SIEMENS

SICAM RTUs

SICAM AK 3

System Description

Unrestricted MC2-025-2.03

Note

Please observe Notes and Warnings for your own safety in the Preface.

Preface

Purpose of this manual

This manual and describes the function and the manner of working of the system SICAM AK 3. It provides the following information and overviews:

- General overview of the product and its applications
- Mechanical design and configuration of the system
- Functionality of the system and interconnection of the individual functions
- Environmental Conditions
- System components with technical data
- Order information

Target Group

This manual is directed to sales managers, customers or project engineers, who are entrusted with telecontrol and automation systems of the product group SICAM RTUs.

Recommendations for Third-Party Products

Siemens does neither receive liability nor warranty for recommendations which are given or implied by this manual. For the correct and intended use of the respective product the associated technical descriptions must be paid attention to in any case.

References to Third-Party Web Sites

Siemens is not responsible for the contents of third-party websites mentioned in this document, as well as the correctness of the publications and links. For all product information the respective manufacturer is responsible.

Typographic and Sign Conventions

- Manuals to be referred to are represented in *italics*, such as e.g. *SICAM RTUs Common Functions System and Basic System Elements*.
- For easy reading, certain designations and names are presented *in this font*
- Symbolic names are presented *in this font*

Placement into the Information Landscape

Document name	Item Number
SICAM AK 3 User Manual	DC2-017-2
SICAM RTUs SAFETY Safety Manual	DC0-117-2
SICAM RTUs / SICAM TOOLBOX II - BDEW Conformity	DC0-113-2
SICAM RTUs / SICAM TOOLBOX II - Administrator Security Manual	DC0-115-2
Folder SICAM TOOLBOX II	M30-001-3
SICAM TOOLBOX II License Catalog	D30-017-5
SICAM RTUs IEC 60870-5-101/104 Interoperability	DC0-013-2
SICAM RTUs IEC 60870-5-103 Interoperability	DC0-026-2
Ax 1703 IEC 60870-5-101/104 Interoperability	DA0-046-2
System Element Data Sheet PE-641x/TCIO66	MC6-036-2
System Element Data Sheet PE-641x/USIO66	MC6-031-2
SICAM TM 1703 I/O-Modules	DC6-041-2

You find current product information on our website: www.siemens.com/sicam.

Further Support

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Notes on Safety

This manual does not constitute a complete catalog of all safety measures required for operating the equipment (module, device) in question because special operating conditions might require additional measures. However, it does contain notes that must be adhered to for your own personal safety and to avoid damage to property. These notes are highlighted with a warning triangle and different keywords indicating different degrees of danger.

Danger
means that death, serious bodily injury or considerable property damage will occur, if the appropriate precautionary measures are not carried out.

Warning
means that death, serious bodily injury or considerable property damage can occur, if the appropriate precautionary measures are not carried out.

Caution
means that minor bodily injury or property damage could occur, if the appropriate precautionary measures are not carried out.

Note
is important information about the product, the handling of the product or the respective part of the documentation, to which special attention is to be given.

Qualified Personnel

Commissioning and operation of the equipment (module, device) described in this manual must be performed by qualified personnel only. As used in the safety notes contained in this manual, qualified personnel are those persons who are authorized to commission, release, ground, and tag devices, systems, and electrical circuits in accordance with safety standards.

Use as Prescribed

The equipment (device, module) must not be used for any other purposes than those described in the Catalog and the Technical Description. If it is used together with third-party devices and components, these must be recommended or approved by Siemens.

Correct and safe operation of the product requires adequate transportation, storage, installation, and mounting as well as appropriate use and maintenance.

During operation of electrical equipment, it is unavoidable that certain parts of this equipment will carry dangerous voltages. Severe injury or damage to property can occur if the appropriate measures are not taken:

- Before making any connections at all, ground the equipment at the PE terminal.
- Hazardous voltages can be present on all switching components connected to the power supply.
- Even after the supply voltage has been disconnected, hazardous voltages can still be present in the equipment (capacitor storage).
- Equipment with current transformer circuits must not be operated while open.
- The limit values indicated in the manual or the operating instructions must not be exceeded; that also applies to testing and commissioning.

Danger

Consider obligatory the safety rules for the accomplishment of works at electrical plants:

1. Switch off electricity all-pole and on all sides!
2. Ensure that electricity cannot be switched on again!
3. Double check that no electrical current is flowing!
4. Discharge, ground, short circuit!
5. Cover or otherwise isolate components that are still electrically active!

Open Source Software

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The Open Source Software used in this product and the license agreements concerning this software can be found on the SICAM RTUs SD card in the file ReadmOSS.htm.

To readout this file, you need an application that you can download from the Internet. You can find details for the download and the use of the application in the *SICAM AK 3 User Manual (DC2-028-2)*.

Table of Contents

1 Introduction

Contents

1.1 Longevity through Continuity and Innovation

Following the principle of our product development, SICAM AK 3 has high functionality and flexibility, through the implementation of innovative and reliable technologies, on the stable basis of a reliable product platform.

The Siemens product line RTU (Remote Terminal Units) within the product family SICAM (Station Information Control Automation Monitoring) with the product AK (automation component) creates the technological requirements. Balanced functionality permits the flexible combination of automation, telecontrol and communication tasks. Complemented with the scalable performance and various redundancy configurations, an optimal adaptation to the respective requirements of the process is achieved.
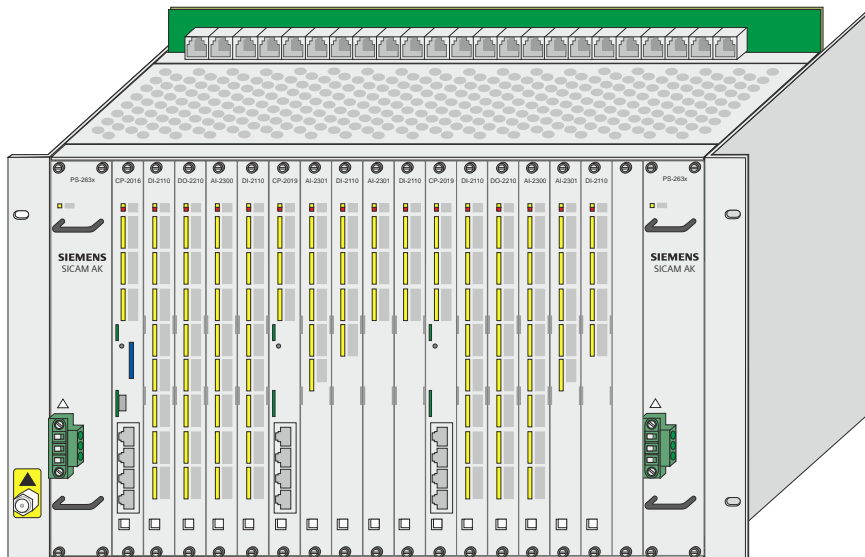
SICAM AK 3 is thus perfectly suitable for automation with integrated telecontrol technology as:

- Telecontrol substation or central device
- Automation unit with autonomous functional groups
- Data node, station control device, front-end or gateway
- With local or remote peripherals

1.2 SICAM AK 3 – the Advantages at a Glance

- Branch-neutral product, therefore high product stability and versatile fields of application, such as
    - Electrical energy distribution and transmission
    - Oil/Gas pipelines
    - Tunnels
    - Hydroelectric power station
- Versatile communication
    - Up to 68 interfaces
    - Serial communication according to IEC 60870-5-101/103
    - LAN/WAN communication according to IEC 60870-5-104 or IEC 61850
    - Numerous communication protocols from different manufacturers
- Open system architecture
    - Modular, open and technology-independent system structure
    - System-consistent improvement and therefore an innovative and future-proof product
- Mechanical Design
    - Modular assembly in a board rack
    - Board rack for rear panel installation or 19'' frame installation
    - Large variety of expansion possibilities
- Simple process interfacing
    - Binary input/output modules, also for 110/220 VDC
    - Analog input/output modules
    - Optional utilization of the intelligent terminal - SICAM TM
    - Direct connection of actuators and sensors
    - Can be located remotely up to 200 m
    - Assembly on 35 mm DIN rail
- Easy engineering
    - SICAM TOOLBOX II
    - Object-orientation
    - Creation of open- and closed-loop control application programs according to IEC 61131-3
    - All engineering tasks can also be carried out remotely
- Redundancy
- Safety-related features
    - Functional safety
- Security functions
    - Security conform (BDEW White-Paper-conformity and integrated Krypto-Chip)
- Plug & play for spare parts
    - Storage of parameters and firmware on a SD card
    - Spare part exchange does not require additional loading with SICAM TOOLBOX II
- Compatibility to the system family SICAM RTUs

1.2.1 Versatile Communication Capability

With SICAM AK 3, a variety of media can be utilized for local and remote communication. (wire connections, FO, radio, dial-up traffic, GSM, GPRS, WAN, LAN, field bus etc.).

Through the simple installation of serial interface modules, in total up to 68 communication interfaces are possible in one SICAM AK 3, whereby a different individual protocol can be used for each interface.

For the communication, protocols according to IEC 60870-5-101/103/104 and IEC 61850 are implemented. The consistent implementation of these standards guarantees a uniform addressing of data from the source through to the sink.

In addition there are also a variety of third-party protocols available. Through this, the seamless integration into existing automation networks is enabled, whereby a long-term safeguarding of already effected investments is ensured.

1.2.2 Open System Architecture

The basis for this automation concept is a modular, open and consequently technology-independent system architecture for processing, communication and peripherals (multi-processor system, firmware).

Standardized interfaces between the individual elements again permit, even with further developments, the latest state of technology to be implemented, without having to modify the existing elements. In this way, a longevity of the product and consequently investment security and continuity can be ensured.
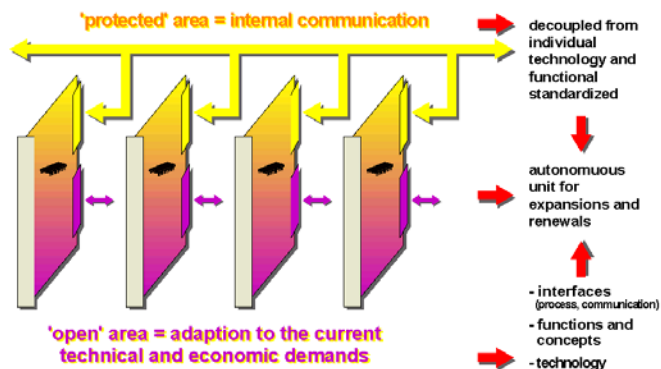
Every board and every module on which a firmware can run, forms, together with the function-determining firmware, one system element.

The adaptation to the specific requirements of the application is achieved through the individual configuration and through the loading of 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. With that, for all module types, all mechanical parameter settings are omitted, such as e.g. the changing of jumpers or loads and thus enables not only the online change, but also a consistent documentation of the set parameters by the SICAM TOOLBOX II as well as a simplified storage.

1.2.3   Simple Process Interfacing

For the central acquisition and output of process signals, up to 16 modules for the process input/output can be inserted into an SICAM AK 3 board rack. The interfacing of the process signals takes place by means of prefabricated connection cables at the rear of the board rack. LEDs at the front give information on the state of each module and of the process signals.

Mounting rack

Connection cable with 96 crimp contacts
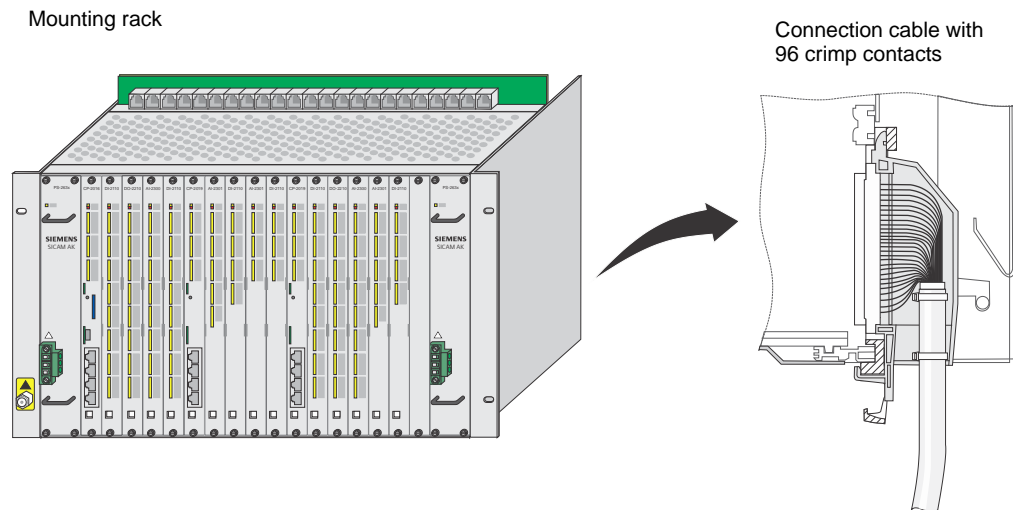
In addition, it is possible to use SICAM TM peripheral elements. An essential feature of the SICAM TM peripheral elements is the efficient and simple interfacing possibility of the process signals. This takes place on so-called I/O modules, which are distinguished through a robust casing, a secure contact as well as solid electronics. The I/O modules are lined up in rows. The contact takes place during the process of latching together, without any further manipulation. Thereby each module remains individually exchangeable.
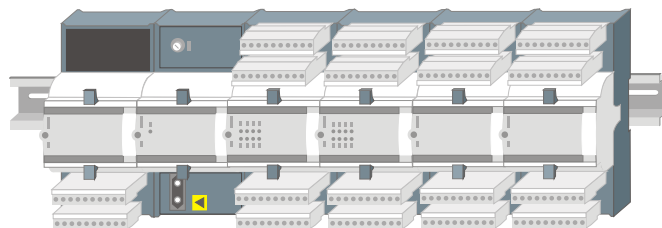
A clearly arranged connection front with LEDs for the status display ensures clarity locally. The structure of the terminals enables a direct sensor/actuator wiring without using intermediate terminals with wire cross-sections up to 2.5 mm^2. Modules for binary inputs and outputs up to 220 VDC open further saving potentials at the interface level.

Depending on the requirements, the I/O modules can be fitted with either an electrical bus or an optical bus, through which the peripheral signals can be acquired as close as possible to the point of origin. In this way a broad cabling can be reduced to a minimum.

1.2.4   Easy Engineering

An essential aspect in the overall economical consideration are the costs that occur for the creation, maintenance and service. For this, the reliable SICAM TOOLBOX II is used.

- Object-orientation

  The object-orientation makes it possible to also utilize the <u>same</u> characteristics of <u>same-type</u> primary-technology units and operational equipment (e.g. disconnectors, circuit breakers, feeders etc.) for the configuration. The close coupling with the design tool ensures the consistent, uniform documentation of the entire plant through to circuit diagram. Through this, considerable rationalization results with engineering.

- Open-loop and closed-loop control according to IEC 61131-3

  Open- and closed-loop control application programs are created by means of CAEx *plus* according to IEC 61131-3, a standard that is generally accepted and recognized in the market. As a result, the training periods are reduced considerably.

- All engineering tasks can also be carried out remotely

  All engineering tasks, from the system diagnostic through to the online test, can also be performed remotely with the SICAM TOOLBOX II. For this, a separate communication link is not necessary: each available communication interface can be used. As far as present, also the Ethernet can be used for the engineering.

  Using further automation units of the SICAM RTUs product family, the SICAM TOOLBOX II can be remotely positioned over an arbitrary number of hierarchies.

  The access to the engineering data is fundamentally protected by a password.

1.2.5   Redundancy

In order to increase the availability of a plant or a plant section, one can design certain system parts redundant, in other words duplicated.

In SICAM AK 3, redundancy is available in various forms:

- Redundant power supply
- Redundant processing and communication elements
- Redundant peripheral elements
- Redundant communication routes (communication links usually have by far the highest failure rate)
- Redundant application programs
- Redundant automation units
- Redundant total systems

1.2.6   Safety-Related Features

Due to the continuously increasing demand for functional safety in plants and machines, it may be necessary to transfer safety-related tasks to an automation unit. Thereby, the reliable and safety-related functions of the system and components is to be ensured according to the relevant national and international standards (IEC 61508, IEC 62061, ISO 13849 and further), both in normal operation and in the case of failure and errors.

For this purpose, SICAM AK 3 can be optionally expanded with a parameter-settable safety application.

1.2.7 Plug & Play for Spare Parts

All data of an automation unit such as firmware and parameters are stored non-volatile centrally on an exchangeable SD Card.

With a restart of the automation unit, and also with a restart of individual modules, all necessary data are automatically transferred from the SD Card to all CPUs and modules.

Consequently, with the exchange of modules, new loading is no longer required, since new modules obtain all data from the storage card. Thereby, work during a service operation is reduced to a minimum.

1.2.8 Compatibility

Older products (such as SICAM AK, AK 1703, AM 1703, AMC 1703) can be easily networked, either via the serial communication according to standard IEC 69870 5 101 or via Ethernet TCP/IP according to standard IEC 60870 5 104. In addition, yet older products (such as SK 1703) are supported with restrictions.

Networking of SICAM AK 3 with other SICAM RTUs products is evidently supported.

1.3   Various Utilizations

Due to the modular architecture, SICAM AK 3 can be used in a variety of ways:

- Front End, Gateway
- Process control applications, automation applications
- Station control device
- Sub-node
- Telecontrol substation
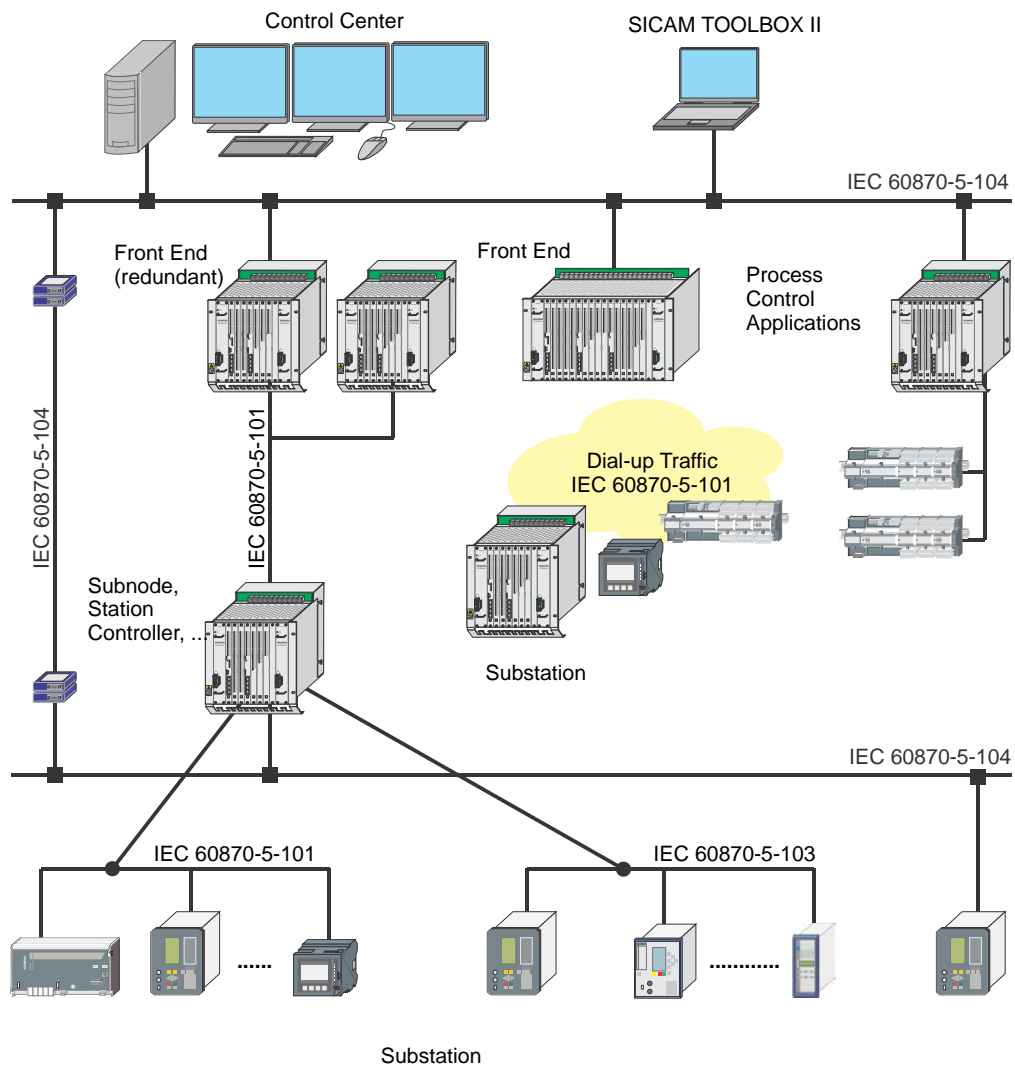
In principle, for this all necessary functionalities are available. The actual application is defined simply through the corresponding configuration and parameterization.

1.3.1 Front End, Gateway

Due to the large number of interfaces (up to 68) and the variety of protocols available, SICAM AK 3 is perfectly suitable for the use as front end for a process control system.

All telecontrol substations – regardless of which manufacturer and over which protocol – are connected to SICAM AK 3. 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.

1.3.2 Process Control Applications, Automation Applications

Open- and closed-loop control application programs are created by means of CAEx *plus* according to IEC 61131-3, a standard that is generally accepted and recognized in the market.

In SICAM AK 3, at every slot a system element with *open-/closed-loop control function* can be installed. Through this and due to the modularity, SICAM AK 3 is suitable for many applications: from smaller automation applications up to complex process control applications. Naturally, all applications can also be combined.

1.3.3 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 could also be installed in the station control device, through which telecontrol station and station control device could be united in one device.

1.3.4 Telecontrol Substation

For telecontrol applications there is a modular, versatile periphery available for the process data interfacing.

Especially due to the possibility of being able to remotely locate SICAM TM peripherals, SICAM AK 3 supports peripheral elements installed centrally and decentralized. 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 AK 3 with CAEx *plus*, through which, at the same time and to the same degree, SICAM AK 3 can become a remote terminal unit and an automation unit in one.

2　System Overview

Contents

2.1 Mechanical Design

2.1.1 Board Racks

With the mechanics, value has been placed on flexibility and easy handling. Board racks with different numbers of slots are available.

The large one (CM-2846, CM-2843) are primarily designed for the 19" (swing) frame installation, but can optionally be used for rear panel installation.

The small board rack (CM-2844) is by default built for rear panel installation.

Basic Board Racks

Board racks with 9 (8 in case of redundant power supply) or 17 slots are available.
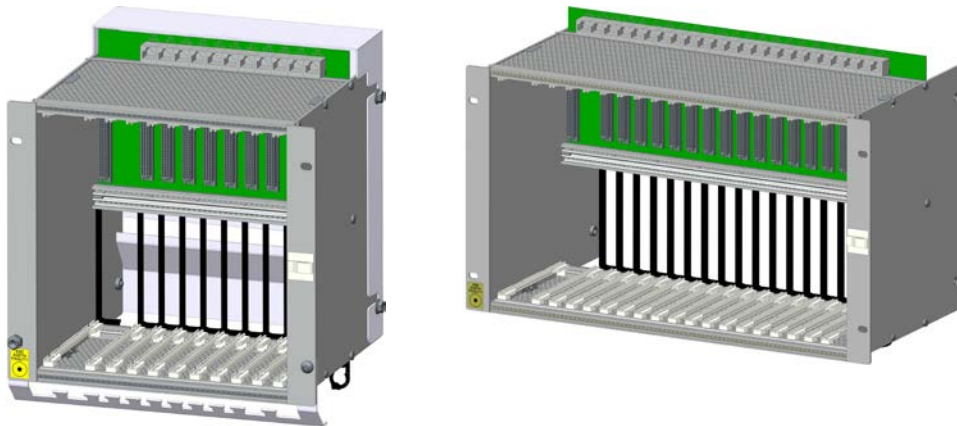
Expansion Board Rack

The optional expansion board rack serves for the installation of up to 16 peripheral elements outside the basic board rack.
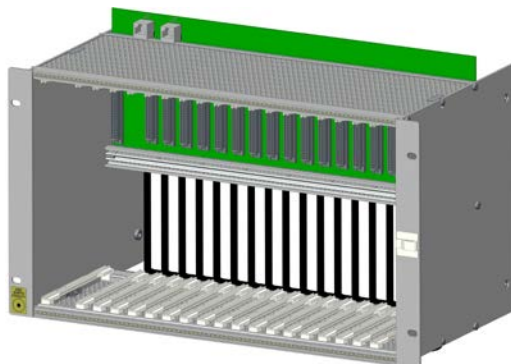
2.1.1.1   Product Overview

Type	Designation	Item-Number/MLFB
CM-2844	SICAM AK 3 board rack with 9 slots	GC2-844 6MF11130CJ440AA0
CM-2846	SICAM AK 3 board rack with 17 slots	GC2-846 6MF11130CJ460AA0
CM-2843	SICAM AK 3 expansion board rack with 16 slots	GC2-843 6MF11130CJ430AA0
	Wall fastening kit CM-2846/43 AK 3 for rear panel installation (incl. rear cover , cable strain relief)	TC2-702 6MF13130CH020AA0

Note

Board racks are delivered without front panels Slots, which are not equipped with a module, must be covered with an empty front panel.

2.1.2   Connection Technique

Almost all necessary external connectors (e.g. communication, peripherals, external periphery bus) can be connected with the help of standard cables or prefabricated cables without any additional tools.

Connection Technique for Peripheral Signals
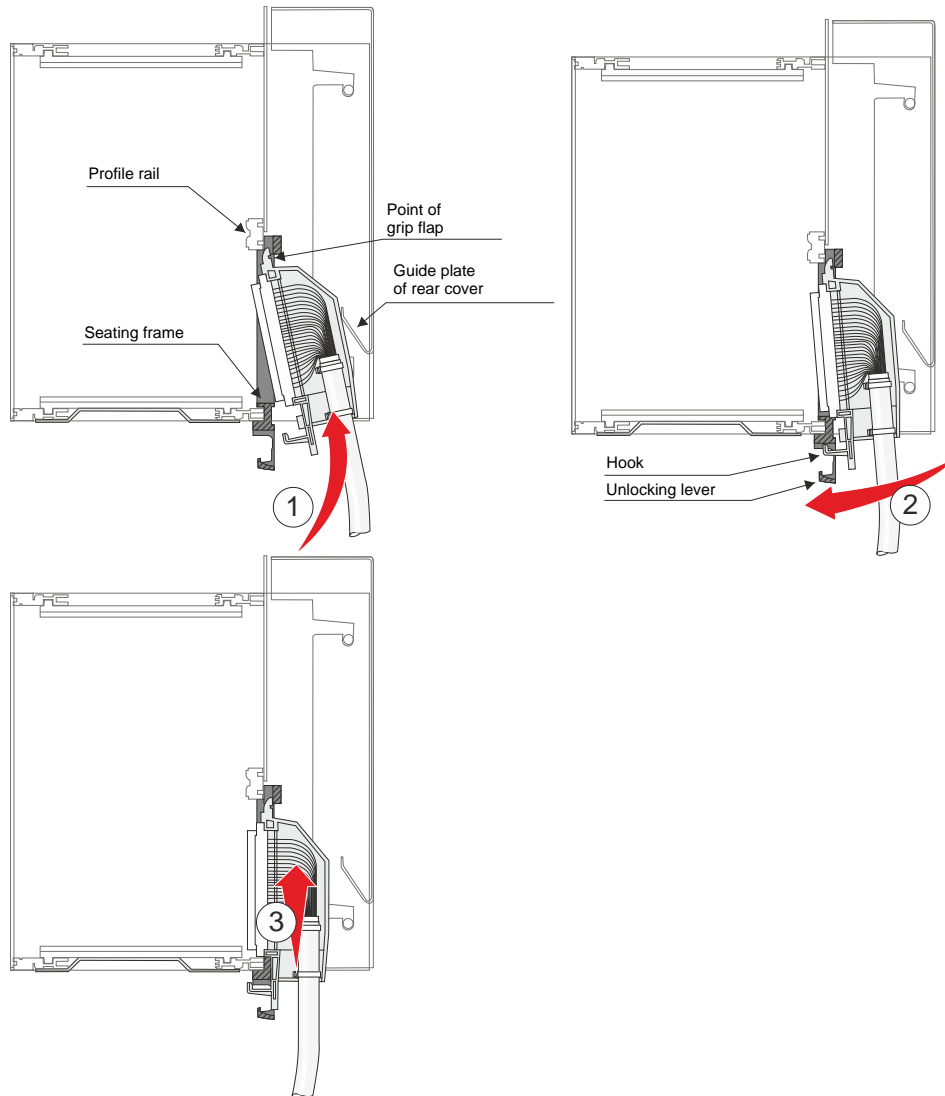
RJ45 Connection Technique for Communication
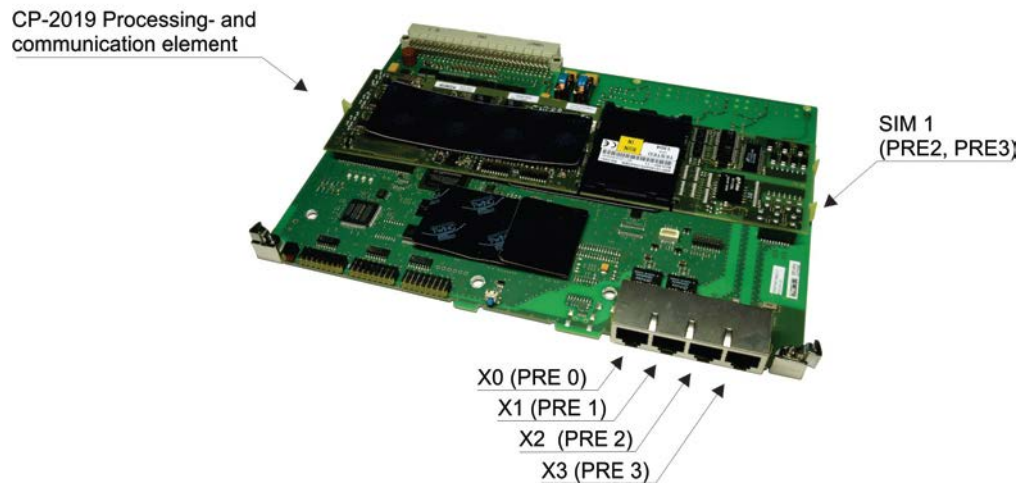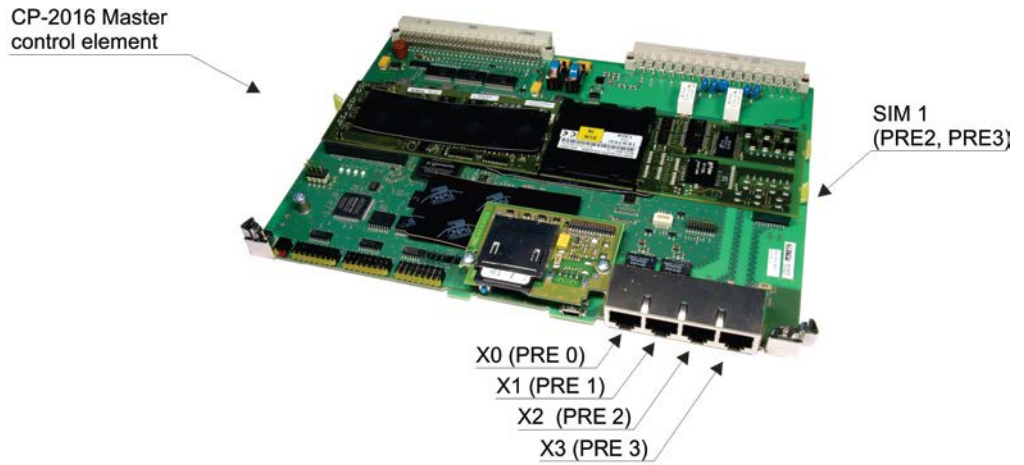
RJ45 Connection Technique for external AX 1703 Peripheral Bus

2.2 System Design

2.2.1 Architecture

A system SICAM AK 3 forms an automation unit of the system family SICAM RTUs and consists of the following parts:

- Board racks
- 1 to 2 power supply modules
- 1 master control element
- Optionally up to 16 processing and communication elements
- Optionally up to 68 protocol elements (interfaces with individual communication protocol)
  - Up to 4 protocol elements on the master control unit
  - up to 4 protocol elements for each processing and communication element
- Overall up to 272 peripheral elements
  - Up to 16 peripheral elements on the master control unit
  - Up to 16 peripheral elements for each processing and communication element

MCE   master control element
PCE   processing and communication element   } Basic system elements
PE   peripheral element
PRE   protocol element
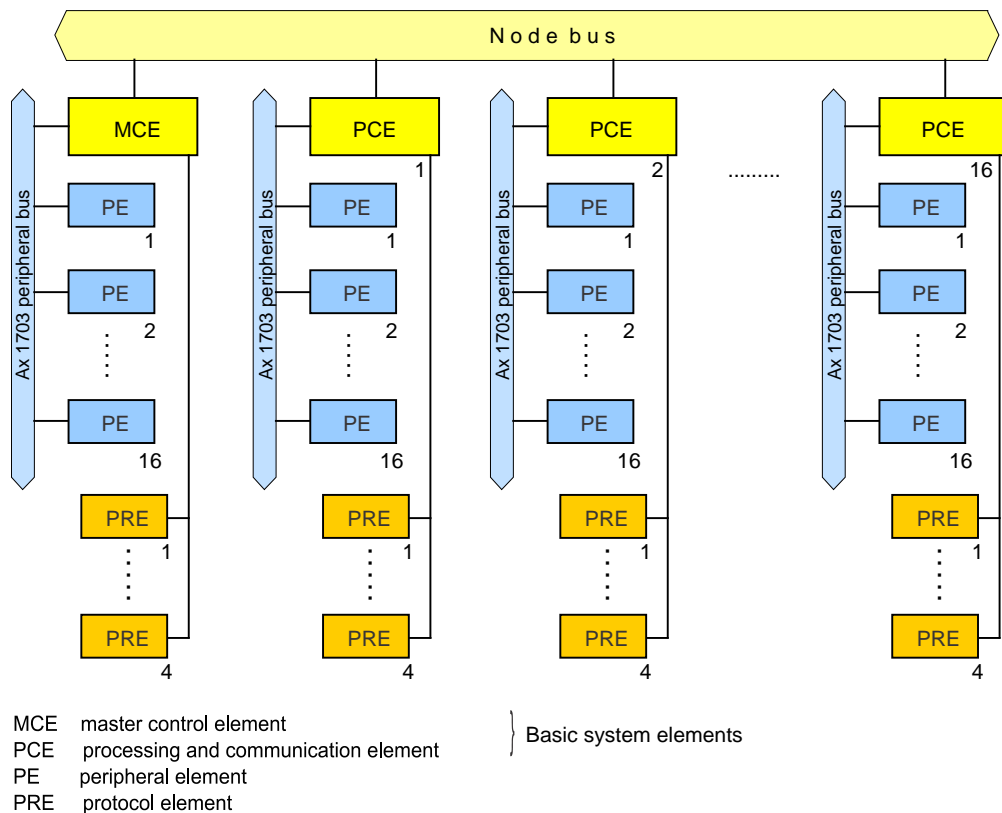
2.2.2 System configuration

2.2.2.1 Basic Board Rack
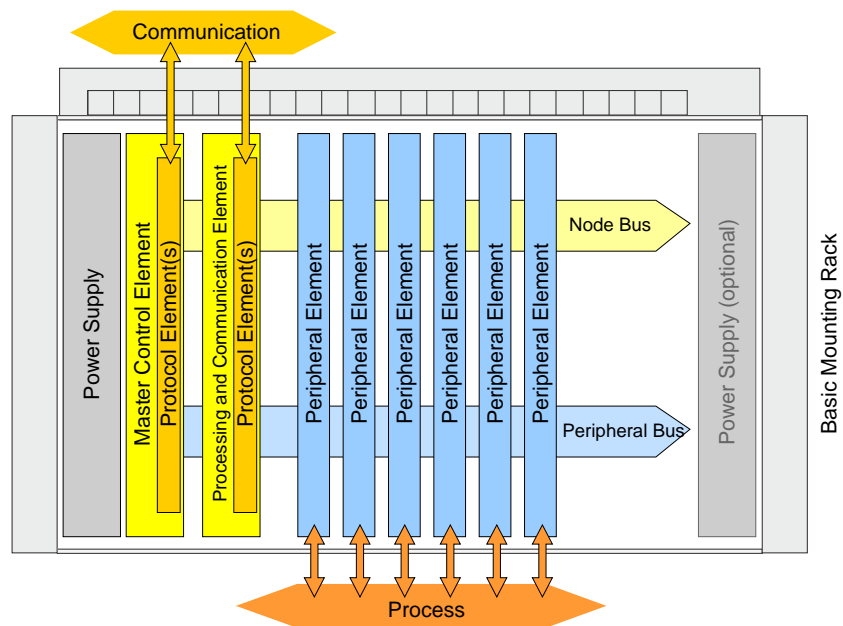
In the basic board rack, 1 master control element and an arbitrary combination of up to 16 processing and communication elements or peripheral elements can be installed.

2.2.2.2 Basic Board Rack with Expansion Board Rack
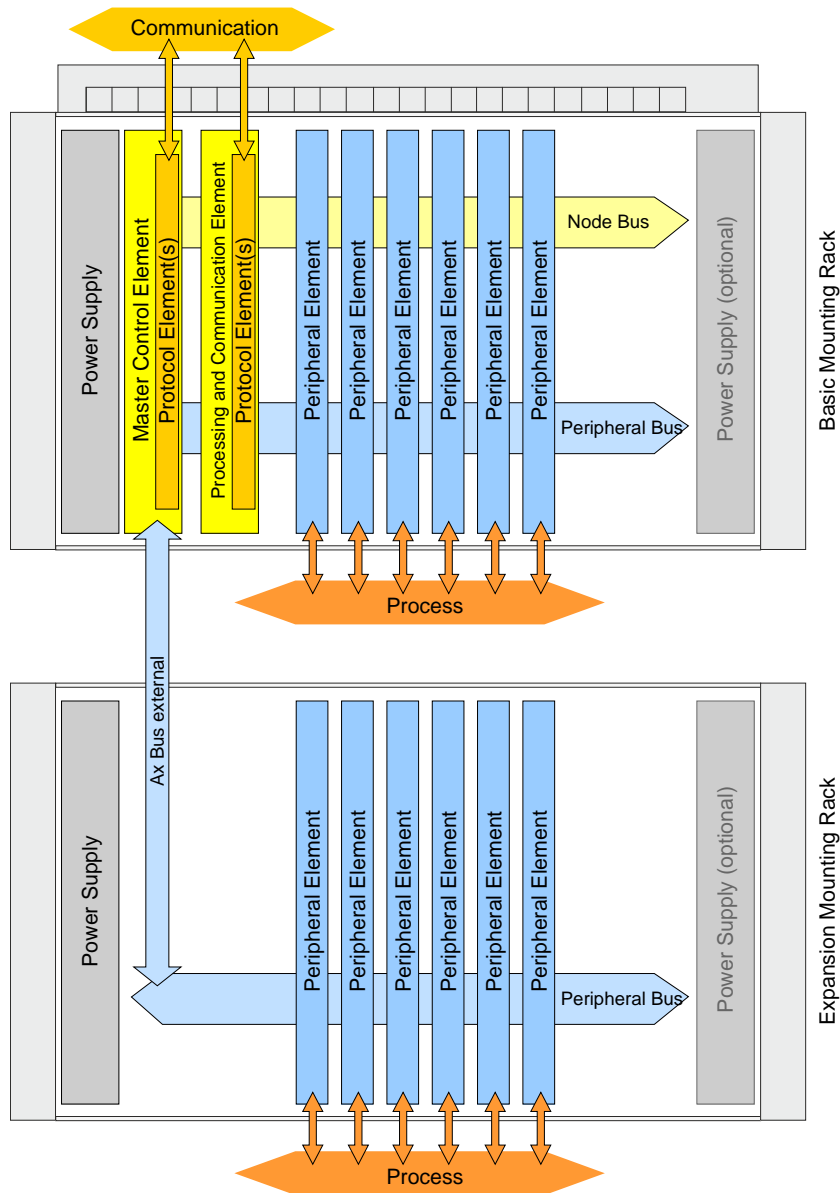
For each basic system element, 1 expansion board rack with respectively up to 16 peripheral elements can be installed.

Therefore, all in all up to 17 expansion board racks are possible.

2.3   Power Supply

The supply voltage for the system SICAM AK 3 is provided by 2 different power supply modules.

2.3.1   Features

- Nominal input voltages (input voltage range) of
    - 24 VDC / 48 VDC / 60 VDC (18 VDC to 78 VDC)
    - 110 VDC / 220 VDC (82,5 VDC to 286 VDC)
    - 115 VAC / 230 VAC (90 VAC to 264 VAC)
- Voltage output 5.1 VDC, max. 120 W
- Self monitoring for failure
- Screw terminals
- Function indication via LEDs

You can find the configuration options for power supply modules in the different board racks in section 5.1, Board Racks.

You find the exact technical specification in section 5.2, Power supply modules.

2.3.2   Product Overview

Type	Designation
PS-2630	Power supply 24 - 60 VDC AK 3
PS-2632	Power supply 110 - 220 VDC, 230 VAC AK 3

2.4 System Elements

A system element is a functional unit consisting of hardware and firmware. The firmware gives the hardware the necessary functionality.

2.4.1 Master Control Element

The master control element is the heart of the automation unit. It provides the parameter-settable *telecontrol function* and the *open /closed-loop function* as well as the node function for the communication. Additionally, it serves as centrally coordinating element for all *system services*, and all internal and integral concepts.
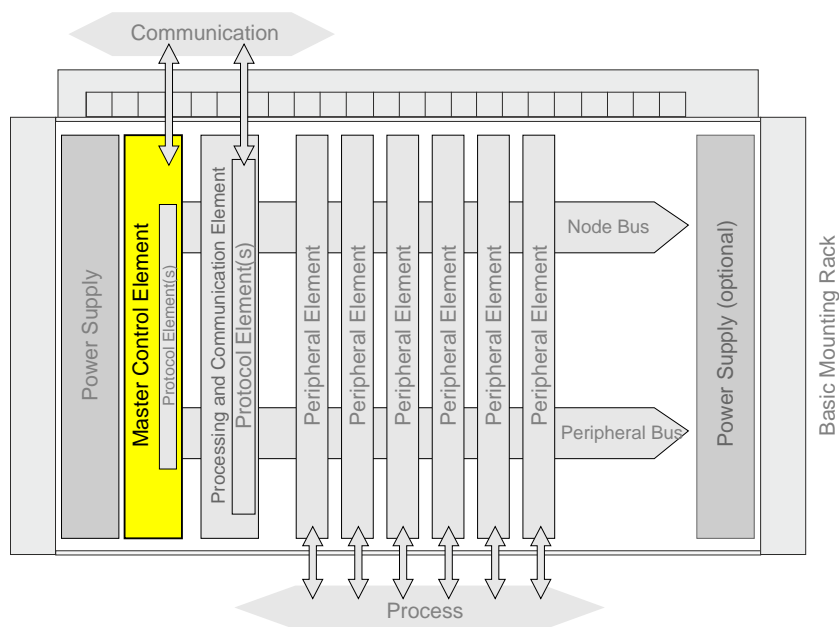
This architecture guarantees

- an autonomous behavior (for instance in the case of communication failure)
- the integration of the *telecontrol function* (spontaneous processing and spontaneous communication) and the *open /closed-loop function* (periodical processing and periodical communication with the periphery) into one common automation device
- a deterministic behavior of the *open /closed-loop function* with guaranteed reaction times

2.4.1.1 Features

- Up to 4 interfaces for the communication with other automation units or control systems
  - serial (point-to-point, multi-point, dial-up traffic); with sub module
  - LAN/WAN (Ethernet TCP/IP); local
- Parameter-settable telecontrol functions via configurable communication protocols
- Freely definable open-/closed-loop control functions with CAEx plus, according to IEC 61131-3
- Communication with up to 16 peripheral elements via the Ax 1703 peripheral bus
- Node function for up to 16 processing and communication elements modular expandable via the node bus
- Storage of the parameters and application program on SD card
- Parameterization, diagnosis and test by means of SICAM TOOLBOX II (locally via USB or D-Sub, and remotely via SFP transceiver)
- Function and error indication via LED
- 1 fault output and 2 synchronization input (via peripheral connection cable)

2.4.1.2 Product Overview

Type	Designation
CP-2016/CPCX26	Central Processor AK 3

More detailed information on the master control element can be found in section *5.3.1; CP-2016/CPCX26.*

2.4.2   Processing and Communication Element

A processing and communication element serves for the establishing of a modular, saleable automation unit by means of multiplication of

- communication options
- connection of peripheral elements
- open- and closed-loop control functions
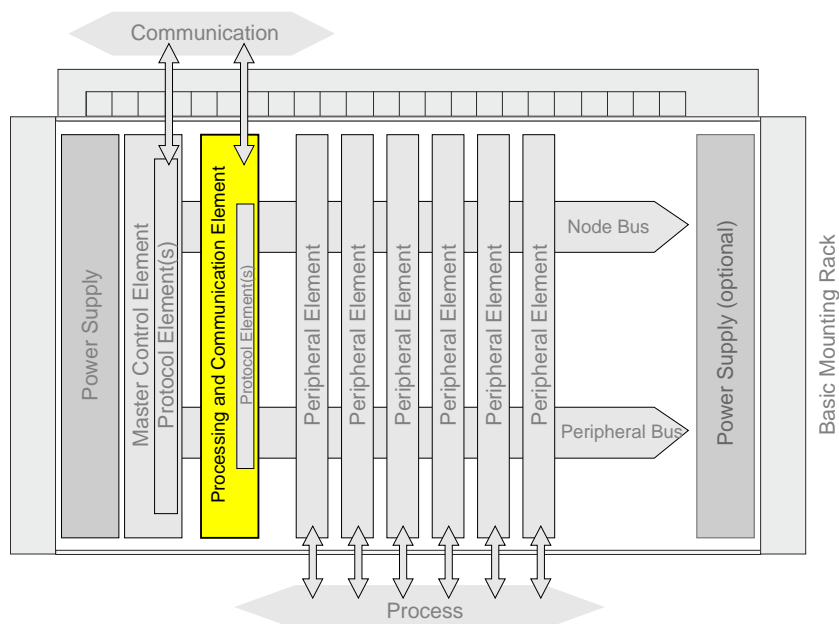
2.4.2.1   Features

- Up to 4 interfaces for the communication with other automation units or control systems
  - serial (point-to-point, multi-point, dial-up traffic); with submodule
  - LAN/WAN (Ethernet); local
- Parameter-settable telecontrol functions via configurable communication protocols
- Freely definable open-/closed-loop control functions with CAEx *plus*, according to IEC 61131-3
- Communication with up to 16 peripheral elements via the Ax 1703 peripheral bus
- Supports redundancy with doubled processing and communication element
- Optionally expandable with parameter-settable application for Functional Safety
- Autonomy: function maintained even in case of master control element failure
- Engineering, diagnosis and test locally or remotely via SICAM TOOLBOX II
- Function and error indication via LED

2.4.2.2 Product Overview

Type	Designation
CP-2019/PCCX26	Communication/Processing AK 3
AP-0771/SPLC01	Safety PLC (optional) [*]

[*] only in conjunction with SICAM TM peripheral elements

More detailed information on the processing and communication element can be found in section *5.3.2, CP-2019/PCCX26.*

The information on the safety application reside in the document *SICAM AK SAFETY Safety Manual*.

2.4.3 Peripheral Elements

The peripheral elements serve for acquisition or output of process signals. They perform process-compliant adaptation, monitoring and processing of the process signals at each point of entrance or exit of the system.

Peripheral elements may be installed:

- in the basic board rack
- in an expansion board rack
  - connected electrically with basic board rack, up to 3 m
- at remote locations by means of SICAM TM peripherals
  - connected electrically with basic board rack, up to 3 m
  - connected optically with basic board rack, up to 200 m

You find comprehensive information on configuration and connection of peripheral elements in the document *SICAM AK 3 User Manual; chapter "Automation Units and Automation Networks".*

Basic examples with peripheral elements from the system families SICAM AK and SICAM TM are represented as follows.

Basic board rack and expansion board rack

Communication

Power Supply

Master Control Element

Protocol Element(s)

Processing and Communication Element

Protocol Element(s)

Peripheral Element

Peripheral Element

Peripheral Element

Peripheral Element

Peripheral Element

Peripheral Element

Node Bus

Peripheral Bus

Power Supply (optional)

Basic Mounting Rack

Process

Power Supply

Peripheral Element

Peripheral Element

Peripheral Element

Peripheral Element

Peripheral Element

Peripheral Element

Peripheral Bus

Power Supply (optional)

Expansion Mounting Rack

Process

Basic board rack and remote SICAM TM peripheral element
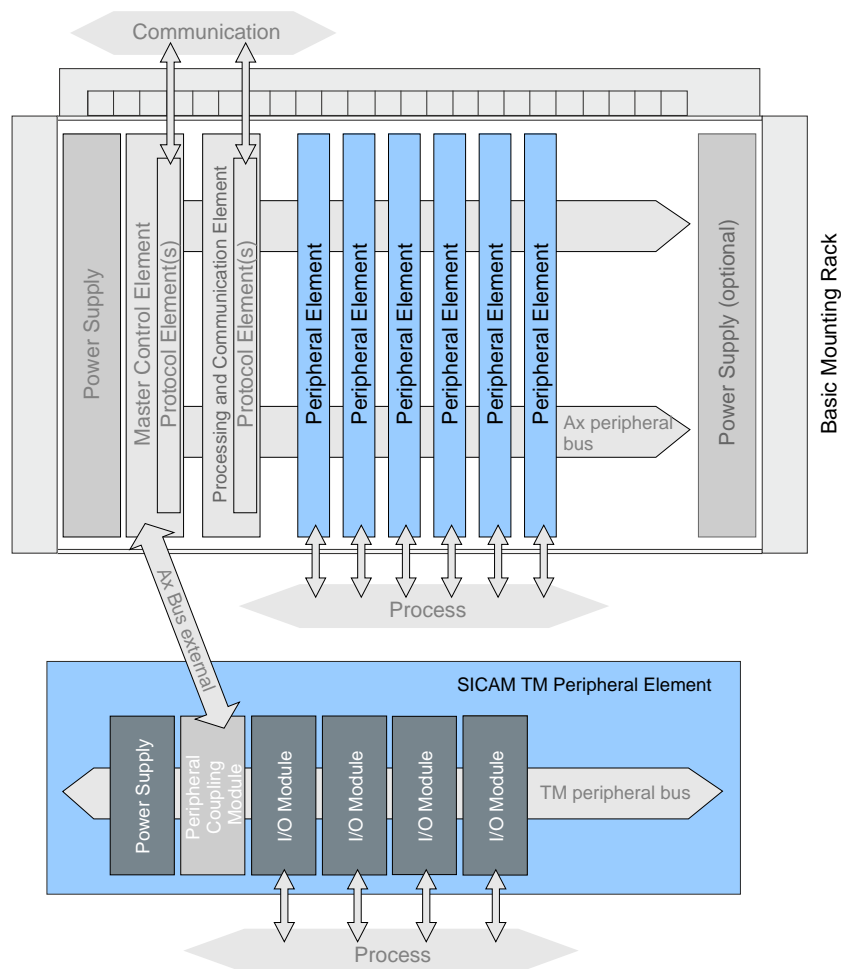
> **Note**
>
> For the connection of a SICAM TM peripheral element, a bus interface module CM-0842 (optical) or CM-0843 (electrical) is required.

2.4.3.1 Features

- Acquisition and preprocessing of process data according to IEC 60870-5-101/104 with and without time tag
  - Single-point and double-point information items
  - Count Pulses
  - Actual values (currents, voltages, temperatures)
- Postprocessing and output of process data according to IEC 60870-5-101/104
  - Single-point information
  - Single-point and double-point commands
  - Setpoint commands (currents, voltages)
- Secured data exchange with the basic system element via the Ax 1703 peripheral bus
- Supervision and failure processing
- Signal state display
- Function and error indication via LED

2.4.3.2 Configuration

For process input and output, peripheral elements can be connected to a basic system element locally in the board rack and/or externally via bus interface modules.

For the connection of peripheral elements inside the basic board rack, there is a local Ax 1703 peripheral bus which is operated either by the master control element or by one of the installed processing and communication elements (definition by means of parameterization).

In order to be able to connect peripheral elements outside the basic board rack, the master control element provides an own external Ax 1703 peripheral bus (*AXPE-C0*), and each installed processing and communication element provides an own external Ax 1703 peripheral bus (*AXPE-Cn*, n = 1…16). Each external bus is available via an RJ45 connector. Each external bus is available via an RJ45 connector.

Bus Interface	Designation	Connection	Number of Peripheral Elements
–	Local Ax 1703 peripheral bus	electrical	CM-2844: up to 8 [1] CM-2846: up to 16 [1]
–	External Ax 1703 peripheral bus	electrical	CM-2843: up to 16
CM-0843	Bus interface module Ax-PE 4x USB	electrical	up to 16 [2]
CM-0842	Bus interface module Ax-PE 4xFO	optical	up to 16 [2]

[1]   for each installed processing and communication element the number is reduced by 1

[2]   up to 4 bus interface modules necessary

Patch cables, by means of those the connection between master control element and bus interfaces or peripheral elements is set up, may be maximum 3 m long each.

The address of the peripheral elements on the Ax 1703 peripheral bus is determined in SICAM TOOLBOX II, when defining the Ax 1703 peripheral bus configuration. The same address will be set on the peripheral elements.

2.4.3.3 Ax 1703 Peripheral Bus

The Ax 1703 peripheral bus permits the secured (hamming distance 4), serial system-internal communication between the basic system element and the peripheral elements. Serial communication also makes it possible to locally detach individual or all peripheral elements without sacrificing any of the full system functionality.

The communication at the Ax 1703 peripheral bus takes place according to the master-slave method, the peripheral elements being the slave and the basic system element the master. Each peripheral element constitutes - regardless of its function, data volume and processing - one participant at the Ax 1703 peripheral bus.

The Ax 1703 peripheral bus is operated with a transmission rate of 16 Mbit/s.

The Ax 1703 peripheral bus may be accessible

- at slots at the backplane of a board rack (internal bus)
- via external connectors (external bus)

Addressing of the bus participants is handled for all peripheral elements via a logical peripheral board address (PBA) that can be set on the peripheral element.

Data of different classes are transmitted over the Ax 1703 peripheral bus:

- spontaneous data for the function package *Telecontrol*
- periodical data for the function package *Automation*

Periodical information is exchanged between the basic system element and the peripheral element based on the cycle of the *open-/closed-loop control function* on the basic system element.

Spontaneous data are transmitted as *messages with process information* and *messages with system information* between the basic system element and the peripheral element, with acknowledgment.

Note

In order to connect peripheral elements electrically and/or optically, resources such as bus interface modules may be required (refer to manual *SICAM AK 3 User Manual; chapter "Automation Units and Automation Networks"*).

2.4.3.4 Product Overview

Type	Designation
DI-2112/BISX26	Binary signal input 8x8, 24 VDC, 1 ms
DI-2113/ BISX26	Binary signal input 8x8, 48/60 VDC, 1 ms
DI-2114/ BISX26	Binary signal input 8x8, 110 VDC, 1 ms
DI-2115/ BISX26	Binary signal input 8x8, 220 VDC, 1 ms
DO-2201/BISO25	Binary output (Transistor, 40x1, 24…60 VDC)
DO-2210/PCCO2X	Checked command output (24…60 VDC + optional SM-2506)
DO-2211/PCCO2X	Checked command output (125 VDC + optional SM-2507)
AI-2300/PASI25	Analog input/output (16x ±20 mA + 4x optional SM-057x)
AI-2302/PASI25	Analog input/output (16x ±6 mA + 4x optional SM-057x)
AI-2303/PASI25	Analog input/output (16x ±24 mA + 4x optional SM-057x)

Detailed information can be found in section 5.6, Peripheral elements.

Submodules

Type	Designation
Input/output modules	
SM-0570	Analog Input Extension (2x+/-20mA)
SM-0571	Analog Output Extension (2x Pt100)
SM-0572	Analog Output Extension (2x ±20 mA/±1 V/±10 V)
SM-0574	Count Pulse Input Extension (2x 24…60 VDC)
Measuring modules	
SM-2506	Measuring module for command output via DO-2210 (24…60 VDC)
SM-2507	Measuring module for command output via DO-2211 (125 VDC)

Detailed information can be found in section 5.7.8, Submodules

SICAM TM Peripheral Elements

Type	Designation
PE-6410/TCIO66	Peripheral controller for Turbine Controller (Ax-PE bus el)
PE-6411/TCIO66	Peripheral controller for Turbine Controller (1x Ax-PE bus opt)
PE-6412/ TCIO66	Peripheral controller for Turbine Controller (2x Ax-PE bus opt)
PE-6410/USIO66	Peripheral controller (Ax-PE bus el)
PE-6411/USIO66	Peripheral controller (1x Ax-PE bus opt)
PE-6412/USIO66	Peripheral controller (2x Ax-PE bus opt)

Detailed information can be found in the relevant system element manual.

2.4.4   Protocol Elements

A protocol element serves for the exchange of data - and thereby for the transmission of mes-
sages - over a communication interface to other remote stations, such as automation units,
control systems, or protective devices. A fundamental characteristic is the separation of proto-
col-bound communication from application tasks of an automation unit.

In SICAM AK 3 we distinguish 2 types of protocol elements. The first type (Hardware-PRE)
consists of hard- and firmware. Both get installed/loaded on a basic system element. The se-
cond type (local PRE) consists only of firmware which gets loaded an a basic system element.
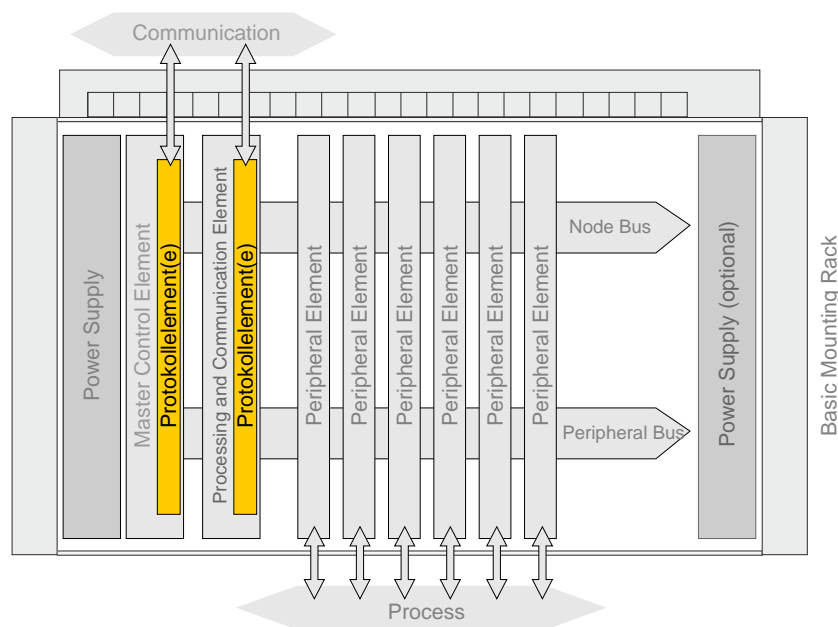
In order to be able to communicate with as many systems as possible, SIEMENS has decided
not only to employ standard protocols, which are normalized by IEC, but to considerably take
part in the creation of these standards.

The automation units communicate preferred according to the following standards:

- IEC 60870-5-101 in case of serial communication
- IEC 60870-5-103 in case of serial communication with protective devices
- IEC 60870-5-104 in case of LAN/WAN networks
- IEC 61850 in case of LAN/WAN networks (e.g. communication with protective devices)

On each available communication interface you can load a communication protocol with the
SICAM TOOLBOX II.

2.4.4.1 Features

- Each interface has its own protocol processor
  - communication has no impact on the application, and vice versa
  - Each processor runs one communication protocol
  - Various different protocols run on one and the same hardware
  - All protocols can be loaded with SICAM TOOLBOX II
- You can change the communication protocol, for instance from serial to LAN, without retroactive effect to the application tasks of an automation unit
- Each automation unit can be equipped with various protocols, this allows easy implementation of data nodes and front ends

2.4.4.1.1 Serial Communication

The following are available as standard protocols for serial communication:

- Point-To-Point Traffic
- multi-point traffic, optionally with relay operation
- Dial-Up Traffic

Naturally, all standard protocols are fully based on the interoperable standard to IEC 60870-5-101, including

- Absolutely free addressing
- Single object orientation
- Time Synchronization
- Integrated remote maintenance functions such as
  - Remote diagnostics
  - Remote parameter setting
  - Online test functions

Yet, there is still a whole series of other available protocols, information thereto can be found in the *SICAM AK 3 User Manual*.

Additional information on interfacing to third party systems and third-party protocols (protocols subject to license) is available on request.

2.4.4.1.2 LAN/WAN Communication

Today, modern automation systems are generally distributed and thus require networks to connect the various components with one another. In its systems, Siemens has for many years provided networks that link the various components with one another.

From the very beginning, great attention was paid to ensuring full integration as well as optimum availability and operational reliability. As network technology continued to become ever more refined, Siemens as well has continuously been updated and upgraded to reflect the latest state of the art without neglecting the criteria of ensuring a long system lifecycle and highest availability.

LAN/WAN communication relies on Ethernet TCP/IP to IEC 60870-5-104, which again guarantees maximum interoperability.

If SICAM AK 3 is used as a station control device, then the communication with the devices of the bay level (bay control units, protective devices) can also be established according to IEC 61850.

IEC 61850 is the communication standard for substation automation which interconnects devices of the bay level and the station control level, based on Ethernet TCP/IP.

2.4.4.2 Product Overview

Standard protocols	Type	Protocol element
• **IEC60870-5-101**		
− IEC60870-5-101 Point-to-point traffic	serial	SM-x551/BPPA0
− IEC60870-5-101 Multi-point traffic (Master)	serial	SM-x551/UMPMA0
− IEC60870-5-101 Multi-point traffic (Master) "for AMIS data transmission"	serial	SM-x551/UMPMA1
− IEC60870-5-101 Multi-point traffic (Slave)	serial	SM-x551/UMPSA0
− IEC60870-5-101 SAT field bus (Master)	serial	SM-x551/SFBMA1
− IEC60870-5-101 SAT field bus (Slave)	serial	SM-x551/SFBSA1
− IEC60870-5-101 Dial-Up (Master) "unbalanced Mode"	serial	SM-x551/DIAMA1
− IEC60870-5-101 Dial-Up (Slave) "unbalanced Mode"	serial	SM-x551/DIASA0
• **IEC60870-5-102**		
− IEC60870-5-102 Transmission of integrated totals (Master)	serial	SM-x551/102MA0
− IEC60870-5-102 Transmission of integrated totals (Slave)	serial	SM-x551/102SA9
• **IEC60870-5-103**		
− IEC60870-5-103 Protocol for interfacing of protective devices (Master)	serial	SM-x551/103MA0
− IEC60870-5-103 Protocol for interfacing of protective devices (Slave)	serial	SM-x551/103SA0
• **IEC60870-5-104**		
− IEC60870-5-104	LAN	SM-2558/ETA4 ET24
− IEC60870-5-104 (RSTP)	LAN	SM-2557/ETA2
• **IEC61850**		
− IEC61850 Client, Server, GOOSE Ed.1	LAN	SM-2558/ETA3
− IEC61850 Client, Server, GOOSE Ed.1 (RSTP)	LAN	SM-2557/ET03
− IEC61850 Client Ed.2	LAN	SM-2558/ETA5 ET25
• **MODBUS (RTU, ASCII)**		
− MODBUS Master	serial	SM-x551/MODMA0
− MODBUS Slave	serial	SM-x551/MODSA0
• **DNP3**		
− DNP3 Master	serial	SM-x551/DNPMA0
− DNP3 Slave	serial	SM-x551/DNPSA0
• **IEC 1107, IEC61107, IEC 62056-21**		
− IEC 1107, IEC61107, IEC 62056-21 counter value protocol (Master)	serial	SM-x551/COUMA0
• **PROFIBUS-DP (DP-V0)**		
− PROFIBUS-DP (DP-V0) Master with external fieldbus gateway "netHost"		SM-2558/DPMiA0

Standard protocols	Type	Protocol element
• **NTP / SNTP**	LAN	CPCX26 PCCX26 SM-2557/ETA2 SM-2557/ET03 SM-2558/ETA4 SM-2558/ETA5
• **SNMP**		
− SNMP Agent	LAN	CPCX26
• **http/https (SSL)**		
− http/https web server [1]	LAN	ET25 SM-2557/ETA2 SM-2557/ET03 SM-2558/ETA3 SM-2558/ETA5
− http/https „remote operation" (remote diagnostics, remote engineering)		CPCX26 PCCX26 SM-2557/ETA2 SM-2557/ET03 SM-2558/ETA3 SM-2558/ETA4 SM-2558/ETA5
• **IPSEC**		
− IPSEC [2]	LAN	CPCX26 PCCX26

[1] web server only for experts during setup or maintenance – the Webserver must be deactivated during operation due to security reasons!

[2] only restricted configurations are supported!

3rd-party protocols (proprietary protocols)	Type	Protocol element
• **SAT 1703**		
− SAT 1703 PCMBA-EE, PCMBA-SSI End-End	serial	SM-x551/SKEEA1
− SAT 1703 PCMBA Multi-point traffic (Master)	serial	SM-x551/PCBMA0
− SAT 1703 PCMBA Multi-point traffic (Slave)	serial	SM-x551/PCBSA0
− SAT 1703 Multi-point traffic (Master) "Relay operation (without routing)"	serial	SM-x551/SKSZA0
− SMI-Field bus (Master)	serial	SM-x551/SMIMA0
− Keyboard-Input, Display-/Printer-Output	serial	SM-x551/TEDAA1
• **Siemens 8TK switch gear interlocking**		
− Siemens switch gear interlocking8TK Multi-point traffic (Slave)	serial	SM-x551/8TKSA0
• **Siemens FW537**		
− Siemens FW537 Point-to-Point Master	serial	SM-x551/F537A0
• **Siemens ILSA**		
− Siemens ILSA Protocol for interfacing of protective devices (Master)	serial	SM-x551/LSAMA0
• **Siemens Simatic S5**		
− Siemens Simatic S5 "SIFAS2" Multi-point traffic (Slave)	serial	SM-x551/SIFUA0
− Siemens Simatic S5 3964/RK512	serial	SM-x551/R512A1
− Siemens Simatic S5 - ST1 "TIM11" Multi-point traffic (Master)	serial	SM-x551/ST1MA0
− Siemens Simatic S5 - ST1 "TIM11" Multi-point traffic (Slave)	serial	SM-x551/ST1SA0
• **Siemens Sinaut8 FW**		
− Siemens Sinaut8 FW PCM/PDM Multi-point traffic (Master)	serial	SM-x551/SA8MA0
− Siemens Sinaut8 FW PCM/PDM Multi-point traffic (Slave)	serial	SM-x551/SA8SA0
• **Siemens Sinaut ST7**		
− Siemens Sinaut ST7 Multi-point traffic (Master)	serial	SM-x551/ST7MA0
• **ABB Indactic 33/41**		
− ABB Indactic 33/41 Multi-point traffic (Slave)	serial	SM-x551/I33SA0
• **ABB RP570/571**		
− ABB RP570/571 Multi-point traffic (Master)	serial	SM-x551/RP5ZA1
− ABB RP570/571 Multi-point traffic (Slave)	serial	SM-x551/RP5UA1
• **ABB SPA-Bus**		
− ABB SPA-Bus protection equipment interface protocol, Multi-point traffic (Master)	serial	SM-x551/SPAMA0
• **Landis & Gyr TG065**		
− Landis & Gyr TG065 Multi-point traffic (Master)	serial	SM-x551/T65MA0
• **Landis & Gyr TG800**		
− Landis & Gyr TG800 Multi-point traffic (Master)	serial	SM-x551/TG8MA0
− Landis & Gyr TG800 Multi-point traffic (Slave)	serial	SM-x551/TG8SA0
• **Siemens AGP "Feeder test equipment"**		
− Feeder test equipment interface protocol (Master)	serial	SM-x551/AGPMA0
• **Alstom ILS**		
− Alstom ILS Multi-point traffic (Master)	serial	SM-x551/ILSMA0
• **ASCII Protocol (SMS-Alarm, Printer)**		
− ASCII Protokoll (SMS Sender/Receiver, serial printer)	serial	SM-x551/SMSA0
• **DSFG-Bus**		
− DSFG-Bus for Gas measuring instruments (Instance- and cross communication)	serial	SM-x551/DSFGA0

3rd-party protocols (proprietary protocols)	Type	Protocol element
• **SMA-Data**		
− SMA-Data Protocol Multi-point traffic (Master)	serial	SM-x551/SMAMA0
• **TLS Traffic control communication protocol**		
− TLS Traffic control communication protocol Multi-point traffic (Master)	serial	SM-x551/TLSAMA1
• **VEAG-Profile**		
− VEAG Profile protocol Point-to-Point Master	serial	SM-x551/VEZA0
• **Kayser Threde BDKIII**		
− Kayser Threde BDKIII Master	serial	SM-x551/BDKMA0
− Kayser Threde BDKIII Slave	serial	SM-x551/BDKSA0
• **IEC60870-5-101 End-End "RWE-Profile"**		
− IEC60870-5-101 End-End (Balanced) "RWE-Profile"	serial	SM-x551/BPPA9
• **IEC60870-5-101 Dial-UP "RWE"**		
− IEC60870-5-101 Dial-UP Master (Balanced) "RWE"	serial	SM-x551/DIAMA8
• **Pfalzwerke protection equipment interface protocol**		
− Protection equipment interface protocol Pfalzwerke	serial	SM-x551/PWSSA0

Note

Information about the standard protocols can be found in section Protocol elements. The 3rd party protocols are described in own documents.

2.5   Firmware Architecture
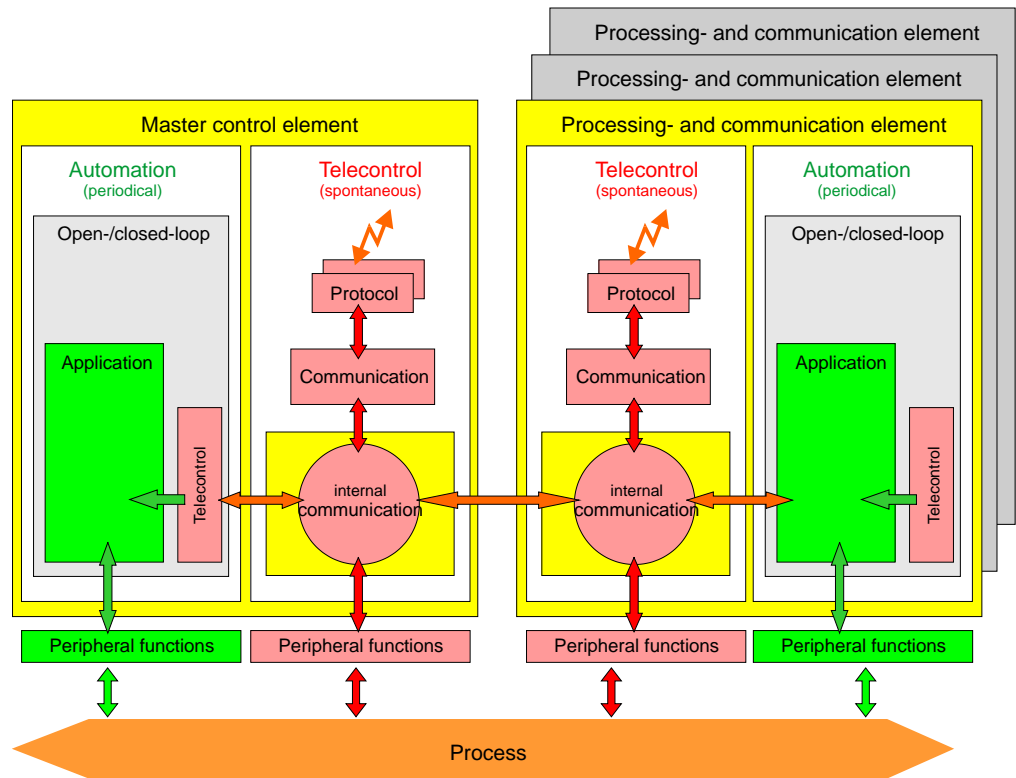
2.6 Engineering

The costs for the creation and maintenance of automation technology plants are determined to an increasing degree by the costs for the creation and updating of the engineering data. The engineering data therefore represent major capital goods of the company, the creation and updating of which by means of a high-quality engineering system results in a considerable reduction of the indirect costs.

For this reason, SIEMENS places great importance on the engineering systems in its product range, and with the SIEMENS TOOLBOX II, thus consequently continues its policy of always providing high-quality, ergonomic products based on innovative system technology, also in the field of engineering systems.

The high demands on the easy and intuitive operability, as well as on the overall ergonomics of an engineering system are satisfied by the SICAM TOOLBOX II through an state-of-the-art operating and display technology, and through forward-looking conception:

- Fully graphical user interface with easy operation
- Uniform "look and feel" (Window technology, Menus, Icons, Help System)
- Industrial standard database system ORACLE ™
- Network support (SIEMENS TOOLBOX II Peer Server)
- Client/Server architecture
- Windows based operating systems
- Standard hardware (Personal Computer)

Basically the SICAM TOOLBOX II is available in the following configurations:

- Local PC Configuration (SICAM TOOLBOX II local)
- Server-Client Configuration (SICAM TOOLBOX II in a network)

The SICAM TOOLBOX II as Integrated Overall Tool

All engineering data is stored, managed and processed on the same hardware platform in a central database by the same tool.

If an exchange of data with devices or systems of other manufacturers should be necessary, then there is a specific data interface for this available that is simple to operate, the source data management.

During the entire lifecycle of the plant, the SICAM TOOLBOX II comprehensively supports all phases of the plant configuration and maintenance for the entire SICAM RTUs system family. The engineering with the SICAM TOOLBOX II therefore goes far beyond conventional device parameterization and comprises the following areas:

- Data Acquisition, Data Modeling
- Parameter setting, test and diagnostic
- Documentation
- Backup and archiving
- Maintenance

2.6.1 Data Acquisition, Data Modeling
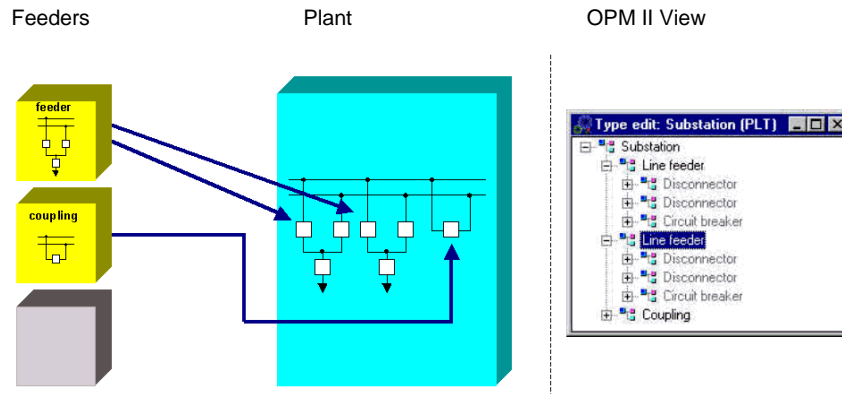
The plant is at the center of the configuration procedure.

For same type primary technology units and resources (objects), types can be modeled, which contain the characteristics of the objects. During engineering, such objects can be created identically many times very easily (one speaks of instantiation). As a result considerable savings can be achieved.

The advantages outweigh not only with the creation but also with the updating of the data for expansions and with consistent change of all same-type objects as well as with the achievable quality with regard to consistency of the engineering data.

2.6.2 Application Program for the Open-/Closed-Loop Control Function

An application program for the open-/closed-loop control function is created according to IEC 61131 3 using CAEx plus, a tool of the SICAM TOOLBOX II. This standard is generally accepted in the market and is recognized. Engineering according to this standard generally only requires short training periods.
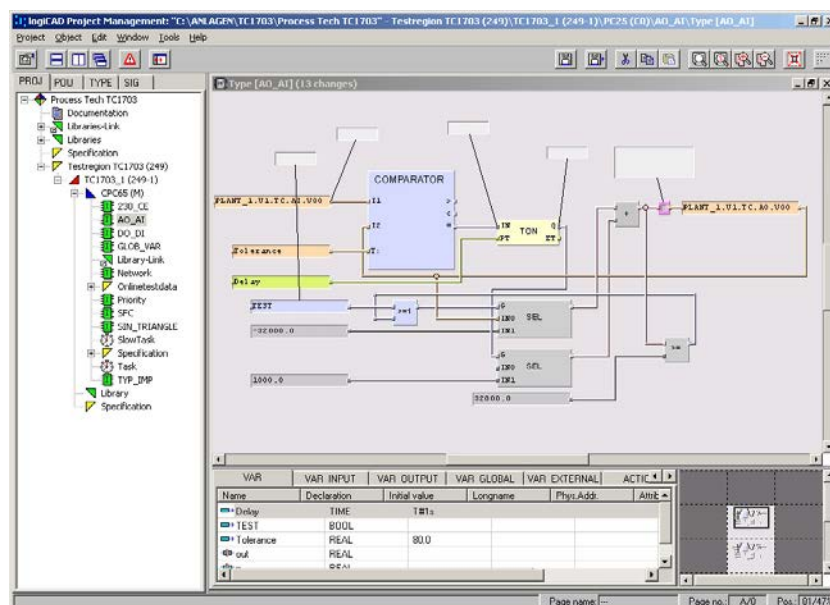
Thereby versatile applications can be easily realized:

- Logical links
- Sum commands, sum alarms
- Limit monitoring
- Bay- and station-related interlocks
- Synchronous comparison with analog of busbar
- Switchover automation, switching sequences (e.g. busbars, transformers)
- Step-by-step controls
- Closed loop control (e.g. tap changer controller)

There are many test function available, both offline as well as online. Consequently, test and commissioning periods can be kept very short.

Example: Signal list

Example: Online Test

Example: Oscilloscope

Unrestricted SICAM RTUs, SICAM AK 3 System Description
Edition 12.2016, MC2-025-2.03

3 Function Packages

Contents

3.1 System Services

System Services is a function package, that provides general functions and basic services in an automation unit, that other function packages require:

- Communication with the engineering system
- Data Flow Control
- Addressing
- Time management
- General interrogation, outstation interrogation
- Self-Test
- Failure
- Diagnostic and Signaling
- Redundancy
- Autonomy

3.1.1 Communication with the Engineering System (SICAM TOOLBOX II)

For the communication between the SIEMENS TOOLBOX II and the automation unit, in two respects there are different variants:

- Physical connection of the SICAM TOOLBOX II with an automation unit
  - Locally
    - Universal Serial Bus (USB) on the master control element
  - Remotely
    - Ethernet (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 above mentioned forms)
  - Remote automation unit (automation unit that can be reached via the local automation unit; consistent remote communication according to IEC 60870-5-101/104 or 61850 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 (for example online test of an application program of the *open-/closed-loop control function*)
- Load firmware, load parameters

3.1.2   Data Flow Control

The data flow control coordinates 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

3.1.2.1   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 protocol elements, are distributed with the help of the automatic data flow routing.

For messages with process information that are to reach sinks within the automation unit - such as peripheral elements, open-/closed-loop control function - the routing information or assignments are automatically derived from parameters from OPM-inputs (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.

Within the SICAM RTUs family, the messages are compatible when using standard protocols, just as with the older products AK 1703, AM 1703, AMC 1703, and BC 1703.

Messages with process information have a 5-stage message address. Message addresses must be parameterized at the sources, such as e.g. peripheral elements, *open-/closed-loop control function*.

3.1.3 Addressing

3.1.3.1 Addressing of Automation Units

An automation unit is addressed by means of:

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

Within a system-technical plant each automation unit must be unambiguously addressed. Therefore a system-technical plant may consist of up to 64.000 automation units.

3.1.3.2 Addressing of System Elements

Within an automation unit, system elements are addressed by means of numbers for:

- Basic system elements
- Peripheral elements
- Protocol elements

3.1.3.3 Addressing of the Process Information

Addressing and the structure of the process information to be passed on are consistent with the IEC 60870 5 101/104 standard. 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 the ASDU, octet 1
CASDU 2	Common address of the ASDU, octet 2
IOA 1	Information object address, octet 1
IOA 2	Information object address, octet 2
IOA 3	Information object address, octet 3

Messages with process information in monitor direction are source-addressed, *messages with process information in control direction* destination-addressed.

3.1.4 Time management

It is an integral element of the time management, that each automation unit and each system element, that has a time-dependent function to fulfill, can manage a clock with corresponding accuracy and resolution. Each automation unit has a central clock, the so-called time server.

3.1.4.1 Clock

After startup, in error-free operation, the time server of the automation unit is time-set after a few minutes by means of an external clock. The synchronization between the time server and the external clock provides the real time accuracy of the automation unit.

The time server itself distributes the time to the clocks of the internal further C-CPUs. Afterwards the time synchronization ensures, that all time servers run in all automation units synchronously.

All clocks within an automation unit are operated and synchronized by a central 10 ms-clock pulse, that is generated by the time server of the automation unit with an accuracy of < 1 ms.

With power-up, all clocks begin to run unsynchronized with the date/time `01.01.2001 00:00:00.000`. Therefore, until the first time setting they have only a relative time, that is flagged with "invalid".

During a reset the time server keeps running, thereby all clocks remain synchronous.

3.1.4.2 Time Setting and Time Synchronization

For the time setting and the time synchronization, there are many options available:

- Direct serial connection of a DCF77 or a GPS time signal receiver (for the reception of minute pulses and serial time signals).
- Time setting over the communication (serial, LAN) from a master station, synchronizing by means of minute pulse of the GPS or DCF77 receiver
- Time setting and time synchronizing over a serial communication
- Time setting and time synchronizing over LAN (Ethernet TCP/IP, SNTP/NTP)

SICAM AK 3 itself can time-set and synchronize, if it is already time-set, further automation units of the product family SICAM RTUs over communication lines of IEC 60870 5 101/103/104 and IEC 61850.

3.1.4.3 Automatic Time Tag

At every point in the system where messages with process information are generated, these messages can be provided with a time tag. Resolution and accuracy of the time tag are dependent on

- the function, that generates the time tag
- the system element in which this takes place (see technical data)

The transfer of the data with standard protocols takes place with 7 octet time (in other words including date, with 1ms resolution) and priority-controlled.

3.1.5   General interrogation, outstation interrogation

Upon 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 internal and external communication connections are set up, and under consideration of a multi-hierarchical network, all affected data points (binary information, analog values, calculated values, etc.) and system information are transmitted to their sinks. This takes place with the initiation of a station interrogation to the corresponding part of the automation network, in which the error occurred.

3.1.6   Self-Test

The self-test is used for the protection against inadmissible operating states. Through a series of monitoring operations, defects of the hardware used or faulty behavior of the firmware are detected.

Depending on the respective supervision, tests are performed

- during startup and/or
- continuously during operation

3.1.6.1   Monitoring the Data Integrity

Monitoring	Detection	Note
Messages with spontaneous information objects on internal interfaces	• Defect of the storage medium used (FIFO) • Internal communication errors	• Checksum
Messages with periodical information on the Ax 1703 peripheral bus	• Communication errors on the Ax 1703 peripheral bus	• Hamming distance 4 • Horizontal and vertical parity

3.1.6.2 Monitoring of Hardware and Firmware

Monitoring	Detection	Note
Watchdog monitoring	• Defect of the CPU used • Faulty behavior of the firmware	
IDLE monitoring	• Faulty behavior of the firmware or application program with endless loops • Excessively long firmware run times etc.	
Code memory monitoring	• Defect of the storage medium used (Flash-PROM or SD card) • Undetected transmission errors when loading the program code	• Checksum
Parameter memory monitoring	• Defect of the storage medium used (Flash-PROM or SD card) • Undetected transmission errors when loading the parameters	• Checksum
Firmware self-monitoring	• Incorrect call parameters with system services and programming errors	
Shadow RAM	• Defect of the storage medium used (DRAM) • Defect of the DRAM refresh logic implemented	
RAM test with addressing error check	• Defect of the storage medium used (DRAM) • Defect of the READ/WRITE equipment • Defect of the RAM in a defined area • Defect of the DRAM refresh logic implemented • Short or interruptions on the data and address bus	
Monitoring forbidden memory access	• Firmware errors	• CPU exception handling
Monitoring forbidden I/O access	• Firmware errors when accessing the I/O address range • Hardware errors	• CPU exception handling
Illegal Opcode	• Firmware errors with e.g. jump operations • Defect of the storage medium used (Flash-PROM) • Defect of the READ equipment • Short or interruptions on the data and address bus	• CPU exception handling
Stack Overflow	• Firmware errors	• CPU exception handling • Firmware

3.1.7 Failure

The system concept of failure management realized in SICAM RTUs ensures the individual marking of the data of failed parts of the system and the correct system and process behavior in the event of a fault.

For this the failure management provides:

- a system function for the failure detection (e.g. for modules/system elements, communication)
- derived from this the marking of the data points affected by the failure in the spontaneous communication with
  — other automation units
  — the *open-/closed-loop control function*
  — the peripheral elements
- periodical information that inform the *open-/closed-loop control function* which peripheral elements - and thereby which periodical information - are affected by the failure
- a parameter-settable behavior of peripheral elements with output function

Consequently, for all data sinks the state is available for every process information and – depending on requirements and functionality – corresponding measures can be initiated.

3.1.8 Diagnostic and Signaling

The diagnostic function manages the system states and error information detected by the individual functions and their monitoring operations. It enables the display of process states, the internal system and fault information on the front panel of the modules and the local or remote diagnostic by means of the SICAM TOOLBOX II.

Each system element delivers its detected system and error states to the master control element with supplementary information (e.g. cause of error, originator description). There they are saved in tables as current and stored information. These information items can be read out and displayed in detail locally or remotely with the help of the SICAM TOOLBOX II. The stored information can be acknowledged and can thus be updated again. For the purpose of better clarity, these tables are divided into classes:

A sum information about the detailed errors is transmitted via the communication to the next automation units and is additionally managed there.

Further, SICAM AK 3 provides up to 2 relay outputs available for signaling, each with normally open and normally closed contact.

Important detail or sum information is displayed by means of LEDs.

3.1.9 Redundancy

With redundancy, one system part is utilized for the operation (*active*), while the other system part is *Standby*.

With simple redundancy applications, the processing system elements are designed redundant, whereby one is *active*, the other is *Standby*. The *Standby* processing system element is continually calibrated, through which, with a failure of the *active* processing element, a switchover to the *Standby* can take place without operational interruption. In this way, redundant automation tasks can be realized simply and cheaply. Up to 5 redundant processing elements can be installed in one SICAM AK 3. Since the power supply can also be designed redundant, an availability is achieved close to that with two separate automation units.

With redundant communication routes, both communication interfaces can be used simultaneously for the purpose of load distribution. If one communication link fails, then all data are transmitted over the communication link still available.

For redundant front ends, the switchover can take place separately for each communication interface. This increases the availability, especially with redundant communication routes to the remote terminal unit.

If the automation units are designed redundant, then a continuous calibration of the open- and closed-loop control application programs can also be performed.

3.1.10 Autonomy

Autonomy means, that an autonomous basic system element and its supplementary system elements (protocol- and peripheral elements) continue to function during the failure of the master control unit. This behavior can be set for each basic system element by means of a parameter.

On failure of the master control unit, data points are flagged with "not topical", which

- are acquired by other system elements in the automation unit and not over the particular peripheral or protocol elements
- are acquired by other automation units that are not connected over the particular protocol elements

After startup of the master control unit, the autonomous basic system element is synchronized without interruption to operation. Due to a general interrogation, the data points flagged with "not topical" on failure of the master control unit are updated.

3.2 Telecontrol

The function package *Telecontrol* includes the following functions:

- Communication with other Automation Units
  - Protocol elements
  - Automatic or selective data flow routing
  - Data Storage
  - Priority control
  - redundant communication routes
- Protocol element control and return information
- Process data input and output
- Decentralized archive

3.2.1 Communication with other Automation Units

3.2.1.1 Protocol elements

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

The communication function differentiates between transmission and receive direction.

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 are 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

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

Priority channels are distinguished with regard to the data that they transport:

- Time synchronization
- System Information
- Process information in control direction
    — Priority channel command (only with selective data flow)
- Process information in monitor direction
    — Priority high with class 1 data
    — Priority medium with class 1 data (only with selective data flow)
    — Priority low with class 1 data (only with selective data flow)
    — Priority high with class 2 data (only with selective data flow)
    — Priority medium with class 2 data
    — Priority low with class 2 data
- Transparent information

Functions for priority channels:

- State compression for measured values (can be set using parameters)
  Specifically reduces the flood of messages, that can continuously generate fluctuating ("floating") 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 peripheral elements, 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 with several information queued at the same time, the higher-priority, highly important information is transmitted first.

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.

3.2.1.5 Redundant Communication Routes

In accordance with the requirements with regard to reaction time, availability, data throughput and transmission media, the following redundancy operating modes are possible:

- Communication with redundant remote stations
- Redundant communication with a remote station (load share operation)

Communication with Redundant Remote Stations

The communication with redundant remote stations is possible with every data communication mode (single-point, multi-point). Thereby both transmission paths are operated independent of each other.

Redundant communication with a Remote Station

The redundant communication to a remote station is possible exclusively in the data communication mode "single-point". It is supported only on an interface pair (SI0, SI1 resp. SI2, SI3) of a serial interface module

The redundant communication to a remote station is enabled through two operating modes:

- Data Split Mode

All messages are transmitted over the parameterized interface (according to the setting in the data flow filter or in the selective data flow routing).

If the communication is faulty over the parameterized interface, all messages are transmitted over the other interface of the interface pair. If the full functioning capability of the parameterized interface is detected, a switchover of the interfaces to normal operation takes place.

— Improvement in the availability
— Different transmission rates possible on both transmission paths
— The data throughput remains unchanged at the same transmission rates

- Load Share Mode

Normally, the messages are transmitted, depending on the data volume, over the less occupied interface. Preferred is always the interface with the lower number (SI0 or SI2).

If the communication is faulty over 1 interface of an interface pair, all messages are transmitted over the other interface of the interface pair. If the full functioning capability of the interface is detected, a switchover of the interfaces to normal operation takes place.

— Improvement of the data throughput and the availability through optimum utilization of the interfaces with every load and in every operating state
— Same transmission rates recommended on both transmission paths
— If the entire traffic is processed over 1 available interface, the data throughput sinks to that value, that would otherwise be achieved with the same conditions in data split mode

3.2.2   Protocol element control and return information

This function is used for the user-specific influencing of the functions of the protocol elements. The main application lies with protocol elements with multi point data communication mode and especially for dial-up traffic configurations.

This function contains two separate independent parts:

- Protocol element control
  — Test if stations are reachable
  — suppression of errors with intentionally switched-off stations
- Protocol element return information
  — Cost control of telephone charges
  — Cost-efficient utilization of the telephone line (e.g. command initiation only then, when a connection has already been established).

3.2.3   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 peripheral elements
- Generation and spontaneous transfer of *messages with process information* over the Ax 1703 peripheral bus for further processing; therein included are
  — Time information (resolution 1 ms or 10 ms, dependent on the peripheral element)
  — Processed input signals
    − Change-monitored conditioned values
    − Change-monitored derived information
- Spontaneous reception of *messages with process information* over the Ax 1703 peripheral bus
- Postprocessing and output of the process data on the peripheral elements

3.2.4 Decentralized Archive (DEAR)

By means of the Decentralized Archive it is possible to store events of a substation locally and, whenever it is required, to transmit to the corresponding control system. On the other hand it is possible to restore the archive of a control system after a communication failure.

Depending on which kind of data is to be archived, it is distinguished in

- spontaneous archiving
- periodical archiving

DEAR is separated in 2 partial functions:

- recording of data into the archive
- transmission of the archive to the control system

3.3 Automation

The function package *Automation* includes the following functions:

- Telecontrol interface
  - — Transfer of Messages with Process Information
    - – Treatment for commands according to IEC 608705101/104
  - — Change Monitoring and Generation of Messages with Time Tag
- *Open/Closed-Loop Control Function*
- 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 monitor direction:

- Single-point information, double-point information, step position information
- Measured Values
- Integrated totals
- Bit string of 32 bit
- Event of protection equipment
- Blocked activation/trip of the protection

messages with process information in control direction

- Single commands, double commands, regulating step commands
- Setpoint commands
- Bit string of 32 bit

3.3.1.1.1 Treatment for commands according to IEC 608705101/104

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

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

The data transfer of the spontaneous information objects to the application program 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 application program of the *open-/closed-loop control function*. For the proper operation of this function, information is required by the application program of the *open-/closed-loop control function* (e.g. from an inter-locking logic) for the choice of a positive or negative confirmation.

The treatment for commands can be activated individually for each command via a parameter, and comprises the following processing functions:

- Prepare command output procedure ("activation")
  — Formal Check
  — Retry suppression
  — Direct command or - select and execute command
  — Check control location
  — Command interlocking
  — 1-out-of n check
  — System element overlapping 1-out-of n check
- Initiate command output procedure ("activation/confirmation")
  — Command to application program
- Monitor pulse duration (only pulse commands)
  — Command output time
  — Return information monitoring
- Terminate command output procedure ("activation/termination")

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 imag-es that are assigned to an element of a spontaneous information object, are monitored for change.

The change monitoring takes place in a grid of the cycle time of each task, 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.

Depending on the type of signal to be monitored, different methods are applied:

- Change of the state (positive edge, positive and negative edge)
- Change of the value (according to the rules of the additive threshold value procedure)

If a spontaneous information object has been activated for transmission due to a change, a *message with process information* is generated. The time tag represents either the current time synchronous with the cycle (resolution 10 ms or multiples thereof) or the time information from an assigned spontaneous information object.

3.3.1.2.1 Additive Threshold Value Procedure

The additive threshold value procedure prevents an unnecessary loading of the transmission links with insignificant changes of the corresponding analog value and acts only on the basic data of the spontaneous information objects with measured values.

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 an application program.

The creation of the application program is carried out by the SICAM TOOLBOX II with the tool CAEx *plus* predominantly in function diagram technology according to IEC 61131-3.

The application program processes process -information (so-called signals) from the peripheral elements connected to the basic system element 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 from and to the peripheral elements connected to the basic system element via the Ax 1703 peripheral bus (process data input and output)
- Transmission of spontaneous information objects from and to functions or peripheral elements within the automation unit, other *open-/closed-loop control function* and other automation units or control systems with the help of 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 programs in 3 tasks running periodically:

- "Fast Task"
- "Task"
- "Slow Task"

The *open-/closed-loop control function* supports 32 programs (type instances) per task. In total, 64 programs are possible over all 3 tasks.

By means of assignment of a program to a task, fast controls can be optimally combined with slower background processing.

The management of these three periodical tasks (Task Management) corresponds with the standard IEC 61131-3. Spontaneous tasks are not supported.

Coordination of the sequences of a task

- Periodical start in the selected cycle
- Input handling
- Program processing
- Output handling
- Online Test
- Real time archive

Coordination of the three tasks with each other

- "Fast Task" runs without interruption and with constant running time
- "Task" and "Slow Task" can be interrupted by higher-priority functions

Cycle Time

- Within the cycle time, all programs assigned to a task (type instances) must process the input handling and the output handling for this task
- The cycle time can be set in the tool CAEx plus for each task (10 ms and multiples)
- The cycle times of the three tasks must be different and ascending from the "Fast Task" to the "Slow Task".

Watchdog Timer

This function monitors the proper sequence of each task within its set cycle time. If a 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 peripheral elements connected.

3.3.2.3   Loading the Application Program

Initial Loading

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

Loading of changes (Reload)

Frequently, in the test and commissioning phase but also with the remedy of faults, changes must be carried out. Most such changes (error rectifications, expansions) to the application program can be loaded without interruption to operation. Far-reaching changes can necessitate a startup of the basic system element and consequently an interruption to operation.

In the case of a loading operation that does not necessitate any interruption to operation, all tasks of the *open-/closed-loop control function* continue to run unaffected. After successful loading, a switchover to the newly loaded application program takes place synchronous with the cycle.

Examples of changes that do not necessitate any interruption to operation:

- if after change, the function corresponds completely with that before change, in other words a change has been performed that is not noticeable from "outside"
- if only new functional parts were added, that do not affect those that already existed
- if parameters of a controller are adapted

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 SICAM TOOLBOX II tool "CAEx *plus* Online Test" and
- the Online Test function of the *open-/closed-loop control function* of the automation unit

While in the tool "CAEx *plus* Online Test", all functions of the man-machine-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, then the selection of the value and its display takes place in the tool "CAEx *plus* Online Test". For this purpose, the *open-/closed-loop control function* is given the task of reading out the selected value and transmit it to the SICAM TOOLBOX II.

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
- Permanent setting of variables and signals
  In order to be able to set variables and signals permanently, a special element ("Force Marker") is set in the function diagram. This element contains the set value and a switch. Depending on the position of the switch, the set value and or that value is transferred, that the source that normally supplies the variable or the signal, is delivered.

Blocking and enabling of *messages with process information* **and periodical information**

The copy operation

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

of

- *Messages with Process Information*
- Periodical Information

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

- per message
- all messages
- per periodical information
- each peripheral element

Changing the execution status of the open/closed-loop control function

- Perform cold start or warm start of the resource
- Start and stop controller
- Perform cold start or warm start of a task
- Task halt and continue
- Program halt and continue

Test means

The available test means are:

(a) Halting of the execution due to a trigger condition (breakpoint)
(b) Execution of a task in cycle steps
(c) Controlling of the recording of the cyclic archive (Real Time Archive)

For each of the functions (a) and (c) a *Trigger Condition* is defined in the tool "CAEx plus Online Test". A trigger conditions consists of up to 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	Condition	<operator>			
BOOL	*variable* <operator> *value*	=		<>	
INT or REAL	*variable* <operator> *value*	<	=	<>	>

The trigger condition is assigned to either a task or the resource (= all tasks), depending on what shall be achieved:

- The function "Halt the execution due to a trigger condition" halts the task or resource, if the trigger condition is satisfied
- The function "Real Time Archive" switches over from Recording the Pre-History to Recording the Post-History, if the trigger condition is satisfied

The trigger condition is evaluated at the end of that task, to which it has been assigned; or at the end of every task, if it has been assigned to the resource.

Real Time Archive

The real time archive of the *open-/closed-loop control function* records variables (and signals) after every cycle, in order to make then available for display with the oscilloscope function of the SIEMENS TOOLBOX II tool "CAEx *plus* Online Test". Which variables are to be recorded is defined in the "CAEx *plus* Online Test". The recording can be controlled in such a way, that pre- and post-history are available for a post-mortem analysis.

For the recording of the variables there is a memory of 100,000 bytes available for each resource.

The recording can be terminated with:

- Operator input in "CAEX plus Online Test"
  The recording is terminated, the entire memory is available as pre-history.
- Definable trigger condition
  The real time archive switches from Recording the Pre-History to Recording the Post-History and continues to record until the memory is full. The division of the memory into pre- and post-history can be defined.

Which variables are to be recorded and at which periodicity, is determined in the "CAEX *plus* Online Test". The periodicity is determined by assigning the recording to a task. From its cycle time and the setting of how many cycles are to be omitted between the recordings, the recording times are produced and consequently the resolution of the display in the oscilloscope function.

*Resolution[ms] = cycle time[ms] of the selected task * (number of cycles to be omitted +1)*

The time period for the pre- and post-history is dependent on the number of variables to be recorded (*# of Var*) and the aforementioned resolution:

*Time period[ms] = (100000*resolution[ms])/((# of Var BOOL)+2*(# of Var INT)+4*(# of Var REAL))*

Display Status Information

For each task the following information are made available to the SICAM TOOLBOX II on request:

- the parameterized cycle time
- the current run time
- the maximum run time
- the 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.

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 peripheral elements
- Periodical transfer of the process information to the *open-/closed-loop control function* over the Ax 1703 peripheral bus;

  therein included are - depending on the peripheral element
  - Non-linearized values of the input signals
  - Processed input signals as not change-monitored conditioned values
  - Processed input signals as change-monitored conditioned values
  - 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* over the Ax 1703 peripheral bus;

  therein included are - depending on the peripheral element
  - Derived information items
  - Processing results
  - Operations-relevant error information (for instance "command output fault")
- Postprocessing and output of the process data on the peripheral elements

4 Ambient Conditions

Contents

4.1   Type of protection

Operational Equipment	Protection according to IEC 60529
Basic board rack CM-2844 (9 slots) GC2-844 / 6MF11130CJ440AA0	Rear panel installation with wall fastening kit IP 20
Basic board rack CM-2846 (17 slots) GC2-846 / 6MF11130CJ460AA0	Rear panel installation with wall fastening kit IP 20
	19" (swing) frame installation with rear cover IP 20
Expansion board rack CM-2843 (16 slots) GC2-843 / 6MF11130CJ430AA0	Rear panel installation with wall fastening kit IP 20
	19" (swing) frame installation with rear cover IP 20

4.2 Mechanical Ambient Conditions

Parameter	Range	Test standard	Cl.	Product stand.	Cl.
Harmonic					
Amplitude of the excursion 1…9 Hz Acceleration 9…200 Hz Acceleration 200…500 Hz	±3.5 mm 10 m/s^2 15 m/s^2	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					
Acceleration; 11 ms duration (function)	100 m/s^2	IEC 60068-2-27		IEC 60870-2-2	Bm
Acceleration; 11 ms duration (resistance)	15 g	IEC 60068-2-27		IEC 60255-21-2	1
Continuous shock					
Acceleration; 16 ms duration	10 g	IEC 60068-2-27	1	IEC 60255-21-2	1
Seismic harmonic					
Amplitude 1…8 Hz (horizontal) Amplitude 1…8 Hz (vertical) Acceleration 8…35 Hz (horizontal) Acceleration 8…35 Hz (vertical)	±3.5 mm ±1.5 mm 1 g 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.

4.3 Climatic Ambient Conditions

Parameter	Range	Test standard	Cl.	Product stand.	Cl.
Minimum air temperature (cold)	-5°C/72 h	IEC 60068-2-1 Ad		IEC 60870-2-2 IEC 60654-1	C1 C1
Maximum temperature (dry heat)	55°C/72 h [*]	IEC 60068-2-2 Bd		IEC 60870-2-2 IEC 60654-1	C2 C2
Damp heat	55°C/48 h 95% rH	IEC 60068-2-30			
Temperature gradient	$\leq$ 30°C/h			IEC 60870-2-2 IEC 60654-1	C2 C2
Relative air humidity	5…95%			IEC 60870-2-2 IEC 60654-1	C1 C1
Absolute air humidity	$\leq$ 29 g/m^3			IEC 60870-2-2 IEC 60654-1	C2 C2
Air pressure	70…106 kPa (up to 3000 m)	IEC 61000-4-5		IEC 60870-2-2 IEC 60654-1	C2 C2
Storage and transport temperature	-30…+85°C				

[*] max. 40°C permissible with fully equipped board rack

Warning

If an operation under ambient conditions from 40°C to 55°C is intended, then only each second CPU-slot may be equipped, to avoid an exceeding of the permitted operating temperature of the modules and to ensure a normal operation.

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 production rooms for electronic and electrotechnical products, telecontrol rooms, storage rooms for valuable and sensible devices.

4.4 Electromagnetic Compatibility

4.4.1 System Properties

Parameter	Value	Test standard	Cl.	Product stand.	Cl.
Discharge of static electricity (ESD)	8 kV-L 6 kV-K	IEC 61000-4-2	3	IEC 60870-2-1 IEC 60255-26	3
Electromagnetic fields	10 V/m 80 MHz…1 GHz 3 V/m 1…2 GHz 1 V/m 2…2.7 GHz	IEC 61000-4-3	3	IEC 60870-2-1 IEC 60255-26	3
Induced HF voltage	10 V	IEC 61000-4-6	3	IEC 61000-6-2	
50 Hz electromagnetic fields	100 A/m (cont.) 1000 A/m (3 s)	IEC 61000-4-8	5	IEC 60870-2-1	4
Pulse shaped magnetic field	1000 A/m	IEC 61000-4-9	5	IEC 60870-2-1	
Radio interference voltage approximate peak value	79/73 dBµV	CISPR22	A	IEC 60870-2-1 CISPR22	A A
Radio interference voltage mean value	66/60 dBµV	CISPR22	A	IEC 60870-2-1 CISPR22	A A
Radio interference field strength (10 m)	40/47 dBµV	CISPR22	A	IEC 60870-2-1 CISPR22	A A

The characteristics required by the european standards EN 61000-6-4 and IEC 61000-6-2 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.

4.4.2   Power Supply

Parameter	Value	Test standard	Cl.	Product stand.	Cl.
Dielectrical test $V_N \leq 60$ V against SELV circuits	2.5 kV$_{rms}$	IEC 60255-27		IEC 60870-2-1 IEC 60255-27	VW3
Dielectrical test $V_N > 60$ V against SELV-circuits	3.0 kV$_{rms}$	IEC 60255-27		IEC 60950-1	2
Impulse voltage 1.2/50 µs common	5.0 kVs	IEC 60255-27		IEC 60870-2-1 IEC 60255-27	VW3
Impulse voltage 1.2/50 µs normal	5.0 kVs	IEC 60255-27		IEC 60870-2-1 IEC 60255-27	VW3
Voltage tolerance DC [1]	+30/-25%	IEC 60870-2-1		IEC 60870-2-1 IEC 60654-2	>DC3 DC4
Voltage tolerance AC [2]	+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
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 kVs	IEC 61000-4-4	4	IEC 60870-2-1 IEC 60255-26	
Surge 1.2/50 µs common	4.0 kVs	IEC 61000-4-5	4	IEC 60870-2-1 IEC 60255-26	
Surge 1.2/50 µs normal	4.0 kVs	IEC 61000-4-5	4	IEC 60870-2-1 IEC 60255-26	
Interruption time AC ($\Delta U = 100\%$)	$\leq$ 50 ms	IEC 61000-4-11		IEC 60870-2-1 IEC 60255-26	>1
Ring waves 100 kHz common	2.0 kVs	IEC 61000-4-12	3	IEC 60870-2-1	3
Ring waves 100 kHz normal	2.0 kVs	IEC 61000-4-12		IEC 60870-2-1	>3
Voltage ripple DC [1]	$\leq$ 15%	IEC 61000-4-17		IEC 60870-2-1 IEC 60255-26	>VR3
Damped oscillatory waves 1 MHz common	2.5 kVs	IEC 61000-4-18	3	IEC 60870-2-1 IEC 60255-26	3-4
Damped oscillatory waves 1 MHz normal	2.5 kVs	IEC 61000-4-18	>3	IEC 60870-2-1 IEC 60255-26	>3-4
Interruption time DC ($\Delta U = 100\%$)	$\leq$ 50 ms	IEC 61000-4-29		IEC 60870-2-1 IEC 60255-26	>1

[1]   referring to supply voltage rated values: 24 VDC/48 VDC/60 VDC, 110 VDC/220 VDC

[2]   referring to supply voltage rated values: 115 V$_{rms}$ AC/230 V$_{rms}$ AC

4.4.3 Digital and Analog Standard I/Os

Parameter	Value	Test standard	Cl.	Product stand.	Cl.
Dielectrical test	1.5 kV$_{rms}$	IEC 60255-27		IEC 60870-2-1 IEC 60255-27	>VW2
Impulse voltage 1.2/50 µs common	2.5 kVs	IEC 60255-27		IEC 60870-2-1 IEC 60255-27	>VW2
Impulse voltage 1.2/50 µs normal	2.5 kVs	IEC 60255-27		IEC 60870-2-1 IEC 60255-27	>VW2
Fast transient burst common	2.0 kVs	IEC 61000-4-4	3	IEC 60870-2-1 IEC 60255-26	
Surge 1.2/50 µs common	2.0 kVs	IEC 61000-4-5	3	IEC 60870-2-1 IEC 60255-26	
Surge 1.2/50 µs normal	2.0 kVs	IEC 61000-4-5	3	IEC 60870-2-1 IEC 60255-26	
Conducted common mode disturbances common	10 V 0…150 kHz 100 V 50/60 Hz	IEC 61000-4-16	3		
Damped oscillatory waves 1 MHz common	1.0 kVs	IEC 61000-4-18	2	IEC 60870-2-1	2
Damped oscillatory waves 1 MHz normal	1.0 kVs	IEC 61000-4-18	>2	IEC 60870-2-1	>2

4.4.3.1 Deviating Values for DO-2210 and DO-2211

Parameter	Value	Test standard	Cl.	Product stand.	Cl.
Fast transient burst common	4.0 kVs	IEC 61000-4-4	4	IEC 60870-2-1 IEC 60255-26	
Damped oscillatory waves 1 MHz common	2.5 kVs	IEC 61000-4-18	3	IEC 60870-2-1 IEC 60255-26	3-4
Conducted common mode disturbances common	1 V 0…150 kHz 10 V 50/60 Hz	IEC 61000-4-16	1		

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

Parameter	Value	Test standard	Cl.	Product stand.	Cl.
Dielectrical test V_N ≤ 60 V against SELV circuits	2.5 kV$_{rms}$	IEC 60255-27		IEC 60870-2-1 IEC 60255-27	VW3
Dielectrical test V_N > 60 V against SELV-circuits	3.0 kV$_{rms}$	IEC 60255-27		IEC 60950-1	2
Impulse voltage 1.2/50 µs common	5.0 kVs	IEC 60255-27		IEC 60870-2-1 IEC 60255-27	VW3
Conducted common mode disturbances common	30 V 0…150 kHz 300 V 50/60 Hz	IEC 61000-4-16	4		

4.4.4 Communication Serial (V.24/V.28)

Parameter	Value	Test standard	Cl.	Product stand.	Cl.
Dielectrical test	1.5 kV$_{rms}$	IEC 60255-27		IEC 60870-2-1 IEC 60255-27	>VW2
Impulse voltage 1.2/50 µs common	2.5 kVs	IEC 60255-27		IEC 60870-2-1 IEC 60255-27	>VW2
Fast transient burst common	2.0 kVs	IEC 61000-4-4	3	IEC 60870-2-1 IEC 60255-26	
Damped oscillatory waves 1 MHz common	2.5 kVs	IEC 61000-4-18	3	IEC 60870-2-1 IEC 60255-26	3-4

The listed values apply for shielded cables with a distance up to 30 m.

4.4.5 Communication Serial (Profibus DP)

Parameter	Value	Test standard	Cl.	Product stand.	Cl.
Dielectrical test	1.5 kV$_{rms}$	IEC 60255-27		IEC 60870-2-1 IEC 60255-27	>VW2
Impulse voltage 1.2/50 µs common	2.5 kVs	IEC 60255-27		IEC 60870-2-1 IEC 60255-27	>VW2
Fast transient burst common	2.0 kVs	IEC 61000-4-4	3	IEC 60870-2-1 IEC 60255-26	

4.4.6 Communication LAN

Parameter	Value	Test standard	Cl.	Product stand.	Cl.
Dielectrical test	1.5 kV$_{rms}$	IEC 60255-27		IEC 60870-2-1 IEC 60255-27	>VW2
Impulse voltage 1.2/50 µs common	2.5 kVs	IEC 60255-27		IEC 60870-2-1 IEC 60255-27	>VW2
Fast transient burst common	2.0 kVs	IEC 61000-4-4	3	IEC 60870-2-1 IEC 60255-26	
Damped oscillatory waves 1 MHz common	2.5 kVs	IEC 61000-4-18	3	IEC 60870-2-1 IEC 60255-26	3-4

The listed values apply for CAT5 cables with a distance up to 100 m.

5 System Components and Technical Data

Contents

5.1 Board Racks

5.1.1 CM-2844

The board rack CM-2844 provides 9 slots (8 with redundant power supply) for modules with double euro format.

The board rack is designed for rear panel installation.
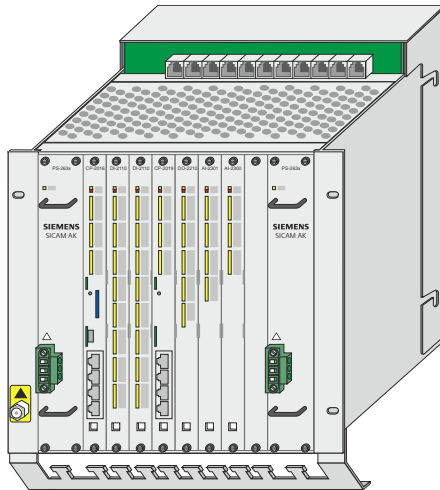
5.1.1.1 Overview

The board rack (48 TE, 9 HE) can be equipped as follows (these parts are not included in the scope of supply)

- 1 master control element
- Up to 8 (arbitrarily mixable)
  — Processing and communication elements
  — Peripheral elements
- 1 to 2 power supply modules PS-263x

Note

When using a 2nd (redundant) power supply you cannot use slot C9.

5.1.1.2 Features and Functions

- Connectors, integrated in the backplane, for
  - 9x Ax 1703 peripheral bus (external)
  - 2x redundancy link (external)
- 2 slot-pairs prepared for redundant basic system elements (redundancy link integrated in the backplane)
- Slots for master control element and power supplies prepared for monitoring of the power supplies by the master control element
- Peripheral elements, installed in the CM-2844, are connected to the internal Ax 1703 peripheral bus, which is driven by exactly one, perhaps redundant, basic system element
- External peripheral elements are connected to the external Ax 1703 peripheral bus (RJ45 M-Ax or Cx-Ax)
- To each basic system element 16 peripheral elements can be connected, hence totally up to 144
- 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

5.1.1.3 Power Supply

The board rack CM-2844 can be equipped with one or two power supplies:

1 power supply module equipped
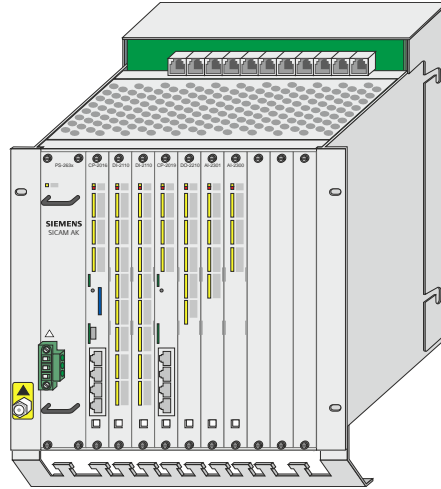
2 power supply modules
equipped
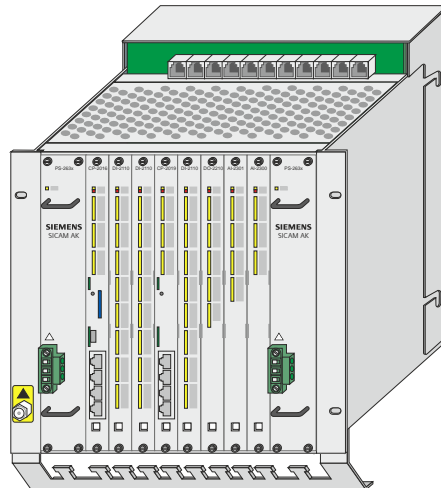
5.1.1.4 Technical Specifications

Backplane and Connectors	
Slot for master control element	Slot 0
2 slot-pairs (wired for redundant basic system elements)	• Slot 1+2 • Slot 4+5
Slots for PS-263x	• 1. Power supply module left • 2. Power supply module right
2 connectors for redundancy link external (M-HSL, C1-HSL)	RJ45 8-pin according to IEC 60603-7
9 connectors for Ax 1703 peripheral bus external (M-Ax resp. Cx-Ax)	RJ45 8-pin according to IEC 60603-7
USB connector for SICAM TOOLBOX II	USB TypMini-B
Voltage output +5 VDC	
	Voltage is taken from the power supply module, and provided current-limited using a PTC
Output nominal voltage [*)	1 A
PTC voltage drop [*)	≤ 100 mV at 1 A and +70°C
Proof against continued short-circuit [*)	Yes
Supply of the board 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
Peripheral connectors	Prefabricated peripheral cables CM-2890, 50x2x0.5, 5 m
Power supply connectors	Screw terminals for direct conductor assembly up to 2.5 mm^2 cross-section
Dimensions	Height 320 mm (9 HU) Width 295 mm (19") Depth 258 mm (power supply not installed) 285 mm (power supply installed)
Weight	Approx. 4.5 kg

[*) applies additionally to the specification of the power supply

5.1.2 CM-2846

The board rack CM-2846 provides 17 slots for modules with double euro format.
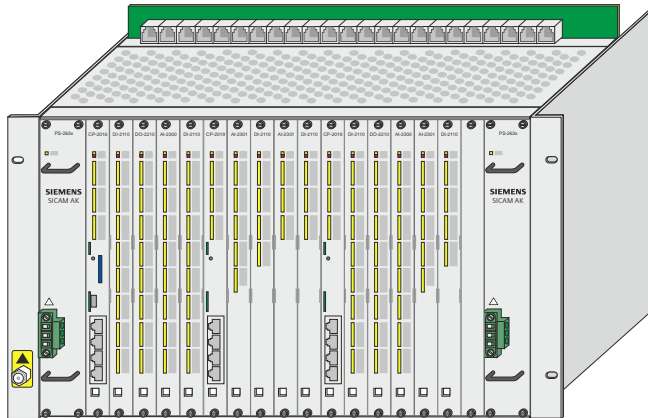
5.1.2.1 Overview

The board rack (84 TE, 9 HE) can be equipped as follows (these parts are not included in the scope of supply)

- 17 double-euro format modules
- 1 master control element
- Up to 16 (arbitrarily mixable)
  — processing and communication elements
  — Peripheral elements
- 1 to 2 power supply modules PS-263x

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.

5.1.2.2 Features and Functions

- Connectors, integrated in the backplane, for
    - 17x Ax 1703 peripheral bus (external)
    - 6x redundancy link (external)
- 6 slot-pairs prepared for redundant basic system elements (redundancy link integrated in the backplane)
- Slots for master control element and power supplies prepared for monitoring of the power supplies by the master control element
- Peripheral elements, installed in the CM-2846, are connected to the internal Ax 1703 peripheral bus, which is driven by exactly one, perhaps redundant, basic system element
- External peripheral elements are connected to the external Ax 1703 peripheral bus (M-Ax or Cx-Ax)
- To each basic system element 16 peripheral elements can be connected, hence totally up to 272
- Wiring peripherals using prefabricated peripheral cables CM-2890
- 2 slots for power supply modules PS-263x
    - for redundancy
- ESD Earth Facility for connecting a ground strap when changing modules
- Unlocking tool for modules included

5.1.2.3 Power Supply

The board rack CM-2846 can be equipped with one or two power supplies:

1 power supply module equipped
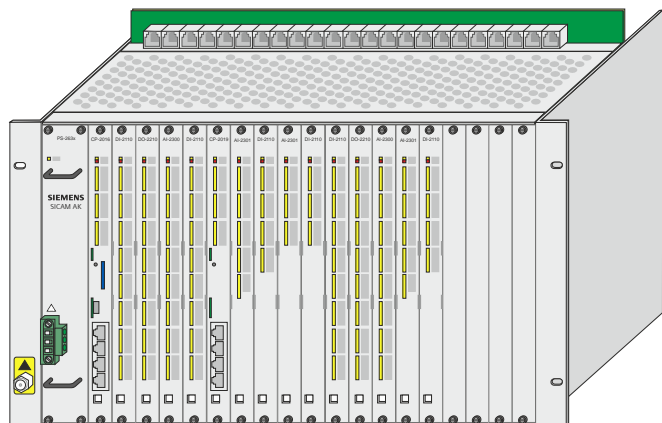
2 power supply modules
equipped

5.1.2.4 Technical Specifications

Backplane and Connectors	
Slot for master control element	Slot 0
5 slot-pairs basic system elements)	• Slot 1+2 • Slot 4+5 • Slot 7+8 • Slot 10+11 • Slot 13+14
Slots for PS-263x	• 1. Power supply module right • 2. Power supply module left
6 connectors for redundancy link external (M-HSL, C1-HSL)	RJ45 8-pin according to IEC 60603-7
17 connectors for Ax 1703 peripheral bus external (M-Ax or Cx-Ax)	RJ45 8-pin according to IEC 60603-7
USB connector for SICAM TOOLBOX II	USB TypMini-B
Voltage output +5 VDC	
	Voltage is taken from the power supply module, and provided current-limited using a PTC
Output nominal voltage [*]	1 A
PTC voltage drop [*]	≤ 100 mV at 1 A and +70°C
Proof against continued short-circuit [*]	Yes
Supply of the board 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 291 mm (9 HU) Width 483 mm (19") Depth 258 mm (power supply not installed) 285 mm (power supply installed)
Weight	Approx. 4.8 kg

[*]   applies additionally to the specification of the power supply

5.1.3   CM-2843

The expansion board rack CM-2843 provides 17 slots for modules with double euro format.
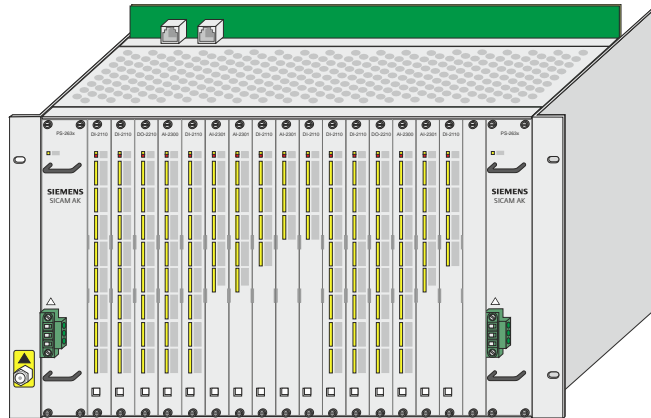
5.1.3.1   Overview

The expansion board rack (84 TE, 9 HE) can be equipped as follows (these parts are not included in the scope of supply)

- up to 17 peripheral elements
- 1 to 2 power supply modules PS-263x

The expansion board rack is designed for 19" (swing) frame installation.

5.1.3.2   Features and Functions

- Connectors, integrated in the backplane, for
  — Ax 1703 peripheral bus
  — Ax 1703 peripheral bus (redundancy)
- Wiring peripherals using prefabricated peripheral cables CM-2890
- 2 slots for power supply modules PS-263x
  — thereof 1 slot for redundancy
- ESD Earth Facility for connecting a ground strap when changing modules
- Unlocking tool for modules included

5.1.3.3 Power Supply

The board rack CM-2843 can be equipped with one or two power supplies:

1 power supply module equipped
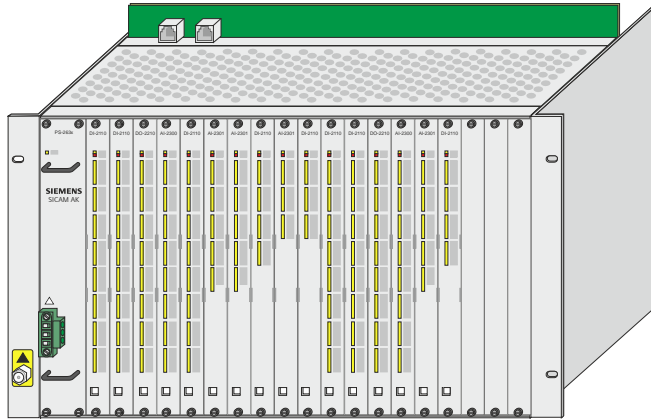
2 power supply modules equipped
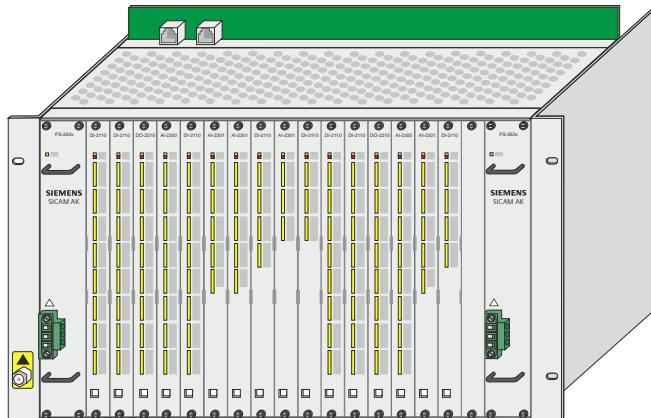
5.1.3.4 Technical Specifications

Backplane and Connectors	
Slots for peripheral elements	Slots 0 … 16
Slots for PS-263x	• 1. Power supply module left (SV0) • 2. Power supply module right (SV1)
1 connector for Ax 1703 peripheral bus	RJ45 8-pin according to IEC 60603-7
1 connector for Ax 1703 peripheral bus (redundant)	RJ45 8-pin according to IEC 60603-7
Supply of the board 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 mm^2 cross-section
Dimensions	Height 291 mm (9 HU) Width 483 mm (19") Depth 258 mm (power supply not installed) 285 mm (power supply installed)
Weight	Approx. 4.8 kg

5.1.4 CM-2848

The board rack CM-2843 provides 17 slots for modules with double euro format.
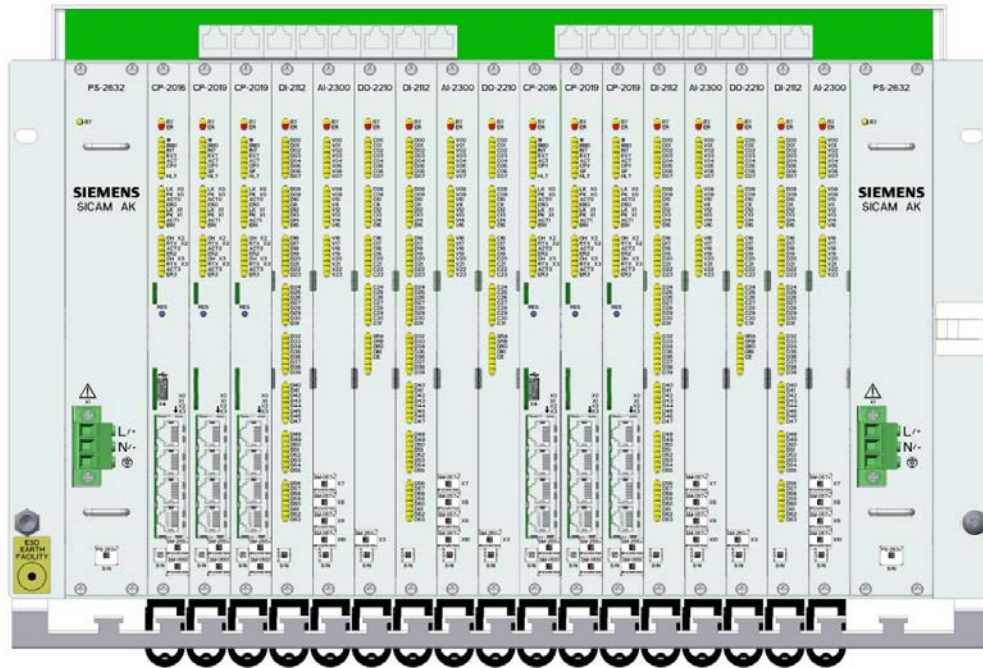
Configuration example

5.1.4.1 Overview

The board rack (84 TE, 9 HE) can be equipped as follows (these parts are not included in the scope of supply)

- 19 double-euro format modules
- 2 master control elements (2 master M-CPUs, CP-2016)
- up to 7 (arbitrarily mixable) processing and communication elements (CP-2019, CP-2017) for each master control element arranged in redundancy pairs

  and/or

- up to 15 peripheral elements subordinated to the respective master M-CPU
- 1 power supply module PS-263x per M-CPU

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.

5.1.4.2 Features and Functions

The board rack CM-2848 is primarily designed for communication and route redundancy.

Note

The board rack CM-2848 is not permitted for SICAM Safety applications according to IEC 61508.
For SICAM Safety applications, refer to SICAM RTUs SAFETY safety manual DC0-117-2.xx.

- Connectors, integrated in the backplane, for
  - 16 x RJ-45 connectors für Ax 1703 peripheral bus (external)
- Slots for master control element and power supplies prepared for monitoring of the power supplies by the master control element
- Peripheral elements installed in the CM-2848 are interconnected trough the internal Ax 1703 peripheral bus, which is driven by exactly one (possibly redundant) basic system element
- External peripheral elements are connected to the external Ax 1703 peripheral bus (RJ-45 Cx-Ax)
- To each basic system element either 16 external singular peripheral elements or 15 internal singular PEs can be connected.
- 2 slots (8TE) for power supply modules PS-263x
  - thereof 1 slot for redundancy
- ESD Earth Facility for connecting a ground strap when changing modules.
- Leverage tool for removal of system elements

Note

Slot 8 is for PE only!

5.1.4.3 Power Supply

The board rack CM-2848 can be equipped with one or two power supplies:

1 power supply module equipped
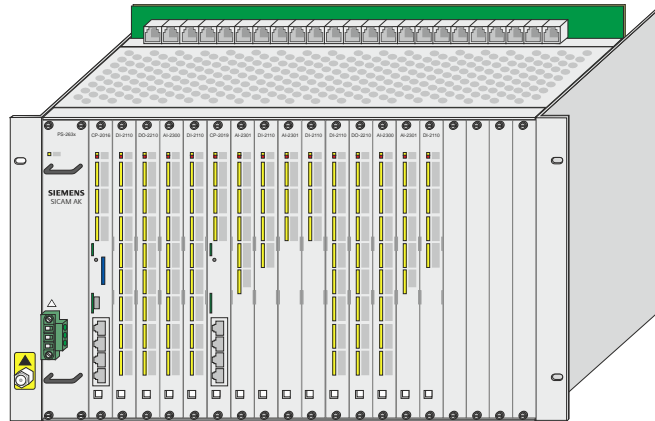
2 power supply modules equipped
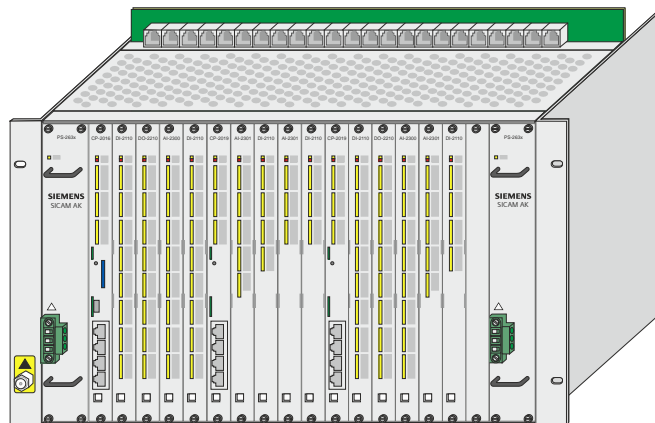
5.1.4.4 Technical Specifications

Hauptplatine und Anschlüsse	
Slot for master control element	Slot 0, 9
8 slot-pairs (wired for redundant basic system elements)	• Slots 0+9 internal HSL connection • Slots 1+10 internal HSL connection • Slots 2+11 internal HSL connection • Slots 3+12 internal HSL connection • Slots 4+13 internal HSL connection • Slots 5+14 internal HSL connection • Slots 6+15 internal HSL connection • Slots 7+16 internal HSL connection
Slot for PS-263x	• Slot SV0: 1st power supply module　　　left • Slot SV1: 2nd power supply module　　　right
5 connectors (M-Ax, C1-Ax to C7-Ax) for external AX peripheral bus in the section "A" of backplane	RJ45 8-pin according to IEC 60603-7
5 connectors (M-Ax, C1-Ax to C7-Ax) for external redundancy AX peripheral bus in the section "B" of backplane	RJ45 8-pin according to IEC 60603-7

Power Supply	
Operating Voltage	5.1 V; supplied by the installed power supply module PS-263x

Mechanics			
Design	Compact metal housing for • rear panel installation • 19 inch (swing) frame installation		
Peripheral connectors	Prefabricated peripheral cables CM-2890, 50x2x0.5, 5 m		
Dimensions	Height 291 mm Width 483 mm Depth 258 mm		
Weight	Approx. 4.8 kg　　　(not equipped; incl. connection cable)		
Total Weight	System Element	Amount	Weight in g	Total Weight in g
	PS-2630	2	900	1800
	CP-2019	4	355	1420
	SM-2551	4	200	800
	DO-221x	6	340	2040
				6060

5.2 Power supply modules

5.2.1 PS-2630, PS-2632

In the system SICAM AK 3 the power supply modules PS-2630 and PS-2632 are used.

5.2.1.1 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 monitored on failure
  - Temperature rise
  - Output voltage failure
- indication of the operating state by means of a LED on the front panel

5.2.1.2 Technical Specifications

Power Supply			
	PS-2630	**PS-2632**	
operating voltage (incl. tolerances)	18 … 78 VDC	82.5 … 286 VDC 45 … 66 Hz	90 … 264 VAC 45 … 66 Hz
Input current $_{out}$ at P = 22 W	4.4 A (24 VDC) 2.13 A (48 VDC) 1.69 A (60 VDC)	950 mA (110 VDC) 460 mA (220 VDC)	935 mA (115 VAC) 490 mA (230 VAC)
Power consumption $_{out}$ at P =22W	106 W (24 VDC) 102 W (48 VDC) 101 W (60 VDC)	104 W (110 VDC) 102 W (220 VDC)	107 W (115 VDC) 103 W (230 VDC)
Efficiency $_{out}$ at P = 120 W	76 % (24 VDC) 79 % (48 VDC) 80 % (60 VDC)	78 % (110 VDC) 80 % (220 VDC)	77 % (115 VAC) 80 % (230 VAC)
Inrush peak current	Inrush current limitation according to IEC 60870-4 (90) class S1		
Bridgeable interruption of the operating voltage (after 30s operation)	min. 50 ms	min. 50 ms	
Reverse voltage protection	No [*]	Can be operated with either polarity	
Overload protection	Yes	Yes	
Short-Circuit Protection	Yes (max. 32 A)	Yes (max. 32 A)	
Can be connected in parallel	Yes (for redundancy)		
Voltage Output			
Output nominal voltage	5 VDC (-1/+2 %)		
Max. output voltage in case of error	6 VDC		
Output nominal current	0.5 … 24 A		
Output nominal power (P_{out})	• 120 W at - 25°C … + 55°C • 120 W bei + 55°C … + 70°C from + 55°C derating: -10%/3°C • 60 W at + 70°C		
Proof against continued short-circuit	Yes		
Mechanics and Connectors			
Mechanics	Housing with front panel		
Dimensions	Double euro format, 8 WU		
Connector	Front side: Supply connector (X1) 3-pin removable screw terminal All screw terminals for direct conductor assembly, up to 2.5 mm² , Rear side: Bus connector (X99) 96-pin according to DIN 41612 type C		
Weight	Approx. 1.3 kg		

[*] fuse is blown, change by authorized personnel only

5.3 Basic system elements

5.3.1 CP-2016/CPCX26

Master control element consisting of a module and loadable firmware.

Type	Designation	Remarks
CP-2016	Central processor AK 3	1 microprocessor and up to 4 communication interfaces
CPCX26	Central processing and communication	Loadable firmware

5.3.1.1 Overview

- 1 microprocessor for central functions within the system, as well as processing and communication functions
- Can be installed in a board rack CM-2844 or CM-2846
- Slot for 1 optional serial interface module
- Up to 4 protocol elements for communication
- Expandable with up to 16 processing and communication elements
- Connection of up to 16 peripheral elements via the own serial Ax 1703 peripheral bus
- Data transport from and to the protocol elements
- Data transport from and to the processing and communication elements
- Data transport from and to the peripheral elements

5.3.1.2 Features and Functions

- System functions
  - Central element, coordinating all system services
  - Central hub function for all connected basic system elements
  - Time management
    - central clock of the automation unit
    - Setting and keeping the own clock's time with a resolution of 10 ms
    - Synchronization via serial communication (another automation unit), via LAN (NTP server), or local (minute pulse or serial time signal)
  - Redundancy
    - Voting and change-over for redundant processing and communication elements of the own automation unit
    - Supports application voting and change-over by an external system, e.g. a control system
  - SICAM TOOLBOX II connection
  - Storing firmware and parameters on a SD Card
- Functions for Telecontrol (Communication)
  - Communication via installable protocol elements to any superior or subordinate automation unit
  - Automatic or selective data flow routing
  - Priority based data transmission (priority control)
  - Own circular buffer and process image for each connected station (data keeping)
  - Redundant Communication Routes
    - Communication with Redundant Remote Stations
    - Redundant communication with a remote station (load share operation)
  - Special application specific functions for dial-up traffic
    - Test if stations are reachable
    - Evaluation of telephone charges possible by means of application program
    - Cost-efficient utilization of the telephone line by means of parameterization (e.g. command output possible only if a connection exists)
- Functions for Telecontrol (Process Peripherals)
  - Transmission of spontaneous information objects from and to peripheral elements, via the serial Ax 1703 peripheral bus
- Functions for Automation
  - Open-/closed-loop control function for the execution of freely definable user programs, created with CAEx plus according to IEC 61131 3, e.g. as function diagram
    - Online test
    - loadable without service interruption
  - Redundant open-/closed-loop control functions
    - Synchronization via redundancy link
  - Transmission of periodic process information between the open-/closed-loop control function and the peripheral elements, via the serial Ax 1703 peripheral bus
- Remote operation of SICAM TOOLBOX II via LAN/WAN possible

Note

The above mentioned functions and features are described in detail in the document
SICAM RTUs Common Functions System and Basic System Elements.

- Security
  - IPSec VPN
    - IPSec in tunnel mode: initiator
    - Authentication / encryptionbased on pre-shared key
    - Internet Key Exchange protocol: IKEv1
    - Authentication algorithms: HMAC-SHA1, HMAC-MD5
    - Encryption algorithms: AES-128, 3DES
    - Diffie-Hellman group: Group1, Group2
  - Security Logging
    - Syslog Client
- Integrated protocols
  - SNMPv3
  - PRP (Parallel Redundancy Protocol)

5.3.1.3 Technical Specifications

Processor and Memory	
M-CPU	
Processor	PPC440EP
Clock frequency	384 MHz
Clock pulse accuracy	±3.5 ppm
Free run accuracy	12.6 ms/h
Parameter/program memory	FLASH-PROM 16 MB
Main memory	DDR SDRAM 128 MB (ECC)
Exchangeable memory	SD card $\geq$ 16 MB (SD, SD-HC, SD-XC) FAT16 or FAT32
Application program max. size	1.5 MB
Flag memory	NVSRAM 128 kB
Number of Variables	50000, thereof 2000 non-volatile
Cycle Time	10 ms or multiples thereof
Inputs for synchronization	
Transmission rate	2.4 kbit/s

External synchronization (serial time signal or minute pulse, parameter-settable)	Input galvanically insulated by optocoupler
	
	• Filter time of the input circuit
	  Make time 25 µs
	  Break time 25 µs
	  Filter tolerance max. 5 µs
	• Input IN SYNC1+/IN SYNC_GND
	  Voltage range 6…31.2 V
	  Input resistance typ. 3 kΩ
	  Level for logical 0 $\leq$ 1.78 V
	  Level for logical 1 6…32 V
	  Nominal value 12 V (4.09 mA)
	  Nominal value 24 V (8.54 mA)
	  Maximum value 31,2 V (11.21 mA)
	• Input IN SYNC2+/IN SYNC_GND
	  Voltage range 32…78 V
	  Input resistance typ. 12 kΩ
	  Level for logical 0 $\leq$ 11.2 V
	  Level for logical 1 24.3…78 V
	  Nominal value 48 V (4.67 mA)
	  Nominal value 60 V (6.87 mA)
	  Maximum value 78 V (8.96 mA)
	
	The circuit is operated using external voltage

Binary outputs (relay)

• Error (OUT ER) • Watchdog (OUT WD)	• 2 outputs, potential-free • Galvanical insulation • Voltage between the two outputs max. 60 VDC + 30 % • Change-over contact
Maximum continuous current	• 2 A 24 VDC • 1 A 60 VDC • 0.77 A 78 VDC
Maximum switching voltage	• 60 VDC + 30 %
Switching cycles	• 10^5 with resistive load and switching capacity • 10^4 with inductive load (L/R = 7 ms)
Switching capacity (resistive load)	• min. 1 mW • max. 60 W
Nominal switching capacity / nominal switching current	• 48 W 24 VDC 2.00 A • 60 W 48 VDC 1.25 A • 60 W 60 VDC 1.00 A
Output Circuits	18…78 VDC (operated by means of an external voltage)

Communication

Ax 1703 peripheral bus (X99)	• TTL • Transmission rate 16 Mbit/s • Securing of data, hamming distance D=4
USB interface for SICAM TOOLBOX II (X5)	• Full Speed (12 Mbit/s) • Electrical interface galvanically insulated
Ethernet interface PRE0 and PRE1 (X0, X1)	Ethernet Interface for protocols and engineering tool - 10/100Base-TX
Serial interfaces PRE2 and PRE3 (X2, X3)	Technical data depend on which protocol element is equipped (see Protocol elements)
Serial system interface	Available via RJ12 (backplane)
Redundancy link	• Electrical high-speed link (internal) via backplane • Electrical high-speed link (external) via RJ45
Electrical high-speed link	• CMOS level electronically inverted • Max. load ± 4 mA
Optical high-speed link	Type TODX297 (Toshiba) or ODLPT-6M (Siemens)
	Optical fiber: Glass fiber (PCF fiber) 10 dB/km
	Transmitter (660 nm) Power launched into the fiber: max min -14 dBm -20 dBm
	Receiver (660 nm) Received power: max min -9 dBm -28 dBm
	Line length (3 dB system reserve): 0…200 m

Power Supply

Operating voltage	5 VDC ±5%, typ. 4,5 W Voltage is picked off at the board rack bus (X99)
Input current I_{max}	1.7 A
Auxiliary voltage SI0, SI1	5 VDC ±5%, max. 200 mA for each interface Circuits are operated using internal voltage (data circuit voltage 5 VDC ±5%, galvanically insulated)

Mechanics and Connectors	
Mechanics	Board without front plate
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 Gold-plated contacts -> 400 mating cycles
Peripheral connector (X100)	2 x 32 pin according to DIN 41612 type E
SICAM TOOLBOX II connector (X4)	5 pin mini USB connector, female
Weight	Approx. 300 g

5.3.2   CP-2019/PCCX26

Optionally equippable processing and communication element consisting of a module and loadable firmware.

Type	Designation	Remarks
CP-2019	Communication processor AK 3	Up to 4 communication interfaces
PCCX26	Ax 1703 peripheral coupling and control	Loadable firmware
AP-0771/SPLC01	Safety PLC	Optional loadable firmware (safety-application)

5.3.2.1   Overview

- 1 microprocessor for processing and communication functions
- Can be installed in a board rack CM-2844 or CM-2846
- Slot for 1 optional serial interface module
- Up to 4 protocol elements for communication
- Connection of up to 16 peripheral elements via the own serial Ax 1703 peripheral bus
- Data transport from and to the protocol elements
- Data transport from and to the peripheral elements
- Optional safety functions

5.3.2.2 Features and Functions

- System functions
  - Time management: keeping the time with a resolution of 10 ms
- Functions for Telecontrol (Communication)
  - Communication via installable protocol elements to any superior or subordinate automation unit
  - Automatic or selective data flow routing
  - Priority based data transmission (priority control)
  - Own circular buffer and process image for each connected station (data keeping)
  - redundant communication routes
    - Communication with Redundant Remote Stations
    - Redundant communication with a remote station (load share operation)
  - Special application specific functions for dial-up traffic
    - Test if stations are reachable
    - Evaluation of telephone charges possible by means of application program
    - Cost-efficient utilization of the telephone line by means of parameterization (e.g. command output possible only if a connection exists)
- Functions for Telecontrol (Process Peripherals)
  - Transmission of spontaneous information objects from and to peripheral elements, via the serial Ax 1703 peripheral bus
- Functions for Automation
  - Open-/closed-loop control function for the execution of freely definable user programs, created with CAEx plus according to IEC 61131 3, e.g. as function diagram
    - 1.5 MB for application program
    - approx. 150.000 variables and signals, 6.000 of them retained
    - cycle of 10 ms or a multiple thereof
    - Online test
    - loadable without service interruption
  - Transmission of periodic process information between the open-/closed-loop control function and the peripheral elements, via the serial Ax 1703 peripheral bus
  - Redundant open-/closed-loop control functions
    - synchronization via redundancy link
- Special features
  - Autonomy: the functions of the system element are maintained even in case of master control element failure
- Remote operation of SICAM TOOLBOX II via LAN/WAN possible

Note

The above mentioned functions and features are described in detail in the document
SICAM RTUs Common Functions System and Basic System Elements.

- Safety functions (optional)
  - — Disable/Enable protection during the program run
  - — Double, diverse program processing
  - — CPU Test
  - — FPU Test (Floating Point Unit)
  - — RAM Test
  - — Code memory test and parameter memory test
  - — Stack Test
  - — Profi safe mechanisms
    For securing the data transmission between safety application and safety I/O modules the PROFIsafe protocol (IEC 61784-3-3) is used
  - — Separated with a MMU protected registers
  - — Logical program run monitoring
  - — Chronological program run monitoring
- Security
  - — IPSec VPN
    - – IPSec in tunnel mode: initiator
    - – Authentication / encryptionbased on pre-shared key
    - – Internet Key Exchange protocol: IKEv1
    - – Authentication algorithms: HMAC-SHA1, HMAC-MD5
    - – Encryption algorithms: AES-128, 3DES
    - – Diffie-Hellman group: Group1, Group2
  - — Security Logging
    - – Syslog Client
- Integrated protocols
  - — SNMPv3
  - — PRP (Parallel Redundancy Protocol)

5.3.2.3 Technical Specifications

Processor and Memory		
Processor	PPC440EP	
Clock frequency	384 MHz	
Clock pulse accuracy	±3.5 ppm	
Free run accuracy	12.6 ms/h	
Parameter/program memory	FLASH-PROM	8 MB
Main memory	DDR-SDRAM	128 MB (ECC) 128 MHz
Diagnostic memory	SRAM	512 kB
Application program max. size	1.5 MB	
Flag memory	NVSRAM	128 kB
Number of Variables	150000, thereof 6000 non-volatile	
Cycle Time	10 ms or multiples thereof	

Communication	
Ax 1703 peripheral bus (X1)	• TTL • Transmission rate 16 Mbit/s • Securing of data, hamming distance D=4
Ethernet interface PRE0 and PRE1 (X0, X1)	Ethernet Interface for protocols and engineering tool - 10/100Base-TX
Serial interfaces PRE2 and PRE3 (X2, X3)	Technical data depend on which protocol element is equipped (see Protocol elements)
Redundancy link	• Electrical high-speed link (internal) via backplane • Electrical high-speed link (external) via RJ45
Electrical high-speed link	• CMOS level electronically inverted • Max. load ± 4 mA
Optical high-speed link	Type TODX297 (Toshiba) or ODLPT-6M (Siemens)
	Optical fiber: Glass fiber (PCF fiber)　　10 dB/km
	Transmitter (660 nm) Power launched into the fiber:　　max　　min 　　　　　　　　　　　　　　　　-14 dBm　-20 dBm
	Receiver (660 nm) Received power:　　　　　　max　　min 　　　　　　　　　　　　　　-9 dBm　-28 dBm
	Line length (3 dB system reserve):　　0…200 m
Power Supply	
Operating voltage	5 VDC ±5%, typ. 4.4 W The voltage is picked off at the bus of board rack
Auxiliary voltage (SI0, SI1, SI2, SI3)	5 VDC ±5%, max. 200 mA for each interface Circuits are operated using internal voltage (data circuit voltage 5 VDC ±5%, galvanically insulated)
Mechanics and Connectors	
Mechanics	Board without front plate
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
Peripheral connector (X100)	2 x 32 pin according to DIN 41612 type E
Weight	Approx. 300 g

5.4   Businterface-Modules

5.4.1   CM-0842

The bus interface CM-0842 is used to connect a basic system element with up to 4 peripheral control modules PE-6411 or PE-6412 (with its belonging I/O modules) by means of

- Fiber optics
- RJ45 patch cables

5.4.1.1   Features and Functions

Bus interface Ax 1703 peripheral bus

- 3 connections to access the TTL level Ax 1703 peripheral bus provided by a (redundant) higher-level basic system element or CM-0843
- 4 connections for providing the electrical Ax 1703 peripheral bus to PE 6411 or PE 6412
- Transmission rate 16 Mbit/s
- up to 4 CM-0842 can be attached side by side
- can be configured "redundant"
- Line address configurable via DIP switch
- Patch cables up to 3 m usable
- Fiber optics up to 200 m usable
- Power supply 18…78 VDC

5.4.1.2   Configuration

> **Note**
> The configurations for the connection of peripheral elements are described in detail in the document *SICAM AK 3 User Manual*, chapter "*Automation Units and Automation Networks*".

5.4.1.3 Technical Specifications

Interfaces	
2 interfaces to the BSE (Ax 1703 peripheral bus, electrical, full duplex) (BSE/X4, RED/X6)	• TTL • Transmission rate 16 Mbit/s • Securing of data, hamming distance D=4 • For connecting patch cables (RJ45 connector), 3 m max.
1 interface to CM 0842 or CM 0843 (Ax 1703 peripheral bus, electrical, full duplex) (LINE 1/X5)	• TTL • Transmission rate 16 Mbit/s • Securing of data, hamming distance D=4 • For connecting patch cables (RJ45 connector), 3 m max.
1 interface to the BSE or to the peripheral control module (Ax 1703 peripheral bus, electrical, half duplex) (LINE 2/X7)	• Optical interface • Transmission rate 16 Mbit/s • Securing of data, hamming distance D=4 • Specification see below
3 interfaces to peripheral control modules (Ax 1703 peripheral bus, electrical, half duplex) (PE/X8, PE/X9, PE/X10)	• Optical interface • Transmission rate 16 Mbit/s • Securing of data, hamming distance D=4 • Specification see below
Optical interface (duplex plastic optical fiber)	Type TODX2950A (Toshiba)
	Glass fiber (PCF fiber) 10 dB/km 16 Mbit/s
	Transmitter (660 nm) Power launched into the fiber: max min -14 dBm -20 dBm
	Receiver (660 nm) Received power: max min -9 dBm -28 dBm
	Line length (3 dB system reserve). 0…200 m

Power Supply	
Operating voltage	18…78 VDC, typ. 120 mA at 24 V Voltage is supplied via terminals

Mechanics and Connectors	
Ax 1703 peripheral bus (BSE/X4, LINE 1/X5, RED/X6)	RJ45
Ax 1703 peripheral bus (LINE 2/X7, PE/X8, PE/X9, PE/X10)	JIS-F07 compatible Glass fiber ODLP200
Dimensions	133.5 x 141 x 43 mm
Weight	Approx. 420 g

5.4.2 CM-0843

The bus interface module CM-0843 is used to connect a basic system element with up to 4 peripheral control modules PE 6410 (with its belonging I/O modules), by means of

- USB cables
- RJ45 patch cables

5.4.2.1 Features and Functions

Bus interface Ax 1703 peripheral bus

- 2 connections to access the TTL-level Ax 1703 peripheral bus provided by a (redundant) higher-level basic system element
- 4 connections for providing the electrical Ax 1703 peripheral bus to PE-6410
- Transmission rate 16 Mbit/s
- up to 4 CM-0843 can be attached side by side
- Patch cables and USB cables up to 3 m usable
- Power supply via USB cable by PE-6410

5.4.2.2 Configuration

> **Note**
> The configurations for the connection of peripheral elements are described in detail in the document *SICAM AK 3 User Manua*l, chapter "*Automation Units and Automation Networks*".

5.4.2.3 Technical Specifications

Interfaces	
2 interfaces to the BSE (Ax 1703 peripheral bus electrical, full duplex) (X7, X8)	• TTL • Transmission rate 16 Mbit/s • Securing of data, hamming distance D=4 • For connecting patch cables (RJ45 connector), 3 m max.
4 interfaces to peripheral control modules (Ax 1703 peripheral bus electrical, half duplex) (X3, X4, X5, X6)	• EIA-485 balanced interface • Transmission rate 16 Mbit/s • Securing of data, hamming distance D=4 • For connecting USB cables (USB A series, 4-pin), 3 m max.
Power Supply	
Operating voltage	3.5…5.25 VDC Voltage is picked off at the Ax 1703 peripheral bus at the interfaces X3, X4, X5, X6 Power consumption per interface (X3, X4, X5, X6): • 1 interface used: typ. 650 mW per interface • 2 interfaces used: typ. 460 mW per interface • 3 interfaces used: typ. 350 mW per interface • 4 interfaces used: typ. 300 mW per interface
Mechanics and Connectors	
Ax 1703 peripheral bus to the BSE (X7, X8)	RJ45
Ax 1703 peripheral bus to peripheral control modules (X3, X4, X5, X6)	USB / A Series, 4-pin
Dimensions	131 x 63 x 73 mm
Weight	Approx. 150 g

5.5 Protocol Elements

5.5.1 Product Overview

This product overview shows which components (hardware and firmware) are required for the operation of each protocol. The X-terms in the brackets indicate the communication interface of the basic system element on which the respective protocol is available.

Standard protocols	Type	CP-2016 (X0, X1)	CP-2019 (X0, X1)	SM-2557 (X2)	SM-2558 (X3)	SM-0551 (X2)	SM-2551 (X2, X3)
• **IEC60870-5-101**							
− IEC60870-5-101 point-to-point traffic	serial					BPPA0	BPPA0
− IEC60870-5-101 multi-point traffic (Master)	serial					UMPMA0	UMPMA0
− IEC60870-5-101 multi-point traffic (Master) "for AMIS data transmission"	serial					UMPMA1	UMPMA1
− IEC60870-5-101 multi-point traffic (Slave)	serial					UMPSA0	UMPSA0
− IEC60870-5-101 SAT field bus (Master)	serial					SFBMA1	SFBMA1
− IEC60870-5-101 SAT field bus (Slave)	serial					SFBSA1	SFBSA1
− IEC60870-5-101 dial-Up (Master) "unbalanced Mode"	serial					DIAMA1	DIAMA1
− IEC60870-5-101 dial-Up (Slave) "unbalanced Mode"	serial					DIASA0	DIASA0
• **IEC60870-5-102**							
− IEC60870-5-102 transmission of integrated totals (Master)	serial					102MA0	102MA0
− IEC60870-5-102 transmission of integrated totals (Slave)	serial					102SA9	102SA9
• **IEC60870-5-103**							
− IEC60870-5-103 protocol for interfacing of protective devices (Master)	serial					103MA0	103MA0
− IEC60870-5-103 protocol for interfacing of protective devices (Slave)	serial					103SA0	103SA0
• **IEC60870-5-104**							
− IEC60870-5-104	LAN	ET24 3)	ET24 3)		ETA4		
− IEC60870-5-104 (RSTP)	LAN			ETA2			

Standard protocols	Type	CP-2016 (X0, X1)	CP-2019 (X0, X1)	SM-2557 (X2)	SM-2558 (X3)	SM-0551 (X2)	SM-2551 (X2, X3)
• **IEC61850**							
− IEC61850 Client, Server, GOOSE Ed.1	LAN				ETA3		
− IEC61850 Client, Server, GOOSE Ed.1 (RSTP)	LAN			ET03			
− IEC61850 Client Ed.2	LAN	ET25 4)	ET25 4)		ETA5		
• **MODBUS (RTU, ASCII)**							
− MODBUS Master	serial					MODMA0	MODMA0
− MODBUS Slave	serial					MODSA0	MODSA0
• **DNP3**							
− DNP3 Master	serial					DNPMA0	DNPMA0
− DNP3 Slave	serial					DNPSA0	DNPSA0
• **IEC 1107, IEC61107, IEC 62056-21**							
− IEC 1107, IEC61107, IEC 62056-21 counter value protocol (Master)	serial					COUMA0	COUMA0
• **PROFIBUS-DP (DP-V0)**							
− PROFIBUS-DP (DP-V0) Master with external fieldbus gateway "netHost"					DPMiA0		
• **NTP / SNTP**	LAN	CPCX26	PCCX26	ETA2 ET03	ETA4 ETA5		
• **SNMP**							
− SNMP Agent	LAN	CPCX26					
• **http/https (SSL)**							
− http/https web server 1)	LAN	ET25	ET25	ETA2 ET03	ETA3 ETA5		
− http/https "remote operation" (remote diagnostics, remote engineering)		CPCX26	PCCX26	ETA2 ET03	ETA3 ETA4 ETA5		
• **IPSEC**							
− IPSEC 2)	LAN	CPCX26	PCCX26		ETA4		

1) web server only for experts during setup or maintenance – the web server must be deactivated during operation due to security reasons!

2) only restricted configurations are supported!

3) controlled connections ("controlled" is selected in the `Connectiondefinition`) may only be configured on one of the two local interfaces (PRE0 or PRE1).
controlling connections ("controlling" is selected in the `Connectiondefinition`) may be configured on both local interfaces (PRE0 and PRE1).

4) ET25 may only be equipped on one of the two local interfaces (PRE0 or PRE1).

Third-party protocols	Type	CP-2016 (X0, X1)	CP-2019 (X0, X1)	SM-2557 (X2)	SM-2558 (X3)	SM-0551 (X2)	SM-2551 (X2, X3)
• **SAT 1703**							
− SAT 1703 PCMBA-EE, PCMBA-SSI End-End	serial					SKEEA1	SKEEA1
− SAT 1703 PCMBA multi-point traffic (Master)	serial					PCBMA0	PCBMA0
− SAT 1703 PCMBA multi-point traffic (Slave)	serial					PCBSA0	PCBSA0
− SAT 1703 multi-point traffic (Master) "relay operation (without routing)"	serial					SKSZA0	SKSZA0
− SMI field bus (Master)	serial					SMIMA0	SMIMA0
− Keyboard input, display/printer output	serial					TEDAA1	TEDAA1
• **Siemens 8TK switch gear interlocking**							
− Siemens switch gear interlocking 8TK multi-point traffic (Slave)	serial					8TKSA0	8TKSA0
• **Siemens FW537**							
− Siemens FW537 point-to-Point Master	serial					F537A0	F537A0
• **Siemens ILSA**							
− Siemens ILSA protocol for interfacing of protective devices (Master)	serial					LSAMA0	LSAMA0
• **Siemens Simatic S5**							
− Siemens Simatic S5 "SIFAS2" multi-point traffic (Slave)	serial					SIFUA0	SIFUA0
− Siemens Simatic S5 3964/RK512	serial					R512A1	R512A1
− Siemens Simatic S5 - ST1 "TIM11" multi-point traffic (Master)	serial					ST1MA0	ST1MA0
− Siemens Simatic S5 - ST1 "TIM11" multi-point traffic (Slave)	serial					ST1SA0	ST1SA0
• **Siemens Sinaut8 FW**							
− Siemens Sinaut8 FW PCM/PDM multi-point traffic (Master)	serial					SA8MA0	SA8MA0
− Siemens Sinaut8 FW PCM/PDM multi-point traffic (Slave)	serial					SA8SA0	SA8SA0

Third-party protocols	Type	CP-2016 (X0, X1)	CP-2019 (X0, X1)	SM-2557 (X2)	SM-2558 (X3)	SM-0551 (X2)	SM-2551 (X2, X3)
• **Siemens Sinaut ST7**							
− Siemens Sinaut ST7 multi-point traffic (Master)	serial					ST7MA0	ST7MA0
• **ABB Indactic 33/41**							
− ABB Indactic 33/41 multi-point traffic (Slave)	serial					I33SA0	I33SA0
• **ABB RP570/571**							
− ABB RP570/571 multi-point traffic (Master)	serial					RP5ZA1	RP5ZA1
− ABB RP570/571 multi-point traffic (Slave)	serial					RP5UA1	RP5UA1
• **ABB SPA Bus**							
− ABB SPA bus protection equipment interface, multi-point traffic (Master)	serial					SPAMA0	SPAMA0
• **Landis & Gyr TG065**							
− Landis & Gyr TG065 multi-point traffic (Master)	serial					T65MA0	T65MA0
• **Landis & Gyr TG800**							
− Landis & Gyr TG800 multi-point traffic (Master)	serial					TG8MA0	TG8MA0
− Landis & Gyr TG800 multi-point traffic (Slave)	serial					TG8SA0	TG8SA0
• **Siemens AGP "Feeder test equipment"**							
− Feeder test equipment interface protocol (Master)	serial					AGPMA0	AGPMA0
• **Alstom ILS**							
− Alstom ILS multi-point traffic (Master)	serial					ILSMA0	ILSMA0
• **ASCII Protocol (SMS-Alarm, Printer)**							
− ASCII protocol (SMS sender/receiver, serial printer)	serial					SMSA0	SMSA0
• **DSFG Bus**							
− DSFG bus for gas measuring instruments (instance- and cross communication)	serial					DSFGA0	DSFGA0
• **SMA Data**							
− SMA data protocol multi-point traffic (Master)	serial					SMAMA0	SMAMA0
• **TLS Traffic control communication protocol**							
− TLS traffic control communication protocol multi-point traffic (Master)	serial					TLSMA1	TLSAMA1

Third-party protocols	Type	CP-2016 (X0, X1)	CP-2019 (X0, X1)	SM-2557 (X2)	SM-2558 (X3)	SM-0551 (X2)	SM-2551 (X2, X3)
• **VEAG Profile**							
− VEAG profile protocol point-to-point Master	serial					VEZA0	VEZA0
• **Kayser Threde BDKIII**							
− Kayser Threde BDKIII Master	serial					BDKMA0	BDKMA0
− Kayser Threde BDKIII Slave	serial					BDKSA0	BDKSA0
• **IEC60870-5-101 End-End "RWE-Profile"**							
− IEC60870-5-101 end-end (balanced) "RWE Profile"	serial					BPPA9	BPPA9
• **IEC60870-5-101 Dial-UP "RWE"**							
− IEC60870-5-101 dial-UP Master (balanced) "RWE"	serial					DIAMA8	DIAMA8
• **Pfalzwerke protection equipment interface**							
− Protection equipment interface protocol Pfalzwerke	serial					PWSSA0	PWSSA0

Note

The features and functions of the "standard protocols" are listed in the following sections. Details about the mentioned functions are described in the document *SICAM RTUs • Ax 1703 Common Functions Protocol Elements.*

The features and functions of the "3rd party protocols" are either described in own interoperability documents or in the respective protocol descriptions.

5.5.2   ET24

The local protocol element *ET24* serves for LAN/WAN communication between control systems or between control system and remote terminal units according to IEC 60870-5-104.

This protocol element consists of a firmware loadable on the basic system elements.

Product	Designation	Remarks
ET24	Ethernet Interface acc. to IEC 60870-5-104	Loadable firmware

5.5.2.1   Features and Functions

General functions	
• **LAN/WAN Communication over Ethernet TCP/IP - general**	
− 10 Mbit/s (full duplex)	✓ 1)
− 10 Mbit/s (half duplex)	✓ 1)
− 10 Mbit/s (full duplex, autonegotiation)	✓ 1)
− 10 Mbit/s (half duplex, autonegotiation)	✓ 1)
− 10/100 Mbit/s (half duplex/full duplex, autonegotiation)	✓ 1)
− 100 Mbit/s (full duplex)	✓ 1)
− 100 Mbit/s (half duplex)	✓ 1)
− 100 Mbit/s (full duplex, autonegotiation)	✓ 1)
− 100 Mbit/s (half duplex, autonegotiation)	✓ 1)
− Auto-MDIX (Auto Medium Dependent Interface Crossover)	✓ 1)
− Parameters for TCP/IP optimization	✓ 1)
− TCP/IP keep alive	✓
• **LAN/WAN Communication over Ethernet TCP/IP according to IEC 60870-5-104**	
− Controlled station	✓
− Controlling station	✓
− Max. connections	100 2)
• **Supported Ports**	
− Port 2404: IEC 60870-5-104	✓
− Port 80: HTTP (Hypertext Transfer Protocol) - "Web server"	
− Port 80: HTTP (Hypertext Transfer Protocol) - "Remote operation for SICAM TOOLBOX II"	✓ 1)
− Port 443: HTTPS (Hypertext Transfer Protocol over SSL/TLS) - "Web server"	
− Port 443: HTTPS (Hypertext Transfer Protocol over SSL/TLS) - "Remote operation for SICAM TOOLBOX II"	✓ 1)
− Port 123: NTP V3 (Network Time Protocol)	✓ 1)
− Port 123: SNTP V3 (Simple Network Time Protocol)	✓ 1)
− Port 2001: "Remote operation for SICAM TOOLBOX II"	
• **Special protocols**	
− Address Resolution Protocol (gratuitous ARP)	✓ 1)

• **Interoperability according to the following documents:**	
− SICAM RTUs Interoperability IEC 60870-5-101/104 (DC0-013-2)	✓
− Ax 1703 Interoperability IEC 60870-5-101/104 (DA0-046-2)	
• **Acquisition of events (transmission of data ready to be sent)**	✓
• **General interrogation, outstation interrogation**	✓
• **Clock synchronization according to NTP (Network Time Protocol)**	
− NTP server	✓ 1)
− NTP client	✓ 1)
− SNTP client	✓ 1)
• **Command transmission**	
− Supervision of maximum transport delay in control direction (Dwell Time Monitoring)	✓
− Set control location	✓
− Check control location	✓
• **Transmission of integrated totals**	✓
• **Protocol element control and return information**	
Protocol element control	
− Interface "enable/disable"	✓
− Send (general) interrogation command	✓
− Preset control location	✓
− Remote operation "enable/disable"	✓ 1)
Protocol element return information	
− Station failure	
− PRE return information 0 "Status DATA TRANSFER (BSE)"	✓
− PRE return information 1 "Status DATA TRANSFER (104)"	✓
− PRE return information 2 "Remote operation enabled/disabled"	✓ 1)
• **Functions for the support of redundant communication routes**	
− PSI redundancy (synchronous connections)	✓
− 104 redundancy according IEC 60870-5-104 Edition 2.0)	
− 104 redundancy "controlling station"	
− 104 redundancy "controlled station" with 1 Ethernet interface	✓
− 104 redundancy "controlled station" with 2 Ethernet interfaces	✓ 3)
− 1703 redundancy	✓
− Deactivation of interface (with protocol element control message)	✓
− Deactivation of interface (with redundancy control message)	✓
− Dual LAN interface with integrated switch for ring or star configurations (DNIP)	
− RSTP mode (max. 39 devices in ring configuration)	
− Line Mode	
− Switch mode	✓ 1)
− Single mode	
− Single + service mode	

• **SICAM TOOLBOX II connection over LAN/WAN ("remote connection")**	
− Remote connection based on HTTP/HTTPS	✓ 1)
− User authentication in SICAM RTUs using connection password	✓ 1)
− Remote connection based on integrated terminal server	
− Remote connection based on integrated terminal server (enable/disable) option	
− Warning "Remote Connection"	✓ 1)
− Remote operation "enable/disable"via control message	✓ 1)
• **Web server**	
− Integrated web server to display connection, statistic and developer information	
− Access to the web server with standard web browser via HTTP	
− Password for web server	
− Web server (enable/disable) option	
• **Security**	
− IPSec VPN	
− IPSec in tunnel mode: initiator	✓ 1)
− Authentication / encryptionbased on pre-shared key	✓ 1)
− Internet Key Exchange protocol: IKEv1	✓ 1)
− Authentication algorithms: HMAC-SHA1, HMAC-MD5	✓ 1)
− Encryption algorithms: AES-128, 3DES	✓ 1)
− Diffie-Hellman group: Group1, Group2	✓ 1)
− Security Logging	
− Syslog Client	✓ 1)
• **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)	✓
− Time stamp (IV = 1) in messages in transmit direction	
− Originator address = 0 for all messages in transmit direction	✓
− WhiteList filter	✓
− Data throughput limitation	✓
− Special functions for project DBAG	
− Breaker delay in transmit direction (<TI = 150>)	
− Send originator address with settable value	
− Special functions for project 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	✓
− Suppress error in case of connection failure but with enabled - NT bit simulation for received data by BSE - After connection failure - General interrogation after connection is OK	✓

1) this function is integrated on the basic system element

2) recommendation max. 10 Connections

3) only in combination with 2nd Ethernet interface with SM-2558/ETA4

> **Note**
>
> The above mentioned functions are described in detail in the document *SICAM RTUs • Ax 1703 Common Functions Protocol Elements*, section *"LAN Communication (104)"*.

5.5.2.2 Modes of Operation

Operating mode	Optional equipment	Note
Electrical ethernet interface (twisted pair)	–	• Ethernet/Fast Ethernet acc. to IEEE 802.3, 10/100Base-TX • Transmission rate 10/100 Mbit/s • RJ45 connector 8-pin acc. to IEC 603.7
Optical ethernet interface (multimode fiber optic)	Media converter or switch [*)]	• Fast Ethernet acc. to IEEE 802.3, 100Base-FX • Transmission rate up to 100 Mbit/s

[*)]   acc. to *SICAM AK 3 User Manual, chapter "Automation Units and Automation Unit Networks"*

5.5.2.3 Communication

For the stations to communicate with each other, suitable transmission facilities and/or network components may be needed in addition.

Own station

System	System Element	Protocol Element	Note
SICAM AK 3	CP-2016/CPCX26 CP-2019/PCCX26	ETA24	

Remote station

System	System Element	Protocol Element	Note
SICAM AK 3	CP-2016/CPCX26 CP-2019/PCCX26	ET24 SM-2558/ETA4	
SICAM AK	CP-2014/CPCX25 CP-2017/PCCX25	SM-2558/ETA4 SM-2557/ETA2 SM-2556/ETA2	
SICAM BC	CP-5014/CPCX55	SM-2558/ETA4 SM-2557/ETA2 SM-2556/ETA2	
SICAM TM	CP-6014/CPCX65	SM-2558/ETA4 SM-2557/ETA2 SM-2556/ETA2	
SICAM EMIC	CP-6010/CPC30	ETT0	
SICAM CMIC	CP-8000/CPC80	ET84	
SICAM MIC	CP-6040/CPC60		only 10Base-TX
SAT 1703 and external systems	–	–	acc. to *SICAM RTUs Interoperability IEC 60870-5-101/104* or *Ax 1703 Interoperability IEC 60870-5-101/104*

5.5.2.4 Configurations

The following table shows on which basic system element the protocol element can be used, and on which interface it is available.

Basic system element (BSE)	Protocol element	BSE interfaces			
		X0	X1	X2	X3
CP-2016	ET24	✓	✓	-	-
CP-2019	ET24	✓	✓	-	-

Note

Controlled Connections ("controlled" is selected in the `Connectiondefinition`) may only be configured on one of the two local interfaces (PRE0 or PRE1).

Controlling Connections ("controlling" is selected in the `Connectiondefinition`) may be configured on both local interfaces (PRE0 and PRE1).

5.5.3 ET25

The local protocol element *ET25* serves for LAN/WAN communication according to IEC 61850. It is used for protection and control of electrical substations in medium and high-voltage technology.

This protocol element consists of a firmware loadable on the basic system elements.

Product	Designation	Remarks
ET25	Ethernet Interface acc. to IEC 61850 Client	Loadable firmware

5.5.3.1 Features and Functions

General functions IEC 61850 Client	
• **LAN/WAN communication via Ethernet TCP/IP - general**	
− 10/100 Mbit/s (half duplex / full duplex)	
− 10 Mbit/s (full duplex, auto negotiation providing 10 Mbit/s)	
− 100 Mbit/s (full duplex, auto negotiation providing 100 Mbit/s)	✓
− Auto-MDIX (Auto Medium Dependent Interface Crossover)	✓ [1]
− TCP/IP optimization parameter	
• **IEC 61850 Client**	
− Edition 1	✓
− Edition 2	✓
− Max. number of servers (max. connections)	100 [2]
− Max. number of "logical devices" (per connection)	[3]
− Max. number of "logical nodes" (per connection)	[3]
− Total number of data points	10000
− Startup PRE	[4]
− Initialization time (after PRE startup)	[5]
− ACSI Services	[6]
− Common Data Classes	[6]
− Attributes	[6]
− Supported functionality according to	
− PICS (Protocol Implementation Conformance Statement)	✓
− PIXIT (Protocol Implementation Extra Information)	✓
− Supported Logical Nodes and their Attributes	✓

• **Supported ports**	
− Port 102: MMS (Manufacturing Message Specification)	✓
− Port 80: HTTP (Hypertext Transfer Protocol) - "Web server"	✓ 1)
− Port 80: HTTP (Hypertext Transfer Protocol) - "Remote operation for SICAM TOOLBOX II"	✓ 1)
− Port 443: HTTPS (Hypertext Transfer Protocol over SSL/TLS) – "Web server"	✓ 1)
− Port 443: HTTPS (Hypertext Transfer Protocol over SSL/TLS) - "Remote operation for SICAM TOOLBOX II"	✓ 1)
− Port 123: NTP V3 (Network Time Protocol)	✓ 1)
− Port 123: SNTP (Simple Network Time Protocol)	✓ 1)
− Port 2001: "Remote Operation for TOOLBOX II"	
• **Acquisition of events**	
− Static Data Sets	✓
− Dynamic Data Sets	✓
− Buffered Reports	✓
− Unbuffered Reports	✓
• **Transmission of files**	
− Disturbance records to SICAM DISTO	✓
• **Transmission of integrated totals**	✓
• **General interrogation, outstation interrogation**	✓
• **Command transmission**	
− Set control location	✓
− Check control location	✓
− Command interlocking	✓
− Direct control with normal security	✓
− Direct control with enhanced security	✓
− SBO control with enhanced security	✓
• **Setting groups**	✓
• **Clock synchronization according to NTP (Network Time Protocol)**	
− NTP Server	✓ 1)
− NTP Client	✓ 1)
− SNTP Client	✓ 1)
• **Functions for supporting redundant communication routes**	
− 1703 redundancy	✓
− Server redundancy	
− GOOSE redundancy	
− Dual LAN interface with integrated switch for ring or star configurations (DNIP)	
– RSTP mode	
– Line mode	
– Switch mode	✓ 1)
– Single mode	✓ 1)
– Single + service mode	✓ 1)

• **Protocol element control and return information**	
Protocol element control messages	
− START connection to server ("initiate")	✓
− STOP connection to server ("conclude")	✓
− Send (general) interrogation command	✓
− Set control location	✓
Protocol element return information	
• **SICAM TOOLBOX II connection over LAN/WAN ("remote connection")**	
− Remote connection based on HTTP/HTTPS	✓ [1]
− Remote connection based on integrated terminal server	
− User authentication in SICAM RTUs using connection password	✓ [1]
− Warning "Remote Connection"	✓ [1]
• **Web server**	
− Integrated web server to display connection-, statistic- and developer information	✓
− Access to the web server with standard web browser via HTTP (Hyper Text Transfer Protocol)	✓ [1]
− Access to the web server with standard web browser via HTTPS (Hyper Text Transfer Protocol Secure)	✓ [1]
• **Special functions**	
− Conversion of the time information (UTC; local time w/wo normal time/daylight saving time)	✓
− 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 RTUs components via 61850	✓

[1] in SICAM CMIC, or SICAM AK3 with local PRE (PRE without NIP) this function is integrated on the basic system element

[2] recommendation: max. 30 (*ETA5, ET25*: max. 50)

[3] not limited (limited only by free memory)

[4] max. startup time (with 10000 data points): approx. 4 min
min. startup time (with 1 data point): approx. 30…60 s (dependent on the configuration of the AU)

[5] after startup and terminated initialization of the PRE, the initialization time amounts for each connected Server 1…3 s (dependent on the data extent in the Server); for instance:
initialization time at 100 Mbit/s and typical data extent for each Server (approx. 500 data points):
1x SIPROTEC 5...approx. 2.5 s   1x SIPROTEC 4...approx. 2 s
10x SIPROTEC 5...approx. 25 s   10x SIPROTEC 4...approx. 20 s

[6] the supported ACSI Services, Common Data Classes and Attributes are described in the document *SICAM RTUs • Ax 1703 Common Functions Protocol Elements, chapter „Basis data types"*

Note

The above mentioned functions are described in detail in the document *SICAM RTUs • Ax 1703 Common Functions Protocol Elements*, section *"LAN Communication (61850)"*.

General functions IEC 61850 Server	
• **LAN/WAN Communication over Ethernet TCP/IP - general**	
− 10/100 Mbit/s (half duplex/full duplex)	
− 10 Mbit/s (full duplex, auto negotiation) IEC61850 should be used with 100 Mbit/s only!	
− 100 Mbit/s (full duplex, auto negotiation)	✓ 1)
− Auto-MDIX (Auto Medium Dependent Interface Crossover)	
− Parameters for TCP/IP optimization	
• **IEC 61850 Server**	
− Edition 1	
− Edition 2	✓
− Max. number of Clients (max. connections)	6
− Max. number of "Logical Devices" (including all servers)	
− Max. number of "Logical Nodes" (including all servers)	
− Max. number of data points	2)
− ACSI services	
− Data classes	
− Attributes	
− Supported functionality according to:	
− PICS (Protocol Implementation Conformance Statement)	✓
− PIXIT (Protocol Implementation Extra Information)	✓
− Supported Logical Nodes and their Attributes	✓
• **Supported Ports**	
− Port 102: MMS (Manufacturing Message Specification)	
− Port 80: HTTP (Hypertext Transfer Protocol) - "Web Server"	
− Port 80: HTTP (Hypertext Transfer Protocol) "Remote connection for SICAM TOOLBOX II"	
− Port 443: HTTPS (Hypertext Transfer Protocol over SSL/TLS) - "Web Server"	
− Port 443: HTTPS (Hypertext Transfer Protocol over SSL/TLS) - "Remote connection for SICAM TOOLBOX II"	
− Port 123: NTP V3 (Network Time Protocol)	
− Port 123: SNTP V3 (Simple Network Time Protocol)	
− Port 2001: "Remote connection for SICAM TOOLBOX II"	
• **Acquisition of events (transmission of data ready to be sent)**	
− Static Data Sets	✓
− Dynamic Data Sets	
− Buffered Reports	✓
− Unbuffered Reports	✓
• **Transmission of files**	
− Disturbance records to SICAM DISTO	✓
• **Transmission of integrated totals**	✓
• **General interrogation**	✓

• **Command transmission**	
− Set control location	
− Check control location	
− Command interlocking	
− Direct Control with normal security	✓
− Direct Control with enhanced security	✓
− SBO control with enhanced security	✓
• **Setting groups**	✓
• **Clock synchronization according to NTP (Network Time Protocol)**	
− NTP Server	✓
− NTP Client	✓
− SNTP Client	✓
• **Functions for the support of redundant communication routes**	
− 1703 redundancy	
− Server redundancy	✓
− GOOSE redundancy	✓
− Dual LAN interface with integrated switch for ring or star configurations (DNIP)	
− RSTP mode	
− Line Mode	
− Switch mode	
− Single mode	
− Single + Service mode	
• **Protocol Element Control and Return Information**	
Protocol element control message	
− Send (general) interrogation command	✓
− Preset control location	
Protocol element return information	
• **SICAM TOOLBOX II connection over LAN/WAN ("remote connection")**	
− Remote connection based on HTTP/HTTPS	✓
− Remote connection based on integrated terminal server	
− User authentication in SICAM RTUs using connection password	✓
− Warning "Remote Connection"	✓ [1]
• **Web server**	
− Integrated web server to display connection-, statistic- and developer information	✓
− Access to the web server with standard web browser via HTTP	✓
• **Special functions**	
− Conversion of the time information (UTC; local time w/wo normal time/daylight saving time)	✓
− 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 RTUs components via IEC 61850	✓

[1] this function is integrated on the basic system element
[2] formulas for the determination of the total number of data points (n):
unbuffered reports: $\#LD \cdot 54 + \#CON (13 (\#LD + \#DP/60) \cdot 2) + \#DP \cdot 14 = n$
buffered reports: $\#LD \cdot 54 + \#CON (19 (\#LD + \#DP/60) \cdot 2) + \#DP \cdot 14 = n$
unbuffered + buffered reports: $\#LD \cdot 54 + \#CON (32 (\#LD + \#DP/60) \cdot 2) + \#DP \cdot 14 = n$

Meaning: The following maximum applies: n = 30000
#LD…...number of Logical Devices
#CON…number of connections
#DP…...number of data points

Note

The above mentioned functions are described in detail in the document *SICAM RTUs • Ax 1703 Common Functions Protocol Elements*, section *"LAN Communication (61850)"*.

GOOSE

- Not implemented!

5.5.3.2 Modes of Operation

Operating mode	Optional equipment	Note
Electrical ethernet interface (twisted pair)	–	• Fast Ethernet acc. to IEEE 802.3, 100Base-TX • Transmission rate up to 100 Mbit/s • RJ45 connector 8-pin acc. to IEC 603.7
Optical ethernet interface (multimode fiber optic)	Media converter or switch [*]	• Fast Ethernet acc. to IEEE 802.3, 100Base-FX • Transmission rate up to 100 Mbit/s

[*] acc. to *SICAM AK 3 User Manual, chapter "Automation Units and Automation Unit Networks"*

5.5.3.3 Communication

For the stations to communicate with each other, suitable transmission facilities and/or network components may be needed in addition.

Client

System	System Element	Protocol Element	Note
SICAM AK 3	CP-2016/CPCX26 CP-2019/PCCX26	ET25	

Server

System	System Element	Protocol Element	Note
SICAM AK 3	CP-2016/CPCX26 CP-2019/PCCX26	SM-2558/ETA3 SM-2558/ETA5	
SICAM AK	CP-2014/CPCX25 CP-2017/PCCX25	SM-2558/ETA3 SM-2556/ET03 SM-2558/ETA5	
SICAM TM	CP-6014/CPCX65	SM-2558/ETA3 SM-2556/ET03 SM-2558/ETA5	
SICAM EMIC	CP-8000/CPC80	ET83 ET85	
Third-party system			IEC 61850 Interoperability

5.5.3.4 Configurations

The following table shows on which basic system element the protocol element can be used, and on which interface it is available.

Basic system element (BSE)	Protocol element	BSE interfaces			
		X0	X1	X2	X3
CP-2016	ET25	✓	✓	-	-
CP-2019	ET25	✓	✓	-	-

Note

ET25 may only be equipped on one of the both local interfaces (PRE0 or PRE1).

5.5.4   SM-2558/ETA3

The protocol element *SM-2558/ETA3* serves for LAN/WAN communication according to
IEC 61850. It is used for protection and control of electrical substations in medium and high-
voltage technology.

This protocol element consists of a communication module and a loadable firmware.

Product	Designation	Remarks
SM-2558	Ethernet Interface Processor 1 Interface	• 1 protocol element per interface • Optionally expandable with 1 serial interface by means of SM-0551 • Can be installed on the basic system elements
ETA3	Ethernet Interface acc. to IEC 61850 Client, Server	Loadable firmware

5.5.4.1   Features and Functions

General Functions IEC 61850 Client	
• **LAN/WAN communication via Ethernet TCP/IP - general**	
− 10/100 Mbit/s (half duplex/full duplex)	
− 10 Mbit/s (full duplex, auto negotiation providing 10 Mbit/s)	
− 100 Mbit/s (full duplex, auto negotiation providing 100 Mbit/s)	✓
− Auto-MDIX (Auto Medium Dependent Interface Crossover)	
− TCP/IP optimization parameter	
• **IEC 61850 Client**	
− Edition 1	✓
− Edition 2	
− max. number of servers (max. connections)	100 [1]
− max. number of "logical devices" (per connection)	100
− max. number of "logical nodes" (per connection)	[2]
− Total number of data points	5000 [3]
− Startup PRE	
− Initialization time (after PRE startup)	
− ACSI Services	[4]
− Common Data Classes	[4]
− Attributes	[4]
− Supported functionality according to	
− PICS (Protocol Implementation Conformance Statement)	✓
− PIXIT (Protocol Implementation Extra Information)	✓
− Supported Logical Nodes and their Attributes	✓

• **Supported ports**	
− Port 102: MMS (Manufacturing Message Specification)	✓
− Port 80: HTTP (Hypertext Transfer Protocol) - "Web server"	✓
− Port 80: HTTP (Hypertext Transfer Protocol) - "Remote operation for SICAM TOOLBOX II"	✓
− Port 443: HTTPS (Hypertext Transfer Protocol over SSL/TLS) - "Web server"	✓
− Port 443: HTTPS (Hypertext Transfer Protocol over SSL/TLS) - "Remote operation for SICAM TOOLBOX II"	✓
− Port 123: NTP V3 (Network Time Protocol)	✓
− Port 123: SNTP (Simple Network Time Protocol)	✓
− Port 2001: "Remote Operation for TOOLBOX II"	
• **Acquisition of events**	
− Static Data Sets	✓
− Dynamic Data Sets	✓
− Buffered Reports	✓
− Unbuffered Reports	✓
• **Transmission of files**	
− Disturbance records to SICAM DISTO	✓
• **Transmission of integrated totals**	✓
• **General interrogation**	✓
• **Command transmission**	
− Set control location	✓
− Check control location	✓
− Command interlocking	✓
− Direct control with normal security	✓
− Direct control with enhanced security	✓
− SBO control with enhanced security	✓
• **Setting groups**	✓
• **Clock synchronization according to NTP (Network Time Protocol)**	
− NTP Server	✓
− NTP Client	✓
− SNTP Client	✓
• **Functions for supporting redundant communication routes**	
− 1703 redundancy	✓
− Server redundancy	
− GOOSE redundancy	
− Dual LAN interface with integrated switch for ring or star configurations (DNIP)	
− RSTP Mode	
− Line Mode	
− Switch mode	
− Single mode	
− Single + Service mode	

• **Protocol element control and return information**	
Protocol element control messages	
− START connection to server ("Initiate")	✓
− STOP connection to server ("Conclude")	✓
− Send (general) interrogation command	✓
− Set control location	✓
Protocol element return information	
• **SICAM TOOLBOX II connection over LAN/WAN ("remote connection")**	
− Remote connection based on HTTP/HTTPS	✓
− Remote connection based on integrated terminal server	
− User authentication in SICAM RTUs using "connection password"	✓
− Warning "Remote Connection"	✓
• **Web server**	
− Integrated web server to display connection, statistic and developer information	✓
− Access to the web server with standard web browser via HTTP (Hyper Text Transfer Protocol)	✓
− Access to the web server with standard web browser via HTTPS (Hyper Text Transfer Protocol Secure)	✓
• **Special functions**	
− Conversion of the time information (UTC; local time w/wo normal time/daylight saving time)	✓
− 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 RTUs components via 61850	✓

[1] recommendation: max. 30

[2] not limited (limited only by free memory)

[3] due to performance matters (initialization times upon connection setup), no more than 2000 data points are recommended

[4] the supported ACSI Services, Common Data Classes and Attributes are described in the document *SICAM RTUs • Ax 1703 Common Functions Protocol Elements, chapter "LAN Communication (61850)", sections "Basis data types" and "Conversion IEC 60870-5-101/104 ↔ IEC 61850"*

Note

The above mentioned functions are described in detail in the document *SICAM RTUs • Ax 1703 Common Functions Protocol Elements*, section *"LAN Communication (61850)"*.

General functions IEC 61850 Server + GOOSE	
• **LAN/WAN communication via Ethernet TCP/IP - general**	
− 10/100 Mbit/s (half duplex/full duplex)	
− 10 Mbit/s (full duplex, auto negotiation providing 10 Mbit/s)	
− 100 Mbit/s (full duplex, auto negotiation providing 100 Mbit/s)	✓
− Auto-MDIX (Auto Medium Dependent Interface Crossover)	
− Parameters for TCP/IP optimization	
• **IEC 61850 Server**	
− Edition 1	✓
− Edition 2	
− Max. number of clients (max. connections)	6
− Max. number of "logical devices" (including all servers)	10
− Max. number of "logical nodes" (including all servers)	400
− Total number of data points	[1]
− ACSI Services	[2]
− Common Data Classes	[2]
− Attributes	[2]
− Supported functionality according to	
− PICS (Protocol Implementation Conformance Statement)	✓
− PIXIT (Protocol Implementation Extra Information)	✓
− Supported Logical Nodes and their Attributes	✓
• **Supported ports**	
− Port 102: MMS (Manufacturing Message Specification)	✓
− Port 80: HTTP (Hypertext Transfer Protocol) - "Web server"	✓
− Port 80: HTTP (Hypertext Transfer Protocol) - "Remote operation for SICAM TOOLBOX II"	✓
− Port 443: HTTPS (Hypertext Transfer Protocol over SSL/TLS) - "Web server"	✓
− Port 443: HTTPS (Hypertext Transfer Protocol over SSL/TLS) - "Remote operation for SICAM TOOLBOX II"	✓
− Port 123: NTP V3 (Network Time Protocol)	✓
− Port 123: SNTP (Simple Network Time Protocol)	✓
− Port 2001: "Remote Operation for SICAM TOOLBOX II"	
• **Acquisition of events**	
− Static Data Sets	✓
− Dynamic Data Sets	
− Buffered Reports	
− Unbuffered Reports	✓
• **Transmission of files**	
− Disturbance records to SICAM DISTO	✓
• **Transmission of integrated totals**	✓
• **General interrogation, outstation interrogation**	✓

• **Command transmission**	
− Set control location	
− Check control location	
− Command interlocking	
− Direct control with normal security	✓
− Direct control with enhanced security	✓
− SBO control with enhanced security	✓
• **Setting groups**	✓
• **Clock synchronization according to NTP (Network Time Protocol)**	
− NTP Server	✓
− NTP Client	✓
− SNTP Client	✓
• **Functions for supporting redundant communication routes**	
− 1703 redundancy	✓
− Server redundancy	✓
− GOOSE redundancy	✓
− Dual LAN interface with integrated switch for ring or star configurations (DNIP)	
− RSTP mode	
− Line mode	
− Switch mode	
− Single mode	
− Single + Service mode	
• **Protocol element control and return information**	
Protocol element control messages	
− Send (general) interrogation command	✓
− Set control location	
Protocol element return information	
• **SICAM TOOLBOX II connection over LAN/WAN ("remote connection")**	
− Remote connection based on http/https	✓
− Remote connection based on integrated terminal server	
− User authentication in SICAM RTUs using connection password	✓
− Warning "Remote Connection"	✓
• **Web server**	
− Integrated web server to display connection-, statistic- and developer information	✓
− Access to the web server with standard web browser via HTTP (Hyper Text Transfer Protocol)	✓
• **Special functions**	
− Conversion of the time information (UTC; local time w/wo normal time/daylight saving time)	✓
− 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 RTUs components via 61850	✓

[1] the max. possible number of data points can not be stated here in general since this is dependent on several factors (number of connected Clients, number of used Logical Devices, number of used Logical Nodes, number of Reports, Memory of the Reports, …); with $ETA3$ it is additionally dependent on the free memory of the basic system element (depending on whether a function chart is used, which protocols are configured, …)

[2] the supported ACSI Services, Common Data Classes and Attributes are described in the document *SICAM RTUs • Ax 1703 Common Functions Protocol Elements, chapter*„Basis data types"

Note

The above mentioned functions are described in detail in the document *SICAM RTUs • Ax 1703 Common Functions Protocol Elements*, section *"LAN Communication (61850)"*.

5.5.4.2 Modes of Operation

Operating mode	Optional equipment	Note
Electrical ethernet interface (twisted pair)	–	• Fast Ethernet acc. to IEEE 802.3, 100Base-TX • Transmission rate up to 100 Mbit/s • RJ45 connector 8-pin acc. to IEC 603.7
Optical ethernet interface (multimode fiber optic)	Media converter or switch [*]	• Fast Ethernet acc. to IEEE 802.3, 100Base-FX • Transmission rate up to 100 Mbit/s

[*] acc. to *SICAM AK 3 User Manual, chapter "Automation Units and Automation Unit Networks"*

5.5.4.3 Communication

For the stations to communicate with each other, suitable transmission facilities and/or network components may be needed in addition.

Client

System	System Element	Protocol Element	Note
SICAM AK 3	CP-2016/CPCX26 CP-2019/PCCX26	SM-2558/ETA3	

Server

System	System Element	Protocol Element	Note
SICAM AK 3	CP-2016/CPCX26 CP-2019/PCCX26	SM-2558/ETA3 SM-2556/ET03 SM-2558/ETA5 ET85	
SICAM AK	CP-2014/CPCX25 CP-2017/PCCX25	SM-2558/ETA3 SM-2556/ET03 SM-2558/ETA5	
SICAM BC	CP-5014/CPCX55	SM-2558/ETA3 SM-2556/ET03	
SICAM TM	CP-6014/CPCX65	SM-2558/ETA3 SM-2556/ET03 SM-2558/ETA5	
Third-party system			IEC 61850 Interoperability

5.5.4.4 Configurations

The following table shows on which basic system element the protocol element can be used, and on which interface it is available.

Basic system element (BSE)	Protocol element	BSE interfaces			
		X0	X1	X2	X3
CP-2016	SM-2558/ETA3	-	-	✓ *)	✓
CP-2019	SM-2558/ETA3	-	-	✓ *)	✓

*) serial interface (V.28) – can be added optionally (SM-0551)

Note

Details about the installation of protocol elements can be found in the *SICAM AK 3 User Manual*, chapter "*Installation*".

5.5.4.5   Technical Specification SM-2558

Communication Circuits	
Electrical LAN interface (twisted pair)	Fast Ethernet acc. IEEE 802.3, 100Base-TX Data rate 100 Mbit/s Line lengths up to 100 m (using CAT 5e cables)
1 serial interface (SM-0551 can be added optionally)	Technical Specifications see data sheet *SM-x551/PROTOCOL (MC0-003-2.00)*
Power Supply	

Operating voltage	4.75…5.25 VDC, typ. 400 mA, max. 500 mA
	                                                            (without SM-0551)
	4.75…5.25 VDC, typ. 525 mA, max. 770 mA
	                                                            (with SM-0551)
	The voltage is supplied by the carrier module.

Mechanics	
Dimensions	227.3 x 63.5 mm
Weight	Approx. 90 g

5.5.5   SM-2558/ETA4

The protocol element *SM-2558/ETA4* serves for LAN/WAN communication between control systems or between control system and remote terminal units according to IEC 60870-5-104.

This protocol element consists of a communication module and a loadable firmware.

Product	Designation	Remarks
SM-2558	Ethernet Interface Processor 1 Interface	• 1 protocol element per interface • Optionally expandable with 1 serial interface by means of SM-0551 • Can be installed on the basic system elements
ETA4	Ethernet Interface acc. to IEC 60870-5-104	Loadable firmware

5.5.5.1   Features and Functions

General functions	
• **LAN/WAN Communication over Ethernet TCP/IP - general**	
− 10 Mbit/s (full duplex)	✓
− 10 Mbit/s (half duplex)	✓
− 10 Mbit/s (full duplex, autonegotiation)	✓
− 10 Mbit/s (half duplex, autonegotiation)	✓
− 10/100 Mbit/s (half duplex/full duplex, autonegotiation)	✓
− 100 Mbit/s (full duplex)	✓
− 100 Mbit/s (half duplex)	✓
− 100 Mbit/s (full duplex, autonegotiation)	✓
− 100 Mbit/s (half duplex, autonegotiation)	✓
− Auto-MDIX (Auto Medium Dependent Interface Crossover)	
− Parameters for TCP/IP optimization	✓
− TCP/IP keep alive	✓
• **LAN/WAN Communication over Ethernet TCP/IP according to IEC 60870-5-104**	
− Controlled station	✓
− Controlling station	✓
− Max. connections	100 [1]
• **Supported Ports**	
− Port 2404: IEC 60870-5-104	✓
− Port 80: HTTP (Hypertext Transfer Protocol) - "Web server"	
− Port 80: HTTP (Hypertext Transfer Protocol) - "Remote operation for SICAM TOOLBOX II"	✓
− Port 443: HTTPS (Hypertext Transfer Protocol over SSL/TLS) - "Web server"	
− Port 443: HTTPS (Hypertext Transfer Protocol over SSL/TLS) - "Remote operation for SICAM TOOLBOX II"	✓
− Port 123: NTP V3 (Network Time Protocol)	✓
− Port 123: SNTP V3 (Simple Network Time Protocol)	✓
− Port 2001: "Remote operation for SICAM TOOLBOX II"	

• **Special protocols**	
− Address Resolution Protocol (gratuitous ARP)	✓
• **General interrogation, outstation interrogation**	✓
• **Interoperability according to the following documents**	
− SICAM RTUs Interoperability IEC 60870-5-101/104 (DC0-013-2)	✓
− Ax 1703 Interoperability IEC 60870-5-101/104 (DA0-046-2)	
• **Acquisition of events (transmission of data ready to be sent)**	✓
• **Clock synchronization according to NTP (Network Time Protocol)**	
− NTP server	✓
− NTP client	✓
− SNTP client	✓
• **Command transmission**	✓
− Supervision of maximum transport delay in control direction	✓
− Set control location	✓
− Check control location	✓
• **Transmission of integrated totals**	✓
• **Protocol element control and return information**	
Protocol element control	
− Interface "enable/disable"	✓
− Send (general) interrogation command	✓
− Preset control location	✓
− Remote operation "enable/disable"	✓
Protocol element return information	
− Station failure	
− PRE return information 0 "Status DATA TRANSFER (BSE)"	✓
− PRE return information 1 "Status DATA TRANSFER (104)"	✓
− PRE return information 2 "Remote operation enabled/disabled"	✓
• **Functions for the support of redundant communication routes**	
− PSI redundancy (synchronous connections)	✓
− 104 redundancy according IEC 60870 5 104 Edition 2.0)	
− 104 redundancy "controlling station"	
− 104 redundancy "controlled station" with 1 Ethernet interface	✓
− 104 redundancy "controlled station" with 2 Ethernet interfaces	✓
− 1703 redundancy	✓
− Deactivation of interface (with protocol element control message)	✓
− Deactivation of interface (with redundancy control message)	✓
− Dual LAN interface with integrated switch for ring or star configurations (DNIP)	
− RSTP mode (max. 39 devices in ring configuration)	
− Line Mode	
− Switch mode	
− Single mode	
− Single + service mode	

● SICAM TOOLBOX II connection over LAN/WAN ("remote connection")	
– Remote connection based on HTTP/HTTPS	✓
– User authentication in SICAM RTUs using connection password	✓
– Remote connection based on integrated terminal server	
– Remote connection based on integrated terminal server (Enable/Disable) option	
– Warning "Remote Connection"	✓
– Remote operation "enable/disable" via control message	✓
● Web server	
– Integrated web server to display connection, statistic and developer information	
– Access to the web server with standard web browser via HTTP	
– Password for web server	
– Web server (enable/disable) option	
● Security	
– IPSec VPN	
– IPSec in tunnel mode: initiator	✓
– Authentication / encryptionbased on pre-shared key	✓
– Internet Key Exchange protocol: IKEv1	✓
– Authentication algorithms: HMAC-SHA1, HMAC-MD5	✓
– Encryption algorithms: AES-128, 3DES	✓
– Diffie-Hellman group: Group1, Group2	✓
– Security Logging	
– Syslog Client	✓ 2)
● 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)	✓
– Time stamp (IV = 1) in messages in transmit direction	
– Originator address = 0 for all messages in transmit direction	✓
– WhiteList filter	✓
– Data throughput limitation	✓
– Special functions for project DBAG	
– Breaker delay in transmit direction (<TI = 150>)	✓
– Send originator address with settable value	✓
– Special functions for project 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	✓
– Suppress error in case of connection failure but with enabled - NT bit simulation for received data by BSE - After connection failure - General interrogation after connection is OK	✓

1) recommendation max. 30 connections

2) only in combination with CP-2016/CPCX26

> **Note**
>
> The above mentioned functions are described in detail in the document *SICAM RTUs • Ax 1703 Common Functions Protocol Elements*, section *"LAN Communication (104)"*.

5.5.5.2 Modes of Operation

Operating mode	Optional equipment	Note
Electrical ethernet interface (twisted pair)	–	• Ethernet/Fast Ethernet acc. to IEEE 802.3, 10/100Base-TX • Transmission rate up to 100 Mbit/s • RJ45 connector 8-pin acc. to IEC 603.7
Optical ethernet interface (multimode fiber optic)	Media converter or switch [*)]	• Fast Ethernet acc. to IEEE 802.3, 100Base-FX • Transmission rate up to 100 Mbit/s

[*)] acc. to *SICAM AK 3 User Manual, chapter "Automation Units and Automation Unit Networks"*

5.5.5.3 Communication

For the stations to communicate with each other, suitable transmission facilities and/or network components may be needed in addition.

Own station

System	System Element	Protocol Element	Note
SICAM AK 3	CP-2016/CPCX26 CP-2019/PCCX26	SM-2558/ETA4	

Remote station

System	System Element	Protocol Element	Note
SICAM AK 3	CP-2016/CPCX26 CP-2019/PCCX26	ET24 SM-2558/ETA4	
SICAM AK	CP-2014/CPCX25 CP-2017/PCCX25	SM-2558/ETA4 SM-2556/ET02 SM-2556/ETA2 SM-2557/ETA2	
SICAM BC	CP-5014/CPCX55	SM-2558/ETA4 SM-2556/ET02 SM-2556/ETA2 SM-2557/ETA2	
SICAM TM	CP-6014/CPCX65	SM-2558/ETA4 SM-2556/ET02 SM-2556/ETA2 SM-2557/ETA2	
SICAM EMIC	CP-6010/CPC30	ETT0	
SICAM CMIC	CP-8000/CPC80	ET84	
SICAM MIC	CP-6040/CPC60		only 10Base-TX
Third-party system	---	---	acc. to *SICAM RTUs Interoperability IEC 60870-5-101/104* or *Ax 1703 Interoperability IEC 60870-5-101/104*

5.5.5.4 Configurations

The following table shows on which basic system element the protocol element can be used, and on which interface it is available.

Basic system element (BSE)	Protocol element	BSE interfaces			
		X0	X1	X2	X3
CP-2016	SM-2558/ETA4	-	-	✓ *)	✓
CP-2019	SM-2558/ETA4	-	-	✓ *)	✓

*) serial interface (V.28) – can be added optionally (SM-0551)

Note

Details about the installation of protocol elements can be found in the *SICAM AK 3 User Manual*, chapter "*Installation*".

5.5.5.5 Technical Specifications

See Technical Specification SM-2558.

5.5.6   SM-2558/ETA5

The protocol element *SM-2558/ETA5* serves for LAN/WAN communication according to IEC 61850. It is used for protection and control of electrical substations in medium and high-voltage technology.

This protocol element consists of a communication module and a loadable firmware.

Product	Designation	Remarks
SM-2558	Ethernet Interface Processor 1 Interface	• 1 protocol element per interface • Optionally expandable with 1 serial interface by means of SM-0551 • Can be installed on the basic system elements
ETA5	Ethernet Interface acc. to IEC 61850 Client, Server	Loadable firmware

5.5.6.1   Features and Functions

General functions IEC 61850 Client	
• **LAN/WAN communication via Ethernet TCP/IP - general**	
− 10/100 Mbit/s (half duplex/full duplex)	
− 10 Mbit/s (full duplex, auto negotiation providing 10 Mbit/s)	
− 100 Mbit/s (full duplex, auto negotiation providing 100 Mbit/s)	✓
− Auto-MDIX (Auto Medium Dependent Interface Crossover)	
− TCP/IP optimization parameter	
• **IEC 61850 Client**	
− Edition 1	✓
− Edition 2	✓
− max. number of servers (max. connections)	100 [1]
− max. number of "logical devices" (per connection)	[2]
− max. number of "logical nodes" (per connection)	[2]
− Total number of data points	10000
− Startup PRE	[3]
− Initialization time (after PRE startup)	[4]
− ACSI Services	[5]
− Common Data Classes	[5]
− Attributes	[5]
− Supported functionality according to	
− PICS (Protocol Implementation Conformance Statement)	✓
− PIXIT (Protocol Implementation Extra Information)	✓
− Supported Logical Nodes and their Attributes	✓

• **Supported ports**	
− Port 102: MMS (Manufacturing Message Specification)	✓
− Port 80: HTTP (Hypertext Transfer Protocol) - "Web server"	✓
− Port 80: HTTP (Hypertext Transfer Protocol) - "Remote operation for SICAM TOOLBOX II"	✓
− Port 443: HTTPS (Hypertext Transfer Protocol over SSL/TLS) - "Web server"	✓
− Port 443: HTTPS (Hypertext Transfer Protocol over SSL/TLS) - "Remote operation for SICAM TOOLBOX II"	✓
− Port 123: NTP V3 (Network Time Protocol)	✓
− Port 123: SNTP (Simple Network Time Protocol)	✓
− Port 2001: "Remote Operation for TOOLBOX II"	
• **Acquisition of events**	
− Static Data Sets	✓
− Dynamic Data Sets	✓
− Buffered Reports	✓
− Unbuffered Reports	✓
• **Transfer of data "File Transfer"**	
− Disturbance records to SICAM DISTO	✓
• **Transmission of integrated totals**	✓
• **General interrogation, outstation interrogation**	✓
• **Command transmission**	
− Set control location	✓
− Check control location	✓
− Command interlocking	✓
− Direct control with normal security	✓
− Direct control with enhanced security	✓
− SBO control with enhanced security	✓
• **Setting groups**	✓
• **Clock synchronization according to NTP (Network Time Protocol)**	
− NTP Server	✓
− NTP Client	✓
− SNTP Client	✓
• **Functions for supporting redundant communication routes**	
− 1703 redundancy	✓
− Server redundancy	
− GOOSE redundancy	
− Dual LAN interface with integrated switch for ring or star configurations (DNIP)	
– RSTP Mode	
– Line Mode	
– Switch mode	
– Single mode	
– Single + Service mode	

• **Protocol element control and return information**	
Protocol element control messages	
− START connection to server ("Initiate")	✓
− STOP connection to server ("Conclude")	✓
− Send (general) interrogation command	✓
− Set control location	✓
Protocol element return information	
• **SICAM TOOLBOX II connection over LAN/WAN ("remote connection")**	
− Remote connection based on HTTP/HTTPS	✓
− Remote connection based on integrated terminal server	
− User authentication in SICAM RTUs using connection password	✓
− Warning "Remote Connection"	✓
• **Web server**	
− Integrated web server to display connection-, statistic- and developer information	✓
− Access to the web server with standard web browser via HTTP (Hyper Text Transfer Protocol)	✓
− Access to the web server with standard web browser via HTTPS (Hyper Text Transfer Protocol Secure)	✓
• **Special functions**	
− Conversion of the time information (UTC; local time w/wo normal time/daylight saving time)	✓
− 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 RTUs components via 61850	✓

[1] recommendation: max. 50

[2] not limited (limited only by free memory)

[3] max. startup time (with10000 data points): approx. 4 min
min. startup time (with 1 data point): approx. 30…60 s (dependent on the configuration of the AU)

[4] after startup and terminated initialization of the PRE, the initialization time amounts for each connected Server 1…3 s (dependent on the data extent in the Server); for instance:
initialization time at 100 Mbit/s and typical data extent for each Server (approx. 500 data points):
1x SIPROTEC 5...approx. 2.5 s   1x SIPROTEC 4...approx. 2 s
10x SIPROTEC 5...approx. 25 s   10x SIPROTEC 4...approx. 20 s

[5] the supported ACSI Services, Common Data Classes and Attributes are described in the document *SICAM RTUs • Ax 1703 Common Functions Protocol Elements, chapter*„Basis data types"

Note

The above mentioned functions are described in detail in the document *SICAM RTUs • Ax 1703 Common Functions Protocol Elements*, section *"LAN Communication (61850)"*.

General functions IEC 61850 Server	
• **LAN/WAN Communication over Ethernet TCP/IP - general**	
− 10/100 Mbit/s (half duplex/full duplex)	
− 10 Mbit/s (full duplex, auto negotiation) IEC61850 should be used with 100 Mbit/s only!	
− 100 Mbit/s (full duplex, auto negotiation)	✓
− Auto-MDIX (Auto Medium Dependent Interface Crossover)	
− Parameters for TCP/IP optimization	
• **IEC 61850 Server**	
− Edition 1	
− Edition 2	✓
− Max. number of Clients (max. connections)	6
− Max. number of "Logical Devices" (including all servers)	
− Max. number of "Logical Nodes" (including all servers)	
− Max. number of data points	*)
− ACSI services	
− Data classes	
− Attributes	
− Supported functionality according to:	
− PICS (Protocol Implementation Conformance Statement)	✓
− PIXIT (Protocol Implementation Extra Information)	✓
− Supported Logical Nodes and their Attributes	✓
• **Supported Ports**	
− Port 102: MMS (Manufacturing Message Specification)	
− Port 80: HTTP (Hypertext Transfer Protocol) - "Web Server"	
− Port 80: HTTP (Hypertext Transfer Protocol) "Remote connection for SICAM TOOLBOX II"	
− Port 443: HTTPS (Hypertext Transfer Protocol over SSL/TLS) - "Web Server"	
− Port 443: HTTPS (Hypertext Transfer Protocol over SSL/TLS) - "Remote connection for SICAM TOOLBOX II"	
− Port 123: NTP V3 (Network Time Protocol)	
− Port 123: SNTP V3 (Simple Network Time Protocol)	
− Port 2001: "Remote connection for SICAM TOOLBOX II"	
• **Acquisition of events (transmission of data ready to be sent)**	
− Static Data Sets	✓
− Dynamic Data Sets	
− Buffered Reports	✓
− Unbuffered Reports	✓
• **Transmission of files**	
− Disturbance records to SICAM DISTO	✓
• **Transmission of integrated totals**	✓
• **General interrogation**	✓

• **Command transmission**	
− Set control location	
− Check control location	
− Command interlocking	
− Direct control with normal security	✓
− Direct control with enhanced security	✓
− SBO control with enhanced security	✓
• **Setting groups**	✓
• **Clock synchronization according to NTP (Network Time Protocol)**	
− NTP Server	✓
− NTP Client	✓
− SNTP Client	✓
• **Functions for the support of redundant communication routes**	
− 1703 redundancy	
− Server redundancy	✓
− GOOSE redundancy	✓
− Dual LAN interface with integrated switch for ring or star configurations (DNIP)	
− RSTP mode	
− Line Mode	
− Switch mode	
− Single mode	
− Single + Service mode	
• **Protocol element control and return information**	
PRE control message	
− Send (general) interrogation command	✓
− Preset control location	
Protocol element return information	
• **SICAM TOOLBOX II connection over LAN/WAN ("remote connection")**	
− Remote connection based on HTTP/HTTPS	✓
− Remote connection based on integrated terminal server	
− User authentication in SICAM RTUs using connection password	✓
− Warning "Remote Connection"	✓
• **Web server**	
− Integrated web server to display connection-, statistic- and developer information	✓
− Access to the web server with standard web browser via HTTP	✓
• **Special functions**	
− Conversion of the time information (UTC; local time w/wo normal time/daylight saving time)	✓
− 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 RTUs components via IEC 61850	✓

[*] formulas for the determination of the total number of data points (n):

unbuffered reports:	$\#LD \cdot 54 + \#CON (13 (\#LD + \#DP/60) \cdot 2) + \#DP \cdot 14 = n$
buffered reports:	$\#LD \cdot 54 + \#CON (19 (\#LD + \#DP/60) \cdot 2) + \#DP \cdot 14 = n$
unbuffered + buffered reports:	$\#LD \cdot 54 + \#CON (32 (\#LD + \#DP/60) \cdot 2) + \#DP \cdot 14 = n$

Meaning: The following maximum applies: n = 80000
#LD…...number of Logical Devices
#CON…number of connections
#DP…...number of data points

GOOSE

- Not implemented!

5.5.6.2 Modes of Operation

Operating mode	Optional equipment	Note
Electrical ethernet interface (twisted pair)	–	• Fast Ethernet acc. to IEEE 802.3, 100Base-TX • Transmission rate up to 100 Mbit/s • RJ45 connector 8-pin acc. to IEC 603.7
Optical ethernet interface (multimode fiber optic)	Media converter or switch [*]	• Fast Ethernet acc. to IEEE 802.3, 100Base-FX • Transmission rate up to 100 Mbit/s

[*] acc. to *SICAM AK 3 User Manual, chapter "Automation Units and Automation Unit Networks"*

5.5.6.3 Communication

For the stations to communicate with each other, suitable transmission facilities and/or network components may be needed in addition.

Client

System	System Element	Protocol Element	Note
SICAM AK 3	CP-2016/CPCX26 CP-2019/PCCX26	SM-2558/ETA5	

Server

System	System Element	Protocol Element	Note
SICAM AK 3	CP-2016/CPCX26 CP-2019/PCCX26	SM-2558/ETA3 SM-2558/ETA5	
SICAM AK	CP-2014/CPCX25 CP-2017/PCCX25	SM-2558/ETA3 SM-2557/ET03 SM-2556/ET03 SM-2558/ETA5	
SICAM TM	CP-6014/CPCX65	SM-2558/ETA3 SM-2557/ET03 SM-2556/ET03 SM-2558/ETA5	
SICAM EMIC	CP-8000/CPC80	ET83 ET85	
Third-party system			IEC 61850 Interoperability

5.5.6.4 Configurations

The following table shows on which basic system element the protocol element can be used, and on which interface it is available.

Basic system element (BSE)	Protocol element	BSE interfaces			
		X0	X1	X2	X3
CP-2016	SM-2558/ETA5	-	-	✓ *)	✓
CP-2019	SM-2558/ETA5	-	-	✓ *)	✓

*) serial interface (V.28) – can be added optionally (SM-0551)

> **Note**
> Details about the installation of protocol elements can be found in the *SICAM AK 3 User Manual*, chapter "*Installation*".

5.5.6.5 Technical Specifications

See Technical Specification SM-2558.

5.5.7 SM-2558/DPMiA0

The protocol element *SM-2558/DPMiA0* serves in connection with the external fieldbus gateway "netHOST" (Hilscher) as PROFIBUS DP Master to connect sensors/actuators via PROFIBUS DP. It is used for automation of electrical substations in medium and high-voltage technology.

This protocol element consists of a communication module, a loadable firmware, and an external fieldbus gateway.

Product	Designation	Remarks
SM-2558	Ethernet Interface Processor 1 Interface	• 1 protocol element per interface • Optionally expandable with 1 serial interface by means of SM-0551 • Can be installed on the basic system elements
DPMiA0	PROFIBUS DP Master acc. to IEC 61158 PROFIBUS DP V0	Loadable firmware
netHOST	Fieldbus gateway for PROFIBUS DP	For details refer to www.hilscher.com

5.5.7.1 Features and Functions

General functions	
• **PROFIBUS DP Master**	
− DP-V0	✓
− DP-V1	
− DP-V2	
− max. number of PROFIBUS DP Slaves	100
− PROFIBUS DP Slave address range	0...99
− max. number of process information in command direction (transmit direction)	1000
− max. number of process information in monitoring direction (receive direction)	5000
− Cycle time (data exchange)	[1]
• **LAN/WAN communication (SM-2558 ←→ netHOST)**	
− 100 MBit (full duplex)	✓
− Auto-MDIX (Auto Medium Dependent Interface Crossover)	
− Hilscher "Marshaller Protocol" (proprietary)	✓
• **Supported Ports**	
− Port 50111: netHOST – Hilscher "Marshaller protocol" (proprietary)	✓
− Port 50112: netHOST – "reserved"	
• **PROFIBUS DP communication (netHOST ←→ PROFIBUS DP Slaves)**	
− PROFIBUS DP according IEC 61158 Type 3 "PROFIBUS DP-V0" (former DIN 19245 or EN 50170)	✓
− Data rate 9.6 kbit/s…12 Mbit/s	✓
• **Acquisition of events (transmission of data ready to be sent)**	✓
• **General interrogation, outstation interrogation**	✓
− Interrogation command "station interrogation (global)" [2]	✓
− Interrogation command "interrogation of group 1…16"	

• **Command transmission**	✓
− Set control location	
− Check control location	
• **Transmission of integrated totals** [3]	✓
− Counter interrogation command (general request counter)	✓
− Counter interrogation command (request counter grout 1…4)	✓
• **Supported message formats in command direction (transmit direction) IEC60870-5-101/-104 → PROFIBUS DP**	
− <TI:=30> Single-point information with time tag CP56Time2a	✓
− <TI:=31> Double-point information with time tag CP56Time2a	✓
− <TI:=33> Bitstring of 32 bit 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 value 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> Set point command, normalized value	✓
− <TI:=49> Set point command, scaled value	✓
− <TI:=50> Set point command, short floating point	✓
− <TI:=51> Bitstring of 32 bit	✓
− <TI:=100> Interrogation command	✓
− <TI:=101> Counter interrogation command	✓
• **Supported message formats in monitoring direction (receive direction) IEC60870-5-101/-104 ← PROFIBUS DP**	
− <TI:=30> Single-point information with time tag CP56Time2a	✓
− <TI:=31> Double-point information with time tag CP56Time2a	✓
− <TI:=33> Bitstring of 32 bit 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 value 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	✓
• **Supported PROFIBUS DP data formats in command direction (transmit direction)**	
− 1BIT	✓
− 1BIT/PULSE	✓
− 2BIT	✓
− 2BIT/PULSE	✓
− BYTE/FLAG	✓
− INT8, UINT8	✓
− INT16, UINT16	✓
− INT32, UINT32	✓
− FLOAT32	✓
− S5INT12	✓
− S5INT12S	
− S5INT13S	

• **Supported PROFIBUS DP data formats in monitoring direction (receive direction)**	
− 1BIT	✓
− 1BIT/PULSE	✓
− 2BIT	✓
− 2BIT/PULSE	✓
− BYTE/FLAG	✓
− INT8, UINT8	✓
− INT16, UINT16	✓
− INT32, UINT32	✓
− FLOAT32	✓
− S5INT12	
− S5INT12S	✓
− S5INT13S	✓
− DP/DP STATUS ("data valid")	✓
• **Protocol element control and return information**	
Protocol element control	
− Send (general) interrogation command to all	✓
− Send (general) interrogation command to GI group	
− Set control location	
Protocol element return information	
− Station failure	✓
− Protocol specific return information 0…7	
• **Redundancy** (functions for the support of redundant communication routes)	
− PROFIBUS redundancy with singular PROFIBUS	✓
− PROFIBUS redundancy with redundant PROFIBUS	✓
• **SICAM TOOLBOX II connection over LAN/WAN ("remote connection")**	
− Remote connection based on http/https	
− Remote connection based on integrated terminal server	
• **Web server**	
• **Special functions**	
− Siemens DP/DP Coupler	✓
• **Engineering**	
− SICAM TOOLBOX II + OPM	✓
• **Engineering (netHOST + PROFIBUS DP)**	
− Hilscher SYCON (integrated in SICAM TOOLBOX II)	
− Hilscher SYCON.net	✓

[1] 10…1000 ms

[2] PROFIBUS DP protocol does not define a general interrogation.
The actual state of data will be read cyclic from netHOST.
After SICAM RTUs internal IEC60870-5-101/-104 general interrogation command from BSE → PRE the interrogated data will be sent to BSE with cause of transmission COT= 20 (interrogated by station interrogation) after next cyclic reading of data.

[3] PROFIBUS DP protocol does not define a counter interrogation procedure.
The actual state of data will be read cyclic from netHOST.
After SICAM RTUs internal IEC60870-5-101/-104 counter interrogation command from BSE → PRE the interrogated counters will be sent to BSE with cause of transmission COT= 37 (requested by general counter request) or with COT= 38-41 (requested by group 1-4 counter request) from PRE internal data base.

> **Note**
>
> The above mentioned functions are described in detail in the document *System Element Manual SM-2558/DPMiA0*.

5.5.7.2 Modes of Operation

Operating mode	Necessary equipment	Note
Electrical ethernet interface (twisted pair)	Fieldbus gateway "netHOST"	Communication between SM-2558 and netHOST • Fast Ethernet acc. to IEEE 802.3, 100Base-TX • Transmission rate up to 100 Mbit/s • RJ45 connector 8-pin according to IEC 603.7
Optical ethernet interface (multimode fiber optic)	Media converter or switch [*)] + Fieldbus gateway "netHOST"	Communication between SM-2558 and netHOST • Fast Ethernet acc. to IEEE 802.3, 100Base-FX • Transmission rate up to 100 Mbit/s
PROFIBUS DP interface (from netHOST to PROFIBUS DP Slaves)		Communication between netHOST and PROFIBUS DP Slaves • Transmission rate 9.6 kbit/s…12 Mbit/s • 9-pole SUB-D connector acc. to PROFIBUS

[*)] at both sides; acc. to *SICAM AK 3 User Manual, chapter "Automation Units and Automation Unit Networks"*

5.5.7.3 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)

System	System Element	Protocol Element	Note
SICAM AK	CP-2016/CPCX26 CP-2019/PCCX26	SM-2558/DPMiA0	max. 100 Slaves [*)]

[*)] external PROFIBUS-DP Gateway Hilscher netHOST required

Remote Station (PROFIBUS-DP Slave)

System	System Element	Protocol Element	Note
Siemens PROFIBUS DP devices	–	–	PROFIBUS DP (DP-V0) compatible
Siemens PROFIBUS DP coupler	–	–	PROFIBUS DP (DP-V0) compatible
External systems	–	–	PROFIBUS DP (DP-V0) compatible

5.5.7.4 Configurations

The following table shows on which basic system element the protocol element can be used, and on which interface it is available.

Basic system element (BSE)	Protocol element	BSE interfaces			
		X0	X1	X2	X3
CP-2016	SM-2558/DPMiA0	-	-	✓ *)	✓
CP-2019	SM-2558/DPMiA0	-	-	✓ *)	✓

*)   serial interface (V.28) – can be added optionally (SM-0551)

Note

Details about the installation of protocol elements can be found in the *SICAM AK 3 User Manual*, chapter "*Installation*".

5.5.7.5 Technical Specifications

See Technical Specification SM-2558.

5.5.8   SM-x551/BPPA0

The protocol element *SM-x551/BPPA0* is a serial communication protocols for point-to-point traffic according to IEC 60870-5-101.

In a point-to-point traffic a master station is connected with one remote terminal unit. Each station has equal access and can spontaneously perform a data transmission.

This protocol element consists of a communication module and a loadable firmware.

Product	Designation	Remarks
SM-2551	Serial Interface Processor 2 Interfaces	• 1 protocol element per interface • SM-2551/PROTOCOL contains per interface the license for 1 standard protocol • Can be installed on the basic system elements
SM-0551	Serial Interface Processor 1 Interface	• 1 protocol element • SM-0551/PROTOCOL contains the license for 1 standard protocol • Can be installed on SM-2558
BPPA0	Point-to-point traffic acc. to IEC 60870-5-101	Loadable firmware

5.5.8.1   Features and Functions

General functions	
• **Serial communications protocol according to IEC60870-5-101**	
• **Balanced transmission**	✓
− Network Configurations	
− Point-to-point configuration	✓
− Multiple point-to-point configuration	✓ 1)
− Max. Connections	1
− System or device (application function)	
− Controlled station	✓
− Controlling station	✓
• **Physical layer / data flow control**	
− Unbalanced interchange circuit accordingV.24/V.28 standard	✓
− Balanced interchange circuit X.24/V.28	✓ 2)
− Transmission medium (full duplex)	✓
− Transmission medium (half duplex)	
− Byte Frame (8E1)	✓
− Data flow control Bit in receive direction	✓
− Data flow control Bit in transmit direction	
• **Interoperability**	
− IEC60870-5-101 Ed.1	✓
− IEC60870-5-101 Ed.2	
• **Interoperability according to following documents**	
− SICAM RTUs Interoperability IEC 60870-5-101/104 (DC0-013-2)	✓
− Ax 1703 Interoperability IEC 60870-5-101/104 (DA0-046-2)	✓

• **Acquisition of events (transmission of data ready to be sent)**	✓
• **General interrogation, outstation interrogation**	✓
− Non Interruptible GI	✓
• **Clock synchronization according IEC60870-5-101**	
− Clock synchronization with <TI:=103> clock synchronization command	✓
− Acquisition of transmission delay (primary station) used for correction of clock synchronization with <TI:=106>	✓
− Acquisition of transmission delay (secondary station) used for correction of clock synchronization with <TI:=106>	✓
− Correction of clock synchronization (via parameter)	
− Accuracy	±20ms
• **Command transmission**	✓
− Supervision of maximum transport delay in control direction (Dwell Time Monitoring)	
− Set control location	✓
− Check control location	✓
• **Transmission of integrated totals**	✓
• **File transfer**	✓
• **Optimized parameters for selected transmission facilities (modems)**	✓
− Predefined optimized parameters for selected transmission facilities	
− Free definable parameters for transmission facility	✓
− 5 V power supply for external modems via DSR status signal 3)	✓
• **Functions for supporting redundant communication routes**	
− NUC redundancy (Norwegian Users Conventions)	
− NUC redundancy "controlling station"	
− NUC redundancy "controlled station"	✓
− 1703 redundancy	✓
− Listening mode when passive	✓
− Tristate of RS-232 interface when passive	✓
− Deactivation of interface (with protocol element control message)	✓
− Deactivation of interface (with redundancy control message)	
• **Protocol element control and return information**	
Protocol element control	
− Send (general) interrogation command to all	✓
− Send (general) interrogation command to selective CASDU	✓
− Send (general) interrogation command for image GI to own BSE	✓
− Send process reset command	
− Set control location	✓
− Data filter in transmit direction "ON/OFF"	✓
− Data filter in receive direction "ON/OFF"	✓
− Activate/deactivate interface	✓
− Activate/deactivate interface + protocol functions	✓
Protocol element return information	
− Station failure	
− PRE return information 0 "Interface activated/deactivated"	✓
− PRE return information 1 "Interface + protocol functions activated/deactivated"	✓

• **Remote maintenance with SICAM TOOLBOX II via serial connection**	✓
• **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 - data filter	✓
− WhiteList Filter – data throughput restriction	✓
− Convert general interrogation command in receive direction to BROADCAST	✓
− Non Interruptible GI	✓
− Send ACTCON for clock synchronization command	✓
− Emulate ACTCON+/-	✓
− Emulate ACTCON, ACTTERM for commands with control message	✓
− Compatibility TCS100	✓
− Special functions for project DBAG / PSI	
− Breaker delay in transmit direction (DBAG-specific special message format <TI=150>)	✓
− Send originator address with settable value	✓
− Transparent Mode (tunneling, container mode)	✓

[1] separate interface for each single point-to-point configuration required

[2] external converter CM-0829 required

[3] ATTENTION: check power consumption of external modem!

Note

The above mentioned functions are described in detail in the document *SICAM RTUs • Ax 1703 Common Functions Protocol Elements*, section *"Point-to-Point Traffic"*.

5.5.8.2 Modes of Operation

Operating mode	Optional equip-ment	Note
Unbalanced interchange circuit V.24/V.28 V.23 Dedicated line	CE-0700	• 300/1200 bit/s • Signals and levels according to V.24, V.28, EIA-232 • RJ45 connector to CE-0700 RXD, TXD, CTS, RTS, DCD, DTR, GND • 4-pin screw terminals on CE-0700 NF-an a, NF-an b, NF-ab a / NF-a, NF-ab b / NF-b
Balanced interchange circuit X.24/X.27 V.11 isochronous	CM-0829	• 2400…64000 bit/s • Signals and levels according to EIA-422 • RJ45 connector to CM-0829 RXD, TXD, CTS, TXC, DCD, DTR, DSR/+5 V, GND or RXD, TXD, RTS, RXC, DCD, DTR, DSR/+5 V, GND • 15-pin D-SUB connector on CM-0829 RXD±, TXD±, DCD±, GND • Corresponds with SM-2541 operating mode 2a, V.11 isochronous
Balanced interface EIA-422 V.11 asynchronous	CM-0829	• 50…115200 bit/s • Signals and levels according to V.11, EIA-422 • RJ45 connector to CM-0829 RXD, TXD, CTS, RTS, DCD, DTR, DSR/+5 V, GND • 15-pin D-SUB connector on CM-0829 RXD±, TXD±, DCD±, GND • Corresponds with SM-2541 operating mode 2a, V.11/EIA-422 asynchronous
Optical interface (multimode fiber optic) Star/Tree	CM-0847	• 50…115200 bit/s • RJ45 connector to CM-0847 RXD, TXD, +5 V, GND • Signals 820 nm • 50/125µ and 62.5/125µ fibers • ST compatible connector on CM-0847
Unbalanced interchange circuit V.24/V.28 V.28 asynchronous	–	• 50…115200 bit/s • Signals and levels according to V.24, V.28, EIA-232 • RJ45 connector RXD, TXD, CTS, RTS, DCD, DTR, DSR/+5 V, GND • RJ45 connector pin assignment corresponds with SM-2541 operating mode 1a, V.28 asynchronous

5.5.8.3 Communication

For the stations to communicate with each other, suitable transmission facilities and/or network components may be needed in addition.

Own station

System	System Element	Protocol Element	Note
SICAM AK 3	CP-2016/CPCX26 CP-2019/PCCX26	SM-2551/BPPA0 SM-0551/BPPA0	

Remote station

System	System Element	Protocol Element	Note
SICAM AK 3	CP-2016/CPCX26 CP-2019/PCCX26	SM-2551/BPPA0 SM-0551/BPPA0	
SICAM AK	CP-2014/CPCX25 CP-2017/PCCX25	SM-2551/BPPA0 SM-0551/BPPA0	
SICAM BC	CP-5014/CPCX55	SM-2551/BPPA0 SM-0551/BPPA0	
SICAM TM	CP-6014/CPCX65	SM-2551/BPPA0 SM-0551/BPPA0	
SICAM EMIC	CP-6010/CPC30	BPPT0	
SICAM CMIC	CP-8000/CPC80	BPPT0	
SICAM MIC	CP-6020/CPC60 CP-6040/CPC60	–	
SICAM 230	–	–	
SAT 1703 and external systems	–	–	acc. to *SICAM RTUs Interoperability IEC 60870-5-101/104* or *Ax 1703 Interoperability IEC 60870-5-101/104*

5.5.8.4 Configurations

The following table shows on which basic system element the protocol element can be used, and on which interface it is available.

Basic system element (BSE)	Protocol element	BSE interfaces			
		X0	X1	X2	X3
CP-2016	SM-2551/BPPA0	-	-	✓	✓
	SM-0551/BPPA0 *)	-	-	✓	-
CP-2019	SM-2551/BPPA0	-	-	✓	✓
	SM-0551/BPPA0 *)	-	-	✓	-

*) installed on SM-2558

Note

Details about the installation of protocol elements can be found in the *SICAM AK 3 User Manual*, chapter "*Installation*".

5.5.8.5 Technical Specification SM-2551 and SM-0551

SM-2551

Communication Circuits	
2 serial interfaces	Interface characteristics, interface signals, operation modes, transmission rates see description of the respective protocol, "Modes" • Byte-asynchronous or byte-isochronous pulse code modulation • Instead of the interface signal DSR the gate circuit voltage (+5 VDC) can be provided (settable) • Ability to be connected in parallel − Outgoing interface signals in tristate technology − Up to 2 interfaces can be connected in parallel − Circuits for incoming interface signals always active • The signals are galvanically insulated from logic circuits • Interfaces are galvanically insulated from each other • Line lengths V.28 − 50 bit/s up to 25 m − 115200 bit/s up to 5 m
Power Supply	
Operating voltage	4.75…5.25 VDC, typ. 300 mA, max. 540 mA at 5 V The voltage is supplied by the carrier module.
Gate circuit voltage +5 VDC instead of DSR	4.7…5.6 VDC The voltage is supplied by the carrier module, galvanically insulated • Max. output current 150 mA at U > 4.75 V • Max. output power 750 mW • Max. idle voltage $\leq$ 5.6 VDC • Not short-circuit proof • Not overload proof • Galvanically insulated from logic voltage
Mechanics	
Dimensions	227.3 x 63.5 mm
Weight	Approx. 200 g

SM-0551

Communication Circuits	
1 serial interface	Interface characteristics, interface signals, operation modes, transmission rates see description of the respective protocol, "Modes"
	• Instead of the interface signal DSR the gate circuit voltage (+5VDC) can be provided (settable)
	• Ability to be connected in parallel
	− Outgoing interface signals in tristate technology
	− Up to 2 interfaces can be connected in parallel
	− Circuits for incoming interface signals always active
	• The signals are galvanically insulated from logic circuits
	• Line lengths V.28
	− 50 Bits/s up to 25 m
	− 115200 bit/s up to 5 m
Power Supply	
Operating voltage	• 4.75…5.25 VDC, typ. 25 mA, max. 50 mA at 5 V
	• 3.14…3.47 VDC, typ. 150 mA, max. 330 mA at 3.3 V
	The voltages are supplied by the carrier module
Gate circuit voltage +5 VDC instead of DSR	4.7…5.6 VDC
	The voltage is supplied by the carrier module, galvanically insulated
	• Max. output current 150 mA at U > 4.75 V
	• Max. output power 750 mW
	• max. idle voltage ≤ 5.6 VDC
	• Not short-circuit proof
	• Not overload proof
	• Galvanically insulated from logic voltage
Mechanics	
Dimensions	56 x 43 x 5,5 mm
Weight	Approx. 15 g

5.5.9 SM-x551/UMPMA0, SM-x551/UMPSA0

The protocol elements *SM-x551/UMPMA0* und *SM-x551/UMPSA0* are serial communication protocols for multi-point traffic according to IEC 60870-5-101.

In a multi-point traffic a master station is connected with one or up to 100 remote terminal units. The data traffic is controlled by the master station.

These protocol elements consist of a communication module and a loadable firmware.

Product	Designation	Remarks
SM-2551	Serial Interface Processor 2 Interfaces	• 1 protocol element per interface • SM-2551/PROTOCOL contains per interface the license for 1 standard protocol • Can be installed on the basic system elements
SM-0551	Serial Interface Processor 1 Interface	• 1 protocol element • SM-0551/PROTOCOL contains the license for 1 standard protocol • Can be installed on SM-2558
UMPMA0	Multi-point traffic (Master) acc. to IEC 60870-5-101	Loadable firmware
UMPSA0	Multi-point traffic (Slave) acc. to IEC 60870-5-101	Loadable firmware

5.5.9.1 Features and Functions

General functions	UMPMA0	UMPSA0
• **Serial communications protocol according to IEC60870-5-101**	✓	✓
• **Unbalanced transmission Master**	✓	
• **Unbalanced transmission Slave**		✓
− Network configurations		
− Point-to-point configuration		
− Multiple point-to-point configuration (each End-End configuration requires a separate interface)		
− Multi-point partyline	✓	✓
− Multi-point star	✓	✓
− max. connections	100	1
− System or device (application function)		
− Controlling station	✓	
− Controlled station		✓

General functions	UMPMA0	UMPSA0
• **Physical layer / data flow control**		
− Unbalanced interchange circuit accordingV.24/V.28 standard	✓	✓
− Balanced interchange circuit X.24/X.27	✓ 1)	✓ 1)
− Transmission medium (full duplex)		
− Transmission medium (half duplex)	✓	✓
− Byte frame (8E1)	✓	✓
− Data flow control bit in receive direction	✓	
− Data flow control bit supervision	✓	
− Data flow control bit in transmit direction		
• **Interoperability**		
− IEC60870-5-101 Ed.1	✓	✓
− IEC60870-5-101 Ed.2		
• **Interoperability according to following documents:**		
− SICAM RTUs Interoperability IEC 60870-5-101/104 (DC0-013-2)	✓	✓
− Ax 1703 Interoperability IEC 60870-5-101/104 (DA0-046-2)	✓	
• **Data acquisition by polling (station interrogation)**	✓	✓
− Continuous interrogation of a remote terminal unit	✓	
− Station failure delay	✓	
− Quick check procedure		
• **Acquisition of events (transmission of data ready to be sent)**	✓	✓
• **General interrogation, outstation interrogation**	✓	✓
− Non Interruptible GI		✓
− 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 IEC60870-5-101**	✓	✓
− Clock synchronization with <TI:=103> clock synchronization command	✓	✓
− Acquisition of transmission delay (primary station) used for correction of clock synchronization with <TI:=106>		
− Acquisition of transmission delay (primary station) used for correction of clock synchronization (with request status of link = proprietary)	✓	
− Acquisition of transmission delay (secondary station) used for correction of clock synchronization with <TI:=106>		✓
− Correction of clock synchronization (via parameter)		✓
− Accuracy		2)
− Accuracy with relay operation		3)
• **Command transmission**	✓	✓
− Demand	✓	
− Supervision of maximum transport delay in control direction (dwell time monitoring)		
− Set control location	✓	
− Check control location	✓	
• **Transmission of integrated totals**	✓	
• **File transfer**	✓	✓

General functions	UMPMA0	UMPSA0
• **Optimized parameters for selected transmission facilities (modems)**		
− Predefined optimized parameters for selected transmission facilities	✓	✓
− Free definable parameters for transmission facility	✓	✓
− 5 V power supply for external modems via DSR status signal [4]	✓	✓
• **Standby transmission line over the public telephone network (PSTN)**	✓	
• **Data transmission using time slot radio**	✓	✓
• **Co-ordination of several masters**	✓	✓
• **Relay operation (multi-point traffic with routing)**	✓	✓
− Main and standby transmission line	✓	✓
• **Functions for supporting redundant communication routes**		
− NUC redundancy (Norwegian Users Conventions)	✓	✓
− NUC redundancy "controlling station"	✓	
− NUC redundancy "controlled station"		✓
− 1703 redundancy	✓	✓
− Listening mode when passive	✓	✓
− Tristate of RS-232 interface when passive	✓	✓
− Activation/deactivation of interface when passive (with protocol element control message)	✓	✓
− Deactivation of interface (with redundancy control message)		
• **Protocol element control and return information**		
Protocol element control		
− Send (general) interrogation command to all	✓	✓
− Send (general) interrogation command to selective CASDU	✓	
− Send (general) interrogation command for image GI to own BSE		
− Send process reset command		
− Set control location	✓	
− Data filter in transmit direction "ON/OFF"	✓	
− Data filter in receive direction "ON/OFF"	✓	
− Activate/deactivate interface	✓	
− Activate/deactivate interface + protocol functions	✓	
− 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		✓
Protocol element return information		
− Station failure	✓	
− Station status	✓	
− Status DTR (1 = state line active)	✓	✓
− Status DSR (1 = state line active)	✓	✓
− Protocol-specific return information 0…3, 6, 7, 8…11	✓	
− Protocol-specific return information value (retries in % of the last hour)	✓	
• **Remote maintenance with SICAM TOOLBOX II via serial connection**	✓	✓

General functions	UMPMA0	UMPSA0
• **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		
− Send general interrogation data as class 1 data		✓
− Non interruptible GI		✓
− Convert general interrogation command in receive direction to BROADCAST		✓
− Do not store general interrogation commands in receive direction		✓
− Send end of init message as class 1 data		✓
− Send ACTCON, ACTTERM message as class 1 data		✓
− Send ACTCON for clock synchronization command		✓
− Emulate ACTCON+/−		✓
− Emulate ACTCON, ACTTERM for commands (with control message)		✓
− Message synchronization		✓
− Filtering of measured values with COT=3 (spontaneous) in transmit direction		✓
• **Transparent mode (tunneling)**	✓	

[1]   requires CM-0829

[2]   ±20 ms

[3]   ±20+n ms; in case of relay operation additional 10 ms for each routing station

[4]   ATTENTION: check power consumption of external modem!

Note

The above mentioned functions are described in detail in the document *SICAM RTUs • Ax 1703 Common Functions Protocol Elements*, section *"Multi-point Traffic"*.

5.5.9.2 Modes of Operation

Operating mode	Optional equipment	Note
Unbalanced interchange circuit V.24/V.28 V.23 Dedicated line	CE-0700	• 300/1200 bit/s • Signals and levels according to V.24, V.28, EIA-232 • RJ45 connector to CE-0700 RXD, TXD, CTS, RTS, DCD, DTR, GND • 4-pin screw terminals on CE-0700 NF-an a, NF-an b, NF-ab a / NF-a, NF-ab b / NF-b
Balanced interface EIA-485 V.11 asynchronous	CM-0829 CM-0819	• 50…115200 bit/s • Signals and levels according to V.11, EIA-485 • RJ45 connector to CM-0819 or CM-0829 RXD, TXD, CTS, RTS, DCD, DTR, DSR/+5 V, GND • Terminal 5-pole on CM-0819 and CM-0829 • Corresponds with SM-2541 operating mode 2a, V.11/EIA-485 asynchronous
Optical interface (multimode fiber optic) Ring	CM-0821	• 50…115200 bit/s • RJ45 connector to CM-0821 RXD, TXD, +5 V, GND, Status • Signals 820 nm • 50/125µ and 62.5/125µ fibers • ST compatible connector on CM-0821
Unbalanced interchange circuit V.24/V.28 V.28 asynchronous	–	• 50…115200 bit/s • Signals and levels according to V.24, V.28, EIA-232 • RJ45 connector RXD, TXD, CTS, RTS, DCD, DTR, DSR/+5 V, GND • RJ45 connector pin assignment corresponds with SM-2541 operating mode 1a, V.28 asynchronous

5.5.9.3 Communication

For the stations to communicate with each other, suitable transmission facilities and/or network components may be needed in addition.

Controlling Station

System	System Element	Protocol Element	Note
SICAM AK 3	CP-2016/CPCX26 CP-2019/PCCX26	SM-2551/UMPMA0 SM-0551/UMPMA0	

Controlled Station

System	System Element	Protocol Element	Note
SICAM AK 3	CP-2016/CPCX26 CP-2019/PCCX26	SM-2551/UMPSA0 SM-0551/UMPSA0	
SICAM AK	CP-2014/CPCX25 CP-2017/PCCX25	SM-2551/UMPSA0 SM-0551/UMPSA0	
SICAM BC	CP-5014/CPCX55	SM-2551/UMPSA0 SM-0551/UMPSA0	
SICAM TM	CP-6014/CPCX65	SM-2551/UMPSA0 SM-0551/UMPSA0	
SICAM EMIC	CP-6010/CPC30	UMPST0	
SICAM CMIC	CP-8000/CPC80	UMPST0	
SICAM MIC	CP-6020/CPC60 CP-6040/CPC60	–	
SAT 1703 and external systems	–	–	acc. to *SICAM RTUs Interoperability IEC 60870-5-101/104* or *Ax 1703 Interoperability IEC 60870-5-101/104*

5.5.9.4   Configurations

The following table shows on which basic system element the protocol element can be used, and on which interface it is available.

Basic system element (BSE)	Protocol element	BSE interfaces			
		X0	X1	X2	X3
CP-2016	SM-2551/UMPxA0	-	-	✓	✓
	SM-0551/UMPxA0 *)	-	-	✓	-
CP-2019	SM-2551/UMPxA0	-	-	✓	✓
	SM-0551/UMPxA0 *)	-	-	✓	-

*)   installed on SM-2558

Note

Details about the installation of protocol elements can be found in the *SICAM AK 3 User Manual*, chapter "*Installation*".

5.5.9.5   Technical Specifications

See Technical Specification SM-2551 and SM-0551.

5.5.10 SM-x551/SFBMA1, SM-x551/SFBSA1

The protocol elements *SM-x551/SFBMA1* und *SM-x551/SFBMA1* are serial communication protocols in multi-point traffic according to IEC 60870-5-101, optimized for the usage of SICAM RTUs devices with field bus.

In a multi-point traffic a master station is connected with one or up to 100 remote terminal units. The data traffic is controlled by the master station.

This protocol elements consist of a communication module and a loadable firmware.

Product	Designation	Remarks
SM-2551	Serial Interface Processor 2 Interfaces	• 1 protocol element per interface • SM-2551/PROTOCOL contains per interface the license for 1 standard protocol • Can be installed on the basic system elements
SM-0551	Serial Interface Processor 1 Interface	• 1 protocol element • SM-0551/PROTOCOL contains the license for 1 standard protocol • Can be installed on SM-2558
SFBMA1	Field bus (Master) based on IEC 60870-5-101	Loadable firmware
SFBSA1	Field bus (Slave) based on IEC 60870-5-101	Loadable firmware

5.5.10.1 Features and Functions

General functions	SFBMA1	SFBSA1
• **Unbalanced transmission Master** (central station, primary station)	✓	
• **Unbalanced transmission Slave** (substation, secondary station)		✓
• **Unbalanced multi-point traffic based on to IEC 60870-5-101**	✓	✓
− Data acquisition by polling (station interrogation)	✓	
− Acquisition of events (transmission of data ready to be sent)	✓	
− General interrogation, substation interrogation	✓	
− Clock synchronization	✓	
− Cyclic, every 5 seconds	✓	
− Command transmission	✓	
− Transmission of integrated totals	✓	
• **Optimized parameters for selected transmission facilities**	✓	
• **Functions for supporting redundant communication routes**	✓	

Note

The above mentioned functions are described in detail in the document *SICAM RTUs • Ax 1703 Common Functions Protocol Elements*, section *"SICAM RTUs Field Bus (SFB)"*.

5.5.10.2 Modes of Operation

Operating mode	Optional equipment	Note
Optical interface (multimode fiber optic) Ring	CM-0821	• 50…115200 bit/s • RJ45 connector to CM-0821 RXD, TXD, +5 V, GND, Status • Signals 820 nm • 50/125µ and 62.5/125µ fibers • ST compatible connector on CM-0821
Optical interface (multimode fiber optic)	CM-0847	• RJ45 connector to CM-0821 RXD, TXD, +5 V, GND, Status
Balanced interface EIA-485 V.11 asynchronous	CM-0829 CM-0819	• 50…115200 bit/s • Signals and levels according to V.11, EIA-485 • RJ45 connector to CM 0819 or CM-0829 RXD, TXD, CTS, RTS, DCD, DTR, DSR/+5 V, GND • Terminal 5-pole on CM-0819 and CM-0829 • corresponds with SM-2541 operating mode 2a, V.11/EIA-485 asynchronous
Unbalanced interchange circuit V.24/V.28 V.28 asynchronous	–	• 50…115200 bit/s • Signals and levels according to V.24, V.28, EIA-232 • RJ45 connector ... DTR, DSR/+5 V, GND • RJ45 connector pin assignment corresponds with SM-2541 operating mode 1a, V.28 asynchronous

5.5.10.3 Communication

For the stations to communicate with each other, suitable transmission facilities and/or network components may be needed in addition.

Controlling Station

System	System Element	Protocol Element	Note
SICAM AK 3	CP-2016/CPCX26 CP-2019/PCCX26	SM-2551/SFBMA1 SM-0551/SFBMA1	

Controlled Station

System	System Element	Protocol Element	Note
SICAM AK 3	CP-2016/CPCX26 CP-2019/PCCX26	SM-2551/SFBSA1 SM-0551/SFBSA1	
SICAM AK	CP-2014/CPCX25 CP-2017/PCCX25	SM-2551/SFBSA1 SM-0551/SFBSA1	
SICAM BC	CP-5014/CPCX55	SM-2551/SFBSA1 SM-0551/SFBSA1	
SICAM TM	CP-6014/CPCX65	SM-2551/SFBSA1 SM-0551/SFBSA1	
SAT 1703	–	–	acc. *SICAM RTUs Interoperability* *IEC 60870-5-101/104* or *Ax 1703 Interoperability* *IEC 60870-5-101/104*

5.5.10.4 Configurations

The following table shows on which basic system element the protocol element can be used, and on which interface it is available.

Basic system element (BSE)	Protocol element	BSE interfaces			
		X0	X1	X2	X3
CP-2016	SM-2551/ SFBxA1	-	-	✓	✓
	SM-0551/SFBxA1 *)	-	-	✓	-
CP-2019	SM-2551/SFBxA1	-	-	✓	✓
	SM-0551/SFBxA1 *)	-	-	✓	-

*) installed on SM-2558

Note

Details about the installation of protocol elements can be found in the *SICAM AK 3 User Manual*, chapter "*Installation*".

5.5.10.5 Technical Specifications

See Technical Specification SM-2551 and SM-0551.

5.5.11   SM-x551/DIAMA1, SM-x551/DIASA0

The protocol elements *SM-x551/DIAMA1* and *SM-x551/DIASA0* are serial communication protocols for dial-up traffic according to IEC 60870-5-101.

In a dial-up traffic a master station is connected with one or several remote terminal units via the public telephone network (ISDN, GSM, analog/digital).

This protocol elements consist of a communication module and a loadable firmware.

Product	Designation	Remarks
SM-2551	Serial Interface Processor 2 Interfaces	• 1 protocol element per interface • SM-2551/PROTOCOL contains per interface the license for 1 standard protocol • Can be installed on the basic system elements
SM-0551	Serial Interface Processor 1 Interface	• 1 protocol element • SM-0551/PROTOCOL contains the license for 1 standard protocol • Can be installed on SM-2558
DIAMA1	Dial-up traffic (Master) based on IEC 60870-5-101 incl. proprietary expansions	Loadable firmware
DIASA0	Dial-up traffic (Slave) based on IEC 60870-5-101 incl. proprietary expansions	Loadable firmware

5.5.11.1 Features and Functions

General functions	DIAMA1	DIASA1
• **Unbalanced transmission Master** (central station, primary station)	✓	
• **Unbalanced transmission Slave** (substation, secondary station)		✓
• **Unbalanced multi-point (dial-up traffic) based on to IEC 60870-5-101**	✓	✓
• **Controlling connection establishment and disconnection**		
− Connection establishment spontaneously and cyclically, controlling station ⇔ controlled station	✓	
− Establishing a connection cyclically at a settable interval (monitoring cycle) ∗ for transmission of low-priority data ∗ for monitoring the station availability ∗ for clock synchronization	✓	
− Controlling connection establishment by means of modem commands	✓	
− AT Hayes, V.25bis, X.20, X.28	✓	
− Arbitrary main telephone number of a telephone network (PSTN)	✓	
− Access control (LOGIN with password) in the private range of IEC 60870-5-101	✓	
− Disconnection control in the private range of IEC 60870-5-101	✓	

Communication when a connection is established according to unbalanced multi-point (dial-up traffic) based on IEC 60870-5-101		
− Data acquisition by polling (station interrogation)	✓	
− Acquisition of events (transmission of data ready to be sent)	✓	
− General interrogation, substation interrogation	✓	
− Clock synchronization	✓	
− Each time a connection has been established	✓	
− When a connection is established, one time per minute	✓	
− Command transmission	✓	
− Transmission of integrated totals	✓	
Co-ordination of several masters in "multi-master operation" (availability and data throughput)	✓	
− The controlling station can simultaneously establish connections to different controlled stations	✓	
Standby transmission line(s) by means of standby telephone numbers of the same or another (PSTN) telephone network	✓	
Multi-hierarchical configurations	✓	
Optimized parameters for selected transmission facilities	✓	
Toll-saving transmission strategies	✓	
Having a telephone set connected in parallel	✓	
Functions for supporting redundant communication routes	✓	

Note

The above mentioned functions are described in detail in the document *SICAM RTUs • Ax 1703 Common Functions Protocol Elements*, section *"Dial-Up Traffic (DIA)"*.

5.5.11.2 Modes of Operation

Operating mode	Optional equipment	Note
Unbalanced interchange circuit V.24/V.28 V.28 asynchronous	Dial-up modem *)	• 50…115200 bit/s • Signals and levels according to V.24, V.28, EIA-232 • RJ45 connector to the modem RXD, TXD, CTS, RTS, DCD, DTR, DSR/+5 V, GND

*) acc. to *SICAM AK 3 User Manual, chapter "Automation Units and Automation unit Networks"*

5.5.11.3 Communication

For the stations to communicate with each other, suitable transmission facilities and/or network components may be needed in addition.

Controlling Station

System	System Element	Protocol Element	Note
SICAM AK 3	CP-2016/CPCX26 CP-2019/PCCX26	SM-2551/DIAMA1 SM-0551/DIAMA1	

Controlled Station

System	System Element	Protocol Element	Note
SICAM AK 3	CP-2016/CPCX26 CP-2019/PCCX26	SM-2551/DIASA0 SM-0551/DIASA0	
SICAM AK	CP-2014/CPCX25 CP-2017/PCCX25	SM-2551/DIASA0 SM-0551/DIASA0	
SICAM BC	CP-5014/CPCX55	SM-2551/DIASA0 SM-0551/DIASA0	
SICAM TM	CP-6014/CPCX65	SM-2551/DIASA0 SM-0551/DIASA0	
SICAM EMIC	CP-6010/CPC30	DIAST0	
SICAM CMIC	CP-8000/CPC80	DIAST0	
SICAM MIC	CP-6020/CPC60 CP-6040/CPC60	–	
SAT 1703	–	–	acc. to *SICAM RTUs Interoperability IEC 60870-5-101/104* or *Ax 1703 Interoperability IEC 60870-5-101/104*

5.5.11.4 Configurations

The following table shows on which basic system element the protocol element can be used, and on which interface it is available.

Basic system element (BSE)	Protocol element	BSE interfaces			
		X0	X1	X2	X3
CP-2016	SM-2551/DIAxA0	-	-	✓	✓
	SM-0551/DIAxA0 *)	-	-	✓	-
CP-2019	SM-2551/DIAxA0	-	-	✓	✓
	SM-0551/DIAxA0 *)	-	-	✓	-

*) installed on SM-2558

Note

Details about the installation of protocol elements can be found in the *SICAM AK 3 User Manual*, chapter "*Installation*".

5.5.11.5 Technical Specifications

See Technical Specification SM-2551 and SM-0551.

5.5.12 SM-x551/103MA0, SM-x551/103SA0

The protocol elements *SM-x551/103MA0* and *SM-x551/103SA0* are serial communication proto-cols in multi-point traffic according to IEC 60870-5-103 for coupling of digital protective devic-es and protection equipment.

The communication takes place between 1 central station and 1 or up to 100 protective devic-es (remote stations). The data traffic is controlled by the master station.

This protocol elements consist of a communication module and a loadable firmware.

Product	Designation	Remarks
SM-2551	Serial Interface Processor 2 Interfaces	• 1 protocol element per interface • SM-2551/PROTOCOL contains per inter-face the license for 1 standard protocol • Can be installed on the basic system elements
SM-0551	Serial Interface Processor 1 Interface	• 1 protocol element • SM-0551/PROTOCOL contains the li-cense for 1 standard protocol • Can be installed on SM-2558
103MA0	Protection device interfacing (Master) acc. to IEC 60870-5-103	Loadable firmware
103SA0	Protection device interfacing (Slave) acc. to IEC 60870-5-103	Loadable firmware

5.5.12.1 Features and Functions

General functions	103MA0	103SA0
• **Unbalanced transmission Master** (central station, primary station)	✓	
• **Unbalanced transmission Slave** (substation, secondary station)		✓
• **Unbalanced multi-point traffic according to IEC 60870-5-103**	✓	✓
− Network configuration		
− Point-to-point configuration (Master+ 1 Slave)	✓	✓
− Multiple point-to-point configuration (separate interface for each single point-to-point configuration required)	✓	✓
− Multipoint partyline	✓	✓
− Multipoint star	✓	✓
− max. Connections	100[1]	1
− System or device (application function)		
− Controlling Station	✓	
− Controlled Station		✓

• **Physical layer / data flow control**		
− Unbalanced interchange circuit accordingV.24/V.28 standard	✓	✓
− Transmission medium (full duplex)		
− Transmission medium (half duplex)	✓	✓
− Byte Frame (8E1)	✓	✓
− Data flow control bit in receive direction	✓	
− Data flow control bit supervision	✓	
− Data flow control bit in transmit direction		
• **Interoperability**		
− Compatibility level 1 (VDEW/ZVEI Standard)		
− Compatibility level 2 (Disturbance Data)		
− Compatibility level 3 (Generic Services)		
− Message Conversion (protocol mode / message format)		
− IEC 60870-5-103 / IEC 60870-5-103 "standard" [default]	✓	✓
− IEC 60870-5-101 / IEC 60870-5-101		✓
− IEC 60870-5-103 / IEC 60870-5-101 "tunneling mode"	✓ 2)	✓ 2)
• **Interoperability according to the following documents**		
− SICAM RTUs Interoperability IEC 60870-5-103 (DC0-026-2)	✓	✓
• **Data acquisition by polling (station interrogation)**	✓	✓
− Continuous Interrogation of a Remote Terminal Unit	✓	
− Station failure delay		
− Quick check procedure		
• **Acquisition of events (transmission of data ready to be sent)**	✓	✓
− Test Mode	✓	
• **General interrogation, substation interrogation**	✓	✓
− Delayed transmission of general intwerrogation command	✓	
− Timeout monitoring for GI-data		
• **Clock synchronization according to IEC60870-5-103**	✓	✓
− Cyclic, can be set in a seconds grid	✓	
− Correction of clock synchronization (via parameter)	✓	
− Accuracy		±20ms
• **Command transmission**	✓	✓
− Demand	✓	
− Supervision of maximum transport delay in control direction		
− Set control location	✓	
− Check control location	✓	
• **Transmission of integrated totals**	✓	✓
• **File transfer**		
− Disturbance records to SICAM DISTO	✓	✓
− Disturbance records to control centre systems according to IEC 60870-5-101/104	✓	
• **Optimized parameters for selected transmission facilities**		
− Predefined optimized parameters for selected transmission facilities	✓	✓
− Free definable parameters for transmission facility	✓	✓
− 5 V power supply via DSR status signal for external modems 3)	✓	✓

• **Functions for supporting redundant communication routes**		
− 1703 redundancy	✓	
− Listening mode when passive	✓	
− Tristate of RS-232 interface when passive	✓	
− Activation/deactivation of interface when passive with protocol element control message	✓	
− Main-/Backup transmission line with 2 interfaces	✓	
− Deactivation of interface (with redundancy control message)	✓	
• **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		
− Reset command		
− Set control location	✓	
− Call cycle START / STOP / CONTINUE	✓	
− Continuous call station x ON / OFF	✓	
− Activate/Deactivate interface	✓	
Protocol element return information		
− Station failure	✓	
− Station status	✓	
− Status DTR (1 = state line active)	✓	✓
− Status DSR (1 = state line active)	✓	✓
− Protocol-specific return information 0…3, 6, 7	✓	
• **Remote maintenance with SICAM TOOLBOX II via serial connection**		
• **Special functions**		
− Send short-circuit location values with GI	✓	
− Resetting the short-circuit location values		
− Reset short-circuit location values with command	✓	
− Reset short-circuit location values automatically	✓	
− 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	✓	
− Remote-configuration of Reyrolle relays	✓	

[1]   recommendation max. 10 stations

[2]   IEC 60870-5-101 messages are transmitted in IEC 60870-5-103 container messages (in the private range); with SICAM RTUs configurations with BC 1703 the conversion of IEC 60870-5-101 → IEC 60870-5-103 → IEC 60870-5-101 can be omitted

[3]   ATTENTION: check power consumption of external modem!

Note

The above mentioned functions are described in detail in the document *SICAM RTUs • Ax 1703 Common Functions Protocol Elements*, section *"Interfacing of Protective Devices (103)"*.

5.5.12.2 Modes of Operation

Operating mode	Optional equipment	Note
Optical interface (multimode fiber optic) Ring	CM-0821	• 50…115200 bit/s • RJ45 connector to CM-0821 RXD, TXD, +5 V, GND, Status • Signals 820 nm • 50/125µ and 62.5/125µ fibers • ST compatible connector on CM-0821
Optical interface (multimode fiber optic)	CM-0847	• RJ45 connector to CM-0847 RXD, TXD, +5 V, GND, Status

Balanced interface EIA-485 V.11 asynchronous	CM-0829
	CM-0819
		• 50…115200 bit/s
		• Signals and levels according to V.11, EIA-485
		• RJ45 connector to CM 0819 or CM-0829
		  RXD, TXD, CTS, RTS, DCD, DTR, DSR/+5 V, GND
		• 5-pin terminals on CM-0819 and CM-0829
		  RX±, TX±, GND
		• corresponds with SM-2541
		  operating mode 2a, V.11/EIA-485 asynchronous

Unbalanced interchange circuit V.24/V.28 V.28 asynchronous	–	• 50…115200 bit/s
		• Signals and levels according to V.24, V.28, EIA-232
		• RJ45 connector RX
		  DTR, DSR/+5 V, GND
		• RJ45 connector pin assignment corresponds with
		  SM-2541 operating mode 1a, V.28 asynchronous

5.5.12.3 Communication

For the stations to communicate with each other, suitable transmission facilities and/or network components may be needed in addition.

Controlling Station

System	System Element	Protocol Element	Note
SICAM AK 3	CP-2016/CPCX26 CP-2019/PCCX26	SM-2551/103MA0 SM-0551/103MA0	

Controlled Station

System	System Element	Protocol Element	Note
SICAM AK 3	CP-2016/CPCX26 CP-2019/PCCX26	SM-2551/103SA0 SM-0551/103SA0	
SICAM AK	CP-2014/CPCX25 CP-2017/PCCX25	SM-2551/103SA0 SM-0551/103SA0	
SICAM BC	CP-5014/CPCX55	SM-2551/103SA0 SM-0551/103SA0	electrical
		Serial interface LOC	optical
SICAM TM	CP-6014/CPCX65	SM-2551/103SA0 SM-0551/103SA0	
External systems	–	–	acc. to *SICAM RTUs Interoperability* *IEC 60870-5-103*

5.5.12.4 Configurations

The following table shows on which BSE the protocol element can be used and to which interface of the BSE the protocol is assigned.

Basic system element (BSE)	Protocol element	BSE interfaces			
		X0	X1	X2	X3
CP-2016	SM-2551/103xA0	-	-	✓	✓
	SM-0551/103xA0 *)	-	-	✓	-
CP-2019	SM-2551/103xA0	-	-	✓	✓
	SM-0551/103xA0 *)	-	-	✓	-

*) installed on SM-2558

Note

Details about the installation of protocol elements can be found in the *SICAM AK 3 User Manual*, chapter "*Installation*".

5.5.12.5 Technical Specifications

See <u>Technical Specification SM-2551 and SM-0551</u>.

5.6 Integrated Protocol SNMPv3 Agent

This protocol is integrated in the firmware of the basic system element.

5.6.1 General

SNMP (Simple Network Management Protocol) is a network protocol used to monitor or control network components (e.g. routers, switches, servers or automation units (PLC, RTU…)) from a central station. The protocol controls the communication between the monitored devices (SNMP-Agents) and the monitoring station (SNMP-Manager).

5.6.2 Features and Functions

General functions	
• **SNMP**	
− SNMPv2	
− SNMPv3	✓
− SNMP Manager	
− SNMP Agent	✓
• **Supported ports**	
− Port 161 (UDP)	✓
− Port 162 (UDP) (reserved for TRAPs)	
• **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 (available from SNMPv2))	✓
− SET (write of SNMP variables)	
− RESPONSE (reply on GET, GETNEXT, GETBULK)	✓
− TRAP (spontaneous data Agent → Manager)	
• **Supported MIBs**	
− RFC1213.MIB	✓
− sicamRTUs.MIB	✓
• **Supported SNMP variables (rough overview)**	
− Plant name	✓
− System-technical region and component number	✓
− Uptime	✓
− Port Status	✓
− Central error table	✓

• **Security**	
− SNMP Security Level: authPriv (comunication with authentication and encryption)	✓
− Protocol for authentication: MD5 (user mane, password)	✓
− Protocol for encryption: DES-56 Bit (with password)	✓
− Encrypted storage of passwords	✓

Note

Further information about SNMPv3 Agent can be found in document *SICAM RTUs • Ax 1703 Common Functions,chapter „SNMPv3 Agent"*.

5.7 Peripheral elements

The peripheral elements are responsible for the input, processing and output of process signals. Processing is performed to some degree by

- Hardware (example: filter, ADC, 1-out-of-n check, DAC)
- Firmware (e.g. smoothing of measured values, time tagging)

The peripheral functions are specific for each I/O module.

General Functions

- Supervision of the function, failure handling
- Signaling via LED's

Functions for Telecontrol and Automation.

- Acquisition and preprocessing of process data according to IEC 60870-5-101/104
  - Transmission of spontaneous process information to the *telecontrol function* for further distribution
  - Transmission of periodical process information to the *open-/closed-loop control function* for further processing
  - Transmission of system information (example: diagnosis data)
- Postprocessing and output of process data according to IEC 60870-5-101/104
  - Reception of spontaneous process information from the *telecontrol function*
  - Transmission of periodical process information to the *open-/closed-loop control function*
  - Reception of system information (example: Parameter)

Note

The functions and the belonging mode of action are described in detail in the manual *SICAM RTUs Common Functions Peripheral Elements* according to IEC 60870 5 101/104.

Note

SICAM TM peripheral elements are not described in this section. You find the details thereto in the data sheet *SICAM TM ▪ PE-641x/USIO66* and in the document *SICAM TM I/O Modules*.

In the following listing, footnotes are used to specify the effect of the functions in detail.

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[f]   **Telecontrol**
the function affects process information which is **spontaneously** transmitted

[f1]   **Telecontrol**
the function delivers (acquisition) **spontaneously** transmitted process information or is controlled by such information (output); partly, periodically transmitted information is also created/required

[a]   **Automation**
the function affects process information which is periodically transmitted

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5.7.1   DI-2112/BISX26

The peripheral element DI-2112/BISX26 is used for the acquisition of binary inputs. It consists of a module and loadable firmware.
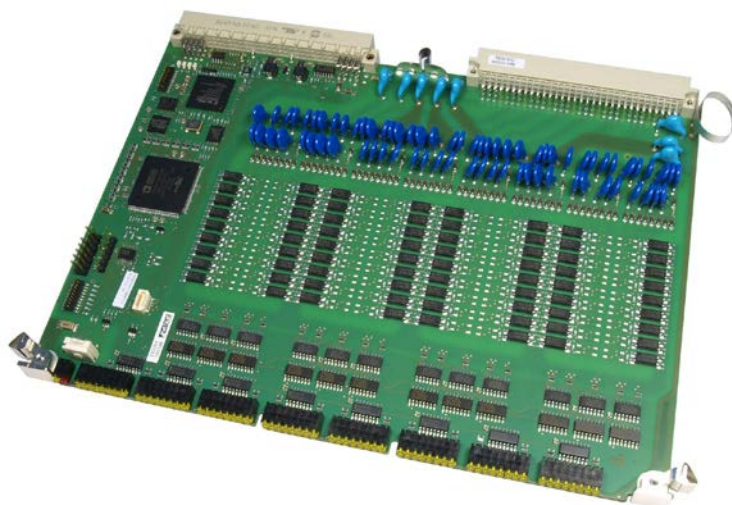
Type	Designation	Remarks
DI-2112	Binary input 8x 8, 24 VDC, acquisition grid 1 ms	Module in double euro format, for equipping in a 19"-board rack
BISX26	Binary signal input	Loadable firmware

5.7.1.1 Overview

- Acquisition and processing according to IEC 608705101/104
    - 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
- Galvanically insulated by optocouplers
- Common return for each group
- Signal voltage 24 VDC
- Filter-equipped input circuit
- Integrated totals not power-fail safe
- Indication of function and state of the inputs via LEDs

5.7.1.2 Features and Functions

- **Single-point information**
  - Acquisition with a resolution of 1 ms [f]
  - Update every 1 ms [a] (or with the same cycle as the open-/closed-loop control function in the basic system element, depending on which cycle is 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 1 ms [a] (or with the same cycle as the open-/closed-loop control function in the basic system element, depending on which cycle is 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 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 608705101/104
  - Spontaneous transmission

Note

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


Additional Functions

- **Return Information to Pulse Command Assignment**
    - Settable assignment
      For binary information items and pulse commands, which are acquired or output
        - On the peripheral element itself
        - On different peripheral elements of the same basic system element

5.7.1.3 Technical Specifications

Processor and Memory	
Processor	BF531
Clock frequency	Fclkin = 32 MHz, Fcore = 400 MHz, Fsys = 133,3 MHz
Program memory	SPI Flash 128 MByte
Main memory	SDRAM 16 MByte
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
Nominal voltages	24 VDC
Operating points	≤ 12 V logical "0" ≥ 18 V logical "1"
Input circuits	18…31.2 VDC (operated by means of external voltage)
Rated current	1.4…5.2 mA (at 18…31.2 V)
Power Supply	
Operating voltage	4,75…5,25 VDC, typ. 1 W Voltage is picked off at the bus of board rack
Mechanics and Connectors	
Ax 1703 peripheral bus	Transmission rate 16 Mbit/s
Peripheral connector	96 pin according to DIN 41612 type C
Dimensions	Double euro format 233.4 x 160 mm, 4 WU
Weight	Approx. 300 g

5.7.2   DI-2113/ BISX26

The peripheral elements DI-211x/BISX26 are used for the acquisition of binary inputs. They consists of a module and loadable firmware.
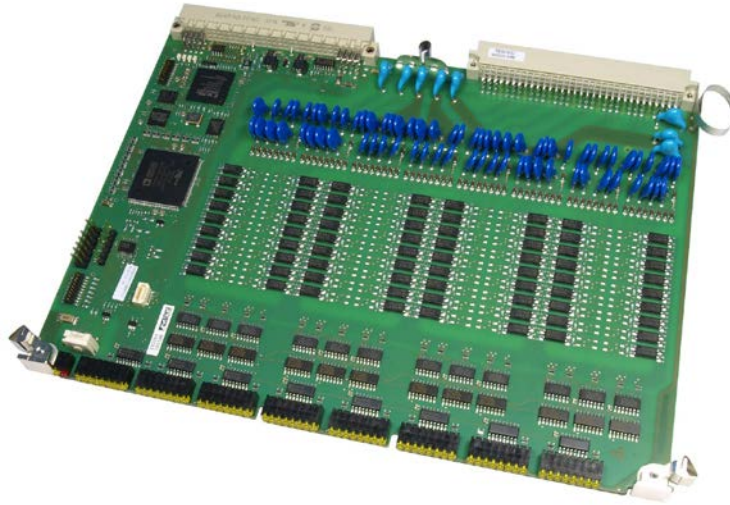
Type	Designation	Remarks
DI-2113	Binary input 8x 8, 48…60 VDC, acquisition grid 1 ms	Module in double euro format, for equipping in a 19"-board rack
BISX26	Binary signal input	Loadable firmware

5.7.2.1   Overview

- 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
- Galvanically insulated by optocouplers
- Common return for each group
- Signal voltage 48...60 VDC
- Parameter-settable polarity and thresholds for each group
- Filter-equipped input circuit
- Indication of function and state of the inputs via LEDs

5.7.2.2 Features and Functions

- **Single-point information**
    - Acquisition with a resolution of 1 ms [f]
    - Update every 1 ms [a] (or with the same cycle as the open-/closed-loop control function in the basic system element, depending on which cycle is 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 1 ms [a] (or with the same cycle as the open-/closed-loop control function in the basic system element, depending on which cycle is 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 >2 ms/>2 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 608705101/104
    - Spontaneous transmission

Note

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

Additional Functions

- **Return Information to Pulse Command Assignment**
  - Settable assignment
    For binary information items and pulse commands, which are acquired or output
    - On the peripheral element itself
    - On different peripheral elements of the same basic system element

5.7.2.3 Technical Specifications

Processor and Memory	
Processor	BF531
Clock frequency	Fclkin = 32 MHz, Fcore = 400 MHz, Fsys = 133,3 MHz
Program memory	SPI Flash 128 MByte
Main memory	SDRAM 16 MByte
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
Nominal voltages	48…60 VDC
Operating points	≤ 24 V logical "0" ≥ 36 V logical "1"
Input circuits	36…78 VDC (operated by means of external voltage)
Rated current	0.6…2.2 mA (at 36…78 V)
Power Supply	
Operating voltage	4,75…5,25 VDC, typ. 1 W Voltage is picked off at the bus of board rack
Mechanics and Connectors	
Ax 1703 peripheral bus	Transmission rate 16 Mbit/s
Peripheral connector	96 pin according to DIN 41612 type C
Dimensions	Double euro format 233.4 x 160 mm, 4 WU
Weight	Approx. 300 g

5.7.3   DI-2114/ BISX26

The peripheral element DI-2114/BISX26 is used for the acquisition of binary inputs. It consists of a module and loadable firmware.
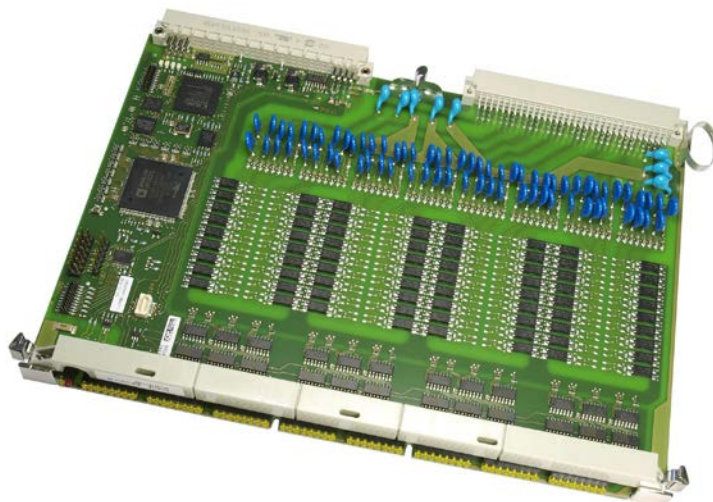
Type	Designation	Remarks
DI-2114	Binary input 8x 8, 110 VDC, acquisition grid 1 ms	Module in double euro format, for equipping in a 19"-board rack
BISX26	Binary signal input	Loadable firmware

5.7.3.1   Overview

- 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
- Galvanically insulated by optocouplers
- Common return for each group
- Signal voltage 110 VDC
- Parameter-settable polarity and thresholds for each group
- Filter-equipped input circuit
- Indication of function and state of the inputs via LEDs

5.7.3.2 Features and Functions

- **Single-point information**
    - Acquisition with a resolution of 1 ms [f]
    - Update every 1 ms [a] (or with the same cycle as the open -/closed-loop control function in the basic system element, depending on which cycle is 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 1 ms [a] (or with the same cycle as the open -/closed-loop control function in the basic system element, depending on which cycle is 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 >2 ms/>2 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 608705101/104
    - Spontaneous transmission

Note

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

Additional Functions

- **Return Information to Pulse Command Assignment**
  - Settable assignment
    For binary information items and pulse commands, which are acquired or output
    - On the peripheral element itself
    - On different peripheral elements of the same basic system element

5.7.3.3 Technical Specifications

Processor and Memory	
Processor	BF531
Clock frequency	Fclkin = 32 MHz, Fcore = 400 MHz, Fsys = 133,3 MHz
Program memory	SPI Flash 128 MByte
Main memory	SDRAM 16 MByte
Binary Inputs	
64 binary inputs 8 aux 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:	110 VDC
Operating points	≤ 55 V logical "0" ≥ 82.5 V logical "1"
Input circuits	82.5…143 VDC (operated by means of external voltage)
Rated current	0.4…1.1 mA (at 82.5…143 V)
Power Supply	
Operating voltage	4,75…5,25 VDC, typ. 1 W Voltage is picked off at the bus of board rack
Mechanics and Connectors	
Ax 1703 peripheral bus	Transmission rate 16 Mbit/s
Peripheral connector	96 pin according to DIN 41612 type C
Dimensions	Double euro format 233.4 x 160 mm, 4 WU
Weight	Approx. 300 g

5.7.4   DI-2115/BISX26

The peripheral element DI-2115/BISX26 is used for the acquisition of binary inputs. It consists of a module and loadable firmware.
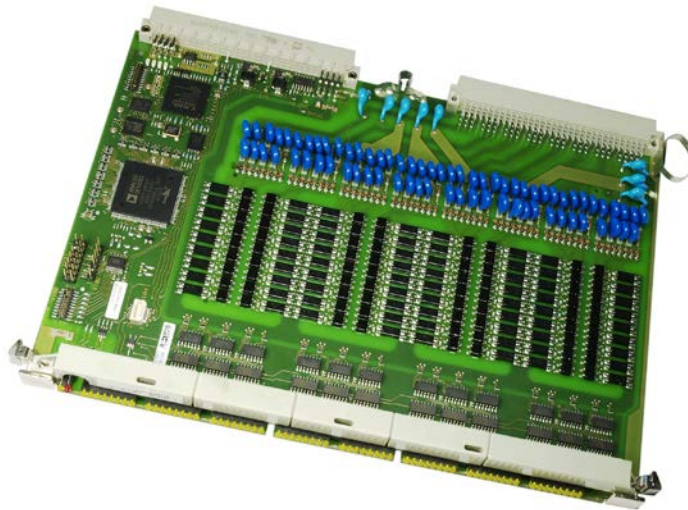
Type	Designation	Remarks
DI-2115	Binary input 8x 8, 220 VDC, acquisition grid 1 ms	Module in double euro format, for equipping in a 19"-board rack
BISX26	Binary signal input	Loadable firmware

5.7.4.1   Overview

- 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 [*]
- Galvanically insulated by optocouplers
- Common return for each group
- Signal voltage 220 VDC
- Parameter-settable polarity and thresholds for each group
- Filter-equipped input circuit
- Indication of function and state of the inputs via LEDs

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[*]   due to the power the 8 additional inputs + max. 2/3 of the 64 inputs may be active simultaneously

5.7.4.2 Features and Functions

- **Single-point information**
    - Acquisition with a resolution of 1 ms [f]
    - Update every 1 ms [a] (or with the same cycle as the open -/closed-loop control function in the basic system element, depending on which cycle is 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 1 ms [a] (or with the same cycle as the open -/closed-loop control function in the basic system element, depending on which cycle is 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 >2 ms/>2 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 608705101/104
    - Spontaneous transmission

Note

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

Additional Functions

- **Return Information to Pulse Command Assignment**
  — Settable assignment
    For binary information items and pulse commands, which are acquired or output
    − On the peripheral element itself
    − On different peripheral elements of the same basic system element

5.7.4.3 Technical Specifications

Processor and Memory	
Processor	BF531
Clock frequency	Fclkin = 32 MHz, Fcore = 400 MHz, Fsys = 133,3 MHz
Program memory	SPI Flash 128 MByte
Main memory	SDRAM 16 MByte
Binary Inputs	
64 binary inputs 8 aux 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
Nominal voltages	220 VDC
Operating points	≤ 110 V logical "0" ≥ 165 V logical "1"
Input circuits	165…250 VDC (operated by means of external voltage)
Rated current	0.2…0.4 mA (at 165…250 V)
Power Supply	
Operating voltage	4,75…5,25 VDC, typ. 1 W Voltage is picked off at the bus of board rack
Mechanics and Connectors	
Ax 1703 peripheral bus	Transmission rate 16 Mbit/s
Peripheral connector	96 pin according to DIN 41612 type C
Dimensions	Double euro format 233.4 x 160 mm, 4 WU
Weight	Approx. 300 g

5.7.5   DO-2201/BISO25

The peripheral element DO-2201/BISO25 is used for output of single-point information. It consists of a module and loadable firmware.
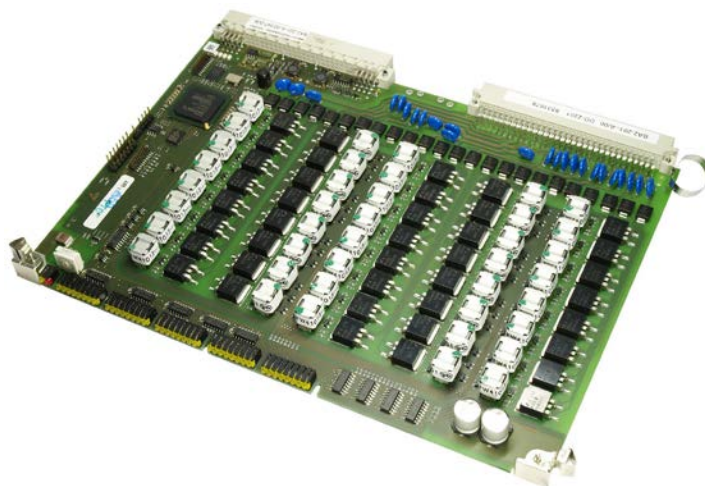
Type	Designation	Remarks
DO-2201	Binary output transistor 40x 1, 24…60 VDC	Module in double euro format, for equipping in a 19"-board rack
BISO25	Binary signal output	Loadable firmware

5.7.5.1   Overview

- Processing and output according to IEC 60870-5-101/104
  - Up to 40 single-point information items
- 40 binary outputs
- With regard to galvanical 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

5.7.5.2   Features and Functions

- **Binary information output**
  - — Selectable behavior on communication failure [fa]
    (deactivation or retention)
  - — Deactivation upon module failure [fa]
  - — Spontaneous transmission [f] or
  - — Periodical transmission [a]

Note

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

5.7.5.3   Technical Specifications

Processor and Memory	
Processor	Xilinx Spartan 6 (XC6SLX45) with Soft-IPcore
Clock frequency	16 MHz
Program memory	SPI-Flash 16 MBytes 　　HW config　　　　　　　64 kBytes 　　Program memory　　　　192 kBytes 　　FPGA Factory Image　　1,572864 MBytes 　　FPGA User Image　　　1,572864 MBytes
Main memory	RAM 512 kBytes 　　Program memory in operation192 kBytes 　　Main memory in operation　64 kBytes
Parameter memory	EEPROM 2048 Bytes (AT24C16A)
Binary Outputs	
40 outputs (transistor)	• With respect to insulation, the outputs form 　− 8 groups 2 inputs each 　− 8 groups 3 inputs 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

Binary Outputs	
Nominal switching capacity (ohmic load, U_N +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 18…78 VDC
Maximum switching voltage	78 VDC Overvoltage protection: max. 1 mA leakage current up to 86 V
Maximum switching capacity	70 W at 78 VDC
Current limitation	10 A with overcurrent 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 $\tau \leq 1$ ms (arbitrary with ext. free-wheeling diode) • Lines $Z \geq 100\ \Omega$, length of line up to 3 km • Lamps $I_N \leq 200$ mA ($I_{In} \leq 3$ A)
Power Supply	
Operating voltage	4,75…5,25 VDC, typ. 0,6 W + 0,03 W for each active output Voltage is picked off at the bus of board rack
Mechanics and Connectors	
Ax 1703 peripheral bus	Transmission rate 16 Mbit/s
Peripheral connector	96 pin according to DIN 41612 type C
Dimensions	Double euro format 233.4 x 160 mm, 4 WU
Weight	Approx. 400 g

5.7.6   DO-2210/PCCO2X

The peripheral elements DO-2210/PCCO2x are used for checked output of pulse commands.
They consist of a module and loadable firmware.

Type	Designation	Remarks
DO-2210	Command output 24…60 VDC	Module in double euro format, for equipping in a 19" board rack, with slot for optional measuring module for command output
PCCO26	Preprocessing and checked command output (Assignment of the commands without group formation)	Loadable firmware
PCCO27	Preprocessing and checked command output (Assignment of the commands in groups)	Loadable firmware

Slot for optional measuring module:

5.7.6.1 Overview

- 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 24…60 VDC
- Each group may have an own fuse circuit
- Pulse outputs are current-limited electronically
- Indication of function and state of the inputs via LEDs

5.7.6.2 Features and Functions

- **Pulse commands** [f1]
  - 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
  - Check control location
  - Command interlocking
  - Synchronization
  - Revision
  - Command output time
    - 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

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Note

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

Additional Functions

- **Return Information to Pulse Command Assignment**
  - Settable assignment
    For binary information items and pulse commands, which are acquired or output
    - On the peripheral element itself
    - On different peripheral elements of the same basic system element

5.7.6.3   Technical Specifications

Processor and Memory	
Processor	Xilinx Spartan 6 (XC6SLX45) with Soft-IPcore
Clock frequency	16 MHz

Program memory	SPI-Flash 16 MBytes
	  HW config 64 kBytes
	  Program memory 192 kBytes
	  FPGA factory image 1,572864 MBytes
	  FPGA user image 1,572864 MBytes

Main memory	RAM 512 kBytes
	  Program memory in operation 192 kBytes
	  Main memory in operation 64 kBytes

Parameter memory	EEPROM 2048 Bytes (AT24C16A)
Binary Outputs	
2 x 32 command outputs 2 group outputs 2 pulse outputs	• 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
Output current (+25°C)	1.5 A continuous current 2 A 1 minute
Switching voltage	24…60 VDC
Maximum switching voltage	60 VDC + 30%
Output Circuits	18…78 VDC (operated by means of an external voltage)
Switching cycles	10^6
Switching capacity	min. 1 mW max. 120 W
Nominal switching capacity	• 48 W/24 VDC • 96 W/48 VDC • 120 W/60 VDC
Optional measuring equipment for command outputs (SM-2506)	
Resolution	12 Bit
Measuring range	30 Ω…44 kΩ
Accuracy	$\leq$ 1 % at 30 Ω…22 kΩ $\leq$ 2 % at 22 kΩ…44 kΩ
Resistance measuring error due to inductive load	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 bei 2,5 V 30…5 kΩ bei 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 board rack

Mechanics and Connectors	
Ax 1703 peripheral bus	Transmission rate 16 Mbit/s
Peripheral connector	96 pin according to DIN 41612 type C
Dimensions	Double euro format 233.4 x 160 mm, 4 WU
Weight	Approx. 340 g

5.7.7 DO-2211/PCCO2x

The peripheral elements DO-2211/PCCO2x are used for checked output of pulse commands.
They consist of a module and loadable firmware.
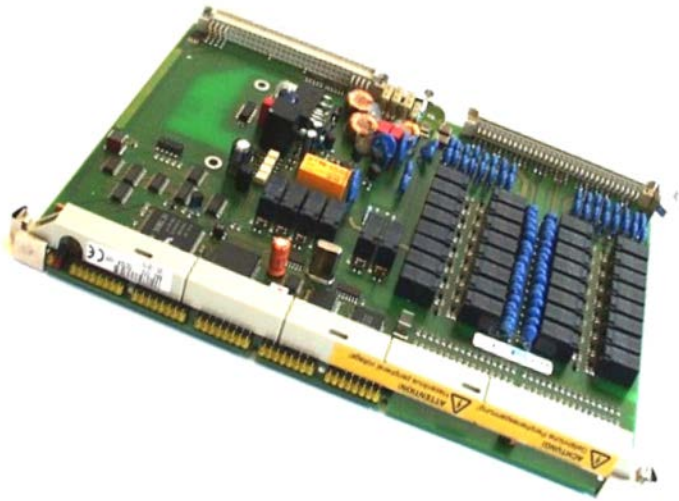
Type	Designation	Remarks
DO-2211	Command output 125 VDC	Module in double euro format, for equipping in a 19" board rack, with slot for optional measuring module for command output
PCCO26	Preprocessing and checked command output (Assignment of the commands without group formation)	Loadable firmware
PCCO27	Preprocessing and checked command output (Assignment of the commands in groups)	Loadable firmware

Slot for optional measuring module:

5.7.7.1 Overview

- 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-2507
- 64 relay-outputs (2 groups) plus
  - 2 group outputs
  - 4 pulse outputs
- Common return for each group
- Switching voltage 125 VDC
- Each group may have an own fuse circuit
- Pulse outputs are current-limited electronically
- Indication of function and state of the inputs via LEDs

5.7.7.2 Features and Functions

- **Pulse commands** [f1]
  - 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-2507
    - 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
  - Check control location
  - Command interlocking
  - Synchronization
  - Revision
  - Command output time
    - 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 *Common Functions Peripheral Elements according to IEC* 60870-5-101/104

Additional Functions

- **Return Information to Pulse Command Assignment**
  - Settable assignment
    For binary information items and pulse commands, which are acquired or output
    - On the peripheral element itself
    - On different peripheral elements of the same basic system element

5.7.7.3 Technical Specifications

Processor and Memory	
Processor	Xilinx Spartan 6 (XC6SLX45) with Soft-IPcore
Clock frequency	16 MHz
Program memory	SPI-Flash 16 MBytes HW config 64 kBytes Program memory 192 kBytes FPGA factory image 1,572864 MBytes FPGA user image 1,572864 MBytes
Main memory	RAM 512 kBytes Program memory in operation 192 kBytes Main memory in operation 64 kBytes
Parameter memory	EEPROM 2048 Bytes (AT24C16A)
Binary Outputs	
2 x 32 command outputs 2 group outputs 2 pulse outputs	• 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
Output current (+25°C)	1.5 A continuous current 2 A 1 minute
Switching voltage	125 VDC
Maximum switching voltage	125 VDC + 20%
Output Circuits	18…150 VDC (operated by means of an external voltage)
Switching cycles	10^6
Switching capacity	min. 1 mW max. 120 W
Nominal switching capacity	• 48 W/24 VDC • 96 W/48 VDC • 120 W/60 VDC • 250 W/125 VDC
Optional measuring equipment for command outputs (SM-2507)	
Resolution	12 Bit
Measuring range	30 Ω…44 kΩ
Accuracy	$\leq$ 1 % at 30 Ω…22 kΩ $\leq$ 2 % at 22 kΩ…44 kΩ
Resistance measuring error due to inductive load	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 bei 2,5 V 30…5 kΩ 　　　　　　　　　　　　　　　bei 10 V 5…44 kΩ

Power Supply	

Operating voltage	5 VDC ± 5%, typ. 1,0 W without SM-2507
	                            typ. 1,6 W with SM-2507
	                               + 0,6 W during command output
	Voltage is picked off at the bus of board rack

Mechanics and Connectors	
Ax 1703 peripheral bus	Transmission rate 16 Mbit/s
Peripheral connector	96 pin according to DIN 41612 type C
Dimensions	Double euro format 233.4 x 160 mm, 4 WU
Weight	Approx. 340 g

5.7.8   AI-2300/PASI25

The peripheral element AI-2300/PASI25 is used for the acquisition of analog values and counting pulses, as well as for the output of analog values. It consists of a module and loadable firmware.

Type	Designation	Remarks
AI-2300	Analog input 16x ±20 mA + 4x optional IOM	Module in double euro format, for equipping in a 19" board rack, with slots for up to 4 optional input/output modules
PASI25	Preprocessing and analog signal input	Loadable firmware

Slots for optional input/output modules

5.7.8.1 Overview

- 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, ±10 VDC) via SM-0572
  - Pulse inputs (24…60 VDC) via SM-0574
- Indication of function and state of the inputs via LEDs

5.7.8.2 Features and Functions

Acquisition Functions

- **Currents**
  - Settable acquisition grid n*100 ms ^{f}
  - Measurement range settable with a resolution of ^{f}
    - 12 bit + sign at ±20 mA
  - Revision ^{t}
  - Noise rejection ^{f}
  - Automatic calibration ^{f}
  - Smoothing ^{t}
  - Adaptation ^{f}
    - Linear (normalized, technologically scaled or short floating point)
    - Zero-Range Suppression
    - Plausibility check
  - Change monitoring ^{t}
  - Spontaneous transmission upon change ^{f}
- **Currents and voltages**
  - Acquisition via the analog inputs of a SM-0570
  - Settable acquisition grid n*100 ms ^{f}
  - Measurement range settable with a resolution of ^{f}
    - 12 bit + sign at ±20 mA
    - 12 bit + sign at ±10 V
    - Shrinking the range results in decreasing resolution
  - Revision ^{t}
  - Noise rejection ^{f}
  - Automatic calibration ^{f}
  - Smoothing ^{t}
  - Adaptation ^{f}
    - Linear (normalized, technologically scaled or short floating point)
    - Zero-Range Suppression
    - Plausibility check
  - Change monitoring ^{t}
  - Spontaneous transmission upon change ^{f}

- **Temperatures** [f1]
  - — 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
      (a) Pt100: -50…+350°C / -58…+662°F / (≈80,31…229,67 Ω)
      (b) Pt100: -100…+700°C / -148…+1292°F / (≈60,25…345,13 Ω)
      (c) Ni100: -60…+250°C / -76…+482°F / (≈74,18…295,52 Ω)
    - − When transferring resistance values
      (a) Pt100:   0…230 Ω
      (b) Pt100:   0…346 Ω
      (c) Ni100:   0…346 Ω
  - — Resolution
    - − When transferring temperatures
      (a) Pt100: 0,20°C / 0,36°F / (90 mΩ)
      (b) Pt100: 0,35°C / 0,63°F / (130 mΩ)
      (c) 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
  - — Adaption
    - − Temperature value (°C, °F)
      calculation by means of implemented characteristics
    - − Resistance value (Ω)
  - — Change Monitoring
  - — spontaneous transmission of changes
- **Integrated totals via count pulses** [f1]
  - — 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 request
    - − Interval control
    - − Frozen absolute value
    - − Frozen relative value
  - — Integrated total transmission according to IEC 608705101/104
  - — Spontaneous transmission

Output Functions

- **setpoint values by means of currents and voltages**
  - — Output via the analog outputs of a SM-0572 [fa]
  - — Output range settable with a resolution [fa]
    - − 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 [fa]
    - − Formal Check
    - − Direct Command
    - − Select and Execute command
  - — Adaptation [f]
    - − Linear (normalized, technologically scaled or short floating point) [f]
  - — Selectable behavior upon communication failure and module failure [fa] (keep value, output substitute value)
  - — Spontaneous transmission [f] or
  - — Periodical transmission [a]

Note

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

5.7.8.3 Technical Specifications

Processor and Memory	
Processor	Xilinx Spartan 6 (XC6SLX45) with Soft-IPcore
Clock frequency	16 MHz

Program memory	SPI-Flash 16 MBytes
	  HW config 64 kBytes
	  Program memory 192 kBytes
	  FPGA factory image 1,572864 MBytes
	  FPGA user image 1,572864 MBytes

Main memory	RAM 512 kBytes
	  Program memory in operation 192 kBytes
	  Main memory in operation 64 kBytes

Parameter memory	EEPROM 2048 Bytes (AT24C16A)
Analogue inputs of AI-230x	
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 Bit + sign)
Sampling rate	Every 5 ms, free running
Accuracy	0/4…20 mA • 0,05%　　　　　　25°C • 0,1%　　　　　　　15…35°C　　　　　class 0.1 • 0,15%　　　　　　0…50°C -20…+20 mA • 0,25%　　　　　　25°C • 0,30%　　　　　　15…35°C　　　　　class 0.3 • 0,40%　　　　　　0…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	4,75…5,25 VDC, typ. 2,5 W Voltage is picked off at the bus of board rack
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
Dimensions	Double euro format 233.4 x 160 mm, 4 WU
Weight	Approx. 270 g

5.7.9   AI-2302/PASI25

The peripheral element AI-2302/PASI25 is used for the acquisition of analog values and counting pulses, as well as for the output of analog values. It consists of a module and loadable firmware.

Type	Designation	Remarks
AI-2302	Analog input 16x ±6 mA + 4x optional IOM	Module in double euro format, for equipping in a 19" board rack, with slots for up to 4 optional input/output modules
PASI25	Preprocessing and analog signal input	Loadable firmware

Slots for optional input/output modules
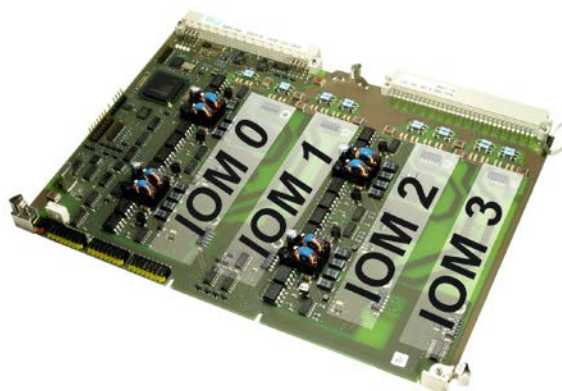
5.7.9.1 Overview

- 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 ±6 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, ±10 VDC) via SM-0572
  — Pulse inputs (24…60 VDC) via SM-0574
- Indication of function and state of the inputs via LEDs

5.7.9.2 Features and Functions

Acquisition Functions

- **Currents**
  — Settable acquisition grid n*100 ms [f]
  — Measurement range settable with a resolution of [f]
    − 12 bit + sign at ±6 mA
  — Revision [t]
  — Noise rejection [f]
  — Automatic calibration [f]
  — Smoothing [t]
  — Adaptation [f]
    − Linear (normalized, technologically scaled or short floating point)
    − Zero-Range Suppression
    − Plausibility check
  — Change monitoring [t]
  — Spontaneous transmission upon change [f]

- **Currents and voltages**
  — Acquisition via the analog inputs of a SM-0570
  — Settable acquisition grid n*100 ms [f]
  — Measurement range settable with a resolution of [f]
    − 12 bit + sign at ±20 mA
    − 12 bit + sign at ±10 V
    − Shrinking the range results in decreasing resolution
  — Revision [t]
  — Noise rejection [f]
  — Automatic calibration [f]
  — Smoothing [t]
  — Adaptation [f]
    − Linear (normalized, technologically scaled or short floating point)
    − Zero-Range Suppression
    − Plausibility check
  — Change monitoring [t]
  — Spontaneous transmission upon change [f]

- **Temperatures** *f1*
  — 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
      (a) Pt100: -50…+350°C / -58…+662°F / (≈80,31…229,67 Ω)
      (b) Pt100: -100…+700°C / -148…+1292°F / (≈60,25…345,13 Ω)
      (c) Ni100: -60…+250°C / -76…+482°F / (≈74,18…295,52 Ω)
    - When transferring resistance values
      (a) Pt100: 0…230 Ω
      (b) Pt100: 0…346 Ω
      (c) Ni100: 0…346 Ω
  — Resolution
    - When transferring temperatures
      (a) Pt100: 0,20°C / 0,36°F / (90 mΩ)
      (b) Pt100: 0,35°C / 0,63°F / (130 mΩ)
      (c) 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
  — Adaption
    - Temperature value (°C, °F)   f implementation by characteristics
    - Resistance value (Ω)
  — Change Monitoring
  — spontaneous transmission of changes
- **Integrated totals via count pulses** *f1*
  — 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 request
    - Interval control
    - Frozen absolute value
    - Frozen relative value
  — Integrated total transmission according to IEC 608705101/104
  — Spontaneous transmission

Output Functions

- **setpoint values by means of currents and voltages**
  - Output via the analog outputs of a SM-0572 [fa]
  - Output range settable with a resolution [fa]
    - 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 [fa]
    - Formal Check
    - Direct Command
    - Select and Execute command
  - Adaptation [f]
    - Linear (normalized, technologically scaled or short floating point) [f]
  - Selectable behavior upon communication failure and module failure [fa] (keep value, output substitute value)
  - Spontaneous transmission [f] or
  - Periodical transmission [a]

Note

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

5.7.9.3 Technical Specifications

Processor and Memory	
Processor	Xilinx Spartan 6 (XC6SLX45) with Soft-IPcore
Clock frequency	16 MHz

Program memory	SPI-Flash 16 MBytes
	  HW config 64 kBytes
	  Program memory 192 kBytes
	  FPGA factory image 1,572864 MBytes
	  FPGA user image 1,572864 MBytes

Main memory	RAM 512 kBytes
	  Program memory in operation 192 kBytes
	  Main memory in operation 64 kBytes

Parameter memory	EEPROM 2048 Bytes (AT24C16A)
Analogue inputs of AI-230x	
16 current inputs	• Max. ±6 mA at 408,3 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 Bit + sign)
Sampling rate	Every 5 ms, free running
Accuracy	0/4…20 mA • 0,05% 25°C • 0,1% 15…35°C class 0.1 • 0,15% 0…50°C -20…+20 mA • 0,25% 25°C • 0,30% 15…35°C class 0.3 • 0,40% 0…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	4,75…5,25 VDC, typ. 2,5 W Voltage is picked off at the bus of board rack
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
Dimensions	Double euro format 233.4 x 160 mm, 4 WU
Weight	Approx. 270 g

5.7.10 AI-2303/PASI25

The peripheral element AI-2303/PASI25 is used for the acquisition of analog values and counting pulses, as well as for the output of analog values. It consists of a module and loadable firmware.

Type	Designation	Remarks
AI-2303	Analog input 16x ±24 mA + 4x optional IOM	Module in double euro format, for equipping in a 19" board rack, with slots for up to 4 optional input/output modules
PASI25	Preprocessing and analog signal input	Loadable firmware

Slots for optional input/output modules

5.7.10.1 Overview

- 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 ±24 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, ±10 VDC) via SM-0572
  - Pulse inputs (24…60 VDC) via SM-0574
- Indication of function and state of the inputs via LEDs

5.7.10.2 Features and Functions

Acquisition Functions

- **Currents**
  - Settable acquisition grid n*100 ms ^{f}
  - Measurement range settable with a resolution of ^{f}
    - 12 bit + sign at ±24 mA
  - Revision ^{t}
  - Noise rejection ^{f}
  - Automatic calibration ^{f}
  - Smoothing ^{t}
  - Adaptation ^{f}
    - Linear (normalized, technologically scaled or short floating point)
    - Zero-Range Suppression
    - Plausibility check
  - Change monitoring ^{t}
  - Spontaneous transmission upon change ^{f}
- **Currents and voltages**
  - Acquisition via the analog inputs of a SM-0570
  - Settable acquisition grid n*100 ms ^{f}
  - Measurement range settable with a resolution of ^{f}
    - 12 bit + sign at ±20 mA
    - 12 bit + sign at ±10 V
    - Shrinking the range results in decreasing resolution
  - Revision ^{t}
  - Noise rejection ^{f}
  - Automatic calibration ^{f}
  - Smoothing ^{t}
  - Adaptation ^{f}
    - Linear (normalized, technologically scaled or short floating point)
    - Zero-Range Suppression
    - Plausibility check
  - Change monitoring ^{t}
  - Spontaneous transmission upon change ^{f}

- **Temperatures** *f1*
  — 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
       (a) Pt100: -50…+350°C / -58…+662°F / (≈80,31…229,67 Ω)
       (b) Pt100: -100…+700°C / -148…+1292°F / (≈60,25…345,13 Ω)
       (c) Ni100: -60…+250°C / -76…+482°F / (≈74,18…295,52 Ω)
    – When transferring resistance values
       (a) Pt100: 0…230 Ω
       (b) Pt100: 0…346 Ω
       (c) Ni100: 0…346 Ω
  — Resolution
    – When transferring temperatures
       (a) Pt100: 0,20°C / 0,36°F / (90 mΩ)
       (b) Pt100: 0,35°C / 0,63°F / (130 mΩ)
       (c) 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
  — Adaption
    – Temperature value (°C, °F)   tralization by means of implemented characteristics
    – Resistance value (Ω)
  — Change Monitoring
  — spontaneous transmission of changes

- **Integrated totals via count pulses** *f1*
  — 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 request
    – Interval control
    – Frozen absolute value
    – Frozen relative value
  — Integrated total transmission according to IEC 608705101/104
  — Spontaneous transmission

Output Functions

- **Setpoint values by means of currents and voltages**
  - Output via the analog outputs of a SM-0572 [fa]
  - Output range settable with a resolution [fa]
    - 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 [fa]
    - Formal Check
    - Direct Command
    - Select and Execute command
  - Adaptation [f]
    - Linear (normalized, technologically scaled or short floating point) [f]
  - Selectable behavior upon communication failure and module failure [fa] (keep value, output substitute value)
  - Spontaneous transmission [f] or
  - Periodical transmission [a]

Note

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

5.7.10.3 Technical Specifications

Processor and Memory	
Processor	Xilinx Spartan 6 (XC6SLX45) with Soft-IPcore
Clock frequency	16 MHz
Program memory	SPI-Flash 16 MBytes HW config 64 kBytes Program memory 192 kBytes FPGA factory image 1,572864 MBytes FPGA user image 1,572864 MBytes
Main memory	RAM 512 kBytes Program memory in operation 192 kBytes Main memory in operation 64 kBytes
Parameter memory	EEPROM 2048 Bytes (AT24C16A)
Analogue inputs of AI-230x	
16 current inputs	• Max. ±24 mA at 102,1 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 Bit + sign)
Sampling rate	Every 5 ms, free running
Accuracy	0/4…20 mA • 0,05% 25°C • 0,1% 15…35°C class 0.1 • 0,15% 0…50°C -20…+20 mA • 0,25% 25°C • 0,30% 15…35°C class 0.3 • 0,40% 0…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	4,75…5,25 VDC, typ. 2,5 W Voltage is picked off at the bus of board rack
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
Dimensions	Double euro format 233.4 x 160 mm, 4 WU
Weight	Approx. 270 g

5.7.11 Submodules

5.7.12 SM-0570

The submodule SM-0570 (analog value module) is used for modular expansion of peripheral modules:

- AI-2300
- AI-2302
- AI-2303

5.7.12.1 Overview

The submodule SM-0570 provides
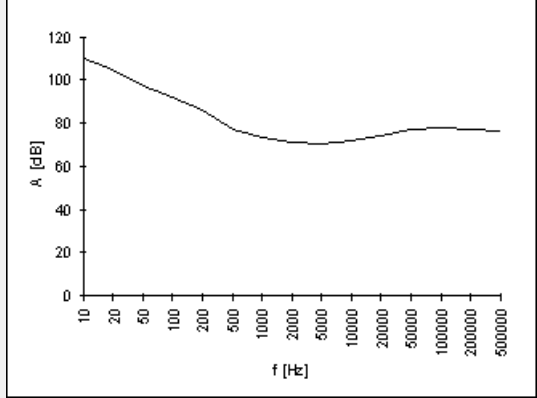
- 2 analog inputs
  — Measuring range -20 mA…+20 mA.
  — Other measuring ranges (e.g. ±5 mA, ±10 mA; ±1 V, ±10 V) are possible when changing load resistors and providing external circuitry

The function of this submodule is determined by the firmware of the basic module.

5.7.12.2 Mechanics

5.7.12.3 Technical Specifications

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…35°C class 0.1 • 0,15% 0…50°C • Long-term stability 0.1% for 5 years - 20 mA to + 20 mA • 0,25% 25°C • 0,3% 15…35°C class 0.3 • 0,4% 0…50°C
CMRR	Min. -70 dB
Noise Rejection	$16^2/_3$ Hz, 50 Hz, 60 Hz: -60 dB
Power Supply	
Operating voltage	5 VDC ±5%, typ. 0.6 W
Input circuits	Circuits are operated by means of an external voltage
Mechanics	
Dimensions	120 x 35 mm
Weight	Approx. 30 g

5.7.13   SM-0571

The submodule SM-0571 (analog value module) is used for modular expansion of peripheral modules:

- AI-2300
- AI-2302
- AI-2303

5.7.13.1 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.

5.7.13.2 Mechanics

5.7.13.3 Technical Specifications

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)	Max. 40 Ω for 2-, 3- and 4-wire-connection technology
Power Supply	
Operating voltage	5 V ±5%, typ. 0,9 W
Input circuits	The circuits are operated by internal voltage
Mechanics	
Dimensions	120 x 35 mm
Weight	Approx. 35 g

5.7.14 SM-0572

The submodule SM-0572 (analog value module) is used for modular expansion of peripheral modules:

- AI-2300
- AI-2302
- AI-2303

5.7.14.1 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…+20 mA
    -10 mA…+10 mA
    -5 mA…+5 mA
  - Selectable voltage output range
    -1 V…+1 V
    -10 V…+10 V

The function of this submodule is determined by the firmware of the basic module.

5.7.14.2 Mechanics

5.7.14.3 Technical Specifications

Memory	
Parameter memory	EEPROM 96 Byte

Output Circuits	
Current outputs	• max. ±20 mA to max. of 500 Ω load • max. ±10 mA to max. of 500 Ω load • max. ±5 mA to max. of 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
Voltage outputs	• ±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

Resolution
  Current outputs
 	
  Voltage outputs
	• 15 bit + sign at ±20 mA
	• 14 bit + sign at ±10 mA
	• 13 bit + sign at ±5 mA
	• 13 bit + sign at ±10 V
	• 11 bit + sign at ±1 V

Setting time	10 ms

Accuracy
 	
  fan operating
    Current outputs
 	
    Voltage outputs
 	
  without fan
    Current outputs
 	
    Voltage outputs
	Valid as soon as an ambient temperature lasts for at least 10 minutes
	
	　　　　　　±20 mA　±10 mA　±5 mA
	+25°C　　　0,05%　　0,05%　　0.05%
	 0…+50°C　　0,2%　　0,4%　　0.8%
	-25…+70°C　0,35%　　0,7%　　1.4%
	
	　　　　　　±10 V　±1 V
	+25°C　　　0,05%　0,5% *)
	 0…+50°C　　0,4%　　4% *)
	-25…+70°C　0,75%　7,5% *)
	
	　　　　　　±20 mA　±10 mA　±5 mA
	+25°C　　　0,1%　　0,15%　　0.25%
	 0…+50°C　　0,25%　　0,5%　　1.0%
	-25…+70°C　0,4%　　0,6%　　1.6%
	
	　　　　　　±10 V　±1 V
	+25°C　　　0,2%　　2% *)
	 0…+50°C　　0,55%　5,5% *)
	-25…+70°C　0,9%　　9% *)

Internal resistance with voltage output	max. 0,6 Ω

Power Supply	
Operating voltage	5 VDC ±5%, type 1,5 W
Output Circuits	Circuits are operated by means of an external voltage

Mechanics	
Dimensions	120 x 35 mm
Weight	Approx. 26 g

*)　if needed, accuracy is possible as for the ±10 V range

5.7.15 SM-0574

The submodule SM-0574 (count module) is used for modular extension of peripheral modules:

- AI-2300
- AI-2302
- AI-2303

5.7.15.1 Overview

The submodule SM-0574 provides

- 2 pulse inputs
  - Nominal voltage 24…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 $\leq$ 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 carrier module.

5.7.15.2 Mechanics

5.7.15.3 Technical Specifications

Memory	
Parameter and counter memory	FRAM 512 Byte

Input circuits and counters	

2 pulse inputs	• Nominal voltage 24…60 VDC (range 18…78 VDC)
	• Maximum pulse frequency 5 kHz
	• Level for logical "0" $\leq$ 12 VDC
	  Level for logical "1" $\geq$ 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

Bounce suppression with counter frequency stage: 5 kHz
                          500 Hz
                          50 Hz
                          20 Hz
	Pulse length pulse discontinuation
	>10 µs >100 µs
	>150 µs >1 ms
	>1.5 ms >10 ms
	>3 ms >25 ms

Backup devices	4 pieces 1F electric double layer capacitors (Gold Caps) Backup devices can be changed

Calculated life time
 	
(time after that 72 hours buffering is still ensured)
	• 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 min. power consumption
	• Disturbance event means failure of the carrier module and autonomous buffered operation of the submodule

Life time	T_D Case A [1] Case B [2] Case C [3] 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 $\leq$ 50 Hz)

Power Supply	
Operating voltage	5 VDC ±5%
Input circuits	Circuits are operated by means of an external voltage

Mechanics	
Dimensions	120 x 35 mm
Weight	Approx. 35 g

[1]   during the disturbance event, a voltage ≥18V (level for logical 1) is fed to both inputs (= worst case power consumption)

[2]   during the disturbance event, a 50 Hz pulse signal is fed to both inputs; bounce suppression is set to 50 Hz

[3]   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

5.7.16   SM-2506

You find information on this submodule in the specification of the carrier module (DO-2210).

5.7.17   SM-2507

You find information on this submodule in the specification of the carrier module (DO-2211).

6 Migration

Contents

This chapter shows options how to migrate older products into SICAM AK 3.

6.1 SICAM AK

6.1.1 Migration Board Rack CM-2847

6.1.1.1 Overview

The migration board rack CM-2847 was developed for migration of the SICAM AK basic system element CP-2017 in the SICAM AK 3 system.

This migration offers the possibility to use the 4 serial interface of the CP-2017 in SICAM AK 3.

Apart from that, there is no difference between the migration board rack CM-2847 and the board rack CM-2846.
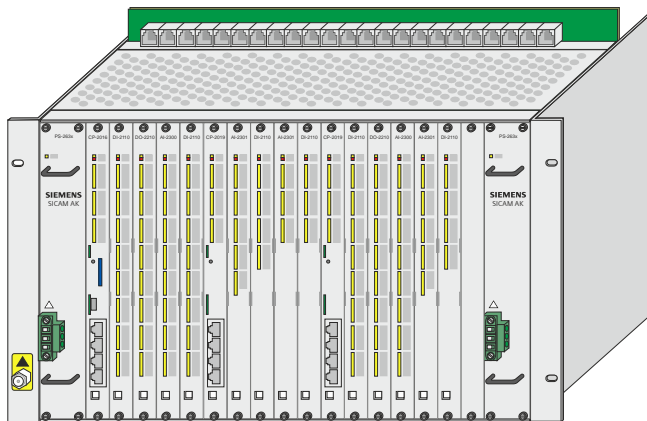
The board rack (84 TE, 9 HE) can be equipped as follows (these parts are not included in the scope of supply)

- 17 double-europe format modules
- 1 master control element (CP-2016)
- Up to 16 (arbitrarily mixable)
  - Processing and communication elements (CP-2017 or CP-2019)
  - Peripheral elements
- 1 to 2 power supply modules PS-263x

The board rack is designed for 19" (swing) frame installation.

6.1.1.2   Features and Functions

- Connectors, integrated in the backplane, for
  - 17x Ax 1703 peripheral bus (external)
  - 6x redundancy link (external)
- 6 slot-pairs prepared for redundant basic system elements (redundancy link integrated in the backplane)
- Slots for master control element and power supplies prepared for monitoring of the power supplies by the master control element
- Peripheral elements, installed in the CM-2847, are connected to the internal Ax 1703 peripheral bus, which is driven by <u>exactly one</u>, perhaps redundant, basic system element
- External peripheral elements are connected to the external Ax 1703 peripheral bus (M-Ax resp. Cx-Ax)
- To each basic system element 16 peripheral elements can be connected, hence totally up to 272
- Wiring peripherals using prefabricated peripheral cables CM-2890
- 2 slots for power supply modules PS-263x
  - for redundancy
- ESD Earth Facility for connecting a ground strap when changing modules
- Unlocking tool for modules included

6.1.1.3   Power Supply

The board rack CM-2847 can be equipped with one or two power supplies:

1 power supply module equipped
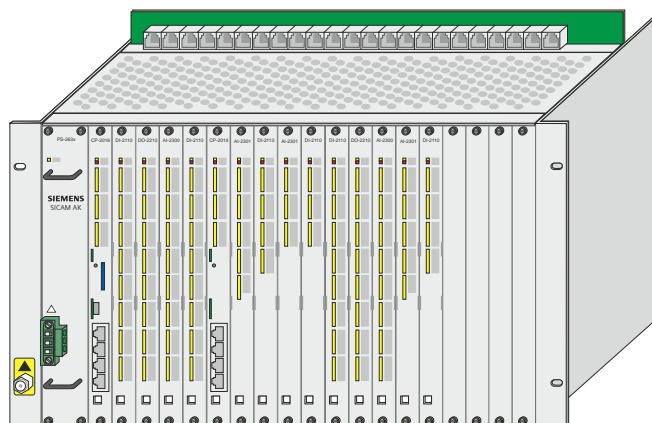
2 power supply modules equipped

6.1.1.4 Technical Specifications

Backplane and Connectors	
Slot for master control element	Slot 0
5 slot-pairs (wired for redundant basic system elements)	• Slot 1+2 • Slot 4+5 • Slot 7+8 • Slot 10+11 • Slot 13+14
Slots for PS-263x	• 1. Power supply module right • 2. Power supply module left
6 connectors for redundancy link external (M-HSL, C1-HSL)	RJ45 8-pin according to IEC 60603-7
17 connectors for Ax 1703 peripheral bus external (M-Ax resp. Cx-Ax)	RJ45 8-pin according to IEC 60603-7
USB connector for SICAM TOOLBOX II	USB TypMini-B
Voltage output +5 VDC	
	Voltage is taken from the power supply module, and provided current-limited using a PTC
Output nominal voltage [*]	1 A
PTC voltage drop [*]	≤ 100 mV at 1 A and +70°C
Proof against continued short-circuit [*]	yes
Supply of the board rack	
Operating voltage	5,1 V; supplied by the installed power supply module PS-263x
Mechanical Design	
Design	Compact metal housing for • 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 mm^2 cross-section
Dimensions	Height 291 mm (9 HU) Width 483 mm (19") Depth 258 mm (power supply not installed) 285 mm (power supply installed)
Weight	Approx. 4.8 kg

[*]   applies additionally to the specification of the power supply

6.1.2 Basic System Element CP-2017/PCCX25

The basic system element CP-2017/PCCX25 is the processing and communication element of the product SICAM AK. It can be expanded with up to 4 serial interface by equipping serial interface modules and the appropriate connection board.

To use this function also in SICAM AK 3, the migration board rack CM-2847 was designed. This board rack enables the installation of the connection board CM-2838, which is required by the basic system element CP-2017/PCCX25.
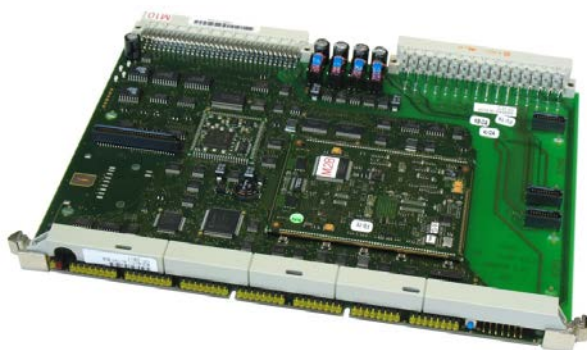
6.1.2.1 Overview

- 1 microprocessor for processing and communication functions
- Can be equipped in board rack CM-2834, CM-2836 and CM-2847
- Slots for up to 2 optional serial interface modules
  - Up to 4 protocol elements for communication
  - Arbitrary combinable
- Connection of up to 16 peripheral elements via the own serial Ax peripheral bus
- Data transport from and to the protocol elements
- Data transport from and to the peripheral elements
- Optional safety functions

Note

Details about features and functions, technical data and assembly can be taken from the following documents:

Document name	Item Number
SICAM AK System Description	MC2-021-2
SICAM AK User Manual	DC2-017-2

6.1.2.2 Front Panel

When using this SICAM AK board in a SICAM AK 3 board rack an own front panel is required. You can find the belonging item number/MLFB number in chapter Order Information, section Migration.

6.1.3 Peripheral Board MX-2400/USIO2x

The peripheral elements MX-2400/USIO2x are used for acquisition of binary values and analog values, as well as for the output of binary values and analog values. They consist of a module and loadable firmware.

6.1.3.1 Overview

- Acquisition and processing according to IEC 608705101/104
    — Single-point and double-point information items
    — Integrated totals
    — Currents and voltages
    — Temperatures via SM-0571
- Processing and output according to IEC 60870-5-101/104
    — Pulse commands (single, double and regulating step commands)
    — Binary information
    — Setpoint commands via currents and voltages via SM-0572
- 32 binary inputs (4 groups)
- 1 additional binary input for power monitoring for each group
- 2 analog inputs
- 16 binary inputs (2 groups)
    — 2 group outputs
    — 1 pulse output
- 2 binary information outputs
- Optionally expandable with an I/O module (galvanically insulated from the logic), alternatively
    — 2 analog inputs (±20 mA) via SM-0570
    — 2 analog inputs (Pt100; Ni100) via SM-0571
    — 2 analog outputs (±20 mA) via SM-0572
    — 2 pulse inputs (24…60 VDC) via SM-0574
- Indication of function and state of the inputs via LEDs

Note

Details about features and functions, technical data and assembly can be taken from the following documents:

Document name	Item Number
SICAM AK System Description	MC2-021-2
SICAM AK User Manual	DC2-017-2

6.1.3.2 Front Panel

When using this SICAM AK board in a SICAM AK 3 board rack an own front panel is required. You find the belonging item number/MLFB in appendix Order Information, section Migration.

6.1.4 Peripheral Element DI-2100/BISI25

The peripheral element DI-2100/BISI25 is used for the acquisition of binary inputs. It consists of a module and loadable firmware.
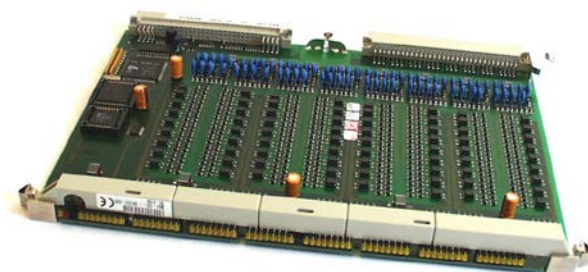
6.1.4.1 Overview

- Acquisition and processing according to IEC 608705101/104
    - 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
- Galvanically insulated by optocouplers
- Common return for each group
- Signal voltage 24...60 VDC
- Filter-equipped input circuit
- Integrated totals not power-fail safe
- Indication of function and state of the inputs via LEDs

Note
Details about features and functions, technical data and assembly can be taken from the following documents:

Document name	Item Number
SICAM AK System Description	MC2-021-2.05
SICAM AK User Manual	DC2-017-2

6.1.4.2 Front Panel

When using this SICAM AK board in a SICAM AK 3 board rack an own front panel is required. You can find the belonging item number/MLFB number in chapterOrder Information, section Migration.

6.1.5 Peripheral Elements DI-2110/BISI26 and DI-2111/BISI26

The peripheral elements DI-2110/BISI26 and DI-2111/BISI26 are used for the acquisition of binary inputs. They consist of a module and loadable firmware.

6.1.5.1 Overview

- 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
- Galvanically insulated by optocouplers
- Common return for each group
- Signal voltage
  - DI-2110: 24…60 VDC
  - DI-2111: 110/220 VDC
- Parameter-settable polarity and thresholds for each group
- Filter-equipped input circuit
- Indication of function and state of the inputs via LEDs

Note

Details about features and functions, technical data and assembly can be taken from the following documents:

Document name	Item Number
SICAM AK System Description	MC2-021-2.05
SICAM AK User Manual	DC2-017-2

6.1.5.2 Front Panel

When using this SICAM AK board in a SICAM AK 3 board rack an own front panel is required. You can find the belonging item number/MLFB number in chapterOrder Information, section Migration.

6.1.6 Expansion Board Rack CM-2833

The expansion board rack CM-2833 is a SICAM AK product, but it can also be used in combination with the system SICAM AK 3.

It provides 16 slots for boards in the double Europe format.

6.1.6.1 Overview

The expansion board rack (84 TE, 9 HE) can be equipped as follows (these parts are not included in the scope of supply)

- up to 16 peripheral elements
- 1 to 2 power supply modules PS-562x

The expansion board rack is designed for 19" (swing) frame installation.

6.2   AK 1703 Ax

6.2.1   Expansion Board Rack CM-2815

The expansion board rack CM-2815 is an AK 1703 Ax product, but it can also be used in combination with the system SICAM AK 3.
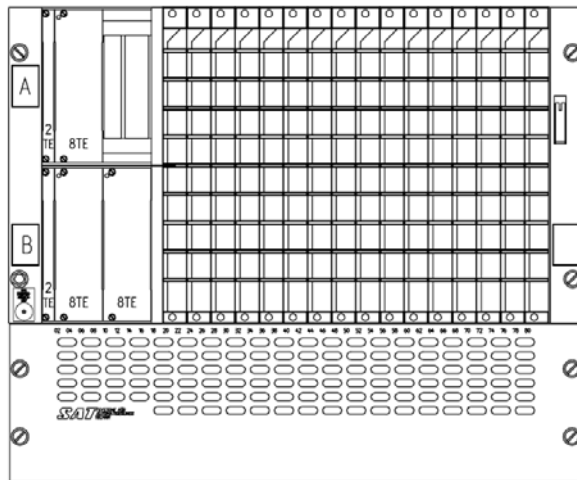
Note

Only peripheral boards whose firmware conforms to IEC 60870-5-101/104 may be used.

6.2.1.1   Overview

AK 1703 expansion board rack (19" double Europe format with 9 height units) with space for:

- 16 AK 1703 peripheral elements
- 18 width units for single Europe format boards with 160 mm depth

6.2.2 Migration of the AK 1703 Ax Connection Boards into SICAM AK 3

When migrating AK 1703 Ax to SICAM AK 3 it is possible to reuse the existing AK 1703 Ax peripheral cabling.

Only the connection board for the peripheral signals (CM-2851 or CM-2852) and the SICAM AK 3 board rack require a minor modification.

- Remove the black seating frame (it is not used for AK 1703 Ax peripheral cabling)
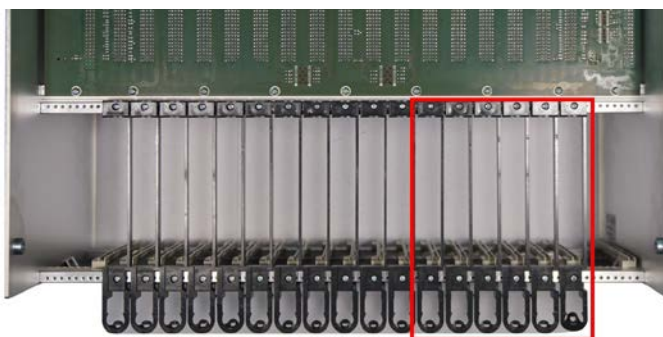
- Break off the guiding pins (these are parts of the board) from the connection board
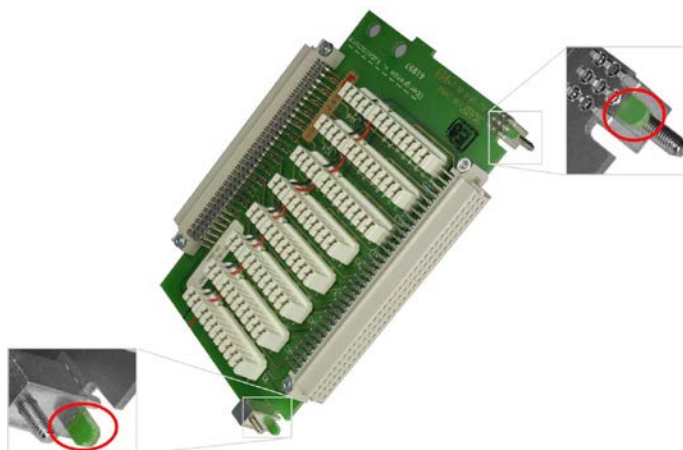
- Peripheral elements and connection boards can be mounted now.
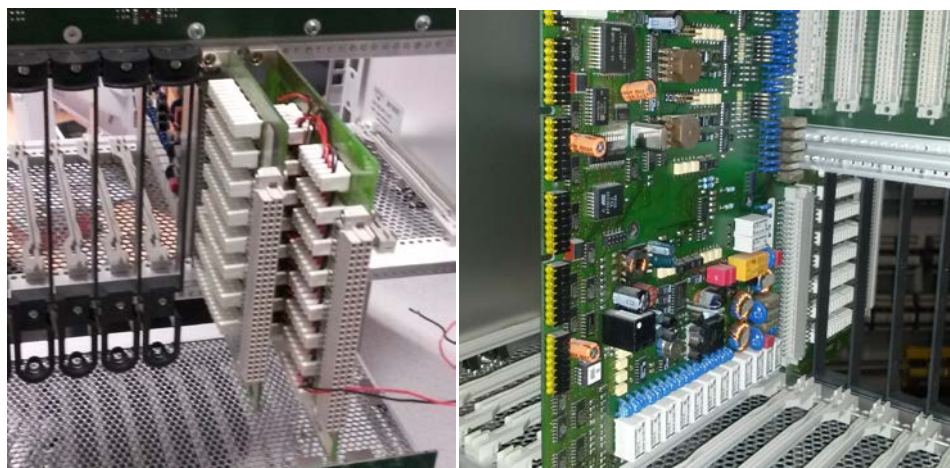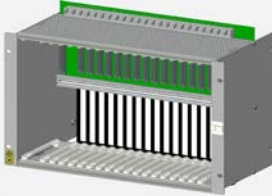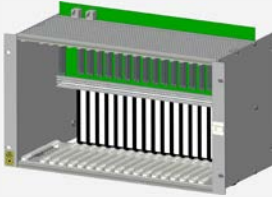
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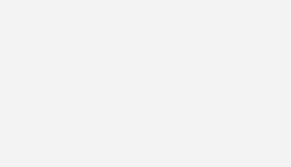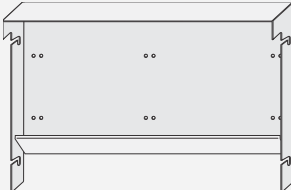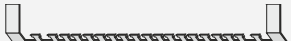
Contents

A.1 Board Racks

	Designation	Item-Number/MLFB
	CM-2844 SICAM AK 3 Board Rack with 9 slots (basic board rack including wall bracket)	GC2-844 6MF11130CJ440AA0
	CM-2846 SICAM AK 3 Board Rack with 17 slots (basic board rack without wall fastening kit)	GC2-846 6MF11130CJ460AA0
	CM-2843 SICAM AK 3 Expansion Board Rack with 16 slots (expansion board rack without wall fastening kit)	GC2-843 6MF11130CJ430AA0
	CM-2848 SICAM AK 3 Redundancy-Board Rack with 17 slots (basic board rack without wall fastening kit)	GC2-848 6MF11130CJ480AA0

A.1.1 Board Rack Installation

	Designation	Item-Number/MLFB
	Wall fastening kit CM-2846/43 AK 3 for rear panel installation contains: - Rear coverCM-2846 - Cable strain reliefCM-2846 - Screw M6 x 12	TC2-702 6MF13130CH020AA0
	Rear cover CM-2846 (part of the wall fastening kit)	TC2-011
	Cable strain relief CM-2846 (part of the wall fastening kit)	TC2-089

	Designation	Item-Number/MLFB
	Rear cover CM-2844 (supplied with board rack CM-2844)	TC2-087
	Cable strain relief CM-2844 (supplied with board rack CM-2844)	TC2-088
	Front panel blank AK 3	TC2-086 6MF13130CA860AA0
	FRBL 19"-2HE Front panel RAL7035 for 19" (swing) frame installation	TF3-161 6MF13140DB610AA1
	Cable entry panel for 19" (swing) frame installation	Rittal DK 7140.535
	Cable clamp rail for 19" (swing) frame installation	Rittal DK 7610.000
	FRBL19"-3HU Front Panel RAL7035 for 19" (swing) frame installation	TF3-162 6MF13140DB620AA0
	EMC earthing strap 140/10/4,5-6,5 [*]	TF3-033 6MF13140DA330AA1
	EMC earthing strap 300/16/6,5-8,5 [*]	TF3-031 6MF13140DA310AA1

[*] depending on the type of 19" frame used for the installation of the board rack, either 2 short or 2 long EMC earthing straps are required, they are not part of the board racks and must be ordered separately
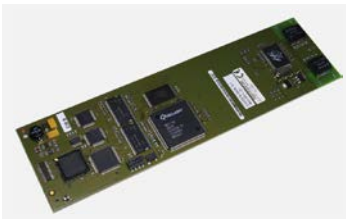
A.2   Power Supply

	Designation	Item-Number/MLFB
	PS-2630 Power supply 24-60 VDC AK 3	GC2-630 6MF11130CG300AA0
	PS-2632 Power supply 110-220 VDC, 230 VAC AK 3	GC2-632 6MF11130CG320AA0

A.3   Basic Modules

	Designation	Item-Number/MLFB
	CP-2016 Central module AK 3	BC2-016 6MF10130CA160AA0
	Front panel CP-2016 AK 3	TC2-070 6MF13130CA700AA0
	CP-2019 Communication/Processing AK 3	BC2-019 6MF10132CA100AA0
	Front panel CP-2019 AK 3	TC2-071 6MF13130CA710AA0
	Front panel CP-2019 FS AK 3	TC2-083 6MF13130CA830AA0

A.4 Serial Interface Modules

	Designation	Item-Number/MLFB
	SM-2551 Serial interface processor 2 interfaces	BC2-551 6MF10130CF510AA0
	SM-2557 Network interface Ethernet 2x 100TX	BC2-557 6MF10130CF570AA0
	SM-2558 Ethernet-Interf. 1x100TX, +1 serial interface optional	BC2-558 6MF10130CF580AA0
	SM-0551 Serial interface processor 1 interface for SM-2558	BC0-551 6MF10130AF510A00

A.5   Peripheral Modules
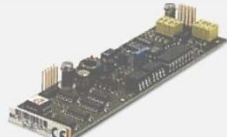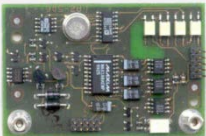
	Designation	Item-Number/MLFB
	DI-2112 Binary signal input 8x8, 24 VDC, 1 ms	BC2-112 6MF10130CB120AA0
	Front panel DI-2112 AK 3	TC2-072 6MF13130CA720AA0
	DI-2113 Binary signal input 8x8, 48/60 VDC, 1 ms	BC2-113 6MF10130CB130AA0
	Front panel DI-2113 AK 3	TC2-073 6MF13130CA730AA0
	DI-2114 Binary signal input 8x8, 110 VDC, 1 ms	BC2-114 6MF10130CB140AA0
	Front panel DI-2114 AK 3	TC2-074 6MF13130CA740AA0
	DI-2115 Binary signal input 8x8, 220 VDC, 1 ms	BC2-115 6MF10130CB150AA0
	Front panel DI-2115 AK 3	TC2-075 6MF13130CA750AA0
	DO-2201 Binary signal output (transistor) 40x1, 24…60 VDC	BA2-201 6MF10110CC010AA0
	Front panel DO-2201 AK 3	TC2-076 6MF13130CA760AA0

	Designation	Item-Number/MLFB
	DO-2210 Checked command output 24…60 VDC	BA2-210 6MF10110CC100AA0
	Front panel DO-2210 AK 3	TC2-077 6MF13130CA770AA0
	DO-2211 Checked command output 125 VDC	BA2-211 6MF10110CC110AA0
	Front panel DO-2211 AK 3	TC2-078 6MF13130CA780AA0
	AI-2300 Analog input/output 16x ±20 mA + 4x2 optional I/O module	BA2-300 6MF10110CD000AA0
	Front panel AI-2300 AK 3	TC2-079 6MF13130CA790AA0
	AI-2302 Analog input/output 16x ±6 mA + 4x2 optional I/O module	BA2-302 6MF10110CD020AA0
	Front panel AI-2302 AK 3	TC2-081 6MF13130CA810AA0
	AI-2303 Analog input/output 16x ±24 mA + 4x2 optional I/O module	BA2-303 6MF10110CD030AA0
	Front panel AI-2303 AK 3	TC2-082 6MF13130CA820AA0

A.5.1   Accessories for DI-2114, DI-2115 and DO-2211
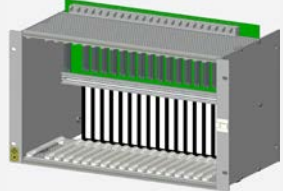
	Designation	Item-Number/MLFB
	Insulation plate double-euro	T12-001 6MF13010CA010AA0
	Insulation plate holder SICAM AK 3 (4 pcs.)	TC2-099 6MF13133CA000AA0

A.5.2   Submodules

	Designation	Item-Number/MLFB
	SM-0570 Analog input extension (2x ±20 mA)	BA0-570 6MF10110AF700AA0
	SM-0571 Analog input extension (2x Pt100)	BA0-571 6MF10110AF710AA0
	SM-0572 Analog output extension (2x ±20 mA/±1V/±10 V)	BA0-572 6MF10110AF720AA0
	SM-0574 Counting pulse input extension (2x 24…60 VDC)	BA0-574 6MF10110AF740AA0
	SM-2506 Measuring module for command output (DO-2210)	BA2-506 6MF10110CF060AA0
	SM-2507 Measuring module for command output (DO-2211)	BA2-507 6MF10110CF070AA0

A.6 Migration

A.6.1 CM-2847 Migration Board Rack AK 3
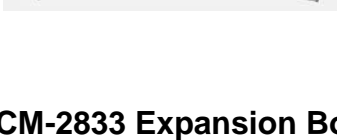
	Designation	Item-Number/MLFB
	CM-2847 Migration Board Rack 17 Slots AK 3 (Basic board rack <u>without</u> wall fastening kit and <u>without</u> cable strain relief)	GC2-847 6MF11130CJ470AA0

A.6.2 SICAM AK Basic Module CP-2017

	Designation	Item-Number/MLFB
	CP-2017 Processing and communication module	BC2-017 6MF10130CA170AA0
	Front panel CP-2017 AK 3	TC2-093 6MF13131CA030AA0
	CM-2838 Connection communication (CP-2017)	BC2-838 6MF10130CJ380AA0
	CM-2860 Patch Plug Standard V.28, ET, TR	CA2-860 6MF12110CJ600AA0
	CM-2869 Patch Plug Profibus	CA2-869 6MF12112CJ600AA0
	CM-0827 Fiber optic interface (electrical-FO)	GC0-827 6MF11110AJ270AA0
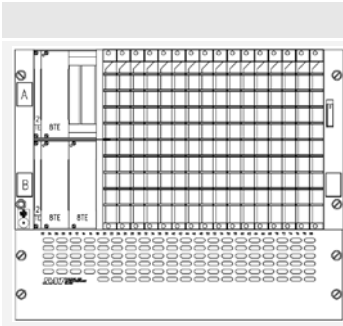
A.6.3 Migration for SICAM AK Peripheral Boards

	Designation	Item-Number/MLFB
	Front panel MX-2400	TC2-083 6MF13130CA830AA0
	Front panel DI-2100	TC2-095 6MF13131CA050AA0
	Front panel DI-2110	TC2-096 6MF13131CA060AA0
	Front panel DI-2111	TC2-097 6MF13131CA070AA0

A.6.4 CM-2833 Expansion Board Rack SICAM AK

	Designation	Item-Number/MLFB
	CM-2833 SICAM AK Expansion Board Rack for 16 Slots (Basic board rack without wall fastening kit and without cable strain relief)	GC2-833 6MF11130CJ330AA0

A.6.5 CM-2815 Expansion Board Rack AK 1703 Ax

	Designation	Item-Number/MLFB
	CM-2815 AK-Expansion Board Rack for 16 PE's	GA2-815 6MF11110CJ150AA0

A.7 SICAM TM Modules

A.7.1 Interface Modules

	Designation	Item-Number/MLFB
	CM-0819 Converter EIA-232/EIA-485, galvanically insulated	GA0-819 6MF11112AJ100AF0
	CM-0821 Field bus interface ring (3x FO, 1x el.)	GA0-821 6MF11110AJ210AA0
	CM-0822 Fieldbus interface star (4x FO)	GA0-822 6MF11110AJ220AA0
	CM-0823 Fieldbus interface ring (3x FO, 1x EIA-485)	GA0-823 6MF11110AJ230AA0
	CM-0847 Fiber optic interface (electrical-FO) AK 3	GC0-847 6MF11130AJ470AA0
	CM-0828 Fiber optic interface (TTL-LWL)	GA0-828 6MF11110AJ280AA0

	Designation	Item-Number/MLFB
	CM-0829 Converter EIA-232/422-EIA-485	GA0-829 6MF11112AJ200AA0
	CM-0843 Ax 1703 bus interface electrical	GA0-843 6MF11110AJ430AH0
	CM-0842 Ax 1703 bus interface 4x FO	GA0-842 6MF11110AJ420AF0

A.7.2   Power Supply Modules

	Designation	Item-Number/MLFB
	PS-6630 Power supply module 24…60 VDC (EMC+)	GC6-630 6MF11130GG300AA0
	PS-6632 Power supply module 110…220 VDC (EMC+)	GC6-632 6MF11130GG320AA0

A.7.3 Peripheral Control Modules

	Designation	Item-Number/MLFB
	PE-6410 Peripheral control module Ax-PE bus (electrical)	GC6-410 6MF11130GE100AA0
	PE-6411 Peripheral control module (1x Ax-PE bus optical)	GC6-411 6MF11130GE110AA0
	PE-6412 Peripheral control module (2x Ax-PE bus optical)	GC6-412 6MF11130GE120AA0

A.7.4 I/O Modules

	Designation	Item-Number/MLFB
	DI-6100 Binary input 2x 8, 24…60 VDC	GC6-100 6MF11130GB000AA0
	DI-6101 Binary input 2x 8, 110/220 VDC	GC6-101 6MF11130GB010AA0

	Designation	Item-Number/MLFB
	DI-6102 Binary input 2x 8, 24…60 VDC 1 ms	GC6-102 6MF11130GB020AA0
	DI-6103 Binary input 2x 8, 110/220 VDC 1 ms	GC6-103 6MF11130GB030AA0
	DI-6104 Binary input 2x 8, 220 VDC	GC6-104 6MF11130GB040AA0
	DO-6200 Binary output transistor 2x 8, 24…60 VDC	GC6-200 6MF11130GC000AA0
	DO-6212 Binary output relays 8x 24…220 VDC/230 VAC	GC6-212 6MF11130GC120AA0
	DO-6220 Command out Basic module	GC6-220 6MF11130GC200AA0

	Designation	Item-Number/MLFB
	DO-6221 Command out Basic module measurement	GC6-221 6MF11130GC210AA1
	DO-6230 Command output Relay module	GC6-230 6MF11130GC300AA0
	AI-6300 Analog input 2x 2, ±20 mA/±10 VDC	GC6-300 6MF11130GD000AA0
	AI-6307 Analog input 2x 2, ±2.5 mA/±5 mA/±10 VDC	GC6-307 6MF11130GD070AA0
	AI-6308 Analog input 2x 2, ±1 mA/±2 mA/±10 VDC	GC6-308 6MF11130GD080AA0
	AI-6310 Analog input 2x 2, Pt100/Ni100	GC6-310 6MF11130GD100AA0

	Designation	Item-Number/MLFB
	AO-6380 Analog output 4x ±20 mA/±10 mA/±10 VDC	GC6-380 6MF11130GD800AA0
	TE-6430 Counter input 2x 24…60 VDC	GC6-430 6MF11130GE300AA0

A.7.5   Safety Modules
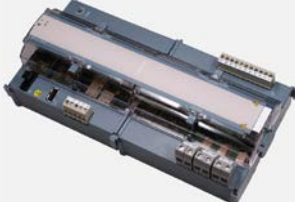
	Designation	Item-Number/MLFB
	DI-6170 Binary input 2 x 4, ±24 VDC	GC6-170 6MF11130GB700AA0
	DO-6270 Binary output 4 x ±24 VDC	GC6-270 6MF11130GC700AA0
	AI-6370 Analog input 4 x 4 to 20 mA	GC6-370 6MF11130GD700AA0

A.7.6   TM I/O-Module Extension Cable

	Designation	Item-Number/MLFB
	CM-2890 Peripheral cable crimp 5 m 100-pole	TC2-890 6MF13131CJ000AA0
	CM-6810 TM I/O-Modules Extension Cable	GC6-810 6MF11130GJ100AA0

A.7.7   Peripheral Elements with Direct Transformer Input

	Designation	Item-Number/MLFB
	AI-6303/TIPS05 Direct Transformer Input (4x220 V, 3x6 A) Ax PE bus electrical + optical	GC6-303 6MF11130GD030AA0
	AI-6304/TIPS05 Direct Transformer Input (4x220V,3x6 A) 2x Ax PE bus optical	GC6-304 6MF11130GD040AA0

A.8 Accessories

A.8.1 Transmission Facilities

	Designation	Item-Number/MLFB
	CE-0700 V.23 Leased line modem for DIN rail installation, 400 mW	G21-200 6MF11020BC000AA0
	DCF77 receiver for DIN rail	GA0-806 6MF11110AJ060AA0
	GPRS-Modem SCALANCE M874-2	6GK5874-2AA00
	Siemens MD741-1 GPRS-Router	6NH9741-1AA00 www.automation.siemens.com
	GSM antenna for outdoor mounting	G21-031 6MF11020BA310AA0
	Antenna cable (coaxial cable RG58 C/U 50 Ω)	TF5-050 6MF13140FA500AA0
	DCF/GPS-BS Lightning protection CN-UB/E-BB	BA0-802 6MF10110AJ020AA0
	GPS antenna connecting kit	TA0-801 6MF13110AJ010AA0
	Power supply cable for modem and DCF77 receiver	TA4-051 6MF13110EA510AA0

A.8.1.1 Recommended Purchased Products

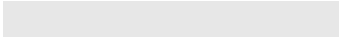|	Designation	Item-Number/MLFB
	TP Radio WDM 8000 Multi-point traffic	www.tpradio.com
	SATELLINE 2ASxE Multi-point traffic	www.satel.com
	Westermo TD-36AV (22…264 VAC/18…300 VDC) Westermo TD-36LV (10…30 VAC/10…60 VDC) Dial-up traffic analog	www.westermo.com
	Westermo IDW-90 Dial-up traffic ISDN	www.westermo.com
	Cinterion MC52iT dual band modem Dial-up traffic GSM inclusive mounting set for DIN rail and connection cable (1.5 m) without antenna!	www.cinterion.com
	Dr. Neuhaus Tainy EMOD-V2-IO Dr. Neuhaus Tainy EMOD-L1-IO	www.neuhaus.de
	netHOST PROFIBUS Master NHST-T100-DP\GR/DPM Art.Nr.:1890.410 (red) Art.Nr.:1891.410 (dark-grey) incl. Sycon.net (Software for PROFIBUS configuration)	www.hilscher.com

Designation	Item-Number/MLFB
Meinberg AW02 DCF77 antenna for outdoor mounting	www.meinberg.de
Meinberg AV4 DCF77 antenna terminal block	www.meinberg.de
Meinberg GPS164DHS Receiver for TS35	www.meinberg.de
Meinberg GPS170	www.meinberg.de
Meinberg GPSANT GPS antenna/converter	www.meinberg.de
Meinberg GPSAV4 Antenna terminal block	www.meinberg.de
Meinberg LANTIME NTP server + antenna + cable	www.meinberg.de
Phoenix FL MC 2000E LC – 2891056 with 1300nm, LC Connection, LWL converter	https://www.phoenixcontact.com

Cross-Over Cable for Direct Connection with RS-232

Following cross-over cables are used for serial communication connections with RS-232 between SICAM AK 3 and other automation units.

	Designation	Item-Number/MLFB
	Cross-Over-Adapter-RJ45 70 cm Order code: 34-02398	http://www.yamaichi.de/
	RJ45 Cable assembly 10m Order code: 32-01843	http://www.yamaichi.de/

A.8.2   Power Supply

	Designation	Item-Number/MLFB
	PS-4620 Additional power supply 24…60 VDC	GA4-620 6MF11110EG200AA0

A.8.2.1   Recommended Third-Party Products

	Designation	Item number/MLFB
	Power supply 115/230 VAC, 100…375 VDC, 24 VDC, 50 W	www.mtm-power.com
	Power supply 5 V/2 A SYKO EWS 01 U.06.05.20 82…264VAC or 36…350VDC	www.syko.de

A.8.3 Miscellaneous

	Designation	Item-Number/MLFB
	CM-0825 SICAM TOOLBOX II connection cable USB (type A – type Mini-B)	TC0-825 6MF13130AJ250AA0
	SD memory card for master control module	CC6-095 6MF12131GA050AA0

A.9 Engineering System SICAM TOOLBOX II

Designation	Item-Number/MLFB
SICAM TOOLBOX II V6	see Licence Catalog D30-017-6.01