

SIMATIC NET

TeleControl Configuration - IEC 60870-5

Configuration Manual

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Warning notice system

This manual contains notices you have to observe in order to ensure your personal safety, as well as to prevent damage to property. The notices referring to your personal safety are highlighted in the manual by a safety alert symbol, notices referring only to property damage have no safety alert symbol. These notices shown below are graded according to the degree of danger.

DANGER

indicates that death or severe personal injury **will** result if proper precautions are not taken.

WARNING

indicates that death or severe personal injury **may** result if proper precautions are not taken.

CAUTION

indicates that minor personal injury can result if proper precautions are not taken.

NOTICE

indicates that property damage can result if proper precautions are not taken.

If more than one degree of danger is present, the warning notice representing the highest degree of danger will be used. A notice warning of injury to persons with a safety alert symbol may also include a warning relating to property damage.

Qualified Personnel

The product/system described in this documentation may be operated only by **personnel qualified** for the specific task in accordance with the relevant documentation, in particular its warning notices and safety instructions. Qualified personnel are those who, based on their training and experience, are capable of identifying risks and avoiding potential hazards when working with these products/systems.

Proper use of Siemens products

Note the following:

WARNING

Siemens products may only be used for the applications described in the catalog and in the relevant technical documentation. If products and components from other manufacturers are used, these must be recommended or approved by Siemens. Proper transport, storage, installation, assembly, commissioning, operation and maintenance are required to ensure that the products operate safely and without any problems. The permissible ambient conditions must be complied with. The information in the relevant documentation must be observed.

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Disclaimer of Liability

We have reviewed the contents of this publication to ensure consistency with the hardware and software described. Since variance cannot be precluded entirely, we cannot guarantee full consistency. However, the information in this publication is reviewed regularly and any necessary corrections are included in subsequent editions.

Preface

Validity of this manual

This configuration manual is valid for the following SIMATIC NET communications modules that support the IEC 60870-5 protocol:

- TIM 1531 IRC - V2.5
- CP 1243-1 - V3.6
- CP 1243-7 LTE - V3.6
- CP 1243-8 IRC - V3.6
- CP 1542SP-1 IRC - V2.4

You will find the device versions and the required configuration software products in the section Communications modules (Page 15).

New in this edition

- New firmware versions of the communications modules specified above
See also the relevant operating instructions
- New and improved functions
 - Extended time synchronization through a local CPU (TIM 1531 IRC)
 - Controllable acceptance of commands or setpoints (command acceptance) in the CPU or via an S7 tag
 - Support of COT11 frames
 - Support of up to four listener ports
- Editorial revision

Replaced manual edition

Edition 02/2024

Structure of the documentation

The documentation for the SIMATIC NET telecontrol communications modules consists of the following manuals in each case:

- Operating instructions or product manual
- Configuration manuals (1 configuration manual for each telecontrol protocol)

You can find the Internet links for the manuals in the Bibliography (Page 211).

For modules that support the IEC 60870-5 protocol, the documentation consists of the following documents:

CP modules

- **Operating instructions**

Valid for the respective CP

- Application, functions, requirements (CPUs, software etc.)
- Hardware description
- Installation, wiring, commissioning, operation
- Configuration (telecontrol-independent functions)
If you use telecontrol functions, read the respective configuration manual.
- Diagnostics, maintenance
- Technical specifications, approvals, accessories

- **Configuration Manual IEC 60870-5**

- Configuration and diagnostics in STEP 7 Professional (TIA Portal)
Exception (CP 1200):
The description of the configuration of cloud access of the CP 1200 ("CloudConnect" parameter group) is not contained in this manual, but in the operating instructions for the respective CP.

TIM 1531 IRC

- **Manual**

- Application and functions
- Requirements (CPUs, configuration software, etc.)
- Hardware description
- Installation, wiring, commissioning, operation
- Diagnostics, maintenance
- Technical specifications, approvals, accessories

- **Configuration Manual IEC 60870-5**

Configuration and diagnostics in STEP 7 Professional (TIA Portal)

Current manual edition on the Internet

You will also find the current version of this manual on the Internet pages of Siemens Industry Online Support:

Link: (<https://support.industry.siemens.com/cs/ww/en/ps/21764/man>)

Required experience

Knowledge in the following areas is required for configuration and diagnostics of the devices:

- SIMATIC STEP 7 Professional
- Data transfer via WAN networks
- Setting up industrial networks with security functions

Abbreviations/device names

The following abbreviations/acronyms are frequently used in this manual:

- **Module / device / CP / TIM**
Names for the respective communications module
- **Mobile wireless CP**
CP 1243-7 LTE
- **STEP 7**
This short form will be used below for the STEP 7 Basic / Professional configuration tool.
- **WBM**
"WBM" is the acronym for the "Web Based Management", the pages of the TIM Web server for configuration and diagnostics data.

Cross-references

In this manual, there are often cross-references to other sections.

To return to the original page after jumping to a cross-reference, some PDF readers support the command <Alt>+<Left arrow>.

License conditions

Note

Open source software

The products contain open source software. Read the license conditions for open source software carefully before using the products.

The operating instructions of the relevant product provide information on finding the license conditions.

Cybersecurity information

Siemens provides products and solutions with industrial cybersecurity functions that support the secure operation of plants, systems, machines and networks.

In order to protect plants, systems, machines and networks against cyber threats, it is necessary to implement – and continuously maintain – a holistic, state-of-the-art industrial cybersecurity concept. Siemens' products and solutions constitute one element of such a concept.

Customers are responsible for preventing unauthorized access to their plants, systems, machines and networks. Such systems, machines and components should only be connected to an enterprise network or the internet if and to the extent such a connection is necessary and only when appropriate security measures (e.g. firewalls and/or network segmentation) are in place.

For additional information on industrial cybersecurity measures that may be implemented, please visit
<https://www.siemens.com/cybersecurity-industry>.

Siemens' products and solutions undergo continuous development to make them more secure. Siemens strongly recommends that product updates are applied as soon as they are available and that the latest product versions are used. Use of product versions that are no longer supported, and failure to apply the latest updates may increase customer's exposure to cyber threats.

To stay informed about product updates, subscribe to the Siemens Industrial Cybersecurity RSS Feed under
<https://new.siemens.com/cert>.

Before configuring and commissioning the modules, learn about their security functions: Functions, performance data and configuration limits (Page 20)

Observe the security recommendations in the "Security" appendix:
Security recommendations (Page 11)

SIMATIC NET glossary

The SIMATIC NET glossary describes terms that may be used in this document.

You will find the SIMATIC NET glossary in the Siemens Industry Online Support at the following address:

Link: (<http://support.automation.siemens.com/WW/view/en/50305045>)

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Security recommendations

Observe the following security recommendations to prevent unauthorized access to the system.

General

- You should make regular checks to make sure that the device meets these recommendations and other internal security guidelines if applicable.
- Evaluate your plant as a whole in terms of security. Use a cell protection concept with suitable products.
- Do not connect the device directly to the Internet. Operate the device within a protected network area.
- Check regularly for new features on the Siemens Internet pages.
 - You can find information on Industrial Security here:
Link: (<http://www.siemens.com/industrialsecurity>)
 - You can find a selection of documentation on the topic of network security here:
Link: (<https://support.industry.siemens.com/cs/ww/en/view/92651441>)
- Keep the firmware up to date. Check regularly for security updates of the firmware and use them.
Information regarding product news and new firmware versions is available at the following address:
Link: (<https://support.industry.siemens.com/cs/ww/en/ps/21764/dl>)

Physical access

Restrict physical access to the device to qualified personnel.

Network attachment

Do not connect the module directly to the Internet. If a connection of the module to the Internet is required, use the security variants of the telecontrol protocols or use protection mechanisms in front of the module. Protection mechanisms are for example a SCALANCE M router or a SCALANCE S security module with firewall.

Security functions of the product

Use the options for security settings in the configuration of the product. These includes among others:

- Protection levels and security functions of the CPU
Configure access to the CPU under "Protection and Security".
Use the other security functions of the CPU to prevent unauthorized access to the station.
You will find information on this in the information system of STEP 7.
- Security function of the communication
 - Using the security functions of the telecontrol protocols.
 - Use the secure protocol variants, for example NTP (secure) or SNMPv3.
 - Leave access to the Web server deactivated.

Passwords

- Define rules for the use of devices and assignment of passwords.
- Regularly update the passwords to increase security.
- Only use passwords with a high password strength. Avoid weak passwords for example "password1", "123456789" or similar.
- Make sure that all passwords are protected and inaccessible to unauthorized personnel.
See also the preceding section for information on this.
- Do not use one password for different users and systems.

Protocols

Secure and non-secure protocols

- Only activate protocols that you require to use the system.
- Use secure protocols when access to the device is not prevented by physical protection measures.
 - The NTP protocol provides a secure alternative with NTP (secure).
 - The HTTP protocol provides a secure alternative with HTTPS when accessing the Web server.
- Deactivate DHCP at interfaces to public networks such as the Internet, for example, to prevent IP spoofing.

Table: Meaning of the column titles and entries

The following table provides you with an overview of the open ports on this device.

- **Protocol / function**
Protocols that the device supports.
- **Port number (protocol)**
Port number assigned to the protocol.

- **Default of the port**

- Open
The port is open at the start of the configuration.
- Closed
The port is closed at the start of the configuration.

-

- **Port status**

- Open
The port is always open and cannot be closed.
- Open after configuration
The port is open if it has been configured.
- Open (login, when configured)
As default the port is open. After this port is configured, the communications partner needs to log in.
- Closed after configuration
The port is closed because the module is always client for this service.

- **Authentication**

Specifies whether or not the protocol authenticates the communications partner during access.

The following ports are relevant. Not all protocols are supported by every device type.

Table 1-1 Server ports

Protocol / function	Port number (protocol)	Default of the port	Port status	Authentication
IEC 60870-5-104	2404 (TCP) Can be set	Closed	Open after configuration	No
IEC 60870-5-104 with TLS	19998 (TCP) Can be set	Closed	Open after configuration	Yes, when Secure Communication is enabled.
S7 and online connections	102 (TCP)	Open	Open after configuration	No
Online security diagnostics (CPs)	8448 (TCP)	Closed **	Open after configuration *	Yes
Communication via SINEMA RC	443 (TCP), 5243 (UDP)	Closed	Open after configuration	Yes
HTTP	80 (TCP)	Closed	Open after configuration	No
HTTPS	443 (TCP)	Closed	Open after configuration	Yes
SNMP	161 (UDP)	Closed	Open after configuration	No (SNMPv1) Yes (SNMPv3)
IPsec (Security devices)	500 (UDP), 4500 (UDP)	Closed	Open after configuration	Yes

* Some service providers consider the opening of port 102 a security vulnerability. To avoid opening port 102 during online diagnostics, see section Online security diagnostics via port 8448 of the TIM (Page 183).

** With the TIM 1531 IRC, Port 8448 is open in the default setting.

Ports of communication partners and routers

Make sure that you enable the required client ports in the corresponding firewall on the communications partners and in intermediary routers.

These can be:

- NTP / NTP (secure) / 123 (UDP)
- DNS / 53 (UDP)
- DHCP / 67, 68 (UDP)
- SMTP / 25 (TCP)
- STARTTLS / 587 (TCP)
- SSL/TLS / 465 (TCP)
- SINEMA RC Autoconfiguration / 443 (TCP) - can be set
- SINEMA RC and OpenVPN / 1194 (UDP) - can be set in SINEMA RC
- IPSec / 500 (UDP) / 4500 (UDP)
- OpenVPN / 1194 (UDP)
- Syslog / 514 (UDP)

Functions and requirements

2.1 Communications modules

Communications modules for the telecontrol protocol IEC 60870-5

The following SIMATIC NET communications modules can be used for the telecontrol protocol IEC 60870-5.

Meaning of symbols in the table:

- X = Supported
- (X) = Master function of individual data points
- - = Not supported

Table 2-1 Communications modules for IEC 60870-5

Module Article number	Number of interfaces *			Station type			STEP 7 product	Required firmware
	IE IEC 60870- 5- 104	RS IEC 60870- 5- 101	M	Master	Node station	Station		
TIM 1531 IRC 6GK7 543-1MX00-0XE0	3	1 **	- ***	X	X	X	STEP 7 Pro- fessional	V2.5
CP 1542SP-1 IRC 6GK7 542-6VX00-0XE0	1	-	- ***	(X)	-	X	STEP 7 Pro- fessional	V2.4
CP 1243-8 IRC 6GK7 243-8RX30-0XE0	1	-	-	(X)	-	X	STEP 7 Ba- sic **** / Professional	V3.6
CP 1243-1 6GK7 243-1BX30-0XE0 6AG1 243-1BX30-2AX0	1	-	-	(X)	-	X	STEP 7 Ba- sic **** / Professional	V3.6
CP 1243-7 LTE 6GK7 243-7KX30-0XE0 6GK7 243-7SX30-0XE0	-	-	1	(X)	-	X	STEP 7 Ba- sic **** / Professional	V3.6

* IE = Ethernet interfaces, RS = serial interfaces, M = integrated mobile wireless interface

** No GSM modules are supported for connection to the serial interface.

*** TIM modules can be connected to mobile wireless networks via modems.

**** STEP 7 Basic with connection of the CP to a third-party master. See note below.

Notes on the table

Notes on the columns:

- Station type "Node station"**
 A node station is located in the plant hierarchy between the master station and other lower-level stations. The module requires at least two interfaces.
 In the configuration, the "network node type" of the interface connected to the master station is configured as "Node station". See section Networking of the interfaces (Page 49) for more on this.
- STEP 7 product with S7-1200 CPs**
 S7-1200 CPs can be configured under STEP 7 Basic for connection to a third-party master. You need STEP 7 Professional project to connect the CPs to SIMATIC NET master or node stations configured in STEP 7.
- Firmware**
 The required firmware versions of the modules relate to the complete configuration described in this manual. You can find the required STEP 7 version for this in the section Software requirements (Page 20).
 Modules with lower firmware versions can also be configured in the current STEP 7 versions with a deviating scope of functions.

2.2 PG routing

PG routing between telecontrol modules

PG routing is supported between the modules listed in the table and via the specified media.

Requirement for CPs

The "Online functions" options are enabled in the "Communication types" parameter group.

Module	TIM 1531 IRC	CP 1200	CP 1542SP-1 IRC
Medium			
TIM 1531 IRC	Ethernet (S7)	Ethernet (S7)	Ethernet (S7)

Max. number of S7 routing connections: 4

2.3 Configuration examples

Below, you will find several configuration examples with the communications modules that can be used.

Communication via Ethernet / Internet, sending e-mails

In the sample configuration shown, S7 stations communicate with the master station via the Ethernet interfaces of the different modules.

With their Ethernet interfaces, TIM modules enable connection to a redundant master station.

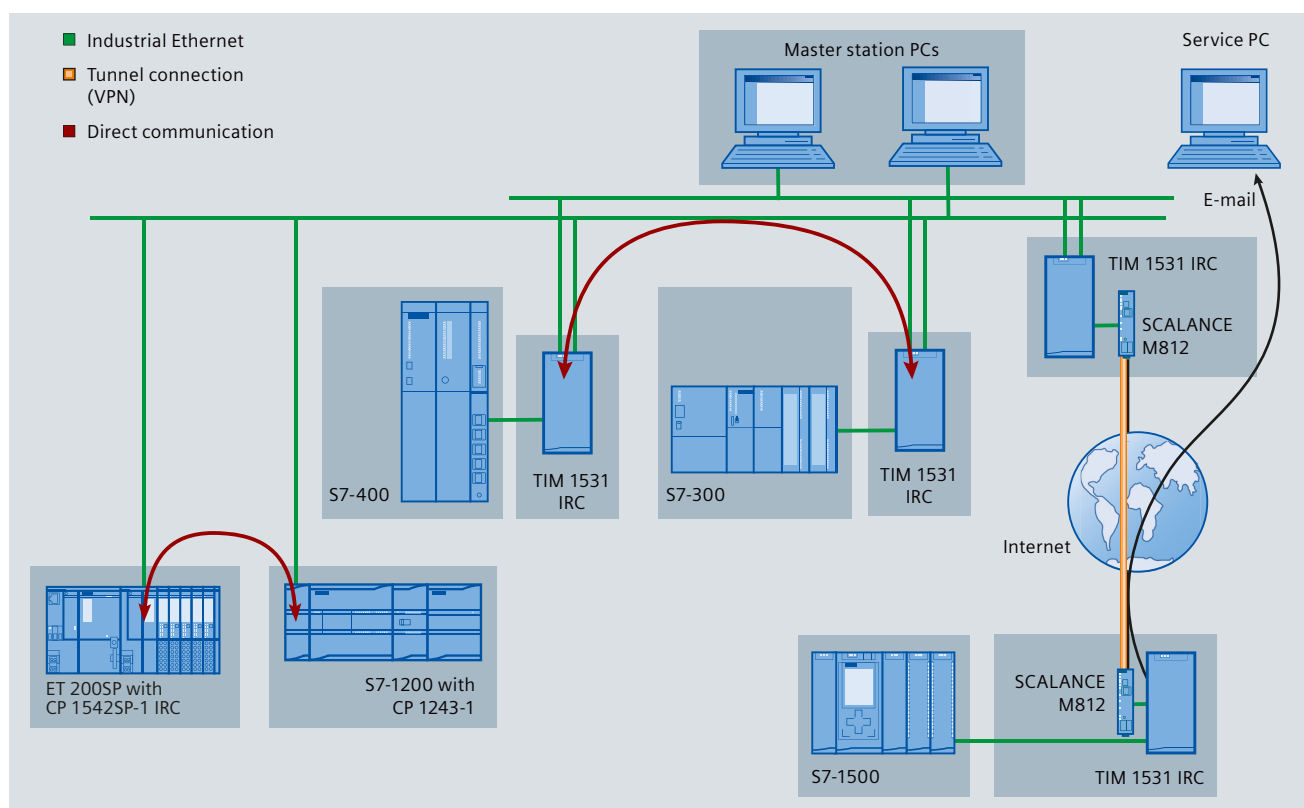


Figure 2-1 Communication via Ethernet / Internet

E-mails

The modules can send e-mails. The following recipients are possible:

- For configured event-driven e-mails:
 - PCs with an Internet connection
 - Cell phones
- For e-mails via OUC blocks:
 - SIMATIC stations with the appropriate program blocks

Direct communication

Direct communication between S7 stations with communications module is possible over IP-based networks. The frames do not run via the master station.

Direct communication can be enabled by the following mechanisms:

- Configured telecontrol connections
For the requirements, see Communications options (Page 29).
- Program blocks of Open User Communication
See OUC program blocks (CP) (Page 189)

Path redundancy using the serial interface

In the following example, the Ethernet interface and the serial interface are used with the TIM 1531 IRC to set up redundant transmission paths.

- Ethernet interface for communication via Ethernet / Internet
- Serial interface for communication via a WAN network (dedicated line or dialup network)

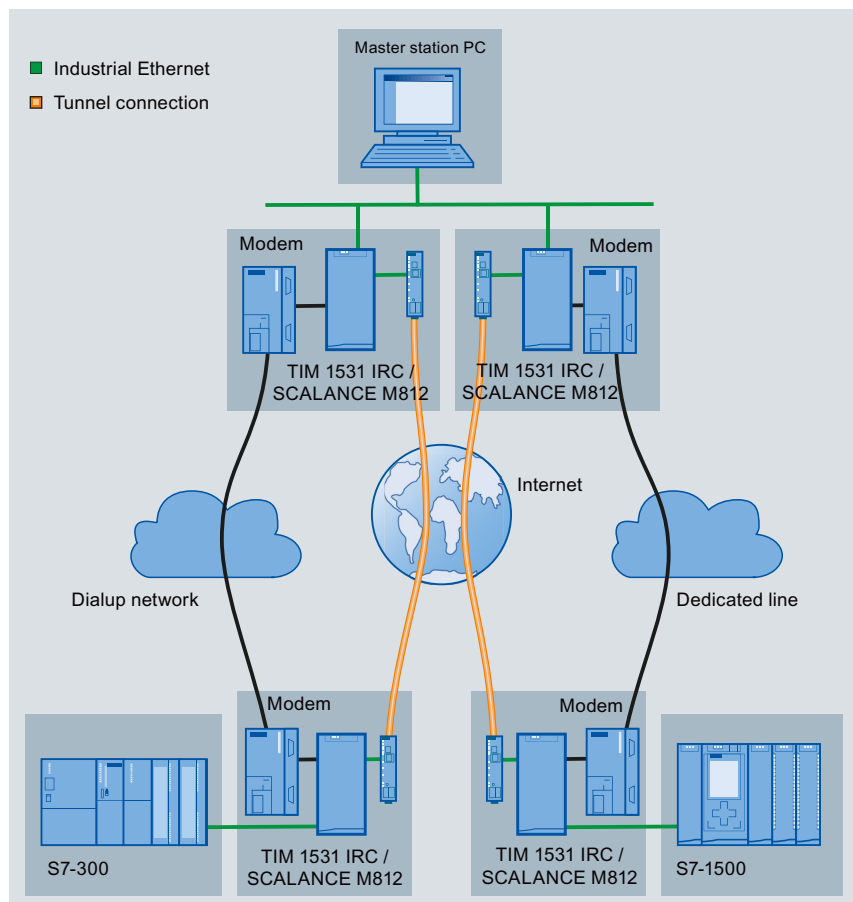


Figure 2-2 Communication via redundant paths

Path redundancy is also possible over two Ethernet networks.

Device redundancy of the TIM 1531 IRC

For information on the device redundancy of the TIM 1531 IRC, see section Device redundancy of the TIM 1531 IRC (Page 56).

2.4 Usable CPUs

Compatible CPUs

The following can be configured as assigned CPUs of the communications modules:

- **TIM 1531 IRC**

- S7-1500

All standard CPUs as of version V2.5

All redundant CPUs (H-CPU, R-CPU) as of version V2.8

Note

As of version 3.0, the S7-1500 CPUs support user authentication that is not supported by the TIM 1531 IRC. Disable this function in the CPU to guarantee access of the TIM 1531 IRC to the data management.

- ET 200SP

All CPUs that can be configured in STEP 7 as of version V2.9

- S7-300

All CPUs with PROFINET interface

- S7-400

All CPUs that can be configured in STEP 7

- **CP 1243-1 / CP 1243-7 LTE / CP 1243-8 IRC**

CPU as of version V4.6

- **CP 1542SP-1 IRC**

CPUs as of version V2.9:

- CPU 1510SP-1 PN

- CPU 1510SP F-1 PN

- CPU 1512SP-1 PN

- CPU 1512SP F-1 PN

- CPU 1514SP-2 PN

- CPU 1514SP F-2 PN

- CPU 1514SP T-2 PN

- CPU 1514SP TF-2 PN

You will find more detailed information on the CPUs and the BusAdapters in the manual /6/ CP 1542SP-1, CP 1542SP-1 IRC, CP 1543SP-1 (Page 212).

2.5 Software requirements

Software for configuration and online functions

The following version of STEP 7 is required for configuring the full range of functions described in this manual:

- STEP 7 Basic / Professional V20

For the required STEP 7 product (STEP 7 Basic or STEP 7 Professional), see section Communications modules (Page 15).

2.6 Functions, performance data and configuration limits

2.6.1 CP 1243-1

Number of CMs/CPs per station

In each S7-1200 station, up to three CMs/CPs can be plugged in and configured.

To use telecontrol communication, three CP 1243-1 modules can be plugged in per station.

Connection resources

- **Telecontrol connections inclusive Inter-station communication / Direct communication**
The CP can establish connections to up to 4 communication partners.
A partner is a single or redundant master or a station (Direct communication).
For information on configuration of direct communication between stations, see section Communications options (Page 29).
- **S7 connections and TCP / UDP / ISO-on-TCP connections**
Max. 14 connection resources, can be distributed as required for:
 - S7 connections (PUT/GET)
Including connections for S7 routing
 - Connections via program blocks (OUC) to S7 stations
- **Online functions**
1 connection resource is reserved for online functions.
- **PG/OP connections**
 - 1 connection resource for PG connections
 - 3 connection resources for OP connections

Number of data points for the data point configuration

Maximum number of configurable data points per CP

- TeleControl Basic: 200
- DNP3: 500
- IEC: 500

Frame memory (send buffer)

The CP has a frame memory (send buffer) for the values of data points that are configured as an event and are to be sent to the communications partner.

The send buffer is divided equally among all configured communications partners. The size of the frame memory can be set in STEP 7, refer to the section Process image, type of transmission, event classes (Page 145).

The maximum size of the send buffer is:

- TeleControl Basic: 64 000 frames
- DNP3: 64 000 events
- IEC: 100 000 events

Messages (e-mail)

- Sending of up to 10 messages (e-mails) with configuration in the message editor

IPsec tunnel (VPN)

Up to 8 IPsec terminals can be established for secure communication with other security modules.

Firewall rules

The maximum number of firewall rules in advanced firewall mode is limited to 256.

The firewall rules are divided up as follows:

- Maximum 226 rules with individual addresses
- Maximum 30 rules with address ranges or network addresses (e.g. 140.90.120.1 - 140.90.120.20 or 140.90.120.0/16)
- Maximum 128 rules with limitation of the transmission speed ("Bandwidth limitation")

2.6.2 CP 1243-7 LTE

Connection resources

- **Telecontrol connections**
 - DNP3 / IEC
The CP can establish connections to up to 4 communication partners.
A partner is a single or redundant master or a station (Direct communication).
 - TeleControl Basic
1 reserved connection for user data exchange with the telecontrol server
Additional Inter-station communication: The inter-station communication between the CPs of two stations takes place via the telecontrol server. It is configured in the "Partner stations" > "Partner for inter-station communication" parameter group.
Configuration limits for inter-station communication: A total of max. 15, of which:
 - Send to partner: Max. 3 ("Send buffer" parameter enabled)
 - Receive from partners: Max. 15 ("Send buffer" parameter disabled)
- **S7 connections and TCP / UDP / ISO-on-TCP connections**
Max. 14 connection resources, can be distributed as required for:
 - S7 connections (PUT/GET)
Including connections for S7 routing
 - Connections via program blocks (OUC) to S7 stations
- **PG/OP connections**
 - 1 connection resource for PG connections
 - 3 connection resources for OP connections
- **Online functions**
1 connection resource is reserved for online functions.
- **TeleService connections**
 - Max. 1 TeleService connection
- **Connections to NTP servers**
Max. 1 connection to an NTP server

User data

With the connection types listed below, the user data of a frame represent a consistent data area in terms of the time of transfer.

User data per frame with the various connection types:

- For TCP connections: Max. 8192 bytes
- For ISO-on-TCP connections: Max. 1452 bytes
- For UDP connections: Max. 1472 bytes

With frames of telecontrol communication, the individual values of the data points are time stamped.

Number of data points for the data point configuration

The maximum number of configurable data points under the telecontrol protocols is:

- TeleControl Basic: 200
- DNP3: 500
- IEC: 500

Frame memory (send buffer)

The CP has a frame memory (send buffer) for the values of data points that are configured as event and are to be sent to the communication partners.

The send buffer has the following maximum size:

- TeleControl Basic: 64000 frames
- DNP3: 100000 events
- IEC: 100000 events

The send buffer is divided equally among all configured communications partners. The size of the frame memory can be set in STEP 7 ("Communication with the CPU" parameter group).

Messages: E-mail / SMS

Up to 10 messages to be sent as e-mails or SMS can be configured in STEP 7.

Maximum number of characters that can be transferred per SMS message: 160 ASCII characters including any value sent at the same time

Maximum number of characters that can be transferred per e-mail: 256 ASCII characters including any value sent at the same time

IPsec tunnel (VPN)

An IPsec tunnel can be established for secure communication with another Security module.

Firewall rules

The maximum number of firewall rules in advanced firewall mode is limited to 256.

The firewall rules are divided up as follows:

- Maximum 226 rules with individual addresses
- Maximum 30 rules with address ranges or network addresses (e.g. 140.90.120.1 - 140.90.120.20 or 140.90.120.0/16)
- Maximum 128 rules with limitation of the transmission speed

2.6.3 CP 1243-8 IRC

Information in the operating instructions

You will find the following information on configuration limits in the operating instructions of the CP 1243-8:

- Number of CMs/CPs per station (3 CMs/CPs, max. 1 CP 1243-8 IRC)
- Connection resources
 - Telecontrol connections (4)
 - TCP connections (4)
 - Online functions
 - S7 connections (8)
 - S7 routing (4)
 - PG/OP connections (2 for PG, 1 for OP)
- Number of data points (500)
- Frame memory (send buffer) (64000)
For information on setting the size in STEP 7, refer to the section Communication with the CPU (Page 78).
For details and the data transmission options, see section Process image, type of transmission, event classes (Page 145).
- E-mail (10)
- IPsec tunnel (VPN) (8)
- Firewall rules

For information on the operating instructions, see /4/ CP 1243-8 IRC (Page 212).

2.6.4 CP 1542SP-1 IRC

Information in the operating instructions

You will find the following information on configuration limits in the operating instructions of the CP:

- Number of CMs/CPs per station (3 CMs/CPs, max. 2 CP 1542SP-1) and slot rules
- Connection resources
 - Telecontrol connections
 - Industrial Ethernet (max 32)
S7 (16), TCP/IP connections (32), ISO-on-TCP (32), UDP (32)
 - Online connections (2)
 - TCP connections for HTTP (12)
 - PG/OP connections (16)
- Number of data points (1500)
- Frame memory (send buffer) (32000)
For details and the data transmission options, see section Process image, type of transmission, event classes (Page 145).
- E-mail (10)
- IPsec tunnel (VPN) (4)
- Firewall rules

For information on the operating instructions, see /6/ CP 1542SP-1, CP 1542SP-1 IRC, CP 1543SP-1 (Page 212).

2.6.5 TIM 1531 IRC

Connection resources

- **Telecontrol connections**
The number of connections or communications partners is limited for the two interface types and every individual interface.
Note that redundant connection paths of a connection between two partners require two connection resources on each partner.
 - Max. number of connections: 128
Distribution over 4 interfaces can take place in any way (max. 128 per interface).
- **E-mail**
A connection to send e-mails can be established during runtime.
- **S7 connections**
 - Max. 4 connection resources for PG/OP connections (see below)

- **PG/OP connections**
4 connection resources for connections to the engineering station or HMI devices (included in the configuration limits of the S7 connections, see above)
- **PG routing**
Max. 4 connections at the same time
- **Online functions**
See PG/OP connections
- **HTTP/HTTPS**
Max. 2 connections per Ethernet interface

Number of data points for the data point configuration

The maximum number of configurable data points is 3000.

Message memory: Send buffer / SD card

The TIM has a frame memory (send buffer) for the values of data points configured as an event.

The send buffer is divided equally among all configured communications partners. The size of the frame memory can be set in STEP 7 ("Communication with the CPU" parameter group).

The maximum size of the send buffer is:

- ST7: 100 000 frames
- DNP3/IEC: 250 000 events

You will find details of how the send buffer works (storing and sending events) as well as the options for transferring data in the section Process image, type of transmission, event classes (Page 145).

For information on saving events on an optional SD card, see section Basic settings (Page 35).

Messages: E-mail

Up to 10 messages which the TIM can send as e-mails can be configured in STEP 7.

- Number of characters per e-mail
Maximum number of characters that can be transferred per e-mail: 256 ASCII characters including any value sent at the same time

Security functions of the transmission protocols

The transmission protocols that can be used for telecontrol communication support the following security functions:

ST7

- **MSC**
The MSC protocol supports authentication of the communications partners and simple encryption of data. A user name and a password are included in the encryption. An MSC tunnel is established between the MSC station and MSC master station.
- **MSCsec**
MSCsec supports authentication of the communications partners and data encryption with a user name and password.
In addition to this, the shared automatically generated key is renewed between the communications partners at a configurable Key exchange interval.

DNP3

- The TIM supports the use of TLS connections as well as secure authentication according to IEEE 1815.

IEC 60870-5-101 / 104

- The TIM supports the use of the following functions:
 - IEC 60870-5-101 / 104
Secure authentication according to IEC 60870-5-7
 - IEC 60870-5-104
TLS connections

Further security functions of the TIM

The TIM also supports the following security functions:

- **NTP (secure)**
For secure transfer during time-of-day synchronization
- **STARTTLS / SSL/TLS**
For the secure transfer of e-mails
- **HTTPS**
For secure access to the Web server of the TIM
- **SNMPv3**
For secure transmission of network analysis information safe from eavesdropping

Note**Plants with security requirements - recommendation**

Use the following options:

- If you have systems with high security requirements, use the secure protocols, for example HTTPS or SNMPv3.
 - If you connect to public networks, you should use security modules with a firewall. With security modules, individual devices, automation cells or network segments of an Ethernet network can be protected. The following security modules, for example, are suitable for this: SCALANCE S, SCALANCE M800
-

Formatting the SD card

The SD card of the TIM 1531 IRC must have the following formatting to be able to save configuration data.

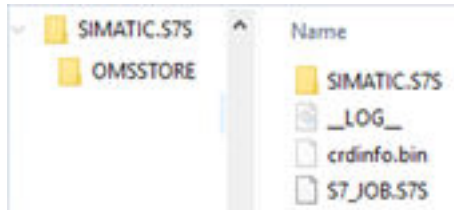


Figure 2-3 Formatting the SD card

You can find information on formatting the SD card in the STEP 7 information system under the search term "Formatting the S7-1500 memory card".

Communication mechanisms

3.1 Communications options

Communication paths

With telecontrol communication, the following paths or connections are possible:

- **Master ⇔ Station connections**
- **Redundant connections**
If two subscribers can be reached via different networks, you can create a maximum of two connections between the subscribers to establish path redundancy.
- **Direct communication (Station ⇔ Station)**
With direct communication, stations communicate directly with each other without the frames being transmitted from a master station. Two stations can thus communicate directly with each other via individual data points.
For information on the configuration, refer to section Master function of the data points (Page 143).

3.2 Addressing

To configure and commission the communications module, the following information is required:

Address information of the communications module

For the addressing, the following parameters must be configured for the module:

- **ASDU address**
Address of the information object (station) on the data link layer
You need the ASDU address to identify the master and the stations in the IEC network.
- **Indexes of the data points (Data point index = Information object address)**
For information on the configuration, see Data point index (Page 144).
- **Address, depending on network type and module type:**
 - IP address and subnet mask; as an alternative: IP address of a DHCP server
If you use DNS, there must be a DNS server (see below) and this must be reachable for the module.
 - Telephone number (for dial-up network)
 - WAN address (for dedicated line)

3.2 Addressing

- Listener port
 - Listener port of the station. The master needs the port number to establish the connection.
 - Listener port of a third-party device with the function "Master"
- DNS server address(es)
 - You need a DNS server if the station sends requests to devices via their FQDN, for example the NTP server.
 - You need a DNS server if the master establishes connections to the stations via their FQDN.

Uniqueness of the addresses

Addressing must be unique within a subnet and within the STEP 7 project.

If you want to use subscriber numbers/station addresses twice in different subnets, you must create two STEP 7 projects.

Uniqueness of the ASDU address

For modules with telecontrol connections that are configured via the "Network data" editor, a consistency check determines the uniqueness of the address.

For CPs with a firmware version $\leq$ V3.0 whose telecontrol connections are configured via the "Partner stations" parameter group, the address cannot be checked for uniqueness with a consistency check. You must ensure uniqueness of the address in this case.

Address information of the master

The following information of the master is required for the configuration of the module:

- ASDU address (address of the information object of the master on the data link layer)
- Address of the master, depending on network type:
 - IP address / subnet mask + port number of the listener port of the master
or
Name resolvable by DNS
(You need the DNS server address, the DNS server must be accessible by the module.)
 - Telephone number (for dial-up network)
 - WAN address (for dedicated line)

Redundant IEC master

The two devices of a redundant master have an identical ASDU address.

They only require different IP addresses or host names.

Configurations with connections over the Internet: VPN connections

For connections running via the Internet, dynamic IP addresses can be used.

To allow communication in both directions and to ensure that the data is protected during transfer, a connection with a VPN tunnel is necessary. For this the security modules of the SCALANCE S or SCALANCE M series are available.

Remember the following points when configuring:

- You configure the master IP address as normal.
- When configuring the interface of the module, configure the IP address of the router.
- You create the VPN configuration with SCALANCE S/SC/M both for the station end and for the control center end in STEP 7.

3.3 Connection establishment

Connection establishment

The master establishes the connection (call operation / polling). This also applies to stations with data points for which the "Master function" option is enabled.

If an established connection is interrupted, a master module tries to re-establish the connection.

Note**Connection interrupted by the mobile wireless network provider**

When using mobile wireless services, remember that existing connections can be interrupted by mobile wireless network providers for maintenance purposes.

Connection establishment in Open User Communication and PG/OP communication

In Open User Communication in an S7 station, the CPU is the connection partner.

Connections are established as soon as the corresponding program blocks are called on the CPU.

This also applies to the situation when a different S7 station sends data. In this case, the receiver station calls the corresponding receiver modules.

3.4 Acknowledgment

Acknowledgment mechanisms for the protocol IEC 60870-5-104

Configuration: Interface of the module > "Advanced options" > Transmission settings - IEC 60870-5"

With each sent data frame, the RTU sends a continuous send sequence number. The data frame initially remains stored in the send buffer of the module.

3.4 Acknowledgment

Upon reception, the master sends the send sequence number from this or (if several data frames are received) the last data frame back to the module as an acknowledgment. The module stores the send sequence number returned by the master as the reception sequence number and uses it as an acknowledgment.

Data frames whose send sequence number is equal to or less than the current receive sequence number are evaluated as successful and deleted from the send buffer of the module.

Parameters:

- **k: Difference between send sequence number N(S) and receive sequence number N(R)**
Maximum number of unacknowledged data frames (I-APDUs) as maximum difference between send sequence number N(S) and receive sequence number N(R).
If k is reached and t_1 has not yet expired, the module does not send any data frames until all sent data frames have been acknowledged by the master.
When k is reached and t_1 has elapsed, the TCP connection is terminated.
- **w: Max. number of unacknowledged data frames**
Maximum number of received data frames (I-APDUs), after which the oldest data frame received from the master must be acknowledged.

For information on the configuration, refer to the section Transmission settings - IEC 60870-5 (Page 70).

Recommendations of the specification:

- w should not be greater than $2/3$ k.
- Recommended value for k: 12
- Recommended value for w: 8

Configuration

4.1 Communication types

"Communication types"

In this parameter group, you enable the communication capability of the module.

Depending on the module type, you can define the telecontrol protocol and other communication types.

- **Enable telecontrol communication**
Enables telecontrol communication with the communication partners.
- **Protocol type**
 - ST7
 - DNP3
 - IEC 60870-5
 - TeleControl Basic
- **Enable online functions**
Enables access to the CPU for the online functions via the CP (diagnostics, loading project data etc.). If the function is enabled, the engineering station can access the CPU via the CP. With the TIM 1531 IRC, this function is enabled in the factory and cannot be disabled. If the option is disabled, you have no access to the CPU via the CP with the online functions. Online diagnostics of the CPU with a direct connection to the interface of the CPU remains possible, however.
S7 routing is supported by the following modules:
 - CP 1243-1, CP 124x-7, CP 1243-8
As of CP firmware V2.1 with CPU $\geq$ V4.2
 - CP 1542SP-1 IRC
As of CP firmware V1.0 with CPU $\geq$ V2.0
 - TIM 1531 IRC

Please note:
Disabling this function means no security measure. To protect the station, use suitable security functions such as firewall, VPN or password protection of the CPU.
- **Enable S7 communication**
Enables the functions of S7 communication with the station CPU and S7 routing in the module. If you configure S7 connections to the relevant station, and these run via the module, you need to enable this option. With the TIM 1531 IRC, this function is enabled in the factory and cannot be disabled.

Open User Communication does not need to be enabled since you then need to create the relevant program blocks. Unintended access to the CP is therefore not possible.

- **Activate telecontrol communication via SINEMA Remote Connect**

Configurable with:

- CP 1243-1
- CP 1243-7 LTE
- CP 1243-8 IRC
- CP 1542SP-1 IRC

For additional details, see appendix SINEMA Remote Connect (CP) (Page 205).

RTU3000C

Configuration

With the RTU3000C, you must configure the following parameters in the STEP 7 project:

- **Communication types**

- Protocol type
The telecontrol communication type configured in the RTU
- Temporary connection
Enable this option if the RTU is connected via mobile wireless and is only in the network temporarily.

- **Ethernet interface**

- WAN settings
The settings are permanently preset depending on the selection of the telecontrol protocol.

Ethernet address

- Dynamic IP address
If a dynamic IP address is assigned by the mobile wireless network provider, this option must be enabled.
- Fixed IP address from the mobile wireless network provider
Enter the fixed IP address of the RTU assigned by the mobile wireless network provider here.
If a mobile router is connected in between, enter the IP address of the router here.

- **Subscriber numbers**

- Subscriber number (RTU)
Only for ST7: Here, you assign the subscriber number of the RTU as it was configured in the WBM of the RTU.
- Subscriber number of the CPU (RTU)
Here, you assign the subscriber number of the CPU as it was configured in the WBM of the RTU.

- **Security**
The security settings configured in the RTU are permanently enabled in STEP 7 in the default setting.
- **Telecontrol connection**
Then create the telecontrol connection between the RTU and its connection partner in the "Network data > TeleControl" editor.

Compiling and loading

The STEP 7 configuration data cannot be loaded into the RTU3000C. The RTU3000C therefore cannot be compiled in STEP 7.

4.2 Basic settings

IEC basic settings

Not all parameters are displayed with every module type.

- **Listener port**
Own listener port of the module. The master needs the port number to establish the connection.
The port number applies to all interfaces of the communications module.
Range of values: 1024...65535
Default: 2404
If you use multiple masters, you can configure up to three more ports. The different masters can then use different ports. If the value "0" is entered, no listener port is configured.
- **Listener port / 2 / 3 / 4 (optional)**
Additional listener ports when you want to use redundant masters with different port numbers.
Range of values: Same as listener port
If the value "0" is entered, no further listener port is configured.
- **Frame memory size**
Validity: TIM 1531 IRC
Here, you set the size of the frame memory for events (send buffer).
The size of the frame memory is divided equally among all configured communications partners. For information on the size of the frame memory, see "Performance data and configuration limits".
You will find details of how the send buffer works (storing and sending events) as well as the options for transferring data in the section Process image, type of transmission, event classes (Page 145).

- **Max. command lifetime**
Validity: TIM 1531 IRC, CP 1542SP-1 IRC
Maximum age of received commands of type Single/Double command with time tag (<58>/<59>)
If the time stamp does not match the value configured here at the time of receipt, the command is rejected without feedback. The parameter is evaluated by stations and node stations.
Range of values: 1...65
Default: 20
- **Max. lifetime of command monitoring**
Validity: TIM 1531 IRC, CP 1542SP-1 IRC
Maximum time for which the communication module in the IEC station waits until the CPU has updated the variable for command execution feedback (Data point for command monitoring).
Range of values (seconds): 1...255
Default: 5
You will find more information on command monitoring in the section Command options (Page 163).

Secure communication options

Validity: TIM 1531 IRC, CP 1542SP-1 IRC

- **Secure listener port**
Own listener port for TLS communication.
The port number applies to all interfaces of the communications module.
Range of values: 1024...65535
Default: 19998
If you use multiple masters, you can configure up to three more ports. The different masters can then use different ports. If the value "0" is entered, no listener port is configured.
- **Secure listener port / 2 / 3 / 4 (optional)**
Additional listener ports for TLS communication when you want to use redundant masters with different port numbers.
Range of values: Same as secure listener port
If the value "0" is entered, no further listener port is configured.

Retentive saving of events

Validity: TIM 1531 IRC

If you use an optional SD card in the TIM, in this parameter group you set the conditions for saving the values of frames whose data points are configured as an event.

You set the behavior via the following parameters:

- **Enable retentive saving**
Activates the retentive saving of events on the SD card in the event of connection disruptions.
- **Number of events before saving**
Saving events on the SD card starts when the number of events in the send buffer configured here is reached.

- **Interruption time before saving**
Saving events on the SD card starts when the time of the connection interruption configured here is reached.
- **Max. number of events in the archive file**
Maximum number of events in the stored archive file
When the number is exceeded, the oldest events are overwritten.

For the maximum number of savable events, see section Functions, performance data and configuration limits (Page 20).

IP routing

Validity: TIM 1531 IRC

Note

The function is not intended for large data volumes.

Restrict routing via the TIM to approx. 1 Mbit/s so that productive operation of the TIM is not impaired.

IP routing

- **Allow IP routing**
Enables IP routing via the interfaces of the module.
- **Routing method**
Defines the paths for IP routing:
 - Local: IP routing only between the Ethernet interfaces of the module
 - Via subnets: IP routing via a maximum of 10 configurable routers that can be accessed via the module's interfaces.

Router addresses

Parameters when the "Via subnets" option is selected for "Routing method":

- **Ethernet interface**
Ethernet interface of the module via which IP routing is to be configured. The IP addresses of the interfaces used for IP routing need to be permanently configured.
An interface can be selected several times for different routes.

Note

Consistency of the address parameters

STEP 7 does not check the consistency between manually configured addresses and the parameters of the module's Ethernet interfaces.

Ensure consistency with the address parameters of the respective interface.

- **Address type**
Selection of the IP version of the address parameters configured below (IPv4 / IPv6)
When using IPv6 addresses, you must enable IPv6 for the respective interface.

4.3 Mobile wireless communications settings (CP 1243-7 LTE)

- **Network address**
Network address of the routing destination (IP address * subnet mask)
- **Subnet mask / Prefix**
Subnet mask (IPv4) or prefix (IPv6) of the routing destination
- **Router address**

4.3 Mobile wireless communications settings (CP 1243-7 LTE)

"Mobile wireless settings"

In this parameter group you configure the following parameters:

- **CP phone number**
Telephone number of the CP
- **Activate PIN**
If your service provider requires a PIN, enable this option.
- **PIN**
PIN of the SIM card
- **Enable data services**
Activates the use of the data services in the mobile wireless network for the CP.

Note

Subsequent disabling

If you have already used data services in operation and then disable them later, you need to reload the configuration data and change the CPU to STOP and then RUN.

- **GPRS (2G) / UMTS (3G) / LTE**

Enable the mobile wireless service(s) you want to use. You can enable individual mobile wireless services or all of them.

"GPRS (2G)" is only supported by CP 1243-7 LTE EU.

- **SMSC**

Phone number of the SMS center (Short Message Service Center)

The box has the following options:

- No number

As default, the CP adopts the SMSC data of the service provider directly from the inserted SIM card. If you want to use the SMSC number of the SIM card, leave the box empty.

- Configured number

If you want to use a different SMSC, enter the phone number of this SMSC.

Note the following:

Note**Permanent storage of the SMSC number**

If you configure an SMSC number, the CP no longer accesses the SMSC data of the SIM card. This is also the case if you delete the SMSC number from the configuration again.

Recommendation:

When you configure an SMSC number, first note down the SMSC number of your service provider located on the SIM card. If you want to use it again later, you can then use the SMSC of your provider again by configuring the SMSC number.

"APN settings"

In this parameter group, you configure the data of the access point. You require the APN to send e-mails.

The CP supports APNs with IPv4 and IPv6 addresses.

Note the information on security in the section Security recommendations (Page 11).

By entering your country in the "Country" box, you can select one of the preset APNs from the drop-down list.

Alternatively configure the APN manually.

Note**Configuration of APN user name and password**

If your service provider requires an APN user name and a password, you can receive the information from them.

If your service provider does not require an APN user name or a password, it can be necessary to configure placeholders for the two parameters. This is the case, for example, when your provider uses the Provider Password Authentication Protocol (PAP) for authentication. In this case, ask your provider for the required details.

User names and passwords can contain up to 64 characters. You will find the characters permitted in the section Character set for user names, passwords and messages (Page 177).

If your service provider does not require an APN user name or a password, it sometimes makes sense to configure placeholders for the two parameters.

"List of preferred networks"

In this parameter group, you specify the dial-in behavior of the CP into various mobile wireless networks.

"TeleService settings"

TeleService can only be used when telecontrol communication is enabled. For a description of the TeleService functions, refer to the configuration manual, see SINEMA Remote Connect (CP) (Page 205).

Reconnection settings

In this parameter group, you can define a trigger-controlled condition or a daily time at which the CP re-establishes the mobile wireless connection.

Mobile wireless connections can be terminated for a wide range of reasons. It may be intentional (through program blocks or maintenance times of the network provider) or be caused by faults or failed stations in the network.

You can plan the establishment of a mobile wireless connection exactly with the function of this parameter group.

During the connection establishment, all function requests to the CP are discarded until the CP has a new IP address.

Parameters

- Reconnection
Enables scheduled reestablishment of a mobile wireless connection
- Reconnection type
 - Full restart including hardware
Restart of communication functions of the CP, including restart of the mobile wireless engine
This option can take several minutes.
 - Fast restart
Restart of mobile wireless communication only. The mobile network engine is not restarted.
This option shortens the duration of the restart somewhat.
- Cyclic restart
Enables connection establishment at a fixed time.
The cyclic restart is permanently enabled in the default setting.
You can only disable the cyclic restart if you enable the "Restart trigger".

- **Daily reconnection time**
You define the daily time for connection establishment here.
To do this, click on the hours in the configuration field and enter them using the keyboard or the right arrow buttons. Then click on the minutes and set them.
 - **Restart trigger**
Enables connection establishment via a trigger set by the CPU, e.g. the occurrence of a specific event. Setting the trigger tag to 1 triggers connection establishment by the CP.
 - **Trigger tag**
Select a tag (Bool) which the CPU sets to 1 on the occurrence of the event.
The trigger tag is automatically reset to 0 after the mobile wireless connection is established.
- You can combine both options (cyclic and triggered) on the connection.

4.4 Time-of-day synchronization

Time-of-day synchronization and security

When security functions are enabled, you need to regularly synchronize the time of day of the communications module.

If you enable the security functions in security CPs, you will find the time parameters under "Security".

Basics of time-of-day synchronization

With telecontrol applications that require time-of-day synchronization, you need to synchronize the time of day of the communications module regularly. If you do not synchronize the time of day, there may be deviations of several seconds per day in the time information of the stations.

The communications module can obtain the time of day from an external source (for the methods see below) and forward the time of day to the station or the connected WAN

networks. When an external time source is used, the connected S7 station can obtain the current time of day both via the CPU and via a communications module (TIM, CP).

Note**Recommendations and requirements**

- **Time-of-day synchronization only by one module of the station**
Only have the time of day of the station from an external time source synchronized by a single module so that a consistent time of day is maintained within the station.
If the CPU takes the time from a communications module, disable time-of-day synchronization of the CPU.
If you have the time synchronized on the communications module and on the CPU via NTP, use the same NTP server to maintain a consistent time of day within the station if possible.
 - **Longer synchronization cycles with unstable networks**
If a network often has connection problems, you can increase its synchronization cycle. In this way, you avoid the frames being marked as "invalid" and discarded after the synchronization time expected by the time client has elapsed.
 - **Enable time-of-day synchronization**
When TLS connections are used, a current time and a current date must be stored in the TIM 1531 IRC or on the CP to check certificates. If no current time is stored, certificates are detected as invalid and, consequently, no TLS connection is established.
-

Time-of-day concept

Before configuring time-of-day synchronization, specify the following:

- Specify the time source in the network.
- Specify the time master in the network.
- Specify the network or networks via which the time of day will be forwarded by the time master to the time slaves.

Methods for receiving the time of day

- **No time source**
The module is not synchronized.
- **From WAN**
The module adopts the time of day from a communication partner.
IEC 60870-5 uses the local time of the master without daylight-saving time designation for the time synchronization of the communications modules.

- **From NTP server / NTP (secure)**
The CP adopts the time of day (UTC) from a configured NTP server.
 - NTP
NTP with support of RFC5905
NTP servers can be configured manually in the table.
The address of the NTP server can also be entered as a URL, e.g. <ntp.server.com>.
 - NTP (secure)
NTP with support of RFC5905 and RFC5906 with shared key
If the security functions are enabled, the "NTP (secure)" method can also be used.
NTP servers of the type NTP (secure) are configured in the global security settings and can be selected for the CP in the "Security > Time synchronization" parameter group in the table.
- **From local station / Time from CPU**
The module takes the time of day (UTC) from the CPU.
The CPU synchronizes all connected CMs/CPs of the station as well as the TIM 1531 IRC with a synchronization cycle of 10 seconds.
Parameters of the CPU:
If the option "CPU synchronizes the modules of the device" is enabled, you can initiate synchronization of all telecontrol CPs of the station with firmware $\geq$ V2.1.77 with the CPU time in a synchronization cycle of 10 seconds.
- **Setting the time of day manually using the WBM (TIM 1531 IRC)**
If you have configured a time source for the TIM, you can also set the time via the WBM, see /2/ TIM 1531 IRC (Page 211).

When a TIM 1531 IRC V2.5 or a CP 1542SP-1 IRC V2.4 with IEC communication receives a synchronization frame from a subscriber that is not configured as time master, the frame is rejected and acknowledged negatively.

CP time during startup

For CPs of the S7-1200 and the ET 200SP and with the TIM 1531 IRC ($\geq$ V2.5), you can find the following option at the bottom in the "Receive time" parameter group:

- Use CPU time before first synchronization by master/master station
The option can be enabled when the "From WAN" time source is configured.
 - When the option is enabled, the CP takes the time from the CPU during the first startup, if a time has not yet been received from the partner over WAN.
 - If the option is disabled, the CP has no valid time during the first startup.

For CPs with firmware version $\leq$ V2.0, the CP reads the CPU time once during start-up, even if the option "No time source" is selected as Time source. The subsequent time synchronization then depends on the configured synchronization method.

"Time" parameter group: UTC and time zone settings

Communications modules with use of the IEC 60870-5 protocol use the local time of the master station/the master with daylight-saving time designation.

Validity:

The functions of this parameter group are valid for:

- CP 1242-7, CP 1243-1, CP 1243-7 LTE, CP 1243-8 (FW $\geq$ V3.5)
- CP 1542SP-1 (FW $\geq$ V2.3)
- TIM 1531 IRC (FW $\geq$ V2.4)

Interpretation of the time of day through the telecontrol communications modules:

In STEP 7, the time is saved as "DTL" data type by the communications modules specified above.

The communications module interprets its time of day as local time without daylight-saving time designation.

Parameters:

- Take time zone values with daylight saving time from PLC
When the option is enabled, the communications module takes the time zone with daylight saving time settings from the CPU.
TIM 1531 IRC: The option is activated if the CPU has been assigned to the TIM (parameter group "Subscriber numbers").
- Time zone
Here you set the local time zone that the communications module will use.
- Use UTC
 - Option enabled:
The module uses UTC in communication with its connection partner. With synchronization via WAN, the communications module expects the time from the partner as UTC.
 - Option disabled:
The communications module uses the local time of the station.

If the communications module receives the time from WAN and synchronizes the CPU, it transmits the time as UTC to the CPU, regardless of whether this option is enabled.
Online diagnostics entries of the station and WBM entries of the TIM 1531 IRC are shown as local time of the PC.

If the communications module does not take the time zone from the CPU, you can configure the changeover between daylight saving time and standard time:

- Activate daylight saving time
Enables the time changeover (daylight saving/standard time)
- Difference between standard and daylight saving time
Time difference in minutes between daylight saving time and standard time
- Start of daylight saving time / standard time
Here you configure when each time changeover starts:
 - Week of the month
Example:
"First" means "First Sunday in March", if "Sunday" is configured as weekday and "March" as month.
 - Weekday
 - "in" = Month
 - "at" = time of changeover

Forwarding the time from the CP to the CPU

Note

Forwarding the time to the CPU

Depending on the firmware version of the modules involved, the time-of-day of the CP can be forwarded to the CPU in different ways.

- Optional forwarding of the CP time to the CPU using a PLC tag:
 - S7-1200
 - ET 200SP
 - Forwarding of the CP time via the backplane bus to the CPU from the firmware versions mentioned below:
 - S7-1200
 - ET 200SP
-

The forwarding of the CP time to the CPU depends on the firmware version of the CP and the CPU. Note the following behavior.

- **Forwarding of the CP time via PLC tag**

With the following firmware versions, this is the only option for forwarding the clock time from the CP to the CPU:

- S7-1200: CP firmware $\leq$ V2.1.5
- ET 200SP: CP firmware $\geq$ V2.0

With this firmware version, the CP can make the time of day available to the CPU as an option via a PLC tag. When this PLC tag is read cyclically by the CPU, the CPU adopts the CP time. Configure the PLC tag in the parameter group "Communication with the CPU" of the CP.

- **Forwarding of the CP time to the CPU via the backplane bus**

The CP time is automatically forwarded to the CPU, when a synchronization method is configured at the CP, and CP and CPU have one of the following firmware versions:

- S7-1200: CP firmware $\geq$ V3.0 and CPU firmware $\geq$ V4.2

If the option "CPU synchronizes the modules of the device" is enabled for the CPU in "PROFINET interface > Time synchronization", all smart modules of the station are synchronized with the CPU time.

- ET 200SP: CP firmware $\geq$ V2.1 and CPU firmware $\geq$ V2.0

As of firmware version V2.1 of the CP, only one module in the station can be time server. This module distributes the time of day within the station. If you want to have the time of the station synchronized via the CPU, disable the time-of-day synchronization for the CP. Since the CPU automatically adopts the CP time, you no longer require the forwarding option using the PLC tag for these firmware versions.

CPs do not support forwarding the time to connected subnets.

Time of day forwarding by the TIM 1531 IRC

The TIM can forward its time of day as follows:

- **To connected networks**

Configuration with "Time-of-day synchronization" > "Send time" or "Receive time"

The procedure for configuration differs in Ethernet and classic WAN networks, see below.

- **To the assigned CPU**

Configuration with "Time-of-day synchronization" > "Send time"

This option cannot be selected if the TIM obtains its time of day from the CPU.

Configuration on the Ethernet interface of the TIM 1531 IRC

Time server

1. In the "Receive time" parameter group, configure the TIM that will be the time server and configure the time source using one of the following options:
 - From NTP server
 - From local station
 - From WAN
2. Configure the interface of the TIM via which time frames will be forwarded in the parameter group "WAN settings" as network node type "Master station".
3. In the parameter group "Send time" for the interface from step 2, enable the option "Forward time to WAN".
The time frames are forwarded to the connected network.
4. If necessary, enable the "To local station" option in the "Send time" parameter group if the assigned CPU should also be synchronized. The prerequisite is that the TIM does not obtain its time from the CPU.

When using TD7onCPU, observe the following:

In this case, also enable forwarding of the time on the interface of the TIM that is networked with the CPU.

Time clients

1. Configure the interfaces of the other TIM modules that will be time slaves in the parameter group "WAN settings" as network node type "Node station" or "Station".
The function is supported for the Ethernet interface and the serial interface.
2. Network the interfaces of the TIM modules involved with each other and with the interface of the time server.
3. For the stations, set the parameters of time-of-day synchronization in the parameter group "Receive time".
4. If necessary, enable the "To local station" option in the "Send time" parameter group if the assigned CPU should also be synchronized.

Configuration with the TIM and with WAN networks

Parameter groups for time-of-day synchronization

For configuring the time-of-day synchronization, the following parameter groups are available:

- **TIM**
 - **Receive time**
Here you specify the connected network via which the TIM will receive the time of day.
 - Master station TIM: Usually via the control center
 - Node station: Definition of the interface (network node type "Node station") via which the TIM receives the time from the master station TIM.
 - Station: Definition of the interface via which the TIM receives the time from the master station TIM or a node station.
 - **Send time**
 - Master station TIM (time server): Definition of the networks to which the TIM forwards the time.
 - Node station: Definition of the interface (network node type "Master station") via which the TIM forwards the time to lower-level networks.
- **Classic WAN**
For classic networks, the "Time-of-day synchronization" is enabled in the network's parameter group of the same name. You also specify the synchronization cycle here. The settings for synchronization are then adopted by all connected TIM modules; see below. The send direction of the time-of-day frames is derived automatically from the network node type of the connected interfaces:
Master station ⇒ Node station ⇒ Station

Configuring time-of-day synchronization via classic WAN networks

TIM modules (time server and clients)

1. In the "Receive time" parameter group, configure the TIM that will be the time server and configure the time source using one of the following options:
 - From NTP server
 - From WAN
(take the time from a network/master station)
2. Configure the interface of the master TIM to which the lower-level stations or node stations are connected with the network node type "Master station".
3. Configure the interfaces of the other TIM modules (time clients) with the network node type "Node station" or "Station".
4. If necessary, enable the "To local station" option in the "Send time" parameter group of the stations if the assigned CPU should also be synchronized.

When using TD7onCPU, observe the following:

In this case, also enable forwarding of the time on the interface of the TIM that is networked with the CPU.

WAN

1. Network the serial interfaces of the involved TIM modules involved with the respective WAN.
2. In the parameter group "Time-of-day synchronization" of the WAN, enable the option "Activate time synchronization for WAN".
3. There, you configure the required synchronization cycle.
4. Enable the time source "From WAN" at the serial interfaces of the stations (time clients). The settings configured for the WAN network are adopted in the following parameter groups of the connected TIM modules:
 - For the time server (master station): "Send time" parameter group (serial interface)
 - For the time clients (node stations / station): "Receive time" parameter group (serial interface)

The send direction of the time-of-day frames is derived automatically from the network node type of the connected interfaces:

Master station ⇒ Node station ⇒ Station

Optional: Multiple time servers

If multiple time servers are connected in the network, you can define a specific subscriber as time server:

1. Configure the telecontrol connections via the interfaces of the two devices.
2. Then select the partner configured via the connection, from which the time of day is obtained, at the time client.
Parameter "Receive time > Obtain time from partner" of the serial interface

Alternatively, you can specify that the communications module accepts the time from all connected time servers with the "Any or no connection partner" parameter. This setting is not recommended because it can result in inconsistencies in the time stamps of the data points and thus in data loss.

4.5 Configuration of interfaces, networks and network nodes

4.5.1 Networking of the interfaces

Module interfaces

The arrangement of the module interfaces in the STEP 7 device symbol (network view) corresponds largely to the structure of the respective device.

For example, the interfaces of a TIM 1531 IRC are arranged as follows:

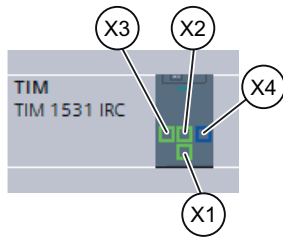


Figure 4-1 Device symbol of the TIM with interface numbers

Networking interfaces

To network an interface depending on the initial situation you have different options:

- Creating a subnet
- Connecting two target devices via a new subnet
- Connecting devices to existing subnet
- Selecting an existing subnet from the "Subnet" list

You will find the description of the individual methods in the STEP 7 information system.

Networking WAN interfaces

Recommendation networking:

To network the interfaces with a WAN network, the following procedure is recommended:

1. Network the WAN networks in the network view of STEP 7.
In the graphic network view, you have an overview of the subnets of the entire system in the project.
2. First configure the interface parameters described in the section WAN settings of the interfaces (Page 52):
 - WAN type
 - Network type
 - Network node type
 - Modem type
3. Select the relevant interface to create a new WAN network. Alternatively:
In the parameter group "Network interface with" of the interface:
 - Using the "Add new subnet" button

On the interface in the device symbol of the module:

- Using the shortcut menu "Create subnet"
- Graphically by dragging (holding the mouse pointer pressed) to the interface symbol of the communications partner

A new WAN network is created that adopts the network type from the connected interface.

Network representation of a classic WAN

A classic WAN network is displayed in blue.

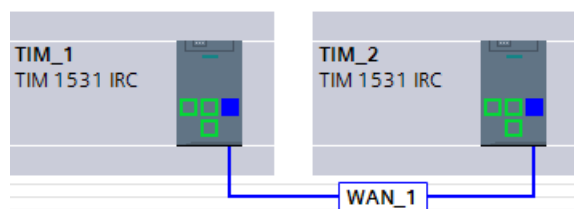


Figure 4-2 TIM modules, serial interfaces networked via classic WAN.

Network with node stations

In the following figure, the center TIM is a node station. The "Network node type" parameter of the interfaces is configured as follows:

- Interface in the direction of the master station: "Node station"
- Interface in the direction of the lower-level network: "Master station"

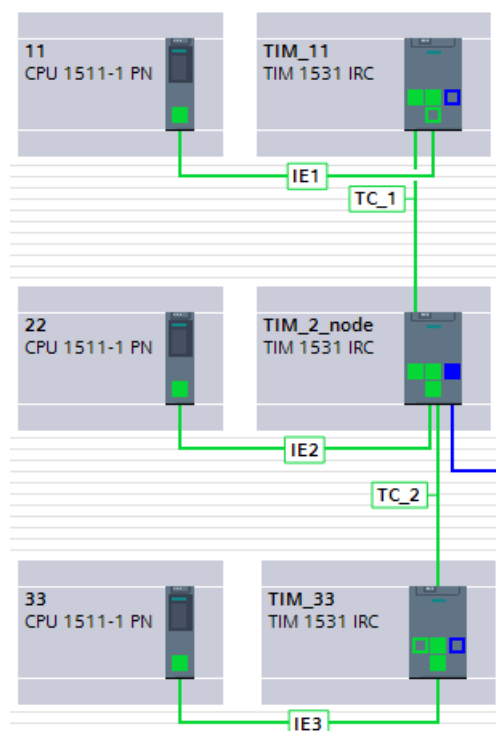


Figure 4-3 Network with master station (top), node station (center) and station (bottom)

4.5.2 WAN settings of the interfaces

WAN settings

The following parameters determine the properties of the interfaces and the connected WAN networks.

First, configure the respective module interface. The subsequently connected WAN network adopts the most important settings.

- **WAN type**

Selection of the WAN type of the interface:

- IP-based
Default setting of the Ethernet interface
- Classic WAN
Default setting of a serial interface

- **Network type**

For IP-based WAN:

- IEC 60870-5
Setting for interfaces that are used for telecontrol data transfer.
- Neutral
Setting for interfaces for S7 connections, e.g. the connection of the TIM 1531 IRC with its higher-level CPU.

In addition with the three Ethernet interfaces of the TIM 1531 IRC:

- Primary TIM
(with device redundancy)
- Backup TIM
(with device redundancy)

Note the special features in relation to device redundancy of the TIM 1531 IRC; see section Device redundancy of the TIM 1531 IRC (Page 56).

For classic WAN:

- Dedicated line
- Dialup network

Classic WAN networks are only supported by TIM modules.

- **Network node type**

Decides the Network node type of the interface:

- Master station
- Node station
For modules that act as node station, the interfaces are configured as follows:
 - Interface in the direction of the master station: "Node station"
 - Interface in the direction of the lower-level network: "Master station"
- Station

You will find an illustration in the section Networking of the interfaces (Page 49).

- **Modem type**

The modem type for connection to the serial interface must be configured for the network type "Dialup network" and, in the case of the classic TIM modules, also for the network type "Dedicated line".

The entries have the following meanings:

- MD2
Dedicated line modem (network type "Dedicated line")
- MD3
Modem for analog dialup networks (network type "Dialup network")
- MD720
The GSM modem MD720 is not supported because it uses frame format FT2.
- Third-party modem
Any compatible modem for the network types "Dedicated line" or "Dial-up network" (analog / GSM)

4.6 Ethernet interface

4.6.1 Ethernet addresses

The Ethernet interface

- **Ethernet CPs**
The telecontrol communication of the Ethernet CPs takes place over the Ethernet interface. Configure the necessary parameters.
- **Mobile wireless CPs**
Mobile wireless CPs do not have a physical Ethernet interface.
In STEP 7, the Ethernet interface is used as a placeholder for the configuration of various address and monitoring parameters.
When using security functions, you must network the interface.

Ethernet addresses

Here you configure the IP address of the CP and the network connection.

If you enable security functions, for example when using telecontrol communication, for reasons of consistency you need to network the CP. To do this create any Ethernet network.

Please note:

A fixed IP address (IPv4/IPv6) is required for the following applications:

- When using S7 communication
- When receiving data via Open User Communication
- When using VPN
- When using SINEMA Remote Connect

Use IPv6 protocol

In addition to IPv4, you can optionally enable IPv6 for the CP.

Options for mobile wireless CPs:

- **Dynamic IP address**
Enable this option if the CP is assigned the IP address dynamically by the network provider.
- **Fixed IP address from the mobile wireless network provider**
Enable this option if you have a mobile wireless contract with which the network provider assigns the CP a fixed IP address.

Ethernet interface > Port [Xn P1]

You will find information on configuration in the STEP 7 information system.

For information on configuring the WAN settings, refer to the section WAN settings of the interfaces (Page 52).

4.6.2 Advanced options

4.6.2.1 TCP connection monitoring

Ethernet interface > Advanced options > TCP connection monitoring

The settings of the two parameters at the Ethernet interface apply to all TCP connections via this interface.

With mobile wireless CPs, the Ethernet interface is the placeholder for the mobile wireless interface.

You can adapt the parameters in the properties of the telecontrol connections for each connection segment. The value under the connection segment applies to this connection segment and overwrites the value that is configured on this interface.

If there are different values for the interface and the connection segment, make sure that the value on the interface is greater than the one under the connection segment.

- **TCP connection monitoring time**
Function: If no data traffic takes place within the TCP connection monitoring time, the communications module sends a keepalive frame to the communication partner and expects an answer within the TCP keepalive timeout.
Default setting: 180 s
With the setting zero (0), monitoring is disabled.
The permissible range depends on the module type.
- **TCP keepalive timeout**
After sending a keepalive frame, the module expects a response from the communications partner within the keepalive timeout. If the module does not receive a response after three keepalive frames, it closes the connection.
With the setting 0 (zero), the function is disabled.
Default setting: 10 s
The permissible range depends on the module type.
If disruptions or delays occur often when transferring in a mobile wireless network, it may be advisable to increase the value, for example, to 30 or 60 seconds.

If there are different values for the interface and the connection segment, make sure that the value on the interface is greater than the one on the connection segment.

4.6.2.2 Transmission settings

You will find the specific parameters of the telecontrol protocol in the section IEC parameters of interfaces (Page 70).

4.6.2.3 MTU size

MTU size

Option for interface-specific reduction of the maximum packet size on OSI Layer 3 (Maximum Transmission Unit - MTU)

If the frame size (e.g. segments) is limited in your plant, you can reduce the size of the packages sent by the communications module with this option.

Range of values: 1000 .. 1500 Byte

Default setting: 1500

4.6.3 Web server access

4.6.3.1 CP

Access to the Web server of the CPU

The Web server is located in the CPU. Via the CP, you have access to the Web server of the CPU.

4.7 Device redundancy of the TIM 1531 IRC

From a PC you can access the Web server of the station if the PC is connected to the system network via LAN.

You will find information on the Web server of the S7-1200 in the manual /7/ S7-1200 system manual (Page 212).

You will find information on the Web server of the ET 200SP in the manual /8/ ET 200SP system manual (Page 213).

4.6.3.2 TIM 1531 IRC

Access to the Web server

You can activate access to the Web server of the TIM via HTTP/HTTPS for each individual Ethernet interface.

As default access is disabled. Refer to the explanations in section Security recommendations (Page 11).

You enable the Web server and make further settings in the parameter group "Web server", see section Web server (TIM 1531 IRC) (Page 76). There you can also enable or disable access.

For access to the Web server you need to enable access on the Ethernet interface ("Access to the Web server") and enable the Web server itself "Web server".

4.7 Device redundancy of the TIM 1531 IRC

Validity of device redundancy

The following explanations of device redundancy apply to:

- Communications module
 - TIM 1531 IRC
 - Firmware version: V2.4 or higher
 - Use as a station
- together with:
- CPU
 - S7-1500R
 - S7-1500H
- Telecontrol protocols
 - DNP3
 - IEC 60870-5
- Supported process control systems
 - SIMATIC PCS 7 TeleControl

Redundancy options

- **Connection redundancy**

Redundant connections to a partner can be established with a single telecontrol communications module.

For redundant connections, see:

Connection table (Page 118)

The following figure shows a possible configuration.

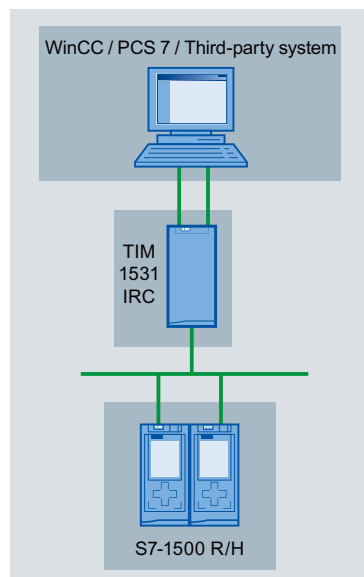


Figure 4-4 Example of connection redundancy

- **Device redundancy**

Starting from the above-named version of the TIM 1531 IRC, device redundancy can be configured in a station for communication with a redundant PCS 7 PC.

The two TIM modules are connected for data synchronization and monitoring during runtime (synchronization connection). The send buffer in both TIM modules is thus identical.

The synchronization connection of the two TIM modules can be established over any Ethernet interface of the TIM.

- The primary TIM is the active module in the normal state.
- The backup TIM is the passive module in the normal state.
It takes over the communication only if the connection of the primary TIM is disrupted.

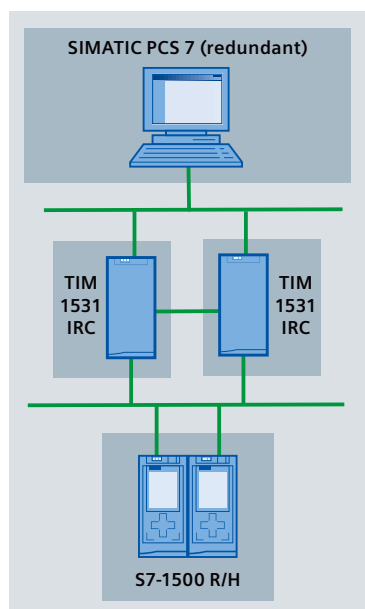


Figure 4-5 Device redundancy of the TIM 1531 IRC in a station - normal state

Device redundancy use cases

The following figure shows the normal state above and below this the failure scenarios in which communication is maintained due to the device redundancy.

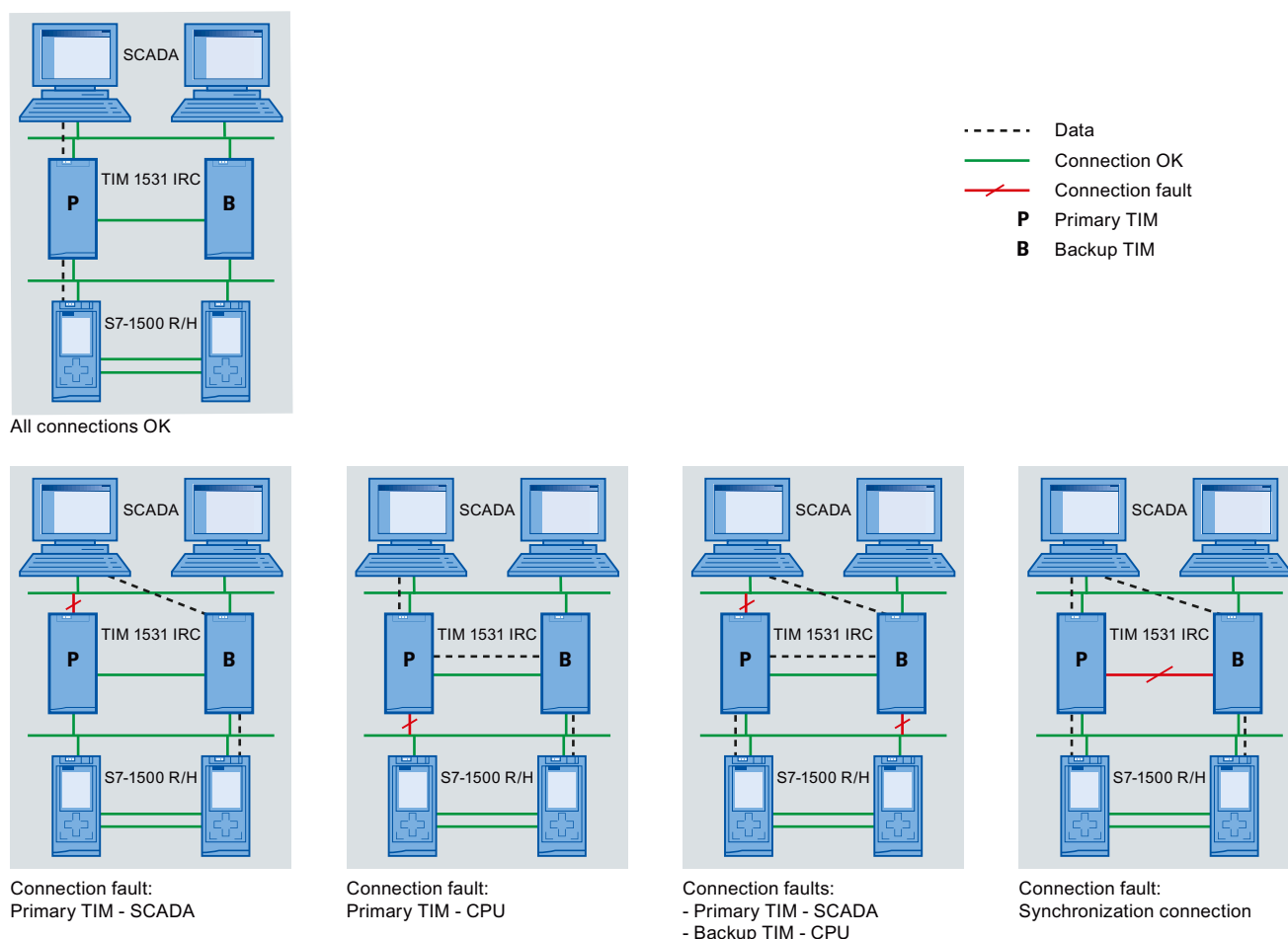


Figure 4-6 Failures caught by device redundancy (connection faults)

Device redundancy maintains communication in the following cases:

- Connection between primary TIM and SCADA system failed
- Connection between primary TIM and local CPU failed
- Connection between primary TIM and SCADA system failed and connection between backup TIM and local CPU failed
- Synchronization connection between primary TIM and backup TIM failed
In this scenario, the data of the primary TIM and the backup TIM is buffered for the SCADA system.

Note

Failures caught

Device redundancy is designed for the connection faults illustrated here.

If several faults or different faults occur at the same time, data may be lost.

Note**Failures not caught**

The detection of a connection failure between TIM and CPU takes some time.

Changes in the data management of the CPU in the time between connection failure (TIM-CPU) and detection of the connection failure are lost.

Configuring device redundancy

For the configuration, follow the steps below. Only the most important steps required for redundancy mode are listed below.

CPU

1. Create a station with an R-CPU or a H-CPU.
2. Configure the required parameters under "Protection & Security".
3. Assign an IP address to both redundant CPUs.
4. Assign the shared system IP address of the CPU.
The redundant TIM modules access the CPU at the system IP address.
The system IP address must be in the same subnet as the IP addresses of the interfaces of the two CPUs.

TIM 1531 IRC

1. Create two TIM 1531 IRC.
2. Connect both TIMs using one interface each to a free interface of the respective R/H-CPU.
The "Network type" (parameter group "WAN settings") of the interfaces of the two TIMs that are connected with the CPU is "Neutral".
The TIMs communicate with the CPUs via their system IP address.
3. Connect the two TIM modules to each other using one Ethernet interface each (synchronization connection).
4. Select one of the two TIMs as primary TIM (the TIM active in normal operation).
To do this, set the "Network type" ("WAN settings" parameter group) of the interface of the synchronization connection to "Primary TIM".
5. If necessary, change the device redundancy port (default setting 5000).
The Device redundancy ID is assigned automatically by default and displayed for both TIMs of the redundancy group.
Alternatively, you can configure the Device redundancy ID manually. In this case, however, the consistency is not checked by STEP 7.
6. Configure the other TIM in the redundancy group as backup TIM (the TIM that is passive in normal operation).
To do this, set the "Network type" ("WAN settings" parameter group) of the interface of the synchronization connection to "Backup TIM".
Under the number of the device redundancy port, the value that you configured for Primary TIM is shown for the Backup TIM.
7. For the backup TIM, select the primary TIM from the "Primary TIM" drop-down list in the "Device redundancy" parameter group.

8. Configure "WAN type" and "Network type" of the two other Ethernet interfaces of the TIM as follows:
 Interface to the CPU: "IP-based" / "Neutral"
 Interface to the Ethernet CP in the PCS 7 PC (master PC):
 - DNP3: "IP-based" / "DNP3", Network node type "Station"
 - IEC: "IP-based" / "IEC 60870-5", Network node type "Station"
9. Assign the primary TIM to your local CPU to which it is connected (parameter group "Subscriber numbers").
 If the redundancy group was created beforehand, the backup TIM is then automatically assigned to the primary CPU.

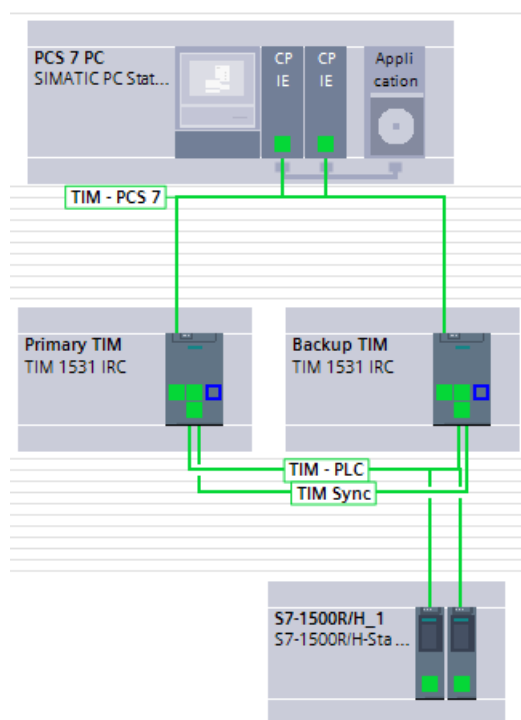


Figure 4-7 Configuration in STEP 7

Then configure the telecontrol connections, the remaining parameters, tags and data points, etc.

Synchronization connection: Secure communication

For the synchronization connection between the redundant TIM modules, you can configure secure communication via the following parameter group:

- Interface > WAN settings > Device redundancy > Secure Communication (TLS)
 - Own certificate ID
ID of own certificate
 - Certificate ID of redundancy partner
ID of the other TIM in the redundancy group
 - Session key exchange interval
Time (minutes) after which the session key is renewed.
The values configured for the two TIMs should be coordinated to one another.

Note

Note that the data transmission speed is reduced for connections secured via TLS.

Points to note when configuring the TIM with device redundancy

The primary TIM is configured in the usual way.

Identical parameters with primary TIM and backup TIM

The following data is identical for both TIMs of the redundancy group. When configured on one TIM, this data is taken over by the other redundant TIM:

- Address on the application layer
The station address/ASDU address of the redundancy group is identical.

Takeover of primary TIM data by the backup TIM

You following functions and parameters are configured in the same way for the primary TIM and backup TIM. A TIM takes the configuration data from the other redundant TIM in each case:

- Basic settings (except IP routing)
- Communication type
- Interface of synchronization connection > WAN settings > Device redundancy
 - Device redundancy > Device redundancy ID
With automatic creation, the device redundancy ID is formed after the primary TIM is compiled.
With consistent configuration, the same ID is applied for the backup TIM.
See the note below (configuring and loading).
 - Secure Communication (TLS) > Enable secure communication
Enabling secure communication (TLS) takes effect on both TIMs.
The three further parameters are configured independently for the two TIMs.

- Communication with the CPU:
 - Cycle idle time
 - Write/read jobs
- E-mail configuration
Note:
E-mail sending is not supported by the backup TIM.
- Subscriber numbers:
 - Assigned CPU
You need to enter the communication certificate of the CPU in both TIMs separately.
 - Station address / ASDU address
Primary TIM and backup TIM have the same station address.
- Log settings
- SNMP
- Protection
- Configuring data points and messages in the data point editor
The data point editor is disabled in the backup TIM.

Manual configuration in both TIMs of the redundancy group

The following data must be configured individually for each TIM of the redundancy group:

- General
- Communication types
- Basic settings > IP routing
- Settings of interfaces, especially DHCP, IPv6 parameters, routing, etc.
- Interface of synchronization connection > WAN settings > Device redundancy > Secure Communication (TLS)
With enabled secure communication (TLS), the three parameters are configured independently for both TIMs; see above.
- Web server
- Web diagnostics
- DNS configuration
- Communication with the CPU: Watchdog bit, partner status
The "manual query" of partners is not possible with the redundant TIM.
- Time-of-day synchronization
- Subscriber numbers
The backup TIM takes the assigned CPU and the station address from the primary TIM.
You need to enter the communication certificate of the CPU in both TIMs separately.

- Certificate manager
The primary TIM and the backup TIM have their own communication certificates.
- Telecontrol connections
Only the primary CPU can be selected as endpoint of the telecontrol connections of the redundancy group.
When the telecontrol connection between primary TIM and master is created, the connection paths of the backup TIM are also found when the connection paths are added; see below for more on this.
Secure communication (TLS) cannot be configured for these connections.

Telecontrol connections

After both connection paths of the telecontrol connection of the redundancy group are selected and added, they are shown in the table of connections.

Before creating the connections in the connection table, show the "End interface/address (red.)" parameter.

- The start point of the connection in the following example is the primary CPU "1500H_1".
- The start interface of the two connection paths is the Ethernet interface X3 of:
 - TIM_R1 (primary TIM)
 - TIM_R2 (backup TIM)
- Endpoint of the connection (master) is the PCS 7 application in this case, the interfaces are the two PC CPs "IE_1" and "IE_2".

If you click the "Add new connection path" button after creating the connection, four connection paths should be found.

Add connection paths			
Select a connection path for connection "Section_1".			
Module name	Subscriber number	Networks	
1500H_1 > TIM_R1 > PCS_7	3 > 3 > 4	PN/IE_11 > PN/IE_14	
1500H_1 > TIM_R1 > PCS_7	3 > 3 > 4	PN/IE_11 > PN/IE_14	
1500H_1 > TIM_R2 > PCS_7	3 > > 4	PN/IE_11 > PN/IE_14	
1500H_1 > TIM_R2 > PCS_7	3 > > 4	PN/IE_11 > PN/IE_14	

Figure 4-8 Add new connection path: Four found connection paths

Add all four connection paths.

After the four connection paths have been applied, the connections of the redundancy group should look similar to the following figure.

Telecontrol connections									
Connection	Start point	Start su...	Start interface	End point	End...	Ext...	Partner list	End interface/address	
Section_1	PLC-9a_dnp	100	TIM_9a_dnp - Ethernet interface [X1]	APPL PCS_7.PCS 7 ...	1	1	1,100	PCS_7 - IE general_1...	
Section_2	PLC-9a_dnp	100	TIM_9b_dnp - Ethernet interface [X1]	APPL PCS_7.PCS 7 ...	1	1	1,100	PCS_7 - IE general_2...	

Figure 4-9 Example (DNP3): Telecontrol connections of the redundant TIM 1531 IRC

In each of the two connections, the end interface and the redundant end interface receive a different CP of the PC station. The redundancy group consists of four connections.

Compiling and loading

Note

Compiling and loading the redundant TIMs

1. Always compile the primary TIM first and then the backup TIM.
 - Do not make any more changes to the configuration after compiling.
If you do need to make a change, compile both modules again afterwards in the specified order.
 - After compiling, make sure that the device redundancy ID of both modules is identical.
2. Always load the primary TIM first and then the backup TIM.

Switchover in redundancy mode

In normal operation, only the primary TIM sends data to the master. The backup TIM holds the frames in its send buffer without sending them. After acknowledgment by the master, the backup TIM also deletes the corresponding frames from the send buffer.

A switchover of send activity from the primary TIM to the backup TIM is only performed in the following cases:

- The connection of the primary TIM to the master fails.
The backup TIM now becomes the active TIM.
- Only with IEC:
The master switches over.

As soon as the configured active connection of the primary TIM returns after a failure, a switch back to the normal state takes place.

Failure of the synchronization connection

If the synchronization connection fails, both TIMs become active.

If the synchronization connection between the two TIMs fails, this can be indicated by sending an event to the master (data point > "Trigger" tab > Station state event type "Status of redundancy synchronization connection changed").

4.8 Serial interface

4.8.1 WAN parameters

You network the interface using the "Subnet" drop-down list.

WAN address

Here, you define the length of the optional address field (LADDR) for the link layer address.

- **Address format (2-byte address)**

Please note: The address format must be the same for all stations of the IEC network (60870-5-101).

- When the option is disabled, the ASDU address is saved in 1 byte (least significant byte of the word).
The range of values for the link layer address is 1...255.
- If the option is enabled, the address range of the link layer address (see below) is increased to 1...65535.

- **WAN address**

Optional link layer address of the interface

Standard range of values: 1...255

Increased range of values with enabled "2-byte address" parameter: 1...65535

4.8.2 Advanced options

4.8.2.1 Dedicated line

Settings dedicated line

Settings serial interface

- **Interface standard**

Standard of the serial interface: RS-232 / RS-485

Select the following value:

- RS-232
When a modem with an RS-232 interface is connected to the interface of the TIM
- RS-485
When a modem with an RS-485 interface is connected
With parallel connection of several modems to the interface of the TIM (star-shaped network)

- **RS-485 termination**

Enable this option when connecting a terminating resistor for the RS-485 bus when a star-shaped network is connected.

Time options

- **Send delay time (after RTS)**

The Send delay time (after RTS) (ms) is started after RTS is set.

- Value = 0
The module waits to send data until it receives the CTS signal (ready to send) from the modem.
- Value > 0
The module does not wait for the CTS signal of the modem, but sends as soon as the configured time has elapsed.

Default setting: 0. Permitted range: 0...65535 ms

- **Send delay time (after CTS)**

The delay time (ms) is used when readiness to send (CTS signal) is received from the modem and when 0 (zero) has been configured for the "Send delay time (after RTS)".

- Value = 0
Transmission is not delayed until the CTS signal of the modem.
- Value > 0
As soon as the CTS signal is received from the modem, the send delay time is started. Sending starts after the time has elapsed.

Default setting: 0. Permitted range: 0...65535 ms

- **RTS off delay**

Only configurable with: TIM 1531 IRC

The RTS OFF delay (ms) defines when the module takes back the RTS signal after sending.

- Value = 0
The module takes the RTS signal back immediately after sending the last character.
- Value > 0
Once the last character has been sent, the RTS OFF delay elapses before the module takes back the RTS signal.

Default setting: 0. Permitted range: 0...65535 ms

4.8.2.2 Dialup network

Settings dialup network

Settings serial interface

- **Interface standard**

Standard of the serial interface: RS-232 / RS-485

Select one of the following values:

- RS-232

When a modem is connected to the interface of the TIM

- RS-485

Connection of the internal terminating resistor of the TIM

With parallel connection of several modems to the interface of the TIM (star-shaped network)

- **RS-485 termination**

Enable the option when connecting a terminating resistor for the RS-485 bus when a star-shaped network is connected.

Call parameters

- **Dialing command**

Dialing command for the local modem

Possible values:

- D (AT command)

- DP (AT command, pulse dialing)

- DT (AT command, tone dialing)

When possible use the dialing command "D".

- **Dialing prefix**

Access number (outside line) for a private branch exchange (typical entry 0 or 9) or for an alternative telephone provider.

Permitted range: Max. 12 digits

With direct connection to the dial-up network and without an alternative telephone provider, this parameter can remain empty.

- **Own phone number**

Entry of your own telephone number for the network node including the area code.

Permitted values:

- Digits 0 ... 9

- Plus character (+) as placeholder for the trunk prefix (usually 00 or 09) before the international area code

Example: +1230123456789

AT initialization

- **User-defined**

If the option is enabled the AT initialization string for the basic settings of the modem can be assigned manually.

If the option is disabled, the AT initialization string is preset for the specific modem:

- MD3 : AT\$45=3\N0F0&W
- MD4 : AT\$45=83\$P1\N0&W

- **Initialization string**

Input box for the AT initialization string

Time options

- **Dial test interval**

The test interval (min) is started when no connection could be established by the communications module after 3 attempts. When the test interval elapses, the communications module attempts to establish a connection again.

If it fails to establish the connection again, the test interval is restarted.

If a new frame is pending for transfer during the test interval in a master station TIM, the TIM attempts to establish a connection immediately.

Default setting: 5. Permitted range: 0...255

- **Max. connection duration**

Only for interfaces with the Network node type "Master station".

Maximum connection duration (s) for a dial-up connection. When the time elapses, the connection is terminated. Frames that are still pending for transmission in the station are transferred the next time a connection is established.

With 0 (null), the dial-up connection is retained until all pending data has been transferred.

Default setting: 5. Permitted range: 0...65535

- **Repetition factor**

The repetition factor determines how often a data frame that has not been acknowledged positively is repeated.

Mobile wireless settings

Communication using mobile wireless networks is not supported.

4.8.2.3**Transmission settings**

You will find the specific parameters of the telecontrol protocol in the section IEC parameters of interfaces (Page 70).

4.9 IEC parameters of interfaces

4.9.1 Transmission settings - IEC 60870-5

Transmission settings - IEC 60870-5

- **ACTTERM**
Enables the sending of acknowledgments with the cause of transmission ACTTERM (cause of transmission <10>).
With this, the end of command processing is signaled to the partner.
With direct communication between two stations, ACTTERM must be configured identically for both partners.
- **Max. time between Select and Operate**
Max. duration (seconds) between Select and Operate. For a Select command to be transferred to the CPU and to take effect, no other frame may be sent to the station between Select and Operate.
Permitted range: 1..65535
Default setting: 1
You define the mode of command processing for each individual command data point, see Command options (Page 163).
- **Monitoring time for connection establishment (t_0)**
Monitoring time for the connection establishment (t_0) in seconds. If the communication partner does not confirm connection establishment within the monitoring time, the module attempts to establish the connection again.
Permitted range: 1..255
Default setting: 30
- **Frame monitoring time (t_1)**
Monitoring time in seconds for the acknowledgement of frames sent by the module by the communication partner. The monitoring time applies to all frames sent by the module in I, S and U format.
If the partner does not send an acknowledgment during the monitoring time, the module terminates the connection to the partner.
Permitted range: 1..255
Default setting: 15

Note**Settings on the master**

When configuring the monitoring times t_1 and t_2 make sure that you make the corresponding settings on the master so that there are no unwanted error messages or connection aborts.

- **Monitoring time for S and U frames (t_2)**
Monitoring time in seconds for the acknowledgment of data frames of the master by the module.
After receiving data from the master, the module acknowledges the received data either:
 - If the module sends data to the master itself within t_2 , it acknowledges the data frames received from the master during t_2 at the same time along with the sent data frame (I format).
 - The module sends an acknowledgment frame (S format) to the master at the latest when t_2 elapses.
 Permitted range: 1 ... 255
 Default setting: 10
 The value of t_2 should be less than that of t_1 .
- **Idle time for test frames (t_3)**
Monitoring time in seconds during which the module does not receive any frames from the master.
When t_3 elapses, the module sends a test/control frame (U format) to the master.
This parameter is intended for situations in which longer idle periods occur; in other words, times when there is no data traffic.
Permitted range: 1 ... 255
 Default setting: 30
- **Difference (k) between N(S) and N(R)**
The difference between the send sequence number $N(S)$ and receive sequence number $N(R)$ of a frame.
The master returns the send sequence number of a frame from the module as acknowledgment, which the sending module then saves as the receive sequence number. Frames whose send sequence number is lower than the receive sequence number after the difference configured here is added are evaluated as having been successfully transferred and are deleted from the send buffer of the module.
Permitted range: 1 ... 64
 Default setting: 12
- **Max. no. of unacknowledged data frames (w)**
w: Maximum number of received data frames (I-APDUs), after which the oldest frame received from the master must be acknowledged.
Permitted range: 1..8
 Default setting: 8
 The value must be less than the value of "Difference between send and receive sequence number" (k).

Acknowledgment mechanism for the IEC protocol

With each sent data frame, the RTU sends a continuous send sequence number. The data frame remains initially stored in the send buffer.

Upon reception, the master sends the send sequence number from this or (if several data frames are received) the last data frame back to the module as an acknowledgment. The module stores the send sequence number returned by the master as the reception sequence number and uses it as acknowledgment.

Frames whose send sequence number is equal to or lower than the current receive sequence number are evaluated as having been successfully transferred and are deleted from the send buffer of the module.

Recommendations of the specification:

- w should not be higher than $2/3$ of k .
- Recommended value for k : 12
- Recommended value for w : 8

4.9.2 Settings IEC master

IEC master

You can find the following parameters in the "Settings IEC master" parameter group of the interfaces of the communications module configured at the IEC network type and the "Master station" network node type.

- **Polling basic interval**

This is where you define the basic interval for station calls by the master station.

Value range: 0 ... 65535 seconds

Default: 30

With the setting 0 (zero), the function is disabled. No cyclic polling takes place, not even for the parameters listed below, the calculation of which is based on the polling basic interval. The basic interval is used for the calculation of the following parameters in the connection configuration:

- Interval for general request
- Interval for counter general request
- Interval for group request
- Interval for counter group request

For information on the configuration, refer to the section Query options (Page 127).

- **Max. number of events per call**

Maximum number of events that can be sent in the response frame of the station after being called by the master station.

Range of values: 0 ... 65535

Default: 0

With the setting 0 (zero), the function is disabled (no limitation).

With respect to the "Partner monitoring time" parameter, see also the section Settings IEC station (Page 73).

4.9.3 Settings IEC station

Event settings

Requirements

- The network node type of the interface is "Station" or "Node station".
- The data points are of the same type.
- The indexes of the data points are in sequence without gaps.
Refer to section Data point index (Page 144).

Function

You can set the form of transfer for the data point types listed below. The settings apply to data points configured as event (triggered).

The function corresponds to the "SQ" bit of the "VARIABLE STRUCTURE QUALIFIER field" according to IEC 60870-5-101.

- **Transfer behavior**
 - Single transfer:
The object address is transferred individually.
SQ = 0
 - Sequential transfer
The object addresses are created contiguously to save data volume during transfer.
SQ = 1

Settings of supported data point types

When Transfer behavior = "Sequential transfer" is configured, the following parameters apply to the listed data point types.

Transfer of the buffered events is triggered as soon as one of the two following conditions is met.

- **Number of events**
Transfer when the configured number of buffered events has been reached.
- **Delay time**
Transfer when the configured delay time (seconds) has been reached.

If you configure 0 (zero), the respective function is disabled.

Other station-relevant parameters

The following station-relevant parameters are defined during configuration of the connections:

- Polling mode

For information on the configuration, refer to section Connection table (Page 118).

You can find other parameters in the following parameter groups:

- Response to general request / Assignment to group request (cause of transmission 20 - 41)
 - You configure the assignment of individual data points to a general request or group request in the data point configuration, see section "General" tab (Page 142).
 - You configure the intervals of the requests in the telecontrol connections, see section Query options (Page 127).

4.10 Configuring WAN networks

Parameters of classic WAN networks

First configure the parameter group "WAN settings" of the communications module interfaces, see section WAN settings of the interfaces (Page 52).

The most important settings of the interface are taken from the connected WAN network when a new network is generated.

The classic WAN networks, shown in blue in STEP 7, have the following parameter groups.

General

Like for any other network, this is where you configure the name and the S7 subnet ID.

Network settings

Network configuration

- **Protocol type**
The following telecontrol protocols may be available, depending on the module type:
 - ST7
 - DNP3
 - IEC 60870-5
- **Network type**
The network type is taken from the connected interface:
 - Dedicated line
 - Dialup network

Access method

Only with dedicated line

- **Access method**
The access method is preset and cannot be changed:
 - Polling

Frame parameters

The parameters are preset and cannot be changed.

- **Frame format**
 - FT1.2
- **Acknowledgment type**
 - Short acknowledgment (1 byte)
- **Repetition factor**

The repetition factor determines how often a data frame that has not been acknowledged positively is repeated:

 - 3
- **Max. frame length**

Maximum size of a data frame within the network:

 - 240

Network settings

- **Dependence on direction**

Direction dependency of the network

 - Duplex
 - Half duplex
- **Transmission speed**

Speed at which the communications module and modem communicate.
From the drop-down list, select a value that is supported by all connected modems.

Time-of-day synchronization

- **Enable time-of-day synchronization for WAN**

When the parameter is enabled, you specify whether the time for the time-of-day synchronization of the connected stations should be transmitted via the WAN network.

You specify the synchronization cycle if the parameter is enabled.

Note**Transfer of the setting by stations**

The connected TIM modules adopt the settings made here on the network.

For information on the time-of-day concept, see section Time-of-day synchronization (Page 41).

Station list

This is where you can find an overview table of the stations connected to the network with their most important parameters.

The WAN address is the station address.

4.11 Web server (TIM 1531 IRC)

The Web server of the TIM

The TIM provides you with the functionality of a Web server for access using a Web browser. The following functions are available via the Web server:

- Read access
 - A selection of diagnostics data
 - A selection of configuration data
- Write access
 - Setting the time
 - Firmware update
 - Module restart
 - Reset to factory settings
 - Recording of statistics values of the Ethernet interfaces

For a description of the content, refer to the manual for the TIM /2/ TIM 1531 IRC (Page 211).

Access rights via "Global security settings"

The rights for access to the Web server are configured in STEP 7 in the Global security settings. Only users created there can log on with the Web server using HTTP/HTTPS. The required rights for diagnostics, access to the Web server and reading and writing data are thus enabled.

You will find further help on the roles and rights of users in the STEP 7 information system.

Access to the Web server and starting Web diagnostics

To be able to connect to the Web server of the TIM, the relevant Ethernet interface must be activated; see also section Web server access (Page 55). As default access is disabled.

For information on starting Web diagnostics, see section Web diagnostics of the TIM 1531 IRC (Page 77).

"Web server" parameter group

General

- **Enable Web server on this module**
Enables data processing in the Web server of the TIM and allows access to this data.
- **Allow access only using HTTPS**
Allows access to the Web server only with the secure protocol HTTPS.

Note

"Allow access only using HTTPS" (security function enabled)

Note the following when the "Allow access only using HTTPS" option is enabled in the "Web server" parameter group:

- The data is transferred encrypted.

Requirements

- The roles specified above with the corresponding rights must be assigned to the user.
 - If the firewall is activated, the HTTP/HTTPS protocols must be allowed.
-

Automatic update

- **Enable automatic update**
Enables automatic updating of the displayed values.
If the option is disabled, only the values at the time of connecting to the Web server are displayed.
- **Update interval**
Select the interval at which you require an update of the displayed values.
Default setting: 30. Permitted range: 5...999

Overview of the interfaces

Here you can see the releasing access to the Web server via the Ethernet interfaces of the TIM.

You can activate access to the Web server of the TIM via HTTP/HTTPS for each individual Ethernet interface.

The settings for activation in the parameter groups "Web server access" and "Web server" are adopted reciprocally in the other parameter group.

4.12 Web diagnostics of the TIM 1531 IRC

Requirements

- The Web server of the module is enabled in the configuration, "Web server" parameter group, and the interface is selected.
- The interface is enabled for access to the Web server in the configuration, "Ethernet interface > Access to Web server" parameter group.

Starting Web diagnostics

1. Establish a physical connection between the engineering station and the SIMATIC station.
2. Set the PC interface in such a way that the module can be reached.
Further help is available in the "Set PG/PC Interface" dialog box.
3. In the STEP 7 project, click the "Web diagnostics" button under the "Web diagnostics" parameter group to establish the connection to the Web browser of the module.

The content is supplied by the integrated Web server of the module. For information on operation and on the contents, see the manual of the TIM /2/ TIM 1531 IRC (Page 211).

4.13 DNS configuration

DNS server

A DNS server may be required when the module itself, a communications partner, or for example an e-mail server should be reachable via the host name (FQDN).

DNS server for e-mail server address

During e-mail configuration, the address of the mail server via which the e-mails are sent must be specified. The address of the mail server can be specified as an IP address or as an FQDN.

If you specify the server address as an FQDN you need to configure a DNS server. In this case the IP address of the mail server is determined via the configured DNS server.

4.14 Communication with the CPU

Communication with the CPU

Here you specify parameters for the access of the communications module within the CPU sampling cycle.

- **Cycle idle time**
Wait time between two sampling cycles of the CPU memory area
- **Max. number of write jobs**
Maximum number of write jobs to the CPU memory area within a CPU sampling cycle
- **Max. number of read jobs**
Maximum number of low-priority read jobs from the CPU memory area within a CPU sampling cycle

You will find the structure of the CPU sampling cycle in section Read cycle (Page 147).

Watchdog bit

- **TIM monitoring / CP monitoring**

Via the watchdog bit, the CPU can be informed of the status of the telecontrol communication of the communications module.

CP time

- **CP time to CPU**

The function allows the CPU to read the time of day of the CP. Using this approach, the CP can synchronize the CPU time.

Procedure:

- The CPU sets the input "Time trigger variable" (BOOL) to 1 with the user program.
- The CP then writes its time to the "CP time variable" (DTL) and resets the "Time trigger variable" value to 0.
- The user program reads the "CP time variable" to set the CPU time.

Recommendation:

Set the "Time trigger variable" no more frequently than once per second to avoid placing an unnecessary communication load on the backplane bus.

CP diagnostics

With the parameter group, you have the option of reading out advanced diagnostics data from the CP using PLC tags.

- **Enable advanced CP diagnostics**

Enable the option to use advanced CP diagnostics.

If the option is enabled, at least the "Diagnostics trigger tag" must be configured.

The following PLC tags for the individual items of diagnostics data can be enabled selectively, depending on the functions supported by the CP.

- **Diagnostics trigger tag**

If the PLC tag (BOOL) from the user program of the CPU is set to 1, the CP updates the values of the following PLC tags for the advanced diagnostics.

After writing the current values to the following PLC tags, the CP sets the "Diagnostics trigger tag" to 0, signaling to the CPU that the updated values can be read from the PLC tags.

Note

Fast setting of the diagnostics trigger tag

Trigger should not be set more often than once per second.

- **Frame memory overflow warning**

PLC tag (data type Byte) for the send buffer overflow pre-warning. Bit 0 is set to 1 when 80% of the fill level of the send buffer is reached.

- **Frame memory occupation**

PLC tag (data type DWord) for the occupation of the send buffer. The number of saved frames is specified.

- **Current IP address**

PLC tag (data type String) for the current IP address of the interface of the CP.

- **VPN IPsec status**
The PLC tag (BOOL) indicates whether a VPN IPsec tunnel is established:
 - 0 = No tunnel established
 - 1 = Tunnel established
- **Connection to SINEMA Remote Connect**
The PLC tag (BOOL) indicates whether there is a connection to the SINEMA RC server:
 - 0 = No connection established
 - 1 = Connection established

PLC tags for partner status / path status

Via the PLC tag that can be configured here, you can monitor the following information about the reachability of the communications partners:

- **Partner status**
Reachability of the remote communications partner
- **Path status**
Status of the connection path or the redundant connection paths to the remote communications partner
For information on communication and the possible connection paths, see section Communications options (Page 29).

For every configured communications partner to which a single or redundant telecontrol connection is created, you can create a PLC tag of the type Word.

Assignment of the PLC tags for partner status / path status

In the two bytes of the PLC tag of the data type Word (DB, memory bit, output) the following information is output:

- **Byte 0: Partner status**
- **Byte 1: Path status**

Byte 0 "Partner status"

Byte 0 codes information on the reachability of the communications partner, on the existing connections and connection paths and on the status of the send buffer of the TIM.

Table 4-1 Assignment of byte 0: Meaning of the bit statuses

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Path redundancy	Connection mode	Temporary connection *	(Reserved)	Frame memory **		Path status	Partner status
0: No redundancy 1: Redundancy exists	0: Permanent 1: Temporary	0: Partner not reachable 1: Partner reachable *	-	0: Send buffer OK 1: Memory occupation > 80 % 3: Overflow (memory allocation 100 %)		0: Not all paths reachable 1: All paths reachable	0: Partner not reachable 1: Partner reachable

* Partners that support temporary connections are set to "accessible" if the partner itself terminates the connection and there is no connection established.

** Status of the send buffer:

If Bit 2 or Bit 2+3 is set on a send buffer overflow or prewarning, the two bits are only reset when the memory occupation falls below 50%.

For information on the send buffer, see section Process image, type of transmission, event classes (Page 145).

Byte 1 "Path status"

Byte 1 shows the status of the connection path (configured connection) to the partner from the point of view of the local TIM.

A maximum of 2 paths (main and substitute path) to a partner can be configured, see section Communications options (Page 29).

Both connection paths must start or end on a local TIM.

The byte shows the following:

- The paths via which the partner can be reached.
- The path currently being used
- The TIM interface via which the main path was configured.
- The TIM interface via which the substitute path was configured.

The path of a connection is specified as a combination of the used interfaces of the TIM and the status of the path.

Byte assignment

Byte 1 is assigned as follows:

- Two bits for the interface of the main path
- Two bits for the interface of the substitute path
- Two bits for the status of the main path
- Two bits for the status of the substitute path

Table 4-2 Assignment of byte 1

Bits 6 + 7	Bits 4 + 5	Bits 2 + 3	Bits 0 + 1
Configured interface		Path status	
Coding for substitute path	Coding for main path	Substitute path (2nd path)	Main path (1st path)

- Configured interface**

The TIM interfaces "Ethernet 1" (IE1), "Ethernet 2" (IE2), "Ethernet 3" (IE3) and WAN1 are numbered through from 0 . 3 (decimal):

- 0 = Ethernet interface IE1 (X1)
- 1 = Ethernet interface IE2 (X2)
- 2 = Ethernet interface IE3 (X3)
- 3 = Serial interface WAN1 (X4)

Status of bit 5 (7)	Status of bit 4 (6)	Meaning
0	0	Coding for Ethernet interface X1 (decimal: No. 0)
0	1	Coding for Ethernet interface X2 (decimal: no. 1)
1	0	Coding for Ethernet interface X3 (decimal: no. 2)
1	1	Coding for serial interface X4 (decimal: no. 3)

- Path status**

- Main path = 1. Path (bits 0 + 1)
- Substitute path = 2nd path (bits 2 + 3)

Status of bit 1 (3)	Status of bit 0 (2)	Meaning bit 1	Meaning bit 0
0	0	Bit 1: Path not current	Bit 0: Subscriber not reachable
0	1	Bit 1: Path not current	Bit 0: Subscriber reachable
1	0	Bit 1: Path current	Bit 0: Subscriber not reachable
1	1	Bit 1: Path current	Bit 0: Subscriber reachable

Coding options of byte 1

Same coding of the configured interface for the main and the substitute path means that there is no path redundancy (only one interface configured). The path status is output via the bits of the main path (1st path).

Table 4-3 Coding options for the path status

Configured interface		Path status	
Coding for substitute path	Coding for main path	Substitute path (2nd path)	Main path (1st path)
0 0	0 0 (Coding for IE1)	Irrelevant (not redundant)	Status IE1
0 0	0 1 (Coding for IE2)	Status IE1	Status IE2
0 0	1 0 (Coding for IE3)	Status IE1	Status IE3

Configured interface		Path status	
0 0	1 1 (Coding for WAN1)	Status IE1	Status WAN1
0 1	0 0	Status IE2	Status IE1
0 1	0 1	Irrelevant (not redundant)	Status IE2
0 1	1 0	Status IE2	Status IE3
0 1	1 1	Status IE2	Status WAN1
1 0	0 0	Status IE3	Status IE1
1 0	0 1	Status IE3	Status IE2
1 0	1 0	Irrelevant (not redundant)	Status IE3
1 0	1 1	Status IE3	Status WAN1
1 1	0 0	Status WAN1	Status IE1
1 1	0 1	Status WAN1	Status IE2
1 1	1 0	Status WAN1	Status IE3
1 1	1 1	Irrelevant (not redundant)	Status WAN1

Manual request

Option to manually trigger a single request of a communication partner or a General Interrogation (IEC)

Validity

The function is supported by:

- TIM 1531 IRC $\geq$ V2.4 together with an S7-300 / 400 / 1500 CPU
- CP 1243-1, CP 1243-8 $\geq$ V3.6
- CP 1542SP-1 IRC $\geq$ V2.3

Functions

In addition to the requests of the master station or master during startup, the option offers the possibility of a manually initiated request using a tag of the CPU.

This option supports the following request types:

- Single or group requests of communication partners (sequential single requests)
- General Interrogation (sequential single requests)

The following applies generally:

Requests can only be made on a station-specific basis. Requesting of multiple stations must be carried out sequentially.

The request is initiated by the tag "Read request". The request type and the addresses are also specified in this tag. The tag contains a user data type, which you must create beforehand.

The result of the request is written to the tag (Byte) "Read result", which can be evaluated by the CPU or the user.

Requirements

- The master function of the data points is enabled.
- Cyclic polling must be disabled.

Tags

The following tags are needed for the request function:

- **Partner request**

A special data type, which you must create as a user data type (UDT), is needed for initiating the request and specifying the request type and the addresses. Proceed as follows:

- Navigate to the "PLC data types" entry of the assigned CPU in the project tree.
- Click the "Add new data type" entry.
- Create the required elements of the UDT (see next section).

	Name	Data type	Default ..	Accessible ...	Writable..	Visible ...	Setpoint
	StartFlag	Byte	16#0	☒	☒	☒	☐
	RequestType	Byte	16#0	☒	☒	☒	☐
	StationAddress	Word	16#0	☒	☒	☒	☐
	ObjectAddress	DWord	16#0	☒	☒	☒	☐

Figure 4-10 Structure of the UDT

- Create a data block in which you insert the previously created UDT.
The UDT can be selected in the drop-down list of the data types under the name you assigned.

For the tag "Partner request", reference the tag of the UDT created for it in the data block you create.

- **Request result**

For the result of the request, create a tag of type Byte and reference it as the tag "Request result".

Structure and coding of the "Partner request" UDT

Structure and contents of the UDT for the IEC 60870-5 protocol:

Data type	Parameter	Range of values and meaning
Byte	Start flag	The TIM starts the request at a 0 → 1 change. After execution of the request, the TIM resets the value to 0.
Byte	Request type	For the range of values, see below
Word	Station address	0 ... 65534
DWord	Object address	1 ... 16777215 The object address remains empty (value = 0) if it is not needed.

Table 4-4 Coding of the "Request type" parameter

Request type	Value
Global Interrogation	1
Group 1 Interrogation	2
Group 2 Interrogation	3
Group 3 Interrogation	4
Group 4 Interrogation	5
Group 5 Interrogation	6
Group 6 Interrogation	7
Group 7 Interrogation	8
Group 8 Interrogation	9
Group 9 Interrogation	10
Group 10 Interrogation	11
Group 11 Interrogation	12
Group 12 Interrogation	13
Group 13 Interrogation	14
Group 14 Interrogation	15
Group 15 Interrogation	16
Group 16 Interrogation	17
Counter Interrogation	18
Group 1 Counter Interrogation	19
Group 2 Counter Interrogation	20
Group 3 Counter Interrogation	21
Group 4 Counter Interrogation	22
Selective request of one object *	23

* The single request of count values is not supported.

Coding of the "Request result" byte

The results of the request are written to the tag "Request result". You need to reset the "Query result" byte manually via the user program after a query.

The values have the following meaning:

Value (hex)	Meaning
No result:	
0x00	No result
"Result OK":	
0x01	OK
"Partner not OK":	
0x88	Station not OK
Error:	
0x80	Error
0x81	Station unknown

Value (hex)	Meaning
0x82	Type unknown
0x83	Group unknown
0x84	Variation unknown
0x85	Timeout
0x86	Already active
0x87	Rejected
0x89	Rejected by partner
0x90	Request incomplete
0x91	Object unknown to the partner

Control of requests

You control the requests in the user program of the CPU.

You set the start flag, which initiates a request, and the respective contents of the parameters "Request type", "Station address" and "Object address" via the CPU.

Note

Recommendation

Set the start flag after you have set all the other parameters.

For the request of various stations, groups or objects, the relevant contents in each case must be written to the UDT by the user program.

4.15 E-mail configuration

Configuring e-mails

In the "E-mail configuration" entry, you configure the protocol to be used and the data for access to the e-mail server.

In the message editor ("Messages" entry), you configure the individual e-mails, see section Messages (Page 172).

Requirements for e-mail

Note the following requirements in the CP configuration for the transfer of e-mails:

- The security functions are enabled.
- The time of the CP is synchronized.

For the configuration, you require the data of the SMTP server and the user account:

- Server address, port number, user name, password, e-mail address of the sender (CP)
- With encrypted transfer: Server certificate

E-mail configuration

If you want to use the secure transfer of e-mails, the module must have the current date and the current time of day.

With the default setting of the SMTP port 25, the module transfers unencrypted e-mails.

If your e-mail service provider only supports encrypted transfer, use one of the following options:

- Port no. 587
By using STARTTLS, the module sends encrypted e-mails to the SMTP server of your e-mail service provider.
Recommendation: If your e-mail provider offers both options (STARTTLS / SSL/TLS), you should use STARTTLS with port 587.
- Port no. 465
By using SSL/TLS (SMTPS), the module sends encrypted e-mails to the SMTP server of your e-mail service provider.

Ask your e-mail service provider which option is supported.

On configuration of the passwords, see Character set for user names, passwords and messages (Page 177).

Importing the certificate with encrypted transfer

To be able to use encrypted transfer, you need to load the certificate of your e-mail account in the certificate manager of STEP 7. You obtain the certificate from your e-mail service provider.

Use the certificate by taking the following steps:

1. Save the certificate of your e-mail service provider in the file system of the engineering station.
2. Import the certificate into your STEP 7 project with "Global security settings > Certificate manager".
3. Use the imported certificate with every module that uses encrypted e-mails via the "Certificate manager" table in the local "Security" parameter group.

For the procedure, refer to the section Certificate manager (Page 102).

4.16 Subscriber numbers

4.16.1 Subscriber numbers

In this folder, you configure the station address and the assignment of the CPU depending on the communications module:

- **CP**
 - ASDU address
ASDU address of the station
The communication module and the station (CPU) have the same ASDU address.
 - Structured ASDU address
Structured ASDU address of the station

The CPU is assigned automatically to the communications module via the rack.
- **TIM**
 - Assigned CPU
The drop-down list only shows the CPUs that are networked with the TIM.
 - Password of the assigned CPU
If the assigned CPU is protected with "No access (complete protection)", enter the password that is configured for the CPU under "Protection & Security > Access level".
 - ASDU address
ASDU address of the station
The communication module and the station (CPU) have the same ASDU address.
 - Structured ASDU address
Structured ASDU address of the station

The ASDU address must be unique within a subnet and within the STEP 7 project.

Observe the basic addressing policies in the section Addressing (Page 29).

Other subscriber numbers

- **Third-party device**
For third-party devices, for example masters outside of the STEP 7 project, you configure the subscriber number in the telecontrol connection.
- **RTU3000C**
 - **Subscriber number of the CPU (RTU)**
Here, you assign the subscriber number of the CPU as it was configured in the WBM of the RTU.

For information on configuring the RTU, see Communication types (Page 33).

Assignment of the CPU and configuration of the subscriber addresses

For modules that communicate via telecontrol connections ("Network data" editor), you assign the CPU and configure the module addresses in the "Subscriber numbers" parameter group.

- **Assigned CPU**

With the following communications modules, which are located in the same rack as the CPU, the local CPU is automatically assigned to the module:

- CPs (S7-1200, ET 200SP)

For communication modules that are not in the same rack as a CPU, you must assign the module to a CPU with which it is networked via the drop-down list. This affects:

- TIM 1531 IRC

The TIM 1531 IRC can be assigned a CPU of the following SIMATIC families: S7-300, S7-400, S7-1500, ET 200SP

When you assign the TIM 1531 IRC to an S7-1500R/H CPU, the system IP address of the S7-1500R/H CPU is used for communication of the TIM with the CPU.

Structured addressing of the IEC protocol

The ASDU address can be configured in two input fields with different formats:

- ASDU address

The address is configured unstructured here as an integer.

Range of values: 0..65534

- Structured ASDU address

You can configure the address structured according to IEC 60870-5-3 here. Plant-based structuring of the ASDU address is enabled by structured addressing.

Two address levels (octets) can be configured.

Range of values: 0.0..255.254

The configured values of the two fields are linked. A configured value is converted and displayed in the other input field.

Conversion of the values:

The values are designated as follows for the conversion:

- ASDU address

Designation of the integer value: X

- Structured ASDU address

Designation of the values of the 2nd octet: A.B

The configured value is applied to the other field according to the following formula:

$$X = A * 256 + B$$

Secure communication with certificates

With the TIM 1531 IRC communications module that is not in the same rack as the CPU, you need to specify the certificate of the CPU in the following cases:

- TIM 1531 IRC
together with

- CPU 1500 / CPU 1500SP-1 as of version V2.9

Additionally for ST7:

- You use TD7onTIM
When TD7onCPU is used, assigning the CPU to the TIM is not permitted.
For information on the configuration, see "Basic settings > Configuration > Telecontrol configuration > Configure".

Creating the CPU certificate and assigning the CPU

For information on requirements and the procedure, see TIM 1531 IRC: TLS certificate of the CPU (Page 90).

4.16.2 TIM 1531 IRC: TLS certificate of the CPU

Validity

The procedure described below relates to:

- TIM 1531 IRC V2.3 as of firmware version V2.3
Together with CPU 1500 as of firmware version V2.9

The communications modules use TLS 1.2; communication complies with IEC/TS 62351-3.

Communication between CPU and telecontrol module

CP: Communication via backplane bus

If the CPU and telecontrol CP are in the same rack, communication between them runs via the backplane bus. The CPU is automatically assigned to the telecontrol CP.

TIM 1531 IRC: Communication with CPUs via Ethernet

The TIM 1531 IRC is not inserted in the rack of the CPU. The TIM can be connected with one or more CPUs via Ethernet. The CPU used for telecontrol communication must be assigned to the TIM.

TIM 1531 IRC: TLS communication with the CPU

The connection of the TIM to the CPU uses secure communication via TLS for all telecontrol protocols supported by the TIM.

For communication via TLS, you need to use a newly created CPU certificate and specify it to the TIM in the "Subscriber numbers" parameter group.

Order of steps

1. First create a new certificate for the CPU (see below).
2. Then network the TIM with the CPU.
3. Then assign the CPU to the TIM.
With this order of steps, the certificate is automatically applied to the subscriber configuration of the TIM.

If you first assign the CPU to the TIM and then create the CPU certificate, you need to look up the ID of the CPU certificate and enter it manually in the subscriber configuration of the TIM or delete the CPU from the "Assigned CPU" field and then assign it again.

Creating the CPU certificate and assigning the CPU 1500

Requirements

The following requirements must be met in order to create and assign certificates:

- As STEP 7 project user, you have at least the rights of the "NET Administrator" role. For more on this, see "Security settings > Users and roles > Assigned roles". If you use the security functions of the S7-1500 V3.0, you also need a created user with the required rights; see Security user (Page 94).
- The devices have the required minimum firmware version, see above.
- The configuration data of the CPU is protected. For more on this, see "Protection & Security > Protection of confidential PLC configuration data"

To be able to assign your local CPU to the TIM 1531 IRC, the following requirements must be met:

- CPU and TIM 1531 IRC are networked.
- The desired telecontrol protocol is enabled for the TIM under "Communication types".

Creating the certificate of the CPU

Proceed as follows to create the CPU certificate:

1. For the CPU, select the parameter group "Protection & Security > Certificate manager > Global security settings".
2. Enable the "Use global security settings for certificate manager" option. The locally created certificate of the CPU present in the default setting cannot be used for TLS communication.

Note:

When the option is enabled, existing certificates of the CPU are deleted.

3. Go to "Protection & Security > Connection mechanisms > Communication to TIA Portal and HMI".
4. In the "PLC communication certificate" row, right-click on the icon for the drop-down list.

5. Click the "Create" button under the open drop-down list.
The "Create certificate" dialog opens. The following options must be selected or are recommended:

- Usage: TLS Server
- Certificate authority (CA): Signed by certification authority
- Common name of subject: Name of the selected CPU
- Encryption method: EC (recommended)
- Hash algorithm: sha256 (recommended)

If necessary, you can add another address type for the CPU under "Subject Alternative Name (SAN)".

6. Retain the settings and click "OK".
The newly created TLS certificate is shown in the CPU as "PLC communication certificate" and in the "Device certificates" table.

When the CPU is assigned to the TIM (see below), the ID of the newly created CPU certificate is automatically entered at the following locations:

- In the "Subscriber numbers" dialog of the TIM
- In the certificate manager of the TIM as partner certificate

Assign CPU to TIM 1531 IRC

1. For the TIM that is to communicate with the CPU, open the "Subscriber numbers" parameter group.
2. Right-click on the icon for the drop-down list in the "Assigned CPU" row.
The list of networked CPUs opens.
3. Select the CPU to be assigned to the TIM and click on the green checkmark below it.
The name of the CPU is displayed in the "Assigned CPU" row.
At the same time, the ID of the certificate created previously for the CPU is automatically displayed in the "Communication certificate" row.

Further configuration

Then configure the other stations as communication partners and the corresponding telecontrol connections.

4.17 Log settings

Log settings

Validity: TIM 1531 IRC

Events can be recorded in log files for monitoring. You can set how the events are recorded:

- **Local logging**
Messages on internal events and errors are saved in the diagnostics buffer of the TIM.
The following events can be recorded:
 - Audit log: Audit events
 - System log: System events
- **Network Syslog**
The messages on the events are sent to a Syslog server in UDP format according to RFC 5424 or RFC 5426. Details about the structure of the Syslog frames and the supported event buffer entries can be found in the section Security recommendations (Page 11).

You will find additional information on the functionality and configuration of the functions in the STEP 7 information system.

4.18 SNMP

SNMP

The scope of performance of the modules is given in the relevant manual.

If the security functions are enabled, you have the following selection and setting options, depending on the module.

SNMP

- **"Enable SNMP"**
If the option is enabled, communication via SNMP is released on the device. As default, SNMPv1 is enabled.
If the option is disabled, queries from SNMP clients are not replied to either via SNMPv1 or via SNMPv3.
- **"Use SNMPv1"**
Enables the use of SNMPv1 for the device. For information on the configuration of the required community strings see below (SNMPv1).
- **"Use SNMPv3"**
Enables the use of SNMPv3 for the device. For information on the configuration of the required algorithms see below (SNMPv3).

SNMPv1

The community strings need to be sent along with queries to the device via SNMPv1.

Note the use of lowercase letters with the preset community strings!

- **"Reading community string"**
The string is required for read access.
Leave the preset string "public" or configure a string.
- **"Allow write access"**
If the option is enabled write access to the device is released and the corresponding community string can be edited.
- **"Writing community string"**
The string is required for write access and can also be used for read access.
Leave the preset string "private" or configure a string.

Note**Security of the access**

For security reasons, change the preset and generally known strings "public" and "private".

SNMPv3

The algorithms need to be configured for encrypted access to the device via SNMPv3.

- **"Authentication algorithm"**
Select the authentication method to be used from the drop-down list.
- **"Encryption algorithm"**
Select the encryption method to be used from the drop-down list.

User management

In the user management that you will find in the global security settings, assign the various users their role.

Below the properties of the roles you can see the rights list of the particular role, for example the various types of access using SNMP. For new roles, you can freely configure individual rights.

You will find information on users, roles and the password policy in the information system of STEP 7.

4.19 Security and certificates

4.19.1 Security user

Creating a security user

You need the relevant configuration rights to be able to configure security functions. For this purpose, you need to create at least one security user with the corresponding rights.

Navigate to the global security settings > "User and roles" > "Users" tab.

1. Create a user and configure the parameters.
2. Assign this user the role "NET Standard" or "NET Administrator" in the area below "Assigned roles".

After logging on, this user can make the necessary settings in the STEP 7 project.

In the future, continue to log on as this user when working on security parameters.

Security functions of the S7-1500 V3.0 together with TIM 1531 IRC $\geq$ V2.4

To be able to use TLS connections of the TIM 1531 IRC together with the S7-1500 CPU $\geq$ V3.0, you need to enable "Legacy access control" for the CPU (parameter group "Protection & Security > Access control").

Security user for S7-1500 (general)

This section does not apply to the TIM 1531 IRC $\geq$ V2.4.

Follow these steps for configuration:

1. Create a new role with full access for the S7-1500.

Roles				
	Name	Description	Runtime time	
	Engineering administrator	System-defined role "Engineering ...	30	
	Engineering standard	System-defined role "Engineering ...	30	
	HMI Administrator	System-defined role "HMI Adminis...	30	
	HMI Operator	System-defined role "HMI Operator"	30	
	HMI Monitor	System-defined role "HMI Monitor"	30	
	HMI Monitor Client	System-defined role "HMI Monitor ...	30	
	HMI Online Configuration Engineer	System-defined role "HMI Online C...	30	
	NET Administrator	System-defined role "NET Adminis...	30	
	NET Standard	System-defined role "NET Standard"	30	
	NET Diagnose	System-defined role "NET Diagnos...	30	
	NewRole	User-defined role	30	Min
<Add new role>				

Engineering rights		Runtime rights		User-specific runtime rights							
Function rights categories											
Runtime rights		Function rights									
Runtime rights ^ ≡		<table border="1"> <thead> <tr> <th>Name</th> <th>Group</th> </tr> </thead> <tbody> <tr> <td>☐ User authentication o...</td> <td>OPC UA</td> </tr> <tr> <td>☒ Full access</td> <td>Access level</td> </tr> </tbody> </table>				Name	Group	☐ User authentication o...	OPC UA	☒ Full access	Access level
Name	Group										
☐ User authentication o...	OPC UA										
☒ Full access	Access level										
▼ S7-1500 V3.1 PLC_st7-3_iecM											

2. Create a new user to whom you assign the new role.

Users				
		User name	Password	Runtime t
	☐	Anonymous		
	☒	admin	*****	300
	☒	NewUser	*****	300
		<Add new user>		

Assigned user groups		Assigned roles		Assigned rights	
Assigned roles					
	Assigned to	Name	Description		
	☐	Engineering administrator	System-defined role "Engineering ...		
	☐	Engineering standard	System-defined role "Engineering ...		
	☐	HMI Administrator	System-defined role "HMI Adminis...		
	☐	HMI Operator	System-defined role "HMI Operator"		
	☐	HMI Monitor	System-defined role "HMI Monitor"		
	☐	HMI Monitor Client	System-defined role "HMI Monitor ...		
	☐	HMI Online Configuration Engineer	System-defined role "HMI Online C...		
	☐	NET Administrator	System-defined role "NET Adminis...		
	☐	NET Standard	System-defined role "NET Standard"		
	☐	NET Diagnose	System-defined role "NET Diagnos...		
	☒	NewRole	User-defined role		

4.19.2 Log settings - Filtering of the system events

Communications problems if the value for system events is set too high

If the value for filtering the system events is set too high, you may not be able to achieve the maximum performance for the communication. The high number of output error messages can delay or prevent the processing of the communications connections.

In "Security > Log settings > Configure system events", set the "Level:" parameter to the value "3 (Error)" to ensure the reliable establishment of the communications connections.

Use of SYSLOG only with 1 VPN connection

If you want to use SYSLOG with level 7 (debug) via VPN connections, this is only possible with a single configured VPN connection.

4.19.3 VPN

4.19.3.1 VPN (Virtual Private Network)

VPN - IPsec

Virtual Private Network (VPN) is a technology for secure transportation of confidential data in public IP networks, for example the Internet. With VPN, a secure connection (IPsec tunnel) is set up and operated between two secure IT systems or networks via a non-secure network.

The IPsec tunnel forwards all data even from protocols of higher layers (HTTP, FTP, etc.).

The data traffic between two network components is transported unrestricted through another network. This allows entire networks to be connected together via a neighboring or intermediate network.

Properties

- VPN forms a logical subnet that is embedded in a neighboring (assigned) network. VPN uses the usual addressing mechanisms of the assigned network, however in terms of the data, it transports its own frames and therefore operates independent of the rest of this network.
- VPN allows communication of the VPN partners with the assigned network.
- VPN is based on tunnel technology and can be individually configured.
- Communication between the VPN partners is protected from eavesdropping or manipulation by using passwords, public keys or a digital certificate (authentication).

Areas of application

- Local area networks can be connected together securely via the Internet ("site-to-site" connection).
- Secure access to a company network ("end-to-site" connection)
- Secure access to a server ("end-to-end" connection)
- Communication between two servers without being accessible to third parties (end-to-end or host-to-host connection)
- Ensuring information security in networked automation systems
- Securing the computer systems including the associated data communication within an automation network or secure remote access via the Internet
- Secure remote access from a PC/programming device to automation devices or networks protected by security modules via public networks.

Cell protection concept

With Industrial Ethernet Security, individual devices or network segments of an Ethernet network can be protected:

- Access to individual devices and network segments protected by security modules is allowed.
- Secure connections via non-secure network structures becomes possible.

Due to the combination of different security measures such as firewall, NAT/NAPT routers and VPN via IPsec tunnels, security modules protect against the following:

- Data espionage
- Data manipulation
- Unwanted access

4.19.3.2 Creating a VPN tunnel for S7 communication between stations

Requirements

To allow a VPN tunnel to be created for S7 communication between two S7 stations or between an S7 station and an engineering station with a security CP, the following requirements must be met:

- The two stations have been configured.
- The CPs in both stations must support the security functions.
- The Ethernet interfaces of the two stations are located in the same subnet.

Note

Communication also possible via an IP router

Communication between the two stations is also possible via an IP router. To use this communications path, however, you need to make further settings.

Procedure

To create a VPN tunnel, you need to work through the following steps:

1. Creating a security user
If the security user has already been created: Log on as this user.
2. Enable the "Activate security features" option
3. Creating the VPN group and assigning security modules
4. Configure the properties of the VPN group
5. Configure local VPN properties of the two CPs

You will find a detailed description of the individual steps in the following paragraphs of this section.

Select "Activate security features"

After logging on, you need to select the "Activate security features" check box in the configuration of both CPs.

You now have the security functions available for both CPs.

Creating the VPN group and assigning security modules

1. In the global security settings, select the entry "Firewall" > "VPN groups" > "Add new VPN group".
2. Double-click on the entry "Add new VPN group", to create a VPN group.
Result: A new VPN group is displayed below the selected entry.
3. In the global security settings, double-click on the entry "VPN groups" > "Assign module to a VPN group".
4. Assign the security modules between which VPN tunnels will be established to the VPN group.

Note

Current date and current time on the CP for VPN connections

Normally, to establish a VPN connection and the associated recognition of the certificates to be exchanged, the current date and the current time are required on both stations.

The establishment of a VPN connection to an engineering station that is also the telecontrol server at the same time (TCSB installed), runs as follows along with the time of day synchronization of the CP:

On the engineering station (with TCSB), you want the CP to establish a VPN connection. The VPN connection is established even if the CP does not yet have the current time. Otherwise the certificates used are evaluated as valid and the secure communication will work.

Following connection establishment, the CP synchronizes its time of day with the PC because the telecontrol server is the time master if telecontrol communication is enabled.

Configure the properties of the VPN group

1. Double-click on the newly created VPN group.
Result: The properties of the VPN group are displayed under "Authentication".
2. Enter a name for the VPN group. Configure the settings of the VPN group in the properties. These properties define the default settings of the VPN group that you can change at any time.

Note

Specifying the VPN properties of the CPs

You specify the VPN properties of the CPs in the "Security" > "Firewall" > "VPN" parameter group of the relevant module.

Result

You have created a VPN tunnel. The firewalls of the CPs are activated automatically: The "Activate firewall" check box is selected as default when you create a VPN group. You cannot deselect the check box.

Download the configuration to all modules that belong to the VPN group.

4.19.3.3 VPN communication with SOFTNET Security Client (engineering station)

Set up VPN tunnel communication between the SOFTNET Security Client and the CP as described in section Creating a VPN tunnel for S7 communication between stations (Page 99).

VPN tunnel communication works only if the internal node is disabled

Under certain circumstances the establishment of VPN tunnel communication between SOFTNET Security Client and the CP fails.

SOFTNET Security Client also attempts to establish VPN tunnel communication to a lower-level internal node. This communication establishment to a non-existing node prevents the required communication being established to the CP.

To establish successful VPN tunnel communication to the CP, you need to disable the internal node.

Use the procedure for disabling the node as explained below only if the described problem occurs.

Disable the node in the SOFTNET Security Client tunnel overview:

1. Remove the checkmark in the "Enable active learning" check box.
The lower-level node initially disappears from the tunnel list.
2. In the tunnel list, select the required connection to the CP.
3. With the right mouse button, select "Enable all members" in the shortcut menu.
The lower-level node appears again temporarily in the tunnel list.
4. Select the lower-level node in the tunnel list.
5. With the right mouse button, select "Delete entry" in the shortcut menu.

Result: The lower-level node is now fully disabled. VPN tunnel communication can be established.

4.19.3.4 Establishment of VPN tunnel communication between the CP and SCALANCE M

Create a VPN tunnel between the CP and a SCALANCE M router as described for the stations.

VPN tunnel communication will only be established if you have selected the check box "Perfect Forward Secrecy" in the global security settings of the created VPN group ("VPN groups > Authentication").

If the check box is not selected, the CP rejects establishment of the tunnel.

4.19.3.5 CP as passive subscriber of VPN connections

Setting permission for VPN connection establishment with passive subscribers

If the CP is connected to another VPN subscriber via a gateway, you need to set the permission for VPN connection establishment to "Responder".

This is the case in the following typical configuration:

VPN subscriber (active) ⇔ gateway (dyn. IP address) ⇔ Internet ⇔ gateway (fixed IP address) ⇔ CP (passive)

Configure the permission for VPN connection establishment for the CP as a passive subscriber as follows:

1. In STEP 7, go to the devices and network view.
2. Select the CP.
3. Open the parameter group "VPN" in the local security settings.
4. For each VPN connection with the CP as a passive VPN subscriber, change the default setting "Initiator/Responder" to the setting "Responder".

4.19.4 Certificate manager

Certificate manager of SIMATIC NET devices

SIMATIC NET communications modules generally use the global certificate manager. You can find this in the project navigation under "Security settings > Security features".

All certificates that are created and displayed by the configuration with the SIMATIC NET communications module can also be found in the global certificate manager.

Certificates for authentication

If you have configured secure communication with authentication for the communications module, own certificates and certificates of the communication partner are required for communication to take place.

All nodes of a STEP 7 project with enabled security functions are supplied with certificates. The STEP 7 project is the certification authority.

Examples of services and functions that require certificates:

- Communication of the TIM 1531 IRC with the higher-level CPU
The connection of the TIM to the CPU uses secure communication via TLS for all telecontrol protocols supported by the TIM.
For communication via TLS, you need to use a newly created CPU certificate and specify it to the TIM in the "Subscriber numbers" parameter group.
For information on the procedure, refer to the section TIM 1531 IRC: TLS certificate of the CPU (Page 90).
- Secure transfer of e-mails
An SSL certificate is created for the module to transfer data via SSL/TLS. It is visible in STEP 7 in the local certificate manager and under "Global security settings > Certificate manager > Device certificates" with the "WebServer" service.

If a STEP 7 communications module is to communicate securely with non-Siemens partners, the relevant certificates of the communications partners must be exchanged. To do this, follow these steps:

1. Import the third-party certificates of the external communications partner
Global security settings of the project > "Trusted certificates and root certification authorities"
2. Assigning a certificate to the communications module

Assigning certificates

If you create certificates for modules in STEP 7 retroactively or import third-party certificates into STEP 7, you need to assign them to the respective module, either via:

- Local certificate manager of the communications module > "Certificates of the partner devices"
- Global security settings of the project > "Trusted certificates and root certification authorities"

For information on the procedure, refer to the section Handling the TLS certificates (Page 103).

You will find further information in the STEP 7 information system.

4.19.5 Handling the TLS certificates

Communication between CPU and telecontrol module

CP: Communication via backplane bus

Since the CPU and CP are in the same rack, communication between them runs via the backplane bus. The CPU is automatically assigned to the telecontrol CP.

TIM 1531 IRC: Communication with CPUs via Ethernet

The TIM 1531 IRC is not inserted in the rack of the CPU. The TIM can be connected with one or more CPUs via Ethernet. The CPU used for telecontrol communication must be assigned to the TIM.

TIM 1531 IRC: TLS communication with the CPU

The connection of the TIM to the CPU uses secure communication via TLS for all telecontrol protocols supported by the TIM.

For communication via TLS, you need to use a newly created CPU certificate and specify it to the TIM in the "Subscriber numbers" parameter group.

Order of steps

When you create a new certificate for the CPU and then assign the CPU to the TIM, the certificate of the CPU is entered automatically in the subscriber configuration of the TIM.

If you first assign the CPU to the TIM and then create the CPU certificate, you need to look up the ID of the CPU certificate and enter it manually in the subscriber configuration of the TIM or delete the CPU from the "Assigned CPU" field and then assign it again.

Validity and requirements

Validity

The description below applies to the following modules:

- TIM 1531 IRC V2.3 as of firmware version V2.3
Together with CPU 1500 as of firmware version V2.9
- CP 1542SP-1 IRC as of firmware version V2.2
Together with ET 200SP CPU as of firmware version V2.9

Requirements

The following requirements must be met to use the certificates as described below:

- As STEP 7 project user, you have at least the rights of the "NET Administrator" role.
For more on this, see "Security settings > Users and roles > Assigned roles".
If you use the security functions of the S7-1500 V3.0, you also need a created user with the required rights; see Security user (Page 94).
- The devices have the required minimum firmware version.
- The configuration data of the CPU is protected.
For more on this, see "Protection & Security > Protection of confidential PLC configuration data"
- The desired telecontrol protocol is enabled for the TIM under "Communication types".
- CPU and TIM 1531 IRC are networked.
- The certificate of the CPU has been created and is in the global certificate manager; see section TIM 1531 IRC: TLS certificate of the CPU (Page 90).

Configuring TLS for telecontrol connections

You can configure secure communication via TLS for telecontrol connections of communications modules:

Network data editor > "TeleControl" tab)

A prerequisite for CPs is activation of the security functions.

TLS connections with project partners

1. First create the telecontrol connections.
2. Select the main connection and the "Secure Communication (TLS)" parameter group in the connection properties.
3. Activate the "Enable secure communication" option.

When all certificates of the connection partners are present, the "own certificate ID" and the "partner certificate ID" are automatically applied to the entire connection, including sub-connections, for Siemens devices.

TLS connections with third-party devices

If you want to use secure communication via TLS for telecontrol connections with third-party devices, you need to perform some additional steps.

1. First, set the secure listener port for TLS or check the setting (Basic settings > Secure listener port). The port number is needed for the connection partner.
2. Create a certificate for the third-party device in STEP 7.
Alternatively, import the certificate into STEP 7, if there is one for the third-party device. See below for information on importing and creating certificates (certificates for TLS connections with third-party devices).
3. Assign the third-party certificate to the STEP 7 connection partner as "Trusted certificate". See below for the procedure (certificates for TLS connections with third-party devices).
4. Export the device certificate of the communications module, the device certificate of the third-party device (if this was created in STEP 7) and the associated CA certificate from STEP 7 and import it into the third-party device or its configuration tool.
5. Create the telecontrol connection and activate the "Enable secure communication" option.
6. Transfer the IDs to the connection parameters.
 - Enter the ID of the imported or created third-party certificate (from the global certificate manager) in the "Partner certificate ID" field.
 - Enter the ID of the STEP 7 connection partner certificate in the "Own certificate ID" field.

Certificates for TLS connections with third-party devices

Importing a third-party certificate or creating and assigning it

Alternatively, you can make the third-party certificate available to the STEP 7 project:

- **Import**
You can save and import the certificate of the third-party device, if there is one, in the file system of the engineering station and in STEP 7.
To import, open the "Trusted certificates and root certification authorities" tab in the global certificate manager, click in a free row and open the "Import" shortcut menu.
You must then assign the imported certificate to the communications module (see below).
- **Create**
Alternatively, you can create a certificate for the third-party device in STEP 7 and import it into the third-party device.
To do this, follow these steps:

1. Open the global certificate manager in the project navigation:
"Security settings > Security features > Certificate manager > tab Device certificates"
2. Click on the "Create" shortcut menu in a free row.
The "Create certificate" dialog opens.

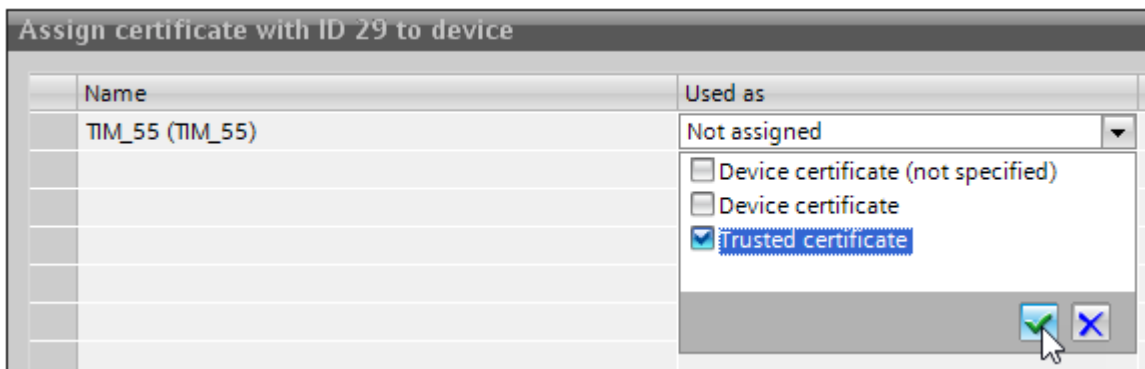
3. Select the following options for the certificate of the third-party device:
 - Usage: TLS Client / Server
 - Certificate authority (CA): Self signed
 - Common name of subject: Enter the name of the third-party device.

Adapt the other parameters to the functionality of the third-party device. If possible, use the most secure supported encryption method.

4. Click "OK" to close the dialog.
The certificate appears in the table.
You will need the certificate ID for the assignment and the telecontrol connection.

- **Assign**

1. In the global certificate manager, select the imported or newly created certificate and open the "Assign" shortcut menu.
2. In the list, select the module the third-party device will communicate with via the telecontrol connection.
3. In the "Used as" row in the ("Not assigned") cell, select the "Trusted certificate" option and click on the green checkmark.



4. Close the dialog with OK.
You will need the certificate ID for the telecontrol connection.

Creating a telecontrol connection and entering a certificate ID

1. Create a telecontrol connection as described above.
2. In the connection properties, select the "Secure Communication (TLS)" parameter group and activate the "Enable secure communication" option.

3. Enter the following values manually:
 - Partner certificate ID: ID of the imported or manually created certificate for the third-party device
 - Own certificate ID: ID of the certificate of the communications module
4. Check the port numbers and third-party device parameters.
 - The Secure Listener port is configured in the "Basic settings" parameter group of the respective module.
 - Configure the network node type in the connection properties ("Third-party device parameters" parameter group).
If the third-party device is the master, select "Master station".

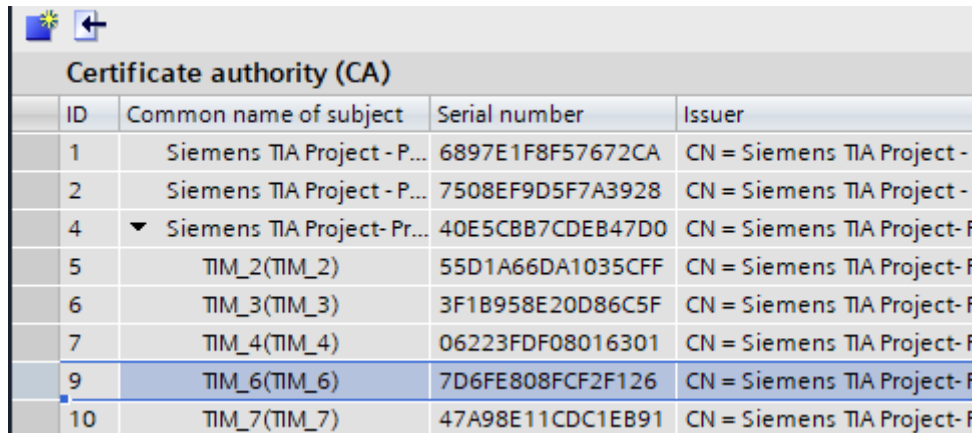
Exporting a STEP 7 certificate for a third-party device and importing it in a third-party device

For the TLS connection with the third-party device, you need to export a device certificate of the communications module created in STEP 7 and the associated CA certificate.

1. Device certificate for the third-party device created in STEP 7
 - In the global certificate manager, open the "Device certificates" tab.
 - Select the device certificate for the third-party device and click the "Export certificate" shortcut menu.
 - Save the certificate in the file system of the engineering station.
You can change the default file format "*.der".
You can find a description of the functions of the certificate file formats in the "Exporting certificates" section in the help system.
2. Device certificate of the communications module
 - In the "Device certificates" tab, select the device certificate of the communications module as partner certificate for the third-party device.
 - Make the "Issuer" column fully visible.
You need the name of the issuer to export the signing CA certificate.
 - Export the selected device certificate of the module using the "Export certificate" shortcut menu.

3. Signing CA certificate

- Change to the "Certificate authority (CA)" tab.
- Select the CA certificate that signed the device certificate of the communications module. When you expand the CA certificate, all derived device certificates, including that of the communications module, are displayed below it.



Certificate authority (CA)			
ID	Common name of subject	Serial number	Issuer
1	Siemens TIA Project - P...	6897E1F8F57672CA	CN = Siemens TIA Project - P...
2	Siemens TIA Project - P...	7508EF9D5F7A3928	CN = Siemens TIA Project - P...
4	▼ Siemens TIA Project- Pr...	40E5CBB7CDEB47D0	CN = Siemens TIA Project- P...
5	TIM_2(TIM_2)	55D1A66DA1035CFF	CN = Siemens TIA Project- P...
6	TIM_3(TIM_3)	3F1B958E20D86C5F	CN = Siemens TIA Project- P...
7	TIM_4(TIM_4)	06223FDF08016301	CN = Siemens TIA Project- P...
9	TIM_6(TIM_6)	7D6FE808FCF2F126	CN = Siemens TIA Project- P...
10	TIM_7(TIM_7)	47A98E11CDC1EB91	CN = Siemens TIA Project- P...

Figure 4-11 Global certificate manager: The CA certificate has the ID 4 here, the device certificate has the ID 9.

- Export the CA certificate via the "Export certificate" shortcut menu.
4. Import all saved certificates as trusted certificates into the third-party device or its configuration tool.
The certificates are required for secure communication during runtime.

Change certificate: Subject Alternative Name

STEP 7 adopts the properties "DNS name", "IP address", and "URI" from the parameter "Subject Alternative Name" (Windows: "Alternative applicant name") from the STEP 7 configuration data.

You can change this parameter of a certificate in the certificate manager of the global security settings. To do this, select the a certificate in the table of device certificates and call the shortcut menu "Renew". Properties of the parameter "Alternative name of the certificate owner" changed in STEP 7 are not adopted by the STEP 7 project.

4.19.6 Global certificate manager

Certificates of SIMATIC NET devices

SIMATIC NET communications modules generally use the global certificate manager. You can find this in the project navigation under "Security settings > Security features".

You can find all local certificates of SIMATIC NET communications modules in the global certificate manager.

4.20 TIM 1531 IRC: Protection

4.20.1 Protection

Protection functions

The module provides various access levels to restrict access to certain functions.

NOTICE
Configuring an access level does not replace the know-how protection
Configuring access levels prevents unauthorized changes to the module by restricting the download rights.
This does not, however, provide write or read protection for blocks on a memory card. Use the know-how protection to protect the code of blocks on the memory card.

The table of access levels

You configure the access levels in the table. The green check mark in the columns on the right of the particular access level indicate the maximum possible operations without knowing the password for this access level.

The default access level is "Full access (no protection)". Every user can read and modify the configuration. No password has been configured and no password is required for online access.

You can configure the following access levels:

- **Full access (no protection)**
The configuration and the blocks can be read and modified by anybody.
- **Read access**
With this access level, without entering the password, only read access to the hardware configuration and the blocks is possible; in other words, you cannot download the blocks or hardware configuration to the TIM without entering the password. Without the password, writing test functions and firmware updates are also not possible.
- **No access (complete protection)**
If the module is completely protected, neither read nor write access to the hardware configuration and blocks is possible.

If you want to use the functions of the unmarked access levels, you will need to enter a password.

With the legitimization provided by using the password, you once again have full access to the module.

Behavior of a password-protected module during operation

Protection of the module is effective after the settings have been loaded on the module.

Before an online function is executed, a check is made to establish whether or not it is permitted. If there is password protection, you will be prompted to enter the password.

Example:

The module was configured for read access and you want to use the "Modify tags" function. Since this is write access, the configured password must be entered before the function can be executed.

The functions protected by the password can only be executed by one PG/PC at any one time. Another PG/PC cannot log on.

The access rights to the protected data apply for the duration of the online connection or until the access rights are canceled again with "Online > Delete access rights".

Each access level allows unrestricted access to certain functions even without entering a password, for example identification using the "Accessible devices" function.

4.20.2 Configuring access protection

Configuration

You can enter several passwords setting up different access rights for different user groups.

The passwords are entered in the table so that precisely one access level is assigned to each password.

The "Access level" column shows how the password takes effect.

Example:

You select the access level "No access (complete protection)" for the module and enter your own password for each of the access levels higher up the table.

For users that do not know any of the passwords, the module is completely protected.

For users who know one of the set passwords the effect depends on the table row in which the password is located:

- The effect of the password in row 1 "Full access (no protection)" is as if the CP was unprotected. Users that know this password have unrestricted access to the module.
- The effect of the password in row 2 "Read access" is as if the module was write-protected. Despite knowing the password, users that know this password only have read access to the module.
- The effect of the password in row 3 "No access (complete protection)" is as if the CP was write and read protected. Users that know this password only have read access to the module.

Procedure

Follow the steps below to set the parameters for the access levels of the module:

1. Open the module properties in the Inspector window.
2. Open the "Protection" entry in the navigation panel.
A table with the possible access levels is displayed in the Inspector window.

3. Select the required access level in the first column of the table. The green check mark in the columns on the right of the particular access level indicate which operations are still possible without entering the password.
4. If you have selected an access level other than "Full access":
 - Assign a password for full access in the "Password" column in the first row (full access).
 - Repeat the selected password in the "Confirm password" column to protect against incorrect entries.
 - Make sure that the password is adequately secure; in other words, that it does not include a pattern that can be machine read!
 - The entry of the password in the first row "Full access (no protection)" is obligatory and allows a user who knows the password unrestricted access to the module, regardless of the selected access level.
5. As necessary, assign other passwords to the required access levels if the selected access level permits this.
6. Download the hardware configuration so that the access level takes effect.

Result

The hardware configuration and the blocks are protected from unauthorized online access according to the set access level. If an operation cannot be executed without a password due to the set access level, a dialog appears prompting entry of a password.

4.21 Telecontrol connections

4.21.1 Telecontrol connections

Telecontrol connections

Telecontrol relationships between the communications modules involved are required for telecontrol communication. Depending on the module type and the firmware version, you perform the configuration in the following parameter groups:

- "Partner stations" parameter group
or
- "Network data" editor

Configuration in the "Partner stations" parameter group

For the following CPs, which only function as stations, the relationships to the master station or to the master are configured in the "Partner stations" parameter group:

- CP 1243-1 / CP 1243-7 LTE / CP 1243-8 IRC up to firmware V3.0
- CP 1542SP-1 IRC up to firmware V1.0

All other settings required for communication with the master station are taken from the other configuration data of the CPs and do not have to be specially configured for the connections.

Configuration in the "Network data" editor

For the following modules, configure telecontrol connections in the "Network data" editor:

- CP 1243-1 / CP 1243-8 IRC as of firmware V3.1
- CP 1243-7 LTE as of firmware V3.3
- CP 1542SP-1 IRC as of firmware V2.0
- TIM 1531 IRC as of firmware V2.0
- Third-party device

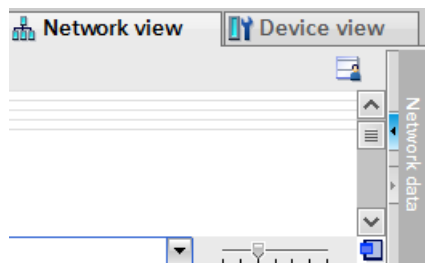
A third-party device is a module that cannot be configured in STEP 7, e.g. the master station of a different manufacturer.

4.21.2 "Network data" editor

Opening the editor "Network data" > "TeleControl" tab

To open the editor, follow the steps below:

1. Open the network view of the project.
On the right you will find the collapsed "Network data" editor.



2. Open the "Network data" editor using the arrow symbol.
The editor is displayed with several tabs, on the left the "Network overview" tab.
3. Expand the editor until the "TeleControl" tab appears.
This tab is further divided into the following tabs:
 - ST7
 - DNP3
 - IEC 60870

Depending on the protocol used, select the corresponding tab to configure the telecontrol connections.

Display and show/hide columns

	Connection	Starting po...	Start subs...	Start interface	Endpoint	End ...	Partner list	End interface/address
	*	*	*		*	*		
	Section_1	1	1	TIM_1 - Ethernet i...	2	2	2,3	TIM_2 - TIM_2 - Ethernet i.
	Section_2	2	2	TIM_2 - Ethernet i...	1	1	2,3	TIM_1 - TIM_1 - Ethernet i.
	Section_3	TIM_2	2	TIM_2 - Serial Inter.	3	3	1	TIM_3 - TIM_3 - Serial Inte
	Section_4	3	3	TIM_3 - Serial Inter.	1	1	1	TIM_2 - TIM_2 - Serial Inte
	Section_5	TIM_2	2	TIM_2 - Ethernet i...	1	1	3, 12	TIM_1 - TIM_1 - Ethernet i.
	Section_6	2	2	TIM_2 - Serial Inter.	3	3	3	TIM_3 - TIM_3 - Serial Inte
	Section_7	3	3	TIM_3 - Serial Inter.	2	2	2	TIM_2 - TIM_2 - Serial Inte
	Section_99	1	1	TIM_1 - Ethernet i...	Third-party device	99	99	192.168.2.99
	Section_8	1	1	TIM_1 - Ethernet i...	1200	12	12	TIM_2 - TIM_2 - Ethernet i.
	Section_9	TIM_2	2	TIM_2 - Ethernet i...	1200	12	1	S7-1200-Station_1 - CP 1..
	Section_10	1200	12	CP 1243-8 IRC - Et...	1	1	1	TIM_2 - TIM_2 - Ethernet i.

Figure 4-12 "Network data" editor, "Telecontrol > ..." tab

In the "Telecontrol connections" table, you can display or hide the columns, arrange them and optimize the column width. Right-click on a column header to access the shortcut menu.

- **Arrange columns**
If you click on a column header and hold down the left mouse button, you can move the column within the table.
- **Show/Hide**
You can show or hide individual columns using this function in the shortcut menu. This increases the legibility of the table.
- **Show all columns**
Shows all columns of the table.
- **Optimize width / Optimize width of all columns**
You use these shortcut menus to optimize the width of the selected column or all columns in the table.
The column width adapts to the widest entry in this column.

Some fields of the table can be edited, in others you configure the parameter via a drop-down list.

Boxes with a missing or bad configuration are shown with a red background.

Names of the connections

You can adapt the default names of the connections.

A maximum of 128 characters from the following ASCII character sets (numbers decimal) are permitted:

- **No. 32..126**
Space , ! " # \$ % & ' () * + , - . / : ; < = > ? @ [\] ^ _ ` { | } ~
- **No. 128, 130..140, 142, 145..156, 158..159, 161..172**
€ , f „ ... † ‡ ^ % ¨ Š ‹ Œ Ž ' ' " " • — — ~ ™ š › œ ž Ÿ ħ € £ ¤ ¥ ¦ § ¨ © ª « ¬
- **No. 174..255**
® ¯ ° ± ² ³ ´ µ ¶ · ¸ ¹ º » ¼ ½ ¾ ¿ À Á Â Ã Ä Å Æ Ç È É Ê Ë Ì Í Î Ï Ð Ñ Ò Ó Ô Õ Ö × Ø Ù Ú Û Ü Ý Þ à á â ã ä å æ ç è é ê ë ì í î ï ð ñ ò ó ô õ ö ÷ ø ù ú û ü ý þ ÿ

Error displays

Faulty connection points, networks or parameters are highlighted in red in the tables.

Causes of faulty connections include, for example:

- Starting point and endpoint are identical.
- The connection runs through an impermissible network.
- The connection runs through an invalid subscriber.

Delete invalid or redundant connections

If there are unauthorized or unwanted redundant connections, you must delete a connection path:

1. In the "Configured connection paths" table, select the unwanted connection path.
2. Click "Delete" in the shortcut menu.

4.21.3 Specifying connection paths

Rules for connection configuration

Note the following rules for connection configuration:

- Telecontrol connections can be configured for the following networks and module types:
 - Connections in Ethernet networks
Configurable between TIM modules, CPs and third-party devices
 - Connections in classic WAN networks (dedicated line/dialup network)
Configurable between two TIM 1531 IRC modules and between TIM 1531 IRC and the third-party device
- You can create connections between endpoints (subscribers) that are configured in the STEP 7 project.
Fields are available in the connection table for the address data and interface parameters of both endpoints.
- You can create connections between an endpoint of the STEP 7 project and a "third-party device" that is not configured in STEP 7, e.g. the master of a third-party manufacturer. If the third-party device is in a different IP subnet and can be reached via a network gateway, configure the network gateway as an endpoint of the connection.
A third-party device in a classic WAN network can also be connected via the serial interface of the TIM 1531 IRC.
- The endpoint of a connection is always the CPU, a PC application (not the communications module) or a third-party device.

- A connection segment for the outward and the return path must be created for each connection with a configured partner (not the third-party device).

Example of a connection between Partner 1 (master) and Partner 2 (station):

- Outward path: Connection segment 1 $\Rightarrow$ 2
- Return path: Connection segment 2 $\Rightarrow$ 1

When you configure the outward path, the return path is created automatically.

- You can configure single and redundant connections between two subscribers.
- Two connections to a partner via the same interface of a module are not allowed.
- A connection via an inconsistent network is invalid.

Example of inconsistent networks:

- A subscriber of a connection segment is connected to another telecontrol protocol.
- Connections via nodes that are not configured as node stations.
- Subscriber with incompatible modems
- Incompatible settings of two modems in a connection
- Incompatible settings between modem and network parameters

Interface-specific configuration of the connection segments

Connections between two endpoints can run over multiple subscribers.

A connection segment between two subscribers can be used for multiple connections.

Individual settings can be configured for specific connection segments and the associated interfaces of the modules. For this reason, the individual connection segments between the interfaces of two devices are displayed in separate lines in the connection table.

	Connection	Starting po...	Start subs...	Start interface	Endpoint	End ...	Partner list	End interface/address
	*	*	*		*	*		
	Section_1	1	1	TIM_1 - Ethernet i...	2	2	2,3	TIM_2 - TIM_2 - Ethernet i.
	Section_2	2	2	TIM_2 - Ethernet i...	1	1	2,3	TIM_1 - TIM_1 - Ethernet i.
	Section_3	TIM_2	2	TIM_2 - Serial Inter.	3	3	1	TIM_3 - TIM_3 - Serial Inte
	Section_4	3	3	TIM_3 - Serial Inter.	1	1	1	TIM_2 - TIM_2 - Serial Inte
	Section_5	TIM_2	2	TIM_2 - Ethernet i...	1	1	3, 12	TIM_1 - TIM_1 - Ethernet i.
	Section_6	2	2	TIM_2 - Serial Inter.	3	3	3	TIM_3 - TIM_3 - Serial Inte
	Section_7	3	3	TIM_3 - Serial Inter.	2	2	2	TIM_2 - TIM_2 - Serial Inte
	Section_99	1	1	TIM_1 - Ethernet i...	Third-party device	99	99	192.168.2.99
	Section_8	1	1	TIM_1 - Ethernet i...	1200	12	12	TIM_2 - TIM_2 - Ethernet i.
	Section_9	TIM_2	2	TIM_2 - Ethernet i...	1200	12	1	S7-1200-Station_1 - CP 1..
	Section_10	1200	12	CP 1243-8 IRC - Et...	1	1	1	TIM_2 - TIM_2 - Ethernet i.

Figure 4-13 "Network data" editor, "Telecontrol > ..." tab

Connection symbols

The connection symbols in the rows of the table and in the connection search window have the following significance:

	Main connection path (outward path), outbound from the start point of the connection.
	- Partial connection path (return part of a main connection path) - Single connection, e.g. to a third-party device.

Creating connections and searching for connection paths

Follow these steps to create connections:

- Click the "Starting point" field in the next free row.
A drop-down list with the available endpoints is displayed.
The first row below the table header is reserved for entering filters; see section Connection table (Page 118).
- Select the starting point (CPU) from the table with a double-click.
- Click the "Endpoint" field in the same row.
Select the endpoint (CPU or PC application) from the table with a double-click.
 - Special case: "Third-party device":
If you want to create a third-party device as endpoint instead of an endpoint from a STEP 7 project, leave the default entry "Third-party device" in the cell.
Configure the interface of the starting point as well as the address data and other parameters of the third-party device by means of entries in the corresponding fields.
With a third-party device as endpoint, the connection search via the dialog described below is disabled.

After an endpoint is selected from the STEP 7 project, the starting point and endpoint are displayed in the table row. The other fields are usually empty and have a red background. Once a connection has been created, the actual course of the connection is not always defined yet. Especially with larger networks, several connection paths are often possible. Use the "Add new connection path" icon to search for the connection path:



4. Leave the table row with the selected starting point and endpoint highlighted and click on the "Add new connection path" icon.

The dialog for defining connection paths opens:

Dialog "Add connection paths"

The possible connection paths are searched for automatically, which is indicated by the progress bar at the bottom of the dialog.

- The status and result of the search are displayed in the "Information" field below.
- The connection paths found are displayed in the "Select a connection path ..." upper table.
- Details for a selected connection path are shown in the "Connection path" table.
- When selecting a connection path, the "Preview" table shows which connection points of the selected connection path are transferred to the connection editor when you click "Add".

5. Select the desired connection path(s).

- If one or more connection paths are displayed in the upper table, select the desired connection path and click on "Add".
"Information" shows whether the connection path has been added or whether it has already been configured.
- If you want to use a redundant connection, select a second path and click on "Add".
Close the dialog using the "Close" button if the added connection paths correspond to the project defaults.
- If no connection is displayed in the table, there is a configuration error in the corresponding stations or networks.
In this case, close the dialog with the "Close" button and complete the configuration.

The "Connection path" table supports you in checking the connection paths. For every configured connection, the detailed connection path is shown here.

A station symbol with an identifier for the connection point is displayed in the "Position" column. The color of the identifier indicates the validity of the connection point:

- Blue: Valid connection point
- Red: Invalid connection point

Icon	Meaning
	Starting point
	Node-input
	Node-output
	Endpoint
	Examples of invalid connection points

Parameters of the connection table

Here, you configure the parameters of the connection table for each connection segment. You can find the description of the parameters in the section Connection table (Page 118).

The "Properties" tab, which shows additional parameters for each connection segment, is displayed below the connection table.

"Properties" tab of the connections

In the parameter groups, you can check the connection segment, correct it if necessary and configure additional properties.

You can find a description of the parameter groups in the section Properties of the IEC connections (Page 121).

4.21.4 Connection table

Filter

The first row below the table header contains a filter function with which you can restrict the selection of configurable subscribers and connection options. Using filters reduces the number of combination possibilities and increases the clarity.

Once you have created some connection segments, enable the filter by entering a recurring name or partial name in the filter cell. The cell is given a colored background, see figure.

	Connection	Starting po...	Start subs...	Start interface	Endpoint	End ...	Partner list
	*	1	*		*	*	
	Section_1	1	1	TIM_1 - Ethernet interfac..	2	2	2,3
	Section_99	1	1	TIM_1 - Ethernet interfac..	Third-party device	99	99
	Section_8	1	1	TIM_1 - Ethernet interfac..	1200	12	12
	Section_10	1200	12	CP 1243-8 IRC - Ether..	1	1	1

Figure 4-14 Connection table

The filter "1" is set in the "Starting point" column.

Example:

You have created connections with the starting points "1200", "1" and "2".
When "1" is entered in the filter cell, only the segments whose starting points start with this partial string are shown: "1" and "1200"

Filters set in multiple columns multiply.

The selection "*" shows all existing connection segments.

The filter icon on the left in the first row () shows or hides an existing filter.

The filter can be applied to all columns with an asterisk (*) in the first cell.

Note:

If you have created connections and set a filter, you cannot create any new connections. You need to reset the filter first in order to create new connections.

Parameters

If parameters are already used by the configuration, the values are transferred to the respective columns.

- **Name**
You can change the default name of the connection segment between two subscribers. See section "Network data" editor (Page 112) for more on this.
- **Starting point**
Select the desired starting point of the connection from the drop-down list.
 - The starting point of a connection is a CPU.
- **Start subscriber**
Station address of the starting point
- **Start interface**
Interface of the starting point module through which the connection runs.
- **Endpoint**
Select the endpoint of the connection.
Endpoints of a connection can be:
 - A CPU
 - A third-party device
The network node type of third-party devices is configured in the properties dialog of the connection, see section Third-party device parameters (Page 128).

Note

Changing the endpoint

If you retroactively change the endpoint of a connection, the new connection segments are added when searching for the connection path.

Note that the segments of the previous connection are retained. You need to delete these yourself.

- **End subscriber**
Station address of the endpoint
- **Partner list**
When a partner (endpoint) is selected that is located in the STEP 7 project, its station address is automatically found during the connection search and entered in the partner list.
In connection segments used for multiple connections, the station address of all destination subscribers is entered.

Note

Manual entry for third-party device

For a third-party device that is not configured in the STEP 7 project, you must enter the station address manually.

The station addresses are entered separated by commas.

- **End interface/address**
Interface of the endpoint module through which the connection runs.
For a third-party device that is not configured in the STEP 7 project, you must enter the IP address (Ethernet) manually.
For third-party devices in serial networks, enter the ASDU address of the third-party device.
- **End port**
Relevant for third-party device (master / station)
Number of the listener port of the partner
For modules of the STEP 7 project, the value is taken from the configuration. It can be changed.
You need to enter the port number for a third-party device.
Range of values: 0 ... 65535
Default: 2404
- **Partner monitoring time**
Relevant for all subscriber types
If the station module does not receive a sign of life from the master on the application layer within the configured time, it classifies the connection as disrupted and terminates it.
After sending data, the master module expects a response from the station within the configured time.

Note

Redundant connection paths

If you configure redundant connection paths between two partners, configure the same time for both paths.

Range of values: 0 ... 65535

With the setting 0 (zero), the function is disabled.

- **Polling mode**
Relevant for master, third-party device (master)
This is where you define the mode in which the master station calls the station.
The value configured for the station is transferred to the master station and stored there.
Ranges of values:
 - **Cyclic**
The station is called cyclically. The duration of the polling cycle is calculated from the "Class 0 polling interval" parameter and the set basic cycle time; see above.
 - **After startup**
The station is only called after the initial startup and after a restart.
If a data point is not configured as event, no data is transmitted during operation with this option.
In a connection segment from the station to the master (return path), the "After startup" setting is set permanently. Transfer during operation is specified via the setting for the outward path (master to station segment).
- **Temporary**
Partners with enabled "Temporary" option are classified as "accessible" if they terminate the connection themselves (e.g. RTU3000C).

Parameters for redundant connection paths

If redundant connection paths are configured, these are configured in the same way as the main paths.

The parameters of the redundant connection paths are distinguished by the following suffix:

- *** (red)**

The parameters of the redundant connection paths have the same functions as those for the main path. See above for the meaning.

Examples:

- **Start interface (red.)**
Interface of the starting point module through which the redundant connection runs.
- **End interface (red.)**
Interface of the endpoint module through which the redundant connection runs.

4.21.5 Properties of the IEC connections

4.21.5.1 General

If you select a connection in the "Telecontrol connections" table in the "Network data" editor, additional parameter groups for this connection are displayed in the "Properties" tab of the Inspector window.

In the parameter groups, you can check the connection, correct it if necessary and configure additional properties.

General

- **Connection**
Shows the name of the connection and the protocol.
You can also change the connection name here.
- **Connection points**
Shows the most important parameters of the connection.
You can also change the station address of a third-party device here.

4.21.5.2 TCP connection monitoring

Ethernet interface > Advanced options > TCP connection monitoring

The settings of the two parameters at the Ethernet interface apply to all TCP connections via this interface.

With mobile wireless CPs, the Ethernet interface is the placeholder for the mobile wireless interface.

You can adapt the parameters in the properties of the telecontrol connections for each connection segment. The value under the connection segment applies to this connection segment and overwrites the value that is configured on this interface.

If there are different values for the interface and the connection segment, make sure that the value on the interface is greater than the one under the connection segment.

- **TCP connection monitoring time**

Function: If no data traffic takes place within the TCP connection monitoring time, the communications module sends a keepalive frame to the communication partner and expects an answer within the TCP keepalive timeout.

Default setting: 180 s

With the setting zero (0), monitoring is disabled.

The permissible range depends on the module type.

- **TCP keepalive timeout**

After sending a keepalive frame, the module expects a response from the communications partner within the keepalive timeout. If the module does not receive a response after three keepalive frames, it closes the connection.

With the setting 0 (zero), the function is disabled.

Default setting: 10 s

The permissible range depends on the module type.

If disruptions or delays occur often when transferring in a mobile wireless network, it may be advisable to increase the value, for example, to 30 or 60 seconds.

If there are different values for the interface and the connection segment, make sure that the value on the interface is greater than the one on the connection segment.

If you have configured a redundant connection to a partner, the parameters can be set separately for both connection paths.

4.21.5.3 IEC 60870-5 security options

Note

Note that the data transmission speed is reduced for connections that are encrypted or secured via TLS.

Secure Authentication

The settings of the parameter group are made for the outward path of the connection. The settings apply to the entire connection segment and are inherited by sub-segments. The settings made for the outward path are automatically adopted for the return path. They are shown grayed out there.

When the option is disabled, the modules authenticate themselves to the partner only with their station address (non-secure). When the option is enabled, the modules use the "Secure Authentication" method according to IEC 60870-5-7. The IEC master and station authenticate themselves with a secret key, the pre-shared key. With the help of the common pre-shared key, after the first connection establishment between master and station, session keys are agreed that are then renewed cyclically. Renewal of the session keys is initiated by the master.

The criteria for key renewal are defined with the "Session key exchange interval" parameter and the other parameters for key exchange (see below). As soon as one of these conditions is met, the session key is renewed.

Parameters

- **Enable IEC security options**

Select the option if you want to use Secure Authentication.

Note:

Make sure that you enable the option for all connections of the module that are to use this function.

- **Security statistics**

Specifies whether the statistics of security events are sent to the master. Security events are authentication requests of the master to the station module. If this option is activated, all authentication requests are stored in the station module with date, time and result and sent to the master for further evaluation.

Security statistics events are only output if a SCADA system is connected to the master.

Range of values:

- Do not send security statistics

- Send security statistics

When this option is enabled, the statistics parameters that can be selected are released for configuration under the table.

Default setting: Do not send security statistics

- **Secure hash algorithm (SHA)**

Selection of the Secure Hash Algorithm (SHA)

Range of values:

- SHA-256

- **Key length**

Specifies the length of the pre-shared key in bytes.

The following length is used:

- 32 bytes (corresponds to 64 characters for the pre-shared key)

- **Max. number of key status queries (Max Session Key Status Count)**

Maximum number of session key status requests of the master within the session key exchange interval. If the value is exceeded, the module notifies all other connected master stations. The master station from which the requests were sent is not notified.

Range of values: 2...255

Default setting: 5

- **Max. number of session key exchanges (Session Key Change Count)**

Maximum number of transferred packages within a session key exchange interval. When the number is reached, the session key is renewed.

Range of values: 0 / 10...10000

Default setting: 1000

With the setting 0 (zero), the key is not changed depending on the transferred packages (function disabled).

- **Session key exchange interval (Session Key Change Interval)**
Maximum time interval (minutes) after which the session key is exchanged between the station module and the master. The interval must be matched up on both communications partners.
Recommendation: Set the exchange interval for the station module twice as high as for the master.
Range of values: 0...65535
Default setting: 15
With the setting 0 (zero), the key is not changed depending on a time interval (function disabled).
- **Authentication timeout**
Maximum wait time of the module after an authentication request to the master. If the waiting time for the response from the master is exceeded, the module generates a security event and sends this to the master.
Range of values: 1... 65535
Default setting: 5
- **Data length of authentication and key status challenge**
Data length (CLN) of an authentication Challenge or session key status Challenge
Range of values: 4... 64
Default setting: 4
- **Max. number of authentication failures**
Maximum number of authentication failures before the Challenger sends an error message and the session key is changed.
Range of values: 0... 65535
Default setting: 25
- **Max. number of sent error messages**
Maximum number of sent error messages. When the configured number is reached, the station stops the sending of error messages.
Range of values: 0... 65535
Default setting: 50
- **Max. number of key exchanges (auth. failure)**
Maximum number of session key changes due to authentication failures. When the configured number is reached, key exchanges due to authentication failures are stopped until the session key is changed for another reason.
Range of values: 0... 65535
Default setting: 50
- **Max. number of response timeouts**
For the master: Maximum number of response timeouts
When the configured value is reached, the master aborts the current action.
Range of values: 0... 65535
Default setting: 20

- **Max. number of key exchanges (restart)**

For the master: Maximum number of key exchanges due to station restart

When the configured value is reached, the master sends no more session keys to the station until the next authentication timeout.

Range of values: 0... 65535

Default setting: 20

- **Pre-shared key**

The pre-shared key can be configured in two ways:

- Manual configuration

Enter the pre-shared key in STEP 7 manually as a hexadecimal value.

- Import as file

Import the pre-shared key from the file system of the engineering station if the pre-shared key was generated by the master or another system. An ANSI-coded text file is suitable, for example.

The pre-shared key of a station module must be identical to the pre-shared key of the master. For information on the format see above, "Key length" parameter.

Security statistics options (IEC 60870-5-104)

When the "Security statistics" parameter is set to "Send security statistics", the station module sends security statistics events to the master, where they are available for further evaluation. Based on the frequency of these events, you can reach conclusions on possible attacks or vulnerabilities of your system.

Security statistics events are only output if a SCADA system is connected to the master.

The following table contains the security statistics events according to IEC 60870-5-7, which are applied to the configured telecontrol connection segments.

Security statistics events

The events are transferred from the station via the ASDU type "Information 41" (integrated total for the statistic).

The following table lists the supported statistics parameters.

- Threshold

There is a threshold for each parameter. Transfer to the master is triggered as event when this threshold is reached.

Value ranges of the parameters: 0...65535

With the setting 0 (zero), the function is disabled and no statistics data is transferred for the value in question.

- IOA (Information object address)

You need to assign an IOA address to each item of statistical information via the configuration.

Value ranges of the parameters: 0...16777215

Parameters according to IEC 60870-5-7	Default
Threshold "Unexpected Messages"	3
Unexpected Messages (IOA)	0

Parameters according to IEC 60870-5-7	Default
Threshold "Authorization Failures"	5
Authorization Failures (IOA)	0
Threshold "Authentication Failures"	5
Authentication Failures (IOA)	0
Threshold "Reply Timeouts"	3
Reply Timeouts (IOA)	0
Threshold "Rekeys Due to Authentication Failures"	3
Rekeys Due to Authentication Failures (IOA)	0
Threshold "Total Messages Sent"	100
Total Messages Sent (IOA)	0
Threshold "Total Messages Received"	100
Total Messages Received (IOA)	0
Threshold "Critical Messages Sent"	100
Critical Messages Sent (IOA)	0
Threshold "Critical Messages Received"	100
Critical Messages Received (IOA)	0
Threshold "Discarded Messages"	10
Discarded Messages (IOA)	0
Threshold "Error Messages Sent"	10
Error Messages Sent (IOA)	0
Threshold "Error Messages Received"	10
Error Messages Received (IOA)	0
Threshold "Successful Authentications"	100
Successful Authentications (IOA)	0
Threshold "Session Key Changes"	10
Session Key Changes (IOA)	0
Threshold "Failed Session Key Changes"	5
Failed Session Key Changes (IOA)	0

4.21.5.4 Secure Communication (TLS)

Configuration of secure TLS connections

With the "Enable secure communication" option, you can configure secure communication via TLS between telecontrol connection partners of the STEP 7 project. When the DNP3 protocol is used, the connection to a third-party device can also be secured via TLS.

You configure the settings for the main connection segment in the top parameter group.

The second parameter group for the substitute connection segment can be edited if a redundant connection was created.

Parameters:

- **Enable secure communication**
Enables secure communication via TLS for this connection segment
- **Partner certificate ID**
ID certificate of the communications partner
For information on creating and handling the certificates, see section TIM 1531 IRC: TLS certificate of the CPU (Page 90).
- **Own certificate ID**
ID of own certificate of the module
- **Partner port**
Port of the partner for secure communication
(for own port, see parameter group "Basic settings" of the module > "Secure listener port")
- **Session key exchange interval**
Maximum time interval (minutes) after which the session key is exchanged between the station module and the master. The interval must be matched up on both communications partners.
Recommendation: Set the exchange interval for the station module twice as high as for the master.
Range of values: 0...65535
Default setting: 15
With the setting 0 (zero), the key is not changed depending on a time interval (function disabled).
- **Max. number of session key exchanges**
Maximum number of transferred packages within a session key exchange interval. When the number is reached, the session key is renewed.
Range of values: 0 / 10...10000
Default setting: 1000
With the setting 0 (zero), the key is not changed depending on the transferred packages (function disabled).
- **Authentication timeout**
Maximum wait time (seconds) of the module after an authentication request to the master. If the waiting time for the response from the master is exceeded, the module generates a security event and sends this to the master.
Range of values: 1... 65535
Default setting: 5

4.21.5.5 Query options

The following parameters can be found in the parameter groups "Options 1st Path" / "Options 2nd Path" of the IEC connections.

Call intervals

The following parameters define the intervals of special calls of the master for the station (cause of transmission 20 - 41).

All parameters are configured as multiples of the "Polling basic interval", see section Settings IEC master (Page 72).

- **Interval for general request**
Defines the interval with which general requests of the master are answered.
- **Interval for group request**
Defines the interval with which the respective group request of the master is answered.
- **Interval for counter general request**
Defines the interval with which counter general requests of the master are answered.
- **Interval for counter group request**
Defines the interval with which the respective counter group request of the master is answered.

You define the setting as to whether a general request is answered and the assignment to a group request for each individual data point in the data point configuration.

4.21.5.6 Third-party device parameters

Third-party device parameters

Only valid for partners that are not configured in the STEP 7 project. The parameter group is only visible when a third-party device is configured as connection partner. These partners are created in the connection table as "Third-party device" for the "Endpoint" parameter.

- **Link-layer address / Link-layer address (red.)**
The two parameters are only active when there is a connection with the third-party device via a serial network.
Enter the link-layer address of the serial interface of the third-party device in the respective input box.
 - The "Link-layer address" field is activated when the "Start interface" is connected to the serial network.
 - The "Link-layer address (red.)" field is activated when the "Start interface (red.)" is connected to the serial network.
- **Network node type third-party device**
Network node type of the third-party device that is accessible via the selected connection path:
 - Master station
(Master)
If the third-party device is the master, you need to configure the network node type of the third-party device as "Master station".
 - Node station
For modules that act as a node station, the following applies:
The interface in the direction of the master station is configured as a "node station".
The interface in the direction of the lower-level network is configured as a "Master station".
 - Station

4.22 Data points

4.22.1 Data point configuration

Data point-related communication with the CPU

No program blocks need to be created for telecontrol modules with data point configuration to transfer user data between the station and communication partner.

The data areas in the memory of the CPU intended for communication with the communications partner are configured data point-related on the module. Each data point is linked to a PLC tag or the tag of a data block.

Requirement: Created PLC tags and/or data blocks (DBs)

PLC tags or DBs must first be created correspondingly on the CPU to allow configuration of the data points.

 WARNING
Writing values to outputs • PLC tags When referencing to PLC tags, note that the values are written immediately to the outputs of the CPU without first being processed by the user program with write access. Writing values has a direct influence on the process. • DB variables When referencing to DB variables, written values are only used when processed by the user program.

The PLC tags for data point configuration can be created in the standard tag table or in a user-defined tag table. All PLC tags intended to be used for data point configuration must have the attribute "Visible in HMI".

Address areas of the PLC tags are input, output or bit memory areas on the CPU.

Note

Number of PLC tags

Observe the maximum possible number of PLC tags that can be used for data point configuration.

The formats and S7 data types of the PLC tags that are compatible with the data point types of the modules can be found in the section Datapoint types (Page 138).

Access to the memory areas of the CPU

The values of the PLC tags or DBs referenced by the data points are read and transferred to the communications partner by the module.

Data received from the communications partner is written by the module to the CPU via the PLC tags or DBs.

Configuring the data points and messages in STEP 7

You configure the data points in STEP 7 in the data point and message editor. You can open both editors alternatively as follows:

- Selecting the communications module
Shortcut menu "Open the data point and messages editor"
- Via the project navigation:
Project > directory of the relevant station > Local modules > required communications module
By double-clicking on the entry, the data point or message editor opens.

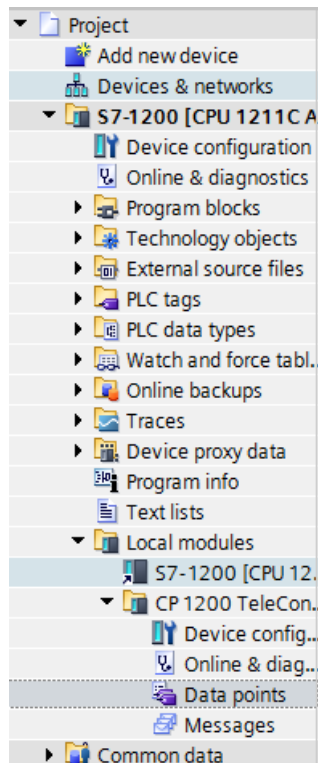


Figure 4-15 Configuring data points and messages

After opening the editor window using the two entries to the right above the table, you can switch over between the data point and message editor.

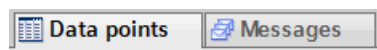


Figure 4-16 Switching over between the two editors

Creating objects

With the data point or message editor open, create a new object (data point / message) by double clicking "<Add object>" in the first table row with the grayed out entry.

A preset name is written in the cell. You can change the name to suit your purposes but it must be unique within the module.

		Name	PLC tag
1		DataPoint	"Tag_1-BI"
2		DataPoint_1	"Tag_2-BQ"
3		DataPoint_2	"Tag_1-BI"

Figure 4-17 Data point table

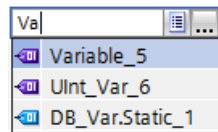
You configure the remaining properties of every object using the drop-down lists of the other table columns and using the parameter boxes shown at the bottom of the screen.

Assigning data points to their data source

After creating it, you assign a new data point to its data source. Depending on the data type of the data point a PLC tag can serve as the data source.

For the assignment you have the following options:

- Click on the table symbol  in the cell of the "PLC tag" column.
All configured PLC tags and the tags of the created data blocks are displayed. Select the required data source with the mouse or keyboard.
- Click the symbol .
A selection list of the configured PLC Tags and the blocks is displayed. From the relevant table, select the required data source.
- In the name box of the PLC tag, enter part of the name of the required data source.
All configured PLC tags and tags of the data blocks whose names contain the letters you have entered are displayed.



Select the required data source.

Simplified creation of multiple data points

You can create multiple data points in one step in the following way:

- Open the data point table.
- Expand the station in the project navigation and select either:
 - "Program blocks" folder (for the assignment of DB tags)
 - or
 - "PLC tags" folder (for the assignment of PLC tags)
- Select the relevant DB or the desired tag table.
The content is displayed in the "Detail view" window under the project navigation.
- In the detail view, select all tags that you want to use for the assignment to data points.
(Multiple selection with <Shift> or <Ctrl>)
- Drag-and-drop the selected tags into the data point table.

Arranging columns and rows, showing/hiding columns

As with many other programs, you can arrange the columns and sort the table according to your needs in the data point or message editor:

- **Arrange columns**
If you click on a column header with the left mouse button pressed, you can move the column.
- **Sorting objects**
If you click briefly with the left mouse button on a column header, you can sort the objects of the table in ascending or descending order according to the entries in this column. The sorting is indicated by an arrow in the column header.
After sorting in descending order of a column the sorting can be turned off by clicking on the column header again.
- **Adapting the column width**
You can reach this function with the following actions:
 - Using the shortcut menu that opens when you click on a column header with the right mouse button.
"Optimize width", "Optimize width of all columns"
 - If you move the cursor close to the limit of a column header, the following symbol appears:



When it does, double-click immediately on the column header. The column width adapts itself to the broadest entry in this column.

- **Showing / hiding columns**
You call this function using the shortcut menu that opens when you click on a column header with the right mouse key.

Copying data points and messages

As with many other programs, you can copy and paste objects in the data point or message editor.

If you right-click in the row of an object in the table, you can access the functions listed below from the shortcut menu:

- **Cut**
- **Copy**
- **Paste**
You can paste cut or copied objects within the table or in the first free row below the table. You can also paste cut or copied objects into tables of other communications modules of the same type and with the same telecontrol protocol.
- **Delete**

If you hold down the <Ctrl> key, you can select several rows that are not contiguous.

With the <Shift> key pressed, you can select the beginning and the end of a contiguous area.

Enable/disable data point validation

When new data points are created or during an import, the data point index, object number and object channel are checked for consistency. With inconsistent numbers, the affected fields are highlighted in red in the data point table.

If you want to temporarily disable the check, you can switch off this function with the following button above the data point table:



These parameters are checked for consistency during compilation, at the latest.

Exporting and importing data points

To simplify the engineering of larger plants, you can export the data points of a configured module and import them into other modules in the project. This is an advantage particularly in projects with many identical or similar stations or data point modules.

Communications modules with the same telecontrol protocol are compatible with each other. Data points can be imported and exported between compatible modules.

You can also access the export/import function:

- Via the shortcut menu of the module in the network or device view

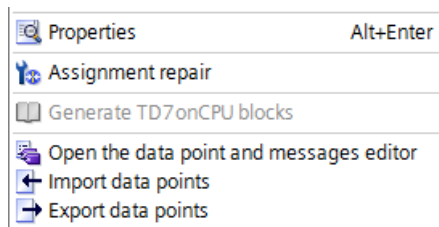


Figure 4-18 Shortcut menu of the module

- Using the two arrow symbols above the data point list

When it is exported the data point information of a module is written to a CSV file.

It is possible to import data points of an older project into a newer project as of STEP 7 V18. If missing parameters were not added in the CSV file, the missing information is filled with default values during the import. In such cases, check the data points carefully.

Recommendation:

Migrate your STEP 7 project to the latest STEP 7 version, if available.

Export

When you call the export function, the export dialog opens. Here, you select the module or modules of the project whose data point information needs to be exported. When necessary, you can export the data points of all modules of the project together.

In the export dialog, you can select the storage location in the file directory. When you export the data of a module you can also change the preset file name.

When you export from several modules, the files are formed with preset names made up of the station name and module name.

The file itself contains the following information in addition to the data point information:

- Module name
- Module type
- CPU name
- CPU type

Editing the export files

You can edit the data point information in an exported CSV file. This allows you to use this file as a configuration template for many other stations.

If you have a project with many stations of the same type, you can copy the CSV file with the data points of a fully configured module for other as yet unconfigured stations and adapt individual parameters to the particular station. This saves you having to configure the data points for every module in STEP 7. Instead, you simply import the copied and adapted CSV file to the other modules of the same type. When you import this file into another module, the changed parameter values of the CSV file are adopted in the data point configuration of this module.

The lines of the CSV file have the following content:

- Line 1: Name,Type,TIA-Version;<Designation of STEP 7 version>
This line must not be changed.
- Line 2: PLC,<CPU name>, <CPU type>,
Meaning: PLC (designation of the station class), CPU name, CPU type
Only the elements <CPU name> and <CPU type> may be changed.
The CPU type must correspond exactly to the name of the CPU in the catalog.
- Line 3: Module,<module name>,<module type>,
Meaning: Module (Designation of the module class), module type, module name
Only the elements <module name> and <module type> may be changed.
Be careful when changing the module names if you want to import data points into several modules (see below).
The module type must correspond exactly to the name of the module in the catalog.
- Line 4: Parameter names (English) of the data points
This line must not be changed.
See below for the meaning (under "Parameters").
- Lines 5..n: Values of the parameters according to line 4 of the individual data points
You can change the parameter values for the import into a new communications module.

Parameter

The parameter designations in the exported CSV file and their translations or corresponding designations in the TIA Portal are listed below:

- Name: Data point name
- PLC tag: CPU tag
- Master Side: Master function
- Datapoint type: Data point type

- Datapoint index: Data point index
- Value monitoring: Value monitoring
Validity: DNP3
- Type of transmission: Type of transmission
- Priority in the scan cycle: Read cycle
- Response to general request: Response to general request
- Assignment to group request no. 1 ... no. 16: Assignment to group request no.
Validity: IEC
- Threshold value trigger: Threshold value trigger
- Threshold value: Threshold
- Time trigger: Time trigger
- Time Trigger Cycle: Trigger
- Event trigger: Event trigger
- Trigger tag: Trigger tag
- Meanvalue generation: Mean value generation
- Unipolar transfer: Unipolar transfer
- Fault suppression time: Fault suppression time
- Smoothing factor: Smoothing factor
- Set limit value 'high': Set limit value 'high'
- Limit value 'high': Limit value 'high'
- Set limit value 'low': Set limit value 'low'
- Limit value 'low': Limit value 'low'
- Control Code: Control Code
- Pulse Limit: Max. number of pulses
- Pulse control: Pulse control
- Pulse OnTime Limit: Max. pulse duration
Validity: DNP3
- Pulse OnTime Surrogate: Pulse duration replacement time
Validity: DNP3
- Short Pulse Duration: Short pulse duration
Validity: IEC
- Long Pulse Duration: Long pulse duration
Validity: IEC
- Command execution mode: Command execution mode
- Mirroring of local value: Mirroring of local value
Validity: DNP3
- PLC tag for local value: PLC tag for local value
Validity: DNP3

- Partners of datapoint: Partners enabled at the data point with which a telecontrol connection is configured.
The partner number is specified for third-party devices.
Multiple partners are separated by commas and placed in quotation marks.
Example: "PLC_1,Partner_1,PLC_4"
- Enable archiving: Enable archiving
Validity: TIM 1531 IRC
- Integration interval: Integration interval
- Alarm event type: Station state events
- Substation address: Substation address
- With timestamp: With time stamp
Validity: DNP3
- Command result: Command result
- PLC tag for command result: PLC tag for command result
- Status trigger: Status trigger
- Timestamp trigger: Time stamp trigger
- Command acceptance: Command acceptance
Validity: IEC
- Tag for command acceptance: Tag for command acceptance
Validity: IEC
- Command monitoring: Command monitoring
Validity: IEC
- Command monitoring data point: Command monitoring data point
Validity: IEC
- S7 Repetition Factor: (is only exported for informational purposes, but the value is not imported again)
- S7 Data Type Value: (is only exported for informational purposes, but the value is not imported again)

Importing into a module

Before importing the data points make sure that the PLC tags required for the data points have been created.

Note that when you import a CSV file all the data points existing on the module will be deleted and replaced by the imported data points.

Select a module and select the import function from the shortcut menu of the module. The import dialog opens in which you select the required CSV file in the file directory.

If the information on the assignment of the individual data points to the relevant PLC tags matches the assignment in the original module, the data points will be assigned to the corresponding PLC tags.

When you import data points into a module, but some required PLC tags have not yet been created in the CPU, the corresponding data point information cannot be assigned. In this

case, you can subsequently create missing PLC tags and then assign them the imported data point information. The "Assignment repair" function is available for this (see below).

If the names of the PLC tags in the module into which the import is made have different names than in the module that exported, the corresponding data points cannot be assigned to your PLC tags.

Importing into several modules

You can import the data points from several modules into the modules of a different project. To do this in the import dialog select all the required CSV files with the control key.

Before importing the data points, make sure that the respective stations have been created with CPUs of the same name, modules of the same name and PLC tags of the same name.

When you import the corresponding stations of the project are searched for based on the module names in the CSV files. If a target station does not exist in the project or the module has a different name, the import of the particular CSV file will be ignored.

Restrictions for the import of data points

In the following situations the import of data points will be aborted:

- An attribute required by the module is missing in the CSV file to be imported.
Example: If a data point to be imported uses a time trigger, the import will be aborted if no time-of-day synchronization was configured for the module.
- The telecontrol protocol used by the module differs from that of the original module.
Modules with the same telecontrol protocol are compatible with each other:

Only when importing into several modules:

- The import is aborted when a module or CPU name is different from the data in the CSV file.

During the import, a log file indicating any errors is generated.

Assignment repair

If you have named the PLC tags in a station into which you want to import differently from the station from which the CSV file was exported, the assignment between data point and PLC tag is lost when you import.

You then have the option to either rename the existing PLC tags appropriately or add missing PLC tags. You can then repair the assignment between unassigned data points and PLC tags. This function is available either via the shortcut menu of the module (see above) or with the following icon to the upper left in the data point editor: 

If a PLC tag with a matching name is found for a data point by the repair function, the assignment is restored. However the data type of the tag is not checked.

After the assignment repair make sure that you check whether the newly assigned PLC tags are correct.

Recommendation:

Before the data point import, copy the tag table or the data block from the source CPU from which the data points are exported into the target CPU into whose communications module the exported data points are to be imported.

4.22.2 Datapoint types

During the configuration of the user data to be transferred, each data point is assigned to a data point type.

Afterwards the protocol-specific data point types along with the compatible S7 data types are listed.

The "Direction" column shows the transmission direction:

- "in": Monitoring direction
- "out": Control direction

Note

Effect of the change of arrays for data points

If an array is modified later, the data point must be recreated.

Data point types of the "IEC 60870-5" protocol

Table 4-5 Supported data point types, IEC types and compatible S7 data types

Format (memory requirements)	Data point type	IEC type	Direction	S7 data types	Operand area
Bit	Single-point information	<1>	in	Bool	I, Q, M, DB
	Single-point information with time tag CP56Time2a ¹⁾	<30>	in	Bool	I, Q, M, DB
	Single command ³⁾	<45>	out	Bool	Q, M, DB
	Single command with time tag CP56Time2a ¹⁾	<58>	out	Bool	Q, M, DB
	Double command with time tag CP56Time2a ¹⁾	<59>	out	Bool	DB ²⁾
Byte	Step position information	<5>	in	Byte, USInt	I, Q, M, DB
	Step position information with time tag CP56Time2a ¹⁾	<32>	in	Byte, USInt	I, Q, M, DB
Integer (16 bits)	Measured value, normalized value	<9>	in	Int	I, Q, M, DB
	Measured value, normalized value with time tag CP56Time2a ¹⁾	<34>	in	Int	I, Q, M, DB
	Measured value, scaled value	<11>	in	Int	I, Q, M, DB
	Measured value, scaled value with time tag CP56Time2a ¹⁾	<35>	in	Int	I, Q, M, DB
	Set point command, normalized value	<48>	out	Int	Q, M, DB
	Set point command, scaled value	<49>	out	Int	Q, M, DB
	Set point command, normalized value with time tag CP56Time2a ¹⁾	<61>	out	Int	Q, M, DB
	Set point command, scaled value with time tag CP56Time2a ¹⁾	<62>	out	Int	Q, M, DB

Format (memory requirements)	Data point type	IEC type	Direction	S7 data types	Operand area
Integer (32 bits)	Bitstring of 32 bits	<7>	in	UDInt, DWord	I, Q, M, DB
	Bitstring of 32 bits with time tag CP56Time2a ¹⁾	<33>	in	UDInt, DWord	I, Q, M, DB
	Integrated totals	<15>	in	UDInt, DWord	I, Q, M, DB
	Integrated totals with time tag CP56Time2a ¹⁾	<37>	in	UDInt, DWord	I, Q, M, DB
	Bitstring of 32 bits	<51>	out	UDInt, DWord	Q, M, DB
	Bitstring of 32 bits with time tag CP56Time2a - control direction ¹⁾	<64>	out	UDInt, DWord	Q, M, DB
Floating-point number (32 bits)	Measured value, short floating point number	<13>	in	Real	Q, M, DB
	Measured value, short floating point number with time tag CP56Time2a ¹⁾	<36>	in	Real	Q, M, DB
	Set point command, short floating point number	<50>	out	Real	Q, M, DB
	Set point command, short floating point with time tag CP56Time2a ¹⁾	<63>	out	Real	Q, M, DB
Data block (1...2 Bit) ²⁾	Double-point information	<3>	in	Array[0..1] of Bool	DB
	Double-point information with time tag CP56Time2a ¹⁾	<31>	in	Array[0..1] of Bool	DB
	Double command	<46>	out	Array[0..1] of Bool	DB
	Regulating step command	<47>	out	Array[0..1] of Bool	DB
	Double command with time tag CP56Time2a ¹⁾	<59>	out	Array[0..1] of Bool	DB
	Regulating step command with time tag CP56Time2a ¹⁾	<60>	out	Array[0..1] of Bool	DB
Data block (1...32 Bit) ²⁾	Bitstring of 32 bits	<7>	in	Array[0..31] of Bool	DB
	Bitstring of 32 bits with time tag CP56Time2a ¹⁾	<33>	in	Array[0..31] of Bool	DB
	Bitstring of 32 bits	<51>	out	Array[0..31] of Bool	DB
	Bitstring of 32 bits with time tag CP56Time2a - control direction ¹⁾	<64>	out	Array[0..31] of Bool	DB

¹⁾ For information on the format of the time stamp, see below.

²⁾ With these data point types, contiguous memory areas of 32 bits can be transferred (Array[0..31] of Bool).

³⁾ Mirroring possible, see below.

Time stamp of the data with the IEC protocol

Time stamps are transferred according to the IEC specification in the "CP56Time2a" format. Note that only the first 3 bytes for milliseconds and minutes are transferred.

Mirroring with Single Command

For the following commands, you can activate mirroring of the current value in the station to the master:

- Single Command <45>

The local value of this data point can be monitored for changes and transferred to the master when changed. A change to a local value can be caused by manual operator input on site, for example.

To allow the value resulting from local events or interventions to be transferred to the master, the data point in question requires a channel for mirroring back. For this, a second data point "Single-point information <1>" is required. Follow the steps below to configure the mirroring function.

Create the data points:

- In the master module
 - Single Command <45>
 - Single-point information <1>

On the master, you need to write the mirrored value into a variable. Therefore, assign the two data points to different variables in the master module.
Assign the same index for both data points.

- In the station module
 - Single Command <45>
 - Single-point information <1>

In the station module, assign the two data points to the same variable.
Assign the same index for both data points.

The value mirrored by the station is written to the "Single-point information <1>" data point type on the master.

Time stamp of the data with the IEC protocol

Time stamps are transferred according to the IEC specification in the "CP56Time2a" format. Note that only the first 3 bytes for milliseconds and minutes are transferred.

4.22.3 Status IDs of the data points**Status identifiers**

The status identifiers of the data points listed in the following tables are transferred along with the value in each data frame to the communications partner. They can be evaluated by the communications partner.

The entries in the table row "Significance" relate to the entry in the table row "Bit status".

Quality descriptor - IEC 60870-5

The status IDs correspond to the following elements of the specification:

Quality descriptor - IEC 60870 Part 5-101

Bit assignment of status byte for the different objects: Data point type <IEC type>

Table 4-6 Information object <1, 30>

Bit	7	6	5	4	3	2	1	0
Flag name	IV invalid	NT not topical	SB substituted	BL blocked	-	-	-	SPI
Meaning	Value is val- id	Value not updated	Substitute value	Value blocked	-	-	-	-
Bit status	0	1	1	1	(always 0)	(always 0)	(always 0)	(always 0)

Table 4-7 Double-point information object <3, 31>

Bit	7	6	5	4	3	2	1	0
Flag name	IV invalid	NT not topical	SB substituted	BL blocked	-	-	DPI	
Meaning	Value is val- id	Value not updated	Substitute value	Value blocked	-	-	-	
Bit status	0	1	1	1	(always 0)	(always 0)	(always 0)	

Table 4-8 Step position <5, 32>, Bitstring <7, 33>, Analog input <9, 11, 13, 34, 35, 36>

Bit	7	6	5	4	3	2	1	0
Flag name	IV invalid	NT not topical	SB substituted	BL blocked	-	-	-	OV overflow *
Meaning	Value is val- id	Value not updated	Substitute value	Value blocked	-	-	-	Value range exceeded, analog val- ue
Bit status	0	1	1	1	(always 0)	(always 0)	(always 0)	1

* With configured limit values of the data point, the "OV overflow" bit is set as follows when the analog value is transferred:

- Limit value 'high':
 - If the limit value is exceeded: OV = 1
 - If the value then falls below the limit value: OV = 0
- Limit value 'low':
 - If the value falls below the limit value: OV = 1
 - If the value then exceeds the limit value: OV = 0

Table 4-9 Counter (Integrated totals) <15, 37>

Bit	7	6	5	4	3	2	1	0
Flag name	IV invalid	CA counter ad- justed	CY carry	SB substituted	SQ sequence number			
Meaning	Value is val- id	Count value corrected	Count value overflow before val- ue is read	Substitute value				
Bit status	0	1	1	1				

4.22.4 "General" tab

Data point table

You will find the most important parameters in the first tab of the data point editor in the default setting of the data point table.

If you hover over the title bar of the data point table with the mouse, you can display all parameters of the data point configuration via the shortcut menu.

General

Parameters:

- **Name**
Unique name of the data point
- **PLC tag**
For the assignment, see section Data point configuration (Page 129).
- **Data point type**
See section Datapoint types (Page 138)
- **Data point index**
See section Data point index (Page 144)
- **Master function**
Enables the master function of the data point.
For the meaning, refer to section Master function of the data points (Page 143).
- **Type of transmission**
For the type of transmission, see section Process image, type of transmission, event classes (Page 145).
- **Read cycle**
Only for inputs
For the read cycle, see section Read cycle (Page 147).

- **Response to general request**
Enables the data point for the response to a general request. If the function is disabled, the value of the data point is not sent to the communications partner following a general request.
- **Assignment to group request**
Assigns the data point to a group request.
For group queries of the master to the respective group, the value of the data point is sent to the master.

4.22.5 Master function of the data points

The master function for direct communication

Direct communication between two telecontrol stations, in which the frames are not transmitted by a master station, is enabled by activating the master function of the data points.

Requirements

Requirements for configuring direct communication between two data points of two partners are:

- A telecontrol connection must be created between the two partners.
Additionally for DNP3: The "Unsolicited" option is selected in the telecontrol connection.
- The data point must be assigned to a partner.
Configuration in the "Partner of data point" column of the data point table.

Meaning of the master function

- **"Master function" enabled**
The values of the data point are handled in the same way as with a master:
 - **Input data points (direction "in")**
Input data points are received by the partner according to the parameters set at the partner.
The "Transfer after call" type of transfer is set permanently.
The options for "Analog value preprocessing" are disabled.
 - **Output data points (direction "out")**
Output data points are sent to the partner according to the trigger configuration.
The "Every value triggered" type of transfer is set permanently.

To activate the option, refer to section "General" tab (Page 142).
- **"Master function" disabled**
 - **Input data points (direction "in")**
Input data points are handled according to the configuration.
The type of transfer and the options for "Analog value preprocessing" can be freely configured.
 - **Output data points (direction "out")**
Output data points are handled according to the configuration.
The "Transfer after call" type of transfer is selected automatically and cannot be changed.

4.22.6 Data point index

The index of a data point is the Information object address.

On the program side, the indexes are in ascending order by default when the data points are created. You can configure the indexes according to your requirements and the following rules.

Configuration of the data point index

Structured addressing

The index can be configured in two input fields with different formats:

- Data point index
The index is configured unstructured here as an integer.
Range of values: 1..16777215
- Structured index
You can configure the index structured according to IEC 60870-5-3 here. Plant-based structuring of the data points is enabled by structured addressing.
Three address levels (octets) can be configured.
Range of values: 0.0.1..255.255.255

The configured values of the two fields are linked. A configured value is converted and displayed in the other input field.

Conversion of configured values

The values are designated as follows for the conversion:

- Data point index
Designation of the integer value: X
- Structured index
Designation of the values of the 3rd octet: A.B.C

The configured value is applied to the other field according to the following formula:

$$X = A * 256 * 256 + B * 256 + C$$

Configuration rules

The following rules apply to configuring the data point index.

- The indexes per communications partner must be unique in a module.
Data point indexes assigned twice are indicated as errors in the consistency check and prevent the project being compiled.
- The indexes of two data points can be identical if the two data points are configured for different partners.
Example:
 - Data point 1, index 1, partner 1
 - Data point 2, index 1, partner 2
 - Data point 3, index 2, partner 1
 - Data point 4, index 2, partner 7
- The corresponding partner indexes must be identical at the send and receive ends.

Index and "sequential transfer"

Validity:

- Modules
 - CP 1243-7 LTE
 - CP 1243-8 IRC
 - CP 1542SP-1 IRC
 - TIM 1531 IRC
- Network node type of the interface for telecontrol communication: Station or node station
- Parameter group: Interface > Advanced options > Settings IEC station > Event settings > Transfer behavior

The joint transfer of event frames in one sequence can be configured for data points without time stamp.

The following requirements must be met for the sequential transfer:

- The data points are of the same type.
- The indexes of the data points are in sequence without gaps.

4.22.7 Process image, type of transmission, event classes

Storage of values

As a rule, the values of all data points are stored in the image memory of the module. Values in the image memory are transferred only after being called by master station TIM.

Values of data points configured as an event are saved in the send buffer in addition.

The image memory, the process image of the module

The image memory is the process image of the TIM. All the current values of the configured data points are stored in the image memory. New values of a data point overwrite the last stored value in the image memory.

The values are sent only after a query by the communications partner - see below "Transfer after call" in the "Types of transmission" section - or along with a message from the send buffer that needs to be transferred immediately.

The send buffer

The send buffer of the TIM is the memory for the individual values of data points that are configured as an event. You will find the size of the send buffer in the manual of the relevant module.

The capacity of the send buffer is divided up equally for all enabled partners (receivers of frames).

If the connection to a communications partner is interrupted, the individual values of the events are retained in the buffer. When the connection returns, the buffered values are sent. The frame memory operates chronologically; in other words, the oldest frames are sent first (FIFO principle).

If a frame was transferred to the communications partner, the transferred value is deleted from the send buffer.

If frames cannot be transferred for a longer period of time and the send buffer is threatening to overflow, the response is as follows:

- If the send buffer reaches a fill level of 80%, a warning message is output.
- If the fill level of the send buffer reaches 100%, no more values are saved until the fill level falls below 100% again.

Type of transmission of the saved data point values

As a rule, the values of data points are stored in the image memory of the module and transferred only when queried by the communications partner.

Events are also stored in the send buffer.

Data points are configured as a static value or as an event using the "Type of transmission" parameter (see below):

- **Static value (no event)**
Static values are entered in the image memory (process image).
Static values correspond the following type of transmission "Transfer after call (class 0)".
- **Event**
The values of data points configured as an event (triggered type of transmission) are also entered in the image memory of the module. The values are also entered in the send buffer.

Types of transmission and event classes

The following types of transmission are possible:

- **Transfer after call (class 0)**
The current value of the data point is entered in the image memory. New values of a data point overwrite the last stored value in the image memory.
After being called by the communications partner, the current value at this time is transferred.
For output data points, this option is the default setting and cannot be changed.
- **Triggered**
Data points are configured as an event using a triggered type of transmission. The values of these data points are entered in the image memory and also in the send buffer.
The values of an event are saved as soon as the configured trigger conditions are met.
The following event classes are available:
 - **Every value triggered**
Each value change is entered in the send buffer in chronological order.
 - **Current value triggered**
Only the last, current value is entered in the send buffer. It overwrites the value stored there previously.

For information on the different trigger types, see section "Trigger" tab (Page 149).

4.22.8 Read cycle

You can control the cyclic reading of PLC or DB tags of the CPU by the communications module by limiting the number of tags to be read. You make this setting in the "Communication with the CPU" parameter group.

You can prioritize the cyclic reading of values of input data points from their assigned CPU tags. Less important input data points need not be read in each CPU sampling cycle. On the other hand, you can prioritize the updating of important input data points. You make this setting for each individual data point in the data point configuration in the "General" tab with the "Read cycle" parameter.

Options of the "Read cycle" parameter

- **Normal cycle**
In the normal cycle, a proportion of the values of the tags are read in each scan cycle.
- **Fast cycle**
The fast cycle is suitable for data to be acquired quickly, e.g. alarms. The value is read in each cycle.

- **Spontaneous**
The data point is registered for monitoring on the CPU and is no longer requested cyclically by the communications module. As soon as the value in the CPU changes, it is actively transferred by the CPU to the communications module. With this setting, make sure that the CPU makes enough subscriptions available and the module has not yet exceeded the maximum permissible number of subscriptions that can be registered. Refer to the section on configuration limits in the manuals for the relevant modules for information on the maximum number of subscriptions that can be registered.
This ensures timely transfer of all changed values while limiting the load on the backplane bus.
- **No monitoring**
The data point is neither monitored nor requested. The value requested from a master station is always equal to zero.
The option can be useful for outputs that will not be monitored and do not return mirrored-back values.

Structure of the CPU scan cycle

The cycle with which the CP scans the memory area of the CPU is made up of the following phases:

- **Read jobs**
 - **High-priority read jobs (Fast cycle)**
For all data points with the assignment "Fast cycle", the CPU tags are read in each scan cycle.
The number of high priority read jobs is not limited.
As a rule, it is sufficient to assign only data to be acquired quickly, such as alarms and contact changeover messages, to the fast cycle.
 - **Low-priority read jobs - proportion (Normal cycle)**
For data points with the assignment "Normal cycle", a proportion of the values of their tags is read in each scan cycle.
At most, as many tags are read in a scan cycle as is configured for "Max. number of read jobs" ("Communication with the CPU"). The values of the other low-priority tags that could not be read in a cycle are read in one of the subsequent cycles.
- **Write jobs**
The values of a configurable number of spontaneous write jobs are written to the CPU in each cycle. You specify the number of values written per cycle in the "Communication with the CPU" parameter group with the "Max. number of write jobs" parameter. The tags that could not be written in a cycle (tags in excess of the configured maximum number) are written in one of the subsequent cycles.
- **Cycle idle time**
This waiting time between two scan cycles is used to reserve adequate time for other processes that access the CPU via the backplane bus.

Since a fixed time cannot be configured for the cycle and since a fixed number of objects has not been assigned to the individual phases, the duration of the scan cycle is variable and can change dynamically.

Note**Restriction when writing setpoints under IEC 60870-5**

If the values are sent by two setpoint data points at almost the same time, the second setpoint transmission may be ignored. Observe an interval of at least 70 milliseconds between sending of setpoints.

4.22.9 "Trigger" tab

Transmission time

Data points are configured as static value ("Transfer after call (class 0)") or as event (triggered) using the "Type of transmission" parameter.

Static values are entered in the process image and transferred after the station is called by the master station; see Process image, type of transmission, event classes (Page 145).

Events are entered in the send buffer. A prerequisite for sending an event value is the configuration of the data point as event in the "General" tab:

- Type of transmission = "Every value triggered"
or
- Type of transmission = "Current value triggered"

When a trigger occurs, the value is saved.

Whether the value of an event is transmitted to the communication partner immediately after activating the trigger or delayed depends on trigger settings.

You define which data is sent immediately or delayed depending on the event class in the interface of the module (network node type "Station") in the parameter group "Settings IEC station > Event properties".

Trigger

Data points are configured as a static value or as an event using the "Type of transmission" parameter:

Saving the value of a data point configured as an event

Saving the value of a data point configured as an event in the send buffer (message memory) can be triggered by various trigger types:

- **Threshold value trigger**

The value of the data point is saved when this reaches a certain threshold. The threshold is calculated as the difference compared with the last stored value, refer to the section Threshold value trigger (Page 154).

- **Time trigger**

The value of the data point is saved at configurable intervals or at a specific time of day.

- **Event trigger (Trigger tag)**

The value of the data point is saved when a configurable trigger signal is fired. For the trigger signal, the edge change (0 → 1) of a trigger tag is evaluated that is set by the user program. The trigger tag is registered for monitoring on the CPU (subscription). When necessary, a separate trigger tag can be configured for each data point.

Resetting the trigger tag in the bit memory area / DB:

If the memory area of a trigger tag is in the bit memory or in a data block, the module resets the trigger tag itself to 0 (zero) as soon as the value of the data point has been transferred. This can take up to 500 milliseconds.

Note**Fast setting of triggers**

Triggers must not be set faster than a minimum interval of 500 milliseconds. This also applies to hardware triggers (input area).

Note**Hardware trigger**

You need to reset hardware triggers via the user program

Commands: Restrictions in relation to combining threshold trigger and event trigger

Not all trigger types can be combined as desired. Note the following restrictions in relation to commands.

In the case of commands, only the threshold trigger is evaluated with the combination threshold trigger + event trigger. This applies to the following data point types:

- Single command <45>
- Double command <46>
- Regulating step command <47>
- Single command with time tag CP56Time2a <58>
- Double command with time tag CP56Time2a <59>
- Regulating step command with time tag CP56Time2a <60>

Status trigger / Time stamp trigger

Validity: TIM 1531 IRC ≥ V2.4, CP 1542-SP1 IRC ≥ V2.3, CP 1200 V3.5

The two triggers initiate sending of the data point value when the status or the time stamp is changed in the CPU. At the same time, the status from the CPU and/or the time stamp of the CPU are transferred with the value.

The time stamp from the CPU is forwarded transparently from the connected TC modules and not modified further.

Requirements for the data points:

- The data point is an event (type of transmission "triggered")
- The "Master function" ("General" tab) of the data points is disabled.
- A UDT is created for each data point that is to use these functions; see below.

To use these two triggers, you must create a data point whose tag references the UDT specified below.

- **Status trigger**

Initiates sending of the data point value when the status is changed in the CPU. The value of the data point is transferred together with the status of the tag formed in the CPU.

Valid for the following data point types (data point type <IEC type>):

- Information objects <1, 3, 5, 30, 31, 32>
- Measured value <9, 11, 13, 34, 35, 36>
- Integrated totals <15, 37>
- Bitstring <7, 33>

For information on coding of the status byte, see section Status IDs of the data points (Page 140).

- **Time stamp trigger**

Initiates sending of the data point value when the time stamp is changed in the CPU. The value of the data point is transferred together with the time stamp of the CPU.

Valid for the following data point types (data point type <IEC type>):

- Information objects <30, 31, 32>
- Measured value <34, 35, 36>
- Integrated totals <37>
- Bitstring <33>

Structure of the common UDT for the "Value", "Status trigger" and "Time stamp trigger" tags

The values of "Value", "Status trigger" and "Time stamp trigger" are written together to one user data type (UDT) even if only one of the two triggers is used.

The UDT has the following structure:

- "Value" tag
The data type must correspond to the data point type whose value will be transferred.
The supported data point types are listed above.
- "Status" tag
Data type: Byte
- "Time" tag
Data type: DTL

You must create a separate UDT for each data point you want to transfer with the "Status trigger" and "Time trigger" options.

Creating the UDT

For the three tags, you must first create a user data type (UDT). Proceed as follows:

1. Navigate to the "PLC data types" entry of the assigned CPU in the project tree.
2. Click the "Add new data type" entry.
3. Optional: Change the name of the UDT
(select new user data type > "Properties" shortcut menu > "General" tab)
4. Then create the needed tags in the UDT.
The data type of the "Value" tag must correspond to the data type of the data point to be transferred in each case.

ValueStatusTime						
	Name	Data type	Default value	Accessible f...	Writa...	Visible ..
	Value	Real	0.0	☒	☒	☒
	Status	Byte	16#0	☒	☒	☒
	Time	DTL	DTL#1970-01-0...	☒	☒	☒
	YEAR	UInt	1970	☒	☒	☒
	MONTH	USInt	1	☒	☒	☒
	DAY	USInt	1	☒	☒	☒
	WEEKDAY	USInt	5	☒	☒	☒
	HOUR	USInt	0	☒	☒	☒
	MINUTE	USInt	0	☒	☒	☒
	SECOND	USInt	0	☒	☒	☒
	NANOSECOND	UDInt	0	☒	☒	☒

Figure 4-19 Structure of the UDT for a measured value with data type "Real"

5. Open a data block or create a new one.
6. Insert the previously created UDT into the data block.
The UDT can be selected under the name that was assigned automatically or that you changed.

Note

Transfer data of the UDT together

Make sure to transfer the data of the UDT together in one OB1 cycle to guarantee consistency of the data.

Enable archiving

Validity: TIM 1531 IRC

With the TIM 1531 IRC you can save the values of triggered data points on the SD card of the CPU.

This option enables retentive storage of the values of events (send buffer) on the SD card in case of connection faults.

Requirement for enabling the function:

- Enabling of the parameter "Enable retentive saving" ("Basic settings" parameter group)
- Disabling of the "Master function" (data point editor > "General" tab)

Archiving is possible for the following data point types:

- Information objects <1/5/30/32>
- Measured value <9/11/13/34/35/36>
- Integrated totals <15/37>
- Bitstring <7/33>

Station state events

Only configurable with TIM 1531 IRC and data point type "Single-point information" <1/30>

The "Master function" option must be disabled.

- **Station state event type**
Select the event at which the station sends frames to the defined partner. The frame is transferred together with the object number.
 - No station state event
 - Status of local CPU changed
(True = RUN, False = STOP)
 - Connection status to local CPU changed
(True = Connection OK, False = Connection not OK)
 - Connection status to substation changed
(True = Connection OK, False = Connection not OK)
 - SD card error
(True = SD card error, False = SD card OK)
 - Status of redundancy synchronization connection changed
(True = Changed connection status; only with device redundancy)
- **Substation address**
When the option "Connection status to substation changed" is selected, enter the station address of the substation whose connection status has changed.

4.22.10 Threshold value trigger

Note**Threshold value trigger: Calculation only after "Analog value preprocessing"**

Note that the analog value preprocessing is performed before the check for a configured threshold value and before calculating the threshold value.

Smoothing factors and any configured integration interval are taken into account in the calculation.

This affects the value that is configured for the threshold value trigger.

Note**Threshold value trigger with configured mean value generation**

With enabled mean value generation, the absolute method for the calculation of the threshold value deviation is used for analog values with the threshold value trigger.

For the time sequence of the analog value preprocessing refer to the section Analog value preprocessing (Page 156).

Threshold value trigger

Function

If the process value deviates by the amount of the threshold value, the process value is saved.

Two methods are used to calculate the threshold value deviation:

- **Absolute method**

With binary and counter values as well as with analog values with configured mean value generation, the absolute method is used to calculate the threshold value deviation.

- **Integrative method**

With analog values without configured mean value generation, the integrating method is used to calculate the threshold value deviation.

In the integrating threshold value calculation, it is not the absolute value of the deviation of the process value from the last stored value that is evaluated, but rather the integrated deviation.

The application of the integrative method to analog values can be switched off via the "Integration interval" (Analog value preprocessing).

Absolute method

There is a check for each binary value to determine whether the current (possibly smoothed) value is outside the threshold value band. The current threshold value band results from the last saved value and the amount of the configured threshold value:

- Upper limit of the threshold value band: Last saved value + threshold value
- Lower limit of the threshold value band: Last saved value - threshold value

As soon as the process value reaches the upper or lower limit of the threshold value band, the value is saved. The newly saved value serves as the basis for calculating the new threshold value band.

Integrative method

The integration threshold value calculation works with a cyclic comparison of the integrated current value with the last stored value. The calculation cycle in which the two values are compared is configurable; see "Integration interval" in section Analog value preprocessing (Page 156).

(Note: The calculation cycle must not be confused with the scan cycle of the CPU memory areas).

The deviations of the current process value are totaled in each calculation cycle. The trigger is set only when the totaled value reaches the configured value of the threshold value trigger and a new process value is entered in the send buffer.

The method is explained based on the following example in which a threshold value of 2.0 is configured.

Table 4-10 Example of the integration calculation of a threshold value configured with 2.0

Time [s] (calculation cycle)	Process value stored in the send buffer	Current process value	Absolute deviation from the stored value	Integrated deviation
0	20.0	20.0	0	0
0.5		20.3	+0.3	0.3
1.0		19.8	-0.2	0.1
1.5		20.2	+0.2	0.3
2.0		20.5	+0.5	0.8
2.5		20.3	+0.3	1.1
3.0		20.4	+0.4	1.5
3.5	20.5	20.5	+0.5	2.0
4.0		20.4	-0.1	-0.1
4.5		20.1	-0.4	-0.5
5.0		19.9	-0.6	-1.1
5.5		20.1	-0.4	-1.5
6.0	19.9	19.9	-0.6	-2.1

With the change in the process value shown in the example, the threshold value trigger configured with 2.0 is initiated twice:

- At the time 3.5 s: The value of the integrated deviation is at 2.0. The new process value stored in the send buffer is 20.5.
- At the time 6.0 s: The value of the integrated deviation is at 2.1. The new process value stored in the send buffer is 19.9.

In this example, if a deviation of the process value of approximately 0.5 should fire the trigger, then with the behavior of the process value shown here a threshold value of approximately 1.5 ... 2.5 would need to be configured.

4.22.11 Analog value preprocessing

For analog value data points, some or all of the functions described below can be configured.

Requirements and restrictions

You will find the requirements for the configuration of the preprocessing options and restrictions in the section relating to the particular function.

Note

Restrictions due to configured triggers

The analog value preprocessing options "Error suppression time", "Limit value calculation" and "smoothing" are not performed if no threshold value trigger is configured for the relevant data point.. In these cases, the read process value of the data point is entered in the image memory and transferred transparently before the preprocessing cycle of the threshold value calculation (500 ms) elapses.

Sequence of the analog value preprocessing options

The values of analog inputs configured as an event are processed according to the following scheme:

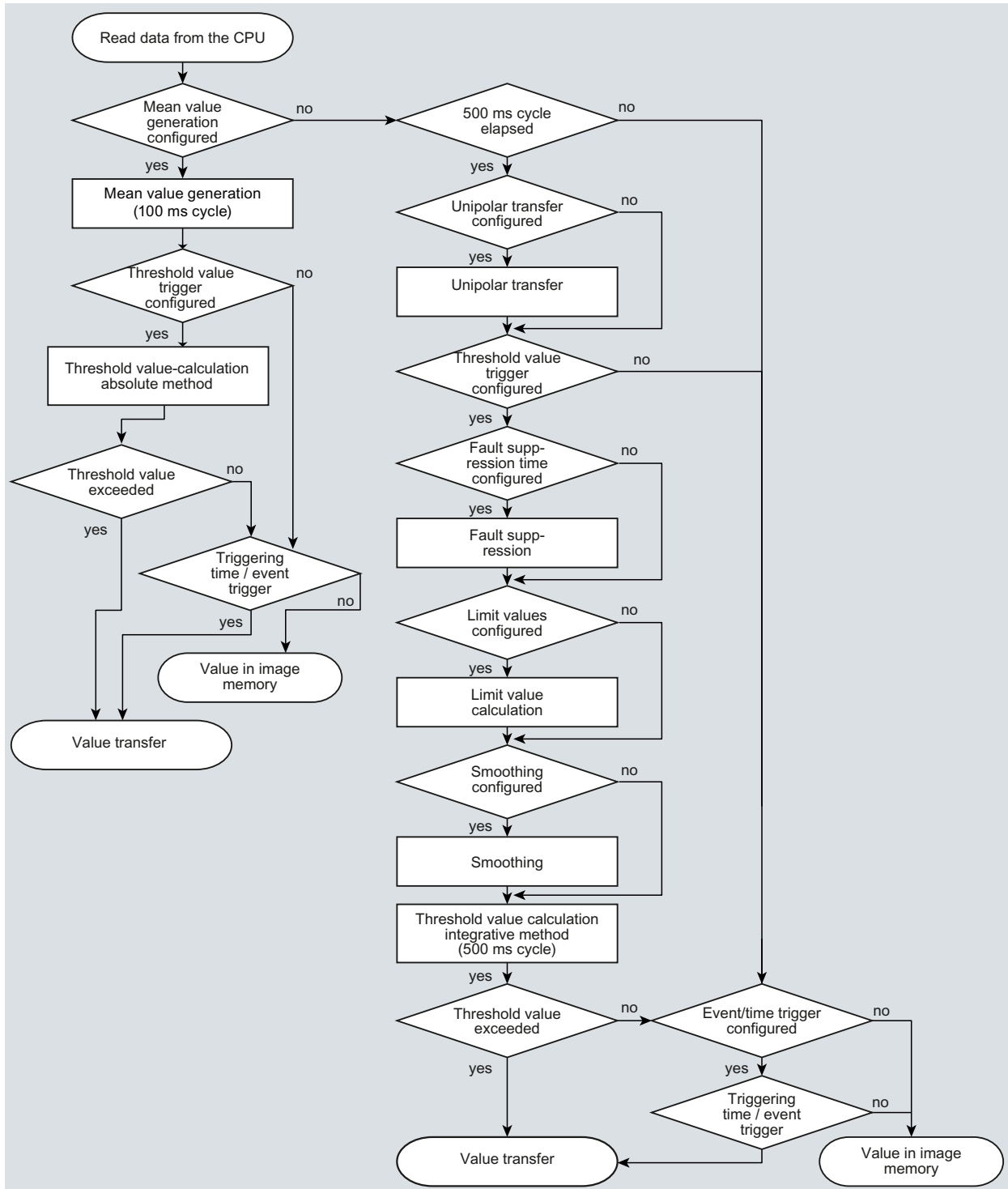


Figure 4-20 Sequence of the analog value preprocessing

The 500 millisecond cycle is started by the integrative threshold value calculation. In this cycle, the values are saved even when the following preprocessing options are enabled:

- Unipolar transfer
- Fault suppression time
- Limit value calculation
- Smoothing

Mean value generation

With this parameter, acquired analog values are transferred as mean values.

For the following protocols, mean value generation is only supported for integers of type "Int":

- TeleControl Basic
- DNP3
- IEC 60870-5

Note

Restricted preprocessing options if mean value generation is configured

If you configure mean value generation for an analog value event, the following preprocessing options are not available:

- Unipolar transfer
 - Fault suppression time
 - Smoothing
 - Threshold value calculation only with the absolute method
-

Function

If mean value generation is active, it makes sense to configure a time trigger..

The current values of an analog data point are read in a 100 millisecond cycle and totaled. The number of read values per time unit depends on the read cycle of the CPU and the CPU sampling cycle of the CP.

The mean value is calculated from the accumulated values as soon as the transfer is triggered by a trigger. Following this, the accumulation starts again so that the next mean value can be calculated.

The mean value can also be calculated if the transmission of the analog value message is triggered by a request from the communications partner. The duration of the mean value calculation period is then the time from the last transmission (for example triggered by the trigger) to the time of the request. Once again, the accumulation restarts so that the next mean value can be calculated.

Input modules: Overflow range / underflow range

As soon as a value is acquired in the overflow or underflow range, mean value generation is stopped. The value 32767 / 7FFF_h or -32768 / 8000_h is saved as an invalid mean value for the current mean value calculation period and sent with the next message.

The calculation of a new mean value is then started. If the analog value remains in the overflow or underflow range, one of the two values named is again saved as an invalid mean value and sent when the next message is triggered.

Note**Fault suppression time > 0 configured**

If you have configured an error suppression time and then enable mean value generation, the value of the error suppression time is grayed out but no longer used. If mean value generation is enabled, the error suppression time is set to 0 (zero) internally.

Unipolar transfer**Restrictions**

Unipolar transfer cannot be configured at the same time as mean value generation. Enabling unipolar transfer has no effect when mean value generation is activated.

Function

With unipolar transfer, negative values are corrected to zero. This can be desirable if values from the underrange should not be transferred as real measured values.

Exception: With process data from input modules, the value -32768 / 8000_h for wire break of a live zero input is transferred.

With a software input, on the other hand, all values lower than zero are corrected to zero.

Fault suppression time**Requirements for the function**

Configuration of the threshold trigger for this data point

Restrictions

The fault suppression time cannot be configured at the same time as mean value generation. A configured value has no effect when mean value generation is activated.

Function

A typical use case for this parameter is the suppression of peak current values when starting up powerful motors that would otherwise be signaled to the control center as a disruption.

The transmission of an analog value in the overflow (7FFF_h) or underflow range (8000_h) is suppressed for the specified time. The value 7FFF_h or 8000_h is only sent after the fault suppression time has elapsed, if it is still pending.

If the value returns to the measuring range before the fault suppression time elapses, the current value is transferred.

Input modules

The suppression is adjusted to analog values that are acquired directly by the S7 analog input modules as raw values. These modules return the specified values for the overflow or underflow range for all input ranges (also for live zero inputs).

An analog value in the overflow range (32767 / 7FFF_h) or underflow range (-32768 / 8000_h) is not transferred for the duration of the fault suppression time. This also applies to live zero inputs. The value in the overflow/underflow range is only sent after the fault suppression time has elapsed, if it is still pending.

Recommendation for finished values that were preprocessed by the CPU:

If the CPU makes preprocessed finished values available in bit memory or in a data block, suppression is only possible or useful if these finished values also adopt the values listed above 32767 / 7FFF_h or -32768 / 8000_h in the overflow or underflow range. If this is not the case, the parameter should not be configured for preprocessed values.

For finished values preprocess in the CPU, the limits for the overflow and underflow can be freely assigned.

Integration interval

The integration interval is used for threshold value processing of analog values according to the integration principle. The threshold value is used for the threshold value trigger; see also section Threshold value trigger (Page 154).

The entered value determines the time interval in which analog values are integrated.

With the setting 0 (zero), the threshold value is calculated without integration. This means lower data volume. In this case, the absolute method is used.

Smoothing factor**Requirements for the function**

Configuration of the threshold trigger for this data point

Restrictions

The smoothing factor cannot be configured at the same time as mean value generation. A configured value has no effect when mean value generation is activated.

Function

Analog values that fluctuate quickly can be evened out using the smoothing function.

The smoothing factors are calculated according to the following formula as with S7 analog input modules.

$$y_n = \frac{x_n + (k - 1) y_{n-1}}{k}$$

where

y_n = smoothed value in the current cycle n

y_{n-1} = smoothed value in the previous cycle n-1

x_n = value acquired in the current cycle n
k = smoothing factor

The following values can be configured for the module as the smoothing factor.

- 1 = No smoothing
- 4 = Weak smoothing
- 32 = Medium smoothing
- 64 = Strong smoothing

Set limit value 'low' / Set limit value 'high'

Requirements for the function

- Configuration of the threshold trigger for this data point
- Supported variable types of the CPU
The analog value data point must alternatively be linked to one of the following variables:
 - PLC tag in the bit memory address area
 - DB variable (variable in data block)

Limit value configuration is not possible for PLC tags that access hardware modules (input/output operand area).

The configuration of limit values is pointless for measured values that have already been preprocessed on the CPU.

Function

In these two input boxes, you can set a limit value in the direction of the start of the measuring range or in the direction of the end of the measuring range. You can also evaluate the limit values, for example as the start or end of the measuring range.

Note

Limit values only apply to threshold value triggers

The limit value settings are only considered in combination with a threshold value trigger. If a different trigger is configured, e.g. a time or PLC tag trigger, the values are sent independent of preprocessing as soon as the trigger condition is met. The limit values are not considered in this case.

Recommendation for quickly fluctuating analog values:

If the analog value fluctuates quickly, it may be useful to smooth the analog value first if limit values are configured.

Status identifier "OVER_RANGE" / "OV overflow"

With protocols that support status identifiers, if the high or low limit value is violated, the status identifier of the data point is set for measuring range violation.

Configuration of the limit value

Depending on the data type, a limit value is configured as an integer decimal number or as a floating-point number.

Table 4-11 Value ranges of the limit values

Data type	Range of values
Int	-32768 ... 32767
DInt	-2147483648 ... 2147483647
Real/LReal	-7.9000E+028..7.9000E+028

Note

Limit value 0 (zero)

- The entry of the value 0 is interpreted as a deactivated limit value for most modules.
Exceptions:
- The value 0 can also be used as a limit value for the following modules as of the indicated firmware version:
 - CP 1243-7 LTE V3.3
 - CP 1542-1 IRC V2.2
 - TIM 1531 IRC V2.2

The following table specifies the ranges of a 32-bit number with regard to the ranges of the raw value of an analog input or output module.

Range	Value of the 16-bit PLC variable *		Module output [mA]			Measuring range [%]
	Decimal	Hexadecimal	0 .. 20 (unipolar)	-20 .. +20 (bipolar)	4 .. 20 (life zero)	
Overflow	32767	7FFF	> 23.515	> 23.515	> 22.810	> 117.593
Overrange	32511	7EFF	23.515	23.515	22.810	117.593
	... 27649	... 6C01	... 20.001	... 20.001	... 20.001	... 100.004
Nominal range (unipolar / life zero)	27648	6C00	20		20	100
	...	...	...		...	...
	0	0000	0		4	0
Nominal range (bipolar)	27648 ...	6C00 ...		20 ...		100 ...
	0	0000		0		0
	... -27648	... 9400		... -20		... -100
Underrange (unipolar / life zero)	-1	FFFF	-0.001		3.999	-0.004
	...	...	...		...	...
	-4864	ED00	-3.518		1.185	-17.59
Underrange (bipolar)	-27649	93FF		-20.001		-100.004
	...	...		...		...
	-32512	8100		-23.516		-117.593
Undershoot / wire break	-32768	8000	< -3.518		< 1.185	< -17.593

* The value ranges (underflow / overflow) in PLC variables with different data types are as follows:

- Int
 - -32768
 - 32767
- DInt
 - -2147483648
 - 2147483647
- Real/LReal
 - -7.9000E+028
 - 7.9000E+028

Note**Evaluation of the value even when the option is disabled**

If you enable one or both options and configure a value and then disable the option later, the grayed out value is nevertheless evaluated.

To disable the two options, delete the previously configured values limit values from the input boxes and then disable the relevant option.

See also

Status IDs of the data points (Page 140)

4.22.12 Command options

Output options

The output options correspond to the specification IEC 60870-5-101 - Qualifier of command.

Parameters

The two output options under "Control Code" can be activated alternatively:

- **LATCH_ON/OFF**

- Qualifier of command - QU (Type 1.1) <1> persistent output

The function permanently latches a command output to the value 0 or 1.

Note:

The latched value is only canceled by a new command. Alternatively, the command can be reset by the user program.

- **PULSE_ON**

Qualifier of command - QU (Type 1.1)

The function evaluates the number and length of the signals (pulses) of command outputs from a master station.

Coding:

- <1> short pulse duration
Corresponding parameter for the module: "Short pulse duration"
- <2> long pulse duration
Corresponding parameter for the module: "Long pulse duration"

The output option "Command execution mode" can be activated independently:

- **Command execution mode**

Qualifier of command / Qualifier of set-point command - S/E (Type 6)

Coding:

- <0> execute
- <1> select

The function defines whether a command is transferred directly to the CPU (direct command transmission) or whether the system waits for a confirmation of execution (execute) after the selection (select) before the command is forwarded.

The station module acknowledges receipt of the selection ASDU with the Qualifier <1> select. After receiving the acknowledgment, the master sends the execution ASDU with the Qualifier <0> execute.

Processing

- LATCH_ON/OFF
The function latches the value of a command as described above.
- PULSE_ON/OFF
The function is coded by the master via a "Qualifier of command". The following codes are evaluated by the communication module in the station:
 - QU (Type 1.1) <0> no additional definition
Corresponding parameter for the module: "Pulse control"
 - QU (Type 1.1) <1> short pulse duration
Corresponding parameter for the module: "Short pulse duration"
 - QU (Type 1.1) <2> long pulse duration
Corresponding parameter for the module: "Long pulse duration"
 - S/E (Type 6) <0> execute
Corresponding parameter for the module: "Command execution mode"
 - S/E (Type 6) <1> select
Corresponding parameter for the module: "Command execution mode"

Data point types

The output options can be configured for the following data point types:

- Control Code (LATCH_ON/OFF / PULSE_ON)
 - Single command ... <45>, <58>
 - Double command ... <46>, <59>
 - Regulating step command ... <47>, <60>
- Command execution mode
 - Single command ... <45>, <58>
 - Double command ... <46>, <59>
 - Regulating step command ... <47>, <60>
 - Set-point command ... <48>, <49>, <61>, <62>

Parameter

Name:	Control Code
Options:	• PULSE_ON • LATCH_ON/OFF
Explanation:	Output option of the command output. See above for the meaning.

Name:	Number of pulses / Max. Number of pulses
Default:	1
Explanation:	Number of pulses that the data point of the master sends to the corresponding data point of the station. In the station, the parameter monitors the number of pulses sent by the master. If the number of pulses received from the master exceeds the specified value, the command is rejected.
Name:	Pulse control
	(only "Double command")
Options:	• Short pulse duration • Long pulse duration
Explanation:	• Short pulse duration Short pulses are intended for time-critical processes, e.g. for controlling circuit breakers. • Long pulse duration Long pulses are intended for process that are not time-critical.
Name:	Short pulse duration (s)
Range of values:	0 ... 65535
Default:	0
Explanation:	Commands from the master with the Qualifier of command = <1> (short pulse duration) are output by the communications module for the duration configured here. If "Short pulse duration" is configured with the value 0 (zero), commands are discarded by the module with the Qualifier of command of <1>.
Name:	Long pulse duration (s)
Range of values:	0 ... 65535
Default:	0
Explanation:	Commands from the master with the Qualifier of command = <2> (long pulse duration) are output by the communications module for the duration configured here. If "Long pulse duration" is configured with the value 0 (zero), commands are discarded by the module with the Qualifier of command of <2>.
Name:	Command execution mode
Options:	• Execute directly • Select and operate

Default:	Execute directly
Explanation:	• Execute directly "direct command transmission" The command is immediately transmitted to the CPU of the station for execution. • Select and operate "select / execute" Procedure: – The command is triggered in the master module The "Select" frame is sent from the master station to the communications module of the station. – The station acknowledges receipt. – The master data point sends the execution frame after receiving the acknowledgment from the station. – The station only forwards the command to the CPU when it receives the "Operate" frame from the master within the configured "Max. time between Select and Operate". The station must not receive any other data frame between Select and Operate. Note: "Max. time between Select and Operate" is configured in the transmission settings of the respective interface.

Command result

Function and validity

The function is intended for reporting back to the communication partner whether a command or setpoint from the communications module was received. The subsequent execution of the command in the CPU is neither recorded nor evaluated.

Validity: Command and setpoint data points with enabled "Master function" option.

The confirmation of receipt is written to the "PLC tag for command result" (Byte, see below) and sent to the corresponding tag of the partner.

The response must be evaluated at the communication partner.

Data types

- Single / double / regulating step command <45, 46, 47>
- Single / double / regulating step command with time tag CP56Time2a <58, 59, 60>
- Set point command, normalized value / scaled value / short floating point value <48, 49, 50>
- Set point command, normalized value / scaled value / short floating point value with time tag CP56Time 2a <61, 62, 63>
- Bitstring of 32 bits without/with time tag <51, 64>

Parameter

Name: **Command result**
 Default: 0
 Explanation: Enables feedback of the command/setpoint receipt to the communication partner.

Name: **Variable for command result**
 Data type: Same data type as the respective data point
 Explanation: The local value must be mapped to this tag.

Configuration of the "Variable for command result"

To supply a command result to the local CPU, you need to configure an S7 tag in STEP 7 (TIA Portal) for the relevant commands/setpoints. The S7 tag has the S7 data type "Byte" and is encoded as follows:

Table 4-12 Possible results of the tags

Value (hex)	Meaning
0x00	No result
0x01	Command/setpoint accepted
0x80	Command/setpoint rejected because the station cannot be reached
0x81	Timeout occurred
0x82	Command/setpoint rejected by the station
0x83	Command/setpoint rejected because CPU in the station is in Stop

Command acceptance**Validity**

- Protocol: IEC 60870-5
- Station type: Station
- Communication modules:
 - TIM 1531 IRC as of firmware V2.5
 - CP 1200 as of firmware V3.6
 - CP 1542SP-1 IRC as of firmware V2.4

Function

With the "Command acceptance" option, a station can selectively accept or reject a command or setpoint that is sent by a specific ASDU address (master). The function can be useful in plants with multiple masters if a station should only accept commands from a specific master.

Master-specific processing of the command in the CPU is handled with the "Tag for command acceptance".

The ASDU address of the master is coded with the first eight bits of this variable; see below.

Bits 8 and 9 of the variable are evaluated for acceptance or rejection of an ON/OFF command.

Configuration

1. First, create a PLC tag or DB tag of the "Word" data type. This is used as "Tag for command acceptance".
2. Write the ASDU address into this tag and occupy bits 8 and 9 according to your requirements (acceptance or rejection of the ON/OFF command).
3. Create a data point for command or setpoint acceptance.
4. Enable the "Command acceptance" option on this data point.
5. Enter the previously created "Tag for command acceptance" there.

Table 4-13 Coding of "Tag for command acceptance"

Bit	.15	.14	.13	.12	.11	.10	.9	.8	.7	.6	.5	.4	.3	.2	.1	.0
Meaning	0 **						OFF	ON	ASDU address of the master							
Notes • Bits 0...7 The ASDU address of the master to be checked is stored here. Permitted range: 0...255 Configuration of the range: – 1...255 Commands/setpoints of a master with an address from 1...255 are evaluated. – 0 The master address is not evaluated. • Bit 8 * When the ON bit is set (bit 8 = 1), an ON command (command bit = 1) is accepted. • Bit 9 * When the OFF bit is set (bit 9 = 1), an OFF command (command bit = 0) is accepted. * Bits 8 and 9 are only evaluated for the data types <45>, <46>, <58> and <59>. They are meaningless for the other data point types (see below). ** Bits 10...15 are not evaluated.																

Response of the station

- ON bit: ON commands with command bit = 1
When the ON bit is set (bit 8 = 1) and the station module receives a command with command bit = 1 from the master configured in bits 0...7, it accepts the command and performs it.
- OFF bit: OFF commands with command bit = 0
When the OFF bit is set (bit 9 = 1) and the station module receives a command with command bit = 0 from the master configured in bits 0...7, it accepts the command and performs it.

Notes:

- Only checking the sender address
If you want to check only the master address (bits 0...7), bits 8 and 9 are still evaluated by the communication module. In this case, you need to permanently occupy the two bits 8 and 9 with 1.
- Rejection
If execution is rejected, the station module sends a negative response to the master with the following information on "CAUSE OF TRANSMISSION":
 - Cause <7> actcon
 - P/N <1> negative confirm

Supported data types

The function is supported by the following data types:

- Single / double / regulating step command <45, 46, 47>
- Single / double / regulating step command with time tag CP56Time2a <58, 59, 60>
- Set point command, normalized value / scaled value / short floating point value <48, 49, 50>
- Set point command, normalized value / scaled value / short floating point value with time tag CP56Time2a <61, 62, 63>
- Bitstring of 32 bits without/with time tag CP56Time2a <51, 64>

Command monitoring**Validity**

- Protocol: IEC 60870-5
- Station type: Station
- Communication modules:
 - TIM 1531 IRC as of firmware V2.5
 - CP 1542SP-1 IRC as of firmware V2.4

Requirements

- The "ACTTERM" function is enabled (interface > "Advanced options > Transmission settings - IEC 60870-5").
- The master function of the data point is disabled.

Function

With the "Command monitoring" option, the station can report to the master whether the received command was executed or not (feedback).

The feedback value of the CPU is saved in a second data point, whose value is returned to the master.

After a command is received, a station usually responds with "ACTCON", optionally with "ACTTERM"; see above.

When the "Command monitoring" function is enabled, the station first sends "ACTCON" to the master.

The communication module forwards the command to the CPU and starts the "Maximum command monitoring lifetime"; see "Basic settings" parameter group.

When the CPU has processed the command, it writes the changed value to the "Data point for command monitoring" and the station module transfers the change with Cause of transmission (COT) = 11 between "ACTCON" and "ACTTERM" to the master.

If the CPU does not process the command within the configured "Maximum command monitoring lifetime" (no changed value), the station module transfers the feedback value with Status = invalid and COT = 11 to the master.

If the CPU supplies a change of the feedback value without a command being received first, the communication module sends the feedback value with COT = 3 (unsolicited) to the master.

Configuration

1. First, create a PLC tag or DB tag of the "Bool" data type for command acceptance.
2. Create a variable of the "Bool" data type for the feedback data point.
3. Create a data point for command acceptance.
4. Create the "Data point for command monitoring".
5. Enable the "Command monitoring" option on the data point for command acceptance.
6. Enter the "Data point for command monitoring" there.

Supported data types

You can use the following data point types for the "Command monitoring" function and the associated data point for feedback to the master:

Command data point type for the "Command monitoring" function	Compatible data point type for feedback to the master ("Data point for command monitoring")
• Single command <45> • Single command with time tag CP56Time2a <58>	• Single-point information <1> • Single-point information with time tag CP56Time2a <30>
• Double command <46> • Double command with time tag CP56Time2a <59>	• Double-point information <3> • Double-point information with time tag CP56Time2a <31>
• Regulating step command <47> • Regulating step command with time tag CP56Time2a <60>	• Step position information <5> • Step position information with time tag CP56Time2a <32>

4.22.13 Partner stations

Activating the partners of the data point

All partners with which a telecontrol connection has been configured are shown in the table.

Enable the partner or partners with which the selected data point is to exchange data using the check box: ☒

4.23 Messages

Configuration of the messages

If important events occur, the communications module can send configured messages. No program blocks need to be used for the configuration.

To transfer messages, telecontrol communication (parameter group "Communication types") no longer needs to be enabled.

The following are configurable:

- E-mails
The recipient can be a PC with an Internet connection or an S7 station.
- SMS (only mobile wireless CPs)
The recipient can be a mobile phone or an S7 station.

Up to 10 messages (e-mail or SMS) can be configured per module.

You configure the messages in the message editor of the module. Alternatively, you will find it:

- In the shortcut menu of the module
- Via the project navigation: Directory of the station > Local modules > Communications module

For the view in STEP 7, refer to the section Data point configuration (Page 129).

Triggering sending of messages

The sending of the message is triggered by an event that is configured in the "Trigger" tab (see below).

Prerequisites, required information and procedure

E-mails

Consider the following requirements in the configuration for the transfer of e-mails:

- Enabling telecontrol communication ("Communication types") parameter group
- Enabling security functions
- Configuring the "E-mail configuration" parameter group

Required information:

- Access data of the SMTP server: Address, port number, user name, password
- When using STARTTLS or SSL/TLS: Certificate of the e-mail service provider

- E-mail addresses of the recipients
- APN (mobile wireless CPs)
You obtain the access data for the mobile wireless network and for an APN for transferring e-mails from your network provider. You configure this in the parameter group "Mobile wireless communication settings".

You perform the configuration in the following parameter groups:

- Enabling security functions
To use e-mails, you need to enable the security functions of the CP, parameter group "Security".
- Configuration of the service / protocol:
"E-mail configuration"
- When using STARTTLS or SSL/TLS:
 - Import of the certificate of the e-mail service provider:
"Global security settings"
 - Using the imported certificate for the module:
Parameter group "Security" > "Certificate manager"

SMS (mobile wireless CPs or TIM)

Required information:

- Number of the SMSC

You perform the configuration in the following parameter groups:

- Enabling the SMS function:
"Communication types" > "Enable SMS"
- Configuration of the SMSC
"Mobile wireless communication settings"
- Configuring the SMS
Message editor

"Message parameter"

Here you configure the phone number or the recipient, the subject (e-mail) and the text of the message.

Text: Number of characters

Maximum number of characters that can be transferred in the message text:

- SMS: Max. 160 ASCII characters including any value sent at the same time
- E-mail: 256 ASCII characters including any value sent at the same time

For the value, see below, "Include value" parameter.

Character set for message texts

Entry of the following permitted characters as ASCII character sets (hexadecimal value and character name):

- 0x20
Space
- 0x21 ... 0x5F
!"#\$%&'()*+,-./0123456789:;<=>?@ABCDEFGHIJKLMN OPQRST
UVWXYZ[\]^_
- 0x61 ... 0x7E
abcdefghijklmnopqrstuvwxyz{|}~
- 0x7C, 0x7E
|~
- Manual line break (↵)
In message texts, you can insert a line break using <Shift>+<Enter>.

"Trigger"

In the "Trigger" parameter group you configure triggering for sending the message and other parameters.

- **E-mail trigger / SMS trigger**

Specifies the event for which the sending of the message is triggered:

- **Use PLC tag**

For the trigger signal to send the e-mail, the edge change (0 → 1) of the trigger bit "PLC tag for trigger" that is set by the user program is evaluated. When necessary, a separate trigger bit can be configured for each message. For information on the trigger bit, see below.

Resetting the trigger bit:

If the memory area of the trigger bit is in the memory area or in a data block, the trigger bit is reset to zero when the message is sent.

In all other cases, you need to reset the trigger bit with the user program.

Note

Fast setting of the diagnostics trigger tag

Trigger should not be set more often than once per second.

Frequent sending of SMS

Depending on the system environment, sending an SMS can take up to 2 minutes. To guarantee secure transmission of SMS in mobile wireless modules, a minimum interval of 10 seconds is recommended for triggering SMS.

- **CPU changes to STOP**

- **CPU changes to RUN**

- **Connection to a partner interrupted**

Triggers the sending of the message when the telecontrol connection to a partner is interrupted.

To specify the partner, see below, "Partner for trigger" parameter.

- **Connection to a partner established**

Triggers the sending of the message when the connection returns.

To specify the partner, see below, "Partner for trigger" parameter.

- **Connection establishment to partner failed**

Triggers the sending of the message when the telecontrol connection to a partner could not be established.

- **TeleService session started**

(Mobile wireless CPs, CP 1542SP-1 IRC)

Triggers the sending of the message when telecontrol communication is enabled and a TeleService connection is established.

- **TeleService session ended**

(Mobile wireless CPs, CP 1542SP-1 IRC)

Triggers the sending of the message when telecontrol communication is enabled and a TeleService connection has been terminated.

- **Weak mobile wireless network**
(SMS only)
If the mobile wireless connection for telecontrol communication is too weak, an SMS message is triggered and sent to the configured recipient.
- **VPN connection established**
(CP 1243-7 LTE, CP 1243-1, CP 1543SP-1)
Triggers the sending of the message when the VPN connection is established or returns.
- **VPN connection terminated**
(CP 1243-7 LTE, CP 1243-1, CP 1543SP-1)
Triggers the sending of the message when the VPN connection is interrupted.
- **SINEMA RC connection established**
(CP 1243-7 LTE, CP 1243-1, CP 1542SP-1 IRC)
Triggers the sending of the message when the VPN or OpenVPN connection is established or returns.
- **SINEMA RC connection terminated**
(CP 1243-7 LTE, CP 1243-1, CP 1542SP-1 IRC)
Triggers the sending of the message when the VPN or OpenVPN connection is interrupted.
- **Partner for trigger**
Here you select from the configured partners of the device the partner whose connection is affected in the trigger options "Connection to a partner established" or "Connection to a partner interrupted".
- **PLC tag for trigger**
PLC tag for the trigger "Use PLC tag"
- **Enable identifier for processing status**
If the option is enabled, every attempt to send returns a status with information about the processing status of the sent message.
The status is written to the "PLC tag for processing status". If there are problems delivering messages, you can determine the status via the Web server of the CPU by displaying the value of the PLC tag there.
For the significance of the status output in hexadecimal, refer to the section Processing status of the messages (SMS / e-mail) (Page 185).
- **PLC tag for processing status**
PLC tag of the type DWORD for the processing status
- **Include value**
When the option is enabled, the module sends a value from the memory area of the CPU for the placeholder \$\$ in the message. To do this enter "\$\$" as a placeholder for the value to be sent in the message text.
Select a PLC tag whose value will be integrated in the message. The value is entered in the message text instead of the placeholder \$\$.
\$\$ as placeholder for the value of a PLC tag supports the following data types:
 - Bool, Byte, Char, USInt, Int, UInt, Word, DWord, UDInt, DInt, Real, String
 - Arrays of these data types
- **PLC tag for value**
PLC tag in which the value to be sent is written.

Error messages

If an error message for the trigger type is displayed when compiling the station, check the configuration.

If you have configured one of the following options as trigger type for the message:

- VPN / IPSec / SINEMA RC
- Check the following:
 - Are the security functions enabled?
 - Is VPN activated?
 - Are additional options set correctly?

4.24 Character set for user names, passwords and messages

Character set for user names, passwords and message texts

The following permitted characters apply to:

- E-mail server:
 - User name and password
- Messages in the message editor:
 - Message texts

Entered as ASCII character sets (hexadecimal value and character name):

- 0x20
Space
- 0x21 ... 0x5F
!"#\$%&'()*+,-./0123456789:;<=>?@ABCDEFGHIJKLMN O P Q R S T
U V W X Y Z [\] ^ _
- 0x61 ... 0x7E
a b c d e f g h i j k l m n o p q r s t u v w x y z { | } ~
- 0x7C, 0x7E
| ~

In addition for message texts:

- Manual line break (↵)
In message texts, you can insert a line break using <Shift>+<Enter>.

Commissioning

5.1 Commissioning the CP

Requirement: Configuration prior to commissioning

A prerequisite for full commissioning of the module is the completeness of the STEP 7 project data.

Commissioning the module

Further commissioning involves the following steps:

1. Compiling the project data
2. Downloading the STEP 7 project data to the device
The STEP 7 project data of the CP is transferred when you load to the station.
To load the station, connect the engineering station on which the project data is located to the CPU.

You will find more details in the STEP 7 information system in the section "Compiling and downloading project data".

5.2 Set time for operation with Security / SINEMA RC

Manual setting the time of day during commissioning

Note

Time-of-day synchronization when using Security / SINEMA RC

When using security functions, such as SINEMA Remote Connect, the CP needs the current time for authentication on the partner or on the SINEMA RC Server.

The CP receives the time from the CPU or from an NTP server before the connection is established for the first time.

Recommendation:

During commissioning, set the time of the CPU manually at least once using the STEP 7 online functions. This is necessary especially if you have configured the "Time from partner" option for the time synchronization. In this way, you ensure that the CPU has a valid time of day when the station starts up and that the CP can exchange the required certificates with the partner or the SINEMA RC Server.

Diagnostics and maintenance

6.1 Diagnostics options

The following diagnostics options are available with most modules. Some functions are limited to specific data types or protocols.

LEDs of the module

You can find information on the LED displays in the operating instructions for the respective module; see Bibliography (Page 211).

STEP 7: The "Diagnostics" tab in the Inspector window

If your engineering station is connected to a module via Ethernet, you will receive the following information about the selected module here:

- Connection status of the engineering station with the module

STEP 7: Diagnostics functions in the "Online > Online and diagnostics" menu

Using the online functions, you can read various diagnostic information from the relevant module from an engineering station on which the STEP 7 project is stored and perform maintenance functions.

You will find additional information on the diagnostics functions of STEP 7 in the STEP 7 information system.

Online access

This is where you establish the online connection to the module.

For the procedure, refer to the STEP 7 information system.

Diagnostics

Here, you can obtain the following static information on the selected module:

- **General**
General information on the module
- **Diagnostic status > Device-specific events**
Here you will find the diagnostics buffer entries of the module and an overview of the sent messages (SMS messages / e-mails).
- **Ethernet interface[X1/2/3]**
Address and statistical information

- **Industrial Remote Communication**

Here, you obtain WAN-specific information on the TIM module:

- **Partner**

Here you will find address and configuration data of the partners, connection statistics and additional diagnostics information. Click on a subscriber to display additional information.

You will also find information on the partners in the WBM, see below.

- **Data point list**

Information on the data points such as configuration data, value, connection status etc.

- **Telegram protocol diagnostics**

With this function, you can enable, evaluate and display the logging of frames of the module.

You can analyze the generated text file using the TIM frame monitor of the SINAUT diagnostics tool.

For a description, see section Telegram protocol diagnostics (Page 184).

- **Ethernet diagnostics**

With the Logging function, you can log the data traffic of the TIM using PCAP functionality for diagnostics purposes.

If an error occurs or if the TIM behaves in an unwanted manner, the communication behavior of the TIM can be recorded. The frame traffic of the TIM is recorded for a defined time or for a configurable number of frames.

The log files are stored as PCAP files on the connected PC and can be evaluated with the Wireshark program, for example.

- **Security**

- **Status**

Shows information on the general data of the module.

- **System log**

Lists the entries of the system log.

- **Audit log**

Lists the entries of the audit log.

- **Packet filter log**

Lists the entries of the packet filter log.

- **Communication status**

This diagnostics page shows the states of the known security modules of the VPN groups, their endpoints and the tunnel properties.

- **SINEMA RC - automatic VPN configuration**

This diagnostics page shows the status of the automatic OpenVPN configuration and the OpenVPN connections.

- **Time**

Specification of the current time in the module and the time source. Possibility to set the time in the module.

- **Advanced**

Contains information on, for example, the system time, the time of synchronization, the synchronization method and the synchronization partner from which the time is obtained.

Functions

You can run the following functions here:

- **Firmware update**
- **Assign IP address**
- **Reset to factory settings**

For information on the functions, refer to the section Maintenance (Page 187).

- **Save service data**

The function is used for logging of internal module processes in situations in which you cannot eliminate unexpected or unwanted behavior of the module yourself.

The log file is created with the "Save service data" button. The files are saved in a *.dmp file and can be evaluated by Siemens personnel if required.

Web server (WBM) of the TIM 1531 IRC

From a PC you can use HTTP/HTTPS to access the Web pages (WBM) of the TIM. The WBM returns a variety of information.

For access to the content, see the manual of the TIM /2/ TIM 1531 IRC (Page 211).

Partner status and connection states in the WBM

You will see the configured partners and the status of the connections to the local and remote communications partners of the TIM on the page "Telecontrol" > "Partner information" of the WBM. For details, see /2/ TIM 1531 IRC (Page 211).

Partner and connection information to the CPU

The TIM can signal the status of the connection and the connection paths to the communications partner to its local CPU via a PLC tag. For information on the configuration, refer to section Communication with the CPU (Page 78).

SNMP

For information on the functions, refer to the section SNMP (Page 184).

6.2 Online security diagnostics via port 8448 of the TIM

Security diagnostics via port 8448

Requirements:

- With an activated firewall, access must be enabled.

If you want to perform security diagnostics in STEP 7 Professional, follow the steps below:

1. Select the desired TIM in STEP 7.
2. Open the "Online & Diagnostics" shortcut menu.
3. In the "Security" parameter group, click the "Connect online" button.

In this way, you perform the security diagnostics via port 8448.

Port 8448 of the TIM 1531 IRC

With the TIM 1531 IRC, Port 8448 is open in the factory and cannot be closed.

6.3 Telegram protocol diagnostics

The telegram protocol diagnostics is available for the following modules:

- S7-1200 telecontrol CPs
- CP 1542SP-1 IRC
- TIM 1531 IRC

The "Telegram protocol diagnostics" function is used to record transferred message frames.

Operation

You operate the function using the three buttons underneath the dialog described above.

- Activate telegram protocol diagnostics
Clicking the button starts logging of the transferred message frames.
400 message frames are recorded per recording cycle. A maximum of 10000 message frames can be stored in a circular buffer.
- Refresh
Updates the recording; a new recording cycle is started.
- Save
Saves the recorded message frames in a binary file. You define the storage location using the button.
- Show saved
Shows the recorded and saved frames.

6.4 SNMP

SNMP (Simple Network Management Protocol)

SNMP is a protocol for management and diagnostics of networks and nodes in the network. To transmit data, SNMP uses the connectionless UDP protocol.

The information on the properties of SNMP-compliant devices is stored in MIB files (MIB = Management Information Base).

Scope of performance of the module as SNMP agent

Not all functions described below are available with every module. Refer to the manual of the respective module for information on the functional scope.

The communications modules support data queries in the following SNMP versions:

- SNMPv1 (standard)
- SNMPv3 (Security)

They return the contents of MIB objects of the standard MIB II according to RFC1213.

- **MIB II**

The MIB supports the following groups of MIB objects:

- System
- Interfaces
The "Interfaces" MIB object provides status information about the module interfaces.
- IP
- ICMP
- TCP
- UDP
- SNMP

The following groups of the MIB II standard are not supported:

- Address Translation (AT)
- EGP
- Transmission

The modules do not support traps.

For more detailed information about the MIB files and SNMP, refer to the manual /9/ SNMP (Page 213).

Configuration

For information on the configuration, see section SNMP (Page 93).

6.5 Processing status of the messages (SMS / e-mail)

Processing status of messages

If the option "Enable identifier for processing status" option is set in the "Trigger" tab of the STEP 7 message configuration, the module outputs a status.

The processing status provides information about the processing state of the sent message. The status is written to a PLC tag of the type DWORD. Select this tag via the "PLC tag for processing status" box.

6.5 Processing status of the messages (SMS / e-mail)

The processing status is returned by the module itself or the servers of the service after transfer of a message to be sent.

E-mails sent via program blocks of Open User Communication return a different status via the block (see block help).

The meaning of the statuses is as follows:

Processing status of the telecontrol messages

Table 6-1 SMS: Meaning of the status ID output in hexadecimal format

Status	Meaning
0000	Transfer completed free of errors
0001	Error in the transfer, possible causes: • SIM card invalid • No network • Wrong destination phone number (number not reachable)

Table 6-2 E-mail: Meaning of the status ID output in hexadecimal format

Status	Meaning
0000	Transfer completed free of errors
82xx	Other error message from the e-mail server Apart from the leading "8", the message corresponds to the three-digit error number of the SMTP protocol.
8401	No channel available. Possible cause: There is already an e-mail connection via the module. A second connection cannot be set up at the same time.
8403	No TCP/IP connection could be established to the SMTP server.
8405	The SMTP server has denied the login request.
8406	An internal SSL error or a problem with the structure of the certificate was detected by the SMTP client.
8407	Request to use SSL was denied.
8408	The client could not obtain a socket for creating a TCP/IP connection to the mail server.
8409	It is not possible to write via the connection. Possible cause: The communications partner reset the connection or the connection aborted.
8410	It is not possible to read via the connection. Possible cause: The communications partner terminated the connection or the connection was aborted.
8411	Sending the e-mail failed. Cause: There was not enough memory space for sending.
8412	The configured DNS server could not resolve specified domain name.
8413	Due to an internal error in the DNS subsystem, the domain name could not be resolved.
8414	An empty character string was specified as the domain name.
8415	An internal error occurred in the cURL module. Execution was aborted.
8416	An internal error occurred in the SMTP module. Execution was aborted.
8417	Requests to SMTP on a channel already being used or invalid channel ID. Execution was aborted.
8418	Sending the e-mail was aborted. Possible cause: Execution time exceeded.

Status	Meaning
8419	The channel was interrupted and cannot be used before the connection is terminated.
8420	Certificate chain from the server could not be verified with the root certificate of the module.
8421	Internal error occurred. Execution was stopped.
8450	Action not executed: Mailbox not available / unreachable. Try again later.
84xx	Other error message from the e-mail server Apart from the leading "8", the message corresponds to the three-digit error number of the SMTP protocol.
8500	Syntax error: Command unknown. This also includes the error of having a command chain that is too long. The cause may be that the e-mail server does not support the LOGIN authentication method. Try sending e-mails without authentication (no user name).
8501	Syntax error. Check the following configuration data: Alarm configuration > E-mail data (Content): • Recipient address ("To" or "Cc").
8502	Syntax error. Check the following configuration data: Alarm configuration > E-mail data (Content): • Email address (sender)
8535	SMTP authentication incomplete. Check the "User name" and "Password" parameters in the configuration.
8550	SMTP server cannot be reached. You have no access rights. Check the following configuration data: • Module configuration > E-mail configuration: – User name – Password – Email address (sender) • Alarm configuration > E-mail data (Content): – Recipient address ("To" or "Cc").
8554	Transfer failed
85xx	Other error message from the e-mail server Apart from the leading "8", the message corresponds to the three-digit error number of the SMTP protocol.

6.6 Maintenance

Maintenance functions

You can find a description of the following maintenance functions in the manual or operating instructions of the respective module, see Bibliography (Page 211).

- Firmware update
- Reset
- Module replacement

OUC program blocks (CP)

A.1 Validity and requirements

Validity

The functions described below are supported by the following modules:

- CP 1243-1
 - As of firmware $\geq$ V3.1
- CP 1243-7 LTE
 - As of firmware $\geq$ V3.1
- CP 1243-8 IRC
 - As of firmware $\geq$ V3.1
- CP 1542SP-1 IRC
 - As of firmware $\geq$ V2.0

Observe the deviations between the firmware versions for secure communication (Secure OUC); see below.

A.2 Program blocks for OUC

Using the program blocks for Open User Communication (OUC)

You can use the instructions (program blocks) listed below for direct communication between S7 stations.

In contrast to telecontrol communication, Open User Communication does not need to be enabled in the configuration because the corresponding program blocks need to be created for this. You will find details on the program blocks in the information system of STEP 7.

Note**No different program block versions**

Note that you cannot use different versions of a program block in a station.

Requirements for Secure OUC

Requirements for the use of the secure transmission via Secure OUC:

- STEP 7: As of V16
- CPU firmware
 - CPU-1200: As of V4.4
 - CPU 151xSP: As of V2.0
- CP firmware
 - CP 1200: As of V3.2
 - CP 1542SP-1 IRC: As of V2.1

Supported program blocks for OUC

The following instructions in the specified minimum version are available for parameter assignment of the Open User Communication:

- **TSEND_C V3.0 / TRCV_C V3.0**
Compact blocks for:
 - Connection establishment/termination and sending data
 - Connection establishment/termination and receiving data

As an alternative, use:

- **TCON V4.0 / TDISCON V2.1**
Connection establishment / connection termination
- **TUSEND V4.0 / TURCV V4.0**
Sending and receiving data via UDP
- **TSEND V4.0 / TRCV V4.0**
Sending and receiving data via TCP or ISOonTCP
- **TMAIL_C V4.0**
Sending e-mails
To transfer encrypted e-mails with this block, the precise time of day is required on the module. Configure the time-of-day synchronization.

Note

Personal data unencrypted in TMAIL_C

Note that TMAIL_C uses personal data, such as user name and password, in its parameters. This data is stored unencrypted in a data block.

To change the configuration data of the module during runtime:

- **T_CONFIG V1.0**
Program-controlled configuration of the IP parameters
Refer to the information on T_CONFIG and on the SDTs "IF_CONF_..." in the section Changing the IP address during runtime (Page 193).

Note

No feedback from the CP

"T_CONFIG" does not support feedback from the CP to the CPU. Errors in the block call or in setting the address parameter are not reported. The block outputs "BUSY" or "DONE" regardless of whether the address parameter was set.

The address parameters can only be configured with temporary validity. In the respective "IF_CONF_..." SDT, the "Mode" = 2 parameter must be set.

- **TC_CONFIG**
Program-controlled change of configuration data of mobile wireless CPs

You can find the program blocks in STEP 7 in the "Instructions > Communication > Open User Communication" task card.

Connection descriptions in system data types (SDTs)

The blocks listed above use the CONNECT parameter for the relevant connection description. TMAIL_C uses the parameter MAIL_ADDR_PARAM.

The connection description is stored in a data block whose structure is specified by the system data type (SDT).

Creating an SDT for the data blocks

Create the SDT required for every connection description as a data block (global DB).

The SDT type is not created by selecting an entry from the "Data type" drop-down list in the declaration table of the block, but by entering the name manually in the "Data type" box, for example "TCON_IP_V4".

The corresponding SDT is then created with its parameters.

Usable SDTs

- **TCON_IP_V4**
For transferring frames via TCP or UDP
- **TCON_QDN**
For TCP or UDP communication via the fully qualified domain name (FQDN) (IPv4 / IPv6)
- **TCON_IP_RFC**
For transferring frames via ISO-on-TCP (direct communication between two S7 stations)
- **TADDR_Param**
For transferring frames via UDP

- **TMail_V4**
For transferring e-mails addressing the e-mail server using an IPv4 address
Recommendation for mobile wireless applications:
Set the parameter "WatchdogTime" from "MAIL_ADDR_PARAM" to a value higher than 3 minutes.
- **TMail_V6**
For transferring e-mails addressing the e-mail server using an IPv6 address
- **TMail_FQDN**
For transferring e-mails addressing the e-mail server using its name (FQDN)
- **IF_CONF**
For changing configuration data of mobile wireless CPs using the TC_CONFIG
- **TCON_IP_V4_SEC**
Only CP 1200
For the secure transfer of data via TCP
- **TCON_QDN_SEC**
Only CP 1200
For the secure transfer of data via the host name
- **TMail_V4_SEC**
For secure transfer of e-mails addressing the e-mail server using an IPv4 address
- **TMail_V6_SEC**
For secure transfer of e-mails addressing the e-mail server using an IPv6 address
- **TMail_QDN_SEC**
For secure transfer of e-mails addressing the e-mail server using the host name

Note on TMail_Vx_SEC / TMail_QDN_SEC:

With these SDTs, the mail server certificate is checked, but not the ID of the "TLSServerCertRef" (STEP 7 internal reference) certificate.

You will find the description of the SDTs with their parameters in the STEP 7 information system under the relevant name.

Connection establishment and termination

Connections are established using the program block TCON. Note that a separate program block TCON must be called for each connection.

A separate connection must be established for each communications partner even if identical blocks of data are being sent.

After a successful transfer of the data, a connection can be terminated. A connection is also terminated by calling TDISCON.

Note

Connection abort

If an existing connection is aborted by the communications partner or due to disturbances on the network, the connection must also be terminated by calling TDISCON. Make sure that you take this into account in your parameter assignment.

A.3 Changing the IP address during runtime

Changing the IP address during runtime

You can change the following address parameters of the CP at runtime controlled by the program:

- IP address
- Subnet mask
- Router address

Apart from the address parameters of the CP, with T_CONFIG the address parameters of DNS servers (IF_CONF_DNS) and NTP servers (IF_CONF_NTP) can also be changed program controlled.

Note

Changing the IP parameters with a dynamic IP address

Note the effects of program-controlled changes to the IP parameters if the CP obtains a dynamic IP address from the connected router: In this case, the CP can no longer be reached by communications partners.

Requirements - Configuration

To be able to change the IP parameters program-controlled, the option "IP address is set directly at the device" must be enabled in the configuration of the IP address of the Ethernet interface of the CP.

Requirements - STEP 7 version

- STEP 7 $\geq$ V14

Requirements - Firmware versions

- **CP 1243-1 / CP 1243-8 IRC**
 - CP firmware $\geq$ V2.1.7x
 - CPU firmware $\geq$ V4.2
- **CP 1542SP-1 IRC**
 - CP firmware $\geq$ V1
 - CPU firmware $\geq$ V2.0 (CPU 151xSP)

Program blocks

Program-controlled changing of the IP parameters is supported by program blocks. The program blocks access address data stored in a suitable system data type (SDT).

The following program blocks and system data types can be used:

- **T_CONFIG**

Along with:

- IF_CONF_V4
- IF_CONF_NTP
- IF_CONF_V6
- IF_CONF_DNS

The address parameters can only be configured with temporary validity in the CP. In the respective "IF_CONF_..." SDT, the "Mode" = 2 parameter must be set.

Note

No feedback from the CP

"T_CONFIG" does not support feedback from the CP to the CPU. Errors in the block call or in setting the address parameter are not reported. The block outputs "BUSY" or "DONE" regardless of whether the address parameter was set.

You can find detailed information on parameter assignment of the blocks and SDTs in the STEP 7 information system.

A.4 SMS messages via OUC

Sending e-mails / SMS messages via OUC

With mobile wireless CPs, you only require the program blocks and system data types (SDTs) described below to transfer SMS messages using Open User Communication (OUC).

In contrast, the event-driven sending of e-mails or SMS messages is independent of program blocks and is configured in STEP 7 in the message editor of the respective module.

Note

Frequent sending of SMS

Depending on the system environment, sending an SMS can take up to 2 minutes.

To guarantee secure transmission of SMS, a minimum interval of 10 seconds is recommended for triggering SMS.

You can control this, for example, by setting the "REC" parameter in the TCON and TSEND_C blocks.

SMS messages via program blocks

Sending SMS messages to one partner

To do this, create the following blocks or system data types (alternatives):

- TCON + TDISCON + TSEND + TCON_Phone
- TSEND_C + TCON_Phone

Receiving SMS messages from one partner

To do this, create the following blocks or system data types (alternatives):

- TCON + TDISCON + TRCV + TCON_Phone
- TRCV_C + TCON_Phone

If you do not enter a phone number in the "PhoneNumber" parameter of the TCON_Phone system data type, the CP cannot receive any SMS messages.

Receiving SMS messages from several partners

As an alternative, you can create a separate block set for each partner as described above for 1 partner or a single block set with the following special feature in the TCON_PHONE block:

If you enter an asterisk (*) after the phone number body in the "PhoneNumber" parameter of the TCON_Phone block, the asterisk acts as a placeholder for all authorized phone numbers with this phone number body.

You configure the phone numbers authorized for access to the CP in STEP 7 in the "Security" parameter group of the CP.

Message text to be sent in the "DATA" parameter

You enter the message text as a string in the "DATA" parameter of TSEND or TSEND_C.

A message can contain up to 160 characters. If the message text contains more than 160 characters, the text is distributed over two or more SMS messages.

Reading out the message text from the "DATA" parameter

To receive an SMS message, parameterize the message text to be read out in the TRCV / TRCV_C blocks in the "DATA" parameter via a data block (DB).

Create a DB of the data type "Struct". Open the properties dialog of the DB (shortcut menu of the DB) and disable optimized block access in the "Attributes" parameter group.

In the structure of the DB, create the following data types for the SMS messages:

- DTL
12 bytes for the time stamp of the received SMS message (time stamp from the network)
- String[22]
String of 22 bytes for the phone number of the sender (+ 2 byte string header)
- String[160]
String of 160 bytes for the message text (+ 2 byte string header)
The SMS message text can contain max. 160 characters.

Per SMS message the structure requires memory space of 198 bytes.

Storing the last 10 received SMS messages

You can output up to 10 received SMS messages from the receive block by making the entry "SMSSTORE" for the "PhoneNumber" parameter of TCON_PHONE.

To store the received data from 10 SMS messages, you need to create an adequately large structure (2000 bytes) for the "DATA" parameter of the receiving block. As described above, the structure has the following organization:

- Received data SMS 1 (DTL, String[22], String[160], Byte)
- Received data SMS 2 (DTL, String[22], String[160], Byte)
- ... to
- Received data SMS 10 (DTL, String[22], String[160], Byte)

The received data of every SMS message has the following structure:

- DTL
12 bytes for the time stamp of the received SMS message (time stamp from the network)
- String[22]
String of 22 bytes for the phone number of the sender (+ 2 byte string header)
- String[160]
String of 160 bytes for the message text (+ 2 byte string header)
- Byte
Status of the SMS message
If more than one SMS message is received the status of every SMS is stored in this status byte:
 - 0 = Invalid
 - 1 = Unread
 - 2 = Read

When receiving multiple SMS messages, per SMS message the structure requires memory space of 200 bytes.

Length information at "LEN" and "DATA" for the blocks "TRCV" / "TRCV_C"

When receiving SMS messages via the blocks TRCV or "TRCV_C" if you enter length information in the "LEN" parameter, this can lead to incorrect information in the data storage of the received information.

Recommendation: Set LEN = 0 and enter the length information in the "DATA" parameter.

Character set for the SMS text

The CP supports the following ASCII character set (hexadecimal value and character name) for SMS message texts sent via program blocks:

- 0x0A
LF (line feed)
- 0x0D
CR (carriage return)
- 0x20
Space

- 0x21 ... 0x5A
!"#\$%&'()*+,-./0123456789:;<=>?@ABCDEFGHIJKLMN OPQRST
UVWXYZ
- 0x61 ... 0x7A
abcdefghijklmnopqrstuvwxyz

A.5 TC_CONFIG for changing configuration data of the CP

Meaning

With the program block TC_CONFIG, you can modify parameters of a mobile wireless CP configured in STEP 7. The configured values are not overwritten retentively. The overwritten values remain valid until TC_CONFIG is called again or until the station starts up again (cold restart after cycling power).

If the STEP 7 configuration data of the CP needs to be changed permanently, the block needs to be called again each time the station restarts (cold restart) or a modified project must be downloaded to the station.

The CONFIG parameter points to the memory area with the configuration data. The configuration data is stored in a data block (DB). The DB cannot be created with optimized block access. The structure of the DB is specified by the system data type (SDT) IF_CONF_v4.

The configuration data to be modified on the CP is put together as necessary in blocks in the SDT "IF_CONF_..." for the individual parameters.

Parameters that are not intended to change as a result of the block are not entered in the SDT. They retain the value configured in STEP 7.

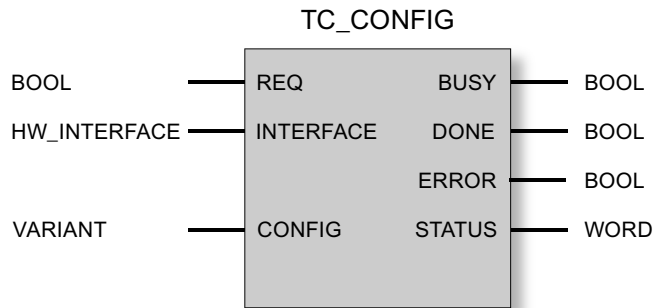
For detailed information on assigning the parameters of the SDT IF_CONF_v4, refer to the section IF_CONF_*: SDTs for the configuration data of the CP (Page 199).

The INTERFACE parameter references the name of the interface of the mobile wireless CP. You will find the name of the interface in the STEP 7 project in the standard tag table of the station in the "System constants" tab under the entry with the value of the "Hardware identifier" of the CP.

Requirements

- To be able to use the function, there must already be values present in the STEP 7 basic configuration of the CP.
- For using the "IF_CONF_PrefProvider" parameter field (preferred mobile wireless networks) of the SDT "IF_CONF_v4":
The mobile wireless network to be used must be set as follows in the configuration of the CP:
"Mobile wireless communication settings > List of preferred networks":
"Preferred mobile wireless networks" = "Contract network and alternative networks"

Call interface in FBD representation



Explanation of the formal parameters

The following table explains all the formal parameters for the TC_CONFIG instruction

Parameter	Declaration	Data type	Range of values	Description
REQ	INPUT	BOOL	0, 1	The processing of the block is started and the status codes initialized on a rising edge. Updating of the DONE, ERROR and STATUS status codes when there is no positive edge.
INTERFACE	INPUT	HW_Interface (WORD)		Reference to the interface of the local CP
CONFIG	INOUT	VARIANT	See also "IF_CONF: SDT for tele-control configuration data"	Reference to the memory area with the collected configuration data to be modified
ENO	OUTPUT	BOOL	0: Error 1: Error-free	Enable output If there is a runtime error with the instruction, ENO = 0 is set.
BUSY	OUTPUT	BOOL	0: Execution of the instruction not yet started, completed or aborted 1: The instruction is executing	Condition code of the execution status of the block
DONE	OUTPUT	BOOL	0: - 1: The instruction executed successfully	This parameter indicates whether or not the job was completed without errors. For the meaning in conjunction with the parameters ERROR and STATUS, refer to Codes of the block.
ERROR	OUTPUT	BOOL	0: - 1: Error	Error code For the meaning in conjunction with the parameters DONE and STATUS, refer to Codes of the block.
STATUS	OUTPUT	WORD		Status code For the meaning in conjunction with the parameters DONE and ERROR, refer to Codes of the block.

The codes BUSY, DONE and ERROR

The codes of DONE and ERROR are relevant only when BUSY = 0.

BUSY	DONE	ERROR	Meaning
0	0	0	No job being executed

You will find all other code combinations of DONE and ERROR in the following table.

The codes DONE, ERROR and STATUS

The following table shows the condition codes formed based on DONE, ERROR and STATUS that must be evaluated by the user program.

DONE	ERROR	STATUS	Meaning
1	0	0000 _H	Job executed without errors
0	0	7000 _H	No job processing active (first block call)
0	0	7001 _H	Job processing started (first block call)
0	0	7002 _H	Job processing already active (renewed block call when BUSY = 1)
0	1	80E0 _H	Internal error
0	1	80E6 _H	No query in progress (block call not started)
0	1	80EB _H	Query temporarily rejected (the CP is currently being configured by STEP 7)
0	1	80F6 _H	Format error of a parameter in the called data block (wrong length, wrong format or invalid value) Check the "IF_CONF" SDT.
0	1	80F7 _H	Wrong ID in the parameter fields of the configuration data: Check the "IF_CONF" SDT.

A.6 IF_CONF_*: SDTs for the configuration data of the CP

Structure of the IF_CONF DB for the TC_CONFIG program block

The CONFIG parameter of the TC_CONFIG program block references the memory area containing the configuration data of the mobile wireless CP to be modified. The configuration data stored in a data block is described as a structure of the IF_CONF_* system data type (SDT).

To be able to use the function, there must already be values present in the STEP 7 basic configuration of the CP.

The IF_CONF DB is made up of a header followed by blocks that correspond to the parameters in the configuration of the CP.

The CP configuration data to be modified is collected together as IF_CONF fields. Parameters that will not be modified are ignored in the IF_CONF structure and remain as they were configured in the STEP 7 project.

Creating the DB and the IF_CONF structures

You can create the parameters of the CP within the IF_CONF DB in one or more structures each with one or more fields.

You will need to type in the data types of the fields using the keyboard. They are not displayed in the selection list. The data types are not case-sensitive.

Follow the steps below to create the IF_CONF.DB:

1. Create a data block of the type "Global DB" with block access "Standard".
2. Create a structure (data type "Struct") in the table of the parameter configuration of the DB. You can specify any name.
3. Under this structure add a header by assigning the name of the header and typing it in in the cell of the data type "IF_CONF_Header".
The header of the structure and its three parameters (see below) is created.
4. Create another structure for the first parameter to be changed by typing in the required data type (for example "IF_CONF_APN") in the cell of the data type.
5. Repeat the last step for all parameters you want to change in the CP using TC_CONFIG.
6. Finally, update the number of fields in the header in the "subfieldCnt" parameter.

Header of IF_CONF

Table A-1 IF_CONF_Header

Byte	Parameter	Data type	Initial value	Description
0 ... 1	fieldType	UINT		Field type: Must always be 0.
2 ... 3	fieldId	UINT		Field ID: Must always be 0.
4 ... 5	subfieldCnt	UINT		Total number of blocks contained in the DB (structures) for the parameters to be changed

General parameters of the parameter fields

Each field has the following general parameters:

- Id
This parameter identifies the field and must not be modified.
- Length
This parameter indicates the length of the field. The value serves as information. Fields with strings and / or arrays have a variable length. Due to hidden bytes, the actual length of fields can be greater than the sum of the displayed parameters.
- Mode
The following values are permitted to these parameters:

Table A-2 Values of "Mode"

Value	Meaning
1	Permanent validity of the configuration data Not relevant for the CP
2	Temporary validity of the configuration data, including deleting of existing permanent configuration data The permanent configuration data is replaced by the structures configured in the block.

"APN settings"

Corresponding parameter group in the configuration:
"Mobile wireless communication settings > APN settings"

Table A-3 IF_CONF_APN

Parameter	Data type	Initial value	Description
Id	UINT	4	ID of the parameter field
Length	UINT		Length of the parameter field in bytes: 174
Mode	UINT		Validity (1, 2) - see above (general parameters)
AccesspointGPRS	STRING [98]		APN: Name of the access point from the mobile wireless network to the Internet
AccesspointUser	STRING [42]		APN user name
AccesspointPassword	STRING [22]		APN password

"CP identification"

Corresponding parameter group in the configuration:
"Security > CP identification"

Table A-4 IF_CONF_Login

Parameter	Data type	Initial value	Description
Id	UINT	5	ID of the parameter field
Length	UINT		Length of the parameter field in bytes: 54
Mode	UINT		Validity (1, 2) - see above (general parameters)
ModemName	STRING [22]		Access ID The value cannot be set.
ModemPassword	STRING [22]		Telecontrol password The password with the CP 1242-7 (6GK7 242-7KX30-0XE0) cannot be changed via the SDT.

"Telecontrol server" (DNS)

Corresponding parameter group in the configuration:
"Partner stations > Telecontrol server"

A.6 IF_CONF_*: SDTs for the configuration data of the CP

This field is only used when the telecontrol server is addressed with a name that can be resolved by DNS. If the telecontrol server is addressed with its IP address, the "IF_CONF_TCS_IP_V4" field is used.

If there is more than one telecontrol server, use the field once per server.

Table A-5 IF_CONF_TCS_Name

Parameter	Data type	Initial value	Description
Id	UINT	6	ID of the parameter field
Length	UINT		Length of the parameter field in bytes: 266
Mode	UINT		Validity (1, 2) - see above (general parameters)
TcsName	-	-	- reserved -
	STRING [254]		Name of the telecontrol server that can be resolved by DNS or IP address as string
RemotePort	UINT		Port of the telecontrol server
Rank	UINT		Priority of the server [1, 2] 1 = first telecontrol server, 2 = second telecontrol server (second server not relevant)

"SMSC"

Corresponding parameter group in the configuration:
"Mobile wireless communication settings > Mobile wireless settings"

Table A-6 IF_CONF_SMS_Provider

Parameter	Data type	Initial value	Description
Id	UINT	10	ID of the parameter field
Length	UINT		Length of the parameter field in bytes: 28
Mode	UINT		Validity (1, 2) - see above (general parameters)
SMSProvider	STRING [20]		Subscriber number of the SMS center (SMSC) of the mobile wireless network provider with which the mobile wireless contract was signed for this station.

"PIN"

Corresponding parameter group in the configuration:
"Mobile wireless communication settings > Mobile wireless settings"

Table A-7 IF_CONF_PIN

Parameter	Data type	Initial value	Description
Id	UINT	11	ID of the parameter field
Length	UINT		Length of the parameter field in bytes: 16

Parameter	Data type	Initial value	Description
Mode	UINT		Validity (1, 2) - see above (general parameters)
Pin	STRING [8]		PIN of the SIM card inserted in the CP The parameter is not relevant if the PIN was correctly configured. If the PIN was incorrectly configured, the correct PIN can be entered.

"Authorized phone number"

Corresponding parameter group in the configuration:

"Security > Authorized phone numbers"

Table A-8 IF_CONF_WakeupList

Parameter	Data type	Initial value	Description
Id	UINT	13	ID of the parameter field
Length	UINT		Length of the parameter field in bytes: 246
Mode	UINT		Validity (1, 2) - see above (general parameters)
WakeupPhone [1...10]	ARRAY [1...10] of STRING [22]		Phone number subscriber authorized to wake up The asterisk (*) at the end of a call number is used a placeholder for direct dialing numbers.

"Preferred mobile wireless networks"

Corresponding parameter group in the configuration:

"Mobile wireless communication settings > List of preferred networks"

Requirement:

The mobile wireless network to be used must be set as follows in the configuration of the CP:

"Mobile wireless communication settings > List of preferred networks":

"Preferred mobile wireless networks" = "Contract network and alternative networks"

Table A-9 IF_CONF_PrefProvider

Parameter	Data type	Initial value	Description
Id	UINT	14	ID of the parameter field
Length	UINT		Length of the parameter field in bytes: 46
Mode	UINT		Validity (1, 2) - see above (general parameters)
Provider [1...5]	ARRAY [1...5] of STRING [6]		Parameter "Contract network and preferred networks" 1st to 5th preferred mobile wireless network to which the CP dials in other than the contract network. No. 1 with highest priority, no. 5 with lowest priority. Entry of the Public Land Mobile Network (PLMN) of the network provider consisting of Mobile Country Code (MCC) and Mobile Network Code (MNC). Example (test network of Siemens AG): 26276

TeleService access (DNS name / IP address of the server)

Corresponding parameter group in the configuration:
 "Mobile wireless communication settings > TeleService settings"

Access data of the TeleService server (switching station). If there is more than one TeleService server, use the field once per server.

With IF_CONF_TS_Name only a TeleService server configured in STEP 7 can be changed but no new one created. If you attempt to create the configuration of a TeleService server with the block, the internal error 80E0 is output at TC_CONFIG.

Table A-10 IF_CONF_TS_Name

Parameter	Data type	Initial value	Description
Id	UINT	20	ID of the parameter field
Length	UINT		Length of the parameter field in bytes: 266
Mode	UINT		Validity (1, 2) - see above (general parameters)
ts_name	String [254]		Name of the TeleService server that can be resolved by DNS or IP address as string
RemotePort	UINT		Port of the engineering station
Rank	UINT		Priority of the server [1] or [2]: 1 = server 1 2 = server 2 (not relevant)

TeleService access (IP address of the server)

IP address of the TeleService server. No longer usable as of firmware version V2.1 of the CP.

If there is more than one TeleService server, use the field once per server.

Table A-11 IF_CONF_TS_IF_V4

Parameter	Data type	Initial value	Description
Id	UINT	21	ID of the parameter field
Length	UINT		Length of the parameter field in bytes: 14
Mode	UINT		Validity (1: permanent, 2: temporary)
RemoteAddress	IP_V4		IP address of the TeleService server
RemotePort	UINT		Port of the TeleService server
Rank	UINT		Priority of the server [1] or [2] 1 = server 1, 2 = server 2

SINEMA Remote Connect (CP)

B.1 Validity and requirements

Validity

Communication via SINEMA Remote Connect is supported by the following modules:

- CP 1243-1
 - As of firmware V3.1
- CP 1243-7 LTE
 - As of firmware V3.1
- CP 1243-8 IRC
 - As of firmware V3.1
 - Under ST7 as MSC station as of firmware V3.2
- CP 1542SP-1 IRC
 - As of firmware V2.0
 - Under ST7 as MSC station as of firmware V2.1

The functions are supported by the following software versions:

- SINEMA Remote Connect
 - As of software version V1.3

B.2 Connection to SINEMA RC

Communication via SINEMA Remote Connect (SINEMA RC)

The "SINEMA RC Server" application provides end-to-end connection management of distributed networks via the Internet. This also includes secure remote access to lower-level stations. Communication between SINEMA RC Server and the remote devices takes place via a VPN tunnel with consideration of the stored access rights.

SINEMA RC uses OpenVPN for encryption of the data. The center of the communication is SINEMA RC Server via which communication runs between the subscribers and that manages the configuration of the communications system.

SCALANCE M routers, which you can use for the connection, also support OpenVPN and connection to SINEMA Remote Connect.

The CP can also handle telecontrol communication via the SINEMA RC server.

Parameter groups

You configure communication via SINEMA RC and telecontrol communication via SINEMA RC in two parameter groups:

- Communication via SINEMA RC:
 > "Security > VPN"
- Telecontrol communication via SINEMA RC:
 > "Communication types"

For information on the supported protocols and configuration, see section Telecontrol via SINEMA RC (Page 207).

Applications

The following application options of the CP result from the combination of the parameters for telecontrol communication and SINEMA RC:

- (1) No telecontrol and no SINEMA RC (CP for network separation only)
- (2) CP only for remote maintenance via SINEMA RC
- (3) CP for telecontrol communication only
- (4) CP uses telecontrol communication, but SINEMA RC only for remote maintenance.
- (5) CP uses SINEMA RC for telecontrol communication and remote maintenance.

The table provides an overview of the applications with the respective parameter settings.

- "On" means that the parameter is activated.
- "Off" means that the parameter is deactivated.

Table B-1 Use cases and parameters to be activated

Use case	Parameter settings (Parameters abbreviated) *		
	SRC	TC	TC-SRC
(1)	Off	Off	Off
(2)	On	Off	Off
(3)	Off	On	Off
(4)	On	On	Off
(5)	On	On	On

* Explanation of the parameter abbreviations:

SRC - Security > VPN (activated) > "VPN connection type":

"Automatic OpenVPN configuration via SINEMA Remote Connect Server"

TC - Communication types > Telecontrol communication enabled

TC-SRC - Communication types >

"Activate telecontrol communication via SINEMA Remote Connect"

B.3 Telecontrol via SINEMA RC

For information on possible applications of communication via SINEMA Remote Connect, see section Connection to SINEMA RC (Page 205).

Requirements

Perform the necessary configuration of SINEMA Remote Connect - Server (not in STEP 7) before configuring the CP in STEP 7. The CP and the communications partner of the CP must be configured in the SINEMA RC Server.

Configuration of the telecontrol communication via SINEMA Remote Connect

Follow the steps below when configuring the module for use of telecontrol communication via SINEMA RC:

1. In the "Communication types" parameter group activate telecontrol communication and select the protocol.
The option for communication via SINEMA RC is not yet visible.
2. Change to the "Security" parameter group and enable the security functions.
(In the "Communication types" parameter group the SINEMA RC option appears disabled and grayed out)
3. Open the "Security > VPN" parameter group and enable VPN.
4. For the parameter "VPN connection type" select the option "Automatic OpenVPN configuration via SINEMA Remote Connect Server" if this is not preset.
(In the "Communication types" parameter group the SINEMA RC option becomes usable.)
5. Change to the "Communication types" parameter group and enable the option "Telecontrol communication via SINEMA Remote Connect".
6. Create the remaining configuration of the SINEMA RC connection of the CP under "Security > VPN".
For information on the configuration, see section Security > VPN > SINEMA Remote Connect (Page 207).

B.4 Security > VPN > SINEMA Remote Connect

Remote maintenance with SINEMA Remote Connect (SINEMA RC)

The application "SINEMA Remote Connect" (SINEMA RC) is available for remote maintenance purposes.

SINEMA RC uses OpenVPN for encryption of the data. The center of the communication is SINEMA RC Server via which communication runs between the subscribers and that manages the configuration of the communications system.

Preparatory steps

Execute the following steps before start configuring the SINEMA RC connection of the module in STEP 7. They are the prerequisite for a consistent STEP 7 project.

- Configuration of SINEMA Remote Connect Server
Configure SINEMA RC Server as necessary (not in STEP 7). The communications module and its communications partners must be configured in the SINEMA RC Server.
- Exporting the CA certificate (optional)
If you want to use the server certificate as authentication method of the communications module during connection establishment, export the CA certificate from SINEMA RC Server. Then import the CA certificate from SINEMA RC Server to the engineering station. Alternatively, you can use the fingerprint of the server certificate as authentication method of the communications module. The fingerprint's duration of validity may be shorter than that of the certificate.
Please note that you need to repeat the import of a certificate in the event of a module replacement.

Configuration of SINEMA Remote Connect

Importing your own certificate

1. On the CP, navigate to the parameter group "Security > Certificate manager > Certificates of the partner devices".
2. Open the certificate selection dialog with a double-click on the first free table row.
3. Select the CA certificate of SINEMA RC Server.

Then navigate to the parameter group "Security > VPN".

VPN > General

1. Activate VPN
2. As "VPN connection type", select the option "Automatic OpenVPN configuration via SINEMA Remote Connect Server" if you wish to use communication via SINEMA Remote Connect.

SINEMA Remote Connect Server

Enter the address and port number of the server.

Server Verification

Here you select the authentication method of the communications module during connection establishment.

- CA Certificate
Under "CA certificate", select the CA certificate from SINEMA RC Server that was previously imported and assigned in the local certificate manager.
The module generally checks the CA certificate of the server and its validity period. The two options cannot be changed.
- Fingerprint
When you select this authentication method, you enter the fingerprint of the server certificate of SINEMA RC Server.

Authentication

- **Device ID**
Enter the device ID generated for the module in SINEMA RC.
- **Device password**
Enter the device password of the module configured in SINEMA RC.
Max. number of characters: 127

Optional settings

The connection establishment is configured in the "Security > VPN > Optional settings" parameter group with the parameter "Connection type".

- **Update interval**
With this parameter you set the interval at which the CP queries the configuration on the SINEMA RC Server.
Note that with the setting 0 (zero) changes to the configuration of the SINEMA RC Server may result in the CP no longer being capable of establishing a connection to the SINEMA RC Server.
- **"Connection type"**
The two options of the parameter have the following effect on the connection establishment:
 - **Auto**
The module establishes a connection to the SINEMA RCServer. The OpenVPN connection is retained until the connection parameters are changed by the SINEMA Remote Connect Server. If the connection is interrupted, the CP automatically re-establishes the connection.
If the connection parameters are changed by the SINEMA Remote Connect Server, the CP requests the new connection data after the update interval configured above has elapsed.
 - **PLC trigger**
The option is intended for sporadic communication of the module via the SINEMA RC Server.
You can use this option when you want to establish temporary connections between the module and a PC. The temporary connections are established via a PLC tag and can be used in servicing situations, for example.

Note**Connection abort**

With a STOP of the CPU, for example due to a firmware update or "Download to device", the OpenVPN connection is aborted.

These functions can only be used when the "Auto" option is enabled.

- **PLC tag for connection establishment**
If the option "PLC trigger" is selected, the module establishes a connection when the PLC tag (Bool) changes to the value 1. During operation the PLC tag can be set when necessary, for example using an HMI panel.
When the PLC tag is reset to 0, the connection is terminated again.

Bibliography

Where to find Siemens documentation

- Article numbers
You will find the article numbers for the Siemens products of relevance here in the following catalogs:
 - SIMATIC NET - Industrial Communication / Industrial Identification, catalog IK PI
 - SIMATIC - Products for Totally Integrated Automation and Micro Automation, catalog ST 70
 You can request the catalogs and additional information from your Siemens representative. You will also find the product information in the Siemens Industry Mall at the following address:
Link: (<https://mall.industry.siemens.com>)
- Manuals on the Internet
You will find SIMATIC NET manuals on the Internet pages of Siemens Industry Online Support:
Link: (<https://support.industry.siemens.com/cs/ww/en/ps/15247/man>)
Go to the required product in the product tree and make the following settings:
Entry type "Manuals"
- Manuals on the data medium
You will find manuals of SIMATIC NET products on the data medium that ships with many of the SIMATIC NET products.

You can find additional references in the bibliographies of the individual manuals.

C.1 /1/ TeleControl configuration manuals

SIMATIC NET - TeleControl
Siemens AG
Configuration manuals of the protocols:
- TeleControl Basic
- SINAUT ST7
- DNP3
- IEC 60870-5
Link: (<https://support.industry.siemens.com/cs/ww/en/ps/21764/man>)

C.2 /2/ TIM 1531 IRC

SIMATIC NET
TIM 1531 IRC
Manual
Siemens AG
Link: (<https://support.industry.siemens.com/cs/ww/en/ps/24710/man>)

C.3 /3/ CP 1243-1

SIMATIC NET

CP 1243-1

Operating Instructions

Siemens AG

Link: (<https://support.industry.siemens.com/cs/ww/en/view/103948898>)

C.4 /4/ CP 1243-8 IRC

SIMATIC NET

CP 1243-8 IRC

Operating Instructions

Siemens AG

Link: (<https://support.industry.siemens.com/cs/ww/en/ps/21162/man>)

C.5 /5/ CP 1243-7 LTE

SIMATIC NET

CP 1243-7 LTE

Operating Instructions

Siemens AG

Link: (<https://support.industry.siemens.com/cs/ww/en/ps/15924/man>)

C.6 /6/ CP 1542SP-1, CP 1542SP-1 IRC, CP 1543SP-1

SIMATIC

CP 1542SP-1, CP 1542SP-1 IRC, CP 1543SP-1

Operating instructions

Siemens AG

Link: (<https://support.industry.siemens.com/cs/ww/en/ps/22144/man>)

Link: (<https://support.industry.siemens.com/cs/ww/en/ps/22143/man>)

C.7 /7/ S7-1200 system manual

SIMATIC

S7-1200 Automation System

system manual

Siemens AG

Link: (<http://support.automation.siemens.com/WW/view/en/34612486>)

C.8 /8/ ET 200SP system manual

SIMATIC
ET 200SP - Distributed I/O System
system manual
Siemens AG
Link: (<http://support.automation.siemens.com/WW/view/en/58649293>)

C.9 /9/ SNMP

SIMATIC NET
Diagnostics and configuration with SNMP
Diagnostics manual
Siemens AG
Link: (<https://support.industry.siemens.com/cs/ww/en/ps/15392/man>)

C.10 /10/ Industrial Ethernet system manual

SIMATIC NET
Industrial Ethernet
System manual
Siemens AG

- Volume 1: Industrial Ethernet
Link: (<https://support.industry.siemens.com/cs/ww/en/view/27069465>)
- Volume 2: Passive network components
Link: (<https://support.industry.siemens.com/cs/ww/en/view/84922825>)

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