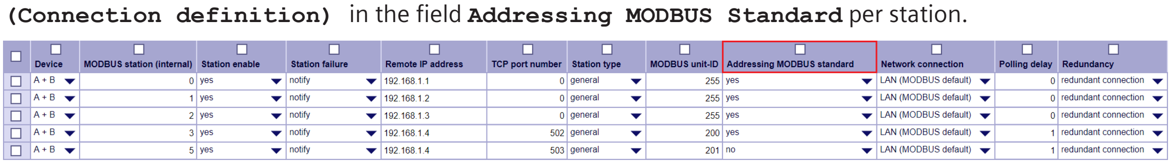
Modbus Function code	Function	Modbus register Aaddress (address list) [dec]	Modbus register address (in message) [dec]
1	Read Coils	00001 to 10000	0000 to 9999
2	Read Discrete Inputs	10001 to 20000	0000 to 9999
3	Read Holding Registers	40001 to 50000	0000 to 9999
4	Read Input Registers	30001 to 40000	0000 to 9999
5	Write Single Coil	00001 to 10000	0000 to 9999
6	Write Single Register	40001 to 50000	0000 to 9999
15	Write Multiple Coils	00001 to 10000	0000 to 9999
16	Write Multiple Registers	40001 to 50000	0000 to 9999

NOTE

The addressing of the Modbus registers is implemented differently depending on manufacturer and must be looked up in the device descriptions!
Some manufacturers also specify the Modbus register address on the line in the address list!

Deviating from the definition for the Modbus protocol, some substations use the Modbus register start address in the Modbus message on the line starting from 1 instead of starting from 0.

The addressing according to Modbus standard can be set in the parameters of the **`Station definition (Connection definition)`** in the field **`Addressing MODBUS Standard`** per station.



	Device	MODBUS station (internal)	Station enable	Station failure	Remote IP address	TCP port number	Station type	MODBUS unit-ID	Addressing MODBUS standard	Network connection	Polling delay	Redundancy
	A + B	0	yes	notify	192.168.1.1	0	general	255	yes	LAN (MODBUS default)	0	redundant connection
	A + B	1	yes	notify	192.168.1.2	0	general	255	yes	LAN (MODBUS default)	0	redundant connection
	A + B	2	yes	notify	192.168.1.3	0	general	255	yes	LAN (MODBUS default)	0	redundant connection
	A + B	3	yes	notify	192.168.1.4	502	general	200	yes	LAN (MODBUS default)	1	redundant connection
	A + B	5	yes	notify	192.168.1.4	503	general	201	no	LAN (MODBUS default)	1	redundant connection

Example:

Modbus address	Modbus address in message	
	Addressing Modbus standard = <yes>	Addressing Modbus standard = <no>
1	0	1
75	74	75
1000	999	1000
1374	1373	1374

Modbus Data (Register/Coils)

The Modbus data essentially contain the contents of the Modbus registers or the contents of the Modbus Coils.

The supported Modbus data formats are documented in section *13.8.12 Modbus Data Formats* and section *13.8.11 Interoperability*.

The Modbus data format is defined for each data point in the message conversion at the protocol element.

Modbus REQUEST or RESPONSE messages typically contain slave address, function code, coil / register address, number of bytes and data.

The exact Modbus message structure is documented for each function code in the section Modbus Request / Response Services.

NOTE

The Modbus protocol does not define the data formats in the Modbus registers!

The addressing of the Modbus registers is implemented differently depending on manufacturer and must be looked up in the device descriptions!

Some manufacturers also specify the Modbus register address on the line in the address list!

Message Protection

Modbus TCP does not use additional method for message protection.

With Modbus TCP the message protection takes place by means of the CRC in the TCP/IP header.

13.8.5.2 Modbus Request/Response Services

For the supported Modbus function codes, the message formats are shown schematically in the following description for Modbus TCP (without TCP/IP frame).

Supported Modbus function codes:

Function code	Designation	Description
01	Read Coils	Read binary marker
02	Read Discrete Inputs	Read binary inputs
03	Read Holding Registers	Read internal register
04	Read Input Registers	Read input register
05	Write Single Coil	Write binary outputs
06	Write Single Register	Write register
15	Write Multiple Coils	Write binary outputs
16	Write Multiple Registers	Write register

All Examples for Modbus TCP Request/Response services are shown with Unit ID=255, but message formats are also same for Unit ID 1 to 247.

Modbus TCP Master - MBAB Header for Read/Write Request:

Request (Query Message)			
Field name	**Example [HEX]**	**Example [DEC]**	**Description**
Transaction identifier Hi	xx	xx	Unambiguous identification of a Modbus Request/ Response Transaction by the Master.
Transaction identifier Lo	xx	xx	
Protocol identifier Hi	00	0	Protocol identifier
Protocol identifier Lo	00	0	Modbus TCP = 0000
Length Hi	xx	xx	Number of bytes starting from (including) Unit-ID field
Length Lo	xx	xx	

Request (Query Message)			
Field name	**Example [HEX]**	**Example [DEC]**	**Description**
Unit Identifier	FF, 1 to F7	255 1 to 247	255 .... not used 1 to 247 .. Modbus RTU station address
Function Code Starting Address Hi Starting Address Lo Data [n]			

Modbus TCP Slave - MBAB Header of Response for Read/Write Request:

Response (Response Message)			
Field name	**Example [HEX]**	**Example [DEC]**	**Description**
Transaction Identifier Hi	xx	xx	Transaction identifier included in request message will be sent back in response message ("mirrored")
Transaction Identifier Lo	xx	xx	
Protocol Identifier Hi	00	0	Protocol identifier Modbus TCP = 0000
Protocol Identifier Lo	00	0	
Length Hi	xx	xx	Number of bytes starting from (including) Unit-ID field
Length Lo	xx	xx	
Unit Identifier	FF, 1 to F7	255 1 to 247	255 .... not used 1 to 247 .... Modbus RTU station address
Function Code Byte Count Data [n]	: :	: :	

NOTE

Broadcast addressing is not supported with Modbus TCP!

Modbus TCP transmission: Re-Assembling of the Modbus Response Messages

SICAM A8000 always sends Modbus requests/response messages in a TCP/IP frame.

Some Modbus devices do not send the Modbus Response in a TCP/IP frame. The Modbus TCP master in SICAM A8000 reassembles a Modbus Response message, which is split over several TCP/IP frames ("Re-Assembling").

Modbus TCP transmission: Polling delay (limitation of the number of Modbus request messages)

Some Modbus devices only allow a limited number of queries within a specified time.

The Modbus TCP master in SICAM A8000 sends a new interrogation or a new message to a Modbus substation only after the expiry of the set "Polling Delay" time.

Read Coils, Read Discrete Inputs [FC = 1, 2]

In the query message of the central station (Modbus TCP Master) the starting address and the number of data points to be transmitted are specified.

Modbus station address [Unit Identifier]	255; 1 to 247 (broadcast not supported)
Function code [Function Code]	01 (Read Coils) 02 (Read Discrete Inputs)
Start address [Starting Address]	0 to 65535
Number of queried data points	1 to 127

Byte count [Byte Count]	1 to 16
Data [Data Coil Status]	8 states (binary information) per byte

Request (Query Message, Read Request) Example: Request of Bits 20 to 56 from the slave 17 (Unit-ID = 255) with function code 1 or 2.			
Field name	**Example [HEX]**	**Example [DEC]**	**Description**
Transaction Identifier Hi	xx	xx	
Transaction Identifier Lo	xx	xx	
Protocol Identifier Hi	00	0	
Protocol Identifier Lo	00	0	
Length Hi	00	0	
Length Lo	06	6	
Unit Identifier	FF	255	
Function Code	01 / 02	1 / 2	
Starting Address Hi	00	0	
Starting Address Lo	13	19	
Number of Points Hi	00	0	
Number of Points Lo	25	37	

Response (Response Message) Example: Response for request for Bit 20 to 56 from slave 17 (Unit-ID = 255) with function code 1 or 2.			
Field name	**Example [HEX]**	**Example [DEC]**	**Description**
Transaction Identifier Hi	xx	xx	
Transaction Identifier Lo	xx	xx	
Protocol Identifier Hi	00	0	
Protocol Identifier Lo	00	0	
Length Hi	00	0	
Length Lo	08	8	
Unit Identifier	FF	255	
Function Code	01 / 02	1 / 2	
Byte Count	05	5	
Data (Coils 27 to 20)	CD	205	1100 1101
Data (Coils 35 to 28)	6 B	107	0110 1011
Data (Coils 43-36)	B2	178	1011 0010
Data (Coils 51-44)	0E	14	0000 1110
Data (Coils 56-52)	1 B	27	0001 1011

In the response message each binary information is transmitted with 1 bit (0 = binary information OFF; 1 = binary information ON).

The number of data points requested refers to the individual items of binary information.

The least significant bit in the 1st data byte contains the status of the addressed binary information.

Read Holding Registers / Read Input Registers [FC = 3, 4]

In the query message of the central station (Modbus TCP Master) the starting address and the number of data points to be transmitted are specified.

Modbus station address [Unit Identifier]	255; 1 to 247 (broadcast not supported)
Function code [Function Code]	03 (Read Holding Registers) 04 (Read Input Registers)

Start address [Starting Address]	0 to 65535
Number of queried data points	1 to 127
Byte count [Byte Count]	2 to 254

Request (Query Message, Read Request) Example: Request of Register 108 to 110 from slave 17 (Unit-ID = 255) with function code 3 or 4.			
Field name	**Example [HEX]**	**Example [DEC]**	**Description**
Transaction Identifier Hi	xx	xx	
Transaction Identifier Lo	xx	xx	
Protocol Identifier Hi	00	0	
Protocol Identifier Lo	00	0	
Length Hi	00	0	
Length Lo	06	6	
Unit Identifier	FF	255	
Function Code	03 / 04	3 / 4	
Starting Address Hi	00	0	
Starting Address Lo	6 B	107	
Number of Points Hi	00	0	
Number of Points Lo	03	3	

Response (Response Message) Example: Response for request of register 108 to 110 from slave 17 (Unit-ID = 255) with function code 3 or 4.			
Field name	**Example [HEX]**	**Example [DEC]**	**Description**
Transaction Identifier Hi	xx	xx	
Transaction Identifier Lo	xx	xx	
Protocol Identifier Hi	00	0	
Protocol Identifier Lo	00	0	
Length Hi	00	0	
Length Lo	09	9	
Unit Identifier	FF	255	
Function Code	03 / 04	3 / 4	
Byte Count	06	6	
Data Hi (Register 108)	02	2	0000 0010
Data Lo (Register 108)	2 B	43	0010 1011
Data Hi (Register 109)	00	0	0000 0000
Data Lo (Register 109)	00	0	0000 0000
Data Hi (Register 110)	00	0	0000 0000
Data Lo (Register 110)	64	100	0110 0100

Write Single Coil [FC = 5]

Binary information, commands from the central station are only transmitted to the substations as single point information. The query message contains the data point address and the state.

Modbus station address [Unit Identifier]	255; 1 to 247 (broadcast not supported)
Function code [Function Code]	5 (Write Single Coil)
Data point address [Coil Address]	0 to 65535
State [Write Data]	0x00 = OFF; 0xFF = ON

Write (Write Request) Example: Write request of single coil address 173 in slave 17 (Unit-ID = 255) with function code 5.			
Field Name	**Example [HEX]**	**Example [DEC]**	**Description**
Transaction Identifier Hi	xx	xx	
Transaction Identifier Lo	xx	xx	
Protocol Identifier Hi	00	0	
Protocol Identifier Lo	00	0	
Length Hi	00	0	
Length Lo	06	6	
Unit Identifier	FF	255	
Function Code	05	05	
Coil Address Hi	00	00	
Coil Address Lo	AC	172	
WRITE Data Hi	FF	255	ON
WRITE Data Lo	00	00	

Response (Response Message) Example: Response to write request of single coil address 173 in slave 17 (Unit-ID = 255) with function code 5.			
Field Name	**Example [HEX]**	**Example [DEC]**	**Description**
Transaction Identifier Hi	xx	xx	
Transaction Identifier Lo	xx	xx	
Protocol Identifier Hi	00	0	
Protocol Identifier Lo	00	0	
Length Hi	00	0	
Length Lo	06	6	
Unit Identifier	FF	255	
Function Code	05	5	
Coil Address Hi	00	0	
Coil Address Lo	AC	172	
WRITE Data Hi	FF	255	ON
WRITE Data Lo	00	0	

With station-selective addressing the content of the query message is sent back by the substation as response to the central station.

Write Single Register [FC = 6]

Measured values and setpoint values are transmitted from the central station (Modbus TCP Master) to the substations with the message Write Single Register. The query message contains the data point address and the state. A maximum of 1 value is transmitted per message.

Modbus station address [Unit Identifier]	255; 1 to 247 (broadcast not supported)
Function code [Function Code]	6 (Write Single Register)
Data point address [Register Address]	0 to 65535

Request (Write Request) **Example: Write the value 0003 into the register 0x0002 of the substation 17 (unit ID = 255) with function code 6.**			
Field Name	**Example [HEX]**	**Example [DEC]**	**Description**
Transaction Identifier Hi	xx	xx	
Transaction Identifier Lo	xx	xx	
Protocol Identifier Hi	00	0	
Protocol Identifier Lo	00	0	
Length Hi	00	0	
Length Lo	06	6	
Unit Identifier	FF	255	
Function Code	06	6	
Register Address Hi	00	0	
Register Address Lo	01	1	
Preset Data Hi	00	0	
Preset Data Lo	03	3	

Response (Response Message) **Example: Response to writing the value 0003 into the register 0x0002 of the substation 17 (unit ID = 255) with function code 6.**			
Field Name	**Example [HEX]**	**Example [DEC]**	**Description**
Transaction Identifier Hi	xx	xx	
Transaction Identifier Lo	xx	xx	
Protocol Identifier Hi	00	0	
Protocol Identifier Lo	00	0	
Length Hi	00	0	
Length Lo	06	6	
Unit Identifier	FF	255	
Function Code	06	6	
Register Address Hi	00	0	
Register Address Lo	01	1	
Preset Data Hi	00	0	
Preset Data Lo	03	3	

With station-selective addressing the content of the query message is sent back by the substation as response to the central station.

NOTE

Modbus TCP (Master, Slave) in SICAM A8000 does not support double register values (such as: FLOAT32, INT32, UINT32,...) with function code = 06 Write Single Register!

Write Multiple Coils [FC = 15]

Multiple binary information/command states can be transmitted from the Modbus TCP central station to the substations with one message. Specified in the query message is the 1st data point address, the number of coils to be written and the status of every individual coil.

(Coil 1 is addressed with "0").

Modbus station address [Unit Identifier]	255; 1 to 247 (broadcast not supported)
Function code [Function Code]	15 (Write Multiple Coils)
Data point address [Coil Address]	0 to 65535
Number of Coils [Quantity of Coils]	1 to 2 Restriction with Modbus RTU Master: With FC = 15 only 1 single command (= 1 coil) resp. 1 double command (= 2 coils) can be transmitted!
State [Write Data]	0 = OFF; 1 = ON (1 bit per coil state)

Write (Write Request)
Example: Write request for multiple coils (10 coils) starting at coil address 20 in slave 17 (Unit-ID = 255) with coil data 0xCD01 and function code 15.

Field Name	Example [HEX]	Example [DEC]	Description
Transaction Identifier Hi	xx	xx	
Transaction Identifier Lo	xx	xx	
Protocol Identifier Hi	00	0	
Protocol Identifier Lo	00	0	
Length Hi	00	0	
Length Lo	09	9	
Unit Identifier	FF	255	
Function Code	0F	15	
Coil Address Hi	00	0	
Coil Address Lo	13	19	
Quantity of Coils Hi	00	0	
Quantity of Coils Lo	0 A	10	
Byte Count	02	2	
WRITE Data Hi (Coils 27-20)	CD	205	`Bit:  1  1  0  0  1  1  0  1 | 0  0  0  0  0  0  0  1` `Coil: 27 26 25 24 23 22 21 20 | -- -- -- -- -- -- 29 28`
WRITE Data Lo (Coils 29-28)	01	1	

Response (Response Message)
Example: Response for write request for multiple coils (10 coils) starting at coil address 20 in slave 17 (Unit-ID = 255) with coil data 0xCD01 and function code 15.

Field Name	Example [HEX]	Example [DEC]	Description
Transaction Identifier Hi	xx	xx	
Transaction Identifier Lo	xx	xx	
Protocol Identifier Hi	00	0	
Protocol Identifier Lo	00	0	
Length Hi	00	0	
Length Lo	06	6	
Unit Identifier	FF	255	
Function Code	0F	15	
Coil Address Hi	00	0	
Coil Address Lo	13	19	
Quantity of Coils Hi	00	0	
Quantity of Coils Lo	0 A	10	

Write Multiple Registers [FC = 16]

Multiple consecutive 16-bit register values can be transmitted from the central station to the substation with one message. Specified in the query message is the 1st Data point address, the number of registers to be written and the register status.

Modbus station address [Unit Identifier]	255; 1 to 247 (broadcast not supported)
Function code [Function Code]	16 (Write Multiple Registers)
Start address [Starting Address]	0 to 65535
Number of registers [No. of Registers]	1 to 125
No. of bytes [Byte Count]	2 to 250

Write (Write Request) **Example: Write request for 2 registers starting at register address 0x0002 with value 00 0A and 01 02 in slave 17 (Unit-ID = 255) with function code 16.**			
Field Name	**Example [HEX]**	**Example [DEC]**	**Description**
Transaction Identifier Hi	xx	xx	
Transaction Identifier Lo	xx	xx	
Protocol Identifier Hi	00	0	
Protocol Identifier Lo	00	0	
Length Hi	00	0	
Length Lo	0 B	11	
Unit Identifier	FF	255	
Function Code	10	16	
Starting Address Hi	00	0	
Starting Address Lo	01	1	
Number of Registers Hi	00	0	
Number of Registers Li	02	2	
Byte Count	04	4	
Data Hi	00	0	
Data Lo	0 A	10	
Data Hi	01	1	
Data Lo	02	2	

Response (Response Message) **Example: Response for write request for 2 registers starting at register address 0x0002 with value 00 0A and 01 02 in slave 17 (Unit-ID = 255) with function code 16.**			
Field Name	**Example [HEX]**	**Example [DEC]**	**Description**
Transaction Identifier Hi	xx	xx	
Transaction Identifier Lo	xx	xx	
Protocol Identifier Hi	00	0	
Protocol Identifier Lo	00	0	
Length Hi	00	0	
Length Lo	06	6	
Unit Identifier	FF	255	
Function Code	10	16	
Starting Address Hi	00	0	
Starting Address Lo	01	1	

Response (Response Message) Example: Response for write request for 2 registers starting at register address 0x0002 with value 00 0A and 01 02 in slave 17 (Unit-ID = 255) with function code 16.			
Field Name	**Example [HEX]**	**Example [DEC]**	**Description**
Number of Registers Hi	00	0	
Number of Registers Lo	02	2	

Exception Response

If a substation has not implemented the data queried from the central station or the queried data is not available, an exception code (exception response) is transmitted instead of the data (response message).

Supported Modbus Exception Codes:

Exception code	Modbus designation	Description	MBCII0	MBSII0
01	Illegal Function Code	The function code is not known to the computer.	✓	✓
02	Illegal Data Address	Modbus register/coil address not supported.	✓	✓
03	Illegal Data Value	Illegal data for the Modbus register.	✓	–
04	Server failure	The server failed during execution.	✓	✓[335]
05	Acknowledge	The Server has accepted the service call, but the service takes a relatively long time to execute. The Server therefore only sends back a confirmation of the service call confirmation.	✓	–
06	Server busy	The Server could not accept the requests. The Client must decide if and when the request should be sent again.	✓	–
10	Gateway problem	Gateway paths not available.	✓	–
11	Gateway problem	The addressed substation does not respond. This exception is generated by the gateway.	✓	–

NOTE

- If the query of the Modbus TCP Master is answered with an Exception Response, then the queried data (except exception Code 10, 11) are emulated by the Modbus RTU Master as invalid (NT = 1 “not topical”) – no retries at the Modbus TCP level.
- The Modbus TCP Master does not make any retries except for exception Code 10, 11 – Retry for serial Modbus Slaves connected via gateway.
- The exception codes are not specially evaluated by the Modbus TCP master – a received exception code is rated as negative acknowledgment.

335 Only with activated parameter for data points marked faulty

13.8.5.3 Data acquisition by querying

The transmission of the data from the remote terminal units to the master station takes place by means of station-selective station interrogations (interrogation procedure, polling) of the parameterized Modbus addresses, controlled by the master station.

The master station performs a cyclic interrogation of the data (Modbus coils/register values) from the remote terminal units (Query/Response Cycle).

Call Procedure (Query/Response Cycle)

A Modbus TCP data transmission sequence will be initiated by the master station. A data transmission sequence consists either of a “Request/Response Service” or of a “Send/Confirm Service” to a selective addressed remote terminal unit (Slave) by IP-address/unit identifier.

The Protocol element for Modbus TCP master does not support broadcast addressing!

The requests (Read Registers/Read Coils) or data messages (Write Registers/Write Coils) provided for the Modbus communication protocol are transmitted from the master station. Data from the remote terminal unit to the master station can only be transmitted as a response to a request.

In contrast to the protocol Modbus “serial”- that establishes connections over serial interfaces - the protocol Modbus TCP enables the communication over networks (Local Area Network “LAN” and Wide Area Network “WAN”). Thereby common network components such as switches and routers can be used.

The Modbus protocol element uses a Modbus oriented data base (Registers, Coils). Every message represents one or multiple data points, such as e.g. one/multiple measured value(s), setpoint value(s), command(s) or alarm(s). Thereby the data are addressed with the Modbus function code, Modbus register address, bit position in the Modbus register or with the Coil address.

The address then determines which signal is concerned, i.e. transmitter and receiver must know the meaning of the address.

The Modbus protocol does not define the data formats in the Modbus registers!

For the transmission of data a “TCP Connection” is established between 2 participating stations.

With Modbus TCP the master is the“Connector” (... the connector establishes a TCP/IP connection) and the Slave is “Listener”.

Prioritization of the data transmission with Modbus

The prioritization of the data to be sent or interrogated is only carried out by the master station. The remote terminal unit (Slave) receives the data written in the Modbus register or Coils and answers the interrogations by the master station with the data stored in the Modbus registers or Coils.

With Modbus normally the interrogation of the data is always performed sequentially i.e. a further Request/ Response interrogation sequence is only started when the previous Request/Response sequence is concluded.

Depending on the case of application the master station can transmit a further message immediately following reception of a valid response message from a remote terminal unit or with “lack of a response” after a configurable TIMEOUT.

Parallel Polling (number of max. Server polled at the same time)

The protocol element for Modbus TCP master uses a so-called parallel polling for querying Modbus registers/ coils for real Modbus TCP slaves (i.e. Modbus slaves with integrated TCP/IP interface). With this procedure, Modbus queries are sent to several substations immediately one after the other and the responses from the slaves are then waited for. This considerably increases the performance of the data query of the Modbus master.

The parallel polling is only carried out for Modbus stations with a unique IP address. Up to a maximum of 5 requests (one request each) are sent to the next 5 Modbus TCP slaves. Then the response is waited for.

As soon as a response is received, the next request is sent (i.e. a maximum of 5 responses are pending).

Parallel polling is not used for Modbus stations with the same IP address, as several serial Modbus slave devices are usually connected to the Modbus TCP via a serial Ethernet converter.

Delay between 2 queries (Polling Delay)

Some Modbus devices only allow a limited number of queries within a specified time. This limitation is typically indicated by “polling delay between 2 query”.

The Modbus master sends a new interrogation or a new message to a Modbus substation only after the expiry of the set “Polling Delay” time.

The delay time must be parameterized in the **`Polling Delay`** field in the parameter **`Connection definition`** for each station. This does not affect the query of other stations.

	Device	MODBUS station (internal)	Station enable	Station failure	Remote IP address	TCP port number	Station type	MODBUS unit-ID	Addressing MODBUS standard	Network connection	Polling delay	Redundancy
	A + B	0	yes	notify	192.168.1.1	0	general	255	yes	LAN (MODBUS default)	0	redundant connection
	A + B	1	yes	notify	192.168.1.2	0	general	255	yes	LAN (MODBUS default)	0	redundant connection
	A + B	2	yes	notify	192.168.1.3	0	general	255	yes	LAN (MODBUS default)	0	redundant connection
	A + B	3	yes	notify	192.168.1.4	502	general	200	yes	LAN (MODBUS default)	1	redundant connection
	A + B	5	yes	notify	192.168.1.4	503	general	201	no	LAN (MODBUS default)	1	redundant connection

[DM_MBCiI0_Polling_Delay, 2, en_US]

Data exchange with Modbus TCP

- Data in the transmit direction (Master → Slave) are transmitted spontaneously. Prioritization of the data: 1:1 to the request of the data from the Register-/Coils
- Data in receive direction (Master ← Slave) are only transmitted in case of interrogation. The query of the register data/coils from the slaves is controlled by the master.

Possible selection for query cycle:

`<Basic cycle>` .... Query of the data in the basic cycle

`<Query cycle-1>` .... Query of the data in the query cycle 1

`<Query cycle 2>` .... Query of the data in the query cycle 2

`<Query cycle 3>` .... Query of the data in the query cycle 3

`<Query cycle 4>` .... Query of the data in the query cycle 4

The query cycle is defined for each data point in the message conversion.

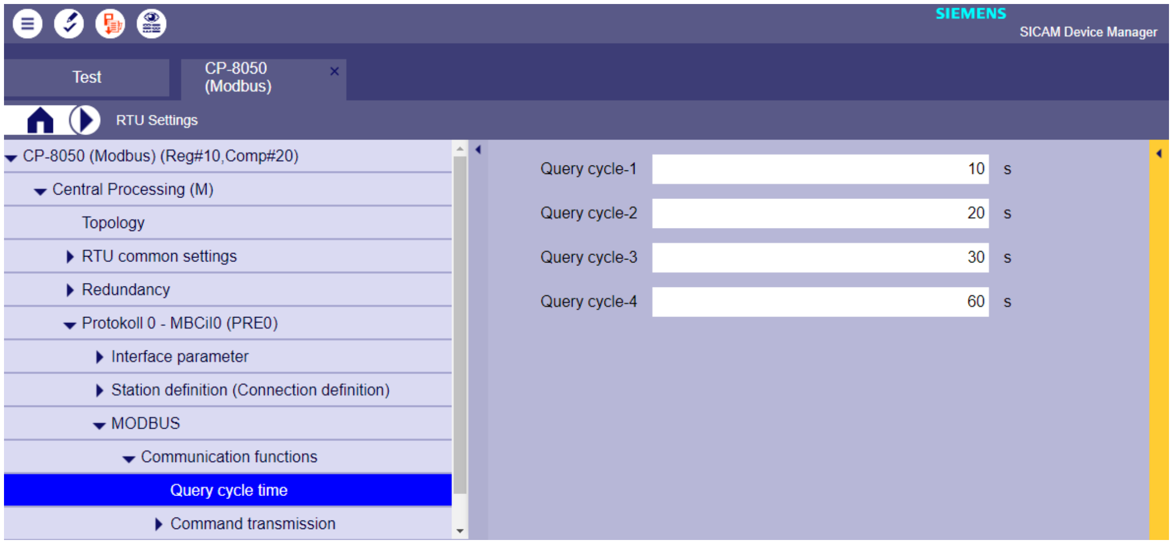
<u>Basic cycle</u>

In the basic cycle, the important data are queried that should be updated as quickly as possible. If it is not necessary to continuously query important data in the basic cycle, the data can be queried in slower query cycles (query cycle 1-4).

<u>Query cycle-1..4</u>

Query of the parameterized data in the adjustable time frame. The time grid for querying cycle times 1-4 must be set with the parameters **`[PRE] MODBUS | Communication functions | Cycle time query | Parameterize cycle 1..4`**.

Possible: 10 Sec – 3600 Sec.



[MBCiI0_DM_Abfrage_Zykluszeit, 1, en_US]

If several data are to be queried at a query cycle, these are queried one after the other.

With the different times of the query cycles 1-4, unimportant data can be queried less often (e.g .: Query of certain data only 1x per minute or 1x / hour). This means that the important data - if available - can be queried more often in the basic cycle.

Modbus master - polling cycle control

- The Modbus master controls the query of the Modbus data.
- If data is assigned to the basic cycle, the query is carried out permanently.
- If no data are assigned to the basic cycle, the query is only carried out if a query of the data is triggered by query cycle 1-4.
- Only one Modbus query is carried out per Modbus station; the next query is sent to the next higher Modbus station number.
- For each Modbus query, several Modbus registers/coils are queried if the Modbus addresses are in ascending order and there is no address gap between them.
- The Modbus addresses are processed in ascending order for each station.
- Modbus addresses that are not assigned to the basic cycle are only queried in the basic cycle if the query of the data is triggered by the query cycle 1-4. The Modbus registers/coils are always queried in ascending order of the Modbus addresses. Modbus addresses that were activated by query cycle 1-4 are not placed in front, but rather queried when it is the turn of the Modbus address in the basic cycle.

Example: *"Modbus master - polling cycle control"*

The following Modbus register addresses should be queried:

Modbus Register/Coil	Modbus Station #1		Modbus Station #2		Modbus Station #3	
Modbus Register Address	40000	B	50000	B	40000	B
	40001	B	50001	B	40001	B
	40002	B	50002	B	40002	B
	40003	B	50003	B	40003	B
	40004	B	50004	B	40004	B
	40005	Z1	50005	B	40005	Z1
	40010	Z1			40010	Z1
	40011	Z1			40011	Z1
	40100	Z2			40100	Z2
	40500	B			40500	B

Query sequence by Master:

		Query by Master:	Note
1.	1	Station#1: Modbus Address [40000 - 40004]	
2.		Station#2: Modbus Address [50000 - 50005]	
3.		Station#3: Modbus Address [40000 - 40004]	
4.	2	Station#1: Modbus Address (40500)	
5.		Station#2: Modbus Address [50000 - 50005]	
6.		Station#3: Modbus Address (40500)	Station#1: Query cycle Z2 is triggerd
7.	3	Station#1: Modbus Address [40000 - 40004]	Station#3: Query cycle Z1 is triggerd
8.		Station#2: Modbus Address [50000 - 50005]	
9.		Station#3: Modbus Address [40000 - 40004]	
10.	4	Station#1: Modbus Address (40100)	
11.		Station#2: Modbus Address [50000 - 50005]	
12.		Station#3: Modbus Address (40005)	
13.	5	Station#1: Modbus Address (40500)	
14.		Station#2: Modbus Address [50000 - 50005]	
15.		Station#3: Modbus Address [40010 - 40011]	
16.	6	Station#1: Modbus Address [40000 - 40004]	
17.		Station#2: Modbus Address [50000 - 50005]	
18.		Station#3: Modbus Address (40500)	
19.	7	Station#1: Modbus Address (40500)	
20.		Station#2: Modbus Address [50000 - 50005]	
21.		Station#3: Modbus Address [40000 - 40004]	
22.	8	Station#1: Modbus Address [40000 - 40004]	
23.		Station#2: Modbus Address [50000 - 50005]	
24.		Station#3: Modbus Address (40500)	

Continuous Interrogation of a Remote Terminal Unit

The “Continuous interrogation of a remote terminal unit” by the master station following the transmission of certain data (e.g. commands or setpoint values) to the remote terminal unit is not supported.

13.8.5.4 Acknowledgment Procedure

All query or data messages that are selectively sent to a substation must be answered by the substation with a response message.

If the response message is not received for longer than the response timeout when the transmission line is not disturbed, then the station is marked as failed in the Modbus TCP stations, or retries are performed in the case of serial substations which are connected to Modbus TCP via a serial Ethernet converter. With retries, the telegrams sent by the master are repeated up to n times (can be parameterized) (= number of retries). After expiry of the Retry number the station is marked as failed.

Retries to a remote terminal unit are transmitted immediately one after the other after expiry of the expected acknowledgement time. I.e. no other remote terminal units are interrogated while a Retry handling is in progress.

Messages transmitted from a remote terminal unit are not acknowledged by the master station.

The “Response Timeout” is set on the protocol element of the central station with the parameter **`[PRE] interface parameter | Network connection | * | MODBUS parameters | Response timeout`**.

The number of retries is set on the protocol element of the central station with the parameter **`[PRE] interface parameter | Network connection | LAN (serial converter #) | MODBUS parameters | Number of retries`**.

Failure Monitoring

The monitoring of the interface by the active master station takes place by means of the cyclic interrogation procedure of the parameterized Modbus register. A communication fault is only reported for failed remote terminal units if this is parameterized accordingly in the parameter “station failure” of the station definition.

Failed remote terminal units continue to be interrogated by the central station by means of the interrogation procedure, however no message repetition (Retry) is carried out during the station interrogation for such remote terminal units.

When the remote terminal unit replies again with the requested register values, the station failure is reset.

Station Initialization

The Modbus protocol does not define any special procedure for station initialization. After startup or redundancy switchover the polling cycle will be started.

Device-specific initialization sequences are not supported by the Modbus master station in SICAM A8000!

13.8.5.5 Acquisition of events (transmission of data ready to be sent)

Data ready to be sent in the master station can either be transmitted to the remote terminal unit spontaneously when they occur or cyclically (or cyclic + spontaneous).

With spontaneous transmission the data are prioritized 1:1 to the cyclic interrogation of the configured Modbus addresses. I.e. after spontaneous transmission the polling cycle will be continued.

With cyclic transmission the data to be transmitted are stored temporarily in the process image on the protocol element of the central station. The transmission takes place cyclically in the interrogation cycle.

The transmission takes place cyclically in the interrogation cycle.

Spontaneous data for sending are not stored in protocol element internal data base for Modbus.

With a failure of the communication to a remote terminal unit, on the protocol element of the master station the fetching of data from the basic system element is disabled but the cyclic transmission of data to the failed RTU is not stopped.

The data are saved in the data storage of the communication function on the basic system element (BSE) until they are deleted by the dwell time monitoring or can be transmitted to the remote station.

After a going interface fault the fetching of data from the basic system element is enabled again and the saved data transmitted by the protocol element according to the prioritization.

NOTE

The protocol element for Modbus TCP master in SICAM A8000 does not support procedures for the transmission of events (event queues)!

Message from the Remote Terminal Unit to the Master Station

Messages from the remote terminal unit to the master station are only transmitted with station interrogation.

A quick-check procedure for speeding up the transmission of data is not implemented.

13.8.5.6 General interrogation, substation interrogation

The general interrogation function (RTU interrogation) is used for updating the master station after startup, redundancy switchover or after communication error.

The Modbus protocol does not define any GI concept!

With a general interrogation within SICAM A8000, all parameterized data are queried by the Modbus TCP master from the connected Modbus slaves.

The received data is handled without change monitoring and the current status of the data is queried with the cause of transmission <COT=20> “by station query ” and passed on to the basic system element.

The general interrogation command is always internally transmitted to the PRE by the BSE in SICAM A8000 on a “station specific” basis.

- The protocol element for Modbus TCP master only supports the general interrogation command “global”.
- A general interrogation command for GA groups is not supported!
- The protocol element for Modbus TCP does not send ACTCON / ACTTERM for the general interrogation command!
- The protocol element does not reproduce any GA data for failed stations.

13.8.5.7 Clock Synchronization

The Modbus TCP protocol does not define any procedures for clock synchronization.

The Modbus TCP master (“Client”) in SICAM A8000 supports time synchronization of the connected Modbus slaves via:

- Time synchronization via Modbus register

Time synchronization via Modbus register

The clock synchronization of Modbus Slaves devices is performed spontaneous or cyclic controlled by the Modbus master station with station selective Modbus message using FC = 16 (WRITE MULTIPLE REGISTERS).

The message format for clock synchronization is free definable (with supported time elements) via parameter for each single MODBUIS Slave.

Clock Synchronization can be done at following Time:

- spontaneous (initiated by command <TI:=45>)
- cyclic every 1 minute (offset = 0 s)
- cyclic every 1 minute (offset = 30 s)
- cyclic each 5th Minute (offset = 0 s)
- cyclic each 10th Minute (offset = 0 s)
- cyclic each 30th Minute (offset = 0 s)
- cyclic each 60th Minute (offset = 0 s)

- after AU internal clock synchronization
- after going communication failure

Supported time elements:

Time element [Byte]	Value Range	Example
Not used	Dummy: UI8 [7 to 0] <0>	
year (high)	year (high) [7 to 0] <0 to 255>	year = 2016 = 07E0 [HEX] → year (high) = 0x07 [HEX]
year (low)	year (low) [7 to 0] <0 to 255>	year = 2016 = 07E0 [HEX] → year (low) = 0xEX [HEX]
year - 2000 (high)	year 2000 (high) [7 to 0] <0 to 255>	year = 2016 → 2016 - 2000 = 16 = 0x0010 [HEX] → year - 2000 (high) = 0x00 [HEX]
year - 2000 (low)	year 2000 (high) [7 to 0] <0 to 255>	year = 2016 → 2016 - 2000 = 16 = 0x0010 [HEX] → year - 2000 (low) = 0x10 [HEX]
Month	Month [7 to 0] <1 to 12>	month = 12 (december) → month = 0x0C [HEX]
Day	Day [7 to 0] <1 to 31>	day = 23 → day = 0x17 [HEX]
Day of week	Day of week [7 to 0] <1 to 7> <1> = Monday; <2> = Tuesday; ... <7> = Sunday	Day of week = Tuesday → Day of week = 0x02 [HEX]
day + day of week	Day [4 to 0] <1 to 31> Day of week [7 to 5] <1 to 7> <1> = Monday; <2> = Tuesday; ... <7> = Sunday	
Hour	Hour [7 to 0] <0 to 23>	hour = 21 = 0x15 [HEX]
hour + SU	Hour [4 to 0] <0 to 23> summer time (SU) [7] <0, 1> SU <0> = standard time (winter time) SU <1> = summer time	
Minute	Minute [5 to 0] <0 to 59>	minute = 59 = 0x3B [HEX]
minute + IV	Minute [6 to 0] <0 to 59> Invalid (IV) [7] <0, 1> IV <0> = valid IV <1> = invalid	
second	second [7 to 0] <0 to 59>	second = 32 = 0x20 [HEX]
millisecond (high)	millisecond n * 1 ms (high) [7 to 0] <0 to 255> n <0 to 59999> = range including seconds	milliseconds = 998 = 03E6 [HEX] → millisecond (high) = 0x03 [HEX]
millisecond (low)	millisecond n * 1 ms (low) [7 to 0] <0 to 255> n <0 to 59999> = range including seconds	milliseconds = 998 = 03E6 [HEX] → millisecond (low) = 0xE6 [HEX]
ticks (10ms)	millisecond n * 10 ms [7 to 0] <0 to 99>	milliseconds = 998 → Ticks (10 ms) = 99 = 0x63 [HEX]

Time element [Byte]	Value Range	Example
ticks (100ms)	millisecond n * 100 ms [7 to 0] <0 to 99>	milliseconds = 998 → Ticks (100 ms) = 9 = 0x09 [HEX]
EOF (End of Frame)		Note: This time element defines the end of the freely configurable time format - this data byte is no longer sent!

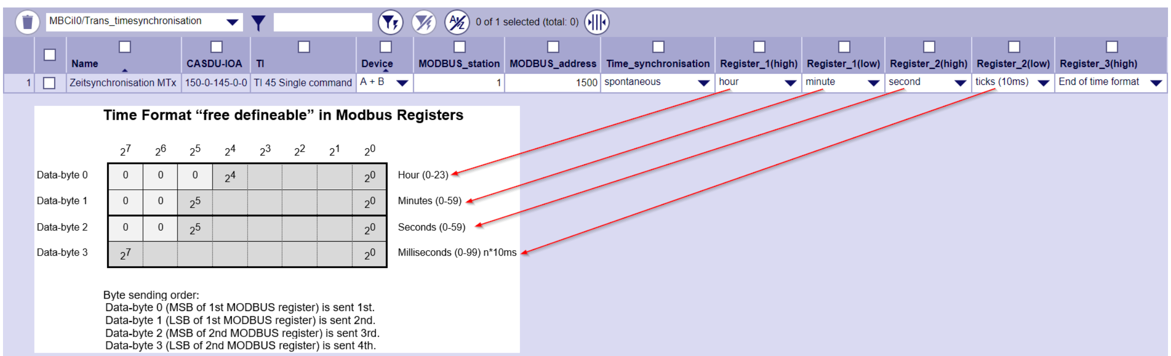
Legend:

[ ] .. Values in square brackets = bit position of the value in the byte

<> .. Values in angle brackets = value range

Free definable Time Synchronization Format (Example)

Time synchronization controlled by <TI:= 5> single command with the address CASDU=150, IOA=145 on the Modbus address 1500.



[MBCiI0_DM_Modbus_Zeitformat, 1, en_US]

13.8.5.8 Command Transmission

Control Location / Check Control Location

The function “Control location” is used so that commands are only output from authorized sources.

If the “control location” function is activated, commands from the protocol element are only transmitted to the substation, when the control location (originator address) is enabled. If the control location is not enabled, the protocol element immediately sends back a negative acknowledgment of activation (ACTCON) to the originator address (further details about setting control location / check control location see section *13.1.4.9 Control location function for commands and setpoint values*).

Messages "To All"

Messages “to all” (acknowledged or unacknowledged) are not supported by the Modbus TCP central station!

13.8.5.9 Transmission of Integrated Totals

The Modbus protocol itself does not define any procedures for counter interrogation.

A counter interrogation command triggered in the SICAM A8000 system is not sent to the Modbus slaves by the protocol element.

The integrated totals are updated cyclically due to the cyclic data exchange between the protocol element and the Modbus TCP slaves.

Forwarding of integrated totals to the basic system element:

- Counter Interrogation
  After a counter interrogation command (SICAM A8000 internal) the integrated totals will be forwarded to the basic system element directly from the protocol element internal process image.

- Cyclic in the parameterized time grid
  After the time grid for cyclic counter values (SICAM A8000 internal) has expired, the counter values are forwarded to the basic system element with the next time they are received.

The sequence number in the counter message is incremented with every counter interrogation message, or with cyclic counter interrogation in the parameterized time grid.
Restrictions:

- The protocol element for Modbus TCP does not send ACTCON / ACTTERM for the SICAM A8000 internal counter interrogation command.
- The protocol element does not reproduce any integrated totals for failed stations.

13.8.6 Parameters and Settings

13.8.6.1 Modbus TCP Master

Parameter Name	Description	Settings
[PRE] Interface parameter Note: • The interface for the protocol is selected in the SICAM Device Manager under**Configuration | Firmware**(see *13.1.4.4 Selection of an Ethernet Interface for Communication Protocols*). • Some parameters may not be displayed until the interface is selected.		
[PRE] Interface parameter | Network connecton | ... | MODBUS Parameter • LAN (MODBUS default) • WAN • LAN (fast dropout detection)		
Response timeout	After sending a Modbus request message, the Modbus TCP master waits to see whether the response is received within the parameterized response timeout.	Permitted range = 0.8 to 25.5 s Default setting = | 3 | 5 | 2 | s
Transmission delay	The configured pause is observed before a Modbus request is sent. This allows the polling speed of the master to be slowed down.	Permitted range = 0 to 255 ms Default setting = | 5 | 5 | 5 | ms
[PRE] Interface parameter | Network connecton | ... | TCP Parameter • LAN (MODBUS default) • WAN • LAN (fast dropout detection)		
TCP connection close	By default, a TCP connection is closed with the “4-way-handshake” (FIN, ACK, FIN, ACK). For special applications (downward compatibility, security, ...) the closing of the TCP connection can also be carried out with RST.	Permitted range = • close with RST • close with FIN or RST default setting = close with RST

Parameter Name	Description	Settings
[PRE] Interface parameter | Network connecton | ... | MODBUS Parameter • LAN (serial converter 1) • LAN (serial converter 2) • freely definable		
Response timeout	After sending a Modbus request messge, the Modbus TCP master waits to see if the response is received within the parameterized response timeout (= expected acknowledgment time).	Permitted range = 0.8 to 25.5 s Default setting = | 3 | 5 | 3 | s
Transmission delay	The parameterized pause is observed before each transmission of a Modbus request. This allows the polling speed of the master to be slowed down.	Allowed range = 0 to 255 ms Default setting = | 5 | 20 | 5 | ms
Retrycount	If a Modbus query is answered by the remote station with exception code = 10 or 11, the Modbus query is repeated (= retry). If no valid response is received from the substation within the set number of retries, the substation is marked as failed. The TCP/IP connection remains established. Note: This parameter is only available for serial Modbus devices that are connected to Modbus TCP with a serial Ethernet converter.	Permitted range = 0 to 15 Default setting = | 2 | 2 | 2 |
[PRE] Interface parameter | Network connecton | ... | TCP Parameter • LAN (serial converter 1) • LAN (serial converter 2) • freely definable		
TCP connection close	By default, a TCP connection is closed with the "4-way handshake" (FIN, ACK, FIN, ACK). For special applications (downward compatibility, security, ...) the closing of the TCP connection can also be carried out with RST.	Permitted range = • close with RST • close with FIN or RST default setting = close with RST
[PRE] Station definition (Connection definition) | Station definition		
Device	This line of the station definition applies to the following devices when redundancy is used. Note: This parameter is only displayed if redundancy is enabled.	Permitted range = • A .. Device A • B .. Device B • A + B .. Device A + B Default setting A + B

Parameter Name	Description	Settings
`MODBUS Station (internal)`	SICAM A8000 internal station number of the remote station. SICAM A8000 internally the same station number is used for diagnosis and data routing. Each substation must be assigned a unique station number.	Permitted range = • 0 to 99 • 255 (= not used) Default setting = 255
`Station enable`	Selective remote stations can be prepared or deactivated with setting ***`no`***. Data to “prepared” stations are fetched by the PRE and discarded without an error message (data is not transferred).	Permitted range = • yes • no Default setting = yes
`Station failure`	If a substation fails, the forwarding of the error message can be suppressed with the setting ***`do not report`*** (may be required for special redundancy configurations)	Permitted range = • notify • suppress Default setting = notify
`Remote IP address`	IP address of the Modbus TCP remote station (IPV4). The Modbus TCP slave device is addressed via the IP address. The Modbus Unit-ID is only used for addressing in exceptional cases (e.g. when a serial slave is connected to Modbus TCP via a converter). The IP address of the remote station (= Modbus TCP slave device) must be unique and must not be entered more than once in the connection definition. Note: The IP address of the own station is set on the BSE.	Permitted range = 0.0.0.0 to 255.255.255.254 Standard setting = 0.0 0.0
`TCP Port number`	TCP Port number for Modbus TCP Protocol.	Permitted range = 0 to 65535 Default setting = 0 (Modbus TCP Port 502)
`Station type`	Device-specific special treatments are activated with the station type. Special treatments for: • General • Sentron 3VA COM-Module: If a Modbus response message with all data bytes = 0xFF is received (= identifier for “3VA = failed”), an exception code = 11 is internally reproduced for this data and the queried data is treated as faulty.	Permitted range = • General • Sentron 3VA via COM-Module Default setting = general

Parameter Name	Description	Settings
`MODBUS Unit-ID`	Station address for serially connected Modbus slave device, if it is connected via a Modbus TCP slave ("Server") i.e. via a gateway. Note: The Modbus TCP slave is addressed via the IP address. The Modbus Unit-ID is only used for addressing in exceptional cases (e.g. when a serial slave is connected to Modbus TCP via a converter).	Permitted range = • 1 to 247 • 255 (= Modbus TCP Slave) Default setting = 1
`Addressing MODBUS standard`	Addressing of the Modbus Register/coils during the transmission on the line: • Modbus Address from 0x0000 (Standard) • Modbus Address from 0x0001 Note: The addressing of the Modbus registers is implemented differently depending on manufacturer and must be looked up in the device descriptions! Some manufacturers also specify the Modbus register address on the line in the address list!	Permitted range = • yes • no Default setting = yes
`Network connection`	Optimized TCP/IP + Modbus parameters for selected network connections. The parameters for the network connections are in the parameters for **`[PRE] Interface parameter / Network connection`**.	Permitted range = • LAN (MODBUS default) • WAN • LAN (fast dropout detection) • LAN (serial converter 1) • LAN (serial converter 2) • freely definable Default setting = LAN (Modbus default)
`Polling Delay`	Delay time between two Modbus request messages. Some Modbus devices only allow a limited number of queries within a specified time. The Modbus TCP master ("Client") sends a new interrogation or a new message to a Modbus substation only after the expiry of the set time.	Permitted range = 0 to 10 s Default setting = 0

Parameter Name	Description	Settings
`Redundancy`	Determination of whether the Modbus TCP slave device ("Server") supports multiple TCP connections for communication with redundant Modbus TCP masters ("Clients"). Note: This parameter is only effective, if on the protocol element for Modbus TCP master (client) the parameter is set to **`[PRE] Redundancy | Operation if passive`**= ***`acc. "Redundancy" in station definition`***.	Permitted range = • redundant connections • not redundant connections default setting = redundant connections
`[PRE] MODBUS | Communication functions | Query cycle time`		
`Query cycle time-1`	The Modbus TCP master can query data in a parameterizable cycle time. The query cycle time is assigned to the data point when parameterizing the data point.	Permitted range = 10 to 3600 s Default setting = 10 s
`Query cycle time-2`	The Modbus TCP master can query data in a parameterizable cycle time. The query cycle time is assigned to the data point when parameterizing the data point.	Permitted range = 10 to 3600 s Default setting = 20 s
`Query cycle time-3`	The Modbus TCP master can query data in a parameterizable cycle time. The query cycle time is assigned to the data point when parameterizing the data point.	Permitted range = 10 to 3600 s Default setting = 30 s
`Query cycle time-4`	The Modbus TCP master can query data in a parameterizable cycle time. The query cycle time is assigned to the data point when parameterizing the data point.	Permitted range = 10 to 3600 s Default setting = 60 s
`[PRE] MODBUS | Communication functions | Max. number Register/Coils per request`		
`Function code 1 (Read Coil Status)`	Maximum number of Modbus coils in a Modbus TCP request.	Permitted range = 1 to 127 Default setting = 127
`Function code 2 (Read Input Status)`	Maximum number of Modbus coils in a Modbus TCP request.	Permitted range = 1 to 127 Default setting = 127
`Function code 3 (Read Holding Registers)`	Maximum number of Modbus register in a Modbus TCP request.	Permitted range = 1 to 125 Default setting = 125
`Function code 4 (Read Input Register)`	Maximum number of Modbus register in a Modbus TCP request.	Permitted range = 1 to 125 Default setting = 125
`[PRE] MODBUS | Communication functions | Command transmission | Command output time`		
`Commands without identifier (sek)`	Command output time (pulse duration) for commands in transmit direction	Permitted range = 0.1 to 6553.5 s Default setting = 0.5 s

Parameter Name	Description	Settings
`Commands with short output time (sek)`	Command output time (pulse duration) for commands in transmit direction	Permitted range = 0.1 to 6553.5 s Default setting = 2 s
`Commands with long output time (sek)`	Command output time (pulse duration) for commands in transmit direction	Permitted range = 0.1 to 6553.5 s Default setting = 10 s

Parameter Name	Description	Settings
[PRE] Data base management Settings for the data base management on BSE (per PRE) see *13.1.4.14 Data Management on the BSE for Communication Protocols*.		
[PRE] Redundancy		
Operation if passive	Behavior of the protocol element in the redundancy state "passive": • ***Stop Modbus (TCP acive)***: – The Modbus TCP communication is stopped - the TCP connection remains established • ***acc. "Redundancy" in station definition***: – TCP connections to Modbus devices that support redundant connections remain established – TCP connections to Modbus devices that only support not redundant connections are terminated – The Modbus TCP master continues to send Modbus requests to the slaves that support redundant connections – Received messages are passed on to the BSE and marked with R = 1 by the BSE • ***Normal operation (Call operation)***: – Same behavior as in redundancy state "active" – SICAM A8000 as Modbus master continues to send Modbus requests to the slaves. – Received messages are passed on to the BSE and marked with R = 1 by the BSE The redundancy control (active/passive) takes place via the internal redundancy control message.	Permitted range = • stop Modbus (TCP active) • acc. "Redundancy" in station definition • normal operation (polling mode) Default setting =

Parameter Name	Description	Settings
`Delay connection setup`	Delay time for the establishment of all non-redundant TCP connections after redundancy switch from passive →active. Note: This parameter is only effective if`Operation if passive`= *`acc. "Redundancy" in station definition`*.	Permitted range = • 3 to 127 s • 0 (= 5 s) Default setting = 0
`[PRE] Advanced parameters | Software test points`		
`...`	The software test points may only be used under the guidance of experts for error detection! Once the fault isolation is completed, software checkpoints must always be turned off.	Permitted range = • yes • no Default setting = no

13.8.6.2 Modbus TCP Slave

Parameter Name	Description	Settings
`[PRE] Interface parameter` Note: • The serial interface for the protocol is selected in the SICAM Device Manager under`Configuration | Firmware`(see *13.1.4.4 Selection of an Ethernet Interface for Communication Protocols*). • Some parameters may not be displayed until the interface is selected.		
`[PRE] Interface parameter | Network connecton | ... | MODBUS Parameter` • LAN (MODBUS default) • WAN • LAN (fast dropout detection) • freely definable		
`Monitoring timeout`	If the Modbus TCP slave ("Server") is not called by the Modbus TCP master ("Client") within the call monitoring time, a failure of the interface is signaled in the Modbus TCP slave device.	Permitted range = 1 to 255 s Default setting = | 30 | 30 | 10 | 30 | s
`Transmission delay`	The parameterized pause is observed before a Modbus response is sent. This allows the polling speed of the master to be slowed down.	Permitted range = 0 to 10 ms Default setting = | 5 | 5 | 5 | 5 | ms
`[PRE] Station definition (Connection definition) | Station definition`		
`Device`	This line of the station definition applies to the following devices when redundancy is used. Note: This parameter is only displayed if redundancy is enabled.	Permitted range = • A .. Device A • B .. Device B • A + B .. Device A + B Default setting A + B

Parameter Name	Description	Settings
`MODBUS Station (internal)`	SICAM A8000 internal station number per server in the remote station. The Modbus TCP slave ("Server") firmware in SICAM A8000 supports up to 100 Modbus TCP servers. A unique station number must be assigned to each server. SICAM A8000 internally the same station number is used for diagnosis and data routing.	Permitted range = 0 to 99 255 (= not used) Default setting = 255
`Station enable`	Selective remote stations can be prepared or deactivated with setting ***`no`***. Data to "prepared" stations are fetched by the PRE and discarded without an error message (data is not transferred).	Permitted range = • yes • no Default setting = yes
`Station failure`	If the TCP connection to a station ("Server") fails, the forwarding of the error message can be suppressed with station failure = ***`do not report`*** (may be required for special redundancy configura-tions).	Permitted range = • notify • suppress Default setting = notify
`Remote IP address`	IP address of the Modbus TCP master ("Client") per server in the IPV4 format. The Modbus TCP slave device is addressed via the IP address. Note: The IP address of the own station is set on the BSE.	Permitted range = 0.0.0.0 to 255.255.255.254 Standard setting = 0.0 0.0
`TCP Port number`	TCP Port number for Modbus TCP Protocol.	Permitted range = 0 to 65535 Default setting = 0 (Modbus TCP Port 502)
`MODBUS unit-ID`	The Modbus unit ID is usually not used with Modbus TCP slaves. If the Modbus TCP master ("Client") nevertheless needs a unique Modbus unit ID for communication, this can be set if necessary.	Permitted range = • 1 to 247 • 255 (= not used) Default setting = 255

Parameter Name	Description	Settings
Addressing MODBUS standard	Addressing of the Modbus registers/coils during the transmission on the line: • Modbus Address from 0x0000 (Standard) • Modbus Address from 0x0001 Note: The addressing of the Modbus registers is implemented differently depending on manufacturer and must be looked up in the device descriptions! Some manufacturers also specify the Modbus register address on the line in the address list!	Permitted range = • yes • no Default setting = yes
Network connection	Optimized TCP/IP + Modbus parameters for selected network connections. The parameters for the network connections are in the parameters for **[PRE] Interface parameter / Network connection**.	Permitted range = • LAN (MODBUS default) • WAN • LAN (fast dropout detection) • free defineable Default setting = LAN (MODBUS default)
MODBUS-exception code 4	In the case of disturbed values in the sending direction with NT=1 or IV=1, the query can be answered with exception code = 4 (SLAVE DEVICE ERROR) instead of the value-specific identification of disturbed values (last valid status, disturbed value, NAN, ...).	Permitted range = • yes • no Default setting = yes
[PRE] MODBUS | Communication functions | Initialisation		
Startup Delay	When the BSE is restarted (from Ready), Modbus communication from the Modbus TCP slave ("Server") is only started after the start-up delay has expired. During the startup delay, the process image for Modbus on the protocol element is updated.	Permitted range = 10 to 65535 s Default setting = 10 s
[PRE] MODBUS | Communication functions | Command transmission | Command output time		
Commands without identifier (sek)	Command output time for commands in receive direction Note: The command output time is assigned to the selective commands in the signal definition.	Permitted range = 0.1 to 6553.5 s Default setting = 0.5 s

<table>
<tr><th>Parameter Name</th><th>Description</th><th>Settings</th></tr>
<tr><td><code>Commands with short output time (sek)</code></td><td>Command output time for commands in receive direction
Note:
The command output time is assigned to the selective commands in the signal definition.</td><td>Permitted range = 0.1 to 6553.5 s
Default setting = 2 s</td></tr>
<tr><td><code>Commands with long output time (sek)</code></td><td>Command output time for commands in receive direction
Note:
The command output time is assigned to the selective commands in the signal definition.</td><td>Permitted range = 0.1 to 6553.5 s
Default setting = 10 s</td></tr>
<tr><td colspan="3"><code>[PRE] Redundancy</code></td></tr>
<tr><td><code>Operation if passive</code></td><td>Behavior of the protocol element in the redundancy state “passive”. <code>Interface "active", normal mode:</code> Same behavior as in redundancy state “= active” Received messages are passed on to the BSE and marked with R = 1 by the BSE Modbus requests from the Modbus master are answered <code>Interface "standby"</code> Received messages are not processed and discarded Modbus interrogation messages are not answered The call timeout is retriggered Datapoints in transmit direction are forwarded by the BSE (provided that the BSE has been parameterized accordingly) to the PRE (otherwise discarded) and actively processed as in the case of redundancy The redundancy control (active/passive) takes place via the internal redundancy control message (refer to Parameter <code>[PRE] Redundancy | Ethernet port if passive</code>).</td><td>Permitted range = interface “active”, normal operation: interface “standby” Default = interface “active”, normal operation</td></tr>
</table>

Parameter Name	Description	Settings
`Delay time passive ⇒ active`	After redundancy switchover from passive → active, the Modbus communication is only started by the Modbus TCP slave ("Server") after the delay time has elapsed.	Permitted range = 0 to 2000 s 0 = no delay Default setting = 1 s
`Ethernet-port if passive`	State of the Ethernet port in redundancy state "passive": • ***`enable`***: – Same State as in redundancy state "active" • ***`power down`***: – Link LED does not light up – Modbus communication is deactivated In the event of a power down, the status of the Ethernet port is as if the Ethernet cable was disconnected • ***`blocked`***: – Link LED lights up – Modbus communication is deactivated	Permitted range = • enable • power down • blocked Default setting = enable
`[PRE] Data base management` Settings for the data base management on BSE (per PRE) see *13.1.4.14 Data Management on the BSE for Communication Protocols*.		
`[PRE] Advanced parameters | Software test points`		
`...`	The software test points may only be used under the guidance of experts for error detection! Once the fault isolation is completed, software checkpoints must always be turned off.	Permitted range = • yes • no Default setting = no

13.8.7 Redundancy

To increase availability, devices (control center, substation) can be designed redundantly. In this section, the possible redundancy concepts themselves that can be realized are not described, rather only those functions supported by the protocol for the support of redundant communication routes.

The redundancy control is implemented on the basic system element and is controlled by system functions or a user program.

The function with redundancy is determined by different parameters.

Redundancy	MBCII0	MBSII0
Protocol redundancy		
Operation if passive Normal operation (Call operation)	✓	✓
Operation if passive: Stopp Modbus (TCP active)	✓	✓
Behavior with passive: according to "redundancy" in the station definition	–	✓

Redundancy	MBCII0	MBSII0
Listening mode (for global/selective station failure handling)	–	–
Listening mode (for Data)	–	–
Device redundancy		
Device redundancy with the same PRE parameters	✓	✓
Device Redundancy with different PRE-Parameter (“A/B-Parameter”)	–	–
Device Redundancy with different PRE-Parameter (“A/B-Parameter”) for signals	✓	✓

13.8.8 Protocol Element Control and Return Information

13.8.8.1 Protocol element control messages

Protocol element control messages can control protocol element internal functions. On the basic system element, IEC 60870-5-101/104 *messages with process information in the control direction* are converted to protocol element control messages and transmitted to the selected protocol element (see *13.1.4.10 Protocol Element Control Messages*).

Supported Protocol element control functions

SF	Protocol element control function `Control_function_(PRE)`	MBCII0 [Client]	MBSII0 [Server]
0	Interface “activate” (Ethernet interface activate): (Ethernet-Port = Active) • Warning: Interface “deactivated” is reset	–	✓
1	Interface “deactivate” (Ethernet interface deactivate): (Ethernet-Port = Power Down) • Any pending communication failures are reset • Warning: Interface “deactivated” is reported	–	✓
2	Ethernet-Port = Forward Non Blocking • Data transmission activated • Link LED lights up	–	✓
3	Ethernet-Port = Forward Blocking • Data transmission blocked • Link LED lights up	–	✓
95	Link up information (for Modbus TCP redundancy) [336]	✓	–
96	Link down information (for Modbus TCP redundancy) [336]	✓	–
240	Send (General)-interrogation command (CASDU=All) [337]	✓	✓
242	Set control location	✓	–
244	Send (General)-interrogation command (CASDU = selective) [337]	✓	✓

13.8.8.2 Protocol Element Return Information

Protocol element return information is internal status information of the protocol elements which is transmitted spontaneously and in the event of a general interrogation with internal message formats from the protocol element to the basic system element. On the basic system element, the protocol element return information items (see *13.1.4.11 Protocol Element Return Information*) are converted to IEC 60870-5-101/104 *messages with process information in monitoring direction*.

336 With this control function, only the status of the link is reported to the PRE (the link is not controlled by PRE)

337 This function is processed on the BSE

Supported Protocol Element Return Information

Protocol element return information `Return information function_(PRE)`	Station	MBCII0 [Client]	MBSII0 [Server]
• Station status	0 to 99	✓	✓
• Station failure	0 to 99	✓	✓

13.8.9 Web server

A web server for internal diagnostic and statistical information is integrated in the protocol firmware. The web server itself is implemented on the basic system element - the protocol-specific web pages are provided by the protocol element.

System	Firmware	Designation	Protocol-specific web pages
CP-8031, CP-8050	MBCII0	Modbus TCP Master (Client)	✓
	MBSII0	Modbus TCP Slave (Server)	✓

Enable/disable web server or start web server via SICAM Device Manager or web browser see *13.1.4.12 Web server for protocol-specific web pages*.

Supported protocol-specific web pages

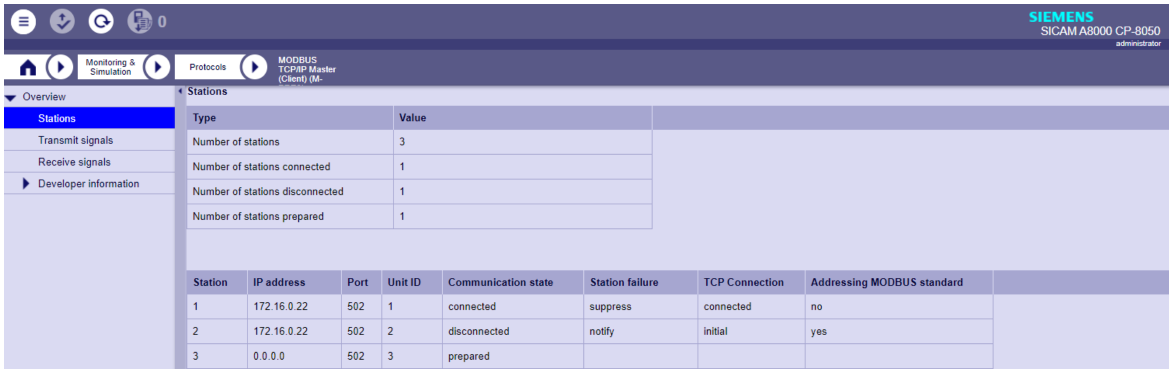
Web page	Modbus TCP Master (Client) [MBCII0]	Modbus TCP Slave (Server) [MBSII0]
Overview[338]	✓	✓
Stations	✓	✓
Transmit signals	✓	✓
Receive signals	✓	✓
Developer Information[338]		
Datastream trace[338]	✓	✓
Ethernet capture[338]	✓	✓
Diagnosis (IDR)[338]	✓	✓
Statistics (IDE)[338]	✓	✓
User diagnosis (IDU)[338]	✓	✓

13.8.9.1 Protocol specific web page: Stations

With web page **Stations** detailed information about the status of the connection to each connected station will be displayed.

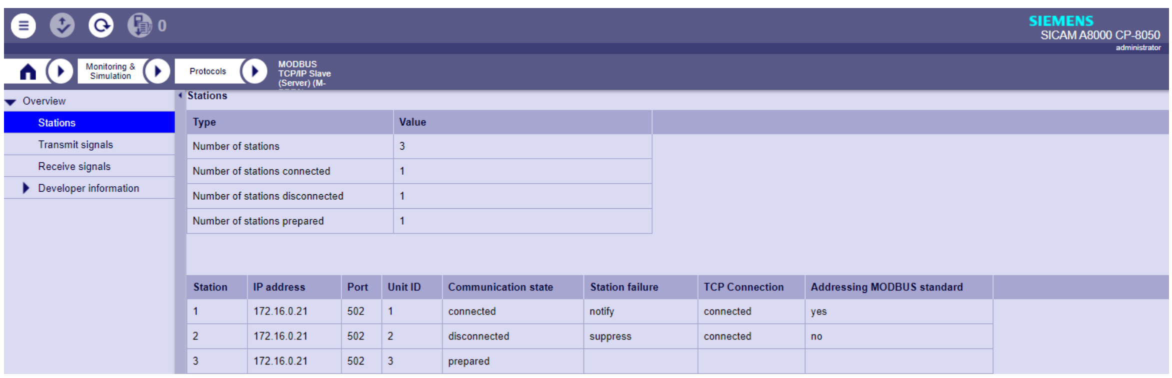
Modbus TCP Master “Client” (MBCII0):

338 See *13.1.4.12 Web server for protocol-specific web pages*



[MBCli0_WEB_Stations, 1, --_--]

Modbus TCP Slave “Server” (MBSII0):



[MBSII0_WEB_Stations, 1, --_--]

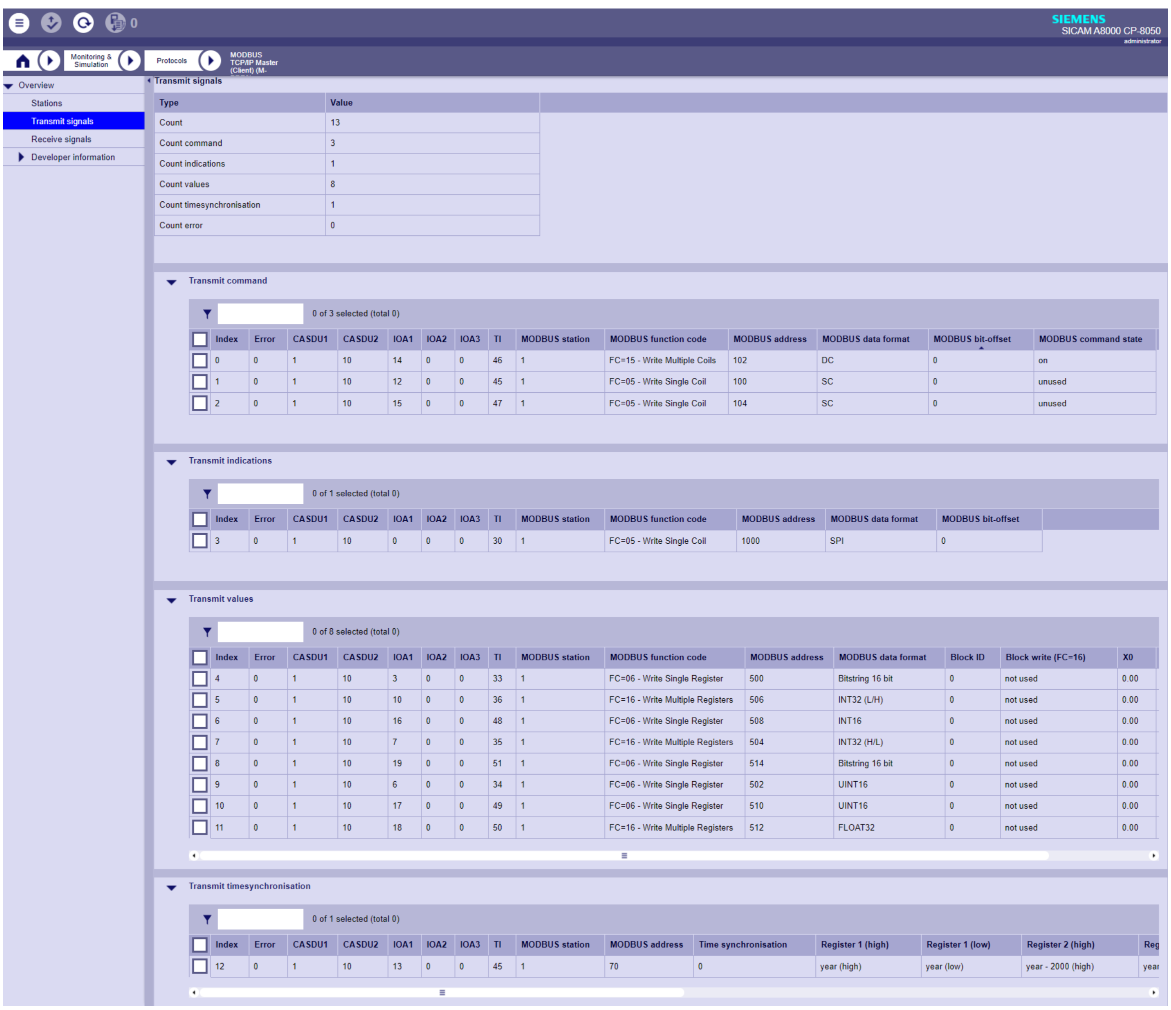
Field	Note
Number of stations	Number of parameterized stations
Number of stations connected	Number of established connections to stations
Number of stations disconnected	Number of cleared connections to stations
Number of stations prepared	Number of prepared connections to stations
Station	Internal station number for this connection
IP address	IP address ot the Modbus TCP server
Port	TCP port number for Modbus TCP
Unit ID	Modbus Unit ID
Communication state	State of the connection to this station • connected • disconnected • prepared
Station failure	report station failure • notify • suppress

Field	Note
TCP connection	State of the TCP connection • connected • initial
Addressing Modbus standard	Addressing of the Modbus Register-/Coils according Modbus Standard: • yes • no

13.8.9.2 Protocol specific web page: Transmit signals

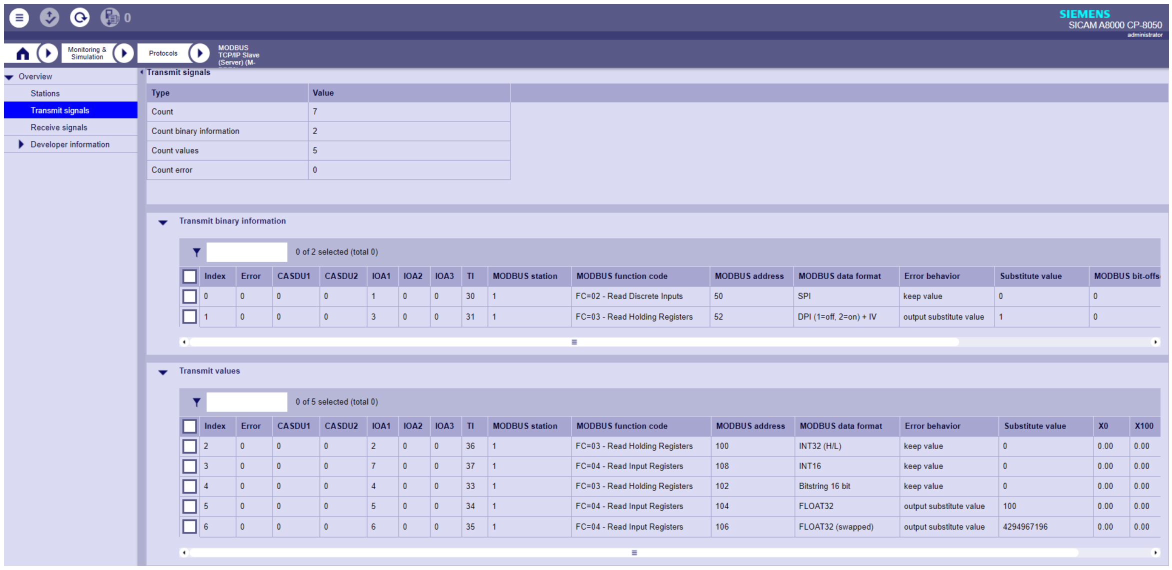
The **Transmit signals** web page displays information of the parameterized and by the protocol processed signals in transmit direction.

Modbus TCP Master "Client" (MBCII0):



[MBCII0_WEB_Transmit_Signals, 1, --_--]

Modbus TCP Slave “Server” (MBSII0):



[MBSII0_WEB_Transmit_signals, 1, --_--]

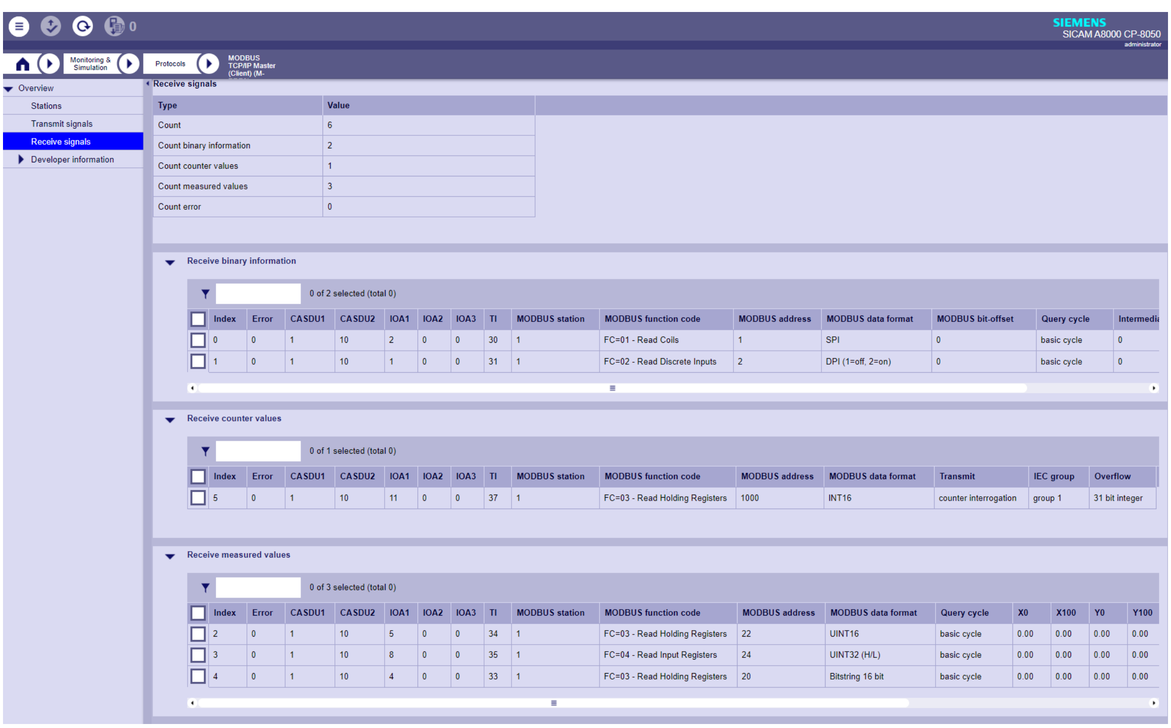
Field	Note
Count	Number of parameterized data points in transmit direction (total number for all stations)
Count command	Number of parameterized data points for “Commands” in transmission direction (total for all stations)
Count indications Count binary indications	Number of parameterized data points for “binary information” in transmit direction (total for all stations)
Count values	Number of parameterized data points for “values” in transmission direction (total for all stations)
Count timesynchronization	Number of parameterized data points for “time synchronization” in transmission direction (total for all stations)
Count error	Number of faulty parameterized data points in transmit direction (total number for all stations)
Transmit command	Parameterized data points for “commands” in transmit direction (total for all stations)
Transmit indications **Transmit binary information**	Parameterized data points for “indications/binary information” in transmit direction (total for all stations)
Transmit values	Parameterized data points for “values” in transmit direction (total for all stations)
Transmit timesynchronisation	Parameterized data points for “time synchronization” in transmit direction (total for all stations)
Index	Internal index in the detailed routing of the message conversion
Error	Error number (the last detected error is displayed in the diagnostic)
CASDU1, CASDU2 IOA1, IOA2, IOA3	Internal IEC 60870-5-101/104 address of the data point
TI	Internal IEC 60870-5-101/104 type identification
Modbus station	Modbus station address
Modbus function code	Modbus function code
Modbus address	Modbus register- or coil-address
Modbus bit-offset	Modbus bit position for the value in Modbus register

Field	Note
Modbus data format	Modbus Data Format
Modbus command state	Modbus command state
Block-ID	Block ID for Block Write with Modbus function code FC = 16
Block write (FC = 16)	Trigger for Block Write with Modbus function code FC = 16
X0	X_0% for value adaptation
X100	X_100% for value adaptation
Y0	Y_0% for value adaptation
Y100	Y_100% for value adaptation
Transient_storage	Transient storage for binary information
Error behaviour	Selection of which value is transferred to Modbus if the internal value is faulty.
Substitute value	Substitute_value
Time synchronization	Trigger for transmitting the time synchronization
Register 1 (high)	Selected time element for time synchronization in the register
Register 1 (low)	Selected time element for time synchronization in the register
:	:
Register n (high)	Selected time element for time synchronization in the register
Register n (low)	Selected time element for time synchronization in the register

13.8.9.3 Protocol specific web page: Receive signals

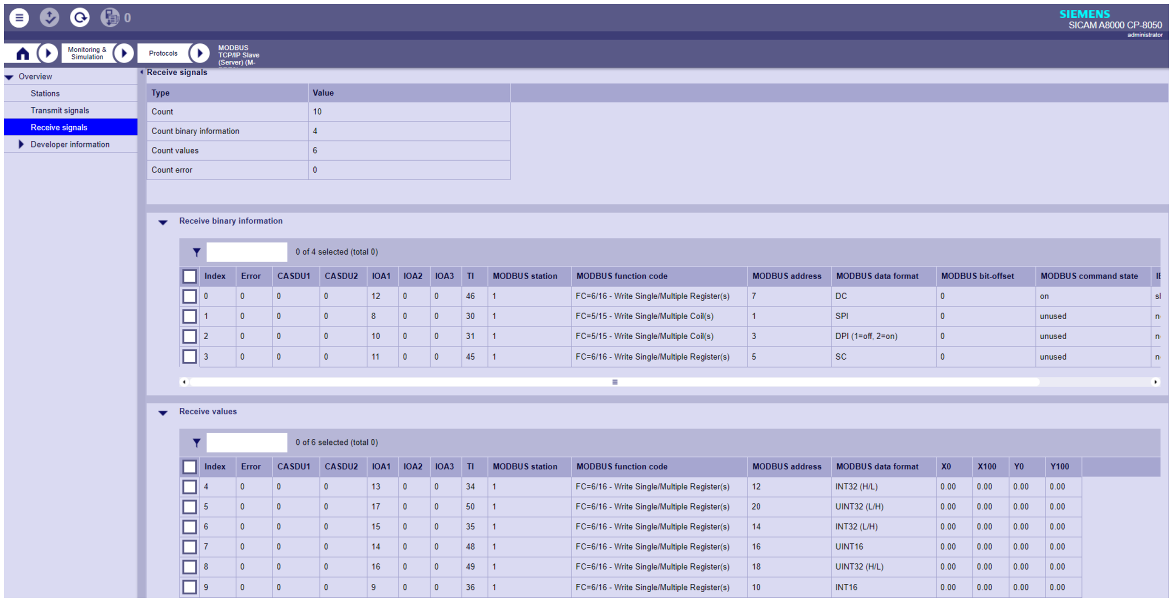
The **Receive signals** web page displays information of the parameterized and by the protocol processed signals in receive direction.

Modbus TCP Master “Client” (MBCII0):



[MBCII0_WEB_Receive_Signals, 1, --_--]

Modbus TCP Slave “Server” (MBSII0):



[MBSII0_WEB_Receive_Signals, 1, --_--]

Field	Note
Count	Number of parameterized data points in receive direction (total number for all stations)
Count binary indications	Number of parameterized data points for “binary information” in receive direction (total for all stations)
Count values	Number of parameterized data points for “values” in receive direction (total for all stations)
Count counter values	Number of parameterized data points for “integrated totals” in receive direction (total for all stations)
Count measured values	Number of parameterized data points for “measured values” in receive direction (total for all stations)
Count error	Number of faulty parameterized data points in receive direction (total number for all stations)
Receive binary information	Parameterized data points for “binary information” in receive direction (total for all stations)
Receive counter values	Parameterized data points for “integrated totals” in receive direction (total for all stations)
Receive measured values	Parameterized data points for “measured values” in receive direction (total for all stations)
Index	Internal index in the detailed routing of the message conversion
Error	Error number (the last detected error is displayed in the diagnostic)
CASDU1, CASDU2 IOA1, IOA2, IOA3	Internal IEC 60870-5-101/104 address of the data point
TI	Internal IEC 60870-5-101/104 type identification
Modbus station	Modbus station address
Modbus function code	Modbus function code
Modbus address	Modbus register- or coil-address
Modbus data format	Modbus Data Format
Modbus bit-offset	Modbus bit position for the value in Modbus register

Field	Note
Query cycle	Query cycle for Modbus data
Intermediate pos t	Intermediate position suppression time for double-point information
Faulty pos t	Suppression time for faulty state for double-point information
Transmit	Transmission time of the integrated total
IEC group	IEC 60870-5-101/104 counter group
Overflow	Value format for counter overflow
X0	X_0% for value adaptation
X100	X_100% for value adaptation
Y0	Y_0% for value adaptation
Y100	Y_100% for value adaptation
Threshold unconditioned	Unconditioned threshold for change monitoring
Threshold additive	Additive threshold for change monitoring
Thresh unit	Unit for threshold

13.8.10 Message Conversion

Data in transmit direction are transferred from the basic system element to the protocol element in SICAM A8000 internal IEC 60870-5-101/104 (without 101/104 blocking) format. The data formats are converted to the Modbus TCP line format on the protocol element. The transmission of the data according to Modbus TCP is controlled by the protocol element.

Data in receive direction is converted by the protocol element from the Modbus TCP format to a SICAM A8000 internal IEC 60870-5-101/104 format and transferred to the basic system element (no 101/104 blocking). The transmission of the data according to Modbus TCP is controlled by the protocol element.

The conversion of the SICAM A8000 internal IEC 60870-5-101/104 message format ↔ Modbus TCP data format and the conversion of the address information are called message conversion.

The parameterization of the conversion from IEC 60870-5-101/104 ↔ Modbus TCP (address and message format) is to be done with the SICAM Device Manager with function “Signals” or with the SICAM TOOLBOX II, OPM II using “SIP Message Address Conversion”.

Supported processing types for message conversion

Data	Direction	Processing type	Master	Slave
Binary information	Receive direction	firmware / **`Rec_binary_information`**	✓	✓
Commands	Receive direction	firmware / **`Rec_binary_information`**	–	✓
Measured values Setpoint values	Receive direction	firmware / **`Rec_value`**	–	✓
Measured values	Receive direction	firmware / **`Rec_measured_value`**	✓	–
Integrated totals	Receive direction	firmware / **`Rec_counter_value`**	✓	–
Binary information Commands	Transmit direction	firmware / **`Trans_binary_information`**	–	✓
Commands	Transmit direction	firmware / **`Trans_command`**	✓	–
Message	Transmit direction	firmware / **`Trans_binary_information`**	✓	–
Measured values	Transmit direction	firmware / **`Trans_value e`**	✓	✓
Setpoint values	Transmit direction	firmware / **`Trans_value e`**	✓	–
Bitstring	Transmit direction	firmware / **`Trans_value`**	✓	✓
Integrated totals	Transmit direction	firmware / **`Trans_value`**	–	✓
Time synchronization	Transmit direction	firmware / **`Trans_timesynchronisation`**	✓	–

General description of the parameters and properties (valid for each type of processing)

Parameter	
`MODBUS_Station`	Address of the Modbus Slave (SICAM A8000 internal): 0 to 99 Note: • This Modbus station number is only used internally by SICAM A8000 for message conversion and internal system functions. This Modbus station number is not transmitted on the line! • With Modbus TCP the Modbus station will be addressed by the IP address (Unit ID = 255). • If a substation with Modbus serial interface is connected via a Device Server (cnverter "Modbus serial ↔ Modbus TCP"), the UNIT-ID is transmitted as Modbus slave address. • The unit ID must be individually parameterized for each connection in the connection definition parameters of the Modbus TCP master.
`MODBUS_address`	Modbus Address (Coil- or Register Address): 1 to 65534 (65535) Note: • The Modbus address (= coil or register address) which is specified in the device descriptions in the Register Map is always parameterized. • According to the Modbus standard, the Modbus register address on the line is always transmitted with offset –1. Example: parameterized Modbus register address = 0001 → Modbus register address = 0000 on the line • Some device manufacturers do not always adhere to the standard on this point and require "parameterized Modbus address" = "Modbus address on the line". In the parameters of the connection definition the Modbus addressing on the line per Modbus station can be set. – Addressing Modbus Standard = yes (default) – Addressing Modbus Standard = no

13.8.10.1 Message Conversion in Transmit Direction – Modbus TCP Master ("Client")

Message conversion in transmit direction: IEC 60870-5-101/104 → Modbus TCP

SICAM A8000: IEC 60870-5-101/104 →		Modbus TCP format	
TI	**Designation**	**FC**	**Data format**
<TI:=30>	Single-point information with time tag CP56Time2a	05, 06, 15, 16	SPI
<TI:=33>	Bitstring of 32 bits with time tag CP56Time2a	06, 16	Bitstring 16-bit
<TI:=34>	Measured value, normalized value with time tag CP56Time2a	06	INT16, UINT16
		16	INT16, INT32 (H/L), INT32 (L/H), UINT16, UINT32 (H/L), UINT32 (L/H), FLOAT32, FLOAT32 (swapped), FLOAT32 (little endian)
<TI:=35>	Measured value, scaled value with time tag CP56Time2a	06	INT16, UINT16
		16	INT16, INT32 (H/L), INT32 (L/H), UINT16, UINT32 (H/L), UINT32 (L/H), FLOAT32, FLOAT32 (swapped), FLOAT32 (little endian)

SICAM A8000: IEC 60870-5-101/104 →		Modbus TCP format	
<TI:=36>	Measured value, floating-point number with time tag CP56Time2a	06	INT16, UINT16
		16	INT16, INT32 (H/L), INT32 (L/H), UINT16, UINT32 (H/L), UINT32 (L/H), FLOAT32, FLOAT32 (swapped), FLOAT32 (little endian)
<TI:=45>	Single command	05, 06, 15, 16	SC, SC (pulse)
<TI:=46>	Double command	05, 06, 15, 16	DC, DC (pulse), SC
<TI:=47>	Regulating step command	05, 06, 15, 16	DC, DC (pulse), SC
<TI:=48>	Setpoint command, normalized value	06	INT16, UINT16
		16	INT16, INT32 (H/L), INT32 (L/H), UINT16, UINT32 (H/L), UINT32 (L/H), FLOAT32, FLOAT32 (swapped), FLOAT32 (little endian)
<TI:=49>	Setpoint command, scaled value	06	INT16, UINT16
		16	INT16, INT32 (H/L), INT32 (L/H), UINT16, UINT32 (H/L), UINT32 (L/H), FLOAT32, FLOAT32 (swapped), FLOAT32 (little endian)
<TI:=50>	Setpoint command, short floating-point number	06	INT16, UINT16
		16	INT16, INT32 (H/L), INT32 (L/H), UINT16, UINT32 (H/L), UINT32 (L/H), FLOAT32, FLOAT32 (swapped), FLOAT32 (little endian)
<TI:=51>	Bitstring 32-bit	06, 16	Bitstring 16-bit
<TI=:100>	(General-)Interrogation command [339]		-
<TI:=101>	Counter interrogation command		-
<TI:=45>	Single command "Time synchronization"		DTx

Modbus Function Codes (FC):

05 .. Write Single Coil

06 .. Write Single Register

15 .. Write Multiple Coils

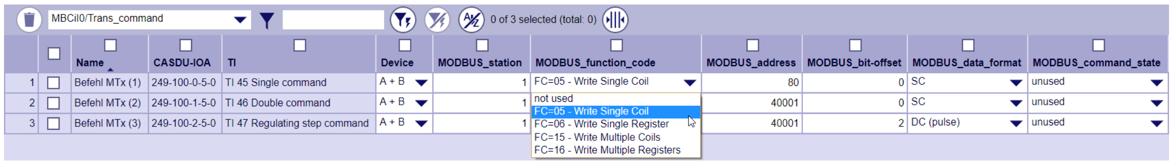
16 .. Write Multiple Registers

Commands

The parameterization of the address and message conversion for commands from Modbus TCP Master ("Client") in transmit direction is to be done with the SICAM Device Manager with the function "Signals" or with the SICAM TOOLBOX II, OPM II.

339 The Modbus protocol defines no general interrogation; with SICAM A8000 internal general interrogation the data requested by the central station are forwarded to the basic system element during the next interrogation with the cause of transmission COT = 20 (interrogated by station interrogation).

Processing type: *firmware* / `Trans_command`



[MBCil0_DM_Sende_Befehl, 2, en_US]

Parameter	
`TI`	Supported type identifications: • <TI:=45> .. Single command • <TI:=46> .. Double command • <TI:=47> .. Regulating step command
`Name`	Name of the signal
`CASDU-IOA`	SICAM A8000 internal IEC 60870-5-101/104 message address (CASDU1, CASDU2, IOA1, IOA2, IOA3)
`MODBUS_Station`	Address of the Modbus Slave (SICAM A8000 internal): • 0 to 99
`MODBUS_function_code`	Supported Modbus function codes: • FC = 05 .. Write Single Coil • FC = 06 .. Write Single Register [340] • FC = 15 .. Write Multiple Coils • FC = 16 .. Write Multiple Register [340]
`MODBUS_address`	Modbus Address (Register or Coil address): • 1 to 65535 (single command; double command with FC = 06, 16) • 1 to 65534 (double command with FC = 05, 15) The bits of a double command are always next to each other.
`MODBUS_bit-offset`	Bit number in the corresponding Modbus register: • 0 .. Single command, double command [with FC = 05, 15] • 0 to 15 .. Single command [only FC = 06, 16] • 0 to 14 .. Double command [only FC = 06, 16] Double commands use 2 contiguous bits in the same Modbus register. With the Modbus Bit-Offset always the 1. bit of the double command specified.

340 Only 1 data point is supported per Modbus register!

Parameter	
MODBUS_data_format	Data format on the Modbus: • SC .. Single command • DC .. Double command [only FC = 15; 06, 16] • SC (pulse) .. Single command pulse • DC (pulse) .. Double command pulse
MODBUS_command_state	Modbus command state: <only double commands> • OFF • ON On the parameterized Modbus_address / Modbus_bit-offset the selected Modbus_command_state is output (possible inversion of the command output) Not used with single commands!

NOTE

With function code FC = 06 (WRITE SINGLE REGISTER) and function code FC = 16 (WRITE MULTIPLE REGISTERS), only 1 data point is supported per Modbus register!

Supported Data Formats

Format	Modbus data format	IEC 60870-5-101/104 data format (TI)
SC	Single command	45, 46, 47
DC	Double command	46, 47
SC (pulse)	Single command pulse	45
DC (pulse)	Double command pulse	46, 47

NOTE

Since the Modbus protocol does not define how the data is represented in the coils/registers, the Modbus format must be specified for the message conversion. Supported Modbus data formats see *13.8.12 Modbus Data Formats*.

Control Location / Check Control Location

The function “Control location” is used so that commands are only output from authorized sources. If the function is activated, commands from the protocol element are only transmitted to the remote station, when the control location (originator address) is enabled.

If the control location is not enabled, the protocol element immediately sends back a negative acknowledgment of activation (ACTCON) to the originator address (further details about control location see section *13.1.4.9 Control location function for commands and setpoint values*).

Command Output Time for Single-/Double Commands

Commands can be transmitted on the Modbus as pulses (1 or 2 bits). The protocol element maps the command output as a pulse to 1 or 2 bits in the Modbus register or 1 or 2 coil addresses of the Modbus slave with the associated command output time.

The command output time (duration of the pulse) is set for commands with qualifier of command = <0> “no additional definition” on protocol element with the parameter **[PRE] MODBUS | Communication func-**

tions | Command transmission | Command pulse duration | Command with no addt'l def. (sec).

The command output time (duration of the pulse) is set for commands with qualifier of command = <1> "short pulse duration" on protocol element with the parameter **[PRE] MODBUS | Communication functions | Command transmission | Command pulse duration | Command with short pulse duration (sec).**

The command output time (duration of the pulse) is set for commands with qualifier of command = <2> "long pulse duration" on protocol element with the parameter **[PRE] MODBUS | Communication functions | Command transmission | Command pulse duration | Command with long pulse duration (sec).**

Max. 10 commands as pulse command (single-, double commands) executed at the same time will be supported.

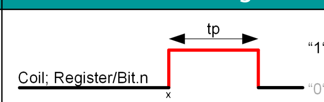
Single Command SC

A single command with the status SCS = ON or SCS = OFF is transmitted on the Modbus with the current status.

Modbus data format	Command state	Command output 1 bit as coil or 1 bit in Modbus register
SC	SCS = ON	 x ... command = ON
	SCS = OFF	 x ... command = OFF

Single Command SC (Pulse)

A single command with command state SCS = ON will be output on the Modbus as pulse with parametrized command output time.

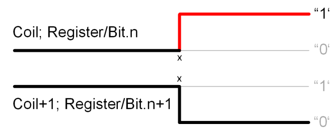
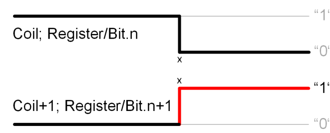
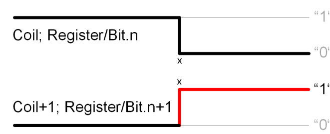
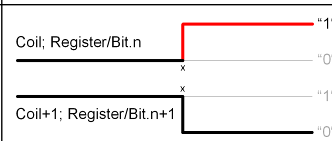
Modbus data format	Command state	Command output 1 bit as coil or 1 bit in Modbus register
SC (pulse)	SCS = ON	 tp ... command output time (pulse duration) x ... command = ON
	SCS = OFF	The OFF state is not evaluated!

If a further command with the same IEC 60870-5-101/104 address is initiated during command output in progress, this one will be discarded with a negative confirmation to the BSE (ACTCON-).

The current pulse output of the command is not affected.

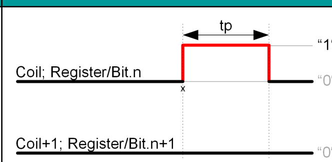
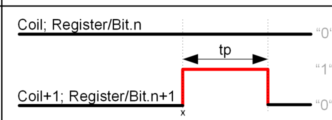
Double Command DC

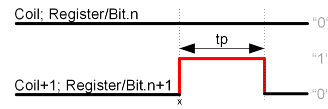
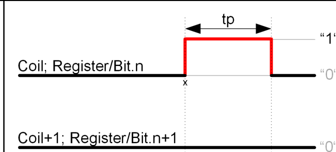
A double command or regulating step command with the status DCS = ON/OFF or RCS = HIGHER/LOWER is output as a state on the Modbus.

Modbus data format	Command state	Command output 2 bit as coil or 2 bit in Modbus register
DC Modbus_command_state = ON	DCS = ON RCS = HIGHER	 x ... command = ON
	DCS = OFF RCS = LOWER	 x ... command = OFF
DC Modbus_command_state = OFF	DCS = ON RCS = HIGHER	 x ... command = ON
	DCS = OFF RCS = LOWER	 x ... command = OFF

Double Command DC (Pulse)

A double command or regulating step command with the status DCS = ON/OFF or RCS = HIGHER/LOWER is output on the Modbus as pulse with the set command output time.

Modbus data format	Command state	Command output 2 bit as coil or 2 bit in Modbus register
DC (pulse) Modbus_command_state = ON	DCS = ON RCS = HIGHER	 tp ... command output time (pulse duration) x ... command = ON
DC (pulse) Modbus_command_state = ON	DCS = OFF RCS = LOWER	 tp ... command output time (pulse duration) x ... command = OFF

Modbus data format	Command state	Command output 2 bit as coil or 2 bit in Modbus register
DC (pulse) Modbus_command_state = OFF	DCS = ON RCS = HIGHER	 tp ... command output time (pulse duration) x ... command = ON
DC (pulse) Modbus_command_state = OFF	DCS = OFF RCS = LOWER	 tp ... command output time (pulse duration) x ... command = OFF

If a further command with the same IEC 60870-5-101/104 address is initiated during command output in progress, this one will be discarded with a negative confirmation to the BSE (ACTCON-).
The current pulse output of the command is not affected.

Message Conversion

The table describes the evaluated elements of the IEC 60870-5-101/104 message during message conversion.

Elements of the message		
TI .. Type identification		• <TI:=45> .. Single command • <TI:=46> .. Double command • <TI:=47> .. Regulating step command
CASDU, IOA .. Message address		Parameter-settable
Cause of transmission		
06 .. Activation		BSE→PRE: evaluated an the PRE (only "activation" accepted)
07 .. Confirmation of activation		PRE→BSE:
08 .. Abortion of activation		BSE→PRE: not supported. Is confirmed negative (ACTCON-)
09 .. Confirmation of the abortion of activation		PRE→BSE: Abortion of the activation is confirmed negative (ACTCON-)
10 .. Activation termination		Not supported
xx .. Other COTs		Not accepted / not supported
T .. Test		Not supported
Information		
SCO/DCO/RCO		
SCS	Single command state	[only <TI:=45>]
	0 .. OFF	Is evaluated (only relevant for single command)
	1 .. ON	Evaluated
DCS	Double command state	[only <TI:=46>]
	0 .. Not allowed	Not supported
	1 .. OFF	Evaluated
	2 .. ON	Evaluated
	3 .. Not allowed	Not supported

Elements of the message		
RCS	Regulating step command state	[only <TI:=47>]
	0 .. Not allowed	Not supported
	1 .. Next step lower	Evaluated
	2 .. Next step higher	Evaluated
	3 .. Not allowed	Not supported
QOC	S/E	
	0 = Execute	Is checked for "execute"
	1 = Select	Not supported; is confirmed negative (ACTCON-)
QU	Command qualifier	
	0 .. No additional definitions	Evaluated
	1 .. Short pulse duration	Evaluated
	2 .. Long pulse duration	Evaluated
	3 .. Persistent command	Not supported

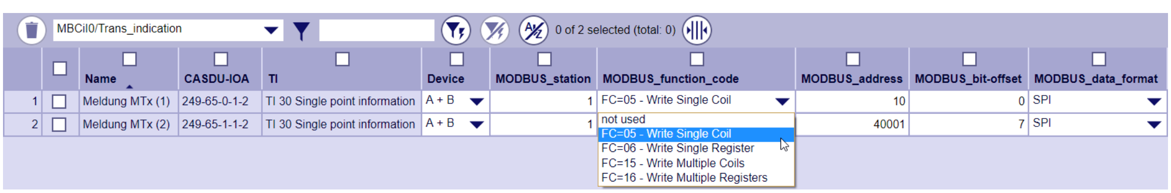
NOTE

Not listed elements of the IEC 60870-5-101/104 message are not rated/not supported!

Binary Information

The parameterization of the address and message conversion for binary information from Modbus TCP Master ("Client") in transmit direction is to be done with the SICAM Device Manager with the function "Signals" or with the SICAM TOOLBOX II, OPM II.

Processing type: *firmware* / `Trans_binary_information`



[MBCil0_DM_Sende_Meldung, 2, en_US]

Parameter	
`TI`	Supported type identifications: • <TI:=30> .. Single-point information with time tag CP56Time2a
`Name`	Name of the signal
`CASDU-IOA`	SICAM A8000 internal IEC 60870-5-101/104 message address (CASDU1, CASDU2, IOA1, IOA2, IOA3)
`MODBUS_Station`	Address of the Modbus Slave (SICAM A8000 internal): • 0 to 99

Parameter	
`MODBUS_function_code`	Supported Modbus function codes: • FC = 05 .. Write Single Coil • FC = 06 .. Write Single Register [341] • FC = 15 .. Write Multiple Coils • FC = 16 .. Write Multiple Register [341]
`MODBUS_address`	Modbus Address (Register of Coil address): • 1 to 65535
`MODBUS_bit-offset`	Bit number in the corresponding Modbus register: • 0 .. Single command [only FC = 05, 15] • 0 to 15 .. Single command [only FC = 06, 16]
`MODBUS_data_format`	Data format on the Modbus: • SPI .. Single-point information

NOTE

With function code FC = 06 (WRITE SINGLE REGISTER) and function code FC = 16 (WRITE MULTIPLE REGISTERS), only 1 data point is supported per Modbus register!
Binary information items are only transmitted by the Modbus master if NT = 0 and IV = 0.

Supported Data Formats

Format	Modbus data format	IEC 60870-5-101/104 data format (TI)
SPI	Single-point information	30

NOTE

Since the Modbus protocol does not define how the data is represented in the coils/registers, the Modbus format must be specified for the message conversion. Supported Modbus data formats see *13.8.12 Modbus Data Formats*.

Message Conversion

The table describes the evaluated elements of the IEC 60870-5-101/104 message during message conversion.

Elements of the message	
TI .. Type identification	• <TI:=30> .. Single-point information with time tag CP56Time2a
CASDU, IOA .. Message address	Parameter-settable
QDS .. Quality descriptor	
BL .. Blocked	Not evaluated
SB .. Substituted	Not evaluated
NT .. Not topical	NT = 1: Binary information is not transmitted!

341 Only 1 data point is supported per Modbus register!

Elements of the message		
IV .. Invalid		IV = 1: Binary information is not transmitted!
Cause of transmission		
xx ..		Not rated
T .. Test		Not evaluated
Information		
Single-point information status		
SPI	0 .. OFF	Evaluated
	1 .. ON	Evaluated
Time tag		
CP56Time2a .. Date + time		Not rated

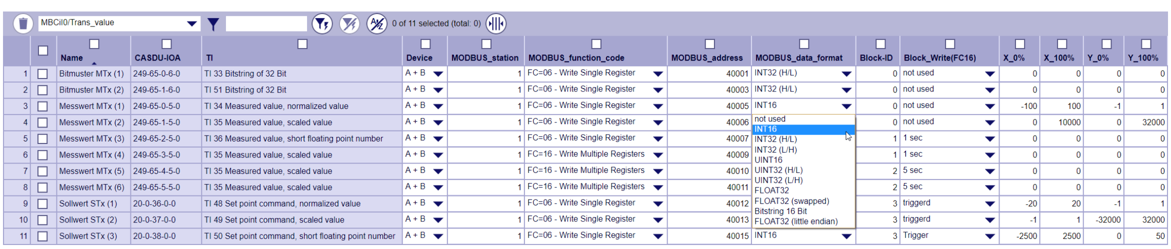
NOTE

Not listed elements of the IEC 60870-5-101/104 message are not rated / not supported!

Measured Values, Setpoint Values, Bitstrings

The parameterization of the address and message conversion for measured values, setpoint values, bitstrings from Modbus TCP Master ("Client") in transmit direction is to be done with the SICAM Device Manager with the function "Signals" or with the SICAM TOOLBOX II, OPM II.

Processing type: *firmware* | **`Trans_value`**



MBCiI0/Trans_value   0 of 11 selected (total: 0)

	Name	CASDU-IOA	TI	Device	MODBUS_station	MODBUS_function_code	MODBUS_address	MODBUS_data_format	Block-ID	Block_Write(FC16)	X_0%	X_100%	Y_0%	Y_100%
1	Bitmuster MTx (1)	249-65-0-6-0	TI 33 Bitstring of 32 Bit	A + B	1	FC=06 - Write Single Register	40001	INT32 (H/L)	0	not used	0	0	0	0
2	Bitmuster MTx (2)	249-65-1-6-0	TI 51 Bitstring of 32 Bit	A + B	1	FC=06 - Write Single Register	40003	INT32 (H/L)	0	not used	0	0	0	0
3	Messwert MTx (1)	249-65-0-5-0	TI 34 Measured value, normalized value	A + B	1	FC=06 - Write Single Register	40005	INT16	0	not used	-100	100	-1	1
4	Messwert MTx (2)	249-65-1-5-0	TI 35 Measured value, scaled value	A + B	1	FC=06 - Write Single Register	40006		0	not used	0	10000	0	32000
5	Messwert MTx (3)	249-65-2-5-0	TI 36 Measured value, short floating point number	A + B	1	FC=06 - Write Single Register	40007		1	1 sec	0	0	0	0
6	Messwert MTx (4)	249-65-3-5-0	TI 35 Measured value, scaled value	A + B	1	FC=16 - Write Multiple Registers	40009		1	1 sec	0	0	0	0
7	Messwert MTx (5)	249-65-4-5-0	TI 35 Measured value, scaled value	A + B	1	FC=16 - Write Multiple Registers	40010		2	5 sec	0	0	0	0
8	Messwert MTx (6)	249-65-5-5-0	TI 35 Measured value, scaled value	A + B	1	FC=16 - Write Multiple Registers	40011		2	5 sec	0	0	0	0
9	Sollwert STx (1)	20-0-36-0-0	TI 48 Set point command, normalized value	A + B	1	FC=06 - Write Single Register	40012		3	triggerd	-20	20	-1	1
10	Sollwert STx (2)	20-0-37-0-0	TI 49 Set point command, scaled value	A + B	1	FC=06 - Write Single Register	40013		3	triggerd	-1	1	-32000	32000
11	Sollwert STx (3)	20-0-38-0-0	TI 50 Set point command, short floating point number	A + B	1	FC=06 - Write Single Register	40015	INT16	3	Trigger	-2500	2500	0	50

[MBCiI0_DM_Sende_Wert, 2, en_US]

Parameter	
`TI`	Supported type identifications: • <TI:=33> .. Bitstring of 32 bits with time tag CP56Time2a • <TI:=34> .. Measured value, normalized value with time tag CP56Time2a • <TI:=35> .. Measured value, scaled value with time tag CP56Time2a • <TI:=36> .. Measured value, short floating-point number with time tag CP56Time2a • <TI:=48> .. Setpoint command, normalized value • <TI:=49> .. Setpoint command, scaled value • <TI:=50> .. Setpoint command, short floating-point number • <TI:=51> .. Bitstring 32-bit
`Name`	Name of the signal
`CASDU-IOA`	SICAM A8000 internal IEC 60870-5-101/104 message address (CASDU1, CASDU2, IOA1, IOA2, IOA3)

Parameter	
`MODBUS_Station`	Address of the Modbus Slave (SICAM A8000 internal): • 0 to 99
`MODBUS_func-tion_code`	Supported Modbus function codes: • FC = 06 .. WRITE SINGLE REGISTER • FC = 16 .. WRITE MULTIPLE REGISTERS
`MODBUS_address`	Modbus address (register address): • 1 to 65535
`MODBUS_data_format`	Data format on the Modbus: • INT16 • INT32 (H/L) [only FC = 16] • INT32 (L/H) [only FC = 16] • UINT16 • UINT32 (H/L) [only FC = 16] • UINT32 (L/H) [only FC = 16] • FLOAT32 [only FC = 16] • FLOAT32 (swapped) [only FC = 16] • FLOAT32 (little endian) [only FC = 16] • Bitstring 16-bit
`Block-ID`	Group of values that are sent with WRITE MULTIPLE REGISTERS (FC = 16) in a Modbus message (blocked transmission): • 0 .. Not used [= spontaneous transmission - only 1 value] • 1 to 250 .. **`Block-ID`** for blocked transmission Values with the same **`Block-ID`** are sent in a Modbus message with WRITE MULTIPLE REGISTERS (FC = 16).
`Block_Write(FC16)`	Transmission method for values that are sent with WRITE MULTIPLE REGISTERS (FC = 16) in a Modbus message (blocked transmission): • not used • Triggered • Trigger • 300, 400, 500, 600, 700, 800, 900 ms 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 15, 20, 30, 60 s
`X_0%, X_100%` **`Y_0%, Y_100%`**	Parameters for value adaptation (scaling): • Valid range of value for X_0% and X_100% see *13.8.12 Modbus Data Formats* • <TI:=34, 48> .. Y_0% and Y_100% must not be greater or less than ±1 • <TI:=35, 49> .. Y_0% and Y_100% must not be less than −32768 or greater than +32767. • Value adaptation inactive at Y_0% = 0 and Y_100% = 0

NOTE

Measured values/setpoint values/bitstrings are only transmitted by the Modbus TCP master if NT = 0 and IV = 0.

Supported Data Formats

Format	Modbus data format	IEC 60870-5-101/104 data format (TI)
INT16	Signed integer 16-bit	34, 35, 36, 48, 49, 50
INT32 (H/L)	Signed integer 32-bit (HIGH before LOW)	34, 35, 36, 48, 49, 50
INT32 (L/H)	Signed integer 32-bit (LOW before HIGH)	34, 35, 36, 48, 49, 50
UINT16	Unsigned integer 16-bit	34, 35, 36, 48, 49, 50
UINT32 (H/L)	Unsigned integer 16-bit (HIGH before LOW)	34, 35, 36, 48, 49, 50
UINT32 (L/H)	Unsigned integer 32-bit (LOW before HIGH)	34, 35, 36, 48, 49, 50
FLOAT32	Short floating-point (IEEE 754)	34, 35, 36, 48, 49, 50
FLOAT32 (swapped)	Short floating-point (IEEE 754) “swapped”	34, 35, 36, 48, 49, 50
FLOAT32 (little endian)	Short floating-point (IEEE 754) “little endian”	34, 35, 36, 48, 49, 50
Bitstring 16-bit	Bitstring of 16 bits	33, 51

NOTE

Since the Modbus protocol does not define how the data is represented in the coils/registers, the Modbus format must be specified for the message conversion. Supported Modbus data formats see *13.8.12 Modbus Data Formats*.

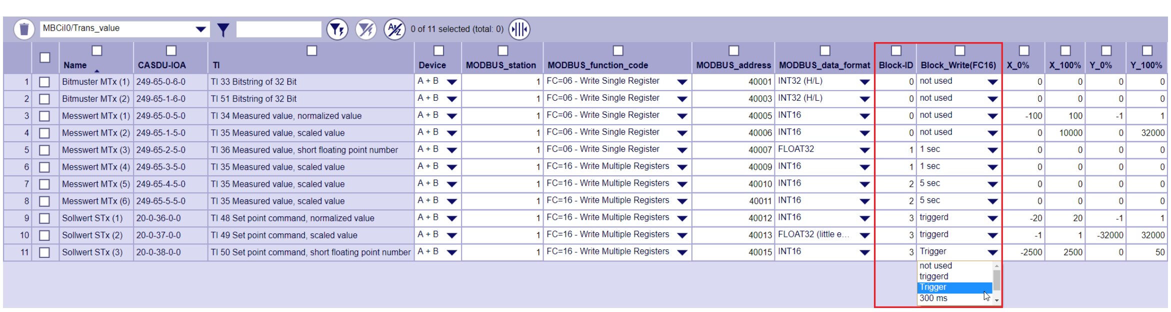
Control Location / Check Control Location

The function “Control location” is used so that setpoint values are only output from authorized sources. If the function is activated, setpoint commands from the protocol element are only transmitted to the remote station, when the control location (originator address) is enabled.

If the control location is not enabled, the protocol element immediately sends back a negative acknowledgment of activation (ACTCON) to the originator address (further details about control location see section *13.1.4.9 Control location function for commands and setpoint values*).

Blocked transmission of values in a Modbus message (WRITE MULTIPLE REGISTERS FC = 16)

With WRITE MULTIPLE REGISTERS (FC = 16) several values can be transmitted in one Modbus message. The values that are to be sent in blocks are stored in the PRE in a process image in the transmit direction and are only sent at the specified transmission time.


MBCil0/Trans_value   0 of 11 selected (total: 0)

	Name	CASDU-IOA	TI	Device	MODBUS_station	MODBUS_function_code	MODBUS_address	MODBUS_data_format	Block-ID	Block_Write(FC16)	X_0%	X_100%	Y_0%	Y_100%
1	Bitmuster MTx (1)	249-65-0-6-0	TI 33 Bitstring of 32 Bit	A + B	1	FC=06 - Write Single Register	40001	INT32 (H/L)	0	not used	0	0	0	0
2	Bitmuster MTx (2)	249-65-1-6-0	TI 51 Bitstring of 32 Bit	A + B	1	FC=06 - Write Single Register	40003	INT32 (H/L)	0	not used	0	0	0	0
3	Messwert MTx (1)	249-65-0-5-0	TI 34 Measured value, normalized value	A + B	1	FC=06 - Write Single Register	40005	INT16	0	not used	-100	100	-1	1
4	Messwert MTx (2)	249-65-1-5-0	TI 35 Measured value, scaled value	A + B	1	FC=06 - Write Single Register	40006	INT16	0	not used	0	10000	0	32000
5	Messwert MTx (3)	249-65-2-5-0	TI 36 Measured value, short floating point number	A + B	1	FC=06 - Write Single Register	40007	FLOAT32	1	1 sec	0	0	0	0
6	Messwert MTx (4)	249-65-3-5-0	TI 35 Measured value, scaled value	A + B	1	FC=16 - Write Multiple Registers	40009	INT16	1	1 sec	0	0	0	0
7	Messwert MTx (5)	249-65-4-5-0	TI 35 Measured value, scaled value	A + B	1	FC=16 - Write Multiple Registers	40010	INT16	2	5 sec	0	0	0	0
8	Messwert MTx (6)	249-65-5-5-0	TI 35 Measured value, scaled value	A + B	1	FC=16 - Write Multiple Registers	40011	INT16	2	5 sec	0	0	0	0
9	Sollwert STx (1)	20-0-36-0-0	TI 48 Set point command, normalized value	A + B	1	FC=16 - Write Multiple Registers	40012	INT16	3	triggerd	-20	20	-1	1
10	Sollwert STx (2)	20-0-37-0-0	TI 49 Set point command, scaled value	A + B	1	FC=16 - Write Multiple Registers	40013	FLOAT32 (little e…	3	triggerd	-1	1	-32000	32000
11	Sollwert STx (3)	20-0-38-0-0	TI 50 Set point command, short floating point number	A + B	1	FC=16 - Write Multiple Registers	40015	INT16	3	Trigger	-2500	2500	0	50

[MBCil0_DM_Sende_Wert_FC16, 3, en_US]

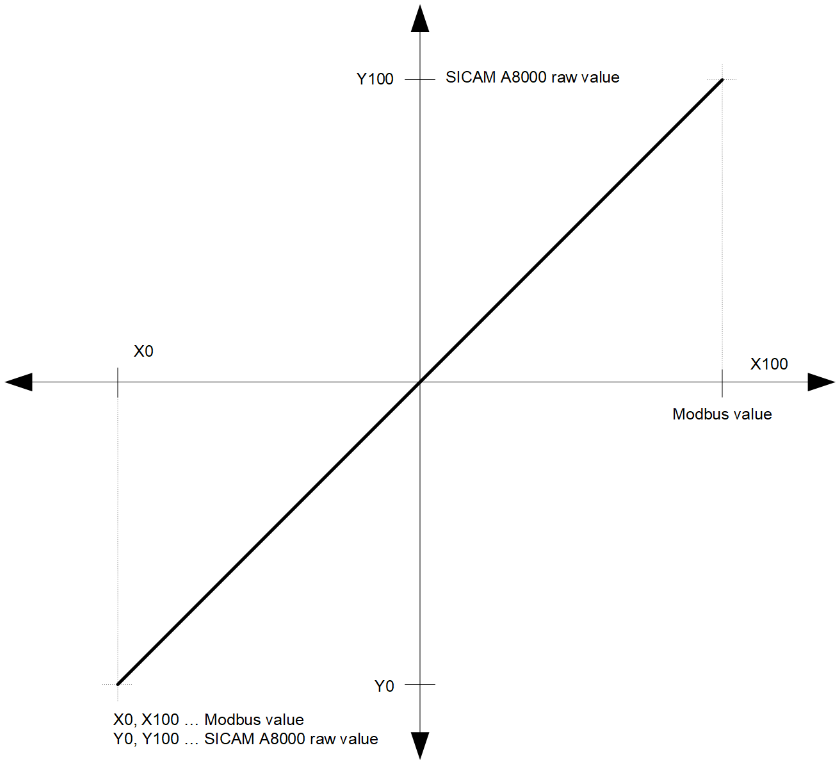
- The blocked transmission of values with FC = 16 (WRITE MULTIPLE REGISTERS) is only started if all values of a **`Block-ID`** have been updated and converted correctly after a restart, redundancy switchover or after an interface failure (with measured values and bitstrings, NT and IV must be 0). The update identifier is reset in the event of a restart, redundancy switchover or interface failure.
- For setpoints <TI:=48, 49, 50> and bitstrings with <TI:=51>, ACTCON- is emulated if an error occurred during the conversion of the values or the control location (if used) is not released. ACTCON+ is simulated when the conversion of the values has been carried out without errors, the control location (if used) is released and the value has been entered in the process image in the transmit direction.
- The **`Block-ID`** may only be used once per Modbus address area for all stations. No spontaneous transmission (**`Block-ID`** = 0) and no further **`Block-ID`** may be used in this address area.
- Gaps in the Modbus address area (“Gaps”) are transmitted with the value 0.
- The blocked transmission takes place after trigger for transmission in the Modbus standard polling procedure.
- The maximum number of Modbus registers (“Quantity”) for blocked transmission is limited to 125 registers (according to Modbus standard).
- For each Modbus slave (server), several Modbus address areas can be parameterized for blocked transmission.

<u>Moment of transmission for blocked transmission:</u>

- Cyclic
  Values with the same **`Block-ID`** are transmitted cyclically in the set time grid **`Block_Write(FC16)`**.
  Time grid: 300, 400, 500, 600, 700, 800, 900 ms
  1, 2, 3, 4, 5, 6, 7, 8 ,9, 10, 15, 20, 30, 60 s
  – When all values with the same **`Block-ID`** in the process image have been updated in the transmit direction, the blocked emission is stimulated and the timer for the cyclical emission is started.
  – The time grid for the transmission time is not synchronized with the time of the basic system element.
  – The time grid of different **`Block-IDs`** is not synchronized with each other.
  – The values are transmitted from the process image with the current status at the time of transfer.
  → A consistent transmission of the values with cyclical transmission is not guaranteed!
- Triggered: Values with the same **`Block-ID`** and **`Block_Write(FC16)`** = "triggered" are saved in a process image and only stimulated for transmission with the value with **`Block_Write(FC16)`** = "Trigger".
  – If necessary, several values can be used as triggers.
  – A blocked transmission of consistent values of a **`Block-ID`** is only ensured if setpoint values with <TI:=48, 49, 50> or bitstrings <TI:=51> are used and the value is transferred at last with **`Block_Write(FC16)`** = "Trigger".

Value Adaptation[not for <TI:=33, 51>]

The value adaptation is defined by the parameters **`X_0%`**, **`X_100%`**, **`Y_0%`**, **`Y_100%`**.



The value adaptation is only performed if `Y_0%` or `Y_100%` ≠ *0* is parameterized.

- If adaptation is activated and the raw value of the SICAM A8000 is smaller than `Y_0%` or greater than `Y_100%`, then the value is limited on `X_0%` or `X_100%` and also transferred.
- If adaptation is not activated (= direct transfer, `Y_0%` = *0*, `Y_100%` = *0*) and the SICAM A8000 raw value is outside the value range of the selected Modbus TCP data format, then the message conversion is aborted and the error message *Error of format conversion in transmit direction* is set.

Message Conversion

The table describes the evaluated elements of the IEC 60870-5-101/104 message during message conversion.

Elements of the message	
TI .. Type identification	• <TI:=33> .. Bitstring of 32 bits with time tag CP56Time2a • <TI:=34> .. Measured value, normalized value with time tag CP56Time2a • <TI:=35> .. Measured value, scaled value with time tag CP56Time2a • <TI:=36> .. Measured value, short floating-point number with time tag CP56Time2a • <TI:=48> .. Setpoint command, normalized value • <TI:=49> .. Setpoint command, scaled value • <TI:=50> .. Setpoint command, short floating-point number • <TI:=51> .. Bitstring 32 bit
CASDU, IOA .. Message address	Parameter-settable
QDS .. Quality descriptor	
BL .. Blocked	Not evaluated
SB .. Substituted	Not evaluated
NT .. Not topical	NT = 1: Value is not transmitted!

Elements of the message		
IV .. Invalid		IV = 1: Value is not transmitted!
OV .. Overflow		Not evaluated
Cause of transmission		
06 .. Activation		Is evaluated (only “activation” allowed) [only <TI:=48, 49, 50, 51>]
07 .. Confirmation of activation		PRE→BSE:
08 .. Abortion of activation		BSE→PRE: not supported Is confirmed negative (ACTCON-)
09 .. Confirmation of the abortion of activation		PRE→BSE: Abortion of the activation is confirmed negative (ACTCON-)
10 .. Activation termination		Not supported
xx .. Other COTs		Not evaluated [only <TI:=33, 34, 35, 36, 37>]
T .. Test		Not evaluated
Information		
Value.. S .. Sign		• Normalized value • Scaled value • IEEE STD 754 = short floating-point number • Dual meter reading • Bitstring 32 bit Only bits 0 to 15 used. Bits 16 to 31 are not evaluated.
QOS	S/E	[only <TI:=48, 49, 50>]
	0 = Execute	Is checked for “execute”
	1 = Select	Not supported; is confirmed negative (ACTCON-)
Time tag		
CP56Time2a .. Date + time		Not evaluated

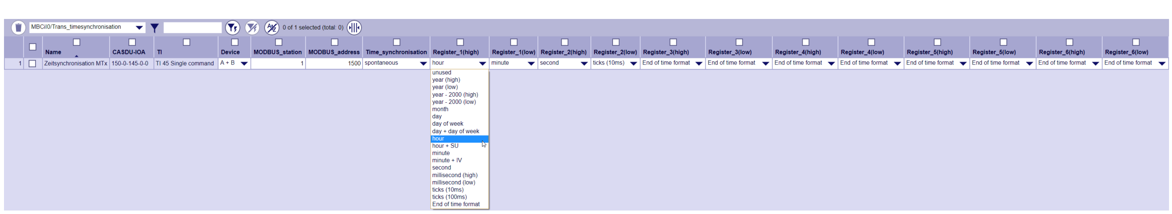
NOTE

Not listed elements of the IEC 60870-5-101/104 message are not rated/not supported!

Time Synchronization

The parameterization of the address and message conversion for time synchronization from Modbus TCP Master (“Client”) in transmit direction is to be done with the SICAM Device Manager with the function “Signals” or with the SICAM TOOLBOX II, OPM II.

Processing type: *firmware* / `Trans_timesynchronisation`



[MBCiI0_DM_Sende_Zeitsynchronisation, 2, en_US]

Parameter	
TI	Supported type identifications: • <TI:=45> .. Single command
Name	Name of the signal
CASDU-IOA	SICAM A8000 internal IEC 60870-5-101/104 message address (CASDU1, CASDU2, IOA1, IOA2, IOA3)
MODBUS_Station	Address of the Modbus Slave (SICAM A8000 internal): • 0 to 99 For each Modbus station, a different message format for time synchronization can be defined. The transmission of the Modbus time synchronization message always takes place station-selective.
MODBUS_address	Modbus address (register address): • 1 to 65535

Parameter	
`Time synchronization`	When will the time synchronization be performed: • Immediately spontaneous • Cyclically every 1st minute (offset = 0 s) • Cyclically every 1st minute (offset = 30 s) • Cyclically every 5th minute (offset = 0 s) • Cyclic every 10. minute (offset = 0 s) • Cyclic every 30. minute (offset = 0 s) • Cyclic every 60. minute (offset = 0 s) Spontaneous .. Transmission is spontaneously controlled by the single command <TI:=45> Offset = 0 s .. Transmission after minute change at 0th second Offset = 30 s .. Transmission after minute change at 30th second (for SICAM A8000 systems)
`Register_1 (high)` **`Register_1 (low)`** **`Register_2 (high)`** **`Register_2 (low)`** **`Register_3 (high)`** **`Register_3 (low)`** **`Register_4 (high)`** **`Register_4 (low)`** **`Register_5 (high)`** **`Register_5 (low)`** **`Register_6 (high)`** **`Register_6 (low)`**	Modbus time element: • Year (high) • Year (low) • Year - 2000 (high) • Year - 2000 (low) • Month • Day • Weekday • Day + day of week • Hour • Hour + SU • Minute • Minute + IV • Second • Millisecond (high) • Millisecond (low) • Ticks (10 ms) • Ticks (100 ms) • End of time format

NOTE

Details for “Modbus time element” see *13.8.12 Modbus Data Formats*. The freely definable Modbus time synchronization message is sent out excluding the end identifier. If the end identifier is in a Register_n (low), then this part of the Modbus register is transferred with the value "0".

Supported Data Formats

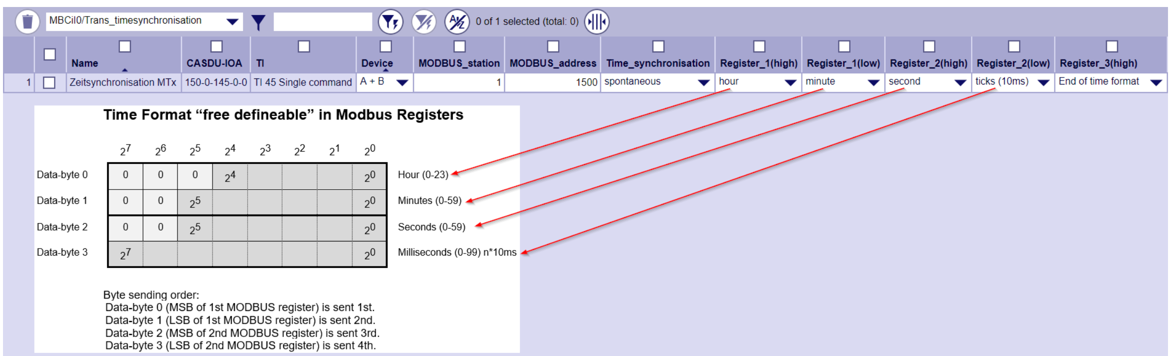
Format	Modbus data format	IEC 60870-5-101/104 data format (TI)
DTx	Date and time (freely definable)	45

NOTE

Since the Modbus protocol does not define how the data is represented in the coils/registers, the Modbus format must be specified for the message conversion. Supported Modbus data formats see *13.8.12 Modbus Data Formats*.

Free Definable Time Synchronization Format (Example)

Time synchronization controlled by <TI:= 45>, single command with the address CASDU=150, IOA=145 on the Modbus address 1500.



[MBCil0_DM_Modbus_Zeitformat, 1, en_US]

Message Conversion

The table describes the evaluated elements of the IEC 60870-5-101/104 message during message conversion.

Elements of the message		
TI .. Type identification		<TI:=45> .. Single command
CASDU, IOA .. Message address		Parameter-settable
Cause of transmission		
06 .. Activation		Is evaluated (only "activation" allowed)
xx .. Other COTs		Not accepted (only "activation" allowed)
T .. Test		Not supported
Information		
SCO		
SCS	Single command state	
	0 .. OFF	Not evaluated
	1 .. ON	Not evaluated
QOC	S/E	
	0 = Execute	Is checked for "execute"
	1 = Select	Not supported
QU	Command qualifier	
	0 .. No additional definitions	Evaluated
	1 .. Short pulse duration	Evaluated
	2 .. Long pulse duration	Evaluated
	3 .. Persistent command	Not supported

NOTE

Not listed elements of the IEC 60870-5-101/104 message are not rated/not supported!

13.8.10.2 Message Conversion in Receive Direction – Modbus TCP Master ("Client")

Message conversion in receive direction: IEC 60870-5-101/104 ← Modbus TCP

SICAM A8000: IEC 60870-5-101/104 ←		Modbus TCP format	
TI	**Designation**	**FC**	**Data format**
<TI:=30>	Single-point information with time tag CP56Time2a	01, 02, 03, 04	SPI
		03, 04	SPI + IV
<TI:=31>	Double-point information with time tag CP56Time2a	01, 02, 03, 04	DPI (1 = off, 2 = on) DPI (1 = on, 2 = off), SPI
		03, 04	DPI (1 = off, 2 = on) + IV DPI (1 = on, 2 = off) + IV
<TI:=33>	Bitstring of 32 bits with time tag CP56Time2a	03, 04	Bitstring 16-bit
<TI:=34>	Measured value, normalized value with time tag CP56Time2a	03, 04	INT16, INT16 + IV, INT32 (H/L), INT32 (L/H), UINT16, UINT16 + IV, UINT32 (H/L), UINT32 (L/H), FLOAT32, FLOAT32 (swapped), FLOAT32 (little endian)
<TI:=35>	Measured value, scaled value with time tag CP56Time2a	03, 04	INT16, INT16 + IV, INT32 (H/L), INT32 (L/H), UINT16, UINT16 + IV, UINT32 (H/L), UINT32 (L/H), FLOAT32, FLOAT32 (swapped), FLOAT32 (little endian)
<TI:=36>	Measured value, floating-point number with time tag CP56Time2a	03, 04	INT16, INT16 + IV, INT32 (H/L), INT32 (L/H), UINT16, UINT16 + IV, UINT32 (H/L), UINT32 (L/H), FLOAT32, FLOAT32 (swapped), FLOAT32 (little endian)
<TI:=37>	Integrated total with time tag CP56Time2a	03, 04	INT16, INT32 (H/L), INT32 (L/H), UINT16, UINT32 (H/L), UINT32 (L/H), FLOAT32, FLOAT32 (swapped), FLOAT32 (little endian)

Modbus Function Codes (FC):

01 .. Read Coils

02 .. Read Discrete Inputs

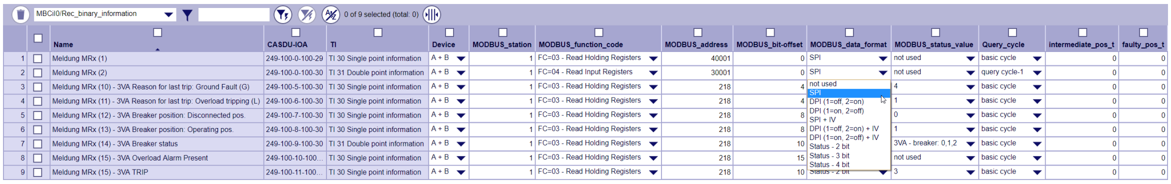
03 .. Read Holding Registers

04 .. Read Input Registers

Binary information

The parameterization of the address and message conversion for binary information from Modbus TCP Master ("Client") in receive direction is to be done with the SICAM Device Manager with the function "Signals" or with the SICAM TOOLBOX II, OPM II.

Processing type: *firmware* | `Rec_binary_information`



	Name	CASDU-IOA	TI	Device	MODBUS_station	MODBUS_function_code	MODBUS_address	MODBUS_bit-offset	MODBUS_data_format	MODBUS_status_value	Query_cycle	intermediate_pos_t	faulty_pos_t
1	Meldung MRx (1)	249-100-0-100-29	TI 30 Single point information	A + B	1	FC=03 - Read Holding Registers	40001	0	SPI	not used	basic cycle	0	0
2	Meldung MRx (2)	249-100-0-100-30	TI 31 Double point information	A + B	1	FC=04 - Read Input Registers	30001	0	SPI	not used	query cycle-1	0	0
3	Meldung MRx (10) - 3VA Reason for last trip: Ground Fault (G)	249-100-5-100-30	TI 30 Single point information	A + B	1	FC=03 - Read Holding Registers	218	4		4	basic cycle	0	0
4	Meldung MRx (11) - 3VA Reason for last trip: Overload tripping (L)	249-100-6-100-30	TI 30 Single point information	A + B	1	FC=03 - Read Holding Registers	218	4		1	basic cycle	0	0
5	Meldung MRx (12) - 3VA Breaker position: Disconnected pos.	249-100-7-100-30	TI 30 Single point information	A + B	1	FC=03 - Read Holding Registers	218	8		0	basic cycle	0	0
6	Meldung MRx (13) - 3VA Breaker position: Operating pos.	249-100-8-100-30	TI 30 Single point information	A + B	1	FC=03 - Read Holding Registers	218	8		1	basic cycle	0	0
7	Meldung MRx (14) - 3VA Breaker status	249-100-9-100-30	TI 31 Double point information	A + B	1	FC=03 - Read Holding Registers	218	10		3VA - breaker: 0,1,2	basic cycle	0	0
8	Meldung MRx (15) - 3VA Overload Alarm Present	249-100-10-100...	TI 30 Single point information	A + B	1	FC=03 - Read Holding Registers	218	15		not used	basic cycle	0	0
9	Meldung MRx (15) - 3VA TRIP	249-100-11-100...	TI 30 Single point information	A + B	1	FC=03 - Read Holding Registers	218	10		3	basic cycle	0	0

[MBCiI0_DM_Empf_Binäre_Information, 2, en_US]

<table>
<tr><th colspan="2">Parameter</th></tr>
<tr><td><code>TI</code></td><td>Supported type identifications:
<TI:=30> .. Single-point information with time tag CP56Time2a
<TI:=31> .. Double-point information with time tag CP56Time2a</td></tr>
<tr><td><code>Name</code></td><td>Name of the signal</td></tr>
<tr><td><code>CASDU-IOA</code></td><td>SICAM A8000 internal IEC 60870-5-101/104 message address (CASDU1, CASDU2, IOA1, IOA2, IOA3)</td></tr>
<tr><td><code>MODBUS_Station</code></td><td>Address of the Modbus Slave (SICAM A8000 internal):
0 to 99</td></tr>
<tr><td><code>MODBUS_func-tion_code</code></td><td>Supported Modbus function codes:
FC = 01 .. Read Coils
FC = 02 .. Read Discrete Inputs
FC = 03 .. Read Holding Registers
FC = 04 .. Read Input Registers</td></tr>
<tr><td><code>MODBUS_address</code></td><td>Modbus address (register address):
1 to 65535
1 to 65534 [only for double-point information with FC = 01, 02]
The bits of a double-point information are always next to each other.</td></tr>
<tr><td><code>MODBUS_bit-offset</code></td><td>Bit number in the corresponding Modbus register:
0 to 15 ... Single-point information [only FC = 03, 04]
0 to 14 ... Double-point information [only FC = 03, 04]
0 to 14 ... Single-point information + IV [only FC = 03, 04]
0 to 13 ... Double-point information + IV [only FC = 03, 04]
Both bits of a double-point information must always be in the same Modbus register!
With the Modbus bit offset always the 1st bit of the double-point information is specified.</td></tr>
<tr><td><code>MODBUS_data_format</code></td><td>Data format on the Modbus:
SPI
DPI (1 = off, 2 = on)
DPI (1 = on, 2 = off)
SPI + IV
DPI (1 = off, 2 = on) + IV
DPI (1 = on, 2 = off) + IV</td></tr>
</table>

Parameter	
`Query_cycle`	Query cycle: • Basic cycle • Query cycle 1 • Query cycle 2 • Query cycle 3 • Query cycle 4 Basic cycle: continuous query of all parameterized data. Query cycle 1 to 4: Query of the parameterized data in the adjustable time grid. The time grid for query cycles 1 to 4 can be parameterized.
`int_posit_t`	Intermediate position suppression time • 0 to 255 s
`Faulty_pos_t`	Faulty position suppression time: • 0 to 255 s

Supported Data Formats

Format	Modbus data format	IEC 60870-5-101/104 data format (TI)
SPI	Single-point information	30, 31
SPI + IV	Single-point information + invalid identifier	30
DPI (1 = off, 2 = on)	Double-point information (OFF before ON)	31
DPI (1=on, 2=off)	Double-point information (ON before OFF)	31
DPI (1 = off, 2 = on) + IV	Double-point information (OFF before ON) + "invalid" identifier	31
DPI (1 = on, 2 = off) + IV	Double-point information (ON before OFF) + “invalid” identifier	31

NOTE

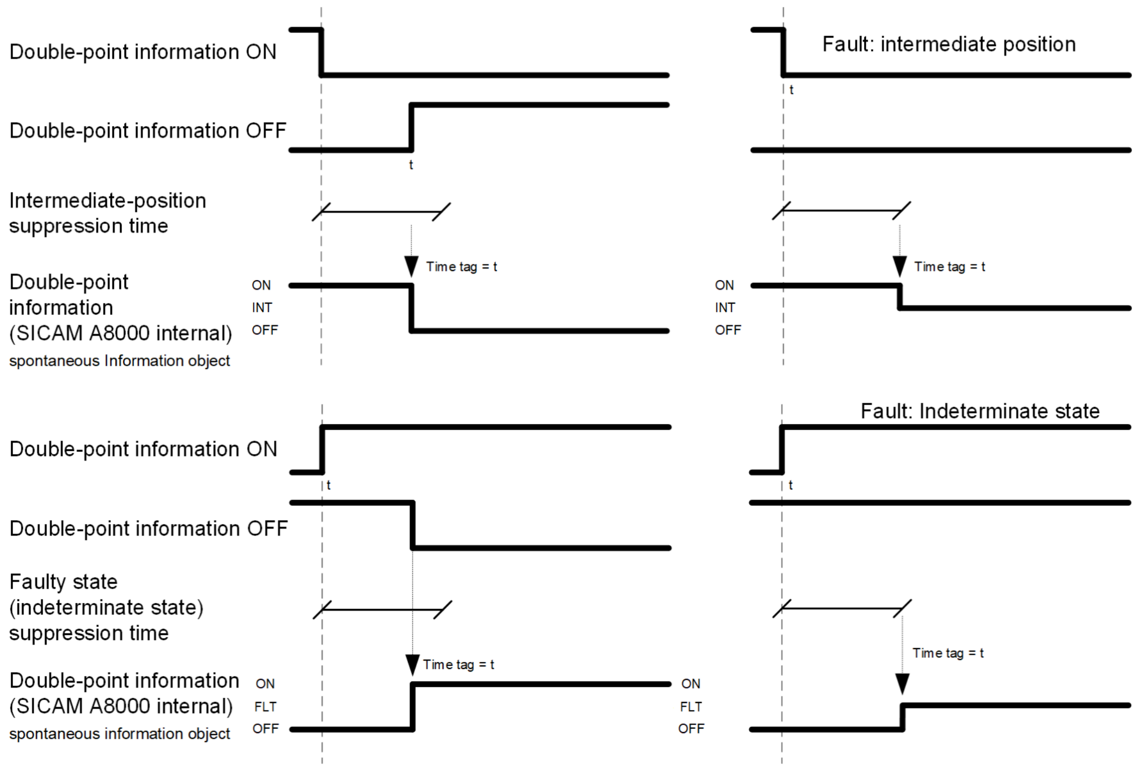
Since the Modbus protocol does not define how the data is represented in the coils/registers, the Modbus format must be specified for the message conversion. Supported Modbus data formats see *13.8.12 Modbus Data Formats*.

Monitoring for Intermediate and Faulty Position

The forwarding of a double-point information from PRE to the BSE with intermediate state (information is not “ON” and not “OFF”) or faulty state (information is “ON” and “OFF”) will be suppressed for a parameterizable time.

For the suppression of the intermediate position an intermediate-position suppression time (parameter **`Intermediate_pos_t`**) can be parameterized for each double-point information.

For the suppression of the faulty position a faulty position suppression time (parameter **`Faulty_pos_t`**) can be parameterized for each double-point information.



Message Conversion

The table describes the evaluated elements of the IEC 60870-5-101/104 message during message conversion.

Elements of the message		
TI .. Type identification		• <TI:=30> .. Single-point information with time tag CP56Time2a • <TI:=31> .. Double-point information with time tag CP56Time2a
CASDU, IOA .. Message address		Parameter-settable
QDS .. Quality descriptor		
BL .. Blocked		Not supported (BL = 0)
SB .. Substituted		Not supported (SB = 0)
NT .. Not topical		NT =1 if SPI + IV = 1 resp. if DPI + IV = 1 (else NT = 0) or upon receiving Exception Response
IV .. Invalid		Not supported (IV = 0)
Cause of transmission		
03 .. Spontaneous		Upon change of information state or quality descriptor
20 .. Interrogated by station interrogation		Upon reception of a GI request
xx .. Other COTs		Not supported
T ..Test		Not supported
Information		
Single-point information status		
SPI	0 .. OFF	Supported
	1 .. ON	Supported
Double-point information state		

Elements of the message		
DPI	0 .. Indeterminate or intermediate state	Supported
	1 .. OFF	Supported
	2 .. ON	Supported
	3 .. Indeterminate state	Supported
Time tag		
CP56Time2a .. Date + time		PRE internal time (receive time)

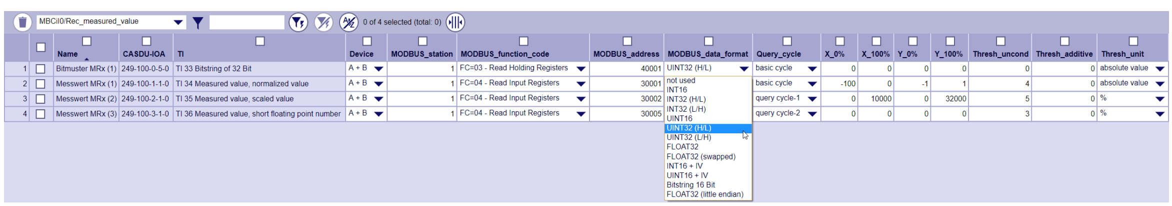
NOTE

Not listed elements of the IEC 60870-5-101/104 message are not rated/not supported!

Measured Values, Bitstrings

The parameterization of the address and message conversion for measured values, bitstrings from Modbus TCP Master ("Client") in receive direction is to be done with the SICAM Device Manager with the function "Signals" or with the SICAM TOOLBOX II, OPM II.

Processing type: *firmware* / `Rec_measured value`



[MBCil0_DM_Empf_Messwert, 2, en_US]

Parameter	
`TI`	Supported type identifications: • <TI:=33> .. Bitstring of 32 bits with time tag CP56Time2a • <TI:=34> .. Measured value, normalized value with time tag CP56Time2a • <TI:=35> .. Measured value, scaled value with time tag CP56Time2a • <TI:=36> .. Measured value, short floating-point number with time tag CP56Time2a
`Name`	Name of the signal
`CASDU-IOA`	SICAM A8000 internal IEC 60870-5-101/104 message address (CASDU1, CASDU2, IOA1, IOA2, IOA3)
`MODBUS_Station`	Address of the Modbus Slave (SICAM A8000 internal): • 0 to 99
`MODBUS_function_code`	Supported Modbus function codes: • FC = 03 .. READ HOLDING REGISTERS • FC = 04 .. READ INPUT REGISTERS
`MODBUS_address`	Modbus address (register address): • 1 to 65535

Parameter	
MODBUS_data_format	Data format on the Modbus: • INT16 • INT32 (H/L) • INT32 (L/H) • UINT16 • UINT32 (H/L) • UINT32 (L/H) • FLOAT32 • FLOAT32 (swapped) • FLOAT32 (little endian) • INT16 + IV • UINT16 + IV • Bitstring 16-bit
Query_cycle	Query cycle: • Basic cycle • Query cycle 1 • Query cycle 2 • Query cycle 3 • Query cycle 4 Basic cycle: continuous query of all parameterized data. Query cycle 1 to 4: Query of the parameterized data in the adjustable time grid. The time grid for query cycles 1 to 4 can be parameterized.
X_0%, X_100% **Y_0%, Y_100%**	Parameters for value adaptation (scaling): • Valid range of value for X_0% and X_100% see *13.8.12 Modbus Data Formats* • <TI:=34> .. Y_0% and Y_100% must not be greater or less than ±1 • <TI:= 35> .. Y_0% and Y_100% must not be less than –32768 or greater than +32767. • Value adoption inactive at X_0% = 0 and X_100% = 0
Thresh_uncond	If the value changes > **Thres_uncond**, the received value is immediately forwarded to the BSE.
Thresh_additive	If the value changes ≤ **Thres_uncond**, the received value is not immediately forwarded to the BSE and the additive measured value change monitoring is performed.
Thresh_unit	• Absolute value [received value from Modbus] • %

Supported Data Formats

Format	Modbus data format	IEC 60870-5-101/104 data format (TI)
INT16	Signed integer 16-bit	34, 35, 36
INT16 + IV	Signed integer 16 bit + "invalid" identifier	34, 35, 36
INT32 (H/L)	Signed integer 32-bit (HIGH before LOW)	34, 35, 36
INT32 (L/H)	Signed integer 32-bit (LOW before HIGH)	34, 35, 36
UINT16	Unsigned integer 16-bit	34, 35, 36

Format	Modbus data format	IEC 60870-5-101/104 data format (TI)
UINT16 + IV	Unsigned integer 16-bit + "invalid" identifier	34, 35, 36
UINT32 (H/L)	Unsigned integer 16-bit (HIGH before LOW)	34, 35, 36
UINT32 (L/H)	Unsigned integer 32-bit (LOW before HIGH)	34, 35, 36
FLOAT32	Short floating-point (IEEE 754)	34, 35, 36
FLOAT32 (swapped)	Short floating-point (IEEE 754) "swapped"	34, 35, 36
FLOAT32 (little endian)	Short floating-point (IEEE 754) "little endian"	34, 35, 36
Bitstring 16-bit	Bitstring of 16 bits	33

NOTE

Since the Modbus protocol does not define how the data is represented in the coils/registers, the Modbus format must be specified for the message conversion. Supported Modbus data formats see *13.8.12 Modbus Data Formats*.

Measured Value Change Monitoring

In order to avoid unnecessarily burdening the SICAM A8000 internal and further communication, the received measured value is monitored for changes according to the following rules:

- The first value determined after startup is transmitted immediately.
- Each change of quality descriptor IV triggers an immediate transfer, the quality descriptor OV does not initiate a transfer.
- Change monitoring in accordance with the method of the additive threshold value procedure:

  The measured value is monitored for changes when it is received. If the deviation compared to the last measured value transmitted is greater than the configured **`Thresh_uncond`**, the new measured value is transmitted immediately. Otherwise, the deviation is added to the last spontaneously transmitted measured value, with the correct sign. Only when the amount of this sum exceeds the parameterizable **`Thresh_additive`**, the current measured value is spontaneously transmitted to the BSE.

Thresh uncond	Thresh additive	Processing
= 0	= 0	Value is transmitted to the BSE upon each status change in the next processing grid
= 0	≠ 0	
≠ 0	= 0	• Change greater **`Thresh_uncond`**: Value is transmitted • Change less than/equal **`Thresh_uncond`**: Additive threshold value procedure
≠ 0	≠ 0	• Change greater **`Thresh_uncond`**: Value is transmitted • Change less than/equal **`Thresh_uncond`**: Additive threshold value procedure

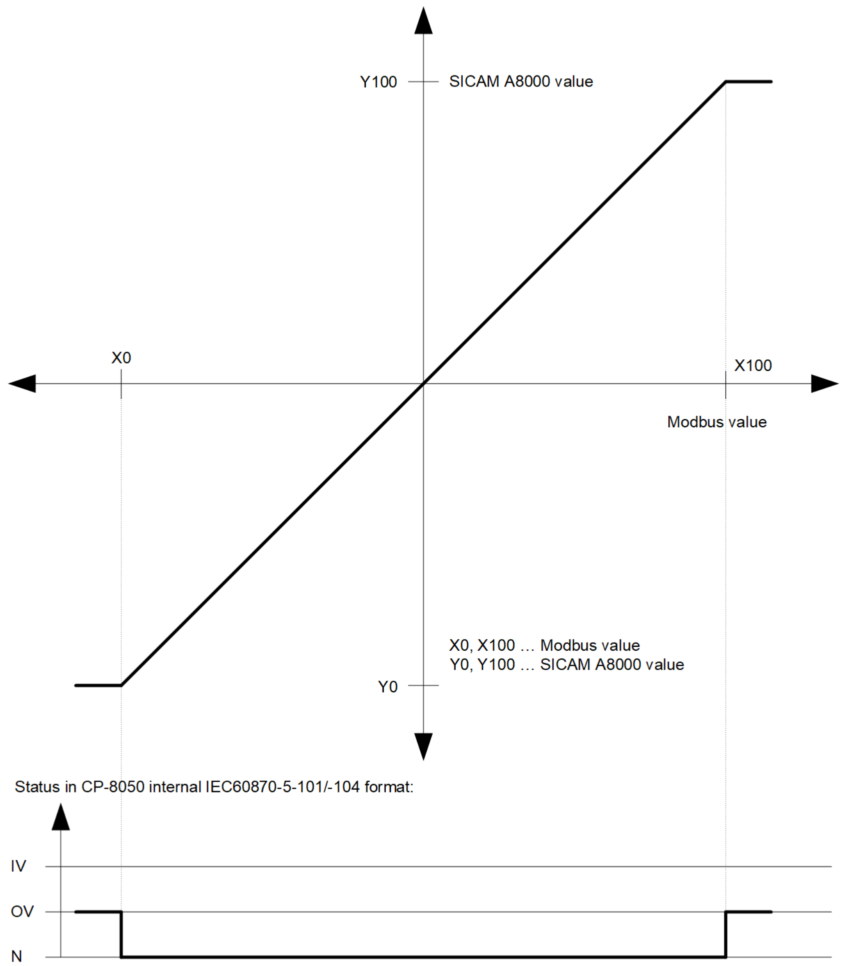
A transmission of the measured value due to a general interrogation does not influence the threshold value procedure.

The thresholds are to be parameterized for every measured value with the parameter **`Thresh_additive`** and the parameter **`Thresh_uncond`** .

For more details and examples of additive monitoring of measured value changes, see *13.1.4.13 Additive Measured Value Change Monitoring*.

Value Adaptation[not for <TI:=33>]

The value adaptation is defined by the parameters **`X_0%`**, **`X_100%`**, **`Y_0%`**, **`Y_100%`**.



The value adaptation is only performed if **`X_0%`** or **`X_100%`** *≠ 0* is parameterized.

If the Modbus value is outside the value range of the selected IEC 60870-5-101/104 type identifier when the value adoption (= direct transfer) is not activated, then OV = 1 is set.

Message Conversion

The table describes the evaluated elements of the IEC 60870-5-101/104 message during message conversion.

Elements of the message	
TI .. Type identification	• <TI:=33> .. Bitstring of 32 bits with time tag CP56Time2a • <TI:=34> .. Measured value, normalized value with time tag CP56Time2a • <TI:=35> .. Measured value, scaled value with time tag CP56Time2a • <TI:=36> .. Measured value, short floating-point number with time tag CP56Time2a
CASDU, IOA .. Message address	Parameter-settable
QDS .. Quality descriptor	

Elements of the message	
BL .. Blocked	Not supported (BL = 0)
SB .. Substituted	Not supported (SB = 0)
NT .. Not topical	NT = 1 • at Modbus Format INT16+IV, UINT16+IV if IV=1 • FLOAT32 format with the value = NAN (Not A Number) • Reception of Exception Response
IV .. Invalid	IV = 0
OV .. Overflow	OV = 1: Without value adaptation: • Modbus value outside the range of the selected type identification With value adaptation: • Modbus value less than X_0% or greater X_100%
Cause of transmission	
03 .. Spontaneous	Alteration of the measured value depending on the thresholds or alteration of the quality descriptor
20 .. Interrogated by station interrogation	Upon reception of a GI request
xx .. Other COTs	Not supported
T .. Test	Not supported
Information	
Value.. S .. Sign	• Normalized value • Scaled value • IEEE STD 754 = short floating-point number • Bitstring 32 bit Only bits 0 to 15 used. Bits 16 to 31 are not evaluated.
Time tag	
CP56Time2a .. Date + time	PRE internal time (receive time)

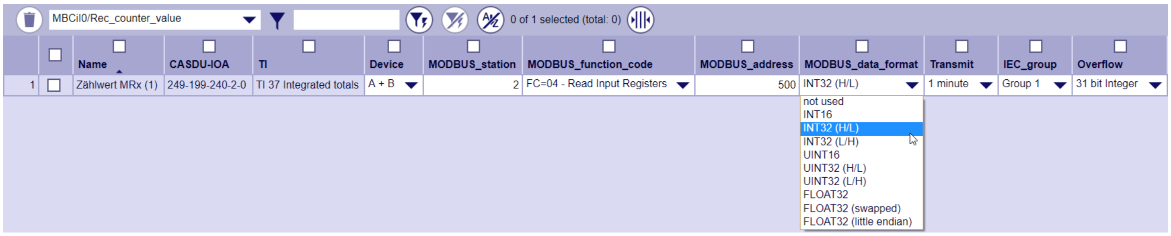
NOTE

Not listed elements of the IEC 60870-5-101/104 message are not rated/not supported!

Integrated Totals

The parameterization of the address and message conversion for integrated totals from Modbus TCP Master ("Client") in receive direction is to be done with the SICAM Device Manager with the function "Signals" or with the SICAM TOOLBOX II, OPM II.

Processing type: *firmware* / **Rec_counter value**



[MBCil0_DM_Empf_Zaehlwert, 2, en_US]

Parameter	
TI	Supported type identifications: • <TI:=37> .. Integrated total with time tag CP56Time2a
Name	Name of the signal
CASDU-IOA	SICAM A8000 internal IEC 60870-5-101/104 message address (CASDU1, CASDU2, IOA1, IOA2, IOA3)
MODBUS_Station	Address of the Modbus Slave (SICAM A8000 internal): • 0 to 99
MODBUS_function_code	Supported Modbus function codes: • FC = 03 .. READ HOLDING REGISTERS • FC = 04 .. READ INPUT REGISTERS
MODBUS_address	Modbus address (register address): • 1 to 65535
MODBUS_data_format	Data format on the Modbus: • INT16 • INT32 (H/L) • INT32 (L/H) • UINT16 • UINT32 (H/L) • UINT32 (L/H) • FLOAT32 • FLOAT32 (swapped) • FLOAT32 (little endian)
Transmit	Counter transmission at: • Counter interrogation • Cyclically every 1, 2, 3, 5, 10, 15, 30, 60 minutes
IEC-Group	IEC 60870-5-101/104 counter group: • Group 1 to 4
Overflow	Overflow treatment at: • 24, 31 bit integer • 2, 3, 4, 5, 6, 7, 8, 9 decades BCD

Supported Data Formats

Format	Modbus data format	IEC 60870-5-101/104 data format (TI)
INT16	Signed integer 16-bit	37
INT32 (H/L)	Signed integer 32-bit (HIGH before LOW)	37
INT32 (L/H)	Signed integer 32-bit (LOW before HIGH)	37
UINT16	Unsigned integer 16-bit	37
UINT32 (H/L)	Unsigned integer 16-bit (HIGH before LOW)	37
UINT32 (L/H)	Unsigned integer 32-bit (LOW before HIGH)	37
FLOAT32	Short floating-point (IEEE 754)	37
FLOAT32 (swapped)	Short floating-point (IEEE 754) “swapped”	37
FLOAT32 (little endian)	Short floating-point (IEEE 754) “little endian”	37

NOTE

Since the Modbus protocol does not define how the data is represented in the coils/registers, the Modbus format must be specified for the message conversion. Supported Modbus data formats see *13.8.12 Modbus Data Formats*.

Message Conversion

The table describes the evaluated elements of the IEC 60870-5-101/104 message during message conversion.

Elements of the message	
TI .. Type identification	• <TI:=37> .. Integrated total with time tag CP56Time2a
CASDU, IOA .. Message address	Parameter-settable
Data point quality descriptor	
Sequence number	With each trigger for latching for a group the sequence number is increased in the range from 1 to 31.
CY .. Carry	On overflow of the count in the associated count period
CA .. Presets	Not supported
IV .. Invalid	IV = 1 • FLOAT32 format with the value = NAN (Not A Number) • Reception of Exception Response
Cause of transmission	
03 .. Spontaneous	When transmitting = periodical data transfer (cyclically every 1, 2, 3, 5, 10, 15, 30, 60 minutes)
37 .. Requested by general counter interrogation	For general counter interrogation
38 to 41 .. Interrogated by group 1 to 4 interrogation	For request counter group (1 to 4)
T .. Test	Not supported
Information	
Value.. S .. Sign	Dual meter reading
Time tag	
CP56Time2a .. Date + time	PRE internal time

NOTE

Not listed elements of the IEC 60870-5-101/104 message are not rated / not supported!

Message Conversion Counter Interrogation Command (SICAM A8000 internal only)

The table describes the evaluated elements of the IEC 60870-5-101/104 message during message conversion.

Elements of the Message		
TI .. Type identification		• <TI:=101> .. Counter interrogation command
CASDU, IOA .. Message address		Defined
QCC .. Identifier counter interrogation		
FRZ	RQT	FRZ ... Freeze RQT ... Request
0	1 to 4	Read (no freeze or reset) Counter interrogation (1 to 4)
	5	Read (no freeze or reset) General counter interrogation
1	1 to 4	Counter freeze without reset Counter interrogation group (1 to 4)
	5	Counter freeze without reset All counter groups
2	1 to 4	Counter freeze with reset Counter interrogation group (1 to 4)
	5	Counter freeze without reset All counter groups
3	1 to 4	Reset counter Counter interrogation group (1 to 4)
	5	Reset counter All counter groups
x	0; 6 to 63	Not supported
Cause of transmission		
06 .. Activation		Must be set
xx .. Other COTs		Not supported
T ..Test		Not supported

13.8.10.3 Message Conversion in Transmit Direction – Modbus TCP Slave ("Server")

Message conversion in transmit direction: IEC 60870-5-101/104 → Modbus TCP

SICAM A8000: IEC 60870-5-101/104 →		Modbus TCP format	
TI	**Designation**	**FC**	**Data format**
<TI:=30>	Single-point information with time tag CP56Time2a	01, 02, 03, 04	SPI SPI + IV
<TI:=31>	Double-point information with time tag CP56Time2a	01, 02, 03, 04	DPI (1 = off, 2 = on) , DPI (1 = on, 2 = off) DPI (1 = off, 2 = on) + IV, DPI (1 = on, 2 = off) + IV
<TI:=33>	Bitstring of 32 bits with time tag CP56Time2a	03, 04	Bitstring 16-bit

SICAM A8000: IEC 60870-5-101/104 →		Modbus TCP format	
<TI:=34>	Measured value, normalized value with time tag CP56Time2a	03, 04	INT16, INT16 + IV, INT32 (H/L), INT32 (L/H), UINT16, UINT16 + IV, UINT32 (H/L), UINT32 (L/H), FLOAT32, FLOAT32 (swapped), FLOAT32 (little endian)
<TI:=35>	Measured value, scaled value with time tag CP56Time2a	03, 04	INT16, INT16 + IV, INT32 (H/L), INT32 (L/H), UINT16, UINT16 + IV, UINT32 (H/L), UINT32 (L/H), FLOAT32, FLOAT32 (swapped), FLOAT32 (little endian)
<TI:=36>	Measured value, floating-point number with time tag CP56Time2a	03, 04	INT16, INT16 + IV, INT32 (H/L), INT32 (L/H), UINT16, UINT16 + IV, UINT32 (H/L), UINT32 (L/H), FLOAT32, FLOAT32 (swapped), FLOAT32 (little endian)
<TI:=37>	Integrated total with time tag CP56Time2a	03, 04	INT16, INT16 + IV, INT32 (H/L), INT32 (L/H), UINT16, UINT16 + IV, UINT32 (H/L), UINT32 (L/H), FLOAT32, FLOAT32 (swapped), FLOAT32 (little endian)
<TI:=45>	Single command	01, 02, 03, 04	SC (pulse)
<TI:=46>	Double command	01, 02, 03, 04	DC (pulse)
<TI:=47>	Regulating step command	01, 02, 03, 04	DC (pulse)
<TI:=48>	Setpoint command, normalized value	03, 04	INT16, INT32 (H/L), INT32 (L/H), UINT16, UINT32 (H/L), UINT32 (L/H), FLOAT32, FLOAT32 (swapped), FLOAT32 (little endian)
<TI:=49>	Setpoint command, scaled value	03, 04	INT16, INT32 (H/L), INT32 (L/H), UINT16, UINT32 (H/L), UINT32 (L/H), FLOAT32, FLOAT32 (swapped), FLOAT32 (little endian)
<TI:=50>	Setpoint command, short floating-point number	03, 04	INT16, INT32 (H/L), INT32 (L/H), UINT16, UINT32 (H/L), UINT32 (L/H), FLOAT32, FLOAT32 (swapped), FLOAT32 (little endian)
<TI:=100>	(General) interrogation command		-

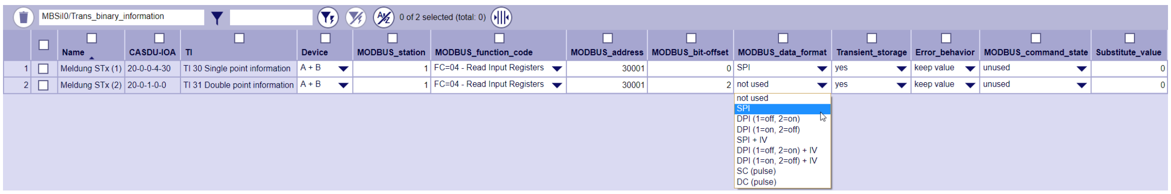
The general interrogation command is processed internally on the protocol element and not transmitted to the remote station. The next time the data is received on the Modbus interface, they are transmitted in response to the general interrogation command from PRE → BSE.

Modbus Function Codes (FC):
01 .. Read Coils
02 .. Read Discrete Inputs
03 .. Read Holding Registers
04 .. Read Input Registers

Binary information

The parameterization of the address and message conversion for binary information from Modbus TCP Slave ("Server") in transmit direction is to be done with the SICAM Device Manager with the function "Signals" or with the SICAM TOOLBOX II, OPM II.

Processing type: *firmware* | `Trans_binary_information`



[MBSil0_DM_Sende_Binäre_Information_Meldungen, 2, en_US]

Parameter	
`TI`	Supported type identifications: • <TI:=30> .. Single-point information with time tag CP56Time2a • <TI:=31> .. Double-point information with time tag CP56Time2a
`Name`	Name of the signal
`CASDU-IOA`	SICAM A8000 internal IEC 60870-5-101/104 message address (CASDU1, CASDU2, IOA1, IOA2, IOA3)
`MODBUS_Station`	Address of the Modbus Slave (SICAM A8000 internal): • 0 to 99
`MODBUS_function_code`	Supported Modbus function codes: • FC = 01 .. Read Coils • FC = 02 .. Read Discrete Inputs • FC = 03 .. Read Holding Registers • FC = 04 .. Read Input Registers
`MODBUS_address`	Modbus address (register or coil address): • 1 to 65535 (single-point information; double-point information with FC = 03, 04) • 1 to 65534 (double-point information with FC = 01, 02) The bits of a double-point information are always next to each other.
`MODBUS_bit-offset`	Bit number in the corresponding Modbus register: • 0 .. Single-point information, double-point information [with FC = 01 02] • 0 to 15 .. Single command [only FC = 03, 04] • 0 to 14 .. Double-point information [only FC = 03, 04] Both bits of a double-point information are in the same Modbus register! With the Modbus bit offset always the 1st bit of the double-point information is specified.

Parameter	
`MODBUS_data_format`	Data format on the Modbus: • SPI • SPI + IV [only FC = 03, 04] • DPI (1 = off, 2 = on) • DPI (1 = on, 2 = off) • DPI (1 = off, 2 = on) + IV [only FC = 03, 04] • DPI (1 = on, 2 = off) + IV [only FC = 03, 04]
`Transient storage`	Transient storage: • Yes [only single-point information] • No With transient storage, a message change is saved until transfer (with multiple changes up to transfer only 1 change is transferred)
`Error_behavior`	Output on Modbus if NT = 1 or IV = 1: • Keep value • Output substitute value
`Substitute_value`	Substitute value if **`error_behavior`** is set to ***`output substitute value`***. Valid range of values see *13.8.12 Modbus Data Formats*. The parameterized substitute value is also used as the initial value.
`MODBUS_command_state`	Not used!

NOTE

The parameters **`substitute_value`** and **`error_behavior`** must be adapted to the requirements of the application!

Supported Data Formats

Format	Modbus data format	IEC 60870-5-101/104 data format (TI)
SPI	Single-point information	30
SPI + IV	Single-point information + invalid identifier	30
DPI (1 = off, 2 = on)	Double-point information (OFF before ON)	31
DPI (1 = on, 2 = off)	Double-point information (ON before OFF)	31
DPI (1 = off, 2 = on) + IV	Double-point information (OFF before ON) + "invalid" identifier	31
DPI (1 = on, 2 = off) + IV	Double-point information (ON before OFF) + “invalid” identifier	31

NOTE

Since the Modbus protocol does not define how the data is represented in the coils/registers, the Modbus format must be specified for the message conversion. Supported Modbus data formats see *13.8.12 Modbus Data Formats*.

Message Conversion

The table describes the evaluated elements of the IEC 60870-5-101/104 message during message conversion.

Elements of the message		
TI .. Type identification		• <TI:=30> .. Single-point information with time tag CP56Time2a • <TI:=31> .. Double-point information with time tag CP56Time2a
CASDU, IOA .. Message address		Parameter-settable
QDS .. Quality descriptor		
BL .. Blocked		Not evaluated
SB .. Substituted		Not evaluated
NT .. Not topical		NT = 1: Depending on the parameter error behavior, either the current state is kept or the parameterized substitute value is output.
IV .. Invalid		IV = 1: Depending on the parameter error behavior, either the current state is kept or the parameterized substitute value is output.
Cause of transmission		
xx ..		Not rated
T .. Test		Not evaluated
Information		
Single-point information status		
SPI	0 .. OFF	Evaluated
	1 .. ON	Evaluated
Double point information state		
DPI	0 .. Indeterminate or intermediate state	Evaluated
	1 .. OFF	Evaluated
	2 .. ON	Evaluated
	3 .. Indeterminate state	Evaluated
Time tag		
CP56Time2a .. Date + time		Not rated

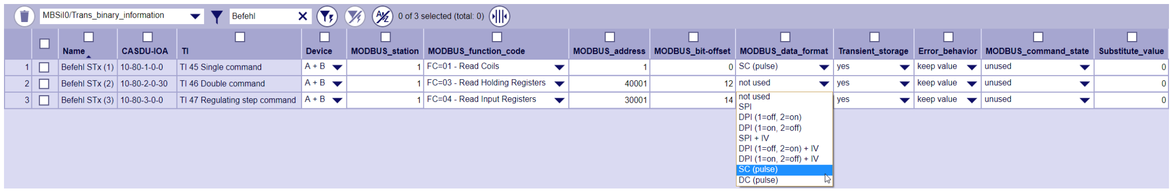
NOTE

Not listed elements of the IEC 60870-5-101/104 message are not rated / not supported!

Commands

The parameterization of the address and message conversion for commands from Modbus TCP Slave ("Server") in transmit direction is to be done with the SICAM Device Manager with the function "Signals" or with the SICAM TOOLBOX II, OPM II.

Processing type: *firmware* / **`Trans_binary_information`**



[MBSiI0_DM_Sende_Binäre_Information_Befehle, 2, en_US]

Parameter	
`TI`	Supported type identifications: • <TI:=45> .. Single command • <TI:=46> .. Double command • <TI:=47> .. Regulating step command
`Name`	Name of the signal
`CASDU-IOA`	SICAM A8000 internal IEC 60870-5-101/104 message address (CASDU1, CASDU2, IOA1, IOA2, IOA3)
`MODBUS_Station`	Address of the Modbus Slave (SICAM A8000 internal): • 0 to 99
`MODBUS_func-tion_code`	Supported Modbus function codes: • FC = 01 .. Read Coils • FC = 02 .. Read Discrete Inputs • FC = 03 .. Read Holding Registers • FC = 04 .. Read Input Registers
`MODBUS_address`	Modbus address (register or coil address): • 1 to 65535 [single command; double command with FC = 03, 04] • 1 to 65534 [double command with FC = 01, 02] The bits of a double command are always next to each other.
`MODBUS_bit-offset`	Bit number in the corresponding Modbus register: • 0 .. Single command, double command [with FC = 01, 02] • 0 to 15 .. Single command [only FC = 03, 04] • 0 to 14 .. Double command [only FC = 03, 04] Both bits of a double command must always be in the same Modbus register! With the Modbus Bit-Offset always the 1. bit of the double command specified.
`MODBUS_data_format`	Data format on the Modbus: • SC (pulse) .. Single command pulse • DC (pulse) .. Double command pulse
`Transient_storage`	Not used!
`Error_behavior`	Not used!
`Substitute_value`	Not used!
`MODBUS_command_state`	Modbus command state: <only double commands> • OFF • ON On the parameterized Modbus_address / Modbus_bit-offset the selected Modbus_command_state is output (possible inversion of the command output)

Supported Data Formats

Format	Modbus data format	IEC 60870-5-101/104 data format (TI)
SC (pulse)	Single command pulse	45
DC (pulse)	Double command pulse	46, 47

NOTE

Since the Modbus protocol does not define how the data is represented in the coils/registers, the Modbus format must be specified for the message conversion. Supported Modbus data formats see *13.8.12 Modbus Data Formats*.

Command Output Time for Single/Double Commands

Commands can be transmitted on the Modbus as pulse(s) (1 or 2 bits). The protocol element maps the command output to 1 or 2 bits in the Modbus register of the Modbus slave with the assigned command output time.

The command output time (duration of the pulse) is set for commands with qualifier of command = <0> "no additional definition" on protocol with the parameter **[PRE] MODBUS | Communication functions | Command transmission | Command pulse duration | Command with no addt'l def. (sec)** .

The command output time (duration of the pulse) is set for commands with qualifier of command = <1> "short command execution time" on protocol with the parameter **[PRE] MODBUS | Communication functions | Command transmission | Command pulse duration | Command with short pulse duration (sec)**.

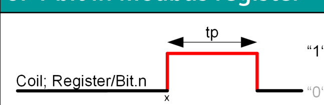
The pulse duration of commands with qualifier of command = <2> "long pulse duration" must be set on the protocol with the parameter **[PRE] MODBUS | Communication functions | Command transmission | Command pulse duration | Command with long pulse duration (sec)** .

Max. 10 commands as pulse command (single-, double commands) executed at the same time will be supported.

Single Command SC (Pulse)

A single command with command state SCS = ON will be output on the Modbus register (or coil) as pulse with the parametrized command output time.

The command output time must be set so that the command pulse in the Modbus register (or coil) is read out at least once from the central station (Modbus master) (depending on the interrogation cycle of the Modbus master).

Modbus data format	Command state	Command output 1 bit as coil or 1 bit in Modbus register
SC (pulse)	SCS = ON	 tp .. command output time (pulse duration) x .. command = ON
	SCS = OFF	The OFF state is not evaluated!

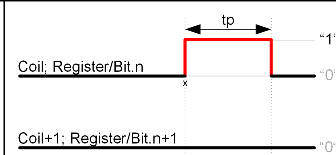
If a further command with the same IEC 60870-5-101/104 address is initiated during command output in progress, this one will be discarded with a negative confirmation to the BSE (ACTCON-).

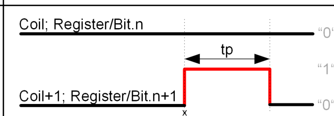
The current pulse output of the command is not affected.

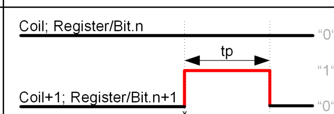
Double Command DC (Pulse)

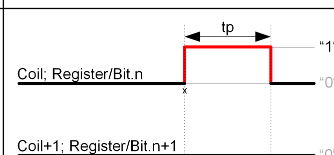
A double command or regulating step command with the status DCS = ON/OFF or RCS = HIGHER/LOWER is output on the parameterized Modbus register (or coil) as pulse with the set command output time.

The command output time must be set so that the command pulse in the Modbus register (or coil) is read out at least once from the central station (Modbus master) (depending on the interrogation cycle of the Modbus master).

<table>
<tr><th>Modbus data format</th><th>Command state</th><th>Command output2 bits as coil or 2 bits in Modbus register</th></tr>
<tr><td>DC (pulse)
Modbus_command_state = ON</td><td>DCS = ON
RCS = HIGHER</td><td>

tp .. command output time (pulse duration)
x .. command = ON</td></tr>
<tr><td>DC (pulse)
Modbus_command_state = ON</td><td>DCS = OFF
RCS = LOWER</td><td>

tp ... command output time (pulse duration)
x .. command = OFF</td></tr>
<tr><td>DC (pulse)
Modbus_command_state = OFF</td><td>DCS = ON
RCS = HIGHER</td><td>

tp .. command output time (pulse duration)
x .. command = ON</td></tr>
<tr><td>DC (pulse)
Modbus_command_state = OFF</td><td>DCS = OFF
RCS = LOWER</td><td>

tp .. command output time (pulse duration)
x .. command = OFF</td></tr>
</table>

If a further command with the same IEC 60870-5-101/104 address is initiated during command output in progress, this one will be discarded with a negative confirmation to the BSE (ACTCON-).

The current pulse output of the command is not affected.

Message Conversion

The table describes the evaluated elements of the IEC 60870-5-101/104 message during message conversion.

Elements of the message	
TI .. Type identification	• <TI:=45> .. Single command • <TI:=46> .. Double command • <TI:=47> .. Regulating step command
CASDU, IOA .. Message address	Parameter-settable
Cause of transmission	

Elements of the message		
06 .. Activation		BSE→PRE: Is evaluated on the PRE (only “activation” allowed)
07 .. Confirmation of activation		PRE→BSE: • ACTCON+ when the Modbus register/coil is read by the master during the pulse duration. • ACTCON- if the Modbus register/coil is not read by the master during the pulse duration.
08 .. Abortion of activation		BSE→PRE: not supported.
09 .. Confirmation of the abortion of activation		PRE→PRE: Abortion of the activation is confirmed negative (ACTCON-)
10 .. Activation termination		Not supported
xx .. Other COTs		Not accepted / not supported
T .. Test		Not supported
Information		
SCO/DCO/RCO		
SCS	Single command state	[only <TI:=45>]
	0 .. OFF	Not evaluated
	1 .. ON	Evaluated
DCS	Double command state	[only <TI:=46>]
	0 .. Not allowed	Not supported
	1 .. OFF	Evaluated
	2 .. ON	Evaluated
	3 .. Not allowed	Not supported
RCS	Regulating step command state	[only <TI:=47>]
	0 .. Not allowed	Not supported
	1 .. Next step lower	Evaluated
	2 .. Next step higher	Evaluated
	3 .. Not allowed	Not supported
QOC	S/E	
	0 = Execute	Is checked for “execute”
	1 = Select	Not supported; is confirmed negative (ACTCON-)
QU	Command qualifier	
	0 .. No additional definitions	Evaluated
	1 .. Short pulse duration	Evaluated
	2 .. Long pulse duration	Evaluated
	3 .. Persistent command	Not supported

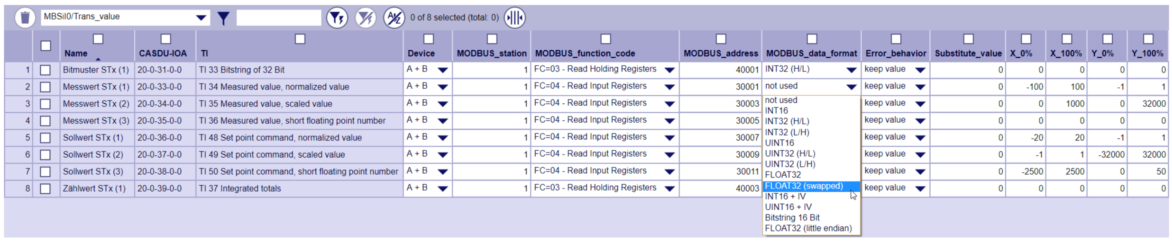
NOTE

Not listed elements of the IEC 60870-5-101/104 message are not rated/not supported!

Measured values, Setpoint values, Integrated Totals, Bitstrings

The parameterization of the address and message conversion for measured values, setpoint values, integrated totals, bitstrings from Modbus TCP Slave ("Server") in transmit direction is to be done with the SICAM Device Manager with the function "Signals" or with the SICAM TOOLBOX II, OPM II.

Processing type: *firmware* / `Trans_value`


MBSiI0/Trans_value
0 of 8 selected (total: 0)

	Name	CASDU-IOA	TI	Device	MODBUS_station	MODBUS_function_code	MODBUS_address	MODBUS_data_format	Error_behavior	Substitute_value	X_0%	X_100%	Y_0%	Y_100%
1	Bitmuster STx (1)	20-0-31-0-0	TI 33 Bitstring of 32 Bit	A + B	1	FC=03 - Read Holding Registers	40001	INT32 (H/L)	keep value	0	0	0	0	0
2	Messwert STx (1)	20-0-33-0-0	TI 34 Measured value, normalized value	A + B	1	FC=04 - Read Input Registers	30001	not used	keep value	0	-100	100	-1	1
3	Messwert STx (2)	20-0-34-0-0	TI 35 Measured value, scaled value	A + B	1	FC=04 - Read Input Registers	30003		keep value	0	0	1000	0	32000
4	Messwert STx (3)	20-0-35-0-0	TI 36 Measured value, short floating point number	A + B	1	FC=04 - Read Input Registers	30005		keep value	0	0	0	0	0
5	Sollwert STx (1)	20-0-36-0-0	TI 48 Set point command, normalized value	A + B	1	FC=04 - Read Input Registers	30007		keep value	0	-20	20	-1	1
6	Sollwert STx (2)	20-0-37-0-0	TI 49 Set point command, scaled value	A + B	1	FC=04 - Read Input Registers	30009		keep value	0	-1	1	-32000	32000
7	Sollwert STx (3)	20-0-38-0-0	TI 50 Set point command, short floating point number	A + B	1	FC=04 - Read Input Registers	30011		keep value	0	-2500	2500	0	50
8	Zählwert STx (1)	20-0-39-0-0	TI 37 Integrated totals	A + B	1	FC=03 - Read Holding Registers	40003		keep value	0	0	0	0	0

not used
INT16
INT32 (H/L)
INT32 (L/H)
UINT16
UINT32 (H/L)
UINT32 (L/H)
FLOAT32
FLOAT32 (swapped)
INT16 + IV
UINT16 + IV
Bitstring 16 Bit
FLOAT32 (little endian)

[MBSiI0_DM_Sende_Wert, 2, en_US]

Parameter	
`TI`	Supported type identifications: • <TI:=33> .. Bitstring of 32 bits with time tag CP56Time2a • <TI:=34> .. Measured value, normalized value with time tag CP56Time2a • <TI:=35> .. Measured value, scaled value with time tag CP56Time2a • <TI:=36> .. Measured value, short floating-point number with time tag CP56Time2a • <TI:=37> .. Integrated total with time tag CP56Time2a • <TI:=48> .. Setpoint command, normalized value • <TI:=49> .. Setpoint command, scaled value • <TI:=50> .. Setpoint command, short floating-point number
`Name`	Name of the signal
`CASDU-IOA`	SICAM A8000 internal IEC 60870-5-101/104 message address (CASDU1, CASDU2, IOA1, IOA2, IOA3)
`MODBUS_Station`	Address of the Modbus Slave (SICAM A8000 internal): • 0 to 99
`MODBUS_function_code`	Supported Modbus function codes: • FC = 03 .. READ HOLDING REGISTERS • FC = 04 .. READ INPUT REGISTERS
`MODBUS_address`	Modbus address (register or coil address): • 1 to 65535 • 1 to 65534 [for all Modbus double register formats (e.g., FLOAT32)]

Parameter	
`MODBUS_data_format`	Data format on the Modbus: • INT16 • INT16 + IV [only <TI:=34, 35, 36, 37>] • INT32 (H/L) • INT32 (L/H) • UINT16 • UINT16 + IV [only <TI:=34, 35, 36, 37>] • UINT32 (H/L) • UINT32 (L/H) • FLOAT32 • FLOAT32 (swapped) • FLOAT32 (little endian) • Bitstring 16-bit
`Error_behavior`	Output on Modbus if NT = 1 or IV = 1: • Keep value • Output substitute value
`Substitute_value`	Substitute value if **`error_behavior`** is set to ***`output substitute value`***. Valid range of values see *13.8.12 Modbus Data Formats*.
`X_0%, X_100%` **`Y_0%, Y_100%`**	Parameters for value adaptation (scaling): • Valid range of value for X_0% and X_100% see *13.8.12 Modbus Data Formats* • <TI:=34> .. Y_0% and Y_100% must not be greater or less than ±1 • <TI:=35> .. Y_0% and Y_100% must not be less than −32768 or greater than +32767. • Value adaptation inactive at Y_0% = 0 and Y_100% = 0

NOTE

The parameters **`substitute_value`** and **`error_behavior`** must be adapted to the requirements of the application!

Supported Data Formats

Format	Modbus data format	IEC 60870-5-101/104 data format (TI)
INT16	Signed integer 16-bit	34, 35, 36, 37, 48, 49, 50
INT16 + IV	Signed integer 16 bit + "invalid" identifier	34, 35, 36, 37
INT32 (H/L)	Signed integer 32-bit (HIGH before LOW)	34, 35, 36, 37, 48, 49, 50
INT32 (L/H)	Signed integer 32-bit (LOW before HIGH)	34, 35, 36, 37, 48, 49, 50
UINT16	Unsigned integer 16-bit	34, 35, 36, 37, 48, 49, 50
UINT16 + IV	Unsigned integer 16-bit + "invalid" identifier	34, 35, 36, 37
UINT32 (H/L)	Unsigned integer 16-bit (HIGH before LOW)	34, 35, 36, 37, 48, 49, 50
UINT32 (L/H)	Unsigned integer 32-bit (LOW before HIGH)	34, 35, 36, 37, 48, 49, 50
FLOAT32	Short floating-point (IEEE 754) normal	34, 35, 36, 37, 48, 49, 50
FLOAT32 (swapped)	Short floating-point (IEEE 754) “swapped”	34, 35, 36, 37, 48, 49, 50

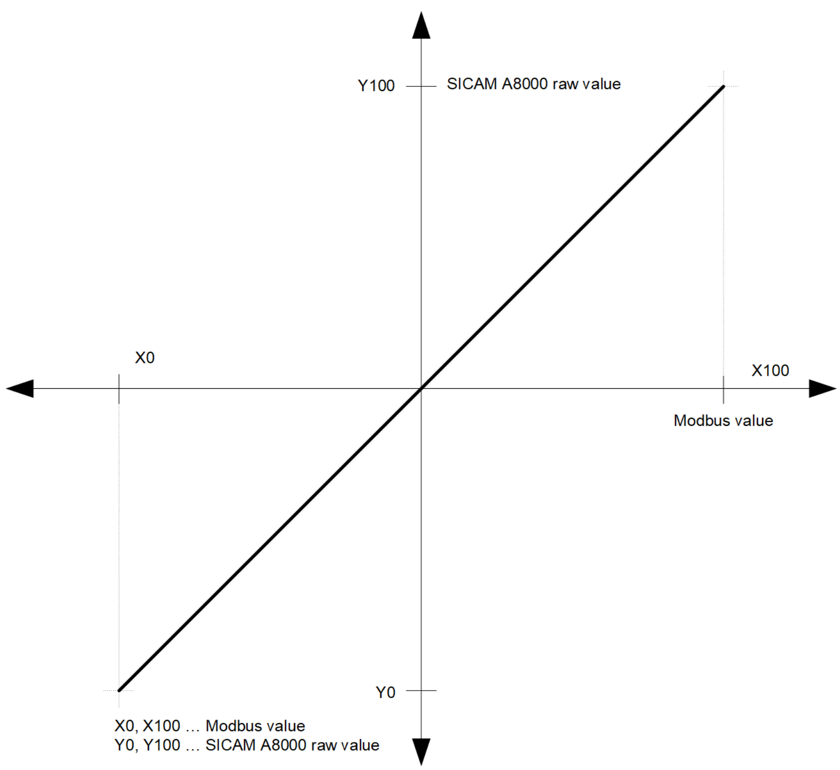
Format	Modbus data format	IEC 60870-5-101/104 data format (TI)
FLOAT32 (little endian)	Short floating-point (IEEE 754) “little endian”	34, 35, 36, 37, 48, 49, 50
Bitstring 16-bit	Bitstring of 16 bits	33

NOTE

Since the Modbus protocol does not define how the data is represented in the coils/registers, the Modbus format must be specified for the message conversion. Supported Modbus data formats see *13.8.12 Modbus Data Formats*.

Value Adaptation[not for <TI:=33, 37>]

The value adaptation is defined by the parameters **`X_0%`**, **`X_100%`**, **`Y_0%`**, **`Y_100%`**.



The value adaptation is only performed if **`Y_0%`** or **`Y_100%`** ≠ *0* is parameterized.

- If, when the value adjustment is active, the SICAM A8000 raw value is smaller than **`Y_0%`** or greater **`Y_100%`**, then
  - no conversion is carried out
  - the error message *`Format conversion error in transmit direction`* is set
  - on the Modbus, either the parameterized substitute value or, for Modbus TCP, data formats with IV: → IV = 1; X_0% or X_100% is output

- If, when the value adjustment is not active (= direct transfer), the SICAM A8000 raw value is outside of the value range of the selected Modbus TCP data format, then
  - no conversion is carried out
  - the error message *`Format conversion error in transmit direction`* is set
  - on the Modbus, either the parameterized substitute value or, for Modbus TCP, data formats with IV: → IV = 1; min. or max. Modbus value for the selected Modbus RTU data format is output
- Modbus formats with IV:
  Regardless of the value adaptation, the NT/IV bit is taken over into the IV bit of the Modbus format.

Message Conversion

The table describes the evaluated elements of the IEC 60870-5-101/104 message during message conversion.

Elements of the message	
TI .. Type identification	• <TI:=33> .. Bitstring of 32 bits with time tag CP56Time2a • <TI:=34> .. Measured value, normalized value with time tag CP56Time2a • <TI:=35> .. Measured value, scaled value with time tag CP56Time2a • <TI:=36> .. Measured value, short floating-point number with time tag CP56Time2a • <TI:=37> .. Integrated total with time tag CP56Time2a
CASDU, IOA .. Message address	Parameter-settable
QDS .. Quality descriptor	
BL .. Blocked	Not evaluated
SB .. Substituted	Not evaluated
NT .. Not topical	NT = 1: Depending on the parameter **`error_behavior`**, either the current state is kept or the parameterized substitute value is output.
IV .. Invalid	IV = 1: Depending on the parameter **`error_behavior`**, either the current state is kept or the parameterized substitute value is output.
OV .. Overflow	Not evaluated
Cause of transmission	
xx .. Other COTs	Not evaluated
T .. Test	Not evaluated
Information	
Value.. S .. Sign	• Normalized value • Scaled value • IEEE STD 754 = short floating-point number • Dual meter reading • Bitstring 32 bit Only bits 0 to 15 used. Bits 16 to 31 are not evaluated.
Time tag	
CP56Time2a .. Date + time	Not evaluated

NOTE

Not listed elements of the IEC 60870-5-101/104 message are not rated/not supported!

Message elements		
TI .. Type identification		• <TI:=48> .. Setpoint command, normalized value • <TI:=49> .. Setpoint command, scaled value • <TI:=50> .. Setpoint command, short floating-point number
CASDU, IOA .. Message address		Parameter-settable
Cause of transmission		
06 .. Activation		BSE→PRE: Is evaluated on the PRE (only "activation" allowed)
07 .. Confirmation of activation		PRE→BSE: • ACTCON+ if the Modbus register is read by the master within 60 seconds. • ACTCON- if the Modbus register is not read by the master within 60 seconds.
08 .. Abortion of activation		BSE→PRE: not supported
09 .. Confirmation of the abortion of activation		PRE→PRE: Abortion of the activation is confirmed negative (ACTCON-)
10 .. Activation termination		Not supported
xx .. Other COTs		Not accepted / not supported
T .. Test		Not supported
Information		
QOS .. Qualifier of setpoint command		
S/E	0 = Execute	Is checked for "execute"
	1 = Select	Not supported; is confirmed negative (ACTCON-)
QL		Not evaluated
Value		• Normalized value • Scaled value • IEEE STD 754 = short floating-point number • Bitstring 32 bit Only bits 0 to 15 used. Bits 16 to 31 are not evaluated.
S	.. Sign	
Time tag		
CP56Time2a .. Date + time		Not evaluated

NOTE

Not listed elements of the IEC 60870-5-101/104 message are not rated/not supported!

13.8.10.4 Message Conversion in Receive Direction – Modbus TCP Slave ("Server")

Message conversion in receive direction: IEC 60870-5-101/104 ← Modbus TCP

SICAM A8000: IEC 60870-5-101/104 ←		Modbus TCP Format	
TI	**Designation**	**FC**	**Data format**
<TI:=30>	Single-point information with time tag CP56Time2a	05, 06,15,16	SPI
<TI:=31>	Double-point information with time tag CP56Time2a	05, 06,15,16	DPI (1 = off, 2 = on), DPI (1 = on, 2 = off), SPI
<TI:=34>	Measured value, normalized value with time tag CP56Time2a	06, 16	INT16, INT32 (H/L), INT32 (L/H), UINT16, UINT32 (H/L), UINT32 (L/H), FLOAT32, FLOAT32 (swapped), FLOAT32 (little endian)
<TI:=35>	Measured value, scaled value with time tag CP56Time2a	06, 16	INT16, INT32 (H/L), INT32 (L/H), UINT16, UINT32 (H/L), UINT32 (L/H), FLOAT32, FLOAT32 (swapped), FLOAT32 (little endian)
<TI:=36>	Measured value, floating-point number with time tag CP56Time2a	06, 16	INT16, INT32 (H/L), INT32 (L/H), UINT16, UINT32 (H/L), UINT32 (L/H), FLOAT32, FLOAT32 (swapped), FLOAT32 (little endian)
<TI:=45>	Single command	05, 06, 15, 16	SC, SC (pulse)
<TI:=46>	Double command	05, 06, 15, 16	DC, DC (pulse)
<TI:=48>	Setpoint command, normalized value	06, 16	INT16, INT32 (H/L), INT32 (L/H), UINT16, UINT32 (H/L), UINT32 (L/H), FLOAT32, FLOAT32 (swapped), FLOAT32 (little endian)
<TI:=49>	Setpoint command, scaled value	06, 16	INT16, INT32 (H/L), INT32 (L/H), UINT16, UINT32 (H/L), UINT32 (L/H), FLOAT32, FLOAT32 (swapped), FLOAT32 (little endian)
<TI:=50>	Setpoint command, short floating-point number	06, 16	INT16, INT32 (H/L), INT32 (L/H), UINT16, UINT32 (H/L), UINT32 (L/H), FLOAT32, FLOAT32 (swapped), FLOAT32 (little endian)
	Time synchronization		

Time synchronization of the SICAM A8000 component via NTP server (time synchronization with internal system message).

Modbus Function Codes (FC):

05 .. Write Single Coil

06 .. Write Single Register

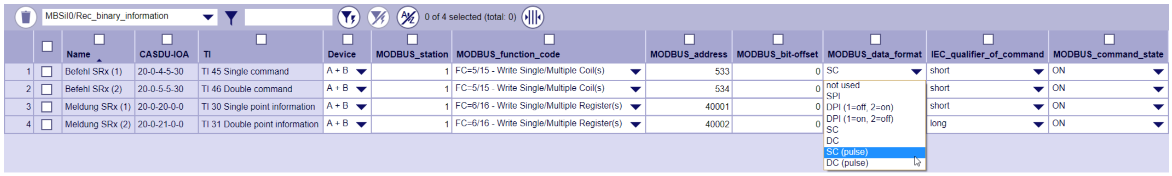
15 .. Write Multiple Coils

16 .. Write Multiple Registers

Indications, Commands

The parameterization of the address and message conversion for binary information, commands from Modbus TCP Slave (“Server”) in receive direction is to be done with the SICAM Device Manager with the function “Signals” or with the SICAM TOOLBOX II, OPM II.

Processing type: *firmware* | `Rec_binary_information`



[MBSiI0_DM_Empf_Binäre_Information, 2, en_US]

Parameter	
TI	Supported type identifications: • <TI:=30> .. Single-point information with time tag CP56Time2a • <TI:=31> .. Double-point information with time tag CP56Time2a • <TI:=45> .. Single command • <TI:=46> .. Double command
Name	Name of the signal
CASDU-IOA	SICAM A8000 internal IEC 60870-5-101/104 message address (CASDU1, CASDU2, IOA1, IOA2, IOA3)
MODBUS_Station	Address of the Modbus Slave (SICAM A8000 internal): • 0 to 99
MODBUS_function_code	Supported Modbus function codes: • FC = 05 .. Write Single Coil • FC = 06 .. Write Single Register • FC = 15 .. Write Multiple Coils • FC = 16 .. Write Multiple Registers
MODBUS_address	Modbus address (register or coil address): • 1 to 65535 (FC = 06, 16; single-point information, single command with FC = 05, 15) • 1 to 65534 (double-point information; double command with FC = 05, 15) The bits of a double-point information/double command are always next to each other.
MODBUS_bit-offset	Bit number in the corresponding Modbus register: • 0 .. [if FC = 05, 15] • 0 to 15 .. Single-point information/single command [only FC = 06, 16] • 0 to 14 .. Double-point information/double command [only FC = 06, 16] Both bits of a double-point information/double command are in the same Modbus register! With the Modbus bit offset always the 1st bit of the double-point information/double command is specified.
MODBUS_data_format	Data format on the Modbus: • SPI .. Single-point information • DPI (1 = off, 2 = on) .. Double-point information [only FC = 06, 16] • DPI (1 = on, 2 = off) .. Double-point information [only FC = 06, 16] • SC .. Single command • DC .. Double command • SC (pulse) .. Single command pulse • DC (pulse) .. Double command pulse

Parameter	
`IEC_quali-fier_of_command`	IEC qualifier of command: [only <TI:=45, 46>] • none • short • long
`MODBUS_command_state`	Modbus command state: [only double command <TI:=46>] • OFF • ON On the parameterized **`Modbus_address/Modbus_bit-offset`** the parameter-ized Modbus_ command_state is output (= inversion of the command output)

Supported Data Formats

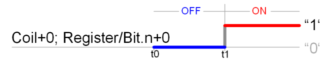
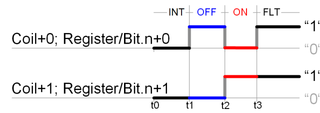
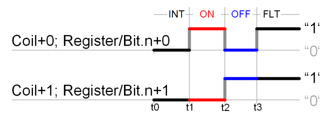
Format	Modbus data format	IEC 60870-5-101/104 data format (TI)
SPI	Single-point information	30
DPI (1 = off, 2 = on)	Double-point information (OFF before ON)	31
DPI (1 = on, 2 = off)	Double-point information (ON before OFF)	31
SC	Single command	45
DC	Double command	46
SC (pulse)	Single command pulse	45
DC (pulse)	Double command pulse	46

NOTE

Since the Modbus protocol does not define how the data is represented in the coils/registers, the Modbus format must be specified for the message conversion. Supported Modbus data formats see *13.8.12 Modbus Data Formats*.

Single-Point Information SPI, Double-Point Information DPI

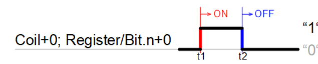
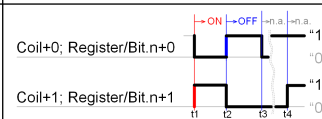
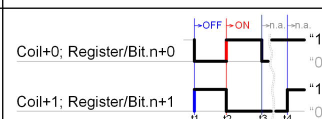
In receive direction, each binary information state is forwarded 1:1 to the BSE on change. For double-point information, no intermediate position suppression and no suppression time for faulty state is performed in the receive direction!

Modbus data format	Modbus binary information state	Binary information state in Modbus coil/register	IEC 60870-5-101/104
SPI	SPI: Bit n+0 <0>: 0 .. OFF <1>: 1 .. ON	 SPI .. 1 bit as coil or 1 bit in Modbus register	SPI: <0> .. OFF <1> .. ON
DPI (1 = off, 2 = on)	DPI: Coding OFF before ON (IEC 60870-5-101/104) Bit n+1 | n+0 <0>: 0 | 0 .. INT [342] <1>: 0 | 1 .. OFF <2>: 1 | 0 .. ON <3>: 1 | 1 .. FLT [343]	 DPI .. 2 bits as coils or 2 bits in Modbus register	DPI: <0>: .. INT [342] <1>: .. OFF <2>: .. ON <3>: .. FLT [343]
DPI (1 = on, 2 = off)	DPI: Coding OFF before ON (IEC 60870-5-101/104) Bit n+1 | n+0 <0>: 0 | 0 .. INT [342] <1>: 0 | 1 .. ON <2>: 1 | 0 .. OFF <3>: 1 | 1 .. FLT [343]	 DPI .. 2 bits as coils or 2 bits in Modbus register	DPI: <0>: .. INT [342] <1>: .. OFF <2>: .. ON <3>: .. FLT [343]

Single Command SC, Double Command DC

In receive direction, the command state is always forwarded to the BSE on receipt 1:1 without change comparison. Commands are not forwarded to the BSE during general interrogation!

342 intermediate position (undefined state or intermediate state)
343 Faulty position (indeterminate state)

Modbus data format	Modbus binary information state	Binary information state in Modbus coil/register	IEC 60870-5-101/104
SC	SC: Bit n+0 <0>: 0 .. OFF <1>: 1 .. ON	 SC .. 1 bit as coil or 1 bit in Modbus register t1 .. <1> ON command is forwarded t2 .. <0> OFF command is forwarded	SCS: <0> .. OFF <1> .. ON
DC	Modbus_command_state = OFF DC: Bit n+1 | n+0 <0>: 0 | 0 .. n.a. <1>: 0 | 1 .. OFF <2>: 1 | 0 .. ON <3>: 1 | 1 .. n.a.	 DPI .. 2 bits as coils or 2 bits in Modbus register t1 .. <2> ON command is forwarded t2 .. <1> OFF command is forwarded t3 .. <0> n.a. is forwarded t4 .. <3> n.a. is forwarded	DCS/RCS: <0>: .. n.a. <1>: .. OFF / LOWER <2>: .. ON / HIGHER <3>: .. n.a.
DC	Modbus_command_state = ON DC: Bit n+1 | n+0 <0>: 0 | 0 .. n.a. <1>: 0 | 1 .. ON <2>: 1 | 0 .. OFF <3>: 1 | 1 .. n.a.	 DPI .. 2 bits as coils or 2 bits in Modbus register t1 .. <1> OFF command is forwarded t2 .. <2> ON command is forwarded t3 .. <0> n.a. is forwarded t4 .. <3> n.a. is forwarded	DCS/RCS: <0>: .. n.a. <1>: .. OFF / LOWER <2>: .. ON / HIGHER <3>: .. n.a.

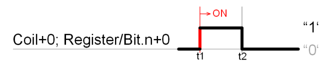
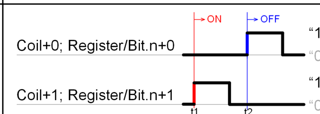
Legend:

n.a. .. Not permitted!

Single Command SC (Pulse), Double Command DC (Pulse)

In receive direction, the ON command state is always transferred to the BSE 1:1 without change comparison. The OFF command state is not transferred.

Commands are not forwarded during general interrogation.

Modbus data format	Modbus binary information state	Binary information state in Modbus coil/register	IEC 60870-5-101/104
SC (pulse)	SC (pulse): Bit n+0 <0>: 0 .. OFF <1>: 1 .. ON	 SC .. 1 bit as coil or 1 bit in Modbus register t1 .. ON command is forwarded t2 .. OFF command is <u>not</u> forwarded	SCS: <1> .. ON
DC (pulse)	DC (pulse): Bit n+1 | n+0 <0>: 0 | 0 .. n.a. <1>: 0 | 1 .. OFF <2>: 1 | 0 .. ON <3>: 1 | 1 .. n.a.	 SC .. 1 bit as coil or 1 bit in Modbus register t1 .. ON command is forwarded t2 .. OFF command is forwarded	DCS/RCS: <0>: .. n.a. <1>: .. OFF / LOWER <2>: .. ON / HIGHER <3>: .. n.a.

Legend:
n.a. .. Not permitted!

Message Conversion

The table describes the evaluated elements of the IEC 60870-5-101/104 message during message conversion.

Elements of the message		
TI .. Type identification		• <TI:=30> .. Single-point information with time tag CP56Time2a • <TI:=31> .. Double-point information with time tag CP56Time2a
CASDU, IOA .. Message address		Parameter-settable
QDS .. Quality descriptor		
BL .. Blocked		Not supported (BL = 0)
SB .. Substituted		Not supported (SB = 0)
NT .. Not topical		Not supported (NT = 0)
IV .. Invalid		Not supported (IV = 0)
Cause of transmission		
03 .. Spontaneous		With change of information state
20 .. Interrogated by station interrogation		Upon reception of a GI request
xx .. Other COTs		Not supported
T ..Test		Not supported
Information		
Single-point information status		
SPI	0 .. OFF	Supported
	1 .. ON	Supported
Double-point information state		

Elements of the message		
DPI	0 .. Indeterminate or intermediate state	Supported
	1 .. OFF	Supported
	2 .. ON	Supported
	3 .. Indeterminate state	Supported
Time tag		
CP56Time2a .. Date + time		PRE internal time (receive time)

NOTE

Not listed elements of the IEC 60870-5-101/104 message are not rated / not supported!

Message elements		
TI .. Type identification		• <TI:=45> .. Single command • <TI:=46> .. Double command
CASDU, IOA .. Message address		Parameter-settable
Cause of transmission		
06 .. Activation		Supported
xx .. Other COTs		Not supported
T ..Test		Not supported
Information (SCO/DCO)		
Single command state		[only <TI:=45>]
SCS	0 .. OFF	Supported
	1 .. ON	Supported
Double command state		[only <TI:=46>]
DCS	0 .. Not allowed	Supported
	1 .. OFF	Supported
	2 .. ON	Supported
	3 .. Not allowed	Supported
S/E		
QOC	0 = Execute	Supported
	1 = Select	Not supported
Command qualifier		
QU	0 .. No additional definitions	Supported
	1 .. Short pulse duration	Supported
	2 .. Long pulse duration	Supported
	3 .. Persistent command	Not supported

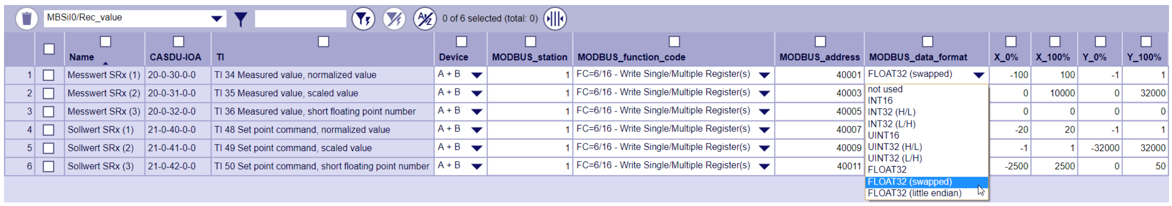
NOTE

Not listed elements of the IEC 60870-5-101/104 message are not rated / not supported!

Measured Values, Setpoint Values

The parameterization of the address and message conversion for measured values, setpoint values from Modbus TCP Slave (“Server”) in receive direction is to be done with the SICAM Device Manager with the function “Signals” or with the SICAM TOOLBOX II, OPM II.

Processing type: *firmware* / **`Rec_value`**


MBSil0/Rec_value
0 of 6 selected (total: 0)

	Name	CASDU-IOA	TI	Device	MODBUS_station	MODBUS_function_code	MODBUS_address	MODBUS_data_format	X_0%	X_100%	Y_0%	Y_100%
1	Messwert SRx (1)	20-0-30-0-0	TI 34 Measured value, normalized value	A + B	1	FC=6/16 - Write Single/Multiple Register(s)	40001	FLOAT32 (swapped)	-100	100	-1	1
2	Messwert SRx (2)	20-0-31-0-0	TI 35 Measured value, scaled value	A + B	1	FC=6/16 - Write Single/Multiple Register(s)	40003		0	10000	0	32000
3	Messwert SRx (3)	20-0-32-0-0	TI 36 Measured value, short floating point number	A + B	1	FC=6/16 - Write Single/Multiple Register(s)	40005		0	0	0	0
4	Sollwert SRx (1)	21-0-40-0-0	TI 48 Set point command, normalized value	A + B	1	FC=6/16 - Write Single/Multiple Register(s)	40007		-20	20	-1	1
5	Sollwert SRx (2)	21-0-41-0-0	TI 49 Set point command, scaled value	A + B	1	FC=6/16 - Write Single/Multiple Register(s)	40009		-1	1	-32000	32000
6	Sollwert SRx (3)	21-0-42-0-0	TI 50 Set point command, short floating point number	A + B	1	FC=6/16 - Write Single/Multiple Register(s)	40011		-2500	2500	0	50

[MBSil0_DM_Empf_Wert, 2, en_US]

Parameter	
`TI`	Supported type identifications: • <TI:=34> .. Measured value, normalized value with time tag CP56Time2a • <TI:=35> .. Measured value, scaled value with time tag CP56Time2a • <TI:=36> .. Measured value, short floating-point number with time tag CP56Time2a • <TI:=48> .. Setpoint command, normalized value • <TI:=49> .. Setpoint command, scaled value • <TI:=50> .. Setpoint command, short floating-point number
`Name`	Name of the signal
`CASDU-IOA`	SICAM A8000 internal IEC 60870-5-101/104 message address (CASDU1, CASDU2, IOA1, IOA2, IOA3)
`MODBUS_Station`	Address of the Modbus Slave (SICAM A8000 internal): • 0 to 99
`MODBUS_function_code`	Supported Modbus function codes: • FC = 06 .. WRITE SINGLE REGISTER • FC = 16 .. WRITE MULTIPLE REGISTERS
`MODBUS_address`	Modbus address (register address): • 1 to 65535 • 1 to 65534 [for all Modbus double register formats (e.g., FLOAT32)]

Parameter	
`MODBUS_data_format`	Data format on the Modbus: • INT16 • INT32 (H/L) [only FC = 16] • INT32 (L/H) [only FC = 16] • UINT16 • UINT32 (H/L) [only FC = 16] • UINT32 (L/H) [only FC = 16] • FLOAT32 [only FC = 16] • FLOAT32 (swapped) [only FC = 16] • FLOAT32 (little endian) [only FC = 16]
`X_0%, X_100%` **`Y_0%, Y_100%`**	Parameters for value adaptation (scaling) • valid range of value for X_0% and X_100% see *13.8.12 Modbus Data Formats* • <TI:=34> .. Y_0% and Y_100% must not be greater or less than ± 1 • <TI:= 35> .. Y_0% and Y_100% must not be less than -32768 or greater than +32767. • Value adoption inactive at X_0% = 0 and X_100% = 0

Supported Data Formats

Format	Modbus data format	IEC 60870-5-101/104 Data format (TI)
INT16	Signed integer 16-bit	34, 35, 36, 48, 49, 50
INT32 (H/L)	Signed integer 32-bit (HIGH before LOW)	34, 35, 36, 48, 49, 50
INT32 (L/H)	Signed integer 32-bit (LOW before HIGH)	34, 35, 36, 48, 49, 50
UINT16	Unsigned integer 16-bit	34, 35, 36, 48, 49, 50
UINT32 (H/L)	Unsigned integer 16-bit (HIGH before LOW)	34, 35, 36, 48, 49, 50
UINT32 (L/H)	Unsigned integer 32-bit (LOW before HIGH)	34, 35, 36, 48, 49, 50
FLOAT32	Short floating-point (IEEE 754)	34, 35, 36, 48, 49, 50
FLOAT32 (swapped)	Short floating-point (IEEE 754) "swapped"	34, 35, 36, 48, 49, 50
FLOAT32 (little endian)	Short floating-point (IEEE 754) "little endian"	34, 35, 36, 48, 49, 50

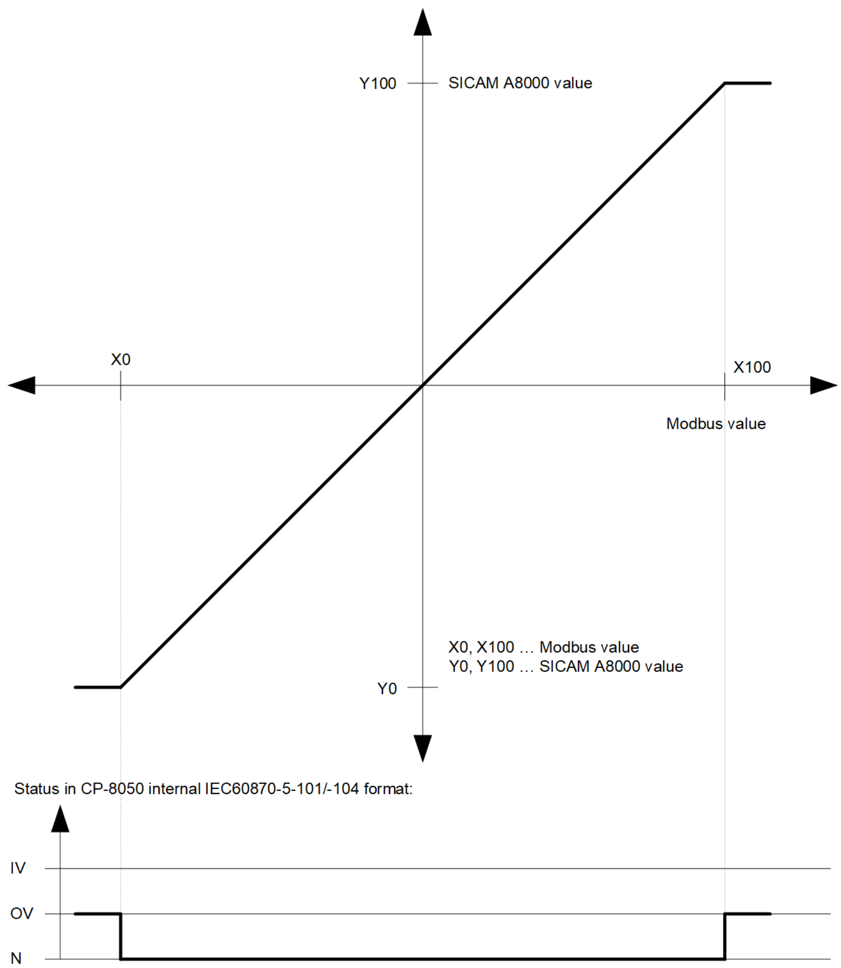
NOTE

As Modbus protocol does not define representation of data in coil/registers the Modbus format must be specified for the message conversion. Supported Modbus data formats see *13.8.12 Modbus Data Formats*.

Modbus data formats, that require multiple registers (e.g. FLOAT32), must always be transmitted in the same Modbus message!

Value adaptation

The value adaptation is defined by the parameters **`X_0%`**, **`X_100%`**, **`Y_0%`**, **`Y_100%`**.



The value adaptation is only performed if **`X_0%`** or **`X_100%`** ≠ *0* is parameterized.

If the Modbus value is outside the value range of the selected IEC 60870-5-101/104 type identifier when the value adoption (= direct transfer) is not activated, then OV = 1 is set.

Change Handling

Received values are only passed on to the basic system element by the Modbus slave protocol element if they are changed.

Since measured values from the Modbus master → slave with FC = 06, 16 are usually only transmitted spontaneously when changed, a measured value change handling with additive threshold value procedure with **`Thresh_uncond`** and **`Thresh_additive`** is not implemented in Modbus TCP slave for SICAM A8000.

Message Conversion

The table describes the evaluated elements of the IEC 60870-5-101/104 message during message conversion.

Elements of the message	
TI .. Type identification	• <TI:=34> .. Measured value, normalized value with time tag CP56Time2a • <TI:=35> .. Measured value, scaled value with time tag CP56Time2a • <TI:=36> .. Measured value, short floating-point number with time tag CP56Time2a • <TI:=48> .. Setpoint command, normalized value • <TI:=49> .. Setpoint command, scaled value • <TI:=50> .. Setpoint command, short floating-point number
CASDU, IOA .. Message address	Parameter-settable
QDS .. Quality descriptor	
BL .. Blocked	Not supported (BL = 0)
SB .. Substituted	Not supported (SB = 0)
NT .. Not topical	NT = 1 if • FLOAT32 format with the value = NAN (Not A Number) or with the value = ∞ (the last received valid value is passed with NT=1)
IV .. Invalid	Not supported (IV = 0)
OV .. Overflow	OV = 1: • Without value adaptation: – Modbus value outside the range of the selected type identification • With value adaptation: – Modbus value less than X_0% or greater X_100%
Cause of transmission	
03 .. Spontaneous	Alteration of the measured value depending on the thresholds or alteration of the quality descriptor [only <TI:=34, 35, 36>]
06 .. Activation	Supported [only <TI:=48, 49, 50>]
20 .. Interrogated by station interrogation	After receipt of a GI request [only <TI:=34, 35, 36>]
xx .. Other COTs	Not supported
T .. Test	Not supported
Information	
Single-point information status	
Value.. S .. Sign	• Normalized value • Scaled value • IEEE STD 754 = short floating-point number
Time tag	
CP56Time2a .. Date + time	PRE internal time (receive time)

NOTE

Not listed elements of the IEC 60870-5-101/104 message are not rated / not supported!

13.8.11 Interoperability

13.8.11.1 Interoperability Modbus TCP Master "Client"

The companion standard defined presents sets of parameters and alternatives from which subsets have to be selected to implement particular telecontrol systems. Other parameters, such as the listed set of different Modbus Function Codes or Modbus Data Formats in command and in monitoring direction allow the specification of the complete set or subsets, as appropriate for given applications. This clause summarizes the parameters of the previous clauses to facilitate a suitable selection for a specific application. If a system is composed of equipment stemming from different manufacturers it is necessary that all partners agree on the selected parameters.

The selected parameters should be crossed in the white boxes.

☐	Function is not supported
X	Function is supported
■	~~Function not defined for this application!~~

Note:
In addition, the full specification of a system may require individual selection of certain parameters for certain parts of the system, such as the individual selection of scaling factors for individually addressable measured values.

Network Configuration

	Configuration	Note
X	LAN / WAN	

Physical layer

Electrical interface

	Selection	Note
X	Ethernet (electrical)	
X	Ethernet (optical)	For Ethernet (optical) external converters are required!

Transmission Speed

	Transmission speed	Note
X	10 Mbit/s	
X	100 Mbit/s	
☐	1000 Mbit/s	

TCP Port

	TCP port	Note
X	502	Registered port number for Modbus TCP. The port number for Modbus TCP is fixed by default.
X	1 to 65535	User specific port number for Modbus TCP.

Connections

	Number of connections	Note
X	Max. 100	

Note:
Each connection can be used as “Server” with individual data base, unique Modbus slave address and unique TCP/IP address of the “Client”.

Link Layer (Modbus)

	Transmission mode
X	TCP/IP mode
	UDP mode

TCP mode

	Byte frame	Note
X	8 data bits	

	Modbus settings	Note
X	Modbus transaction number (16 bits)	MBAP header
X	Protocol identifier = “0” (16-Bit)	MBAP header
X	Length (16 bits)	MBAP header
X	Unit identifier (8 bits)	MBAP header
■	~~Modbus slave address (8 bits)~~	
X	Modbus function code (8 bits)	
X	Modbus register address (16 bits)	The Modbus address addresses a 16-bit Modbus register
■	~~Cyclic redundancy check "CRC" (16 bits)~~	CRC is not used with Modbus TCP (CRC of the TCP/IP frame is used)

MBAP header ... Modbus Application Protocol Header

Link Layer

	Description	Note
X	Unbalanced transmission Master/Slave	
X	Modbus TCP Master (Client)	
☐	Modbus TCP Slave (Server)	

Message Length

	Description	Note
X	TCP Mode: Maximum message length 253 Bytes	

Address of the Link Layer

	Description	Note
X	1 octet (8 bits) ... Unit identifier	Unit identifier (1 to 247, 255) (Modbus slave address 1 to 247)
☐	Broadcast addressing	

Application Layer

Modbus Function Codes

	Modbus function code	Data formats
	Data access (read/write bit)	
X	01 = Read Coils	<20> SPI <21> DPI (1 = off, 2 = on) <22> DPI (1 = on, 2 = off)
X	02 = Read Discrete Inputs	<20> SPI <21> DPI (1 = off, 2 = on) <22> DPI (1 = on, 2 = off)
X	05 = Write Single Coil	<20> SPI <30> SC <31> SC (pulse) <35> DC2 (pulse)
X	15 = Write Multiple Coils	<20> SPI <30> SC <31> SC (pulse) <32> DC <35> DC2 (pulse)
	Data access (16-bit read/write)	

	Modbus function code	Data formats
X	03 = Read Holding Registers	<01> INT16 <02> UINT16 <03> INT32 (H/L) <04> UINT32 (H/L) <05> INT32 (L/H) <06> UINT32 (L/H) <7a> FLOAT32 <7b> FLOAT32 (swapped) <7c> FLOAT32 (little endian) <16> BS16 <20> SPI <21> DPI (1 = off, 2 = on) <22> DPI (1 = on, 2 = off) <23> INT16 + IV <24> UINT16 + IV <50> SPI + IV <51> DPI (1 = off, 2 = on) + IV <52> DPI (1 = on, 2 = off) + IV
X	04 = Read Input Registers	<01> INT16 <02> UINT16 <03> INT32 (H/L) <04> UINT32 (H/L) <05> INT32 (L/H) <06> UINT32 (L/H) <7a> FLOAT32 <7b> FLOAT32 (swapped) <7c> FLOAT32 (little endian) <16> BS16 <20> SPI <21> DPI (1 = off, 2 = on) <22> DPI (1 = on, 2 = off) <23> INT16 + IV <24> UINT16 + IV <50> SPI + IV <51> DPI (1 = off, 2 = on) + IV <52> DPI (1 = on, 2 = off) + IV
X	06 = Write Single Register	<01> INT16 <02> UINT16 <16> BS16 <20> SPI [344] <30> SC [344] <31> SC (pulse) [344] <32> DC [344] <35> DC2 (pulse) [344]

344 Only 1 data point is supported per Modbus register!

	Modbus function code	Data formats
X	16 = Write Multiple Registers	<01> INT16 <02> UINT16 <03> INT32 (H/L) <04> UINT32 (H/L) <05> INT32 (L/H) <06> UINT32 (L/H) <7a> FLOAT32 <7b> FLOAT32 (swapped) <7c> FLOAT32 (little endian) <16> BS16 <20> SPI [344] <30> SC [344] <31> SC (pulse) [344] <32> DC [344] <35> DC2 (pulse) [344] <1xx> DTx
☐	22 = Mask Write Register	
☐	23 = Read / Write Multiple Registers	
☐	24 = Read FIFO Queue	
	Data access (read/write file)	
☐	20 = Read File Record	
☐	21 = Write File Record	
	Diagnosis	
☐	07 = Read Exception Status	
☐	08 = Diagnostics (Sub-Code 00 to 18, 20)	
☐	11 = Get Com Event Counter	
☐	12 = Get Com Event Log	
☐	17 = Report Slave ID	
☐	43 = Read Device Identification (Sub-Code = 14)	
	Other	
☐	43 = Encapsulated Interface Transport (Sub-Code 13, 14)	

Modbus Exception Status

	Modbus exception code[345]	Note
X	01 = Illegal Function	Modbus function code not implemented
X	02 = Illegal Data Address	Requested Data Address not implemented (not available)
X	03 = Illegal Data Value	Illegal data for the Modbus register.
X	04 = Server Failure	The server failed during execution.
X	05 = Acknowledge	The Server has accepted the service call, but the service takes a relatively long time to execute. The Server therefore only sends back a confirmation of the service call confirmation.
X	06 = Server Busy	The Server could not accept the requests. The Client must decide if and when the request should be sent again.
X	10 (0x0A) = Gateway Problem (Gateway Paths not available)	Gateway paths not available. Retry by the Modbus TCP Master for serial Modbus Slaves (connected via gateway)
X	11 (0x0B) = Gateway Problem (The targeted device failed to respond)	The addressed substation does not respond. This exception is generated by the gateway. Retry through the Modbus TCP Master for serial Modbus slaves (connected via gateway)

Note:

- Requested data which are answered by the Modbus TCP slave with exception code (except 10, 11), are mapped with NT = 1 (not topical) - no retries on Modbus TCP level.
- The exception codes are not specially evaluated by the Modbus TCP master – a received exception code is rated as negative acknowledgment.

13.8.11.2 Interoperability Modbus TCP Slave “Server”

The companion standard defined presents sets of parameters and alternatives from which subsets have to be selected to implement particular telecontrol systems. Other parameters, such as the listed set of different Modbus Function Codes or Modbus Data Formats in command and in monitoring direction allow the specification of the complete set or subsets, as appropriate for given applications. This clause summarizes the parameters of the previous clauses to facilitate a suitable selection for a specific application. If a system is composed of equipment stemming from different manufacturers it is necessary that all partners agree on the selected parameters.

The selected parameters should be crossed in the white boxes.

☐ Function is not supported

☒ Function is supported

■ Function not defined for this application!

[345] The exception codes are not specially evaluated by the Modbus TCP master - a received exception code is rated as negative acknowledgment.

Note:
In addition, the full specification of a system may require individual selection of certain parameters for certain parts of the system, such as the individual selection of scaling factors for individually addressable measured values.

Network configuration

	Configuration	Note
X	LAN / WAN	

Physical layer

Electrical interface

	Selection	Note
X	Ethernet (electrical)	
X	Ethernet (optical)	For Ethernet (optical) external converters are required!

Transmission Speed

	Transmission speed	Note
X	10 Mbit/s	
X	100 Mbit/s	
	1000 Mbit/s	

TCP Port

	TCP port	Note
X	502	Registered port number for Modbus TCP. The port number for Modbus TCP is fixed by default.
X	1 to 65535	User specific port number for Modbus TCP.

Connections

	Number of connections	Note
X	Max. 100	

Note:
Each connection can be used as “Server” with individual data base, unique Modbus slave address and unique TCP/IP address of the “Client”.

Link Layer (Modbus)

	Transmission mode
X	TCP/IP mode
	UDP mode

TCP Mode

	Byte frame	Note
X	8 data bits	

	Modbus settings	Note
X	Modbus transaction number (16 bits)	MBAP header
X	Protocol identifier = “0” (16-Bit)	MBAP header
X	Length (16 bits)	MBAP header
X	Unit identifier (8 bits)	MBAP header
■	~~Modbus slave address (8 bits)~~	
X	Modbus function code (8 bits)	
X	Modbus register address (16 bits)	The Modbus address addresses a 16-bit Modbus register
■	~~Cyclic redundancy check "CRC" (16 bits)~~	CRC is not used with Modbus TCP (CRC of the TCP/IP frame is used)

MBAP header ... Modbus Application Protocol Header

Link Layer

	Description	Note
X	Unbalanced transmission Master/Slave	
	Modbus TCP Master (Client)	
X	Modbus TCP Slave (Server)	

Message Length

	Description	Note
X	TCP Mode: Maximum message length 253 Bytes	

Address of the Link Layer

	Description	Note
X	1 octet (8 bits) ... Unit identifier	Unit identifier (1 to 247, 255) (Modbus slave address 1 to 247)
	Broadcast addressing	

Application Layer

Modbus Function Codes

	Modbus function code	Data formats
	Data access (read/write bit)	
X	01 = Read Coils	<20> SPI <21> DPI (1 = off, 2 = on) <22> DPI (1 = on, 2 = off)
X	02 = Read Discrete Inputs	<20> SPI <21> DPI (1 = off, 2 = on) <22> DPI (1 = on, 2 = off)
X	05 = Write Single Coil	<20> SPI <30> SC <31> SC (pulse) <35> DC2 (pulse)
X	15 = Write Multiple Coils	<20> SPI <21> DPI (1 = off, 2 = on) <22> DPI (1 = on, 2 = off) <30> SC <31> SC (pulse) <32> DC <35> DC2 (pulse)
	Data access (16-bit read/write)	
X	03 = Read Holding Registers	<01> INT16 <02> UINT16 <03> INT32 (H/L) <04> UINT32 (H/L) <05> INT32 (L/H) <06> UINT32 (L/H) <7a> FLOAT32 <7b> FLOAT32 (swapped) <7c> FLOAT32 (little endian) <16> BS16 <20> SPI <21> DPI (1 = off, 2 = on) <22> DPI (1 = on, 2 = off) <23> INT16 + IV <24> UINT16 + IV <50> SPI + IV <51> DPI (1 = off, 2 = on) + IV <52> DPI (1 = on, 2 = off) + IV

	Modbus function code	Data formats
X	04 = Read Input Registers	<01> INT16 <02> UINT16 <03> INT32 (H/L) <04> UINT32 (H/L) <05> INT32 (L/H) <06> UINT32 (L/H) <7a> FLOAT32 <7b> FLOAT32 (swapped) <7c> FLOAT32 (little endian) <16> BS16 <20> SPI <21> DPI (1 = off, 2 = on) <22> DPI (1 = on, 2 = off) <23> INT16 + IV <24> UINT16 + IV <50> SPI + IV <51> DPI (1 = off, 2 = on) + IV <52> DPI (1 = on, 2 = off) + IV
X	06 = Write Single Register	<01> INT16 <02> UINT16 <20> SPI [346] <21> DPI (1 = off, 2 = on) [346] <22> DPI (1 = on, 2 = off) [346] <30> SC [346] <31> SC (pulse) [346] <32> DC [346] <35> DC2 (pulse) [346]
X	16 = Write Multiple Registers	<01> INT16 <02> UINT16 <03> INT32 (H/L) <04> UINT32 (H/L) <05> INT32 (L/H) <06> UINT32 (L/H) <7a> FLOAT32 <7b> FLOAT32 (swapped) <7c> FLOAT32 (little endian) <20> SPI [346] <21> DPI (1 = off, 2 = on) [346] <22> DPI (1 = on, 2 = off) [346] <30> SC [346] <31> SC (pulse) [346] <32> DC [346] <35> DC2 (pulse) [346]
	22 = Mask Write Register	

346 Per Modbus register several data points are supported!

	Modbus function code	Data formats
☐	23 = Read / Write Multiple Registers	
☐	24 = Read FIFO Queue	
	Data access (read/write file)	
☐	20 = Read File Record	
☐	21 = Write File Record	
	Diagnosis	
☐	07 = Read Exception Status	
☐	08 = Diagnostics (Sub-Code 00 to 18, 20)	
☐	11 = Get Com Event Counter	
☐	12 = Get Com Event Log	
☐	17 = Report Slave ID	
☐	43 = Read Device Identification (Sub-Code = 14)	
	Other	
☐	43 = Encapsulated Interface Transport (Sub-Code 13, 14)	

Modbus Exception Status

	Modbus exception codes	Note
X	01 = Illegal Function	Modbus Function Code not implemented
X	02 = Illegal Data Address	Requested data not implemented (not available) or Modbus data formats not fully queried across multiple registers/coils (FLOAT32, INT32, DP, etc.).
X	03 = Illegal Data Value	Illegal data for the Modbus register.
X	04 = Server Failure	If the slave's internal status for queried data is IV = 1, then the old value/substitute value or exception code = 4 is transmitted (configurable).
☐	05 = Acknowledge	The Server has accepted the service call, but the service takes a relatively long time to execute. The Server therefore only sends back a confirmation of the service call confirmation.
☐	06 = Server Busy	The Server could not accept the requests. The Client must decide if and when the request should be sent again.

	Modbus exception codes	Note
☐	10 (0x0A) = Gateway Problem (Gateway Paths not available)	Gateway paths not available. Retry by the Modbus TCP Master for serial Modbus Slaves (connected via gateway).
☐	11 (0x0B) = Gateway	The addressed substation does not respond. This exception is generated by the gateway. Retry by the Modbus TCP Master for serial Modbus Slaves (connected via gateway).

13.8.12 Modbus Data Formats

Supported Modbus data formats:

Format #	Format	Designation	Register	Coil
General formats				
1	INT16	Signed integer 16-bit	✓	–
2	UINT16	Unsigned integer 16-bit	✓	–
3	INT32 (H/L)	Signed integer 32-bit (HIGH before LOW)	✓	–
4	UINT32 (H/L)	Unsigned integer 32-bit (HIGH before LOW)	✓	–
5	INT32 (L/H)	Signed integer 32-bit (LOW before HIGH)	✓	–
6	UINT32 (L/H)	Unsigned integer 32-bit (LOW before HIGH)	✓	–
7a	FLOAT32	Short floating-point (IEEE 754)	✓	–
7b	FLOAT32 (swapped)	Short floating-point (IEEE 754) "swapped"	✓	–
7c	FLOAT32 (little endian)	Short floating-point (IEEE 754) "little endian"	✓	–
16	Bitstring 16-bit	Bitstring of 16 bit	✓	–
20	SPI	Single-point information	✓	✓
21	DPI (1 = off, 2 = on)	Double-point information (OFF before ON)	✓	✓
22	DPI (1 = on, 2 = off)	Double-point information (ON before OFF)	✓	✓
23	S2B	Status information - 2-bit	✓	–
24	S3B	Status information - 3-bit	✓	–
25	S4B	Status information - 4-bit	✓	–
30	SC	Single command	✓	✓
31	SC (pulse)	Single command "pulse"	✓	✓
32	DC	Double command	✓	✓
33	DC1	Double command (1 bit)	✓	✓
35	DC2 (pulse)	Double command "pulse"	✓	✓
Device specific formats				
50	SPI + IV	Single-point information + invalid identifier	✓	–
51	DPI (1 = off, 2 = on) + IV	Double-point information (OFF before ON) + invalid identifier	✓	–
52	DPI (1 = on, 2 = off) + IV	Double-point information (ON before OFF) + invalid identifier	✓	–
53	INT16 + IV	Signed integer 16-bit + invalid identifier	✓	–
54	UINT16 + IV	Unsigned integer 16-bit + invalid identifier	✓	–
1xx	DTx	Date & time (free parameter-settable)	✓	–

Data formats in a Modbus register are always displayed/transmitted in "big endian" (HIGH before LOW order).

Data in Modbus Register:

	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0	
Data byte 0	2^{15}							2^8	MSB
Data byte 1	2^7							2^0	LSB

The most significant bit (MSB) is transmitted first!

Format-1: INT16 – Signed Integer 16-Bit

	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
Data byte 0	S	2^{14}						2^8
Data byte 1	2^7							2^0

S (sign): <0> = "+"; <1> = "-"
Value range: -32768 0 to +32767
Note: Negative values will be stored in two's complement.

Format-2: UINT16 – Unsigned Integer 16 Bit

	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
Data byte 0	2^{15}							2^8
Data byte 1	2^7							2^0

Value range: 0 to 65535

Format-3: INT32 (H/L) – Signed Integer 32 Bit (HIGH before LOW)

	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
Data byte 0	S	2^{30}						2^{24}
Data byte 1	2^{23}							2^{16}
Data byte 2	2^{15}							2^8
Data byte 3	2^7							2^0

S (sign): <0> = "+"; <1> = "-"
Value range: -2 147 483 648 to 0 to +2 147 483 647
Note: Negative values will be stored in two's complement.

Format-4: UINT32 (H/L) – Unsigned Integer 32 Bit (HIGH before LOW)

	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
Data byte 0	2^{31}							2^{24}
Data byte 1	2^{23}							2^{16}
Data byte 2	2^{15}							2^8
Data byte 3	2^7							2^0

Value range: 0 to 4 294 967 295

Format-5: INT32 (L/H) – Signed Integer 32 Bit (LOW before HIGH)

	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
Data byte 0	2^{15}							2^8
Data byte 1	2^7							2^0
Data byte 2	S	2^{30}						2^{24}
Data byte 3	2^{23}							2^{16}

S (sign): <0> = "+"; <1> = "-"
Value range: -2 147 483 648 to 0 to +2 147 483 647
Note: Negative values will be stored in two's complement.

Format-6: UINT32 (L/H) – Unsigned Integer 32 Bit (LOW before HIGH)

	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
Data byte 0	2^{15}							2^8
Data byte 1	2^7							2^0
Data byte 2	2^{31}							2^{24}
Data byte 3	2^{23}							2^{16}

Value range: 0 to 4 294 967 295

Format-7a: FLOAT32 – Short Floating-Point (IEEE 754)

	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0	
Data byte 0	2^{-8}							2^{-15}	Mantissa
Data byte 1	2^{-16}							2^{-23}	Mantissa
Data byte 2	S	2^7						2^1	Exponent, S
Data byte 3	2^0	2^{-1}						2^{-7}	Mantissa

Value range:~$1.1 \cdot 10^{-38}$ bis~$3.4 \cdot 10^{38}$
S (sign): <0> = "+"; <1> = "-"
Exponent: <255> = "NaN" (not a number) or∞

Format-7b: FLOAT32 (swapped) – Short Floating-Point (IEEE 754) "Swapped"

	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0	
Data byte 0	S	2^7						2^1	Exponent, S
Data byte 1	2^0	2^{-1}						2^{-7}	Mantissa
Data byte 2	2^{-8}							2^{-15}	Mantissa
Data byte 3	2^{-16}							2^{-23}	Mantissa

Value range:~$1.1 \cdot 10^{-38}$ bis~$3.4 \cdot 10^{38}$
S (sign): <0> = "+"; <1> = "-"
Exponent: <255> = "NaN" (not a number) or∞

Format-7c: FLOAT32 (little endian) – Short Floating-Point (IEEE 754) "Little Endian"

	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0	
Data byte 0	2^{-16}							2^{-23}	Mantissa
Data byte 1	2^{-8}							2^{-15}	Mantissa
Data byte 2	2^0	2^{-1}						2^{-7}	Mantissa
Data byte 3	S	2^7						2^1	Exponent, S

Value range:~$1.1 \cdot 10^{-38}$ bis~$3.4 \cdot 10^{38}$
S (sign): <0> = "+"; <1> = "-"
Exponent: <255> = "NaN" (not a number) or∞

Format-16: Bitstring 16-Bit

	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
Data byte 0	2^{15}							2^8
Data byte 1	2^7							2^0

Format-20: SPI – Single-Point Information

Single-point information as coil or 1 bit in Modbus register.

	n
Coil	SPI

	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
Data byte 0	2^{15}							2^8
Data byte 1	2^7							2^0

	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
Data byte 0	SPI_{15}	SPI_{14}	SPI_{13}	SPI_{12}	SPI_{11}	SPI_{10}	SPI_9	SPI_8
Data byte 1	SPI_7	SPI_6	SPI_5	SPI_4	SPI_3	SPI_2	SPI_1	SPI_0

Note: Modbus Master firmware supports with function code FC=6,16
in transmit direction only 1x SPI for each Modbus register!

Value range: 0, 1

SPI – Single-Point Information

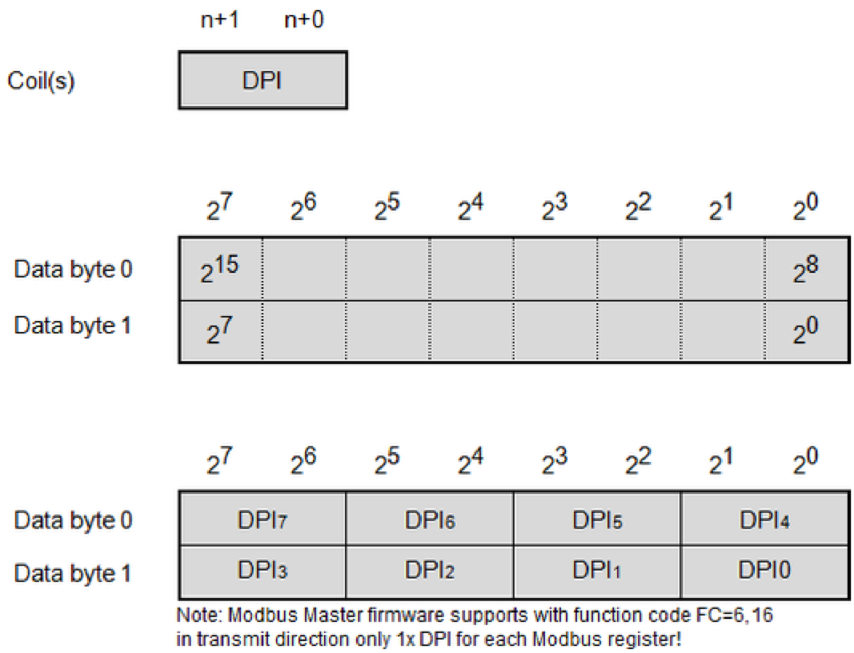
<0> = OFF
<1> = ON

Bit (n+0)	Coding (IEC 60870-5-101/104)
0	**OFF**
1	**ON**

Format-21: DPI (1 = off, 2 = on) – Double-Point Information (OFF before ON)

Format-22: DPI (1 = on, 2 = off) – Double-Point Information (ON before OFF)

Double-point information in 2 adjacent bits in the Modbus register or as 2 adjacent bits as coil.
Note:
The 2 bits of DPI must be located always in same byte of a Modbus register.



Value range: 0 to 3

DPI – Double-Point Information (OFF before ON)- DPI (1 = off, 2 = on)

<0> = Indeterminate or intermediate state

<1> = OFF

<2> = ON

<3> = Indeterminate state

DPI – Double-Point Information (ON before OFF)- DPI (1 = on, 2 = off)

<0> = Indeterminate or intermediate state

<1> = ON

<2> = OFF

<3> = Indeterminate state

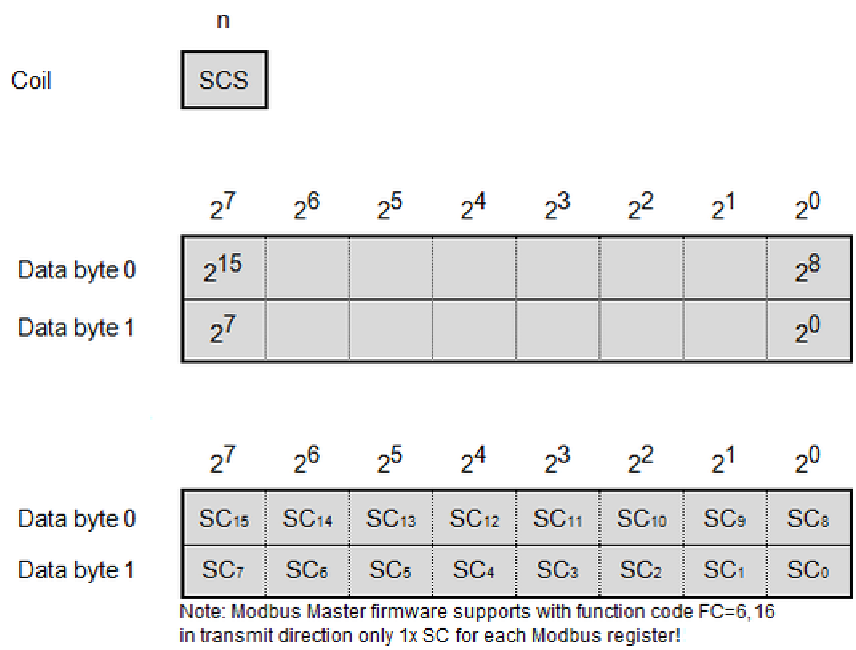
	Bit (n+1)	Bit (n+0)	Coding OFF before ON (IEC 60870-5-101/104)	Coding ON before OFF
0	0	0	INT	INT
1	**0**	**1**	**OFF**	**ON**
2	**1**	**0**	**ON**	**OFF**
3	1	1	FLT	FLT

INT .. Intermediate position (indeterminate or intermediate state)

FLT .. Faulty position (indeterminate state)

Format-30: SC – Single Command

A single command with command state ON or OFF can be sent as coil (1 bit) or as 1 bit Modbus register.



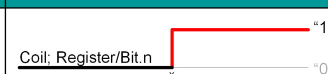
Value range: 0, 1

SCS – Single Command State

<0> = OFF

<1> = ON

Command	Modbus format	Command Transmission
Single command ON	SC	COIL (n); register/bit (n) = ON
Single command OFF	SC	COIL (n); register/bit (n) = "OFF"

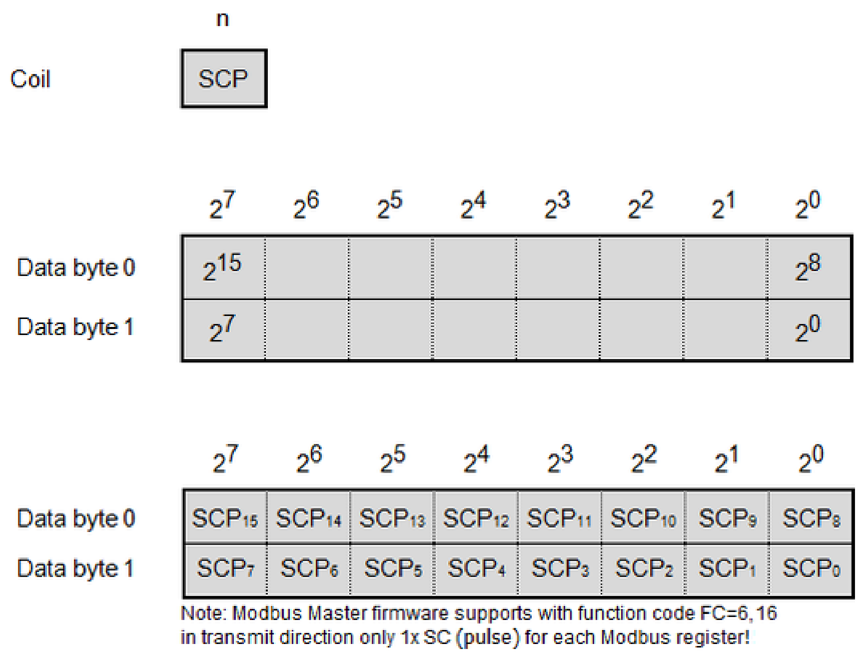
Modbus format	Command state	Command output SC as Coil or 1 Bit in Modbus Register
SC	SCS = ON	 x ... command = ON
	SCS = OFF	 x ... command = OFF

Format-31: SC (pulse) – Single Command (Pulse)

A single command with command state ON can be sent as pulse with the parametrized command output time as coil (1 bit) or as bit in the Modbus register .

The command state OFF is not evaluated.

The command state will be set to INACTIVE after command output time.



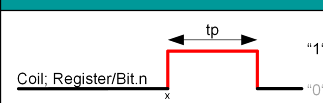
Value range: 0, 1

SCP – Command State (Pulse)

<0> = inactive

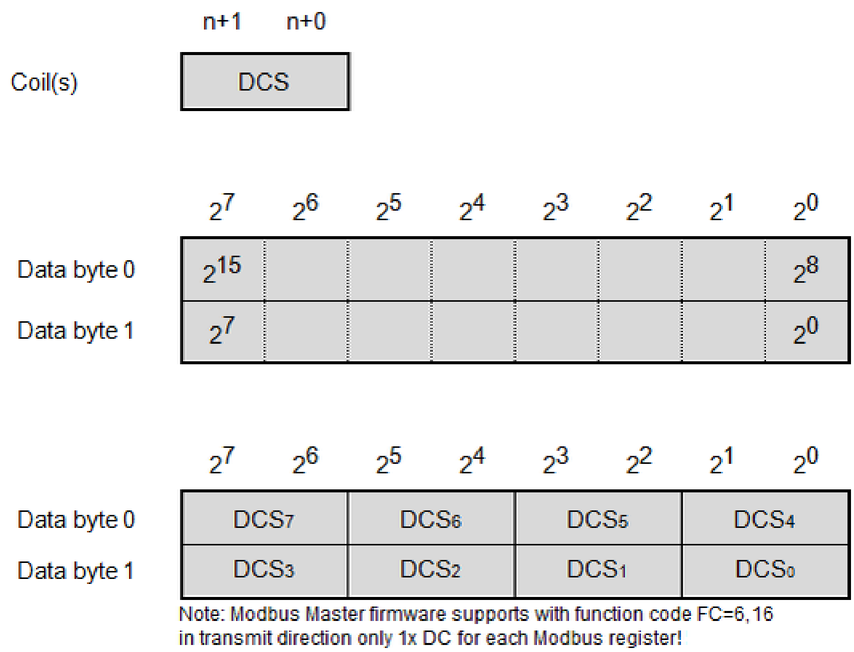
<1> = active

Command	Modbus format	Command Transmission
Single command ON	SC (pulse)	COIL (n); register/bit (n) = pulse

Modbus format	Command state	Command output SC as Coil or 1 Bit in Modbus Register
SC (pulse)	SCS = ON	 tp ... command output time (pulse duration) x ... command = ON
	SCS = OFF	The OFF state is not evaluated!

Format-32: DC – Double Command (2-Bit)

The command state of a double command resp. regulating step command (2 bit) is transferred with 2 consecutive bits as coils or bits in the Modbus register.

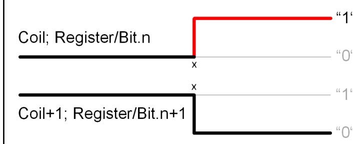
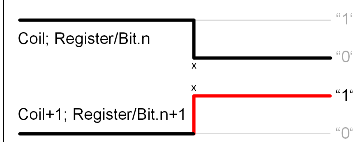
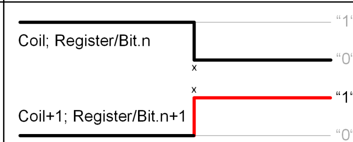
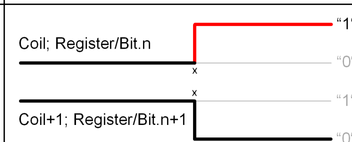


Value range: 0 to 3

DCS – Double Command State[Modbus_command_state = OFF]
<1> = OFF
<2> = ON

DCS – Double Command State[Modbus_command_state = ON]
<1> = ON
<2> = OFF

	Bit (n+1)	Bit (n+0)	Coding OFF before ON (IEC 60870-5-101/104) [Modbus_command_state = OFF]	Coding ON before OFF [Modbus_command_state = ON]
0	0	0	Not permitted	Not permitted
1	**0**	**1**	**OFF**	**ON**
2	**1**	**0**	**ON**	**OFF**
3	1	1	Not permitted	Not permitted

Modbus format	Command state	Command output 2 bits as coil or 2 bits in Modbus register
DC Modbus_command_state = ON	DCS = ON RCS = HIGHER	 x ... command = ON
	DCS = OFF RCS = LOWER	 x ... command = OFF
DC Modbus_command_state = OFF	DCS = ON RCS = HIGHER	 x ... command = ON
	DCS = OFF RCS = LOWER	 x ... command = OFF

Format-33: DC1 – Double Command (1 Bit)

A double command with command state ON or OFF can be sent as coil (1 bit) with coil address (n) or as 1 bit Modbus register.

	n
Coil	DCS

	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
Data byte 0	2^{15}							2^8
Data byte 1	2^7							2^0

	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
Data byte 0	DCS_{15}	DCS_{14}	DCS_{13}	DCS_{12}	DCS_{11}	DCS_{10}	DCS_9	DCS_8
Data byte 1	DCS_7	DCS_6	DCS_5	DCS_4	DCS_3	DCS_2	DCS_1	DCS_0

Note: Modbus Master firmware supports with function code FC=6,16
in transmit direction only 1x DC (1 bit) for each Modbus register!

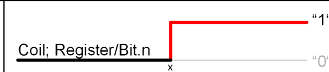
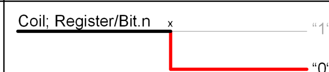
Value range: 0, 1

DCS – Double Command State (1 Bit)

<0> = OFF

<1> = ON

Command	Modbus format	Command Transmission
Double command ON	DC1	COIL (n); register/bit (n) = ON
Double command OFF	DC1	COIL (n); register/bit (n) = "OFF"

Modbus format	Command state	Command output DC as coil or 1 bit in Modbus register
DC1	DCS = ON	 x ... command = ON
	DCS = OFF	 x ... command = OFF

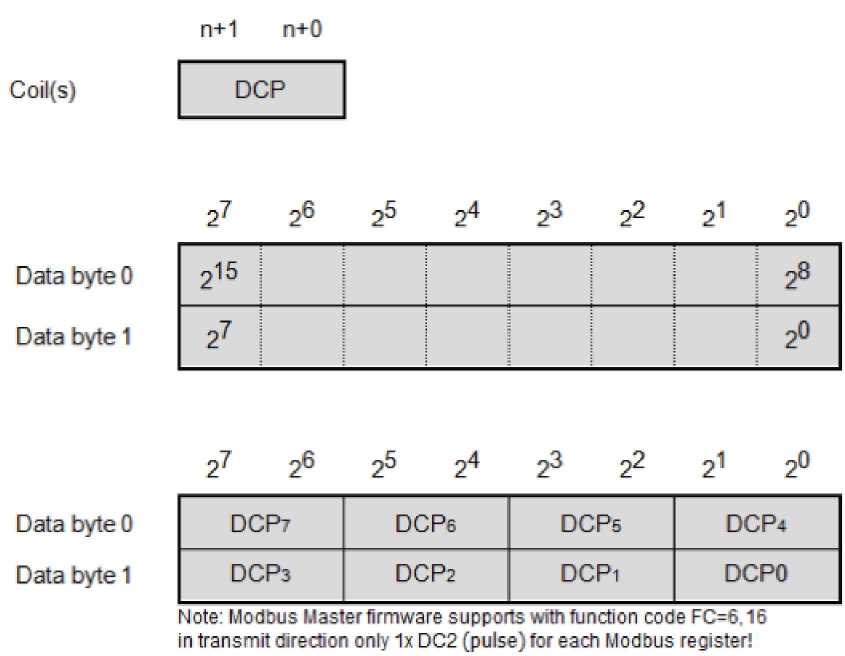
Format-35: DC2 (pulse) – Double Command (Pulse)

A double command or regulating step command with the command state DCS = ON/OFF or RCS = HIGHER/LOWER is transferred on Modbus with the set command output time as pulse (2 bits) with 2 coils or 2 bits in the Modbus register.

The command state ON or HIGH is transmitted as 1-bit pulse on coil address (n+0 or n+1) or in register address/bit (n+0 or n+1).

The command state OFF or LOWER is transmitted as 1-bit pulse on coil address (n+1 or n+0) or in register address/bit (n+1 or n+0).

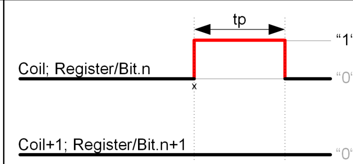
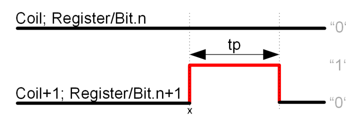
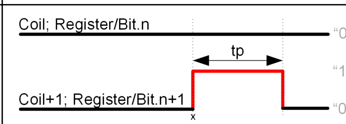
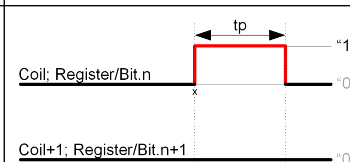
The command state will be set to INACTIVE after command output time.



Value range: 0 to 3

DCP – Double Command (Pulse) – per Bit

<0> = INACTIVE
<1> = ACTIVE

Modbus format	Command state	Command output 2 bits as coil or 2 bits in Modbus register
DC2 (pulse) Modbus_command_state = ON	DCS = ON RCS = HIGHER	 tp ... command output time (pulse duration) x ... command = ON
DC2 (pulse) Modbus_command_state = ON	DCS = OFF RCS = LOWER	 tp ... command output time (pulse duration) x ... command = OFF
DC2 (pulse) Modbus_command_state = OFF	DCS = ON RCS = HIGHER	 tp ... command output time (pulse duration) x ... command = ON
DC2 (pulse) Modbus_command_state = OFF	DCS = OFF RCS = LOWER	 tp ... command output time (pulse duration) x ... command = OFF

Format-50: SPI + IV – Single-Point Information + Invalid Identifier

	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
Data byte 0	IV	SPI14	SPI13	SPI12	SPI11	SPI10	SPI09	SPI08
Data byte 1	SPI07	SPI06	SPI05	SPI04	SPI03	SPI02	SPI01	SPI00

IV (invalid identifier):
<0> = Valid
<1> = Invalid

SPI (Single-Point Information)

<0> = OFF
<1> = ON

Note:

- IV bit applies to all binary information in the Modbus register.
- Unused SPIs/bits are transferred with <0>.
- In a Modbus register several single- and double-point information can be transmitted mixed.

Format-51: DPI (1 = off, 2 = on) + IV – Double-Point Information (OFF before ON) + Invalid Identifier

Format-52: DPI (1 = on, 2 = off) + IV – Double-Point Information (ON before OFF) + Invalid Identifier

	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
Databyte 0	IV		DPI6		DPI5		DPI4	
Databyte 1	DPI3		DPI2		DPI1		DPI0	

IV (invalid identifier):
<0> = Valid
<1> = Invalid

Double-Point Information (OFF before ON)DPI (1 = off, 2 = on)
<0> = Indeterminate or intermediate state
<1> = OFF
<2> = ON
<3> = Indeterminate state

Double-Point Information (ON before OFF)DPI (1 = on, 2 = off)
<0> = Indeterminate or intermediate state
<1> = ON
<2> = OFF
<3> = Indeterminate state

	Bit (n+1)	Bit (n+0)	Coding OFF before ON (IEC 60870-5-101/104)	Coding ON before OFF
0	0	0	INT	INT
1	**0**	**1**	**OFF**	**ON**
2	**1**	**0**	**ON**	**OFF**
3	1	1	FLT	FLT

INT .. Intermediate position (indeterminate or intermediate state)
FLT .. Faulty position (indeterminate state)

Note:

- IV bit applies to all binary information in the Modbus register.
- Unused DPIs/bits are transferred with <0>.
- In a Modbus register several single-point and double-point information items can be transmitted mixed.
- Double-point information items must always be transferred completely in a Modbus register byte.

Format-53: INT16 + IV – Signed Integer 16-Bit + Invalid Identifier

	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
Databyte 0	IV	S	2^{13}					2^8
Databyte 1	2^7							2^0

IV (invalid identifier):
<0> = Valid
<1> = Invalid
S (sign):
<0> = "+"
<1> = "–"
Value range: -16384 0 to +16383
Note: Negative values will be stored in two's complement.

Format-54: UINT16 + IV – Unsigned Integer 16-Bit + Invalid Identifier

	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
Databyte 0	IV	2^{14}						2^8
Databyte 1	2^7							2^0

IV (invalid identifier):
<0> = Valid
<1> = Invalid
Value range: 0 to 32767

Format-1xx: DTx – Date + Time (free configurable)

	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0	
Data byte 0	2^{15}							2^8	HIGH – time element
Data byte 1	2^7							2^0	LOW – time element
Data byte 2	2^{15}							2^8	HIGH – time element
Data byte 3	2^7							2^0	LOW – time element
Data byte 4	2^{15}							2^8	HIGH – time element
Data byte 5	2^7							2^0	LOW – time element
Data byte 6	2^{15}							2^8	HIGH – time element
Data byte 7	2^7							2^0	LOW – time element
Data byte 8	2^{15}							2^8	HIGH – time element
Data byte 9	2^7							2^0	LOW – time element
Data byte 10	2^{15}							2^8	HIGH – time element
Data byte 11	2^7							2^0	LOW – time element

Note:

- Only the configured number of bytes will be sent.
- If “End of Frame” is in the HIGH data byte, then the Modbus register will not be sent.
- If “End of Frame” is in the LOW data byte, then the Modbus register will be sent and in the LOW data byte “0” will be sent.

Byte sending order:
Data byte 0 (MSB of 1st Modbus register) is sent as 1st data byte.
Data byte 1 (LSB of 1st Modbus register) is sent as 2nd data byte.
Data byte 2 (MSB of 2nd Modbus register) is sent as 3rd data byte.
:
:
Data byte n will be sent as last byte.

Time element	Value range	Example
Not used	Dummy: UI8 [7 to 0] <0>	
Year (high)	Year (high) [7 to 0] <0 to 255>	Year = 2016 = 07E0 [HEX] →Year (high) = 0x07 [HEX]
Year (low)	Year (low) [7 to 0] <0 to 255>	Year = 2016 = 07E0 [HEX] →Year (low) = 0xEX [HEX]
Year - 2000 (high)	Year 2000 (high) [7 to 0] <0 to 255>	Year = 2016→2016 - 2000 = 16 = 0x0010 [HEX] →Year - 2000 (high) = 0x00 [HEX]

Time element	Value range	Example
Year - 2000 (low)	Year 2000 (high) [7 to 0] <0 to 255>	Year = 2016→2016 - 2000 = 16 = 0x0010 [HEX] →Year - 2000 (low) = 0x10 [HEX]
Month	Month [7 to 0] <1 to 12>	Month = 12 (December)→Month = 0x0C [HEX]
Day	Day [7 to 0] <1 to 31>	Day = 23→Day = 0x17 [HEX]
Day of week	Day of week [7 to 0] <1 to 7> <1> = Monday; <2> = Tuesday; ... <7> = Sunday	Day of week = Tuesday→Day of week = 0x02 [HEX]
Day + day of week	Day [4 to 0] <1 to 31> Day of week [7 to 5] <1 to 7> <1> = Monday; <2> = Tuesday; ... <7> = Sunday	
Hour	Hour [7 to 0] <0 to 23>	Hour = 21 = 0x15 [HEX]
Hour + SU	Hour [4 to 0] <0 to 23> Summer time (SU) [7] <0, 1> SU <0> = standard time (winter time) SU <1> = summer time	
Minute	Minute [5 to 0] <0 to 59>	Minute = 59 = 0x3B [HEX]
Minute + IV	Minute [6 to 0] <0 to 59> Invalid (IV) [7] <0, 1> IV <0> = valid IV <1> = invalid	
Second	Second [7 to 0] <0 to 59>	Second = 32 = 0x20 [HEX]
Millisecond (high)	Millisecond n·1 ms (high) [7 to 0] <0 to 255> n <0 to 59999> = range including seconds	Milliseconds = 998 = 03E6 [HEX] →Millisecond (high) = 0x03 [HEX]
Millisecond (low)	Milliseconds n·1 ms (low) [7 to 0] <0 to 255> n <0 to 59999> = range including seconds	Milliseconds = 998 = 03E6 [HEX] →Millisecond (low) = 0xE6 [HEX]
Ticks (10 ms)	Milliseconds n·10 ms [7 to 0] <0 to 99>	Milliseconds = 998 →Ticks (10 ms) = 99 = 0x63 [HEX]
Ticks (100 ms)	Milliseconds n·100 ms [7 to 0] <0 to 9>	Milliseconds = 998 →Ticks (100 ms) = 9 = 0x09 [HEX]
EOF (End of Frame)		Note: This time element defines the end of the freely configurable time format - this data byte is no longer sent!

Legend: [7 to 0] = bit position in data byte of Modbus register
< > = valid range of value

13.9 DNP3

13.9.1 Introduction

The DNP3 protocol is a standardized transmission protocol for serial communication with devices in point-to-point traffic and multi-point traffic or for communication via LAN.

Protocol firmware for DNP3:

Firmware	System	Standard and function
DNPSI0	CP-8031, CP-8050	DNP3 Slave "serial"
DNPMI0	CP-8031, CP-8050	DNP3 Master "serial"
DNPII1	CP-8031, CP-8050	DNP3 TCP/IP Slave
DNPII2	CP-8031, CP-8050	DNP3 TCP/IP Master

The DNP3 protocol (Distributed Network Protocol) is an official communication standard for telecontrol. The protocol is used as transmission protocol between control systems and remote stations.

Typically the messages are transmitted over serial connections (ITU-T V.24 (EIA-232) / ITU-T V.28 (EIA-422) as well as over a network (TCP/IP) based infrastructure. The DNP3 telecontrol protocol is standardized and further developed by the DNP Users Group.

The DNP3 protocol defines one controlling station with one or multiple controlled stations.

The controlling station and the controlled stations work with a communication protocol according to DNP3 in multi-point traffic.

The supported functionality (interoperability) of the various devices can be seen in the device specific "DNP3 Device Profile Document" – for SICAM A8000 in section *13.9.9 Interoperabilität (DNP3 Device Profile Document)*.

Multi-point traffic describes a communication protocol with which a central station is connected with one or several substations over a communications link in a linear or star configuration. The data traffic is controlled by the central station, whereby with DNP3, in contrast to other protocols, the substation can also send unsolicited spontaneous data (unsolicited responses).

The protocol element DNPMI0 supports the serial communication of a central station with up to max. 20 remote stations (Slaves) on a communication line.

Every controlled station is assigned an unambiguous station number (DNP source address) in the range 0 to 65519. The controlling station is also assigned an unambiguous station number in the range 0 to 65519.

The station number 65535 (0xFFFF) is used for the simultaneous addressing of all stations (broadcast). With broadcast no reply (response message) is transmitted from the substations to the central station.

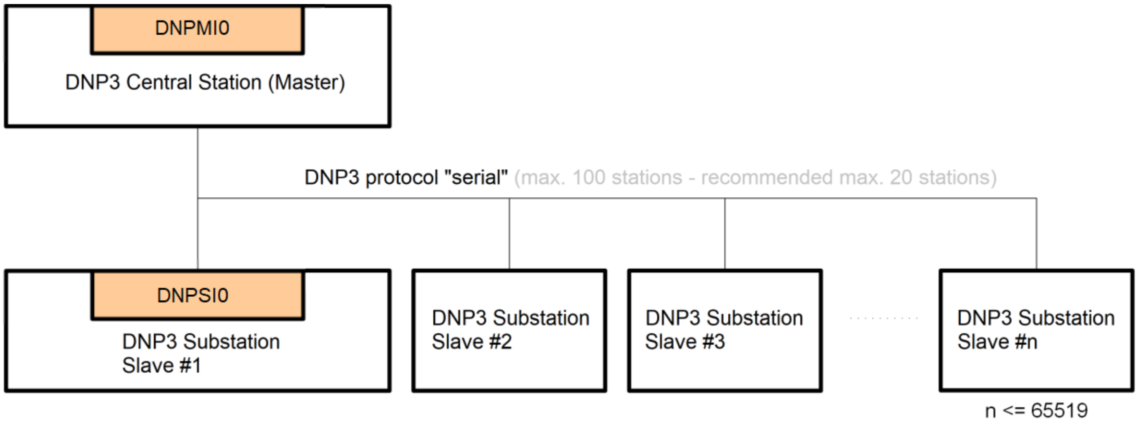
The protocol element DNPSI0 enables the serial communication of one controlled station with one controlling station.

As "Multi-Slave" the protocol element DNPII1 enables the communication of one or multiple substation(s) with one or multiple central station(s) over Ethernet (LAN/WAN). A controlled station can only communicate with one unambiguous controlling station.

With DNP3 a data transmission can be initiated by the central station and also by the substation. A data transmission consists either of a "request/response sequence" (query/response) to selectively addressed substations or of a simultaneous addressing of all connected substations (broadcast/no response).

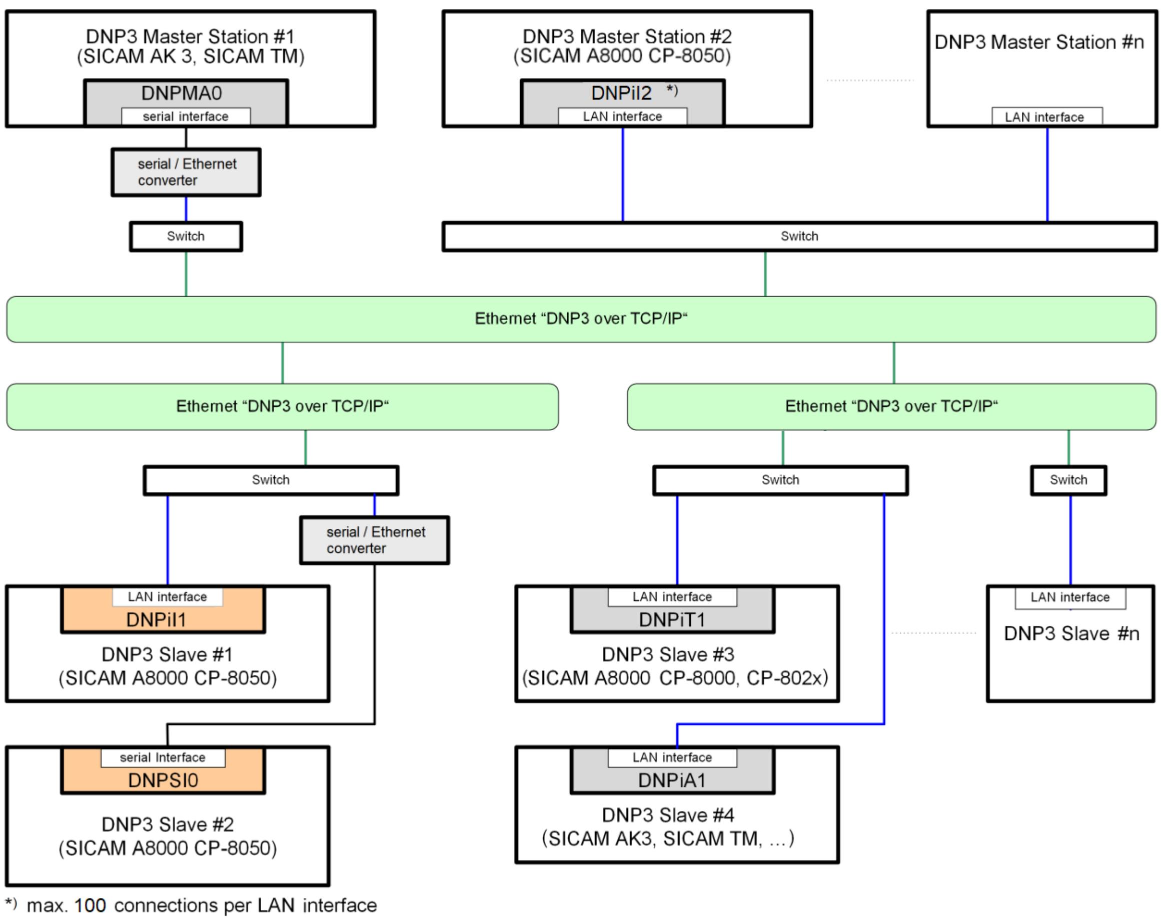
The cyclic queries or data messages provided for the DNP3 communication protocol are transmitted by the controlling station. Data from the controlled station to the controlling station can be transmitted either as direct response to a query or as spontaneous data without preceding query.

Schematic configuration DNP3 “seriell”:



[DNP3_config, 2, en_US]

Schematic configuration DNP3 TCP/IP:



[DNP3i_config, 2, en_US]

On the application layer the DNP3 communication protocol uses the “unbalanced transmission procedure”, in order to communicate with more than one substation. However, on the link layer the communication between the two stations takes place as “balanced transmission procedure”. As a result it is also possible for the substation to send spontaneous data (unsolicited responses), without preceding call of the central station.

That means either, that as primary station the controlling station initiates messages transmissions and the controlled station processes these and replies or that, in the case of unsolicited responses, the controlled station starts the message transmission spontaneously and the controlling station processes these and replies or acknowledges.

In multi-point traffic with polling mode the DNP3 protocol requires only a half duplex transmission medium and can be used in a star or linear structure.

If the substations use the spontaneous data transmission (unsolicited responses), then with a half-duplex transmission medium collisions can occur in the message traffic. Either because several substations at the same time, or the central station and one substation start with the data transmission. If collisions are to be completely avoided, then this is only achieved with a full-duplex transmission medium, and only one substation may be connected to one central station.

In all other cases collisions can occur and consequently the data transmission can be impaired.

13.9.2 Functions

Function	DNPMI0	DNPSI0	DNPII2	DNPII1
DNP3				
Serial communication protocol according to DNP3 - IEEE 1815-2012 Standard for Electric Power Systems Communications - Distributed Network Protocol (DNP3)	✓	✓	–	–
LAN/WAN communication protocol according to DNP3 - IEEE 1815-2012 Standard for Electric Power Systems Communications - Distributed Network Protocol (DNP3)	–	–	✓	✓
TCP/IP Port number (default)	–	–	20000	20000
DNP3 Master “serial”	✓	–	–	–
DNP3 Slave “serial”	–	✓	–	–
DNP3 Master “TCP”	–	–	✓	–
DNP3 Slave “TCP”	–	–	–	✓
Max. number of DNP3 remote stations	20	1	100 [347]	100 [347]
DNP3 Station numbers	0 to 65519	0 to 65519	0 to 65519	0 to 65519
Max. number of supported data points	10000	10000	10000	10000
Interoperability				
Interoperability according to section *13.9.9 Interoperabilität (DNP3 Device Profile Document)*	✓	✓	✓	✓
Supported DNP3 data formats and DNP3 functionality (Object/Variation, ...) according to section *13.9.9 Interoperabilität (DNP3 Device Profile Document)*	✓	✓	✓	✓
DNP3 Level 1	✓	✓	✓	✓
DNP3 Level 2	✓	✓	✓	✓
DNP3 Level 3	Partly	Partly	Partly	Partly
DNP3 Level 4	–	–	–	–
Network configuration				
LAN/WAN	–	–	✓	✓
Point-to-point configuration (DNP3 Master with 1 DNP3 Slave)	✓	✓	–	–

347 Recommended: 50

Function	DNPMI0	DNPSI0	DNPII2	DNPII1
Multiple point-to-point configuration: • DNP3 Master with 1 DNP3 Slave • For each single point-to-point configuration a separate interface is required	✓	✓	–	–
Line configuration	✓	✓	–	–
Star configuration	✓	✓	–	–
Data concentrator	✓	✓	✓	✓
Physical interface				
direct link interface (RS-232)	✓	✓	–	–
RS-485	✓	✓	–	–
RS-422	✓	✓	–	–
Ethernet (10, 100 Mbit/s)	–	–	✓	✓
CP-8031, CP-8050: X4 (RS-485/RS-422); X5 (RS-232)	✓	✓	–	–
CI-8551 [348]: X1, X2 (RS-232, RS-485/RS-422); X3 (RS-485/ RS-422); X4, X5 (RS-232)	✓	✓	–	–
CP-8031, CP-8050: X2, X3	–	–	✓	✓
CI-852x [349]: X1, X2, X3, X4, X5	–	–	✓	✓
Baud rates: 50, 75, 100,134.5, 150, 200, 300, 600, 1050, 1200, 1800, 2000, 2400, 4800, 9600, 19200, 38400, 56000, 57600, 64000, 115200 bits/s	✓	✓	–	–
Ethernet 10 Mbit/s, IEEE 802.3, 10Base TX, electrical	–	–	✓	✓
Fast Ethernet 100 Mbit/s, IEEE 802.3, 100Base TX, electrical	–	–	✓	✓
Ethernet interface (properties)				
Ethernet interface (*13.1.4.6 Ethernet Interface – Module Properties*)	–	–	✓	✓
Parameter for TCP/IP optimization: MTU-Size (Maximum Transmission Unit)	–	–	✓	✓
Parameter for TCP/IP optimization: TCP min. expected acknowledgment time	–	–	✓	✓
DNP3 Protocol				
Bit transmission layer:				
• DNP3 message frame similar to IEC 60870-5-1/FT3	✓	✓	–	–
• Byte frame: **8N1**, 8E1, 8O1, 8O1.5, 8N2, 8E2, 8O2	✓	✓	–	–
• Message protection: d = 6	✓	✓	✓	✓
• CRC $g(x) = x^{16} + x^{13} + x^{12} + x^{11} + x^{10} + x^8 + x^6 + x^5 + x^2 + 1$	✓	✓	✓	✓
Data communication control DNP3:				
• Master/Slave (Request/Response)	✓	✓	✓	✓
• “Unsolicited Responses” spontaneous transmission by the substation	–	✓	–	✓

348 With CP-8031 not supported by default. With a license (see *14.8 SICAM A8000 CP-803x Extended CI-Module*) 1 communication module CI-8551 can be used additionally also with CP-8031.
349 With CP-8031 not supported by default. With a license (see *14.8 SICAM A8000 CP-803x Extended CI-Module*) 1 communication module CI-852x can be used additionally also with CP-8031.

Function	DNPMI0	DNPSI0	DNPII2	DNPII1
• Full duplex or half duplex	✓	✓	–	–
Command transmission				
Secure authentication for commands	✓	✓	✓	✓
Control location function (set/check control location)	–	–	–	–
Select Before Operate for commands and setpoint values	✓	✓	✓	✓
Check Back Before Operate for commands and setpoint values	–	✓	–	✓
Emulation of ACTCON for commands and setpoint values (according IEC 60870-5-101/104)	✓	–	✓	–
Emulation of ACTCON- for commands (according IEC 60870-5-101/104), when a command is discarded from an unreleased control location.	–	–	–	–
Emulation of ACTTERM for commands and setpoint values (according IEC 60870-5-101/104)	–	–	–	–
Transmission of integrated totals	✓	✓	✓	✓
File transfer(DNP3 Obj. 70)				
Read directory content	–	✓	–	✓
Read file	–	✓	–	✓
Write file	–	✓	–	✓
Delete file	–	✓	–	✓
Change directory [350]	–	–	–	–
Supported files:				
• Firmware update of the slave device (Master→Slave)	–	–	–	–
General interrogation				
Emulation of ACTCON/ACTTERM for general interrogation (according IEC 60870-5-101/104)	–	–	–	–
Clock synchronization				
Clock synchronization of the substation via DNP3	✓	✓	✓	✓
Clock synchronization of the substation via NTP [351]	–	–	–	✓
Optimized parameters for selected transmission facilities				
Predefined parameters for selected transmission facilities	✓	✓	–	–
Adjustable parameters for free definable transmission facility	✓	✓	–	–
Supply of connected transmission facilities with 5 V/12 V ATTENTION: Check power consumption of the external transmission facility!	✓	✓	–	–
Special functions				
Sags & Swells	✓	✓	✓	✓
Non-volatile memory of COS/SOE	–	✓	–	✓

350 Change directory is not supported. Files are only supported in the ROOT directory.

351 The time synchronization with NTP is performed from BSE. If time synchronization of the remote station is done by NTP, then the time synchronization with DNP3 must be deactivated.

Function	DNPMI0	DNPSI0	DNPII2	DNPII1
Supported IEC 60870-5-101/-104 data formats in transmit direction				
<TI:=30> ... Single-point information with time tag CP56Time2a	✓	✓	✓	✓
<TI:=31> ... Double-point information with time tag CP56Time2a	–	✓	–	✓
<TI:=33> ... Bitstring of 32 bits with time tag CP56Time2a	–	✓	–	✓
<TI:=34> ... Measured value, normalized value with time tag CP56Time2a	✓	✓	✓	✓
<TI:=35> ... Measured value, scaled value with time tag CP56Time2a	✓	✓	✓	✓
<TI:=36> ... Measured value, short floating-point number with time tag CP56Time2a	✓	✓	✓	✓
<TI:=37> ... Integrated total with time tag CP56Time2a	–	✓	–	✓
<TI:=45> ... Single command	✓	–	✓	–
<TI:=46> ... Double command	✓	–	✓	–
<TI:=47> ... Regulating step command	✓	–	✓	–
<TI:=48> ... Setpoint command, normalized value	✓	–	✓	–
<TI:=49> ... Setpoint command, scaled value	✓	–	✓	–
<TI:=50> ... Setpoint command, short floating-point number	✓	–	✓	–
<TI:=100> ... (General) Interrogation command	✓	–	✓	–
<TI:=101> ... Counter Interrogation Command	✓	–	✓	–
Supported IEC 60870-5-101/-104 data formats in receive direction				
<TI:=30> ... Single-point information with time tag CP56Time2a	✓	✓	✓	✓
<TI:=31> ... Double-point information with time tag CP56Time2a	✓	–	✓	–
<TI:=33> ... Bitstring of 32 bits with time tag CP56Time2a	✓	–	✓	–
<TI:=34> ... Measured value, normalized value with time tag CP56Time2a	✓	–	✓	–
<TI:=35> ... Measured value, scaled value with time tag CP56Time2a	✓	–	✓	–
<TI:=36> ... Measured value, short floating-point number with time tag CP56Time2a	✓	–	✓	–
<TI:=37> ... Integrated total with time tag CP56Time2a	✓	–	✓	–
<TI:=45> ... Single command	–	✓	–	✓
<TI:=46> ... Double command	–	✓	–	✓
<TI:=48> ... Setpoint command, normalized value	–	✓	–	✓
<TI:=49> ... Setpoint command, scaled value	–	✓	–	✓
<TI:=50> ... Setpoint command, short floating-point number	–	✓	–	✓
Redundancy(functions for supporting redundant communication routes)				
Protocol redundancy	✓	✓	–	–
Device redundancy	–	–	–	–
Hot-standby redundancy	–	✓	–	–

Function	DNPMI0	DNPSI0	DNPII2	DNPII1
Protocol element control and return information				
Protocol element control messages:				
• Set control location	–	–	–	–
Protocol element return information:				
• Station status	✓	✓	✓	✓
• Station failure	✓	✓	✓	✓
Security				
TLS (IEC 62351-3 “Transport Layer Security”)	–	–	✓	✓
Max. Connections with TLS	–	–	25	25
Mixture of connections with/without TLS	–	–	✓	✓
Portnumber (TCP) for TLS	–	–	19998	19998
Port number (TCP) for TLS parameter-settable (1024 to 65535)	–	–	✓	✓
PKI certificate management	–	–	✓	✓
Encryption TLS:				
• unencrypted	–	–	✓	✓
• encrypted	–	–	✓	✓
• null cipher	–	–	✓	✓
Secure authentication:				
Secure authentication version 2 (SAv2)	✓	✓	✓	✓
Secure authentication version 5 (SAv5)	✓	✓	✓	✓
Message authentication codes (supported MAC algorithms):				
• SHA1 (4 octets)	✓	✓	✓	✓
• SHA1 (8 octets)	✓	✓	✓	✓
• SHA1 (10 octets)	✓	✓	✓	✓
• SHA256 (8 octets)	✓	✓	✓	✓
• SHA256 (16 octets)	✓	✓	✓	✓
• AESGMAC (12 octets)	✓	✓	✓	✓
symmetric key (pre shared keys)	✓	✓	✓	✓
asymmetric keys (certificates)	–	–	–	–
User role management:	✓	✓	✓	✓
• Viewer	✓	✓	✓	✓
• Operator	✓	✓	✓	✓
• Engineer	✓	✓	✓	✓
• Installer	✓	✓	✓	✓
• SECADM	✓	✓	✓	✓
• SECAUD	✓	✓	✓	✓
• RBACMNT	✓	✓	✓	✓
• Single User	✓	✓	✓	✓
Secure authentification for following DNP3 functions:				
• 00 = Confirm	–	–	–	–
• 01 = Read	–	–	–	–
• 02 = Write	✓[352]	✓[353]	✓[352]	✓[353]

352 If the DNP3 Slave requires secure authentication for this function, secure authentication is performed by the SICAM A8000 DNP3 Master.

353 SICAM A8000 DNP3 Slave requires secure authentication for this function if secure authentication is enabled in the parameterization.

Function	DNPMI0	DNPSI0	DNPII2	DNPII1
• 03 = Select	✓[352]	✓[353]	✓[352]	✓[353]
• 04 = Operate	✓[352]	✓[353]	✓[352]	✓[353]
• 05 = Direct Operate	✓[352]	✓[353]	✓[352]	✓[353]
• 06 = Direct Operate - no Acknowledgement	✓[352]	✓[353]	✓[352]	✓[353]
• 07 = Immediate Freeze	–	–	–	–
• 08 = Immediate Freeze - no Acknowledgement	–	–	–	–
• 09 = Freeze and Clear	–	–	–	–
• 10 = Freeze & Clear - no Acknowledgement	–	–	–	–
• 13 = Cold Start	✓[352]	✓[353]	✓[352]	✓[353]
• 14 = Warm Start	✓[352]	✓[353]	✓[352]	✓[353]
• 20 = Enable Unsolicited Messages	✓[352]	✓[353]	✓[352]	✓[353]
• 21 = Disable Unsolicited Messages	✓[352]	✓[353]	✓[352]	✓[353]
• 22 = Assign Class	–	–	–	–
• 23 = Delay Measurement	–	–	–	–
• 25 = Open	✓[352]	✓[353]	✓[352]	✓[353]
• 26 = Close	✓[352]	✓[353]	✓[352]	✓[353]
• 27 = Delete	✓[352]	✓[353]	✓[352]	✓[353]
• 28 = Get File Info	✓[352]	✓[353]	✓[352]	✓[353]
• 29 = Authenticate File	✓[352]	✓[353]	✓[352]	✓[353]
• 31 = Activate Configuration	✓[352]	✓[353]	✓[352]	✓[353]
• 129 = Response	–	–	–	–
• 130 = Unsolicited Message	–	–	–	–
Web server				
Protocol-internal diagnostic and statistic information via protocol-specific web pages	✓	✓	✓	✓
Engineering				
SICAM Device Manager	✓	✓	✓	✓
SICAM TOOLBOX II	✓	✓	✓	✓

Restrictions

- Only selected DNP3 function codes are supported
- Max. data index (per data type) = 65535

NOTE

SICAM A8000 as DNP3 TCP/IP substation may only be connected once to a central station. In the station definition (connection definition), the DNP destination address and DNP source address may always only occur once.

It is not possible to connect multiple substations (e.g., DNP source address 1000, 1001, and 1002) to the same central station (e.g., DNP destination address 10). If this is still necessary, a substitute value for the DNP destination address and DNP source address can be set for a maximum of 4 connections.

13.9.3 Modes of Operation

Serial Communication

The operating mode of the interface is determined by parameters of the protocol element and optional equipment.

Operating mode	Interface → optional DTE	Interface signals
Unbalanced interchange circuit (V.24/V.28) RS-232 asynchronous	X5	RXD, TXD, CTS [354], RTS, DCD, DTR, DSR/VCC, GND
Balanced interface (V.11) RS-485 (2-wire)/ RS-422 (4-wire) asynchronous	X4	TXD+, TXD-, RXD+, RXD- (4-wire)
Balanced interface (V.11) RS-485 (2-wire)/ RS-422 (4-wire) asynchronous	X5 → PHOENIX PSM-ME-RS232/ RS485-P interface converter	Interface signals at X5: (towards PHOENIX PSM-ME-RS232/RS485-P) RXD, TXD, CTS, RTS, DCD, DTR, GND Interface signals at PHOENIX PSM-ME-RS232/RS485-P: • RS-485 2-wire D(A), D(B), GND • RS-422 (4-wire): D(A), D(B), T(A), T(B), GND
Optical interface with CM-0847 (Multimode)	X5 → CM-0847	Interface at X5 towards CM-0847: RXD, TXD, CTS, RTS, DCD, DTR, DSR/ VCC, GND

LAN/WAN Communication (TCP/IP)

Standard Operation Mode	Interface → optional DTE	Interface signals
Electrical ethernet-interface (twisted pair)	X2 X3	TXD+, TXD-, RXD+, RXD-

13.9.4 Communication

For the stations to communicate with each other, suitable transmission facilities and/or network components may be needed in addition.

Own Station (Central station - DNP3 Master serial)

System	System element	Protocol Element	Remarks
SICAM A8000 Series	CP-8031/CPCI85 CP-8050/CPCI85 CP-8050/EPCI85	DNPMI0	max. 100 Slaves

Remote station (Substation - DNP3 Slave serial)

System	System element	Protocol Element	Remarks
SICAM A8000 Series	CP-8031/CPCI85 CP-8050/CPCI85 CP-8050/EPCI85	DNPSI0	max. 1 Master
SICAM A8000 Series	CP-8000/CPC80 CP-8021/CPC80 CP-8022/CPC80	DNPST0	max. 1 Master

354 not usable (reserved for SICAM TOOLBOX II)

System	System element	Protocol Element	Remarks
SICAM AK 3	CP-2016/CPCX26 CP-2019/PCCX26	SM-2551/DNPSA0 SM-0551/DNPSA0	max. 1 Master
Legacy systems (SICAM AK, SICAM, TM SICAM BC, SICAM EMIC)	CP-20xx CP-50xx CP-60xx	SM-2551/DNPSA0 SM-0551/DNPSA0 DNPST0	max. 1 Master
Third-party system	–	–	according to *13.9.9 Interoperabilität (DNP3 Device Profile Document)*

Own station (substation - DNP3 slave serial)

System	System element	Protocol Element	Remarks
SICAM A8000 Series	CP-8031/CPCI85 CP-8050/CPCI85 CP-8050/EPCI85	DNPSI0	max. 1 Master

Remote station "Central station" (DNP3 Master serial)

System	System element	Protocol Element	Remarks
SICAM A8000 Series	CP-8031/CPCI85 CP-8050/CPCI85 CP-8050/EPCI85	DNPMI0	max. 100 Slaves
SICAM A8000 Series	CP-8000/CPC80 CP-8021/CPC80 CP-8022/CPC80	DNPMT0	max. 10 Slaves
SICAM AK 3	CP-2016/CPCX26 CP-2019/PCCX26	SM-2551/DNPMA0 SM-0551/DNPMA0	max. 20 Slaves
Legacy systems (SICAM AK, SICAM TM, SICAM BC)	CP-20xx CP-60xx CP-50xx	SM-2551/DNPMA0 SM-0551/DNPMA0	max. 20 Slaves
Siemens devices	–	–	according to *13.9.9 Interoperabilität (DNP3 Device Profile Document)*
Third-party system	–	–	according to *13.9.9 Interoperabilität (DNP3 Device Profile Document)*

Own Station (Central station - DNP3 TCP/IP Master)

System	System element	Protocol Element	Remarks
SICAM A8000 Series	CP-8031/CPCI85 CP-8050/CPCI85 CP-8050/EPCI85	DNPII2	max. 100 Slaves

Remote station (Substation - DNP3 TCP/IP Slave)

System	System element	Protocol Element	Remarks
SICAM A8000 Series	CP-8031/CPCI85 CP-8050/CPCI85 CP-8050/EPCI85	DNPII1	max. 100 Master
SICAM A8000 Series	CP-8000/CPC80 CP-8021/CPC80 CP-8022/CPC80	DNPiT1	max. 4 Master
Siemens devices	–	–	according to *13.9.9 Interoperabilität (DNP3 Device Profile Document)*
Third-party system	–	–	according to *13.9.9 Interoperabilität (DNP3 Device Profile Document)*

Own station (Substation - DNP3 TCP/IP Slave)

System	System element	Protocol Element	Remarks
SICAM A8000 Series	CP-8031/CPCI85 CP-8050/CPCI85 CP-8050/EPCI85	DNPII1	max. 100 Master

Remote station (Central station DNP3 TCP/IP Master)

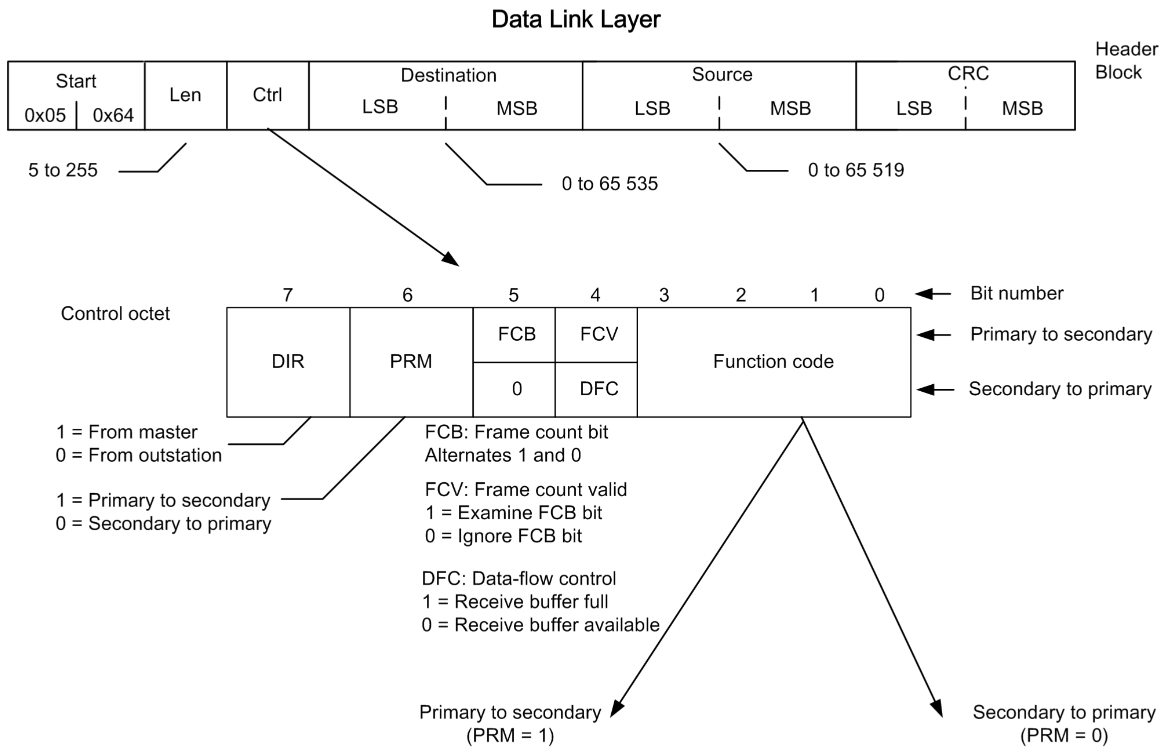
System	System element	Protocol Element	Remarks
SICAM A8000 Series	CP-8031/CPCI85 CP-8050/CPCI85 CP-8050/EPCI85	DNPII2	max. 100 Slaves
SICAM A8000 Series	CP-8000/CPC80 CP-8021/CPC80 CP-8022/CPC80	DNPiT2	max. 4 Slaves
Siemens devices	–	–	according to *13.9.9 Interoperabilität (DNP3 Device Profile Document)*
Third-party system	–	–	according to *13.9.9 Interoperabilität (DNP3 Device Profile Document)*

13.9.5 Communication according to DNP3

Bit transmission layer (DNP3 serial)

The bit-transmission layer deals primarily with the physical media over which the protocol is transmitted. The bit transmission layer handles e.g. the state of the media (free or busy) and the synchronization via the media (start and stop).

Most commonly, DNP3 is used over a simple, asynchronous, serial transmission such as RS-232 or RS-485 with the physical media wire line and fiber optic. In addition, transmission can be made via Ethernet.



Primary function code	Function-code name	FCV bit
0	RESET_LINK_STATES	0
1	-	-
2	TEST_LINK_STATES	1
3	CONFIRMED_USER_DATA	1
4	UNCONFIRMED_USER_DATA	0
5	-	-
6	-	-
7	-	-
8	-	-
9	REQUEST_LINK_STATUS	0
A	-	-
B	-	-
C	-	-
D	-	-
E	-	-
F	-	-

Secondary function code	Function-code name
0	ACK
1	NACK
2	-
3	-
4	-
5	-
6	-
7	-
8	-
9	-
A	-
B	LINK_STATUS
C	-
D	-
E	-
F	NOT_SUPPORTED

[dwdalila-030314.vsd, 1, en_US]

Figure 13-17 Bit transmission layer

Data transmission package begins with a data header and a 16-bit CRC (cyclic redundancy check) of all 16 bytes of the package is performed.

A package is part of a complete message submitted through the physical layer. The maximum size of the data package is 256 Byte. Each package has a 16-bit source address and a 16-bit destination address, which can also be a common address (0xFFFF).

The 10-byte link layer header contains:

- The address information
- A 16-bit start code
- The package length
- A data transfer control byte

The data transmission control byte indicates the cause of the data transmission and the status of the logical connection. The data transmission control byte can have the following values:

- ACK (data transmission confirmation)
- NACK (negative confirmation)
- Connection needs reset
- Connection is reset
- Request data transmission confirmation of the package

If a data transmission acknowledgment is requested, the receiver must respond with an ACK data package when the package is received and the CRC checks were successful. If no data transmission confirmation is requested, no response is required.

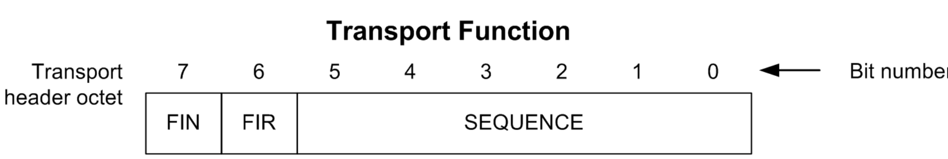
Pseudo Transport Layer

The pseudo-transport layer segments application messages into multiple data transmission packages.

The pseudo transport layer introduces a single byte function code for each package. The byte function code indicates what the data transmission package is:

- The 1st package of a message
- The last package of a message
- Both (for individual message packages)

The function code provides a continuous packet sequence number. This package sequence number is incremented with each package and allows the transport layer of the recipient to analyze the package.



[dwtrfnct-030314, 1, en_US]

Figure 13-18 Pseudo Transport Layer

Application Layer

The application layer responds to received messages and creates messages based on the necessity and availability of the user data. As soon as messages are available, they are sent to the pseudo transport layer. The messages are segmented here, sent to the data link layer and transferred through the physical layer.

If the data that is to be sent is too large for an individual application message, a number of application messages can be created and sent in a sequential manner. Each message is an independent application message. Their only connection with each other is the label in all messages that says that more messages will follow. Only the last message does not contain this label. Each application message refers to a fragment due to the fact that the user data may be fragmented. A message can thus be a single fragment message or a multi-fragment message.

Application packages from DNP3 slaves are normally responses to queries. A DNP3 slave can also send a message without a request, thus, an unsolicited response.

As in the data link layer, application fragments can be sent with a confirmation request. An application confirmation indicates that a message was not only received, but rather it was also syntactically analyzed without any errors. A data transmission confirmation or an ACK indicate only that the transmission package was received and that the CRC checks were error-free. Each application package begins with an application layer header, followed by one or more object heads/object data. The application layer header contains an application control code and an application function code.

If one of the following conditions is fulfilled, then the application control code contains labels:

- The package is a multi-package message.
- An application layer acknowledgment is requested for the package.
- The package is not requested.

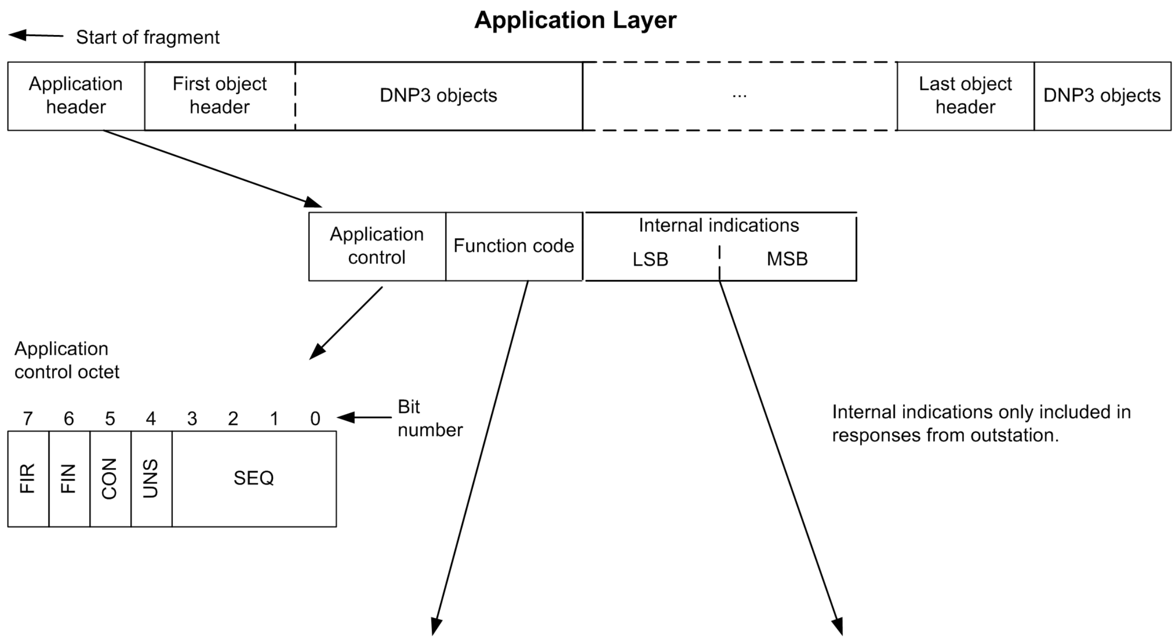
The application control code contains a continual application layer number. With this application layer number, the receiving application layer can recognize alien packages or lost packages.

The application function code in the header of the application layer indicates the cause or the requested function in the message. While DNP3 allows a number of data types in a single message, it also allows only an individual query for a data type within the message.

Examples for application function codes include:

- Acknowledgments for confirmation on the application layer
- Read and write
- Select and execute (SBO (select before operate), controls)
- Direct control (for switching objects without SBO)
- Save and delete (for counters)
- Restart (both cold and warm)
- Enable and disable non-requested messages
- Selection of the classes

The application function code in the header of the application layer applies for all object headers. Thus, the application function code applies for all data within the message package.



Function code

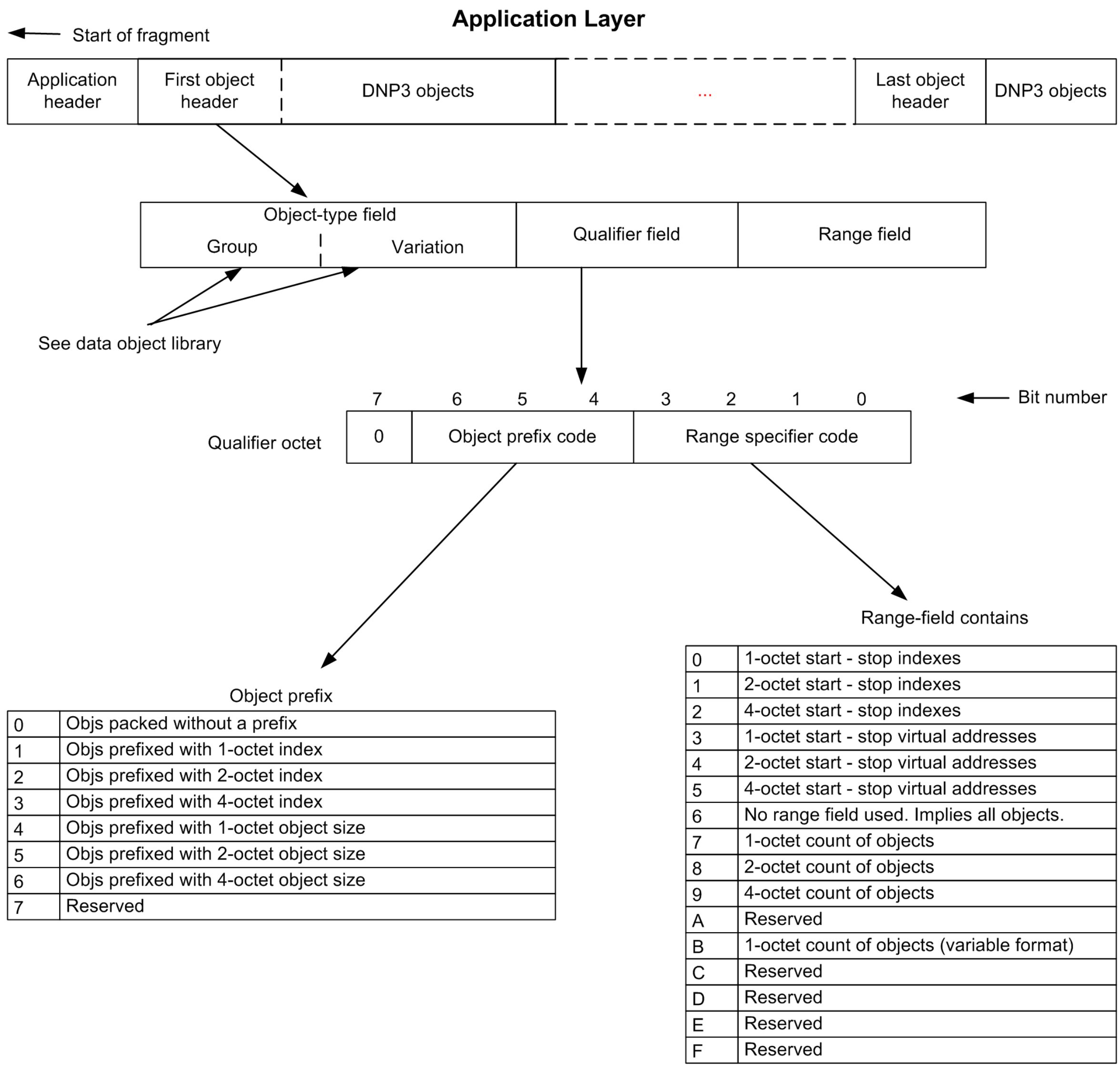
Requests (Hex)			
0	Confirm	10	Initialize application
1	Read	11	Start application
2	Write	12	Stop application
3	Select	14	Enable unsolicited
4	Operate	15	Disable unsolicited
5	Dir operate	16	Assign class
6	Dir operate - No resp	19	Open file
		1A	Close file
		1C	Get file information
D	Cold restart	1D	Authenticate file
E	Warm restart	1E	Cancel file
F	Initialize data		
Responses (Hex)			
81	Response		
82	Unsolicited response		

Internal indications

LSB	
IIN1.0	All stations
IIN1.1	Class 1 events
IIN1.2	Class 2 events
IIN1.3	Class 3 events
IIN1.4	Need time
IIN1.5	Local control
IIN1.6	Device trouble
IIN1.7	Device restart
MSB	
IIN2.0	Function code not supported
IIN2.1	Object unknown
IIN2.2	Parameter error
IIN2.3	Event buffer overflow
IIN2.4	Already executing
IIN2.5	Configuration corrupt
IIN2.6	Reserved 1
IIN2.7	Reserved 2

[dwaplay1-030314.vsd, 1, en_US]

Figure 13-19 Application Layer – Part 1



Object prefix

0	Objs packed without a prefix
1	Objs prefixed with 1-octet index
2	Objs prefixed with 2-octet index
3	Objs prefixed with 4-octet index
4	Objs prefixed with 1-octet object size
5	Objs prefixed with 2-octet object size
6	Objs prefixed with 4-octet object size
7	Reserved

Range-field contains

0	1-octet start - stop indexes
1	2-octet start - stop indexes
2	4-octet start - stop indexes
3	1-octet start - stop virtual addresses
4	2-octet start - stop virtual addresses
5	4-octet start - stop virtual addresses
6	No range field used. Implies all objects.
7	1-octet count of objects
8	2-octet count of objects
9	4-octet count of objects
A	Reserved
B	1-octet count of objects (variable format)
C	Reserved
D	Reserved
E	Reserved
F	Reserved

[dwaplay2-040314.vsd, 1, en_US]

Figure 13-20 Application Layer – Part 2

13.9.6 Parameters and Settings

13.9.6.1 DNP3 Slave Serial

Parameter name	Description	Settings
`[PRE] Interface parameter` Note: • The serial interface for the protocol is selected in the SICAM Device Manager under Configuration | Firmware(refer to *13.1.4.5 Selection of a serial interface for communication protocols*). • Some parameters may only be displayed after selecting the interface or only with “Show all parameters”.		
`Baud rate`	The DNP3 slave protocol in SICAM A8000 CP-8050 supports baud rates in the range of 50 Bd to 115200 Bd.	Permitted range = 50, 75, 100, 134.5, 150, 200, 300, 600, 1050, 1200, 1800, 2000, 2400, 4800, 9600, 19200, 38400, 56000, 57600, 64000, 115200 Default setting = 2400

Parameter name	Description	Settings
Data bits	Number of data bits per data byte on the bit transmission layer.	Permitted range = 8 bit Default setting = 8 bit
Parity	Parity bit for data bytes on the bit transmission layer.	Permitted range = no, even, odd parity Default setting = no parity
Stop bits	Stop bits for data bytes on the bit transmission layer.	Permitted range = 1, 1.5, 2 bit Default setting = 1 bit
[PRE] Interface Parameter | Time settings for interface modem Refer to *13.1.4.8 Time settings for transmission facilities*.		
Time settings for transmission facilities		Permitted range = • Freely definable • Direct connection (RS-232) • Direct link interface (RS-485) • Direct link interface (RS-422) • Direct link interface (RS-485 with CM-08x9) • Direct connection (optical) with CM-0827 Default setting = free definable
[PRE] Interface parameter | Time settings for free definable interface modem Refer to *13.1.4.8 Time settings for transmission facilities*. Default settings:		
Pause time (tp)		Default setting = 0 ms
Set-up time (tv)		Default setting = 20 ms
Run out time (tn)		Default setting = 11 ms
DCD handling		Default setting = disabled
Continuous level monitoring time (tcl)		Default setting = 10 s
Transmission delay at level (tcldly)		Default setting = 0.2 s
Bounce suppression time (tbounce)		Default setting = 10 ms
Disable time (tdis)		Default setting = 0 ms
[PRE] Station definition		
DNP3 Destination address	Address of the DNP3 Master (Address of the remote station)	Permitted range = 1 to 65519 Default setting = 1
DNP3 Source address	Address of the DNP3 Slaves (Link address of the own station)	Permitted range = 1 to 65519 Default setting = 1
[PRE] DNP3 | Time settings, retries		
Timeout transmit delay	The data will be sent only after this timeout. This is to avoid collisions. This time should be set differently for all connected substations.	Permitted range = 0, 0.01 to 655.35 s Default setting = 0
Max. random transmission delay	To avoid collisions, the transmission delay is extended by a random value in the range from 0 to max. random transmission delay.	Permitted range = 0 to 1000 ms Default setting = 50 ms

Parameter name	Description	Settings
[PRE] DNP3 | Time settings, retries | Monitoring times		
Idle monitoring time	After transmission disturbances or message interruption the idle state is monitored. After expiry of the monitoring time the receiver is resynchronized.	Permitted range = 0 to 32767 bits Default setting = 33 bits
Character monitoring time	Message gap monitoring: Maximum possible gap between successive bytes of a message. If a gap is detected, the message is ignored and the idle monitoring time is started.	Permitted range = 0 to 32767 Bit Default setting = 33 bits
Expected acknowledgment time correction	Extension of the automatically determined acknowledgment time. (Required if transmission is delayed by transmission equipment or slow responding remote stations)	Permitted range = 0 to 655.35 s Default setting = 2 s
Timeout application confirmation	Expected acknowledgment time for the acknowledgment of the appli-cation layer.	Permitted range = 0, 0.1 to 6553.5 s Default setting = 10 s
Monitoring timeout	When the call monitoring time expires (slave is no longer called by the master), a failure of the inter-face is signaled.	Permitted range = 0 to 65535 s 0 .. no monitoring Default setting = 3600 s
[PRE] DNP3 | Time settings, retries | Monitoring times		
Retries for INIT-messages SEND/CONFIRM (station selective)		Permitted range = 0 to 255 Default setting = 1
Retries for data messages SEND/NO REPLY (broadcast)		Permitted range = 0 to 255 Default setting = 2
[PRE] DNP3 | Communication functions | Initialisation		
Link init after going failure		Permitted range = yes, no Default setting = yes
[PRE] DNP3 | Communication functions | Cyclical monitoring of the remote station		
Test function cycle time	Test function of the link layer according to IEC 60870-5-2	Permitted range = 0 to 65535 s <0> .. no monitoring Default setting = 100 s

13.9.6.2 DNP3 Slave TCP/IP

Parameter name	Description	Settings
[PRE] Interface parameter Note: • The interface for the protocol is selected in the SICAM Device Manager under Configuration | Firmware(refer to *13.1.4.4 Selection of an Ethernet Interface for Communication Protocols*). • Some parameters may not be displayed until the interface is selected.		
[PRE] Interface parameter | Network connection | TCP parameter		
TCP connection close	Setting for closing the TCP connection: • close with RST: if necessary a TCP connection is always closed with RST (Restart). • close with FIN or RST: depending on the situation, the protocol firmware decides - if necessary - whether a TCP connection is closed with RST or FIN.	Permitted range = • close with FIN or RST • close with RST Default setting = • close with FIN or RST
[PRE] Station definition (Connection definition) | Station definition Note: The required parameters must be set for each connection to a DNP3 remote station.		
Station number (internal)	CP-8050 internal station number for diagnosis, data routing.	Permitted range = 0 to 99 ... internal station number 255 ... not used Default setting = 255
Station enable	Selective connections can be prepared or deactivated with "Station enable = no".	Permitted range = yes, no Default setting = yes
Station failure	If the connection fails, the transmission of the error message can be suppressed with "station failure = no".	Permitted range = • indicate error • indicate no error Default setting = notify
IP-address	IP address of the remote station (IPV4). With IP address = 0.0.0.0 any IP address of the remote station is accepted. This function is only possible with 1 connection in "Listening Mode". Note: The IP address of the own station is set on the BSE.	Permitted range = 0.0.0.0 to 255.255.255.254 Standard setting = 0.0 0.0
Port number	DNP3 port number (standard = 20000).	Permitted range = 0 to 65535 0 = 20000 Default setting = 0

Parameter name	Description	Settings
`Connection type`	• Connector: The TCP connection for this DNP3 connection is established by CP-8050. • listener: The TCP connection for this DNP3 connection is established by the remote station. CP-8050 waits for the establishment of the TCP connection ("listener").	Permitted range = • listener • connector Default setting = listener
`Connection Mode`	Ethernet level transport protocol.	Permitted range = • TCP • TCP&UDP • UDP Default setting = TCP
`Protocol type`		Permitted range = DNP3 Slave Default setting = DNP3 Slave
`Station name`	Naming of the connection to the remote site. e.g.: District control center	Permitted range = • any text (up to 20 characters) Default setting =
`DNP destination address`	Address of the DNP3 Master (Address of the remote station)	Permitted range = 1 to 65 519 Default setting = 1
`DNP source address`	Address of the DNP3 Slaves. (Link address of the own station)	Permitted range = 1 to 65 519 Default setting = 1
`Interface monitoring cycle time (sec.)`	Cycle time for monitoring the connection using the function “Test function for link”.	Permitted range = 0, 1 to 65535 s 0 .. no monitoring Default setting = 1 s
`DNPS enable unsol. messages`		Permitted range = yes, no Default setting = no
`DNPS send multifragments`		Permitted range = yes, no Default setting = no
`DNPS data class 1 as unsol. message`	Should the data of the event class be sent as an unsolicited message immediately or only after approval by the remote station.	Permitted range = • wait for release from the remote station • Send immediately Default setting = wait for release from the remote station
`DNPS data class 2 as unsol. message`	Should the data of the event class be sent as an unsolicited message immediately or only after approval by the remote station.	Permitted range = • wait for release from the remote station • Send immediately Default setting = wait for release from the remote station

Parameter name	Description	Settings
DNPS data class 3 as unsol. message	Should the data of the event class be sent as an unsolicited message immediately or only after approval by the remote station.	Permitted range = • wait for release from the remote station • Send immediately Default setting = wait for release from the remote station
Acknowledgment link layer	What type of acknowledgment should be used for sent data?	Permitted range = • no acknowledgment • only for multi fragments • always expect acknowledgment Default setting = no acknowledgment
Timeout appl. conf. (ms)	Expected acknowledgment time for the acknowledgment of the application layer. This acknowledgment is only sent by the remote station after receiving a complete fragment.	Permitted range = 0 to 65535 ms Default setting = 0 ms
Transmission delay (ms)	Data is only sent after the transmission delay has elapsed.	Permitted range = 0 to 5000 ms Default setting = 0 ms
Replace DNP source/destination address	The DNP source/destination address can be replaced for a maximum of 4 stations/connections. The required parameters are under **[PRE] Station definition (Connection definition) | Advanced parameters | Project specific settings | DNP3 source/destinaton address exchange for station a, b, c, d**.	Permitted range = yes, no Default setting = no
Encryption TLS		Permitted range = • unencrypted • encrypted • null cipher Default setting = unencrypted
Certificate		Permitted range = • not used • Certificate 1 : • Certificate 10 • EST Default setting = not used

Parameter name	Description	Settings
Certificate authority		Permitted range = • not used • Certificate authority 1 : • Certificate authority 10 • EST Default setting = not used
SA mode	Selection of the used secure authentication.	Permitted range = • not used • SAv2 • Sav5 Default setting = not used
SA MAC Algorithm	Procedure for calculating the MAC (= Message Authentication Code). The setting must match for master and slave.	Permitted range = • not used • SHA1 (4 octets) • SHA1 (8 octets) • SHA1 (10 octets) • SHA256 (8 octets) • SHA256 (16 octets) • AESGMAC (12 octets) Default setting = not used
SA Aggressive Mode		Permitted range = • disabled • activated Default setting = disabled
SA Blocking SHA1	With Secure Authentication Sav5, the SHA1 mode can be blocked.	Permitted range = yes, no Default setting = no
Statistic Information	Release of the statistical information of object groups 121 and 122.	Permitted range = • disabled • activated Default setting = disabled
SA User Conf. Line number 0 : **SA User Conf. Line number 7**	Assignment of the line number from the table of the user configuration to the respective station number or session. User number 1 starts from the left with the first line number used.	Permitted range = • x .. user selected • 'empty' .. no user selected Default = no user selected
[PRE] Station definition (Connection definition) | Advanced parameters | Project specific settings | DNP3 source/destination address exchange for station a, b, c, d		
Station number (internal)	Station number (internal) in the connection definition for which the DNP3 source address and DNP3 destination address should be replaced.	Permitted range = 0 to 99 ... internal station number 255 ... not used (default) Default setting = 255

Parameter name	Description	Settings
`new DNP3 destination link address`	New DNP3 destination link address. In the transmit direction, the new DNP3 destination address is transmitted instead of the DNP3 destination address in the station definition (Connection definition). Note: This function is required if several remote stations use the same DNP3 destination address. For this purpose, different DNP3 destination addresses are parameterized in the connection definition - when transmitting in the sending direction, the DNP3 destination address is replaced by the new DNP3 destination address. (This feature is supported for a maximum of 4 connections)	Permitted range = 0 to 65 519 Default setting = 0
`new DNP3 source address`	New DNP3 source address. In the transmit direction, the new DNP3 source address is transmitted instead of the DNP3 source address in the station definition (Connection definition). Note: This function is required if several remote stations use the same DNP3 source address. For this purpose, different DNP3 source addresses are parameterized in the connection definition - when transmitting in the sending direction, the DNP3 source address is replaced by the new DNP3 source address. (This feature is supported for a maximum of 4 connections)	Permitted range = 0 to 65 519 Default setting = 0

13.9.6.3 DNP3 Slave Serial, TCP/IP

Parameter name	Description	Settings
`[PRE] DNP3 | Message structure | Settings in transmit direction`		
`Maximum link fragment size`	Maximum link fragment size of a DNP3 message in transmit direction	Permitted range = 20 to 292 Default setting = 292
`Maximum application fragment size`	Maximum byte number of a DNP3 fragment in transmit direction	Permitted range = 100 to 2048 Default setting = 2048
`[PRE] DNP3 | Message structure | Settings in receive direction`		
`Maximum link fragment size`	Maximum link fragment size of a DNP3 message in receive direction	Permitted range = 20 to 292 Default setting = 292
`Maximum application fragment size`	Maximum byte number of a DNP3 fragment in receive direction	Permitted range = 100 to 2048 Default setting = 2048

Parameter name	Description	Settings
[PRE] DNP3 | Time settings, retries | Monitoring times		
Retries for data messages SEND/CONFIRM (station selective)	Max. number of message repetitions during transmission. If a sent message is not acknowledged by the partner within the expected acknowledgment time, the message is sent again. After the retries have expired, the interface is marked as faulty.	Permitted range = 0 to 255 Default setting = 2
[PRE] DNP3 | Communication functions | Initialisation		
Startup Delay	When restarting the SICAM A8000 device, the DNP3 protocol on the line is only activated after a delay. During the startup delay, the process image of the DNP3 protocol is updated.	Permitted range = 5 to 200 s Default setting = 20 s
[PRE] DNP3 | Communication functions | Unsolicited Messages		
Send data as unsolicited messages	[355]	Permitted range = yes, no Default setting = yes
Send static data as unsolicited messages		Permitted range = yes, no Default setting = no
Data class 1 as unsol. message	[355]	Permitted range = • wait for release from the remote station • Send immediately Default setting = transmit immediately
Data class 2 as unsol. message	[355]	Permitted range = • wait for release from the remote station • Send immediately Default setting = transmit immediately
Data class 3 as unsol. message	[355]	Permitted range = • wait for release from the remote station • Send immediately Default setting = transmit immediately
Number of class 1 events for transmission		Permitted range = 0 to 100 Default setting = 10
Delay of class 1 events for transmission		Permitted range = 0 to 65535 s Default setting = 1.5 s
Number of class 2 events for transmission		Permitted range = 0 to 100 Default setting = 10
Delay of class 2 events for transmission		Permitted range = 0 to 65535 s Default setting = 1.5 s

[355] applies only for DNPSI0

Parameter name	Description	Settings
Number of class 3 events for transmission		Permitted range = 0 to 100 Default setting = 5
Delay of class 3 events for transmission		Permitted range = 0 to 65535 s Default setting = 1.5 s
Retrycount for unsolicited messages		Permitted range = 0 to 255 Default setting = 5
Timeout unsolicited messages retry .		Permitted range = 0, 0.1 to 6553.5 s Default setting = 5 s
Timeout unsolicited messages offline retry .		Permitted range = 0, 0.1 to 6553.5 s Default setting = 0 s
Timeout Retry Behavior		Permitted range = • unchanged • append new events Default = append new events
Project specific settings		Permitted range = yes, no Default setting = no
[PRE] DNP3 | Communication functions | Unsolicited Messages | Project specific settings		
Behavior unsol. messages after startup		Permitted range = • yes, transmit immediately • only after time setting is complete • only after request data class 0 is complete Default setting = yes, transmit immediately
[PRE] DNP3 | Communication functions | Clock synchronisation		
Enable time setting[356]	Selection of the time source.	Permitted range = • via DNP3 Protocol • via NTP Server Default setting = DNP3 protocol
Request time setting		Permitted range = • cyclically, after restart and connection establishment • only after restart • after restart and connection establishment • do not request a time setting Standard setting = cyclically, after restart and connection establishment

356 applies only for DNPII1

Parameter name	Description	Settings
Cycle time for sending clock synchronization command	Time grid for cyclic time setting.	Permitted range = 0 to 65535 s 0 .. No cyclic time setting 65535 .. Time setting only after restart or going communication failure Default setting = 300 s
Correction time for clock synchronization command	The time in the clock synchronization command is changed by the automatically determined transmission time and correction time.	Permitted range = -60.00 to +60.00 ms Default setting = 0 s
Time format in receive direction	The DNP3 protocol uses UTC time format on the line. This parameter defines how the time format is converted from DNP3 to SICAM A8000.	Permitted range = • use received time without (conversion) • from UTC to local time with DST correction • from UTC to local time without DST correction Default setting = from UTC to local time with DST correction
Time format in transmit direction	The DNP3 protocol uses UTC time format on the line. This parameter defines how the time format is converted from SICAM A8000 to DNP3.	Permitted range = • use local time • from local time incl. DST correction to UTC • from local time without DST correction to UTC Default setting = from local time incl. DST correction to UTC
Link address for taking over the time synchronization[357]	When setting the time via DNP3 protocol, the time synchronization is only taken over by this link address (=DNP3 source address).	Permitted range = 0 to 65519 Default setting = 0
[PRE] DNP3 | Communication functions | Cyclical monitoring of the remote station		
Test function cycle time[358]	Cycle time for monitoring the interface using the function "Test function for link".	Permitted range = 0 to 65535 s 0 .. no monitoring Default setting = 100 s
Send cyclic link layer messages as		Permitted range = • Query link status • Query test link Default setting = Query link status
Monitoring timeout[359]		Permitted range = 0 to 65535 s Default setting = 3600 s

357 applies only for DNPII1
358 applies only for DNPSI0
359 applies only for DNPII0

Parameter name	Description	Settings
[PRE] DNP3 | Communication functions | Command transmission		
Timeout SELECT → OPERATE	Maximum waiting time between a SELECT and an OPERATE for a valid command.	Permitted range = 0, 0.1 to 6553.5 s Default setting = 20 s
Timeout emulate SELECT	Waiting time to simulate a SELECT command if SELECT before OPERATE is not supported by the master but is still needed. With an OPERATE command, a SELECT is first generated and then an EXECUTE after this time has expired.	Permitted range = 0, 0.1 to 6553.5 s Default setting = 2 s
Enable SCBO (check back before operate)	When this function is enabled, the commands (SELECT + OPERATE) are processed differently from the DNP3 standard. While a SELECT is running, a new received SELECT is discarded and the old one remains active. An OPERATE applies to the first SELECT.	Permitted range = yes, no Default setting = no
CROB command mode	According to DNP3 standard, no other messages may be received between SELECT and OPERATE, otherwise the current SELECT will be deleted. In case of “non DNP3 compliant”, SELECT will not be cleared.	Permitted range = • DNP3 compliant • non DNP3 compliant Default setting = non DNP3 compliant
[PRE] DNP3 | Communication functions | File transfer		
Enable file transfer	Enable function file transfer.	Permitted range = yes, no Default setting = no
Enable authentication	Authentication for file transfer required	Permitted range = yes, no Default setting = no
Enable parameter transfer		Permitted range = yes, no Default setting = no
Maximum block size		Permitted range = 100 to 2048 bytes Default setting = 1024 byte
Timeout file transfer		Permitted range = 3 to 255 min Default setting = 10 min
[PRE] DNP3 | Communication functions | Secure Authentication		
SA Mode[360]	Enable and select secure authentication.	Permitted range = • not used • SAv2 • SAv5 Default setting = not used

360 only applies to DNPSI0 (with DNPII1 these parameters are in the station definition)

Parameter name	Description	Settings
SA MAC Algorithm[360]		Permitted range = • not used • SHA1 (4 octets) • SHA1 (8 octets) • SHA1 (10 octets) • SHA256 (8 octets) • SHA256 (16 octets) • AESGMAC (12 octets) Default setting = not used
SA Agressive Mode[360]		Permitted range = yes, no Default setting = no
Maximum number of retries	Max. number of authentication attempts until communication with the remote station is terminated. The same setting is possible as for max. number of errors.	Permitted range = 1 to 250 Default setting = 10
Timeout Authentication Reply	Waiting time to receive a response to an authentication attempt.	Permitted range = 0 to 65535 s Default setting = 2 s
Key Change Interval	As soon as the "Key Change Interval" has expired or the "Number of messages until Key Change" has been reached, the current session key for this user becomes invalid and must be renewed. This value should be set twice as high in the slave as in the master.	Permitted range = 0 to 65535 s Default setting = 1800 s
Message number until Key Change	As soon as the "Key Change Interval" has expired or the "Number of messages until Key Change" has been reached, the current session key for this user becomes invalid and must be renewed. This value should be set twice as high in the slave as in the master.	Permitted range = 1 to 32000 Default setting = 2000
Maximum number of errors	Number of error messages to be sent before further error messages are sent.[361]	Permitted range = 1 to 250 Default setting = 2
[PRE] DNP3 | Communication functions | Secure Authentication | SA v5		
Data length Random Challenge	Amount of random challenge data sent in the challenge and key status message.	Permitted range = 4 to 64 Default setting = 4
Number of session key status queries	Number of session key status queries within the expected session key change interval until the substation sends an error message.	Permitted range = 1 to 250 Default setting = 5

361 applies only for SAv2

Parameter name	Description	Settings
SA Blocking SHA1[362]	With Secure Authentication Sav5, the SHA1 mode can be blocked.	Permitted range = yes, no Default setting = no
Statistic Information[362]	Release of the statistical information of object groups 121 and 122.	Permitted range = • disabled • activated Default setting = disabled
[PRE] DNP3 | Communication functions | Secure Authentication | User Configuration		
Role	User role	Permitted range = • VIEWER • OPERATOR • ENGINEER • INSTALLER • SECADM • SECAUD • RBACMNT • SINGLEUSER • not used Default setting =
Key	Key definition per user.	Permitted range = 0 to 64 characters Valid characters: 'a' to 'f'; 'A' to 'F'; '0' to '9' Default setting =
[PRE] DNP3 | Data base management DNP3		
Data link layer confirmation[363]	Selection of the DNP3 acknowledgment for sent data. With "no acknowledgment" an "Application Confirmation" is expected for multi fragments.	Permitted range = • no acknowledgment • only for multi fragments • always expect acknowledgment Default setting = no acknowledgment
Send multifragments[363]		Permitted range = yes, no Default setting = yes
Optimized indexing		Permitted range = yes, no Default setting = no
Delete oldest event if event buffer overflow	If the event buffer overflows, depending on the selection • the oldest data will be deleted • the newest data will be deleted	Permitted range = yes, no Default setting = yes

362 only applies to DNPSI0 (with DNPII1 these parameters are in the station definition)
363 applies only for DNPSI0

Parameter name	Description	Settings
Data compression for analog change events	For measured value events in the transmit direction, all events (= no state compression) or only the last change (= state compression) can be transmitted.	Permitted range = yes, no Default setting = no
Conversion of NT-bit	Conversion of NT bit (IEC 60870-5-101/104) to DNP3 state.	Permitted range = • to DNP3 status “offline“ • to DNP3 status “communication lost“ • to DNP3 status “communication lost“ and “offline“ Default setting = to DNP3 status “communication lost“
Failure management in transmit direction		Permitted range = • NT bit = 1 • IV bit = 1 • NT bit and/or IV bit = 1 Default setting = NT bit = 1
Force binary input variation 1	If the default data type for “binary input (object 1)” is set to “binary input”, this enabling causes a suppression of the automatic switchover to “binary input variation 2”. All DNP3 states are replaced by “online”.	Permitted range = yes, no Default setting = no
Keep/holding back event data on BSE - binary indication[364]	If the event memory for single / double messages on the DNP3 protocol is full, this data can be restored to the BSE. The following priority levels must be parameterized for this: • Indications: High priority class 1	Permitted range = yes, no Default setting = no
Keep/holding back event data on BSE - measured values[364]	If the event memory for measured values on the DNP3 protocol is full, this data can be restored to the BSE. The following priority levels must be parameterized for this: • Measured values: Low priority class 2 • Integrated totals: Middle priority class 2	Permitted range = yes, no Default setting = no
Save events on SD card		Permitted range = yes, no Default setting = no
Memory for Single Binary Input Events		Permitted range = 20 to 255 Default setting = 250

364 applies only for DNPSI0

Parameter name	Description	Settings
`Memory for Double Binary Input Events`		Permitted range = 20 to 255 Default setting = 250
`Memory for analog Input Events`		Permitted range = 20 to 255 Default setting = 250
`Memory for Binary Counter Events`		Permitted range = 10 to 100 Default setting = 100
`Memory for Binary Output Events`		Permitted range = 10 to 100 Default setting = 30
`Memory for analog Output Events`		Permitted range = 10 to 100 Default setting = 30
`[PRE] DNP3 | Data base management DNP3 | Default data object settings`		
`For binary input (object 1)`	Data types are referenced with Object/Variation. A request for data without a defined variation (any variation) is answered with the default object variant parameterized here.	Permitted range = • binary input • binary input with status Default setting = binary input
`For binary input change (object 2)`	Data types are referenced with Object/Variation. A request for data without a defined variation (any variation) is answered with the default object variant parameterized here.	Permitted range = • binary input without time • binary input with time • binary input with relative time Default setting = binary input with time
`For double binary input (object 3)`	Data types are referenced with Object/Variation. A request for data without a defined variation (any variation) is answered with the default object variant parameterized here.	Permitted range = • binary input • binary input with status Default setting = binary input
`For double binary input change (object 4)`	Data types are referenced with Object/Variation. A request for data without a defined variation (any variation) is answered with the default object variant parameterized here.	Permitted range = • binary input without time • binary input with time • binary input with relative Default setting = binary input with time
`For binary output (object 10)`	Data types are referenced with Object/Variation. A request for data without a defined variation (any variation) is answered with the default object variant parameterized here.	Permitted range = • binary output • binary output with status Default setting = binary output with status
`For binary counter (object 20)`	Data types are referenced with Object/Variation. A request for data without a defined variation (any variation) is answered with the default object variant parameterized here.	Permitted range = • 16-bit counter • 16-bit counter with status • 32-bit counter • 32-bit counter with status Default setting = 32-bit counter with status

Parameter name	Description	Settings
`For frozen binary counter (object 21)`	Data types are referenced with Object/Variation. A request for data without a defined variation (any variation) is answered with the default object variant parameterized here.	Permitted range = • 16-bit counter • 16-bit counter with status • 32-bit counter • 32-bit counter with status Default setting = 32-bit counter with status
`For binary counter change event (object 22)`	Data types are referenced with Object/Variation. A request for data without a defined variation (any variation) is answered with the default object variant parameterized here.	Permitted range = • 16-bit counter with time • 16-bit counter with status • 32-bit counter with time • 32-bit counter with status Default setting = 32-bit counter with status
`For frozen binary counter event (object 23)`	Data types are referenced with Object/Variation. A request for data without a defined variation (any variation) is answered with the default object variant parameterized here.	Permitted range = • 16-bit counter with time • 16-bit counter with status • 32-bit counter with time • 32-bit counter with status Default setting = 32-bit counter with status
`For analog input (object 30)`	Data types are referenced with Object/Variation. A request for data without a defined variation (any variation) is answered with the default object variant parameterized here.	Permitted range = • 16-bit analog input with status • 16-bit analog input without status • 32-bit analog input with status • 32-bit analog input without status • Short floating-point Default setting = 32-bit analog input with status

Parameter name	Description	Settings
For analog input change (object 32)	Data types are referenced with Object/Variation. A request for data without a defined variation (any variation) is answered with the default object variant parameterized here.	Permitted range = • 16-bit analog change event with time • 16-bit analog change event without time • 32-bit analog change event with time • 32-bit analog change event without time • Short floating-point analog change event without time • Short floating-point analog change event with time Default setting = 32-bit analog change event with time
For analog input deadband (object 34)	Data types are referenced with Object/Variation. A request for data without a defined variation (any variation) is answered with the default object variant parameterized here.	Permitted range = • 16-bit analog input deadband • 32-bit analog input deadband • Short floating-point analog input deadband Default setting = 32-bit analog input deadband
For analog output status (object 40)	Data types are referenced with Object/Variation. A request for data without a defined variation (any variation) is answered with the default object variant parameterized here.	Permitted range = • 16-bit analog output status • 32-bit analog output status • Short floating-point analog output status Default setting = 32-bit analog output status
[PRE] Data base management Settings for the data base management on BSE (per PRE) - see *13.1.4.14 Data Management on the BSE for Communication Protocols*		
[PRE] Redundancy		
Ethernet-port if passive[365]		Permitted range = • active • power down • blocked Default setting = enable

[365] applies only for DNPII1

Parameter name	Description	Settings
`Operation if passive`[366]	DNP3 protocol functionality on the line in the redundant state passive. • Transmitter active, normal mode – The DNP3 protocol works identically as in the redundancy state active. – Received data is passed on by the BSE with the status R=1. These messages can be filtered out by the BSE during transmission at interfaces. • Transmitter active, listening mode • Transmitter "tristate", listening mode – The electrical interface is switched to "tristate". – The electrical interfaces of redundant components can be switched in parallel. – Failure monitoring via listening mode	Permitted range = • Transmitter active, normal mode • Transmitter active, listening mode • Transmitter “tristate”, listening mode Default setting = 0
`Delay time passive → aktive`[366]	With redundancy switching from passive → active, the protocol element is switched to active with delay.	Permitted range = 0, 1 to 2000 s 0 .. No delay 1 to 2000 ... delay time Default setting = 0
`Listening mode (failure monitoring time)`[366]	Failure monitoring time in listening mode.	Permitted range = 0, 1 to 60000 s 0 .. monitoring disabled 1 to 60000 .. monitoring time Default setting = 0
`[PRE] Redundancy | DNP3 hot standby redundancy`[367]		
`Redundancy used as hot standby`[367]	Enable the hot standby redundancy function.	Permitted range = • normal redundancy mode • hot standby active data base • hot standby passive data base Default setting = normal redundancy mode

366 applies only for DNPSI0
367 applies only for DNPSI0

Parameter name	Description	Settings
`Target BSE for hot standby container`[367]	Basic system element with redundant DNP3 protocol in hot standby mode.	Permitted range = • unused • own BSE • BSE 01 to BSE 20 Default setting = unused
`Target SSE for hot standby container`[367]	Supplementary system element with redundant DNP3 protocol in hot standby mode.	Permitted range = • unused • PRE 00 to PRE 03 Default setting = unused
**`[PRE] Advanced parameters	Web server`**		
`HTTP web server`	With a web browser protocol-internal information can be displayed. Note: For safety reasons, the web server should be disabled in a system in operation.	Permitted range = disabled, enabled Default setting = disabled
**`[PRE] Advanced parameters	Software test points`**		
...	The software test points may only be used under the guidance of experts for error detection! Once the fault isolation is completed, software checkpoints must always be turned off.	Permitted range = yes, no Default setting = no

13.9.7 Web server

A web server for internal diagnostic and statistical information is integrated in the protocol firmware. The web server itself is implemented on the basic system element – the protocol-specific web pages are provided by the protocol element.

System	Firmware	Designation	Protocol-specific web pages
CP-8031, CP-8050	DNPMI0	DNP3 Master serial	✓
	DNPSI0	DNP3 Slave serial	✓
	DNPII2	DNP3 TCP/IP Master	✓
	DNPII1	DNP3 TCP/IP Slave	✓

Enable/disable web server or start web server via SICAM Device Manager or web browser see *13.1.4.12 Web server for protocol-specific web pages*.

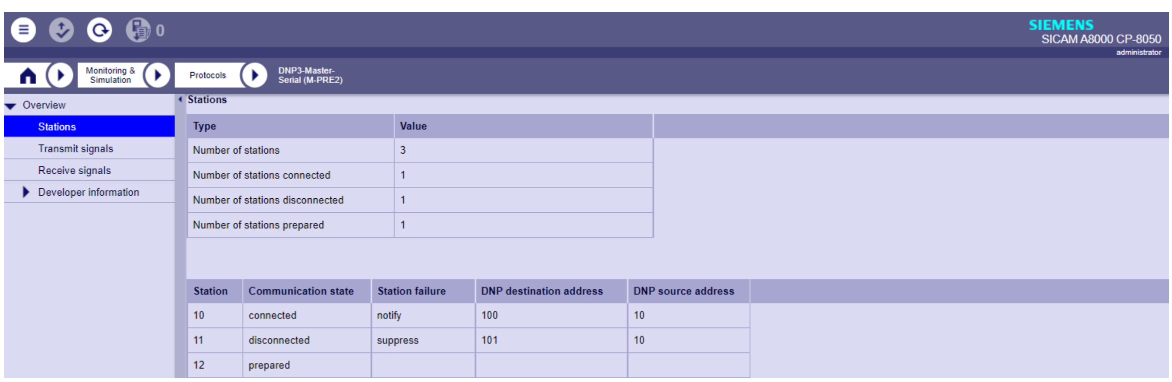
Supported protocol-specific web pages

Web page	DNP3 Master [DNPMI0]	DNP3 Slave [DNPSI0]	DNP3 TCP/IP Master [DNPII2]	DNP3 TCP/IP Slave [DNPII1]
Overview[368]	✓	✓	✓	✓
Stations	✓	✓	✓	✓
Transmit signals	✓	✓	✓	✓
Receive signals	✓	✓	✓	✓
Developer Information[368]				
Datastream trace[368]	✓	✓	✓	✓
Ethernet capture[368]	–	–	✓	✓
Serialtest (IDH)[368]	✓	✓	–	–
Serialtest (IDZ)[368]	✓	✓	–	–
Diagnosis (IDR)[368]	✓	✓	✓	✓
Statistics (IDE)[368]	✓	✓	✓	✓
User diagnosis (IDU)[368]	✓	✓	✓	✓

13.9.7.1 Protocol specific web page: Stations

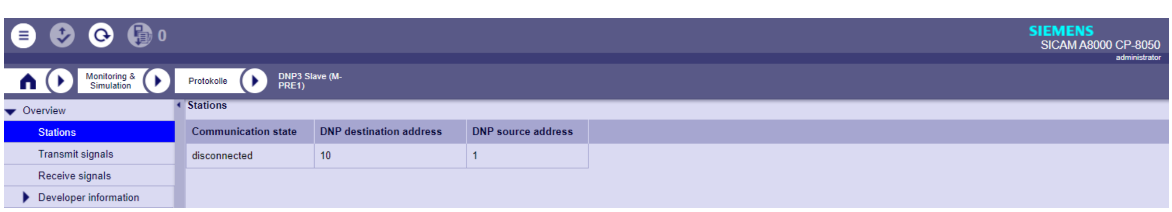
With web page **Stations** detailed information about the status of the connection to each connected station will be displayed.

DNP3 Master serial (DNPMI0):



[DNPMI0_Web_stations, 1, --_--]

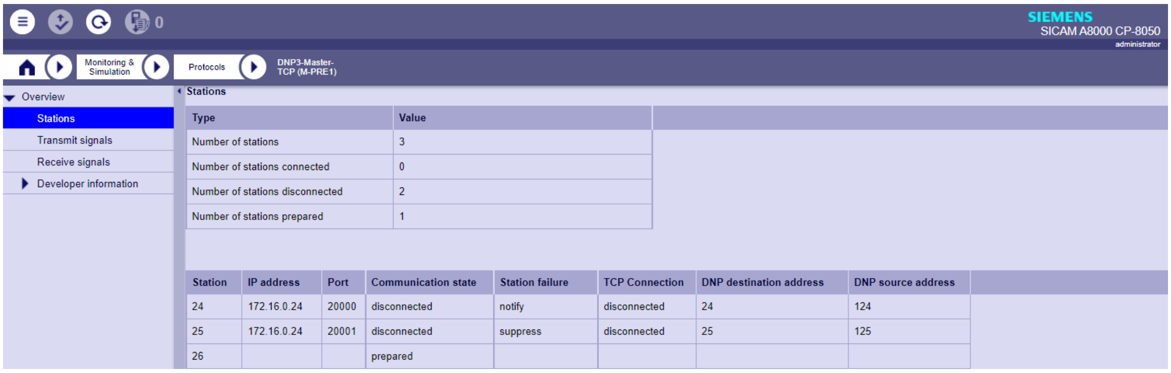
DNP3 Slave serial (DNPSI0):



[DNPSI0_WEB_stations, 1, --_--]

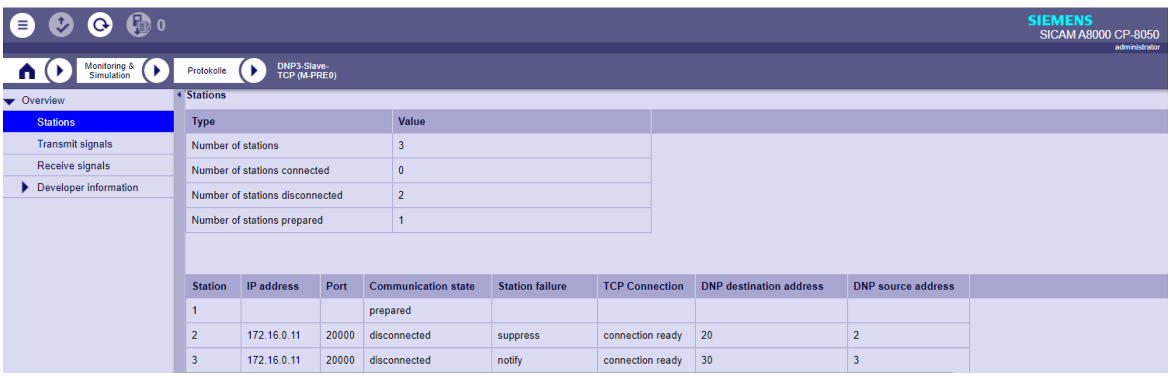
DNP3 TCP Master (DNPII2):

368 See *13.1.4.12 Web server for protocol-specific web pages*



[DNPiI2_WEB_Stations, 1, --_--]

DNP3 TCP Slave (DNPII1):



[DNPiI1_WEB_stations, 1, --_--]

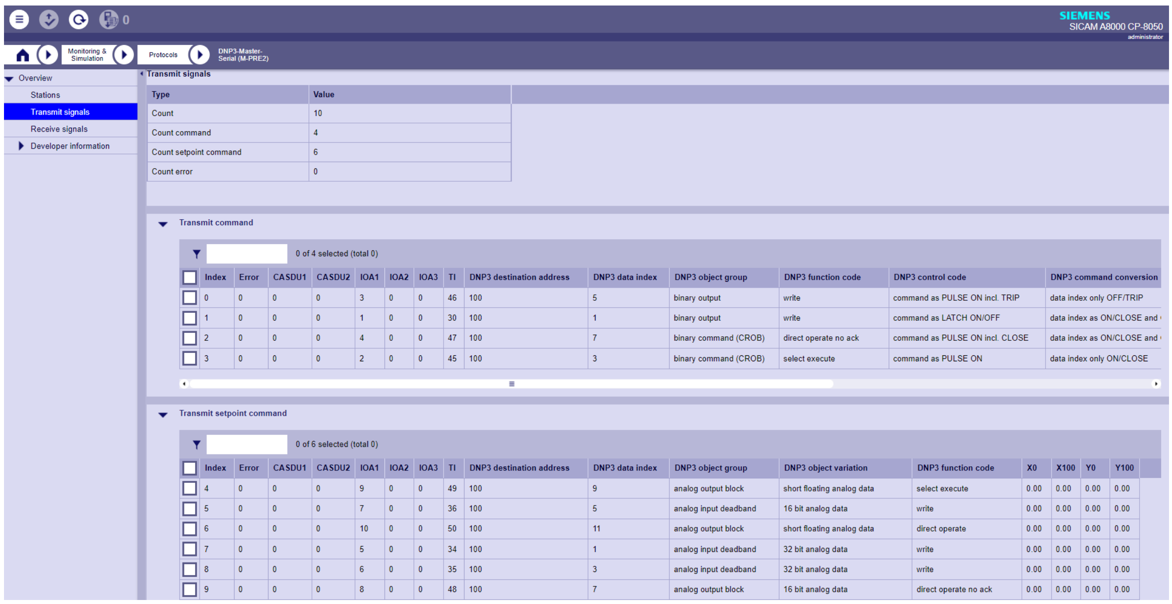
Field	Note
Number of stations	Number of parameterized stations
Number of stations connected	Number of established connections to stations
Number of stations disconnected	Number of cleared connections to stations
Number of stations prepared	Number of prepared connections to stations
Station	Internal station number for this connection
IP address	IP address of the DNP3 remote station for this station
Port	TCP port number for DNP3 protocol
Communication state	State of the connection to this station: • connected • disconnected • prepared
Station failure	report station failure • notify • suppress
TCP connection	State of the TCP connection • prepared • connection ready • connected • disconnected • initial

Field	Note
DNP destination address	DNP3 Destination address
DNP source address	DNP3 Source address

13.9.7.2 Protocol specific web page: Transmit signals

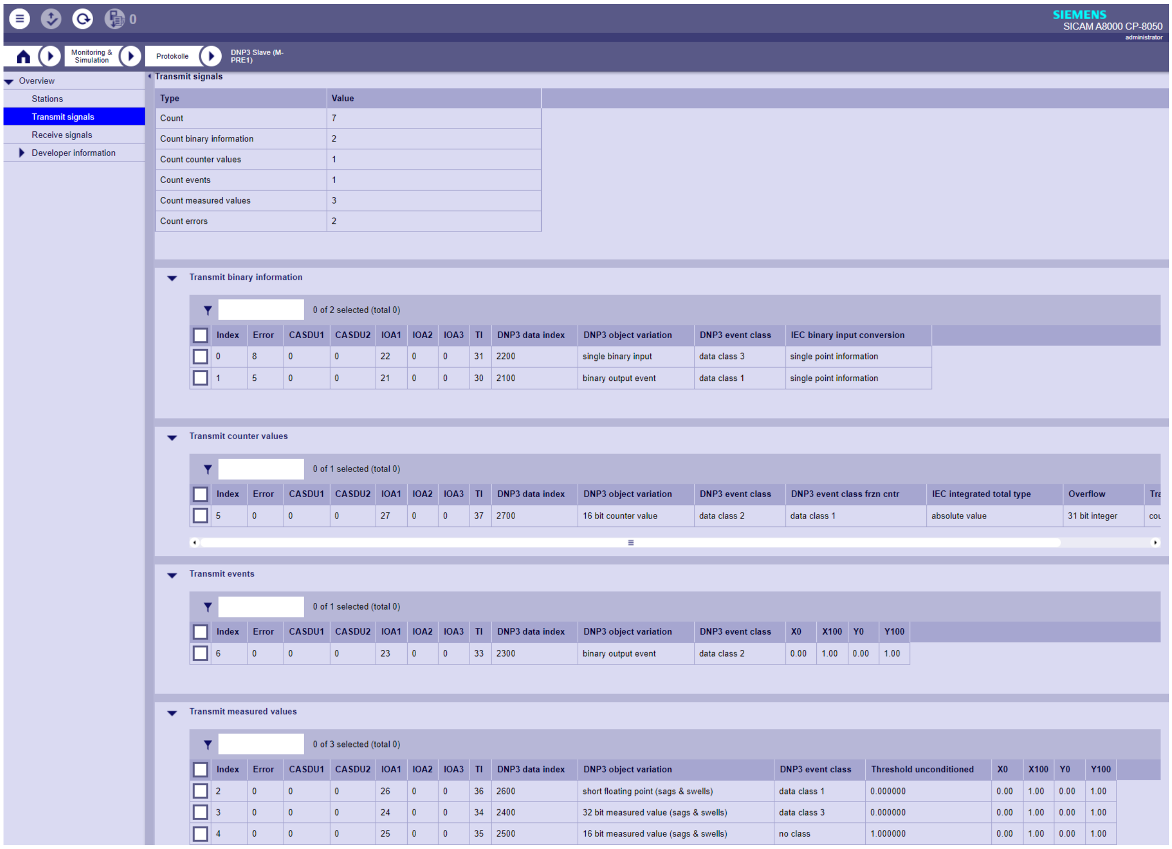
The **Transmit signals** web page displays information of the parameterized and by the protocol processed signals in transmit direction.

DNP3 Master (DNPMI0):



[DNPMI0_WEB_transmit_signals_1, 1, --_--]

DNP3 Slave (DNPSI0):



[DNPSI0_WEB_transmit_signals_1, 1, --_--]

Field	Note
Count	Number of parameterized data points in transmit direction (total number for all stations)
Count command	Number of parameterized data points for “Commands” in transmission direction (total for all stations)
Count setpoint command	Number of parameterized data points for “Setpoint Commands” in transmission direction (total for all stations)
Count binary indications	Number of parameterized data points for “binary information” in transmit direction (total for all stations)
Count events	Number of parameterized data points for “Events” in transmit direction (total for all stations)
Count measured values	Number of parameterized data points for “measured values” in transmit direction (total for all stations)
Count error	Number of faulty parameterized data points in transmit direction (total number for all stations)
Transmit command	Parameterized data points for “commands” in transmit direction (total for all stations)
Transmit setpoint command	Parameterized data points for “Setpoint Commands” in transmit direction (total for all stations)
Transmit binary information	Parameterized data points for “indications/binary information” in transmit direction (total for all stations)
Transmit counter values	Parameterized data points for “integrated totals” in transmit direction (total for all stations)

Field	Note
Transmit events	Parameterized data points for “Events” in transmit direction (total for all stations)
Transmit measured values	Parameterized data points for “measured values” in transmit direction (total for all stations)
Index	Internal index in the detailed routing of the message conversion
Error	Error number (the last detected error is displayed in the diag-nostic)
CASDU1, CASDU2 IOA1, IOA2, IOA3	Internal IEC 60870-5-101/104 address of the data point
TI	Internal IEC 60870-5-101/104 type identification
DNP3 destination address	DNP3 Destination address
DNP3 data index	DNP3 address of the data point
DNP3 object group	DNP3 object group
DNP3 object variation	DNP3 object variation
DNP3 function code	DNP3 function code
DNP3 control code	Conversion of the command to DNPS
DNP3 command conversion	Conversion of the command to DNPS
DNP3 cmd on time	Command output time
DNP3 cmd off time	Command output time
RS CASDU1, RS CASDU2 RS IOA1, RS IOA2, RS IOA3	IEC 60870-5-101/104 address of the assigned return information
X0	X_0% for value adaptation
X100	X_100% for value adaptation
Y0	Y_0% for value adaptation
Y100	Y_100% for value adaptation

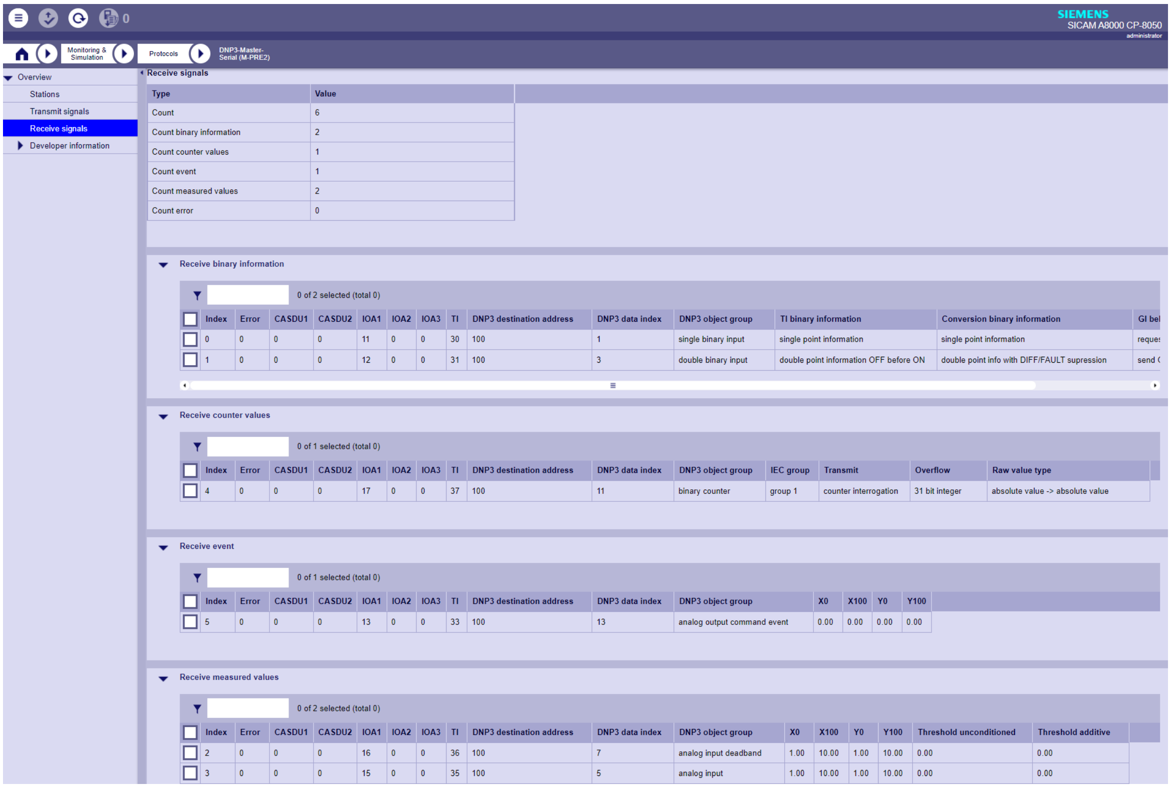
The filter 

affects all fields in the table (see *13.1.4.12 Web server for protocol-specific web pages*).

13.9.7.3 Protocol specific web page: Receive signals

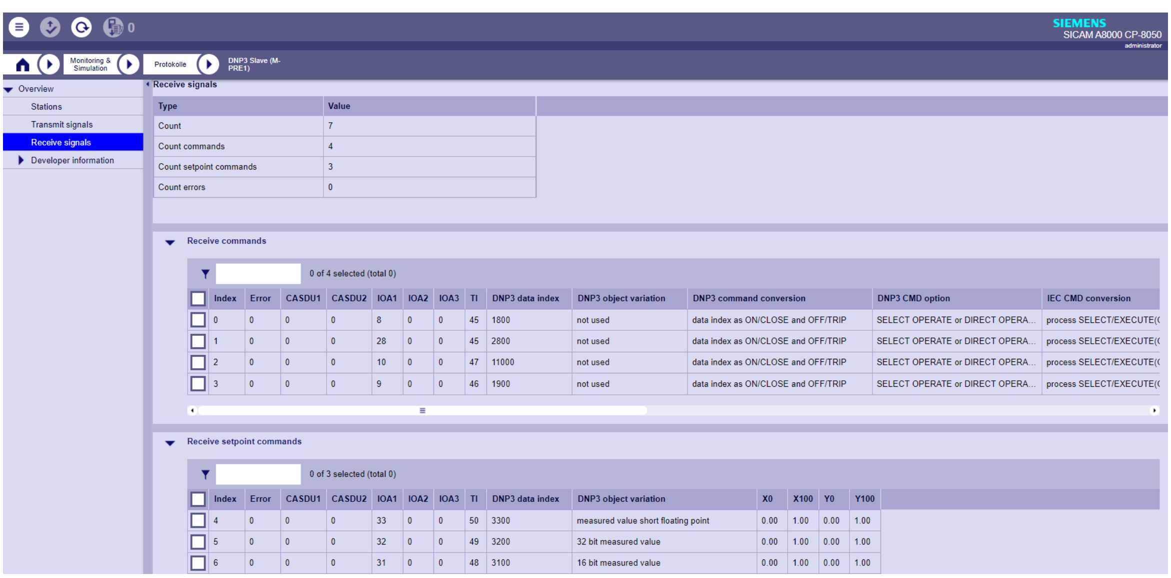
The **Receive signals** web page displays information of the parameterized and by the protocol processed signals in receive direction.

DNP3 Master (DNPMI0):



[DNPMI0_WEB_receive_signals_1, 1, --_--]

DNP3 Slave (DNPSI0):



[DNPSI0_WEB_receive_signals_1, 1, --_--]

Field	Note
Count	Number of parameterized data points in receive direction (total number for all stations)
Count binary indications	Number of parameterized data points for “binary information” in receive direction (total for all stations)

Field	Note
Count counter values	Number of parameterized data points for “integrated totals” in receive direction (total for all stations)
Count event	Number of parameterized data points for “events” in receive direction (total for all stations)
Count measured values	Number of parameterized data points for “measured values” in receive direction (total for all stations)
Count commands	Number of parameterized data points for “commands” in receive direction (total for all stations)
Count setpoint commands	Number of parameterized data points for “setpoint commands” in receive direction (total for all stations)
Count error	Number of faulty parameterized data points in receive direction (total number for all stations)
Receive binary information	Parameterized data points for “binary information” in receive direction (total for all stations)
Receive counter values	Parameterized data points for “integrated totals” in receive direction (total for all stations)
Receive event	Parameterized data points for “events” in receive direction (total for all stations)
Receive measured values	Parameterized data points for “measured values” in receive direction (total for all stations)
Receive commands	Parameterized data points for “command” in receive direction (total for all stations)
Receive setpoint commands	Parameterized data points for “Setpoint Commands” in receive direction (total for all stations)
Index	Internal index in the detailed routing of the message conversion
Error	Error number (the last detected error is displayed in the diagnostic)
CASDU1, CASDU2 IOA1, IOA2, IOA3	Internal IEC 60870-5-101/104 address of the data point
TI	Internal IEC 60870-5-101/104 type identification
DNP3 destination address	DNP3 Destination address
DNP3 data index	DNP3 address of the data point within the object group
DNP3 object variation	DNP3 object variation
DNP3 object group	DNP3 object group defines which data types are contained in a data block.
TI binary information	Conversion of the Binary Information
DNP3 command conversion	Conversion of the commands
DNP3 command option	Option for conversion of commands
IEC CMD conversion	Command conversion to IEC 60870-5-101/104
QOC	Qualifier of Command (IEC 60870-5-101/104)
Retrigger cycle	Cycle time for retrigger command
TERM-CASDU1, TERM-CASDU2 TERM-IOA1, TERM-IOA2, TERM-IOA3	Internal IEC 60870-5-101/104 address of the data point of the assigned return information for commands for the simulation of the IEC 60870-5-101/104 termination
CMD off interlocking reference	Reference number in the protocol element control message for command interlocking
CMD on interlocking reference	Reference number in the protocol element control message for command interlocking
CMD bay level local reference	Reference number in the protocol element control message for command interlocking

Field	Note
Conversion binary information	Conversion of the binary information
GI behavior	Behavior with General Interrogation
IEC group	IEC 60870-5-101/104 counter group
Transmit	Transmission time of the integrated total
Overflow	Value format for counter overflow
Raw value type	Raw value type
X0	X_0% for value adaptation
X100	X_100% for value adaptation
Y0	Y_0% for value adaptation
Y100	Y_100% for value adaptation
Threshold unconditioned	Unconditioned threshold for change monitoring
Threshold additive	Additive threshold for change monitoring

The filter 

affects all fields in the table (see *13.1.4.12 Web server for protocol-specific web pages*).

13.9.8 Message Conversion

Data in transmit direction is transferred from the basic system element to the protocol element in SICAM A8000 internal IEC 60870-5-101/104 (without 101/104 blocking) format. The data formats are converted to the DNP3 line format on the protocol element. The transmission of the data to the remote station according to DNP3 is controlled by the protocol element.

Data in receive direction is converted by the protocol element from the DNP3 format to a SICAM A8000 internal IEC 60870-5-101/104 format and transferred to the basic system element (no 101/104 blocking).

The conversion of the SICAM A8000 internal IEC 60870-5-101/104 message format ↔ DNP3 data format and the conversion of the address information are called message conversion.

The parameterization of the conversion from IEC 60870-5-101/104 ↔ DNP3 (address and message format) is to be done with the SICAM Device Manager with function “Signals” or with the SICAM TOOLBOX II, OPM II using “SIP Message Address Conversion”.

Supported Processing Types for Message Conversion

Data	Direction	Processing type	DNPMI0	DNPSI0	DNPII2	DNPII1
Events	Receive direction	*firmware* / `Rec_event`	✓	–	✓	–
Binary information		*firmware* / `Rec_binary_information`	✓	–	✓	–
Measured values		*firmware* / `Rec_measured value`	✓	–	✓	–
Integrated Totals		*firmware* / `Rec_counter value`	✓	–	✓	–
Commands		*firmware* / `Rec_command`	–	✓	–	✓
Setpoint values		*firmware* / `Rec_setpoint_value`	–	✓	–	✓

Data	Direction	Processing type	DNPMI0	DNPSI0	DNPII2	DNPII1
Events	Transmit direction	*firmware* / **Trans_event**	–	✓	–	✓
Binary information		*firmware* / **Trans_binary_information**	–	✓	–	✓
Measured values		*firmware* / **Trans_measured_value**	–	✓	–	✓
Integrated Totals		*firmware* / **Trans_counter_value**	–	✓	–	✓
Commands		*firmware* / **Trans_command**	✓	–	✓	–
Setpoint values		*firmware* / **Trans_setpoint_command**	✓	–	✓	–

General description of the parameters and properties (valid for each type of processing)

Parameter	
	The data is transmitted according to DNP3 with the set **Own station number** to the remote station with the set **Station number** of the remote station.
DNP3_Data_index	DNP3 Data index: 0 to 65535

Parameter	
DNP3_Object_variant	DNP3 Object variant: • 32-bit measured value • 16-bit measured value • Measured value short floating-point • Binary output event • Binary output command event • Analog output event • Analog output command event • Binary input • Double binary input • 32-bit measured value • 16-bit measured value • 16-bit measured value • Measured value short floating-point • 32-bit measured value (sags & swells) • 16-bit measured value (sags & swells) • Short floating-point (sags & swells) • 32-bit integrated total • 16-bit integrated total • 32-bit integrated total delta • 16-bit integrated total delta
DNP3_Event_class	DNP3 Event class: • No class • Data class 1 • Data class 2 • Data class 3

Each data object is defined by the used object type and object variant. Within an object type, the data objects are distinguished by the data index. This data index can by definition be a maximum of 42949671295. The DNP3 firmware only supports a maximum data index of 65535. Thus, a maximum of 65536 data points can be used for an object type.

For different object types, the same data index may be used, since the differentiation of the data is made possible by the object type.

With DNP3, the data is addressed (DNP object) with “object/variation” and “data index”. The central station query of the data may be either specific (e.g., ”binary input with status”) or with a common request (e.g., ”binary input - any variation”).

The default data types for queries with “any variation” are set in the firmware for DNP3 slave with the following parameters: **[PRE] DNP3 | Communication functions | Data base management DNP3 | Default data object settings**

13.9.8.1 Message Conversion in Transmit Direction (Slave → Master)

Message Conversion in Transmit Direction IEC 60870-5-101/104 → DNP3

SICAM A8000: IEC 60870-5-101/104		DNP3		
Type Identification	Designation	Designation	Object type	Object variant
<TI:=30>	Single-point information with CP56Time2a time tag	• Binary Input • Binary Input Change	1 2	0, 1, 2 0, 1, 2, 3
<TI:=31>	Double-point information with time tag CP56Time2a	• Binary Input • Binary Input Change • Double Binary Input • Double Binary Input Change	1 2 3 4	0, 1, 2 0, 1, 2, 3 0, 1, 2 0, 1, 2, 3
<TI:=34>	Measured value, normalized value with time tag CP56Time2a	• Analog Input • Analog Change Event	30 32	0, 1, 2, 3, 4 0, 1, 2
<TI:=35>	Measured value, scaled value with time tag CP56Time2a	• Analog Input • Analog Change Event	30 32	0, 1, 2, 3, 4 0, 1, 2
<TI:=36>	Measured value, short floating point number with time tag CP56Time2a	• Analog Input • Analog Change Event	30 32	0, 1, 2, 3, 4 0, 1, 2
<TI:=37>	Integrated totals with time tag CP56Time2a	• Binary Counter • Frozen Counter • Frozen Counter Event	20 21 23	0, 1, 5 0, 1, 5, 9 0, 1, 5
	Time synchronization	• Time Delay Fine [369]	52	2

Binary information

The parameterization of the address and message conversion for binary information in transmit direction takes place for DNP3 Slave with SICAM TOOLBOX II, OPM II (object oriented process data manager).

369 The message is generated by the protocol firmware

Parameter Category:
firmware/**Trans_binary_information**

Parameter	Value
Lk_Reg	2
Lk_Comp	1
Lk_BSE	020 CP-8050/CPCI85
Lk_SSE	128 AP-0599/DNPSI0
Lk_DS	Protocols
Lk_Cat	DNPSI0/Trans_binary_information
Lk_Prep	Activated
CASDU1	2
CASDU2	1
IOA1	1
IOA2	0
IOA3	0
TI	Single pt. information (TI 30)
IEC_binary_input_conversion	single point information
DNP3_data_index	1
DNP3_object_variation	binary input
DNP3_event_class	data class 1

Parameter	Value
Lk_Reg	2
Lk_Comp	1
Lk_BSE	020 CP-8050/CPCI85
Lk_SSE	128 AP-0599/DNPSI0
Lk_DS	Protocols
Lk_Cat	DNPSI0/Trans_binary_information
Lk_Prep	Activated
CASDU1	2
CASDU2	1
IOA1	1
IOA2	2
IOA3	0
TI	Double pt. information (TI 31)
IEC_binary_input_conversion	double point information OFF before ON
DNP3_data_index	1
DNP3_object_variation	double binary input
DNP3_event_class	data class 1

Measured values

The parameterization of the address and message conversion for measured values in transmit direction takes place for DNP3 Slave with SICAM TOOLBOX II, OPM II (object oriented process data manager).

Parameter Category:
firmware /**Trans_measured_value**

Parameter	Value
Lk_Reg	2
Lk_Comp	1
Lk_BSE	020 CP-8050/CPCI85
Lk_SSE	128 AP-0599/DNPSI0
Lk_DS	Protocols
Lk_Cat	DNPSI0/Trans_measured_value
Lk_Prep	Activated
CASDU1	2
CASDU2	1
IOA1	1
IOA2	1
IOA3	0
TI	Measured val. short floating point (TI 36)
DNP3_data_index	1
DNP3_object_variation	measured value short floating point
DNP3_event_class	data class 2
Thresh_uncond	0
Measured_val_adap_X_0%	-1000
Measured_val_adap_X_100%	1000
Measured_val_adap_Y_0%	-1000
Measured_val_adap_Y_100%	1000

Integrated totals

The parameterization of the address and message conversion for integrated totals in transmit direction takes place for DNP3 Slave with SICAM TOOLBOX II, OPM II (object oriented process data manager).

Parameter Category:
firmware /**Trans_counter_value**

Parameter	Value
Lk_Reg	2
Lk_Comp	1
Lk_BSE	020 CP-8050/CPCI85
Lk_SSE	128 AP-0599/DNPSI0
Lk_DS	Protocols
Lk_Cat	DNPSI0/Trans_counter_value
Lk_Prep	Activated
CASDU1	2
CASDU2	1
IOA1	1
IOA2	4
IOA3	0
TI	Count 31 bit + sign (TI 37)
DNP3_data_index	1
DNP3_object_variation	32 bit delta counter value
DNP3_event_class	data class 3
IEC_integrated_total_type	relative value (delta)
Overflow	31 Bit Integer
Transmit	Spontaneous integrated total

13.9.8.2 Message Conversion in Receive Direction (Slave ← Master)

Message Conversion in Receive Direction IEC 60870-5-101/104 ← DNP3

SICAM A8000: IEC 60870-5-101/104		DNP3		
Type Identification	Designation	Designation	Object type	Object variant
<TI:=45>	Single command	• Control Relay Output Block	12	1

SICAM A8000: IEC 60870-5-101/104		DNP3		
<TI:=46>	Double-point information	• Control Relay Output Block	12	1
<TI:=48>	Set point command, normalized value	• 32 Bit Analog Output Block • 16 Bit Analog Output Block • Short Floating Point Analog Output Block	41 41 41	1 2 3
<TI:=49>	Setpoint command, scaled value	• 32 Bit Analog Output Block • 16 Bit Analog Output Block • Short Floating Point Analog Output Block	41 41 41	1 2 3
<TI:=50>	Set point command, short floating point number	• 32 Bit Analog Output Block • 16 Bit Analog Output Block • Short Floating Point Analog Output Block	41 41 41	1 2 3
	Time Synchronization	• Request Data class 0, 1 , 2 or 3	60 [370]	1, 2, 3, 4
		• Enable/disable unsolicited messages for data class 1, 2 or 3. Enable/disable sponta-neous message transmission	60 [370]	2, 3, 4
		• Assign Class Assign the given data to class 1, 2 or 3	[370]	
		• Delay Measurement Runtime measurement	[370]	
		• Time and Date Time synchronization	50 [370]	1

Commands

The parameterization of the address and message conversion for commands in receive direction takes place for DNP3 Slave with SICAM TOOLBOX II, OPM II (object oriented process data manager).

370 This telegram is only evaluated on the PRE

Parameter Category:
firmware /**Rec_command**

Parameter	Value
Lk_Reg	2
Lk_Comp	1
Lk_BSE	020 CP-8050/CPCI85
Lk_SSE	128 AP-0599/DNPSI0
Lk_DS	Protocols
Lk_Cat	DNPSI0/Rec_command
Lk_Prep	Activated
DNP3_data_index	1
DNP3_object_variation	NOT USED
DNP3_CMD_command_conversion	Data index as ON/CLOSE and OFF/TRIP
DNP3_CMD_option	SELECT OPERATE or DIRECT OPERATE
IEC_CMD_conversion	process SELECT/EXECUTE(OPERATE)
QOC	command time fixed by hardware
Retrigger_cycle	no retriggered command
CASDU1	2
CASDU2	1
IOA1	1
IOA2	5
IOA3	0
TI	Single command (TI 45)
TERM-CASDU1	255
TERM-CASDU2	255
TERM-IOA1	255
TERM-IOA2	255
TERM-IOA3	255
CMD_OFF_interlocking_reference	0
CMD_ON_interlocking_reference	0
CMD_bay_level_LOCAL_reference	10

Setpoint values

The parameterization of the address and message conversion for setpoint values in receive direction takes place for DNP3 Slave with SICAM TOOLBOX II, OPM II (object oriented process data manager).

Parameter Category:
firmware /**Rec_setpoint_value**

Parameter	Value
Lk_Reg	2
Lk_Comp	1
Lk_BSE	020 CP-8050/CPCI85
Lk_SSE	128 AP-0599/DNPSI0
Lk_DS	Protocols
Lk_Cat	DNPSI0/Rec_setpoint_command
Lk_Prep	Activated
DNP3_data_index	0
DNP3_object_variation	16 bit measured value
CASDU1	2
CASDU2	1
IOA1	0
IOA2	6
IOA3	0
TI	Setpoint val. positioning comm. short floating point (TI 50)
Measured_val_adap_X_0%	0
Measured_val_adap_X_100%	1
Measured_val_adap_Y_0%	0
Measured_val_adap_Y_100%	1

13.9.9 Interoperabilität (DNP3 Device Profile Document)

Revision History

VERSION	Date	Reason for Changes
1.00	2018-08-30	Initial Version for SICAM A8000 CP-8050 with DNPSI0 firmware or DNPII1 firmware using the Triangle MicroWorks, Inc. DNP3 Slave Source Code Library version 3.22.0000 Note: Initial version of DNP3 Device Profile Document for SICAM A8000 CP-8050 is based on DNP3 Device Profile Document based on template DNP3Spe_DeviceProfile_April2016.docx
1.03	2019-04-24	Firmwares for DNP3 Master (“serial”) and DNP3 Master (TCP) added. DNP3 Profile Document valid for following firmwares: • DNPSI0 ... DNP3 Slave ("serial") • DNPMI0 ... DNP3 Master ("serial") • DNPII1 ... DNP3 Slave (TCP) • DNPII2 ... DNP3 Master (TCP) Note: DNP3 firmwares using the Triangle MicroWorks, Inc. DNP3 Master/Slave Source Code Library version 3.22.0000.
1.04	2020-09-24	Update Note: DNP3 firmwares using the Triangle MicroWorks, Inc. DNP3 Master/Slave Source Code Library updated to version 3.26.0000.

VERSION	Date	Reason for Changes
1.05	2020-09-24 2020-09-13	• DNPSI0 Rev. 03.50 .. DNP3 Slave ("serial") – security fixes (remote code execution vulnerability) – DNP3 protocol stack updated • DNPMI0 Rev. 03.50 .. DNP3 Master ("serial") – security fixes (remote code execution vulnerability) – DNP3 protocol stack updated Note: DNP3 firmwares using the Triangle MicroWorks DNP3 Master/Slave Source Code Library updated to version 3.26.0000
	2020-09-30	• DNPII1 Rev. 03.50 .. DNP3 Slave ("TCP") – security fixes (remote code execution vulnerability) – DNP3 protocol stack updated • DNPII2 Rev. 03.50 .. DNP3 Master ("TCP") – security fixes (remote code execution vulnerability) – DNP3 protocol stack updated Note: DNP3 firmwares using the Triangle MicroWorks DNP3 Master/Slave Source Code Library updated to version 3.26.0000.
	2021-11-26	• DNPSI0 Rev. 03.70 .. DNP3 Slave ("serial") – file transfer in receive direction • DNPII1 Rev. 03.70 .. DNP3 Slave (TCP) – file transfer in receive direction
	2022-07-29	• DNPSI0 Rev. 03.85 .. DNP3 Slave ("serial") – "Secure Authentication" version 2 and 5 with symmetric key exchange procedure – optimized indexing for "binary output data" and "analog output data" • DNPII1 Rev. 03.85 .. DNP3 Slave (TCP) – "Secure Authentication" version 2 and 5 with symmetric key exchange procedure – optimized indexing for "binary output data" and "analog output data" • DNPMI0 Rev. 03.85 .. DNP3 Master "serial" – DNP3 protocol stack updated • DNPII2 Rev. 03.85 .. DNP3 Master (TCP) – DNP3 protocol stack updated Note: DNP3 firmwares using the Triangle MicroWorks DNP3 Source Code Library updated to version 3.29.0000.

Vendors must produce a Device Profile Document for each device they manufacture implementing DNP3. The Device Profile Document clearly identifies any deviations from the implementation levels described in this document and any other issues that may arise when determining the device's compatibility with another device.

The instructions for completing Device Profile Forms and information are given in Clause 14 of the specification - Interoperability.

Note: there are empty "placeholder" sections in the Device Profile document. These are intentionally blank, being used so that section numbering does not change when entries are deleted from the document. Likewise, to ensure existing section numbers do not change, all new entries are added at the end of the relevant section.

1 Device Properties

This document is intended to be used for several purposes, including:

- Identifying the capabilities of a DNP3 device (Master Station or Outstation)
- Recording the settings of a specific instance of a device (parameter settings for a specific instance of the device in the user's total DNP3 estate)
- Matching user requirements to product capabilities when procuring a DNP3 device

The document is therefore structured to show, for each technical feature, the capabilities of the device (or capabilities required by the device when procuring).

It is also structured to show the current value (or setting) of each of the parameters that describe a specific instance of the device. This "current value" may also show a functional limitation of the device. For example when implementing secure authentication it is not required that all DNP3 devices accept aggressive mode requests during critical exchanges (see Device Profile 1.12.4), in which case a vendor would mark this current value as "No – does not accept aggressive mode requests".

Additionally, the current value may sometimes be used to show a value that a device can achieve because of hardware or software dependencies. Users should note that if an entry in the capabilities column of the Device Profile is grayed-out then there may be information in the current value column that is pertinent to the device's capabilities.

Unless otherwise noted, multiple boxes in the second column below should be selected for each parameter to indicate all capabilities supported or required. Parameters without checkboxes in the second column do not have capabilities and are included so the current value may be shown in the third column.

The items listed in the capabilities column below may be configurable to any of the options selected, or set to a fixed value when the device was designed. Item 1.1.10 contains a list of abbreviations for the possible ways in which the configurable parameters may be set. Since some parameters may not be accessible by each of these methods supported, an abbreviation for the configuration methods supported by each parameter is shown in the fourth column of the tables below.

If this document is used to show the current values, the third column should be filled in even if a fixed parameter is selected in the capabilities section ("N/A" may be entered for parameters that are Not Applicable).

If this document is used to show the current value of parameters, then column 3 applies to a single connection between a master and an outstation.

1.1 DEVICE IDENTIFICATION	Capabilities	Current Value	If configurable, list methods
1.1.1 Device Function: Masters send DNP requests, while Outstations send DNP responses. If a single physical device can perform both functions, a separate Device Profile Document must be provided for each function.	● Master ● Outstation	● Master ● Outstation	
1.1.2 Vendor Name: The name of the organization producing the device. Note: The current value of this outstation parameter is available remotely using protocol object Group 0 Variation 252.		Siemens AG Humboldstraße 59 90459 Nuremberg Germany	
1.1.1 Device Name: The model and name of the device, sufficient to distinguish it from any other device from the same organization. Note: The current value of this outstation parameter is available remotely using protocol object Group 0 Variation 250.		SICAM A8000 CP-8031, CP-8050 with DNPSI0 or DNPII1 or DNPMI0 or DNPII2 firmware.	
1.1.4 Device manufacturer's hardware version string: Note: The current value of this outstation parameter is available remotely using protocol object Group 0 Variation 243.		CP-8031: 6MF28031AA00 CP-8050: 6MF28050AA00 CI-8520: 6MF28520AA00 CI-8522: 6MF28522AA00	
1.1.5 Device manufacturer's software version string: Note: The current value of this outstation parameter is available remotely using protocol object Group 0 Variation 242.		DNPSI0 V3.86 (1) DNPII1 V3.85 (2) DNPMI0 V3.86 (3) DNPII2 V3.85 (4) (1) DNP3 Slave "serial" (2) DNP3 Slave "TCP" (3) DNP3 Master "serial" (4) DNP3 Master "TCP"	
1.1.6 Device Profile Document Version Number: Version of the Device Profile Document is indicated by a whole number incremented with each new release. This should match the latest version shown in the Revision History at the beginning of this document.		V1.03	

1.1 DEVICE IDENTIFICATION	Capabilities	Current Value	If configurable, list methods
1.1.7 DNP Levels Supported for: Indicate each DNP3 Level to which the device conforms fully. For Masters, requests and responses can be indicated independently.	Masters only Requests Response ☐ .... ☐ .... None ☒ .... ☒ .... Level 1 ☒ .... ☒ .... Level 2 ☐ .... ☐ .... Level 3 ☐ .... ☐ .... Level 4 Outstations Only Requests and Responses ☐ .... None ☒ .... Level 1 ☒ .... Level 2 ☐ .... Level 3 ☐ .... Level 4	Note: Most but not all of level 3 features are also supported.	
1.1.8 Supported Function Blocks:	☐ Self-Address Support ☐ Data Sets ☒ File Transfer ☐ Virtual Terminals ☐ Mapping to IEC 61850 Object Models defined in a DNP3 XML file ☐ Function code 31, activate configuration ☒ Authentication (if checked then see 1.12)	Note: File Transfer supported by DNP3 Slave only (DNPSI0, DNPII1 firmware)	
1.1.9 Notable Additions: A brief description intended to quickly identify (for the reader) the most obvious features the device supports in addition to the Highest DNP Level Supported. The complete list of features is described in the Implementation Table.		Note: Most but not all of level 3 features are also supported.	

1.1 DEVICE IDENTIFICATION	Capabilities	Current Value	If configurable, list methods
1.1.10 Methods to set Configurable Parameters:	☐ XML – Loaded via DNP3 File Transfer ☐ XML – Loaded via other transport mechanism ☐ Terminal – ASCII Terminal Command Line 1 ☒ Software – Vendor software named - SICAM Device Manager or - SICAM TOOLBOX II ☐ Proprietary file loaded via DNP3 file transfer ☐ Proprietary file loaded via other transport mechanism ☐ Direct – Keypad on device front panel ☐ Factory – Specified when device is ordered ☐ Protocol – Set via DNP3 (e.g. assign class) ☐ Other, explain ______________________		
1.1.11 DNP3 XML files available On-Line: XML configuration files names that can be read or written through DNP3 File Transfer to a device. A device's currently running configuration is returned by DNP3 on-line XML file read from the device. DNP3 on-line XML file write to a device will update the device's configuration when the Activate Configuration (function code 31) is received.	Rd Wr Filename Description of Contents ☐ dnpDP.xml Complete Device Profile ☐ dnpDPcap.xml Device Profile Capabilities ☐ dnpDPcfg.xml Device Profile config. values	Note: DNP3 XML files not supported	
1.1.12 External DNP3 XML files available Off-line: XML configuration file names that can be read or written from an external system, typically from a system that maintains the outstation configuration. External off-line XML file read permits an XML definition of a new configuration to be supplied from off-line configuration tools. External off-line XML file write permits an XML definition of a new configuration to be supplied to off-line configuration tools.	Rd Wr Filename Description of Contents ☐ ☐ dnpDP.xml Complete Device Profile ☐ ☐ dnpDPcap.xml Device Profile Capabilities ☐ ☐ dnpDPcfg.xml Device Profile config. values	Note: DNP3 XML files not supported	

1.1 DEVICE IDENTIFICATION	Capabilities	Current Value	If configurable, list methods
1.1.13 Connections Supported:	☒ Serial (complete section 1.2) ☒ IP Networking (complete section 1.3) ☐ Other, explain ___________________________	- DNPSI0 = ser. (1) - DNPMI0 = ser. (2) - DNPII1 = IP (3) - DNPII2 = IP (4) (1) DNP3 Slave "serial" (2) DNP3 Master "serial" (3) DNP3 Slave "TCP/UDP" (4) DNP3 Master "TCP/UDP"	
1.1.14 Conformance Testing: Where conformance testing has been completed for the outstation or master station, specify the version of the published DNP3 test procedures that was successfully passed. If independently tested, identify the organization that performed the test.	☒ Self-tested, version DNP3 Slave tested by SIEMENS AG Austria according "DNP3 IED Certification Procedure Subset Level 2 Version 2.7 2-March-2016" ☐ Independently tested, version ________________ Test organization name ____________________		

1.2 SERIAL CONNECTIONS	Capabilities	Current Value	If configurable, list methods
1.2.1 Port Name: Name used to reference the communication port defined in this section.		CP-8031, CP-8050: - Port X5: RS-232 - Port X4: RS-422 - Port X4: RS-485 CI-8551: - Port X1,X2, X4, X5: RS-232 - Port X1, X2, X3: RS-422 - Port X1, X2, X3: RS-485	DNPMI0, DNPSI0 mapping to one of available serial ports.
1.2.2 Serial Connection Parameters:	☒ Asynchronous - 8 Data Bits, 1 Start Bit, 1 Stop Bit, No Parity ☒ Other, explain - Asynchronous - 8 Data Bits, 1 Start Bit, 1/2 Stop Bit, Even/Odd Parity	8 Data Bits, 1 Start Bit, 1 Stop Bit, No Parity	

1.2 SERIAL CONNECTIONS	Capabilities	Current Value	If configurable, list methods
1.2.3 Baud Rate:	☐ Fixed at _______ ☐ Configurable, range ____ to ____ ☒ Configurable, selectable from 50, 75, 100, 134.5, 150, 200, 300, 600, 1050, 1200, 1800, 2000, 2400, 4800, 9600, 19200, 38400, 56000, 57600, 64000, 115200 ☐ Configurable, other, describe _______________	9600	

1.2 SERIAL CONNECTIONS	Capabilities	Current Value	If configurable, list methods
1.2.4 Hardware Flow Control (Handshaking): Describe hardware signaling requirements of the interface. Where a transmitter or receiver is inhibited until a given control signal is asserted, it is considered to require that signal prior to sending or receiving characters. Where a signal is asserted prior to transmitting, that signal will be maintained active until after the end of transmission. Where a signal is asserted to enable reception, any data sent to the device when the signal is not active could be discarded.	☐ None **RS-232 / V.24 / V.28 Options:** <u>Asserts:</u> ☒ RTS before Tx ☐ DTR before Tx ☐ RTS before Rx ☐ DTR before Rx ☒ Always RTS ☒ Always DTR <u>Requires before Tx:</u> CTS ☐ Asserted ☐ Deasserted DCD ☐ Asserted ☒ Deasserted DSR ☐ Asserted ☐ Deasserted RI ☐ Asserted ☐ Deasserted Requires Rx inactive before Tx <u>Requires before Rx:</u> CTS ☐ Asserted ☐ Deasserted DCD ☐ Asserted ☐ Deasserted DSR ☐ Asserted ☐ Deasserted RI ☐ Asserted ☐ Deasserted <u>Always ignores:</u> ☒ CTS ☐ DCD ☒ DSR ☒ RI ☐ Other, explain ____________ **RS-422 / V.11 Options:** ☐ Requires Indication before Rx ☒ Asserts Control before Tx ☐ Other, explain ____________ **RS-485 Options:** ☒ Requires Rx inactive before Tx ☐ Other, explain ☐ **Other, explain** ____________	Note: "always RTS" and "always DTR" is only possible with parameter tv=0 ("RTS before Tx").	

1.2 SERIAL CONNECTIONS	Capabilities	Current Value	If configurable, list methods
1.2.5 Interval to Request Link Status: Indicates how often to send Data Link Layer status requests on a serial connection. This parameter is separate from the TCP Keep-alive timer.	☐ Not Supported ☐ Fixed at_________ seconds ☒ Configurable, range 0 to 65535 seconds ☐ Configurable, selectable from ___,___,___ seconds ☐ Configurable, other, describe________________	0 seconds	
1.2.6 Supports DNP3 Collision Avoidance: Indicates whether a device uses a collision avoidance algorithm. Collision avoidance may be implemented by a back-off timer with two parameters that define the back-off time range or by some other vendor-specific mechanism. The recommended back-off time is specified as being a fixed minimum delay plus a random delay, where the random delay has a maximum value specified. This defines a range of delay times that are randomly distributed between the minimum value and the minimum **plus** the maximum of the random value. If a back-off timer is implemented with only a fixed or only a random value, select the Back-off time method and set the parameter that is not supported to "Fixed at 0 ms".	☐ No ☒ Yes, using Back-off time = (Min + Random) method Minimum Back-off time: ☐ Fixed at_________ ms ☒ Configurable, range 0 to 65535 ms ☐ Configurable, selectable from ___,___,___ ms ☐ Configurable, other, describe________________ Maximum Random Back-off time component: ☒ Fixed, range 20 to 120 ms ☐ Configurable, range _____ to ______ ms ☐ Configurable, selectable from ___,___,___ ms ☐ Configurable, other, describe________________ ☐ Other, explain ________________________	30 ms	

1.2 SERIAL CONNECTIONS	Capabilities	Current Value	If configurable, list methods
1.2.7 Receiver Inter-character Timeout: When serial interfaces with asynchronous character framing are used, this parameter indicates if the receiver makes a check for gaps between characters (i.e. extension of the stop bit time of one character prior to the start bit of the following character within a message). If the receiver performs this check and the timeout is exceeded then the receiver discards the current data link frame. A receiver that does not discard data link frames on the basis of inter-character gaps is considered to not perform this check. Where no asynchronous serial interface is fitted, this parameter is not applicable. In this case none of the options shall be selected.	☐ Not checked ☐ No gap permitted ☐ Fixed at _____ bit times ☐ Fixed at _____ ms ☒ Configurable, range 0 to 32767 bit times ☐ Configurable, range ____ to ____ ms ☐ Configurable, Selectable from ___,___,___bit times ☐ Configurable, Selectable from ____, ____, ____ ms ☐ Configurable, other, describe ________________ ☐ Variable, explain ____	100 Bit	
1.2.8 Inter-character gaps in transmission: When serial interfaces with asynchronous character framing are used, this parameter indicates whether extra delay is ever introduced between characters in the message, and if so, the maximum width of the gap. Where no asynchronous serial interface is fitted, this parameter is not applicable. In this case none of the options shall be selected.	☒ None (always transmits with no inter-character gap) ☐ Maximum _____ bit times ☐ Maximum _____ ms		

1.3 IP NETWORKING	Capabilities	Current Value	If configurable, list methods
1.3.1 Port Name: Name used to reference the communication port defined in this section.		CP-8031, CP-8050: - Port X2, X3: Ethernet CI-852x: - Port X1-X5: Ethernet	
1.3.2 Type of End Point:	☒ TCP Initiating ☒ TCP Listening ☒ TCP Dual ☐ UDP Datagram	(list all active) Default: TCP Listening	
1.3.3 IP Address of this Device:		configurable	
1.3.4 Subnet Mask:		configurable	
1.3.5 Gateway IP Address:		configurable	

1.3 IP NETWORKING	Capabilities	Current Value	If configurable, list methods
1.3.6 Accepts TCP Connections or UDP Datagrams from:	☐ Allows all (show as *.*.*.* in 1.3.7) ☐ Limits based on an IP address ☒ Limits based on list of IP addresses ☒ Limits based on a wildcard IP address ☐ Limits based on list of wildcard IP addresses ☐ Other, explain________________	Wildcard IP address = 0.0.0.0 Supported only for one connection using TCP listening.	
1.3.7 IP Address(es) from which TCP Connections or UDP Datagrams are accepted:			
1.3.8 TCP Listen Port Number: If Outstation or dual end point Master, port number on which to listen for incoming TCP connect requests. Required to be configurable for Masters and recommended to be configurable for Outstations.	☐ Not Applicable (Master w/o dual end point) ☐ Fixed at 20,000 ☒ Configurable, range 1024 to 65535 ☐ Configurable, selectable from ____,____,____ ☐ Configurable, other, describe________________	Default: 20000 configurable for each connection.	
1.3.9 TCP Listen Port Number of remote device: If Master or dual end point Outstation, port number on remote device with which to initiate connection. Required to be configurable for Masters and recommended to be configurable for Outstations.	☐ Not Applicable (Outstation w/o dual end point) ☐ Fixed at 20,000 ☒ Configurable, range 1024 to 65535 ☐ Configurable, selectable from ____,____,____ ☐ Configurable, other, describe_______________	Default: 20000 configurable for each connection.	
1.3.10 TCP Keep-alive timer: The time period for the keep-alive timer on active TCP connections.	☒Timer disabled ☐ Fixed at __________ms ☐ Configurable, range _______ to _______ms ☐ Configurable, selectable from ____,____,____ms ☐ Configurable, other, describe_______________		
1.3.11 Local UDP port: Local UDP port for sending and/or receiving UDP datagrams. Master may let system choose an available port. Outstation must use one that is known by the master.	☐ Fixed at 20,000 ☐ Configurable, range _______ to _______ ☐ Configurable, selectable from ____,____,____ ☐ Configurable, other, describe_______________ ☐ Let system choose (Masters only)		
1.3.12 Destination UDP port for DNP3 Requests (Masters only):	☐ Fixed at 20,000 ☐ Configurable, range _______ to _______ ☐ Configurable, selectable from ____,____,____ ☐ Configurable, other, describe_______________		

1.3 IP NETWORKING	Capabilities	Current Value	If configurable, list methods
1.3.13 Destination UDP port for initial unsolicited null responses (UDP only Outstations): The destination UDP port for sending initial unsolicited Null response.	☐ None ☐ Fixed at 20,000 ☐ Configurable, range _______ to _______ ☐ Configurable, selectable from ____,____,____ ☐ Configurable, other, describe_______________		
1.3.14 Destination UDP port for responses (UDP only Outstations): The destination UDP port for sending all responses other than initial unsolicited Null response.	☐ None ☐ Fixed at 20,000 ☐ Configurable, range _______ to _______ ☐ Configurable, selectable from ____,____,____ ☐ Configurable, other, describe_______________ ☐ Use local port number (as specified in 1.3.11)		
1.3.15 Multiple outstation connections (Masters only): Indicates whether multiple outstation connections are supported.	☒ Supports multiple outstations (Masters only)	max. 100 connections supported	
1.3.16 Multiple master connections (Outstations Only): Indicates whether multiple master connections are supported and the method that can be used to establish connections.	☒ Supports multiple masters (Outstations only) If supported, the following methods may be used: ☒ Method 1 (based on IP address) - required ☒ Method 2 (based on IP port number) - recommended ☐ Method 3 (browsing for static data) - optional	max. 100 connections supported, requiring different destination link addresses. Note: max. 4 connections supported with identical destination link address	
1.3.17 Time synchronization support:	☒ DNP3 LAN procedure (function code 24) ☐ DNP3 Write Time (not recommended over LAN) 1 ☒ Other, explain: - NTP - SNTP ☐ Not Supported	DNP3 LAN only supported by DNP3 TCP Slave/Master. DNP3 Write Time only supported by DNP3 Serial Slave/Master.	

1.4 LINK LAYER	Capabilities	Current Value	If configurable, list methods
1.4.1 Data Link Address: Indicates if the link address is configurable over the entire valid range of 0 to 65,519. Data link addresses 0xFFF0 through 0xFFFF are reserved for broadcast or other special purposes.	☐ Fixed at______ ☒ Configurable, range 0 to 65519 ☐ Configurable, selectable from ____,____,____ ☐ Configurable, other, describe________________		
1.4.2 DNP3 Source Address Validation: Indicates whether the device will filter out messages not from a specific source address.	☐ Never ☒ Always, one address allowed (shown in 1.4.3) ☐ Always, any one of multiple addresses allowed (each selectable as shown in 1.4.3) ☐ Sometimes, explain________________	Always (single address)	configurable via SICAM Device Manager or SICAM TOOLBOX II
1.4.3 DNP3 Source Address(es) expected when Validation is Enabled: Selects the allowed source address(es).	☐ Configurable to any 16 bit DNP Data Link Address value ☒ Configurable, range 0 to 65519 ☐ Configurable, selectable from ____,____,____ ☐ Configurable, other, describe________________		configurable via SICAM Device Manager or SICAM TOOLBOX II
1.4.4 Self Address Support using address 0xFFFC: If an Outstation receives a message with a destination address of 0xFFFC it shall respond normally with its own source address. It must be possible to disable the feature if supported.	☐ Yes (only allowed if configurable) ☒ No		
1.4.5 Sends Confirmed User Data Frames: A list of conditions under which the device transmits confirmed link layer services (TEST_LINK_STATES, RESET_LINK_STATES, CONFIRMED_USER_DATA).	☒ Never ☒ Sometimes, only for multi fragments ☒ Always	Default = Never	configurable via SICAM Device Manager or SICAM TOOLBOX II
1.4.6 Data Link Layer Confirmation Timeout: This timeout applies to any secondary data link message that requires a confirm or response (link reset, link status, user data, etc)	☐ None ☐ Fixed at______ ms ☒ Configurable, range 0 to 65535ms ☐ Configurable, selectable from ___,___,___ms ☐ Configurable, other, describe________________ ☐ Variable, explain ________________________		configurable via SICAM Device Manager or SICAM TOOLBOX II
1.4.7 Maximum Data Link Retries: The number of times the device will retransmit a frame that requests Link Layer confirmation.	☐ Never Retries ☐ Fixed at ___________ ☒ Configurable, range 0 to 255 ☐ Configurable, selectable from ____,____,____ ☐ Configurable, other, describe______________	2	configurable via SICAM Device Manager or SICAM TOOLBOX II

1.4 LINK LAYER	Capabilities	Current Value	If configurable, list methods
1.4.8 Maximum number of octets Transmitted in a Data Link Frame: This number includes the CRCs. With a length field of 255, the maximum size would be 292.	☐ Fixed at ___________ ☒ Configurable, range 20 to 292 ☐ Configurable, selectable from ____,____,____ Configurable, other, describe_______________	292	configurable via SICAM Device Manager or SICAM TOOLBOX II
1.4.9 Maximum number of octets that can be Received in a Data Link Frame: This number includes the CRCs. With a length field of 255, the maximum size would be 292. The device must be able to receive 292 octets to be compliant.	☐ Fixed at ___________ ☒Configurable, range 20 to 292 ☐ Configurable, selectable from ____,____,____ ☐ Configurable, other, describe_______________	292	configurable via SICAM Device Manager or SICAM TOOLBOX II

1.5 APPLICATION LAYER	Capabilities	Current Value	If configurable, list methods
1.5.1 Maximum number of octets Transmitted in an Application Layer Fragment other than File Transfer: This size does not include any transport or frame octets. • Masters must provide a setting less than or equal to 249 to be compliant. • Outstations must provide a setting less than or equal to 2048 to be compliant. Note: The current value of this outstation parameter is available remotely using protocol object Group 0 Variation 240.	☐ Fixed at ___________ ☒ Configurable, range 100 to 2048 ☐ Configurable, selectable from ____,____,____ ☐ Configurable, other, describe_______________	2048	configurable via SICAM Device Manager or SICAM TOOLBOX II
1.5.2 Maximum number of octets Transmitted in an Application Layer Fragment containing File Transfer:	☒ Same current value as 1.5.1 ☐ Fixed at ___________ ☐ Configurable, range ________ to ________ ☐ Configurable, selectable from ____,____,____ ☐ Configurable, other, describe_______________		

1.5 APPLICATION LAYER	Capabilities	Current Value	If configurable, list methods
1.5.3 Maximum number of octets that can be Received in an Application Layer Fragment: This size does not include any transport or frame octets. • Masters must provide a setting greater than or equal to 2048 to be compliant. • Outstations must provide a setting greater than or equal to 249 to be compliant. Note: The current value of this outstation parameter is available remotely using protocol object Group 0 Variation 241.	☐ Fixed at ___________ ☒ Configurable, range 100 to 2048 ☐ Configurable, selectable from ____,____,____ ☐ Configurable, other, describe_______________	2048	configurable via SICAM Device Manager or SICAM TOOLBOX II
1.5.4 Timeout waiting for Complete Application Layer Fragment: Timeout if all frames of a message fragment are not received in the specified time. Measured from time first frame of a fragment is received until the last frame is received.	☐ None ☐ Fixed at______ ms ☒ Configurable, range 100 to 6553500 ms ☐ Configurable, selectable from ___,___,___ms ☐ Configurable, other, describe________________ ☐ Variable, explain ________________________		configurable via SICAM Device Manager or SICAM TOOLBOX II
1.5.5 Maximum number of objects allowed in a single control request for CROB (group 12): Note: The current value of this outstation parameter is available remotely using protocol object Group 0 Variation 216.	☒ Fixed at 10 (enter 0 if controls are not supported for CROB) ☐ Configurable, range ________ to _______ ☐ Configurable, selectable from ____,____,____ ☐ Configurable, other, describe_______________ ☐ Variable, explain ________________________ ☐ Same current value as 1.5.3		
1.5.6 Maximum number of objects allowed in a single control request for Analog Outputs (group 41):	☒ Fixed at 10 (enter 0 if controls are not supported for Analog Outputs) ☐ Configurable, range ________ to _______ ☐ Configurable, selectable from ____,____,____ ☐ Configurable, other, describe_______________ ☐ Variable, explain ________________________ ☐ Same current value as 1.5.3		

1.5 APPLICATION LAYER	Capabilities	Current Value	If configu-rable, list methods
1.5.7 Maximum number of objects allowed in a single control request for Data Sets (groups 85, 86, 87):	☒ Fixed at 0 (enter 0 if controls are not supported for Data Sets) ☐ Configurable, range ________ to ________ ☐ Configurable, selectable from ____,____,____ ☐ Configurable, other, describe_______________ ☐Variable, explain ______________________ Same current value as 1.5.3		
1.5.8 Supports mixing object groups (AOBs, CROBs and Data Sets) in the same control request:	☐ Not applicable – controls are not supported ☒ Yes ☐ No		
1.5.9 Control Status Codes Supported: Indicates which control status codes are supported by the device: • Masters must indicate which control status codes they accept in outstation responses. • Outstations must indicate which control status codes they generate in responses. Control status code 0 (success) must be supported by Masters and Outstations.	☒ 1 – TIMEOUT ☒ 2 – NO_SELECT ☒ 3 – FORMAT_ERROR ☒ 4 – NOT_SUPPORTED ☒ 5 – ALREADY_ACTIVE ☒ 6 – HARDWARE_ERROR ☒ 7 – LOCAL ☒ 8 – TOO_MANY_OBJS ☒ 9 – NOT_AUTHORIZED ☒ 10 – AUTOMATION_INHIBIT ☐ 11 – PROCESSING_LIMITED ☐ 12 – OUT_OF_RANGE ☐ 13 – DOWNSTREAM_LOCAL ☐ 14 – ALREADY_COMPLETE ☐ 15 – BLOCKED ☐ 16 – CANCELLED ☐ 17 – BLOCKED_OTHER_MASTER ☐ 18 – DOWNSTREAM_FAIL ☐ 126 – RESERVED ☐ 127 – UNDEFINED		

1.6 FILL OUT THE FOLLOWING ITEMS FOR MASTERS ONLY	Capabilities	Current Value	If configurable, list methods
1.6.1 Timeout waiting for Complete Application Layer Response(ms): Timeout on Master if all fragments of a response message are not received in the specified time.	☐ None ☐ Fixed at______ ms ☒ Configurable, range 0 to 65535 ms ☐ Configurable, selectable from ___,___,___ms ☐ Configurable, other, describe________________ ☐ Variable, explain ________________________	Default: 5000 ms	configurable via SICAM Device Manager or SICAM TOOLBOX II
1.6.2 Maximum Application Layer Retries for Request Messages: The number of times a Master will retransmit an application layer request message if a response is not received. This parameter must never cause a Master to retransmit time sync messages.	☐ None ☒ Fixed at 2 ☐ Configurable, range _______ to _______ ☐ Configurable, selectable from ___,___,___ ☐ Configurable, other, describe_______________ ☐ Variable, explain ________________________		
1.6.3 Timeout waiting for First or Next Fragment of an Application Layer Response: Timeout between a request and the first fragment of a response, or between subsequent fragments of the same response, or between an Application Layer Confirmation and a subsequent fragment.	☐ None ☐ Fixed at______ ms ☐ Configurable, range _______ to _______ms ☐ Configurable, selectable from ___,___,___ms ☐ Configurable, other, describe________________ ☐ Variable, explain ________________________	see 1.6.1	
1.6.4 Issuing controls to off-line devices: Indicates if the Master issues control requests to devices that are thought to be off-line (i.e. the Master has not seen responses to previous Master requests).	☐ Not applicable – controls are not supported ☐ Yes ☒ No		
1.6.5 Issuing controls to off-scan devices: Indicates if the Master issues control requests to devices that are currently off-scan (i.e. the Master has been configured not to issue poll requests to the device).	☐ Not applicable – controls are not supported ☒ Yes ☐ No		
1.6.6 Maximum Application Layer Retries for Control Select Messages (same sequence number): Indicates the number of times a Master will retransmit an application layer control select request message if a response is not received – using the same message sequence number.	☐ None (required) ☒ Fixed at 2 ☐ Configurable, range _______ to _______ ☐ Configurable, selectable from ___,___,___ ☐ Configurable, other, describe_______________ ☐ Variable, explain ________________________		

1.6 FILL OUT THE FOLLOWING ITEMS FOR MASTERS ONLY	Capabilities	Current Value	If configurable, list methods
1.6.7 Maximum Application Layer Retries for Control Select Messages (new sequence number): Indicates the number of times a Master will retransmit an application layer control select request message if a response is not received – using a new message sequence number.	☒ None (required) ☐ Fixed at______ ☐ Configurable, range _______ to _______ ☐ Configurable, selectable from ___,___,___ ☐ Configurable, other, describe_______________ ☐ Variable, explain _______________________		
1.6.8 Item deleted			
1.6.9 Item deleted			
1.6.10 Item deleted			
1.6.11 Item deleted			

1.7 FILL OUT THE FOLLOWING ITEMS FOR OUTSTATIONS ONLY	Capabilities	Current Value	If configurable, list methods
1.7.1 Timeout waiting for Application Confirm of solicited response message:	☐ None ☐ Fixed at______ ms ☒ Configurable, range 100 to 6553500ms ☐ Configurable, selectable from ___,___,___ms ☐ Configurable, other, describe________________ ☐ Variable, explain _______________________	Default = 10 sec	configurable via SICAM Device Manager or SICAM TOOLBOX II
1.7.2 How often is time synchronization required from the master: Details of when the master needs to perform a time synchronization to ensure that the outstation clock does not drift outside of an acceptable tolerance. If the option to relate this to IIN1.4 is used then details of when IIN1.4 is asserted are in section 1.10.2.	☐ Never needs time ☐ Within ______ seconds after IIN1.4 is set ☐ Periodically, fixed at _______ seconds ☒ Periodically, between 0 and 65535 seconds	Default = 300 sec 0=no time synchronization over DNP3	configurable via SICAM Device Manager or SICAM TOOLBOX II
1.7.3 Device Trouble Bit IIN1.6: If IIN1.6 device trouble bit is set under certain conditions, explain the possible causes.	☒ Never used ☐ Reason for setting_________________________		

1.7 FILL OUT THE FOLLOWING ITEMS FOR OUTSTATIONS ONLY	Capabilities	Current Value	If configu-rable, list methods
1.7.4 File Handle Timeout: If there is no activity referencing a file handle for a configurable length of time, the outstation must do an automatic close on the file. The timeout value must be configurable up to 1 hour. When this condition occurs the outstation will send a File Transport Status Object (group 70 var 6) using a status code value of file handle expired (0x02).	☒ Not applicable, files not supported ☐ Fixed at______ ms ☒ configurable range 3000 to 255000 ms (3 to 255 minutes) ☐ Configurable, selectable from ___,___,___ms ☐ Configurable, other, describe________________ ☐ Variable, explain ________________________	Note: - "Not applicable, files not supported" valid for DNP3 Master - "Configurable range" valid for DNP3 Slave only.	default = 10000 ms (=10 min)
1.7.5 Event Buffer Overflow Behavior:	☒ Discard the oldest event ☒ Discard the newest event ☐ Other, explain __________________________	Default = discard oldest	configurable via SICAM Device Manager or SICAM TOOLBOX II

1.7 FILL OUT THE FOLLOWING ITEMS FOR OUTSTATIONS ONLY	Capabilities	Current Value	If configurable, list methods
1.7.6 Event Buffer Organization: Explain how event buffers are arranged (per Object Group, per Class, single buffer, etc) and specify the number of events that can be buffered.	☒ Per Object Group (see part 3) ☐ Per Class Class 1: ☐ Fixed at______ ☐ Configurable, range _______ to _______ ☐ Configurable, selectable from ___,___,___ ☐ Configurable, other, describe_____________ Class 2: ☐ Fixed at______ ☐ Configurable, range _______ to _______ ☐ Configurable, selectable from ___,___,___ ☐ Configurable, other, describe_____________ Class 3: ☐ Fixed at______ ☐ Configurable, range _______ to _______ ☐ Configurable, selectable from ___,___,___ ☐ Configurable, other, describe_____________ ☐ Single Buffer ☐ Fixed at______ ☐ Configurable, range _______ to _______ ☐ Configurable, selectable from ___,___,___ ☐ Configurable, other, describe_____________ ☐ Other, describe ___________		
1.7.7 Sends Multi-Fragment Responses: Indicates whether an Outstation sends multi-fragment responses (Masters do not send multi-fragment requests).	☒ Yes ☐No	Yes	configurable via SICAM Device Manager or SICAM TOOLBOX II

1.7 FILL OUT THE FOLLOWING ITEMS FOR OUTSTATIONS ONLY	Capabilities	Current Value	If configurable, list methods
1.7.8 Last Fragment Confirmation: Indicates whether the Outstation requests confirmation of the last fragment of a multi-fragment response.	☒ Always ☐ Sometimes, explain ___________________ ☒ Never	Never	configurable via SICAM Device Manager or SICAM TOOLBOX II
1.7.9 DNP Command Settings preserved through a device restart: If any of these settings are written through the DNP protocol and they are not preserved through a restart of the Outstation, the Master will have to write them again after it receives a response in which the Restart IIN bit is set.	☒ Assign Class ☒ Analog Deadbands ☐ Data Set Prototypes ☐ Data Set Descriptors ☐ Function Code 31 Activate Configuration		
1.7.10 Supports configuration signature: Indicates whether an Outstation supports the Group 0 device attribute "Configuration signature" (variation 200). If yes, list the vendor-defined name(s) of the algorithm(s) available to calculate the signature. Note: The algorithm used for calculating the signature is identified by name in a string that can be determined remotely using protocol object Group 0 Variation 201. If only a single algorithm is available, identifying that algorithm in this object is optional.	☐ Configuration signature supported If configuration signature is supported, then the following algorithm(s) are available for calculating the signature: Algorithm Name: ___________________		
1.7.11 Requests Application Confirmation: Indicate if application confirmation is requested: • when responding with events • when sending non-final fragments of multi-fragment responses Note: to be compliant both must be selected as "yes".	For event responses: ● Yes ○ No ○ Configurable For non-final fragments: ● Yes ○ No ○ Configurable		
1.7.12 Supports Clock Management Indicates whether the Outstation supports the clock management functionality: • supports timestamped object variations required for its subset level with a time accuracy that is consistent with section 1.10 of this Device Profile • if the outstation asserts IIN1.4 [NEED_TIME], it shall support DNP3 time synchronization functionality	☒ Yes ☐ No		

1.8 OUTSTATION UNSOLICITED RESPONSE SUPPORT	Capabilities	Current Value	If configurable, list methods
1.8.1 Supports Unsolicited Reporting: When the unsolicited response mode is configured "off", the device is to behave exactly like an equivalent device that has no support for unsolicited responses. If set to On, the Outstation will send a null Unsolicited Response after it restarts, then wait for an Enable Unsolicited Response command from the master before sending additional Unsolicited Responses containing event data.	☐ Yes ☐ No ☒ Configurable, selectable from On and Off	Yes	
1.8.2 Master Data Link Address: The destination address of the master device where the unsolicited responses will be sent.	☐ Fixed at______ ☒ Configurable, range 0 to 65519 ☐ Configurable, selectable from ____,____,____ ☐ Configurable, other, describe______________		
1.8.3 Unsolicited Response Confirmation Timeout: This is the amount of time that the outstation will wait for an Application Layer confirmation back from the master indicating that the master received the unsolicited response message. As a minimum, the range of configurable values must include times from one second to one minute. This parameter may be the same one that is used for normal, solicited, application confirmation timeouts, or it may be a separate parameter.	☐ Fixed at______ ms ☒ Configurable, range 0 to 655350 ms ☐ Configurable, selectable from ___,___,___ms ☐ Configurable, other, describe______________ ☐ Variable, explain ______________________	10000 ms	
1.8.4 Number of Unsolicited Retries: This is the number of retries that an outstation transmits in each unsolicited response series if it does not receive confirmation back from the master. The configured value includes identical and regenerated retry messages. To be compliant, one of the choices must provide for an indefinite (and potentially infinite) number of transmissions.	☐ None ☐ Fixed at __________ ☒ Configurable, range 0 to 255 ☐ Configurable, selectable from ____,____,____ ☐ Configurable, other, describe____________ ☐ Unlimited	5	

1.9 OUTSTATION UNSOLICITED RESPONSE TRIGGER CONDITIONS	Capabilities	Current Value	If configurable, list methods
1.9.1 Number of class 1 events:	☐ Class 1 not used to trigger Unsolicited Responses ☐ Fixed at ________ ☒ Configurable, range 1 to 100 ☐ Configurable, selectable from ____,____,____ ☐ Configurable, other, describe______________	30	
1.9.2 Number of class 2 events:	☐ Class 2 not used to trigger Unsolicited Responses ☐ Fixed at ________ ☒ Configurable, range 1 to 100 ☐ Configurable, selectable from ____,____,____ ☐ Configurable, other, describe______________	30	
1.9.3 Number of class 3 events:	☐ Class 3 not used to trigger Unsolicited Responses ☐ Fixed at ________ ☒ Configurable, range 1 to 100 ☐ Configurable, selectable from ____,____,____ ☐ Configurable, other, describe______________	10	
1.9.4 Total number events from any class:	☐ Total Number of Events not used to trigger Unsolicited Responses ☐ Fixed at __________ ☒ Configurable, range ________ to ________ ☐ Configurable, selectable from ____,____,____ ☐ Configurable, other, describe______________		
1.9.5 Hold time after class 1 event: A value of 0 indicates that responses are not delayed due to this parameter.	☐ Class 1 not used to trigger Unsolicited Responses ☐ Fixed at __________ ☒ Configurable, range 0 to 65535 ms ☐ Configurable, selectable from ____,____,____ ms ☐ Configurable, other, describe______________ ☐ Use value specified in section 1.9.8	1500 ms	

1.9 OUTSTATION UNSOLICITED RESPONSE TRIGGER CONDITIONS	Capabilities	Current Value	If configurable, list methods
1.9.6 Hold time after class 2 event: A value of 0 indicates that responses are not delayed due to this parameter.	☐ Class 2 not used to trigger Unsolicited Responses ☐ Fixed at ___________ ☒ Configurable, range 0 to 65535 ms ☐ Configurable, selectable from ____,____,____ ms ☐ Configurable, other, describe______________ ☐ Same current value as 1.9.8	1500 ms	
1.9.7 Hold time after class 3 event: A value of 0 indicates that responses are not delayed due to this parameter.	☐ Class 3 not used to trigger Unsolicited Responses ☐ Fixed at ___________ ☒ Configurable, range 0 to 65535 ms ☐ Configurable, selectable from ____,____,____ ms ☐ Configurable, other, describe______________ ☐ Same current value as 1.9.8	1500 ms	
1.9.8 Hold time after event assigned to any class: A configured value of 0 indicates that responses are not delayed due to this parameter.	☐ Class events not used to trigger Unsolicited Responses ☒ Fixed at 0 ms ☐ Configurable, range ________ to _______ ms ☐ Configurable, selectable from ____,____,____ ms ☐ Configurable, other, describe______________	0 ms	
1.9.9 Retrigger Hold Timer: The hold-time timer may be retriggered for each new event detected (increased possibly of capturing all the changes in a single response) or not retriggered (giving the master a guaranteed update time).	☐ Hold-time timer will be retriggered for each new event detected (may get more changes in next response) ☒ Hold-time timer will not be retriggered for each new event detected (guaranteed update time)		
1.9.10 Other Unsolicited Response Trigger Conditions:	______________________________		

1.10 OUTSTATION PERFORMANCE	Capabilities	Current Value	If configurable, list methods
1.10.1 Maximum Time Base Drift (milliseconds per minute): If the device is synchronized by DNP, what is the clock drift rate over the full operating temperature range.	☐ Fixed at 1 ms ☐ Range ________ to _______ ms ☐ Selectable from ____,____,____ ms ☐ Other, describe______________	1 ms	
1.10.2 When does outstation set IIN1.4: When does the outstation set the internal indication IIN1.4 NEED_TIME.	☐ Never ☐ Asserted at startup until first Time Synchronization request received ☐ Periodically every____ seconds ☒ Periodically, range 0 to 65535 seconds ☐ Periodically, selectable from ____,____,___ seconds ____ seconds after last time sync ☐ Range ____to____ seconds after last time sync ☐ Selectable from___,___,___ seconds after last time sync ☐ When time error may have drifted by ____ ms ☐ When time error may have drifted by range ____to____ ms ☐ When time error may have drifted by selectable from ____,____,___ ms	300 seconds	
1.10.3 Maximum Internal Time Reference Error when set via DNP (ms): The difference between the time set in a DNP Write Time message, and the time actually set in the Outstation.	☒ Fixed at 1 ms ☐ Range ________ to _______ ms ☐ Selectable from ____,____,____ ms ☐ Other, describe______________	100 ms	
1.10.4 Maximum Delay Measurement error (ms): The difference between the time reported in the delay measurement response and the actual time between receipt of the delay measurement request and issuing the delay measurement reply.	☐ Fixed at __________ ms ☒ Range -20 ms to +20 ms ☐ Selectable from ____,____,____ ms ☐ Other, describe	+10 ms	
1.10.5 Maximum Response time (ms): The amount of time an Outstation will take to respond upon receipt of a valid request. This does not include the message transmission time.	☒ Fixed at 1000 ms ☐ Range ________ to _______ ms ☐ Selectable from ____,____,____ ms ☐ Other, describe______________	1000 ms	
1.10.6 Maximum time from start-up to IIN 1.4 assertion (ms):	☒ Fixed at 0 ms ☐ Range ________ to _______ ms ☐ Selectable from ____,____,____ ms ☐ Other, describe until start up delay is finished	0 ms	

1.10 OUTSTATION PERFORMANCE	Capabilities	Current Value	If configurable, list methods
1.10.7 Maximum Event Time-tag error for local Binary and Double-bit I/O (ms): The error between the time-tag reported and the absolute time of the physical event. This error includes the Internal Time Reference Error. Note: The current value of this parameter is available remotely using protocol object Group 0 Variation 217.	☒ Fixed at 100 ms ☐ Range ________ to _______ ms ☐ Selectable from ____,____,____ ms ☐ Other, describe	100 ms	
1.10.8 Maximum Event Time-tag error for local I/O other than Binary and Double-bit data types (ms):	☒ Fixed at 100 ms ☐ Range ________ to _______ ms ☐ Selectable from ____,____,____ ms ☐ Other, describe	100 ms	

1.11 INDIVIDUAL FIELD OUTSTATION PARAMETERS:	Value of Current Setting	If configurable, list methods
1.11.1 User-assigned location name or code string (same as g0v245):		not supported
1.11.2 User-assigned ID Code/number string (same as g0v246):		not supported
1.11.3 User-assigned name string for the outstation (same as g0v247):		not supported
1.11.4 Device Serial Number string (same as g0v248):		not supported
1.11.5 User-assigned secondary operator name (same as g0v206):		not supported
1.11.6 User-assigned primary operator name (same as g0v207):		not supported
1.11.7 User-assigned system name (same as g0v208):		not supported
1.11.8 User-assigned owner name (same as g0v244):		not supported

1.12 SECURITY PARAMETERS	Capabilities	Current Value	If configurable, list methods
1.12.1 DNP3 device support for secure authentication: If the device does not support secure authentication then ignore the rest of this section. If the device does support secure authentication then specify the version(s) that are supported in the device. The version number is an integer value defined in the DNP3 Specification. The Secure Authentication procedure defined in IEEE 1815-2010 is version 2. The Secure Authentication procedure defined in IEEE 1815-2012 is version 5.	Supported version(s): ☐ Fixed at ___________ ☒ Configurable, selectable from none, SAv2, SAv5		not supported
1.12.2 Maximum number of users: The secure authentication algorithm provides support for multiple users. The device must support details for each user (update keys, session keys, etc). A user is identified by a 16-bit user number, allowing a maximum of 65535 users. Devices are not mandated to support this number of potential users. Indicate here the actual limit to the number of simultaneous users that can be supported.	☒ Fixed at DNPSI0 = 4 DNPII1 = 8 DNPMI0 = 16 DNPII2 = 16 ☐ Configurable, range _______ to _______		not supported
1.12.3 Security message response timeout: Authentication of critical messages may involve additional message exchanges (challenges and responses) which can require an extension to the normal DNP3 message response timeout. This timeout specifies an additional time to be used when the extra security transactions are involved. The maximum allowable timeout extension should not exceed 120 seconds.	☐ Fixed at ___________ ms ☒ Configurable, range 0 to 65535 seconds ☐ Configurable, selectable from ____,____,____ ms ☐ Configurable, other, describe_______________		default = 2 seconds
1.12.4 Aggressive mode of operation (receive): DNP3 devices may (optionally) accept "aggressive" mode requests, where challenge data used for authentication is appended to a critical message rather than needing to be solicited via a separate message exchange.		● Yes - accepts aggressive mode requests ● No – does not accept aggressive mode requests	default = No

1.12 SECURITY PARAMETERS	Capabilities	Current Value	If configurable, list methods
1.12.5 Aggressive mode of operation (issuing): DNP3 devices must support the issuing of "aggressive" mode of operation, where challenge data used for authentication is appended to a critical message rather than needing to be solicited via a separate message exchange. Specific instances of devices may have the use of aggressive mode switched off.		● Yes - issues aggressive mode requests ● No – does not issue aggressive mode requests	default = No
1.12.6 Session Key change interval: To counter an attack that compromises the session key, the session key is changed at regular intervals. The maximum interval is 2 hours. Outstation devices invalidate the current set of session keys if they have not been changed by the master station after a period of twice this configured value. To accommodate systems with infrequent communications, this change interval can be disabled and just the session key change message count used (see 1.12.7)	☐ Can be disabled When enabled: ☒ Configurable, range 0 to 65535 seconds		default = 1800 seconds
1.12.7 Session Key change message count: In addition to changing the session key at regular intervals, the key shall also be changed after a specified number of messages have been exchanged. The maximum allowable value for this message count is 10,000	☒ Configurable, range 1 to 32000		default = 2000
1.12.8 Maximum error count (SAv2 only): To assist in countering denial of service attacks when using SAv2, a DNP3 device shall stop replying with error codes after a number of successive authentication failures. This error count has a maximum value of 10. Setting the error count to zero inhibits all error messages. See 1.12.21 for error counts when using SAv5	☐ Not applicable (not using SAv2) ☒ Configurable, range 1 to 250		default = 2

1.12 SECURITY PARAMETERS	Capabilities	Current Value	If configurable, list methods
1.12.9 MAC algorithm requested in a challenge exchange: Part of the authentication message is hashed using an MAC algorithm. Secure Authentication version 2 specifies that DNP3 devices must support SHA-1 and may optionally support SHA-256 for this hashing process. Secure Authentication version 5 specifies that SHA-256 is the default. The output of the MAC algorithm is truncated (the resulting length dependent on the media being used).	☒ SHA-1 (truncated to the leftmost 4 octets) ☒ SHA-1 (truncated to the leftmost 8 octets) ☒ SHA-1 (truncated to the leftmost 10 octets) ☒ SHA-256 (truncated to the leftmost 8 octets) ☒ SHA-256 (truncated to the leftmost 16 octets) ☒ AES-GMAC ☐ Other, explain _______________		default = SHA-1 (10 octetts)
1.12.10 Key-wrap algorithm to encrypt session keys: During the update of a session key, the key is encrypted using AES-128 or optionally using other algorithms.	☒ AES-128 ☐ AES-256 ☐ Other, explain ______________		
1.12.11 Cipher Suites used with DNP implementations using TLS: When TLS is supported, DNP3 Secure Authentication mandates the support of TLS_RSA_WITH_AES_128_SHA. The specification has a number of recommended cipher suite combinations. Indicate the supported Cipher Suites for implementations using TLS.	☐ Not relevant – TLS is not used ☐ TLS_RSA encrypted with AES128 ☐ TLS_RSA encrypted with RC4_128 ☐ TLS_RSA encrypted with 3DES_EDE_CBC ☐ TLS_DH, signed with DSS, encrypted with 3DES_EDE_CBC ☐ TLS_DH, signed with RSA, encrypted with 3DES_EDE_CBC ☐ TLS_DHE, signed with DSS, encrypted with 3DES_EDE_CBC ☐ TLS_DHE, signed with RSA, encrypted with 3DES_EDE_CBC ☐ TLS_DH, signed with DSS, encrypted with AES128 ☐ TLS_DH, signed with DSS, encrypted with AES256 ☐ TLS_DH encrypted with AES128 ☐ TLS_DH encrypted with AES256 ☐ Other, explain _______________		Note: TLS is supported as extra function (not part of security parameters).
1.12.12 Change cipher request timeout: Implementations using TLS shall terminate the connection if a response to a change cipher request is not seen within this timeout period.	☐ Not relevant – TLS is not used ☐ Fixed at ___________ ☐ Configurable, range _______ to _______ ☐ Configurable, selectable from ____,____,____ ☐ Configurable, other, describe_______________		Note: TLS is supported as extra function (not part of security parameters).

1.12 SECURITY PARAMETERS	Capabilities	Current Value	If configurable, list methods
1.12.13 Number of Certificate Authorities supported: Implementations using TLS shall support at least 4 Certificate Authorities. Indicate the number supported.			Note: TLS is supported as extra function (not part of security parameters).
1.12.14 Certificate Revocation check time: Implementations using TLS shall evaluate Certificate Revocation Lists on a periodic basis, terminating a connection if a certificate is revoked.	☐ Not relevant – TLS is not used ☐ Fixed at __________ hours ☐ Configurable, range _______ to _______hours ☐ Configurable, selectable from ____,____,____hours ☐ Configurable, other, describe_______________		Note: TLS is supported as extra function (not part of security parameters).
1.12.15 Additional critical function codes: The DNP3 specification defines those messages with specific function codes that are critical and must be used as part of a secure authentication message exchange. Messages with other function codes are optional and changes to this list should be noted here. Note: Secure Authentication version 5 defines additional functions as critical that were not considered critical in version 2. These are shown in the next column annotated with "V2 only".	Additional function codes that are to be considered as "critical": ☐ 0 (Confirm) ☐ 1 (Read) ☐ 7 (Immediate freeze) ☐ 8 (Immediate freeze – no ack) ☐ 9 (Freeze-and-clear) ☐ 10 (Freeze-and-clear – no ack) ☐ 11 (Freeze-at-time) ☐ 12 (Freeze-at-time – no ack) ☐ 22 (Assign Class) ☐ 23 (Delay Measurement) ☐ 25 (Open File) – V2 only ☐ 26 (Close File) – V2 only ☐ 27 (Delete File) – V2 only ☐ 28 (Get File Info) – V2 only ☐ 30 (Abort File) – V2 only ☐ 129 (Response) ☐ 130 (Unsolicited Response)		
1.12.16 Other critical fragments: Other critical transactions can be defined and should be detailed here. Examples could be based on time (for example: the first transaction after a communications session is established). Other examples could be based on specific data objects (for example: the reading of specific data points).	Describe any other critical fragment exchanges:		

1.12 SECURITY PARAMETERS	Capabilities	Current Value	If configurable, list methods
1.12.17 Support for remote update key changes: Devices implementing secure authentication version 5 or later have the option to support remote update key changes. If remote update key change is supported then the procedure using symmetric cryptography is mandatory. Additional support for the procedure using asymmetric (public key) cryptography is optional.	☒ Remote update key change by symmetric cryptography. Supported key change methods: ☒ AES-128 key wrap with SHA-1-HMAC ☒ AES-256 key wrap with SHA-256-HMAC ☒ AES-256 key wrap with AES-GMAC ☐ Remote update key change by asymmetric cryptography Supported key change methods: ☐ RSAES-OAEP-1024/SHA-1 with DSA SHA-1 and SHA-1-HMAC ☐ RSAES-OAEP-2048/SHA-256 with DSA SHA-256 and SHA-256-HMAC ☐ RSAES-OAEP-3072/SHA-256 with DSA SHA-256 and SHA-256-HMAC ☐ RSAES-OAEP-2048/SHA-256 with DSA SHA-256 and AES-GMAC ☐ RSAES-OAEP-3072/SHA-256 with DSA SHA-256 and AES-GMAC		default = AES-128 with SHA-1-HMAC
1.12.18 "Default" user credentials are permitted to expire:	☐ Yes ☐ No		not supported
1.12.19 Secure Authentication enabled:	☒ Configurable, selectable from On and Off ☐ Always On		default = off

1.12 SECURITY PARAMETERS	Capabilities	Current Value	If configurable, list methods
1.12.20 Length of the challenge data: The length of the challenge data used when setting up session keys shall be between a minimum length of 4 octets and a maximum length of 32 octets.	☐ Fixed at ___________ octets ☒ Configurable, range 4 to 64 octets ☐ Configurable, selectable from ____,____,____ octets ☐ Configurable, other, describe_______________		default = 4
1.12.21 Maximum statistic counts (SAv5): The SAv5 specification allows event objects to be generated when the statistics reach certain threshold values. Indicate here how these thresholds are set if using SAv5. Note that "Max Rekeys Due to Restarts" only applies to Masters and can be omitted from the Device Profile for Outstations.	**Max Authentication Failures:** ☐ Not applicable (not using SAv5) ☒ Fixed at 5 ☐Configurable, range _______ to _______ **Max Reply Timeouts:** ☐ Not applicable (not using SAv5) ☒ Fixed at 3 ☐Configurable, range _______ to _______ **Max Authentication Rekeys:** ☐ Not applicable (not using SAv5) ☒ Fixed at 3 ☐Configurable, range _______ to _______ **Max Error Messages Sent:** ☐ Not applicable (not using SAv5) ☒ Fixed at 2 ☐Configurable, range _______ to _______ **Max Rekeys Due to Restarts:** ☐Not applicable (not using SAv5) ☒ Fixed at 3 ☐Configurable, range _______ to _______		

1.13 BROADCAST FUNCTIONALITY	Capabilities	Current Value	If configurable, list methods
This section indicates which functions are supported by the device when using broadcast addresses. Note that this section shows only entries that may have a meaningful purpose when used with broadcast requests.			
1.13.1 Support for broadcast functionality:	○ Disabled ● Enabled ○ Configurable		

1.13 BROADCAST FUNCTIONALITY	Capabilities	Current Value	If configurable, list methods
1.13.2 Write functions (FC = 2) supported with broadcast requests:	Write clock (g50v1 with qualifier code 07): ○Disabled ● Enabled ○ Configurable, other (described elsewhere) Write last recorded time (g50v3 with qualifier code 07): ○ Disabled ● Enabled ○ Configurable, other (described elsewhere) Clear RESTART (g80v1 with qualifier code 00 and index = 7, value = 0): ○ Disabled ● Enabled ○ Configurable, other (described elsewhere) Write of any other group / variation / qualifier code ○ Disabled ● Enabled ○ Configurable, other (described elsewhere)		
1.13.3 Direct operate functions (FC = 5) supported with broadcast requests:	○ Disabled ● Enabled ○ Configurable, other (described elsewhere)		
1.13.4 Direct operate, no acknowledgment functions (FC = 6) supported with broadcast requests:	○ Disabled ● Enabled ○ Configurable, other (described elsewhere)		
1.13.5 Immediate freeze functions (FC = 7) supported with broadcast requests:	○ Disabled ● Enabled ○ Configurable, other (described elsewhere)		
1.13.6 Immediate freeze, no acknowledgment functions (FC = 8) supported with broadcast requests:	○ Disabled ● Enabled ○ Configurable, other (described elsewhere)		
1.13.7 Freeze and clear functions (FC = 9) supported with broadcast requests:	○ Disabled ● Enabled ○ Configurable, other (described elsewhere)		

1.13 BROADCAST FUNCTIONALITY	Capabilities	Current Value	If configurable, list methods
1.13.8 Freeze and clear, no acknowledgment functions (FC = 10) supported with broadcast requests:	○ Disabled ● Enabled ○ Configurable, other (described elsewhere)		
1.13.9 Freeze at time functions (FC = 11) supported with broadcast requests:	● Disabled ○ Enabled ○ Configurable, other (described elsewhere)		
1.13.10 Freeze at time, no acknowledgment functions (FC = 12) supported with broadcast requests:	● Disabled ○ Enabled ○ Configurable, other (described elsewhere)		
1.13.11 Cold restart functions (FC = 13) supported with broadcast requests:	○ Disabled ● Enabled ○ Configurable, other (described elsewhere)		
1.13.12 Warm restart functions (FC = 14) supported with broadcast requests:	○ Disabled ● Enabled ○ Configurable, other (described elsewhere)		
1.13.13 Initialize data functions (FC = 15) supported with broadcast requests:	● Disabled ○ Enabled ○ Configurable, other (described elsewhere)		
1.13.14 Initialize application functions (FC = 16) supported with broadcast requests:	● Disabled ○ Enabled ○ Configurable, other (described elsewhere)		
1.13.15 Start application functions (FC = 17) supported with broadcast requests:	● Disabled ○ Enabled ○ Configurable, other (described elsewhere)		
1.13.16 Stop application functions (FC = 18) supported with broadcast requests:	● Disabled ○ Enabled ○ Configurable, other (described elsewhere)		
1.13.17 Save configuration functions (FC = 19) supported with broadcast requests:	● Disabled ○ Enabled ○ Configurable, other (described elsewhere)		

1.13 BROADCAST FUNCTIONALITY	Capabilities	Current Value	If configurable, list methods
1.13.18 Enable unsolicited functions (FC = 20) supported with broadcast requests:	Enable unsolicited by event Class (g60v2, g60v3 and g60v4 with qualifier code 06): ○ Disabled ● Enabled ○ Configurable, other (described elsewhere) Enable unsolicited for any other group / variation / qualifier code: ○ Disabled ● Enabled ○ Configurable, other (described elsewhere)		
1.13.19 Disable unsolicited functions (FC = 21) supported with broadcast requests:	Disable unsolicited by event Class (g60v2, g60v3 and g60v4 with qualifier code 06): ○ Disabled ● Enabled ○ Configurable, other (described elsewhere) Disable unsolicited for any other group / variation / qualifier code: ○ Disabled ● Enabled ○ Configurable, other (described elsewhere)		
1.13.20 Assign class functions (FC = 22) supported with broadcast requests:	○ Disabled ● Enabled ○ Configurable, other (described elsewhere)		
1.13.21 Record current time functions (FC = 24) supported with broadcast requests:	○ Disabled ● Enabled ○ Configurable, other (described elsewhere)		
1.13.22 Activate configuration (FC = 31) supported with broadcast requests:	● Disabled ○ Enabled ○ Configurable, other (described elsewhere)		

2 Mapping to IEC 61850 Object Models

This optional section allows each configuration parameter or point in the DNP Data map to be tied to an attribute in the IEC 61850 object models.

Earlier versions of this section (up to version 2.07) used mappings based on an "access point" section 2.1.1 and then a series of XPath references (section 2.1.2).

Section 2.1.2 has been superseded in version 2012 onwards with mappings defined using either predefined rules (section 2.1.3) or specified as an equation (section 2.1.4). The list of pre-defined rules is found in the IEEE 1815-1 document.

TREE MAPPING BETWEEN DNP3 AND IEC 61850 OBJECTS
2.1.1 Access Point:
2.1.2 Mapping (section superseded)
2.1.3 Rule based mapping Use this element when mapping to/from IEC 61850 using one of the predefined rules in IEEE 1815.1 Mapping is bi-directional.

IEC 61850 Object	DNP Xpath Reference
MyIED	
- LLN0	
- Mod	
- stVal	Rule is: BOOLEAN_TO_BI
	dnp:dataPointsList/dnp:binaryInputPoints/dnp:dataPoints/dnp:binaryInput[dnp:index=0]/dnp:dnpData/dnp:state
- q	Rule is: QUALITY_TO_BIN_FLAG
	dnp:dataPointsList/dnp:binaryInputPoints/dnp:dataPoints/dnp:binaryInput[dnp:index=0]/dnp:dnpData/dnp:quality
- t	Rule is: TIME_TO_TIME
	dnp:dataPointsList/dnp:binaryInputPoints/dnp:dataPoints/dnp:binaryInput[dnp:index=0]/dnp:dnpData/dnp:timestamp
- Mod1	
- stVal	Rule is: DPS_TO_2_BI
	dnp:dataPointsList/dnp:binaryInputPoints/dnp:dataPoints/dnp:binaryInput[dnp:index=1]/dnp:dnpData/dnp:state
	dnp:dataPointsList/dnp:binaryInputPoints/dnp:dataPoints/dnp:binaryInput[dnp:index=2]/dnp:dnpData/dnp:state
- q	Rule is: QUALITY_TO_BIN_FLAG
	dnp:dataPointsList/dnp:binaryInputPoints/dnp:dataPoints/dnp:binaryInput[dnp:index=1]/dnp:dnpData/dnp:q
	dnp:dataPointsList/dnp:binaryInputPoints/dnp:dataPoints/dnp:binaryInput[dnp:index=2]/dnp:dnpData/dnp:q
- LLN1	
- Mod1.t	
- t	Rule is: TIME_TO_TIME
	dnp:dataPointsList/dnp:binaryInputPoints/dnp:dataPoints/dnp:binaryInput[dnp:index=1]/dnp:dnpData/dnp:timestamp
	dnp:dataPointsList/dnp:binaryInputPoints/dnp:dataPoints/dnp:binaryInput[dnp:index=2]/dnp:dnpData/dnp:timestamp

2.1.4 Equation based mapping
Use this element when mapping to/from IEC 61850 using an equation to map 0 or more input parameters to a single output parameter. Direction of mapping is determined by the variable on the left hand side of the equation.

Equation parameter	DNP Xpath Reference / IEC 61850 Path reference	FC	CDC	Data Type	enumTypeId
Mapping Equation: celsius = ((value * scale) - 32) / 1.8					
scale	dnp:dataPointsList/dnp:analogInputPoints/dnp:dataPoints/dnp:analogInput[dnp:index=9]/dnp:scaleFactor				
value	dnp:dataPointsList/dnp:analogInputPoints/dnp:dataPoints/dnp:analogInput[dnp:index=10]/dnp:dnpData/dnp:value				
celsius	MyIED/LLN0.Mod.mag	MX	MV	FLOAT32	

Equation parameter	DNP Xpath Reference / IEC 61850 Path reference	FC	CDC	Data Type	enumTypeId
Mapping Equation: value = ((celsius * 1.8) + 32) / scale					
value	dnp:dataPointsList/dnp:analogInputPoints/dnp:dataPoints/dnp:analogInput[dnp:index=11]/dnp:dnpData/dnp:value				
celsius	MyIED/LLN0.Mod.mag	MX	MV	FLOAT32	
scale	MyIED/LLN0.Mod.scaleFactor	MX	MV	FLOAT32	

3 Capabilities and Current Settings for Device Database (Outstations Only)

The following tables identify the capabilities and current settings for each DNP3 data type. Details defining the data points available in the device are shown in part 5 of this Device Profile.

3.1 BINARY INPUTS Static (Steady-State) Group Number: 1 Event Group Number: 2	Capabilities (leave tick-boxes blank if this data type is not supported)	Current Value	If configurable, list methods
3.1.1 Static Variation reported when variation 0 requested or in response to Class polls:	☒ Variation 1 – packed format ☒ Variation 2 – with flag ☐ Based on point Index (add column to table in part 5)	Variation 1	
3.1.2 Event Variation reported when variation 0 requested or in response to Class polls: Note: The support for binary input events can be determined remotely using protocol object Group 0 Variation 237.	☒ Variation 1 – without time ☒ Variation 2 – with absolute time ☒ Variation 3 – with relative time ☐ Based on point Index (add column to table in part 5)	Variation 2	
3.1.3 Event reporting mode: When responding with event data and more than one event has occurred for a data point, an Outstation may include all events or only the most recent event. "All events" must be checked to be compliant.	☐ Only most recent ☒ All events ☐ Based on point Index (add column to table in part 5)		
3.1.4 Binary Inputs included in Class 0 response:	☒ Always ☐ Never ☐ Only if the point is assigned to a class ☐ Based on point Index (add column to table in part 5)		
3.1.5 Binary Inputs Event Buffer Organization: When event buffers are allocated per object group (see part 1.7.6), indicate the number of events that can be buffered for Binary Inputs. If event buffers are not allocated per object group then set "Fixed at 0".	☐ Fixed at ___________ ☒ Configurable, range 20 to 250 ☐ Configurable, selectable from ____,____,____ ☐ Configurable, other, describe_______________		default = 250

3.2 DOUBLE-BIT BINARY INPUTS **Static (Steady-State) Group Number: 3** **Event Group Number: 4**	**Capabilities** **(leave tick-boxes blank if this data type is not supported)**	**Current Value**	**If configurable, list methods**
3.2.1 Static Variation reported when variation 0 requested or in response to Class polls: Note: The support for double-bit binary inputs can be determined remotely using protocol object Group 0 Variation 234.	☒ Variation 1 – packed format ☒ Variation 2 – with flag ☐ Based on point Index (add column to table in part 5)	Variation 1	
3.2.2 Event Variation reported when variation 0 requested or in response to Class polls:	☒ Variation 1 – without time ☒ Variation 2 – with absolute time ☒ Variation 3 – with relative time ☐ Based on point Index (add column to table in part 5)	Variation 2	
3.2.3 Event reporting mode: When responding with event data and more than one event has occurred for a data point, an Outstation may include all events or only the most recent event. "All events" must be checked to be compliant.	☒ Only most recent ☐ All events ☐ Based on point Index (add column to table in part 5)		
3.2.4 Double-bit Binary Inputs included in Class 0 response:	☒ Always ☐ Never ☐ Only if the point is assigned to a class ☐ Based on point Index (add column to table in part 5)		
3.2.5 Double-bit Binary Inputs Event Buffer Organization: When event buffers are allocated per object group (see part 1.7.6), indicate the number of events that can be buffered for Double-bit Binary Inputs. If event buffers are not allocated per object group then set "Fixed at 0".	☐ Fixed at ___________ ☒ Configurable, range 20 to 250 ☐ Configurable, selectable from ____,____,____ ☐ Configurable, other, describe_______________		default = 250

3.3 BINARY OUTPUT STATUS AND CONTROL RELAY OUTPUT BLOCK **Binary Output Status Group Number: 10** **Binary Output Event Group Number: 11** **CROB Group Number: 12** **Binary Output Command Event Group Number: 13**	**Capabilities** **(leave tick-boxes blank if this data type is not supported)**	**Current Value**	**If configurable, list methods**
3.3.1 Minimum pulse time allowed with Trip, Close, and Pulse On commands:	☒ Fixed at 100 ms (hardware may limit this further) ☐ Based on point Index (add column to table in part 5)		
3.3.2 Maximum pulse time allowed with Trip, Close, and Pulse On commands:	☒ Fixed at 60000 ms (hardware may limit this further) ☐ Based on point Index (add column to table in part 5)		

3.3 BINARY OUTPUT STATUS AND CONTROL RELAY OUTPUT BLOCK Binary Output Status Group Number: 10 Binary Output Event Group Number: 11 CROB Group Number: 12 Binary Output Command Event Group Number: 13	Capabilities (leave tick-boxes blank if this data type is not supported)	Current Value	If configurable, list methods
3.3.3 Binary Output Status included in Class 0 response:	☒ Always ☐ Never ☐ Only if the point is assigned to a class ☐ Based on point Index (add column to table in part 5)		
3.3.4 Reports Output Command Event Objects:	☐ Never ☐ Only upon a successful Control ☒ Upon all control attempts		configurable for each single command or setpoint command.
3.3.5 Static Variation reported when variation 0 requested or in response to Class polls:	☒ Variation 1 – packed format ☒ Variation 2 – output status with flags ☐ Based on point Index (add column to table in part 5)	Variation 2	
3.3.6 Event Variation reported when variation 0 requested or in response to Class polls: Note: The support for binary output events can be determined remotely using protocol object Group 0 Variation 222.	☐ Variation 1 – status without time ☒ Variation 2 – status with time ☐ Based on point Index (add column to table in part 5)	Variation 2	
3.3.7 Command Event Variation reported when variation 0 requested or in response to Class polls:	☐ Variation 1 – command status without time ☒ Variation 2 – command status with time ☐ Based on point Index (add column to table in part 5)	Variation 2	
3.3.8 Event reporting mode: When responding with event data and more than one event has occurred for a data point, an Outstation may include all events or only the most recent event	☐ Only most recent ☒ All events	All events	
3.3.9 Command Event reporting mode: When responding with event data and more than one event has occurred for a data point, an Outstation may include all events or only the most recent event	☐ Only most recent ☒ All events	All events	

3.3 BINARY OUTPUT STATUS AND CONTROL RELAY OUTPUT BLOCK Binary Output Status Group Number: 10 Binary Output Event Group Number: 11 CROB Group Number: 12 Binary Output Command Event Group Number: 13	Capabilities (leave tick-boxes blank if this data type is not supported)	Current Value	If configu-rable, list methods
3.3.10 Maximum Time between Select and Operate:	☐ Not Applicable ☐ Fixed at _____ seconds ☒ Configurable, range 0.1 to 6553.5 seconds ☐ Configurable, selectable from___,___,___ seconds ☐ Configurable, other, describe________________ ☐ Variable, explain ________________________ ☐ Based on point Index (add column to table in part 5)	20 seconds	
3.3.11 Binary Outputs Event Buffer Organization: When event buffers are allocated per object group (see part 1.7.6), indicate the number of events that can be buffered for Binary Outputs. If event buffers are not allocated per object group then set "Fixed at 0".	☐ Fixed at ___________ ☒ Configurable, range 10 to 100 ☐Configurable, selectable from ____,____,____ ☐ Configurable, other, describe_______________	Note: - valid for DNP3 Slave only.	default = 30
3.3.12 Binary Output Commands Event Buffer Organization: When event buffers are allocated per object group (see part 1.7.6), indicate the number of events that can be buffered for Binary Output Commands. If event buffers are not allocated per object group then set "Fixed at 0".	☐ Fixed at ___________ ☒ Configurable, range 10 to 100 ☐ Configurable, selectable from ____,____,____ ☐ Configurable, other, describe_______________	Note: - valid for DNP3 Slave only.	default = 30

3.4 COUNTERS/FROZEN COUNTERS Counter Group Number: 20 Frozen Counter Group Number: 21 Counter Event Group Number: 22 Frozen Counter Event Group Number: 23	Capabilities (leave tick-boxes blank if this data type is not supported)	Current Value	If configurable, list methods
3.4.1 Static Counter Variation reported when variation 0 requested or in response to Class polls:	☒ Variation 1 – 32-bit with flag ☒ Variation 2 – 16-bit with flag ☒ Variation 5 – 32-bit without flag ☒ Variation 6 – 16-bit without flag ☐ Based on point Index (add column to table in part 5)	Variation 1	
3.4.2 Counter Event Variation reported when variation 0 requested or in response to Class polls: Note: The support for counter events can be determined remotely using protocol object Group 0 Variation 227.	☒ Variation 1 – 32-bit with flag ☒ Variation 2 – 16-bit with flag ☒ Variation 5 – 32-bit with flag and time ☒ Variation 6 – 16-bit with flag and time ☐ Based on point Index (add column to table in part 5)	Variation 1	
3.4.3 Counters included in Class 0 response:	☒ Always ☐ Never ☐ Only if the point is assigned to a class ☐ Based on point Index (add column to table in part 5)		
3.4.4 Counter Event reporting mode: When responding with event data and more than one event has occurred for a data point, an Outstation may include all events or only the most recent event. Only the most recent event is typically reported for Counters. When reporting "only most recent", the counter value reported in the response may be the value at the time of the original event or it may be the value at the time of the response.	☐ Only most recent (value at time of event) ☒ Only most recent (value at time of response) ☐ All events ☐ Based on point Index (add column to table in part 5)		
3.4.5 Static Frozen Counter Variation reported when variation 0 requested or in response to Class polls:	☒ Variation 1 – 32-bit with flag ☒ Variation 2 – 16-bit with flag ☐ Variation 5 – 32-bit with flag and time ☐ Variation 6 – 16-bit with flag and time ☒ Variation 9 – 32-bit without flag ☒ Variation 10 – 16-bit without flag ☐ Based on point Index (add column to table in part 5)	Variation 1	
3.4.6 Frozen Counter Event Variation reported when variation 0 requested or in response to Class polls: Note: The support for frozen counter events can be determined remotely using protocol object Group 0 Variation 225.	☒ Variation 1 – 32-bit with flag ☒ Variation 2 – 16-bit with flag ☒ Variation 5 – 32-bit with flag and time ☒ Variation 6 – 16-bit with flag and time ☐ Based on point Index (add column to table in part 5)	Variation 1	

3.4 COUNTERS/FROZEN COUNTERS Counter Group Number: 20 Frozen Counter Group Number: 21 Counter Event Group Number: 22 Frozen Counter Event Group Number: 23	Capabilities (leave tick-boxes blank if this data type is not supported)	Current Value	If configurable, list methods
3.4.7 Frozen Counters included in Class 0 response:	☐ Always ☒ Never ☐ Only if the point is assigned to a class ☐ Based on point Index (add column to table in part 5)		
3.4.8 Frozen Counter Event reporting mode: When responding with event data and more than one event has occurred for a data point, an Outstation may include all events or only the most recent event. All events are typically reported for Frozen Counters.	☐ Only most recent frozen value ☒ All frozen values ☐ Based on point Index (add column to table in part 5)		
3.4.9 Counters Roll Over at:	☒ 16 Bits (65,535) ☒ 32 Bits (4,294,967,295) ☐ Other Fixed Value _________ ☐ Configurable; range _________ to__________ ☐ Configurable, selectable from ___,___,___ ☐ Configurable, other, describe________________ ☐ Based on point Index (add column to table in part 5)	32 Bits	
3.4.10 Counters frozen by means of:	☒ Master Request ☐ Freezes itself without concern for time of day ☐ Freezes itself and requires time of day ☐ Other, explain ____________________________		
3.4.11 Counters Event Buffer Organization: When event buffers are allocated per object group (see part 1.7.6), indicate the number of events that can be buffered for Counters. If event buffers are not allocated per object group then set "Fixed at 0".	☐ Fixed at __________ ☒ Configurable, range 10 to 100 ☐ Configurable, selectable from ____,____,____ ☐ Configurable, other, describe_______________	Note: - valid for DNP3 Slave only.	default = 100

3.4 COUNTERS/FROZEN COUNTERS Counter Group Number: 20 Frozen Counter Group Number: 21 Counter Event Group Number: 22 Frozen Counter Event Group Number: 23	Capabilities (leave tick-boxes blank if this data type is not supported)	Current Value	If configurable, list methods
3.4.12 Frozen Counters Event Buffer Organization: When event buffers are allocated per object group (see part 1.7.6), indicate the number of events that can be buffered for Frozen Counters. If event buffers are not allocated per object group then set "Fixed at 0".	☐ Fixed at ___________ ☒ Configurable, range 10 to 100 ☐ Configurable, selectable from ____,____,____ ☐ Configurable, other, describe_______________	Note: - valid for DNP3 Slave only.	default = 100
3.4.13 Reports counter events for change of value: Indicate if counter events are created when the counter value changes.	☒ Yes for all counters ☐ No for all counters ☐ Configurable, based on point Index (add column to table in part 5)		

3.5 ANALOG INPUTS / FROZEN ANALOG INPUTS Static (Steady-State) Group Number: 30 Static Frozen Group Number: 31 Event Group Number: 32 Frozen Analog Input Event Group Number: 33 Deadband Group Number: 34	Capabilities (leave tick-boxes blank if this data type is not supported)	Current Value	If configurable, list methods
3.5.1 Static Variation reported when variation 0 requested or in response to Class polls:	☒ Variation 1 – 32-bit with flag ☒ Variation 2 – 16-bit with flag ☒ Variation 3 – 32-bit without flag ☒ Variation 4 – 16-bit without flag ☒ Variation 5 – single-precision floating point with flag ☐ Variation 6 – double-precision floating point with flag ☐ Based on point Index (add column to table in part 5)	Variation 1	
3.5.2 Event Variation reported when variation 0 requested or in response to Class polls: Note: The support for analog input events can be determined remotely using protocol object Group 0 Variation 231.	☒ Variation 1 – 32-bit without time ☒ Variation 2 – 16-bit without time ☒ Variation 3 – 32-bit with time ☒ Variation 4 – 16-bit with time ☒ Variation 5 – single-precision floating point w/o time ☐ Variation 6 – double-precision floating point w/o time ☒ Variation 7 – single-precision floating point with time ☐ Variation 8 – double-precision floating point with time ☐ Based on point Index (add column to table in part 5)	Variation 3	

3.5 ANALOG INPUTS / FROZEN ANALOG INPUTS Static (Steady-State) Group Number: 30 Static Frozen Group Number: 31 Event Group Number: 32 Frozen Analog Input Event Group Number: 33 Deadband Group Number: 34	Capabilities (leave tick-boxes blank if this data type is not supported)	Current Value	If configurable, list methods
3.5.3 Event reporting mode: When responding with event data and more than one event has occurred for a data point, an Outstation may include all events or only the most recent event. Only the most recent event is typically reported for Analog Inputs. When reporting "only most recent", the analog value reported in the response may be the value at the time of the original event or it may be the value at the time of the response.	☐ Only most recent (value at time of event) ☒ Only most recent (value at time of response) ☒ All events ☐ Based on point Index (add column to table in part 5)	All events	
3.5.4 Analog Inputs Included in Class 0 response:	☒ Always ☐ Never ☐ Only if the point is assigned to a class ☐ Based on point Index (add column to table in part 5)		
3.5.5 How Deadbands are set:	☐ A. Global Fixed ☒ B. Configurable through DNP ☐ C. Configurable via other means ☒ D. Other, explain configurable via SICAM Device Manager or SICAM TOOLBOX II ☐ Based on point Index - column in part 5 specifies which of the options applies, B, C, or D		
3.5.6 Analog Deadband Algorithm: simple - just compares the difference from the previous reported value integrating - keeps track of the accumulated change other - indicating another algorithm	☒ Simple ☐ Integrating ☐ Other, explain __________________________ ☐ Based on point Index (add column to table in part 5)		

3.5 ANALOG INPUTS / FROZEN ANALOG INPUTS Static (Steady-State) Group Number: 30 Static Frozen Group Number: 31 Event Group Number: 32 Frozen Analog Input Event Group Number: 33 Deadband Group Number: 34	Capabilities (leave tick-boxes blank if this data type is not supported)	Current Value	If configurable, list methods
3.5.7 Static Frozen Analog Input Variation reported when variation 0 requested or in response to Class polls:	☐ Variation 1 – 32-bit with flag ☐ Variation 2 – 16-bit with flag ☐ Variation 3 – 32-bit with time-of-freeze ☐ Variation 4 – 16-bit with time-of-freeze ☐ Variation 5 – 32-bit without flag ☐ Variation 6 – 16-bit without flag ☐ Variation 7 – Single-precision, floating-point with flag ☐ Variation 8 – Double-precision, floating-point with flag ☐ Based on point Index (add column to table in part 5)		Not supported
3.5.8 Frozen Analog Input Event Variation reported when variation 0 requested or in response to Class polls: Note: The support for frozen analog input events can be determined remotely using protocol object Group 0 Variation 230.	☐ Variation 1 – 32-bit without time ☐ Variation 2 – 16-bit without time ☐ Variation 3 – 32-bit with time ☐ Variation 4 – 16-bit with time ☐ Variation 5 – Single-precision, floating-point without time ☐ Variation 6 – Double-precision, floating-point without time ☐ Variation 7 – Single-precision, floating-point with time ☐ Variation 8 – Double-precision, floating-point with time ☐ Based on point Index (add column to table in part 5)		Not supported
3.5.9 Frozen Analog Inputs included in Class 0 response:	☐ Always ☐ Never ☐ Only if the point is assigned to a class ☐ Based on point Index (add column to table in part 5)		Not supported
3.5.10 Frozen Analog Input Event reporting mode: When responding with event data and more than one event has occurred for a data point, an Outstation may include all events or only the most recent event. All events are typically reported for Frozen Analog Inputs.	☐ Only most recent frozen value ☐ All frozen values ☐ Based on point Index (add column to table in part 5)		Not supported

3.5 ANALOG INPUTS / FROZEN ANALOG INPUTS Static (Steady-State) Group Number: 30 Static Frozen Group Number: 31 Event Group Number: 32 Frozen Analog Input Event Group Number: 33 Deadband Group Number: 34	Capabilities (leave tick-boxes blank if this data type is not supported)	Current Value	If configurable, list methods
3.5.11 Analog Inputs Event Buffer Organization: When event buffers are allocated per object group (see part 1.7.6), indicate the number of events that can be buffered for Analog Inputs. If event buffers are not allocated per object group then set "Fixed at 0".	☐ Fixed at ___________ ☒ Configurable, range 20 to 255 ☐ Configurable, selectable from ____,____,____ ☐ Configurable, other, describe________________	Note: - valid for DNP3 Slave only.	default = 250
3.5.12 Frozen Analog Inputs Event Buffer Organization: When event buffers are allocated per object group (see part 1.7.6), indicate the number of events that can be buffered for Frozen Analog Inputs. If event buffers are not allocated per object group then set "Fixed at 0".	☐ Fixed at ___________ ☐ Configurable, range _______ to _______ ☐ Configurable, selectable from ____,____,____ ☐ Configurable, other, describe________________		Not supported

3.6 ANALOG OUTPUTS / ANALOG OUTPUT COMMANDS Analog Output Status Group Number: 40 Analog Outputs Group Number: 41 Analog Output Events Group Number: 42 Analog Output Command Events Group Number: 43	Capabilities (leave tick-boxes blank if this data type is not supported)	Current Value	If configurable, list methods
3.6.1 Static Analog Output Status Variation reported when variation 0 requested or in response to Class polls:	☒ Variation 1 – 32-bit with flag ☒ Variation 2 – 16-bit with flag ☒ Variation 3 – single-precision floating point with flag ☐ Variation 4 – double-precision floating point with flag ☐ Based on point Index (add column to table in part 5)	Variation 1	
3.6.2 Analog Output Status Included in Class 0 response:	☒ Always ☐ Never ☐ Only if the point is assigned to a class ☐ Based on point Index (add column to table in part 5)		
3.6.3 Reports Output Command Event Objects:	☒ Never ☐ Only upon a successful Control ☐ Upon all control attempts		

3.6 ANALOG OUTPUTS / ANALOG OUTPUT COMMANDS Analog Output Status Group Number: 40 Analog Outputs Group Number: 41 Analog Output Events Group Number: 42 Analog Output Command Events Group Number: 43	Capabilities (leave tick-boxes blank if this data type is not supported)	Current Value	If configurable, list methods
3.6.4 Event Variation reported when variation 0 requested or in response to Class polls: Note: The support for analog output events can be determined remotely using protocol object Group 0 Variation 219.	☒ Variation 1 – 32-bit without time ☒ Variation 2 – 16-bit without time ☒ Variation 3 – 32-bit with time ☒ Variation 4 – 16-bit with time ☒ Variation 5 – single-precision floating point w/o time ☐ Variation 6 – double-precision floating point w/o time ☒ Variation 7 – single-precision floating point with time ☐ Variation 8 – double-precision floating point with time ☐ Based on point Index (add column to table in part 5)		Not supported
3.6.5 Command Event Variation reported when variation 0 requested or in response to Class polls:	☒ Variation 1 – 32-bit without time ☒ Variation 2 – 16-bit without time ☒ Variation 3 – 32-bit with time ☒ Variation 4 – 16-bit with time ☒ Variation 5 – single-precision floating point w/o time ☐ Variation 6 – double-precision floating point w/o time ☒ Variation 7 – single-precision floating point with time ☐ Variation 8 – double-precision floating point with time ☐ Based on point Index (add column to table in part 5)		Not supported
3.6.6 Event reporting mode: When responding with event data and more than one event has occurred for a data point, an Outstation may include all events or only the most recent event.	☒ Only most recent ☐ All events		Not supported
3.6.7 Command Event reporting mode: When responding with event data and more than one event has occurred for a data point, an Outstation may include all events or only the most recent event.	☒ Only most recent ☐ All events		Not supported

3.6 ANALOG OUTPUTS / ANALOG OUTPUT COMMANDS Analog Output Status Group Number: 40 Analog Outputs Group Number: 41 Analog Output Events Group Number: 42 Analog Output Command Events Group Number: 43	Capabilities (leave tick-boxes blank if this data type is not supported)	Current Value	If configurable, list methods
3.6.8 Maximum Time between Select and Operate:	☐ Not Applicable ☐ Fixed at _____ seconds ☒ Configurable, range 0.1 to 6553.5 seconds ☐ Configurable, selectable from ___,___,___seconds ☐ Configurable, other, describe________________ ☐ Variable, explain _______________________ ☐ Based on point Index (add column to table in part 5)	20 seconds	
3.6.9 Analog Outputs Event Buffer Organization: When event buffers are allocated per object group (see part 1.7.6), indicate the number of events that can be buffered for Analog Outputs. If event buffers are not allocated per object group then set "Fixed at 0".	☐ Fixed at ___________ ☒ Configurable, range 10 to 100 ☐ Configurable, selectable from ____,____,____ ☐ Configurable, other, describe_______________	Note: - valid for DNP3 Slave only (DNPSI0, DNPII1 firmware)	default = 30
3.6.10 Analog Output Commands Event Buffer Organization: When event buffers are allocated per object group (see part 1.7.6), indicate the number of events that can be buffered for Analog Output Commands. If event buffers are not allocated per object group then set "Fixed at 0".	☐ Fixed at ___________ ☒ Configurable, range 10 to 100 ☐ Configurable, selectable from ____,____,____ ☐ Configurable, other, describe_______________	Note: - valid for DNP3 Slave only (DNPSI0, DNPII1 firmware)	default = 30

3.7 FILE CONTROL Group Number: 70	Capabilities	Current Value	If configurable, list methods
3.7.1 File Transfer Supported:	Supported (as defined in section 1.1.8) If not supported then do not complete other entries in section 3.7)	File transfer supported by DNP3 Slave only.	default = no
3.7.2 File Authentication: Indicates whether a valid authentication key must be obtained prior to open and delete requests.	☐ Always ☒ Sometimes = configurable (yes, no) ☐ Never		default = no
3.7.3 File Append Mode: Indicates if a file can be opened and appended to versus just overwritten.	☐ Always ☐ Sometimes, explain _____________________ ☒ Never		

3.7 FILE CONTROL Group Number: 70	Capabilities	Current Value	If configurable, list methods
3.7.4 Permissions Support: Indicates the device is capable of using the indicated permissions.	☒ Owner Read Allowed: 0x0100 ☒ Owner Write Allowed: 0x0080 ☐ Owner Execute Allowed: 0x0040 ☐ Group Read Allowed: 0x0020 ☐ Group Write Allowed: 0x0010 ☐ Group Execute Allowed: 0x0008 ☐ World Read Allowed: 0x0004 ☐ World Write Allowed: 0x0002 ☐ World Execute Allowed: 0x0001		
3.7.5 Multiple Blocks in a Fragment: File data is transferred in a series of blocks of a maximum specified size. This indicates whether only a single block or multiple blocks will be sent in fragment.	☐ Yes ☒ No		
3.7.6 Max number of Files Open at one time:	☒ Fixed at 1 ☐ Configurable, range ________ to ________ ☐ Configurable, selectable from _____,_____,_____ ☐ Configurable, other, describe_______________		

3.8 OCTET STRING & EXTENDED OCTET STRING POINTS Static (Steady-State) Group Number: 110, 114 Event Group Number: 111, 115	Capabilities (leave tick-boxes blank if this data type is not supported)	Current Value	If configurable, list methods
3.8.1 Event reporting mode: When responding with event data and more than one event has occurred for a data point, an Outstation may include all events or only the most recent event.	☐ Only most recent ☐ All events ☐ Based on point Index (add column to table in part 5)		Not supported
3.8.2 Octet Strings Included in Class 0 response:	☐ Always ☐ Never ☐ Only if the point is assigned to a class ☐ Based on point Index (add column to table in part 5)		Not supported

3.8 OCTET STRING & EXTENDED OCTET STRING POINTS Static (Steady-State) Group Number: 110, 114 Event Group Number: 111, 115	Capabilities (leave tick-boxes blank if this data type is not supported)	Current Value	If configurable, list methods
3.8.3 Octet Strings Event Buffer Organization: When event buffers are allocated per object group (see part 1.7.6), indicate the number of events that can be buffered for Octet Strings. If event buffers are not allocated per object group then set "Fixed at 0".	☐ Fixed at ___________ ☐ Configurable, range _______ to _______ ☐ Configurable, selectable from ____,____,____ ☐ Configurable, other, describe_______________		Not supported
3.8.4 Object Group Selection Indicate which object group is used to transport octet string objects.	☐ Fixed, group 110 for all objects ☐ Fixed, group 114 for all objects ☐ Configurable, group 110 or 114 for all objects ☐ Based on point Index (add column to table in part 5)		Not supported

3.9 VIRTUAL TERMINAL PORT NUMBERS (POINTS) Static (Steady-State) Group Number: 112 Event Group Number: 113	Capabilities	Current Value	If configurable, list methods
3.9.1 Virtual Terminals Event Buffer Organization: When event buffers are allocated per object group (see part 1.7.6), indicate the number of events that can be buffered for Virtual Terminals. If event buffers are not allocated per object group then set "Fixed at 0".	☐ Fixed at ___________ ☐ Configurable, range _______ to _______ ☐ Configurable, selectable from ____,____,____ ☐ Configurable, other, describe_______________		Not supported

3.10 DATA SET PROTOTYPE Group Number: 85 Variation Number: 1	Capabilities	Current Value	If configurable, list methods

This version of the Device Profile document has no requirement for describing Data Set Prototype capabilities and current settings. This page is intentionally left blank, existing as a placeholder for future use.

3.11 DATA SET DESCRIPTOR CONTENTS AND CHARACTERISTICS Group Number: 86 Variation Numbers: 1 and 2	Capabilities	Current Value	If configurable, list methods

This version of the Device Profile document has the requirement for describing Data Set Descriptor capabilities being repeated for each Data Set (details can be found in section 5.11).

4 IMPLEMENTATION TABLE

The following implementation table identifies which object groups and variations, function codes and qualifiers the device supports in both requests and responses. The Request columns identify all requests that may be sent by a Master, or all requests that must be parsed by an Outstation. The Response columns identify all responses that must be parsed by a Master, or all responses that may be sent by an Outstation.

NOTE	The implementation table must list all functionality implemented in the Device.

4.1 DNP3 OBJECT GROUP & VARIATION

The following table identifies the objects variations, function codes, and qualifiers supported by the DNP3 Master implementation for CP-8050 (using Triangle MicroWorks, Inc. DNP3 Slave Source Code Library) in both request messages and in response messages.

OBJECT			REQUEST (Library may send)		RESPONSE (Library will parse)	
Object Number	Variation Number	Description	Function Codes (dec)	Qualifier Codes (hex)	Function Codes (dec)	Qualifier Codes (hex)
1	0	Binary Input – Any Variation	1 (read) 22 (assign class)	00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 28 (index)		
1	1	Binary Input	1 (read)	00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 28 (index)	129 (response)	00, 01 (start-stop) 17, 28(index)
1	2	Binary Input with Status	1 (read)	00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 28 (index)	129 (response)	00, 01 (start-stop) 17, 28(index)
2	0	Binary Input Change – Any Variation	1 (read)	06 (no range, or all) 07, 08 (limited qty)		
2	1	Binary Input Change without Time	1 (read)	06 (no range, or all) 07, 08 (limited qty)	129 (response) 130 (unsol. resp)	17, 28 (index)
2	2	Binary Input Change with Time	1 (read)	06 (no range, or all) 07, 08 (limited qty)	129 (response) 130 (unsol. resp)	17, 28 (index)
2	3	Binary Input Change with Relative Time	1 (read)	06 (no range, or all) 07, 08 (limited qty)	129 (response) 130 (unsol. resp)	17, 28 (index)

OBJECT			REQUEST (Library may send)		RESPONSE (Library will parse)	
3	0	Double Bit Input – Any Variation	1 (read) 22 (assign class)	00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 28 (index)		
3	1	Double Bit Input	1 (read)	00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 28 (index)	129 (response)	00, 01 (start-stop) 17, 28(index)
3	2	Double Bit Input with Status	1 (read)	00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 28 (index)	129 (response)	00, 01 (start-stop) 17, 28(index)
4	0	Double Bit Input Change – Any Variation	1 (read)	06 (no range, or all) 07, 08 (limited qty)		
4	1	Double Bit Input Change without Time	1 (read)	06 (no range, or all) 07, 08 (limited qty)	129 (response) 130 (unsol. resp)	17, 28 (index)
4	2	Double Bit Input Change with Time	1 (read)	06 (no range, or all) 07, 08 (limited qty)	129 (response) 130 (unsol. resp)	17, 28 (index)
4	3	Double Bit Input Change with Relative Time	1 (read)	06 (no range, or all) 07, 08 (limited qty)	129 (response) 130 (unsol. resp)	17, 28 (index)
10	0	Binary Output – Any Variation	1 (read) 22 (assign class)	00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 28 (index)		

OBJECT			REQUEST (Library may send)		RESPONSE (Library will parse)	
10	1	Binary Output	1 (read)	00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 28 (index)	129 (response)	00, 01 (start-stop) 17, 28(index)
			1 (write)	00, 01 (start-stop)		
10	2	Binary Output Status	1 (read)	00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 28 (index)	129 (response)	00, 01 (start-stop) 17, 28(index)
12	1	Control Relay Output Block	3 (select) 4 (operate) 5 (direct op)	17, 28 (index)	129 (response)	echo of request
			6 (dir. op, no ack)	17, 28 (index)		
20	0	Binary Counter – Any Variation	1 (read) 22 (assign class)	00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 28 (index)		
			7 (freeze) 8 (freeze no ack) 9 (freeze and clear) 10 (frz. cl. no ack)	00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 28 (index)		
20	1	32-Bit Binary Counter (with Flag)	1 (read)	00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 28 (index)	129 (response)	2020
20	2	16-Bit Binary Counter (with Flag)	1 (read)	00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 28 (index)	129 (response)	20

OBJECT			REQUEST (Library may send)		RESPONSE (Library will parse)	
20	5	32-Bit Binary Counter without Flag	1 (read)	00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 28 (index)	129 (response)	00, 01 (start-stop) 17, 28(index)
20	6	16-Bit Binary Counter without Flag	1 (read)	00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 28 (index)	129 (response)	00, 01 (start-stop) 17, 28(index)
21	0	Frozen Counter – Any Variation	1 (read) 22 (assign class)	00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 28 (index)		
21	1	32-Bit Frozen Counter (with Flag)	1 (read)	00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 28 (index)	129 (response)	00, 01 (start-stop) 17, 28(index)
21	2	16-Bit Frozen Counter (with Flag)	1 (read)	00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 28 (index)	129 (response)	00, 01 (start-stop) 17, 28(index)
21	5	32-Bit Frozen Counter with Time Of Freeze	1 (read)	00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 28 (index)	129 (response)	00, 01 (start-stop) 17, 28(index)
21	6	16-Bit Frozen Counter with Time Of Freeze	1 (read)	00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 28 (index)	129 (response)	00, 01 (start-stop) 17, 28(index)

OBJECT			REQUEST (Library may send)		RESPONSE (Library will parse)	
21	9	32-Bit Frozen Counter without Flag	1 (read)	00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 28 (index)	129 (response)	00, 01 (start-stop) 17, 28(index)
21	10	16-Bit Frozen Counter without Flag	1 (read)	00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 28 (index)	129 (response)	00, 01 (start-stop) 17, 28(index)
22	0	Counter Change Event – Any Variation	1 (read)	06 (no range, or all) 07, 08 (limited qty)		
22	1	32-Bit Counter Change Event without Time	1 (read)	06 (no range, or all) 07, 08 (limited qty)	129 (response) 130 (unsol. resp)	17, 28 (index)
22	2	16-Bit Counter Change Event without Time	1 (read)	06 (no range, or all) 07, 08 (limited qty)	129 (response) 130 (unsol. resp)	17, 28 (index)
22	5	32-Bit Counter Change Event with Time	1 (read)	06 (no range, or all) 07, 08 (limited qty)	129 (response) 130 (unsol. resp)	17, 28 (index)
22	6	16-Bit Counter Change Event with Time	1 (read)	06 (no range, or all) 07, 08 (limited qty)	129 (response) 130 (unsol. resp)	17, 28 (index)
23	0	Frozen Counter Event (Variation 0 is used to request default variation)	1 (read)	06 (no range, or all) 07, 08 (limited qty)		17, 28 (index)
23	1	32-Bit Frozen Counter Event	1 (read)	06 (no range, or all) 07, 08 (limited qty)	129 (response) 130 (unsol. resp)	17, 28 (index)
23	2	16-Bit Frozen Counter Event	1 (read)	06 (no range, or all) 07, 08 (limited qty)	129 (response) 130 (unsol. resp)	17, 28 (index)
23	5	32-Bit Frozen Counter Event with Time	1 (read)	06 (no range, or all) 07, 08 (limited qty)	129 (response) 130 (unsol. resp)	17, 28 (index)

OBJECT			REQUEST (Library may send)		RESPONSE (Library will parse)	
23	6	16-Bit Frozen Counter Event with Time	1 (read)	06 (no range, or all) 07, 08 (limited qty)	129 (response) 130 (unsol. resp)	17, 28 (index)
30	0	Analog Input - Any Variation	1 (read) 22 (assign class)	00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 28 (index)		
30	1	32-Bit Analog Input	1 (read)	00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 28 (index)	129 (response)	00, 01 (start-stop) 17, 28(index)
30	2	16-Bit Analog Input	1 (read)	00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 28 (index)	129 (response)	00, 01 (start-stop) 17, 28(index)
30	3	32-Bit Analog Input without Flag	1 (read)	00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 28 (index)	129 (response)	00, 01 (start-stop) 17, 28(index)
30	4	16-Bit Analog Input without Flag	1 (read)	00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 28 (index)	129 (response)	00, 01 (start-stop) 17, 28(index)
30	5	short floating point	1 (read)	00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 28 (index)	129 (response)	00, 01 (start-stop) 17, 28(index)
32	0	Analog Change Event – Any Variation	1 (read)	06 (no range, or all) 07, 08 (limited qty)		

OBJECT			REQUEST (Library may send)		RESPONSE (Library will parse)	
32	1	32-Bit Analog Change Event without Time	1 (read)	06 (no range, or all) 07, 08 (limited qty)	129 (response) 130 (unsol. resp)	17, 28 (index)
32	2	16-Bit Analog Change Event without Time	1 (read)	06 (no range, or all) 07, 08 (limited qty)	129 (response) 130 (unsol. resp)	17, 28 (index)
32	3	32-Bit Analog Change Event without Time	1 (read)	06 (no range, or all) 07, 08 (limited qty)	129 (response) 130 (unsol. resp)	17, 28 (index)
32	4	16-Bit Analog Change Event without Time	1 (read)	06 (no range, or all) 07, 08 (limited qty)	129 (response) 130 (unsol. resp)	17, 28 (index)
32	5	short floating point Analog Change Event without Time	1 (read)	06 (no range, or all) 07, 08 (limited qty)	129 (response) 130 (unsol. resp)	17, 28 (index)
32	7	short floating point Analog Change Event without Time	1 (read)	06 (no range, or all) 07, 08 (limited qty)	129 (response) 130 (unsol. resp)	17, 28 (index)
34	0	Analog Input Deadband (Variation 0 is used to request default variation)	1 (read)	00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 28 (index)		
34	1	16 bit Analog Input Deadband	1 (read)	00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 28 (index)	129 (response)	00, 01 (start-stop) 17, 28(index)
			2 (write)	17, 28 (index)		
34	2	32 bit Analog Input Deadband	1 (read)	00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 28 (index)	129 (response)	00, 01 (start-stop) 17, 28(index)
			2 (write)	17, 28 (index)		

OBJECT			REQUEST (Library may send)		RESPONSE (Library will parse)	
34	3	Short Floating Point Analog Input Deadband	1 (read)	00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 28 (index)	129 (response)	00, 01 (start-stop) 17, 28(index)
			2 (write)	17, 28 (index)		
40	0	Analog Output Status (Variation 0 is used to request default variation)	1 (read) 22 (assign class)	00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 28 (index)		
40	1	32-Bit Analog Output Status	1 (read)	00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 28 (index)	129 (response)	00, 01 (start-stop) 17, 28(index)
40	2	16-Bit Analog Output Status	1 (read)	00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 28 (index)	129 (response)	00, 01 (start-stop) 17, 28(index)
40	3	short floating point Analog Output Status	1 (read)	00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 28 (index)	129 (response)	00, 01 (start-stop) 17, 28(index)
41	1	32-Bit Analog Output Block	3 (select) 4 (operate) 5 (direct op)	17, 28 (index)	129 (response)	echo of request
			6 (dir. op, no ack)	17, 28 (index)		
41	2	16-Bit Analog Output Block	3 (select) 4 (operate) 5 (direct op)	17, 28 (index)	129 (response)	echo of request
			6 (dir. op, no ack)	17, 28 (index)		

OBJECT			REQUEST (Library may send)		RESPONSE (Library will parse)	
41	3	short floating point Analog Output Block	3 (select) 4 (operate) 5 (direct op)	17, 28 (index)	129 (response)	echo of request
			6 (dir. op, no ack)	17, 28 (index)		
50	1	Time and Date	1 (read)	07 (limited qty = 1)	129 (response)	07 (limited quantity = 1)
			2 (write)	07 (limited qty = 1)		
51	1	Time and Date CTO			129 (response)) 130 (unsol. resp)	07 (limited quantity = 1)
51	2	Unsynchronized Time and Date CTO			129 (response)) 130 (unsol. resp)	07 (limited quantity = 1)
52	1	Time Delay Coarse			129 (response)	07 (limited quantity = 1)
52	2	Time Delay Fine			129 (response)	07 (limited quantity = 1)
60	1	Class 0 Data	1 (read)	06 (no range, or all)		
60	2	Class 1 Data	1 (read)	06 (no range, or all) 07, 08 (limited qty)		
			20 (enable. unsol.) 21 (disable unsol.) 22 (assign class)	06 (no range, or all)		
60	3	Class 2 Data	1 (read)	06 (no range, or all) 07, 08 (limited qty)		
			20 (enable. unsol.) 21 (disable unsol.) 22 (assign class)	06 (no range, or all)		
60	4	Class 3 Data	1 (read)	06 (no range, or all) 07, 08 (limited qty)		
			20 (enable. unsol.) 21 (disable unsol.) 22 (assign class)	06 (no range, or all)		

OBJECT			REQUEST (Library may send)		RESPONSE (Library will parse)	
70	0	File Control - any variation	1 (read)	06 (no range, or all) 07, 08 (limited qty)		
			22 (assign class)	06 (no range, or all)		
70	2	File Control - authentication	29 (authenticate file)	5B (Cnt = 1)	129 (response)	5B (Cnt = 1)
70	3	File Control - file command	25 (open) 27 (delete)	5B (Cnt = 1)		
70	4	File Control - file command status	26 (close) 30 (abort)	5B (Cnt = 1)	129 (response)	5B (Cnt = 1)
70	5	File Control - file transport	1 (read) 2 (write)	5B (Cnt = 1)	129 (response) 130 (unsol. resp)	5B (Cnt = 1)
					129 (response)	5B (Cnt = 1)
70	6	File Control - file transport status			129 (response) 130 (unsol. resp)	5B (Cnt = 1)
70	7	File Control - file descriptor	28 (get file info)	5B (Cnt = 1)	129 (response)	5B (Cnt = 1)
					130 (unsol. resp)	5B (Cnt = 1)
70	8	File Control - file specification string	31 (acti config)	5B		
80	1	Internal Indications	1 (read)	00, 01 (start-stop)	129 (response)	00, 01 (start-stop)
			2 (write)	00 (start-stop) index = 4 or 7		

4.2 FUNCTION CODES

Application Layer Function Codes			
	Functioncode	**Mnemonic**	**Description**
	0	Confirm	Message Application Confirmation
	1	Read	Request/Response of data objects
	2	Write	Store data objects, reply with status (only for write data and time, write analog deadband and clear internal indication bit restart)
	3	Select	SBO Control Select – reply with status
	4	Operate	SBO Operate – reply with status
	5	Direct Operate	Select and Operate relays – reply with status (IIN)
	6	Direct Operate - no Acknowledgement	Select and Operate relays – no status reply
	7	Immediate Freeze	Copy specified objects to freeze buffer, reply with status (IIN)
	8	Immediate Freeze - no Acknowledgement	Copy objects to freeze buffer, no status reply
	9	Freeze and Clear	Copy objects to freeze buffer then reset objects and reply (IIN)
	10	Freeze & Clear – no Acknowledgement	Copy to freeze buffer and reset objects, no status reply
	13	Cold Start	Initiate desired reset, reply with time till available
	14	Warm Start	Initiate partial reset, reply with time till available
	20	Enable Unsolicited Messages	Enable spontaneous reporting of the specified objects

Application Layer Function Codes			
	21	Disable Unsolicited Messages	Disable spontaneous reporting of the specified objects
	22	Assign Class	Assign objects to a particular class
	23	Delay Measurement	Calculate communication line round-trip message delay
	25	Open	Open File
	26	Close	Close File
	27	Delete	Delete File
	28	Get File Info	Get File Information
	29	Authenticate File	Authenticate File
	31	acti config	Activate Configuration
	129	Response	A reply to a specific request message
	130	Unsolicited Message	Unsolicited response message

5 DATA POINTS LIST (OUTSTATIONS ONLY)

This part of the Device Profile shows, for each data type, a table defining the data points available in the device or a description of how this information can be obtained if the database is configurable.

5.1 Definition of Binary Input Point List: List all addressable points. Points that do not exist (for example, because an option is not installed) shall be omitted from the table. Note: the number of binary inputs present in the device, and the maximum binary input index, are available remotely using object Group 0 Variations 239 and 238.	☐ Fixed, list shown in table below ☒ Configurable (current list may be shown in table below) ☐ Other, explain______________________

Binary Input points list:

Point Index	Name	Event Class Assigned (1, 2, 3 or none)	Name for State when value is 0	Name for State when value is 1	Description
0	Single binary example 1	1	Off	On	Any binary indication
1	Single binary example 2	1	Off	On	Any binary indication
2	Single binary example 3	1	Off	On	Any binary indication
: :	Add more rows as necessary				

5.2 Definition of Double-bit Input Point List: List all addressable points. Points that do not exist (for example, because an option is not installed) shall be omitted from the table. Note: the number of double-bit inputs present in the device, and the maximum double-bit input index, are available remotely using object Group 0 Variations 236 and 235.	☐ Fixed, list shown in table below ☒ Configurable (current list may be shown in table below) ☐ Other, explain______________________

Double-bit Input points list:

Point Index	Name	Event Class Assigned (1, 2, 3 or none)	Name for State when value is 0 (Intermediate)	Name for State when value is 1 (Off)	Name for State when value is 2 (On)	Name for State when value is 3 (Indeterminate)	Description
0	Double binary input example 1	1	Intermediate	Off	On	Indeterminate	Circuit Breaker
1	Double binary input example 2	1	Intermediate	Open	Closed	Indeterminate	Disconnector
2	Double binary input example 3	1	Intermediate	Open	Closed	Indeterminate	Disconnector
: :	Add more rows as necessary						

5.3 Definition of Binary Output Status/Control relay output block (CROB) Point List:	
List all addressable points. Points that do not exist (for example, because an option is not installed) shall be omitted from the table. Note: the number of binary outputs present in the device, and the maximum binary output index, are available remotely using object Group 0 Variations 224 and 223.	☐ Fixed, list shown in table below ☒ Configurable (current list may be shown in table below) ☐ Other, explain_____________________

Binary Output Status and CROB points list:

Point Index	Name	Supported Control Operations: Select/Operate	Direct Operate	Direct Operate – No Ack	Pulse On	Pulse Off	Latch On	Latch Off	Trip	Close	Count > 1	Cancel Currently Running Operation	Name for State when value is 0	Name for State when value is 1	Event Class Assigned (1, 2, 3 or none): Change	Command	Description
0	Binary Command example 1	X			X				X	X			Off	On	None	None	Any binary command
1	Binary Command example 2		X		X				X						None	None	Any binary command

2	Binary Command example 3			X			X			X			Off	On	None	None	Any binary command
2	Binary Command			X				X	X						None	None	Any binary command
	example 4																
: :	Add more rows as necessary																

5.4 Definition of Counter/Frozen Counter Point List: List all addressable points. Points that do not exist (for example, because an option is not installed) shall be omitted from the table. Note: the number of counters present in the device, and the maximum counter index, are available remotely using object Group 0 Variations 229 and 228.	☐ Fixed, list shown in table below ☒ Configurable (current list may be shown in table below) ☐ Other, explain______________________

Counter / Frozen Counter points list:

Point Index	Name	Event Class Assigned (1, 2, 3 or none)	Frozen Counter Exists (Yes or No)	Event Class Assigned to Frozen Counter Events (1, 2, 3 or none)	Description
0	Binary Counter example 1	3	Yes	3	Any binary counter
1	Binary Counter example 2	3	Yes	3	Any binary counter
2	Binary Counter example 3	3	Yes	3	Any binary counter
: :	Add more rows as necessary				

5.5 Definition of Analog Input Point List: List all addressable points. Points that do not exist (for example, because an option is not installed) shall be omitted from the table. Note: the number of analog inputs present in the device, and the maximum analog input index, are available remotely using object Group 0 Variations 233 and 232.	☐ Fixed, list shown in table below ☒ Configurable (current list may be shown in table below) ☐ Other, explain______________________

Point Index	Name	Event Class Assigned (1, 2, 3 or none)	Transmitted Value		Scaling		Dead-band	Units	Resolution	Description
			Min	Max	Multi-plier	Offset				
0	Analog Input example 1	2	-32768	32767	1	0	150			Any analog input
1	Analog Input example 2	2	0	10000	1	0	60			Any analog input

2	Analog Input example 3	2	-1	1	1	0	0,02			Any analog input
: :	Add more rows as necessary									

5.6 Definition of Analog Output Status/Analog Output Block Point List: List all addressable points. Points that do not exist (for example, because an option is not installed) shall be omitted from the table. Note: the number of analog outputs present in the device, and the maximum analog output index, are available remotely using object Group 0 Variations 221 and 220.	☐ Fixed, list shown in table below ☒ Configurable (current list may be shown in table below) ☐ Other, explain______________________

Analog Output points list:

		Supported Control Operations			**Transmitted Value**		**Scaling**				**Event Class Assigned (1, 2, 3 or none)**		
Point Index	**Name**	**Select/Operate**	**Direct Operate**	**Direct Operate – No Ack**	**Min**	**Max**	**Multiplier**	**Offset**	**Units**	**Resolution**	**Change**	**Command**	**Description**
0	Analog Output example 1	X			-32768	32767	1	0			None	None	Any analog output
1	Analog Output example 2		X		0	100	1	0			None	None	Any analog output
2	Analog Output example 3			X	-5	5	1	0			None	None	Any analog output
: :	Add more rows as necessary												

5.7 Definition of File Names that may be read or written:	☐ Fixed, list shown in table below ☐ Configurable (current list may be shown in table below) ☐ Other, explain______________________

Sequential Files list:

File Name	**Event Class Assigned (1, 2, 3 or none)**	**Authentication Required for:**			**Description**
		Read	**Write**	**Delete**	

Add more rows as necessary					

5.8 Definition of Octet String and Extended Octet String Point List: List all addressable points. Points that do not exist (for example, because an option is not installed) shall be omitted from the table.	☐ Fixed, list shown in table below ☐ Configurable (current list may be shown in table below) ☐ Other, explain_____________________

Octet String and Extended Octet String points list:

Point Index	Name	Event Class Assigned (1, 2, 3 or none)	Group Number used to trans-port the object	Description
0				
1				
2				
: :	Add more rows as necessary			

5.9 Definition of Virtual Terminal Port Numbers: List all addressable points. Points that do not exist (for example, because an option is not installed) shall be omitted from the table.	☐ Fixed, list shown in table below ☐ Configurable (current list may be shown in table below) ☐ Other, explain_____________________

Ports list:

Virtual Port Numb er (Point Index)	Name	Event Class Assigned (1, 2, 3 or none)	Description
0			
1			
2			
: :	Add more rows as necessary		

5.10 Definition of Data Set Prototypes: List of all data set prototypes. The following table is repeated for each Data Set Prototype defined. Note: the numbers of data set prototypes known to the device are available remotely using the protocol object Group 0 Variations 212 and 213.	☐ Fixed, list shown in table below ☐ Configurable, list methods: (a list of currently defined Data Set Prototypes may be shown in tables below) ☐ Other, explain_____________________

Prototype Description:

Element Number	Descriptor Code (check one)							Element Description	Data Type Code (check one)									Maximum Data length	Ancillary Value: ID = Identifier number UUID = UUID value NSPC = Prototype namespace NAME = Prototype name DAEL = Data element name CTLS = Control status name CTLV = Control value name
	ID	UUID	NSPC	NAME	DAEL	CTLS	CTLV		NONE	VSTR	UINT	INT	FLT	OSTR	BSTR	TIME	UNCD		
0	X							Mandatory DNP identifier			X								
1		X						UUID assigned to prototype						X					
2																			
: :								Add more rows as necessary											

5.11 Definition of Data Set Descriptors: List of all data set descriptors. The following table is repeated for each Data Set Descriptor defined. Note: the numbers of data sets known to the device are available remotely using the protocol object Group 0 Variations 214 and 215.	☐ Fixed, Data Set Descriptors are shown in table below ☐ Configurable (current list may be shown in table below) ☐ Other, explain______________________

Data Set Description:

5.11.1 Data Set Properties:	☐ Readable ☐ Writable ☐ Outstation maintains a static data set ☐ Outstation generates a data set event ☐ Data set defined by master
5.11.2 Event Class Assigned:	☐ Class 1 ☐ Class 2 ☐ Class 3
5.11.3 Static Data Set included in Class 0 response:	☐ Always ☐ Never ☐ Only if assigned to a class

Element Number	Descriptor Code (check one)						Element Description	Data Type Code (check one)									Maximum Data length	Ancillary Value: ID = Identifier number NAME = Data Set name DAEL = Data element name CTLS = Control status name CTLV = Control value name PTYP = UUID and (optional) instance name
	ID	NAME	DAEL	CTLS	CTLV	PTYP		NONE	VSTR	UINT	INT	FLT	OSTR	BSTR	TIME	UNCD		

0	X						Mandatory DNP identifier			X								
1																		
:							Add more rows as necessary											

5.12 Data Set Descriptor – Point Index Attributes

The following table is optional and correlates data set elements to point indexes of standard DNP3 Data Objects. The element number below refers to the position in the present value (object 87) or event (object 88) data set and will not match the element number in the data set descriptor or data set prototype tables above.

Duplicate this table for each Data Set Descriptor defined

Data Set Description:

Element Number	DNP3 Group Number	Point Index
0		
1		
2		
: :	Add more rows as necessary	

13.10 PROFIBUS-DP

13.10.1 Introduction

The PROFIBUS-DP protocol is a serial fieldbus protocol for connecting PROFIBUS-DP field devices. To connect PROFIBUS-DP field devices to CP-8031, CP-8050, the external field bus gateway Hilscher netHOST NHST-T100-DP/DPM is required as a PROFIBUS-DP master.

Protocol firmware for PROFIBUS-DP:

Firmware	System	Standard and function
DPMI0	CP-8031, CP-8050	PROFIBUS-DP (DPV0) Master

PROFIBUS (PROcess Field BUS) is a manufacturer-independent, open fieldbus standard with a broad worldwide application range in production and process automation.

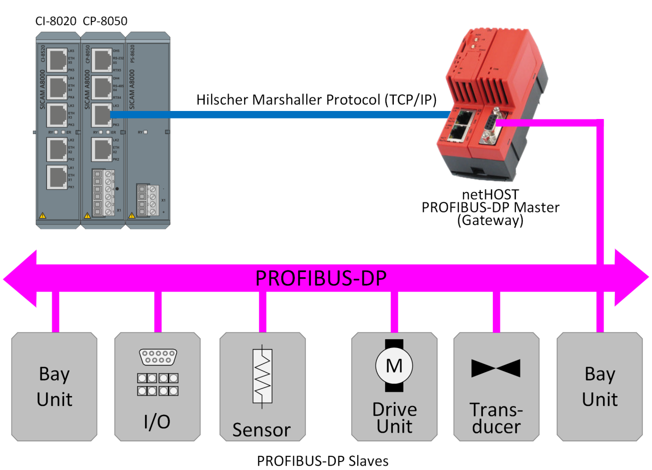
The PROFIBUS-DP protocol is defined in the IEC 61158 standard.

PROFIBUS-DP defines master and slave stations.

The protocol element for PROFIBUS-DP in conjunction with the external fieldbus gateway netHOST supports the function for “PROFIBUS-DP (DPV0) Master”.

The field bus gateway netHOST is connected to the CP-8031, CP-8050 or CI-8520 via a LAN interface (Ethernet).

Schematic configuration:



[sc_DPMI0_Configuration_Basic, 1, --_--]

13.10.2 Functions

Function	DPMI0
PROFIBUS-DP master interface in CP-8031, CP-8050 with external field bus gateway	
Fieldbus Gateway: Hilscher netHOST NHST-T100-DP/DPM (= PROFIBUS-DP Master)	✓
PROFIBUS-DP according to IEC 61158 Typ 3 “PROFIBUS DP-V0”: PROFIBUS-DP for cyclical exchange of data and diagnostics (formerly DIN 19245 or EN 50170)	✓
Max. number of supported data points	2000

Function	DPMI0
Network configuration	
CP-8031, CP-8050 + netHOST = PROFIBUS-DP Master	✓
Max. number PROFIBUS-DP slaves	100
Max. number PROFIBUS-DP slaves (recommendation)	30 to 50
PROFIBUS-DP Slave addresses	0 to 99
Physical interface	
Interface between CP-8031, CP-8050 ↔ Field bus - Gateway (netHOST): Fast Ethernet 100 Mbit/s, IEEE 802.3, 100Base TX, electrical	✓
Interface between fieldbus gateway (netHOST) ↔ PROFIBUS-DP Slaves: PROFIBUS-DP (electrical)	✓
Baud rates	
PROFIBUS-DP (electrical) 9,6 kbit/s to 12 Mbit/s	✓
Communication protocol between CP-8031, CP-8050 ↔ Field bus Gateway (netHOST)	
Hilscher Marshaller-Protocol (TCP/IP): Port#: 50111	✓
Request/Response Services	✓
Communication protocol between fieldbus gateway (netHOST) ↔ PROFIBUS-DP Slaves	
PROFIBUS-DP according to IEC 61158 Typ 3 “PROFIBUS DP-V0”: (formerly DIN 19245 or EN 50170)	✓
Data acquisition from PROFIBUS-DP slaves (data read from the fieldbus gateway)	
Cyclic (cycle time for data exchange) = 10 to 1000 ms The cycle time for data acquisition by netHOST is independent of the cycle time on the PROFIBUS-DP	✓
Command transmission to PROFIBUS-DP slaves	
spontaneous/cyclical Commands are transmitted as impulse on the PROFIBUS-DP (the 1. edge of the pulse is transmitted spontaneously, the 2nd edge is transmitted in cycle after expiration of the command output time)	✓
• Control location function (set/check control location)	✓
• Emulation of ACTCON for commands and setpoint values (according IEC 60870-5-101/104)	✓
• Emulation of ACTCON- for commands and setpoint values (according IEC 60870-5-101/104), when a command or setpoint value is discarded from an unreleased control location.	✓
• Emulation of ACTERM for commands and setpoint values (according IEC 60870-5-101/104)	–

Function	DPMI0
PROFIBUS-DP data formats in transmit direction (= command or control direction)	
1BIT	✓
2BIT	
1BIT/PULSE	
2BIT/PULSE	
BYTE/FLAG	
INT8	
UINT8	
INT16	
UINT16	
INT32	
UINT32	
FLOAT32	
S5INT12S	
PROFIBUS-DP data formats in receive direction (signaling or monitoring direction)	
1BIT	✓
2BIT	
1BIT/PULSE	
2BIT/PULSE	
BYTE/FLAG	
DP/DP Status	
INT8	
UINT8	
INT16	
UINT16	
INT32	
UINT32	
FLOAT32	
S5INT12S	
S5INT13S	

Function	DPMI0
Supported IEC60870-5-101/104 data formats in transmit direction (command or control direction)	
TI 30 .. Single-point information with time tag CP56Time2a	✓
TI 31 .. Double-point information with time tag CP56Time2a	
TI 33 .. Bitstring of 32 bits with time tag CP56Time2a	
TI 34 .. Measured value, normalized value with time tag CP56Time2a	
TI 35 .. Measured value, scaled value with time tag CP56Time2a	
TI 36 .. Measured value, short floating-point number with time tag CP56Time2a	
TI 37 .. Integrated totals with time tag CP56Time2a	
TI 45 .. Single command	
TI 46 .. Double command	
TI 47 .. Regulating step command	
TI 48 .. Setpoint command, normalized value	
TI 49 .. Setpoint command, scaled value	
TI 50 .. Setpoint command, short floating-point number	
TI 51 .. Bitstring of 32-bit	
TI 100 .. (General) interrogation command	
TI 101 .. Counter interrogation command	
Supported IEC 60870-5-101/104 data formats in receive direction (signaling or monitoring direction)	
TI 30 .. Single-point information with time tag CP56Time2a	✓
TI 31 .. Double-point information with time tag CP56Time2a	
TI 33 .. Bitstring of 32 bits with time tag CP56Time2a	
TI 34 .. Measured value, normalized value with time tag CP56Time2a	
TI 35 .. Measured value, scaled value with time tag CP56Time2a	
TI 36 .. Measured value, short floating-point number with time tag CP56Time2a	
TI 37 .. Integrated totals with time tag CP56Time2a	
TI 45 .. Single command	
TI 46 .. Double command	
TI 47 .. Regulating step command	
Redundancy(functions for supporting redundant communication routes)	
PROFIBUS redundancy with singular PROFIBUS	✓
PROFIBUS redundancy with redundant PROFIBUS	✓
Special Functions	
Siemens DP/DP-coupler	✓
Protocol element control and return information	
Protocol element control messages:	
• Setting control location	✓
Protocol element return information:	
• Station status	✓
• Station failure	✓
Web server	
Protocol-internal diagnostic and statistic information via protocol-specific web pages	–

Function	DPMI0
Engineering	
Hilscher SYCON.net (for the parametrization of PROFIBUS-DP and netHOST)	✓
SICAM Device Manager	✓
SICAM TOOLBOX II	✓

Restrictions

- Emulation of ACTTERM for commands/setpoint values according to IEC 60870-5-101/104 is not supported.
- "Select-Before-Operate" for commands/setpoint values is not supported.
- PROFIBUS-DP Slave address is only supported in range 0 to 99.
  (Slave address according PROFIBUS-DP: 0 to 125)
- The parameterized cycle time for the data exchange between CP-8031, CP-8050 and netHOST cannot always be observed. (The processing time depends on the number of parameterized data points and the number of data changes).
- The output of information transients in transmit direction on the PROFIBUS-DP slave cannot be guaranteed due to the cyclic data exchange.
- The acquisition of information transients in receive direction on the PROFIBUS-DP slave cannot be guaranteed due to the cyclic data exchange.
- Commands in Receive Direction (PROFIBUS-DP→CP-8031, CP-8050) must be transmitted as impulses to the PROFIBUS-DP (= edge-triggered evaluation) so that no undesired actions are triggered (undesired actions possible with status transmission after Power UP).
- Suppression of intermediate and faulty position for double-point information in receive direction is not supported.

NOTE

Using switches or other network components is not recommended!
Reason:

- high load on the local network due to communication from/to netHOST
- time-critical watchdog monitoring in netHOST

13.10.3 Modes of Operation

The operating mode of the interface is determined by parameters of the protocol element and optional equipment.

Standard Operation Mode	Optional equipment	Interface signals (X2, X3)
Electrical Ethernet interface (Twisted Pair)	Hilscher netHOST	TXD+, TXD-, RXD+, RXD-
Optical Ethernet interface (Fiber optic)	Media converter or switch (on both sides) + Hilscher netHOST	TXD+, TXD-, RXD+, RXD-

Standard Operation Mode		Interface Signals on Hilscher netHOST
PROFIBUS-DP interface (from netHOST to the PROFIBUS-DP Slaves)	- PROFIBUS-DP cable - PROFIBUS-DP plug	RXD/TXD-P, RXD/TXD-N, DGND

13.10.4 Communication

For the stations to communicate with each other, suitable transmission facilities and/or network components may be needed in addition.

Own Station "PROFIBUS-DP Master" (master station)

System	System element	Protocol Element	Remarks
SICAM A8000 Series	CP-8031/CPCI85 CP-8050/CPCI85 CP-8050/EPCI85	DPMI0	The connected remote station is the fieldbus gateway for PROFIBUS-DP master (Hilscher netHOST).

Remote Station "PROFIBUS-DP Slave" (remote station)

System	System element	Protocol Element	Remarks
Siemens PROFIBUS-DP Slave devices	-	-	according to PROFIBUS-DP (DPV0) Standard. Supported PROFIBUS-DP data formats according to *13.10.9 PROFIBUS-DP Data Formats*
SICAM A8000 Series	CP-8031/CPCI85 CP-8050/CPCI85 CP-8050/EPCI85	DPMI0	PROFIBUS-DP Master with Siemens DP/DP-Coupler as PROFIBUS-DP Slave
SICAM AK 3	CP-2016/CPCX26 CP-2019/PCCX26	SM-2558/DPMA0	PROFIBUS-DP Master with Siemens DP/DP-Coupler as PROFIBUS-DP Slave
Legacy systems (SICAM AK, SICAM TM, SICAM BC)	CP-20xx CP-50xx CP-60xx	SM-2558/DPMA0	PROFIBUS-DP Master with Siemens DP/DP-Coupler as PROFIBUS-DP Slave
Third-party system	-	-	according to PROFIBUS-DP (DPV0) Standard. Supported PROFIBUS-DP data formats according to *13.10.9 PROFIBUS-DP Data Formats*

13.10.5 Communication according to PROFIBUS-DP

PROFIBUS (PROcess Field BUS) is a manufacturer-independent, open fieldbus standard with a broad worldwide application range in production and process automation. Currently the PROFIBUS-DP is defined in the IEC 61158 standard.

PROFIBUS-DP defines master and slave stations.

The protocol element for PROFIBUS-DP in CP-8050 in conjunction with the external fieldbus gateway netHOST supports the function for "PROFIBUS-DP Master".

The field bus gateway netHOST is connected to the CP-8050 or CI-852x via a LAN interface (Ethernet/fibre optics).

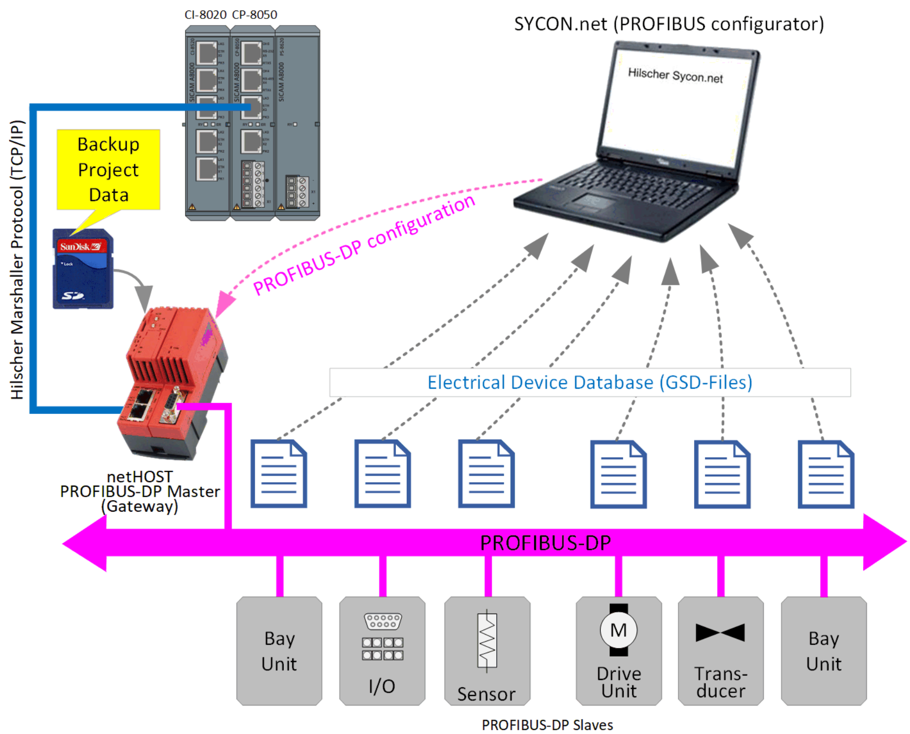
The configuration for PROFIBUS-DP Master in netHOST is carried out with the Windows-based software "SYCON.net" by Hilscher. The configuration data are loaded directly into the netHOST. The PROFIBUS-DP protocol is executed by the netHOST.

The processing of data from/to PROFIBUS-DP slaves in CP-8050 is performed by the protocol element DPMI0.

The protocol element controls the data traffic between CP-8050 ↔ netHOST with the LAN-based Hilscher Marshaller protocol. This protocol is used to initialize the netHOST and transfer the data from/to the PROFIBUS-DP slaves.

The message conversion IEC 60870-5-101/104 ↔ PROFIBUS-DP is performed by the protocol element DPMI0.

Schematic configuration:



NOTE

The GSD file can be requested from the device manufacturer of the PROFIBUS-DP slaves.

After updating the firmware in the PROFIBUS-DP slave, some PROFIBUS DP slave devices require the use of a new GSD file that matches the firmware version.

13.10.5.1 Fieldbus Gateway for PROFIBUS-DP Master (netHOST)

The external fieldbus gateway for PROFIBUS-DP Master (Hilscher netHOST NHST-T100-DP/DPM) is connected to the CP-8050 or the CI-852x via the Ethernet/Fiber Optic interface.

The PROFIBUS-DP slave devices are connected to the PROFIBUS-DP interface on the netHOST.

Technical Data

Power supply	24 V DC ± 6 V (typ. 130mA at 24 V, 3.2W)
Operating temperature range	0 ... +60 °C

	Designation	MLFB / Order number
	netHOST PROFIBUS Master NHST-T100-DP/DPM Art.Nr.:1890.410 Color: red	– This accessory must be ordered directly from Hilscher. Web: *www.hilscher.com* *http://de.hilscher.com/sales_subsidiaries.html* *http://de.hilscher.com/sales_distributors.html*
	netHOST PROFIBUS Master NHST-T100-DP\GR/DPM Art.Nr.:1891.410 Color: dark grey	– This accessory must be ordered directly from Hilscher. Web: *www.hilscher.com* *http://de.hilscher.com/sales_subsidiaries.html* *http://de.hilscher.com/sales_distributors.html*
		SYCON.net - Windows based software - "PROFIBUS configurator" Note: SYCON.net is automatically included when ordering NHST-T100-DP/DPM and is usually supplied on DVD or is available via download.

NOTE

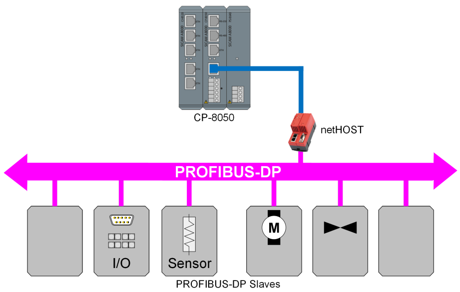
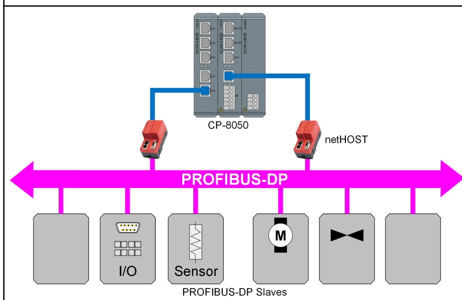
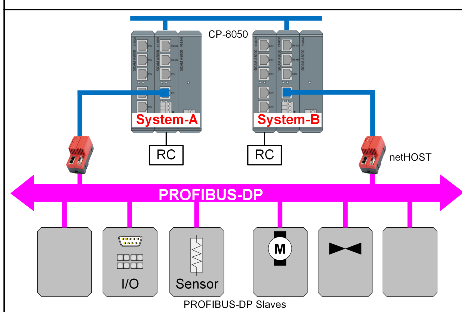
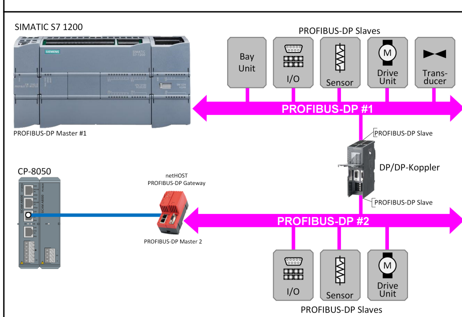
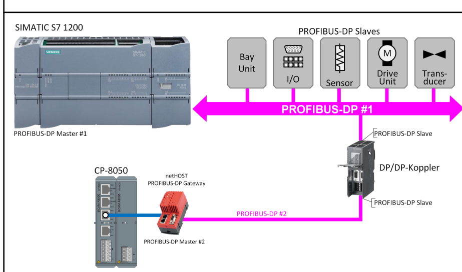
Before using the netHOST for the first time, the firmware must be updated as the device is not supplied with the latest firmware.

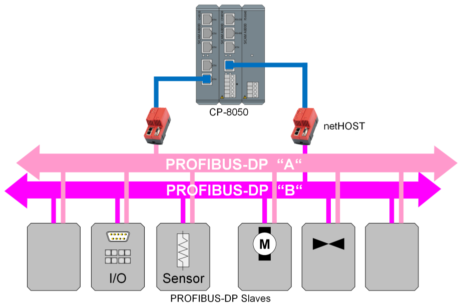
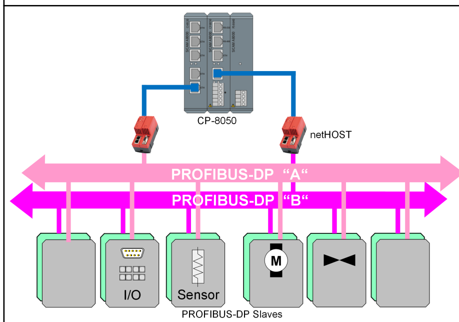
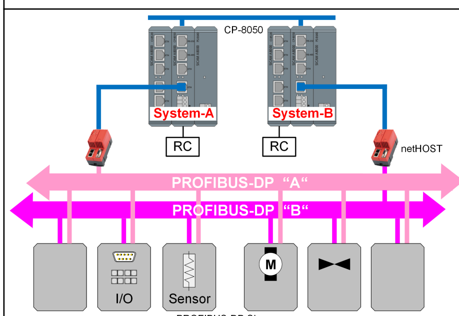
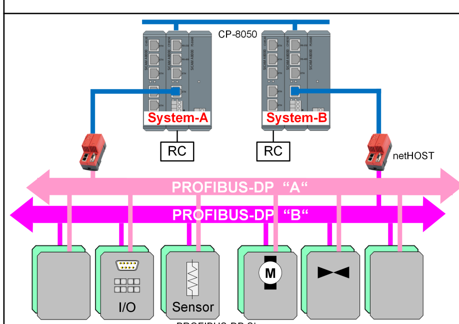
The current firmware for netHOST is included in SYCON.net.

The current version of SYCON.net can be downloaded under *https://www.hilscher.com/support/downloads/* "netHOST".

For details on updating the firmware in netHOST see Appendix B SYCON.net + netHOST Quickstart Guide.

13.10.5.2 PROFIBUS-DP configurations with CP-8050

Supported configurations	Description
	**singular PROFIBUS + singular PRE (no redundancy)** ● singular PROFIBUS ● PROFIBUS-DP Slaves with singular PROFIBUS-DP interface ● Singular CP-8050 automation unit as PROFIBUS-DP Master – singular PRE for PROFIBUS-DP Master – singular netHOST for PROFIBUS-DP Master → only 1 PROFIBUS-DP Master is "active" on the bus
	**singular PROFIBUS + redundant PREs** ● singular PROFIBUS ● PROFIBUS-DP Slaves with singular PROFIBUS-DP interface ● Singular CP-8050 automation unit as PROFIBUS-DP Master – Redundant PRE for PROFIBUS-DP Master – redundant netHOST for PROFIBUS-DP Master → only 1 PROFIBUS-DP Master is "active" on the bus Limitation: no redundancy if CP-8050 fails!
	**singular PROFIBUS + redundant AEs** ● singular PROFIBUS ● PROFIBUS-DP Slaves with singular PROFIBUS-DP interface ● redundant CP-8050 automation unit as PROFIBUS-DP Master – Redundant PRE for PROFIBUS-DP Master – redundant netHOST for PROFIBUS-DP Master → only 1 PROFIBUS-DP Master is "active" on the bus → the RedundancyControl-Logic (RC) is applied in the function diagram implemented in the CP-8050 (data exchange via IEC 60870-5-104 connection)
	**Coupling of 2 PROFIBUS networks with DP/DP-coupler** ● 2 separate PROFIBUS-DP configurations ● The data between the PROFIBUS-DP is exchanged via the DP/DP coupler ● the DP/DP-coupler is 2x slave
	**CP-8050 as PROFIBUS-DP Slave with DP/DP-coupler** ● CP-8050 supports only PROFIBUS-DP Master with netHOST ● With netHOST + DP/DP-coupler, CP-8050 is connected to the PROFIBUS as a PROFIBUS-DP slave

Supported configurations	Description
	**singular PROFIBUS - DP + redundant PREs** • redundant PROFIBUS • PROFIBUS Slaves with redundant PROFIBUS-DP interface • singular CP-8050 automation unit as PROFIBUS-DP Master – Redundant PRE for PROFIBUS-DP Master – redundant netHOST for PROFIBUS-DP Master → both PROFIBUS-DP Master are "active" on the bus Limitation: no redundancy if CP-8050 fails!
	**singular PROFIBUS-DP + redundant PREs** • redundant PROFIBUS • redundant PROFIBUS Slaves • singular CP-8050 automation unit as PROFIBUS-DP Master – Redundant PRE for PROFIBUS-DP Master – redundant netHOST for PROFIBUS-DP Master → both PROFIBUS-DP Master are "active" on the bus Limitation: no redundancy if CP-8050 fails!
	**Redundant PROFIBUS-DP + redundant AUs** • redundant PROFIBUS • PROFIBUS Slaves with redundant PROFIBUS-DP interface • redundant CP-8050 automation unit as PROFIBUS-DP Master – Redundant PRE for PROFIBUS-DP Master – redundant netHOST for PROFIBUS-DP Master → both PROFIBUS-DP Master are "active" on the bus → the RedundancyControl-Logic (RC) is applied in the function diagram implemented in the CP-8050 (data exchange via IEC 60870-5-104 connection)
	**Redundant PROFIBUS-DP + redundant AUs** • redundant PROFIBUS • redundant PROFIBUS Slaves • redundant CP-8050 automation unit as PROFIBUS-DP Master – Redundant PRE for PROFIBUS-DP Master – redundant netHOST for PROFIBUS-DP Master → both PROFIBUS-DP Master are "active" on the bus → the RedundancyControl-Logic (RC) is applied in the function diagram implemented in the CP-8050 (data exchange via IEC 60870-5-104 connection)

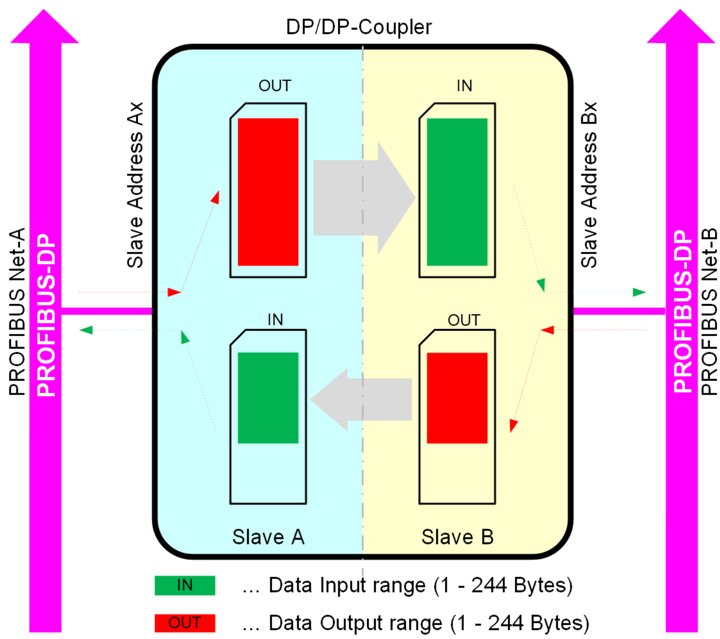
DP/DP-coupler

The PROFIBUS DP/DP-coupler is used to connect two PROFIBUS-DP networks with one another and thus to transfer data from the master of one network to the master of the other network.

	Designation	MLFB/Order number
	SIMATIC DP, DP/DP-Coupler Coupling module for connecting two PROFIBUS-DP networks; redundant power supply.	6ES7158-0AD01-0XA0

The DP/DP-coupler assumes the functionality of 2 slaves; a slave for the 1st master (for example CP-8050 / DPMI0) and a slave for the 2nd master (for example: SIMATIC S7).
The output data of one slave are taken over as input data of the other slave and vice versa.

Schematic operation of the DP/DP-coupler:



DP/DP-coupler status

The Siemens DP/DP-coupler provides a "Data valid" information in the input data, which describes the state of the communication to the other master. By evaluating the "Data valid" information, the validity of the data can be determined.
For the Siemens DP/DP-coupler, the "Data valid" information is to be activated via DIP switch.

The "Data valid" information is displayed in the 1st bit of the 1st input byte:

- "0" → PROFIBUS communication to the remote station failed
- "1" → PROFIBUS communication to the remote station OK

The "Data valid" information is used by the protocol element to form the "NT bit" of the data concerned. In the SIP message address conversion, the "Data valid" information must be assigned to the DP data format "DP/DP STATUS".

When changing the "Data valid" information, all data of this PROFIBUS-DP slave will be emulated with the corresponding state of the NT bit or IV bit in case of integrated totals <TI:=137>.
The "NT bit" of the "Data valid" information is not set.

Processing the data after initialization of the DP/DP-coupler (e.g.: after Power ON):

- PROFIBUS communication to the remote station failed:
  All input data of the PROFIBUS-DP slave (except "Data valid") are emulated to the BSE with the state "0" and "NT = 1".
  Note:
  After restarting the "DP/DP-coupler" it sends all input data with the status "0".
- PROFIBUS communication to remote station OK:
  - In rare cases, all input data of the PROFIBUS-DP slave are transmitted by the DP/DP-coupler with status = "0" and "Data valid" = 1.
  - As a result, the data points would be falsely passed on with the state = "0" and "NT = 0" (valid) for a short time.
  - Delayed handling of all data after changing the DP/DP-coupler status of "Data invalid → valid" suppresses the transmission of possibly incorrect data.

The delayed handling of the data after changing the DP/DP-coupler status of "Data invalid → valid" must be set on the protocol with the parameter **`[PRE] PROFIBUS-DP (netHOST) | Communication functions | Query cycle time | DP/DP coupler delay`**

NOTE

If PROFIBUS communication in one network fails, the slave continues to operate undisturbed in the other PROFIBUS network.
Only the "Data Valid" information (if supported by the DP/DP-coupler) is reset!

13.10.5.3 Control and Return Information of Protocol Elements

Protocol element control messages

Protocol element control messages can control protocol element internal functions. On the basic system element, IEC 60870-5-101/104 *`messages with process information in the control direction`* are converted to protocol element control messages and transmitted to the selected protocol element (see *13.1.4.10 Protocol Element Control Messages*).

Supported Protocol Element Control Functions

SF	Protocol element control function `Control_function_(PRE)`	DPMI0
242	Setting control location	✓

Protocol Element Return Information

Protocol element return information is internal status information of the protocol elements which is transmitted spontaneously and in the event of a general interrogation with internal message formats from the protocol element to the basic system element. On the basic system element, the protocol element return information items (see *13.1.4.11 Protocol Element Return Information*) are converted to IEC 60870-5-101/104 *`messages with process information in the monitoring direction`*.

Supported Protocol Element Return Information

Protocol element return information **`Return information function_(PRE)`**	Station	DPMI0
Station failure	255	✓

13.10.6 Parameters and Properties

Parameter name	Description	Settings
`[PRE] Interface - parameter` Note: • The interface for the protocol is selected in the SICAM Device Manager under Configuration | Firmware(refer to *13.1.4.4 Selection of an Ethernet Interface for Communication Protocols*). • Some parameters may not be displayed until the interface is selected.		
**`[PRE] Station definition	Station definition`**		
`Station number`	Station number for PROFIBUS-DP Slave device and SICAM A8000 internal station number for diagnostic and data routing.	Permitted range = 0 to 99 ... Station number 255 ... not used (default) Default setting = 255
`Station enable`	Selective stations (PROFIBUS-DP devices) can be prepared or deactivated with Station enable = ***no***.	Permitted range = yes, no Default setting = yes
`Station failure`	If the connection fails, the transmission of the error message can be suppressed with station failure = ***no***.	Permitted range = • indicate • do not indicate Default setting = notify
**`[PRE] PROFIBUS-DP (netHOST)	netHOST`**		
`IP-address of remote station (netHOST)`	IP address of the netHOST as remote station (IPV4). Note: The IP address of the own station is set on the BSE.	Permitted range = 0.0.0.0 to 255.255.255.254 Standard setting = 0.0 0.0
`Marshaller protocol response timeout`	For the connection of the netHOST the “Marshaller Protocol” is used. The protocol uses only “Request/ Response services”. Each “request” is monitored by a “response timeout”. If the timeout expires, the TCP connection is closed.	Permitted range = 2.0 to 20.0 s Default setting = 2.5 s
**`[PRE] PROFIBUS-DP (netHOST)	Communication functions	Initialisation`**		
`Startup Delay`	When restarting the BSE, the PROFIBUS-DP interface is only activated after a delay. This delay is used to update the process image on the PRE after a restart before the communication is started.	Permitted range = 10 to 65535 s Default setting = 10

Parameter name	Description	Settings
[PRE] PROFIBUS-DP (netHOST) | Communication functions | Query cycle time		
Cycle time for data exchange	In this grid, the input data is read from the netHOST.	Permitted range = 10 to 1000 ms Default setting = 50 ms
Number of runtime overruns till warning	If processing of the requested input data cannot be completed in n (parameter) consecutive cycles, the *Runtime Error Exceeded* warning is set.	Permitted range = 0 to 255 Default setting = 3
DP/DP-coupler delay		Permitted range = 3 to 255 s Default setting = 3 s
[PRE] PROFIBUS-DP (netHOST) | Communication functions | Command transmission		
Command output time	This command output time is used to determine the pulse duration for commands with the time code "without additional specification (QOC = 0)"	Permitted range = 0.05 to 3276.75 s Default setting = 1 s
[PRE] PROFIBUS-DP (netHOST) | Communication functions | Advanced parameters | Suppress external errors		
Configuration fault		Permitted range = yes, no Default setting = no
Slave does not support listed function		Permitted range = yes, no Default setting = no
Wrong parametrization (identnumber,...)		Permitted range = yes, no Default setting = no
Slave parametrized from another master		Permitted range = yes, no Default setting = no
Slave must be parametrized new		Permitted range = yes, no Default setting = no
Watchdog monitoring addressed		Permitted range = yes, no Default setting = no
Overrun of extended diagnostic data		Permitted range = yes, no Default setting = no
[PRE] Redundancy		
Operation if passive		Permitted range = • listening mode (singular PROFIBUS-DP) • normal operation (redundant PROFIBUS-DP) default operation = normal operation (redundant PROFIBUS-DP)
[PRE] Data base management Settings for the data base management on BSE (per PRE) – see *13.1.4.14 Data Management on the BSE for Communication Protocols*		
[PRE] Advanced parameters | Software test points		
...	The software test points may only be used under the guidance of experts for error detection! Once the fault isolation is completed, software checkpoints must always be turned off.	Permitted range = yes, no Default setting = no

13.10.7 Function for the Support of Redundant Communication Routes

To increase the availability central stations as well as remote terminal units can be implemented redundantly. In this section, not the possible redundancy concepts themselves that can be realized are described, rather only those functions supported by the protocol element for the support of redundant systems or communication routes.

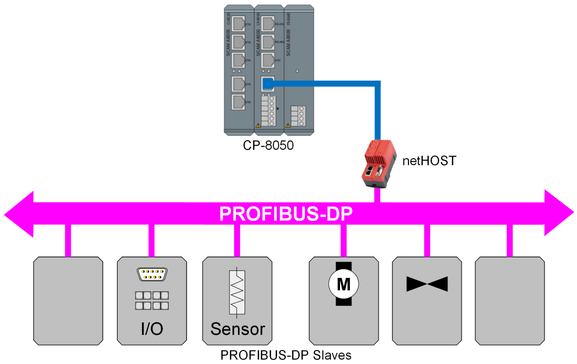
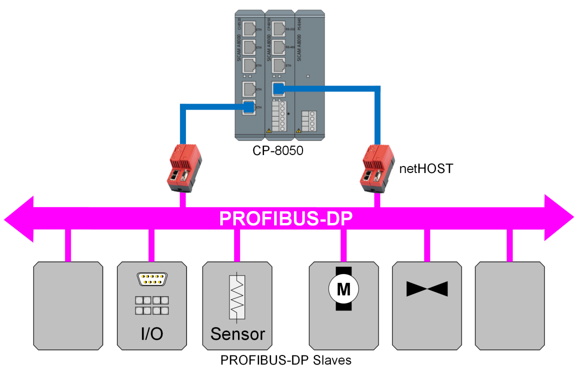
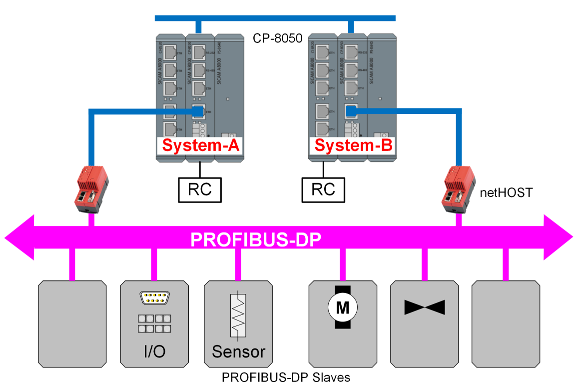
The protocol element for PROFIBUS-DP Master in CP-8050 supports the following redundancy operating modes:

- PROFIBUS-DP Master redundancy with "singular PROFIBUS"
  - redundant PROFIBUS-DP Master are connected to the same PROFIBUS
  - only 1 PROFIBUS-DP Master is "active" on the bus (Master Class 1)
  - the 2nd PROFIBUS-DP Master is in state "STANDBY" (Master Class 2)
- PROFIBUS-DP Master redundancy with "redundant PROFIBUS"
  - redundant PROFIBUS-DP Master are connected to separate PROFIBUS
  - PROFIBUS-DP slaves are either duplicated or equipped with 2 PROFIBUS-DP interfaces
  - both PROFIBUS-DP Master are "active" on the bus (Master Class 1)

Redundancy states

CP-8050 Redundancy state	Redundancy state of the firmware [Operation if passive]	PROFIBUS-DP Masters in netHOST
AKTIV	AKTIV [=normal operation]	OPERATE (Master Class 1)
PASSIVE	STANDBY [=listening mode (singular PROFIBUS-DP)]	STANDBY (Master Class 2)
PASSIVE	PASSIVE [=normal operation (redundant PROFIBUS-DP)]	OPERATE (Master Class 1)

13.10.7.1 PROFIBUS-DP Master with "singular PROFIBUS"

Supported configurations	Description
	**singular PROFIBUS + singular PRE (no redundancy)** • singular PROFIBUS • PROFIBUS-DP Slaves with singular PROFIBUS-DP interface • Singular CP-8050 automation unit as PROFIBUS-DP Master – singular PRE's for PROFIBUS-DP Master – singular netHOST for PROFIBUS-DP Master → only 1 PROFIBUS-DP Master is "active" on the bus
	**singular PROFIBUS + redundant PRE's** • singular PROFIBUS • PROFIBUS-DP Slaves with singular PROFIBUS-DP interface • Singular CP-8050 automation unit as PROFIBUS-DP Master – redundant PRE's for PROFIBUS-DP Master – redundant netHOST for PROFIBUS-DP Master → only 1 PROFIBUS-DP Master is "active" on the bus Restriction: no redundancy if CP-8050 fails!
	**singular PROFIBUS + redundant AE's** • singular PROFIBUS • PROFIBUS-DP Slaves with singular PROFIBUS-DP interface • redundant CP-8050 automation unit as PROFIBUS-DP Master – redundant PRE's for PROFIBUS-DP Master – redundant netHOST for PROFIBUS-DP Master → only 1 PROFIBUS-DP Master is "active" on the bus → the RedundancyControl-Logic (RC) is applied in the function diagram of CP-8050 (Data exchange via IEC 60870-5-104 Connection)

The switchover of the redundancy state in the master station takes place system-internal through redundancy control messages possible redundancy states:

- AKTIV (netHOST: PROFIBUS-DP Master = "OPERATE")
- PASSIV (netHOST: PROFIBUS-DP Master = "STANDBY")

In redundancy state "PASSIVE" the PROFIBUS-DP Master is switched in netHOST to "STANDBY" (=Master Class 2). The data exchange with the PROFIBUS-DP slaves is performed with the Master Class 2 service "Read Input".

The operating mode of the interface must be set with parameter **`[PRE] Redundancy | Operation if passive`** to **`"listening mode (singular PROFIBUS-DP)"`**.

The bus address must be unique for data communication on the PROFIBUS.

For the redundancy state "PASSIVE", the PROFIBUS-DP master address at the protocol element is set with the parameter **`[PRE] Redundancy | PROFIBUS-DP master address`** and must match the configuration in netHOST.

The parameterization of the master address is checked by the protocol element.

The PROFIBUS-DP master address on the bus depends on the parameter **`[PRE] Redundancy | System A/B`** and the redundancy state determined by the protocol element and assigned to netHOST in the "STANDBY" state.

Reason:

After starting up the CP-8050 all interfaces are "PASSIVE" for a short time. Since the configured PROFIBUS-DP master address in netHOST can not be determined in this phase, the netHOST is assigned a unique PROFIBUS-DP master address.

The PROFIBUS-DP master address configured in the netHOST is used in the redundancy state "ACTIVE" (= "Operate") for communication on the PROFIBUS. In the redundancy state "PASSIVE" (netHOST = "STANDBY"), the PROFIBUS-DP master address parameterized in the netHOST is used only for the failure monitoring of the active master by the netHOST.

For example: "PROFIBUS-DP Master Address = 1" (=netHOST configuration "default"):

PROFIBUS-DP Master Address at PROFIBUS-DP	Redundancy state	System-A/B	Algorithm
1	"AKTIV"	A, B	= parameterized address
0	"PASSIVE"	A	= parameterized address -1
2	"PASSIVE"	B	= parameterized address +1

Delay passive => active

In the master station is determined by the parameter **`[PRE] Redundancy | Delay passive Þ active`** a delay in the switching of the redundancy state from "PASSIVE" (= STANDBY) to "ACTIVE".

During the delay time, the internal process image in the send direction (output data) for the PROFIBUS-DP slaves is updated with an inter-system general interrogation.

After this time, the PROFIBUS-DP master is switched to "ACTIVE (= Operate)" in netHOST.

NOTE

With redundancy switchover "PASSIVE" → "ACTIVE", all data in the process image (= output data) at the protocol element must be updated within the parameterized delay time.

Non-updated values are set to the configured initial value.

After the parameterized delay time has elapsed, the communication is started on the PROFIBUS and the output data are transmitted to the PROFIBUS-DP slaves.

Listening mode "failure monitoring"

In the redundancy state "PASSIVE", station-selective failure monitoring of the PROFIBUS-DP slaves is performed. The monitoring is done with the parameter **`[PRE] Redundancy | Listening mode (failure monitoring time)`** "<> 0" activated (0 = no monitoring).

The failure monitoring time is triggered per station upon receipt of the "Read Input" response. When the monitoring time expires, the station is reported as failed.

With redundancy switchover of "ACTIVE" → "PASSIVE", the failure monitoring is started for all configured stations.

With redundancy switchover of "PASSIVE" → "ACTIVE", the failure monitoring is stopped for all configured stations.

NOTE

If the "ACTIVE" master fails, no input data is received from the PROFIBUS-DP slaves in the "PASSIVE" master and the PROFIBUS-DP slaves are not marked as failed (no NT-bit simulation for the input data).

If the PROFIBUS-DP slaves fail, these are marked as failed (NT-bit simulation for the input data).

Forwarding of input data in listening mode

In listening mode, input data can be forwarded to the BSE.

The forwarding of the input data to the basic system element in the listening mode can be activated/deactivated with parameter **`[PRE] Redundancy | Forwarding of input data in listening mode`**.

NOTE

The input data may be inconsistent with the input data of the "ACTIVE" master!

Reason: Different query procedures for input data in the "ACTIVE/PASSIVE" master!

Behavior of the master station in the redundancy state "ACTIVE":

- PROFIBUS-DP master works as master class 1 (= "normal operation") on the bus
- Data communication on PROFIBUS-DP started in netHOST ("Data Exchange Mode")
  - cyclic reading of the input data of PROFIBUS-DP slaves from the netHOST
  - cyclic writing of the output data to PROFIBUS-DP slaves in the netHOST
  - Spontaneous writing of binary output data on change
  - Read the PROFIBUS-DP slave diagnostic information (signaled by reading the input data)
- Input data is marked on the basic system element with "R = 0" (data received from "active" interface)
- Failure monitoring of netHOST by Marshaller protocol
- Failure monitoring of the PROFIBUS-DP slaves by cyclic "Data Exchange Mode"
  (no failure monitoring of the redundant PROFIBUS-DP master)

Behavior of the central station with redundancy switchover "ACTIVE" → "PASSIVE":

- Reset netHOST
- Start of the PROFIBUS-DP master in netHOST in "STANDBY-Mode"

Behavior of the central station with redundancy switchover "PASSIVE" → "ACTIVE":

- Start of the delay time
- Initialization of the process image for output data (transmission direction) with the configured initial values

- Update process image for output data (transmission direction) by internal GA
- After expiry of the delay time: Switch PROFIBUS-DP master in netHOST to "Operate mode"

Behavior of the master station in the redundancy state "PASSIVE":

- PROFIBUS-DP master operates as "Master Class 2" on the bus
- cyclic reading of input data from PROFIBUS-DP slaves with Class 2 Service "Read Input"
- Input data in the listening mode (if the transmission to the BSE is enabled) is marked as "R=1" on the basic system element (data received from "passive" interface)
- Output data in the transmission direction to a protocol element in the "passive" redundancy state are forwarded from the basic system element (depending on the parameterization) to the protocol element or discarded at the BSE.

  Output data which are passed on to the protocol element are discarded on the PRE.
- Failure monitoring of netHOST by Marshaller protocol
- Failure monitoring of the PROFIBUS-DP slaves by cyclic "Read Input" service. (no failure monitoring of the redundant PROFIBUS-DP master)

NOTE

For PROFIBUS-DP redundancy, the watchdog function must be "Enabled" in the PROFIBUS-DP slave.

If there is no bus failure during redundancy switching, then the watchdog time must be adjusted accordingly.

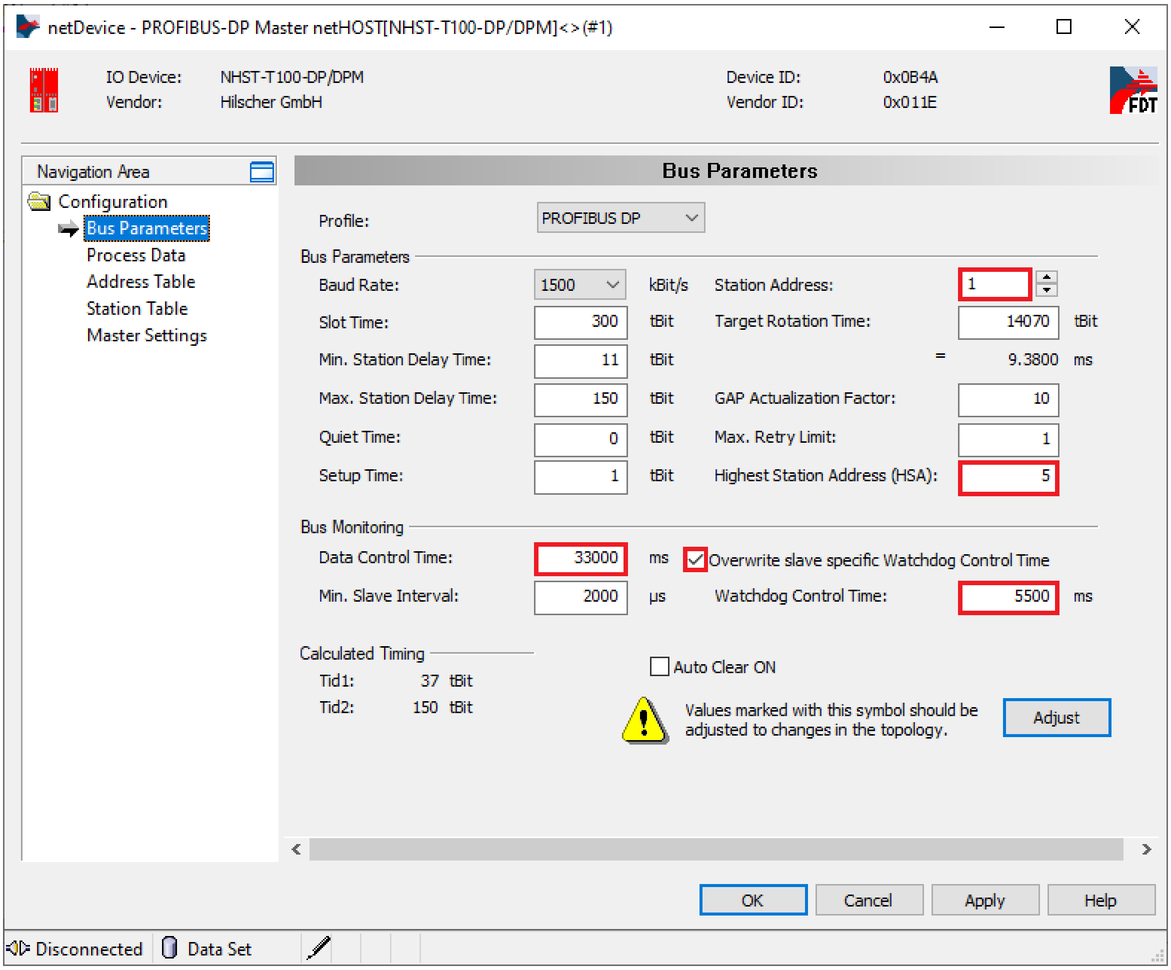
→ the watchdog in PROFIBUS-DP Slave is triggered with "Data Exchange".

→ it the watchdog expires (depending on the functionality in the PROFIBUS-DP slave), the outputs are terminated or a safe

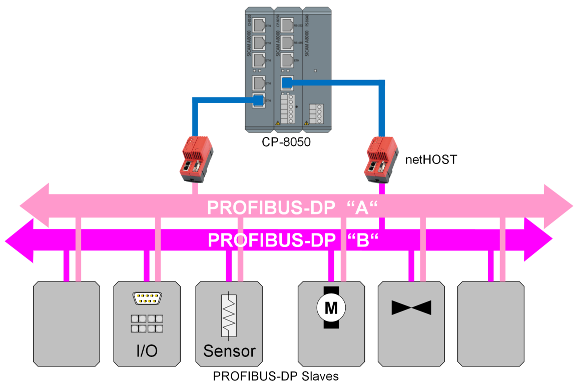
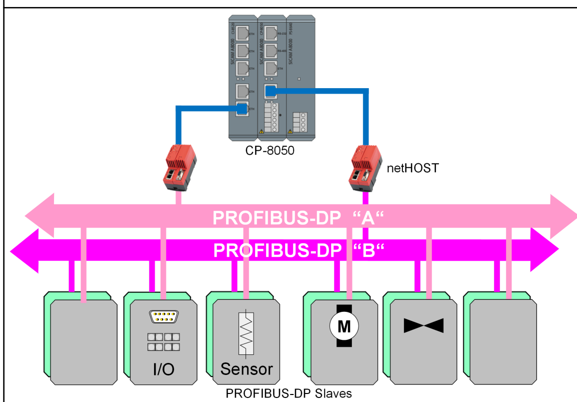
state is adopted.

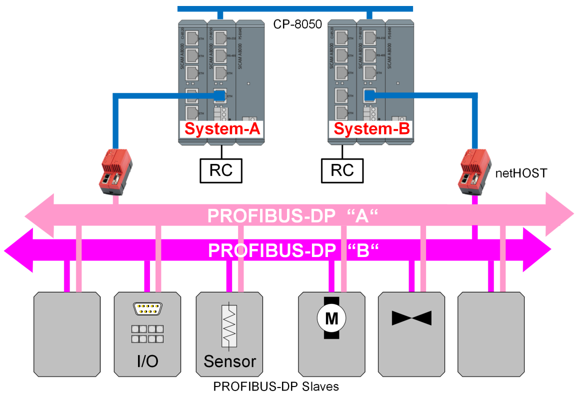
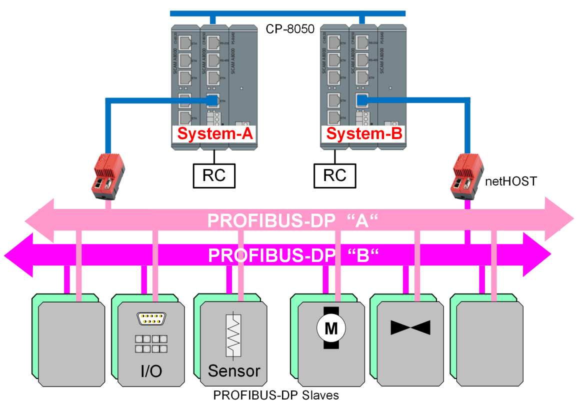
Example: netHOST settings

Sycon.net Parameter	Meaning
Station address	PROFIBUS-DP Master address for netHOST on BUS
Highest Station Address (HSA)	Highest Station Address of a PROFIBUS-DP Masters on BUS. (Default = 126) HSA should normally be "0,1,2" for redundant PROFIBUS-DP masters. This value must be changed, otherwise the bus regeneration will take a long time at low baud rate when a new master is added.
Watchdog Control Time	Watchdog time for PROFIBUS-DP Slave → Die WDC-time must be set higher as: twdc >= tmstio + tred + tres twdc .... Watchdog Control Time tmstio .. Marshaller-Timeout (default = 2.5 Sec) tred ..... Delay time for redundancy switchover passive=>active (default = 2 sec.) tres ...... Reserve
Data Control Time	must be set to 6 times the watchdog control time.
Overwrite Slave specific watchdog control time	With this parameter, the watchdog control time in all PROFIBUS-DP slaves is set to the parameterized value for watchdog control time.


netDevice - PROFIBUS-DP Master netHOST[NHST-T100-DP/DPM]<>(#1)
IO Device: NHST-T100-DP/DPM
Vendor: Hilscher GmbH
Device ID: 0x0B4A
Vendor ID: 0x011E
FDT
Navigation Area
Configuration
Bus Parameters
Process Data
Address Table
Station Table
Master Settings
Bus Parameters
Profile: PROFIBUS DP
Bus Parameters
Baud Rate: 1500 kBit/s
Station Address: 1
Slot Time: 300 tBit
Target Rotation Time: 14070 tBit
= 9.3800 ms
Min. Station Delay Time: 11 tBit
Max. Station Delay Time: 150 tBit
GAP Actualization Factor: 10
Quiet Time: 0 tBit
Max. Retry Limit: 1
Setup Time: 1 tBit
Highest Station Address (HSA): 5
Bus Monitoring
Data Control Time: 33000 ms
Overwrite slave specific Watchdog Control Time
Min. Slave Interval: 2000 µs
Watchdog Control Time: 5500 ms
Calculated Timing
Tid1: 37 tBit
Tid2: 150 tBit
Auto Clear ON
Values marked with this symbol should be adjusted to changes in the topology.
Adjust
OK
Cancel
Apply
Help
Disconnected
Data Set

13.10.7.2 PROFIBUS-DP Master with "redundant PROFIBUS"

Supported configurations	Description
	**redundant PROFIBUS-DP + redundant PRE's** ● redundant PROFIBUS ● PROFIBUS Slaves with redundant PROFIBUS-DP interface ● singular CP-8050 automation unit as PROFIBUS-DP Master – redundant PRE's for PROFIBUS-DP Master – redundant netHOST for PROFIBUS-DP Master → both PROFIBUS-DP Master are "active" on the bus Restriction: no redundancy if CP-8050 fails!
	**redundant PROFIBUS-DP + redundant PRE's** ● redundant PROFIBUS ● redundant PROFIBUS Slaves ● singular CP-8050 automation unit as PROFIBUS-DP Master ● - redundant PRE's for PROFIBUS-DP Master - redundant netHOST for PROFIBUS-DP Master → both PROFIBUS-DP Master are "active" on the bus Restriction: no redundancy if CP-8050 fails!

<table>
<tr><th>Supported configurations</th><th>Description</th></tr>
<tr><td>
</td><td>redundant PROFIBUS-DP + redundant AU's
• redundant PROFIBUS
• PROFIBUS Slaves with redundant PROFIBUS-DP interface
• redundant CP-8050 automation unit as PROFIBUS-DP Master
– redundant PRE's for PROFIBUS-DP Master
– redundant netHOST for PROFIBUS-DP Master
→ both PROFIBUS-DP Master are "active" on the bus
→ the RedundancyControl-Logic (RC) is applied in the function diagram of CP-8050
(Data exchange via IEC 60870-5-104 Connection)</td></tr>
<tr><td>
</td><td>redundant PROFIBUS-DP + redundant AU's
• redundant PROFIBUS
• redundant PROFIBUS Slaves
• redundant CP-8050 automation unit as PROFIBUS-DP Master
– redundant PRE's for PROFIBUS-DP Master
– redundant netHOST for PROFIBUS-DP Master
→ both PROFIBUS-DP Master are "active" on the bus
→ the RedundancyControl-Logic (RC) is applied in the function diagram of CP-8050
(Data exchange via IEC 60870-5-104 Connection)</td></tr>
</table>

The switchover of the redundancy state in the master station takes place system-internal through redundancy control messages possible redundancy states:

- AKTIV (netHOST: PROFIBUS-DP Master = "OPERATE")
- PASSIV (netHOST: PROFIBUS-DP Master = "OPERATE")

The operating mode on the PROFIBUS is not changed during redundancy switching. Both PROFIBUS-DP master interfaces ("ACTIVE" + "PASSIVE") work on the PROFIBUS as Master Class 1 in "data exchange mode".

The operating mode of the interface must be set with parameter **`[PRE] Redundancy | Operation if passive (redundant PROFIBUS-DP)`**" to "normal operation (redundant PROFIBUS-DP)".

Behavior of the master station in the redundancy state "ACTIVE":

- PROFIBUS-DP master works as master class 1 (= "normal operation") on the bus
- Data communication on PROFIBUS-DP started in netHOST ("Data Exchange Mode")
  - cyclic reading of the input data of PROFIBUS-DP slaves from the netHOST
  - cyclic writing of the output data to PROFIBUS-DP slaves in the netHOST
  - Spontaneous writing of binary output data on change
  - Read the PROFIBUS-DP slave diagnostic information (signaled by reading the input data)

- Input data is marked on the basic system element with "R = 0" (data received from "active" interface)
- Failure monitoring of netHOST by Marshaller protocol
- Failure monitoring of the PROFIBUS-DP Slaves by cyclic "Data Exchange Mode" (no failure monitoring of the redundant PROFIBUS-DP Master)

Behavior of the Master Station in the redundancy state "PASSIVE":

... the same behavior as in the redundancy state "ACTIVE" except:

- Input data are marked on the basic system element with "R=1"
  (data received from "passive" interface)
- Output data in transmission direction are forwarded from the basic system element (depending on the parameterization) to the protocol element or discarded at the BSE. Output data passed to the protocol element is transferred from the PRE to the PROFIBUS-DP slave(s).

NOTE

- To enable sending of output data in the redundancy state "PASSIVE" to the redundant PROFIBUS the user data filter on MCPU must be disabled for the corresponding PRE with the parameter **`[BSE] Redundancy | Settings for PREs (linie. red. w. appl. voting) | Option: user data filter deact`**.
- In the case of redundancy switching, PROFIBUS-DP slaves may still cause unwanted output of initial values.

This problem occurs e.g. if:

- Setpoint input to PROFIBUS-DP slave (setpoint from SCADA system via IEC 60870-5-104)
- Restart of the redundant PROFIBUS-DP interface (restart of the AE, CPU-selective startup, ...)
- As setpoint values are not sent during GI according IEC 60870-5-104, the setpoint value in the process image of the PRE is not updated (setpoint value will be initialized with "initial value")
- Initial value is output at the PROFIBUS-DP slave

13.10.8 Message Conversion

Data in transmit direction are transferred from the basic system element to the protocol element in SICAM A8000 internal IEC 60870-5-101/104 (without 101/104 blocking) format. The data formats are converted to the PROFIBUS-DP line format on the protocol element. The data is transmitted to the external Field bus Gateway netHOST cyclically and spontaneously via the proprietary Hilscher Marshaller protocol. The transmission of data to the PROFIBUS-DP slaves is controlled by netHOST.

Data in the receive direction are read cyclically by the protocol element from the external fieldbus gateway netHOST and converted from the PROFIBUS-DP format into a SICAM A8000 internal IEC 60870-5-101/104 format and transferred to the basic system element (no 101/104 blocking).

Message conversion is the conversion of the message formats of the SICAM A8000 internal message formats from IEC 60870-5-101/104 format ↔ PROFIBUS-DP data formats and the conversion of the address information.

The parameterization of the conversion from IEC 60870-5-101/104 ↔ PROFIBUS-DP (address and message format) is to be done with the SICAM Device Manager with function “Signals” or with the SICAM TOOLBOX II, OPM II using “SIP Message Address Conversion”.

Supported Processing Types for Message Conversion

Data	Direction	Processing type	DPMI0
Binary information Commands	Receive direction	firmware / **`Rec_binary_information`**	✓
Measured values	Receive direction	firmware / **`Rec_measured_values`**	✓
Integrated totals	Receive direction	firmware / **`Rec_counter_value`**	✓
Commands Binary information items	Transmit direction	firmware /**`Trans_binary_information`**	✓
Measured values Setpoint values	Transmit direction	firmware / **`Trans_value`**	✓

General description of the parameters and properties (applies for each type of processing)

Parameter	
`DP_Station_number`	Address of the PROFIBUS-DP Slave: • 0 to 99 The PROFIBUS-DP station number is used internally by SICAM A8000 for message conversion and internal system functions and also externally on the PROFIBUS-DP!

13.10.8.1 Message Conversion in Transmit Direction (Master → Slave)

Message Conversion in Transmit Direction IEC 60870-5-101/104 → PROFIBUS-DP

SICAM A8000: IEC 60870-5-101/104 →		PROFIBUS-DP
TI	**Designation**	**Data format**
<TI:=30>	Single-point information with time tag CP56Time2a	1BIT, BYTE/FLAG
<TI:=31>	Double-point information with time tag CP56Time2a	2BIT
<TI:=33>	Bitstring of 32 bits with time tag CP56Time2a	UINT32
<TI:=34>	Measured value, normalized value with time tag CP56Time2a	INT8, UINT8, INT16, UINT16, INT32, UINT32, FLOAT32, S5INT12
<TI:=35>	Measured value, scaled value with time tag CP56Time2a	INT8, UINT8, INT16, UINT16, INT32, UINT32, FLOAT32, S5INT12
<TI:=36>	Measured value, floating-point number with time tag CP56Time2a	INT8, UINT8, INT16, UINT16, INT32, UINT32, FLOAT32, S5INT12
<TI:=37>	Integrated total with time tag CP56Time2a	INT16, UINT16, INT32, UINT32, FLOAT32
<TI:=45>	Single command	1BIT/PULSE
<TI:=46>	Double command	2BIT/PULSE
<TI:=47>	Regulating step command	2BIT/PULSE
<TI:=48>	Setpoint command, normalized value	INT8, UINT8, INT16, UINT16, INT32, UINT32, FLOAT32, S5INT12
<TI:=49>	Setpoint command, scaled value	INT8, UINT8, INT16, UINT16, INT32, UINT32, FLOAT32, S5INT12
<TI:=50>	Setpoint command, short floating-point number	INT8, UINT8, INT16, UINT16, INT32, UINT32, FLOAT32, S5INT12
<TI:=51>	Bitstring 32-bit	UINT32

SICAM A8000: IEC 60870-5-101/104 →		PROFIBUS-DP
<TI:=100>	(General) interrogation command	-
<TI:=101>	Counter interrogation command	-

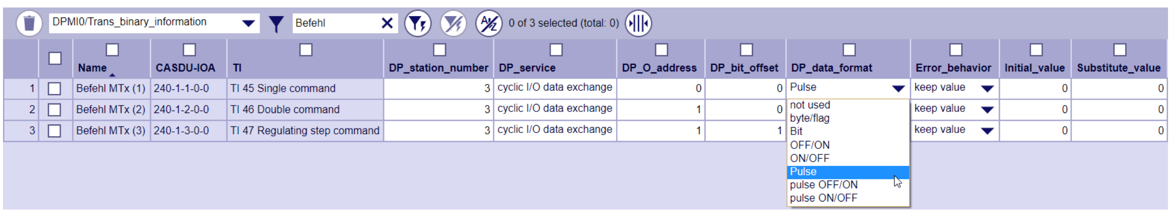
NOTE

The parameters **`initial_value`**, **`substitute_value`** and **`error_behavior`** must be adapted to the requirements of the application! This applies especially for setpoint values.

Commands

The parameterization of the address and message conversion for commands in transmit direction is to be done with the SICAM Device Manager with the function “Signals” or with the SICAM TOOLBOX II, OPM II.

Processing type: *`firmware`* / **`Trans_binary_information`**



[DPMI0_DM_Sende_Binaere_Information_Befehle, 2, en_US]

Parameter	
`TI`	Supported type identifications: • <TI:=45> .. Single command • <TI:=46> .. Double command • <TI:=47> .. Regulating step command
`Name`	Name of the signal
`CASDU-IOA`	SICAM A8000 internal IEC 60870-5-101/104 message address (CASDU1, CASDU2, IOA1, IOA2, IOA3)
`DP_Station_number`	Address of the DP-Slave on the PROFIBUS: • 0 to 99
`DP_service`	PROFIBUS-DP Service: Cyclic I/O data exchange
`DP_O_address`	Output address in netHOST according to configuration in SYCON.net: • 0 to 5759
`DP_bit_offset`	Bit offset in corresponding output byte: • 0 to 7 ... Single command • 0 to 6 ... Double command or regulating step command
`DP_data_format`	Data format on PROFIBUS: • pulse [single command] • pulse OFF/ON [double-/regulating step command] • pulse ON/OFF [double-/regulating step command]
`Error_behavior`	Output on PROFIBUS-DP if NT = 1 or IV = 1: Keep value

Parameter	
`Initial_value`	After restart of the protocol element this initial value will be sent to PROFIBUS-DP slave 0
`Substitute value`	Substitute value if error behavior is set to ***`output substitute value`***: 0

Supported Data Formats

Format	PROFIBUS-DP data format	IEC 60870-5-101/104 Data format (TI)
1BIT/PULSE	pulse	45
2BIT PULSE	pulse OFF/ON	46, 47
2BIT PULSE	pulse ON/OFF	46, 47

NOTE

Since the data formats in PROFIBUS-DP are not defined in the output data, the PROFIBUS-DP data format must be specified for the conversion of SICAM A8000 → PROFIBUS-DP. Supported data formats see *13.10.9 PROFIBUS-DP Data Formats*.

Control Location / Control Location Check

The function “Control location” is used so that commands are only output from authorized sources. If the “Control location” function is activated, commands from the protocol element for PROFIBUS-DP master are only transmitted to the PROFIBUS-DP device when the "control location" (originator address) is enabled. If the control location is not enabled, the protocol element immediately sends back a negative acknowledgment of activation (ACTCON) to the originator address (further details about setting control location / check control location see section *13.1.4.9 Control location function for commands and setpoint values*).

Command Output Time for Single/Double Commands

Commands are transmitted on the PROFIBUS-DP as pulses (1 or 2 bits). The protocol element maps the command output to 1 or 2 bits in the "output process image of spontaneous information" of the PROFIBUS-DP slave with the assigned command output time.

The command output time (duration of the pulse) is set for commands with qualifier of command = <0> “no additional definition” on protocol with the parameter **`[PRE] PROFIBUS-DP (netHost) | Communication functions | Command transmission | Command pulse duration`**.

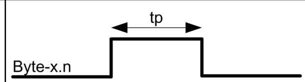
The command output time (duration of the pulse) is set for commands with qualifier of command = <1> “short pulse duration” on the basic system element with the parameter **`[BSE] RTU-common settings | short pulse duration`**.

The command output time (duration of the pulse) is set for commands with qualifier of command = <2> “long pulse duration” on the basic system element with the parameter **`[BSE] RTU-common settings | long pulse duration`**.

Max. 10 commands as pulse command (single-, double commands) executed at the same time will be supported.

Single command

A single command with command state SCS = ON will be output on the PROFIBUS as pulse with parametrized command output time.

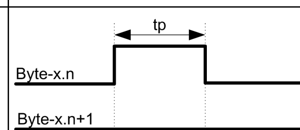
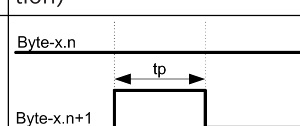
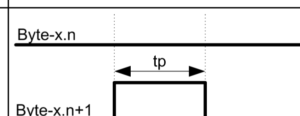
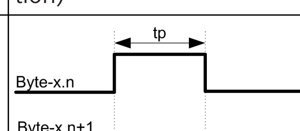
PROFIBUS-DP data format	Command state	Command output (1 bit in output range)
pulse	SCS = ON	 tp ... command output time (pulse duration)
	SCS = OFF	The OFF state is not evaluated!

A running command output is re triggered by another command with the same command state.

Double command / Regulating step command

A double command or regulating step command with the status DCS = ON/OFF or RCS = HIGHER/LOWER is output on the PROFIBUS as pulse with the set command output time.

PROFIBUS-DP data format	Command state	DP_O_address
pulse ON/OFF	ON	parameterized DP_O_address; Bitoffset
	OFF	parameterized DP_O_address; Bitoffset + 1
pulse OFF/ON	ON	parameterized DP_O_address; Bitoffset + 1
	OFF	parameterized DP_O_address; Bitoffset

PROFIBUS-DP data format	Command state	Command output (2 bit in output range)
pulse ON/OFF	DCS = ON RCS = HIGHER	 tp ... command output time (pulse duration)
	DCS = OFF RCS = LOWER	 tp ... command output time (pulse duration)
pulse OFF/ON	DCS = ON RCS = HIGHER	 tp ... command output time (pulse duration)
	DCS = OFF RCS = LOWER	 tp ... command output time (pulse duration)

A running command output is re triggered by another command with the same command state. A running command output is aborted by another command with the antivalent command state and the new command state is output.

Message Conversion

The table describes the evaluated elements of the IEC 60870-5-101/104 message during message conversion.

Elements of the message		
TI .. Type identification		• <TI:=45> .. Single command • <TI:=46> .. Double command • <TI:=47> .. Regulating step command
CASDU, IOA .. Message address		Parameter-settable
Cause of transmission		
06 .. Activation		Is evaluated (only "activation" allowed)
xx .. Other COTs		Not accepted (only "activation" allowed)
T .. Test		Not supported
Information		
SCO/DCO/RCO		
SCS	Single command state	[only <TI:=45>]
	0 .. OFF	Not evaluated
	1 .. ON	Evaluated
DCS	Double command state	[only <TI:=46>]
	0 .. Not allowed	Not supported
	1 .. OFF	Evaluated
	2 .. ON	Evaluated
	3 .. Not allowed	Not supported
RCS	Regulating step command state	[only <TI:=47>]
	0 .. Not allowed	Not supported
	1 .. Next step lower	Evaluated
	2 .. Next step higher	Evaluated
	3 .. Not allowed	Not supported
QOC	S/E	
	0 = Execute	Is checked for "execute"
	1 = Select	Not supported
QU	Command qualifier	
	0 .. No additional definitions	Evaluated
	1 .. Short pulse duration	Evaluated
	2 .. Long pulse duration	Evaluated
	3 .. Persistent command	Not supported

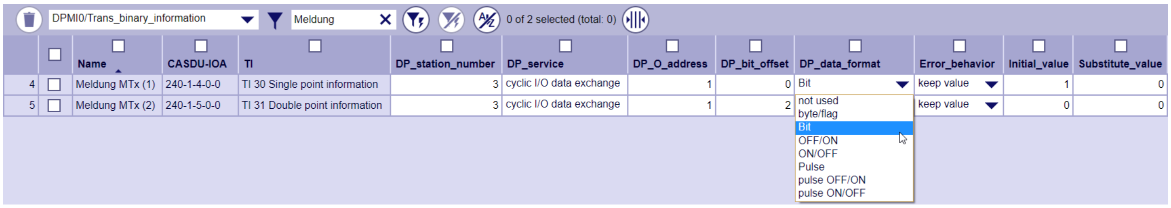
NOTE

Not listed elements of the IEC 60870-5-101/104 message are not rated/not supported!

Binary Information

The parameterization of the address and message conversion for binary information in transmit direction is to be done with the SICAM Device Manager with the function "Signals" or with the SICAM TOOLBOX II, OPM II.

Processing type: *firmware* / **Trans_binary_information**



[DPMI0_DM_Sende_Binaere_Information_Meldungen, 2, en_US]

Parameter	
TI	Supported type identifications: • <TI:=30> .. Single-point information with time tag CP56Time2a • <TI:=31> .. Double-point information with time tag CP56Time2a
Name	Name of the signal
CASDU-IOA	SICAM A8000 internal IEC 60870-5-101/104 message address (CASDU1, CASDU2, IOA1, IOA2, IOA3)
DP_Station_number	Address of the DP-Slave on the PROFIBUS: • 0 to 99
DP_service	PROFIBUS-DP Service: Cyclic I/O data exchange
DP_O_address	Output address in netHOST according to configuration in SYCON.net: • 0 to 5759
DP_bit_offset	Bit offset in corresponding output byte: • 0 to 7 ... Single-point information • 0 to 6 ... Double-point information
DP_data_format	Data format on PROFIBUS: • Byte/Flag [single-point information] • Bit [single-point information] • OFF/ON [double-point information] • ON/OFF [double-point information]
Error_behavior	Output on PROFIBUS-DP if NT = 1 or IV = 1: • Keep value • Output substitute value
Initial_value	After restart of the protocol element this initial value will be sent to PROFIBUS-DP slave. The initial value is output on the PROFIBUS until valid data are available. Valid range of values see *13.10.9 PROFIBUS-DP Data Formats*.
Substitute value	Substitute value if error behavior is set to ***output substitute value***. Valid range of values see *13.10.9 PROFIBUS-DP Data Formats*.

NOTE

The parameters **initial_value**, **substitute_value** and **error_behavior** must be adapted to the requirements of the application!

Supported Data Formats

Format	PROFIBUS-DP data format	IEC 60870-5-101/104 Data format (TI)
BYTE/FLAG	byte/flag	30
1BIT	bit	30
2BIT	OFF/ON	31
2BIT	ON/OFF	31

NOTE

Since the data formats in PROFIBUS-DP are not defined in the output data, the PROFIBUS-DP data format must be specified for the conversion of SICAM A8000 → PROFIBUS-DP. Supported data formats see *13.10.9 PROFIBUS-DP Data Formats*.

Message Conversion

The table describes the evaluated elements of the IEC 60870-5-101/104 message during message conversion.

Elements of the message		
TI .. Type identification		• <TI:=30> .. Single-point information with time tag CP56Time2a • <TI:=31> .. Double-point information with time tag CP56Time2a
CASDU, IOA .. Message address		Parameter-settable
QDS .. Quality descriptor		
BL .. Blocked		Not evaluated
SB .. Substituted		Not evaluated
NT .. Not topical		NT = 1: Depending on the parameter **`error_behavior`**, either the current state is kept or the parameterized substitute value is output.
IV .. Invalid		IV = 1: Depending on the parameter **`error_behavior`**, either the current state is kept or the parameterized substitute value is output.
Cause of transmission		
xx ..		Not evaluated
T .. Test		Not evaluated
Information		
Single-point information status		
SPI	0 .. OFF	Evaluated
	1 .. ON	Evaluated
Double point information state		
DPI	0 .. Indeterminate or intermediate state	Evaluated
	1 .. OFF	Evaluated
	2 .. ON	Evaluated
	3 .. Indeterminate state	Evaluated

Elements of the message	
Time tag	
CP56Time2a .. Date + time	Not rated

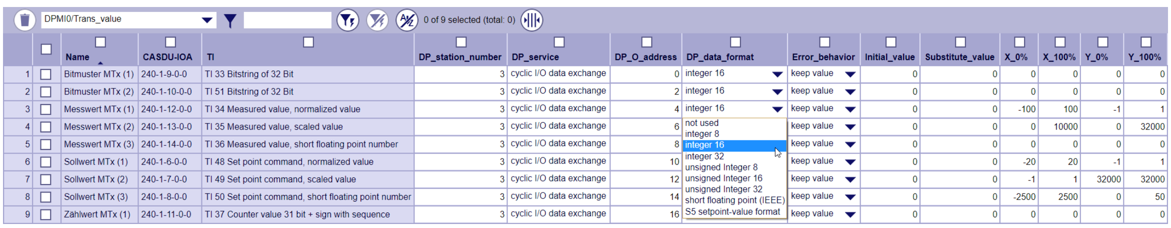
NOTE

Not listed elements of the IEC 60870-5-101/104 message are not rated / not supported!

Measured values, Setpoint values, Integrated Totals, Bitstrings

The parameterization of the address and message conversion for measured values, setpoint values, integrated totals, bitstrings in transmit direction is to be done with the SICAM Device Manager with the function "Signals" or with the SICAM TOOLBOX II, OPM II.

Processing type: *`firmware`* / **`Trans_value`**


DPMI0/Trans_value 0 of 9 selected (total: 0)

	Name	CASDU-IOA	TI	DP_station_number	DP_service	DP_O_address	DP_data_format	Error_behavior	Initial_value	Substitute_value	X_0%	X_100%	Y_0%	Y_100%
1	Bitmuster MTx (1)	240-1-9-0-0	TI 33 Bitstring of 32 Bit	3	cyclic I/O data exchange	0	integer 16	keep value	0	0	0	0	0	0
2	Bitmuster MTx (2)	240-1-10-0-0	TI 51 Bitstring of 32 Bit	3	cyclic I/O data exchange	2	integer 16	keep value	0	0	0	0	0	0
3	Messwert MTx (1)	240-1-12-0-0	TI 34 Measured value, normalized value	3	cyclic I/O data exchange	4	integer 16	keep value	0	0	-100	100	-1	1
4	Messwert MTx (2)	240-1-13-0-0	TI 35 Measured value, scaled value	3	cyclic I/O data exchange	6	not used integer 8	keep value	0	0	0	10000	0	32000
5	Messwert MTx (3)	240-1-14-0-0	TI 36 Measured value, short floating point number	3	cyclic I/O data exchange	8	integer 16	keep value	0	0	0	0	0	0
6	Sollwert MTx (1)	240-1-6-0-0	TI 48 Set point command, normalized value	3	cyclic I/O data exchange	10	integer 32 unsigned Integer 8	keep value	0	0	-20	20	-1	1
7	Sollwert MTx (2)	240-1-7-0-0	TI 49 Set point command, scaled value	3	cyclic I/O data exchange	12	unsigned Integer 16	keep value	0	0	-1	1	32000	32000
8	Sollwert MTx (3)	240-1-8-0-0	TI 50 Set point command, short floating point number	3	cyclic I/O data exchange	14	unsigned Integer 32 short floating point (IEEE)	keep value	0	0	-2500	2500	0	50
9	Zählwert MTx (1)	240-1-11-0-0	TI 37 Counter value 31 bit + sign with sequence	3	cyclic I/O data exchange	16	S5 setpoint-value format	keep value	0	0	0	0	0	0

[DPMI0_DM_Sende_Wert, 2, en_US]

Parameter	
`TI`	Supported type identifications: • <TI:=33> .. Bitstring of 32 bits with time tag CP56Time2a • <TI:=34> .. Measured value, normalized value with time tag CP56Time2a • <TI:=35> .. Measured value, scaled value with time tag CP56Time2a • <TI:=36> .. Measured value, short floating-point number with time tag CP56Time2a • <TI:=37> .. Integrated total with time tag CP56Time2a • <TI:=48> .. Setpoint command, normalized value • <TI:=49> .. Setpoint command, scaled value • <TI:=50> .. Setpoint command, short floating-point number • <TI:=51> .. Bitstring 32-bit
`Name`	Name of the signal
`CASDU-IOA`	SICAM A8000 internal IEC 60870-5-101/104 message address (CASDU1, CASDU2, IOA1, IOA2, IOA3)
`DP_Station_number`	Address of the DP-Slave on the PROFIBUS: • 0 to 99
`DP_service`	PROFIBUS-DP Service: Cyclic I/O data exchange
`DP_O_address`	Output address in netHOST according to configuration in SYCON.net: • 0 to 5759

Parameter	
DP_data_format	Data format on PROFIBUS: • Integer 8 • Integer 16 • Integer 32 • Unsigned integer 8 • Unsigned integer 16 • Unsigned integer 32 • Short floating-point (IEEE 754) • S5 setpoint-value format
Error_behavior	Output on PROFIBUS-DP if NT = 1 or IV = 1: • Keep value • Output substitute value
Initial_value	After restart of the protocol element this initial value will be sent to PROFIBUS-DP slave. The initial value is output on the PROFIBUS until valid data are available. Valid range of values see *13.10.9 PROFIBUS-DP Data Formats*.
Substitute value	Substitute value if error behavior is set to ***output substitute value***. Valid range of values see *13.10.9 PROFIBUS-DP Data Formats*.
X_0%, X_100% **Y_0%, Y_100%**	Parameters for value adaptation (scaling): • <TI:=34, 48> .. **Y_0%** and **Y_100%** must not be greater or less than ±1. • <TI:=35, 49> .. **Y_0%** and **Y_100%** may not be smaller −32768 or greater +32767. • Value adaptation inactive at **Y_0%** and **Y_100%** = 0 Valid range of value for **X_0%** and **X_100%** see *13.10.9 PROFIBUS-DP Data Formats*.

NOTE

The parameters **initial_value**, **substitute_value** and **error_behavior** must be adapted to the requirements of the application!

Supported Data Formats

Format	PROFIBUS-DP data format	IEC 60870-5-101/104 Data format (TI)
INT8	Signed integer 8-bit (7-bit binary + S)	34, 35, 36, 48, 49, 50
INT16	Signed integer 16-bit (15-bit binary + S)	34, 35, 36, 37, 48, 49, 50
INT32	Signed integer 32-bit (31-bit binary + S)	34, 35, 36, 37, 48, 49, 50
UINT8	Unsigned integer 8-bit (8-bit binary)	34, 35, 36, 48, 49.50
UINT16	Unsigned integer 16-bit (16-bit binary)	34, 35, 36, 37, 48, 49, 50
UINT32	Unsigned integer 32-bit (32-bit binary)	33, 34, 35, 36, 37, 48, 49, 50, 51
FLOAT32	Short floating-point (IEEE 754)	34, 35, 36, 37, 48, 49, 50
S5INT12	Simatic S5, 12-bit (11-bit binary + S) "setpoint value - format"	34, 35, 36, 48, 49, 50

NOTE

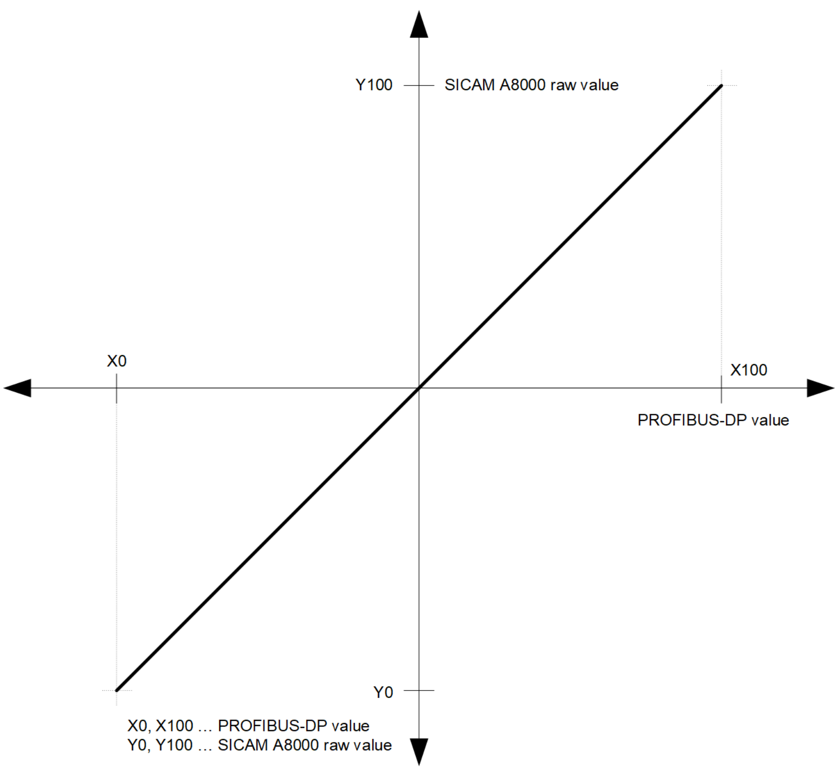
Since the data formats in PROFIBUS-DP are not defined in the output data, the PROFIBUS-DP data format must be specified for the conversion of SICAM A8000 → PROFIBUS-DP. Supported data formats see *13.10.9 PROFIBUS-DP Data Formats*.

Control Location / Control Location Check

The function “Control location” is used so that setpoint values are only output from authorized sources. If the “Control location” function is activated, setpoint commands from the protocol element for PROFIBUS-DP master are only transmitted to the PROFIBUS-DP device when the control location (originator address) is enabled. If the control location is not enabled, the protocol element immediately sends back a negative acknowledgment of activation (ACTCON) to the originator address (further details about setting control location / check control location see section *13.1.4.9 Control location function for commands and setpoint values*).

Value adaptation:[not for <TI:=33, 37, 51>]

The value adaptation is defined by the parameters **`X_0%`**, **`X_100%`**, **`Y_0%`**, **`Y_100%`**.



The value adaptation is only performed if **`Y_0%`** or **`Y_100%`** ≠ *0* is parameterized.

- If the value adaptation is enabled and the SICAM A8000 raw value is less than **`Y_0%`** or greater than **`Y_100%`**, no conversion is carried out and the error message *`Error of format conversion in transmit direction`* is set.

  On PROFIBUS-DP, the last valid value is still output.
- If adaptation is not activated (= direct transfer) and the SICAM A8000 raw value is outside the value range of the selected PROFIBUS-DP data format, then no message conversion is done and the error message *`Error of format conversion in transmit direction`* is set.

  On PROFIBUS-DP, the last valid value is still output.

Message Conversion

The table describes the evaluated elements of the IEC 60870-5-101/104 message during message conversion.

Elements of the message		
TI .. Type identification		• <TI:=33> .. Bitstring of 32 bits with time tag CP56Time2a • <TI:=34> .. Measured value, normalized value with time tag CP56Time2a • <TI:=35> .. Measured value, scaled value with time tag CP56Time2a • <TI:=36> .. Measured value, short floating-point number with time tag CP56Time2a • <TI:=37> .. Integrated total with time tag CP56Time2a • < TI:=48> .. Setpoint command, normalized value • <TI:=49> .. Setpoint command, scaled value • <TI:=50> .. Setpoint command, short floating-point number • < TI:=51> .. Bitstring 32 bit
CASDU, IOA .. Message address		Parameter-settable
QDS .. Quality descriptor		
BL .. Blocked		Not evaluated
SB .. Substituted		Not evaluated
NT .. Not topical		NT = 1: Depending on the parameter **`error_behavior`**, either the current state is kept or the parameterized **`substitute_value`** is output.
IV .. Invalid		IV = 1: Depending on the parameter **`error_behavior`**, either the current state is kept or the parameterized **`substitute_value`** is output.
OV .. Overflow		Not evaluated
Cause of transmission		
06 .. Activation		Is evaluated (only “activation” allowed) [only <TI:=48, 49, 50, 51>]
xx .. Other COTs		Not evaluated [only <TI:=33, 34, 35, 36, 37>]
T .. Test		Not evaluated
Information		
Value.. S .. Sign		• Normalized value • Scaled value • IEEE STD 754 = short floating-point number • Dual meter reading • Bitstring 32 bit
QOS	S/E	[only <TI:=48, 49, 50>]
	0 = Execute	Is checked for “execute”
	1 = Select	Not supported
Time tag		
CP56Time2a .. Date + time		Not evaluated

NOTE

Not listed elements of the IEC 60870-5-101/104 message are not rated/not supported!

13.10.8.2 Message Conversion in Receive Direction (Master ← Slave)

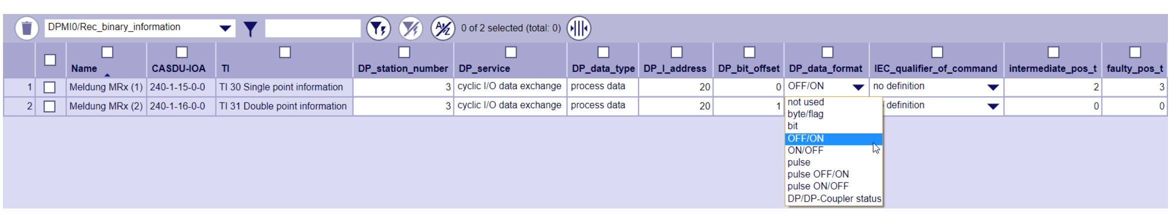
Message Conversion in Receive Direction IEC 60870-5-101/104 ← PROFIBUS-DP

SICAM A8000: IEC 60870-5-101/104 ←		PROFIBUS-DP
TI	**Designation**	**Data format**
<TI:=30>	Single-point information with time tag CP56Time2a	1BIT, BYTE/FLAG, DP/DP STATUS
<TI:=31>	Double-point information with time tag CP56Time2a	2BIT
<TI:=33>	Bitstring of 32 bits with time tag CP56Time2a	INT8, UINT8, INT16, UINT16, INT32, UINT32, FLOAT32, S5INT12S, S5INT13S
<TI:=34>	Measured value, normalized value with time tag CP56Time2a	INT8, UINT8, INT16, UINT16, INT32, UINT32, FLOAT32, S5INT12S, S5INT13S
<TI:=35>	Measured value, scaled value with time tag CP56Time2a	INT8, UINT8, INT16, UINT16, INT32, UINT32, FLOAT32, S5INT12S, S5INT13S
<TI:=36>	Measured value, floating-point number with time tag CP56Time2a	INT8, UINT8, INT16, UINT16, INT32, UINT32, FLOAT32, S5INT12S, S5INT13S
<TI:=37>	Integrated total with time tag CP56Time2a	INT16, UINT16, INT32, UINT32, FLOAT32
<TI:=45>	Single command	1BIT/PULSE
<TI:=46>	Double command	2BIT/PULSE
<TI:=47>	Regulating step command	2BIT/PULSE

Binary information items

The parameterization of the address and message conversion for binary information in receive direction is to be done with the SICAM Device Manager with the function “Signals” or with the SICAM TOOLBOX II, OPM II.

Processing type: *firmware* / `Rec_binary_information`



[DPMI0_DM_Empfang_Binäre_Information, 1, en_US]

Parameter	
`TI`	Supported type identifications: • <TI:=30> .. Single-point information with time tag CP56Time2a • <TI:=31> .. Double-point information with time tag CP56Time2a
`Name`	Name of the signal
`CASDU-IOA`	SICAM A8000 internal IEC 60870-5-101/104 message address (CASDU1, CASDU2, IOA1, IOA2, IOA3)
`DP_Station_number`	Address of the DP-Slave on the PROFIBUS: • 0 to 99

Parameter	
DP_service	PROFIBUS-DP Service: Cyclic I/O data exchange
DP_data_type	Used data type on PROFIBUS: Process data
DP_I_address	Input address in netHOST according to configuration in SYCON.net: • 0 to 5711
DP_bit_offset	Bit number in corresponding input byte: • 0 to 7 ... Single-point information • 0 to 6 ... Double-point information
DP_data_format	Data format on PROFIBUS: • Byte/Flag [single-point information] • Bit [single-point information] • OFF/ON [double-point information] • ON/OFF [double-point information] • DP/DP-Coupler status [only single-point information]
IEC_quali-fier_of_command	IEC qualifier of command: [not relevant]
Intermediate_pos_t	Intermediate position suppression time 0 to 255 s
Faulty_pos_t	Faulty position suppression time: 0 to 255 s

Supported Data Formats

Format	PROFIBUS-DP data format	IEC 60870-5-101/104 Data format (TI)
BYTE/FLAG	byte/flag	30
1BIT	bit	30
DP/DP STATUS	DP/DP-coupler status	30
2BIT	OFF/ON	31
2BIT	ON/OFF	31

NOTE

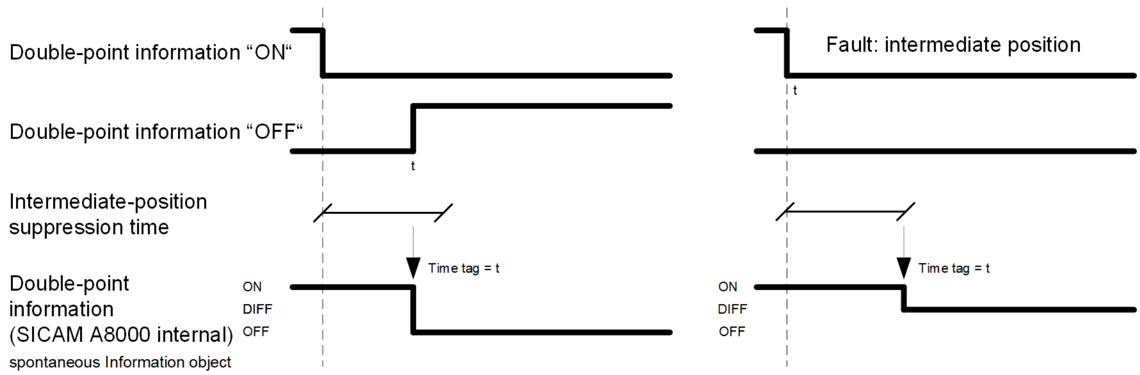
Since the data formats in PROFIBUS-DP are not defined in the input data, the PROFIBUS-DP data format must be specified for the conversion from PROFIBUS-DP → SICAM A8000. Supported data formats see *13.10.9 PROFIBUS-DP Data Formats*.

Monitoring for Intermediate and Faulty Position

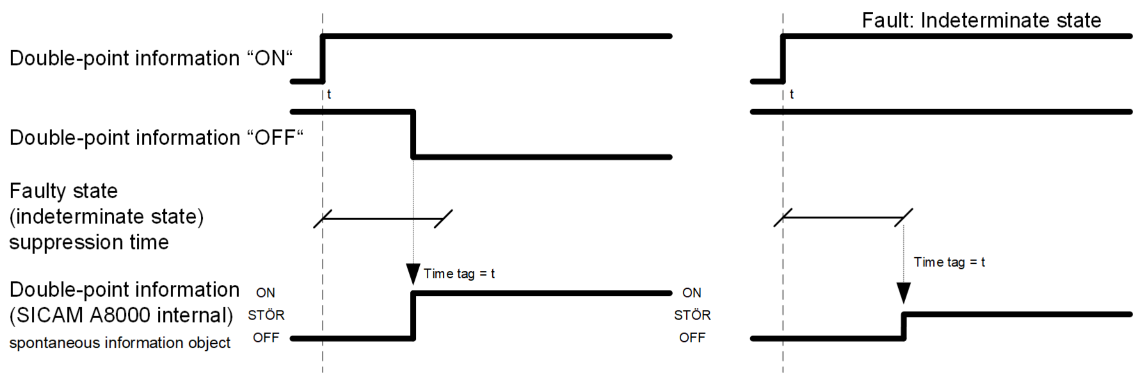
The transfer of an intermediate position (neither ON- nor OFF binary information exists) or a faulty position (both ON- as well as OFF binary information exists) from PRE → BSE is suppressed for a parameterizable time.

For the suppression of the intermediate position an intermediate-position suppression time (parameter **Intermediate_pos_t**) can be parameterized for each double-point information.

For the suppression of the faulty position a faulty position suppression time (parameter **Faulty_pos_t**) can be parameterized for each double-point information.



[Doppelmeldung_Diff, 1, en_US]



[Doppelmeldung_Stoer, 1, en_US]

Message Conversion

The table describes the evaluated elements of the IEC 60870-5-101/104 message during message conversion.

Elements of the message		
TI .. Type identification		• <TI:=30> .. Single-point information with time tag CP56Time2a • <TI:=31> .. Double-point information with time tag CP56Time2a
CASDU, IOA .. Message address		Parameter-settable
QDS .. Quality descriptor		
BL .. Blocked		Not supported (BL = 0)
SB .. Substituted		Not supported (SB = 0)
NT .. Not topical		NT = 1 if DP/DP-Coupler status “data valid = 0” (otherwise NT=0)
IV .. Invalid		Not supported (IV = 0)
Cause of transmission		
03 .. Spontaneous		Upon change of information state or quality descriptor
20 .. Interrogated by station interrogation		Upon reception of a GI request
xx .. Other COTs		Not supported
T .. Test		Not supported
Information		
Single-point information status		
SPI	0 .. OFF	Supported
	1 .. ON	Supported
Double-point information state		

Elements of the message		
DPI	0 .. Indeterminate or intermediate state	Supported
	1 .. OFF	Supported
	2 .. ON	Supported
	3 .. Indeterminate state	Supported
Time tag		
CP56Time2a .. Date + time		protocol-internal time (receive time)

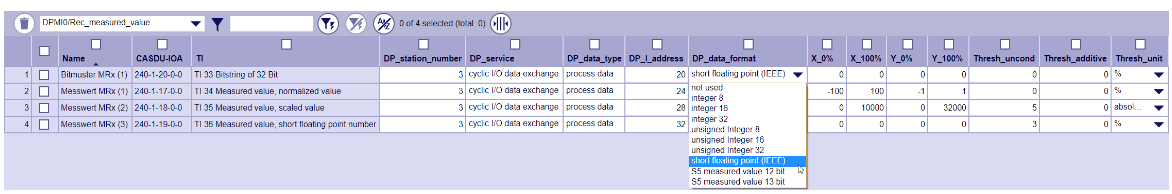
NOTE

Not listed elements of the IEC 60870-5-101/104 message are not rated/not supported!

Measured Values, Bitstrings

The parameterization of the address and message conversion for measured values, bitstrings in receive direction is to be done with the SICAM Device Manager with the function "Signals" or with the SICAM TOOLBOX II, OPM II.

Processing type: *firmware* / **`Rec_measured value`**



[DPMI0_DM_Empfang_Messwert, 2, en_US]

Parameter	
`TI`	Supported type identifications: • <TI:=33> .. Bitstring of 32 bits with time tag CP56Time2a • <TI:=34> .. Measured value, normalized value with time tag CP56Time2a • <TI:=35> .. Measured value, scaled value with time tag CP56Time2a • <TI:=36> .. Measured value, short floating-point number with time tag CP56Time2a
`Name`	Name of the signal
`CASDU-IOA`	SICAM A8000 internal IEC 60870-5-101/104 message address (CASDU1, CASDU2, IOA1, IOA2, IOA3)
`DP_Station_number`	Address of the DP-Slave on the PROFIBUS • 0 to 99
`DP_service`	PROFIBUS-DP Service: Cyclic I/O data exchange
`DP_data_type`	Used data type on PROFIBUS: Process data
`DP_I_address`	Input address in netHOST according to configuration in SYCON.net: • 0 to 5711

Parameter	
DP_data_format	Data format on PROFIBUS: • Integer 8 • Integer 16 • Integer 32 • Unsigned integer 8 • Unsigned integer 16 • Unsigned integer 32 • Short floating-point (IEEE 754) • S5 measured value 12-bit, 13-bit
X_0%, X_100% **Y_0%, Y_100%**	Parameters for value adaptation (scaling): • <TI:=34> .. **Y_0%** and **Y_100%** must not be greater or less than ±1. • <TI:=35> .. **Y_0%** and **Y_100%** may not be smaller −32768 or greater +32767. • Value adaptation inactive at **X_0%** and **X_100%** = 0. Valid range of value for **X_0%** and **X_100%** see *13.10.9 PROFIBUS-DP Data Formats*.
Thresh_uncond	If the value changes > **Thres_uncond**, the value is immediately forwarded to the Basic System Element.
Thresh_additive	If the value changes ≤ **Thres_uncond**, the value is not immediately forwarded to the Basic System Element and an additive change monitoring is performed.
Thresh_unit	• Absolute value [received value from PROFIBUS] • %

Supported Data Formats

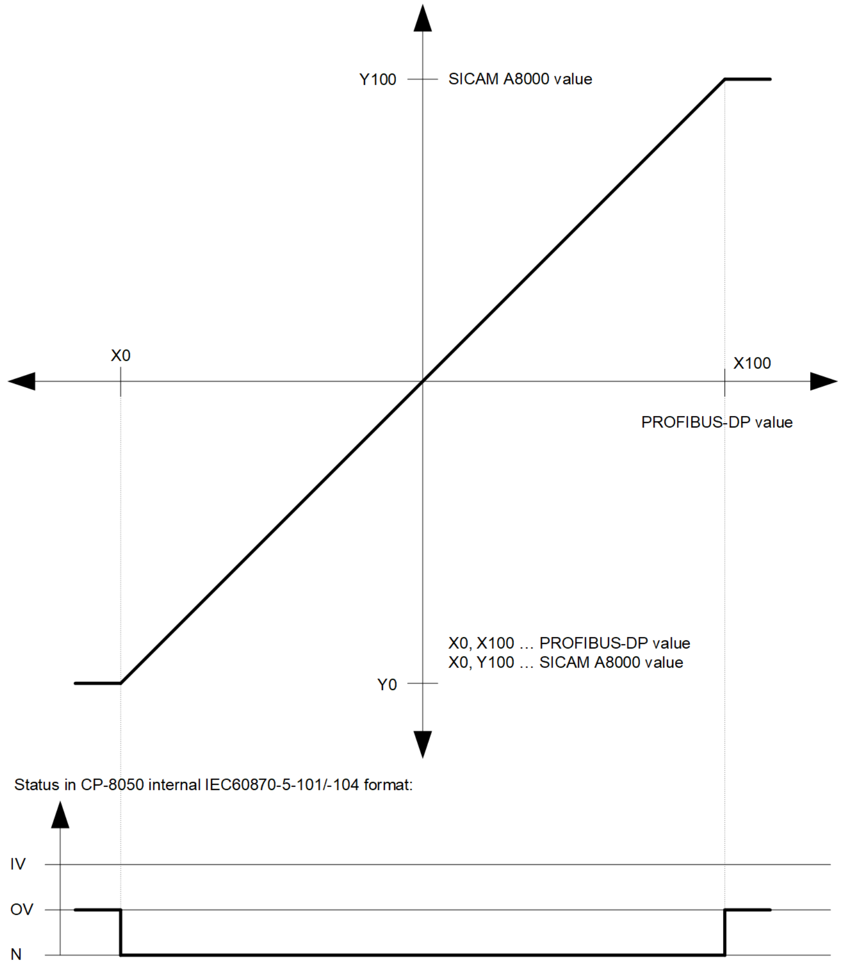
Format	PROFIBUS-DP data format	IEC 60870-5-101/104 Data format (TI)
INT8	Signed integer 8-bit (7-bit binary + S)	33, 34, 35, 36
INT16	Signed integer 16-bit (15-bit binary + S)	33, 34, 35, 36
INT32	Signed integer 32-bit (31-bit binary + S)	33, 34, 35, 36
UINT8	Unsigned integer 8-bit (8-bit binary)	33, 34, 35, 36
UINT16	Unsigned integer 16-bit (16-bit binary)	33, 34, 35, 36
UINT32	Unsigned integer 32-bit (32-bit binary)	33, 34, 35, 36
FLOAT32	Short floating-point (IEEE 754)	33, 34, 35, 36
S5INT12S	Simatic S5, 12-bit (11-bit binary + status + S) measured value - format	33, 34, 35, 36
S5INT13S	Simatic S5, 13-bit (12-bit binary + status + S) measured value - format	33, 34, 35, 36

NOTE

Since the data formats in PROFIBUS-DP are not defined in the input data, the PROFIBUS-DP data format must be specified for the conversion from PROFIBUS-DP → SICAM A8000. Supported data formats see *13.10.9 PROFIBUS-DP Data Formats*.

Value adaptation:[not for <TI:=33>]

The value adaptation is defined by the parameters **`X_0%`**, **`X_100%`**, **`Y_0%`**, **`Y_100%`**.



The value adaptation is only performed if **`X_0%`** or **`X_100%`** ≠ ***0*** is parameterized.

If the PROFIBUS-DP value is outside the value range of the selected IEC 60870-5-101/104 type identifier when the value adaptation is not activated (= direct transfer), then OV = 1 is set.

Message Conversion

The table describes the evaluated elements of the IEC 60870-5-101/104 message during message conversion.

Elements of the message	
TI .. Type identification	• <TI:=33> .. Bitstring of 32 bits with time tag CP56Time2a • <TI:=34> .. Measured value, normalized value with time tag CP56Time2a • <TI:=35> .. Measured value, scaled value with time tag CP56Time2a • <TI:=36> .. Measured value, short floating-point number with time tag CP56Time2a
CASDU, IOA .. Message address	Parameter-settable
QDS .. Quality descriptor	
BL .. Blocked	Not supported (BL = 0)
SB .. Substituted	Not supported (SB = 0)
NT .. Not topical	NT = 1 if DP/DP-Coupler status “data valid = 0” (otherwise NT=0)

Elements of the message	
IV .. Invalid	IV = 1 at: • FLOAT32 format with the value = NAN (Not A Number) • S5INT12S, S5INT13S with F = 1 (open-circuit) (otherwise IV = 0)
OV .. Overflow	OV = 1 <u>Without value adaptation:</u> • PROFIBUS-DP value outside the range of the selected type identification <u>With value adaptation:</u> • PROFIBUS-DP value less than X_0% or greater X_100% • S5INT12S, S5INT13S with Ü = 1 (overflow)
Cause of transmission	
03 .. Spontaneous	Alteration of the measured value depending on the thresholds or alteration of the quality descriptor
20 .. Interrogated by station interrogation	Upon reception of a GI request
xx .. Other COTs	Not supported
T .. Test	Not supported
Information	
Value.. S .. Sign	• Normalized value • Scaled value • IEEE STD 754 = short floating-point number • Bitstring 32 bit
Time tag	
CP56Time2a .. Date + time	Not evaluated

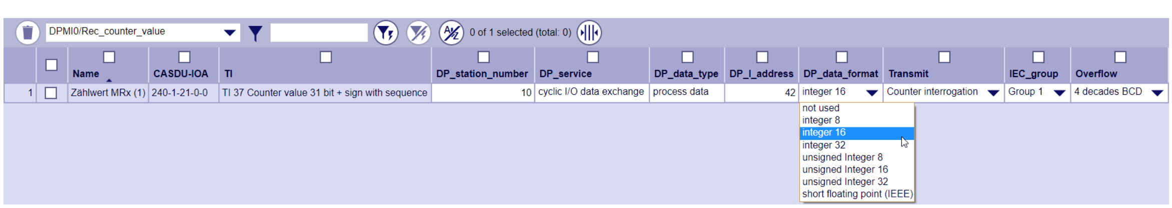
NOTE

Not listed elements of the IEC 60870-5-101/104 message are not rated/not supported!

Integrated Totals

The parameterization of the address and message conversion for integrated totals in receive direction is to be done with the SICAM Device Manager with the function “Signals” or with the SICAM TOOLBOX II, OPM II.

Processing type: *`firmware`* / **`Rec_counter value`**



[DPMI0_DM_Empfang_Zaehlwert, 2, en_US]

Parameter	
`TI`	Supported type identifications: • <TI:=37> .. Integrated total with time tag CP56Time2a
`Name`	Name of the signal
`CASDU-IOA`	SICAM A8000 internal IEC 60870-5-101/104 message address (CASDU1, CASDU2, IOA1, IOA2, IOA3)
`DP_Station_number`	Address of the DP-Slave on the PROFIBUS: • 0 to 99
`DP_service`	PROFIBUS-DP Service: Cyclic I/O data exchange
`DP_data_type`	Used data type on PROFIBUS: Process data
`DP_I_address`	Input address in netHOST according to configuration in SYCON.net: • 0 to 5711
`DP_data_format`	Data format on PROFIBUS: • Integer 8 • Integer 16 • Integer 32 • Unsigned integer 8 • Unsigned integer 16 • Unsigned integer 32 • Short floating-point (IEEE 754)
`Transmit`	Counter transmission at: • Counter interrogation • Cyclically every 1, 2, 3, 5, 10, 15, 30, 60 minutes
`IEC_group`	IEC 60870-5-101/104 counter group: • Group 1 to 4
`Overflow`	Overflow treatment at: • 24, 31 bit integer • 2, 3, 4, 5, 6, 7, 8, 9 decades BCD

Supported Data Formats

Format	PROFIBUS-DP data format	IEC 60870-5-101/104 Data format (TI)
INT8	Signed integer 8-bit (7-bit binary + S)	37
INT16	Signed integer 16-bit (15-bit binary + S)	37
INT32	Signed integer 32-bit (31-bit binary + S)	37
UINT8	Unsigned integer 8-bit (8-bit binary)	37
UINT16	Unsigned integer 16-bit (16-bit binary)	37
UINT32	Unsigned integer 32-bit (32-bit binary)	37
FLOAT32	Short floating-point (IEEE 754)	37

NOTE

Since the data formats in PROFIBUS-DP are not defined in the input data, the PROFIBUS-DP data format must be specified for the conversion from PROFIBUS-DP → SICAM A8000. Supported data formats see *13.10.9 PROFIBUS-DP Data Formats*.

Message Conversion

The table describes the evaluated elements of the IEC 60870-5-101/104 message during message conversion.

Elements of the message	
TI .. Type identification	• <TI:=37> .. Integrated total with time tag CP56Time2a
CASDU, IOA .. Message address	Parameter-settable
Data point quality descriptor	
Sequence number	With each trigger for latching for a group the sequence number is increased in the range from 1 to 31.
CY .. Carry	On overflow of the count in the associated count period
CA .. Presets	Not supported
IV .. Invalid	IV = 1 if DP/DP-Coupler status “data valid = 0” (otherwise IV = 0)
Cause of transmission	
03 .. Spontaneous	When transmitting = periodical data transfer
37 .. Requested by general counter interrogation	For general request counter (all counter groups)
38 to 41 .. Interrogated by group 1 to 4 interrogation	For request counter group (1 to 4)
T .. Test	Not supported
Information	
Value.. S .. Sign	Dual meter reading
Time tag	
CP56Time2a .. Date + time	Not evaluated

NOTE

Not listed elements of the IEC 60870-5-101/104 message are not rated/not supported!

Message Conversion Counter Interrogation Command (SICAM A8000 internal only)

The table describes the evaluated elements of the IEC 60870-5-101/104 message during message conversion.

<table>
<tr><th colspan="3">Elements of the message</th></tr>
<tr><td colspan="2">TI .. Type identification</td><td>• <TI:=101> .. Counter interrogation command</td></tr>
<tr><td colspan="2">CASDU, IOA .. Message address</td><td>Defined</td></tr>
<tr><td colspan="2">QCC .. Identifier counter interrogation</td><td></td></tr>
<tr><td>FRZ</td><td>RQT</td><td>FRZ ... Freeze
RQT ... Request</td></tr>
</table>

Elements of the message		
0	1 to 4	Read (no freeze or reset) Counter interrogation (1 to 4)
	5	Read (no freeze or reset) General counter interrogation
1	1 to 4	Counter freeze without reset Request counter group (1 to 4)
	5	Counter freeze without reset All counter groups
2	1 to 4	Counter freeze with reset Request counter group (1 to 4)
	5	Counter freeze without reset All counter groups
3	1 to 4	Reset counter Request counter group (1 to 4)
	5	Reset counter All counter groups
x	0; 6 to 63	Not supported
Cause of transmission		
06 .. Activation		Is evaluated (only “activation” allowed)
xx .. Other COTs		Not supported
T .. Test		Not supported

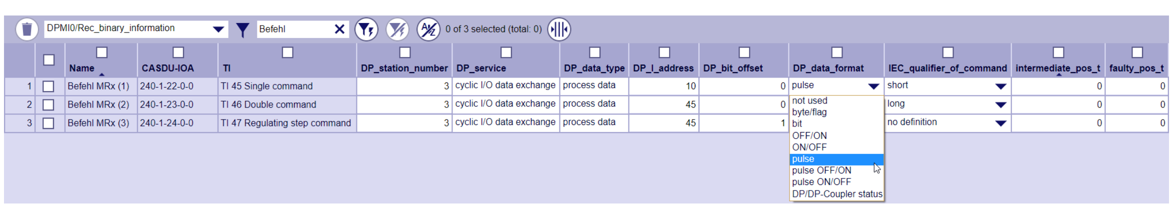
NOTE

Not listed elements of the IEC 60870-5-101/104 message are not rated/not supported!

Commands

The parameterization of the address and message conversion for commands in receive direction is to be done with the SICAM Device Manager with the function “Signals” or with the SICAM TOOLBOX II, OPM II.

Processing type: *firmware* / **`Rec_binary_information`**



[DPMI0_DM_Empf_Binaere_Information_Befehle_GER, 1, en_US]

Parameter	
`TI`	Supported type identifications: • <TI:=45> .. Single command • <TI:=46> .. Double command • <TI:=47> .. Regulating step command
`Name`	Name of the signal
`CASDU-IOA`	SICAM A8000 internal IEC 60870-5-101/104 message address (CASDU1, CASDU2, IOA1, IOA2, IOA3)

Parameter	
`DP_Station_number`	Address of the DP-Slave on the PROFIBUS: • 0 to 99
`DP_service`	PROFIBUS-DP Service: Cyclic I/O data exchange
`DP_data_type`	Used data type on PROFIBUS: Process data
`DP_I_address`	Input address in netHOST according to configuration in SYCON.net: • 0 to 5711
`DP_bit_offset`	Bit number in corresponding input byte: • 0 to 7 ... Single command • 0 to 6 ... Double command or regulating step command
`DP_data_format`	Data format on PROFIBUS: • pulse [single command] • pulse OFF/ON [double-/regulating step command] • pulse ON/OFF [double-/regulating step command]
`IEC_qualifier_of_command`	IEC qualifier of command: • none • short • long
`Intermediate_pos_t`	not relevant for commands
`Faulty_pos_t`	not relevant for commands

Supported Data Formats

Format	PROFIBUS-DP data format	IEC 60870-5-101/104 Data format (TI)
1BIT/PULSE	pulse	45
2BIT PULSE	pulse OFF/ON	46, 47
2BIT PULSE	pulse ON/OFF	46, 47

NOTE

Since the data formats in PROFIBUS-DP are not defined in the input data, the PROFIBUS-DP data format must be specified for the conversion from PROFIBUS-DP → SICAM A8000. Supported data formats see *13.10.9 PROFIBUS-DP Data Formats*.

Commands in Receive Direction

Commands from PROFIBUS-DP Slaves → SICAM A8000 must be transmitted as a “1-bit pulse” or as a “2-bit pulse” with a limited pulse duration. The processing of commands by the protocol element is edge-triggered; only the positive edge is evaluated.

The impulse transmission in commands is necessary to prevent unwanted actions possible by the transmission of states after power UP.

Command output time

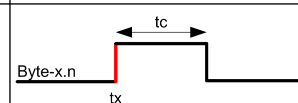
The command output time (= qualifier of command) is selectively assigned to each command in the IEC Command ID field:

- none ... <0> “no additional definition”
- short .... <1> “short command execution time”
- long .... <2> “long command execution time”

Single command

A pulse with a positive edge in the PROFIBUS-DP input data is converted to an IEC 60870-5-101/104 single command with the status SCS = ON.

The negative edge is not evaluated; the duration of the pulse is not monitored.

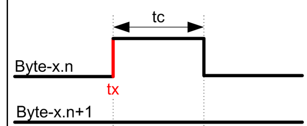
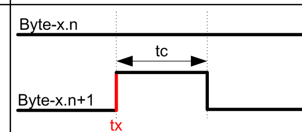
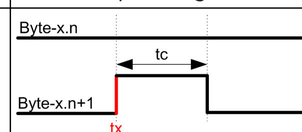
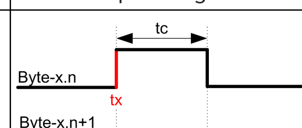
PROFIBUS-DP data format	Command state	Command pulse (1 bit in input range)
pulse	SCS = ON	 tc ... command output time (pulse duration at PROFIBUS) tx ... single command with pos. edge
	SCS = OFF	The OFF state is not evaluated!

Double command / Regulating step command

A pulse with a positive edge in the PROFIBUS-DP input data is converted to an IEC 60870-5-101/104 double command or regulating step command with the status DCS = ON/OFF or RCS = HIGHER/LOWER.

The negative edge is not evaluated; the duration of the pulse is not monitored.

PROFIBUS-DP data format	Command state	DP_I_address
pulse ON/OFF	ON	parameterized DP_I_address; bit offset
	OFF	parameterized DP_I_address; bit offset + 1
pulse OFF/ON	ON	parameterized DP_I_address; bit offset + 1
	OFF	parameterized DP_I_address; bit offset

PROFIBUS-DP data format	**Command state**	**Command pulse** (2 bit in input range)
pulse ON/OFF	DCS = ON RCS = HIGHER	 tc ... command output time (pulse dura-tion at PROFIBUS) tx ... Double command / regulating step command with pos. edge
	DCS = OFF RCS = LOWER	 tc ... command output time (pulse dura-tion at PROFIBUS) tx ... Double command / regulating step command with pos. edge
pulse OFF/ON	DCS = ON RCS = HIGHER	 tc ... command output time (pulse dura-tion at PROFIBUS) tx ... Double command / regulating step command with pos. edge
	DCS = OFF RCS = LOWER	 tc ... command output time (pulse dura-tion at PROFIBUS) tx ... Double command / regulating step command with pos. edge

Message Conversion

The table describes the evaluated elements of the IEC 60870-5-101/104 message during message conversion.

Elements of the message		
TI .. Type identification		• <TI:=45> .. Single command • <TI:=46> .. Double command • <TI:=47> .. Regulating step command
CASDU, IOA .. Message address		Parameter-settable
Cause of transmission		
06 .. Activation		Supported
xx .. Other COTs		Not supported
T .. Test		Not supported
Information		
SCO/DCO/RCO		
SCS	Single command state	[only <TI:=45>]
	0 .. OFF	Not supported
	1 .. ON	Supported
DCS	Double command state	[only <TI:=46>]
	0 .. Not allowed	Not supported
	1 .. OFF	Supported
	2 .. ON	Supported
	3 .. Not allowed	Not supported
RCS	Regulating step command state	[only <TI:=47>]
	0 .. Not allowed	Not supported
	1 .. Next step lower	Supported
	2 .. Next step higher	Supported
	3 .. Not allowed	Not supported
QOC	S/E	
	0 = Execute	Supported
	1 = Select	Not supported
QU	Command qualifier	
	0 .. No additional definitions	Supported
	1 .. Short pulse duration	Supported
	2 .. Long pulse duration	Supported
	3 .. Persistent command	Not supported

NOTE

Not listed elements of the IEC 60870-5-101/104 message are not rated/not supported!

13.10.9 PROFIBUS-DP Data Formats

Supported PROFIBUS-DP data formats:

Format #	Format	Designation
General formats		
1	1BIT	1 bit (ON, OFF)

Format #	Format	Designation
2	1BIT/PULSE	1 bit (ON, OFF) OFF controlled by PRE after timeout (command output time)
3	2BIT	2 Bit (ON, OFF) (OFF before ON or ON before OFF)
4	2BIT/PULSE	2 Bit (ON, OFF) (OFF before ON or ON before OFF) OFF controlled by PRE after timeout (command output time)
5	BYTE/FLAG	8-Bit binary (0 = OFF, <> 0 = ON)
6	INT8	Signed integer 8-bit (7-bit binary + S)
7	UINT8	Unsigned integer 8-bit (8-bit binary)
8	INT16	Signed integer 16-bit (15-bit binary + S)
9	UINT16	Unsigned integer 16-bit (16-bit binary)
10	INT32	Signed integer 32-bit (31-bit binary + S)
11	UINT32	Unsigned integer 32-bit (32-bit binary)
12	FLOAT32	Short floating-point (IEEE 754)
Device specific formats		
100	S5INT12	Simatic S5, 12 Bit (11 Bit binary + S) “setpoint value - format“
101	S5INT12S	Simatic S5, 12 Bit (11 Bit binary + status + S) “measured value - format“
102	S5INT13S	Simatic S5, 13 Bit (12-bit binary + status + S) "measured value format"
110	DP/DP STATUS	DP/DP-Coupler status; 1 Bit (“Data Valid” Indication)

NOTE

Data formats larger than 1 Byte are always displayed/transmitted in "Big Endian" (HIGH before LOW order).

Format-1: 1BIT

Single-point information (bit) in Input/Output Byte. Reference: Offset= x / Bit#=n (0-7).

Value range: 0, 1
<0> = OFF
<1> = ON

Format-2: 1BIT/Impulse

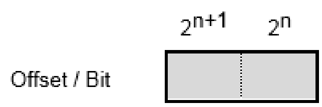
Pulse command in Output Byte. Reference: Offset = x / Bit# = n (0 to 7).

Value range: 0, 1
<0> = OFF
<1> = ON

Note: After expiration of the command output time, the state is set to OFF by the PRE.

Format-3: 2BIT – OFF/ON, ON/OFF

2 adjacent Bits in the Input/Output byte. Reference: Offset = x / Bit# = n (0 to 6), Bit# = n+1 (1 to 7).
Note: The 2 bits must always be in the same Input/Output Byte.



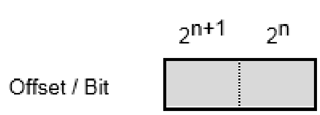
Value range: 0 to 3

Assignment: 2BIT - OFF/ON
<0> = Indeterminate or intermediate state
<1> = OFF
<2> = ON
<3> = Indeterminate state

Assignment: 2BIT- ON/OFF
<0> = Indeterminate or intermediate state
<1> = ON
<2> = OFF
<3> = Indeterminate state

Format-4: 2BIT/Pulse – OFF/ON, ON/OFF

2 adjacent bits (pulse command) in the Input/Output byte. Reference: Offset = x / Bit# = n (0 to 6), Bit# = n+1 (1 to 7).
Note: The 2 bits must always be in the same Input/Output Byte.



Value range: 0 to 3

Assignment: 2BIT/PULSE-OFF/ON
<0> = inactive
<1> = OFF
<2> = ON
<3> = Not allowed

Assignment 2BIT/PULSE-ON/OFF
<0> = inactive
<1> = ON
<2> = OFF
<3> = Not allowed

Note: After expiration of the command output time in transmit direction, the state is set to "inactive" by the PRE.

Format-5: BYTE/FLAG (8 Bit binary)

	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
Offset = x+0	2^7							2^0

Value range: 0 to 255
Assignment:
<00> = OFF
<01 to 255> = ON

Format-6: INT8 – Unsigned Integer 8-Bit (7-Bit Binary + S)

	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
Offset = x+0	S	2^6						2^0

Value range: –128 0 to +127
Sign (S): 0 = "+", 1 = "-"
Note: Negative values are represented in two's complement.

Format-7: UINT8 – Unsigned Integer 8-Bit (8-Bit Binary)

	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
Offset = x+0	2^7							2^0

Value range: 0 to 255

Format-8: INT16 – Unsigned Integer 16-Bit (15-Bit Binary + S)

	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
Offset= x+0	S	2^{14}						2^8
Offset = x+1	2^7							2^0

Value range: –32768 0 to +32767
Sign (S): 0 = "+", 1 = "-"
Note: Negative values are represented in two's complement.

Format-9: UINT16 – Unsigned Integer 16-Bit (16-Bit Binary)

	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
Offset= x+0	2^{15}							2^8
Offset = x+1	2^7							2^0

Value range: 0 to 65535

Format-10: INT32 – Unsigned Integer 32-Bit (31-Bit Binary + S)

	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
Offset = x+0	S	2^{30}						2^{24}
Offset = x+1	2^{23}							2^{16}
Offset = x+2	2^{15}							2^8
Offset = x+3	2^7							2^0

Value range: -2 147 483 648 to 0 to +2 147 483 647
Sign (S): 0 = "+", 1 = "-"
Note: Negative values are represented in two's complement.

Format-11: UINT32 – Unsigned Integer 32-Bit (32-Bit Binary)

	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
Offset = x+0	2^{31}							2^{24}
Offset = x+1	2^{23}							2^{16}
Offset = x+2	2^{15}							2^8
Offset = x+3	2^7							2^0

Value range: 0 to 4 294 967 295

Format-12: FLOAT32 – Short Floating-Point (IEEE 754)

The format complies with the IEEE 754 floating - point format specification.

	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0	
Offset = x+0	S	2^7						2^1	Exponent, S
Offset = x+1	2^0	2^{-1}						2^{-7}	Mantissa
Offset = x+2	2^{-8}							2^{-15}	Mantissa
Offset = x+3	2^{-16}							2^{-23}	Mantissa

Value range: $1 \cdot 10^{-38}$ to ~ $3{,}4 \cdot 10^{38}$
Sign (S): <0> = "+", <1> = "-"
Exponent: <255> = "NaN" (not a number) or ∞

Format-100: S5INT12 – Simatic S5, 12 Bit (11 Bit binary + S) “setpoint value format“

	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
Offset= x+0	S	2^{10}						2^4
Offset = x+1	2^3			2^0	0	0	0	0

Value range: –2048 0 to +2047
Sign (S): 0 = "+", 1 = "-"
Note: Negative values are represented in two's complement.

Format-101: S5INT12S – Simatic S5, 12-Bit (11-Bit Binary + State + S) "Measured value format"

	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
Offset= x+0	S	2^{10}						2^4
Offset = x+1	2^3			2^0	X	X	E	O

Value range: -2048 to 0 to +2047
Sign (S): 0 = "+", 1 = "-"
Note: Negative values are represented in two's complement.

Status: E .... Error bit ("open-circuit")
O .... Overflow bit
X .... not used (=0)

Format-102: S5INT13S – Simatic S5, 13-Bit (12-Bit Binary + State + S) "Measured value format"

	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
Offset= x+0	S	2^{11}						2^5
Offset = x+1	2^4				2^0	X	E	O

Value range: –4096 0 to +4095
Sign (S): 0 = "+", 1 = "-"
Note: Negative values are represented in two's complement.

Status: E .... Error bit ("open-circuit")
O .... Overflow bit
X .... not used (=0)

Format-110: DP/DP STATUS

This bit indicates the validity of the process data received from the entire slave (e.g. Siemens DP/DP-coupler). Single-point information (bit) in Input Byte. Reference: Offset = x / Bit# = n (0 to 7).

Value range: 0, 1
<0> = Data not valid
<1> = Data valid

13.11 PROFINET-IO

13.11.1 Introduction

The PROFINET-IO protocol is a Ethernet based field bus protocol for connecting PROFINET-IO field devices. To connect PROFINET-IO field devices, the external field bus gateway Hilscher netHOST NHST-T100-EN/PNM is required as a PROFINET-IO master.

Protocol firmware for PROFINET-IO:

Firmware	System	Standard and function
PNMI0	CP-8031, CP-8050	PROFINET-IO Master ("Controller")

PROFINET-IO (Process Field Network) is the open Industrial Ethernet standard of the PROFINET-IO user organization for automation. PROFINET-IO uses TCP/IP and IT standards, is real-time Ethernet-capable and enables the integration of field bus systems.

PROFINET-IO defines the following devices:

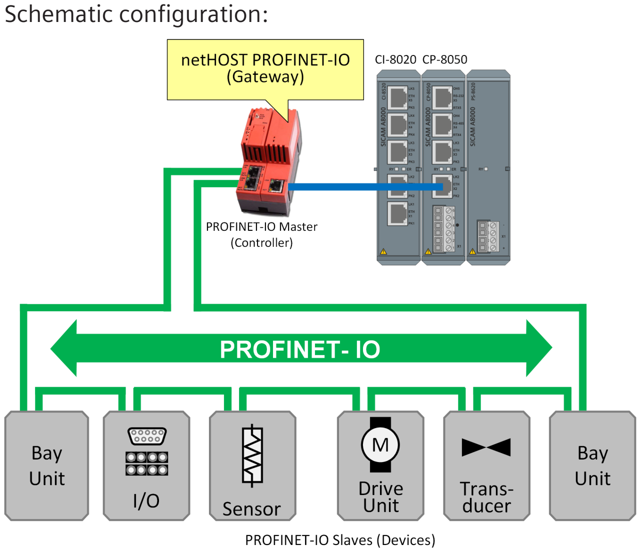
- PROFINET-IO Master (=Controller)
- PROFINET-IO Slave (=Device)

The protocol element for PROFINET-IO in conjunction with the external field bus gateway netHOST supports the function for “PROFINET-IO master” according to IEC 61158 Type 10 “PROFINET” for PROFINET IO RT_Class_1: unsynchronized communication.

The field bus gateway netHOST is connected to the CP-8031, CP-8050 or CI-8520 via a LAN interface (Ethernet/fibre optics).

The PROFINET-IO cabling between netHOST and the PROFINET IO devices takes place with suitable Ethernet cables. For PROFINET-IO configurations, Ethernet switches suitable for PROFINET can also be used.

Schematic configuration:



13.11.2 Functions

Function	PNMI0
PROFINET-IO master interface with external field bus gateway	
Field bus gateway: Hilscher netHOST NHST-T100-EN/PNM (=PROFINET-IO Master)	✓
PROFINET-IO according to IEC 61158 Type 10 “PROFINET”	✓
PROFINET-IO RT_Class_1: unsynchronized communication (usual communication with PROFINET)	✓
Max. number of supported data points	2000
Network configuration	
Max. number PROFINET-IO devices	100
Max. number PROFINET-IO devices “recommendation”	30-50
PROFINET-IO Line	✓
PROFINET-IO Star (with ext. PROFINET-Switch)	✓
PROFINET-IO Ring (with MRP-Manager)	✓
Max. number PROFINET-IO devices in the ring	50
Physical interface	
Interface between CP-8031, CP-8050 ↔ Field bus Gateway (netHOST):	
• Fast Ethernet 100 Mbit/s, IEEE 802.3, 100Base TX, electrical	✓
Interface between field bus gateway (netHOST) ↔ PROFINET-IO Slaves:	
• Fast Ethernet 100 Mbit/s, IEEE 802.3, 100Base TX, electrical	✓
Communication protocol between CP-8031, CP-8050 ↔ Field bus Gateway (netHOST)	
Hilscher Marshaller Protocol (TCP/IP): Port#: 50111	✓
Request/Response Services	✓
Communication protocol between field bus gateway (netHOST) ↔ PROFINET-IO Slaves:	
PROFINET-IO	✓
Data acquisition from the PROFINET-IO slaves (data read from the field bus gateway)	
cyclic (cycle time for data exchange) = 10 - 1000 ms (the cycle time of the data acquisition between the protocol element and netHOST is independent of the cycle time on the PROFINET-IO)	✓
Command transmission to the PROFINET-IO slaves	
spontaneous/cyclical Commands are transmitted as impulse on the PROFINET-IO. (the positive edge of the pulse is transmitted spontaneously, the negative edge is transmitted in cyclic data exchange after the command output time has expired)	✓
• Control location function (set/check control location)	✓
• Emulation of ACTCON for commands and setpoint values (according IEC 60870-5-101/104)	✓
• Emulation of ACTCON- for commands and setpoint values (according IEC 60870-5-101/104), when a command or setpoint value is discarded from an unreleased control location.	✓
• Emulation of ACTTERM for commands and setpoint values (according IEC 60870-5-101/104)	–

Function	PNMI0
Supported PROFINET-IO data formats in transmit direction (command or control direction)	
1BIT	✓
2BIT	
1BIT/PULSE	
2BIT/PULSE	
BYTE/FLAG	
INT8	
UINT8	
INT16	
UINT16	
INT32	
UINT32	
FLOAT32	
S5INT12S	
Supported PROFINET-IO data formats in receive direction (signaling or monitoring direction)	
1BIT	✓
2BIT	
1BIT/PULSE	
2BIT/PULSE	
BYTE/FLAG	
INT8	
UINT8	
INT16	
UINT16	
INT32	
UINT32	
FLOAT32	
S5INT12S	
S5INT13S	

Function	PNMI0
Supported IEC60870-5-101/104 data formats in transmit direction (command or control direction)	
TI 30 .. Single-point information with time tag CP56Time2a	✓
TI 31 .. Double-point information with time tag CP56Time2a	
TI 33 .. Bitstring of 32 bits with time tag CP56Time2a	
TI 34 .. Measured value, normalized value with time tag CP56Time2a	
TI 35 .. Measured value, scaled value with time tag CP56Time2a	
TI 36 .. Measured value, short floating-point number with time tag CP56Time2a	
TI 37 .. Integrated total with time tag CP56Time2a	
TI 45 .. Single command	
TI 46 .. Double command	
TI 47 .. Regulating step command	
TI 48 .. Setpoint command, normalized value	
TI 49 .. Setpoint command, scaled value	
TI 50 .. Setpoint command, short floating-point number	
TI 51 .. Bitstring of 32-bit	
TI 100 .. (General) Interrogation command	
TI 101 .. Counter interrogation command	
Supported IEC 60870-5-101/104 data formats in receive direction (signaling or monitoring direction)	
TI 30 .. Single-point information with time tag CP56Time2a	✓
TI 31 .. Double-point information with time tag CP56Time2a	
TI 33 .. Bitstring of 32 bits with time tag CP56Time2a	
TI 34 .. Measured value, normalized value with time tag CP56Time2a	
TI 35 .. Measured value, scaled value with time tag CP56Time2a	
TI 36 .. Measured value, short floating-point number with time tag CP56Time2a	
TI 37 .. Integrated total with time tag CP56Time2a	
TI 45 .. Single command	
TI 46 .. Double command	
TI 47 .. Regulating step command	
Redundancy(functions for supporting redundant communication routes)	
PROFINET System redundancy	–
Protocol redundancy	✓
Protocol element control and return information	
Protocol element control messages:	
• Set control location	✓
Protocol element return information:	
• Station status	✓
• Station failure	✓
Web server	
Protocol-internal diagnostic and statistic information via protocol-specific web pages	✓

Function	PNMI0
Engineering	
Hilscher SYCON.net (for the parametrization of PROFIBUS-IO and netHOST)	✓
SICAM Device Manager	✓
SICAM TOOLBOX II	✓

Restrictions

- PN System redundancy according to PROFINET specification is not supported.
- PROFINET-IO communication according to PROFINET CBA (Component Based Automation) is not supported.
- PROFINET-IO communication according to PROFINET RT_Class_3 (synchronized communication with highest precision) is not supported.
- PROFINET-IO slave (= device) function is not supported.
- Replicas of ACTERM for commands / setpoint values / integrated totals according to IEC 60870-5-101/104 is not supported.
- “Select-Before-Operate” for commands/setpoint values is not supported.
- The parameterized cycle time for the data exchange between CP-8031, CP-8050 and netHOST cannot always be observed. (The processing time depends on the number of parameterized data points and the number of data changes).
- The output of information transients in transmit direction on the PROFINET-IO slave cannot be guaranteed due to the cyclic data exchange.
- The acquisition of information transients in receive direction on the PROFINET-IO slave cannot be guaranteed due to the cyclic data exchange.
- Commands in Receive Direction (PROFIBUS-IO→CP-8031, CP-8050) must be transmitted as impulses to the PROFINET-IO (= edge-triggered evaluation) so that no undesired actions are triggered (undesired actions possible with status transmission after Power UP).
- Suppression of intermediate and faulty position for double-point information in receive direction is not supported.
- Diagnostic / alarm information according to PROFINET-IO is not supported.
- All data formats on the PROFINET-IO are treated in “Big Endian” representation.

NOTE

- Only PROFINET-suitable switches or other network components may be used!
- No other Ethernet-based communication protocols should be used on the network for PROFINET!

13.11.3 Modes of Operation

The operating mode of the interface is determined by parameters of the protocol element and optional equipment.

Standard Operation Mode	Optional equipment	Interface signals (X2, X3)
Electrical Ethernet interface (Twisted Pair)	Hilscher netHOST	TXD+, TXD-, RXD+, RXD-
Optical Ethernet interface (Fiber optic)	Media converter or switch (on both sides) + Hilscher netHOST	TXD+, TXD-, RXD+, RXD-

Standard Operation Mode		Interface Signals on Hilscher netHOST
PROFINET-IO Interface (from netHOST to the PROFIBUS-IO Slaves)	-	RXD/TXD-P, RXD/TXD-N, DGND

13.11.4 Communication

For the stations to communicate with each other, suitable transmission facilities and/or network components may be needed in addition.

Own Station "PROFINET-IO Master" (master station)

System	System element	Protocol Element	Remarks
SICAM A8000 Series	CP-8031/CPCI85 CP-8050/CPCI85 CP-8050/EPCI85	PNMI0	The directly connected remote station is the field bus gateway Hilscher netHOST NHST-T100-EN/PNM. The field bus gateway assumes the function of the PROFINET IO master (= controller) on PROFINET. Max. 100 PROFINET-IO Slaves can be connected or max. 50 in MRP ring configuration.

Remote Station "PROFINET-IO Slave" (remote station)

System	System element	Protocol Element	Remarks
Siemens PROFINET-IO Slave devices	-	-	according to PROFINET-IO standard. Supported data formats according to *13.11.9 PROFINET-IO Data formats*
Third-party system	-	-	according to PROFINET-IO standard. Supported data formats according to *13.11.9 PROFINET-IO Data formats*

13.11.5 Communication according to PROFINET-IO

PROFINET-IO (Process Field Network) is the open Industrial Ethernet standard of the PROFINET-IO user organization for automation. PROFINET-IO uses TCP/IP and IT standards, is real-time Ethernet-capable and enables the integration of field bus systems.

PROFINET-IO defines the following devices:

- PROFINET-IO Master (=Controller)
- PROFINET-IO Slave (=Device)

The protocol element for PROFINET-IO in CP-8050 in conjunction with the external field bus gateway netHOST supports the function for "PROFINET IO master" according to IEC 61158 Type 10 "PROFINET" for PROFINET IO RT_Class_1: unsynchronized communication.

The field bus gateway netHOST is connected to the CP-8531, CP-8050 or CI-8520 via a LAN interface (Ethernet/fibre optics). The configuration for PROFIBUS-IO Master in netHOST is carried out with the Windows-based software "SYCON.net" by Hilscher.

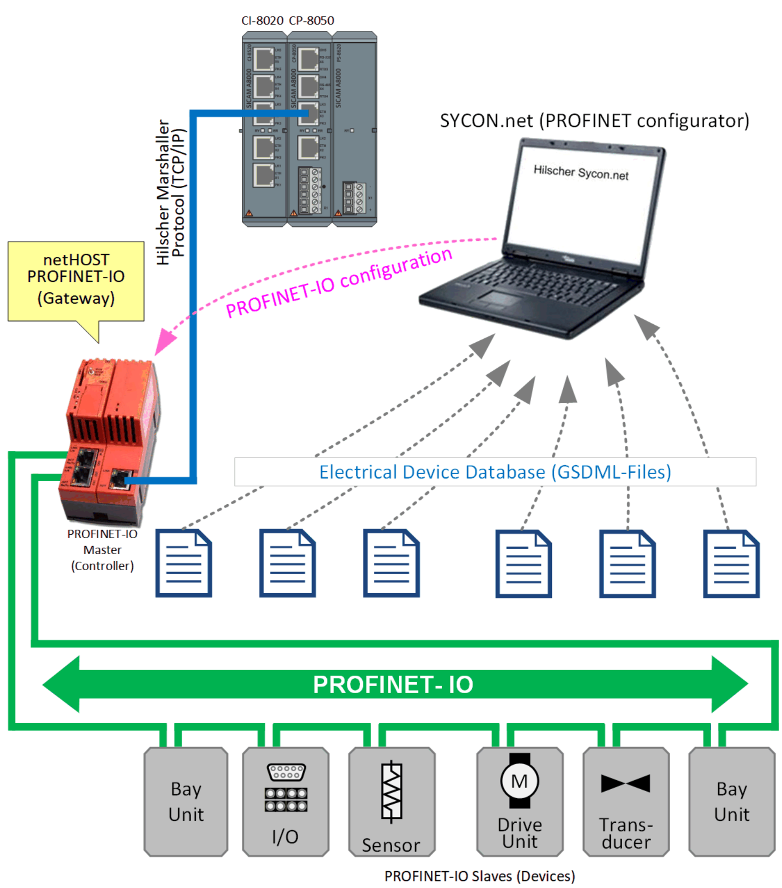
The configuration data is loaded directly into the netHOST. The PROFIBUS-IO protocol is executed by the netHOST.

The processing of data from/to PROFIBUS-IO slaves in SICAM A8000 is performed by the protocol element PNMI0.

The protocol element controls the data traffic between SICAM A8000 ↔ netHOST with the LAN-based Hilscher Marshaller protocol. This protocol is used to initialize the netHOST and transfer the data from/to the PROFIBUS-IO slaves.

The message conversion IEC 60870-5-101/104 ↔ PROFINET-IO is performed by the protocol element DPMI0.

Schematic configuration:



[PNMI0_Configuration_Basic_GSDML, 2, en_US]

NOTE

The GSDML file can be requested from the device manufacturer of the PROFIBUS-IO slaves.
(Download from homepage of the manufacturer, download from the device or included)
After updating the firmware in the PROFINET IO slave, some PROFINET IO slave devices require the use of a new GSDML file matching the firmware version.

13.11.5.1 PROFINET-IO Gateway

The fieldbus gateway for PROFINET-IO master (Hilscher netHOST NHST-T100-EN/PNM) is connected to the CP-8031, CP-8050 or the CI-852x via the Ethernet/optical fiber interface.
The PROFIBUS-IO slave devices are connected to the PROFIBUS-IO interface on the netHOST.

Technical Data

Function	• PROFINET-IO Controller for up tp 128 PROFINET-Slaves • Open access via TCP/IP based access protocol (=Marshaller-Protocol)
Power Supply	24 V DC ± 6 V (typ. 130mA at 24V, 3.2W)
Operating temperature range	0 ... +60 °C

	Explanation	MLFB / Order number
	netHOST PROFINET Master (Ethernet LAN PROFINET IO-Controller) NHST-T100-EN/PNM Art.Nr.: 1890.840 Color:red	- This accessory must be ordered directly from Hilscher. Web: *www.hilscher.com* *http://de.hilscher.com/sales_subsidiaries.html* *http://de.hilscher.com/sales_distributors.html*
	netHOST PROFINET Master (Ethernet LAN PROFINET IO-Controller) NHST-T100-EN/PNM\GR Art.Nr.: 9385.620 Color: dark grey	- This accessory must be ordered directly from Hilscher. Web: *www.hilscher.com* *http://de.hilscher.com/sales_subsidiaries.html* *http://de.hilscher.com/sales_distributors.html*
		SYCON.net - Windows based software - "PROFINET-IO configurator" Note: SYCON.net is automatically included when ordering NHST-T100-EN/PNM and is usually supplied on DVD or is available via download.

NOTE

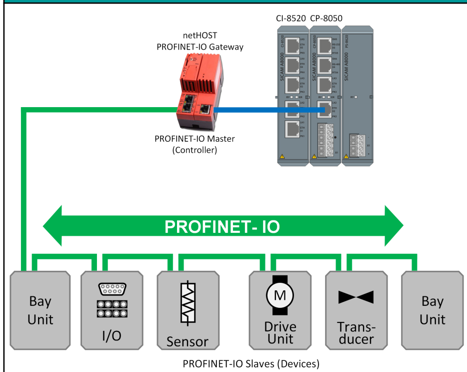
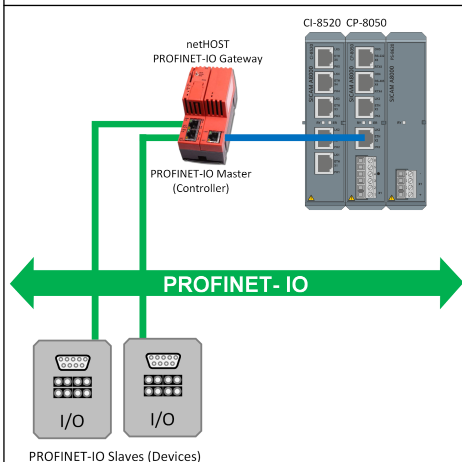
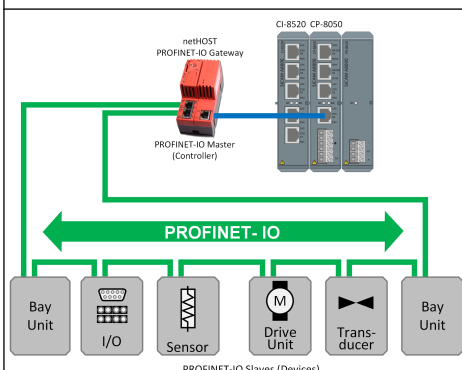
Before using netHOST for the first time, the firmware must be updated because the device is not delivered with the latest firmware.

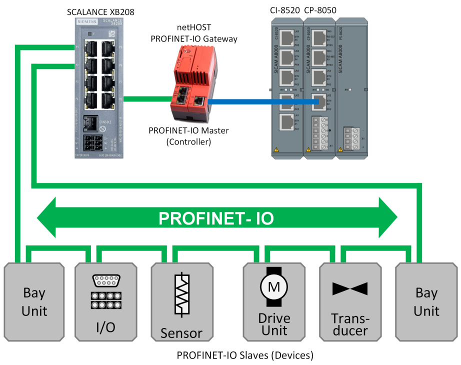
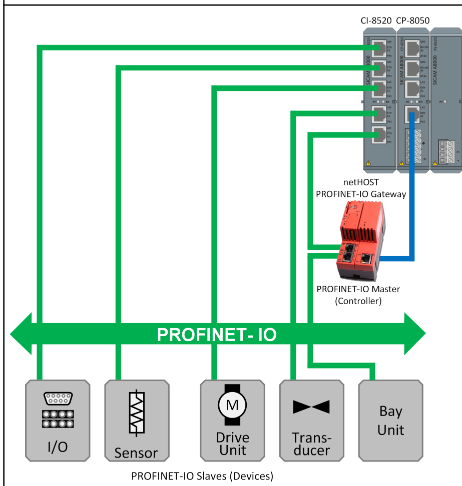
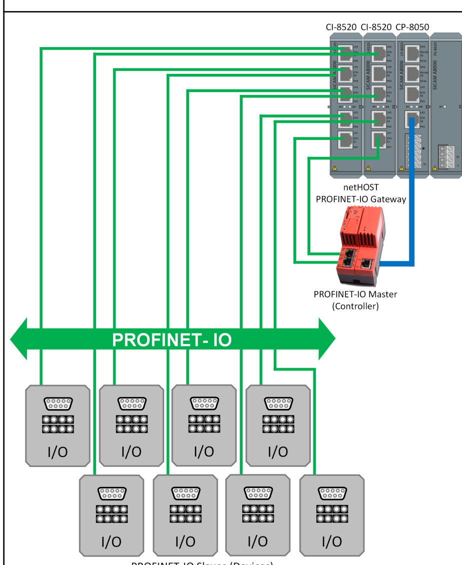
The current firmware for netHOST is included in SYCON.net.

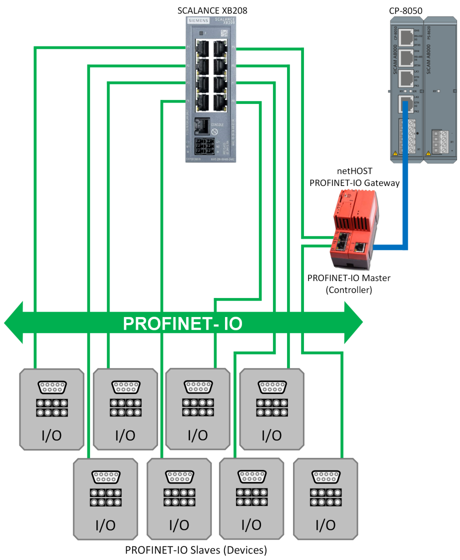
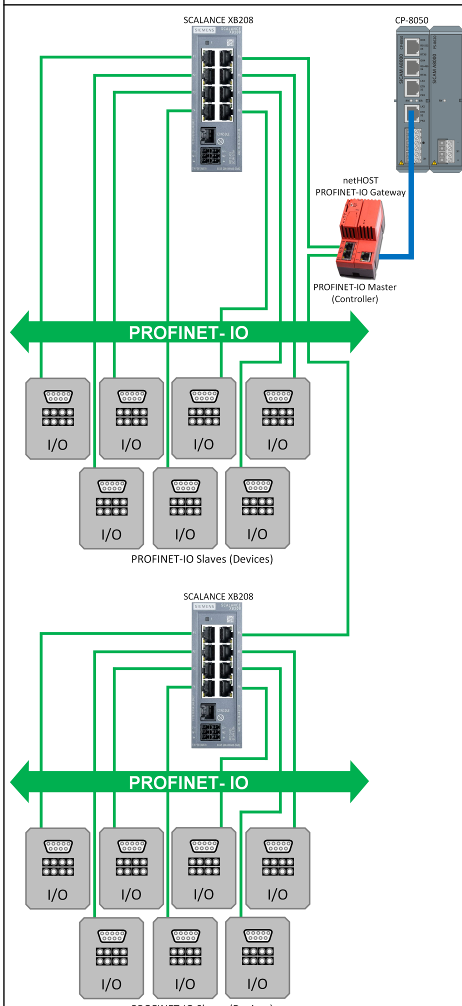
The current version of SYCON.net can be downloaded under*https://www.hilscher.com/support/downloads/*"netHOST".

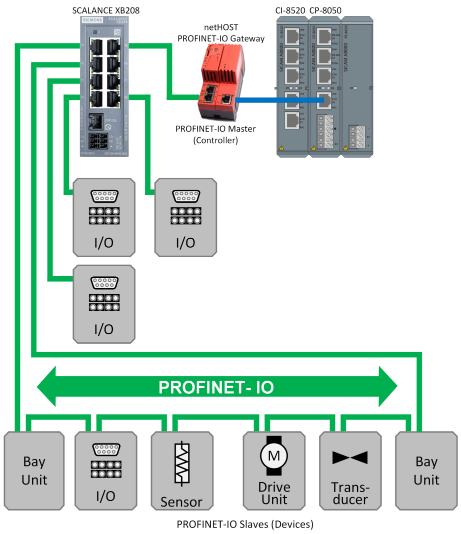
For details on updating the firmware in netHOST see Appendix B SYCON.net + netHOST Quickstart Guide.

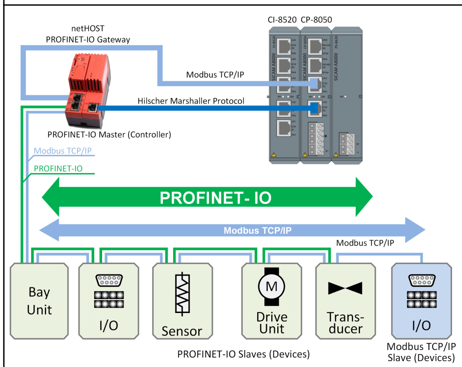
13.11.5.2 PROFINET-IO configurations with CP-8050

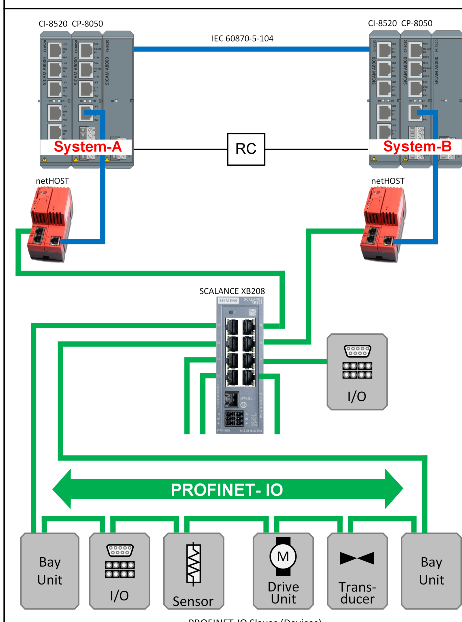
Supported configurations	Description
	**PROFINET-IO Line** ● all PROFINET-IO slaves have 2 Ethernet interfaces ● the PROFINET-IO slaves are connected in line → If a PROFINET IO slave device is switched off or fails, the following PROFINET IO devices are no longer available!
	**PROFINET-IO Star with 2 slaves** ● all PROFINET-IO slaves have 1 Ethernet interfaces ● the PROFINET-IO slaves are connected in a star → If a PROFINET IO slave device is switched off or fails, then the other ROFINET-IO device is still reachable!
	**PROFINET-IO Ring** ● all PROFINET-IO slaves have 2 Ethernet interfaces ● the PROFINET-IO slaves are connected in a ring ● Ring redundancy with MRP ● Max. 50 PROFINET-IO devices in the ring → with simple ring interruption the slaves are still reachable! Note: ● The license for MRP ("Media Redundancy Protocol") must also be purchased in netHOST!

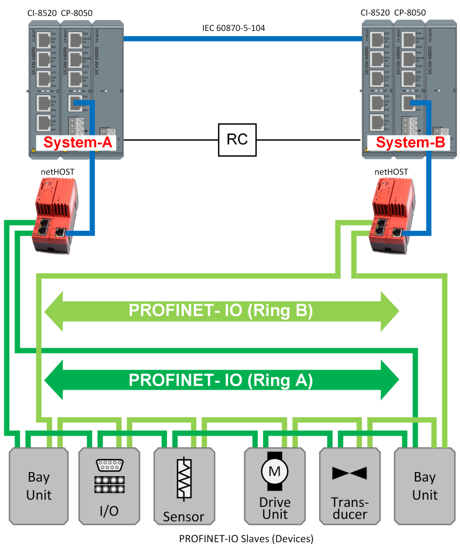
Supported configurations	Description
	**PROFINET-IO Ring with SCALANCE XB208** • all PROFINET-IO slaves have 2 Ethernet interfaces • the PROFINET-IO slaves are connected in a ring • Ring redundancy with MRP • On the SCALANCE XB208, port 1 and port 2 are configured by default as ring ports (Change via XB208 WEB parameterization possible) • Max. 50 PROFINET-IO devices in the ring → with simple ring interruption the slaves are still reachable! Note: The MRP manager function must be activated in the SCALANCE XB208!
	**PROFINET-IO Star with 5 slaves** • all PROFINET-IO slaves have 1 Ethernet interfaces • the PROFINET-IO slaves are connected in a star • the CI-8520 is used as an integrated switch in CP-8031, CP-8050 → If a PROFINET IO slave device is switched off or fails, the other PROFINET IO devices are still reachable!
	**PROFINET-IO Star with 8 slaves** • all PROFINET-IO slaves have 1 Ethernet interfaces • the PROFINET-IO slaves are connected in a star • 2 CI-8520 are used as an integrated switch in CP-8031, CP-8050 → If a PROFINET IO slave device is switched off or fails, the other PROFINET IO devices are still reachable!

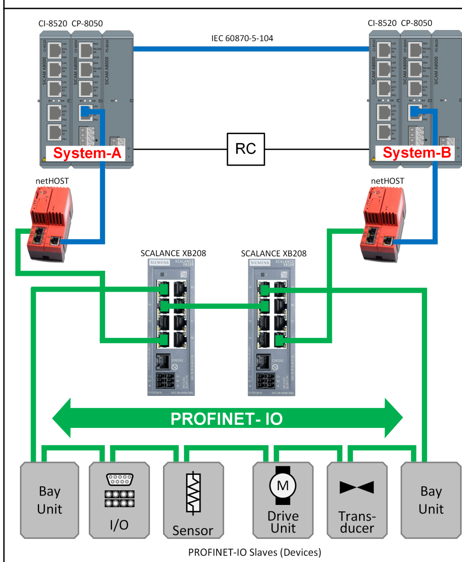
Supported configurations	Description
	**PROFINET-IO Star with 8 slaves** • all PROFINET-IO slaves have 1 Ethernet interfaces • the PROFINET-IO slaves are connected in a star • 1 Siemens SCALANCE XB208 as switch for PROFINET-IO devices → If a PROFINET IO slave device is switched off or fails, the other PROFINET IO devices are still reachable!
	**PROFINET-IO Star with 14 slaves** • all PROFINET-IO slaves have 1 Ethernet interfaces • the PROFINET-IO slaves are connected in a star • 2 Siemens SCALANCE XB208 as switch for PROFINET-IO devices → If a PROFINET IO slave device is switched off or fails, the other PROFINET IO devices are still reachable!
	PROFINET-IO Star with >16 slaves • several Siemens SCALANCE XB208 or SCALANCE XB216 can be used in cascade.

Supported configurations	Description
	**PROFINET-IO Ring/Star with SCALANCE XB208** • PROFINET IO devices with only 1 PROFINET interface can be connected in a star configuration and PROFINET IO devices with 2 PROFINET interfaces can be connected in a ring to a SCALANCE XB-208. → Further information see • PROFINET-IO Ring with SCALANCE XB-208 • PROFINET-IO Star with SCALANCE XB-208

	**PROFINET-IO Line & Modbus TCP Line "Mixed"**
	• all PROFINET-IO slaves have 2 Ethernet interfaces
	• the PROFINET-IO slaves are connected in line
	• Modbus TCP slaves are connected at the end of the PROFINET-/O line
	• 2 PREs are equipped in CP-8050
	  – PROFINET-IO Master
	  – Modbus TCP Master
	• The netHOST is used as switch
	→ If a PROFINET IO slave device is switched off or fails, the following PROFINET IO devices or Modbus TCP devices can no longer be reached!

	**Redundant AU with single PROFINET-IO ring/star**
	• The PROFINET IO devices are connected via a "singular PROFINET IO" (ring, star or line)
	• All PROFINET IO devices are connected to the SCALANCE XB208.
	• For PROFINET IO devices in ring structure, the SCALANCE XB208 is the "MRP manager".
	• The AUs (CP-8050) are redundant (only one is active)
	  – The "active AU" makes the data conversion from/to PROFINET-IO
	  – The "passive AU" makes no data conversion (is not possible)
	  – the "passive AU" monitors the connected PROFINET IO devices for failure (PROFINET IO bus scan)

<table>
<tr><th>Supported configurations</th><th>Description</th></tr>
<tr><td>
</td>
<td>Redundant AU with redundant PROFINET-IO ring

Each PROFINET IO device is equipped with 2 independent PROFINET IO interfaces (2 ports each).
(typically 2 PROFINET-IO CPUs)
All PROFINET IO devices are connected to Ring-A and RING-B with a PROFINET interface.
Both AUs (CP-8050) are "active" on the assigned PROFINET-IO ring.
Data communication takes place independently on both PROFINET IO rings.
The MRP master function must be activated in netHOST.
The data from the PROFINET IO devices to the AUs are always transferred to Ring-A and Ring-B.
Received data is passed from the "passive" AE with R = 1.
Data in transmission direction can be filtered out with the "passive" AE.
</td></tr>
<tr><td>
</td>
<td>Redundant AU with single PROFINET-IO ring + 2x XB208

Each PROFINET IO device is equipped with 1x PROFINET-IO interface (2 ports).
Only the "active" AU (CP-8050) is "active" on the PROFINET-IO ring.
Data in the receive direction are not forwarded by the "passive" AU.
Data in transmission direction are discarded by the "passive" AU.
The SCALANCE XB208s are used as MRP masters.
The MRP function in NetHOST is not used
The SCALANCE XB208 must be parameterized in Sycon.net as a PROFINET IO slave!
</td></tr>
</table>

13.11.5.3 Ethernet interface

The interface is selected according to *13.1.4.4 Selection of an Ethernet Interface for Communication Protocols*

- the IP address/subnet mask/default gateway for the own Ethernet interface is set with the parameter **`[Home] Communication | LAN Interfaces`** in field **`IPV4 Address/IPV4 Subnet Mask/IPV4 Default Gateway`**.

13.11.5.4 Settings for netHOST

The IP address of the netHOST must be set on the protocol with the parameter **`[PRE] PROFINET-IO (netHOST) | netHOST | Set the IP address of the remote terminal (netHOST)`**.

The communication between the CP-8050 and the netHOST takes place via the proprietary Hilscher Marshaller protocol (TCP / IP port: 50111).

The Marshaller protocol uses only "Request/Response Services".

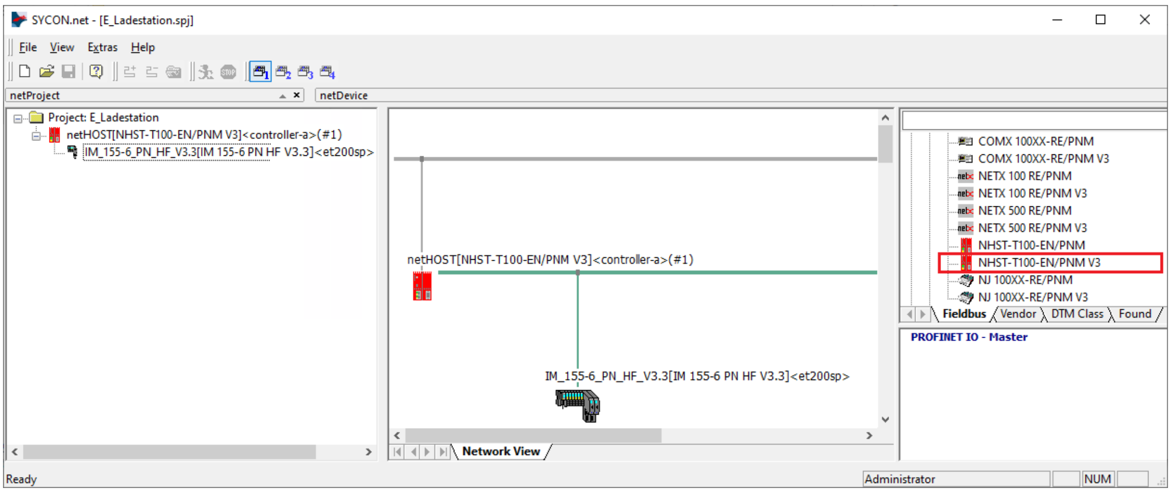
Each request is monitored by a response timeout; If the timeout expires, the TCP connection is closed. The monitoring time is set on the protocol with the parameter **`[PRE] PROFINET-IO (netHOST) | netHOST | Marshaller protocol response timeout set`**.

Setting the IP address on the netHOST

The setting of the IP address on the netHOST must be carried out in accordance with Hilscher's instructions.

PROFINET-IO parameterization for netHOST with Hilscher SYCON.net

- For PROFINET-IO the fieldbus NHST-T100-EN/PNM V3 must be used as PROFINET-IO master in SYCON.net.



[SYCON_Profinet_V3_red, 1, --_--]

13.11.5.5 Station Definition

All connected PROFINET IO devices must be entered in the protocol element for PROFINET IO master in the parameters of the **`[PRE] Station definition`**.

Parameter Name	Description	Settings
`[PRE] Station definition`		
`Station number`	CP-8050 internal station number for diagnosis, data routing. Each PROFINET IO slave must be assigned a unique station number.	Permitted range = 0 to 99 ... internal station number 255 ... not used (default) Standard setting = 255
`Station enable`	Selective PROFINET-IO slaves can be prepared or deactivated with "Station enable = no".	Permitted range = yes, no Default setting = yes
`station failure`	If a PROFINET-IO slave fails, the transmission of the error message can be suppressed with "station failure = no".	Permitted range = • notify • suppress default setting = notify
`Device name`	Name of the PROFINET-IO device according to PROFINET specification.	Permitted range = • Max. 240 characters • valid signs: a-z, 0-9, "-", "," may not start with "-", "," Default setting =

All PROFINET-IO devices released in the station definition must also be parameterized with sycon.net in the netHOST.

13.11.5.6 Data transfer from/to PROFINET IO devices

13.11.5.7 Control and Return Information of Protocol Elements

Protocol element control messages

Protocol element control messages can control protocol element internal functions. On the basic system element, IEC 60870-5-101/104 *messages with process information in the control direction* are converted to protocol element control messages and transmitted to the selected protocol element (see *13.1.4.10 Protocol Element Control Messages*).

Supported Protocol Element Control Functions

SF	Protocol element control function Control_function_(PRE)	PNMI0
242	Setting control location	✓

Protocol Element Return Information

Protocol element return information is internal status information of the protocol elements which is transmitted spontaneously and in the event of a general interrogation with internal message formats from the protocol element to the basic system element. On the basic system element, the protocol element return information items (see *13.1.4.11 Protocol Element Return Information*) are converted to IEC 60870-5-101/104 *messages with process information in the monitoring direction*.

Supported Protocol Element Return Information

Protocol element return information Return information function_(PRE)	Station	PNMI0
Station failure	255	✓

13.11.5.8 Redundancy

MRP Ring redundancy on PROFINET

PROFINET devices can be connected in a ring structure.
Due to the ring configuration, the PROFINET devices can still be reached with a simple ring interruption.

Ring configuration requires the following functions:

- all devices in the ring must be equipped with 2 PROFINET interfaces
- all devices in the ring must support MRP according to IEC 61158 Type 10 "PROFINET"
- Ring redundancy is controlled by the MRP protocol
  (Media Redundancy Protocol).
- at least 1 device in the ring must support the MRP Manager function

Applicable devices

- IE switches of the SCALANCE X product family (please note firmware versions):
  – XB 208, XB 216, X-200, X-200IRT, X-300, X-400, X-500
- SIMATIC-S7-PROFINET devices with integrated IE switch (at least 2 ports)
- other IEC 61158 Type 10 "PROFINET" compliant third-party MRP devices.

Installation Guidelines

- All ring participants must support MRP and activate the MRP protocol
- The maximum number of ring participants is 50
  Otherwise, reconfiguration times > 200 ms may occur

... further installation guidelines and configuration notes are in the documentation **Structure of a ring topology based on "MRP" for Siemens SCALANCE X**.

13.11.6 Parameters and Properties

Parameter name	Description	Settings
`[PRE] Interface parameter` Note: • The interface for the protocol is selected in the SICAM Device Manager under Configuration | Firmware(refer to *13.1.4.4 Selection of an Ethernet Interface for Communication Protocols*). • Some parameters may not be displayed until the interface is selected.		
**`[PRE] Station definition	Station definition`**		
`Station number`	SICAM A8000 internal station number for diagnosis, data routing. Each PROFINET IO slave must be assigned a unique station number.	Permitted range = 0 to 99 ... internal station number 255 ... not used (default) Default setting = 255
`Station enable`	Selective PROFINET-IO slaves can be prepared or deactivated with Station enable = ***no***.	Permitted range = yes, no Default setting = yes
`Station failure`	If a PROFINET-IO slave fails, the transmission of the error message can be suppressed with station failure = ***no***.	Permitted range = • indicate • do not indicate Default setting = indicate
`Device name`	Name of the PROFINET-IO device according to PROFINET specification.	Permitted range = • Max. 240 characters • valid signs: a-z, 0-9, "-", "," may not start with "-", "," Default setting =
**`[PRE] PROFINET-IO (netHOST)	netHOST`**		
`IP-address of remote station (netHOST)`	IP address of the netHOST as remote station (IPV4). Note: The IP address of the own station is set on the BSE.	Permitted range = 0.0.0.0 to 255.255.255.254 Standard setting = 0.0 0.0
`Marshaller protocol response timeout`	For the connection of the netHOST the “Marshaller Protocol” is used. The protocol uses only “Request/ Response services”. Each “request” is monitored by a “response timeout”. If the timeout expires, the TCP connection is closed.	Permitted range = 2.0 to 20.0 s Default setting = 2.5 s

Parameter name	Description	Settings
[PRE] PROFINET-IO (netHOST) | Communication functions | Initialization		
Startup Delay	When restarting the BSE, the PROFINET-IO interface is only activated after a delay. This delay is used to update the process image on the PRE after a restart before the communication is started.	Permitted range = 10 to 65535 s Default setting = 10 s
[PRE] PROFINET-IO (netHOST) | Communication functions | Query cycle time		
Cycle time for data exchange	In this grid, the input data is read from the netHOST.	Permitted range = 10 to 1000 ms Default setting = 20 ms
Number of runtime overruns till warning	If processing of the requested input data cannot be completed in n (parameter) consecutive cycles, the *Runtime Error Exceeded* warning is set.	Permitted range = 0 to 255 Default setting = 3
Delay - processing input data	After going out of service the state of the input data briefly goes to 0 and the provider status to "invalid". Due to the delayed processing input data after the device failure, a forwarding of the input data with state = 0 and NT = 1 is suppressed.	Permitted range = 0.1 to 25.5 s Default setting = 1 s
[PRE] PROFINET-IO (netHOST) | Communication functions | communication transmission		
Command output time	This command output time defines the pulse duration for commands with the time code "without additional specification (QOC=0)".	Permitted range = 0.05 to 3276.75 s Default setting = 1 s
[PRE] Redundancy		
Operation if passive		Permitted range = • listening mode (singular PROFINET-IO) • normal operation (redundant PROFINET-IO) Default setting = normal operation (redundant PROFINET-IO)
[PRE] Data base management Settings for the data base management on BSE (per PRE) – see *13.1.4.14 Data Management on the BSE for Communication Protocols*		
[PRE] Advanced parameters | Web server		
HTTP Web server	Protocol-specific web server for extended diagnostics/statistics.	Permitted range: • activated • Deactivated (=standard setting)

Parameter name	Description	Settings
[PRE] Advanced parameters | Software test points		
...	The software test points may only be used under the guidance of experts for error detection! Once the fault isolation is completed, software checkpoints must always be turned off.	Permitted range = yes, no Default setting = no

13.11.7 Web server

A web server for internal diagnostic and statistic information is integrated in the protocol firmware. The web server itself is implemented on the basic system element – the protocol-specific web pages are provided by the protocol element.

System	Firmware	Protocol function	PRE specific Web Pages
CP-8031, CP-8050	PNMIO	PROFINET-IO Master (Controller)	✓

Enable/disable web server or start web server via SICAM Device Manager or web browser see *13.1.4.12 Web server for protocol-specific web pages*.

Supported protocol-specific web pages

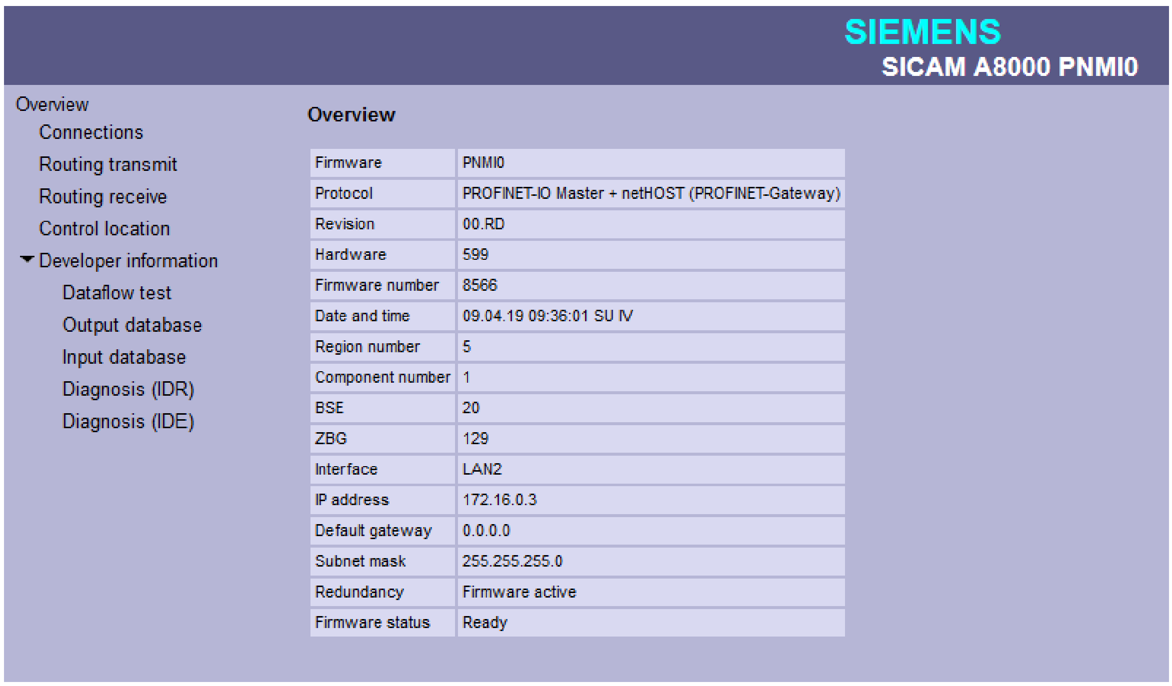
PRE specific Web Pages	PNMIO
Overview	✓
Connections	–
Routing Transmit	–
Routing Receive	–
Control location	–
Developer Information	
Dataflow test	✓
Output database	–
Input database	–
Diagnosis (IDR)	✓
Diagnosis (IDE)	✓

Overview

On the web page**Overview**general information of the firmware is displayed.

Field	Note
Firmware	Name of firmware
Protocol	Protocol function
Revision	Revision of firmware
Hardware	Hardware number (system internal)
Firmware number	Firmware number (system internal)
Date and time	Current date + time of firmware
Region number	Region number (system internal)
Component number	Component number (system internal)
BSE	Basic system element number (system internal)
ZBG	Supplementary system element number (internal)
Interface	Selected Ethernet Interface

Field	Note
IP address	Own IP address of the assigned interface
Default gateway	Default gateway of the assigned interface
Subnet mask	Subnet mask of the assigned interface
Redundancy	Current redundancy status of the firmware: • Firmware active • Firmware passive
Firmware status	State of the firmware:



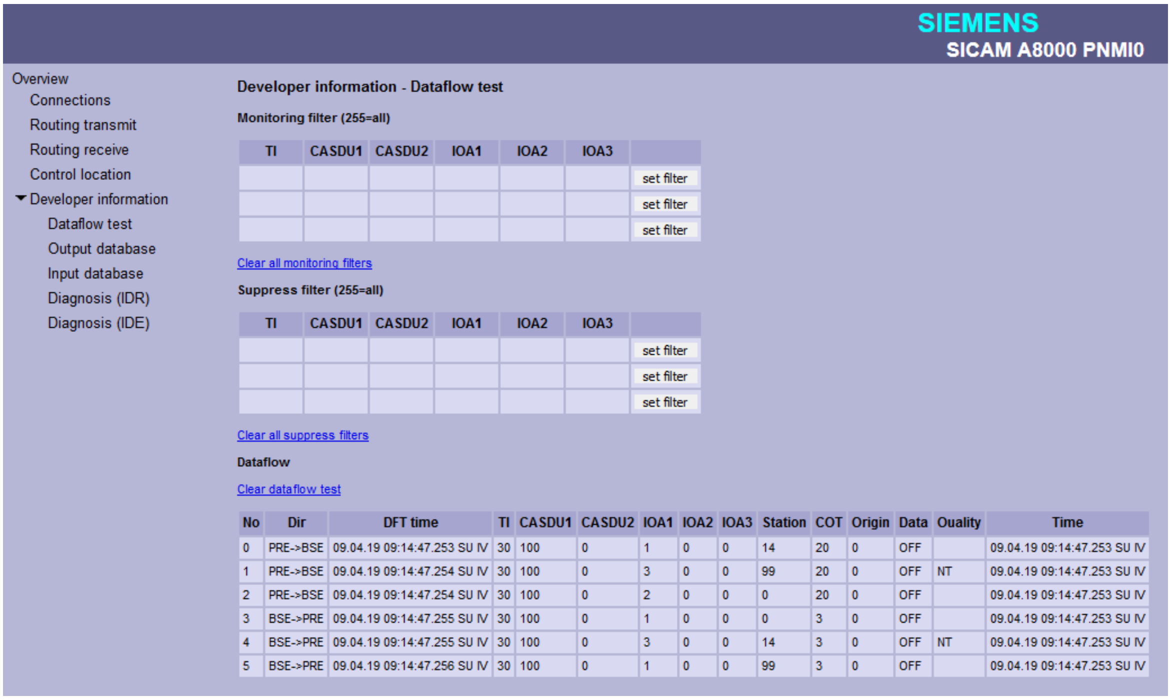
Developer Information – Dataflow Test

On the web page**Developer Information – Dataflow Test**the messages transmitted on the internal interface between PRE and BSE are displayed.

The last 200 received or transmitted messages will be displayed.

Field	Note
No.	Consecutive message number
Dir	Direction of the transmission • PRE→BSE: Received data • BSE→PRE: Transmitted data
DFT Time	Logging time
TI	IEC 60870-5-101/104 Type identification (SICAM A8000 internal)
CASDU1, CASDU2 IOA1, IOA2, IOA3	IEC 60870-5-101/104 Address of data point (SICAM A8000 internal)
Station	Station number of the connection (SICAM A8000 internal)
COT	IEC 60870-5-101/104 Cause of transmission (SICAM A8000 internal) (COT = Cause Of Transmission)
Origin	IEC 60870-5-101/104 Originator address (SICAM A8000 internal) (origin = Originator)
Data	IEC 60870-5-101/104 State of data point (SICAM A8000 internal)

Field	Note
Quality	IEC 60870-5-101/104 Quality descriptor of data point (SICAM A8000 internal)
Time	Receive time



Message filter for simultaneous logging ("Monitoring Filter")

With filter enabled, only messages will be logged which are selected by filter. If no filter is selected, all messages will be logged.

With the value 255 this field is set to Wildcard, which means that all messages with this field (0 to 255) are also logged.

The filter will be activated by **set filter**.

The filters will be cleared with Clear all monitoring filters.

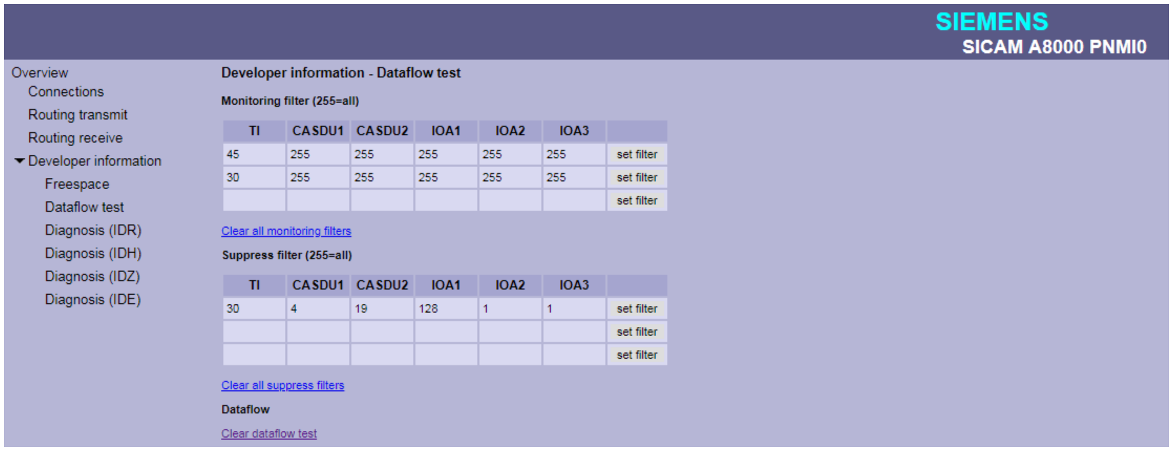
Message filter for simultaneous logging ("Suppress Filter")

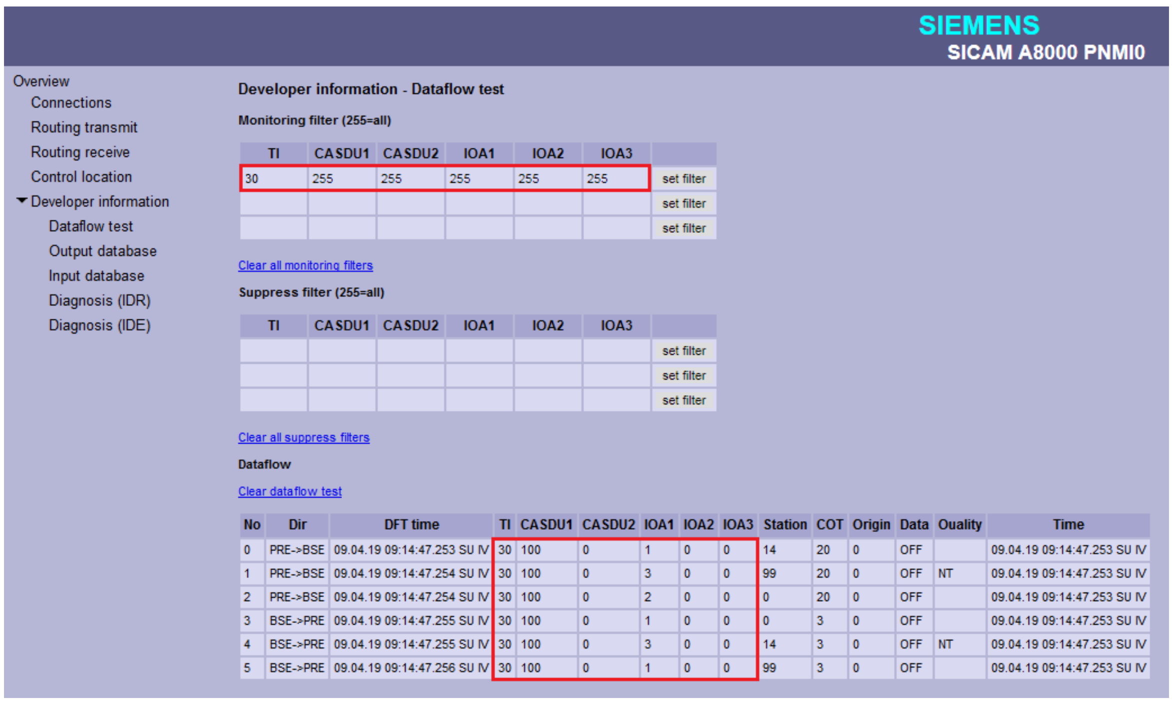
If a filter is selected, the messages selected by the filter are not logged (suppressed). If no filter is selected all messages will be logged.

With the value 255 this field is set to Wildcard, which means that all messages with this field (0 to 255) are suppressed.

The filter will be activated by **set filter**.

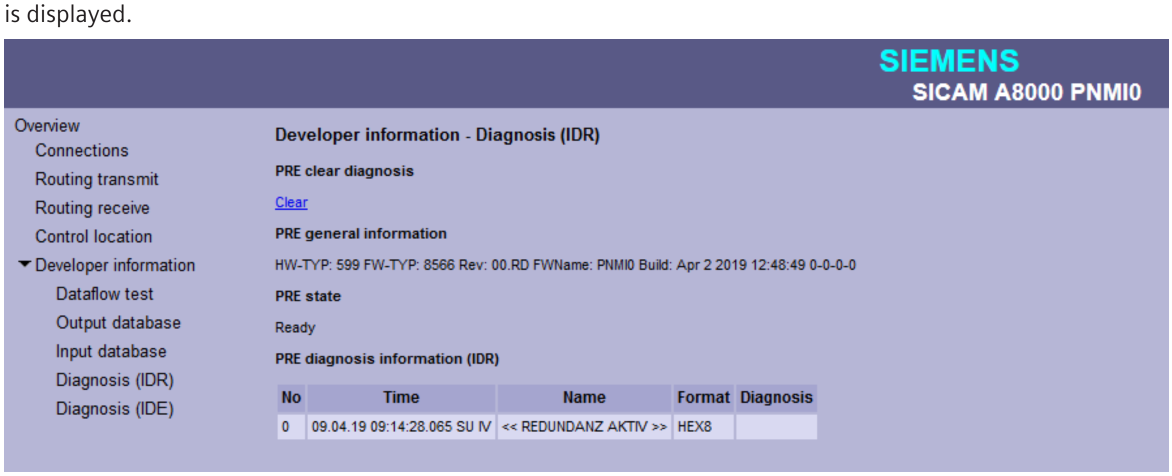
The filters will be cleared with Clear all suppress filters.





Developer Information – Diagnosis (IDR)

On the web page**Developer Information – Diagnosis (IDR)**protocol element-internal diagnostic information is displayed.



Deletion of the IDR-diagnostic information on PRE (“PRE clear diagnosis”)

The IDR diagnostic information on the PRE can be deleted under**PRE clear diagnosis**with Clear.

General information of PRE firmware (“PRE general Information”)

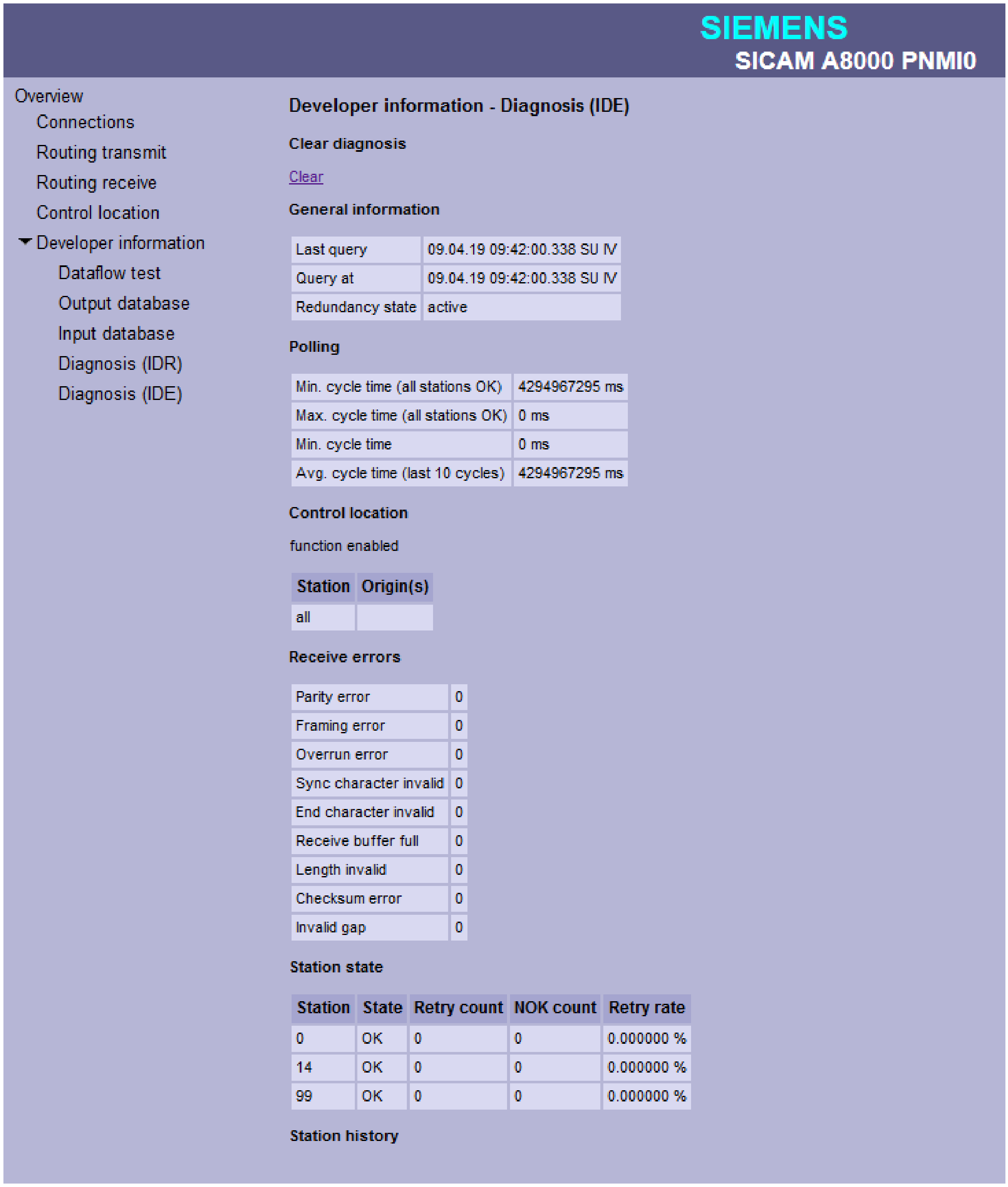
Field	Note
HW-TYP	Hardware type of PRE firmware
FW-TYP	Firmware type of PRE firmware
Rev	Revision of PRE firmware

IDR diagnostic information of the PRE firmware (“PRE diagnosis information (IDR)”)

Field	Note
No	Consecutive number
Time	Date + time of IDR logging
Name	Diagnosis text
Format	Format of diagnosis information in next column • CHAR, HEX8, HEX16, HEX32, DEC8, DEC16, DEC32, FLOAT32
Diagnosis	Detail information for IDR diagnosis

Developer Information – Diagnosis (IDE)

On the web page**Developer Information – Diagnosis (IDE)**PRE internal diagnostic information resp. statistic information is displayed.



Deletion of the IDE diagnostic information on PRE (“Clear diagnosis”)

The IDE diagnostic information on the PRE can be deleted under**Clear diagnosis**with Clear.

General information of the IDE diagnosis (“General information”)

Field	Note
Cleared at	Time of IDE diagnosis information cleared
Query at	Last query time of IDE diagnosis information
Redundancy state	Current redundancy status of the firmware: • active • passive

General information of the IDE diagnosis (“Polling”)

Field	Note
Min. cycle time (all stations OK)	Is currently not supported!
Max. cycle time (all stations OK)	Is currently not supported!
Min. cycle time	Is currently not supported!
Avg. cycle time (last 10 cycles)	Is currently not supported!

Information on the control location of the PRE (“Control location”)

Field	Note
Control location	State of the control location function on PRE. Control location: • Function enabled • Function disabled
Station	The activated control locations will be displayed when control location function is enabled. Control location: • All • 0, 1, 2 to 255
Origin(s)	Enabled control locations

Receive error statistics (“Receive Errors”)

Field	Note
Parity error	Not used
Framing error	Not used
Overrun error	Number of detected overflow errors (In case of overflow error the firmware load is too high - the received bytes can no longer be processed correctly)
Sync character invalid	Number of detected synchronization errors
End character invalid	Number of detected end character errors
Receive buffer full	Number of detected errors for receive buffer full
Length invalid	Number of detected length invalid errors
Checksum error	Number of detected checksum errors
Invalid gap	Not used

State of Communication Link (“Station state”)

For each station, the current status and statistics about the number of failures and retries are displayed.

Field	Note
Station	Station number (internal)
State	Status: • OK .... Communication link OK • NOK ..... Communication link NOK (failed)
Retry count	Number of retries since last Clear diagnosis
NOK count	Number of communication link NOK (failed) since last Clear diagnosis
Retry rate	Number of retries in % since last “Clear diagnosis”

Chronological list of retries and station failures (“Station History”)

Field	Note
Time	Date + time of communication error (OK, NOK, retry)
Station	Station number (internal)
State	Status: • Retry no x ... Retry number x • Station OK • Station NOK

13.11.8 Message Conversion

Data in transmit direction are transferred from the basic system element to the protocol element in SICAM A8000 internal IEC 60870-5-101/104 (without 101/104 blocking) format. The data formats are converted to the PROFINET-IO line format on the protocol element. The data is transmitted to the external Field bus Gateway netHOST cyclically and spontaneously via the proprietary Hilscher Marshaller protocol. The transmission of data to the PROFINET-IO slaves is controlled by netHOST.

Data in the receive direction are read cyclically by the protocol element from the external fieldbus gateway netHOST and converted from the PROFINET-IO format into a SICAM A8000 internal IEC 60870-5-101/104 format and transferred to the basic system element (no 101/104 blocking).

Message conversion is the conversion of the message formats of the SICAM A8000 internal message formats from IEC 60870-5-101/104 format ↔ PROFINET-IO data formats and the conversion of the address information.

The parameterization of the conversion from IEC 60870-5-101/104 ↔ PROFINET-IO (address and message format) is to be done with the SICAM Device Manager with function “Signals” or with the SICAM TOOLBOX II, OPM II using “SIP Message Address Conversion”.

Supported Processing Types for Message Conversion

Data	Direction	Processing type	PNMI0
Binary information Commands	Receive direction	firmware / `Rec_binary_information (cyclic IO)`	✓
Measured values	Receive direction	firmware / `Rec_measured_value (cyclic IO)`	✓
Integrated totals	Receive direction	firmware / `Rec_counter_value`	✓

Data	Direction	Processing type	PNMI0
Commands Binary information items	Transmit direction	firmware/**Trans_binary_information (cyclic IO)**	✓
Measured values Setpoint values	Transmit direction	firmware / **Trans_value (cyclic IO)**	✓

General description of the parameters and properties (applies for each type of processing)

Parameter	
PNIO_station_number	Station number for PROFINET-IO Slave (SICAM A8000 internal) Possible: 0 to 99 The PROFINET IO station number is only used internally by SICAM A8000 for message conversion, diagnostics and in the station definition! The station number is not transmitted on PROFINET-IO.
PNIO_provider_status	Transmit direction (SICAM A8000 → PROFINET-IO Slave): The provider status (IOPS) indicates the validity of the data of a submodule, which is formed from the sum of all “data point selective” provider statuses. A submodule is usually assigned several SICAM A8000 data points. Already 1 faulty SICAM A8000 data point sets the entire provider status of the submodule to faulty. The output of this data with provider status = “invalid” is manufacturer-specific (“value deactivation” or “value retention”). Receive direction (SICAM A8000 ← PROFINET-IO Slave): In the receive direction, the provider status (IOPS) is automatically converted to the data point quality identifier NT (not topical).

13.11.8.1 Message Conversion in Transmit Direction (Master → Slave)

Message Conversion in Transmit Direction IEC 60870-5-101/104 → PROFINET-IO

SICAM A8000: IEC 60870-5-101/104 →		PROFINET-IO
TI	**Designation**	**Data format**
<TI:=30>	Single-point information with time tag CP56Time2a	1BIT, BYTE/FLAG
<TI:=31>	Double-point information with time tag CP56Time2a	2BIT
<TI:=33>	Bitstring of 32 bits with time tag CP56Time2a	UINT32
<TI:=34>	Measured value, normalized value with time tag CP56Time2a	INT8, UINT8, INT16, UINT16, INT32, UINT32, FLOAT32, S5INT12
<TI:=35>	Measured value, scaled value with time tag CP56Time2a	INT8, UINT8, INT16, UINT16, INT32, UINT32, FLOAT32, S5INT12
<TI:=36>	Measured value, floating-point number with time tag CP56Time2a	INT8, UINT8, INT16, UINT16, INT32, UINT32, FLOAT32, S5INT12
<TI:=37>	Integrated total with time tag CP56Time2a	INT16, UINT16, INT32, UINT32, FLOAT32
<TI:=45>	Single command	1BIT/PULSE
<TI:=46>	Double command	2BIT/PULSE
<TI:=47>	Regulating step command	2BIT/PULSE
<TI:=48>	Setpoint command, normalized value	INT8, UINT8, INT16, UINT16, INT32, UINT32, FLOAT32, S5INT12

SICAM A8000: IEC 60870-5-101/104 →		PROFINET-IO
<TI:=49>	Setpoint command, scaled value	INT8, UINT8, INT16, UINT16, INT32, UINT32, FLOAT32, S5INT12
<TI:=50>	Setpoint command, short floating-point number	INT8, UINT8, INT16, UINT16, INT32, UINT32, FLOAT32, S5INT12
<TI:=51>	Bitstring 32-bit	UINT32
<TI:=100>	(General) interrogation command	-
<TI:=101>	Counter interrogation command	-

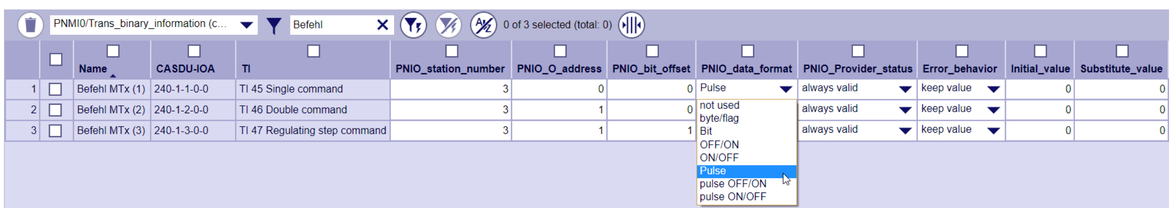
NOTE

The parameters **`initial_value`**, **`substitute_value`** and **`error_behavior`** must be adapted to the requirements of the application! This applies especially for setpoint values.

Commands

The parameterization of the address and message conversion for commands in transmit direction is to be done with the SICAM Device Manager with the function “Signals” or with the SICAM TOOLBOX II, OPM II.

Processing type: *Firmware/* | **`Trans_binary_information (cyclic IO)`**



Parameter	
`TI`	Supported type identifications: • <TI:=45> .. Single command • <TI:=46> .. Double command • <TI:=47> .. Regulating step command
`Name`	Name of the signal
`104 address`	SICAM A8000 internal IEC 60870-5-101/104 message address (CASDU1, CASDU2, IOA1, IOA2, IOA3)
`PNIO_station_number`	SICAM A8000 internal station number for PROFINET-IO Slave: • 0 to 99
`PNIO_O_address`	Output address in netHOST according to configuration in SYCON.net: • 0 to 5699
`PNIO_bit_offset`	Bit offset in corresponding output byte: • 0 to 7 ... Single command • 0 to 6 ... Double command or regulating step command The permissible Bit_Offset depends on the selected PROFINET-IO data format.
`PNIO_data_format`	Data format on PROFINET-IO: • pulse • pulse OFF/ON • pulse ON/OFF

Parameter	
PNIO_provider_status	Provider status on PROFINET-IO: • always valid • invalid: NT/IV = 1 The data point selective provider status is set to “invalid” for NT/IV = 1. • invalid: NT/IV = 1 + initialization The data point selective provider status is set to “invalid” after startup or with NT/IV = 1. The provider status affects all parameterized information objects of the submodule.
Error_behavior	Output on PROFINET-IO if NT = 1 or IV = 1: • Keep value
Initial_value	After restart of the protocol element this initial value will be sent to PROFINET-IO slave. • 0
Substitute value	Substitute value if error behavior is set to ***output substitute value***: • 0

Supported Data Formats

Format	PROFINET-IO Data format	IEC 60870-5-101/104 Data format (TI)
1BIT/PULSE	pulse	45
2BIT PULSE	pulse OFF/ON	46, 47
2BIT PULSE	pulse ON/OFF	46, 47

NOTE

Since the data formats in PROFINET-IO are not defined in the output data, the PROFIBUS-DP data format must be specified for the conversion of SICAM A8000 → PROFINET-IO. Supported data formats see *13.11.9 PROFINET-IO Data formats*.

Control Location / Control Location Check

The function “Control location” is used so that commands are only output from authorized sources. If the “Control location” function is activated, commands from the protocol element for PROFINET-IO master are only transmitted to the PROFINET-IO device when the control location (originator address) is enabled. If the control location is not enabled, the protocol element immediately sends back a negative acknowledgment of activation (ACTCON) to the originator address. Further details about setting control location / check control location see section *13.1.4.9 Control location function for commands and setpoint values*.

Command Output Time for Single/Double Commands

Commands are transmitted on the PROFINET-IO as pulses (1 or 2 bits). The protocol element maps the command output to 1 or 2 bits in the "output process image of spontaneous information" of the PROFINET-IO slave with the assigned command output time.

The command output time (duration of the pulse) is set for commands with qualifier of command = <0> “no additional definition” on protocol with the parameter **[PRE] PROFINET-IO (netHost) | Communication functions | Command transmission | Command pulse duration**.

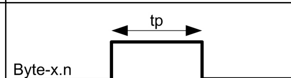
The command output time (duration of the pulse) is set for commands with qualifier of command = <1> “short pulse duration” on the basic system element with the parameter **`[BSE] RTU-common settings | short pulse duration`**.

The command output time (duration of the pulse) is set for commands with qualifier of command = <2> “long pulse duration” on the basic system element with the parameter **`[BSE] RTU-common settings | long pulse duration`**.

Max. 10 commands as pulse command (single-, double commands) executed at the same time will be supported.

Single command

A single command with command state SCS = ON will be output on the PROFINET-IO as pulse with parametrized command output time.

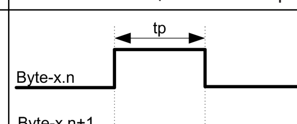
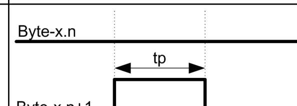
PROFINET-IO data formats	Command state	Command output (1 bit in output range)
pulse	SCS = ON	 tp ... command output time (pulse duration)
	SCS = OFF	The OFF state is not evaluated!

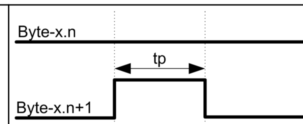
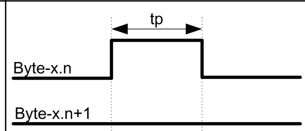
A running command output is re triggered by another command with the same command state.

Double command / Regulating step command

A double command or regulating step command with the status DCS = ON/OFF or RCS = RCS = HIGHER/LOWER is output on the PROFINET-IO as pulse with the set command output time.

PROFINET-IO data formats	Command state	PNIO_O_address
pulse ON/OFF	ON	parameterized PNIO_O_address; PNIO_bit_offset
	OFF	parameterized PNIO_O_address; PNIO_bit_offset + 1
pulse OFF/ON	ON	parameterized PNIO_O_address; PNIO_bit_offset + 1
	OFF	parameterized PNIO_O_address; PNIO_bit_offset

PROFINET-IO Data format	Command state	Command output (2 bit in output range)
pulse ON/OFF	DCS = ON RCS = HIGHER	 tp ... command output time (pulse duration)
	DCS = OFF RCS = LOWER	 tp ... command output time (pulse duration)

pulse OFF/ON	DCS = ON RCS = HIGHER	 tp ... command output time (pulse duration)
	DCS = OFF RCS = LOWER	 tp ... command output time (pulse duration)

A running command output is re triggered by another command with the same command state. A running command output is aborted by another command with the antivalent command state and the new command state is output.

Message Conversion

The table describes the evaluated elements of the IEC 60870-5-101/104 message during message conversion.

Elements of the message		
TI .. Type identification		• <TI:=45> .. Single command • <TI:=46> .. Double command • <TI:=47> .. Regulating step command
CASDU, IOA .. Message address		Parameter-settable
Cause of transmission		
06 .. Activation		Is evaluated (only “activation” allowed)
xx .. Other COTs		Not accepted (only “activation” allowed)
T .. Test		Not supported
Information		
SCO/DCO/RCO		
SCS	Single command state	[only <TI:=45>]
	0 .. OFF	Not evaluated
	1 .. ON	Evaluated
DCS	Double command state	[only <TI:=46>]
	0 .. Not allowed	Not supported
	1 .. OFF	Evaluated
	2 .. ON	Evaluated
	3 .. Not allowed	Not supported
RCS	Regulating step command state	[only <TI:=47>]
	0 .. Not allowed	Not supported
	1 .. Next step lower	Evaluated
	2 .. Next step higher	Evaluated
	3 .. Not allowed	Not supported
QOC	S/E	
	0 = Execute	Is checked for “execute”
	1 = Select	Not supported

Elements of the message		
QU	Command qualifier	
	0 .. No additional definitions	Evaluated
	1 .. Short pulse duration	Evaluated
	2 .. Long pulse duration	Evaluated
	3 .. Persistent command	Not supported

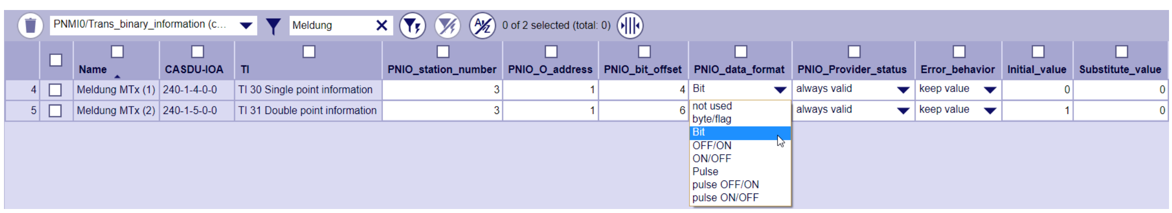
NOTE

Not listed elements of the IEC 60870-5-101/104 message are not rated/not supported!

Binary Information

The parameterization of the address and message conversion for binary information in transmit direction is to be done with the SICAM Device Manager with the function “Signals” or with the SICAM TOOLBOX II, OPM II.

Processing type: *Firmware/* | `Trans_binary_information (cyclic IO)`



Parameter	
`TI`	Supported type identifications: • <TI:=30> .. Single-point information with time tag CP56Time2a • <TI:=31> .. Double-point information with time tag CP56Time2a
`Name`	Name of the signal
`104 address`	SICAM A8000 internal IEC 60870-5-101/104 message address (CASDU1, CASDU2, IOA1, IOA2, IOA3)
`PNIO_station_number`	SICAM A8000 internal station number for PROFINET-IO Slave: • 0 to 99
`PNIO_O_address`	Output address in netHOST according to configuration in SYCON.net: • 0 to 5699
`PNIO_bit_offset`	Bit offset in corresponding output byte: • 0 to 7 ... Single-point information • 0 to 6 ... Double-point information
`PNIO_data_format`	Data format on PROFINET-IO: • byte/flag • bit • OFF/ON • ON/OFF

Parameter	
PNIO_provider_status	Provider status on PROFINET-IO: • always valid • invalid: NT/IV = 1 The data point selective provider status is set to "invalid" for NT/IV = 1. • invalid: NT/IV = 1 + initialization The data point selective provider status is set to "invalid" after startup or with NT/IV = 1. The provider status affects all parameterized information objects of the submodule.
Error_behavior	Output on PROFINET-IO if NT = 1 or IV = 1: • Keep value • Output substitute value
Initial_value	After restart of the protocol element this initial value will be sent to PROFINET-IO slave. • The initial value is output on the PROFINET-IO until valid data is available. Valid range of values see *13.11.9 PROFINET-IO Data formats*.
Substitute value	Substitute value if disturbance behavior is set to ***output substitute value*** and the provider status = "always valid" is parameterized. Valid range of values see *13.11.9 PROFINET-IO Data formats*.

NOTE

The parameters **initial_value**, **substitute_value** and **error_behavior** must be adapted to the requirements of the application!

Supported Data Formats

Format	PROFINET-IO Data format	IEC 60870-5-101/104 Data format (TI)
BYTE/FLAG	byte/flag	30
1BIT	bit	30
2BIT	OFF/ON	31
2BIT	ON/OFF	31

NOTE

Since the data formats in PROFINET-IO are not defined in the output data, the PROFIBUS-DP data format must be specified for the conversion of SICAM A8000 → PROFINET-IO. Supported data formats see *13.11.9 PROFINET-IO Data formats*.

Message Conversion

The table describes the evaluated elements of the IEC 60870-5-101/104 message during message conversion.

Elements of the message		
TI .. Type identification		• <TI:=30> .. Single-point information with time tag CP56Time2a • <TI:=31> .. Double-point information with time tag CP56Time2a
CASDU, IOA .. Message address		Parameter-settable
QDS .. Quality descriptor		
BL .. Blocked		Not evaluated
SB .. Substituted		Not evaluated
NT .. Not topical		NT = 1: With provider status = "always valid", either the current state is retained or the parameterized **`substitute_value`** is output, depending on the parameter **`error_behavior`**. With provider status = "invalid", the output of the faulty data is done according to the manufacturer-specific function in the PROFINET-IO slave.
IV .. Invalid		IV = 1: Depending on the parameter **`error_behavior`**, either the current state is kept or the parameterized **`substitute_value`** is output.
Cause of transmission		
xx ..		Not evaluated
T .. Test		Not evaluated
Information		
Single-point information status		
SPI	0 .. OFF	Evaluated
	1 .. ON	Evaluated
Double point information state		
DPI	0 .. Indeterminate or intermediate state	Evaluated
	1 .. OFF	Evaluated
	2 .. ON	Evaluated
	3 .. Indeterminate state	Evaluated
Time tag		
CP56Time2a .. Date + time		Not rated

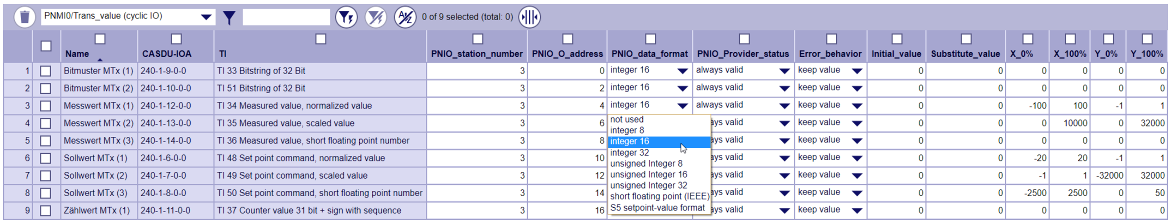
NOTE

Not listed elements of the IEC 60870-5-101/104 message are not rated / not supported!

Measured values, Setpoint values, Integrated Totals, Bitstrings

The parameterization of the address and message conversion for measured values, setpoint values, integrated totals, bitstrings in transmit direction is to be done with the SICAM Device Manager with the function "Signals" or with the SICAM TOOLBOX II, OPM II.

Processing type: *`firmware`* / **`Trans_value (cyclic IO)`**



PNMI0/Trans_value (cyclic IO) — 0 of 9 selected (total: 0)

		Name	CASDU-IOA	TI	PNIO_station_number	PNIO_O_address	PNIO_data_format	PNIO_Provider_status	Error_behavior	Initial_value	Substitute_value	X_0%	X_100%	Y_0%	Y_100%
1	☐	Bitmuster MTx (1)	240-1-9-0-0	TI 33 Bitstring of 32 Bit	3	0	integer 16	always valid	keep value	0	0	0	0	0	0
2	☐	Bitmuster MTx (2)	240-1-10-0-0	TI 51 Bitstring of 32 Bit	3	2	integer 16	always valid	keep value	0	0	0	0	0	0
3	☐	Messwert MTx (1)	240-1-12-0-0	TI 34 Measured value, normalized value	3	4	integer 16	always valid	keep value	0	0	-100	100	-1	1
4	☐	Messwert MTx (2)	240-1-13-0-0	TI 35 Measured value, scaled value	3	6	not used integer 8	ays valid	keep value	0	0	0	10000	0	32000
5	☐	Messwert MTx (3)	240-1-14-0-0	TI 36 Measured value, short floating point number	3	8	integer 16	ays valid	keep value	0	0	0	0	0	0
6	☐	Sollwert MTx (1)	240-1-6-0-0	TI 48 Set point command, normalized value	3	10	integer 32 unsigned Integer 8	ays valid	keep value	0	0	-20	20	-1	1
7	☐	Sollwert MTx (2)	240-1-7-0-0	TI 49 Set point command, scaled value	3	12	unsigned Integer 16 unsigned Integer 32	ays valid	keep value	0	0	-1	1	-32000	32000
8	☐	Sollwert MTx (3)	240-1-8-0-0	TI 50 Set point command, short floating point number	3	14	short floating point (IEEE)	ays valid	keep value	0	0	-2500	2500	0	50
9	☐	Zählwert MTx (1)	240-1-11-0-0	TI 37 Counter value 31 bit + sign with sequence	3	16	S5 setpoint-value format	ays valid	keep value	0	0	0	0	0	0

Parameter	
TI	Supported type identifications: • <TI:=33> .. Bitstring of 32 bits with time tag CP56Time2a • <TI:=34> .. Measured value, normalized value with time tag CP56Time2a • <TI:=35> .. Measured value, scaled value with time tag CP56Time2a • <TI:=36> .. Measured value, short floating-point number with time tag CP56Time2a • <TI:=37> .. Integrated total with time tag CP56Time2a • <TI:=48> .. Setpoint command, normalized value • <TI:=49> .. Setpoint command, scaled value • <TI:=50> .. Setpoint command, short floating-point number • <TI:=51> .. Bitstring 32-bit
Name	Name of the signal
104 address	SICAM A8000 internal IEC 60870-5-101/104 message address (CASDU1, CASDU2, IOA1, IOA2, IOA3)
PNIO_station_number	SICAM A8000 internal station number for PROFINET-IO Slave: • 0 to 99
PNIO_O_address	Output address in netHOST according to configuration in SYCON.net: • 0 to 5699
PNIO_data_format	Data format on PROFINET-IO: • Integer 8 • Integer 16 • Integer 32 • Unsigned integer 8 • Unsigned integer 16 • Unsigned integer 32 • Short floating-point (IEEE 754) • S5 setpoint-value format
PNIO_provider_status	Provider status on PROFINET-IO: • always valid • invalid: NT/IV = 1 The data point selective provider status is set to “invalid” for NT/IV = 1. • invalid: NT/IV = 1 + initialization The data point selective provider status is set to “invalid” after startup or with NT/IV = 1. The provider status affects all parameterized information objects of the submodule.

Parameter	
Error_behavior	Output on PROFINET-IO if NT = 1 or IV = 1 and provider status = "always valid": • Keep value • Output substitute value
Initial_value	After restart of the protocol element this initial value will be sent to PROFINET-IO slave. • The initial value is output on the PROFINET-IO until valid data is available. Valid range of values see *13.11.9 PROFINET-IO Data formats*.
Substitute value	Substitute value if error behavior is set to ***output substitute value*** (else = 0). Valid range of values see *13.11.9 PROFINET-IO Data formats*.
X_0%, X_100% **Y_0%, Y_100%**	Parameters for value adaptation (scaling): • <TI:=34, 48> .. **Y_0%** and **Y_100%** must not be greater or less than ±1. • <TI:=35, 49> .. **Y_0%** and **Y_100%** may not be smaller −32768 or greater +32767. • Value adaptation inactive at **Y_0%** and **Y_100%** = 0 Valid range of value for **X_0%** and **X_100%** see *13.11.9 PROFINET-IO Data formats*.

NOTE

The parameters **initial_value**, **substitute_value** and **error_behavior** must be adapted to the requirements of the application!

Supported Data Formats

Format	PROFINET-IO Data format	IEC 60870-5-101/104 Data format (TI)
INT8	Signed integer 8-bit (7-bit binary + S)	34, 35, 36, 48, 49, 50
INT16	Signed integer 16-bit (15-bit binary + S)	34, 35, 36, 37, 48, 49, 50
INT32	Signed integer 32-bit (31-bit binary + S)	34, 35, 36, 37, 48, 49, 50
UINT8	Unsigned integer 8-bit (8-bit binary)	34, 35, 36, 48, 49.50
UINT16	Unsigned integer 16-bit (16-bit binary)	34, 35, 36, 37, 48, 49, 50
UINT32	Unsigned integer 32-bit (32-bit binary)	33, 34, 35, 36, 37, 48, 49, 50, 51
FLOAT32	Short floating-point (IEEE 754)	34, 35, 36, 37, 48, 49, 50
S5INT12	Simatic S5, 12-bit (11-bit binary + S) "setpoint value - format"	34, 35, 36, 48, 49, 50

NOTE

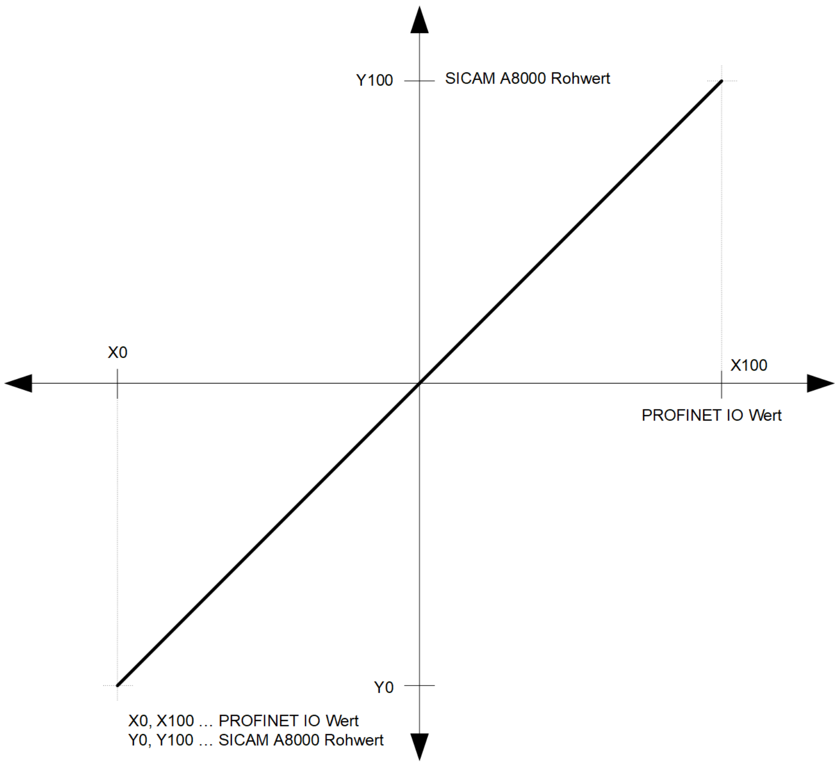
Since the data formats in PROFINET-IO are not defined in the output data, the PROFIBUS-DP data format must be specified for the conversion of SICAM A8000 → PROFINET-IO. Supported data formats see *13.11.9 PROFINET-IO Data formats*.

Control Location / Control Location Check

The function "Control location" is used so that setpoint values are only output from authorized sources. If the "Control location" function is activated, setpoint command from the protocol element for PROFINET-IO master are only transmitted to the PROFINET-IO device when the "control location" (originator address) is enabled. If the control location is not enabled, the protocol element immediately sends back a negative acknowledgment of activation (ACTCON-) to the originator address. Further details about setting control location / check control location see section *13.1.4.9 Control location function for commands and setpoint values*.

Value adaptation:[not for <TI:=33, 37, 51>

The value adaptation is defined by the parameters **`X_0%`**, **`X_100%`**, **`Y_0%`**, **`Y_100%`**.



The value adaptation is only performed if **`Y_0%`** or **`Y_100%`** ≠ *0* is parameterized.

- If the value adaptation is enabled and the SICAM A8000 raw value is less than **`Y_0%`** or greater than **`Y_100%`**, no conversion is carried out and the error message *`Error of format conversion in transmit direction`* is set.
  On PROFINET-IO, the last valid value is still output.
- If adaptation is not activated (= direct transfer) and the SICAM A8000 raw value is outside the value range of the selected PROFINET-IO data format, then no message conversion is done and the error message *`Error of format conversion in transmit direction`* is set.
  On PROFINET-IO, the last valid value is still output.

Message Conversion

The table describes the evaluated elements of the IEC 60870-5-101/104 message during message conversion.

Elements of the message		
TI .. Type identification		• <TI:=33> .. Bitstring of 32 bits with time tag CP56Time2a • <TI:=34> .. Measured value, normalized value with time tag CP56Time2a • <TI:=35> .. Measured value, scaled value with time tag CP56Time2a • <TI:=36> .. Measured value, short floating-point number with time tag CP56Time2a • <TI:=37> .. Integrated total with time tag CP56Time2a • <TI:=48> .. Setpoint command, normalized value • <TI:=49> .. Setpoint command, scaled value • <TI:=50> .. Setpoint command, short floating-point number • <TI:=51> .. Bitstring 32 bit
CASDU, IOA .. Message address		Parameter-settable
QDS .. Quality descriptor		
BL .. Blocked		Not evaluated
SB .. Substituted		Not evaluated
NT .. Not topical		NT = 1: With provider status = “always valid”, either the current state is retained or the parameterized **`substitute_value`** is output, depending on the parameter **`error_behavior`**. With provider status = “invalid”, the output of the faulty data is done according to the manufacturer-specific function in the PROFINET-IO slave.
IV .. Invalid		IV = 1: With provider status = “always valid”, either the current state is retained or the parameterized **`substitute_value`** is output, depending on the parameter **`error_behavior`**. With provider status = “invalid”, the output of the faulty data is done according to the manufacturer-specific function in the PROFINET-IO slave.
OV .. Overflow		Not evaluated
Cause of transmission		
06 .. Activation		Is evaluated (only “activation” allowed) [only <TI:=48, 49, 50, 51>]
xx .. Other COTs		Not evaluated [only <TI:=33, 34, 35, 36, 37>]
T .. Test		Not evaluated
Information		
Value.. S ..Sign		• Normalized value • Scaled value • IEEE STD 754 = short floating-point number • Dual meter reading • Bitstring 32 bit
QOS	S/E	[only <TI:=48, 49, 50>]
	0 = Execute	Is checked for “execute”
	1 = Select	Not supported
Time tag		
CP56Time2a .. Date + time		Not rated

NOTE

Not listed elements of the IEC 60870-5-101/104 message are not rated / not supported!

13.11.8.2 Message Conversion in Receive Direction (Master ← Slave)

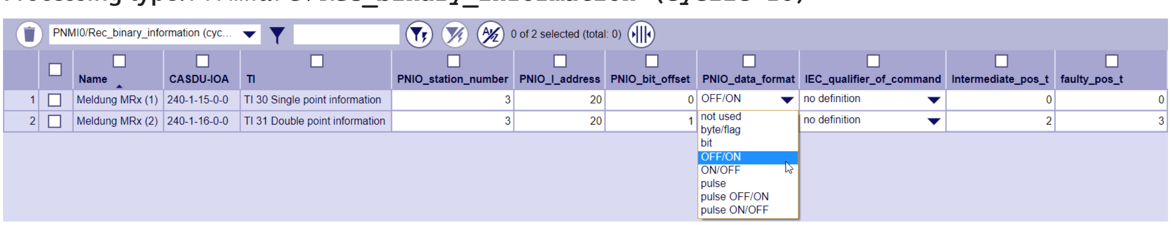
Message conversion in receive direction: IEC 60870-5-101/104 ← PROFINET-IO

SICAM A8000: IEC 60870-5-101/104 ←		PROFINET-IO
TI	**Designation**	**Data format**
<TI:=30>	Single-point information with time tag CP56Time2a	1BIT, BYTE/FLAG
<TI:=31>	Double-point information with time tag CP56Time2a	2BIT
<TI:=33>	Bitstring of 32 bits with time tag CP56Time2a	INT8, UINT8, INT16, UINT16, INT32, UINT32, FLOAT32, S5INT12S, S5INT13S
<TI:=34>	Measured value, normalized value with time tag CP56Time2a	INT8, UINT8, INT16, UINT16, INT32, UINT32, FLOAT32, S5INT12S, S5INT13S
<TI:=35>	Measured value, scaled value with time tag CP56Time2a	INT8, UINT8, INT16, UINT16, INT32, UINT32, FLOAT32, S5INT12S, S5INT13S
<TI:=36>	Measured value, floating-point number with time tag CP56Time2a	INT8, UINT8, INT16, UINT16, INT32, UINT32, FLOAT32, S5INT12S, S5INT13S
<TI:=37>	Integrated total with time tag CP56Time2a	INT16, UINT16, INT32, UINT32, FLOAT32
<TI:=45>	Single command	1BIT/PULSE
<TI:=46>	Double command	2BIT/PULSE
<TI:=47>	Regulating step command	2BIT/PULSE

Binary information items

The parameterization of the address and message conversion for binary information in receive direction is to be done with the SICAM Device Manager with the function “Signals” or with the SICAM TOOLBOX II, OPM II.

Processing type: *firmware* / **`Rec_binary_information (cyclic IO)`**



Parameter	
`TI`	Supported type identifications: • <TI:=30> .. Single-point information with time tag CP56Time2a • <TI:=31> .. Double-point information with time tag CP56Time2a
`Name`	Name of the signal
`CASDU-IOA`	SICAM A8000 internal IEC 60870-5-101/104 message address (CASDU1, CASDU2, IOA1, IOA2, IOA3)
`PNIO_station_number`	SICAM A8000 internal station number for PROFINET-IO Slave: • 0 to 99

Parameter	
PNIO_I_Address	Input address in netHOST according to configuration in SYCON.net: • 0 to 5651
PNIO_bit_offset	Bit number in corresponding input byte: • 0 to 7 ... Single-point information • 0 to 6 ... Double-point information
PNIO_data_format	Data format on PROFINET-IO: • byte/flag • bit • OFF/ON • ON/OFF
IEC_qualifier_of_command	IEC qualifier of command: (not relevant for single/double-point information)
Intermediate_pos_t	Intermediate position suppression time 0 to 255 s
Faulty_pos_t	Faulty position suppression time: 0 to 255 s

Supported Data Formats

Format	PROFINET-IO Data format	IEC 60870-5-101/104 Data format (TI)
BYTE/FLAG	byte/flag	30
1BIT	bit	30
2BIT	OFF/ON	31
2BIT	ON/OFF	31

NOTE

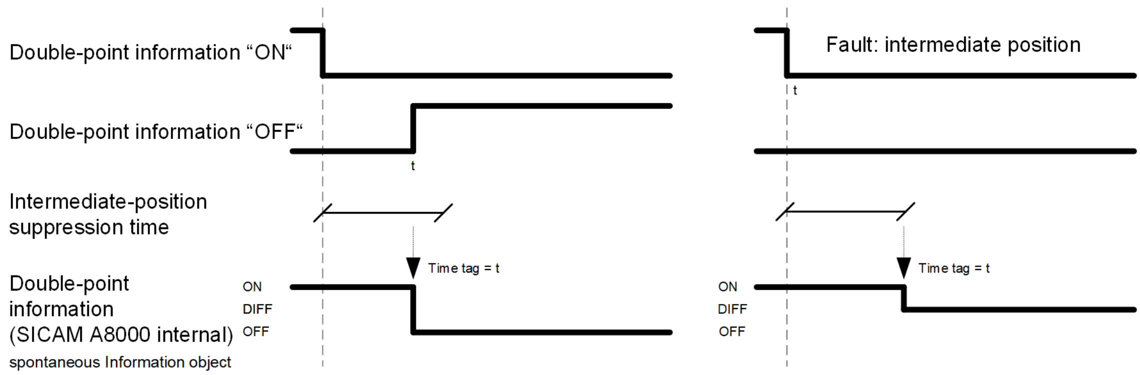
Since the data formats in PROFINET-IO are not defined in the input data, the PROFINET-IO data format must be specified for the conversion from PROFINET-IO → SICAM A8000. Supported data formats see *13.11.9 PROFINET-IO Data formats*.

Monitoring for Intermediate and Faulty Position

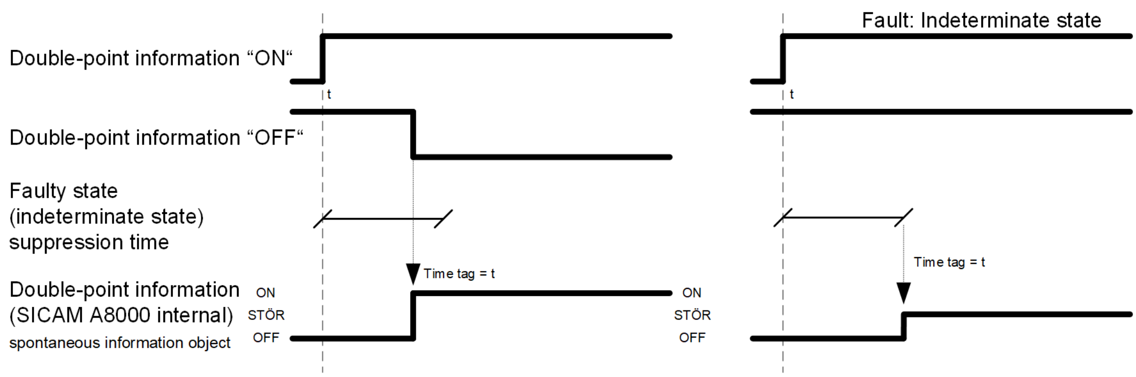
The transfer of an intermediate position (neither ON- nor OFF binary information exists) or a faulty position (both ON- as well as OFF binary information exists) from PRE → BSE is suppressed for a parameterizable time.

For the suppression of the intermediate position an intermediate-position suppression time (parameter **Intermediate_pos_t**) can be parameterized for each double-point information.

For the suppression of the faulty position a faulty position suppression time (parameter **Faulty_pos_t**) can be parameterized for each double-point information.



[Doppelmeldung_Diff, 1, en_US]



[Doppelmeldung_Stoer, 1, en_US]

Message Conversion

The table describes the evaluated elements of the IEC 60870-5-101/104 message during message conversion.

Elements of the message		
TI .. Type identification		• <TI:=30> .. Single-point information with time tag CP56Time2a • <TI:=31> .. Double-point information with time tag CP56Time2a
CASDU, IOA .. Message address		Parameter-settable
QDS .. Quality descriptor		
BL .. Blocked		Not supported (BL = 0)
SB .. Substituted		Not supported (SB = 0)
NT .. Not topical		NT = 1 if provider_status = "invalid" (else NT = 0)
IV .. Invalid		Not supported (IV = 0)
Cause of transmission		
03 .. Spontaneous		Upon change of information state or quality descriptor
20 .. Interrogated by station interrogation		Upon reception of a GI request
xx .. Other COTs		Not supported
T .. Test		Not supported
Information		
Single-point information status		
SPI	0 .. OFF	Supported
	1 .. ON	Supported
Double-point information state		

Elements of the message		
DPI	0 .. Indeterminate or intermediate state	Supported
	1 .. OFF	Supported
	2 .. ON	Supported
	3 .. Indeterminate state	Supported
Time tag		
CP56Time2a .. Date + time		protocol-internal time (receive time)

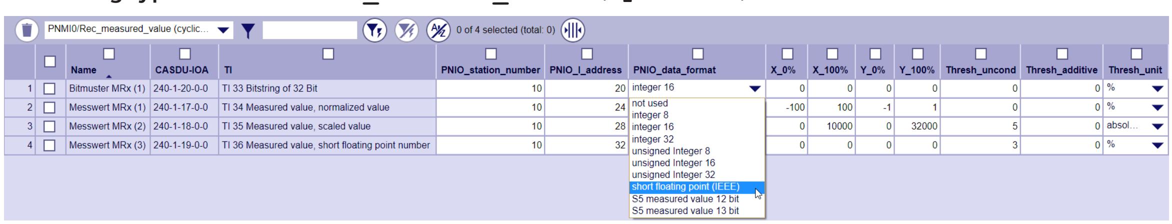
NOTE

Not listed elements of the IEC 60870-5-101/104 message are not rated/not supported!

Measured Values, Bitstrings

The parameterization of the address and message conversion for measured values, bitstrings in receive direction is to be done with the SICAM Device Manager with the function “Signals” or with the SICAM TOOLBOX II, OPM II.

Processing type: *firmware* / `Rec_measured_value (cyclic IO)`



Parameter	
`TI`	Supported type identifications: • <TI:=33> .. Bitstring of 32 bits with time tag CP56Time2a • <TI:=34> .. Measured value, normalized value with time tag CP56Time2a • <TI:=35> .. Measured value, scaled value with time tag CP56Time2a • <TI:=36> .. Measured value, short floating-point number with time tag CP56Time2a
`Name`	Name of the signal
`104 address`	SICAM A8000 internal IEC 60870-5-101/104 message address (CASDU1, CASDU2, IOA1, IOA2, IOA3)
`PNIO_station_number`	SICAM A800 internal station number for PROFINET-IO Slave: • 0 to 99
`PNIO_I_Address`	Input address in netHOST according to configuration in SYCON.net: • 0 to 5651

Parameter	
PNIO_data_format	Data format on PROFINET-IO: • Integer 8 • Integer 16 • Integer 32 • Unsigned integer 8 • Unsigned integer 16 • Unsigned integer 32 • Short floating-point (IEEE 754) • S5 Measured value 12 Bit • S5 Measured value 13 Bit
X_0%, X_100% **Y_0%, Y_100%**	Parameters for value adaptation (scaling): • <TI:=34> .. **Y_0%** and **Y_100%** must not be greater or less than ±1. • <TI:= 35> .. **Y_0%** and **Y_100%** may not be smaller –32768 or greater +32767. • Value adaptation inactive at **X_0%** = 0 and **X_100%** = 0. Valid range of value for **X_0%** and **X_100%** see *13.11.9 PROFINET-IO Data formats*.
Thresh_uncond	If the value changes > **Thres_uncond**, the received value is immediately forwarded to the BSE.
Thresh_additive	If the value changes ≤ **Thres_uncond**, the received value is not immediately forwarded to the BSE and the additive change monitoring is performed.
Thresh_unit	• Absolute value (received value from PROFINET-IO) • %

Supported Data Formats

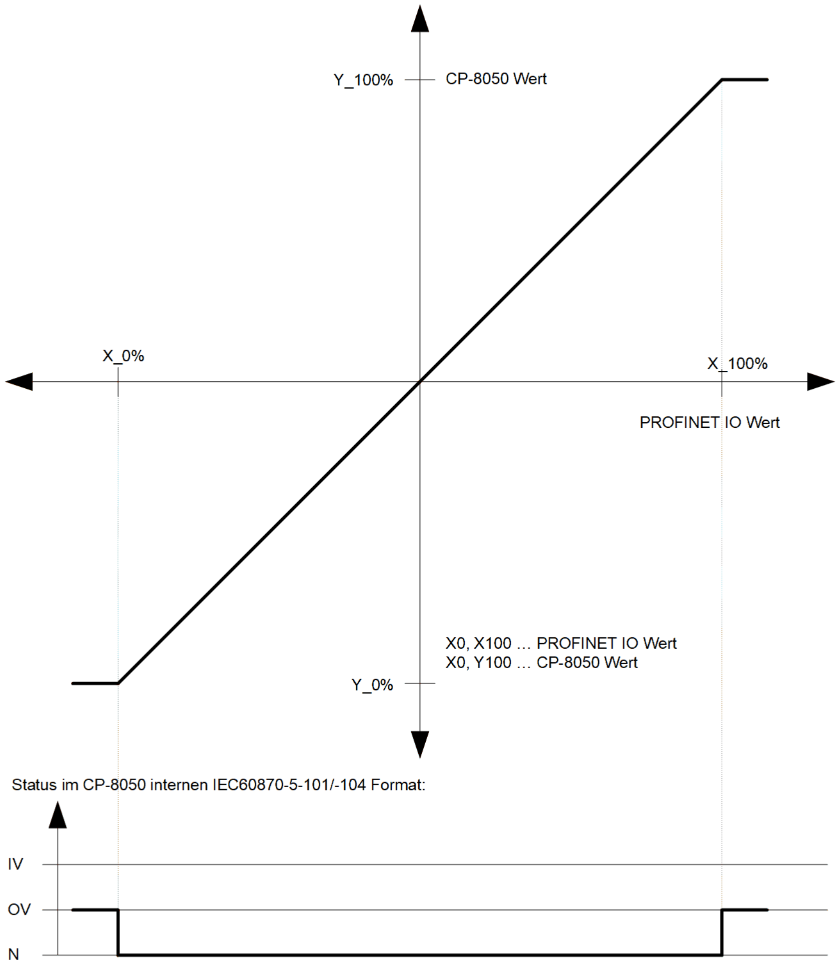
Format	PROFINET-IO Data format	IEC 60870-5-101/104 Data format (TI)
INT8	Signed integer 8-bit (7-bit binary + S)	33, 34, 35, 36
INT16	Signed integer 16-bit (15-bit binary + S)	33, 34, 35, 36
INT32	Signed integer 32-bit (31-bit binary + S)	33, 34, 35, 36
UINT8	Unsigned integer 8-bit (8-bit binary)	33, 34, 35, 36
UINT16	Unsigned integer 16-bit (16-bit binary)	33, 34, 35, 36
UINT32	Unsigned integer 32-bit (32-bit binary)	33, 34, 35, 36
FLOAT32	Short floating-point (IEEE 754)	33, 34, 35, 36
S5INT12S	Simatic S5, 12-bit (11-bit binary + status + S) "measured value format"	33, 34, 35, 36
S5INT13S	Simatic S5, 13-bit (12-bit binary + status + S) "measured value format"	33, 34, 35, 36

NOTE

Since the data formats in PROFINET-IO are not defined in the input data, the PROFINET-IO data format must be specified for the conversion from PROFINET-IO → SICAM A8000. Supported data formats see *13.11.9 PROFINET-IO Data formats*.

Value adaptation:[not for <TI:=33>]

The value adaptation is defined by the parameters **`X_0%`**, **`X_100%`**, **`Y_0%`**, **`Y_100%`**.



The value adaptation is only performed if **`X_0%`** or **`X_100%`** ≠ *0* is parameterized.

If the PROFINET-IO value is outside the value range of the selected IEC 60870-5-101/104 type identifier when the value adaptation is not activated (= direct transfer), then OV = 1 is set.

Message Conversion

The table describes the evaluated elements of the IEC 60870-5-101/104 message during message conversion.

Elements of the message	
TI .. Type identification	• <TI:=33> .. Bitstring of 32 bits with time tag CP56Time2a • <TI:=34> .. Measured value, normalized value with time tag CP56Time2a • <TI:=35> .. Measured value, scaled value with time tag CP56Time2a • <TI:=36> .. Measured value, short floating-point number with time tag CP56Time2a
CASDU, IOA .. Message address	Parameter-settable
QDS .. Quality descriptor	
BL .. Blocked	Not supported (BL = 0)
SB .. Substituted	Not supported (SB = 0)

Elements of the message	
NT .. Not topical	NT = 1 if provider_status = “invalid” (else NT = 0)
IV .. Invalid	IV = 1 at: • FLOAT32 format with the value = NAN (Not A Number) • S5INT12S, S5INT13S with F = 1 (open-circuit) (otherwise IV = 0)
OV .. Overflow	OV = 1: Without value adaptation: • PROFINET-IO value outside the range of the selected type identification With value adaptation: • PROFINET-IO value less than X_0% or greater X_100% • S5INT12S, S5INT13S with Ü = 1 (overflow)
Cause of transmission	
03 .. Spontaneous	Alteration of the measured value depending on the thresholds or alteration of the quality descriptor
20 .. Interrogated by station interrogation	Upon reception of a GI request
xx .. Other COTs	Not supported
T .. Test	Not supported
Information	
Value.. S .. Sign	• Normalized value • Scaled value • IEEE STD 754 = short floating-point number • Bitstring 32 bit
Time tag	
CP56Time2a .. Date + time	protocol-internal time (receive time)

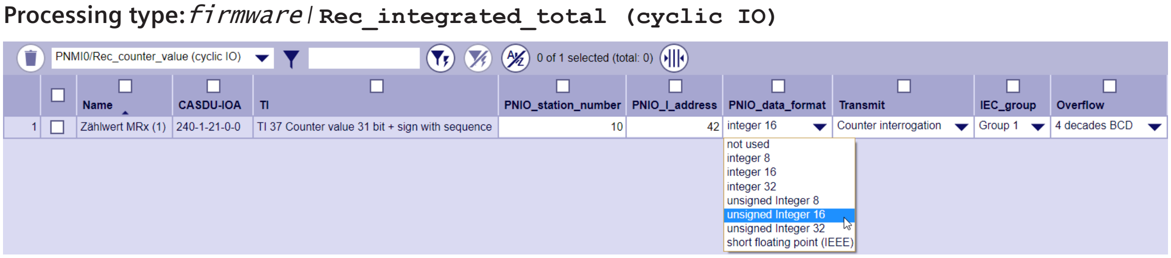
NOTE

Not listed elements of the IEC 60870-5-101/104 message are not rated/not supported!

Integrated Totals

The parameterization of the address and message conversion for integrated totals in receive direction is to be done with the SICAM Device Manager with the function “Signals” or with the SICAM TOOLBOX II, OPM II.

Processing type: *firmware* / `Rec_integrated_total (cyclic IO)`



Parameter	
`TI`	Supported type identifications: • <TI:=37> .. Integrated total with time tag CP56Time2a
Name	Name of the signal
`104 address`	SICAM A8000 internal IEC 60870-5-101/104 message address (CASDU1, CASDU2, IOA1, IOA2, IOA3)
`PNIO_station_number`	SICAM A8000 internal station number for PROFINET-IO Slave: • 0 to 99
`PNIO_I_Address`	Input address in netHOST according to configuration in SYCON.net: • 0 to 5651
`PNIO_data_format`	Data format on PROFINET-IO: • Integer 8 • Integer 16 • Integer 32 • Unsigned integer 8 • Unsigned integer 16 • Unsigned integer 32 • Short floating-point (IEEE 754)
`Transmit`	Counter transmission at: • Counter Interrogation • Cyclically every 1, 2, 3, 5, 10, 15, 30, 60 minutes
`IEC_group`	IEC 60870-5-101/104 counter group: • Group 1 to 4
`Overflow`	Overflow treatment at: • 24, 31 bit integer • 2, 3, 4, 5, 6, 7, 8, 9 decades BCD

Supported Data Formats

Format	PROFINET-IO Data format	IEC 60870-5-101/104 Data format (TI)
INT8	Signed integer 8-bit (7-bit binary + S)	37
INT16	Signed integer 16-bit (15-bit binary + S)	37
INT32	Signed integer 32-bit (31-bit binary + S)	37
UINT8	Unsigned integer 8-bit (8-bit binary)	37
UINT16	Unsigned integer 16-bit (16-bit binary)	37
UINT32	Unsigned integer 32-bit (32-bit binary)	37
FLOAT32	Short floating-point (IEEE 754)	37

NOTE

Since the data formats in PROFINET-IO are not defined in the input data, the PROFINET-IO data format must be specified for the conversion from PROFINET-IO → SICAM A8000. Supported data formats see *13.11.9 PROFINET-IO Data formats*.

Message Conversion

The table describes the evaluated elements of the IEC 60870-5-101/104 message during message conversion.

Elements of the message	
TI .. Type identification	• <TI:=37> .. Integrated total with time tag CP56Time2a
CASDU, IOA .. Message address	Parameter-settable
Data point quality descriptor	
Sequence number	With each trigger for latching for a group the sequence number is increased in the range from 1 to 31.
CY .. Carry	On overflow of the count in the associated count period
CA .. Presets	Not supported
IV .. Invalid	IV = 1 if provider_status = "invalid" (else IV = 0)
Cause of transmission	
03 .. Spontaneous	When transmitting = "periodical data transfer"
37 .. Requested by general counter interrogation	For general counter interrogation
38-41 .. Interrogated by group 1 to 4 interrogation	For request counter group (1 to 4)
T .. Test	Not supported
Information	
Value.. S .. Sign	• Dual meter reading
Time tag	
CP56Time2a .. Date + time	Protocol internal time

NOTE

Not listed elements of the IEC 60870-5-101/104 message are not rated/not supported!

Message Conversion "Counter Interrogation Command" (SICAM A8000 internal only)

The table describes the evaluated elements of the IEC 60870-5-101/104 message during message conversion.

<table>
<tr><th colspan="3">Elements of the message</th></tr>
<tr><td colspan="2">TI .. Type identification</td><td>• <TI:=101> .. Counter interrogation command</td></tr>
<tr><td colspan="2">CASDU, IOA .. Message address</td><td>Defined</td></tr>
<tr><td colspan="2">QCC .. Identifier counter interrogation</td><td></td></tr>
<tr><td>FRZ</td><td>RQT</td><td>FRZ ... Freeze
RQT ... Request</td></tr>
<tr><td rowspan="2">0</td><td>1 to 4</td><td>Read (no freeze or reset)
Counter interrogation (1 to 4)</td></tr>
<tr><td>5</td><td>Read (no freeze or reset)
General counter interrogation</td></tr>
<tr><td rowspan="2">1</td><td>1 to 4</td><td>Counter freeze without reset
Request counter group (1 to 4)</td></tr>
<tr><td>5</td><td>Counter freeze without reset
All counter groups</td></tr>
</table>

Elements of the message		
2	1 to 4	Counter freeze with reset Request counter group (1 to 4)
	5	Counter freeze without reset All counter groups
3	1 to 4	Reset counter Request counter group (1 to 4)
	5	Reset counter All counter groups
x	0; 6 .. 63	Not supported
Cause of transmission		
06 .. Activation		Is evaluated (only “activation” allowed)
xx .. Other COTs		Not supported
T ..Test		Not supported

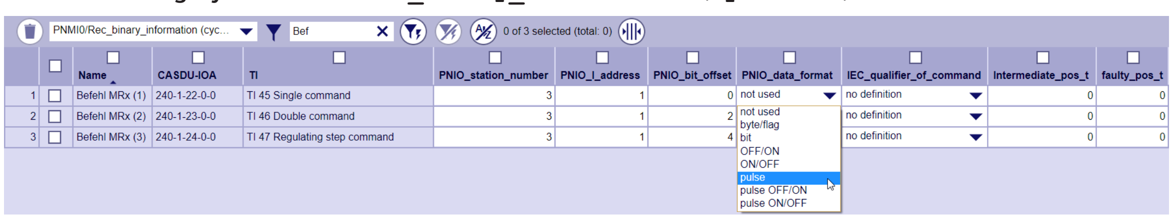
NOTE

Not listed elements of the IEC 60870-5-101/104 message are not rated/not supported!

Commands

The parameterization of the address and message conversion for commands in receive direction is to be done with the SICAM Device Manager with the function “Signals” or with the SICAM TOOLBOX II, OPM II.

Parameter category: *firmware* | `Rec_binary_information (cyclic IO)`



Parameter	
`TI`	Supported type identifications: • <TI:=45> .. Single command • <TI:=46> .. Double command • <TI:=47> .. Regulating step command
`CASDU-IOA`	SICAM A8000 internal IEC 60870-5-101/104 message address
`PNIO_station_number`	SICAM A8000 internal station number for PROFINET-IO Slave: • 0 to 99
`PNIO_I_Address`	Input address in netHOST according to configuration in SYCON.net: • 0 to 5651
`PNIO_bit_offset`	Bit number in corresponding input byte: • 0 to 7 ... Single command • 0 to 6 ... Double command or regulating step command

Parameter	
PNIO_data_format	Data format on PROFINET-IO: • pulse • pulse OFF/ON • pulse ON/OFF
IEC_quali-fier_of_command	IEC qualifier of command: • none • short • long

Supported Data Formats

Format	PROFINET-IO Data format	IEC 60870-5-101/104 Data format (TI)
1BIT/PULSE	pulse	45
2BIT PULSE	pulse OFF/ON	46, 47
2BIT PULSE	pulse ON/OFF	46, 47

NOTE

Since the data formats in PROFINET-IO are not defined in the input data, the PROFINET-IO data format must be specified for the conversion from PROFINET-IO → SICAM A8000. Supported data formats see *13.11.9 PROFINET-IO Data formats*.

Commands in Receive Direction

Commands from PROFINET-IO Slaves → SICAM A8000 must be transmitted as a “1-bit pulse” or as a “2-bit pulse” with a limited pulse duration. The processing of commands by the protocol element is edge-triggered; only the positive edge is evaluated.
The impulse transmission in commands is necessary to prevent unwanted actions possible by the transmission of states after power UP.

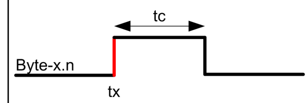
Command output time

The command output time (= qualifier of command) is selectively assigned to each command in the IEC Command ID field:

- none ... <0> “no additional definition”
- short .... <1> “short command execution time”
- long .... <2> “long command execution time”

Single command

A pulse with a positive edge in the PROFINET-IO input data is converted to an IEC 60870-5-101/104 single command with the status SCS = ON.
The negative edge is not evaluated; the duration of the pulse is not monitored.

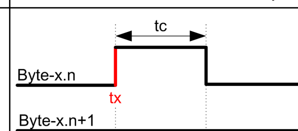
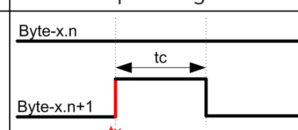
PROFINET-IO Data format	Command state	Command pulse (1 bit in input range)
pulse	SCS = ON	 tc ... command output time (pulse duration at PROFINET-IO) tx ... single command with pos. edge
	SCS = OFF	The OFF state is not evaluated!

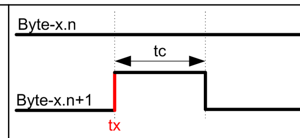
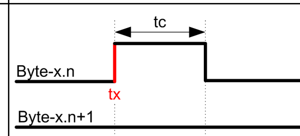
Double command / Regulating step command

A pulse with a positive edge in the PROFINET-IO input data is converted to an IEC 60870-5-101/104 double command or regulating step command with the status DCS = ON/OFF or RCS = HIGHER/LOWER.

The negative edge is not evaluated; the duration of the pulse is not monitored.

PROFINET-IO Data format	Command state	PNIO_I_Address
pulse ON/OFF	ON	parameterized PNIO_I_Address; Bitoffset
	OFF	parameterized PNIO_I_Address; Bitoffset + 1
pulse OFF/ON	ON	parameterized PNIO_I_Address; Bitoffset + 1
	OFF	parameterized PNIO_I_Address; Bitoffset

PROFINET-IO Data format	Command state	Command pulse (2 bit in input range)
pulse ON/OFF	DCS = ON RCS = HIGHER	 tc ... command output time (pulse duration at PROFINET-IO) tx ... Double command / regulating step command with pos. edge
	DCS = OFF RCS = LOWER	 tc ... command output time (pulse duration at PROFINET-IO) tx ... Double command / regulating step command with pos. edge

pulse OFF/ON	DCS = ON RCS = HIGHER	 tc ... command output time (pulse duration at PROFINET-IO) tx ... Double command / regulating step command with pos. edge
	DCS = OFF RCS = LOWER	 tc ... command output time (pulse duration at PROFINET-IO) tx ... Double command / regulating step command with pos. edge

Message Conversion

The table describes the evaluated elements of the IEC 60870-5-101/104 message during message conversion.

Elements of the message		
TI .. Type identification		• <TI:=45> .. Single command • <TI:=46> .. Double command • <TI:=47> .. Regulating step command
CASDU, IOA .. Message address		Parameter-settable
Cause of transmission		
06 .. Activation		Supported
xx .. Other COTs		Not supported
T .. Test		Not supported
Information		
SCO/DCO/RCO		
SCS	Single command state	[only <TI:=45>]
	0 .. OFF	Not supported
	1 .. ON	Supported
DCS	Double command state	[only <TI:=46>]
	0 .. Not allowed	Not supported
	1 .. OFF	Supported
	2 .. ON	Supported
	3 .. Not allowed	Not supported
RCS	Regulating step command state	[only <TI:=47>]
	0 .. Not allowed	Not supported
	1 .. Next step lower	Supported
	2 .. Next step higher	Supported
	3 .. Not allowed	Not supported

Elements of the message		
QOC	S/E	
	0 = Execute	Supported
	1 = Select	Not supported
QU	Command qualifier	
	0 .. No additional definitions	Supported
	1 .. Short pulse duration	Supported
	2 .. Long pulse duration	Supported
	3 .. Persistent command	Not supported

NOTE

Not listed elements of the IEC 60870-5-101/104 message are not rated/not supported!

13.11.9 PROFINET-IO Data formats

Supported PROFINET-IO data formats

Format #	Format	Designation
General formats		
1	1BIT	1 bit (ON, OFF)
2	1BIT/PULSE	1 bit (ON, OFF) OFF controlled by PRE after timeout (command output time)
3	2BIT	2 Bit (ON, OFF) (OFF before ON or ON before OFF)
4	2BIT/PULSE	2 Bit (ON, OFF) (OFF before ON or ON before OFF) OFF controlled by PRE after timeout (command output time)
5	BYTE/FLAG	8-Bit binary (0 = OFF, <> 0 = ON)
6	INT8	Signed integer 8-bit (7-bit binary + S)
7	UINT8	Unsigned integer 8-bit (8-bit binary)
8	INT16	Signed integer 16-bit (15-bit binary + S)
9	UINT16	Unsigned integer 16-bit (16-bit binary)
10	INT32	Signed integer 32-bit (31-bit binary + S)
11	UINT32	Unsigned integer 32-bit (32-bit binary)
12	FLOAT32	Short floating-point (IEEE 754)
Device specific formats		
100	S5INT12	Simatic S5, 12 Bit (11 Bit binary + S) “setpoint value - format”
101	S5INT12S	Simatic S5, 12 Bit (11 Bit binary + status + S) “measured value - format”
102	S5INT13S	Simatic S5, 13 Bit (12-bit binary + status + S) "measured value format"

NOTE

Data formats larger than 1 Byte are always displayed/transmitted in PROFINET-IO in "Big Endian" (HIGH before LOW order).

Format-1: 1BIT

Single-point information (bit) in Input/Output Byte. Reference: Offset = x / Bit# = n (0 to 7).

Value range: 0, 1
<0> = OFF
<1> = ON

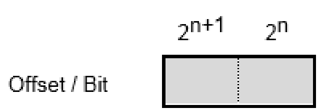
Format-2: 1BIT/Impulse

Pulse command in Output Byte. Reference: Offset = x / Bit# = n (0 to 7).

Value range: 0, 1
<0> = OFF
<1> = ON
Note: After expiration of the command output time, the state is set to OFF by the PRE.

Format-3: 2BIT – OFF/ON, ON/OFF

2 adjacent Bits in the Input/Output byte. Reference: Offset = x / Bit# = n (0 to 6), Bit# = n+1 (1 to 7).
Note: The 2 bits must always be in the same Input/Output Byte.



Value range: 0 to 3

Assignment: 2BIT - OFF/ON
<0> = Indeterminate or intermediate state
<1> = OFF
<2> = ON
<3> = Indeterminate state

Assignment 2BIT - ON/OFF
<0> = Indeterminate or intermediate state
<1> = ON
<2> = OFF
<3> = Indeterminate state

Format-4: 2BIT/Pulse – OFF/ON, ON/OFF

2 adjacent bits (pulse command) in the Input/Output byte. Reference: Offset = x / Bit# = n (0 to 6), Bit# = n+1 (1 to 7).
Note: The 2 bits must always be in the same Input/Output Byte.

	2^{n+1}	2^n
Offset / Bit		

Value range: 0 to 3

Assignment: 2BIT/PULSE-OFF/ON
<0> = inactive
<1> = OFF
<2> = ON
<3> = Not allowed

Assignment 2BIT/PULSE-ON/OFF
<0> = inactive
<1> = ON
<2> = OFF
<3> = Not allowed

Note: After expiration of the command output time in transmit direction, the state is set to "inactive" by the PRE.

Format-5: BYTE/FLAG (8 Bit binary)

	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
Offset = x+0	2^7							2^0

Value range: 0 to 255
Assignment:
<00> = OFF
<01 to 255> = ON

Format-6: INT8 – Unsigned Integer 8-Bit (7-Bit Binary + S)

	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
Offset = x+0	S	2^6						2^0

Value range: –128 0 to +127
Sign (S): 0 = "+", 1 = "-"
Note: Negative values are represented in two's complement.

Format-7: UINT8 – Unsigned Integer 8-Bit (8-Bit Binary)

	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
Offset = x+0	2^7							2^0

Value range: 0 to 255

Format-8: INT16 – Unsigned Integer 16-Bit (15-Bit Binary + S)

	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
Offset= x+0	S	2^{14}						2^8
Offset = x+1	2^7							2^0

Value range: –32768 0 to +32767
Sign (S): 0 = "+", 1 = "-"
Note: Negative values are represented in two's complement.

Format-9: UINT16 – Unsigned Integer 16-Bit (16-Bit Binary)

	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
Offset= x+0	2^{15}							2^8
Offset = x+1	2^7							2^0

Value range: 0 to 65535

Format-10: INT32 – Unsigned Integer 32-Bit (31-Bit Binary + S)

	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
Offset = x+0	S	2^{30}						2^{24}
Offset = x+1	2^{23}							2^{16}
Offset = x+2	2^{15}							2^8
Offset = x+3	2^7							2^0

Value range: -2 147 483 648 to 0 to +2 147 483 647
Sign (S): 0 = "+", 1 = "-"
Note: Negative values are represented in two's complement.

Format-11: UINT32 – Unsigned Integer 32-Bit (32-Bit Binary)

	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
Offset = x+0	2^{31}							2^{24}
Offset = x+1	2^{23}							2^{16}
Offset = x+2	2^{15}							2^8
Offset = x+3	2^7							2^0

Value range: 0 to 4 294 967 295

Format-12: FLOAT32 – Short Floating-Point (IEEE 754)

Note: The format complies with the IEEE 754 floating - point format specification.

	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0	
Offset = x+0	S	2^7						2^1	Exponent, S
Offset = x+1	2^0	2^{-1}						2^{-7}	Mantissa
Offset = x+2	2^{-8}							2^{-15}	Mantissa
Offset = x+3	2^{-16}							2^{-23}	Mantissa

Value range: $1 \cdot 10^{-38}$ to ~ $3{,}4 \cdot 10^{38}$
Sign (S): 0 = "+", 1 = "-"
Exponent: <255> = "NaN" (not a number) or ∞

Format-100: S5INT12 – Simatic S5, 12 Bit (11 Bit binary + S) “setpoint value format“

	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
Offset= x+0	S	2^{10}						2^4
Offset = x+1	2^3			2^0	0	0	0	0

Value range: –2048 0 to +2047
Sign (S): 0 = "+", 1 = "-"
Note: Negative values are represented in two's complement.

Format-101: S5INT12S – Simatic S5, 12-Bit (11-Bit Binary + State + S) "Measured value format"

	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
Offset= x+0	S	2^{10}						2^4
Offset = x+1	2^3			2^0	X	X	E	O

Value range: –2048 0 to +2047
Sign (S): 0 = "+", 1 = "-"
Note: Negative values are represented in two's complement.

Status: E .... Error bit ("open-circuit")
O .... Overflow bit
X .... not used (=0)

Format-102: S5INT13S – Simatic S5, 13-Bit (12-Bit Binary + State + S) "Measured value format"

	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
Offset= x+0	S	2^{11}						2^5
Offset = x+1	2^4				2^0	X	E	O

Value range: –4096 0 to +4095

Sign (S): 0 = "+", 1 = "-"

Note: Negative values are represented in two's complement.

Status: E .... Error bit ("open-circuit")
O .... Overflow bit
X .... not used (=0)

13.12 AGP (Power Distributor Branch Specific Test Equipment)

13.12.1 Introduction

The AGP protocol is a serial transmission protocol for coupling the AGP (Power distributor branch specific test equipment). The AGP is only connected via fiber optic cables. An additional media converter RS-232 ↔ optical is required for this.

Protocol fiirmware for coupling AGP:

Firmware	System	Standard and function
AGPMI0	CP-8031, CP-8050	AGP protocol master (end-end protocol for coupling the "Power distributor branch specific test equipment")

Power distributor branch specific test equipment

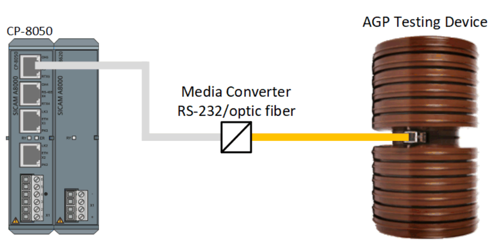
The trend towards compact, factory-ready, type-tested indoor switchgear places new demands on the line test to be integrated. If the test continues to be carried out conventionally, the advantages of compact concepts are quickly exhausted. The traditional primary devices (switching element, test rail and in particular the test resistor with its heat development) do not fit into the desired types of switchboards.

The AGP uses a resource-saving, low-loss method, which can be used in branch-connected compact switch cells. Discriminating faulty networks provides safe results even on large networks with high cable counts. According to the state of the art, the device is maintenance-free.

The AGP requires no external power supply. By means of AGP, an energy pulse is controlled synchronously from the covered operating rail to the mains voltage to the trolley branch to be tested. The resulting current profile is evaluated by the integrated control unit.

The test request, the test result and the status of the test device are serially exchanged via a fiber optic connection between the control unit (under high voltage) and an associated field device.

Schematic configuration:



[AGPMI0_Configuration_Basic, 1, en_US]

13.12.2 Functions

Function	AGPMI0
AGP - Power distributor branch specific test equipment	
Serial communication protocol based on IEC 60870-5-2 for coupling the AGP (Power distributor branch specific test equipment)	✓
Unbalanced transmission:	✓
• CP-8031, CP-8050 = Master	✓
• AGP = Slave	✓
• Max. number of connected AGP devices per interface	1
Network configuration	
Point-to-point configuration (Master + 1 Slave)	✓

Function	AGPMI0
Physical interface	
RS-232 (external media converter “RS-232↔optical” required)	✓
Physical interface at the AGP	
Optical interface (plastic fiber optic with ST plug)	✓
Baud rates	
38400 bit/s	✓
Bit transmission layer / message frame	
Message frame according to IEC 60870-5-1/FT1.2	✓
Byte frame = 11 bits (8E1)	✓
Message protection d = 4:	
• Checksum (8 bits) + parity bit (even) + transmission rules	✓
Pulse code modulation, byte asynchronous	✓
Message length	1 to 255 bytes
AGP functions	
Acquisition of events (transmission of data ready to be sent):	✓
• Data acquisition by polling (status indications, measured values) after request, if the test conditions are met	✓
Indications:	✓
• Suppression of intermediate and faulty position for double-point information	✓
General Interrogation:	✓
• Answering of the general interrogation from the process image of the protocol firmware	✓
• Emulation of ACTCON/ACTTERM for general interrogation (according IEC 60870-5-101/104)	–
Command transmission:	✓
• Spontaneous, if the test conditions are met	✓
• Control location function (set/check control location)	–
“Select Before Operate” for commands and setpoint values	–
• Emulation of ACTCON for commands/setpoint values according IEC 60870-5-101/104	✓
• Emulation of ACTCON- for commands/setpoint values (according to IEC 60870-5-101/104) when a command is discarded from an unreleased control location.	–
• Emulation of ACTTERM for commands/setpoint values (according IEC 60870-5-101/104)	–
Clock synchronization	–
Supported IEC60870-5-101/104 data formats in transmit direction **(command or control direction)**	
<TI:=34> .. Measured value, normalized value with time tag CP56Time2a	✓
<TI:=35> .. Measured value, scaled value with time tag CP56Time2a	
<TI:=36> .. Measured value, short floating-point number with time tag CP56Time2a	
<TI:=45> .. Single command	
<TI:=48> .. Setpoint command, normalized value	
<TI:=49> .. Setpoint command, scaled value	
<TI:=50> .. Setpoint command, short floating-point number	

Function	AGPMI0
Supported IEC 60870-5-101/104 data formats in receive direction **(signaling or monitoring direction)**	
<TI:=30> .. Single-point information with time tag CP56Time2a	
<TI:=31> .. Double-point information with time tag CP56Time2a	
<TI:=34> .. Measured value, normalized value with time tag CP56Time2a	✓
<TI:=35> .. Measured value, scaled value with time tag CP56Time2a	
<TI:=36> .. Measured value, short floating-point number with time tag CP56Time2a	
Redundancy (functions for the support of redundant communication routes)	
Protocol redundancy	
• "Tristate" of RS-232 interface when passive	–
• Listening mode when passive	–
Port redundancy	
• Deactivation of interface (with redundancy control message)	–
• Activation/Deactivation of interface when passive with protocol element control message	–
Device redundancy	–
Web server	
Log internal diagnostic- and statistic information via protocol-specific web pages	✓
Engineering	
SICAM Device Manager	✓
SICAM TOOLBOX II	✓

13.12.3 Modes of Operation

The operating mode of the interface is determined by parameters of the protocol element and optional equipment.

Standard Operation Mode	Interface →optional DCE	Interface signals
Unbalanced interchange circuit (V.24/V.28) RS-232 asynchronous	X5 → Media converter (RS-232/ optical) UN1373BiS	RXD, TXD, CTS [371], GND

13.12.4 Communication

For the stations to communicate with each other, suitable transmission facilities and/or network components may be needed in addition.

Own Station AGP Master" (central station)

System	System element	Protocol Element	Remarks
SICAM A8000 Series	CP-8031/CPCI85 CP-8050/CPCI85 CP-8050/EPCI85	AGPMI0	max. 1 AGP device as remote station

Remote Station AGP (Substation)

System	System element	Protocol Element	Remarks
Siemens AGP	–	–	

371 not usable (reserved for SICAM TOOLBOX II)

13.12.5 Communication According to AGP

For the data transmission from/to AGP a serial transmission protocol is used.

Data transfer between the CP-8031, CP-8050 and the AGP is controlled exclusively by the protocol firmware (AGP master). The AGP replies only to queries by the master. Data from AGP → master can only be transmitted as a reply to a request.

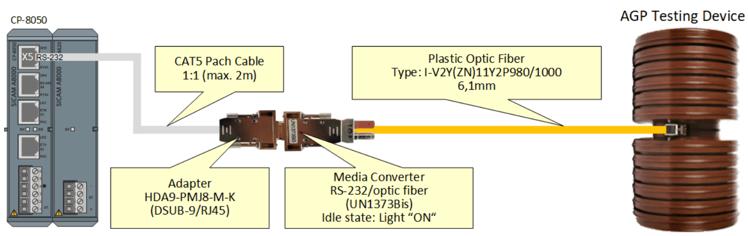
The data transmission takes place exclusively with the baud rate 38400 bit/s.

To connect the AGP, an optical connection with plastic FO is required (idle state = light ON).

CP-8050 requires a media converter (optical/RS-232) and an adapter.

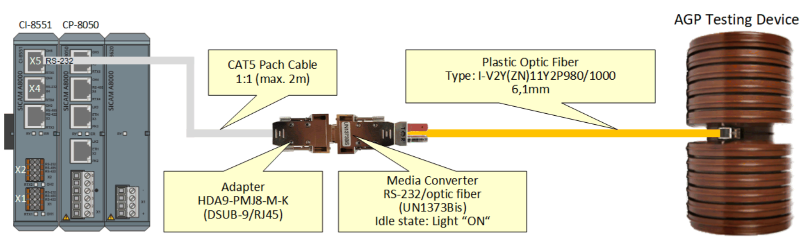
On the AGP side, the media converter with ST connection is required (included).

Schematic Configuration - AGP test equipment on CP-8031, CP-8050 (X5)



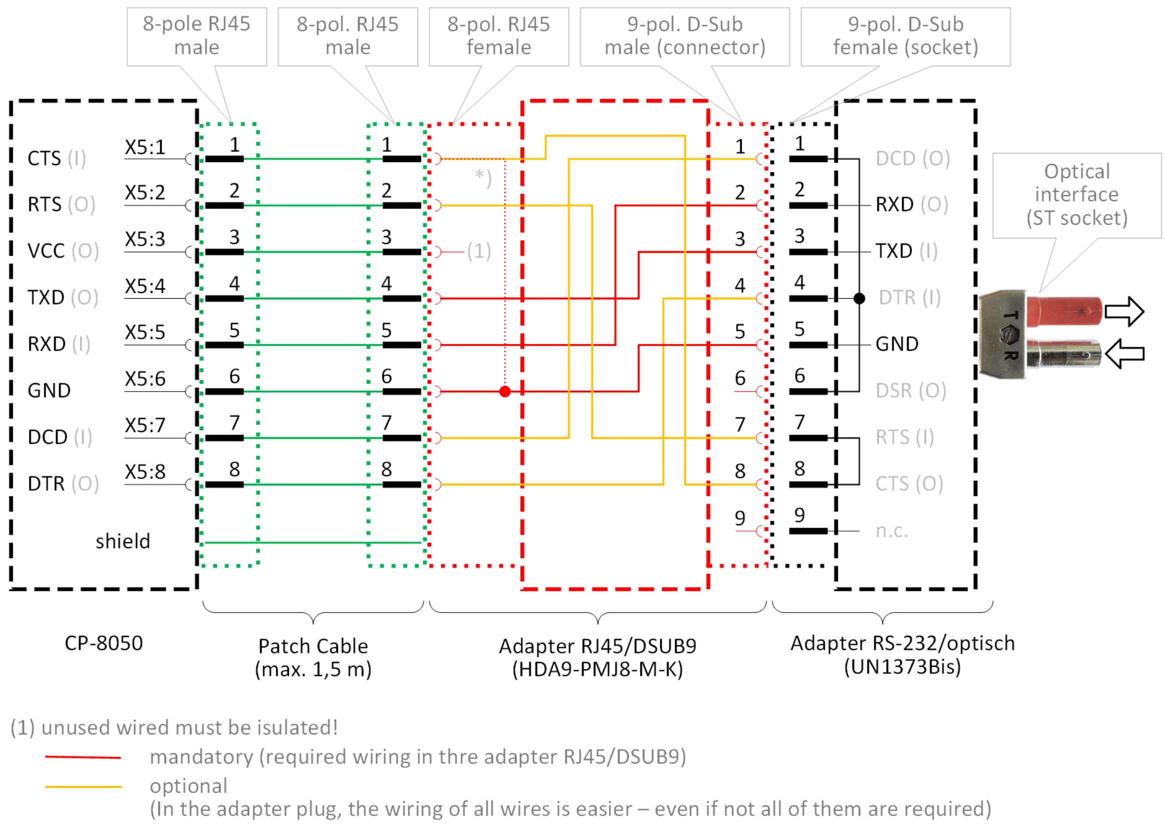
[AGPMI0_Configuration_CP_8050, 1, en_US]

Schematic Configuration - AGP test equipment on CI-8551 (X1, X2, X4, X5)



[AGPMI0_Configuration_CP_8051, 1, en_US]

Wiring for Connection CP-8031, CP-8050 (X5) or CI-8551 [372] (X4, X5) ↔ UN1373BiS



[AGP_Adapter_RJ45_DSUB9, 1, en_US]

NOTE

With a serial connection via CP-8031, CP-8050 interface X5 a bridge between CTS and GND is required, as far as the interface shall also be used for the connection with the engineering PC.

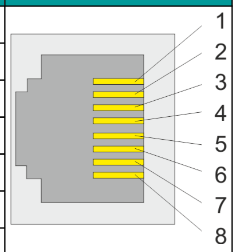
The CTS status line cannot be used by the protocol!

If the interface shall not be used as serial engineering interface, the function can be disabled with the parameter **`Serial engineering interface`** = ***`disabled`***. Thereby no connection between CTS and GND is required.

Recommended D-sub/RJ45 adapter: RS Pro Series HDA D-Sub-Adapter for Sub-D terminal block, 9-pole (Order information see *Recommended third-party products, Page 2186*). The adapter RS Pro HDA9-SMJ8-M-K provides a wired RJ45 socket and an unwired D-sub plug (male).

372 With CP-8031 not supported by default. With a license (see *14.8 SICAM A8000 CP-803x Extended CI-Module*) 1 communication module CI-8551 can be used additionally also with CP-8031.

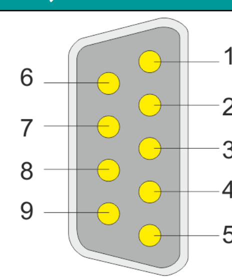
Wiring of the RJ45 Socket

Pin	Wire color	
1	black	
2	yellow	
3	orange	
4	red	
5	green	
6	brown	
7	grey	
8	blue	
Shield	black	

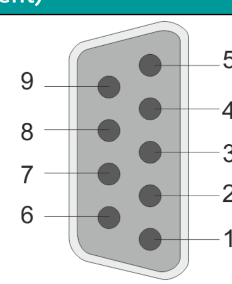
NOTE

There are other similar converters on the market - the color of the wires can be different (check wire color and pin assignment)!

Pin Assignment RS-232 Interface on D-Sub/RJ45 Adapter

Pin	RS-232 signal	Designation	D-Sub9 plug (male)
1	DCD (I)	Receive level	
2	RXD (I)	Receive data	
3	TXD (O)	Transmit data	
4	DTR (O)	DEE ready	
5	GND	Signal ground	
6	n.c.		
7	RTS (O)	Request to send	
8	CTS (I)	Clear to send	
9	n.c.		

Pin Assignment RS-232 Interface on Media Converter UN1373BiS

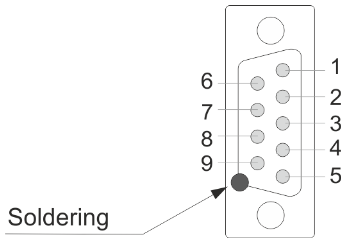
Pin	RS-232 signal	Designation	D-Sub9 socket (female) UN1373BiS (DCE assignment) [373]
1	DCD (O)		
2	RXD (O)	Receive data	
3	TXD (I)	Transmit data	
4	DTR (I)		
5	GND	Signal ground	
6	DSR (O)		
7	RTS (I)		
8	CTS (O)		
9	n.c.		

Wiring at the 9-pole D-sub plug:

The assignment of the pins at the D-sub plug (backside view of plug) can be made according to wiring diagram.

373 Front view of socket

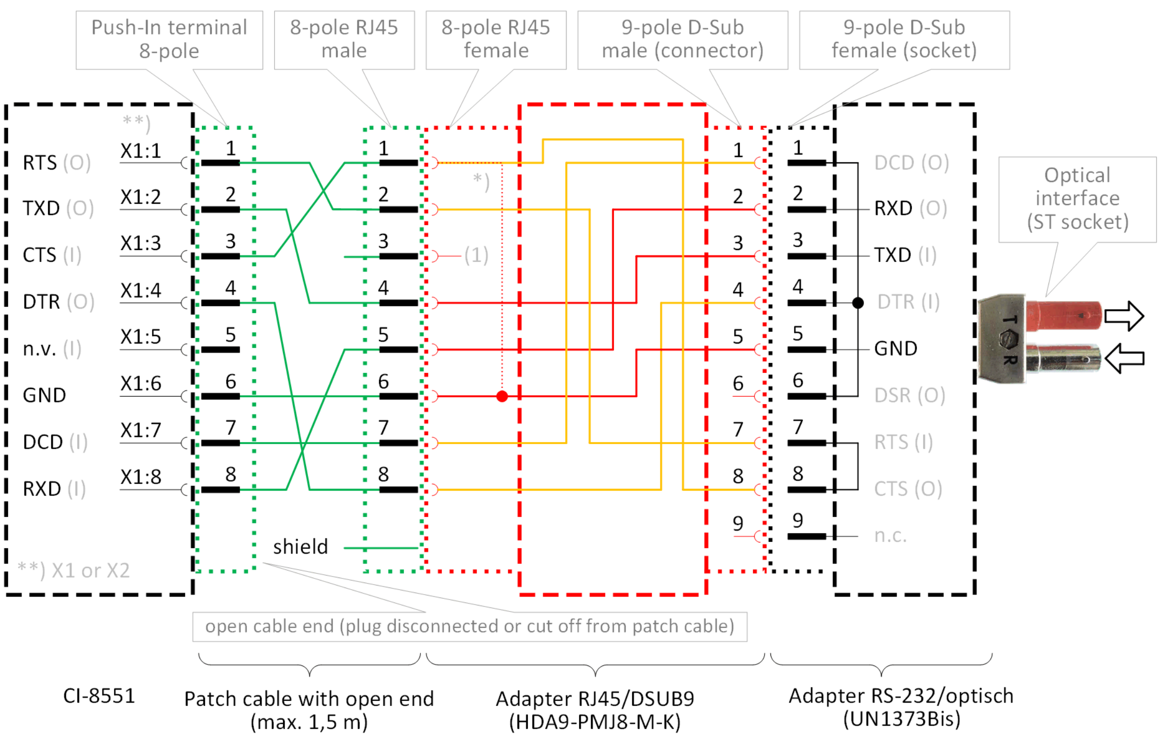
Unused wires must be isolated!



[dw_9-pole_DSUB_soldering, 1, en_US]

When using the shield, it must be soldered to the metal plate of the D-sub plug.

Wiring for Connection CI-8551 (X1, X2) ↔ UN1373BiS



(1) unused wired must be isulated!

mandatory (required wiring in thre adapter RJ45/DSUB9)

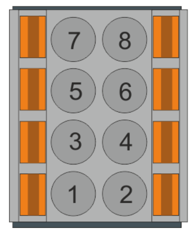
optional

(In the adapter plug, the wiring of all wires is easier – even if not all of them are required)

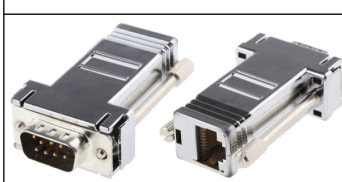
[AGP_Adapter_PUSH_IN8_DSUB9, 1, en_US]

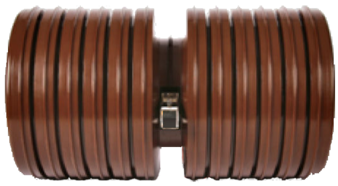
The AGP tester can also be connected to the X1, X2 interface of the CI-8551 module with an open ended patch cable. For interface X1 or X2 RS-232 must be selected.

Connector X1, X2 (CI-8551)

Pin	RS-232 signal	Push-in terminal 8-pole
8	RXD (I)	
7	DCD (I)	
6	GND	
5	n.c.	
4	DTR (O)	
3	CTS (I)	
2	TXD (O)	
1	RTS (O)	

Necessary Accessories

	Designation	Order number
	**UN1373BiS (Media converter optical/RS-232)** AGP coupling plug for connection to AGP Gateway including license key for operating the firmware with the AGP. Fiber optic connector for V.24 data transmission over shorter distances with a 1000 µ PMMA fiber for IBM PC. Power supply from the data circuit. Current consumption: approx. 5 mA Data rate: approx. 40 kBaud Electric connection: D-sub connector, 9-pin, socket Wavelength: 660 nm Launched power: 15 µW (-18 dBm) (V_{TxD} = 10 V) Sensitivity: 0,2 µW (-37 dBm) Optic budget: 16 dB (+3 dB system reserve) Typical range: 60 m Optical connection: ST-plug Optical signal layer: inversion (idle state: light ON) Housing: plastic, metallized Operating temperature 0 to +65°C Art.Nr.: UN1373BiS	To be ordered at Siemens Walter-shausen. Order designation: UN1373BiS
	D-Sub/RJ45 Adapter (male) HDA9-PMJ8-M-K Order nr. 382-2689	*http://at.rson-line.com/web/p/products/3822689/*
	Plastic FO with ST-connector Type: I-V2Y(ZN)11Y2P980/1000 6.1mm	

	Designation	Order number
	AGP “Power distributor branch specific test equipment”	To order at: Siemens Waltershausen Order designation: AGP test cylinder
	AGP License The license is included with the**UN1373BiS (Media converter optical/RS-232)**from Siemens Waltershausen.	

13.12.5.1 Data transmission from/to AGP

Test sequence (without measured value query current integral)

If the test conditions are met (circuit breaker is switched off and voltage from the busbar is present), the test (without MW query) can be started by means of a command message. After checking the AGP, the detected AGP status messages are transmitted.

AGP state messages:

- Result check OK
- Result check NOK
- Fault: Temperature too high
- Fault: Voltage difference too low
- Fault: Timeout negative half wave
- Fault: no zero crossing of the voltage
- Fault: Voltage integral too small
- Fault: Effective value of the voltage too high
- Fault: Primary voltage not within the permitted range
- Failure: Feedback signal not active
- Failure: Feedback signal during test
- Failure: no feedback signal when switched on
- Failure: Feedback signal not ready
- Failure: Fault current sensor
- Failure: Fault temperature sensor
- Aggregated fault: Fault
- Aggregated fault: Failure
- Communication failure
- Check running

Test sequence (with measured value query current integral)

This corresponds to the previous test procedure. Additionally only the calculated current integral as a measured value is queried and transmitted after the transmission of the test result.

Status request

In this case, no check is carried out, but only the current AGP status messages are queried and transmitted.

General Rules

After a test has been started, it must wait at least 3 seconds until a new test can be carried out.

13.12.5.2 Function for the Support of Redundant Communication Routes

This function is currently not supported!

13.12.6 Parameters and Properties

Parameter name	Description	Settings
[PRE] Interface parameter Note: Some parameters may not be displayed until the interface is selected.		
Interface	“Virtual serial interface“ (CP-8050 internal). The "virtual serial interface" is assigned on the BSE to a serial interface plug. *13.1.4.5 Selection of a serial interface for communication protocols*	Permitted range = COM1 to COM50 Default setting = not used
Baud rate	The AGP device supports only baud rate 38400 bps.	Permitted range = 38400 Default setting = 38400
[PRE] Interface Parameter | Time settings for interface modem		
Pause time (tp)	Before a message transmission, a parameter-settable pause time "tp" is maintained.	Permitted range = 0 to 32767 ms Default setting = 0 ms
[PRE] AGP | Station definition | Station definition		
Station number (internal)	CP-8031, CP-8050 internal station number of the remote station Internally the same station number is used for diagnosis and data routing. Each substation must be assigned a unique station number.	Permitted range = 0 to 99 .. Station number 255 ... not used Default setting = not used
Station failure	If a substation fails, the forwarding of the error message can be suppressed with station failure = indicate no error. (possibly required for special redundancy configurations)	Permitted range = • indicate error • indicate no error Default setting = notify
[PRE] AGP | License		
License key	The license key is mandatory for the connection to the AGP device. The license is included in the scope of delivery of the **UN1373Bis (media converter optical/RS-232)** when ordering from Siemens Waltershausen.	Permitted range = 16 digit license key (numbers 0-9 and letters A-F) Default setting =
[PRE] AGP | Link-layer		
Amount of dummy bytes prior to telegram	Used to enable the controller of the AGP from standby.	Permitted range = 1 to 12 Default setting = 8

Parameter name	Description	Settings
[PRE] AGP | Time settings, retries | Monitoring times		
Idle monitoring time	After transmission disturbances or message interruption the idle state is monitored. After expiry of the monitoring time the receiver is resynchronized.	Permitted range = 0 to 32767 bits Default setting = 33 bit
Character monitoring time	Message gap monitoring Maximum pause between successive bytes of a message Idle monitoring time is started after detection of message interruption.	Permitted range = 0 to 32767 bits Default setting = 33 bit
Expected acknowledgment time correction	The expected acknowledgment time is determined automatically. Signal propagation delays and further delay times must be considered in the correction factor for the expected acknowledgment time.	Permitted range = 0 to 655.35 s Default setting = 0.2 s
[PRE] AGP | Time settings, retries | Retries		
Retries for data message SEND/CONFIRM (station selective)	Retries for data messages (not for acknowledgment message)	Permitted range = 0 to 255 Default setting = 3
[PRE] AGP | Communication functions | Initialisation		
Default value voltage range	This value is used as the default value and can be changed with a setpoint value (voltage range).	Permitted range = 0 to 255 Default setting = 0
[PRE] AGP | Communication functions | Command transmission		
Enable 1 out of n command handling	If 1-out-of-n monitoring is activated, new commands or setpoint values are blocked as long as a command or setpoint value is still active.	Permitted range = yes, no Default setting = no
[PRE] AGP | Communication functions | communication transmission | Command concept for third party coupling		
Simulation ACTCON/ACTTERM	If enabled, then ACTCON (positive or negative) will be passed immediately, depending on the 1-out-of-n test, and ACTTERM will be positively generated immediately after ACTCON positiv.	Permitted range = yes, no Default setting = no
ACTCON monitoring time		Permitted range = 0 to 60000 s Default setting = 5 s
ACTTERM monitoring time for short pulse duration		Permitted range = 0 to 60000 s Default setting = 10 s
ACTTERM monitoring time for long pulse duration		Permitted range = 0 to 60000 s Default setting = 20 s

Parameter name	Description	Settings
[PRE] AGP | Communication functions | Binary information		
Faulty position suppression time	Double-point information items received by the AGP device with faulty position will only be forwarded after the suppression time for faulty state has expired. If a valid status of the double-point information is received within the suppression time for faulty state, then the suppression time for faulty state is aborted and only the valid state of the double-point information is forwarded.	Permitted range = 0 to 60 s Default setting = 10 s
Intermediate position suppression time	Double-point information items received by the AGP device with intermediate position will only be forwarded after the suppression time for intermediate position has expired. If a valid status of the double-point information is received within the suppression time for intermediate position, then the suppression time for intermediate position is aborted and only the valid state of the double-point information is forwarded.	Permitted range = 0 to 60 s Default setting = 10 s
[PRE] Data base management Settings for the data base management on BSE (per PRE) - see *13.1.4.14 Data Management on the BSE for Communication Protocols*		
[PRE] Advanced parameters | Web server		
HTTP Web server	Activation of the local web server to display status and diagnostic information of the protocol firmware.	Permitted range = enabled, disabled Default setting = disabled
[PRE] Advanced parameters | Software test points		
...	The software test points may only be used under the guidance of experts for error detection! Once the fault isolation is completed, software checkpoints must always be turned off.	Permitted range = yes, no Default setting = no

NOTE

On the basic system element in the topology for AGPMI0 you have to enter "multi-point traffic master with station# 1".

13.12.7 Web Server

A web server for internal diagnostic and statistical information is integrated in the protocol firmware. The web server itself is implemented on the basic system element - the protocol-specific web pages are provided by the protocol element.

System	Firmware	Designation	Protocol-specific web pages
CP-8050	AGPMI0	AGP protocol master for coupling the Power distributor branch specific test equipment	✓

Enable/disable web server or start web server via SICAM Device Manager or web browser see *13.1.4.12 Web server for protocol-specific web pages*.

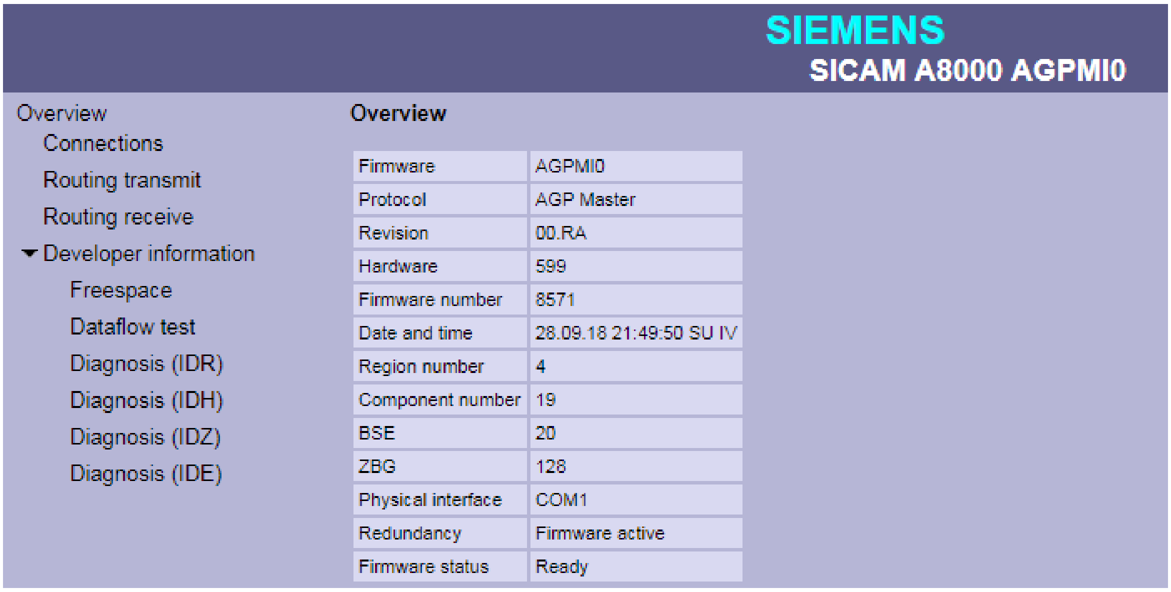
Supported protocol-specific web pages

Web page	AGPMI0
Overview	✓
Connections	✓
Routing Transmit	✓
Routing Receive	✓
Developer Information	
Freespace	✓
Dataflow Test	✓
Diagnosis (IDR)	✓
Diagnosis (IDH)	✓
Diagnosis (IDZ)	✓
Diagnosis (IDE)	✓

13.12.7.1 Overview

With web page **Overview** general information of the firmware will be displayed.

Field	Note
Firmware	Name of firmware
Protocol	Protocol function
Revision	Revision of firmware
Hardware	Hardware number (system internal)
Firmware number	Firmware number (system internal)
Date and time	Current date + time of firmware
Region number	Region number (system internal)
Component number	Component number (system internal)
BSE	Basic system element number (system internal)
ZBG	Supplementary system element number (internal)
Physical interface	Used COM interface
Redundancy	Current redundancy status of the firmware: • Firmware active • Firmware passive
Firmware status	State of the firmware:

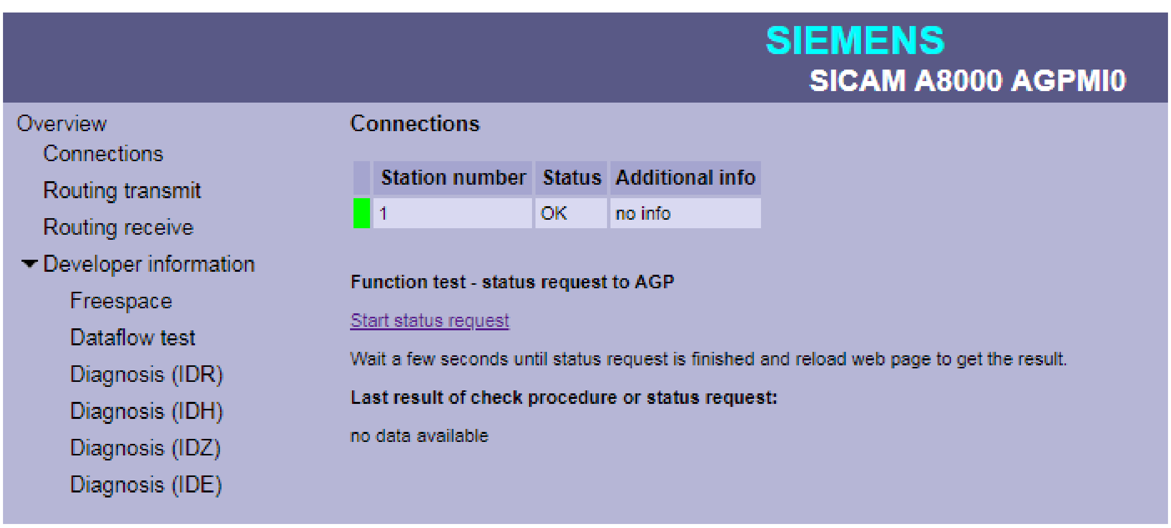


[AGPMI0_WEB_01_overview, 1, en_US]

13.12.7.2 Connections

With web page **Connections** detailed information about the status of the connection to each connected AGP device will be displayed.

Field	Note
Station number	1 (SICAM A8000 internal station number of connection to AGP)
Status	State of the connection to AGP: • OK • NOK
Additional info	Extra information



[AGPMI0_WEB_02_connections, 1, en_US]

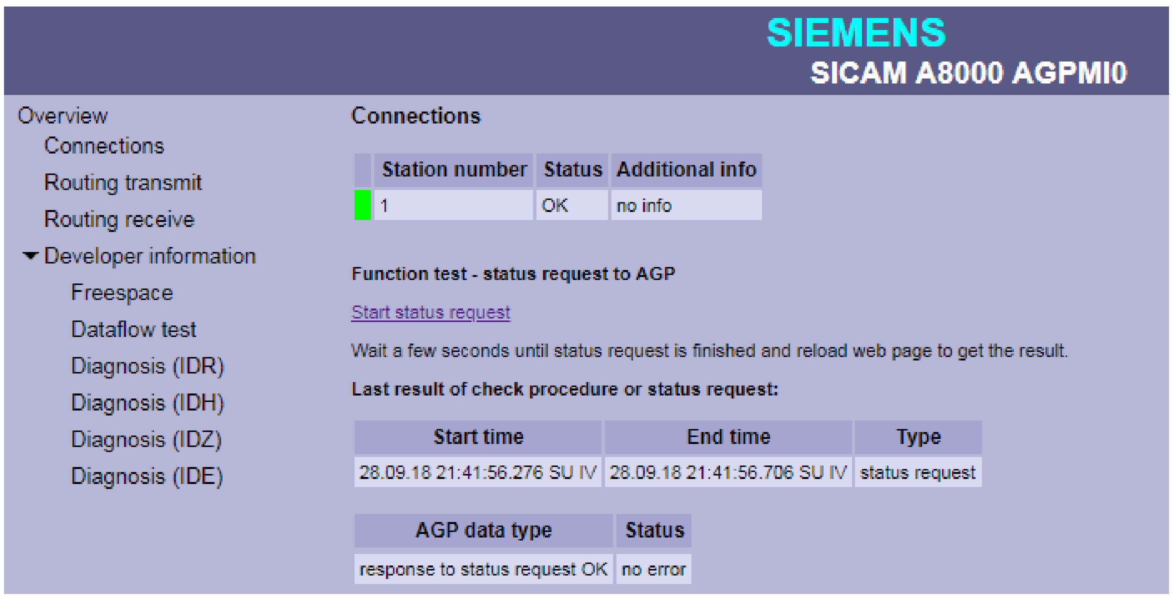
Start Status Request

Start status request sends a status query to the AGP device. The result of the last check procedure or status request is displayed under **Last result of check procedure or status request**.

Last Result of Check Procedure or Status Request

Time and data of the last check procedure or status request is displayed under **Last result of check procedure or status request**.

Field	Note
Start time	Start time of the last test or status query
End time	End time of the last check or status query
Type	Type of last communication sequence with AGP
AGP data type	AGP Data type of the last check or status request
Status	AGP Data state of the last check or status request



[AGPMI0_WEB_02_connections_with_last_check_result, 1, en_US]

13.12.7.3 Routing Transmit

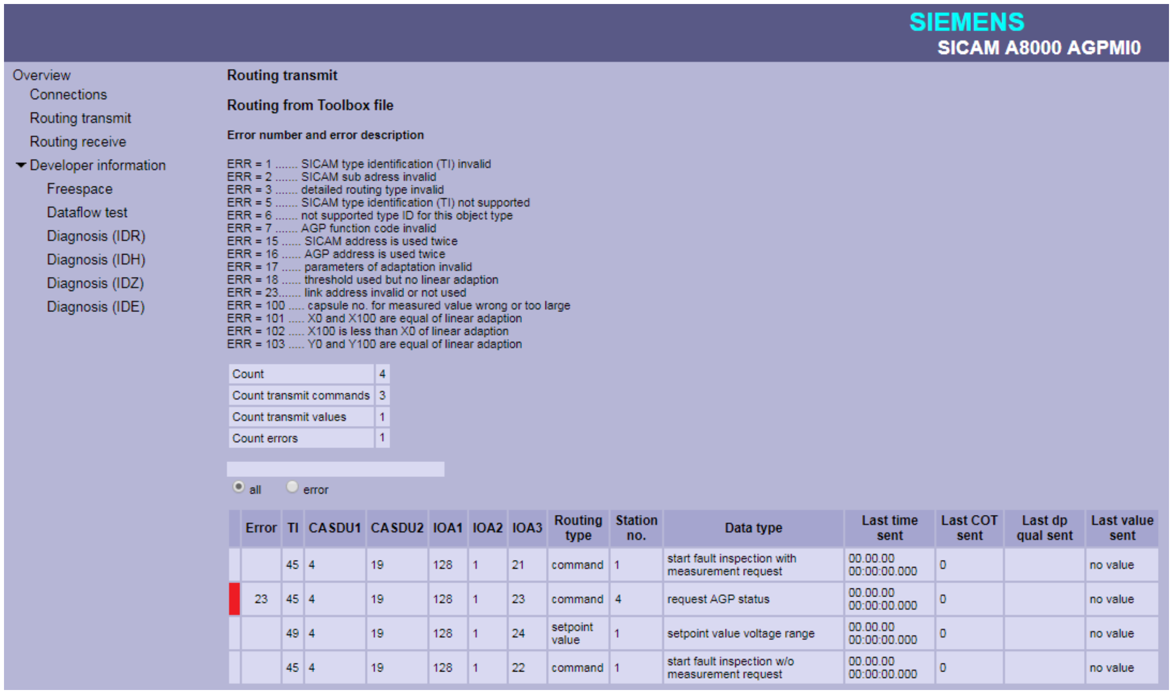
With web page **Routing Transmit** the information of the parameterized data points in the send direction for the connected AGP device are displayed.

Field	Note
Count	Number of parameterized data points in transmit direction
Count transmit commands	Number of incorrectly parameterized data points for "commands" in the transmit direction
Count transmit values	Number of incorrectly parameterized data points for "setpoint values" in the transmit direction
Count error	Number of faulty parameterized data points in transmit direction

Field	Note
Error	Error number • ERR = 0 .... no error • ERR = 1 .... SICAM type identification (TI) invalid • ERR = 2 .... SICAM sub address invalid • ERR = 3 .... detailed routing type invalid • ERR = 5 .... SICAM type identification (TI) not supported • ERR = 6 .... not supported type ID for this object type • ERR = 7 .... AGP function code invalid • ERR = 15 ...... SICAM address is used twice • ERR = 16 ...... AGP address is used twice • ERR = 17 ...... parameters of adaptation invalid • ERR = 18 ...... threshold used but no linear adaptation • ERR = 23....... link address invalid or not used • ERR = 100 ..... capsule no. for measured value wrong or too large • ERR = 101 ..... X0 and X100 are equal of linear adaptation • ERR = 102 ..... X100 is less than X0 of linear adaptation • ERR = 103 ..... Y0 and Y100 are equal of linear adaptation
TI	IEC 60870-5-101/104 Type identification (SICAM A8000 internal)
CASDU1, CASDU2 IOA1, IOA2, IOA3	IEC 60870-5-101/104 Address of data point (SICAM A8000 internal)
Routing type	Detailed routing type for this data point: • command • setpoint value
Station no.	Station number of the AGP device
Data type	Used AGP data type for this data point
Last time sent	Time of the last transmission for this data point BSE → PRE
Last COT sent	Last transmitted cause of transmission (COT) for this data point from BSE → PRE
Last dp qual sent	Last sent quality descriptor for this data point from the BSE → PRE
Last value sent	Last sent value for this data point from the BSE → PRE

Routing Transmit (Filter not used)

All parameterized data points in transmission direction are displayed.
Incorrect parameterized data points are marked "red".



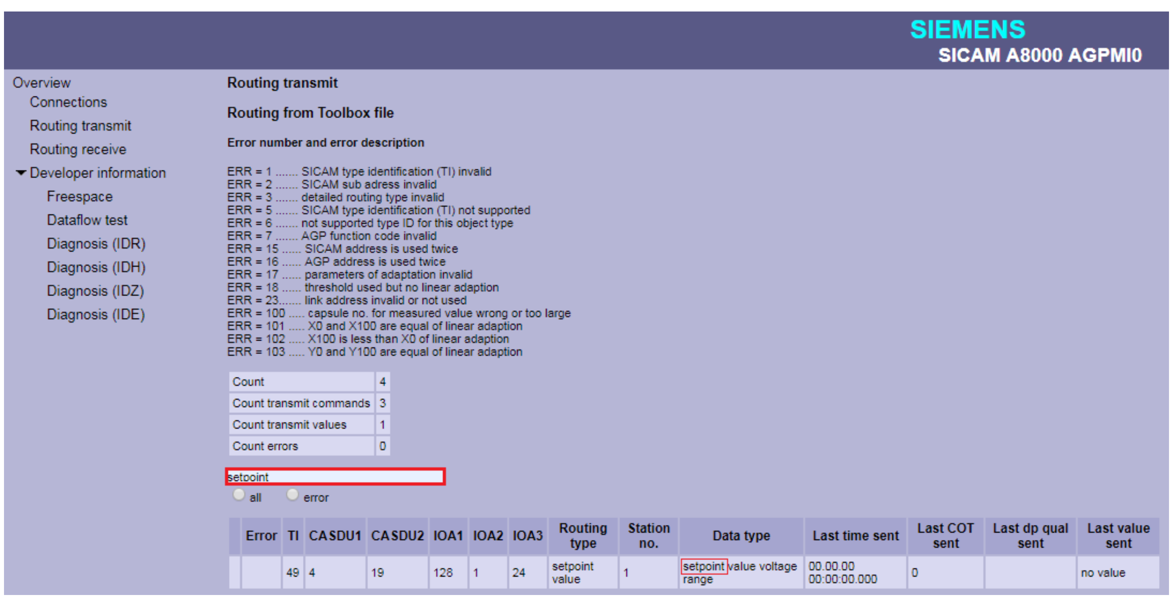
Count	4
Count transmit commands	3
Count transmit values	1
Count errors	1

	Error	TI	CASDU1	CASDU2	IOA1	IOA2	IOA3	Routing type	Station no.	Data type	Last time sent	Last COT sent	Last dp qual sent	Last value sent
		45	4	19	128	1	21	command	1	start fault inspection with measurement request	00.00.00 00:00:00.000	0		no value
	23	45	4	19	128	1	23	command	4	request AGP status	00.00.00 00:00:00.000	0		no value
		49	4	19	128	1	24	setpoint value	1	setpoint value voltage range	00.00.00 00:00:00.000	0		no value
		45	4	19	128	1	22	command	1	start fault inspection w/o measurement request	00.00.00 00:00:00.000	0		no value

[AGPMI0_WEB_03_routing_transmit_err1, 1, en_US]

Routing Transmit - with text filter

Note: The filter affects all fields of the table.



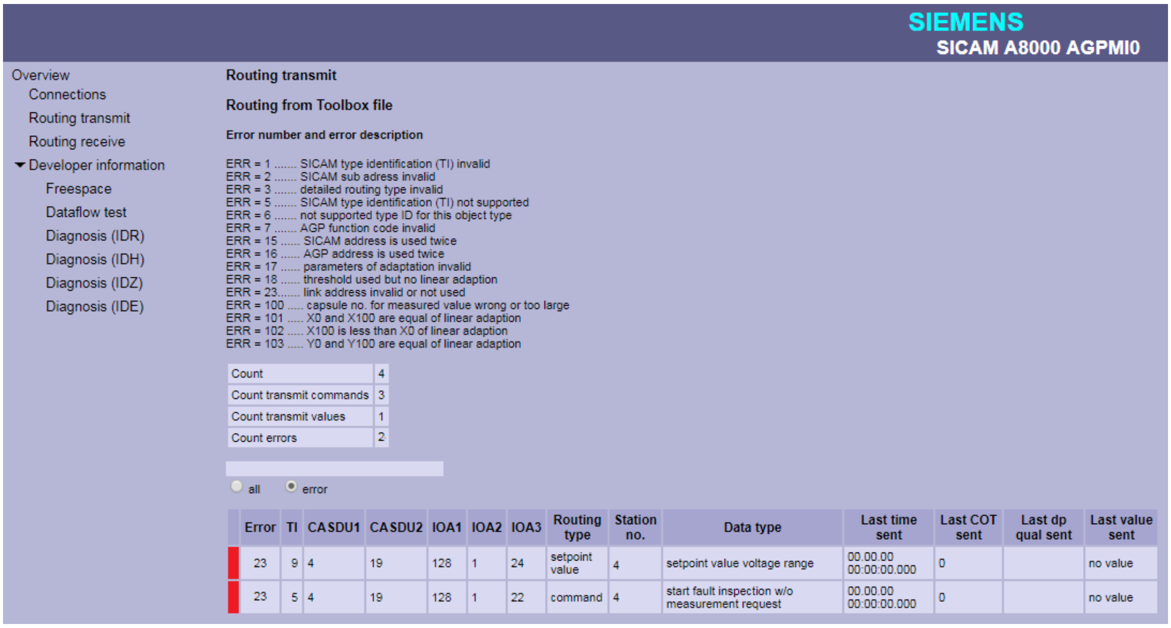
Count	4
Count transmit commands	3
Count transmit values	1
Count errors	0

	Error	TI	CASDU1	CASDU2	IOA1	IOA2	IOA3	Routing type	Station no.	Data type	Last time sent	Last COT sent	Last dp qual sent	Last value sent
		49	4	19	128	1	24	setpoint value	1	setpoint value voltage range	00.00.00 00:00:00.000	0		no value

[AGPMI0_WEB_03_routing_transmit_filter, 1, en_US]

Routing Transmit - with filter for incorrectly parameterized data points

All faulty parameterized data points in transmit direction are displayed.



[AGPMI0_WEB_03_routing_transmit_err2, 1, en_US]

13.12.7.4 Routing Receive

With web page **Routing Receive** the information of the parameterized data points in the receive direction for the connected AGP device is displayed.

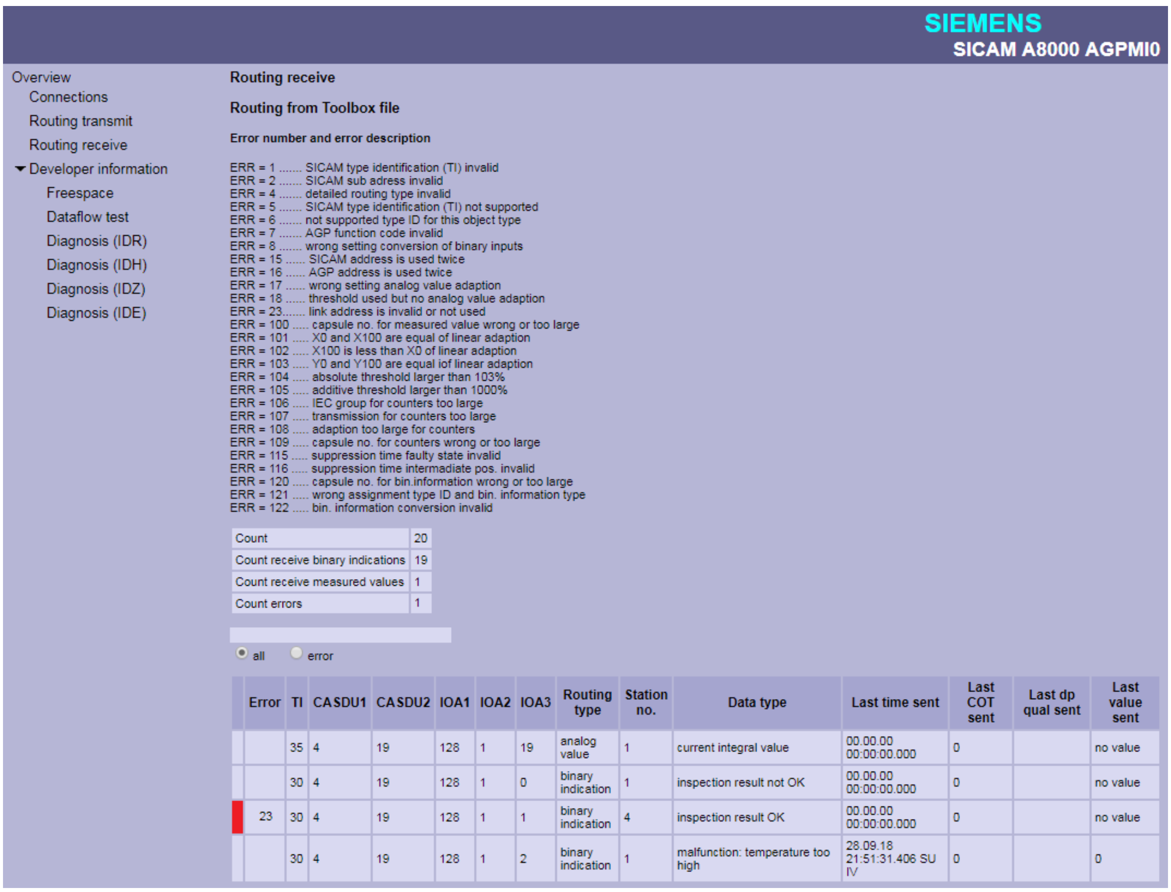
Field	Note
Count	Number of parameterized data points in receive direction
Count receive binary idica-tions	Number of incorrectly parameterized data points for "binary information" in receive direction
Count receive measuered values	Number of incorrectly parameterized data points for "measured values" in the receive direction
Count errors	Number of faulty parameterized data points in receive direction

Field	Note
Error	Error number • ERR = 0 .... no error • ERR = 1 .... SICAM type identification (TI) invalid • ERR = 2 .... SICAM sub address invalid • ERR = 4 .... detailed routing type invalid • ERR = 5 .... SICAM type identification (TI) not supported • ERR = 6 .... not supported type ID for this object type • ERR = 7 .... AGP function code invalid • ERR = 8 .... wrong setting conversion of binary inputs • ERR = 15 ...... SICAM address is used twice • ERR = 16 ...... AGP address is used twice • ERR = 17 ...... wrong setting analog value adaptation • ERR = 18 ...... threshold used but no analog value adaptation • ERR = 23....... link address is invalid or not used • ERR = 100 ..... capsule no. for measured value wrong or too large • ERR = 101 ..... X0 and X100 are equal of linear adaptation • ERR = 102 ..... X100 is less than X0 of linear adaptation • ERR = 103 ..... Y0 and Y100 are equal iof linear adaptation • ERR = 104 ..... absolute threshold larger than 103% • ERR = 105 ..... additive threshold larger than 1000% • ERR = 106 ..... IEC group for counters too large • ERR = 107 ..... transmission for counters too large • ERR = 108 ..... adaptation too large for counters • ERR = 109 ..... capsule no. for counters wrong or too large • ERR = 115 ..... suppression time faulty state invalid • ERR = 116 ..... suppression time intermadiate pos. Invalid • ERR = 120 ..... capsule no. for bin.information wrong or too large • ERR = 121 ..... wrong assignment type ID and bin. information type • ERR = 122 ..... bin. information conversion invalid
TI	IEC 60870-5-101/104 Type identification (SICAM A8000 internal)
CASDU1, CASDU2 IOA1, IOA2, IOA3	IEC 60870-5-101/104 Address of data point (SICAM A8000 internal)
Routing type	Detailed routing type for this data point: • binary indication • analog value
Station no.	Station number of the AGP device
Data type	AGP data type: • current integral value • inspection result not OK • inspection result OK • malfunction: temperature too high
Last time sent	Time of the last transfer of the data point PRE → BSE

Field	Note
Last COT sent	Last transmitted cause of transmission (COT) for this data point from PRE → BSE
Last dp qual sent	Last sent quality descriptor for this data point from the PRE → BSE
Last value sent	Last sent value for this data point from the PRE → BSE

Routing Receive (Filter not used)

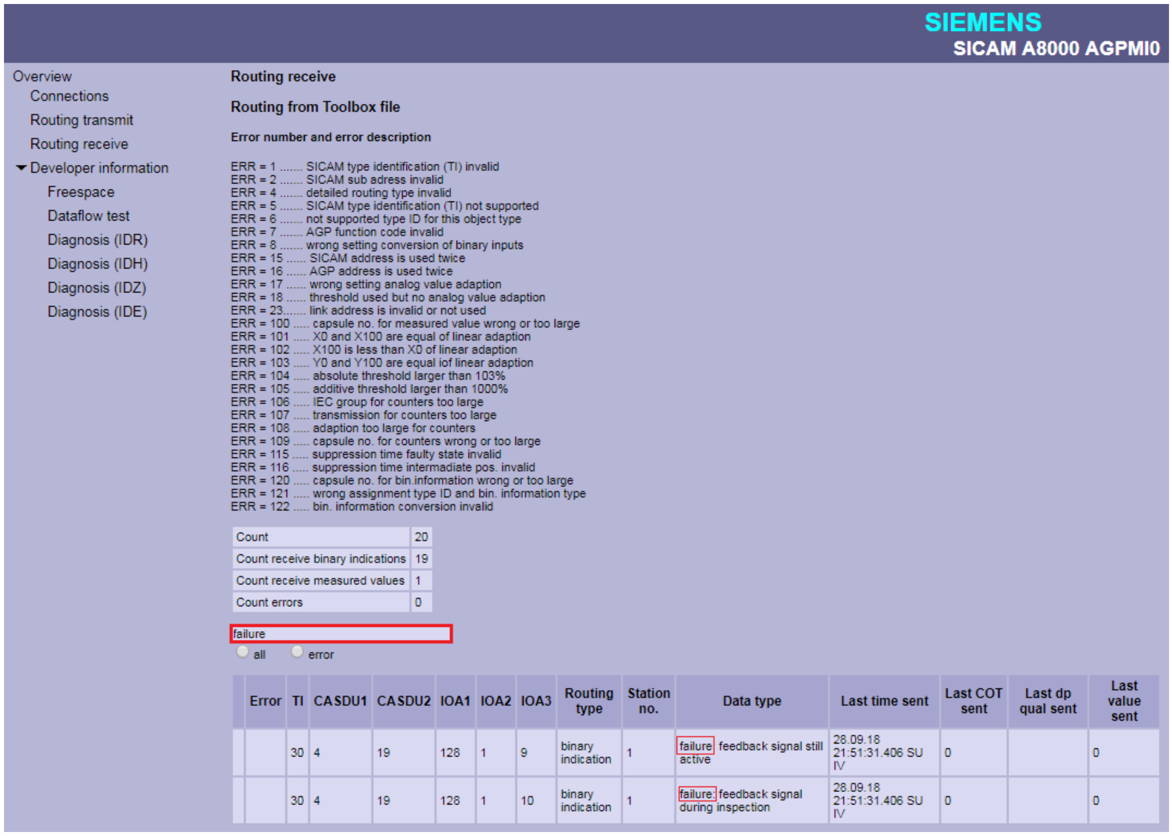
All faulty parameterized data points in receive direction are displayed. Faulty data points are marked "red".



[AGPMI0_WEB_04_routing_receive, 1, en_US]

Routing Receive - with text filter

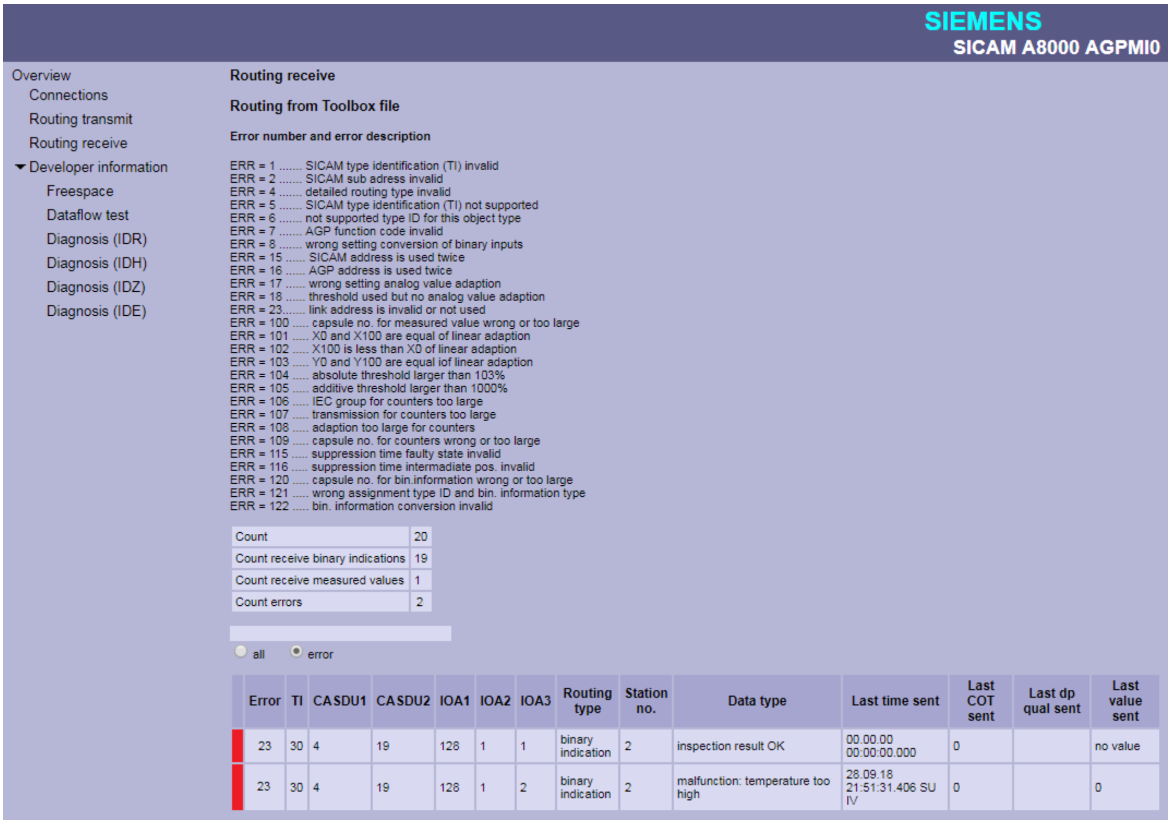
Note: The filter affects all fields of the table.



[AGPMI0_WEB_04_routing_receive_filter, 1, en_US]

Routing Receive - with filter for incorrectly parameterized data points

All faulty parameterized data points in receive direction are displayed.

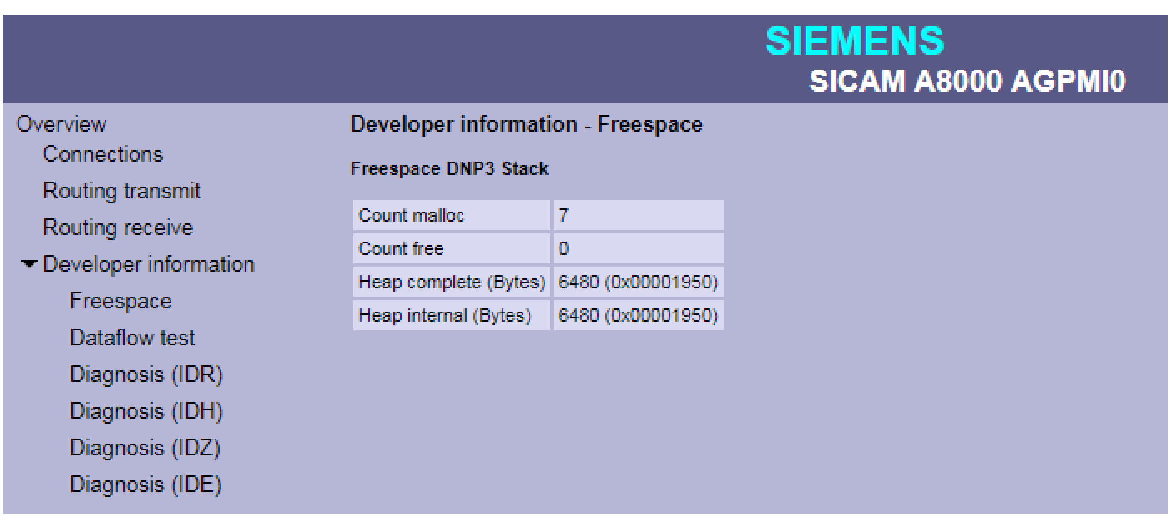


[AGPMI0_WEB_04_routing_receive_err2, 1, en_US]

13.12.7.5 Developer Information – Freespace

With web page **Developer Information – Freespace** internal information (free memory) of the firmware is displayed.

Field	Note
Count malloc	Internal information
Count free	Internal information
Heap complete (Bytes)	Internal information
Heap internal (Bytes)	Internal information



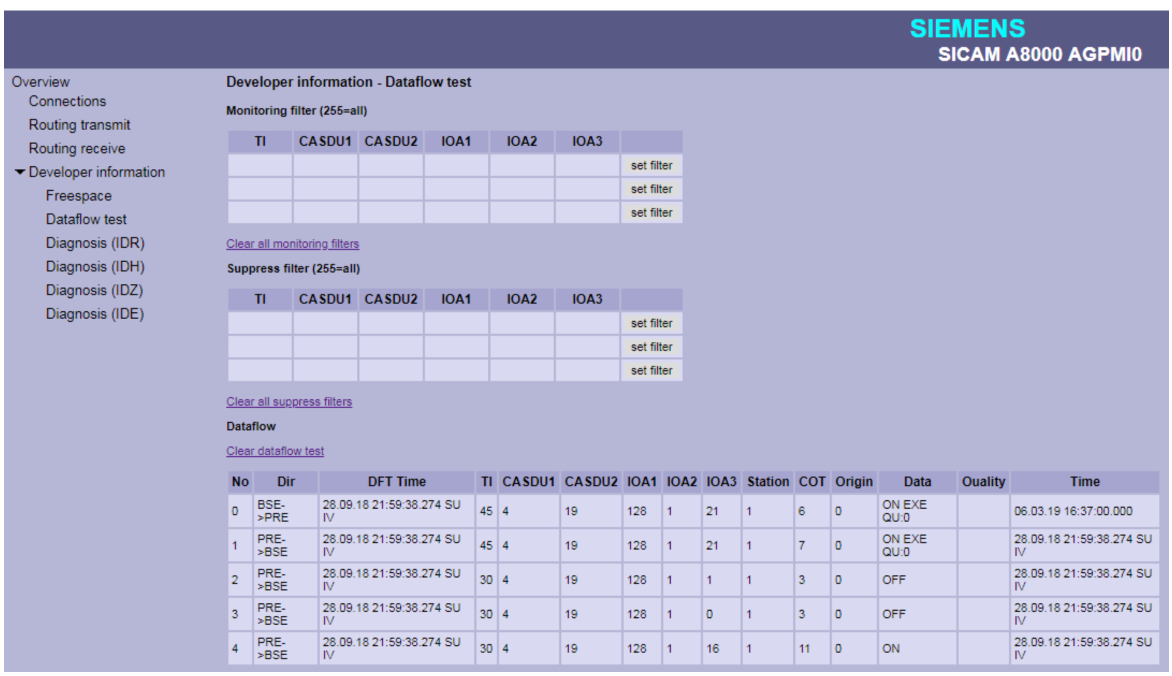
[AGPMI0_WEB_11_freespace, 1, en_US]

13.12.7.6 Developer Information – Dataflow Test

With web page **Developer Information – Dataflow Test**, messages transmitted via internal interface between PRE and BSE will be displayed.

The last 200 received or transmitted messages will be displayed.

Field	Note
No.	Consecutive message number
Dir	Direction of the transmission • PRE → BSE: Received data • BSE → PRE: Transmitted data
DFT Time	Logging time
TI	IEC 60870-5-101/104 Type identification (SICAM A8000 internal)
CASDU1, CASDU2 IOA1, IOA2, IOA3	IEC 60870-5-101/104 Address of data point (SICAM A8000 internal)
Station	Station number of the connection (SICAM A8000 internal)
COT	IEC 60870-5-101/104 Cause of transmission (SICAM A8000 internal) (COT = Cause Of Transmission)
Origin	IEC 60870-5-101/104 Originator address (SICAM A8000 internal) (origin = Originator)
Data	IEC 60870-5-101/104 State of data point (SICAM A8000 internal)
Quality	IEC 60870-5-101/104 Quality descriptor of data point (SICAM A8000 internal)
Time	Receive time (AGP)



[AGPMI0_WEB_05_dataflow_test, 1, en_US]

Message filter for simultaneous logging ("Monitoring Filter")

With filter enabled, only messages will be logged which are selected by filter. If no filter is selected, all messages will be logged.

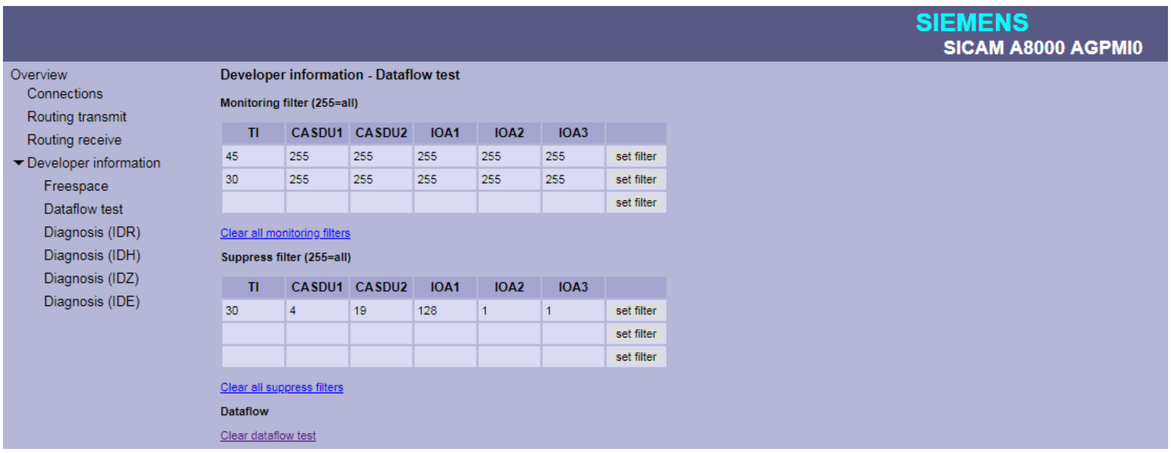
With the value 255 this field is set to "Wildcard", which means that all messages with this field (0 to 255) are also logged.

The filter will be activated by **set filter**.

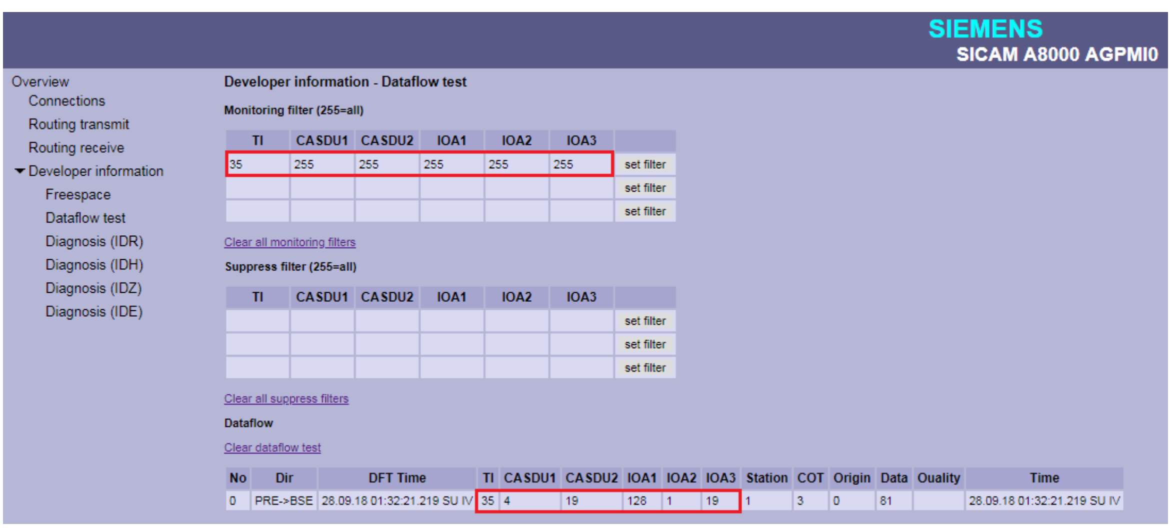
The filters will be cleared with Clear all monitoring filters.

Message filter for simultaneous logging (“Suppress Filter”)

If a filter is selected, the messages selected by the filter are not logged (suppressed). If no filter is selected all messages will be logged.
With the value 255 this field is set to “Wildcard”, which means that all messages with this field (0 to 255) are suppressed.
The filter will be activated by **set filter**.
The filters will be cleared with Clear all suppress filters.



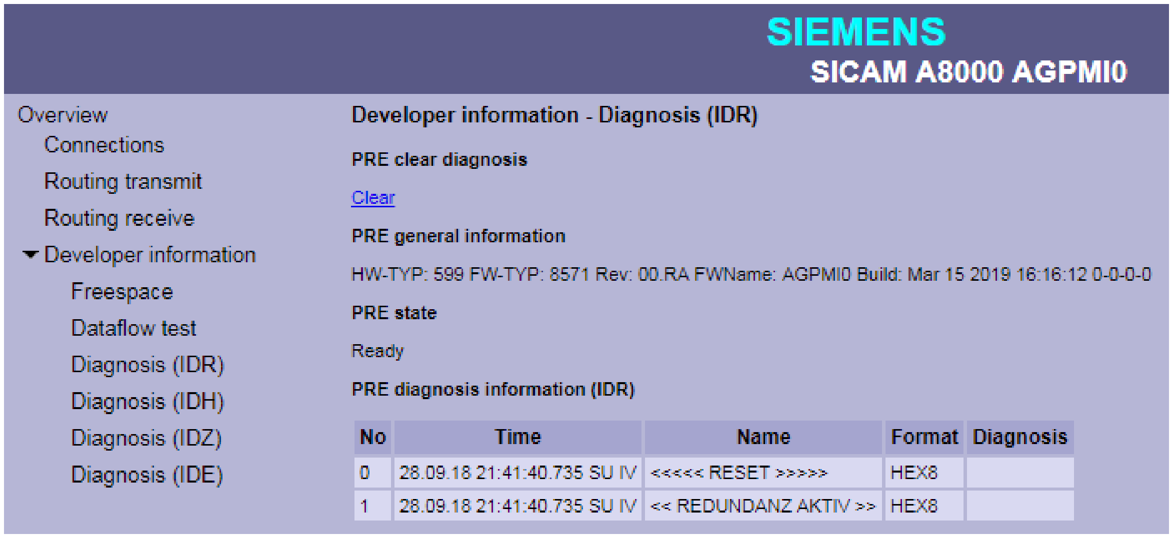
[AGPMI0_WEB_05_dataflow_test_filter_settings, 1, en_US]



[AGPMI0_WEB_05_dataflow_test_filter_red, 1, en_US]

13.12.7.7 Developer Information – Diagnosis (IDR)

With web page **Developer Information - Diagnosis (IDR)** internal diagnosis information of the protocol element (PRE) will be displayed.



[AGPMI0_WEB_10_IDR, 1, en_US]

Deletion of the IDR diagnosis information on PRE (“PRE clear diagnosis“)

The IDR diagnostic information on the PRE can be deleted under "PRE clear diagnostics" with Clear.

General information of PRE firmware ("PRE general Information")

Field	Note
HW-TYP	Hardware type of PRE firmware
FW-TYP	Firmware type of PRE firmware
Rev	Revision of PRE firmware

IDR diagnostic information of the PRE firmware ("PRE diagnosis information (IDR)")

Field	Note
No	Consecutive number
Time	Date + time of IDR logging
Name	Diagnosis text
Format	Format of diagnosis information in next column • CHAR, HEX8, HEX16, HEX32, DEC8, DEC16, DEC32, FLOAT32
Diagnosis	Detail information for IDR diagnosis

13.12.7.8 Developer Information – Diagnosis (IDH)

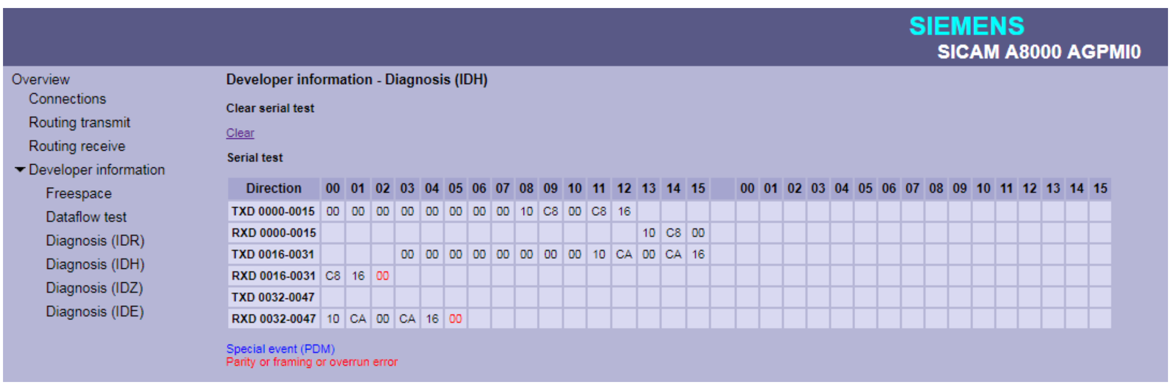
The **Developer Information – Diagnosis (IDH)** web page will display the last 2000 to 4000 data sent/received in HEX and ASCII without time tag.

Deleting the IDH diagnostic information on the PRE ("Clear serial test")

The IDH diagnostic information (serial test) on the PRE, can be deleted under "Clear serial test" with Clear.

IDH-Diagnostic information "serial test"

Field	Note
Direction	TXD = Transmit Data (of PRE) RXD = Receive Data (of PRE)
00, 01, 02, .. 15	Byte no. (0 to 15) per row The transmitted/received bytes are entered in chronological order into the byte number TXD xxxx-yyyy, RXD xxxx-yyyy.
TXD xxxx-yyyy	Byte number for transmit data
RXD xxxx-yyyy	Byte number for receive data
HEX	The left range of the table (byte number 0 to 15) shows the sent/received data is in HEX.
ASCII	The right range of the table (byte number 0 to 15) shows the sent/received data is in ASCII.



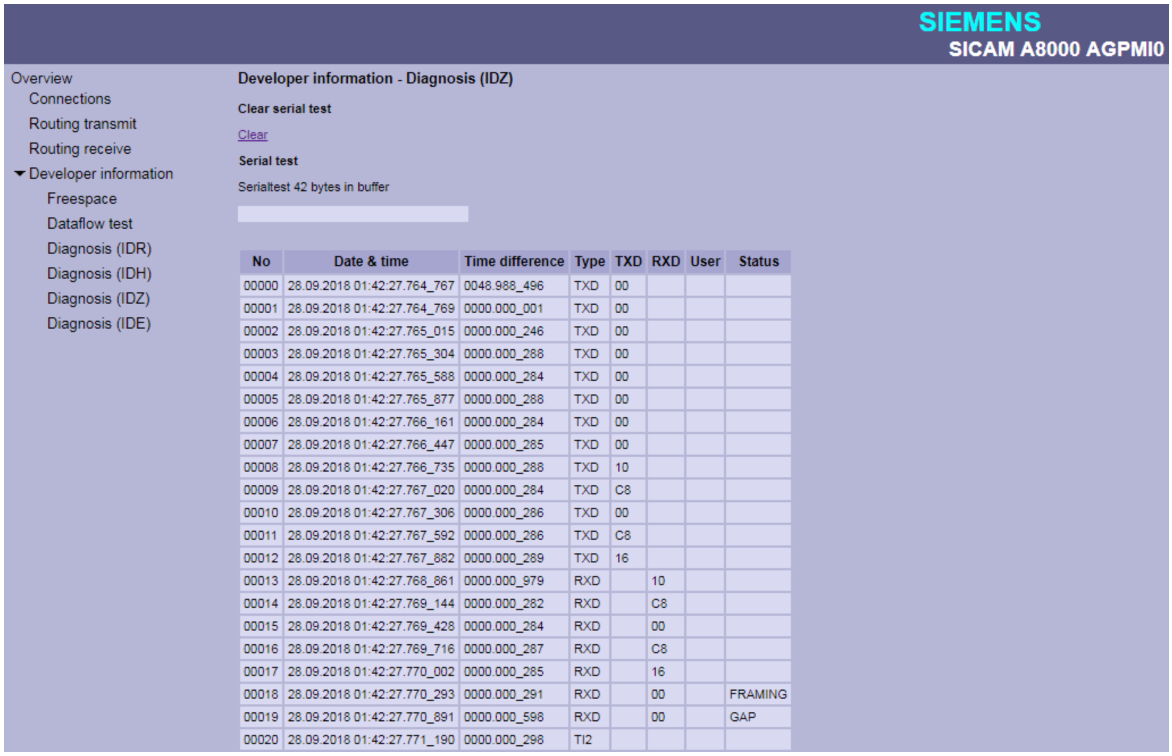
[AGPMI0_WEB_08_IDH, 1, en_US]

13.12.7.9 Developer Information – Diagnosis (IDZ)

On the web page **Developer Information – Diagnosis (IDZ**) detailed information of the last 10,000 transmitted/received data or "transmission events" with time tags are shown.

Deleting the IDZ diagnostic information on the PRE ("Clear serial test")

The IDZ diagnostic information on the PRE can be cleared under "Clear serial test" with Clear.



[AGPMI0_WEB_09_IDZ, 1, en_US]

IDZ-diagnostic information “Serial test“

Field	Note
Serial test xxxxx bytes in buffer.	Number of stored transmission events in the buffer (max 10000). If more than 10,000 transmission events are recorded, the value xxxxx remains at 10000 and the oldest transmission events are deleted.

Field	Note
No	Consecutive number
Date and time	Current date + time of the entry
Time difference	Difference time to previous event:

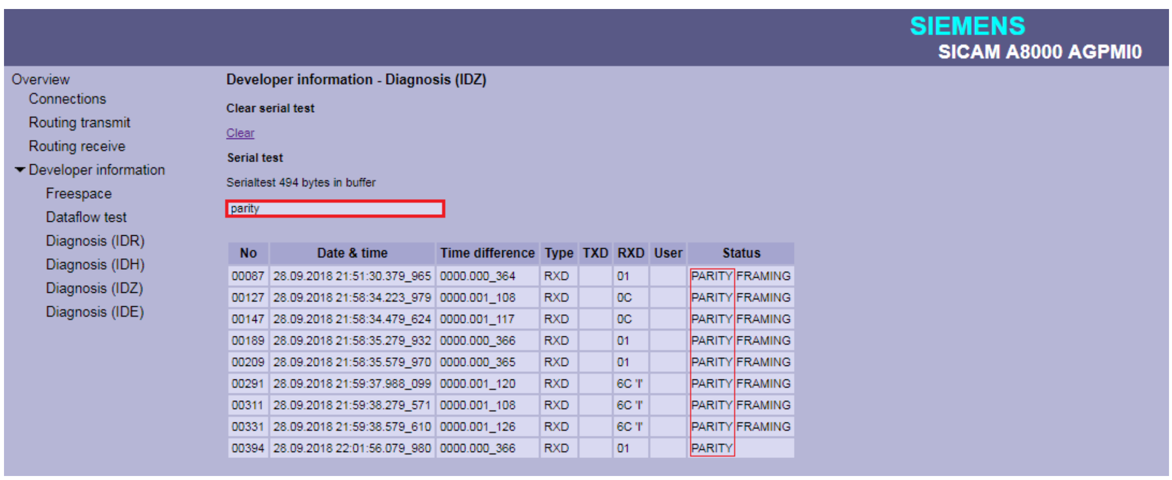
Field	Note
Type	Tansmission event: • TXD ... Data byte sent • RXD ... Data byte received • TPD ... Data bit sent ON/OFF (pulse duration modulation) [374] • RPD ... Data bit received ON/OFF (pulse duration modulation) [374] • RTS ON ... RTS status line ON <OUT> (manually controlled by PRE) • RTS OFF ... RTS status line OFF <OUT> (manually controlled by PRE) • RTS_T0 ON ... RTS status line ON <OUT> (controlled by UART) • RTS_T0 OFF ... RTS status line OFF <OUT> (controlled by UART) • DTR ON ... DTR status line ON <OUT> • DTR OFF ... DTR status line OFF <OUT> • DCD ON ... DCD status line ON <IN> • DCD OFF ... DCD status line OFF <IN> • CTS ON ... CTS status line ON <IN> • CTS OFF ... CTS status line OFF <IN> • DCD_T1 ON ... DCD bounce suppression ON • DCD_T1 OFF ... DCD bounce suppression OFF • TI0 ... Timer 0 expiration • TI1 ... Timer 1 expiration • TI2 ... Timer 2 expiration (typical: used for expected acknowledgment time) • TI3 ... Timer 3 expiration (typical: used for newsync) • TI4 ... Timer 4 expiration • TI5 ... Timer 5 expiration • TI6 ... Timer 6 expiration • TI7 ... Timer 7 expiration • USER ... User transmission event (including user identifier <0 to 255> – triggered by the PRE firmware – Entry chronological to IDZ (only for diagnosis) – User identification is entered in the column "User".
TXD	Data byte/bit sent • xx,'x' ... Displayed in HEX, 'ASCII' • ON, OFF ... TXD bit status ON/OFF (only with pulse duration modulation) [374]
RXD	Data byte/bit received • xx,'x' ... Displayed in HEX, 'ASCII' • ON, OFF ... RXD bit status "ON/OFF" (only with pulse duration modulation) [374]

[374] only possible with CI-8551

Field	Note
User	Additional information about the transmission event "Type = User": • 0 to 255 ... If Type = USER, then the value transmitted by the PRE firmware is entered in the "USER" field.
Status	Status for transmission event “Type=RXD”: • GAP ... Pause detected on reception ("message gap") • PARITY ... Parity fault • FRAMING ... Framing fault • OVERRUN ... Overrun fault • OVERRUN_BUFFER ... Overrun RX (Intermediate buffer error)

IDZ-diagnostic information "Serial test" - with text filter

Note: The filter affects all fields of the table.

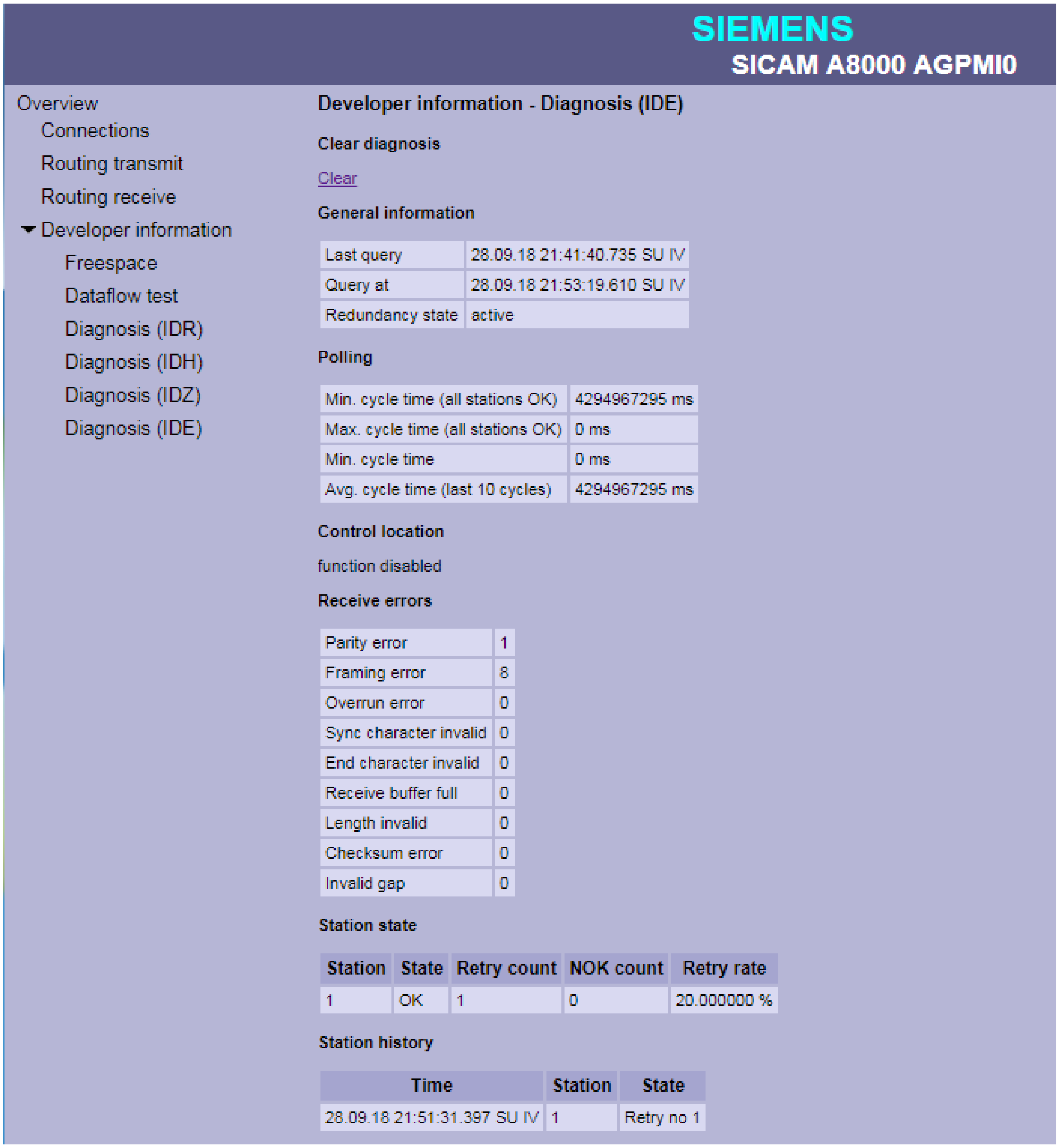


No	Date & time	Time difference	Type	TXD	RXD	User	Status
00087	28.09.2018 21:51:30.379_965	0000.000_364	RXD		01		PARITY FRAMING
00127	28.09.2018 21:58:34.223_979	0000.001_108	RXD		0C		PARITY FRAMING
00147	28.09.2018 21:58:34.479_624	0000.001_117	RXD		0C		PARITY FRAMING
00189	28.09.2018 21:58:35.279_932	0000.000_366	RXD		01		PARITY FRAMING
00209	28.09.2018 21:58:35.579_970	0000.000_365	RXD		01		PARITY FRAMING
00291	28.09.2018 21:59:37.988_099	0000.001_120	RXD		6C 'l'		PARITY FRAMING
00311	28.09.2018 21:59:38.279_571	0000.001_108	RXD		6C 'l'		PARITY FRAMING
00331	28.09.2018 21:59:38.579_610	0000.001_126	RXD		6C 'l'		PARITY FRAMING
00394	28.09.2018 22:01:56.079_980	0000.000_366	RXD		01		PARITY

[AGPMI0_WEB_09_IDZ_filter, 1, en_US]

13.12.7.10 Developer Information – Diagnosis (IDE)

The **Developer Information – Diagnosis (IDE)** web page displays protocol-internal diagnostics information or statistics information.



[AGPMI0_WEB_07_IDE, 1, en_US]

Deletion of the IDE diagnostic information on PRE ("Clear diagnosis")

The IDE diagnostic information on the PRE can be cleared under **Clear diagnosis** with Clear.

General information of the IDE diagnosis ("General information")

Field	Note
Cleared at	Time of IDE diagnosis information cleared
Query at	Last query time of IDE diagnosis information
Redundancy state	Actual redundancy state of PRE firmware

General information of the IDE diagnosis ("Polling")

Field	Note
Min. cycle time (all stations OK)	Minimum cycle time for all OK stations
Max. cycle time (all stations OK)	Maximum cycle time for all OK stations
Min. cycle time	Minimum cycle time
Avg. cycle time (last 10 cycles)	Average cycle time (last 10 cycles)

Information on the control location of the PRE ("Control location")

Field	Note
	The activated control locations will be displayed when control location function is enabled. Note: this function is currently not supported!

Receive error statistics ("Receive Errors")

Field	Note
Parity error	Number of detected parity errors
Framing error	Number of detected byte frame errors
Overrun error	Number of detected overflow errors In case of overflow error the firmware load is too high - the received bytes can no longer be processed correctly.
Sync character invalid	Number of detected synchronization errors
End character invalid	Number of detected end character errors
Receive buffer full	Number of detected errors for receive buffer full
Length invalid	Number of detected length invalid errors
Checksum error	Number of detected checksum errors
Invalid gap	Number of detected errors for inadmissible gap in the message (gap between 2 bytes within a message).

State of Communication Link ("Station state")

For each station, the current status and statistics about the number of failures and retries are displayed.

Field	Note
Station	Station number (internal)
State	OK .... Communication link OK NOK ..... Communication link NOK (failed)
Retry count	Number of retries since last Clear diagnosis
NOK count	Number of communication link NOK (failed) since last Clear diagnosis
Retry rate	Number of retries in % since last Clear diagnosis

Chronological list of retries and station failures (“Station History”)

Field	Note
Time	Date + Time of communication error (OK, NOK, Retry)
Station	Station number (internal)
State	Status: • Retry no x ... Retry number x • Station OK • Station NOK

13.12.8 Message Conversion

Data in transmit direction are transferred from the basic system element to the protocol element in SICAM A8000 internal IEC 60870-5-101/104 (without 101/104 blocking) format. The conversion of the data formats IEC 60870-5-101/104 ↔ AGP is performed by the protocol element. The transmission of the data to the AGP is controlled by the protocol element.

Data in receive direction will be read by the protocol element from the external AGP device after check or status request, then converted by the protocol element from the AGP data format → SICAM A8000 internal IEC 60870-5-101/104 format and transferred to the basic system element (no 101/104 blocking).

The conversion of the SICAM A8000 internal IEC 60870-5-101/104 message format ↔ AGP data format and the conversion of the address information are called message conversion.

The parameterization of the conversion from IEC 60870-5-101/104 ↔ AGP (address and message format) is to be done with SICAM Device Manager with function “Signals” or SICAM TOOLBOX II, OPM II using “SIP Message Address Conversion”.

Supported processing types for message conversion:

Data	Direction	Processing type	AGPMI0
Binary information	Receive direction	firmware /`Rec_binary_information`	✓
Measured values	Receive direction	firmware /`Rec_measured_value`	✓
Commands	Transmit direction	firmware /`Trans_command`	✓
Measured values Setpoint values	Transmit direction	firmware /`Trans_value`	✓

13.12.8.1 Message Conversion in Transmit Direction (Master → Slave)

Message Conversion in Transmit Direction IEC 60870-5-101/104 → AGP

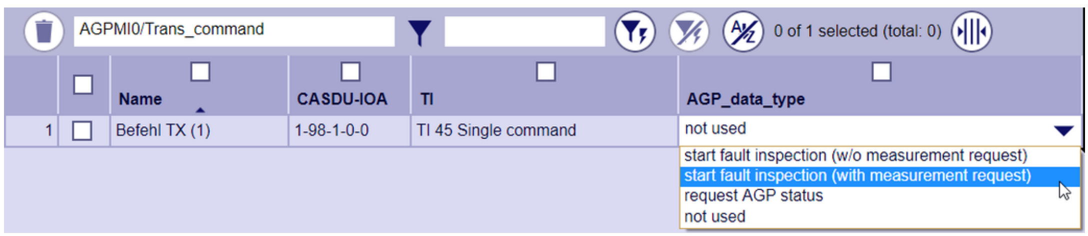
SICAM A8000: IEC 60870-5-101/104 →		AGP
TI	**Designation**	**Data format**
<TI:=34>	Measured value, normalized value with time tag CP56Time2a	Setpoint value voltage range
<TI:=35>	Measured value, scaled value with time tag CP56Time2a	Setpoint value voltage range
<TI:=36>	Measured value, short floating-point number with time tag CP56Time2a	Setpoint value voltage range
<TI:=45>	Single command	Start check with/without measured value query, status request
<TI:=48>	Setpoint command, normalized value	Setpoint value voltage range
<TI:=49>	Setpoint command, scaled value	Setpoint value voltage range

SICAM A8000: IEC 60870-5-101/104 →		AGP
<TI:=50>	Setpoint command, short floating-point number	Setpoint value voltage range
<TI:=100>	(General) interrogation command	[375]

Commands

The parameterization of the address and message conversion for commands in transmit direction is to be done with the SICAM Device Manager with the function "Signals" or with the SICAM TOOLBOX II, OPM II.

Processing type: *firmware* / **`Trans_command`**



[AGPMI0_DM_Sende_Befehl, 1, en_US]

Parameters	
`TI`	Supported type identifications: • <TI:=45> .. Single command
`CASDU, IOA`	SICAM A8000 internal IEC 60870-5-101/104 message address (CASDU1, CASDU2, IOA1, IOA2, IOA3)
`AGP_data_type`	AGP Function: • Start fault inspection (w/o measurement request) • Start fault inspection (w/o measurement request) • Request AGP status

ACTCON/ACTTERM

If the simulation ACTCON/ACTTERM with the parameter **`[PRE] AGP | Communication functions | Command transmission | Command concept to third party connection | Simulation ACTCON/ACTTERM`** is enabled, the transfer of ACTCON takes place depending on the 1-out-of-n-check. If the AGP message *`Check is running`* appears, the status ACTTERM is formed based on this message (positive for the message status = 1, negative after 5 seconds). If this message does not exist, the ACTTERM is generated positively immediately after ACTCON.

Message Conversion

The table describes the evaluated elements of the IEC 60870-5-101/104 message during message conversion.

Elements of the message	
TI .. Type identification	<TI:=45> .. Single command
CASDU, IOA .. Message address	Parameter-settable
Cause of transmission	
06 .. Activation	Is evaluated (only "activation" allowed)
xx .. Other COTs	Not accepted (only "activation" allowed)
T .. Test	Not supported

375 The GI data – in response to a general interrogation command – is transmitted by the protocol element from the PRE-internal process image to the BSE and redistributed by the BSE.

Elements of the message		
Information		
SCO/DCO/RCO		
SCS	Single command state	[only <TI:=45>]
	0 .. OFF	Not evaluated
	1 .. ON	Evaluated
QOC	S/E	
	0 = Execute	Is checked for "execute"
	1 = Select	Not supported
QU	Command qualifier	
	0 .. No additional definitions	Evaluated
	1 .. Short pulse duration	Evaluated
	2 .. Long pulse duration	Evaluated
	3 .. Persistent command	Not supported

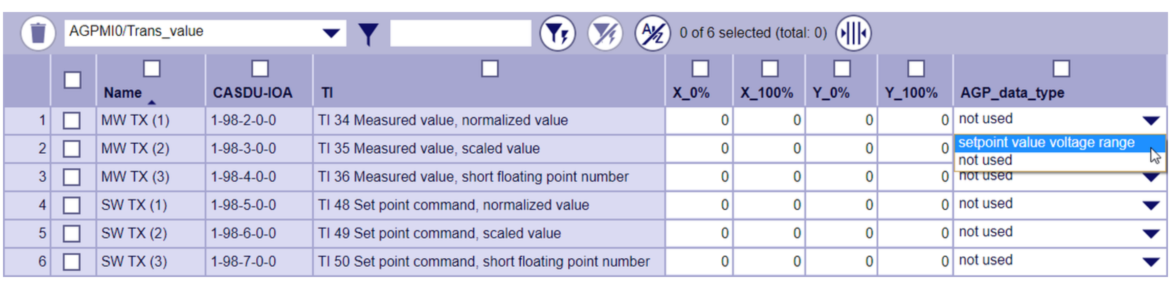
NOTE

Not listed elements of the IEC 60870-5-101/104 message are not rated/not supported!

Measured Values, Setpoint Values

The parameterization of the address and message conversion for measured values and setpoint values in transmit direction is to be done with the SICAM Device Manager with the function "Signals" or with the SICAM TOOLBOX II, OPM II.

Processing type: *firmware* / **`Trans_value`**



AGPMI0/Trans_value — 0 of 6 selected (total: 0)

	Name	CASDU-IOA	TI	X_0%	X_100%	Y_0%	Y_100%	AGP_data_type
1	MW TX (1)	1-98-2-0-0	TI 34 Measured value, normalized value	0	0	0	0	not used
2	MW TX (2)	1-98-3-0-0	TI 35 Measured value, scaled value	0	0	0	0	setpoint value voltage range / not used
3	MW TX (3)	1-98-4-0-0	TI 36 Measured value, short floating point number	0	0	0	0	not used
4	SW TX (1)	1-98-5-0-0	TI 48 Set point command, normalized value	0	0	0	0	not used
5	SW TX (2)	1-98-6-0-0	TI 49 Set point command, scaled value	0	0	0	0	not used
6	SW TX (3)	1-98-7-0-0	TI 50 Set point command, short floating point number	0	0	0	0	not used

[AGPMI0_DM_Sende_Wert, 1, en_US]

Parameters	
`TI`	Supported type identifications: • <TI:=34> .. Measured value, normalized value with time tag CP56Time2a • <TI:=35> .. Measured value, scaled value with time tag CP56Time2a • <TI:=36> .. Measured value, short floating-point number with time tag CP56Time2a • <TI:=48> .. Setpoint command, normalized value • <TI:=49> .. Setpoint command, scaled value • <TI:=50> .. Setpoint command, short floating-point number
`CASDU, IOA`	SICAM A8000 internal IEC 60870-5-101/104 message address (CASDU1, CASDU2, IOA1, IOA2, IOA3)

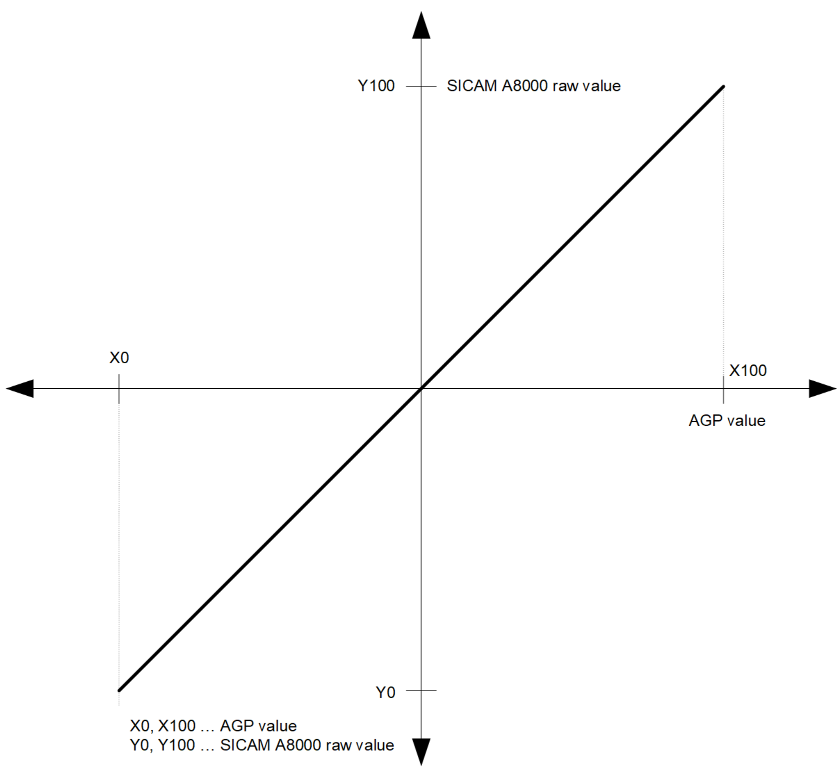
Parameters	
AGP_Data format	AGP function: • Setpoint value voltage range
X_0%, X_100% **Y_0%, Y_100%**	Parameters for value adaptation (scaling) • <TI:=34, 48> .. X_0% and X_100% must not be greater or less than ±1. • <TI:=35, 49> .. X_0% and X_100% must not be less than −32768 or greater than +32767. • Value adaptation inactive at Y_0% and Y_100% = 0 • Y_0% = 0, Y_100% = 250

ACTCON/ACTTERM

If the simulation ACTCON/ACTTERM with the parameter **[PRE] AGP | Communication functions | Command transmission | Command concept to third party connection | Simulation ACTCON/ACTTERM** is released, the transfer of ACTCON takes place for setpoint values depending on the 1 out of n check. ACTTERM is not generated for setpoint values.

Value Adaptation

The value adaptation is defined by the parameters **X_0%**, **X_100%**, **Y_0%**, **Y_100%**.



The value adaptation is only performed if **Y_0%** or **Y_100%** ≠ *0* is parameterized.

- If the value adaptation is enabled and the SICAM A8000 raw value is less than **Y_0%** or greater than **Y_100%**, no conversion is carried out and the error message *Error of format conversion in transmit direction* is set. The last valid value is retained.
- If the value adaptation is not enabled (= direct transfer) and the SICAM A8000 raw value is outside the value range of the selected AGP data format, then no message conversion is performed and the error message *Error of format conversion in transmit direction* is set. The last valid value is retained.

NOTE

- The AGP value has a value range of 0 to 255 (`X_100%` = ***255***).
- The value adaptation for the voltage range must be for `Y_0%` = ***0*** and `Y_100%` = ***250***.

Message Conversion

The table describes the evaluated elements of the IEC 60870-5-101/104 message during message conversion.

Elements of the message		
TI .. Type identification		• <TI:=34> .. Measured value, normalized value with time tag CP56Time2a • <TI:=35> .. Measured value, scaled value with time tag CP56Time2a • <TI:=36> .. Measured value, short floating-point number with time tag CP56Time2a • < TI:=48> .. Setpoint command, normalized value • <TI:=49> .. Setpoint command, scaled value • <TI:=50> .. Setpoint command, short floating-point number
CASDU, IOA .. Message address		Parameter-settable
QDS .. Quality descriptor		
BL .. Blocked		Not evaluated
SB .. Substituted		Not evaluated
NT .. Not topical		Not evaluated
IV .. Invalid		Not evaluated
OV .. Overflow		Not evaluated
Cause of transmission		
06 .. Activation		Is evaluated (only "activation" allowed) [only <TI:=48, 49, 50>]
xx .. Other COTs		Not evaluated
T .. Test		Not evaluated
Information		
Value.. S .. Sign		• Normalized value • Scaled value • IEEE STD 754 = short floating-point number
QOS	S/E	[only <TI:=48, 49, 50>]
	0 = Execute	Is checked for "execute"
	1 = Select	Not supported
Time tag		
CP56Time2a .. Date + time		Not evaluated

NOTE

Not listed elements of the IEC 60870-5-101/104 message are not rated/not supported!

13.12.8.2 Message Conversion in Receive Direction (Master ← Slave)

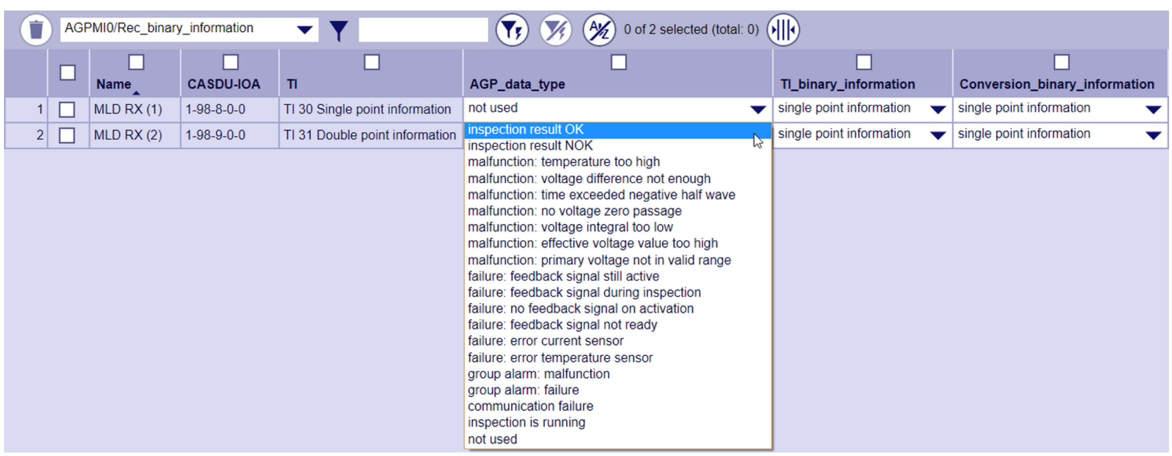
Message Conversion in Receive Direction IEC 60870-5-101/104 ← AGP

SICAM A8000: IEC 60870-5-101/104 ←		AGP
TI	**Designation**	**Data format**
<TI:=30>	Single-point information with time tag CP56Time2a	Status messages (result check, fault, failure)
<TI:=31>	Double-point information with time tag CP56Time2a	Status messages (result check, fault, failure)
<TI:=34>	Measured value, normalized value with time tag CP56Time2a	Calculated current integral value
<TI:=35>	Measured value, scaled value with time tag CP56Time2a	Calculated current integral value
<TI:=36>	Measured value, short floating-point number with time tag CP56Time2a	Calculated current integral value

Binary Information

The parameterization of the address and message conversion for binary information in receive direction is to be done with the SICAM Device Manager with the function “Signals” or the SICAM TOOLBOX II, OPM II .

Processing type: *firmware* / `Rec_binary_information`



[AGPMI0_DM_Empf_Meldung, 1, en_US]

Parameters	
`TI`	Supported type identifications: • <TI:=30> .. Single-point information with time tag CP56Time2a • <TI:=31> .. Double-point information with time tag CP56Time2a
`CASDU, IOA`	SICAM A8000 internal IEC 60870-5-101/104 message address (CASDU1, CASDU2, IOA1, IOA2, IOA3)

Parameters	
`AGP_data_type`	AGP status indication: • Inspection result OK • Inspection result NOK • Malfunction: temperature too high • Malfunction: voltage difference not enough • Malfunction: time exceeded negative half wave • Malfunction: no voltage zero crossing • Malfunction: voltage integral too low • Malfunction: effective voltage value too high • Malfunction: primary voltage not in valid range • Failure: feedback signal still active • Failure: feedback signal during inspection • Failure: no feedback signal on activation • Failure: feedback signal not ready • Failure: error current sensor • Failure: error temperature sensor • Group alarm: malfunction • Group alarm: failure • Communication failure • Inspection is running When the status is queried, the status indications *`inspection result OK`* and *`inspection result NOK`* are not transmitted.
`TI_binary_information`	Message conversion: • Single-point information <TI:=30> • Single point information inverted <TI:=30> • Double-point information state OFF <TI:=31> • Double-point information state ON <TI:=31>
`Conversion_binary_information`	Message conversion to IEC 60870-5-101/104: • Single-point information • Transient information transfer only ON • Transient information emulate OFF • Double-point information with INT/FLT suppression • Double-point information without INT/FLT suppression

Supported Data Formats (AGP Status Indications)

AGP function code	AGP status indication	IEC 60870-5-101/104 Data format (TI)
	• Inspection result OK • Inspection result NOK	30, 31
	• Malfunction: temperature too high • Malfunction: voltage difference not enough • Malfunction: time exceeded negative half wave • Malfunction: no voltage zero crossing • Malfunction: voltage integral too low • Malfunction: effective voltage value too high • Malfunction: primary voltage not in valid range • Failure: feedback signal still active • Failure: feedback signal during inspection • Failure: no feedback signal on activation • Failure: feedback signal not ready • Failure: error current sensor • Failure: error temperature sensor • Group alarm: malfunction • Group alarm: failure • Communication failure • Inspection is running	30

Double-Point Information

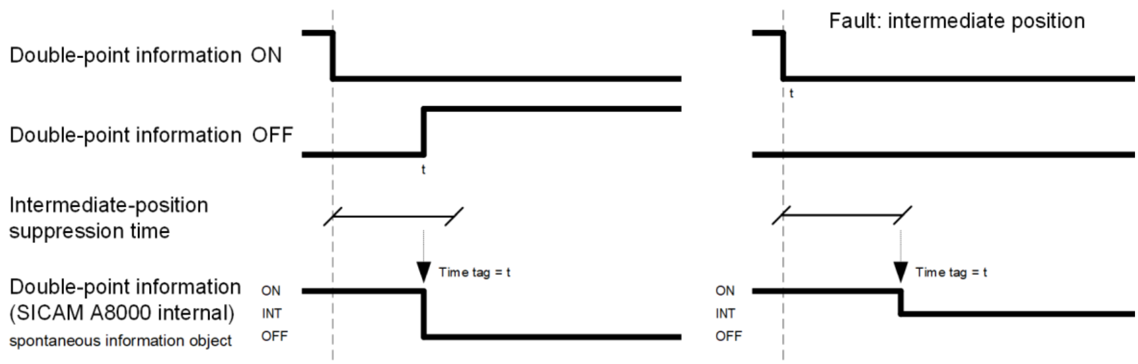
If desired, selected status information from the AGP device (e.g., “result check”) may be forwarded by the protocol element as a double message. For this, two images with the same CASDU and IOA address must be created in the message conversion in the receive direction for each double-point information.

The 1st image of the double-point information is assigned in the field **`Data type Information`** to the value double-point information state OFF (TI 31). The 2nd image of the double-point information is assigned in the field **`Data type Information`** to the value double-point information state ON (TI 31).

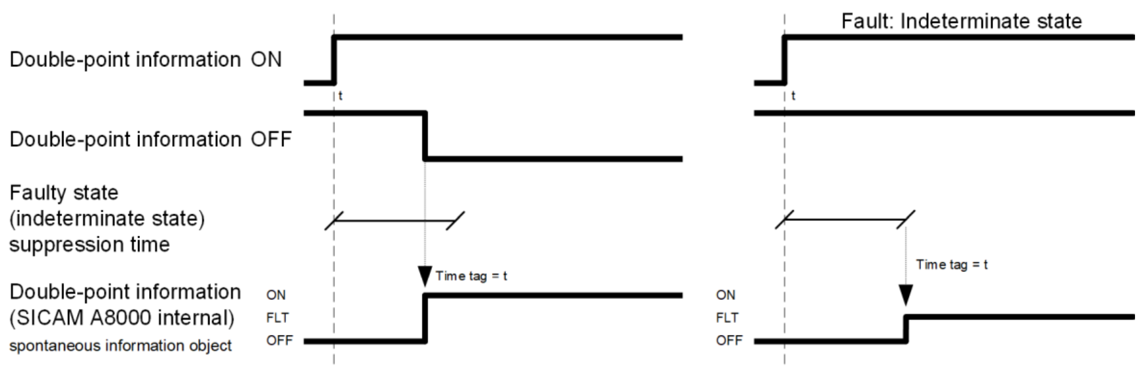
Monitoring for Intermediate and Faulty Position

The forwarding of a double-point information from PRE → BSE with intermediate state (information is not ON and not OFF) or faulty state (information is ON and OFF) will be suppressed for a parameterizable time.

For the suppression of the intermediate position, an intermediate position suppression time can be set for all double-point information items with (parameter **`[PRE] AGP | Communication functions | Binary information | Intermediate position suppression time`**).



For the suppression of the faulty position, a suppression time for faulty state can be set for all double-point information items with parameter (**`[PRE] AGP | Communication functions | Binary information | Faulty position suppression time`**).



Message Conversion

The table describes the evaluated elements of the IEC 60870-5-101/104 message during message conversion.

Elements of the message	
TI .. Type identification	• <TI:=30> .. Single-point information with time tag CP56Time2a • <TI:=31> .. Double-point information with time tag CP56Time2a
CASDU, IOA .. Message address	Parameter-settable
QDS .. Quality descriptor	
BL .. Blocked	Not supported (BL = 0)
SB .. Substituted	Not supported (SB = 0)
NT .. Not topical	Not supported (NT = 0)
IV .. Invalid	Not supported (IV = 0)
Cause of transmission	
03 .. Spontaneous	• With change of information state • Transient information items (if these are set by the AGP) are always transmitted with cause of transmission = 3 (spontaneous).
20 .. Interrogated by station interrogation	On reception of a GI request • A GI request (station interrogation/general interrogation) is always answered by the protocol element itself from the PRE internal process image.
xx .. Other COTs	Not supported

Elements of the message		
T .. Test		Not supported
Information		
Single-point information status		
SPI	0 .. OFF	supported
	1 .. ON	supported
Double point information state		
DPI	0 .. Indeterminate or intermediate state	Supported
	1 .. OFF	Supported
	2 .. ON	Supported
	3 .. indeterminate state	Supported
Time tag		
CP56Time2a .. Date + time		Protocol-internal time (receive time) or, in the case of general interrogation, the internal time at which the GI data is emulated from the protocol element from the protocol-internal process image.

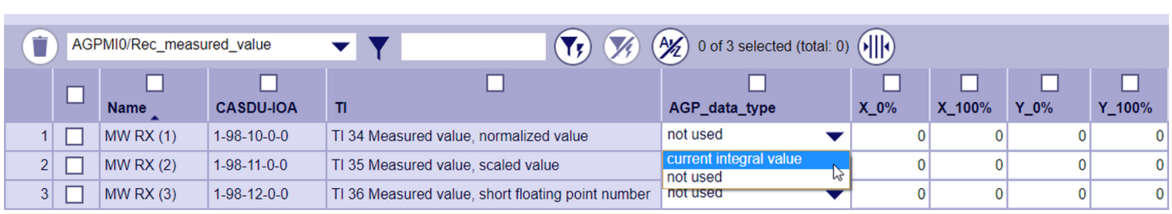
NOTE

Not listed elements of the IEC 60870-5-101/104 message are not rated/not supported!

Measured Values

The parameterization of the address and message conversion for measured values in receive direction is to be done with the SICAM Device Manager with the function “Signals” or with the SICAM TOOLBOX II, OPM II.

Processing type: *firmware* | `Rec_measured value`



[AGPMI0_DM_Empf_Messwert, 1, en_US]

Parameters	
`TI`	Supported type identifications: • <TI:=34> .. Measured value, normalized value with time tag CP56Time2a • <TI:=35> .. Measured value, scaled value with time tag CP56Time2a • <TI:=36> .. Measured value, short floating-point number with time tag CP56Time2a
`CASDU, IOA`	SICAM A8000 internal IEC 60870-5-101/104 message address (CASDU1, CASDU2, IOA1, IOA2, IOA3)

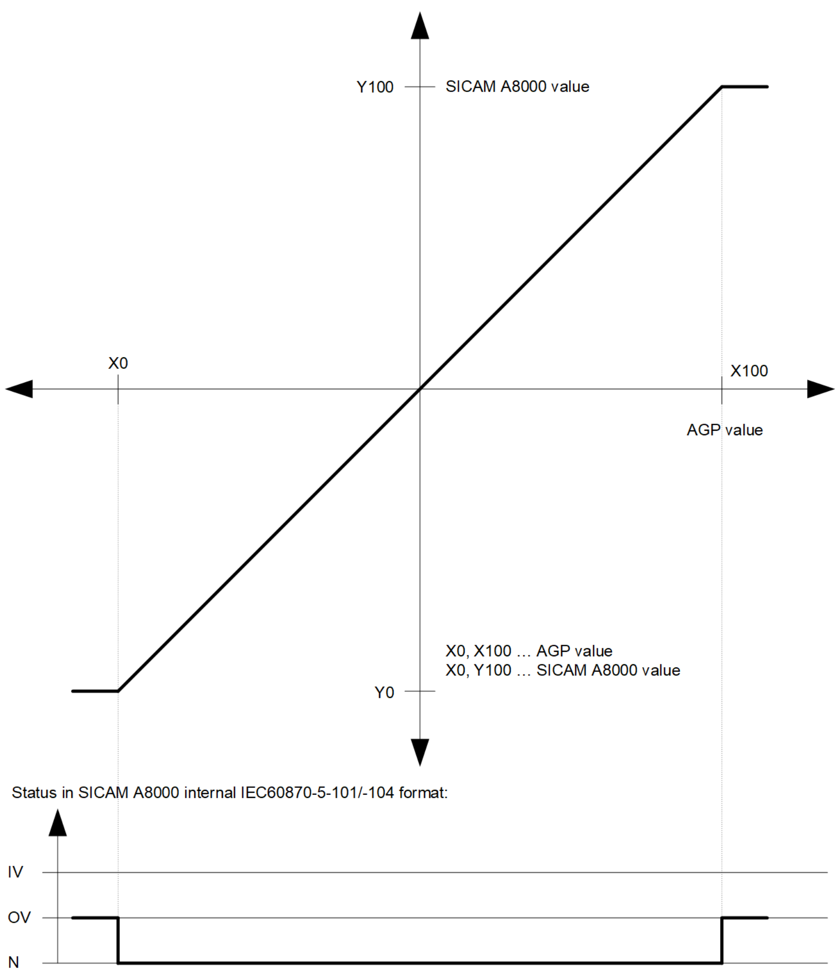
Parameters	
AGP_data_type	AGP measured value: • Current integral value
X_0%, X_100% **Y_0%, Y_100%**	Parameters for value adaptation (scaling) • <TI:=34> .. Y_0% and Y_100% must not be greater or less than ±1. • <TI:=35> .. Y_0% and Y_100% must not be less than −32768 or greater than +32767. • Value adaptation inactive at X_0% and X_100% = 0

Supported Data Formats (AGP Measured Values)

AGP function code	AGP value	IEC 60870-5-101/104 Data format (TI)
	Current integral value	34, 35, 36

Value Adaptation

The value adaptation is defined by the parameters **X_0%**, **X_100%**, **Y_0%**, **Y_100%**.



The value adaptation is only performed if **X_0%** or **X_100%** ≠ *0* is parameterized.

If the value adaptation is not activated (= direct transfer) and the AGP value is outside the value range of the selected IEC 60870-5-101/104 type identifier, then OV = 1 is set.

NOTE

The AGP value has a value range of 0 to 255 (**`X_100%`** = ***255***).

Message Conversion

The table describes the evaluated elements of the IEC 60870-5-101/104 message during message conversion.

Elements of the message	
TI .. Type identification	• <TI:=34> .. Measured value, normalized value with time tag CP56Time2a • <TI:=35> .. Measured value, scaled value with time tag CP56Time2a • <TI:=36> .. Measured value, short floating-point number with time tag CP56Time2a
CASDU, IOA .. Message address	Parameter-settable
QDS .. Quality descriptor	
BL .. Blocked	Not supported (BL = 0)
SB .. Substituted	Not supported (SB = 0)
NT .. Not topical	Not supported (NT = 0)
IV .. Invalid	Not supported (IV = 0)
OV .. Overflow	OV = 1: Without value adaptation: • AGP value outside the range of the selected type identification With value adaptation: • AGP value less than X_0% or greater X_100%
Cause of transmission	
03 .. Spontaneous	The AGP value is always passed on after every check with measured value query.
20 .. Interrogated by station interrogation	On reception of a GI request • A GI request (station interrogation/general interrogation) is always answered by the protocol element itself from the PRE internal process image.
xx .. Other COTs	Not supported
T .. Test	Not supported
Information	
Value.. S .. Sign	• normalized value • Scaled value • IEEE STD 754 = short floating-point number
Time tag	
CP56Time2a .. Date + Time	Protocol-internal time (receive time) or, in the case of general interrogation, the internal time at which the GI data is emulated from the protocol element from the protocol-internal process image.

NOTE

Not listed elements of the IEC 60870-5-101/104 message are not rated/not supported!

13.13 DSfG

13.13.1 Introduction

The DSfG-Bus protocol is a serial transmission protocol for devices with digital interface for gas measurement devices (DSfG). The coupling of the CP-8050 (as DSfG bus slave "instance") to the DSfG bus takes place exclusively via a RS-485 interface.

Protocol firmware for DSfG-Bus:

Firmware	System	Standard and function
DSFGI0	CP-8031, CP-8050	DSfG bus Slave "Instance" The DSfG bus slave supports data exchange with the DSfG bus master and direct data exchange with other DSfG bus slaves in the cross traffic.

DSfG bus:

The DSfG-Bus (Digital interface for gas measurement devices) is a digital communication protocol for the transmission of billing and monitoring data in the field of natural gas measurement.

The DSfG bus uses as electrical interface RS-485. The individual DSfG subscribers are connected to the bus via bus stub lines. Up to 31 subscriber can be connected to the DSfG bus. One subscriber is mandatory the DSfG bus master the other max. 30 subscriber are DSfG bus slaves (= instances).

Data transfer on the DSfG bus is controlled by the master. DSfG bus slaves may only transfer data if they are requested by the master or in the case of cross traffic (= direct data exchange between the slaves) after release from the master (after requested for cross traffic).

13.13.2 Functions

Function	DSFGI0
DSfG	
Serial communication protocol according to DSfG (Digital interface for gas measurement devices)	✓
DSfG class A ... local DSfG bus in in the measuring station according to DVGW work sheet G 485	Partly
DSfG class B ... data transmission via DSfG-DFÜ in accordance with DVGW worksheet G 485	–
DSfG class C ... Data transmission by means of IEC 60870-5-104 telecontrol protocol (TCP/IP) [376]	Partly
Signature	–
Network configuration	
DSfG bus: RS_485	✓
DSfG bus with unbalanced transmission: • the DSfG bus master controls the communication at the DSfG bus • direct data exchange between slaves possible (= cross traffic) (DSfG master coordinates the cross traffic)	✓
DSfG-Bus Master: • external master for DSfG bus control is mandatory!	1
DSfG bus: max. slaves (slave = “Instance”)	30

376 DSfG-C = Mapping of the DSfG on IEC 60870-5-101 / 104 according to the DSVG document: Gas Information Nr. 7 – 3. Revision 04/2007 Technical specification for DSfG realizations part 2: Mapping of DSfG to the IEC60870-5-101 and -104. The task of the DSfG-C is to integrate the DSfG into the existing IEC 60870-5-101/104 infrastructure of the measuring system operator.

Function	DSFGI0
Physical interface	
CP-8031, CP-8050: X4 (RS-485, RS-422); X5 (RS-232) [377]	✓
CI-8551 [378]: X1, X2 (RS-232, RS-232, RS-422); X3 (RS-485, RS-422); X4, X5 (RS-232) [377]	✓
Baud rates: 9600, 19200, 38400, 57600, 115200 bit/s	✓
Message Protection: Vertical- horizontal parity	✓
DSfG bus functions	
Data transmission:	
• direct data exchange with the central station (master)	✓
• direct cross traffic with other slaves	✓
• direct cross traffic with other slaves	–
	–
Direct cross traffic:	
• reading archives for billing	–
• reading archives and logbooks for the diagnosis of operational situations	–
• read individual DSfG data elements for online tracking, operational management, dispatching, prognoses	✓
• read individual data elements for the diagnosis of error situations	–
• write individual data elements for the triggering of switching commands, specification of controller setpoints, adjustment of gas quality tables.	✓
• combined reading and writing of individual data elements and/or standard queries and/or archives for special tasks (revision, remote revision, remote calibration, ..).	–
• combined reading and writing of data ranges using the message type NTY = D for manufacturer-specific tasks (remote configuration, tele control panel, ..)	–
• reading data element areas for announcing the station (bus analysis)	–
• read and write private data elements / areas for vendor-specific applications	–
Supported IEC 60870-5-101/104 message formats in control direction (CP-8031, CP-8050→DSfG **Transmit direction**	
<TI:=49> ... Setpoint command, scaled value	✓
<TI:=50> ... Setpoint command, short floating-point number	✓
<TI:=58> ... Single command with CP56Time2a time tag	–
<TI:=59> ... Double command with time tag CP56Time2a	–
<TI:=63> ... Setpoint command, floating-point number with time tag CP56Time2a	–
<TI:=120-126> ... Transmission of data	–
Supported IEC60870-5-101/-104 message formats in transmit direction (CP-8031, CP-8050←DSfG) **("Receive direction")**	
<TI:=30> ... Single-point information with time tag CP56Time2a	✓
<TI:=31> ... Double-point information with time tag CP56Time2a	–
<TI:=33> ... Bitstring of 32 bits with time tag CP56Time2a	–
<TI:=34> ... Measured value, normalized value with time tag CP56Time2a	✓

377 With an additional external interface converter (RS-232 ↔ RS-485), an RS-232 interface of the CP-8031, CP-8050 or the CI-8551 can also be used.

378 With CP-8031 not supported by default. With a license (see *14.8 SICAM A8000 CP-803x Extended CI-Module*) 1 communication module CI-8551 can be used additionally also with CP-8031.

Function	DSFGI0
<TI:=35> ... Measured value, scaled value with time tag CP56Time2a	✓
<TI:=36> ... Measured value, floating-point number with time tag CP56Time2a	✓
<TI:=37> ... Integrated total with time tag CP56Time2a	✓
<TI:=120-126> ... Transmission of data	–
Web server	
Protocol-internal diagnostic and statistic information via protocol-specific web pages	✓
Engineering	
SICAM Device Manager	✓
SICAM TOOLBOX II	✓

Restrictions

- DSfG bus according to DSfG class A (local DSfG bus in the measuring system) is supported to a limited extent.
- DSfG bus according to DSfG class B (data transmission via DSfG-DFÜ) is not supported.
- DSfG bus according to DSfG class C (data transmission via IEC 70870-5-104) is supported with restrictions.
- Emulations of ACTTERM for setpoint values according to IEC 60870-5-101/104 are not supported.
- "Select-Before-Operate" for setpoint values is not supported.
- Control location, control location check for setpoint values is not supported
- Redundancy is not supported!

13.13.3 Modes of Operation

The operating mode of the interface is determined by parameters of the protocol element and optional equipment.

Standard operating mode	Interface → optional DCE	Interface signals
Balanced interface (V.11) RS 485 (2 wire)/ RS-422 (4 wire) asynchronous	CP-8031, CP-8050: X4 CI-8551 [379]: X1, X2 (RS-485) X3 (RS-485)	RS-485 2-wire: TXD+/RXD+, TXD-/RXD-, GND
Unbalanced interchange circuit (V.24/V.28) RS-232 asynchronous	CP-8031, CP-8050: X5 (RS-232) CI-8551 [379]: X1, X2 (RS-232) X4, X5 (RS-232) with external interface converter RS-232 ↔ RS-485 e.g.: PHOENIX PSM-ME-RS232/RS485-P	RS-232: RXD, TXD, CTS [380], RTS, DCD, DTR, VCC/OUT [381], GND

379 With CP-8031 not supported by default. With a license (see *14.8 SICAM A8000 CP-803x Extended CI-Module*) 1 communication module CI-8551 can be used additionally also with CP-8031.

380 Not usable (reserved for SICAM TOOLBOX II)

381 VCC/OUT not with CI-8551/X1, X2

NOTE

With a serial connection via X5 interface of CP-8031, CP-8050 a bridge between CTS and GND is required, as far as the interface shall also be used for the connection with the engineering PC.

The CTS status line cannot be used by the protocol!

If the interface shall not be used as serial engineering interface, the function can be disabled with the parameter **`Serial engineering interface = disabled`**. Thereby no connection between CTS and GND is required.

13.13.4 Communication

For the stations to communicate with each other, suitable transmission facilities and/or network components may be needed in addition.

Own station "DSfG bus slave instance" (slave)

System	System element	Protocol Element	Remarks
SICAM A8000 Series	CP-8031/CPCI85 CP-8050/CPCI85 CP-8050/EPCI85	DSFGI0	1x DSfG bus Slave (=instance) Remote station: • 1 DSfG bus master • max. 30 DSfG bus slaves (for cross traffic)

Remote station "DSfG bus master" (master station)

System	System element	Protocol Element	Remarks
Third-party system	-	-	Master according to DSfG bus.

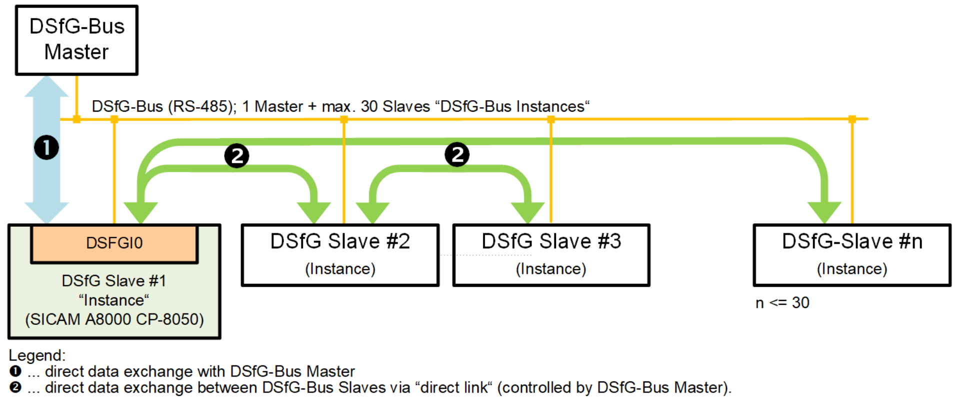
Remote station "DSfG bus slave instance" (slave)

System	System element	Protocol Element	Remarks
SICAM A8000 Series	CP-8031/CPCI85 CP-8050/CPCI85 CP-8050/EPCI85	DSFGI0	according to DSfG bus
Third-party system	-	-	according to DSfG bus

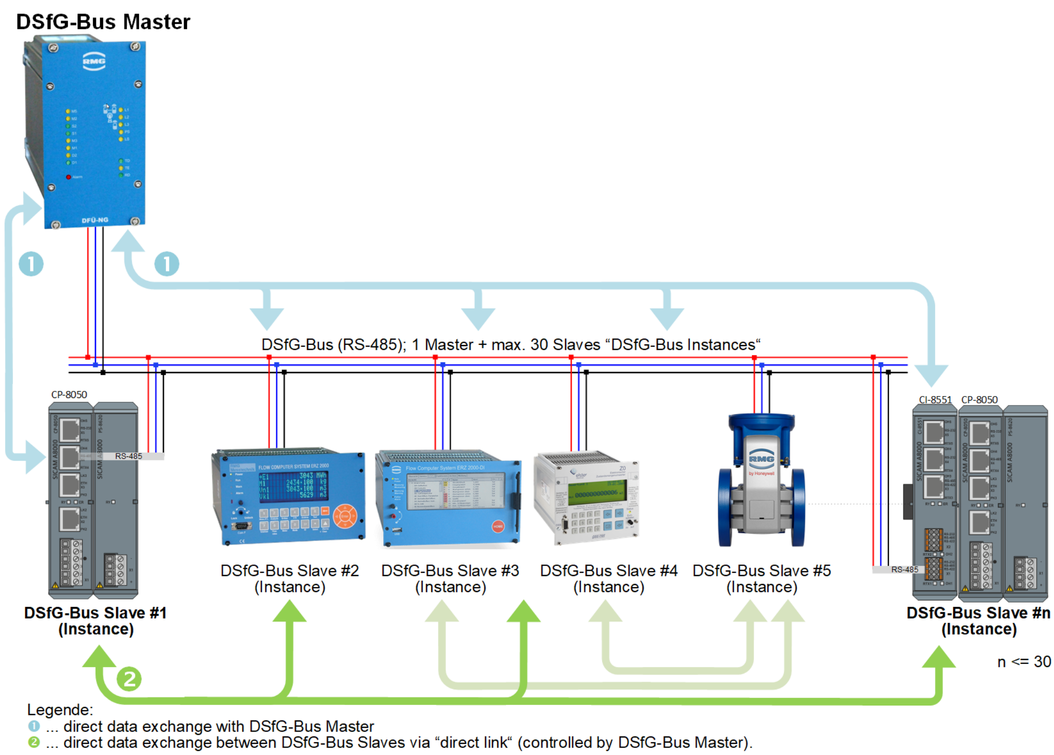
13.13.5 Communication according to DSfG

The DSfG bus uses as electrical interface RS-485. The individual DSfG subscribers are connected to the bus via bus stub lines. Up to 31 subscriber can be connected to the DSfG bus. One subscriber is mandatory the DSfG bus master, the other max. 30 subscriber are DSfG bus slaves (=instance).

Data transfer on the DSfG bus is controlled by the master. DSfG bus slaves may only transfer data if they are requested by the master or in the case of cross traffic (= direct data exchange between the slaves) after release from the master (after requested for cross traffic).



Schematic configuration – CP-8050 as DSfG bus slave:



13.13.6 Parameter and Settings

Parameter Name	Description	Settings
[PRE] Interface parameter Note: Some parameters may not be displayed until the interface is selected.		
Interface	"Virtual serial interface" (CP-8050 internal). The "virtual serial interface" is assigned on the BSE to a serial interface plug. *13.1.4.5 Selection of a serial interface for communication protocols* Note: DSfG-Bus requires the selection of an RS-485 interface!	Permitted range = COM1 to COM50 Default setting = not used
Baud rate	The DSfG bus slave protocol in CP-8050 supports baud rates in the range of 9600 Bd to 115200 Bd.	Permitted range = 9600, 19200, 38400, 57600, 115200 bit/s Default setting = 9600
[PRE] Interface Parameter | Time settings for interface modem See *13.1.4.8 Time settings for transmission facilities*.		
Pause time (tp)	Before a message transmission, a parameter-settable pause time "tp" is maintained before the transmission level is switched on with RTS.	Permitted range = 0 to 32767 ms 0 = no pause time Default setting = 0
Set-up time (tv)	After switching on the transmission level with RTS, the message transmission is started after the set-up time "tv" has expired.	Permitted range = 0 to 32767 ms 0 = no set-up time Default setting = 1 ms
Run out time (tn)	After the message transmission has ended the transmit signal level (RTS) is only switched off after expiry of the Run out time "tn".	Permitted range = 0 to 32767 ms 0 = no run-out time Default setting = 1 ms
[PRE] Station definition		
Own station number (DSFG instance)	Own DSfG station number or instance number on the DSfG bus.	Permitted range = 1 to 30 Default setting =
[PRE] Station definition | Station definition		
Station number (DSFG instance)	Station number of the connected slaves (instances) on the DSfG bus for cross traffic. The DSfG bus master always has station number 31 – DSfG bus master is not entered in the station definition!	Permitted range = 1 to 30 255 = not used Default setting = 255
Station enable	Direct data exchange with other DSfG bus slaves via cross traffic is only possible at enabled stations.	Permitted range = yes, no Default setting = yes
Blocking number	Max. Number of DSfG messages that are transmitted blocked per query.	Permitted range = 1 to 4 Default setting = 4

Parameter Name	Description	Settings
`Access code 1`	Access code 1 (password) for setpoint values.	Permitted range = • Max. 40 ASCII characters • all printable ASCII characters in the range 0x20 - 0x7E • 0 to 9; A to Z; a to z; "-"; " "; ... Default setting =
`Access code 2`	Access code 2 (password) for setpoint values.	Permitted range = • Max. 40 ASCII characters • all printable ASCII characters in the range 0x20 - 0x7E • 0 to 9; A to Z; a to z; "-"; " "; ... Default setting =
`[PRE] Station definition | Type plate (own station)`		
`Instance type (address: aaa)`	DSfG type plate of the own station.	Permitted range = • Max. 10 ASCII characters • all printable ASCII characters in the range 0x20 - 0x7E • 0 to 9; A to Z; a to z; "-"; " "; ... Default setting = X
`Fabricator (address aba)`	DSfG type plate of the own station.	Permitted range = • Max. 40 ASCII characters • all printable ASCII characters in the range 0x20 - 0x7E • 0 to 9; A to Z; a to z; "-"; " "; ... Default setting = SIEMENS
`Device type (address abb)`	DSfG type plate of the own station.	Permitted range = • Max. 40 ASCII characters • all printable ASCII characters in the range 0x20 - 0x7E • 0 to 9; A to Z; a to z; "-"; " "; ... Default setting = SICAM A8000 (CP-8050)
`Factory-no. (address abc)`	DSfG type plate of the own station.	Permitted range = • Max. 40 ASCII characters • all printable ASCII characters in the range 0x20 - 0x7E • 0 to 9; A to Z; a to z; "-"; " "; ... Default setting =
`Construction year (address abd)`	DSfG type plate of the own station.	Permitted range = 0 to 65535 Default setting = 2019

Parameter Name	Description	Settings
Comission date (address abf)	DSfG type plate of the own station.	Permitted range = • Max. 40 ASCII characters • all printable ASCII characters in the range 0x20 - 0x7E • 0 to 9; A to Z; a to z; "-"; " "; ... Default setting =
[PRE] DSFG | Time settings, retries | Monitoring times		
Application counter (q-time)	Within this monitoring time, the response to a query must be received by the addressed remote station (for example, another DSfG bus slave in cross traffic).	Permitted range = 0, 0.1 to 6553.5 s 0 = no failure detection Default setting = 8
Failure counter	Number of unsuccessful calls until the DSfG station is reported as failed.	Permitted range = 0 to 255 Default setting = 0
Timeout for access code		Permitted range = 0 to 655.35 s Default setting = 120 s
[PRE] DSFG | Time settings, retries | Retries		
Application - Retry	Max. Number of attempts until a cyclical query for user data is aborted.	Permitted range = 0 to 255 Default setting = 3
[PRE] DSFG | Communication functions | Multiple queries Note: here the multiple queries to other DSFG bus stations in the cross traffic are defined.		
Station no. (DSFG instance)	DSfG station number (instance) of the remote station for cross traffic.	Permitted range = 1 to 30 255 = not used Default setting = 255
DB1-DB5	DSFG data element address. For example: bdde ... print	Permitted range = • Max. 5 ASCII characters • a to z; "-" Default setting =
Cycle time	The multiple queries are carried out cyclically in the parameterized time grid.	Permitted range = 0 to 65535 s 0 = no multiple queries Default setting = 0 s
[PRE] DSFG | Communication functions | Transmission of integrated totals		
Delay time counter interrogation	With counter interrogation CP-8050 → DSfG bus, the query of the counters is delayed by the parameterized value.	Permitted range = 0 to 50 s 0 = no delay Default setting = 0 s
[PRE] DSFG | Advanced parameters		
Time tag	The data from the DSfG bus are passed on in the receive direction either with the Ax time or the DSFG time.	Permitted range = • Ax time • DSFG time Default setting = Ax-Zeit

Parameter Name	Description	Settings
[PRE] Data base management (settings for the data base management on BSE (per PRE)) See *13.1.4.14 Data Management on the BSE for Communication Protocols*		
[PRE] Advanced parameters | Software test points		
...	The software test points may only be used under the guidance of experts for error detection! Once the fault isolation is completed, software checkpoints must always be turned off.	Permitted range = yes, no Default setting = no

NOTE

On the basic system element in the topology for DSFG you have to enter “multi-point traffic master”. The stations for the cross traffic are the remote stations, which are entered as “Slaves” in the topology.

13.13.7 Web server

A web server is integrated in the protocol firmware for internal diagnostic information. The web server is part of basic system element – the PRE specific web pages will be provided by protocol element.

System	Firmware	Protocol function	PRE-specific web pages
SICAM A8000 CP-8050	DSFGI0	DSfG-Bus Slave (Instance)	✓

NOTE

For security reasons, the integrated web server is deactivated by default. If needed, it can be enabled for access by the user with the parameter **[PRE] Advanced parameters | Webserver | HTTP-Webserver** .

The PRE-specific web pages can be displayed with a standard web browser, for example *Google Chrome®*, are displayed.
For the access to the web server the communication protocol HTTP (Hyper Text Transfer Protocol) is used with the port number 80 or the communication protocol HTTPS (Hyper Text Transfer Protocol over SSL/TLS) is used with the port number 443.

With the SICAM Device Manager, the PRE-specific web pages can be called up via a link under **protocol details**.

[AGPMI0_WEB_DM_start_Webserver, 2, en_US]

The PRE-specific web pages can also be called up directly via the IP address of the automation unit.

CPU	PRE	Example
M-CPU	0 to 7	https://172.16.0.3/pre0 https://172.16.0.3/pre7 or https://172.16.0.3/mpre0 https://172.16.0.3/mpre7
C-CPU0	0 to 3	https://172.16.0.3/c0pre0
C-CPU1	0 to 3	https://172.16.0.3/c1pre0
C-CPU2	0 to 3	https://172.16.0.3/c2pre3
C-CPU3	0 to 3	https://172.16.0.3/c3pre3

Table 13-4 Supported PRE-specific web pages

PRE-specific web page	DSFGI0
Overview	✓
Connections	✓
Routing Transmit	✓
Routing Receive	✓
Developer Information	
Freespace	✓
Dataflow Test	✓
Diagnosis (IDR)	✓
Diagnosis (IDH)	✓
Diagnosis (IDZ)	✓
Diagnosis (IDE)	✓

NOTE

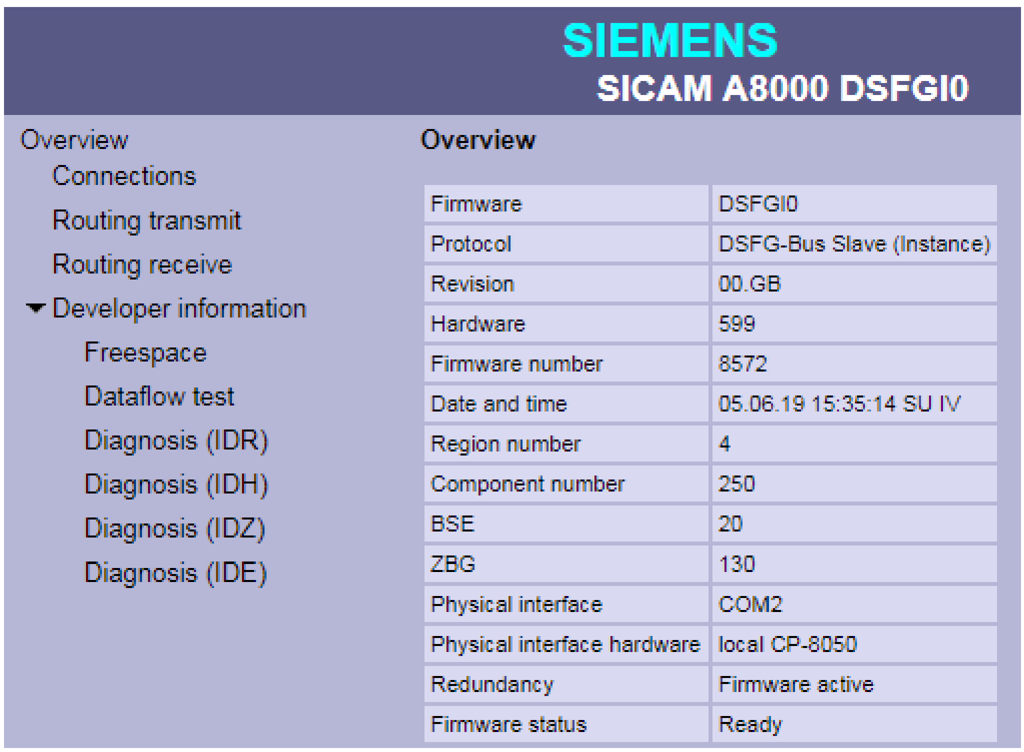
- The values displayed on the web pages indicate the current status when the web page is started.
  The values of a web page are not updated automatically.
  A manual updating of the web page displayed in the web browser can be performed e.g. by means of a refresh of the web browser.
- The web pages will be displayed only in English language!

13.13.7.1 Overview

With web page **Overview** general information of the firmware will be displayed.

Field	Note
Firmware	Name of firmware
Protocol	Protocol function: DSfG-Bus Slave (Instance)
Revision	Revision of Firmware
Hardware	Hardware number (system internal)
Firmware number	Firmware number (system internal)
Date and time	actual date + time of firmware
Region number	Region number (system internal)
Component number	Component number (system internal)
BSE	Basic system element number (system internal)

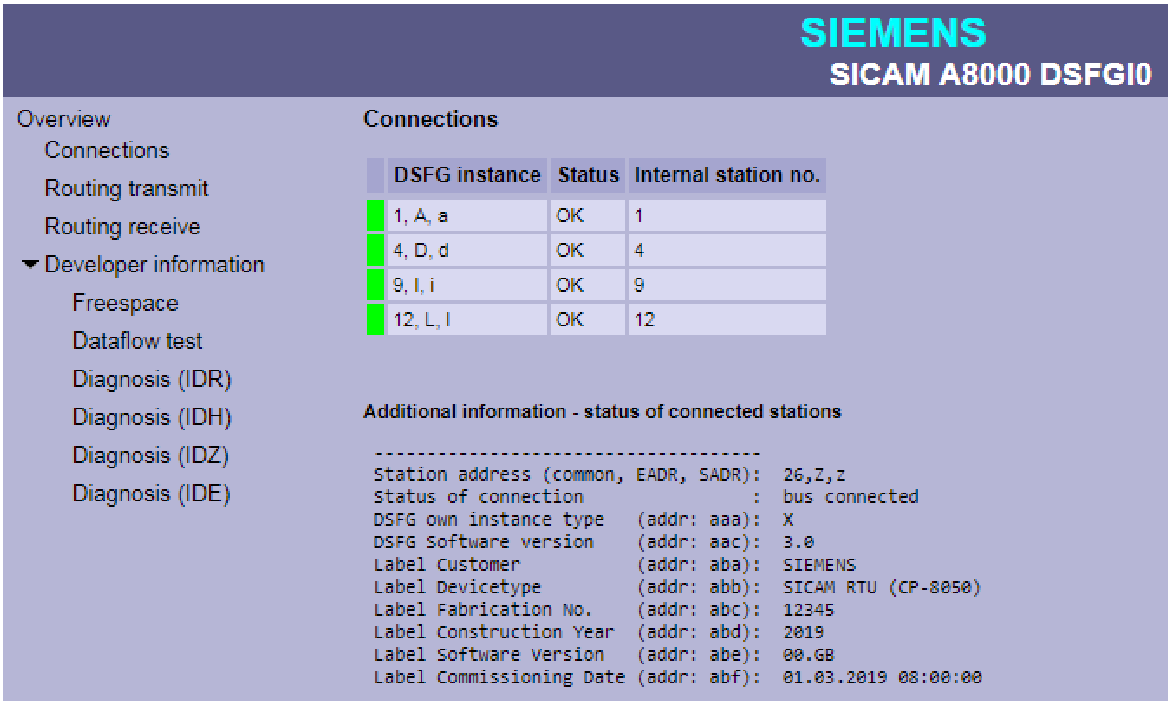
Field	Note
ZBG	Supplementary system element number “SSE” (internal)
Physical Interface	Selected virtual COM interface (internal)
Physical interface hardware	Selected module for COM interface
Redundancy	actual date + time of firmware • Firmware active • Firmware passive
Firmware status	State of the firmware: • Ready • Failure state information (e.g.: exception, kill, ...)



13.13.7.2 Connections

With web page **Connections** detailed information about the status of the connection to each connected DSFG-device will be displayed.
The DSfG bus master always has station number 31 and is not displayed in this overview!

Field	Note
DSFG instance	DSfG station address ("Instance")
Status	State of the connection to the DSfG station • OK • NOK
Internal station no.	CP-8050 internal station number (for diagnostic and data routing)



Parameterized DSfG bus devices for which error-free communication is possible are highlighted in green.

Additional Information – Status of Connected Stations

The device data read out from the parameterized and connected DSfG devices are displayed here.

The device data of the own station are displayed as the first entry.

Field	Note
Station address (common, EAR, SADR)	DSfG-Station address ("Instance") at DSfG-Bus
State of connection	State of the connection to the DSfG station • OK • Bus connected • NOK
DSFG own instance type (addr: aaa)	DSfG device data - typ of the DSfG station ("Instance"): • R2 ... • U2 ... • X ...
DSFG Software version (addr: aac)	DSfG device data- DSFG software version
Label Customer (addr: aba)	DSfG device data - manufacturer
Label device type (addr: abb)	DSfG device data - device designation
Label Fabrication no. (addr: abc)	DSfG device data - fabrication number
Label Construction year (addr: abd)	DSfG device data - production year
Label Software version (addr: abf)	DSfG device data- software version
Label Commissioning Date (addr: abf)	DSfG device data- commissioning date

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- Routing receive
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  - Dataflow test
  - Diagnosis (IDR)
  - Diagnosis (IDH)
  - Diagnosis (IDZ)
  - Diagnosis (IDE)

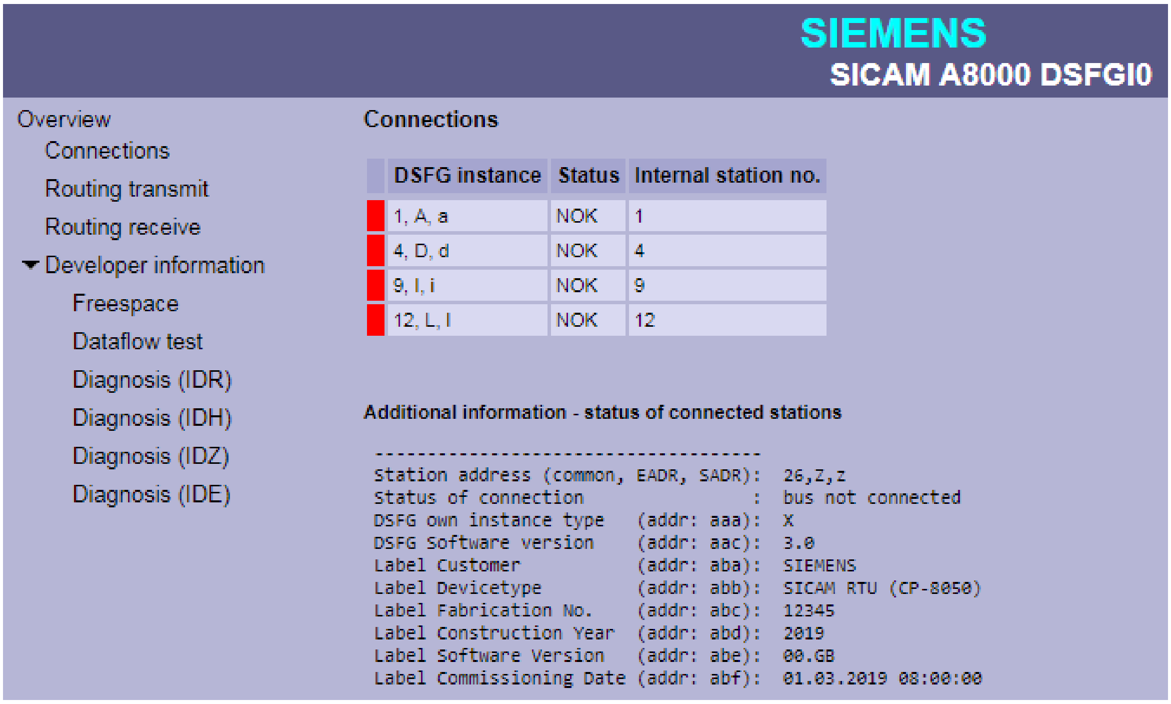
Connections

DSFG instance	Status	Internal station no.
1, A, a	OK	1
4, D, d	OK	4
9, I, i	OK	9
12, L, l	OK	12

Additional information - status of connected stations

```
-------------------------------------
Station address (common, EADR, SADR):  26,Z,z
Status of connection                :  bus connected
DSFG own instance type    (addr: aaa):  X
DSFG Software version     (addr: aac):  3.0
Label Customer            (addr: aba):  SIEMENS
Label Devicetype          (addr: abb):  SICAM RTU (CP-8050)
Label Fabrication No.     (addr: abc):  12345
Label Construction Year   (addr: abd):  2019
Label Software Version    (addr: abe):  00.GB
Label Commissioning Date (addr: abf):  01.03.2019 08:00:00
-------------------------------------
Station address (common, EADR, SADR):   1,A,a
Status of connection                :  OK
DSFG own instance type    (addr: aaa):  U2
DSFG Software version     (addr: aac):  2.0
Label Customer            (addr: aba):  RMG Messtechnik
Label Devicetype          (addr: abb):  ERZ 2000
Label Fabrication No.     (addr: abc):  16387
Label Construction Year   (addr: abd):  2013
Label Software Version    (addr: abe):  2.0.0
Label Commissioning Date (addr: abf):  01.08.2013 06:00:00
-------------------------------------
Station address (common, EADR, SADR):   4,D,d
Status of connection                :  OK
DSFG own instance type    (addr: aaa):  U2
DSFG Software version     (addr: aac):  2.0
Label Customer            (addr: aba):  RMG Messtechnik
Label Devicetype          (addr: abb):  ERZ 2000
Label Fabrication No.     (addr: abc):  16388
Label Construction Year   (addr: abd):  2013
Label Software Version    (addr: abe):  2.0.0
Label Commissioning Date (addr: abf):  01.08.2013 06:00:00
-------------------------------------
Station address (common, EADR, SADR):   9,I,i
Status of connection                :  OK
DSFG own instance type    (addr: aaa):  R2
DSFG Software version     (addr: aac):  2.0
Label Customer            (addr: aba):  RMG Messtechnik
Label Devicetype          (addr: abb):  ERZ 2000
Label Fabrication No.     (addr: abc):  16387
Label Construction Year   (addr: abd):  2013
Label Software Version    (addr: abe):  2.0.0
Label Commissioning Date (addr: abf):  01.08.2013 06:00:00
-------------------------------------
Station address (common, EADR, SADR):  12,L,l
Status of connection                :  OK
DSFG own instance type    (addr: aaa):  R2
DSFG Software version     (addr: aac):  2.0
Label Customer            (addr: aba):  RMG Messtechnik
Label Devicetype          (addr: abb):  ERZ 2000
Label Fabrication No.     (addr: abc):  16388
Label Construction Year   (addr: abd):  2013
Label Software Version    (addr: abe):  2.0.0
Label Commissioning Date (addr: abf):  01.08.2013 06:00:00
```

Parameterized DSfG bus devices for which no communication is possible or which have failed are highlighted in red.



13.13.7.3 Routing Transmit

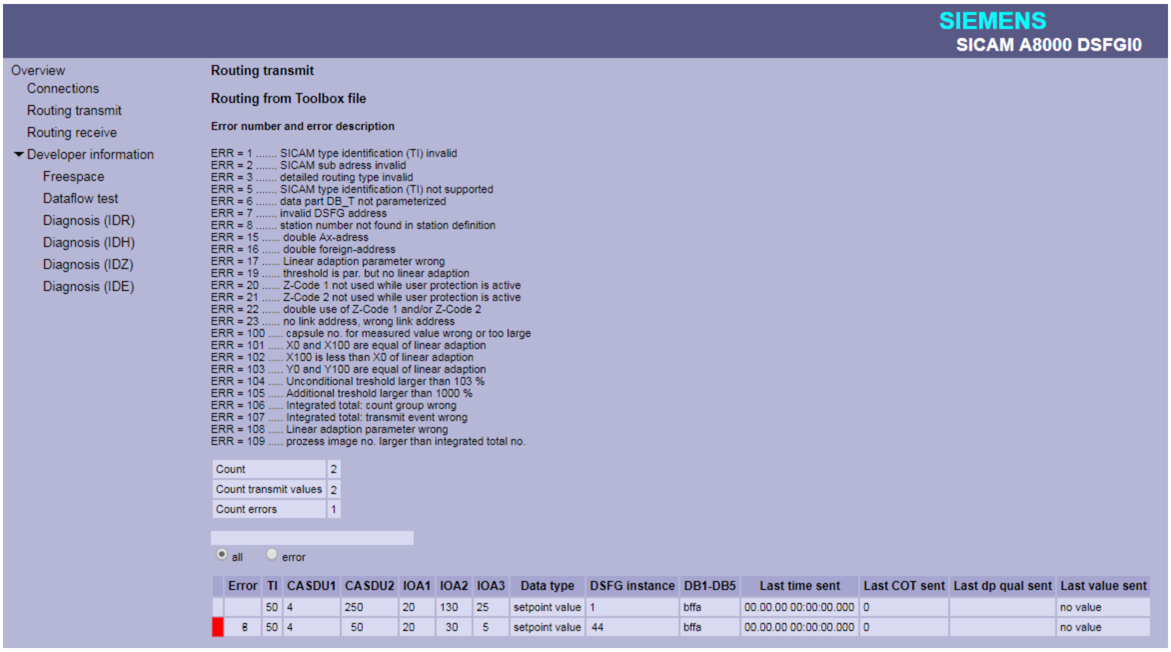
With web page **Routing Transmit** the information of the parameterized DSfG data points in transmit direction are displayed.

Field	Note
Count	Number of parameterized data points in transmit direction (total for all stations)
Count transmit values	Number of incorrectly parameterized data points for "values" in transmission direction (total for all stations)
Count errors	Number of faulty parameterized data points in transmit direction (total number for all stations)

Field	Note
Error	Error number • ERR = 0 .... no error • ERR = 1 .... SICAM type identification (TI) invalid • ERR = 2 .... SICAM sub adress invalid • ERR = 3 .... detailed routing type invalid • ERR = 5 .... SICAM type identification (TI) not supported • ERR = 6 .... data part DB_T not parameterized • ERR = 7 .... invalid DSFG address • ERR = 8 .... station number not found in station definition • ERR = 15 ...... double Ax-adress • ERR = 16 ...... double foreign-address • ERR = 17 ...... Linear adaption parameter wrong • ERR = 19 ...... threshold is par. but no linear adaption • ERR = 20 ...... Z-Code 1 not used while user protection is active • ERR = 21 ...... Z-Code 2 not used while user protection is active • ERR = 22 ...... double use of Z-Code 1 and/or Z-Code 2 • ERR = 23 ...... no link address, wrong link address • ERR = 100 ..... capsule no. for measured value wrong or too large • ERR = 101 ..... X0 and X100 are equal of linear adaption • ERR = 102 ..... X100 is less than X0 of linear adaption • ERR = 103 ..... Y0 and Y100 are equal of linear adaption • ERR = 104 ..... Unconditional treshold larger than 103 % • ERR = 105 ..... Additional treshold larger than 1000 % • ERR = 106 ..... Integrated total: count group wrong • ERR = 107 ..... Integrated total: transmit event wrong • ERR = 108 ..... Linear adaption parameter wrong • ERR = 109 ..... prozess image no. larger than integrated total no.
TI	IEC 60870-5-101/104 Type identification (CP-8050 internal)
CASDU1, CASDU2 IOA1, IOA2, IOA3	CP-8050 internal IEC 60870-5-101/104 Address of the data point
Data type	DSFG data type for this data point: • setpoint value
DSFG instance	DSfG station address (Instance)
DB1-DB5	DSFG address of the datapoint
Last time sent	Last transmission time of specific data point
Last COT sent	Last transmitted cause of transmission (COT) for this data point from BSE → PRE
Last dp qual sent	Last sent quality descriptor for this data point from the BSE → PRE
Last value sent	Last sent value for this data point from the BSE → PRE

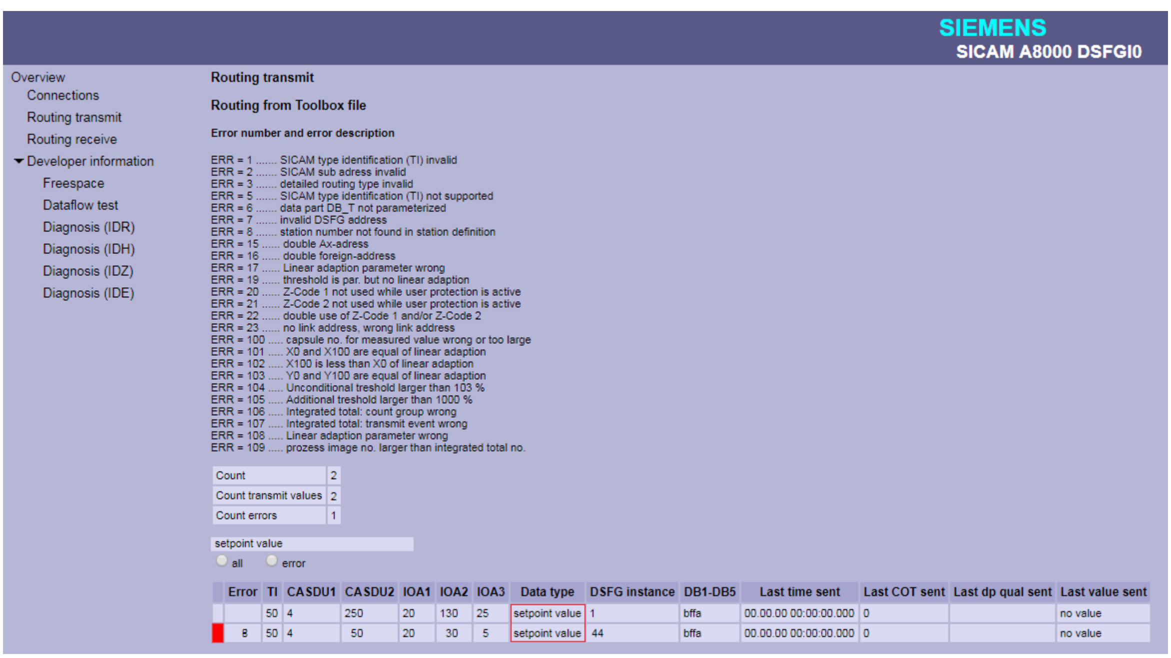
Routing Transmit (Filter not used)

All parameterized data points in transmission direction are displayed.
Incorrect parameterized data points are marked "red".



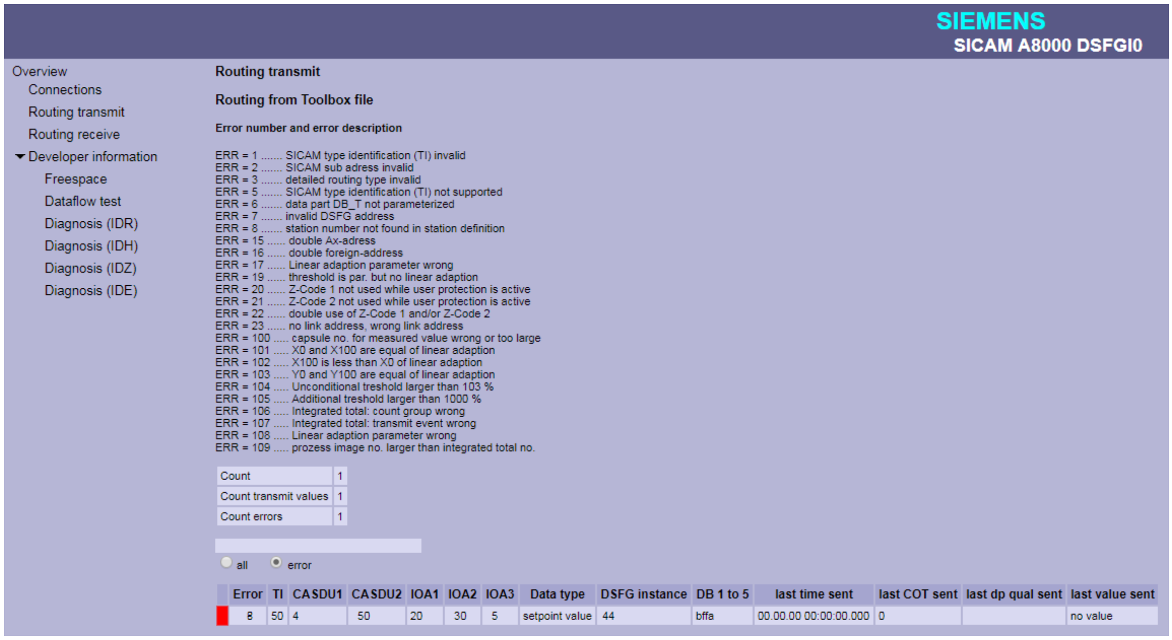
Routing Transmit - with text filter

Note: The filter affects all fields of the table.



Routing Transmit - with filter for incorrectly parameterized data points

All faulty parameterized data points in transmit direction are displayed.



13.13.7.4 Routing Receive

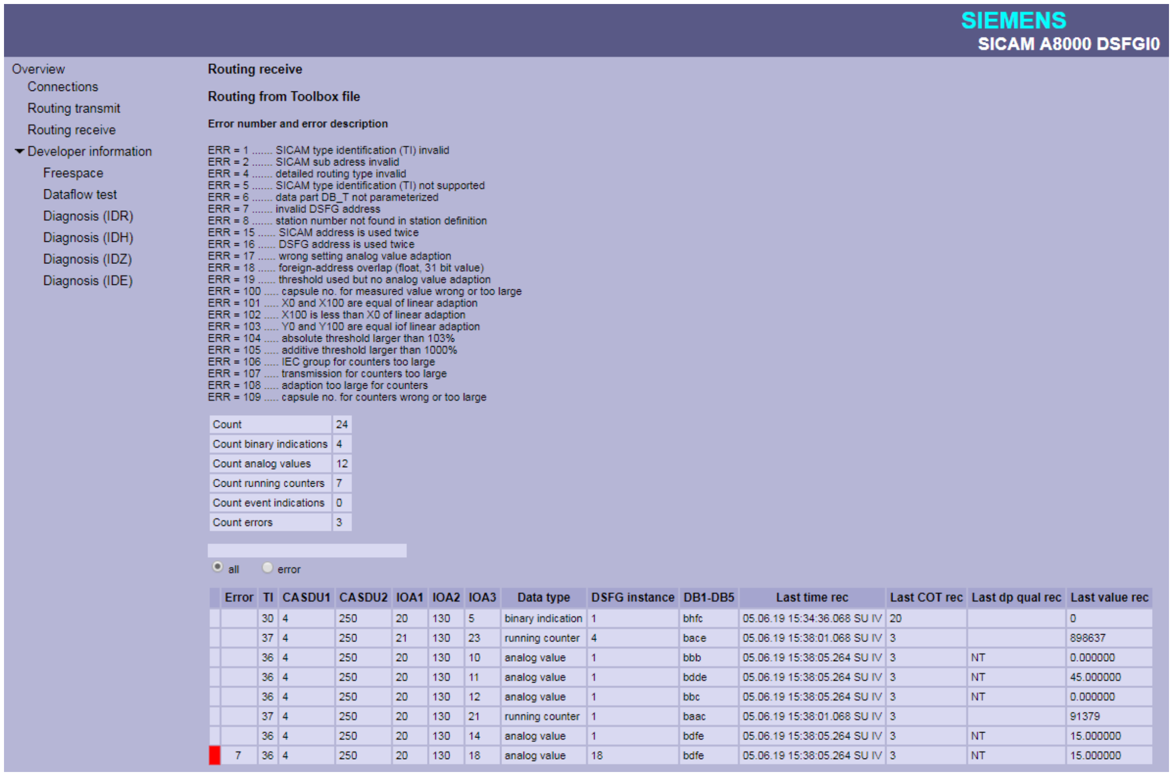
With web page **Routing Receive** the information of the parameterized DSfG data points in receive direction are displayed.

Field	Note
Count	Number of parameterized data points in receive direction (total for all stations)
Count binary indications	Number of incorrectly parameterized data points for "binary information" in receive direction (total for all stations)
Count analog values	Number of incorrectly parameterized data points for "measured values" in receive direction (total for all stations)
Count running counters	Number of incorrectly parameterized data points for "integrated totals" in receive direction (total for all stations)
Count event indications	Number of incorrectly parameterized data points for "event informations, alarms" in the receive direction (total for all stations)
Count errors	Number of faulty parameterized data points in receive direction (total for all stations)

Field	Note
Error	Error number • ERR = 0 .... no error • ERR = 1 .... SICAM type identification (TI) invalid • ERR = 2 .... SICAM sub adress invalid • ERR = 4 .... detailed routing type invalid • ERR = 5 .... SICAM type identification (TI) not supported • ERR = 6 .... data part DB_T not parameterized • ERR = 7 .... invalid DSFG address • ERR = 8 .... station number not found in station definition • ERR = 15 ...... SICAM address is used twice • ERR = 16 ...... DSFG address is used twice • ERR = 17 ...... wrong setting analog value adaption • ERR = 18 ...... foreign-address overlap (float, 31 bit value) • ERR = 19 ...... threshold used but no analog value adaption • ERR = 100 ..... capsule no. for measured value wrong or too large • ERR = 101 ..... X0 and X100 are equal of linear adaption • ERR = 102 ..... X100 is less than X0 of linear adaption • ERR = 103 ..... Y0 and Y100 are equal iof linear adaption • ERR = 104 ..... absolute threshold larger than 103% • ERR = 105 ..... additive threshold larger than 1000% • ERR = 106 ..... IEC group for counters too large • ERR = 107 ..... transmission for counters too large • ERR = 108 ..... adaption too large for counters • ERR = 109 ..... capsule no. for counters wrong or too large
TI	IEC 60870-5-101/104 Type identification (CP-8050 internal)
CASDU1, CASDU2 IOA1, IOA2, IOA3	CP-8050 internal IEC 60870-5-101/104 Address of the data point
Data type	DSFG data type: • analog value • binary indication • running counter
DSFG instance	DSfG station address (Instance)
DB1-DB5	DSFG address of the datapoint
Last time rec	Time of the last transfer of the data point PRE → BSE
Last COT rec	Last transmitted cause of transmission (COT) for this data point from PRE → BSE
Last dp qual rec	Last sent quality descriptor for this data point from the PRE → BSE
Last value rec	Last received and transferred value for this data point from PRE → BSE

Routing Receive (Filter not used)

All faulty parameterized data points in receive direction are displayed. Faulty data points are marked "red".



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Routing from Toolbox file

Error number and error description

ERR = 1 .... SICAM type identification (TI) invalid
ERR = 2 .... SICAM sub adress invalid
ERR = 4 .... detailed routing type invalid
ERR = 5 .... SICAM type identification (TI) not supported
ERR = 6 .... data part DB_T not parameterized
ERR = 7 .... invalid DSFG address
ERR = 8 .... station number not found in station definition
ERR = 15 ...... SICAM address is used twice
ERR = 16 ...... DSFG address is used twice
ERR = 17 ...... wrong setting analog value adaption
ERR = 18 ...... foreign-address overlap (float, 31 bit value)
ERR = 19 ...... threshold used but no analog value adaption
ERR = 100 ..... capsule no. for measured value wrong or too large
ERR = 101 ..... X0 and X100 are equal of linear adaption
ERR = 102 ..... X100 is less than X0 of linear adaption
ERR = 103 ..... Y0 and Y100 are equal iof linear adaption
ERR = 104 ..... absolute threshold larger than 103%
ERR = 105 ..... additive threshold larger than 1000%
ERR = 106 ..... IEC group for counters too large
ERR = 107 ..... transmission for counters too large
ERR = 108 ..... adaption too large for counters
ERR = 109 ..... capsule no. for counters wrong or too large

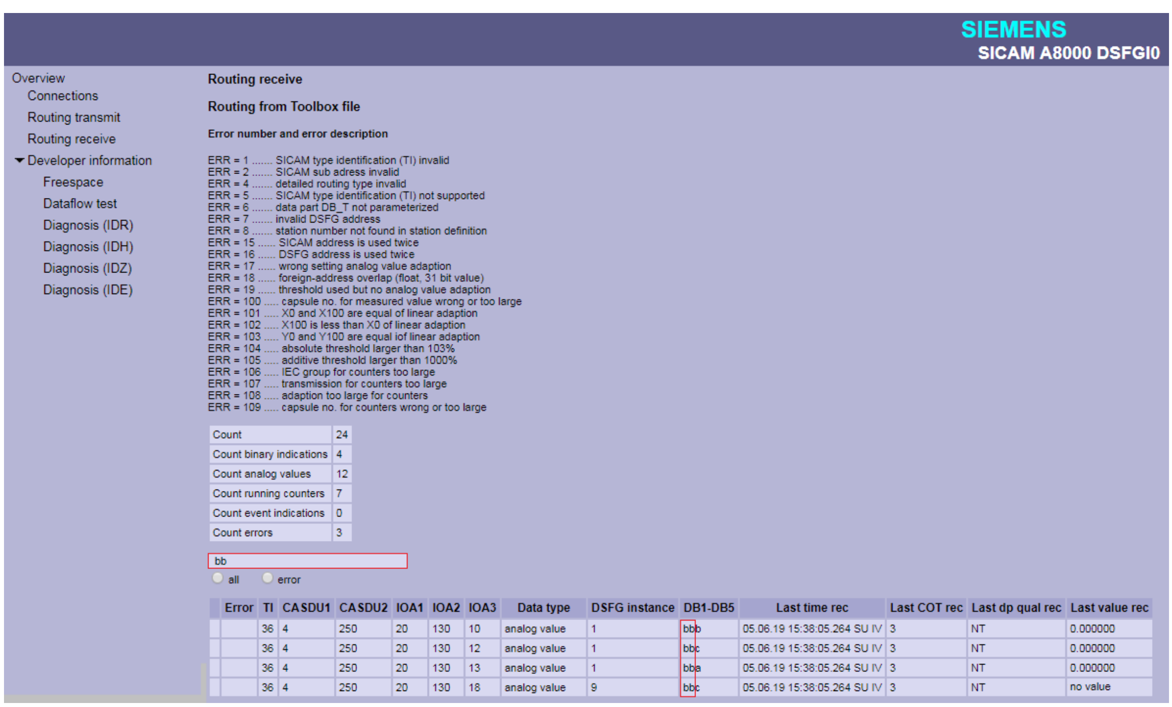
Count	24
Count binary indications	4
Count analog values	12
Count running counters	7
Count event indications	0
Count errors	3

all error

Error	TI	CASDU1	CASDU2	IOA1	IOA2	IOA3	Data type	DSFG instance	DB1-DB5	Last time rec	Last COT rec	Last dp qual rec	Last value rec
	30	4	250	20	130	5	binary indication	1	bhfc	05.06.19 15:34:36.068 SU IV	20		0
	37	4	250	21	130	23	running counter	4	bace	05.06.19 15:38:01.068 SU IV	3		898637
	36	4	250	20	130	10	analog value	1	bbb	05.06.19 15:38:05.264 SU IV	3	NT	0.000000
	36	4	250	20	130	11	analog value	1	bdde	05.06.19 15:38:05.264 SU IV	3	NT	45.000000
	36	4	250	20	130	12	analog value	1	bbc	05.06.19 15:38:05.264 SU IV	3	NT	0.000000
	37	4	250	20	130	21	running counter	1	baac	05.06.19 15:38:01.068 SU IV	3		91379
	36	4	250	20	130	14	analog value	1	bdfe	05.06.19 15:38:05.264 SU IV	3	NT	15.000000
7	36	4	250	20	130	18	analog value	18	bdfe	05.06.19 15:38:05.264 SU IV	3	NT	15.000000

Routing Receive - with text filter

Note: The filter affects all fields of the table.



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Routing from Toolbox file

Error number and error description

ERR = 1 .... SICAM type identification (TI) invalid
ERR = 2 .... SICAM sub adress invalid
ERR = 4 .... detailed routing type invalid
ERR = 5 .... SICAM type identification (TI) not supported
ERR = 6 .... data part DB_T not parameterized
ERR = 7 .... invalid DSFG address
ERR = 8 .... station number not found in station definition
ERR = 15 ...... SICAM address is used twice
ERR = 16 ...... DSFG address is used twice
ERR = 17 ...... wrong setting analog value adaption
ERR = 18 ...... foreign-address overlap (float, 31 bit value)
ERR = 19 ...... threshold used but no analog value adaption
ERR = 100 ..... capsule no. for measured value wrong or too large
ERR = 101 ..... X0 and X100 are equal of linear adaption
ERR = 102 ..... X100 is less than X0 of linear adaption
ERR = 103 ..... Y0 and Y100 are equal iof linear adaption
ERR = 104 ..... absolute threshold larger than 103%
ERR = 105 ..... additive threshold larger than 1000%
ERR = 106 ..... IEC group for counters too large
ERR = 107 ..... transmission for counters too large
ERR = 108 ..... adaption too large for counters
ERR = 109 ..... capsule no. for counters wrong or too large

Count	24
Count binary indications	4
Count analog values	12
Count running counters	7
Count event indications	0
Count errors	3

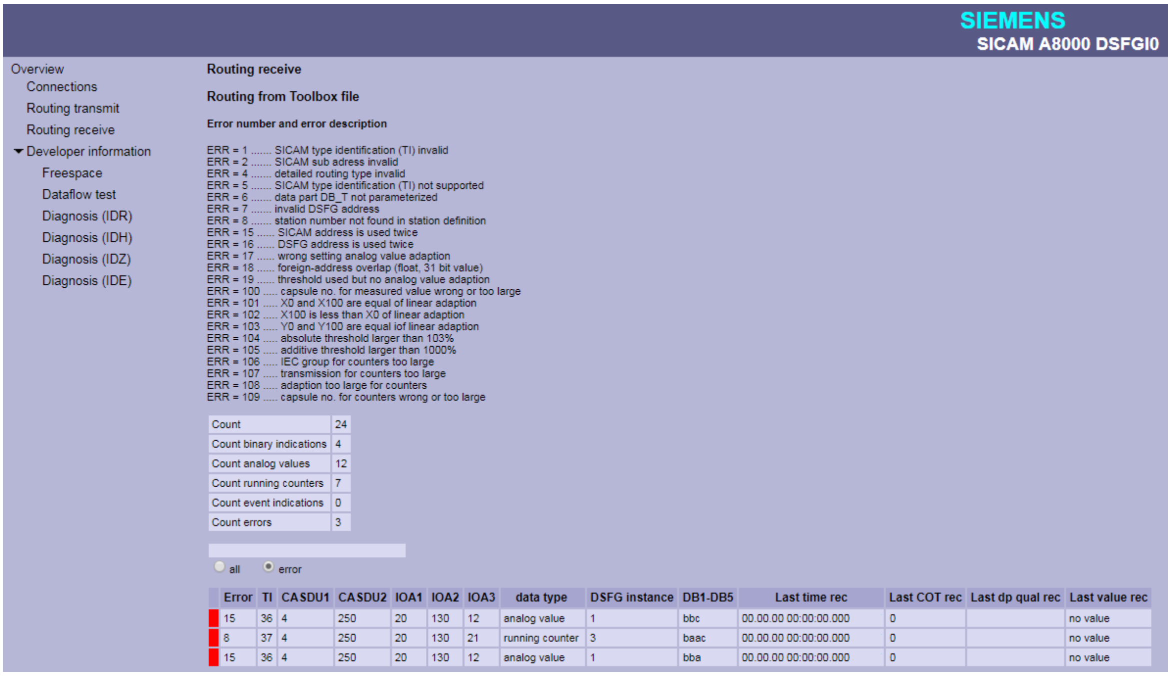
bb

all error

Error	TI	CASDU1	CASDU2	IOA1	IOA2	IOA3	Data type	DSFG instance	DB1-DB5	Last time rec	Last COT rec	Last dp qual rec	Last value rec
	36	4	250	20	130	10	analog value	1	bbb	05.06.19 15:38:05.264 SU IV	3	NT	0.000000
	36	4	250	20	130	12	analog value	1	bbc	05.06.19 15:38:05.264 SU IV	3	NT	0.000000
	36	4	250	20	130	13	analog value	1	bba	05.06.19 15:38:05.264 SU IV	3	NT	0.000000
	36	4	250	20	130	18	analog value	9	bbc	05.06.19 15:38:05.264 SU IV	3	NT	no value

Routing Receive - with filter for incorrectly parameterized data points

All faulty parameterized data points in receive direction are displayed.

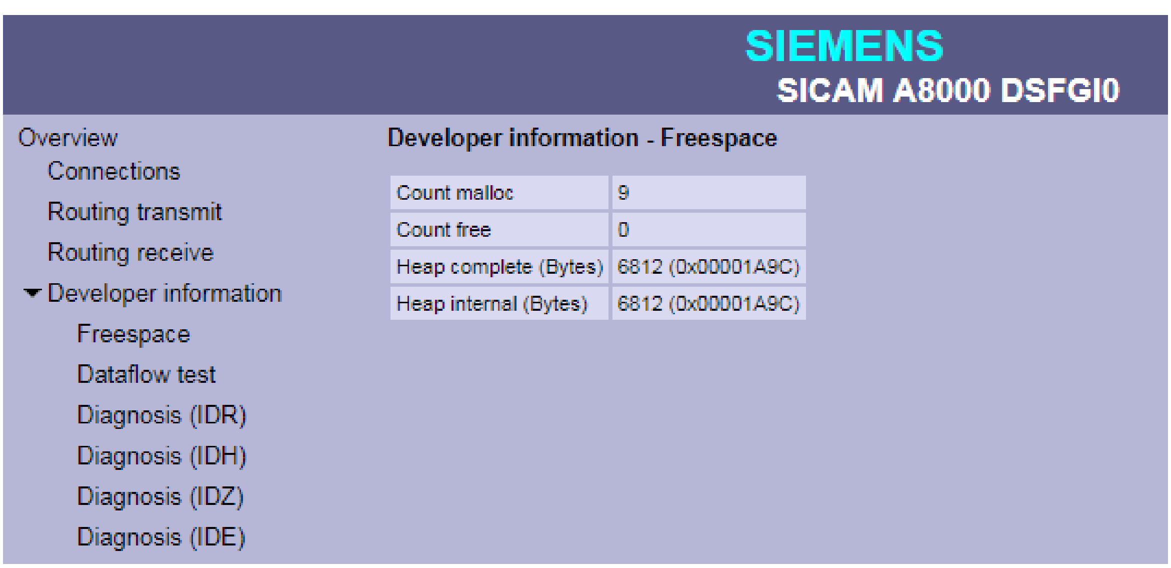


13.13.7.5 Developer Information – Freespace

On the web page **Developer Information – Freespace** internal information (free memory) of the firmware is displayed.

These informations are helpful for the developer in case of problems.

Field	Note
Count malloc	Internal information
Count free	Internal information
Heap complete (Bytes)	Internal information
Heap internal (Bytes)	Internal information

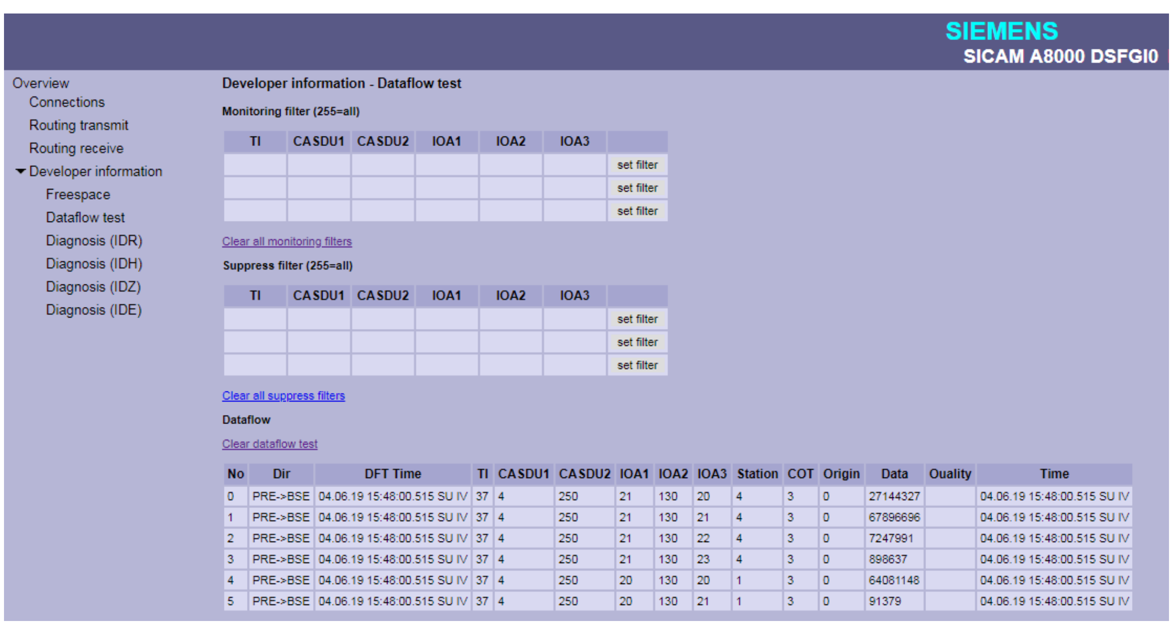


13.13.7.6 Developer Information – Dataflow Test

With web page **Developer Information – Dataflow Test** messages transmitted via internal interface from PRE ↔ BSE will be displayed.

The last 200 messages transmitted from PRE <-> BSE will be displayed..

Field	Note
No.	Message number
Dir	Direction (Dir = Direction) • PRE → BSE: Received data • BSE → PRE: Transmitted data
DFT Time	Logging time
TI	IEC 60870-5-101/104 Type identification (CP-8050 internal)
CASDU1, CASDU2 IOA1, IOA2, IOA3	CP-8050 internal IEC 60870-5-101/104 Address of the data point
Station	CP-8050 internal station number of connection
COT	IEC 60870-5-101/104 cause of transmission (CP-8050 internal) (COT = Cause Of Transmission)
Origin	IEC 60870-5-101/104 originator address (CP-8050 internal) (origin = Originator)
Data	IEC 60870-5-101/104 state of the data point (CP-8050 internal)
Quality	IEC 60870-5-101/104 Quality descriptor of the data point (CP-8050 internal)
Time	Receive time (from DSfG-Bus)



Message filter for simultaneous logging ("Monitoring Filter")

With filter enabled, only messages will be logged which are selected by filter. If no filter is selected all messages will be logged.

The value "255" sets this field to "Wildcard". i.e. all messages are logged with this field (0-255).

The filter will be activated by set filter.

The filters will be cleared with Clear all monitoring filters.

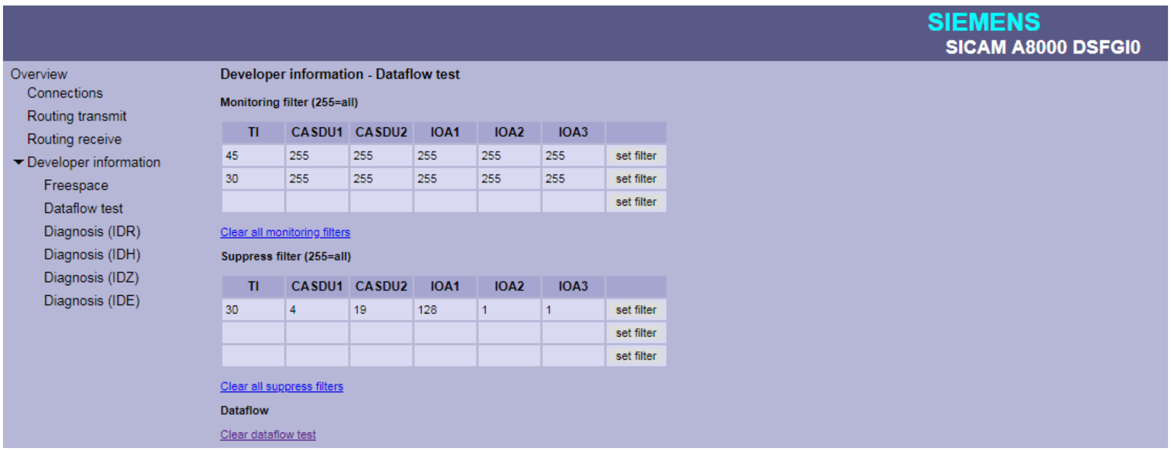
Message filter for logging - Suppress Filter

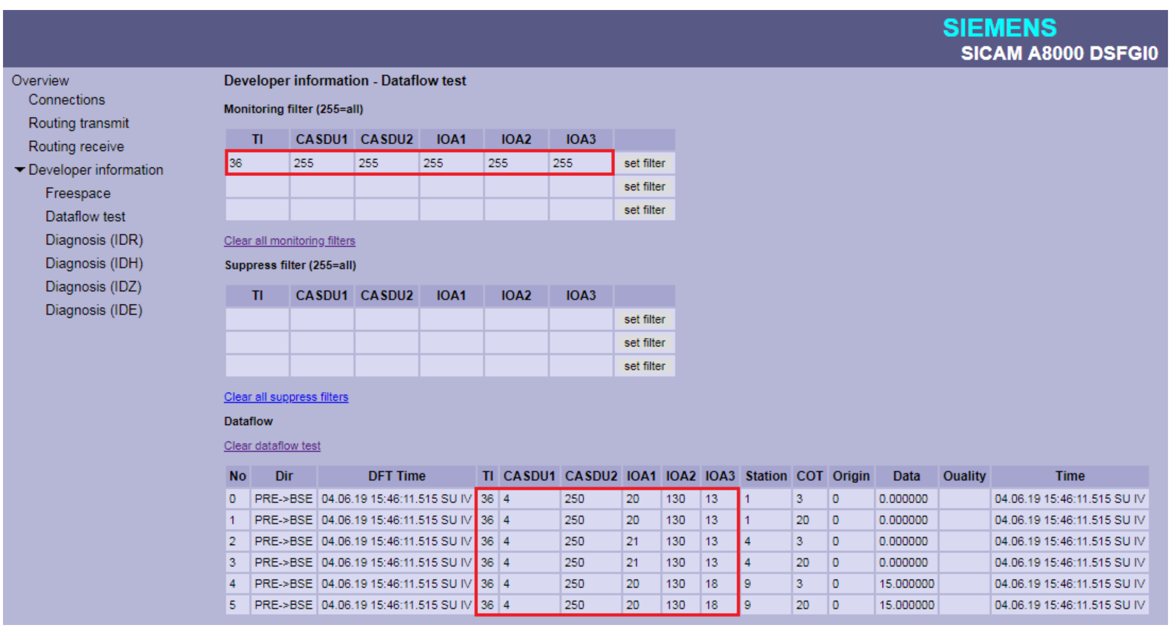
If a filter is selected, the messages selected by the filter are not logged (i.e., "suppressed"). If no filter is selected all messages will be logged.

The value "255" sets this field to "Wildcard". i.e. all messages with this field (0-255) are suppressed.

The filter will be activated by set filter.

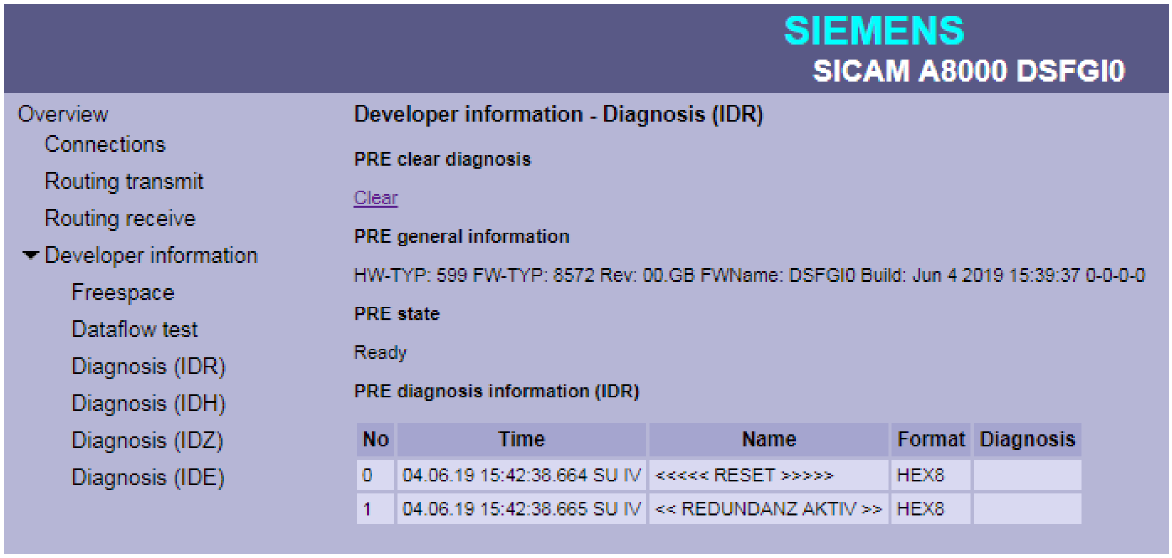
The filters will be cleared with Clear all suppress filters.





13.13.7.7 Developer Information – Diagnosis (IDR)

With web page **Developer Information - Diagnosis (IDR)** internal diagnosis information of protocol elements (PRE) will be displayed.



Deletion of the IDR diagnosis information on PRE ("PRE clear diagnosis")

The IDR diagnostic information on the PRE can be deleted under "PRE clear diagnostics" with Clear.

General information of PRE firmware ("PRE general Information")

Field	Note
HW-TYP	Hardware type of PRE firmware
FW-TYP	Firmware type of PRE firmware
Rev	Revision of PRE firmware
FWName	Name of PRE firmware
Build	State of generation of the PRE firmware

IDR diagnostic information of the PRE firmware ("PRE diagnosis information (IDR)")

Field	Note
No	Consecutive number
Time	Date + time of IDR logging
Name	Diagnosis text
Format	Format of diagnosis information in next column • CHAR, HEX8, HEX16, HEX32, DEC8, DEC16, DEC32, FLOAT32
Diagnosis	Detail information for IDR diagnosis

13.13.7.8 Developer Information – Diagnosis (IDH)

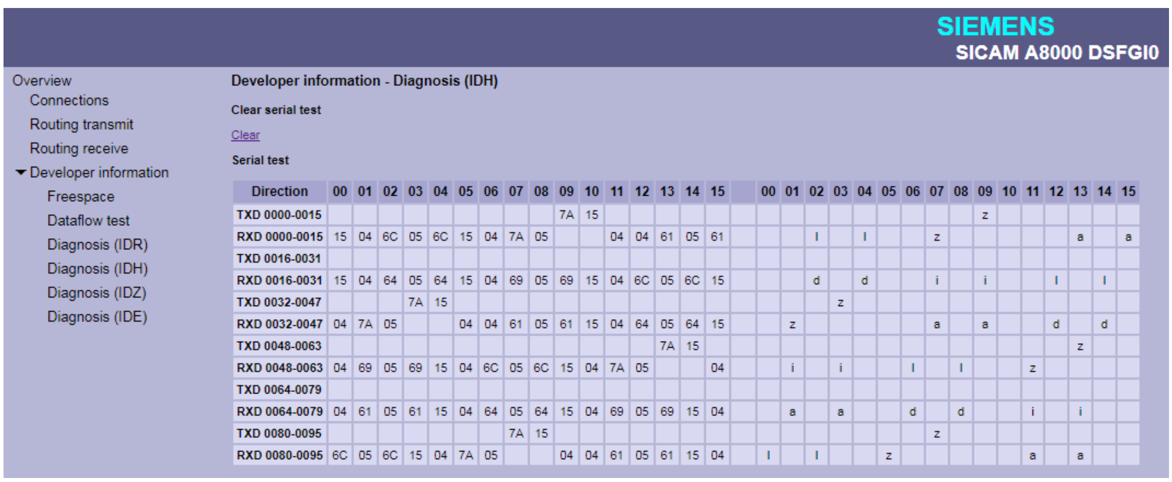
The **Developer Information – Diagnosis (IDH)** web-page will display the last 2000-4000 data sent / received in HEX and ASCII without timestamps.

Deleting the IDH diagnostic information on the PRE ("Clear serial test")

The IDH diagnostic information (serial test) on the PRE, can be deleted under "Clear serial test" with Clear.

IDH-Diagnostic information "serial test"

Field	Note
Direction	TXD = Transmit Data (of PRE) RXD = Receive Data (of PRE)
00, 01, 02, .. 15	Byte no. (0-15) per row The transmitted/received bytes are entered in chronological order into the byte number TXD xxxx-yyyy, RXD xxxx-yyyy.
TXD xxxx-yyyy	Byte number for transmit data
RXD xxxx-yyyy	Byte number for receive data
HEX	Date sent/received will be displayed as HEX in left area of table (Byte number 00..15).
ASCII	Date sent/received will be displayed as ASCII in left area of table (Byte number 00..15).



Direction	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15
TXD 0000-0015										7A	15					
RXD 0000-0015	15	04	6C	05	6C	15	04	7A	05			04	04	61	05	61
TXD 0016-0031																
RXD 0016-0031	15	04	64	05	64	15	04	69	05	69	15	04	6C	05	6C	15
TXD 0032-0047				7A	15											
RXD 0032-0047	04	7A	05			04	04	61	05	61	15	04	64	05	64	15
TXD 0048-0063														7A	15	
RXD 0048-0063	04	69	05	69	15	04	6C	05	6C	15	04	7A	05			04
TXD 0064-0079																
RXD 0064-0079	04	61	05	61	15	04	64	05	64	15	04	69	05	69	15	04
TXD 0080-0095								7A	15							
RXD 0080-0095	6C	05	6C	15	04	7A	05			04	04	61	05	61	15	04

Direction	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15
TXD 0000-0015										z						
RXD 0000-0015			l		l			z						a		a
TXD 0016-0031																
RXD 0016-0031			d		d			i		i			l		l	
TXD 0032-0047				z												
RXD 0032-0047		z						a		a			d		d	
TXD 0048-0063														z		
RXD 0048-0063		i		i			l		l			z				
TXD 0064-0079																
RXD 0064-0079		a		a			d		d			i		i		
TXD 0080-0095								z								
RXD 0080-0095	l		l			z						a		a		

13.13.7.9 Developer Information – Diagnosis (IDE)

The **Developer Information – Diagnosis (IDE)** web page displays protocol-internal diagnostic and statistic information.

SIEMENS
SICAM A8000 DSFGI0

Overview
Connections
Routing transmit
Routing receive
Developer information
Freespace
Dataflow test
Diagnosis (IDR)
Diagnosis (IDH)
Diagnosis (IDZ)
Diagnosis (IDE)

Developer information - Diagnosis (IDE)

Clear diagnosis

Clear

General information

Last query	04.06.19 15:42:38.665 SU IV
Query at	04.06.19 15:48:52.677 SU IV
Redundancy state	active

Polling

Min. cycle time (all stations OK)	0 ms
Max. cycle time (all stations OK)	2497 ms
Min. cycle time	2497 ms
Avg. cycle time (last 10 cycles)	48 ms

Control location

function disabled

Receive errors

Parity error	0
Framing error	0
Overrun error	0
Sync character invalid	0
End character invalid	0
Receive buffer full	0
Length invalid	0
Checksum error	0
Invalid gap	7

Station state

Station	State	Retry count	NOK count	Retry rate
1	OK	0	1	100.000000 %
4	OK	0	1	100.000000 %
9	OK	0	1	100.000000 %
12	OK	0	1	100.000000 %

Station history

Time	Station	State
04.06.19 15:44:16.111 SU IV	1	Station NOK
04.06.19 15:44:16.112 SU IV	4	Station NOK
04.06.19 15:44:16.112 SU IV	9	Station NOK
04.06.19 15:44:16.112 SU IV	12	Station NOK
04.06.19 15:46:10.612 SU IV	1	Station OK
04.06.19 15:46:10.612 SU IV	4	Station OK
04.06.19 15:46:10.612 SU IV	9	Station OK
04.06.19 15:46:10.612 SU IV	12	Station OK

Deletion of the IDE diagnostic information on PRE (“Clear diagnosis”)

The IDE diagnostic information on the PRE can be cleared under **Clear diagnosis** with Clear.

General information of the IDE diagnosis ("General information")

Field	Note
Cleared at	Time of IDE diagnosis information cleared
Query at	Last query time of IDE diagnosis information
Redundancy state	Actual redundancy state of PRE firmware

General information of the IDE diagnosis ("polling")

Field	Note
Min. cycle time (all stations OK)	Minimum cycle time for all OK stations
Max. cycle time (all stations OK)	Maximum cycle time for all OK stations
Min. cycle time	Minimum cycle time
Avg. cycle time (last 10 cycles)	Average cycle time (last 10 cycles)

Information on the control location of the PRE (“Control location”)

Field	Note
	The activated control locations will be displayed when control location function is enabled. Note: this function is currently not supported!

Receive error statistics

Field	Note
Parity error	Number of detected parity errors
Framing error	Number of detected byte frame errors
Overrun error	Number of detected overflow errors In case of overflow error the firmware load is too high – the received bytes can no longer be processed correctly.
Sync character invalid	Number of detected synchronization errors
End character invalid	Number of detected end character errors
Receive buffer full	Number of detected errors for receive buffer full
Length invalid	Number of detected length invalid errors
Checksum error	Number of detected checksum errors
Invalid gap	Number of detected errors for inadmissible gap in the message (gap between 2 bytes within a message).

State of Communication Link ("Station State")

For each station, the current status and statistics about the number of failures and retries are displayed.

Field	Note
Station	Station number (internal)
State	OK .... Communication link OK NOK ..... Communication link NOK (failed)
Retry count	Number of retries since last Clear diagnosis

Field	Note
NOK count	Number of communication link NOK (failed) since last Clear diagnosis
Retry rate	Number of retries in % since last Clear diagnosis

Chronological list of retries and station failures ("Station history")

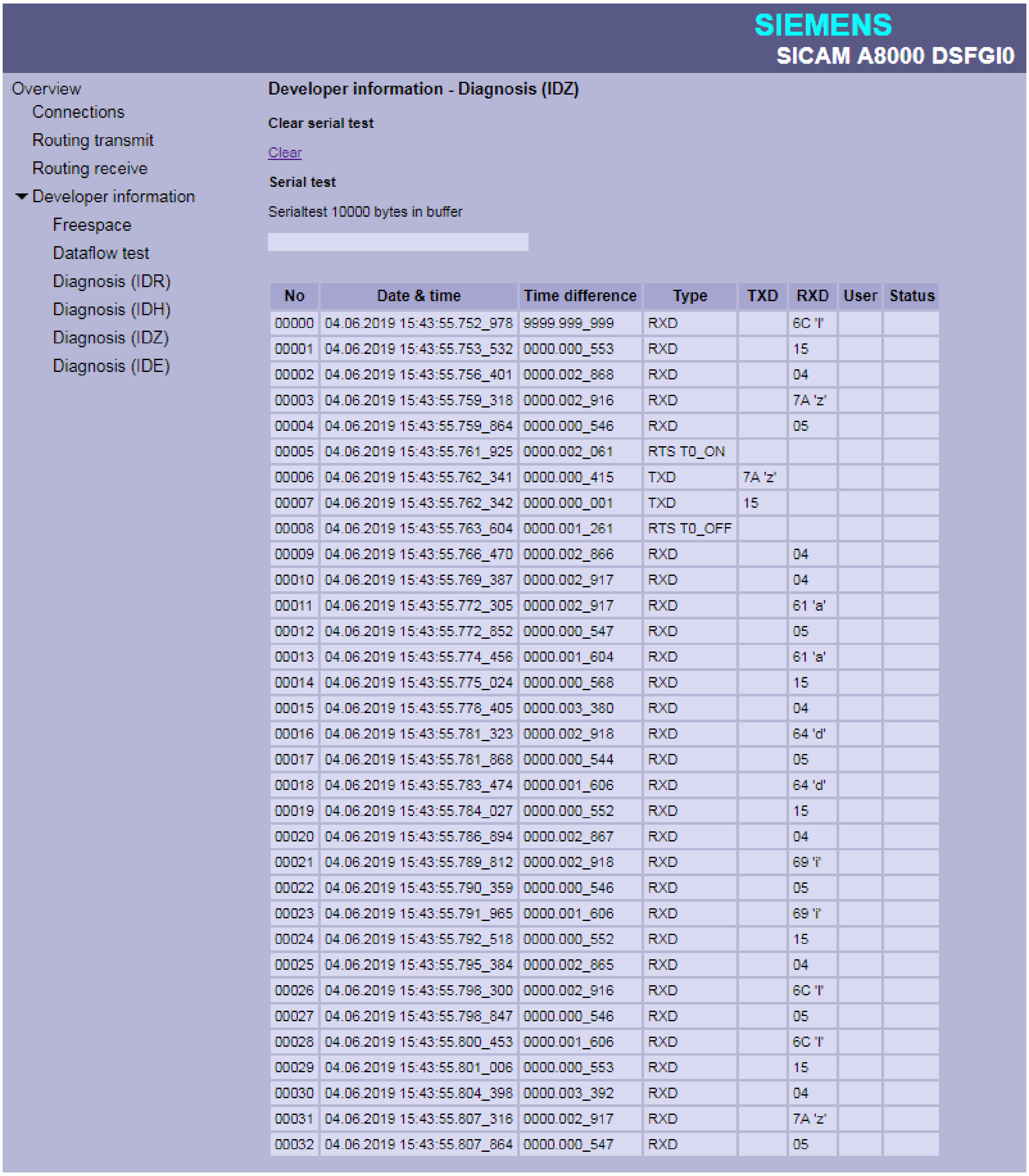
Field	Note
Time	Date + time of communication error (OK, NOK, retry)
Station	Station number (internal)
State	Status: • Retry no x ... Retry number x • Station OK • Station NOK

13.13.7.10 Developer Information – Diagnosis (IDZ)

On the web page **Developer Information – Diagnosis (IDZ**) detailed information of the last 10,000 transmitted/received data or "transmission events" with time tags are shown.

Deleting the IDZ diagnostic information on the PRE ("Clear serial test")

The IDZ diagnostic information on the PRE can be cleared under "Clear serial test" with Clear.



No	Date & time	Time difference	Type	TXD	RXD	User	Status
00000	04.06.2019 15:43:55.752_978	9999.999_999	RXD		6C 'l'		
00001	04.06.2019 15:43:55.753_532	0000.000_553	RXD		15		
00002	04.06.2019 15:43:55.756_401	0000.002_868	RXD		04		
00003	04.06.2019 15:43:55.759_318	0000.002_916	RXD		7A 'z'		
00004	04.06.2019 15:43:55.759_864	0000.000_546	RXD		05		
00005	04.06.2019 15:43:55.761_925	0000.002_061	RTS T0_ON				
00006	04.06.2019 15:43:55.762_341	0000.000_415	TXD	7A 'z'			
00007	04.06.2019 15:43:55.762_342	0000.000_001	TXD	15			
00008	04.06.2019 15:43:55.763_604	0000.001_261	RTS T0_OFF				
00009	04.06.2019 15:43:55.766_470	0000.002_866	RXD		04		
00010	04.06.2019 15:43:55.769_387	0000.002_917	RXD		04		
00011	04.06.2019 15:43:55.772_305	0000.002_917	RXD		61 'a'		
00012	04.06.2019 15:43:55.772_852	0000.000_547	RXD		05		
00013	04.06.2019 15:43:55.774_456	0000.001_604	RXD		61 'a'		
00014	04.06.2019 15:43:55.775_024	0000.000_568	RXD		15		
00015	04.06.2019 15:43:55.778_405	0000.003_380	RXD		04		
00016	04.06.2019 15:43:55.781_323	0000.002_918	RXD		64 'd'		
00017	04.06.2019 15:43:55.781_868	0000.000_544	RXD		05		
00018	04.06.2019 15:43:55.783_474	0000.001_606	RXD		64 'd'		
00019	04.06.2019 15:43:55.784_027	0000.000_552	RXD		15		
00020	04.06.2019 15:43:55.786_894	0000.002_867	RXD		04		
00021	04.06.2019 15:43:55.789_812	0000.002_918	RXD		69 'i'		
00022	04.06.2019 15:43:55.790_359	0000.000_546	RXD		05		
00023	04.06.2019 15:43:55.791_965	0000.001_606	RXD		69 'i'		
00024	04.06.2019 15:43:55.792_518	0000.000_552	RXD		15		
00025	04.06.2019 15:43:55.795_384	0000.002_865	RXD		04		
00026	04.06.2019 15:43:55.798_300	0000.002_916	RXD		6C 'l'		
00027	04.06.2019 15:43:55.798_847	0000.000_546	RXD		05		
00028	04.06.2019 15:43:55.800_453	0000.001_606	RXD		6C 'l'		
00029	04.06.2019 15:43:55.801_006	0000.000_553	RXD		15		
00030	04.06.2019 15:43:55.804_398	0000.003_392	RXD		04		
00031	04.06.2019 15:43:55.807_316	0000.002_917	RXD		7A 'z'		
00032	04.06.2019 15:43:55.807_864	0000.000_547	RXD		05		

IDZ-diagnostic information “Serial test“

Field	Note
Serial test <u>xxxxx</u> bytes in buffer.	Number of stored transmission events in the buffer (max 10000). If more than 10,000 transmission events are recorded, the value <u>xxxxx</u> remains at 10000 and the oldest transmission events are deleted.

Field	Note
No	Consecutive number
Date and time	Current date + time of the entry

Field	Note
Time difference	Difference time to previous event:

Type	Tansmission event:
	• TXD ... Data byte sent
	• RXD ... Data byte received
	• TPD ... Data bit sent "ON / OFF" (pulse duration modulation) [382]
	• RPD ... Data bit received "ON / OFF" (pulse duration modulation) [382]
	• RTS ON ... RTS status line “ON“ <OUT> (“manually" controlled by PRE)
	• RTS OFF ... RTS status line “OFF“ <OUT> (“manually" controlled by PRE)
	• RTS_T0 ON ... RTS status line “ON“ <OUT> (controlled by UART)
	• RTS_T0 OFF ... RTS status line “OFF“ <OUT> (controlled by UART)
	• DTR ON ... DTR status line “ON“ <OUT>
	• DTR OFF ... DTR status line “OFF“ <OUT>
	• DCD ON ... DCD status line “ON“ <IN>
	• DCD OFF ... DCD status line “OFF“ <IN>
	• CTS ON ... CTS status line “ON“ <IN>
	• CTS OFF ... CTS status line “OFF“ <IN>
	• DCD_T1 ON ... DCD bounce suppression “ON“
	• DCD_T1 OFF ... DCD bounce suppression “OFF“
	• TI0 ... Timer 0 expiration
	• TI1 ... Timer 1 expiration
	• TI2 ... Timer 2 expiration (typically used for acknowledgment time)
	• TI3 ... Timer 3 expiration (typically used for newsync)
	• TI4 ... Timer 4 expiration
	• TI5 ... Timer 5 expiration
	• TI6 ... Timer 6 expiration
	• TI7 ... Timer 7 expiration
	• USER ... User transmission event (including user identifier <0-255>
	  – triggered by the PRE firmware
	  – Entry chronological to IDZ (only for diagnosis)
	  – User identification is entered in the column "User".

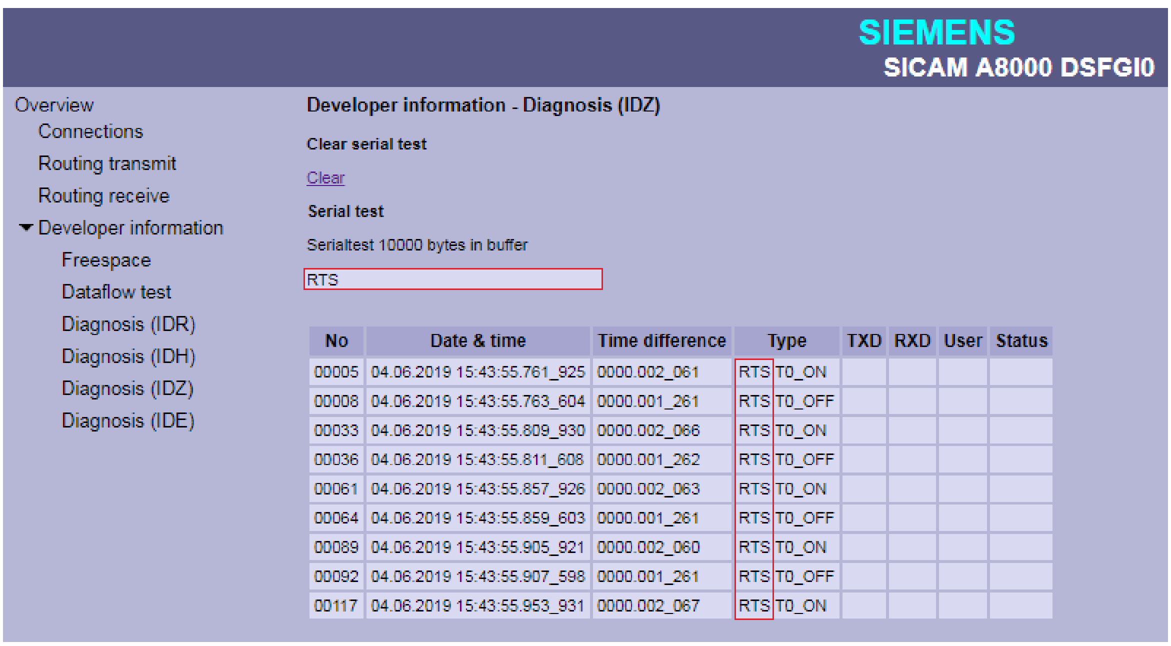
TXD	Data-Byte/-Bit sent • xx,‘x‘ ... Displayed in HEX, ‘ASCII‘ • ON, OFF ... TXD Bit status “ON/OFF“ (only with pulse duration modulation) [382]
RXD	Data-Byte/-Bit received • xx,‘x‘ ... Displayed in HEX, ‘ASCII‘ • ON, OFF ... RXD Bit status “ON/OFF“ (only with pulse duration modulation) [382]

[382] only possible with CI-8551

Field	Note
User	Additional information about the transmission event "Type = User": • 0-255 ... If Type = USER, then the value transmitted by the PRE firm-ware is entered in the "USER" field.
Status	Status for transmission event “Type=RXD“: • GAP ... Pause detected on reception ("message gap") • PARITY ... Parity fault • FRAMING ... Framing fault • OVERRUN ... Overrun fault • OVERRUN_BUFFER ... Overrun RX (Intermediate buffer error)

IDZ-diagnostic information "Serial test" - with text filter

Note: The filter affects all fields of the table.



No	Date & time	Time difference	Type		TXD	RXD	User	Status
00005	04.06.2019 15:43:55.761_925	0000.002_061	RTS	T0_ON				
00008	04.06.2019 15:43:55.763_604	0000.001_261	RTS	T0_OFF				
00033	04.06.2019 15:43:55.809_930	0000.002_066	RTS	T0_ON				
00036	04.06.2019 15:43:55.811_608	0000.001_262	RTS	T0_OFF				
00061	04.06.2019 15:43:55.857_926	0000.002_063	RTS	T0_ON				
00064	04.06.2019 15:43:55.859_603	0000.001_261	RTS	T0_OFF				
00089	04.06.2019 15:43:55.905_921	0000.002_060	RTS	T0_ON				
00092	04.06.2019 15:43:55.907_598	0000.001_261	RTS	T0_OFF				
00117	04.06.2019 15:43:55.953_931	0000.002_067	RTS	T0_ON				

13.13.8 Message Conversion

Data in transmit direction are transferred from the basic system element to the protocol element in SICAM A8000 internal IEC 60870-5-101/104 (without 101/104 blocking) format. The conversion of the data formats IEC 60870-5-101/104 ↔ DSfG is performed by the protocol element. The transmission of data to the DSfG bus is controlled by the protocol element.

Data in receive direction are converted by the protocol element from the DSfG format → SICAM A8000 internal IEC 60870-5-101/104 format and transferred to the basic system element (without 101/104 blocking).

The conversion of the SICAM A8000 internal IEC 60870-5-101/104 message format ↔ DSfG data format and the conversion of the address information are called message conversion.

The parameterization of the conversion from IEC 60870-5-101/104 ↔ DSfG (address and message format) is to be done with SICAM Device Manager with function “Signals” or SICAM TOOLBOX II, OPM II using “SIP Message Address Conversion”.

Supported Processing Types for Message Conversion

Data	Direction	Processing type	DSFGI0
Binary information	Receive direction	firmware / **`Rec_binary_information`**	✓
Event state information	Receive direction	firmware / **`Rec_event_state_information`**	✓
Measured values	Receive direction	firmware / **`Rec_measured_value`**	✓
Integrated totals	Receive direction	firmware / **`Rec_counter_value`**	✓
Setpoint values	Transmit direction	firmware / **`Trans_value`**	✓

General description of the parameters and properties (applies for each type of processing)

Parameter	
`DB1-DB5`	**DSfG address "Data element address DEL".** The DSfG data element list is defined in the DVGW document *Gas-Information Nr. 7 - 3. Revision 04/2007 Technical specification for DSfG realizations, part 3: DSfG Data element list*. In some cases, plant operators provide "customer-specific DSfG data element lists" with the DSfG data element lists actually used. The data element address is 5-level [DB1] [DB2] [DB3] [DB4] [DB5] DB1 ... higher value part of the DSfG data element address DB5 ... lower value part of the DSfG data element address Possible: 'a' to 'z' and Default '-' <u>Examples:</u> beba .. Calorific value for gas quality dei .. GC-State condition overview daia .. Area of the single component nitrogen DB1 = a.....common description b ..... corrector c .... registration instance d ..... gas quality e ..... data element list for the instance via DFÜ f ...... control unit specific h ..... odorization
`DSFG_data_type`	DSfG data type: • 2 .. integer • 3 .. rational integer • 4 .. number in exponential representation • 6 .. HEX number

Parameter	
`DSFG_access`	DSfG access rights to the setpoint in the addressed DSfG device: • S read and write • E .. value can only be changed if the calibration switch is open • B .. value can only be changed if the user safety is open • Access code 1 .. Value can only be changed with access code 1 (password) • Access code 2 .. Value can only be changed with access code 2 (password)
`DSFG_Revision`	DSfG-Revision: • not used • Revision report DSfG values with **`DSFG_interrogation_type`** = "attention message" are not passed on to the system with **`DSFG_revision`** = "revision state information" until the revision state information is no longer pending.

13.13.8.1 Message Conversion in Transmit Direction (SICAM A8000 → DSfG)

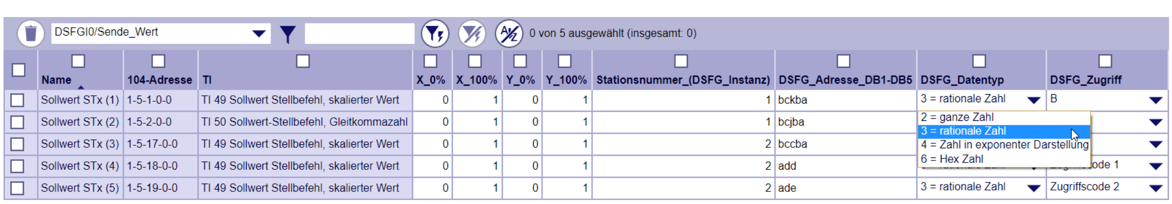
Data to the DSfG master or data to another DSfG slave ("instance") in cross-traffic.

SICAM A8000: IEC 60870-5-101/104 →		DSfG
TI	**Designation**	**Data format**
<TI:=49>	Setpoint command, scaled value	DSfG setpoint value: • 2 .. integer • 3 .. rational integer • 4 .. number in exponential representation • 6 .. HEX number
<TI:=50>	Setpoint command, short floating-point number	DSfG setpoint value: • 2 .. integer • 3 .. rational integer • 4 .. number in exponential representation • 6 .. HEX number
<TI:=100>	(General) interrogation command	[383]

Setpoint values

The parameterization of the address and message conversion for setpoint values in transmit direction is to be done with the SICAM Device Manager with the function "Signals" or with the SICAM TOOLBOX II, OPM II.

Processing type: *firmware* / **`Trans_value`**



[DSFGI0_DM_Sende_Wert, 1, en_US]

383 The (general) interrogation command is not transferred on the DSfG bus. The GA data - in response to a general interrogation command - are transmitted by protocol element from the Protocol internal process image to the BSE and redistributed by the BSE.

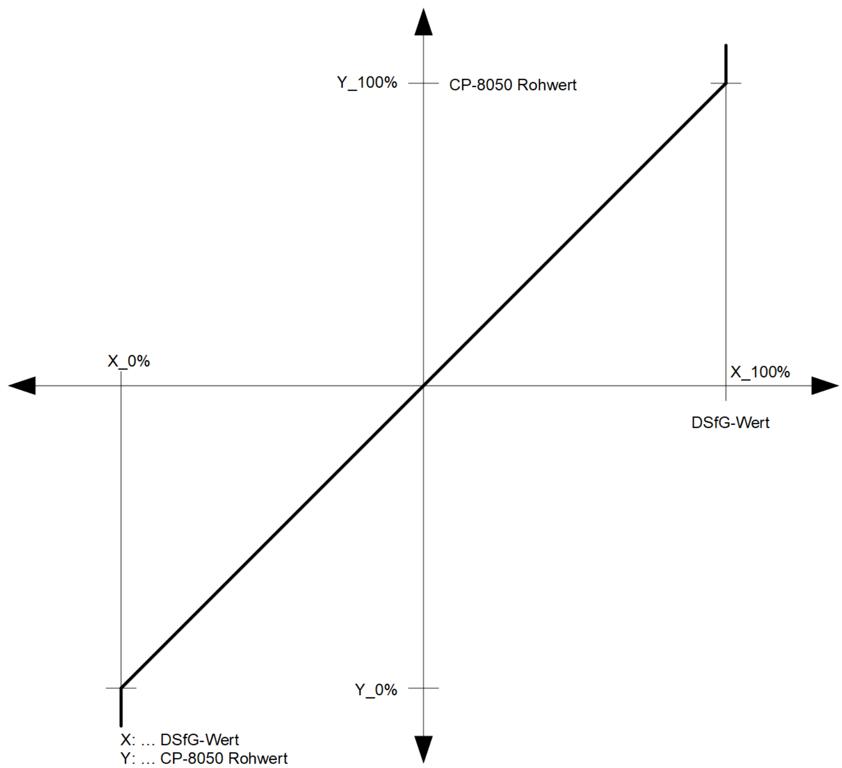
Parameter	
TI	Supported type identifications: • <TI:=49> .. Setpoint command, scaled value • <TI:=50> .. Setpoint command, short floating-point number
Name	Name of the signal
104 address	SICAM A8000 internal IEC 60870-5-101/104 message address (CASDU1, CASDU2, IOA1, IOA2, IOA3)
X_0%, X_100% **Y_0%, Y_100%**	Parameters for value adaptation (scaling): • <TI:=49> .. X_0% and X_100% must not be less than −32768 or greater than +32767. • Value adaptation inactive at Y_0% and Y_100% = 0
Station_number_(DSFG_Instanz)	DSfG station number (instance) of the remote station: • 1 to 30 • 255 = not used
DSFG_address_DB1-DB5	DSFG address (data element address) of the setpoint value: • a to z .. String max. 5 characters
DSFG_data_type	DSfG data type: • 2 = integer • 3 = rational integer • 4 = number in exponential representation • 6 = HEX number
DSFG_access	DSfG access rights to the setpoint in the addressed DSfG device: • S ... read and write • E ... value can only be changed if the calibration switch is open • B ... value can only be changed if the user safety is open • Access code 1 ... Value can only be changed with access code 1 (password) • Access code 2 ... Value can only be changed with access code 2 (password)

Supported Data Formats

DSfG data type	DSfG setpoint value	IEC 60870-5-101/104 Data format (TI)
• 2 = integer • 3 = rational integer • 4 = number in exponential representation • HEX number		49, 50

Value adaptation

The value adaptation is defined by the parameters **X_0%**, **X_100%**, **Y_0%**, **Y_100%**.



The value adaptation is only performed if **`Y_0%`** or **`Y_100%`** ≠ *0* is parameterized.

- If adaptation is activated and the raw value of the SICAM A8000 is smaller than **`Y_0%`** or greater than **`Y_100%`**, then the value is limited on **`X_0%`** or **`X_100%`** and also transferred.
- If adaptation is not activated (= direct transfer, **`Y_0%`** = *0*, **`Y_100%`** = *0*) and the SICAM A8000 raw value is outside the value range of the selected DSfG data format, then the message conversion is aborted and the error message *`Error of format conversion in transmit direction`* is set.

Message Conversion

The table describes the evaluated elements of the IEC 60870-5-101/104 message during message conversion.

Elements of the message	
TI .. Type identification	• <TI:=49> .. Setpoint command, scaled value • <TI:=50> .. Setpoint command, short floating-point number
CASDU, IOA .. Message address	Parameter-settable
QDS .. Quality descriptor	
BL .. Blocked	Not evaluated
SB .. Substituted	Not evaluated
NT .. Not topical	Not evaluated
IV .. Invalid	Not evaluated
OV .. Overflow	Not evaluated
Cause of transmission	
06 .. Activation	BSE → PRE: not evaluated
07 .. Confirmation of activation	PRE → BSE: not supported
08 .. Abortion of activation	BSE → PRE: not evaluated
09 .. Confirmation of the abortion of activation	PRE → BSE: not supported
10 .. Activation termination	PRE → BSE: not supported

Elements of the message		
xx .. Other COTs		Not evaluated
T .. Test		Not evaluated
Information		
Value.. S .. Sign		• Scaled value • IEEE STD 754 = short floating-point number
QOS	S/E	
	0 = Execute	Not evaluated
	1 = Select	Not evaluated
Time tag		
CP56Time2a .. Date + time		Not evaluated

NOTE

Not listed elements of the IEC 60870-5-101/104 message are not rated/not supported!

13.13.8.2 Message Conversion in Receive Direction (SICAM A8000 ← DSfG)

Data from the DSfG bus master or data from another DSfG bus slave (“instance”) in the cross traffic.

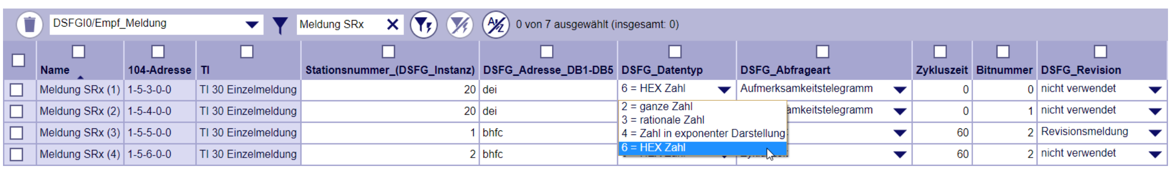
SICAM A8000: IEC 60870-5-101/104 ←		DSfG
TI	**Designation**	**Data format**
<TI:=30>	Single-point information with time tag CP56Time2a	DSfG message: • 2 .. integer • 3 .. rational integer • 4 .. number in exponential representation • 6 .. HEX number
<TI:=34>	Measured value, normalized value with time tag CP56Time2a	DSfG measured value: • 2 .. integer • 3 .. rational integer • 4 .. number in exponential representation • 6 .. HEX number
<TI:=35>	Measured value, scaled value with time tag CP56Time2a	DSfG measured value: • 2 .. integer • 3 .. rational integer • 4 .. number in exponential representation • 6 .. HEX number
<TI:=35>	Measured value, scaled value with time tag CP56Time2a	DSfG event information: • 2 .. integer

SICAM A8000: IEC 60870-5-101/104 ←		DSfG
<TI:=36>	Measured value, floating-point number with time tag CP56Time2a	DSfG measured value: • 2 .. integer • 3 .. rational integer • 4 .. number in exponential representation • 6 .. HEX number
<TI:=37>	Integrated total with time tag CP56Time2a	DSfG integrated total: • 2 .. integer • 3 .. rational integer • 4 .. number in exponential representation • 6 .. HEX number

Binary information items

The parameterization of the address and message conversion for binary information in receive direction is to be done with the SICAM Device Manager with the function “Signals” or with the SICAM TOOLBOX II, OPM II.

Processing type: *`firmware`* / **`Rec_binary_information`**



[DSFGI0_DM_Empf_Meldung, 1, en_US]

Parameter	
`TI`	Supported type identifications: • <TI:=30> .. Single-point information with time tag CP56Time2a
`Name`	Name of the signal
`104 address`	SICAM A8000 internal IEC 60870-5-101/104 message address (CASDU1, CASDU2, IOA1, IOA2, IOA3)
`Station_number_(DSFG_Instanz)`	DSfG station number (instance) of the remote station: • 1 to 30 • 255 = not used
`DSFG_address_DB1-DB5`	DSfG address (data element address) of the binary information: • a to z .. String max. 5 characters
`DSFG_data_type`	DSfG data type: • 2 = integer • 3 = rational integer • 4 = number in exponential representation • 6 = HEX number

Parameter	
`DSFG_query type`	DSFG-query type: • Cycle time The message status is queried cyclically in this time grid. • Attention message If the attention message is received with NTY = B, NTY = L, NTY = W, the parameterized time is started. The binary information for this instance should be received within this time. If the message is not received, the message will be queried after this time and any changed data will be passed on.
`Cycle time`	Cycle time for DSfG query: • 0 to 32767 s
`Bit number`	Bit number within the DSfG type: • 0 to 31
`DSFG_Revision`	DSfG-Revision: • not used • Revision report

Supported Data Formats

DSfG data type	DSfG message:	IEC 60870-5-101/104 Data format (TI)
• 2 = integer • 3 = rational integer • 4 = number in exponential representation • 6 = HEX number	1 bit within the DSfG data type.	30

Message Conversion

The table describes the evaluated elements of the IEC 60870-5-101/104 message during message conversion.

Elements of the message	
TI .. Type identification	• <TI:=30> .. Single-point information with time tag CP56Time2a
CASDU, IOA .. Message address	Parameter-settable
QDS .. Quality descriptor	
BL .. Blocked	Not supported (BL = 0)
SB .. Substituted	Not supported (SB = 0)
NT .. Not topical	NT = 1: • if no response to the queried value is received
IV .. Invalid	Not supported (IV = 0)
Cause of transmission	
03 .. Spontaneous	• upon change of information state or quality descriptor of the data point
20 .. Interrogated by station interrogation	• Upon reception of a GI request in the case of a general interrogation, all parameterized values are queried and, when received with the cause of transmission COT = 20, passed on to the BSE
xx .. Other COTs	Not supported

Elements of the message		
T .. Test		Not supported
Information		
Single-point information status		
SPI	0 .. OFF	Supported
	1 .. ON	Supported
Time tag		
CP56Time2a .. Date + time		Protocol-internal time (receive time)

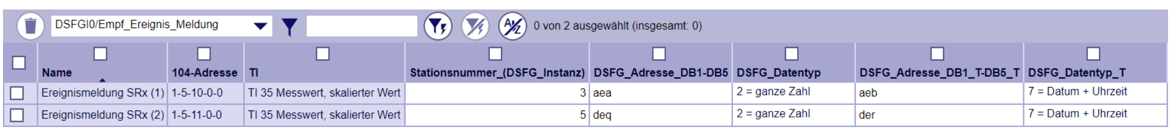
NOTE

Not listed elements of the IEC 60870-5-101/104 message are not rated/not supported!

Event information

The parameterization of the address and message conversion for event binary information in receive direction is to be done with the SICAM Device Manager with the function “Signals” or with the SICAM TOOLBOX II, OPM II.

Processing type: *`firmware`* | **`Rec_event_state_information`**



[DSFGI0_DM_Empf_Ereignis_Meldung, 1, en_US]

Parameter	
`TI`	Supported type identifications: • <TI:=35> .. Measured value, scaled value with time tag CP56Time2a
`Name`	Name of the signal
`104 address`	SICAM A8000 internal IEC 60870-5-101/104 message address (CASDU1, CASDU2, IOA1, IOA2, IOA3)
`Station_number_(DSFG_Instanz)`	DSfG station number (instance) of the remote station: • 1 to 30 • 255 = not used
`DSFG_address_DB1-DB5`	DSfG address (data element address) of the event information: • a to z .. String max. 5 characters
`DSFG_data_type`	DSfG data type of the event information: • 2 = integer
`DSFG_address_DB1_T-DB5_T`	DSfG address (data element address) of the time information of the event information: • a to z .. String max. 5 characters
`DSFG_Datentyp_T`	DSfG-Data type for the time of the event information: • 7 .. Date + time

Event information

Event information are only requested from the instance when an attention message is received. Event information are only forwarded to the BSE if there is a change (time + date or value). Event reports are passed on as a measured value to the BSE with the DSfG time and the DSfG value. The event number (1 to 999) is transferred in the DSfG value. The event number is manufacturer-independent and defined for billing-specific errors according to the DSfG standard.

A positive number means an “incoming event information” , a negative number an “outgoing event number”.

Supported Data Formats

DSfG data type	DSfG data type for time	IEC 60870-5-101/104 Data format (TI)
• 7 = Date + time		35

Message Conversion

The table describes the evaluated elements of the IEC 60870-5-101/104 message during message conversion.

Elements of the message		
TI .. Type identification		• <TI:=35> .. Measured value, scaled value with time tag CP56Time2a
CASDU, IOA .. Message address		Parameter-settable
QDS .. Quality descriptor		
BL .. Blocked		Not supported (BL = 0)
SB .. Substituted		Not supported (SB = 0)
NT .. Not topical		NT = 1: • if no response to the queried value is received
IV .. Invalid		Not supported (IV = 0)
OV .. Overflow		Not supported (OV = 0)
Cause of transmission		
03 .. Spontaneous		• upon change of information state or quality descriptor of the data point
20 .. Interrogated by station interrogation		• Upon reception of a GI request in the case of a general interrogation, all parameterized values are queried and, when received with the cause of transmission COT = 20, passed on to the BSE
xx .. Other COTs		Not supported
T .. Test		Not supported
Information		
Value.. S .. Sign		• Scaled value The DSfG event information is passed on to the BSE as measured value. The event number (1 to 999) is transferred in the DSfG value. The event number is manufacturer-independent and defined for billing-specific errors according to the DSfG standard. A positive number means an “incoming event information”, a negative number an “outgoing event-information”.
Time_tag		
CP56Time2a .. Date + time		DSfG-time (= time read out from DSFG_address_DB1_T to DB5_T)

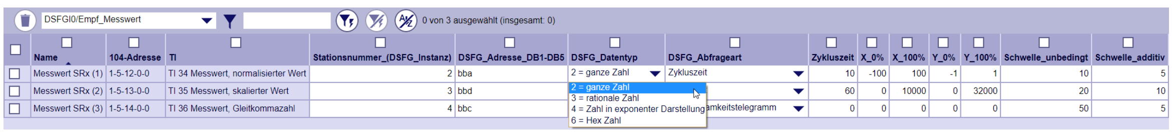
NOTE

Not listed elements of the IEC 60870-5-101/104 message are not rated/not supported!

Measured Values

The parameterization of the address and message conversion for measured values in receive direction is to be done with the SICAM Device Manager with the function “Signals” or with the SICAM TOOLBOX II, OPM II.

Processing type: *firmware* | `Rec_measured value`



[DSFGI0_DM_Empf_Messwert, 1, en_US]

Parameter	
`TI`	Supported type identifications: • <TI:=34> .. Measured value, normalized value with time tag CP56Time2a • <TI:=35> .. Measured value, scaled value with time tag CP56Time2a • <TI:=36> .. Measured value, short floating-point number with time tag CP56Time2a
`Name`	Name of the signal
`104 address`	SICAM A8000 internal IEC 60870-5-101/104 message address (CASDU1, CASDU2, IOA1, IOA2, IOA3)
`Station_number_(DSFG_Instanz)`	DSfG station number (instance) of the remote station: • 1 to 30 • 255 = not used
`DSFG_address_DB1-DB5`	DSFG address (data element address) of the measured value: • a to z .. String max. 5 characters
`DSFG_data_type`	DSfG data type: • 2 .. integer • 3 .. rational integer • 4 .. number in exponential representation • 6 .. HEX number
`DSFG_query type`	DSFG-query type: • Cycle time The measured value is queried cyclically in this time grid. If the measured value is queried by another instance during the cycle period, the measured value is also processed in SICAM A8000 and the cycle time for this measured value is retriggered. This prevents unnecessary queries on the DSFG bus. • Attention message If the attention message is received with NTY = M, the parameterized time is started. The measured value for this instance should be received within this time. If the measured value is not received, the measured value is queried after this time.

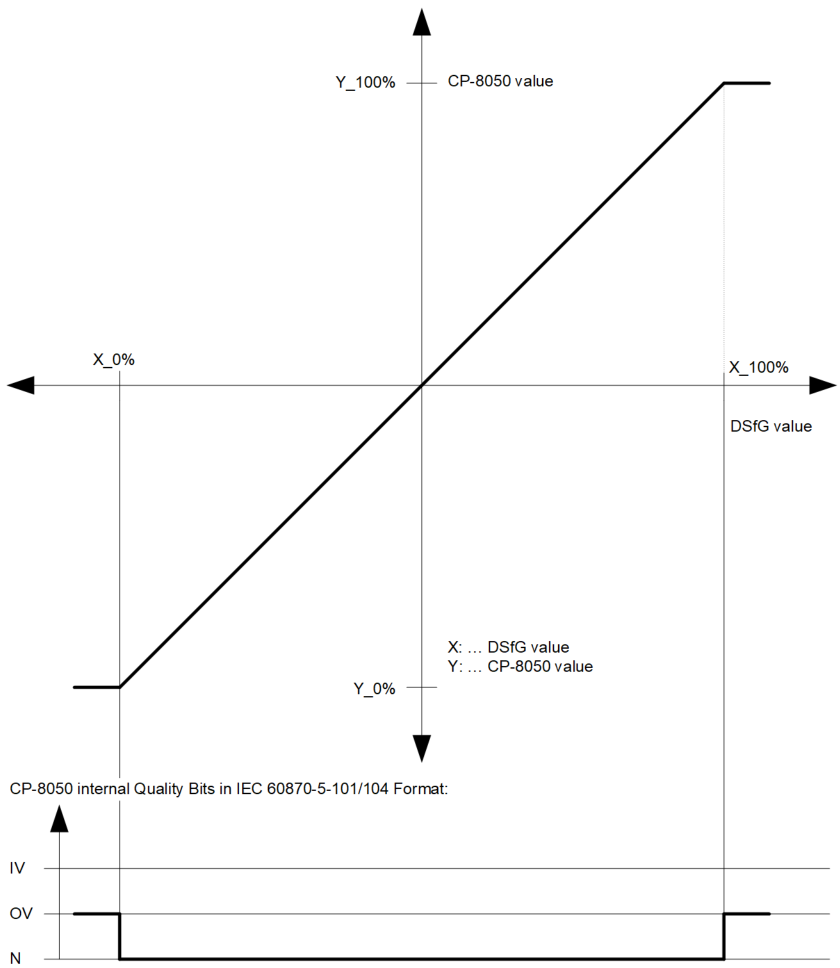
Parameter	
`Cycle time`	Cycle time for DSfG query: • 0 to 32767 s
`X_0%`, `X_100%` **`Y_0%`, `Y_100%`**	Parameters for value adaptation (scaling): • <TI:=34> .. Y_0% and Y_100% must not be less or greater than ±1. • <TI:=35> .. Y_0% and Y_100% must not be less than −32768 or greater than +32767. • Value adaptation inactive at X_0% and X_100% = 0
`Thresh_uncond`	thresh_uncond for value adaptation If the value changes > **`Thres_uncond`**, the received value is immediately forwarded to the BSE.
`Thresh_additive`	Additive threshold for value adaptation: If the value changes ≤ **`Thres_uncond`**, the received value is not immediately forwarded to the BSE and the additive change monitoring is performed. Additive change monitoring: If the summed changes (= sign correct addition of changes since the last transfer) > **`Thres_additive`**, the received value is passed to the BSE.

Supported data formats (DSfG measured values)

DSfG data type	DSfG measured value	IEC 60870-5-101/104 Data format (TI)
• 2 = integer • 3 = rational integer • 4 = number in exponential representation • 6 = HEX number		34, 35, 36

Value Adaptation

The value adaptation is defined by the parameters **`X_0%`**, **`X_100%`**, **`Y_0%`**, **`Y_100%`**.



[DSFGIO_Anpassung_Messwerte_RX, 1, en_US]

The value adaptation is only performed if **`x_0%`** or **`x_100%`** *≠ 0* is parameterized.

- If the DSfG value is outside the value range of the selected IEC 60870-5-101/104 type identifier when the value adaptation is not activated (= direct transfer), then OV = 1 is set.

DSfG data type	DSfG value range
• 2 .. integer	
• 3 .. rational integer	
• 4 .. number in exponential representation	
• 6 .. HEX number	

Change Monitoring

In order to avoid unnecessarily burdening the SICAMA8000 internal and further communication, the measured value is monitored for changes according to the following rules:

- The first value determined after startup is transmitted immediately
- Each change of quality descriptor IV triggers an immediate transfer, the quality descriptor OV does not initiate a transfer
- Change monitoring in accordance with the method of the additive threshold value procedure

Additive Threshold Value Procedure

Upon receiving, the measured value is monitored for changes. If the deviation from the last spontaneously transmitted measured value is greater than the parameterized **`thresh_uncond`** , then the new measured value is transmitted immediately to the BSE. Otherwise, the deviation is added to the last spontaneously transmitted measured value, with the correct sign. Only when the amount of this sum exceeds the parameterizable **`Thresh_additive`**, the current measured value is spontaneously transmitted to the BSE.

`Thresh uncond`	**`Thresh additive`**	Processing
0	0	Value is transmitted to the BSE with every change
0	≠ 0	
≠ 0	0	• Change ≥ **`thresh_uncond`**: Value is transmitted to the BSE
≠ 0	≠ 0	• Change ≥ **`thresh_uncond`**: Value is transmitted to the BSE • Change < **`thresh_uncond`**: Additive threshold value procedure

A transmission of the measured value due to a general interrogation does not influence the threshold value procedure.
The thresholds are to be parameterized for every measured value with the parameter **`Thresh_additive`** and the parameter **`Thresh_uncond`** .

Message Conversion

The table describes the evaluated elements of the IEC 60870-5-101/104 message during message conversion.

Elements of the message	
TI .. Type identification	• <TI:=34> .. Measured value, normalized value with time tag CP56Time2a • <TI:=35> .. Measured value, scaled value with time tag CP56Time2a • <TI:=36> .. Measured value, short floating-point number with time tag CP56Time2a
CASDU, IOA .. Message address	Parameter-settable
QDS .. Quality descriptor	
BL .. Blocked	Not supported (BL = 0)
SB .. Substituted	Not supported (SB = 0)
NT .. Not topical	NT = 1: • if no response to the queried value is received.
IV .. Invalid	Not supported (IV = 0)
OV .. Overflow	OV = 1: • DSfG value outside the parameterized measuring range (X_0%, X_100%) or conditioned value outside the range Y_0%, Y_100%. The conditioned value is limited to Y_0% or Y_100%.
Cause of transmission	
03 .. Spontaneous	• upon change of information state or quality descriptor of the data point

Elements of the message	
20 .. Interrogated by station interrogation	• Upon reception of a GI request in the case of a general interrogation, all parameterized values are queried and, when received with the cause of transmission COT = 20, passed on to the BSE.
xx .. Other COTs	Not supported
T .. Test	Not supported
Information	
Value.. S .. Sign	• Normalized value • Scaled value • IEEE STD 754 = short floating-point number
Time tag	
CP56Time2a .. Date + time	Protocol-internal time (receive time) or, in the case of general interrogation, the internal time at which the GI data is emulated from the protocol element from the protocol-internal process image.

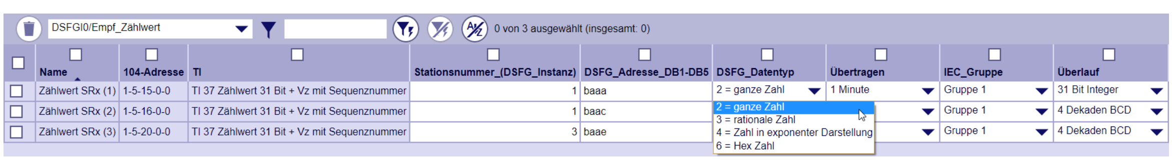
NOTE

Not listed elements of the IEC 60870-5-101/104 message are not rated/not supported!

Integrated Totals

The parameterization of the address and message conversion for integrated totals in receive direction is to be done with the SICAM Device Manager with the function "Signals" or with the SICAM TOOLBOX II, OPM II.

Processing type: *firmware* / **`Rec_counter value`**



[DSFGI0_DM_Empf_Zaehlwert, 1, en_US]

Parameter	
`TI`	Supported type identifications: • <TI:=37> .. Integrated total with time tag CP56Time2a
`Name`	Name of the signal
`104 address`	SICAMA8000 internal IEC 60870-5-101/104 message address (CASDU1, CASDU2, IOA1, IOA2, IOA3)
`Station_number_(DSFG_Instanz)`	DSfG station number (instance) of the remote station: • 1 to 30 • 255 = not used
`DSFG_address_DB1-DB5`	DSFG address (data element address) of the integrated total: • a to z .. String max. 5 characters

Parameter	
DSFG_data_type	DSfG data type: • 2 = integer • 3 = rational integer • 4 = number in exponential representation • 6 = HEX number
Transmit	Definition for transmit integrated totals to BSE (counter freeze and read): • Counter interrogation • 1 minute • 2 minutes • 3 minutes • 5 minutes • 10 minutes • 15 minutes • 30 minutes • 60 minutes The integrated totals are queried by the selected instance when the counter is queried or in the set time grid.
IEC_Group	IEC 60870-5-101/104 counter group: • Group 1 to 4
Overflow	IEC 60870-5-101/104 counter overflow treatment at: • 24, 31 bit integer • 2, 3, 4, 5, 6, 7, 8, 9 decades BCD

Supported data formats (DSfG integrated total)

DSfG data type	DSfG integrated total	IEC 60870-5-101/104 Data format (TI)
• 2 .. integer • 3 .. rational integer • 4 .. number in exponential representation • 6 .. HEX number		37

Message Conversion

The table describes the evaluated elements of the IEC 60870-5-101/104 message during message conversion.

Elements of the message	
TI .. Type identification	• <TI:=37> .. Integrated total with time tag CP56Time2a
CASDU, IOA .. Message address	Parameter-settable
Data point quality descriptor	
Sequence number	With each trigger for latching for a group the sequence number is increased in the range from 1 to 31.
CY .. Carry	On overflow of the count in the associated count period
CA .. Presets	Not supported
IV .. Invalid	Supported
Cause of transmission	

Elements of the message	
03 .. Spontaneous	interrogated counter values with a transmission activation by: • Interval control • counter interrogation message including latching trigger
37 .. Requested by general counter interrogation	Counter interrogation message without trigger for latching for all groups
38 to 41 .. Interrogated by group 1 to 4 interrogation	Counter interrogation message without trigger for latching for interrogated group
T .. Test	Not supported
Information	
Value.. S .. Sign	Dual counter reading (absolute value at the last query time)
Time tag	
CP56Time2a .. Date + time	Protocol-internal time

NOTE

Not listed elements of the IEC 60870-5-101/104 message are not rated/not supported!

Message Conversion “Counter Interrogation Command” (SICAM A8000 internal only)

The table describes the evaluated elements of the IEC 60870-5-101/104 message during message conversion.

Elements of the message		
TI .. Type identification		• <TI:=101> .. Counter interrogation command
CASDU, IOA .. Message address		Defined
QCC .. Identifier counter interrogation		
FRZ	RQT	FRZ .. Freeze (= latch) RQT .. Request (= requirement)
0	1…4	Read (no freeze or reset) request counter group (1…4)
	5	Read (no freeze or reset) General counter interrogation
1	1…4	Counter freeze without reset request counter group (1…4)
	5	Counter freeze without reset All counter groups
2	1…4	Counter freeze with reset request counter group (1…4)
	5	Counter freeze without reset All counter groups
3	1…4	Reset counter request counter group (1…4)
	5	Reset counter All counter groups
x	0; 6…63	Not supported
Cause of transmission		

Elements of the message	
06 .. Activation	Must be set
xx .. Other COTs	Not supported
T .. Test	Not supported

NOTE

Not listed elements of the IEC 60870-5-101/104 message are not rated/not supported!

13.14 IOT

13.14.1 Introduction

The IOT protocol ("Internet Of Things") is an Ethernet protocol for transmitting messages (process information) to the cloud for processing/data analysis by higher-level systems. The connection to the Internet is made via an external GPRS router or via Internet access via Ethernet.

Protocol firmware for IOT:

Firmware	System	Standard and function
OPUPI0	CP-8031, CP-8050	IOT-Publisher (MQTT) for AWS Cloud (Amazon Web Services) and Microsoft Cloud (Azure)
OPUPI1	CP-8031, CP-8050	IOT Publisher for MindSphere (Siemens)

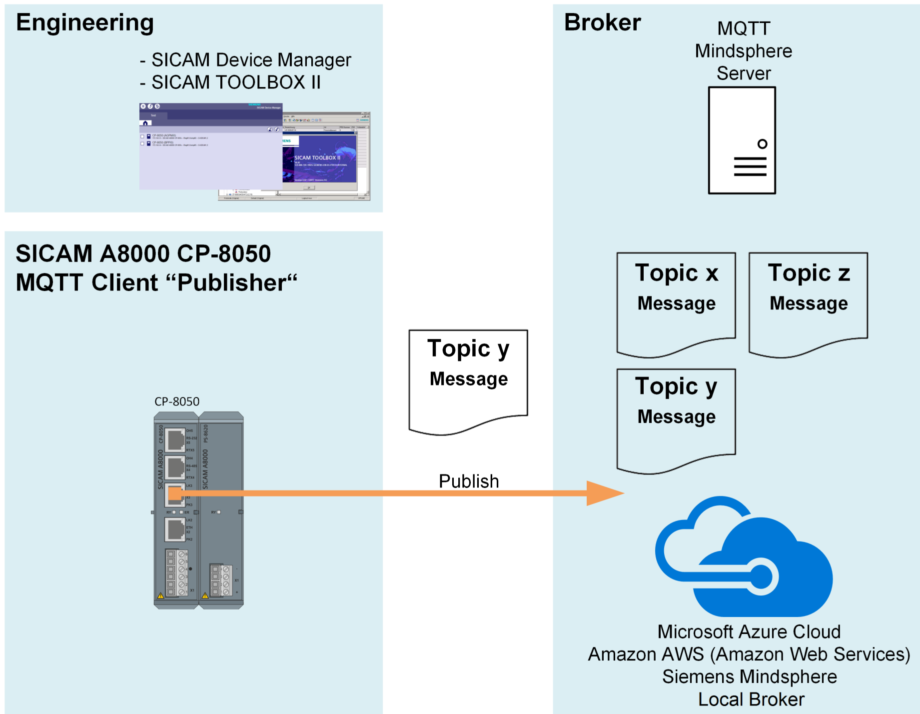
IOT Data Transfer/Data Processing – Overview

- CP-8031, CP-8050 sends messages with process information as a "Publisher" to a "Broker" of a cloud provider (Microsoft Azure, Amazon Web Services, Siemens MindSphere).
- The messages are stored in the broker.
- Subscribers can register at the broker for data from selected devices.
- The stored messages are distributed by the broker to the subscribers.
- The subscribers can then carry out extensive data analyzes and evaluations as required with the associated data from the cloud.

NOTE

If you send data to MindSphere with a time tag A in one transmission and use the time tag A again in a subsequent transmission, the data from the first transmission will be completely overwritten (this applies to OPUPI1).

Schematic configuration for IOT Publisher (MQTT):



[OPUPIx_Configuration, 1, en_US]

13.14.2 Functions

Function	OPUPI0	OPUPI1
"IOT-Publisher"	✓	✓
Supported IOT protocols		
OPC UA PubSub 1.04 (MQTT) (IEC 62541)	✓	–
MindConnect (HTTPS, native MindSphere IoT Protocol)	–	✓
Network configuration		
IOT Publisher to Cloud-Destination	1	1
Port number MQTT	1883	–
Port number MQTT + TLS	8883	–
Port number HTTPS	–	443
Broker Mode		
MQTT	✓	–
Supported cloud services		
AWS (Amazon Web Services)	✓	–
Azure (Microsoft)	✓	–
Local Broker	✓	–
MindSphere (Siemens)	✓	✓

Function	OPUPI0	OPUPI1
Connection mode for cloud services		
AWS (Amazon Web Services)	TLS	–
Azure (Microsoft)	TLS	–
Local Broker	– without TLS – with TLS – with TLS + JWT [384]	–
MindSphere (Siemens)	– with TLS + JWT [384]	HTTPS
Security		
Preshared Key	–	✓
Username, Password	✓	–
Certificates	✓	–
License		
License required to use the firmware inCP-8031, CP-8050.	–	–
Physical Interface Ethernet		
CP-8031, CP-8050: X2, X3	✓	✓
CI-852x [385]: X1, X2, X3, X4, X5	✓	✓
Ethernet interface (properties)		
Ethernet Interface(*13.1.4.6 Ethernet Interface – Module Properties*)	✓	✓
TCP/IP optimization parameters	✓	✓
TCP/IP keep alive	✓	✓
Supported IEC60870-5-101/104 Data formats in transmit direction (SICAM A8000→IOT)		
<TI:=30> ... Single-point information with time tag CP56Time2a	✓	✓
<TI:=31> ... Double-point information with time tag CP56Time2a		
<TI:=32> ... Transformer tap position value CP56Time2a time tag		
<TI:=34> ... Measured value, normalized value with time tag CP56Time2a		
<TI:=35> ... Measured value, scaled value with time tag CP56Time2a		
<TI:=36> ... Measured value, floating-point number with time tag CP56Time2a		
<TI:=37> ... Integrated totals with time tag CP56Time2a		
Supported IEC60870-5-101/104 data formats in receive direction (SICAM A8000←IOT)		
–	–	–
Web server		
Protocol-internal diagnostic and statistic information via protocol-specific web pages	✓	✓

384 Json WEB Token

385 With CP-8031 not supported by default. With a license (see *14.8 SICAM A8000 CP-803x Extended CI-Module*) 1 communication module CI-852x can be used additionally also with CP-8031.

Function	OPUPI0	OPUPI1
Engineering		
SICAM Device Manager	✓	✓
SICAM TOOLBOX II	✓	✓

Restrictions

- In receive direction “SICAM A8000←IOT” no data formats are supported!
- Redundancy is not supported!

13.14.3 Modes of Operation

The operating mode of the interface is determined by parameters of the protocol element and optional equipment.

Standard Operation Mode	Optional equipment	Interface signals (X2, X3)
Electrical Ethernet interface (Twisted Pair)	GPRS/EDGE/LTE Router	TXD+, TXD-, RXD+, RXD-

13.14.4 Communication

For the stations to communicate with each other, suitable transmission facilities and/or network components may be needed in addition.

Own station "IOT-Publisher" (Client)

System	System element	Protocol element	Remarks
SICAM A8000 Series	CP-8031/CPCI85 CP-8050/CPCI85 CP-8050/EPCI85	OPUPI0	IOT Publisher MQTT for: • Microsoft Azure Cloud • Amazon Web Services (AWS) • MindSphere (Siemens)
		OPUPI1	IOT Publisher (MindSphere) for: Siemens MindSphere

Remote station "Broker" (Server for WEB Services)

System	System element	Protocol element	Remarks
Broker for Microsoft Azure Cloud	–	–	–
Broker for Amazon AWS Cloud	–	–	–
Broker for Siemens MindSphere Cloud	–	–	–
local Broker	–	–	–

13.14.5 Parameters and Settings

13.14.5.1 IOT-Publisher (MQTT) (OPUPI0)

Parameter name	Description	Settings
`[PRE] Interface parameter` Note: Some parameters may not be displayed until the interface is selected.		
`Interface`	Ethernet interface (SICAM A8000 internal). An Ethernet connector is assigned to the Ethernet interface on the BSE. *13.1.4.4 Selection of an Ethernet Interface for Communication Protocols*	Permitted range = • LAN1 to LAN50 • VPN1 to VPN8 Default setting = not used
`[PRE] Broker mode`		
`Broker mode`	Selection with which protocol data should be sent to the broker	Permitted range = • MQTT = default setting • AMQP No more supported as of revision 03.01
`[PRE] AMQP Broker`		
`Station number (internal)`	SICAM A8000 internal station number for diagnostic, data routing	Permitted range = • 0 to 99 ... internal station number • 255 ... not used Default setting = 255
`Station failure`	If the TCP/IP connection fails, the transmission of the error message can be suppressed with**`Station failure`**= ***`no`***	Permitted range = • yes (notification) • no (no notification) Default setting = yes
`Station name`	Dynamic part in the Publisher ID	Permitted range = • Max. 64 characters • Valid signs: A to Z, a to z, 0 to 9, "_" Default setting =
`AMQP IP address`	IP Address of the broker (AMQP) as remote station (in format: IPV4). Note: **`AMQP IP address`**is only required if the broker has a static IP address (0.0.0.0 =**`AMQP host name`**is used). The IP address of the own station is set on the BSE.	Permitted range = 0.0.0.0 to 255.255.255.254 Standard setting = 0.0 0.0

Parameter name	Description	Settings
`Connection Mode`	Mode whether AMQP should be used encrypted or unencrypted	Permitted range = • without TLS, without SASL (Port 5672) • with TLS, without SASL (Port 5671) • without TLS, with SASL (Auth. Plain) (Port 5672) • with TLS, with SASL (Auth. Plain) (Port 5671) • with TLS, with SASL (Auth. Plain) Azure (Port 5671) Default setting = with TLS, with jSON web token (JWT)
`AMQP host name`	Host name of the AMQP broker Example for Siemens Mind-Sphere:**`AMQP host name`**= ***`mqtt.eu1.mindsphere.io`***	Permitted range = • Max. 128 characters • Valid signs: A to Z, a to z, 0 bis 9, _, . Default setting =
`AMQP source`		Permitted range = • Max. 128 characters • Valid signs: A to Z, a to z, 0 to 9, "_"
`AMQP target`		Permitted range = • Max. 128 characters • Valid signs: A to Z, a to z, 0 to 9, "_"
`AMQP/SASL username`	User name for MQTT authentication (not used with JWT)	Permitted range = • Max. 128 characters • Valid signs: A to Z, a to z, 0 to 9, "_" Default setting =
`AMQP/SASL password`	Password for MQTT authentication (not used with JWT)	Permitted range = • Max. 128 characters • Valid signs: A to Z, a to z, 0 to 9, "_" Default setting =
`Encoding`		Permitted range = • SIEMENS • OPC_UA Default setting = SIEMENS
`File transfer`		Permitted range = 0 to 65535 s Default setting =
`KeepAlive`		Permitted range = 0 to 65535 s Default setting =
`Keyframe`		Permitted range = 0 to 65535 s Default setting =

Parameter name	Description	Settings
`Metaframe`		Permitted range = 0 to 65535 s Default setting =
`SAS Token validity`		Permitted range = 0 to 65535 days Default setting =
`SAS connection string`		Permitted range = • Max. 128 characters • Valid signs: A to Z, a to z, 0 to 9, "_"
`Measuring value cycle`	Time for the state compression for measured values	Permitted range = 0 to 65535 s Default setting = 30 s
`MSS (maximum segment size)`	Maximale TCP/IP segment size	Permitted range = 0 to 1460 byte Default setting = 1460 byte
`DNS server`	IP Address of the DNS Server (in format IVP4). Note: IP-Address 8.8.8.8 = Google DNS Server (public DNS-Server)	Permitted range = 0.0.0.0 to 255.255.255.254 Standard setting = 0.0 0.0
`Data points learning`	Dynamic learning of the data points. No detailed routing of the data points required. The name of the data point is algorithmically generated from the IEC 60870-5-101/104 address.	Permitted range = • always • during first general interrogation • detail routing only Default setting = always
`Certificate`	Own certificate/private key for the TLS encryption	Permitted range = • Not used • Certificate 1 to 10 • EST Default setting = not used
`Certificate authority`	Broker certificate for authentication	Permitted range = • Certificate authority 1 to 10 • EST Default setting = not used
`[PRE] MQTT Broker`		
`Station number (internal)`	SICAM A8000 internal station number for diagnostic, data routing	Permitted range = • 0 to 99 ... internal station number • 255 ... not used Default setting = 255
`Station failure`	If the TCP/IP connection fails, the transmission of the error message can be suppressed with station failure = ***`nein`***.	Permitted range = • yes (notification) • no (no notification) Default setting = yes

Parameter name	Description	Settings
`Station name`	Dynamic part in the Publisher ID	Permitted range = • Max. 64 characters • Valid signs: A to Z, a to z, 0 to 9, "_" Default setting =
`MQTT IP address`	IP Address of the broker (MQTT) as remote station (in format: IPV4). Note: **`MQTT IP address`**is only required if the broker has a static IP address (0.0.0.0 =**`MQTT host name`**is used). The IP address of the own station is set on the BSE.	Permitted range = 0.0.0.0 to 255.255.255.254 Standard setting = 0.0 0.0
`Connection Mode`	Mode whether MQTT should be encrypted or unencrypted	Permitted range = • without TLS (Port 1883) • with TLS (Port 8883) • with TLS, with jSON web token (JWT, Port 8883) Default setting = with TLS, with jSON web token (JWT)
`MQTT host name`	Host name of the MQTT Broker Example for Siemens Mind-Sphere:**`MQTT host name`**=***`mqtt.eu1.mindsphere.io`***	Permitted range = • Max. 128 characters • Valid signs: A to Z, a to z, 0 bis 9, _, . Default setting =
`MQTT Client ID`	Name of publisher at MQTT level. Default equal to the publisher ID.	Permitted range = • Max. 128 characters • Permitted characters: all (incl. special characters) Default setting =
`MQTT topic`	Topic for the MQTT message. Note: Topic name for Siemens Mind-Sphere: c/{ClientID}/o/opcua/{VersionMS}/u/{Meas:d}{File:d}{Meta:m}	Permitted range = • Max. 128 characters • Permitted characters: all (incl. special characters) Default setting =
`MQTT user name`	User name for MQTT authentication (not used with JWT)	Permitted range = • Max. 128 characters • Valid signs: A to Z, a to z, 0 to 9, "_" Default setting =
`MQTT password`	Password for MQTT authentication (not used with JWT)	Permitted range = • Max. 128 characters • Valid signs: A to Z, a to z, 0 to 9, "_" Default setting =

Parameter name	Description	Settings
`File transfer`		Permitted range = 0 to 65535 s Default setting =
`KeepAlive`		Permitted range = 0 to 65535 s Default setting =
`Keyframe`		Permitted range = 0 to 65535 s Default setting =
`Metaframe`		Permitted range = 0 to 65535 s Default setting =
`Measuring value cycle`	Time for the state compression for measured values	Permitted range = 0 to 65535 s Default setting = 30 s
`MSS (maximum segment size)`	Maximum TCP/IP Segment Size	Permitted range = 0 to 1460 byte Default setting = 1460 byte
`DNS server`	IP Address of the DNS Servers (in format: IPV4). Note: IP-Address 8.8.8.8 = Google DNS Server (public DNS-Server)	Permitted range = 0.0.0.0 to 255.255.255.254 Standard setting = 0.0 0.0
`Data points learning`	Dynamic learning of the data points. No detailed routing of the data points required. The name of the data point is algorithmically generated from the IEC 60870-5-101/104 address.	Permitted range = • always • during first general interrogation • detail routing only Default setting = always
`Certificate`	Own certificate/private key for the TLS encryption	Permitted range = • Not used • Certifivate 1 to 10 • EST Default setting = not used
`Certificate authority`	Broker certificate for authentication	Permitted range = • Certificate authority 1 to 10 • EST Default setting = not used
`[PRE] HTTP web server`		
`HTTP web server`	With a web browser protocol-internal information can be displayed. Note: For safety reasons, the web server should be disabled in a system in operation.	Permitted range = • disabled • enabled Default setting = disabled

13.14.5.2 IOT-Publisher (MindSphere) (OPUPI1)

Parameter name	Description	Settings
[PRE] Interface parameter Note: Some parameters may not be displayed until the interface is selected.		
Interface	Ethernet interface (SICAM A8000 internal). The Ethernet interface is assigned on the BSE to a serial interface plug. *13.1.4.4 Selection of an Ethernet Interface for Communication Protocols*	Permitted range = • LAN1 to LAN50 • VPN1 to VPN8 Default setting = not used
[PRE] Mindsphere		
Station number (internal)	SICAM A8000 internal station number for diagnostic, data routing	Permitted range = • 0 to 99 ... internal station number • 255 ... not used Default setting = 255
Station failure	If the TCP/IP connection fails, the transmission of the error message can be suppressed with**Station failure**= ***no***	Permitted range = • yes (notification) • no (no notification) Default setting = yes
MindSphere IP address	IP Address of the tenant as remote station (in format: IPV4). Note: **MindSphere IP address**is only required if the tenant has a static IP address (0.0.0.0 =**MindSphere host name**is used). The IP address of the own station is set on the BSE.	Permitted range = 0.0.0.0 to 255.255.255.254 Standard setting = 0.0 0.0
Tenant	Tenant of the MindSphere customer	Permitted range = • Max. 256 characters • Valid signs: A to Z, a to z, 0 to 9, “_” Default setting =
Init Token	Initial Access Token from the MindSphere	Permitted range = • Max. 2048 characters Default setting =
User Agent	Agent ID from the MindSphere	Permitted range = • Max. 256 characters • Valid signs: A to Z, a to z, 0 to 9, “_” Default setting =

Parameter name	Description	Settings
`MindSphere host name`	Host name of the MindSphere Tenant	Permitted range = • Max. 256 characters • Valid signs: A to Z, a to z, 0 to 9, "_", "." Default setting =
`Initial Registration URI`	Registration address from the MindSphere	Permitted range = • Max. 256 characters • Valid signs: A to Z, a to z, 0 to 9, "_", "." Default setting =
`Security Policy`		Permitted range = • Preshared Key Default setting = PreShared Key
`KeepAlive`	Key Rotation Interval	Permitted range = 0 to 65535 s Default setting = 60 s
`Keyframe`	Time between 2 general interroga-tions	Permitted range = 0 to 65535 s Default setting = 7200 s
`MSS (maximum segment size)`	Maximum TCP/IP Segment Size	Permitted range = 0 to 1460 byte Default setting = 1460 byte
`DNS server`	IP Address of the DNS Servers (in format: IPV4). Note: IP-Address 8.8.8.8 = Google DNS Server (Öpublic DNS-Server)	Permitted range = 0.0.0.0 to 255.255.255.254 Standard setting = 0.0 0.0
`Learn data points`	Dynamic learning of the data points. No detailed routing of the data points required. The name of the data point is algo-rithmically generated from the IEC 60870-5-101/104 address.	Permitted range = • always • with first general interroga-tion • only via message address conversion Default setting = always
`Buffer time`	Time interval in which data is "collected" and then uploaded together	Permitted range = 0 to 65535 ms Default setting = 10000 ms
`Certificate authority`	MindSphere certificate for authen-tication at TLS level	Permitted range = • Not used • Certificate authority 1 to 10 Default setting = not used
`[PRE] HTTP-Webserver`		
`HTTP web server`	With a standard web browser, protocol-internal information can be displayed. Note: For safety reasons, the web server should be "disabled" in a system in operation.	Permitted range = • disabled • enabled Default setting = disabled

13.14.6 Web server

A web server for internal diagnostic and statistical information is integrated in the protocol firmware. The web server itself is implemented on the basic system element - the protocol-specific web pages are provided by the protocol element.

System	Firmware	Designation	Protocol-specific web pages
CP-8050	OPUPI0	IOT-Publisher (MQTT) for AWS Cloud (Amazon Web Services), MindSphere (Siemens) and Microsoft Cloud (Azure)	✓
	OPUPI1	IOT Publisher for MindSphere (Siemens)	✓

Enable/disable web server or start web server via SICAM Device Manager or web browser see *13.1.4.12 Web server for protocol-specific web pages*.

Supported protocol-specific web pages

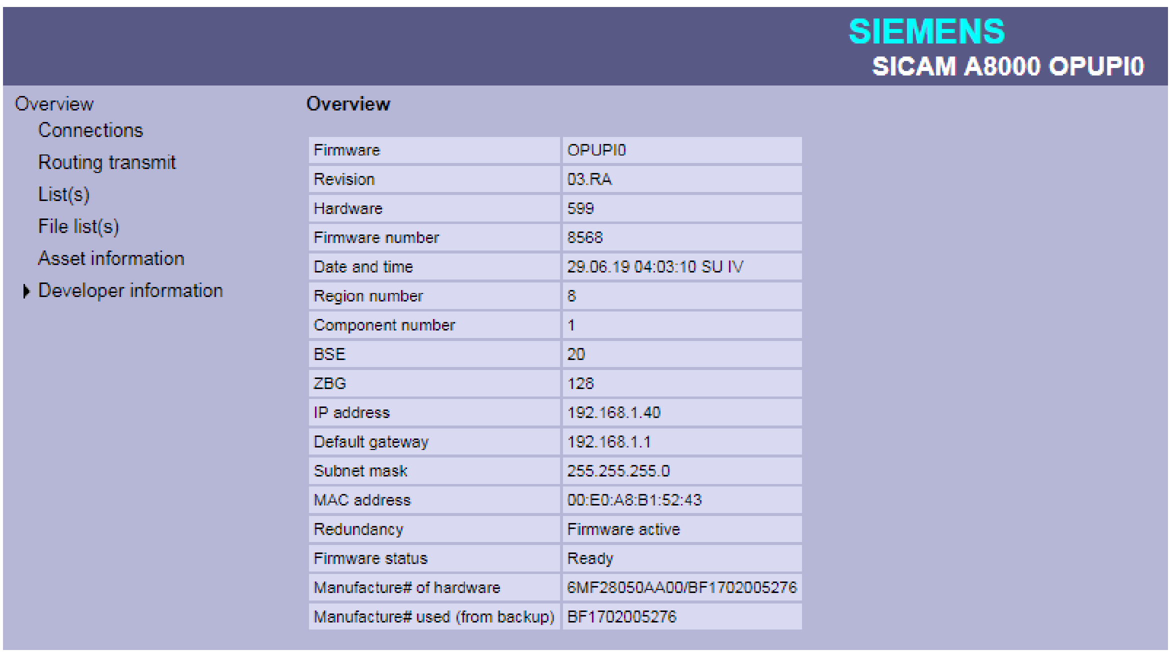
Web page	OPUPI0	OPUPI1
Overview		
Connections	✓	✓
Routing Transmit	✓	✓
List(s)	✓	✓
File List(s)	✓	–
Asset Information	✓	✓
Developer Information		
Freespace	✓	✓
Duration	✓	✓
Connection Log	✓	✓
Dataflow Test	✓	✓
Diagnosis (IDR)	✓	✓
Diagnosis (IDH)	–	–
Diagnosis (IDZ)	–	–
Diagnosis (IDE)	–	–

13.14.6.1 Overview

With web page **Overview** general information of the firmware will be displayed.

Field	Note
Firmware	Name of firmware
Revision	Revision of Firmware
Hardware	Hardware number (system internal)
Firmware number	Firmware number (system internal)
Date and time	actual date + time of firmware
Region number	Region number (system internal)
Component number	Component number (system internal)
BSE	Basic system element number (system internal)
ZBG	Supplementary system element number “SSE” (internal)
IP address	Own IP address of the assigned interface

Field	Note
Default gateway	Default gateway of the assigned interface
Subnet mask	Subnet mask of the assigned interface
MAC address	MAC address of the assigned interface
Redundancy	Current redundancy status of the firmware: • Firmware active • Firmware passive
Firmware status	State of the firmware:
Manufacture# of hardware	MLFB-number + Serial number of the hardware group
Manufacture# used (from backup)	MLFB-number + Serial number of the hardware group from the SD Card (Spare part concept)



[OPUPIx_WEB_01_Overview, 1, --_--]

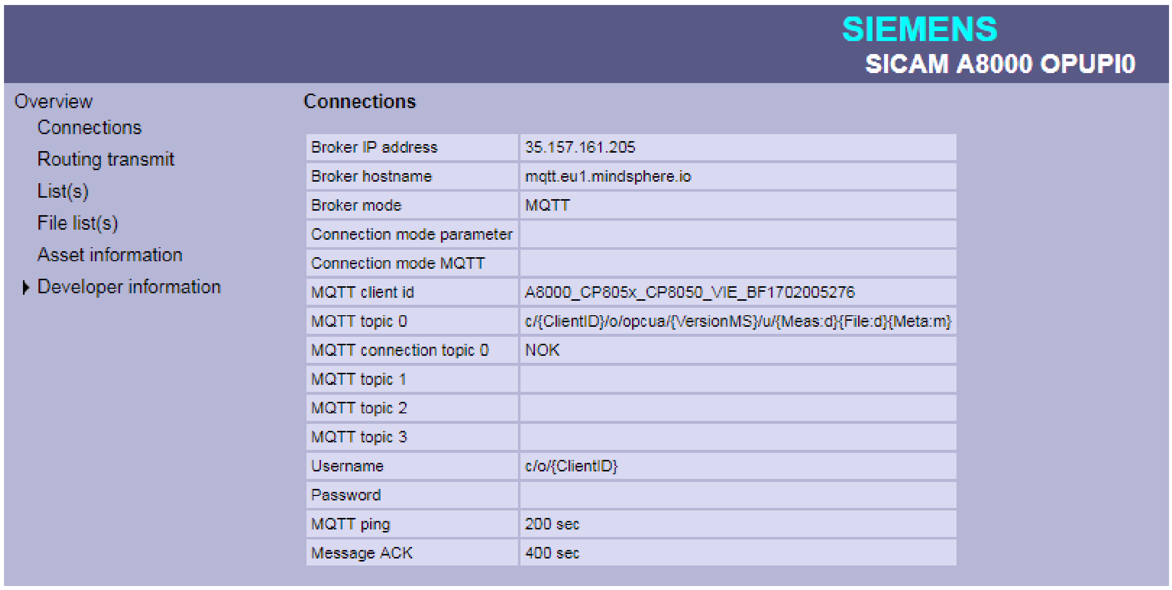
13.14.6.2 Connections

With web page **Connections** detailed information about the status of the connection to the broker will be displayed.

Field	Note
Broker IP address	IP address of the broker
Broker host name	Host name of the broker
Broker mode	Broker mode: • MQTT
Connection mode parameter	MQTT Connection Mode (encrypted / unencrypted, authentication)
Connection mode MQTT	MQTT Connection Mode (encrypted / unencrypted, authentication)
MQTT client id	Client ID on MQTT level (default: Publisher ID)
MQTT topic 0	Topic from which MQTT subscriber can pick up the data
MQTT topic 1 [386]	not used
MQTT topic 2 [386]	not used
MQTT topic 3 [386]	not used

[386] only OPUPI0

Field	Note
Username	Username for authentication on protocol level
Password	Password for authentication on protocol level
MQTT ping	Monitoring time on MQTT level
Message ACK	Acknowledgment time for last sent message to the broker (Publish ACK)



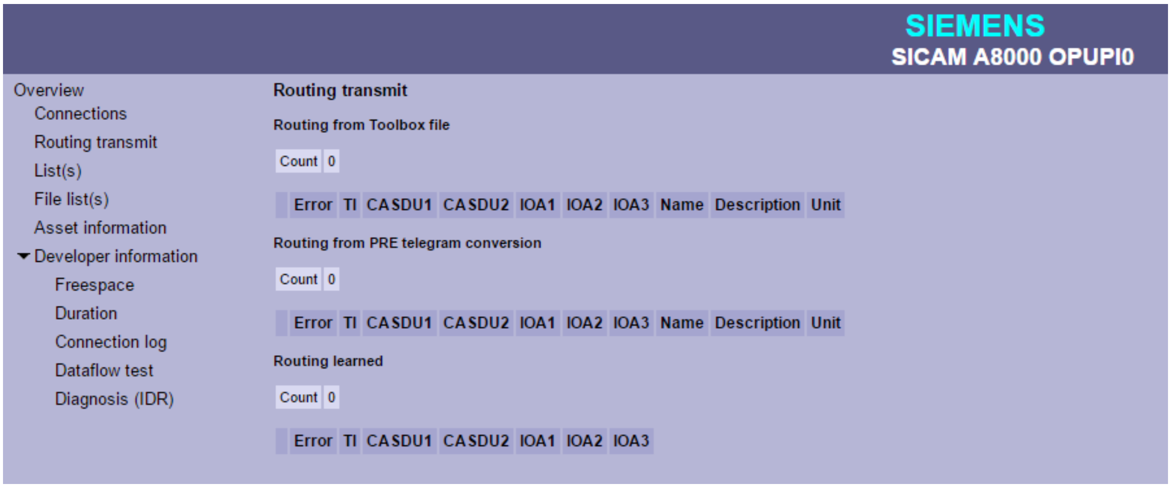
[OPUPIx_WEB_02_Connections, 1, --_--]

13.14.6.3 Routing Transmit

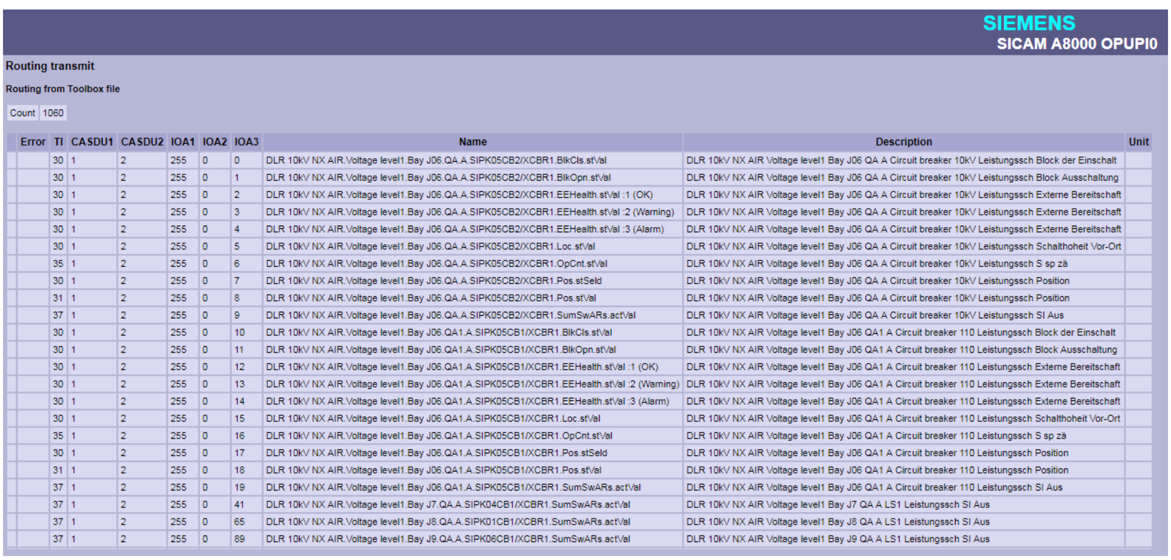
With web page **Routing Transmit** information about the parameterized data points to the broker in transmit direction are shown.

Field	Note
Routing from Toolbox file	Automatically converted data points from the applied signals
Count	Number of parameterized data points in transmit direction from the Toolbox file
Error	Error number • ERR = 0 .... no fault
Routing from PRE message conversion	Message conversion based on SIP message conversion (detailed routing)
Count	Number of parameterized data points in transmit direction
Error	Error number • ERR = 0 .... no fault
Routing learned	Number of learned data points in transmit direction
Count	Number of parameterized data points in transmit direction
Error	Error number • ERR = 0 .... no fault
TI	IEC 60870-5-101/104 Type identification (SICAM A8000 internal)
CASDU1, CASDU2 IOA1, IOA2, IOA3	IEC 60870-5-101/104 Address of data point (SICAM A8000 internal)
Name	Data point name
Description	Long text
Unit	Address of the data point

All parameterized data points in transmission direction are displayed. Incorrect parameterized data points are marked "red".



[OPUPIx_WEB_03_Routing_Transmit, 1, --_--]



Routing transmit

Routing from Toolbox file

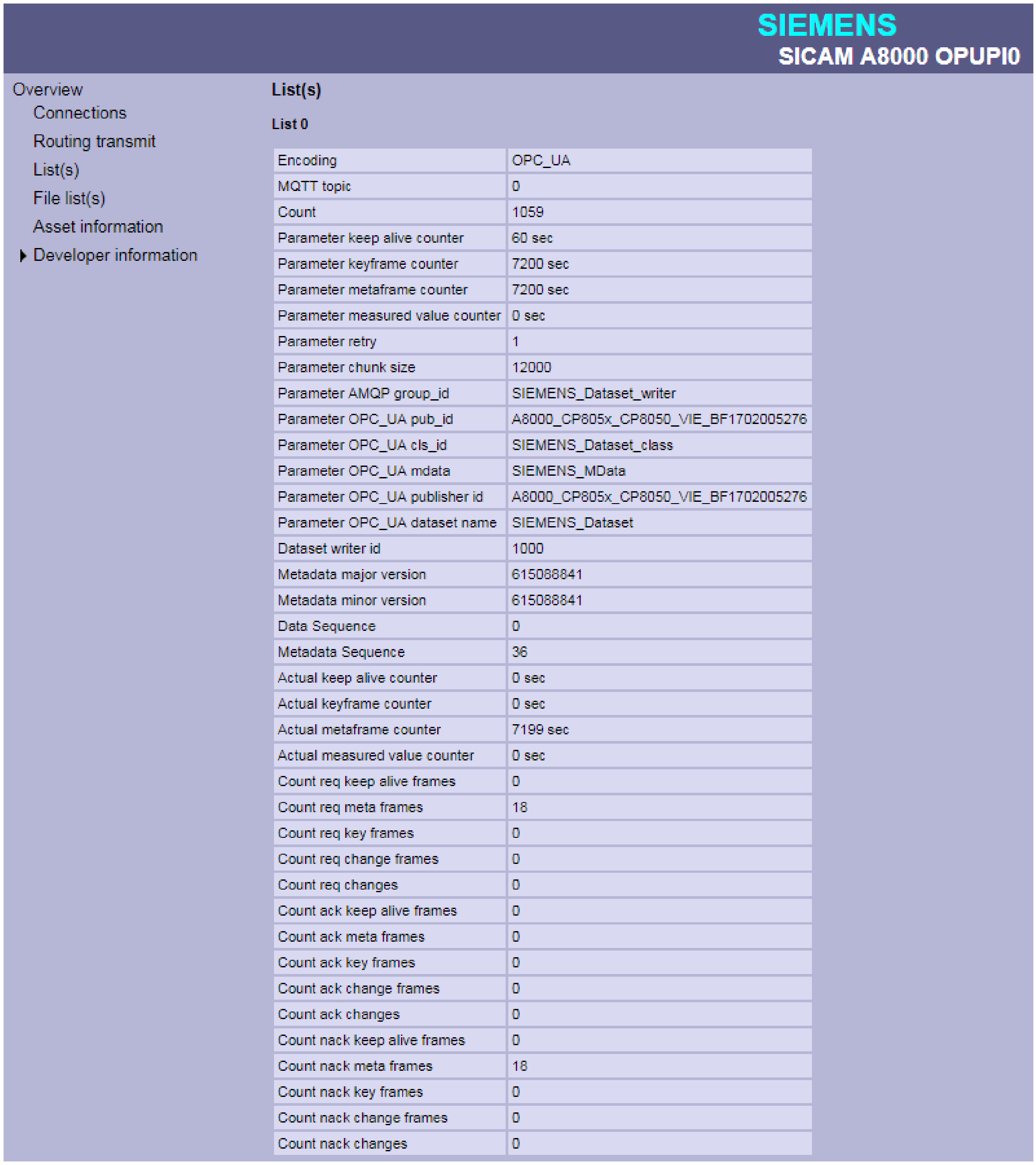
Count 1060

Error	TI	CASDU1	CASDU2	IOA1	IOA2	IOA3	Name	Description	Unit
	30	1	2	255	0	0	DLR 10kV NX AIR.Voltage level1.Bay J06.QA.A.SIPK05CB2/XCBR1.BlkCls.stVal	DLR 10kV NX AIR Voltage level1 Bay J06 QA A Circuit breaker 10kV Leistungssch Block der Einschalt	
	30	1	2	255	0	1	DLR 10kV NX AIR.Voltage level1.Bay J06.QA.A.SIPK05CB2/XCBR1.BlkOpn.stVal	DLR 10kV NX AIR Voltage level1 Bay J06 QA A Circuit breaker 10kV Leistungssch Block Ausschaltung	
	30	1	2	255	0	2	DLR 10kV NX AIR.Voltage level1.Bay J06.QA.A.SIPK05CB2/XCBR1.EEHealth.stVal :1 (OK)	DLR 10kV NX AIR Voltage level1 Bay J06 QA A Circuit breaker 10kV Leistungssch Externe Bereitschaft	
	30	1	2	255	0	3	DLR 10kV NX AIR.Voltage level1.Bay J06.QA.A.SIPK05CB2/XCBR1.EEHealth.stVal :2 (Warning)	DLR 10kV NX AIR Voltage level1 Bay J06 QA A Circuit breaker 10kV Leistungssch Externe Bereitschaft	
	30	1	2	255	0	4	DLR 10kV NX AIR.Voltage level1.Bay J06.QA.A.SIPK05CB2/XCBR1.EEHealth.stVal :3 (Alarm)	DLR 10kV NX AIR Voltage level1 Bay J06 QA A Circuit breaker 10kV Leistungssch Externe Bereitschaft	
	30	1	2	255	0	5	DLR 10kV NX AIR.Voltage level1.Bay J06.QA.A.SIPK05CB2/XCBR1.Loc.stVal	DLR 10kV NX AIR Voltage level1 Bay J06 QA A Circuit breaker 10kV Leistungssch Schalthoheit Vor-Ort	
	35	1	2	255	0	6	DLR 10kV NX AIR.Voltage level1.Bay J06.QA.A.SIPK05CB2/XCBR1.OpCnt.stVal	DLR 10kV NX AIR Voltage level1 Bay J06 QA A Circuit breaker 10kV Leistungssch S sp zä	
	30	1	2	255	0	7	DLR 10kV NX AIR.Voltage level1.Bay J06.QA.A.SIPK05CB2/XCBR1.Pos.stSeld	DLR 10kV NX AIR Voltage level1 Bay J06 QA A Circuit breaker 10kV Leistungssch Position	
	31	1	2	255	0	8	DLR 10kV NX AIR.Voltage level1.Bay J06.QA.A.SIPK05CB2/XCBR1.Pos.stVal	DLR 10kV NX AIR Voltage level1 Bay J06 QA A Circuit breaker 10kV Leistungssch Position	
	37	1	2	255	0	9	DLR 10kV NX AIR.Voltage level1.Bay J06.QA.A.SIPK05CB2/XCBR1.SumSwARs.actVal	DLR 10kV NX AIR Voltage level1 Bay J06 QA A Circuit breaker 10kV Leistungssch SI Aus	
	30	1	2	255	0	10	DLR 10kV NX AIR.Voltage level1.Bay J06.QA1.A.SIPK05CB1/XCBR1.BlkCls.stVal	DLR 10kV NX AIR Voltage level1 Bay J06 QA1 A Circuit breaker 110 Leistungssch Block der Einschalt	
	30	1	2	255	0	11	DLR 10kV NX AIR.Voltage level1.Bay J06.QA1.A.SIPK05CB1/XCBR1.BlkOpn.stVal	DLR 10kV NX AIR Voltage level1 Bay J06 QA1 A Circuit breaker 110 Leistungssch Block Ausschaltung	
	30	1	2	255	0	12	DLR 10kV NX AIR.Voltage level1.Bay J06.QA1.A.SIPK05CB1/XCBR1.EEHealth.stVal :1 (OK)	DLR 10kV NX AIR Voltage level1 Bay J06 QA1 A Circuit breaker 110 Leistungssch Externe Bereitschaft	
	30	1	2	255	0	13	DLR 10kV NX AIR.Voltage level1.Bay J06.QA1.A.SIPK05CB1/XCBR1.EEHealth.stVal :2 (Warning)	DLR 10kV NX AIR Voltage level1 Bay J06 QA1 A Circuit breaker 110 Leistungssch Externe Bereitschaft	
	30	1	2	255	0	14	DLR 10kV NX AIR.Voltage level1.Bay J06.QA1.A.SIPK05CB1/XCBR1.EEHealth.stVal :3 (Alarm)	DLR 10kV NX AIR Voltage level1 Bay J06 QA1 A Circuit breaker 110 Leistungssch Externe Bereitschaft	
	30	1	2	255	0	15	DLR 10kV NX AIR.Voltage level1.Bay J06.QA1.A.SIPK05CB1/XCBR1.Loc.stVal	DLR 10kV NX AIR Voltage level1 Bay J06 QA1 A Circuit breaker 110 Leistungssch Schalthoheit Vor-Ort	
	35	1	2	255	0	16	DLR 10kV NX AIR.Voltage level1.Bay J06.QA1.A.SIPK05CB1/XCBR1.OpCnt.stVal	DLR 10kV NX AIR Voltage level1 Bay J06 QA1 A Circuit breaker 110 Leistungssch S sp zä	
	30	1	2	255	0	17	DLR 10kV NX AIR.Voltage level1.Bay J06.QA1.A.SIPK05CB1/XCBR1.Pos.stSeld	DLR 10kV NX AIR Voltage level1 Bay J06 QA1 A Circuit breaker 110 Leistungssch Position	
	31	1	2	255	0	18	DLR 10kV NX AIR.Voltage level1.Bay J06.QA1.A.SIPK05CB1/XCBR1.Pos.stVal	DLR 10kV NX AIR Voltage level1 Bay J06 QA1 A Circuit breaker 110 Leistungssch Position	
	37	1	2	255	0	19	DLR 10kV NX AIR.Voltage level1.Bay J06.QA1.A.SIPK05CB1/XCBR1.SumSwARs.actVal	DLR 10kV NX AIR Voltage level1 Bay J06 QA1 A Circuit breaker 110 Leistungssch SI Aus	
	37	1	2	255	0	41	DLR 10kV NX AIR.Voltage level1.Bay J7.QA.A.SIPK04CB1/XCBR1.SumSwARs.actVal	DLR 10kV NX AIR Voltage level1 Bay J7 QA A LS1 Leistungssch SI Aus	
	37	1	2	255	0	65	DLR 10kV NX AIR.Voltage level1.Bay J8.QA.A.SIPK01CB1/XCBR1.SumSwARs.actVal	DLR 10kV NX AIR Voltage level1 Bay J8 QA A LS1 Leistungssch SI Aus	
	37	1	2	255	0	89	DLR 10kV NX AIR.Voltage level1.Bay J9.QA.A.SIPK06CB1/XCBR1.SumSwARs.actVal	DLR 10kV NX AIR Voltage level1 Bay J9 QA A LS1 Leistungssch SI Aus	

[OPUPIx_WEB_03_Routing_Transmit_b, 1, --_--]

13.14.6.4 List(s)

The current data model that is sent to the MindSphere is displayed on the **List(s)** website.

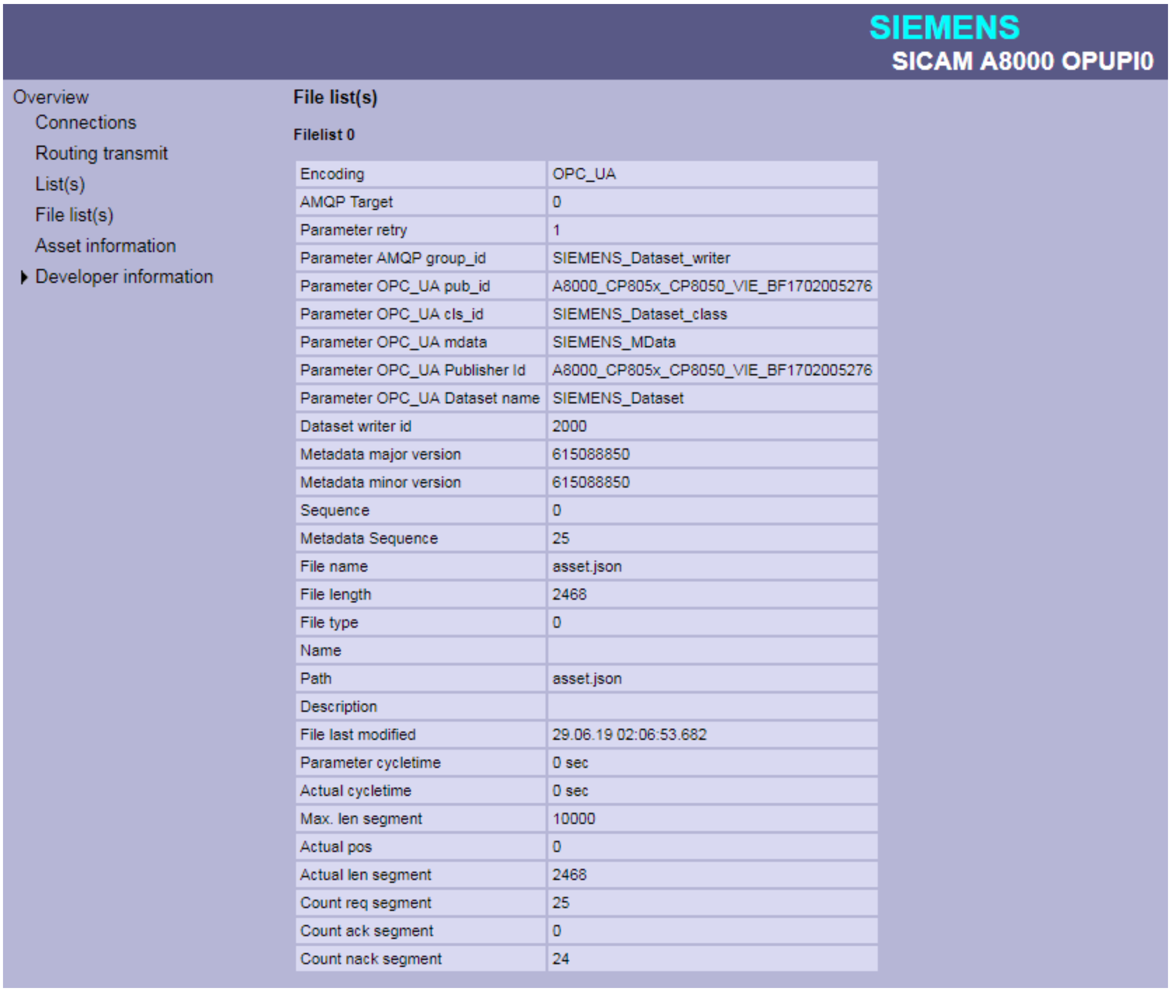


Encoding	OPC_UA
MQTT topic	0
Count	1059
Parameter keep alive counter	60 sec
Parameter keyframe counter	7200 sec
Parameter metaframe counter	7200 sec
Parameter measured value counter	0 sec
Parameter retry	1
Parameter chunk size	12000
Parameter AMQP group_id	SIEMENS_Dataset_writer
Parameter OPC_UA pub_id	A8000_CP805x_CP8050_VIE_BF1702005276
Parameter OPC_UA cls_id	SIEMENS_Dataset_class
Parameter OPC_UA mdata	SIEMENS_MData
Parameter OPC_UA publisher id	A8000_CP805x_CP8050_VIE_BF1702005276
Parameter OPC_UA dataset name	SIEMENS_Dataset
Dataset writer id	1000
Metadata major version	615088841
Metadata minor version	615088841
Data Sequence	0
Metadata Sequence	36
Actual keep alive counter	0 sec
Actual keyframe counter	0 sec
Actual metaframe counter	7199 sec
Actual measured value counter	0 sec
Count req keep alive frames	0
Count req meta frames	18
Count req key frames	0
Count req change frames	0
Count req changes	0
Count ack keep alive frames	0
Count ack meta frames	0
Count ack key frames	0
Count ack change frames	0
Count ack changes	0
Count nack keep alive frames	0
Count nack meta frames	18
Count nack key frames	0
Count nack change frames	0
Count nack changes	0

[OPUPIx_WEB_04_Lists, 1, --_--]

13.14.6.5 File List(s)

The **File List(s)** website provides information about the last file sent (example: Asset information).



SIEMENS
SICAM A8000 OPUPI0

Overview
Connections
Routing transmit
List(s)
File list(s)
Asset information
Developer information

File list(s)

Filelist 0

Encoding	OPC_UA
AMQP Target	0
Parameter retry	1
Parameter AMQP group_id	SIEMENS_Dataset_writer
Parameter OPC_UA pub_id	A8000_CP805x_CP8050_VIE_BF1702005276
Parameter OPC_UA cls_id	SIEMENS_Dataset_class
Parameter OPC_UA mdata	SIEMENS_MData
Parameter OPC_UA Publisher Id	A8000_CP805x_CP8050_VIE_BF1702005276
Parameter OPC_UA Dataset name	SIEMENS_Dataset
Dataset writer id	2000
Metadata major version	615088850
Metadata minor version	615088850
Sequence	0
Metadata Sequence	25
File name	asset.json
File length	2468
File type	0
Name	
Path	asset.json
Description	
File last modified	29.06.19 02:06:53.682
Parameter cycletime	0 sec
Actual cycletime	0 sec
Max. len segment	10000
Actual pos	0
Actual len segment	2468
Count req segment	25
Count ack segment	0
Count nack segment	24

[OPUPIx_WEB_05_File_Lists, 1, --_--]

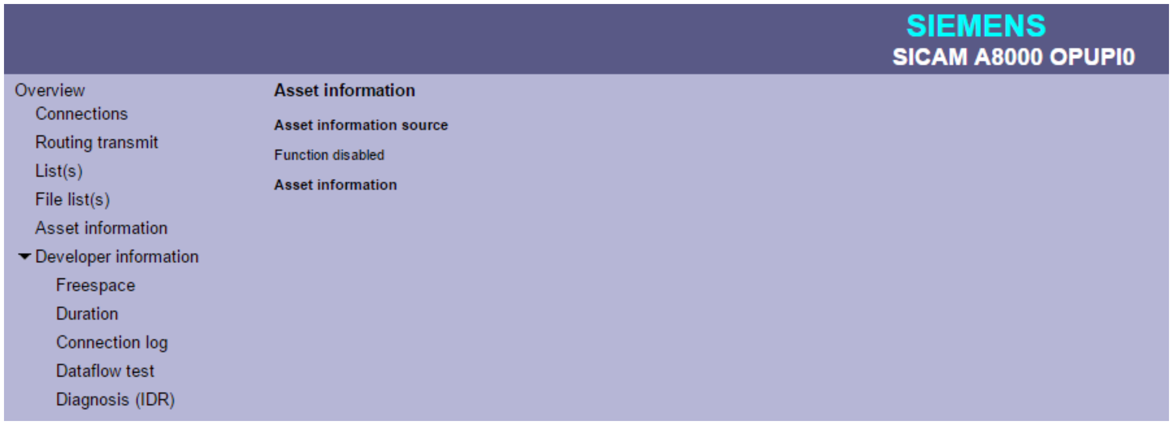
13.14.6.6 Asset Information

The **Asset Information** web page displays information from substations of other protocol elements (example: IEC 61850. The information is exchanged between the protocol firmwares.

NOTE

This function is currently only supported between the protocols **ETI5** and **OPUPI0**.

Field	Note
Asset information source	Asset information source • Function blocked • Information about the protocol element from which the asset information is read (Example: Revision, IP address, ...)
Asset Information	Asset information - provided by another protocol

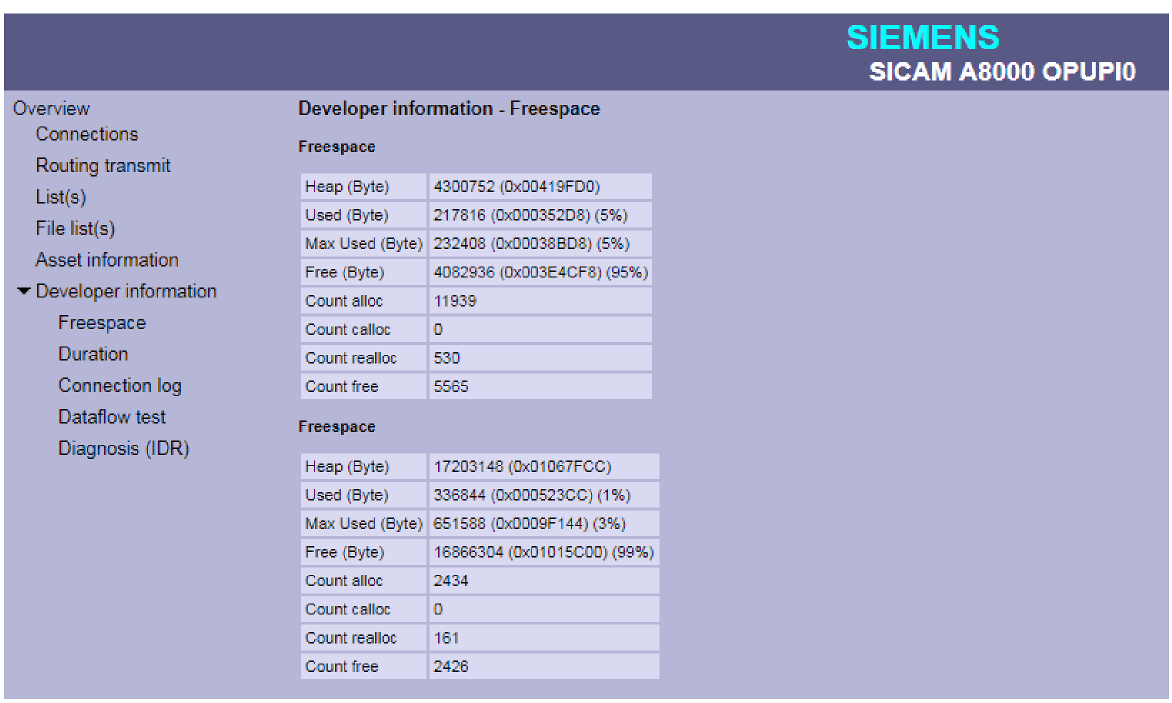


[OPUPIx_WEB_06_Asset_Information, 1, --_--]

13.14.6.7 Developer Information - Freespace

With web page **Developer Information – Freespace** internal information (free memory) of the firmware is displayed.
This information is helpful in the case of error detection and should be sent to support as needed.

Field	Note
Heap (Byte)	Internal information
Used (Byte)	Internal information
Max Used (Byte)	Internal information
Free (Byte)	Internal information
Count alloc	Internal information
Count calloc	Internal information
Count realloc	Internal information
Count free	Internal information

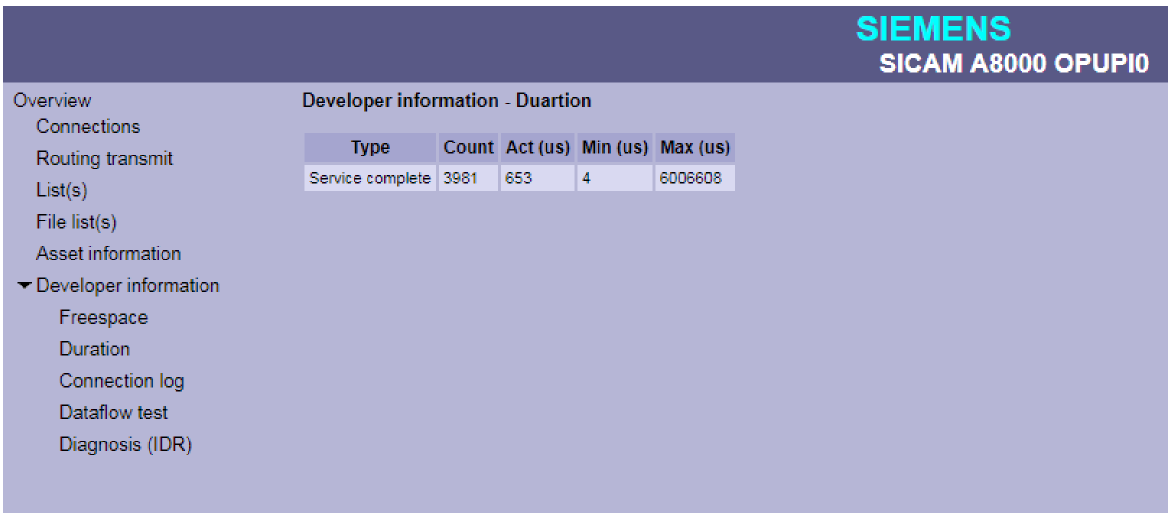


[OPUPIx_WEB_07_Freespace, 1, --_--]

13.14.6.8 Developer Information - Duration

Internal task transfer times are displayed on the **Developer Information - Duration** website.
This information is helpful for the developer in case of problems.

Field	Note
Type	Internal information
Count	Internal information
Act (us)	Internal information
Min (us)	Internal information
Max (us)	Internal information

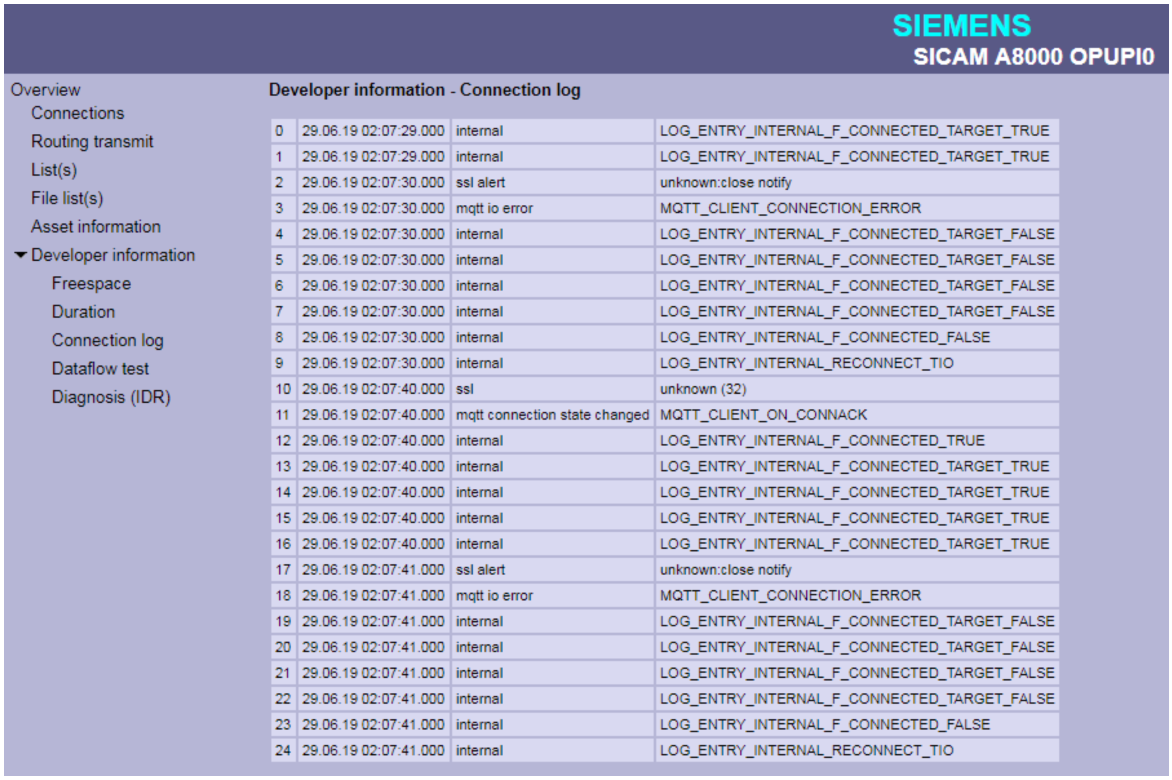


[OPUPIx_WEB_08_Duration, 1, --_--]

13.14.6.9 Developer Information - Connection Log

A chronological list of connection information (connection status) to the broker is displayed on the **Developer Information – Connection log** website.
The connection log list will be deleted on restart or reset. A maximum of 100 entries are saved in the list.

Field	Note
No.	Consecutive number
Time	Time of logging in the log
Error	Type of error
Status	Error state



0	29.06.19 02:07:29.000	internal	LOG_ENTRY_INTERNAL_F_CONNECTED_TARGET_TRUE
1	29.06.19 02:07:29.000	internal	LOG_ENTRY_INTERNAL_F_CONNECTED_TARGET_TRUE
2	29.06.19 02:07:30.000	ssl alert	unknown:close notify
3	29.06.19 02:07:30.000	mqtt io error	MQTT_CLIENT_CONNECTION_ERROR
4	29.06.19 02:07:30.000	internal	LOG_ENTRY_INTERNAL_F_CONNECTED_TARGET_FALSE
5	29.06.19 02:07:30.000	internal	LOG_ENTRY_INTERNAL_F_CONNECTED_TARGET_FALSE
6	29.06.19 02:07:30.000	internal	LOG_ENTRY_INTERNAL_F_CONNECTED_TARGET_FALSE
7	29.06.19 02:07:30.000	internal	LOG_ENTRY_INTERNAL_F_CONNECTED_TARGET_FALSE
8	29.06.19 02:07:30.000	internal	LOG_ENTRY_INTERNAL_F_CONNECTED_FALSE
9	29.06.19 02:07:30.000	internal	LOG_ENTRY_INTERNAL_RECONNECT_TIO
10	29.06.19 02:07:40.000	ssl	unknown (32)
11	29.06.19 02:07:40.000	mqtt connection state changed	MQTT_CLIENT_ON_CONNACK
12	29.06.19 02:07:40.000	internal	LOG_ENTRY_INTERNAL_F_CONNECTED_TRUE
13	29.06.19 02:07:40.000	internal	LOG_ENTRY_INTERNAL_F_CONNECTED_TARGET_TRUE
14	29.06.19 02:07:40.000	internal	LOG_ENTRY_INTERNAL_F_CONNECTED_TARGET_TRUE
15	29.06.19 02:07:40.000	internal	LOG_ENTRY_INTERNAL_F_CONNECTED_TARGET_TRUE
16	29.06.19 02:07:40.000	internal	LOG_ENTRY_INTERNAL_F_CONNECTED_TARGET_TRUE
17	29.06.19 02:07:41.000	ssl alert	unknown:close notify
18	29.06.19 02:07:41.000	mqtt io error	MQTT_CLIENT_CONNECTION_ERROR
19	29.06.19 02:07:41.000	internal	LOG_ENTRY_INTERNAL_F_CONNECTED_TARGET_FALSE
20	29.06.19 02:07:41.000	internal	LOG_ENTRY_INTERNAL_F_CONNECTED_TARGET_FALSE
21	29.06.19 02:07:41.000	internal	LOG_ENTRY_INTERNAL_F_CONNECTED_TARGET_FALSE
22	29.06.19 02:07:41.000	internal	LOG_ENTRY_INTERNAL_F_CONNECTED_TARGET_FALSE
23	29.06.19 02:07:41.000	internal	LOG_ENTRY_INTERNAL_F_CONNECTED_FALSE
24	29.06.19 02:07:41.000	internal	LOG_ENTRY_INTERNAL_RECONNECT_TIO

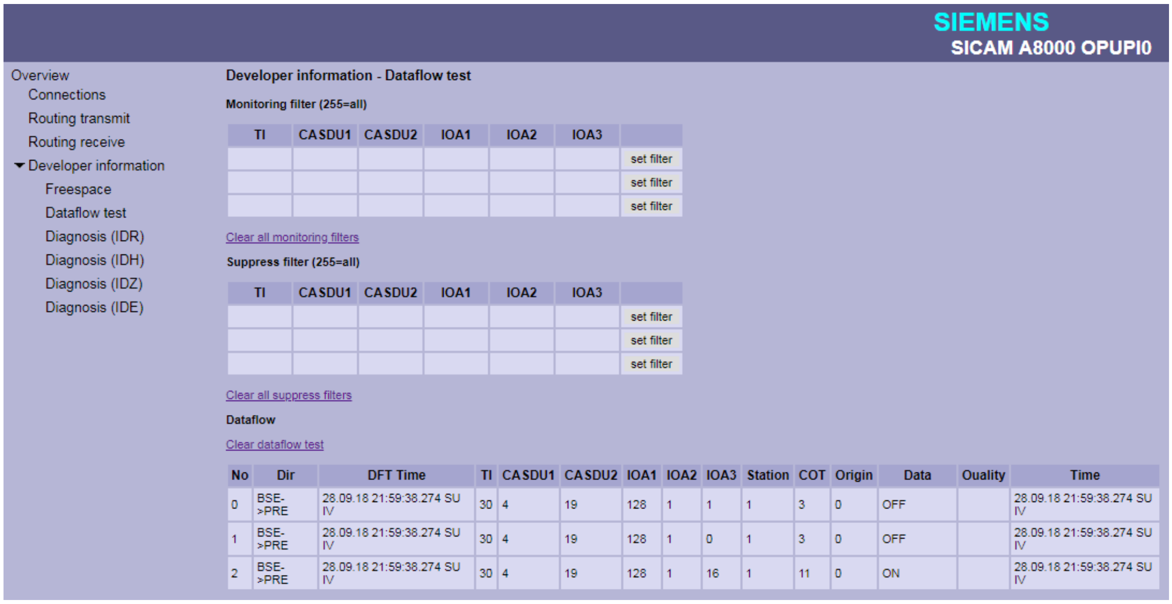
[OPUPIx_WEB_09_Connection_Log, 1, --_--]

13.14.6.10 Developer Information – Dataflow Test

With web page **Developer Information – Dataflow Test**, messages transmitted via internal interface between PRE and BSE will be displayed.

The last 200 messages transmitted from PRE <-> BSE will be displayed..

Field	Note
No.	Message number
Dir	Direction (Dir = Direction) • PRE → BSE: Received data • BSE → PRE: Transmitted data
DFT Time	Logging time
TI	IEC 60870-5-101/104 Type identification (SICAM A8000 internal)
CASDU1, CASDU2 IOA1, IOA2, IOA3	IEC 60870-5-101/104 Address of data point (SICAM A8000 internal)
Station	Station number of the connection (SICAM A8000 internal)
COT	IEC 60870-5-101/104 Cause of transmission (SICAM A8000 internal) (COT = Cause Of Transmission)
Origin	IEC 60870-5-101/104 Originator address (SICAM A8000 internal) (origin = Originator)
Data	IEC 60870-5-101/104 State of data point (SICAM A8000 internal)
Quality	IEC 60870-5-101/104 Quality descriptor of data point (SICAM A8000 internal)
Time	Time in logged message



[OPUPIx_WEB_10_dataflow_test, 1, --_--]

Message filter for simultaneous logging (“Monitoring Filter”)

With filter enabled, only messages will be logged which are selected by filter. If no filter is selected all messages will be logged.

With the value 255 this field is set to “Wildcard”, which means that all messages with this field (0 to 255) are also logged.

The filter will be activated by **set filter**.

The filters will be cleared with Clear all monitoring filters.

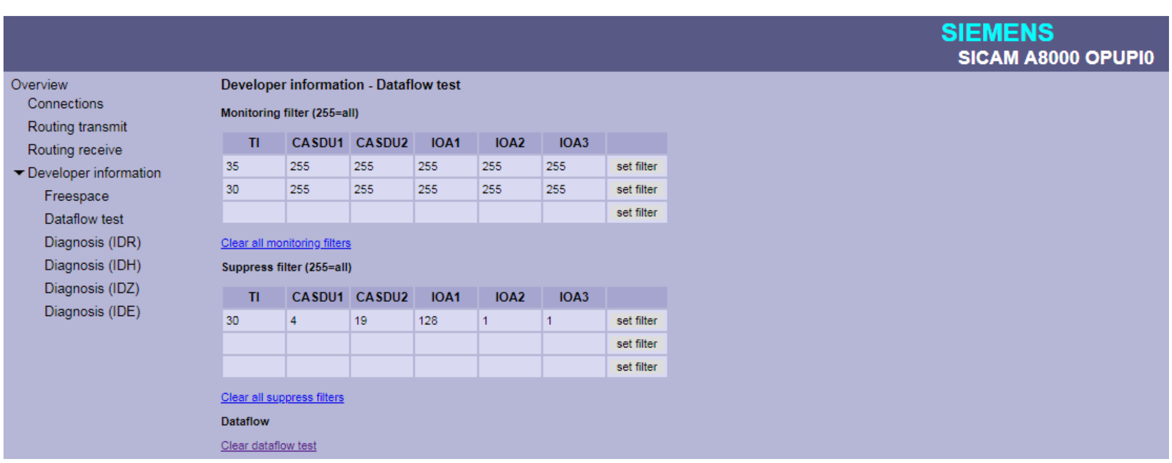
Message filter for simultaneous logging (“Suppress Filter”)

If a filter is selected, the messages selected by the filter are not logged (suppressed). If no filter is selected all messages will be logged.

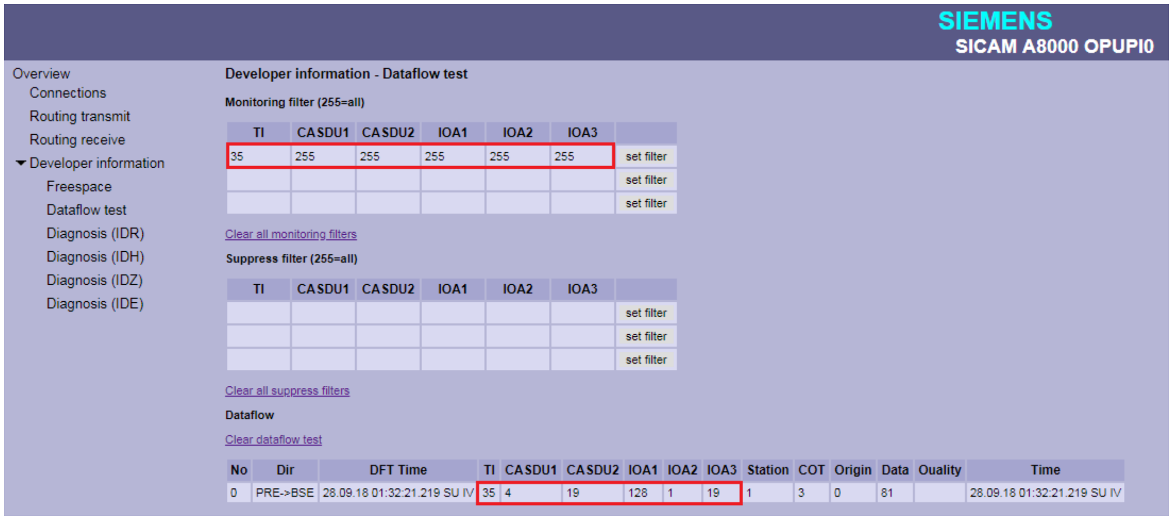
With the value 255 this field is set to “Wildcard”, which means that all messages with this field (0 to 255) are suppressed.

The filter will be activated by **set filter**.

The filters will be cleared with Clear all suppress filters.



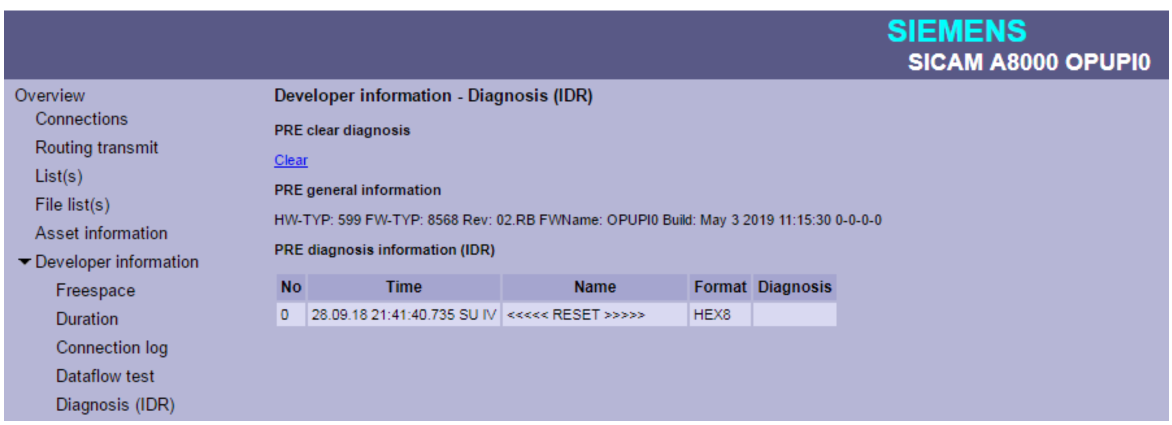
[OPUPIx_WEB_10_dataflow_test_filter_settings, 1, --_--]



[OPUPIx_WEB_10_dataflow_test_filter_red, 1, --_--]

13.14.6.11 Developer Information – Diagnosis (IDR)

With web page **Developer Information - Diagnosis (IDR)** internal diagnosis information of protocol elements (PRE) will be displayed.



[OPUPIx_WEB_11_IDR, 1, --_--]

Deletion of the IDR-diagnostic information on PRE ("PRE clear diagnosis")

The IDR diagnostic information on the PRE can be deleted under **PRE clear diagnostiocs** with Clear.

General information of PRE firmware ("PRE general Information")

Field	Note
HW-TYP	Hardware type of PRE firmware
FW-TYP	Firmware type of PRE firmware
Rev	Revision of PRE firmware
FWName	Name of PRE firmware
Build	State of generation of the PRE firmware

IDR diagnostic information of the PRE firmware ("PRE diagnosis information (IDR)")

Field	Note
No	Consecutive number
Time	Date + time of IDR logging

Field	Note
Name	Diagnosis text
Format	Format of diagnosis information in next column • CHAR, HEX8, HEX16, HEX32, DEC8, DEC16, DEC32, FLOAT32
Diagnosis	Detail information for IDR diagnosis

13.14.7 Message Conversion

Data in transmit direction are transferred from the basic system element to the protocol element in SICAM A8000 internal IEC 60870-5-101/104 (without 101/104 blocking) format. The conversion of the data formats IEC 60870-5-101/104 ↔ IOT is performed by the protocol element. The transmission of the data to the IOT cloud is controlled by the protocol element.

Data in the receive direction are not supported by the protocol element!

The conversion of the SICAM A8000 internal IEC 60870-5-101/104 message format → IOT data format and the conversion of the address information are called message conversion.

The parameterization of the conversion from IEC 60870-5-101/104 ↔ IOT (address and message format) is to be done with SICAM Device Manager with function “Signals” or SICAM TOOLBOX II, OPM II using “SIP Message Address Conversion”.

Supported processing types for message conversion:

Data	Direction	Processing type	OPUPI0	OPUPI1
Binary information	Transmit direction	firmware/**Send**	✓	✓
Measured values	Transmit direction	firmware/**Send**	✓	✓
Integrated Totals	Transmit direction	firmware/**Send**	✓	✓

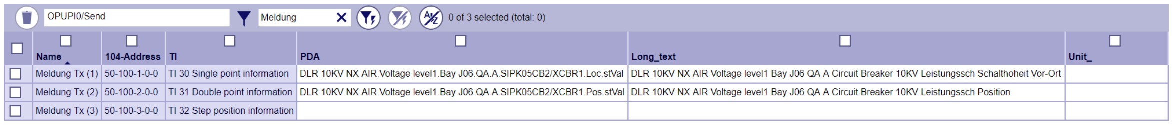
13.14.7.1 Message Conversion in Transmit Direction (SICAM A8000 → IOT)

SICAM A8000: IEC 60870-5-101/104 →		IOT
TI	**Designation**	**Designation**
<TI:=30>	Single-point information with time tag CP56Time2a	SPSValue
<TI:=31>	Double-point information with time tag CP56Time2a	DPSValue
<TI:=32>	Transformer tap position value CP56Time2a time tag	StepPosValue
<TI:=34>	Measured value, normalized value with time tag CP56Time2a	MeasuredValue
<TI:=35>	Measured value, scaled value with time tag CP56Time2a	MeasuredValue
<TI:=36>	Measured value, short floating-point number with time tag CP56Time2a	MeasuredValue
<TI:=37>	Integrated total with time tag CP56Time2a	CounterValue

Binary Information

The parameterization of the address and message conversion for binary information in transmit direction is to be done with the SICAM Device Manager with the function “Signals” or with the SICAM TOOLBOX II, OPM II.

Processing type: *firmware*/**Send**



OPUPI0/Send | Meldung | 0 of 3 selected (total: 0)

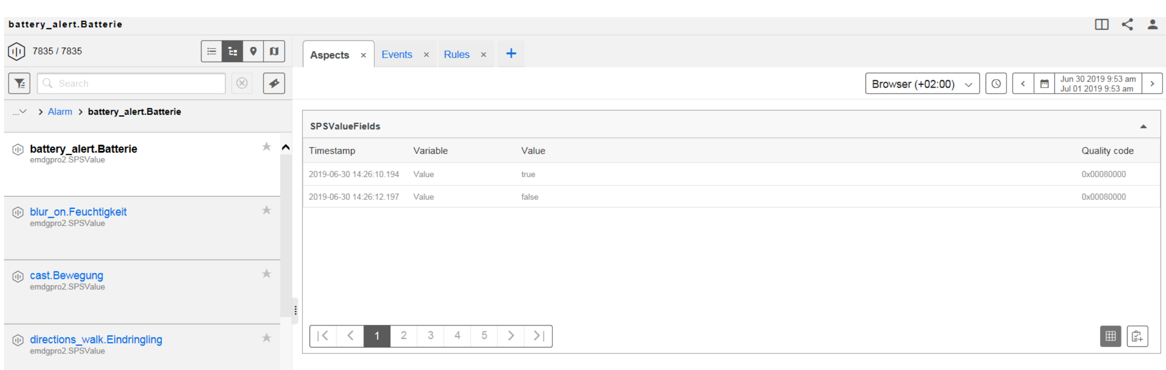
Name	104-Address	TI	PDA	Long_text	Unit_
Meldung Tx (1)	50-100-1-0-0	TI 30 Single point information	DLR 10KV NX AIR.Voltage level1.Bay J06.QA.A.SIPK05CB2/XCBR1.Loc.stVal	DLR 10KV NX AIR Voltage level1 Bay J06 QA A Circuit Breaker 10KV Leistungssch Schalthoheit Vor-Ort	
Meldung Tx (2)	50-100-2-0-0	TI 31 Double point information	DLR 10KV NX AIR.Voltage level1.Bay J06.QA.A.SIPK05CB2/XCBR1.Pos.stVal	DLR 10KV NX AIR Voltage level1 Bay J06 QA A Circuit Breaker 10KV Leistungssch Position	
Meldung Tx (3)	50-100-3-0-0	TI 32 Step position information			

[OPUPI0_DM_Send_Meldung, 1, en_US]

Parameters	
TI	Supported type identifications: • <TI:=30> .. Single-point information with time tag CP56Time2a • <TI:=31> .. Double-point information with time tag CP56Time2a • <TI:=32> .. Step position information with CP56Time2a time tag
Name	Name of the signal
104 address	SICAM A8000 internal IEC 60870-5-101/104 message address (CASDU1, CASDU2, IOA1, IOA2, IOA3)
VTA	Process-technical address of the data point: • Max. 128 characters • Permitted characters: all incl. special characters Example: /Alarm/battery_alert.Battery
Long text	Description of the data point: • Max. 128 characters • Permitted characters: all incl. special characters Example: /Alarm/battery_alert.Battery
Unit_	not used for binary information

Examples for alarms (SPS = SinglePointState) in MindSphere:(possible representation in subscriber):

TI:	30
CASDU1:	1
CASDU2:	2
IOA1:	30
IOA2:	4
IOA3:	5
VTA:	/Alarm/battery_alert.Battery
Long text:	/Alarm/battery_alert.Battery



Message Conversion

The table describes the evaluated elements of the IEC 60870-5-101/104 message during message conversion.

Elements of the message		
TI .. Type identification		• <TI:=30> .. Single-point information with time tag CP56Time2a • <TI:=31> .. Double-point information with time tag CP56Time2a • <TI:=32> .. Step position information with CP56Time2a time tag
CASDU, IOA .. Message address		Parameter-settable
QDS .. Quality descriptor		
BL .. Blocked		Is evaluated and implemented on quality information from PubSub
SB .. Substituted		Is evaluated and implemented on quality information from PubSub
NT .. Not topical		Is evaluated and implemented on quality information from PubSub
IV .. Invalid		Is evaluated and implemented on quality information from PubSub
Cause of transmission		
xx ..		Evaluated
T .. Test		Not evaluated
Information		
Single-point information status		only <TI:=30> Single-point information with time tag CP56Time2a
SPI	0 .. OFF	evaluated
	1 .. ON	Evaluated
Double point information state		Only <TI:=31> Double-point information with time tag CP56Time2a
DPI	0 .. Indeterminate or intermediate state	Evaluated
	1 .. OFF	Evaluated
	2 .. ON	Evaluated
	3 .. Indeterminate state	Evaluated
Step position information		Only <TI:=32> Step position information with time tag CP56Time2a
VTI	Values of the intermediate state information –64 to +63	Evaluated
	Intermediate state <0> Operational equip-ment not in intermediate state <1> Operational equip-ment in intermediate state	Evaluated
Time tag		
CP56Time2a .. Date + time		Evaluated

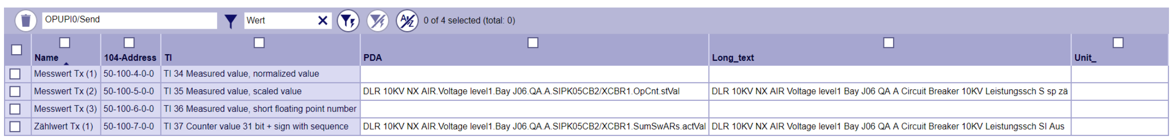
NOTE

Not listed elements of the IEC 60870-5-101/104 message are not rated/not supported.

Measured Values, Integrated Totals

The parameterization of the address and message conversion for measured values in transmit direction is to be done with the SICAM Device Manager with the function “Signals” or with the SICAM TOOLBOX II, OPM II.

Processing type: *firmware*/**Send**



OPUPI0/Send | Wert | 0 of 4 selected (total: 0)

Name	104-Address	TI	PDA	Long_text	Unit_
Messwert Tx (1)	50-100-4-0-0	TI 34 Measured value, normalized value			
Messwert Tx (2)	50-100-5-0-0	TI 35 Measured value, scaled value	DLR 10KV NX AIR.Voltage level1.Bay J06.QA.A.SIPK05CB2/XCBR1.OpCnt.stVal	DLR 10KV NX AIR Voltage level1 Bay J06 QA A Circuit Breaker 10KV Leistungssch S sp zä	
Messwert Tx (3)	50-100-6-0-0	TI 36 Measured value, short floating point number			
Zählwert Tx (1)	50-100-7-0-0	TI 37 Counter value 31 bit + sign with sequence	DLR 10KV NX AIR.Voltage level1.Bay J06.QA.A.SIPK05CB2/XCBR1.SumSwARs.actVal	DLR 10KV NX AIR Voltage level1 Bay J06 QA A Circuit Breaker 10KV Leistungssch SI Aus	

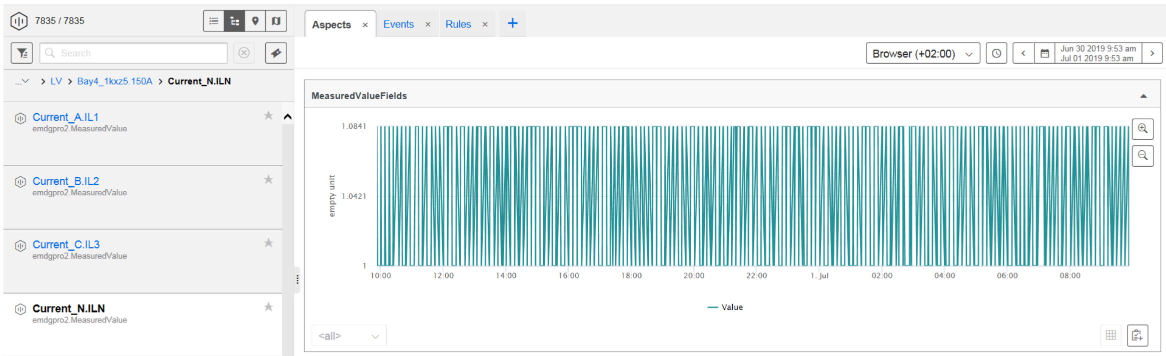
[OPUPI0_DM_Send_Wert, 1, en_US]

Parameters	
TI	Supported type identifications: • <TI:=34> .. Measured value, normalized value with time tag CP56Time2a • <TI:=35> .. Measured value, scaled value with time tag CP56Time2a • <TI:=36> .. Measured value, short floating-point number with time tag CP56Time2a • <TI:=37> .. Integrated total with time tag CP56Time2a
Name	Name of the signal
104 address	SICAM A8000 internal IEC 60870-5-101/104 message address (CASDU1, CASDU2, IOA1, IOA2, IOA3)
VTA	Process-technical address of the data point: • Max. 128 characters • Permitted characters: all incl. special characters Example: P_GEN_1
Long text	Description of the data point: • Max. 128 characters • permitted characters: all incl. special characters Example: Performance Generator 1
Unit_	Description of the data point: • Max. 65 characters • Permitted characters: all incl. special characters Examples: MW, mA, MegaWatt,...

Example for MeasuredValue in MindSphere:(possible representation in subscriber):

TI:	36
CASDU1:	1
CASDU2:	2
IOA1:	3
IOA2:	4
IOA3:	5

VTA: LV/Bay4_1kxz5.150A/Current_N.ILN
Long text: LV/Bay4_1kxz5.150A/Current_N.ILN
Unit:



Message Conversion

The table describes the evaluated elements of the IEC 60870-5-101/104 message during message conversion.

Elements of the message	
TI .. Type identification	• <TI:=34> .. Measured value, normalized value with time tag CP56Time2a • <TI:=35> .. Measured value, scaled value with time tag CP56Time2a • <TI:=36> .. Measured value, short floating-point number with time tag CP56Time2a
CASDU, IOA .. Message address	Parameter-settable
QDS .. Quality descriptor	
BL .. Blocked	Is evaluated and implemented on quality information from PubSub
SB .. Substituted	Is evaluated and implemented on quality information from PubSub
NT .. Not topical	Is evaluated and implemented on quality information from PubSub
IV .. Invalid	Is evaluated and implemented on quality information from PubSub
OV .. Overflow	Is evaluated and implemented on quality information from PubSub
Cause of transmission	
xx .. Other COTs	Evaluated
T .. Test	Not evaluated
Information	
Value.. S .. Sign	• Normalized value • Scaled value • IEEE STD 754 = short floating-point number
Time tag	
CP56Time2a .. Date + time	Evaluated

NOTE

Not listed elements of the IEC 60870-5-101/104 message are not rated/not supported.

Elements of the message	
TI .. Type identification	• <TI:=37> .. Integrated total with time tag CP56Time2a
CASDU, IOA .. Message address	Parameter-settable
Data point quality descriptor	
Sequence number	Not evaluated
CY .. Carry	Not evaluated
CA .. Presets	Not evaluated
IV .. Invalid	Is evaluated and implemented on quality information from PubSub
Cause of transmission	
xx .. Other COTs	Evaluated
T .. Test	Not evaluated
Information	
Value.. S .. Sign	Binary counter reading
Time tag	
CP56Time2a .. Date + time	Evaluated

NOTE

Not listed elements of the IEC 60870-5-101/104 message are not rated/not supported.

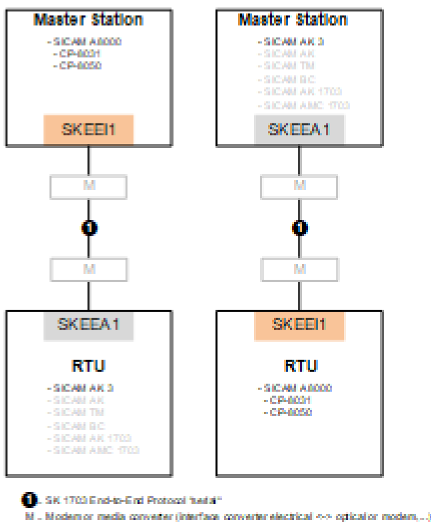
13.15 SAT SK 1703 Point-to-Point

The SAT SK 1703 point-to-point traffic protocol is a proprietary, serial point-to-point transmission protocol for connecting devices from the SAT SK 1703 system family to the CP-8031, CP-8050 with message formats in accordance with “SK 1703 external data block formats” or “SSI-formats”.

Protocol firmware for SAT SK 1703 101 point-to-point traffic:

Firmware	System	Standard and function
SKEEI1	CP-8031, CP-8050	SAT SK 1703 Point-to-Point (PCMBA)

Schematic configuration:



[SKEEI1_config [GER], 1, en_US]

Optional external transmission devices (dedicated line modems, media converters,...) can be used for the connection.

13.15.1 Functions

Function	SKEEI1
SAT SK 1703 Point-to-Point	
Serial communication protocol according to SAT SK 1703 PCMBA point-to-point (based on IEC 60870-5-1)	✓
SICAM A8000 = SAT SK 1703 PCMBA point-to-point (Central station, Substation)	✓
Message formats according to:	
• SAT 1703 external data block formats	✓
• SAT-SSI system integration formats	✓
max. number of supported data points:	
• max. number of SK 1703 binary information messages in transmit direction (1 binary information message = 16 single-point information items or 8 double-point information items or 4 double-point information items with command return information)	200
• maximum number of SK 1703 messages (= binary information and values) in the receive direction	2000

Function	SKEEI1
Network configuration	
Point-to-point configuration	✓
Multiple point-to-point configurations Separate interface for each single point-to-point configuration required!	✓
Data concentrator	✓
Multi-hierarchical configurations (further components can be connected to substations)	✓
Physical interface	
direct link interface (RS-232)	✓
RS-422	✓
CP-8031, CP-8050: X4 (RS-422); X5 (RS-232)	✓
CI-8551 [387]: X1, X2 (RS-232, RS-422); X3 (RS-422); X4, X5 (RS-232)	✓
Baud rates:	
• 50, 75, 100, 134.5, 150, 200, 300, 600, 1050, 1200, 1800, 2000, 2400, 4800, 9600, 19200	✓
• Different baud rates in transmit-/receive direction	–
Data transmission line (full duplex)	✓
Bit transmission layer / message frame	
Message formats on the line according to IEC 60870-5-1 / FT1.2	✓
Modulation PCM (pulse code modulated - byte asynchronous)	✓
Byte Frame: 11 Bit (8E1)	✓
Message protection d = 4	✓
• Checksum (8 bits)	✓
• Parity Bit (even)	✓
• Transmission rules according to IEC 60870-5-1/FT1.2	✓
Message formats according to SAT SK 1703 external data block formats	
• packed/unpacked	✓
• only page number = 1	✓
• Chaining in transmit direction	–
• Chaining in receive direction	✓
Message formate according to SAT-SSI system integration formats	✓
2-buffer operation in transmit direction	–
2-Buffer operation in receive direction	✓
Message length	1-255 Bytes
SAT SK 1703 Point-to-Point Protocol Functions	
Transmission service according to SAT SK 1703 PCMBA point-to-point protocol	✓
Data transmission spontaneously because of change and general interrogation	✓
Conversion of the SK 1703 data formats↔IEC 60870-5-101/104 Data formats	✓
Message formats on the line:	
• SAT SK 1703 external data block formats (packed/unpacked)	✓
• SAT-SSI system integration formats	✓

387 With CP-8031 not supported by default. With a license (see *14.8 SICAM A8000 CP-803x Extended CI-Module*) 1 communication module CI-8551 can be used additionally also with CP-8031.

Function	SKEEI1
Station Failure Delay	–
Binary information	
Suppression of intermediate and faulty position for double-point information	–
Measured values	
Value adaption (scaling)	✓
Change Monitoring	–
Commands/Setpoint values	
Spontaneous transmission for commands/setpoint values	✓
Regulating Commands (SK 1703)	–
Control location (set control location, check)	✓
Emulation of ACTCON for commands, setpoint values (according IEC 60870-5-101/104)	✓
Emulation of ACTCON- for commands, setpoint values (according IEC 60870-5-101/104), when a command/setpoint value is discarded from an unreleased control location.	✓
Emulation of ACTTERM for commands/setpoint values (according IEC 60870-5-101/104)	–
General interrogation	
SK 1703 General interrogation triggered by IEC 60870-5-101 general interrogation command	✓
Emulation of ACTCON, ACTTERM (according IEC 60870-5-101/104) general interrogation	–
Clock synchronization	
Time setting of the remote station	✓
Time synchronization of the remote station	✓
Time synchronization of the own device in receive direction	–
Correction of the time synchronization (configurable) - with/without delay acquisition	✓
Accuracy	±20 ms
Test Functions	
Cyclic monitoring by interface checking message	✓
Redundancy	
Protocol redundancy:	
• Tristate of RS-232 interface if passive	✓
• Protocol function in redundancy state = "passive" – acknowledged operation (normal operation)	✓
• Listening mode (for station failure handling)	✓
• Listening mode (for data)	✓
Device redundancy:	
• Device redundancy with the same PRE parameters	✓
• Device redundancy with different PRE parameters (“A/B parameters”)	✓
• Device redundancy with different PRE parameters (“A/B parameters”) for signals	✓
Protocol element control and return information	
Protocol element control messages:	
• Set control location	✓

Function	SKEEI1
• Activation/Deactivation of Interface + Protocol	✓
Protocol element return information:	
• Station status	–
• Station failure	–
• Protocol-specific return information 15: Interface + protocol functions “activate/deactivate”	✓
Supported SK 1703 external data block formats in transmit/receive direction	
Non-real-time binary values:	
• DFK=00H: 8-bit binary value and sign	✓
• DFK=10H: 11-bit binary value and sign	✓
• DFK=20H: 15-bit binary value and sign	✓
• DFK=20H: 16-bit binary value	✓
• DFK=30H: 31-bit binary value and sign	✓
• DFK=30H: 32-bit binary value	✓
• DFK=40H: 7-bit binary value and sign	✓
• DFK=40H: 8-bit binary value	✓
• DFK=50H: 23-bit binary value and sign	✓
• DFK=50H: 24-bit binary value	✓
BCD values that aren’t in real time:	
• DFK=01H: 4 decades BCD	✓
• DFK=01H: 3.5 decades BCD + sign	✓
• DFK=01H: Decimal point control message for display output, 4 values	–
• DFK=11H: 8 decades BCD	✓
• DFK=11H: 7.5 decades BCD + sign	✓
• DFK=11H: Decimal point control message for display output	–
• DFK=21H: 2 decades BCD	✓
• DFK=21H: 1.5 decades BCD + sign	✓
• DFK=21H: Transformer tap position value	✓
• DFK=31H: 6 decades BCD	✓
• DFK=31H: 5.5 decades BCD + sign	✓
Bitstrings that aren’t in real time	
• DFK=02H: Bitstring 16-bit	✓
• DFK=12H: Bitstring 32-bit	✓
Binary information items that aren’t in real time	
• DFK=03H: 16 single-point information items	✓
• DFK=03H: 16 error information items	✓
• DFK=13H: 4 double-point information items (MG/MA) with command return information	✓
• DFK=23H: 16 single-point fleeting information items	–
• DFK=33H: 1 binary information item	–
• DFK=43H: 8 double-point information items (MG/MA), status stored	✓
Commands that aren’t in real time	
• DFK=04H: 1 Single command (from a group of 16 commands)	✓
• DFK=14H: 8 status information items in control direction	–
Combination messages that aren’t in real time – binary value + information items:	
• DFK=06H: 8 bit binary value + sign + 4 bit limiting-value information + 2 bit gradient information	–

Function	SKEEI1
• DFK=16H: 11 bit binary value + sign + 4 bit limiting-value information + 2 bit gradient information	–
Transparent data that isn't in real-time:	
• DFK=07H: 16-bit transparent data	✓
• DFK=17H: 32-bit transparent data	✓
Floating-point data that isn't in real time:	
• DFK=08H: 32-bit floating-point value	✓
Computer link formats that aren't in real time	
• DFK=0FH: 32bit binary value + 2 status byte	–
• DFK=1FH: 32bit binary value + 3 status byte	–
• DFK=2FH: 32bit binary value + 4 status byte	–
• DFK=3FH: 2-57 byte data	✓
• DFK=4FH: Data acknowledgment	–
Single objects that aren't in real-time:	
• DFK=09H: 1 single-point information	–
• DFK=09H: 1 error information item	–
• DFK=19H: 1 double-point information item (MG/MA)	–
• DFK=29H: 1 double-point information item (MG/MA) + command return information	–
• DFK=39H: 1 single command	–
Real time binary values:	
• DFK=80H: 8-bit binary value and sign	✓
• DFK=90H: 11-bit binary value and sign	✓
• DFK=A0H: 15-bit binary value and sign	✓
• DFK=A0H: 16-bit binary value	✓
• DFK=B0H: 31-bit binary value and sign	✓
• DFK=B0H: 32-bit binary value	✓
• DFK=C0H: 7-bit binary value and sign	✓
• DFK=C0H: 8-bit binary value	✓
• DFK=D0H: 23-bit binary value and sign	✓
• DFK=D0H: 24-bit binary value	✓
Real time BCD values:	
• DFK=81H: 4 decades BCD	✓
• DFK=81H: 3.5 decades BCD + sign	✓
• DFK=91H: 8 decades BCD	✓
• DFK=91H: 7.5 decades BCD + sign	✓
• DFK=A1H: 2 decades BCD	✓
• DFK=A1H: 1.5 decades BCD + sign	✓
• DFK=A1H: Transformer tap position value	✓
• DFK=B1H: 6 decades BCD	✓
• DFK=B1H: 5.5 decades BCD + sign	✓
Real-time bitstrings:	
• DFK=82H: Bitstring 16-bit	✓
• DFK=92H: Bitstring 32-bit	✓
Real-time information items:	
• DFK=83H: 16 single-point information items (GI format)	–
• DFK=83H: 8 double-point information items (Z/D) (GI format)	–

Function	SKEEI1
• DFK=83H: 4 double-point information items (Z/D) with command return information (GI format)	–
• DFK=83H: 16 single-point information items	✓
• DFK=83H: 16 error information items	✓
• DFK=83H: 8 double-point information items (Z/D)	✓
• DFK=83H: 8 double-point information items (MG/MA)	✓
• DFK=83H: 4 binary information items (Z/D) with command return information	✓
• DFK=83H: 4 binary information items (MG/MA) with command return information	✓
• DFK=B3H: 1 single-point information item (spontaneous format)	–
• DFK=B3H: 1 double-point information item (Z/D) (spontaneous format)	–
• DFK=B3H: 1 double-point information item (Z/D) with command return information (spontaneous format)	–
• DFK=E3H: 16 single-point information items (1 ms)	✓
• DFK=E3H: 8 double-point information items (Z/D) (1 ms)	✓
• DFK=E3H: 4 binary information items (Z/D) with command return informations (1 ms)	✓
Real-time commands:	
• DFK=84H: 1 single command	✓
• DFK=A4H: 1 single command (1 ms)	✓
Real-time combination messages – binary values + information items:	
• DFK=86H: 8 bit binary value + sign + 4 bit limiting-value information + 2 bit gradient information	–
• DFK=96H: 11 bit binary value + sign + 4 bit limiting-value information + 2 bit gradient information	–
Real-time transparent data:	
• DFK=87H: 16-bit transparent data	✓
• DFK=97H: 32-bit transparent data	✓
• DFK=A7H: 16-bit transparent data (1 ms)	✓
Real-time floating-point data:	
• DFK=88H: 32-bit floating-point value	✓
Real-time computer link formats:	
• DFK=8FH: 32bit binary value + 2 status byte	–
• DFK=9FH: 32bit binary value + 3 status byte	–
• DFK=AFH: 32bit binary value + 4 status byte	–
Real-time single objects:	
• DFK=89H: 1 single-point information item (1 ms)	–
• DFK=89H: 1 error information item (1 ms)	–
• DFK=99H: 1 double-point information item (Z/D) (1 ms)	–
• DFK=A9H: 1 double-point information items (Z/D) (1 ms) + command return information (1 ms)	–
• DFK=B9H: 1 single command (1 ms)	–
Real-time system messages:	
• DFK=B3H: Time setting acknowledgment control message	–
• DFK=B3H: Time setting acknowledgment data message	–
• DFK=B3H: Time change message	–
• DFK=B3H: Period message	–
System messages:	
• DFK=05H: System message - Interface testing message	✓
• DFK=05H: System message - Error message between 2 adjacent components	✓

Function	SKEEI1
• DFK=05H: System message - Error interrogation message[388]	✓
• DFK=05H: System message - Answer to error interrogation message[388]	✓
• DFK=05H: System message - GI request message	✓
• DFK=05H: System message - Information refresh request	–
• DFK=05H: System message - Time setting message [389]	✓
• DFK=05H: System message - Interrogation message for time and date [390]	✓
• DFK=05H: System message - Response message for time [391] [389]	✓
• DFK=05H: System message - Response message for date[391] [389]	✓
• DFK=05H: System message - Counter interrogation message	✓
• DFK=05H: System message -- Error interrogation table acknowledgment[388]	✓
• DFK=05H: System message - Error message between non-adjacent components	✓
• DFK=05H: System message - message “Component X failure” [390]	✓
• DFK=05H: System message - Remote reset[388]	✓
• DFK=05H: System message - Read interrogation message memory	–
• DFK=05H: System message - Read response message memory	–
• DFK=05H: System message - Periphery control message	–
Down line loading messages: [388]	
• DFK=15H: Down line loading message - Start	✓
• DFK=15H: Down line loading message - End	✓
• DFK=15H: Down line loading message - E (Enable)	✓
• DFK=15H: Down line loading message - G (Go or Select)	✓
• DFK=15H: Down line loading message - WPI (Write Parameter intern)	✓
• DFK=15H: Down line loading message - WPE (Write Parameter external)	✓
• DFK=15H: Down line loading message - WP (Write Parameter)	✓
• DFK=15H: Down line loading message - DP (Display Parameter)	✓
• DFK=15H: Down line loading message - Y (re triggering session time)	✓
• DFK=15H: Down line loading message - Response message DATA	✓
• DFK=15H: Down line loading message - Response message END	✓
• DFK=15H: Down line loading message - Service container for Ax service response	–
• DFK=15H: Down line loading message - Service container for Ax service command	–
Supported SSI formats in transmit/receive direction	
Priority controlled data:	
• DF = 01: Digital value unsigned 32 Bit	✓
• DF = 02: Digital value signed 32 Bit	✓
• DF = 03: Transformer tap position value	✓
• DF = 04: Floatingpoint	✓
• DF = 05: Combination message	–
• DF = 06: Computer link format	–
• DF = 07: String	✓
• DF = 08: Transparent Data	✓
• DF = 09: 16 single-point information items	✓

388 only for remote maintenance of SK 1703
389 only in transmit direction
390 only in transmit direction
391 is only sent in response to “Interrogation message for time and date”

Function	SKEEI1
• DF = 10: 8 double-point information items	✓
• DF = 11: 4 double-point information items with BRM	✓
• DF = 12: 1 single data point message	–
• DF = 13: Command	✓
• DF = 16: 32 binary informations	–
• DF = 17: 1 single-point information	–
• DF = 18: 1 double-point information	–
• DF = 19: 1 double-point information with command return information	–
• DF = 20: 1 single command	–
Chronological data:	
• DF = 101: Digital value unsigned 32 bit with time	✓
• DF = 102: Digital value signed 32 bit with time	✓
• DF = 103: Transformer tap position value with time	✓
• DF = 104: Floatingpoint with time	✓
• DF = 105: Combination message with time	–
• DF = 106: Computer link format with time	–
• DF = 107: String with time	–
• DF = 108: Transparent data with time	✓
• DF = 109: 16 Single-point information with time	✓
• DF = 110: 8 double-point information items with time	✓
• DF = 111: 4 double-point information items with BRM with time	✓
• DF = 112: 1 single data point message with time	–
• DF = 113: Command with time	✓
• DF = 116: 32 binary informations with time	–
• DF = 117: 1 single-point information with time	–
• DF = 118: 1 double-point information item with time	–
• DF = 119: 1 double-point information item with Command return information with time	–
• DF = 120: 1 single command with time	–
Sort system messages:	
• DF = 100.00: Time setting acknowledgment control message	–
• DF = 100.01: Time setting acknowledgment data message	–
• DF = 100.02: Time change message	–
• DF = 100.03: Time section message	–
• DF = 100.04: Overtime section message	–
Remote parameterization message:	
• DF = 14.00: DLL-START	✓[388]
• DF = 14.01: DLL-ENDE	✓[388]
• DF = 14.02: DLL-Enable	✓[388]
• DF = 14.03: DLL-Go or Select	✓[388]
• DF = 14.04: DLL-Write Parameter Internal	✓[388]
• DF = 14.05: DLL-Write Parameter external	✓[388]
• DF = 14.06: DLL-Write Parameter	✓[388]
• DF = 14.07: DLL-Display parameter	✓[388]
• DF = 14.08: DLL- re trigger session time	✓[388]
• DF = 14.09: DLL-response message data	✓[388]
• DF = 14.10: DLL-response message end	✓[388]

Function	SKEEI1
• DF = 14.11: DLL-service container for Ax-service answer	–
• DF = 14.12: DLL-service container for Ax-service command	–
Service computer messages:	
• DF = 15: SR command message	–
System messages:	
• DF = 00.00: Interface testing message	✓
• DF = 00.01: Error message between 2 adjacent components	✓
• DF = 00.02: Error interrogation message	✓[388]
• DF = 00.03: Response to error interrogation message	✓[388]
• DF = 00.04: Error interrogation table acknowledgment	✓[388]
• DF = 00.05: Error message between non-adjacent components	✓
• DF = 00.06: Component X Failure	✓[390]
• DF = 00.07: GI request message	✓
• DF = 00.08: Information refresh request	–
• DF = 00.09: Time setting (SAT 1703)	✓[389]
• DF = 00.10: Interrogation message for time and date	✓[390]
• DF = 00.11: Answer message for time and ank. So/Wi	✓[389]
• DF = 00.12: Response message for date	✓[389]
• DF = 00.13: Counter Interrogation	✓
• DF = 00.14: Remote reset	✓[388]
• DF = 00.15: Periphery control message	–
Supported IEC60870-5-101/104 message formats in transmit direction (command or control direction)	
TI 30 .. Single-point information with time tag CP56Time2a	✓
TI 31 .. Double-point information with time tag CP56Time2a	✓
TI 32 .. Step position information with CP56Time2a time tag	✓
TI 33 .. Bitstring of 32 bits with time tag CP56Time2a	✓
TI 34 .. Measured value, normalized value with time tag CP56Time2a	✓
TI 35 .. Measured value, scaled value with time tag CP56Time2a	✓
TI 36 .. Measured value, short floating-point number with time tag CP56Time2a	✓
TI 37 .. Integrated total with time tag CP56Time2a	✓
TI 45 .. Single command	✓
TI 46 .. Double command	✓
TI 47 .. Regulating step command	✓
TI 48 .. Setpoint command, normalized value	✓
TI 49 .. Setpoint command, scaled value	✓
TI 50 .. Setpoint command, short floating-point number	✓
TI 51 .. Bitstring of 32-bit	✓
TI 100 .. (Station-) interrogation command (General interrogation command)	✓
TI 101 .. Counter interrogation command	✓
TI 103 .. Clock Synchronization Command	✓
Supported IEC 60870-5-101/104 message formats in receive direction (signaling or monitoring direction)	
TI 30 .. Single-point information with time tag CP56Time2a	✓
TI 31 .. Double-point information with time tag CP56Time2a	✓
TI 32 .. Step position information with CP56Time2a time tag	✓

Function	SKEEI1
TI 33 .. Bitstring of 32 bits with time tag CP56Time2a	✓
TI 34 .. Measured value, normalized value with time tag CP56Time2a	✓
TI 35 .. Measured value, scaled value with time tag CP56Time2a	✓
TI 36 .. Measured value, short floating-point number with time tag CP56Time2a	✓
TI 37 .. Integrated total with time tag CP56Time2a	✓
TI 45 .. Single command	✓
TI 46 .. Double command	✓
TI 47 .. Regulating step command	✓
TI 48 .. Setpoint command, normalized value	✓
TI 49 .. Setpoint command, scaled value	✓
TI 50 .. Setpoint command, short floating-point number	✓
TI 51 .. Bitstring of 32-bit	✓
TI 100 .. (Station-) interrogation command (General interrogation command)	✓
TI 101 .. Counter interrogation command	✓
TI 103 .. Clock Synchronization Command	✓
TI 142 .. User data container	✓
TI 143 .. Real-time system information	–
Web server	
Protocol-internal diagnostic and statistic information via protocol-specific web pages	✓
Engineering	
SICAM Device Manager	✓
SICAM TOOLBOX II	✓
Remote maintenance of SK 1703 systems with SICAM TOOLBOX II	✓

Restrictions

- no different baud rates in transmit- and receive direction possible
- no Chaining in transmit direction
- no 2-buffer operation in transmit direction
- number of records=1 for external data block formats (number of records > 1 is not supported)
- no message filter in transmit/receive direction
- no 2 data streams (NEZ and EZ)
- no real-time concept for SK 1703 (ZA, ZSA,...)
- no time period message emulation in receive direction
- no measured value change monitoring
- no “load share operation”
- no remote maintenance of systems of the product family Ax 1703 and ACP 1703
- no regulating commands
- no emulation of IEC 60870-5-101/104 SELECT/EXECUTE for commands, setpoint values
- restricted emulation of IEC 60870-5-101/104 SELECT/EXECUTE for commands, setpoint values
- no emulation of IEC 60870-5-101/104 ACTTERM for commands, setpoint values

- no emulation of IEC 60870-5-101/104 ACTCON, ACTTERM for general interrogation
- The command return informations “Breaker tripping” and “Switching operation in progress” is not converted in transmit direction.
- No conversion of BCD values (SK 1703) or floating-point values (SK 1703>) to normalized values (<TI:=34> or <TI:=48>) or vice versa
- only selected IEC 60870-5-101/104 message formats are supported
- only selected SK 1703 external data formats are supported
- only selected SSI system integration formats are supported
- only selected system messages are supported

NOTE

For the coupling of substations with the SAT SK 1703 point-to-point protocol, the restricted functionality in CP-8031/50 must be observed!

13.15.2 Modes of Operation

The operating mode of the interface is determined by parameters of the protocol element and optional equipment.

Standard operating mode	Interface → optional DCE	Interface signals (X1-X5)
Unbalanced interchange circuit (V.24/V.28) RS-232 asynchronous	CP-8031,CP-8050: X5 CI-8551 [392]: X1, X2, X4, X5	RXD, TXD, CTS[393], RTS, DCD, DTR, DSR/VCC, GND
Balanced interface (V.11) RS-422 (4 wire) asynchronous	CP-8031,CP-8050: X4 CI-8551 [392]: X1, X2, X3	RS-422 (4-wire): TXD+, TXD-, RXD+, RXD-, GND

NOTE

The serial interface X5 of the CP-8031, CP-8050 can optionally be used by the SICAM TOOLBOX II for engineering.
In order to use the serial interface with the CTS signal by the communication protocol, the serial engineering interface must be disabled with the parameter **`[BSE] System settings | Serial interfaces | Serial engineering interface`**.

13.15.3 Communication

For the stations to communicate with each other, suitable transmission facilities and/or network components may be needed in addition.

Own station

System	Master module	Protocol element	Remarks
SICAM A8000 Series	CP-8031/CPCI85 CP-8050/CPCI85 CP-8050/EPCI85	SKEEI1	

392 With CP-8031 not supported by default. With a license (see *14.8 SICAM A8000 CP-803x Extended CI-Module*) 1 communication module CI-8551 can be used additionally also with CP-8031.
393 Not usable (reserved for SICAM TOOLBOX II)

Remote station

System	Master module	Protocol element	Remarks
SICAM AK 3	CP-2016/CPCX26 CP-2019/PCCX26	SM-2551/SKEEA1 SM-0551/SKEEA1	
Legacy systems:			
SICAM AK AK 1703 ACP	CP-2010/MC25 CP-2012/PCCE25 CP-2017/PCCX25	SM-2551/SKEEA1 SM-0551/SKEEA1	
SICAM BC BC 1703 ACP	CP-5000/CPC55 CP-5014/CPCX55	SM-2551/SKEEA1 SM-0551/ SKEEA1	
SICAM TM TM 1703 ACP	CP-4003/CCP4x CP-6003/CPC65 CP-6014/CPCX65	SM-2551/ SKEEA1 SM-0551/ SKEEA1	
AK 1703	CP-2000/MC00 CP-2002/PCCE00 CP-2002/CE00 CP-2012/CE20	SM-2551/ SKEEA1 SM-0551/ SKEEA1 SM-2541/SKEE10 SM-2541/SKEE11	
AMC 1703	CP-4000/CPC4x	SM-2551/SKEEA1 SM-0551/SKEEA1 SM-2540/PCBE10 SM-2541/SKEE10 SM-2541/SKEE11	
SK 1703 KSK 1703	KR-ISIO2/KE02 (KEF) KR-ISIO2/KEMZ15 (KEMK)	SIP-SA/PCBE00 SIP-SA/PCBU00	
SK 1703 KSK 1703	CP-2001/KE4S20 CP-2001/KE4S01	SM-2540/PCBE10 SM-2540/PCBU10 SM-2541/SKEE10	
MK 1703	MK-CU/MKPExx MK-CU/MKPNxx MK-SI	MKCBE0	
Third-party systems:			
Third-party system	–	–	according to SK 1703 PCMBA Point-to-Point

13.15.4 Control and Return Information of Protocol Elements

13.15.4.1 Protocol Element Control Messages

Protocol element control messages can control protocol element internal functions. On the basic system element, IEC 60870-5-101/104 *messages with process information in the control direction* are converted to protocol element control messages and transmitted to the selected protocol element (see *13.1.4.10 Protocol Element Control Messages*).

Supported Protocol Element Control Messages

SF	Protocol element control message `Control_function_(PRE)`	SKEEI1
20	"Deactivate" Interface + Protocol function	✓
21	"Activate" Interface + Protocol function	✓

SF	Protocol element control message `Control_function_(PRE)`	SKEEI1
240	Send (General)-interrogation command (CASDU=All)	✓
241	(General) Interrogation command to GI group	✓
242	Setting control location	–
243	Reset command	–
244	Send (General)-interrogation command (CASDU = selective)	✓

13.15.4.2 Protocol Element Return Information

Protocol element return information is internal status information of the protocol elements which is transmitted spontaneously and in the event of a general interrogation with internal message formats from the protocol element to the basic system element. On the basic system element, the protocol element return information items (see *13.1.4.11 Protocol Element Return Information*) are converted to IEC 60870-5-101/104 *messages with process information in the monitoring direction*.

Supported Protocol Element Return Information

Protocol element return information `Return_information_function_(PRE)`	Station	SKEEI1
Station status	255	–
Station failure	255	✓
Protocol-specific return information 15: • Interface + protocol functions “activate/deactivate”: Return information for PRE control message interface + protocol function “activate/deactivate” <0> = interface “activated” <1> = interface “deactivated”	255	✓

13.15.5 Parameters and Properties

Parameter name	Description	Settings
`[PRE] Interface parameter` Note: • The serial interface for the protocol is selected in the SICAM Device Manager under Configuration | Firmware(refer to *13.1.4.5 Selection of a serial interface for communication protocols*). • some parameters may only be displayed after selecting the interface or only with “Show all parameters”.		
`Baud rate`	Transmission rate in send and receive direction.	Permitted range = 50, 75, 100, 134.5, 150, 200, 300, 600, 1050, 1200, 1800, 2000, 2400, 4800, 9600, 19200, 38400, 56000, 57600, 64000 Bit/s Default setting = 9600
`[PRE] SK 1703 | Common settings`		
`Protocol format`	Protocol format on the line: PCMBA-EE: SAT 1703 external data block formats PCMBA-SSI: SAT-SSI system integration formats	Permitted range = PCMBA-EE PCMBA-SSI Default setting = PCMBA-EE

Parameter name	Description	Settings
Region number of the remote station	Region number of the remote station.	Permitted range = 0 to 255 Default setting = 255
Comp-nr of the remote station	Component number of the remote station	Permitted range = 0 to 255 Default setting = 255
Target region number for SSI	Target region number for system messages in transmission direction (only for protocol format = PCMBA-SSI).	Permitted range = 0 to 255 Default setting = 255
Comp nr. for SSI messages in the receive direction	Component number for SSI messages in the receive direction.	Permitted range = • Received comp nr. • Comp-nr of the remote station • Default setting = Received comp nr.
Traffic management	Data transmission on the line acknowledged/unacknowledged (regardless of the redundancy).	Permitted range = • acknowledged • unacknowledged Default setting = acknowledged
[PRE] SK 1703 | Common settings| Assignment DA->DFK		
Assignment DA -> DFK	The data format identifier (DFK) used must be set for each SK 1703 data type (DA 0 to 30).	Permitted range, Default setting = refer to SICAM Device Manager
[PRE] SK 1703 | Message Structure		
Comp-nr. in transmit direction	Component number contained in messages in transmit direction (only for protocol format = PCMBA-EE).	Permitted range = • yes • no Default setting = yes
Comp-nr. in receive direction	Component number contained in messages in receive direction (only for protocol format = PCMBA-EE).	Permitted range = • yes • no Default setting = yes
Packing	Packing of messages in transmit-/receive direction (only for protocol format = PCMBA-EE).	Permitted range = • yes • no Default setting = yes
[PRE] SK 1703 | Time settings, retries | Monitoring times		
Expected acknowledgment time correction	The expected acknowledgment time is determined automatically. Signal propagation delays and further delay times must be considered in the correction factor for the expected acknowledgment time.	Permitted range = 0 to 655.35 s Default setting = 0.02 s
Idle monitoring time	After transmission disturbances or message interruption the idle state is monitored. After expiry of the monitoring time the receiver is resynchronized.	Permitted range = 0 to 32767 bits Default setting = 33 bits

Parameter name	Description	Settings
`Character monitoring time`	Message gap monitoring: Maximum possible gap between successive bytes of a message. Idle monitoring time is started after detection of message interruption.	Permitted range = 0 to 32767 bits Default setting = 22 bits
`[PRE] SK 1703 | Time settings, retries | Time settings`		
`Idle-time of message`	Pause (idle time in bits) before sending a message in the event of a communication failure or in unacknowledged operation.	Permitted range = 0 to 4000 bits Default setting = 33 bits
`[PRE] SK 1703 | Time settings, retries | Retries`		
`Retries for data message SEND/CONFIRM`	Number of maximum message repetitions to be performed. Station failure if no response for a sent message is received after the last retry.	Permitted range = 0 to 255 Default setting = 2
`[PRE] SK 1703 | Communication functions | Clock synchronization`		
`Time synchronization`	Release of the cyclic clock synchronization of the remote station.	Permitted range = • none • Transmitter with delay acquisition • Transmitter without delay acquisition Default setting = none
`Time setting after internal time setting`	With internal time setting (e.g. with SICAM TOOLBOX II) a time setting of the remote station can be carried out.	Permitted range = • yes • no Default setting = no
`[PRE] SK 1703 | Communication functions | NT bit emulation`		
`NT bit in case of AE failure`	If a connected automation unit (AU) fails, all affected signals in the receiving direction are marked with NT=1 when receiving: • Component X - Failure • RT error message (AU failure as RT error message from the central error table (DA=16, BG=29, W#=0.2,...)	Permitted range = • Component X - Failure • Real-time error message Default setting = Component X - Failure
`NT bit in case of AU failure`	If a real/virtual module fails, the affected real-time messages can be simulated with NT=1, if the module failures are transmitted to the affected automation unit (AU) with real-time messages from the central error table (DA=16, BG=20, W#=1,2).	Permitted range = • yes • no Default setting = no

Parameter name	Description	Settings
[PRE] SK 1703 | Communication functions | Transmission of integrated totals | Counter interrogation		
IEC-FRZ	Freeze identifier according to IEC 60870-5-101/104.	Permitted range = 0 to 3 • 0 = Request • 1 = Freeze • 2 = Freeze + Reset • 3 = Reset Default setting = 0
IEC_RQT	Request group according to IEC 60870-5-101/104.	Permitted range = 0 to 63 • 0 = not used • 1 to 63 = Freeze group Default setting = 0
SK- freeze	Freeze identifier according to SK 1703.	Permitted range = 0 to 3 • 0 = Transmit • 1 = Freeze + Transmit • 2 = Freeze without transmitting • 3 = Freeze + transmitting or switching off spontaneous transmission in MK 1703 • 4 = do not convert Default setting = 0
SK-Group	Counter group according to SK 1703.	Permitted range = 0 to 3 Default setting = 0
Select	Counter value set according to SK 1703.	Permitted range = 0 or 1 Default setting = 0
[PRE] SK 1703 | Communication functions | Binary information items		
Update time for Binary information items	Timeout for updating an SK 1703 message group format for a general interrogation or startup or for redundancy switchover.	Permitted range = 5 to 600 s Default setting = 60 s
Conversion of double-point information items	Conversion of double-point information items in transmit/receive direction. • do not invert: Binary information basic position MG (SK 1703) = ON (Ax 1703) • Invert: Binary information basic position MG (SK 1703) = OFF (Ax 1703)	Permitted range = • do not invert • invert: Default setting = do not invert

<table>
<tr><th>Parameter name</th><th>Description</th><th>Settings</th></tr>
<tr><td colspan="3"><code>[PRE] SK 1703 | Communication functions | General interrogation</code></td></tr>
<tr><td><code>TYP GA GI request</code></td><td>Conversion of the general interrogation in the transmit direction.
• Standard (NRT+RT)
Non-real-time (NRT) + real-time (RZ) data are requested with the general interrogation.
• only NRT
Non-real-time (NRT) data are requested with the general interrogation.
• only RT
Non-real-time (NRT) data are requested with the general interrogation.</td><td>Permitted range =
• Standard (NRT+RT)
• only NRT
• only RT
Default setting = Standard (RT +NRT)</td></tr>
<tr><td><code>Remote station sends data with status GI</code></td><td>If the remote station does not send information with Status=GI (or only cyclically), unchanged data is not passed on with GI.
With the parameter<code>Remote station sends data with status GI</code>= no the messages are forwarded the next time they are received.</td><td>Permitted range =
• yes
• no
Default setting = yes</td></tr>
<tr><td colspan="3"><code>[PRE] SK 1703 | Communication functions | Test functions (interface monitoring)</code></td></tr>
<tr><td><code>Interface monitoring "cycle time"</code></td><td>In this time frame, the interface is checked cyclically with the service function "test function of the connection layer".</td><td>Permitted range = 0 to 65535 s
• 0 .. no monitoring
Default setting = 10 s</td></tr>
<tr><td><code>Mode monitoring message</code></td><td>Counter in monitoring message.
• Standard (0-255)
• ASCII 0-9</td><td>Permitted range =
• Standard (0-255)
• ASCII 0-9
Default setting = Standard (0- 255)</td></tr>
<tr><td colspan="3"><code>[PRE] SK 1703 | Communication functions | Message filter | System message filter receive direction</code></td></tr>
<tr><td><code>GI request</code></td><td>Filter message in receive direction.</td><td>Permitted range =
• yes
• no
Default setting = no</td></tr>
<tr><td><code>Informations refresh</code></td><td>Filter message in receive direction.</td><td>Permitted range =
• yes
• no
Default setting = no</td></tr>
<tr><td><code>Error message from non-adjacent comp.</code></td><td>Filter message in receive direction.</td><td>Permitted range =
• yes
• no
Default setting = no</td></tr>
</table>

Parameter name	Description	Settings
`Counter Interrogation`	Filter message in receive direction.	Permitted range = • yes • no Default setting = no
`Component X - Failure`	Filter message in receive direction.	Permitted range = • yes • no Default setting = no
`Interrogation message for time and date`	Filter message in receive direction.	Permitted range = • yes • no Default setting = no
`[PRE] SK 1703 | Communication functions | Message filter | System message filter transmit direction`		
`GI request`	Filter message in transmit direction.	Permitted range = • yes • no Default setting = no
`Informations refresh`	Filter message in transmit direction.	Permitted range = • yes • no Default setting = no
`Error message from non-adjacent comp.`	Filter message in transmit direction.	Permitted range = • yes • no Default setting = no
`Counter Interrogation`	Filter message in transmit direction.	Permitted range = • yes • no Default setting = no
`Time setting`	Filter message in transmit direction.	Permitted range = • yes • no Default setting = no
`Response message for time`	Filter message in transmit direction.	Permitted range = • yes • no Default setting = no
`Response message for date`	Filter message in transmit direction.	Permitted range = • yes • no Default setting = no

Parameter name	Description	Settings
[PRE] Redundancy		
Operation if passive	Behavior of the protocol element in the redundancy state “passive”: • interface “ACTIVE”, acknowl-edged: – Same behavior as in redundancy state = “active”. – The passive protocol continues to send messages to the remote station. Received messages are passed on to the BSE and marked with R = 1 by the BSE. • Interface “TRISTATE”: – The passive protocol continues to send messages to the remote station. – Received (listened) data is passed on to the BSE and marked with R = 1 by the BSE. – Listening mode for station failure handling. The redundancy control (active/passive) takes place via the internal redundancy control message.	Permitted range = • interface “ACTIVE”, acknowl-edged • Interface “TRISTATE” Default setting = interface “ACTIVE”, acknowledged
Delay passive => active	With redundancy switching from passive → active, the protocol element is switched to active with delay.	Permitted range = • 1 to 2000 s • 0 (= no delay) Default setting = 0
Listening mode (failure monitoring time)	If no message is received from the remote station within the failure monitoring time, the remote station is reported as failed.	Permitted range = 0 to 60000 s • 0 (= no monitoring) Default setting = 0
[PRE] Data base management Settings for the data base management on BSE (per PRE) see *13.1.4.14 Data Management on the BSE for Communication Protocols*		
[PRE] Advanced parameters | Software test points		
...	The software test points may only be used under the guidance of experts for error detection! Once the fault isolation is completed, software checkpoints must always be turned off.	Permitted range = yes, no Default setting = no

13.15.6 Web server

A web server for internal diagnostic and statistic information is integrated in the protocol firmware. The web server itself is implemented on the basic system element – the protocol-specific web pages are provided by the protocol element.

System	Firmware	Designation	Protocol specific web pages
CP-8031, CP-8050	SKEEI1	SK 1703 PCMBA Point-to-Point	✓

Enable/disable web server or start web server via SICAM Device Manager or web browser see *13.1.4.12 Web server for protocol-specific web pages*.

Supported protocol-specific web pages

Web page	SKEEI1
Overview[394]	✓
Stations	–
Transmit signals	–
Receive signals	–
Developer Information[394]	
Datastream trace[394]	✓
Diagnosis (IDR)[394]	✓
Serialtest (IDH)[394]	✓
Serialtest (IDZ)[394]	✓
Statistic (IDE)[394]	✓
User diagnosis (IDU)[394]	✓

13.15.7 Message Conversion

Data in transmit direction are transferred from the basic system element to the protocol element in SICAM A8000 internal IEC 60870-5-101/104 (without 101/104 blocking) format. The conversion of the data formats IEC 60870-5-101/104 ↔ SK 1703 Point-to-Point (external data block formats or SSI formats) is performed by the protocol element. The transmission of the data towards the SK 1703 Point-to-Point is controlled by the protocol element.

Data in receive direction are converted by the protocol element from the SK 1703 Point-to-Point format (external data block formats or SSI formats) → SICAM A8000 internal IEC 60870-5-101/104 format and transferred to the basic system element (without 101/104 blocking).

The conversion of the message formats from the SICAM A8000 internal IEC 60870-5-101/104 ↔ SK 1703 point-to-point format (external data block formats or SSI formats) and the conversion of the address information is referred to as message conversion.

The parameterization of the address conversion from SICAM A8000 internal IEC 60870-5-101/104 ↔ SK 1703 Point-to-Point (address and message format) is to be done with SICAM Device Manager with function “Signals” or with the SICAM TOOLBOX II, OPM II using “SIP Message Address Conversion”.

394 See *13.1.4.12 Web server for protocol-specific web pages*

Supported processing types for message conversion:

Data	Direction	Processing type		SKEEI1
Commands	Receive direction	*firmware* / **Rec_setpoint_command**		✓
Values, Binary information items	Receive direction	*firmware* /**Receive_Fr**		✓
Commands	Transmit direction	*firmware* /**Trans_command**		✓
Values, Binary information items	Transmit direction	*firmware* /**Transmit detailed routing**		✓

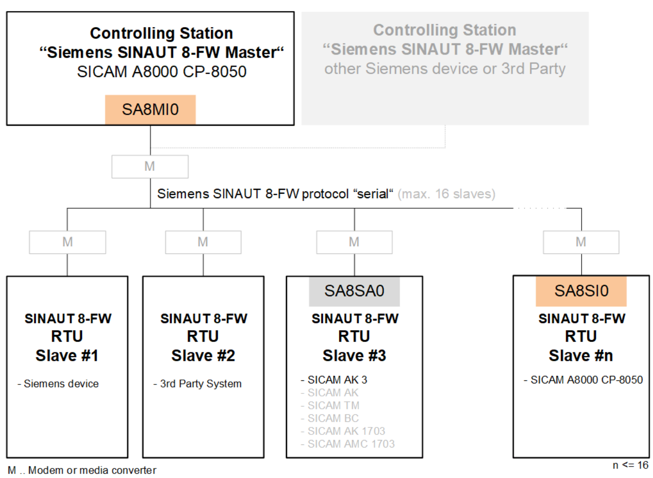
13.16 Siemens SINAUT 8-FW

The Siemens SINAUT 8-FW protocol is a proprietary serial transmission protocol for connecting devices from the SINAUT 8-FW system family to the SICAM A8000.

Protocol firmwares for Siemens SINAUT 8-FW:

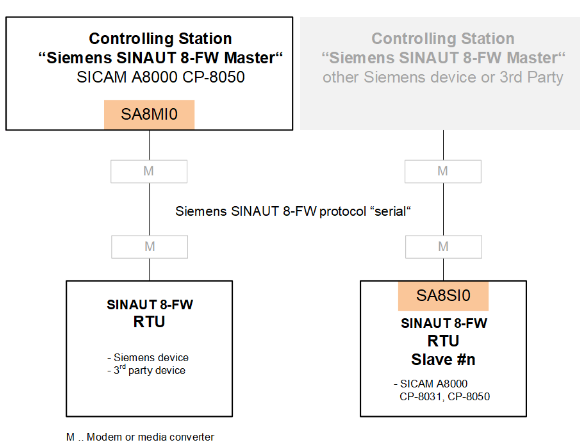
Firmware	System	Standard and function
SA8MI0	CP-8031, CP-8050	Siemens SINAUT 8-FW multi-point traffic master or end-end center
SA8SI0	CP-8031, CP-8050	Siemens SINAUT 8 multi-point traffic slave or end-end substation

Schematic configuration: Multi-point traffic



[SA8xI0_config_GV_GER, 1, en_US]

Schematic configuration: End-end traffic



[SA8xI0_config_EE_GER, 1, en_US]

Optional external transmission devices (dedicated line modems, media converters,...) can be used for the connection.

13.16.1 Functions

Function	SA8MI0	SA8SI0
Siemens SINAUT 8-FW		
Serial communication protocol according to SINAUT 8-FW multi-point traffic	✓	✓
Serial communication protocol according to SINAUT 8-FW point-to-point traffic	✓	✓
SICAM A8000 = SINAUT 8-FW multi-point traffic master, point-to-point traffic center	✓	–
SICAM A8000 = SINAUT 8-FW multi-point traffic slave, point-to-point traffic substation	–	✓
max. number of remote stations (multi-point traffic)	16	1
max. number of remote stations (point-to-point traffic)	1	1
Station numbers (SINAUT 8-FW)	1 to 127	
Broadcast addressing (broadcast slave address = 255)	–	–
Max. number of supported data points		
License		
License required to use the firmware in CP-8031, CP-8050 *14.7 SICAM 8 Licensed Protocol*	✓	✓
License management with Siemens ALM (Automation License Manager)	✓	✓
Engineering: Import license from ALM	✓	✓
Network configuration		
Point-to-point configuration	✓	✓
Multiple point-to-point configurations Separate interface for each single point-to-point configuration required!	✓	✓
Multi-point traffic – line configuration	✓	✓
Multi-point traffic – star configuration	✓	✓
Data concentrator	✓	✓
Physical interface		
direct link interface (RS-232)	✓	✓
RS-485	✓	✓
RS-422	✓	✓
Data transmission path in multi-point traffic (half duplex)	✓	✓
Data transmission path in point-to-point traffic (full duplex)	✓	✓
Bit transmission layer / message frame		
SINAUT 8-FW PCM	✓	✓
• Baud rates: 50, 75, 100, 110, 134.5, 150, 200, 300, 600, 1050, 1200, 1800, 2000, 2400, 4800, 9600	✓	✓
• CP-8031, CP-8050: X4 (RS-485/RS-422); X5 (RS-232)	✓	✓
• CI-8551 [395]: X1, X2 (RS-232, RS-485/RS-422); X3 (RS-485/RS-422); X4, X5 (RS-232)	✓	✓
• Modulation = PCM: Pulse code modulated - byte asynchronous (with IEC header)	✓	✓
• Byte Frame: 11 Bit (8O1)	✓	✓
• Message formats (with fixed and variable block length) on the line according to IEC 60870-5-1 / FT1.2	✓	✓

395 With CP-8031 not supported by default. With a license (see *14.8 SICAM A8000 CP-803x Extended CI-Module*) 1 communication module CI-8551 can be used additionally also with CP-8031.

Function	SA8MI0	SA8SI0
• Single characters on the line according to IEC 60870-5-1 / FT1.2	–	–
• Transmission rules according to IEC 60870-5-1/FT1.2	✓	✓
• Message length	1-255 Bytes	
• Message protection: d = 4 (checksum 8 bits) + parity bit "odd")	✓	✓
SINAUT 8-FW PDM	✓	✓
• Baud rates: 50, 100, 150, 200, 300, 600, 1200	✓	✓
• CI-8551 [395]: X1, X2 (RS-232, RS-485/RS-422); X3 (RS-485/RS-422); X4, X5 (RS-232)	✓	✓
• Modulation = PDM: Pulse Duration Modulation	✓	✓
• Modulation ratio transmission direction (1:2.0, 1:2.2, 1:2.4, 1:2.6, 1:2.8, 1:3.0)	✓	✓
• Modulation ratio receive direction (1:2.0, 1:2.2, 1:2.4, 1:2.6, 1:2.8, 1:3.0)	✓	✓
• Distortion (0 to 99%)	✓	✓
• Synchronization receiver (pos./neg. edge)	✓	–
• Invert sender	✓	✓
• Invert receiver	–	✓
• Message end in send direction (3 to 355 long characters)	✓	✓
• Message protection: d = 2 (parity), d = 4 (10-bit CRC), d = 6 (16-bit CRC)	✓	✓
• SINAUT 8-FW station number is sent	✓	✓
• SINAUT 8-FW station number is received	✓	✓
SINAUT 8-FW Protocol Functions		
Transmission services according to SINAUT 8-FW protocol	✓	✓
Data acquisition by polling (station interrogation)	✓	–
Acquisition of Events (Transmission of Data Ready to be Sent)	✓	✓
• QUICK CHECK procedure	✓	✓
• QUICK SCAN procedure	✓	✓
Conversion of the SINAUT 8-FW data formats↔IEC 60870-5-101/104 Data formats	✓	✓
Station Failure Delay	–	–
Binary information		
Suppression of intermediate and faulty position for double-point information	–	–
Measured values		
Scaling of measured values	✓	✓
Change monitoring for measured values in the receive direction	✓	–
Commands/Setpoint values		
Spontaneous transmission for commands/setpoint values	✓	–
Regulating Commands (SINAUT 8-FW)	–	–
Control location (set control location, check)	✓	–
Emulation of ACTCON for commands, setpoint values (according IEC 60870-5-101/104)	✓	–
Emulation of ACTCON- for commands, setpoint values (according IEC 60870-5-101/104), when a command/setpoint value is discarded from an unreleased control location.	✓	–
Emulation of ACTTERM for commands/setpoint values (according IEC 60870-5-101/104)	✓	–
Emulation of ACTTERM for setpoint values (according IEC 60870-5-101/104)	✓	–

Function	SA8MI0	SA8SI0
General interrogation		
Emulation of ACTCON, ACTTERM (according IEC 60870-5-101/104) general interrogation	–	–
Redundancy		
Protocol redundancy:		
• Tristate of RS-232 interface if passive	✓	✓
• Protocol function in redundancy state = “passive” – polling mode	✓	✓
• Listening mode (for global/selective station failure handling)	–	–
• Listening mode (for data)	–	–
Device redundancy:		
• Device redundancy with the same PRE parameters	✓	✓
• Device redundancy with different PRE parameters (“A/B parameters”)	✓	✓
• Device redundancy with different PRE parameters (“A/B parameters”) for signals	✓	✓
Protocol element control and return information		
Protocol element control messages:		
• Set control location	✓	–
Protocol element return information:		
• Station status	✓	–
• Station failure	✓	✓
• Mirror check command	–	✓
Supported SINAUT 8-FW message formats in transmit direction		
SB1 .. Switching commands	✓	–
SB2 .. 1 analog setpoint	✓	–
SB5 .. 1 digital setpoint, 8 bits	✓	–
SB6 .. 1 digital setpoint, 16 bits	✓	–
SO1 .. Check command	✓	–
SO2 .. Message repetition request/TFK positive acknowledgment	✓	–
SO3 .. Startup acknowledgment command	✓	–
SO4 .. Reset command	✓	–
SO6 .. Group scan command	✓	–
SO16 .. Synchronization of the precise time (10 minutes synchronization)	✓	–
SO17 .. Synchronization of the precise time (1 minutes synchronization)	✓	–
SO18 .. Synchronization of the precise time (setting of calendar)	✓	–
SO20 .. Startup request	–	–
SO24 .. Error bitstring query	✓	–
SO32 .. Request message (only in shared traffic)	✓	–
ÜB3 .. Indications 1 byte	–	–
ÜB4 .. Single or double-point indications 4 byte	–	✓
ÜB5 .. Indications 8 byte	–	–
ÜB6a .. Indications 1 byte real-time 10 ms (only for point-to-point traffic)	–	✓
ÜB6b .. Indications 1 byte real-time 1 ms	–	–
ÜB8 .. Measured values 8 bits – 4 MV	–	✓
ÜB9 .. Measured values 8 bits – 8 MV	–	✓

Function	SA8MI0	SA8SI0
ÜB10 .. Measured values 11 bits – 2 MV	–	✓
ÜB11 .. 4 measured values, 11 bits – 4 MV	–	✓
ÜB14 .. Transformer taps, BCD-coded, dual-coded	–	✓
ÜB15 .. 1 metered value, BCD-coded with 7 decades	–	✓
ÜB16 .. 1 metered value, dual-coded	–	✓
ÜO1 .. Check block (only for point-to-point traffic)	–	✓
ÜO2 .. Single error record of remote station	–	–
ÜO10 .. Acknowledge record for startup request	–	✓
ÜO13 .. Error bitstring (ZFBIT) (only for point-to-point traffic)	–	✓
ÜO14 .. Last STOP cause (only for point-to-point traffic)	–	✓
ÜO16 .. Operation bitstring (ZBBIT)	–	✓
ÜO20 .. Reply message in polling mode	–	✓
Supported SINAUT 8-FW message formats in receive direction		
SB1 .. Switching commands	–	✓
SB2 .. 1 analog setpoint	–	✓
SB5 .. 1 digital setpoint, 8 bits	–	✓
SB6 .. 1 digital setpoint, 16 bits	–	✓
SO1 .. Check command	–	✓
SO2 .. Message repetition request/TFK positive acknowledgment	–	✓
SO3 .. Startup acknowledgment command	–	✓
SO4 .. Reset command	–	✓
SO6 .. Group scan command	–	✓
SO16 .. Synchronization of the precise time (10 minutes synchronization)	–	–
SO17 .. Synchronization of the precise time (1 minutes synchronization)	–	–
SO18 .. Synchronization of the precise time (setting of calendar)	–	–
SO20 .. Startup request		✓
SO24 .. Error bitstring query	–	✓
SO32 .. Call command (SO32) (only in shared traffic)	–	✓
ÜB3 .. Indications 1 byte	✓	–
ÜB4 .. Single or double-point indications 4 byte	✓	–
ÜB5 .. Indications 8 byte	✓	–
ÜB6a .. Indications 1 byte real-time 10 ms	✓	–
ÜB6b .. Indications 1 byte real-time 1 ms	✓	–
ÜB8 .. Measured values 8 bits – 4 MV	✓	–
ÜB9 .. Measured values 8 bits – 8 MV	✓	–
ÜB10 .. Measured values 11 bits – 2 MV	✓	–
ÜB11 .. Measured values, 11 bits – 4 MV	✓	–
ÜB14 .. Transformer taps, BCD-coded, dual-coded	✓	–
ÜB15 .. 1 metered value, BCD-coded with 7 decades	✓	–
ÜB16 .. 1 metered value, dual-coded	✓	–
ÜO1 .. Check block (only for point-to-point traffic)	✓	–
ÜO2 .. Single error record of remote station	✓	–
ÜO13 .. Error bitstring	✓	–
ÜO14 .. last STOP cause	✓	–
ÜO16 .. Operation bitstring (ZBBIT)	✓	–
ÜO20 .. Reply message in polling mode	✓	–

Function	SA8MI0	SA8SI0
Supported IEC 60870-5-101/104 message formats in transmit direction		
TI 30 .. Single-point information with time tag CP56Time2a	–	✓
TI 31 .. Double-point information with time tag CP56Time2a	–	✓
TI 32 .. Step position information with CP56Time2a time tag	–	✓
TI 33 .. Bitstring of 32 bits with time tag CP56Time2a	–	–
TI 34 .. Measured value, normalized value with time tag CP56Time2a	–	✓
TI 35 .. Measured value, scaled value with time tag CP56Time2a	✓	✓
TI 36 .. Measured value, short floating-point number with time tag CP56Time2a	✓	✓
TI 37 .. Integrated total with time tag CP56Time2a	–	✓
TI 45 .. Single command	✓	–
TI 46 .. Double command	✓	–
TI 49 .. Setpoint command, scaled value	✓	–
TI 50 .. Setpoint command, short floating-point number	✓	–
TI 100 .. (Station-) interrogation command (General interrogation command)	–	–
TI 101 .. Counter interrogation command	–	–
TI 103 .. Clock Synchronization Command	–	–
Supported IEC 60870-5-101/104 message formats in receive direction		
TI 30 .. Single-point information with time tag CP56Time2a	✓	–
TI 31 .. Double-point information with time tag CP56Time2a	✓	–
TI 32 .. Step position information with CP56Time2a time tag	✓	–
TI 33 .. Bitstring of 32 bits with time tag CP56Time2a	✓	–
TI 34 .. Measured value, normalized value with time tag CP56Time2a	✓	–
TI 35 .. Measured value, scaled value with time tag CP56Time2a	✓	✓
TI 36 .. Measured value, short floating-point number with time tag CP56Time2a	✓	✓
TI 37 .. Integrated total with time tag CP56Time2a	✓	–
TI 45 .. Single command	–	✓
TI 46 .. Double command	–	✓
TI 49 .. Setpoint command, scaled value	–	✓
TI 50 .. Setpoint command, short floating-point number	–	✓
TI 100 .. (Station-) interrogation command (General interrogation command)	–	–
TI 101 .. Counter interrogation command	–	–
TI 103 .. Clock Synchronization Command	–	–
Web server		
Protocol-internal diagnostic and statistic information via protocol-specific web pages	✓	✓
Engineering		
SICAM Device Manager	✓	✓
SICAM TOOLBOX II	✓	✓

Restrictions Master + Slave

- SINAUT 8-FW data formats are only supported to a limited extent.
- The DCD signal is not evaluated (the receiving channel must be permanently open).

Restrictions master

- Real-time remote synchronization is not supported in multi-point traffic.
  (only setting the time to the 1st substation in multi-point traffic is supported)

Restrictions Slave

- Persistent commands are not supported.
- Time synchronization via the SINAUT 8 communication connection is not supported.
- System number is not supported for organizational messages. (except operating bitstring)
- System number cannot be used as an "address extension" (= same message number but different system number) for continuous measured values.
- Single or double-point information items – 1 byte real-time:
  - Time resolution only 10 ms
  - only single point information TI 30
  - only 1 double-point information TI 31
  - Only possible in point-to-point traffic!

NOTE

For the coupling of devices with the SINAUT 8-FW protocol, the restricted functionality in SICAM A8000 must be observed!

13.16.2 Modes of Operation

The operating mode of the interface is determined by parameters of the protocol element and optional equipment.

Standard operating mode	Interface → optional DCE	Interface signals
Unbalanced interchange circuit (V.24/V.28) RS-232 asynchronous	CP-8031, CP-8050: X5 CI-8551 [396]: X1, X2, X4, X5	RXD, TXD, CTS [397], RTS, ~~DCD~~, DTR, DSR/VCC, GND
Balanced interface (V.11) RS-485 (2-wire)/ RS-422 (4-wire) asynchronous	CP-8031, CP-8050: X4 CI-8551 [396]: X1, X2, X3	RS-485 2-wire TXD+/RXD+, - TXD-/RXD-, GND RS-422 (4-wire): TXD+, TXD-, RXD+, RXD-, GND

NOTE

With a serial connection via X5 interface of CP-8031, CP-8050 a bridge between CTS and GND is required, as far as the interface shall also be used for the connection with the engineering PC.

The CTS status line cannot be used by the protocol!

If the interface shall not be used as serial engineering interface, the function can be disabled with the parameter **`Serial engineering interface = disabled`**. Thereby no connection between CTS and GND is required.

396 With CP-8031 not supported by default. With a license (see *14.8 SICAM A8000 CP-803x Extended CI-Module*) 1 communication module CI-8551 can be used additionally also with CP-8031.

397 Not usable (reserved for SICAM TOOLBOX II)

13.16.3 Communication

For the stations to communicate with each other, suitable transmission facilities and/or network components may be needed in addition.

Own station (SINAIT 8-FW multi-point traffic master or point-to-point center)

System	Master module	Protocol element	Remarks
SICAM A8000 Series	CP-8031/CPCI85 CP-8050/CPCI85 CP-8050/EPCI85	SA8MI0	Max. 16 Slaves

Remote station (SINAUT 8-FW multi-point traffic slave or point-to-point substation)

System	Master module	Protocol element	Remarks
SICAM A8000 Series	CP-8031/CPCI85 CP-8050/CPCI85 CP-8050/EPCI85	SA8SI0	
SICAM AK 3	CP-2016/CPCX26 CP-2019/PCCX26	SM-2551/SA8SA0 SM-0551/SA8SA0	
Legacy systems (SICAM AK, SICAM TM, SICAM BC)	CP-20xx CP-60xx CP-50xx	SM-2551/SA8SA0 SM-0551/SA8SA0	
Siemens			Substation according to SINAUT 8-FW protocol
Third-party system			Substation according to SINAUT 8-FW protocol

Own station (SINAUT 8-FW multi-point traffic slave or point-to-point substation)

System	Master module	Protocol element	Remarks
SICAM A8000 Series	CP-8031/CPCI85 CP-8050/CPCI85 CP-8050/EPCI85	SA8SI0	

Remote station (SINAUT 8-FW multi-point traffic master or point-to-point center)

System	Master module	Protocol element	Remarks
SICAM A8000 Series	CP-8031/CPCI85 CP-8050/CPCI85 CP-8050/EPCI85	SA8MI0	max. 16 substations
SICAM AK 3	CP-2016/CPCX26 CP-2019/PCCX26	SM-2551/SA8MA0 SM-0551/SA8MA0	
Legacy systems (SICAM AK, SICAM TM, SICAM BC)	CP-20xx CP-60xx CP-50xx	SM-2551/SA8MA0 SM-0551/SA8MA0	
Siemens			Central station according to SINAUT 8-FW protocol
Third-party system			Central station according to SINAUT 8-FW protocol

13.16.4 Protocol Element Control and Return Information

13.16.4.1 Protocol Element Control Messages

Protocol element control messages can control protocol element internal functions. On the basic system element, IEC 60870-5-101/104 *messages with process information in the control direction* are converted to protocol element control messages and transmitted to the selected protocol element (see *13.1.4.10 Protocol Element Control Messages*).

Supported Protocol Element Control Messages

SF	Protocol element control message `Control_function_(PRE)`	SA8MI0 [Master]	SA8SI0 [Slave]
0	Mirror check command	–	✓
1	Do not mirror check command	–	✓
240	(General-) interrogation command (CASDU = all) [398]	✓	–
242	Setting control location	✓	–

Protocol-specific Protocol Element Control Messages

SF	Protocol element control message `Control_function_(PRE)`	Station	Z-Par	FL	Description
0	Mirror check command	–	–		
1	Do not mirror check command	–	–		

13.16.4.2 Protocol Element Return Information

Protocol element return information is internal status information of the protocol elements which is transmitted spontaneously and in the event of a general interrogation with internal message formats from the protocol element to the basic system element. On the basic system element, the protocol element return information items (see *13.1.4.11 Protocol Element Return Information*) are converted to IEC 60870-5-101/104 *messages with process information in the monitoring direction*.

Supported Protocol Element Return Information

Protocol element return information `Return information function_(PRE)`	Station	SA8MI0 [Master]	SA8SI0 [Slave]
• Station status	0 to 99, 255 [399]	✓	✓
• Station failure	0 to 99, 255 [399]	–	✓

398 This function is processed on the BSE

399 For end-end traffic and multi-point traffic slave, station number = 255 (=not used).

13.16.5 Parameters and Settings

13.16.5.1 Parameters and Properties for SINAUT 8-FW Master

Parameter name	Description	Settings
[PRE] Interface parameter Note: • The serial interface for the protocol is selected in the SICAM Device Manager under Configuration | Firmware(refer to *13.1.4.5 Selection of a serial interface for communication protocols*). • some parameters may only be displayed after selecting the interface or only with "Show all parameters".		
[PRE] Interface parameters (modulation method = PDM – modulation)		
Baud rate receive direction	Transmission rate in receive direction.	Permitted range = 50, 100, 150, 200, 300, 600, 1200 Bit/s Default setting = 1200
Baud rate transmit direction	Transmission rate in transmit direction	Permitted range = 50, 100, 150, 200, 300, 600, 1200 Bit/s Default setting = 1200
Modulation method	Modulation method for SINAUT 8-FW message on the line.	Permitted range = • PDM - Modulation • PCM - Modulation with IEC header Default setting = PDM modulation
Time settings for transmission facilities	Selection of the transmission facility. Connection of the transmission facilities as described (additional adapters / cables are sometimes required)	Permitted range = • free definable • direct link interface (RS-232) • direct link interface (RS-485) • direct link interface (RS-422) Default setting = free definable
[PRE] Interface parameters (modulation method = PCM – modulation with IEC header)		
Baud rate	Transmission rate in send and receive direction.	Permitted range = 50, 75, 100, 110 134.5, 150, 200, 300, 600, 1050, 1200, 1800, 2000, 2400, 4800, 9600 Bit/s Default setting = 1200
Modulation method	Modulation method for SINAUT 8-FW message on the line.	Permitted range = • PDM - Modulation • PCM - Modulation with IEC header Default setting = PDM modulation
Time settings for transmission facilities	Selection of the transmission facility. Connection of the transmission facilities as described (additional adapters / cables are sometimes required)	Permitted range = • free definable • direct link interface (RS-232) • direct link interface (RS-485) • direct link interface (RS-422) Default setting = free definable

Parameter name	Description	Settings
[PRE] Interface parameter | Time settings for free definable interface modem The time settings are predefined for selected transmission facilities - in addition, the time settings can be freely defined (see *13.1.4.8 Time settings for transmission facilities*).		
Pause time (tp)		Default setting = 30 ms
Set-up time (tv)		Default setting = 100 ms
Run out time (tn)		Default setting = 0 ms
[PRE] Station definition		
Station number (internal)	SICAM A8000 internal station number of the SINAUT 8-FW remote station. Internally the same station number is used for diagnosis and data routing. Each substation must be assigned a unique station number.	Permitted range = 0 to 99 .. internal station number 255 ... not used Default setting = not used
SINAUT8_Station	SINAUT 8-FW station number of the remote station.	Permitted range = • 1 to 127 • 255 ... not used Default setting = not used
Station enable	Selective remote stations can be prepared or deactivated with "Station enable = no". Data to "prepared" stations are fetched by the PRE and discarded without an error message (that means that data is not transferred).	Permitted range = • yes • no Default setting = yes
Station failure	If a substation fails, the forwarding of the error message can be suppressed with station failure = "do not report". (possibly required for special redundancy configurations)	Permitted range = • indicate error • indicate no error Default setting = notify
Interrogation list 1 **Interrogation list 2** **Interrogation list 3** **Interrogation list 4**	The interrogation lists are determined by the substation and contain the values of a selected message number range.	Permitted range = • 0 = not available • 1 = available Default setting = not available
[PRE] SINAUT8 | Common settings		
Protocol type		Permitted range = • Point-to-point traffic central station • Multi-point traffic central station Default setting = Point-to-point traffic central station
[PRE] SINAUT8 | Time settings, retries | Monitoring times		
Receive timeout	Failure monitoring in listening mode.	Permitted range = 1 to 60000 s (0 = no monitoring) Default setting = 60 s

Parameter name	Description	Settings
`Idle monitoring time`	After transmission disturbances or message interruption the idle state is monitored. After expiry of the monitoring time the receiver is resynchronized.	Permitted range = 0 to 32767 bits Default setting = 33 bits
`Character monitoring time`	Message gap monitoring: Maximum possible gap between successive bytes of a message. Idle monitoring time is started after detection of message interruption.	Permitted range = 0 to 32767 bits Default setting = 22 bits
`Expected acknowledgment time correction`	The expected acknowledgment time is determined automatically. Signal propagation delays and further delay times must be considered in the correction factor for the expected acknowledgment time.	Permitted range = 0 to 655.35 s Default setting = 0.01 s
`[PRE] SINAUT8 | Time settings, retries | Retries`		
`Retries for data message SEND/CONFIRM (station selective)`	Number of maximum message repetitions to be performed. Station failure if no response for a sent message is received after the last retry.	Permitted range = 0 to 255 Default setting = 2
`[PRE] SINAUT8 | Communication functions | Data transmission control`		
`Cyclic interrogation of the interrogation lists 2-4 in the multi-point traffic`	The interrogation lists 2, 3, 4 are interrogated cyclically in the configured time grid. Interrogation list 1 is only interrogated in the case of a general interrogation.	Permitted range = 0 to 60000 s Default setting = 0 s
`Lock quick check procedure in multi-point traffic`	With the quick check procedure, changed data can be transmitted more quickly in multi-point traffic, since only those stations are queried that have saved data for transmission.	Permitted range = • yes • no Default setting = no
`Monitoring counter for start-up and overflow acknowledgment command`		Permitted range = 0 to 255 Default setting = 2
`In the event of overflow of the substation, also acknowledge the TFK buffer`		Permitted range = • yes • no Default setting = no
`Record length for reset command`		Permitted range = • 16 bits • 8 bits Default setting = 16 bit
`[PRE] SINAUT8 | Communication functions | Clock synchronisation`		
`Enable clock synchronization`	Enable cyclic clock synchronization of the SINAUT 8-FW substation.	Permitted range = • yes • no Default setting = no

Parameter name	Description	Settings
`Period for clock synchronization`	The clock synchronization of the substation takes place cyclically in this time frame.	Permitted range = • 10 minutes • 1 minute Default setting = 10 minutes
`Set calendar`		Permitted range = • yes • no Default setting = no
`Correction fine time (clock synchronization)`	The synchronization of the fine time takes place (with SO16) exactly every 10th minute. Message runtimes and other delay times can be compensated with this correction time. Example: • Correction time = 0.44 s → time of transmission = hh:x9:59:560	Permitted range = 0 to 2.55 s Default setting = 0 s
`[PRE] SINAUT8 | Communication functions | Command transmission`		
`SINAUT8 time code for IEC time code short` **`SINAUT8 time code for IEC time code long`**	For IEC 60870-5-101/104 commands with qualifier of command = <1> “short pulse duration” and qualifier of command = <2> “long pulse duration”, the SINAUT 8 time code must be configured for all commands together. For IEC 60870-5-101/104 commands with qualifier of command = <0> “no additional specification” the SINAUT 8 time identifier must be configured for each command with the parameter**`SINAUT8_Zeitkennung`**in the parameters of the signal definition.	Permitted range = 0 to 15 Default setting = 0
`Enable simulation ACCON/ ACTTERM`	For commands and setpoint values, the protocol ACTCON and ACTTERM are copied to the BSE if required.	Permitted range = • yes • no Default setting = no

Parameter name	Description	Settings
[PRE] SINAUT8 | Communication functions | Binary information		
Time code for messages with a time tag	If one of the configured time codes is set for messages with a time tag in the receive direction, the “IV bit of the time” is set during message conversion in the IEC 60870-5-101/104 message to the BSE. Possible time codes: A = 1 minute overflow B = Startup C = not synchronized D = not real time	Permitted range = • don't evaluate • D • C • C, D • B • B, D • B, C • B, C, D • A • A, D • A, C • A, C, D • A, B • A, B, D • A, B, C • A, B, C, D Default setting = do not evaluate
[PRE] SINAUT8 | Communication functions | Binary information | Internal error messages		
Audit record not received		Permitted range = 0 to 31 255 = Default setting = 255
GI is incomplete		Permitted range = 0 to 31 255 = Default setting = 255
Additional request unsuc-cessful		Permitted range = 0 to 31 255 = Default setting = 255
loss of information possible		Permitted range = 0 to 31 255 = Default setting = 255
Startup of the substation		Permitted range = 0 to 31 255 = Default setting = 255
Error in measured value cycle		Permitted range = 0 to 31 255 = Default setting = 255
[PRE] SINAUT8 | Communication functions | Transmission of measured value		
Start message number **End message number**	Continuous measured values are selected by the start message number and end message number.	Permitted range = 0 to 1023 Default setting = 0

Parameter name	Description	Settings
Receive timeout for cyclic measured values	Failure monitoring time in listening mode.	Permitted range = • 0 .. no monitoring • 1 to 60000 s Default setting = no monitoring
[PRE] SINAUT8 | Communication functions | Transmission of integrated totals		
Integrated total with DT=block cyclically	If integrated totals with the data type (DT) = "cyclic" are received from the SINAUT8 substation, these can be blocked for forwarding to the BSE.	Permitted range = • yes • no Default setting = no
[PRE] SINAUT8 | Communication functions | General interrogation		
GI check for completeness		Permitted range = • 0 = no GI check for completeness • 1 to 65535 s Default setting = No GI check for completeness
Delay of the GI when starting the substation	When the substation starts up, the general interrogation command can be sent out by the control center with a delay.	Permitted range = 0.1 to 6553.5 s (0 = no delay) Default setting = 0
Increasing the message sequence identification for GA	Definition of whether messages increase the message sequence identification in the case of a general interrogation (data type = "queried").	Permitted range = • yes • no Default setting = no
[PRE] SINAUT8 | Communication functions | Test function (check procedure)		
Cycle time of the check command	The check command is sent cyclically from the master to the substation(s).	Permitted range = • 0 = check command is not sent • 1 to 65535 s Default setting = No GI check for completeness
number unanswered Check commands until error message		Permitted range = 1 to 255 Default setting = 2

Parameter name	Description	Settings
[PRE] Redundancy		
Operation if passive	Behavior of the protocol element in the redundancy state "passive": • Interface "ACTIVE": – Same behavior as in redundancy state = "active". – The passive master continues to send SINAUT8 message to the substations. Received messages are passed on to the BSE and marked with R = 1 by the BSE. • Interface "TRISTATE": – The passive master does not send any SINAUT 8-FW data or SINAUT 8-FW request messages. – Received (=listened) data is not passed on to the BSE. – Listening mode for global/station selective station failure handling The redundancy control (active/passive) takes place via the internal redundancy control message.	Permitted range = • Interface "ACTIVE" polling mode (=OPERATION) • Interface "TRISTATE" Default setting = Interface "ACTIVE" polling mode (=OPERATION)
Delay time passive ⇒ active	With redundancy switching from passive → active, the protocol element is switched to active with delay.	Permitted range = • 1 to 2000 s • 0 (= no delay) Default setting = 0
Checking the MSIs (1 - 31) in standby mode	Checking the message sequence identifiers received in standby.	Permitted range = • yes • no Default setting = no
[PRE] Data base management Settings for the data base management on BSE (per PRE) see *13.1.4.14 Data Management on the BSE for Communication Protocols*.		
[PRE] Advanced parameters | Software test points		
...	The software test points may only be used under the guidance of experts for error detection! Once the fault isolation is completed, software checkpoints must always be turned off.	Permitted range = yes, no Default setting = no

13.16.5.2 Parameters and Properties for SINAUT 8-FW Slave

Parameter name	Description	Settings
[PRE] Interface parameter Note: • The serial interface for the protocol is selected in the SICAM Device Manager under Configuration | Firmware(refer to *13.1.4.5 Selection of a serial interface for communication protocols*). • some parameters may only be displayed after selecting the interface or only with “Show all parameters”.		
[PRE] Interface parameters (modulation method = PDM – modulation)		
Baud rate receive direction	Transmission rate in receive direction.	Permitted range = 50, 100, 150, 200, 300, 600, 1200 Bit/s Default setting = 1200
Baud rate transmit direction	Transmission rate in transmit direction	Permitted range = 50, 100, 150, 200, 300, 600, 1200 Bit/s Default setting = 1200
Modulation method	Modulation method for SINAUT 8-FW message on the line.	Permitted range = • PDM - Modulation • PCM - Modulation with IEC header Default setting = PDM modulation
Time settings for transmission facilities	Selection of the transmission facility. Connection of the transmission facilities as described (additional adapters / cables are sometimes required)	Permitted range = • free definable • direct link interface (RS-232) • direct link interface (RS-485) • direct link interface (RS-422) Default setting = free definable
[PRE] Interface parameters (modulation method = PCM – modulation with IEC header)		
Baud rate	Transmission rate in send and receive direction.	Permitted range = 50, 75, 100, 110 134.5, 150, 200, 300, 600, 1050, 1200, 1800, 2000, 2400, 4800, 9600 Bit/s Default setting = 1200
Modulation method	Modulation method for SINAUT 8-FW message on the line.	Permitted range = • PDM - Modulation • PCM - Modulation with IEC header Default setting = PDM modulation
Time settings for transmission facilities	Selection of the transmission facility. Connection of the transmission facilities as described (additional adapters / cables are sometimes required)	Permitted range = • free definable • direct link interface (RS-232) • direct link interface (RS-485) • direct link interface (RS-422) Default setting = free definable
[PRE] Interface parameter | Time settings for free definable interface modem The time settings are predefined for selected transmission facilities - in addition, the time settings can be freely defined (see *13.1.4.8 Time settings for transmission facilities*).		
Pause time (tp)		Default setting = 30 ms

Parameter name	Description	Settings
`Set-up time (tv)`		Default setting = 100 ms
`Run out time (tn)`		Default setting = 11 ms
`[PRE] Station definition`		
`Own station number`	SINAUT 8-FW station number of the own station. Each substation must be assigned a unique station number.	Permitted range = 1 to 30 Default setting = 1
`[PRE] SINAUT8 | Common settings`		
`Protocol type`		Permitted range = • Point-to-point traffic substation • Multi-point traffic substation Default setting = Point-to-point traffic substation
`Send last cause of stop (TGN=782).`	Send last cause of stop with TGN=872 (=organizational message) after start-up acknowledgment command.	Permitted range = • yes • no Default setting = no
`IV and NT-Bit assessment`	Determines whether information is sent with “NT/IV=1”. Example: The SINAUT8 information message consists of up to 32 single-point information items. Blocking of transmission if at least one or all NT/IV bits are set.	Permitted range = • no IV and NT-Bit assessment • Block transmission if at least one IV/NT bit is set • Block transmission if all IV/NT bits are set Default setting = no IV and NT-Bit assessment
`[PRE] SINAUT8 | Common settings| Message number limits receive direction`		
`1. Message number digital setpoint values`	1. Message number for digital setpoint values. The message numbers below are reserved for commands.	Permitted range = 0 to 1023 Default setting = 256
`1. Message number analog setpoint values`	1. Message number for analog setpoint values. The message numbers below are reserved for digital setpoint values.	Permitted range = 0 to 1023 Default setting = 512
`[PRE] SINAUT8 | Time settings, retries | Monitoring times`		
`Monitoring timeout`	When the call monitoring time expires (slave is no longer called by the master), a failure of the interface is signaled.	Permitted range = 0 to 60000 s (0 = no monitoring) Default setting = 60 s
`Idle monitoring time`	After transmission disturbances or message interruption the idle state is monitored. After expiry of the monitoring time the receiver is resynchronized.	Permitted range = 0 to 32767 bits Default setting = 33 bits
`Character monitoring time`	Message gap monitoring: Maximum possible gap between successive bytes of a message. Idle monitoring time is started after detection of message interruption.	Permitted range = 0 to 32767 bits Default setting = 22 bits

Parameter name	Description	Settings
[PRE] SINAUT8 | Communication functions | Initialization		
Startup Delay	After a restart, the internal protocol process image is updated during the startup delay time. Then the communication is started.	Permitted range = 0 to 255 s Default setting = 10 s
[PRE] SINAUT8 | Communication functions | Initialization | CASDU for reset command		
CASDU1		Permitted range = 0 to 255 Default setting = 255
CASDU2		Permitted range = 0 to 255 Default setting = 255
[PRE] SINAUT8 | Communication functions | Data Transfer Control | Interrogation lists in multi-point traffic | Interrogation list 1-4		
Start message number	The interrogation lists 2, 3, 4 are interrogated cyclically in the configured time grid. Interrogation list 1 is only interrogated in the case of a general interrogation.	Permitted range = 0 to 984 Default setting = 0
End message number		Permitted range = 0 to 984 Default setting = 255
[PRE] SINAUT8 | Communication functions | Data communication control | Binary information		
Swap single/double-point information	Swap single/double-point information byte by byte.	Permitted range = • yes • no Default setting = no
[PRE] SINAUT8 | Communication functions | Data communication control | Measured values		
Substitute value 8-bit measured value	SINAUT 8-FW substitute value for 8-bit measured value if the NT and/or the IV bit is set in the IEC 60870-5-101/104 value.	Permitted range = -256 to 255 Default setting = 0
Substitute value 11-bit measured value	SINAUT 8-FW substitute value for 11-bit measured value if the NT and/or the IV bit is set in the IEC 60870-5-101/104 value.	Permitted range = -2048 to 2047 Default setting = 0
Substitute value transformer taps:	SINAUT 8-FW substitute value for transformer taps if the NT and/or the IV bit is set in the IEC 60870-5-101/104 value.	Permitted range = 0 to 255 Default setting = 0
Block measured values at GI	Measured values can be blocked in the case of a general interrogation.	Permitted range = • yes • no Default setting = no
Blocking time of the continuous measured values with running GA	In the case of a general query, the transmission of the continuous measured values (= cyclical measured values) is stopped for the duration of the blocking time.	Permitted range = 0.1 to 6553.5 s Default setting = 0

Parameter name	Description	Settings
Send measured value/transformer tap with NT/IV = 1	Independent from parameter **IV and NT-Bit assessment** transformer taps and measured values can be sent with “NT/IV=1”. If released, these values are also transmitted in the case of a general interrogation.	Permitted range = • yes • no Default setting = no
Send continuous measured values spontaneously	If no spontaneous data is to be transmitted, continuous measured values are transmitted permanently in ascending order of the address. In addition, the values assigned to the continuous measured values can also be transmitted spontaneously.	Permitted range = • yes • no Default setting = yes
OV-Bit assessment	If the OV bit is evaluated and is set in the IEC 60870-5-101/104 message, the measured value in the SINAUT 8-FW message is set to a fixed value. Measured value 8 bits → +/-254 Measured value 11 bits → +/-2046 (pos./neg. overflow possible)	Permitted range = • yes • no Default setting = no
[PRE] SINAUT8 | Communication functions | Data communication control | Transmission of integrated totals		
Block integrated totals at GI	The transmission of integrated totals can be blocked during an ongoing general interrogation.	Permitted range = • yes • no Default setting = no
[PRE] SINAUT8 | Communication functions | Data communication control | General interrogation		
Increase message sequence identification for GA	In the case of a general interrogation, the increase in the message sequence identifier can be deactivated when data is transmitted with the data type “interrogated”.	Permitted range = • yes • no Default setting = yes
Send GI with parameterizable CASDU	<yes> GI with parameterized CASDU <no> GI with learned CASDU from transmission detail routing	Permitted range = • yes • no Default setting = yes
[PRE] SINAUT8 | Communication functions | Data communication control | General interrogation | CASDU for general Interrogation		
CASDU1		Permitted range = 0 to 255 Default setting = 255
CASDU2		Permitted range = 0 to 255 Default setting = 255

Parameter name	Description	Settings
[PRE] Redundancy		
Operation if passive	Behavior of the protocol element in the redundancy state "passive": • Interface "ACTIVE": – Same behavior as in redundancy state = "active". – The passive slave continues to send SINAUT8 message. Received messages are passed on to the BSE and marked with R = 1 by the BSE. • Interface "TRISTATE": – The passive slave sends no SIANUT 8-FW messages. – Received (=listened) data is not passed on to the BSE. The redundancy control (active/ passive) takes place via the internal redundancy control message.	Permitted range = • Interface "ACTIVE" polling mode (=OPERATION) • Interface "TRISTATE" Default setting = Interface "ACTIVE" polling mode (=OPERATION)
Delay time passive ⇒ active	With redundancy switching from passive → active, the protocol element is switched to active with delay.	Permitted range = • 1 to 2000 s • 0 (= no delay) Default setting = 0
[PRE] Data base management Settings for the data base management on BSE (per PRE) see *13.1.4.14 Data Management on the BSE for Communication Protocols*.		
[PRE] Advanced parameters | Software test points		
...	The software test points may only be used under the guidance of experts for error detection! Once the fault isolation is completed, software checkpoints must always be turned off.	Permitted range = yes, no Default setting = no

13.16.6 Web server

A web server for internal diagnostic and statistic information is integrated in the protocol firmware. The web server itself is implemented on the basic system element – the protocol-specific web pages are provided by the protocol element.

System	Firmware	Designation	Protocol specific web pages
CP-8031, CP-8050	SA8MI0	Siemens SINAUT 8-FW Master	✓
	SA8SI0	Siemens SINAUT 8-FW Slave	✓

Enable/disable web server or start web server via SICAM Device Manager or web browser see *13.1.4.12 Web server for protocol-specific web pages*.

Supported protocol-specific web pages

Web page	SINAUT 8-FW Master [SA8MI0]	SINAUT 8-FW Slave [SA8SI0]
Overview[400]	✓	✓
Stations	✓	✓
Transmit signals	✓	✓
Receive signals	✓	✓
Developer Information[400]		
Datastream trace[400]	✓	✓
Diagnosis (IDR)[400]	✓	✓
Serialtest (IDH)[400]	✓	✓
Serialtest (IDZ)[400]	✓	✓
Statistic (IDE)[400]	✓	✓
User diagnosis (IDU)[400]	✓	✓

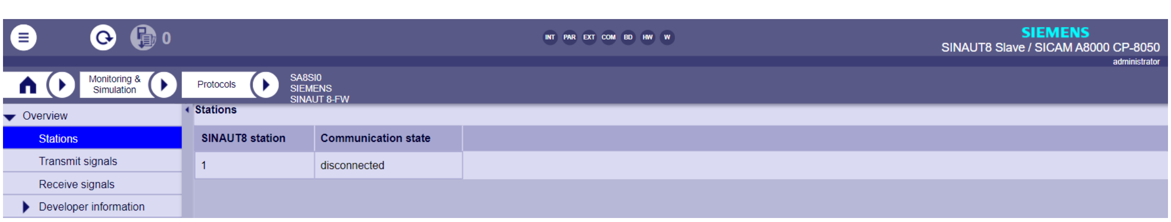
13.16.6.1 Protocol specific web page: Stations

The **Stations** web page displays information about the status of the connections to the connected stations.

Siemens SINAUT 8-FW Master (SA8MI0):

[SA8MI0_WEB_Stations_GER, 1, en_US]

Siemens SINAUT 8-FW Slave (SA8SI0):



[SA8SI0_WEB_Stations_GER, 1, en_US]

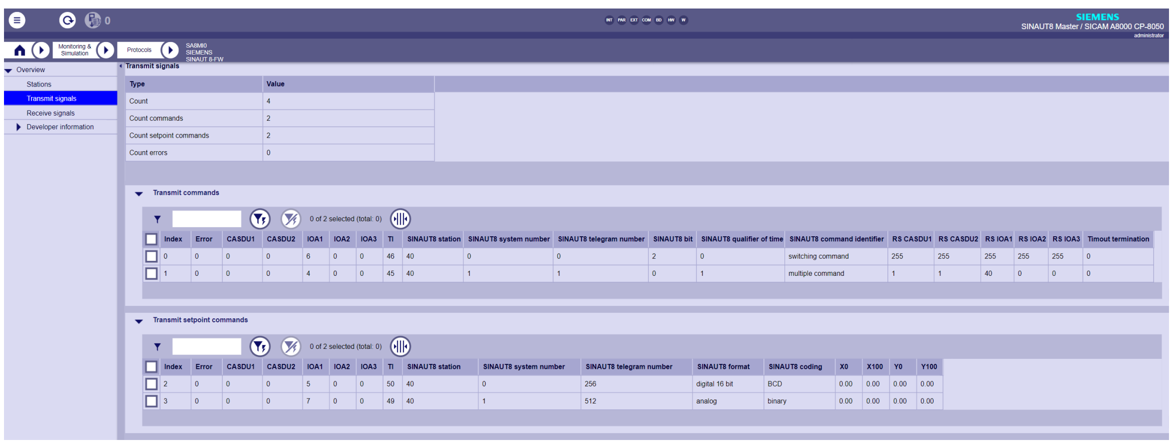
400 See *13.1.4.12 Web server for protocol-specific web pages*

Field	Note
Number of stations	Number of parameterized stations
Number of stations connected	Number of established connections to stations
Number of stations disconnected	Number of cleared connections to stations
Number of stations prepared	Number of prepared connections to stations
Station	Internal station number for this connection
SINAUT8 station	SINAUT 8-FW Station Number
Communication state	State of the connection to this station
Station failure	report station failure

13.16.6.2 Protocol specific web page: Transmit signals

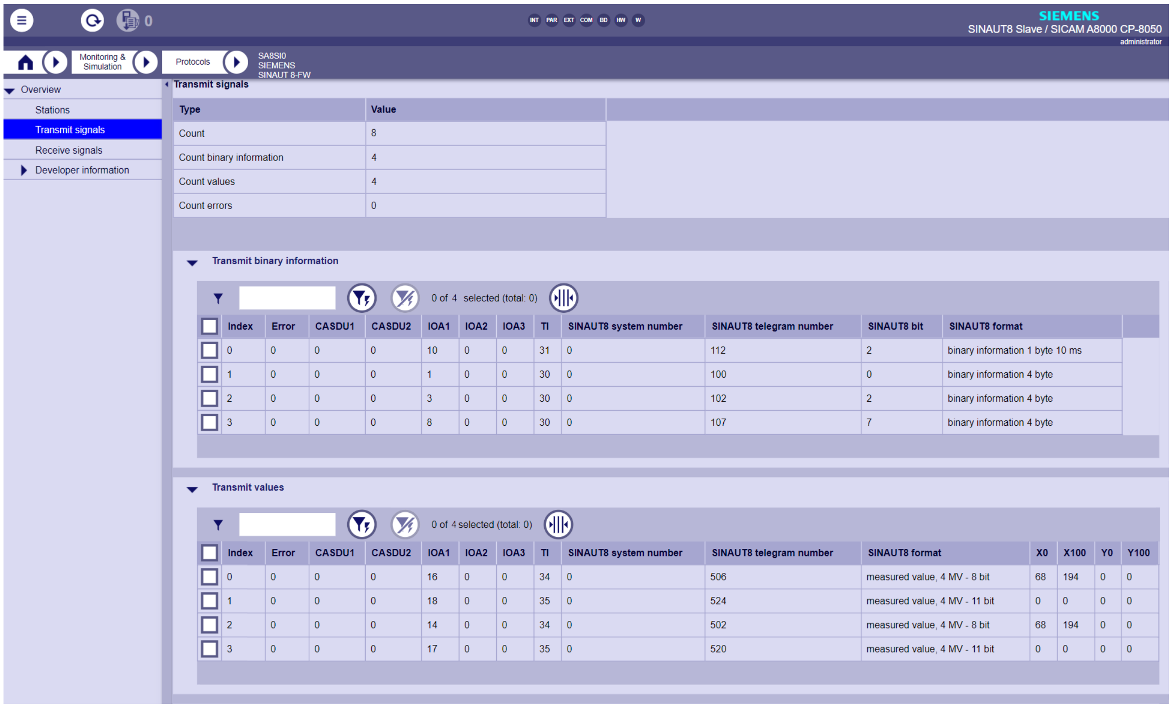
The **Transmit signals** web page displays information of the parameterized and by the protocol processed signals in transmit direction.

Siemens SINAUT 8-FW Master (SA8MI0):



[SA8MI0_WEB_Transmit_signals_GER, 1, en_US]

Siemens SINAUT 8-FW Slave (SA8SI0):



[SA8SI0_WEB_Transmit_signals_GER, 1, en_US]

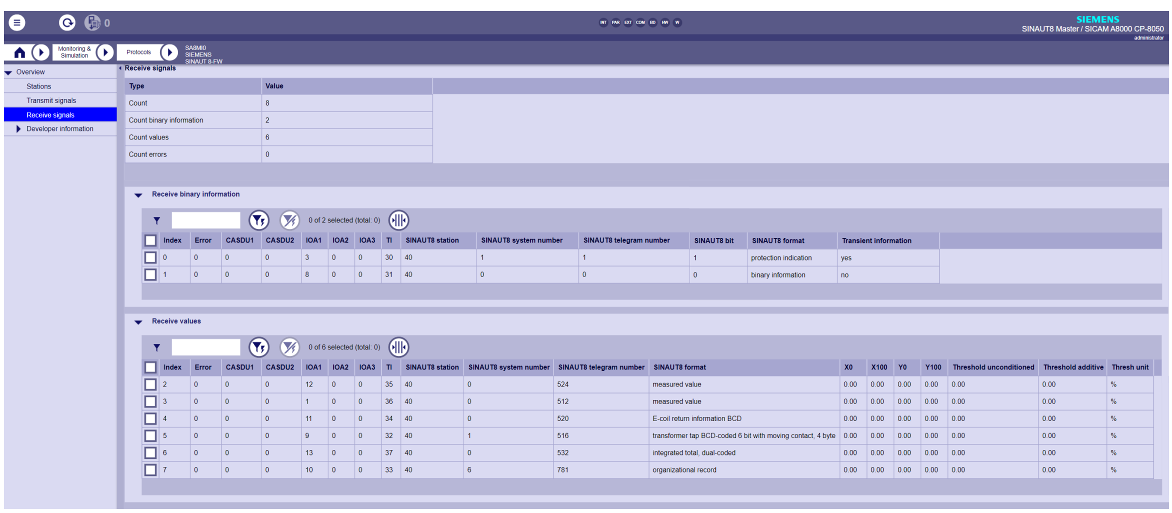
Field	Note
Count	Number of parameterized data points in transmit direction (total for all stations)
Count commands	Number of parameterized data points for “Commands” in trans-mission direction (total for all stations)
Count setpoint commands	Number of parameterized data points for “setpoint values” in transmit direction (total for all stations)
Count binary indications	Number of parameterized data points for “binary information“ in transmit direction
Count values	Number of parameterized data points for “Values” in the transmit direction
Count errors	Number of faulty parameterized data points in transmit direction (total number for all stations)
Transmit commands	Parametrized data points for “commands” in transmit direction (total for all stations)
Transmit setpoint commands	Parameterized data points for “setpoint values” in transmit direc-tion (total for all stations)
Transmit binary information	Parameterized data points for “binary information items” in transmit direction
Transmit values	Parametrized data points for “values” in transmit direction
Index	Internal index in the detailed routing of the message conversion
Error	Error number (the last detected error is displayed in the diagnostic)
CASDU1, CASDU2 IOA1, IOA2, IOA3	Internal IEC 60870-5-101/104 address of the data point
SINAUT8 station	Siemens SINAUT 8-FW Station Number
TI	Internal IEC 60870-5-101/104 type identification
SINAUT8 system number	Siemens SINAUT 8-FW system number (Message address)

Field	Note
SINAUT8 message number	Siemens SINAUT 8-FW Message number (Message address)
SINAUT8 bit	Siemens SINAUT 8-FW Bit position of the binary information item in the addressed message
SINAUT8 format	Siemens SINAUT 8-FW Format
SINAUT8 coding	Siemens SINAUT 8-FW Coding
X0, X100, Y0, Y100	X_0%, X_100%, Y_0%, Y_100% for value adaptation
SINAUT8 qualifier of time	Siemens SINAUT 8-FW time code
SINAUT8 command identifier	Siemens SINAUT 8-FW qualifier of command
RS CASDU1, RS CASDU2 RS IOA1, RS IOA2, RS IOA3	Address of the associated return information for command in transmit direction (Internal IEC 60870-5-101/104 address of the data point)
Timeout termination	Command execution monitoring time

13.16.6.3 Protocol specific web page: Receive signals

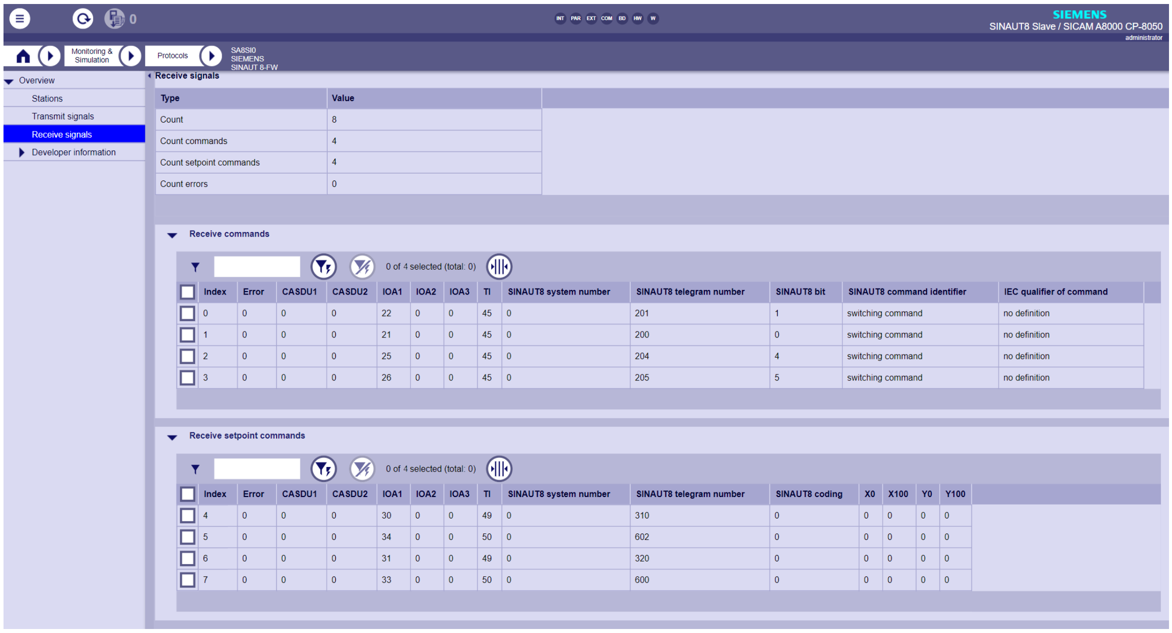
The **Receive signals** web page displays information of the parameterized and by the protocol processed signals in receive direction.

Siemens SINAUT 8-FW Master (SA8MI0):



[SA8MI0_WEB_Receive_signals_GER, 1, en_US]

Siemens SINAUT 8-FW Slave (SA8SI0):



[SA8Si0_WEB_Receive_signals_GER, 1, en_US]

Field	Note
Count	Number of parameterized data points in receive direction (total for all stations)
Count binary indications	Number of parameterized data points for “binary” information in receive direction (total for all stations)
Count values	Number of parameterized data points for “values” in receive direction (total for all stations)
Count commands	Number of parameterized data points for “commands” in receive direction
Count setpoint commands	Number of parameterized data points for “setpoint values” in receive direction
Count errors	Number of faulty parameterized data points in receive direction (total number for all stations)
Receive binary information	Parameterized data points for “binary information items” in receive direction (total for all stations)
Receive values	Parameterized data points for “values” in receive direction (total for all stations)
Receive commands	Parametrized data points for “commands” in receive direction
Receive setpoint commands	Parametrized data points for “setpoint values” in receive direction
Index	Internal index of the detailed routing of the message conversion
Error	Error number (the last detected error is displayed in the diagnostic)
CASDU1, CASDU2 IOA1, IOA2, IOA3	Internal IEC 60870-5-101/104 address of the data point
TI	Internal IEC 60870-5-101/104 type identification
SINAUT8 station	Siemens SINAUT 8-FW Station Number
SINAUT8 system number	Siemens SINAUT 8-FW system number (Message address)
SINAUT8 message number	Siemens SINAUT 8-FW Message number (Message address)
SINAUT8 bit	Siemens SINAUT 8-FW Bit position of the binary information item in the addressed message
SINAUT8 format	Siemens SINAUT 8-FW Format

Field	Note
Transient information	Siemens SINAUT 8-FW Identifier for transient information
SINAUT8 command identifier	Siemens SINAUT 8-FW qualifier of command
IEC qualifier of command	IEC 60870-5-101/104 Command qualifier
SINAUT8 coding	Siemens SINAUT 8-FW Coding
X0, X100, Y0, Y100	X_0%, X_100%, Y_0%, Y_100% for value adaptation
Threshold unconditioned	Unconditioned threshold for change monitoring
Threshold additive	Additive threshold for change monitoring
Thresh unit	Unit of the threshold for change monitoring

13.16.7 Message Conversion

Data in transmit direction are transferred from the basic system element to the protocol element in SICAM A8000 internal IEC 60870-5-101/104 (without 101/104 blocking) format. The conversion of the data formats IEC 60870-5-101/104 ↔ SINAUT 8-FW is performed by the protocol element. The transmission of the data towards the SINAUT 8-FW is controlled by the protocol element.

Data in receive direction are converted by the protocol element from the SINAUT 8-FW format → SICAM A8000 internal IEC 60870-5-101/104 format and transferred to the basic system element (without 101/104 blocking).

The conversion of the SICAM A8000 internal IEC 60870-5-101/104 message format ↔ SINAUT 8-FW data format and the conversion of the address information are called message conversion.

The parameterization of the address conversion from SICAM A8000 internal IEC 60870-5-101/104 ↔ SINAUT 8-FW (address and message format) is to be done with SICAM Device Manager with function “Signals” or with the SICAM TOOLBOX II, OPM II using “SIP Message Address Conversion”.

Supported processing types for message conversion:

Data	Direction	Processing type	SA8MI0 [Master]	SA8SI0 [Slave]
Binary information items	Receive direction	*firmware* / **Rec_binary_information**	✓	–
Values	Receive direction	*firmware* /**Rec_values**	✓	–
Commands	Transmit direction	*firmware* /**Trans_command**	✓	–
Setpoint value	Transmit direction	*firmware* / **Trans_setpoint_command**	✓	–
Commands	Receive direction	*firmware* / **Rec_setpoint_command**	–	✓
Setpoint value	Receive direction	*firmware* / **Rec_setpoint_value**	–	✓
Binary information	Transmit direction	*firmware* /**Trans_indica-tion**	–	✓
Values	Transmit direction	*firmware* /**Trans_values**	–	✓

13.16.7.1 Message conversion in transmit direction – SINAUT 8-FW Master

Message conversion in transmit direction: SICAM A8000→ SINAUT 8-FW

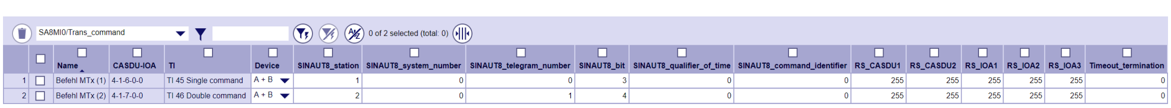
SICAM A8000: IEC 60870-5-101/104 →		SINAUT 8-FW	
TI	Designation		Designation
TI 35	Measured value, scaled value with time tag CP56Time2a	SB2 SB5 SB6	Setpoint values analog Setpoint values digital 8 bits Setpoint values digital 16 bits

SICAM A8000: IEC 60870-5-101/104 →		SINAUT 8-FW	
TI 36	Measured value, short floating-point number with time tag CP56Time2a	SB2 SB5 SB6	Setpoint values analog Setpoint values digital 8 bits Setpoint values digital 16 bits
TI 45	Single command	SB1 SO4 SO6 SO24	Switching command Reset command Group scan command[401] Error bitstring query command
TI 46	Double command	SB1 SO4 SO6 SO24	Switching command Reset command Group scan command[401] Error bitstring query command
TI 49	Setpoint command, scaled value	SB2 SB5 SB6	Setpoint values analog Setpoint values digital 8 bits Setpoint values digital 16 bits
TI 50	Setpoint command, short floating-point number	SB2 SB5 SB6	Setpoint values analog Setpoint values digital 8 bits Setpoint values digital 16 bits
–	–	SO1	Check command [402]
–	–	SO2	Message repetition request (TFK acknowledgment) [402]
–	–	SO3	Startup acknowledgment command [402]
–	System message GI (GI request for image-GI)	SO6	Group scan command Query list 1-4 [402] [403]
–	Time setting	SO16 SO17 SO18	10 minutes synchronization 1 minute synchronization Set calendar
–	–	SO24	Error bitstring query [402]
–	–	SO32	Call command [402] [403]

Commands

The parameterization of the address and message conversion for commands in transmit direction (with SINAUT 8-FW Master) is to be done with the SICAM Device Manager with the function "Signals" or with the SICAM TOOLBOX II, OPM II.

Processing type: *firmware* / `Trans_command`



SA8MI0/Trans_command | 0 of 2 selected (total: 0)

		Name	CASDU-IOA	TI	Device	SINAUT8_station	SINAUT8_system_number	SINAUT8_telegram_number	SINAUT8_bit	SINAUT8_qualifier_of_time	SINAUT8_command_identifier	RS_CASDU1	RS_CASDU2	RS_IOA1	RS_IOA2	RS_IOA3	Timeout_termination
1	☐	Befehl MTx (1)	4-1-6-0-0	TI 45 Single command	A + B	1	0	0	3	0	0	255	255	255	255	255	0
2	☐	Befehl MTx (2)	4-1-7-0-0	TI 46 Double command	A + B	2	0	1	4	0	0	255	255	255	255	255	0

[SA8MI0_DM_Sende_Befehl_GER, 1, en_US]

401 The group scan command is also generated by the protocol itself (e.g. for general interrogation, list query, after buffer overflow,...)!

402 These message formats are generated by the protocol element itself!

403 These message formats are only used in multi-point traffic (polling mode)!

Parameter	
TI	Supported type identifications: • TI 45 .. Single command • TI 46 .. Double command
Name	Name of the signal
CASDU-IOA	SICAM A8000 internal IEC 60870-5-101/104 message address (CASDU1, CASDU2, IOA1, IOA2, IOA3)
Device	In which device is the signal processed in the event of redundancy. • A • B • A + B
SINAUT8_Station	SINAUT 8-FW station number of the remote station: • 1 to 127
SINAUT8_System-nummer	SINAUT 8-FW System number: • 0 .. Main system • 1 to 6 .. Subsystem
SINAUT8_Message_number	SINAUT 8-FW Message number: • 0 to 255 = SB1 .. Switching command • 519 = SO4 .. Reset command • 521 = SO6 .. Group scan command • 781 = SO24 .. Error bitstring query command
SINAUT8_Bit	Bit number of the command within the SINAUT 8-FW message number: • 0 to 7.. with single command • 0, 2, 4, 6 .. with double command • 0 .. other information types
SINAUT8_time_code	SINAUT-8-FW ID of the command output time for IEC 60870-5-101/104 commands without additional specification: • 0 .. Switching command CB (circuit breaker) • 8 .. Switching command (disconnector) • 15 .. Persistent command
SINAUT8_qualifier_of_command	SINAUT-8-FW command type: • Switching command • Persistent command • Multiple commands [404] • Temporary interruption • Command interruption (is not supported)

404 With multiple commands, the associated command bits are set depending on the command status (ON/OFF) (only with SA8MI0).

Parameter	
`RM_CASDU1`, **`RM_CASDU2`** **`RM_IOA1`**, **`RM_IOA2`**, **`RM_IOA3`**	SICAM A8000 internal IEC 60870-5-101/104 message address of the return information assigned to the command: (CASDU1, CASDU2, IOA1, IOA2, IOA3)
`Timeout_Termination`	Command execution monitoring time: (Timeout between command acknowledgment and receipt of the return information for the command). • 0 .. monitoring disabled • 1 to 255 (*100 ms) = 100 ms to 25.5 s

Supported Data Formats:

SINAUT 8-FW Format	Designation	IEC 60870-5-101/104 data format (TI)
SB1	Switching command	45, 46
SO4	Reset command	45, 46
SO6	Group scan command	45, 46
SO24	Error bitstring query command	45, 46

Legend: TI 45 = Single command
TI 46 = Double command

Control Location / Check Control Location

The function “Control location” is used so that commands are only output from authorized sources. If the function is activated, commands from the protocol element are only transmitted to the remote station, when the control location (originator address) is enabled.

If the control location is not enabled, the protocol element immediately sends back a negative acknowledgment of activation (ACTCON) to the originator address (further details about control location see section *13.1.4.9 Control location function for commands and setpoint values*).

SINAUT8 time code for commands

For IEC 60870-5-101/104 commands with qualifier of command = <0> “no additional specification” the SINAUT 8 time identifier must be configured for each command with the parameter **`SINAUT8_time_code`** in the parameters of the signal definition.

For IEC 60870-5-101/104 commands with command identifier = <1> “short command execution time”, the SINAUT 8 time code must be set for all commands together with the parameter **`[PRE] SINAUT8 | Communication functions | command transmission | Parameterize SINAUT8 time code for IEC time code short`**.

For IEC 60870-5-101/104 commands with command identifier = <2> “long command execution time”, the SINAUT 8 time code must be set for all commands together with the parameter **`[PRE] SINAUT8 | Communication functions | command transmission | Parameterize SINAUT8 time code for IEC time code short`**.

Emulation of ACTCON, ACTTERM for commands

For commands, ACTCON+/- and ACTTERM+/- are emulated by the protocol in accordance with IEC 60870-5. Select/Execute is not supported (execute only).

If a command can be correctly converted from IEC 60870-5-101/104 to SINAUT 8-FW, ACTCON+ is replicated after the command has been sent. If a command cannot be converted or if the command is not parameterized in the signals, ACTCON- is simulated.

If no return information address is configured for a command, ACTTERM+ is immediately reproduced (after ACTCON+).

In the case of commands with a parameterized return information address, a parameterizable time is waited for the feedback.

The emulation of ACTCON/ACTTERM is released with the parameter **`[PRE] SINAUT8 | Communication functions | command transmission | Release ACTCON/ACTTERM`**.

If the associated response for the command is received within the **`Timeout_Termination`** time, then the ACTTERM+ protocol is emulated. If the return information is not received within **`Timeout_Termination`**, the protocol ACTTERM- is emulated when the time has expired.

Message Conversion

The table describes the evaluated elements of the IEC 60870-5-101/104 message during message conversion.

Message elements		
TI .. Type identification		• TI 45 .. Single command • TI 46 .. Double command
CASDU-IOA .. Message address		Parameter-settable
Cause of transmission		
06 .. Activation		Is evaluated (only “activation” allowed)
07 .. Confirmation of activation		Is emulated from the protocol after command transmission.
08 .. Abortion of activation		BSE→PRE: not supported. Is confirmed negative (ACTCON-)
09 .. Confirmation of the abortion of activation		PRE→BSE: Abortion of the activation is confirmed negative (ACTCON-)
10 .. Activation termination		If no return information is assigned to the command, then ACTTERM is emulated immediately (after ACTCON). If the command has a return information associated with it, then ACTTERM is emulated upon receipt of the return information.
xx .. Other COTs		not accepted
T .. Test		Not supported
Information		
SCO/DCO		
SCS	Single command state	[Only TI45]
	0 .. OFF	Evaluated
	1 .. ON	Evaluated
DCS	Double command state	[Only TI46]
	0 .. Not allowed	Evaluated
	1 .. OFF	Evaluated
	2 .. ON	Evaluated
	3 .. Not allowed	Evaluated
QOC	S/E	
	0 = Execute	Is checked for “execute”
	1 = Select	Not supported

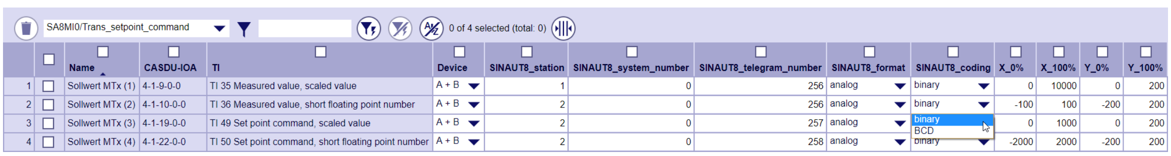
Message elements		
QU	Command qualifier	
	0 .. No additional definitions	Not evaluated
	1 .. Short pulse duration	Not evaluated
	2 .. Long pulse duration	Not evaluated
	3 .. Persistent command	Not supported

Not listed elements of the IEC 60870-5-101/104 message are not rated/not supported!

Setpoint values

The parameterization of the address and message conversion for commands in transmit direction (with SINAUT 8-FW Master) is to be done with the SICAM Device Manager with the function “Signals or with the SICAM TOOLBOX II, OPM II.

Processing type: *firmware* /**`Trans_setpoint_command`**


SA8MI0/Trans_setpoint_command — 0 of 4 selected (total: 0)

	Name	CASDU-IOA	TI	Device	SINAUT8_station	SINAUT8_system_number	SINAUT8_telegram_number	SINAUT8_format	SINAUT8_coding	X_0%	X_100%	Y_0%	Y_100%
1	Sollwert MTx (1)	4-1-9-0-0	TI 35 Measured value, scaled value	A + B	1	0	256	analog	binary	0	10000	0	200
2	Sollwert MTx (2)	4-1-10-0-0	TI 36 Measured value, short floating point number	A + B	2	0	256	analog	binary	-100	100	-200	200
3	Sollwert MTx (3)	4-1-19-0-0	TI 49 Set point command, scaled value	A + B	2	0	257	analog	binary BCD	0	1000	0	200
4	Sollwert MTx (4)	4-1-22-0-0	TI 50 Set point command, short floating point number	A + B	2	0	258	analog	binary	-2000	2000	-200	200

[SA8MI0_DM_Sende_Sollwert_GER, 1, en_US]

Parameter	
`TI`	Supported type identifications: • TI 35 .. Measured value, scaled value with time tag CP56Time2a • TI 36 .. Measured value, short floating-point number with time tag CP56Time2a • TI 49 .. Setpoint command, scaled value • TI 50 .. Setpoint command, short floating-point number
`Name`	Name of the signal
`CASDU-IOA`	SICAM A8000 internal IEC 60870-5-101/104 message address (CASDU1, CASDU2, IOA1, IOA2, IOA3)
`Device`	In which device is the signal processed in the event of redundancy. • A • B • A + B
`SINAUT8_Station`	SINAUT 8-FW station number of the remote station: • 1 to 127
`SINAUT8_System-nummer`	SINAUT 8-FW System number: • 0 .. Main system • 1 to 7 .. Subsystem
`SINAUT8_Message_number`	SINAUT 8-FW Message number: • 256 to 511 .. Setpoint values digital (SB5, SB6) • 512 to 767 .. Setpoint values analog (SB2)

Parameter	
SINAUT8_Format	SINAUT-8-FW Setpoint value format: • analog • digital 8 bits • digital 16 bits
SINAUT8_coding	SINAUT-8-FW setpoint value coding: • binary • BCD
X_0%, X_100% **Y_0%, Y_100%**	Parameters for value adaptation (scaling): • Valid value range for **X_0%, X_100%** - see IEC 60870-5-104 data formats • **X_0%, X_100%** .. Value range of the remote station (SINAUT 8-FW) • **Y_0%, Y_100%** .. IEC 60870-5-101/104 Value Range SICAM A8000 (internal) • TI 35: .. **Y_0%, Y_100%** must not be less than –32768 or greater than +32767. • Value adaptation inactive at **Y_0%** = 0 and **Y_100%** = 0

Supported Data Formats:

SINAUT 8-FW Format	Designation	IEC 60870-5-101/104 data format (TI)
SB2	Setpoint values analog	35, 36, 49, 50
SB5	Setpoint values digital 8 bits	35, 36, 49, 50
SB6	Setpoint values digital 16 bits	35, 36, 49, 50

Legend: TI 35 = Measured value, scaled value with time tag CP56Time2a
TI 36 = Measured value, short floating-point number with time tag CP56Time2a
TI 49 = Setpoint command, scaled value
TI 50 = Setpoint command, short floating-point number

Control Location / Check Control Location

The function “Control location” is used so that setpoint commanads are only output from authorized sources. If the function is activated, setpoint commands from the protocol element are only transmitted to the remote station, when the control location (originator address) is enabled.

If the control location is not enabled, the protocol element immediately sends back a negative acknowledgment of activation (ACTCON) to the originator address (further details about control location see section *13.1.4.9 Control location function for commands and setpoint values*).

Emulation of ACTCON, ACTTERM for setpoint values

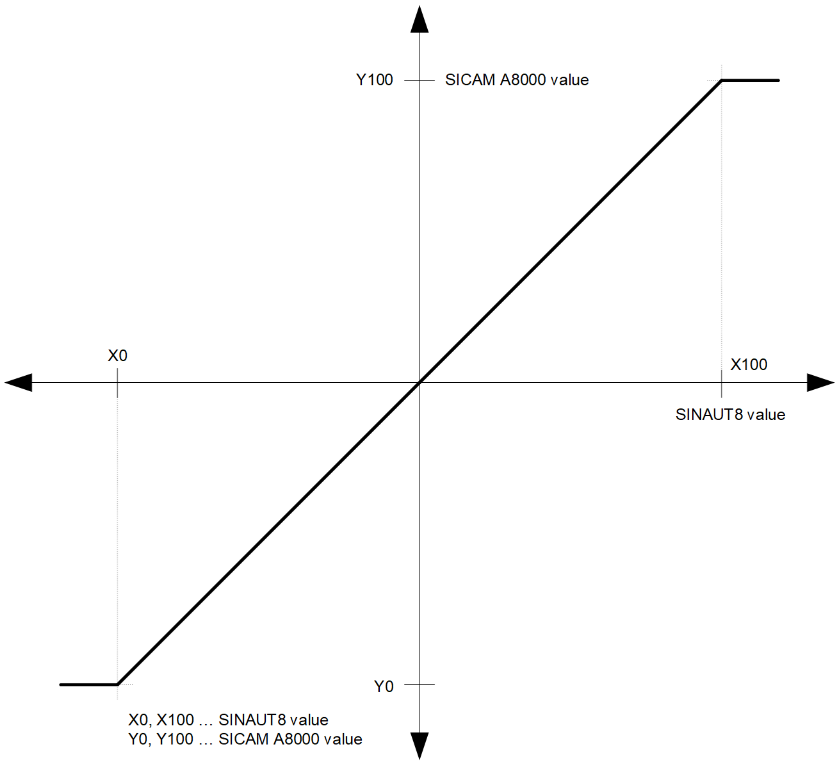
For setpoints, ACTCON+/- is emulated by the protocol in accordance with IEC 60870-5. Select/Execute is not supported (execute only). If a setpoint value can be correctly converted from IEC 60870-5-101/104 to SINAUT 8-FW, ACTCON+ is emulated after the command has been sent.

If a setpoint value cannot be converted or if the setpoint value is not parameterized in the signals, ACTCON- is emulated.

ACTTERM is not supported for setpoint values!

Value Adaptation

The value adaptation is defined by the parameters **`X_0%`**, **`X_100%`**, **`Y_0%`**, **`Y_100%`**.



[SA8MIO_Anpassung_Messwerte_TX_GER, 1, en_US]

13.16.7.2 Message Conversion in Receive Direction – SINAUT 8-FW Master

Message conversion in receive direction: SICAM A8000 ← SINAUT 8-FW

SICAM A8000: IEC 60870-5-101/104 ←		SINAUT 8-FW	
TI	**Designation**		**Designation**
TI 30	Single-point information with time tag CP56Time2a	ÜB3 ÜB4 ÜB5 ÜO16 ÜB6a ÜB6b	Indications 1 byte Indications 4 byte Indications 8 byte Operation bitstring (ZBBIT) Indications 1 byte real-time 10 ms Indications 1 byte real-time 1 ms
TI 31	Double-point information with time tag CP56Time2a	ÜB3 ÜB4 ÜB5 ÜB6a ÜB6b	Indications 1 byte Indications 4 byte Indications 8 byte Indications 1 byte real-time 10 ms Indications 1 byte real-time 1 ms
TI 32	Step position information with CP56Time2a time tag	ÜB14	Transformer stages with running contact
TI 33	Bitstring of 32 bits with time tag CP56Time2a	ÜO1 ÜO13 ÜO2	Audit record Error bitstring [405] Single error record

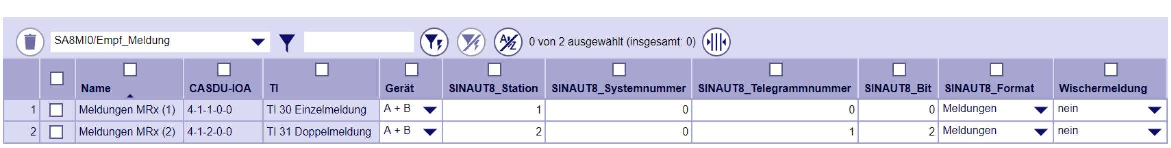
405 These message formats are only used in point-to-point traffic.

SICAM A8000: IEC 60870-5-101/104 ←		SINAUT 8-FW	
TI 34	Measured value, normalized value with time tag CP56Time2a	ÜB8 ÜB9 ÜB10 ÜB11	Measured value 8-bit (4x MV) Measured value 8-bit (8x MV) Measured value 11-bit (2x MV) Measured value 11-bit (4x MV) E-coil feedback
TI 35	Measured value, scaled value with time tag CP56Time2a	ÜB8 ÜB9 ÜB10 ÜB11	Measured value 8-bit (4x MV) Measured value 8-bit (8x MV) Measured value 11-bit (2x MV) Measured value 11-bit (4x MV) E-coil feedback
TI 36	Measured value, short floating-point number with time tag CP56Time2a	ÜB8 ÜB9 ÜB10 ÜB11 ÜB15 ÜB16	Measured value 8-bit (4x MV) Measured value 8-bit (8x MV) Measured value 11-bit (2x MV) Measured value 11-bit (4x MV) E-coil feedback Integrated total BCD encoded Integrated total dual encoded
TI 37	Integrated total with time tag CP56Time2a	ÜB8 ÜB9 ÜB10 ÜB11 ÜB15 ÜB16	Measured value 8-bit (4x MV) Measured value 8-bit (8x MV) Measured value 11-bit (2x MV) Measured value 11-bit (4x MV) Integrated total BCD encoded Integrated total dual encoded
		ÜO1 ÜO13 ÜO2	Audit record Error bitstring [405] Single error record
–	–	ÜO14	Last stop cause [406] [405]
–	–		Receipt of Quick Check/SCAN [406]
–	–	ÜO20	Reply message in polling mode [406]

Binary information items

The parameterization of the address and message conversion for binary information items in receive direction (with SINAUT 8-FW Master) is to be done with the SICAM Device Manager with the function “Signals” or with the SICAM TOOLBOX II, OPM II.

Processing type: *firmware* / **`Rec_binary_information`**


SA8MI0/Empf_Meldung — 0 von 2 ausgewählt (insgesamt: 0)

		Name	CASDU-IOA	TI	Gerät	SINAUT8_Station	SINAUT8_Systemnummer	SINAUT8_Telegrammnummer	SINAUT8_Bit	SINAUT8_Format	Wischermeldung
1		Meldungen MRx (1)	4-1-1-0-0	TI 30 Einzelmeldung	A + B	1	0	0	0	Meldungen	nein
2		Meldungen MRx (2)	4-1-2-0-0	TI 31 Doppelmeldung	A + B	2	0	1	2	Meldungen	nein

[SA8MI0_DM_Empf_Meldung_GER, 1, en_US]

406 These message formats are only evaluated by the protocol element itself and are not converted to IEC 60870-5-101/104.

Parameter	
TI	Supported type identifications: • TI 30 .. Single-point information with time tag CP56Time2a • TI 31 .. Double-point information with time tag CP56Time2a
Name	Name of the signal
CASDU-IOA	SICAM A8000 internal IEC 60870-5-101/104 message address (CASDU1, CASDU2, IOA1, IOA2, IOA3)
Device	In which device is the signal processed in the event of redundancy. • A • B • A + B
SINAUT8_Station	SINAUT 8-FW station number of the remote station: • 1 to 127
SINAUT8_System-nummer	SINAUT 8-FW System number: • 0 .. Main system • 1 to 6 .. Subsystem
SINAUT8_Message_number	SINAUT 8-FW Message number: • 0 to 511 .. Binary information items • 1016 to 1019 .. Operation bitstring (ZBBIT)
SINAUT8_Bit	Bit number of the binary information item within the SINAUT 8-FW message number: • 0 to 7 .. Single Point Information (1 bit) • 0, 2, 4, 6 .. Double-point information (2 bits) • 0 .. other information types
SINAUT8_Format	SINAUT-8-FW message format: • Binary information items • Protection signals
Transient information	Identifier for transient information: • yes / no

Supported Data Formats:

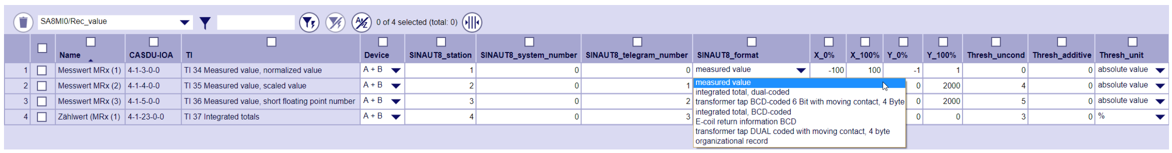
SINAUT 8-FW Format	Designation	IEC 60870-5-101/104 data format (TI)
ÜB3	Indications 1 byte	30, 31
ÜB4	Indications 4 byte	30, 31
ÜB5	Indications 8 byte	30, 31
ÜO16	Operation bitstring (ZBBIT)	30
ÜB6a	Indications 1 byte real-time 10 ms	30, 31
ÜB6b	Indications 1 byte real-time 1 ms	30, 31

Legend: TI 30 = Single-point information with time tag CP56Time2a
TI 31 = Double-point information with time tag CP56Time2a

Measured Values, Integrated Totals

The parameterization of the address and message conversion for measured values, integrated totals in receive direction (with SINAUT 8-FW Master) is to be done with the SICAM Device Manager with the function “Signals” or with the SICAM TOOLBOX II, OPM II.

Processing type: *firmware* | **`Rec_values`**



[SA8MI0_DM_Empf_Werte_GER, 1, en_US]

Parameter	
`TI`	Supported type identifications: • TI 33 .. Bitstring of 32 bits with time tag CP56Time2a • TI 34 .. Measured value, normalized value with time tag CP56Time2a • TI 35 .. Measured value, scaled value with time tag CP56Time2a • TI 36 .. Measured value, short floating-point number with time tag CP56Time2a • TI 37 .. Integrated total with time tag CP56Time2a
`Name`	Name of the signal
`CASDU-IOA`	SICAM A8000 internal IEC 60870-5-101/104 message address (CASDU1, CASDU2, IOA1, IOA2, IOA3)
`Device`	In which device is the signal processed in the event of redundancy. • A • B • A + B
`SINAUT8_Station`	SINAUT 8-FW station number of the remote station: • 1 to 127
`SINAUT8_System-nummer`	SINAUT 8-FW System number: • 0 .. Main system • 1 to 6 .. Subsystem
`SINAUT8_Message_number`	SINAUT 8-FW Message number: • 0 to 984 .. Measured values • 0 to 767 .. Integrated totals
`SINAUT8_Format`	SINAUT-8-FW Format: • Measured values • 1 metered value, dual-coded • Transformer taps BCD codiert 6 bits with running contact, 4 bytes • 1 metered value, BCD-coded with 7 decades • E-coil return information BCD • Transformer taps DUAL 6 bits with running contact, 4 bytes • organizational set
`Transient information`	Identifier for transient information: • yes / no

Parameter	
X_0%, X_100% **Y_0%, Y_100%**	Parameters for value adaptation (scaling): • **X_0%, X_100%** .. Value range of remote station (SINAUT 8-FW) valid range see SINAUT 8 data formats • **Y_0%, Y_100%** .. IEC 60870-5-101/104 Value Range SICAM A8000 (internal) • TI 34: .. **Y_0%** and **Y_100%** must not be greater or less than ±1 • TI 35: .. **Y_0%**, **Y_100%** must not be smaller than –32768 (only integer values allowed) Value adaptation inactive at **Y_0%** = 0 and **Y_100%** = 0
Thresh_uncond	If the value changes > **Thres_uncond**, the received value is immediately forwarded to the BSE.
Thresh_additive	If the value changes ≤ **Thres_uncond**, the received value is not immediately forwarded to the BSE and the additive measured value change monitoring is performed.
Threshold unit	• Absolute value (received value from SINAUT 8-FW) • %

Supported Data Formats:

SINAUT 8-FW Format	Designation	IEC 60870-5-101/104 data format (TI)
ÜB8	4 measured values 8 bits	35, 36
ÜB9	8 measured values 8 bits	34, 35, 36
ÜB10	2 measured values 11 bits	34, 35, 36
ÜB11	4 measured values 11 bits	34, 35, 36
	E-coil feedback	34, 35, 36
ÜB15	Integrated total BCD encoded	37
ÜB16	Integrated total dual encoded	37

Legend: TI 34 = Measured value, normalized value with time tag CP56Time2a
TI 35 = Measured value, scaled value with time tag CP56Time2a
TI 36 = Measured value, short floating-point number with time tag CP56Time2a
TI 37 = Integrated totals with time tag CP56Time2a

Additive Measured Value Change Monitoring

In order to avoid unnecessarily burdening the SICAM A8000 internal and further communication, the received measured value is monitored for changes according to the following rules:

- The first value determined after startup is transmitted immediately
- Each change of quality descriptor IV triggers an immediate transfer, the quality descriptor OV does not initiate a transfer
- Change monitoring in accordance with the method of the additive threshold value procedure:

  The measured value is monitored for changes when it is received. If the deviation compared to the last measured value transmitted to BSE is greater than the configured **thresh_uncond** , the new measured value is transmitted immediately. Otherwise, the deviation is added to the last spontaneously transmitted measured value, with the correct sign. Only when the amount of this sum exceeds the parameterizable **Thresh_additive**, the current measured value is spontaneously transmitted to the BSE.

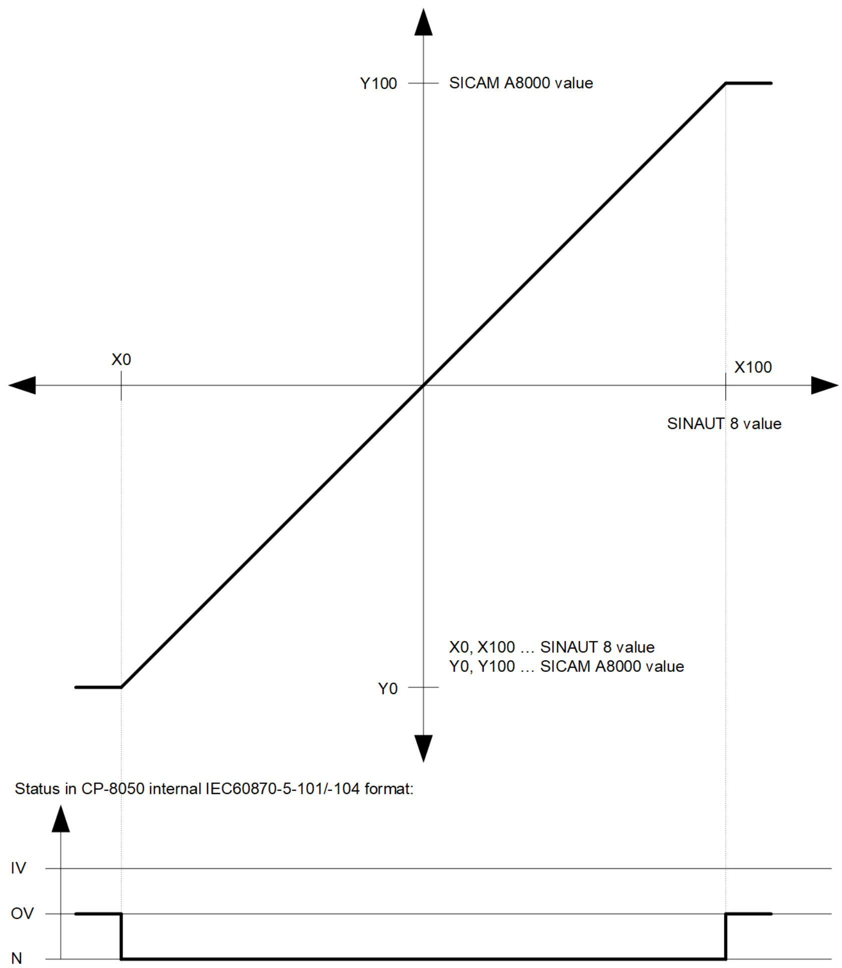
Thresh uncond	Thresh additive	Processing
=0	=0	→ Value is transmitted to the BSE upon each status change in the next processing grid
=0	≠0	
≠0	=0	• Change greater **`Thresh_uncond`**: → value is transmitted • Change less than/equal **`Thresh_uncond`**: → Additive threshold value procedure
≠0	≠0	• Change greater **`Thresh_uncond`**: → value is transmitted • Change less than/equal **`Thresh_uncond`**: → Additive threshold value procedure

A transmission of the measured value due to a general interrogation does not influence the threshold value procedure. The thresholds are to be parameterized for every measured value with the parameter **`Thresh_additive`** and the parameter **`Thresh_uncond`**.

For more details and examples of additive monitoring of measured value changes, see *13.1.4.13 Additive Measured Value Change Monitoring*.

Value Adaptation

The value adaptation is defined by the parameters **`X_0%`**, **`X_100%`**, **`Y_0%`**, **`Y_100%`**.



[SA8MI0_Anpassung_Messwerte_RX_GER, 1, en_US]

The value adaptation is only performed if `x_0%` or `x_100%` ≠ 0 is parameterized.

13.16.7.3 Message conversion in transmit direction – SINAUT 8-FW Slave

Message conversion in transmit direction: SICAM A8000 → SINAUT 8-FW

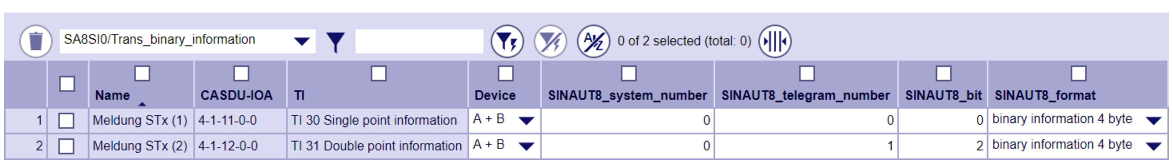
SICAM A8000: IEC 60870-5-101/104 →		SINAUT 8-FW	
TI	**Designation**		**Designation**
TI 30	Single-point information with time tag CP56Time2a	ÜB4 ÜO16 ÜB6a	Indications 4 byte Operation bitstring (ZBBIT) Indications 1 byte real-time 10 ms
TI 31	Double-point information with time tag CP56Time2a	ÜB4 ÜB6a	Indications 4 byte Indications 1 byte real-time 10 ms
TI 32	Step position information with CP56Time2a time tag	ÜB14	Transformer stages with running contact
TI 34	Measured value, normalized value with time tag CP56Time2a	ÜB8 ÜB9 ÜB10 ÜB11	Measured value 8-bit (4x MV) Measured value 8-bit (8x MV) Measured value 11-bit (2x MV) Measured value 11-bit (4x MV)

SICAM A8000: IEC 60870-5-101/104 →		SINAUT 8-FW	
TI 35	Measured value, scaled value with time tag CP56Time2a	ÜB8 ÜB9 ÜB10 ÜB11	Measured value 8-bit (4x MV) Measured value 8-bit (8x MV) Measured value 11-bit (2x MV) Measured value 11-bit (4x MV)
TI 36	Measured value, short floating-point number with time tag CP56Time2a	ÜB8 ÜB9 ÜB10 ÜB11	Measured value 8-bit (4x MV) Measured value 8-bit (8x MV) Measured value 11-bit (2x MV) Measured value 11-bit (4x MV)
TI 37	Integrated total with time tag CP56Time2a	ÜB15 ÜB16	Integrated total BCD encoded Integrated total dual encoded
–	–	ÜO1	Audit record
–	–	ÜO10	Acknowledgment record on start-up query [407]
–	–	ÜO13	Error bitstring “ZFBIT” [408]
–	–	ÜO14	Last stop cause [407] [408]
–	–	ÜO20	Reply message in polling mode [407]

Binary information items

The parameterization of the address and message conversion for binary information items in transmit direction (with SINAUT 8-FW Slave) is to be done with the SICAM Device Manager with the function “Signals” or with the SICAM TOOLBOX II, OPM II.

Processing type: *firmware* / `Trans_binary_information`


SA8SI0/Trans_binary_information — 0 of 2 selected (total: 0)

		Name	CASDU-IOA	TI	Device	SINAUT8_system_number	SINAUT8_telegram_number	SINAUT8_bit	SINAUT8_format
1	☐	Meldung STx (1)	4-1-11-0-0	TI 30 Single point information	A + B	0	0	0	binary information 4 byte
2	☐	Meldung STx (2)	4-1-12-0-0	TI 31 Double point information	A + B	0	1	2	binary information 4 byte

[SA8SI0_DM_Sende_Meldung_GER, 1, en_US]

Parameter	
`TI`	Supported type identifications: • TI 30 .. Single-point information with time tag CP56Time2a • TI 31 .. Double-point information with time tag CP56Time2a
`Name`	Name of the signal
`CASDU-IOA`	SICAM A8000 internal IEC 60870-5-101/104 message address (CASDU1, CASDU2, IOA1, IOA2, IOA3)
`Device`	In which device is the signal processed in the event of redundancy. • A • B • A + B
`SINAUT8_System-nummer`	SINAUT 8-FW System number: • 0 .. Main system • 1 to 6 .. Subsystem

407 These message formats are only evaluated by the protocol element itself and are not converted to IEC60870-5-101/104!

408 These message formats are only used in point-to-point traffic.

Parameter	
SINAUT8_Message_number	SINAUT 8-FW Message number: • 0 to 511 .. Binary information items ÜB4: The messages are always transmitted in steps of 4 (4, 8, 12, ..) i.e. The highest configurable message number = 508. • 1016 to 1019 .. Operation bitstring (ZBBIT)
SINAUT8_Bit	Bit number of the binary information item within the SINAUT 8-FW message number: • 0 to 7 .. Single Point Information (1 bit) • 0, 2, 4, 6 .. Double-point information (2 bits) • 0 .. other information types
SINAUT8_Format	SINAUT-8-FW message format: • Indications 4 byte • Indications 1 byte 10 ms

Supported Data Formats:

SINAUT 8-FW Format	Designation	IEC 60870-5-101/104 data format (TI)
ÜB4	Indications 4 byte	30, 31
ÜB6a	Indications 1 byte real-time 10 ms	30, 31
ÜO16	Operation bitstring (is transmitted with SINAUT-8 Format “Binary information items 4 byte”)	30

Legend: TI 30 = Single-point information with time tag CP56Time2a
TI 31 = Double-point information with time tag CP56Time2a

Message Conversion

The table describes the evaluated elements of the IEC 60870-5-101/104 message during message conversion.

Message elements		
TI .. Type identification		• TI 30 .. Single-point information with time tag CP56Time2a • TI 31 .. Double-point information with time tag CP56Time2a
CASDU-IOA .. Message address		Parameter-settable
QDS .. Quality descriptor		
BL .. Blocked		Not evaluated
SB .. Substituted		Not evaluated
NT .. Not topical		Not evaluated
IV .. Invalid		Not evaluated
Cause of transmission		
03 .. Spontaneous		Upon change of information state or quality descriptor
20 .. Interrogated by station interrogation		Upon reception of a GI request
xx .. Other COTs		Not supported
T .. Test		Not evaluated
Information		
Single-point information status		
SPI	0 .. OFF	Supported
	1 .. ON	Supported

Message elements		
Double-point information state		
DPI	0 .. Indeterminate or intermediate state	Supported
	1 .. OFF	Supported
	2 .. ON	Supported
	3 .. Indeterminate state	Supported
Time tag		
CP56Time2a .. Date + time		With ÜB6a messages 1 byte real-time (10 ms), the time and the IV bit of the time are converted to the SINAUT 8-FW time format.

Not listed elements of the IEC 60870-5-101/104 message are not rated/not supported!

Supported elements of the SINAUT 8-FW message:

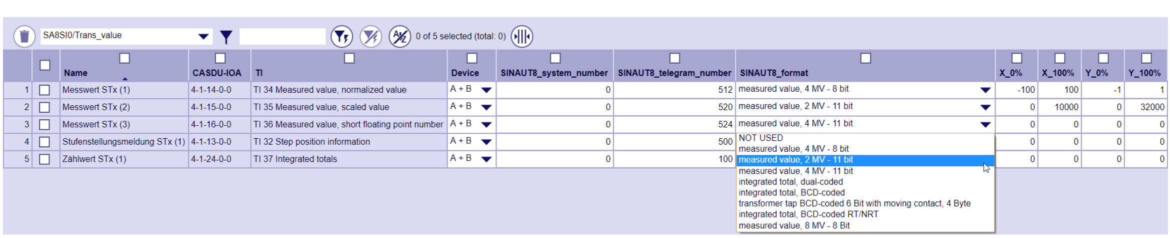
Elements of the SINAUT 8-FW message	
SINAUT8 message type	• ÜB4 .. Indications 4 byte • ÜB6a .. Indications 1 byte real-time 10 ms • ÜO16 .. Operation bitstring (ZBBIT)
Station number	= **`SINAUT8_Station`** (= 0 to 127)
Data type	ÜB4: Data type = spontaneous or interrogated ÜB6a: Data type = organizational ÜO16: Data type = organizational or interrogated
TGE ..	= 0
ÜB .. Overflow bit	= 0 or 1
TFK .. Message sequence identification	= 1 to 31
Record length	ÜB4: Record length = 4 ÜB6a: Record length = 5 ÜO16: Record length = 4
Message number	= **`SINAUT8_Telegrammnummer`** ÜB4: Message number = 0 to 508 ÜB6a: Message number = 0 to 511 In the case of a general interrogation, "messages with time" are transmitted in SINAUT8 format "messages - 4 bytes" (ÜB4) in steps of 4 (4, 8, 12,...). ÜO16: Message number = 1016
System number	SINAUT 8-FW System number: • 0 .. Main system • 1 to 6 .. Subsystem

Elements of the SINAUT 8-FW message	
Information byte I1 to I4; I5	ÜB4: • I1 to I4: E1 to E32 (single-point information) • I1 to I4: E1 to E32 (double-point information) All odd inputs (E1, E3, ..) correspond to “OFF”. All even inputs (E2, E4, ..) correspond to “ON”. • I5=0
	ÜB6a: • I1 .. Single-Point Information E1 to E8 (single-point information) • I1 .. Double-Point Information E1 to E8 (double-point information) All odd inputs (E1, E3, ..) correspond to “OFF”. All even inputs (E2, E4, ..) correspond to “ON”. • I2: .. Revision marks (changes from the “old” state) • I3 .. Time x 10 ms (less significant) • I4 .. Time x 10 ms (high significant) • I5 .. Identifier: A .. 1 minute overflow (not supported = 0) B .. Start up (not supported = 0) C .. not synchronized (not supported = 0) D .. not real-time (invalid identifier "IV bit" of the time information)
	ÜO16: • I1 to I4: E0 to E31 (markings of pending error numbers) • I5 = 0 From the point of view of the protocol in the substation, the operating bit header is treated like a normal information message. Only the error bit bar is also updated. The operation bitstring is transmitted with SINAUT-8 Format “Binary information items 4 byte”.

Measured values, integrated totals, transformer step position information

The parameterization of the address and message conversion for measured values, integrated totals, transformer step position information in transmit direction (with SINAUT 8-FW Slave) is to be done with the SICAM Device Manager with the function “Signals” or with the SICAM TOOLBOX II, OPM II.

Processing type: *firmware* / `Trans_values`



SA8SI0/Trans_value — 0 of 5 selected (total: 0)

	Name	CASDU-IOA	TI	Device	SINAUT8_system_number	SINAUT8_telegram_number	SINAUT8_format	X_0%	X_100%	Y_0%	Y_100%
1	Messwert STx (1)	4-1-14-0-0	TI 34 Measured value, normalized value	A + B	0	512	measured value, 4 MV - 8 bit	-100	100	-1	1
2	Messwert STx (2)	4-1-15-0-0	TI 35 Measured value, scaled value	A + B	0	520	measured value, 2 MV - 11 bit	0	10000	0	32000
3	Messwert STx (3)	4-1-16-0-0	TI 36 Measured value, short floating point number	A + B	0	524	measured value, 4 MV - 11 bit	0	0	0	0
4	Stufenstellungsmeldung STx (1)	4-1-13-0-0	TI 32 Step position information	A + B	0	500		0	0	0	0
5	Zählwert STx (1)	4-1-24-0-0	TI 37 Integrated totals	A + B	0	100		0	0	0	0

[SA8SI0_DM_Sende_Werte_GER, 1, en_US]

Parameter	
TI	Supported type identifications: • TI 32 .. Step position information with CP56Time2a time tag • TI 34 .. Measured value, normalized value with time tag CP56Time2a • TI 35 .. Measured value, scaled value with time tag CP56Time2a • TI 36 .. Measured value, short floating-point number with time tag CP56Time2a • TI 37 .. Integrated total with time tag CP56Time2a
Name	Name of the signal
CASDU-IOA	SICAM A8000 internal IEC 60870-5-101/104 message address (CASDU1, CASDU2, IOA1, IOA2, IOA3)
Device	In which device is the signal processed in the event of redundancy. • A • B • A + B
SINAUT8_System-nummer	SINAUT 8-FW System number: • 0 .. Main system • 1 to 6 .. Subsystem
SINAUT8_Message_number	SINAUT 8-FW Message number: • 0 to 984 .. Measured values (ÜB8, ÜB9, ÜB10, ÜB11) • 0 to 767 .. Integrated totals (ÜB15, ÜB16) • 0 to 511 .. Transformer taps (ÜB14)
SINAUT8_Format	SINAUT-8-FW Format: • NOT USED • Measured value, 4 MV - 8 bits • Measured value , 2 MV- 11 bits • Measured value, 4 MV - 11 bits • Measured value, 8 MV - 8 bits • Integrated totals, dual-coded • Integrated totals, BCD-coded • Integrated totals, BCD-coded EZ/NEZ • Transformer taps BCD coded 6 bits with running contact, 4 bytes
X_0%, X_100% **Y_0%, Y_100%**	Parameters for value adaptation (scaling): • Valid value range for **X_0%** , **X_100%** - see IEC 60870-5-104 data formats • **X_0%**, **X_100%** .. Value range of the remote station (SINAUT 8-FW) • **Y_0%**, **Y_100%** .. IEC 60870-5-101/104 Value Range SICAM A8000 (internal) • TI 34: **Y_0%** and **Y_100%** must not be greater or less than ±1 • TI 35: **Y_0%**, **Y_100%** must not be less than –32768 or greater than +32767. • Value adaptation inactive at **Y_0%** = 0 and **Y_100%** = 0

Supported Data Formats:

SINAUT 8-FW Format	Designation	IEC 60870-5-101/104 data format (TI)
ÜB8	Measured value 8-bits (4x MV)	34, 35, 36
ÜB9	Measured value 8-bits (2x MV)	34, 35, 36
ÜB10	Measured value 11-bits (2x MV)	34, 35, 36
ÜB11	Measured value 11-bits (4x MV)	34, 35, 36
ÜB14	Transformer stages with running contact	32
ÜB15	Integrated total BCD encoded	37
ÜB15	Integrated total BCD-coded with time ("project-specific format")	37
ÜB16	Integrated total dual encoded	37

Legend: TI 32 = Step position information with time tag CP56Time2a
TI 34 = Measured value, normalized value with time tag CP56Time2a
TI 35 = Measured value, scaled value with time tag CP56Time2a
TI 36 = Measured value, short floating-point number with time tag CP56Time2a
TI 37 = Integrated totals with time tag CP56Time2a

Interrogation lists in multi-point traffic

In multi-point traffic, the SINAUT8-FW master can request measured values from substations with interrogation lists 1 to 4.

In the SICAM A8000 substation, the measured values are assigned to the corresponding interrogation list with the parameters **Start message number** and **End message number** in the parameters **[[PRE] SINAUT8 | Communication functions | Data Transfer Control | Interrogation lists in multi-point traffic | Interrogation list 1-4**.

Transmission of disturbed measured values

Disturbed measured values in the transmission direction (NT=1 or IV=1) are either not transmitted or a parameterized substitute value is transmitted.

With the parameter **[PRE] SINAUT8 | Communication functions | Measured values | Measured value/transformer step with NT/IV=1**, the transmission of disturbed values can be deactivated.

If the transmission of disturbed values is activated, a substitute value is transmitted instead of the value. The substitute values for **Substitute value 8-bit measured value, Substitute value 11-bit measured value and substitute value transformer step** are set with the parameters under **[PRE] SINAUT8 | Communication functions | Measured values**.

If the OV bit is evaluated for measured values, a fixed substitute value is transmitted for measured values with OV=1.

- Substitute value for OV=1 for 8-bits measured values: +/- 254
- Substitute value for OV=1 for 11-bits measured values: +/- 2046

The evaluation of the OV bit is enabled/disabled with the parameter **[PRE] SINAUT8 | Communication functions | Measured values | Evaluate OV bit**.

Continuous measured values

If no spontaneous events are to be sent, continuous measured values are transmitted permanently in ascending order of the address. Measured values that are transmitted as continuous measured values can also be transmitted spontaneously.

The spontaneous transmission of measured values that are transmitted as continuous measured values can be enabled/diaabled with the parameter **[PRE] SINAUT8 | Communication functions | Measured values | Send continuous measured values spontaneously**.

With the parameter **[PRE] SINAUT8 | Communication functions | Measured values | Block measured values with GI**, the transmission of continuous measured values can be blocked with GI.

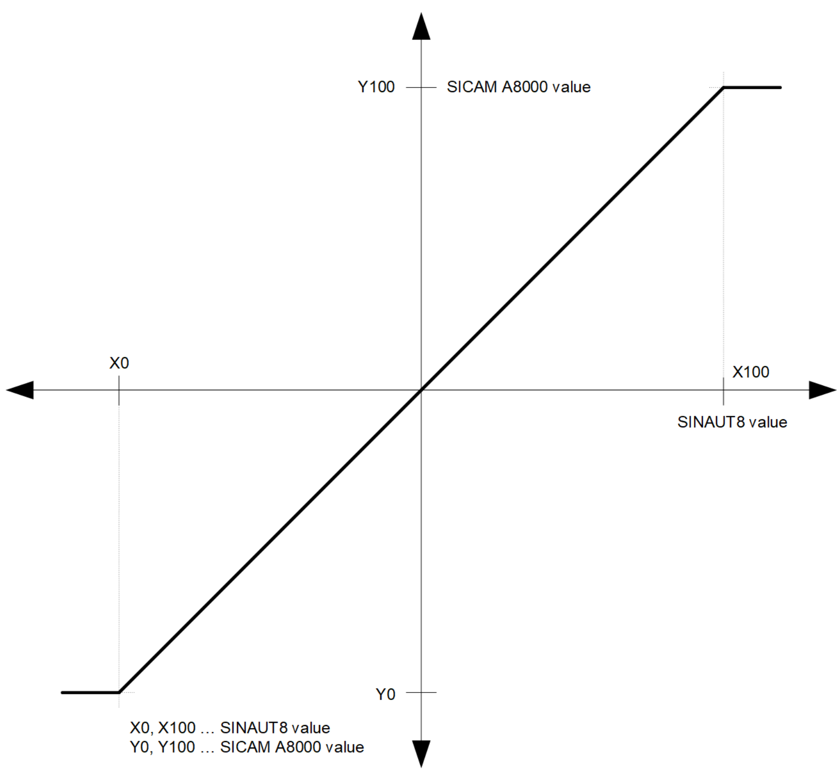
The duration of the lock is set with the parameter **[PRE] SINAUT8 | Communication functions | Measured values | Blocking time of the continuous measured values while GA is running**.

Block integrated totals at GI

With the parameter **[PRE] SINAUT8 | Communication functions | Integrated totals transmission | Block integrated totals while GI**, the transmission of integrated totals can be suppressed.

Value Adaptation

The value adaptation is defined by the parameters **X_0%**, **X_100%**, **Y_0%**, **Y_100%**.



[SA8SI0_Anpassung_Messwerte_TX_GER, 1, en_US]

Value Adaptation	
Transmit direction	SINAUT8 Value $_{external}$ = k * value$_{SICAM\ A8000}$ + d[409]
	k = (Y100 - Y0) / (X100 - X0) d = Y0 - k * X0

If the value adaptation is not activated (= direct transfer; **X_0%** = 0, **X_100%** = 0), the value is transferred unchanged.

409 Value adaption in receive direction: Row value = value$_{intern}$ = IEC 60870-5-101/104 value (SICAM A8000 internal); value$_{external}$ = SINAUT 8 value of the remote station.

The value adaptation is only performed if `x_0%` or `x_100%` <> "0" is parameterized.

If the value is less than `x_0%` or greater than `x_100%` when the value adaptation is activated, the value adaptation is carried out anyway, the OV bit is set and the value is transmitted.

If the value after the value adaptation is outside the value range of the SINAUT 8 data format, the value is set to the maximum value of the data format, the OV bit is set and the value is transmitted.

Message Conversion

The table describes the evaluated elements of the IEC 60870-5-101/104 message during message conversion.

Message elements	
TI .. Type identification	• TI 32 .. Step position information with CP56Time2a time tag • TI 34 .. Measured value, normalized value with time tag CP56Time2a • TI 35 .. Measured value, scaled value with time tag CP56Time2a • TI 36 .. Measured value, short floating-point number with time tag CP56Time2a • TI 37 .. Integrated total with time tag CP56Time2a
CASDU-IOA .. Message address	Evaluated
QDS .. Quality descriptor	
BL .. Blocked	is not evaluated [does not apply to TI 37]
SB .. Substituted	is not evaluated [does not apply to TI 37]
NT .. Not topical	evaluated [does not apply for TI 37]
IV .. Invalid	If the transmission of disturbed values (NT=1 oder IV=1) is activated, a substitute value is transmitted instead of the value.
OV .. Overflow	With OV=1: The evaluation of the OV bit is enabled/disabled with the parameter **`[PRE] SINAUT8 | Communication functions | Measured values | Evaluate OV bit`**. If the OV bit is evaluated for measured values, a fixed substitute value is transmitted for measured values with OV=1.
Cause of transmission	
03 .. Spontaneous	Evaluated
20 .. Interrogated by station interrogation	Evaluated
xx .. Other COTs	Not evaluated
T .. Test	Not evaluated
Information	
Value.. S .. Sign	• TI 34: normalized value • TI 35: scaled value • TI 36: IEEE STD 754 = short floating-point number • TI 32: Tap position (value with intermediate position display) • TI 37: Dual counter reading Sequence number, CA .. Counter was adjusted, CY. Transmission in not evaluated
Time tag	
CP56Time2a .. Date + time	Not rated

Not listed elements of the IEC 60870-5-101/104 message are not rated/not supported!

Supported elements of the SINAUT 8-FW message:

Elements of the SINAUT 8-FW message	
SINAUT8 message type	• ÜB8 .. Measured value 8-bits (4x MV) • ÜB9 .. Measured value 8-bits (8x MV) • ÜB10 .. Measured value 11-bits (2x MV) • ÜB11 .. Measured value 11-bits (4x MV) • ÜB14 .. Transformer stages with running contact • ÜB15 .. Integrated total BCD encoded • ÜB15 .. Integrated total BCD-coded with time ("project-specific format") • ÜB16 .. Integrated total dual encoded
Station number	= **`SINAUT8_Station`** (= 0 to 127)
Data type	ÜB8, ÜB9, ÜB10, ÜB11: Data type = spontaneous, cyclic or interrogated ÜB14, ÜB15, ÜB16: Data type = spontaneous or interrogated
TGE ..	= 0
ÜB .. Overflow bit	= 0 or 1
TFK .. Message sequence identification	= 1 to 31
Record length	ÜB8: Record length = 5 ÜB9: Record length = 7 ÜB10, ÜB14, ÜB15, ÜB16: Record length = 4 ÜB11: Record length = 6
Message number	= **`SINAUT8_Telegrammnummer`** ÜB8: Message number = 512 to 984 Each measured value occupies 2 message addresses; therefore each message is transmitted in steps of 8. ÜB9: Message number = 512 to 984 Each measured value occupies 2 message addresses; therefore each message is transmitted in steps of 16. ÜB10: Message number = 512 to 984 Each 11 bits measured value occupies 2 message addresses; therefore each message is transmitted in steps of 4. ÜB11: Message number = 512 to 984 Each 11 bits measured value occupies 2 message addresses; therefore each message is transmitted in steps of 8. ÜB14: Message number = 0 to 511 ÜB15: Message number = 0 to 764 ÜB16: Message number = 0 to 764
System number	SINAUT 8-FW System number: • 0 .. Main system • 1 to 6 .. Subsystem

Elements of the SINAUT 8-FW message	
Information byte I1 to I4; I5 Information byte I1 to I8; I9	ÜB8: • I1 to I4: Measured value 1 to 4 • I5 = sign for each measured value 1 to 4
	ÜB9: • I1 to I8: Measured value 1 to 8 • I9 = sign for each measured value 1 to 8
	ÜB10: • I1 to I4: Measured value 1, 2 incl. sign for measured value 1,2 • I5 = 0
	ÜB11: • I1 to I8: Measured value 1 to 4 incl. sign for measured value 1 to 4 • I9 = 0
	ÜB14: • I1 to I4: Transformer step value 1 to 4 (incl. running contact bit and error bit) • I5 = 0
	ÜB15: • I1 to I4: Integrated total value (6 decades BCD) + identifier Identifier: - re-storing bit (UB) = “0/1”. UB is inverted with each transmission. - Internal error bit (FBI) = “0” - External error bit (FBE) = “0” • I5 = 0
	ÜB15: Integrated total BCD-coded with time (“project-specific format”) • I1 to I4: Integrated total value (7 decades BCD) + identifier Identifier: - re-storing bit (UB) = “0/1”. UB is inverted with each transmission. - Internal error bit (FBI) = “0” - External error bit (FBE) = “0” • I5 to I7 = day, hour, minute
	ÜB16: • I1 to I4: Integrated total (28-bit) + identifier Identifier: - re-storing bit (UB) = “0/1”. UB is inverted with each transmission. - Internal error bit (FBI) = “0” - External error bit (FBE) = “0” • I5 = 0
	ÜB8, ÜB9, ÜB10, ÜB11 • Negative values are transmitted in 2's complement • Sign per measured value: 1 = “-”, 0 = “+”

Audit record [ÜO1]

The audit record is transmitted in point-to-point traffic as a reaction to the received test command. The message is formed on the protocol without the need for parameterization for message conversion.

Supported elements of the SINAUT 8-FW message:

Elements of the SINAUT 8-FW message	
SINAUT8 message type	• ÜO1 .. Audit record
Station number	= **SINAUT8_Station** (= 0 to 127)
Data type	= organizational
TGE ..	= 0
ÜB .. Overflow bit	= 0 or 1
TFK .. Message sequence identification	= 1 to 31
Record length	= 0
Message number	= 512
System number	= 0
Information byte I1, I2	I1 = 10101010 (check bit pattern) I2 = 01010101 (check bit pattern)

Error bitstring „ZFBIT [ÜO13]

The error bitstring is only transmitted once in point-to-point traffic after a restart of the SINAUT 8-FW substation and after a request from the SINAUT 8-FW master station. The error bitstring is the operating bitstring saved since the last error bitstring query of the SINAUT 8-FW master station. From the point of view of the control center, the error bitstring has a purely "archive character".

The message is formed on the protocol without the need for parameterization for message conversion.

Supported elements of the SINAUT 8-FW message:

Elements of the SINAUT 8-FW message	
SINAUT8 message type	• ÜO13 .. Error bitstring "ZFBIT"
Station number	= **SINAUT8_Station** (= 0 to 127)
Data type	= organizational
TGE ..	= 0
ÜB .. Overflow bit	= 0 or 1
TFK .. Message sequence identification	= 1 to 31
Record length	= 4
Message number	= 781
System number	= 0
Information byte I1 to I4, I5	• I1 to I4: Error markers • I5 = 0

Last stop cause [ÜO14]

The last cause of the stop is only transmitted in the point-to-point traffic after an error bit header query by the SINAUT 8-FW central station.

The transfer of the last cause of the stop can be enabled/disabled with the parameter **[PRE] SINAUT8 | General Settings | Send last stop cause (TGN=782)** .

The message is formed on the protocol without the need for parameterization for message conversion.

Supported elements of the SINAUT 8-FW message:

Elements of the SINAUT 8-FW message	
SINAUT8 message type	• ÜO14 .. Last stop cause
Station number	= **SINAUT8_Station** (= 0 to 127)
Data type	= organizational
TGE ..	= 0
ÜB .. Overflow bit	= 0 or 1
TFK .. Message sequence identification	= 1 to 31
Record length	= 4
Message number	= 782
System number	0 to 7
Information byte I1, I2	• I1: Error source (Program nr.) I1 [7]: 0 = error message from the program; 1 = error message from the device I2 [7] 0 = new entry; 1 = no new entry (has already been transferred) • I2: Mode • I3: Error number • I4: Additional information to 1 • I5: Additional information to 2 • I6 to I9 = 0

Acknowledge record for startup request [ÜO10]

After the SINAUT 8-FW central station has started up, the acknowledgment record is used to query whether the required parameters for the smoothing factor and threshold value are stored in the substation.

The message is formed on the protocol without the need for parameterization for message conversion.

Supported elements of the SINAUT 8-FW message:

Elements of the SINAUT 8-FW message	
SINAUT8 message type	• ÜO10 .. Acknowledge record for startup request
Station number	= **SINAUT8_Station** (= 1 to 127)
Data type	= organizational
TGE ..	= 0
ÜB .. Overflow bit	= 0 or 1
TFK .. Message sequence identification	= 1 to 31
Record length	= 2
Message number	= 772
System number	= 0
Information byte I1, I2	• I1: Status of the parameters in the RAM in the SINAUT 8-FW substation after a startup 00 = Startup (parameters in RAM, e.g. smoothing factor, threshold value are deleted) FF = Startup (parameters in RAM were retained) • I2 = 0

Reply message in polling mode [ÜO20]

The response message in polling mode is used in multi-point traffic (only in "PCM" mode) as a short acknowledgment for Quick-Check Scan (= simultaneous query of all stations for spontaneous information) and Quick Scan (= query of a station for spontaneous information).
The message is formed on the protocol without the need for parameterization for message conversion.

Supported elements of the SINAUT 8-FW message:

Elements of the SINAUT 8-FW message	
SINAUT8 message type	• ÜO20 .. Reply message in polling mode
Station number	= `SINAUT8_Station` (= 1 to 127)
Inf.	0 = Acknowledgment of quick check scan 1 = Negative acknowledgment on quick scan

13.16.7.4 Message Conversion in Receive Direction – SINAUT 8-FW Slave

Message conversion in receive direction: SICAM A8000 ← SINAUT 8-FW

SICAM A8000: IEC 60870-5-101/104 ←		SINAUT 8-FW	
TI	**Designation**		**Designation**
TI 35	Measured value, scaled value with time tag CP56Time2a	SB2 SB5 SB6	Setpoint values analog Setpoint values digital 8 bits Setpoint values digital 16 bits
TI 36	Measured value, short floating-point number with time tag CP56Time2a	SB2 SB5 SB6	Setpoint values analog Setpoint values digital 8 bits Setpoint values digital 16 bits
TI 45	Single command	SB1	Switching command
TI 46	Double command	SB1	Switching command
TI 49	Setpoint command, scaled value	SB2 SB5 SB6	Setpoint values analog Setpoint values digital 8 bits Setpoint values digital 16 bits
TI 50	Setpoint command, short floating-point number	SB2 SB5 SB6	Setpoint values analog Setpoint values digital 8 bits Setpoint values digital 16 bits
–	–	SO1	Check command [410]
–	–	SO2	Message repetition request (TFK acknowledgment) [410]
–	–	SO3	Startup acknowledgment command [410]
–	SICAM A8000 internal system messages: “FC=131 Reset for own module”	SO4	Reset command
–	SICAM A8000 internal system messages: “FC=155 Image-GI request”	SO6	Group scan command Query list 1-4[410] [411]
–	~~Time setting~~	~~SO16~~ ~~SO17~~ ~~SO18~~	~~10 minutes synchronization~~ ~~1 minute synchronization~~ ~~Set calendar~~
–	–	SO20	Start-up query (Start/restart)

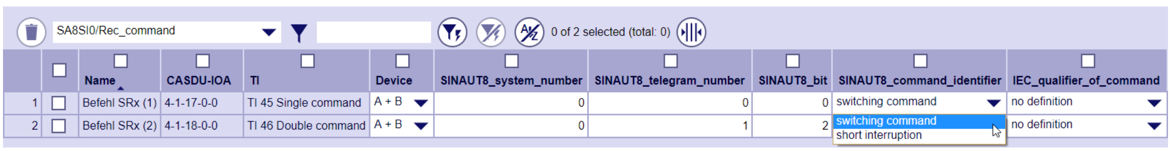
410 These message formats are only processed at the protocol element and are not converted from/to IEC 60870-5-101/104!
411 These message formats are only used in multi-point traffic (polling mode)!

SICAM A8000: IEC 60870-5-101/104 ←		SINAUT 8-FW	
–	–	SO24	Error bitstring query [410]
–	–	SO32	Call command in multi-point traffic“Quick check scan”[410 411]

Commands

The parameterization of the address and message conversion for commands in the receive direction (with SINAUT 8-FW Slave) is done with the SICAM Device Manager with the function“Signals”or with the SICAM TOOLBOX II, OPM II.

Processing type: *firmware* | `Rec_command`



[SA8SI0_DM_Empf_Befehl_GER, 1, en_US]

Parameter	
`TI`	Supported type identifications: • TI 45 .. Single command • TI 46 .. Double command
`Name`	Name of the signal
`CASDU-IOA`	SICAM A8000 internal IEC 60870-5-101/104 message address (CASDU1, CASDU2, IOA1, IOA2, IOA3)
`Device`	In which device is the signal processed in the event of redundancy. • A • B • A + B
`SINAUT8_System-nummer`	SINAUT 8-FW System number: • 0 .. Main system • 1 to 6 .. Subsystem
`SINAUT8_Message_number`	SINAUT 8-FW Message number: • 0 to 255 .. Commands
`SINAUT8_Bit`	Bit number of the binary information item within the SINAUT 8-FW message number: • 0 to 7 .. 1-bit Information • 0, 2, 4, 6 .. 2-bit Information • 0 .. other information types
`SINAUT8_Befehlsken-nung`	SINAUT-8-FW message format: • Switching command • Temporary interruption
`IEC_quali-fier_of_command`	IEC 60870-5-101/104 Qualifier of command: • none .. no additional definition • short .. short command execution time • long .. long command execution time

Supported Data Formats:

SINAUT 8-FW Format	Designation	IEC 60870-5-101/104 data format (TI)
SB1	Switching command	45, 46

Legend: TI 45 = Single command TI
46 = Double command

Message Conversion

The table describes the evaluated elements of the IEC 60870-5-101/104 message during message conversion.

Message elements		
TI .. Type identification		• TI 45 .. Single command • TI 46 .. Double command
CASDU-IOA .. Message address		Parameter-settable
Cause of transmission		
06 .. Activation		Supported
xx .. Other COTs		Not supported
T .. Test		Not supported
Information		
SCO/DCO		
SCS	Single command state	[only TI 45]
	0 .. OFF	Supported
	1 .. ON	Supported
DCS	Double command state	[only TI 46]
	0 .. Not allowed	Supported
	1 .. OFF	Supported
	2 .. ON	Supported
	3 .. Not allowed	Supported
QOC	S/E	
	0 = Execute	Supported
	1 = Select	Not supported
QU	Command qualifier	
	0 .. No additional definitions	Supported
	1 .. Short pulse duration	Supported
	2 .. Long pulse duration	Supported
	3 .. Persistent command	Not supported

Not listed elements of the IEC 60870-5-101/104 message are not rated/not supported!

Supported elements of the SINAUT 8-FW message:

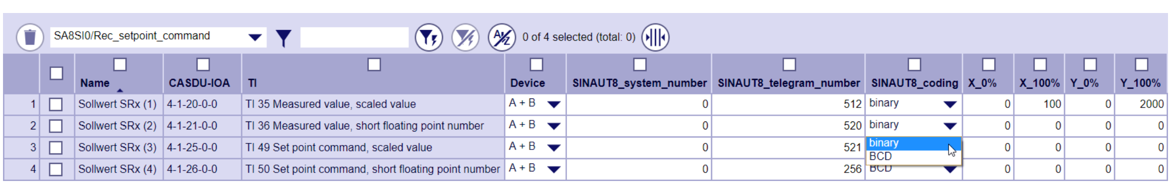
Elements of the SINAUT 8-FW message	
SINAUT8 message type	• SB1 .. Indications 4 byte
Station number	= station number of the SINAUT-8 substation (0 to 127)
Data type	= spontaneous
TGE ..	= 0

Elements of the SINAUT 8-FW message	
ÜB .. Overflow bit	= 0
TFK .. Message sequence identification	= 0
Record length	= 0
Message number	= **`SINAUT8_Telegrammnummer`** = 0 to 255
System number	SINAUT 8-FW System number: • 0 .. Main system • 1 to 6 .. Subsystem
Information byte I1, I2	SB1: • I1: command byte (command state“ON/OFF”for 1-bit or 2-bit information) Bit 0 to 7 .. Single commands Bit 0+1, 2+3, 4+5, 6+7 .. Double commands • I2: Identifier ZK .. Time code“Command execution time”(not evaluated) • BK .. Qualifier of command (switching command or temporary interruption; other command identifiers are not supported) • P .. Parity-bit

Setpoint values

The parameterization of the address and message conversion for setpoint values in the receive direction (with SINAUT 8-FW Slave) is done with the SICAM Device Manager with the function“Signals”or with the SICAM TOOLBOX II, OPM II.

Processing type: *firmware* / **`Rec_setpoint_value`**


SA8SI0/Rec_setpoint_command
0 of 4 selected (total: 0)

	Name	CASDU-IOA	TI	Device	SINAUT8_system_number	SINAUT8_telegram_number	SINAUT8_coding	X_0%	X_100%	Y_0%	Y_100%
1	Sollwert SRx (1)	4-1-20-0-0	TI 35 Measured value, scaled value	A + B	0	512	binary	0	100	0	2000
2	Sollwert SRx (2)	4-1-21-0-0	TI 36 Measured value, short floating point number	A + B	0	520	binary	0	0	0	0
3	Sollwert SRx (3)	4-1-25-0-0	TI 49 Set point command, scaled value	A + B	0	521	binary BCD	0	0	0	0
4	Sollwert SRx (4)	4-1-26-0-0	TI 50 Set point command, short floating point number	A + B	0	256	BCD	0	0	0	0

[SA8SI0_DM_Empf_Sollwert_GER, 1, en_US]

Parameter	
`TI`	Supported type identifications: • TI 35 .. Measured value, scaled value with time tag CP56Time2a • TI 36 .. Measured value, short floating-point number with time tag CP56Time2a • TI 49 .. Setpoint command, scaled value • TI 50 .. Setpoint command, short floating-point number
`Name`	Name of the signal
`CASDU-IOA`	SICAM A8000 internal IEC 60870-5-101/104 message address (CASDU1, CASDU2, IOA1, IOA2, IOA3)
`Device`	In which device is the signal processed in the event of redundancy. • A • B • A + B

Parameter	
SINAUT8_System-nummer	SINAUT 8-FW System number: • 0 .. Main system • 1 to 6 .. Subsystem
SINAUT8_Message_number	SINAUT 8-FW Message number: • 0 to 255 .. Commands
SINAUT8_coding	SINAUT 8-FW coding of the setpoint values: • binary • BCD
X_0%, X_100% **Y_0%, Y_100%**	Parameters for value adaptation (scaling): • **X_0%**, **X_100%** .. Value range of the remote station (SINAUT 8-FW) Valid range of values see SINAUT 8 data formats • **Y_0%**, **Y_100%** .. IEC 60870-5-101/104 Value Range SICAM A8000 (internal) Valid value range for X_0%, X_100% - see IEC 60870-5-104 data formats • TI 34: **Y_0%** and **Y_100%** must not be greater or less than ±1 • TI 35: .. **Y_0%**, **Y_100%** must not be smaller than −32768 (only integer values allowed) Value adaptation inactive at **Y_0%** = 0 and **Y_100%** = 0

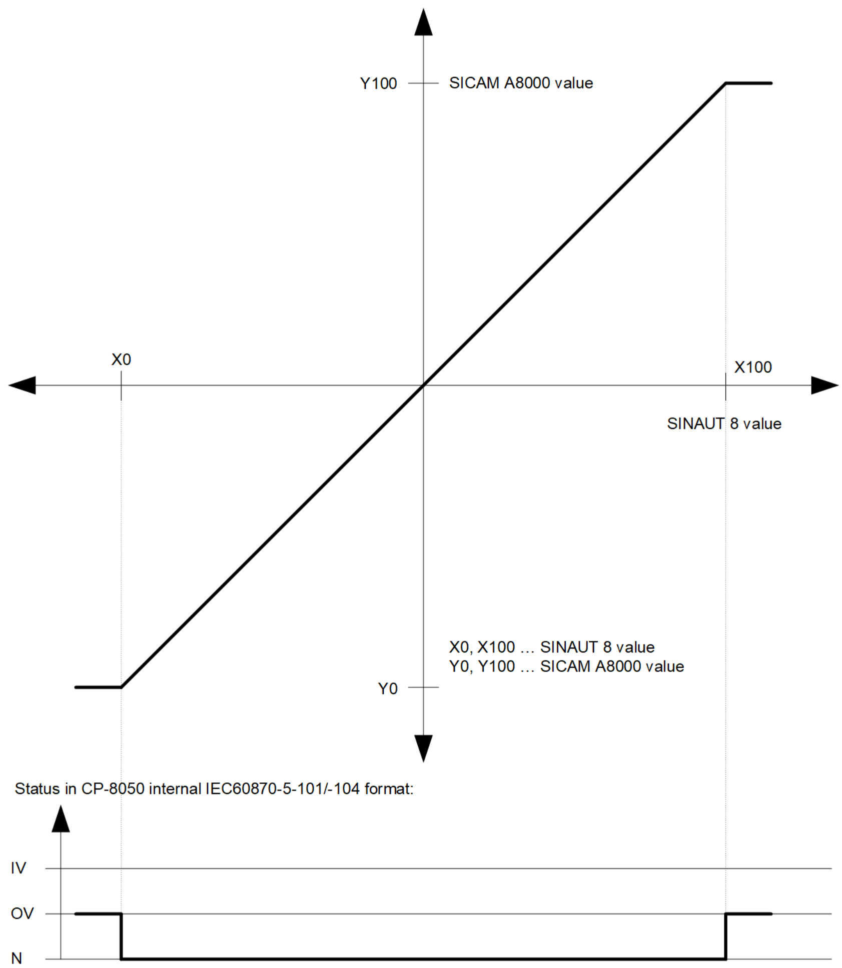
Supported Data Formats:

SINAUT 8-FW Format	Designation	IEC 60870-5-101/104 data format (TI)
SB2	Setpoint values analog	35, 36, 49, 50
SB5	Setpoint values digital 8 bits	35, 36, 49, 50
SB6	Setpoint values digital 16 bits	35, 36, 49, 50

Legend:
TI 35 .. Measured value, scaled value with time tag CP56Time2a
TI 36 .. Measured value, short floating-point number with time tag CP56Time2a
TI 49 .. Setpoint command, scaled value
TI 50 .. Setpoint command, short floating-point number

Value Adaptation

The value adaptation is defined by the parameters **X_0%**, **X_100%**, **Y_0%**, **Y_100%**.



[SA8SI0_Anpassung_Sollwerte_RX_GER, 1, en_US]

Value Adaptation	
Receive direction	SINAUT8 Value $_{external}$ = k * value$_{SICAM\ A8000}$ + d[412]
	k = (Y100 - Y0) / (X100 - X0) d = Y0 - k * X0

If the value adaptation is not activated (= direct transfer; **X_0%** = 0, **X_100%** = 0), the value is transferred unchanged.

The value adaptation is only performed if **X_0%** or **X_100%**<>"0"is parameterized.

If the value is less than **X_0%** or greater than **X_100%** when the value adaptation is activated, the value adaptation is carried out anyway, the OV bit is set and the value is transmitted.

If the value after the value adaptation is outside the value range of the SINAUT 8 data format, the value is set to the maximum value of the data format, the OV bit is set and the value is transmitted.

Message Conversion

The table describes the evaluated elements of the IEC 60870-5-101/104 message during message conversion.

412 Value adaption in transmit direction: Row value = value$_{intern}$ = IEC 60870-5-101/104 value (SICAM A8000 internal); value$_{external}$ = SINAUT 8 value of the remote station.

Message elements	
TI .. Type identification	• TI 35 .. Measured value, scaled value with time tag CP56Time2a • TI 36 .. Measured value, short floating-point number with time tag CP56Time2a • TI 49 .. Setpoint command, scaled value • TI 50 .. Setpoint command, short floating-point number
CASDU-IOA .. Message address	Parameter-settable
QDS .. Quality descriptor	
BL .. Blocked	Not supported (BL = 0)
SB .. Substituted	Not supported (SB = 0)
NT .. Not topical	Not supported
IV .. Invalid	
OV .. Overflow	OV = 1: If the value after the value adaptation is outside the value range of the data format of the corresponding TI. If the received setpoint is passed on in scaled format (measured value or setpoint command) and if the received value is greater than 32767, then"IV bit"and"OV bit"will be set (value = 32767).
Cause of transmission	
03 .. Spontaneous	Change of setpoint value [only TI 35, 36]
06 .. Activation	Change of setpoint value [only TI 49, 50]
xx .. Other COTs	Not supported
T .. Test	Not supported
Information	
Value.. S .. Sign	• Scaled value • IEEE STD 754 = short floating-point number
Time tag	
CP56Time2a .. Date + time	PRE internal time (receive time)

Not listed elements of the IEC 60870-5-101/104 message are not rated/not supported!

Supported elements of the SINAUT 8-FW message:

Elements of the SINAUT 8-FW message	
SINAUT8 message type	• SB2 .. Setpoint value analog (8 bits) • SB5 .. Setpoint value digital (8 bits) • SB6 .. Setpoint value digital (16 bits)
Station number	= station number of the SINAUT-8 substation (0 to 127)
Data type	= spontaneous
TGE ..	= 0
ÜB .. Overflow bit	= 0
TFK .. Message sequence identification	= 0
Record length	SB2: Record length = 3 SB5: Record length = 4 SB6: Record length = 0
Message number	= **`SINAUT8_Telegrammnummer`** SB2: Message number = 512 to 767 (setpoint value analog) SB2, SB6: Message number = 256 to 511 (setpoint value digital)

Elements of the SINAUT 8-FW message	
System number	SINAUT 8-FW System number • 0 .. Main system • 1 to 6 .. Subsystem
Information byte I1, I2	SB2: • I1: Setpoint value analog (8 bits) • I2: Sign Negative values are transmitted in 2's complement Sign: 1 =“-”, 0 =“+”
	SB5: • I1: Setpoint value (8 bits); binary or BCD • I2 = 0 In the case of implausible BCD values, setpoint values in the receive direction are discarded with the error message“Format conversion error in receive direction”.
	SB6: • I1, I2: Setpoint value (16 bits); binary or BCD In the case of implausible BCD values, setpoint values in the receive direction are discarded with the error message“Format conversion error in receive direction”.

Check command [SO1]

The check command [SO1] is only transmitted cyclically from the SINAUT 8-FW central station to the substation in point-to-point traffic; as a reaction to the check command received, the substation sends the audit record [ÜO1] to the control center.

The message is processed directly on the protocol without the need for parameterization for message conversion.

Supported elements of the SINAUT 8-FW message:

Elements of the SINAUT 8-FW message	
SINAUT8 message type	• SO1 .. Check command
Station number	= SINAUT 8-FW Station number (0 to 127)
Data type	= organizational
TGE ..	= 0
ÜB .. Overflow bit	= 0
TFK .. Message sequence identification	= 0
Record length	= 0
Message number	= 512
System number	= 0
Information byte I1, I2	I1 = 10101010 (check bit pattern) I2 = 01010101 (check bit pattern)

Message repetition request / TFK positive acknowledgment [SO2]

The message is used to acknowledge transmitted messages and as a message repetition request. The message is processed directly on the protocol without the need for parameterization for message conversion.

Supported elements of the SINAUT 8-FW message:

Elements of the SINAUT 8-FW message	
SINAUT8 message type	• SO2 .. Message repetition request / TFK positive acknowledgment
Station number	= SINAUT 8-FW Station number (0 to 127)
Data type	= organizational
TGE ..	= 0
ÜB .. Overflow bit	= 0
TFK .. Message sequence identification	= 0
Record length	= 2
Message number	= 513
System number	= 0
Information byte I1, I2	• I1: Message sequence identification number (TFK) of the message to be retransmitted. Identifier: - only acknowledgment - request without acknowledgment - request with acknowledgment - overflow bit is acknowledged • I2 = 0

Startup acknowledgment command [SO3]

After a start-up (power failure, reset), the substation sends messages with the messages sequence identifier = 31. The messages are not saved in the substation.

The control center must specifically confirm the start-up of the substation with a startup acknowledgment command (address 514). After successful acknowledgment, the substation transmits the error bitstring (address 781) with the message sequence identifier = 1 and the"last STOP cause"(address 782) with the message sequence identifier = 2 and switches to normal operation.

In multi-point traffic, only the message sequence identifier is initialized.

The message is processed directly on the protocol without the need for parameterization for message conversion.

Supported elements of the SINAUT 8-FW message:

Elements of the SINAUT 8-FW message	
SINAUT8 message type	• SO3 .. Startup acknowledgment command
Station number	= SINAUT 8-FW Station number (0 to 127)
Data type	= organizational
TGE ..	= 0
ÜB .. Overflow bit	= 0
TFK .. Message sequence identification	= 0
Record length	= 2
Message number	= 514
System number	= 0
Information byte I1, I2	= 0

Reset command [SO4]

The reset command is used as a reset command for the own device.

The message is processed directly on the protocol without the need for parameterization for message conversion and as a SICAM A8000 internal system message"FC=131 Reset for own module"transferred to the configured destination address (destination region, destination component).

Supported elements of the SINAUT 8-FW message:

Elements of the SINAUT 8-FW message	
SINAUT8 message type	• SO4 .. Reset command
Station number	= SINAUT 8-FW Station number (0 to 127)
Data type	= organizational
TGE ..	= 0
ÜB .. Overflow bit	= 0
TFK .. Message sequence identification	= 0
Record length	= 2
Message number	= 519
System number	= 0, 2
Information byte I1, I2	= 0

Group scan command [SO6]

The group query command is used as a general interrogation command.

The message is processed directly on the protocol without the need for parameterization for message conversion and as a SICAM A8000 internal system telegram FC=155"Image-GI request"passed to the BSE with the CASDU according to the parameter **`[PRE] SINAUT8 | Communication functions | General interrogation | CASDU passed on for general interrogation`** or with the parameterized CASDUs of the message conversion in the transmission direction (depending on the parameterization, several image GI requests can be passed on in this way).

Supported elements of the SINAUT 8-FW message:

Elements of the SINAUT 8-FW message	
SINAUT8 message type	• SO6 .. Group scan command
Station number	= SINAUT 8-FW Station number (0 to 127)
Data type	= organizational
TGE ..	= 0
ÜB .. Overflow bit	= 0
TFK .. Message sequence identification	= 0
Record length	= 2
Message number	= 521

Elements of the SINAUT 8-FW message	
System number	= 0
Information byte I1, I2	• I1: Request group 1 .. General interrogation (station selective) 2 .. Counter interrogation (station selective) ← is not supported! 3 .. Partly interrogation 3 (station selective) ← is not supported! 4 .. Partly interrogation 4 (station selective) ← is not supported! 5 .. Total image interrogation ← is not supported! 6 .. Partly image interrogation (e.g.: ZW)¬← not supported! 7 .. Partly image interrogation (e.g.: MW)¬← not supported! 8 .. Partly image interrogation (e.g.: MLD)¬← not supported! • I2 = 0

13.17 DLMS Ethernet Counter Interfacing

13.17.1 Introduction

The DLMS Ethernet Meter Protocol is a proprietary LAN transmission protocol for communication with Landis & Gyr meters based on DLMS and IEC 1107 (IEC 62056-21).

Protocol firmware for DLMS Ethernet meter coupling:

Firmware	System	Standard and function
ETMCI9	CP-8031, CP-8050	DLMS Ethernet counter interfacing Master (Client)

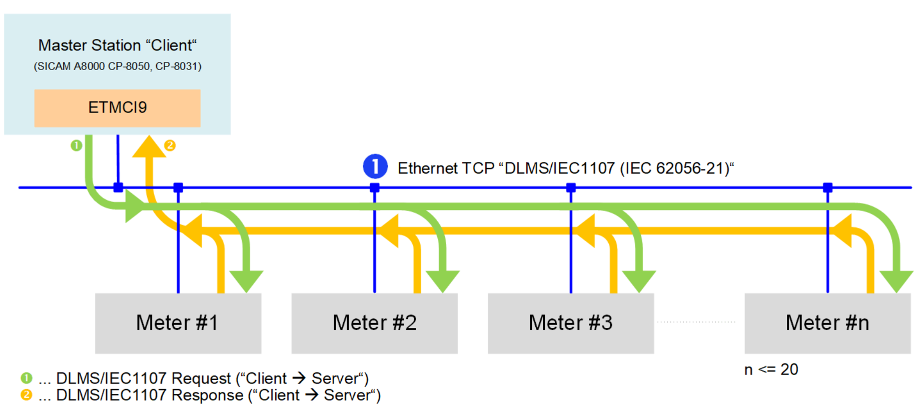
Communication with the meter requires selected communication modules in the meter.

The Ethernet interface with the following settings is used to connect the meters:

- Autonegotiation (100 Mbit/s full duplex), Auto-MDIX

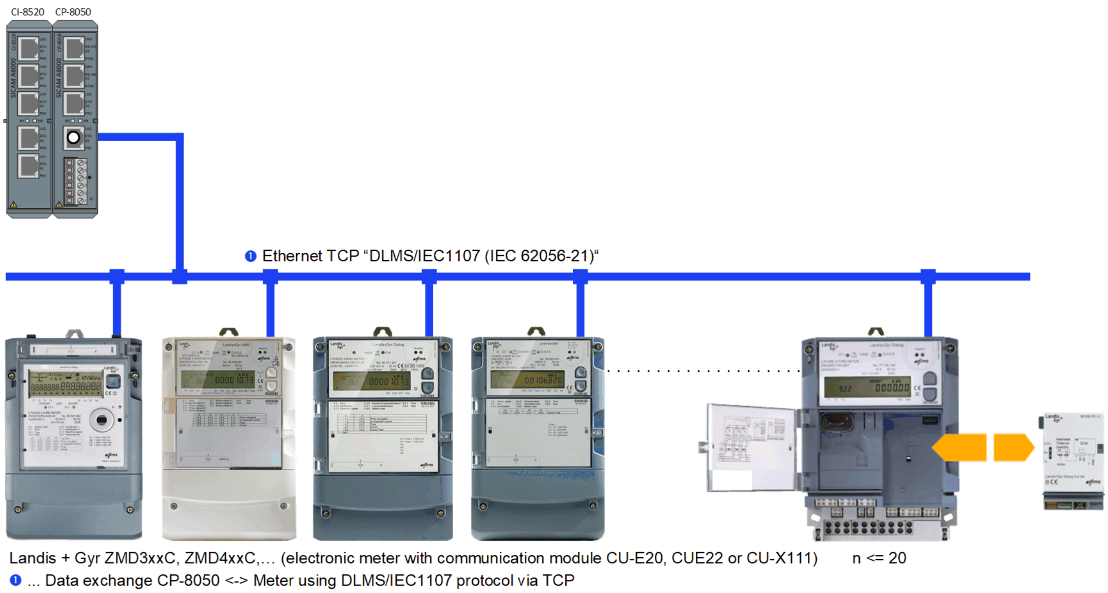
Data is transferred via Ethernet (TCP/IP).
The counter values are transmitted with DLMS via TCP/IP; the transmission of other services (e.g. time setting, reading out the serial number, reading out the messages ...) takes place with IEC 1107 (IEC 62056-21) via TCP/IP.
The data transfer is controlled by the DLMS/1107 client (=ETMCI9 protocol in SICAM A8000); the counters are the servers.

Schematic configuration:



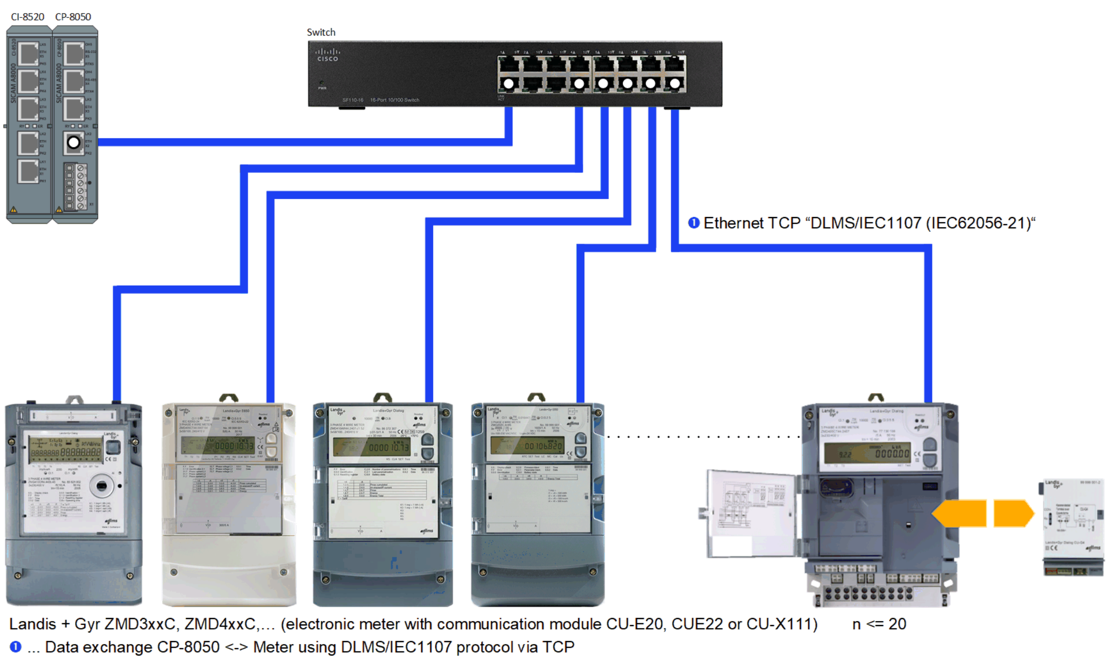
[ETMCI9_Configuration_Schematisch_GER, 1, en_US]

Configuration (Example 1):



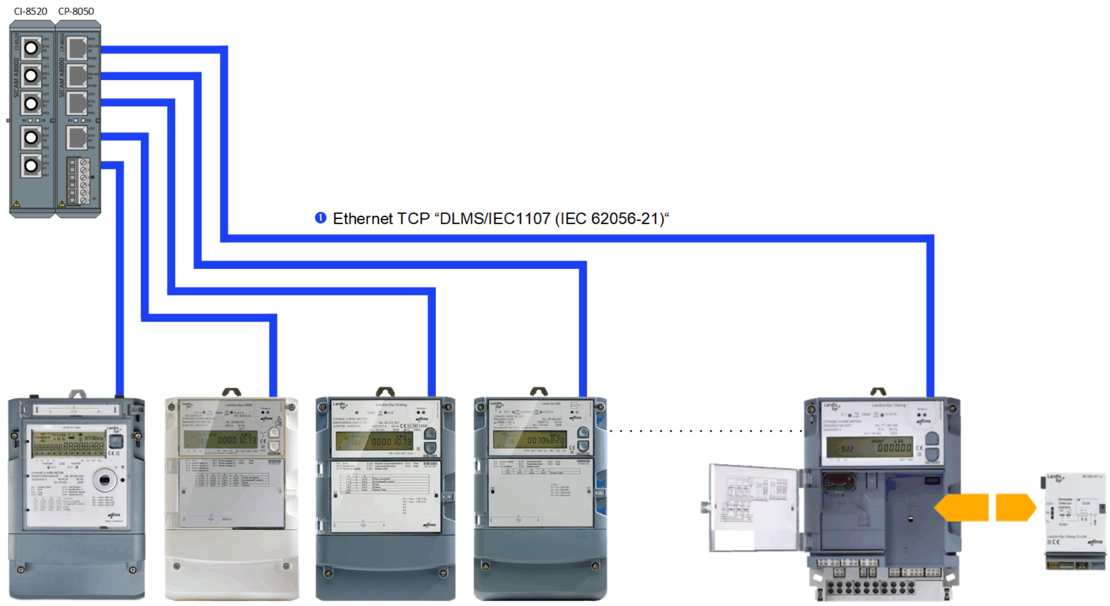
[ETMCI9_Configuration_GER, 1, en_US]

Configuration (Example 2) - with external switch:



[ETMCI9_Configuration_Detail2_GER, 1, en_US]

Configuration (Example 3) – CP-8050 with CI-8520 as switch:



[ETMCI9_Configuration_Detail1_GER, 1, en_US]

NOTE

- CP-8050: max. 2x CI-8520 possible!
- Several CI-8520 switches cannot be combined, i.e. only 1x CI-8520 switch possible per protocol element.

13.17.2 Functions

Function	ETMCI9
Ethernet meter coupling (Ethernet Meter Client)	
Proprietary Ethernet communication protocol according to DLMS/1107 for coupling Landis & Gyr meters with the communication module CUE-20, CUE-22, CUE-111	✓
DLMS/1107 "Client" via Ethernet	✓
DLMS/1107 "Server" via Ethernet	–
max. number meter (slaves)	20
Port Number TCP (default)	1000
Port Number TCP "Can be set by parameter"	1 to 65535
Max. number of supported data points (all connections)	2000
Network configuration	
LAN/WAN	✓
Ethernet interface (properties)	
Ethernet acc. IEEE 802.3 (100Base-TX)	✓
Autonegotiation (100 Mbit/s full duplex), Auto-MDIX	✓
Ethernet Interface *13.1.4.6 Ethernet Interface – Module Properties*	✓

Function	ETMCI9
Supported 1107 functions (IEC 62056-21)	
Mode-C	✓
Block check character (BCC) mandatory	✓
Identification of the device	✓
Reading the device address (serial number)	✓
Reading the time information	✓
Time setting	✓
Password Input	✓
Break Message (B0)	✓
Time window exceeded	✓
Supported DLMS functions(IEC 62056-42, IEC 62056-46, IEC 62056-53)	
Disconnect	✓
Connect	✓
MAP120 (partial emulation of MAP120 reading software functions)	✓
Read IEC addresses	✓
Read table of content	–
Last reset	✓
Polling (object query)	✓
Acknowledgement	✓
Object list	–
IEC60870-5-101/-104 data formats in transmit direction	
TI 100 .. (General) Interrogation command	✓
TI 101 .. Counter Interrogation Command	–
TI 103 .. Clock Synchronization Command	✓
IEC60870-5-101/-104 data formats in receive direction	
TI 30 .. Single-point information with time tag CP56Time2a	✓
TI 37 .. Integrated total with time tag CP56Time2a	✓
Data acquisition by querying	
Reading out the messages via IEC 1107	✓
Reading out the integrated totals via DLMS	✓
Conversion of the messages IEC 1107→IEC 60870-5-101/104	✓
Conversion of the integrated totals DLMS→IEC 60870-5-101/104	✓
Scaling of integrated totals (with multiplier and constant factors */)	✓
1107 messages via user data container in SICAM A8000	–
Billing data (Register)	–
Load profile	–
Logbook	–
Command Transmission	–
Transmission of integrated totals	
Cyclic polling of integrated totals with DLMS	✓

Function	ETMCI9
Transmission of the integrated totals with <TI:=101> counter interrogation command	–
General interrogation	
1107 binary information	✓
DLMS integrated totals	–
SICAM A8000 internal emulation of ACTCON/ACTTERM for general interrogation (according to IEC 60870-5-101/104)	–
Clock synchronization	
Clock synchronization of meter with IEC 1107 (IEC 62056-21) via TCP/IP	✓
Redundancy	
Device redundancy:	
• Device redundancy with the same PRE parameters	✓
• Device redundancy with different PRE parameters (“A/B parameters”)	–
• Device redundancy with different PRE parameters (“A/B parameters”) for signals	✓
Protocol element control messages	–
Protocol element return information	
Station failure	✓
Web server	
Log internal diagnostic- and statistic information via protocol-specific web pages	–
Engineering	
SICAM Device Manager	✓
SICAM TOOLBOX II	✓

Restrictions

- Only a subset of DLMS is supported
- Only a subset of IEC 1107 is supported
- The time synchronization of the meters is only with IEC 1107
- “Loading of parameters” is not supported
- File transfer (load profile) is not supported
- Message Formats In receive direction (SICAM A8000←meter): Only DLMS counts and 1107 alert “Time window exceeded” are supported
- SICAM A8000 internal IEC 1107 data transmission via container is not supported
- no coding
- With IEC 1107 only Mode-C is supported
- With IEC 1107, the block check character (BCC) is mandatory
- The object list is not supported
- No Emulation of ACTCON, ACTTERM according IEC 60870-5-101/104 for general interrogation

- Meter interrogation command with <TI:=101> is not supported
- Redundancy is only partially supported

NOTE

- The ETMCI9 protocol element only supports a subset of the 1707/DLMS protocol for connecting Landis + Gyr meters via Ethernet!
- For the connection of Landis + Gyr meters, the limited functionality of the 1107/DLMS client function in SICAM A8000 must be observed!

13.17.3 Modes of Operation

Standard Operation Mode	Interface → optional DTE	Interface signals
Electrical ethernet-interface (twisted pair)	CP-8050: X2, X3 CI-8520: X1 to X5 CI-8522: X1 to X3	TXD+, TXD-, RXD+, RXD-

13.17.4 Communication

Additional suitable transmission devices and/or network components may be required for communication with the meters.

Own station = central station "Ethernet Meter Client"

System	System element	Protocol element	Remarks
SICAM A8000 Series	CP-8031/CPCI85 CP-8050/CPCI85 CP-8050/EPCI85	ETMCI9	max. 20 meters per protocol with ETMCI9

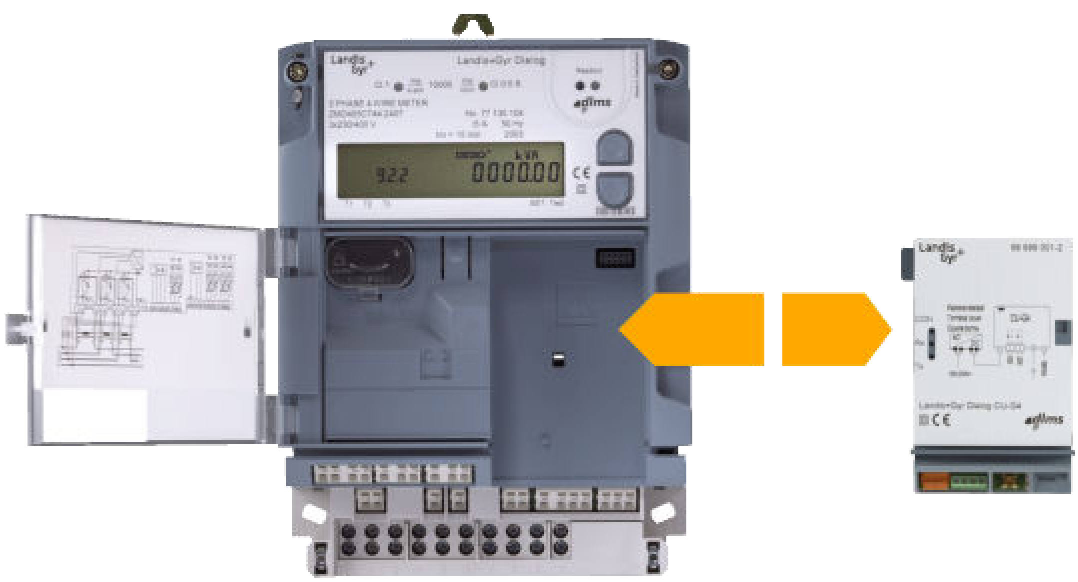
Remote station = substation "Landis & Gyr meter"

Counter	Supported communication modules	Comments
• Landis + Gyr E650 Series 3 - ZMD310CT/AT  [ph_ZMD310CT, 1, --_--]	• CU-E20 • CU-E22 • CU-XE111	Landis+Gyr E650 Industrial and commercial meters
• Landis + Gyr E650 Series 4 - ZMD4xxCT/AT, ZFD4xxCT/AT • ZMD402 • ZMD405  [ph_ZMD405, 1, --_--]  [ph_ZMD405C_w, 1, --_--]	• CU-E20 • CU-E22 • CU-XE111	Landis+Gyr E650 Industrial and commercial meters

Counter	Supported communication modules	Comments
• ZMD410  [ph_ZMD410, 1, --_--]		
• ZFD402 • ZFD405 • ZFD410		

Landis & Gyr communication modules

The inserted Landis & Gyr communication module is internally connected to the meter via a serial interface. The messages from the Ethernet interface are transmitted serially from the communication module to the meter.



[ZMD4xxC, 1, --_--]

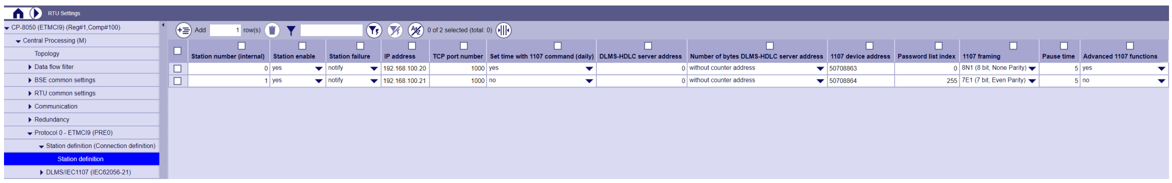
Supported communication modules	Functions	Comments
• CU-E20 	Communication Interfaces: • Ethernet Connection IEEE802.3, 10 Mbps • direct link interface (RS-232) Protocols: • IEC 62056-21 • DLMS • TCP/IP	Can be used directly in: Landis + Gyr E650 ZxD300/400xT or E850 ZxQ
• CU-E22 	Communication Interfaces: • Ethernet Connection IEEE802.3, 10 Mbps • RS-485 • CS+ Protocols: • IEC 62056-21 • DLMS • TCP/IP	Can be used directly in: Landis + Gyr E650 ZxD300/400xT or E850 ZxQ
• CU-XE111 	Communication Interfaces: • 2x Ethernet Connection (ETH0, ETH1) IEEE802.3, 10 Mbps • direct link interface (RS-232) • RS-485/RS-422 Protocols: • IEC 62056-21 • DLMS • TCP/IP • IEC 60870-5-104 [413]	Can be used directly in: Landis + Gyr E650 ZxD300/400xT, E850 ZxQ or S650 SxD400xT Note: • Firmware version B30 is required in the meter for CU-XE111! • Compared to CU-E20 and CU-E22, CU-XE111 only offers limited IEC 1107 functionality (only connect/disconnect).

413 For IEC60870-5-104 a spec. Firmware version + license is required in the meter! → Check with Landis + Gyr whether the selected meter supports this function.

13.17.5 Communication According to DLMS/1107

Station Definition

All connected meters must be entered in the **`[PRE] Station definition`**. The ETMCI9 protocol supports a maximum of 20 meters.



[ETMCI9_Stationsdefinition_GER, 1, en_US]

For a description of the fields, see *13.17.8 Parameters and Settings*.

TCP/IP connection setup to the meters

After a start-up delay of 60 seconds, the ETMCI9 protocol establishes a TCP connection to the meter device and then reads the serial number using the 1107 read command in order to check the device address of the connected meter.
In SICAM A8000, the TCP port number for the DLMS/1107 protocol over TCP/IP can be set with the parameter **`[PRE] Station definition | TCP Port number`** in the range 0 to 65535 (default setting = 1000).

If the serial number cannot be read or the serial number is not identical to the configured **`1107 device address`** in the **`Station definition (Connection definition)`**, the TCP connection is closed again.

IEC 1107 (IEC 62056-21)

Only Mode-C according to IEC 1107 (IEC 62056-21) is supported - the block check character (BCC) is mandatory.
The IEC 1107 data is transported from/to the meter via Ethernet using TCP and converted to IEC 1107 “serial” in the CU-E20/CU-E22/CU-XE111 meter communication module and transmitted to the meter.

Supported IEC 1107 (IEC 62056-21) functions:

- Identification of the device
- Reading the device address (serial number)
- Reading the time information
- Time setting
- Password Input
- Break Message (B0)
- Time window exceeded

Identification of the device

The identification of the device is used to establish a connection with the meter. The response includes the manufacturer designation, baud rate and manufacturer-specific designation for the meter.
When identifying the device (meter), a “Request Message” is sent to the meter and this is answered by the meter with an “Identification Message”.

Reading the device address (serial number)

After the TCP connection has been established, the serial number of the meter is read using the 1107 read command.
If the serial number cannot be read or the serial number is not identical to the configured **`1107 device address in the Station definition (Connection definition)`**, the TCP connection is closed again.
After a break message (B0) the new connection setup starts after 5 seconds.
To read the device address (serial number), a "Programming Command Message" (read mode "R" in register "D110") is sent to the meter and the meter responds with a "Data Message".

Reading the time information

The time of the counter is read cyclically - together with the query of the DLMS counter values - using the 1107 read command.
When reading the time information, a "Programming Command Message" (read mode "R" in register "C003") is sent to the meter and the meter responds with a "Data Message".

Time setting

The time setting of the meters can be carried out by the protocol in SICAM A8000 at:

- Changing the time in SICAM A8000 (e.g.: Daylight-Saving- and Normal Time)
- Meter time deviation
- 1x daily fixed at 03:08

If the time deviation of the meter to the system time of the SICAM A8000 is smaller than the parameter **`[PRE] DLMS/IEC1107 (IEC62056-21) | Time setting lower threshold`**, then no time setting of the meter is carried out.
If the time deviation of the meter is between the upper and lower threshold, the meter is automatically timed.
If the time deviation of the meter to the system time of the SICAM A8000 is greater than the parameter **`[PRE] DLMS/IEC1107 (IEC62056-21) | Time setting upper threshold`**, then no automatic time setting of the meter is carried out (manual time setting of the meter required) and a diagnosis message is also output.
The meters are timed selectively for each meter via Ethernet in accordance with IEC 1107 (IEC 62056-21) Mode-C "time setting".
The time setting of the meter is done with a "Programming Command Message" (write mode "W" in register "C003") to the meter and the meter responds with a "Acknowledgement Message".

Password Input

Password P0/P1 is used for the following functions:

- Read time
- Read device address

Password P1 is used for the following functions:

- Set time

If required, the access password is sent to the meter with a "Programming Command Message" (Password "P0") or (Password "P1") and the meter responds with an "Acknowledgement Message".

Break Message (B0)

The break message (B0) is then sent to the meter if a running service is to be aborted immediately because of another high-priority function or to prepare a new service.

Time window exceeded

Querying the message from the meter "time window exceeded".

DLMS

The DLMS commands/data are transported via Ethernet using TCP and "serial" converted in the meter communication module CU-E20/CU-E22/CU-XE111 and transmitted to the meter.
Supported DLMS functions:

- Disconnect
- Connect
- MAP120 (partial emulation of MAP120 reading software functions)
- Read IEC addresses
- Read table of content (currently not supported)
- Last reset
- Polling (object query)
- Acknowledgement

Disconnect, Connect

Disconnect and connect are used according to DLMS when the corresponding services are running.

MAP120 (emulation of the MAP120 reading software)

To read out the meter values with DLMS, the meter is switched to the MAP120 mode.

Read IEC addresses

Read table of content

Output of all objects of the meter (currently not supported)

Last reset

Read out the information when the meter was last reset.

Polling (object query) - reading out the meter values

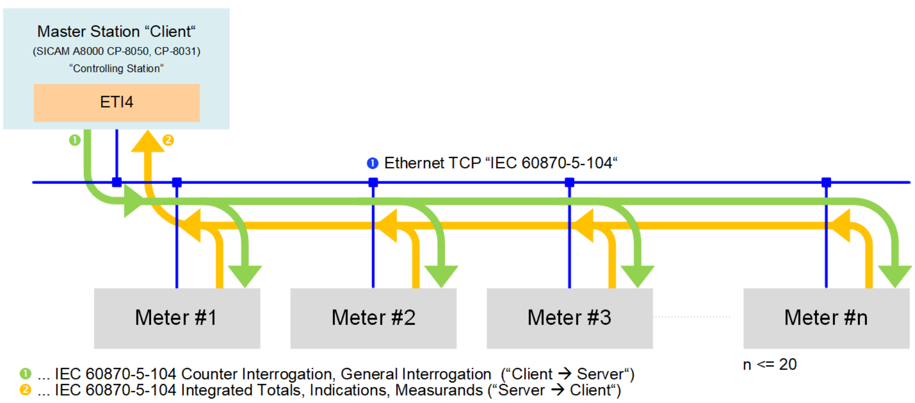
When the TCP connection is established, the meter values of the meters (i.e. the configured object numbers) are queried from the meters cyclically in the configured **`DLMS query cycle`**.

Acknowledgement

Confirmation (acknowledgment) of the meter for certain DLMS commands.

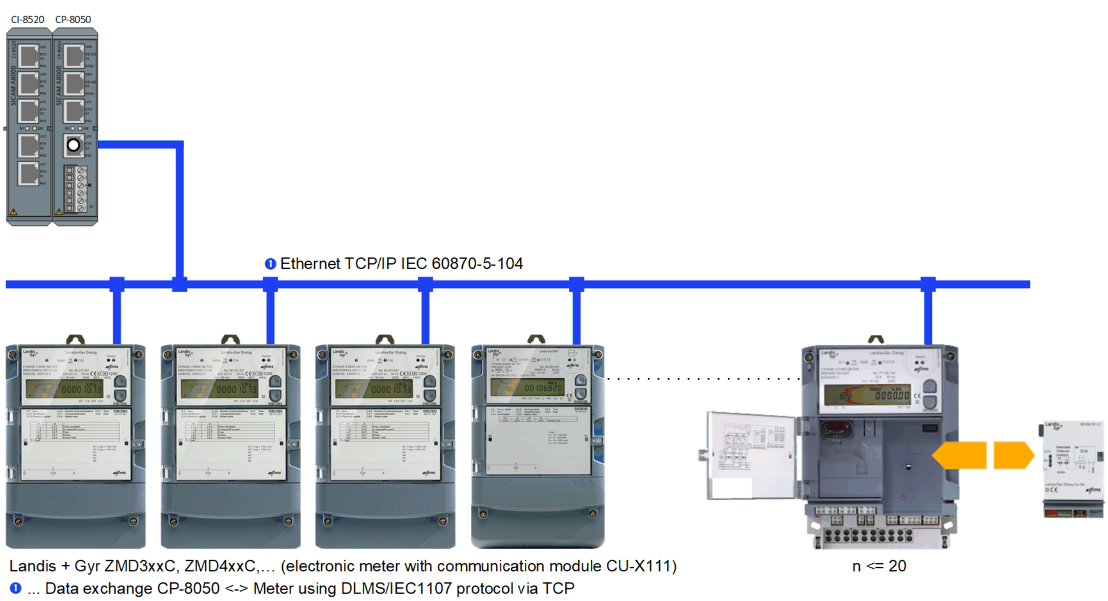
13.17.6 Meter coupling with IEC 608070-5-104

Landis + Gyr meters that support the CU-XE111 communication module (e.g.: ZMD405CT) can also be coupled with the IEC 60870-5-104 protocol.



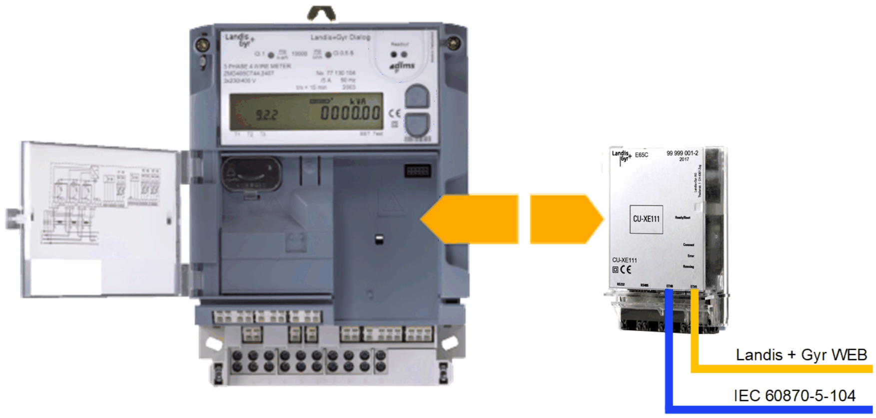
[ETMCI9_Configuration_Schematisch_104_GER, 1, en_US]

Configuration (Example 4):



[ETMCI9_Configuration_104_GER, 1, en_US]

Landis + Gyr meter with communication module CU-X111:



[L&G Kommunikationsmodul CU-XE111, 1, --_--]

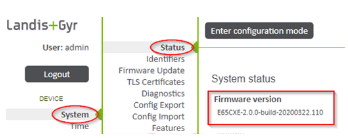
Required functions in the meter

- the meter must support the CU-XE111 communication module.
- In order for the CU-XE111 communication module to be used with the meter, a specific software version must be loaded in the meter (e.g. firmware B30 for ZMD meters).
- an additional “Scada1” license is required in the meter for the IEC 60870-5-104 protocol. The license is either supplied when the meter is ordered or can be downloaded later with the license file from the meter's website. The license can only be loaded into the meter with the appropriate user authorization.

NOTE

For details - whether a specific meter can be coupled with IEC 60870-5-104 - always ask Landis + Gyr!

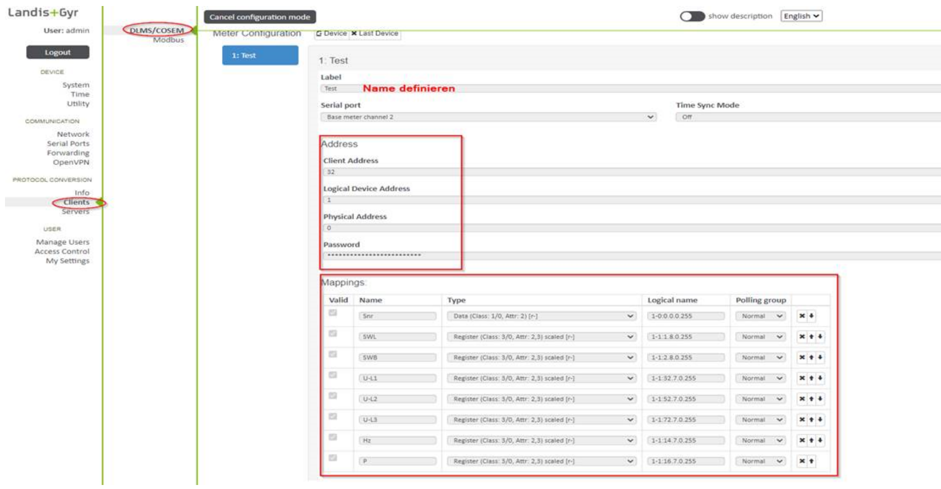
Firmware Version



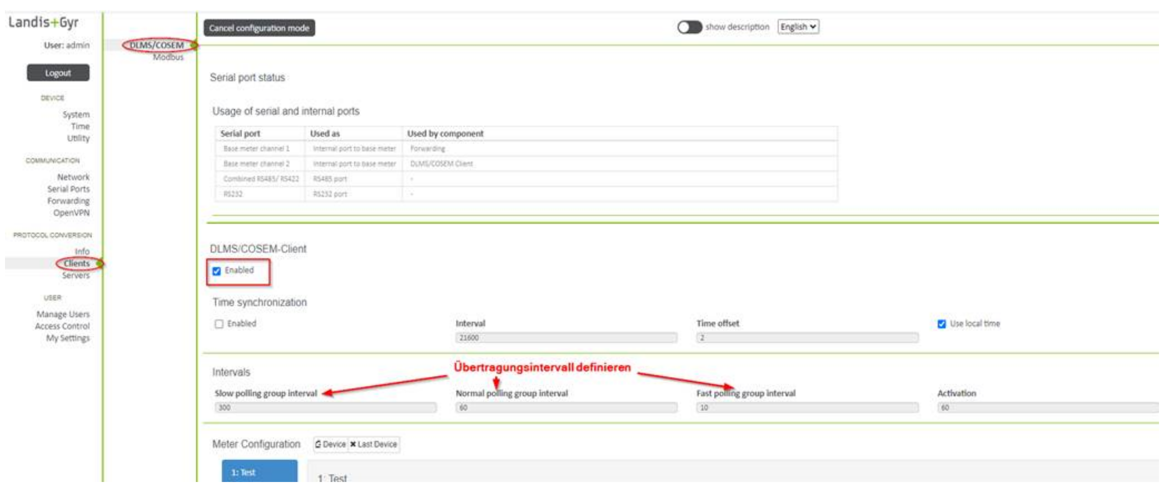
Feature License

Parameterization in the meter (example):

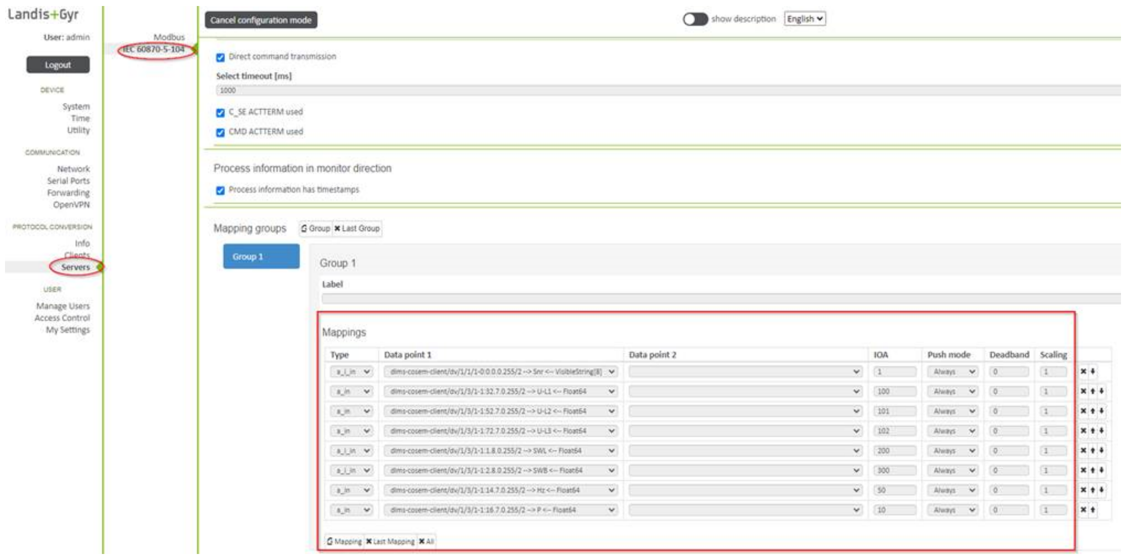
- The IEC104 address can be set freely and is mapped using two tables.
- First, the DLMS data points are defined with a freely definable name, type logical name (=OBIS code) and assigned to a polling group.



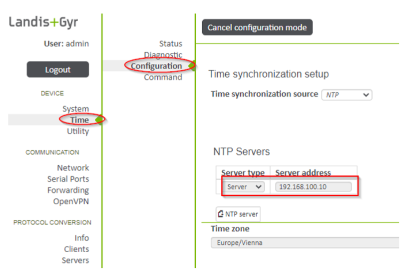
- The transmission interval for each polling group can be configured.
  - slow polling group interval
  - normal polling group interval
  - fast polling group interval



- The defined data points are then mapped into a freely definable IOA.
  - the IOA is parameterized unstructured
  - Push mode = Always: The data points are sent at the defined transmission intervals
  - Measured value thresholds (deadband) can be configured
  - Measured values can be adjusted (Scaling <1>)



- The meter is time-synchronized via NTP



13.17.7 Protocol Element Control and Return Information

13.17.7.1 Protocol element control messages

Protocol element control messages are not supported

13.17.7.2 Protocol element - Return information

Protocol element return information are internal status information of the protocol elements which are transmitted spontaneously and in the event of a general interrogation with internal message formats from the protocol element to the basic system element. On the basic system element, the protocol element return information (see *13.1.4.11 Protocol Element Return Information*) are converted to IEC 60870-5-101/104 *messages with process information in the monitoring direction*.

Supported protocol element return information

Protocol element return information `Return information function_(PRE)`	Station	ETMCI9 [Client]
• Station failure	0 to 19	✓

13.17.8 Parameters and Settings

Parameter Name	Description	Settings
[PRE] Interface parameter Note: • The serial interface for the protocol is selected in the SICAM Device Manager under Configuration | Firmware(refer to *13.1.4.4 Selection of an Ethernet Interface for Communication Protocols*). • Some parameters may not be displayed until the interface is selected.		
[PRE] Station definition		
Station number (internal)	CP-8050 internal station number of the meter. The internal station number is used for diagnostics and data routing. A unique internal station number must be assigned to each meter. The meter is addressed on the line using its IP address. All connected meters must be parameterized in the station definition.	Permitted range = 0 to 19 .. internal station number 255 ... not used Default setting = not used
Station enable	Selective stations (meter) can be prepared or deactivated with “Station enable = no”.	Permitted range = yes, no Default setting = yes
Station failure	If a station (counter) fails, the forwarding of the error message can be suppressed with “station failure=no”.	Permitted range = • notify • suppress default setting = notify
IP-address	IP address of the meter in IPV4 format. If only 1 meter is connected, any IP address of the meter (only 1 connection in “Listening Mode”) is processed with IP address = 0.0.0.0. Note: the IP address of the own station is set on the BSE.	Permitted range = 0.0.0.0 to 255.255.255.254 Standard setting = 0.0 0.0
TCP Port number	TCP port number for the DLMS/ 1107 Ethernet protocol.	Permitted range = 0 to 65535 Standard setting = 1000
Set time with 1107 command (daily)	Daily meter time setting with IEC 1107 command at 03:08. Attention: Security-Level P1 required!	Permitted range = yes, no Default setting = no
DLMS-HDLC Server address	HDLC-Server address Note: Changing this parameter requires detailed knowledge of the protocol and should only be done in consultation with an expert.	Permitted range = 0 to 65535 Default setting = 0

Parameter Name	Description	Settings
Number of bytes DLMS-HDLC Server address	Number of bytes of HDLC Server address. (0 or 4 Byte) Note: Changing this parameter requires detailed knowledge of the protocol and should only be done in consultation with an expert.	Permitted range = • Without meter address • Upper + Lower HDLC (high +low) Default setting = without meter address
1107 device address	1107 Device address of the meter (max. 16 ASCII characters). The 1107 device address must be unique! If only one meter is used, the device address does not have to be configured. Device address: e.g. serial number or device number of the meter.	Permitted range = 16 ASCII characters (no character also valid) Default setting = 0
Password index in list	Selection of the password for the meter using an index in the password list.	Permitted range = 0 to 19 ; 255 255 ... not used Default setting = 0
1107 Framing	Framing for IEC 1107 messages. The 1107 messages are transmitted with Ethernet frames.	Permitted range = • 8N1 (8 Bit, None Parity) • 7E1 (7 Bit, Even Parity) • Default setting = 8N1 (8 Bit, None Parity)
Pause time	Pause time before each request message to each meter. (pause time = n*10ms)	Permitted range = 0 to 255 (= 0 to 2.55 s) Default setting = 0 s
Extended 1107 functions	Activation of the 1107 functions. <yes>: 1107 functions <no>: only serial number can be read out via 1107. (<no> is required for communication module CU-XE111 - the communication module CU-XE111 only supports the 1107 functions to a very limited extent)	Permitted range = yes, no Default setting = no
[PRE] DLMS/IEC1107 (IEC62056-21)		
retry count	Max. number of retries for DLMS/1107 queries.	Permitted range = 0 to 255 Default setting = 2
Expected acknowledgment time correction	The expected acknowledgment time is determined automatically. Signal propagation delays and further delay times must be taken into account in the correction factor for the expected acknowledgment time.	Permitted range = 0 to 6553.5 s Default setting = 0.3 s
[PRE] DLMS/IEC1107 (IEC62056-21) | Password list		
Password 0 **Password 1** **:** **Password 19**	Passwords for establishing a connection with the meter devices. Only numeric passwords are accepted.	Permitted range = 00000000 to 99999999 (max. 8 character) Default setting = 00000000

Parameter Name	Description	Settings
[PRE] DLMS/IEC1107 (IEC62056-21) | DLMS		
HDLC client address	Address of the HDLC client. Changing this parameter requires detailed knowledge of the protocol and should only be done in consultation with an expert.	Permitted range = 0 to 255 Default setting = 16
DLMS query cycle	The meter values from all counters are queried cyclically in the set DLMS query cycle.	Permitted range = • disabled • 1 minute • 5 minutes • 10 minutes • 15 minutes • 1 hour • 6 hours • 12 hours • 24 hours Default setting = 15 minutes
[PRE] DLMS/IEC1107 (IEC62056-21) | IEC1107		

Read serial number after reconnect	Read serial number after reconnect.
	• Security level P0:
	  – Read time + serial number
	• Security level P1:
	  – Read time + serial number
	  – Time setting possible
	• do not read:
	  – just read time
		Permitted range =
		• Security level P0
		• Security level P1
		• do not read:
		Default setting = security level P1

Time setting lower threshold	If the deviation of the time in the meter is below this threshold, no time setting is carried out. If the deviation of the time in the meter is above this threshold, a time setting is carried out.	Permitted range = 0 to 255 s Default setting = 2 s
Time setting upper threshold	If the deviation of the time in the meter is above this threshold, a warning is issued.	Permitted range = 0 to 255 s Default setting = 20 s
[PRE] Advanced parameters | Software test points		
...	The software test points may only be used under the guidance of experts for error detection! Once the fault isolation is completed, software checkpoints must always be turned off.	Permitted range = yes, no Default setting = no

13.17.9 Message Conversion

Data in transmit direction are transferred from the basic system element to the protocol element in SICAM A8000 internal IEC 60870-5-101/104 (without 101/104 blocking) format. The conversion of the data formats IEC 60870-5-101/104 ↔ 1107/DLMS is performed by the protocol element. The transmission of the data towards the meter is controlled by the protocol element.

Data in receive direction are converted by the protocol element from the 1107/ DLMS format → SICAM A8000 internal IEC 60870-5-101/104 format and transferred to the basic system element (no 101/104 blocking). The transmission of the data on 1107/DLMS is controlled by the protocol element. The conversion of the SICAM A8000 internal IEC 60870-5-101/104 message format ↔ 1107/DLMS data format and the conversion of the address information are called message conversion.

The parameterization of the address conversion from SICAM A8000 internal IEC 60870-5-101/104 ↔ 1107/ DLMS (address and message format) is to be done with SICAM Device Manager with function “Signals” or SICAM TOOLBOX II, OPM II using “SIP Message Address Conversion”.

Supported processing types for message conversion:

Data	Direction	Processing type	ETMCI9
Binary information	Receive direction	firmware /**`Rec_1107_message`**	✓
Integrated Totals	Receive direction	firmware /**`REC_DLMS_integrated_total`**	✓
General Interroga-tion	Transmit direction	–	✓
Counter interroga-tion	Transmit direction	–	–
Time synchroniza-tion	Transmit direction	–	✓

13.17.9.1 Message Conversion in Transmit Direction (ETMCI9 Client)

Message conversion in transmit direction: SICAM A8000 → Meter

SICAM A8000: IEC 60870-5-101/104 →		Meter: DLMS/1107	
TI	**Designation**	**Format**	**Designation**
TI 100	(General) Interrogation command		Query command Query the message “time window exceeded” with IEC 1107
TI 103	Clock Synchronization Command		Setting the time of the meter with IEC 1107

General Interrogation

Integrated totals are not forwarded during general interrogation. The 1107 messages are forwarded to the BSE in case of a general interrogation from the protocol-internal process image with the cause of transmission <COT:=20> “queried by station interrogation”.

ACTCON and ACTTERM for <TI:=101> (general) interrogation command is not supported by the protocol.

Setting the time of the meter

The time setting of the meters can be carried out by the protocol in SICAM A8000 at:

- Changing the time in SICAM A8000 (e.g.: Daylight-Saving- and Normal Time)
- Time deviation in the meter

If the time deviation of the meter to the system time of the SICAM A8000 is smaller than the parameter **`[PRE] DLMS/IEC1107 (IEC62056-21) | Time setting lower threshold`**, then no time setting of the meter is carried out.

If the time deviation of the meter is between the upper and lower threshold, the meter is automatically timed.

If the time deviation of the meter to the system time of the SICAM A8000 is greater than the parameter **`[PRE] DLMS/IEC1107 (IEC62056-21) | Time setting upper threshold`**, then no automatic time setting of the meter is carried out (manual time setting of the meter required) and a diagnosis message is also output.

The meters are timed selectively for each meter via Ethernet in accordance with IEC 1107 (IEC 62056-21) Mode-C "time setting".

13.17.9.2 Message Conversion in Receive Direction (ETMCI9 Client)

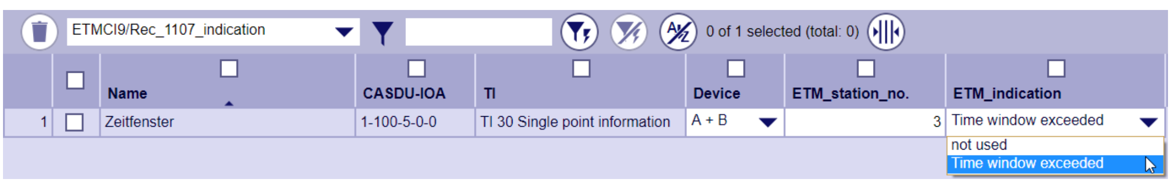
Message conversion in receive direction: SICAM A8000 ← Meter

SICAM A8000: IEC 60870-5-101/104 ←		Meter: DLMS/1107	
TI	**Designation**	**Format**	**Designation**
TI 30	Single-point information with time tag CP56Time2a		Message
TI 37	Integrated total with time tag CP56Time2a	<INT64>	Integrated total

Binary Information

The parameterization of the address and message conversion for binary information of the meter from DLMS client in receive direction is to be done with the SICAM Device Manager with the function "Signals" or with the SICAM TOOLBOX II, OPM II.

Processing type: *firmware* / **`Rec_1107_message`**



[ETMCI9_DM_Empf_1107_Meldung_GER, 1, en_US]

Parameter	
`TI`	Supported type identifications: • TI 30 .. Single-point information with time tag CP56Time2a
`Name`	Name of the signal
`CASDU-IOA`	SICAM A8000 internal IEC 60870-5-101/104 message address (CASDU1, CASDU2, IOA1, IOA2, IOA3)
`Device`	In which device is the signal processed in the event of redundancy. • A • B • A + B

Parameter	
ETM_Station_nr.	SICAM A8000 internal station number of the meter: • 0-19 • 255 ... not used Note: The meter is addressed on the Ethernet by its IP address.
ETM_message	Meter message to be converted to IEC 60870-5-101/104: • Time window exceeded Note: Other messages are currently not supported!

Supported Data Formats:

IEC 1107 Format	IEC 60870-5-101/104 Data format (TI)
Message	30

Legend: TI 30 = Single-point information with time tag CP56Time2a

Message Conversion

The table describes the evaluated elements of the IEC 60870-5-101/104 message during message conversion.

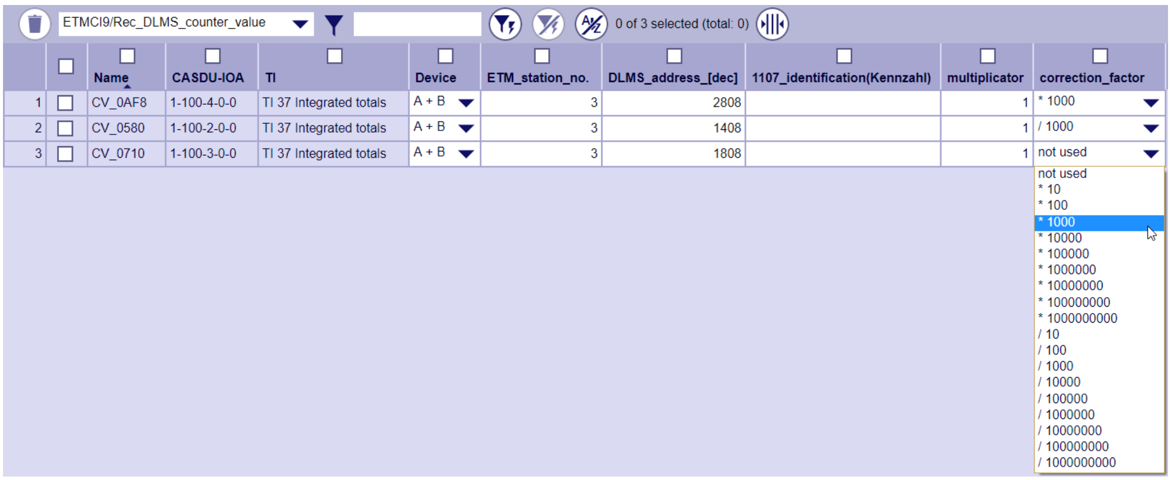
Elements of the (IEC 60870-5-101/104) tmessage		
TI .. Type identification		• TI 30 .. Single-point information with time tag CP56Time2a
CASDU, IOA .. Message address		Parameter-settable
QDS .. Quality descriptor		
BL .. blocked		not supported (BL=0)
SB .. substituted		not supported (SB=0)
NT .. not topical		not supported (NT=0)
IV .. invalid		not supported (IV=0)
Cause of transmission (COT)		
03 .. Spontaneous		upon change of information state or quality descriptor
20 .. Interrogated by station interrogation		Upon reception of a GI request
xx .. Other COTs		Not supported
T .. Test		Not supported
Information		
Single-point information status		
SPI	0 .. OFF	supported
	1 .. ON	supported
Time tag		
CP56Time2a .. Date + Time		PRE internal time (receive time)

... not listed elements of the IEC 60870-5-101/104 message are not rated / not supported!

Integrated Totals

The parameterization of the address and message conversion for integrated totals of the meter from DLMS client in receive direction is to be done with the SICAM Device Manager with the function "Signals" or with the SICAM TOOLBOX II, OPM II.

Processing type: *firmware* /**`REC_DLMS_integrated_total`**



[ETMCI9_DM_Empf_DLMS_Zählwert_GER, 1, en_US]

Parameter	
`TI`	Supported type identifications: • TI 37 .. Integrated total with time tag CP56Time2a
`Name`	Name of the signal
`CASDU-IOA`	SICAM A8000 internal IEC 60870-5-101/104 message address (CASDU1, CASDU2, IOA1, IOA2, IOA3)
`Device`	In which device is the signal processed in the event of redundancy. • A • B • A + B
`ETM_Station_nr.`	SICAM A8000 internal station number of the meter: • 0-19 • 255 ... not used Note: The meter is addressed on the Ethernet by its IP address.
`DLMS_Address_[dez]`	DLMS Object number (dezimal). The parameterized DLMS object numbers are cyclically queried from the meter by SICAM A8000 as DLMS client in the DLMS cycle. • 0 to 65535
`1107_Kennzahl`	EDIS/OBIS identifier of the signal. The EDIS/OBIS code is only used for documentation with the signals and is not evaluated for message conversion.

Parameter	
`multiplier`	Count value multiplier (converter factor): The multiplier can be used to correct the meter value by any conversion factor that may be present. • Value range = FLOAT32
`Correction factor`	Meter value correction factor: • *10, *100, *1,000, *10,000, *100,000, *1,000,000, *10,000,000 , *100,000,000, *1,000,000,000 • /10, /100, /1,000, /10,000, /100,000, /1,000,000, /10,000,000 , / 100,000,000, /1,000,000,000 Note: The decimal point in the meter value can be shifted with the correction factor.

Supported Data Formats:

DLMS format	DLMS data format	IEC 60870-5-101/104 Data format (TI)
Integrated total	INT64	37

Legend: TI 37 = integrated totals with time tag CP56Time2a

Transmission of Integrated Totals

The parameterized meter values (DLMS addresses/object numbers) are cyclically queried by the protocol ETMCI9 in SICAM A8000 as DLMS client in the parameterized DLMS query cycle; converted to IEC60870-5-104 and passed on upon change to the BSE with <TI:=37> meter value with CP56Time2a time stamp.

The meter interrogation command with <TI:=101> is not supported!

Meter value adjustment

Received meter values can be corrected by the protocol firmware with the following functions:

- multiplier
  With the multiplier, the meter value can be corrected by a conversion factor that may have to be taken into account. The received meter value is multiplied by the configured multiplier.
- Correction factor
  With the correction factor, the meter value can be multiplied or divided by a selected factor and thus a simple value adjustment can be carried out with a constant factor. With the correction factor, a simple conversion with the most important 10s factor values is possible "=shifting of the decimal point" (e.g.: Wh → kWh or kWh → MWh or MWh → kWh).

Message Conversion

The table describes the evaluated elements of the IEC 60870-5-101/104 message during message conversion.

Elements of the (IEC 60870-5-101/104) tmessage	
TI .. Type identification	• TI 37 .. Integrated totals with time tag CP56Time2a
CASDU, IOA .. Message address	Parameter-settable
Quality information for data	

Elements of the (IEC 60870-5-101/104) tmessage	
Sequence number	The sequence number is incremented with each DLMS query, from 1 to 31. With ETMCI9 there is currently only one global sequence number. This is initialized with 1 after a restart and incremented with each DLMS query. If the communication to individual meters does start later, then the meter values are not forwarded to the BSE with the sequence number beginning with 1, but with the currently running global sequence number.
CY .. Carry	not supported (CY=0) The carry must be carried out in the meter processing point(s).
CA .. Presets	not supported (CA=0)
IV .. invalid	not supported (IV=0)
Cause of transmission (COT)	
03 .. Spontaneous	in the event of a change in the information status, meter value or quality identifier in the course of the cyclic query of the meter values
37 .. requested by general counter interrogation	The meter value can be forwarded to the BSE – controlled by a software test point – with the cause of transmission <COT:=37>. The software test point is acitvated with the parameter **[PRE] DLMS/IEC1107 (IEC62056-21) advanced parameters | Software Test Points | Send meter values with cause of transmission 37**. The meter interrogation command with <TI:=101> is not supported.
38 to 41 .. interrogated by group 1 to 4 interrogation	Not supported
xx .. Other COTs	Not supported
T .. Test	Not supported
Information	
Value.. S .. Sign	• binary counter reading
Time tag	
CP56Time2a .. Date + Time	PRE internal time (receive time)

... not listed elements of the IEC 60870-5-101/104 message are not rated / not supported!

13.18 Ursatron 8000

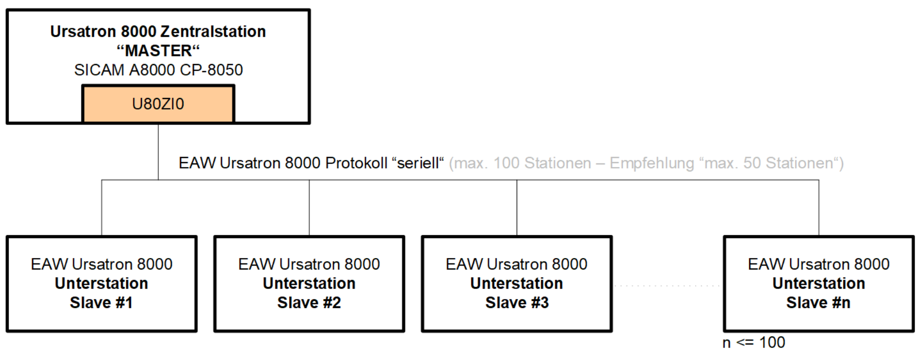
13.18.1 Introduction

The U80ZI0 protocol is a serial communication protocol for communication with EAW Ursatron 8000 substations in multi-point traffic (master/slave).

Protocol firmware for EAW Ursatron 8000:

Firmware	System	Standard and function
U80ZI0	CP-8031, CP-8050	Ursatron 8000 Master

Schematic configuration:



13.18.2 Functions

Function	U80ZI0
EAW Ursatron 8000	
Serial communication protocol according to EAW Ursatron 8000 (U8000)	✓
CP-8031, CP-8050 = U8000 Master	✓
Max. number of slaves	100
Max. number slaves “recommended”	50
U8000 slave addresses	1-127
U8000 broadcast addressing (broadcast slave address = 255)	–
Max. number of supported data points	2000
Network configuration	
Point-to-point configuration (U8000 master + 1x U8000 slave)	✓
Multiple point-to-point configuration (U8000 Master + 1 U8000 Slave), each point-to-point configuration requires its own interface)	✓
Multi-point traffic – line configuration	✓
Multi-point traffic – star configuration	✓
Data concentrator	✓
Physical interface	
direct link interface (RS-232)	✓
RS-485	✓

Function	U80ZI0
RS-422	✓
CP-8031, CP-8050: X4 (RS-485, RS-422); X5 (RS-232)	✓
CI-8551 [414]: X1, X2 (RS-232, RS-422, RS-485); X3 (RS-422, RS-485); X4, X5 (RS-232)	✓
Baud rates: 50, 75, 100, 134.5, 150, 200, 300, 600, 1050, 1200, 1800, 2000, 2400, 4800, 9600, 19200, 38400, 56000, 57600, 64000, 115200 bits/s	✓
Bit transmission layer / message frame	
Message formats according to IEC 60870-5-1/FT1.2	✓
U8000 transmission procedures according to the link layer to IEC 60870-5-2 (with U8000 specific changes)	✓
Byte Frame: 8E1	✓
Message protection: d = 4 • Checksum (8 bits) • Parity bit (Even)	✓
Modulation PCM (pulse code modulated - byte asynchronous)	✓
Message length	1-255 Bytes
Supported U8000 function codes in transmit direction (CP-8031, CP-8050→U8000)	
<FC:=06> ... Switching command	
<FC:=09> ... Query the state of the connection layer	
<FC:=10> ... Query of user data of class 1	✓
<FC:=11> ... Query of user data of class 2	
<FC:=14> ... General interrogation / query of information objects	
Supported U8000 function codes in receive direction (CP-8031, CP-8050←U8000)	
<FC:=00> ... ACK: positive acknowledge	
<FC:=01> ... NAK: negative acknowledge (Message not accepted)	
<FC:=08> ... Station answer	✓
<FC:=09> ... NO acknowledge (requested data not available)	
<FC:=11> ... Link layer OK	
Supported U8000 message formats (Type codes) in transmit direction (CP-8031; CP-8050→U8000)	
<TC:=136> ... Integrated total preset value 4 decades (16 bits)	–
<TC:=137> ... Integrated total preset value 8 decades (32 bits)	–
<TC:=246> ... Commands (switching commands)	✓
<TC:=255> ... GI command	✓
<TC:= > ... Station reset	–
Supported U8000 message formats (Type codes) in receive direction (CP-8031; CP-8050←U8000)	
<TC:=000> ... Binary information (single, double and transient information)	✓
<TC:=002> ... Bitstring 16-bit	–
<TC:=003> ... Bitstring 32-bit	–
<TC:=004> ... Measured value (12 Bit)	✓

[414] With CP-8031 not supported by default. With a license (see *14.8 SICAM A8000 CP-803x Extended CI-Module*) 1 communication module CI-8551 can be used additionally also with CP-8031.

Function	U80ZI0
<TC:=006> ... Measured value (8 Bit)	✓
<TC:=008> ... Integrated total 4 decades (16 bits)	–
<TC:=009> ... Integrated total 8 decades (32 bits)	–
<TC:=015> ... System indications (sum error values, bounce messages)	✓
<TC:=128> ... Native system indication (SEM) • <TC:=128> is not transmitted on the line • SEM are generated internally by the protocol firmware	✓
Supported IEC60870-5-101/-104 message formats in receive direction (Central station→Remote station)	
<TI:=45> ... Single command	✓
<TI:=46> ... Double command	
<TI:=47> ... Regulating step command	
<TI:=100> ... (General) Interrogation command	
Supported IEC60870-5-101/-104 message formats in receive direction (Central station←Remote station)	
<TI:=30> ... Single-point information with time tag CP56Time2a	✓
<TI:=31> ... Double-point information with time tag CP56Time2a	✓
<TI:=34> ... Measured value, normalized value with time tag CP56Time2a	✓
<TI:=35> ... Measured value, scaled value with time tag CP56Time2a	✓
<TI:=36> ... Measured value, short floating-point number with time tag CP56Time2a	✓
<TI:=37> ... Integrated total with time tag CP56Time2a	–
Data Acquisition by Querying	
Query of the messages and measured values in the basic cycle (polling cycle)	✓
Conversion U8000 Data formats↔IEC 60870-5-101/104 Data formats	✓
Scaling of measured values	✓
Suppression of intermediate and faulty position for double-point information	–
Command Transmission	
spontaneous/cyclical	✓
Commands are transmitted as impulse (the positive edge of the pulse is transmitted spontaneously, the negative edge is transmitted in cyclic data exchange after the command output time has expired)	✓
Control location function (set/check control location)	✓
Emulation of ACTCON for commands (according IEC 60870-5-101/104)	–
Emulation of ACTCON- for commands (according IEC 60870-5-101/104), when a command is discarded from an unreleased control location.	✓
Emulation of ACTTERM for commands/setpoint values (according IEC 60870-5-101/104)	–
General interrogation	
U8000 General interrogation triggered by system message "general interrogation"	✓
U8000 General interrogation triggered by single command	✓
U8000 General interrogation triggered by protocol element control message	✓
Emulation of ACTCON/ACTTERM for general interrogation (according IEC 60870-5-101/104)	–

Function	U80ZI0
Redundancy(functions for supporting redundant communication routes)	
Protocol redundancy:	
• Tristate of RS-232 interface if passive	✓
• Protocol function in redundancy state = passive – normal operation (RS-232 = active)	✓
• Protocol function in redundancy state = PASSIVE – listening mode (RS-232 = TRISTATE)	✓
Protocol element control and return information	
Protocol element control messages:	
• Set control location	✓
Protocol element return information	
• Station status	✓
• Station failure	✓
Web server	
Protocol-internal diagnostic information / statistic information via PRE-specific web pages	✓
Engineering	
SICAM Device Manager	✓
SICAM TOOLBOX II	✓

Restrictions

- EAW Ursatron 8000 supports no real-time data.
  (Received data is forwarded by the protocol firmware with the reception time)
- Ursatron 8000 function code / type codes are only partially supported.

NOTE

- The protocol element for CP-8031, CP-8050 only supports a subset of the functionality of the EAW Ursatron 8000 protocol!
- For the connection of EAW Ursatron 8000 substations, the limited functionality of the central function in CP-8031, CP-8050 must be considered!

13.18.3 Modes of Operation

The operating mode of the interface is determined by parameters of the protocol element and optional equipment.

Standard operating mode	Interface → optional DCE	Interface signals (X1-X5)
Unbalanced interchange circuit (V.24/V.28) RS-232 asynchronous	CP-8031, CP-8050: X5 CI-8551 [415]: X1, X2, X4, X5	RXD, TXD, CTS, RTS, DCD, DTR, DSR/ VCC, GND
Balanced interface (V.11) RS-485 (2-wire)/ RS-422 (4-wire) asynchronous	CP-8031, CP-8050: X4 CI-8551 [415]: X1, X2, X3	• RS-485 2-wire TXD+/RXD+, - TXD-/RXD-, GND • RS-422 (4-wire): TXD+, TXD-, RXD+, RXD-, GND

415 With CP-8031 not supported by default. With a license (see *14.8 SICAM A8000 CP-803x Extended CI-Module*) 1 communication module CI-8551 can be used additionally also with CP-8031.

NOTE

With a serial connection via X5 interface of CP-8031, CP-8050 a bridge between CTS and GND is required, as far as the interface shall also be used for the connection with the engineering PC.

The CTS status line cannot be used by the protocol!

If the interface shall not be used as serial engineering interface, the function can be disabled with the parameter **`Serial engineering interface = disabled`**. Thereby no connection between CTS and GND is required.

13.18.4 Communication

For the stations to communicate with each other, suitable transmission facilities and/or network components may be needed in addition.

Own station = master station "Ursatron 8000 Master"

System	System element	Protocol Element	Remarks
SICAM A8000 Series	CP-8031/CPCI85 CP-8050/CPCI85 CP-8050/EPCI85	U80ZI0	max. 100 Slaves

Remote station = substation "Ursatron 8000 Slave"

System	System element	Protocol Element	Remarks
Ursatron 8000	-	-	

13.18.5 Parameter and Setting

Parameter Name	Description	Settings
`[PRE] Interface parameter` Note: Some parameters may not be displayed until the interface is selected.		
`Interface`	"Virtual serial interface" (CP-8050 internal). The "virtual serial interface" is assigned on the BSE to a serial interface plug. *13.1.4.5 Selection of a serial interface for communication protocols*	Permitted range = COM1 to COM50 Default setting = not used
`Baud Rate`	Baud rate transmit- and receive direction. The protocol firmware supports baud rates in range 50 Bd to 115200 Bd.	Permitted range = 50, 75, 100, 134.5, 150, 200, 300, 600, 1050, 1200, 1800, 2000, 2400, 4800, 9600, 19200, 38400, 56000, 57600, 64000, 115200 Standard setting = 1200
`[PRE] Interface Parameter | Time settings for interface modem` See *13.1.4.8 Time settings for transmission facilities*.		
`[PRE] Interface Parameter | Time settings for free definable interface modem` See *13.1.4.8 Time settings for transmission facilities*. Default settings:		
`Pause time (tp)`		Default setting = 30 ms
`Set-up time (tv)`		Default setting = 100 ms

Parameter Name	Description	Settings
Run out time (tn)		Default setting = 0 ms
DCD-evaluation		Default setting = disabled
Continuous level monitoring time (tcl)		Default setting = 10 s
Transmission delay at level (tcldly)		Default setting = 0.2 s
Bounce suppression time (tbounce)		Default setting = 10 ms
Disable time (tdis)		Default setting = 0 ms
[PRE] Station definition		
Station number (internal)	CP-8050 internal station number for diagnosis and data routing. Each U8000 slave must be assigned a unique internal station number.	Permitted range = 0 to 99 ... internal station number 255 ... not used (default) Standard setting = 255
Ursatron 8000 station number	Ursatron 8000 station number.	Permitted range = 1 to 127 Standard setting = 1
Station enable	Selective U8000 slaves can be prepared or deactivated with "Station enable = no".	Permitted range = yes, no Default setting = yes
Station failure	If a U8000 slave fails, the transmission of the error message can be suppressed with "station failure = no".	Permitted range = • notify • suppress default setting = notify
Priority level	For the priority control of the station interrogation (polling cycle), each station is assigned to a priority level.	Permitted range = • high priority • medium priority • low priority (A) • low priority (B) default = high priority
Number of calls	At the station interrogation (polling cycle), a station change will be carried out at least after the number of calls has expired.	Permitted range = 1 to 63 Standard setting = 1
[PRE] Ursatron 8000 | Time settings, retries | Monitoring times		
Expected acknowledgment time	Maximum waiting time for the substation response when querying data of class 1 or querying data of class 2 or in the case of general interrogation before a telegram repetition is initiated. Note: Adapt time to transmission rate and maximum messager length in receive direction.	Permitted range = 0.02 to 655.35 s Default setting = 5 s

Parameter Name	Description	Settings
Expected_ack_time_corr_factor	The expected acknowledgment time for short messages is determined automatically. Signal propagation delays and further delay times must be taken into account in the correction factor for the expected acknowledgment time.	Permitted range = 0 to 655.35 s Default setting = 0.2 s
Idle monitoring time	After transmission disturbances or message interruption the idle state is monitored. After expiry of the monitoring time the receiver is resynchronized.	Permitted range = 0 to 32767 Bit Standard setting = 33 Bit
Character Monitoring Time	Message gap monitoring Maximum dead time between successive bytes of a message Idle monitoring time is started after detection of message interruption.	Permitted range = 0 to 32767 Bit Standard setting = 33 Bit
[PRE] Ursatron 8000 | Time settings, retries | Retries		
Retries for data message SEND/CONFIRM (station selective)	Number of maximum message repetitions to be performed. Station failure if no response for a sent message is received after the last retry.	Permitted range = 0 to 255 Standard setting = 2
[PRE] Ursatron 8000 | Communication functions | Data communication control | Station call prioritization		
No. of station calls in high priority level	Number of high priority stations called up to level change.	Permitted range = 0 to 99 Standard setting = 1
No. of station calls in medium priority level	Number of medium-level stations called up to level change.	Permitted range = 0 to 99 Standard setting = 1
No. of station calls in low priority (A) level	Number of low-level (A) stations called up to level change.	Permitted range = 0 to 99 Standard setting = 1
No. of station calls in low priority (B) level	Number of low-level (B) stations called up to level change.	Permitted range = 0 to 99 Standard setting = 1

Parameter Name	Description	Settings
[PRE] Redundancy		
Operation if passive	Behavior of the protocol firmware in the redundancy state "passive": • Interface "active", normal operation – Behavior as in redundancy state = "active". – Received messages are marked by the BSE with "R=1" (= data from redundant interface) • Interface "tristate", listening mode – Interface "tristate" – no polling cycle – received messages are forwarded to the BSE – received messages are marked by the BSE with "R=1" (= receive data from redundant interface) – messages in transmit direction are picked up by the BSE and rejected by the PRE!	Permitted range = • Interface "active", normal operation • Interface "tristate", listening mode Default = Interface "active", normal operation
Delay time passive ⇒ aktive	With redundancy switching from passive → active, the protocol element is switched to "active" with delay. During the delay time, the PRE internal process image is updated.	Permitted range = 0 to 2000 s 0 = no delay Default setting = 1 s
Listening mode (failure monitoring time)	Failure monitoring time in listening mode.	Permitted range = 0, 1 to 60000 s 0 = monitoring disabled 1 to 60000 ... monitoring time Default setting = 0 s
[PRE] Data base management (settings for the data base management on BSE (per PRE)) see *13.1.4.14 Data Management on the BSE for Communication Protocols*		
[PRE] Advanced parameters | Web server		
HTTP web server	With a standard web browser, protocol-internal information can be displayed. Note: For safety reasons, the web server should be "disabled" in a system in operation.	Permitted range = disabled, enabled Default setting = disabled

Parameter Name	Description	Settings
[PRE] Advanced parameters | Software test points		
...	The software test points may only be used under the guidance of experts for error detection! Once the fault isolation is completed, software checkpoints must always be turned off.	Permitted range = yes, no Default setting = no

13.18.6 Web server

A web server is integrated in the protocol firmware for internal diagnostic information. The web server is part of basic system element – the PRE specific web pages will be provided by protocol element.

System	Firmware	Protocol function	PRE-specific web pages
SICAM A8000 CP-8050	U80ZI0	Ursatron 8000 Master	✓

NOTE

For security reasons, the integrated web server is deactivated by default. If needed, it can be enabled for access by the user with the parameter **[PRE] Advanced parameters | Webserver | HTTP-Webserver** .

The PRE-specific web pages can be displayed with a standard web browser, for example *Google Chrome®*, are displayed.

For the access to the web server the communication protocol HTTP (Hyper Text Transfer Protocol) is used with the port number 80 or the communication protocol HTTPS (Hyper Text Transfer Protocol over SSL/TLS) is used with the port number 443.

With the SICAM Device Manager, the PRE-specific web pages can be called up via a link under **protocol details**.

The PRE-specific web pages can also be called up directly via the IP address of the automation unit.

CPU	PRE	Example
M-CPU	0 to 7	https://172.16.0.3/pre0 https://172.16.0.3/pre7 or https://172.16.0.3/mpre0 https://172.16.0.3/mpre7
C-CPU0	0 to 3	https://172.16.0.3/c0pre0
C-CPU1	0 to 3	https://172.16.0.3/c1pre0

CPU	PRE	Example
C-CPU2	0 to 3	https://172.16.0.3/c2pre3
C-CPU3	0 to 3	https://172.16.0.3/c3pre3

Table 13-5 Supported PRE-specific web pages

PRE-specific web page	U80ZI0
Overview	✓
Connections	✓
Routing Transmit	✓
Routing Receive	✓
Developer Information	
Dataflow Test	✓
Diagnosis (IDR)	✓
Diagnosis (IDH)	✓
Diagnosis (IDZ)	✓
Diagnosis (IDE)	✓

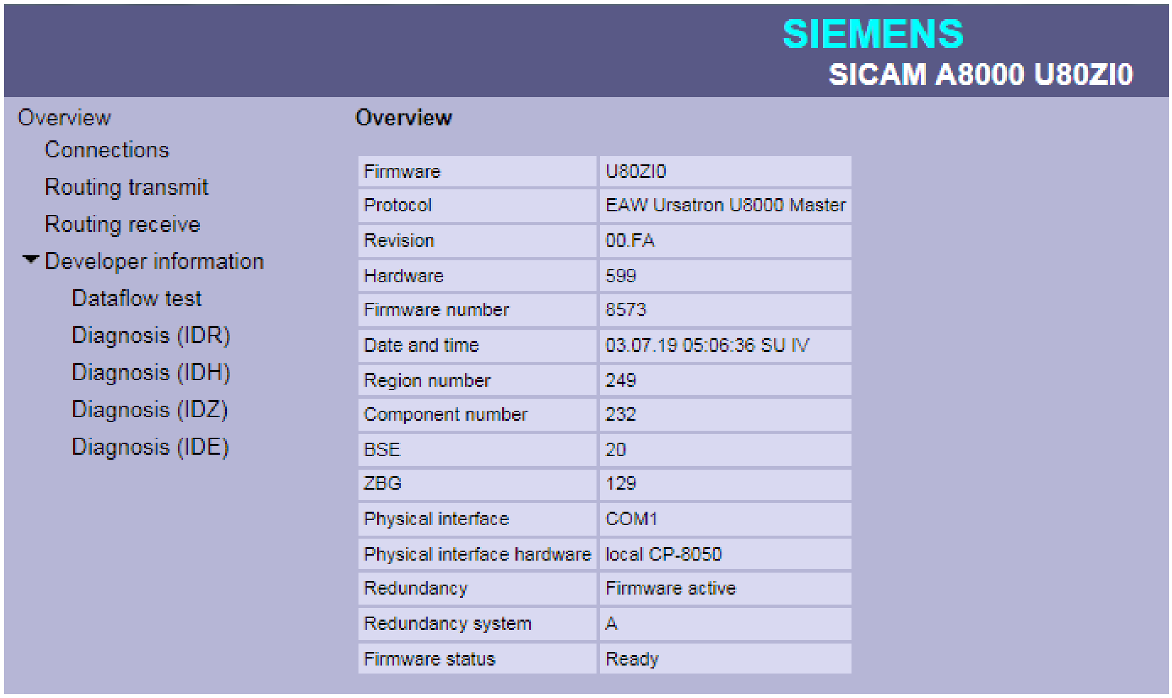
NOTE

- The values displayed on the web pages indicate the current status when the web page is started.
  The values of a web page are not updated automatically.
  A manual updating of the web page displayed in the web browser can be performed e.g. by means of a refresh of the web browser.
- The web pages will be displayed only in English language!

13.18.6.1 Overview

With web page **Overview** general information of the firmware will be displayed.

Field	Note
Firmware	Name of firmware
Protocol	Protocol function: EAW Ursatron Master
Revision	Revision of Firmware
Hardware	Hardware number (system internal)
Firmware number	Firmware number (system internal)
Date and time	actual date + time of firmware
Region number	Region number (system internal)
Component number	Component number (system internal)
BSE	Basic system element number (system internal)
ZBG	Supplementary system element number “SSE” (internal)
Physical Interface	Selected virtual COM interface (internal)
Redundancy	actual date + time of firmware • Firmware active • Firmware passive
Firmware status	State of the firmware:



13.18.6.2 Connections

With web page **Connections** detailed information about the status of the connection to each configured U8000 station will be displayed.

Field	Note
Station Nr	1..99 (CP-8050 internal stations number of connection)
U8000 station	1..127 (U8000 station number on the line)
State	State of the connection: • OK • NOK

[U80ZI0_Web_Connections_OK, 1, --_--]

Parameterized U8000 stations for which no communication is possible or which have failed are highlighted in red.

[U80ZI0_Web_Connections_NOK, 1, --_--]

13.18.6.3 Routing Transmit

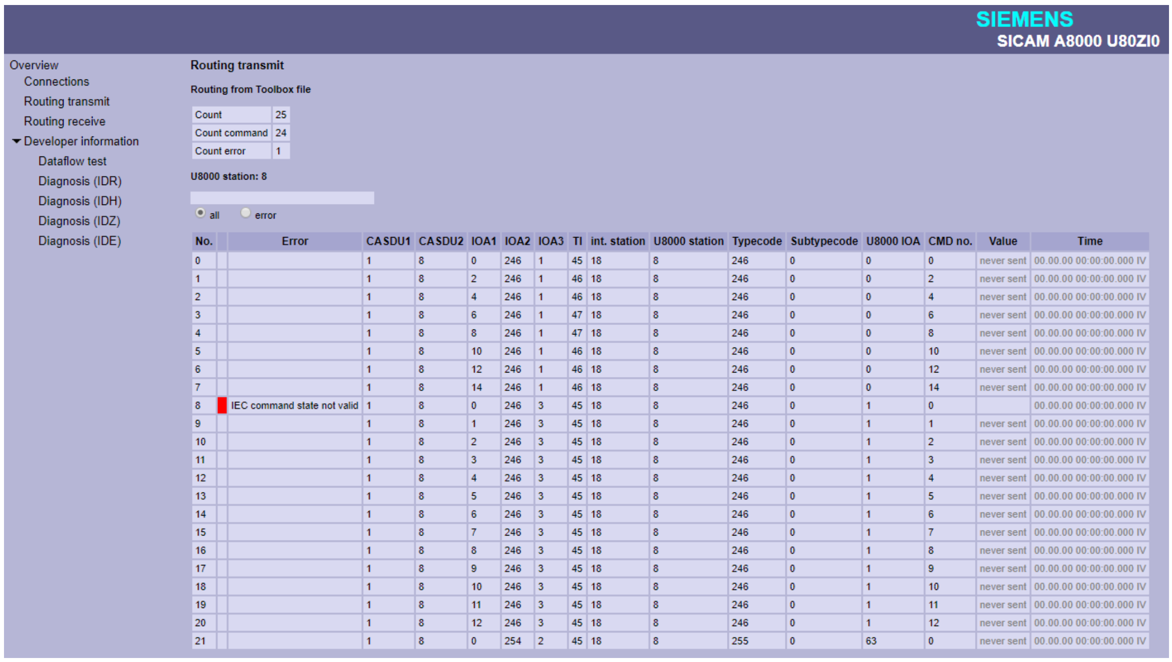
With web page **Routing Transmit** the information of the parameterized U8000 data points in transmit direction are displayed.

Field	Note
Count	Number of parameterized data points in transmit direction (total for all stations)
Count command	Number of incorrectly parameterized data points for "Commands" in transmission direction (total for all stations)
Count errors	Number of faulty parameterized data points in transmit direction (total for all stations)
Error	Error text • ERR = 0 .... No error • ERR = 1 .... SICAM type identification (TI) invalid • ERR = 2 .... SICAM sub adress invalid • ERR = 3 .... U8000 bit number invalid • ERR = 5 .... U8000 Information Object Address invalid • ERR = 6 .... Station number not possible • ERR = 7 .... U8000 address not unique • ERR = 8 .... Type of SIP message address conversion not valid • ERR = 9 .... IEC-address not unique • ERR = 16 ...... IEC command state not valid • ERR = 18 ...... Typecode is not supported • ERR = 19 ...... Typeidentification is not supported • ERR = 20 ...... Internal station number is not valid
CASDU1, CASDU2 IOA1, IOA2, IOA3	CP-8050 internal IEC 60870-5-101/104 Address of the data point
TI	IEC 60870-5-101/104 Type identification (CP-8050 internal)
Int. station	CP-8050 internal station number
U8000 station	U8000 station number
Typecode	U8000 Typcode
Subtypecode	U8000 Subtypcode (is not used)
U8000 IOA	U8000 Information object address
CMD no.	U8000 command number

Field	Note
Last value sent	Last sent value for this data point from the BSE → PRE
Time	Time of the last transfer of the data point BSE → PRE

Routing Transmit (Filter not used)

All parameterized data points in transmission direction are displayed.
Incorrect parameterized data points are marked "red".



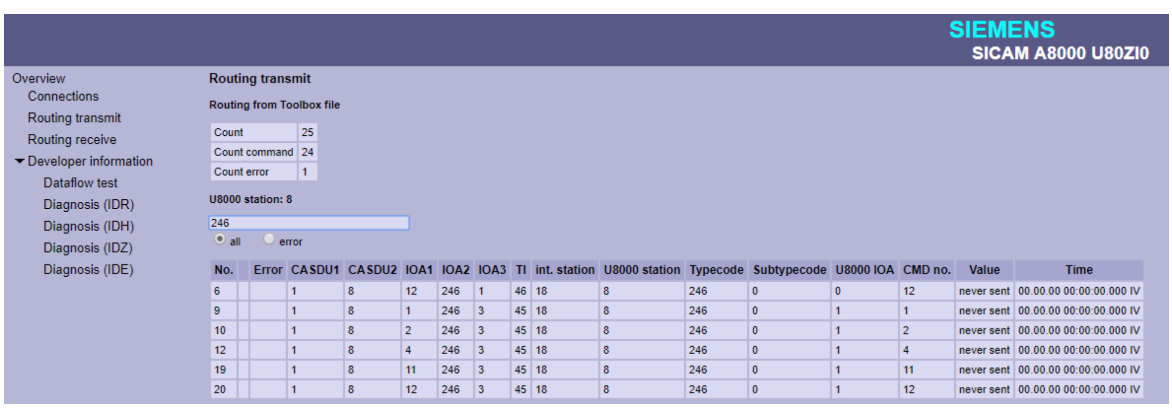
Count	25
Count command	24
Count error	1

No.		Error	CASDU1	CASDU2	IOA1	IOA2	IOA3	TI	int. station	U8000 station	Typecode	Subtypecode	U8000 IOA	CMD no.	Value	Time
0			1	8	0	246	1	45	18	8	246	0	0	0	never sent	00.00.00 00:00:00.000 IV
1			1	8	2	246	1	46	18	8	246	0	0	2	never sent	00.00.00 00:00:00.000 IV
2			1	8	4	246	1	46	18	8	246	0	0	4	never sent	00.00.00 00:00:00.000 IV
3			1	8	6	246	1	47	18	8	246	0	0	6	never sent	00.00.00 00:00:00.000 IV
4			1	8	8	246	1	47	18	8	246	0	0	8	never sent	00.00.00 00:00:00.000 IV
5			1	8	10	246	1	46	18	8	246	0	0	10	never sent	00.00.00 00:00:00.000 IV
6			1	8	12	246	1	46	18	8	246	0	0	12	never sent	00.00.00 00:00:00.000 IV
7			1	8	14	246	1	46	18	8	246	0	0	14	never sent	00.00.00 00:00:00.000 IV
8		IEC command state not valid	1	8	0	246	3	45	18	8	246	0	1	0		00.00.00 00:00:00.000 IV
9			1	8	1	246	3	45	18	8	246	0	1	1	never sent	00.00.00 00:00:00.000 IV
10			1	8	2	246	3	45	18	8	246	0	1	2	never sent	00.00.00 00:00:00.000 IV
11			1	8	3	246	3	45	18	8	246	0	1	3	never sent	00.00.00 00:00:00.000 IV
12			1	8	4	246	3	45	18	8	246	0	1	4	never sent	00.00.00 00:00:00.000 IV
13			1	8	5	246	3	45	18	8	246	0	1	5	never sent	00.00.00 00:00:00.000 IV
14			1	8	6	246	3	45	18	8	246	0	1	6	never sent	00.00.00 00:00:00.000 IV
15			1	8	7	246	3	45	18	8	246	0	1	7	never sent	00.00.00 00:00:00.000 IV
16			1	8	8	246	3	45	18	8	246	0	1	8	never sent	00.00.00 00:00:00.000 IV
17			1	8	9	246	3	45	18	8	246	0	1	9	never sent	00.00.00 00:00:00.000 IV
18			1	8	10	246	3	45	18	8	246	0	1	10	never sent	00.00.00 00:00:00.000 IV
19			1	8	11	246	3	45	18	8	246	0	1	11	never sent	00.00.00 00:00:00.000 IV
20			1	8	12	246	3	45	18	8	246	0	1	12	never sent	00.00.00 00:00:00.000 IV
21			1	8	0	254	2	45	18	8	255	0	63	0	never sent	00.00.00 00:00:00.000 IV

[U80ZI0_Web_Routing_transmit, 1, --_--]

Routing Transmit - with text filter

Note: The filter affects all fields of the table.



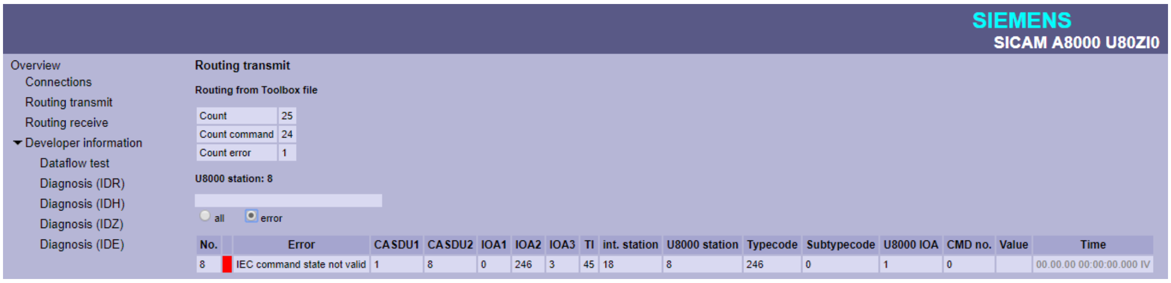
Count	25
Count command	24
Count error	1

No.	Error	CASDU1	CASDU2	IOA1	IOA2	IOA3	TI	int. station	U8000 station	Typecode	Subtypecode	U8000 IOA	CMD no.	Value	Time
6		1	8	12	246	1	46	18	8	246	0	0	12	never sent	00.00.00 00:00:00.000 IV
9		1	8	1	246	3	45	18	8	246	0	1	1	never sent	00.00.00 00:00:00.000 IV
10		1	8	2	246	3	45	18	8	246	0	1	2	never sent	00.00.00 00:00:00.000 IV
12		1	8	4	246	3	45	18	8	246	0	1	4	never sent	00.00.00 00:00:00.000 IV
19		1	8	11	246	3	45	18	8	246	0	1	11	never sent	00.00.00 00:00:00.000 IV
20		1	8	12	246	3	45	18	8	246	0	1	12	never sent	00.00.00 00:00:00.000 IV

[U80ZI0_Web_Routing_transmit_Textfilter, 1, --_--]

Routing Transmit - with filter for incorrectly parameterized data points

All faulty parameterized data points in transmit direction are displayed.



[U80ZI0_Web_Routing_transmit_Error_Filter, 1, --_--]

13.18.6.4 Routing Receive

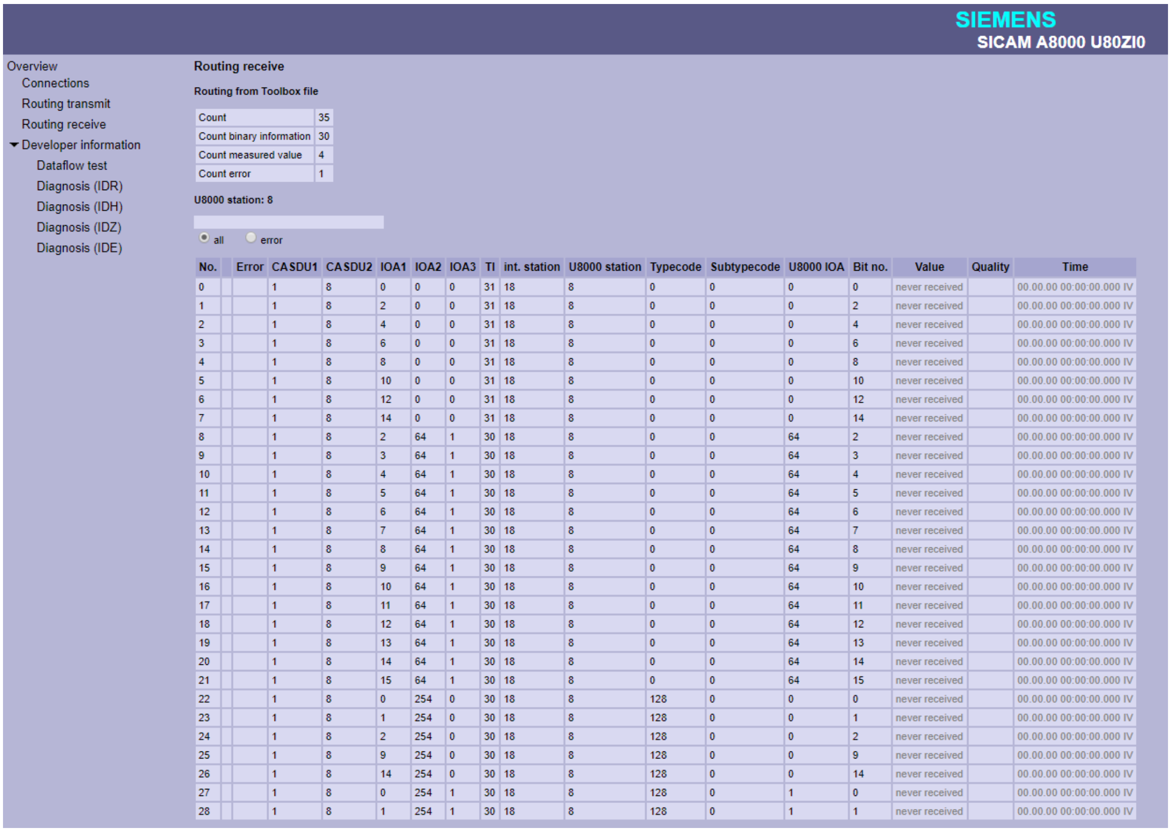
With web page **Routing Receive** the information of the parameterized U8000 data points in receive direction are displayed.

Field	Note
Count	Number of parameterized data points in receive direction (total for all stations)
Count binary indications	Number of error-free parameterized data points for "binary information" in receive direction (total for all stations)
Count measured values	Number of error-free parameterized data points for "measured values" in receive direction (total for all stations)
Count errors	Number of faulty parameterized data points in receive direction (total number for all stations)

Field	Note
Error	Error text • ERR = 0 .... No error • ERR = 1 .... SICAM type identification (TI) invalid • ERR = 2 .... SICAM sub adress invalid • ERR = 3 .... U8000 bit number invalid • ERR = 4 .... Datatype not valid • ERR = 5 .... IEC-address not unique • ERR = 6 .... Station number not possible • ERR = 7 .... U8000 typecode not corresponding to TI • ERR = 8 .... Type of SIP message address conversion not valid • ERR = 9 .... U8000-address not unique • ERR = 11 ...... U8000 informationobject address invalid • ERR = 12 ...... IEC-address (AX-address) not unique • ERR = 14 ...... Typecode is not supported • ERR = 15 ...... Subtypecode is not supported • ERR = 16 ...... IEC command state not valid • ERR = 18 ...... not enough process images • ERR = 19 ...... Parameter X0/X100 not valid • ERR = 20 ...... Parameter Y0/Y100 are equal • ERR = 21 ...... Parameter X0 is greater or equal X100 • ERR = 22 ...... Parameter Y0/Y100 not valid • ERR = 24 ...... Indication attribute not valid • ERR = 25 ...... Invalid transient bit • ERR = 26 ...... Invalid IV bit • ERR = 27 ...... DPI negation bit invalid • ERR = 30 ...... SICAM RTUs message format is not supported
CASDU1, CASDU2 IOA1, IOA2, IOA3	CP-8050 internal IEC 60870-5-101/104 Address of the data point
TI	IEC 60870-5-101/104 Type identification (CP-8050 internal)
Int. station	CP-8050 internal station number
U8000 station	U8000 station number
Typecode	U8000 Typcode
Subtypecode	U8000 Subtypcode (is not used)
U8000 IOA	U8000 Information object address
Bit no.	U8000 Bitnummer
Value	Last received and transferred value for this data point from PRE → BSE
Quality	IEC60870-5-101/104 Quality descriptor of the data point (CP-8050 internal, only NT-Bit)
Time	Time of the last transfer of the received data point PRE → BSE

Routing Receive (Filter not used)

All faulty parameterized data points in receive direction are displayed. Faulty data points are marked "red".



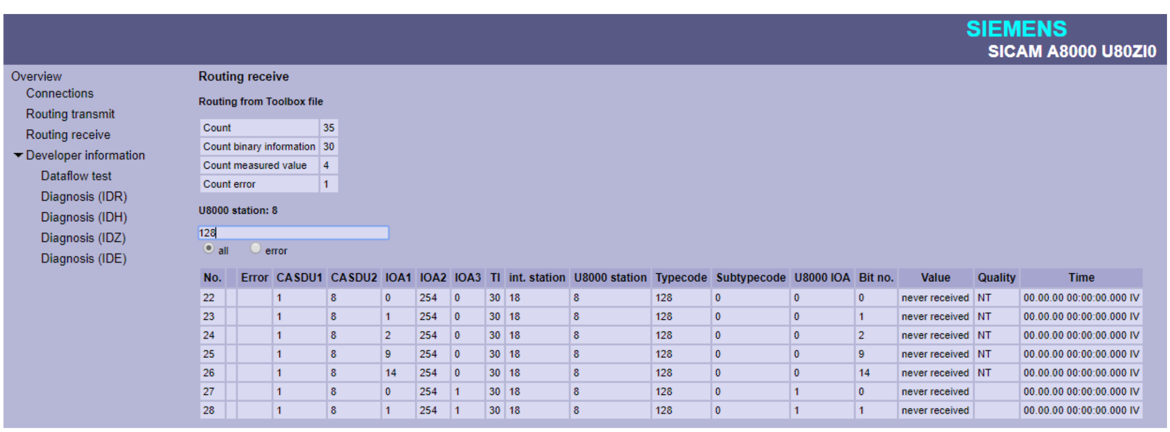
Count	35
Count binary information	30
Count measured value	4
Count error	1

No.		Error	CASDU1	CASDU2	IOA1	IOA2	IOA3	TI	int. station	U8000 station	Typecode	Subtypecode	U8000 IOA	Bit no.	Value	Quality	Time
0			1	8	0	0	0	31	18	8	0	0	0	0	never received		00.00.00 00:00:00.000 IV
1			1	8	2	0	0	31	18	8	0	0	0	2	never received		00.00.00 00:00:00.000 IV
2			1	8	4	0	0	31	18	8	0	0	0	4	never received		00.00.00 00:00:00.000 IV
3			1	8	6	0	0	31	18	8	0	0	0	6	never received		00.00.00 00:00:00.000 IV
4			1	8	8	0	0	31	18	8	0	0	0	8	never received		00.00.00 00:00:00.000 IV
5			1	8	10	0	0	31	18	8	0	0	0	10	never received		00.00.00 00:00:00.000 IV
6			1	8	12	0	0	31	18	8	0	0	0	12	never received		00.00.00 00:00:00.000 IV
7			1	8	14	0	0	31	18	8	0	0	0	14	never received		00.00.00 00:00:00.000 IV
8			1	8	2	64	1	30	18	8	0	0	64	2	never received		00.00.00 00:00:00.000 IV
9			1	8	3	64	1	30	18	8	0	0	64	3	never received		00.00.00 00:00:00.000 IV
10			1	8	4	64	1	30	18	8	0	0	64	4	never received		00.00.00 00:00:00.000 IV
11			1	8	5	64	1	30	18	8	0	0	64	5	never received		00.00.00 00:00:00.000 IV
12			1	8	6	64	1	30	18	8	0	0	64	6	never received		00.00.00 00:00:00.000 IV
13			1	8	7	64	1	30	18	8	0	0	64	7	never received		00.00.00 00:00:00.000 IV
14			1	8	8	64	1	30	18	8	0	0	64	8	never received		00.00.00 00:00:00.000 IV
15			1	8	9	64	1	30	18	8	0	0	64	9	never received		00.00.00 00:00:00.000 IV
16			1	8	10	64	1	30	18	8	0	0	64	10	never received		00.00.00 00:00:00.000 IV
17			1	8	11	64	1	30	18	8	0	0	64	11	never received		00.00.00 00:00:00.000 IV
18			1	8	12	64	1	30	18	8	0	0	64	12	never received		00.00.00 00:00:00.000 IV
19			1	8	13	64	1	30	18	8	0	0	64	13	never received		00.00.00 00:00:00.000 IV
20			1	8	14	64	1	30	18	8	0	0	64	14	never received		00.00.00 00:00:00.000 IV
21			1	8	15	64	1	30	18	8	0	0	64	15	never received		00.00.00 00:00:00.000 IV
22			1	8	0	254	0	30	18	8	128	0	0	0	never received		00.00.00 00:00:00.000 IV
23			1	8	1	254	0	30	18	8	128	0	0	1	never received		00.00.00 00:00:00.000 IV
24			1	8	2	254	0	30	18	8	128	0	0	2	never received		00.00.00 00:00:00.000 IV
25			1	8	9	254	0	30	18	8	128	0	0	9	never received		00.00.00 00:00:00.000 IV
26			1	8	14	254	0	30	18	8	128	0	0	14	never received		00.00.00 00:00:00.000 IV
27			1	8	0	254	1	30	18	8	128	0	1	0	never received		00.00.00 00:00:00.000 IV
28			1	8	1	254	1	30	18	8	128	0	1	1	never received		00.00.00 00:00:00.000 IV

[U80ZI0_Web_Routing_receive, 1, --_--]

Routing Receive - with text filter

Note: The filter affects all fields of the table.



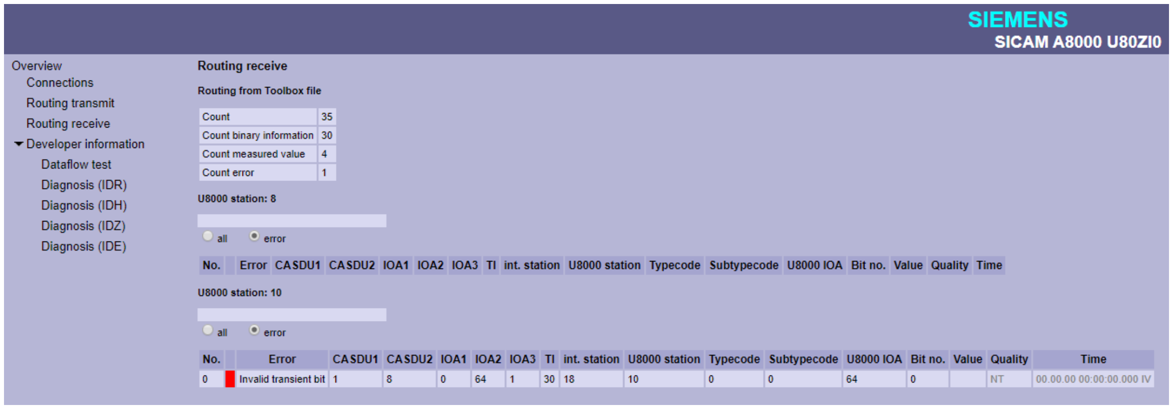
Count	35
Count binary information	30
Count measured value	4
Count error	1

No.		Error	CASDU1	CASDU2	IOA1	IOA2	IOA3	TI	int. station	U8000 station	Typecode	Subtypecode	U8000 IOA	Bit no.	Value	Quality	Time
22			1	8	0	254	0	30	18	8	128	0	0	0	never received	NT	00.00.00 00:00:00.000 IV
23			1	8	1	254	0	30	18	8	128	0	0	1	never received	NT	00.00.00 00:00:00.000 IV
24			1	8	2	254	0	30	18	8	128	0	0	2	never received	NT	00.00.00 00:00:00.000 IV
25			1	8	9	254	0	30	18	8	128	0	0	9	never received	NT	00.00.00 00:00:00.000 IV
26			1	8	14	254	0	30	18	8	128	0	0	14	never received	NT	00.00.00 00:00:00.000 IV
27			1	8	0	254	1	30	18	8	128	0	1	0	never received		00.00.00 00:00:00.000 IV
28			1	8	1	254	1	30	18	8	128	0	1	1	never received		00.00.00 00:00:00.000 IV

[U80ZI0_Web_Routing_receive_Textfilter, 1, --_--]

Routing Receive - with filter for incorrectly parameterized data points

All faulty parameterized data points in receive direction are displayed.



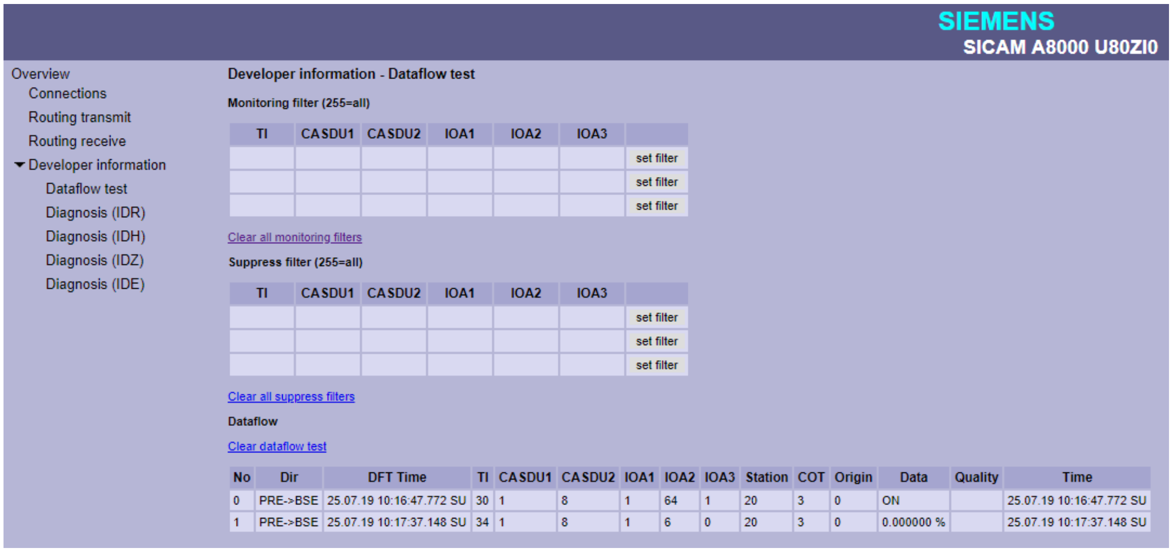
[U80ZI0_Web_Routing_receive_Error_Filter, 1, --_--]

13.18.6.5 Developer Information – Dataflow Test

With web page **Developer Information – Dataflow Test** messages transmitted via internal interface from PRE ↔ BSE will be displayed.

The last 200 messages transmitted from PRE <-> BSE will be displayed..

Field	Note
No.	Message number
Dir	Direction (Dir = Direction) • PRE → BSE: Received data • BSE → PRE: Transmitted data
DFT Time	Logging time
TI	IEC 60870-5-101/104 Type identification (CP-8050 internal)
CASDU1, CASDU2 IOA1, IOA2, IOA3	CP-8050 internal IEC 60870-5-101/104 Address of the data point
Station	CP-8050 internal station number for the U8000 station
COT	IEC 60870-5-101/104 cause of transmission (CP-8050 internal) (COT = Cause Of Transmission)
Origin	IEC 60870-5-101/104 originator address (CP-8050 internal) (origin = Originator)
Data	IEC 60870-5-101/104 state of the data point (CP-8050 internal)
Quality	IEC 60870-5-101/104 Quality descriptor of the data point (CP-8050 internal)
Time	Receive time



Telegram filter for simultaneous logging ("Monitoring Filter")

With filter enabled, only messages will be logged which are selected by filter. If no filter is selected all messages will be logged.

The value "255" sets this field to "Wildcard". i.e. all messages are logged with this field (0-255).

The filter will be activated by set filter.

The filters will be cleared with Clear all monitoring filters.

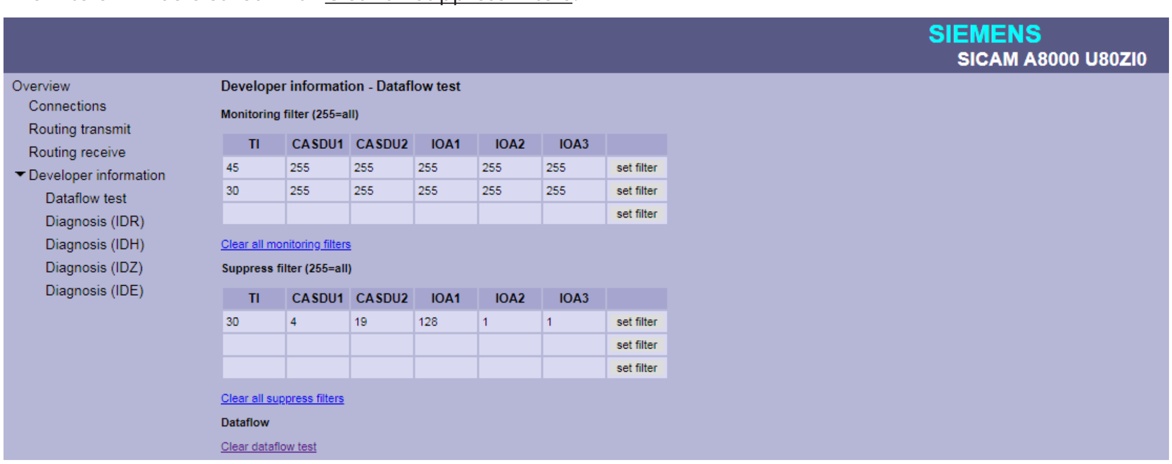
Message filter for logging - Suppress Filter

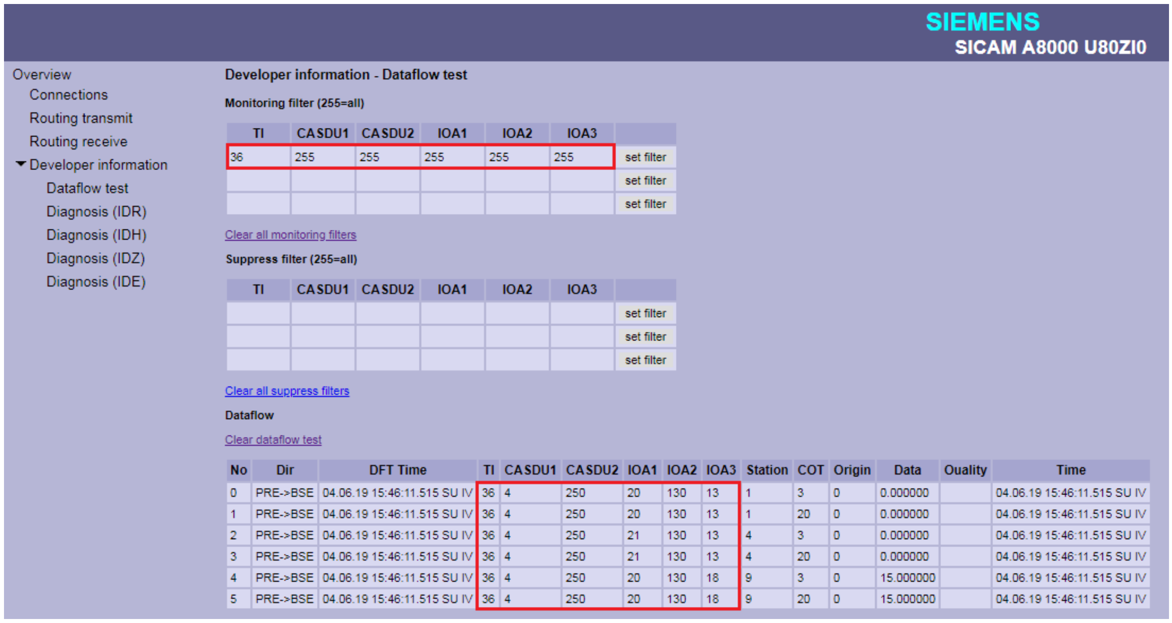
If a filter is selected, the messages selected by the filter are not logged (i.e., "suppressed"). If no filter is selected all messages will be logged.

The value "255" sets this field to "Wildcard". i.e. all messages with this field (0-255) are suppressed.

The filter will be activated by set filter.

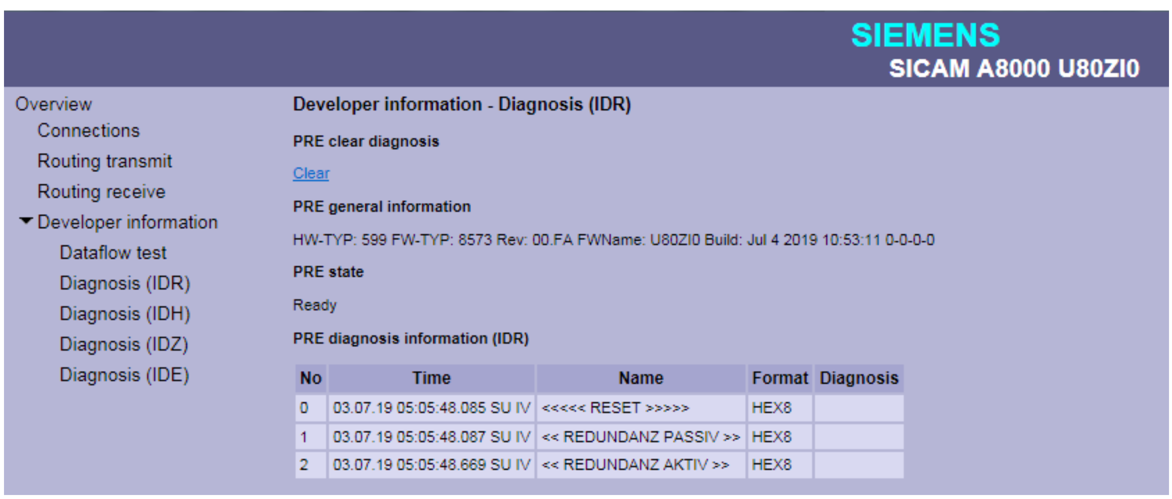
The filters will be cleared with Clear all suppress filters.





13.18.6.6 Developer Information – Diagnosis (IDR)

With web page **Developer Information - Diagnosis (IDR)** internal diagnosis information of protocol elements (PRE) will be displayed.



Deletion of the IDR diagnosis information on PRE (“PRE clear diagnosis“)

The IDR diagnostic information on the PRE can be deleted under "PRE clear diagnostics" with Clear.

General information of PRE firmware ("PRE general Information")

Field	Note
HW-TYP	Hardware type of PRE firmware
FW-TYP	Firmware type of PRE firmware
Rev	Revision of PRE firmware
FWName	Name of PRE firmware
Build	State of generation of the PRE firmware

IDR diagnostic information of the PRE firmware ("PRE diagnosis information (IDR)")

Field	Note
No	Consecutive number
Time	Date + time of IDR logging
Name	Diagnosis text
Format	Format of diagnosis information in next column • CHAR, HEX8, HEX16, HEX32, DEC8, DEC16, DEC32, FLOAT32
Diagnosis	Detail information for IDR diagnosis

13.18.6.7 Developer Information – Diagnosis (IDH)

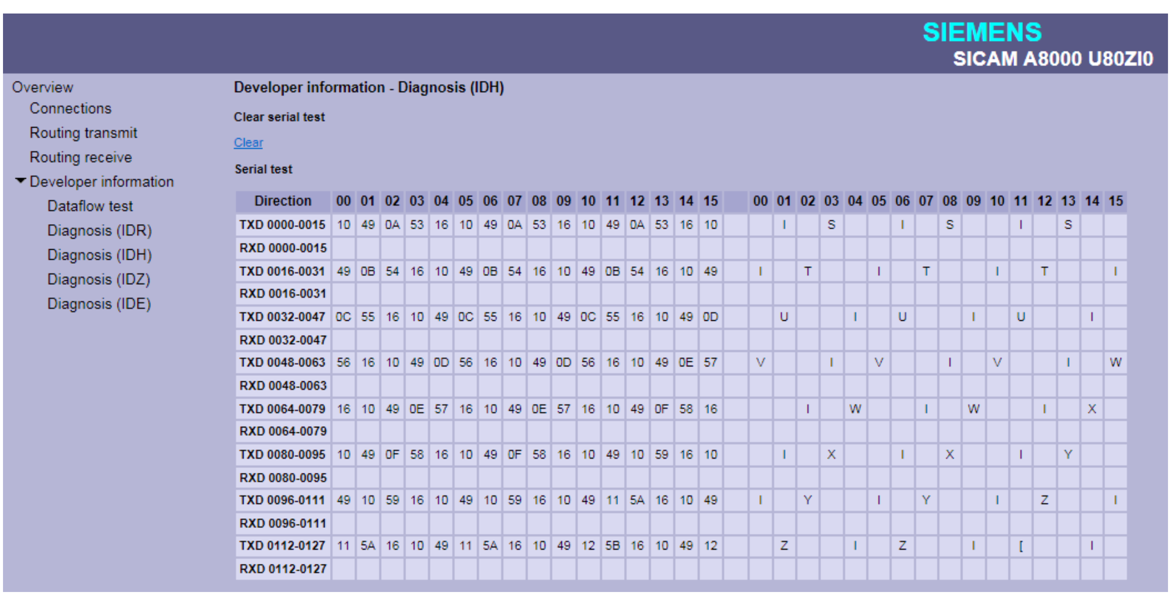
The **Developer Information – Diagnosis (IDH)** web-page will display the last 2000-4000 data sent / received in HEX and ASCII without timestamps.

Deleting the IDH diagnostic information on the PRE ("Clear serial test")

The IDH diagnostic information (serial test) on the PRE, can be deleted under "Clear serial test" with Clear.

IDH-Diagnostic information "serial test"

Field	Note
Direction	TXD = Transmit Data (of PRE) RXD = Receive Data (of PRE)
00, 01, 02, .. 15	Byte no. (0-15) per row The transmitted/received bytes are entered in chronological order into the byte number TXD xxxx-yyyy, RXD xxxx-yyyy.
TXD xxxx-yyyy	Byte number for transmit data
RXD xxxx-yyyy	Byte number for receive data
HEX	The left range of the table (byte number 00..15) shows the sent/received data are in HEX.
ASCII	The right range of the table (byte number 00..15) shows the sent/received data are in ASCII.

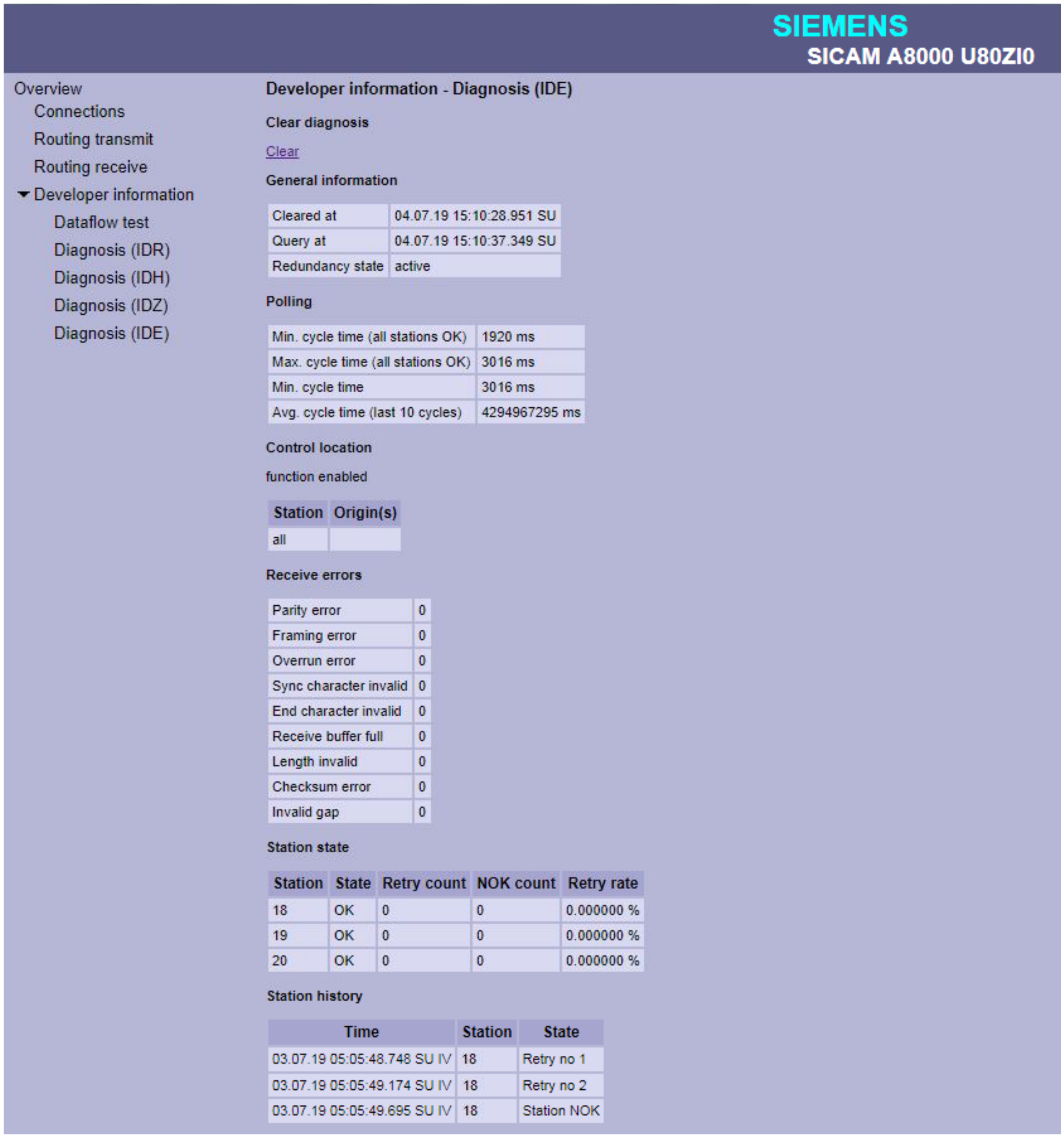


Direction	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15
TXD 0000-0015	10	49	0A	53	16	10	49	0A	53	16	10	49	0A	53	16	10
RXD 0000-0015																
TXD 0016-0031	49	0B	54	16	10	49	0B	54	16	10	49	0B	54	16	10	49
RXD 0016-0031																
TXD 0032-0047	0C	55	16	10	49	0C	55	16	10	49	0C	55	16	10	49	0D
RXD 0032-0047																
TXD 0048-0063	56	16	10	49	0D	56	16	10	49	0D	56	16	10	49	0E	57
RXD 0048-0063																
TXD 0064-0079	16	10	49	0E	57	16	10	49	0E	57	16	10	49	0F	58	16
RXD 0064-0079																
TXD 0080-0095	10	49	0F	58	16	10	49	0F	58	16	10	49	10	59	16	10
RXD 0080-0095																
TXD 0096-0111	49	10	59	16	10	49	10	59	16	10	49	11	5A	16	10	49
RXD 0096-0111																
TXD 0112-0127	11	5A	16	10	49	11	5A	16	10	49	12	5B	16	10	49	12
RXD 0112-0127																

Direction	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15
TXD 0000-0015		I		S			I		S			I		S		
RXD 0000-0015																
TXD 0016-0031	I		T			I		T			I		T			I
RXD 0016-0031																
TXD 0032-0047		U			I		U			I		U			I	
RXD 0032-0047																
TXD 0048-0063	V			I		V			I		V			I		W
RXD 0048-0063																
TXD 0064-0079			I		W			I		W			I		X	
RXD 0064-0079																
TXD 0080-0095		I		X			I		X			I		Y		
RXD 0080-0095																
TXD 0096-0111	I		Y			I		Y			I		Z			I
RXD 0096-0111																
TXD 0112-0127		Z			I		Z			I		[			I	
RXD 0112-0127																

13.18.6.8 Developer Information – Diagnosis (IDE)

The **Developer Information – Diagnosis (IDE)** web page displays protocol-internal diagnostic and statistic information.



Deletion of the IDE diagnostic information on PRE (“Clear diagnosis”)

The IDE diagnostic information on the PRE can be cleared under **Clear diagnosis** with Clear.

General information of the IDE diagnosis (“General information”)

Field	Note
Cleared at	Time of IDE diagnosis information cleared
Query at	Last query time of IDE diagnosis information
Redundancy state	Current redundancy status of the protocol firmware

General information of the IDE diagnosis (“Polling”)

Field	Note
Min. cycle time (all stations OK)	Minimum cycle time for all OK stations
Max. cycle time (all stations OK)	Maximum cycle time for all OK stations
Min. cycle time	Minimum cycle time
Avg. cycle time (last 10 cycles)	Average cycle time (last 10 cycles)

Information on the control location of the PRE (“Control location”)

Field	Note
	The activated control locations will be displayed when control location function is enabled.

Receive error statistics (“Receive Errors”)

Field	Note
Parity error	Number of detected parity errors
Framing error	Number of detected byte frame errors
Overrun error	Number of detected overflow errors In case of overflow error the firmware load is too high – the received bytes can no longer be processed correctly.
Sync character invalid	Number of detected synchronization errors
End character invalid	Number of detected end character errors
Receive buffer full	Number of detected errors for receive buffer full
Length invalid	Number of detected length invalid errors
Checksum error	Number of detected checksum errors
Invalid gap	Number of detected errors for inadmissible gap in the message (gap between 2 bytes within a message).

State of Communication Link (“Station state”)

For each station, the current status and statistics about the number of failures and retries are displayed.

Field	Note
Station	Station number (internal)
State	OK .... Communication link OK NOK ..... Communication link NOK (failed)
Retry count	Number of retries since last Clear diagnosis
NOK count	Number of communication link NOK (failed) since last Clear diagnosis
Retry rate	Number of retries in % since last Clear diagnosis

Chronological list of retries and station failures ("Station History")

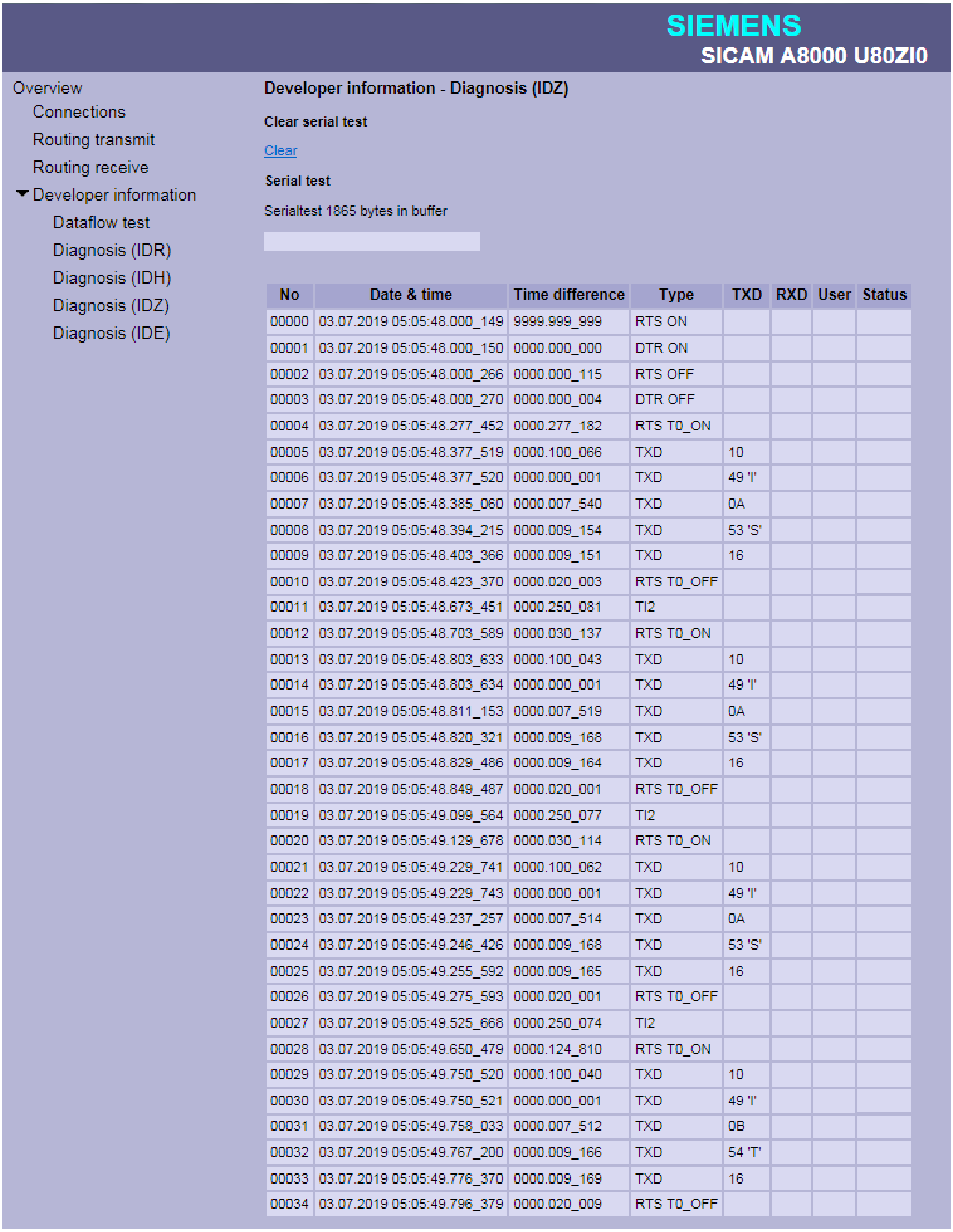
Field	Note
Time	Date + time of communication error (OK, NOK, retry)
Station	Station number (internal)
State	Status: • Retry no x ... Retry number x • Station OK • Station NOK

13.18.6.9 Developer Information – Diagnosis (IDZ)

On the web page **Developer Information – Diagnosis (IDZ**) detailed information of the last 10,000 transmitted/received data or "transmission events" with time tags are shown.

Deleting the IDZ diagnostic information on the PRE ("Clear serial test")

The IDZ diagnostic information on the PRE can be cleared under "Clear serial test" with Clear.



SIEMENS
SICAM A8000 U80ZI0

Overview
Connections
Routing transmit
Routing receive
Developer information
Dataflow test
Diagnosis (IDR)
Diagnosis (IDH)
Diagnosis (IDZ)
Diagnosis (IDE)

Developer information - Diagnosis (IDZ)

Clear serial test

Clear

Serial test

Serialtest 1865 bytes in buffer

No	Date & time	Time difference	Type	TXD	RXD	User	Status
00000	03.07.2019 05:05:48.000_149	9999.999_999	RTS ON				
00001	03.07.2019 05:05:48.000_150	0000.000_000	DTR ON				
00002	03.07.2019 05:05:48.000_266	0000.000_115	RTS OFF				
00003	03.07.2019 05:05:48.000_270	0000.000_004	DTR OFF				
00004	03.07.2019 05:05:48.277_452	0000.277_182	RTS T0_ON				
00005	03.07.2019 05:05:48.377_519	0000.100_066	TXD	10			
00006	03.07.2019 05:05:48.377_520	0000.000_001	TXD	49 'I'			
00007	03.07.2019 05:05:48.385_060	0000.007_540	TXD	0A			
00008	03.07.2019 05:05:48.394_215	0000.009_154	TXD	53 'S'			
00009	03.07.2019 05:05:48.403_366	0000.009_151	TXD	16			
00010	03.07.2019 05:05:48.423_370	0000.020_003	RTS T0_OFF				
00011	03.07.2019 05:05:48.673_451	0000.250_081	TI2				
00012	03.07.2019 05:05:48.703_589	0000.030_137	RTS T0_ON				
00013	03.07.2019 05:05:48.803_633	0000.100_043	TXD	10			
00014	03.07.2019 05:05:48.803_634	0000.000_001	TXD	49 'I'			
00015	03.07.2019 05:05:48.811_153	0000.007_519	TXD	0A			
00016	03.07.2019 05:05:48.820_321	0000.009_168	TXD	53 'S'			
00017	03.07.2019 05:05:48.829_486	0000.009_164	TXD	16			
00018	03.07.2019 05:05:48.849_487	0000.020_001	RTS T0_OFF				
00019	03.07.2019 05:05:49.099_564	0000.250_077	TI2				
00020	03.07.2019 05:05:49.129_678	0000.030_114	RTS T0_ON				
00021	03.07.2019 05:05:49.229_741	0000.100_062	TXD	10			
00022	03.07.2019 05:05:49.229_743	0000.000_001	TXD	49 'I'			
00023	03.07.2019 05:05:49.237_257	0000.007_514	TXD	0A			
00024	03.07.2019 05:05:49.246_426	0000.009_168	TXD	53 'S'			
00025	03.07.2019 05:05:49.255_592	0000.009_165	TXD	16			
00026	03.07.2019 05:05:49.275_593	0000.020_001	RTS T0_OFF				
00027	03.07.2019 05:05:49.525_668	0000.250_074	TI2				
00028	03.07.2019 05:05:49.650_479	0000.124_810	RTS T0_ON				
00029	03.07.2019 05:05:49.750_520	0000.100_040	TXD	10			
00030	03.07.2019 05:05:49.750_521	0000.000_001	TXD	49 'I'			
00031	03.07.2019 05:05:49.758_033	0000.007_512	TXD	0B			
00032	03.07.2019 05:05:49.767_200	0000.009_166	TXD	54 'T'			
00033	03.07.2019 05:05:49.776_370	0000.009_169	TXD	16			
00034	03.07.2019 05:05:49.796_379	0000.020_009	RTS T0_OFF				

IDZ-diagnostic information "Serial test"

Field	Note
Serial test xxxxx bytes in buffer.	Number of stored transmission events in the buffer (max 10000). If more than 10,000 transmission events are recorded, the value xxxxx remains at 10000 and the oldest transmission events are deleted.

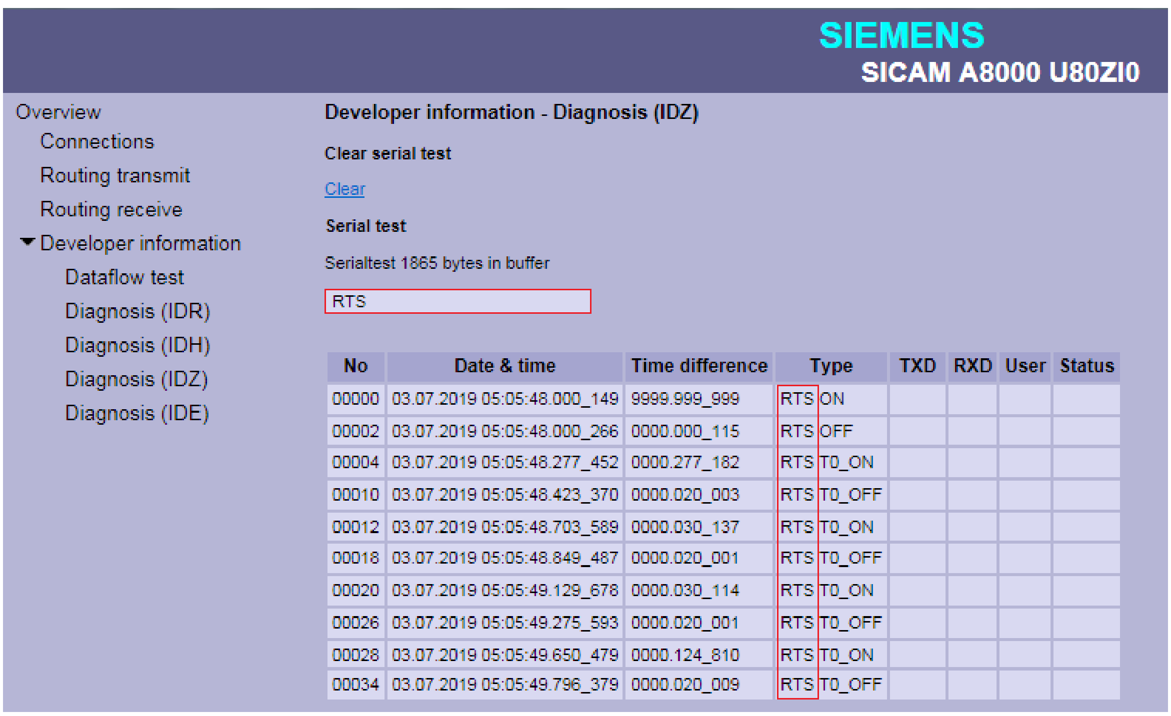
Field	Note
No	Consecutive number
Date and time	Current date + time of the entry
Time difference	Difference time to previous event:
Type	Tansmission event: • TXD ... Data byte sent • RXD ... Data byte received • TPD ... Data bit sent "ON / OFF" (pulse duration modulation) [416] • RPD ... Data bit received "ON / OFF" (pulse duration modulation) [416] • RTS ON ... RTS status line “ON“ <OUT> (“manually "controlled by PRE) • RTS OFF ... RTS status line “OFF“ <OUT> (“manually "controlled by PRE) • RTS_T0 ON ... RTS status line “ON“ <OUT> (controlled by UART) • RTS_T0 OFF ... RTS status line “OFF“ <OUT> (controlled by UART) • DTR ON ... DTR status line “ON“ <OUT> • DTR OFF ... DTR status line “OFF“ <OUT> • DCD ON ... DCD status line “ON“ <IN> • DCD OFF ... DCD status line “OFF“ <IN> • CTS ON ... CTS status line “ON“ <IN> • CTS OFF ... CTS status line “OFF“ <IN> • DCD_T1 ON ... DCD bounce suppression “ON“ • DCD_T1 OFF ... DCD bounce suppression “OFF“ • TI0 ... Timer 0 expiration • TI1 ... Timer 1 expiration • TI2 ... Timer 2 expiration (typically used for acknowledgment time) • TI3 ... Timer 3 expiration (typically used for newsync) • TI4 ... Timer 4 expiration • TI5 ... Timer 5 expiration • TI6 ... Timer 6 expiration • TI7 ... Timer 7 expiration • USER ... User transmission event (including user identifier <0-255> – triggered by the PRE firmware – Entry chronological to IDZ (only for diagnosis) – User identification is entered in the column "User".
TXD	Data-Byte/-Bit sent • xx,‘x‘ ... Displayed in HEX, ‘ASCII‘ • ON, OFF ... TXD Bit status “ON/OFF“ (only with pulse duration modulation) [416]
RXD	Data-Byte/-Bit received • xx,‘x‘ ... Displayed in HEX, ‘ASCII‘ • ON, OFF ... RXD Bit status “ON/OFF“ (only with pulse duration modulation) [416]

416 only possible with SICAM A8000 CI-8551

Field	Note
User	Additional information about the transmission event "Type = User": • 0-255 ... If Type = USER, then the value transmitted by the PRE firmware is entered in the "USER" field.
Status	Status for transmission event “Type=RXD”: • GAP ... Pause detected on reception ("message gap") • PARITY ... Parity fault • FRAMING ... Framing fault • OVERRUN ... Overrun fault • OVERRUN_BUFFER ... Overrun RX (Intermediate buffer error)

IDZ-diagnostic information "Serial test" - with text filter

Note: The filter affects all fields of the table.



No	Date & time	Time difference	Type		TXD	RXD	User	Status
00000	03.07.2019 05:05:48.000_149	9999.999_999	RTS	ON				
00002	03.07.2019 05:05:48.000_266	0000.000_115	RTS	OFF				
00004	03.07.2019 05:05:48.277_452	0000.277_182	RTS	T0_ON				
00010	03.07.2019 05:05:48.423_370	0000.020_003	RTS	T0_OFF				
00012	03.07.2019 05:05:48.703_589	0000.030_137	RTS	T0_ON				
00018	03.07.2019 05:05:48.849_487	0000.020_001	RTS	T0_OFF				
00020	03.07.2019 05:05:49.129_678	0000.030_114	RTS	T0_ON				
00026	03.07.2019 05:05:49.275_593	0000.020_001	RTS	T0_OFF				
00028	03.07.2019 05:05:49.650_479	0000.124_810	RTS	T0_ON				
00034	03.07.2019 05:05:49.796_379	0000.020_009	RTS	T0_OFF				

13.18.7 Message Conversion

Data in transmit direction are transferred from the basic system element to the protocol element in CP-8050 internal IEC 60870-5-101/104 (without 101/104 blocking) format. The conversion of the data formats IEC 60870-5-101/104 ↔ U8000 is performed by the protocol element.

The transmission on the serial transmission line according to U8000 is controlled by the protocol element.

Data in receive direction are converted by the protocol element from the U8000 data format → CP-8050 internal IEC 60870-5-101/104 format and transferred to the basic system element (no 101/104 blocking).

The conversion of the CP-8050 internal IEC 60870-5-101/104 message format ↔ U8000 data format and the conversion of the address information are called message conversion.

The parameterization of the conversion from IEC 60870-5-101/104 ↔ U8000 (address and message format) is to be done with SICAM Device Manager with function “Signals” or SICAM TOOLBOX II, OPM II using “SIP Message Address Conversion”.

Supported processing types for message conversion:

Data	Direction	Processing type	U80ZI0
Binary information Measured values	Receive direction	firmware /`Receive_detail_routing`	✓
Commands	Transmit direction	firmware /`Trans_command`	✓

13.18.7.1 Message Conversion in Transmit Direction (Master → Slave)

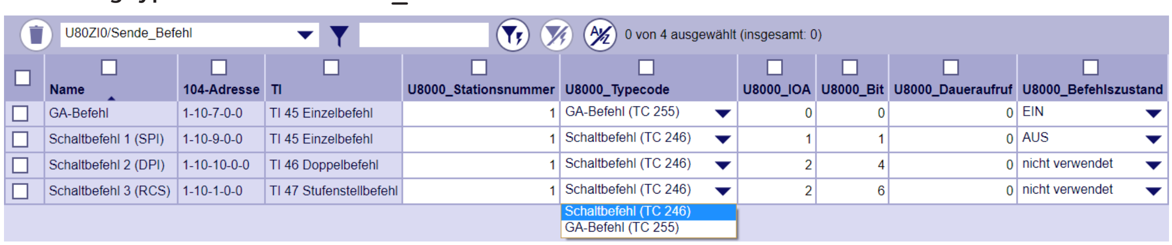
Message Conversion in Transmit Direction SICAM A8000 → U8000

CP-8050: IEC 60870-5-101/104 →		U8000 Datenformat	
TI	**Designation**	**Type code**	**Designation**
<TI:=45>	Single command	246	Switching command
<TI:=45>	Single command	255	GI command
<TI:=46>	Double command	246	Switching command
<TI:=47>	Regulating step command	246	Switching command
<TI:=100>	(General) interrogation command	255	GI command

Commands

The parameterization of the address and message conversion for commands in transmit direction is to be done with the SICAM Device Manager with the function “Signals” or with the SICAM TOOLBOX II, OPM II.

Processing type: *firmware* / `Trans_command`



Parameter	
`TI .. Type identification`	Supported type identifications: • <TI:=45> .. Single command • <TI:=46> .. Double command • <TI:=47> .. Regulating step command
`Name`	Name of the signal
`104 address`	SICAM A8000 internal IEC 60870-5-101/104 message address (CASDU1, CASDU2, IOA1, IOA2, IOA3)
`U8000_Station number`	Ursatron 8000 station number: • 1 to 127
`U8000_Typcode`	Ursatron 8000 Type code: • <TC:=246> .. Switching command • <TC:=255> .. GI command
`U8000_IOA`	Ursatron 8000 information object address: • 0 to 63

Parameter	
U8000_Bit	Position of command within the Ursatron 8000 information object address: • 0 to 15 .. Single command • 0 to 14 .. Double command or regulating step command In double command or regulating step command both command bits must be within the same U8000_IAO.
U8000_Continuous call	Continuous call of the substation after command transmission: • 0 .. no continuous call • 1 to 255 s
U8000_Command_state	Assignment of the command state to U8000 bit number for double commands and regulating step commands (="inversion of the commands"): • Not used [only single command TI:=45] • ON (only with double command <TI:=46> or regulating step commands <TI:=47>) • OFF (only with double command <TI:=46 or regulating step commands <TI:=47>)

Supported Data Formats

U8000 Format	U8000 Typ-Code	U8000 message format	IEC 60870-5-101/104 Data format (TI)
SC	<TC:=246>	Switching command	45
DC	<TC:=246>	Switching command	46, 47
DC	<TC:=255>	GI command	45

Legend: TI 45 = Single command
TI 46 = Double command
TI 47 = Regulating step command

Control Location / Check Control Location

The function “Control location” is used so that commands are only output from authorized sources. If the “Control location” (originator address) function is activated, commands from the protocol element for U8000 master are only transmitted to the substation when the “control location” is enabled. If the control location is not enabled, the protocol element immediately sends back a negative acknowledgment of activation (ACTCON) to the originator address (further details about setting control location / check control location see section *13.1.4.9 Control location function for commands and setpoint values*).

Command Output Time for Single/Double Commands

The command output time for single/double commands is determined in the U8000 substation.

The protocol firmware does not support emulation of pulse commands from the A8000 to U8000 substations. The IEC 60870-5-101/104 command status is transferred directly (without evaluating the SICAM A8000 internal command execution time) to the U8000 substation.

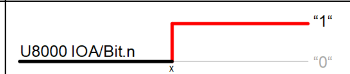
Continous station polling

After the command has been transmitted to a U8000 substation, it can be queried continuously for a configured time(Continuous call of the substation by the master). This means that the response to a command is quickly recorded.

With another command to the same station, the permanent call is retriggered. If a command is sent to another station, an ongoing call is canceled.

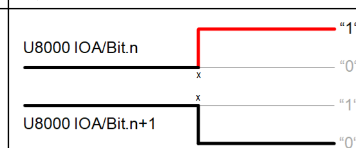
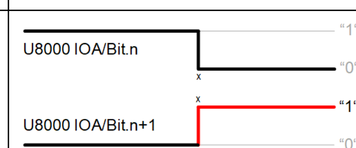
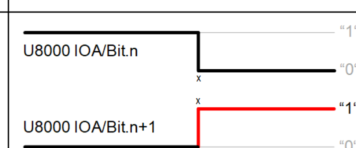
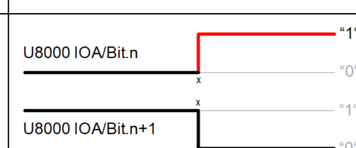
Single command

A single command with the state SCS = ON is transmitted to the U8000 substation with the state SC = ON.

U8000 Datenformat	Command state	Command output (1 bit in the U8000 data of U8000 IOA)
SC (U8000_Command_state = not used)	SCS = ON	
	SCS = OFF	• Not evaluated! • A U8000 OFF command must be implemented internally on the SICAM A8000 with a further single command with SCS = ON. The U8000 OFF command must be transmitted on another bit. • An U8000 ON/OFF command on the same bit is not supported!

Double command / Regulating step command

A double command or regulating step command with the status DCS = ON/OFF or RCS=Higher/Lower is output to the U8000 substation with double command state DC = ON/OFF.

U8000 Datenformat	Command state	Command output (2 bits in the U8000 data of U8000 IOA)
DC (U8000_Command_state = ON)	DCS = ON RCS = HIGHER	
	DCS = OFF RCS = LOWER	
DC (U8000_Command_state = OFF)	DCS = ON RCS = HIGHER	
	DCS = OFF RCS = LOWER	

Message Conversion

The table describes the evaluated elements of the IEC 60870-5-101/104 message during message conversion.

Elements of the message		
TI .. Type identification		• TI 45 .. Single command • TI 46 .. Double command • TI 47 .. Regulating step command
CASDU, IOA .. Message address		Can be set by parameter
Cause of transmission		
06 .. Activation		Is evaluated (only “activation” allowed)
xx .. Other COTs		Not supported
T .. Test		Not supported
Information		
SCO/DCO/RCO		
SCS	Single command state	Only <TI:=45>
	0 .. OFF	Not supported
	1 .. ON	Evaluated
DCS	Double command state	Only <TI:=46>
	0 .. Not allowed	Not supported
	1 .. OFF	Evaluated
	2 .. ON	Evaluated
	3 .. Not allowed	Not supported
RCS	Regulating step command state	Only <TI:=47>
	0 .. Not allowed	Not supported
	1 .. Next step lower	Evaluated
	2 .. Next step higher	Evaluated
	3 .. Not allowed	Not supported
QOC	S/E	
	0 = Execute	Is checked for “execute”
	1 = Select	Not supported
QU	Command qualifier	
	0 .. No additional definitions	Not evaluated
	1 .. Short pulse duration	Not evaluated
	2 .. Long pulse duration	Not evaluated
	3 .. Persistent command	Not evaluated

NOTE

Not listed elements of the IEC 60870-5-101/104 message are not rated/not supported.

13.18.7.2 Message Conversion in Receive Direction (Master ← Slave)

Message Conversion in Receive Direction SICAM A8000 ← U8000

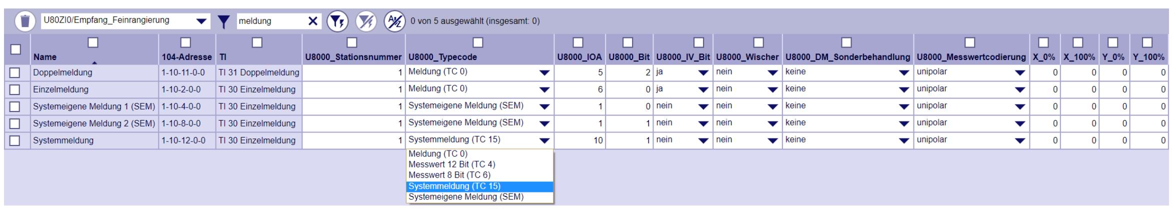
CP-8050: IEC 60870-5-101/104 ←		U8000	
TI	**Designation**	**Type code**	**Designation**
<TI:=30>	Single-point information with time tag CP56Time2a	0	Binary information (1 bit)
		15	System information (1 bit)
		128	Native system indication “SEM” (1 bit)

CP-8050: IEC 60870-5-101/104 ←		U8000	
<TI:=31>	Double-point information with time tag CP56Time2a	0	Binary information (2 bit)
		15	System information (2 bit)
		128	Native system indication “SEM” (2 bit)
<TI:=34>	Measured value, normalized value with time tag CP56Time2a	6	Measured value 8 bits
		4	Measured value 12 bits
<TI:=35>	Measured value, scaled value with time tag CP56Time2a	6	Measured value 8 bits
		4	Measured value 12 bits
<TI:=36>	Measured value, floating-point number with time tag CP56Time2a	6	Measured value 8 bits
		4	Measured value 12 bits

Binary information items

The parameterization of the address and message conversion for binary information in receive direction is to be done with the SICAM Device Manager with the function “Signals” or with the SICAM TOOLBOX II, OPM II.

Processing type: *firmware* /**`Receive_detail_routing`**



U80ZI0/Empfang_Feinrangierung meldung 0 von 5 ausgewählt (insgesamt: 0)

Name	104-Adresse	TI	U8000_Stationsnummer	U8000_Typecode	U8000_IOA	U8000_Bit	U8000_IV_Bit	U8000_Wischer	U8000_DM_Sonderbehandlung	U8000_Messwertcodierung	X_0%	X_100%	Y_0%	Y_100%
Doppelmeldung	1-10-11-0-0	TI 31 Doppelmeldung	1	Meldung (TC 0)	5	2	ja	nein	keine	unipolar	0	0	0	0
Einzelmeldung	1-10-2-0-0	TI 30 Einzelmeldung	1	Meldung (TC 0)	6	0	ja	nein	keine	unipolar	0	0	0	0
Systemeigene Meldung 1 (SEM)	1-10-4-0-0	TI 30 Einzelmeldung	1	Systemeigene Meldung (SEM)	1	0	nein	nein	keine	unipolar	0	0	0	0
Systemeigene Meldung 2 (SEM)	1-10-8-0-0	TI 30 Einzelmeldung	1	Systemeigene Meldung (SEM)	1	1	nein	nein	keine	unipolar	0	0	0	0
Systemmeldung	1-10-12-0-0	TI 30 Einzelmeldung	1	Systemmeldung (TC 15)	10	1	nein	nein	keine	unipolar	0	0	0	0

Meldung (TC 0)
Messwert 12 Bit (TC 4)
Messwert 8 Bit (TC 6)
Systemmeldung (TC 15)
Systemeigene Meldung (SEM)

Parameter	
`TI .. Type identification`	Supported type identifications: • <TI:=30> .. Single-point information with time tag CP56Time2a • <TI:=31> .. Double-point information with time tag CP56Time2a
`Name`	Name of the signal
`104 address`	SICAM A8000 internal IEC 60870-5-101/104 message address (CASDU1, CASDU2, IOA1, IOA2, IOA3)
`U8000_Station number`	Ursatron 8000 station number: • 1 to 127
`U8000_Typcode`	Ursatron 8000 Type code: • <TC:=0> .. Binary information (single- or double-point information) • <TC:=15> .. System information • <SEM> .. Native system indication Native system indications (SEM) are generated internally by the protocol firmware from various error indications of the U8000 substation.
`U8000_IOA`	Ursatron 8000 information object address: • 0 to 255 • 1 .. Sum status 1 • 2 .. Sum status 2 The Protocol element can generate a system-specific message (SEM) for each sum status.

Parameter	
U8000_Bit	Position of the message (single or double-point information) within the Ursatron 8000 information object address: • 0 to 15 .. Single-point information • 0 to 14 .. Double-point information • 0 .. Native system indication (SEM)
U8000_IV_Bit	Convert IV bit for faulty binary information from Ursatron 8000 to NT bit: • Yes • No
U8000_Transient	Identifier for transient information: • Yes • No Transient indications are only transmitted from Ursatron 8000 substations with binary information state ON.
U8000_DM_Special handling	Special handling for Ursatron 8000 double-point information: • None • Inverted • Cross-over
U8000_meas-ured_value_coding	For binary information not evaluated
X_0%, X_100%, Y_0%, Y_100%	For binary information not evaluated (must be "0")

Supported Data Formats

U8000 Format	U8000 Datenformat	IEC 60870-5-101/104 Data format (TI)
Single-point information	bit	30
Double-point information	OFF/ON	31
Double-point information	ON/OFF	31
System information	bit	30
Native system indication	bit	30

Legend: TI 30 = Single-point information with time tag CP56Time2a
TI 31 = Double-point information with time tag CP56Time2a

Binary information faulty – Conversion U8000 IV bit → IEC 60870-5-101/104 NT bit

When converting messages, it can be specified for each message whether the U8000 IV bit (invalid) should be converted to the IEC 60870-5-101/104 NT bit.

A message from the U8000 substation is set to fault at:

- Signal test error (a test value can be applied internally to each message)
- Open-circuit
- Bounce message

Suppression of intermediate and faulty position for double-point information

A suppression of intermediate and faulty position for double-point information of U8000 substations is not supported from the protocol firmware.
A suppression of intermediate and faulty position for double-point information must be done in the U8000 substation.

System Information

U8000 system information are transferred spontaneously in the event of changes or with GI (before the user data).
U8000 system information is passed on internally as binary information to the SICAM A8000.

Native system indication

Native system indications (SEM) are generated internally by the protocol firmware from different error bits of the U8000 sum status.
<TC:=128> is only used internally by protocol to identify the system's own messages and is not transmitted on the line.
The sum status address 1 is always passed on by the U8000 substation, the sum status address 2 is only passed on if it is equipped accordingly. With FIC 2 the sum status address 1 is simulated, the sum status address 2 is not available.
There is a mixed assignment of status and transient information messages on the sum status address 1.

Special functions for double-point information items

When converting the message, it can be specified for each double-point information how the status of the U8000 double-point information should be converted to the IEC 60870-5-101/104 double-point information status.
Possible treatment/special treatment for double-point information:

- None
  The received U8000 double-point information state is converted unchanged in the direction of the SICAM A8000.

U8000 double-point information		IEC 60870-5-101/104	State of the double-point information
Bit (n+1)	Bit (n+0)	DPI	
0	0	0	Undefined state or intermediate state
0	1	1	OFF
1	0	2	ON
1	1	3	Indeterminate state

- Inverted
  The status of the bits received in a double-point information is inverted before it is forwarded to the SICAM A8000 (“0”→”1”, “1”→”0”).

U8000 Double-point information (State on reception)		U8000 Double-point information (state after inversion)		IEC 60870-5-101/104	State of the double-point information
Bit (n+1)	Bit (n+0)	Bit (n+1)	Bit (n+0)	DPI	
0	0	1	1	3	Indeterminate state
0	1	1	0	2	ON
1	0	0	1	1	OFF
1	1	0	0	0	Undefined state or intermediate state

- Cross-over
  The status of the bits received in a double-point information is swapped before it is forwarded to the SICAM A8000 ("Bit (n+1)" ↔ "Bit (n+0)".

U8000 Double-point information (State on reception)		U8000 Double-point information (state after inversion)		IEC 60870-5-101/104	State of the double-point information
Bit (n+1)	Bit (n+0)	Bit (n+1)	Bit (n+0)	DPI	
0	0	0	0	0	Undefined state or intermediate state
0	1	1	0	2	ON
1	0	0	1	1	OFF
1	1	1	1	3	Indeterminate state

Transient information

Transient information is only transmitted from U8000 substations with the ON binary information state. When converting transient information to the BSE, the protocol firmware transmits the ON binary information state with the PRE internal receive time "t" and the OFF binary information state with the receive time "t + 10 ms".

Transient information are not transmitted by the U8000 substation during a general interrogation. In the case of a general interrogation, transient information are transferred from the protocol firmware from the protocol internal process image with the "OFF" status towards the basic system element.

Message Conversion

The table describes the evaluated elements of the IEC 60870-5-101/104 message during message conversion.

Elements of the (IEC 60870-5-101/104) tmessage	
TI .. Type identification	• TI 30 .. Single-point information with time tag CP56Time2a • TI 31 .. Double-point information with time tag CP56Time2a
CASDU, IOA .. Message address	Can be set by parameter
QDS .. Quality descriptor	
BL .. blocked	Not supported (BL = 0)
SB .. Substituted	Not supported (SB = 0)
NT .. Not topical	NT bit depending of the parameter `U8000_IV_Bit`: <no> .. NT = 0 <yes> .. NT = State of the U8000 IV bit
IV .. Invalid	Not supported (IV = 0)

Elements of the (IEC 60870-5-101/104) tmessage		
03 .. Spontaneous		Upon change of information state or quality descriptor
20 .. Interrogated by station interrogation		On reception of a GI request
xx .. Other COTs		Not supported
T .. Test		Not supported
Information		
SPI	0 .. OFF	Supported
	1 .. ON	Supported
double command state		
DPI	0 .. Undefined state or intermediate state	Supported
	1 .. OFF	Supported
	2 .. ON	Supported
	3 .. Indeterminate state	Supported
Time_tag		
CP56Time2a .. Date + Time		Protocol-internal time (receive time)

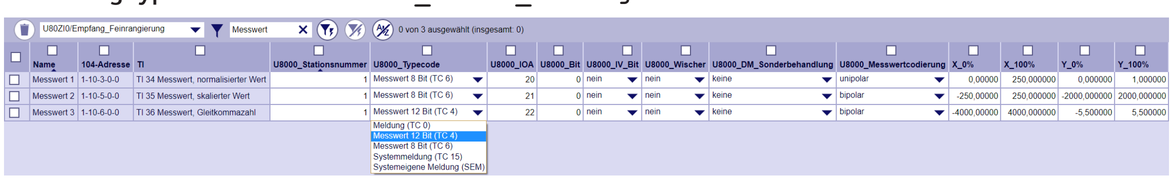
NOTE

Not listed elements of the IEC 60870-5-101/104 message are not rated/not supported.

Measured values

The parameterization of the address and message conversion for measured values in receive direction is to be done with the SICAM Device Manager with the function “Signals” or with the SICAM TOOLBOX II, OPM II.

Processing type: *firmware* /**Receive_detail_routing**



Parameter	
TI .. Type identification	Supported type identifications: • <TI:=34> .. Measured value, normalized value with time tag CP56Time2a • <TI:=35> .. Measured value, scaled value with time tag CP56Time2a • <TI:=36> .. Measured value, short floating point number with time tag CP56Time2a
Name	Name of the signal
104 address	SICAM A8000 internal IEC 60870-5-101/104 message address (CASDU1, CASDU2, IOA1, IOA2, IOA3)
U8000_Station number	Ursatron 8000 station number: • 1 to 127
U8000_Typcode	Ursatron 8000 Type code: • <TC:=4> ... Measured value 12 bits • <TC:=6> ... Measured value 8 bits

Parameter	
`U8000_IOA`	Ursatron 8000 information object address: • 0 to 255
`U8000_Bit`	Not evaluated for measured values (must be “0”)
`U8000_IV_Bit`	Not evaluated for measured values (must be set to “no”)
`U8000_Transient`	Not evaluated for measured values (must be set to “no”)
`U8000_DM_Special handling`	Not evaluated for measured values (must be set to “none”)
`U8000_measured_value_coding`	Coding for measured values: • unipolar • bipolar
`X_0%, X_100%, Y_0%, Y_100%`	Parameters for value adaptation (scaling) • <TI:=34> .. Y_0% and Y_100% must not be less or greater than ±1. • <TI:=35> .. Y_0% and Y_100% must not be less than −32768 or greater than +32767. Value adaptation inactive at X_0% and X_100% = 0 Valid range of value for X_0% and X_100% see section *13.18.8 U8000 Data format*.

Supported Data Formats

U8000 Format	U8000 Datenformat	IEC 60870-5-101/104 Data format (TI)
Measured value 8 bits	Measured value 8-bit (TC:=6)	34, 35, 36
Measured value 12 bits	Measured value 12-bit (TC:=4)	34, 35, 36

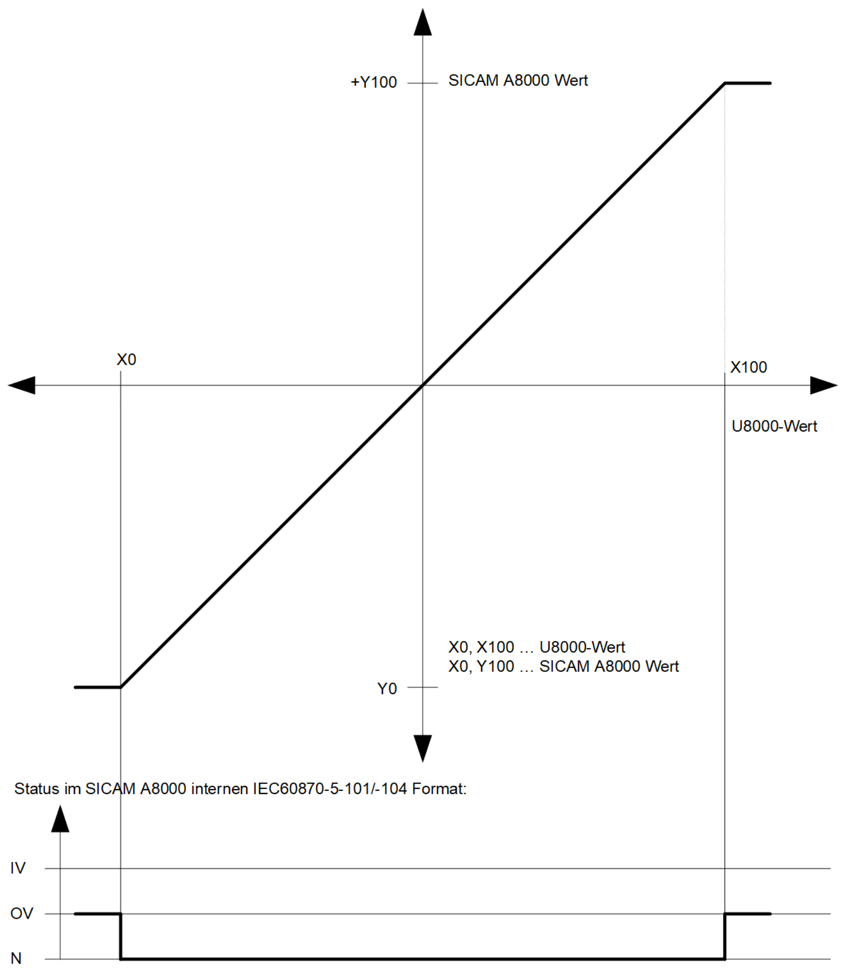
Legend: TI 34 = measured value, normalized value with time tag CP56Time2a
TI 35 = measured value, scaled value with time tag CP56Time2a
TI 36 = measured value, short floating point number with time tag CP56Time2a

U8000 measured values

U8000 Format	U8000 message format	U8000 value range
Measured value 8-bit (unipolar)	Measured value 8-bit (TC:=6)	0 % to 100 % = 0 to 250
Measured value 8-bit (bipolar)	Measured value 8-bit (TC:=6)	-100 % to +100 % = -250 to +250
Measured value 12-bit (unipolar)	Measured value 12-bit (TC:=4)	0 % to 100 % = 0 to 4000
Measured value 12-bit (bipolar)	Measured value 12-bit (TC:=4)	-100 % to +100 % = -4000 to +4000

Value adaptation:

The value adaptation is defined by the parameters X_0%, X_100%, Y_0%, Y_100%.



The value adaptation is only performed if X_0% or X_100% ≠ "0" is parameterized.

NOTE

If the U8000 value is outside the value range of the selected IEC 60870-5-101/104 type identifier when the value adaptation is not activated (direct transfer), then OV = 1 is set.

Message Conversion

The table describes the evaluated elements of the IEC 60870-5-101/104 message during message conversion.

Elements of the message	
TI .. Type identification	• TI 34 .. Measured value, normalized value with time tag CP56Time2a • TI 35 .. Measured value, scaled value with time tag CP56Time2a • TI 36 .. Measured value, short floating point number with time tag CP56Time2a
CASDU, IOA .. Message address	Can be set by parameter
QDS .. Quality descriptor	
BL .. blocked	Not supported (BL = 0)
SB .. Substituted	Not supported (SB = 0)
NT .. Not topical	Not supported (NT = 0)

Elements of the message	
IV .. Invalid	Not supported (IV = 0)
OV .. Overflow	OV = 1: Without value adaptation: • U8000 value outside the range of the selected type identification With value adaptation: • U8000 value less than X_0% or greater X_100%
03 .. Spontaneous	On alteration of the information state, measured value (depending on the thresholds) or the quality descriptor
20 .. Interrogated by station interrogation	On reception of a GI request
xx .. Other COTs	Not supported
T .. Test	Not supported
Information	
Value.. S .. Sign	• Normalized value • Scaled value • IEEE STD 754 = short floating point number
Time tag	
CP56Time2a .. Date + Time	Protocol-internal time (receive time)

NOTE

Not listed elements of the IEC 60870-5-101/104 message are not rated/not supported.

13.18.8 U8000 Data format

13.19 ÖBB VLZ (PIPS1)

13.19.1 Introduction

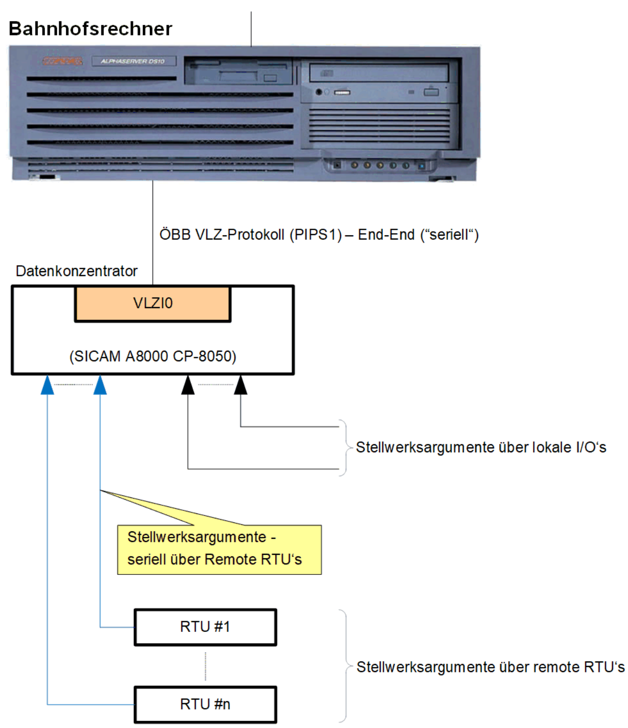
The ÖBB VLZ (PIPS1) protocol is a customized serial transmission protocol for transmitting RCC-arguments from the data concentrator to the station computer in end-end traffic.

Protocol firmware for ÖBB VLZ (PIPS1):

Firmware	System	Standard and function
VLZI0	CP-8031, CP-8050	ÖBB VLZ (PIPS1) Protocol (Data concentrator for RCC-arguments)

- The protocol is defined in document ÖBB "Pflichtenheft für den Datenkonzentrator für die Übermittlung von Stellwerksargumenten" (c) ÖBB 14. July 1986.
- The ÖBB VLZ (PIPS1) protocol is an end-end traffic communication protocol.
- CP-8031, CP-8050 is used as data concentrator.
- RCC-arguments are transmitted from the data concentrator to the station computer.

Schematic configuration:



[dw_VLZI0_config, 1, en_US]

13.19.2 Functions

Function	VLZI0
ÖBB VLZ (PIPS1) Protocol	
Serial communication protocol (ASCII) according to ÖBB "Pflichtenheft für den Datenkonzentrator für die Übermittlung von Stellwerksargumenten" (c) ÖBB 14. Juli 1986	✓
Communication with max. 1 remote station (Station computer)	✓
CP-8031, CP-8050 = remote station (="data concentrator")	✓
Max. number of supported data points (RCC-arguments)	2048
Network configuration	
Point-to-point configuration	✓
Multiple point-to-point configuration (separate interface for each single point-to-point configuration required)	
Physical interface	
direct link interface (RS-232)	✓
RS-422	
CP-8031, CP-8050: X4 (RS-422), X5 (RS-232)	
CI-8551 [417]: X1 (RS-232, RS-422), X2 (RS-232, RS-422), X3 (RS-422), X4 (RS-232), X5 (RS-232)	
Baud rates: 50, 75, 100, 110, 134.5, 150, 200, 300, 600, 1050, 1200, 1800, 2000, 2400, 4800, 9600, 19200, 38400, 56000, 57600, 64000, 115200 bits/s	
Bit transmission layer	
Byte frame	7E1
Message protection (Parity Bits; BCC1, BBC2 ... Block-Check-Character)	d=4
ÖBB VLZ (PIPS1) Functions	
Data communication control:	
• Point-to-point full duplex	✓
VLZ (PIPS1) Messages in transmit direction (= signaling or monitoring direction):	
• RCC-arguments (binary information)	✓
• Test message	
• GI start	
• GI end	
• Acknowledgment message	
VLZ (PIPS1) Messages in receive direction (= command or control direction):	
• identification message	✓
• Enquiry Message	
• GI request	
• Test message	
• Acknowledgment message	
• Acknowledgment message + GI request	

417 With CP-8031 not supported by default. With a license (see *14.8 SICAM A8000 CP-803x Extended CI-Module*) 1 communication module CI-8551 can be used additionally also with CP-8031.

Function	VLZI0
Supported IEC60870-5-101/-104 message formats in transmit direction (CP-8031, CP-8050→VLZ) **(= signaling or monitoring direction)**	
<TI=30> ... Single-point information with time tag CP56Time2a	✓
Supported IEC60870-5-101/-104 message formats in receive direction (CP-8031, CP-8050←VLZ) **(= command or control direction)**	
–	–
Web server	
Protocol-internal diagnostic information / statistic information via PRE-specific web pages	–
Engineering	
SICAM Device Manager	✓
SICAM TOOLBOX II	✓

Restrictions

- only RCC-arguments (messages) in transmit direction (CP-8031, CP-8050 “Data concentrator”→station computer are supported.
- Train number data is not supported.
- Test mode (BCC1, BCC2 is transmitted with “ZZ”) is not supported.

NOTE

The ÖBB VLZ (PIPS1) protocol in CP-8031, CP-8050 only supports a limited functionality of the functionality defined in the ÖBB “Pflichtenheft für den Datenkonzentrator für die Übermittlung von Stellwerksargumenten”.

13.19.3 Modes of Operation

The operating mode of the interface is determined by parameters of the protocol element and optional equipment.

Operating mode	Interface → optional DTE	Interface signals
Unbalanced interchange circuit (V.24/V.28) RS-232 asynchronous	X5	RXD, TXD, CTS [418], RTS, DCD, DTR, DSR/VCC, GND
Balanced interface (V.11) RS-422 (4 wire) asynchronous	X4	TXD+, TXD-, RXD+, RXD-, GND (4 wire)

418 not usable (reserved for SICAM TOOLBOX II)

Operating mode	Interface → optional DTE	Interface signals
Balanced interface (V.11) RS-422 (4 wire) asynchronous	X5 --> PHOENIX PSM-ME-RS232/ RS485-P interface converter	Interface signals at X5: (towards PHOENIX PSM-ME-RS232/RS485-P): RXD, TXD, CTS, RTS, DCD, DTR, GND Interface signals at PHOENIX PSM-ME-RS232/RS485-P: RS-422 (4-wire): D(A), D(B), T(A), T(B), GND
Optical interface with CM-0847 (Multimode)	X5 → CM-0847	Interface at X5 towards CM-0847: RXD, TXD, CTS, RTS, DCD, DTR, DSR/ VCC, GND

13.19.4 Communication

For the stations to communicate with each other, suitable transmission facilities and/or network components may be needed in addition.

Own Station "data concentrator" (Substation)

System	System element	Protocol Element	Remarks
SICAM A8000 Series	CP-8031/CPCI85 CP-8050/CPCI85 CP-8050/EPCI85	VLZI0	max. 1 remote station (station computer)

Remote station "station computer" (master station)

System	System element	Protocol Element	Remarks
Station computer	-	-	functionality according to ÖBB VLZ (PIPS1)

13.19.5 Communication according to ÖBB VLZ (PIPS1)

13.19.5.1 Message Formats

Message Format	Direction	CP-8050	not numbered message	numbered message	acknowl-edged message
identification message	DK ← BHF	Receive direction	✓	–	✓?
Enquiry Telegramm	DK ← BHF	Receive direction	✓	–	–
Test message	DK → BHF	Transmit direction	✓	–	✓
RCC-arguments	DK → BHF	Transmit direction	–	✓	✓
GI-request message	DK ← BHF	Receive direction	✓	–	✓
GI-Start	DK → BHF	Transmit direction	–	✓	✓
GI-End	DK → BHF	Transmit direction	–	✓	✓
Acknowledgment message	DK → BHF DK ← BHF	Transmit direction Receive direction	✓	–	–
Acknowledgment message + GI-request	DK ← BHF	Receive direction	✓	–	–

Legend:

BHF	...	Station computer
DK	...	Data concentrator (CP-8050)
Receive direction (CP-8050)	...	Command direction (=control direction)
Transmit direction (CP-8050)	...	Signaling direction (=monitoring direction)
not numbered message	...	no message number in message
numbered message	...	Messagers are transmitted with a consecutive message number

13.19.6 Parameter and Setting

Parameter Name	Description	Settings
[PRE] Interface parameter Note: Some parameters may not be displayed until the interface is selected.		
Interface	"Virtual serial interface" (CP-8050 internal). The "virtual serial interface" is assigned on the BSE to a serial interface plug. *13.1.4.5 Selection of a serial interface for communication protocols* Note: ÖBB VLZ (PIPS1) requires the selection of a full-duplex RS-232 or RS-422 interface!	Permitted range = COM1 to COM50 Default setting = not used
Baud Rate	The ÖBB VLZ (PIPS1) protocol supports baud rates in the range of 50 Bd to 115200 Bd.	Permitted range = 50, 75, 100, 134.5, 150, 200, 300, 600, 1050, 1200, 1800, 2000, 2400, 4800, 9600, 19200, 38400, 56000, 57600, 64000, 115200 Standard setting = 1200
[PRE] Interface Parameter | Time settings for interface modem See *13.1.4.8 Time settings for transmission facilities*.		
Pause time (tp)	Before a message transmission, a parameter-settable pause time "tp" is maintained before the transmission level is switched on.	Permitted range = 0 to 32767 ms Default setting = 10 ms
Set-up time (tv)	After switching on the transmission level with RTS, the message transmission is started after the set-up time "tv" has expired.	Permitted range = 0 to 32767 ms Default setting = 0 ms
Run out time (tn)	After the message transmission has ended the transmit signal level (RTS) is only switched off after expiry of the Run out time "tn".	Permitted range = 0 to 32767 ms Default setting = 0 ms
[PRE] Station definition		
Station ID	The station identifier identifies the station where the protocol element is installed. (Station ID is transmitted decimal, i.e. "BCD encoded")	Permitted range = 0 to 99 Standard setting = 0
[PRE] VLZ (PIPS1) | Communication functions | RCC-arguments		
H4 identifier – RZÜ address valid (NT=0)	H4 identifier in the message if all RCC-arguments of the RZÜ address are valid (NT=0).	Permitted range = A-Z, a-z, 0-9, +, -, \, ? Default = W

Parameter Name	Description	Settings
H4 identifier – RZÜ address invalid (NT=1)	H4 identifier in the message if at least 1 RCC-arguments of the RZÜ address is invalid (NT=1).	Permitted range = A-Z, a-z, 0-9, +, -, \, ? Default = W
[PRE] VLZ (PIPS1) | Communication functions | Identification / Enquiry		
Confirmation	Determination of the confirmation of the "Inquiry Request" or the "Identification request".	Permitted range = - none - Test message Default = Test message
[PRE] VLZ (PIPS1) | Communication functions | Test message		
Cycle Time	If no information is to be transmitted within the parameterized time, a "test message" is sent to check the communication, which must be acknowledged by the remote station.	Permitted range = 0 to 255 s <0> ... monitoring disabled Default setting = 10 s
H1-Identifier	H1-Identifier in test message (max. 1 character)	Permitted range = A-Z, a-z, 0-9, +, -, \, ? default setting = X
H4-Identifier	H4-Identifier in test message (max. 1 character)	Permitted range = A-Z, a-z, 0-9, +, -, \, ? Default = W
Message character TC3-TC8	Message character TC3-TC8 in test message (max. 6 character)	Permitted range = A-Z, a-z, 0-9, +, -, \, ? Default seting = \D+++
[PRE] VLZ (PIPS1) | Communication functions | Initialization		
Startup delay	When restarting the CP-8050 device, the VLZ (PIPS1) protocol on the line is only activated after a delay. This delay is used to update the process image on the PRE after a restart before the communication is started.	Permitted range = 10 to 255 s Standard setting = 30
[PRE] VLZ (PIPS1) | Time settings, retries | Monitoring times		
Idle monitoring time	After transmission disturbances or message interruption the idle state is monitored. After expiry of the monitoring time the receiver is resynchronized.	Permitted range = 0 to 32767 Bit Standard setting = 33 Bit
Character Monitoring Time	Message gap monitoring Maximum pause between successive bytes of a message Idle monitoring time is started after detection of message interruption.	Permitted range = 0 to 32767 Bit Standard setting = 33 Bit
Acknowledgment timeout	Maximum waiting time for the acknowledgment of the remote station, before a message repetition is initiated.	Permitted range = 0.5 to 655.35 s Default setting = 3 s
[PRE] VLZ (PIPS1) | Time settings, retries | Retries		
Retries for data messages SEND/CONFIRM (station selective)	Retries for data messages (not for acknowledgment message)	Permitted range = 0 to 255 Standard setting = 3

Parameter Name	Description	Settings
[PRE] Data base management		
Settings for the data base management on BSE (per PRE) - see *13.1.4.14 Data Management on the BSE for Communication Protocols*		
[PRE] Advanced parameters | Software test points		
...	The software test points may only be used under the guidance of experts for error detection! Once the fault isolation is completed, software checkpoints must always be turned off.	Permitted range = yes, no Default setting = no

13.19.7 Message Conversion

Data in transmit direction are transferred from the basic system element to the protocol element in CP-8050 internal IEC 60870-5-101/104 (without 101/104 blocking) format. The conversion of the data formats IEC 60870-5-101/104 ↔ ÖBB VLZ (PIPS1) is performed by the protocol element. The transmission of the data to the remote station according to ÖBB VLZ (PIPS1) is controlled by the protocol element.

Data in the receive direction are not supported by the ÖBB VLZ (PIPS1) protocol element! Messages for data communication control are generated and processed directly on the protocol element.

The conversion of the CP-8050 internal IEC 60870-5-101/104 message format ↔ ÖBB VLZ (PIPS1) data format and the conversion of the address information are called message conversion.

The parameterization of the conversion from IEC 60870-5-101/104 ↔ ÖBB VLZ (PIPS1) (address and message format) is to be done with SICAM Device Manager with function “Signals” or SICAM TOOLBOX II, OPM II using “SIP Message Address Conversion”.

Supported processing types for message conversion:

Data	Direction	Processing type	VLZI0
RCC-arguments (binary information)	Transmit direction	firmware /**Trans_RCC_argument**	✓

13.19.7.1 Message conversion in transmit direction

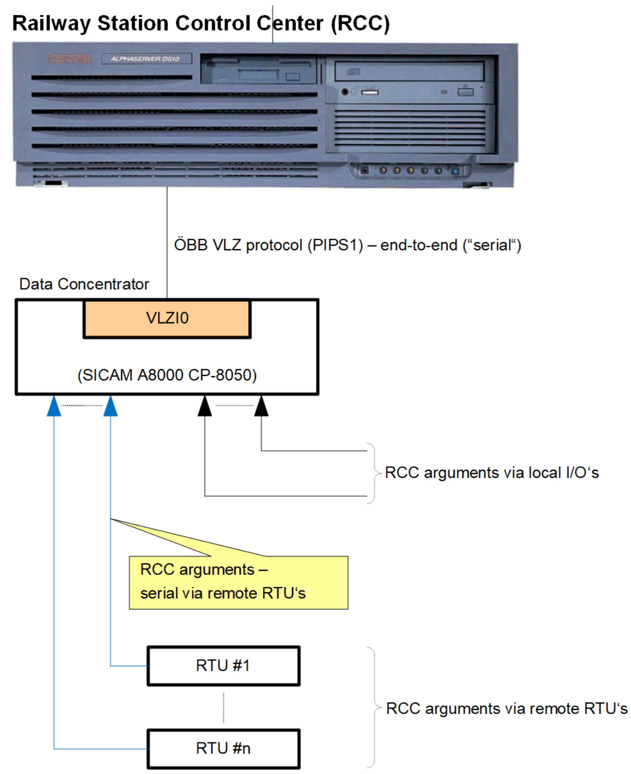
Message Conversion in Transmit Direction IEC 60870-5-101/104 → ÖBB VLZ (PIPS1)

CP-8050: IEC 60870-5-101/104 →		ÖBB VLZ (PIPS1)
TI	**Designation**	**Designation**
<TI:=30>	Single-point information with CP56Time2a time tag	RCC-Argument(s) (binary information)
	-	Test message [419]
	-	GI start [419]
	-	GI end [419]
	-	acknowledgment message [419]

RCC-arguments (binary informations)

The parameterization of the address and message conversion for RCC-arguments (binary information) in transmit direction is to be done with SICAM TOOLBOX II, OPM II.

419 These messages are generated directly on the protocol element

Parameter Category: *firmware*/**`Trans_RCC_argument`**	

Parameters	
`TI .. Type Identification`	Supported Type Identifications: <TI:=30> ... Single-point information with CP56Time2a time tag
`CASDU1, CASDU2` **`IOA1, IOA2, IOA3`**	CP-8050 internal IEC 608705-101/104 message address
`RZÜ_address`	RZÜ_address 0 .. 255 (dezimal) Note: the RZÜ-address is transmitted in <ASCII> "HEX-coded". RZÜ-address [DEC]): 0-255 RZÜ-address [HEX]: 0x00-0xFF RZÜ-address [ASCII]: <00> ... <09>, <0A> ... <0F> <10> ... <19>, <1A> ... <1F> . . <F0> ... <F9>, <FA> ... <FF>
`RZÜ_Bit_Offset`	RZÜ-bit number (within the data byte of the RZÜ-address) 0 .. 7 (dezimal) Bit 0 = least significant bit in data byte D1 or D2 Bit 7 = most significant bit in data byte D1 or D2 The data bytes D1, D2 are transmitted in <ASCII> "HEX-coded".

13.19.7.2 Message Conversion in receive direction

Message Conversion in receive direction IEC 60870-5-101/104 ← ÖBB VLZ (PIPS1)

CP-8050: IEC 60870-5-101/104 ←		ÖBB VLZ (PIPS1)
TI	Designation	Designation
-	-	Identification message [420]
-	-	Enquiry message [420]
-	-	GI-request [420]
-	-	Test message [420]
-	-	Acknowledgment message [420]
-	-	Acknowledgment message + GI request message [420]

420 These messages are processed directly on the protocol element and not converted to IEC 60870-5-101/104!

13.20 ÖBB X25

13.20.1 Introduction

The ÖBB X25 protocol is a serial transmission protocol (HDLC) to connect CP-8031, CP-8050 to the X25-Net of ÖBB to transmit ESTW-Data according to the ÖBB X25 "Pflichtenheft". For connection an external "PAD" (PAD = "Packed Assembler Disassembler") is required.

Protocol firmware for coupling to ÖBB X25:

Firmware	System	Standard and function
OX25I1	CP-8031, CP-8050	ÖBB X25 protocol with external "PAD" for the transmission of ESTW-Data (RCC-arguments).

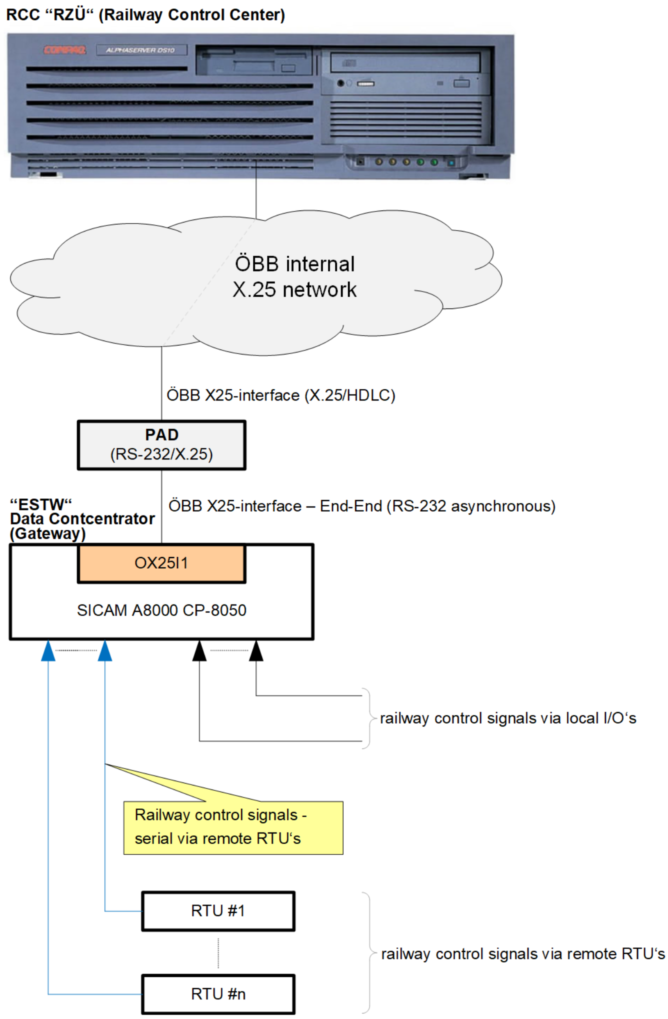
As part of an electronic signal box "ESTW", the CP-8031, CP-8050 supplies RCC-arguments as "non-safety-relevant information" via the ÖBB internal X25 network to the computer-aided train monitoring system "RZÜ".

The connection to the X25 network takes place via the X25 interface according to the specifications for the X25 interface of the "Österreichischen Bundesbahnen (Version 2.0 vom 22.03.1993)".

The X25-interface is supplied via the external "PAD". The CP-8031, CP-8050 is connected to the "PAD" via a serial RS-232 interface.

The protocol element only supports a fixed leased line via X25 packet data networks. The connection to the remote station via the X25 network of the ÖBB must be established by the externally connected "PAD".

Schematic configuration:



[OX25I1_config, 1, en_US]

13.20.2 Functions

Function	OX25I1
ÖBB X25	
Serial communication protocol according to: Pflichtenheft für X25-Schnittstelle der Österreichischen Bundesbahnen (Version 2.0 vom 22.03.1993).	✓[421]
CP-8031, CP-8050 = "ESTW" (electronic signal box)	✓
Remote station = RZÜ (computer-controlled train monitoring)	✓
Max. number of remote stations (per interface)	1
Max. number of supported data points	10000
Netz configuration (X25 Net)	
Point-to-point connection via own routed connections	–
Dedicated connection via packet data networks "Permanent Virtual Circuit"	✓
Dial-up connection via packet data networks "Virtual Call"	–

421 Only a limited functionality of the ÖBB X25 protocol is supported.

Function	OX25I1
external “PAD” (Packed Assembler Disassember) for X25-interface according to requirements for ÖBB X25 interface requirement: • X25 interface is provided by external “PAD”. • The X25 interface is defined in the ESTW Supplement 7 agreement. • The X25 interface must be compatible with the Austrian Post's DATEX-P network. (according to ÖNORM A2625 Ausgabe 1984)	✓
Physical interface	
direct link interface (RS-232)	✓
CP-8031, CP-8050: X5 (RS-232)	
CI-8551[422]: X1 (RS-232), X2 (RS-232), X4 (RS-232), X5 (RS-232)	
Baud rates: 50, 75, 100, 110, 134.5, 150, 200, 300, 600, 1050, 1200, 1800, 2000, 2400, 4800, 9600,**19200**, 38400, 56000, 57600, 64000, 115200 bit/s	
Message Protection: CRC $g(x) = x^{16} + x^{15} + x^5 + 1$ (Initial value 0xFFFF)	
ÖBB X25-interface - supported protocol function	
Supported ÖBB X25 message formats in transmit direction (CP-8031, CP-8050→ÖBB X25) "signalling direction"	
• <Main group 01> .. RCC-arguments (Track switch, DKW, EKW)	✓
• <Main group 10> .. RCC-arguments (start information)	✓
• <Main group 16> .. RCC-arguments (Main signal)	✓
• <Main group 18> .. RCC-arguments (Protection signal)	✓
• <Main group 31> .. RCC-arguments (Isolated track)	✓
• <Main group 32> .. RCC-arguments (Isolated track)	✓
• <Main group 33> .. RCC-arguments (Freimelde Abschnitt)	✓
• <Main group 44> .. RCC-arguments (Agreement)	✓
• <Main group 53> .. Train number messages (binary information)	–
• <Main group 100> .. RCC-arguments (RZÜ-Fahrstraße)	✓
• <Main group 124> .. General interrogation command receipt	✓
• <Main group 126> .. Life cycle message	✓
• <Main group 127> .. Command receipt	✓
• <Main group 174> .. Train number	–
• <Main group 255> .. Gneral interrogation command	–
Supported ÖBB X25 message formats in receive direction (CP-8031, CP-8050←ÖBB X25) “control direction”:	
• <Main group 126> .. Life cycle message	✓
• <Main group 174> .. Train number command	–
• <Main group 255> .. Gneral interrogation command	✓
Supported IEC60870-5-101/-104 message formats in transmit direction CP-8031, CP-8050→ÖBB X25) “signalling direction”	
<TI=33> .. Bitstring of 32 bits with time tag CP56Time2a	✓

[422] With CP-8031 not supported by default With a license (see *14.8 SICAM A8000 CP-803x Extended CI-Module*) 1 communication module CI-8551 can be used additionally also with CP-8031.

Function	OX25I1
Supported IEC60870-5-101/-104 message formats in receive direction (CP-8031, CP-8050←ÖBB X25) "control direction":	
–	–
Protocol element control and return information	
Protocol element control messages:	
• Set control location	–
Protocol element return information	
• Station status	✓
• Station failure	✓
Web server	
Protocol-internal diagnostic information / statistic information via PRE-specific web pages	–
Engineering	
SICAM Device Manager	✓
SICAM TOOLBOX II	✓

Restrictions

- Only a limited functionality of the ÖBB X25 protocol is supported.
  - Train number data is not supported.
  - Safety-related information is not supported.
  - Dial-up connections over packet data services are not supported.
  - Recommissioning informaton is not supported.
- IEC 60870-5-101/104 message formats are only partially supported.
- Redundancy is not supported!

NOTE

- The protocol element supports only limited functionality of the ÖBB X25-Protocol!
- Pay attention to this limited functionality when coupling CP-8031, CP-8050 to RZÜ!

13.20.3 Modes of Operation

The operating mode of the interface is determined by parameters of the protocol element and optional equipment.

Standard Operation Mode	Interface → optional DTE	Interface signals
Unbalanced interchange circuit (V.24/V.28) RS-232 asynchronous	External "PAD" for X25 interface required.	RXD, TXD, CTS [423], GND

[423] not usable (reserved for SICAM TOOLBOX II)

13.20.4 Communication

For the stations to communicate with each other, suitable transmission facilities and/or network components may be needed in addition.

Own station "ESTW" (CP-8031, CP-8050 = electronic RCC)

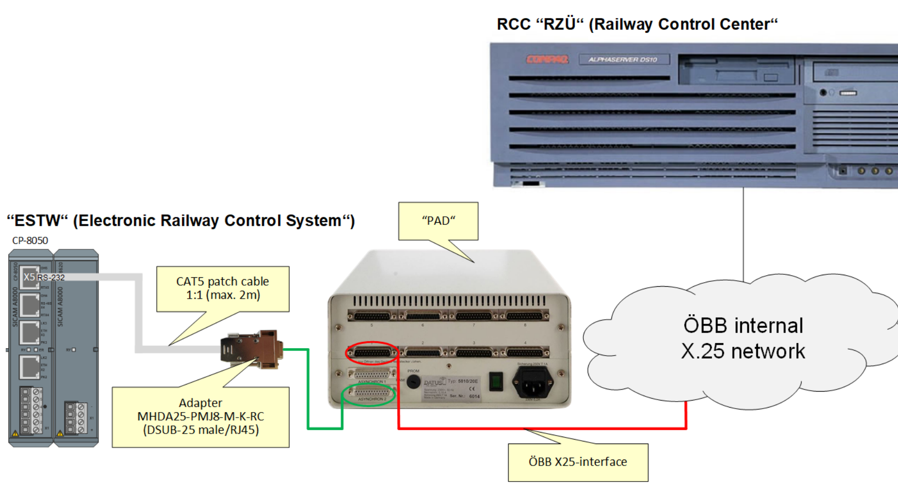
System	System element	Protocol Element	Remarks
SICAM A8000 Series	CP-8031/CPCI85 CP-8050/CPCI85 CP-8050/EPCI85	OX25I1	1x RZÜ as remote station

Remote station "RZÜ" (computer-controlled train monitoring)

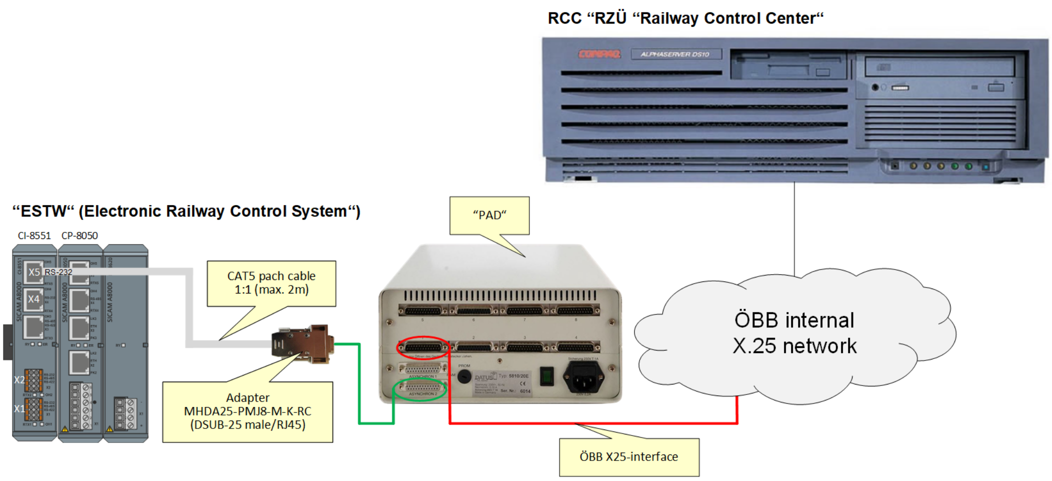
System	System element	Protocol Element	Remarks
RZÜ	-	-	Interface according to: Pflichtenheft für X25-Schnittstelle der Österreichischen Bundesbahnen (Version 2.0 vom 22.03.1993).

13.20.5 Communication According to ÖBB X25

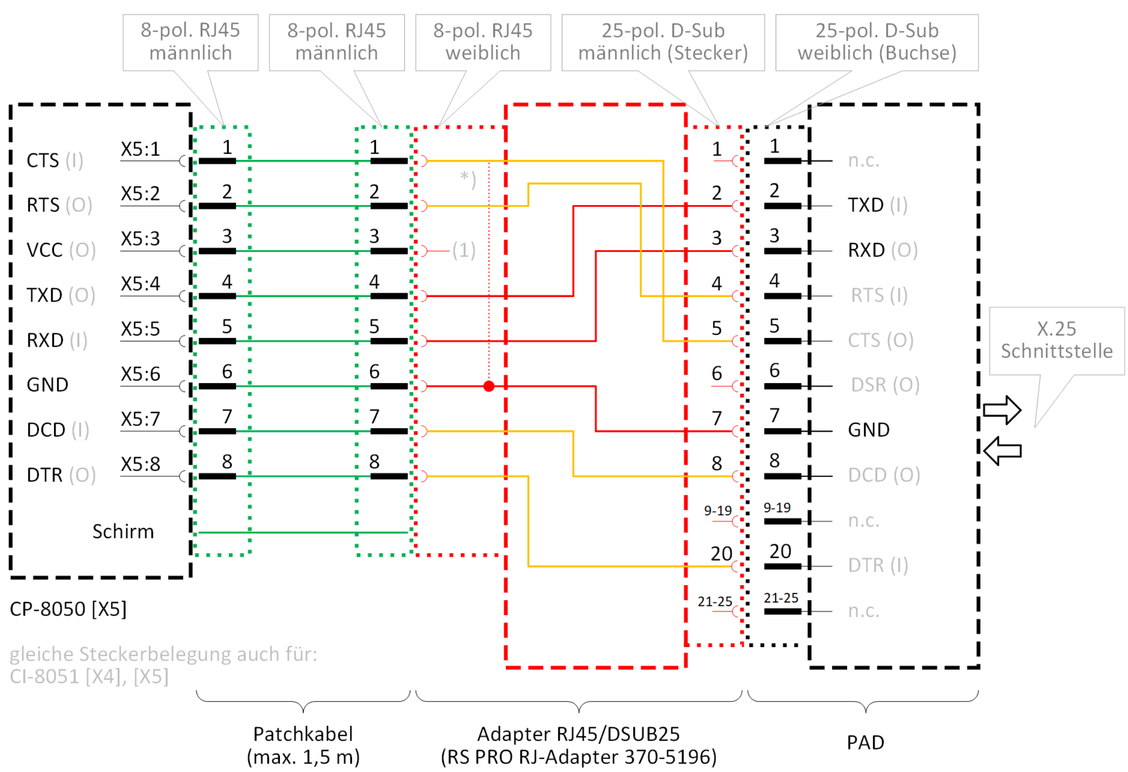
Schematic configuration – CP-8031, CP-8050 (X5) on RZÜ:



Schematic configuration – CP-8050 with CI-8551 (X1, X2, X4, X5) on RZÜ:



Wiring for connection CP-8050 (X5) or CI-8551 (X4, X5) ↔ "PAD"



(1) nicht benutzte Adern müssen isoliert werden!

mandatory (erforderliche Verdrahtung im Adapter RJ45/DSUB25)

optional
(im Adapterstecker ist die Verdrahtung aller Adern - auch wenn nicht alle Signale benötigt werden - einfacher)

NOTE

With a serial connection via X5 interface of CP-8031, CP-8050 a bridge between CTS and GND is required, as far as the interface shall also be used for the connection with the engineering PC.

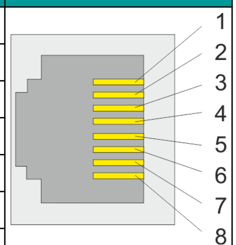
The CTS status line cannot be used by the protocol!

If the interface shall not be used as serial engineering interface, the function can be disabled with the parameter **`Serial engineering interface = disabled`**. Thereby no connection between CTS and GND is required.

Recommended D-Sub/RJ45 Adapter - RS PRO RJ-Adapter, 25-pole Sub-D connector, RJ45 socket connector - Order information see chap. *Recommended third-party products, Page 2186*. The D-Sub/RJ45 adapter provides a wired RJ-45 socket and an unwired D-sub plug (male).

Wiring of the RJ-45 socket connector on RS PRO RJ-Adapter, 25-pole Sub-D connector, RJ-45 socket connector:

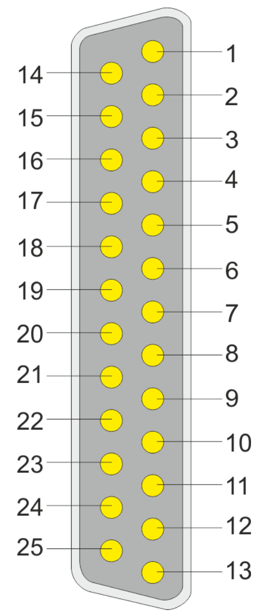
Pin	Wire color	
1	black	
2	yellow	
3	orange	
4	red	
5	green	
6	brown	
7	grey	
8	blue	
Shield	Black ("Drain Wire")	



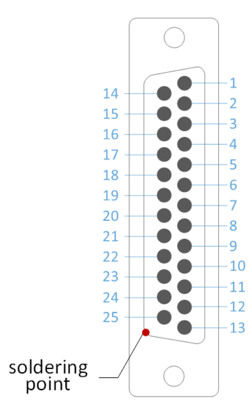
NOTE

There are other similar converters on the market - the color of the wires can be different! (Check wire color and pin assignment!).

Connector pin assignment of the DSUB-25 connector for RS-232 interface on PRO RJ-Adapter, 25-pole Sub-D connector, RJ45 socket connector:

Pin	RS-232 signal	Designation	D-Sub25 (male) "connector" 25-pole
1	n.c.		
2	TXD (I)	Transmit data	
3	RXD (O)	Receive data	
4	n.c.		
5	n.c.		
6	n.c.		
7	GND	Signal ground	
8	n.c.		
9	n.c.		
10	n.c.		
11	n.c.		
12	n.c.		
13	n.c.		
14	n.c.		
15	n.c.		
16	n.c.		
17	n.c.		
18	n.c.		
19	n.c.		
20	n.c.		
21	n.c.		
22	n.c.		
23	n.c.		
24	n.c.		
25	n.c.		
	Shield	Shield	

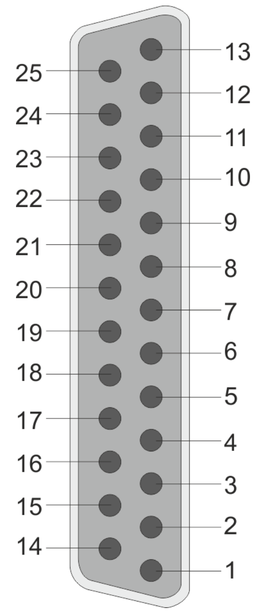
Wiring at the 25-pole D-sub plug: (View of socket connector "rear" side) The assignment of the pins at the D-sub plug can be made according to wiring diagram.



[DB25_Back_Loetpunkt, 1, en_US]

Unused wires must be isolated! When using the shield, it must be soldered to the metal plate of the D-sub plug.

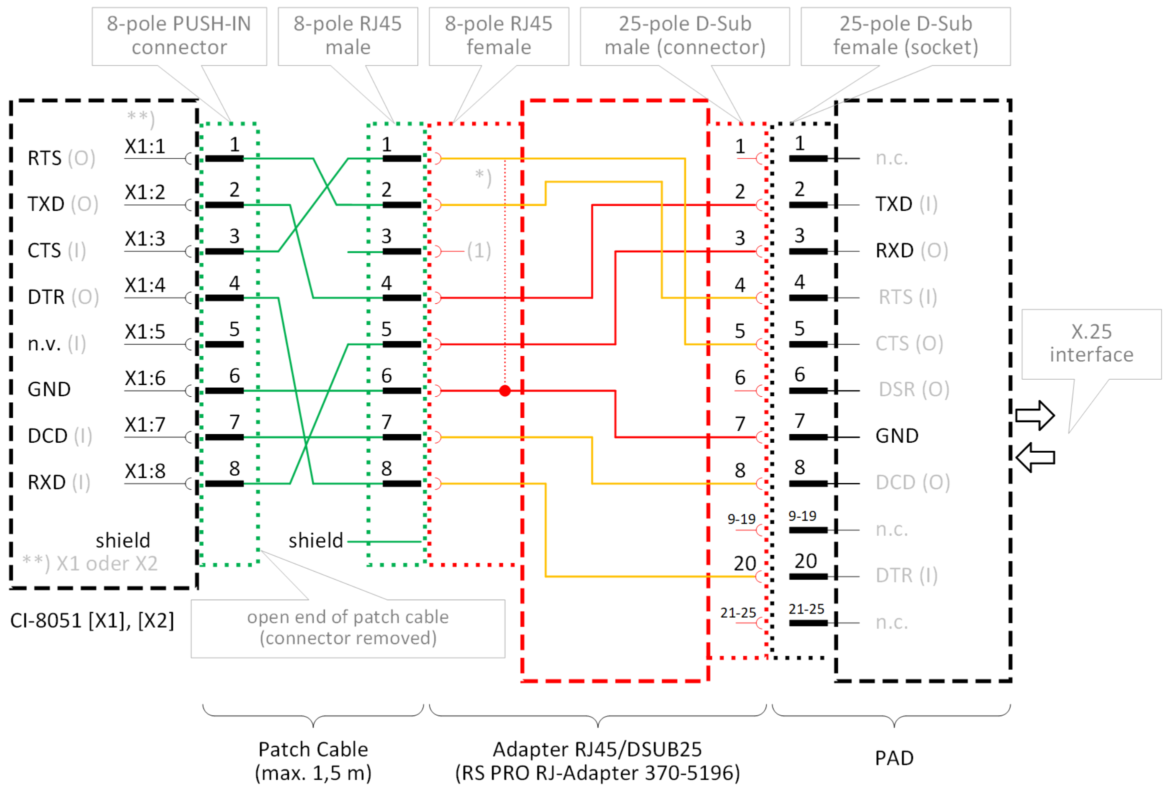
Connector pin assignment of RS-232 interface (Asynchronous) on the DSUB-25 socket connector of the "PAD's"

Pin	RS-232 signal	Designation	D-Sub25 (female) "socket connector" (DCE assignment) [424]
1			
2	TXD (I)	Transmit data	
3	RXD (O)	Receive data	
4	RTS (I)	Switch on sender	
5	CTS (O)	Clear to send	
6	DSR (O)	Ready for operation	
7	GND	Signal ground	
8	DCD (O)	Receive signal recognition	
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20	DTR (I)	DEE ready for operation	
21			
22			
23			
24			
25			
-	Shield	Shield	

Wiring for connection CI-8551 (X1, X2) ↔ "PAD"

The external "PAD" can also be connected to the X1, X2 interface of the CI-8551 module with an "open ended" patch cable. For interface X1 or X2 "RS-232" must be selected.

424 Front view of socket connector

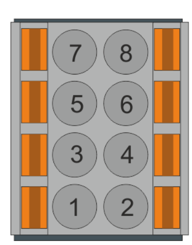


(1) unused wires must be isolated!

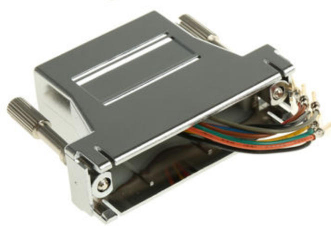
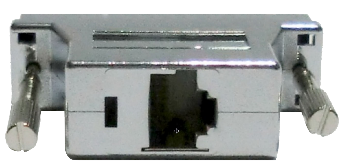
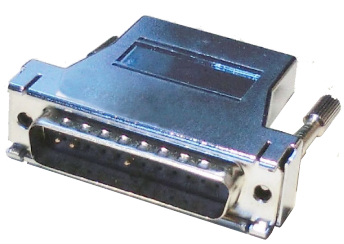
mandatory (required wiring in the RJ45/DSUB25 adapter)

optional
(wiring of all cables in the adapter is easier, even if not all signals are required)

Connector X1, X2 (CI-8551)

Pin	RS-232 signal	Push-in terminal 8-pole
8	RXD (I)	
7	DCD (I)	
6	GND	
5	n.c.	
4	DTR (O)	
3	CTS (I)	
2	TXD (O)	
1	RTS (O)	

Necessary Accessories

	Designation	Order number
	DATUS-PAD 5810/20E Note: The PAD is factory provided by the ÖBB.	www.datus.com DATUS-PAD 5810/20E
	RS PRO RJ adapter, 25-pole SUB-D connector, RJ45 socket connector, Adapter, 39 mm RS Order nr. 370-5196	*https://at.rs-online.com/web/p/rj-adapter-kupplungen-und-verlangerungen/3705196/*

13.20.5.1 Data transmission X25-interface

X25-interface

- The X25-interface is supplied via the external "PAD".
- The CP-8050 is connected to the "PAD" via a serial RS-232 interface.
- The X25 interface is defined in the ESTW Supplement 7 agreement. The X25 interface must be compatible with the DATEX-P network of Austrian Post (according to ÖNORM A2625 edition 1984).
- The parameterization of the externally connected "PAD's" must be carried out offline using a suitable terminal emulation program in accordance with ÖBB requirements.
- Data transmission on the X25-interface (PAD ↔ RZÜ) according to X.25 HDLC Lap B (DIN 66221, ISO 3309).

PAD	Designation	Order number
	DATUS-PAD 5810/20E The PAD from Datus has two asynchronous interfaces as basic equipment. In addition, slots with additional interfaces can be built into the PAD.	*www.datus.com* DATUS-PAD 5810/20E

Connection type of the X25 interface

The protocol element in CP-8050 only supports a fixed leased line via X25 packet data networks (= "Permanent Virtual Circuit").

X25 connection type	OX25I1
– Point-to-point connection via own routed connections	
– Dedicated connection via packet data networks "Permanent Virtual Circuit"	X
– Dial-up connection via packet data networks "Virtual Call"	

The connection setup for the fixed leased line via the X25 network of the ÖBB must be carried out by the externally connected "PAD".

Initialization of the X25 interface

The life cycle message is sent cyclically by the CP-8050 and the remote station and is used to monitor the interface.

If the remote station does not receive a valid life cycle messages within the double **`cycle time for monitoring messages (life cycle)`**, the interface is reported as failed.

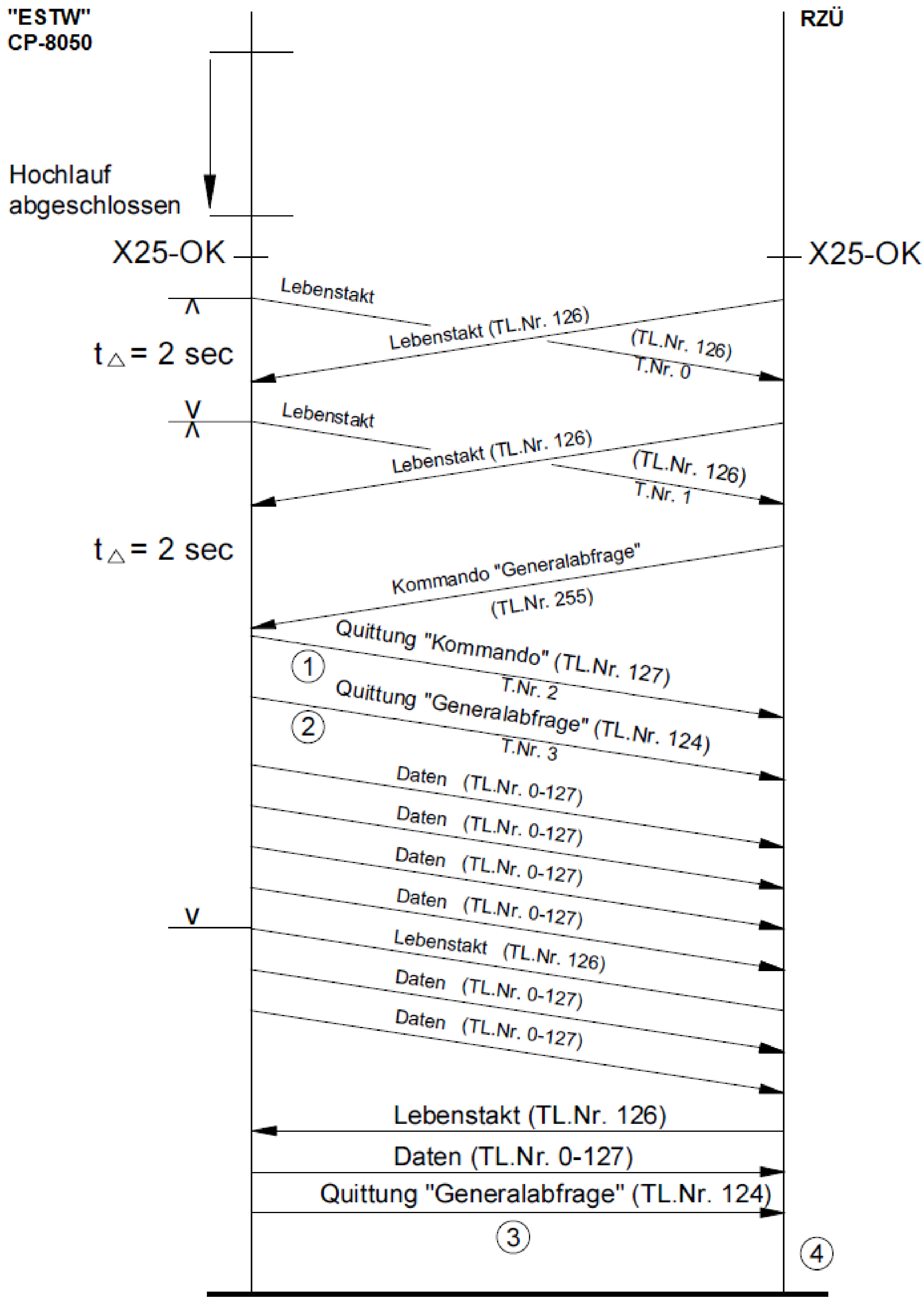
After the interface fails, the transmission of the life cycle messages is stopped for at least 3 life cycle periods. Then the own message number is set to 0.

When the first life cycle message is received from the remote site, the message number of the remote site is adopted.

	Function	Note
0	• X.25 connection not established	• The X.25 connection establishment is controlled by the "PAD".
1	• X.25 connection established, has not yet received two life cycle frames in the specified period.	
2	• Life cycle frames are received cyclically within the specified period. • General interrogation has not yet been initiated.	• Interface fault is reset after receipt of 2 Life cycle frames with consecutive telegram numbers. • NO data transmission as long as no GI has been triggered!
3	• Life cycle frames are received cyclically within the specified period. • General interrogation has been initiated but has not yet been completed.	• After an going interface fault, a GI is waited for, then the interface is released again (message sent).

4	• Life cycle frames are received cyclically within the specified period. • General interrogation has been initiated but has not yet been completed.	• GI messages are sent. • Spontaneous messages are transmitted during a running GI.
5	• Cyclical sending and receiving of life cycle frames.	
6	• Interface in operation.	• Messages are transmitted spontaneously when there is a change.

Establishing a connection after startup of the CP-8050 without recommissioning condition



TL.Nr. ... Message number

(1) ... Command receipt
(2) ... ACK-General interrogation (Bit 3 of the control location 1 is 1)
(3) ... ACK-General interrogation (Bit 2 of the control location 1 is 1)
(4) ... Interface in operation.

Acknowledgment of messages on the X25 interface

Messages of the main groups 0-127 are sent without acknowledgment. Commands (messages of the main group 128-255) must be acknowledged with an acknowledgment message.

Retries

No retries are carried out for sent messages.

Command messages

The protocol firmware OX25I1 does not support command messages in the transmit direction.

General Interrogation

The protocol firmware stores the signal box data in send direction in an internal process image.
The following data is transmitted when a general interrogation command is received from the remote station:

- Command-Acknowledgement
- Acknowledgment for general interrogation command
- all signal box data (from the PRE internal process image)
- GI-End Message

The protocol firmware OX25I1 does not send a general interrogation command to the remote station.

13.20.5.2 Function for the Support of Redundant Communication Routes

This function is currently not supported!

13.20.6 Parameter and Setting

Parameter Name	Description	Settings
`[PRE] Interface parameter` Note: Some parameters may not be displayed until the interface is selected.		
`Interface`	“Virtual serial interface“ (CP-8050 internal). The "virtual serial interface" is assigned on the BSE to a serial interface plug. *13.1.4.5 Selection of a serial interface for communication protocols*	Permitted range = COM1 to COMxx Default setting = not used
`Baud Rate`	The protocol firmware supports selected baud rates in range 50 Bd to 115200 Bd.	Permitted range = 50, 75, 100, 134.5, 150, 200, 300, 600, 1050, 1200, 1800, 2000, 2400, 4800, 9600, 19200, 38400, 56000, 57600, 64000, 115200 Standard setting = 19200

Parameter Name	Description	Settings
Parity	Parity bit for data byte on the bit transmission layer of the RS-232 interface between CP-8050 ↔ PAD.	Permitted range = • no Parity • even Parity • odd Parity Default setting = no parity
Stop bits	Stop bits for data byte on the bit transmission layer of the RS-232 interface between CP-8050 ↔ PAD.	Permitted range = 1, 1.5, 2 Bit Standard setting = 1 Bit
[PRE] Station definition | Own Stellenbezeichnung		
Station and facility identification	The station and system identifier are defined by 4 characters. The first 3 characters represent the station identifier, the 4th character represents the system identifier. Example: PEN1 → station identifier = PEN → facility identification = 1	Permitted range = • max. 4 ASCII characters • permitted ASCII signs: 0-9; A-Z; a-z Default setting =
Control center	Unique identifier of the control point.	Permitted range = 0 to 255 Standard setting = 255
[PRE] Station definition | Stellenbezeichnung of the remote station		
Station and facility identification	The station and system identifier are defined by 4 characters. The first 3 characters represent the station identifier, the 4th character represents the system identifier. Example: HBF1 → station identifier = HBF1 → facility identification = 1	Permitted range = • max. 4 ASCII characters • permitted ASCII signs: 0-9; A-Z; a-z Default setting =
[PRE] OX25 | Communication functions | Initialization		
Startup delay	When restarting the CP-8050 device, the X25 protocol on the line is only activated after a delay. During the startup delay, the process image on the PRE is updated.	Permitted range = 0 to 255 s Standard setting = 15
[PRE] OX25 | Communication functions | Time settings		
Cycle time for monitoring messages (life cycle)	Cycle time for life cycle telegram. The life cycle message is sent cyclically by the CP-8050 and the remote station and is used to monitor the interface. If the remote station does not receive a valid life cycle messages within the double cycle time for monitoring messages, the interface is reported as failed.	Permitted range = 2 to 127 s Default setting = 2 s
Pause time (tp)	Before a message transmission, a parameter-settable pause time "tp" is maintained before the transmission level is switched on with RTS.	Permitted range = 0 to 32767 ms 0 = no pause time Standard setting = 10

Parameter Name	Description	Settings
[PRE] OX25 | Time settings | Monitoring times		
Idle monitoring time	After transmission disturbances or message interruption the idle state is monitored. After expiry of the monitoring time the receiver is resynchronized.	Permitted range = 0 to 32767 Bit Standard setting = 22 Bit
Character Monitoring Time	Message gap monitoring Maximum pause between successive bytes of a message Idle monitoring time is started after detection of message interruption.	Permitted range = 0 to 32767 Bit Standard setting = 22 Bit
Timeout transmission signal box data	The signal box information of the different main groups is transferred internally to the PRE with <TI: = 33> "32 bit bit pattern with time stamp CP56Time2a". If a main group consists of more than 32 bit data (4 bytes), then all data must be transferred to the PRE within the timeout.	Permitted range = 2 to 20 s Default setting = 5 s
[PRE] OX25 | General interrogation		
Timeout for GI end infor-mation	The end of GI message is trans-mitted to the remote station after the configured timeout. The timeout is started on receipt of a GI command from the remote station (main group = 255).	Permitted range = 0 to 255 s Default setting = 5 s
[PRE] Data base management Settings for the data base management on BSE (per PRE) - see *13.1.4.14 Data Management on the BSE for Communication Protocols*		
[PRE] Advanced parameters | Options		
CRC-Polynom	The CRC (2 bytes for message backup) of the ÖBB X25 protocol can be inverted for transmission and the byte order can be exchanged if necessary.	Permitted range = • CCITT-CRC inversion and cross-over • normal CCITT-CRC Default: CCITT-CRC inversion and cross-over
[PRE] Advanced parameters | Software test points		
...	The software test points may only be used under the guidance of experts for error detection! Once the fault isolation is completed, software checkpoints must always be turned off.	Permitted range = yes, no Default setting = no

NOTE

On the basic system element in the topology for OX25I1 you have to enter following.

- QID-ST = End-End
- Uhr-Sync = disabled
- GI = do not send
- Data flow direction = both directions
- Data flow direction = automatic and selective
- Service function messages = disabled

13.20.7 Message Conversion

Data in transmit direction are transferred from the basic system element to the protocol element in CP-8050 internal IEC 60870-5-101/104 (without 101/104 blocking) format. The conversion of the data formats IEC 60870-5-101/104 ↔ ÖBB X25 is performed by the protocol element. The transmission of data to the X-25 interface is controlled by the protocol element.

User data in receive direction (ÖBB X25 → CP-8050) are not supported. Control functions like e.g. general interrogation are processed direct on the protocol element and not converted to IEC 60870-5-101/104!

The conversion of the CP-8050 internal IEC 60870-5-101/104 message format → ÖBB X25 data format and the conversion of the address information are called message conversion.

The parameterization of the conversion from IEC 60870-5-101/104 → ÖBB X25 (address and message format) is to be done with SICAM Device Manager with function "Signals" or SICAM TOOLBOX II, OPM II using "SIP Message Address Conversion".

Supported processing types for message conversion:

Data	Direction	Processing type	OX25I1
Signal box data	Transmit direction	firmware/**`Trans_RCC_arguments`**	✓

13.20.7.1 Message Conversion in Transmit Direction (CP-8050 → ÖBB X25)

Message Conversion in Transmit Direction CP-8050 → ÖBB X25

CP-8050: IEC 60870-5-101/104 →		ÖBB X25
TI	**Designation**	**Message Format**
<TI:=33>	Bit string of 32 bit with time tag CP56Time2a	Signal box data • <Main group 01> ... RCC-arguments (Track switch, DKW, EKW) • <Main group 10> ... RCC-arguments (start information) • <Main group 16> ... RCC-arguments (Main signal) • <Main group 18> ... RCC-arguments (Protection signal) • <Main group 31> ... RCC-arguments (Isolated track) • <Main group 32> ... RCC-arguments (Isolated track) • <Main group 33> ... RCC-arguments (Freimelde Abschnitt) • <Main group 44> ... RCC-arguments (Agreement) • <Main group 100> ... RCC-arguments (RZÜ-Fahrstraße)
	-	• <Main group 124> ... General interrogation command acknowledgement [425]
		• <Main group 126> ... Life cycle message [426]
		• <Main group 127> ... Command acknowledgment [425]

Signal box data

The parameterization of the address and message conversion for signal box data in transmit direction is to be done with the SICAM Device Manager with the function “Signals” or the SICAM TOOLBOX II, OPM II.

Processing: *firmware*/`Trans_RCC_arguments`

Parameters	
`TI .. Type Identification`	Supported Type Identifications: • <TI:=33> ... Bit sting of 32 Bit with time tag CP56Time2a
`Name`	Name of the signal
`104 address`	CP-8050 internal IEC 60870-5-101/104 message address (CASDU1, CASDU2, IOA1, IOA2, IOA3)

[425] The general interrogation command is processed direct on the protocol element and not converted towards basic system element The GI-Data are transmitted by the protocol element out of the PRE-internal process image to the remote station. The messages "General interrogation command acknowledgment" and "command acknowledgment" are generated directly on the protocol element and transmitted to the remote station.

[426] The life cycle message is generated direct at the protocol element and transmitted to the remote station.

Parameters	
OX25_Main_group	ÖBB X25 address “Main group” for signal box data according to ÖBB X-25 protocol specification. • 01 = Track switch, DKW, EKW • 10 = Start message • 16 = Main signal • 18 = Protection signal • 31 = Isolated track • 32 = Isolated track • 33 = Freimelde Abschnitt • 44 = Agreement • 100 = RZÜ Fahrstraße
OX25_Element	ÖBB X25 element address for signal box data according to ÖBB X-25 protocol specification. • 0 to 65535
OX25_Message identifier	Identification whether the X25 signal box data are transmitted CP-8050 internally with one or with two messages in the format <TI:=33> bit pattern of 32 bits (= 4 bytes). • 1/1 ... Part “1 of 1” for signal box data (signal box data 4 Byte) • 1/2 ... Part “1 of 2” for signal box data (signal box data 8 Byte) • 2/2 ... Part “2 of 2” for signal box data (signal box data 8 Byte)
OX25_IV_NT_Bit	Conversion of the IEC 60870-5-101/104 “NT-/IV-Bit” to “Z-Bit” of the ÖBB X25 protocol. Predefined control words of the main groups contain a “Z-Bit” (Z=1... state not actual). NT- or IV-Bit =1: With “NT/IV=1”, all “Z-Bit’s” and the status of the control word are set according to the parameterization. • Z=1, Data=0 • Z=1, Data from message

Message Conversion

The table describes the evaluated elements of the IEC 60870-5-101/104 message during message conversion.

Elements of the message	
TI .. Type Identification	• TI 33 .. Bit sting of 32 Bit with time tag CP56Time2a
CASDU, IOA .. Message address	Parameter-settable
QDS .. Quality descriptor	
BL .. blocked	not evaluated
SB .. substituted	not evaluated
NT .. not topical	Conversion to ÖBB X25 “Z-Bit” and data settable with **OX25_IV_NT_Bit**.
IV .. invalid	Conversion to ÖBB X25 “Z-Bit” and data settable with **OX25_IV_NT_Bit**.
OV .. overflow	not evaluated
Cause of transmission	
03 .. spontaneous	not evaluated
xx .. other COTs	not evaluated
T .. Test	not evaluated
Information	

Elements of the message	
BSI .. binary displayed additional information	• Bit string (32 bit) ... is converted to ÖBB X25 signal box data.
Time tag	
CP56Time2a .. Date + Time	not evaluated

... not listed elements of the IEC 60870-5-101/104 message are not rated / not supported!

13.20.7.2 Message Conversion in Receive Direction (CP-8050 ← ÖBB X25)

Message Conversion in Receive Direction CP-8050 ← ÖBB X25:

CP-8050: IEC 60870-5-101/104 ←		ÖBB X25
TI	Designation	Message Format
	-	<Main group 126> ... Life cycle message[427]
	-	<Main group 255> ... General interrogation command [428]

427 The life cycle message is processed direct at the protocol element and not converted towards the basic system element.

428 The general interrogation command is processed direct on the protocol element and not converted towards basic system element The GI-Data are transmitted by the protocol element out of the PRE-internal process image to the remote station.

13.21 HSR

13.21.1 Introduction

HSR (High Availability Seamless Redundancy) is a redundancy protocol for the lossless, redundant transmission of data over Ethernet networks in ring structure.

Like PRP, HSR (High Availability Seamless Redundancy Protocol) is specified in IEC 62439-3. Both protocols provide redundancy without switching time.

The principle function can be found in the definition of PRP. PRP sends the same message over 2 separate networks. In contrast, the message is duplicated in HSR in the 2 directions of the ring. The receiver receives it accordingly over 2 ways in the ring, takes the 1st. message and rejects the 2nd (see PRP).

While NO messages are forwarded in the terminal at PRP, a switch function is built into the HSR node. Therefore, the HSR node forwards messages in the ring that are not addressed to it.

In order to avoid circling messages in the ring, corresponding mechanisms are defined in HSR. The connection of SAN (Single Attached Node) devices is only possible with HSR using a REDBOX.

PRP and HSR systems can be redundantly coupled with 2 REDBOXES.

Each device in the network is connected via 2 Ethernet interfaces. The messages are transmitted on both interfaces and transmitted simultaneously in both directions in the ring. Thus 2 identical messages arrive at the target within a time frame (in a error-free state). The first is passed to the application and the second is discarded.

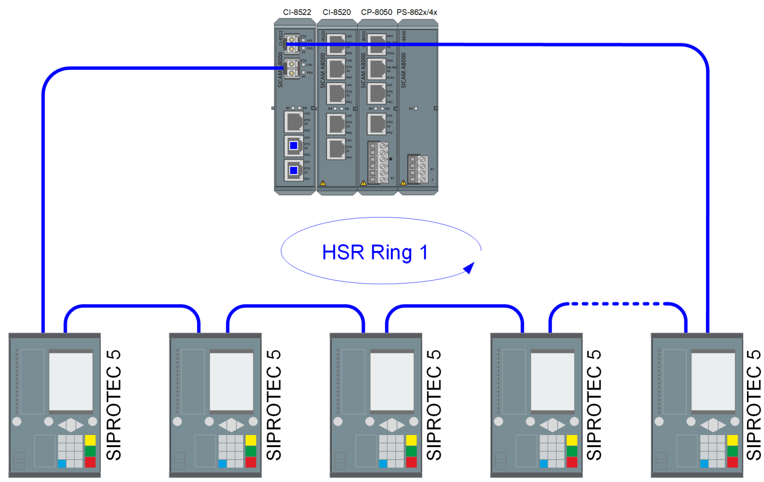
The ring is monitored by cyclic HSR management telegrams (cycle time 1 second). An open ring is signaled by a warning.

CP-8050 uses the "duplicate discard" mode in HSR, that means that duplicates are discarded and not passed to the TCP/IP stack.

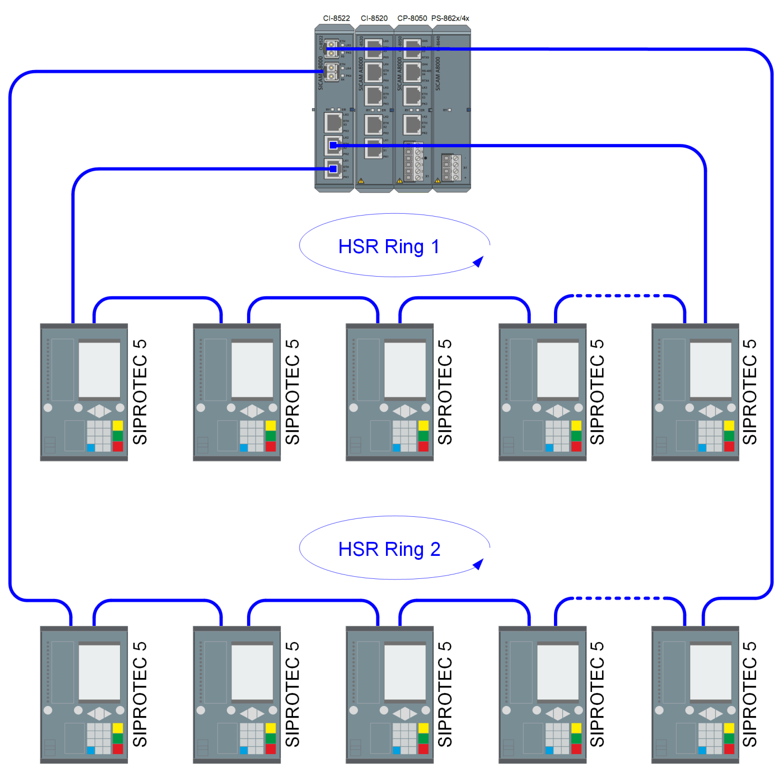
NOTE

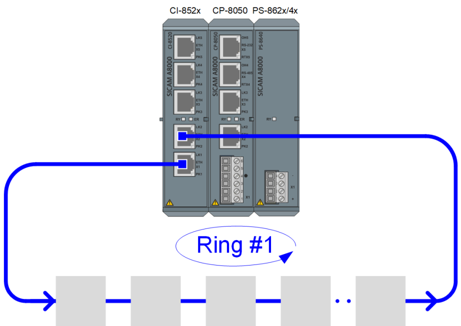
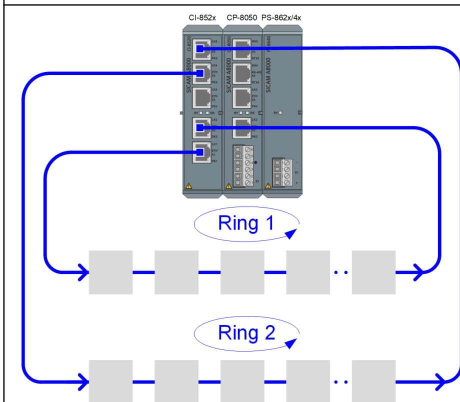
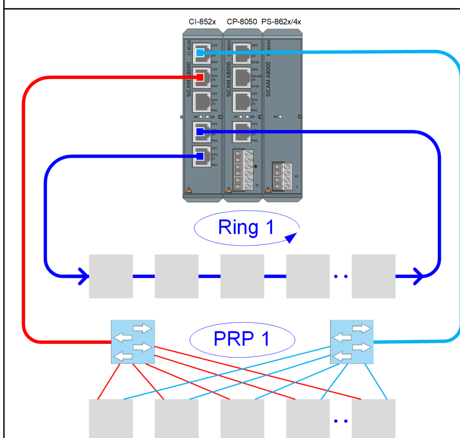
- HSR can only be used with the CI-852x module.
- Only 1 redundancy protocol can be used per ring.
- 2 HSR rings are possible for each CI-852x module.
- 2 redundancy protocols for Ethernet networks are possible for each CI-852x module (here 2x HSR or 1x HSR with RSTP, PRP or Line Mode).
- The choice, which 2 of the 5 interfaces on the module are used for the HSR ring, is arbitrary.
- For HSR, the parameter **`System | Hardware | Module properties | Type = HSR`** must be set in the SICAM Device Manager for the used LAN port group in the module properties of the CI-852x module.
- In a HSR ring, a maximum of 512 unique source MAC addresses are allowed.
- 2 rings on the same CI-852x module must not be connected! (also not via switch, REDBOX, ...)
- On the same CI-852x module, devices from one ring are not visible in the other ring.

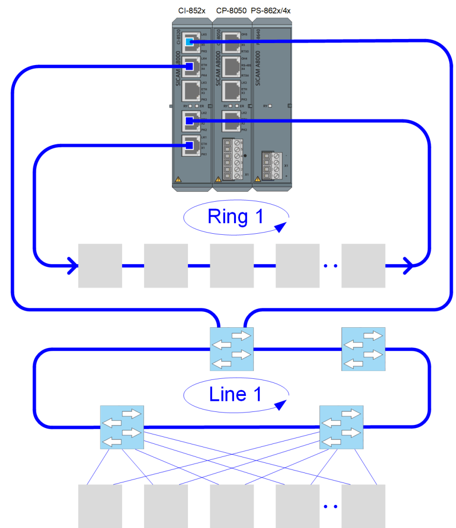
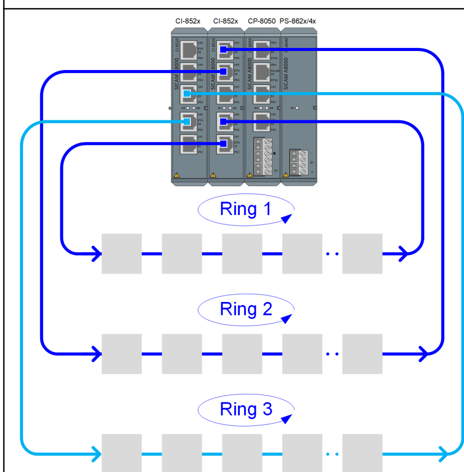
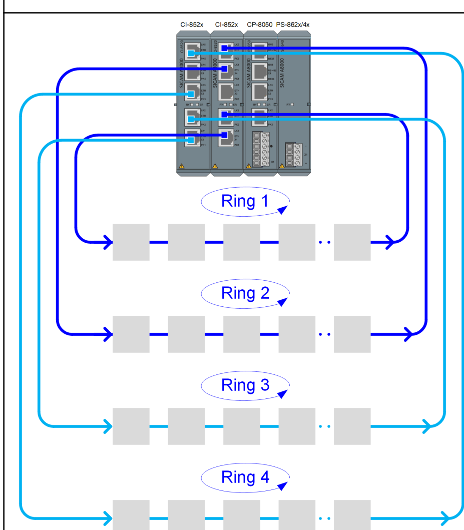
Schematic configuration with 1 HSR ring



Schematic configuration with 2 HSR rings

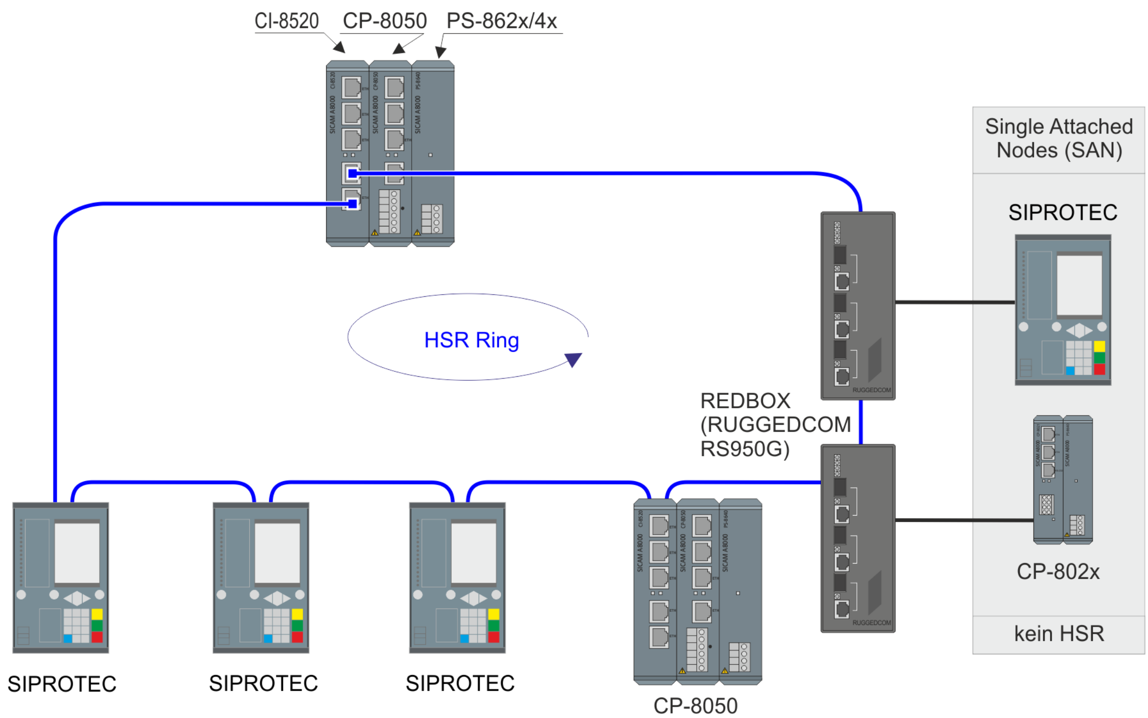


Schematic configuration	Description
	**1 redundancy protocol for Ethernet network (1 ring)** • Only 1 type for Ethernet redundancy protocol is supported on both ports of a LAN port group.
	**2 redundancy protocols for Ethernet networks (2 rings)** • Any Ethernet redundancy protocol can be selected for each LAN port group. • Only 1 type for Ethernet redundancy protocol is supported on both ports of a LAN port group. • The Ethernet networks of the different LAN port groups of a CI-852x module must not be connected.
	**2 redundancy protocols for Ethernet networks (1 ring + PRP)** • Any Ethernet redundancy protocol can be selected for each LAN port group. • Only 1 type for Ethernet redundancy protocol is supported on both ports of a LAN port group. • The Ethernet networks of the different LAN port groups of a CI-852x module must not be connected.

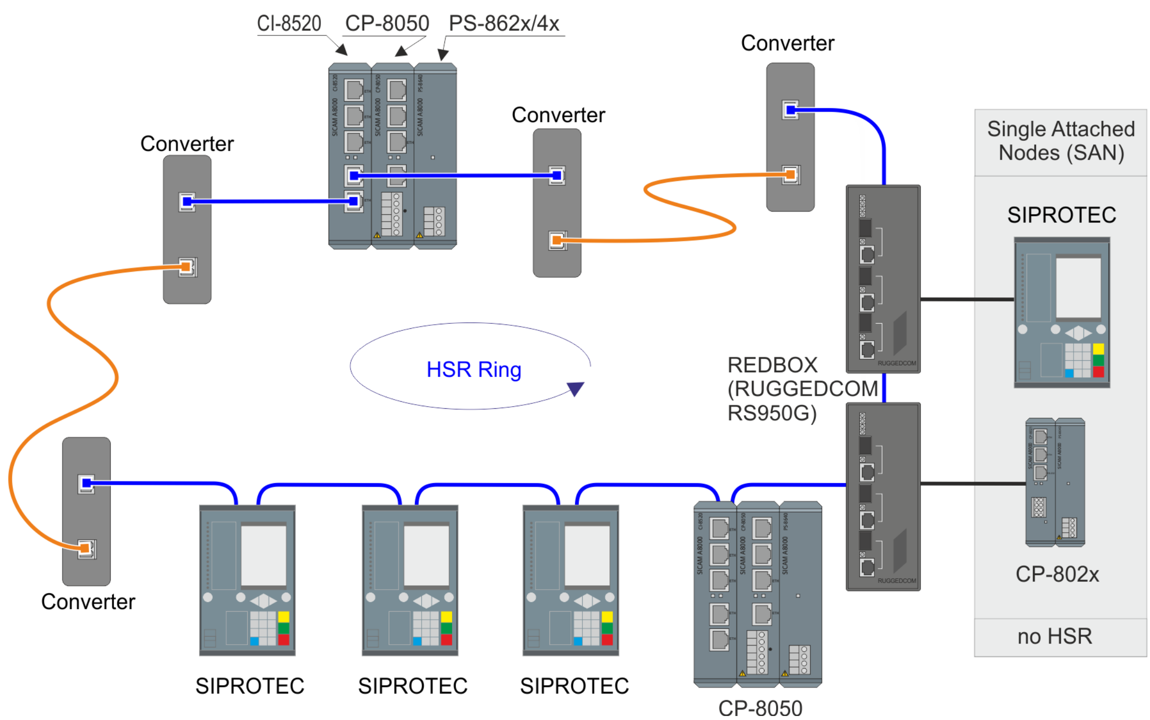
Schematic configuration	Description
	**2 redundancy protocols for Ethernet networks (1 ring + Line Mode)** • Any Ethernet redundancy protocol can be selected for each LAN port group. • Only 1 type for Ethernet redundancy protocol is supported on both ports of a LAN port group. • The Ethernet networks of the different LAN port groups of a CI-852x module must not be connected.
	**3 redundancy protocols for Ethernet networks (3 rings)** • Any Ethernet redundancy protocol can be selected for each LAN port group. • Only 1 type for Ethernet redundancy protocol is supported on both ports of a LAN port group. • The Ethernet networks of the different LAN port groups of a CI-852x module must not be connected. Note: 3 rings are shown in this picture - any Ethernet redundancy protocol can be selected for each LAN port group.
	**4 redundancy protocols for Ethernet networks (4 rings)** • Any Ethernet redundancy protocol can be selected for each LAN port group. • Only 1 type for Ethernet redundancy protocol is supported on both ports of a LAN port group. • The Ethernet networks of the different LAN port groups of a CI-852x module must not be connected. Note: 4 rings are shown in this picture - any Ethernet redundancy protocol can be selected for each LAN port group.

13.21.2 Use Cases

HSR configuration with electrically connected devices



HSR configuration with electrically/optically connected devices



Recommended converter see: *13.21.3 Optical converters (media converters)*

NOTE

For the above configuration, using CI-8522 in place of CI-8520 can reduce the dependency on external optical media converters as CI-8522 has dedicated optical interface support.

13.21.3 Optical converters (media converters)

The use of converters and fiber-optic cables can significantly increase the distance between the base device and I/O rows and between the individual I/O rows. Depending on the type of cable and converter used, different cable lengths can be achieved.

The following optical converters can be used for network redundancy protocols:

Converter	RSTP	PRP	HSR	Line-Mode
Ruggedcom RMC	✓	*	*	✓
Siemens SCALANCE X101-1	✓	*	*	✓
Siemens SCALANCE X101-1LD	✓	*	*	✓
Phönix FL MC 2000E LC	✓	✓	✓	✓

* ... Converter can only be used if the parameter "MTU-size" is set to 1494 bytes for all devices in the communication network. (some devices do not support this parameter)

NOTE

- Only converters that support a transmission speed of 100 Mbit/s can be used.
- for HSR and PRP, the converter used must support the "oversized frames/jumbo frames" function of 1524 byte Ethernet frames (1528 bytes for VLAN).
- Switch (with learning function) cannot be used as a media converter in an HSR ring.
(For this, any kind of switch and switch redundancy function in the switch should be deactivated, which is usually not possible.)

Siemens Ruggedcom RMC

<table>
<tr>
<td>
MLFB:

6GK6001-0AC01-0FA0
6GK6001-0AC02-0FA0
6GK6001-0AC03-0FA0

</td>
<td>

LC socket for opt. connector


Dimensions (WxHxD) 58 x 109 x 94
Ambient temperature (operation): -40 °C ... 85 °C
MLFB: 6GK6001-0AC01-0FA0

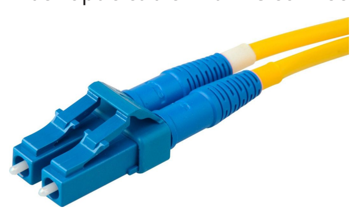
– Nominal voltage: VDC 24
– Voltage range: VDC 18 ... 36

MLFB: 6GK6001-0AC02-0FA0

– Nominal voltage: VDC 48
– Voltage range: VDC 36 ... 59

MLFB: 6GK6001-0AC03-0FA0

– Nominal voltage: HI
– Voltage range: VDC 88-300 or VAC 85-264

Fiber optic cable with LC connector


– max. length: 2 km
– Multimode
– Wavelength: 1300 nm
– 1x 100TX to 1x 100FX

</td>
</tr>
</table>

<table>
<tr>
<td>
MLFB:

6GK6001-0AC01-0EA0
6GK6001-0AC02-0EA0
6GK6001-0AC03-0EA0

</td>
<td>

LC socket for opt. connector


Dimensions (WxHxD) 58 x 109 x 94
Ambient temperature (operation): -40 °C ... 85 °C
MLFB: 6GK6001-0AC01-0EA0

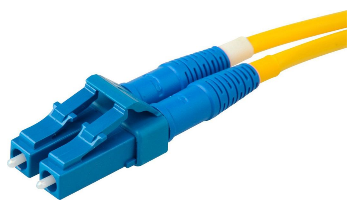
Nominal voltage: VDC 24
Voltage range: VDC 18 ... 36

MLFB: 6GK6001-0AC02-0EA0

Nominal voltage: VDC 48
Voltage range: VDC 36 ... 59

MLFB: 6GK6001-0AC03-0EA0

Nominal voltage: HI
Voltage range: VDC 88-300 or VAC 85-264

Fiber optic cable with LC connector


max. length: 15 km
Singlemode
Wavelength: 1310 nm
100TX to 1x 100FX

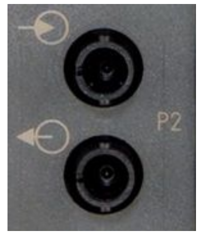
</td>
</tr>
</table>

<table>
<tr>
<td>MLFB:
• 6GK6001-0AC01-0DA0
• 6GK6001-0AC02-0DA0
• 6GK6001-0AC03-0DA0
</td>
<td>• MTRJ socket for opt. connector


• Dimensions (WxHxD) 58 x 109 x 94
• Ambient temperature (operation): -40 °C ... 85 °C
• MLFB: 6GK6001-0AC01-0DA0
– Nominal voltage: VDC 24
– Voltage range: VDC 18 ... 36
• MLFB: 6GK6001-0AC02-0DA0
– Nominal voltage: VDC 48
– Voltage range: VDC 36 ... 59
• MLFB: 6GK6001-0AC03-0DA0
– Nominal voltage: HI
– Voltage range: VDC 88-300 or VAC 85-264
• LWL with MTRJ-connector

– max. length: 2 km
– Multimode
– Wavelength: 1300 nm
– 1x 100TX to 1x 100FX</td>
</tr>
</table>

Siemens SCALANCE

<table>
<tr>
<td>Type: X101-1
MLFB:
• 6GK5101-1BB00-2AA3
</td>
<td>• ST socket for opt. connector
(ST/BFOC ... straight tip/bayonet fiber optic connector)


• Dimensions (WxHxD) 40 x 125 x 124
• Ambient temperature (operation): -10 °C ... 60 °C
• Nominal voltage: VDC 24
• Voltage range: VDC 18 ... 32
• Current consumption: 120 mA
• Fiber optic cable with ST connector

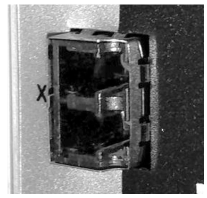
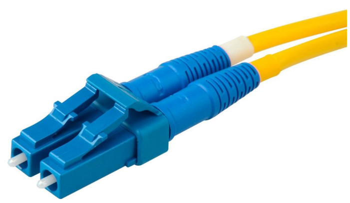
– max. length: 4 km at
  – cross-section: 62,5/125 µm
  – Multimode
– max. length: 5 km at
  – cross-section: 50/125 µm
  – Multimode</td>
</tr>
</table>

Type: X101-1LD
MLFB:
• 6GK5101-1BC00-2AA3

	• ST socket for opt. connector
	
	• Dimensions (WxHxD) 40 x 125 x 124
	• Ambient temperature (operation): -10 °C ... 60 °C
	• Nominal voltage: VDC 24
	• Voltage range: VDC 18 ... 32
	• Current consumption: 120 mA
	• Fiber optic cable with ST connector
	
	– max. length: 26 km at
	  – cross-section: 10/125 µm
	  – Singlemode

Phoenix FO Converter

Type: FL MC 2000E LC
Order number:
• 2891056

	• LC socket for opt. connector
	
	• Dimensions (WxHxD) 30 x 130 x 100
	• Ambient temperature (operation): -40 °C ... 75 °C
	• Nominal voltage: VDC 24 or 48
	• Voltage range: VDC 12 ... 57
	• Current consumption: 110 mA (VDC 24)
	• Fiber optic cable with LC connector
	
	– max. length: 8 km at
	  – cross-section: 62,5/125 µm
	  – Attenuation: 0,7 dB/km
	  – Wavelength: 1000 nm
	– max. length: 3.3 km at
	  – cross-section: 62,5/125 µm
	  – Attenuation: 2,6 dB/km
	  – Wavelength: 600 nm
	– max. length: 9.6 km at
	  – cross-section: 50/125 µm
	  – Attenuation: 0,7 dB/km
	  – Wavelength: 1200 nm
	– max. length: 5.3 km at
	  – cross-section: 50/125 µm
	  – Attenuation: 1,6 dB/km
	  – Wavelength: 800 nm

13.22 RSTP

13.22.1 Introduction

RSTP (Rapid Spanning Tree Protocol) is a standardized network protocol for redundancy control of backup links in network with fast enabling/disabling of backup links. The Rapid Spanning Tree Protocol (RSTP) is used in the event of an error to reorganize the network structure. That means, after a network path fails, RSTP redirects the data to a different path. The RSTP protocol is used for disabling redundant backup links in local network and if necessary to enable backup links in case of failure of a link.

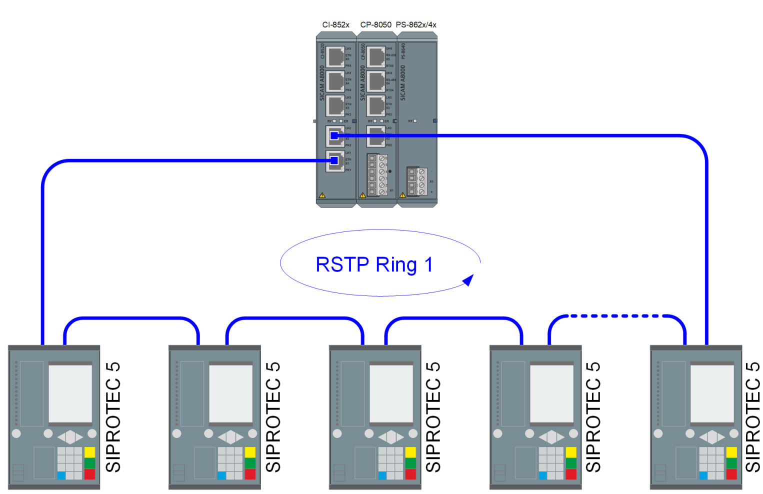
The maximum number of switches in a network will be calculated on the basis of the RSTP timer for "max age": max. number of switches = max age - 1. That means, in a ring topology up to 39 devices can be connected.

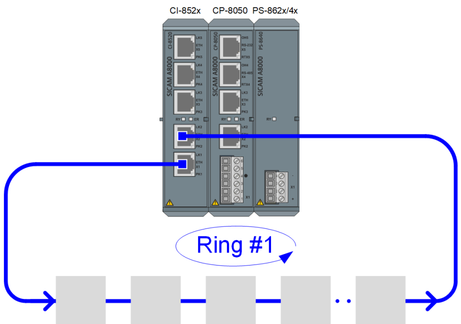
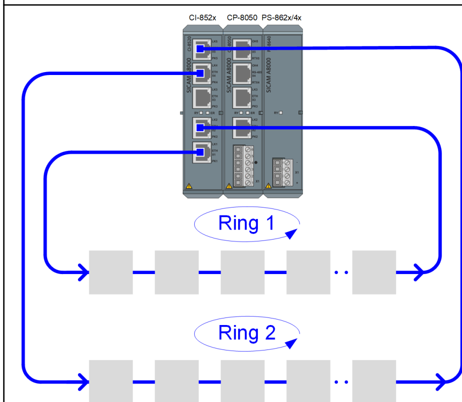
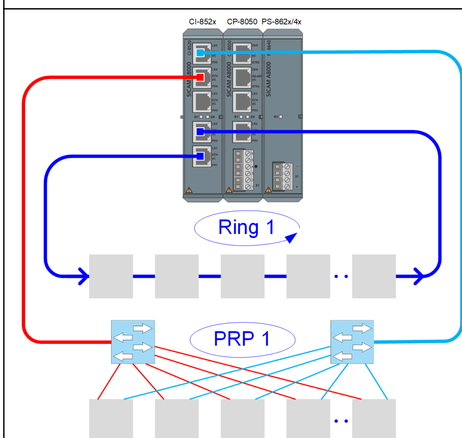
The RSTP-Protocol is defined in the standard IEEE 802.1D, Edition 2004.

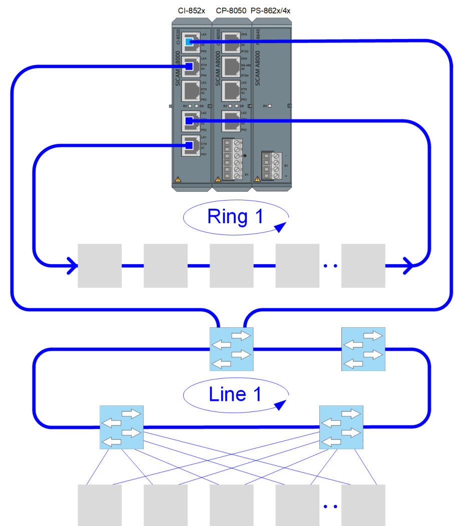
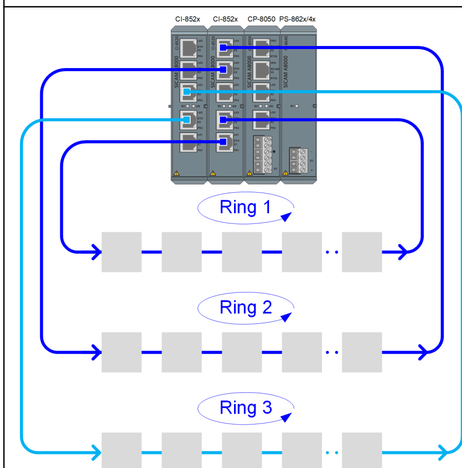
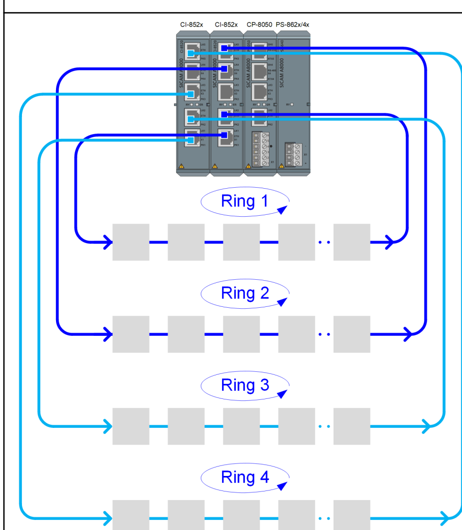
NOTE

- RSTP can only be used with a CI-852x module.
- Only 1 redundancy protocol can be used per ring.
- 2 RSTP rings are possible for each CI-852x module.
- 2 redundancy protocols for Ethernet networks are possible for each CI-852x module (here 2x RSTP or 1x RSTP with HSR, PRP or Line Mode).
- The choice, which 2 of the 5 interfaces on the module are used for the RSTP-ring, is arbitrary.
- For RSTP, the parameter **`System | Hardware | Module properties | Type = RSTP`** must be set in the SICAM Device Manager for the used LAN port group in the module properties of the CI-852x module.
- In a RSTP-ring, a maximum of 512 unique source MAC addresses are allowed.
- 2 rings on the same CI-852x module must not be connected! (also not via switch, REDBOX, ...)
- On the same CI-852x module, devices from one ring are not visible in the other ring.

Schematic configuration with 1 RSTP ring

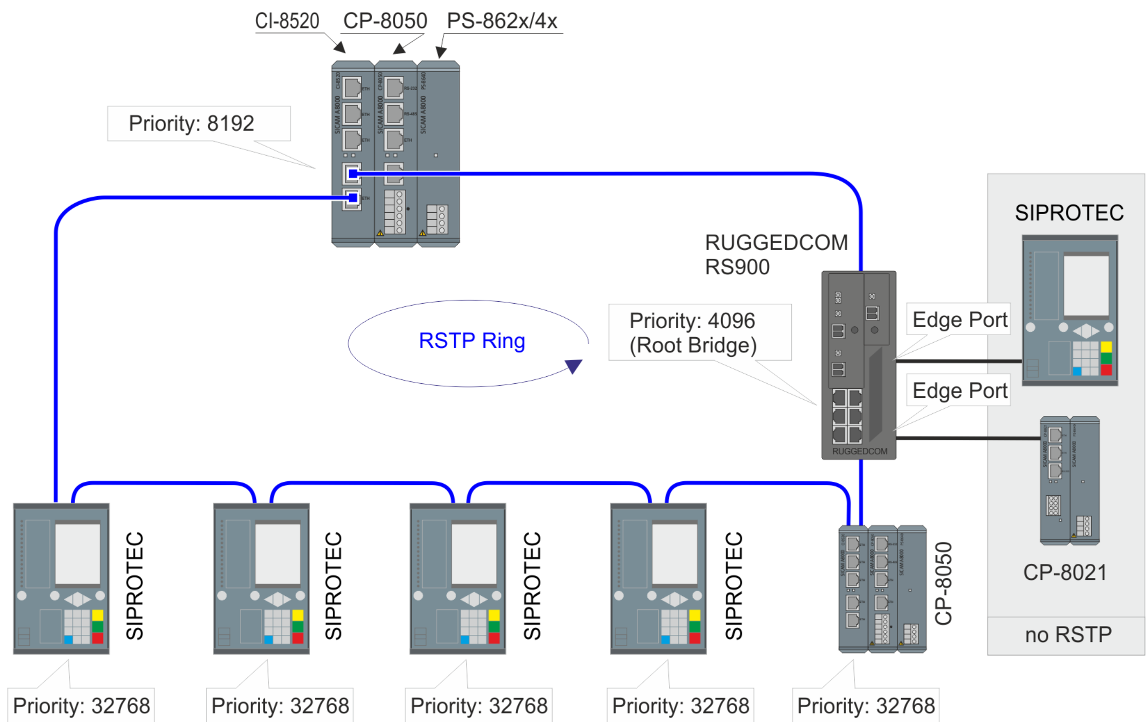


Schematic configuration	Description
	**1 redundancy protocol for Ethernet network (1 ring)** • Only 1 type for Ethernet redundancy protocol is supported on both ports of a LAN port group.
	**2 redundancy protocols for Ethernet networks (2 rings)** • Any Ethernet redundancy protocol can be selected for each LAN port group. • Only 1 type for Ethernet redundancy protocol is supported on both ports of a LAN port group. • The Ethernet networks of the different LAN port groups of a CI-852x module must not be connected.
	**2 redundancy protocols for Ethernet networks (1 ring + PRP)** • Any Ethernet redundancy protocol can be selected for each LAN port group. • Only 1 type for Ethernet redundancy protocol is supported on both ports of a LAN port group. • The Ethernet networks of the different LAN port groups of a CI-852x module must not be connected.

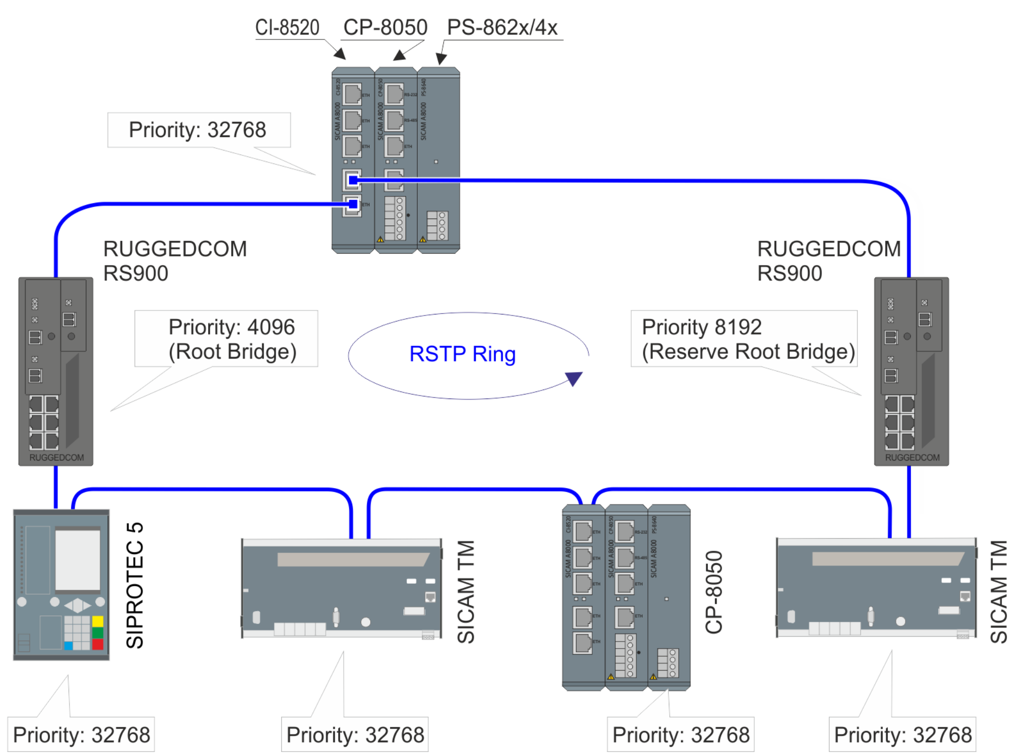
Schematic configuration	Description
	**2 redundancy protocols for Ethernet networks (1 ring + Line Mode)** • Any Ethernet redundancy protocol can be selected for each LAN port group. • Only 1 type for Ethernet redundancy protocol is supported on both ports of a LAN port group. • The Ethernet networks of the different LAN port groups of a CI-852x module must not be connected.
	**3 redundancy protocols for Ethernet networks (3 rings)** • Any Ethernet redundancy protocol can be selected for each LAN port group. • Only 1 type for Ethernet redundancy protocol is supported on both ports of a LAN port group. • The Ethernet networks of the different LAN port groups of a CI-852x module must not be connected. Note: 3 rings are shown in this picture - any Ethernet redundancy protocol can be selected for each LAN port group.
	**4 redundancy protocols for Ethernet networks (4 rings)** • Any Ethernet redundancy protocol can be selected for each LAN port group. • Only 1 type for Ethernet redundancy protocol is supported on both ports of a LAN port group. • The Ethernet networks of the different LAN port groups of a CI-852x module must not be connected. Note: 4 rings are shown in this picture - any Ethernet redundancy protocol can be selected for each LAN port group.

13.22.2 Use Cases

Example 1: RSTP Configuration with Electrically Connected Devices

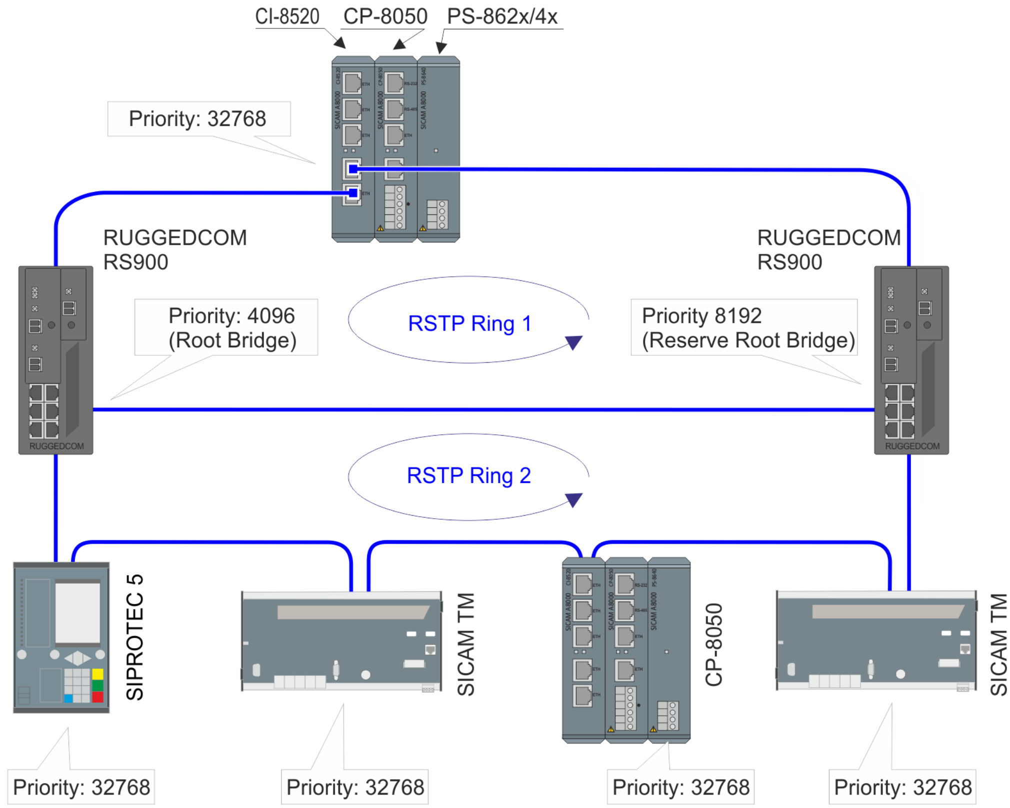


Example 2: 1 RSTP Ring with 2 RS900 as Root Bridge(s)



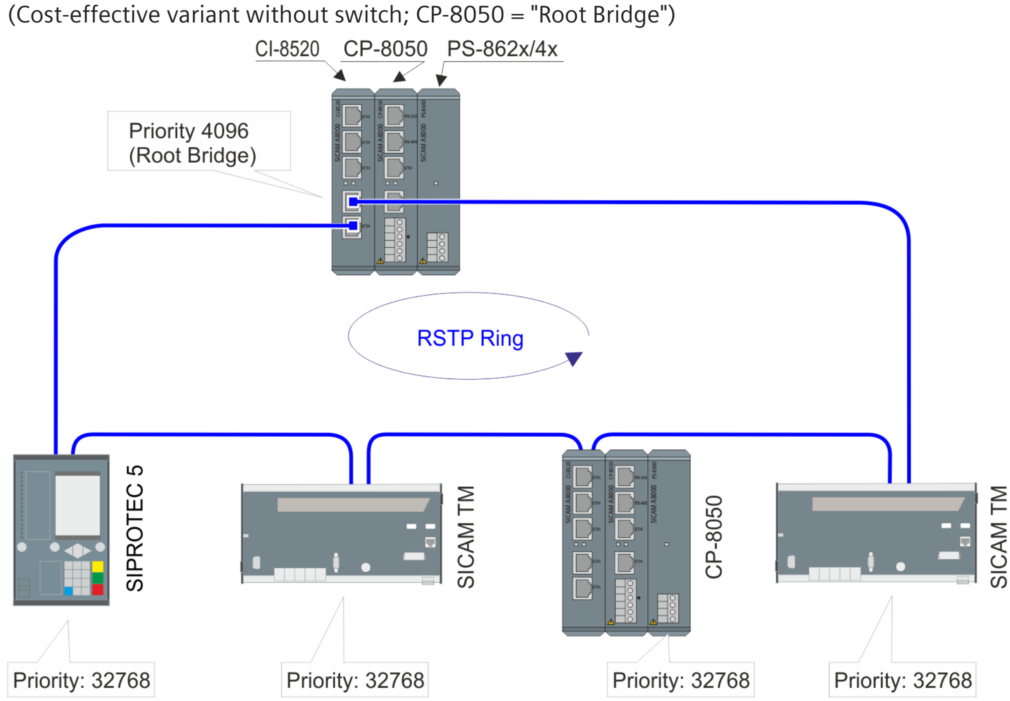
Example 3: 2 RSTP Rings with 2 RS900 as Root Bridge(s)

Default configuration for redundancy (the CP-8050 is doubled above).



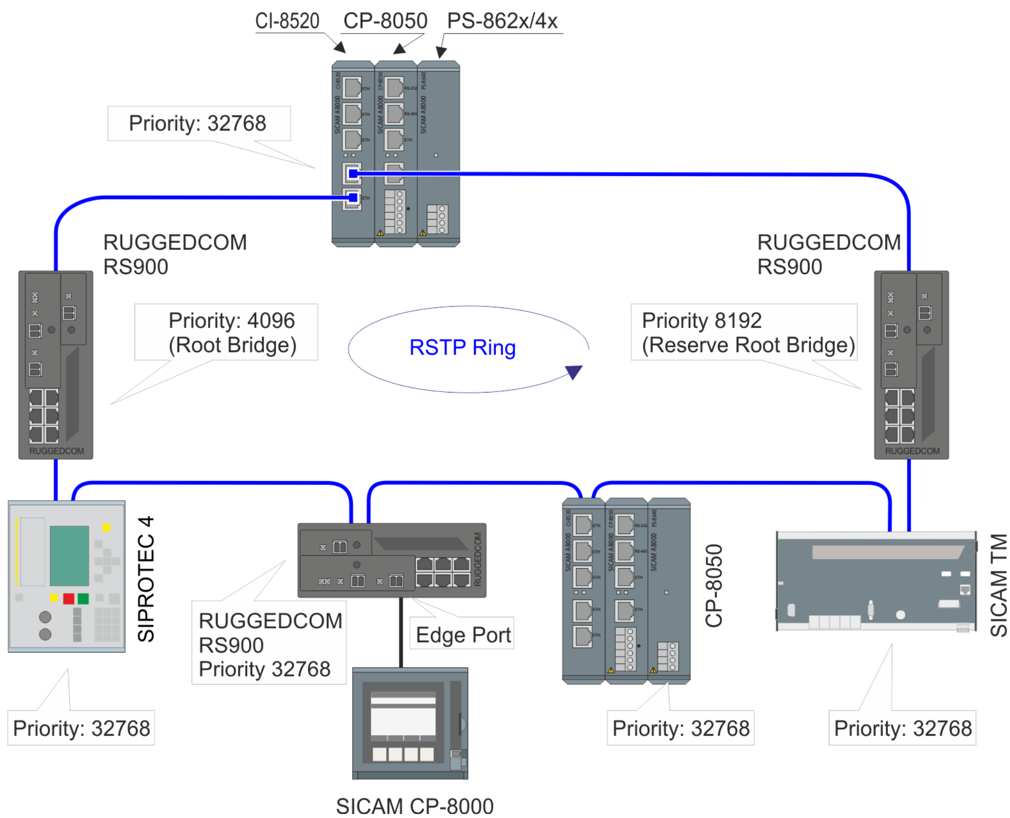
Example 4: 1 RSTP Ring without RS900 Switch

(Cost-effective variant without switch; CP-8050 = "Root Bridge")



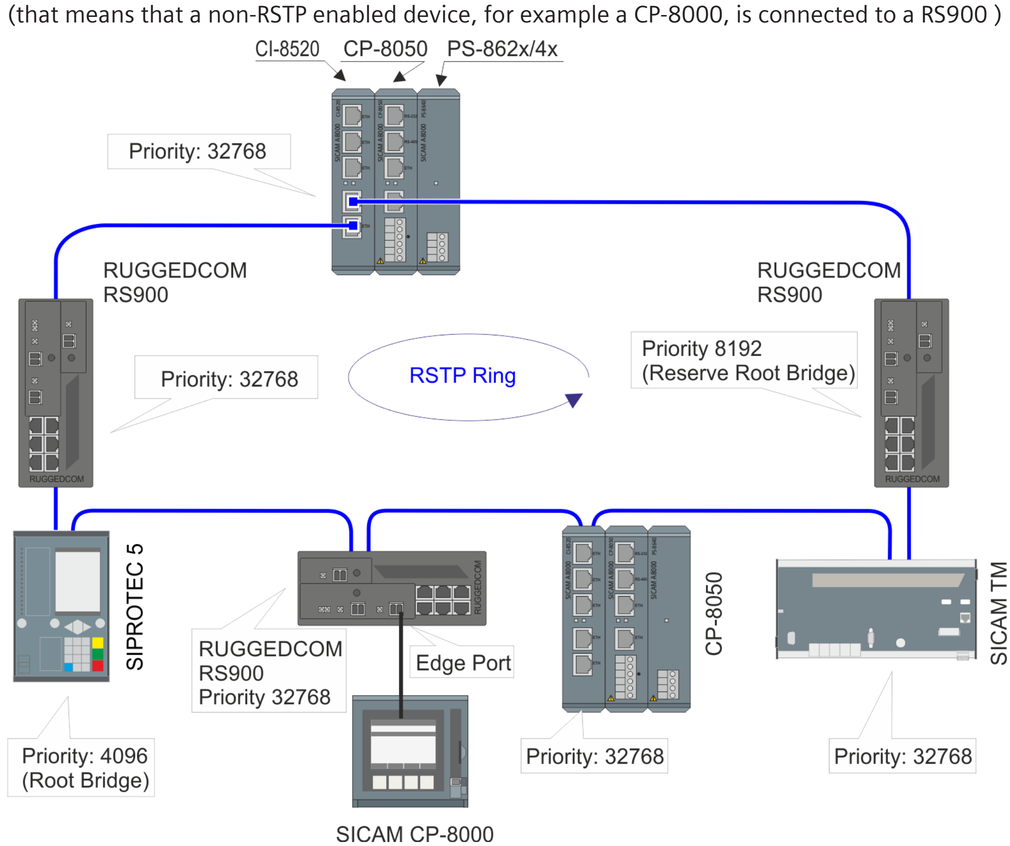
Example 5: 1 RSTP Ring with 2 RS900 as Root Bridge(s) incl. RS900 as Edge Port

(that means that a non-RSTP enabled device, for example a CP-8000, is connected to a RS900)

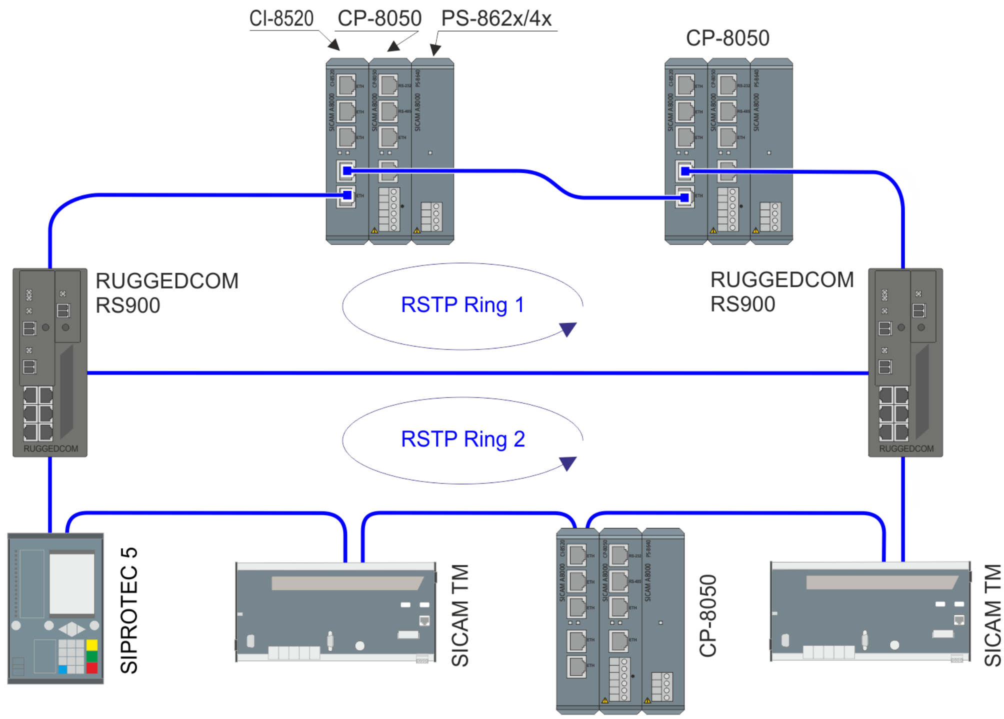


Example 6: 1 RSTP Ring with 2 RS900 as Root Bridge(s) incl. RS900 as Edge Port

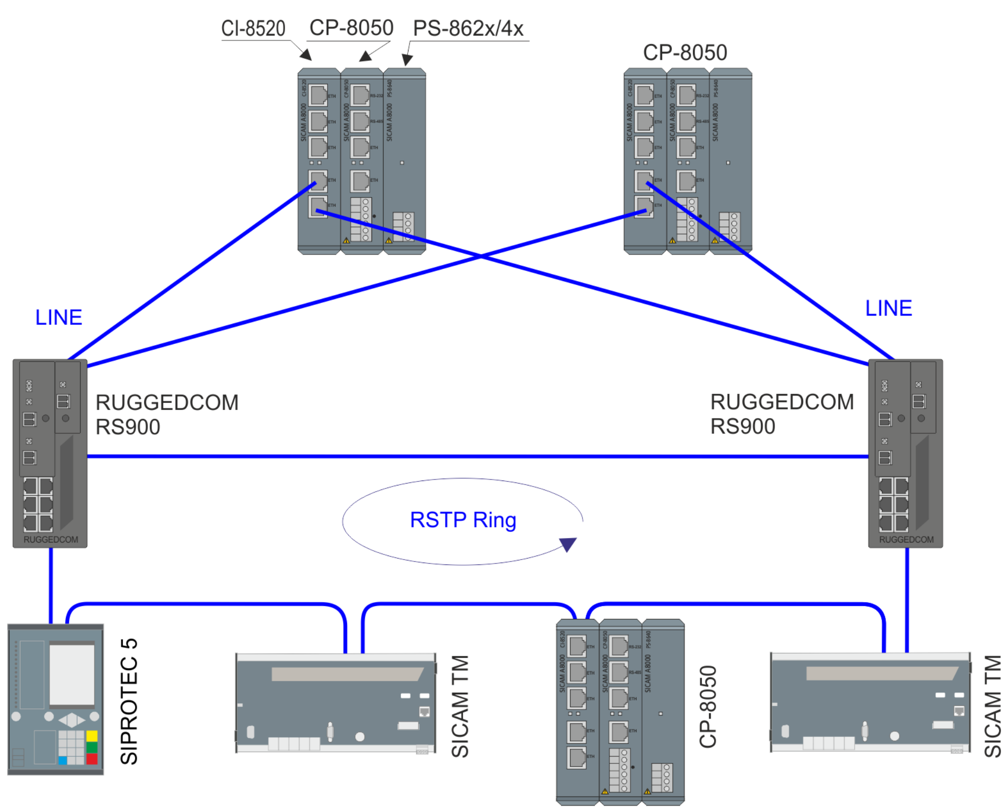
(that means that a non-RSTP enabled device, for example a CP-8000, is connected to a RS900)



Example 7: RSTP with 2 Active CP-8050 and 2 RSTP Rings with Redundant Switch



Example 8: Combination of Line Mode with 2 Active CP-8050 and 1 RSTP Ring with Redundant Switch



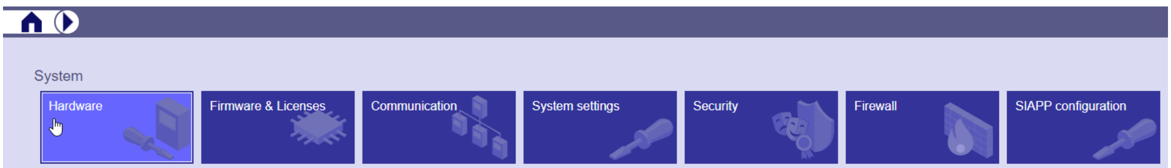
NOTE

For all the above mentioned use cases and involving long distance communication (more than 100 m), Siemens recommends to use CI-8522 in place of CI-8520.

13.22.3 Parameter and Setting

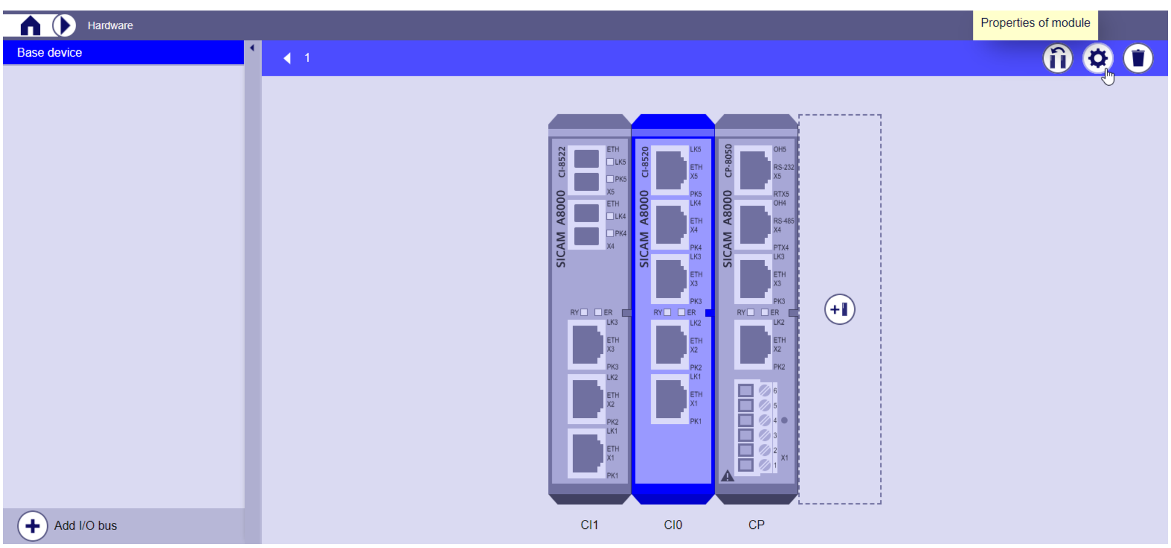
With CP-8050, the parameters for RSTP must be set with the SICAM Device Manager as follows:

- System | Hardware



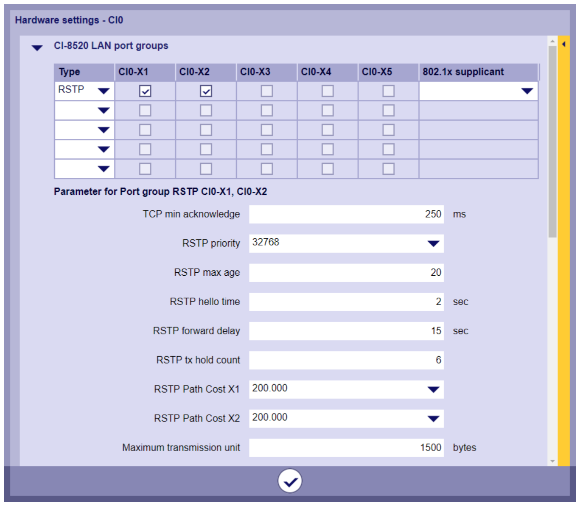
[DM_System_Hardware_GER, 1, en_US]

- Select communication module for Ethernet interface
- Module properties



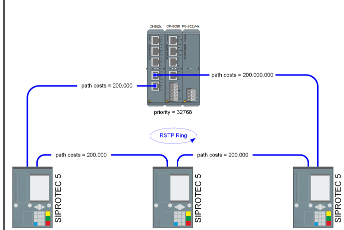
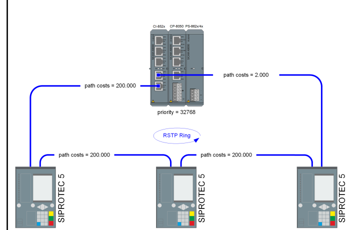
[DM_System_Hardware_CI-852x_Moduleigenschaften_GER, 1, en_US]

- Parameters for port group RSTP



Parameter settings for RSTP networks

Parameter Name	Settings
`RSTP priority`	The priority defines the position of the bridge in the network. The lower the value, the higher the priority. The bridge with the highest priority is the root bridge. Siemens recommends setting the priority of the root bridge to 0. Siemens recommends setting the priority of the replacement root bridge, which should be located right next to the root bridge, to 4096. The replacement root bridge should replace the root bridge in case of a failure. Siemens recommends setting the priority of all other devices and bridges to 32 768. 0 to 61 440, in increments of 4096 Standard setting = 32 768
`RSTP maximum age`	The parameter MaxAge is preset to 20. This setting is specified as the standard setting in the IEEE Std 802.1DTM - 2004 standard and can be increased up to 40. The basic function of this parameter is that messages with a higher or the same age are discarded. The aging itself is determined by the number of switches passed through. The MaxAge parameter must be defined in such a way that all switches, taking this definition into account, must be able to reach the root switch, even in the event of line interruptions or a device failure. 6 to 40 Standard setting = 20
`RSTP hello time`	This time determines at what intervals the HelloTime telegrams are transmitted. 1 or 2 s Default setting = 2 s
`RSTP forward delay`	The forwarding delay time is the maximum number of seconds that a port waits until a new topology is distributed in the RSTP network and until the status is changed from **learning** and **listening** to **forwarding** . 4 to 30 s Default setting = 15 s

<table>
<tr><th>Parameter Name</th><th colspan="2">Settings</th></tr>
<tr><td><code>RSTP Transmit hold counter</code></td><td colspan="2">Transmit Hold Count is a meter that applies to all ports of the bridge. It limits the number of RSTP telegrams per port transmitted in sequence and without delay. When this telegram is transmitted, only one more telegram per second is transmitted. For a highly meshed system, a Transmit Hold Count that is set low will result in a significant slowing of the reconfiguration when the root switch fails.
Siemens recommends not changing the Transmit Hold Count setting.
1 to 10
Standard setting = 6</td></tr>
<tr><td><code>RSTP Path Cost X*</code> (Port 1)
<code>RSTP Path Cost X*</code> (Port 2)</td><td colspan="2">With RSTP, each device chooses a preferred route to the root bridge. This is the path with the lowest path costs. The path costs indicate the quality of a line. Each connection between 2 devices/switches have certain path costs. The path costs of the selected ports for the RSTP ring can be different for both ports. The path costs to the root bridge are exchanged between neighboring devices - the own path costs <code>RSTP Path Cost X*</code> are added to the path costs. The higher the value, the worse the line. A device preferably chooses the route with the lowest path costs to the root bridge, the other is only taken if this fails!
With the parameter "RSTP Path Cost" it is possible to configure preferred routes in the RSTP ring.
In IEEE Std 802.1D™ - 2004 this value is determined depending on the speed. For example, path costs of 200 000 are defined for 100 Mbit.
Siemens recommends not to change this setting.
0 to 200 000 000
Standard setting = 200 000</td></tr>
<tr><td></td><td>Example 1:
Here the CP-8050 will take the left path because the path costs to the root bridge (SIP5 with priority 4096) are 400 000. The other route would have higher costs and is therefore only taken if the preferred route fails.
</td><td>Example 2:
Here the CP-8050 will take the right path because the path costs to the root bridge (SIP5 with priority 4096) are 202 000. The other route would have higher costs and is therefore only taken if the preferred route fails.
</td></tr>
</table>

Parameter settings for networks (Common)

Parameter Name	Settings
`Parameter name 802.1x suppli-cant`	SICAM A8000 CP-8031/CP-8050 supports IEEE 802.1X as suppli-cant with EAP_TLS (EAP mode). It is not possible to use suppli-cant and authenticator functionality on the same port. 802.1x functionality only supports RSA certificates. (For details see SICAM A8000 Series Administrator Security Manual)
`TCP minimum expected acknowl-edgment time`	Depending on the transmission medium for LAN /WAN/GPRS/ UMTS/LTE; ... the parameter **`TCP minimum expected acknowledgment time`** must be set accordingly if necessary. LAN/WAN >=250 ms. GPRS/UMTS/LTE >=1000 ms. 0 ms to 3000 s Default setting = 250 ms
`Maximum transmission unit`	Ethernet MTU (Maximum Transmission Unit). 68 to 9000 Bytes Default setting = 1500 byte

13.23 PRP

13.23.1 Introduction

PRP (Parallel Redundancy Protocol) is a redundancy protocol for Ethernet networks which is specified in the norm IEC 62439-3. In comparison to conventional redundancy procedures, for example, RSTP (Rapid Spanning Tree Protocol, IEEE 802.1D-2004), PRP offers a switchover without interruptions what avoids a dead time in the event of a fault, and thus the highest availability.

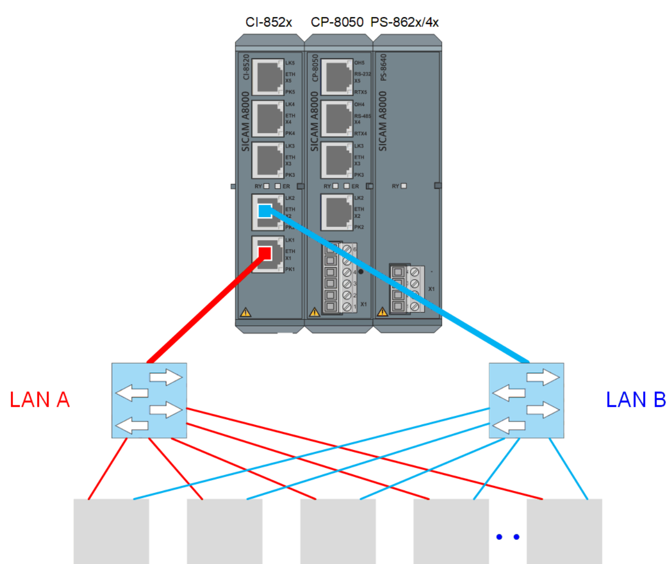
Previous redundancy methods are based on mechanisms where the power-system components (switches and bridges) agree with each other and find the best communication path for normal operation.

In the event of a fault, for example, in a cable, an optical fiber, or in case of a switch failure, the interruption is detected and alternative paths are found in the network and connected. No communication can take place during this switching procedure. Depending on the size and on the configuration of the Ethernet network, this state can last for 10 ms up to around 1 s. A protocol extension in the end device is not necessary in this case because the protocol is implemented in the switches.

PRP adopts a different approach.

The redundancy procedure is generated in the end device itself. The procedure is simple: The redundant end device has 2 Ethernet interfaces with the same address (DAN, Double Attached Node). Then, the same indication is sent twice, with PRP (parallel) via 2 separated networks. Both indications are unambiguously identified with a sequence number.

The receiver takes the information that arrives first, stores the ID of the information in a duplicate filter using the source address and the sequence number of the information. Thereby, the receiver recognizes the 2nd redundant information and discards it.



[Ethernet_Redundanz_PRP, 1, --_--]

If the 1st indication is missing, the 2nd indication with the same information arrives via the other network. This redundancy avoids a switchover of the network and is therefore a redundancy without interruption. The end device does not forward any indication to the other network.

Since this procedure is realized in the Ethernet layer (same MAC address), it is transparent and can be used by all Ethernet informative data protocols (IEC 61850, DNP, other TCP/IP based protocols).

Topology, performance, and latency may be different for both networks, but latencies may vary only to a certain extent.

In addition, it is possible to use one of the 2 networks for the transmission of not redundant indications. To do so, connect a SAN (Single Attached Node) device to a network. In this way, a PRP end device can communicate with a SAN end device (in a not redundant way). If you wish to connect a SAN end device in a redundant way to a PRP system, use a REDBOX (redundancy box). This REDBOX provides PRP functionality externally as an inline device. However, the PRP procedure also presents a disadvantage: You are buying the increased redundancy function at the cost of a duplicate network (2x switches, cables).

There are 2 versions of PRP: PRP-0 and the successor PRP-1. Siemens implements PRP-1.

Supported Standard	Description
IEC 62439-3 Edition 2.0 (2012-07)	Industrial communication networks - High availability automation networks - Part 3: Parallel Redundancy Protocol (PRP) and High-availability Seamless Redundancy (HSR)

In a PRP structure all data are transmitted at the same time via 2 independent networks (LAN A and LAN B). Topology, performance and latency can be different in both networks, but latency may only differ within a certain range.

CP-8050 uses the "duplicate discard" mode in PRP, that means that duplicates are discarded and not passed to the TCP/IP stack.

For the CI-852x module, the lower numbered Ethernet port is the LAN A port (for example: X1 = LAN A, X2 = LAN B).

NOTE

Both networks must not be connected, as otherwise an Ethernet double addressing takes place and this can lead to malfunctions!

The advantage of PRP over other protocols is, that in the case of a communication failure within one network, there is a bumpless switch over and hence no loss of data. Disadvantage of PRP is the operation of 2 independent networks.

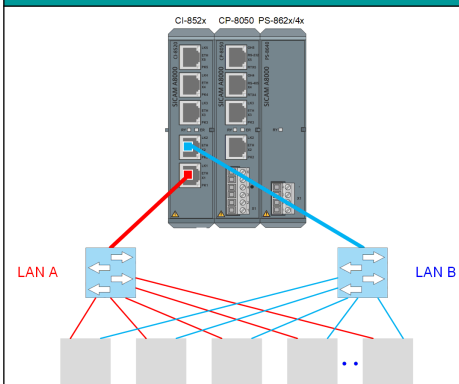
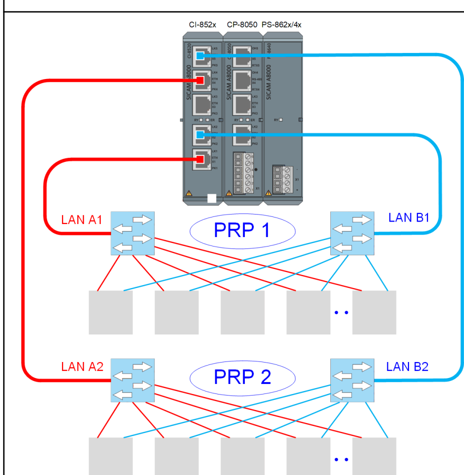
Depending on the connection PRP distinguishes the following device types:

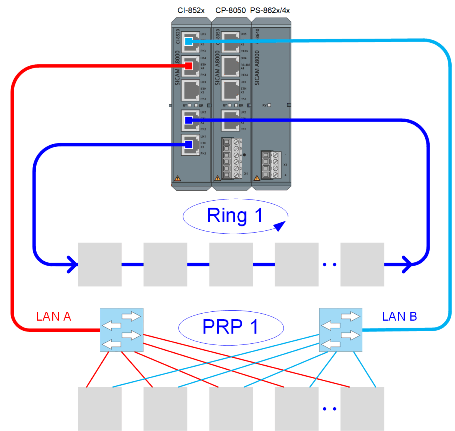
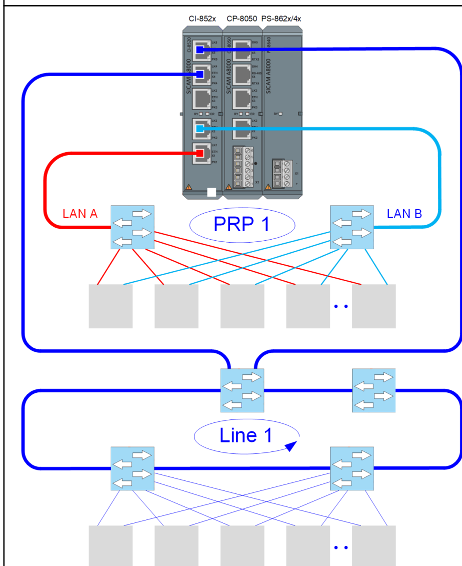
- Dual Attached Nodes (DAN)
  Devices which are connected with both networks. There is a separate interface for each network connection.
- Single Attached Nodes (SAN) Devices which are connected with just one network.
- Virtual Double Attached Nodes (VDAN)
  VDANs are devices with just one interface, but which are connected with both networks via a redundancy box (RedBox).

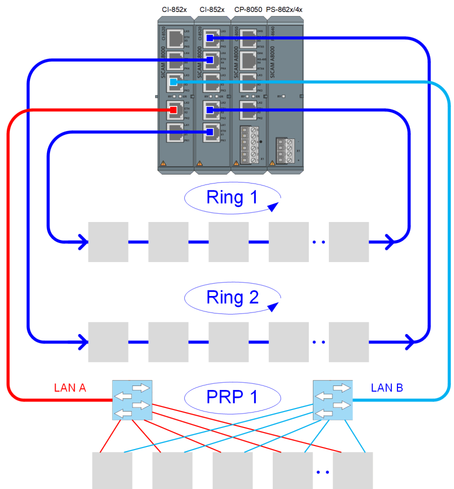
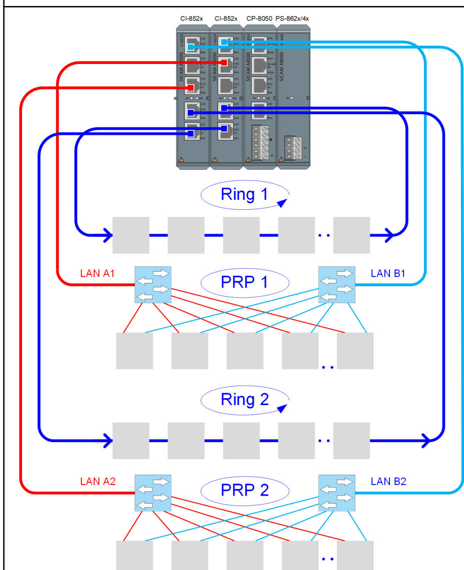
NOTE

- PRP can only be used with a CI-852x module.
- Only 1 redundancy protocol can be used per LAN port group.
- 2 separated PRP networks are possible for each CI-852x module.
- 2 redundancy protocols for Ethernet networks are possible for each CI-852x module (here 2x PRP or 1x PRP with HSR, PRP or Line Mode).
- The choice, which 2 of the 5 interfaces on the module are used for the PRP network, is arbitrary
- For PRP, the parameter **`System | Hardware | Module properties | Type = PRP`** must be set in the SICAM Device Manager for the used LAN port group in the module properties of the CI-852x module.
- In a PRP network, a maximum of 512 unique source MAC addresses are allowed.
- The networks of the 2 LAN port groups on the same CI-852x module must not be connected!
(also not via switch, REDBOX, ...)
- On the same CI-852x module, devices from one ring/network are not visible in the other ring/network.
- PRP is monitored every second with a message. A failure of the monitoring is signaled by a warning.
- For the CI-852x module, the lower numbered Ethernet port is the LAN A port (for example: X1 = LAN A, X2 = LAN B)

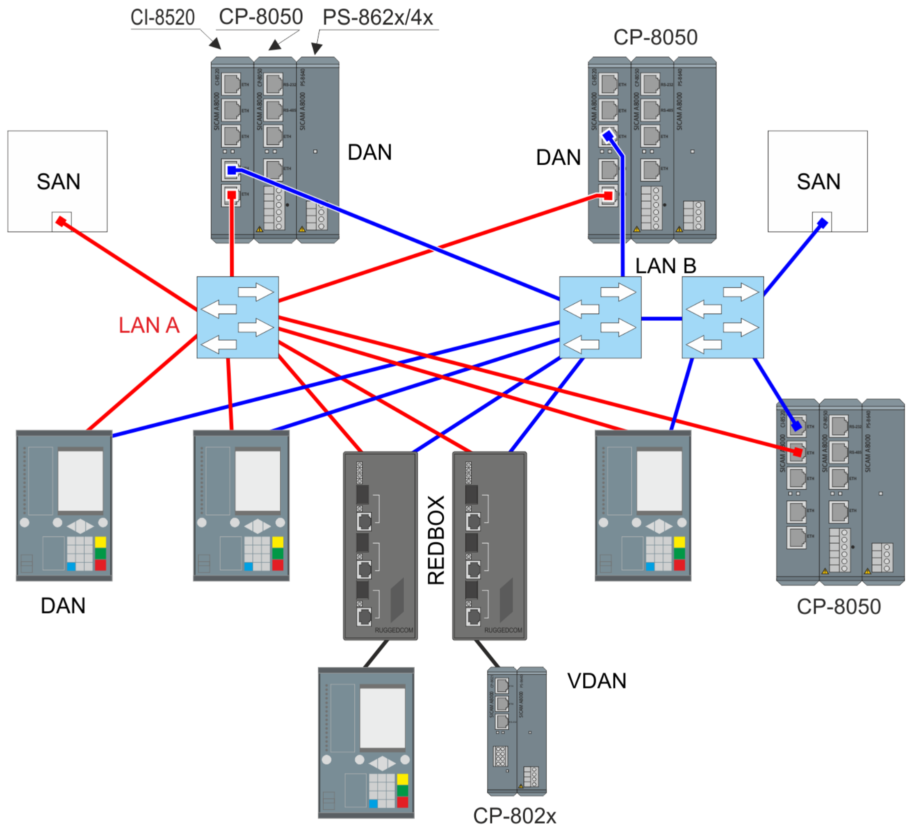
Schematic configuration with 1 RSTP ring

Schematic configuration	Description
	**1 redundancy protocol for Ethernet network (1 x PRP)** • Only 1 type for Ethernet redundancy protocol is supported on both ports of a LAN port group.
	**2 redundancy protocols for Ethernet networks (PRP + PRP)** • Only 1 type for Ethernet redundancy protocol is supported on both ports of a LAN port group. • The Ethernet networks of the different LAN port groups of a CI-852x module must not be connected.

Schematic configuration	Description
	**2 redundancy protocols for Ethernet networks (Ring + PRP)** • Any Ethernet redundancy protocol can be selected for each LAN port group. • Only 1 type for Ethernet redundancy protocol is supported on both ports of a LAN port group. • The Ethernet networks of the different LAN port groups of a CI-852x module must not be connected.
	**2 redundancy protocols for Ethernet networks (PRP + Line Mode)** • Any Ethernet redundancy protocol can be selected for each LAN port group. • Only 1 type for Ethernet redundancy protocol is supported on both ports of a LAN port group. • The Ethernet networks of the different LAN port groups of a CI-852x module must not be connected.

Schematic configuration	Description
	**3 redundancy protocols for Ethernet networks (PRP + 2 Rings)** • Any Ethernet redundancy protocol can be selected for each LAN port group. • Only 1 type for Ethernet redundancy protocol is supported on both ports of a LAN port group. • The Ethernet networks of the different LAN port groups of a CI-852x module must not be connected.
	**4 redundancy protocols for Ethernet networks (2 x PRP + 2 Rings)** • Any Ethernet redundancy protocol can be selected for each LAN port group. • Only 1 type for Ethernet redundancy protocol is supported on both ports of a LAN port group. • The Ethernet networks of the different LAN port groups of a CI-852x module must not be connected.

13.23.2 Application example



NOTE

- All switches along the way must support the function "oversized frames/jumbo frames" 1524 byte Ethernet frames (1528 bytes with VLAN).
- When using remote operation, the network card must also support the "oversized frames/jumbo frames" function of 1524 byte Ethernet frames (1528 bytes with VLAN).

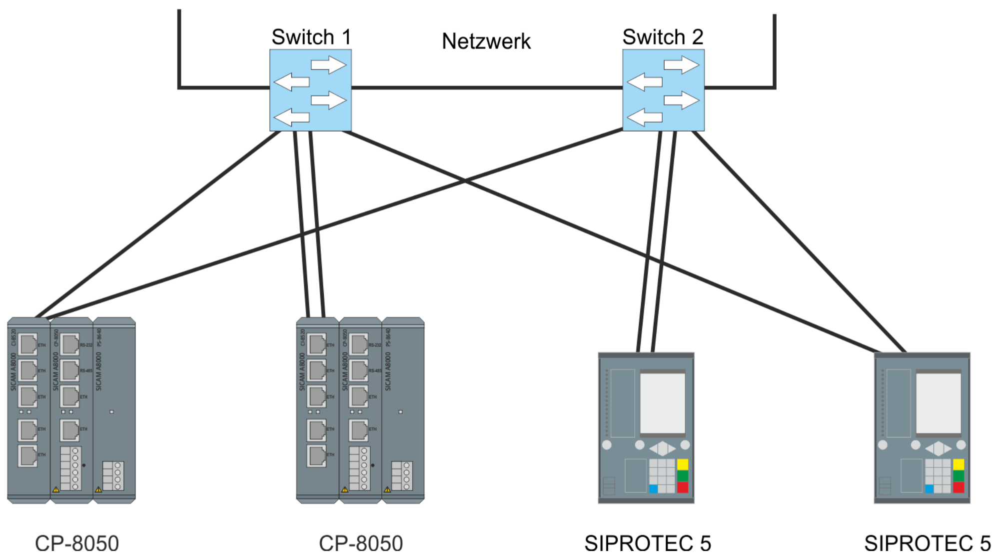
13.24 Line Mode

13.24.1 Line Mode

Line Mode is a Siemens-specific network redundancy protocol used in redundancy configurations at the Ethernet level.

The line mode serves as a "redundant cable connection" to one or two switches.

The CI-852x module for CP-8050 has 2 electrical Ethernet interfaces that can be used in line mode. In line mode, the CP-8050 can communicate via 2 Ethernet cables, but not at the same time. The 2nd channel always serves as a reserve. This results in the network structure shown in following Figure, which shows the connection of the two connections to different switch ports.



The two physical connections are monitored. Therefore, when a connection is interrupted, a corresponding message can always be generated and submitted.

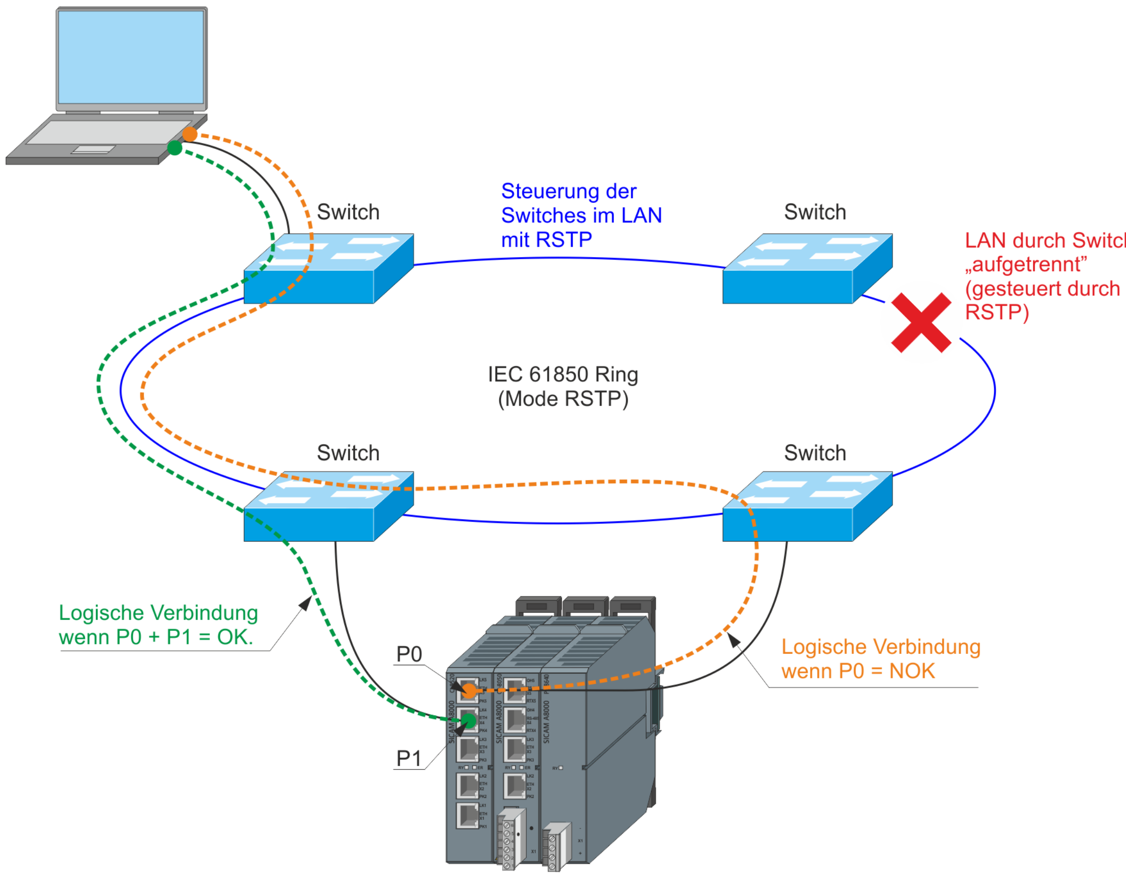
Since the method is implemented in the Ethernet layer, it is transparent and usable for all Ethernet user data protocols (IEC 61850, DNP, other TCP/IP-based protocols).

In line mode, the integrated switch for the Ethernet ports is controlled so that only 1 port is always switched to "forwarding".

Line Mode:

- The data link layer (Layer-2) is always set up for both ports.
- The Ethernet packet forwarding is only performed on the port set to "Forwarding". The other port is set to "Blocking".
- The basic system element firmware of the CP-8050 controls the operation of each port for the Ethernet packet distribution:
  - deactivated (= "Blocking")
  - activated (= "Forwarding")
    (By default Port-0 is set to "Forwarding" and Port-1 to "Blocking")

If the Ethernet connection ("Link Down") of the port set to "Forwarding" fails, the protocol element immediately sets the failed port to "Blocking" and the other port to "Forwarding".



CP-8050

After enabling (= switching on "Forwarding") a port, special Ethernet packets are sent out, so that the switches in the network quickly learn the "new ways" for the reachability of the MAC address of the activated ports.

In addition, a RARP (reverse ARP) is sent with its own IP address.

This method is Siemens specific and the Ethernet packets used are transmitted with Ethertype = 0x8827.

Channel Switching in Line Mode

When the active compound, the one which transmits the data between the device and the external switch, is interrupted, the interruption is detected and reported. Simultaneously, with the detection of the interruption, a switchover to the second channel (another port) is performed, so that the data traffic is continued almost uninterrupted. The interrupt message is then transmitted over the reserve channel.

Port-0 is the Ethernet port on the CI-852x module with the lower interface number (e.g.: X1)

Port-1 is the Ethernet port on the CI-852x module with the higher interface number (e.g.: X3)

Failure of the External Switch

If both connections are connected to ports in different switches, the failure of an external switch does not lead to a connection interruption to a control center. In this case, all devices that had actively established a connection via the failed switch, will switch to their second connection, which is connected to another switch and the operation can be continued.

The external switches themselves are usually connected via a ring structure, so that they realize their own redundancy with each other.

Switch Over Time

The switching time to the second connection in the event of a connection failure is approx. 1 ms.

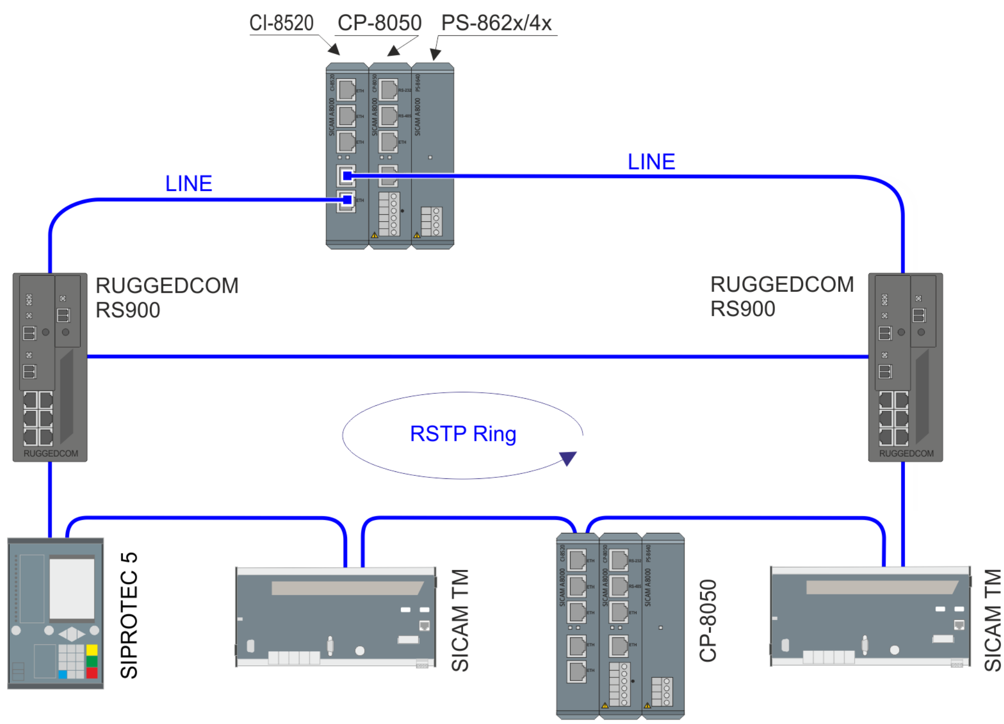
This applies to the Line Mode operating mode if both ports of the CI-852x module are connected to external switches.

Interface RJ45

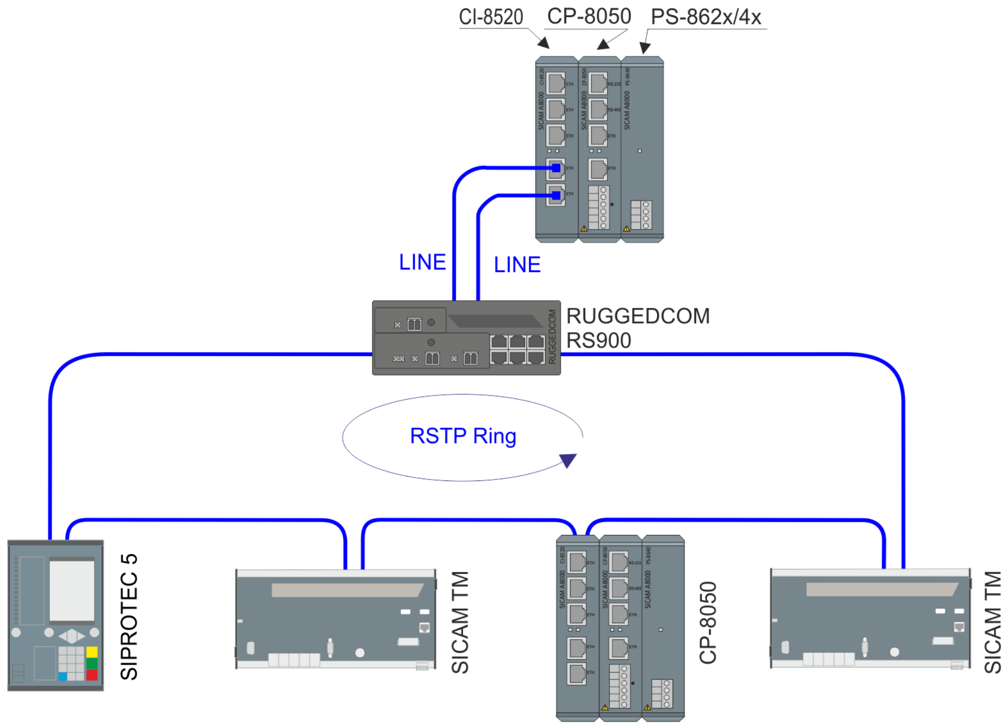
For Ethernet connections with RJ45, which are operated in line mode, both interfaces are not operational at the same time. The connection is established automatically when the connection to a switch/partner is detected. The second port remains inactive until the connection of the active port is lost. Then the connection is automatically resumed on the second port. The respective non-active channel is monitored with regard to the link status.

13.24.2 Use Cases

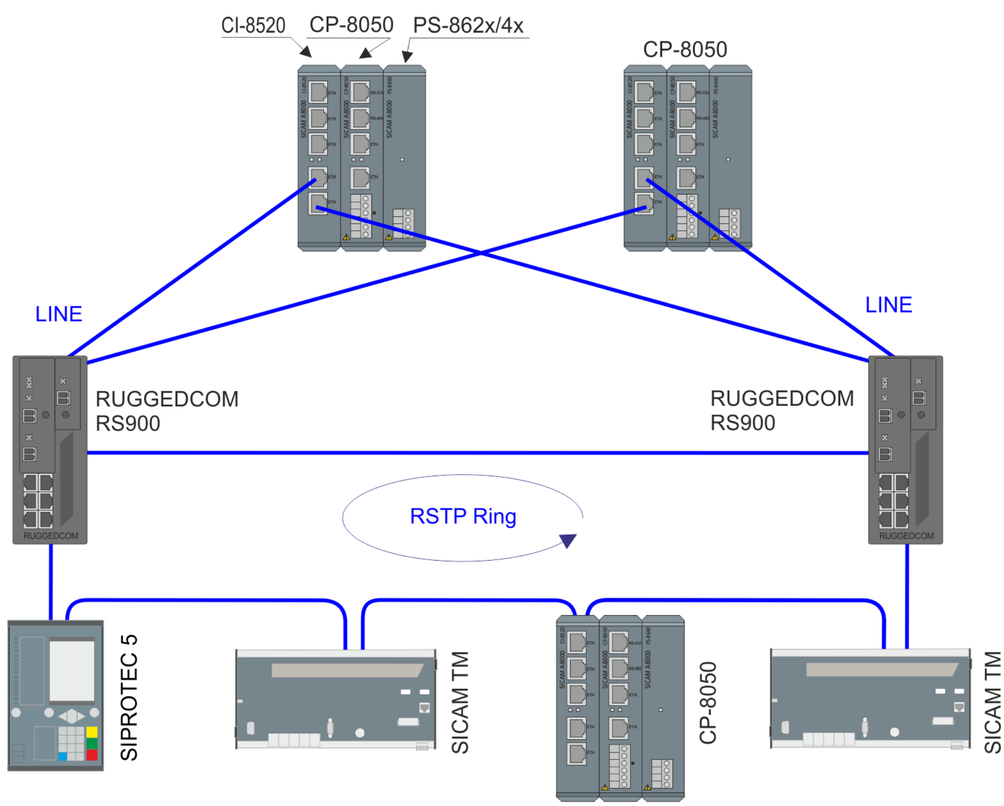
Example 1: Combination Line Mode with RSTP Mode on 2 Redundant Switches



Example 2: Combination Line Mode with RSTP Mode on 1 Switch



Example 3: Combination of Line Mode with 2 Active CP-8050 and 1 RSTP Ring with Redundant Switch



NOTE

For all the above mentioned use cases and involving long distance communication (more than 100 m), Siemens recommends to use CI-8522 in place of CI-8520.

13.24.3 Configuration information

- Line Mode can only be used with a CI-852x Ethernet Interface module
- For each CI-852x Ethernet Interface module only one Line Mode is permitted
- For each CI-852x Ethernet Interface module, only one redundancy protocol is possible for Ethernet networks (here only Line Mode).
- The choice, which 2 of the 5 interfaces on the module are used for the Line Mode, is arbitrary
- The Line Mode must be activated for the used CI-852x Ethernet interfaces.

The relevant parameter can be found under **`[BSE] System settings | Network settings | Interface | Mode = Line Mode`**.

13.25 VLAN

13.25.1 Introduction

Virtual Local Area Networks (VLANs) are logical networks that are implemented on a physical LAN.

In this way, several logically separated networks can be operated for different areas on one physical network.

The technical basis for VLANs is described in the IEEE 802.1Q standard.

To be able to screen and if necessary prioritize the data traffic of a virtual LAN against the other network parties, the data packets must have a corresponding identification. For this, the MAC-Frames are expanded with an additional feature (a “tag”). The corresponding procedure is therefore also called Frame Tagging.

The Tagging is realized with an additional field in the MAC-Frame. In this field, two items of information essential for the virtual LAN are contained:

- VLAN-ID

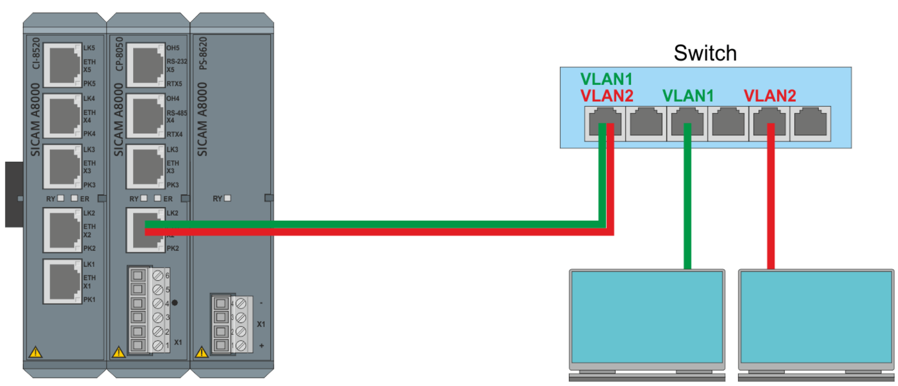
  The virtual LAN is identified with an unambiguous number. This ID determines the association of a data packet to a logical (virtual) LAN. With this 12-bit value, up to 4094 different VLAN's can be defined (the VLAN-IDs “0” and “4095” are reserved or not allowed).

- Priority

  The priority of a VLAN-identified data packet is flagged with a 3-bit value. Thereby “0” stands for the lowest priority, the “7” for highest priority. Data packets without VLAN Tag are handled with the priority “0”.

13.25.2 Sample Applications

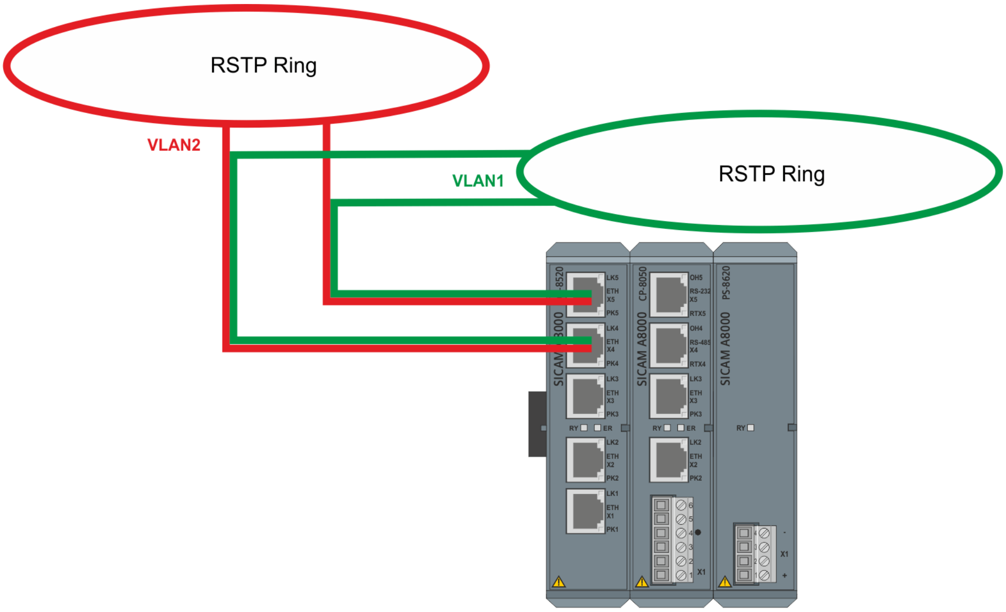
One application is that several logical VLANs are 'transmitted' to a CP-8050 over a single physical connection. In the switch, the individual VLANs are then "switched through" to different physical switch ports.



[dw_use_case_vlan_1, 1, --_--]

The switch is a "VLAN aware switch" which processes the VLAN information (VLAN tag) in the Ethernet header.

Another application example is the integration of the CP-8050 in a physical ring, where different "logical rings" are implemented via VLANs.



[dw_use_case_vlan_2, 1, --_--]

13.25.3 Configuration

On the CP8050, VLANs can be added to any simple Ethernet interface and to Ethernet switching groups. The HSR and PRP switching groups are not supported in the first version.

The configuration is done in the Device Manager under **`System | Communication | LAN interfaces | VLAN interfaces`**

The following parameters can be set for a VLAN:

- **`Port group`**

  This parameter can be used to select the Ethernet interface or the switching group to which a VLAN is to be added

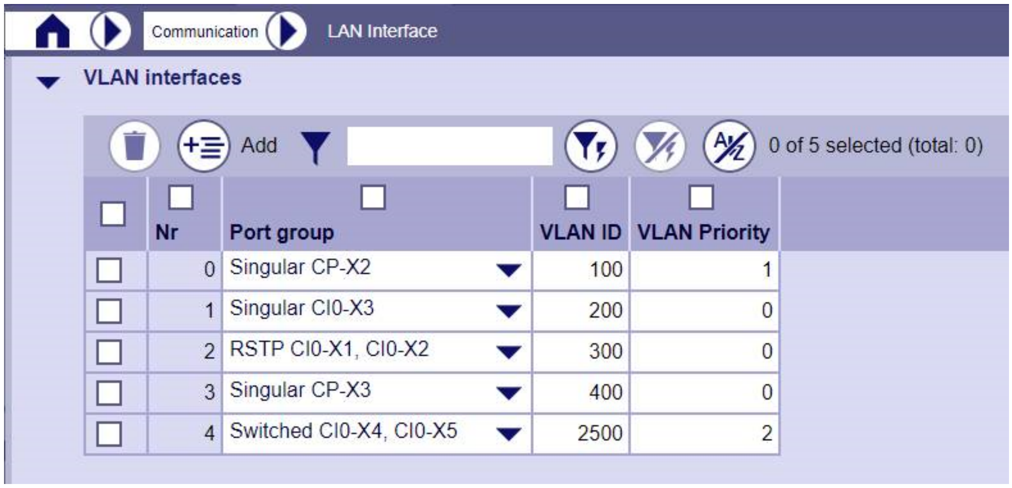
- **`VLAN ID`**

  This parameter can be used to specify the ID that is to be assigned to the VLAN. The valid range of values is [1 ... 4094]

- **`VLAN Priority`**

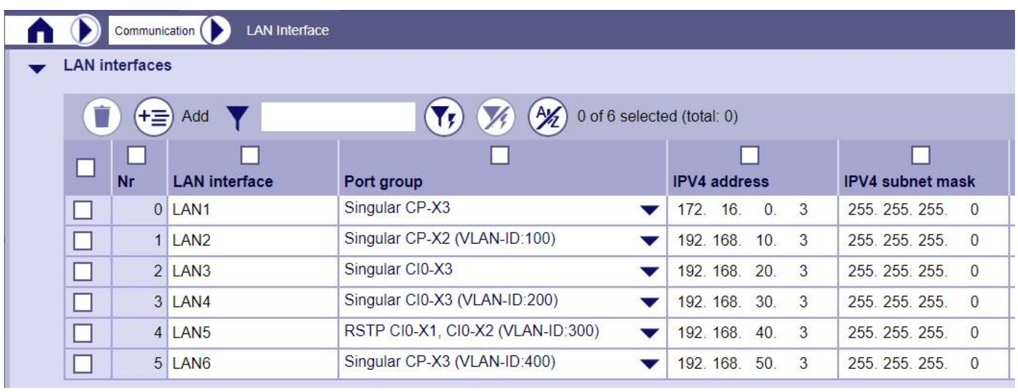
  This parameter can be used to specify the 3-bit priority value for VLAN packets that are sent via this VLAN. The valid range of values is [0 ... 7]

Example



[sc_VLAN_config_1, 1, en_US]

The configured VLANs can then be used just like the physical interfaces for configuration of the LAN interfaces:



[sc_VLAN_config_2, 1, en_US]

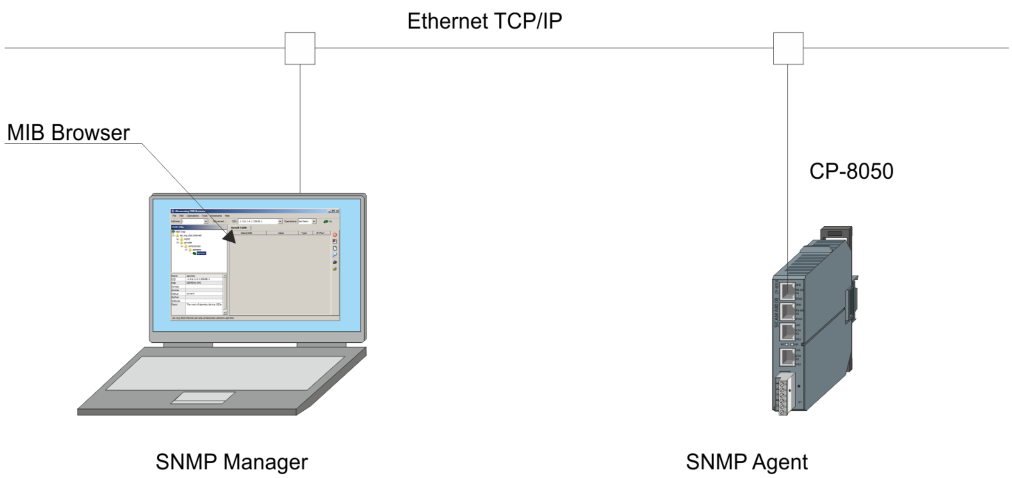
13.26 SNMP

13.26.1 Introduction

SNMP (Simple Network Management Protocol) is a network protocol used to monitor or control network components (e.g. routers, switches, servers, automation units, RTUs) from a central station. The protocol controls the communication between the monitored devices (SNMP Agents) and the monitoring station (SNMP Manager).

Due to the integration of an SNMPv3 Agent in SICAM A8000 it is possible to read out SNMP Variables (stored in the MIB = Management Information Base) via network with a standard network management software (SNMP Manager). The information and data transmitted with SNMP are displayed according to their functionality in the SNMP Manager in some kind of tree structure.

CP-8031/CP-8050 supports the security models USM (User-based Security Model) and TSM (Transport Security Model) via TLS. USM and TSM are not supported at the same time, both must be selected via parameters. TSM is supported from CPCI85 FW version 4.70 upwards.



[dw_A8000_snmp_config_8050, 1, --_--]

The SNMP protocol (Agent) is integrated in the firmware of the master module.

SNMP variables retrievable via:

- Standard SNMP network management software
- SCADA system with integrated SNMP manager.
- SICAM SCC

13.26.2 Functions

Function	SNMP
SNMP	
SNMPv2	–
SNMPv3	✓
• SNMP queries from SNMP Manager are only supported according to SNMPv3	✓
• Traps are transmitted to up to 5 SNMP managers in accordance with SNMPv3	✓
SNMP Agent:	
• Support of max. 4 Users	✓

Function	SNMP
Supported Ports USM:	
Port 161: SNMP, Incoming, UDP	✓
Port 162: SNMP Trap, Outgoing, UDP	✓
Supported Ports TSM:	
PORT 10161: SNMP, Incoming, TCP	✓
PORT 10162: SNMP Trap, Outgoing, TCP	✓
SNMP-functions	
GET (to request a management data record)	✓
GETNEXT (to request the subsequent data record; to pass through tables)	✓
GETBULK (to request several data records at once; e.g. several rows of a table) [429]	–
RESPONSE (answer to GET, GETNEXT, GETBULK)	✓
TRAP (spontaneous data from SNMP Agent to SNMP Manager) [430]	✓
Supported MIBs	
sicamRTUs	✓
MIB-2 (RFC1213)	✓
Ethernet-MIB (RFC3635)	✓
Host-Resources-MIB (RFC2790)	✓
USM-MIB (RFC2574)	✓
VACM-MIB (RFC2575)	✓
DGPI-MIB (Siemens Energy Management Digital Grid Product Inventory MIB)	✓
Supported SNMP variables MCPU (rough overview)	
Plant name	✓
Firmware Revision	✓
Uptime	✓
Port status	✓
central error table	✓
TRAP “History” (Reading back of the last sent TRAPs)	
• max. Number of saved traps: 50	✓
Asset Management (Inventory data of Siemens Energy Management Digital Grid devices and software products)	✓
Supported SNMP-Variables CCPU, PRE, PE	✓
SNMPv3 “Security Level”	
authPriv (Communication with authentication and encryption)	✓
SNMPv3 - USM “auth Protocol” (Protocol for authentication "User name, Password")	
MD5 (Message Digest Algorithm 5)	✓
SHA, SHA1, SHA2 (Secure Hash Algorithm)	✓

429 available from SNMPv2

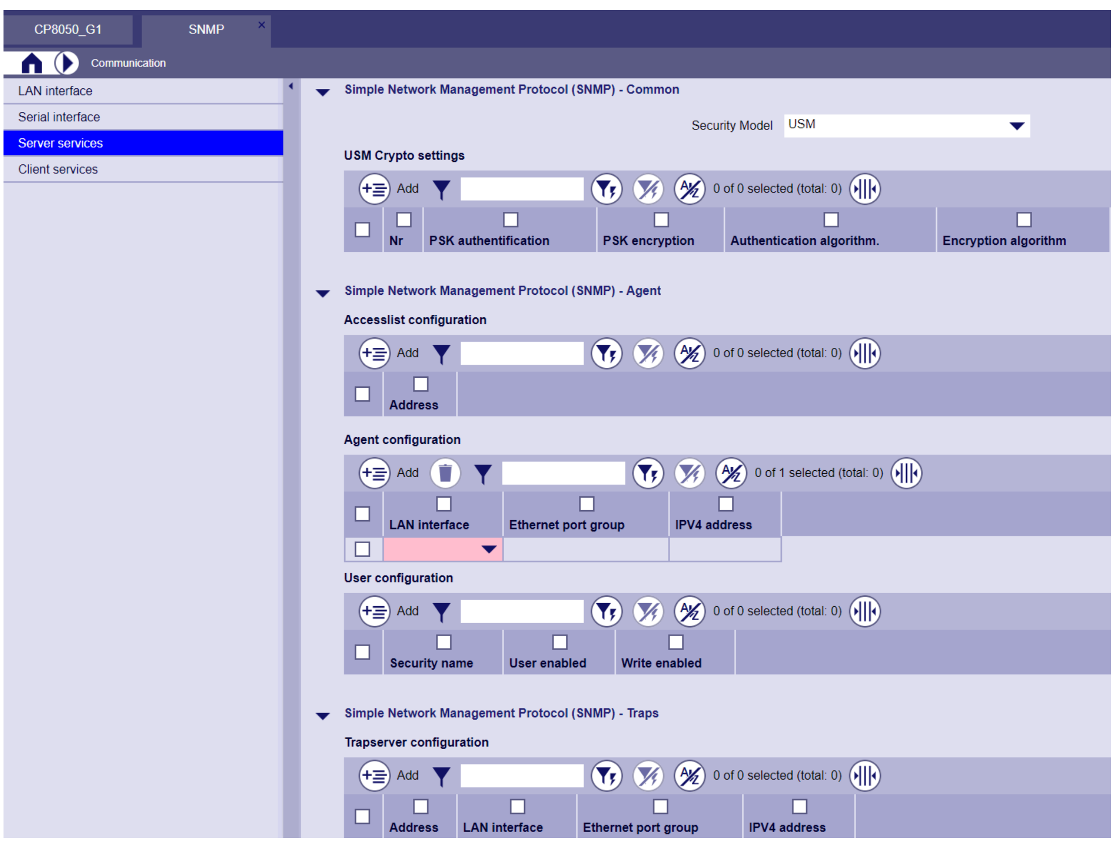
430 Traps are transmitted with Security Level = "authPriv" with username = "Trap" and the configured passwords for authentication and encryption

Function	SNMP
SNMPv3 - USM “Privacy Protocol” (Protocol for encryption)	
DES (Data Encryption Standard)	✓
AES (Advanced Encryption Standard)	✓
SNMPv3 - TSM "Certificate Signatur algorithmus"	
SHA1	✓
SHA256	✓
Security: Encrypted storage of passwords	
Security: Encrypted storage of passwords	✓

13.26.3 Configuration with SICAM Device Manager

General settings for USM and TSM

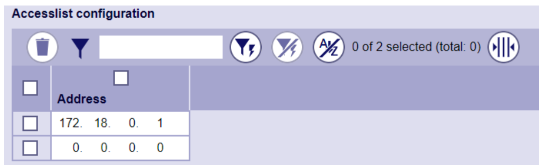
The pages for configuration can be found under **HOME | Communication | Server services | Simple Network Management Protocol (SNMP) - Common**



[sc_Selection, 1, en_US]

- User configuration:
  - A maximum of 4 users is possible
  - A user is only active if the parameter **User enabled** is set to **yes**.
  - If the parameter **Write enabled** is set to **yes**, the user can also execute "SET" commands.

- Trap configuration:
  - A maximum of 5 users is possible
  - Trap only becomes active when a server is defined
  - To delete a trap server, you have to delete it from the **Trap server configuration**.
- The firewall does not have to be configured, it is done automatically.
- If necessary, complete the **Access list configuration**.

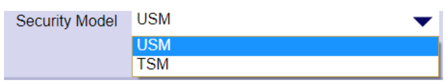


[sc_Accesslist, 1, en_US]

A maximum of 2 addresses can be added, if more than 2 addresses are needed, they can be released via the firewall.
If the access list is empty, anyone can make an SNMP request.
If there is an entry, SNMP requests can only be made from the IP addresses on this list.

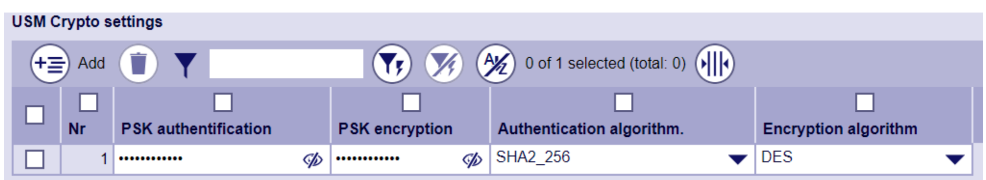
USM configuration

- In the **Simple Network Management Protocol (SNMP) – Common** area, select the security model **USM**



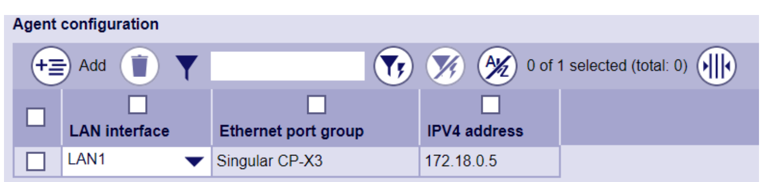
[sc_SecurityModel, 1, en_US]

- In the **USM Crypto settings** area, add new crypto settings and define them.



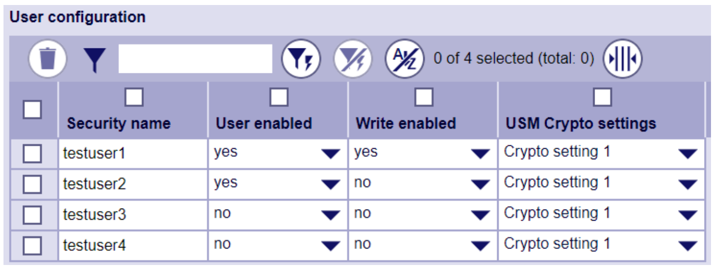
[sc_AddCrypto, 1, en_US]

- Select the desired LAN interface under **SNMP Agent Configuration**.



[sc_AgentConfig, 1, en_US]

- Add the user(s) under **User Configuration**. A maximum of 4 users can be configured.
  In the **User enabled** column, you can enable or disable the user.
  In the figure below, only the users **testuser1** and **testuser2** can send requests.
  In the **Writing enabled** column, you define whether the user has read access (GET) as well as write access (SET).
  In the following picture, user **testuser1** can select SET and GET, **testuser2** can only select GET crypto settings.



User configuration

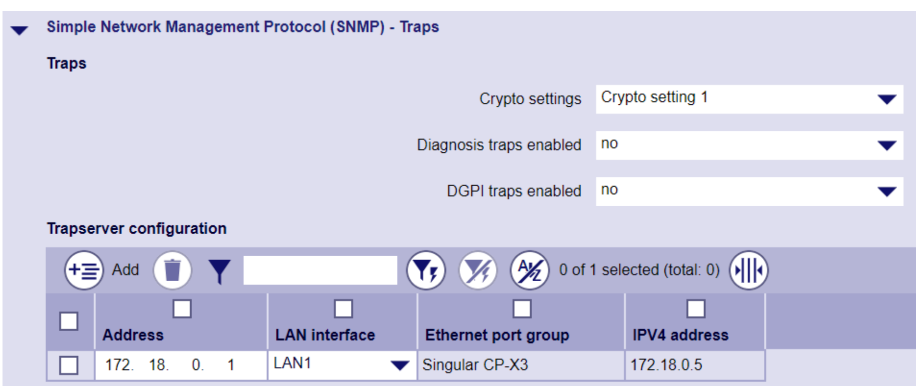
0 of 4 selected (total: 0)

	Security name	User enabled	Write enabled	USM Crypto settings
☐	testuser1	yes	yes	Crypto setting 1
☐	testuser2	yes	no	Crypto setting 1
☐	testuser3	no	no	Crypto setting 1
☐	testuser4	no	no	Crypto setting 1

[sc_UserConfig, 1, en_US]

Traps

- To activate traps, you have to add a trap server in the **Simple Network Management Protocol (SNMP) – Traps** area. Maximum 5 users are possible
  Configure **LAN interface** and **Crypto settings**.



Simple Network Management Protocol (SNMP) - Traps

Traps

Crypto settings	Crypto setting 1
Diagnosis traps enabled	no
DGPI traps enabled	no

Trapserver configuration

Add

0 of 1 selected (total: 0)

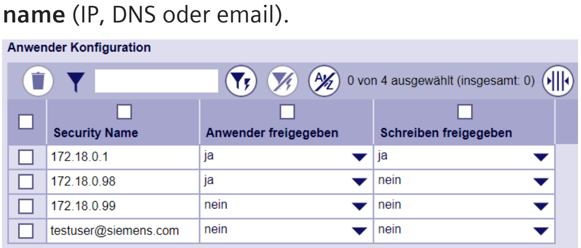
	Address	LAN interface	Ethernet port group	IPV4 address
☐	172. 18. 0. 1	LAN1	Singular CP-X3	172.18.0.5

[sc_Traps, 1, en_US]

TSM configuration

NOTE

The SAN (Subject Alternative Name) from the certificate of the remote station must be set as **Security name** (IP, DNS oder email).



Anwender Konfiguration

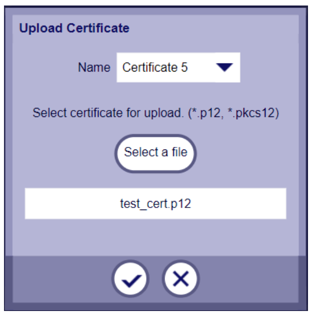
0 von 4 ausgewählt (insgesamt: 0)

	Security Name	Anwender freigegeben	Schreiben freigegeben
☐	172.18.0.1	ja	ja
☐	172.18.0.98	ja	nein
☐	172.18.0.99	nein	nein
☐	testuser@siemens.com	nein	nein

- In the **Simple Network Management Protocol (SNMP) – Common** area, select the security model **TSM**

[sc_ChooseCerts, 1, en_US]

- Import in SICAM WEB under **HOME | Certificates | Certificates and Keys** the local certificate.



[sc_localCert, 1, en_US]

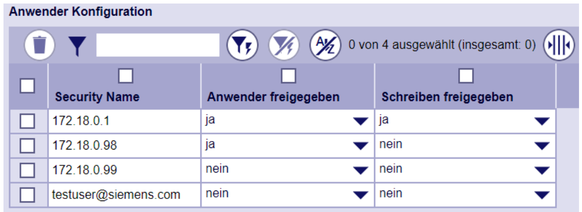
- Import in SICAM WEB under **HOME | Certificates | Certificates authorities** the CA certificate (Certification Authority).

[sc_CA, 1, en_US]

- Return to the SICAM Device Manager and select in the **Simple Network Management Protocol (SNMP) – Common** area, security model **TSM**
- Select the wanted **TSM Certificate** and **TSM Certificate Authority**.

[sc_ChooseCerts, 1, en_US]

- The **SNMP Agent Configuration** is identically with USM.
- **User Configuration**



[sc_userConfig TSM, 1, en_US]

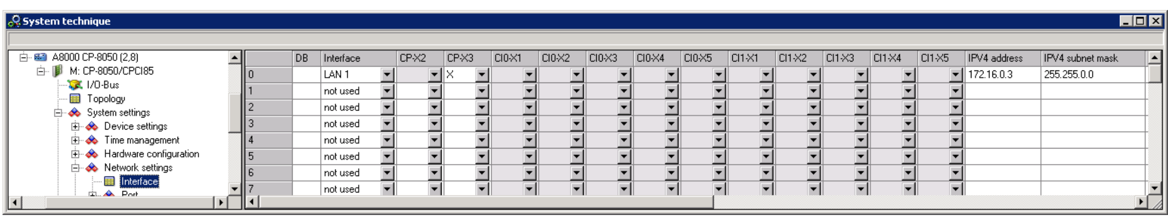
13.26.4 Configuration with the SICAM TOOLBOX II

NOTE

SICAM TOOLBOX II supports only the configuration of USM (User-based Security Model). Use the SICAM Device Manager for the configuration of TSM (Transport Security Model).

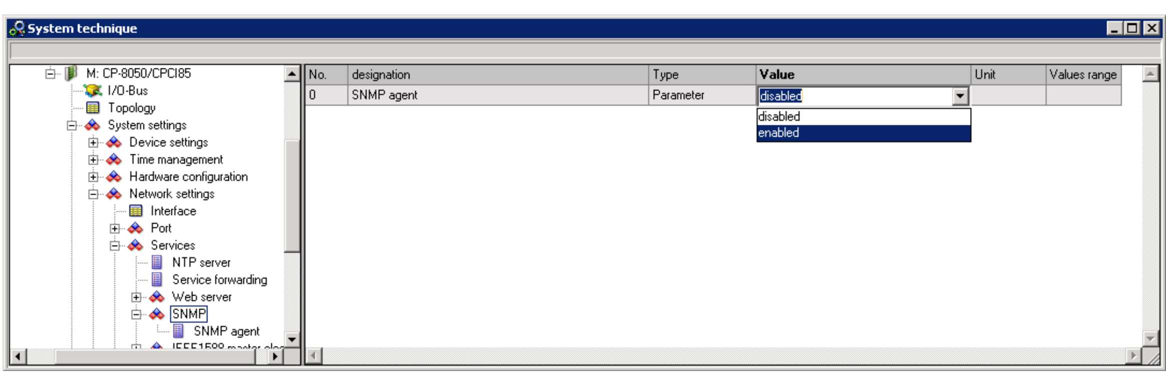
Configuration of an interface for SNMP

The selection and configuration of the interface on which the SNMP Manager is connected, takes place under **`[BSE] System settings | Network settings | Interface`**. Choose a LAN interface (e.g. LAN 1) under **`Interface`**, choose the hardware interface on which the SNMP Manager will be connected (e.g. CP-X3) and enter IP address and subnet mask of this interface.



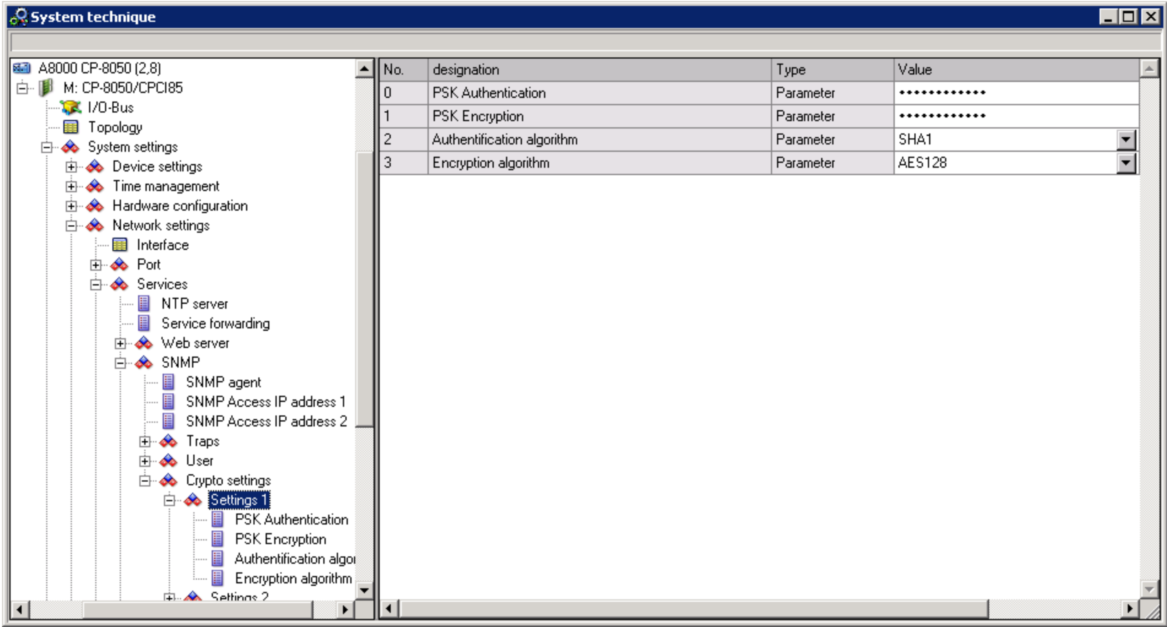
Enable SNMP

SNMP is enabled for the system under **`[BSE] System settings | Network settings | Services | SNMP | SNMP Agent`** . Afterwards enter the IP address of the PC/Laptop with the SNMP Manager under **`SNMP Access IP address 1`**.



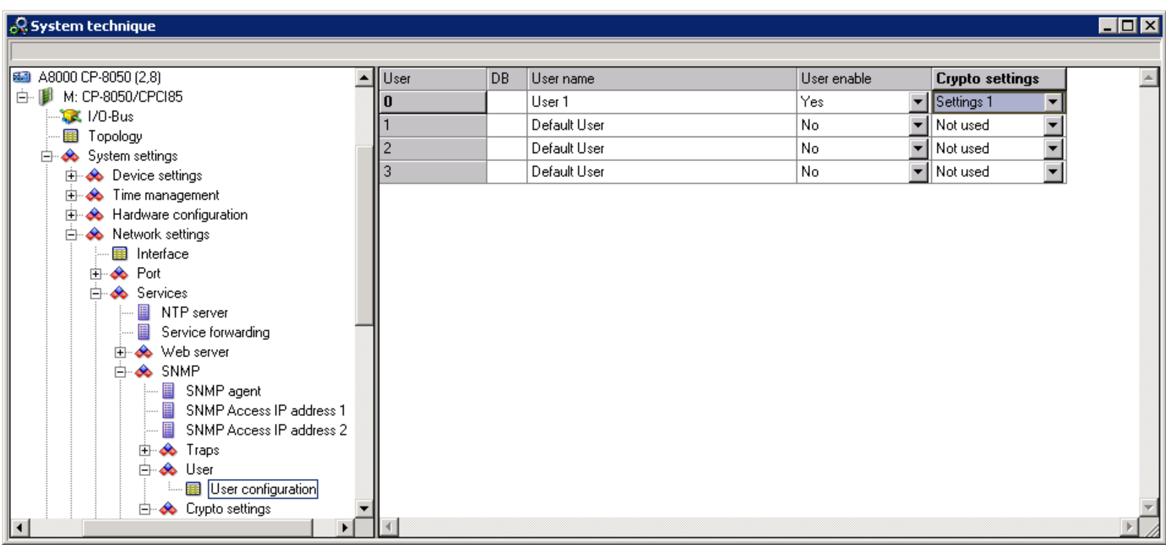
Crypto settings for SNMP V3 User

In CP-8050 4 SNMP users are available to which different crypto settings can be assigned. These settings can be made under **`[BSE] System settings | Network settings | Services | SNMP | Crypto settings`**.



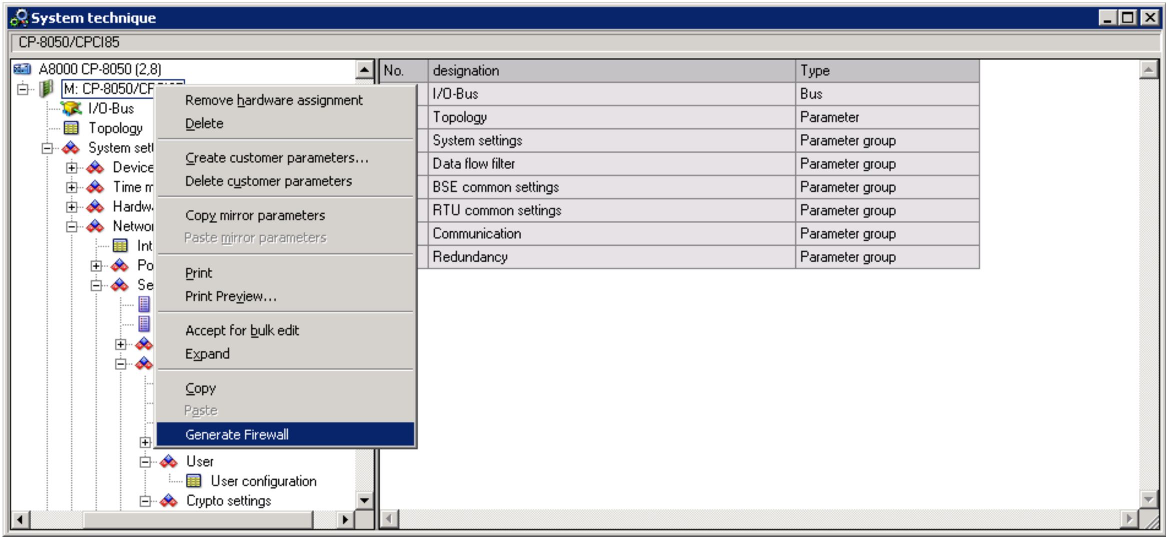
Configuration of a SNMP V3 User

The configuration of a SNMP V3 users is made under **`[BSE] System settings | Network settings | Services | SNMP | User | User configuration`**. Specify a name, assign a crypto setting to this user name and release it.

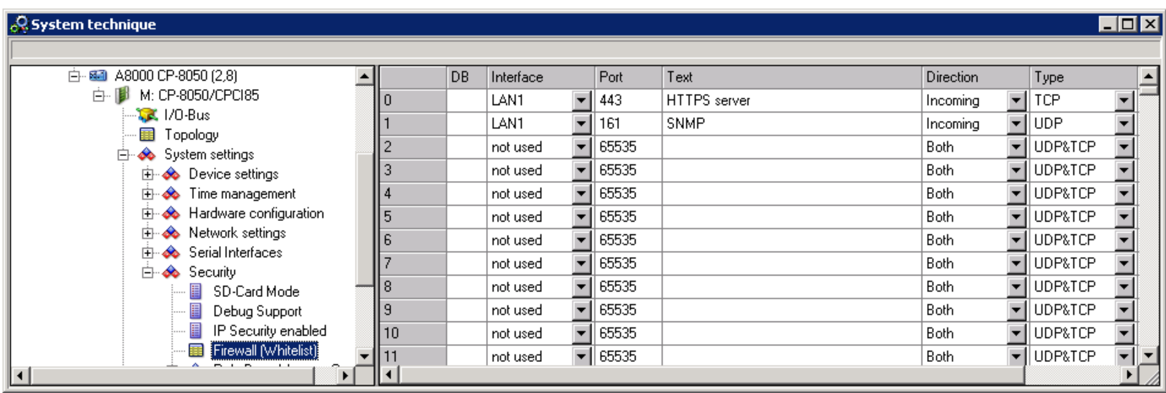


Generate and display firewall

Choose in OPM the system element (M:CP-8050/CPCI85), open the popup menu and click on **Generate Firewall**.



Open the firewall under **`[BSE] System settings | Security | Firewall (Whitelist)`**. Check if Port 161; SNMP is set.

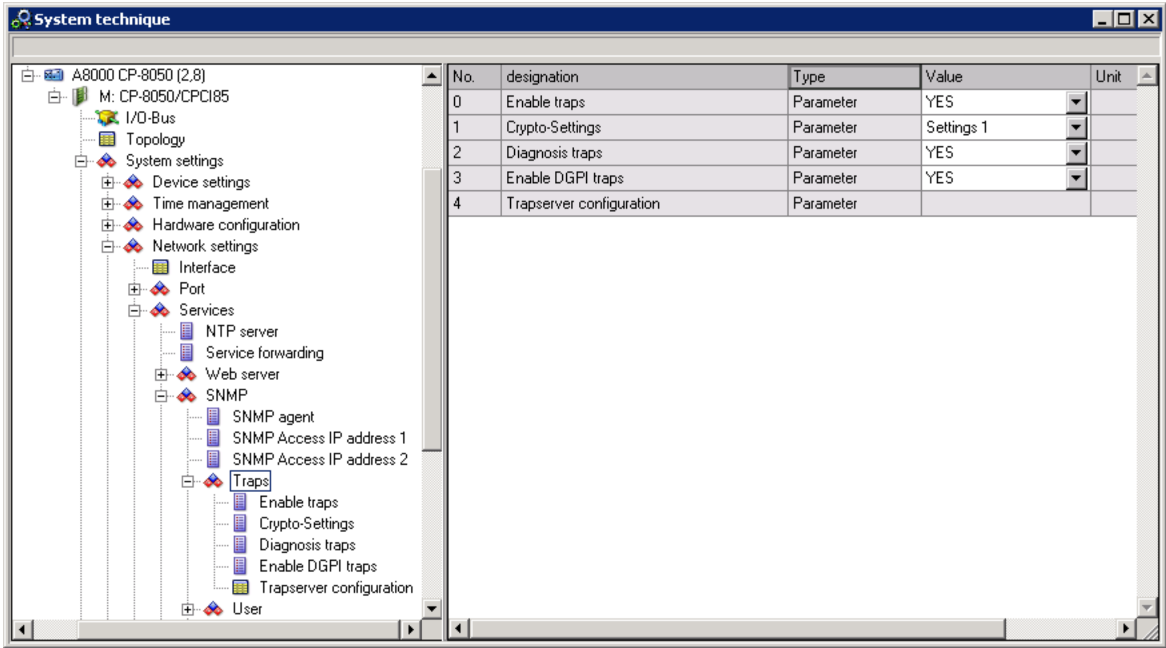


Load changes to the target system

Now you can load the SNMP configuration into the target system (**Target system | SICAM 1703 | Load parameter**). After a Restart the SNMP-Manager can communicate via SNMP with CP-8050.

Enable SNMP traps

To use the Trap function you have to enable the desired traps under **`[BSE] System settings | Network settings | Services | SNMP | Traps`**.

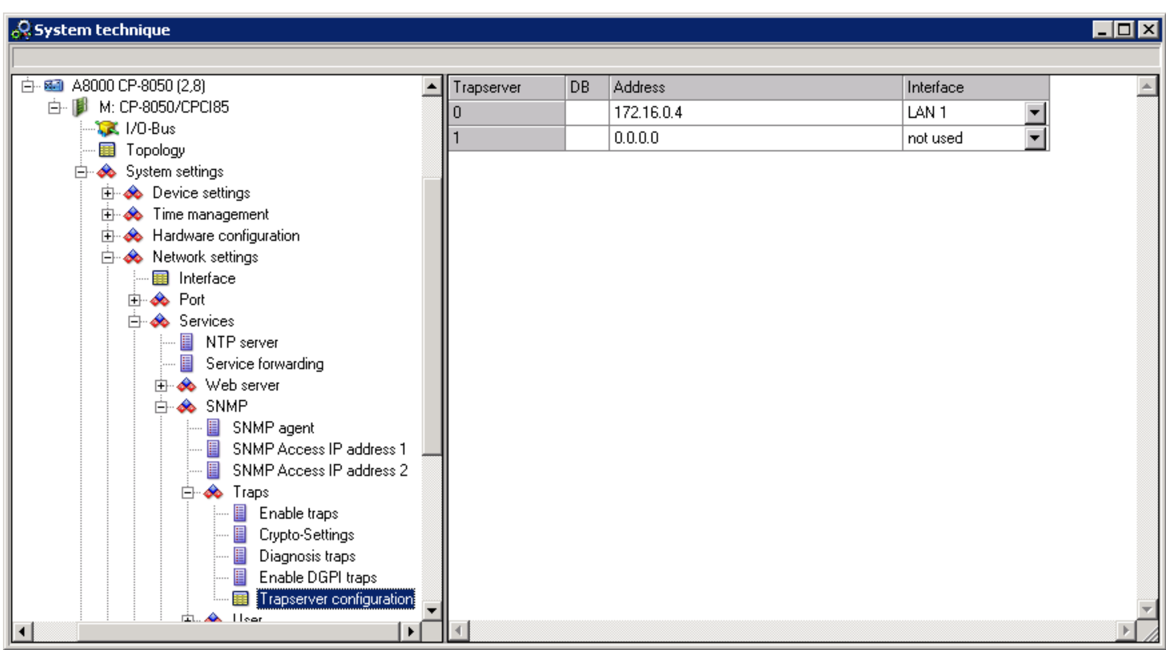


NOTE

In the SNMP Manager, the user must be configured with the user name "Trap" and the passwords of the Traps/Crypto settings.

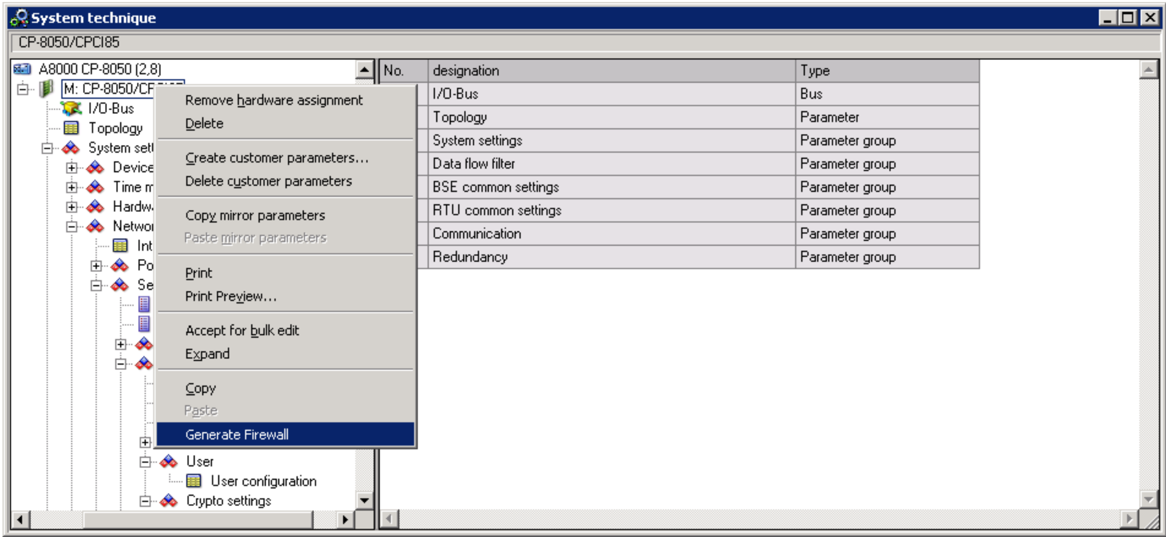
Configure SNMP traps

The IP address and interface to which the traps shall be sent (e.g. PC with SNMP Manager) must be set under **`[BSE] System settings | Network settings | Services | SNMP | Traps | Trapserver configuration`**.

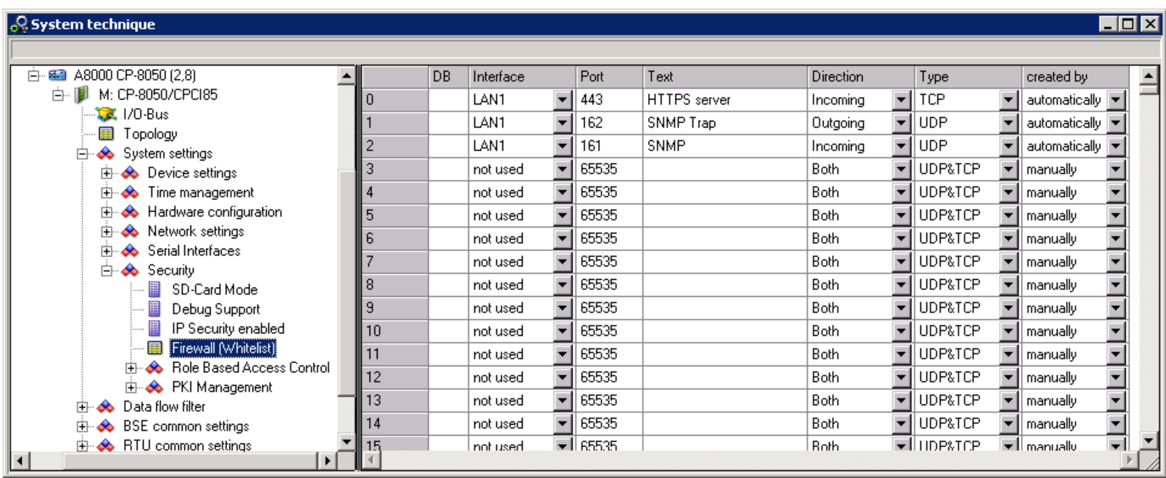


Generate and display firewall for traps

Choose in OPM the system element (M:CP-8050/CPCI85), open the popup menu and click on **Generate Firewall**.



Open the firewall under **`[BSE] System settings | Security | Firewall (Whitelist)`**. Check if Port 162; SNMP Trap is set.



NOTE

From then on the traps will be sent spontaneously from CP-8050 to the SNMP manager.

TRAP-History

For selected SNMP traps, a limited number of changes can be read out via the SNMP variable "TRAP history". The 50 most recently sent traps are entered in an SNMP table and can be read out with GET/GETBULK GETNEXT (see SNMP Variables).

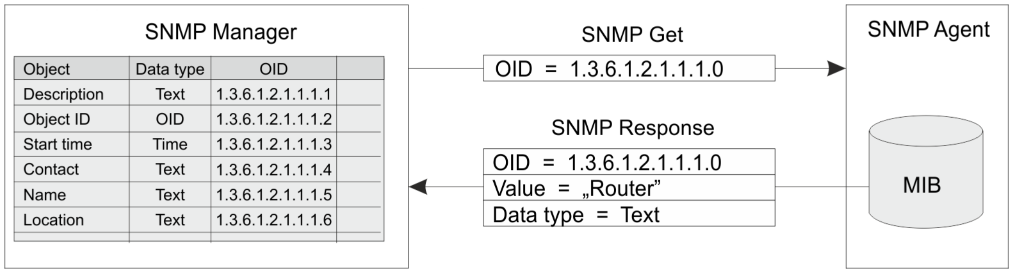
NOTE

The TRAP history is deleted on reset or restart!

13.26.5 SNMP MIBs – Management Information Base

A MIB (Management Information Base) describes the information which can be retrieved or modified via a network management protocol (for instance SNMP). These information items are named “Managed Objects”.

These are description files, in which the single values are listed in table form. A MIB is specific for each component.



13.26.5.1 Download of the MIB-Files

The MIB files can be downloaded from the SIOS Portal (Siemens Industry Online Support) *https://support.industry.siemens.com* :

- Search for **SICAM RTUS MIB** in the SIOS Portal
- Click in the list of results on **SICAM RTUs SNMP MIB File** (Download)
  After the download you get the file **SICAMRTUs_SNMP_MIB_V06.00.00.zip**.
- Save this file to the computer where the MIB Browser is installed (for example, **C:/Siemens**) and unpack the MIB files.

13.26.5.2 Import the MIB files in the MIB Browser

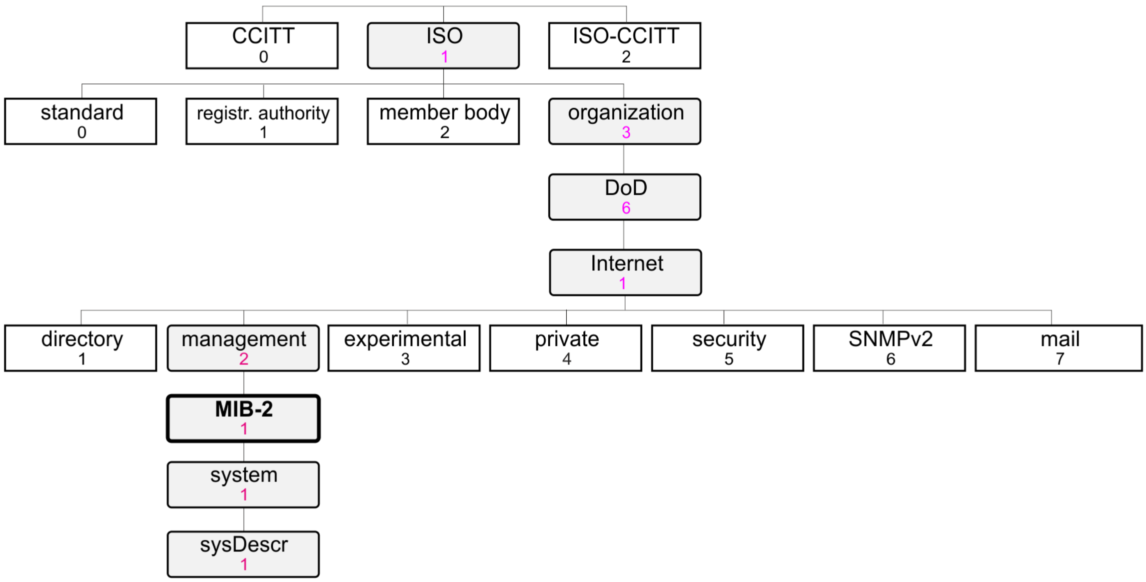
The import of the MIB files into your MIB browser must be done in the following sequence:

- Import of **SIEMENS-SMI.mib**
- Import of **sicamRTUs.mib**
- Import of **digitalGridProductInventory.mib**
- Import of **digitalGridSecurityMonitoring.mib**
- Import of **emergencyUser.mib**
- Import of **RFC1213-MIB.mib** (optional)
- Import of **RFC3635_mib.mib** (Ethernet-MIB, optional)
- Import of **RFC2790_mib.mib** (Host-Resources-MIB, optional)

Beside a standard MIB browsers you can load the MIB files also with the control center system SICAM SCC and 250 SCALA.

13.26.5.3 MIB: MIB-2 (RFC1213)

By means of this standard MIB, basic data of a SICAM A8000 system can be read out. The corresponding object ID is called:
Path: iso.org.dod.internet.management.MIB-2.system.sysDescr (1.3.6.1.2.1.1.1)

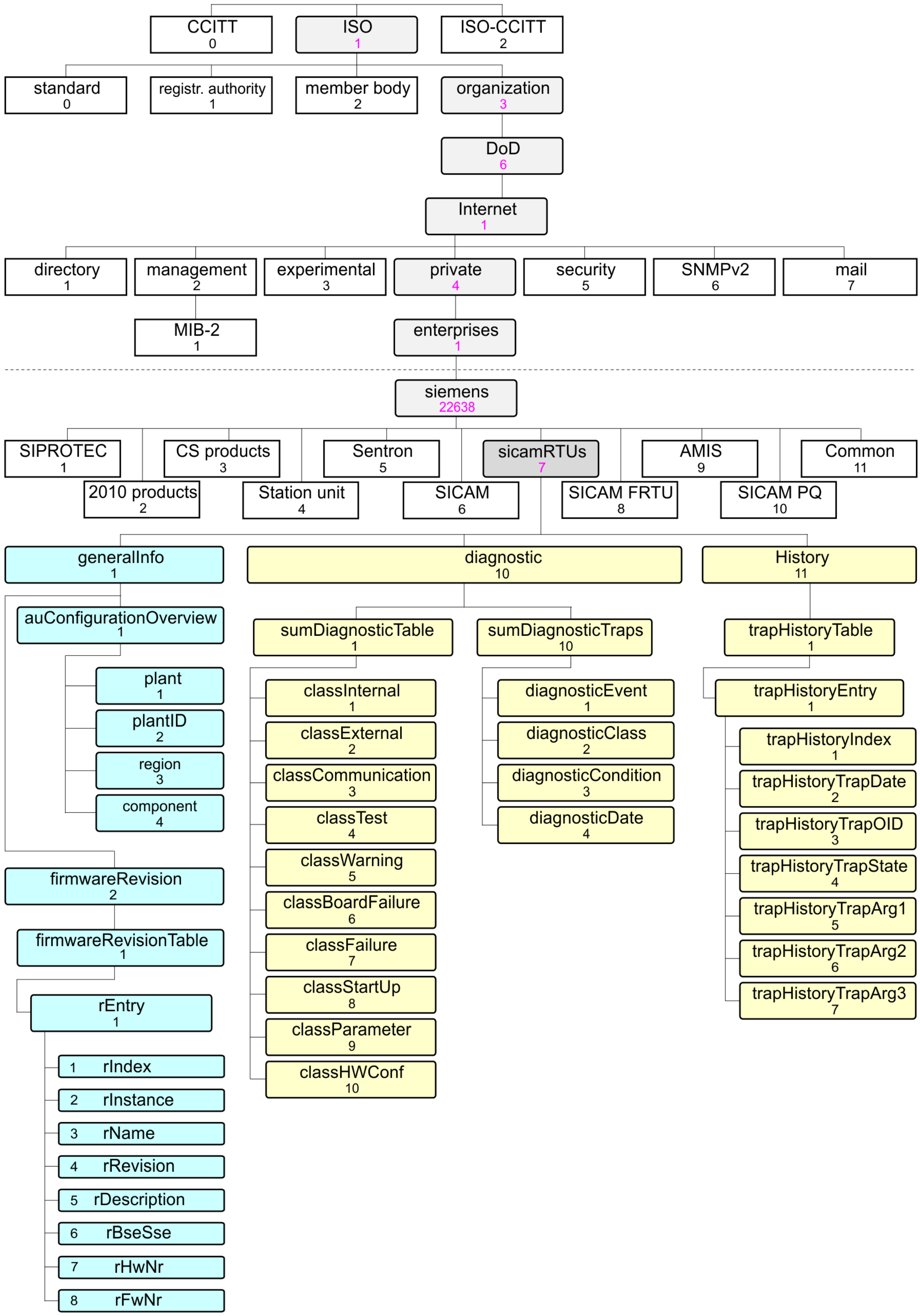


Following objects are in this Object ID:

Objects	Description / Example
Vendor	Siemens AG
ProductFamily	SICAM A8000
ProductName	CP-8050
OrderNumber	6MF28..... (MLFB number)
HwVersion	HW version of the device
FwVersion	FW version of the device(e.g.: FW: 01.PB)
SwVersion	SW version of the device
ProductSerialNumber	Serial number of the device(e.g.: SN: GC8-050--_88_BF1702....)

13.26.5.4 sicamRTUs

Path: iso.org.dod.internet.private.enterprises.siemens.sicamRTUs (1.3.6.1.4.1.22638.7)

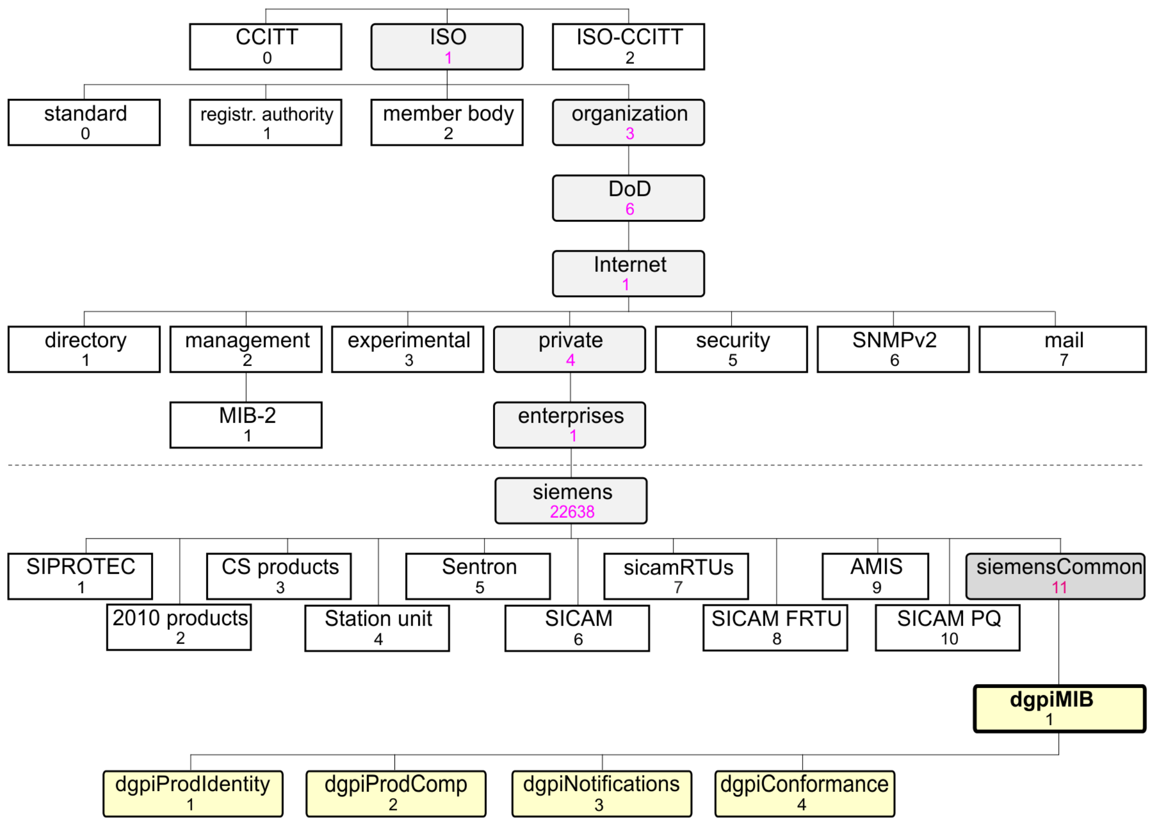


13.26.5.5 MIB: dgpiMIB

(**D**igital **G**rid **P**roduct **I**nventory)

This private MIB implements the “Enterprise Asset Management (EAM)” domain model for all products of EM DG PRO.

Path: iso.org.dod.internet.private.enterprises.siemens.siemensCommon.dgpiMIB (1.3.6.1.4.1.22638.11.1)



Object group 1: dgpiProdIdentity

This collection contains the supplier name (“Siemens AG”) and some customer-related information at product level, such as asset UUID (inventory number), customer name, product location and geo position. These customer-related objects can only be read via SNMP. That is, they must be configured by the customer in other ways (e.g., product-specific engineering tool, Web UI, etc.)

With the SICAM TOOLBOX II, this data can be entered with the following parameter: **`[BSE] System settings | Device settings`**

Sub-Object group	Objects	Description
-	dgpiVendorName	Siemens AG
	dgpiAssetUuid	
	dgpiCustomerName	
	dgpiLocationName	
	dgpiGeoPositionLatitude	
	dgpiGeoPositionLongi-tude	
	dgpiGeoPositionAltitude	

Object group 2: dgpiProdComp

This collection contains the product & component table (*`dgpiProductComponentsTable`*), which is the most important object of the MIB. The product and its components are represented by lines in this table. The first line is always occupied by the product, the following lines by the components. The order of the components in the rows of this table is not mandatory.

Sub-Object group	Objects	Description
dgpiProductComponent-sTable	dgpiProdCompIndex	Index of the table line
	dgpiProdCompContai-nedIn	Identifies the containment hierarchy of the product and its components. It's zero in the product line because the product is at the top of the hierarchy. In the component rows, it corresponds to the value of the object *dgpiProdCompIndex* of the product line (if the component is directly from the product) or its "parent" component row (if the component is contained in a "parent" component).
	dgpiProdCompClass	identifies the class of the product or component of this line e.g.: hwProduct
	dgpiProdCompName	contains the name of the product or component e.g.: SICAM A8000 CP-8050
	dgpiProdCompDescrip-tion	contains a brief description of the product or component
	dgpiProdCompOrder-Number	contains the MLFB number of the product or component e.g.: 6MF28050AA00
	dgpiProdCompSerial-Number	contains the serial number of the product or component e.g.: BF1612034390
	dgpiProdCompVersion	contains the version number of the FW, HW, SW or the configuration
	dgpiProdCompHwSlot	contains the number or name of the slot where the hard-ware component is located
	dgpiProdCompManu-factDate	contains the date of manufacture of the HW product or component
	dgpiProdCompConfi-gLastChange	contains the last modification date and the last modifica-tion time of the updatable component
-	dgpiProductCompTable-LastChange	contains the date and time of the last change of each *dgpiProductComponentsTable* object. The change includes creation, removal and modification of table rows. This is in contrast to the *dgpiProdCompLastChange* Change object, which refers to changing of rows, that represent certain component classes.

Object group 3: dgpiNotifications

This group defines a notification (SNMPv2 trap, SNMPv3 indication). This notification can be enabled/disabled in the Sicam Device Manager with the parameter **Communication | Server Services | Simple Network Management Protocol (SNMP) - Traps | DGPI traps enabled**.

Sub-Object group	Objects	Description
-	dgpiNotificationsEna-bled	enables/disables the sending of this notification
	dgpiNotificationProd-CompChanged	

Object group 4: dgpiConformance

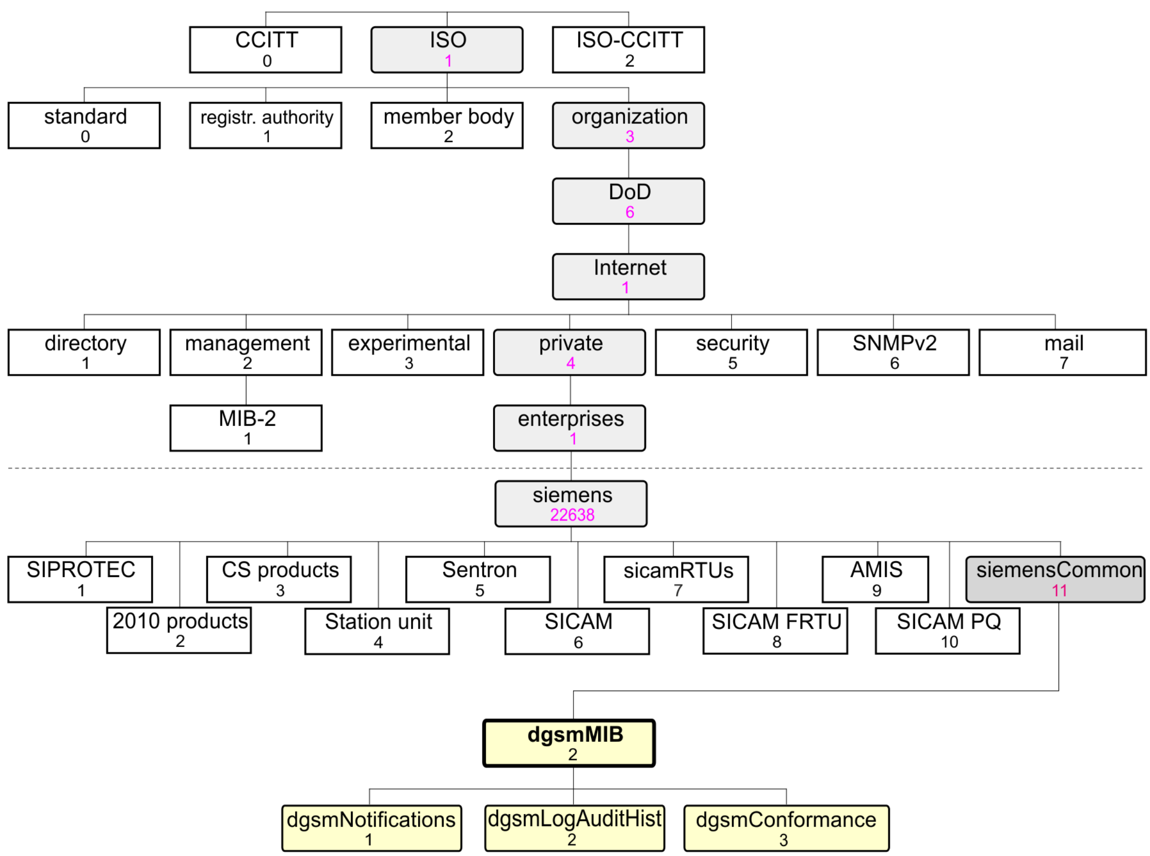
This group contains compliance instructions. It defines that the implementation of the product identity and product & component group objects is mandatory. The implementation of the objects of the notification group is optional. The latter takes into account that not all SNMP agent implementations are prepared for sending SNMP traps or indications.

Sub-Object group	Objects	Description
dgpiCompliances	dgpiCompliances	
dgpiGroups	dgpiProductIdentityGroup	
	dgpiProdCompGroup	
	dgpiNotifObjectsGroup	
	dgpiNotifNotificationsGroup	

13.26.5.6 MIB: dgsmMIB

(**D**igital **G**rid **S**ecurity **M**onitoring)

Path: iso.org.dod.internet.private.enterprises.siemens.siemensCommon.dgsmMIB (1.3.6.1.4.1.22638.11.2)



[dw_SNMP_MIB_Structure_dgsmMIB, 1, --_--]

Object group 1: dgsmNotifications

This group defines a notification (SNMPv2 trap, SNMPv3 indication). This notification can be enabled/disabled in the Sicam Device Manager with the parameter **Communication | Server Services | Simple Network Management Protocol (SNMP) - Traps | DGPI traps enabled**.

Sub-Object group	Objects	Description
-	dgsmNotificationsEnabled	enables/disables the sending of this notification
	dgsmLogAuditNotification	

Object group 2: dgsmLogAuditHist

This collection contains the product and component table (dgsmLogAuditHistTable), which is the most important object of the MIB. The product and its components are represented by lines in this table. The first line is always filled with the product, the following lines with the components. The order of the components in the rows of this table is not mandatory.

Sub-Object group	Objects	Description
dgsmLogAuditHistTable	dgsmLogAudit	Index of the table line
	dgsmLogAuditNotifSeverity	sets the severity of the logaudit notification. The enumeration contains two values: alert(1), warning(4)
	dgsmLogAuditNotifVersion	contains the version information of the logaudit notification
	dgsmLogAuditNotifTimeStamp	contains the date and time when the logaudit notification was initiated
	dgsmLogAuditNotifHostName	contains the name of the host that issued the logaudit notification
	dgsmLogAuditNotifAppName	contains the name of the application that issued the logaudit message
	dgsmLogAuditNotifMsgId	contains the message identifier of the logaudit notification
	dgsmLogAuditNotifMessage	contains the message body of the logaudit notification
	dgsmLogAuditNumEntries	contains the number of entries (rows) of the dgsmLogAuditHistTable
	dgsmLogAuditEldestEntry	contains the index to the entry of the dgsmLogAuditHistTable that stores the oldest LogAudit notification
	dgsmLogAuditLatestEntry	contains the index to the entry of the dgsmLogAuditHistTable in which the latest LogAudit notification is stored

Object group 3: dgsmConformance

This group contains compliance instructions. It defines that the implementation of the product identity and product & component group objects is mandatory. The implementation of the objects of the notification group is optional. The latter takes into account that not all SNMP agent implementations are prepared for sending SNMP traps or indications.

Sub-Object group	Objects	Description
dgsmCompliances	dgsmCompliances	
dgsmGroups	dgsmProductIdentityGroup	
	dgsmProdCompGroup	
	dgsmNotifObjectsGroup	
	dgsmNotifNotificationsGroup	

13.26.6 SNMP Variables

13.26.6.1 Introduction

The current state of the supported SNMP variables can be read out by the SNMP manager with the SNMP services GET / GETNEXT / GETBULK. CP-8050 supports the query of SNMP variables from different SNMP managers with different IP addresses. The SNMP response is sent back to the SNMP manager from which the SNMP request (GET / GETNEXT / GETBULK) was received.

SNMP variables of the following MIB files are supported:

- MIB-2 (RFC1213)
- sicamRTUs
- Ethernet-MIB (RFC3635)
- Host-Resources-MIB (RFC2790)
- USM-MIB (RFC2574)
- VACM-MIB (RFC2575)
- DGPI-MIB (Siemens Energy Management Digital Grid Product Inventory MIB)

13.26.6.2 SNMP Variables for MIB: sicamRTUs

General Information

<sicamRTUs.MIB> SNMP address object identifier (OID)	Object description	Data type	GET / Response	GET NEXT / Response	GETBULK / Response	TRAP
1.3.6.1.4.1.22638.7.1	**SICAM RTUs – General Information**			✓	✓	
1.3.6.1.4.1.22638.7.1.1	**SICAM RTUs – General Information - device-specific**			✓	✓	
1.3.6.1.4.1.22638.7.1.1.1	Plant name [431]	Text	✓	✓		
1.3.6.1.4.1.22638.7.1.1.2	Plant ID	Text	✓	✓		
1.3.6.1.4.1.22638.7.1.1.3	System-technical region number	Integer	✓	✓		
1.3.6.1.4.1.22638.7.1.1.4	System-technical component number	Integer	✓	✓		
1.3.6.1.4.1.22638.7.1.2	**SICAM RTUs – Firmware revision**			✓	✓	
1.3.6.1.4.1.22638.7.1.2.1.1.2	Firmware instance	Text	✓	✓		
1.3.6.1.4.1.22638.7.1.2.1.1.3	System element name	Text	✓	✓		
1.3.6.1.4.1.22638.7.1.2.1.1.4	Firmware-Revision	Text	✓	✓		
1.3.6.1.4.1.22638.7.1.2.1.1.5	System element description	Text	✓	✓		
1.3.6.1.4.1.22638.7.1.2.1.1.6	System element address	Text	✓	✓		
1.3.6.1.4.1.22638.7.1.2.1.1.7	Hardware number	Text	✓	✓		
1.3.6.1.4.1.22638.7.1.2.1.1.8	Firmware number	Text	✓	✓		
1.3.6.1.4.1.22638.7.10	**SICAM RTUs – diagnostic information**			✓	✓	
1.3.6.1.4.1.22638.7.10.1	**SICAM RTUs – diagnostic information – central error table**			✓	✓	
1.3.6.1.4.1.22638.7.10.1.1	Sum diagnosis table | Fault 1 “Class internal”	Text	✓	✓		
1.3.6.1.4.1.22638.7.10.1.2	Sum diagnosis table | Fault 2 “Class external”	Text	✓	✓		
1.3.6.1.4.1.22638.7.10.1.3	Sum diagnosis table | Fault 3 “Class communication”	Text	✓	✓		
1.3.6.1.4.1.22638.7.10.1.4	Sum diagnosis table | Fault 4 “Class test”	Text	✓	✓		
1.3.6.1.4.1.22638.7.10.1.5	Sum diagnosis table | Fault 5 “Class warning”	Text	✓	✓		
1.3.6.1.4.1.22638.7.10.1.6	Sum diagnosis table | Fault 6 “Class module failure”	Text	✓	✓		
1.3.6.1.4.1.22638.7.10.1.7	Sum diagnosis table | Fault 7 “Class failure”	Text	✓	✓		
1.3.6.1.4.1.22638.7.10.1.8	Sum diagnosis table | Fault 8 “Class startup”	Text	✓	✓		
1.3.6.1.4.1.22638.7.10.1.9	Sum diagnosis table | Fault 9 “Class parameter”	Text	✓	✓		

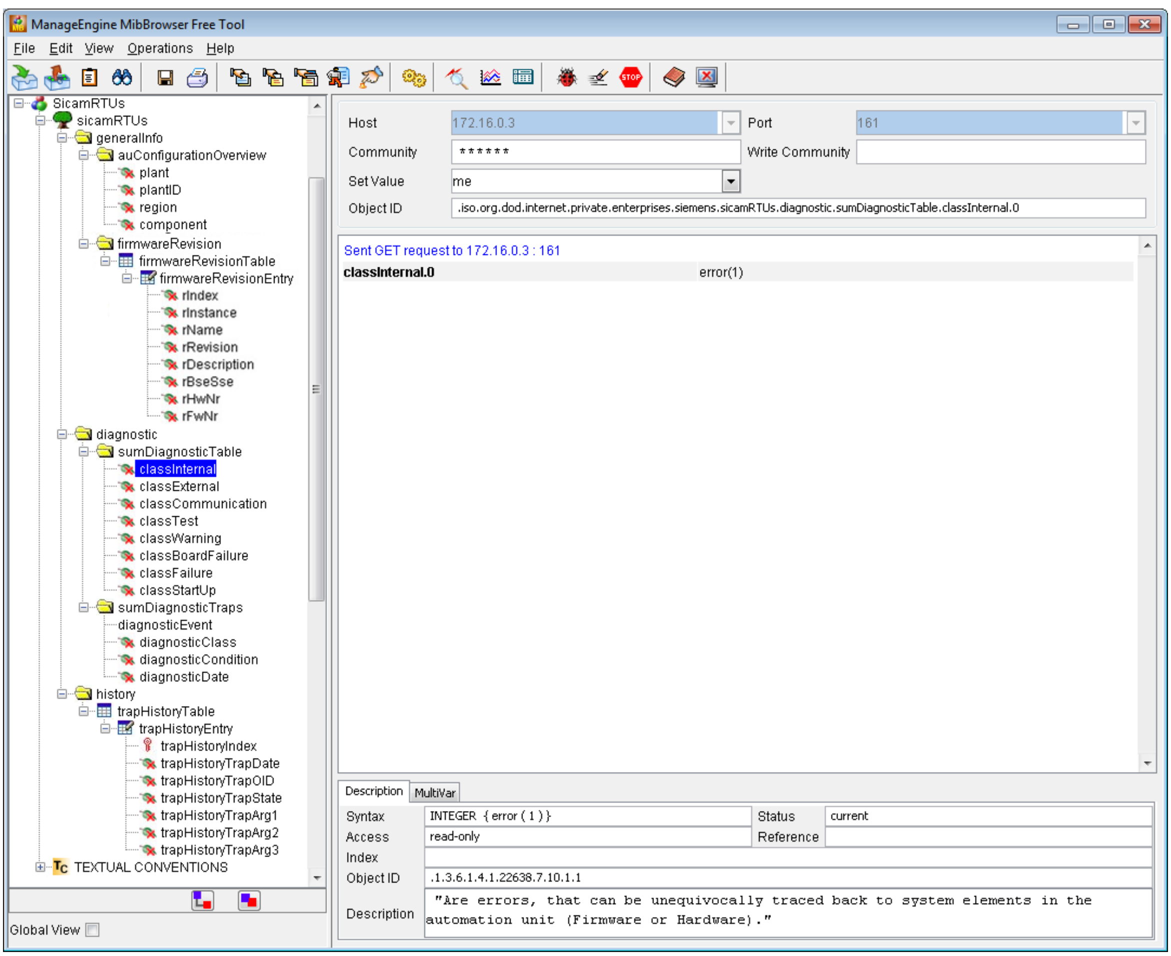
[431] The shown value equals the parameter on M: AU common settings | Plant.

<sicamRTUs.MIB> SNMP address object identifier (OID)	Object description	Data type	GET / Response	GET NEXT / Response	GETBULK / Response	TRAP
1.3.6.1.4.1.22638.7.10.1.10	Sum diagnosis table | Fault 10 “Class configuration”	Text	✓	✓		
1.3.6.1.4.1.22638.7.11	**SICAM RTUs – History**		✓	✓		
1.3.6.1.4.1.22638.7.11.1	SICAM RTUs – History – TRAP-History				✓	

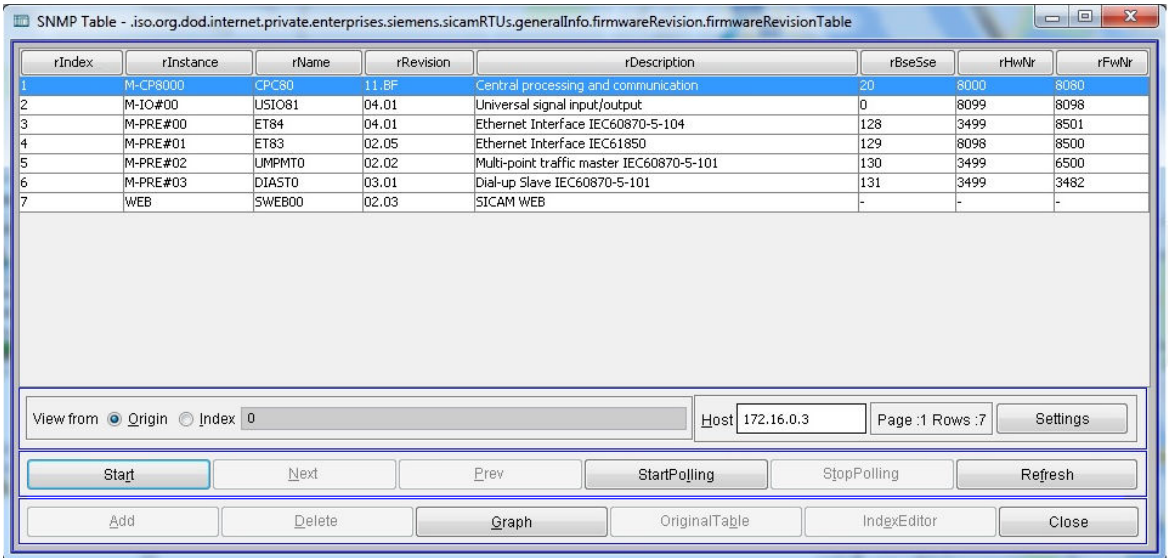
NOTE

All SNMP variables of the sicamRTUs.MIB can only be read via SNMP but not changed. SNMP variables can not be read or changed with the SICAM TOOLBOX II. The central error table in SICAM RTUs is referred to as the sum diagnostic table.

Example: SNMP GET for OID: 1.3.6.1.4.1.22638.7.10.1.1 Sum diagnosis table | Fault 1 „Class internal“



Example for firmware revision interrogation table (retrieved with ManageEngine MIB browser):



rIndex	rInstance	rName	rRevision	rDescription	rBseSse	rHwNr	rFwNr
1	M-CP8000	CPC80	11.BF	Central processing and communication	20	8000	8080
2	M-IO#00	USIO81	04.01	Universal signal input/output	0	8099	8098
3	M-PRE#00	ET84	04.01	Ethernet Interface IEC60870-5-104	128	3499	8501
4	M-PRE#01	ET83	02.05	Ethernet Interface IEC61850	129	8098	8500
5	M-PRE#02	UMPMT0	02.02	Multi-point traffic master IEC60870-5-101	130	3499	6500
6	M-PRE#03	DIAST0	03.01	Dial-up Slave IEC60870-5-101	131	3499	3482
7	WEB	SWEB00	02.03	SICAM WEB	-	-	-

Traps

The following diagnostic information are sent spontaneously as SNMP Traps to the SNMP Manager:

<sicamRTUs.MIB> SNMP address object identifier (OID)	Object description	Data type	GET / Response	GET NEXT / Response	GETBULK / Response	TRAP
1.3.6.1.4.1.22638.7.10.10	SICAM RTUs Traps (formerly sum diagnosis traps)					
1.3.6.1.4.1.22638.7.10.10.1	SICAM RTUs Event = Diagnostic Events					✓
1.3.6.1.4.1.22638.7.10.10.2	Diagnostics Error Group: Error 1 - 10 (These correspond to the error classes in the central error table, see above)	Integer				✓
1.3.6.1.4.1.22638.7.10.10.3	Diagnostic Condition: 0 = going, 1 = coming	Integer				✓
1.3.6.1.4.1.22638.7.10.10.4	Diagnostic Date: Time when the trap occurred	Date + Time				✓

NOTE

All SNMP variables of the sicamRTUs.MIB can only be read via SNMP but not changed.
SNMP variables can not be read or changed with the SICAM TOOLBOX II.

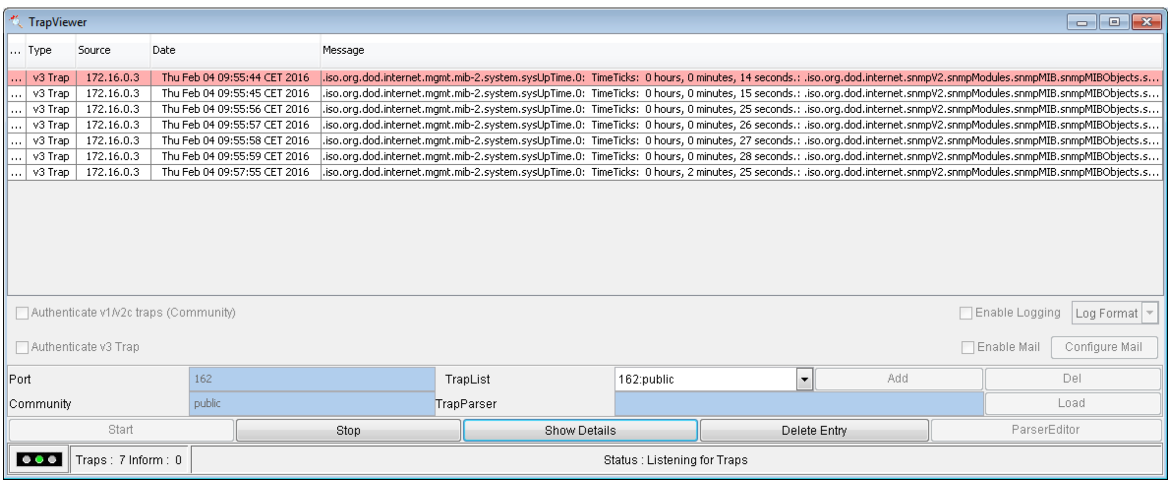
The following state information are sent spontaneously as SNMP Traps to the SNMP Manager:

<sicamRTUs.MIB> SNMP address object identifier (OID)	Object description	Data type	GET / Response	GET NEXT / Response	GETBULK / Response	TRAP
1.3.6.1.6.3.1.1.5.1	ColdStart trap					✓
1.3.6.1.6.3.1.1.5.3	linkDown trap					✓
1.3.6.1.6.3.1.1.5.4	linkUp trap					✓

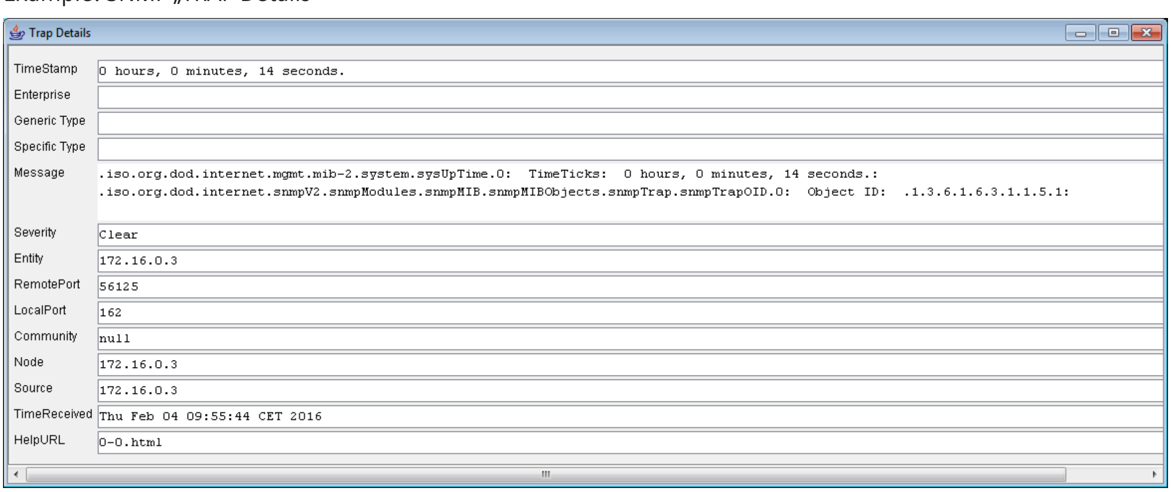
NOTE

All SNMP variables of the sicamRTUs.MIB can only be read via SNMP but not changed.
SNMP variables can not be read or changed with the SICAM TOOLBOX II.

Example: SNMP „TRAPs“



Example: SNMP „TRAP Details“



Traps History

The following status information "TRAP History" can be requested by the SNMP Manager:

<sicamRTUs.MIB> SNMP address object identifier (OID)	Object description	Data type	GET / Response	GET NEXT / Response	GETBULK / Response	TRAP
1.3.6.1.4.1.22638.7.11.1	SNMP table with the last 50 traps sent				✓	

NOTE

All SNMP variables of the sicamRTUs.MIB can only be read via SNMP but not changed.
SNMP variables can not be read or changed with the SICAM TOOLBOX II.

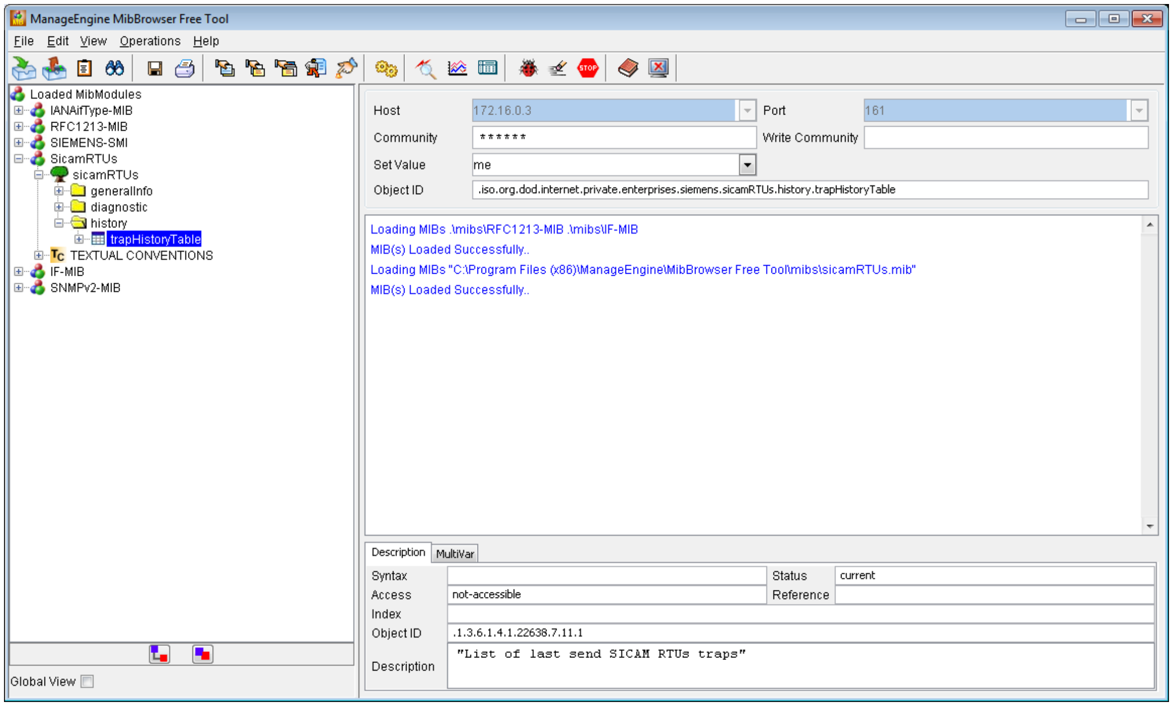
The following traps are entered in the TRAP history:

<sicamRTUs.MIB> SNMP address object identifier (OID)	Object description	Data type	GET / Response	GET NEXT / Response	GETBULK / Response	TRAP
1.3.6.1.6.3.1.1.5.1	ColdStart trap					✓
1.3.6.1.6.3.1.1.5.3	linkDown trap					✓
1.3.6.1.6.3.1.1.5.4	linkUp trap					✓
1.3.6.1.4.1.22638.7.10.1.1	Sum diagnosis table | Fault 1 “Class internal”					✓
1.3.6.1.4.1.22638.7.10.1.2	Sum diagnosis table | Fault 2 “Class external”					✓
1.3.6.1.4.1.22638.7.10.1.3	Sum diagnosis table | Fault 3 “Class communication”					✓
1.3.6.1.4.1.22638.7.10.1.4	Sum diagnosis table | Fault 4 “Class test”					✓
1.3.6.1.4.1.22638.7.10.1.5	Sum diagnosis table | Fault 5 “Class warning”					✓
1.3.6.1.4.1.22638.7.10.1.6	Sum diagnosis table | Fault 6 “Class module failure”					✓
1.3.6.1.4.1.22638.7.10.1.7	Sum diagnosis table | Fault 7 “Class failure”					✓
1.3.6.1.4.1.22638.7.10.1.8	Sum diagnosis table | Fault 8 “Class startup”					✓
1.3.6.1.4.1.22638.7.10.1.9	Sum diagnosis table | Fault 8 “Class parameter”					✓
1.3.6.1.4.1.22638.7.10.1.10	Sum diagnosis table | Fault 8 “Class configuration”					✓

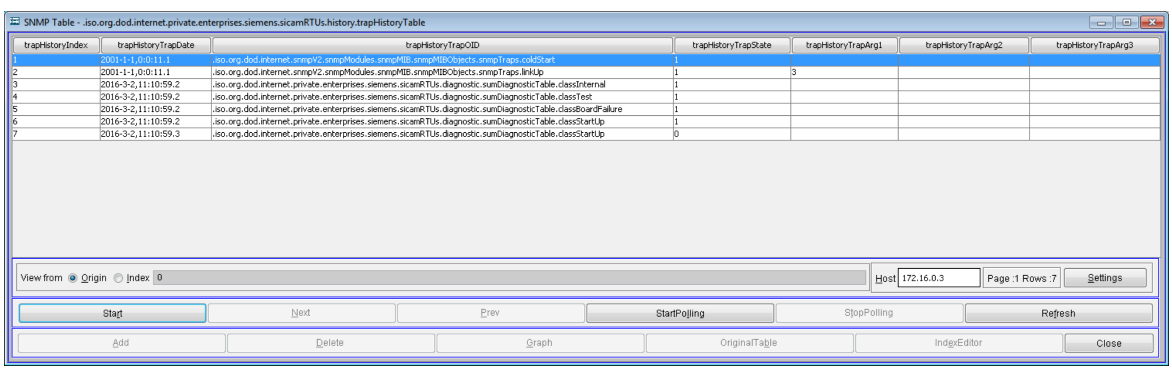
NOTE

All SNMP variables of the sicamRTUs.MIB can only be read via SNMP but not changed.
SNMP variables can not be read or changed with the SICAM TOOLBOX II.

Example: Interrogation of the SNMP "TRAP History"



Example: SNMP “TRAP History” table



13.26.6.3 SNMP variables for MIB: dgpiMIB

Object group 1: dgpiProdIdentity

This collection contains the supplier name (“Siemens AG”) and some customer-related information at product level, such as asset UUID (inventory number), customer name, product location and geo position. These customer-related objects can only be read via SNMP. That is, they must be configured by the customer in other ways (e.g., product-specific engineering tool, Web UI, etc.)

With the SICAM TOOLBOX II, this data can be entered with the following parameter:

Sub-Object group	Objects	Description / SICAM TOOLBOX II Parameter
-	dgpiVendorName	fix: "Siemens AG"
	dgpiAssetUuid	is generated by the device itself
	dgpiCustomerName	**[BSE] System settings | Device settings | Customer**
	dgpiLocationName	**[BSE] System settings | Device settings | Device name**
	dgpiGeoPositionLatitude	**[BSE] System settings | Device settings | Geographical position | Latidude**
	dgpiGeoPositionLongi-tude	**[BSE] System settings | Device settings | Geographical position | Longitude**
	dgpiGeoPositionAltitude	**[BSE] System settings | Device settings | Geographical position | Altitude**

Object group 2: dgpiProdComp

This collection contains the product & component table (*dgpiProductComponentsTable*), which is the most important object of the MIB. The product and its components are represented by lines in this table. The first line is always occupied by the product, the following lines by the components. The order of the components in the rows of this table is not mandatory.

Sub-Object group	Objects	Description
dgpiProductComponent-sTable	dgpiProdCompIndex	Index of the table line
	dgpiProdCompContai-nedIn	Identifies the containment hierarchy of the product and its components. It's zero in the product line because the product is at the top of the hierarchy. In the component rows, it corresponds to the value of the object *dgpiProdCompIndex* of the product line (if the component is directly from the product) or its "parent" component row (if the component is contained in a "parent" component).
	dgpiProdCompClass	identifies the class of the product or component of this line e.g.: hwProduct
	dgpiProdCompName	contains the name of the product or component e.g.: SICAM A8000 CP-8050
	dgpiProdCompDescrip-tion	contains a brief description of the product or component
	dgpiProdCompOrder-Number	contains the MLFB number of the product or component e.g.: 6MF28050AA00
	dgpiProdCompSerial-Number	contains the serial number of the product or component e.g.: BF1612034390
	dgpiProdCompVersion	contains the version number of the FW, HW, SW or the configuration
	dgpiProdCompHwSlot	contains the number or name of the slot where the hard-ware component is located
	dgpiProdCompManu-factDate	contains the date of manufacture of the HW product or component
	dgpiProdCompConfi-gLastChange	contains the last modification date and the last modifica-tion time of the updatable component
-	dgpiProductCompTable-LastChange	contains the date and time of the last change of each *dgpiProductComponentsTable* object. The change includes creation, removal and modification of table rows. This is in contrast to the *dgpiProdCompLastChange* Change object, which refers to changing of rows, that represent certain component classes.

Object group 3: dgpiNotifications

This group defines a notification (SNMPv2 trap) that will be sent when the *dgprProductComponentsTable* has changed.

Sub-Object group	Objects	Description
-	dgpiNotificationsEna-bled	enables/disables the sending of this notification

13.27 ARP

The "ARP" Address Resolution Protocol assigns a MAC address to a given IP address and stores this mapping in the ARP tables of the participating computers.

After Link Up (Start-up or connect cable), the basic system element transmits 3 time Gratuitous ARP messages in single second interval (ARP request broadcast) in which the own IP address is entered as the source and destination IP address. This means that the Ethernet interface notifies its current (possibly new) MAC address without being asked and the ARP / MAC tables in the connected network devices are updated immediately.

Also, HW issues in the network that lead to link up / link down can be detected by the increased occurrence of gratuitous ARPs.

14 Licenses

14.1 Introduction

The functionality of the systems can be expanded by installing the following licenses:

Designation	ALM License	Function Point Manager License
• SICAM 8 Extended Processing	6MF2750-2EP00	✓
• SICAM 8 IEC104 Firewall	6MF2750-2FW40	✓
• SICAM 8 Redundancy	6MF2750-2RE00	✓
• SICAM 8 SIAPP Container	6MF2750-2LX00	✓
• SICAM 8 Extended SICAM WEB	6MF2750-2WE00	✓
• SICAM 8 Licensed Protocol	6MF2750-2PR00	✓
• SICAM A8000 CP-803x Extended CI-Module	6MF2750-2EX00	✓
• SICAM A8000 - 852x Redbox	6MF2750-2RB00	✓
		For more licenses, see SICAM Function Point Manager.

Each license can only be used on one system.

Types of licenses:

- **ALM License**

  These licenses are ordered using order numbers. The delivery takes place via OSD download. Order information see section *A.2 SICAM License*

  License Management requires the Automation License Manager (ALM).

  The transfer of the licenses into the parameter set of a CP-8031/CP-8050 device takes place via the import function of your engineering tool (**SICAM Device Manager**from V3.01 or**SICAM TOOLBOX II**from 6.03)

  A replacement of spare parts is possible because the license is bound to the parameter set.

- **SICAM Function Point Manager License**

  SICAM Function Point Manager Licenses are generated with the *SICAM Function Point Manager*.

  The ordering process is described in the user manual**Function Point Manager**, section**SICAM License Files**.

  The licenses are transferred to the device using**SICAM WEB**.

  FPM licenses are linked to the serial number of the device. A new license is therefore required when the device is replaced. In this case please consult our Customer Support Center.

  The serial number of the device (12 characters, BF1711xxxxxx) can be found in the following places:

  – SICAM WEB: **HOME | Applications | Licenses**

  – SICAM WEB: **HOME | Serial number | Master Module**

  – Type Plate

NOTE

- Licensed features can be used up to 21 days without a valid license. Then you need a valid license to continue using the feature.

  Exception: The function package **Extended SICAM WEB** requires a valid license from the beginning

- Licenses can no longer be returned if they have been imported into a device.

14.2 SICAM 8 Extended Processing (EPCI85)

Extended processing/communication firmware for CP-8050. A separate license is required for each EPCI85 used.

Functions

- On an EPCI85 up to 4 protocols can be executed
- Up to 4 EPCI85 per CP-8050 system can be used
- 1 additional PLC (logic) resource per EPCI85
- Coupling of a SICAM A8000 rack (1 rack per license; maximum of 4 licenses per device)
- With global redundancy, a second license is required for Device B

Requirements

- CPCI85 Central Processing/Communication Rev. 3.10 or higher
- SICAM Device Manager V3.01 or higher
- SICAM TOOLBOX II V6.03 or higher
- For permanent operation a license is required

Comparison CPCI85 - EPCI85

	Central processing and communication (CPCI85)	Extended processing and communication (EPCI85)
Max. installable EPCI85	4	-
Max. installable protocols	8	4
Max. installable I/O master firmware files	16	0
Max. number of stations for all protocols	400	200
Max. number of data points	400 000	400 000
Max. size of the „retained“ logic memory (CAEx plus or CFC)	32768 Byte	12732 Byte
Max. number of „retained“ input messages (CAEx plus or CFC)	255	127
Maximum racks that can be equipped with up to 16 rack I/O firmware files each	-	1

Order information - Function Point Manager License

SICAM Function Point Manager Licenses are generated with the *SICAM Function Point Manager*.
The ordering process is described in the **Function Points Manager** user manual, section **SICAM License Files** .

Order information - ALM License

Medium	Designation	MLFB
OSD Download	SICAM 8 Extended Processing	6MF2750-2EP00

14.3 SICAM 8 IEC104 Firewall (FWI4)

IEC 60870-5-104 Application Layer Firewall with stand-alone TCP/IP stack (stack separation).
When using FWI4 on the local ports of the master modules (CP-8050 and CP-8031) one speaks of an "application layer firewall". When used with CI-8520 or CI-8522, it is a "hardware based application layer firewall".

Functions

- unencrypted IEC 60870-5-104 central/substation
- Routing of the data of the network interface takes place only on layer 7 (stack separation)
- IEC 60870-5-104 Edition 2.0 (see CP-8050 Manual, Chapter IEC 60870-5-104/Interoperability)
- up to 100 remote stations
- 104 redundancy according IEC 60870-5-104 Edition 2.0
- Data throughput limit
- WhiteList filter
- No other network services are possible on this interface
- With global redundancy, a second license is required for Device B

Requirements

- CPCI85 Central Processing/Communication Rev. 3.10 or higher
- SICAM Device Manager V3.01 or higher
- For permanent operation a license is required

Order information - Function Point Manager License

SICAM Function Point Manager Licenses are generated with the *SICAM Function Point Manager*.
The ordering process is described in the **Function Points Manager** user manual, section **SICAM License Files** .

Order information - ALM License

Medium	Designation	MLFB
OSD Download	SICAM 8 IEC104 Firewall	6MF2750-2FW40

14.4 SICAM 8 Redundancy

Functions

- Device redundancy with PLC synchronization via the Ethernet Based I/O bus incl. singular I/Os *(via encrypted I/O bus)*
- Device redundancy with PLC synchronization via routed IP network
- Integrated system voter function
- Global and protocol-selective voting
- Soft or hardware voting to select the active device

Requirements

- Latest versions of I/O and protocol firmware files (V04.00)
- SICAM Device Manager V3.10 or higher
- For permanent operation a license is required

Order information - Function Point Manager License

SICAM Function Point Manager Licenses are generated with the *SICAM Function Point Manager*.
The ordering process is described in the **Function Points Manager** user manual, section **SICAM License Files** .

Order information - ALM License

Medium	Designation	MLFB
OSD Download	SICAM 8 Redundancy	6MF2750-2RE00 (contains 2 licenses; device A and B)

14.5 SICAM 8 SIAPP Container

14.5.1 Introduction

SICAM Applications (SIAPPs) are third-party applications using the runtime environment of CP-8031/CP-8050 platform. SIAPPs can be created using SIAPP Software Development Kit (SDK) based on Docker.
Examples for applications:

- Web based HMI APP (customer specific web server, using RTU data)
- Server APP LDAP, Radius, Syslog, FTP within a secure environment
  Customer specific APP: user defined communication protocols and data point conversions

SICAM CP-8031/CP-8050 provides container technology:

- SIAPPs run on a SICAM CP-8031/CP-8050 in a protected SICAM Application Runtime (SIAR) environment
- Separation of SIAPP and RTU functions
- Access to process data of RTU via EDGE DATA API
- Up to 3 SIARs containing 1 – 3 SIAPPs are supported
- Up to 3 SIAPPs are supported in total

A license for each SICAM application runtime is necessary.
For more information on parameters and engineering refer to the SICAM Device Manager Manual.

Order information - Function Point Manager License

SICAM Function Point Manager Licenses are generated with the *SICAM Function Point Manager*.
The ordering process is described in the **Function Points Manager** user manual, section **SICAM License Files** .

Order information - ALM License

Medium	Designation	MLFB
OSD Download	SICAM 8 SIAPP Container	6MF2750-2LX00

14.5.2 Edge data API

The Edge data API provides access to the RTU engineered data in read/write direction. The API supports some data formats as well as data point quality and time information.
The following IEC60870 data types are supported and mapped by the Edge Data API:

IEC60870 Data Type	EDGE Data Type	extra information
TI=30, Single-point information	Unsigned Integer 32 Bit	
TI=31, Double-point information	Unsigned Integer 32 Bit	
TI=32, Transformer tap position	Signed Integer 32 Bit	
TI=33, 32 Bit Bit string	Unsigned Integer 32 Bit	
TI=34, Measured value 15 Bit + sign, normalized	Short floating point 32 Bit	
TI=35, Measured value 15 Bit + sign, scaled	Signed Integer 32 Bit	
TI=36, Measured value short floating point	Short floating point 32 Bit	
TI=37, Integrated total 31 Bit + sign	Signed Integer 32 Bit	
TI=45, Single command	Unsigned Integer 32 Bit	Only ACTIVATION and EXECUTE are supported

IEC60870 Data Type	EDGE Data Type	extra information
TI=46 Double command	Unsigned Integer 32 Bit	Only ACTIVATION and EXECUTE are supported
TI=47 Step-by-step command	Unsigned Integer 32 Bit	Only ACTIVATION and EXECUTE are supported
TI=48, Setpoint value, standard	Short floating point 32 Bit	Only ACTIVATION and EXECUTE are supported
TI=49, Setpoint value, normalized	Signed Integer 32 Bit	Only ACTIVATION and EXECUTE are supported
TI=50, Setpoint value, short floating point	Short floating point 32 Bit	Only ACTIVATION and EXECUTE are supported
TI=51, 32 Bit Bit string	Unsigned Integer 32 Bit	

14.6 SICAM 8 Extended SICAM WEB

Extended SICAM WEB Firmware for CP-8050.

Functions

- Import of signal names from other devices for monitoing & simulation
- Simulation of unavailable devices (test phase)
- Representation of measured values as a graph
- Logic IEC Parameters
  - Changing and restoring in the SICAM WEB Logic View
  - Import of CSV files with logic IEC parameters

Requirements

- CPCI85 Central Processing/Communication Rev. 3.10 or higher
- SICAM Device Manager V3.01 or higher
- SICAM TOOLBOX II V7.01 or higher
- A valid license was installed (no test operation possible)

Configuration

Enable the function "Import CSV"

After loading the license into the device, this function must still be activated.

- Open in SICAM Device Manager **HOME | Communication | Server Services**
- In section**Engineering interface (Web)**you find the function **Extended SICAM WEB Functions (License required)**.
- Select **enable** to activate the function.

Order information - Function Point Manager License

SICAM Function Point Manager Licenses are generated with the *SICAM Function Point Manager*.
The ordering process is described in the user manual**Function Point Manager**, section**SICAM License Files**.

Ordering Information

Medium	Designation	MLFB
OSD Download	SICAM 8 Extended SICAM WEB	6MF2750-2WE00

14.7 SICAM 8 Licensed Protocol

Functions

Required for the use of the following protocols:

- SAT SAT 1703 Point-to-Point (standard/SSI formats)
- Siemens SINAUT 8 FW Master
- Siemens SINAUT 8 FW Slave

Requirements

- SICAM Device Manager V3.10 or higher
- For permanent operation a license is required

Order information - Function Point Manager License

SICAM Function Point Manager Licenses are generated with the *SICAM Function Point Manager*.
The ordering process is described in the **Function Points Manager** user manual, section **SICAM License Files** .

Ordering Information

Medium	Designation	MLFB
OSD Download	SICAM 8 Licensed Protocol	6MF2750-2PR00

14.8 SICAM A8000 CP-803x Extended CI-Module

Functions

Extension of CP-803x with:

- 1 x communication module (CI-8520, CI-8522 or CI-8551)
  and/or
- 1 x I/O remote module (CI-8530, CI-8531, CI-8532 or CI-8533)

Requirements

- SICAM Device Manager V3.85 or higher
- For permanent operation a license is required

Order information - Function Point Manager License

SICAM Function Point Manager Licenses are generated with the *SICAM Function Point Manager*.
The ordering process is described in the **Function Points Manager** user manual, section **SICAM License Files** .

Ordering Information

Medium	Designation	MLFB
OSD Download	SICAM A8000 CP-803x Extended CI-Module	6MF2750-2EX00

14.9 CI-852x RedBox

Functions

Data traffic between 2 LAN port groups of a CI-852x module. The following types of LAN port groups can be combined:

- Singular ⇔ PRP
- Switched ⇔ PRP
- Singular ⇔ HSR
- Switched ⇔ HSR
- Singular ⇔ RSTP
- Switched ⇔ RSTP
- Switched ⇔ Line Mode
- Singular ⇔ Line Mode

Only one RedBox can be configured per device.

Requirements

- SICAM Device Manager V3.90 or higher
- For permanent operation a license is required

Order information - Function Point Manager License

SICAM Function Point Manager Licenses are generated with the *SICAM Function Point Manager*.
The ordering process is described in the **Function Points Manager** user manual, section **SICAM License Files** .

Order information - ALM License

Medium	Designation	MLFB
OSD Download	SICAM A8000 - 852x Redbox	6MF2750-2RB00

14.10 Installation of an ALM License

In order to use ALM license, the following steps are necessary:

- Transfer of the ALM license to the engineering PC with the Automation ALM License Manager
- Import and activate the ALM license with the engineering tool

14.10.1 Transfer of a ALM license to the engineering PC with the Automation ALM License Manager

To transfer the ALM license from the USB stick to the engineering PC, you must plug the USB stick into a free USB port of your engineering PC.
The USB stick is immediately recognized and displayed by the Automation License Manager.
In the directory tree on the left, select the USB stick that contains the licenses. The list of available licenses is displayed on the right side of the Automation License Manager.

- Select the appropriate license
- Open the context menu (right mouse button). Select the entry **Transfer...**
- Select a local hard disk in the following dialog
- Click **OK**, to transfer the license to your hard drive
- Close the Automation License Manager

NOTE

The installation of a ALM licenses is also possible with Drag & Drop or Copy & Paste, see also **almreadme.rtf**
The ALM license can also be transferred to a license server.

14.10.2 Import and activate the ALM license

After transferring the license, it must still be imported into the Engineering Tool (SICAM Device Manager, SICAM TOOLBOX II) and then activated.
Proceed as follows with the **SICAM Device Manager**:

- Open the device for which the license was purchased
- Click **Configuration** and **Licenses**
  (The license page will only be opened when the project is saved)
- Click the icon for importing the license in the Automation License Manager
- Click on the license and confirm the selection
- In the **Licensable Functions** table, open the list box in the **License Key / License Number** column and select the license to activate it

Proceed as follows with the **SICAM TOOLBOX II**:

- In the system technique of the OPM II, select the device (component) for which the license was purchased
- Open the context menu and select **License...**
- In the **License** window click on **Import license...**
- In the **Licensable Functions** table, open the list box in the **License Key / License Number** column and select the license to activate it

14.10.3 Automation License Manager

Important information about installation and use of the Automation License Manager can be found in **almreadme.rtf** and in **almapp_b.pdf** (Programming and Operating Manual, available in English only) after SICAM Device Manager installation at:

C:/Program Files/Siemens/Automation License Manager or **C:/Program Files/Siemens/Automation License Manager/manual**

NOTE

The file **ReadMe_OSS** of the SICAM Device Manager is also located in the installation directory.

Note that a restart is required after each (new) installation of the Automation License Manager.

After the restart, the ALM service is running. Open **services.msc**to check the running ALM service.

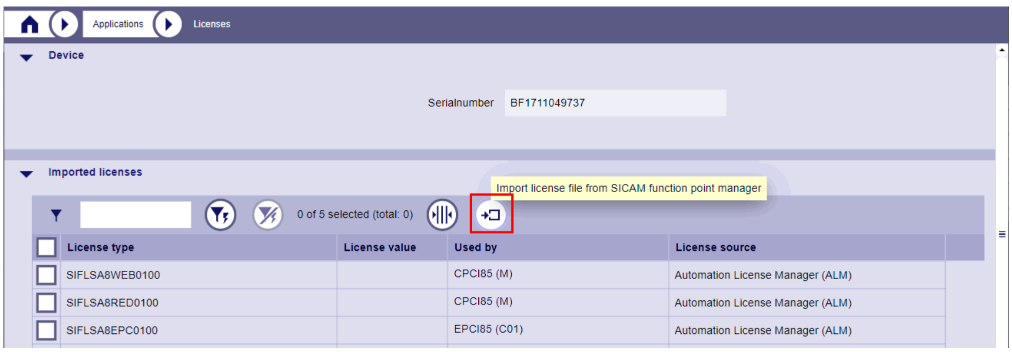
14.11 Installation of a SICAM Function Point Manager License

NOTE

SICAM Function Point Manager Licenses are generated with the *SICAM Function Point Manager*.
The ordering process is described in the **Function Points Manager** user manual, section **SICAM License Files** .

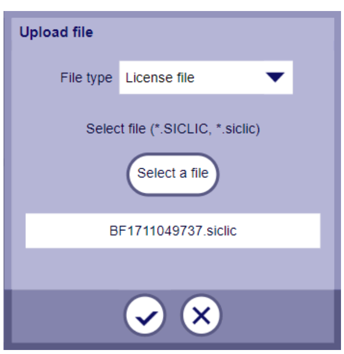
The installation of the FPM license (*.SICLIC file) takes place with **SICAM WEB**.

- Click **HOME | Applications | Licenses**
- Click in section **Imported licenses** on **Import license file from SICAM Function Point Manager**



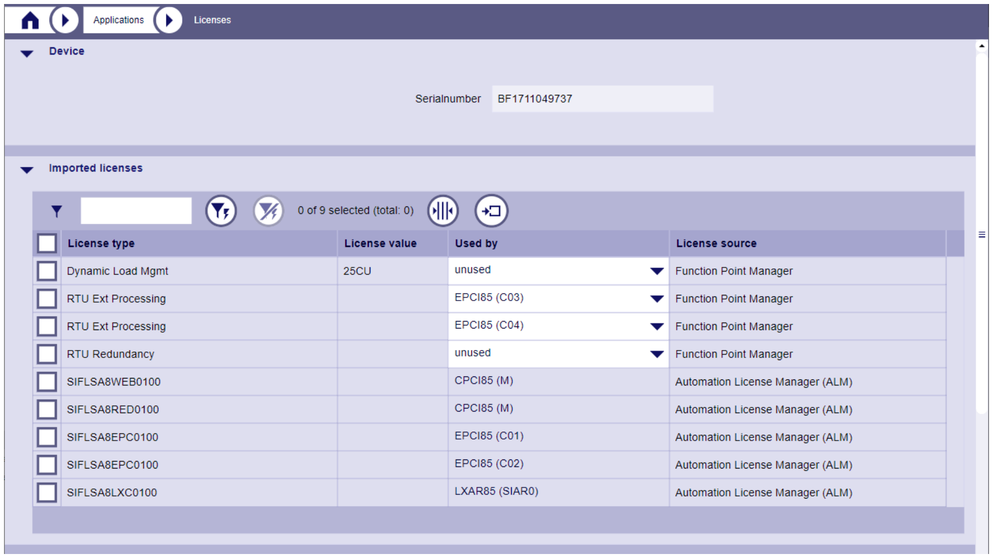
[sc_sweb_app_load_fpm_lic_01, 1, en_US]

- Click in dialog **Upload file** on **Select file** and then confirm the selection.

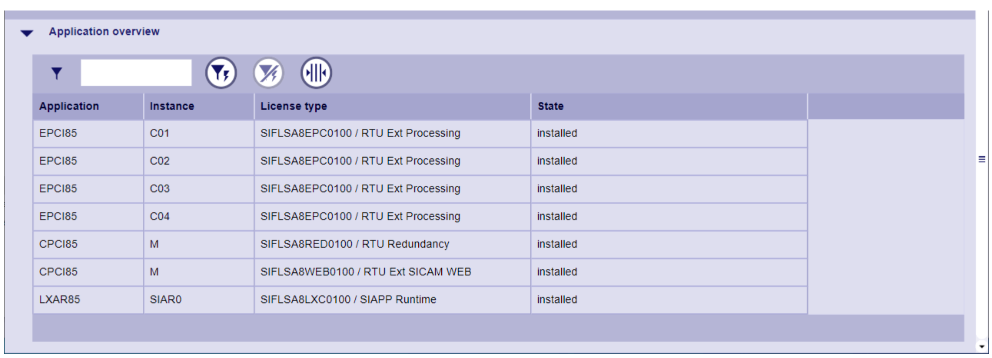


[sc_sweb_app_load_fpm_lic_02, 1, en_US]

- If the license file is imported successfully, the new license will appear in the **Imported Licenses** section. If an automatic assignment was not possible, you must do this manually in the **Used by** column.



[sc_sweb_lic_01a, 1, en_US]



[sc_sweb_lic_01b, 1, en_US]

Figure 14-1 Application overview

NOTE

Pay attention to the following points when importing the license:

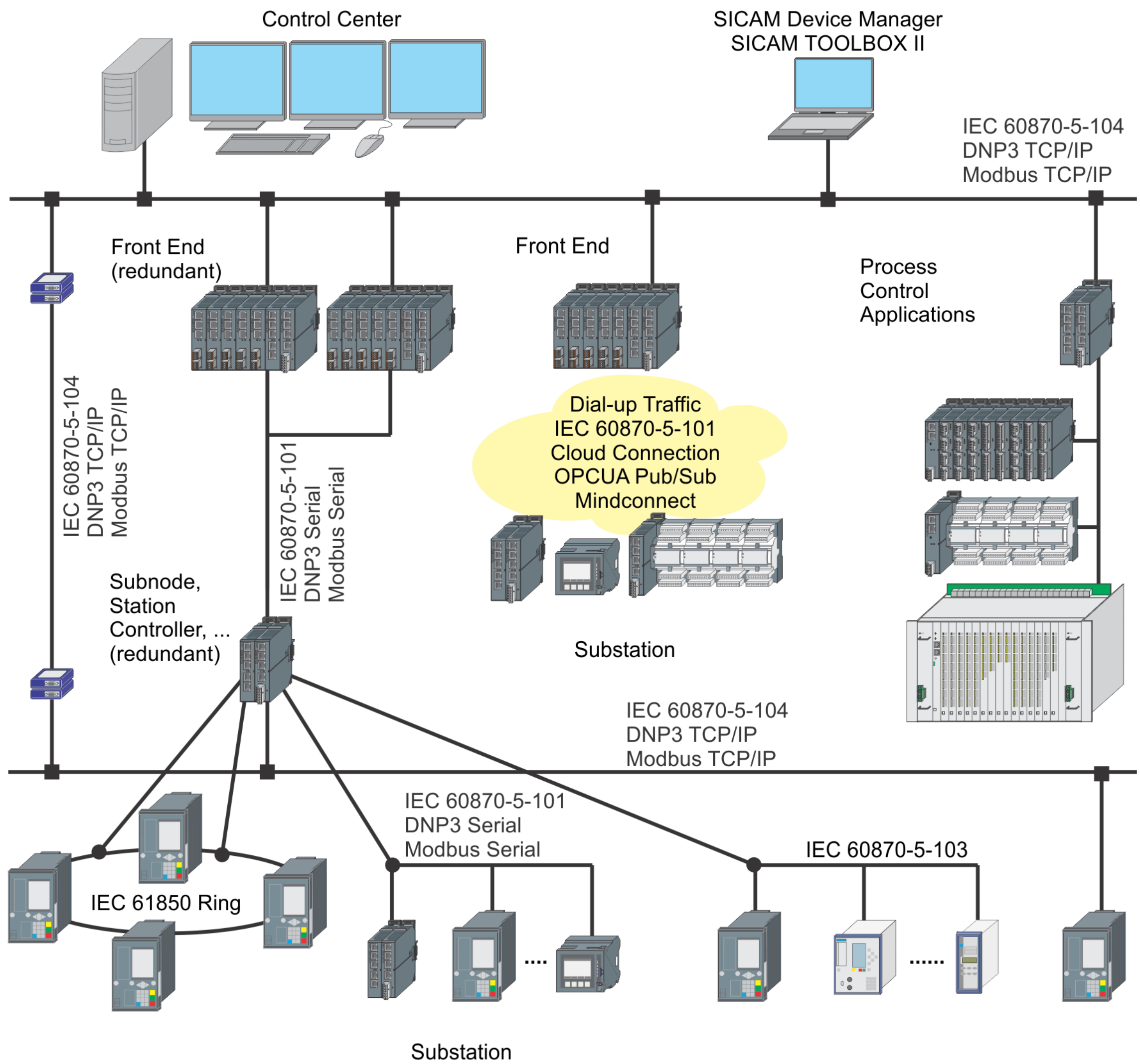
- The time on the device must be set correctly
- Only use license files generated for the device
  (The serial number listed in the license file must match the serial number of the device.)

15 Sample Applications

15.1 Application Overview

Due to the modular architecture, SICAM CP-8050 can be used in a variety of ways:

- Front End, Gateway
- Process control applications, automation applications
- Station Control Device, Sub-Node
- Telecontrol substation



[dw_CP-8050_Application_Overview, 1, en_US]

15.1.1 Front End, Gateway

Due to the large number of different interfaces (up to 32) and the protocols that can be used on them (up to 24), SICAM CP-8050 is ideally suited for use as a front end for a process control system.

All telecontrol substations - regardless of the manufacturer and via which protocol - are coupled to SICAM CP-8050. In the front end, the signal processing and adaptation takes place for the respective control system. From the perspective of the control system, there is no difference which protocol and which system behavior the substation actually has.

15.1.2 Process control applications, automation applications

Open- and closed-loop control application programs are created by means of CAEx plus or CFC according to IEC 61131-3, a standard that is generally accepted and recognized in the market.

Through this and due to the modularity, SICAM CP-8050 is suitable for many applications: from smaller automation applications up to complex process control applications. Naturally, all applications can also be combined.

15.1.3 Station Control Device, Sub-Node

The functionality of a station control device can be simply regarded as a combination of the functionality of a front end (interfacing of diverse bay devices, protective devices, processing of the data for the power system control) and the functionality of process control applications (open- and closed loop control application programs), and is therefore perfectly suited for this application. In addition, further telecontrol peripherals can also be installed in the station control device, through which telecontrol station and station control device are united in one device.

15.1.4 Telecontrol substation

For telecontrol applications, modular, versatile I/O modules are available for process data coupling.

SICAM CP-8050 supports centrally and decentrally installed I/O modules especially through the use of remote I/O rows. Flexible communication functions also permit redundant communication and communication over stand-by transmission lines.

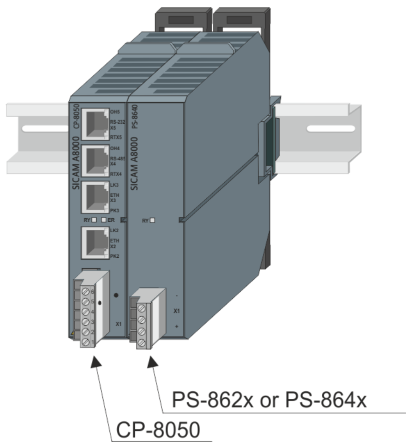
Naturally, arbitrary open- and closed-loop control application programs can be realized in SICAM CP-8050 with CAEx plus and CFC, through which, at the same time and to the same degree, SICAM CP-8050 can become a remote terminal unit and an automation unit in one.

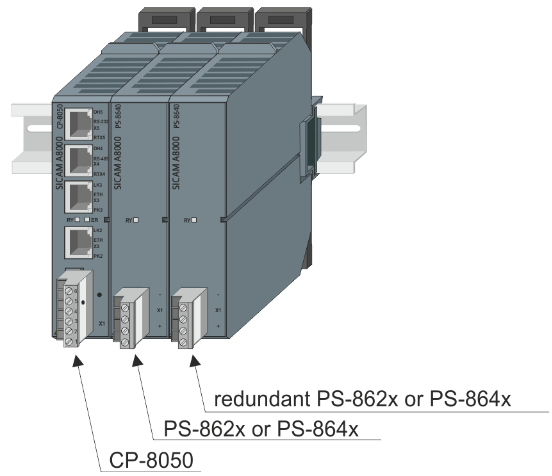
15.2 Expansion Stages

15.2.1 Basic Configurations

Master Module with Power Supply (Minimum Configuration)

Usage for simple data nodes. Selection of power supply according power consumption. Due to redundancy reasons a second power supply module can be used.

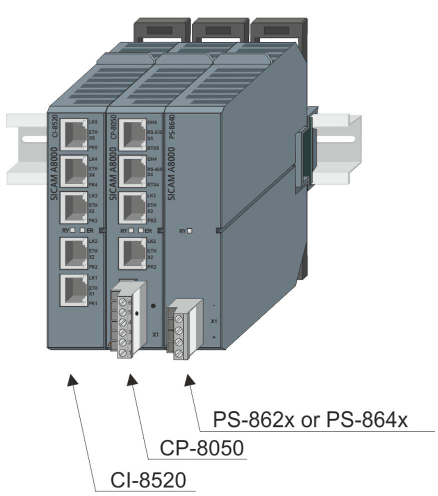


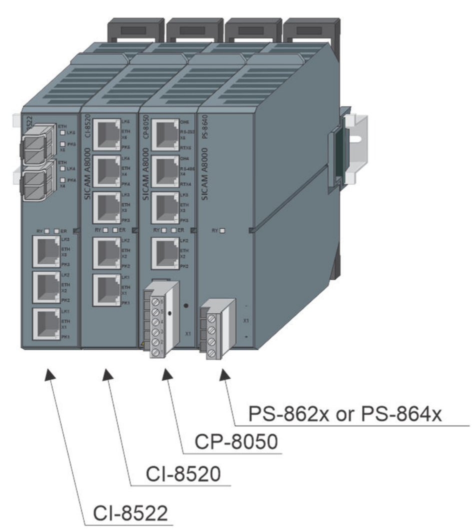


Designation	MLFB
CP-8050 Master Module	6MF28050AA00
PS-8620 Power supply DC 24 V to 60 V, 12 W	6MF28620AA00
PS-8640 Power supply DC 24 V to 60 V, 45 W	6MF28640AA00
PS-8622 Power supply DC 110 V to 220 V, 12 W	6MF28622AA00
PS-8642 Power supply DC 100 V to 240 V or VAC 45 W	6MF28642AA00

Master Module with Power Supply and Communication Module(s)

Usage for simple data nodes. Selection of power supply according power consumption. Up to 2 communication modules, each with 5 interfaces, are possible.

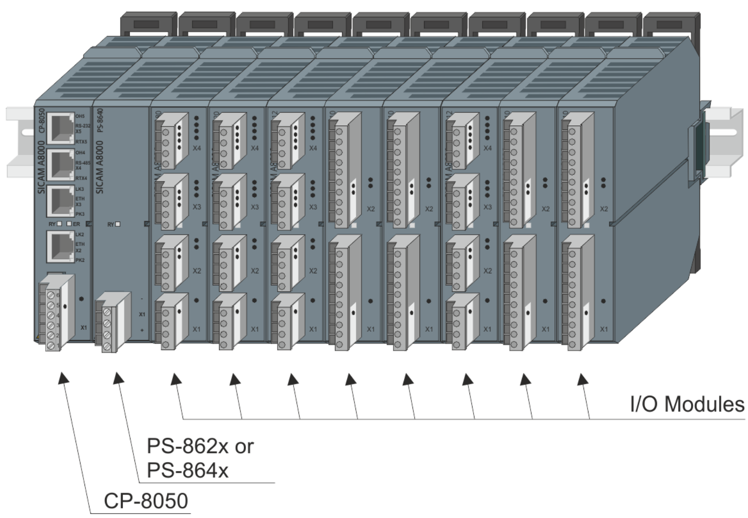




Designation	MLFB
CP-8050 Master Module	6MF28050AA00
PS-8620 Power supply DC 24 V to 60 V, 12 W	6MF28620AA00
PS-8640 Power supply DC 24 V to 60 V, 45 W	6MF28640AA00
PS-8622 Power supply DC 110 V to 220 V, 12 W	6MF28622AA00
PS-8642 Power supply DC 100 V to 240 V or VAC 45 W	6MF28642AA00
CI-8520 Ethernet Extension Module	6MF28520AA00
CI-8522 Network Interface Fiber Optic Extension Module	6MF28522AA00

Master Module with Power Supply and I/O Modules

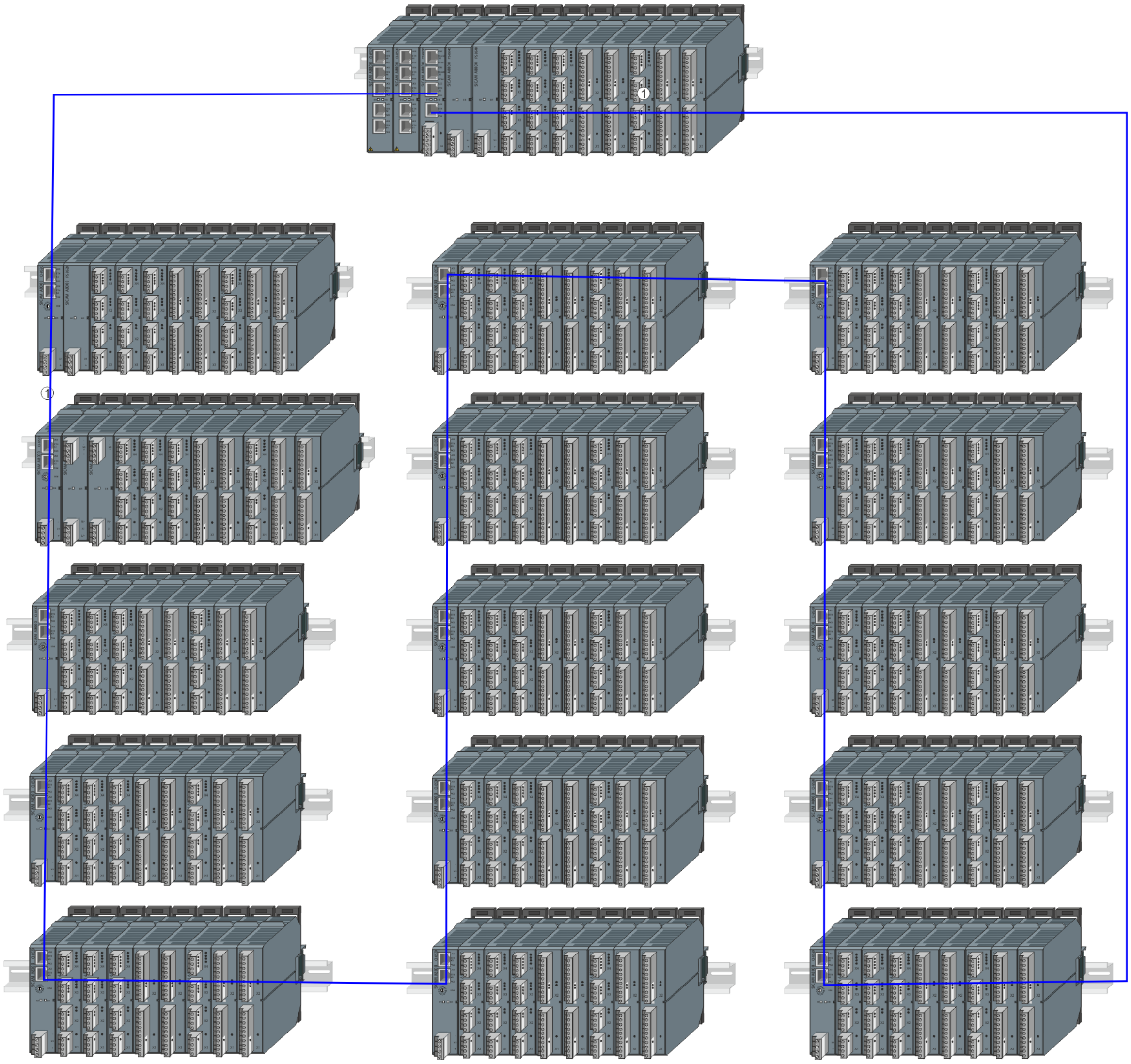
Usage as automation system with local I/O modules. Selection of power supply according power consumption of the system. Due to redundancy reasons a second power supply module can be used.



Designation	MLFB
CP-8050 Master Module	6MF28050AA00
PS-8620 Power supply DC 24 V to 60 V, 12 W	6MF28620AA00
PS-8640 Power supply DC 24 V to 60 V, 45 W	6MF28640AA00
PS-8622 Power supply DC 110 V to 220 V, 12 W	6MF28622AA00
PS-8642 Power supply DC 100 V to 240 V or VAC 45 W	6MF28642AA00
SICAM I/O Module	See chapter *[OptUnresolvedLink]SICAM I/O modules[/OptUnresolvedLink]*

15.2.2 Maximum Configuration

CP-8050 with 15 I/O-Rows in Ring Configuration



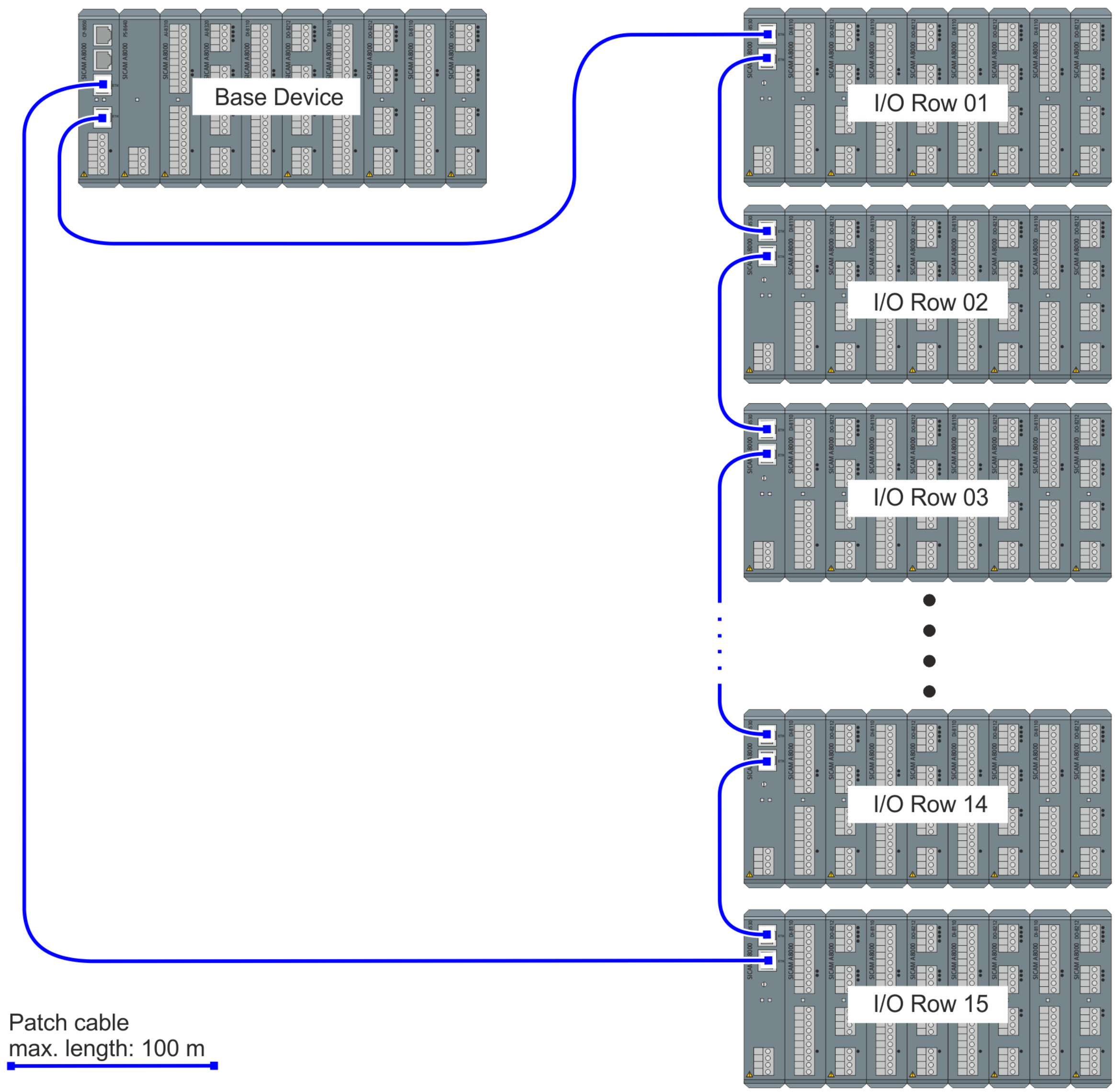
[CP-8050_config_max, 1, --_--]

15.3 Ring Configurations

15.3.1 Ring configurations with electrically connected I/O rows

Example 1: Base device with I/O modules + 15 electrically connected I/O remote rows

If the base device and the I/O row(s) are electrically connected, the cable may not exceed 100 m in length. This also applies to the connection between the I/O rows.

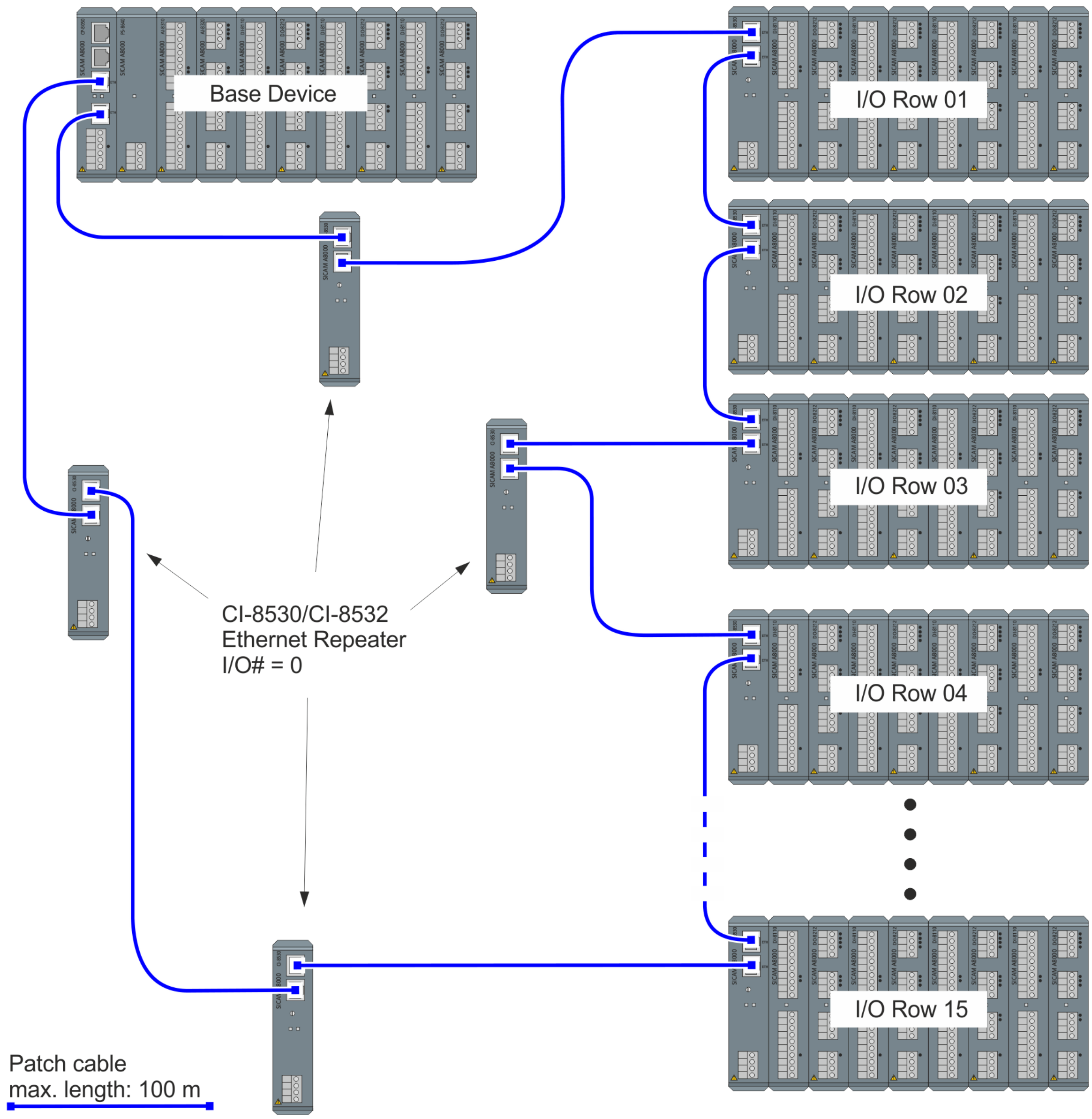


[CP-8050_config_Ring_el_remote_io_v1, 1, en_US]

Example 2: Base device with I/O modules + 15 electrically connected I/O remote rows + „Ethernet-Repeater“

An "Ethernet Repeater" can be used to extend the max. cable length between the base device and the I/O rows or between the I/O rows. Each "Ethernet repeater" can extend the route by 100 m. The I/O Remote Modules CI-8530 or CI-8532 can be used as “Ethernet Repeater”.

The I/O# of the “Ethernet Repeater” in the ring configuration must be set to 0.



NOTE

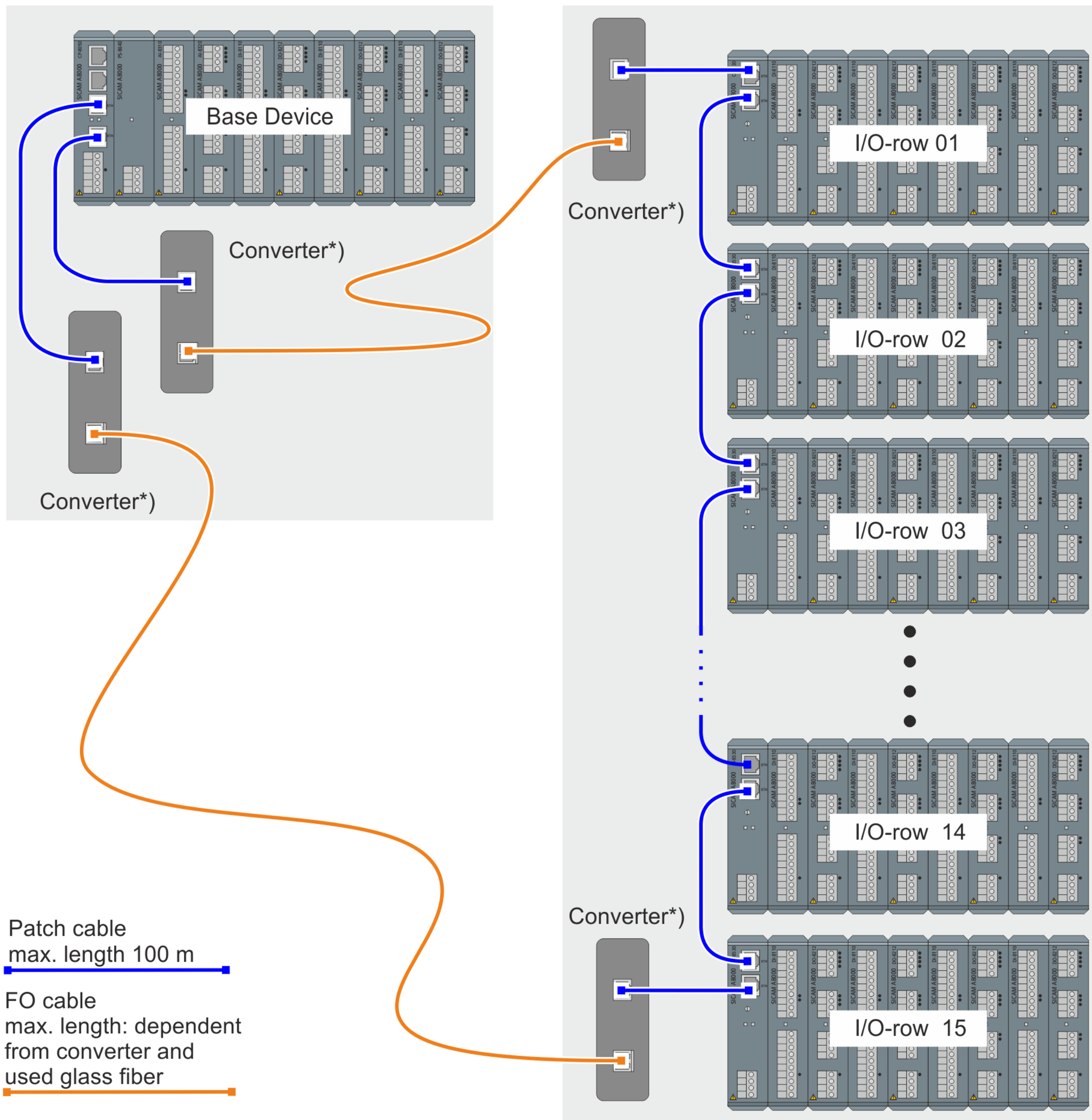
Configuration:

- Up to 20 CI-8530/CI-8532 can be used in a ring/line configuration as an I/O Remote module or "Ethernet Repeater".
  Maximum 15 out of these can be used as I/O Remote module.
- No I/O-Modules may be connected to the "Ethernet Repeaters".
- Ethernet I/O ring and Ethernet I/O line may not be connected to other Ethernet networks.

Refer to *12.3.4 SICAM I/O Remote Modules* for LED display status on the Ethernet Repeaters.

15.3.2 Ring configurations with optically connected I/O rows

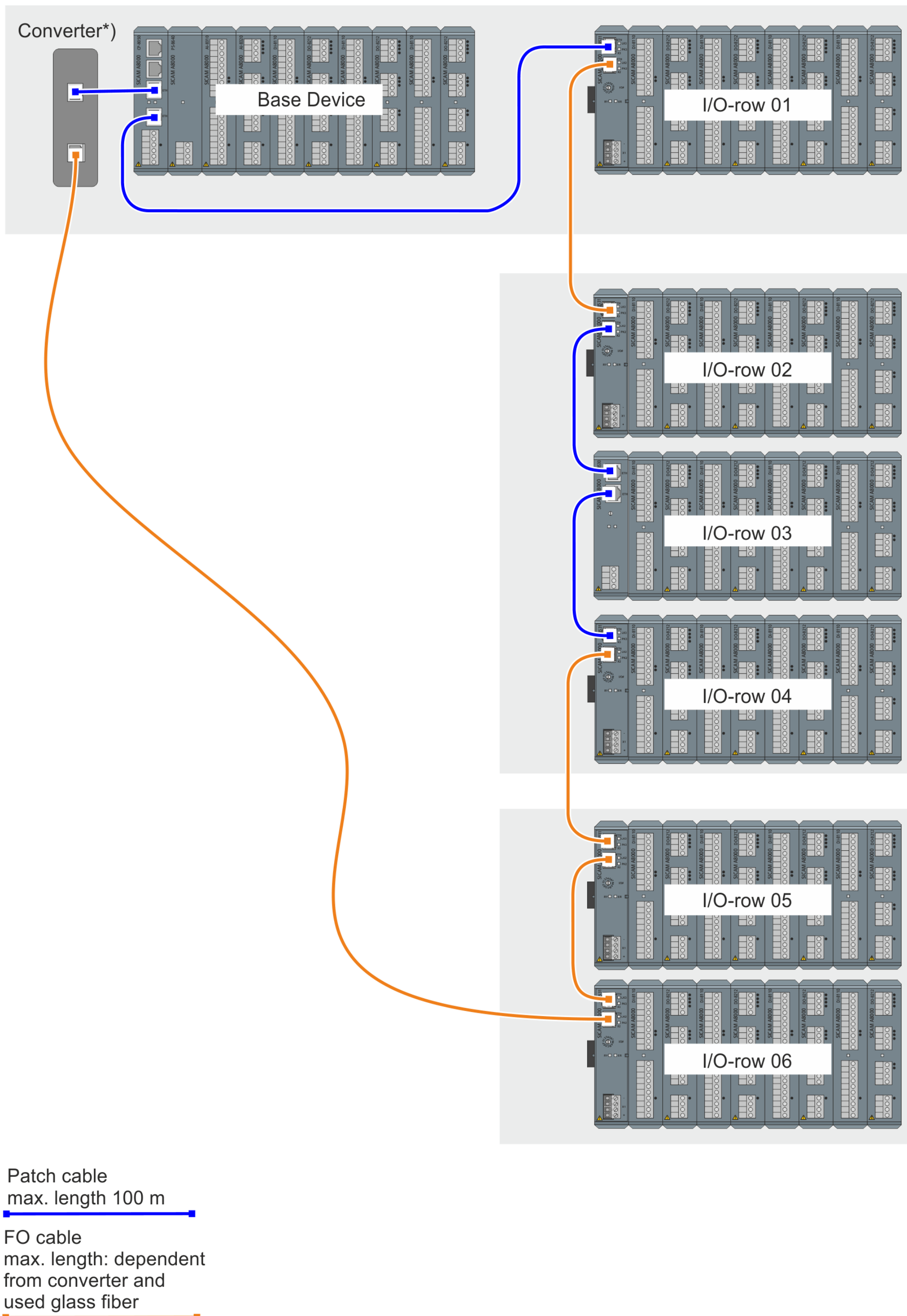
Example 1: Basic device with I/O modules; optical connection to the I/O rows; electronic connection between the I/O rows



[CP-8050_config_Ring_opt_remote_io_v1, 1, en_US]

*) Converter see section: *15.3.3 Optical Converter (Media Converter) for I/O rows*

Example 2: Basic device with I/O modules; optical and electrical connection to the I/O rows and between the I/O rows



[dw_CP-8050_config_Ring_opt_remote_io_v3, 2, en_US]

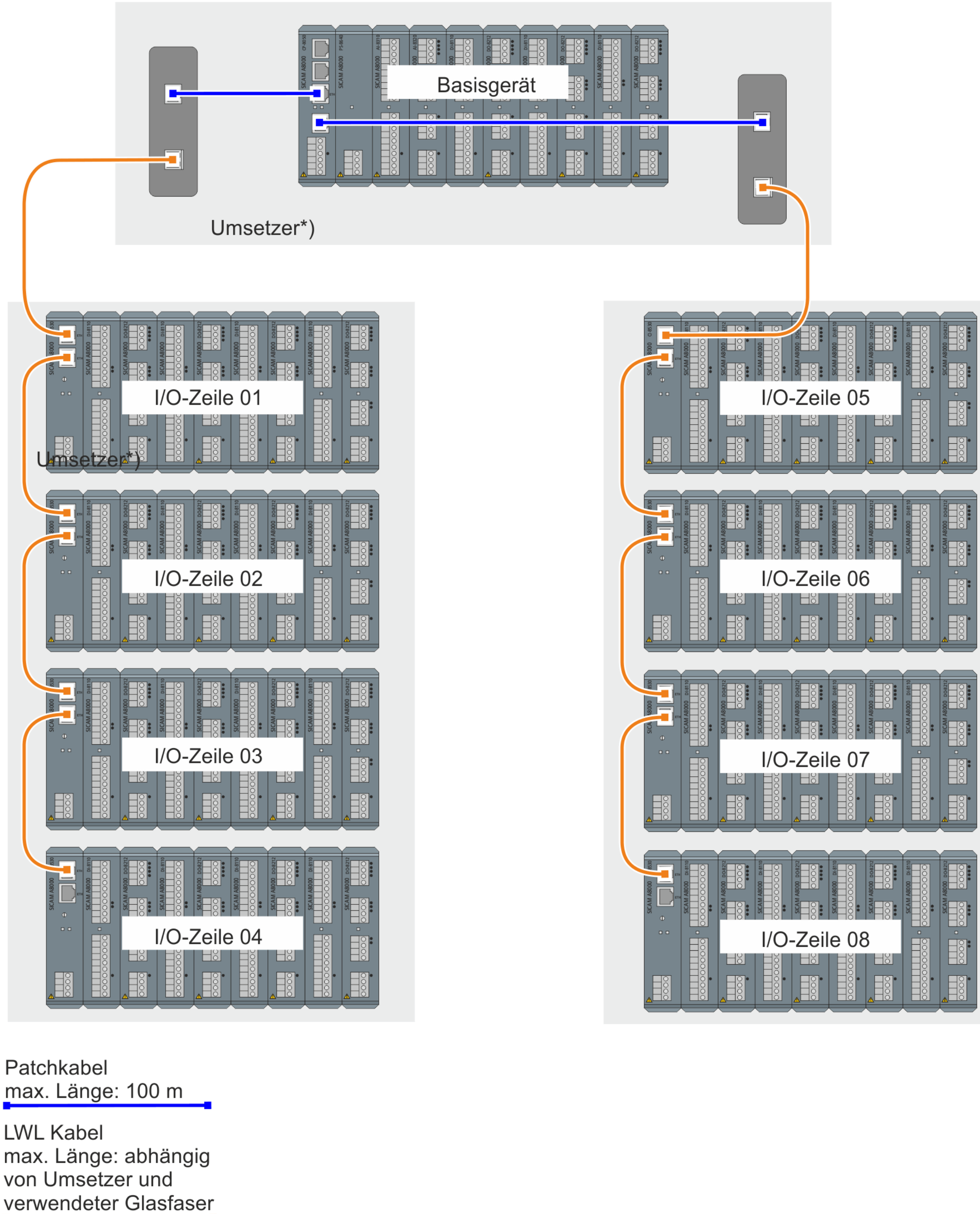
*) Converter see section: *15.3.3 Optical Converter (Media Converter) for I/O rows*

NOTE

- If the CI-8531/CI-8533 is used as an I/O remote module and one of the connections is an electrical SFP transceiver, no optical converter is required between the CP-8050 and CI-8531/CI-8533.
- If the CI-8531/CI-8533 is used as an I/O remote module and both connections are optical SFP transceivers, then an optical converter is required between the CP-8050 and CI-8531/CI-8533.

Example 3: Basic device with I/O modules; optical connection to the I/O rows; ring open

No closed ring (e.g. due to local conditions). No error message is set! The I/O numbers must be unique.



[dw_use_case_optic_remote_io_open_ring, 1, en_US]

*) Converter see section: *15.3.3 Optical Converter (Media Converter) for I/O rows*

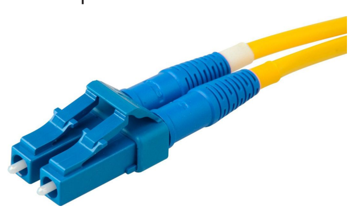
15.3.3 Optical Converter (Media Converter) for I/O rows

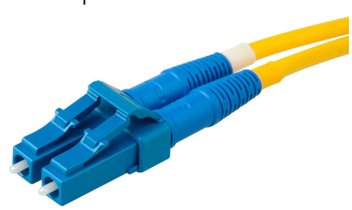
The use of converters and fiber-optic cables can significantly increase the distance between the base device and I/O-rows and between the individual I/O-rows. Depending on the type of cable and converter used, different cable lengths can be achieved.

NOTE

- Only converters that support a transmission speed of 100 Mbit/s can be used.
- CI-8531/CI-8533 acts as a media converter with 1 electrical SFP and 1 optical SFP
- A maximum of 20 devices with Ethernet connection may be used in the I/O Line (ring/line configuration)
  Examples:
  - 15 I/O-rows = 15 x CI-8530/CI-8532 + 4 optical converters = 19 (optical converters are always required in pairs)
  - 15 I/O-rows = 15 x CI-8530/CI-8532 + 5 x CI-8530/CI-8532 with switch position "I/O#=0" = 20
  - Example: 15 I/O-rows = 15 x CI-853x + 2 x CI-8531/33 = 17
- The converters must support the cut-through-process (Cut-Through-Forwarding/Cut-Through-Switching).
  Cut-through delay time (latency time): 6-8 µs (micro seconds)
- Ethernet I/O Ring and Ethernet I/O line may not be connected to other Ethernet networks.

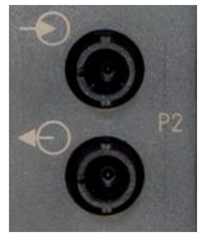
Siemens Ruggedcom RMC

MLFB: • 6GK6001-0AC01-0FA0 • 6GK6001-0AC02-0FA0 • 6GK6001-0AC03-0FA0 	• LC socket for opt. connector  • Dimensions (WxHxD) 58 x 109 x 94 • Ambient temperature (operation): -40 °C ... 85 °C • MLFB: 6GK6001-0AC01-0FA0 – Nominal voltage: VDC 24 – Voltage range: VDC 18 ... 36 • MLFB: 6GK6001-0AC02-0FA0 – Nominal voltage: VDC 48 – Voltage range: VDC 36 ... 59 • MLFB: 6GK6001-0AC03-0FA0 – Nominal voltage: HI – Voltage range: VDC 88-300 or VAC 85-264 • Fiber optic cable with LC connector  – max. length: 2 km – Multimode – Wavelength: 1300 nm – 1x 100TX to 1x 100FX

MLFB: • 6GK6001-0AC01-0EA0 • 6GK6001-0AC02-0EA0 • 6GK6001-0AC03-0EA0  	• LC socket for opt. connector  • Dimensions (WxHxD) 58 x 109 x 94 • Ambient temperature (operation): -40 °C ... 85 °C • MLFB: 6GK6001-0AC01-0EA0 – Nominal voltage: VDC 24 – Voltage range: VDC 18 ... 36 • MLFB: 6GK6001-0AC02-0EA0 – Nominal voltage: VDC 48 – Voltage range: VDC 36 ... 59 • MLFB: 6GK6001-0AC03-0EA0 – Nominal voltage: HI – Voltage range: VDC 88-300 or VAC 85-264 • Fiber optic cable with LC connector  – max. length: 15 km – Singlemode – Wavelength: 1310 nm – 100TX to 1x 100FX

MLFB: • 6GK6001-0AC01-0DA0 • 6GK6001-0AC02-0DA0 • 6GK6001-0AC03-0DA0  	• MTRJ socket for opt. connector  • Dimensions (WxHxD) 58 x 109 x 94 • Ambient temperature (operation): -40 °C ... 85 °C • MLFB: 6GK6001-0AC01-0DA0 – Nominal voltage: VDC 24 – Voltage range: VDC 18 ... 36 • MLFB: 6GK6001-0AC02-0DA0 – Nominal voltage: VDC 48 – Voltage range: VDC 36 ... 59 • MLFB: 6GK6001-0AC03-0DA0 – Nominal voltage: HI – Voltage range: VDC 88-300 or VAC 85-264 • LWL with MTRJ-connector  – max. length: 2 km – Multimode – Wavelength: 1300 nm – 1x 100TX to 1x 100FX

Siemens SCALANCE

<table>
<tr>
<td>Type: X101-1
MLFB:
• 6GK5101-1BB00-2AA3
</td>
<td>• ST socket for opt. connector
(ST/BFOC ... straight tip/bayonet fiber optic connector)


• Dimensions (WxHxD) 40 x 125 x 124
• Ambient temperature (operation): -10 °C ... 60 °C
• Nominal voltage: VDC 24
• Voltage range: VDC 18 ... 32
• Current consumption: 120 mA
• Fiber optic cable with ST connector

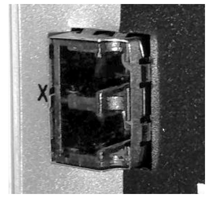
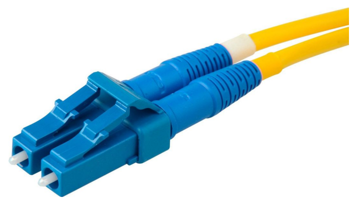
– max. length: 4 km at
  – cross-section: 62,5/125 µm
  – Multimode
– max. length: 5 km at
  – cross-section: 50/125 µm
  – Multimode</td>
</tr>
</table>

Type: X101-1LD
MLFB:
• 6GK5101-1BC00-2AA3

	• ST socket for opt. connector
	
	
	• Dimensions (WxHxD) 40 x 125 x 124
	• Ambient temperature (operation): -10 °C ... 60 °C
	• Nominal voltage: VDC 24
	• Voltage range: VDC 18 ... 32
	• Current consumption: 120 mA
	• Fiber optic cable with ST connector
	
	– max. length: 26 km at
	  – cross-section: 10/125 µm
	  – Singlemode

Phoenix FO Converter

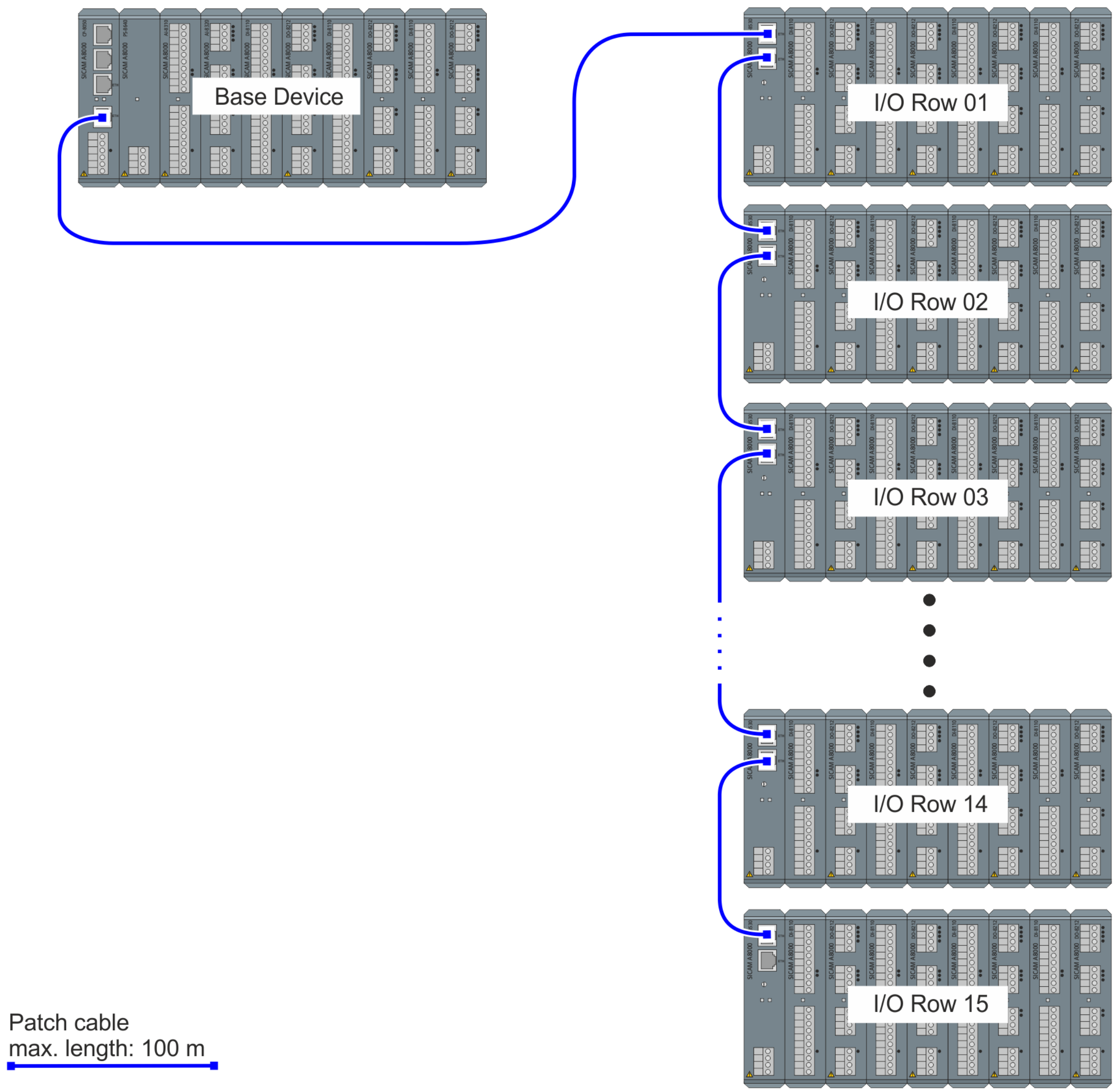
Type: FL MC 2000E LC
Order number:
• 2891056

	• LC socket for opt. connector
	
	• Dimensions (WxHxD) 30 x 130 x 100
	• Ambient temperature (operation): -40 °C ... 75 °C
	• Nominal voltage: VDC 24 or 48
	• Voltage range: VDC 12 ... 57
	• Current consumption: 110 mA (VDC 24)
	• Fiber optic cable with LC connector
	
	– max. length: 8 km at
	  – cross-section: 62,5/125 µm
	  – Attenuation: 0,7 dB/km
	  – Wavelength: 1000 nm
	– max. length: 3.3 km at
	  – cross-section: 62,5/125 µm
	  – Attenuation: 2,6 dB/km
	  – Wavelength: 600 nm
	– max. length: 9.6 km at
	  – cross-section: 50/125 µm
	  – Attenuation: 0,7 dB/km
	  – Wavelength: 1200 nm
	– max. length: 5.3 km at
	  – cross-section: 50/125 µm
	  – Attenuation: 1,6 dB/km
	  – Wavelength: 800 nm

15.4 Line Configurations

15.4.1 Line configurations with electrically connected I/O rows

Example 1: Base device with I/O modules + 15 electrically connected I/O rows

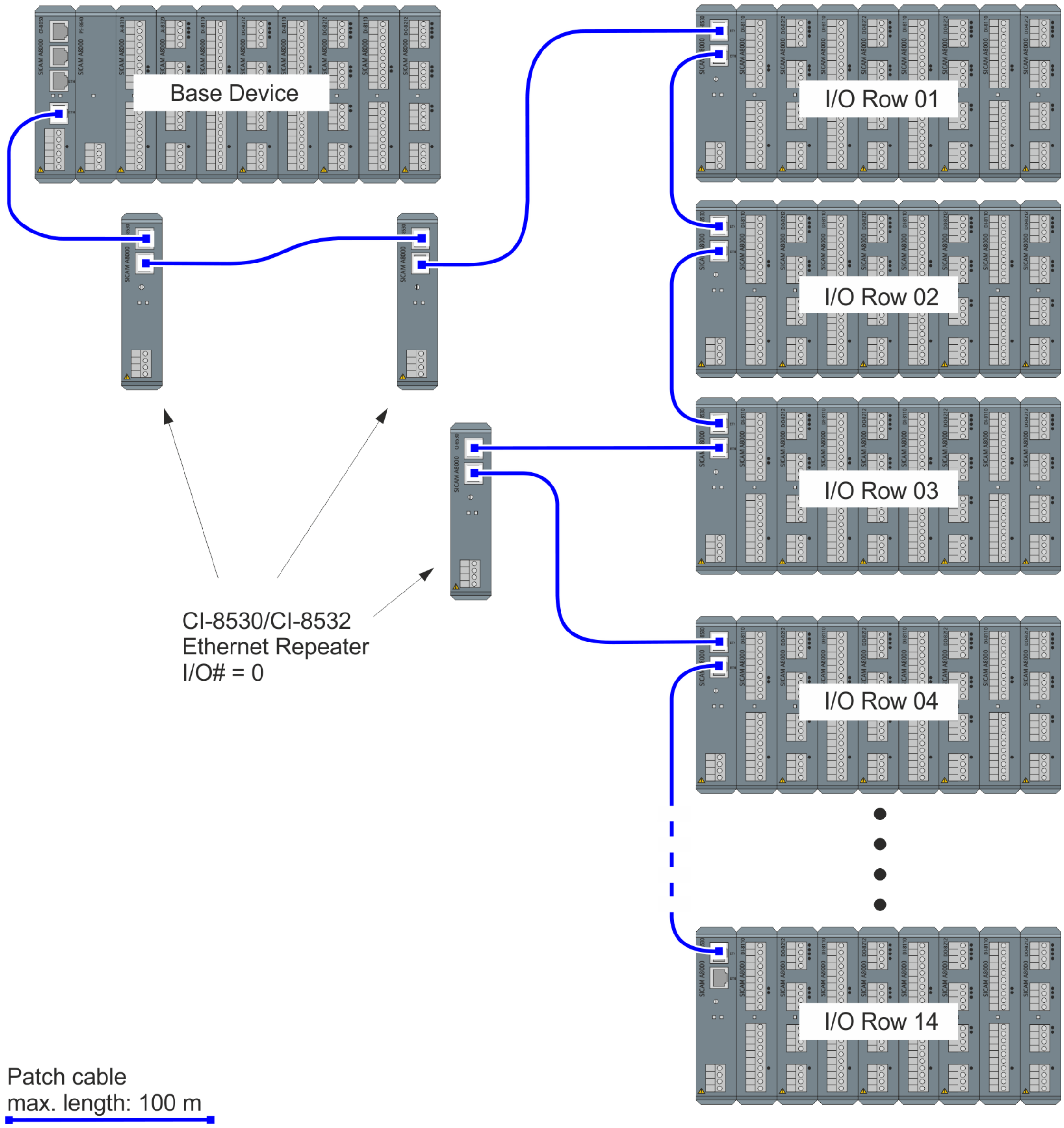


[CP-8050_config_line_el_remote_io_v1, 1, en_US]

Example 2: Base device with I/O modules + 15 electrically connected I/O rows + „Ethernet-Repeater"

An "Ethernet Repeater" can be used to extend the max. cable length between the base device and the I/O rows or between the I/O rows. Each "Ethernet repeater" can extend the route by 100 m. The I/O remote modules CI-8530 or CI-8532 can be used as "Ethernet Repeater".

The I/O# of the "Ethernet Repeater" in the line configuration must be set to 0.



NOTE

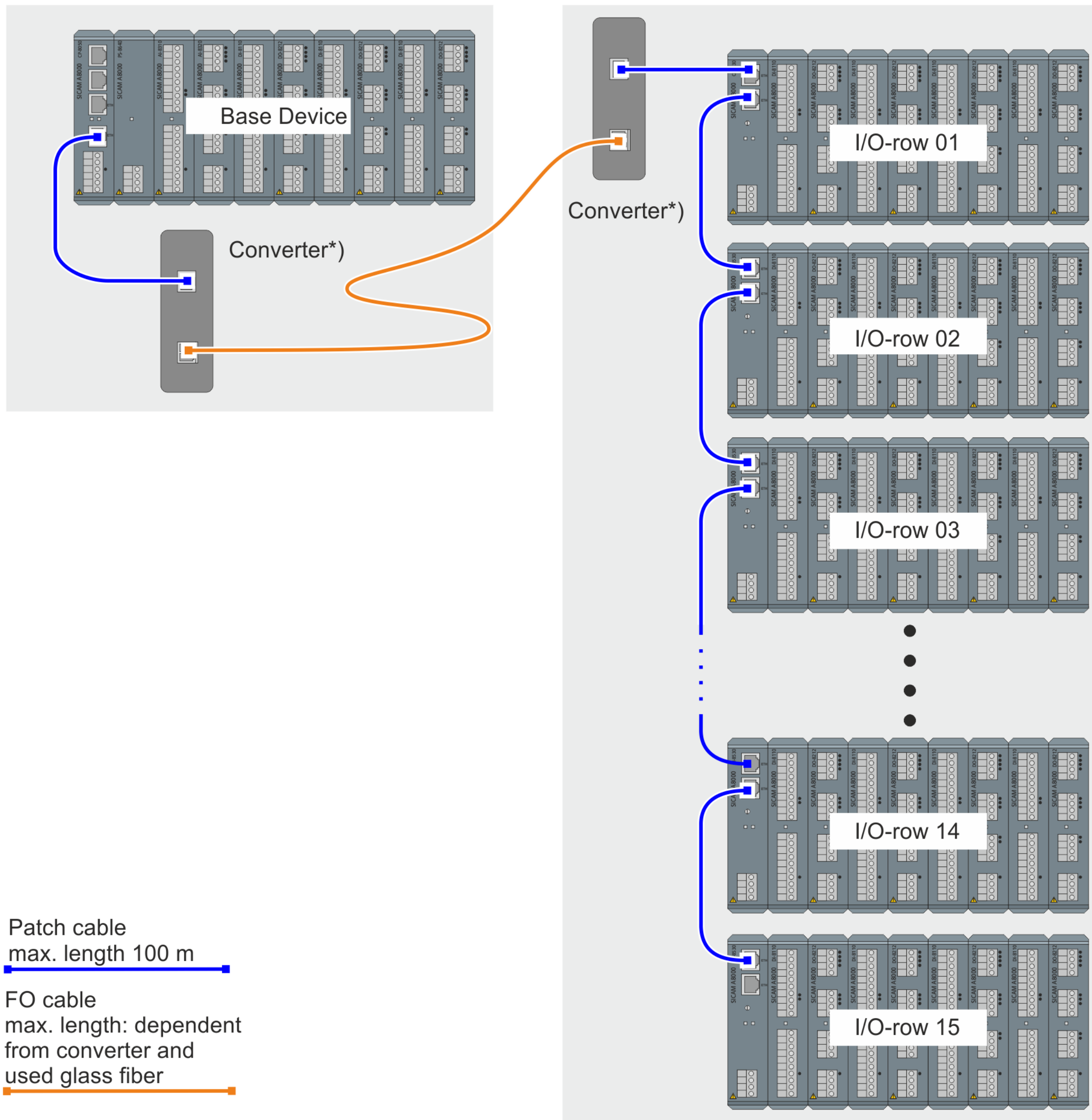
Configuration:

- Up to 20 CI-8530/CI-8532 can be used in a ring/line configuration as an I/O Remote module or "Ethernet Repeater".
  Maximum 15 out of these can be used as I/O Remote module.
- No I/O-Modules may be connected to the "Ethernet Repeaters".
- Ethernet I/O ring and Ethernet I/O line may not be connected to other Ethernet networks.

Refer to *12.3.4 SICAM I/O Remote Modules* for LED display status on the Ethernet Repeaters.

15.4.2 Line configurations with optically connected I/O rows

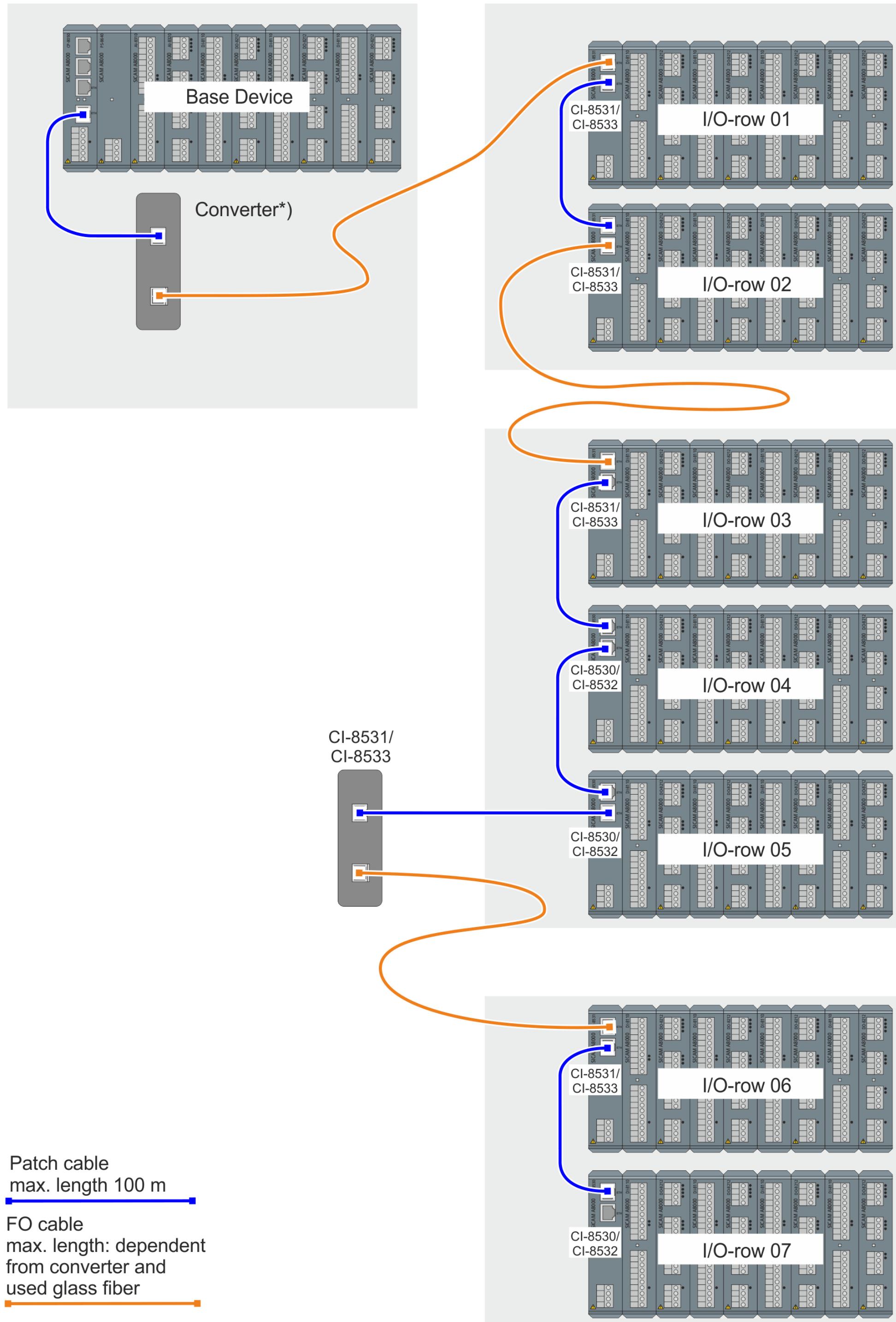
Example 1: Base device with I/O modules + optically connected I/O rows



[CP-8050_config_line_opt_remote_io_v1, 1, en_US]

*) Converter see chapter: *15.3.3 Optical Converter (Media Converter) for I/O rows*

Example 2: Base device with I/O modules + optically connected I/O rows

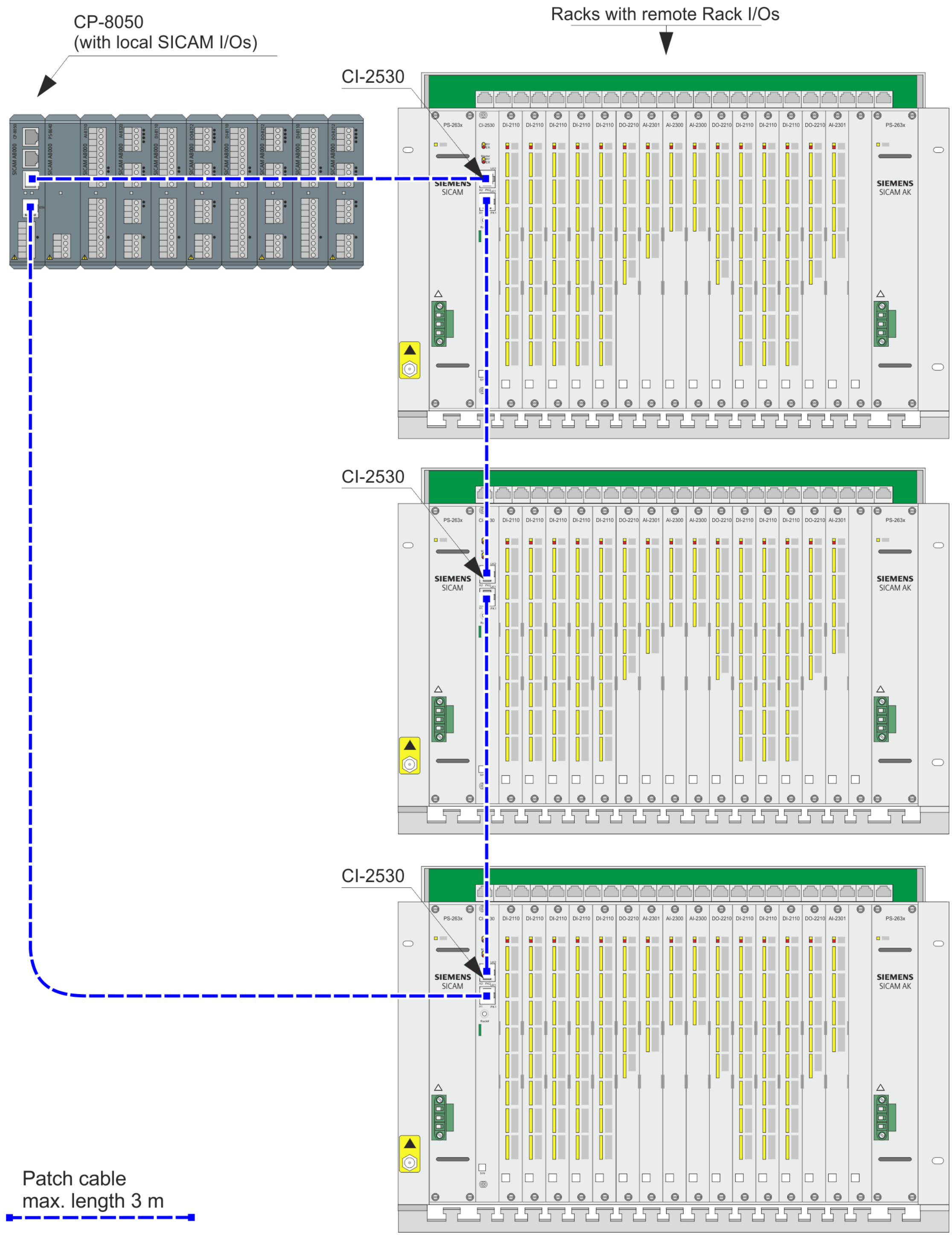


[dw_CP-8050_config_line_opt_remote_io_v3, 2, en_US]

*) Converter see chapter: *15.3.3 Optical Converter (Media Converter) for I/O rows*

15.5 Configurations with SICAM A8000 Rack I/Os

15.5.1 CP-8050 with local SICAM I/0s and 3 Racks with remote Rack I/Os

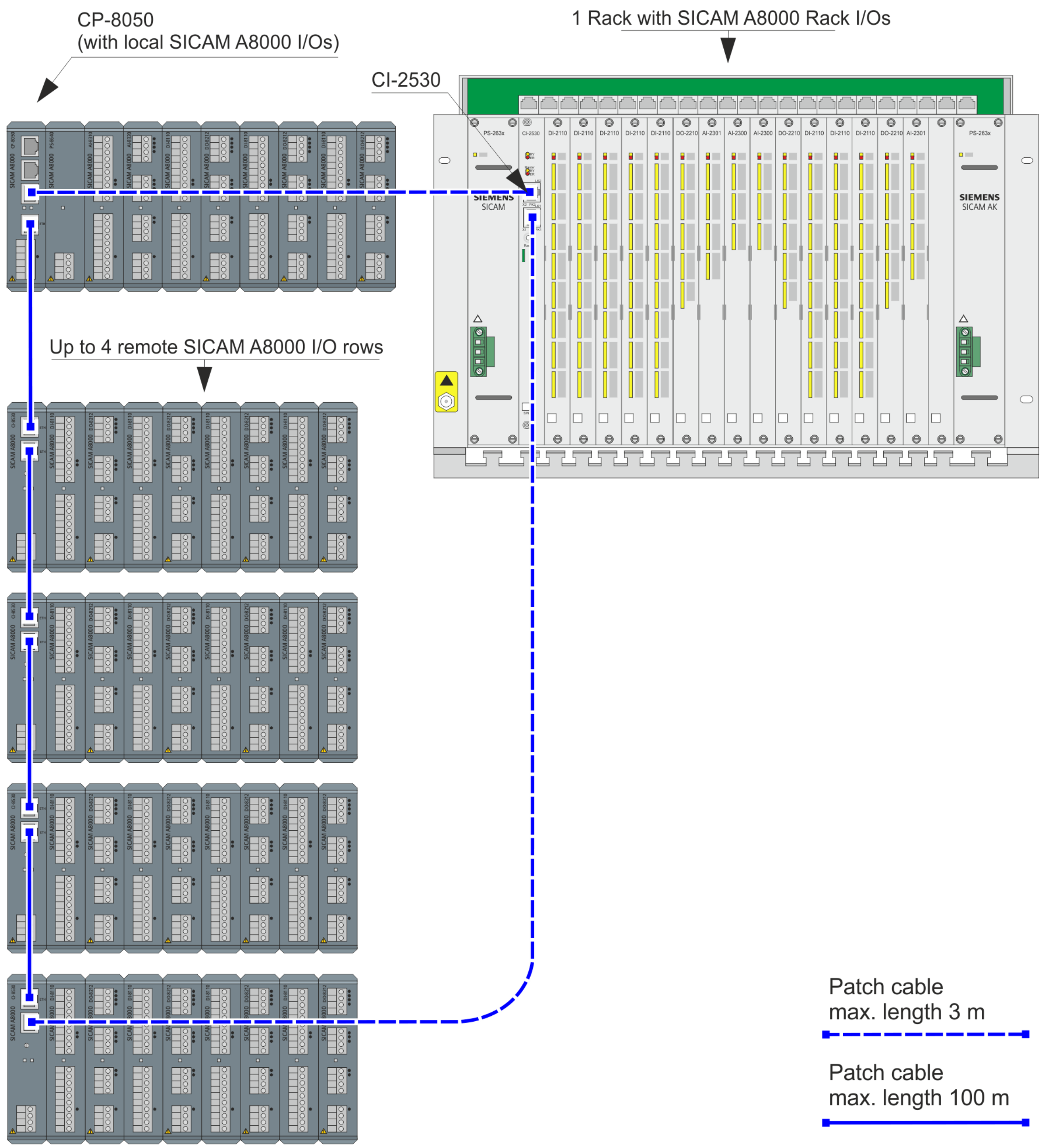


[dw_use_case_rack_sol_CP-8050+3rack_ring, 3, en_US]

NOTE

A maximum of 4 SICAM A8000 racks with I/O modules is possible

15.5.2 CP-8050 with 4 SICAM A8000 I/0 rows and 1 SICAM A8000 Rack



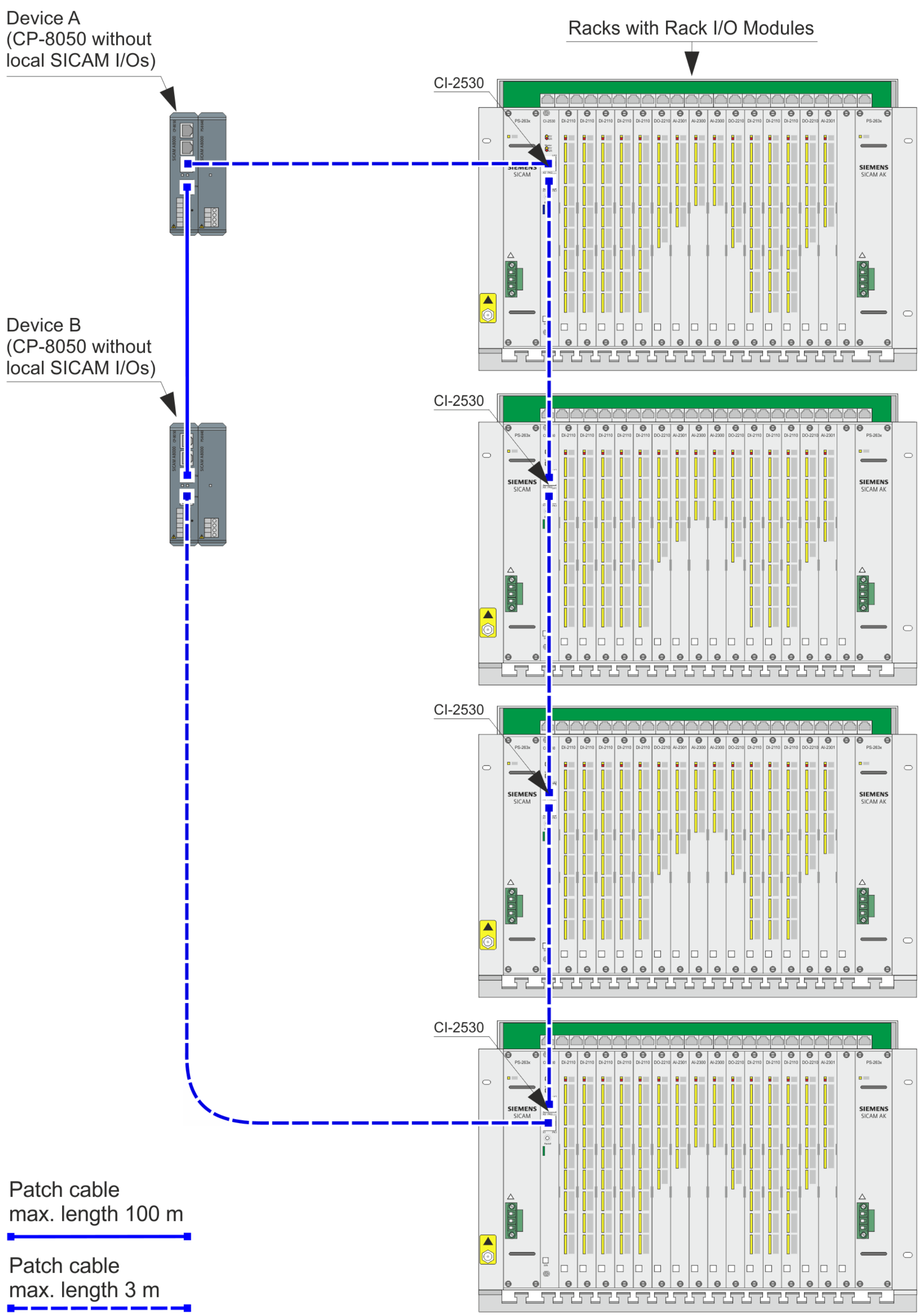
[dw_use_case_rack_sol_CP-8050+1rack+4IO_rows, 3, en_US]

Table 15-1 Further configuration options:

Number of SICAM A8000 lines in the ring	Number of SICAM A8000 racks in the ring
0 (local I/Os possible)	4
4	3
8	2

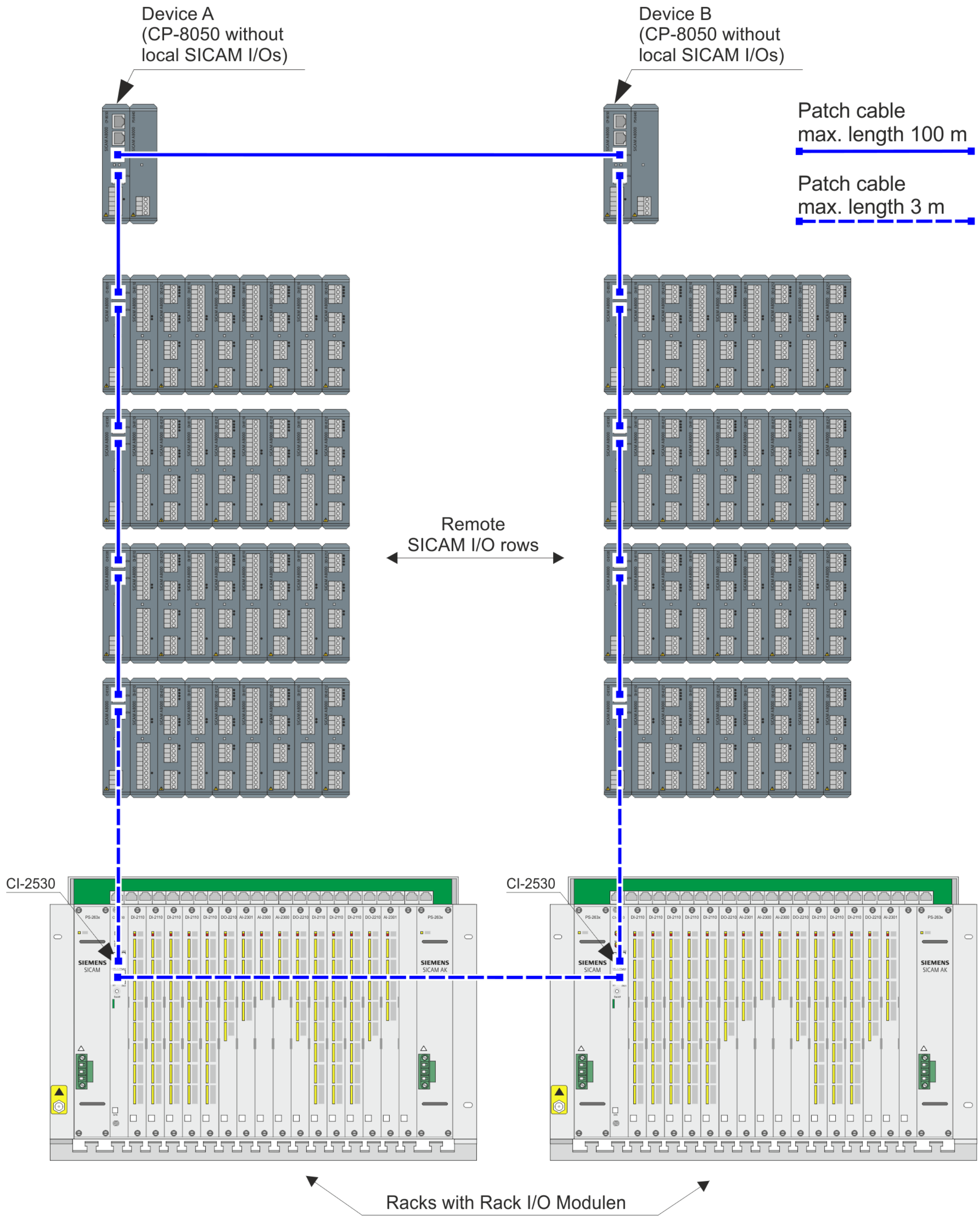
Number of SICAM A8000 lines in the ring	Number of SICAM A8000 racks in the ring
12	1
15	0

15.5.3 Redundant CP-8050 with 4 SICAM A8000 Racks



[dw_use_case_rack_sol_red_CP-8050_4_rack_ring, 1, en_US]

15.5.4 Redundant CP-8050 with 8 SICAM A8000 I/O rows and 2 SICAM A8000 Racks



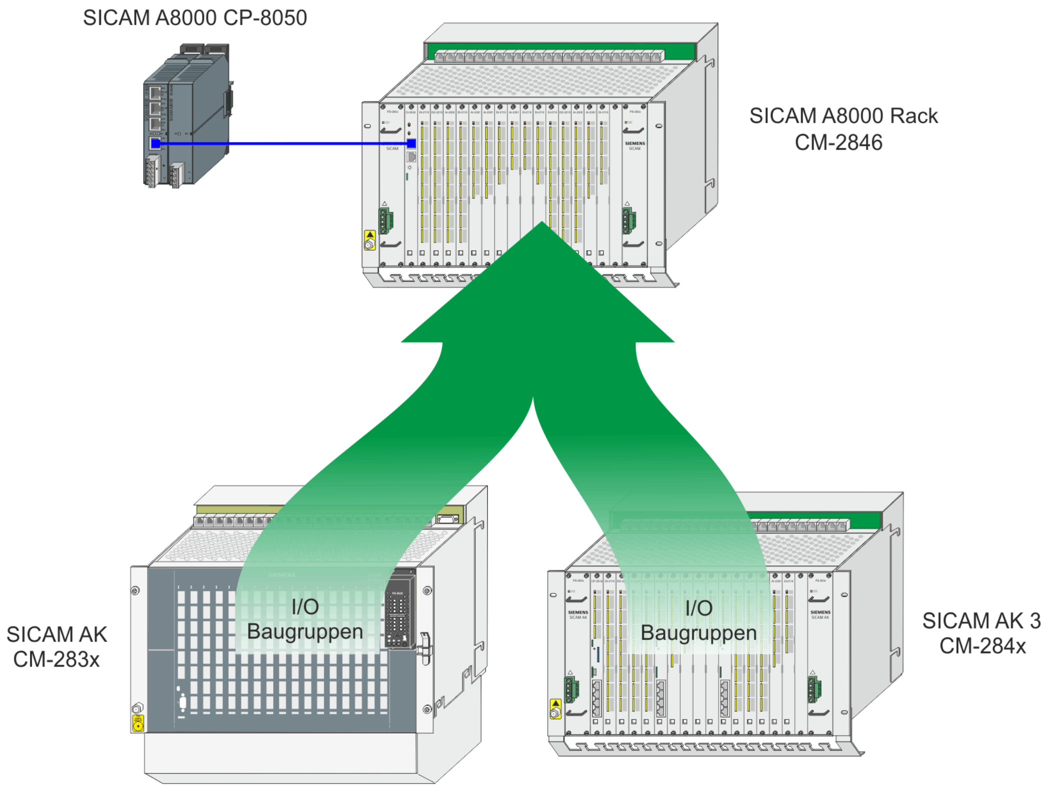
[dw_use_case_rack_sol_red_CP-8050_2_rack_8_rows_ring, 1, en_US]

15.6 Migration of SICAM AK/AK3 I/O modules into the SICAM A8000 rack solution

I/O modules from SICAM AK and AK 3 systems can be coupled to the CP-8050 without any problems using SICAM A8000 racks.

Proceed as follows:

- Equip a SICAM A8000 rack with the CI-2530 SICAM Rack I/O remote module and the required power supply modules (PS-2630/32)
- Insert all I/O modules from the AK rack into the SICAM A8000 rack
- Cover all modules and empty slots with the appropriate front panels



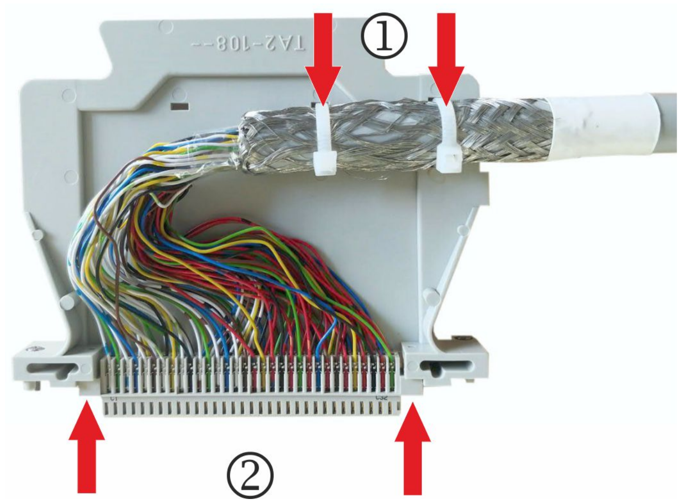
[dw_Migrate_AK_IO_into_CM-2846, 1, --_--]

Conversion from CM-2885 to CM-2890

For I/O modules that are connected with the peripheral cable CM-2885 (connection cable for AK 1703), the handle shell of the peripheral cable must be exchanged in order to be compatible with the SICAM A8000 rack connection technology.

Proceed as follows:

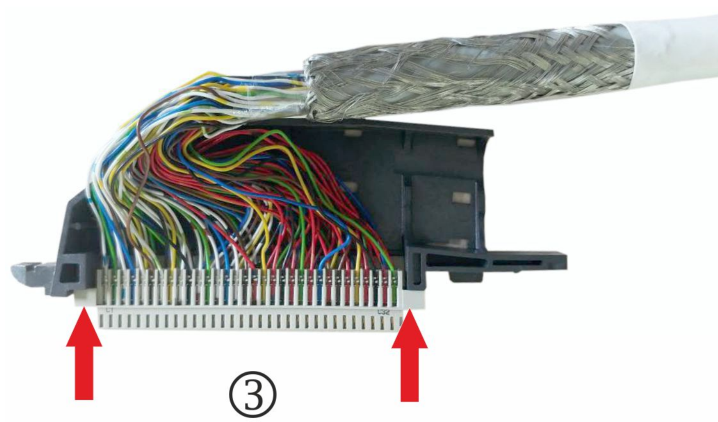
- Cut and remove the zip ties (1)
- Remove the screws (2)



[dw_CM-2885_to_CM-2890_01, 1, --_--]

Figure 15-1 Initial state of CM-2885

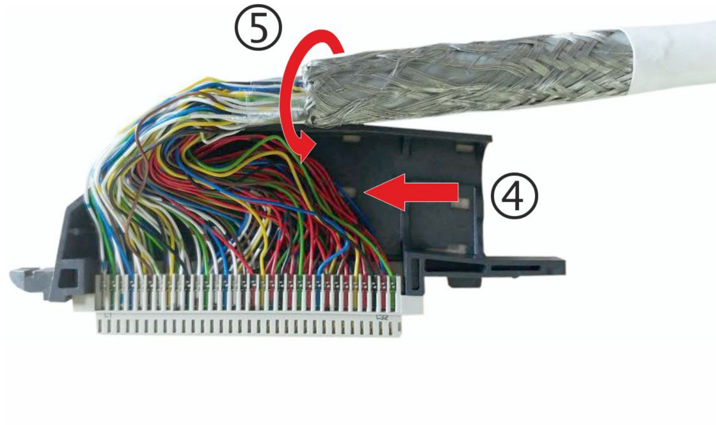
- Fix the clamp in 6MF13130CA000AA0 with the old screws (3)



[dw_CM-2885_to-CM-2890_02a, 1, --_--]

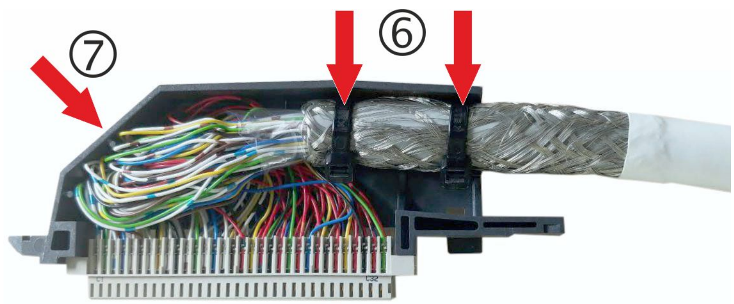
- Push the wires away to free the hole (4)

- Turn the cable so that it lies over the wires (5)



[dw_CM-2885_to-CM-2890_02b, 1, --_--]

- Fix the cable with two cable ties (6); make sure that both are in the area of the screen and that the heads do not protrude
- Note that there are no wires sticking out (7)



[dw_CM-2885_to_CM-2890_03, 1, --_--]

15.7 Initial Commissioning

15.7.1 Mounting of the basic device (CP-8050 + PS-86xx)

The minimum configuration of a basic device consists of the master module and a power supply module. Both modules can be installed on the DIN rail by hand, without any tools.

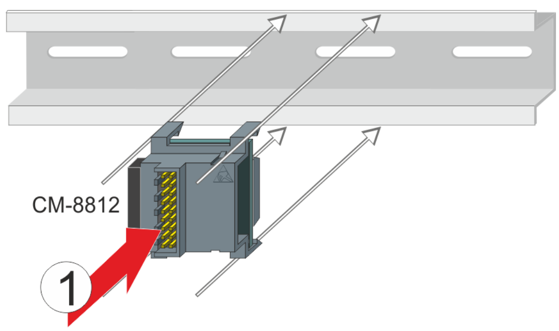
NOTE

Danger of damaging the 50-pole bus connector of the master module.

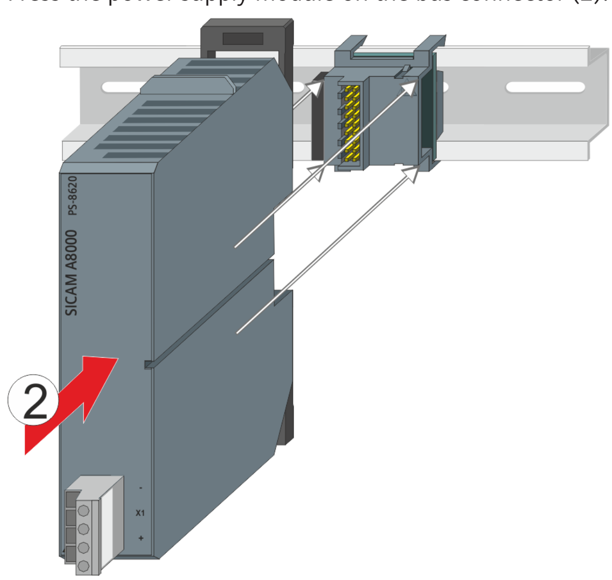
The pins of the bus connector can be damaged, if the master module is not plugged exactly on it bus connector. To avoid this, Siemens recommends to mount at first the power supply module and afterwards the master module. Thus the master module can use the tongue/groove system between the module housings. This integrated system enables an exact positioning of the module on the bus connector.

Mounting of the power supply module

✧ The power supply module is equipped with bus connector CM-8812. Disconnect the bus connector from the module and mount it at the required position on the DIN rail (1).

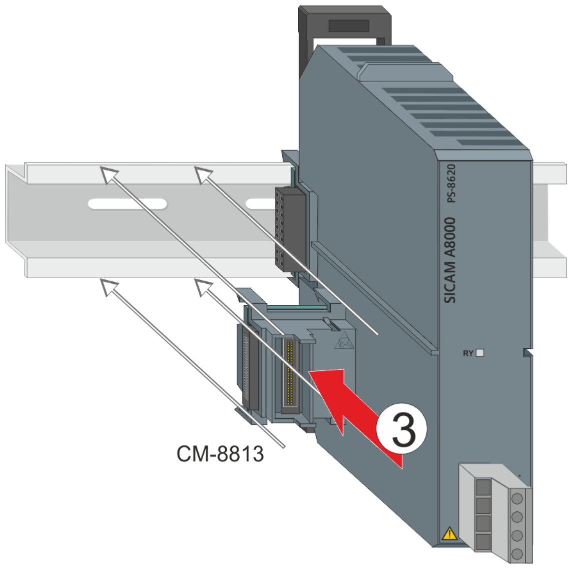


✧ Press the power supply module on the bus connector (2).

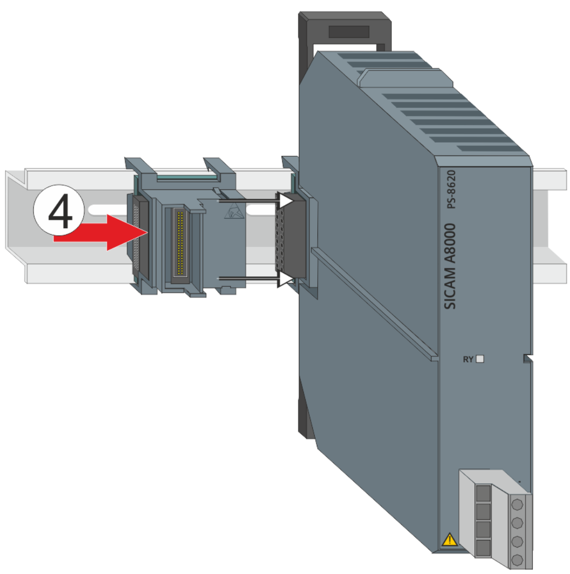


Installation of the Master Module

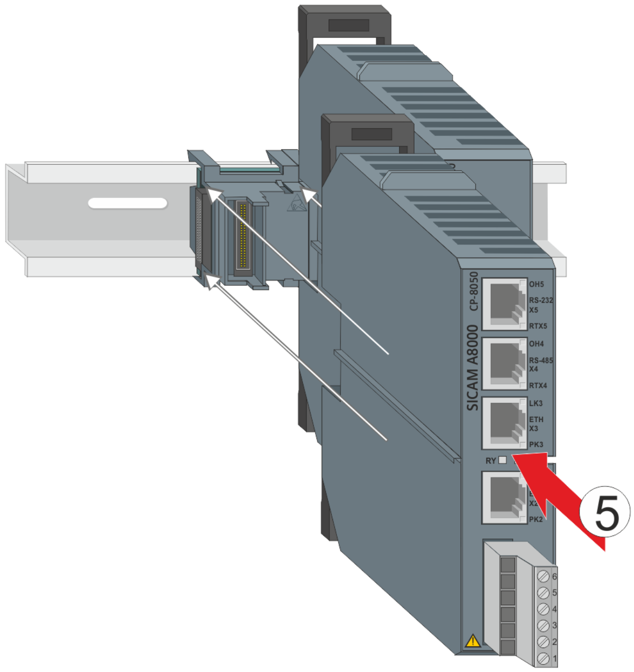
✧ Click now the bus connector of the master module (CM-8813) left from the power supply module on the DIN rail (3).



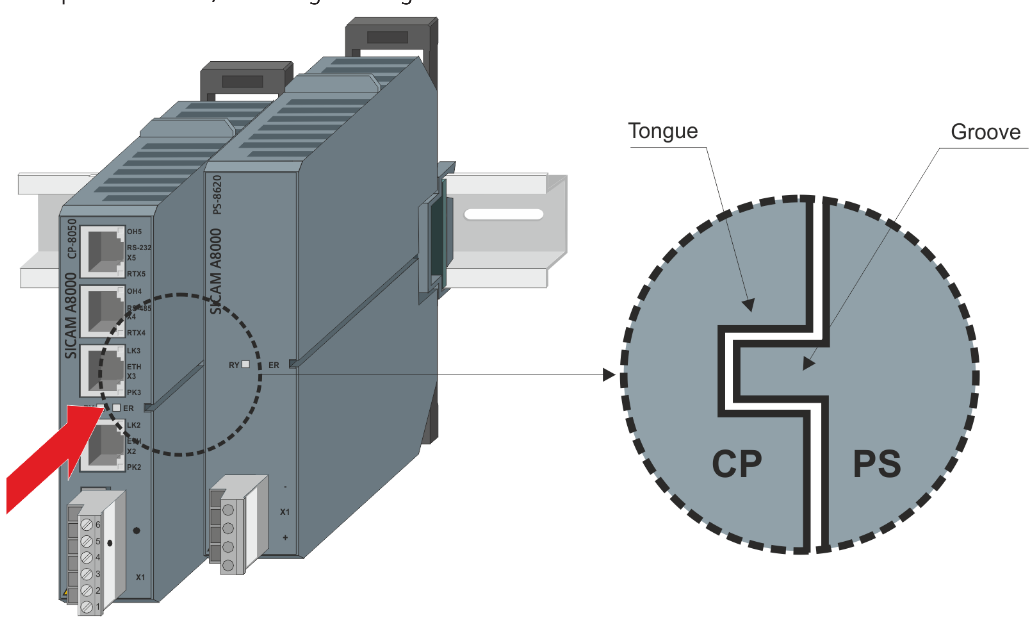
✧ Push it into the bus connector of the power supply module (4). Both elements must be aligned seamless.



✧ Press now the master module careful on its bus connector (5).



✧ Take particular care, that tongue and groove of both modules fit into each other.



15.7.2 First Time Login on the AU with SICAM WEB

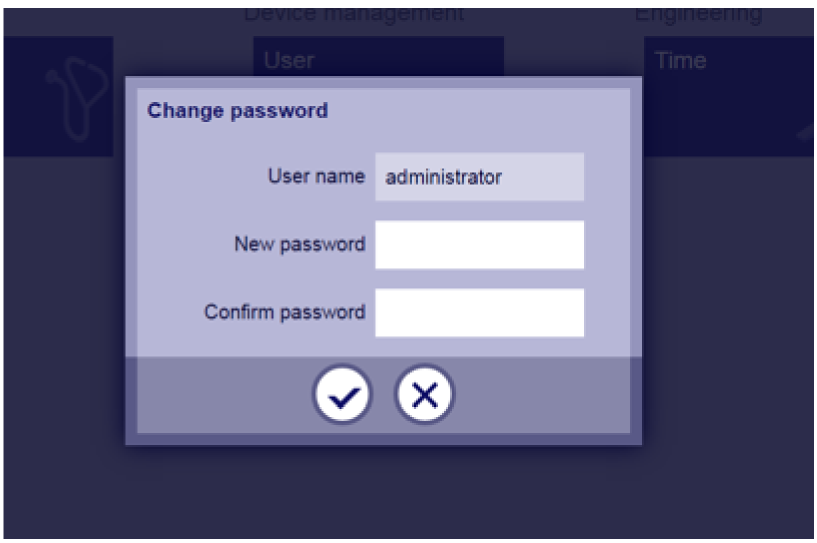
Preconditions:

- The hardware of the systems (CP-8050, PS-86xx ...) is installed and ready for operation
- The connection between engineering PC and CP-8050 is established

Procedure:

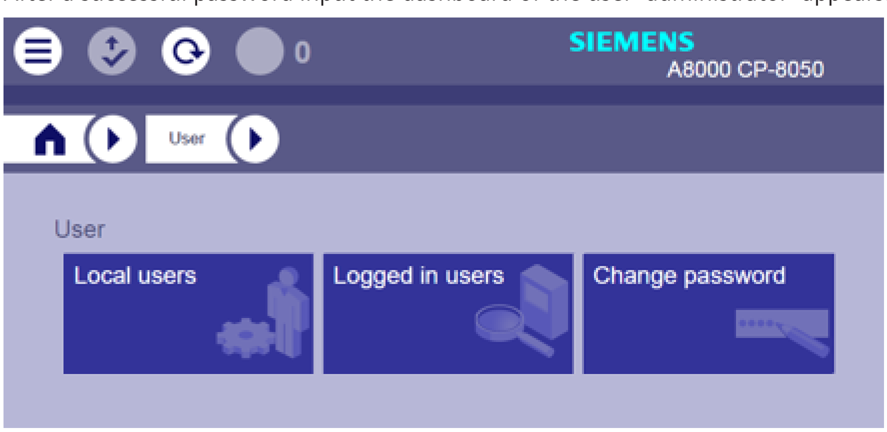
✧ Open a web browser and enter in the address bar the standard IP address (https://172.16.0.3) of your CP-8050.

✧ If the CP-8050 is in status "Factory Settings" (e.g. during commissioning), you can only login with default user "administrator". No password is assigned to this user in the "Factory Settings". You are requested to set one now.



This password must have between 8 and 54 signs (letters, numbers and special characters are possible). If you do not enter a password, you will be logged off.

✧ After a successful password input the dashboard of the user "administrator" appears.



NOTE

Depending on the parameterization, either an http or https address must be entered in the browser, in order to establish the connection. During the first connection setup via https, a check is made if a corresponding security certificate has been installed. If this is missing, it must be installed manually (see *www.siemens.com/gridsecurity*, Tab `Cyber Security General Downloads`, Register `Application Notes`, Document `Certificate trusting in web browsers`).

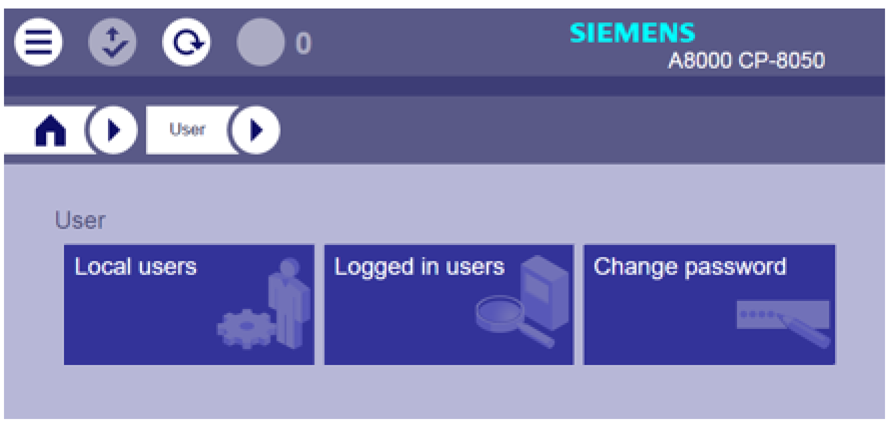
15.7.3 Creation of a local user

Preconditions:

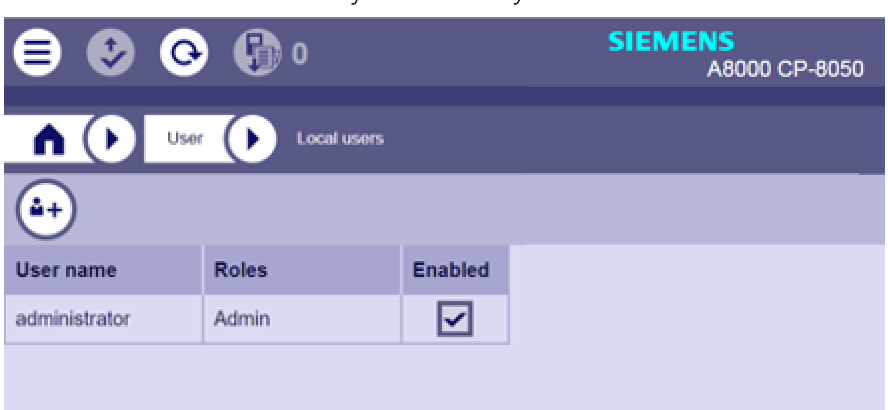
- User with "administrator rights" is logged on to the device.

Procedure:

✧ On the dashboard click the tile "Local User".

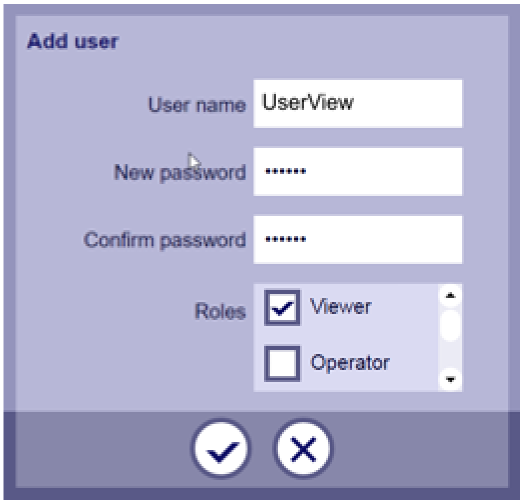


The sub menu "Local User" shows now which users exist on the connected device and which role they have. A device which is in delivery status has only the user "administrator".



✧ Click on  to create an additional local user.

✧ Define username, password and role of the new local user.



✧ Save your settings with a click on 

The sub menu "Local User" shows now the new created user and which role he has.

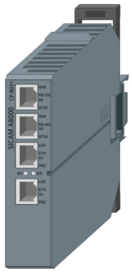
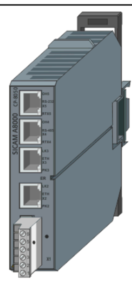
✧ By clicking the check box in column "Activated" you can activate or deactivate the new user.

NOTE

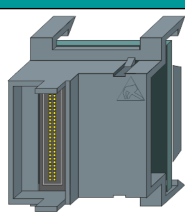
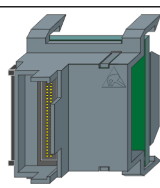
To delete a local user select it in the local user list and click on  .

A Ordering Information

A.1 SICAM A8000 Master Modules

	Designation	MLFB
	CP-8031 Master Module	6MF28031AA00
	CP-8050 Master Module	6MF28050AA00

Spare Part

	Designation	Order number
	CM-8813 Bus connector CP-8031/CP-8050 (this bus connector is part of CP-8031/CP-8050)	C53207-A5813-D481 (for master modules with version EE and lower)
		C53207-A5813-D482 (for master modules with version FF and higher)

	Designation	Order number
	Locking hook SICAM A8000 3 cm Module	C53207-A5014-D481 (for master modules with version EE and lower) Minimum Order Quantity: 10 pieces
		C53207-A5014-D482 (for master modules with version FF and higher) Minimum Order Quantity: 10 pieces

A.2 SICAM License

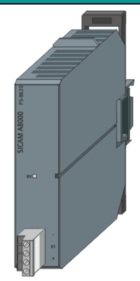
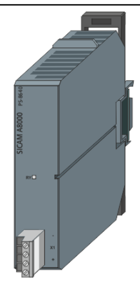
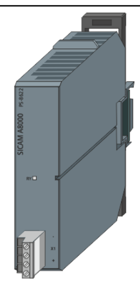
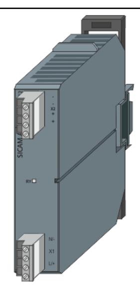
ALM Licenses - OSD Download

	Designation	MLFB
	SICAM 8 Extended Processing	6MF2750-2EP00
	SICAM 8 IEC104 Firewall	6MF2750-2FW40
	SICAM 8 SIAPP Container	6MF2750-2LX00
	SICAM 8 Redundancy	6MF2750-2RE00 (contains 2 licenses; device A and B)
	SICAM 8 Extended SICAM WEB	6MF2750-2WE00
	SICAM 8 Licensed Protocol	6MF2750-2PR00
	SICAM A8000 CP-803x Extended CI-Module	6MF2750-2EX00
	SICAM A8000 - 852x Redbox	6MF2750-2RB00

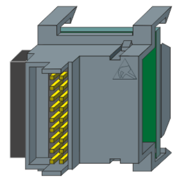
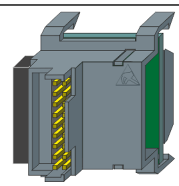
SICAM Function Point Manager License

SICAM Function Point Manager Licenses are generated with the *SICAM Function Point Manager*.
The ordering process is described in the user manual**Function Point Manager**, section**SICAM License Files**.

A.3 SICAM A8000 Power Supply Modules

	Designation	MLFB
	PS-8620 Power Supply DC 24 - 60 V 12 W	6MF28620AA00
	PS-8640 Power Supply DC 24 - 60 V 45 W	6MF28640AA00
	PS-8622 Power Supply DC 110 - 220 V 12 W	6MF28622AA00
	PS-8642 Power Supply 100-240VDC o. VAC 45W	6MF28642AA00

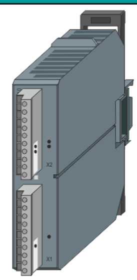
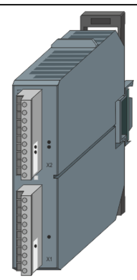
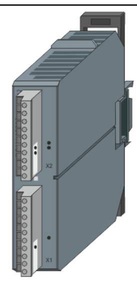
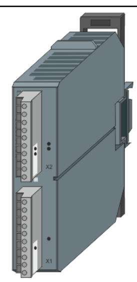
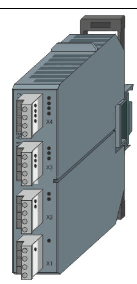
Spare Part

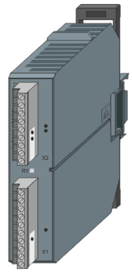
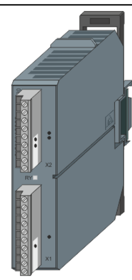
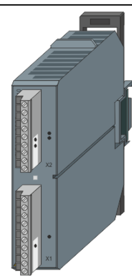
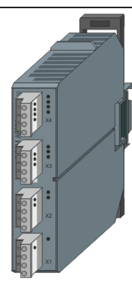
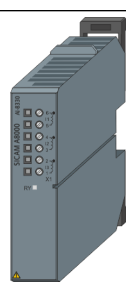
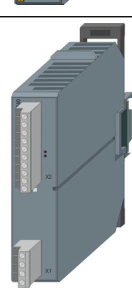
	Designation	Order number
	CM-8812 Bus connector SICAM I/O (this bus connector is part of all PS-862x and PS-864x)	C53207-A5812-D481 (for power supply modules with version EE and lower) Minimum Order Quantity: 10 pcs.
		C53207-A5812-D482 (for power supply modules with version FF and higher) Minimum Order Quantity: 10 pcs.
	Locking hook SICAM A8000 3 cm Module	C53207-A5014-D481 (for master modules with version EE and lower) Minimum Order Quantity: 10 pieces
		C53207-A5014-D482 (for master modules with version FF and higher) Minimum Order Quantity: 10 pieces

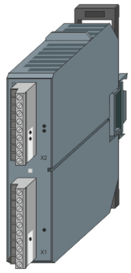
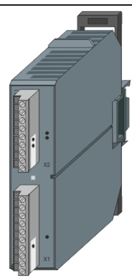
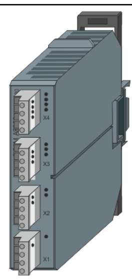
A.4 SICAM A8000 Rack Power Supply Modules

	Designation	MLFB
	PS-2630 Power Supply 24-60 VDC	6MF11130CG300AA0
	PS-2632 Power supply 110-220 VDC, 230 VAC	6MF11130CG320AA0

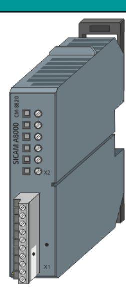
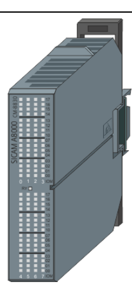
A.5 SICAM A8000 I/O-Module

	Designation	MLFB
	DI-8110 Digital input 2x8, 24VDC	6MF28110AA00
	DI-8111 Digital input 2x8, 48/60VDC	6MF28111AA00
	DI-8112 Digital input 2x8, 110VDC	6MF28112AA00
	DI-8113 Digital input 2x8, 220VDC	6MF28113AA00
	DO-8212 Dig Outp Rel 8x 24-220VDC/230VAC	6MF28212AA00

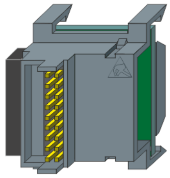
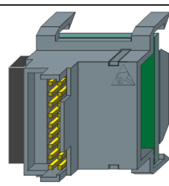
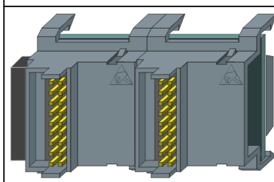
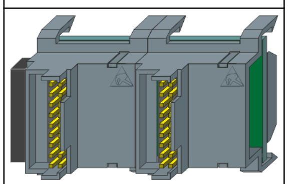
	Designation	MLFB
	DO-8221 Secured command output	6MF2822-1AA00
	DO-8230 Digital output transistor 16x 24-60VDC	6MF28230AA00
	AI-8310 Analog input 2x2 Pt100/Pt1000	6MF28310AA00
	AI-8320 Analog input 4x ±20mA/±10V	6MF28320AA00
	AI-8330 Ana. Input 3xI(6A) with AI-8340	6MF28330AA00
	AI-8340 Ana. Input (4xU(250V), 2xDO)	6MF28340AA00

	Designation	MLFB
	AI-8510 Ana. Inp. (3xU(240V),3xI(LoPo)) Note: CM-8820 is required for current measurement!	6MF28510AA00
	AI-8511 Ana. Inp. (3xU(LoPo),3xI(LoPo))	6MF28511AA00
	AO-8380 Analog output 4x ±20mA/±10V	6MF28380AA00

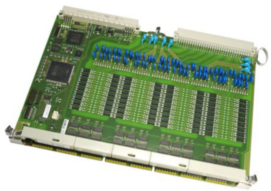
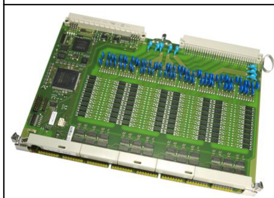
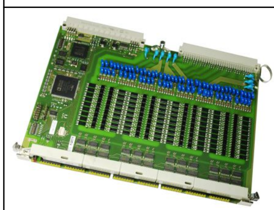
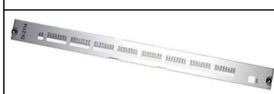
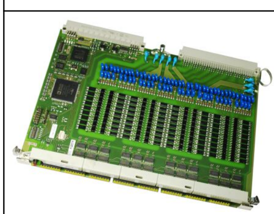
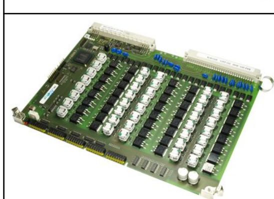
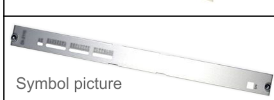
Accessories

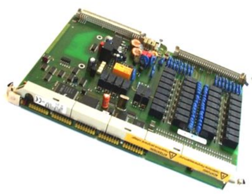
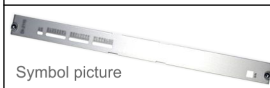
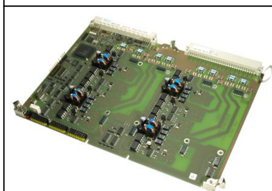
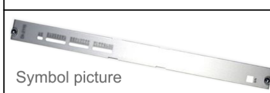
	Designation	MLFB
	CM-8820 CT-Adapter 3xI 1A_5A/225mV	6MF28820AA00
	CM-8830 SICAM I/O Module LED Unit	6MF28830AA00

Spare Part

	Designation	Order number
	CM-8812 Bus connector SICAM I/O (this bus connector is part of all SICAM I/O-Modules)	C53207-A5812-D481 (for I/O-modules with version EE and lower) Minimum Order Quantity: 10 pieces
		C53207-A5812-D482 (for I/O-modules with version FF and higher) Minimum Order Quantity: 10 pieces
	CM-8816 Bus Connector AI-8340 (this bus connector is part of all AI-8330 modules)	C53207-A5815-D481 (for AI-8330 module with version EE and lower)
		C53207-A5815-D482 (for AI-8330 module with version FF and higher)
	Locking Hook SICAM A8000 3 cm Module	C53207-A5014-D481 Minimum Order Quantity: 10 pieces
		C53207-A5014-D482 (for I/O-modules with version FF and higher) Minimum Order Quantity: 10 pieces

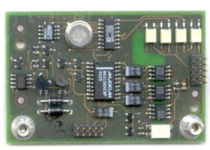
A.6 SICAM A8000 Rack I/O Modules

	Designation	MLFB
	DI-2112 Digital Input 8x8, 24VDC,1ms	6MF10130CB120AA0
	Front panel DI-2112	6MF13130CA720AA0
	DI-2113 Digital Input 8x8, 48/60VDC,1ms	6MF10130CB130AA0
	Front panel DI-2113	6MF13130CA730AA0
	DI-2114 Digital Input 8x8, 110VDC,1ms	6MF10130CB140AA0
	Front panel DI-2114	6MF13130CA740AA0
	DI-2115 Digital Input 8x8, 220VDC,1ms	6MF10130CB150AA0
	Front panel DI-2115	6MF13130CA750AA0
	DO-2201 Dig. Outp.Trans 40x1,24-60VDC	6MF10110CC010AA0
	Front panel DO-2201	6MF13130CA760AA0

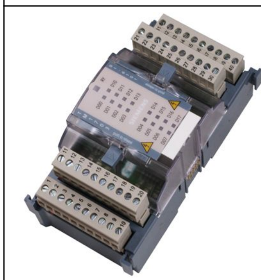
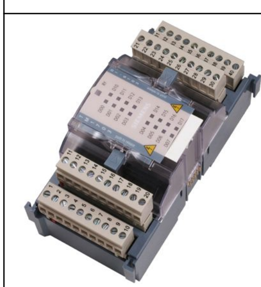
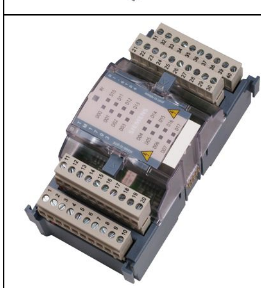
	Designation	MLFB
	DO-2210 Command Output 24-60VDC	6MF10110CC100AA0
 Symbol picture	Front panel DO-2210	6MF13130CA770AA0
	DO-2211 Command Output 125VDC	6MF10110CC110AA0
 Symbol picture	Front panel DO-2211	6MF13130CA780AA0
	AI-2300 Ana. Inp.16x ±20mA + 4x opt.IOM	6MF10110CD000AA0
 Symbol picture	Front panel AI-2300	6MF13130CA790AA0

Submodules

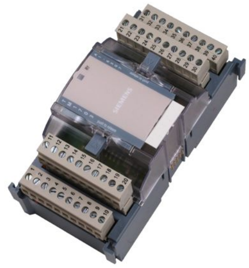
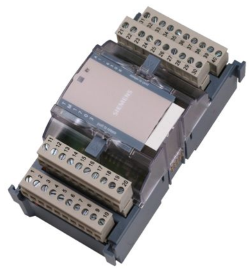
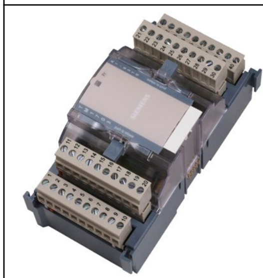
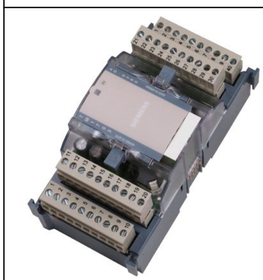
	Designation	MLFB
	SM-0570 Analog Input Extension (2x+/-20mA)	6MF10110AF700AA0
	SM-0571 Analog Value Extension (2x Pt100)	6MF10110AF710AA0

	Designation	MLFB
	SM-0572 Analog output extension (2x ±20 mA, ±1/10 V)	6MF10110AF720AA0
	SM-0574 Counter input (2x24-60VDC)	6MF10110AF740AA0
	SM-2506 Measuring module for command output 24-60VDC	6MF10110CF060AA0

A.7 SICAM TM 1703 I/O-Modules

	Designation	MLFB
	DI-6100 Binary input 2x8 DC 24...60 V	6MF11130GB000AA0
	DI-6101 Binary input 2x8 DC 110/220 V	6MF11130GB010AA0
	DI-6102 Binary input 2x8 DC 24...60 V, 1 ms	6MF11130GB020AA0
	DI-6103 Binary input 2x8 DC 110/220 V, 1 ms	6MF11130GB030AA0
	DI-6104 Binary input 2x8 DC 220 V	6MF11130GB040AA0

	Designation	MLFB
	DO-6200 Binary output transistor 2x8 DC 24...60 V	6MF11130GC000AA0
	DO-6212 Binary output relays 8x DC 24...220 V / AC 230 V	6MF11130GC120AA0
	DO-6220 Checked command output basic module	6MF11130GC200AA0
	DO-6221 Checked command output basic module measurement	6MF11130GC210AA0
	DO-6230 Checked command output relay module	6MF11130GC300AA0
	AI-6300 Analog input 2x2 ±20 mA/±10 V	6MF11130GD000AA0

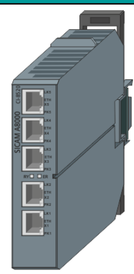
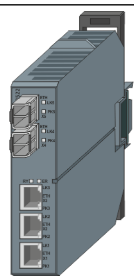
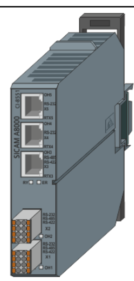
	Designation	MLFB
	AI-6307 Analog input 2x2 ±2.5 mA/±5 mA/±10 V	6MF11130GD070AA0
	AI-6308 Analog input 2x2 ±1 mA/±2 mA/±10 V	6MF11130GD080AA0
	AI-6310 Analog input 2x2 Pt100/Ni100	6MF11130GD100AA0
	AO-6380 Analog output 4x ±20 mA/±10 mA/±10 V	6MF11130GD800AA0
	TE-6420 Speed acquisition 2x2 5/24VDC/NAMUR	6MF11130GE200AA0

	Designation	MLFB
	TE-6430 Counting Pulse Inp. 2x DC 24 to 60 V	6MF11130GE300AA0
	TE-6450 Position acquisition 2x2 SSI/RS422	6MF11130GE500AA0

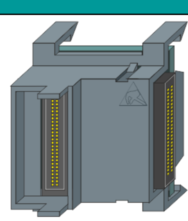
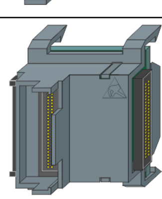
Accessories for coupling SICAM TM I/O modules to CP-8050

	Designation	MLFB
	CM-6812 Coupling to SICAM TM I/O	6MF11130GJ120AA0

A.8 Communication Modules

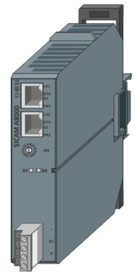
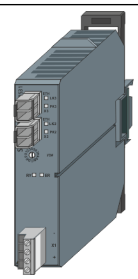
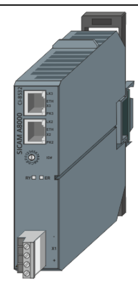
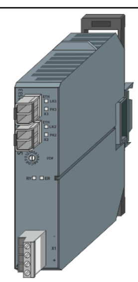
	Designation	MLFB
	CI-8520 Ethernet Interface	6MF28520AA00
	CI-8522 Network Interface F/O	6MF28522AA00
	CI-8551 Communication Interface serial	6MF28551AA00

Spare Part

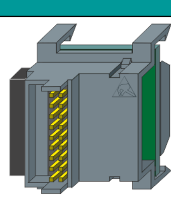
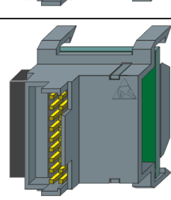
	Designation	Order number
	CM-8814 Bus connector Comm. Int. 1 pcs (this bus connector is part of all CI-852x and CI-8551 modules)	C53207-A5814-D481 (for communication modules with version EE and lower)
		C53207-A5814-D482 (for communication modules with version FF and higher)

	Designation	Order number
	Locking hook SICAM A8000 3 cm Module	C53207-A5014-D481 (for master modules with version EE and lower) Minimum Order Quantity: 10 pieces
		C53207-A5014-D482 (for master modules with version FF and higher) Minimum Order Quantity: 10 pieces

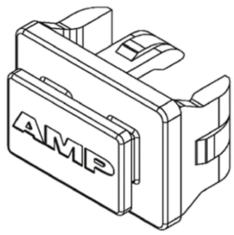
A.9 SICAM A8000 I/O Remote Modules

	Explanation	MLFB
	CI-8530 SICAM I/O Remote 24-60VDC el.	6MF28530AA00
	CI-8531 SICAM I/O Remote 24-60VDC F/O	6MF28531AA00
	CI-8532 SICAM I/O Remote 110-220VDC el.	6MF28532AA00
	CI-8533 SICAM I/O Remote 110-220VDC F/O	6MF28533AA00

Spare Part

	Explanation	Order number / MLFB
	CM-8812 Bus connector SICAM I/O (this bus connector is part of all SICAM I/O Remote Modules)	C53207-A5812-D481 (for I/O remote modules with version EE and lower) Minimum order quantity: 10 pcs.
		C53207-A5812-D482 (for I/O remote modules with version FF and higher) Minimum order quantity: 10 pcs.

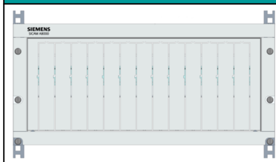
	Explanation	Order number / MLFB
	Locking hooks SICAM A8000 3cm module	C53207-A5014-D481 (for I/O remote modules with version EE and lower) Minimum order quantity: 10 pieces
		C53207-A5014-D482 (for I/O remote modules with version FF and higher) Minimum order quantity: 10 pieces
	CM-0839 SFP-Receiver electrical Type: Electrical SFP Transmission media: Electrical Typical range: 100 m Speed Ethernet: 100 Mbps Power consumption: 1 W	6MF12132AJ300AA0BB
	CM-0838 SFP-Transceiver Optical Type: Optical SFP (Multimode) Transmission media: Optical Typical range: 2 000 m Function: 100BaseFX Separate TX and RX terminals Wavelength: 1310 nm Connector: LC Duplex Power consumption: 0.5 W	6MF12130AJ380AA0
	SFP-Transceiver optical 24 km Type: Optical SFP (Single mode) Transmission media: Optical Typical range: 24 km Function: 100BaseFX Separate TX and RX terminals Wavelength: 1310 nm Connector: LC Duplex	C53207A5104D481 1
	SFP-Transceiver optical 60 km Type: Optical SFP (Single mode) Transmission media: Optical Typical range: 60 km Function: 100BaseFX Separate TX and RX terminals Wavelength: 1310 nm Connector: LC Duplex	C53207A5105D481 1

	Explanation	Order number / MLFB
	Dust cover for SFP 1367147-1	*https://www.rs-online.com/*
	Dust cover for SFP 1367147-3	*https://www.rs-online.com/*

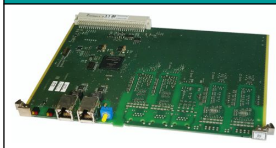
NOTE

Please consider that purchased (spare) parts may have different EMC levels than SICAM A8000. This can influence the overall performance of the system.

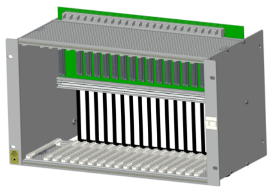
A.10 SICAM A8000 Module Rack

	Designation	Order number
	CM-8846 SICAM A8000 Module Rack	C53207-A5846-D481-1

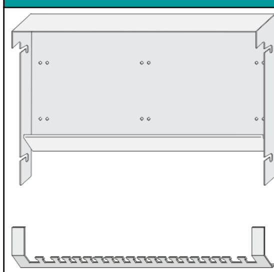
A.11 SICAM A8000 Rack I/O Remote Modules

	Designation	MLFB
	CI-2530 SICAM Rack I/O Remote	6MF22530AA00
	CI-2530 Front panel	6MF22530FA00

A.12 SICAM A8000 Rack

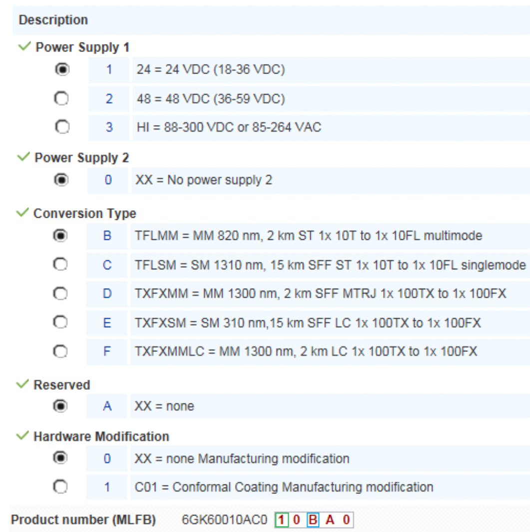
	Designation	MLFB
	CM-2846 SICAM A8000 I/O Rack for 17 slots (without wall mounting kit and without cable strain relief)	6MF11130CJ460AA0

Accessories

	Designation	MLFB
	Wall fastening kit for CM-2846 contains: • Rear cover CM-2846 • Cable strain relief CM-2846 • Screw M6 x 12	6MF13130CH020AA0
	CM-2890 Periphery cable crimp 5m 100 pins	6MF13131CJ000AA0
	Grip flap for CM-2890 connector	6MF13130CA000AA1
	Front panel blank	6MF13130CA860AA0
	FRBL 19"-2HE RAL7035 for 19" (swing-) frame installation	6MF13140DB610AA1
	Cable entry panel for 19 inch (swing-) frame installation	Rittal DK 7140.535
	Cable clamp rail for 19 inch (swing-) frame installation	Rittal DK 7610.000 FRBL19"-
	3HU Front panel RAL7035 for 19" (swing-) frame installation	6MF13140DB620AA0
	EMC earthing strap 140/10/4.5-6.5 *)	6MF13140DA330AA1
	EMC earthing strap 300/16/6.5-8.5 *)	6MF13140DA310AA1

A.13 Transmission Facilities

	Designation	MLFB / Order number
	Siemens Converter LWE - RS-232 For details see: *http://w3.siemens.com/smartgrid/global/en/products-systems-solutions/protection/accessories/communication-equipment/pages/7xv5652.aspx*	7XV5652
	SIEMENS Mini Starcoupler For details see: *http://w3.siemens.com/smartgrid/global/en/products-systems-solutions/protection/accessories/communication-equipment/pages/7xv5450.aspx*	7XV5450
	Siemens SCALANCE M874-2 GPRS-Router 2.5G router; for wireless IP communication of Ethernet-based programmable controllers via 2.5G cellular VPN, firewall, NAT; 2-port switch *https://mall.industry.siemens.com/mall/de/WW/Catalog/Products/10224648*	6GK5874-2AA00-2AA2
	MD741-1 GPRS router	6NH97411AA00
	Dr. Neuhaus Tainy EMOD-V2-IO or Dr. Neuhaus Tainy EMOD-L1-IO	*http://www.sage-mcom.com/de/smart-city/dr-neuhaus/*

<table>
<tr><th></th><th>Designation</th><th>MLFB / Order number</th></tr>
<tr><td></td><td>Siemens Ruggedcom RMC

Description
Power Supply 1
1 24 = 24 VDC (18-36 VDC)
2 48 = 48 VDC (36-59 VDC)
3 HI = 88-300 VDC or 85-264 VAC
Power Supply 2
0 XX = No power supply 2
Conversion Type
B TFLMM = MM 820 nm, 2 km ST 1x 10T to 1x 10FL multimode
C TFLSM = SM 1310 nm, 15 km SFF ST 1x 10T to 1x 10FL singlemode
D TXFXMM = MM 1300 nm, 2 km SFF MTRJ 1x 100TX to 1x 100FX
E TXFXSM = SM 310 nm,15 km SFF LC 1x 100TX to 1x 100FX
F TXFXMMLC = MM 1300 nm, 2 km LC 1x 100TX to 1x 100FX
Reserved
A XX = none
Hardware Modification
0 XX = none Manufacturing modification
1 C01 = Conformal Coating Manufacturing modification
Product number (MLFB) 6GK60010AC0 1 0 B A 0

6GK6001-0AC0x-0yA0
x ...... Power Supply 1
y ... Conversion Type</td><td>VDC 24:
6GK6001-0AC01-0BA0
6GK6001-0AC01-0CA0
6GK6001-0AC01-0DA0
6GK6001-0AC01-0EA0
6GK6001-0AC01-0FA0

VDC 48:
6GK6001-0AC02-0BA0
6GK6001-0AC02-0CA0
6GK6001-0AC02-0DA0
6GK6001-0AC02-0EA0
6GK6001-0AC02-0FA0

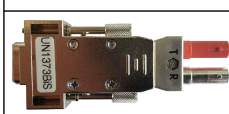
VDC 88-300, VAC 85-264:
6GK6001-0AC03-0BA0
6GK6001-0AC03-0CA0
6GK6001-0AC03-0DA0
6GK6001-0AC03-0EA0
6GK6001-0AC03-0FA0</td></tr>
<tr><td></td><td>Siemens Ruggedcom RS950G "REDBOX"</td><td>https://w3.siemens.com/mcms/industrial-communication/en/rugged-communication/ruggedcom-portfolio/switches-routers-layer-2/compact-switches/pages/rs950g.aspx</td></tr>
<tr><td></td><td>Siemens SCALANCE Type: X101-1
Siemens SCALANCE Type: X101-1LD</td><td>6GK5101-1BB00-2AA3
6GK5101-1BC00-2AA3</td></tr>
<tr><td></td><td>SIMATIC DP, DP/DP-Coupler
Coupling module for connecting two PROFIBUS-DP networks; redundant power supply.</td><td>6ES7158-0AD01-0XA0</td></tr>
</table>

	Designation	MLFB / Order number
	netHOST PROFIBUS Master NHST-T100-DP/DPM Art.Nr.:1890.410 Color:red	- This accessory must be ordered directly from Hilscher. Web: *www.hilscher.com* *http://de.hilscher.com/sales_subsidiaries.html* *http://de.hilscher.com/sales_distributors.html*
	netHOST PROFIBUS Master NHST-T100-DP\GR/DPM Art.Nr.:1891.410 Color: dark grey	- This accessory must be ordered directly from Hilscher. Web: *www.hilscher.com* *http://de.hilscher.com/sales_subsidiaries.html* *http://de.hilscher.com/sales_distributors.html*
	netHOST PROFINET Master (Ethernet LAN PROFINET IO-Controller) NHST-T100-EN/PNM Art.Nr.:1890.840 Color:red	- This accessory must be ordered directly from Hilscher. Web: *www.hilscher.com* *http://de.hilscher.com/sales_subsidiaries.html* *http://de.hilscher.com/sales_distributors.html*
	netHOST PROFINET Master (Ethernet LAN PROFINET IO-Controller) NHST-T100-EN/PNM\GR Art.Nr.: 9385.620 Color: dark grey	- This accessory must be ordered directly from Hilscher. Web: *www.hilscher.com* *http://de.hilscher.com/sales_subsidiaries.html* *http://de.hilscher.com/sales_distributors.html*
	Phoenix FO converter Type: FL MC 2000E LC	*https://www.phoenixcontact.com* Order number: 2891056

NOTE

Please consider that purchased (spare) parts may have different EMC levels than SICAM A8000. This can influence the overall performance of the system.

A.14 Interface Modules

	Designation	MLFB / Order number
	CM-0847 Fibre optical interface (el.-FO)	6MF11130AJ470AA0
	PHOENIX PSM-ME-RS232/RS485-P interface converter	*https://www.phoenixcontact.com* Order number: 2744416
	Phönix PSM-EG-RS232/RS422-P/4K interface converter	MLFB / Order number: *https://www.phoenixcontact.com* Order number: 2761266
	**UN1373BiS (Media converter optical/RS-232)** AGP coupling plug for connection to AGP Gateway including license key for operating the firmware with the AGP. Fiber optic connector for V.24 data transmission over shorter distances with a 1000 µ PMMA fiber for IBM PC. Power supply from the data circuit. Current consumption: approx. 5 mA Data rate: approx. 40 kBaud Electric connection: D-sub connector, 9-pin, socket Wavelength: 660 nm Launched power: 15 µW (-18 dBm) (V_{TxD} = 10 V) Sensitivity: 0,2 µW (-37 dBm) Optic budget: 16 dB (+3 dB system reserve) Typical range: 60 m Optical connection: ST plug Optical signal layer: inversion (idle state: light ON) Housing: plastic, metallized Operating temperature 0 to +65°C Art.Nr.: UN1373BiS	To be ordered at Siemens Walter-shausen. Order designation: UN1373BiS

NOTE

Please consider that purchased (spare) parts may have different EMC levels than SICAM A8000. This can influence the overall performance of the system.

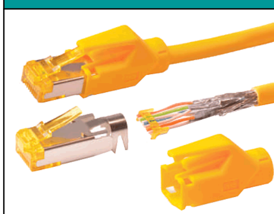
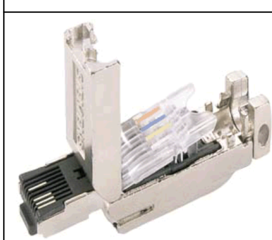
A.15 Recommended Upstream Power Supply Devices

	Designation	
	MTM Power HSA50 S24 AC 90 to 264 V or DC 120 to 340 V Output DC 24 V, 2,1 A	
	SYKO EWS 01 U.06.05.20 AC 82 to 264 V Output 5 V, 2 A SYKO EWS 01 U.06.24.05 DC 36 to 350 V Output 24 V, 0,5 A	

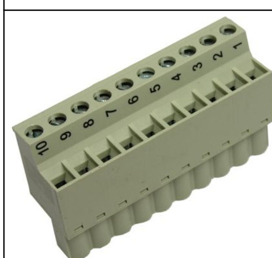
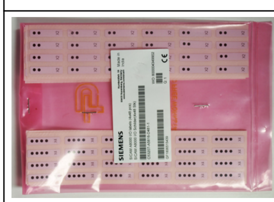
A.16 Cables and Connectors

Ethernet cable and optical cables

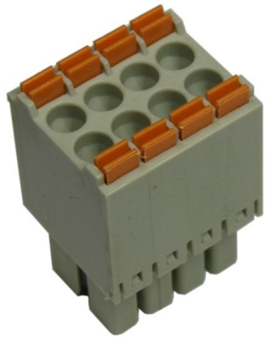
	Explanation	Length	Order designation
	Industrial Ethernet TP-Kabel RJ45/RJ45, CAT 6A (only for -25 °C to +80 °C) SF/FTP cable with high quality connectors	1 m	6XV1870-3QH10
		2 m	6XV1870-3QH20
		3 m	6XV1870-3QH30
		4 m	6XV1870-3QH40
		6 m	6XV1870-3QH60
		10 m	6XV1870-3QN10
	Industrial Ethernet FastConnect TP standard cable GP 4x 2, TP installation CAT 6A cable for connection to IE FC RJ45 Plug 4x 2, AWG24, sold by the meter, delivery length max. 2000 m, Minimum order 20 m SF/FTP cable with high quality connectors	from 50 m:	6XV1878-2A Fixed installation - rigid
			6XV1878-2B Fixed installation - flexible
	Fiber optic cable of type LC-LC multimode duplex, OM1 orange (62.5 µm/125 µm)	–	*https://export.rsdelivers.com/* RS, stock no. 536-7106

	Designation	Order designation
	CAT6A crimp connector	Hirose / Type TM31P
	Connector for 10/100/1000 Ethernet TX	6GK1901-1BB11-2AB0 (RS-Comp.-Order# 758-9193)
	Connector for 10/100/1G/10G Ethernet TX	6GK1901-1BB12-2AB0 (RS-Comp.-Order# 203-3745)

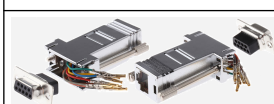
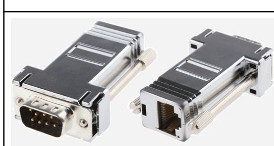
Terminals for I/O modules and CP-8050

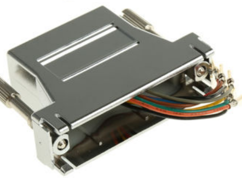
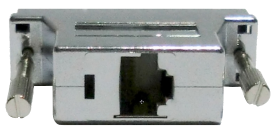
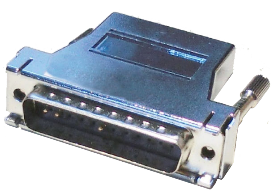
	Designation	Order number
	Removable screw terminal 4-pole Phoenix Type designation: FRONT-MSTB-2,5/4-ST-5,08	*https://www.phoenixcontact.com* Order number: 1709836 Minimum order quantity: 50 pcs.
	Removable screw terminal 6-pole Phoenix Type designation: FRONT-MSTB-2,5/6-ST-5,08	*https://www.phoenixcontact.com* Order number: 1715757 Minimum order quantity: 50 pcs.
	Removable screw terminal 10-pole Phoenix Type designation: FRONT-MSTB-2,5/10-ST-5,08	*https://www.phoenixcontact.com* Order number: 1709767 Minimum order quantity: 50 pcs.
	SICAM A8000 I/O labels (4x48 pcs.) Set, each with 48 pieces (X1, X2, X3, X4)	Order number: C53207-A5816-D481-1

Terminals for CP-8021, CP-8022 and CI-8551

	Designation	Order number
	Push-in terminal 8-pole Phoenix Type designation: DFMC 1,5/ 4-ST-3,5	*https://www.phoenixcon-tact.com* Order number: 1714514 Minimum order quantity: 50 pcs.
	SICAM A8000 COM labels (4x48 pcs.) Set, each with 48 pieces (X1, X2, X3, X6)	Order number: C53207-A5835-D481-1

Recommended third-party products

	Explanation	Ethernet Link
	Connection CM-8820 → AI 8510 HSLCH FRNC (7x 0.75 mm²)	*http://www.meinhart.at/home/*
	Connection CM-8820 → AI 8510 ÖLFLEX FD 855 CP (7 G 0.5 mm²)	*http://www.lappkabel.de/*
	D-Sub/RJ45 adapter (socket) MHDA9-SMJ8-M-K Order number 382-2695	*http://at.rs-online.com/web/p/products/3822695/*
	D-Sub/RJ45 adapter (male) HDA9-PMJ8-M-K Order number 382-2689	*http://at.rs-online.com/web/p/products/3822689/*

	Explanation	Ethernet Link
   	RS PRO RJ Adapter 25-pole D-Sub Male, RJ45 Female Adapter, 39 mm RS Order number 370-5196	*https://at.rs-online.com/web/p/rj-adapter-kupplungen-und-verlangerungen/3705196/*
	FTDI - Chip US232R-10 (RS 429-274) with 10 cm cable	*http://at.rs-online.com/web/p/products/0429274/*
	FTDI - Chip US232R-100-BLK (RS 687-7806) with 1-m cable	*http://at.rs-online.com/web/p/products/6877806/*

NOTE

If the purchased spare parts claim higher or lower EMC levels than Siemens devices, then the overall EMC level claimed for Siemens devices cannot be achieved.

A.17 Memory Cards

	Designation	MLFB
	SD card 512 MB Temperature range - 40 to + 70 °C (Spare Part)	6MF12132GA050AA0
	SD card 2 GB Temperature range - 25 to + 70 °C (Spare Part)	6MF12131GA050AA0

A.18 IE RJ45 Port Lock

	Designation	MLFB
	RJ45 Port Lock Port lock with key for mechanical closing of RJ45 ports 1 pack = 1 piece	6GK1901-1BB50-0AA0

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