SIEMENS

SENTRON

Protection devices 3WL/3VL circuit breakers with communication capability - PROFIBUS

System Manual

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Table of contents

1 Introduction and overview

1.1 General information

1.1.1 Structure of the manual

Purpose of the manual

This manual describes the diverse application options of circuit breakers with communication capability in power distribution.

1.1.2 Introduction

In industrial automation, the demand for communication capability, data transparency and flexibility is growing constantly. To enable industrial switchgear technology to meet this demand, the use of bus systems and intelligent switching devices is unavoidable since industrial production and building management are now inconceivable without communication technology.

The demands on the electrical and mechanical properties of circuit breakers, their adaptability and cost-effectiveness have contributed to the unexpectedly far-reaching development of circuit breakers in recent years. Progress in rationalization and automation has accelerated this process.

1.1.3 SENTRON circuit breakers

SENTRON is a range of circuit breakers with communication capability comprising two models:

- SENTRON WL: air circuit breaker
- SENTRON VL: compact circuit breaker

In power distribution systems they can transfer important information via bus systems to a central control room for the purpose of:

- Diagnostics management
- Fault management
- Maintenance management
- Cost center management

Utilization of the resulting possibilities turns a circuit breaker into something more than just a switching and protection device. Only when the automation and low-voltage switchgear and controlgear used can be fully integrated into a communication solution in a user-friendly and fully functional way, can the following functions be implemented:

- Integrated communication
- Data acquisition
- Forwarding
- Evaluation
- Visualization of data

Data acquisition and evaluation

Status information, alarm messages, trigger information, and threshold violations (e.g. overcurrent, phase unbalance, overvoltage) are acquired and forwarded. Transparency in power distribution enables a fast response to such statuses. Important messages can be transmitted to the cell phones of the maintenance personnel as text messages by means of additional modules (e.g. WinCC and Funkserver Pro). Timely evaluation of this data enables selective intervention in the process and prevents plant failures.

Maintenance

Information for preventive maintenance (e.g. number of switching cycles or operating hours) enables timely planning of personnel and material. This increases the level of plant availability. Destruction of sensitive system components due to failures is prevented. Communication helps to provide specific information about the location and cause of power failures. Recording of phase currents allows precise determination of the cause of the fault (e.g. triggered by short circuit of 2317 A in phase L2 on 27.08.2007 at 14:27). This is the basis for fast correction of the fault and creates a significant potential for cost savings.

Statistics and cost-effectiveness

Recording of power, energy and the power factor cos φ opens up further possibilities. Energy profiles can be created and the costs can be clearly allocated thanks to the transparent representation of energy consumption for business administration analysis. Energy costs can later be optimized by compensating for load peaks and troughs.

Modular and intelligent

The SENTRON circuit breaker program consists of a small number of components with a host of combination options, and it encompasses a performance range from 16 A to 6300 A. The versatility in power distribution achieved by this modularity enables low-cost, flexible integration of the SENTRON circuit breakers into higher-level system solutions using communication.

Saving costs

The benefits of the SENTRON circuit breakers result both from their modular design and compact construction. This saves costs for work processes in planning and trade, and for switchgear manufacturers and plant operators. It also saves space and energy.

Easy planning

This results from the use of the SENTRON circuit breakers and the SIMARIS deSign planning tool, which enables the solution of previously tedious and difficult processes, primarily for planning offices but also for control cabinet builders.

System solutions

Embedding of the SENTRON circuit breakers into a higher-level communication system makes it possible to parameterize the circuit breakers via PROFIBUS DP, Ethernet or the Internet, or to optimize the entire power distribution system by means of an integrated power management system.

1.2 Bus systems

Bus systems are used to connect distributed devices with various levels of intelligence. Bus systems differ in their topologies and mechanisms, with some designed for quite specific application cases, and others aimed more at open applications.

Bus systems in automation

The most important bus systems in the areas of automation and power distribution are described below:

- PROFIBUS DP
- Ethernet
- Modbus RTU

1.2.1 PROFIBUS DP

Definition/standard

PROFIBUS DP is an open, standardized and multi-vendor fieldbus system. It is standardized in compliance with IEC 61158/EN 50170 and is thus the ideal basis for the high data exchange requirements in the area of distributed I/O and field devices. To-date (July 2007), more than 1,100 manufacturers offer in excess of 1,700 products and the user organizations in 23 countries support the users of more than 4 million installed PROFIBUS nodes.

Integration into automation systems

Integration and linking to current concepts in automation is similarly unproblematic since all the large manufacturers offer PROFIBUS DP master modules for programmable logic controllers (PLCs). And with high data transfer rates of up to 12 MBaud/s, the systems operate almost in real time.

Master-master communication

The protocol used for PROFIBUS DP node communication ensures communication between the complex automation devices with equal priority (masters). Each node completes its communication tasks within a fixed time frame.

Master-slave communication (token-passing procedure)

Furthermore, simple cyclic data exchange is used for communication between a master and the simple I/O devices (slaves) assigned to it. PROFIBUS DP uses a hybrid bus access control for this comprising a central token-passing procedure between the active bus nodes (masters) and a central master-slave procedure for data exchange between the active and passive bus nodes.

System configuration

The following system configurations can be implemented with this bus access control:

- Pure master-slave system
- Pure master-master system with token passing
- A combination of both systems

The following figure shows communication on PROFIBUS:

- Token passing between the available masters
- Polling between master and slave nodes

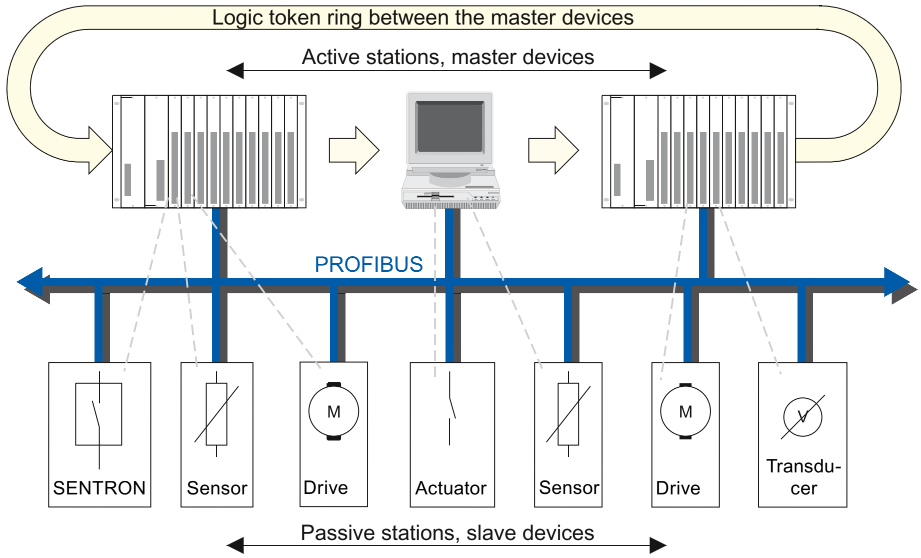


Figure 1-1 Communication on PROFIBUS

The figure above shows an example with three master modules and seven slaves. The three master devices form a logical ring. The token is controlled by the MAC (media access control). It generates the token in the startup phase and checks if actually only one token circulates in the logical ring.

Master classes

Each slave that communicates cyclically via PROFIBUS DP is assigned to a class 1 master. Cyclic data traffic takes place in accordance with the DP standard profile (DPV0).

Master class 1 A class 1 master is used primarily for performing automation tasks. In addition to cyclic data exchange, a class 1 master can also establish an acyclic communication connection with its slaves and thus make use of the expanded functions of a slave.

Master class 2 A class 2 master is especially suitable for commissioning, diagnostics and visualization tasks. It is connected to PROFIBUS DP in addition to the class 1 master and can access slaves via acyclic services and exchange data, provided the slaves permit it.

Acyclic data transfer

Acyclic data transfer is implemented via DPV1. DPV1 adds several functions to the existing PROFIBUS standard. These include reparameterization of the slave configuration during operation, and the establishment of acyclic data traffic. With the help of DPV1, data can also be read direct from the slave by a class 2 master, even though it still has a logical link to a class 1 master. In physical terms, DPV1 transfer and DP standard transfer take place over one line.

Acyclic data transfer is used, for example, in conjunction with operator control and monitoring systems such as WinCC or configuration software like Switch ES Power (see Chapter). The PC used here with built-in PROFIBUS DP interface card then handles the function as a class 2 master. From there, the data sets are transferred via DPV1 and the new values are set, e.g. in the case of changing the value for the tripping current. However, cyclic data exchange between the circuit breaker and the PLC continues.

1.2.2 Ethernet

Definition/standard

Industrial Ethernet is a powerful cell network in accordance with the IEE 802.3 (ETHERNET) standard. Transfer rates up to 1 Gbit/s in conjunction with "Switching Full Duplex" and "Autosensing" make it possible to adapt the required power in the system to the prevailing requirements. The data rate can be selected to suit particular needs, as integrated compatibility makes it possible to introduce the technology in stages. With a current market share of over 80%, Ethernet is the most frequently used LAN in the world.

The benefits of Ethernet are as follows:

- Ethernet is especially suitable for harsh industrial environments subject to electromagnetic interference.
- With the new technology of the Internet, Ethernet offers diverse options for global networking.
- With Industrial Ethernet, SIMATIC NET ® offers the means of using intranets, extranets and the Internet - already available in the office area - in EMI-polluted production processes and process automation.

Communication between peers

Ethernet is not designed on the master-slave principle like PROFIBUS DP. All nodes are equal peers on the bus and each can transmit and/or receive.

A sender can only start transmitting on the bus if no other node is transmitting at that moment. This is implemented by having each node "listen in" to determine if message frames are addressed to it or if there is currently no active sender. If a sender has started transmitting, the transmitted frame is checked for corruption. If the frame is not modified, transmission is continued.

If the sender detects corruption in its data, another sender must have started before it, and both nodes terminate transmission. The sender restarts transmission again after a random time.

This access procedure is called CSMA/CD. This "random" access procedure cannot guarantee that a reply is sent within a specific time period. That depends heavily on the bus traffic load. For this reason, it is not possible to implement real-time applications with Ethernet.

Data transfer

There are several methods of transferring the data of the SENTRON circuit breakers on PROFIBUS DP to Ethernet. These are represented here by two solutions using SIEMENS components:

Solution 1	A SIMATIC S7 controller is equipped with a PROFIBUS DP interface (CPU-internal interface or modules with communications processors) and an Ethernet interface. The data transferred by the circuit breakers over PROFIBUS DP is "re-sorted" in the SIMATIC and communicated via Ethernet. The CP 343-1, CP 343-1 IT, CP 343-1 PN, CP 443-1 and CP 443-1 IT are available as possible Ethernet communications processors for the S7.
Solution 2	As an autonomous component, the IE/PB link forms the seamless transition between Industrial Ethernet and PROFIBUS DP.

Ordering information

Ordering information and further gateway options can be found in the Catalog "Industrial Communication" (IK PI) Chapter 8.

1.2.3 Modbus RTU

Definition/standard

Modbus RTU is an open, serial communication protocol based on the master-slave architecture. It can be implemented extremely easily on any serial interfaces. Modbus comprises one master and several slaves, with communication controlled exclusively by the master.

Communication

Modbus RTU has two fundamental communication mechanisms:

- Query/response (Polling): The master sends a request frame to any station and expects a response frame.
- Broadcast: The master sends a command to all stations on the network. These execute the command without acknowledgment.

Message frames

The message frames allow process data (input/output data) to be written or read either individually or in groups.

Modbus RTU is used on different transmission media. Implementation on the RS485 physical bus, a shielded, twisted-pair cable with terminating resistors as on PROFIBUS DP, is widespread.

Applications

The Modbus RTU protocol is used for:

- Networking of controllers
- Linking input/output modules

Use of Modbus RTU is recommended above all for applications with:

- Low time requirements

1.2.4 Communication structure of the SENTRON circuit breakers

The figure below provides an overview of the communication options of the SENTRON circuit breakers and their modules.

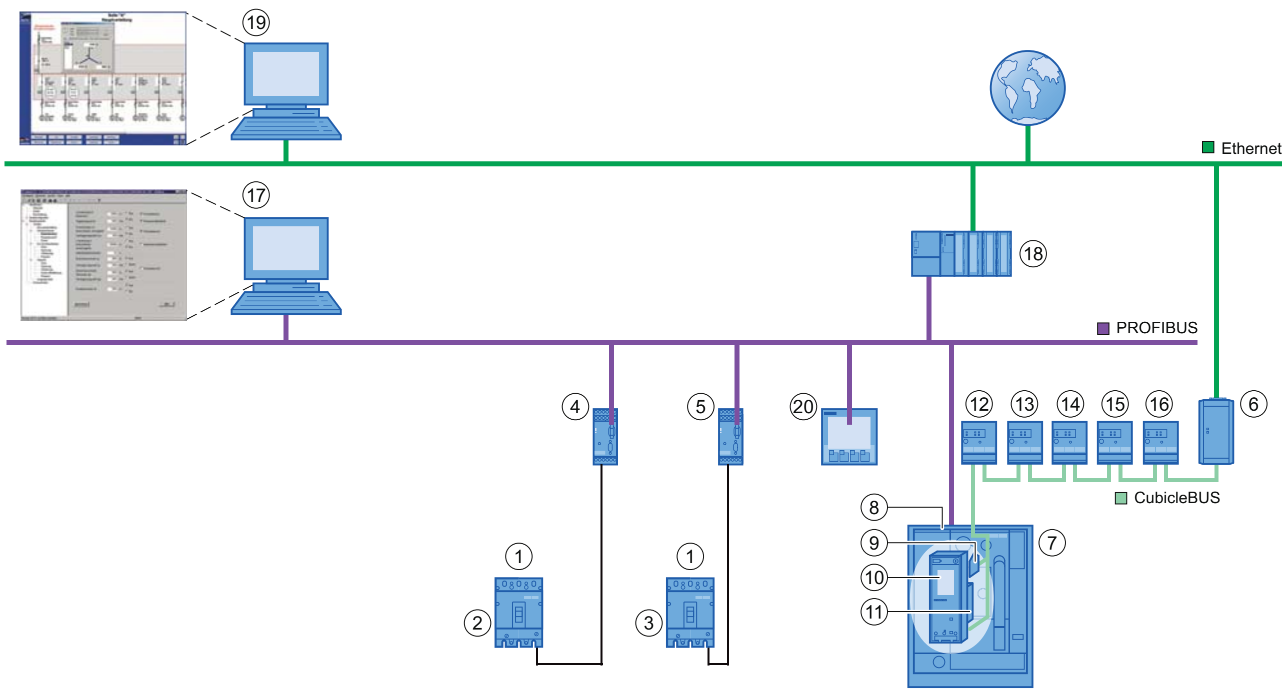
The SENTRON circuit breaker system is extremely flexible:

- The lowest level is the simple parameterization of the circuit breakers.
- The field level includes a PLC and software tools where necessary.

The individual circuit breakers and their modules are described in the following chapters.

The graphic below shows the system architecture of the SENTRON circuit breakers.

Since the communication profile is identical with that of PROFIBUS DP, software tools can be shared.



① 3VL molded-case circuit breaker
② Electronic trip unit LCD ETU
③ Electronic trip unit ETU
④ COM20 PROFIBUS module [1] from Release 2 including ZSI
⑤ COM20 PROFIBUS module [1] including ZSI
⑥ BDA PLUS with Ethernet interface
⑦ 3WL air circuit breaker
⑧ COM15 PROFIBUS module [2]
⑨ Breaker Status Sensor (BSS)
⑩ Electronic trip unit ETU
⑪ Metering function PLUS
⑫ ZSI module
⑬ Digital output module with relay contacts
⑭ Digital output module with relay contacts, configurable
⑮ Analog output module
⑯ Digital input module
⑰ Software tool, e.g. Switch ES Power on PC
⑱ PLC, e.g. SIMATIC S7
⑲ HMI, e.g. PCS7 Faceplates
⑳ PAC power monitoring devices

[1] The COM21 module is required for a Modbus RTU connection.
[2] The COM16 module is required for a Modbus RTU connection.

Figure 1-2 System architecture of the SENTRON circuit breakers

General information 2

2.1 Other system manuals and literature

Sources of information and other documentation

The following manuals supplement the present manual:

Operating Instructions of the SENTRON WL circuit breaker	3ZX1812-0WL00-0AN1
System Manual for S7-300/400, System and Standard Functions (Reference Manual)	6ES7810-4CA08-8AW1
Weigmann / Kilian; Distributed systems with PROFIBUS DP / DPV1	3. Revised edition 2002; Order No. A19100-L531-B839 MLFB 6ZB3500-0AC01-0AA0 Publicis Corporate Publishing
PROFIBUS International; Vers. Oct. 2009, PROFIBUS Technology and Applications, system description	Order No.: 4001, downloadable at PROFIBUS (www.profibus.com)
PROFIBUS International; Vers. 1.3; PROFIBUS Profiles for Low Voltage Switchgear (LVSG)	Order No.: 3122, only available for downloading as Acrobat PDF in English for members of PROFIBUS International at PROFIBUS (www.profibus.com)
PROFIBUS International; Vers. 1.0 Sept. 1998; PROFIBUS Technical Guideline, Installation Guidelines for PROFIBUS DP / FMS	Order No.: 2111; only available for downloading as Acrobat PDF in English and German for members of PROFIBUS International at PROFIBUS (www.profibus.com)

2.2 Approvals

The SENTRON product range complies with the following directives:

- Low Voltage Directive 2006/95/EC
- EMC Directive 2004/108/EC
- Underwriters Laboratories, Inc.: UL 508 registered (Industrial Control Equipment)
- Canadian Standards Association: CSA C22.2 Number 142, tested (Process Control Equipment)

2.3 Standards and approvals

The SENTRON series is based on the IEC 60947-2 standard. PROFIBUS DP meets all the requirements and criteria of IEC 61131, Part 2, and the requirements for CE marking. 3VL/3WL have CSA and UL approvals.

The SENTRON VL/WL circuit breakers comply with the standards:

- IEC 60947-1, EN 60947-1
- DIN VDE 0660, Part 100
- IEC 60947-2, EN 60947-2
- DIN VDE 0660, Part 101
- Isolating features in accordance with IEC 60947-2, EN 60947-2

2.4 Orientation aids

The manual contains various features supporting quick access to specific information:

- At the beginning of the manual you will find a table of contents.
- The chapters contain subheadings that provide an overview of the content of the section.
- Following the appendices, a glossary defines important technical terms used in the manual.
- Finally, a comprehensive index allows quick access to information on specific subjects.

2.5 Up-to-the-minute information at all times

Your regional contact for low-voltage switchgear with communications capability will be happy to help you with any queries you have regarding the SENTRON series. A list of contacts and the latest version of the manual are available on the Internet at: SENTRON (http://www.siemens.com/sentron)

2.6 Scope

This manual applies to circuit breakers with the following designations:

SENTRON

- VL160 to VL1600
- 3WL1 and 3WL5

Disclaimer of liability

The products described here were developed to perform safety-oriented functions as part of an overall installation or machine. A complete safety-oriented system generally features sensors, evaluation units, signaling units, and reliable shutdown concepts. It is the responsibility of the manufacturer to ensure that a system or machine is functioning properly as a whole. Siemens AG, its regional offices, and associated companies (hereinafter referred to as "Siemens") cannot guarantee all the properties of a whole plant or machine that has not been designed by Siemens.

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Up-to-the-minute information

You can find further assistance on the

Internet at: Technical support (http://www.siemens.com/lowvoltage/technical-support)

3WL air circuit breakers 3

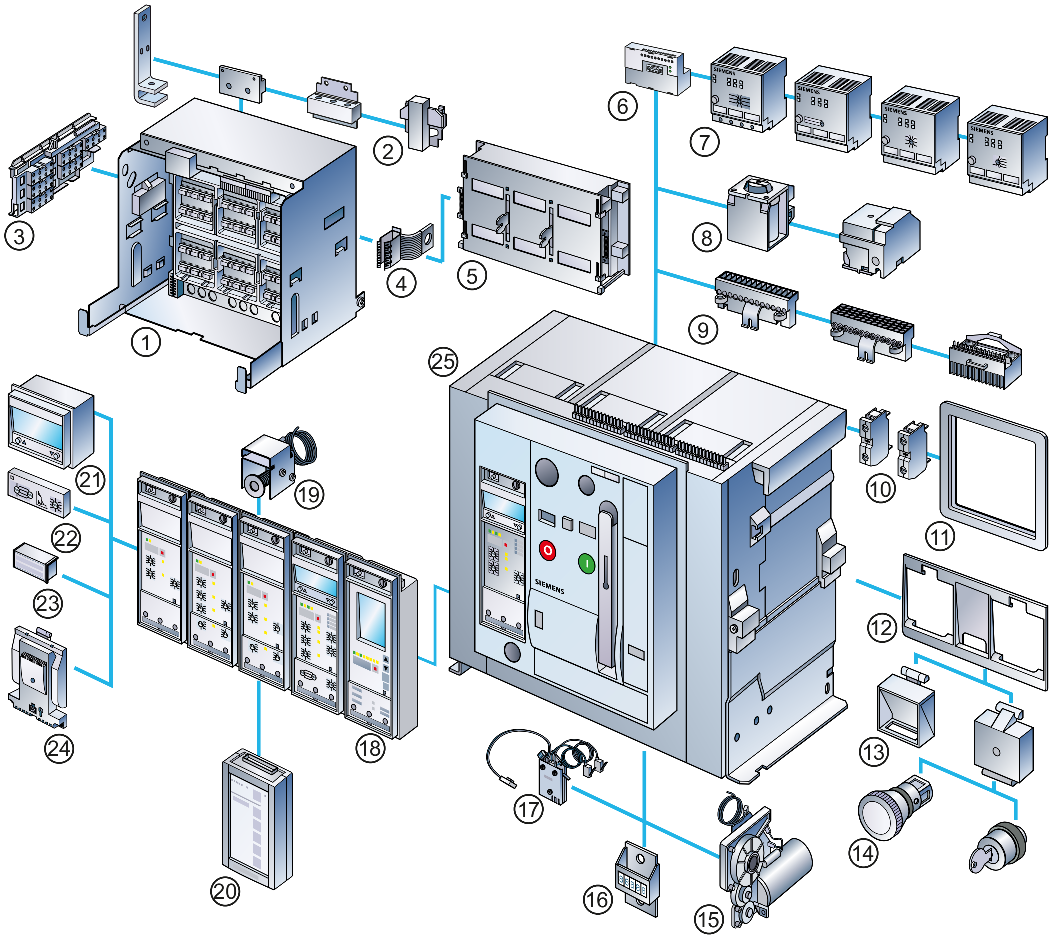
3.1 Introduction and overview

Alongside the traditional circuit breaker tasks such as protecting plants, transformers, generators and motors, additional requirements have been added:

- A complete overview of the plant from a central control room is required
- All the information must be available at all times

Networking of the switches with each other and with other components is the defining feature of a modern power distribution system. The 3WL family of air circuit breakers also offers:

- Remote diagnostics and service over the Internet
- Operating personnel is informed in good time of faults in the plant



①	Guide frame	⑭	Key-operated EMERGENCY STOP pushbutton
②	Main front terminal, flange, horizontal, vertical	⑮	Motorized operating mechanism
③	Position signaling switch	⑯	Switching cycles counter
④	Grounding contact, leading	⑰	Breaker Status Sensor (BSS)
⑤	Shutters	⑱	Overcurrent release (ETU)
⑥	COM15 PROFIBUS module or COM16 Modbus RTU module	⑲	Reset solenoid
⑦	External CubicleBUS modules	⑳	Breaker Data Adapter PLUS (BDA PLUS)
⑧	Switch-on solenoid, auxiliary release	㉑	Four-line LCD module
⑨	Auxiliary conductor plug-in system	㉒	Ground-fault protection module
⑩	Auxiliary switch block	㉓	Rated current module
⑪	Door sealing frame	㉔	Metering function module
⑫	Locking set base plate	㉕	3WL air circuit breakers
⑬	Transparent insert, function insert		

Figure 3-1 3WL air circuit breakers, accessories

Sizes and versions

- With three sizes, the 3WL air circuit breaker covers the range from 250 A to 6300 A.
- The 3WL is available in a three-pole and four-pole version
- There is a fixed-mounted 3WL circuit breaker version, and a withdrawable version.
- The devices are available in different switching capacity classes, so short-circuit currents up to 150 kA can be safely shut down.

Adaptation

The 3WL air circuit breaker can be adapted to prevailing plant conditions. Each circuit breaker can be set to the suitable rated current, for example, using a rated current module. This ensures optimal protection characteristics even when the plant is modified. The module can be replaced quickly. Time-consuming replacement of the transformer is not necessary.

Parameter set switchover (ETU76B)

It is possible to switch between two different parameter sets. This function is necessary, for example, if an automatic change is made from mains operation to generator operation in the event of a power failure and there is the possibility of all tripping conditions changing.

Safety

It is possible to prevent undesired switching on by means of interlocks and locking options on the switch.

Example

The accessories, from the auxiliary release, motorized operating mechanism all the way to the communication system, are simple and easy to retrofit. The accessories are the same across the entire range. This simplifies ordering and reduces stockkeeping costs.

Solid-state overcurrent trip unit (ETU)

The core of each switch is the solid-state overcurrent trip unit (ETU). There are three different options for adapting the protection functions, metering functions, and signaling functions to the requirements of the plant: From simple overload protection and short-circuit protection, up to trip units with a host of metering and signaling functions that can be parameterized remotely.

Communications capability

All circuit breakers with trip units of the type ETU45B and ETU76B have communications capability. Additional components that are networked internally via the CubicleBUS can be installed in these communication-capable trip units. To confer communications capability on a 3WL with the ETU15B, ETU25B or ETU27B trip unit, the overcurrent release must be replaced as this trip unit has no facility for connecting to the CubicleBUS.

PROFIBUS DP connection

The circuit breaker is connected to PROFIBUS DP via the RS485 interface of the COM15 module. It is possible to run networking/communication at a higher level (intranet/Internet) using the Breaker Data Adapter PLUS.

3.1.1 The CubicleBUS

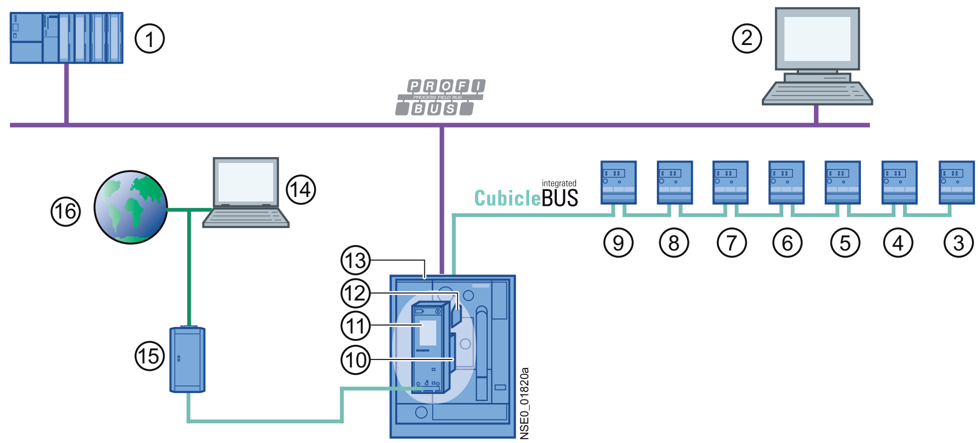
Within the integrated and modular architecture of the SENTRON WL, the CubicleBUS connects all intelligent components within the SENTRON WL and enables simple and safe connection of other external additional components. The CubicleBUS is already prepared in all complete circuit breakers with the trip units ETU45B and ETU76B (CubicleBUS integrated). Only in conjunction with COM15 and BSS is all data available and usable via the CubicleBUS.

Retrofitting components

The high modularity of the system allows retrofitting of communication functions (e.g. metering function) at any time. Retrofitting of a SENTRON WL that does not yet have communications capability (e.g. change from ETU25B to ETU45B, BSS and COM15 with CubicleBUS) is also possible on-site in the plant. All modules on the CubicleBUS can access the available source data of the circuit breaker direct and thus ensure extremely high-speed access to information.

In addition, the connection of external add-on modules to CubicleBUS allows low-cost solutions for connecting further communication-capable devices in the switching station.

The figure below shows the system architecture of the SENTRON WL that with the CubicleBUS enables simultaneous communication via PROFIBUS DP.
The breaker can be parameterized via the Ethernet interface with the help of BDA PLUS.



① PLC, e.g. SIMATIC S7 data acquisition and processing
② PC with Switch ES Power SENTRON 3WL/3VL parameterization and visualization tool via PROFIBUS DP
③ Digital input module
④ Analog output module
⑤ Digital output module, configurable
⑥ Digital output module, relay, configurable
⑦ Digital output module
⑧ Digital output module, relay
⑨ ZSI module
⑩ Metering function PLUS
⑪ ETU
⑫ BSS
⑬ COM15
⑭ Output device, e.g. notebook with browser
⑮ BDA PLUS
⑯ Ethernet/intranet/Internet (only BDA PLUS)

Figure 3-2 System architecture of the SENTRON WL

3.1.2 Communications capability of electronic trip units (ETU)

The electronic trip units ETU45B and ETU76B are both capable of communication. The CubicleBUS is brought out at the terminals X8:1 to X8:4 in the circuit breaker.

Versions

The communication-capable trip units differ in their design:

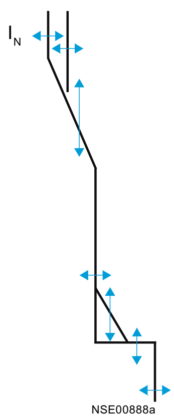
- The ETU45B has a rotary coding switch on the front for setting the protection parameters. These can only be read via the communication system.
- Optionally, the ETU45B can be equipped with a four-line display for showing the measured values. The protection parameters can only be modified via PROFIBUS DP.
- The ETU76B offers a pixel-graphics display with a clear, key-operated menu. This display can be used not only to show measured values, status information and maintenance information, but also to read all available parameters and modify them with password protection.

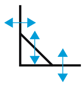
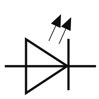
Tripping system

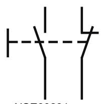
The table below provides an overview of the functions and options of the tripping system of the trip units ETU15B, ETU25B and ETU27B without communications capability, and of the communication-capable trip units ETU45B and ETU76B.

3.1.3 Function overview of the overcurrent tripping system

Table 3- 1 Function overview of the tripping system of the ETU

Basic function			ETU45B	ETU76B
		Overload protection	✓	✓
		Function can be switched off/off	–	✓
		Adjustment range $I_R = I_n$ × ...	0,4-0,45-0,5-0,55-0,6-0,65-0,7-0,8- 0,9-1	0,4...1
		Switchable overload protection (I^2t or I^4t-dependent function)	✓	✓
		Adjustment range time-lag class t_R at 6 × I_R for I^2t	2-3.5-5.5-8-10-14-17-21-25-30 s	2...30 s
		Adjustment range time-lag class t_R at 6 × I_R for I^4t	1-2-3-4-5 s	1...5 s
		Thermal memory can be switched on/off	✓	✓
		Phase loss sensitivity	at t_{sd} = 20 ms (M)	✓ (on/off)
		N-conductor protection	✓	✓
		Function can be switched on/off	✓	✓
		N-conductor adjustment range $I_N = I_n$ × ...	0,5...1	0,2...2
		Short-time delayed short-circuit protection	✓	✓
		Function can be switched on/off	✓	✓
		Adjustment range $I_{sd} = I_n$ × ...	1,25-1,5-2-2,5-3-4- 6-8-10-12	1.25 x I_n...0.8 x I_{cw}
		Adjustment range delay time t_{sd}	M-100-200-300-400 ms	M-80...4000 ms
		Switchable short-time delayed short-circuit protection (I^2t-dependent function)	✓	✓
		Adjustment range delay time t_{sd} at I^2t	100-200-300-400 ms	100...400 ms
		ZSI function	Per CubicleBUS module	Per CubicleBUS module
		Instantaneous short-circuit protection	✓	✓
		Function can be switched on/off	✓	✓
		Adjustment range $I_i = I_n$ × ...	1.5-2.2-3-4-6-8-10-12 x I_{cs}	1.5 x I_n...0.8 x I_{cs}
		Ground-fault protection	Retrofittable module	Retrofittable module
		Tripping and alarm functions	✓	✓
		Tripping function can be switched on/off	✓	✓
		Alarm function can be switched on/off	–	✓

Basic function			ETU45B	ETU76B
 NSE00889		Recording of the ground-fault current via summation current conversion with internal or external N-conductor transformer	✓	✓
		Recording of the ground-fault current via external transformer	✓	✓
		Adjustment range of the response current I_g for tripping	A-B-C-D-E	A...E*
		Adjustment range of the response current I_g for alarm	A-B-C-D-E	A...E*
		Adjustment range of the delay time t_g	100-200-300-400-500 ms	100...500 ms
		Switchable ground-fault protection (I^2t-dependent function)	✓	✓
		Adjustment range delay time t_g at I^2t	100-200-300-400-500 ms	100...500 ms
		ZSI-G function	Per CubicleBUS module	Per CubicleBUS module
		Switchable	–	✓
		LCD alphanumeric (4-line)	Optional	–
		LCD graphical	–	✓
		CubicleBUS integrated	✓	✓
		Communications capability via PROFIBUS DP	✓	✓
		Metering function capability with metering function PLUS	✓	✓
 NSE00890		Overcurrent release active	✓	✓
		Alarm	✓	✓
		ETU fault	✓	✓
		L tripping operation	✓	✓
		S tripping operation	✓	✓
		I tripping operation	✓	✓
		N tripping operation	✓	✓
		G tripping operation	✓ (only with ground-fault protection module)	✓ (only with ground-fault protection module)
		G alarm	✓ (only with ground-fault protection module)	✓ (only with ground-fault protection module)
		Tripping operation as a result of extended protection function	✓	✓
		Communication	✓	✓

Basic function			ETU45B	ETU76B
 NSE00891		Load pick up	✓	✓
		Load shedding	✓	✓
		Leading signal overload trip 200 ms	✓	✓
		Temperature alarm	✓	✓
		Phase unbalance	✓	✓
		Instantaneous short-circuit trip	✓	✓
		Short-time delayed short-circuit trip	✓	✓
		Overload trip	✓	✓
		Neutral conductor trip	✓	✓
		Ground-fault protection trip	✓ (only with ground-fault protection module)	✓ (only with ground-fault protection module)
		Ground-fault alarm	✓ (only with ground-fault protection module)	✓ (only with ground-fault protection module)
		Auxiliary relay	✓	✓
		ETU fault	✓	✓

* Set values for Ig

Size I/II

A 100 A
B 300 A
C 600 A
D 900 A
E 1200 A

Size III

A 400 A
B 600 A
C 800 A
D 1000 A
E 1200 A

3.1.4 Availability of the data on the CubicleBUS

Data library

Each data point from the data library of the SENTRON circuit breakers can only be generated by a single module, the data source. If this data source (node) is available, the data points assigned to the data source will also be available.

This availability is described and also communicated in the "property bytes". If a data source (node) is not available, the data point will also not exist. This can also be seen in the associated property byte. Chapter Data library (Page 175) provides a precise description of the individual data points.

Data point groups

The table below provides an overview of the internal CubicleBUS nodes and their assigned data point groups (combination of several data points). The table below shows which data points from the data library are generated by which CubicleBUS module:

Table 3- 2 Assignment of data points to CubicleBUS modules

Data point group Data points with the same source	CubicleBUS nodes			
	ETU from ETU45B	BSS	COM15	Metering function PLUS
Protection parameter set A	✓			
Protection parameter set B (not for ETU45B)	✓			
Extended protection parameters				✓
Parameters for threshold values				✓
PROFIBUS communication parameters			✓	
Parameters for setting measured values				✓
Data for device identification	✓		✓	
Switch position information			✓	
Status information (switch on/off, spring energy store, etc.)		✓		
Alarms	✓			
Tripping operations	✓			✓
Threshold value messages				✓
Maintenance information	✓		✓	
Temperature in circuit breaker		✓		
Temperature in the control cabinet			✓	
3-phase currents	✓			
Current in N-conductor, ground-fault current; depending on equipment	✓			
3-phase voltages				✓
Power P, Q, S, energy				✓
Cos φ				✓
Frequency, total harmonic distortion, form factor, peak factor				✓
Harmonic analysis				✓
Waveform buffer				✓
Logbook for events and tripping operations			✓	
System time			✓	

3.2 COM15 module and BSS module

3.2.1 PROFIBUS DP COM15 module

With the COM15, the SENTRON WL circuit breaker can exchange data via PROFIBUS DP. The COM15 fetches some of the most important information about the status of the switch (on/off, spring energy store, ready, etc.) from the BSS (Breaker Status Sensor) via the CubicleBUS. This is why both modules are offered together as a PROFIBUS DP communication connection (option F02).

PROFIBUS DP module COM15 and BSS

The COM15 for the SENTRON WL enables the connection of the circuit breaker to PROFIBUS DP. It supports the PROFIBUS protocols DPV0 and DPV1, and it can communicate simultaneously with two masters of class 1 and class 2. This especially facilitates the commissioning of parameterization tools and diagnostics tools like Switch ES Power, and of operator control and monitoring systems (e.g. WinCC) for the SENTRON WL.

Securing

It is possible to disable control/write access to the circuit breaker via hardware and software if this is necessary for security reasons, e.g. to prevent switching via PROFIBUS (manual/automatic mode) or to prevent the modification of parameters.

Integral clock

An integral clock adds a time stamp to all events such as minimum and maximum measured values, alarms, and tripping signals. This clock can be synchronized via PROFIBUS DP in the same way as the clock of COM15 of SENTRON WL.

Temperature sensor

The COM15 has an integral temperature sensor that provides the temperature in the control cabinet thanks to its installation location outside the circuit breaker.

The BSS also contains a temperature sensor that shows the temperature in the breaker. Both sensors are factory-calibrated.

Detecting the switch position

The switch position (operating position, test position, disconnected position and not present) is detected by means of three built-in micro switches on the underside of COM15, and can be read out via PROFIBUS DP. The circuit breaker can only be switched on and off in the connected position and the test position.

3.2.2 Connection of the COM15 module

The COM15 is connected by plugging it into position X7 of the auxiliary conductor plug-in system.

Pin assignment

The figure below shows the printing on the COM15, the external pin assignment for connecting the switch-on solenoid, the shunt release, PROFIBUS write protection, and the free input/output.

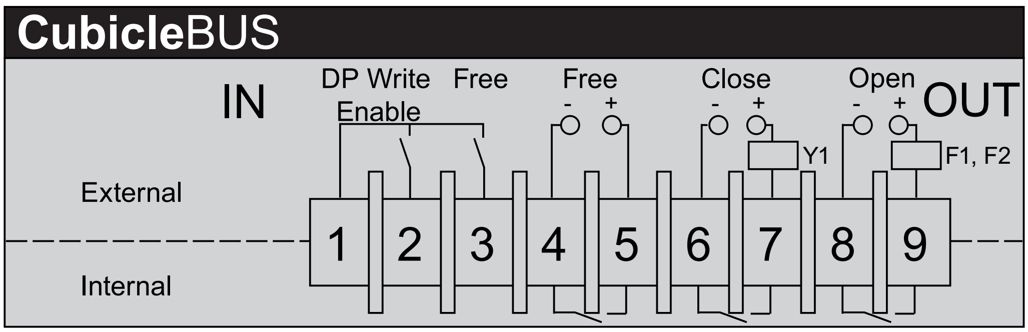


Figure 3-3 COM15 pin assignment

Electrical connection to the CubicleBUS

The electrical connection to the circuit breaker and the CubicleBUS connection to the CubicleBUS nodes inside the circuit breaker (ETU, BSS, metering function) must be established. For this purpose, the four lines brought out of the rear of COM15 are connected to section X8 of the auxiliary conductor plug-in system.

Further components and connections

- If the switch-on and switch-off solenoids are designed for higher voltages than 24 V DC, coupling relays must be used.
- If the second auxiliary trip unit (F2, F3, F4) is used instead of the first auxiliary trip unit (F1) to switch off via PROFIBUS DP, the connection points X5:11 and X5:12 must be used.
- The free user output can be used as desired. The connection must be made in the same way as that of a coupling link (see Figure 2-4). One application example would be control of the F7 solenoid for retracting the red tripped plunger if option K10 is installed. As with Open and Close, only voltages up to 24 V DC can be used (note polarity!). With other voltages, coupling links must be used.
- The PROFIBUS line is connected to the 9-pin interface on the front of COM15.
- The CubicleBUS connection for RJ45 plugs to which the external CubicleBUS modules can be connected is located on the rear. If no external CubicleBUS module is connected, the terminating resistor supplied in the form of a RJ45 plug must be used.

- The unassigned user input can be connected via a contact element to the 24 V DC voltage from Pin1 to transmit the status of the contact element.
- Free operator output on COM15 (from Version 0907 or 0905; firmware version V1.13.0). From this version, the COM module offers an alternative function with which the status of the tripped signaling switch S45 of the BSS module is output at the operator output. A high level at the output means the circuit breaker has tripped.
  Switchover from the Modbus "operator output" to the Modbus "tripped signal" takes place via data point 19 (data set 93, byte 11), with bit 4 (bit 4 to 1). Switchover to "operator output" takes place automatically by setting or resetting the operator output (byte 11.0 or byte 11.1 in data set 93).

Connection of the COM15

The figure below shows how COM15 must be wired with the auxiliary current plug-in contacts to allow switching on/off via PROFIBUS. This figure only applies for contacts with 24 V DC!

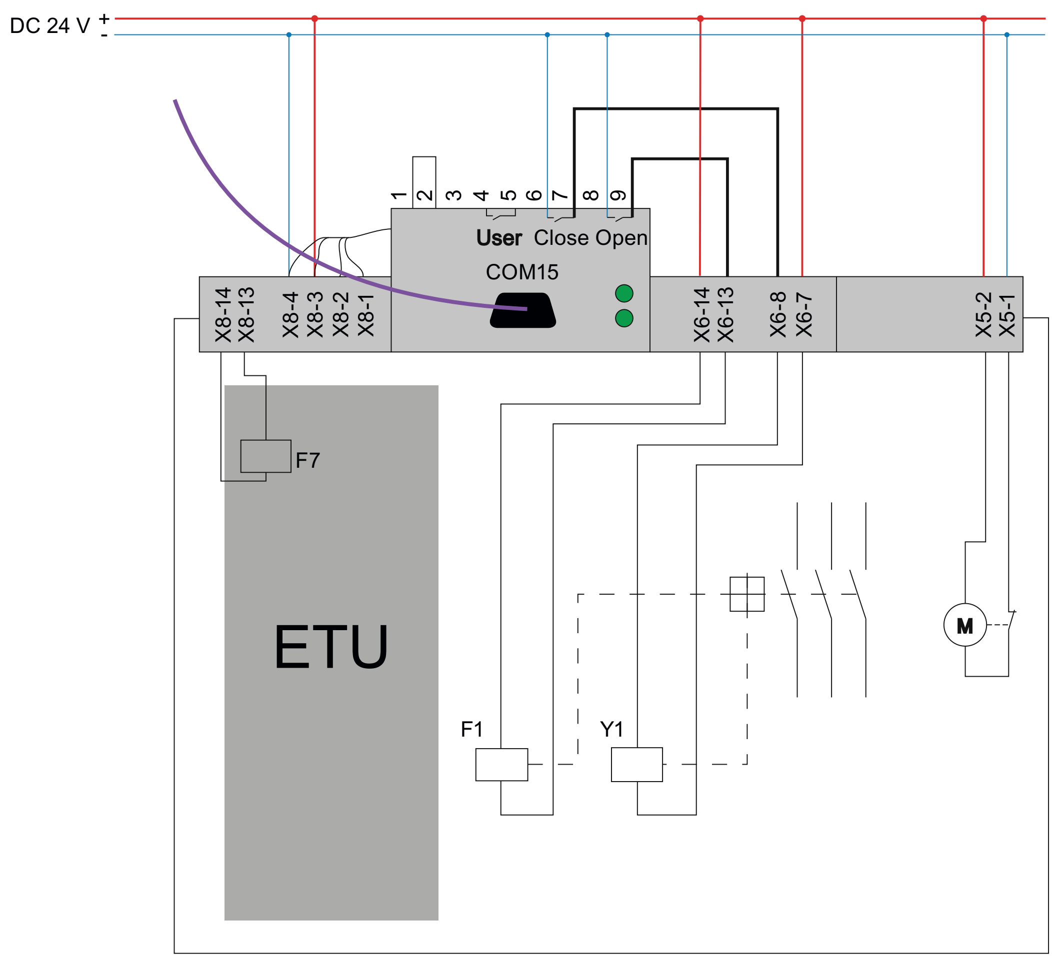


Figure 3-4 Wiring of the COM15 at 24 V DC

The figure below shows the wiring if contacts are installed with voltages not equal to 24 V DC.

- Coupling relays must be used.
- If F1 is not used for switching off, the connection points X5:11 / X5:12 must be connected for F2 to F4.

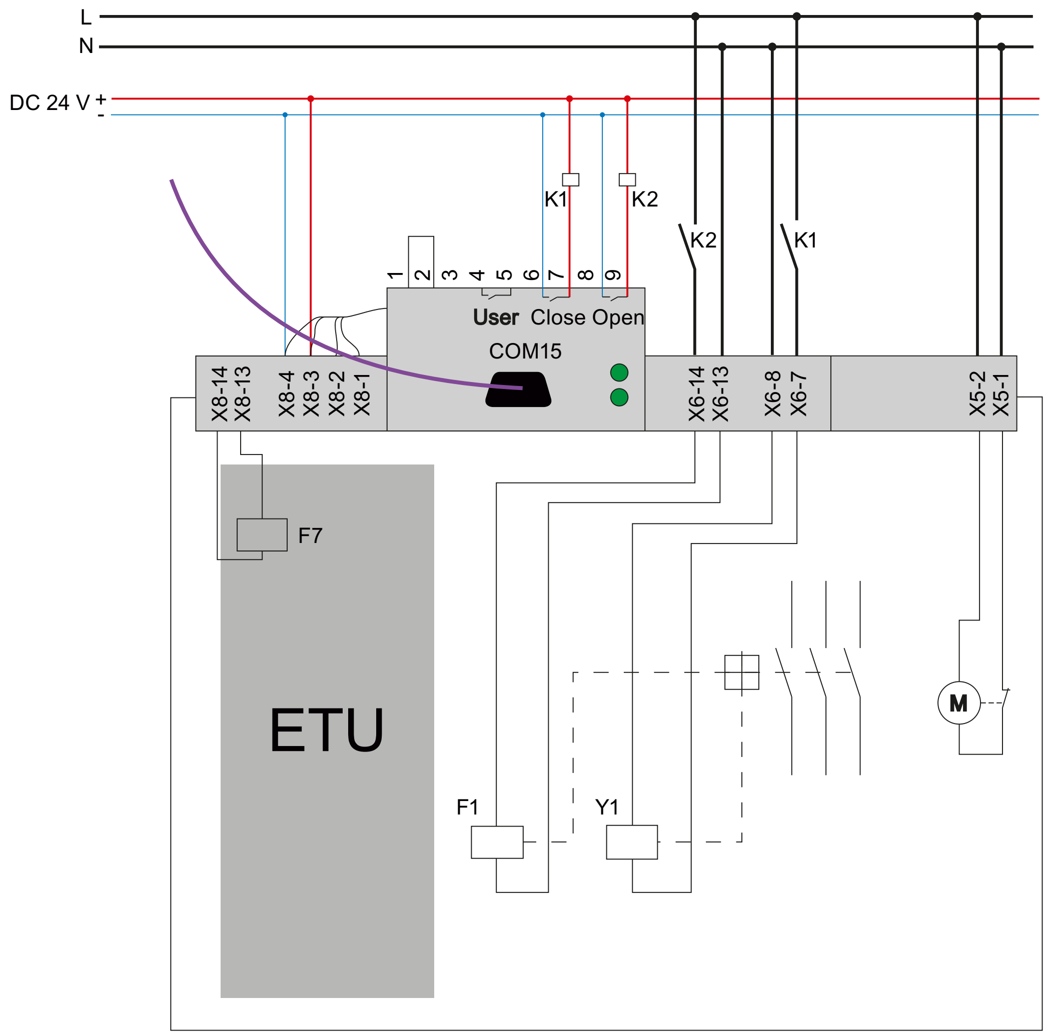


Figure 3-5 Wiring of COM15 at voltage not equal to 24 V DC

RJ45 connection

The figure below shows the COM15 from behind. It shows the RJ45 connection for the external CubicleBUS modules. If no external CubicleBUS module is connected, the bus must be terminated with the terminating resistor supplied.

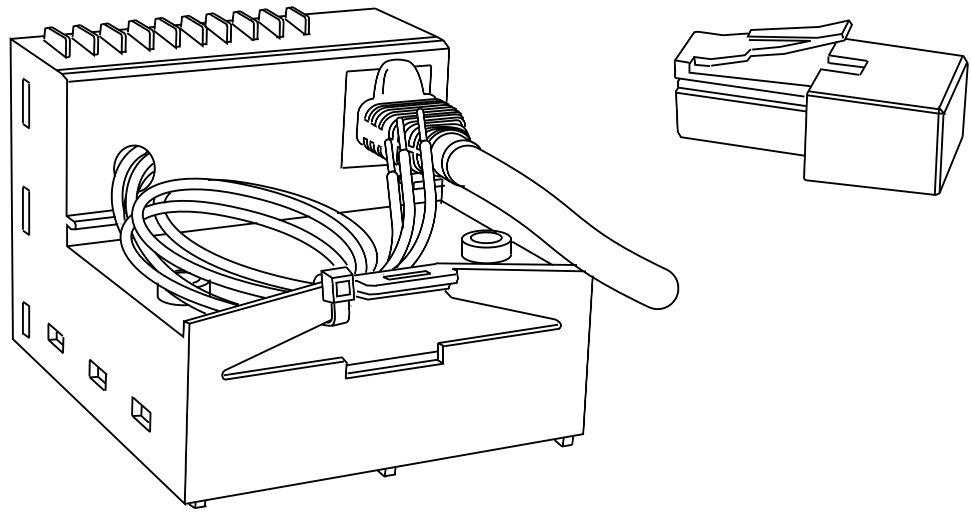


Figure 3-6 COM15 with RJ45 connection for CubicleBUS modules

Connection of the CubicleBUS nodes

The four black cables that are brought out of the COM15 must be connected to terminal strip X8. The COM15 is connected with the nodes on the CubicleBUS in the circuit breaker in this way.

Table 3- 3 Terminal strip connection X8 between COM15 and CubicleBUS nodes

Meaning	Position and printing on the cable
CubicleBUS -	X8:1
CubicleBUS +	X8:2
+24 V DC	X8:3
Ground 24 V DC	X8:4

3.2.3 PROFIBUS installation guideline

The COM15 must be installed in accordance with the installation guidelines for PROFIBUS DP published by PROFIBUS International (PI, www.profibus.com). Of primary importance here are equipotential bonding and shielding.

3.2.4 PROFIBUS write protection (DPWriteEnable)

In applications in power distribution, it is necessary to disable write access via PROFIBUS temporarily or permanently. There is a hardware input on the COM15 for this purpose. Pin1 provides the 24 V DC supply that can be run back via a contact to Pin 2 (DPWriteEnable), for example.

If this input is not bridged (that is, actively enabled), write access is not possible (with exceptions).

Without a bridge at the input of the write protection, the following actions will be disabled:

- Switching on or off
- Resetting the current tripping operation
- Changing the protection parameters
- Changing the parameters for the extended protection function (metering function)
- Changing the parameters for communication
- Changing the parameters for measured value setting (metering function)
- Resetting maintenance information (counter)
- "Forcing" the digital outputs (in the "Operate Modules" window of Switch ES Power)
- Transfer DPV1 startup parameters from the object manager of Switch ES Power

The following actions are still permitted in write-protect mode:

- Modifying and setting of trigger functions for the waveform buffer
- Reading out the contents of the waveform buffer
- Changing the parameters for threshold values
- Setting/modifying the system time
- Modifying the free texts (comment, plant identifier)
- Resetting the min./max. values
- Modifying the free user output

Transfer of necessary information

Despite the write protection, all the necessary information can be transferred, but the status of the circuit breaker cannot be changed.

This is reserved for the operator of the power distribution system. All non-disabled actions are used only for remote diagnostics and do not affect the current status. However, it is possible to diagnose tripping operations and waveforms more precisely, even remotely.

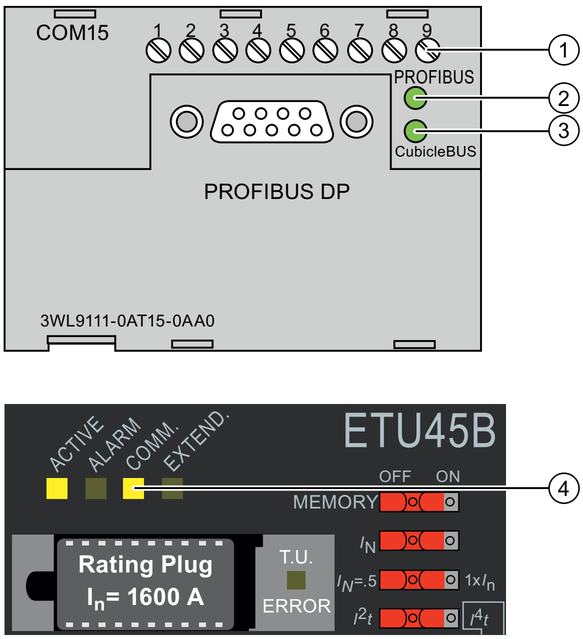
3.2.5 Data exchange via the COM15

When configuring the COM15 for data exchange, you must note that the COM15 is supplied as standard with the PROFIBUS DP address 126. This must be changed by the user when configuring the system (e.g. with display of the ETU76B).

Diagnosing the communication system

The COM15 has two LEDs called PROFIBUS and CubicleBUS for diagnosing communication. The operating status for PROFIBUS DP and the CubicleBUS can be read from these.

The figure below shows the front view of the PROFIBUS module of the SENTRON WL with the PROFIBUS connection and the two LEDs. The lower figure shows part of the ETU45B and its LEDs for status indication.



① Connecting terminals

② PROFIBUS LED

③ CubicleBUS LED

④ Communication LED on the trip unit

Figure 3-7 COM15 PROFIBUS module of the SENTRON WL and ETU45B

PROFIBUS LED

The PROFIBUS LED shows the status of the PROFIBUS communication of the COM15 module.

Table 3- 4 PROFIBUS LED

PROFIBUS LED	Meaning
Off	No voltage on the COM15
Red	No communication with master class 1, even if only master class 2 is connected.
Green	PROFIBUS communication functioning Cyclic data traffic with class 1 master

CubicleBUS LED

The CubicleBUS LED shows the status of the CubicleBUS communication of the COM15 module.

Table 3- 5 CubicleBUS LED

CubicleBUS LED	Meaning
Off	No CubicleBUS module found
Red	CubicleBUS fault
Flashing green	A CubicleBUS node has been found but no metering function/metering function PLUS, and no trip unit
Steady green light	CubicleBUS node found and connection with metering function/metering function PLUS, and/or trip unit

Two LEDs must be considered for assessing a functional CubicleBUS in the switch:

- The "COMM" LED on the trip unit must be green, that is, at least one other CubicleBUS node must be detected from the perspective of the trip unit.
  At the least, this is only the metering function/metering function PLUS, if the CubicleBUS has been subsequently interrupted.
- The CubicleBUS LED on the COM15 must then be considered. If this shows a steady green light, there is a connection from the COM15 at least to the metering function/metering function PLUS.
- If both LEDs show a green light (steady light from CubicleBUS on the COM15 module and COMM on the trip unit), there is continuous communication between the trip unit, the COM15 and PROFIBUS DP.

Data exchange via PROFIBUS DP

Data exchange then functions as follows:

- An up-to-date image of all the data of the SENTRON WL (with the exception of the waveform buffer) is always stored in the COM15 module. Consequently, a data query from the COM15 module to the PLC can be answered within just a few milliseconds.
- Write data from the PLC is forwarded to the correct addressee on the CubicleBUS.

Detecting the switch position

The COM15 module has three micro switches on the underside for determining the position of a slide-in circuit breaker in the guide frame. Depending on which switch is actuated, the position described above is communicated (1 = actuated). The table below gives the definition of the position on:

Table 3- 6 COM15, micro switch

Switch position	Rear switch (S46)	Middle switch (S47)	Front switch (S48)
Connected position	1	0	0
Test/check position	0	1	0
Disconnected position	0	0	1
Switch not present	0	0	0

When the circuit breaker is moved, the micro switch that has been actuated is released before the next one is actuated. No micro switch is actuated in the intervening period. As far as communication is concerned, this means that when the breaker is moved, the "old" status is communicated until a new defined status is reached.

Once the "disconnected position" micro switch has been released, there is no way of determining the direction in which the breaker is being moved.

If it is pushed in, the next position is the "test position". The COM15 communicates "switch not present" until the "test position" switch is actuated. Despite the message indicating that it is not present, the diagnosis is delayed by 10 seconds to ensure that it is not triggered when pushing in the breaker. In other words, when the "disconnect position" micro switch is released, "switch not present" is communicated immediately via the cyclic channel and also via the DPV1 data sets. The diagnostic message appears, however, after a delay. If the "test position" micro switch is actuated before the 10 seconds are out, no diagnosis is triggered.

If it is pulled out, no other micro switch is actuated. The position "switch not present" is communicated immediately on the cyclic channel and in the DPV1 data sets.

In the case of fixed-mounted circuit breakers, a counter plate is screwed to the COM15 and this transfers the connected position.

3.2.6 Breaker Status Sensor (BSS)

To display, for example, internal ciruit breaker statuses on the control cabinet, or to read the statuses via PROFIBUS DP, a BSS module must be installed along with the necessary signaling switches. A requirement for this is that the circuit breaker has an electronic trip unit of the type ETU45B or higher. All micro switches that receive the information on the status of the circuit breaker are attached to the BSS or connected to it. The BSS makes this digital information available on the CubicleBUS.

Retrofitting

A SENTRON WL can also be retrofitted with the BSS. The BSS acquires the following information:

- Status of the spring energy store
- Position of the main contacts (switch on/off)
- Ready-to-close signaling
- Tripped signaling switch on the trip unit (connected with the red tripped plunger)
- Signaling switch on auxiliary trip unit
- Temperature in the circuit breaker dependent on the installation location in the switch (the sensor is calibrated at the factory)

Note

Ordering data

The BSS is already included in the order option "Z=F02" (PROFIBUS DP communication). If a BSS is desired without PROFIBUS DP communication, this can be specified when ordering the switch with the option "Z=F01", or it can be ordered later as a spare part.

3.3 Metering functions

3.3.1 Metering function PLUS

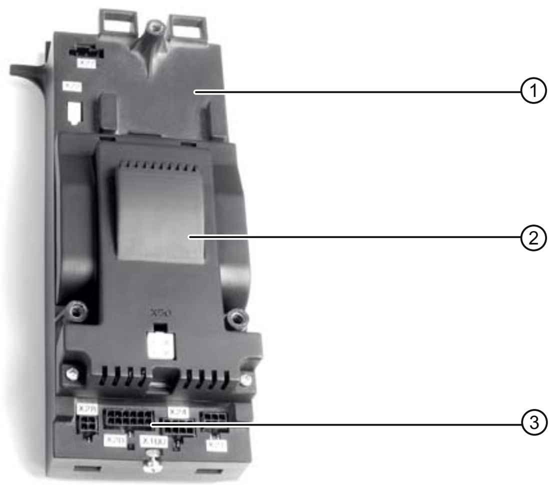
The integral metering function PLUS can be operated with all trip units with CubicleBUS connection. It extends the protection functions of the trip unit and provides further warning thresholds and additional diagnostics options. With its extensive measured values, the integral metering function PLUS in SENTRON WL provides all the electrical measured values for communication.

Metering function PLUS

The properties of the metering function PLUS are:

- In addition to the current values supplied by the trip unit, the metering function PLUS provides all the necessary measured values in power distribution (voltage, power, etc.) to enable power management.
- The metering function PLUS offers options for monitoring and protecting the connected power distribution system using the extended protection function (e.g. overvoltage).
- The possibility of generating warnings when adjustable thresholds are exceeded enables the very early response to plant faults or unusual plant statuses.
- Use of the metering function PLUS can increase plant availability.

The figure below shows that the metering function PLUS is mounted on the rear of the trip unit (ETU).



① Rear of the ETU
② Metering function PLUS
③ Connection for the breaker identification module

Figure 3-8 Metering function PLUS

Data exchange with trip unit

The trip unit and the metering function PLUS exchange all current data via a high-speed synchronous interface. The metering function PLUS provides all connected modules (e.g. COM15) with the following data for further processing via the CubicleBUS:

- The parameters for the extended protection function
- The parameters for the threshold values
- The measured value settings
- The determined measured values

Connection

The internal switch wiring is continued via the CubicleBUS connection. Depending on the equipment of the switch, the cable leads to the BSS or direct to the X8 terminals.

Mounting

The metering function PLUS can be operated with all switches with ETU45B and ETU76B. If the metering function PLUS is ordered together with the circuit breaker using the short code "Z=F05", it is already built-in and ready for operation. The metering function PLUS can be retrofitted at any time if the switch is fitted with one of the above-listed trip units. The metering function PLUS is screwed onto the trip unit and the CubicleBUS cables are clicked into place.

NOTICE
If retrofitting is carried out by the customer, the metering function PLUS will not be calibrated together with the trip unit. Siemens accepts no liability for the accuracy information in the table "Metering function PLUS - measured values for communication".

Harmonic analysis

The metering function PLUS samples the applied currents and the voltage, saves the measured values, and carries out a fast Fourier transformation. The result is the percentage distribution of the harmonic oscillations up to the 29th harmonic. The determined values are made available via the CubicleBUS and can be displayed via Switch ES Power (see Chapter), and saved for later diagnostics as an Excel-compatible "*.csv" file. In the case of the ETU76B trip unit, the measured and calculated values can also be shown on the display.

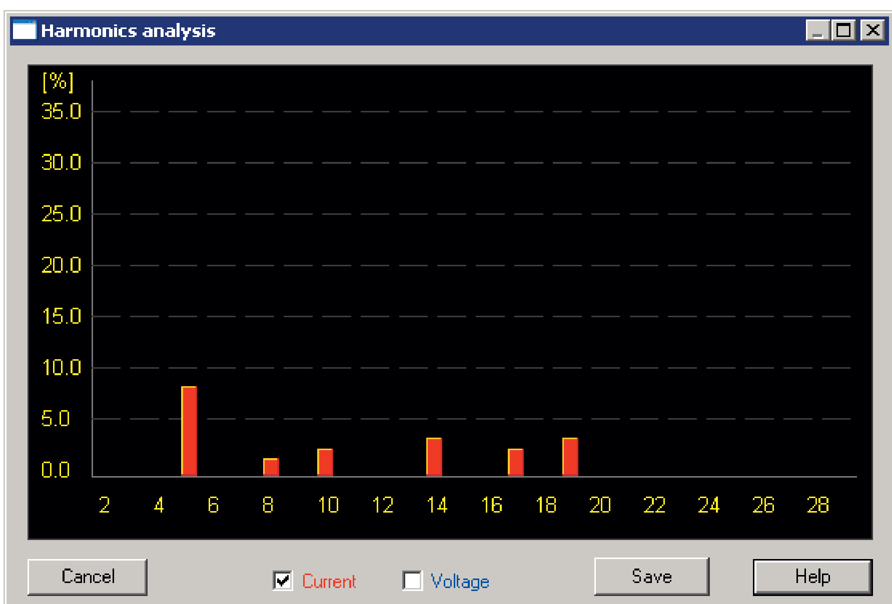


Figure 3-9 Harmonics analysis of the metering function PLUS

Harmonics can be generated by the following:

- Domestic electronics, lighting and computers
- Single-phase power supply units
- Uninterruptible power supplies via inverters
- Saturated iron cores with inductances (transformers and reactors)
- Converters
- Rectifiers and inverters (especially in the case of speed-controlled asynchronous machines)
- Induction and arc furnaces, welding equipment
- Spark erosion machines

The harmonic currents thus caused instigate voltage drops at the system reactances. These result in significant overvoltages or power surges if there is a resonance condition due to additional series resonant circuits or anti-resonant circuits.

Harmonic currents can cause the following problems in plants:

Overload of the neutral conductor

- Overheating of transformers and reactors
- Overheating of cables and switching elements
- Overloading of compensation capacitors
- Voltage distortions
- Overheating and power-up difficulties for rotating-field motors
- Zero point faults
- Signal corruption on bus lines
- Interference with electronic components

Costs arise as a result of the following:

- Insufficient system quality increases the risk of failure of plant sections and can result in production standstills.
- If the provided power is exceeded, energy costs increase
- Faults in the open-loop and closed-loop control systems result in production faults and failures
- Occurrence of luminance changes, flickering, lighting failure
- Defective compensation systems and thus plant standstill
- Spurious tripping of protection equipment can result in standstill of plant sections
- Overload of the transformer and the cable result in increased fire hazard
- Reduction in the service life of electronic components

If increased harmonics are measured, it is advisable to carry out a 3-phase system analysis. This measurement, including the neutral conductor, must be carried out with the appropriate harmonics measuring devices over an extended period up to the 100th harmonic. The right choice of measuring connection point and professional analysis of the measured data are essential components in developing a concept that removes or at least reduces the harmonics and associated faults.

Standards

You can find further information in the EN 6100-2-4 standard where upper limits are defined for harmonics. The application area of this standard refers to harmonics up to the 50th harmonic order, intermediate harmonics up to the 50th harmonic order and voltage components at higher frequencies above the 50th harmonic order.

Waveform buffer

The metering function PLUS has two independent waveform buffers (A and B) with which the current measured values are captured and buffered for one second. The buffer is continuously overwritten with the new measured values. If an event (trigger event) now occurs, the 1 s measured values are saved for later analysis of the events.

Typically, the function is used for analyzing a short-circuit (trigger event). But other events can also be analyzed.

Each of these waveform buffers has 8 channels, one each for the currents I_{L1}, I_{L2}, I_{L3}, IN and I_g as well as for the voltages V_{L1N}, V_{L2N} and V_{L3N}. Each channel is sampled with a frequency of 1.649 kHz, and the values are buffered for 1 s.

The waveform can be represented and exported with Switch ES Power, for example.

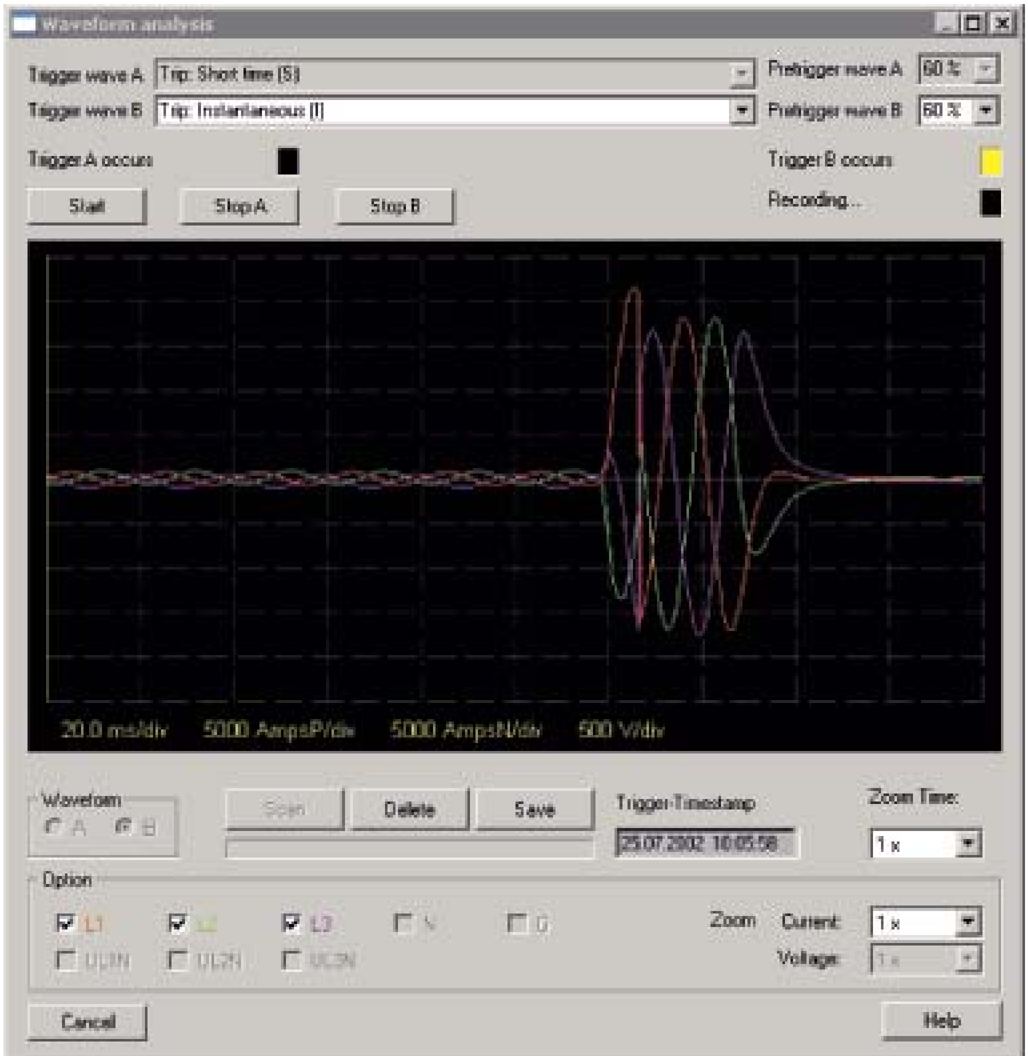


Figure 3-10 Waveform acquisition of the metering function PLUS

The example in the figure shows the 3 phases L1, L2 and L3. It shows an event in waveform buffer B with a 3-phase instantaneous short-circuit. You can see from the figure that the short-circuit occurred at the time 10:05:58. Further, you can see that in L1 a maximum short-circuit current of approximately 23 kA has arisen, and that the short-circuit has been completely switched off after approximately 50 ms.

Trigger event

Tripping operations, alarm signals and threshold warnings are available as trigger events so that the voltage wave for an undervoltage trip can be recorded. The trigger event can be set individually for each waveform buffer. In addition, the position in the stopped waveform buffer at which the trigger should be located can be stored.

The relationship between pre-history and post-history can be set in this way. If the pre-history of the trigger event is to be analyzed, the position can be set to 80%, for example. If the event occurs, 0.8 of a second of pre-history and 0.2 of a second of post-history are available in the waveform buffer, and an available COM15 adds a time stamp to the trigger event.

Data export

The extensive analysis data (approximately 25 KB per waveform) can be downloaded and analyzed with Switch ES Power and the display of the ETU76B. There are different zoom options and export functions available depending on the program.

When downloading, you must first select which channels are necessary, since approximately 1 minute per channel is required for downloading. The time duration is explained partly because, as well as recording the measured values, calculating the harmonics, and the extended protection function, the metering function also has to carry out tasks with higher priority and thus the communication process takes longer. Also, a large volume of data is transferred. The progress of this process is indicated by a progress bar in Switch ES Power.

3.3.2 Voltage transformer

For safety reasons, a voltage transformer is used to operate the metering function PLUS. This prevents voltage signals of up to 1 kV reaching the back of the ETU direct via the auxiliary conductor connections.

The voltage transformer converts the high primary voltage to a secondary voltage between 100 V and 120 V, depending on the version.

Connection

On the primary side, the voltage converter can be star or delta-connected. On the secondary side, it is always star-connected to the auxiliary conductor plug-in system (X8:5 to X8:8). The figure below shows the connection of the voltage transformer for operating with a metering function. On the primary side, the transformer can be star or delta-connected. Refer to the Operating Instructions for details.

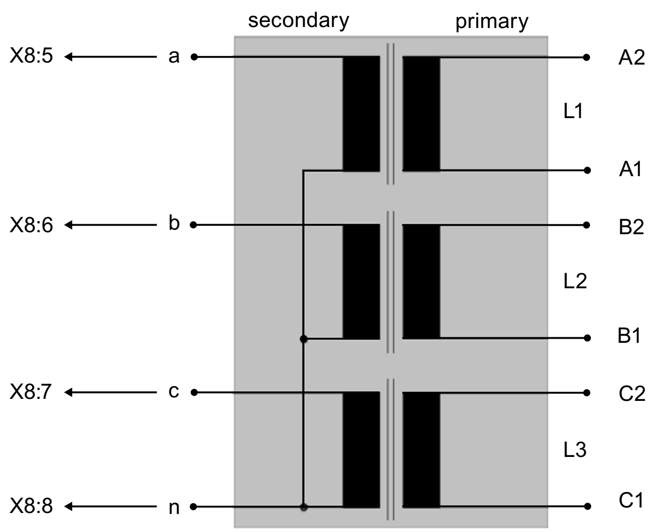


Figure 3-11 Connection of the voltage transformer for metering function

Maximum distance from voltage transformer

The maximum distance depends on the cross-section and the required accuracy class. Assuming a cross-section of 1.5 mm^2, the maximum distance from the voltage transformer is 50 m for Class 0.5, and 100 m for Class 3. If electromagnetic interference is expected, shielded cables must be used.

Parameters for setting the measured value

To determine the measured values, the data of the voltage transformer must be taken into account and set in the metering function. This includes:

- Primary voltage of the voltage transformer (factory setting: 400 V)
- Secondary voltage of the voltage transformer (factory setting: 100 V)
- Type of connection on the primary side (factory setting: star)

If the parameters have to be changed, the following setting options are available:

- With the BDA PLUS
- With the display of the ETU76B
- Data set 128 via PROFIBUS DP

Accuracy

The load of the metering function PLUS is 27 kΩ so that up to six metering functions can be connected simultaneously to a voltage transformer with apparent power of 2.5 VA (note accuracy class and cable length!).

The accuracy of the voltage transformer depends on the number of connected metering functions per voltage transformer:

- Class 0.5 for 1 to 3 metering functions
- Class 3 for 4 to 6 metering functions

These specifications apply for ambient temperatures of 30 to 50 °C and a primary-side voltage of 80 to 120% for a period of one year.

If the accuracy specified in the tables below has to be achieved, a Class 0.5 voltage transformer must be used. As well as the measured values specified in the table, the metering function also provides a minimum and maximum measured value.

Note

If the metering function is retrofitted at the customer end, the specified accuracy values cannot be guaranteed due to lack of calibration with the trip unit.

Table 3- 7 Metering function PLUS - Measured values for communication

Measured value	Range of values	Accuracy (when ordering the switch + trip unit + metering function PLUS direct) [1]
Currents I_{L1} / I_{L2} / I_{L3}, I_n	30 … 8000 A	± 1 %
Ground-fault current I_g (measurement with external G transformer)	100 … 1200 A	± 5 %
Phase-to-phase voltages V_{L12}, V_{L23}, V_{L31}	80 … 120% V_n	± 1 %
Star point voltages V_{L1N}, V_{L2N}, V_{L3N}	80 … 120% V_n	± 1 %
Instantaneous mean value of the phase-to-phase voltages V_{Llavg}	80 … 120% V_n	± 1 %
Instantaneous means value of the star point voltages V_{Lnavg}	80 … 120% V_n	± 1 %
Apparent power S_{L1}, S_{L2}, S_{L3}	13 … 8000 kVA	± 2 %
Total apparent power S_{total}	13 … 24000 kVA	± 2 %
Active power P_{L1}, P_{L2}, P_{L3}	– 8000 … 8000 kW	± 2% (cos φ > 0.6)
Total active power P_{total}	– 24000 … 24000 kVA	± 2% (cos φ > 0.6)
Reactive power Q_{L1}, Q_{L2}, Q_{L3}	– 6400 … 6400 kvar	± 4% (cos φ > 0.6)
Total reactive power Q_{total}	– 20000 … 20000 kvar	± 4% (cos φ > 0.6)
Power factors cos φ_{L1}, cos φ_{L2}, cos φ_{L3}	– 0,6 … 1 … 0,6	± 0,04
Power factors cos φ_{avg}	– 0,6 … 1 … 0,6	± 0,04
Long-term mean value of currents I_{L1}, I_{L2}, I_{L3}	30 … 8000 A	± 1 %
Long-time mean value of 3-phase current	30 … 8000 A	± 1 %
Long-time mean value of active power P_{L1}, P_{L2}, P_{L3}	13 … 8000 kW	± 2% (cos φ > 0.6)
Long-time mean value of 3-phase active power	13 … 8000 kW	± 2% (cos φ > 0.6)
Long-time mean value of apparent power S_{L1}, S_{L2}, S_{L3}	13 … 8000 kW	± 2 %
Long-time mean value of 3-phase apparent power	13 … 8000 kW	± 2 %
Long-time mean value of 3-phase reactive power	– 24000 … 24000 kvar	± 4% (cos φ > 0.6)
Active energy in normal direction	1 … 10000 MWh	± 2 %
Active energy in reverse direction	1 … 10000 MWh	± 2 %
Reactive energy in normal direction	1 … 10000 Mvarh	± 4 %
Reactive energy in reverse direction	1 … 10000 Mvarh	± 4 %
Frequency	15 … 440 Hz	± 0.1 Hz
THD for current and voltage	2 … 100 %	± 3% from the measuring range to the 29th harmonic
Current and voltage phase unbalance	2 … 150 %	± 1 %

[1] Accuracy is specified as follows: ± (x%) of the full-scale value + 2 LSD (least significant digit) for one year after calibration; use of a Class 0.5 voltage transformer as well as connection of no more than 3 SENTRON WLs to this voltage transformer.

Table 3- 8 Reference conditions:

Input current		I_{nmax} ± 1%
Input voltage		V_n ± 1%
Frequency		f = 50 Hz
Power factor		cos φ = 1
Waveform		Sine, THD ≤ 5%; symmetrical load
Ambient temperature		35 °C ± 5 °C
Auxiliary voltage		24 V DC in accordance with DIN 19240/EN 61131
Warm-up time		2 hours
Relative humidity		Up to 90%
Interfering fields		None
Measuring range:	Current	0.2 … 1.2 I_{nmax}
	Voltage	0.8 … 2 V_{nmax}

Extended protection function

Additional tripping criteria can be set via the protection function of the metering function PLUS. A parameterized delay time can achieve "debouncing" of briefly occurring events. With this, the switch only trips if the set event persists longer than the delay time.

The extended protection function of the metering function PLUS can monitor the following criteria and trigger the trip unit when limits are exceeded:

Table 3- 9 Protection function of the metering function PLUS

Parameters	Setting range	Possible delay
Phase unbalance current	5 … 50 %	0 … 15 s
THD current	5 … 50 %	5 … 15 s
Phase unbalance voltage	5 … 50 %	0 … 15 s
Undervoltage	100 … 1100 V	0 … 15 s
Overvoltage	200 … 1200 V	0 … 15 s
THD voltage	3 … 50 %	5 … 15 s
Direction of rotation of phase	–	–
Active power in normal direction	1 … 12000 kW	0 … 15 s
Active power in reverse direction	1 … 12000 kW	0 … 15 s
Underfrequency	40 … 70 Hz	0 … 15 s
Overfrequency	40 … 70 Hz	0 … 15 s

3.3.3 Delay of the threshold warning

You can parameterize whether a warning is generated when a threshold value is violated. This can be delayed like the extended protection function. These warnings are communicated on the CubicleBUS (e.g. for the configurable output module or as a trigger for the waveform buffer) and transferred via the COM15.

Table 3- 10 Threshold values of the metering function

Parameters	Setting range	Possible delay
Overcurrent	30 … 10000 A	0 … 255 s
Overcurrent ground fault	30 … 12000 A	0 … 255 s
Overcurrent N-conductor	30 … 10000 A	0 … 255 s
Phase unbalance current	5 … 50%	0 … 255 s
Long-term mean value of current	30 … 10000 A	0 … 255 s
THD current	5 … 50%	0 … 255 s
Undervoltage	100 … 1100 V	0 … 255 s
Overvoltage	100 … 1100 V	0 … 255 s
Phase unbalance voltage	3 … 50%	0 … 255 s
THD voltage	3 … 50%	0 … 255 s
Peak factor and form factor	1 … 2.550	5 … 255 s
Active power in normal direction	1 … 12000 kW	5 … 255 s
Active power in reverse direction	1 … 12000 kW	0 … 255 s
Power factor, capacitive	- 0.999 … – 1.000	0 … 255 s
Power factor, inductive	- 0.999 … – 1.000	0 … 255 s
Long-time mean value of active power	1 … 12000 kW	0 … 255 s
Apparent power	1 … 12000 kVA	0 … 255 s
Reactive power in normal direction	1 … 12000 kvar	0 … 255 s
Reactive power in reverse direction	1 … 12000 kvar	0 … 255 s
Long-time mean value of apparent power	1 … 12000 kVA	0 … 255 s
Long-time mean value of reactive power	1 … 12000 kvar	0 … 255 s
Underfrequency	40 … 70 Hz	0 … 255 s
Overfrequency	40 … 70 Hz	0 … 255 s

3.4 Functions and parameters

3.4.1 Important functions and parameters for communication

Thanks to their modular design and many diverse modules, the SENTRON WL circuit breakers provide an extremely large range of functions far beyond that of strict protection functions. This includes, for example, load management, threshold values, or additional tripping conditions of the extended protection function. These functions can also be utilized without communication.

3.4.2 Load management

Load management is used to avoid peaks in the load curve or to reduce their effects. Brief peaks can result in a circuit breaker overload and thus a tripping operation, or they can result in the energy supplier raising the price. Energy prices are generally calculated based on the maximum consumption values. Brief peaks can result in assignment to another tariff group and thus a higher energy price.

From trip unit ETU45B, the SENTRON WL provides two current thresholds for local load management. Load shedding is the upper threshold, and load pick up is the lower threshold. Both values can be used locally, or in higher-level systems such as a PLC, to briefly shut down parts of the loads (e.g. air conditioners) so that the peaks in the load curve are reduced.

The figure below explains the functional principle of the load management functions "load shedding" and "load pick up". This is based on a circuit breaker with an overload parameter of 1000 A.

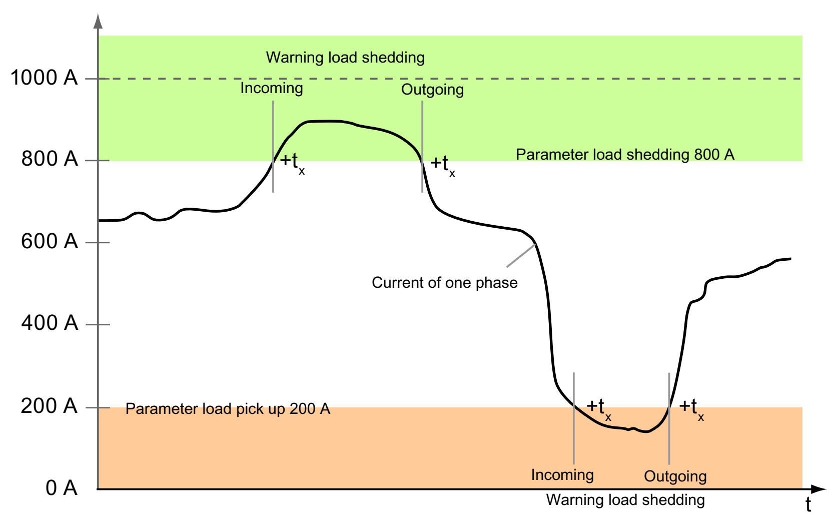


Figure 3-12 Load management functions: Load shedding and load pick up

Important: Violation of the upper or lower thresholds never results in a circuit breaker trip and instead only generates a message!

Threshold "load shedding"

If the current exceeds the set load shedding parameter in one phase, a "load shedding alarm" is generated. Only when this lower threshold is violated by all three phases is the "load shedding alarm" reset. These alarm messages are displayed direct as alarms in Switch ES Power and they result in a yellow background in the status screen in the main overview. However, they are also channeled into the event log and are provided with a time stamp there.

Note

The event log is only available with COM15!

Threshold "load pick up"

The opposite applies for the load pick up threshold. If all three phases fall below the set parameters, a "load pick up alarm" is generated. If only one of the three currents exceeds the value of the parameter, the "load pick up alarm" is reset.

Delay time t_x

To prevent these messages being generated by brief current peaks and troughs, they can be delayed by the delay time t_x from 1 s to 15 s.

Where can the parameters be set?

The parameters for load management can be found in the parameter tree of Switch ES Power under "Device parameters – Switch – Protection function – Supplement".

Local switching signals

The signals load shedding/load pick up are available as outputs on the digital output module with rotary coding switch for automatically shutting down and connecting loads. The configurable output module can also be set in such a way as to output the load shedding and load pick up status.

3.4.3 Extended protection function

The extended protection function metering function PLUS adds further tripping criteria to those of the trip unit. If an additional tripping condition from the extended protection function is activated (e.g. phase unbalance voltage > 8%), this always results in a tripping operation that the metering function initiates via the trip unit.

The options specified in the table "Protection function of the metering function PLUS" in Chapter Voltage transformer (Page 48) are available as additional monitoring criteria.

3.4.4 Threshold values

As well as the load management facility (load shedding/load pick up), the metering function PLUS provides another option for automatic monitoring of operating data and for generating an alarm when a normal status is exited.

In general, the same monitoring functions are available for the threshold values as for the extended protection function. The greatest difference, however, is that the violation of a threshold never results in a tripping operation.

Together with the extended protection function, two thresholds can thus be defined (e.g. for overvoltage). With the lower of the two, only an alarm is generated via the threshold function (e.g. > 410 V), and if the voltage continues to rise, a tripping operation is triggered (e.g. > 430 V).

3.4.5 Lower limit of power transmission

Despite extremely high accuracy in recording the current over a large dynamic range, a fault current is generated with a switch with high rated current (e.g. 4000 A) at 1% accuracy in the lower range. One possible result of this is that when the switch is off (main contacts opened), a current flow of up to 40 A can be displayed and transferred via the communication system. To avoid this, it is possible to convert all recorded current values less than or equal to this parameter to zero using the parameter "Lower limit of power transmission". The factory setting for this value is 50 A. This means all values less than or equal to 50 A will appear on the display as 0 and will be used as 0 for internal calculations (power), and transferred as 0 via the communication system.

If this parameter is changed to 0, this function is switched off and all recorded measured current values are used direct.

The parameter for this can be found in the parameter tree of Switch ES Power under "Device parameters – Switch – Measured value settings".

3.4.6 Direction of incoming supply

The direction of "flow" of the energy at a given time, or how much energy has "flowed" in both directions until now, is important above all for coupling switches. It is necessary here to define a "normal direction". This can be either "top down" or "bottom up".

Depending on this, the measured active power values have a positive sign (in normal direction) or a negative sign (in reverse direction). The measured currents, by contrast, always have a positive sign!

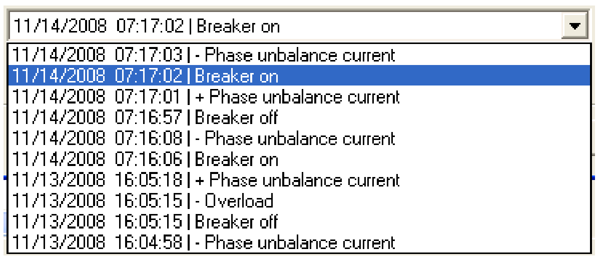
The transferred energy values flow into two counters, active energy in the normal direction and active energy in the reverse direction. Neither energy counter has a sign.

3.4.7 Events and tripping operations

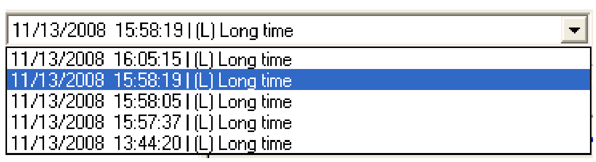
All events (with the exception of tripping operations) are provided with a time stamp and an incoming (+) or outgoing (–) indicator, and entered in the event log.

In the event log, the last ten events registered on the CubicleBUS are stored in the COM15. The trip log contains the last five tripping operations. Both can be evaluated via Switch ES Power.

Events



Tripping operations



The event log has a depth of ten events and works like a FIFO memory, that is, when a new event arrives, the last event is removed from the event log.

The trip log functions in a similar way to the event log, but only the last five tripping operations are entered with a time stamp. An incoming or outgoing message is unnecessary in this case.

Note

The event log and the trip log are only available with the COM15 module.

3.5 External CubicleBUS modules

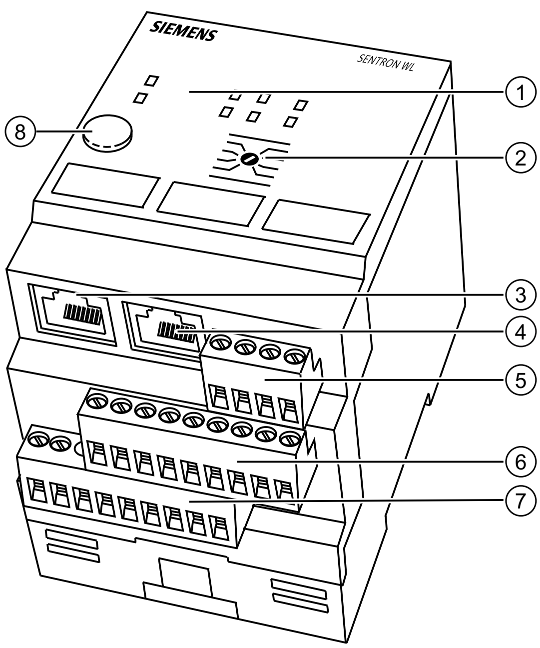
3.5.1 General information

General (description and equipment)

External CubicleBUS modules enable communication of the SENTRON WL circuit breaker with secondary devices in the circuit breaker field. It can be used, for example, to control analog indicators, to transfer alarms and the reason for tripping the circuit breaker, and to read in additional control signals. With the help of one of these modules, a Zone Selective Interlocking can also be implemented for short circuits.

Five different CubicleBUS modules can output data from the CubicleBUS system.

All external CubicleBUS modules have the same housing. The CubicleBUS can be connected to X1 and X2 with an RJ45 connector, or it can be connected to X3. This depends on whether or not a COM15 is available.



① LED
② Rotary coding switch
③ X1: CubicleBUS
④ X2: CubicleBUS
⑤ X3: CubicleBUS
⑥ X5: Inputs/outputs
⑦ X4: Inputs/outputs
⑧ Push to trip button

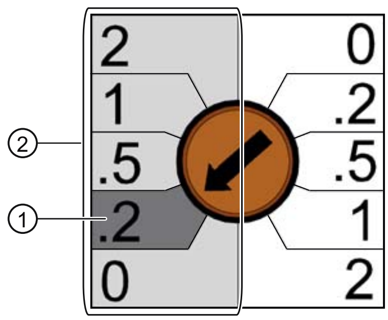
Figure 3-13 External CubicleBUS module

3.5.1.1 Rotary coding switch

With the exception of the configurable output module, all external CubicleBUS modules are configured using rotary coding switches.

The function indicated by the pointer of the rotary coding switch is active in each case. On some modules (e.g. digital output module) you must first consider the group selection (e.g. "1st Module" in the left position; color-coded) and then any additional meaning (e.g. time delay). The sections for the individual modules contain more detailed information.

In the figure below, the rotary coding switch has been set as follows:



① 0.2 = delay of 0.2 s

② Switch position left = Module 1

Figure 3-14 Rotary coding switch setting on the CubicleBUS module - Delay time [s]

3.5.1.2 Installing the CubicleBUS modules

The external CubicleBUS modules are snapped onto a standard 35 mm DIN rail in the switching panel. You must note that the length of the connecting cable of the first module to the circuit breaker must not exceed 2 m.

For connecting the CubicleBUS modules to each other and to the circuit breaker, only the pre-assembled cables supplied or separately ordered should to be used. These cables enable both the communication of the CubicleBUS modules and their 24 V DC supply.

3.5.1.3 Connection of the power supply

The CubicleBUS must be supplied once with 24 V DC along its length. The connections X8:3 and X8:4 or the 4-pin connectors of the external CubicleBUS modules (X3) can be used for this purpose. The 24 V are transferred over the CubicleBUS cables. The required power of the 24 V DC supply depends on the configuration of the CubicleBUS. The technical data of the external CubicleBUS modules is listed in this chapter. The control system of the CubicleBUS must be connected to a secure power supply because in the event of a short circuit the system voltage reverts to an unspecified value.

Note

Hot plugging (hot swapping) of CubicleBUS cables/modules is not permitted.

The CubicleBUS is supplied with 24 V DC on X3. The table below shows the pin assignment of X3 on the CubicleBUS module:

Table 3- 11 Pin assignment of the X3 on the CubicleBUS module

X3:1	Ground 24 V DC
X3:2	CubicleBUS communication cable -
X3:3	CubicleBUS communication cable +
X3:4	+24 V DC

3.5.1.4 Maximum configuration of the CubicleBUS

The CubicleBUS can comprise up to 13 nodes.

These include:

- Trip unit ETU
- Metering function PLUS
- Breaker Status Sensor (BSS)
- COM15
- BDA PLUS
- ZSI module
- Digital output module with switch position left (1st module)
- Digital output module with switch position right (2nd module)
- Digital configurable output module
- Digital input module with switch position left (1st module: "Parameterswitch")
- Digital input module with switch position right (2nd module: "PROFIBUS-Inputs")
- Analog output module with switch position left (1st module)
- Analog output module with switch position right (2nd module).

In practice, only one selection of these modules is usually necessary

3.5.1.5 Installation guidelines for the CubicleBUS

The following guidelines apply for installing the CubicleBUS:

- Total length of the CubicleBUS cables max. 10 m.
- Only the pre-assembled cables must be used for connecting the CubicleBUS modules.
- At the last module, the cable must be terminated with a terminating resistor of 120 Ω, which is included with every module.
- The cables must always be connected from module to module. Spur lines are not permissible!
- The power supply must be ensured with a 24 V DC power supply with the usual tolerance and the properties listed in Chapter External current consumption with CubicleBUS (Page 83).
- If a ZSI module is used, it must be connected as the first external module.

3.5.1.6 Connection of external CubicleBUS modules

Note

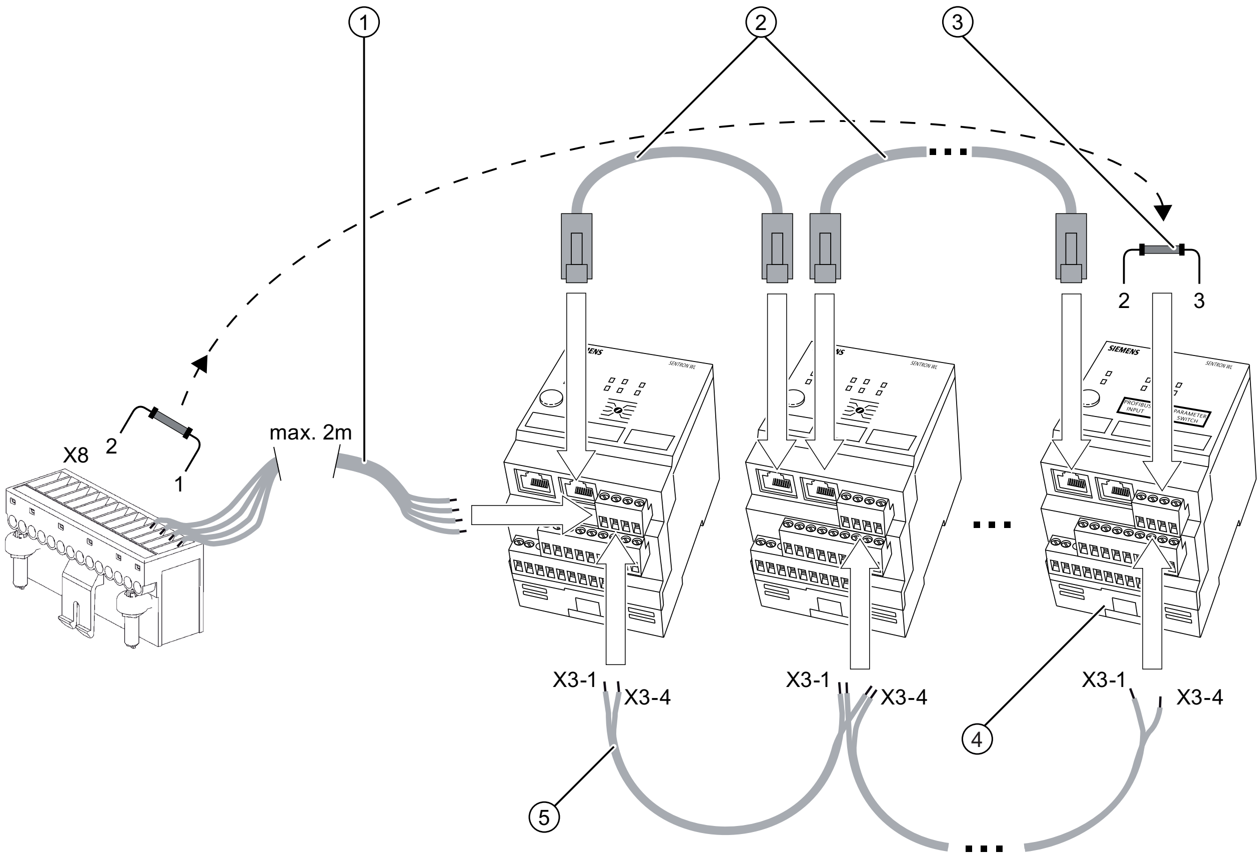
Selecting the power supply

A sufficient external power supply of 24 V DC must be ensured. You can find additional information on this in Chapter External current consumption with CubicleBUS (Page 83).

Connection of the CubicleBUS without COM15

The figure below shows the connection of external CubicleBUS modules to the SENTRON WL without COM15.

- Make the first connection with four wires.
- Connect the CubicleBUS with RJ45 connectors using the supplied CubicleBUS cables.
- Connect the power supply to the X3 interface.



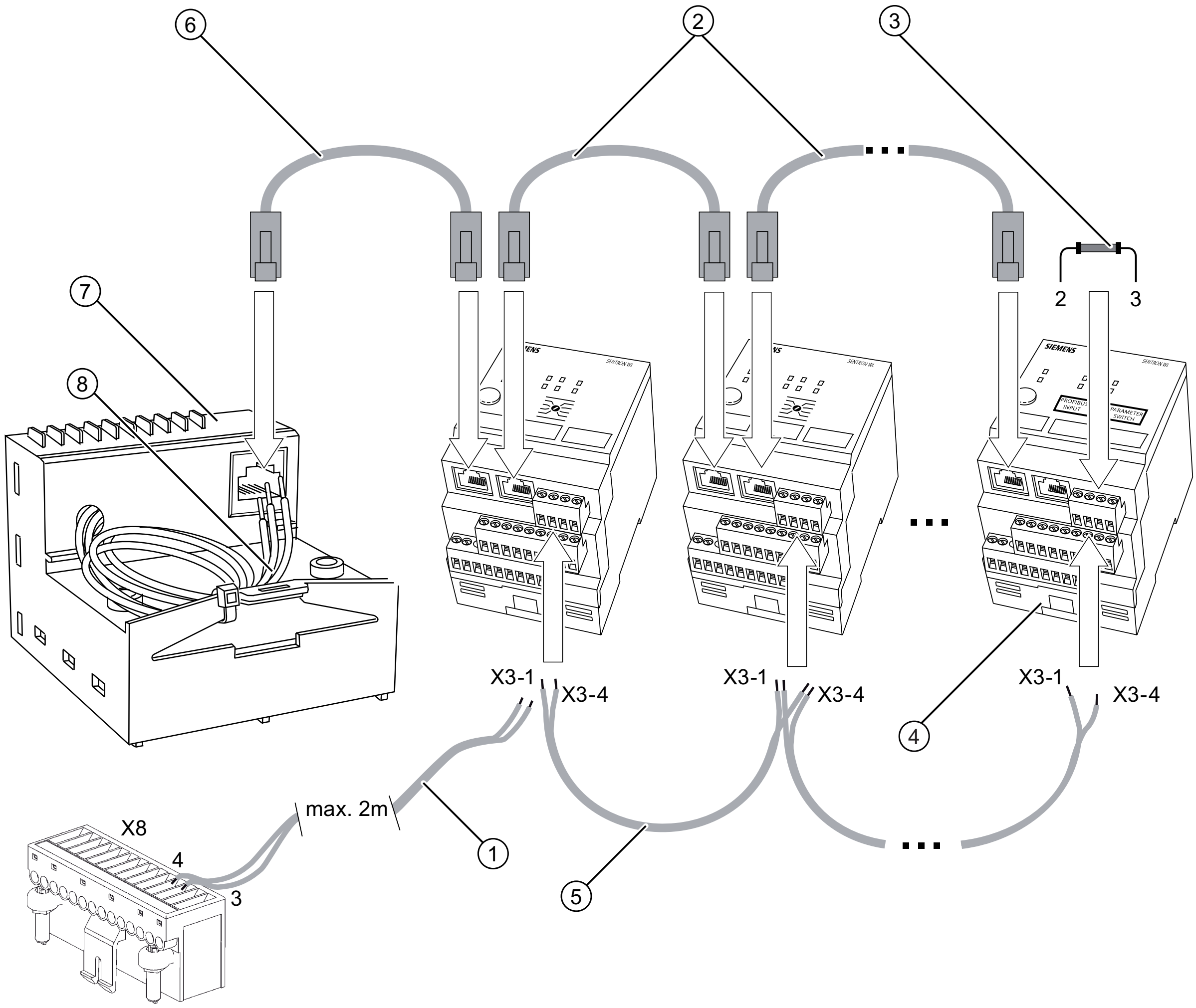
① Only with more than 2 CubicleBUS modules: Connecting cable between X8 and the first CubicleBUS module for power supply with 24 V DC
② Connecting cables between the modules
③ Terminating resistor 120 Ω 0.5 W on the last module
④ CubicleBUS modules
⑤ Cable connection for power supply with 24 V DC

Figure 3-15 Connection of the CubicleBUS without COM15

Connection of the CubicleBUS with COM15

The figure below shows the connection of external CubicleBUS modules to the SENTRON WL with COM15:

- Connect the external CubicleBUS modules using the supplied 0.5 m CubicleBUS cables and integrate them into the system.
- Provide the CubicleBUS with a terminating resistor.
- Connect the power supply to the X3 interface.



①	Only with more than 2 CubicleBUS modules: Connecting cable between X8 and the first CubicleBUS module for power supply with 24 V DC
②	Connecting cables between the CubicleBUS modules
③	Terminating resistor 120 Ω 0.5 W on the last module
④	CubicleBUS module
⑤	Connecting cables between the CubicleBUS modules for power supply with 24 V DC
⑥	Connecting cable between COM15 and 1st CubicleBUS module (with two RJ45 connectors)
⑦	COM15
⑧	Wire four cables to X8

Figure 3-16 Connection of the CubicleBUS with COM15

3.5.1.7 LED indicator

The LEDs on the external CubicleBUS modules enable simple diagnostics and testing of the module. As explained in the tables below, the internal status and the communication connection can be diagnosed and thus the correct cabling can be checked.

The tables below provide an overview of the LED indicators:

DEVICE LED

The DEVICE LED indicates the status of the external CubicleBUS module:

Table 3- 12 DEVICE LED

DEVICE LED	Meaning
Red	Internal fault in the CubicleBUS module
Yellow	CubicleBUS module in test/force mode
Green	Module in operation

CubicleBUS LED

The CubicleBUS LED on the external CubicleBUS modules indicates whether there is a communication relationship with other modules:

Table 3- 13 CubicleBUS LED

CubicleBUS LED	Meaning
Green	There is a connection to another CubicleBUS module.
Off	No other CubicleBUS module detected.

Other LEDs

All other LEDs indicate whether the outputs are set or the inputs are supplied with 24 V DC and have thus been activated.

Table 3- 14 LEDs

All other LEDs	Meaning
Yellow	• On the input module this means a high signal at the relevant input. • On digital output modules, the output is active and the contact is closed. • On the analog output module, a yellow LED indicates either that the full-scale deflection value has been exceeded by 20% (in the case of V, I, P), or cos phi is greater than 0.8, or the frequency is greater than 45 Hz.
Off	If none of the above listed statuses apply, the LED is off.

3.5.1.8 Test of the digital input and output modules

To prevent malfunctions of the circuit breaker or one of its components, the test must only be carried out before commissioning. The correct functioning of the CubicleBUS modules can be checked in test mode. A distinction must be made between the individual modules.

Carry out test mode

- Test mode is started by pressing the "Test" button on the CubicleBUS module once.
- All inputs or outputs and the associated LEDs are then switched off.
- The color of the DEVICE LED changes from green to yellow.
- Repeated pressing of the "Test" button when the LED is switched on causes the relevant input or output to be switched on and off alternately.
- On the input module, the signals are also transferred via the CubicleBUS as well as the LEDs of the inputs, and then to any connected PROFIBUS DP.
- In the case of the digital outputs, the LEDs and associated outputs in each case are switched through. This enables checking of the connected devices.

"Forcing"

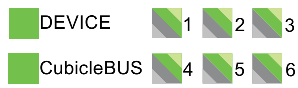
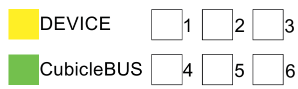
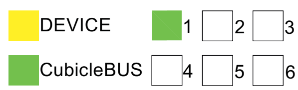
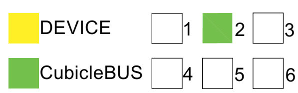
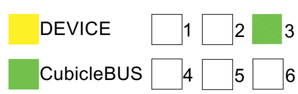
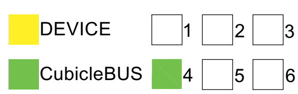
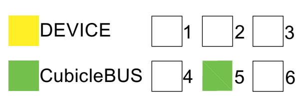
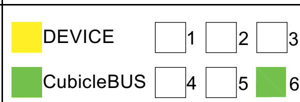
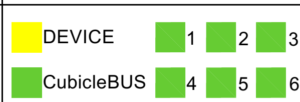
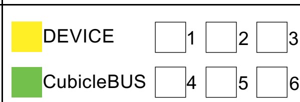
The inputs of the input module, the outputs of the output module, the ZSI input and the ZSI output can be "forced" via the communication system of Switch ES Power. This means test mode can be switched on via the communication system and the inputs or outputs can be overwritten for test purposes.

If the "Test" key is not pressed for longer than 30 s, or no change is triggered via the communication system, test mode is automatically canceled.

Testing process

The table below shows the testing process for checking the digital inputs and outputs on the CubicleBUS.

Table 3- 15 Testing process for the digital inputs/outputs on the CubicleBUS

Normal operation		Normal operating status of the input module or output module. The inputs or outputs are on or off according to the wiring or the pending signals.
Press "Test" button		The module then switches to test mode, indicated by the yellow DEVICE LED.
Press "Test" button		Input or output 1 is selected by pressing once. This is indicated by the green LED 1. Following this, the output can be switched on or off alternately, or the on or off signal of the input can be transferred by quickly pressing the "Test" button (1 s).
After a pause of longer than 2 s, press the "Test" button.		Input or output 2 selected. As under 1, the output can be switched by quickly pressing the button. On relay modules, a click can be heard.
After a pause of longer than 2 s, press the "Test" button.		Input or output 3 selected. On input modules, the presence of 24 V DC is simulated at the relevant input and transferred via c.
After a pause of longer than 2 s, press the "Test" button.		Input or output 4 selected. Fast pressing of the "Test" button tests the selected input or output.
After a pause of longer than 2 s, press the "Test" button.		Input or output 5 selected. Fast pressing of the "Test" button tests the selected input or output.
After a pause of longer than 2 s, press the "Test" button.		Input or output 6 selected. Fast pressing of the "Test" button tests the selected input or output.
After a pause of longer than 2 s, press the "Test" button.		LED overall test. If the "Test" button is not pressed again within 5 s, test mode is canceled.
Press the "Test" button within 5 s.		The test run can start from the beginning.

Shows a yellow light

Shows a green light

Not lit

3.5.2 Digital input module

Up to two digital input modules can be operated simultaneously on a CubicleBUS, once as a module with the position "PROFIBUS INPUT" and once as a "PARAMETER SWITCH". The polarity of the inputs is not important.

Input module function

The digital input module offers connections for up to six additional binary signals (24 V DC). The signals are transferred direct via PROFIBUS DP and processed at the fieldbus level. Such signals include:

- The status of a Buchholz relay
- The open/closed signal of the control cabinet door
- Violation of a specified temperature
- The status of an MCCB without direct communications capability or of a switch disconnector can also be transferred on PROFIBUS DP.

These protective devices can also be switched in conjunction with the configurable output module, resulting in a low-cost alternative to other solutions with additional PROFIBUS DP input/output modules.

Switch position "PROFIBUS INPUT"

In switch position "PROFIBUS INPUT", a total of six inputs are available.

Switch position "PARAMETER SWITCH"

If the rotary coding switch is in position "PARAMETER SWITCH", there are also six inputs available, but in this configuration the first input has the effect of changing the active parameter set. If the connected ETU does not have two parameter sets (e.g. ETU45B), this input can also be used without restriction.

Rotary coding switch

The position of the rotary coding switch selects the operating mode.

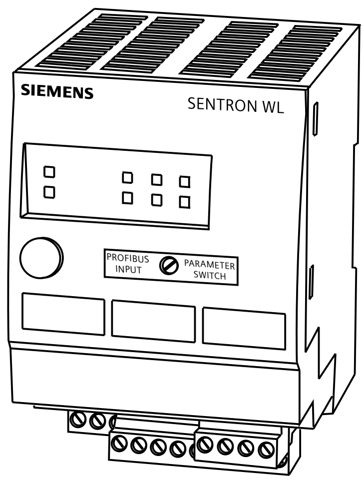


Figure 3-17 Digital input module

3.5.2.1 Parameter set changeover

There are two different parameter sets for the protection function in the ETU76B trip unit. This protection function is necessary when switching between mains operation and generator operation in the event of a power failure, and there is the possibility of all tripping conditions changing.

Changeover

Changeover between the two parameter sets can be made by means of:

- PROFIBUS DP communication
- Display in the ETU76B
- Digital input module

Since the CubicleBUS is an event-driven bus, the ETU76B trip unit switches to the other parameter set when a changeover request is made via the CubicleBUS.

This means, if a changeover is made to parameter set B, for example, even though the input on the digital input module is at "0" (parameter set A), the active parameter set in the trip unit changes to parameter set B. Only when the input on the digital input module is set to "1" and then back again to "0" is an event for changing to parameter set A initiated on the CubicleBUS.

For this purpose, the first input on the module is used in the position "PARAMETER SWITCH" of the rotary coding switch. If a "1" signal (LED on input 1 is yellow) is detected there, changeover to parameter set B is signaled to the trip unit. If the input signal changes back to "0", changeover to parameter set A is communicated and the LED at input 1 goes out.

3.5.2.2 Technical data

The table below contains the technical data of the digital input module on the CubicleBUS:

Table 3- 16 Technical data of the digital input module

Operating voltage on the CubicleBUS min./max. (V)	19.2 / 28.8
Current consumption from the CubicleBUS min./max. (mA)	29 / 43
Number of isolated channels per digital input module	6
Voltage value for reliable detection of a "1" signal (V)	> 16 V
Current consumption per input at a "1" signal (mA)	7.5
Voltage value for reliable detection of a "0" signal (V)	< 1 V
Current consumption per input at a "0" signal (mA)	0
Maximum number of modules possible on one CubicleBUS	2
Power loss min./max. (W)	0.72 / 0.94
Dimensions W/H/D (mm)	70 / 86 / 95
Weight (kg)	0.223
Temperature range (°C)	-20 / 60

3.5.3 Digital output module with rotary coding switch

Six binary information items about the switch status (alarms and tripping operations) can be output via the digital output module to external signaling devices (e.g. indicator lights, horns), or used for selective shutdown of other plant units (e.g. frequency converters).

The switch position on the left selects the events in the adjacent dark-gray field, and the switch position on the right selects the events in the adjacent light-gray field.

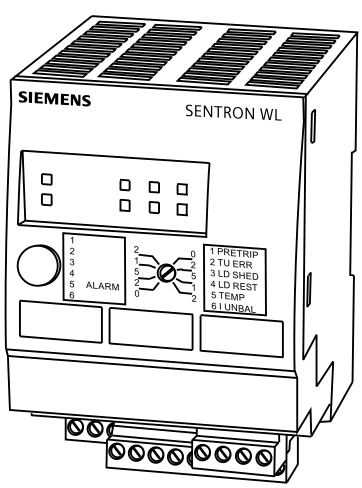


Figure 3-18 Digital output module

Versions

The current carrying capacity of an output is 150 mA here, and the maximum voltage is 24 V DC. Only direct voltage can be switched. The output module offers a changeover contact in each case with a maximum load of up to 12 A. Voltages to 230 V and AC voltage are possible. In addition, the relay contacts are isolated.

Load shedding message

By means of the load shedding and load pick up signals, a load can be switched off or connected automatically, dependent on the capacity utilization of the circuit breaker. This is the first stage of energy management.

Configuration

The configuration of the module is set using a rotary coding switch that selects one of the two output assignments as well as the associated delay time.

Switch position left

If the rotary coding switch is set to one of the positions in the left dark-gray field, the outputs 1 to 6 are assigned the subsequent event signals:

1. Tripping operation due to overload (L)
2. Short-time delayed short-circuit release (S)
3. Instantaneous short-circuit release (I)
4. Ground-fault tripping (G)
5. Ground-fault alarm signal
6. Tripping operation due to overload in the neutral conductor (N)

Switch position right

If the rotary coding switch is set to one of the positions in the right light-gray field, the outputs 1 to 6 are assigned the following functions:

1. Leading signal of overload trip (delay time 0 s)
2. Fault in trip unit (ETU)
3. Load shedding
4. Load pick up
5. Temperature alarm
6. Phase unbalance current

Delay time

As well as the assignment of the outputs, an additional delay time can be set using the rotary coding switch. 0/0.2 s/0.5 s/1 s and 2 s are available. This can be used, for example, to suppress briefly occurring events and to output these only after they are pending for longer (e.g. phase unbalance). The leading overload trip signal that can be used for advance shutdown and protection of connected frequency converters is independent of the set delay time and is always instantaneous.

Maximum assignment on the CubicleBUS

Up to two digital output modules with rotary coding switches can be operated simultaneously on a CubicleBUS. For this purpose, these must be configured once in the operating mode switch position left and once in the operating mode switch position right.

LED indicators

The LEDs indicate the current status of the six outputs. If an LED is off, the associated output is not set. If the output is activated, the LED shows a yellow light.

3.5.3.1 Technical data

The table below contains the technical data of the digital output module with rotary coding switch on the CubicleBUS:

Table 3- 17 Technical data of the digital output module with rotary coding switch

Operating voltage on the CubicleBUS min./max. (V)	19.2 / 28.8
Current consumption from the CubicleBUS min./max. (mA) relay	29 / 250
Number of isolated channels per digital output module	6
Max. possible aggregate current of all 6 outputs; relay output at 24 V DC/250 V AC/250 V DC (A)	10 / 10 / 2.5
Max. possible current on relay outputs per channel at 24 V DC (A)	2.7
Maximum number of modules possible on one CubicleBUS	2
Power loss min./max. (W)	0.74 / 5.4
Dimensions W/H/D (mm)	70 / 86 / 95
Weight (kg) relay	0.321
Temperature range (°C)	– 20 / 60

3.5.4 Configuration of the digital output module

Digital configurable output module

The digital configurable output module has six outputs. The outputs are configured exclusively per software.

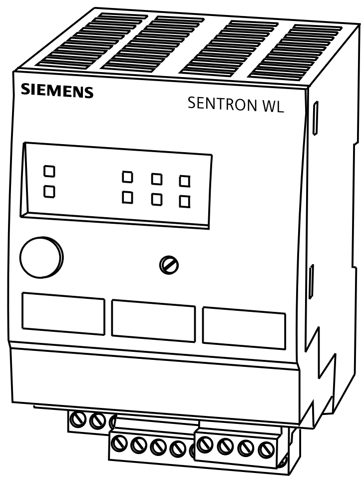


Figure 3-19 Digital configurable output module

Configuration

In contrast to the modules with rotary coding switch, the outputs are assigned per software instead of by means of a selector switch. Switch ES Power is available as configuration software. A separate node "Config. output module" is available in the navigation tree of the tool. The events listed in the adjacent table can be assigned to the outputs via these nodes using drop-down fields.

Assigning the outputs

The first three outputs of the module can be assigned up to six events that are connected to the output via an OR logic operation. This allows, for example, the implementation of a group signal if the switch is in overload excitation or if a warning for phase unbalance is present. The last three outputs can only be assigned one of the events direct.

Events

Status messages, alarms, tripped signals, threshold violation signals, triggers of the waveform buffer, bits that are directly addressable via PROFIBUS, and the active parameter set are available as events for configuration.

Control via PROFIBUS DP

The outputs of the module can be set direct via PROFIBUS DP (by a PLC, for example) via the PROFIBUS DP bits that are transferred via data set 69 to byte position 13. Together with the digital input module, it is possible to integrate switchgear that does not have direct communications capability into a communication system.

Status detection

The status can be read in via the input module. With this, for example, a motorized operating mechanism could be switched on or off via the digital configurable output module. However, many other diverse applications are conceivable.

Threshold delay

In contrast to the digital output module with rotary coding switch, it is not possible to add a time delay to the event. If, for example, a threshold value is to be output with a delay via the digital configurable output module, this can only be achieved by delaying the threshold value.

3.5.4.1 LED indicator

As on the digital output module with rotary coding switch, this module also indicates the status of the outputs via the labeled LEDs. The table below contains a list of all events on the CubicleBUS that can be output via the digital configurable output module.

These events are available to the digital configurable output module

Table 3- 18 Events on the CubicleBUS

Status	Switch on
	Switch off
	Spring energy store compressed
	Ready for closing
	General warning
	General tripping operation
	PROFIBUS write protection active
	PROFIBUS communication OK
Alarms	Overload
	Overload in neutral conductor
	Load shedding
	Load pick up
	Ground-fault alarm
	Overtemperature
	ETU fault
	Phase unbalance current

Tripping operations	Overload (L)
	Short-time delayed short circuit (S)
	Instantaneous short circuit (I)
	Ground fault (G)
	Overload in neutral conductor (N)
	Phase unbalance current
	Phase unbalance voltage
	Underfrequency
	Overfrequency
	Undervoltage
	Overvoltage
	Active power in normal direction
	Active power in reverse direction
	THD current
	THD voltage
	Reverse direction of rotation of phase
PROFIBUS output bits	PROFIBUS bit 1
	PROFIBUS bit 2
	PROFIBUS bit 3
	PROFIBUS bit 4
	PROFIBUS bit 5
	PROFIBUS bit 6
Active parameter set	Parameter set A active
	Parameter set B active

Threshold values	Overcurrent
	Overcurrent in neutral conductor
	Overcurrent ground fault
	Phase unbalance current
	Phase unbalance voltage
	Long-term mean value of current
	Undervoltage
	Overvoltage
	THD current
	THD voltage
	Peak factor
	Form factor
	Underfrequency
	Overfrequency
	Active power in normal direction
	Active power in reverse direction
	Apparent power
	Reactive power in normal direction
	Reactive power in reverse direction
	Power factor, capacitive
	Power factor, inductive
	Long-time mean value of active power
	Long-time mean value of reactive power
	Long-time mean value of apparent power
Occurred trigger event	Waveform buffer A
	Waveform buffer B

3.5.4.2 Technical data

The table below shows the technical data of the digital configurable output module on the CubicleBUS:

Table 3- 19 Technical data of the digital configurable output module

Operating voltage on the CubicleBUS min./max. (V)	19.2 / 28.8
Current consumption from the CubicleBUS min./max. (mA)	29/39 (250 rel.)
Number of isolated channels per digital output module	6
Max. possible current per channel with 24 V DC relay	2.7
Max. aggregate current (6 channels) relay at 24 V DC/250 V AC/250 V DC (A)	10 / 10 / 2.5
Maximum number of modules on one Cubicle	1
Power loss min./typ./max. (W)	0.74 / 5.4
Dimensions W/H/D (mm)	70 / 86 / 95
Weight (kg)/relay	0.321
Temperature range (°C)	– 20 / 60

3.5.5 Analog output module

Via the analog output module, the most important measured values made available via the CubicleBUS can be output to analog indicator instruments, e.g. rotary coil instruments, in the control cabinet door. Four channels are available in each analog output module for this purpose. The signals are available at two physical interfaces, a 4 - 20 mA interface and a 0 - 10 V interface.

Interfaces

The measured values can be picked up in the form of 0 - 10 V via the X4 connector on the CubicleBUS module, and the 4 - 20 mA interface is available on the X5 connector. Both output forms are always active simultaneously.

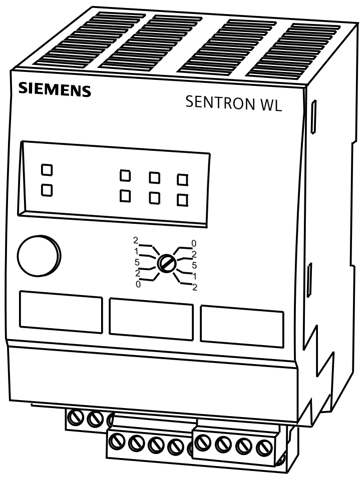


Figure 3-20 Analog output module

3.5.5.1 Selecting the measured values

The measured values output via the four analog channels are selected using a rotary coding switch. The output forms I, V, P, f and cos ϕ are available. The selection box of the rotary coding switch is divided vertically. If the switch is set to a value in the left half, the module is automatically addressed as Module 1, so any second module must then be set to a value in the right half. Only in this way is simultaneous operation with two analog output modules possible.

Maximum assignment

Up to 2 analog output modules can be operated on one CubicleBUS.

Indicators

All rotary coil instruments with an inner flow resistance of more than 20 kΩ (as voltage output) and between 50 Ω and 250 Ω (as current output) can be used as indicator. The LEDs for the cannels show a yellow light when the current value exceeds 20% of the full-scale deflection value (in the case of V, I, P), or cos ϕ is greater than 0.8, or the frequency is greater than 45 Hz.

Switch position "I"

If the rotary coding switch is at switch position "I", the measured current values are output linearly:

A01: Current in phase I_{L1}

A02: Current in phase I_{L2}

A03: Current in phase I_{L3}

A04: Current in neutral conductor

Calculation of full-scale value

Since the circuit breaker can be designed for different rated currents, there must be automatic scaling to the full-scale value, or interpretation of the maximum output value of the analog output module. The value of the currently used rating plug is used for this.

The maximum value is calculated by multiplying the value of the rating plug by 1.2 and then rounding up to the nearest 100.

Example: With a rating plug of 1600 A, the full-scale value of the rotary coil instrument must be 2000 A (1600 x 1.2 = 1920 ⇒ 2000 A). That is, 0 V/4 mA correspond to 0 A, 10 V/20 mA correspond to 2000 A.

Switch position "V"

If the rotary coding switch is at switch position "V", the following

voltages will be applied to the four analog outputs:

A01: External conductor voltage V_{L12}

A02: External conductor voltage V_{L23}

A03: External conductor voltage V_{L31}

A04: Phase-to-neutral voltage V_{L1N}

In most cases, the external conductor voltages are indicated on the control cabinet doors. For this reason, the first three channels are assigned these measured values. If the voltage is required between a phase and the neutral conductor, it is available via the output.

The full-scale deflection value for the rotary coil instrument is derived by multiplying the rated voltage of the system by 1.1 and then rounding up to the nearest 50 value.

Example: The rated voltage of the system is 400 V. The full-scale value is then 450 V (400 V x 1.1 = 440 V ⇒ 450 V).

Switch position "P"

If the rotary coding switch is at the "P" position, the measured values of the power are output via the four channels:

A01: Active power phase P_{L1}

A02: Active power phase P_{L2}

A03: Active power phase P_{L3}

A04: Total apparent power S_{total}

To calculate the full-scale deflection value of the active power per phase, the value of the rating plug must be multiplied by the rated voltage of the system. The full-scale deflection value is then subdivided into a value range shown in the table below.

For the total apparent power and the total active power (position f), the calculated value still has to be multiplied by 3 before the full-scale deflection value can be read from the table.

The table below gives the value ranges for power [W/VA]:

Table 3- 20 Value ranges for power [W/VA] on the analog output module

From	To	Full-scale deflection value
0	49.999	50.000
50.000	99.999	100.000
100.000	199.999	200.000
200.000	299.999	300.000
300.000	399.999	400.000
400.000	499.999	500.000
500.000	999.999	1.000.000
1.000.000	1.999.999	2.000.000
2.000.000	2.999.999	3.000.000
3.000.000	4.999.999	5.000.000
5.000.000	9.999.999	10.000.000
10.000.000	19.999.999	20.000.000
20.000.000	∞	30.000.000

Example:

I_R = 1600 A, rated voltage = 400 V; ⇒ Full-scale deflection value = 1,000,000 W

Switch position "f"

If the rotary coding switch is at the "f" position, the most important measured values are output, with the exception of the currents. In conjunction with another module in the position "I", all important measured values are thus displayed:

A01: Frequency of the system

A02: Mean value of the phase-to-phase voltage

A03: Total active power

A04: Mean value of the power factors

The scale for the display of the frequency must reach from 45 Hz to 65 Hz. This makes it possible to display the standard frequencies in the IEC and UL countries. Example: 45 Hz correspond to 0 V/4 mA and 65 Hz correspond to 10 V/20 mA. The scalings of the other measured values can be read in the appropriate switch positions.

Switch position "cos φ"

The measured values below are output in the switch position "cos φ":

A01: Power factor cos φ_{L1}
A02: Power factor cos φ_{L2}
A03: Power factor cos φ_{L3}
A04: Phase unbalance current in %

The display of the power factors ranges from 0.7 capacitive (corresponding to 0 V/4 mA) through 1 (corresponding to 5 V/12 mA) to 0.7 inductive (corresponding to 10 V/20 mA). The phase unbalance of the three currents is output from 0% (0 V/4 mA) to 50% (10 V/20 mA).

Note the correct polarity when connecting.

3.5.5.2 Test function

Test mode is activated by pressing the "TEST" button. Test mode is indicated by the yellow DEVICE LED. During test mode, the measured values continue to be updated but are not output on the relevant channel.

Test mode is carried out as follows:

- Pressing the "TEST" button switches to test mode.
- When the "TEST" button is next pressed, output 1 is selected. This is indicated by LED A01. The test output signal is output. With currents, voltages and power, this corresponds to the full-scale value, in the case of cos φ_1 and frequency 55 Hz.
- When the button is next pressed, output 2 is selected. This is indicated by LED A02. This automatically deletes the value at output 1 and sets the value at output 2.
- By repeating the previous step, all four outputs can be gradually tested with regard to their wiring and correct scaling.
- If output A04 is selected and the "TEST" button is pressed, all four LEDs are activated but no output is set. When the button is next pressed, output 1 is selected again.
- If the "TEST" button is not pressed for 30 seconds after selecting an output, test mode is automatically canceled and normal operating mode is activated. The currently pending values in the background are now available again at the outputs.

3.5.5.3 Technical data

The table below shows the technical data of the analog output module on the CubicleBUS:

Table 3- 21 Technical data of the analog configurable output module

Operating voltage on the CubicleBUS min./max. (V)	19.2 / 28.8
Current consumption from the CubicleBUS min./max. (mA)	63 1 50
Inner flow resistance of the rotary coil instrument voltage min./max.	20 kΩ/∞
Inner flow resistance of the rotary coil instrument current min./max.	20/250 Ω
Maximum number of modules on one Cubicle	2
Power loss min./typ./max. (W)	0.74 / 5.4
Dimensions W/H/D (mm)	70 / 86 / 95
Weight (kg)	0.223 / 0.321
Temperature range (°C)	– 20 / 60

3.5.6 ZSI module

To be able to use the ZSI function on the SENTRON WL circuit breaker, the external CubicleBUS ZSI module must be used.

Advantages

Zone Selective Interlocking (ZSI) offers full selectivity with the extremely short delay time t_{ZSI} = 50 ms, irrespective of the number of grading levels and the location of the short-circuit in the distribution system. The benefit is all the greater the higher the number of grading levels in large systems, and the longer the resulting delay times for standard time grading.

By shortening the break time, ZSI significantly reduces stress and damage in the switchgear in the event of a short-circuit.

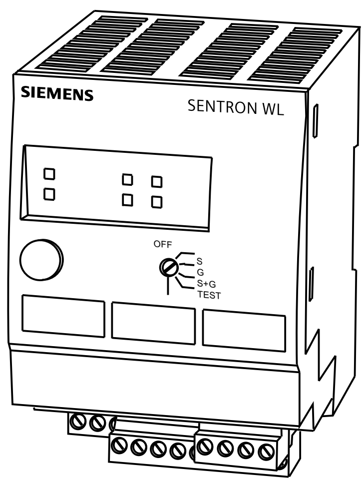


Figure 3-21 ZSI module

You can find more detailed information on this in Chapter "Zone Selective Interlocking (Page 105)

3.6 Measuring accuracy

3.6.1 3WL breaker measuring accuracy

The measuring accuracy depends on the circuit breaker components.

The accuracy (when ordering the switch + trip unit + metering function PLUS direct) refers to the full-scale value.

The full-scale value refers to the maximum rated current $I_{n\ max}$ of the breaker, regardless of the size of the rating plug and the rated current I_n set by it.

Example:

If a rating plug 630 A is used with a 1000 A switch, the accuracy for the full-scale value is 1000 A.

ETU45B		
	Display	With communication
Without metering function PLUS	± 10%	± 10%
With metering function PLUS	± 10%	± 1%[1]

ETU76B		
	Display	With communication
Without metering function PLUS	± 10%	± 10%
With metering function PLUS	± 1%[1]	± 1%[1]

[1] If a metering function PLUS is retrofitted, an accuracy of ± 3% is available, and this in turn is oriented around the full-scale value.

3.7 External current consumption with CubicleBUS

3.7.1 Power required by a SENTRON WL with CubicleBUS

The SENTRON WL circuit breakers with CubicleBUS must also communicate and indicate internally and externally, even when the main contacts are open. For this reason, it is necessary here to connect an external power supply. The required power differs here according to the degree of configuration and options used.

General information

The transformers for the SENTRON WL circuit breakers consist of two parts:

- Rogowski coils: supply the current values
- Energy transformers: supply the trip unit with energy

In the case of breakers without additional external supply, the trip units are already activated with 80 A 3-phase or higher for size 1 and 2, and with 150 A 3-phase or higher for size 3, and they monitor the power distribution.

Energy requirements

On the ETU45B trip unit, the energy from the transformers is sufficient to activate not only the protection functions but also the four-line display. Auxiliary power is only required for the backlighting. If the CubicleBUS is connected with 24 V DC, the display of the ETU45B draws its power from this voltage.

The pixel-graphics display of the ETU76B requires more power than the energy transformer can supply. For this reason, the display of the ETU76B only functions when an external CubicleBUS power supply is connected. This does not affect the protection functions!

> NOTICE
>
> **Number of CubicleBUS components**
>
> If more CubicleBUS components than just the trip unit are used in a SENTRON WL circuit breaker, this breaker must be supplied with an external 24 V DC auxiliary voltage.

CubicleBUS connection

The CubicleBUS comprises four cores, two for communication and two for the 24 V DC power supply.

Connect the CubicleBUS as follows to the external terminals X8:1 to X8:4:

- 24 V DC to X8:3
- Ground of 24 V DC to X8:4

3.7.2 Selecting the power supply

Note the following when selecting the power supply:

- First, you must use the available CubicleBUS modules to calculate the maximum continuous current drawn by the CubicleBUS modules from the CubicleBUS supply.
- The second variable to be calculated is the peak inrush current of all modules. The power supply must be able to carry the maximum peak inrush current for a period of 100 ms.

The table below contains the details of continuous current drawn and the maximum start-up current for selecting the suitable power supply for a SENTRON WL circuit breaker with CubicleBUS.

Table 3- 22 Calculating the power consumption of the CubicleBUS modules for SENTRON WL with CubicleBUS system

CubicleBUS module	Number of modules per CubicleBUS	Max. continuous current per module from the CubicleBUS	Max. start-up current per module from the CubicleBUS
ETU45B trip unit	1	120 mA	2000 mA
ETU76B trip unit	1	170 mA	2000 mA
Metering function PLUS	1	120 mA	120 mA
Breaker Status Sensor BSS	1	40 mA	110 mA
COM15 PROFIBUS communication module	1	125 mA	180 mA
ZSI module	1	50 mA	125 mA
Digital output module with rotary coding switch, relay outputs	1-2	180 mA	125 mA
Digital output module, configurable, relay outputs	1	180 mA	125 mA
Analog output module	1-2	110 mA	800 mA
Digital input module	1-2	30 mA	125 mA
BDA PLUS	1	250 mA	350 mA

Connection of several SENTRON WLs

To connect several SENTRON WL circuit breakers to a power supply, the aggregates of the continuous currents and start-up currents must be taken into account.

SITOP Power power supply

The appropriate power supplies can be selected from the Siemens SITOP Power range.

Example:

A switch consists of an ETU45B, BSS, COM15, metering function, and output module with relay contacts.

The maximum continuous current is 585 mA, and the maximum start-up current is 2635 mA. That is, a SITOP Power 2 is sufficient for power supply. For one or more SENTRON WLs, a power supply from the SITOP range can be selected. You can find further technical data in the Catalog KT 10.1 or in the online Mall (https://mall.automation.siemens.com (https://mall.automation.siemens.com)).

The table below provides the values for selecting the power supply with SITOP:

Table 3- 23 Power supply from the SITOP range for SENTRON WL with CubicleBUS

Max. continuous current	Max. start-up current	Type	Order number
0 to 2 A	Up to 7 A up to 300 ms	SITOP Power 2	6EP1332-2BA10
2 to 5 A	Up to 20 A up to 350 ms	SITOP Power 5	6EP1333-2BA01
5 to 10 A	Up to 38 A up to 200 ms	SITOP Power 10	6EP1334-2BA01

3VL molded-case circuit breaker

4

4.1 Brief description

4.1.1 Brief description of SENTRON VL

Thanks to their compact design, the SENTRON VL160 to VL1600 circuit breakers meet the high requirements of today's electrical distribution systems. They are available both with thermo-magnetic overcurrent trip units (16 A to 630 A), and with solid-state overcurrent trip units (63 A to 1600 A). Depending on the desired level of diversity of the data, the SENTRON VL can be connected to PROFIBUS DP via the COM20 module or via SIMOCODE-DP, depending on the ETU used.

General information

The basic circuit breaker is designed for fixed mounting and can be easily changed to a plug-in version or a withdrawable version using the appropriate kit. The available 3-pole and 4-pole SENTRON VL circuit breakers are especially suitable for applications in the area of plant, motor or generator protection, in starter combinations or as non-automatic air circuit breakers.

Note

Validity of the values

The values specified in this chapter apply only for the ETUs with the order numbers 3VLxxx-xMxxx, 3VLxxx-xNxxx, or 3VLxxx-xUxx. For other order numbers, the values given may vary slightly.

Connection

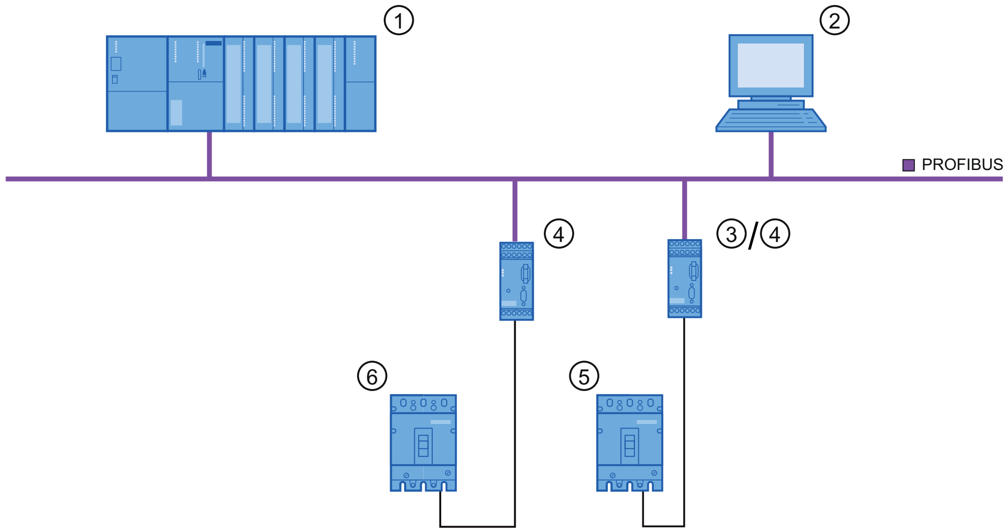
Depending on the ETU used, the SENTRON VL can be connected to PROFIBUS DP via the PROFIBUS DP module COM20, or via SIMOCODE-DP.

Accessories

Interlocking and locking options ensure increased safety in critical processes. The accessories, from the auxiliary trip unit and motorized operating mechanisms to the communication system, are simple and easy to retrofit.

System architecture

The system architecture of the SENTRON VL allows communication via PROFIBUS DP to a notebook or via Ethernet/intranet/Internet. A shared PROFIBUS profile together with the SENTRON WL enables use of shared programs both in a PLC and on a PC.



① PLC, e.g. SIMATIC S7
② PC
③ COM20
④ COM20 from Release 2
⑤ SENTRON VL with ETU
⑥ SENTRON VL with LCD ETU

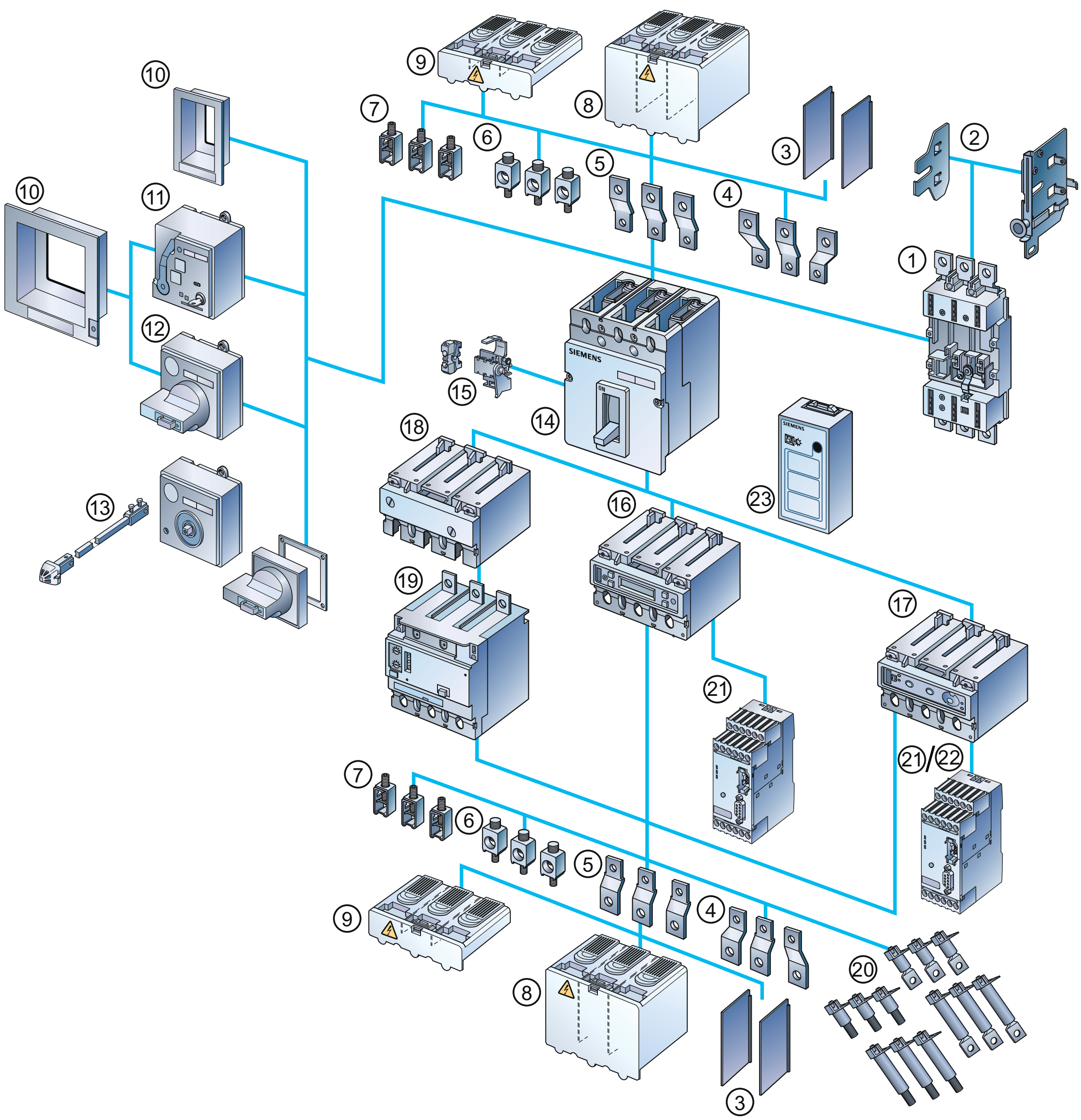
Figure 4-1 System architecture of the SENTRON VL

4.1.2 Overview of the accessories

There is a host of accessories available for the SENTRON VL circuit breakers. There are:

- External accessories, e.g. overcurrent release, PROFIBUS DP module COM20, and front rotary operating mechanism. External accessories are mounted outside the SENTRON VL.
- Internal accessories, e.g. alarm switches, shunt releases. Internal accessories are mounted inside the SENTRON VL under the front plate in "compartments". This means no additional space is required. The compartments are located to the left and right of the toggle handle. It must be noted here that certain internal accessories must only be mounted in certain compartments (see the paragraph "Installing components in the accessory compartments")!

The figure below shows an overview of the accessories of the SENTRON VL:



① Withdrawable/plug-in socket
② Withdrawable side panels
③ Phase barriers
④ Flared busbars
⑤ Straight connection bars
⑥ Multiple feed-in terminal for Al/Cu
⑦ Box terminal for Cu
⑧ Extended terminal cover
⑨ Standard terminal cover
⑩ Masking/cover frame for door cut-out
⑪ Stored-energy motorized operating mechanism
⑫ Front rotary operating mechanism
⑬ Door-coupling rotary operating mechanism
⑭ SENTRON 3VL circuit breaker
⑮ Internal accessories
⑯ Solid-state overcurrent trip unit LCD ETU
⑰ Solid-state overcurrent trip unit with communication function
⑱ Thermal/magnetic overcurrent release
⑲ RCD module
⑳ Rear terminals – flat and round
㉑ COM20 communication module for PROFIBUS DP from Release 2
㉒ COM20 communication module for PROFIBUS DP
㉓ Battery power supply with test function for electronic trip unit

Figure 4-2 SENTRON VL, accessories

4.1.3 Properties of the trip units

Every trip unit of the SENTRON VL can in principle be enabled for communication with the appropriate accessories. However, they vary in their equipment (such as the display) and in the available options for setting the protection parameters (rotary coding switch, keyboard, software).

The thermal-magnetic overcurrent trip units can be used for rated currents in the range from 16 A to 630 A. Communication via PROFIBUS DP with a SENTRON VL with thermal-magnetic trip unit is only possible via SIMOCODE-DP.

4.1.4 Electronic overcurrent tripping systems

The electronic overcurrent tripping systems **ETU** and **LCD ETU** are suitable for rated currents in the range from 63 A to 1600 A.

The difference between the two ETUs is that on the ETU without LCD, the settings for tripping current, delay time, etc. must be made using the rotary coding switch.

By contrast, on the SENTRON VL with LCD ETU, the settings can be made conveniently using a menu-prompted display that also shows current values during operation such as those for the current of individual phases.

ETU

On the electronic trip units with rotary coding switch (ETU), COM20 is required for connecting to PROFIBUS DP.

LCD ETU

On the electronic trip units with display (LCD ETU, Order No. 3VLx7xx-xU), connection to PROFIBUS DP is possible with the help of the PROFIBUS DP module COM20, Release 2.

4.1.5 Protection functions

The table below shows the protection functions of the different trip units and their setting ranges.

Overcurrent releases VL160 to VL1600 - Function overview

Order No. supplement	Releases	System protection	Starter/generator protection	Motor protection	Starter protection	Non-automatic circuit breakers	Function	Setting options					
								L Overload protection	S[1] Short-circuit protection (short-time delayed)		I[1] Short-circuit protection (instantaneous)	G Ground-fault protection	
								$I_r = \times I_n$	$I_{sd} = \times I_r$	t_{sd} [s]	$I_i = \times I_n$	$I_g = \times I_n$	t_g [s]
DK	M	--	--	--	✓	--	I	--	--	--	7 ... 15	--	--
DE	M	--	--	--	--	✓	I	--	--	--	8 ... 18	--	--
EE	M	--	--	--	--	✓	I	--	--	--	8 ... 18	--	--
DA	TM[2]	✓	--	--	--	--	LI	1	--	--	9 ... 18[4]	--	--
DD	TM[2]	✓	--	--	--	--	LI	0.8 ... 1	--	--	9 ... 18[4]	--	--
DC	TM[2]	✓	--	--	--	--	LI	0.8 ... 1	--	--	5 ... 10	--	--
EH	TM[2]	✓	--	--	--	--	LI	1	--	--	9 ... 18[4]	--	--
EJ	TM[2]	✓	--	--	--	--	LI	0.8 ... 1	--	--	5 ... 10	--	--
EA	TM[2]	✓	--	--	--	--	LIN	1	--	--	9 ... 18[4]	--	--
EC	TM[2]	✓	--	--	--	--	LIN	0.8 ... 1	--	--	5 ... 10	--	--
EM	TM[2]	✓	--	--	--	--	LIN	0.8 ... 1	--	--	5 ... 10	--	--
SP	ETU10M[3]	--	--	✓	--	--	LI	0.4 ... 1	--	--	1.25 ... 11	--	--
MP	ETU10M[3]	--	--	✓	--	--	LI	0.4 ... 1	--	--	1.25 ... 11	--	--
SB	ETU10	✓	--	--	--	--	LI	0.4 ... 1	--	--	1.25 ... 11	--	--
MB	ETU10	✓	--	--	--	--	LI	0.4 ... 1	--	--	1.25 ... 11	--	--
LB	ETU10	✓	--	--	--	--	LI	0.4 ... 1	--	--	1.25 ... 11	--	--
TA	ETU10	✓	--	--	--	--	LIN	0.4 ... 1	--	--	1.25 ... 11	--	--
NA	ETU10	✓	--	--	--	--	LIN	0.4 ... 1	--	--	1.25 ... 11	--	--
LA	ETU10	✓	--	--	--	--	LIN	0.4 ... 1	--	--	1.25 ... 11	--	--
TB	ETU10	✓	--	--	--	--	LI	0.4 ... 1	--	--	1.25 ... 11	--	--
NB	ETU10	✓	--	--	--	--	LI	0.4 ... 1	--	--	1.25 ... 11	--	--
SL	ETU12	✓	--	--	--	--	LIG	0.4 ... 1	--	--	1.25 ... 11	0.6 ... 1, OFF	0.1 ... 0.3
ML	ETU12	✓	--	--	--	--	LIG	0.4 ... 1	--	--	1.25 ... 11	0.6 ... 1, OFF	0.1 ... 0.3
SF	ETU12	✓	--	--	--	--	LIG	0.4 ... 1	--	--	1.25 ... 11	0.6 ... 1, OFF	0.1 ... 0.3
MF	ETU12	✓	--	--	--	--	LIG	0.4 ... 1	--	--	1.25 ... 11	0.6 ... 1, OFF	0.1 ... 0.3
TN	ETU12	✓	--	--	--	--	LING	0.4 ... 1	--	--	1.25 ... 11	0.6 ... 1, OFF	0.1 ... 0.3
NN	ETU12	✓	--	--	--	--	LING	0.4 ... 1	--	--	1.25 ... 11	0.6 ... 1, OFF	0.1 ... 0.3
SE	ETU20	--	✓	--	--	--	LSI	0.4 ... 1	1.5 ... 10	0 ... 0.5	11	--	--
ME	ETU20	--	✓	--	--	--	LSI	0.4 ... 1	1.5 ... 10	0 ... 0.5	11	--	--
LE	ETU20	--	✓	--	--	--	LSI	0.4 ... 1	1.5 ... 10	0 ... 0.5	11	--	--
TE	ETU20	--	✓	--	--	--	LSI	0.4 ... 1	1.5 ... 10	0 ... 0.5	11	--	--
NE	ETU20	--	✓	--	--	--	LSI	0.4 ... 1	1.5 ... 10	0 ... 0.5	11	--	--
TF	ETU20	--	✓	--	--	--	LSIN	0.4 ... 1	1.5 ... 10	0 ... 0.5	11	--	--
NF	ETU20	--	✓	--	--	--	LSIN	0.4 ... 1	1.5 ... 10	0 ... 0.5	11	--	--
LF	ETU20	--	✓	--	--	--	LSIN	0.4 ... 1	1.5 ... 10	0 ... 0.5	11	--	--
SG	ETU22	--	✓	--	--	--	LSIG	0.4 ... 1	1.5 ... 10	0 ... 0.5	11	0.6 ... 1, OFF	0.1 ... 0.3
MG	ETU22	--	✓	--	--	--	LSIG	0.4 ... 1	1.5 ... 10	0 ... 0.5	11	0.6 ... 1, OFF	0.1 ... 0.3
SH	ETU22	--	✓	--	--	--	LSIG	0.4 ... 1	1.5 ... 10	0 ... 0.5	11	0.6 ... 1, OFF	0.1 ... 0.3
MH	ETU22	--	✓	--	--	--	LSIG	0.4 ... 1	1.5 ... 10	0 ... 0.5	11	0.6 ... 1, OFF	0.1 ... 0.3
TH	ETU22	--	✓	--	--	--	LSING	0.4 ... 1	1.5 ... 10	0 ... 0.5	11	0.6 ... 1, OFF	0.1 ... 0.3
NH	ETU22	--	✓	--	--	--	LSING	0.4 ... 1	1.5 ... 10	0 ... 0.5	11	0.6 ... 1, OFF	0.1 ... 0.3
SS	ETU30M[3]	--	--	✓	--	--	LI	0.4 ... 1	--	--	6/8/11	--	--
MS	ETU30M[3]	--	--	✓	--	--	LI	0.4 ... 1	--	--	6/8/11	--	--
LS	ETU30M[3]	--	--	✓	--	--	LI	0.4 ... 1	--	--	6/8/11	--	--
UP	LCD ETU40M[3]	--	--	✓	--	--	LI	0.4 ... 1	--	--	1.25 ... 11	--	--
UH	LCD ETU40	--	✓	--	--	--	LI, LS, LSI	0.4 ... 1	1.5 ... 10	0 ... 0.5	1.25 ... 11	--	--
UJ	LCD ETU40	--	✓	--	--	--	LI, LSI, LIN, LSIN	0.4 ... 1	1.5 ... 10	0 ... 0.5	1.25 ... 11	--	--
UL	LCD ETU42	--	✓	--	--	--	LSIG	0.4 ... 1	1.5 ... 10	0 ... 0.5	1.25 ... 11	0.4 ... 1	0.1 ... 0.5
UM	LCD ETU42	--	✓	--	--	--	LSIG	0.4 ... 1	1.5 ... 10	0 ... 0.5	1.25 ... 11	0.4 ... 1	0.1 ... 0.5
UN	LCD ETU42	--	✓	--	--	--	LSIG, LSING	0.4 ... 1	1.5 ... 10	0 ... 0.5	1.25 ... 11	0.4 ... 1	0.1 ... 0.5

1) Size-dependent

2) TM up to In = 630 A

3) Motor protection up to In = 500 A

General data

Order No. supplement	Releases	Thermal image	Phase failure	Communication-capable	Ground-fault protection	Number of poles	N pole protected 1)	I^2t (ON/OFF)	Trip class (t_C)	Time-lag class (t_R)	Thermal-magnetic releases	Magnetic releases	Electronic release	LCD display
DK	M	--	--	--	--	3	--	--	--	--	--	✓	--	--
DE	M	--	--	--	--	3	--	--	--	--	--	✓	--	--
EE	M	--	--	--	--	4	--	--	--	--	--	✓	--	--
DA	TM 2)	✓	--	--	--	3	--	--	--	--	✓	--	--	--
DD	TM 2)	✓	--	--	--	3	--	--	--	--	✓	--	--	--
DC	TM 2)	✓	--	--	--	3	--	--	--	--	✓	--	--	--
EH	TM 2)	✓	--	--	--	4	--	--	--	--	✓	--	--	--
EJ	TM 2)	✓	--	--	--	4	--	--	--	--	✓	--	--	--
EA	TM 2)	✓	--	--	--	4	100 %	--	--	--	✓	--	--	--
EC	TM 2)	✓	--	--	--	4	60 %	--	--	--	✓	--	--	--
EM	TM 2)	✓	--	--	--	4	100 %	--	--	--	✓	--	--	--
SP	ETU10M 3)	✓	40 % I_R	--	--	3	--	--	10	--	--	--	✓	--
MP	ETU10M 3)	✓	40 % I_R	✓	--	3	--	--	10	--	--	--	✓	--
SB	ETU10	✓	--	--	--	3	--	--	--	2.5 ... 30	--	--	✓	--
MB	ETU10	✓	--	✓	--	3	--	--	--	2.5 ... 30	--	--	✓	--
LB	ETU10	✓	--	--	--	3	--	--	--	2.5 ... 30	--	--	✓	--
TA	ETU10	✓	--	--	--	4	50/100 %	--	--	2.5 ... 30	--	--	✓	--
NA	ETU10	✓	--	✓	--	4	50/100 %	--	--	2.5 ... 30	--	--	✓	--
LA	ETU10	✓	--	--	--	4	50/100 %	--	--	2.5 ... 30	--	--	✓	--
TB	ETU10	✓	--	--	--	4	--	--	--	2.5 ... 30	--	--	✓	--
NB	ETU10	✓	--	✓	--	4	--	--	--	2.5 ... 30	--	--	✓	--
SL	ETU12	✓	--	--	①	3	--	--	--	2.5 ... 30	--	--	✓	--
ML	ETU12	✓	--	✓	①	3	--	--	--	2.5 ... 30	--	--	✓	--
SF	ETU12	✓	--	--	②	3	--	--	--	2.5 ... 30	--	--	✓	--
MF	ETU12	✓	--	✓	②	3	--	--	--	2.5 ... 30	--	--	✓	--
TN	ETU12	✓	--	--	②	4	50/100 %	--	--	2.5 ... 30	--	--	✓	--
NN	ETU12	✓	--	✓	②	4	50/100 %	--	--	2.5 ... 30	--	--	✓	--
SE	ETU20	✓	--	--	--	3	--	✓	--	--	--	--	✓	--
ME	ETU20	✓	--	✓	--	3	--	✓	--	--	--	--	✓	--
LE	ETU20	✓	--	--	--	3	--	✓	--	--	--	--	✓	--
TE	ETU20	✓	--	--	--	4	--	✓	--	--	--	--	✓	--
NE	ETU20	✓	--	✓	--	4	--	✓	--	--	--	--	✓	--
TF	ETU20	✓	--	--	--	4	50/100 %	✓	--	--	--	--	✓	--
NF	ETU20	✓	--	✓	--	4	50/100 %	✓	--	--	--	--	✓	--
LF	ETU20	✓	--	--	--	4	50/100 %	✓	--	--	--	--	✓	--
SG	ETU22	✓	--	--	①	3	--	✓	--	--	--	--	✓	--
MG	ETU22	✓	--	✓	①	3	--	✓	--	--	--	--	✓	--
SH	ETU22	✓	--	--	②	3	--	✓	--	--	--	--	✓	--
MH	ETU22	✓	--	✓	②	3	--	✓	--	--	--	--	✓	--
TH	ETU22	✓	--	--	②	4	50/100 %	✓	--	--	--	--	✓	--
NH	ETU22	✓	--	✓	②	4	50/100 %	✓	--	--	--	--	✓	--
SS	ETU30M 3)	✓	40 % I_R	--	--	3	--	--	10, 20, 30	--	--	--	✓	--
MS	ETU30M 3)	✓	40 % I_R	✓	--	3	--	--	10, 20, 30	--	--	--	✓	--
LS	ETU30M 3)	✓	40 % I_R	--	--	3	--	--	10, 20, 30	--	--	--	✓	--
UP	LCD ETU40M 3)	✓	5 ... 50 % I_R	✓ 4)	--	3	--	--	5, 10, 15, 20, 30	--	--	--	✓	✓
UH	LCD ETU40	✓	--	✓ 4)	--	3	--	✓	--	2.5 ... 30	--	--	✓	✓
UJ	LCD ETU40	✓	--	✓ 4)	--	4	50 ... 100 %, OFF	✓	--	2.5 ... 30	--	--	✓	✓
UL	LCD ETU42	✓	--	✓ 4)	①	3	--	✓	--	2.5 ... 30	--	--	✓	✓
UM	LCD ETU42	✓	--	✓ 4)	①/③	3	--	✓	--	2.5 ... 30	--	--	✓	✓
UN	LCD ETU42	✓	--	✓ 4)	②	4	50 ... 100 %, OFF	✓	--	2.5 ... 30	--	--	✓	✓

1) Size-dependent
2) TM up to In = 630 A
3) Motor protection up to In = 500 A
4) With COM20/COM21 from release 2

Ground-fault protection

① Vectorial summation current formation (3-conductor system)
② Vectorial summation current formation (4-conductor system)
③ Direct recording of the ground-fault current in the neutral point of the transformer

4.1.6 Data transfer via PROFIBUS DP

There are two options for transferring data of the SENTRON VL circuit breaker over PROFIBUS DP: via COM20, or via SIMOCODE-DP. The versions differ primarily with regard to data volume, flexibility, and installation costs.

Connection via the COM20 module

The COM20 module is connected to the ETU of the SENTRON VL. All the available data (see table below) is read from the trip unit and made available on the bus via this connection. This option provides a direct communication link between the SENTRON VL and PROFIBUS DP. The SENTRON VL circuit breaker must be equipped with a communication-enabled ETU for connection to the COM20.

Connection via SIMOCODE-DP

The alternative via SIMOCODE-DP represents an indirect communication link to the SENTRON VL. There is no direct communication link to the trip unit.

The maximum current is calculated by the transformer integrated into SIMOCODE-DP and transmitted as a percentage of the current setting. The circuit breaker statuses are applied to PROFIBUS DP via the SIMOCODE-DP inputs by means of the auxiliary and alarm switches. The outputs of SIMOCODE-DP can be used to switch the breaker on and off via an optional motorized operating mechanism. Alarms and error messages from the circuit breaker are not transferred.

The following list provides an overview of the transferrable data of COM20.

Table 4- 1 Connection of the SENTRON VL trip units

List	ETU + COM20	BDA PLUS
Switching on or off (in conjunction with a motorized operating mechanism)	✓	
Delete alarm and tripping operation buffer	✓	
Delete min./max. measured values	max. only	
Delete maintenance information	✓	
ON or OFF status	✓	✓
Tripped signals	✓	✓
Tripped signals with cause of tripping operation, tripping current and time stamp	✓	✓
Alarm (e.g. overload)	✓	✓
Max. phase current of a phase	✓	✓
Phase currents with min./max. value and time stamp	max. only	✓
Neutral conductor current with min./max. value and time stamp	max. only*	✓ without min./max.
Read/write to LCD ETU	read only	✓
Read ETU	✓	
Number and type of LSIG tripping operations	✓	
Operating hours	✓	
Type of trip unit: LSIG	✓	✓
3/4-pole switch	✓	✓
Current sensor rating	✓	✓
Serial no. of the trip unit	✓	✓
Software version of the trip unit	✓	✓
Time synchronization	✓	
ZSI functionality	✓	

* without time stamp

4.2 COM20 connection

4.2.1 Data exchange with the COM20

With the COM20, the SENTRON VL circuit breaker can exchange data via PROFIBUS DP with two masters simultaneously, e.g. class 1 master and class 2 master. This facilitates in particular the commissioning of parameterization tools and diagnostics tools and of operator control and monitoring systems (e.g. WinCC) for the SENTRON VL.

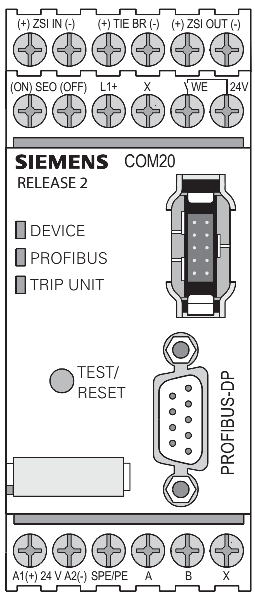


Figure 4-3 PROFIBUS COM20

After configuring and startup, the COM20 communicates with the PROFIBUS class 1 master via the cyclic message frame. This contains three basic types with variable contents. In addition, larger data blocks, called data sets, can be requested from the user program (PC and/or PLC). The pre-assignments in the basic types ensure quick and easy entry/startup. The PROFIBUS profile shared with the SENTRON WL is described in Chapter PROFIBUS profile for SENTRON circuit breakers (Page 135), and the data sets are listed in the Chapter Data library (Page 175).

Interlocking and securing

If security considerations demand it, it is possible to lock control/write access to the circuit breaker via hardware and software using a hardware wire jumper (WE terminal).

For the purpose, for example, of preventing switching via PROFIBUS DP (manual/automatic mode with connected motorized operating mechanism) or modification of parameters.

Time stamp

All important events receive a time stamp from the integral clock (time stamp for tripping operations (TripLog), no time stamp for alarms (WarningLog), no time stamp for maximum values (Tstamp)), to enable tracing of the precise course of a fault, for example. The clock can be synchronized with the clock of the automation system by means of a simple mechanism.

4.2.2 Setting the PROFIBUS address of the COM20

When configuring the COM20 for data exchange, you must note that the COM20 is supplied as standard with the PROFIBUS DP address 126. This must then be changed by the user when configuring the system.

The address is set or changed via the "addressing plug" (3UF7910-0AA00-0). The address is set at the addressing plug and the addressing plug is connected with the COM20 (above the PROFIBUS interface). The TEST/RESET button on the COM20 must be pressed for approximately 3 seconds. As soon as the address has been transferred, the DEVICE LED flashes and the addressing plug can be removed again.

Example
PROFIBUS address: 58

1 OFF
2 ON
4 OFF
8 ON
16 ON
32 ON
64 OFF

2 + 8 + 16 + 32 = 58

Note

Addressing plug

The addressing plug must be ordered once.

Other options for changing the PROFIBUS address are described in Chapter Setting and changing the PROFIBUS address of the COM15/COM20 (Page 131).

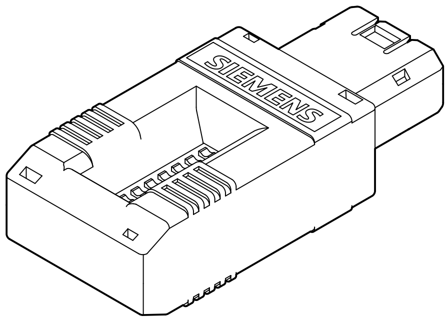


Figure 4-4 Addressing plug (3UF7910-0AA00-0)

4.2.3 COM20 pin assignment

The COM20 must be supplied with 24 V DC for operations and this must be applied to the terminals A2 (ground) and A1 (+). This voltage is looped-through via the communication cable to the ETU (trip unit) of the 3VL switch such that this is also operated when the main contacts are open. Without this supply the ETU would not be able to communicate diagnostics information, such as the reason for the last tripping operation if there is no internal supply.

The auxiliary and alarm switches are not wired to COM20, but direct to the ETU, and the communication status is forwarded to COM20.

The figure below shows the principle of the connection between the COM20 and a SENTRON VL including the LEDs and the PROFIBUS write protection DPWriteEnable.

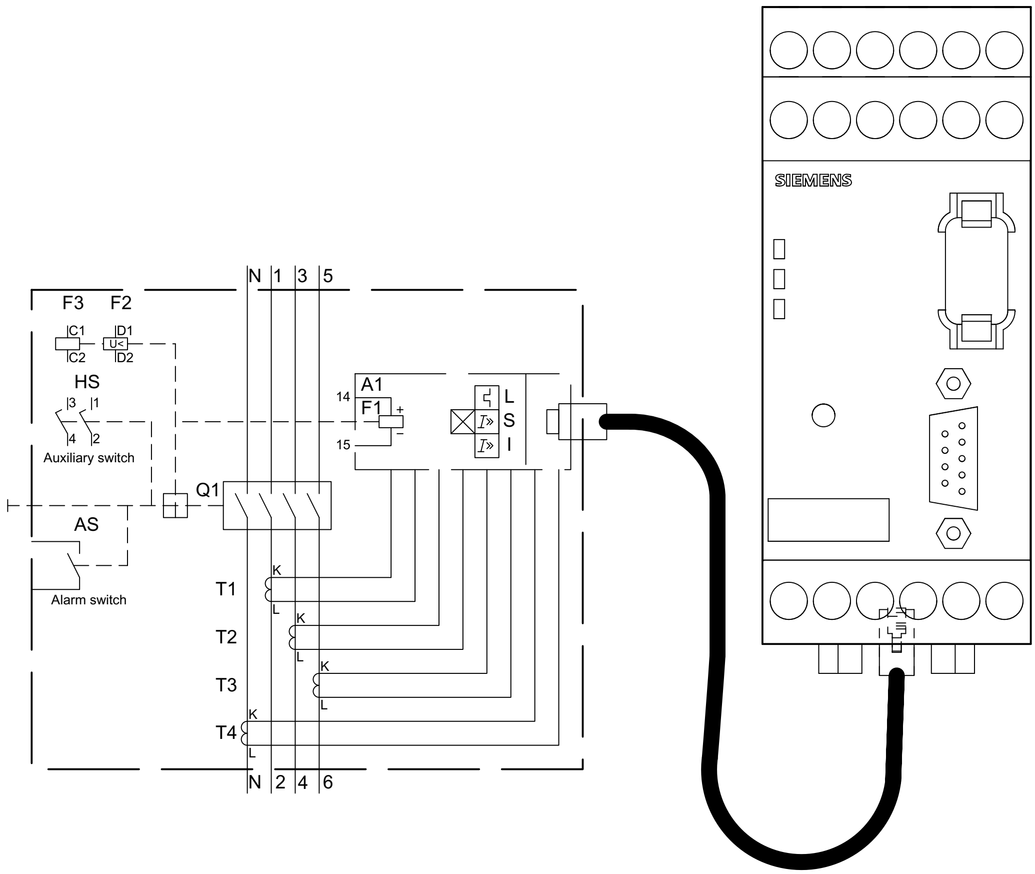


Figure 4-5 COM20 connection to SENTRON VL

4.2.4 PROFIBUS installation guidelines COM20

The COM20 must be installed in accordance with the installation guidelines for PROFIBUS DP published by PROFIBUS International (PI, www.profibus.com). Of primary importance here are equipotential bonding and shielding.

4.2.5 PROFIBUS DP write protection with COM20

In real applications in power distribution, it is necessary to disable write access via PROFIBUS temporarily or permanently, during maintenance work, for example.

You must ensure remote access is possible for setting the PROFIBUS DP address and the trip unit values. For this, the inputs WE and 24 V DC (DPWriteEnable) on the COM20 must be jumpered or closed via a switch.

If this is not the case, no settings can be written to the COM20 and the LCD ETU. In addition, operation of the motorized operating mechanism via PROFIBUS DP is not possible.

4.2.6 Communication connection to the ETU

The next page contains a description of how to establish the communication link between the COM20 and the SENTRON VL with ETU.

The ON/OFF position (auxiliary switch), and the triggered signal (alarm switch) of the switch are signaled via the wiring of the ETU. The auxiliary and alarm switches are supplied with the communication-capable ETU. You can find details in the operating instructions for the communication-capable, solid-state overcurrent trip unit (ETUs).

Different communication cables must be used depending on which SENTRON VL circuit breaker is used. A 1.5 m connecting cable is included with the communication-capable ETU. These cables are listed with their different lengths and switch assignments in the table below. They can be ordered as accessories.

Table 4- 2 Communication cables available for order

3VL9000-8AQ60	3VL4 - 1.5 m	JG - 59.05 in.
3VL9000-8AQ61	3VL4 - 3 m	JG - 118.1 in.
3VL9000-8AQ70	3VL5 / 3VL6 / 3VL7 / 3VL8 - 1.5 m	LG / MG / NG / PG - 59.05 in.
3VL9000-8AQ71	3VL5 / 3VL6 / 3VL7 / 3VL8 - 3 m	LG / MG / NG / PG - 118.1 in.
3VL9000-8AQ80	3VL2 / 3VL3 - 1.5 m	DG / FG - 59.05 in.
3VL9000-8AQ81	3VL2 / 3VL3 - 3 m	DG / FG - 118.1 in.

An extension of the cables beyond the specified dimensions is not permissible!

4.2.7 Connecting the optional motorized operating mechanism to COM20

If the circuit breaker is to be switched on or off via the bus, the electric motorized operating mechanism with spring energy store is needed.

Note

The contact between WE and 24 V must be closed for the remote function! Without this wire jumper, the SENTRON VL cannot be switched on or off via PROFIBUS DP.

More information on fitting the motorized operating mechanism can be found in the installation instructions for the motorized operating mechanism.

Connection diagram of the COM20 to the motorized operating mechanism, SENTRON VL

Table 4- 3 Connection of the motorized operating mechanism, SENTRON VL

	Motor	COM20	Power supply	
			DC	AC
L2–	X20.1		GND	N
S2A	X20.2	SEO (ON)		
S2B	X20.3	SEO (OFF)		
L1+	X20.4	L1+	L+	L
PE	X20.5		PE	PE

Table 4- 4 Technical data of the COM20 PROFIBUS module

Permissible ambient temperature	In operation	-25 °C...+70 °C, no condensation
	During storage and transportation	-40 °C...+80 °C
Installation altitude above sea level		< 2000 m
	Permissible max. ambient temperature +50 °C (no safe isolation)	< 3000 m
Weight		approx. 0.28 kg
Degree of protection according to IEC 60529		IP20
Shock resistance (sine pulse)		100 m/s² 20 ms 220 m/s² 11 ms
Mounting position		Arbitrary
Immunity to electromagnetic interference according to IEC 60947-1	Conducted interference; burst according to IEC 61000-4-4	2 kV (power ports) 2 kV (signal ports)
	Conducted interference; high-frequency according to IEC 61000-4-6	10 V
	Conducted interference; surge according to IEC 61000-4-5	1 kV (line to ground)
	Electrostatic discharge; ESD according to IEC 61000-4-2	8 kV (air discharge) 4 kV (contact discharge)
	Field-based interference suppression; radiated immunity according to IEC 61000-4-3	10 V/m
Immunity to electromagnetic interference according to IEC 60947-1	Conducted and radiated interference emission	DIN EN 55011, A /DIN EN 55022, A
Safe isolation according to IEC 60947-1	All circuits are safely isolated from the control circuit for the motor operator in accordance with IEC 60947-1 (terminal SEO (ON), SEO (OFF), L1+), that is, dimensioned with double creepages and clearances	
Fixing	Snap-mounted to 35 mm DIN rail or screw fixing via additional push-in lugs	
Indicator	Green/red/yellow "Device" LED	• Green: Ready • Red: Function test negative, device disabled • Yellow: Memory submodule or addressing plug detected • Off: No control supply voltage

Green "PROFIBUS" LED	• Continuous light: Communication with PLC • Flashing: Baud rate recognized/communicating with PC/PG	
	Green "Trip Unit" LED	• Continuous light: Communication with ETU • Flashing: ZSI detected/not detected • Off: No communication
TEST/RESET button		Setting of the communication address of the side box
		ZSI function test
		Reset of the side box back to the start sequence
System interface	Front	10-pin system interface for connecting the addressing plug
	Bottom	RJ45 socket for communication link to ETU
PROFIBUS DP interface		Connection of PROFIBUS DP cable via terminal connection A, B (max. 1.5 MBaud) or 9-pin SUB-D socket (max. 12 MBaud)
Operating voltage	V_S in accordance with DIN EN 61131-2 0.85 ... 1.2 x V_S	24 V DC
Power consumption		1.2 W
Current consumption	V_S = 24 V DC	Max. 50 mA
Rated insulating voltage	V_I	300 V (pollution degree 3)
Rated peak withstand voltage	V_{Imp}	4 kV
Relay outputs for controlling a motorized operating mechanism (3VL9x00-3Mx00) for VL160x and VL160-VL1600	Number	2 monostable relay outputs; isolated NO contacts
	ON duration	300 ms, fixed setting
	Rated short-circuit capacity	2 A
	Specified short-circuit protection	See operating instructions of the motorized operating mechanism used.
Output	ZSI OUT - Output for Zone Selective Interlocking (ZSI); max. 8 circuit breakers	
Inputs (binary)	1 input with its own supply (24 V DC) from the device electronics for the WE function (write protection for PROFIBUS DP/Modbus RTU)	
	H signal	V_{In}: 15...30 V; I_{In}: Typically 5 mA for 24 V
	L signal	V_{In}: 0...5 V; I_{In}: Typically 0.75 mA for 5 V
	ZSI IN - Input for Zone Selective Interlocking (ZSI); max. 20 circuit breakers	

Conductor cross-sections	Tightening torque	0.8...1.2 Nm
	Solid	1 x 0.5...4 mm²; 2 x 0.5...2.5 mm²
	Finely stranded with end sleeve	1 x 0.5...2.5 mm²; 2 x 0.5...1.5 mm²
	AWG cable (solid)	1 x AWG 20 to 12; 2 x AWG 20 to 14
	AWG cable (finely stranded)	1 x AWG 20 to 14; 2 x AWG 20 to 16

Note

Transmission line

It is recommended to transfer the ZSI signal via a twisted-pair signal line with a cross-section of at least 0.75 mm². The maximum length must not exceed 400 m. Recommended cable type: Shielded MSR cable LSYCY (2 x 0.75 mm²); made by: Siemens

Note

The motorized operating mechanism must be in automatic mode for switching via PROFIBUS DP!

4.2.8 LED indicators on the COM20

To monitor whether the COM20 is ready for operation and data exchange is taking place, three LEDs designated TRIP UNIT, PROFIBUS and DEVICE are located on the front cover of the COM20. The operating statuses explained in the tables below can be read from these LEDs.

DEVICE LED

The DEVICE LED provides information on the status of the COM20.

Table 4- 5 DEVICE LED

DEVICE LED	Meaning
Off	No voltage on the COM20
Green steady light	COM20 is supplied, there is no fault, no addressing plug is connected
Steady yellow light	The addressing plug is connected; the address setting has not yet been read or stored in non-volatile memory.
Flashing yellow	The addressing plug is connected; the address setting has been read and stored in non-volatile memory.
Flashing red	The addressing plug is connected and has a fault.
Red rapid flashing	COM20 has a serious internal fault

PROFIBUS LED

The PROFIBUS LED shows the status of the PROFIBUS DP communication of the COM20.

Table 4- 6 PROFIBUS LED

PROFIBUS LED	Meaning
Off	No connection active
Static green (steady light)	COM20 is supplied externally with 24 V DC; PROFIBUS class 1 master connection active
Flashing green	COM20 is supplied externally with 24 V DC; PROFIBUS class 2 master connection active; no PROFIBUS class 1 master connection active

LED TRIP UNIT (ETU)

The TRIP UNIT LED provides information on the status of the trip unit

Table 4- 7 LED TRIP UNIT (ETU)

ETU LED	Meaning
Off	No voltage on COM20; no communication or communication fault between the 3VL ETU and the COM20
Static green (steady light)	COM20 is supplied externally with 24 V DC; communication with 3VL ETU in order
Flashing green	The ZSI signal is active on the connected ETU (used as indicator for the ZSI test)

4.2.9 Measuring accuracy

The following values apply for the current values of the ETU and the LCD ETU that are transferred via communication or indicated in the display of the LCD ETU.

Current	Accuracy
0.0 - 0.2 x I_n	Activation limit of the ETU No transfer of current values.
0.2 - 0.3 x I_n	± 25 %
0.3 - 1.0 x I_n	± 10 %

Zone Selective Interlocking 5

5.1 ZSI

5.1.1 Introduction

With circuit breakers on several grading levels, the aim is to assign these selectively to each other so that in the event of an overcurrent only the circuit breaker immediately upstream switches off the overcurrent.

5.1.2 Selectivity

A plant with several protective devices switched in series is selective only if the protective device immediately in front of the fault location picks up in the event of an overcurrent and switches off the overcurrent alone. Branches not affected continue to be supplied.

5.1.3 Time selectivity

One method of achieving this aim in the short-circuit or ground fault is time selectivity of the circuit breakers.

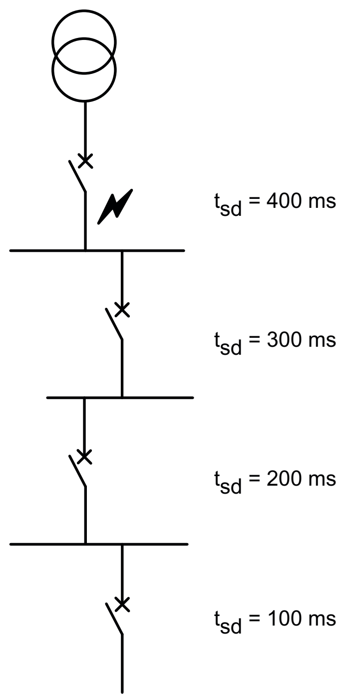


Figure 5-1 Example of time selectivity

This means each level of the circuit breaker receives another time delay (t_{sd}) that rises in the direction of the incoming supply. Tripping of the circuit breakers that are further removed from the short-circuit is thus delayed and the circuit breaker closest to the short-circuit is given time to switch the short-circuit off.

The disadvantage of such a system, however, is that one short-circuit trip is always delayed and that there is a long delay in switching off a short-circuit close to the infeed, and the plant is thus loaded with the short-circuit current for longer than necessary. This can require increased dimensioning of the system.

5.1.4 ZSI function

The ZSI function (ZSI = Zone Selective Interlocking) offers full selectivity with an extremely short delay time (t_{ZSI}) regardless of the number of grading levels and the location of the fault in the distribution system in the short-time-delayed S range and G range of the trip characteristic.

S range = short-time-delayed short-circuit protection	=> t_{ZSI} = 50 ms
G range = ground fault protection	=> t_{ZSI} = 100 ms

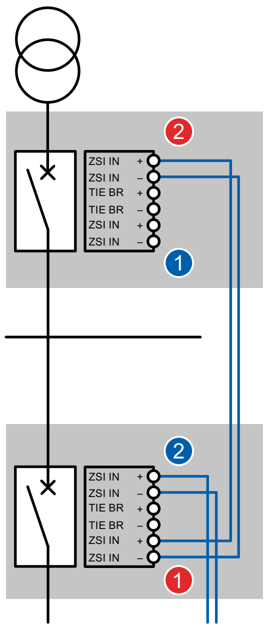
The benefit of ZSI is all the greater the higher the number of grading levels in large and meshed networks, and the longer the resulting delay times for standard time grading.

By shortening the break time, the ZSI function significantly reduces stress in the switchgear in the event of a short-circuit and/or ground fault.

Note

The ZSI function is only effective in the case of short-time-delayed short-circuit protection S up to the level of the preset maximum short-time-delayed short-circuit protection. If the short-circuit current exceeds this permissible maximum value, the short-circuit current is so great that instantaneous tripping of the circuit breaker always takes place in order to protect the system.

5.1.5 Operating principle



- Every circuit breaker is equipped with a ZSI module
- The ZSI modules are linked to each other via twisted-pair connections
- The ZSI output (ZSI OUT) ① is connected with the ZSI input (ZSI IN) ②
- ZSI modules in one grading level are switched in parallel (see examples)
- Coupling switches can be integrated (see examples)
- Medium voltage can be integrated (see examples)
- Extremely simple parameterization of the ZSI modules

5.1.6 Course over time

5.1.6.1 Condition ZSI = ON and presence of a short-circuit (S)

1. The overcurrent releases detect a short-circuit (S) and start the predefined delay times t_{sd}
2. Each circuit breaker that detects the short-circuit informs the higher-level breakers of the detected short-circuit (ZSI_OUT ⇒ ZSI_IN ⇒ ZSI_OUT ...)
3. Each circuit breaker that receives no information (ZSI IN) from subordinate grading levels and detects the short-circuit forces a short-circuit trip after 50 ms (t_{ZSI}).
4. Otherwise, a short-circuit trip occurs at the end of the delay time t_{sd}

Result: The ZSI module switches off the short-circuit after 50 ms in the next level to the fault.

5.1.6.2 Condition ZSI = ON and presence of a ground fault (G)

1. The overcurrent releases detect the ground fault and start the predefined delay times t_g = ground fault (G)
2. Each circuit breaker that detects the ground fault informs the higher-level breakers of the detected ground fault (ZSI_OUT ⇒ ZSI_IN ⇒ ZSI_OUT ...)
3. Each circuit breaker that receives no information (ZSI IN) from subordinate grading levels and detects the ground fault forces a short-circuit trip after 100 ms (t_{ZSI}).
4. Otherwise a trip occurs at the end of the delay time t_g (100 - 500 ms)

Result: The ZSI module switches off the ground fault after 100 ms in the next level to the fault.

Overview of the times:

t_{ZSI} = Guaranteed non-tripping time: 50 ms short-circuit/100 ms ground fault

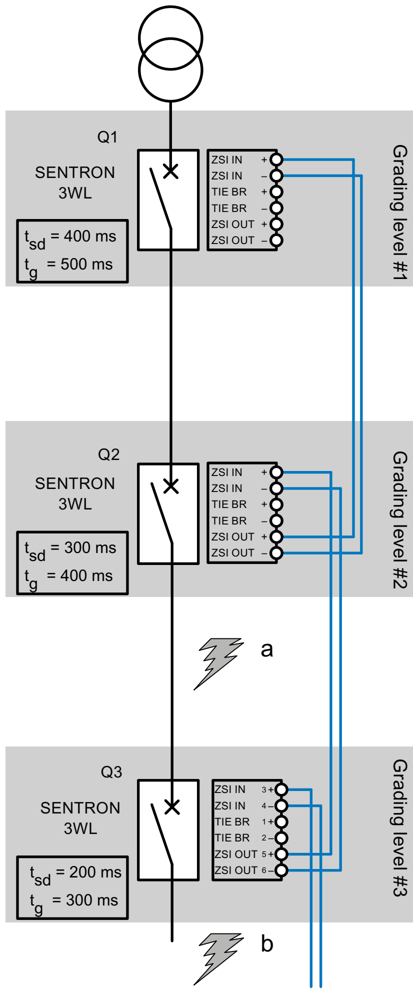
t_{sd} = From 80 – 4000 ms depending on the tripping unit ETU

t_g = 100 – 500 ms

Plus the typical mechanical tripping time depending on the circuit breaker 20 – 40 ms

5.2 Examples

5.2.1 Function example



Example from the perspective of the circuit breaker (Q2). The operational principle of the ZSI is explained using the following graphic.

5.2.2 Tabular representation

5.2.2.1 Short-circuit

Tabular representation from the perspective of the circuit breaker Q2:

Table 5- 1 Short-circuit

ZSI ON / OFF	S	ZSI-IN	ZSI-OUT	Delay time	Time
OFF				t_{sd}	300 ms
OFF	X		X	t_{sd}	300 ms
ON		X		t_{sd}	300 ms
ON	X	X	X	t_{sd}	300 ms
ON				t_{ZSI}	50 ms
ON	X		X	t_{ZSI}	50 ms

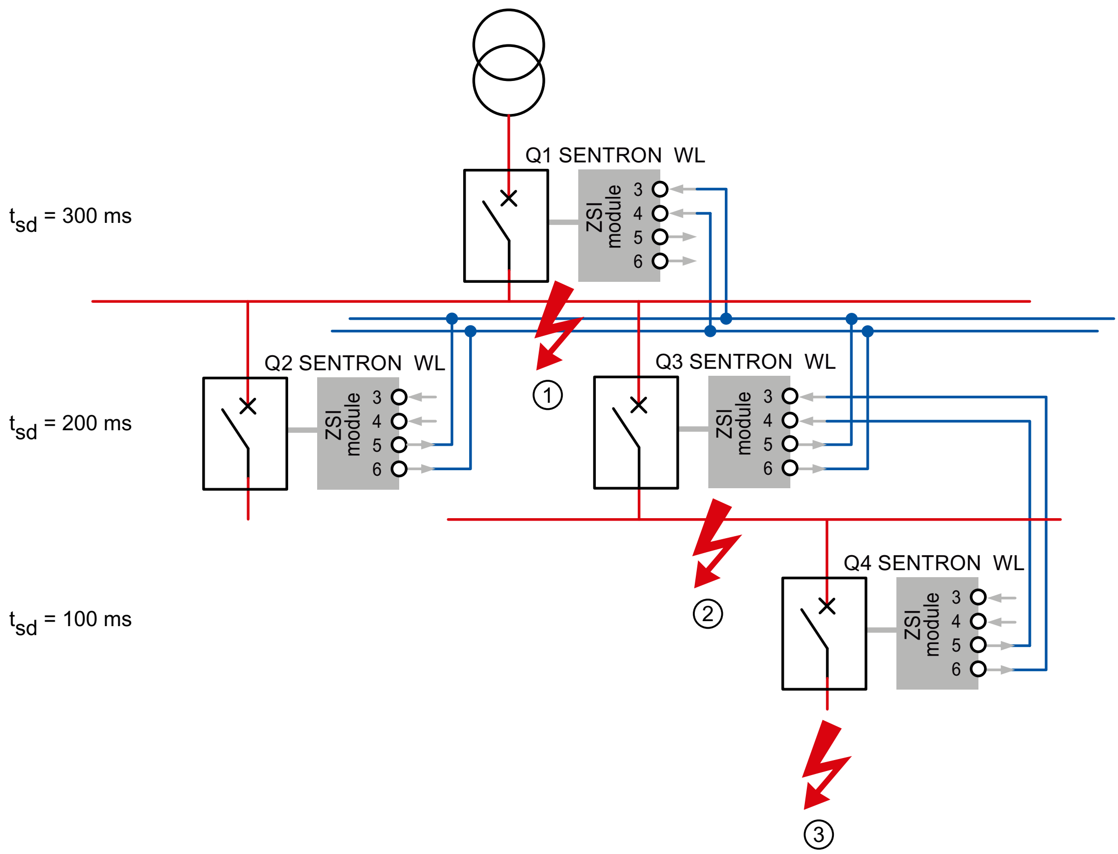
5.2.2.2 Ground fault

Table 5- 2 Ground fault

ZSI ON / OFF	GF	ZSI-IN	ZSI-OUT	Delay time	Time
OFF				t_g	400 ms
OFF	X		X	t_g	400 ms
ON		X		t_g	400 ms
ON	X	X	X	t_g	400 ms
ON				t_{ZSI}	100 ms
ON	X		X	t_{ZSI}	100 ms

5.2.2.3 Example of 3 grading levels without coupling switch

The graphic below shows the functional principle of the ZSI function using an example in the power distribution system. Both SENTRON VL and SENTRON WL circuit breakers are used in different grading levels.



Short-circuit in grading level 3

- The switches Q4, Q3 and Q1 detect a short-circuit. Q4 informs Q3 and Q1 via the ZSI signal so that these do not trip in t_{ZSI} = 50 ms.
- Since Q4 in turn does not receive information (ZSI IN) from a subordinate breaker, it is responsible for switching off the short-circuit as quickly as possible (with delay time t_{ZSI} = 50 ms). If this does not happen because, for example, the switch is incapacitated, Q3 operates as a backup and trips after the time-selective setting time of t_{sd} = 200 ms.
- Although Q2 receives the ZSI-IN signal, it is not traversed by the overcurrent.
  For this reason, no action is taken with Q2.

Short-circuit in grading level 2

- Q1 and Q3 determine a short-circuit, Q4 does not. This is why Q3 also does not receive any ZSI information from Q4, but in turn provides ZSI information for Q1. On the basis of this information, Q3 knows that it is closest to the short-circuit and trips with a delay of t_{ZSI} = 50 ms instead of t_{sd} = 200 ms.
Time saving = 150 ms.
- Although Q2 receives the ZSI-IN signal, it is not traversed by the overcurrent.
For this reason, no action is taken with Q2.

Short-circuit in grading level 1

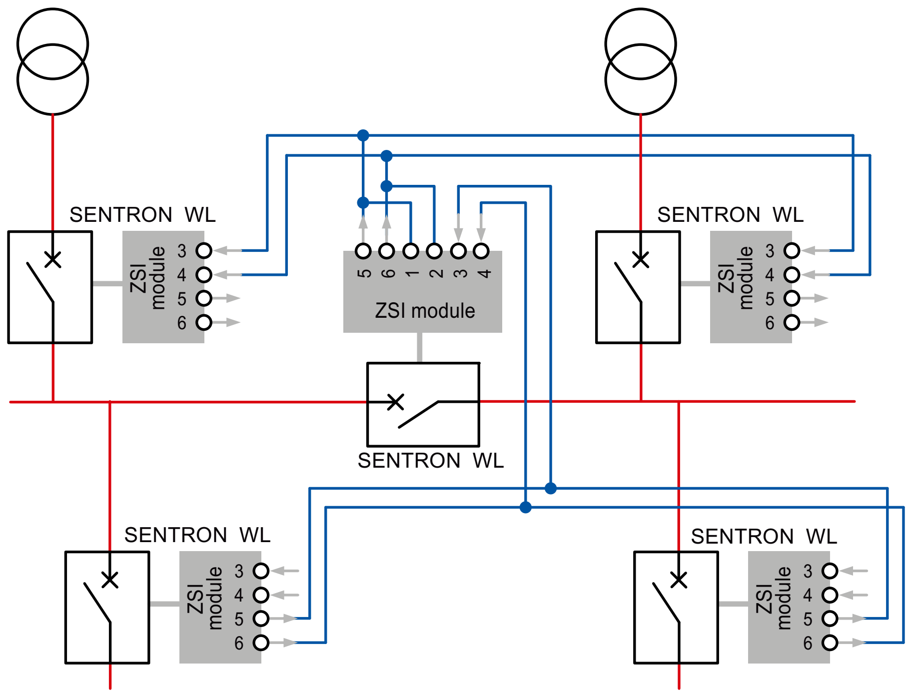
Only Q1 determines this short-circuit. It also does not receive information from a subordinate grading level, and therefore trips after t_{ZSI} = 50 ms.
Time saving = 250 ms.

5.2.2.4 Cancelation of the ZSI OUT signal

- ZSI OUT at short-circuit
after removal of the short-circuit current, but after 100 ms at the earliest
- ZSI OUT at ground fault
after removal of the ground fault current, but after 500 ms at the earliest
- MV OUT for medium voltage
after removal of the overcurrent, but after 500 ms at the earliest
- The ZSI OUT signal is canceled at the latest after 3 s

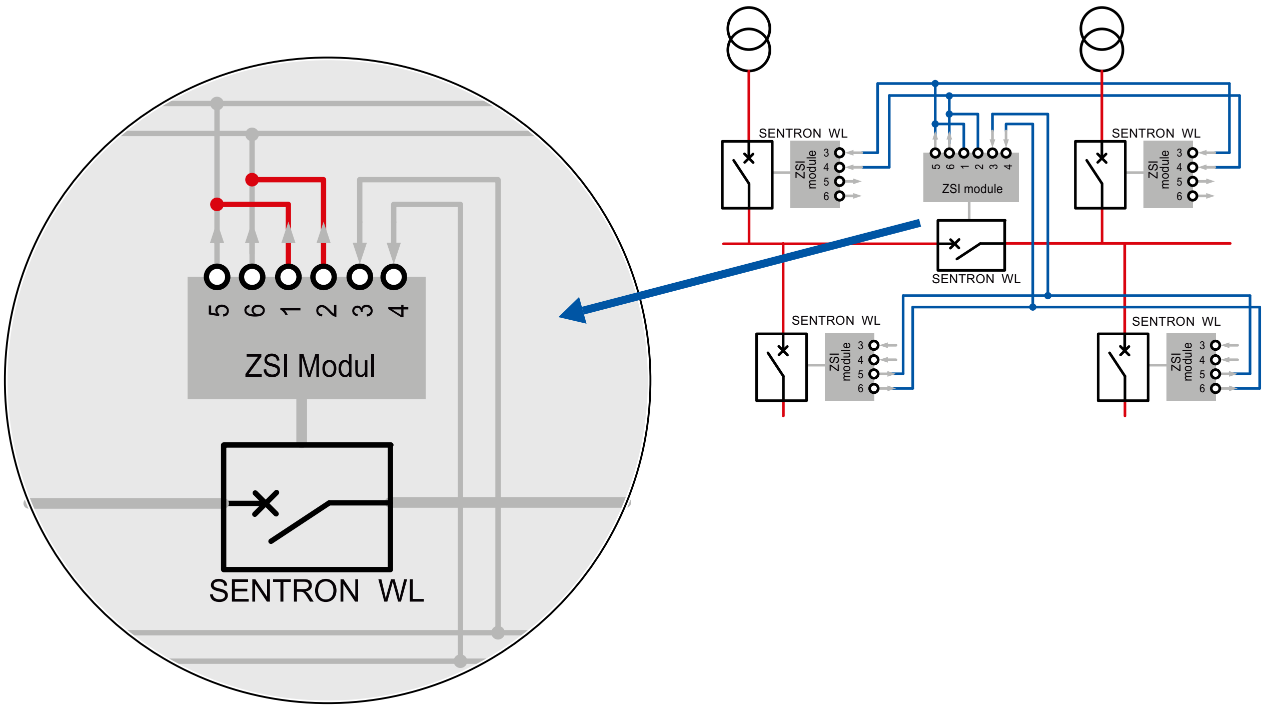
5.2.2.5 Coupling switch

Wiring example of 3 grading levels with coupling switch



The **TIE BRKR** function (X4-1, 2) ensures that the **ZSI IN signal** (3, 4) is immediately forwarded to the output **ZSI OUT** (5, 6) even if the coupling switch is switched off. Without the TIE BRKR function, the ZSI signal would not be forwarded.

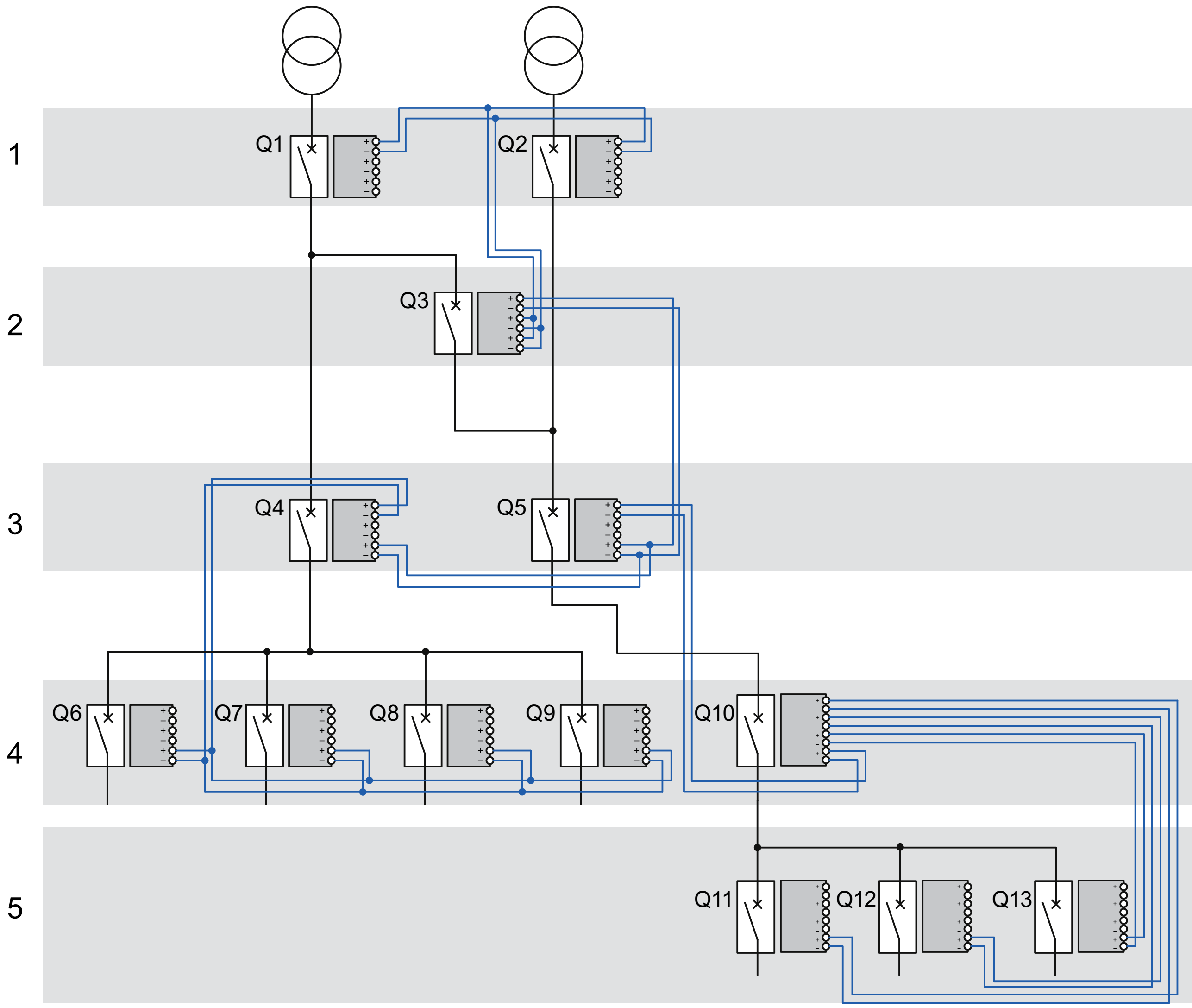
The coupling switch is a separate grading level and receives its own delay time t_{sd}.

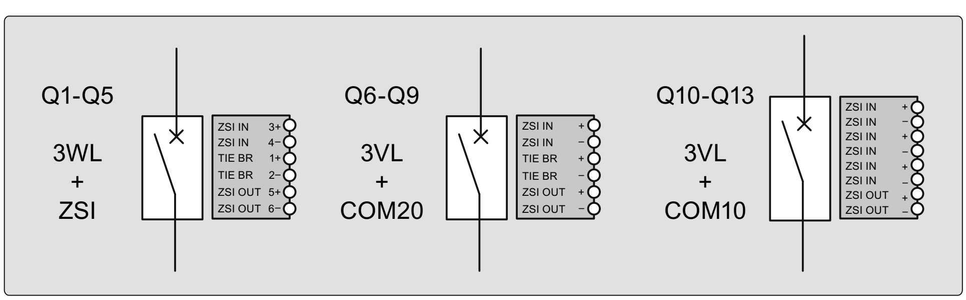


5.2.2.6 Wiring example

The example shows ZSI wiring and the set delay times in a mixed system with 3WL and 3VL.

Grading level 2 is a coupling switch. Coupling switches are treated as separate grading levels and receive their own delay time.

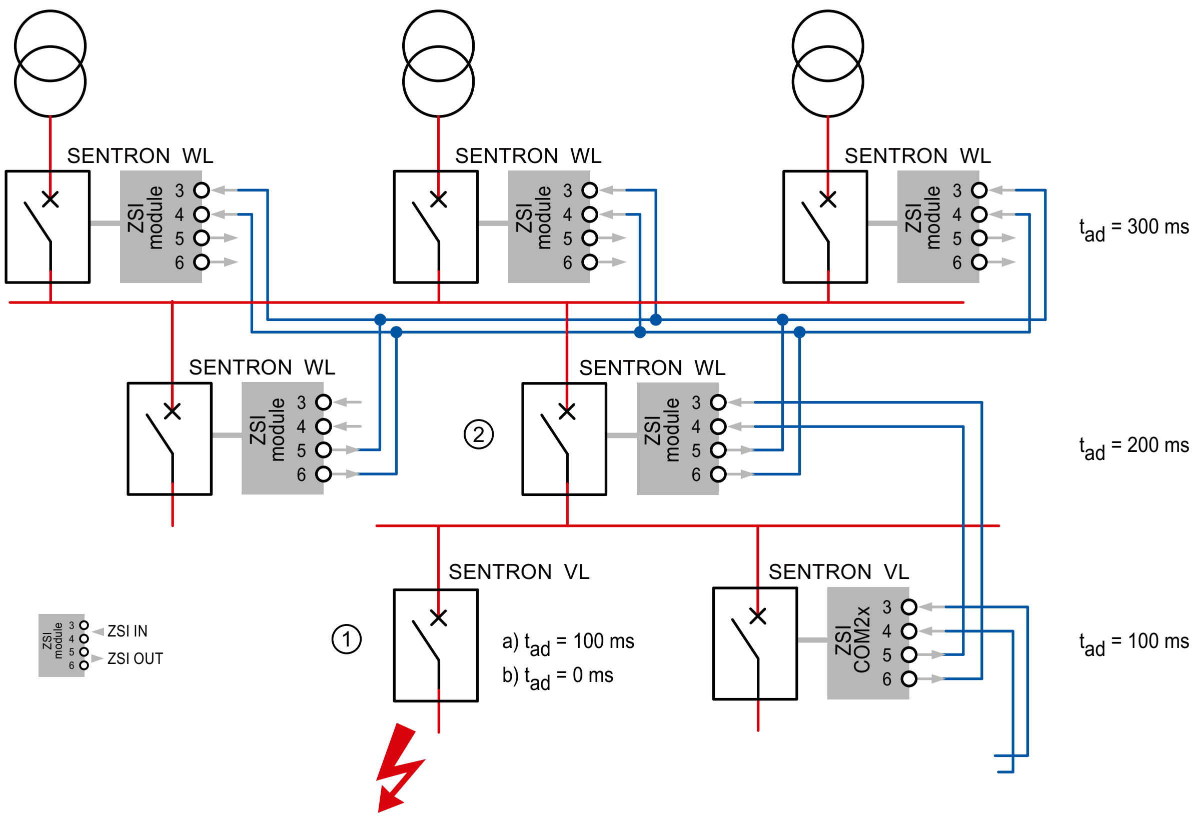




1	Q1 - Q2	t_{sd} = 400 ms
2	Q3	t_{sd} = 300 ms
3	Q4 - Q5	t_{sd} = 200 ms
4	Q6 - Q10	t_{sd} = 100 ms
5	Q11 - Q13	t_{sd} = 0 ms

5.2.2.7 Circuit breakers without ZSI function

Circuit breakers without ZSI function can be integrated into a system equipped with ZSI. However, they must have no delay time since otherwise the selectivity of the circuit breakers cannot be guaranteed.

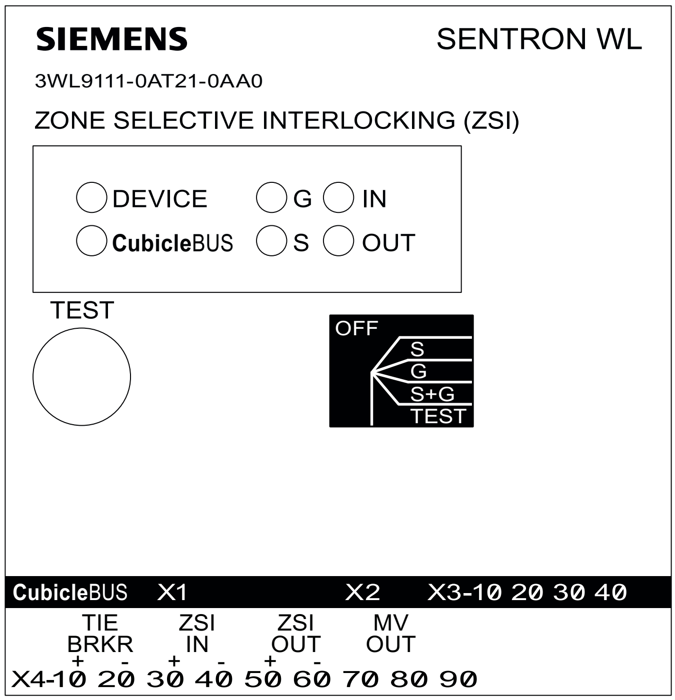


Short-circuit at circuit breaker ①

- t_{sd} = 100 ms
  Short-circuit at circuit breaker ①. Circuit breaker ① will switch off the short-circuit with a delay time t_{sd} of 100 ms. The short-circuit is also detected by circuit breaker ② and since no ZSI-IN signal is detected, switch-off is executed with a delay time t_{ZSI} of 50 ms.
  $t_{sd} > t_{ZSI}$
  100 ms ① > 50 ms ②
  ⇒ circuit breaker ② trips before circuit breaker ①.
  The short-circuit is switched off non-selectively.
- t_{sd} = 0 ms
  Short-circuit at circuit breaker ①. Circuit breaker ① will switch off the short-circuit with a delay time t_{sd} of 0 ms (instantaneous). The short-circuit is also detected by circuit breaker ② and since no ZSI-IN signal is detected, switch-off is executed with a delay time t_{ZSI} of 50 ms.
  $t_{ZSI} > t_{sd}$
  50 ms ② > 0 ms ①
  ⇒ circuit breaker ① trips before circuit breaker ②.
  The short-circuit is switched off selectively.

5.3 SENTRON 3WL

To be able to use the ZSI function on the SENTRON WL circuit breaker, the external CubicleBUS ZSI module must be used.



5.3.1 Technical data

Operating voltage on the CubicleBUS min./max. (V)	19.2 / 28.8
Current consumption from the CubicleBUS min./max. (mA)	31 / 61
Automatic resetting of the outputs after a maximum of	3 s
Shortest time that blocking signal is pending at the outputs LV	100 ms
Shortest time that blocking signal is pending at the outputs MV	500 ms
Typical tripping time including all delays	approx. 80 ms
Maximum number of switches that can be connected to ZSI IN	20
Maximum number of switches that can be connected to ZSI OUT	8
Maximum number of ZSI modules possible on one CubicleBUS	1
Maximum cable length with 2 x 0.75 mm^2	400 m
Power loss min./typ./max. (W)	0.8 / 1.76
Dimensions W/H/D (mm)	70 / 86 / 95
Weight (kg)	0.223
Temperature range (°C)	– 20 / 60

5.3.2 Applications

The function of ZSI can be used for the short-circuit between the phases (S), short-circuit to ground (G), or both simultaneously (S + G). The ZSI module provides ZSI information for the medium voltage level via the MV-OUT signal.

If a coupling switch is used in a power distribution system, it can be integrated into the ZSI concept.

5.3.3 Configuration

The operating mode is set using a rotary coding switch. If this is at the "OFF" position, the ZSI function is switched off.

5.3.4 Connection

The ZSI module must always be connected to COM1x or X8 as the first external CubicleBUS module.

Up to 20 circuit breakers can be connected in parallel to ZSI IN, and up to 8 circuit breakers can be connected in parallel to ZSI OUT.

5.3.5 Test function

The outputs are set in the "TEST" switch position on the rotary coding switch (that is, a blocking signal is sent to other breakers).

Pressing the "TEST" button switches the ZSI module to test mode. Test mode is indicated by the yellow DEVICE LED. The inputs and outputs are selected in the same way as on the digital input/output modules. If the input of the ZSI module is selected, the input can be activated by pressing and releasing the "TEST" button. If the outputs are selected, they can be activated by pressing and releasing the "TEST" button.

This makes it possible to check the cables.

The trip times can be checked with the function testing device (3WL9111-0AT44-0AA0).

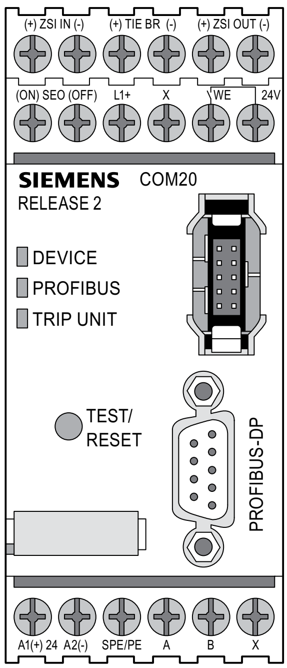
5.3.6 LED

The activated inputs or outputs are indicated by a yellow LED.

5.4 SENTRON 3VL

5.4.1 COM20/COM 21

To be able to use the ZSI function on the SENTRON VL circuit breaker, the external communication module COM20 (PROFIBUS DP) or COM21 (Modbus RTU) and an ETU or LCD ETU with communication capability must be used.



5.4.2 Technical data

Operating voltage min./max. (V)	20,4 / 28,8
Current consumption max. (mA)	50 mA
Automatic resetting of the outputs after a maximum of	3 s
Shortest time that blocking signal is pending at the outputs LV	100 ms
Typical tripping time including all delays	approx. 80 ms
Maximum number of switches that can be connected to ZSI IN	20
Maximum number of switches that can be connected to ZSI OUT	8
Maximum cable length with 2 x 0.75 mm^2	400 m
Power losses typ. [W]	1,2
Dimensions W/H/D (mm)	45 / 106 / 86
Weight (kg)	0,28
Temperature range (°C)	-25 / +70

Note

Cable type recommendation

It is recommended to transfer the ZSI signal via a twisted-pair signal line with a cross-section of at least 0.75 mm^2. The maximum length must not exceed 400 m. (Exception: If the higher-level breaker is equipped with a COM10, the maximum cable length is limited to 20 m). Recommended cable type: Shielded MSR cable LSYCY (2 x 0.75 mm^2); made by: Siemens

Communication with LCD trip units that have a "U" as the 9th character in the order number is only possible with COM2x RELEASE 2 or higher.

5.4.3 Applications

The function of ZSI can be used for the short-circuit between the phases (S), short-circuit to ground (G), or both simultaneously (S + G).

If a coupling switch is used in a power distribution system, it can be integrated into the ZSI concept.

5.4.4 Configuration

Data point 421 (Page 275) (Table 8-86) and data set 129 (Page 239) are available for controlling the ZSI functionality with the help of communication.

You can find more information in the Service & Support Portal (http://www.siemens.com/lowvoltage/support).

Alternatively, with LCD trip units that have a "U" as the 9th character in the order number, the setting can be made via the menu of the trip unit. At the factory, the ZSI function is switched off for trip units that can be parameterized using a rotary coding switch, and it is switched on for trip units that have a menu.

5.4.5 Connection

Up to 20 circuit breakers can be connected in parallel to ZSI IN, and up to 8 circuit breakers can be connected in parallel to ZSI OUT.

5.4.6 LED

If the ZSI function is activated, the Trip Unit LED on COM2x flashes green.

DEVICE
PROFIBUS
TRIP UNIT

6 PROFIBUS data transfer

6.1 Integration of the circuit breakers into a communication system

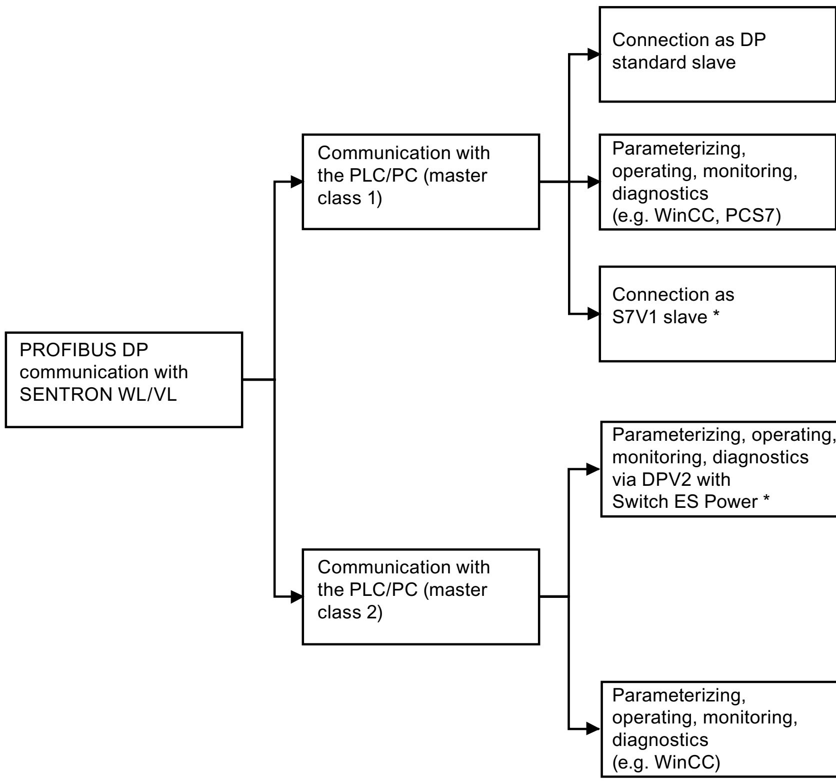
There are diverse possibilities for integrating the SENTRON circuit breakers into a communication system. A shared profile (type and content of the data transfer) for SENTRON WL and SENTRON VL also enables the use of identical programs at the automation level and the PC level.

6.2 Communication

The PROFIBUS DP modules COM15 for the SENTRON WL and COM20 for the SENTRON VL have been briefly introduced in the earlier chapters. Both modules are the interfaces between the circuit breakers and the information world. From the perspective of PROFIBUS DP, the COM15 and COM20 behave identically here. This has the advantage that for all circuit breakers from 16 A to 6300 A, a shared GSD file (generic station description) can be used for integration into PROFIBUS DP systems. A distinction cannot be made and need not be made. With an identical PROFIBUS DP profile, it is possible to identify the addressed circuit breaker in detail (e.g. device description, order number, test date, etc.).

Another significant advantage of a shared communication profile is the use of identical software for automation systems and PCs, and for operator control and monitoring software like WinCC and PCS7.

The figure below shows the different communication options in a chart.



* without COM20

Figure 6-1 Communication options of PROFIBUS DP with SENTRON WL and SENTRON VL

Profile basis

The standardized profile for circuit breakers (PI profile PI 3.122) kept by PI (PROFIBUS International) is used as the basis for the profile.

6.3 Communication with a PROFIBUS DP class 1 master

A class 1 master is referred to as the configuring master that determines at startup the mode in which the slave is to communicate. A class 1 master is usually a PLC, e.g. a SIMATIC S7 with PROFIBUS DP interface.

Configuration

The following configuring methods are available:

- Via a GSD file
- Via an object manager

Both configuration methods are described in detail on the pages below.

However, it is important that, regardless of the selected configuration, it is also always possible to take up communication with DPV1, and to read or write acyclic information.

6.4 Communication with a PROFIBUS DP class 2 master

PCs with PROFIBUS DP cards are usually class 2 masters, e.g. when using Switch ES Power.

Communication with a class 2 master always takes place via DPV2.

6.5 Integration with the GSD file

Downloading the GSD file

The current version of the GSD file for the SENTRON circuit breakers can be downloaded from the Service and Support Homepage:

1. Navigate to Service and support (http://support.automation.siemens.com)
2. Enter "sentron gsd" in the area "Search for product information" and select "GO"
   In the search result, the file "3WL_3VL.zip" contains all the necessary files.

Configuring tool

The device parameters are configured with a configuring tool possessed by every PROFIBUS DP master:

- With a SIMATC S7 as the master, this is the HW Config of the SIMATIC STEP7 package.
- If it is not a SIMATIC S7, configuration can be carried out, for example, with the corresponding tool of the vendor, dependent on the master.

Installing the GSD

If the GSD file that contains the generic station description of the circuit breaker has not yet been installed, this must be integrated in advance into the configuring tool.

You integrate the GSD file into the SIMATIC development environment with the hardware configuration editor "HW Config" as follows:

1. Open the "Hardware" object in the SIMATIC Manager
2. From the "Options" menu, choose "Install New GSD ...".
3. Select the source and the file "Siem80C0.gs*". The place holder "*" represents the relevant language index, g = German, e = English.

Following this, the SENTRON WL/VL is available for further configuring in the HW catalog under "PROFIBUS DP\Other field devices\Switchgear".

Note

The GSD file supports both DPV0 and DPV1.

Example

The figure below shows the configuration tool of STEP7 HW Config with which both the automation system of S7 and its fieldbuses can be configured.

To insert a SENTRON circuit breaker, either a CPU with integral PROFIBUS DP interface or a PROFIBUS DP CP card in the rack must be configured and assigned to PROFIBUS DP.

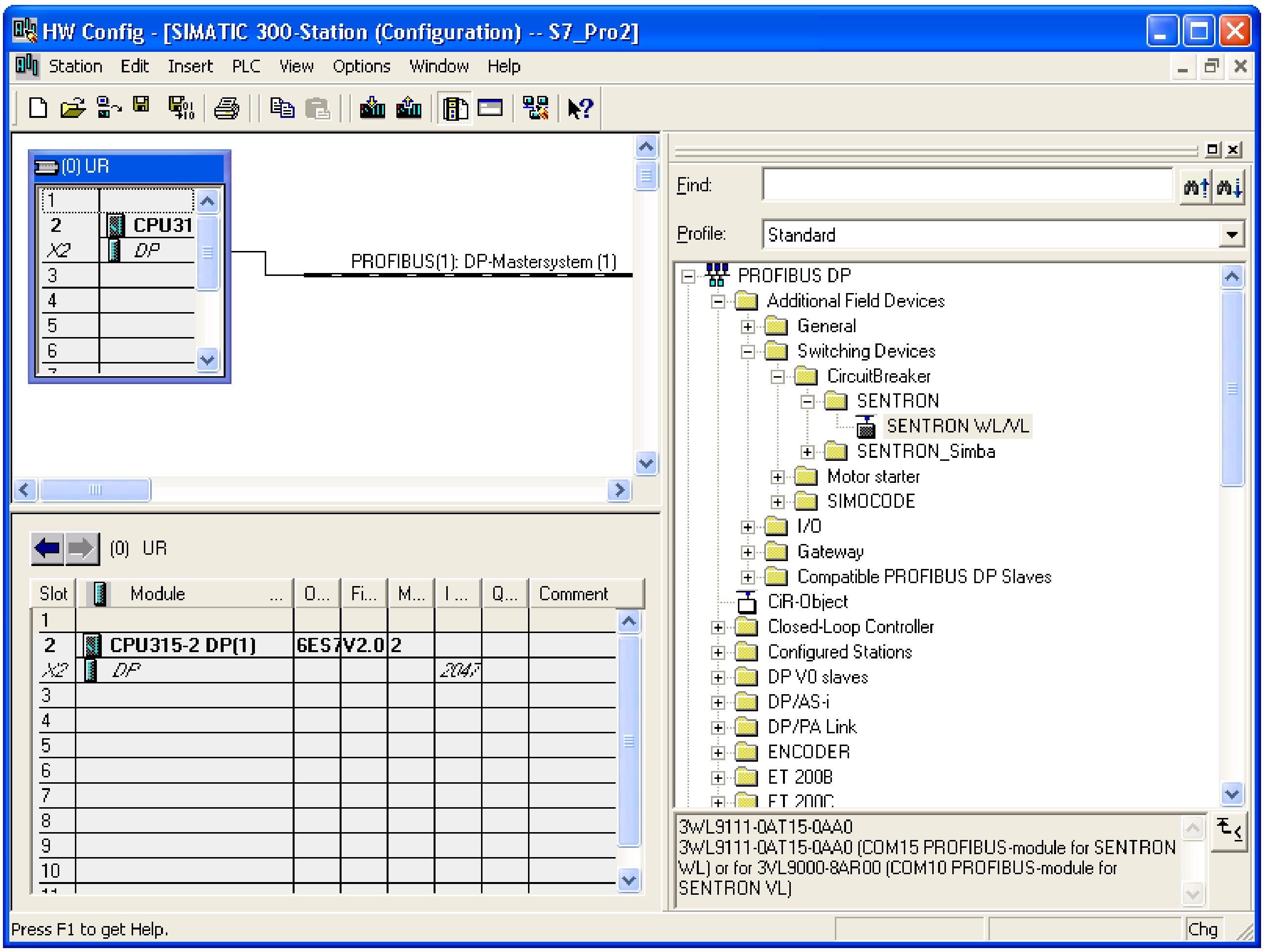


Figure 6-2 Configuration tool of STEP7 HW Config

Create master system

You can create a DP master system with the configuration editor "HW Config" as follows:

- Assign a master address between 1 and 125 (e.g. 11).
- Select the desired data transmission rate (e.g. 1.5 Mbit/s).
- Select the PROFIBUS DP profile.

Note

Other settings may be required in the master system depending on the PROFIBUS DP configuration. These are not described further here.

Inserting and addressing a slave

- The "SENTRON WL/VL" is selected in the "Hardware Catalog" and dragged and dropped to the master system.
- To operate the slave on PROFIBUS DP, assign and set an address that is unique on this PROFIBUS DP line.
- Select a basic type between 1 and 3 and confirm with "OK".
- If changes are to be made to the properties, this must be done by calling "Properties DP slave" after selecting the slave.

The figure below shows the popup window that appears after the SENTRON VL/WL has been dragged and dropped from the device library. The basic breaker type with which the SENTRON VL/WL is configured by the PLC is selected in this window.

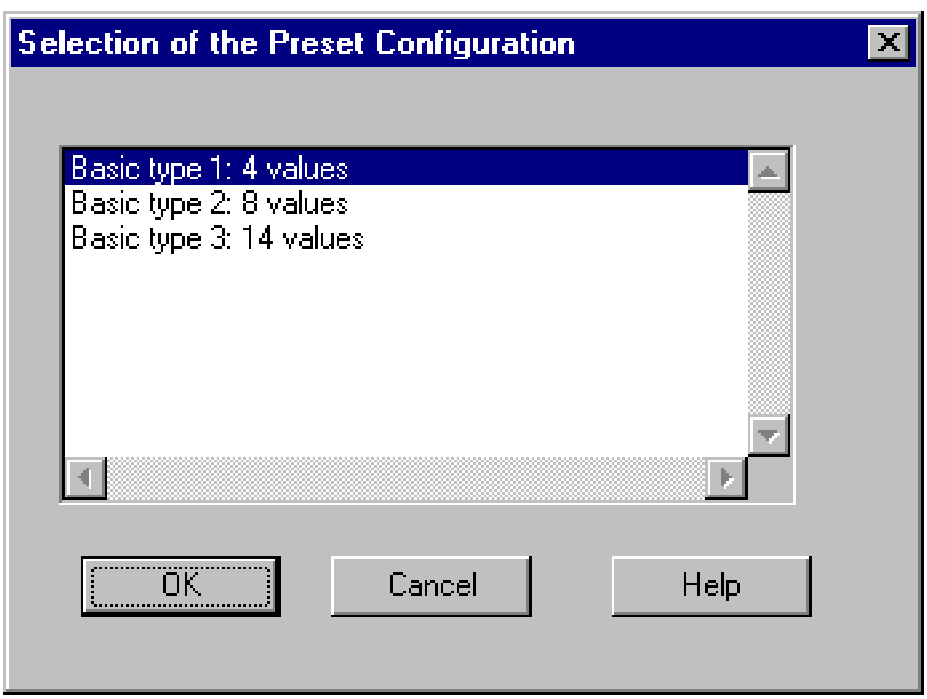


Figure 6-3 Selecting the preset configuration

Note

When selecting the slave "SENTRON WL/VL", only an MLFB number (e.g. 3WL9111-0AT15-0AA0) is displayed as information.

Note

The settings on the "Hex Parameterization" tab do not need to be considered here. The PROFIBUS DP addresses 0 and 126 cannot be assigned. Address 0 is intended for the PG (class 2 master) and 126 is used predominantly for startup purposes or is also frequently used as the address of DP slaves as delivered.

Through integration with the GSD file, the SENTRON circuit breaker is always incorporated as a DP standard slave. It is optionally possible to transfer additional data via DPV1 and, for example, to change parameters.

Setting the input address/output address of the S7

After selecting the basic type, a SENTRON circuit breaker symbol is shown on PROFIBUS DP. In the lower area of the split window, the input address/output address of the S7 which can be accessed in the STEP7 program can/must be set.

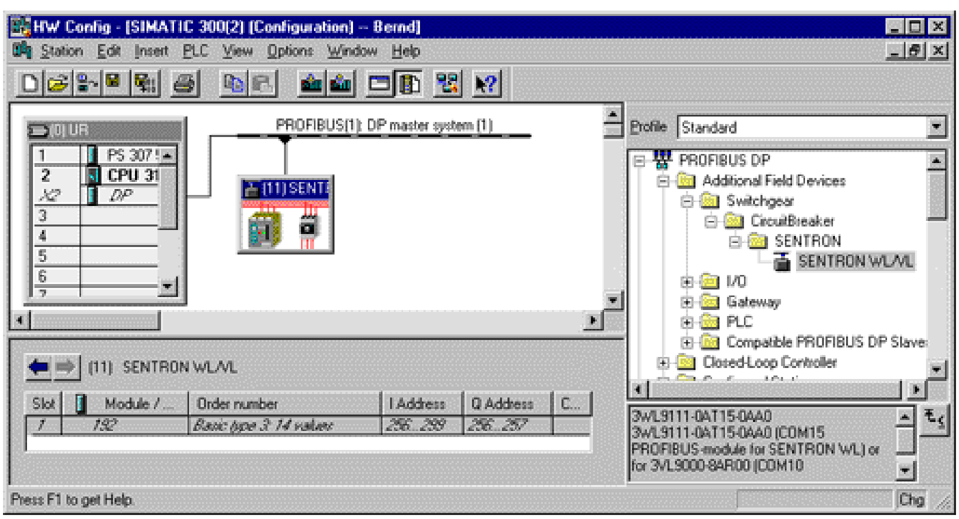
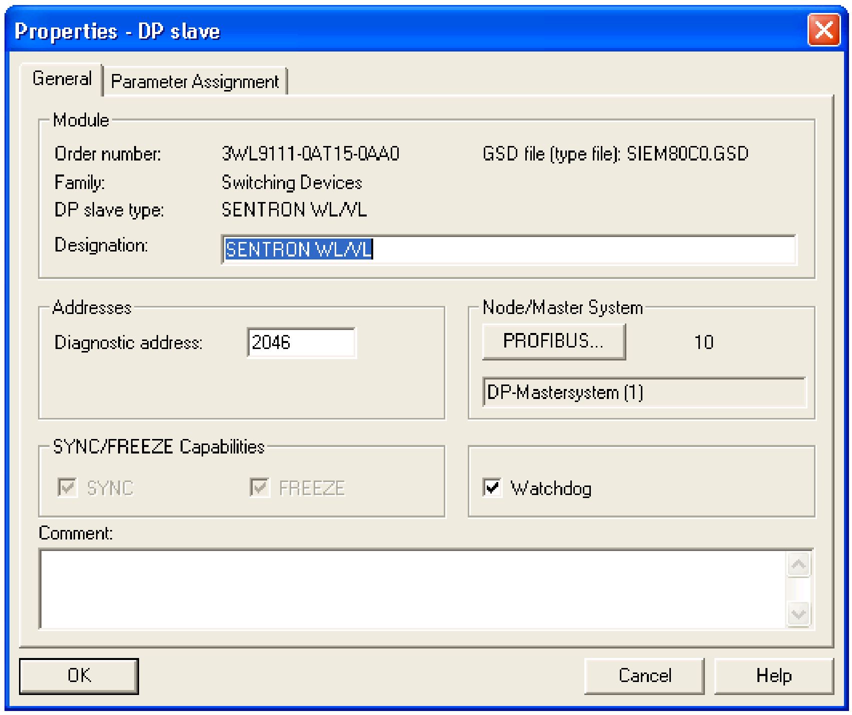


Figure 6-4 Setting the input address and the output address of the S7

Reading out the diagnostics address for S7 functions

For certain functions (e.g. reading out diagnostics), the diagnostics address is subsequently necessary. You obtain this using the context menu (right-click on the slave) and the function "Object properties". You can then close the window again by clicking the "OK" button.

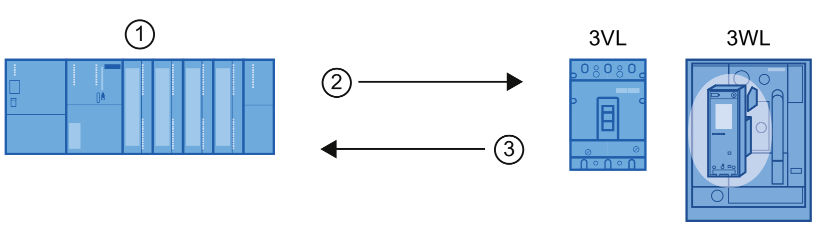


6.6 The three communication paths

This concept enables you to get started quickly and simply with PROFIBUS DP communication with SENTRON circuit breakers.

The figures below show the three possible communication paths that enable you to get started simply and quickly and allow you to adapt to complex applications.

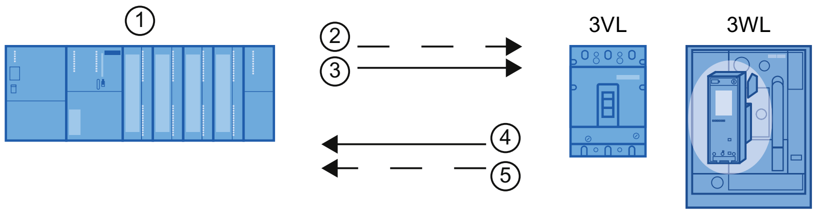
Path 1



① S7 class 1 master
② Request DPV0 cyclic
③ Response DPV0 cyclic

Path 1 enables fast and simple entry to PROFIBUS DP communication. This path contains sufficient data to meet most requirements. Communication with path 1 always takes place with a class 1 master. With cyclic data, certain contents are predefined. These can be changed in the three basic types and thus easily adapted to requirements (e.g. replacement of the phase-to-phase voltage UL12 by the number of operating hours).

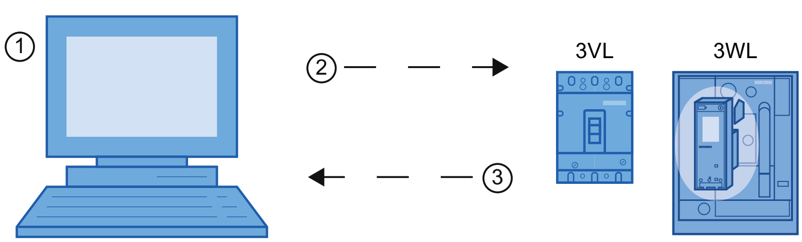
Path 2



① S7 class 1 master
② Request DPV1 acyclic
③ Request DPV0 cyclic
④ Response DPV0 cyclic
⑤ Response DPV1 acyclic

With this, the SENTRON circuit breaker can also be used to read or write acyclic data sets from a class 1 master. This is useful, for example, to request extremely extensive data volumes. However, this data, e.g. data of the waveform buffer, does not have to be read cyclically.

Path 3



① PC class 2 master
② Request DPV1 acyclic
③ Response DPV1 acyclic

With this, the SENTRON circuit breaker can be used to read or write acyclic data sets from a class 2 master. This is useful, for example, to request extremely extensive data volumes. Switch ES Power uses this path for communication with the 3WL circuit breaker.

6.7 Setting and changing the PROFIBUS address of the COM15/COM20

Presettings

The PROFIBUS DP addresses are stored in the PROFIBUS DP modules COM15 and COM20 of the circuit breakers. Address 126 is the default as supplied. All nodes on PROFIBUS DP must have a unique address. This is why a new address has to be assigned when commissioning the PROFIBUS DP modules.

Assigning an address (COM20)

- If there is no cyclic data exchange with a class 1 master, the changed address becomes effective immediately. In the case of Switch ES Power this manifests itself as follows: When downloading parameters with a new address, these are adopted and activated and thus the connection with Switch ES Power is immediately interrupted. The slave can be accessed under the new address from now on. Switch ES Power must be restarted.
- The address is set or changed via the "addressing plug" (3UF7910-0AA0). For this, the addressing plug is connected with the COM20 (above the PROFIBUS interface) and the TEST/RESET key on the COM20 is pressed for approximately 3 seconds. As soon as the address has been transferred, the PROFIBUS LED flashes and the addressing plug can be removed again.

Assigning an address (COM15)

The COM15 of the SENTRON WL assumes the new address, but operation with the changed address only becomes effective later when the 24 V DC power supply of the CubicleBUS has been interrupted for a short time. The new address only becomes active when power has been restored.

Changing the PROFIBUS address via PROFIBUS DP

Note

To change the PROFIBUS DP address using Switch ES Power, you must first ensure that the current address (e.g. 126 at initial startup) has only been assigned once. For this reason, all new COM15 modules must never be connected simultaneously to PROFIBUS DP, because otherwise all modules with the same address will be overwritten. It is therefore necessary for the new modules to be connected to PROFIBUS DP gradually and each addressed individually.

Proceed as follows to change the address:

From the "Switching device" menu select "Online Open".

1. A dialog box then opens in which you can select, via the relevant application access point and the selected PROFIBUS DP interface, the currently effective PROFIBUS DP address of the slave whose address is to be changed. 126 must be selected on the new PROFIBUS DP modules COM20/COM15.
2. Click on OK to load all parameters including the communication parameters from the device into Switch ES Power where they can be changed.
3. In the tree on the left side, select the point "Communication" and select the desired new address in the drop-down field.
4. In the "Target System" menu, select the entry "Load in Switching Device". This transfers all parameters currently displayed in Switch ES Power to the circuit breaker.

NOTICE
Write protection
Without the wire jumper "DPWriteEnable", the PROFIBUS write protection on the COM15 is active and the changes will not be adopted.

The figure below shows how the PROFIBUS address and the content of the cyclic data traffic can be set with the help of Switch ES Power.

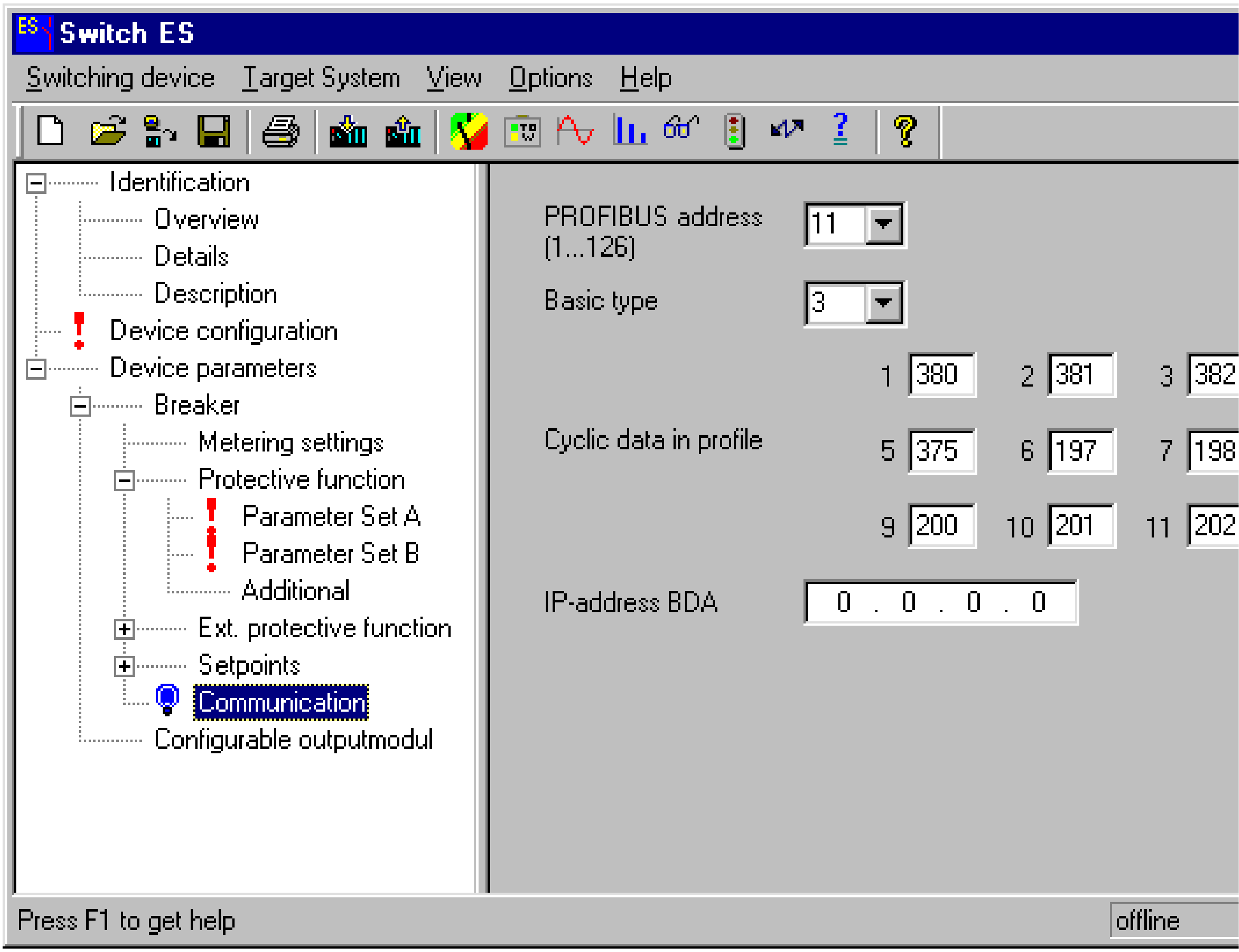


Figure 6-5 Setting the PROFIBUS address with SWITCH ES Power (here Version V1.0)

Changing the PROFIBUS address via the BDA PLUS; COM15).

If the connection with the circuit breaker has been established (e.g. via a local point-to-point (PPP) connection or over Ethernet), you proceed as for Switch ES Power:

Select "Device Parameters - Switches - Communication", and change the address there.

Setting the PROFIBUS address via STEP7 (Set_Slave_Address)

Both PROFIBUS DP modules support the PROFIBUS DP function Set_Slave_Add. With the help of this class 2 master function, the address of a slave can be changed on PROFIBUS DP.

The address can be changed either in the SIMATIC Manager or in HW Config in the STEP7 software package. The procedure is as follows: From the "Target System" menu in one of the two programs, select "Assign PROFIBUS Address".

In the window that then opens showing the connected nodes, change the address of the DP slave.

Note

The address can only be changed in Wait_Prm status, that is, the slave must not have a cyclic connection with a class 1 master. The address change will then be carried out immediately.

The figure below shows how the PROFIBUS address can be changed via STEP7. This requires the PC with STEP7 to be connected with the slave via a PROFIBUS interface.

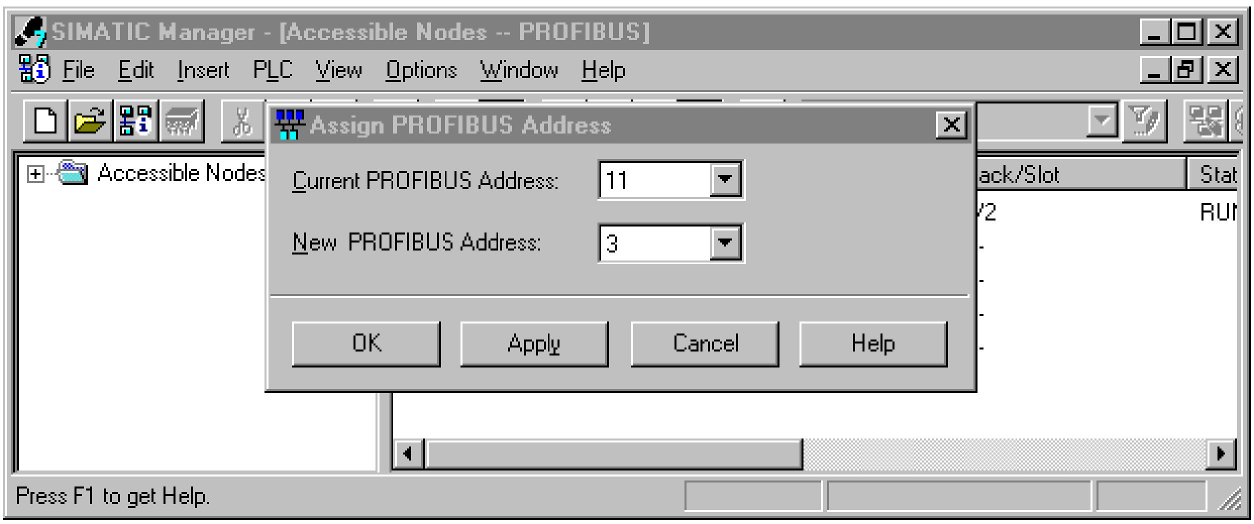


Figure 6-6 Setting the PROFIBUS address using STEP7

Changing the address using DS160

The PROFIBUS DP address of the relevant slave is found in data set 160 at byte position 5. This can be not only be read but also changed by overwriting DS160. In other words, the address can be changed by a one-off request for acyclic writing of DS160 in the user program of the PLC.

Changing the address of the COM15 (SENTRON WL) with the help of the ETU76B

Thanks to its structured menu, the ETU76B also offers the option of changing the PROFIBUS DP address. To do so, proceed as follows:

1. Press "ESC" twice to exit the "screen saver" with the display of the current values. Pressing "ESC" (or any of the three buttons) once switches the backlighting on, and by pressing it a second time the main menu is displayed.
2. Use the "Up"/"Down" keys to select "Change Parameter" in the main menu and confirm with "ENTER".
3. Select "PROFIBUS" in the "Communication" submenu.

6.8 PROFIBUS profile for SENTRON circuit breakers

The creation of shared, cross-vendor profiles for different device classes (e.g. motor starters, measuring devices, etc.) is promoted by PROFIBUS International (PI). In the area of low-voltage switchgear, a separate profile has been specified for circuit breakers. This forms the basis for the shared PROFIBUS profile for the SENTRON VL and SENTRON WL circuit breakers. The PI profile has been supplemented with the functions for diagnostics and the DPV1 expansions.

PI profile

SENTRON WL and VL comply with PI's PROFIBUS profile for circuit breakers.

The communication profile on the PROFIBUS DP of the SENTRON circuit breakers has been integrated into the profile for low-voltage switchgear (circuit breaker part) of PROFIBUS International (PI) and passed there.

Both SENTRON circuit breakers thus communicate in accordance with the latest standard in communication technology.

You can obtain the document on request from Technical Support (http://www.siemens.com/lowvoltage/technical-support).

6.9 Cyclic data traffic

In cyclic data traffic, each message frame transfers a fixed number of user data. When parameterizing the slave (in this case the SENTRON WL or SENTRON VL), the volume of data to be transferred cyclically between the circuit breaker and the PLC must be established. Cyclic data exchange is the best method of transferring information that is required continuously and quickly. The interval between two values depends on the number of nodes, the volume of data, and the baud rate.

Field of application

The data volume cannot be changed during operation. For this reason, exclusively cyclic data exchange is very suitable for communication requiring only small volumes of user data. If larger data packets have to be transferred occasionally for setting checks or maintenance checks, cyclic data traffic is less suitable because this capacity - only occasionally required - would have to be taken account of in each message frame, making the frames extremely long and the transfer slower.

Basic types for cyclic data exchange

Due to the large volume of data provided by the SENTRON circuit breakers, it was necessary to find a compromise between data volume and performance on PROFIBUS DP. If a large volume of information is transferred with each data exchange but little of it is used, this impairs the performance capability on PROFIBUS DP.

For this reason, there are three basic types available for efficient and flexible transfer. Depending on the application, the most suitable basic type with its associated bus configuration can be selected at the configuration stage. Configuring is carried out with a PROFIBUS DP configuration tool such as COM PROFIBUS or HW Config of the SIMATIC S7. The basic types are already pre-assigned and offer a good method of fast commissioning without additional configuring/parameterizing.

It is possible to assemble a user-defined configuration within a basic type with the help of Switch ES Power, for example.

Note

Data that is not constantly required can be additionally transferred via DPV1.

Pre-assignment of the three basic types

After selection of a basic type using the configuration tool of the PROFIBUS DP master, this configured slave is prompted at the start by the master to communicate in the basic type set.

Each individual SENTRON circuit breaker can be configured with another basic type.

The selection of the basic type defines first the volume of data and thus the length of the message frame. Without further settings, it is then possible to transfer the most important data of the circuit breaker. The status of the circuit breaker is identical in all three basic types. This information field has a size of 2 bytes. According to the status box, the basic types consist of 4 to 14 data blocks. These are pre-assigned. Each data block has an associated property byte.

The format for all pre-assigned measured values is an integer with a length of 1 word. This must be interpreted as the Motorola format that is a de-facto standard on PROFIBUS DP.

The tables below contain lists of the data blocks of the 3 basic types:

Basic type 1 consists of the binary status information and 4 data blocks. The pre-assignment of basic type 1 is specially designed for current transmission.

Table 6- 1 Basic type 1

Byte	Definition	Default	Data point
0 / 1	Binary status information	Binary status information	
2 / 3	Data block 1	Current in phase 1	380
4 / 5	Data block 2	Current in phase 2	381
6 / 7	Data block 3	Current in phase 3	382
8 / 9	Data block 4	Max. current in phase under highest load	374
10	PB of data block 1	PB of current phase 1	
11	PB of data block 2	PB of current phase 2	
12	PB of data block 3	PB of current phase 3	
13	PB of data block 4	PB of maximum current in phase under highest load	

Basic type 2 is pre-assigned for metering function.

Table 6- 2 Basic type 2

Byte	Definition	Default	Data point
0 / 1	Binary status information	Binary status information	
2 / 3	Data block 1	Current in phase 1	380
4 / 5	Data block 2	Current in phase 2	381
6 / 7	Data block 3	Current in phase 3	382
8 / 9	Data block 4	Max. current in phase under highest load	374
10 / 11	Data block 5	Current in neutral conductor	375
12 / 13	Data block 6	Mean value of the phase-to-phase voltages	203 *
14 / 15	Data block 7	Mean value of power factors of 3 phases	168 *
16 / 17	Data block 8	Total active energy of 3 phases	238 *
18	PB of data block 1	PB of current phase 1	
19	PB of data block 2	PB of current phase 2	
20	PB of data block 3	PB of current phase 3	
21	PB of data block 4	PB of max. current in phase under highest load	
22	PB of data block 5	PB of current in neutral conductor	
23	PB of data block 6	PB of the mean value of phase-to-phase voltages	
24	PB of data block 7	PB of the mean value of the three power factors	
25	PB of data block 8	PB of total active energy	

* Alternatively, these fields can contain the default numbers of basic type 3. If there are no changes here, the default value is nevertheless transferred.

Basic type 3 consists of 14 data blocks and has input data in the 44th byte on the PLC.

Table 6- 3 Basic type 3

Byte	Definition	Default	Data point
0 / 1	Binary status information	Binary status information	
2 / 3	Data block 1	Current in phase 1	380
4 / 5	Data block 2	Current in phase 2	381
6 / 7	Data block 3	Current in phase 3	382
8 / 9	Data block 4	Max. current in phase under highest load	374
10 / 11	Data block 5	Current in neutral conductor	375
12 / 13	Data block 6	Phase-to-phase voltage L_{12}	197
14 / 15	Data block 7	Phase-to-phase voltage L_{23}	198
16 / 17	Data block 8	Phase-to-phase voltage L_{31}	199
18 / 19	Data block 9	Neutral point voltage L_{1N}	200
20 / 21	Data block 10	Neutral point voltage L_{2N}	201
22 / 23	Data block 11	Neutral point voltage L_{3N}	202
24 / 25	Data block 12	Mean value of power factors of 3 phases	168
26 / 27	Data block 13	Total active energy of 3 phases	238
28 / 29	Data block 14	Total apparent power of 3 phases	217
30	PB of data block 1	PB of current phase 1	
31	PB of data block 2	PB of current phase 2	
32	PB of data block 3	PB of current phase 3	
33	PB of data block 4	PB of max. current in phase under highest load	
34	PB of data block 5	PB of current in neutral conductor	
35	PB of data block 6	PB of the phase-to-phase voltage L_{12}	
36	PB of data block 7	PB of the phase-to-phase voltage L_{23}	
37	PB of data block 8	PB of the phase-to-phase voltage L_{31}	
38	PB of data block 9	PB of the neutral point voltage L_{1N}	
39	PB of data block 10	PB of the neutral point voltage L_{2N}	
40	PB of data block 11	PB of the neutral point voltage L_{3N}	
41	PB of data block 12	PB of the mean value of the three power factors	
42	PB of data block 13	PB of total active energy	
43	PB of data block 14	PB of total apparent power	

Basic type 1

According to the 2-byte status information, basic type 1 consists of 4 data blocks. These are pre-assigned in such a way that they are suitable above all for use with a SENTRON VL and a SENTRON WL without metering function. The most important currents of the phases are transferred. This pre-assignment can be changed. It is not practical to transfer the current in the neutral conductor in the case of a 3-pole SENTRON VL. Instead, another value from the data library can be transferred there, such as the number of switching cycles. This value is transferred in the cyclic message frame in the position of the fourth data block instead of the current in the neutral conductor.

Basic type 1 is suitable above all for the SENTRON VL and/or the SENTRON WL without metering function.

Basic type 2

Basic type 2 has 8 data blocks that for a SENTRON WL are pre-assigned with a metering function. However, not all voltages are transferred in detail. Only their mean values are transferred and in most cases this is sufficient.

Basic type 3

Basic type 3 has 14 data blocks that are pre-assigned measured values. These are pre-assigned in such a way that unmodified use is only meaningful with a SENTRON WL with metering function. However, as already described, it is possible to select basic type 3 and to replace the pre-assigned, unavailable measured values (e.g. phase-to-phase voltage) with suitable maintenance data or parameter data. All information with a maximum length of 2 bytes can be used to replace the pre-assigned data. All other values are "cast", that is, truncated and adapted so that only the 2 least-significant bytes are transferred.

Property byte (PB)

In each of the basic types, the assigned data blocks are followed by their associated property bytes. Each data block has its own property byte.

The property byte is information additional to the associated data block and describes the properties of the associated data point.

This does not have to be evaluated but it may contain important information for the application. A property byte is also available for every data point in the DPV1 data sets. If the content of one or more data blocks of the cyclic message frame is replaced, the property byte adapts automatically.

The property byte can be used, for example, to determine whether or not a value is available. When using a SENTRON VL with the standard assignment of basic type 2, the voltage values are designated "not available". This allows the structuring of a standard interface in an HMI (operator control and monitoring system) system that shows or hides the field dependent on this bit. Measured values are always "read only", but some maintenance information is "read only, but can be reset". Parameters are "read/write" or "read only" depending on the source (e.g. ETU).

All this information can be determined from the property byte.

The table below contains the definitions of the property byte:

Table 6- 4 Defining of the property byte

Bit	Value	Description
0/1	0	Read/write
	1	Read only, but can be reset (e.g. maintenance)
	2	Read only, can only be written at the factory
	3	Read only
2		Not used
3		Not used
4		Value in the valid range
5		Option switched on
6		Option available
7		Not used

Table 6- 5 Examples of evaluating the property byte

Value		Meaning resolution
Hexadecimal	Decimal	
0x73	115	Bit 0/1 = 3 ⇒ "Read only"
		Bit 4 = true ⇒ "Range valid"
		Bit 5 = true ⇒ "Option switched on"
		Bit 6 = true ⇒ "Available"
0x50	80	Bit 0/1 = 3 ⇒ "Read/write"
		Bit 4 = true ⇒ "Range valid"
		Bit 5 = false ⇒ "Option switched off"
		Bit 6 = true ⇒ "Available"

Binary status information in the cyclic channel

The binary status information is identical in all three basic types and provides the most important status information about the circuit breaker. It cannot be changed. The binary status information in the cyclic channel is transferred at the start of the data frame at every data exchange.

The binary status information consists of 2 bytes. Further explanations of data formats are given in Chapter Data library (Page 175).

The information coding is identical in SENTRON WL and SENTRON VL provided the data is available.

The table below contains a description of the binary status information in the cyclic frame:

Table 6- 6 Binary status information in the cyclic frame

Byte	Bit	Value	SENTRON WL	SENTRON VL
			COM15	COM20
n	0/1	0..3	Position of circuit breaker	
		0	Disconnected position	Not available
		1	Connected position	
		2	Test position	
		3	Switch is not available	
	2/3	0..3	Status of the circuit breaker	
		0	Not ready	
		1	OFF	
		2	ON	
		3	Switch has tripped	
	4		Ready-to-close signal available	Not available
	5		Undervoltage release charged	Not available
	6		Spring energy store is compressed	Not available
	7		Overload warning present	
n+1	0		An activated threshold has been exceeded	Not available
	1		An alarm signal is currently present	Not available
	2		PROFIBUS write protection disable deactivated, changes allowed	
	3		Status of the free user input	Not available
	4/5/6	0..7	Reason for last tripping operation	
		0	No tripping operation or last tripping operation acknowledged	
		1	Overload tripping (L)	
		2	Instantaneous short-circuit	
		3	Short time-delayed short-circuit (I)	
		4	Ground fault (G)	
		5	Tripping operation as a result of extended protection function	Tripping operation as a result of extended protection function (temperature)
		6	Overload in neutral conductor	
		7		
	7		Load shedding alarm	Not available

Control bytes

All three basic types contain a 2-byte block with the most important binary information for controlling the circuit breaker. This is transferred with each frame.

The three basic types differ in the scope and content of the data reported by the circuit breaker to the class 1 master (e.g. PLC) with each Data_Exchange. From the perspective of the PLC, this data is by definition input data.

The output data of the class 1 master is identical in all three basic types. The control bytes in the direction of the switch are always 2 bytes in length. The switch can be switched on and off, trips acknowledged, and memory contents reset via these control bytes.

For all controllers, it is sufficient to set the relevant bits for 0.5 to 5 seconds because setting of the outputs is edge-triggered. Following this, these control bits must be reset to avoid subsequently triggering any undesired actions.

The table below contains a description of the control bytes for the SENTRON circuit breaker:

Table 6- 7 Control bytes for SENTRON circuit breakers

Byte	Bit	Value	SENTRON WL	SENTRON VL
			COM15	COM20
n	0 / 1	0..3	Switching the circuit breaker	
		0	Not defined (no action)	
		1	Switch off (opening of the main contacts)	
		2	Switch on (closing of the main contacts)	
		3	Not defined (no action)	
	2		A currently active tripping operation is acknowledged and reset	
	3		Not used	
	4		Setting of the free user output	Not used
	5		Not used	
	6		Not used	
	7		Not used	
n + 1	0		Not used	
	1		Not used	
	2		Delete tripping and event log	
	3		Reset all minimum/maximum value memories (on WL, except temperature)	
	4		Reset minimum/maximum value buffers for temperatures	Not available
	5		Not used	
	6		Reset all maintenance information and counters which can be reset	
	7		Bit for synchronizing the system time to the current half hour	

7 Data transfer to the PLC

7.1 Interface to S7-300 and control/diagnosis via PROFIBUS

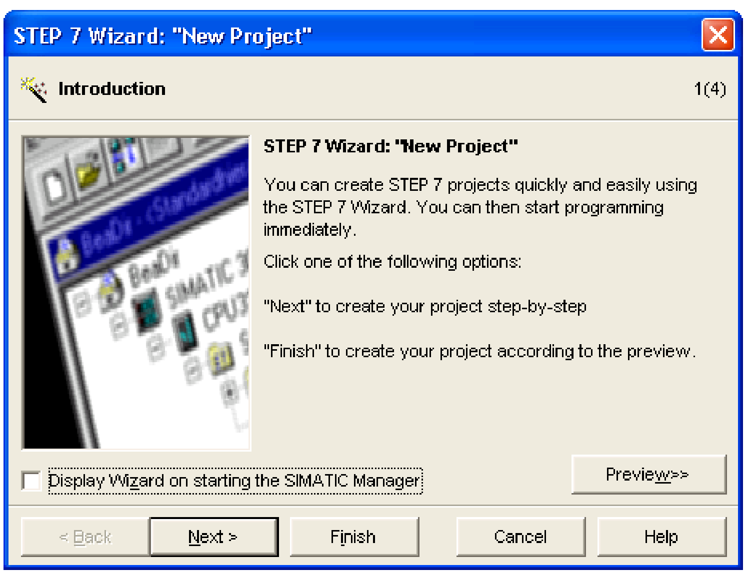
7.1.1 Creating a new project

Creating a new project in SIMATIC Manager:

Opening the window "STEP 7 Wizard: New Project" via "File > Wizard: New Project"

Step 1 Introduction

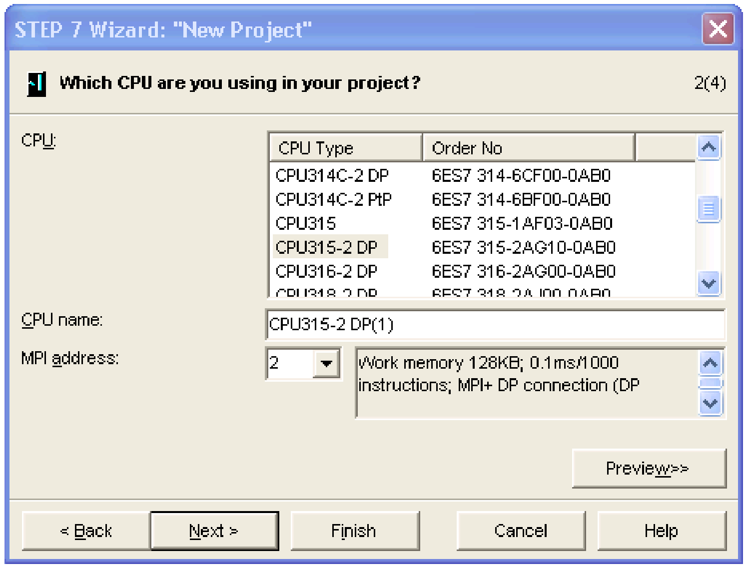
Introductory information regarding behavior when creating new projects.



To continue, click "Next".

Step 2 Select CPU

Select the CPU to be used and assign a name and an MPI address.



To continue, click "Next".

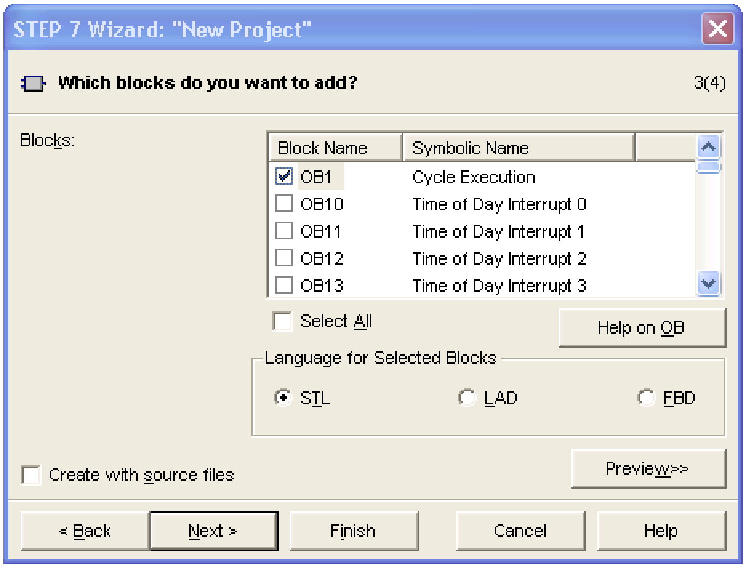
Step 3 Add blocks

Select the blocks to be used later and adapted to suit customer specifications.

Table 7- 1 Set a checkmark to select the blocks to be used later

Block name	Symbolic name	Description of use
OB1	Cycle Execution	Mandatory: cyclic execution of the user program
OB82	I/O Fault point 1	Useful: incoming or outgoing component fault
OB86	Loss of Rack Fault	Useful: failure of a distributed component (e.g. SENTRON WL/VL)
OB100	Complete Restart	Optional: startup condition for restart (e.g. UserOutput)
OB101	Restart	Optional: startup condition for warm restart (e.g. UserOutput)
OB102	Cold Restart	Optional: startup condition for cold restart (e.g. UserOutput)

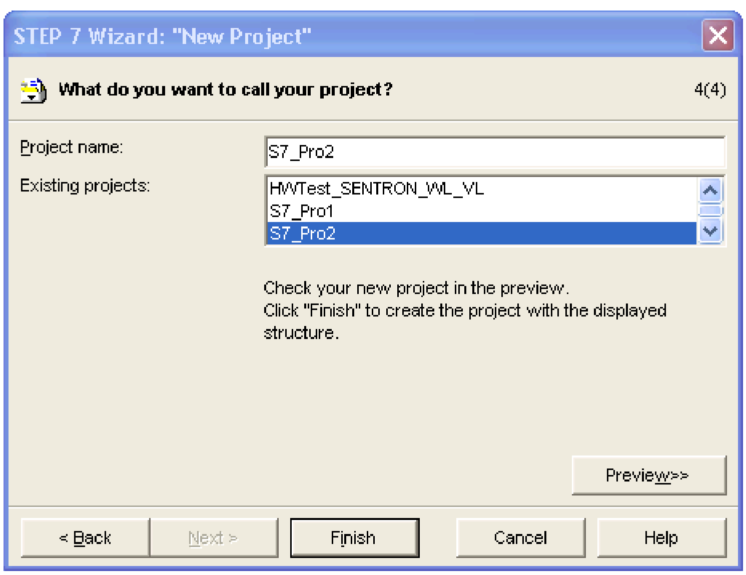
Select the language for programming



To continue, click "Next".

Step 4 Assign project name

Assign an individual name for the project.



Then click "Finish".

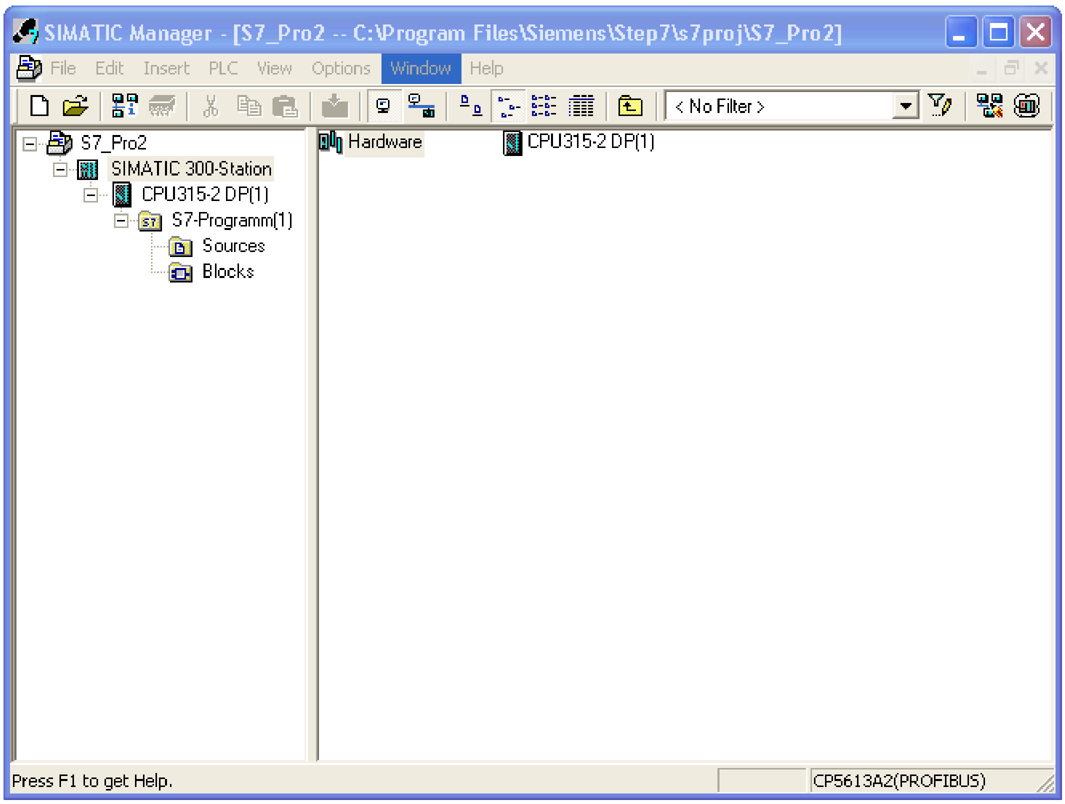
Result

A complete project structure with CPU has been created

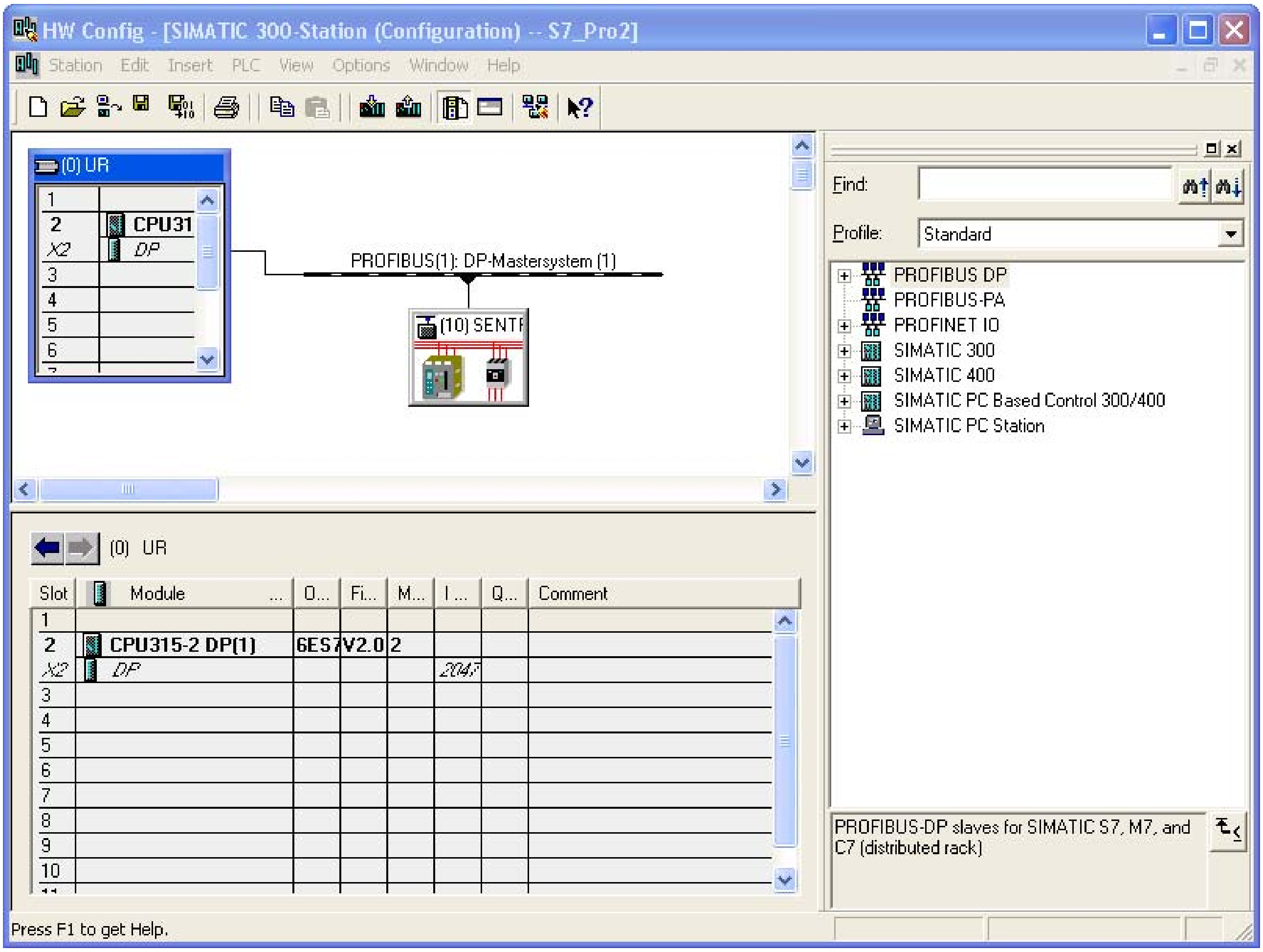
7.1.2 Hardware configuration in HW Config

Step 1 Starting HW Config

Start HW Config by double-clicking on "Hardware" in the generated project structure under "Project Name > Station Name"
In the example, "S7_Pro2 > SIMATIC 300-Station"



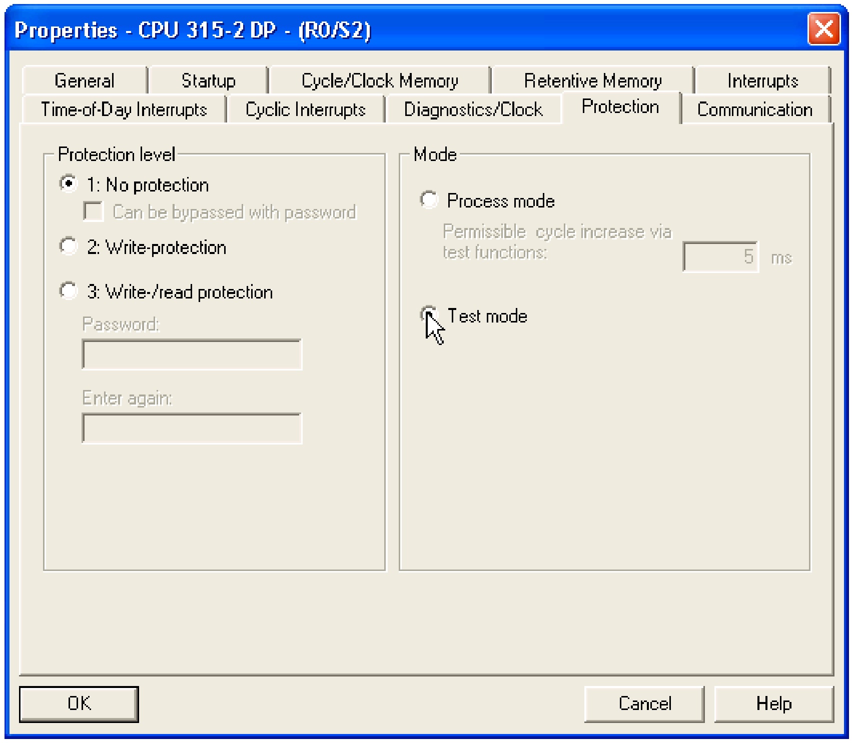
Step 2 Configuring the CPU settings



Select the module rack by clicking on it.
Then double-click on the CPU in the module rack.

"Properties of the CPU..."

The settings are relatively diverse and are described in the STEP7 Help.
For later testing and monitoring, "Test mode" on the "Protection" tab should be activated during commissioning.
Click "OK" to apply the settings.

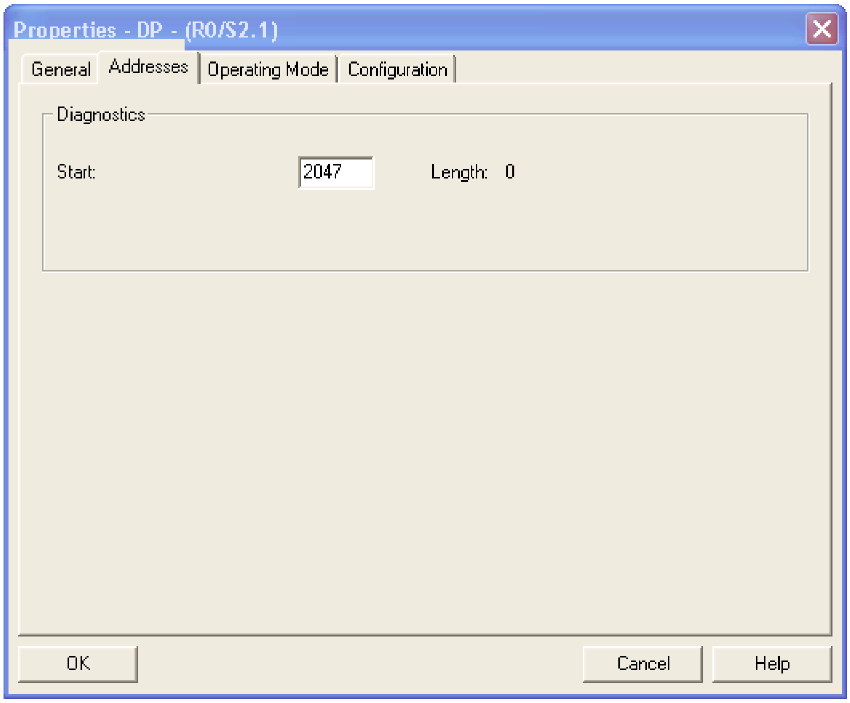


Step 3 Configuring the DP settings

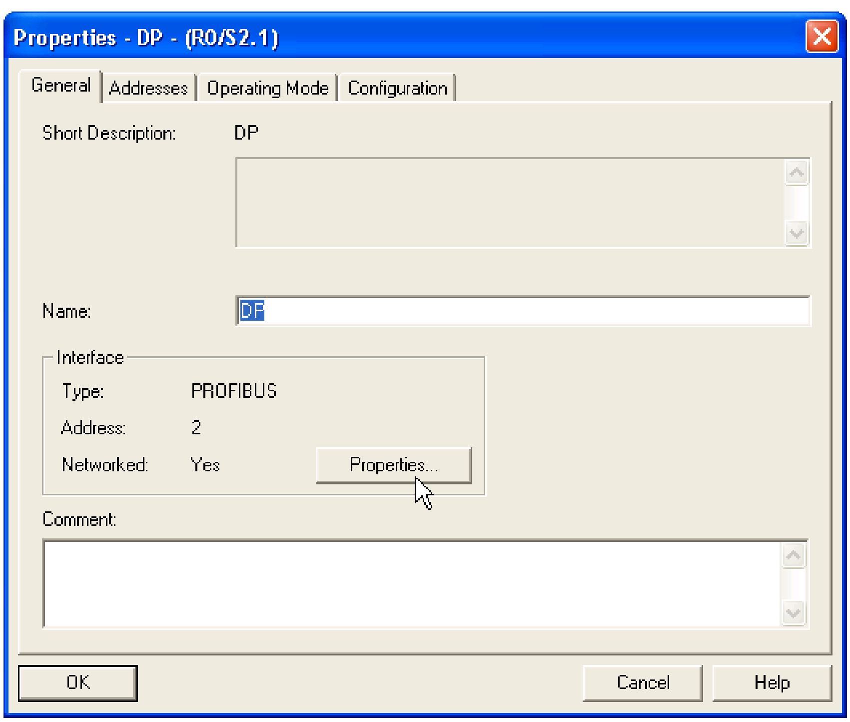
Select the module rack by clicking on it.
Then double-click on the line with the DP interface in the module rack.

"Properties - DP..."

The diagnostics address property may be needed later for software creation. You can find this information under the "Addresses" tab.

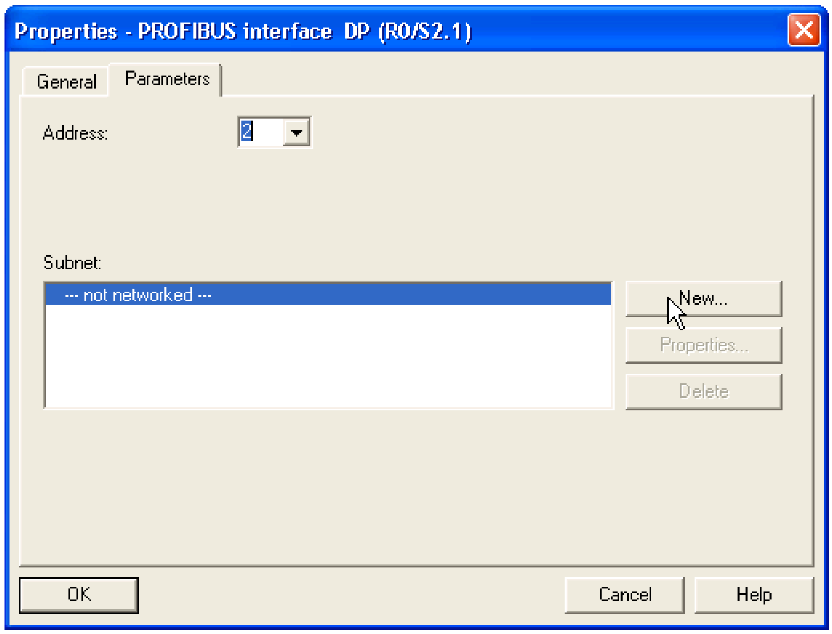


Click on "Properties" on the "General" tab to configure the settings for the network. > A new window opens: "Properties - PROFIBUS interface DP"



"Properties - PROFIBUS interface DP..."

On the "Parameters" tab, select the desired PROFIBUS address in your future network. Then select a network on the "Parameters" tab or create a new network using the "Properties > New subnet PROFIBUS" button



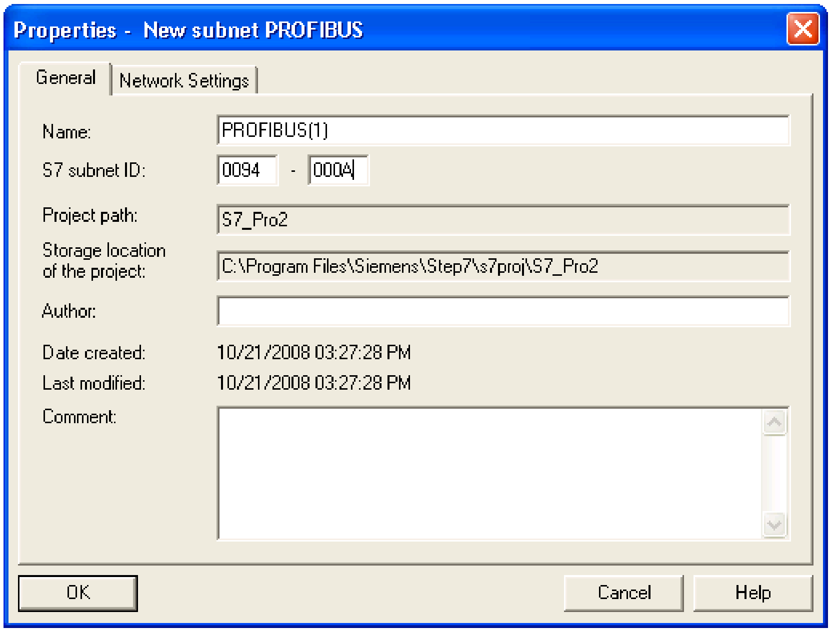
Properties - New Subnet PROFIBUS

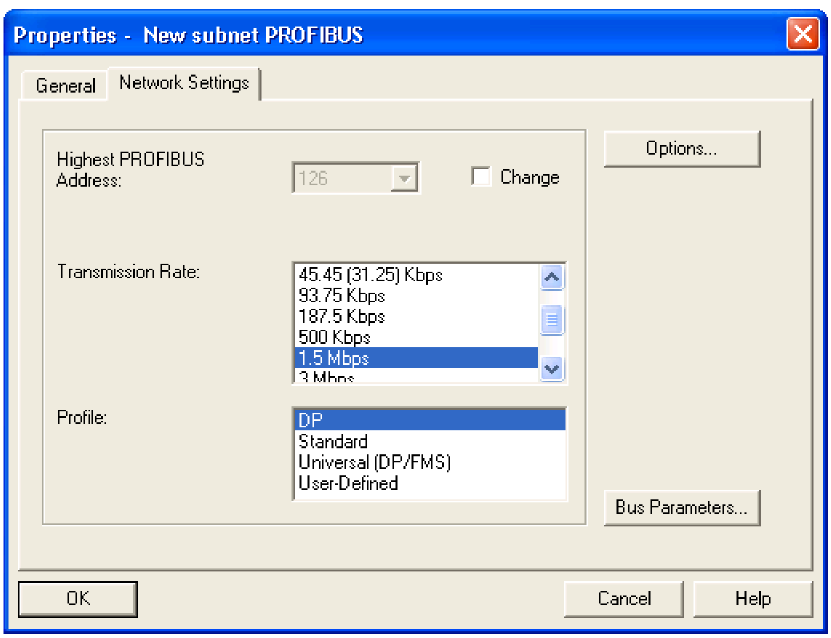
Define the settings for the documentation on the "General" tab, and change the network settings on the "Network Settings" tab.
In our example, it is sufficient to accept the standard settings by clicking "OK".

Accept also the settings of "Properties - PROFIBUS interface DP..." by clicking on "OK".

Check the "DP Master" setting on the "Operating Mode" tab

Click "OK" to close configuration of the DP settings.





Step 4 Creating the SENTRON WL/VL as a PROFIBUS node

For the precise steps, please refer to the Chapter Integration with the GSD file (Page 125)

Step 5

After all settings have been made, the created configuration still has to be saved and compiled for use in the CPU. To do this, use the menu command "Station > Save and Compile"

Step 6

Following this, the data can be transferred to the S7. To do so, use the menu command

"Target System > Load to Module".
The subsequent dialog box must be checked for the correct controller.

You have now completed the configuration for the hardware.
The HW Config program can now be closed.

Note

Before doing this, the setting for the connection to the CPU may have to be set

---

Interface setting for initial configuration of a CPU via MPI (Page 152)

7.1.3 Interface setting for initial configuration of a CPU via MPI

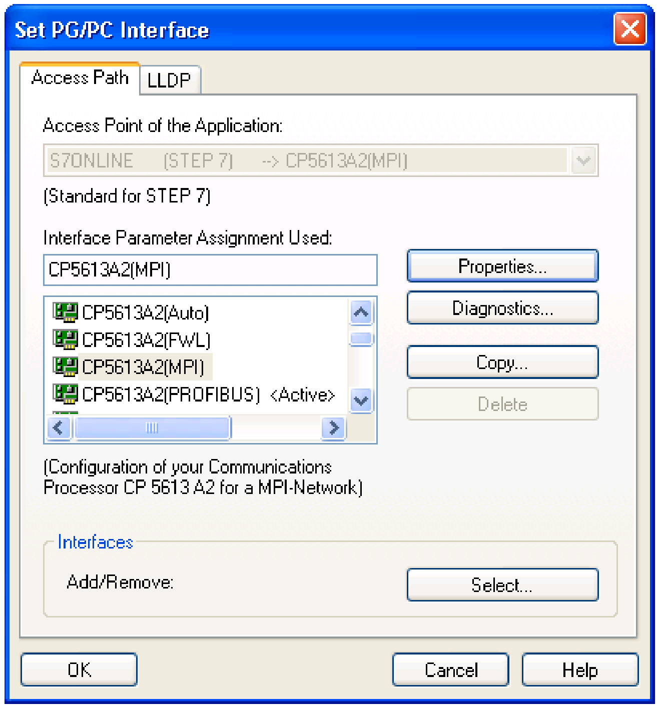
Step 1 Set PG/PC interface

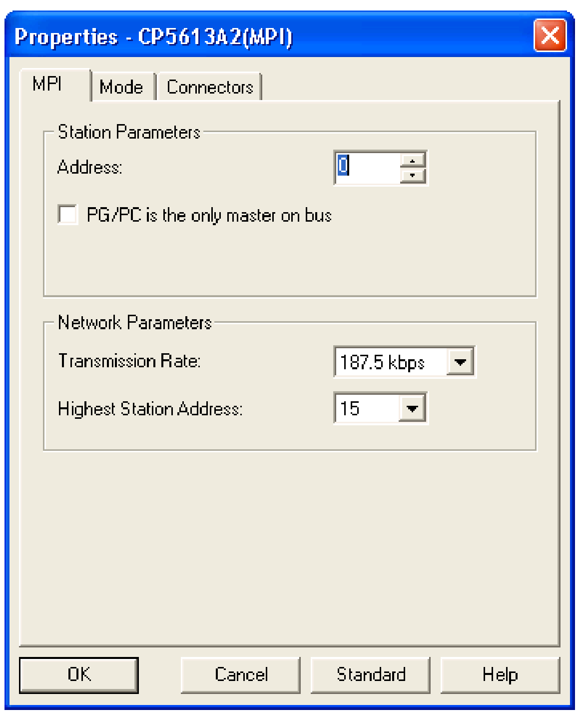
Select the setting dialog box via SIMATIC Manager
"Options > Set PG/PC Interface"

Select "Interface Parameter Assignment Used" for the connection to the S7 controller, e.g.

- CP5611(MPI)
- CP5613(MPI)
- CP5511(MPI)
- CP5512(MPI)

The standard settings for the transmission rate (187.5 Kbit/s) and highest station address (15) should not be changed. Any address can be selected.


Set PG/PC Interface
Access Path
LLDP
Access Point of the Application:
S7ONLINE (STEP 7) --> CP5613A2(MPI)
(Standard for STEP 7)
Interface Parameter Assignment Used:
CP5613A2(MPI)
Properties...
Diagnostics...
Copy...
Delete
CP5613A2(Auto)
CP5613A2(FWL)
CP5613A2(MPI)
CP5613A2(PROFIBUS) <Active>
(Configuration of your Communications Processor CP 5613 A2 for a MPI-Network)
Interfaces
Add/Remove:
Select...
OK
Cancel
Help


Properties - CP5613A2(MPI)
MPI
Mode
Connectors
Station Parameters
Address:
0
PG/PC is the only master on bus
Network Parameters
Transmission Rate:
187.5 kbps
Highest Station Address:
15
OK
Cancel
Standard
Help

7.2 Control program example

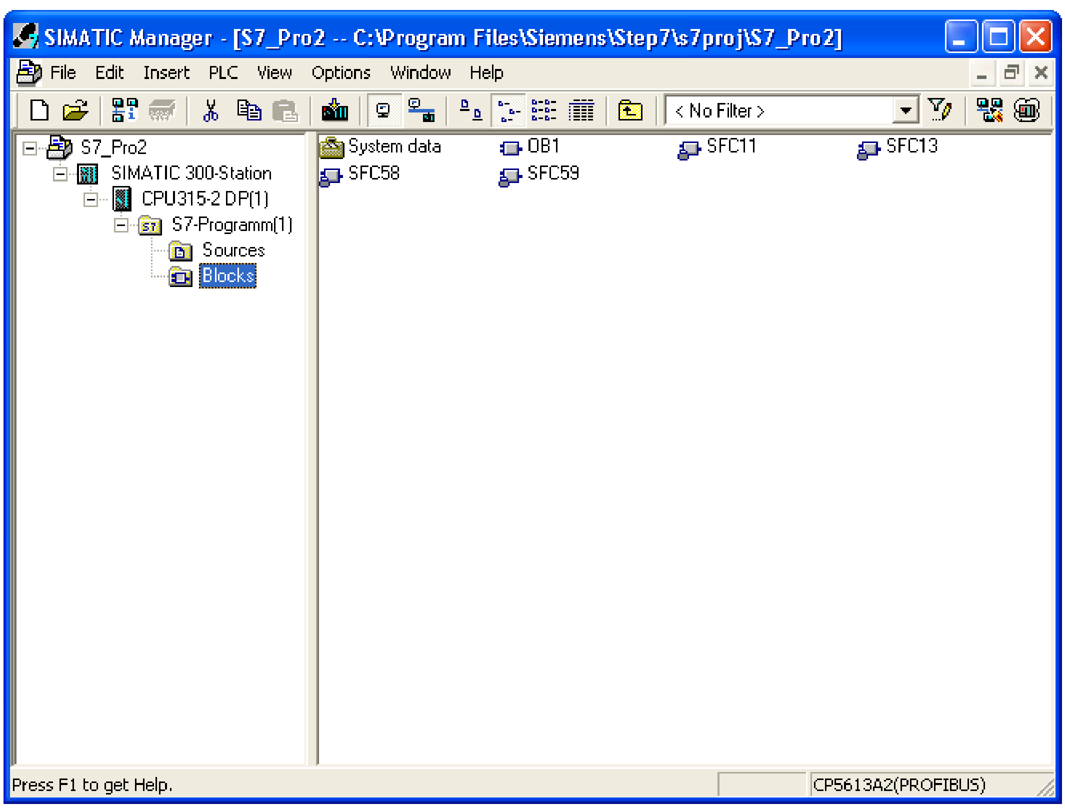
7.2.1 Control program example

Note

The examples below are designed to provide an impression of the general use of the functions. However, they do not represent an autonomous executable program!

7.2.2 Procedure for opening the programming tool

Open the window "LAD/STL/FBD" via
"Project Name > Station Name > Controller Name > S7 Program Name > Block Folder ("S7_Pro2 > SIMATIC 300-Station > CPU315-2 DP (1) > S7-Program (1) > Blocks") and double-click on "Blocks (OB1)" in the "SIMATIC Manager"



The programming representation then appears in OB1.

7.2.3 Using cyclic data

General

Programming is carried out in OB1 or in a block called by OB1

Step 1 Copying status information for programming

Network 1

Fetch I/O data of the status and save for further use

```
L     PIW  256        //Value from hardware configuration "I
address"
T     MW    10        //User-defined storage location MW, ...
```

This makes the bit information accessible for further program execution via M 10.0 – M 11.7

Step 2 Prepare status information (example: status of the circuit breaker)

Network 2

Only using the example of "Status of the circuit breaker"

```
A     M     10.2      //Bit n.2 from the status information
A     M     10.3      //Bit n.3 from the status information
=     "RM_TRIP"  //Signal for further processing
                      //(value 3 = tripped)
AN    M     10.2      //Bit n.2 from the status information
A     M     10.3      //Bit n.3 from the status information
=     "RM_ON"        //Signal for further processing (value 2 = ON)
A     M     10.2      //Bit n.2 from the status information
AN    M     10.3      //Bit n.3 from the status information
=     "RM_OFF"        //Signal for further processing (value
1 = OFF)
                      //only with hardware defect/failure
AN    M     10.2      //Bit n.2 from the status information
AN    M     10.3      //Bit n.3 from the status information
=     "RM_nOK"        //Signal for further processing
                      //(Value 0 = not ready)
```

Step 3 Prepare measured values (basic type 1)

Network 3

Validity is a requirement here - see description "Property byte"

```
//Fetch measured value 1 (standard "Current in L1")
L     PIW  258       //Value from hardware configuration
                     //"I address" + Offset 2
//Please insert – customer-specific evaluation
//Fetch measured value 2 (standard "Current in L2")
L     PIW  260       //Value from hardware configuration
                     //"I address" + Offset 4
//Please insert – customer-specific evaluation
//Fetch measured value 3 (standard "Current in L3")
L     PIW  262       //Value from hardware configuration
                     //"I address" + Offset 6
//Please insert – customer-specific evaluation
//Fetch measured value 4 (standard "max. current")
L     PIW  264       //Value from hardware configuration
                     //"I address" + Offset 8
//Please insert – customer-specific evaluation
```

Step 4 Prepare control information for output

Network 4

Description of use – but without customer-specific component

```
//Please insert - customer's off-condition
=     M     50.0      //Bit n.0 in the control information
//Please insert - Customer's on-condition
AN    M     50.0      //Interlocking of the invalid command - Off
priority
=     M     50.1      //Bit n.1 in the control information
//Please insert – conditions for synchronization bit
=     M     51.7      //Bit n+1.7 Synchronization bit
//continue with other control commands ...
```

Step 5 Forward control information to the switch

Network 5

Forward the information from M50.0 – M 51.7 to the switch.
This executes the commands!

```
      L     MW    50 //Control information M50.0 - M51.7
      T     PQW  256 //Value from hardware configuration "Q address"
```

Note

Programming of Step 5 is also necessary for initializing OBs 100-102 when using the user-defined output to prevent switchover of the user-defined output at complete restart of the controller. Storage of the control information (here "MW50") must also be retentive.

7.2.4 Read data sets

General

Data sets are used for transferring larger data volumes outside the process image and they are executed using the standard function SFC59, "RD_REC".

Step 1 Call block

To call the block, type in the line "Call SFC59" with return in program code.

Note

If block SFC59 is not yet included in the block folder, it is automatically copied from the standard library of STEP7.

Help via "F1" when the cursor is in the line "CALL RD_REC".

Network 6
Intermediate result after entering "Call SFC59"

```
CALL "RD_REC"
 REQ    :=
 IOID   :=
 LADDR  :=
 RECNUM :=
 RET_VAL:=
 BUSY   :=
 RECORD :=
```

Step 2 Assignment with parameters (example: data set 94 'Current measured values')

All parameters must be set customer-specifically.

Note

Help via "F1" when the cursor is in the line "CALL RD_REC"

Network 6
Read data set 94 "Current measured values"

Fetching the current measured values from data set 94 "Current measured values"

```
"CALL RD_REC"
REQ :=M 70.0       //Triggered by program sequence
IOID :=B#16#54     //ID area inputs
LADDR :=W#16#100   //Hardware configuration "I address" in HEX
RECNUM :=B#16#5E   //Data set number "94" in HEX
RET_VAL:=MW 72     //Acknowledgment SFC59
BUSY :=M 71.0      //Acknowledgment Read still active
RECORD :=P#DB10.DBX 0.0 BYTE 197
```

Note

P#DB10.DBX 0.0 BYTE 197 represents a pointer for storing the read data

P# = ID pointer
DB10 = data block to be used
DBX0.0 = offset (here, 0 bytes)
BYTE = ID for repetition factor type
197 = repetition factor (data set length → 197 bytes)

However, this data block must first be generated!
The precise structure of the data sets is included in Chapter Data library (Page 175)

7.2.5 Write data sets

General

Data sets are used for transferring larger data volumes outside the process image and they are executed using the standard function SFC58, "WR_REC".

Step 1 Call block

To call the block, type in the line "Call SFC58" with return in program code.

Note

If block SFC58 is not yet included in the block folder, it is automatically copied from the standard library of STEP7.

Network 7

Intermediate result after entering "Call SFC58"

```
CALL "WR_REC"
 REQ    :=
 IOID   :=
 LADDR  :=
 RECNUM :=
 RECORD :=
 RET_VAL:=
 BUSY   :=
```

Step 2 Assignment with parameters (example: data set 68 'Data of the CubicleBUS Modules')

All parameters must be set customer-specifically.

Note

Help via "F1" when the cursor is in the line "CALL WR_REC"

Network 7

Write data set 68 "Data of the CubicleBUS Modules"

e.g. for setting the time-of-day!

```
CALL "WR_REC"
 REQ    :=M 80.0    //Triggered by program sequence
 IOID   :=B#16#54   //ID area inputs
 LADDR  :=W#16#100  //Hardware configuration "I address" in HEX
 RECNUM :=B#16#44   //Data set number "68" in HEX
 RECORD :=P#DB20.DBX10.0 BYTE 45
 RET_VAL:=MW 82     //Acknowledgment SFC58
 BUSY   :=M 81.0    //Acknowledgment write still active
```

Note

P#DB20.DBX 10.0 BYTE 45 represents a pointer for storing the read data:

P# = ID pointer
DB20 = data block to be used
.DBX10.0 = offset (here 10 bytes)
BYTE = ID for repetition factor type
45 = repetition factor (data set length → 45 bytes)

However, this data block must first be generated!
The precise structure of the data sets is included in Chapter 10.

7.2.6 Reading out diagnostics

General

The diagnostics are used for more precise identification of plant statuses.

Step 1 Call block

To call the block, type in the line "Call SFC13" with return in program code.

Note

If block SFC13 is not yet included in the block folder, it is automatically copied from the standard library of STEP7.

Network 8
Intermediate result after entering "Call SFC13"

```
CALL "DPNRM_DG"
 REQ    :=
 LADDR  :=
 RET_VAL:=
 RECORD :=
 BUSY   :=
```

Step 2 Assignment with parameters

All parameters must be set customer-specifically.

Note

Help via "F1" when the cursor is in the line "CALL DPNRM_DG".

Network 8
Intermediate result after entering "Call SFC13"

```
CALL  "DPNRM_DG"
 REQ    :=M90.0     //Triggered by program sequence
 LADDR  :=W#16#7FE  //Diagnostics address of the slave in HEX
 RET_VAL:=MW92      //
 RECORD :=P#DB20.DBX 60.0 BYTE 28
 BUSY   :=M91.1     //Acknowledgment read still active
```

Note

P#DB20.DBX 60.0 BYTE 28 represents a pointer for storing the read data:

P# = ID pointer
DB20 = data block to be used
.DBX60.0 = offset (here 60 bytes)
BYTE = ID for repetition factor type
28 = repetition factor (diagnostics length → 28 bytes)

However, this data block must first be generated!
The precise structure of the diagnostics is included in Chapter 10.

7.2.7 Sync/Unsync/Freeze/Unfreeze

General

These commands are functions that aim at any number of nodes (slaves) simultaneously.

Step 1 Call block

To call the block, type in the line "Call SFC11" with return in program code.

Note

If block SFC11 is not yet included in the block folder, it is automatically copied from the standard library of STEP7.

Network 9
Intermediate result after entering "Call SFC11"

```
CALL  "DPSYC_FR"
 REQ    :=
 LADDR  :=
 GROUP  :=
 MODE   :=
 RET_VAL:=
 BUSY   :=
```

Step 2 Assignment with parameters

All parameters must be set customer-specifically.

Note

Function codes mode

B#16#04 (UNFREEZE);B#16#08 (FREEZE);B#16#10 (UNSYNC);B#16#20 (SYNC)

```
CALL  "DPSYC_FR"
 REQ    := M95.0   //Triggered by program sequence
 LADDR  :=W#16#7FF //Diagnostics address of the master (CPU) in HEX
 GROUP  :=B#16#1   //Distribution list – groups to be addressed
 MODE   :=MB97     //Function code (e.g. B#16#10 = SYNC)
 RET_VAL:=MW98     //Acknowledgment of the standard block
 BUSY   :=M 96.0   //Acknowledgment still active
```

Note

P#DB20.DBX 60.0 BYTE 28 represents a pointer for storing the read data:

P# = ID pointer
DB20 = data block to be used
DBX60.0 = offset (here 60 bytes)
BYTE = ID for repetition factor type
28 = repetition factor (diagnostics length → 28 bytes)
However, this data block must first be generated!
The precise sequence of the diagnostics is included in Chapter Data library (Page 175).

Determine group assignment

A group assignment is required for the functions "SYNC/FREEZE". Commands can be executed on several nodes simultaneously via this assignment.

Double-click on the PROFIBUS line used. A dialog box opens in which the nodes can be assigned to the groups.

On the "Group Properties" tab, several groups with different functions can be named and configured here. Each slave then has to be assigned to the desired groups on the "Group Assignment" tab.

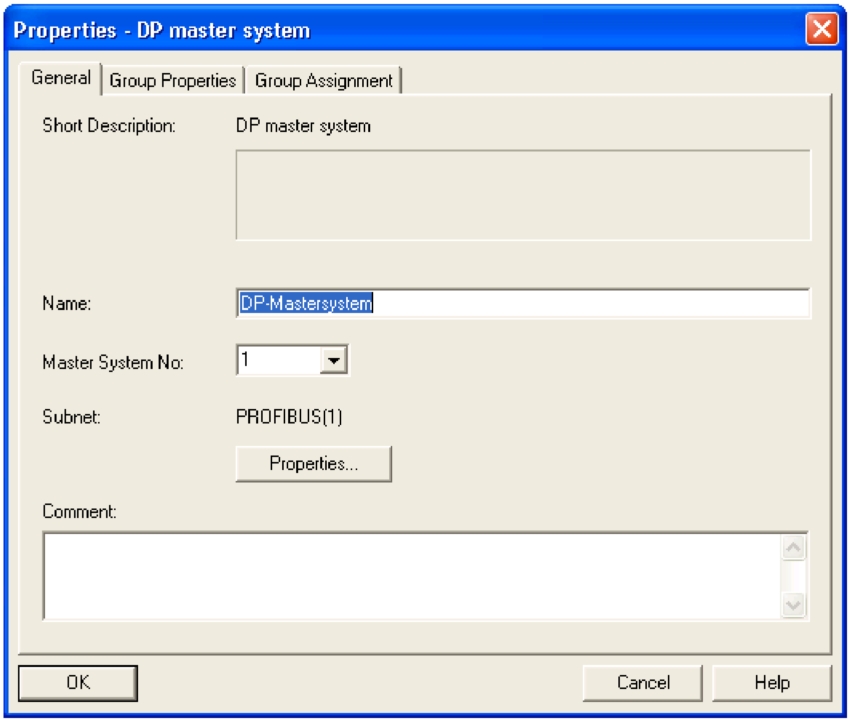


Figure 7-1 Group_General

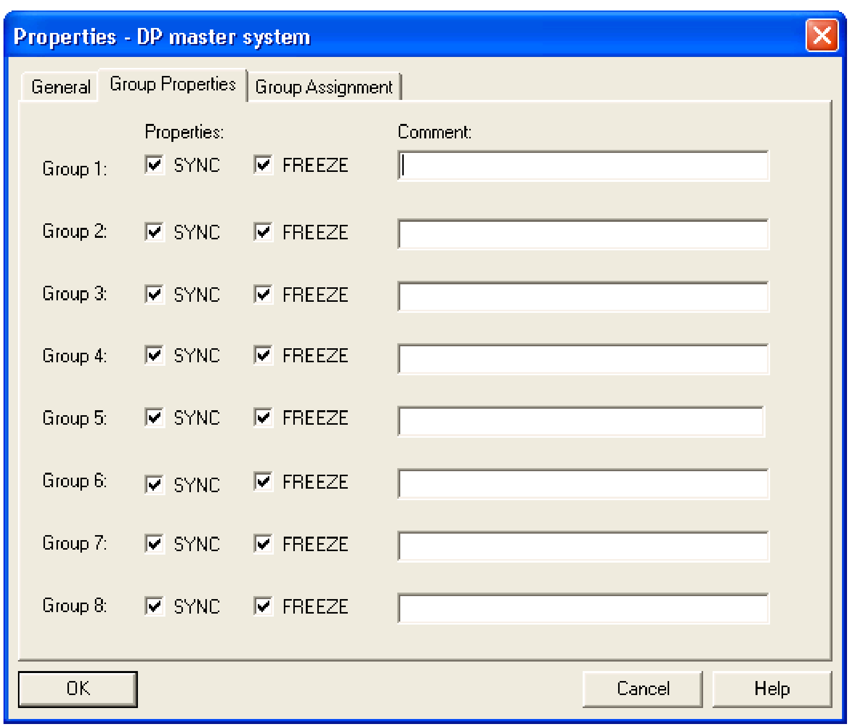


Figure 7-2 Group_Group Properties

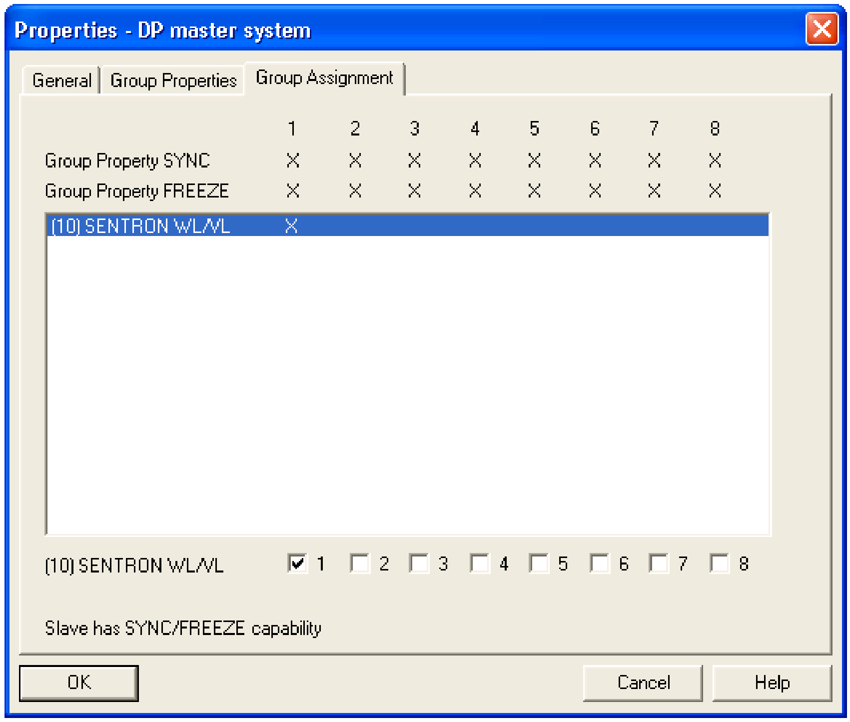


Figure 7-3 Group_Group Assignment

7.3 Functional sequences/description of functions

7.3.1 Diagnostic messages

Diagnostics

By requesting diagnostics data, the DP master checks in the startup phase whether the DP slave is available and ready for parameterization. The diagnostics data communicated by the DP slave consists of a diagnostics data section defined in EN 50170, and specific DP slave diagnostic information. The DP slave informs the DP master of its operating state (PROFIBUS DP-related) via the diagnostics data, and of the cause for the diagnostic message in a diagnostics case.

Local diagnostics event

A DP slave has the option of reporting a local diagnostics event to the DP master via the Layer-2 message frame priority "high-prio" of the Data_Exchange-Response frame in Layer 2. Then the DP master requests the diagnostics data from the DP slave for evaluation.

If there are no current diagnostics events pending, the Data_Exchange-Response frame has a "low-prio" ID. The diagnostics data of a DP slave can also be requested at any time by a DP master without special reporting of diagnostics events.

Diagnostic messages with S7 stations

Modules with diagnostics capability in the distributed I/O are able to report events such as a partial station failure, wire break in signal modules, short-circuit/overload of an I/O channel, or failure of the load voltage supply, via a diagnostic interrupt. In the case of a coming or outgoing diagnostic interrupt, the CPU operating system calls the organization block for diagnostic interrupt OB 82. If a diagnostic interrupt occurs and OB 82 is not programmed, the CPU enters STOP mode.

Coming/outgoing event

A failure (coming event) or the return (outgoing event) of a DP slave is reported by the operating system of the S7-CPU via OB 86. If OB 86 has not been programmed, the S7 CPU switches to STOP mode when the event occurs.

The table below explains the structure of the diagnostics of the circuit breaker.

Table 7- 2 Structure of the PROFIBUS diagnostics

Part of the diagnostics	Byte	Bit	SENTRON WL	SENTRON VL
			COM15	COM20
DP standard	0		Station status 1	
	1		Station status 2	
	2		Station status 3	
	3		PROFIBUS master address	
	4		Identification number High Byte (0x80)	
	5		Identification number Low Byte (0xC0)	
Additional header	6		0x42 fixed	
	7	0	Device-specific diagnostics available	
	8		0x05 fixed	
	9		0x82 fixed	
	10		0x00 fixed	
	11		0x00 fixed	
	12		0x00 fixed	
	13		0x0F fixed	
	14		0x81 fixed	
	15		0x01 fixed	
	16		0x00 fixed	

<table>
<tr><th>Part of the diagnostics</th><th>Byte</th><th>Bit</th><th colspan="2">SENTRON WL</th><th>SENTRON VL</th></tr>
<tr><th></th><th></th><th></th><th colspan="2">COM15</th><th>COM20</th></tr>
<tr><td rowspan="31">Device-specific diagnostics</td><td>17</td><td></td><td colspan="3">0x00 fixed - not used</td></tr>
<tr><td rowspan="10">18</td><td>0</td><td colspan="3">Communication module (COM15, COM20) not ready-to-operate</td></tr>
<tr><td>1</td><td colspan="3">Not used</td></tr>
<tr><td rowspan="5">2/3</td><td colspan="2">State of the main contacts</td><td rowspan="5">Not used</td></tr>
<tr><td>0</td><td>OK</td></tr>
<tr><td>1</td><td>Perform visual inspection on main contacts</td></tr>
<tr><td>2</td><td>Immediate maintenance of main contacts</td></tr>
<tr><td>3</td><td>Not used</td></tr>
<tr><td>4</td><td colspan="2">Circuit breaker not available</td><td>Not used</td></tr>
<tr><td>5</td><td colspan="3" rowspan="3">Not used</td></tr>
<tr><td>6</td></tr>
<tr><td>7</td></tr>
<tr><td rowspan="8">19</td><td>0</td><td colspan="3">Connection between circuit breaker and communication module (COM15, COM20) interrupted</td></tr>
<tr><td>1</td><td colspan="3">Not used</td></tr>
<tr><td>2</td><td colspan="2">Last action on the CubicleBUS:
Module removed</td><td rowspan="3">Not used</td></tr>
<tr><td>3</td><td colspan="2">Last action on the CubicleBUS:
module added</td></tr>
<tr><td>4</td><td colspan="2">Last action on the CubicleBUS:
Fault detected</td></tr>
<tr><td>5</td><td colspan="3" rowspan="3">Not used</td></tr>
<tr><td>6</td></tr>
<tr><td>7</td></tr>
<tr><td>20-23</td><td colspan="3">CubicleBUS module list: Last action
(see 19.2 to 19.4)</td><td rowspan="15">Not used</td></tr>
<tr><td rowspan="8">20</td><td>0</td><td colspan="2" rowspan="9">Not assigned</td></tr>
<tr><td>1</td></tr>
<tr><td>2</td></tr>
<tr><td>3</td></tr>
<tr><td>4</td></tr>
<tr><td>5</td></tr>
<tr><td>6</td></tr>
<tr><td>7</td></tr>
<tr><td rowspan="6">21</td><td>0</td></tr>
<tr><td>1</td><td colspan="2">BDA PLUS</td></tr>
<tr><td>2</td><td colspan="2">Not assigned</td></tr>
<tr><td>3</td><td colspan="2">Graphic display ETU76B</td></tr>
<tr><td>4</td><td colspan="2">Analog output module No. 2</td></tr>
<tr><td>5</td><td colspan="2">Analog output module No. 1</td></tr>
</table>

Part of the diagnostics	Byte	Bit	SENTRON WL	SENTRON VL
			COM15	COM20
		6	Metering function	
		7	Not assigned	
	22	0	Configurable output module	
		1	Not assigned	
		2	Digital output module Rotary coding switch Module No. 2	
		3	Digital input module Rotary coding switch 'PARAMETER SWITCH'	
		4	BreakerStatus Sensor (BSS)	
		5	Digital output module Rotary coding switch Module No. 1	
		6	Digital input module Rotary coding switch 'PROFIBUS INPUT'	
		7	Not assigned	
	23	0	COM15	
		1	ETU (trip unit)	
		2	ZSI module	
		3	Not assigned	
		4		
		5		
		6		
		7		
	24-27	Module presence list on the CubicleBUS		Not used
	24		Assignment see byte 20	
	25		Assignment see byte 21	
	26		Assignment see byte 22	
	27		Assignment see byte 23	

Diagnostics of the SENTRON WL

If the PLC master sets byte 0 to "08" instead of "00", the slave has reported an external diagnostic message in accordance with the standard. This is automatically generated by the ASIC.

External diagnostics trip

If there is an external diagnostic message, "01" instead of "00" is set in byte 7.

External diagnostics on SENTRON WL are only triggered if one of the following statuses occurs:

- COM15 is not ready for operation.
- Bit 18.2 or/and 18.3 report a number not equal to 0 (that is, essentially a maintenance message).
- Bit 18.4 is set, that is, the circuit breaker is not present.
- One of the bits of byte 19 is equal to "1".

Module presence on the CubicleBUS

In bytes 24 to 27, the presence of a module on the CubicleBUS is entered. If a module is added, or another is removed, or a fault is detected on a module, the relevant bit in byte 19 (19.2, 19.3, 19.4) is set and the affected module is indicated in bytes 20 to 23. A coming diagnostic message is triggered on PROFIBUS DP. If nothing else changes on the module triggering the diagnostics, the message goes again after 10 seconds (provided there are no other reasons for a diagnosis). The information about the last change (19.2, 19.3 or 19.4 plus module number byte 20 to 24) remains until another message is received. If a module is added, the relevant module is indicated in bytes 20 to 24. In the module presence list, the added module does not appear until after the outgoing diagnostic message (10 s). The user can see at any time which module was last added on the CubicleBUS.

The same applies for removing modules, with the difference that they are not removed from the module presence list until after the outgoing diagnostic message.

Error messages

In the case of error messages on a module, the CubicleBUS module remains in the module presence list.

Diagnostics of the SENTRON VL

The SENTRON VL has fewer diagnostic messages than the SENTRON WL. There are coming and outgoing diagnostic messages here too.

The following messages are available:

- There are no diagnostic messages
- The COM20 is out of service
- The communication connection between COM20 and SENTRON VL has been interrupted

Diagnostic interrupt in S7 and S7V1 operating mode

If the SENTRON circuit breakers are configured using the object manager, they are activated in operating mode S7V1. A diagnostic message here does not automatically result in execution of OB 82. Diagnostic interrupts are not supported.

The diagnostic information can be read by the slave at any time using SFC 13.

Example:

The figure below shows the online diagnostics in the STEP7 Tool HW Config using the example of a SENTRON WL. It represents the diagnostic information as text. It indicates the modules detected on the CubicleBUS and the last action on the CubicleBUS. Maintenance information is also available.

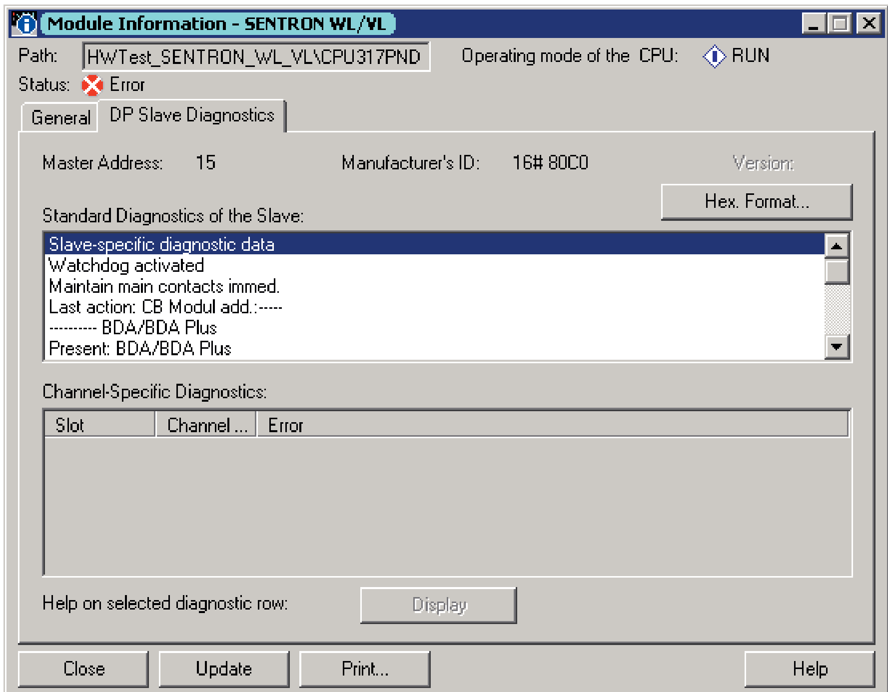


Figure 7-4 Online diagnostics in the STEP7 tool HW Config

The figure below shows the diagnostic buffer of the S7 that contains the currently displayed diagnostic information of the SENTRON WL. There is no incoming diagnostic message.

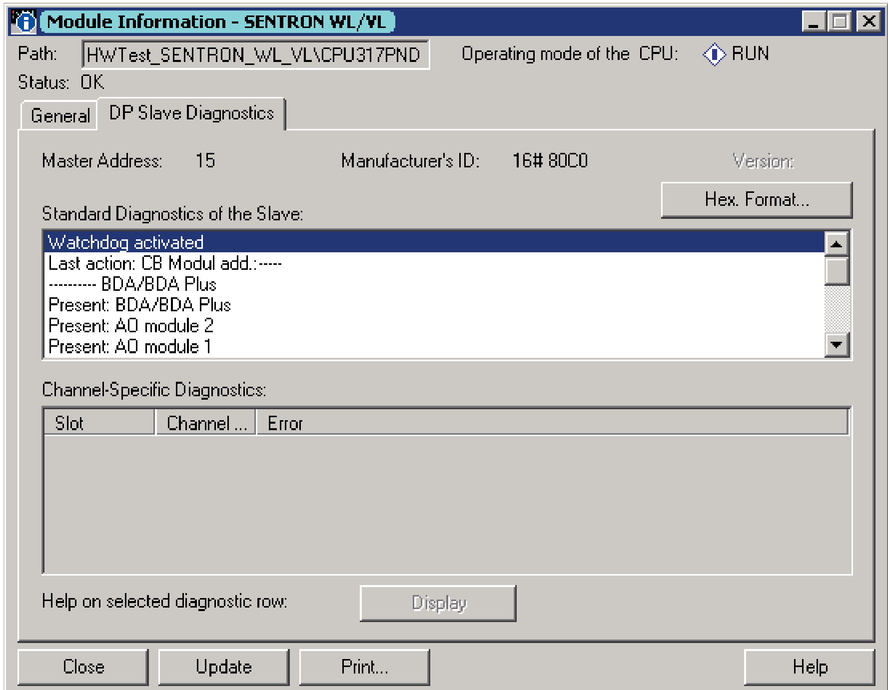


Figure 7-5 Diagnostic buffer of the S7

7.3.2 SYNC and FREEZE

To coordinate the data exchange, PROFIBUS DP offers the user the control commands SYNC (synchronization of the outputs) and FREEZE (freezing of the inputs). The SENTRON circuit breakers VL and WL support both SYNC and FREEZE mode.

With SFC11 DPSYNC_FR, the control commands are triggered from the user program of the S7. Not every master supports this function.

SYNC/FREEZE groups

A DP master with the relevant functionality can send the SYNC and/or FREEZE control commands (broadcast frames) to a group of DP slaves simultaneously. For this purpose, the DP slaves are combined into SYNC and FREEZE groups. Up to 8 groups can be formed for a master system. However, each DP slave can only be assigned to a maximum of one group.

SYNC

The control command SYNC enables the user to synchronize the outputs on several slaves simultaneously. When the control command SYNC is received, the addressed DP slaves switch the data of the last Data_Exchange frame from the DP master in their transfer buffer to the outputs. This enables simultaneous activation (synchronization) of the output data on several DP slaves.

UNSYNC

SYNC mode of the addressed DP slaves is revoked with the control command UNSYNC. The DP slave is then involved again in cyclic data transfer, that is, the data sent by the DP master is switched immediately to the outputs.

FREEZE

The control command FREEZE enables the user to "freeze" the input data of DP slaves. If a FREEZE command is sent to a group of DP slaves, all these DP slaves simultaneously freeze the signals currently active at their inputs. These can then be read by the DP master. The input data on the DP slaves is not updated until after receipt of a new FREEZE command.

UNFREEZE

The control command UNFREEZE revokes FREEZE mode of the addressed DP slaves so that these return to cyclic data transfer with the DP master. The input data is immediately updated by the DP slave and can then be immediately read by the DP master.

Please note that after a complete restart or a restart, a DP slave does not change to SYNC mode or FREEZE mode until it has received the first SYNC or FREEZE commands from the DP master.

7.3.3 Time synchronization

General

To achieve a reliable time of day in conjunction with all other circuit breakers, the clock in every device must be regularly synchronized with the other switches to the correct time.

Step 1 Updating the time of day

Load the current time into every circuit breaker from the PLC. First, data set 68 with the current system time must be sent to all circuit breakers via the acyclic services of the DPV1 channel.
(See Chapter Write data sets (Page 159)).

Step 2 Sync frame

Shortly before the half hour (e.g. 14:29:50), send a SYNC command to the affected SYNC group.
From now on, all control commands until the next SYNC command or the next UNSYNC command will be delayed.
(See Chapter Sync/Unsync/Freeze/Unfreeze (Page 161))

Step 3 Set Sync bit

In all affected circuit breakers, set the bit for synchronization of the clocks (bit 7 of byte 1 of the control byte).

(see Chapter Using cyclic data (Page 155))

Step 4 Sync frame

Send a SYNC command again at the half hour (e.g. 14:30:00). This rounds the clocks up or down to the half hour in all devices within the SYNC group.
(See Chapter Sync/Unsync/Freeze/Unfreeze (Page 161))

Step 5 Unsync frame

Send an UNSYNC command to the affected SYNC group.

(See Chapter Sync/Unsync/Freeze/Unfreeze (Page 161))

Step 6 Reset Sync bit

In all affected circuit breakers, reset the bit for synchronization of the clocks (bit 7 of byte 1 of the control byte).
(See Chapter Using cyclic data (Page 155))

8 Data library

The communication system of the SENTRON circuit breakers is extremely versatile and flexible. The large number of data points can be read, and to a certain extent written, via data sets. Many of them can be integrated into the cyclic message frame. This chapter provides a detailed description of the different data points and their properties.

General

The basis for the shared profile of the SENTRON circuit breakers is an overall database referred to as a data library. This data library defines which circuit breaker supports which data points.

Properties of the data points

The data library also describes the properties of all data points:

- What is the data point number of this data point and what is its name?
- What is the source of this data point?
- What is the format of this data point?
- What is the size of this data point?
- What is the scaling of this data point?
- In which data set is this data point available?

8.1 Chapter overview

This chapter describes the data points of the data library.

- In the first section, the data points are combined into function classes. Function classes are, for example, data for identification, device parameters, or measured values. This subdivision quickly enables users to find the desired data point and its properties.
- The second part of this chapter describes the structure of the read/write data sets that in turn consist of the data points described in the previous section. This allows the data sets transferred via PROFIBUS to be interpreted in the master.
- The third section of this chapter describes the different formats of the data points. This includes the description of the Motorola format used, e.g. "int" and "unsigned int", as well as, above all, the description of special formats. A special format is, for example, the binary breakdown of the data point that specifies the last tripping operation.

8.2 Scaling

The measured values are always transferred as integer values (format "INTEGER" = "INT") and never as Floating Point numbers (format "REAL"). These values can be signed. For this, a scaling factor must be added in the case of some measured values so that the transferred measured value can be correctly interpreted. The scaling factor to be displayed in each case can be taken from the table shown below (from "data points").

Frequency example

The measured value of the current frequency (data point #262) varies between 15.00 and 440.00 Hz. The decimal places could not be communicated using the INTEGER format without scaling. For this reason, the measured value is scaled with 10^2, and a value of between 1500 and 44000 is communicated. At the receiver end (PROFIBUS master), this value must now be multiplied by the scaling factor corresponding to the exponent of 10 (-2, multiplication by 10^{-2}). The exponent at the receiver end is always specified for the scaling factor.

8.3 Abbreviations of the data sources

Table 8- 1 The following abbreviations are used in the data sources:

Abbreviation	Meaning
ETU	Electronic trip unit
Meter. fct.	Metering function or metering function PLUS
DI	Digital input module
DO	Digital output module
BDA	Breaker Data Adapter PLUS
BSS	Breaker Status Sensor
conf. DO	Configurable digital output module

8.4 Units

The measured values have the following measuring units unless otherwise indicated in the tables:

Measured value	Measuring unit	Name
Current	A	Ampere
Voltage	V	Volts
Power	kW	kilowatt
Power	kVA	kilovolt ampere
Reactive power	kVA_r	kilovolt ampere (reactive)
Energy	kWh	kilowatt/hour
Reactive energy	kVArh	kilovolt ampere (reactive)/hour
Energy	MWh	megawatt/hour
Reactive energy	MVA_rh	Megavolt ampere (reactive)/hour
Temperature	°C	Degrees Celsius
THD/form factor/peak factor	%	Percent
Frequency	Hz	Hertz
Delay time	s	Seconds

This also applies to the min./max. values.

8.5 Function classes

8.5.1 Function classes of the data points

In this section, the data points are combined into function classes. Function classes are, for example, data for identification, device parameters, or measured values. This subdivision quickly enables users to find the desired data point and its properties.

8.5.2 Data points for controlling the SENTRON circuit breakers

The SENTRON circuit breakers can be controlled with the data points listed in the table below (e.g. switch on, switch off, and also functions that control the CubicleBUS modules).

Table 8- 2 Data points for controlling the circuit breaker

Description	Data point	Source WL	Source VL	Format	Length (bits)	Scaling	Contained in DS.Byte
Controls the functions/commands (e.g. reset min./max. values) of the communication module	18	COM15	COM20	Format (18)	8	—	DS51.181 DS93.10
Controls the outputs of the communication module (e.g. switching the breaker)	19	COM15	COM20	Format (19)	8	—	DS51.182 DS93.11
Date of the last parameter change	84	COM15	—	Time	64	—	DS91.10
System time of the circuit breaker	90	COM15	COM20	Time	64	—	DS51.194 DS68.4 DS52.44*
Controls the digital output module 1	121	DO1	—	Format (121)	8	—	DS93.8
Controls the digital output module 2	126	DO2	—	Format (121)	8	—	DS93.9
Controls the trip unit	406	ETU	—	Format (406)	16	—	DS93.4
6 PROFIBUS bits for the digital configurable output module	426	COM15	—	Format (426)	6	—	DS69.13** DS93.1

* COM20 only

** Read only

8.5.3 Data points for detailed diagnostics of the SENTRON circuit breakers

The SENTRON circuit breakers provide a host of data for detailed diagnostics shown in the table below:

Table 8- 3 Data points for detailed diagnostics of the SENTRON circuit breakers

Description	Data point	Source WL	Source VL	Format	Length (bits)	Scaling	Contained in DS.Byte
PROFIBUS write protection (DPWriteEnable)	14	COM15	COM20	Format (14)	1	—	DS69.11
Trip log of the last 5 tripping operations with time	15	COM15	COM20	Format (15)	480	—	DS51.0
Event log of the last 10 events with time	16	COM15	—	Format (16)	960	—	DS51.60 DS92.42
Number of switching operations under load	80	COM15	—	unsigned int	16	0	DS91.0
Number of switching operations caused by trips	81	COM15	COM20	unsigned int	16	0	DS91.2
Switching cycle counter (for switching cycle on/off)	82	COM15	—	unsigned int	16	0	DS91.4
Runtime meter (when On + current > 0)	83	COM15	COM20	unsigned long	32	0	DS91.6
Number of short-circuit releases (SI)	104	ETU	COM20	unsigned int	16	0	DS91.18
Number of overload trips (L)	105	ETU	COM20	unsigned int	16	0	DS91.20
Number of ground-fault tripping operations (G)	106	ETU	COM20	unsigned int	16	0	DS91.22
Total of deactivated I^2t values L1, L2, L3, N	107	ETU	COM20	Format (107)	128	0	DS91.24
Tripping operations by metering function PLUS	307	Meter. fct. PLUS	—	Format (307)	16	—	DS92.28
Threshold warnings	308	Meter. fct. PLUS	—	Format (308)	32	—	DS92.30
Harmonics of current/voltage to the 29th	309	Meter. fct. PLUS	—	Format (309)	928	0	DS64.0
Order number of the trip unit	371	ETU	—	18 x char	144	—	DS97.126
Time until presumed overload trip	379	ETU	—	unsigned int	16	0	DS51.1
Last unacknowledged tripping operation of the trip unit	401	ETU	ETU	Format (401)	8	—	DS92.26
Currently pending alarms	402	ETU	ETU	Format (402)	16	—	DS92.24
Current at the moment of shutdown	403	ETU	ETU	unsigned int	16	0(VL)/1	DS92.34
Phase at the moment of shutdown	404	ETU	ETU	Format (373)	3	—	DS92.36
Switch position at the digital input module 1	111	DI1	—	Format (111)	8	—	DS69.3

Description	Data point	Source WL	Source VL	Format	Length (bits)	Scaling	Contained in DS.Byte
Switch position at the digital input module 2	115	DI2	—	Format (111)	8	—	DS69.4
Switch position at the digital output module 1	119	DO1	—	Format (119)	8	—	DS69.5
Switch position at the digital output module 2	124	DO2	—	Format (119)	8	—	DS69.6
Shows the phase with maximum load	373	ETU	ETU	Format (373)	3	—	DS51.183 DS52.24*
Position and status of the circuit breaker in the frame	24	COM15	COM20	Format (24)	4	—	DS51.202 DS92.37 DS52.25*
Modules connected to the CubicleBUS	88	COM15	—	Format (88)	32	—	DS92.20 DS91.48
Status of the inputs of the digital input module 1	110	DI1	—	Hex	8	—	DS69.0
Status of the inputs of the digital input module 2	114	DI2	—	Hex	8	—	DS69.1
Status of outputs of the digital output module 1	118	DO1	—	Hex	8	—	DS68.14
Status of outputs of the digital output module 2	123	DO2	—	Hex	8	—	DS68.15
Status of the connected PROFIBUS	17	COM15	COM20	Format (17)	3	—	DS51.180 DS52.54*
Status of the circuit breaker (on/off/powered, etc.)	328	BSS	COM20	Format (328)	8	—	DS51.203 DS52.22* DS92.40
Maintenance information about the main contacts	405	ETU	—	Format (405)	2	—	DS91.40

* COM20 only

8.5.4 Data points for identifying the SENTRON circuit breakers

The SENTRON circuit breakers provide a host of data for detailed diagnostics shown in the table below:

Table 8- 4 Data points for identifying the SENTRON circuit breakers

Description	Data point	Source WL	Source VL	Format	Length (bits)	Scaling	Contained in DS.Byte
User text (freely editable)	20	COM15	COM20	64 x char	512	—	DS165.4
Plant identifier (freely editable)	21	COM15	—	64 x char	512	—	DS165.68
Date (freely editable)	22	COM15	—	Time	64	—	DS165.132
Author (freely editable)	23	COM15	—	30 x char	240	—	DS165.140
ID number of the COM15	91	COM15	COM20	16 x char	128	—	DS162.4
Market in which the trip unit is used	95	ETU	COM20	Format (95)	2	—	DS97.47
Identification number of circuit breaker	96	ETU	—	20 x char	160	—	DS97.48
Test date of switch	98	ETU	—	Time	64	—	DS97.74 DS100.4
Switching capacity class	99	ETU	—	Format (99)	4	—	DS97.82
Size	100	ETU	—	Format (100)	2	—	DS97.83
Rated voltage (LL) of the circuit breaker	101	ETU	—	unsigned int	16	0	DS97.84
Rated current of the external g transformer	102	ETU	—	unsigned int	16	0	DS97.86 DS129.70
Order number of the circuit breaker (on the SENTRON VL, this is the order number of the trip unit)	103	ETU	—	Format (103)	160	—	DS162.20 DS97.88
Number of poles of circuit breaker	108	ETU	ETU	Format (108)	3	—	DS97.144
Type (metering function, metering function PLUS)	138	Meter. fct.	—	Format (138)	8	—	DS162.40
Rating plug	377	ETU	ETU	unsigned int	16	0	DS51.208 DS97.146
Circuit breaker frame	378	ETU	ETU	unsigned int	16	0	DS97.148
Order number of the trip unit	407	ETU	—	16 x char	144	—	DS97.0
Date of manufacture of trip unit	408	ETU	—	Time	64	—	DS97.18
Identification number of trip unit	409	ETU	—	17 x char	136	—	DS97.26
N transformer connected	411	ETU	ETU	Format (411)	1	—	DS97.45
Type of trip unit	412	ETU	ETU	Format (412)	5	—	DS162.41

8.5.5 Data points for measured values current

The table below contains the data points for measured values current:

Table 8- 5 Data points for measured values current

Description	Data point	Source WL	Source VL	Format	Length (bits)	Scaling	Contained in DS.Byte
Phase unbalance current (as %)	172	Meter. fct.	ETU	unsigned ch ar	8	0	DS94.0
Long-time mean value of 3-phase current	193	Meter. fct.	ETU	unsigned int	16	0	DS94.2
Long-time mean value of current L1	194	Meter. fct.	—	unsigned int	16	0	DS94.4
Long-time mean value of current L2	195	Meter. fct.	—	unsigned int	16	0	DS94.6
Long-time mean value of current L3	196	Meter. fct.	—	unsigned int	16	0	DS94.8
Minimum long-term mean value for current	244	Meter. fct.	—	unsigned int	16	0	DS72.24
Maximum long-term mean value for current	245	Meter. fct.	COM20	unsigned int	16	0	DS72.26
Current of phase with maximum load	374	ETU	ETU	unsigned int	16	0	DS51.186 DS52.6*
Current in neutral conductor	375	ETU	ETU	unsigned int	16	0	DS51.190 DS94.18 DS52.8*
Current which flows to ground	376	ETU	ETU	unsigned int	16	0	DS51.192 DS94.20 DS52.10*
Current in phase 1	380	ETU	ETU	unsigned int	16	0	DS94.10
Current in phase 2	381	ETU	ETU	unsigned int	16	0	DS94.12
Current in phase 3	382	ETU	ETU	unsigned int	16	0	DS94.14
Mean current value over the three phases	383	ETU	ETU	unsigned int	16	0	DS94.16
Minimum current in phase 1	384	ETU	—	unsigned int	16	0	DS72.0
Maximum current in phase 1	385	ETU	—	unsigned int	16	0	DS72.2
Minimum current in phase 2	386	ETU	—	unsigned int	16	0	DS72.4
Maximum current in phase 2	387	ETU	—	unsigned int	16	0	DS72.6
Minimum current in phase 3	388	ETU	—	unsigned int	16	0	DS72.8
Maximum current in phase 3	389	ETU	—	unsigned int	16	0	DS72.10
Minimum current in neutral conductor	390	ETU	—	unsigned int	16	0	DS72.12
Maximum current in neutral conductor	391	ETU	ETU	unsigned int	16	0	DS72.14
Minimum current which flows to ground	392	ETU	—	unsigned int	16	0	DS72.16
Maximum current which flows to ground	393	ETU	ETU	unsigned int	16	0	DS72.18
Minimum mean value over the three phases	394	ETU	—	unsigned int	16	0	DS72.20
Maximum mean value over the three phases	395	ETU	ETU	unsigned int	16	0	DS72.22

* COM20 only

8.5.6 Data points for measured values voltage

The table below contains the data points for measured values voltage:

Table 8- 6 Data points for measured values voltage

Description	Data point	Source WL	Source VL	Format	Length (bits)	Scaling	Contained in DS.Byte
Phase unbalance voltage (in %)	173	Meter. fct.	—	unsigned char	8	0	DS94.22
Phase-to-phase voltage between phase L1 and L2	197	Meter. fct.	—	unsigned int	16	0	DS94.24
Phase-to-phase voltage between phase L2 and L3	198	Meter. fct.	—	unsigned int	16	0	DS94.26
Phase-to-phase voltage between phase L3 and L1	199	Meter. fct.	—	unsigned int	16	0	DS94.28
Neutral point voltage phase L1	200	Meter. fct.	—	unsigned int	16	0	DS94.30
Neutral point voltage phase L2	201	Meter. fct.	—	unsigned int	16	0	DS94.32
Neutral point voltage phase L3	202	Meter. fct.	—	unsigned int	16	0	DS94.34
Mean value of phase-to-phase voltage	203	Meter. fct.	—	unsigned int	16	0	DS94.36
Mean value of neutral-point star voltage	204	Meter. fct.	—	unsigned int	16	0	DS94.38
Minimum phase-to-phase voltage between phase L1 and L2	205	Meter. fct.	—	unsigned int	16	0	DS73.0
Maximum phase-to-phase voltage between phase L1 and L2	206	Meter. fct.	—	unsigned int	16	0	DS73.2
Minimum phase-to-phase voltage between phase L2 and L3	207	Meter. fct.	—	unsigned int	16	0	DS73.4
Maximum phase-to-phase voltage between phase L2 and L3	208	Meter. fct.	—	unsigned int	16	0	DS73.6
Minimum phase-to-phase voltage between phase L3 and L1	209	Meter. fct.	—	unsigned int	16	0	DS73.8
Maximum phase-to-phase voltage between phase L3 and L1	210	Meter. fct.	—	unsigned int	16	0	DS73.10
Minimum of the neutral point voltage phase L1	211	Meter. fct.	—	unsigned int	16	0	DS73.12
Maximum of the neutral point voltage phase L1	212	Meter. fct.	—	unsigned int	16	0	DS73.14
Minimum of the neutral point voltage phase L2	213	Meter. fct.	—	unsigned int	16	0	DS73.16
Maximum of the neutral point voltage phase L2	214	Meter. fct.	—	unsigned int	16	0	DS73.18

Description	Data point	Source WL	Source VL	Format	Length (bits)	Scaling	Contained in DS.Byte
Minimum of the neutral point voltage phase L3	215	Meter. fct.	—	unsigned int	16	0	DS73.20
Maximum of the neutral point voltage phase L3	216	Meter. fct.	—	unsigned int	16	0	DS73.22

8.5.7 Data points for measured values power

The table below contains the data points for measured values power:

Table 8- 7 Data points for measured values power

Description	Data point	Source WL	Source VL	Format	Length (bits)	Scaling	Contained in DS.Byte
Total apparent power	217	Meter. fct.	—	unsigned int	16	0	DS94.40
Apparent power in phase L1	218	Meter. fct.	—	unsigned int	16	0	DS94.62
Apparent power in phase L2	219	Meter. fct.	—	unsigned int	16	0	DS94.64
Apparent power in phase L3	220	Meter. fct.	—	unsigned int	16	0	DS94.66
Total active power	221	Meter. fct.	—	signed int	16	0	DS94.42
Active power in phase L1	222	Meter. fct.	—	signed int	16	0	DS94.44
Active power in phase L2	223	Meter. fct.	—	signed int	16	0	DS94.46
Active power in phase L3	224	Meter. fct.	—	signed int	16	0	DS94.48
Total reactive power	225	Meter. fct.	—	signed int	16	0	DS94.50
Reactive power in phase L1	226	Meter. fct.	—	signed int	16	0	DS94.76
Reactive power in phase L2	227	Meter. fct.	—	signed int	16	0	DS94.78
Reactive power in phase L3	228	Meter. fct.	—	signed int	16	0	DS94.80
Long-time mean value of 3-phase active power	229	Meter. fct.	—	signed int	16	0	DS94.52
Long-time mean value of active power in phase L1	230	Meter. fct.	—	signed int	16	0	DS94.54
Long-time mean value of active power in phase L2	231	Meter. fct.	—	signed int	16	0	DS94.56
Long-time mean value of active power in phase L3	232	Meter. fct.	—	signed int	16	0	DS94.58
Long-time mean value of 3-phase apparent power	233	Meter. fct.	—	unsigned int	16	0	DS94.60
Long-time mean value of apparent power in phase L1	234	Meter. fct.	—	unsigned int	16	0	DS94.68
Long-time mean value of apparent power in phase L2	235	Meter. fct.	—	unsigned int	16	0	DS94.70
Long-time mean value of apparent power in phase L3	236	Meter. fct.	—	unsigned int	16	0	DS94.72
Long-time mean value of 3-phase reactive power	237	Meter. fct.	—	signed int	16	0	DS94.74
Minimum of the mean value of the apparent power	246	Meter. fct.	—	unsigned int	16	0	DS74.4
Maximum of the mean value of the apparent power	247	Meter. fct.	—	unsigned int	16	0	DS74.6
Minimum of the mean value of the reactive power	248	Meter. fct.	—	signed int	16	0	DS74.12

Description	Data point	Source WL	Source VL	Format	Length (bits)	Scaling	Contained in DS.Byte
Maximum of the mean value of the reactive power	249	Meter. fct.	—	signed int	16	0	DS74.14
Minimum of the mean value of the active power	250	Meter. fct.	—	signed int	16	0	DS74.8
Maximum of the mean value of the active power	251	Meter. fct.	—	signed int	16	0	DS74.10

8.5.8 Data points for other measured values

The table below contains the data points for other measured values :

Table 8- 8 Data points for other measured values

Description	Data point	Source WL	Source VL	Format	Length (bits)	Scaling	Contained in DS.Byte
Mean value of the power factor	168	Meter. fct.	—	signed int	16	- 3	DS51.184 DS94.98
Power factor in phase L1	169	Meter. fct.	—	signed int	16	- 3	DS94.100
Power factor in phase L2	170	Meter. fct.	—	signed int	16	- 3	DS94.102
Power factor in phase L3	171	Meter. fct.	—	signed int	16	- 3	DS94.104
Minimum of the mean value of the power factor	242	Meter. fct.	—	signed int	16	- 3	DS74.0
Maximum of the mean value of the power factor	243	Meter. fct.	—	signed int	16	- 3	DS74.2
Temperature in the control cabinet (acc. in COM15)	71	COM 15	—	unsigned c har	8	0	DS94.114
Minimum temperature in the control cabinet	72	COM 15	—	unsigned c har	8	0	DS77.0
Maximum temperature in the control cabinet	73	COM 15	—	unsigned c har	8	0	DS77.1
Temperature in circuit breaker (acc. in BSS)	330	BSS	—	unsigned c har	8	0	DS94.115
Minimum temperature in the circuit breaker	74	COM 15	—	unsigned c har	8	0	DS77.2
Maximum temperature in the circuit breaker	75	COM 15	—	unsigned c har	8	0	DS77.3
Active energy in normal direction [MWh]	238	Meter. fct.	—	unsigned long	32	0	DS94.82
Active energy in normal direction [kWh]	433 1)	Meter. fct.	—	unsigned long	32	0	DS94.116
Active energy in reverse direction [MWh]	239	Meter. fct.	—	unsigned long	32	0	DS94.86
Active energy in reverse direction [kWh]	434 1)	Meter. fct.	—	unsigned long	32	0	DS94.120
Reactive energy in normal direction [MVarh]	240	Meter. fct.	—	unsigned long	32	0	DS94.90
Reactive energy in normal direction [kVarh]	435 1)	Meter. fct.	—	unsigned long	32	0	DS94.124
Reactive energy in reverse direction [MVarh]	241	Meter. fct.	—	unsigned long	32	0	DS94.94
Reactive energy in reverse direction [kVarh]	436 1)	Meter. fct.	—	unsigned long	32	0	DS94.128
Frequency 3VL	396	—	—	unsigned int	16	- 2	DS94.112
Frequency	262	Meter. fct.	—	unsigned int	16	- 2	DS94.106

Description	Data point	Source WL	Source VL	Format	Length (bits)	Scaling	Contained in DS.Byte
Minimum frequency	252	Meter. fct.	—	unsigned int	16	- 2	DS76.2
Maximum frequency	253	Meter. fct.	—	unsigned int	16	- 2	DS76.0
THD of current	254	Meter. fct.	—	unsigned char	8	0	DS94.108
Minimum THD of current	255	Meter. fct.	—	unsigned char	8	0	DS76.4
Maximum THD of current	256	Meter. fct.	—	unsigned char	8	0	DS76.5
THD of voltage	257	Meter. fct.	—	unsigned char	8	0	DS94.109
Minimum THD of voltage	258	Meter. fct.	—	unsigned char	8	0	DS76.6
Maximum THD of voltage	259	Meter. fct.	—	unsigned char	8	0	DS76.7
Peak factor	260	Meter. fct.	—	unsigned char	8	- 1	DS94.111
Minimum peak factor	263	Meter. fct.	—	unsigned char	8	- 1	DS72.28
Maximum peak factor	264	Meter. fct.	—	unsigned char	8	- 1	DS72.29
Form factor	261	Meter. fct.	—	unsigned char	8	- 1	DS94.110
Minimum form factor	265	Meter. fct.	—	unsigned char	8	- 1	DS72.30

1) When parameterizing via Switch ES Power, data points 433, 434, 435 and 436 are reset to 426 after download and cannot be used with Switch ES.

8.5.9 Data points for the time stamp (TS) of the measured values

The table below contains the data points for the time stamp (TS) of the measured values:

Table 8- 9 Data points for the time stamp (TS) of the measured values

Description	Data point	Source WL	Source VL	Format	Length (bits)	Scaling	Contained in DS.Byte
TS minimum current in phase L1	25	COM15	—	Time	64	—	DS72.32
TS maximum current in phase L1	26	COM15	—	Time	64	—	DS72.40
TS minimum current in phase L2	27	COM15	—	Time	64	—	DS72.48
TS maximum current in phase L2	28	COM15	—	Time	64	—	DS72.56
TS minimum current in phase L3	29	COM15	—	Time	64	—	DS72.64
TS maximum current in phase L3	30	COM15	—	Time	64	—	DS72.72
TS minimum current in neutral conductor	33	COM15	—	Time	64	—	DS72.112
TS maximum current in neutral conductor	34	COM15	—	Time	64	—	DS72.120
TS minimum current that flows to ground	35	COM15	—	Time	64	—	DS72.128
TS maximum current that flows to ground	36	COM15	—	Time	64	—	DS72.136
TS minimum mean value over the three phases	31	COM15	—	Time	64	—	DS72.80
TS maximum mean value over the three phases	32	COM15	—	Time	64	—	DS72.88
TS minimum long-term mean value for current	55	COM15	—	Time	64	—	DS72.96
TS maximum long-term mean value of current	56	COM15	—	Time	64	—	DS72.104
TS minimum phase-to-phase voltage between phase L1 and L2	37	COM15	—	Time	64	—	DS73.24
TS maximum phase-to-phase voltage between phase L1 and L2	38	COM15	—	Time	64	—	DS73.32
TS minimum phase-to-phase voltage between phase L2 and L3	39	COM15	—	Time	64	—	DS73.40
TS maximum phase-to-phase voltage between phase L2 and L3	40	COM15	—	Time	64	—	DS73.48
TS minimum phase-to-phase voltage between phase L3 and L1	41	COM15	—	Time	64	—	DS73.56
TS maximum phase-to-phase voltage between phase L3 and L1	42	COM15	—	Time	64	—	DS73.64
TS minimum of the neutral point voltage phase L1	43	COM15	—	Time	64	—	DS73.72
TS maximum of the neutral point voltage phase L1	44	COM15	—	Time	64	—	DS73.80
TS minimum of the neutral point voltage phase L2	45	COM15	—	Time	64	—	DS73.88
TS maximum of the neutral point voltage phase L2	46	COM15	—	Time	64	—	DS73.96
TS minimum of the neutral point voltage phase L3	47	COM15	—	Time	64	—	DS73.104

Description	Data point	Source WL	Source VL	Format	Length (bits)	Scaling	Contained in DS.Byte
TS maximum of the neutral point voltage phase L3	48	COM15	—	Time	64	—	DS73.112
TS minimum of the mean value of the apparent power	57	COM15	—	Time	64	—	DS74.16
TS maximum of the mean value of the apparent power	58	COM15	—	Time	64	—	DS74.24
TS minimum of the mean value of the active power	49	COM15	—	Time	64	—	DS74.32
TS maximum of the mean value of the active power	50	COM15	—	Time	64	—	DS74.40
TS minimum of the mean value of the reactive power	51	COM15	—	Time	64	—	DS74.48
TS maximum of the mean value of the reactive power	52	COM15	—	Time	64	—	DS74.56
TS minimum of the mean value of the power factor	53	COM15	—	Time	64	—	DS74.64
TS maximum of the mean value of the power factor	54	COM15	—	Time	64	—	DS74.72
TS minimum temperature in the control cabinet	76	COM15	—	Time	64	—	DS77.4
TS maximum temperature in the control cabinet	77	COM15	—	Time	64	—	DS77.12
TS minimum temperature in the circuit breaker	78	COM15	—	Time	64	—	DS77.20
TS maximum temperature in the circuit breaker	79	COM15	—	Time	64	—	DS77.28
TS minimum frequency	59	COM15	—	Time	64	—	DS76.8
TS maximum frequency	60	COM15	—	Time	64	—	DS76.16
TS minimum THD of current	61	COM15	—	Time	64	—	DS76.24
TS maximum THD of current	62	COM15	—	Time	64	—	DS76.32
TS minimum THD of voltage	63	COM15	—	Time	64	—	DS76.40
TS maximum THD of voltage	64	COM15	—	Time	64	—	DS76.48
TS minimum peak factor	65	COM15	—	Time	64	—	DS72.144
TS maximum peak factor	66	COM15	—	Time	64	—	DS72.152
TS minimum form factor	67	COM15	—	Time	64	—	DS72.160
TS maximum form factor	68	COM15	—	Time	64	—	DS72.168

8.5.10 Parameters of the SENTRON circuit breakers (primary protection function)

The table below contains the parameters of the SENTRON circuit breakers (primary protection function):

Table 8- 10 Parameters of the SENTRON circuit breakers (primary protection function)

Description	Data point	Source WL	Source VL	Format	Length (bits)	Scaling	Contained in DS.Byte
Active parameter set	370	ETU	ETU	Format (370)	1	—	DS129.65
Time lag class (SENTRON VL LCD ETU40M only)	331	—	ETU	Format (331)	8	0	DS129.68
Overload parameter I_R parameter set A (PS A)	333	ETU	ETU	unsigned int	16	0	DS129.4
Time-lag class t_R PS A	335	ETU	ETU	unsigned int	16	– 1	DS129.8
Short-circuit protection instantaneous I_i PS A	336	ETU	ETU	unsigned int	16	1 / 0 (VL)	DS129.10
Short-circuit protection delayed I_{sd} PS A	337	ETU	ETU	unsigned int	16	1 / 0 (VL)	DS129.12
Delay time for short-circuit protection t_{sd} PS A	338	ETU	ETU	unsigned int	16	–3	DS129.14
Overload protection neutral conductor I_N PS A (WL)	334	ETU	—	unsigned int	16	0	DS129.6
Overload protection neutral conductor I_N (VL)	365	—	ETU	unsigned c har	8	0	DS129.66
Ground-fault protection I_g PS A	339	ETU	ETU	unsigned int	16	0	DS129.16
Delay time for ground-fault protection t_g PS A	340	ETU	ETU	unsigned int	16	– 3	DS129.18
Ground fault alarm I_{g2} PS A	341	ETU	—	unsigned int	16	0	DS129.20
Delay time for ground fault alarm t_{g2} PS A	342	ETU	—	unsigned int	16	– 3	DS129.22
I^4t characteristic for overload protection PS A	345	ETU	—	Format (345)	1	—	DS129.26
I^2t characteristic for delayed short-circuit protection PS A	343	ETU	ETU	Format (343)	1	—	DS129.24
I^2t characteristic for ground-fault protection PS A	344	ETU	ETU	Format (344)	1	—	DS129.25
Thermal memory PS A	346	ETU	ETU	Format (346)	1	—	DS129.27
Phase loss sensitivity PS A	347	ETU	—	Format (347)	1	—	DS129.28
Cooling time constant PS A	348	ETU	—	unsigned int	16	0	DS129.30
Overload parameter I_R parameter set B (PS B)	349	ETU	—	unsigned int	16	0	DS129.32

Description	Data point	Source WL	Source VL	Format	Length (bits)	Scaling	Contained in DS.Byte
Time-lag class t_R PS B	351	ETU	—	unsigned int	16	– 1	DS129.36
Short-circuit protection instantaneous I_i PS B	352	ETU	—	unsigned int	16	1	DS129.38
Short-circuit protection delayed I_{sd} PS B	353	ETU	—	unsigned int	16	1	DS129.40
Delay time for short-circuit protection t_{sd} PS B	354	ETU	—	unsigned int	16	– 3	DS129.42
Overload protection neutral conductor I_N PS B	350	ETU	—	unsigned int	16	0	DS129.34
Ground-fault protection I_g PS B	355	ETU	—	unsigned int	16	0	DS129.44
Delay time for ground fault t_g PS B	356	ETU	—	unsigned int	16	– 3	DS129.46
Ground fault alarm I_{g2} PS B	357	ETU	—	unsigned int	16	0	DS129.48
Delay time for ground fault alarm t_{g2} PS B	358	ETU	—	unsigned int	16	– 3	DS129.50
I_4t characteristic for overload protection PS B	361	ETU	—	Format (345)	1	—	DS129.54
I_2t curve for delayed short-circuit protection PS B	359	ETU	—	Format (343)	1	—	DS129.52
I^2t curve for ground-fault protection PS B	360	ETU	—	Format (344)	1	—	DS129.53
Thermal memory PS B	362	ETU	—	Format (346)	1	—	DS129.55
Phase loss sensitivity PS B	363	ETU	—	Format (347)	1	—	DS129.56
Cooling time constant PS B	364	ETU	—	unsigned int	16	0	DS129.58
Load shedding	367	ETU	—	unsigned int	16	0	DS129.60
Load pick up	368	ETU	—	unsigned int	16	0	DS129.62
Delay time for load shedding/pick up	366	ETU	—	unsigned c har	8	0	DS129.64
Overload pre-alarm (VL only)	369	—	—	unsigned int	16	0	DS128.44
Active parameter set	370	ETU	ETU	Format (370)	1	—	DS129.65

8.5.11 Parameters of the SENTRON circuit breakers (extended protection function)

The table below contains the parameters of the SENTRON circuit breakers (extended protection function):

Table 8- 11 Parameters of the SENTRON circuit breakers (extended protection function)

Description	Data point	Source WL	Source VL	Format	Length (bits)	Scaling	Contained in DS.Byte
Current unbalance	139	Meter. fct.	ETU	unsigned char	8	0	DS128.41
Delay time for current unbalance	140	Meter. fct.	—	unsigned char	8	0	DS128.42
Active power in normal direction	141	Meter. fct.	—	unsigned int	16	0	DS128.14
Delay time for active power in normal direction	142	Meter. fct.	—	unsigned char	8	0	DS128.18
Active power in reverse direction	143	Meter. fct.	—	unsigned int	16	0	DS128.16
Delay time for active power in reverse direction	144	Meter. fct.	—	unsigned char	8	0	DS128.19
Underfrequency	147	Meter. fct.	—	unsigned int	16	0	DS128.22
Delay time for underfrequency	148	Meter. fct.	—	unsigned char	8	0	DS128.25
Overfrequency	149	Meter. fct.	—	unsigned int	16	0	DS128.26
Delay time for overfrequency	150	Meter. fct.	—	unsigned char	8	0	DS128.24
Voltage unbalance	151	Meter. fct.	—	unsigned char	8	0	DS128.32
Delay time for voltage unbalance	152	Meter. fct.	—	unsigned char	8	0	DS128.33
Undervoltage	153	Meter. fct.	—	unsigned int	16	0	DS128.34
Delay time for undervoltage	154	Meter. fct.	—	unsigned char	8	0	DS128.38
Overvoltage	155	Meter. fct.	—	unsigned int	16	0	DS128.36
Delay time for overvoltage	156	Meter. fct.	—	unsigned char	8	0	DS128.39
THD of current	158	Meter. fct.	—	unsigned char	8	0	DS128.28
Delay time of THD of current	159	Meter. fct.	—	unsigned char	8	0	DS128.29

Description	Data point	Source WL	Source VL	Format	Length (bits)	Scaling	Contained in DS.Byte
THD of voltage	160	Meter. fct.	—	unsigned char	8	0	DS128.30
Delay time of THD of voltage	161	Meter. fct.	—	unsigned char	8	0	DS128.31

8.5.12 Parameters of the SENTRON circuit breakers (parameters for threshold value alarms)

The table below contains the parameters of the SENTRON circuit breakers (parameters for threshold value alarms):

Table 8- 12 Parameters of the SENTRON circuit breakers (parameters for threshold value alarms)

Description	Data point	Source WL	Source VL	Format	Length (bits)	Scaling	Contained in DS.Byte
Overcurrent	267	Meter. fct.	—	unsigned int	16	0	DS130.48
Delay time for overcurrent	268	Meter. fct.	—	unsigned char	8	0	DS130.56
Current that flows to ground	269	Meter. fct.	—	unsigned int	16	0	DS130.50
Delay time of current that flows to ground	270	Meter. fct.	—	unsigned char	8	0	DS130.57
Overcurrent in neutral conductor	271	Meter. fct.	—	unsigned int	8	0	DS130.52
Delay time for overcurrent in neutral conductor	272	Meter. fct.	—	unsigned char	8	0	DS130.58
Phase unbalance current	273	Meter. fct.	—	unsigned char	8	0	DS130.59
Delay time for current phase unbalance	274	Meter. fct.	—	unsigned char	8	0	DS130.60
Long-time mean value of current	275	Meter. fct.	—	unsigned int	16	0	DS130.54
Delay time for long-time mean value of current	276	Meter. fct.	—	unsigned char	8	0	DS130.61
Undervoltage	277	Meter. fct.	—	unsigned int	16	0	DS130.62
Delay time for undervoltage	278	Meter. fct.	—	unsigned char	8	0	DS130.64
Phase unbalance voltage	279	Meter. fct.	—	unsigned char	8	0	DS130.65
Delay time for voltage phase unbalance	280	Meter. fct.	—	unsigned char	8	0	DS130.66
Overvoltage	281	Meter. fct.	—	unsigned int	16	0	DS130.68
Delay time for overvoltage	282	Meter. fct.	—	unsigned char	8	0	DS130.70
Active power in normal direction	283	Meter. fct.	—	unsigned int	16	0	DS130.4
Delay time for active power in normal direction	284	Meter. fct.	—	unsigned char	8	0	DS130.12
Active power in reverse direction	285	Meter. fct.	—	unsigned int	16	0	DS130.6

Description	Data point	Source WL	Source VL	Format	Length (bits)	Scaling	Contained in DS.Byte
Delay time for active power in reverse direction	286	Meter. fct.	—	unsigned char	8	0	DS130.13
Power factor, capacitive	287	Meter. fct.	—	signed int	16	– 3	DS130.8
Delay time for power factor, capacitive	288	Meter. fct.	—	unsigned char	8	0	DS130.14
Power factor, inductive	289	Meter. fct.	—	signed int	16	– 3	DS130.10
Delay time for power factor, inductive	290	Meter. fct.	—	unsigned char	8	0	DS130.15
Long-time mean value of active power	291	Meter. fct.	—	unsigned int	16	0	DS130.30
Delay time for long-term mean value of active power	292	Meter. fct.	—	unsigned char	8	0	DS130.34
Long-time mean value of apparent power	293	Meter. fct.	—	unsigned int	16	0	DS130.32
Delay time for long-term mean value of apparent power	294	Meter. fct.	—	unsigned char	8	0	DS130.35
Long-time mean value of reactive power	295	Meter. fct.	—	unsigned int	16	0	DS130.36
Delay time for long-term mean value of reactive power	296	Meter. fct.	—	unsigned char	8	0	DS130.40
Reactive power in normal direction	297	Meter. fct.	—	unsigned int	16	0	DS130.38
Delay time for reactive power in normal direction	298	Meter. fct.	—	unsigned char	8	0	DS130.41
Reactive power in reverse direction	299	Meter. fct.	—	unsigned int	16	0	DS130.42
Delay time for reactive power in reverse direction	300	Meter. fct.	—	unsigned char	8	0	DS130.46
Apparent power	301	Meter. fct.	—	unsigned int	16	0	DS130.44
Delay time for apparent power	302	Meter. fct.	—	unsigned char	8	0	DS130.47
Overfrequency	303	Meter. fct.	—	unsigned char	8	0	DS130.16
Delay time for overfrequency	304	Meter. fct.	—	unsigned char	8	0	DS130.17
Underfrequency	305	Meter. fct.	—	unsigned char	8	0	DS130.18
Delay time for underfrequency	306	Meter. fct.	—	unsigned char	8	0	DS130.19
THD current	319	Meter. fct.	—	unsigned char	8	0	DS130.20
Delay time for THD current	320	Meter. fct.	—	unsigned char	8	0	DS130.21
THD voltage	321	Meter. fct.	—	unsigned char	8	0	DS130.22

Description	Data point	Source WL	Source VL	Format	Length (bits)	Scaling	Contained in DS.Byte
Delay time for THD voltage	322	Meter. fct.	—	unsigned char	8	0	DS130.23
Peak factor	323	Meter. fct.	—	unsigned int	16	– 2	DS130.24
Delay time for peak factor	324	Meter. fct.	—	unsigned char	8	0	DS130.28
Form factor	325	Meter. fct.	—	unsigned int	16	– 2	DS130.26
Delay time for the form factor	326	Meter. fct.	—	unsigned char	8	0	DS130.29

8.5.13 Parameters of the SENTRON circuit breakers (communication, measured value adjustment, etc.)

The table below contains the parameters of the SENTRON circuit breakers (communication, measured value adjustment, etc.):

Table 8- 13 Parameters of the SENTRON circuit breakers (communication, measured value adjustment, etc.)

Description	Data point	Source WL	Source VL	Format	Length (bits)	Scaling	Contained in DS.Byte
PROFIBUS address	5	COM15	COM20	unsigned int	8	0	DS160.5
Basic type of PROFIBUS data transfer	6	COM15	COM20	Hex	2	—	DS160.6
Data in the cyclic profile of PROFIBUS	7	COM15	COM20	Format (7)	224	—	DS160.8
IP address of the BDA PLUS	10	BDA PLU S	—	Format (10)	40	—	DS160.42
Assignment of the configurable digital output module	129	conf. DO	—	Format (129)	168	—	DS128.46
Normal direction of incoming supply	145	Meter. fct.	—	Format (145)	1	—	DS128.20
Direction of rotation of phase	146	Meter. fct.	—	Format (146)	1	—	DS128.21
The voltage transformer can be star or delta-connected on the primary side	162	Meter. fct.	—	Format (162)	1	—	DS128.4
Rated voltage of the system (on the primary side)	164	Meter. fct.	—	unsigned int	16	0	DS128.6
Secondary voltage of transformer	165	Meter. fct.	—	unsigned c har	8	0	DS128.8
Length of period for calculating long-term mean value	166	Meter. fct.	—	unsigned c har	8	0	DS128.9
Number of sub-periods for calculating long-term mean value	167	Meter. fct.	—	unsigned c har	8	0	DS128.10
Lower limit of power transmission	372	ETU	—	unsigned int	16	0	DS128.12
Ground fault transformer detection type	410	ETU	ETU	Format (410)	2	—	DS97.44 DS129.69

8.6 Data sets

8.6.1 Data set DS 0 S7-V1 system diagnostics

This section explains the structure of the read/write data sets that in turn consist of the data points described in the previous section. This allows the data sets transferred via PROFIBUS to be interpreted in the master.

The SENTRON circuit breaker communicates via PROFIBUS in a cyclic connection with a class 1 master, e.g. a PLC. In addition to the data in the cyclic channel, the master can scan other data (event-driven) in the form of DPV1 data sets. Writing and controlling via DPV1 data sets is also possible. A connection with a class 2 master would also provide the DPV1 data sets (e.g. SIMATIC OPC). This section is concerned with the detailed description of these data sets.

The data sets are described in chronological, rising order. The header of the table also includes an indication in each case of whether this data set can be read and written.

The table below shows the content of data set 0 that contains the information as to whether the slave is signaling an external diagnosis.

The table below contains the data sets DS0:S7-V1 system diagnostics (length 4 bytes, read-only):

Table 8- 14 Content of data set 0

Byte	Description	Data point	Source WL	Source VL	Format	Length (bits)	Scaling
0	0x0F, if an external diagnosis is present, 0x00, if there is no external diagnosis	—	COM15	COM20	—	8	—
1	Fixed at 0x03	—	COM15	COM20	—	8	—
2	Fixed at 0x00	—	COM15	COM20	—	8	—
3	Fixed at 0x00	—	COM15	COM20	—	8	—

8.6.2 Data set DS 1 system diagnostics

The table below shows the content of data set 1 that has a length of 16 bytes and that includes the content of DS0 in the first four bytes. Further information about diagnostics is available in DS92.

The table below contains the data sets DS1: System diagnostics (length 16 bytes, read-only).

Table 8- 15 Content of data set 1

Byte	Description	Data point	Source WL	Source VL	Format	Length (bits)	Scaling
0	Identical to DS0	—	COM15	COM20	—	32	—
4	Channel type; value 0x7D	—	COM15	COM20	—	8	—
5	Length of the channel diagnostics; value 0x20	—	COM15	COM20	—	8	—
6	Number of channels; value 0x01	—	COM15	COM20	—	8	—
7	Per channel 1 bit; value 0x01	—	COM15	COM20	—	8	—
8	Reserved; value 0x00	—	COM15	COM20	—	64	—

8.6.3 Data set DS 51 main overview

The table below shows the content of data set 51 that copies the most important information from other data sets and makes it available in the form of a complete overview. This data set is used in Switch ES Power to display the data of the main overview.

The table below contains the data sets DS51: Main overview (length 238 bytes, read-only):

Table 8- 16 Content of data set 51

Byte	Description	Data point	Source WL	Source VL	Format	Length (bits)	Scaling
0	Trip log of the last 5 tripping operations with time	15	COM15	COM20	Format (15)	480	—
60	Event log of the last 10 events with time	16	COM15	COM20	Format (16)	960	—
180	Status of the connected PROFIBUS	17	COM15	COM20	Format (17)	3	—
181	Controls the commands/functions (e.g. delete/reset min./max. values) of the communication module	18	COM15	COM20	Format (18)	8	—
182	Controls the outputs of the communication module (e.g. switching the breaker)	19	COM15	COM20	Format (19)	8	—
183	Shows the phase with maximum load	373	ETU	ETU	Format (373)	3	—
184	Mean value of the power factor	168	Meter. fct.	—	signed int	16	–3
186	Current of phase with maximum load	374	ETU	ETU	unsigned int	16	0
188	Time until presumed overload trip	379	ETU	—	unsigned int	16	0
190	Current in neutral conductor	375	ETU	ETU	unsigned int	16	0
192	Current which flows to ground	376	ETU	ETU	unsigned int	16	0
194	System time of the circuit breaker	90	COM15	COM20	Time	64	—
202	Position of the circuit breaker in the frame	24	COM15	COM20	Format (24)	4	—
203	Status of the circuit breaker (on/off/powered, etc.)	328	BSS	COM20	Format (328)	8	—
204	Overload parameter I_R parameter set A (PS A)	333	ETU	ETU	unsigned int	16	0
206	Overload parameter I_R parameter set B (PS B)	349	ETU	—	unsigned int	16	0
208	Rating plug	377	ETU	ETU	unsigned int	16	0
210	Active parameter set	370	ETU	—	Format (370)	1	—
211	Reserved	—	—	—	—	72	—
220	Property byte for byte 0 (trip log of the last 5 tripping operations with time)	—	COM15	COM20	PB	8	—

Byte	Description	Data point	Source WL	Source VL	Format	Length (bits)	Scaling
221	Property byte for byte 60 (event log of the last 10 events with time)	—	COM15	COM20	PB	8	—
222	Property byte for byte 180 (status of the connected PROFIBUS)	—	COM15	COM20	PB	8	—
223	Property byte for byte 181 (controls the commands/functions (e.g. delete/reset min./max. values) of the communication module)	—	COM15	COM20	PB	8	—
224	Property byte for byte 182 (controls the outputs of the communication module (e.g. switching the breaker))	—	COM15	COM20	PB	8	—
225	Property byte for byte 183 (shows the phase with maximum load)	—	ETU	ETU	PB	8	—
226	Property byte for byte 184 (mean value of the power factor)	—	Meter. fct.	—	PB	8	—
227	Property byte for byte 186 (current of the phase with maximum load)	—	ETU	ETU	PB	8	—
228	Property byte for byte 188 (time until presumed overload trip)	—	ETU	—	PB	8	—
229	Property byte for byte 190 (current in neutral conductor)	—	ETU	ETU	PB	8	—
230	Property byte for byte 192 (current that flows to ground)	—	ETU	ETU	PB	8	—
231	Property byte for byte 194 (system time of the circuit breaker)	—	COM15	COM20	PB	8	—
232	Property byte for byte 202 (position of the circuit breaker in the frame)	—	COM15	COM20	PB	8	—
233	Property byte for byte 203 (status of the circuit breaker (on/off/charged, etc.))	—	BSS	COM20	PB	8	—
234	Property byte for byte 204 (overload parameter I_R parameter set A)	—	ETU	ETU	PB	8	—
235	Property byte for byte 206 (overload parameter I_R parameter set B)	—	ETU	—	PB	8	—
236	Property byte for byte 208 (rating plug)	—	ETU	ETU	PB	8	—
237	Property byte for byte 210 (active parameter set)	—	ETU	—	PB	8	—

8.6.4 Data set DS 52 main overview 1

The table below contains the data sets DS52: Main overview 1 (length 16 bytes, read-only):

Table 8- 17 Content of data set 52

Byte	Description	Data point	Source WL	Source VL	Format	Length (bits)	Scaling
0	Current value phase 1	380	—	ETU	unsigned int	16	0
2	Current value phase 2	381	—	ETU	unsigned int	16	0
4	Current value phase 3	382	—	ETU	unsigned int	16	0
6	Present maximum current of the phase with maximum load	374	—	ETU	unsigned int	16	0
8	Current value N conductor (trip unit)	375	—	ETU	unsigned int	16	0
10	Current value ground fault (trip unit)	376	—	ETU	unsigned int	16	0
12	Warnings and setpoints in the communication module	402	—	ETU	Format (402)	16	—
14	Current at the moment of shutdown	403	—	ETU	unsigned int	16	0
16	Phase at the moment of shutdown	404	—	ETU	Format (373)	8	—
17	Reserved	—	—	—	unsigned char	16	—
19	Switches and indicates the current parameter set	370	—	ETU	Format (370)	1	—
20	Reserved	—	—	—	unsigned char	16	—
22	Status of the circuit breaker	328	—	ETU	Format (328)	8	—
23	Tripping operations, basic protection function, last trip	401	—	ETU	Format (401)	8	—
24	Number of the phase with maximum load	373	—	ETU	Format (373)	3	—
25	Position of circuit breaker	24	—	ETU	Format (24)	4	—
26	Mean value of all phases	383	—	ETU	unsigned int	16	0
28	Long-time mean value of 3-phase current	193	—	ETU	unsigned int	16	0
30	Phase unbalance current in %	172	—	ETU	unsigned char	8	0
31	Maximum phase unbalance current in %	437	—	ETU	unsigned char	8	0

Byte	Description	Data point	Source WL	Source VL	Format	Length (bits)	Scaling
32	Max. mean value of phase	395	—	ETU	unsigned int	16	0
34	Max. current value N conductor	391	—	ETU	unsigned int	16	0
36	Current value, max. ground phase	393	—	ETU	unsigned int	16	0
38	Max. current over the phases L1, L2 and L3	398	—	ETU	unsigned int	16	0
40	Max. long-term mean value current	245	—	ETU	unsigned int	16	0
42	Reserved	—	—	—	unsigned char	16	—
44	System time	90	—	COM20	Time	64	—
52	Reserved	—	—	—	unsigned char	16	—
54	BUS communication	17	—	COM20	Format (17)	8	—
55	Interlocking of write accesses via DP BUS (see external inputs in the communication module)	14	—	COM20	Format (14)	8	—
56	Reserved	—	—	—	unsigned char	16	—
58	Trip log of the last 5 tripping operations with time	15	—	ETU	Format (15)	480	—
118	Reserved	—	—	COM20	—	16	—
120	Property byte for byte 0 (current value phase 1)	—	—	ETU	Property byte PB	8	—
121	Property byte for byte 2 (current value phase 2)	—	—	ETU	PB	8	—
122	Property byte for byte 4 (current value phase 3)	—	—	ETU	PB	8	—
123	Property byte for byte 6 (present maximum current of the phase with maximum load)	—	—	ETU	PB	8	—
124	Property byte for byte 8 (current value N conductor (trip unit))	—	—	ETU	PB	8	—
125	Property byte for byte 10 (current value ground fault (trip unit))	—	—	ETU	PB	8	—
126	Property byte for byte 12 (alarms and setpoints in the communication module)	—	—	ETU	PB	8	—
127	Property byte for byte 14 (current at moment of shutdown)	—	—	ETU	PB	8	—
128	Property byte for byte 16 (phase at moment of shutdown)	—	—	ETU	PB	8	—
129	Reserved	—	—	—	unsigned char	16	—
131	Property byte for byte 19 (switches and indicates the current parameter set)	—	—	ETU	PB	8	—

Byte	Description	Data point	Source WL	Source VL	Format	Length (bits)	Scaling
132	Reserved	—	—	—	unsigned char	16	—
134	Property byte for byte 22 (status of circuit breaker)	—	—	ETU	PB	8	—
135	Property byte for byte 23 (tripping operations, basic protection function, last trip)	—	—	ETU	PB	8	—
136	Property byte for byte 24 (number of the phase with maximum load)	—	—	ETU	PB	8	—
137	Property byte for byte 25 (position of the circuit breaker)	—	—	ETU	PB	8	—
138	Property byte for byte 26 (mean value of all phases)	—	—	ETU	PB	8	—
139	Property byte for byte 28 (long-term mean value for 3-phase current)	—	—	ETU	PB	8	—
140	Property byte for byte 30 (phase unbalance current in %)	—	—	ETU	PB	8	—
141	Property byte for byte 31 (maximum phase unbalance current in %)	—	—	ETU	PB	8	—
142	Property byte for byte 32 (max. mean phase value)	—	—	ETU	PB	8	—
143	Property byte for byte 34 (max. current value N conductor)	—	—	ETU	PB	8	—
144	Property byte for byte 36 (max. current value ground phase)	—	—	ETU	PB	8	—
145	Property byte for byte 38 (max. current over phases L1, L2 and L3)	—	—	ETU	PB	8	—
146	Property byte for byte 40 (max. current long-term mean value)	—	—	ETU	PB	8	—
147	Reserved	—	—	—	unsigned char	8	—
148	Property byte for byte 44 (system time)	—	—	COM20	PB	8	—
149	Reserved	—	—	—	unsigned char	8	—
150	Property byte for byte 54 (communication BUS)	—	—	COM20	PB	8	—
151	Property byte for byte 55 (interlocking of write accesses via DP BUS (see external inputs in the communication module))	—	—	COM20	PB	8	—
152	Property byte for byte 58 (trip log of the last 5 tripping operations with time)	—	—	COM20	PB	8	—
153	Reserved	—	—	—	unsigned char	8	—
154		check			OK		—

8.6.5 Data set DS 64 data of the harmonic analysis

The table below shows the content of data set 64 in which the components of the harmonics of current and voltage are transmitted. The content is described in the format (309). The property byte provides information as to whether the data point is available. Generally, a harmonic analysis is only available with a SENTRON WL with metering function PLUS.

The table below contains the data sets DS64: Data of the harmonic analysis (length 131 bytes, read-only):

Table 8- 18 Content of data set 64

Byte	Description	Data point	Source WL	Source VL	Format	Length (bits)	Scaling
0	Harmonics of current/voltage to the 29th	309	Meter. fct.	—	Format (309)	928	0
116	Reserved	—	—	—	—	112	—
130	Property byte for byte 0 (harmonics of current/voltage up to the 29th)	—	Meter. fct.	—	PB	8	—

8.6.6 Data set DS 68 data of the CubicleBUS module

The table below shows the content of data set 68 via which the outputs of the digital output modules can be read and also controlled, and the system time can be read out. In addition, it is possible to set the system time and also the outputs of the PROFIBUS interfaces for switching breakers on or off.

The table below contains the data sets DS68: Data of the CubicleBUS module (length 45 bytes, read/write):

Table 8- 19 Content of data set 68

Byte	Description	Data point	Source WL	Source VL	Format	Length (bits)	Scaling
0	Header; value 0x00 00 00 00	—	COM15	COM20	—	32	—
4	System time of the circuit breaker	90	COM15	COM20	Time	64	—
12	Controls the outputs of the communication module (e.g. switching the breaker)	19	COM15	COM20	Format (19)	8	—
13	Reserved	—	—	—	—	8	—
14	Status of the outputs of the digital output module 1	118	DO1	—	Hex	8	—
15	Status of the outputs of the digital output module 2	123	DO2	—	Hex	8	—
16	Reserved	—	—	—	—	192	—
40	Property byte for byte 4 (system time of the circuit breaker)	—	COM15	COM20	PB	8	—
41	Property byte for byte 12 (controls the outputs of the communication module (e.g. switching the breaker))	—	COM15	COM20	PB	8	—
42	Reserved	—	—	—	—	8	—
43	Property byte for byte 14 (status of the outputs of the digital output module 1)	—	DO1	—	PB	8	—
44	Property byte for byte 15 (status of the outputs of the digital output module 2)	—	DO2	—	PB	8	—

8.6.7 Data set DS 69 status of the modules

The table below shows the content of data set 69 in which the statuses of the inputs on the digital input modules and the input on the COM15 module are transmitted. It also contains the switch positions on the digital input modules and output modules on the CubicleBUS.

The table below contains the data sets DS69: Status of the modules (length 43 bytes, read-only):

Table 8- 20 Content of data set 69

Byte	Description	Data point	Source WL	Source VL	Format	Length (bits)	Scaling
0	Status of the inputs of the digital input module 1	110	DI1	—	Hex	8	—
1	Status of the inputs of the digital input module 2	114	DI2	—	Hex	8	—
2	Controls the outputs of the communication module (e.g. switching the breaker) and checkback signals	19	COM15	COM20	Format (19)	8	—
3	Switch position at the digital input module 1	111	DI1	—	Format (111)	8	—
4	Switch position at the digital input module 2	115	DI2	—	Format (111)	8	—
5	Switch position at the digital output module 1	119	DO1	—	Format (119)	8	—
6	Switch position at the digital output module 2	124	DO2	—	Format (119)	8	—
7	Reserved	—	—	—	—	32	—
11	PROFIBUS write protection (DPWriteEnable)	14	COM15	COM20	Format (14)	1	—
12	Reserved	—	—	—	—	8	—
13	6 PROFIBUS bits for the digital configurable output module	426	COM15	—	Format (426)	6	—
14	Reserved	—	—	—	—	120	—
29	Property byte for byte 13 (6 PROFIBUS bits for the digital configurable output module)	—	COM15	—	PB	8	—
30	Property byte for byte 0 (status of the inputs of digital input module 1)	—	DI1	—	PB	8	—
31	Property byte for byte 1 (status of the inputs of digital input module 2)	—	DI2	—	PB	8	—
32	Property byte for byte 2 (controls the outputs of the communication module (e.g. switching the breaker) and checkback signals)	—	COM15	COM20	PB	8	—
33	Property byte for byte 3 (switch position on the digital input module 1)	—	DI1	—	PB	8	—
34	Property byte for byte 4 (switch position on the digital input module 2)	—	DI2	—	PB	8	—
35	Property byte for byte 5 (switch position on digital output module 1)	—	DO1	—	PB	8	—

Byte	Description	Data point	Source WL	Source VL	Format	Length (bits)	Scaling
36	Property byte for byte 6 (switch position on digital output module 2)	—	DO2	—	PB	8	—
37	Reserved	—	—	—	—	32	—
41	Property byte for byte 11 (PROFIBUS write protection (DPWriteEnable))	—	COM15	COM20	PB	8	—
42	Reserved	—	—	—	—	8	—

8.6.8 Data set DS 72 min. and max. measured values

The table below shows the content of data set 72 in which the minimum and maximum measured values of the currents are transmitted. It also contains the associated time stamps for these minimum and maximum measured values.

The table below contains the data sets DS72: Min./max. measured values of the currents and the associated time stamps (length 236 bytes, read-only):

Table 8- 21 Content of data set 72

Byte	Description	Data point	Source WL	Source VL	Format	Length (bits)	Scaling
0	Minimum current in phase 1	384	ETU	—	unsigned int	16	0
2	Maximum current in phase 1	385	ETU	—	unsigned int	16	0
4	Minimum current in phase 2	386	ETU	—	unsigned int	16	0
6	Maximum current in phase 2	387	ETU	—	unsigned int	16	0
8	Minimum current in phase 3	388	ETU	—	unsigned int	16	0
10	Maximum current in phase 3	389	ETU	—	unsigned int	16	0
12	Minimum current in neutral conductor	390	ETU	—	unsigned int	16	0
14	Maximum current in neutral conductor	391	ETU	ETU	unsigned int	16	0
16	Minimum current which flows to ground	392	ETU	—	unsigned int	16	0
18	Maximum current which flows to ground	393	ETU	ETU	unsigned int	16	0
20	Minimum mean value over the three phases	394	ETU	—	unsigned int	16	0
22	Maximum mean value over the three phases	395	ETU	ETU	unsigned int	16	0
24	Minimum long-term mean value for current	244	Meter. fct.	—	unsigned int	16	0
26	Maximum long-term mean value for current	245	Meter. fct.	ETU	unsigned int	16	0
28	Minimum peak factor	263	Meter. fct.	—	unsigned char	8	–1
29	Maximum peak factor	264	Meter. fct.	—	unsigned char	8	–1
30	Minimum form factor	265	Meter. fct.	—	unsigned char	8	–1
31	Maximum of the form factor	266	Meter. fct.	—	unsigned char	8	–1
32	TS minimum current in phase L1	25	COM15	—	Time	64	—

Byte	Description	Data point	Source WL	Source VL	Format	Length (bits)	Scaling
40	TS maximum current in phase L1	26	COM15	—	Time	64	—
48	TS minimum current in phase L2	27	COM15	—	Time	64	—
56	TS maximum current in phase L2	28	COM15	—	Time	64	—
64	TS minimum current in phase L3	29	COM15	—	Time	64	—
72	TS maximum current in phase L3	30	COM15	—	Time	64	—
80	TS minimum mean value over the three phases	31	COM15	—	Time	64	—
88	TS maximum mean value over the three phases	32	COM15	—	Time	64	—
96	TS minimum long-term mean value for current	55	COM15	—	Time	64	—
104	TS maximum long-term mean value of current	56	COM15	—	Time	64	—
112	TS minimum current in neutral conductor	33	COM15	—	Time	64	—
120	TS maximum current in neutral conductor	34	COM15	—	Time	64	—
128	TS minimum current that flows to ground	35	COM15	—	Time	64	—
136	TS maximum current that flows to ground	36	COM15	—	Time	64	—
144	TS minimum peak factor	65	COM15	—	Time	64	—
152	TS maximum peak factor	66	COM15	—	Time	64	—
160	TS minimum form factor	67	COM15	—	Time	64	—
168	TS maximum form factor	68	COM15	—	Time	64	—
176	Reserved	—	—	—	—	192	—
200	Property byte for byte 0 (minimum current in phase 1)	—	ETU	—	PB	8	—
201	Property byte for byte 2 (maximum current in phase 1)	—	ETU	—	PB	8	—
202	Property byte for byte 4 (minimum current in phase 2)	—	ETU	—	PB	8	—
203	Property byte for byte 6 (maximum current in phase 2)	—	ETU	—	PB	8	—
204	Property byte for byte 8 (minimum current in phase 3)	—	ETU	—	PB	8	—
205	Property byte for byte 10 (maximum current in phase 3)	—	ETU	—	PB	8	—
206	Property byte for byte 12 (minimum current in neutral conductor)	—	ETU	—	PB	8	—
207	Property byte for byte 14 (maximum current in neutral conductor)	—	ETU	ETU	PB	8	—
208	Property byte for byte 16 (minimum current that flows to ground)	—	ETU	—	PB	8	—
209	Property byte for byte 18 (maximum current that flows to ground)	—	ETU	ETU	PB	8	—
210	Property byte for byte 20 (minimum mean value over the three phases)	—	ETU	—	PB	8	—
211	Property byte for byte 22 (maximum mean value over the three phases)	—	ETU	ETU	PB	8	—

Byte	Description	Data point	Source WL	Source VL	Format	Length (bits)	Scaling
212	Property byte for byte 24 (minimum current long-term mean value)	—	Meter. fct.	—	PB	8	—
213	Property byte for byte 26 (maximum current long-term mean value)	—	Meter. fct.	ETU	PB	8	—
214	Property byte for byte 28 (minimum of the peak factor)	—	Meter. fct.	—	PB	8	—
215	Property byte for byte 29 (maximum of the peak factor)	—	Meter. fct.	—	PB	8	—
216	Property byte for byte 30 (minimum of the form factor)	—	Meter. fct.	—	PB	8	—
217	Property byte for byte 31 (maximum of the form factor)	—	Meter. fct.	—	PB	8	—
218	Property byte for byte 32 (TS minimum current in phase 1)	—	COM15	—	PB	8	—
219	Property byte for byte 40 (TS maximum current in phase L1)	—	COM15	—	PB	8	—
220	Property byte for byte 48 (TS minimum current in phase L2)	—	COM15	—	PB	8	—
221	Property byte for byte 56 (TS maximum current in phase L2)	—	COM15	—	PB	8	—
222	Property byte for byte 64 (TS minimum current in phase L3)	—	COM15	—	PB	8	—
223	Property byte for byte 72 (TS maximum current in phase L3)	—	COM15	—	PB	8	—
224	Property byte for byte 80 (TS minimum mean value over the three phases)	—	COM15	—	PB	8	—
225	Property byte for byte 88 (TS maximum mean value over the three phases)	—	COM15	—	PB	8	—
226	Property byte for byte 96 (TS minimum current long-term mean value)	—	COM15	—	PB	8	—
227	Property byte for byte 104 (TS maximum current long-term mean value)	—	COM15	—	PB	8	—
228	Property byte for byte 112 (TS minimum current in neutral conductor)	—	COM15	—	PB	8	—
229	Property byte for byte 120 (TS maximum current in neutral conductor)	—	COM15	—	PB	8	—
230	Property byte for byte 128 (TS minimum current that flows to ground)	—	COM15	—	PB	8	—
231	Property byte for byte 136 (TS maximum current that flows to ground)	—	COM15	—	PB	8	—
232	Property byte for byte 144 (TS minimum of the peak factor)	—	COM15	—	PB	8	—
233	Property byte for byte 152 (TS maximum of the peak factor)	—	COM15	—	PB	8	—

Byte	Description	Data point	Source WL	Source VL	Format	Length (bits)	Scaling
234	Property byte for byte 160 (TS minimum of the form factor)	—	COM15	—	PB	8	—
235	Property byte for byte 168 (TS maximum of the form factor)	—	COM15	—	PB	8	—

8.6.9 Data set DS 73 min. and max. measured values of the voltages

The table below shows the content of data set 73 in which the minimum and maximum measured values of the voltages are transmitted. It also contains the associated time stamps for these minimum and maximum measured values.

The table below contains the data sets DS73: Min./max. measured values of the voltages and the associated time stamps (length 174 bytes, read-only):

Table 8- 22 Content of data set 73

Byte	Description	Data point	Source WL	Source VL	Format	Length (bits)	Scaling
0	Minimum phase-to-phase voltage between phase L1 and L2	205	Meter. fct.	—	unsigned int	16	0
2	Maximum phase-to-phase voltage between phase L1 and L2	206	Meter. fct.	—	unsigned int	16	0
4	Minimum phase-to-phase voltage between phase L2 and L3	207	Meter. fct.	—	unsigned int	16	0
6	Maximum phase-to-phase voltage between phase L2 and L3	208	Meter. fct.	—	unsigned int	16	0
8	Minimum phase-to-phase voltage between phase L3 and L1	209	Meter. fct.	—	unsigned int	16	0
10	Maximum phase-to-phase voltage between phase L3 and L1	210	Meter. fct.	—	unsigned int	16	0
12	Minimum of the neutral point voltage phase L1	211	Meter. fct.	—	unsigned int	16	0
14	Maximum of the neutral point voltage phase L1	212	Meter. fct.	—	unsigned int	16	0
16	Minimum of the neutral point voltage phase L2	213	Meter. fct.	—	unsigned int	16	0
18	Maximum of the neutral point voltage phase L2	214	Meter. fct.	—	unsigned int	16	0
20	Minimum of the neutral point voltage phase L3	215	Meter. fct.	—	unsigned int	16	0
22	Maximum of the neutral point voltage phase L3	216	Meter. fct.	—	unsigned int	16	0
24	TS minimum phase-to-phase voltage between phase L1 and L2	37	COM15	—	Time	64	—
32	TS maximum phase-to-phase voltage between phase L1 and L2	38	COM15	—	Time	64	—
40	TS minimum phase-to-phase voltage between phase L2 and L3	39	COM15	—	Time	64	—
48	TS maximum phase-to-phase voltage between phase L2 and L3	40	COM15	—	Time	64	—
56	TS minimum phase-to-phase voltage between phase L3 and L1	41	COM15	—	Time	64	—
64	TS maximum phase-to-phase voltage between phase L3 and L1	42	COM15	—	Time	64	—

Byte	Description	Data point	Source WL	Source VL	Format	Length (bits)	Scaling
72	TS minimum of the neutral point voltage phase L1	43	COM15	—	Time	64	—
80	TS maximum of the neutral point voltage phase L1	44	COM15	—	Time	64	—
88	TS minimum of the neutral point voltage phase 2	45	COM15	—	Time	64	—
96	TS maximum of the neutral point voltage phase L2	46	COM15	—	Time	64	—
104	TS minimum of the neutral point voltage phase L3	47	COM15	—	Time	64	—
112	TS maximum of the neutral point voltage phase L3	48	COM15	—	Time	64	—
120	Reserved	—	—	—	—	240	—
150	Property byte for byte 0 (minimum phase-to-phase voltage between phase L1 and L2)	—	Meter. fct.	—	PB	8	—
151	Property byte for byte 2 (maximum phase-to-phase voltage between phase L1 and L2)	—	Meter. fct.	—	PB	8	—
152	Property byte for byte 4 (minimum phase-to-phase voltage between phase L2 and L3)	—	Meter. fct.	—	PB	8	—
153	Property byte for byte 6 (maximum phase-to-phase voltage between phase L2 and L3)	—	Meter. fct.	—	PB	8	—
154	Property byte for byte 8 (minimum phase-to-phase voltage between phase L3 and L1)	—	Meter. fct.	—	PB	8	—
155	Property byte for byte 10 (maximum phase-to-phase voltage between phase L3 and L1)	—	Meter. fct.	—	PB	8	—
156	Property byte for byte 12 (minimum of the neutral point voltage phase L1)	—	Meter. fct.	—	PB	8	—
157	Property byte for byte 14 (maximum of the neutral point voltage phase L1)	—	Meter. fct.	—	PB	8	—
158	Property byte for byte 16 (minimum of the neutral point voltage phase L2)	—	Meter. fct.	—	PB	8	—
159	Property byte for byte 18 (maximum of the neutral point voltage phase L2)	—	Meter. fct.	—	PB	8	—
160	Property byte for byte 20 (minimum of the neutral point voltage phase L3)	—	Meter. fct.	—	PB	8	—
161	Property byte for byte 22 (maximum of the neutral point voltage phase L3)	—	Meter. fct.	—	PB	8	—
162	Property byte for byte 24 (TS minimum phase-to-phase voltage between phase L1 and L2)	—	COM15	—	PB	8	—
163	Property byte for byte 32 (TS maximum phase-to-phase voltage between phase L1 and L2)	—	COM15	—	PB	8	—
164	Property byte for byte 40 (TS minimum phase-to-phase voltage between phase L2 and L3)	—	COM15	—	PB	8	—

Byte	Description	Data point	Source WL	Source VL	Format	Length (bits)	Scaling
165	Property byte for byte 48 (TS maximum phase-to-phase voltage between phase L2 and L3)	—	COM15	—	PB	8	—
166	Property byte for byte 56 (TS minimum phase-to-phase voltage between phase L3 and L1)	—	COM15	—	PB	8	—
167	Property byte for byte 64 (TS maximum phase-to-phase voltage between phase L3 and L1)	—	COM15	—	PB	8	—
168	Property byte for byte 72 (TS minimum of the neutral point voltage phase L1)	—	COM15	—	PB	8	—
169	Property byte for byte 80 (TS maximum of the neutral point voltage phase L1)	—	COM15	—	PB	8	—
170	Property byte for byte 88 (TS minimum of the neutral point voltage phase 2)	—	COM15	—	PB	8	—
171	Property byte for byte 96 (TS maximum of the neutral point voltage phase L2)	—	COM15	—	PB	8	—
172	Property byte for byte 104 (TS minimum of the neutral point voltage phase L3)	—	COM15	—	PB	8	—
173	Property byte for byte 112 (TS maximum of the neutral point voltage phase L3)	—	COM15	—	PB	8	—

8.6.10 Data set DS 74 min. and max. measured values of the powers

The table below shows the content of data set 74 in which the minimum and maximum measured values of the powers are transmitted. It also contains the associated time stamps for these minimum and maximum measured values.

Table 8- 23 Content of data set 74

Byte	Description	Data point	Source WL	Source VL	Format	Length (bits)	Scaling
0	Minimum of the mean value of the power factor	242	Meter. fct.	—	signed int	16	– 3
2	Maximum of the mean value of the power factor	243	Meter. fct.	—	signed int	16	– 3
4	Minimum of the mean value of the apparent power	246	Meter. fct.	—	unsigned int	16	0
6	Maximum of the mean value of the apparent power	247	Meter. fct.	—	unsigned int	16	0
8	Minimum of the mean value of the active power	250	Meter. fct.	—	signed int	16	0
10	Maximum of the mean value of the active power	251	Meter. fct.	—	signed int	16	0
12	Minimum of the mean value of the reactive power	248	Meter. fct.	—	signed int	16	0
14	Maximum of the mean value of the reactive power	249	Meter. fct.	—	signed int	16	0
16	TS minimum of the mean value of the apparent power	57	COM15	—	Time	64	—
24	TS maximum of the mean value of the apparent power	58	COM15	—	Time	64	—
32	TS minimum of the mean value of the active power	49	COM15	—	Time	64	—
40	TS maximum of the mean value of the active power	50	COM15	—	Time	64	—
48	TS minimum of the mean value of the reactive power	51	COM15	—	Time	64	—
56	TS maximum of the mean value of the reactive power	52	COM15	—	Time	64	—
64	TS min. of the mean value of the power factor	53	COM15	—	Time	64	—
72	TS max. of the mean value of the power factor	54	COM15	—	Time	64	—
80	Reserved	—	—	—	—	320	—
120	Property byte for byte 0 (minimum mean value of the power factor)	—	Meter. fct.	—	PB	8	—
121	Property byte for byte 2 (maximum mean value of the power factor)	—	Meter. fct.	—	PB	8	—
122	Property byte for byte 4 (minimum mean value of the apparent power)	—	Meter. fct.	—	PB	8	—

Byte	Description	Data point	Source WL	Source VL	Format	Length (bits)	Scaling
123	Property byte for byte 6 (maximum mean value of the apparent power)	—	Meter. fct.	—	PB	8	—
124	Property byte for byte 8 (minimum mean value of the active power)	—	Meter. fct.	—	PB	8	—
125	Property byte for byte 10 (maximum mean value of the active power)	—	Meter. fct.	—	PB	8	—
126	Property byte for byte 12 (minimum mean value of the reactive power)	—	Meter. fct.	—	PB	8	—
127	Property byte for byte 14 (maximum mean value of the reactive power)	—	Meter. fct.	—	PB	8	—
128	Property byte for byte 16 (TS minimum mean value of the apparent power)	—	COM15	—	PB	8	—
129	Property byte for byte 24 (TS maximum mean value of the apparent power)	—	COM15	—	PB	8	—
130	Property byte for byte 32 (TS minimum mean value of the active power)	—	COM15	—	PB	8	—
131	Property byte for byte 40 (TS maximum mean value of the active power)	—	COM15	—	PB	8	—
132	Property byte for byte 48 (TS minimum mean value of the reactive power)	—	COM15	—	PB	8	—
133	Property byte for byte 56 (TS maximum mean value of the reactive power)	—	COM15	—	PB	8	—
134	Property byte for byte 64 (TS minimum mean value of the power factor)	—	COM15	—	PB	8	—
135	Property byte for byte 72 (TS max. mean value of the power factor)	—	COM15	—	PB	8	—

8.6.11 Data set DS 76 min. and max. measured values of the frequency and the THD

The table below shows the content of data set 76 in which the minimum and maximum measured values of the frequency and the THD are transmitted. It also contains the associated time stamps for these minimum and maximum measured values.

The table below contains the data sets DS76: Min./max. measured values of the frequency/THD and the associated time stamps (length 92 bytes, read-only):

Table 8- 24 Content of data set 76

Byte	Description	Data point	Source WL	Source VL	Format	Length (bits)	Scaling
0	Maximum frequency	253	Meter. fct.	—	unsigned int	16	– 2
2	Minimum frequency	252	Meter. fct.	—	unsigned int	16	– 2
4	Minimum THD of current	255	Meter. fct.	—	unsigned char	8	0
5	Maximum THD of current	256	Meter. fct.	—	unsigned char	8	0
6	Minimum THD of voltage	258	Meter. fct.	—	unsigned char	8	0
7	Maximum THD of voltage	259	Meter. fct.	—	unsigned char	8	0
8	TS minimum frequency	59	COM15	—	Time	64	—
16	TS maximum frequency	60	COM15	—	Time	64	—
24	TS minimum THD of current	61	COM15	—	Time	64	—
32	TS maximum THD of current	62	COM15	—	Time	64	—
40	TS minimum THD of voltage	63	COM15	—	Time	64	—
48	TS maximum THD of voltage	64	COM15	—	Time	64	—
56	Reserved	—	—	—	—	192	—
80	Property byte for byte 0 (maximum of the frequency)	—	Meter. fct.	—	PB	8	—
81	Property byte for byte 2 (minimum of the frequency)	—	Meter. fct.	—	PB	8	—
82	Property byte for byte 4 (minimum of the THD of current)	—	Meter. fct.	—	PB	8	—
83	Property byte for byte 5 (maximum of the THD of current)	—	Meter. fct.	—	PB	8	—
84	Property byte for byte 6 (minimum of the THD of voltage)	—	Meter. fct.	—	PB	8	—
85	Property byte for byte 7 (maximum of the THD of voltage)	—	Meter. fct.	—	PB	8	—
86	Property byte for byte 8 (TS minimum of the frequency)	—	COM15	—	PB	8	—
87	Property byte for byte 16 (TS maximum of the frequency)	—	COM15	—	PB	8	—

Byte	Description	Data point	Source WL	Source VL	Format	Length (bits)	Scaling
88	Property byte for byte 24 (TS minimum of the THD of current)	—	COM15	—	PB	8	—
89	Property byte for byte 32 (TS maximum of the THD of current)	—	COM15	—	PB	8	—
90	Property byte for byte 40 (TS minimum of the THD of voltage)	—	COM15	—	PB	8	—
91	Property byte for byte 48 (TS maximum of the THD of voltage)	—	COM15	—	PB	8	—

8.6.12 Data set DS 77 min. and max. measured values of the temperatures

The table below shows data set 77 in which the minimum and maximum measured values of the temperatures are transmitted. It also contains the associated time stamps for these minimum and maximum measured values.

Table 8- 25 Content of data set 77

Byte	Description	Data point	Source WL	Source VL	Format	Length (bits)	Scaling
0	Minimum temperature in the control cabinet	72	COM15	—	unsigned c har	8	0
1	Maximum temperature in the control cabinet	73	COM15	—	unsigned c har	8	0
2	Minimum temperature in the circuit breaker	74	BSS	—	unsigned c har	8	0
3	Maximum temperature in the circuit breaker	75	BSS	—	unsigned c har	8	0
4	TS minimum temperature in the control cabinet	76	COM15	—	Time	64	—
12	TS maximum temperature in the control cabinet	77	COM15	—	Time	64	—
20	TS minimum temperature in the circuit breaker	78	COM15	—	Time	64	—
28	TS maximum temperature in the circuit breaker	79	COM15	—	Time	64	—
36	Reserved	—	—	—	—	112	—
50	Property byte for byte 0 (minimum temperature in the control cabinet)	—	COM15	—	—	—	—
51	Property byte for byte 1 (maximum temperature in the control cabinet)	—	COM15	ETU	PB	8	—
52	Property byte for byte 2 (minimum temperature in the circuit breaker)	—	BSS	ETU	PB	8	—
53	Property byte for byte 3 (maximum temperature in the circuit breaker)	—	BSS	ETU	PB	8	—
54	Property byte for byte 4 (TS minimum temperature in the control cabinet)	—	COM15	ETU	PB	8	—
55	Property byte for byte 12 (TS maximum temperature in the control cabinet)	—	COM15	ETU	PB	8	—
56	Property byte for byte 20 (TS minimum temperature in the circuit breaker)	—	COM15	ETU	PB	8	—
57	Property byte for byte 28 (TS maximum temperature in the circuit breaker)	—	COM15	ETU	PB	8	—

8.6.13 Data set DS 91 statistical information

The table below shows the content of data set 91 in which the statistical information on the SENTRON circuit breakers is transmitted. As with the other data sets, the property of each data point is additionally transmitted in the property byte.

The table below contains the data sets DS91: Statistical information (length 84 bytes, read-only):

Table 8- 26 Content of data set 91

Byte	Description	Data point	Source WL	Source VL	Format	Length (bits)	Scaling
0	Number of switching operations under load	80	COM15	COM20	unsigned int	16	0
2	Number of switching operations caused by trips	81	COM15	COM20	unsigned int	16	0
4	Switching cycle counter (for switching cycle on/off)	82	COM15	—	unsigned int	16	0
6	Runtime meter (when On + current > 0)	83	COM15	COM20	unsigned long	32	0
10	Date of the last parameter change	84	COM15	—	Time	64	—
18	Number of short-circuit releases (SI)	104	ETU	COM20	unsigned int	16	0
20	Number of overload trips (L)	105	ETU	COM20	unsigned int	16	0
22	Number of ground-fault tripping operations (G)	106	ETU	COM20	unsigned int	16	0
24	Total of deactivated I^2t values L1, L2, L3, N	107	ETU	—	Format (107)	128	0
40	Maintenance information about the main contacts	405	ETU	—	Format (405)	2	—
41	Reserved	—	—	—	—	56	—
48	Modules connected to c	88	COM15	—	Format (88)	32	—
52	Reserved	—	—	—	—	144	—
70	Property byte for byte 0 (number of switching operations under load)	—	COM15	COM20	PB	8	—
71	Property byte for byte 2 (number of switching operations caused by trips)	—	COM15	COM20	PB	8	—
72	Property byte for byte 4 (switching cycle counter (for switching cycle on/off))	—	COM15	—	PB	8	—
73	Property byte for byte 6 (runtime meter (when On + current > 0))	—	COM15	COM20	PB	8	—
74	Property byte for byte 10 (date of last parameter change)	—	COM15	—	PB	8	—
75	Property byte for byte 18 (number of short-circuit tripping operations (SI))	—	ETU	COM20	PB	8	—
76	Property byte for byte 20 (number of overload trips (L))	—	ETU	COM20	PB	8	—

Byte	Description	Data point	Source WL	Source VL	Format	Length (bits)	Scaling
77	Property byte for byte 22 (number of ground-fault tripping operations (G))	—	ETU	COM20	PB	8	—
78	Property byte for byte 24 (total of deactivated I^2t values L1, L2, L3, N)	—	ETU	—	PB	8	—
79	Property byte for byte 40 (maintenance information on the main contacts)	—	ETU	—	PB	8	—
80	Reserved	—	—	—	—	32	—

8.6.14 Data set DS 92 diagnostics data

The table below shows the content of data set 92 via which the data for detailed diagnostics of the SENTRON circuit breakers is transmitted.

The table below contains the data sets DS92: Diagnostics data (length 194 bytes, read-only):

Table 8- 27 Content of data set 92

Byte	Description	Data point	Source WL	Source VL	Format	Length (bits)	Scaling
0	Device status 1 (identical standard diagnostics)	—	COM15	COM20	DP standard	8	—
1	Device status 2 (identical standard diagnostics)	—	COM15	COM20	DP standard	8	—
2	Device status 3 (identical standard diagnostics)	—	COM15	COM20	DP standard	8	—
3	Address of the class 1 master	—	COM15	COM20	unsigned c har	8	0
4	SENTRON identification number (0x80C0)	—	COM15	COM20	hex	16	—
6	Fixed value 0x42	—	COM15	COM20	hex	8	—
7	External diagnostics bit; 1 = diagnosis; 0 = no diagnosis	—	COM15	COM20	hex	1	—
8	Fixed header; value 0x05 82 00 00 00	—	COM15	COM20	hex	40	—
13	Reserved	—	—	—	unsigned c har	8	—
14	Diagnostic messages	—	COM15	COM20	Diagnostic s	16	—
16	Module affected by diagnostics	—	COM15	—	Format (88)	32	—
20	Modules connected to the CubicleBUS	88	COM15	—	Format (88)	32	—
24	Currently pending alarms	402	ETU	ETU	Format (402)	16	—
26	Last unacknowledged tripping operation of the trip unit	401	ETU	ETU	Format (401)	8	—
27	Reserved	—	—	—	unsigned c har	8	—
28	Tripping operations by metering function/metering function PLUS	307	Meter. fct.	—	Format (307)	16	—
30	Threshold warnings	308	Meter. fct.	—	Format (308)	32	—
34	Current at the moment of shutdown	403	ETU	ETU	unsigned int	16	0(VL)/1
36	Phase at the moment of shutdown	404	ETU	ETU	Format (373)	3	—
37	Position of the circuit breaker in the frame	24	COM15	COM20	Format (24)	4	—
38	Reserved	—	—	—	unsigned c har	16	—

Byte	Description	Data point	Source WL	Source VL	Format	Length (bits)	Scaling
40	Status of the circuit breaker (on/off/powered, etc.)	328	BSS	COM20	Format (328)	8	—
41	Reserved	—	—	—	unsigned c har	8	—
42	Event log of the last 10 events with time	16	COM15	—	Format (16)	960	—
162	Reserved	—	—	—	unsigned c har	144	—
180	Property byte for byte 20 (modules connected to the CubicleBUS)	—	COM15	—	PB	8	—
181	Property byte for byte 24 (currently pending alarms)	—	ETU	ETU	PB	8	—
182	Property byte for byte 26 (last unacknowledged tripping operation of the trip unit)	—	ETU	ETU	PB	8	—
183	Property byte for byte 28 (tripping operations by metering function/metering function PLUS)	—	Meter. fct.	—	PB	8	—
184	Property byte for byte 30 (threshold value warnings)	—	Meter. fct.	—	PB	8	—
185	Property byte for byte 34 (current at the moment of shutdown)	—	ETU	ETU	PB	8	—
186	Property byte for byte 36 (phase at the moment of shutdown)	—	ETU	ETU	PB	8	—
187	Property byte for byte 37 (position of the circuit breaker in the frame)	—	COM15	COM20	PB	8	—
188	Reserved	—	—	—	unsigned c har	8	—
189	Property byte for byte 40 (status of the circuit breaker (on/off/charged, etc.))	—	BSS	ETU	PB	8	—
190	Property byte for byte 42 (event log of the last 10 events with time)	—	COM15	COM20	PB	8	—
191	Reserved	—	—	—	unsigned c har	24	—

8.6.15 Data set DS 93 controlling the circuit breakers

The table below shows DS93 via which the SENTRON circuit breakers are switched on, the min./max. buffer deleted, the outputs of the digital output modules forced, and the 6 available PROFIBUS bits (can be output via the configurable digital output module) are set.

The table below contains the data sets DS93: Controlling the circuit breakers (length 27 bytes, write-only):

Table 8- 28 Content of data set 93

Byte	Description	Data point	Source WL	Source VL	Format	Length (bits)	Scaling
0	Header; value 0x00 00 00 00	—	COM15	COM20	—	32	—
4	Controls the trip unit	406	ETU	ETU	Format (406)	16	—
6	Reserved	—	—	—	unsigned c har	16	—
8	Controls the digital output module 1	121	DO1	—	Format (121)	8	—
9	Controls the digital output module 2	126	DO2	—	Format (121)	8	—
10	Controls the buffers (e.g. min./max. values) of the communication module	18	COM15	COM20	Format (18)	8	—
11	Controls the outputs of the communication module (e.g. switching the breaker)	19	COM15	COM20	Format (19)	8	—
12	Reserved	—	—	—	unsigned c har	8	—
13	6 PROFIBUS bits for the digital configurable output module	426	COM15	—	Format (426)	6	—
14	Reserved	—	—	—	unsigned c har	40	—
19	Property byte for byte 13 (6 PROFIBUS bits for the digital configurable output module)	—	COM15	—	PB	8	—
20	Property byte for byte 4 (controls the trip unit)	—	ETU	ETU	PB	8	—
21	Property byte for byte 6 (reserved)	—	Meter. fct.	—	PB	8	—
22	Property byte for byte 8 (controls digital output module 1)	—	DO1	—	PB	8	—
23	Property byte for byte 9 (controls digital output module 2)	—	DO2	—	PB	8	—
24	Property byte for byte 10 (controls the buffers (e.g. min./max. values) of the communication module)	—	COM15	COM20	PB	8	—
25	Property byte for byte 11 (controls the outputs of the communication module (e.g. switching the breaker))	—	COM15	COM20	PB	8	—
26	Reserved	—	—	—	unsigned c har	8	—

8.6.16 Data set DS 94 current measured values

The table below shows data set 94 in which all current measured values are transmitted. The additional property bytes provide information on the availability and correctness of the measured values.

The table below contains the data sets DS94 (up to byte 140; part 2 follows): Current measured values (length 197 bytes, read-only):

Table 8- 29 Content of data set 94

Byte	Description	Data point	Source WL	Source VL	Format	Length (bits)	Scaling
0	Phase unbalance current (as %)	172	Meter. fct.	ETU	unsigned char	8	0
1	Reserved	—	—	—	unsigned char	8	—
2	Long-time mean value of 3-phase current	193	Meter. fct.	ETU	unsigned int	16	0
4	Long-time mean value of current L1	194	Meter. fct.	—	unsigned int	16	0
6	Long-time mean value of current L2	195	Meter. fct.	—	unsigned int	16	0
8	Long-time mean value of current L3	196	Meter. fct.	—	unsigned int	16	0
10	Current in phase L1	380	ETU	ETU	unsigned int	16	0
12	Current in phase L2	381	ETU	ETU	unsigned int	16	0
14	Current in phase L3	382	ETU	ETU	unsigned int	16	0
16	Mean current value over the three phases	383	ETU	ETU	unsigned int	16	0
18	Current in neutral conductor	375	ETU	ETU	unsigned int	16	0
20	Current which flows to ground	376	ETU	ETU	unsigned int	16	0
22	Phase unbalance voltage (in %)	173	Meter. fct.	—	unsigned char	8	0
23	Reserved	—	—	—	—	8	—
24	Phase-to-phase voltage between phase L1 and L2	197	Meter. fct.	—	unsigned int	16	0
26	Phase-to-phase voltage between phase L2 and L3	198	Meter. fct.	—	unsigned int	16	0
28	Phase-to-phase voltage between phase L3 and L1	199	Meter. fct.	—	unsigned int	16	0
30	Neutral point voltage phase L1	200	Meter. fct.	—	unsigned int	16	0
32	Neutral point voltage phase L2	201	Meter. fct.	—	unsigned int	16	0

Byte	Description	Data point	Source WL	Source VL	Format	Length (bits)	Scaling
34	Neutral point voltage phase L3	202	Meter. fct.	—	unsigned int	16	0
36	Mean value of phase-to-phase voltage	203	Meter. fct.	—	unsigned int	16	0
38	Mean value of neutral-point star voltage	204	Meter. fct.	—	unsigned int	16	0
40	Total apparent power	217	Meter. fct.	—	unsigned int	16	0
42	Total active power	221	Meter. fct.	—	signed int	16	0
44	Active power in phase L1	222	Meter. fct.	—	signed int	16	0
46	Active power in phase L2	223	Meter. fct.	—	signed int	16	0
48	Active power in phase L3	224	Meter. fct.	—	signed int	16	0
50	Total reactive power	225	Meter. fct.	—	signed int	16	0
52	Long-time mean value of 3-phase active power	229	Meter. fct.	—	signed int	16	0
54	Long-time mean value of active power in phase L1	230	Meter. fct.	—	signed int	16	0
56	Long-time mean value of active power in phase L2	231	Meter. fct.	—	signed int	16	0
58	Long-time mean value of active power in phase L3	232	Meter. fct.	—	signed int	16	0
60	Long-time mean value of 3-phase apparent power	233	Meter. fct.	—	unsigned int	16	0
62	Apparent power in phase L1	218	Meter. fct.	—	unsigned int	16	0
64	Apparent power in phase L2	219	Meter. fct.	—	unsigned int	16	0
66	Apparent power in phase L3	220	Meter. fct.	—	unsigned int	16	0
68	Long-time mean value of apparent power in phase L1	234	Meter. fct.	—	unsigned int	16	0
70	Long-time mean value of apparent power in phase L2	235	Meter. fct.	—	unsigned int	16	0
72	Long-time mean value of apparent power in phase L3	236	Meter. fct.	—	unsigned int	16	0
74	Long-time mean value of 3-phase reactive power	237	Meter. fct.	—	signed int	16	0
76	Reactive power in phase L1	226	Meter. fct.	—	signed int	16	0
78	Reactive power in phase L2	227	Meter. fct.	—	signed int	16	0
80	Reactive power in phase L3	228	Meter. fct.	—	signed int	16	0
82	Active energy in normal direction [MWh]	238	Meter. fct.	—	unsigned long	32	0
86	Active energy in reverse direction [MWh]	239	Meter. fct.	—	unsigned long	32	0
90	Reactive energy in normal direction [MVArh]	240	Meter. fct.	—	unsigned long	32	0

Byte	Description	Data point	Source WL	Source VL	Format	Length (bits)	Scaling
94	Reactive energy in reverse direction [MVArh]	241	Meter. fct.	—	unsigned long	32	0
98	Mean value of the power factor	168	Meter. fct.	—	signed int	16	–3
100	Power factor in phase L1	169	Meter. fct.	—	signed int	16	–3
102	Power factor in phase L2	170	Meter. fct.	—	signed int	16	–3
104	Power factor in phase L3	171	Meter. fct.	—	signed int	16	–3
106	Frequency	262	Meter. fct.	—	unsigned int	16	–2
108	THD of current	254	Meter. fct.	—	unsigned char	8	0
109	THD of voltage	257	Meter. fct.	—	unsigned char	8	0
110	Form factor	261	Meter. fct.	—	unsigned char	8	–1
111	Peak factor	260	Meter. fct.	—	unsigned char	8	–1
112	Frequency 3VL	396	—	—	unsigned char	16	-2
114	Temperature in the control cabinet (measured in the COM15)	71	COM15	—	unsigned char	8	0
115	Temperature in circuit breaker (measured in the BSS)	330	BSS	—	unsigned char	8	0
116	Active energy in normal direction [kWh]	433	Meter. fct.	—	unsigned long	32	—
120	Active energy in reverse direction [kWh]	434	Meter. fct.	—	unsigned long	32	—
124	Reactive energy in normal direction [kVArh]	435	Meter. fct.	—	unsigned long	32	—
128	Reactive energy in reverse direction [kVArh]	436	Meter. fct.	—	unsigned long	32	—
132	Reserved	—	—	—	unsigned char	32	—
136	Property byte for byte 116 (active energy in normal direction)	—	Meter. fct.	—	PB	8	—
137	Property byte for byte 120 (active energy in reverse direction)	—	Meter. fct.	—	PB	8	—
138	Property byte for byte 124 (reactive energy in normal direction)	—	Meter. fct.	—	PB	8	—
139	Property byte for byte 128 (reactive energy in reverse direction)	—	Meter. fct.	—	PB	8	—
140	Property byte for byte 0 (phase unbalance current (in %))	—	Meter. fct.	ETU	PB	8	—
141	Property byte for byte 2 (long-time mean value of 3-phase current)	—	Meter. fct.	ETU	PB	8	—
142	Property byte for byte 4 (long-time mean value of current L1)	—	Meter. fct.	—	PB	8	—

Byte	Description	Data point	Source WL	Source VL	Format	Length (bits)	Scaling
143	Property byte for byte 6 (long-time mean value of current L2)	—	Meter. fct.	—	PB	8	—
144	Property byte for byte 8 (long-time mean value of current L3)	—	Meter. fct.	—	PB	8	—
145	Property byte for byte 10 (current in phase L1)	—	ETU	ETU	PB	8	—
146	Property byte for byte 12 (current in phase L2)	—	ETU	ETU	PB	8	—
147	Property byte for byte 14 (current in phase L3)	—	ETU	ETU	PB	8	—
148	Property byte for byte 16 (mean current value over the three phases)	—	ETU	ETU	PB	8	—
149	Property byte for byte 18 (current in neutral conductor)	—	ETU	ETU	PB	8	—
150	Property byte for byte 20 (current that flows to ground)	—	ETU	ETU	PB	8	—
151	Property byte for byte 22 (phase unbalance voltage (in %))	—	Meter. fct.	—	PB	8	—
152	Property byte for byte 24 (phase-to-phase voltage between phase L1 and L2)	—	Meter. fct.	—	PB	8	—
153	Property byte for byte 26 (phase-to-phase voltage between phase L2 and L3)	—	Meter. fct.	—	PB	8	—
154	Property byte for byte 28 (phase-to-phase voltage between phase L3 and L1)	—	Meter. fct.	—	PB	8	—
155	Property byte for byte 30 (neutral point voltage phase L1)	—	Meter. fct.	—	PB	8	—
156	Property byte for byte 32 (neutral point voltage phase L2)	—	Meter. fct.	—	PB	8	—
157	Property byte for byte 34 (neutral point voltage phase L3)	—	Meter. fct.	—	PB	8	—
158	Property byte for byte 36 (mean value of phase-to-phase voltage)	—	Meter. fct.	—	PB	8	—
159	Property byte for byte 38 (mean value of neutral point voltage)	—	Meter. fct.	—	PB	8	—
160	Property byte for byte 40 (total apparent power)	—	Meter. fct.	—	PB	8	—
161	Property byte for byte 42 (total active power)	—	Meter. fct.	—	PB	8	—
162	Property byte for byte 44 (active power in phase L1)	—	Meter. fct.	—	PB	8	—
163	Property byte for byte 46 (active power in phase L2)	—	Meter. fct.	—	PB	8	—
164	Property byte for byte 48 (active power in phase L3)	—	Meter. fct.	—	PB	8	—
165	Property byte for byte 50 (total reactive power)	—	Meter. fct.	—	PB	8	—
166	Property byte for byte 52 (long-time mean value of 3-phase active power)	—	Meter. fct.	—	PB	8	—

Byte	Description	Data point	Source WL	Source VL	Format	Length (bits)	Scaling
167	Property byte for byte 54 (long-time mean value of active power in phase L1)	—	Meter. fct.	—	PB	8	—
168	Property byte for byte 56 (long-time mean value of active power in phase L2)	—	Meter. fct.	—	PB	8	—
169	Property byte for byte 58 (long-time mean value of active power in phase L3)	—	Meter. fct.	—	PB	8	—
170	Property byte for byte 60 (long-time mean value of 3-phase apparent power)	—	Meter. fct.	—	PB	8	—
171	Property byte for byte 62 (apparent power in phase L1)	—	Meter. fct.	—	PB	8	—
172	Property byte for byte 64 (apparent power in phase L2)	—	Meter. fct.	—	PB	8	—
173	Property byte for byte 66 (apparent power in phase L3)	—	Meter. fct.	—	PB	8	—
174	Property byte for byte 68 (long-time mean value of apparent power in phase L1)	—	Meter. fct.	—	PB	8	—
175	Property byte for byte 70 (long-time mean value of apparent power in phase L2)	—	Meter. fct.	—	PB	8	—
176	Property byte for byte 72 (long-time mean value of apparent power in phase L3)	—	Meter. fct.	—	PB	8	—
177	Property byte for byte 74 (long-time mean value of 3-phase reactive power)	—	Meter. fct.	—	PB	8	—
178	Property byte for byte 76 (reactive power in phase L1)	—	Meter. fct.	—	PB	8	—
179	Property byte for byte 78 (reactive power in phase L2)	—	Meter. fct.	—	PB	8	—
180	Property byte for byte 80 (reactive power in phase L3)	—	Meter. fct.	—	PB	8	—
181	Property byte for byte 82 (active energy in normal direction)	—	Meter. fct.	—	PB	8	—
182	Property byte for byte 86 (active energy in reverse direction)	—	Meter. fct.	—	PB	8	—
183	Property byte for byte 90 (reactive energy in normal direction)	—	Meter. fct.	—	PB	8	—
184	Property byte for byte 94 (reactive energy in reverse direction)	—	Meter. fct.	—	PB	8	—
185	Property byte for byte 98 (mean value of power factor)	—	Meter. fct.	—	PB	8	—
186	Property byte for byte 100 (power factor in phase L1)	—	Meter. fct.	—	PB	8	—
187	Property byte for byte 102 (power factor in phase L2)	—	Meter. fct.	—	PB	8	—
188	Property byte for byte 104 (power factor in phase L3)	—	Meter. fct.	—	PB	8	—
189	Property byte for byte 106 (frequency)	—	Meter. fct.	—	PB	8	—

8.6.17 Data set DS 97 detailed identification

The table below shows data set 97 via which all necessary information for precise identification of the SENTRON circuit breakers can be retained.

The table below contains the data sets DS97: detailed identification (length 223 bytes, read-only):

Table 8- 30 Content of data set 97

Byte	Description	Data point	Source WL	Source VL	Format	Length (bits)	Scaling
0	Order number of the trip unit	407	ETU	—	16 x char	144	—
18	Date of manufacture of trip unit	408	ETU	—	Time	64	—
26	Identification number of trip unit	409	ETU	ETU	17 x char	136	—
43	Reserved	—	—	—	—	8	—
44	Ground fault transformer detection type	410	ETU	ETU	Format (410)	2	—
45	N transformer connected	411	ETU	ETU	Format (411)	1	—
46	Reserved	—	—	—	—	8	—
47	Market in which the trip unit is used	95	ETU	ETU	Format (95)	2	—
48	Identification number of circuit breaker	96	ETU	—	20 x char	160	—
68	Reserved	—	—	—	—	48	—
74	Test date of switch	98	ETU	—	Time	64	—
82	Switching capacity class	99	ETU	—	Format (99)	4	—
83	Size	100	ETU	—	Format (100)	2	—
84	Rated voltage (LL) of the circuit breaker	101	ETU	—	unsigned int	16	0
86	Rated current of the external g transformer	102	ETU	—	unsigned int	16	0
88	Order number of the circuit breaker (trip unit VL)	103	ETU	—	Format (103)	160	—
108	Reserved	—	—	—	—	144	—
126	Order number of the trip unit	371	ETU	—	18 x char	144	—
144	Number of poles of circuit breaker	108	ETU	ETU	Format (108)	3	—
145	Reserved	—	—	—	—	8	—
146	Rating plug	377	ETU	ETU	unsigned int	16	0
148	Circuit breaker frame	378	ETU	ETU	unsigned int	16	0
150	Reserved	—	—	—	—	32	—
154	Order number of communication module	424	—	—	16 x char	128	—
170	Serial number of communication module	425	—	COM20	16 x char	128	—

Byte	Description	Data point	Source WL	Source VL	Format	Length (bits)	Scaling
186	Reserved	—	—	—	—	112	—
200	Property byte for byte 0 (order number of trip unit)	—	ETU	—	PB	8	—
201	Property byte for byte 18 (date of manufacture of trip unit)	—	ETU	—	PB	8	—
202	Property byte for byte 26 (identification number of trip unit)	—	ETU	ETU	PB	8	—
203	Property byte for byte 44 (ground fault transformer detection method)	—	ETU	ETU	PB	8	—
204	Property byte for byte 45 (N transformer connected)	—	ETU	ETU	PB	8	—
205	Reserved	—	—	—	—	8	—
206	Property byte for byte 47 (market in which the trip unit is used)	—	ETU	ETU	PB	8	—
207	Property byte for byte 48 (identification number of circuit breaker)	—	ETU	—	PB	8	—
208	Reserved	—	—	—	—	8	—
209	Property byte for byte 74 (test date for switch)	—	ETU	—	PB	8	—
210	Property byte for byte 82 (switching capacity class)	—	ETU	—	PB	8	—
211	Property byte for byte 83 (size)	—	ETU	—	PB	8	—
212	Property byte for byte 84 (rated voltage (LL) of circuit breaker)	—	ETU	—	PB	8	—
213	Property byte for byte 86 (rated current of external g transformer)	—	ETU	—	PB	8	—
214	Property byte for byte 88 (order number of circuit breaker (trip unit VL))	—	ETU	—	PB	8	—
215	Reserved	—	—	—	—	8	—
216	Property byte for byte 126 (order number of trip unit)	—	ETU	—	PB	8	—
217	Property byte for byte 144 (number of poles of circuit breaker)	—	ETU	ETU	PB	8	—
218	Property byte for byte 146 (rating plug)	—	ETU	ETU	PB	8	—
219	Property byte for byte 148 (circuit breaker frame)	—	ETU	ETU	PB	8	—
220	Reserved	—	—	—	—	8	—
221	Property byte for byte 154 (order number COM10)	—	—	—	PB	8	—
222	Property byte for byte 170 (serial number COM10)	—	—	COM20	PB	8	—

8.6.18 Data set DS 100 identification overview

The table below shows data set 100 that contains the identification of the relevant switch (test data, manufacturer, device name or family, device class, etc.).

The table below contains the data sets DS100: Identification overview (length 100 bytes, read-only):

Table 8- 31 Content of data set 100

Byte	Description	Data point	Source WL	Source VL	Format	Length (bits)	Scaling
0	Header; value 0x00 00 00 00	—	COM15	COM20	—	32	—
4	Test date of switch	98	ETU	—	PROFIBUS time	64	—
12	Manufacturer (SIEMENS or SE&A)	—	COM15	COM20	20 x char	160	—
32	Device name (SENTRON WL or SENTRON VL)	—	COM15	COM20	24 x char	192	—
56	Device family (fixed value 0x03)	—	COM15	COM20	hex	8	—
57	Device bus family (fixed value 0x01)	—	COM15	COM20	hex	8	—
58	Device class (1 = air circuit breaker; 2 = compact circuit breaker)	—	COM15	COM20	hex	8	—
59	System (fixed value 0x06)	—	COM15	COM20	hex	8	—
60	Function group (Bit .0 for COM15)	—	COM15	COM20	hex	8	—
61	Reserved	—	—	—	—	8	—
62	Abbreviated designation (PCB or MCCB)	—	COM15	COM20	16 x char	128	—
78	HW version	—	COM15	COM20	4 x char	32	—
82	PROFIBUS identification number (0x00 00 80 C0)	—	COM15	COM20	hex	32	—
86	Reserved	—	—	—	—	16	—
88	Service number (lower part of switch identification number)	—	COM15	COM20	8 x char	64	—
96	Firmware version of PROFIBUS module	—	COM15	COM20	4 x char	32	—

8.6.19 Data set DS 128 parameters of the metering function and extended protection function

The table below shows data set 128 via which the parameters of the metering function and the extended protection function can be read out but also set. It also contains the assignments of the configurable digital output module.

The table below contains the data sets DS128: Parameters of the metering function and the extended protection function (length 103 bytes, read/write):

Table 8- 32 Content of data set 128

Byte	Description	Data point	Source WL	Source VL	Format	Length (bits)	Scaling
0	Header; value 0x00 00 00 00	—	COM15	COM20	—	32	—
4	The voltage transformer can be star or delta-connected on the primary side	162	Meter. fct.	—	Format (162)	1	—
5	Reserved	—	—	—	—	8	—
6	Rated voltage of the system (on the primary side)	164	Meter. fct.	—	unsigned int	16	0
8	Secondary voltage of transformer	165	Meter. fct.	—	unsigned char	8	0
9	Length of period for calculating long-term mean value	166	Meter. fct.	—	unsigned char	8	0
10	Number of sub-periods for calculating long-term mean value	167	Meter. fct.	—	unsigned char	8	0
11	Reserved	—	—	—	—	8	—
12	Lower limit of power transmission	372	ETU	—	unsigned int	16	0
14	Active power in normal direction	141	Meter. fct.	—	unsigned int	16	0
16	Active power in reverse direction	143	Meter. fct.	—	unsigned int	16	0
18	Delay time for active power in normal direction	142	Meter. fct.	—	unsigned char	8	0
19	Delay time for active power in reverse direction	144	Meter. fct.	—	unsigned char	8	0
20	Normal direction of incoming supply	145	Meter. fct.	—	Format (145)	1	—
21	Direction of rotation of phase	146	Meter. fct.	—	Format (146)	1	—
22	Underfrequency	147	Meter. fct.	—	unsigned int	16	0
24	Delay time for overfrequency	150	Meter. fct.	—	unsigned char	8	0
25	Delay time for underfrequency	148	Meter. fct.	—	unsigned char	8	0
26	Overfrequency	149	Meter. fct.	—	unsigned int	16	0

Byte	Description	Data point	Source WL	Source VL	Format	Length (bits)	Scaling
28	THD of current	158	Meter. fct.	—	unsigned char	8	0
29	Delay time of THD of current	159	Meter. fct.	—	unsigned char	8	0
30	THD of voltage	160	Meter. fct.	—	unsigned char	8	0
31	Delay time of THD of voltage	161	Meter. fct.	—	unsigned char	8	0
32	Voltage unbalance	151	Meter. fct.	—	unsigned char	8	0
33	Delay time for voltage unbalance	152	Meter. fct.	—	unsigned char	8	0
34	Undervoltage	153	Meter. fct.	—	unsigned int	16	0
36	Overvoltage	155	Meter. fct.	—	unsigned int	16	0
38	Delay time for undervoltage	154	Meter. fct.	—	unsigned char	8	0
39	Delay time for overvoltage	156	Meter. fct.	—	unsigned char	8	0
40	Reserved	—	—	—	—	8	—
41	Current unbalance	139	Meter. fct.	ETU	unsigned char	8	0
42	Delay time for current unbalance	140	Meter. fct.	—	unsigned char	8	0
43	Reserved	—	—	—	—	8	—
44	Overload pre-alarm (VL only)	369	—	—	unsigned int	16	0
46	Assignment of config. dig. output module	129	conf. DO	—	Format (129)	168	—
67	Reserved	—	—	—	—	24	—
70	Property byte for byte 4 (voltage transformer can be star or delta-connected on the primary side)	—	Meter. fct.	—	PB	8	—
71	Reserved	—	—	—	—	8	—
72	Property byte for byte 6 (rated voltage of system (on the primary side))	—	Meter. fct.	—	PB	8	—
73	Property byte for byte 8 (secondary voltage of transformer)	—	Meter. fct.	—	PB	8	—
74	Property byte for byte 9 (length of period for calculating long-term mean value)	—	Meter. fct.	—	PB	8	—
75	Property byte for byte 10 (number of sub-periods for calculating long-term mean value)	—	Meter. fct.	—	PB	8	—
76	Reserved	—	—	—	—	8	—
77	Property byte for byte 12 (lower limit of power transmission)	—	ETU	—	PB	8	—

Byte	Description	Data point	Source WL	Source VL	Format	Length (bits)	Scaling
78	Property byte for byte 14 (active power in normal direction)	—	Meter. fct.	—	PB	8	—
79	Property byte for byte 16 (active power in reverse direction)	—	Meter. fct.	—	PB	8	—
80	Property byte for byte 18 (delay time for active power in normal direction)	—	Meter. fct.	—	PB	8	—
81	Property byte for byte 19 (delay for active power in reverse direction)	—	Meter. fct.	—	PB	8	—
82	Property byte for byte 20 (normal direction of incoming supply)	—	Meter. fct.	—	PB	8	—
83	Property byte for byte 21 (direction of rotation of phase)	—	Meter. fct.	—	PB	8	—
84	Property byte for byte 22 (underfrequency)	—	Meter. fct.	—	PB	8	—
85	Property byte for byte 24 (delay for overfrequency)	—	Meter. fct.	—	PB	8	—
86	Property byte for byte 25 (delay for underfrequency)	—	Meter. fct.	—	PB	8	—
87	Property byte for byte 26 (overfrequency)	—	Meter. fct.	—	PB	8	—
88	Property byte for byte 28 (THD of current)	—	Meter. fct.	—	PB	8	—
89	Property byte for byte 29 (delay time of THD of current)	—	Meter. fct.	—	PB	8	—
90	Property byte for byte 30 (THD of voltage)	—	Meter. fct.	—	PB	8	—
91	Property byte for byte 31 (delay time of THD of voltage)	—	Meter. fct.	—	PB	8	—
92	Property byte for byte 32 (voltage unbalance)	—	Meter. fct.	—	PB	8	—
93	Property byte for byte 33 (delay time for voltage unbalance)	—	Meter. fct.	—	PB	8	—
94	Property byte for byte 34 (undervoltage)	—	Meter. fct.	—	PB	8	—
95	Property byte for byte 36 (overvoltage)	—	Meter. fct.	—	PB	8	—
96	Property byte for byte 38 (delay time for undervoltage)	—	Meter. fct.	—	PB	8	—
97	Property byte for byte 39 (delay time for overvoltage)	—	Meter. fct.	—	PB	8	—
98	Property byte for byte 40 (reserved)	—	Meter. fct.	—	PB	8	—
99	Property byte for byte 41 (current unbalance)	—	Meter. fct.	ETU	PB	8	—
100	Property byte for byte 42 (delay time for current unbalance)	—	Meter. fct.	—	PB	8	—

Byte	Description	Data point	Source WL	Source VL	Format	Length (bits)	Scaling
101	Property byte for byte 44 (overload pre-alarm (VL only))	—	—	—	PB	8	—
102	Property byte for byte 46 (assignment of config. dig. output module)	—	conf. DO	—	PB	8	—

8.6.20 Data set DS 129 Parameters of the protection function and settings for load shedding and load pick up

The table below shows DS129 that contains the parameters (overload protection, time-lag class, short-circuit protection, thermal memory, phase loss sensitivity, etc.) of the protection function, and the settings for load shedding and load pick up.

The table below shows DS129 that contains the parameters of the protection function, and the settings for load shedding and load pick up:

Table 8- 33 Content of data set 129

Byte	Description	Data point	Source WL	Source VL	Format	Length (bits)	Scaling
0	Header; value 0x00 00 00 00	—	COM15	COM20	—	32	—
4	Overload parameter I_R parameter set A (PS A)	333	ETU	ETU	unsigned int	16	0
6	Overload protection neutral conductor I_N PS A (WL)	334	ETU	—	unsigned int	16	0
8	Time-lag class t_R PS A	335	ETU	ETU	unsigned int	16	–1
10	Short-circuit protection instantaneous I_i PS A	336	ETU	ETU	unsigned int	16	1 / 0(VL)
12	Short-circuit protection delayed I_{sd} PS A	337	ETU	ETU	unsigned int	16	1 / 0(VL)
14	Delay time for short-circuit protection t_{sd} PS A	338	ETU	ETU	unsigned int	16	–3
16	Ground-fault protection I_g PS A	339	ETU	ETU	unsigned int	16	0
18	Delay time for ground fault t_g PS A	340	ETU	ETU	unsigned int	16	–3
20	Ground fault alarm I_{g2} PS A	341	ETU	—	unsigned int	16	0
22	Delay time for ground fault alarm t_{g2} PS A	342	ETU	—	unsigned int	16	–3
24	I^2t characteristic for delayed short-circuit protection PS A	343	ETU	ETU	Format (343)	1	—
25	I^2t characteristic for ground-fault protection PS A	344	ETU	ETU	Format (344)	1	—
26	I^4t characteristic for overload protection PS A	345	ETU	—	Format (345)	1	—
27	Thermal memory PS A	346	ETU	ETU	Format (346)	1	—
28	Phase loss sensitivity PS A	347	ETU	—	Format (347)	1	—
29	Reserved	—	—	—	—	8	—
30	Cooling time constant PS A	348	ETU	—	unsigned int	16	0
32	Overload parameter I_R parameter set B (PS B)	349	ETU	—	unsigned int	16	0

Byte	Description	Data point	Source WL	Source VL	Format	Length (bits)	Scaling
34	Overload protection neutral conductor I_N PS B	350	ETU	—	unsigned int	16	0
36	Time-lag class t_R PS B	351	ETU	—	unsigned int	16	–1
38	Short-circuit protection instantaneous I_i PS B	352	ETU	—	unsigned int	16	1
40	Short-circuit protection delayed I_{sd} PS B	353	ETU	—	unsigned int	16	1
42	Delay time for short-circuit protection t_{sd} PS B	354	ETU	—	unsigned int	16	–3
44	Ground-fault protection I_g PS B	355	ETU	—	unsigned int	16	0
46	Delay time for ground fault t_g PS B	356	ETU	—	unsigned int	16	–3
48	Ground-fault protection alarm I_{g2} PS B	357	ETU	—	unsigned int	16	0
50	Delay time for ground fault alarm t_{g2} PS B	358	ETU	—	unsigned int	16	–3
52	I^2t curve for delayed short-circuit protection PS B	359	ETU	—	Format (343)	1	—
53	I^2t curve for ground-fault protection PS B	360	ETU	—	Format (344)	1	—
54	I^4t characteristic for overload protection PS B	361	ETU	—	Format (345)	1	—
55	Thermal memory PS B	362	ETU	—	Format (346)	1	—
56	Phase loss sensitivity PS B	363	ETU	—	Format (347)	1	—
57	Reserved	—	—		—	8	—
58	Cooling time constant PS B	364	ETU	—	unsigned int	16	0
60	Load shedding	367	ETU	—	unsigned int	16	0
62	Load pick up	368	ETU	—	unsigned int	16	0
64	Delay time for load shedding / pick up	366	ETU	—	unsigned c har	8	0
65	Active parameter set	370	ETU	—	Format (370)	1	—
66	Overload protection neutral conductor I_N (VL)	365	—	ETU	unsigned c har	8	0
67	ZSI on/off	421	—	ETU	Format (421)	8	—
68	Time lag class (SENTRON VL LCD ETU40M only)	331	—	ETU	Format (331)	8	0
69	Ground fault transformer detection type	410	ETU	ETU	Format (410)	2	—

Byte	Description	Data point	Source WL	Source VL	Format	Length (bits)	Scaling
70	Rated current of the external g transformer	102	ETU	—	unsigned int	16	0
72	Reserved	—	—	—	—	208	—
98	Property byte for byte 70 (rated current of external g transformer)	—	ETU	—	PB	8	—
99	Property byte for byte 68 (time lag class (SENTRON VL LCD ETU40M only))	—	ETU	ETU	PB	8	—
100	Property byte for byte 4 (overload parameter I_R parameter set A (PS A))	—	ETU	ETU	PB	8	—
101	Property byte for byte 6 (Overload protection neutral conductor I_N PS A (WL))	—	ETU	—	PB	8	—
102	Property byte for byte 8 (time lag class t_R PS A)	—	ETU	ETU	PB	8	—
103	Property byte for byte 10 (short-circuit protection instantaneous I_i PS A)	—	ETU	ETU	PB	8	—
104	Property byte for byte 12 (short-circuit protection delayed I_{sd} PS A)	—	ETU	ETU	PB	8	—
105	Property byte for byte 14 (delay time short-circuit protection t_{sd} PS A)	—	ETU	ETU	PB	8	—
106	Property byte for byte 16 (ground-fault protection I_g PS A)	—	ETU	ETU	PB	8	—
107	Property byte for byte 18 (delay time for ground fault t_g PS A)	—	ETU	ETU	PB	8	—
108	Property byte for byte 20 (ground fault alarm I_{g2} PS A)	—	ETU	—	PB	8	—
109	Property byte for byte 22 (delay time for ground fault alarm t_{g2} PS A)	—	ETU	—	PB	8	—
110	Property byte for byte 24 (I^2t characteristic for delayed short-circuit protection PS A)	—	ETU	ETU	PB	8	—
111	Property byte for byte 25 (I^2t characteristic for ground-fault protection PS A)	—	ETU	ETU	PB	8	—
112	Property byte for byte 26 (I^4t characteristic for overload protection PS A)	—	ETU	—	PB	8	—
113	Property byte for byte 27 (thermal memory PS A)	—	ETU	ETU	PB	8	—
114	Property byte for byte 28 (phase loss sensitivity PS A)	—	ETU	—	PB	8	—
115	Property byte for byte 30 (cooling time constant PS A)	—	ETU	—	PB	8	—
116	Property byte for byte 32 (overload parameter I_R parameter set B (PS B))	—	ETU	—	PB	8	—
117	Property byte for byte 34 (overload protection neutral conductor I_N PS B)	—	ETU	—	PB	8	—
118	Property byte for byte 36 (time lag class t_R PS B)	—	ETU	—	PB	8	—
119	Property byte for byte 38 (short-circuit protection instantaneous I_i PS B)	—	ETU	—	PB	8	—

Byte	Description	Data point	Source WL	Source VL	Format	Length (bits)	Scaling
120	Property byte for byte 40 (short-circuit protection delayed I_{sd} PS B)	—	ETU	—	PB	8	—
121	Property byte for byte 42 (delay time short-circuit protection t_{sd} PS B)	—	ETU	—	PB	8	—
122	Property byte for byte 44 (ground-fault protection I_g PS B)	—	ETU	—	PB	8	—
123	Property byte for Byte 46 (delay time for ground fault t_g PS B)	—	ETU	—	PB	8	—
124	Property byte for byte 48 (ground fault alarm I_{g2} PS B)	—	ETU	—	PB	8	—
125	Property byte for byte 50 (delay time for ground fault alarm t_{g2} PS B)	—	ETU	—	PB	8	—
126	Property byte for byte 52 (I^2t characteristic for delayed short-circuit protection PS B)	—	ETU	—	PB	8	—
128	Property byte for byte 54 (I^4t characteristic for overload protection PS B)	—	ETU	—	PB	8	—
129	Property byte for byte 55 (thermal memory PS B)	—	ETU	—	PB	8	—
130	Property byte for byte 56 (phase loss sensitivity PS B)	—	ETU	—	PB	8	—
131	Property byte for byte 58 (cooling time constant PS B)	—	ETU	—	PB	8	—
132	Property byte for byte 60 (load shedding)	—	ETU	—	PB	8	—
133	Property byte for byte 62 (load pick up)	—	ETU	—	PB	8	—
134	Property byte for byte 64 (delay time for load shedding/pick up)	—	ETU	—	PB	8	—
135	Property byte for byte 65 (active parameter set)	—	ETU	—	PB	8	—
136	Property byte for byte 66 (overload protection neutral conductor I_N (VL))	—	—	ETU	PB	8	—
137	Property byte for byte 67 (ZSI on/off)	—	—	ETU	PB	8	—
138	Property byte for byte 68 (time lag class (SENTRON VL LCD ETU40M only))	—	—	ETU	PB	8	—

8.6.21 Data set DS 130 Parameters for the threshold values

The table below shows the DS130 via which the parameters for generating threshold alarms can be read out and modified.

The table contains the data sets DS130: Parameters for the threshold values (length 148 bytes, read/write) Part 1:

Table 8- 34 Content of data set 130

Byte	Description	Data point	Source WL	Source VL	Format	Length (bits)	Scaling
0	Header; value 0x00 00 00 00	—	COM15	COM20	—	32	—
4	Active power in normal direction	283	Meter. fct.	—	unsigned int	16	0
6	Active power in reverse direction	285	Meter. fct.	—	unsigned int	16	0
8	Power factor, capacitive	287	Meter. fct.	—	signed int	16	–3
10	Power factor, inductive	289	Meter. fct.	—	signed int	16	–3
12	Delay time for active power in normal direction	284	Meter. fct.	—	unsigned char	8	0
13	Delay time for active power in reverse direction	286	Meter. fct.	—	unsigned char	8	0
14	Delay time for power factor, capacitive	288	Meter. fct.	—	unsigned char	8	0
15	Delay time for power factor, inductive	290	Meter. fct.	—	unsigned char	8	0
16	Overfrequency	303	Meter. fct.	—	unsigned char	8	0
17	Delay time for overfrequency	304	Meter. fct.	—	unsigned char	8	0
18	Underfrequency	305	Meter. fct.	—	unsigned char	8	0
19	Delay time for underfrequency	306	Meter. fct.	—	unsigned char	8	0
20	THD current	319	Meter. fct.	—	unsigned char	8	0
21	Delay time for THD current	320	Meter. fct.	—	unsigned char	8	0
22	THD voltage	321	Meter. fct.	—	unsigned char	8	0
23	Delay time for THD voltage	322	Meter. fct.	—	unsigned char	8	0
24	Peak factor	323	Meter. fct.	—	unsigned int	16	–2
26	Form factor	325	Meter. fct.	—	unsigned int	16	–2
28	Delay time for peak factor	324	Meter. fct.	—	unsigned char	8	0

Byte	Description	Data point	Source WL	Source VL	Format	Length (bits)	Scaling
29	Delay time for the form factor	326	Meter. fct.	—	unsigned char	8	0
30	Long-time mean value of active power	291	Meter. fct.	—	unsigned int	16	0
32	Long-time mean value of apparent power	293	Meter. fct.	—	unsigned int	16	0
34	Delay time for long-term mean value of active power	292	Meter. fct.	—	unsigned char	8	0
35	Delay time for long-term mean value of apparent power	294	Meter. fct.	—	unsigned char	8	0
36	Long-time mean value of reactive power	295	Meter. fct.	—	unsigned int	16	0
38	Reactive power in normal direction	297	Meter. fct.	—	unsigned int	16	0
40	Delay time for long-term mean value of reactive power	296	Meter. fct.	—	unsigned char	8	0
41	Delay time for reactive power in normal direction	298	Meter. fct.	—	unsigned char	8	0
42	Reactive power in reverse direction	299	Meter. fct.	—	unsigned int	16	0
44	Apparent power	301	Meter. fct.	—	unsigned int	16	0
46	Delay time for reactive power in reverse direction	300	Meter. fct.	—	unsigned char	8	0
47	Delay time for apparent power	302	Meter. fct.	—	unsigned char	8	0
48	Overcurrent	267	Meter. fct.	—	unsigned int	16	0
50	Current that flows to ground	269	Meter. fct.	—	unsigned int	16	0
52	Overcurrent in neutral conductor	271	Meter. fct.	—	unsigned int	16	0
54	Long-time mean value of current	275	Meter. fct.	—	unsigned int	16	0
56	Delay time for overcurrent	268	Meter. fct.	—	unsigned char	8	0
57	Delay time of current that flows to ground	270	Meter. fct.	—	unsigned char	8	0
58	Delay time for overcurrent in neutral conductor	272	Meter. fct.	—	unsigned char	8	0
59	Phase unbalance current	273	Meter. fct.	—	unsigned char	8	0
60	Delay time for current phase unbalance	274	Meter. fct.	—	unsigned char	8	0
61	Delay time for long-time mean value of current	276	Meter. fct.	—	unsigned char	8	0

Byte	Description	Data point	Source WL	Source VL	Format	Length (bits)	Scaling
62	Undervoltage	277	Meter. fct.	—	unsigned int	16	0
64	Delay time for undervoltage	278	Meter. fct.	—	unsigned char	8	0
65	Phase unbalance voltage	279	Meter. fct.	—	unsigned char	8	0
66	Delay time for voltage phase unbalance	280	Meter. fct.	—	unsigned char	8	0
67	Reserved	—	—	—	—	8	—
68	Overvoltage	281	Meter. fct.	—	unsigned int	16	0
70	Delay time for overvoltage	282	Meter. fct.	—	unsigned char	8	0
71	Reserved	—	—	—	—	232	—
100	Property byte for byte 4 (active power in normal direction)	—	Meter. fct.	—	PB	8	—
101	Property byte for byte 6 (active power in reverse direction)	—	Meter. fct.	—	PB	8	—
102	Property byte for byte 8 (capacitive power factor)	—	Meter. fct.	—	PB	8	—
103	Property byte for byte 10 (inductive power factor)	—	Meter. fct.	—	PB	8	—
104	Property byte for byte 12 (delay time for active power in normal direction)	—	Meter. fct.	—	PB	8	—
105	Property byte for byte 13 (delay time for active power in reverse direction)	—	Meter. fct.	—	PB	8	—
106	Property byte for byte 14 (delay time for capacitive power factor)	—	Meter. fct.	—	PB	8	—
107	Property byte for byte 15 (delay time for inductive power factor)	—	Meter. fct.	—	PB	8	—
108	Property byte for byte 16 (overfrequency)	—	Meter. fct.	—	PB	8	—
109	Property byte for byte 17 (delay time for overfrequency)	—	Meter. fct.	—	PB	8	—
110	Property byte for byte 18 (underfrequency)	—	Meter. fct.	—	PB	8	—
111	Property byte for byte 19 (delay time for underfrequency)	—	Meter. fct.	—	PB	8	—
112	Property byte for byte 20 (current THD)	—	Meter. fct.	—	PB	8	—
113	Property byte for byte 21 (delay for current THD)	—	Meter. fct.	—	PB	8	—
114	Property byte for byte 22 (voltage THD)	—	Meter. fct.	—	PB	8	—
115	Property byte for byte 23 (delay time for voltage THD)	—	Meter. fct.	—	PB	8	—
116	Property byte for byte 24 (peak factor)	—	Meter. fct.	—	PB	8	—
117	Property byte for byte 26 (form factor)	—	Meter. fct.	—	PB	8	—
118	Property byte for byte 28 (delay time for peak factor)	—	Meter. fct.	—	PB	8	—

Byte	Description	Data point	Source WL	Source VL	Format	Length (bits)	Scaling
119	Property byte for byte 29 (delay time for form factor)	—	Meter. fct.	—	PB	8	—
120	Property byte for byte 30 (long-term mean value for active power)	—	Meter. fct.	—	PB	8	—
121	Property byte for byte 32 (long-term mean value for apparent power)	—	Meter. fct.	—	PB	8	—
122	Property byte for byte 34 (delay time for long-term mean value of active power)	—	Meter. fct.	—	PB	8	—
123	Property byte for byte 35 (delay time for long-term mean value of apparent power)	—	Meter. fct.	—	PB	8	—
124	Property byte for byte 36 (long-term mean value for reactive power)	—	Meter. fct.	—	PB	8	—
125	Property byte for byte 38 (reactive power in normal direction)	—	Meter. fct.	—	PB	8	—
126	Property byte for byte 40 (delay for long-term mean value for reactive power)	—	Meter. fct.	—	PB	8	—
127	Property byte for byte 41 (delay for reactive power in normal direction)	—	Meter. fct.	—	PB	8	—
128	Property byte for byte 42 (reactive power in reverse direction)	—	Meter. fct.	—	PB	8	—
129	Property byte for byte 44 (apparent power)	—	Meter. fct.	—	PB	8	—
130	Property byte for byte 46 (delay time for reactive power in reverse direction)	—	Meter. fct.	—	PB	8	—
131	Property byte for byte 47 (delay time for apparent power)	—	Meter. fct.	—	PB	8	—
132	Property byte for byte 48 (overcurrent)	—	Meter. fct.	—	PB	8	—
133	Property byte for byte 50 (current that flows to ground)	—	Meter. fct.	—	PB	8	—
134	Property byte for byte 52 (overcurrent in neutral conductor)	—	Meter. fct.	—	PB	8	—
135	Property byte for byte 54 (long-term mean value for current)	—	Meter. fct.	—	PB	8	—
136	Property byte for byte 56 (delay time for overcurrent)	—	Meter. fct.	—	PB	8	—
137	Property byte for byte 57 (delay time of current that flows to ground)	—	Meter. fct.	—	PB	8	—
138	Property byte for byte 58 (delay time for overcurrent in neutral conductor)	—	Meter. fct.	—	PB	8	—
139	Property byte for byte 59 (phase unbalance current)	—	Meter. fct.	—	PB	8	—
140	Property byte for byte 60 (delay time for phase unbalance current)	—	Meter. fct.	—	PB	8	—
141	Property byte for byte 61 (delay time for long-term mean value for current)	—	Meter. fct.	—	PB	8	—
142	Property byte for byte 62 (undervoltage)	—	Meter. fct.	—	PB	8	—

Byte	Description	Data point	Source WL	Source VL	Format	Length (bits)	Scaling
143	Property byte for byte 64 (delay time for undervoltage)	—	Meter. fct.	—	PB	8	—
144	Property byte for byte 65 (phase unbalance voltage)	—	Meter. fct.	—	PB	8	—
145	Property byte for byte 66 (delay time for phase unbalance voltage)	—	Meter. fct.	—	PB	8	—
146	Property byte for byte 68 (overvoltage)	—	—	—	PB	8	—
147	Property byte for byte 70 (delay time for overvoltage)	—	Meter. fct.	—	PB	8	—

8.6.22 Data set DS 131 Switching the parameters for the extended protection function and the threshold values on and off

The table below shows DS131 via whose property bytes the parameters of the protection function, the extended protection function, and the threshold parameters can be switched on and off.

The table below contains the data sets DS131: Parameters for switching the parameters for the extended protection function and the threshold values on and off (length 70 bytes, read/write):

Table 8- 35 Content of data set 131

Byte	Description	Data point	Source WL	Source VL	Format	Length (bits)	Scaling
0	Header; value 0x00 00 00 00	—	COM15	COM20	—	32	—
4	Property byte for DS129.4 (overload parameter I_R parameter set A (PS A))	—	ETU	ETU	PB	8	—
5	Property byte for DS129.6 (overload protection neutral conductor I_N PS A (WL))	—	ETU	—	PB	8	—
6	Property byte for DS129.10 (short-circuit protection instantaneous I_i PS A)	—	ETU	ETU	PB	8	—
7	Property byte for DS129.12 (short-circuit protection delayed I_{sd} PS A)	—	ETU	ETU	PB	8	—
8	Property byte for DS129.16 (ground-fault protection I_g PS A)	—	ETU	ETU	PB	8	—
9	Property byte for DS129.20 (ground fault alarm I_{g2} PS A)	—	ETU	—	PB	8	—
10	Property byte for DS129.32 (overload parameter I_R parameter set B (PS B))	—	ETU	—	PB	8	—
11	Property byte for DS129.34 (overload protection neutral conductor I_N PS B)	—	ETU	—	PB	8	—
12	Property byte for DS129.38 (short-circuit protection instantaneous I_i PS B)	—	ETU	—	PB	8	—
13	Property byte for DS129.40 (short-circuit protection delayed I_{sd} PS B)	—	ETU	—	PB	8	—
14	Property byte for DS129.44 (ground-fault protection I_g PS B)	—	ETU	—	PB	8	—
15	Property byte for DS129.48 (ground fault alarm I_{g2} PS B)	—	ETU	—	PB	8	—
16	Property byte for DS128.14 (active power in normal direction)	—	Meter. fct.	—	PB	8	—
17	Property byte for DS128.16 (active power in reverse direction)	—	Meter. fct.	—	PB	8	—
18	Property byte for DS128.21 (direction of rotation of phase)	—	Meter. fct.	—	PB	8	—
19	Property byte for DS128.22 (underfrequency)	—	Meter. fct.	—	PB	8	—
20	Property byte for DS128.26 (overfrequency)	—	Meter. fct.	—	PB	8	—
21	Property byte for DS128.28 (THD of current)	—	Meter. fct.	—	PB	8	—

Byte	Description	Data point	Source WL	Source VL	Format	Length (bits)	Scaling
22	Property byte for DS128.30 (THD of current)	—	Meter. fct.	—	PB	8	—
23	Property byte for DS128.32 (voltage unbalance)	—	Meter. fct.	—	PB	8	—
24	Property byte for DS128.34 (undervoltage)	—	Meter. fct.	—	PB	8	—
25	Property byte for DS128.36 (overvoltage)	—	Meter. fct.	—	PB	8	—
26	Property byte for DS128.41 (current unbalance)	—	Meter. fct.	ETU	PB	8	—
27	Property byte for DS130.4 (active power in normal direction)	—	Meter. fct.	—	PB	8	—
28	Property byte for DS130.6 (active power in reverse direction)	—	Meter. fct.	—	PB	8	—
29	Property byte for DS130.8 (capacitive power factor)	—	Meter. fct.	—	PB	8	—
30	Property byte for DS130.10 (inductive power factor)	—	Meter. fct.	—	PB	8	—
31	Property byte for DS130.16 (overfrequency)	—	Meter. fct.	—	PB	8	—
32	Property byte for DS130.18 (underfrequency)	—	Meter. fct.	—	PB	8	—
33	Property byte for DS130.20 (current THD)	—	Meter. fct.	—	PB	8	—
34	Property byte for DS130.22 (voltage THD)	—	Meter. fct.	—	PB	8	—
35	Property byte for DS130.24 (peak factor)	—	Meter. fct.	—	PB	8	—
36	Property byte for DS130.26 (form factor)	—	Meter. fct.	—	PB	8	—
37	Property byte for DS130.30 (long-term mean value for active power)	—	Meter. fct.	—	PB	8	—
38	Property byte for DS130.32 (long-term mean value for apparent power)	—	Meter. fct.	—	PB	8	—
39	Property byte for DS130.36 (long-term mean value for reactive power)	—	Meter. fct.	—	PB	8	—
40	Property byte for DS130.38 (reactive power in normal direction)	—	Meter. fct.	—	PB	8	—
41	Property byte for DS130.42 (reactive power in reverse direction)	—	Meter. fct.	—	PB	8	—
42	Property byte for DS130.44 (apparent power)	—	Meter. fct.	—	PB	8	—
43	Property byte for DS130.48 (overcurrent)	—	Meter. fct.	—	PB	8	—
44	Property byte for DS130.50 (current that flows to ground)	—	Meter. fct.	—	PB	8	—
45	Property byte for DS130.52 (overcurrent in neutral conductor)	—	Meter. fct.	—	PB	8	—
46	Property byte for DS130.54 (long-term mean value for current)	—	Meter. fct.	—	PB	8	—
47	Property byte for DS130.59 (phase unbalance current)	—	Meter. fct.	—	PB	8	—
48	Property byte for DS130.62 (undervoltage)	—	Meter. fct.	—	PB	8	—
49	Property byte for DS130.65 (phase unbalance voltage)	—	Meter. fct.	—	PB	8	—
50	Property byte for DS130.68 (overvoltage)	—	Meter. fct.	—	PB	8	—

Byte	Description	Data point	Source WL	Source VL	Format	Length (bits)	Scaling
51	Property byte for DS128.44 (overload pre-alarm (VL only))	—	—	—	PB	8	—
52	Property byte for DS129.27 (thermal memory PS A)	—	ETU	ETU	PB	8	—
53	Property byte for DS129.67 (ZSI on/off)	—	—	ETU	PB	8	—
54	Property byte for DS97.45 (N transformer connected)	—	ETU	ETU	PB	8	—
55	Reserved	—	—	—	—	120	—

8.6.23 Data set DS 160 Parameters for communication

The following table shows data set 160, in which the parameters for communication are stored. These parameters can be read and also set via this data set.

The table contains the data sets DS160: Parameters for communication (length 77 bytes, read/write):

Table 8- 36 Content of data set 160

Byte	Description	Data point	Source WL	Source VL	Format	Length (bits)	Scaling
0	Header; value 0x00 00 00 00	—	COM15	COM20	—	32	—
4	Reserved	—	—	—	—	8	—
5	PROFIBUS address	5	COM15	COM20	unsigned c har	8	0
6	Basic type of PROFIBUS data transfer	6	COM15	COM20	Hex	2	—
7	Reserved	—	—	—	—	8	—
8	Data in the cyclic profile of PROFIBUS	7	COM15	COM20	Format (7)	224	—
36	Reserved	—	—	—	—	48	—
42	IP address of the BDA PLUS	10	BDA PLU S	—	Format (10)	40	—
48	Reserved	—	—	—	—	176	—
70	Reserved	—	—	—	—	8	—
71	Property byte for byte 5	—	COM15	COM20	PB	8	—
72	Property byte for byte 6	—	COM15	COM20	PB	8	—
73	Reserved	—	—	—	PB	8	—
74	Property byte for byte 8	—	COM15	COM20	PB	8	—
75	Reserved	—	—	—	PB	8	—
76	Property byte for byte 42	—	BDA PLU S	—	PB	8	—

8.6.24 Data set DS 162 device configuration

The table below shows data set 162 that contains the device configuration. The circuit breaker currently connected can be read out via this data set.

The table below contains the data sets DS162: Device configuration (length 75 bytes, read-only):

Table 8- 37 Content of data set 162

Byte	Description	Data point	Source WL	Source VL	Format	Length (bits)	Scaling
0	Header; value 0x00 00 00 00	—	COM15	COM20	—	32	—
4	ID number of the COM15	91	COM15	COM20	16 x char	128	—
20	Order number of the circuit breaker (on the SENTRON VL, this is the order number of the trip unit)	103	ETU	—	Format (103)	160	—
40	Type (metering function, metering function PLUS)	138	Meter. fct.	—	Format (138)	8	—
41	Type of trip unit	412	ETU	ETU	Format (412)	5	—
42	Hardware/software version 3VL	423	—	ETU	16 x char	128	—
58	Reserved	—	—	—	—	96	—
70	Property byte for byte 4	—	COM15	COM20	PB	8	—
71	Property byte for byte 20	—	ETU	—	PB	8	—
72	Property byte for byte 40	—	Meter. fct.	—	PB	8	—
73	Property byte for byte 41	—	ETU	ETU	PB	8	—
74	Property byte for byte 42	—	ETU	ETU	PB	8	—

8.6.25 Data set DS 165 Identification comment

The table below shows data set 165 in which user-specific texts such as comments, plant identifier, date and author can be stored in the SENTRON circuit breaker.

The table below contains the data sets DS165: Identification comment (length 194 bytes, read/write):

Table 8- 38 Content of data set 165

Byte	Description	Data point	Source WL	Source VL	Format	Length (bits)	Scaling
0	Header; value 0x00 00 00 00	—	COM15	COM20	—	32	—
4	User text (freely editable)	20	COM15	COM20	64 x char	512	—
68	Plant identifier (freely editable)	21	COM15	—	64 x char	512	—
132	Date (freely editable)	22	COM15	—	Time	64	—
140	Author (freely editable)	23	COM15	—	30 x char	240	—
170	Reserved	—	—	—	—	160	—
190	Property byte for byte 4	—	COM15	COM20	PB	8	—
191	Property byte for byte 68	—	COM15	—	PB	8	—
192	Property byte for byte 132	—	COM15	—	PB	8	—
193	Property byte for byte 140	—	COM15	—	PB	8	—

8.7 Formats

8.7.1 Formats of the data points

The different formats of the data points are described in this section. This includes the description of the Motorola format used, e.g. "int" and "unsigned int", as well as, above all, the description of special formats. A special format is, for example, the binary breakdown of the data point that specifies the last tripping operation.

All available data points and the data set in which they are transferred over PROFIBUS have been described on the preceding pages. In the "Format" column, an explanation is given of which data type is referred to and how this content is to be interpreted. A distinction must be made here between generally valid formats and special formats that are usually binary coded.

8.7.2 General data formats

Many data points have a data length of more than one byte. In this case, the numbers can be stored either in Little-Endian- format (Intel) or in Big-Endian- format (Motorola) depending on the processor type for which the format has been developed. In Big-Endian format, the higher-order byte is before the lower-order byte to facilitate reading, and with Intel, the bytes are in the opposite order.

The table below shows the standard formats used, with their value ranges and purposes.

Table 8- 39 Standard data formats

Format	Length in byte	Signs	Value range unscaled	Used for ...
unsigned int	2	—	0 ... 65535	Measured values, parameters, etc.
signed int	2	✓	– 32678 ... 32767	Negative measured values
unsigned char	1	—	0 ... 255	Measured values, parameters with lower value range
char	1	—	0 ... 255	ASCII characters
unsigned long	4	—	0 ... 4294967295	Measured values and maintenance information with a large measuring range

In general, all data communicated over PROFIBUS is transferred in the Motorola (Big-Endian) format.

Format "unsigned int"

The format "unsigned int" is used primarily for transferring parameters and measured values, as well as statistical information. If the value range is insufficient, scaling is used.

To transfer measured values that can also be negative (e.g. power factors), the format "signed int" is used.

Format "unsigned char"

If the value range of a parameter or measured value is severely restricted (e.g. phase unbalance of 0 to 50%), the data type "unsigned char" is sufficient.

Text elements consisting of ASCII characters are assembled using the data type "char".

Format "unsigned long"

If the value range is insufficient, the data type "unsigned long" is fallen back on. This is used, for example, with the runtime meter. If "unsigned int" were to be used for this, the runtime meter would overflow after seven-and-a-half years.

Format "hex"

The format "hex" is always used where there is a concatenation of binary information, e.g. when transferring the statuses at the inputs of the binary input module. However, it is also used when hexadecimal numbers are transferred.

Format of the PB

Chapter Cyclic data traffic (Page 135) contains the description of the format of the property byte PB.

Time format

The S7-compatible time format (DATE_AND_TIME) is used for communicating time stamps. The time stamp in DS100 is represented according to the PROFIBUS standard and is an exception to this rule.

Table 8- 40 Format time

Byte	Bit	Meaning
0	—	Year
1	—	Month
2	—	Day
3	—	Hour
4	—	Minute
5	—	Seconds
6	—	Low-order digits of milliseconds
7	4 - 7	Higher-order digits of milliseconds (4MSB)
7	0 - 3	Weekday (1 =Sunday, ..., 7 = Saturday)

All time stamps are transferred in this format

Table 8- 41 PROFIBUS time format (DS100.4)

Byte	Bit	Meaning
0	—	Higher-order digits of milliseconds
1	—	Low-order digits of milliseconds
2	—	Minute
3	0 - 4	Hour
3	7	1 = Summertime; 0 = Wintertime
4	0 - 4	Day of the month (1 ... 31)
4	5 - 7	Weekday (1 = Monday, ..., 7 = Sunday)
5	—	Month
6	—	Year (02 = 2002)
7	—	Reserved

This time format is compliant with the PROFIBUS time format.

8.7.3 Special data formats

Special data formats are used where the inflexible standard formats cannot be used. The special data formats are used, for example, with binary-coded or complex data points. If a special data format has been used with a data point, this is indicated in the first and second part of this chapter in the format column with Format (X). The X represents a consecutive number of the special data formats used, described below. In the majority of cases, the X in the format agrees with the data point number to simplify the search.

In the case of bit interpretations, the meaning is always to be seen with a high-active signal.

The table below shows the format (7) for the data in the cyclic profile of PROFIBUS.

Table 8- 42 Format (7) cyclic data in DP

Byte	Meaning
0	Assignment (data point number) of the 1st data block in the cyclic message frame
2	Assignment (data point number) of the 2nd data block in the cyclic message frame
4	Assignment (data point number) of the 3rd data block in the cyclic message frame
6	Assignment (data point number) of the 4th data block in the cyclic message frame
8	Assignment (data point number) of the 5th data block in the cyclic message frame
10	Assignment (data point number) of the 6th data block in the cyclic message frame
12	Assignment (data point number) of the 7th data block in the cyclic message frame
14	Assignment (data point number) of the 8th data block in the cyclic message frame
16	Assignment (data point number) of the 9th data block in the cyclic message frame
18	Assignment (data point number) of the 10th data block in the cyclic message frame
20	Assignment (data point number) of the 11th data block in the cyclic message frame
22	Assignment (data point number) of the 12th data block in the cyclic message frame
24	Assignment (data point number) of the 13th data block in the cyclic message frame
26	Assignment (data point number) of the 14th data block in the cyclic message frame

The table below shows the format (10) for the IP addresses that consist of four digits from 0 to 255 each separated by a dot, e.g. 192.168.121.101.

Table 8- 43 Format (10) IP address BDA PLUS

Byte	Meaning
0	unsigned int: 1. sub-IP address X._._._
1	unsigned int: 2. sub-IP address _.X._._
2	unsigned int: 3. sub-IP address _._.X.__
3	unsigned int: 4. sub-IP address _._._.X
4	Reserved

The table below shows the format (14) for PROFIBUS write protection. A hardware input on COM15 and COM10 or COM 20 deactivates write protection via PROFIBUS.

Table 8- 44 Format (14) PROFIBUS write protection

Byte	Bit	Meaning
0	0	0 = write protection active; 1 = write protection inactive

8.7.4 Data formats 15 to 24

The table below shows the format (15) "trip log". It contains the last 5 tripping operations with time stamp and source.

Table 8- 45 Format (15) "trip log"

Byte	Bit	Meaning
0-7	Time	Time stamp of the 1st tripping operation
8	—	Reserved 0x00
9	Reason for tripping operation	Reason for trip of 1st tripping operation 1 = overload 2 = instantaneous Short circuit 3 = delayed Short-circuit 4 = Ground fault 5 = Ext. protection function 6 = Overload N-conductor 7 = ETU self-protection (analog override) 8 = Overtemperature 20 = Unbalance Current 21 = Unbalance Voltage 22 = Active power in normal dir. 23 = Active power in reverse dir. 24 = Overvoltage 25 = Undervoltage 26 = Overfrequency 27 = Underfrequency 28 = THD current 29 = THD voltage 30 = Change in phase dir. of rot.
10	—	Source of 1st tripping operation 14 = Meter. function/M. PLUS 25 = Trip unit
11	—	Reserved 0x00
12-19	—	Time stamp of 2nd tripping operation
20	—	Reserved 0x00
21	—	Reason for 2nd tripping operation
22	—	Source of 2nd tripping operation
23	—	Reserved 0x00
24-31	—	Time stamp of 3rd tripping operation
32	—	Reserved 0x00
33	—	Reason for 3rd tripping operation
34	—	Source of 3rd tripping operation
35	—	Reserved 0x00
36-43	—	Time stamp of 4th tripping operation
44	—	Reserved 0x00
45	—	Reason for 4th tripping operation
46	—	Source of 4th tripping operation
47	—	Reserved 0x00

Byte	Bit	Meaning
48-55	—	Time stamp of 5th tripping operation
56	—	Reserved 0x00
57	—	Reason for 5th tripping operation
58	—	Source of 5th tripping operation
59	—	Reserved 0x00

The table below shows the format (16) "event log". It contains the last 10 events with time stamp. Example, see below.

Table 8- 46 Format (16) "event log"

Byte	Bit	Meaning		
0-7	—	Time stamp of 1st event		
8	—	Reserved 0x00		
9	—	Coming "+"	Going "-"	Event description
		1	2	Overload warning
		3	4	Overload warning N-conductor
		5	6	Load shedding alarm
		7	8	Load pick up message
		9	10	Phase unbalance warning
		11	12	Fault in trip unit
		13	14	Ground fault warning
		15	16	Overtemperature warning
		20	—	Switch on
		21	—	Switch off
		40	41	Threshold warning TV current
		42	43	TV ground fault
		44	45	TV overcurrent N-conductor
		46	47	TV unbalance current
		48	49	TV long-term mean value for current
		50	51	TV undervoltage
		52	53	TV unbalance voltage
		54	55	TV overvoltage
		56	57	TV long-term mean value for active power
		58	59	TV long-term mean value for apparent power
		60	61	TV long-term mean value for reactive power
		62	63	TV reactive power in normal direction
		64	65	TV reactive power in reverse direction
		66	67	TV apparent power
		68	69	TV overfrequency
		70	71	TV underfrequency
		72	73	TV under power factor

Byte	Bit	Meaning		
		74	75	TV over power factor
		76	77	TV THD current
		78	79	TV THD voltage
		80	81	TV peak factor
		82	83	TV form factor
		84	85	TV active power in normal direction
		86	87	TV active power in reverse direction
10	—	Source of 1st event 14 = Meter. function/M. PLUS 25 = Trip unit		
11	—	Reserved 0x00		
12-19	—	Time stamp of 2nd event		
20	—	Reserved 0x00		
21	—	2. event		
22	—	Source of 2nd event		
23	—	Reserved 0x00		
24-31	—	Time stamp of 3rd event		
32	—	Reserved 0x00		
33	—	3. event		
34	—	Source of 3rd event		
35	—	Reserved 0x00		
36-43	—	Time stamp of 4th event		
44	—	Reserved 0x00		
45	—	4. event		
46	—	Source of 4th event		
47	—	Reserved 0x00		
48-55	—	Time stamp of 5th event		
56	—	Reserved 0x00		
57	—	5. event		
58	—	Source of 5th event		
59	—	Reserved 0x00		
60-67	—	Time stamp of 6th event		
68	—	Reserved 0x00		
69	—	6. event		
70	—	Source of 6th event		
71	—	Reserved 0x00		
72-79	—	Time stamp of 7th event		
80	—	Reserved 0x00		
81	—	7. event		
82	—	Source of 7th event		
83	—	Reserved 0x00		
84-91	—	Time stamp of 8th event		

Byte	Bit	Meaning
92	—	Reserved 0x00
93	—	8. event
94	—	Source of 8th event
95	—	Reserved 0x00
96-103	—	Time stamp of 9th event
104	—	Reserved 0x00
105	—	9. event
106	—	Source of 9th event
107	—	Reserved 0x00
108-115	—	Time stamp of 10th event
116	—	Reserved 0x00
117	—	10. event
118	—	Source of 10th event
119	—	Reserved 0x00

Table 8- 47 Event log, example (incomplete or extracts)

Date	Time stamp	event
06.06.08	14:19:58	- Threshold THD voltage
06.06.08	14:19:44	+ Threshold THD voltage
06.06.08	14:19:24	- Threshold undervoltage
06.06.08	14:19:14	+ Threshold undervoltage

The table below shows the format (17) "Status PROFIBUS DP". The status can be used to scan for a cyclic connection.

Table 8- 48 Format (17) "Status PROFIBUS DP"

Byte	Bit	Meaning
0	0	No cyclic data traffic with class 1 master
0	1	The communication module has no valid PROFIBUS address
0	2	PROFIBUS address can no longer be changed

The table below shows the format (18) "Control communication module". Some settings of the switch can be changed via this format.

Table 8- 49 Format (18) "Control communication module"

Byte	Bit	Meaning
0	2	Deletes the maintenance counters
0	3	Deletes the min./max. temperatures
0	4	Deletes all min./max. values except temperature
0	5	Synchronizes the clock to xx:30:00.000
0	6	Deletes the contents of the trip log and event log
0	7	Revokes the disable on the DP address and sets the address to 126

The table below shows the format (19) "Control communication module outputs". The circuit breaker can be switched on or off with this, for example.

Table 8- 50 Format (19) "Control communication module outputs"

<table>
<tr><th>Byte</th><th>Bit</th><th colspan="2">Meaning</th></tr>
<tr><td>0</td><td>0</td><td colspan="2">Set user output</td></tr>
<tr><td>0</td><td>1</td><td colspan="2">Reset user output</td></tr>
<tr><td>0</td><td>2</td><td colspan="2">Open circuit breaker</td></tr>
<tr><td>0</td><td>3</td><td colspan="2">Close the circuit breaker</td></tr>
<tr><td>0</td><td>4</td><td colspan="2">Switch user output mode to trip message [1]</td></tr>
<tr><td rowspan="3">0</td><td rowspan="3">5</td><td colspan="2">Status of user output mode [1]</td></tr>
<tr><td>0</td><td>Trip is output</td></tr>
<tr><td>1</td><td>Actuated by user</td></tr>
<tr><td>0</td><td>6</td><td colspan="2">Read status of user output</td></tr>
<tr><td>0</td><td>7</td><td colspan="2">Read status of user input (COM15 only)</td></tr>
</table>

[1] as of firmware version V1.13.0 of the COM15

The table below shows the format (24) "position in frame". Data point 24 specifies the position of the SENTRON WL in the guide frame.

Table 8- 51 Format (24) "Position in frame"

Byte	Value	Meaning
0	0	Disconnected position
0	1	Connected position
0	2	Test position
0	3	Switch not available

8.7.5 Data formats 88 to 162

The table below shows the format (88) "CubicleBUS modules" that contains the modules connected on the CubicleBUS.

Table 8- 52 Format (88) "CubicleBUS modules"

Byte	Bit	Meaning
0	0	COM15
0	1	Trip unit ETU
0	2	ZSI module
1	0	Configurable digital output module
1	2	Digital output module #2
1	3	Digital input module #2
1	4	Breaker Status Sensor BSS
1	5	Digital output module #1
1	6	Digital input module #1
2	1	BDA PLUS
2	3	Graphic display ETU76B
2	4	Analog output module #2
2	5	Analog output module #1
2	6	Metering function or M. PLUS

The table below shows the format (95) "Market" specifying the market for which the circuit breaker has been built and tested.

Table 8- 53 Format (95) "Market"

Byte	Value	Meaning
0	1	IEC
0	2	UL
0	3	ANSI

The table below shows the format (99) "Switching capacity class" that specifies the maximum level of the breaking current.

Table 8- 54 Format (99) "Switching capacity class"

Byte	Value	Meaning
0	2	ECO switching capacity N/IntClassN
0	3	Standard switching capacity S/IntClassS
0	4	High switching capacity H/IntClassH
0	5	Extremely high switching capacity C/IntClassC

The table below shows the format (100) "Size". The size is determined by the rated switch current and the switching capacity class.

Table 8- 55 Format (100) "Size"

Byte	Value	Meaning
0	1	Size 1
0	2	Size 2
0	3	Size 3

The table below shows the format (103) "Order number LS", via which the switch can be identified.

Table 8- 56 Format (103) "Order number LS"

Byte	Bit	Meaning
0	—	3
1	—	W
2	—	L
3	—	Market
4	—	Size
5/6	—	Rated current
7	—	Hyphen
8	—	Switching capacity class
9	—	Trip unit E = ETU45B without display, F = ETU45B with display, J = ETU55B, N = ETU76B
10	—	Trip unit supplement B = without ground fault detection module G = with ground fault detection module
11	—	Number of poles
12	—	Type of main connections
13	—	Hyphen
14	—	Drive
15	—	1. auxiliary trip unit
16	—	2. auxiliary trip unit
17	—	Auxiliary current switch
18	0	Option F02
18	2	Option F04
18	3	Option F05
18	6	Option F01
18	7	Options F20 to F22
19	0	Option K01
19	1	Option K10 to K13

The table below shows the format (107) "switched-off I^2t values" that contains the total of switched-off I^2t values per phase in the format "unsigned long".

Table 8- 57 Format (107) "Switched-off I2t values"

Byte	Bit	Meaning
0	—	Phase L1 (unsigned long)
4	—	Phase L2 (unsigned long)
8	—	Phase L3 (unsigned long)
12	—	Phase N (unsigned long)

The table below shows the format (108) "Number of poles" that specifies the number of protected poles for the main circuit.

Table 8- 58 Format (108) "Number of poles"

Byte	Value	Meaning
0	1	3-pole
0	2	4-pole (with N-conductor)

The table below shows the format (111) "Switch position DI" that also distinguishes the switch position of the digital input module between Module 1 and 2.

Table 8- 59 Format (111) "Switch position DI"

Byte	Value	Meaning
0	1	Parameter set switching (Module #1)
0	2	6 x digital inputs (Module #2)

The table below shows the format (119) "Switch position DO" that specifies which output block is selected with which delay.

Table 8- 60 Format (119) "Switch position DO"

Byte	Value	Meaning
0	0x01	Module #1 trip instantaneous
0	0x02	Module #1 trip delayed 200 ms
0	0x03	Module #1 trip delayed 500 ms
0	0x04	Module #1 trip delayed 1 s
0	0x05	Module #1 trip delayed 2 s
0	0x06	Module #2 alarm instantaneous
0	0x07	Module #2 alarm delayed 200 ms
0	0x08	Module #2 alarm delayed 500 ms
0	0x09	Module #2 alarm delayed 1 s
0	0x0A	Module #2 alarm delayed 2 s

The table below shows the format (121) "Control DO outputs" for controlling the outputs of the digital output modules with rotary coding switches.

Table 8- 61 Format (121) "Control DO outputs"

Byte	Value	Meaning
0	0	No action
0	1	Set output 1 ("1")
0	2	Reset output 1 ("0")
0	3	Set output 2 ("1")
0	4	Reset output 2 ("0")
0	5	Set output 3 ("1")
0	6	Reset output 3 ("0")
0	7	Set output 4 ("1")
0	8	Reset output 4 ("0")
0	9	Set output 5 ("1")
0	10	Reset output 5 ("0")
0	11	Set output 6 ("1")
0	12	Reset output 6 ("0")
0	13	Switch force mode off (overwriting of the actually valid data)

The table below shows the format (129) "Configurable output module". Event 1 of the 1st output provides an example of the assignment for all others.

Table 8- 62 Format (129) "Configurable output module"

Byte	Value	Meaning
0	—	1. event at the 1st output
0	0x00	Not assigned
0	0x01	Switch on
0	0x02	Switch off
0	0x03	Spring energy store compressed
0	0x04	Ready for switching on
0	0x05	General warning
0	0x06	Group tripped signal
0	0x07	DP write protection active
0	0x08	DP communication OK
0	0x09	Alarm: Overload
0	0x0A	Alarm: Overload N-conductor
0	0x0B	Alarm: Load shedding
0	0x0C	Alarm: Ground fault
0	0x0D	Alarm: Overtemperature
0	0x0E	Alarm: µP-Error
0	0x0F	Alarm: Phase unbalance Current
0	0x10	Alarm: Load pick up
0	0x11	Trip: Overload L
0	0x12	Trip: Delayed short-circuit I
0	0x13	Trip: Instantaneous Short-circuit S

Byte	Value	Meaning
0	0x15	Trip: Ground fault G
0	0x16	Trip: Overload N-conductor N
0	0x17	Trip: Phase unbalance current
0	0x18	Trip: Phase unbalance voltage
0	0x19	Trip: Underfrequency
0	0x1A	Trip: Overfrequency
0	0x1B	Trip: Undervoltage
0	0x1C	Trip: Overvoltage
0	0x1D	Trip: Active power in normal direction
0	0x1E	Trip: Active power in reverse direction
0	0x1F	Trip: THD current
0	0x20	Trip: THD voltage
0	0x21	Trip: Reverse direction of rotation of phase
0	0x22	Threshold value TV: Overcurrent
0	0x23	TV: Overcurrent N-conductor
0	0x24	TV: Overcurrent ground fault
0	0x25	TV: Phase unbalance current
0	0x26	TV: Phase unbalance voltage
0	0x27	TV: Long-term av. Current
0	0x28	TV: Undervoltage
0	0x29	TV: Overvoltage
0	0x2A	TV: THD current
0	0x2B	TV: THD voltage
0	0x2C	TV: Peak factor
0	0x2D	TV: Form factor
0	0x2E	TV: Underfrequency
0	0x2F	TV: Overfrequency
0	0x30	TV: Active power in normal direction
0	0x31	TV: Active power in reverse direction
0	0x32	TV: Apparent power
0	0x33	TV: Reactive power in normal direction
0	0x34	TV: Reactive power in reverse direction
0	0x35	TV: cos φ capacitive
0	0x36	TV: cos φ inductive
0	0x37	TV: Long-time mean value of active power
0	0x38	TV: Long-time mean value of reactive power
0	0x39	TV: Long-time mean value of apparent power
0	0x3A	Trigger event A occurred
0	0x3B	Trigger event B occurred
0	0x3C	Parameter set A active
0	0x3D	Parameter set B active
0	0x3E	PROFIBUS bit 1 (#426)

Byte	Value	Meaning
0	0x3F	PROFIBUS bit 2 (#426)
0	0x40	PROFIBUS bit 3 (#426)
0	0x41	PROFIBUS bit 4 (#426)
0	0x42	PROFIBUS bit 5 (#426)
0	0x43	PROFIBUS bit 6 (#426)
1	—	2. event at the 1st output
2	—	3. event at the 1st output
3	—	4. event at the 1st output
4	—	5. event at the 1st output
5	—	6. event at the 1st output
6	—	1. event at the 2nd output
7	—	2. event at the 2nd output
8	—	3. event at the 2nd output
9	—	4. event at the 2nd output
10	—	5. event at the 2nd output
11	—	6. event at the 2nd output
12	—	1. event at the 3rd output
13	—	2. event at the 3rd output
14	—	3. event at the 3rd output
15	—	4. event at the 3rd output
16	—	5. event at the 3rd output
17	—	6. event at the 3rd output
18	—	Event at the 4th output
19	—	Event at the 5th output
20	—	Event at the 6th output

The table below shows the format (138) "Type of the metering function". It specifies which type of metering function is built in.

Table 8- 63 Format (138) "Type of the metering function"

Byte	Value	Meaning
0	0x00	No metering function
0	0x02	Metering function
0	0x03	Metering function PLUS

The table below shows the format (145) "Direction of incoming supply". The sign for active power and reactive power depend on the "Direction of incoming supply".

Table 8- 64 Format (145) "Direction of incoming supply"

Byte	Value	Meaning
0	0	From top to bottom
0	1	From bottom to top

The table below shows the format (146) "Direction of rotation of phase". The normal status of the direction of rotation of the phase can be set using this.

Table 8- 65 Format (146) "Direction of rotation of phase"

Byte	Value	Meaning
0	0	Right (e.g. L1 – L2 – L3)
0	1	Left (e.g. L1 – L3 – L2 or similar)

The table below shows the format (162) "Voltage transformer". The setting of the primary connection also influences the location of the measured voltage variables.

Table 8- 66 Format (162) "Voltage transformer"

Byte	Value	Meaning
0	0	The voltage transformer is delta-connected on the primary side.
0	1	The voltage transformer is star-connected on the primary side.

8.7.6 Data formats 307 to 373

The table below shows the format (307) "Tripping of the metering function" that displays the content of the last tripping operation by the extended protection function.

Table 8- 67 Format (307) "Tripping of the metering function"

Byte	Value	Meaning
0/1	0x0000	No tripping operation
0/1	0x0001	Phase unbalance current
0/1	0x0002	Phase unbalance voltage
0/1	0x0004	Active power in normal direction
0/1	0x0008	Active power in reverse direction
0/1	0x0040	Overvoltage
0/1	0x0080	Undervoltage
0/1	0x0100	Overfrequency
0/1	0x0200	Underfrequency
0/1	0x0400	THD current
0/1	0x0800	THD voltage
0/1	0x1000	Change of phase rotation

The table below shows the format (308) "Threshold alarms" that displays the currently pending threshold alarms.

Table 8- 68 Format (308) "Threshold alarms"

Byte	Bit	Meaning
1	0	cos φ capacitive
1	1	cos φ inductive
1	2	THD current
1	3	THD voltage
1	4	Peak factor
1	5	Form factor
1	6	Active power in normal direction
1	7	Active power in reverse direction
2	0	Long-time mean value of active power
2	1	Long-time mean value of apparent power
2	2	Long-time mean value of reactive power
2	3	Reactive power in normal direction
2	4	Reactive power in reverse direction
2	5	Apparent power
2	6	Overfrequency
2	7	Underfrequency
3	0	Overcurrent
3	1	Overcurrent ground fault
3	2	Overcurrent N-conductor
3	3	Phase unbalance current
3	4	Long-term mean value of current
3	5	Undervoltage
3	6	Phase unbalance voltage
3	7	Overvoltage

The table below shows the format (309) "Harmonic analysis". To calculate, the value must be multiplied by the signed exponent.

Table 8- 69 Format (309) "Harmonic analysis"

Harmonic	Byte	Bit	Meaning
1st	0	—	Harmonic current: Exponent (signed char)
	1	—	Harmonic current: Value (unsigned char)
	2	—	Harmonic voltage: Exponent (signed char)
	3	—	Harmonic voltage: Value (unsigned char)
2nd	4	—	Harmonic current: Exponent (signed char)
	5	—	Harmonic current: Value (unsigned char)
	6	—	Harmonic voltage: Exponent (signed char)
	7	—	Harmonic voltage: Value (unsigned char)
3rd - 28th	8 ... 111	—	...
29th	112	—	Harmonic current: Exponent (signed char)
	113	—	Harmonic current: Value (unsigned char)
	114	—	Harmonic voltage: Exponent (signed char)
	115	—	Harmonic voltage: Value (unsigned char)

The table below shows the format (328) "Status of the switch" that transfers the data the BSS has collected via a micro switch.

Table 8- 70 Format (328) "Status of the switch"

Byte	Bit	Meaning
0	0	Switch is off
0	1	Switch is on
0	2	Switch has tripped (tripped signaling switch)
0	3	Switch is ready
0	4	Spring energy store is compressed
0	5	Switch on 1st auxiliary trip unit actuated
0	6	Switch on 2nd auxiliary trip unit actuated

The table below shows the format (331) Trip class (VL only). The value of the trip class is adapted to the connected motor.

Table 8- 71 Format (331) "Trip class (VL only)"

Byte	Value	Meaning
0	5	3-second delay @ 7.2 x rated current
0	10	6-second delay @ 7.2 x rated current
0	15	9-second delay @ 7.2 x rated current
0	20	12-second delay @ 7.2 x rated current
0	30	18-second delay @ 7.2 x rated current

The table below shows the format (343) "I^2t characteristic for S" via which the I^2t characteristic is switched on and off.

Table 8- 72 Format (343) "I2t characteristic for S"

Byte	Value	Meaning
0	0	I^2t characteristic for delayed short-circuit protection switched off.
0	1	I^2t characteristic for delayed short-circuit protection switched on.

The table below shows the format (344) "I^2t characteristic for G" via which the I^2t characteristic is switched on and off.

Table 8- 73 Format (344) "I2t characteristic for G"

Byte	Value	Meaning
0	0	I^2t characteristic for ground-fault protection switched off.
0	1	I^2t characteristic for ground-fault protection switched on.

The table below shows the format (345) "I^4t characteristic for L" via which the I^4t characteristic is switched on and off.

Table 8- 74 Format (345) "I4t characteristic for L"

Byte	Value	Meaning
0	0	I^4t characteristic for overload protection switched off.
0	1	I^4t characteristic for overload protection switched on.

The table below shows the format (346) "Thermal memory" via which the thermal memory is switched on and off.

Table 8- 75 Format (346) "Thermal memory"

Byte	Value	Meaning
0	0	Thermal memory switched off
0	1	Thermal memory switched on

The table below shows the format (347) "Phase loss sensitivity" via which the phase loss sensitivity is switched on and off.

Table 8- 76 Format (347) "Phase loss sensitivity"

Byte	Value	Meaning
0	0	Phase loss sensitivity switched off
0	1	Phase loss sensitivity switched on

The table below shows the format (370) "Active parameter set" that specifies which of the parameter sets is active.

Table 8- 77 Format (370) "Active parameter set"

Byte	Value	Meaning
0	0	Parameter set A active
0	1	Parameter set B active

The table below shows the format (373) "Phase number" that specifies the phase number of the most loaded phase and the phase of the tripping operation.

Table 8- 78 Format (373) "Phase number"

Byte	Value	Meaning
0	0	Phase L1
0	1	Phase L2
0	2	Phase L3
0	3	N-conductor
0	4	Ground fault

8.7.7 Data formats 401 to 426

The table below shows the format (401) "Trip unit: tripping operations'", which shows the last unacknowledged tripping operation of the trip unit.

Table 8- 79 Format (401) Trip unit: "tripping operations"

Byte	Value	Meaning
0	0x00	No tripping operation
0	0x01	Overload (L)
0	0x02	Instantaneous short circuit (I)
0	0x04	Short-time delayed short circuit (S)
0	0x08	Ground fault (G)

The table below shows the format (402) "Trip unit: alarms" via which the trip unit communicates the currently pending alarms.

Table 8- 80 Format (402) Trip unit: "Alarms"

Byte	Value	Meaning
0	0	Overload
0	1	Overload N-conductor
0	2	Load shedding
0	3	Load pick up
0	4	Phase unbalance current
0	5	Microprocessor fault
0	6	Ground fault
0	7	Overtemperature
1	0	Leading overload tripping alarm
1	1	Short-time mean value current

The table below shows format (405) "Contact status" that is calculated empirically from the maintenance information.

Table 8- 81 Format (405) "Contact status"

Byte	Value	Meaning
0	0	No maintenance necessary yet on main contacts (Note: Despite this, the main contacts must be checked after every tripping operation!)"
0	1	Perform immediate visual inspection on main contacts.
0	2	Prepare maintenance of the main contacts

The table below shows the format (406) "Control trip unit" via which the statistical information can be reset, among other things.

Table 8- 82 Format (406) "Control trip unit"

Byte	Value	Meaning
0/1	0x0002	Delete last trip signal in trip unit
0/1	0x0022	Reset counter and statistical information of the trip unit

The table below shows the format (410) "Ground fault detection" with which the ground fault detection method is set.

Table 8- 83 Format (410) "Ground fault detection"

Byte	Value	Meaning
0	0	Detecting the current against ground via an external transformer
0	1	Calculation of the current against ground using vectorial summation
0	2	Detecting the current against ground using vectorial summation (alarm) and an external transformer (tripping)

The table below shows format (411) "N transformer" that indicates whether an N transformer is connected.

Table 8- 84 Format (411) "N transformer"

Byte	Value	Meaning
0	0	No transformer in the N-conductor
0	1	Transformer in the N-conductor

The table below shows the format (412) "'Trip unit type" that indicates which trip unit is used and how it is equipped.

Table 8- 85 Format (412) "Trip unit type" 3WL

Byte	Value	IEC / UL	Meaning
0	4	IEC	ETU45B
0	5	IEC	ETU45B with display
0	6	IEC	ETU45B with ground fault
0	7	IEC	ETU45B with display and ground fault
0	13	IEC	ETU76B
0	14	IEC	ETU76B with ground fault
0	17	UL	ETU748
0	18	UL	ETU748 with display
0	19	UL	ETU748 with ground fault
0	20	UL	ETU748 with display and ground fault
0	22	UL	ETU776
0	23	UL	ETU745

Table 8- 86 Format (412) "Trip unit type" 3VL

Byte	Value	IEC / UL	Meaning
0	15	IEC	LCD ETU
0	16	IEC	LCD ETU with motor protection
0	27	IEC	ETU with "LI" protection
0	28	IEC	ETU with "LS" protection
0	29	IEC	ETU with motor protection and adjustable trip class
0	30	UL	ETU with "LI" protection
0	31	UL	ETU with "LS" protection
0	32	UL	ETU with motor protection
0	33	IEC	LCD ETU with "LSI" protection and ground fault signal
0	34	IEC	ETU with motor protection and "LI" protection
0	35	UL	LCD ETU with "LSI" protection and ground fault signal
0	37	UL	LCD ETU with "LSI" protection and ground fault signal only

The table below shows the format (421) "Parameter ZSI".

Table 8- 87 Format (421) "Parameter ZSI"

<table>
<tr><th>Byte</th><th>Bit</th><th colspan="2">Meaning</th></tr>
<tr><td>0</td><td>0</td><td colspan="2">ZSI short-circuit active</td></tr>
<tr><td>0</td><td>1</td><td colspan="2">ZSI ground fault active</td></tr>
<tr><td>0</td><td>2</td><td colspan="2">Not used</td></tr>
<tr><td>0</td><td>3</td><td colspan="2">Not used</td></tr>
<tr><td rowspan="3">0</td><td rowspan="3">4/5</td><td>0</td><td>ZSI switched off</td></tr>
<tr><td>1</td><td>ZSI input and output active</td></tr>
<tr><td>2</td><td>ZSI output active</td></tr>
<tr><td>0</td><td>6</td><td colspan="2">Not used</td></tr>
<tr><td>0</td><td>7</td><td colspan="2">Not used</td></tr>
</table>

The table below shows the format (426) "PROFIBUS bit" via which signals from PROFIBUS can be applied to the configurable output module.

Table 8- 88 Format (426) "PROFIBUS bit"

Byte	Bit	Meaning
0	0	PROFIBUS bit 1
0	1	PROFIBUS bit 2
0	2	PROFIBUS bit 3
0	3	PROFIBUS bit 4
0	4	PROFIBUS bit 5
0	5	PROFIBUS bit 6

List of abbreviations

A

A.1 List of abbreviations

The abbreviations used in the manual are explained below.

AC	Alternating current
AWG	American Wire Gauge
BDA PLUS	Breaker Data Adapter
BSS	Breaker Status Sensor
COM15	Communication module
CUB -	CubicleBUS, connection "-"
CUB +	CubicleBUS, connection "+"
DC	Direct current
DIN	German Industry Standard
ED	ON time; exceeding the permissible ON time results in destruction
ESD	Electrostatic sensitive device
ETU	Electronic trip unit, solid-state overcurrent trip unit
EN	European standard
EMC	Electromagnetic compatibility
EXTEND.	Extended protection function
F1	First shunt release
F2	Second shunt release
F3	Undervoltage release
F4	Undervoltage release with delay
F5	Tripping solenoid
F7	Remote reset solenoid
I/O	In/Out, input and output module
I tripping operation	Instantaneous short-circuit trip
ID	Identification number
IEC	International Electrotechnical Commission
L1	Conductor/phase 1
L2	Conductor/phase 2
L3	Conductor/phase 3
LED	Light emitting diode
LV	Low-voltage
M	Motor
MV	Medium-high voltage
N	Neutral conductor
NC	Normally closed contact

S	Normally open contact
S1	Signaling switch, switching position
S10	Electric ON
S12	Motor cutout switch
S13	Cutout switch for remote reset
S14	Cutout switch for shunt release F1 (overexcited)
S15	Cutout switch for switch-on solenoid Y1 (overexcited)
S22	Signaling switch on 1st auxiliary trip unit
S23	Signaling switch on 2nd auxiliary trip unit
S24	Tripped signaling switch
S42	Signaling switch on CubicleBUS side on first auxiliary trip unit F1
S43	Signaling switch on CubicleBUS side on second auxiliary trip unit F2, F3 or F4
S7	Signaling switch, switching position
S8	Signaling switch, switching position
ST	Shunt release
T.U. ERROR	Trip unit error, fault in overcurrent trip unit
TEST	Test position
t_{sd}	Delay time for short time-delayed short-circuit protection
t_{ZSI}	Guaranteed non-tripping time
UL	Underwriters Laboratories Inc.
UVR	Undervoltage release (instantaneous)
UVR t_d	Undervoltage release (delayed)
VDE	Association of German Electrical Engineers
VT	Voltage transformer
X	Terminal marking according to DIN
Y1	Switch-on solenoid
ZSI	Zone Selective Interlocking

You can find more abbreviations, especially with regard to possible settings, in the 3WL Manual.

Glossary

Auxiliary trip unit

Undervoltage releases and shunt releases are available.

BSS module

Breaker Status Sensor - for collecting the information about the status of the circuit breaker by means of signaling switch, and the transfer of this information to the CubicleBUS.

COM15 module

The communication module is the interface adapter for

- Converting the CubicleBUS signals to PROFIBUS DP signals and vice versa
- Provision of three isolated outputs for control functions (ON, OFF, 1x freely available)
- One input, freely usable for information from the switchgear
- Additional function when used as slide-in circuit breaker:
  - Recording the position of the circuit breaker in the guide frame with the signaling switches S46, S47 and S48.

CubicleBUS

Data bus system in the vicinity of the circuit breaker and to the fieldbus (PROFIBUS DP)

Energy transformer

Generates energy (power supply) for the internal supply of the overcurrent release.

Manual connector coding

The manual connectors can be coded to prevent the auxiliary conductor connections from being connected incorrectly.

Mechanical interlock

This function supports different types of mechanical interlocking for circuit breakers.

Motorized operating mechanism

A geared motor automatically charges the stored-energy spring mechanism as soon as voltage has been applied to the auxiliary supply connections. After one closing operation, the stored-energy spring mechanism is automatically charged for the next closing operation.

Position indicator

This indicates the position of the circuit breaker (disconnected/test/operating position) in the guide frame.

Position signaling switch

This is used for remotely displaying the circuit breaker position in the guide frame.

Rated current coding

The rated current is coded in the factory, that is, each circuit breaker can only be used in a guide frame with the same rated current.

Remote resetting

Using the optional remote reset solenoid, the electrical signal of the tripped signaling switch and the reset button are reset.

Safe OFF

This additional function prevents the circuit breaker from closing and fulfills the isolation condition in the OFF position to IEC 60947-2:

- "Mechanical OFF" button pressed
- Main contacts open
- Withdrawable circuit breakers: racking handle removed
- The various interlocking conditions are fulfilled

Shunt release (F1, F2)

For remotely opening the circuit breaker and blocking it against closing.

Switching position signaling switch

This auxiliary switch is actuated depending on the switching status of the circuit breaker.

Undervoltage release (delayed)

For remotely opening and interlocking the circuit breaker. Voltage dips must not cause the circuit breaker to open.

Undervoltage release (instantaneous/short-time delay)

For remotely opening and interlocking the circuit breaker as well as for using the circuit breaker in EMERGENCY OFF circuits (to EN 60204-1 / DIN VDE 0113 Part 1) in conjunction with a separate EMERGENCY OFF device. Brief voltage dips (t_d < 80 ms for instantaneous undervoltage release, t_d < 200 ms for short-time delay undervoltage release) must not cause the circuit breaker to open.

Index

R

S

T

Z