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Manual

SENTRON

Communication 3WL air circuit breaker via COM35 - PROFINET IO, Modbus TCP

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Air circuit breakers Communication of 3WL air circuit breakers via COM35 - PROFINET IO, Modbus TCP

Manual

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Introduction

1

Target readers of this documentation

The information contained in this documentation is provided for the benefit of:

- Planners
- Switchgear manufacturers
- Commissioning engineers
- Users
- Maintenance personnel

1.1 Reference documents

You can find further details in the following documents:

- SENTRON WL - 3WL1 Circuit Breaker (IEC) (https://support.industry.siemens.com/cs/ww/en/view/109761064)
- SENTRON WL - 3WL2 Low Voltage Insulated Case Circuit Breaker (NAFTA UL489) (https://support.industry.siemens.com/cs/ww/en/view/21465740)
- SENTRON WL - 3WL3 Low Voltage Power Circuit Breaker (ANSI) (https://support.industry.siemens.com/cs/ww/en/view/21463215)

1.2 Technical Support

You can find further support on the Internet at:

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

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Find out about training courses on offer on the following link.

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1.4 Security

1.4.1 Security information

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3WL air circuit breaker

2

2.1 Introduction and overview

The 3WL air circuit breaker (SENTRON WL) is extremely flexible in use and offers consistent communication capability. With the 3WL circuit breakers, just four sizes cover a performance range of 400 A to 6300 A.

The basis for this manual are sizes 1 to 3. These sizes are characterized by the same design, the same operation and the same comprehensive accessories. You will find information about the communication modules of the 3WL10 in the 3WL10 Communication Manual:

- 3WL10 Air Circuit Breakers (CB), Withdrawable (https://support.industry.siemens.com/cs/ww/en/view/109748198)
- 3WL10 Air Circuit Breakers (CB), Fixed (https://support.industry.siemens.com/cs/ww/en/view/109748199)

The COM35 communication module described in this manual is suitable for the following circuit breaker versions:

Table 2- 1 Circuit breaker versions

Designation	Electronic trip unit (ETU)	Market/standard	Sizes
3WL1	ETU45B / ETU76B	IEC 60947-2	1 … 3
3WL2	ETU745 / ETU748 / ETU776	NAFTA / UL 489	1 … 3
3WL3	ETU745 / ETU748 / ETU776	NAFTA / UL 1066	2 … 3
3WL5	ETU45B	IEC 60947-2 / UL 489	1 … 3

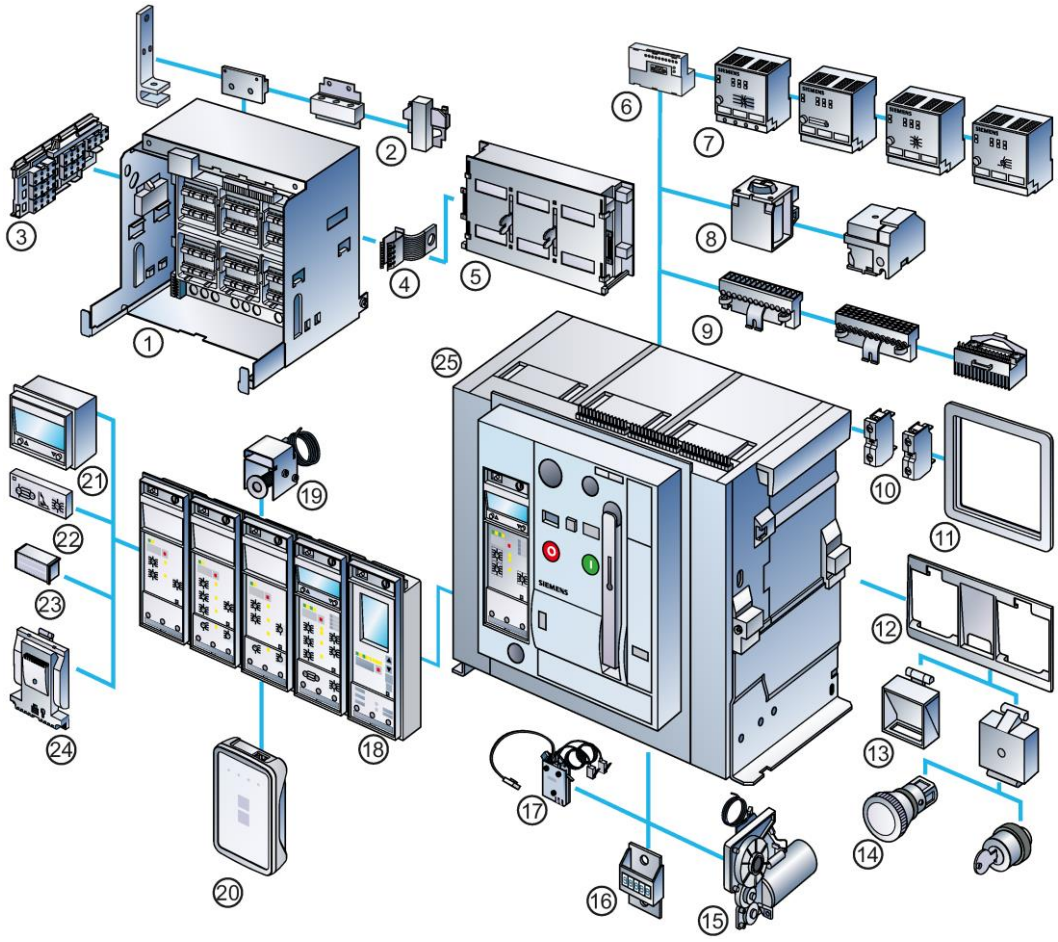
Communication-capable circuit breaker

The circuit breaker is more than just a switching and protection device. A circuit breaker incorporates electronic components that enable it to acquire and process many different items of data in addition to the actual protection function. These data are therefore available for different applications via the communication modules and can be further processed therefore, e.g. in a central control room:

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

With the COM35 communication module, the following functions are possible:

- Reading and writing parameters
- Reading circuit breaker states
- Reading measured values
- Closing/opening the circuit breaker via communication
- Transmission of messages and alarms
- Transmission of maintenance information
- Detecting the position of the circuit breaker in the guide frame
- Additional functions via internal inputs and outputs
- Switching the DAS function on/off



① Guide frame
② Main front terminal, flange, horizontal, vertical
③ Position signaling switch
④ Grounding contact, leading
⑤ Shutter
⑥ COM35 / COM15 / COM16
⑦ External CubicleBUS modules
⑧ Closing coil, auxiliary release
⑨ Auxiliary conductor plug-in system
⑩ Auxiliary switch block
⑪ Door sealing frame
⑫ Interlocking set base plate
⑬ Transparent insert, function insert
⑭ Key-operated emergency stop pushbutton
⑮ Motorized operating mechanism
⑯ Operating cycles counter
⑰ Breaker Status Sensor (BSS)
⑱ Electronic trip unit (ETU)
⑲ Reset solenoid
⑳ TD400
㉑ Four-line LCD module
㉒ Ground fault protection module
㉓ Rating plug
㉔ Metering function module
㉕ 3WL air circuit breaker

Figure 2-1 3WL air circuit breaker, accessories

Electronic trip unit (ETU)

The core of each circuit breaker is the electronic trip unit (ETU) with its overcurrent release function. There are 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.

Communication capability

All circuit breakers with trip units of the type ETU45B, ETU745, ETU748, ETU776 and ETU76B have communication capability. Additional components that are networked internally via the CubicleBUS can be installed in these communication-capable trip units.

To confer communication capability on a 3WL with the ETU15B, ETU25B or ETU27B trip unit, the electronic trip unit (ETU) must be replaced as this trip unit has no facility for connecting to the CubicleBUS.

2.2 CubicleBUS

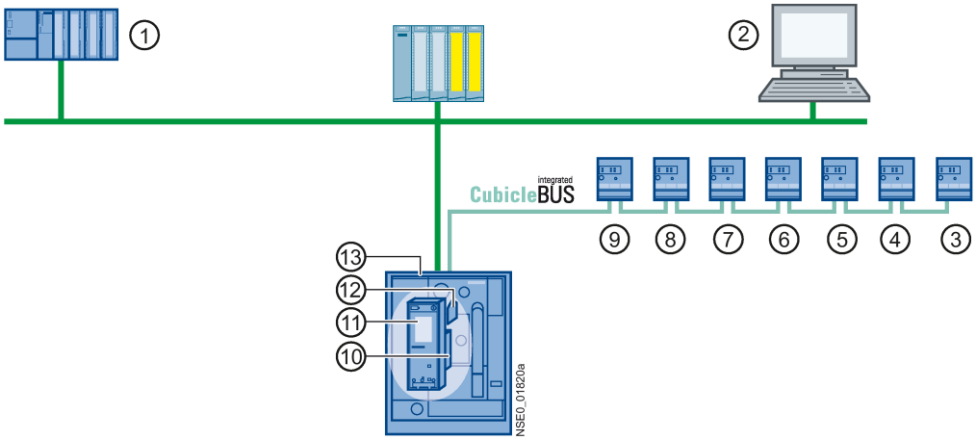
Within the integrated and modular architecture of SENTRON WL, the CubicleBUS connects all intelligent components within SENTRON WL as an internal communication bus inside the circuit breaker and enables simple and safe connection of other external additional components.

Retrofitting components

The high modularity of the system allows retrofitting of communication functions (e.g. the metering function) at any time. Retrofitting of a SENTRON WL that does not yet have communication capability is also possible on-site in the plant by qualified personnel. 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 switchgear.

The figure below shows the system architecture of the SENTRON WL that with the CubicleBUS enables simultaneous communication via COM35.



① PLC
② Parameterization and visualization tool (e.g. powerconfig or powermanager)
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 COM35

Figure 2-2 System architecture of the SENTRON WL

2.3 Availability of the data

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 and the current state of the data point are described and also communicated in the "property bytes" (PB). 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. You will find information on the individual data points in Chapter Data library (Page 141).

The data point and property byte result in the complete information.

By combining the two items of information, you can quickly obtain the meta-knowledge about the circuit breaker without having to know the device itself.

Data point groups

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

Table 2- 2 Assignment of data points to CubicleBUS modules

Data point group, data points with the same source	CubicleBUS node			
	ETU	BSS	COM35	Metering function PLUS
Protection parameter set A	✓	–	–	–
Protection parameter set B (DAS) (with ETU76B / ETU776)	✓	–	–	–
Enhanced protection parameters	–	–	–	✓
Parameters for threshold values	–	–	–	✓
Communication parameters	–	–	✓	–
Parameters for setting measured values	–	–	–	✓
Data for device identification	✓	–	✓	–
Circuit breaker position in the guide frame	–	–	✓	–
Status information (e.g. circuit breaker open/closed, spring energy store)	–	✓	–	–
Warnings	✓	–	–	–
Trips	✓	–	–	✓
Threshold value messages	–	–	–	✓
Maintenance information	✓	–	✓	–
Temperature in the circuit breaker (BSS)	–	✓	–	–
Temperature in the control cabinet (COM35)	–	–	✓	–
3-phase currents	✓	–	–	–
Current in the neutral 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	–	–	✓	–
DAS (Dynamic Arc-Flash Sentry) with ETU76B, ETU776	✓	–	✓	–

2.4 Breaker Status Sensor (BSS)

To read out circuit breaker states via communication, a BSS module must be installed, including the required signaling switches. A requirement for this is that the circuit breaker has a communication-capable electronic trip unit.

All microswitches 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 (circuit breaker open/closed)
- Ready-to-close signaling
- Trip alarm switch on the trip unit (connected with the red tripped plunger)
- Signaling switch on auxiliary trip unit
- Temperature in the circuit breaker depending on the installation location in the circuit breaker (the sensor is calibrated at the factory)

Note

Ordering data

The BSS is already included in the order option "Z=F35".

If a BSS without a communication module is required, this can already be specified with the option "Z=F01" when the circuit breaker is ordered. You can order a BSS subsequently as a spare part.

2.5 Metering functions

2.5.1 Metering function PLUS

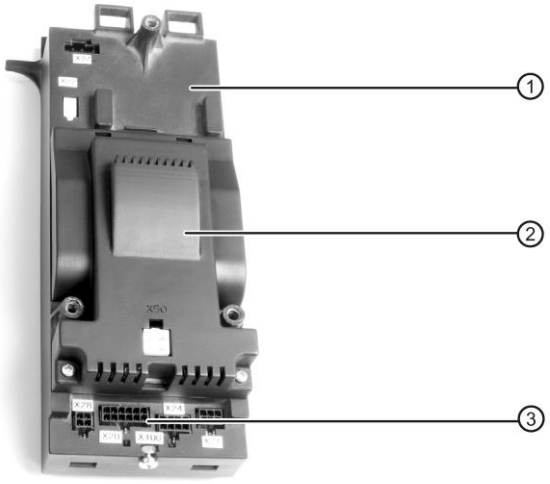
The integral metering function PLUS can be operated with all trip units with CubicleBUS connection. It extends the protection functions of the trip unit and provides further warning thresholds and additional diagnostics options. With its extensive measured values, the integral metering function PLUS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

Properties

The properties of the metering function PLUS are:

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

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 Ports of the ETU

Figure 2-3 Metering function PLUS

Data exchange with trip unit

The trip unit and the metering function PLUS exchange all measured values via an internal high-speed synchronous interface.

The metering function PLUS provides all connected modules (e.g. COM35) with the following data for further processing via the CubicleBUS:

- Parameters for the enhanced protection function
- Parameters for the threshold values
- Measured value settings
- Determined measured values

Connection

The internal circuit breaker wiring is continued via the CubicleBUS connection. Depending on the equipment of the circuit breaker, the cable is routed to the BSS or directly to the X8 terminals.

Note

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

2.5.2 Harmonics analysis

The metering function PLUS samples the applied currents and the voltage, saves the measured values, and performs a Fast Fourier Transformation. The result is the percentage distribution of the harmonic oscillations up to the 29th harmonic. The measured values are made available via the CubicleBUS and can be displayed via powerconfig and saved for later diagnostics as an Excel-compatible "*.csv" file. In the case of the ETU76B or ETU776 trip unit, the measured and calculated values can also be shown on the display.

Harmonics

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 converters (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 voltage drops 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 cables
- Interference with electronic components

Costs

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 result in plant standstill
- Spurious tripping of protection equipment results in standstill of plant sections
- Overload of the transformer and the cable results in increased fire hazard
- Reduction in the service life of electronic components

If increased harmonics are measured, it is advisable to perform a 3-phase system analysis. This measurement, including the neutral conductor, must be performed 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.

2.5.3 Waveform buffer

The metering function PLUS has two independent high-resolution waveform buffers (A and B) with which the current measured values are captured and buffered for 1 s. The FIFO buffer is continually overwritten with the new measured values. If a trigger event occurs, the 1-s measured values are stored for subsequent analysis of the event.

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

Each of these waveform buffers has 8 channels:

- One channel each for the currents
  - I_{L1}
  - I_{L2}
  - I_{L3}
  - I_N
  - I_g
- One channel each for the voltages
  - U_{L1N}
  - U_{L2N}
  - U_{L3N}

Each channel is sampled with a frequency of 1.649 kHz. The values are buffered for 1 s

The waveform can be represented and exported with powerconfig, for example.

Trigger event

Tripping operations, warnings, 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. It is also possible to store the position in the stopped waveform buffer at which the trigger will be located.

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 s of pre-history and 0.2 s of post-history are available in the waveform buffer, and an available COM35 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 powerconfig. 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 min 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 enhanced protection function, the metering function also has to perform tasks with higher priority. Also, a large volume of data is transferred.

The progress of this process is indicated by a progress bar in powerconfig.

2.5.4 Measured values of the metering function

Table 2- 3 Metering function PLUS - measured values for communication

Measured value	Value range	Accuracy (when ordering the circuit breaker, trip unit and 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 U_{L12}, U_{L23}, U_{L31}	80 … 120% U_n	±1%
Star point voltages U_{L1N}, U_{L2N}, U_{L3N}	80 … 120% U_n	±1%
Instantaneous mean value of the phase-to-phase voltages U_{LLavg}	80 … 120% U_n	±1%
Instantaneous mean value of the neutral-point displacement voltages U_{Lnavg}	80 … 120% U_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
Average of the power factor cos φ_{avg}	−0.6 … 1 … 0.6	±0.04
Long-time 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] The precision is specified as follows: ± (x%) of the full-scale value + two 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 three SENTRON WLs to this voltage transformer.

Table 2- 4 Reference conditions

Reference conditions		Reference values
Input current $I_{n\ max}$		±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 h
Relative humidity		Up to 90%
Interfering fields		None
Measuring range	Current $I_{n\ max}$	0.2 … 1.2
	Voltage $U_{n\ max}$	0.8 … 2

2.5.5 Enhanced protection function

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

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

Table 2- 5 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 phase rotation	–	–
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

2.5.6 Delay of the threshold warning

You can parameterize whether a warning is generated when an upper or lower threshold value is violated. This warning can be delayed like the enhanced 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 COM35.

Table 2- 6 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 neutral conductor	30 … 10000 A	0 … 255 s
Phase unbalance current	5 … 50%	0 … 255 s
Long-time 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

2.5.7 3WL circuit breaker measuring accuracy

The measuring accuracy depends on the circuit breaker components.

The accuracy (when ordering the circuit breaker, trip unit and 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 circuit 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 circuit breaker, the accuracy for the full-scale value is 1000 A as follows:

Table 2- 7 Measuring accuracy ETU45B / ETU745 / ETU748

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

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

Table 2- 8 Measuring accuracy ETU76B / ETU776

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

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

2.6 Functions and parameters

2.6.1 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 enhanced protection function. These functions can also be utilized without communication.

2.6.2 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.

With the communication-capable ETU, 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 pickup". This is based on a circuit breaker with an overload parameter of 1000 A.

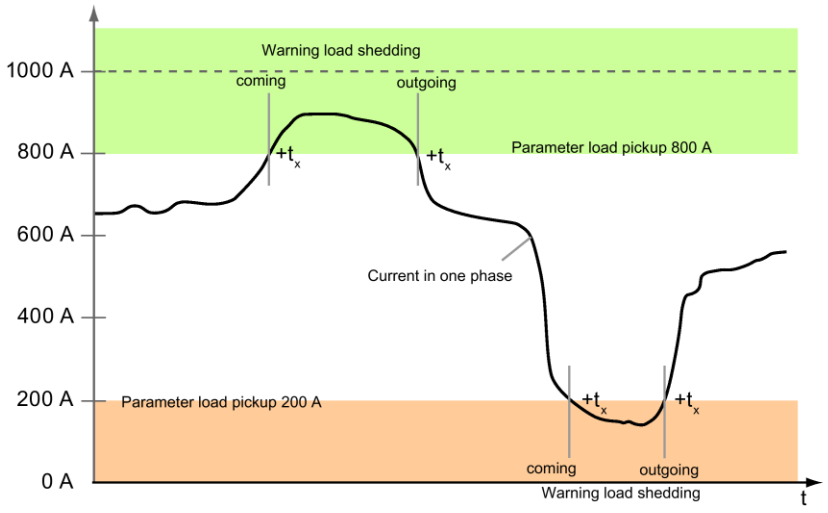


Figure 2-4 Load management functions: Load shedding and load pickup

Note

Violation of the upper or lower thresholds does not result in a circuit breaker trip and instead only ever generates a message.

Threshold for load shedding

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

Note

The event log is only available with COM35.

Threshold for load pickup

If the current in all three phases drops below the parameter setting, a message "load pickup warning" is generated. If only one of the three currents exceeds the value of the parameter, the "load pickup warning" 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.

Local switching signals

The signals load shedding/load pickup 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 pickup status.

2.6.3 Enhanced protection function

The enhanced protection function metering function PLUS adds further tripping criteria to those of the trip unit. If an additional tripping criterion from the enhanced 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 Table 2-5 Protection function of the metering function PLUS (Page 25) are available as additional monitoring criteria.

See also

Enhanced protection function (Page 25)

2.6.4 Setpoint values

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

In general, the same monitoring functions are available for the threshold values as for the enhanced protection function. The greatest difference, however, is that the violation of a threshold does not result in tripping.

Together with the enhanced protection function, two threshold values can be defined (e.g. for overvoltage):

- For the lower threshold value, only a warning is generated via the threshold value function (e.g. > 410 V).
- When the voltage rises, a trip (e.g. > 430 V) is triggered.

2.6.5 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 circuit breaker with high rated current (e.g. 4000 A) at 1% accuracy in the lower range.

The residual current can result in a current flow of up to 40 A being displayed and transferred via the communication system, when the circuit breaker is off (main contacts opened). 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.

- All values ≤ 50 A are shown on the display as 0.
- All values ≤ 50 A are used for internal calculations (power) as 0.
- All values ≤ 50 A are transmitted as 0 via the communication.

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

You will find the parameter in the parameter tree of powerconfig as follows:

powerconfig menu: Device → Device parameter → Circuit breaker → Metering settings

2.6.6 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 tie-breakers. It is necessary here to define a "normal direction". The normal direction 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 transmitted energy values are used in two counters:

- Active energy in the normal direction
- Active energy in reverse direction

Neither energy counter has a sign.

2.6.7 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 20 events registered on the CubicleBUS are stored in the COM35. The trip log contains the last 20 tripping operations. Both can be evaluated via powerconfig.

The event log contains up to 20 events and works like a FIFO buffer: 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. An incoming or outgoing message is unnecessary in this case.

Note

The event log and the trip log are only available with the COM35 module.

2.7 External CubicleBUS modules

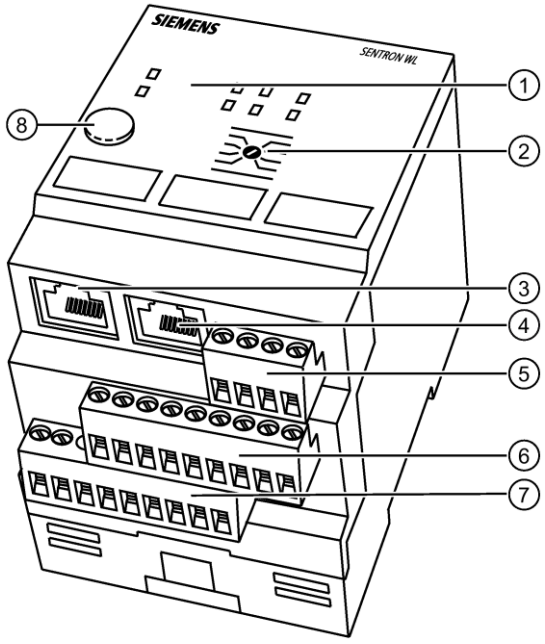
2.7.1 General information

Description and equipment

External CubicleBUS modules enable communication of the SENTRON WL circuit breaker with secondary devices in the circuit breaker section. It can be used, for example, to control analog indicators, to transfer warning messages 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 enclosure. The CubicleBUS can be connected to X1 and X2 with an RJ45 connector (present on the COM35), or it can be connected to X3.



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 2-5 External CubicleBUS module

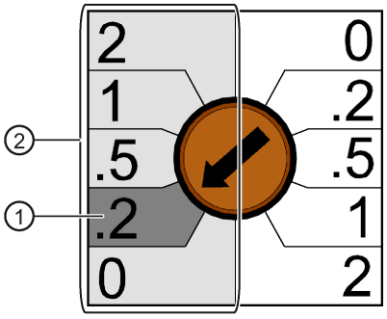
2.7.1.1 Rotary coding switch

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).

For further information, please refer to the individual modules.

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



① .2 = delay of 0.2 s

② Circuit breaker position left = Module 1

Figure 2-6 Rotary coding switch setting on the CubicleBUS module – delay time [s]

2.7.1.2 Installing the CubicleBUS modules

The external CubicleBUS modules are snapped onto a standard 35 mm DIN rail in the switchboard 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 be used. These cables enable both the communication of the CubicleBUS modules and their 24 V DC supply.

2.7.1.3 Connecting 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 DC 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.

Table 2- 9 Pin assignment of X3 on the CubicleBUS module

Connection	Assignment
X3:1	Ground 24 V DC
X3:2	CubicleBUS communication cable −
X3:3	CubicleBUS communication cable +
X3:4	+24 V DC

2.7.2 Maximum configuration of the CubicleBUS

The CubicleBUS can comprise up to 13 nodes of the following list:

- Trip unit ETU
- Metering function PLUS
- Breaker Status Sensor (BSS)
- COM35
- TD400
- ZSI module
- Digital output module with circuit breaker position left (1st module)
- Digital output module with circuit breaker position right (2nd module)
- Digital configurable output module
- Digital input module with circuit breaker position left (1st module: "Parameter switch")
- Digital input module with circuit breaker position right (2nd module: "PROFIBUS inputs")
- Analog output module with circuit breaker position left (1st module)
- Analog output module with circuit breaker position right (2nd module)

2.7.3 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 power supply (Page 75).
- If a ZSI module is used, it must be connected as the first external module.

2.7.4 Connection of external CubicleBUS modules

Note

Selecting the power supply

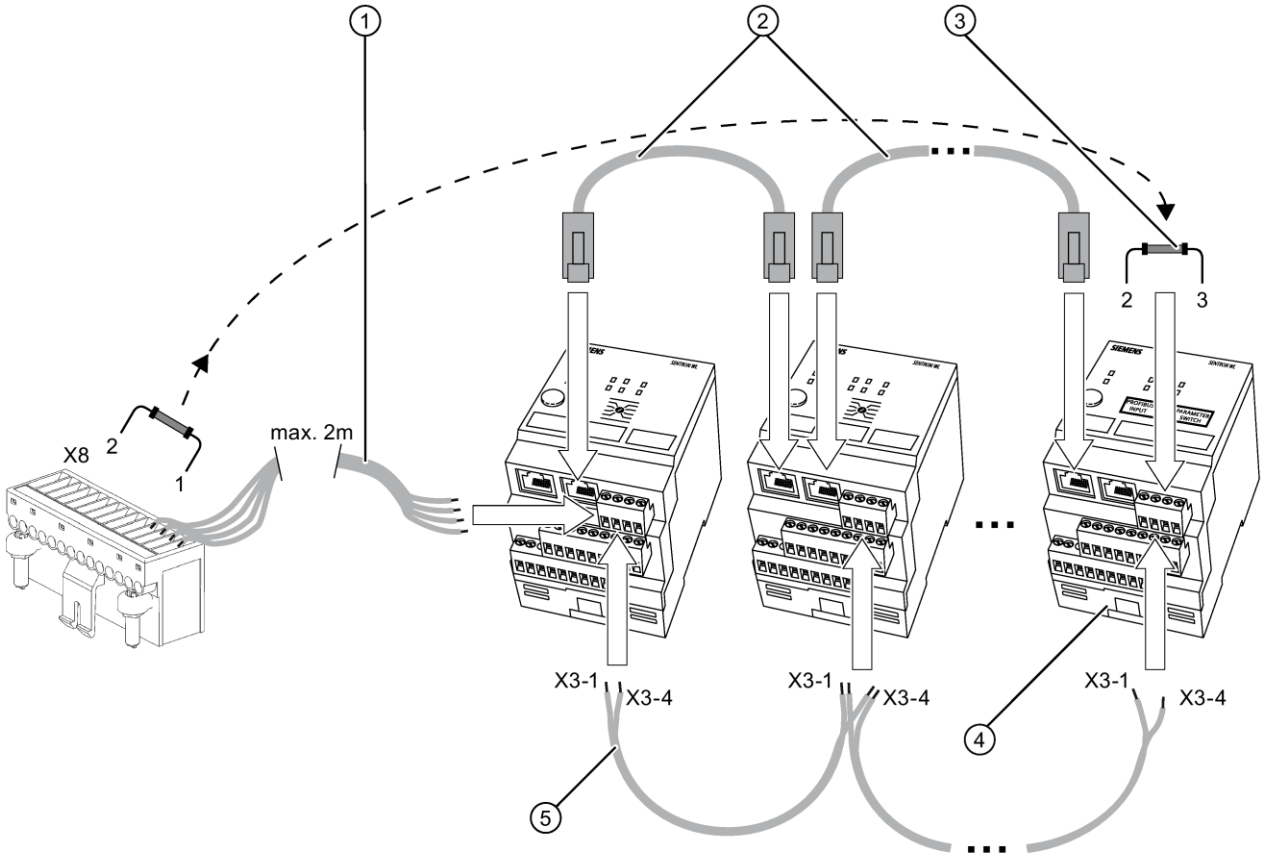
A sufficient external power supply of 24 V DC must be ensured.

You will find further information on this in Chapter Power drawn by a SENTRON WL with CubicleBUS (Page 75).

Connection of the CubicleBUS without COM35

The figure below shows the connection of external CubicleBUS modules to the SENTRON WL without COM35.

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



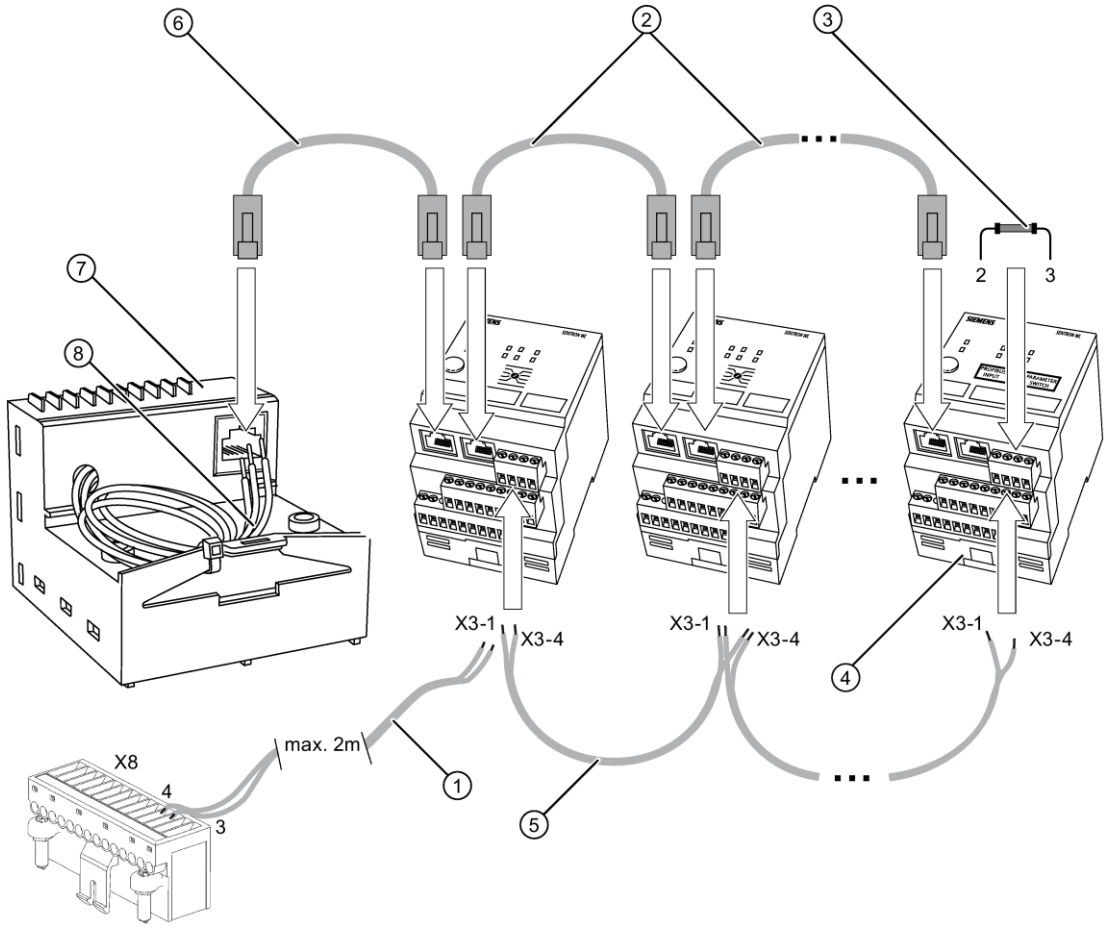
① Only with more than two CubicleBUS modules: Connecting cable between X8 and the first CubicleBUS module for power supply with 24 V DC
② Connecting cables between the modules
③ Terminating resistor 120 Ω 0.5 W on the last module
④ CubicleBUS modules
⑤ Cable connection for power supply with 24 V DC

Figure 2-7 Connection of the CubicleBUS without COM35

Connection of the CubicleBUS with COM35

The figure below shows the connection of external CubicleBUS modules to the SENTRON WL with COM35:

- 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 two 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 COM35 and the first CubicleBUS module (with two RJ45 connectors)
⑦ COM35
⑧ Four cables wired to X8

Figure 2-8 Connection of the CubicleBUS with COM35

2.7.5 LED display

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:

LED DEVICE

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

Table 2- 10 LED DEVICE

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

CubicleBUS LED

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

Table 2- 11 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 2- 12 Other LEDs

All other LEDs	Meaning
Yellow	• On the input module this means a high signal at the relevant input. • On the 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 U, I, P), or cos φ 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.

2.7.6 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 performed before commissioning. The correct functioning of the CubicleBUS modules can be checked in test mode. A distinction must be made between the individual modules.

Perform test mode

Test mode is started by pressing the "Test" button on the CubicleBUS module once.

All inputs/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/output to be switched on and off alternately.

On the input module, the signals are also transferred via the CubicleBUS via the COM35 communication module to the PROFINET and MODBUS TCP.

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.

"Enable"

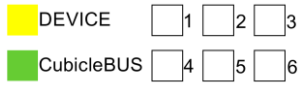
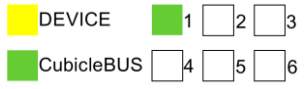
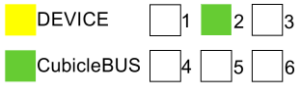
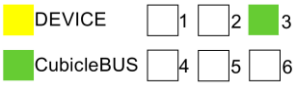
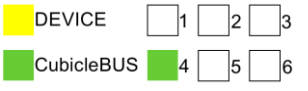
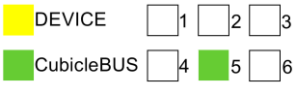
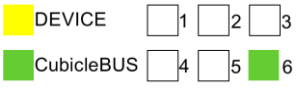
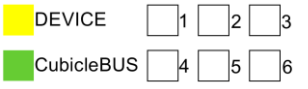
The inputs of the input module, the outputs of the output module, the ZSI input and the ZSI output can be "enabled" via the communication system of powerconfig. Test mode can be switched on via the communication system and the inputs/outputs can be overwritten for test purposes.

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 2- 13 Testing process for the digital inputs/outputs on the CubicleBUS

State/action	LED display	Description
Normal operation		Normal operating state of the input/output module. The inputs/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/output 1 is selected by pressing once, displayed by the green LED 1. Following this, the output can be switched on and off alternately, or the on/off signal of the input can be transferred by quickly and repeatedly pressing the "Test" button (1 s).
After a pause of at least 2 s, press the "Test" button.		Input/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 at least 2 s, press the "Test" button.		Input/output 3 selected. On input modules, the presence of 24 V DC is simulated at the relevant input and transferred via COM35.
After a pause of at least 2 s, press the "Test" button.		Input/output 4 selected. Fast pressing of the "Test" button tests the selected input/output.
After a pause of at least 2 s, press the "Test" button.		Input/output 5 selected. Fast pressing of the "Test" button tests the selected input/output.
After a pause of at least 2 s, press the "Test" button.		Input/output 6 selected. Fast pressing of the "Test" button tests the selected input/output.
After a pause of at least 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.

= LED lights up yellow.

= LED lights up green.

= LED not illuminated.

2.7.7 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. The position "PROFIBUS INPUT" means that the information is available at the COM35 via PROFINET and Modbus TCP.

Input module function

The digital input module offers connections for up to six additional binary signals. The signals are transferred directly via communication and processed at the fieldbus level.

Such signals include:

- Status of a Buchholz relay
- Open/closed signal of the control cabinet door
- Violation of a specified temperature

The status of an MCCB without direct communication capability or of a switch disconnector can also be transferred.

Combined with the configured output module, these protection relays can also be switched.

Circuit breaker position "PROFIBUS INPUT"

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

Circuit breaker position "PARAMETER SWITCH"

If the rotary coding switch is in the "PARAMETER SWITCH" position, six inputs are also available. However, 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 (see Figure 2-5 External CubicleBUS module (Page 33)) selects the operating mode.

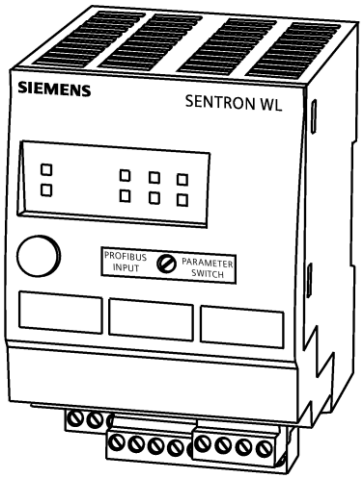


Figure 2-9 Digital input module

See also

General information (Page 33)

2.7.7.1 Parameter set switching

There are two different parameter sets (A and B) for the protection function in the ETU76B or ETU776 trip unit.

The various parameter sets are important, e.g. when you switch from line operation to generator operation and you may have to change protection settings.

The 2nd parameter set (B) can also be used for the function DAS of the COM35.

Switchover

It is possible to switch over between the two parameter sets by means of:

- Communication
- Display in ETU76B or ETU776
- Digital CubicleBUS input module
- DAS function of the COM35

Since the CubicleBUS is an event-driven bus, the ETU then switches to the other parameter set when a switchover request is made via the CubicleBUS.

Digital CubicleBUS input module

If a switchover is made to parameter set B, even though the input on the digital input module (terminal X5, 2-3) is at "0" (parameter set A), the active parameter set in the trip unit switches 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 switching over 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, switchover to parameter set B is signaled to the trip unit. If the input signal changes back to "0", switchover to parameter set A is communicated and the LED at input 1 goes out.

2.7.7.2 Technical data

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

Table 2- 14 Technical data of the digital input module

Description	Value
Operating voltage on the CubicleBUS	• Min. 19.2 V • Max. 28.8 V
Current consumption from the CubicleBUS	• Min. 29 mA • Max. 43 mA
Number of isolated channels per digital input module	6 channels
Voltage value for reliable detection of a "1" signal	> 16 V
Current consumption per input at a "1" signal	7.5 mA
Voltage value for reliable detection of a "0" signal	< 1 V
Current consumption per input at a "0" signal	0 mA
Maximum number of modules possible on one CubicleBUS	2 modules
Power consumption	• Min. 0.72 W • Max. 0.94 W
Dimensions (W x H x D)	70 mm x 86 mm x 95 mm
Weight	0.223 kg
Temperature range	−40 °C … +60 °C

2.7.8 Digital output module with rotary coding switch

Six binary information items about the circuit breaker status (warnings 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 circuit breaker position on the left selects the events via the rotary coding switch in the adjacent dark-gray field, and the circuit breaker position on the right selects the events in the adjacent light-gray field.

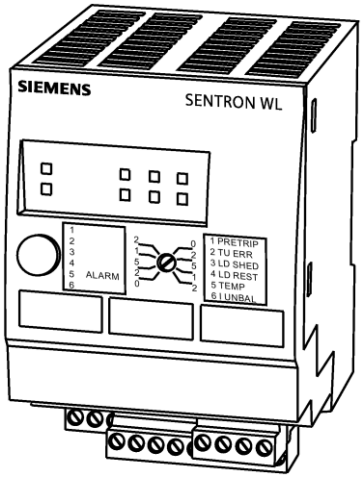


Figure 2-10 Digital output module with rotary coding switch

2.7.8.1 Properties

Versions

The output module offers a changeover contact in each case with a maximum load of up to 12 A. Voltages up to 230 V and AC voltage are possible. In addition, the relay contacts are isolated.

Load shedding signal

By means of the load shedding and load pickup signals, a load can be switched off or connected automatically, depending 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.

Circuit breaker position left

If the rotary coding switch (see Figure 2-5 External CubicleBUS module (Page 33)) is set to one of the positions in the left dark-gray field, the outputs 1 to 6 are assigned the following event signals:

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

Circuit breaker position right

If the rotary coding switch (see Figure 2-10 Digital output module with rotary coding switch (Page 45)) 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 pickup
5. Temperature alarm
6. Phase unbalance current

Delay time

As well as the assignment of the outputs, a delay time can be set using the rotary coding switch. These rated voltages are:

- 0 s
- 0.2 s
- 0.5 s
- 1 s
- 2 s

A delay time can be used, for example, to suppress briefly occurring events and to output events only after they are pending for a longer time (e.g. phase unbalance). The leading overload trip signal that can be used for premature disconnection and protection of connected frequency converters 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, the digital output module must be configured once in the "circuit breaker position left" operating mode and once in the "circuit breaker position right" operating mode.

LED displays

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 lights up yellow.

See also

General information (Page 33)

Digital output module with rotary coding switch (Page 45)

2.7.8.2 Technical data

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

Table 2- 15 Technical data of the digital output module with rotary coding switch

Description		Value
Operating voltage on the CubicleBUS		• Min. 19.2 V • Max. 28.8 V
Current consumption from the CubicleBUS		• Min. 29 mA • Max. 250 mA
Number of isolated channels per digital output module		6 channels
Max. possible aggregate current of all 6 outputs	Relay output	
	At 24 V DC	10 A
	At 250 V AC	10 A
	At 250 V DC	2.5 A
Max. possible current on relay outputs per channel at 24 V DC		2.7 A
Maximum number of modules possible on one CubicleBUS		2 modules
Power consumption		• Min. 0.74 W • Max. 5.4 W
Dimensions (W x H x D)		70 mm x 86 mm x 95 mm
Weight of relay		0.321 kg
Temperature range		−40 °C … +60 °C

2.7.9 Configuration of the digital output module

Digital configurable output module

The digital configurable output module has six outputs. The outputs are configured exclusively using the powerconfig software.

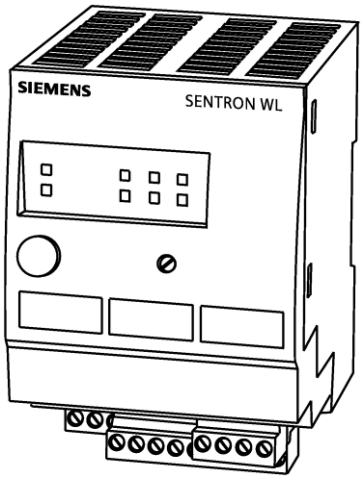


Figure 2-11 Digital configurable output module

Configuration

Unlike on the modules with a rotary coding switch, the outputs are assigned via software rather than with a selector switch. powerconfig is available as the 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 circuit breaker is in overload excitation or if a warning for phase unbalance is pending. The last three outputs can only be assigned one of the events directly.

Events

The following events/data are available for the configuration:

- Status messages
- Warnings
- Tripped signals
- Messages about upper threshold value violations
- Messages about triggers of the waveform buffers that occurred
- Directly via the bits addressable via PROFIBUS
- The active parameter set

Controlling via communication

The outputs of the module can be set directly 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 switching devices that do not have direct communication 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.

2.7.9.1 LED display

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 2- 16 LED display of the digital output module

Event	Status
Status	Circuit breaker closed
	Circuit breaker open
	Spring energy store charged
	Ready for closing
	Group warning
	General tripping operation
	Write protection active
	Communications OK
Warnings	Overload
	Overload in neutral conductor
	Load shedding
	Load pickup
	Ground-fault alarm
	Overtemperature
	ETU fault
	Phase unbalance current
Trips	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 phase rotation
PROFIBUS output bits	PROFIBUS bit 1
	PROFIBUS bit 2

Event	Status
	PROFIBUS bit 3
	PROFIBUS bit 4
	PROFIBUS bit 5
	PROFIBUS bit 6
Active parameter set	Parameter set A active
	Parameter set B active
Setpoint values	Overcurrent
	Overcurrent in neutral conductor
	Overcurrent ground fault
	Phase unbalance current
	Phase unbalance voltage
	Long-time 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

2.7.9.2 Technical data

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

Table 2- 17 Technical data of the digital output module

Description		Value
Operating voltage on the CubicleBUS		• Min. 19.2 V • Max. 28.8 V
Current consumption		• Min. 29 mA • Max. 39 mA
Number of isolated channels per digital output module		6 channels
Max. possible current per channel with 24 V DC relay		2.7 A
Max. total current (6 channels)	Relay at	
	24 V DC	10 A
	250 V AC	10 A
	250 V DC	2.5 A
Maximum number of modules possible on one CubicleBUS		1 module
Power consumption		• Min. 0.74 W • Max. 5.4 W
Dimensions (W x H x D)		70 mm x 86 mm x 95 mm
Weight of relay		0.321 kg
Temperature range		−40 °C … +60 °C

2.7.10 Analog output module

Via the analog output module, the most important measured values transmitted 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:

- 4 to 20-mA interface
- 0 to 10-V interface

Interfaces

- The measured values can be picked up in the output form of 0 to 10 V via the X4 connector on the CubicleBUS module.
- Via the X5 connector, the 4 to 20-mA interface is available.

Both output forms are active simultaneously.

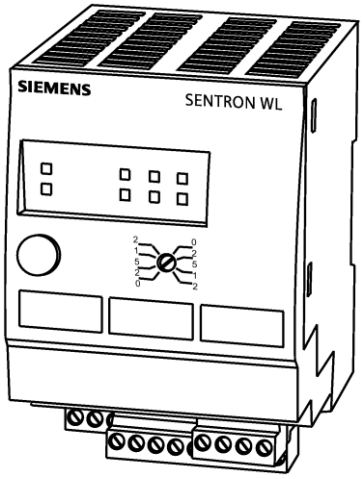


Figure 2-12 Analog output module

2.7.10.1 Selecting the measured values

The measured values output via the four analog channels are selected using a rotary coding switch. The measured values I, V, P, f and cos φ are available. The selection box of the rotary coding switch is divided vertically. If the circuit breaker is set to a value in the left half, the module is automatically addressed as Module 1. 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 two analog output modules can be operated on a 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 channels light up yellow 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.

Circuit breaker position "I"

If the rotary coding switch is at circuit breaker 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 A x factor 1.2 = 1920 A corresponds to 2000 A (rounded).

- 0 V / 4 mA corresponds to 0 A
- 10 V / 20 mA corresponds to 2000 A

Circuit breaker position "U"

If the rotary coding switch is in the circuit breaker position "U", the following voltages are routed to four analog outputs:

- A01: Phase-to-phase voltage U_{L12}
- A02: Phase-to-phase voltage U_{L23}
- A03: Phase-to-phase voltage U_{L31}
- A04: Voltage phase conductor – neutral conductor U_{L1N}

In most cases, the phase-to-phase 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 output 4.

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 power system is 400 V.

400 V x factor 1.1 = 440 V corresponds to 450 V (rounded)

- The full-scale value is then 450 V.

Circuit breaker 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 2- 18 Value ranges for power values [W/VA] on the analog output module

From	To	Full-scale deflection value
0	49999	50000
50000	99999	100000
100000	199999	200000
200000	299999	300000
300000	399999	400000
400000	499999	500000
500000	999999	1000000
1000000	1999999	2000000
2000000	2999999	3000000
3000000	4999999	5000000
5000000	9999999	10000000
10000000	19999999	20000000
20000000	∞	30000000

Example:

I_R = 1600 A, rated voltage = 400 V corresponds to full-scale deflection value = 1,000,000 W

Circuit breaker position "f"

If the rotary coding switch is in the "f" position, the most important measured values are output, with the exception of the currents. When it is used together with another module in the position "I", all important measured values are 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 corresponds to 0 V / 4 mA
- 65 Hz corresponds to 10 V / 20 mA

Circuit breaker position "cos φ"

The measured values below are output in the circuit breaker 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 as %

The display of the power factors has the following scope:

- From 0.7 capacitive (corresponds to 0 V / 4 mA)
- Via 1 (corresponds to 5 V / 12 mA)
- To 0.7 inductive (corresponds to 10 V / 20 mA)

The phase unbalance between the three currents is displayed as follows:

- From 0% (0 V / 4 mA)
- To 50% (10 V / 20 mA)

Note

Note the correct polarity when connecting.

2.7.10.2 Test mode

Test mode is enabled 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 performed as follows:

1. Press the "Test" button.
   The device switches to test mode.
2. Press the "Test" button again.
   Output 1 is selected, 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.
3. Press the "Test" button again.
   Output 2 is selected, indicated by LED A02. The value at output 1 is reset and the value at output 2 is set.
4. Repeat the previous steps to check all four outputs for wiring and scaling.
5. **If output A04 is selected:** Press the "Test" button.
   All four LEDs are activated, but no output is output.
6. Press the "Test" button again.
   Output 1 is selected.

Note

After 30 s without the button being pressed, the device returns to the normal operating mode. The currently pending values in the background are now available again at the outputs.

2.7.10.3 Technical data

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

Table 2- 19 Technical data of the analog configurable output module

Description	Value
Operating voltage on the CubicleBUS	• Min. 19.2 V • Max. 28.8 V
Current consumption from the CubicleBUS	• Min. 63 mA • Max. 150 mA
Inner flow resistance of the rotary coil instrument voltage	• Min. 20 kΩ • Max. ∞
Inner flow resistance of the rotary coil instrument current	• Min. 20 Ω • Max. 250 Ω
Maximum number of modules possible on one CubicleBUS	2 modules
Power consumption	• Min. 0.74 W • Max. 5.4 W
Dimensions (W x H x D)	70 mm x 86 mm x 95 mm
Weight (kg)	• 0.223 kg • 0.321 kg
Temperature range	−40 °C … +60 °C

2.7.11 Zone Selective Interlocking (ZSI)

2.7.11.1 ZSI module

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

Benefits

ZSI (Zone Selective Interlocking) 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 to the switchgear in the event of a short-circuit.

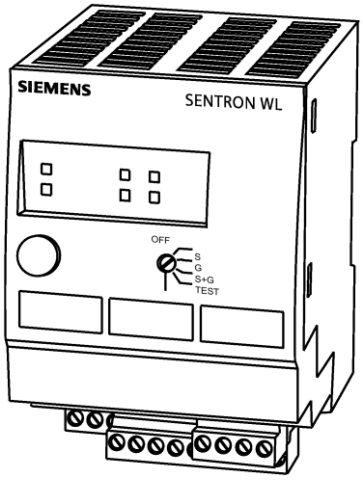


Figure 2-13 ZSI module

You will find further information on this in Chapter ZSI (Page 61).

2.7.11.2 ZSI

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.

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.

Time selectivity

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

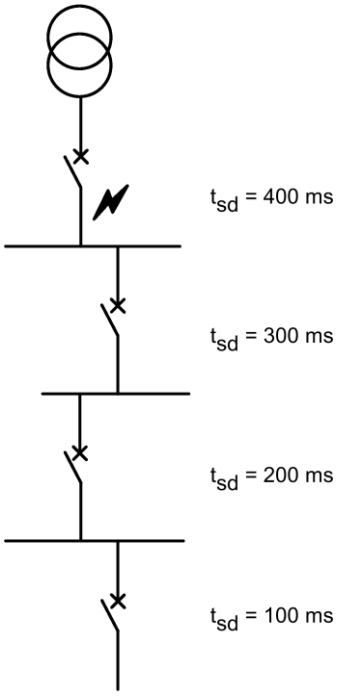


Figure 2-14 Example of time selectivity

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.

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.

Table 2- 20 ZSI function

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.

Operating principle

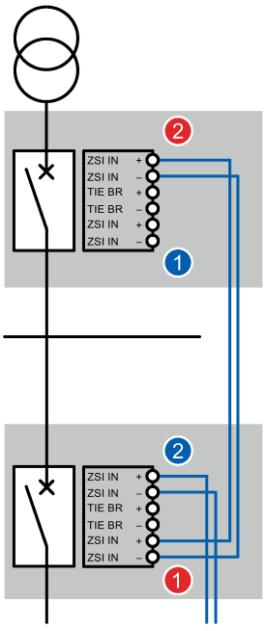


Figure 2-15 Operating principle

- 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)
- Tie-breakers can be integrated (see examples)
- Medium voltage can be integrated (see examples)
- Extremely simple parameterization of the ZSI modules

Course over time

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 circuit 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 clears the short-circuit after 50 ms in the next level to the fault.

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 circuit breakers of the detected ground fault (ZSI_OUT ⇒ ZSI_IN ⇒ ZSI_OUT and others).
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 to 500 ms)

Result: The ZSI module clears 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 to 4000 ms depending on the ETU
- t_g = 100 to 500 ms
- Plus the typical mechanical tripping time depending on the circuit breaker 20 to 40 ms

2.7.11.3 Examples

Function example

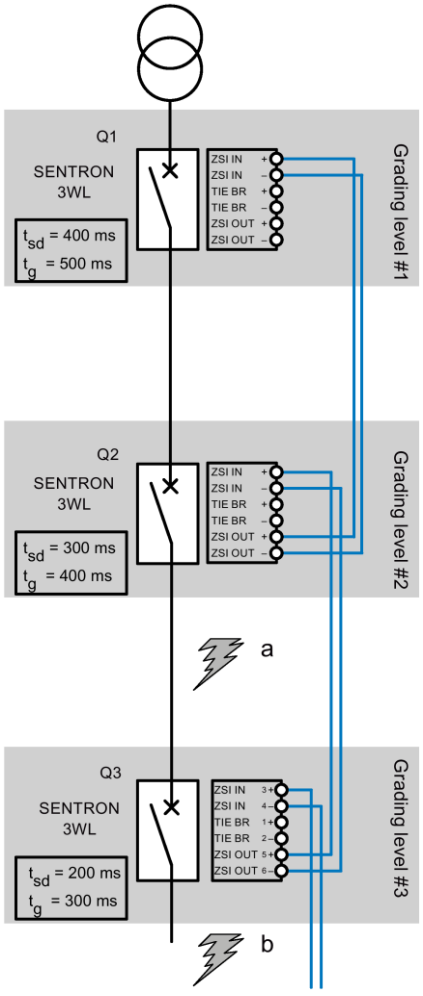


Figure 2-16 Function example

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

Tabular representation

Short-circuit

Tabular representation from the perspective of the circuit breaker Q2:

Table 2- 21 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

Ground fault

Table 2- 22 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

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.

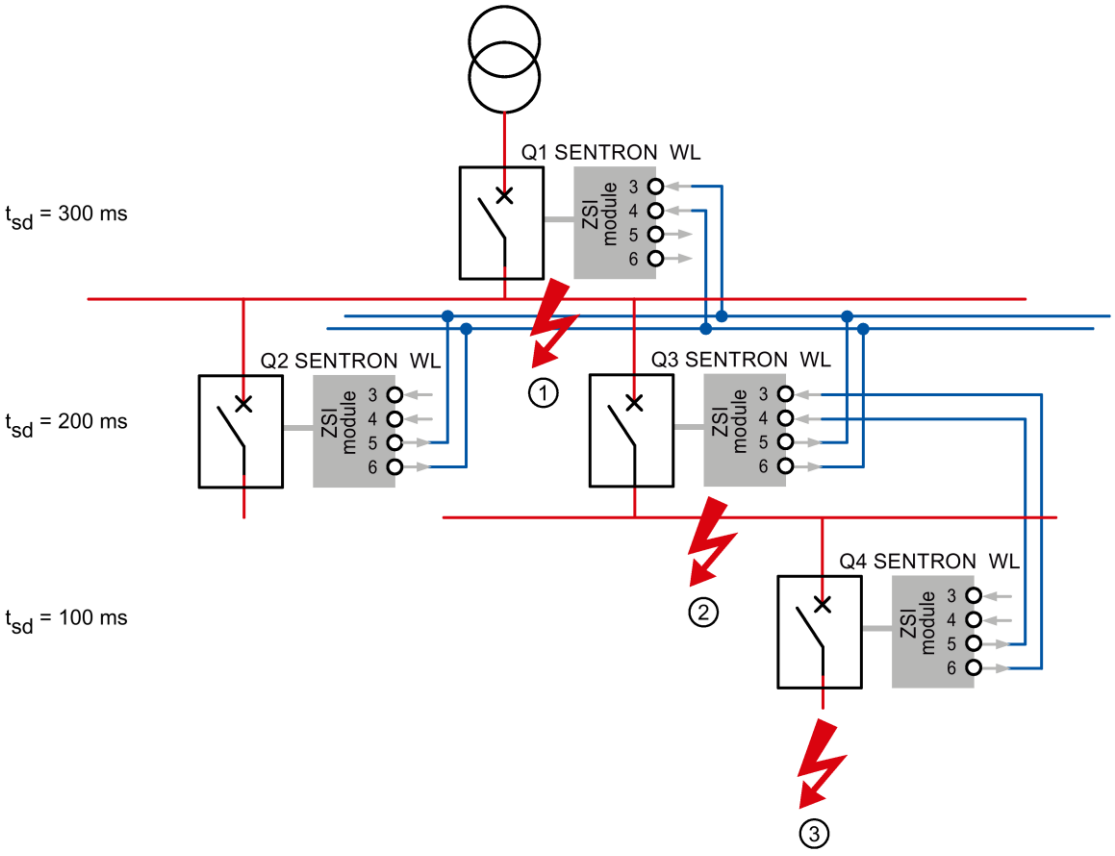


Figure 2-17 Function example power supply

Short-circuit in grading level 3

- The circuit breakers 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 circuit breaker, it is responsible for clearing the short-circuit as quickly as possible (with delay time t_{ZSI} = 50 ms). If this does not happen because, for example, the circuit breaker 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.

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

Coupling switch

Wiring example of 3 grading levels with tie-breaker

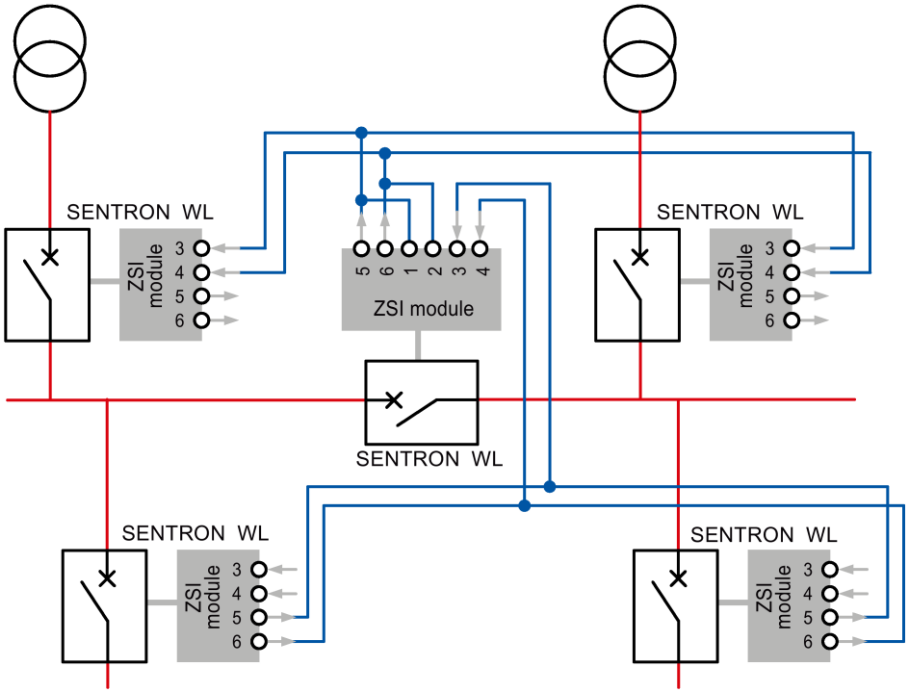
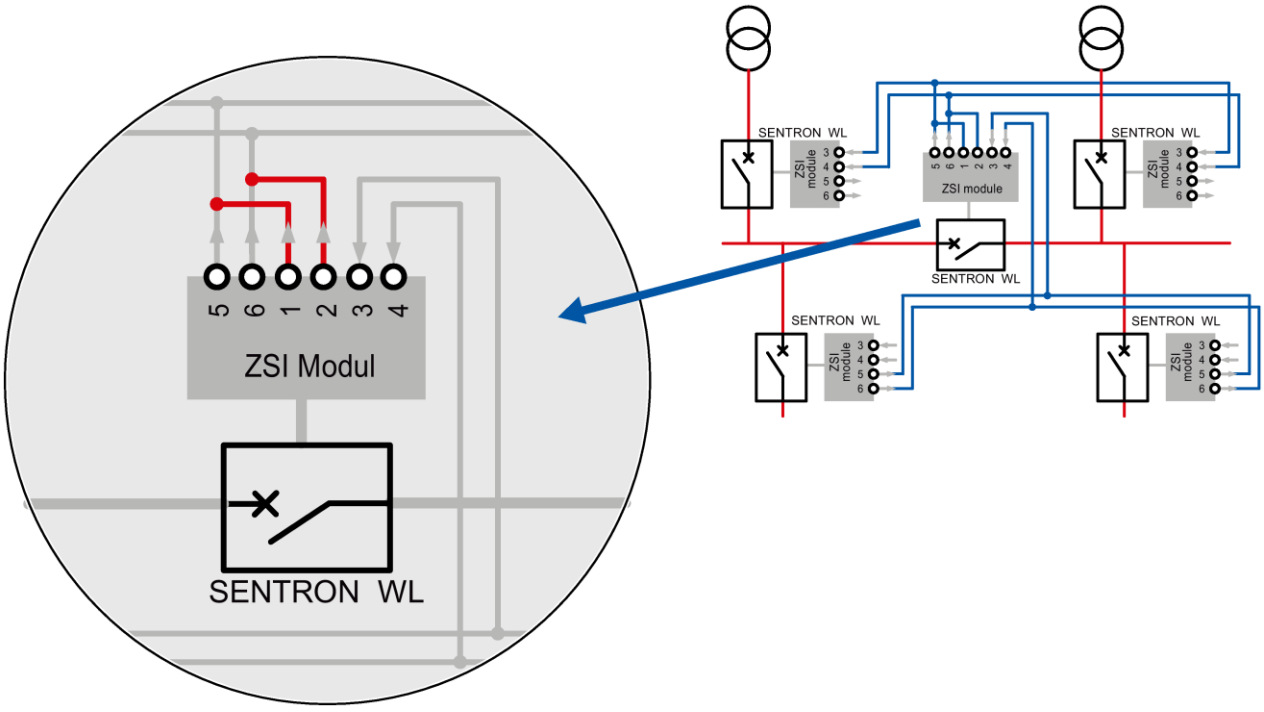


Figure 2-18 Wiring example of 3 grading levels with tie-breaker

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 tie-breaker is switched off. Without the TIE BRKR function, the ZSI signal would not be forwarded.

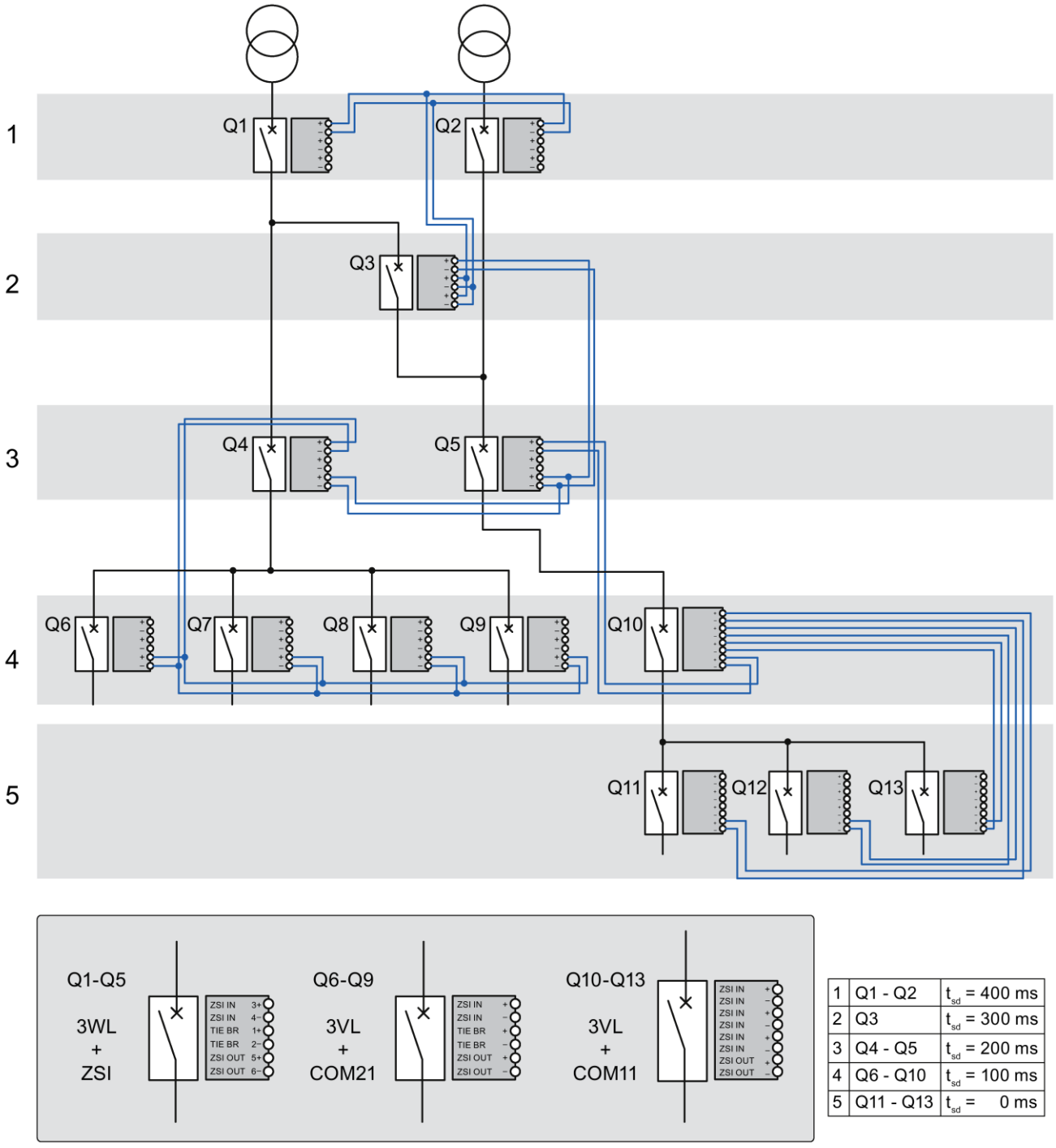
The tie-breaker is a separate grading level and receives its own delay time t_{sd}.



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 tie-breaker. Tie-breakers 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

Figure 2-19 Delay time grading level 2

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.

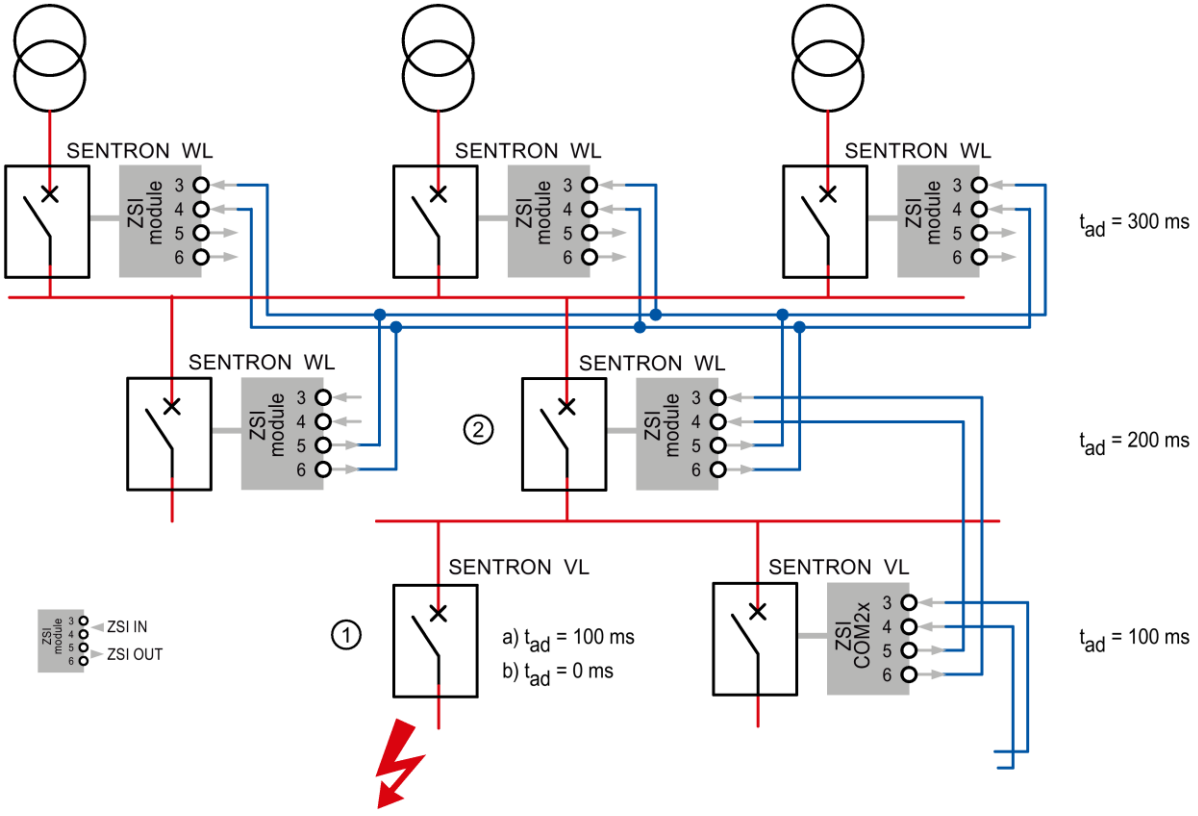


Figure 2-20 Integration of a circuit breaker without ZSI function

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.

2.7.11.4 SENTRON 3WL

Introduction

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

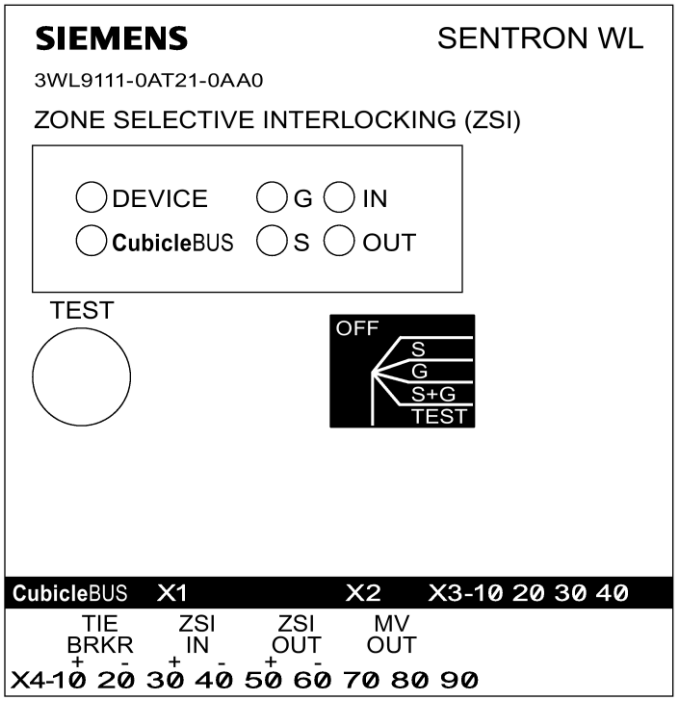


Figure 2-21 SENTRON WL circuit breaker

Technical data

Table 2- 23 Technical data

Description	Value
Operating voltage on the CubicleBUS	• Min. 9.2 V • Max. 28.8 V
Current consumption from the CubicleBUS	• Min. 31 mA • Max. 61 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
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 circuit breakers that can be connected to ZSI IN	20
Maximum number of circuit breakers 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 consumption	• Min. 0.8 W • Max. 1.76 W
Dimensions (W x H x D)	70 mm x 86 mm / 95 mm
Weight	0.223 kg
Temperature range	−40 … +60 °C

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 tie-breaker is used in a power distribution system, it can be integrated into the ZSI concept.

Configuration

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

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.

Test function

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

LED

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

2.8 External power supply

2.8.1 Power drawn 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 and no internal power supply to the ETUs is possible via the built-in energy transformers. For this reason, it is necessary here to connect an external power supply (24 V DC).

The power requirement is different depending on the number of components used.

General information

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

- Rogowski coils (instrument transformers): Supply the measured current values.
- Energy transformers: Supply the electronic trip units (ETUs) with power.

In the case of circuit 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 / ETU745 / ETU748 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 required for the backlighting. If the CubicleBUS is connected with 24 V DC, the display draws its power from this voltage.

The pixel-graphics display of the ETU76B / ETU776 requires more power than the energy transformer can supply. For this reason, the display only functions when an external CubicleBUS power supply is connected.

This does not affect the protection functions.

Note

Number of CubicleBUS components

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

CubicleBUS connection

The CubicleBUS comprises four cores:

- Two for communication
- Two for 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

2.8.2 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 starting current for selecting the suitable power supply for a SENTRON WL circuit breaker with CubicleBUS.

Table 2- 24 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. starting current per module from the CubicleBUS
Electronic trip units ETU45B / 745 / 748	1	120 mA	2000 mA
Electronic trip units ETU76B / 776 / 776G	1	170 mA	2000 mA
Metering function PLUS	1	120 mA	120 mA
Breaker Status Sensor (BSS)	1	40 mA	110 mA
COM35 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

Connection of several SENTRON WLs

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

Power supply - Power

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

Example

A circuit breaker consists of an ETU45B, BSS, COM35, metering function, and output module with relay contacts.

The maximum continuous current is 585 mA. The maximum starting current is 2635 mA.

You will find further technical data in Catalog KT 10.1 or online (https://mall.automation.siemens.com) in the Mall.

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

Table 2- 25 Power supply from the SITOP range for SENTRON WL with CubicleBUS

Max. continuous current	Type	Article number
5 A	SITOP PSU6200 24 V / 5 A	6EP3333-7SB00-0AX0
10 A	SITOP PSU6200 24 V /10 A	6EP3334-7SB00-3AX0

COM35

3

3.1 General

The COM35 is the communication module for the 3WL air circuit breaker. The COM35 is part of the circuit breaker internal CubicleBUS system and provides the following functions together with other CubicleBUS nodes:

- Reading out circuit breaker data
- Setting parameters
- Opening / closing circuit breakers
- Reading out maintenance information
- Outputting messages and warnings

The COM35 supports the PROFINET IO and Modbus TCP communication protocols. The two protocols can be used simultaneously and independently. It is not necessary to configure which protocol will be used. This makes it possible to use the circuit breaker in different systems (e.g. in energy management and automation).

Use of only one protocol is also possible.

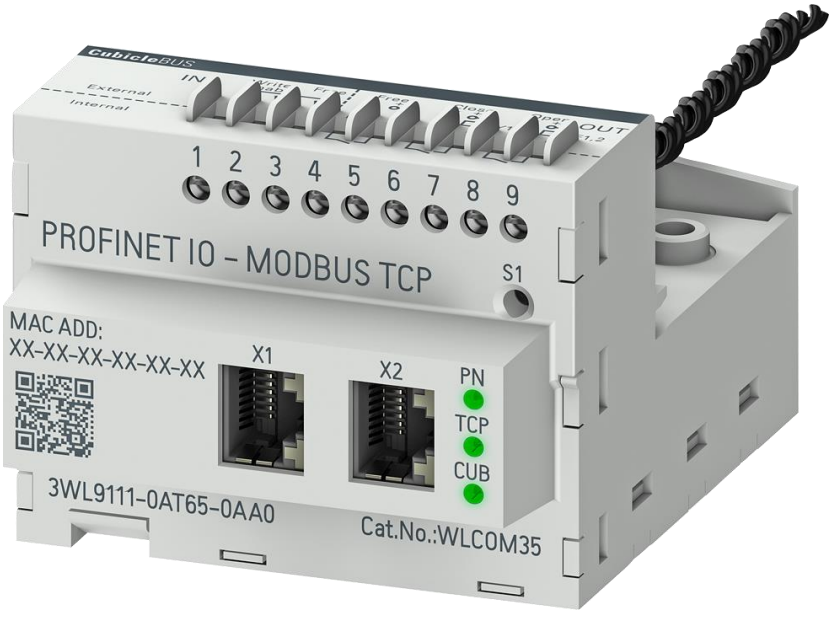


Figure 3-1 COM35

Displays

The COM35 has three LEDs to display the states of the COM module and the communication interfaces.

Table 3- 1 LED displays

LED	Display		Meaning
PROFINET IO (PN)	Green		• Normal PROFINET IO communication • Communication with PROFINET IO controller
	Flashing green		Active communication only with PROFINET IO supervisor
	Red		• No communication with PROFINET IO controller • No communication with PROFINET IO supervisor
Modbus TCP (TCP)	Green		At least one opened Modbus TCP connection
	Flashing green		• Ethernet link available • No Modbus TCP connection
	Off		No Ethernet link available
CubicleBUS (CUB)	Green		• CubicleBUS node active • Metering function / metering function PLUS or ETU active
	Flashing green		• CubicleBUS node active • No metering function / metering function PLUS and no ETU found
	Red		CubicleBUS communication with fault
	Off		No CubicleBUS nodes active

Special operating states of the COM35 are signaled by the interaction of all LEDs

Table 3- 2 LED displays for special operating states

Display			Meaning
PN		PN and TCP LED flash alternately green, CUB LED is off	Visual identification of the COM35 is active. The identification ends automatically after 10 s. You can terminate identification before this time by pressing the function button.
TCP			
CUB			
PN		PN and TCP LED flash alternately red, CUB LED flashes red	Serious device error. The COM35 is not operable.
TCP			
CUB			
PN		PN and TCP LED flash alternately green, CUB LED flashes green	Restricted operation. The COM35 is starting or shutting down.
TCP			
CUB			
PN		All LEDs light up orange	The device is restarting after a reset or after the auxiliary voltage has been switched on. The display is shown for 1 s.
TCP			
CUB			

3.2 Properties

Security

You can prevent control/write access to the circuit breaker via hardware and software if this is necessary for safety reasons. In this way, you can, for example, prevent operation via communication (remote operation) or modification of parameters.

You will find further information on this in Chapter Security information (Page 8).

Integral clock

An integral clock adds a time stamp to all events (such as minimum and maximum measured values, warnings, and tripping operations). This clock can be synchronized.

You will find further information on this in Chapter Time synchronization (Page 104).

Temperature sensor

- The COM35 has an integral temperature sensor that provides only the approximate 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 circuit breaker.
- The two temperature sensors are calibrated in the factory and do not require further calibration.
- The two temperature sensors can also be heated up by the surrounding electronic components. This means the sensed temperatures may differ from the actual ambient temperatures.

Circuit breaker position detection

The following circuit breaker positions in the guide frame are detected via three built-in microswitches on the underside of the COM35.

- Connected position
- Test position
- Disconnected position
- Not present

The circuit breaker position can be read out via communication.

It is only possible to access the entire circuit breaker in the connected position or the test position.

Switch function

The COM35 has two Ethernet ports (100BASE-T) with a switch function. These can be used to connect further PROFINET or Modbus nodes (daisy chain).

Function button

The function button can be used to reset the setting parameters of the COM35 to the factory settings.

Technical data

The COM35 is part of the circuit breaker. Unless stated otherwise, the technical data of the circuit breaker apply.

You will find further information on this in Chapter Technical data (Page 105).

Ambient temperatures

The 3WL circuit breakers are suitable for use in any climate in accordance with IEC 60068-2-30.

They are intended for use in enclosed rooms in which no severe operating conditions (such as dust, caustic vapors, hazardous gases) prevail.

When installed in dusty and damp areas, suitable enclosures must be provided.

Installation location

The COM35 is part of the circuit breaker and is installed in the auxiliary conductor terminals at position X7.

The auxiliary conductor terminals X7 cannot be used together with a COM35.

Standards and specifications

The COM35 is part of the circuit breaker. Unless stated otherwise, the technical data of the circuit breaker apply.

You will find further information on this in Chapter Technical data (Page 105).

3.3 Commissioning

Modbus TCP

First commissioning can be performed using the powerconfig software. This is only possible if COM35 has been activated with 24 V DC.

- The COM35 can be connected via an Ethernet interface to a PC/notebook and powerconfig and be found and parameterized via the search function of powerconfig.
- The COM35 can be connected with the TD400 via the front connector of the ETU to a PC / notebook with powerconfig, found using the search function of powerconfig and parameterized.

PROFINET

The COM35 supports the standard commissioning function of PROFINET (e.g. with a GSDML file).

3.4 Connection of the COM35 module

The COM35 is connected by plugging it into position X7 of the auxiliary conductor plug-in system. You will find further information in the circuit breaker operating instructions stated in Chapter Reference documents (Page 7).

Pin assignment

The figure below shows the inscription on the COM35, the external pin assignment for connecting the closing coil, the shunt release, write protection via communication, and the free input/output.

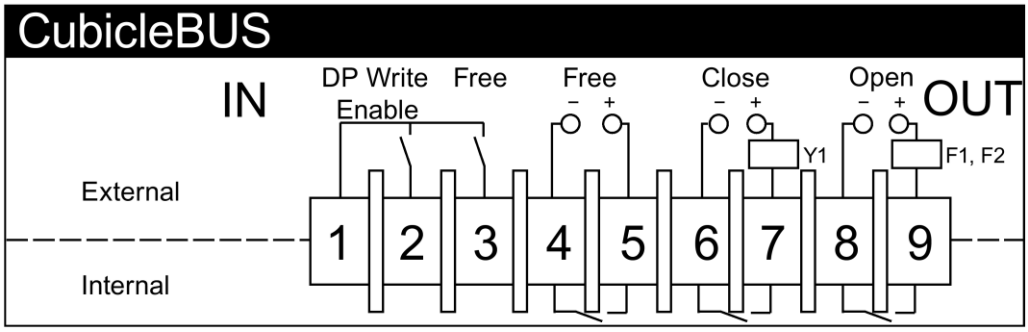


Figure 3-2 COM35 pin assignment

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 cables brought out of the rear of COM35 are connected to position X8 of the auxiliary conductor plug-in system.

Further components and connections

- If the closing and opening coils 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 COM35, 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 3-3 Wiring of COM35 at voltage 24 V DC (Page 86)). One application example would be, for example, to reset the tripped signal via communication by operating the F7 solenoid for retracting the red tripped plunger. The F7 solenoid is part of the Z option K10. This function is only possible with function K01 (automatic reset of the anti-pumping device).
  - As with Open and Close, only voltages up to 24 V DC can be used.

    Note

    Observe the polarity.

  - With other voltages, coupling links must be used.
- 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 an RJ45 plug must be used.
- The free user input can be connected via a contact element to the 24 V DC voltage from Pin 1 to transmit the status of the contact element. The input can be used to activate the DAS function. You will find further information on this in Chapter Dynamic Arc Flash Sentry (DAS) maintenance mode (Page 91).
- The free user output on the COM35 can be configured as follows with the powerconfig software.
  - The state of the tripped signaling switch S45 of the BSS module can be output at the user output (high level at the output = the circuit breaker has tripped).
  - The activated DAS function can be output.
  - The output can be switched on or off via the communication.

See also

Connection of the COM35 module (Page 84)

Closing/opening the circuit breaker via the communication system

The figure below shows how COM35 must be wired with the auxiliary current plug-in contacts to allow opening/closing via communication (PN, PB or Modbus) .

Note

This figure only applies for contacts with 24 V DC!

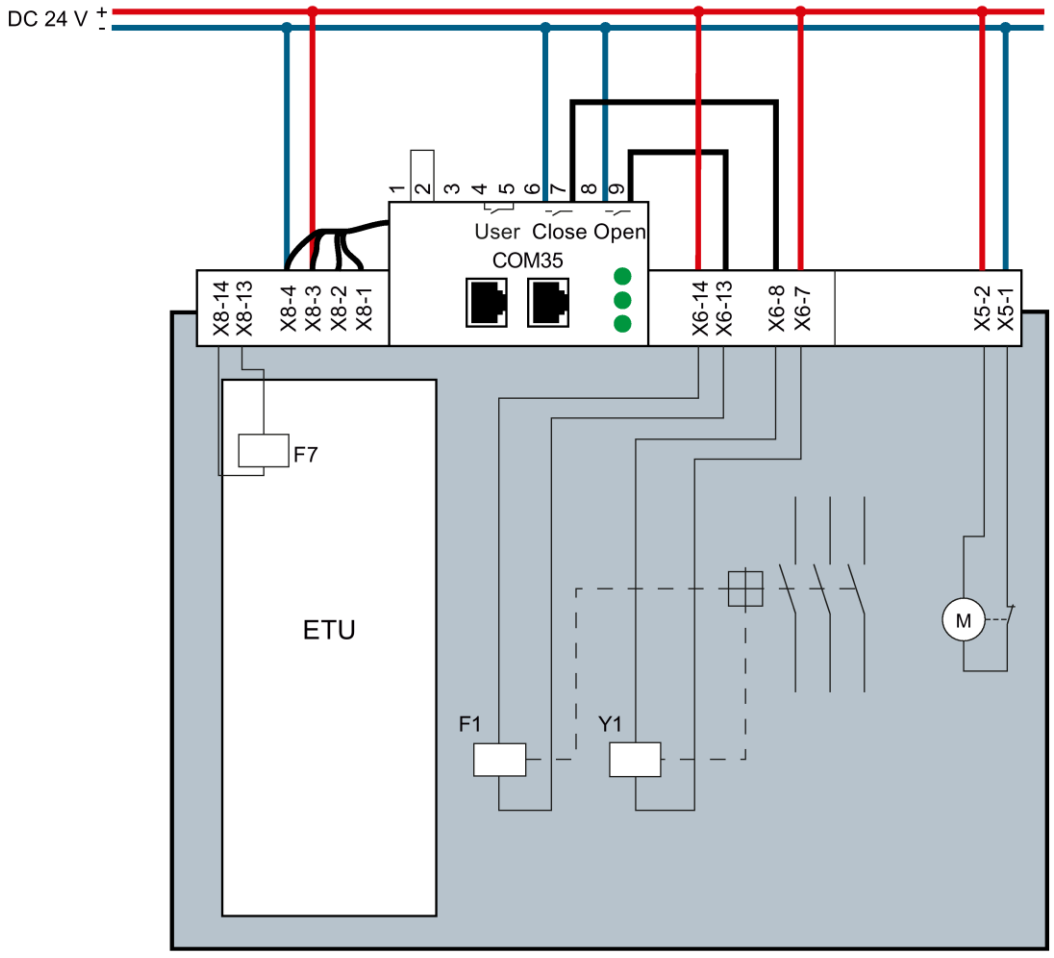


Figure 3-3 Wiring of COM35 at voltage 24 V DC

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.

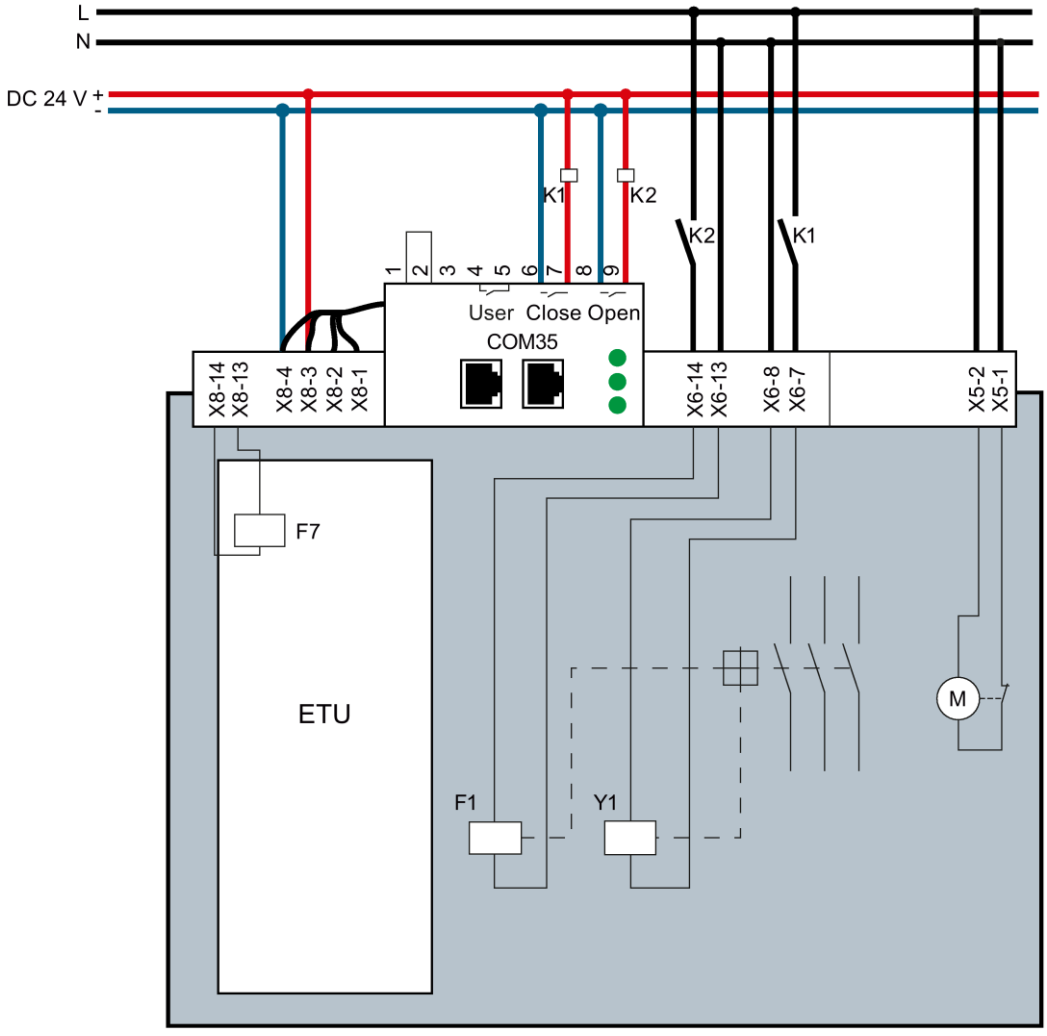


Figure 3-4 Wiring of COM35 at voltage not equal to 24 V DC

RJ45 connection

The figure below shows COM35 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.

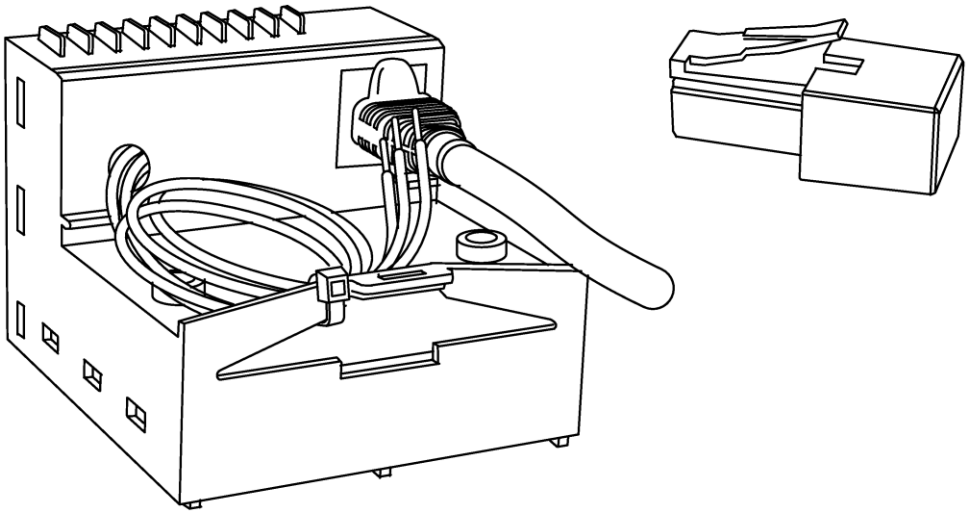


Figure 3-5 COM35 with RJ45 connection for CubicleBUS modules

Connection of the CubicleBUS nodes

The four black cables that are brought out of the COM35 must be connected to terminal strip X8. The COM35 is connected with the nodes on the CubicleBUS in the circuit breaker in this way.

Table 3- 3 Terminal strip connection X8 between COM35 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

3.5 Write protection (DPWriteEnable)

Disable write access

In applications in power distribution, it is necessary to disable write access via communication interfaces temporarily or permanently. There is a hardware input on the COM35 for this purpose. Pin 1 provides the 24 V DC supply that can be returned, for example, via a circuit breaker to Pin 2 (DPWriteEnable).

When the input is open (delivery condition of the COM35), write protection is active and modifications and actions are always locked.

Approved modifications/actions

The exceptions are the following modifications and actions that are also permitted in write-protected mode:

- Modifying/setting of trigger functions for the waveform buffer
- Reading out the contents of the waveform buffer
- Changing the parameters for threshold values
- Setting/changing the system time
- Modifying the free texts (comment, plant identifier)
- Resetting the min./max. values
- Resetting the settings to factory settings with function button S1

Locked modifications/actions

All other modifications/actions are locked, e.g.:

- Closing/opening the circuit breaker via communication
- Resetting the current tripping operation
- Modification of the protection parameters
- Modification of the parameters for the enhanced protection function/metering function
- Modification of the parameters for communication
- Changing the parameters for measured value setting/metering function
- Resetting maintenance information (counter)
- Switching over digital outputs
- Updating of the firmware of the COM35 via the powerconfig software
- Modification of the function of the free user input/output (e.g. trip alarm switch/DAS)
- Resetting the settings to factory settings with PROFINET

Write protection application

With write protection, it is possible to prevent closing/opening of the circuit breaker and modification of parameters. This protection can be temporary or permanent.

Example: Permanent protection

- Pin 1 and 2 of the COM35 open = write protection is activated.
- Pin 1 and 2 of the COM35 closed = write protection is deactivated.

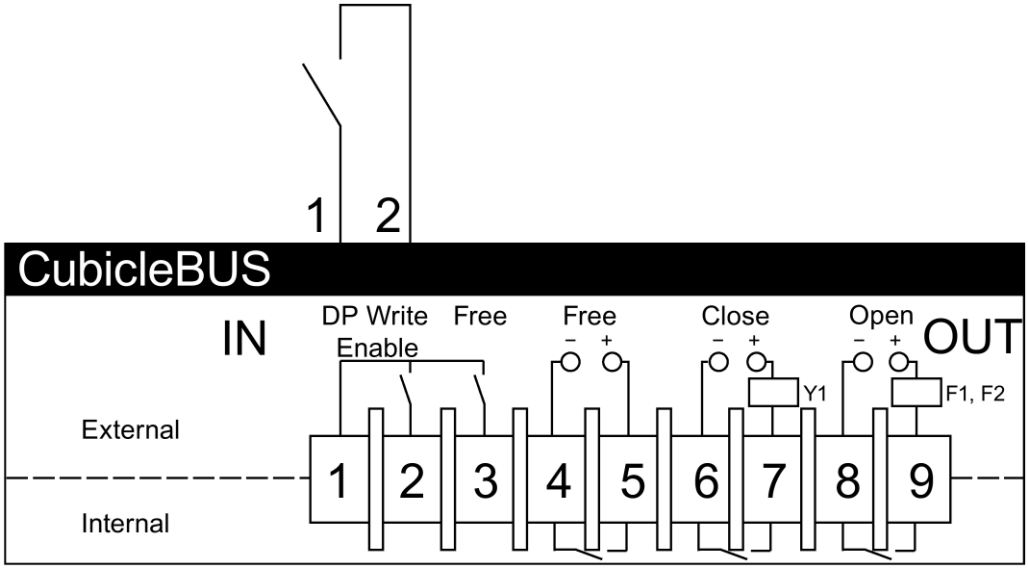


Figure 3-6 Write protection temporarily on/off

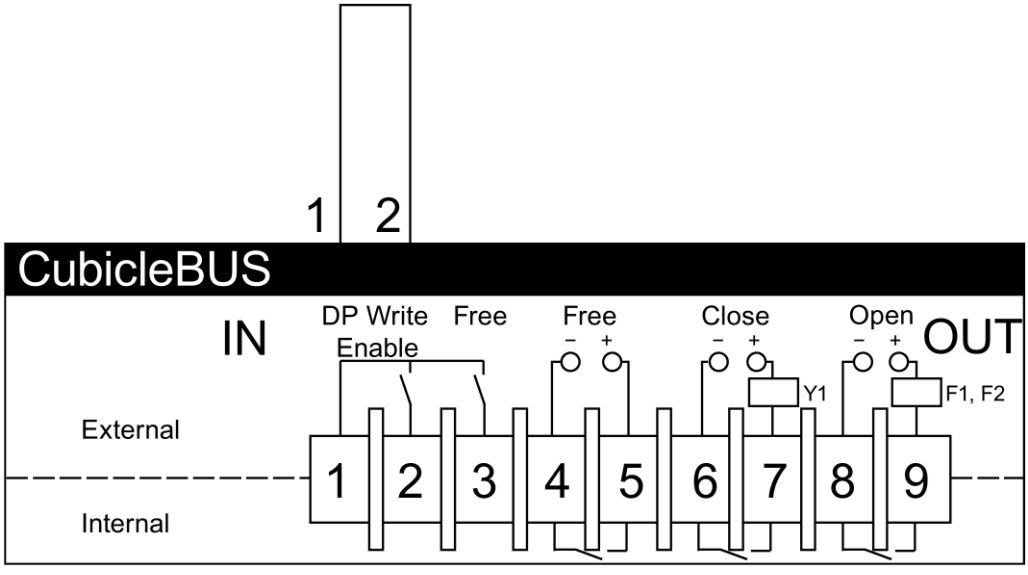


Figure 3-7 Write protection off

Example: Temporary protection

- Door switch

  To protect service personnel during maintenance work, it is possible to prevent the circuit breaker from being operated via communication while the switchgear door is open.

- Selector switch

  It is possible to put a selector switch in the switchgear door. In this way, you can choose whether remote operation/parameterization will be possible or whether you would like to prevent or permit it temporarily.

- Security

  The write protection is a very secure way of preventing impermissible operation and modification of parameters. You can temporarily enable (if you require it yourself) or disable remote operation/parameterization by a second independent path (e.g. by the PLC).

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.

All non-disabled actions are used only for remote diagnostics.

3.6 Dynamic Arc Flash Sentry (DAS) maintenance mode

DANGER

Danger to life or risk of serious injury due to dangerous voltage!

Turn off and lock out all power supplying this equipment before working on the device.

Reattach all covers before reconnecting this device to the power sources.

Installation and maintenance work must be performed by qualified personnel.

This section describes the DAS maintenance mode for a 3WL air circuit breaker with a COM35 communication module.

3.6.1 Required components

The following components are required for a 3WL air circuit breaker for the DAS function:

- Circuit breaker
  - 3WL1 with electronic trip unit ETU76B (IEC)
  - 3WL2 with electronic trip unit ETU776 (UL489)
  - 3WL3 with electronic trip unit ETU776 (UL1066)
- COM35 PROFINET IO - Modbus TCP communication module

3.6.2 Circuit diagram

Connections of the COM35 communication module for the DAS maintenance mode:

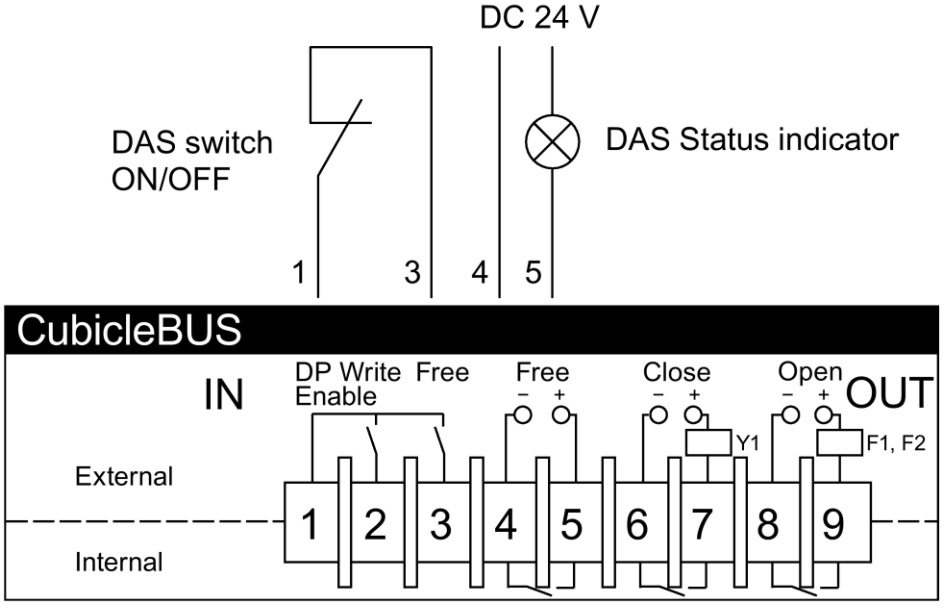


Figure 3-8 DAS circuit diagram

DAS maintenance mode is activated via terminals 1 and 3 on the COM35. A normally-closed contact is used for control. This means that DAS maintenance mode is active when the terminals are open.

Note

Unlike the digital CubicleBUS module, the COM35 uses a normally-closed contact to activate the 2nd parameter set (DAS).

3.6.3 powerconfig commissioning and service software

DAS maintenance mode is not set in the ETU of the 3WL circuit breaker by default. It must be parameterized with the powerconfig commissioning and service software (as of version 3.11).

Note

If DAS maintenance mode of the COM35 is used, it is no longer possible to switch over the 2nd parameter set by the digital CubicleBUS module. DAS maintenance mode of the COM35 takes precedence and will overwrite all other attempts to modify the 2nd parameter set.

3.6.4 Standards

DAS maintenance mode is an energy-reducing maintenance circuit with a local status display in accordance with the following standards:

- National Electrical Code (NEC) Section 240.87 Arc-Flash energy reduction (Energy-reducing maintenance switching with local status indicator)
- NFPA 70E Standard for Electrical Safety in the Workplace
- DIN EN 50110-1 Operation of electrical installations/B.6 Arc hazard

3.6.5 Application description

To protect service personnel better during maintenance work on the switchgear, the potential accidental arc energy must be reduced by modified protection settings on the ETU.

If service personnel enters the switchgear, DAS maintenance mode must be activated by the service personnel via a circuit breaker. The second parameter set (B) of the ETU is used for DAS maintenance mode. The active DAS maintenance mode is indicated by a blue DAS light.

On exiting the switchgear, the DAS maintenance mode must be deactivated by the service personnel.

Two suggested circuits are shown below.

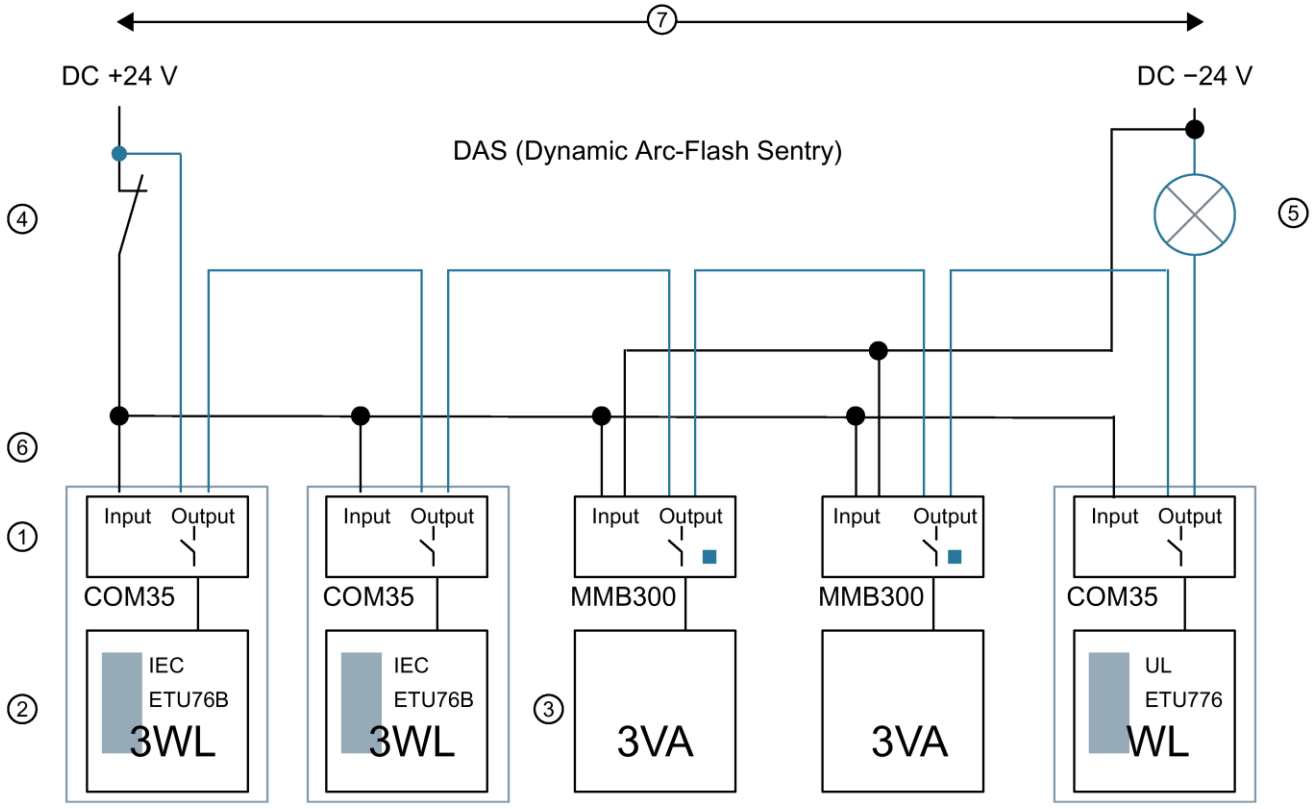


Figure 3-9 Example of application of DAS maintenance mode

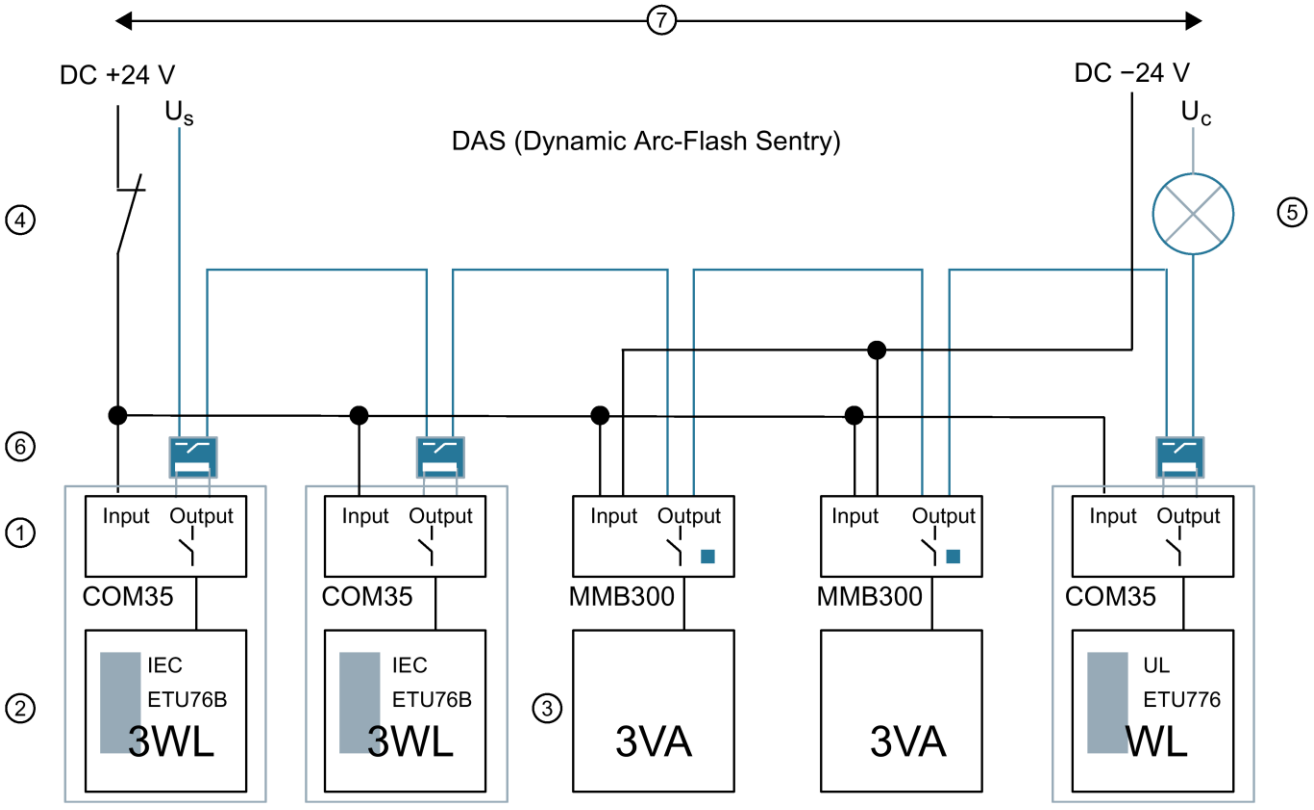


Figure 3-10 Example of application of DAS maintenance mode with coupling relays

① The COM35 communication module with the DAS maintenance mode.

Parameter set B of the ETU is activated with the input and output contacts of the COM35. The activated DAS maintenance mode has priority and overwrites all other commands for changing over the parameter sets. This applies until maintenance mode is deactivated.

The DAS function is not active when the circuit breaker with the COM35 communication module is delivered and must be parameterized via the powerconfig software.

② The set DAS protection parameters are activated by changing over to the second parameter set (parameter set B) of the ETU76B / ETU776 of the 3WL air circuit breaker. The parameters of parameter set B can be set with the powerconfig software or the ETU display.

③ In DAS maintenance mode, air circuit breakers and 3VA molded case circuit breakers can be used together with MMB300.

④ Open/close circuit breaker for activating DAS maintenance mode.

The circuit breaker must be a normally-closed contact (NO) and installed easily accessible at the entrance of the switchgear room.

⑤ The "DAS active" light should be mounted easily visible. The signal lamp only lights up when all circuit breakers are in DAS maintenance mode. The output of the COM35 can be loaded with max. 400 mA at 24 V DC. For higher switching powers, a coupling relay must also be used here.

⑥ If a different voltage than 24 V DC is to be used for signaling "DAS active", coupling relays must be used.

⑦ To avoid faults, the total cable length of the DAS system should not be longer than 50 m/165 ft.

3.6.6 Parameter set B

The ETU76B and ETU776 have two independent parameter sets A and B.

The ETU can be parameterized on the display or with the powerconfig commissioning and service software.

The parameter set A must contain the set values and delays required for protection of the power distribution system. The protection parameters must be determined by qualified personnel (e.g. with the SIMARIS design planning tool).

For parameter set B, the set values of parameter set A are adopted and adapted for DAS maintenance mode. The parameters must be chosen such that the possible accidental arc energy is reduced and there is no deliberate delay in short-circuit protection.

3.6.7 Parameter assignment via communication

For the DAS function, the free user input and the free user output must be parameterized via data point 478 in data set 161:

- Free user input: Parameter set switching
- Free user output: Parameter set message

⚠ WARNING

Risk of serious injury due to re-parameterization!

The plant operator must ensure that, when the DAS function is used, no re-parameterization of the function of the free user input and output is performed via communication. Such re-parameterization can be effectively prevented by setting the write protection.

3.7 Circuit breaker position detection

The COM35 module has three microswitches on the underside for determining the position of a withdrawable circuit breaker in the guide frame. Depending on which microswitch is operated, the position of the circuit breaker in the guide frame is communicated (1 = operated).

The table below states the definition of the position:

Table 3- 4 COM35 microswitch

Circuit breaker position	Circuit breaker at rear (S46)	Circuit breaker at center (S47)	Circuit breaker at front (S48)
Connected position	1	0	0
Test position	0	1	0
Disconnected position	0	0	1
Circuit breaker not available	0	0	0

When the circuit breaker is moved, the microswitch that has been operated is released before the next microswitch is operated. No microswitch is operated in the intervening period. As far as communication is concerned, this means that when the circuit breaker is moved, the "old" status is communicated until a new defined status is reached. If the circuit breaker is in an intermediate position for a longish time, the message "Breaker not available" is output.

In the case of fixed-mounted circuit breakers, a counter plate is screwed firmly to the COM35. This transfers the connected position.

3.8 Security functions

The COM35 provides security functions that, together with the Industrial Security functions, based on the international standard IEC 62443 / ISA99, permits a comprehensive security concept for their power distribution.

3.8.1 Protection of the network infrastructure

In addition to the use of the security functions of the COM35, the network infrastructure in which the 3WL is operated should also be protected, for example, by blocking certain ports in an external firewall. You will find further information on this in Chapter Security information (Page 8).

Table 3- 5 Port list

Port type	Port number (decimal)	Service	Explanation
TCP	502 (default, but freely configurable)	Modbus TCP	The Modbus TCP port should be blocked in the gateway to another network if no Modbus TCP connection to the 3WL from this network is required.
UDP	161	SNMP	This service is required for operation of the PROFINET IO interface.
	17008, 17009	Device detection and commissioning	These ports are used by powerconfig and powermanager for commissioning the COM35. These ports should be blocked in the gateway to another network (e.g. in a router firewall).
	34964	PROFINET RPC Endpointmapper	This service is required for operation of the PROFINET IO interface.
	49152 … 49155	PROFINET RPC Device Server	

3.8.2 Hardware write protection

The hardware write protection on the COM35 is a very secure and simple security function. The write protection can prevent write and switching operations via communication on the circuit breaker and is active by default in the factory settings.

You will find further information in Chapter Write protection (DPWriteEnable) (Page 89).

3.8.3 IP filter

Switching operations or parameter changes via Modbus TCP from another subnet can be prevented by the IP filter.

If the IP filter of the COM35 is active, the COM35 compares each time a connection is established via Modbus TCP whether the IP address of the remote station is in the same subnet as the COM35. If this is not the case, the remote station only gets restricted access rights. Accesses via PROFINET IO remain unrestricted.

The following actions, among others, are then prevented:

- Closing/opening the circuit breaker via communication
- Resetting the current tripping operation
- Modification of the protection parameters
- Modification of the parameters for the enhanced protection function/metering function
- Modification of the parameters for communication
- Changing the parameters for measured value setting/metering function
- Resetting of maintenance information (e.g. counters)
- Activating the digital outputs
- Updating of the firmware of the COM35 via the powerconfig software
- Modification of the function of the free user input/output (trip alarm/DAS)
- Resetting the settings to factory settings with PROFINET
- Changing the parameters for threshold values
- Setting/changing the system time
- Modifying the free texts (comment, plant identifier)
- Resetting the min./max. values

The IP filter can be activated/deactivated via Modbus TCP or PROFINET. In the factory settings/as-delivered state, the IP filter is deactivated.

3.8.4 Configurable Modbus TCP port

The TCP port for Modbus TCP connections can be configured. If a different port number from the default port number (502) is assigned, attacks on the COM35 are made difficult because the attacker must guess the port or find it with a port scan.

3.8.5 Signed firmware

Firmware upgrades of the COM35 are digitally signed by Siemens and therefore protected against manipulation. The COM35 can detect defective, manipulated upgrades or those destined for another device and refuse installation.

The digitally signed firmware upgrades make the COM module future-proof and it can install further security functions and security updates safely.

3.9 Resetting to factory settings

The COM35 can be reset to the factory settings in two ways:

- Via the function button S1 on the COM35
- Via PROFINET

Note

By resetting to the factory settings, all communication parameters and security settings are reset. The COM35 must then be re-parameterized in the same way as for first commissioning.

3.9.1 Function button

The factory setting reset is initiated by pressing and holding the function button for 5 s.

The device signals "restricted operation" (LEDs flash green). This state remains for approx. 12 s.

If all LEDs light up orange for 1 s ("LED test"), the device restarts. The device restarts the application and signals "restricted operation" (LEDs flash green). Depending on the expansion level of the circuit breaker, this can take 10 s.

The device then switches to normal operation.

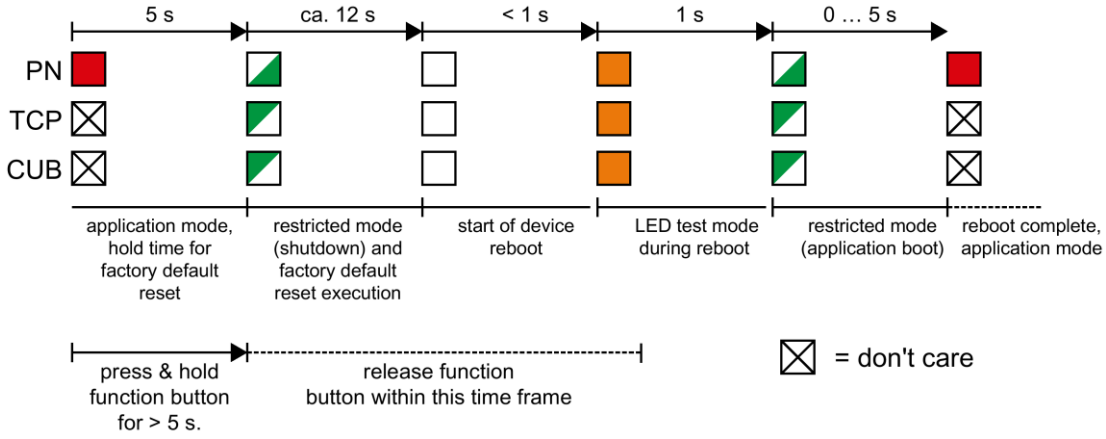
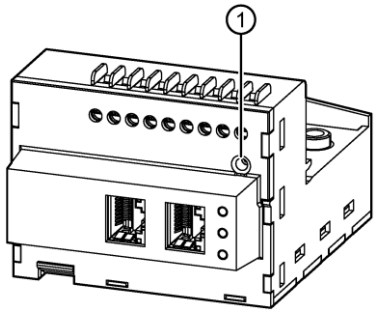


Figure 3-11 COM35 factory setting reset

Note

If the COM35 restarts (all LEDs light up orange for 1 s), you release the function button to prevent another reset to the factory settings.



① Function button S1

Figure 3-12 Function button on the COM35

3.9.2 PROFINET

The standard functions of PROFINET for resetting to the factory settings are supported by COM35.

3.10 Firmware update

With the powerconfig software, firmware updates can be installed on the COM35. The firmware is digitally signed and therefore protected from manipulation or damage.

During the upgrade process, the COM35 restarts once. If existing network connections are lost, they have to be reestablished after the COM35 has restarted. The parameters of the COM35, minimum and maximum values and the event and trip log are retained throughout the restart. The system time should be reset after the restart. You will find more information in Chapter Time synchronization (Page 104).

If the upgrade process of the COM35 is interrupted, it continues to run without restriction with the previous firmware version. powerconfig informs the user whether the firmware update has been successful or failed. You will find further information on this in Chapter powerconfig (Page 103).

3.10.1 powerconfig

The firmware of the COM35 can be updated via the powerconfig software. The update can be accessed with the following menu items:

powerconfig menu: Device → Update → Update COM35 Firmware

You will find further information on the Internet (https://support.industry.siemens.com/cs/ww/en/view/63452759).

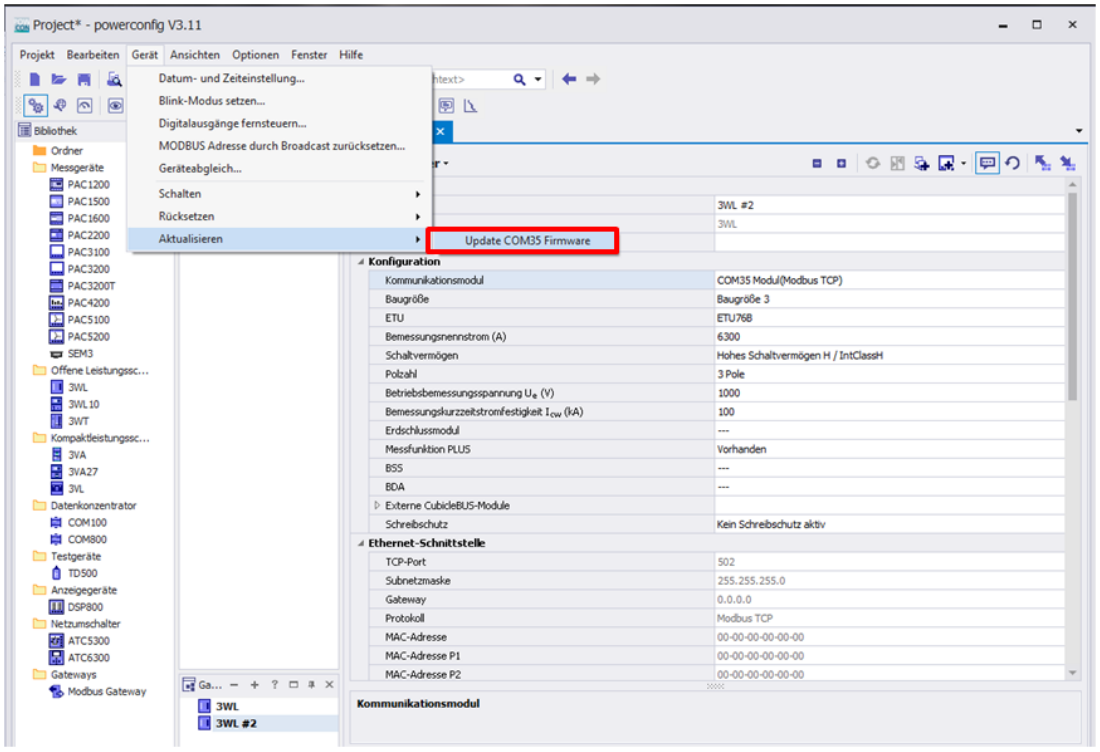


Figure 3-13 Updating the powerconfig firmware

3.10.2 Firmware files

Up-to-date firmware files can be obtained through Siemens Industry Online Support.

In the Siemens Industry Online Support, you can set "filters" for various individual focuses (e.g. topics, configurations, products) or mark specific entries as "favorites". To avoid yourself having to check whether there is news or changes to these focuses, you can get notified by the Online Support, e.g. by email (https://support.industry.siemens.com/cs/start?lc=en-US).

3.11 Time synchronization

The system time of the circuit breaker is generated by the COM35 and can be set on the COM35.

Note

After a restart of the COM35, the system time has to be reset.

3.11.1 Parameters

The time can be set directly in the system time parameters in data set 68. You will find further information on this in Chapter Data set DS 68: Data of the CubicleBUS module (Page 166).

3.11.2 Synchronization

The time can be synchronized in data point 18 in data sets 51 and 93. Writing value 1 into bit 5 sets the system time forward/back to the nearest half hour.

3.11.3 powerconfig

The system time of the 3WL can be set with the powerconfig software. The system time can be accessed with the following menu items:

powerconfig menu: Device → Date and Time Settings

3.12 COM35 in the ETU display

The COM35 can be operated with all communication-capable 3WL circuit breakers. However, because it is not possible to update the firmware of the old ETUs, the COM35 is not recognized on the display of the ETU76B and ETU776 and is only displayed as COM. The fact that it is not recognized on the display does not restrict communication in any way.

3.13 Event and trip log

The COM35 records the last 20 system events and the last 20 tripping operations of the circuit breaker in an event and trip log.

Both logs are FIFO memories: If a log already contains 20 entries, a new entry will overwrite the oldest entry in the log in question.

Event and trip log are permanent: They are retained even during an interruption of the auxiliary voltage of the COM35.

- The trip log can be read out via data set 53, data point 15.

  You will find further information on this in Chapter Data set DS 53: Trip log (Page 164).

  Note

  For reasons of compatibility, the trip log is also offered in data set 51. Only the last 5 tripping operations can be retrieved from there.

- The event log can be read out via data set 54, data point 16.

  You will find further information on this in Chapter Data set DS 54: Event log (Page 165).

  Note

  For reasons of compatibility, the event log is also offered in data sets 51 and 92. Only the last 10 events can be retrieved from there.

3.14 Technical data

Device configuration

- 2 digital inputs
- 3 digital outputs
- 2 Ethernet interfaces for connecting to the PC or network

Energy consumption/maximum load capacity

Table 3- 6 Energy consumption/maximum load capacity

IEC 61558 SELV/PELV - UL 1310 Class 2 power supply only		
Power supply	24 V DC	125 mA max.
Write Enable		10 mA max.
Free IN		10 mA max.
Free OUT		400 mA max.
Close		400 mA max.
Open		400 mA max.

Supply voltage

Table 3- 7 Supply voltage

Parameters	Value
Design of the power supply	• Power supply unit DC • IEC 61558 SELV/PELV • UL 1310 Class 2
Operating range	24 V DC ±20%
Power consumption	2.6 VA
Overvoltage category	CAT I
Short-circuit protection	Yes
Protected against polarity reversal	Yes

Digital input

Table 3- 8 Digital input

Parameters		Value
Number		2
Type		Active
Maximum switching voltage		24 V DC internal
Input current	Signal "1" detection	1 … 10 mA
	Signal "0" detection	≤ 0.2 mA
Protected against polarity reversal		Yes

Digital output

NOTICE
Material damage due to voltage > 24 V DC
For voltages > 24 V DC, the closing/opening coils or reset coils are damaged.
For voltages > 24 V DC, always use coupling relays.

The digital outputs are suitable for the closing/opening coils of the 3WL.

Table 3- 9 Digital output "Close" and "Open"

Parameters		Value
Number		2
Type		Passive
Maximum switching voltage		24 V DC ±20%
Output current	For signal "1"	Depends on the load and the external power supply
	Continuous load	400 mA (70 °C)
	Short overload due to the closing/opening coils	800 mA (70 °C)
	For signal "0"	≤ 0.2 mA
Overvoltage category		CAT I
Short-circuit protection		No

Table 3- 10 Digital output "Free"

Parameters		Value
Number		1
Type		Passive
Maximum switching voltage		24 V DC ±20%
Output current	For signal "1"	Depends on the load and the external power supply
	Continuous load	400 mA (70 °C)
	Transient overload	800 mA (70 °C, for pulse control 500 ms)
	For signal "0"	≤ 0.2 mA
Overvoltage category		CAT I
Short-circuit protection		No

Communication

Table 3- 11 Ethernet interface

Parameters	Value
Ethernet	Modbus TCP, PROFINET IO
Ethernet connection	RJ45, Ethernet switch functionality
Data rate	100 Mbps

Connection elements

Table 3- 12 I/O interface connections

Parameters		Value
Conductor cross-section	Rigid	1.5 mm²
	Flexible with end sleeve, without plastic sleeve	1.0 mm²
	Flexible with end sleeve and plastic sleeve	1.0 mm²
American Wire Gauge		18 … 16 AWG
Tightening torque		0.5 Nm

Dimensions and weights

Table 3- 13 Dimensions and weights

Parameters		Value
Enclosure dimensions W x H x D		72 mm 60 mm 92 mm
Weight	Device without packaging	160 g
	Device including packaging	165 g

Degree of protection and safety class

Table 3- 14 Degree of protection and safety class

Parameters	Value
Protection class	Safety class II
Degree of protection according to IEC 60529	IP20

Ambient conditions

Table 3- 15 Ambient conditions

Parameters		Value
Temperature range	Ambient temperature during operating phase	−40 °C … +70 °C
	Ambient temperature during transport and storage	−40 °C … +70 °C
Pollution degree		3

Approvals

Table 3- 16 Approvals

Parameters	Value
CE conformity to	• EN 60947-1 • EN 60947-2 • EN 50581
Suitable for circuit breakers with UL approval	UL489/UL1066

3.15 PROFINET IO

3.15.1 Performance features of the COM35 PROFINET module

With the COM35 communication module, you can access the data of the 3WL circuit breakers via the PROFINET IO during operation. The PROFINET IO can be run concurrently with the Modbus TCP protocol without any problem.

3.15.1.1 Overview

The COM35 communication module has the following performance features:

- Direct connection between the further Ethernet nodes by two integrated Switched Ethernet ports into the IRT domain of PROFINET
- The COM35 satisfies the highest conformance class (Conformance Class C) and the highest net load class (Net Load Class III)
- Support for ring redundancy (MRP) by the integrated Switched Ethernet ports
- The SENTRON devices communicate directly with SIMATIC S7 and SIMOTION via PROFINET IO.
  This means:
  The COM35 communication module as the PROFINET IO device provides measured variables and states of the 3WL circuit breakers for the PROFINET IO controller. The module receives information (e.g. commands) from the PROFINET IO controller and forwards this information to the 3WL circuit breaker.
- Thanks to support for PROFINET IRT, the 3WL circuit breakers can be used without restriction directly in factory automation networks (e.g. alongside SIMATIC S7, SINUMERIK, SINAMICS and SIMOTION).
- Simple engineering with SIMATIC STEP 7 V5 or other programming systems thanks to the use of the GDSML file
- Direct integration in TIA Portal ≥ V15.1
- Optimal use of the process image of a controller thanks to the selection of individual measured variables

- You can use all the functions of the 3WL circuit breakers via the COM35 communication module. This permits the use of the powermanager and powerconfig software either independently of or parallel with PROFINET IO.
- The data rates 100 Mbps are supported via the two RJ45 sockets.
- Time synchronization of the COM35 via SNTP
- IP settings: IP address, subnet, gateway
  - With the powerconfig parameterization software
  - Via PROFINET DCP protocol (e.g. in the STEP 7 HW Config)
- Generation of diagnostics, maintenance, and hardware interrupts
- Status display via LED

3.15.1.2 Technical data of the communication interfaces

Table 3- 17 Technical data

Description		Values
Industrial Ethernet	IRT capable switch	• Auto crossover • Auto negotiation
Connection		2 shielded 8-pole RJ45 sockets[1)]
Data transmission PROFINET IO: Supported baud rate in Mbps		100
NameOfStation[2)]		Maximum of 240 characters
Supported communication protocols		PROFINET infrastructure protocols • DCP • LLDP • SNMP • DFP • MRP, MRPD • …
Measured variables to be transferred		Cyclically definable via GSDML file or acyclically via data sets

1) The connector must meet the requirements of the PROFINET guideline of the PNO. You will find further information on the Internet (https://profibus.com).

2) Each device on the bus must have a unique NameOfStation and a corresponding IP configuration.

3.15.2 Parameterization/addressing

3.15.2.1 Measured variables

The measured variables and status information of the SENTRON 3WL circuit breaker are available to the higher-level power management system or automation system via PROFINET.

PROFINET

PROFINET provides:

- Cyclic data traffic
- Acyclic data traffic
- Acyclic alarm messages

Information on the measured variables

The measured variables include, for example:

- Measured values
- Extreme values of the measured values
- Energy values

The status information includes, for example:

- Switching state of the circuit breaker
- State of the circuit breaker
- State of the external inputs/outputs

You will find more information on the measured variables in Chapter Data library (Page 141).

The measured variables and status information are provided both in cyclic data traffic and acyclic data traffic.

In cyclic data traffic, the measured variables and status information are provided:

- As the basic types, a predefined structure according to the PROFINET profile low-voltage switchgear (LVSG) is available.
- As individual measured variables

In acyclic data traffic, the measured variables and status information are provided as data sets.

Configuring via the GSDML file

In the GSDML file, all functionalities of the COM35 both for engineering and for data exchange with the important IO Device are described.

There are basic types with predefined measured variables for time-saving commissioning and efficient data transfer that are defined according to the PROFINET profile low-voltage switchgear (LVSG).

The user can also define individual measured variables to be transferred.

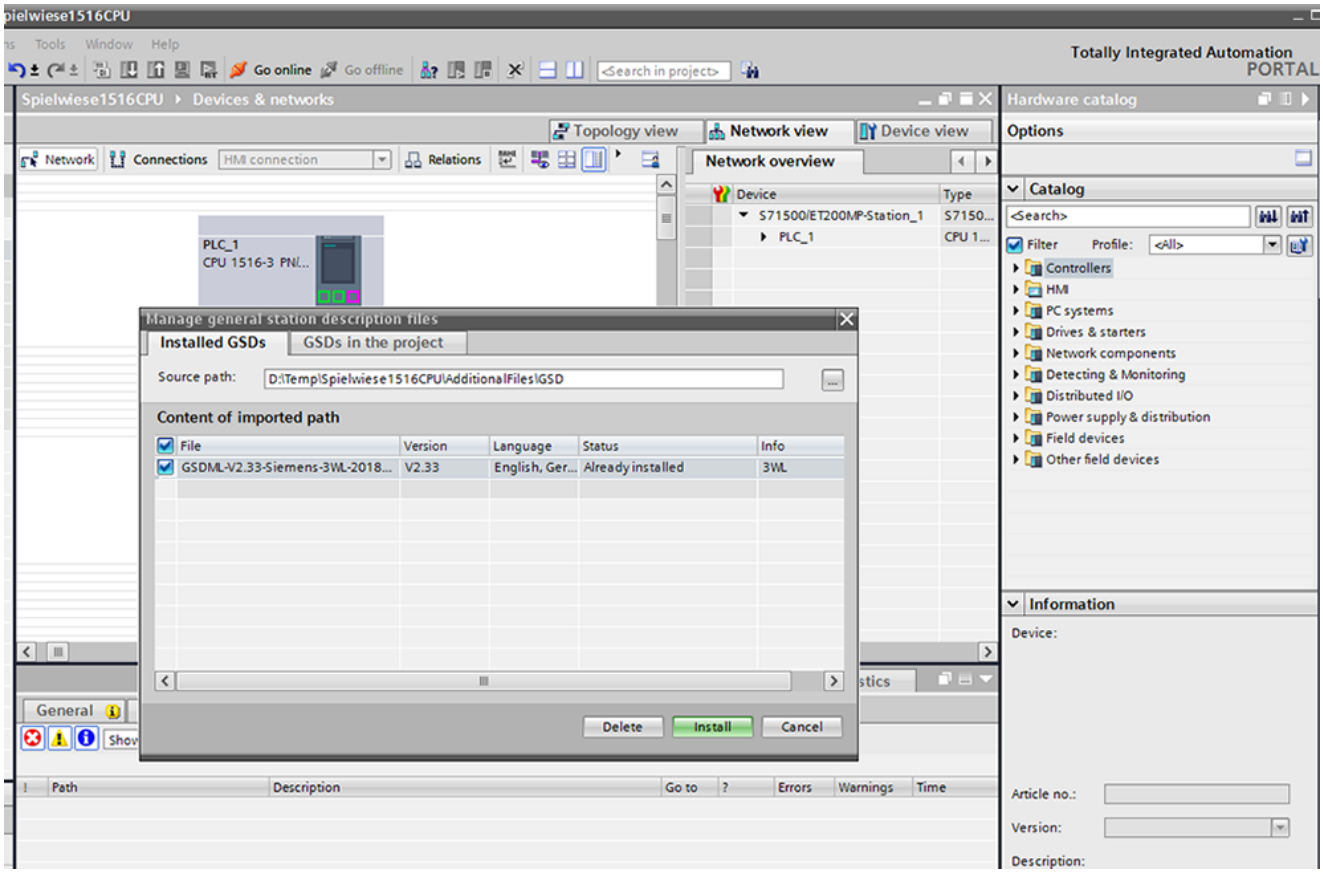


Figure 3-14 Initializing GSMDL file

After GSDML integration, the 3WL circuit breaker can be found as follows:

Hardware Catalog → Catalog → Other Field Devices → PROFINET IO → Switching Devices → Siemens AG → Circuit Breaker → SENTRON

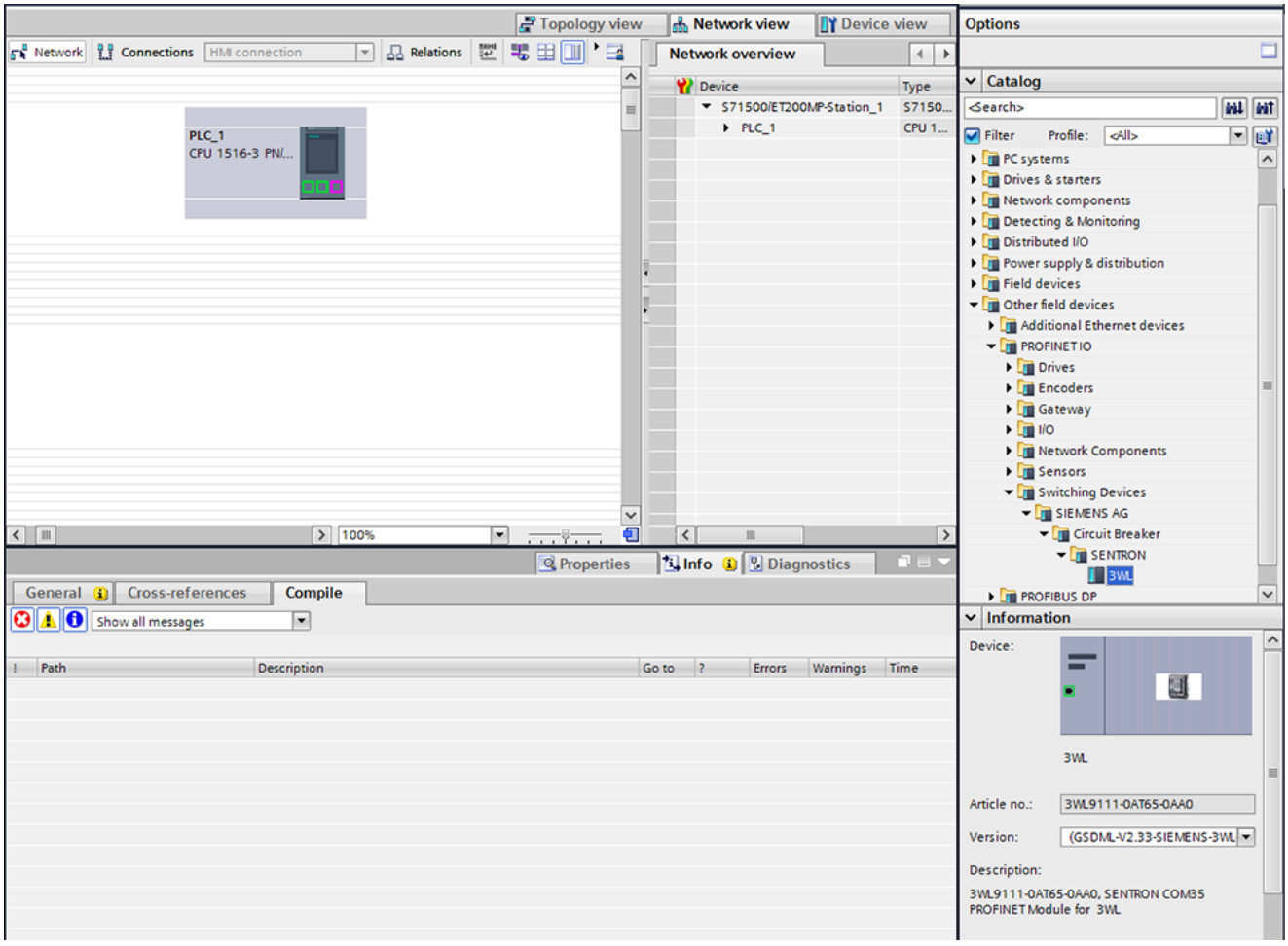


Figure 3-15 Catalog overview

3.15.2.2 Cyclic data traffic

In cyclic data traffic, each cycle transfers an optional number of user data. Cyclic data exchange is especially suitable for transferring information that is required continuously and quickly. The COM35 communication module fits into the time control of PROFINET Real-Time (RT).

- The PROFINET IO controller specifies the parameterizable update time.
- The maximum quantity structure of the cyclic data is 244 bytes of input data and 2 bytes of output data.
- The COM35 communication module supports update times of 0.5 to 512 ms.

Table 3- 18 List of all modules that can be plugged in for the project

Module name	Name	Length (bytes)	In / Out
Status and control (Fixed In Slot1)	StatusSteuerung	2	In, Out
Basic type 1	Basic_type_1	12	In
Basic type 2	Basic_type_2	24	In
Basic type 3	Basic_type_3	42	In
Temperature outside circuit breaker	MeterTempComBox	1	In
Number of switching operations under load	DiagCountGearLoad	2	In
Number of protective trips	DiagCountGearTrip	2	In
Number of mechanical switching operations	DiagCountGearControl	2	In
Process operating hours counter	DiagHourMetering	4	In
Status digital inputs module 1	StatusInputModul1	1	In
Status digital inputs module 2	StatusInputModul2	1	In
Mean power factor value	MeterPowerFactorAVG	2	In
Power factor L1	MeterPowerFactorL1	2	In
Power factor L2	MeterPowerFactorL2	2	In
Power factor L3	MeterPowerFactorL3	2	In
Phase unbalance current	MeterCurrentUnbal	1	In
Phase unbalance voltage	MeterVoltageUnbal	1	In
Current L1	MeterMMCurrentL1	2	In
Current L2	MeterMMCurrentL2	2	In
Current L3	MeterMMCurrentL3	2	In
Current mean value of all phases	MeterMMCurrentAVGAll	2	In
Voltage L1-L2	MeterUL1L2	2	In
Voltage L2-L3	MeterUL2L3	2	In
Voltage L3-L1	MeterUL3L1	2	In
Voltage L1-N	MeterUL1N	2	In
Voltage L2-N	MeterUL2N	2	In
Voltage L3-N	MeterUL3N	2	In
Instantaneous mean value L-L	MeterVoltageLLAVG	2	In
Instantaneous mean value L-N	MeterVoltageLNAVG	2	In
Total apparent power	MeterKVATotal	2	In

Module name	Name	Length (bytes)	In / Out
Apparent power L1	MeterKVAL1	2	In
Apparent power L2	MeterKVAL2	2	In
Apparent power L3	MeterKVAL3	2	In
Active power total	MeterKWTotal	2	In
Active power L1	MeterKWL1	2	In
Active power L2	MeterKWL2	2	In
Active power L3	MeterKWL3	2	In
Total reactive power	MeterKvarTotal	2	In
Reactive power L1	MeterKvarL1	2	In
Reactive power L2	MeterKvarL2	2	In
Reactive power L3	MeterKvarL3	2	In
Active energy import (MWh)	MeterKWHours	4	In
Active energy export (MWh)	MeterKWHoursReverse	4	In
Reactive energy import (MVArh)	MeterKvarHours	4	In
Reactive energy export (MVArh)	MeterKWHoursReverse	4	In
Frequency	MeterMMFrequency	2	In
Temperature in circuit breaker	MeterTempMSAE	1	In
Current parameter set	ControlSwitchParaSet	1	In
Maximum current of phase with maximum load	MeterCurrentMaxAll	2	In
Current in neutral conductor	MeterCurrentNeutral	2	In
Current ground fault	MeterCurrentGround	2	In
Time to trip	DiagTimeToTrip	2	In
Warnings in the ETU	DiagWarningTripUnit	2	In
Active energy import (kWh)	MeterActivePowerKWh	4	In
Active energy export (kWh)	MeterActivePowerReverseKWh	4	In
Reactive energy import (kVArh)	MeterReactivePowerKvarh	4	In
Reactive energy export (kVArh)	MeterReactivePowerReverseKvarh	4	In

Selection of the modules

The 3WL circuit breaker has a modular design and can be configured individually in the project.

The "status and control" module is permanently connected to the 3WL circuit breaker in slot 1, subslot 1 and is inserted automatically.

The "status and control" module contains two input bytes for the binary status information and two output bytes for control of the circuit breaker.

Both the control and the control bytes are implemented according to the LVSG profile of the PNO.

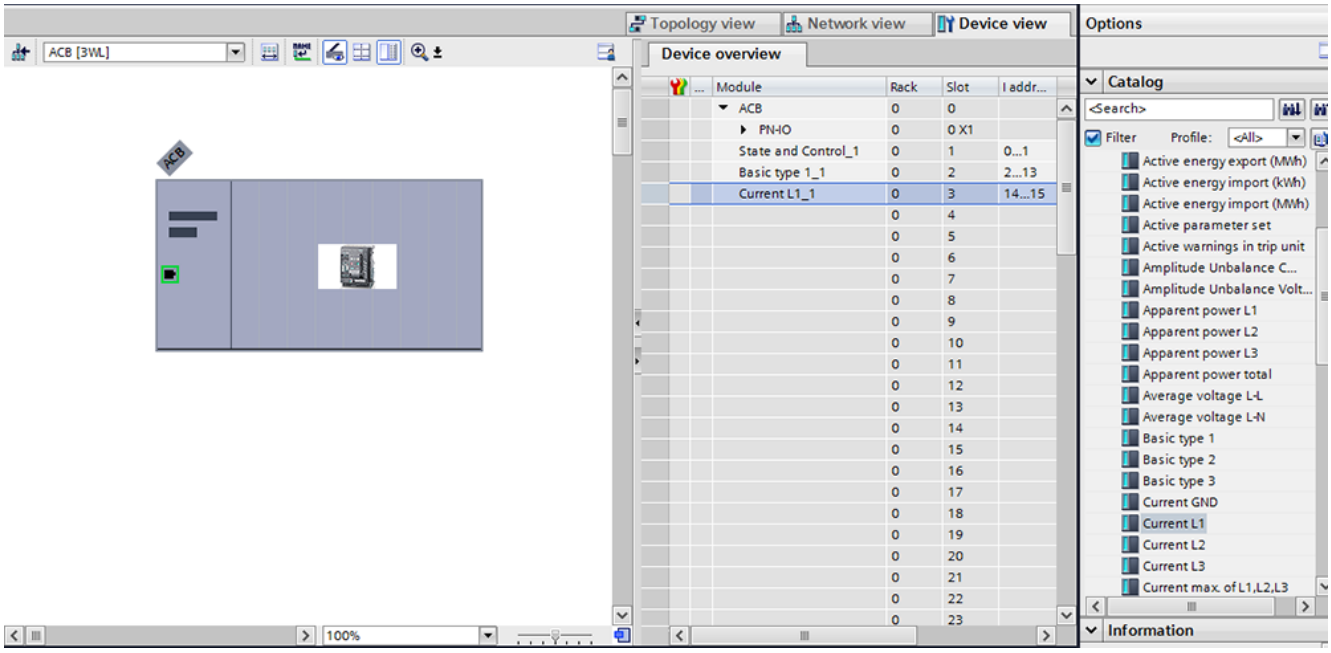


Figure 3-16 Selection of the modules

Binary status information

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

Table 3- 19 Binary status information in the cyclic frame

Byte	Bit	Value	SENTRON WL
n	0 / 1	0 … 3	Position of circuit breaker
		0	Disconnected position
		1	Connected position
		2	Test position
		3	Circuit breaker not available
	2/3	0 … 3	Status of the circuit breaker
		0	Not ready
		1	Off
		2	In
		3	Circuit breaker has tripped
	4	–	Ready-to-close signal available
	5	–	Undervoltage release charged
	6	–	Spring energy store is charged
	7	–	Overload warning is pending
n + 1	0	–	An activated threshold has been exceeded
	1	–	A warning message is pending
	2	–	PROFIBUS write protection disable deactivated, changes allowed
	3	–	Status of the free user input
	4 / 5 / 6	0 … 7	Reason for last trip
		0	No tripping operation or last tripping operation acknowledged
		1	Overload protection, long delayed (L tripping)
		2	Instantaneous short-circuit protection (I tripping)
		3	Short-time delay short-circuit protection (S tripping)
		4	Ground-fault tripping (G tripping)
		5	Tripping operation as a result of enhanced protection function
		6	Neutral conductor protection (N tripping)
		7	–
	7	–	Load shedding warning

Control bytes

The control bytes for controlling the circuit breaker are always 2 bytes long. With these control bytes, you can:

- Open/close circuit breakers
- Acknowledge messages
- Reset memory contents

Setting the outputs is edge-triggered. It is enough to set the corresponding bits for 0.5 s. 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 3- 20 Control bytes for SENTRON circuit breakers

Byte	Bit	Value	SENTRON WL
n	0 / 1	0 … 3	Switch 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	–	Control of the free user output
	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
	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

Free selection of the modules

The cyclic data can be configured in any way from the available modules. You will find further information in Table 3-18 List of all modules that can be plugged in for the project (Page 114).

Further individual modules or property bytes are provided in addition to the basic types.

Basic type 1

Basic type 1 comprises four data blocks. These are pre-assigned in such a way that they are suitable above all for use with a SENTRON WL without metering function. The most important currents of the phases are transferred.

The predefined data blocks cannot be modified.

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

Table 3- 21 Basic type 1

Byte	Definition	Default
0 / 1	Data block 1	Current in phase 1
2 / 3	Data block 2	Current in phase 2
4 / 5	Data block 3	Current in phase 3
6 / 7	Data block 4	Max. current in phase under highest load
8	PB of data block 1	PB of current in phase 1
9	PB of data block 2	PB of current in phase 2
10	PB of data block 3	PB of current in phase 3
11	PB of data block 4	PB of max. current in the phase under highest load

Basic type 2

Basic type 2 has eight 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. That is sufficient in most cases.

The predefined data blocks cannot be modified.

Basic type 2 is pre-assigned for metering function.

Table 3- 22 Basic type 2

Byte	Definition	Default
0 / 1	Data block 1	Current in phase 1
2 / 3	Data block 2	Current in phase 2
4 / 5	Data block 3	Current in phase 3
6 / 7	Data block 4	Max. current in phase under highest load
8 / 9	Data block 5	Current in neutral conductor
10 / 11	Data block 6	Mean value of phase-to-phase voltages
12 / 13	Data block 7	Mean value of power factors of 3 phases
14 / 15	Data block 8	Total of active energies of the 3 phases
16	PB of data block 1	PB of current in phase 1
17	PB of data block 2	PB of current in phase 2
18	PB of data block 3	PB of current in phase 3
19	PB of data block 4	PB of max. current in phase under highest load
20	PB of data block 5	PB of current in neutral conductor
21	PB of data block 6	PB of the mean value of phase-to-phase voltages
22	PB of data block 7	PB of the mean value of 3 power factors
23	PB of data block 8	PB of total active energy

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.

The predefined data blocks cannot be modified.

Table 3- 23 Basic type 3

Byte	Definition	Default
0 / 1	Data block 1	Current in phase 1
2 / 3	Data block 2	Current in phase 2
4 / 5	Data block 3	Current in phase 3
6 / 7	Data block 4	Max. current in phase under highest load
8 / 9	Data block 5	Current in neutral conductor
10 / 11	Data block 6	Phase-to-phase voltage L12
12 / 13	Data block 7	Phase-to-phase voltage L23
14 / 15	Data block 8	Phase-to-phase voltage L31
16 / 17	Data block 9	Neutral point voltage L1N
18 / 19	Data block 10	Neutral point voltage L2N
20 / 21	Data block 11	Neutral point voltage L3N
22 / 23	Data block 12	Mean value of power factors of 3 phases
24 / 25	Data block 13	Total of active energies of the 3 phases
26 / 27	Data block 14	Total apparent power of 3 phases
28	PB of data block 1	PB of current in phase 1
29	PB of data block 2	PB of current in phase 2
30	PB of data block 3	PB of current in phase 3
31	PB of data block 4	PB of max. current in phase under highest load
32	PB of data block 5	PB of current in neutral conductor
33	PB of data block 6	PB of phase-to-phase voltage L12
34	PB of data block 7	PB of phase-to-phase voltage L23
35	PB of data block 8	PB of phase-to-phase voltage L31
36	PB of data block 9	PB of neutral point voltage L1N
37	PB of data block 10	PB of neutral point voltage L2N
38	PB of data block 11	PB of neutral point voltage L3N
39	PB of data block 12	PB of the mean value of 3 power factors
40	PB of data block 13	PB of the total of the active energies
41	PB of data block 14	PB of the total of apparent power

Property byte (PB)

In each of the basic types, the assigned data blocks are followed by the 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 property byte 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 data sets. If the contents of one data block or multiple data blocks of the cyclic telegram are replaced, the property byte adapts automatically.

The property byte can be used, for example, to determine whether or not a value is available. This allows the structuring of a standard interface in an HMI (operator control and monitoring 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 3- 24 Definition 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 activated.
6	–	Option available
7	–	Not used.

The table below contains examples of evaluations of the property byte:

Table 3- 25 Examples of evaluating the property byte

Value		Meaning
Hexadecimal	Decimal	
0x73	115	Bit 0 / 1 = 3 → "Read only"
		Bit 4 = true → "Range valid"
		Bit 5 = true → "Option activated"
		Bit 6 = true → "Option available"
0x50	80	Bit 0 / 1 = 3 → "Read/write"
		Bit 4 = true → "Range valid"
		Bit 5 = false → "Option deactivated"
		Bit 6 = true → "Option available"

See also

Cyclic data traffic (Page 114)

3.15.3 Acyclic data traffic

Description

In addition to cyclic data traffic, acyclic data can be transferred (e.g. parameters, diagnostics information, commands, further data). Acyclic data transfer takes place in parallel with cyclic data traffic.

You can use acyclic data traffic by the following methods:

- SIMATIC S7 CPUs contain system function blocks (SFB 52, SFB 53, SFB 54). With these, the CPUs can read and write the data sets individually, and read the alarm messages.
- Any PROFINET supervisor can read and write data sets.
- Any other PROFINET controller can read and write data sets.

Note

Acyclic connections to masters

The COM35 communication module supports simultaneously up to four supervisor connections by which the acyclic connection is established and data sets are read/written.

3.15.3.1 Content of the data sets

Definition of data sets

The data sets are defined in a similar way to the COM15 (PROFIBUS module) for the 3WL circuit breaker to make the transition from PROFIBUS to PROFINET easier.

You will find a description of the data sets in Chapter Data library (Page 141).

In addition to the existing data sets, the I&M0 to I&M4 data sets for identification and maintenance of the circuit breakers/modules according to the PROFINET standard were implemented.

I&M device identification

These data sets contain the I&M information according to the PROFINET standard IEC 61158-6-10 and are used for unique identification of a 3WL circuit breaker.

Addressing the I&M data sets

Table 3- 26 Addressing the I&M data sets

Reading the I&M0 data set	Addressing the slot
For the 3WL	Slot "X1": • Slot number 1 • Subslot 1
For the COM35 communication module	Slot "0": • Slot number 0 • Subslot 1, 0x8000, 0x8001 and 0x8002

Reading all other data sets I&M1 to I&M4 is permitted across all combinations slot 0 subslot XXXX.

Writing the data sets I&M1 to I&M4 is only permitted via slot 0 subslot 1.

You can address the slot and the subslot with the slot's diagnostics address you have defined in the properties of the PROFINET device in the HW Config, for example.

Table 3- 27 Structure of data set 0xaff0 (IM0 data: read-only access)

Byte	Number of bits	Format	Standard	Description
0	16	Unsigned short	0x0020	Block type: IM0
2	16	Unsigned short	0x0038	Block length
4	8	Unsigned char	0x01	Block version High
5	8	Unsigned char	0x00	Block version Low
I&M data block 0				
0006	16	Unsigned short	42	IM0 manufacturer ID[1)]
0008	160	Char 20	–	IM0 article number
0028	128	Char 16	–	IM0 serial number
0044	16	Unsigned short	–	IM0 hardware version
0046	32	• 1*char • 3*unsigned short	–	IM0 firmware version
0050	16	Unsigned short	0x0001	IM0 counter for changes
0052	16	Unsigned short	0x0000	IM0 profile ID
0054	16	Unsigned short	0x0005	IM0 profile-specific ID
0056	16	Unsigned short	0x0201	IM0 version of the I&M data
0058	16	Unsigned short	001E	IM0 supported I&M data
Total bytes: 60				

1) Standard: 42. "42" stands for Siemens AG.

Table 3- 28 Structure of the data set 0xaff1 (IM1 data read and write access)

Byte	Number of bits	Format	Standard	Description
0	16	Unsigned short	0x0021	Block type: IM1
2	16	Unsigned short	0x0038	Block length
4	8	Unsigned char	0x01	Block version High
5	8	Unsigned char	0x00	Block version Low
I&M data block 1				
0006	256	Char 32	20h	IM1 plant identifier
0040	176	Char 22	20h	IM1 location identifier
Total bytes: 60				

Table 3- 29 Structure of the data set 0xaff2 (IM2 data: read and write access)

Byte	Number of bits	Format	Standard	Description
0	16	Unsigned short	0x0022	Block type: IM2
2	16	Unsigned short	0x0038	Block length
4	8	Unsigned char	0x01	Block version High
5	8	Unsigned char	0x00	Block version Low
I&M data block 2				
0006	128	Char 16	YYYY-MM-DD	IM2 installation date
0022	304	Char 38	20h	Reserved
Total bytes: 60				

Table 3- 30 Structure of the data set 0xaff3 (IM3 data: read and write access)

Byte	Number of bits	Format	Standard	Description
0	16	Unsigned short	0x0023	Block type: IM3
2	16	Unsigned short	0x0038	Block length
4	8	Unsigned char	0x01	Block version High
5	8	Unsigned char	0x00	Block version Low
I&M data block 3				
0006	432	Char 54	20h	IM3 comment
Total bytes: 60				

Table 3- 31 Structure of the data set 0xaff4 (IM4 data: read and write access)

Byte	Number of bits	Format	Standard	Description
0	16	Unsigned short	0x0023	Block type: IM4
2	16	Unsigned short	0x0038	Block length
4	8	Unsigned char	0x01	Block version High
5	8	Unsigned char	0x00	Block version Low
I&M data block 2				
0006	432	Char 54	00h	IM4 signature
Total bytes: 60				

3.15.3.2 Data set error telegrams

If a data set is rejected by the COM35, the following happens:

The request is negatively acknowledged with an NRS telegram.

The request is signaled to the master with an error telegram, including negative acknowledgment and error code.

The error telegram has the following structure:

Function_Num	Error_Decode	Error_Code_1	Error_Code_2

- **Function_Num**

  If no error: B#16#00

  For an error:

  – Function identification from data set (DS) record Reading 0xDE, writing 0xDF

  – DS record protocol element not used: B#16#C0

- **Error_Decode**

  Location of error detection: COM35 0x80

- **Error_Code_1**

  Error identification (see following table)

- **Error_Code_2**

  Manufacturer-specific extension of the error identification: COM35 0x00, not used.

Table 3- 32 Error_Code_1 and its cause

Code	Cause
0xA0	Read error (on read access to a "write only" DSx)
0xA1	Write error (on write access to a "read only" DSx and general error with write access)
0xA9	Function is not supported (on write access for I&M0 data)
0xB0	Invalid index (for non-implemented DSx)
0xB1	"Write"/"read" (IM data) length error (on incorrect length data for "write" DSx)
0xB2	Invalid slot (when an invalid slot is specified for "read" and "write" DSx)
0xB6	Access denied (e.g. due to write protection)
0xC2	Busy: • For a "write" DS: The COM35 is busy with another task. It can therefore not be re-initialized. • For a "read" DS: The COM35 is busy with a task in progress. Initialized data are not yet ready.
0xC4	Internal error: Data point is not found.

Note

The error telegram structure used and the error codes were based on the SIMATIC error messages.

3.15.4 Alarm, error and system messages

The COM35 is designed as a diagnostics-capable IO Device. It detects internal and external faults and reports them to the IO controller as diagnostics, maintenance or hardware interrupts. They can be evaluated, for example, in TIA using the alarm OBs.

You obtain detailed information on the error event in case of an alarm, for example, using the SFB54 (RALRM) in the corresponding alarm OB.

The alarms of the COM35 are implemented as diagnostics, maintenance or hardware interrupts with channel information.

3.15.4.1 Structure of the diagnostic message

The following describes the basic structure of the diagnostic data sets with the individual blocks.

Diagnostic interrupt/maintenance alarm

Table 3- 33 Diagnostic interrupt/maintenance alarm

Alarm	Length
BlockType	2 bytes
BlockLength	2 bytes
BlockVersion	2 bytes
AlarmType	2 bytes
API	4 bytes
SlotNumber	2 bytes
SubslotNumber	2 bytes
ModuleIdentNumber	4 bytes
SubmoduleIdentNumber	4 bytes
AlarmSpecifier	2 bytes
UserStructureIdentifier	2 bytes
ChannelNumber	2 bytes
ChannelProperties	2 bytes
ChannelErrorTypes	2 bytes
ExtChannelErrorType	2 bytes
ExtChannelAddValue	4 bytes

Hardware interrupt

Table 3- 34 Hardware interrupt

Alarm	Length
BlockType	2 bytes
BlockLength	2 bytes
BlockVersion	2 bytes
AlarmType	2 bytes
API	4 bytes
SlotNumber	2 bytes
SubslotNumber	2 bytes
ModuleIdentNumber	4 bytes
SubmoduleIdentNumber	4 bytes
AlarmSpecifier	2 bytes
UserStructureIdentifier	2 bytes
UserData	4 bytes

"BlockType" data block

0x0002: AlarmNotification "Low" for diagnostic interrupts

0x0001: AlarmNotification "High" for hardware interrupts

"BlockLength" data block

In the "BlockLength" data field, the number of subsequent bytes of the diagnostic data set is coded. This corresponds to the length of the diagnostic data set without the number of bytes for the "BlockType" and "BlockLength" data fields, which each have a length of 2 bytes.

"BlockVersion" data block

W#16#0100: Block version of the diagnostic data set is 1.0.

"AlarmType" data block

W#16#0001: Diagnostic interrupt

W#16#0002: Hardware interrupt

"API" data block

API (Application Process Identifier): The COM35 uses the standard API "0".

"SlotNumber", "SubslotNumber" data blocks

The COM35 has the following structure as a modular PROFINET IO device:

Table 3- 35 "SlotNumber", "SubslotNumber" data blocks

Designation	SlotNumber	SubslotNumber
Head module • Interface • Port1 • Port2	0	0x0001 0x8000 0x8001 0x8002
Breaker	0x0001	0x0001

"ModuleIdentNumber", "SubmoduleIdentNumber" data blocks

The ModuleIdentNumber and SubmoduleIdentNumber of the module causing the alarm.

"AlarmSpecifier" data block, sequence

Table 3- 36 "AlarmSpecifier" data block, sequence

Bits	Meaning
Bit 0 … 10	Sequence number
Bit 11	Channel diagnostics available.
Bit 12	Manufacturer-specific status information available.
Bit 13	At least one channel diagnosis available.
Bit 14	Reserved.
Bit 15	At least one of the modules configured within this AR signals a diagnosis.

"UserStructureIdentifier" data block

Table 3- 37 "UserStructureIdentifier" data block

UserStructureIdentifier	Meaning
0x0000 … 0x7FFF	User specified
0x8000	ChannelDiagnosis
0x8002	Extended channel diagnosis

The COM35 signals all diagnostic interrupts as "Extended Channeldiagnosis". For that reason, the value of the "UserStructureIdentifier" field for the diagnostic interrupt is always "0x8002".

The hardware interrupts are signaled as "User specified" and have the value from 1 to XXX. The precise structure of the hardware interrupts is described below.

"ChannelNumber" data block

For diagnostic interrupts only

Table 3- 38 "ChannelNumber" data block

ChannelNumber	Meaning
0x0000 … 0x7FFF	Manufacturer-specific
0x8000	Submodule

"ChannelProperties" data block

Table 3- 39 "ChannelProperties" data block

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
.Direction			.Specifier		.Qualifier		.Acc.	.Type							

"ChannelProperties.Type (bits 0 to 7)" data block

Table 3- 40 "ChannelProperties.Type (bits 0 to 7)" data block

Value	Meaning
0	If ChannelNumber has the value 0x8000.
1	1 bit
2	2 bits
3	4 bits
4	8 bits
5	16 bits
6	32 bits
7	64 bits

"ChannelProperties.Accumulative (bit 8)" data block

Table 3- 41 "ChannelProperties.Accumulative (bit 8)" data block

Value	Meaning
0	No channel error group signal
1	Channel error group signal (more than one channel affected)

Combination of "ChannelProperties.Qualifier (Bit 9/10)" and "ChannelProperties.Specifier (Bit 11 / 12)"

Table 3- 42 Combination of "ChannelProperties.Qualifier (Bit 9/10)" and "ChannelProperties.Specifier (Bit 11 / 12)"

Maintenance Required Bit 9	Maintenance Demanded Bit 10	Specifier bit 12 / 11	Meaning	Diagnosis in the SIMATIC S7 300 and SIMATIC S7 400 user program
0	0	00	All lower-level diagnoses are no longer pending.	Evaluation of diagnostic interrupts with SFB54 in OB82
		01	Diagnosis is pending.	Evaluation of diagnostic interrupts with SFB54 in OB82, data set reading with SFB52
		10	Diagnosis is no longer pending.	Evaluation of diagnostic interrupts with SFB54 in OB82
		11	Status message. Only possible for manufacturer-specific errors.	
	1	00	Reserved	–
		01	Maintenance requirement is pending.	Evaluation of diagnostic interrupts with SFB54 in OB82, data set reading with SFB52
		10	Maintenance requirement is no longer pending.	Evaluation of diagnostic interrupts with SFB54 in OB82
		11	Maintenance requirement is no longer pending; all others are still pending.	
1	0	00	Reserved	–
		01	Maintenance demand is pending.	Evaluation of diagnostic interrupts with SFB54 in OB82, data set reading with SFB52
		10	Maintenance demand is no longer pending.	Evaluation of diagnostic interrupts with SFB54 in OB82
		11	Maintenance demand is no longer pending; all others are still pending.	
	1	00	Reserved	–
		01	Stepped diagnosis is pending.	Evaluation of diagnostic interrupts with SFB54 in OB82, data set reading with SFB52
		10	Stepped diagnosis is no longer pending.	Evaluation of diagnostic interrupts with SFB54 in OB82
		11	Stepped diagnosis is no longer pending; all others are still pending.	

"ChannelProperties.Direction (bits 13 to 15)" data block

Table 3- 43 "ChannelProperties.Direction (bits 13 to 15)" data block

Value	Meaning
000	Manufacturer-specific
001	Input
010	Output
011	Input/Output
100 … 111	Reserved

"ChannelErrorType" data block

In the "ChannelErrorType" field, the messages for the diagnostic interrupts and maintenance alarms are transferred.

The more precise alarm information is defined as follows in the "ChannelErrorType" and "ExtChannelErrorType" fields specifically for the COM35:

3.15.4.2 Diagnostics/maintenance alarm messages

Table 3- 44 Diagnostics/maintenance alarm

ChannelErrorType (hex)/message	ExtChannelErrorType
0x100 The circuit breaker has tripped (Diag). As additional information, the trip reasons are signaled in the "ExtChannelErrorType" field.	1 = Overload trip 2 = Short-circuit trip 3 = Short-time delayed short-circuit trip 4 = Ground-fault trip 5 = Enhanced protection function 6 = Overload trip in the neutral conductor 8 = Overtemperature 20 = Current unbalance 21 = Voltage unbalance 22 = Active power in normal direction 23 = Active power in reverse direction 24 = Overvoltage 25 = Undervoltage 26 = Overfrequency 27 = Underfrequency 28 = THD current 29 = THD voltage 30 = Phase sequence detection
0x101 Position of the circuit breaker in the guide frame changed (Diag). As the additional information, the new position of the circuit breaker is signaled in the "ExtChannelError-Type" field.	0 = Connected position (going) 1 = Disconnected (coming) 2 = Test position (coming) 3 = Not available (coming)
0x102 Maintenance of the circuit breaker necessary (maintenance). As additional information, the necessary maintenance is signaled in the "ExtChannelErrorType" field.	0 = No maintenance necessary (going) 1 = Perform immediate visual inspection on main contacts (coming) 2 = Prepare maintenance of the main contacts (coming)

3.15.5 Hardware interrupt messages

The structure of the hardware interrupt differs from that of the diagnostic interrupt from field "UserStructIdentifier".

The hardware interrupt messages are defined as follows specifically for the COM35:

Table 3- 45 Hardware interrupt messages for the COM35

UserStructIdentifier (hex)/message	UserData (4 bytes)
0x1 CubicleBus module status	StatusCubicleBusModule: 0x00000001 = COM35 0x00000002 = Electronic trip unit ETU 0x00000004 = ZSI module 0x00000100 = Configurable digital output module 0x00000400 = Digital output module No. 2 0x00000800 = Digital input module No. 2 0x00001000 = Breaker Status Sensor (BSS) 0x00002000 = Digital output module No. 1 0x00004000 = Digital input module No. 1 0x00020000 = BDA or BDA PLUS or TD400 0x00080000 = Graphical display ETU76B 0x00100000 = Analog output module No. 2 0x00200000 = Analog output module No. 1 0x00400000 = Metering function or metering function PLUS

Table 3- 46 Hardware interrupt messages for the COM35

UserStructIdentifier (hex)/message	Byte 0	Byte 1 … 3
0x2Changing the switching state of the circuit breaker	0x01 = OFF 0x02 = ON 0x21 = OFF via UVR	Reserved
0x3 Ready-to-close signaling	0x01 = Ready to close 0x02 = Not ready to close	
0x5 Spring energy store of the circuit breaker	0x01 = Is not charged 0x02 = Is charged	
0x6 Changeover parameter set A/B	0x01 = Protection parameter set A active 0x02 = Protection parameter set B active	
0x7 Protection parameter has been changed.	ID of the parameter	
0x9 Write protection status changed.	0x01 = Write protection is active 0x02 = B Write protection is inactive	
0xA Action is not possible when write protection is active.	Reserved	
0xB Output not remotely operated.	Reserved	

3.16 Modbus TCP

The COM35 supports the Modbus TCP protocol of the Modbus Organization, described in the following specifications:

- Modbus Application Protocol V1.1b
- Modbus Messaging Implementation Guide V1.0b

You will find further information on the Internet (http://www.modbus.org/).

3.16.1 Addressing

For Modbus TCP, the device is addressed via its IP address.

The device has a data point "IPv4 suite" with the format 476 (see Table 4-104 Format (476) "IPv4 suite" (Page 251)) that contains the communication parameters for access via TCP/IP. The data point can be found in Table 4-54 Content of data set 161 (Page 222) with byte offset 6 or at the Modbus register address 41220 (hex: 0xA104).

The standard TCP port for a Modbus TCP server is 502. The device has a data point "Modbus TCP port" that is configured as 502 in the as-delivered state. It is possible to change this value. You will find further information on this in Chapter Configurable Modbus TCP port (Page 99).

See also

Data set DS 161: Parameters for communication (Page 222)

3.16.2 Function codes

The COM35 supports the following Modbus function codes with the associated register address ranges:

Table 3- 47 Modbus function codes

Name of area	Function codes	Address area
Value buffer area	03 (0x03): Read value buffer area	0 (0x0000) … 42336 (0xA560)
	16 (0x10): Write value buffer area	
Basic type data	04 (0x04): Read basic type data	0 (0x0000) … 21 (0x0015)[1)]

[1)] Range depends on settings. You will find further information on this in Chapter Read basic type data (Page 139).

3.16.3 Read value buffer area

Corresponds to Modbus function code 03 (hex: 0x03) "Read Holding Registers". This reads values from the value buffer area of the circuit breaker.

The request must contain a valid Modbus register address of a data point as the start address and must not extend beyond the end of a data set. You will find further information on this in Chapter Data sets for SENTRON WL (Page 162).

3.16.4 Write value buffer area

Corresponds to Modbus function code 16 (hex: 0x10) "Write Multiple Registers". This can be used to write complete data areas or complex data types and transfer them to the value buffer area.

The request must contain a valid Modbus register address of a data point or start from the start address of a data set. You will find further information on this in Chapter Data sets for SENTRON WL (Page 162). Data points whose value is to be changed must be written completely.

3.16.5 Read basic type data

Corresponds to Modbus function code 04 (hex: 0x04) "Read Input Registers". In this way, all basic type data of a circuit breaker are read. Depending on the settings, the structure and length of the requestable data may vary.

There are three basic types available for efficient and flexible transfer. As the factory setting, the basic type 3 is selected. Depending on the application, a different basic type can be chosen. With data point 6 in data set DS 160 (see Table 4-53 Content of data set 160 (Page 221)), the currently set basic type is read out and a different basic type can be selected.

If a basic type is chosen, the list of the data points it contains can be read out via data point 7 in data set 160. Via the same data point, it is possible to adapt the basic setting of a basic type to your own requirements. You will find further information in Table 4-61 Format (7) cyclic data in DP (Page 229)

You will find further information on the basic settings of the three basic types in Chapter Data formats of the basic types (Page 253). If a basic type is written via data point 6 in data set 160, the basic settings of this basic type are restored and any adjustments are overwritten.

See also

Data set DS 160: Parameters for communication (Page 221)

Special data formats (Page 228)

Data library

4

The communication system of the SENTRON circuit breakers is extremely versatile and flexible. The majority of data points can be read, and to a certain extent written, via data sets. Many of them can be integrated into the basic types.

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?
- Which register address does the data point start with?
- In which data set is this data point available?

4.1 Chapter overview

This chapter describes the data points of the data library.

First part

In the first part, 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.

Second part

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 part. This allows the data sets transferred via Modbus TCP to be interpreted in the master.

Third part

The third part 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.

4.2 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. You will find the scaling factor in question in Chapter Data sets for SENTRON WL (Page 162).

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 (Modbus 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.

4.3 Units

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

Table 4- 1 Units

Measured value	Measuring unit	Name
Current	A	ampere
Voltage	V	volt
Power	kW	kilowatt
Power	kVA	kilovolt ampere
Reactive power	kVAr	kilovolt ampere (reactive)
Energy	kWh	kilowatt/hour
Reactive energy	kVArh	kilovolt ampere (reactive) hour
Energy	MWh	megawatt/hour
Reactive energy	MVArh	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.

4.4 Function classes

4.4.1 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.

4.4.2 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 (close/open), and also functions that control the CubicleBUS modules).

Table 4- 2 Data points for controlling the circuit breaker

Description	Data point	Source WL	Format	Length (bits)	Scaling	Contained in DS.Byte
Controls the functions/commands of the communication module (e.g. reset min./ max. values)	18	COM35	Format (18)	8	–	DS51.181
Controls the outputs of the communication module (e.g. switching the circuit breaker)	478	COM35	Format (478)	8	–	DS161.48
Date of the last parameter change	84	COM35	Time	64	–	DS51.182
System time of the circuit breaker	90	COM35	Time	64	–	DS93.11
Controls digital output module 1	121	DO1	Format (121)	8	–	DS91.10
Controls digital output module 2	126	DO2	Format (126)	8	–	DS51.194
Controls the trip unit	406	ETU	Format (406)	16	–	DS68.4
6 communication bits for the digital configurable output module	426	COM35	Format (426)	6	–	DS93.8

4.4.3 Data points for detailed diagnostics of the SENTRON circuit breakers

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

Table 4- 3 Data points for detailed diagnostics of the SENTRON circuit breakers

Description	Data point	Source WL	Format	Length (bits)	Scaling	Contained in DS.Byte
Write protection (DPWriteEnable)	14	COM35	Format (14)	1	–	DS69.11
Trip log of the last 5 tripping operations with time	15	COM35	Format (15)	480	–	DS51.0
Event log of the last 10 events with time	16	COM35	Format (16)	960	–	DS51.60
Trip log of the last 20 tripping operations with time	15	COM35	Format (15)	1920	–	DS53.0
Event log of the last 20 events with time	16	COM35	Format (16)	1920	–	DS54.0
Number of switching operations under load	80	COM35	Unsigned int	16	0	DS92.42
Number of switching operations caused by trips	81	COM35	Unsigned int	16	0	DS91.0
Switching cycle counter (for switching cycle on/off)	82	COM35	Unsigned int	16	0	DS91.2
Runtime meter (when On + current > 0)	83	COM35	Unsigned long	32	0	DS91.4
Number of short-circuit trips (SI)	104	ETU	Unsigned int	16	0	DS91.6
Number of overload trips (L)	105	ETU	Unsigned int	16	0	DS91.18
Number of ground-fault trips (G)	106	ETU	Unsigned int	16	0	DS91.20
Total of switched-off I^2t values L1, L2, L3, N	107	ETU	Format (107)	128	0	DS91.22
Tripping operations by metering function PLUS	307	Meter. fct. PLUS	Format (307)	16	–	DS91.24
Threshold warnings	308	Meter. fct. PLUS	Format (308)	32	–	DS92.28
Harmonics of current/voltage to the 29th harmonic	309	Meter. fct. PLUS	Format (309)	928	0	DS92.30
Article number of the trip unit	371	ETU	18 x char	144	–	DS64.0
Time until presumed overload trip	379	ETU	Unsigned int	16	0	DS97.126
Last unacknowledged tripping operation of the trip unit	401	ETU	Format (401)	8	–	DS51.1
Currently pending warnings	402	ETU	Format (402)	16	–	DS92.26
Current at the moment of switch-off	403	ETU	Unsigned int	16	–	DS92.24

Description	Data point	Source WL	Format	Length (bits)	Scaling	Contained in DS.Byte
Phase at the moment of switch-off	404	ETU	Format (373)	3	–	DS92.34
Circuit breaker position at the digital input module 1	111	DI1	Format (111)	8	–	DS92.36
Circuit breaker position at the digital input module 2	115	DI2	Format (111)	8	–	DS69.3
Circuit breaker position at the digital output module 1	119	DO1	Format (119)	8	–	DS69.4
Circuit breaker position at the digital output module 2	124	DO2	Format (119)	8	–	DS69.5
Display of the phase under highest load	373	ETU	Format (373)	3	–	DS69.6
Position and status of the circuit breaker in the frame	24	COM35	Format (24)	4	–	DS51.183
Modules connected to the CubicleBUS	88	COM35	Format (88)	32	–	DS91.48
Status of the inputs of digital input module 1	110	DI1	Hex	8	–	DS51.202
Status of the inputs of digital input module 2	114	DI2	Hex	8	–	DS92.37
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	–	DS92.20
Status of the circuit breaker (e.g. on/off/charged)	328	BSS	Format (328)	8	–	DS69.0
Maintenance information about the main contacts	405	ETU	Format (405)	2	–	DS69.1

4.4.4 Data points for identifying the SENTRON circuit breakers

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

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

Description	Data point	Source WL	Format	Length (bits)	Scaling	Contained in DS.Byte
User text (freely editable)	20	COM35	64 x char	512	–	DS165.4
Plant identifier (freely editable)	21	COM35	64 x char	512	–	DS165.68
Date (freely editable)	22	COM35	Time	64	–	DS165.132
Author (freely editable)	23	COM35	30 x char	240	–	DS165.140
ID number COM	91	COM35	16 x char	128	–	DS162.4
Market in which the trip unit is used	95	ETU	Format (95)	2	–	DS97.47
ID number of circuit breaker	96	ETU	20 x char	160	–	DS97.48
Test date of the circuit breaker	98	ETU	Time	64	–	DS97.74 DS100.4
Interrupting 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
Article number of circuit breaker (for the SENTRON VL: article number of the trip unit)	103	ETU	Format (103)	160	–	DS162.20 DS97.88
Number of poles of circuit breaker	108	ETU	Format (108)	3	–	DS97.144
Type (metering function, metering function PLUS)	138	Meter. fct.	Format (138)	8	–	DS162.40
Rating plug	377	ETU	Unsigned int	16	0	DS51.208 DS97.146
Circuit breaker frame	378	ETU	Unsigned int	16	0	DS97.148
Article 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
ID number of trip unit	409	ETU	17 x char	136	–	DS97.26
N transformer connected	411	ETU	Format (411)	1	–	DS97.45
Type of trip unit	412	ETU	Format (412)	5	–	DS162.41

4.4.5 Data points for measured values current

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

Table 4- 5 Data points for measured values current

Description	Data point	Source WL	Format	Length (bits)	Scaling	Contained in DS.Byte
Phase unbalance current (as %)	172	Meter. fct.	Unsigned char	8	0	DS94.0
Long-time mean value of 3-phase current	193	Meter. fct.	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-time mean value of current	244	Meter. fct.	Unsigned int	16	0	DS72.24
Maximum long-time mean value of current	245	Meter. fct.	Unsigned int	16	0	DS72.26
Current of phase with maximum load	374	ETU	Unsigned int	16	0	DS51.186 DS52.6
Current in neutral conductor	375	ETU	Unsigned int	16	0	DS51.190 DS94.18 DS52.8
Current that flows to ground	376	ETU	Unsigned int	16	0	DS51.192 DS94.20 DS52.10
Current in phase 1	380	ETU	Unsigned int	16	0	DS94.10
Current in phase 2	381	ETU	Unsigned int	16	0	DS94.12
Current in phase 3	382	ETU	Unsigned int	16	0	DS94.14
Mean value current phases 1 … 3	383	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

Description	Data point	Source WL	Format	Length (bits)	Scaling	Contained in DS.Byte
Maximum current in neutral conductor	390	ETU	Unsigned int	16	0	DS72.12
Maximum current in neutral conductor	391	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	Unsigned int	16	0	DS72.18
Minimum of the mean value Phases 1 … 3	394	ETU	Unsigned int	16	0	DS72.20
Maximum of the mean value Phases 1 … 3	395	ETU	Unsigned int	16	0	DS72.22

4.4.6 Data points for measured values voltage

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

Table 4- 6 Data points for measured values voltage

Description	Data point	Source WL	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 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

Description	Data point	Source WL	Format	Length (bits)	Scaling	Contained in DS.Byte
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
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

4.4.7 Data points for measured values power

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

Table 4- 7 Data points for measured values power

Description	Data point	Source WL	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

Description	Data point	Source WL	Format	Length (bits)	Scaling	Contained in DS.Byte
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 apparent power	246	Meter. fct.	Unsigned int	16	0	DS74.4
Maximum of the mean value of apparent power	247	Meter. fct.	Unsigned int	16	0	DS74.6
Minimum of the mean value of reactive power	248	Meter. fct.	Signed int	16	0	DS74.12
Maximum of the mean value of reactive power	249	Meter. fct.	Signed int	16	0	DS74.14
Minimum of the mean value of active power	250	Meter. fct.	Signed int	16	0	DS74.8
Maximum of the mean value of active power	251	Meter. fct.	Signed int	16	0	DS74.10

4.4.8 Data points for other measured values

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

Table 4- 8 Data points for other measured values

Description	Data point	Source WL	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 (measured in the COM35)	71	COM35	Signed char	8	0	DS94.114
Minimum temperature in the control cabinet	72	COM35	Signed char	8	0	DS77.0
Maximum temperature in the control cabinet	73	COM35	Signed char	8	0	DS77.1
Temperature in circuit breaker (measured in the BSS)	330	BSS	Signed char	8	0	DS94.115
Minimum temperature in the circuit breaker	74	COM35	Signed char	8	0	DS77.2
Maximum temperature in the circuit breaker	75	COM35	Signed char	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	Meter. fct.	Unsigned long	32	0	DS94.116
Active energy in reverse direction [MWh]	239	Meter. fct.	Signed long	32	0	DS94.86
Active energy in reverse direction [kWh]	434	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	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	Meter. fct.	Unsigned long	32	0	DS94.128
Frequency	262	Meter. fct.	Unsigned int	16	−2	DS94.106
Minimum frequency	252	Meter. fct.	Unsigned int	16	−2	DS76.2

Description	Data point	Source WL	Format	Length (bits)	Scaling	Contained in DS.Byte
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

4.4.9 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 4- 9 Data points for the time stamp (TS) of the measured values

Description	Data point	Source WL	Format	Length (bits)	Scaling	Contained in DS.Byte
TS minimum current in phase L1	25	COM35	Time	64	–	DS72.32
TS maximum current in phase L1	26	COM35	Time	64	–	DS72.40
TS minimum current in phase L2	27	COM35	Time	64	–	DS72.48
TS maximum current in phase L2	28	COM35	Time	64	–	DS72.56
TS minimum current in phase L3	29	COM35	Time	64	–	DS72.64
TS maximum current in phase L3	30	COM35	Time	64	–	DS72.72
TS minimum current in neutral conductor	33	COM35	Time	64	–	DS72.112
TS maximum current in neutral conductor	34	COM35	Time	64	–	DS72.120
TS minimum current that flows to ground	35	COM35	Time	64	–	DS72.128
TS maximum current that flows to ground	36	COM35	Time	64	–	DS72.136
TS minimum mean value over the three phases	31	COM35	Time	64	–	DS72.80
TS maximum mean value over the three phases	32	COM35	Time	64	–	DS72.88
TS minimum long-time mean value of current	55	COM35	Time	64	–	DS72.96
TS maximum long-time mean value of current	56	COM35	Time	64	–	DS72.104
TS minimum phase-to-phase voltage between phase L1 and phase L2	37	COM35	Time	64	–	DS73.24
TS maximum phase-to-phase voltage between phase L1 and phase L2	38	COM35	Time	64	–	DS73.32
TS minimum phase-to-phase voltage between phase L2 and phase L3	39	COM35	Time	64	–	DS73.40
TS maximum phase-to-phase voltage between phase L2 and phase L3	40	COM35	Time	64	–	DS73.48
TS minimum phase-to-phase voltage between phase L3 and phase L1	41	COM35	Time	64	–	DS73.56
TS maximum phase-to-phase voltage between phase L3 and phase L1	42	COM35	Time	64	–	DS73.64
TS minimum of the neutral point voltage phase L1	43	COM35	Time	64	–	DS73.72
TS maximum of the neutral point voltage phase L1	44	COM35	Time	64	–	DS73.80
TS minimum of the neutral point voltage phase L2	45	COM35	Time	64	–	DS73.88

Description	Data point	Source WL	Format	Length (bits)	Scaling	Contained in DS.Byte
TS maximum of the neutral point voltage phase L2	46	COM35	Time	64	–	DS73.96
TS minimum of the neutral point voltage phase L3	47	COM35	Time	64	–	DS73.104
TS maximum of the neutral point voltage phase L3	48	COM35	Time	64	–	DS73.112
TS minimum of the mean value of apparent power	57	COM35	Time	64	–	DS74.16
TS maximum of the mean value of apparent power	58	COM35	Time	64	–	DS74.24
TS minimum of the mean value of active power	49	COM35	Time	64	–	DS74.32
TS maximum of the mean value of active power	50	COM35	Time	64	–	DS74.40
TS minimum of the mean value of reactive power	51	COM35	Time	64	–	DS74.48
TS maximum of the mean value of reactive power	52	COM35	Time	64	–	DS74.56
TS minimum of the mean value of the power factor	53	COM35	Time	64	–	DS74.64
TS maximum of the mean value of the power factor	54	COM35	Time	64	–	DS74.72
TS minimum temperature in the control cabinet	76	COM35	Time	64	–	DS77.4
TS maximum temperature in the control cabinet	77	COM35	Time	64	–	DS77.12
TS minimum temperature in the circuit breaker	78	COM35	Time	64	–	DS77.20
TS maximum temperature in the circuit breaker	79	COM35	Time	64	–	DS77.28
TS minimum frequency	59	COM35	Time	64	–	DS76.8
TS maximum frequency	60	COM35	Time	64	–	DS76.16
TS minimum THD of current	61	COM35	Time	64	–	DS76.24
TS maximum THD of current	62	COM35	Time	64	–	DS76.32
TS minimum THD of voltage	63	COM35	Time	64	–	DS76.40
TS maximum THD of voltage	64	COM35	Time	64	–	DS76.48
TS minimum peak factor	65	COM35	Time	64	–	DS72.144
TS maximum peak factor	66	COM35	Time	64	–	DS72.152
TS minimum form factor	67	COM35	Time	64	–	DS72.160
TS maximum form factor	68	COM35	Time	64	–	DS72.168

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

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

Table 4- 10 Parameters of the SENTRON circuit breakers (primary protection function)

Description	Data point	Source WL	Format	Length (bits)	Scaling	Contained in DS.Byte
Active parameter set	370	ETU	Format (370)	1	–	DS129.65
Overload parameter I_R PS A	333	ETU	Unsigned int	16	0	DS129.4
Time-lag class t_R PS A	335	ETU	Unsigned int	16	−1	DS129.8
Short-circuit protection instantaneous I_i PS A	336	ETU	Unsigned int	16	1 / 0 (VL)	DS129.10
Short-circuit protection delayed I_{sd} PS A	337	ETU	Unsigned int	16	1 / 0 (VL)	DS129.12
Delay time for short-circuit protection t_{sd} PS A	338	ETU	Unsigned int	16	−3	DS129.14
Overload protection neutral conductor I_N PS A (WL)	334	ETU	Unsigned int	16	0	DS129.6
Ground-fault protection I_g PS A	339	ETU	Unsigned int	16	0	DS129.16
Delay time for ground-fault protection t_g PS A	340	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	Format (343)	1	–	DS129.24
I^2t characteristic for ground-fault protection PS A	344	ETU	Format (344)	1	–	DS129.25
Thermal memory PS A	346	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 PS B	349	ETU	Unsigned int	16	0	DS129.32
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

Description	Data point	Source WL	Format	Length (bits)	Scaling	Contained in DS.Byte
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 characteristic 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 pickup	368	ETU	Unsigned int	16	0	DS129.62
Delay time for load shedding/pickup	366	ETU	Unsigned char	8	0	DS129.64
Active parameter set	370	ETU	Format (370)	1	–	DS129.65

4.4.11 Parameters of the SENTRON circuit breakers (enhanced protection function)

The table below contains the parameters of the SENTRON circuit breakers (enhanced protection function).

Table 4- 11 Parameters of the SENTRON circuit breakers (enhanced protection function)

Description	Data point	Source WL	Format	Length (bits)	Scaling	Contained in DS.Byte
Current unbalance	139	Meter. fct.	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
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

4.4.12 Parameters of the SENTRON circuit breakers (parameters for threshold warnings)

The table below contains the parameters of the SENTRON circuit breakers (parameters for threshold warnings).

Table 4- 12 Parameters of the SENTRON circuit breakers (parameters for threshold warnings)

Description	Data point	Source WL	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 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	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 long-time 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 long-time 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 long-time 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	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

4.4.13 Parameters of the SENTRON circuit breakers (e.g. communication, measured value setting)

The table below contains the parameters of the SENTRON circuit breakers (e.g. communication, measured value setting).

Table 4- 13 Parameters of the SENTRON circuit breakers (e.g. communication, measured value setting)

Description	Data point	Source WL	Format	Length (bits)	Scaling	Contained in DS.Byte
Basic type of Modbus data transfer	6	COM35	Hex	2	–	DS160.6
Data in the cyclic profile of Modbus	7	COM35	Format (7)	224	–	DS160.8
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 phase rotation	146	Meter. fct.	Format (146)	1	–	DS128.21
The voltage transformer can be star (wye) 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 char	8	0	DS128.8
Length of period for calculating long-time mean value	166	Meter. fct.	Unsigned char	8	0	DS128.9
Number of sub-periods for calculating long-time mean value	167	Meter. fct.	Unsigned char	8	0	DS128.10
Lower limit of power transmission	372	ETU	Unsigned int	16	0	DS128.12
Ground fault transformer detection type	410	ETU	Format (410)	2	–	DS97.44 DS129.69

4.5 Data sets for SENTRON WL

4.5.1 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 for displaying the data of the main overview.

The following table contains the data set DS 51: Main overview (length 119 Modbus registers, read-only):

Table 4- 14 Content of data set 51

Byte offset	Modbus register			Description	Data point	Source WL	Format	Length (bits)	Scaling
	Address		High/Low						
	Dec	Hex							
0	13057	0x3301	–	Trip log of the last 5 tripping operations with time	15	COM35	Format (15)	480	–
60	13087	0x331F	–	Event log of the last 10 events with time	16	COM35	Format (16)	960	–
180	13147	0x335B	LOW	Reserved	–	–	–	8	–
181	13147	0x335B	HIGH	Controls the commands/functions of the communication module (e.g. clear or reset min./max. values)	18	COM35	Format (18)	8	–
182	13148	0x335C	LOW	Reserved	–	–	–	8	–
183	13148	0x335C	HIGH	Shows the phase with maximum load	373	ETU	Format (373)	3	–
184	13149	0x335D	–	Mean value of the power factor	168	Meter. fct.	Signed int	16	−3
186	13150	0x335E	–	Current of phase with maximum load	374	ETU	Unsigned int	16	0
188	13151	0x335F	–	Time until presumed overload trip	379	ETU	Unsigned int	16	0
190	13152	0x3360	–	Current in neutral conductor	375	ETU	Unsigned int	16	0
192	13153	0x3361	–	Current that flows to ground	376	ETU	Unsigned int	16	0
194	13154	0x3362	–	System time of the circuit breaker	90	COM35	Time	64	–
202	13158	0x3366	LOW	Position of the circuit breaker in the frame	24	COM35	Format (24)	4	–
203	13158	0x3366	HIGH	Status of the circuit breaker (e.g. on/off/charged)	328	BSS	Format (328)	8	–

Byte offset	Modbus register			Description	Data point	Source WL	Format	Length (bits)	Scaling
	Address		High/Low						
	Dec	Hex							
204	13159	0x3367	–	Overload parameter I_R PS A	333	ETU	Unsigned int	16	0
206	13160	0x3368	–	Overload parameter I_R PS B	349	ETU	Unsigned int	16	0
208	13161	0x3369	–	Rating plug	377	ETU	Unsigned int	16	0
210	13162	0x336A	LOW	Active parameter set	370	ETU	Format (370)	1	–
211	13162	0x336A	–	Reserved	–	–	–	72	–
220	13167	0x336F	LOW	Property byte: Trip log of the last 5 tripping operations with time	–	COM35	PB	8	–
221	13167	0x336F	HIGH	Property byte: Event log of the last 10 events with time	–	COM35	PB	8	–
222	13168	0x3370	LOW	Reserved	–	–	–	8	–
223	13168	0x3370	HIGH	Property byte of the communication module: Controls the commands/functions (e.g. clear or reset min./max. values)	–	COM35	PB	8	–
224	13169	0x3371	LOW	Reserved	–	–	–	8	–
225	13169	0x3371	HIGH	Property byte for byte 183: Shows the phase with maximum load	–	ETU	PB	8	–
226	13170	0x3372	LOW	Property byte: Mean value of the power factor	–	Meter. fct.	PB	8	–
227	13170	0x3372	HIGH	Property byte: Current of phase with maximum load	–	ETU	PB	8	–
228	13171	0x3373	LOW	Property byte for byte 188: Time until presumed overload trip	–	ETU	PB	8	–
229	13171	0x3373	HIGH	Property byte: Current in neutral conductor	–	ETU	PB	8	–
230	13172	0x3374	LOW	Property byte: Current that flows to ground	–	ETU	PB	8	–
231	13172	0x3374	HIGH	Property byte: System time of the circuit breaker	–	COM35	PB	8	–
232	13173	0x3375	LOW	Property byte: Position of the circuit breaker in the frame	–	COM35	PB	8	–

Byte offset	Modbus register		High/Low	Description	Data point	Source WL	Format	Length (bits)	Scaling
	Address								
	Dec	Hex							
233	13173	0x3375	HIGH	Property byte: Status of the circuit breaker (e.g. on/off/charged)	–	BSS	PB	8	–
234	13174	0x3376	LOW	Property byte: Overload parameter I_R PS A	–	ETU	PB	8	–
235	13174	0x3376	HIGH	Property byte: Overload parameter I_R PS B	–	ETU	PB	8	–
236	13175	0x3377	LOW	Property byte rating plug	–	ETU	PB	8	–
237	13175	0x3377	HIGH	Property byte: Active parameter set	–	ETU	PB	8	–

4.5.2 Data set DS 53: Trip log

The table below shows the content of data set 53 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 to display the trip log.

The following table contains the data set DS 53: Main overview (length 121 Modbus registers, read-only):

Table 4- 15 Content of data set 53

Byte offset	Modbus register		High/Low	Description	Data point	Source WL	Format	Length (bits)	Scaling
	Address								
	Dec	Hex							
0	13569	0x3501	–	Trip log of the last 20 tripping operations with time	15	COM35	Format (15)	1920	–
240	13689	0x3579	LOW	Property byte: Trip log of the last 20 tripping operations with time	–	COM35	PB	8	–

4.5.3 Data set DS 54: Event log

The table below shows the content of data set 54 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 to display the event log.

The following table contains the data set DS 54: Main overview (length 121 Modbus registers, read-only):

Table 4- 16 Content of data set 54

Byte offset	Modbus register			Description	Data point	Source WL	Format	Length (bits)	Scaling
	Address		High/Low						
	Dec	Hex							
0	13825	0x3601	–	Event log of the last 20 tripping operations with time	16	COM35	Format (15)	1920	–
240	13945	0x3679	LOW	Property byte: Event log of the last 20 events with time	–	COM35	PB	8	–

4.5.4 Data set DS 64: Data of the harmonics 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 following table contains the data set DS 64: Data of the harmonics analysis (length 66 Modbus registers, read-only):

Table 4- 17 Content of data set 64

Byte offset	Modbus register			Description	Data point	Source WL	Format	Length (bits)	Scaling
	Address		High/Low						
	Dec	Hex							
0	16385	0x4001	–	Harmonics of current/voltage to the 29th harmonic	309	Meter. fct.	Format (309)	928	0
116	16443	0x403B	–	Reserved	–	–	–	112	–
130	16450	0x4042	LOW	Property byte: Harmonics of current/voltage to the 29th harmonic	309	Meter. fct.	PB	8	–

4.5.5 Data set DS 68: Data of the CubicleBUS module

The table below shows the content of data set 68 in which you can do the following:

- Read and control outputs of the digital output modules
- Read out and set the system time
- Set outputs of the communication module (close/open circuit breaker)

The following table contains the data set DS 68: Data of the CubicleBUS module (length 23 Modbus register, read and write):

Table 4- 18 Content of data set 68

Byte offset	Modbus register			Description	Data point	Source WL	Format	Length (bits)	Scaling
	Address		High/Low						
	Dec	Hex							
0	17409	0x4401	–	Header; value 0x00 00 00 00	–	COM35	–	32	–
4	17411	0x4403	–	System time of the circuit breaker	90	COM35	Time	64	–
12	17415	0x4407	–	Reserved	–	–	–	16	–
14	17416	0x4408	LOW	Status of outputs of the digital output module 1	118	DO1	Hex	8	–
15	17416	0x4408	HIGH	Status of outputs of the digital output module 2	123	DO2	Hex	8	–
16	17417	0x4409	–	Reserved	–	–	–	192	–
40	17429	0x4415	LOW	Property byte: System time of the circuit breaker	–	COM35	PB	8	–
41	17429	0x4415	HIGH	Reserved	–	COM35	–	8	–
42	17430	0x4416	LOW	Reserved	–	–	–	8	–
43	17430	0x4416	HIGH	Property byte: Status of outputs of the digital output module 1	–	DO1	PB	8	–
44	17431	0x4417	LOW	Property byte: Status of outputs of the digital output module 2	–	DO2	PB	8	–

4.5.6 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 COM35 module are transmitted. It also contains the circuit breaker positions on the digital input modules and output modules on the CubicleBUS.

The following table contains the data set DS 69: Status of the modules (length 22 Modbus registers, read-only):

Table 4- 19 Content of data set 69

Byte offset	Modbus register			Description	Data point	Source WL	Format	Length (bits)	Scaling
	Address		High/Low						
	Dec	Hex							
0	17665	0x4501	LOW	Status of the inputs of digital input module 1	110	DI1	Hex	8	–
1	17665	0x4501	HIGH	Status of the inputs of digital input module 2	114	DI2	Hex	8	–
2	17666	0x4502	LOW	Reserved	–	–	–	8	–
3	17666	0x4502	HIGH	Circuit breaker position at the digital input module 1	111	DI1	Format (111)	8	–
4	17667	0x4503	LOW	Circuit breaker position at the digital input module 2	115	DI2	Format (111)	8	–
5	17667	0x4503	HIGH	Circuit breaker position at the digital output module 1	119	DO1	Format (119)	8	–
6	17668	0x4504	LOW	Circuit breaker position at the digital output module 2	124	DO2	Format (119)	8	–
7	17668	0x4504	–	Reserved	–	–	–	32	–
11	17670	0x4506	HIGH	Communication module write protection (WriteEnable)	14	COM35	Format (14)	1	–
12	17671	0x4507	LOW	Reserved	–	–	–	8	–
13	17671	0x4507	HIGH	6 Modbus communication module bits for the digital configurable output module	426	COM35	Format (426)	6	–
14	17672	0x4508	–	Reserved	–	–	–	120	–
29	17679	0x450F	HIGH	Property byte: 6 Modbus communication module bits for the digital configurable output module	–	COM35	PB	8	–
30	17680	0x4510	LOW	Property byte: Status of the inputs of digital input module 1	–	DI1	PB	8	–

Byte offset	Modbus register			Description	Data point	Source WL	Format	Length (bits)	Scaling
	Address		High/Low						
	Dec	Hex							
31	17680	0x4510	HIGH	Property byte: Status of the inputs of digital input module 2	–	DI2	PB	8	–
32	17681	0x4511	LOW	Reserved	–	–	–	8	–
33	17681	0x4511	HIGH	Property byte: Circuit breaker position at the digital input module 1	–	DI1	PB	8	–
34	17682	0x4512	LOW	Property byte: Circuit breaker position at the digital input module 2	–	DI2	PB	8	–
35	17682	0x4512	HIGH	Property byte: Circuit breaker position at the digital output module 1	–	DO1	PB	8	–
36	17683	0x4513	LOW	Property byte: Circuit breaker position at the digital output module 2	–	DO2	PB	8	–
37	17683	0x4513	–	Reserved	–	–	–	32	–
41	17685	0x4515	HIGH	Property byte: Communication module write protection (WriteEnable)	–	COM35	PB	8	–
42	17686	0x4516	LOW	Reserved	–	–	–	8	–

4.5.7 Data set DS 72: Min./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 following table contains the data set DS 72: Min./max. measured values of the currents and the associated time stamps (length 118 Modbus registers, read-only):

Table 4- 20 Content of data set 72

Byte offset	Modbus register			Description	Data point	Source WL	Format	Length (bits)	Scaling
	Address		High/Low						
	Dec	Hex							
0	18433	0x4801	–	Minimum current in phase 1	384	ETU	Unsigned int	16	0
2	18434	0x4802	–	Maximum current in phase 1	385	ETU	Unsigned int	16	0
4	18435	0x4803	–	Minimum current in phase 2	386	ETU	Unsigned int	16	0
6	18436	0x4804	–	Maximum current in phase 2	387	ETU	Unsigned int	16	0
8	18437	0x4805	–	Minimum current in phase 3	388	ETU	Unsigned int	16	0
10	18438	0x4806	–	Maximum current in phase 3	389	ETU	Unsigned int	16	0
12	18439	0x4807	–	Maximum current in neutral conductor	390	ETU	Unsigned int	16	0
14	18440	0x4808	–	Maximum current in neutral conductor	391	ETU	Unsigned int	16	0
16	18441	0x4809	–	Minimum current which flows to ground	392	ETU	Unsigned int	16	0
18	18442	0x480A	–	Maximum current which flows to ground	393	ETU	Unsigned int	16	0
20	18443	0x480B	–	Minimum mean value over 3 phases	394	ETU	Unsigned int	16	0
22	18444	0x480C	–	Maximum mean value over 3 phases	395	ETU	Unsigned int	16	0
24	18445	0x480D	–	Minimum long-time mean value of current	244	Meter. fct.	Unsigned int	16	0
26	18446	0x480E	–	Maximum long-time mean value of current	245	Meter. fct.	Unsigned int	16	0
28	18447	0x480F	LOW	Minimum peak factor	263	Meter. fct.	Unsigned char	8	−1
29	18447	0x480F	HIGH	Maximum peak factor	264	Meter. fct.	Unsigned char	8	−1
30	18448	0x4810	LOW	Minimum form factor	265	Meter. fct.	Unsigned char	8	−1

Byte offset	Modbus register			Description	Data point	Source WL	Format	Length (bits)	Scaling
	Address		High/Low						
	Dec	Hex							
31	18448	0x4810	HIGH	Maximum of the form factor	266	Meter. fct.	Unsigned char	8	−1
32	18449	0x4811	–	TS minimum current in phase L1	25	COM35	Time	64	–
40	18453	0x4815	–	TS maximum current in phase L1	26	COM35	Time	64	–
48	18457	0x4819	–	TS minimum current in phase L2	27	COM35	Time	64	–
56	18461	0x481D	–	TS maximum current in phase L2	28	COM35	Time	64	–
64	18465	0x4821	–	TS minimum current in phase L3	29	COM35	Time	64	–
72	18469	0x4825	–	TS maximum current in phase L3	30	COM35	Time	64	–
80	18473	0x4829	–	TS maximum mean value over 3 phases	31	COM35	Time	64	–
88	18477	0x482D	–	TS maximum mean value over 3 phases	32	COM35	Time	64	–
96	18481	0x4831	–	TS minimum long-time mean value of current	55	COM35	Time	64	–
104	18485	0x4835	–	TS maximum long-time mean value of current	56	COM35	Time	64	–
112	18489	0x4839	–	TS minimum current in neutral conductor	33	COM35	Time	64	–
120	18493	0x483D	–	TS maximum current in neutral conductor	34	COM35	Time	64	–
128	18497	0x4841	–	TS minimum current that flows to ground	35	COM35	Time	64	–
136	18501	0x4845	–	TS maximum current that flows to ground	36	COM35	Time	64	–
144	18505	0x4849	–	TS minimum peak factor	65	COM35	Time	64	–
152	18509	0x484D	–	TS maximum peak factor	66	COM35	Time	64	–
160	18513	0x4851	–	TS minimum form factor	67	COM35	Time	64	–
168	18517	0x4855	–	TS maximum form factor	68	COM35	Time	64	–
176	18521	0x4859	–	Reserved	–	–	–	192	–
200	18533	0x4865	LOW	Property byte: Minimum current in phase 1	–	ETU	PB	8	–

Byte offset	Modbus register			Description	Data point	Source WL	Format	Length (bits)	Scaling
	Address		High/Low						
	Dec	Hex							
201	18533	0x4865	HIGH	Property byte: Maximum current in phase 1	–	ETU	PB	8	–
202	18534	0x4866	LOW	Property byte: Minimum current in phase 2	–	ETU	PB	8	–
203	18534	0x4866	HIGH	Property byte: Maximum current in phase 2	–	ETU	PB	8	–
204	18535	0x4867	LOW	Property byte: Minimum current in phase 3	–	ETU	PB	8	–
205	18535	0x4867	HIGH	Property byte: Maximum current in phase 3	–	ETU	PB	8	–
206	18536	0x4868	LOW	Property byte: Minimum current in neutral conductor	–	ETU	PB	8	–
207	18536	0x4868	HIGH	Property byte: Maximum current in neutral conductor	–	ETU	PB	8	–
208	18537	0x4869	LOW	Property byte: Minimum current that flows to ground	–	ETU	PB	8	–
209	18537	0x4869	HIGH	Property byte for byte 18: Maximum current that flows to ground	–	ETU	PB	8	–
210	18538	0x486A	LOW	Property byte: Minimum mean value over 3 phases	–	ETU	PB	8	–
211	18538	0x486A	HIGH	Property byte: Maximum mean value over 3 phases	–	ETU	PB	8	–
212	18539	0x486B	LOW	Property byte: Minimum long-time mean value of current	–	Meter. fct.	PB	8	–
213	18539	0x486B	HIGH	Property byte: Maximum long-time mean value of current	–	Meter. fct.	PB	8	–
214	18540	0x486C	LOW	Property byte: Minimum peak factor	–	Meter. fct.	PB	8	–
215	18540	0x486C	HIGH	Property byte: Maximum peak factor	–	Meter. fct.	PB	8	–
216	18541	0x486D	LOW	Property byte: Minimum form factor	–	Meter. fct.	PB	8	–

Byte offset	Modbus register			Description	Data point	Source WL	Format	Length (bits)	Scaling
	Address		High/Low						
	Dec	Hex							
217	18541	0x486D	HIGH	Property byte: Maximum form factor	–	Meter. fct.	PB	8	–
218	18542	0x486E	LOW	Property byte: TS minimum current in phase L1	–	COM35	PB	8	–
219	18542	0x486E	HIGH	Property byte: TS maximum current in phase L1	–	COM35	PB	8	–
220	18543	0x486F	LOW	Property byte: TS minimum current in phase L2	–	COM35	PB	8	–
221	18543	0x486F	HIGH	Property byte: TS maximum current in phase L2	–	COM35	PB	8	–
222	18544	0x4870	LOW	Property byte: TS minimum current in phase L3	–	COM35	PB	8	–
223	18544	0x4870	HIGH	Property byte: TS maximum current in phase L3	–	COM35	PB	8	–
224	18545	0x4871	LOW	Property byte: TS maximum mean value over 3 phases	–	COM35	PB	8	–
225	18545	0x4871	HIGH	Property byte: TS maximum mean value over 3 phases	–	COM35	PB	8	–
226	18546	0x4872	LOW	Property byte: TS minimum long-time mean value of current	–	COM35	PB	8	–
227	18546	0x4872	HIGH	Property byte: TS maximum long-time mean value of current	–	COM35	PB	8	–
228	18547	0x4873	LOW	Property byte: TS minimum current in neutral conductor	–	COM35	PB	8	–
229	18547	0x4873	HIGH	Property byte: TS maximum current in neutral conductor	–	COM35	PB	8	–
230	18548	0x4874	LOW	Property byte: TS minimum current that flows to ground	–	COM35	PB	8	–
231	18548	0x4874	HIGH	Property byte: TS maximum current that flows to ground	–	COM35	PB	8	–

Byte offset	Modbus register		High/Low	Description	Data point	Source WL	Format	Length (bits)	Scaling
	Address								
	Dec	Hex							
232	18549	0x4875	LOW	Property byte: TS minimum peak factor	–	COM35	PB	8	–
233	18549	0x4875	HIGH	Property byte: TS maximum peak factor	–	COM35	PB	8	–
234	18550	0x4876	LOW	Property byte: TS minimum form factor	–	COM35	PB	8	–
235	18550	0x4876	HIGH	Property byte: TS maximum form factor	–	COM35	PB	8	–

4.5.8 Data set DS 73: Min./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 following table contains the data set DS 73: Min./max. measured values of the voltages and the associated time stamps (length 87 Modbus registers, read-only):

Table 4- 21 Content of data set 73

Byte offset	Modbus register		High/Low	Description	Data point	Source WL	Format	Length (bits)	Scaling
	Address								
	Dec	Hex							
0	18689	0x4901	–	Minimum phase-to-phase voltage between phase L1 and phase L2	205	Meter. fct.	Unsigned int	16	0
2	18690	0x4902	–	Maximum phase-to-phase voltage between phase L1 and phase L2	206	Meter. fct.	Unsigned int	16	0
4	18691	0x4903	–	Minimum phase-to-phase voltage between phase L2 and phase L3	207	Meter. fct.	Unsigned int	16	0
6	18692	0x4904	–	Maximum phase-to-phase voltage between phase L2 and phase L3	208	Meter. fct.	Unsigned int	16	0

Byte offset	Modbus register		High/Low	Description	Data point	Source WL	Format	Length (bits)	Scaling
	Address								
	Dec	Hex							
8	18693	0x4905	–	Minimum phase-to-phase voltage between phase L3 and phase L1	209	Meter. fct.	Unsigned int	16	0
10	18694	0x4906	–	Maximum phase-to-phase voltage between phase L3 and phase L1	210	Meter. fct.	Unsigned int	16	0
12	18695	0x4907	–	Minimum of the neutral point voltage phase L1	211	Meter. fct.	Unsigned int	16	0
14	18696	0x4908	–	Maximum of the neutral point voltage phase L1	212	Meter. fct.	Unsigned int	16	0
16	18697	0x4909	–	Minimum of the neutral point voltage phase L2	213	Meter. fct.	Unsigned int	16	0
18	18698	0x490A	–	Maximum of the neutral point voltage phase L2	214	Meter. fct.	Unsigned int	16	0
20	18699	0x490B	–	Minimum of the neutral point voltage phase L3	215	Meter. fct.	Unsigned int	16	0
22	18700	0x490C	–	Maximum of the neutral point voltage phase L3	216	Meter. fct.	Unsigned int	16	0
24	18701	0x490D	–	TS minimum phase-to-phase voltage between phase L1 and phase L2	37	COM35	Time	64	–
32	18705	0x4911	–	TS maximum phase-to-phase voltage between phase L1 and phase L2	38	COM35	Time	64	–
40	18709	0x4915	–	TS minimum phase-to-phase voltage between phase L2 and phase L3	39	COM35	Time	64	–
48	18713	0x4919	–	TS maximum phase-to-phase voltage between phase L2 and phase L3	40	COM35	Time	64	–
56	18717	0x491D	–	TS minimum phase-to-phase voltage between phase L3 and phase L1	41	COM35	Time	64	–
64	18721	0x4921	–	TS maximum phase-to-phase voltage between phase L3 and phase L1	42	COM35	Time	64	–

Byte offset	Modbus register		High/Low	Description	Data point	Source WL	Format	Length (bits)	Scaling
	Address								
	Dec	Hex							
72	18725	0x4925	–	TS minimum of the neutral point voltage phase L1	43	COM35	Time	64	–
80	18729	0x4929	–	TS maximum of the neutral point voltage phase L1	44	COM35	Time	64	–
88	18733	0x492D	–	TS minimum of the neutral point voltage phase 2	45	COM35	Time	64	–
96	18737	0x4931	–	TS maximum of the neutral point voltage phase L2	46	COM35	Time	64	–
104	18741	0x4935	–	TS minimum of the neutral point voltage phase L3	47	COM35	Time	64	–
112	18745	0x4939	–	TS maximum of the neutral point voltage phase L3	48	COM35	Time	64	–
120	18749	0x493D	–	Reserved	–	–	–	240	–
150	18764	0x494C	LOW	Property byte: Minimum phase-to-phase voltage between phase L1 and phase L2	–	Meter. fct.	PB	8	–
151	18764	0x494C	HIGH	Property byte: Maximum phase-to-phase voltage between phase L1 and phase L2	–	Meter. fct.	PB	8	–
152	18765	0x494D	LOW	Property byte: Minimum phase-to-phase voltage between phase L2 and phase L3	–	Meter. fct.	PB	8	–
153	18765	0x494D	HIGH	Property byte: Maximum phase-to-phase voltage between phase L2 and phase L3	–	Meter. fct.	PB	8	–
154	18766	0x494E	LOW	Property byte: Minimum phase-to-phase voltage between phase L3 and phase L1	–	Meter. fct.	PB	8	–
155	18766	0x494E	HIGH	Property byte for byte 10: Maximum phase-to-phase voltage between phase L3 and phase L1	–	Meter. fct.	PB	8	–

Byte offset	Modbus register			Description	Data point	Source WL	Format	Length (bits)	Scaling
	Address		High/Low						
	Dec	Hex							
156	18767	0x494F	LOW	Property byte: Minimum of the neutral point voltage phase L1	–	Meter. fct.	PB	8	–
157	18767	0x494F	HIGH	Property byte: Maximum of the neutral point voltage phase L1	–	Meter. fct.	PB	8	–
158	18768	0x4950	LOW	Property byte: Minimum of the neutral point voltage phase L2	–	Meter. fct.	PB	8	–
159	18768	0x4950	HIGH	Property byte: Maximum of the neutral point voltage phase L2	–	Meter. fct.	PB	8	–
160	18769	0x4951	LOW	Property byte: Minimum of the neutral point voltage phase L3	–	Meter. fct.	PB	8	–
161	18769	0x4951	HIGH	Property byte: Maximum of the neutral point voltage phase L3	–	Meter. fct.	PB	8	–
162	18770	0x4952	LOW	Property byte: TS minimum phase-to-phase voltage between phase L1 and phase L2	–	COM35	PB	8	–
163	18770	0x4952	HIGH	Property byte: TS maximum phase-to-phase voltage between phase L1 and phase L2	–	COM35	PB	8	–
164	18771	0x4953	LOW	Property byte: TS minimum phase-to-phase voltage between phase L2 and phase L3	–	COM35	PB	8	–
165	18771	0x4953	HIGH	Property byte for byte 48: TS maximum phase-to-phase voltage between phase L2 and phase L3	–	COM35	PB	8	–
166	18772	0x4954	LOW	Property byte: TS minimum phase-to-phase voltage between phase L3 and phase L1	–	COM35	PB	8	–
167	18772	0x4954	HIGH	Property byte: TS maximum phase-to-phase voltage between phase L3 and phase L1	–	COM35	PB	8	–

Byte offset	Modbus register		High/Low	Description	Data point	Source WL	Format	Length (bits)	Scaling
	Address								
	Dec	Hex							
168	18773	0x4955	LOW	Property byte: TS minimum of the neutral point voltage phase L1	–	COM35	PB	8	–
169	18773	0x4955	HIGH	Property byte: TS maximum of the neutral point voltage phase L1	–	COM35	PB	8	–
170	18774	0x4956	LOW	Property byte: TS minimum of the neutral point voltage phase L2	–	COM35	PB	8	–
171	18774	0x4956	HIGH	Property byte: TS maximum of the neutral point voltage phase L2	–	COM35	PB	8	–
172	18775	0x4957	LOW	Property byte: TS minimum of the neutral point voltage phase L3	–	COM35	PB	8	–
173	18775	0x4957	HIGH	Property byte: TS maximum of the neutral point voltage phase L3	–	COM35	PB	8	–

4.5.9 Data set DS 74: Min./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.

The following table contains the data set DS 74: Min./max. measured values of the powers:

Table 4- 22 Content of data set 74

Byte offset	Modbus register			Description	Data point	Source WL	Format	Length (bits)	Scaling
	Address		High/Low						
	Dec	Hex							
0	18945	0x4A01	–	Minimum of the mean value of the power factor	242	Meter. fct.	Signed int	16	−3
2	18946	0x4A02	–	Maximum of the mean value of the power factor	243	Meter. fct.	Signed int	16	−3
4	18947	0x4A03	–	Minimum of the mean value of apparent power	246	Meter. fct.	Unsigned int	16	0
6	18948	0x4A04	–	Maximum of the mean value of apparent power	247	Meter. fct.	Unsigned int	16	0
8	18949	0x4A05	–	Minimum of the mean value of active power	250	Meter. fct.	Unsigned int	16	0
10	18950	0x4A06	–	Maximum of the mean value of active power	251	Meter. fct.	Unsigned int	16	0
12	18951	0x4A07	–	Minimum of the mean value of reactive power	248	Meter. fct.	Unsigned int	16	0
14	18952	0x4A08	–	Maximum of the mean value of reactive power	249	Meter. fct.	Unsigned int	16	0
16	18953	0x4A09	–	TS minimum of the mean value of apparent power	57	COM35	Time	64	–
24	18957	0x4A0D	–	TS maximum of the mean value of apparent power	58	COM35	Time	64	–
32	18961	0x4A11	–	TS minimum of the mean value of active power	49	COM35	Time	64	–
40	18965	0x4A15	–	TS maximum of the mean value of active power	50	COM35	Time	64	–
48	18969	0x4A19	–	TS minimum of the mean value of reactive power	51	COM35	Time	64	–

Byte offset	Modbus register		High/Low	Description	Data point	Source WL	Format	Length (bits)	Scaling
	Address								
	Dec	Hex							
56	18973	0x4A1D	–	TS maximum of the mean value of reactive power	52	COM35	Time	64	–
64	18977	0x4A21	–	TS minimum of the mean value of the power factor	53	COM35	Time	64	–
72	18981	0x4A25	–	TS maximum of the mean value of the power factor	54	COM35	Time	64	–
80	18985	0x4A29	–	Reserved	–	–	–	320	–
120	19005	0x4A3D	LOW	Property byte: Minimum of the mean value of the power factor	–	Meter. fct.	PB	8	–
121	19005	0x4A3D	HIGH	Property byte: Maximum of the mean value of the power factor	–	Meter. fct.	PB	8	–
122	19006	0x4A3E	LOW	Property byte: Minimum of the mean value of apparent power	–	Meter. fct.	PB	8	–
123	19006	0x4A3E	HIGH	Property byte: Maximum of the mean value of apparent power	–	Meter. fct.	PB	8	–
124	19007	0x4A3F	LOW	Property byte: Minimum of the mean value of active power	–	Meter. fct.	PB	8	–
125	19007	0x4A3F	HIGH	Property byte: Maximum of the mean value of active power	–	Meter. fct.	PB	8	–
126	19008	0x4A40	LOW	Property byte: Minimum of the mean value of reactive power	–	Meter. fct.	PB	8	–
127	19008	0x4A40	HIGH	Property byte: Maximum of the mean value of reactive power	–	Meter. fct.	PB	8	–
128	19009	0x4A41	LOW	Property byte: TS minimum of the mean value of apparent power	–	COM35	PB	8	–
129	19009	0x4A41	HIGH	Property byte: TS maximum of the mean value of apparent power	–	COM35	PB	8	–

Byte offset	Modbus register		High/Low	Description	Data point	Source WL	Format	Length (bits)	Scaling
	Address								
	Dec	Hex							
130	19010	0x4A42	LOW	Property byte: TS minimum of the mean value of active power	–	COM35	PB	8	–
131	19010	0x4A42	HIGH	Property byte: TS maximum of the mean value of active power	–	COM35	PB	8	–
132	19011	0x4A43	LOW	Property byte: TS minimum of the mean value of reactive power	–	COM35	PB	8	–
133	19011	0x4A43	HIGH	Property byte: TS maximum of the mean value of reactive power	–	COM35	PB	8	–
134	19012	0x4A44	LOW	Property byte: TS minimum of the mean value of the power factor	–	COM35	PB	8	–
135	19012	0x4A44	HIGH	Property byte: TS maximum of the mean value of the power factor	–	COM35	PB	8	–

4.5.10 Data set DS 76: Min./max. measured values of frequency and THD

The table below shows the content of data set 76 in which the minimum and maximum measured values of frequency and THD are transmitted. It also contains the associated time stamps for these minimum and maximum measured values.

The following table contains the data set DS 76: Min./max. measured values of frequency/THD and the associated time stamps (length 46 Modbus registers, read-only):

Table 4- 23 Content of data set 76

Byte offset	Modbus register		High/Low	Description	Data point	Source WL	Format	Length (bits)	Scaling
	Address								
	Dec	Hex							
0	19457	0x4C01	–	Maximum frequency	253	Meter. fct.	Unsigned int	16	−2
2	19458	0x4C02	–	Minimum frequency	252	Meter. fct.	Unsigned int	16	−2
4	19459	0x4C03	LOW	Minimum THD of current	255	Meter. fct.	Unsigned char	8	0
5	19459	0x4C03	HIGH	Maximum THD of current	256	Meter. fct.	Unsigned char	8	0

Byte offset	Modbus register			Description	Data point	Source WL	Format	Length (bits)	Scaling
	Address		High/Low						
	Dec	Hex							
6	19460	0x4C04	LOW	Minimum THD of voltage	258	Meter. fct.	Unsigned char	8	0
7	19460	0x4C04	HIGH	Maximum THD of voltage	259	Meter. fct.	Unsigned char	8	0
8	19461	0x4C05	–	TS minimum frequency	59	COM35	Time	64	–
16	19465	0x4C09	–	TS maximum frequency	60	COM35	Time	64	–
24	19469	0x4C0D	–	TS minimum THD of current	61	COM35	Time	64	–
32	19473	0x4C11	–	TS maximum THD of current	62	COM35	Time	64	–
40	19477	0x4C15	–	TS minimum THD of voltage	63	COM35	Time	64	–
48	19481	0x4C19	–	TS maximum THD of voltage	64	COM35	Time	64	–
56	19485	0x4C1D	–	Reserved	–	–	–	192	–
80	19497	0x4C29	LOW	Property byte: Maximum frequency	–	Meter. fct.	PB	8	–
81	19497	0x4C29	HIGH	Property byte: Minimum frequency	–	Meter. fct.	PB	8	–
82	19498	0x4C2A	LOW	Property byte: Minimum THD of current	–	Meter. fct.	PB	8	–
83	19498	0x4C2A	HIGH	Property byte: Maximum THD of current	–	Meter. fct.	PB	8	–
84	19499	0x4C2B	LOW	Property byte: Minimum THD of voltage	–	Meter. fct.	PB	8	–
85	19499	0x4C2B	HIGH	Property byte: Maximum THD of voltage	–	Meter. fct.	PB	8	–
86	19500	0x4C2C	LOW	Property byte: TS minimum frequency	–	COM35	PB	8	–
87	19500	0x4C2C	HIGH	Property byte: TS maximum frequency	–	COM35	PB	8	–
88	19501	0x4C2D	LOW	Property byte: TS minimum THD of current	–	COM35	PB	8	–
89	19501	0x4C2D	HIGH	Property byte: TS maximum THD of current	–	COM35	PB	8	–
90	19502	0x4C2E	LOW	Property byte: TS minimum THD of voltage	–	COM35	PB	8	–
91	19502	0x4C2E	HIGH	Property byte: TS maximum THD of voltage	–	COM35	PB	8	–

4.5.11 Data set DS 77: Min./max. measured values of the temperatures

The table below shows the content of 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.

The following table contains the data set DS 77: Min./max. measured values of the temperatures:

Table 4- 24 Content of data set 77

Byte offset	Modbus register			Description	Data point	Source WL	Format	Length (bits)	Scaling
	Address		High/Low						
	Dec	Hex							
0	19713	0x4D01	LOW	Minimum temperature in the control cabinet	72	COM35	Signed char	8	0
1	19713	0x4D01	HIGH	Maximum temperature in the control cabinet	73	COM35	Signed char	8	0
2	19714	0x4D02	LOW	Minimum temperature in the circuit breaker	74	BSS	Signed char	8	0
3	19714	0x4D02	HIGH	Maximum temperature in the circuit breaker	75	BSS	Signed char	8	0
4	19715	0x4D03	–	TS minimum temperature in the control cabinet	76	COM35	Time	64	–
12	19719	0x4D07	–	TS maximum temperature in the control cabinet	77	COM35	Time	64	–
20	19723	0x4D0B	–	TS minimum temperature in the circuit breaker	78	COM35	Time	64	–
28	19727	0x4D0F	–	TS maximum temperature in the circuit breaker	79	COM35	Time	64	–
36	19731	0x4D13	–	Reserved	–	–	–	112	–
50	19738	0x4D1A	LOW	Property byte: Minimum temperature in the control cabinet	–	COM35	PB	8	–
51	19738	0x4D1A	HIGH	Property byte: Maximum temperature in the control cabinet	–	COM35	PB	8	–
52	19739	0x4D1B	LOW	Property byte: Minimum temperature in the circuit breaker	–	BSS	PB	8	–
53	19739	0x4D1B	HIGH	Property byte: Maximum temperature in the circuit breaker	–	BSS	PB	8	–
54	19740	0x4D1C	LOW	Property byte: TS minimum temperature in the control cabinet	–	COM35	PB	8	–

Byte offset	Modbus register		High/Low	Description	Data point	Source WL	Format	Length (bits)	Scaling
	Address								
	Dec	Hex							
55	19740	0x4D1C	HIGH	Property byte: TS maximum temperature in the control cabinet	–	COM35	PB	8	–
56	19741	0x4D1D	LOW	Property byte: TS minimum temperature in the circuit breaker	–	COM35	PB	8	–
57	19741	0x4D1D	HIGH	Property byte: TS maximum temperature in the circuit breaker	–	COM35	PB	8	–

4.5.12 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 following table contains the data set DS 91: Statistical information (length 42 Modbus registers, read-only):

Table 4- 25 Content of data set 91

Byte offset	Modbus register		High/Low	Description	Data point	Source WL	Format	Length (bits)	Scaling
	Address								
	Dec	Hex							
0	23297	0x5B01	–	Number of switching operations under load	80	COM35	Unsigned int	16	0
2	23298	0x5B02	–	Number of switching operations caused by trips	81	COM35	Unsigned int	16	0
4	23299	0x5B03	–	Switching cycle counter (for switching cycle on/off)	82	COM35	Unsigned int	16	0
6	23300	0x5B04	–	Runtime meter (when On + current > 0)	83	COM35	Unsigned long	32	0
10	23302	0x5B06	–	Date of the last parameter change	84	COM35	Time	64	–
18	23306	0x5B0A	–	Number of short-circuit trips (SI)	104	ETU	Unsigned int	16	0
20	23307	0x5B0B	–	Number of overload trips (L)	105	ETU	Unsigned int	16	0
22	23308	0x5B0C	–	Number of ground-fault trips (G)	106	ETU	Unsigned int	16	0
24	23309	0x5B0D	–	Total of switched-off I^2t values L1, L2, L3, N	107	ETU	Format (107)	128	0

Byte offset	Modbus register			Description	Data point	Source WL	Format	Length (bits)	Scaling
	Address		High/Low						
	Dec	Hex							
40	23317	0x5B15	LOW	Maintenance information about the main contacts	405	ETU	Format (405)	2	–
41	23317	0x5B15	–	Reserved	–	–	–	56	–
48	23321	0x5B19	–	Modules connected to the CubicleBUS	88	COM35	Format (88)	32	–
52	23323	0x5B1B	–	Reserved	–	–	–	144	–
70	23332	0x5B24	LOW	Property byte: Number of switching operations under load	–	COM35	PB	8	–
71	23332	0x5B24	HIGH	Property byte: Number of switching operations caused by trips	–	COM35	PB	8	–
72	23333	0x5B25	LOW	Property byte: Switching cycle counter (for switching cycle on/off)	–	COM35	PB	8	–
73	23333	0x5B25	HIGH	Property byte: Runtime meter (when On + current > 0)	–	COM35	PB	8	–
74	23334	0x5B26	LOW	Property byte: Date of the last parameter change	–	COM35	PB	8	–
75	23334	0x5B26	HIGH	Property byte: Number of short-circuit trips (SI)	–	ETU	PB	8	–
76	23335	0x5B27	LOW	Property byte: Number of overload trips (L)	–	ETU	PB	8	–
77	23335	0x5B27	HIGH	Property byte: Number of ground-fault trips (G)	–	ETU	PB	8	–
78	23336	0x5B28	LOW	Property byte: Total of switched-off I^2t values L1, L2, L3, N	–	ETU	PB	8	–
79	23336	0x5B28	HIGH	Property byte: Maintenance information about the main contacts	–	ETU	PB	8	–
80	23337	0x5B29	–	Reserved	–	–	–	24	–
83	23338	0x5B2A	HIGH	Property byte: Nodes on the CubicleBUS	–	COM35	PB	8	–

4.5.13 Data set DS 92: Diagnostic data

The table below shows the content of data set 92 in which the data for detailed diagnostics of the SENTRON circuit breakers is transmitted.

The following table contains the data set DS 92: Diagnostic data (length 97 Modbus registers, read-only):

Table 4- 26 Content of data set 92

Byte offset	Modbus register			Description	Data point	Source WL	Format	Length (bits)	Scaling
	Address		High/Low						
	Dec	Hex							
0	23553	0x5C01	LOW	Reserved	–	COM35	–	32	–
4	23555	0x5C03	–	SENTRON identification number (0x0E05)	–	COM35	Hex	16	–
6	23556	0x5C04	LOW	Fixed value 0x42	–	COM35	Hex	8	–
7	23556	0x5C04	HIGH	External diagnostic bit • 1 = Diagnosis • 0 = No diagnosis	–	COM35	Hex	1	–
8	23557	0x5C05	–	Fixed header; value 0x05 82 00 00 00	–	COM35	Hex	40	–
13	23559	0x5C07	HIGH	Reserved	–	–	Unsigned char	56	–
20	23563	0x5C0B	–	Modules connected to the CubicleBUS	88	COM35	Format (88)	32	–
24	23565	0x5C0D	–	Currently pending warnings	402	ETU	Format (402)	16	–
26	23566	0x5C0E	LOW	Last unacknowledged tripping operation of the trip unit	401	ETU	Format (401)	8	–
27	23566	0x5C0E	HIGH	Reserved	–	–	Unsigned char	8	–
28	23567	0x5C0F	–	Tripping operations by metering function/metering function PLUS	307	Meter. fct.	Format (307)	16	–
30	23568	0x5C10	–	Threshold warnings	308	Meter. fct.	Format (308)	32	–
34	23570	0x5C12	–	Current at the moment of switch-off	403	ETU	Unsigned int	16	1
36	23571	0x5C13	LOW	Phase at the moment of switch-off	404	ETU	Format (373)	3	–
37	23571	0x5C13	HIGH	Position of the circuit breaker in the frame	24	COM35	Format (24)	4	–
38	23572	0x5C14	–	Reserved	–	–	Unsigned char	16	–

Byte offset	Modbus register			Description	Data point	Source WL	Format	Length (bits)	Scaling
	Address		High/Low						
	Dec	Hex							
40	23573	0x5C15	LOW	Status of the circuit breaker (e.g. on/off/charged)	328	BSS	Format (328)	8	–
41	23573	0x5C15	HIGH	Reserved	–	–	Unsigned char	8	–
42	23574	0x5C16	–	Event log of the last 10 events with time	16	COM35	Format (16)	960	–
162	23634	0x5C52	–	Reserved	–	–	Unsigned char	144	–
180	23643	0x5C5B	LOW	Property byte: Modules connected to the CubicleBUS	–	COM35	PB	8	–
181	23643	0x5C5B	HIGH	Property byte: Currently pending warnings	–	ETU	PB	8	–
182	23644	0x5C5C	LOW	Property byte: Last unacknowledged tripping operation of the trip unit	–	ETU	PB	8	–
183	23644	0x5C5C	HIGH	Property byte: Tripping operations by metering function/metering function PLUS	–	Meter. fct.	PB	8	–
184	23645	0x5C5D	LOW	Property byte: Threshold warnings	–	Meter. fct.	PB	8	–
185	23645	0x5C5D	HIGH	Property byte: Current at the moment of switch-off	–	ETU	PB	8	–
186	23646	0x5C5E	LOW	Property byte: Phase at the moment of switch-off	–	ETU	PB	8	–
187	23646	0x5C5E	HIGH	Property byte: Position of the circuit breaker in the frame	–	COM35	PB	8	–
188	23647	0x5C5F	LOW	Reserved	–	–	Unsigned char	8	–
189	23647	0x5C5F	HIGH	Property byte: Status of the circuit breaker (e.g. on/off/charged)	–	BSS	PB	8	–
190	23648	0x5C60	LOW	Property byte: Event log of the last 10 events with time	–	COM35	PB	8	–
191	23648	0x5C60	–	Reserved	–	–	Unsigned char	24	–

4.5.14 Data set DS 93: Controlling the circuit breakers

The table below shows the content of data set 93, by which the SENTRON circuit breakers are closed, the min./max. buffers cleared, the outputs of the digital output modules forced, and the six available communication bits (can be output via the configurable digital output module) set.

The following table contains the data set DS 93: Controlling the circuit breakers (length 14 Modbus registers, write-only):

Table 4- 27 Content of data set 93

Byte offset	Modbus register			Description	Data point	Source WL	Format	Length (bits)	Scaling
	Address		High/Low						
	Dec	Hex							
0	23809	0x5D01	–	Header; value 0x00 00 00 00	–	COM35	–	32	–
4	23811	0x5D03	–	Controls the trip unit	406	ETU	Format (406)	16	–
6	23812	0x5D04	–	Reserved	–	–	Unsigned char	16	–
8	23813	0x5D05	LOW	Controls digital output module 1	121	DO1	Format (121)	8	–
9	23813	0x5D05	HIGH	Controls digital output module 2	126	DO2	Format (126)	8	–
10	23814	0x5D06	LOW	Controls the memories of the communication module (e.g. min./ max. values)	18	COM35	Format (18)	8	–
11	23814	0x5D06	HIGH	Reserved	–	COM35	–	8	–
12	23815	0x5D07	LOW	Reserved	–	–	Unsigned char	8	–
13	23815	0x5D07	HIGH	6 communication module bits for the digital configurable output module	426	COM35	Format (426)	6	–
14	23816	0x5D08	–	Reserved	–	–	Unsigned char	40	–
19	23818	0x5D0A	HIGH	Property byte: 6 communication module bits for the digital configurable output module	–	COM35	PB	8	–
20	23819	0x5D0B	LOW	Property byte: Controls the trip unit	–	ETU	PB	8	–
21	23819	0x5D0B	HIGH	Property byte: Re-served	–	Meter. fct.	PB	8	–
22	23820	0x5D0C	LOW	Property byte: Controls digital output module 1	–	DO1	PB	8	–
23	23820	0x5D0C	HIGH	Property byte: Controls digital output module 2	–	DO2	PB	8	–

Byte offset	Modbus register			Description	Data point	Source WL	Format	Length (bits)	Scaling
	Address		High/Low						
	Dec	Hex							
24	23821	0x5D0D	LOW	Property byte: Controls the memories of the communication module (e.g. min./ max. values)	–	COM35	PB	8	–
25	23821	0x5D0D	HIGH	Property byte: Controls the outputs of the communication module (e.g. switching the circuit breaker)	–	COM35	PB	8	–
26	23822	0x5D0E	LOW	Reserved	–	–	Unsigned char	8	–

4.5.15 Data set DS 94: Actual measured values

The table below shows the content of data set 94 in which all actual measured values are transmitted. The additional property bytes provide information on the availability and correctness of the measured values.

The following table contains the data set DS 94; actual measured values (length 99 Modbus register, read-only):

Table 4- 28 Content of data set 94 Modbus register address hex: 0x5E0x (dec: 24065 to 24079)

Byte offset	Modbus register			Description	Data point	Source WL	Format	Length (bits)	Scaling
	Address		High/Low						
	Dec	Hex							
0	24065	0x5E01	LOW	Phase unbalance current (as %)	172	Meter. fct.	Unsigned char	8	0
1	24065	0x5E01	HIGH	Reserved	–	–	Unsigned char	8	–
2	24066	0x5E02	–	Long-time mean value of 3-phase current	193	Meter. fct.	Unsigned int	16	0
4	24067	0x5E03	–	Long-time mean value of current L1	194	Meter. fct.	Unsigned int	16	0
6	24068	0x5E04	–	Long-time mean value of current L2	195	Meter. fct.	Unsigned int	16	0
8	24069	0x5E05	–	Long-time mean value of current L3	196	Meter. fct.	Unsigned int	16	0
10	24070	0x5E06	–	Current in phase L1	380	ETU	Unsigned int	16	0
12	24071	0x5E07	–	Current in phase L2	381	ETU	Unsigned int	16	0
14	24072	0x5E08	–	Current in phase L3	382	ETU	Unsigned int	16	0

Byte offset	Modbus register			Description	Data point	Source WL	Format	Length (bits)	Scaling
	Address		High/Low						
	Dec	Hex							
16	24073	0x5E09	–	Mean current value over the three phases	383	ETU	Unsigned int	16	0
18	24074	0x5E0A	–	Current in neutral conductor	375	ETU	Unsigned int	16	0
20	24075	0x5E0B	–	Current that flows to ground	376	ETU	Unsigned int	16	0
22	24076	0x5E0C	LOW	Phase unbalance voltage (in %)	173	Meter. fct.	Unsigned char	8	0
23	24076	0x5E0C	HIGH	Reserved	–	–	–	8	–
24	24077	0x5E0D	–	Phase-to-phase voltage between phase L1 and L2	197	Meter. fct.	Unsigned int	16	0
26	24078	0x5E0E	–	Phase-to-phase voltage between phase L2 and L3	198	Meter. fct.	Unsigned int	16	0
28	24079	0x5E0F	–	Phase-to-phase voltage between phase L3 and L1	199	Meter. fct.	Unsigned int	16	0

Table 4- 29 Content of data set 94 Modbus register address hex: 0x5E1x (dec: 24080 to 24095)

Byte offset	Modbus register			Description	Data point	Source WL	Format	Length (bits)	Scaling
	Address		High/Low						
	Dec	Hex							
30	24080	0x5E10	–	Neutral point voltage phase L1	200	Meter. fct.	Unsigned int	16	0
32	24081	0x5E11	–	Neutral point voltage phase L2	201	Meter. fct.	Unsigned int	16	0
34	24082	0x5E12	–	Neutral point voltage phase L3	202	Meter. fct.	Unsigned int	16	0
36	24083	0x5E13	–	Mean value of phase-to-phase voltage	203	Meter. fct.	Unsigned int	16	0
38	24084	0x5E14	–	Mean value of neutral point voltage	204	Meter. fct.	Unsigned int	16	0
40	24085	0x5E15	–	Total apparent power	217	Meter. fct.	Unsigned int	16	0
42	24086	0x5E16	–	Total active power	221	Meter. fct.	Signed int	16	0
44	24087	0x5E17	–	Active power in phase L1	222	Meter. fct.	Signed int	16	0
46	24088	0x5E18	–	Active power in phase L2	223	Meter. fct.	Signed int	16	0
48	24089	0x5E19	–	Active power in phase L3	224	Meter. fct.	Signed int	16	0
50	24090	0x5E1A	–	Total reactive power	225	Meter. fct.	Signed int	16	0
52	24091	0x5E1B	–	Long-time mean value of 3-phase active power	229	Meter. fct.	Signed int	16	0
54	24092	0x5E1C	–	Long-time mean value of active power in phase L1	230	Meter. fct.	Signed int	16	0
56	24093	0x5E1D	–	Long-time mean value of active power in phase L2	231	Meter. fct.	Signed int	16	0
58	24094	0x5E1E	–	Long-time mean value of active power in phase L3	232	Meter. fct.	Signed int	16	0
60	24095	0x5E1F	–	Long-time mean value of 3-phase apparent power	233	Meter. fct.	Unsigned int	16	0

Table 4- 30 Content of data set 94 Modbus register address hex: 0x5E2x (dec: 24096 to 24110)

Byte offset	Modbus register			Description	Data point	Source WL	Format	Length (bits)	Scaling
	Address		High/Low						
	Dec	Hex							
62	24096	0x5E20	–	Apparent power in phase L1	218	Meter. fct.	Unsigned int	16	0
64	24097	0x5E21	–	Apparent power in phase L2	219	Meter. fct.	Unsigned int	16	0
66	24098	0x5E22	–	Apparent power in phase L3	220	Meter. fct.	Unsigned int	16	0
68	24099	0x5E23	–	Long-time mean value of apparent power in phase L1	234	Meter. fct.	Unsigned int	16	0
70	24100	0x5E24	–	Long-time mean value of apparent power in phase L2	235	Meter. fct.	Unsigned int	16	0
72	24101	0x5E25	–	Long-time mean value of apparent power in phase L3	236	Meter. fct.	Unsigned int	16	0
74	24102	0x5E26	–	Long-time mean value of 3-phase reactive power	237	Meter. fct.	Signed int	16	0
76	24103	0x5E27	–	Reactive power in phase L1	226	Meter. fct.	Signed int	16	0
78	24104	0x5E28	–	Reactive power in phase L2	227	Meter. fct.	Signed int	16	0
80	24105	0x5E29	–	Reactive power in phase L3	228	Meter. fct.	Signed int	16	0
82	24106	0x5E2A	–	Active energy in normal direction [MWh]	238	Meter. fct.	Unsigned long	32	0
86	24108	0x5E2C	–	Active energy in reverse direction [MWh]	239	Meter. fct.	Unsigned long	32	0
90	24110	0x5E2E	–	Reactive energy in normal direction [MVArh]	240	Meter. fct.	Unsigned long	32	0

Table 4- 31 Content of data set 94 Modbus register address hex: 0x5E3x (dec: 24112 to 24127)

Byte offset	Modbus register			Description	Data point	Source WL	Format	Length (bits)	Scaling
	Address		High/Low						
	Dec	Hex							
94	24112	0x5E30	–	Reactive energy in reverse direction [MVArh]	241	Meter. fct.	Unsigned long	32	0
98	24114	0x5E32	–	Mean value of the power factor	168	Meter. fct.	Signed int	16	–3
100	24115	0x5E33	–	Power factor in phase L1	169	Meter. fct.	Signed int	16	–3
102	24116	0x5E34	–	Power factor in phase L2	170	Meter. fct.	Signed int	16	–3
104	24117	0x5E35	–	Power factor in phase L3	171	Meter. fct.	Signed int	16	–3
106	24118	0x5E36	–	Frequency	262	Meter. fct.	Unsigned int	16	–2
108	24119	0x5E37	LOW	THD of current	254	Meter. fct.	Unsigned char	8	0
109	24119	0x5E37	HIGH	THD of voltage	257	Meter. fct.	Unsigned char	8	0
110	24120	0x5E38	LOW	Form factor	261	Meter. fct.	Unsigned char	8	–1
111	24120	0x5E38	HIGH	Peak factor	260	Meter. fct.	Unsigned char	8	–1
112	24121	0x5E39	–	Frequency 3VL	396	–	Unsigned char	16	-2
114	24122	0x5E3A	LOW	Temperature in the control cabinet (measured in the COM35)	71	COM35	Signed char	8	0
115	24122	0x5E3A	HIGH	Temperature in circuit breaker (measured in the BSS)	330	BSS	Signed char	8	0
116	24123	0x5E3B	–	Active energy in normal direction [kWh]	433	Meter. fct.	Unsigned long	32	–
120	24125	0x5E3D	–	Active energy in reverse direction [kWh]	434	Meter. fct.	Unsigned long	32	–
124	24127	0x5E3F	–	Reactive energy in normal direction [kVArh]	435	Meter. fct.	Unsigned long	32	–

Table 4- 32 Content of data set 94 Modbus register address hex: 0x5E4x (dec: 24129 to 24143)

Byte offset	Modbus register			Description	Data point	Source WL	Format	Length (bits)	Scaling
	Address		High/Low						
	Dec	Hex							
128	24129	0x5E41	–	Reactive energy in reverse direction [kVArh]	436	Meter. fct.	Unsigned long	32	–
132	24131	0x5E43	–	Reserved	–	–	Unsigned char	32	–
136	24133	0x5E45	LOW	Property byte: Active energy in normal direction	–	Meter. fct.	PB	8	–
137	24133	0x5E45	HIGH	Property byte: Active energy in reverse direction	–	Meter. fct.	PB	8	–
138	24134	0x5E46	LOW	Property byte: Reactive energy in normal direction	–	Meter. fct.	PB	8	–
139	24134	0x5E46	HIGH	Property byte: Reactive energy in reverse direction	–	Meter. fct.	PB	8	–
140	24135	0x5E47	LOW	Property byte: Phase unbalance current (as %)	–	Meter. fct.	PB	8	–
141	24135	0x5E47	HIGH	Property byte: Long-time mean value of 3-phase current	–	Meter. fct.	PB	8	–
142	24136	0x5E48	LOW	Property byte: Long-time mean value of current L1	–	Meter. fct.	PB	8	–
143	24136	0x5E48	HIGH	Property byte: Long-time mean value of current L2	–	Meter. fct.	PB	8	–
144	24137	0x5E49	LOW	Property byte: Long-time mean value of current L3	–	Meter. fct.	PB	8	–
145	24137	0x5E49	HIGH	Property byte: Current in phase L1	–	ETU	PB	8	–
146	24138	0x5E4A	LOW	Property byte: Current in phase L2	–	ETU	PB	8	–
147	24138	0x5E4A	HIGH	Property byte: Current in phase L3	–	ETU	PB	8	–
148	24139	0x5E4B	LOW	Property byte: Mean current value over the three phases	–	ETU	PB	8	–
149	24139	0x5E4B	HIGH	Property byte: Current in neutral conductor	–	ETU	PB	8	–
150	24140	0x5E4C	LOW	Property byte: Current that flows to ground	–	ETU	PB	8	–

Byte offset	Modbus register			Description	Data point	Source WL	Format	Length (bits)	Scaling
	Address		High/Low						
	Dec	Hex							
151	24140	0x5E4C	HIGH	Property byte: Phase unbalance voltage (in %)	–	Meter. fct.	PB	8	–
152	24141	0x5E4D	LOW	Property byte: Phase-to-phase voltage between phase L1 and L2	–	Meter. fct.	PB	8	–
153	24141	0x5E4D	HIGH	Property byte: Phase-to-phase voltage between phase L2 and L3	–	Meter. fct.	PB	8	–
154	24142	0x5E4E	LOW	Property byte: Phase-to-phase voltage between phase L3 and L1	–	Meter. fct.	PB	8	–
155	24142	0x5E4E	HIGH	Property byte: Neutral point voltage phase L1	–	Meter. fct.	PB	8	–
156	24143	0x5E4F	LOW	Property byte: Neutral point voltage phase L2	–	Meter. fct.	PB	8	–
157	24143	0x5E4F	HIGH	Property byte: Neutral point voltage phase L3	–	Meter. fct.	PB	8	–

Table 4- 33 Content of data set 94 Modbus register address hex: 0x5E5x (dec: 24144 to 24159)

Byte offset	Modbus register			Description	Data point	Source WL	Format	Length (bits)	Scaling
	Address		High/Low						
	Dec	Hex							
158	24144	0x5E50	LOW	Property byte: Mean value of phase-to-phase voltage	–	Meter. fct.	PB	8	–
159	24144	0x5E50	HIGH	Property byte: Mean value of neutral point voltage	–	Meter. fct.	PB	8	–
160	24145	0x5E51	LOW	Property byte: Total apparent power	–	Meter. fct.	PB	8	–
161	24145	0x5E51	HIGH	Property byte: Total active power	–	Meter. fct.	PB	8	–
162	24146	0x5E52	LOW	Property byte: Active power in phase L1	–	Meter. fct.	PB	8	–
163	24146	0x5E52	HIGH	Property byte: Active power in phase L2	–	Meter. fct.	PB	8	–
164	24147	0x5E53	LOW	Property byte: Active power in phase L3	–	Meter. fct.	PB	8	–
165	24147	0x5E53	HIGH	Property byte: Total reactive power	–	Meter. fct.	PB	8	–
166	24148	0x5E54	LOW	Property byte: Long-time mean value of 3-phase active power	–	Meter. fct.	PB	8	–
167	24148	0x5E54	HIGH	Property byte: Long-time mean value of active power in phase L1	–	Meter. fct.	PB	8	–
168	24149	0x5E55	LOW	Property byte: Long-time mean value of active power in phase L2	–	Meter. fct.	PB	8	–
169	24149	0x5E55	HIGH	Property byte: Long-time mean value of active power in phase L3	–	Meter. fct.	PB	8	–
170	24150	0x5E56	LOW	Property byte: Long-time mean value of 3-phase apparent power	–	Meter. fct.	PB	8	–
171	24150	0x5E56	HIGH	Property byte: Apparent power in phase L1	–	Meter. fct.	PB	8	–
172	24151	0x5E57	LOW	Property byte: Apparent power in phase L2	–	Meter. fct.	PB	8	–
173	24151	0x5E57	HIGH	Property byte: Apparent power in phase L3	–	Meter. fct.	PB	8	–
174	24152	0x5E58	LOW	Property byte: Long-time mean value of apparent power in phase L1	–	Meter. fct.	PB	8	–

Byte offset	Modbus register			Description	Data point	Source WL	Format	Length (bits)	Scaling
	Address		High/Low						
	Dec	Hex							
175	24152	0x5E58	HIGH	Property byte: Long-time mean value of apparent power in phase L2	–	Meter. fct.	PB	8	–
176	24153	0x5E59	LOW	Property byte: Long-time mean value of apparent power in phase L3	–	Meter. fct.	PB	8	–
177	24153	0x5E59	HIGH	Property byte: Long-time mean value of 3-phase reactive power	–	Meter. fct.	PB	8	–
178	24154	0x5E5A	LOW	Property byte: Reactive power in phase L1	–	Meter. fct.	PB	8	–
179	24154	0x5E5A	HIGH	Property byte: Reactive power in phase L2	–	Meter. fct.	PB	8	–
180	24155	0x5E5B	LOW	Property byte: Reactive power in phase L3	–	Meter. fct.	PB	8	–
181	24155	0x5E5B	HIGH	Property byte: Active energy in normal direction	–	Meter. fct.	PB	8	–
182	24156	0x5E5C	LOW	Property byte: Active energy in reverse direction	–	Meter. fct.	PB	8	–
183	24156	0x5E5C	HIGH	Property byte: Reactive energy in normal direction	–	Meter. fct.	PB	8	–
184	24157	0x5E5D	LOW	Property byte: Reactive energy in reverse direction	–	Meter. fct.	PB	8	–
185	24157	0x5E5D	HIGH	Property byte: Mean value of the power factor	–	Meter. fct.	PB	8	–
186	24158	0x5E5E	LOW	Property byte: Power factor in phase L1	–	Meter. fct.	PB	8	–
187	24158	0x5E5E	HIGH	Property byte: Power factor in phase L2	–	Meter. fct.	PB	8	–
188	24159	0x5E5F	LOW	Property byte: Power factor in phase L3	–	Meter. fct.	PB	8	–
189	24159	0x5E5F	HIGH	Property byte: Frequency	–	Meter. fct.	PB	8	–

Table 4- 34 Content of data set 94 Modbus register address hex: 0x5E6x (dec: 24160 to 24163)

Byte offset	Modbus register			Description	Data point	Source WL	Format	Length (bits)	Scaling
	Address		High/Low						
	Dec	Hex							
190	24160	0x5E60	LOW	Property byte: THD of current	–	Meter. fct.	PB	8	–
191	24160	0x5E60	HIGH	Property byte: THD of voltage	–	Meter. fct.	PB	8	–
192	24161	0x5E61	LOW	Property byte: Form factor	–	Meter. fct.	PB	8	–
193	24161	0x5E61	HIGH	Property byte: Peak factor	–	Meter. fct.	PB	8	–
194	24162	0x5E62	LOW	Reserved	–	–	–	–	–
195	24162	0x5E62	HIGH	Property byte: Temperature in the control cabinet (measured in the COM15)	–	COM35	PB	8	–
196	24163	0x5E63	LOW	Property byte: Temperature in circuit breaker (measured in the BSS)	–	BSS	PB	8	–

4.5.16 Data set DS 97: Detailed identification

The table below shows the content of data set 97 from which all necessary information for precise identification of the SENTRON circuit breakers can be obtained.

The following table contains the data set DS 97: Detailed identification (length 112 Modbus registers, read-only):

Table 4- 35 Content of data set 97

Byte offset	Modbus register			Description	Data point	Source WL	Format	Length (bits)	Scaling
	Address		High/Low						
	Dec	Hex							
0	24833	0x6101	–	Article number of the trip unit	407	ETU	16 x char	144	–
18	24842	0x610A	–	Date of manufacture of trip unit	408	ETU	Time	64	–
26	24846	0x610E	–	Identification number of trip unit	409	ETU	17 x char	136	–
43	24854	0x6116	HIGH	Reserved	–	–	–	8	–
44	24855	0x6117	LOW	Ground fault transformer detection type	410	ETU	Format (410)	2	–
45	24855	0x6117	HIGH	N transformer connected	411	ETU	Format (411)	1	–
46	24856	0x6118	LOW	Reserved	–	–	–	8	–
47	24856	0x6118	HIGH	Market in which the trip unit is used	95	ETU	Format (95)	2	–
48	24857	0x6119	–	Identification number of circuit breaker	96	ETU	20 x char	160	–
68	24867	0x6123	–	Reserved	–	–	–	48	–
74	24870	0x6126	–	Test date of the circuit breaker	98	ETU	Time	64	–
82	24874	0x612A	LOW	Interrupting class	99	ETU	Format (99)	4	–
83	24874	0x612A	HIGH	Size	100	ETU	Format (100)	2	–
84	24875	0x612B	–	Rated voltage (LL) of the circuit breaker	101	ETU	Unsigned int	16	0
86	24876	0x612C	–	Rated current of the external G transformer	102	ETU	Unsigned int	16	0
88	24877	0x612D	–	Article number of the circuit breaker (trip unit VL)	103	ETU	Format (103)	160	–
108	24887	0x6137	–	Reserved	–	–	–	144	–
126	24896	0x6140	–	Article number of the trip unit	371	ETU	18 x char	144	–
144	24905	0x6149	LOW	Number of poles of circuit breaker	108	ETU	Format (108)	3	–

Byte offset	Modbus register		High/Low	Description	Data point	Source WL	Format	Length (bits)	Scaling
	Address								
	Dec	Hex							
145	24905	0x6149	HIGH	Reserved	–	–	–	8	–
146	24906	0x614A	–	Rating plug	377	ETU	Unsigned int	16	0
148	24907	0x614B	–	Circuit breaker frame	378	ETU	Unsigned int	16	0
150	24908	0x614C	–	Reserved	–	–	–	400	–
200	24933	0x6165	LOW	Property byte: Article number of the trip unit	–	ETU	PB	8	–
201	24933	0x6165	HIGH	Property byte: Date of manufacture of trip unit	–	ETU	PB	8	–
202	24934	0x6166	LOW	Property byte: Identification number of trip unit	–	ETU	PB	8	–
203	24934	0x6166	HIGH	Property byte: Ground fault transformer detection type	–	ETU	PB	8	–
204	24935	0x6167	LOW	Property byte: N transformer connected	–	ETU	PB	8	–
205	24935	0x6167	HIGH	Reserved	–	–	–	8	–
206	24936	0x6168	LOW	Property byte: Market in which the trip unit is used	–	ETU	PB	8	–
207	24936	0x6168	HIGH	Property byte: Identification number of circuit breaker	–	ETU	PB	8	–
208	24937	0x6169	LOW	Reserved	–	–	–	8	–
209	24937	0x6169	HIGH	Property byte: Test date of the circuit breaker	–	ETU	PB	8	–
210	24938	0x616A	LOW	Property byte: Interrupting class	–	ETU	PB	8	–
211	24938	0x616A	HIGH	Property byte: Size	–	ETU	PB	8	–
212	24939	0x616B	LOW	Property byte: Rated voltage (LL) of the circuit breaker	–	ETU	PB	8	–
213	24939	0x616B	HIGH	Property byte: Rated current of the external G transformer	–	ETU	PB	8	–
214	24940	0x616C	LOW	Property byte: Article number of the circuit breaker (trip unit VL)	–	ETU	PB	8	–
215	24940	0x616C	HIGH	Reserved	–	–	–	8	–
216	24941	0x616D	LOW	Property byte: Article number of the trip unit	–	ETU	PB	8	–

Byte offset	Modbus register			Description	Data point	Source WL	Format	Length (bits)	Scaling
	Address		High/Low						
	Dec	Hex							
217	24941	0x616D	HIGH	Property byte: Number of poles of circuit breaker	–	ETU	PB	8	–
218	24942	0x616E	LOW	Property byte: Rating plug	–	ETU	PB	8	–
219	24942	0x616E	HIGH	Property byte: Circuit breaker frame	–	ETU	PB	8	–
220	24943	0x616F	LOW	Reserved	–	–	–	8	–
221	24943	0x616F		Reserved	–	–	PB	16	–

4.5.17 Data set DS 100: Identification overview

The table below shows the content of data set 100, which contains the identification of the circuit breaker (e.g. test date, manufacturer, device name or family, device class).

The following table contains the data set DS 100: Identification overview (length 50 Modbus registers, read-only):

Table 4- 36 Content of data set 100

Byte offset	Modbus register			Description	Data point	Source WL	Format	Length (bits)	Scaling
	Address		High/Low						
	Dec	Hex							
0	25601	0x6401	–	Header; value 0x00 00 00 00	–	COM35	–	32	–
4	25603	0x6403	–	Test date of the circuit breaker	–	ETU	Time	64	–
12	25607	0x6407	–	Manufacturer (SIEMENS or SE&A)	–	COM35	20 x char	160	–
32	25617	0x6411	–	Device name (SENTRON WL)	–	COM35	24 x char	192	–
56	25629	0x641D	LOW	Device family (fixed value 0x03)	–	COM35	Hex	8	–
57	25629	0x641D	HIGH	Device bus family (fixed value 0x01)	–	COM35	Hex	8	–
58	25630	0x641E	LOW	Device class 1 = Air circuit breaker 2 = Molded case circuit breaker	–	COM35	Hex	8	–
59	25630	0x641E	HIGH	System (fixed value 0x06)	–	COM35	Hex	8	–
60	25631	0x641F	LOW	Function group: Bit 0.5 for COM35	–	COM35	Hex	8	–

Byte offset	Modbus register		High/Low	Description	Data point	Source WL	Format	Length (bits)	Scaling
	Address								
	Dec	Hex							
61	25631	0x641F	HIGH	Reserved	–	–	–	8	–
62	25632	0x6420	–	Abbreviated designation (PCB or MCCB)	–	COM35	16 x char	128	–
78	25640	0x6428	–	Hardware version	495	COM35	4 x char	32	–
82	25642	0x642A	–	PROFINET ID number (0x002A0E05)	–	COM35	Hex	32	–
86	25644	0x642C	–	Reserved	–	–	–	16	–
88	25645	0x642D	–	Service number (lower part of circuit breaker identification number)	–	COM35	8 x char	64	–
96	25649	0x6431	–	Firmware version of Modbus module	503	COM35	4 x char	32	–

4.5.18 Data set DS 128: Parameters of the metering function and enhanced protection function

The table below shows the content of data set 128 by which the parameters of the metering function and the enhanced protection function can be read out but also set. It also contains the assignments of the configurable digital output module.

The following table contains the data set DS 128: Parameters of the metering function and the enhanced protection function (length 52 Modbus registers, read/write):

Table 4- 37 Content of data set 128 Modbus register address hex 0x800x (dec 32769 … 32783)

Byte offset	Modbus register		High/Low	Description	Data point	Source WL	Format	Length (bits)	Scaling
	Address								
	Dec	Hex							
0	32769	0x8001	–	Header; value 0x00 00 00 00	–	COM35	–	32	–
4	32771	0x8003	LOW	The voltage transformer can be star (wye) or delta-connected on the primary side	162	Meter. fct.	Format (162)	1	–
5	32771	0x8003	HIGH	Reserved	–	–	–	8	–
6	32772	0x8004	–	Rated voltage of the system (on the primary side)	164	Meter. fct.	Unsigned int	16	0
8	32773	0x8005	LOW	Secondary voltage of transformer	165	Meter. fct.	Unsigned char	8	0
9	32773	0x8005	HIGH	Length of period for calculating long-time mean value	166	Meter. fct.	Unsigned char	8	0

Byte offset	Modbus register			Description	Data point	Source WL	Format	Length (bits)	Scaling
	Address		High/Low						
	Dec	Hex							
10	32774	0x8006	LOW	Number of sub-periods for calculating long-time mean value	167	Meter. fct.	Unsigned char	8	0
11	32774	0x8006	HIGH	Reserved	–	–	–	8	–
12	32775	0x8007	–	Lower limit of power transmission	372	ETU	Unsigned int	16	0
14	32776	0x8008	–	Active power in normal direction	141	Meter. fct.	Unsigned int	16	0
16	32777	0x8009	–	Active power in reverse direction	143	Meter. fct.	Unsigned int	16	0
18	32778	0x800A	LOW	Delay time for active power in normal direction	142	Meter. fct.	Unsigned char	8	0
19	32778	0x800A	HIGH	Delay time for active power in reverse direction	144	Meter. fct.	Unsigned char	8	0
20	32779	0x800B	LOW	Normal direction of incoming supply	145	Meter. fct.	Format (145)	1	–
21	32779	0x800B	HIGH	Direction of phase rotation	146	Meter. fct.	Format (146)	1	–
22	32780	0x800C	–	Underfrequency	147	Meter. fct.	Unsigned int	16	0
24	32781	0x800D	LOW	Delay time for overfrequency	150	Meter. fct.	Unsigned char	8	0
25	32781	0x800D	HIGH	Delay time for underfrequency	148	Meter. fct.	Unsigned char	8	0
26	32782	0x800E	–	Overfrequency	149	Meter. fct.	Unsigned int	16	0
28	32783	0x800F	LOW	THD of current	158	Meter. fct.	Unsigned char	8	0
29	32783	0x800F	HIGH	Delay time for THD of current	159	Meter. fct.	Unsigned char	8	0

Table 4- 38 Content of data set 128 Modbus register address hex 0x801x (dec 32784 … 32792)

Byte offset	Modbus register			Description	Data point	Source WL	Format	Length (bits)	Scaling
	Address		High/Low						
	Dec	Hex							
30	32784	0x8010	LOW	THD voltage	160	Meter. fct.	Unsigned char	8	0
31	32784	0x8010	HIGH	Delay time for THD of voltage	161	Meter. fct.	Unsigned char	8	0
32	32785	0x8011	LOW	Voltage unbalance	151	Meter. fct.	Unsigned char	8	0
33	32785	0x8011	HIGH	Delay time for voltage unbalance	152	Meter. fct.	Unsigned char	8	0
34	32786	0x8012	–	Undervoltage	153	Meter. fct.	Unsigned int	16	0
36	32787	0x8013	–	Overvoltage	155	Meter. fct.	Unsigned int	16	0
38	32788	0x8014	LOW	Delay time for undervoltage	154	Meter. fct.	Unsigned char	8	0
39	32788	0x8014	HIGH	Delay time for overvoltage	156	Meter. fct.	Unsigned char	8	0
40	32789	0x8015	LOW	Reserved	–	–	–	8	–
41	32789	0x8015	HIGH	Current unbalance	139	Meter. fct.	Unsigned char	8	0
42	32790	0x8016	LOW	Delay time for current unbalance	140	Meter. fct.	Unsigned char	8	0
43	32790	0x8016	HIGH	Reserved	–	–	–	8	–
44	32791	0x8017	–	Reserved	–	–	–	16	0
46	32792	0x8018	–	Assignment of the configured digital output module	129	Conf. DO	Format (129)	168	–

Table 4- 39 Content of data set 128 Modbus register address hex 0x802x (dec 32802 … 32815)

Byte offset	Modbus register			Description	Data point	Source WL	Format	Length (bits)	Scaling
	Address		High/Low						
	Dec	Hex							
67	32802	0x8022	–	Reserved	–	–	–	24	–
70	32804	0x8024	LOW	Property byte: The voltage transformer can be star (wye) or delta-connected on the primary side	–	Meter. fct.	PB	8	–
71	32804	0x8024	HIGH	Reserved	–	–	–	8	–
72	32805	0x8025	LOW	Property byte: Rated voltage of the system (on the primary side)	–	Meter. fct.	PB	8	–
73	32805	0x8025	HIGH	Property byte: Secondary voltage of transformer	–	Meter. fct.	PB	8	–
74	32806	0x8026	LOW	Property byte: Length of period for calculating long-time mean value	–	Meter. fct.	PB	8	–
75	32806	0x8026	HIGH	Property byte: Number of sub-periods for calculating long-time mean value	–	Meter. fct.	PB	8	–
76	32807	0x8027	LOW	Reserved	–	–	–	8	–
77	32807	0x8027	HIGH	Property byte 2: Lower limit of power transmission	–	ETU	PB	8	–
78	32808	0x8028	LOW	Property byte: Active power in normal direction	–	Meter. fct.	PB	8	–
79	32808	0x8028	HIGH	Property byte: Active power in reverse direction	–	Meter. fct.	PB	8	–
80	32809	0x8029	LOW	Property byte: Delay time for active power in normal direction	–	Meter. fct.	PB	8	–
81	32809	0x8029	HIGH	Property byte: Delay time for active power in reverse direction	–	Meter. fct.	PB	8	–
82	32810	0x802A	LOW	Property byte: Normal direction of incoming supply	–	Meter. fct.	PB	8	–
83	32810	0x802A	HIGH	Property byte: Direction of phase rotation	–	Meter. fct.	PB	8	–
84	32811	0x802B	LOW	Property byte: Underfrequency	–	Meter. fct.	PB	8	–
85	32811	0x802B	HIGH	Property byte: Delay time for overfrequency	–	Meter. fct.	PB	8	–

Byte offset	Modbus register		High/Low	Description	Data point	Source WL	Format	Length (bits)	Scaling
	Address								
	Dec	Hex							
86	32812	0x802C	LOW	Property byte: Delay time for underfrequency	–	Meter. fct.	PB	8	–
87	32812	0x802C	HIGH	Property byte: Overfrequency	–	Meter. fct.	PB	8	–
88	32813	0x802D	LOW	Property byte: THD of current	–	Meter. fct.	PB	8	–
89	32813	0x802D	HIGH	Property byte: Delay time for THD of current	–	Meter. fct.	PB	8	–
90	32814	0x802E	LOW	Property byte: THD of voltage	–	Meter. fct.	PB	8	–
91	32814	0x802E	HIGH	Property byte: Delay time for THD of voltage	–	Meter. fct.	PB	8	–
92	32815	0x802F	LOW	Property byte: Voltage unbalance	–	Meter. fct.	PB	8	–
93	32815	0x802F	HIGH	Property byte: Delay time for voltage unbalance	–	Meter. fct.	PB	8	–

Table 4- 40 Content of data set 128 Modbus register address hex 0x803x (dec 32816 … 32820)

Byte offset	Modbus register		High/Low	Description	Data point	Source WL	Format	Length (bits)	Scaling
	Address								
	Dec	Hex							
94	32816	0x8030	LOW	Property byte: Undervoltage	–	Meter. fct.	PB	8	–
95	32816	0x8030	HIGH	Property byte: Overvoltage	–	Meter. fct.	PB	8	–
96	32817	0x8031	LOW	Property byte: Delay time for undervoltage	–	Meter. fct.	PB	8	–
97	32817	0x8031	HIGH	Property byte: Delay time for overvoltage	–	Meter. fct.	PB	8	–
98	32818	0x8032	LOW	Property byte: Reserved	–	Meter. fct.	PB	8	–
99	32818	0x8032	HIGH	Property byte: Current unbalance	–	Meter. fct.	PB	8	–
100	32819	0x8033	LOW	Property byte: Delay time for current unbalance	–	Meter. fct.	PB	8	–
101	32819	0x8033	HIGH	Reserved	–	–	PB	8	–
102	32820	0x8034	LOW	Property byte: Assignment of the configurable digital output module	–	Conf. DO	PB	8	–

4.5.19 Data set DS 129: Parameters of the protection function and settings for load shedding and load pickup

The table below shows the content of data set 129 that contains the parameters of the protection function (e.g. overload protection, time-lag class, short-circuit protection, thermal memory, phase loss sensitivity), and the settings for load shedding and load pickup.

The following table contains DS 129: Parameters of the protection function and settings for load shedding and load pickup

Table 4- 41 Content of data set 129 Modbus register address hex 0x810x (dec 33025 … 33039)

Byte offset	Modbus register			Description	Data point	Source WL	Format	Length (bits)	Scaling
	Address		High/Low						
	Dec	Hex							
0	33025	0x8101	–	Header; value 0x00 00 00 00	–	COM35	–	32	–
4	33027	0x8103	–	Overload parameter I_R PS A	333	ETU	Unsigned int	16	0
6	33028	0x8104	–	Overload protection neutral conductor I_N PS A (WL)	334	ETU	Unsigned int	16	0
8	33029	0x8105	–	Time-lag class t_R PS A	335	ETU	Unsigned int	16	–1
10	33030	0x8106	–	Short-circuit protection instantaneous I_i PS A	336	ETU	Unsigned int	16	1
12	33031	0x8107	–	Short-circuit protection delayed I_{sd} PS A	337	ETU	Unsigned int	16	1
14	33032	0x8108	–	Delay time for short-circuit protection t_{sd} PS A	338	ETU	Unsigned int	16	–3
16	33033	0x8109	–	Ground-fault protection I_g PS A	339	ETU	Unsigned int	16	0
18	33034	0x810A	–	Delay time for ground fault t_g PS A	340	ETU	Unsigned int	16	–3
20	33035	0x810B	–	Ground-fault alarm I_{g2} PS A	341	ETU	Unsigned int	16	0
22	33036	0x810C	–	Delay time for ground-fault alarm t_{g2} PS A	342	ETU	Unsigned int	16	–3
24	33037	0x810D	LOW	I^2t characteristic for delayed short-circuit protection PS A	343	ETU	Format (343)	1	–
25	33037	0x810D	HIGH	I^2t characteristic for ground-fault protection PS A	344	ETU	Format (344)	1	–
26	33038	0x810E	LOW	I^4t characteristic for overload protection PS A	345	ETU	Format (345)	1	–
27	33038	0x810E	HIGH	Thermal memory PS A	346	ETU	Format (346)	1	–

Byte offset	Modbus register			Description	Data point	Source WL	Format	Length (bits)	Scaling
	Address		High/Low						
	Dec	Hex							
28	33039	0x810F	LOW	Phase loss sensitivity PS A	347	ETU	Format (347)	1	–
29	33039	0x810F	HIGH	Reserved	–	–	–	8	–

Table 4- 42 Content of data set 129 Modbus register address hex 0x811x (dec 33040 … 33055)

Byte offset	Modbus register			Description	Data point	Source WL	Format	Length (bits)	Scaling
	Address		High/Low						
	Dec	Hex							
30	33040	0x8110	–	Cooling time constant PS A	348	ETU	Unsigned int	16	0
32	33041	0x8111	–	Overload parameter I_R PS B	349	ETU	Unsigned int	16	0
34	33042	0x8112	–	Overload protection neutral conductor I_N PS B	350	ETU	Unsigned int	16	0
36	33043	0x8113	–	Time-lag class t_R PS B	351	ETU	Unsigned int	16	−1
38	33044	0x8114	–	Short-circuit protection instantaneous I_i PS B	352	ETU	Unsigned int	16	1
40	33045	0x8115	–	Short-circuit protection delayed I_{sd} PS B	353	ETU	Unsigned int	16	1
42	33046	0x8116	–	Delay time for short-circuit protection t_{sd} PS B	354	ETU	Unsigned int	16	−3
44	33047	0x8117	–	Ground-fault protection I_g PS B	355	ETU	Unsigned int	16	0
46	33048	0x8118	–	Delay time for ground fault t_g PS B	356	ETU	Unsigned int	16	−3
48	33049	0x8119	–	Ground-fault protection I_{g2} PS B	357	ETU	Unsigned int	16	0
50	33050	0x811A	–	Delay time for ground fault alarm t_{g2} PS B	358	ETU	Unsigned int	16	−3
52	33051	0x811B	LOW	I^2t characteristic for delayed short-circuit protection PS B	359	ETU	Format (343)	1	–
53	33051	0x811B	HIGH	I^2t characteristic for ground-fault protection PS B	360	ETU	Format (344)	1	–
54	33052	0x811C	LOW	I^4t characteristic for overload protection PS B	361	ETU	Format (345)	1	–
55	33052	0x811C	HIGH	Thermal memory PS B	362	ETU	Format (346)	1	–

Byte offset	Modbus register		High/Low	Description	Data point	Source WL	Format	Length (bits)	Scaling
	Address								
	Dec	Hex							
56	33053	0x811D	LOW	Phase loss sensitivity PS B	363	ETU	Format (347)	1	–
57	33053	0x811D	HIGH	Reserved	–	–	–	8	–
58	33054	0x811E	–	Cooling time constant PS B	364	ETU	Unsigned int	16	0
60	33055	0x811F	–	Load shedding	367	ETU	Unsigned int	16	0

Table 4- 43 Content of data set 129 Modbus register address hex 0x812x (dec 33056 … 33061)

Byte offset	Modbus register		High/Low	Description	Data point	Source WL	Format	Length (bits)	Scaling
	Address								
	Dec	Hex							
62	33056	0x8120	–	Load pickup	368	ETU	Unsigned int	16	0
64	33057	0x8121	LOW	Delay time for load shedding/pickup	366	ETU	Unsigned char	8	0
65	33057	0x8121	HIGH	Active parameter set	370	ETU	Format (370)	1	–
66	33058	0x8122	–	Reserved	–	–	–	16	0
68	33059	0x8123	LOW	Reserved	–	–	–	8	0
69	33059	0x8123	HIGH	Ground fault transformer detection type	410	ETU	Format (410)	2	–
70	33060	0x8124	–	Rated current of the external G transformer	102	ETU	Unsigned int	16	0
72	33061	0x8125	–	Reserved	331	–	–	208	–

Table 4- 44 Content of data set 129 Modbus register address hex 0x813x (dec 33074 … 33087)

Byte offset	Modbus register		High/Low	Description	Data point	Source WL	Format	Length (bits)	Scaling
	Address								
	Dec	Hex							
98	33074	0x8132	LOW	Property byte: Rated current of the external G transformer	333	ETU	PB	8	–
99	33074	0x8132	HIGH	Reserved	–	–	–	8	–
100	33075	0x8133	LOW	Property byte: Overload parameter I_R PS A	335	ETU	PB	8	–

Byte offset	Modbus register			Description	Data point	Source WL	Format	Length (bits)	Scaling
	Address		High/Low						
	Dec	Hex							
101	33075	0x8133	HIGH	Property byte: Overload protection neutral conductor I_N PS A (WL)	336	ETU	PB	8	–
102	33076	0x8134	LOW	Property byte: Time-lag class t_R PS A	337	ETU	PB	8	–
103	33076	0x8134	HIGH	Property byte: Short-circuit protection instantaneous I_i PS A	338	ETU	PB	8	–
104	33077	0x8135	LOW	Property byte: Short-circuit protection delayed I_{sd} PS A	339	ETU	PB	8	–
105	33077	0x8135	HIGH	Property byte: Delay time for short-circuit protection t_{sd} PS A	340	ETU	PB	8	–
106	33078	0x8136	LOW	Property byte: Ground-fault protection I_g PS A	341	ETU	PB	8	–
107	33078	0x8136	HIGH	Property byte: Delay time for ground fault t_g PS A	342	ETU	PB	8	–
108	33079	0x8137	LOW	Property byte: Ground-fault alarm I_{g2} PS A	343	ETU	PB	8	–
109	33079	0x8137	HIGH	Property byte: Delay time for ground-fault alarm t_{g2} PS A	344	ETU	PB	8	–
110	33080	0x8138	LOW	Property byte: I^2t characteristic for delayed short-circuit protection PS A	345	ETU	PB	8	–
111	33080	0x8138	HIGH	Property byte: I^2t characteristic for ground-fault protection PS A	346	ETU	PB	8	–
112	33081	0x8139	LOW	Property byte: I^4t characteristic for overload protection PS A	347	ETU	PB	8	–
113	33081	0x8139	HIGH	Property byte: Thermal memory PS A	348	ETU	PB	8	–
114	33082	0x813A	LOW	Property byte: Phase loss sensitivity PS A	349	ETU	PB	8	–
115	33082	0x813A	HIGH	Property byte: Cooling time constant PS A	350	ETU	PB	8	–
116	33083	0x813B	LOW	Property byte: Overload parameter I_R PS B	351	ETU	PB	8	–

Byte offset	Modbus register		High/Low	Description	Data point	Source WL	Format	Length (bits)	Scaling
	Address								
	Dec	Hex							
117	33083	0x813B	HIGH	Property byte: Overload protection neutral conductor I_N PS B	352	ETU	PB	8	–
118	33084	0x813C	LOW	Property byte: Time-lag class t_R PS B	353	ETU	PB	8	–
119	33084	0x813C	HIGH	Property byte: Short-circuit protection instantaneous I_i PS B	354	ETU	PB	8	–
120	33085	0x813D	LOW	Property byte: Short-circuit protection delayed I_{sd} PS B	355	ETU	PB	8	–
121	33085	0x813D	HIGH	Property byte: Delay time for short-circuit protection t_{sd} PS B	356	ETU	PB	8	–
122	33086	0x813E	LOW	Property byte: Ground-fault protection I_g PS B	357	ETU	PB	8	–
123	33086	0x813E	HIGH	Property byte: Delay time for ground fault t_g PS B	358	ETU	PB	8	–
124	33087	0x813F	LOW	Property byte: Ground fault alarm I_{g2} PS B	359	ETU	PB	8	–
125	33087	0x813F	HIGH	Property byte: Delay time for ground fault alarm t_{g2} PS B	360	ETU	PB	8	–

Table 4- 45 Content of data set 129 Modbus register address hex 0x814x (dec 33088 … 33094)

Byte offset	Modbus register		High/Low	Description	Data point	Source WL	Format	Length (bits)	Scaling
	Address								
	Dec	Hex							
126	33088	0x8140	LOW	Property byte: I^2t characteristic for delayed short-circuit protection PS B	361	ETU	PB	8	–
127	33088	0x8140	HIGH	Property byte: I^2t characteristic for ground-fault protection PS B	362	ETU	PB	8	–
128	33089	0x8141	LOW	Property byte: I^4t characteristic for overload protection PS B	363	ETU	PB	8	–
129	33089	0x8141	HIGH	Property byte: Thermal memory PS B	364	ETU	PB	8	–
130	33090	0x8142	LOW	Property byte: Phase loss sensitivity PS B	367	ETU	PB	8	–

Byte offset	Modbus register		High/Low	Description	Data point	Source WL	Format	Length (bits)	Scaling
	Address								
	Dec	Hex							
131	33090	0x8142	HIGH	Property byte: Cooling time constant PS B	368	ETU	PB	8	–
132	33091	0x8143	LOW	Property byte: Load shedding	366	ETU	PB	8	–
133	33091	0x8143	HIGH	Property byte: Load pickup	370	ETU	PB	8	–
134	33092	0x8144	LOW	Property byte: Delay time for load shedding/pickup	365	ETU	PB	8	–
135	33092	0x8144	HIGH	Property byte: Active parameter set	421	–	PB	8	–
136	33093	0x8145	–	Reserved	–	–	–	16	–
138	33094	0x8146	LOW	Property byte: Time lag class (SENTRON VL LCD ETU40M only)	331	–	PB	8	–

4.5.20 Data set DS 130: Parameters for the threshold values

The table below shows the content of the data set 130, in which the parameters for generating threshold warnings can be read out and modified.

The tables contain the data set 130: Parameters for the threshold values (length 74 Modbus registers, read/write):

Table 4- 46 Content of data set 130 Modbus register address hex 0x820x (dec 33281 … 33295)

Byte offset	Modbus register		High/Low	Description	Data point	Source WL	Format	Length (bits)	Scaling
	Address								
	Dec	Hex							
0	33281	0x8201	–	Header; value 0x00 00 00 00	–	COM35	–	32	–
4	33283	0x8203	–	Active power in normal direction	283	Meter. fct.	Unsigned int	16	0
6	33284	0x8204	–	Active power in reverse direction	285	Meter. fct.	Unsigned int	16	0
8	33285	0x8205	–	Power factor, capacitive	287	Meter. fct.	Signed int	16	−3
10	33286	0x8206	–	Power factor, inductive	289	Meter. fct.	Signed int	16	−3
12	33287	0x8207	LOW	Delay time for active power in normal direction	284	Meter. fct.	Unsigned char	8	0

Byte offset	Modbus register			Description	Data point	Source WL	Format	Length (bits)	Scaling
	Address		High/Low						
	Dec	Hex							
13	33287	0x8207	HIGH	Delay time for active power in reverse direction	286	Meter. fct.	Unsigned char	8	0
14	33288	0x8208	LOW	Delay time for power factor, capacitive	288	Meter. fct.	Unsigned char	8	0
15	33288	0x8208	HIGH	Delay time for power factor, inductive	290	Meter. fct.	Unsigned char	8	0
16	33289	0x8209	LOW	Overfrequency	303	Meter. fct.	Unsigned char	8	0
17	33289	0x8209	HIGH	Delay time for overfrequency	304	Meter. fct.	Unsigned char	8	0
18	33290	0x820A	LOW	Underfrequency	305	Meter. fct.	Unsigned char	8	0
19	33290	0x820A	HIGH	Delay time for underfrequency	306	Meter. fct.	Unsigned char	8	0
20	33291	0x820B	LOW	THD current	319	Meter. fct.	Unsigned char	8	0
21	33291	0x820B	HIGH	Delay time for THD current	320	Meter. fct.	Unsigned char	8	0
22	33292	0x820C	LOW	THD voltage	321	Meter. fct.	Unsigned char	8	0
23	33292	0x820C	HIGH	Delay time for THD voltage	322	Meter. fct.	Unsigned char	8	0
24	33293	0x820D	–	Peak factor	323	Meter. fct.	Unsigned int	16	–2
26	33294	0x820E	–	Form factor	325	Meter. fct.	Unsigned int	16	–2
28	33295	0x820F	LOW	Delay time for peak factor	324	Meter. fct.	Unsigned char	8	0
29	33295	0x820F	HIGH	Delay time for the form factor	326	Meter. fct.	Unsigned char	8	0

Table 4- 47 Content of data set 130 Modbus register address hex 0x821x (dec 33296 … 33311)

Byte offset	Modbus register			Description	Data point	Source WL	Format	Length (bits)	Scaling
	Address		High/Low						
	Dec	Hex							
30	33296	0x8210	–	Long-time mean value of active power	291	Meter. fct.	Unsigned int	16	0
32	33297	0x8211	–	Long-time mean value of apparent power	293	Meter. fct.	Unsigned int	16	0
34	33298	0x8212	LOW	Delay time long-time mean value of active power	292	Meter. fct.	Unsigned char	8	0
35	33298	0x8212	HIGH	Delay time long-time mean value of apparent power	294	Meter. fct.	Unsigned char	8	0
36	33299	0x8213	–	Long-time mean value of reactive power	295	Meter. fct.	Unsigned int	16	0
38	33300	0x8214	–	Reactive power in normal direction	297	Meter. fct.	Unsigned int	16	0
40	33301	0x8215	LOW	Delay time long-time mean value of reactive power	296	Meter. fct.	Unsigned char	8	0
41	33301	0x8215	HIGH	Delay time for reactive power in normal direction	298	Meter. fct.	Unsigned char	8	0
42	33302	0x8216	–	Reactive power in reverse direction	299	Meter. fct.	Unsigned int	16	0
44	33303	0x8217	–	Apparent power	301	Meter. fct.	Unsigned int	16	0
46	33304	0x8218	LOW	Delay time for reactive power in reverse direction	300	Meter. fct.	Unsigned char	8	0
47	33304	0x8218	HIGH	Delay time for apparent power	302	Meter. fct.	Unsigned char	8	0
48	33305	0x8219	–	Overcurrent	267	Meter. fct.	Unsigned int	16	0
50	33306	0x821A	–	Current that flows to ground	269	Meter. fct.	Unsigned int	16	0
52	33307	0x821B	–	Overcurrent in neutral conductor	271	Meter. fct.	Unsigned int	16	0
54	33308	0x821C	–	Long-time mean value of current	275	Meter. fct.	Unsigned int	16	0
56	33309	0x821D	LOW	Delay time for overcurrent	268	Meter. fct.	Unsigned char	8	0
57	33309	0x821D	HIGH	Delay time of current that flows to ground	270	Meter. fct.	Unsigned char	8	0
58	33310	0x821E	LOW	Delay time for overcurrent in neutral conductor	272	Meter. fct.	Unsigned char	8	0

Byte offset	Modbus register			Description	Data point	Source WL	Format	Length (bits)	Scaling
	Address		High/Low						
	Dec	Hex							
59	33310	0x821E	HIGH	Phase unbalance current	273	Meter. fct.	Unsigned char	8	0
60	33311	0x821F	LOW	Delay time for current phase unbalance	274	Meter. fct.	Unsigned char	8	0
61	33311	0x821F	HIGH	Delay time long-time mean value of current	276	Meter. fct.	Unsigned char	8	0

Table 4- 48 Content of data set 130 Modbus register address hex 0x822x (dec 33312 … 33316)

Byte offset	Modbus register			Description	Data point	Source WL	Format	Length (bits)	Scaling
	Address		High/Low						
	Dec	Hex							
62	33312	0x8220	–	Undervoltage	277	Meter. fct.	Unsigned int	16	0
64	33313	0x8221	LOW	Delay time for undervoltage	278	Meter. fct.	Unsigned char	8	0
65	33313	0x8221	HIGH	Phase unbalance voltage	279	Meter. fct.	Unsigned char	8	0
66	33314	0x8222	LOW	Delay time for voltage phase unbalance	280	Meter. fct.	Unsigned char	8	0
67	33314	0x8222	HIGH	Reserved	–	–	–	8	–
68	33315	0x8223	–	Overvoltage	281	Meter. fct.	Unsigned int	16	0
70	33316	0x8224	LOW	Delay time for overvoltage	282	Meter. fct.	Unsigned char	8	0
71	33316	0x8224	–	Reserved	–	–	–	232	–

Table 4- 49 Content of data set 130 Modbus register address hex 0x823x (dec 33331 … 33343)

Byte offset	Modbus register			Description	Data point	Source WL	Format	Length (bits)	Scaling
	Address		High/Low						
	Dec	Hex							
100	33331	0x8233	LOW	Property byte: Active power in normal direction	–	Meter. fct.	PB	8	–
101	33331	0x8233	HIGH	Property byte: Active power in reverse direction	–	Meter. fct.	PB	8	–
102	33332	0x8234	LOW	Property byte: Power factor, capacitive	–	Meter. fct.	PB	8	–
103	33332	0x8234	HIGH	Property byte: Power factor, inductive	–	Meter. fct.	PB	8	–
104	33333	0x8235	LOW	Property byte: Delay time for active power in normal direction	–	Meter. fct.	PB	8	–
105	33333	0x8235	HIGH	Property byte: Delay time for active power in reverse direction	–	Meter. fct.	PB	8	–
106	33334	0x8236	LOW	Property byte: Delay time for power factor, capacitive	–	Meter. fct.	PB	8	–
107	33334	0x8236	HIGH	Property byte: Delay time for power factor, inductive	–	Meter. fct.	PB	8	–
108	33335	0x8237	LOW	Property byte: Overfrequency	–	Meter. fct.	PB	8	–
109	33335	0x8237	HIGH	Property byte: Delay time for overfrequency	–	Meter. fct.	PB	8	–
110	33336	0x8238	LOW	Property byte: Underfrequency	–	Meter. fct.	PB	8	–
111	33336	0x8238	HIGH	Property byte: Delay time for underfrequency	–	Meter. fct.	PB	8	–
112	33337	0x8239	LOW	Property byte: THD current	–	Meter. fct.	PB	8	–
113	33337	0x8239	HIGH	Property byte: Delay time for THD current	–	Meter. fct.	PB	8	–
114	33338	0x823A	LOW	Property byte: THD voltage	–	Meter. fct.	PB	8	–
115	33338	0x823A	HIGH	Property byte: Delay time for THD voltage	–	Meter. fct.	PB	8	–
116	33339	0x823B	LOW	Property byte: Peak factor	–	Meter. fct.	PB	8	–
117	33339	0x823B	HIGH	Property byte: Form factor	–	Meter. fct.	PB	8	–
118	33340	0x823C	LOW	Property byte: Delay time for peak factor	–	Meter. fct.	PB	8	–

Byte offset	Modbus register		High/Low	Description	Data point	Source WL	Format	Length (bits)	Scaling
	Address								
	Dec	Hex							
119	33340	0x823C	HIGH	Property byte: Delay time for the form factor	–	Meter. fct.	PB	8	–
120	33341	0x823D	LOW	Property byte: Long-time mean value of active power	–	Meter. fct.	PB	8	–
121	33341	0x823D	HIGH	Property byte: Long-time mean value of apparent power	–	Meter. fct.	PB	8	–
122	33342	0x823E	LOW	Property byte: Delay time long-time mean value of active power	–	Meter. fct.	PB	8	–
123	33342	0x823E	HIGH	Property byte: Delay time long-time mean value of apparent power	–	Meter. fct.	PB	8	–
124	33343	0x823F	LOW	Property byte: Long-time mean value of reactive power	–	Meter. fct.	PB	8	–
125	33343	0x823F	HIGH	Property byte: Reactive power in normal direction	–	Meter. fct.	PB	8	–

Table 4- 50 Content of data set 130 Modbus register address hex 0x824x (dec 33344 … 33354)

Byte offset	Modbus register		High/Low	Description	Data point	Source WL	Format	Length (bits)	Scaling
	Address								
	Dec	Hex							
126	33344	0x8240	LOW	Property byte: Delay time long-time mean value of reactive power	–	Meter. fct.	PB	8	–
127	33344	0x8240	HIGH	Property byte: Delay time for reactive power in normal direction	–	Meter. fct.	PB	8	–
128	33345	0x8241	LOW	Property byte: Reactive power in reverse direction	–	Meter. fct.	PB	8	–
129	33345	0x8241	HIGH	Property byte: Apparent power	–	Meter. fct.	PB	8	–
130	33346	0x8242	LOW	Property byte: Delay time for reactive power in reverse direction	–	Meter. fct.	PB	8	–
131	33346	0x8242	HIGH	Property byte: Delay time for apparent power	–	Meter. fct.	PB	8	–

Byte offset	Modbus register			Description	Data point	Source WL	Format	Length (bits)	Scaling
	Address		High/Low						
	Dec	Hex							
132	33347	0x8243	LOW	Property byte: Over-current	–	Meter. fct.	PB	8	–
133	33347	0x8243	HIGH	Property byte: Current that flows to ground	–	Meter. fct.	PB	8	–
134	33348	0x8244	LOW	Property byte: Over-current in neutral conductor	–	Meter. fct.	PB	8	–
135	33348	0x8244	HIGH	Property byte: Long-time mean value of current	–	Meter. fct.	PB	8	–
136	33349	0x8245	LOW	Property byte: Delay time for overcurrent	–	Meter. fct.	PB	8	–
137	33349	0x8245	HIGH	Property byte: Delay time of current that flows to ground	–	Meter. fct.	PB	8	–
138	33350	0x8246	LOW	Property byte: Delay time for overcurrent in neutral conductor	–	Meter. fct.	PB	8	–
139	33350	0x8246	HIGH	Property byte: Phase unbalance current	–	Meter. fct.	PB	8	–
140	33351	0x8247	LOW	Property byte: Delay time for current phase unbalance	–	Meter. fct.	PB	8	–
141	33351	0x8247	HIGH	Property byte: Delay time long-time mean value of current	–	Meter. fct.	PB	8	–
142	33352	0x8248	LOW	Property byte: Un-dervoltage	–	Meter. fct.	PB	8	–
143	33352	0x8248	HIGH	Property byte: Delay time for undervoltage	–	Meter. fct.	PB	8	–
144	33353	0x8249	LOW	Property byte: Phase unbalance voltage	–	Meter. fct.	PB	8	–
145	33353	0x8249	HIGH	Property byte: Delay time for voltage phase unbalance	–	Meter. fct.	PB	8	–
146	33354	0x824A	LOW	Property byte: Over-voltage	–	Meter. fct.	PB	8	–
147	33354	0x824A	HIGH	Property byte: Delay time for overvoltage	–	Meter. fct.	PB	8	–

4.5.21 Data set DS 131: Switching the parameters for the enhanced protection function and the threshold values on/off

The table below shows the content of data set 131 in whose property bytes the parameters of the protection function, the enhanced protection function, and the threshold parameters can be switched on and switched off.

The following table contains the data set DS 131: Parameters for switching the parameters for the enhanced protection function and the threshold values on/off (length 35 Modbus registers, read/write):

Table 4- 51 Content of data set 131 Modbus register address hex 0x830x (dec 33537 to 33551)

Byte offset	Modbus register			Description	Data point	Source WL	Format	Length (bits)	Scaling
	Address		High/Low						
	Dec	Hex							
0	33537	0x8301	–	Header; value 0x00 00 00 00	–	COM35	–	32	–
4	33539	0x8303	LOW	Property byte: Overload parameter I_R PS A	–	ETU	PB	8	–
5	33539	0x8303	HIGH	Property byte: Overload protection neutral conductor I_N PS A (WL)	–	ETU	PB	8	–
6	33540	0x8304	LOW	Property byte: Short-circuit protection instantaneous I_i PS A	–	ETU	PB	8	–
7	33540	0x8304	HIGH	Property byte: Short-circuit protection delayed I_{sd} PS A	–	ETU	PB	8	–
8	33541	0x8305	LOW	Property byte: Ground-fault protection I_g PS A	–	ETU	PB	8	–
9	33541	0x8305	HIGH	Property byte: Ground-fault alarm I_{g2} PS A	–	ETU	PB	8	–
10	33542	0x8306	LOW	Property byte: Overload parameter I_R PS B	–	ETU	PB	8	–
11	33542	0x8306	HIGH	Property byte: Overload protection neutral conductor I_N PS B	–	ETU	PB	8	–
12	33543	0x8307	LOW	Property byte: Short-circuit protection instantaneous I_i PS B	–	ETU	PB	8	–
13	33543	0x8307	HIGH	Property byte: Short-circuit protection delayed I_{sd} PS B	–	ETU	PB	8	–
14	33544	0x8308	LOW	Property byte: Ground-fault protection I_g PS B	–	ETU	PB	8	–

Byte offset	Modbus register			Description	Data point	Source WL	Format	Length (bits)	Scaling
	Address		High/Low						
	Dec	Hex							
15	33544	0x8308	HIGH	Property byte: Ground fault alarm I_{g2} PS B	–	ETU	PB	8	–
16	33545	0x8309	LOW	Property byte: Active power in normal direction	–	Meter. fct.	PB	8	–
17	33545	0x8309	HIGH	Property byte: Active power in reverse direction	–	Meter. fct.	PB	8	–
18	33546	0x830A	LOW	Property byte: Direction of phase rotation	–	Meter. fct.	PB	8	–
19	33546	0x830A	HIGH	Property byte: Underfrequency	–	Meter. fct.	PB	8	–
20	33547	0x830B	LOW	Property byte: Overfrequency	–	Meter. fct.	PB	8	–
21	33547	0x830B	HIGH	Property byte: THD of current	–	Meter. fct.	PB	8	–
22	33548	0x830C	LOW	Property byte: THD of current	–	Meter. fct.	PB	8	–
23	33548	0x830C	HIGH	Property byte: Voltage unbalance	–	Meter. fct.	PB	8	–
24	33549	0x830D	LOW	Property byte: Undervoltage	–	Meter. fct.	PB	8	–
25	33549	0x830D	HIGH	Property byte: Overvoltage	–	Meter. fct.	PB	8	–
26	33550	0x830E	LOW	Property byte: Current unbalance	–	Meter. fct.	PB	8	–
27	33550	0x830E	HIGH	Property byte: Active power in normal direction	–	Meter. fct.	PB	8	–
28	33551	0x830F	LOW	Property byte: Active power in reverse direction	–	Meter. fct.	PB	8	–
29	33551	0x830F	HIGH	Property byte: Power factor, capacitive	–	Meter. fct.	PB	8	–

Table 4- 52 Content of data set 131 Modbus register address hex 0x831x (dec 33552 to 33551)

Byte offset	Modbus register			Description	Data point	Source WL	Format	Length (bits)	Scaling
	Address		High/Low						
	Dec	Hex							
30	33552	0x8310	LOW	Property byte: Power factor, inductive	–	Meter. fct.	PB	8	–
31	33552	0x8310	HIGH	Property byte: Overfrequency	–	Meter. fct.	PB	8	–
32	33553	0x8311	LOW	Property byte: Underfrequency	–	Meter. fct.	PB	8	–
33	33553	0x8311	HIGH	Property byte: THD current	–	Meter. fct.	PB	8	–
34	33554	0x8312	LOW	Property byte: THD voltage	–	Meter. fct.	PB	8	–
35	33554	0x8312	HIGH	Property byte: Peak factor	–	Meter. fct.	PB	8	–
36	33555	0x8313	LOW	Property byte: Form factor	–	Meter. fct.	PB	8	–
37	33555	0x8313	HIGH	Property byte: Long-time mean value of active power	–	Meter. fct.	PB	8	–
38	33556	0x8314	LOW	Property byte: Long-time mean value of apparent power	–	Meter. fct.	PB	8	–
39	33556	0x8314	HIGH	Property byte: Long-time mean value of reactive power	–	Meter. fct.	PB	8	–
40	33557	0x8315	LOW	Property byte: Reactive power in normal direction	–	Meter. fct.	PB	8	–
41	33557	0x8315	HIGH	Property byte: Reactive power in reverse direction	–	Meter. fct.	PB	8	–
42	33558	0x8316	LOW	Property byte: Apparent power	–	Meter. fct.	PB	8	–
43	33558	0x8316	HIGH	Property byte: Overcurrent	–	Meter. fct.	PB	8	–
44	33559	0x8317	LOW	Property byte: Current that flows to ground	–	Meter. fct.	PB	8	–
45	33559	0x8317	HIGH	Property byte: Overcurrent in neutral conductor	–	Meter. fct.	PB	8	–
46	33560	0x8318	LOW	Property byte: Long-time mean value of current	–	Meter. fct.	PB	8	–
47	33560	0x8318	HIGH	Property byte: Phase unbalance current	–	Meter. fct.	PB	8	–
48	33561	0x8319	LOW	Property byte: Undervoltage	–	Meter. fct.	PB	8	–

Byte offset	Modbus register			Description	Data point	Source WL	Format	Length (bits)	Scaling
	Address		High/Low						
	Dec	Hex							
49	33561	0x8319	HIGH	Property byte: Phase unbalance voltage	–	Meter. fct.	PB	8	–
50	33562	0x831A	LOW	Property byte: Over-voltage	–	Meter. fct.	PB	8	–
51	33562	0x831A	HIGH	Reserved	–	–	–	8	–
52	33563	0x831B	LOW	Property byte: Thermal memory PS A	–	ETU	PB	8	–
53	33563	0x831B	HIGH	Reserved	–	–	–	8	–
54	33564	0x831C	LOW	Property byte: N trans-former connected	–	ETU	PB	8	–
55	33564	0x831C	–	Reserved	–	–	–	120	–

4.5.22 Data set DS 160: Parameters for communication

The following table shows data set 160, in which the parameters for reading out and setting the communication are stored.

The table contains the data set DS 160: Parameters for communication (length 39 Modbus registers, read/write):

Table 4- 53 Content of data set 160

Byte offset	Modbus register			Description	Data point	Source WL	Format	Length (bits)	Scaling
	Address		High/Low						
	Dec	Hex							
0	40961	0xA001	–	Header; value 0x00 00 00 00	–	COM35	–	32	–
4	40963	0xA003	LOW	Reserved	–	–	–	16	–
6	40964	0xA004	LOW	Basic type of Modbus data transfer	6	COM35	Hex	2	–
7	40964	0xA004	HIGH	Reserved	–	–	–	8	–
8	40965	0xA005	–	Data in the cyclic pro-file of Modbus	7	COM35	Format (7)	224	–
36	40979	0xA013	–	Reserved	–	–	–	48	–
47	40985	0xA019	–	Reserved	–	–	–	200	–
72	40997	0xA025	LOW	Property byte: Basic type of Modbus data transfer	6	COM35	PB	8	–
73	40997	0xA025	HIGH	Reserved	–	–	–	8	–
74	40998	0xA026	LOW	Property byte: Data in the cyclic profile of Modbus	7	COM35	PB	8	–
75	40998	0xA026	HIGH	Reserved	–	–	–	8	–

4.5.23 Data set DS 161: Parameters for communication

The following table shows the content of data set 161, in which the parameters for reading out and setting the communication of the COM35 are stored.

The table contains the data set DS 161: Parameters for communication (length 82 Modbus registers, read/write):

Table 4- 54 Content of data set 161

Byte offset	Modbus register			Description	Data point	Source WL	Format	Length (bits)	Scaling
	Address		High/Low						
	Dec	Hex							
0	41217	0xA101	–	Header; value 0x00 00 00 00	–	COM35	–	32	–
4	41219	0xA103	–	Reserved	–	–	–	16	–
6	41220	0xA104	–	Structure for IPv4 device address, network mask and gateway of the COM35	476	COM35	Format (476)	96	–
18	41226	0xA10A	–	SNTP server IPv4 device address	479	COM35	Unsigned long	32	–
22	41228	0xA10C	–	SNTP operating mode	480	COM35	–	16	–
24	41229	0xA10D	–	SNTP port	481	COM35	Unsigned int	16	–
26	41230	0xA10E	–	Modbus TCP port	482	COM35	Unsigned int	16	–
28	41231	0xA10F	–	Switching IP filters on/off	486	COM35	–	16	–
30	41232	0xA110	–	COM35 MAC address	488	COM35	–	48	–
36	41235	0xA113	–	COM35 switch port 1 MAC address	489	–	–	48	–
42	41238	0xA116	–	COM35 switch port 2 MAC address	490	COM35	–	48	–
48	41241	0xA119	–	Activate device identification	522	COM35	–	16	–
50	41242	0xA11A	–	Controlling the inputs/outputs of the COM35	478	COM35	Format (478)	16	–
52	41243	0xA11B	–	COM35 firmware version	492	COM35	–	72	–
61	41247	0xA11F	HIGH	Reserved	–	–	–	704	–
149	41291	0xA14B	HIGH	Property byte: Structure for IPv4 device address, network mask and gateway of the COM35	–	COM35	PB	8	–
150	41292	0xA14C	LOW	Property byte: SNTP server IPv4 address	–	COM35	PB	8	–

Byte offset	Modbus register			Description	Data point	Source WL	Format	Length (bits)	Scaling
	Address		High/Low						
	Dec	Hex							
151	41292	0xA14C	HIGH	Property byte: SNTP operating mode	–	COM35	PB	8	–
152	41293	0xA14D	LOW	Property byte: SNTP port	–	COM35	PB	8	–
153	41293	0xA14D	HIGH	Property byte: Modbus TCP port	–	COM35	PB	8	–
154	41294	0xA14E	LOW	Property byte: Switching IP filters on/off	–	COM35	PB	8	–
155	41294	0xA14E	HIGH	Property byte: COM35 MAC address	–	COM35	PB	8	–
156	41295	0xA14F	LOW	Property byte: COM35 switch port 1 MAC address	–	COM35	PB	8	–
157	41295	0xA14F	HIGH	Property byte: COM35 switch port 2 MAC address	–	COM35	PB	8	–
158	41296	0xA150	LOW	Property byte: Activate device identification	–	COM35	PB	8	–
159	41296	0xA150	HIGH	Property byte: Controlling the inputs and outputs of the COM35	–	COM35	PB	8	–
160	41297	0xA151	LOW	Property byte: COM35 firmware version	–	COM35	PB	8	–
161	41297	0xA151	HIGH	Reserved	–	–	–	24	–

4.5.24 Data set DS 162: Device configuration

The table below shows the content of data set 162 that contains the device configuration. The circuit breaker currently connected can be read out in this data set.

The following table contains the data set DS 162: Device configuration (length 38 Modbus registers, read-only):

Table 4- 55 Content of data set 162

Byte offset	Modbus register			Description	Data point	Source WL	Format	Length (bits)	Scaling
	Address		High/Low						
	Dec	Hex							
0	41473	0xA201	–	Header; value 0x00 00 00 00	–	COM35	–	32	–
4	41475	0xA203	–	ID number of the COM35	91	COM35	16 x char	128	–
20	41483	0xA20B	–	Article number of circuit breaker	103	ETU	Format (103)	160	–
40	41493	0xA215	LOW	Type (metering function, metering function PLUS)	138	Meter. fct.	Format (138)	8	–
41	41493	0xA215	HIGH	Type of trip unit	412	ETU	Format (412)	5	–
42	41494	0xA216	–	Reserved	–	–	–	224	–
70	41508	0xA224	LOW	Property byte: ID number of the COM35	–	COM35	PB	8	–
71	41508	0xA224	HIGH	Property byte: Article number of circuit breaker	–	ETU	PB	8	–
72	41509	0xA225	LOW	Property byte: Type (metering function, metering function PLUS)	–	Meter. fct.	PB	8	–
73	41509	0xA225	HIGH	Property byte: Type of trip unit	–	ETU	PB	8	–
74	41510	0xA226	LOW	Reserved	–	–	–	8	–

4.5.25 Data set DS 163: Profinet device name

The following table contains the data set DS 163: Profinet device name:

Table 4- 56 Content of data set 163

Byte offset	Modbus register			Description	Data point	Source WL	Format	Length (bits)	Scaling
	Address		High/Low						
	Dec	Hex							
0	41729	0xA301	–	Header; value 0x00 00 00 00	–	COM35	–	32	–
4	41731	0xA303	–	PROFINET device name	509	COM35	–	1920	–
244	41751	0xA37B	LOW	Property byte: PROFINET device name	509	COM35	–	8	–

4.5.26 Data set DS 165: Identification comment

The table below shows the content of 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 following table contains the data set DS 165: Identification comment (length 97 Modbus registers, read/write):

Table 4- 57 Content of data set 165

Byte offset	Modbus register			Description	Data point	Source WL	Format	Length (bits)	Scaling
	Address		High/Low						
	Dec	Hex							
0	42241	0xA501	–	Header; value 0x00 00 00 00	–	COM35	–	32	–
4	42243	0xA503	–	User text (freely editable)	20	COM35	64 x char	512	–
68	42275	0xA523	–	Plant identifier (freely editable)	21	COM35	64 x char	512	–
132	42307	0xA543	–	Date (freely editable)	22	COM35	Time	64	–
140	42311	0xA547	–	Author (freely editable)	23	COM35	30 x char	240	–
170	42326	0xA556	–	Reserved	–	–	–	160	–
190	42336	0xA560	LOW	Property byte: User text (freely editable)	–	COM35	PB	8	–
191	42336	0xA560	HIGH	Property byte: Plant identifier (freely editable)	–	COM35	PB	8	–
192	42337	0xA561	LOW	Property byte: Date (freely editable)	–	COM35	PB	8	–
193	42337	0xA561	HIGH	Property byte: Author (freely editable)	–	COM35	PB	8	–

4.6 Formats

4.6.1 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 are 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.

4.6.2 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 4- 58 Standard data formats

Format	Length in byte	Signs	Value range unscaled	Use
Unsigned int	2	–	0 … 65535	e.g. measured values, parameters
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 Modbus is transferred in 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". In this case, the data type "unsigned char" indicates a "byte" that can assume a value from the range 0 to 255.

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 property byte

You will find the description of the format of the property byte PB in Chapter Table 4-61 Format (7) cyclic data in DP (Page 229).

Time format

The S7-compatible time format (DATE_AND_TIME) is used for communicating time stamps. The time stamp in RB100 is represented according to the PROFIBUS standard and is an exception to this rule.

Table 4- 59 Format time

Byte	Bit	Meaning
0	–	Year
1	–	Month
2	–	Day
3	–	Hour
4	–	Minute
5	–	Second
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 4- 60 PROFIBUS time format

Byte	Bit	Meaning
0	–	Higher-order digits of milliseconds
1	–	Low-order digits of milliseconds
2	–	Minute
3	0 … 4	Hour
3	7	• 1 = Daylight saving time • 0 = Standard time
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.

See also

Special data formats (Page 228)

4.6.3 Special data formats

Special data formats are used where the inflexible standard formats cannot be used, e.g. for binary coded or compound 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 most 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.

Format (7) cyclic data in DP

The table below shows the format (7) for the data in the cyclic profile of Modbus.

Table 4- 61 Format (7) cyclic data in DP

Byte	Meaning
0	Assignment (data point number) of the 1st data block in the cyclic telegram
2	Assignment (data point number) of the 2nd data block in the cyclic telegram
4	Assignment (data point number) of the 3rd data block in the cyclic telegram
6	Assignment (data point number) of the 4th data block in the cyclic telegram
8	Assignment (data point number) of the 5th data block in the cyclic telegram
10	Assignment (data point number) of the 6th data block in the cyclic telegram
12	Assignment (data point number) of the 7th data block in the cyclic telegram
14	Assignment (data point number) of the 8th data block in the cyclic telegram
16	Assignment (data point number) of the 9th data block in the cyclic telegram
18	Assignment (data point number) of the 10th data block in the cyclic telegram
20	Assignment (data point number) of the 11th data block in the cyclic telegram
22	Assignment (data point number) of the 12th data block in the cyclic telegram
24	Assignment (data point number) of the 13th data block in the cyclic telegram
26	Assignment (data point number) of the 14th data block in the cyclic telegram

Format (10) IP address

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 4- 62 Format (10) IP address

OFFSET (byte)	Meaning
0	Unsigned int: Sub-IP address X._._._
1	Unsigned int: Sub-IP address _.X._._
2	Unsigned int: Sub-IP address _._.X.__
3	Unsigned int: Sub-IP address _._._.X
4	Reserved

Format (14) Write protection

The table below shows the format (14) for write protection. The write protection can be deactivated using a hardware input on COM35.

Table 4- 63 Format (14) Write protection

Byte	Bit	Meaning
0	0	• 0 = Write protection active • 1 = No write protection active

4.6.4 Data formats 15 to 24

Format (15) "trip log"

The table below shows the format (15) "trip log". It contains the last 5 tripping operations with time stamp and source.

Table 4- 64 Format (15) "trip log"

Byte	Bit	Meaning
0 … 7	Time	Time stamp of the 1st tripping operation
8	–	Reserved 0x00
9	Trip reason	Trip reason 1st tripping operation • 1 = Overload • 2 = Instantaneous short-circuit • 3 = Delayed short-circuit • 4 = Ground fault • 5 = Enhanced protection function • 6 = Overload in neutral conductor • 7 = ETU self-protection (analog override) • 8 = Overtemperature • 20 = Current unbalance • 21 = Voltage unbalance • 22 = Active power in normal direction • 23 = Active power in reverse direction • 24 = Overvoltage • 25 = Undervoltage • 26 = Overfrequency • 27 = Underfrequency • 28 = THD current • 29 = THD voltage • 30 = Change direction of phase rotation
10	–	Source of 1st tripping operation • 14 = Metering function/M. PLUS • 25 = Trip unit
11	–	Reserved 0x00
12 … 19	–	Time stamp of the 2nd tripping operation
20	–	Reserved 0x00
21	–	Trip reason 2nd tripping operation
22	–	Source of 2nd tripping operation
23	–	Reserved 0x00
24 … 31	–	Time stamp of the 3rd tripping operation
32	–	Reserved 0x00

Byte	Bit	Meaning
33	–	Trip reason 3rd tripping operation
34	–	Source of 3rd tripping operation
35	–	Reserved 0x00
36 … 43	–	Time stamp of the 4th tripping operation
44	–	Reserved 0x00
45	–	Trip reason 4th tripping operation
46	–	Source of 4th tripping operation
47	–	Reserved 0x00
48 … 55	–	Time stamp of the 5th tripping operation
56	–	Reserved 0x00
57	–	Trip reason 5th tripping operation
58	–	Source of 5th tripping operation
59	–	Reserved 0x00

Format (16) "Event log"

The table below shows the format (16) "event log". It contains the last 10 events with time stamp. Example, see below.

Table 4- 65 Format (16) "Event log"

Byte	Bit	Meaning		
0 … 7	–	Time stamp of the 1st event		
8	–	Reserved 0x00		
9	–	Coming "+"	Going "–"	Event description
		1	2	Overload warning
		3	4	Overload warning neutral conductor
		5	6	Load shedding warning
		7	8	Load pickup message
		9	10	Phase unbalance warning
		11	12	Fault in trip unit
		13	14	Ground fault warning
		15	16	Overtemperature warning
		20	–	Circuit breaker closed
		21	–	Circuit breaker open
		40	41	TV current
		42	43	TV ground fault
		44	45	TV overcurrent in neutral conductor
		46	47	TV unbalance current
		48	49	TV long-time mean value for current
		50	51	TV undervoltage
		52	53	TV unbalance voltage

Byte	Bit	Meaning		
		54	55	TV overvoltage
		56	57	TV long-time mean value for active power
		58	59	TV long-time mean value for apparent power
		60	61	TV long-time 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
		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 = Metering function/M. PLUS • 25 = Trip unit		
11	–	Reserved 0x00		
12-19	–	Time stamp of 2nd event		
20	–	Reserved 0x00		
21	–	2nd event		
22	–	Source of 2nd event		
23	–	Reserved 0x00		
24-31	–	Time stamp of 3rd event		
32	–	Reserved 0x00		
33	–	3rd event		
34	–	Source of 3rd event		
35	–	Reserved 0x00		
36-43	–	Time stamp of 4th event		
44	–	Reserved 0x00		
45	–	4th event		
46	–	Source of 4th event		
47	–	Reserved 0x00		
48-55	–	Time stamp of 5th event		
56	–	Reserved 0x00		
57	–	5th event		

Byte	Bit	Meaning
58	–	Source of 5th event
59	–	Reserved 0x00
60-67	–	Time stamp of 6th event
68	–	Reserved 0x00
69	–	6th event
70	–	Source of 6th event
71	–	Reserved 0x00
72-79	–	Time stamp of 7th event
80	–	Reserved 0x00
81	–	7th event
82	–	Source of 7th event
83	–	Reserved 0x00
84-91	–	Time stamp of 8th event
92	–	Reserved 0x00
93	–	8th event
94	–	Source of 8th event
95	–	Reserved 0x00
96-103	–	Time stamp of 9th event
104	–	Reserved 0x00
105	–	9th event
106	–	Source of 9th event
107	–	Reserved 0x00
108-115	–	Time stamp of 10th event
116	–	Reserved 0x00
117	–	10th event
118	–	Source of 10th event
119	–	Reserved 0x00

Table 4- 66 Event log, example (incomplete or excerpts)

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

Format (18) "Control communication module"

The table below shows the format (18) "Control communication module" for changing the setting of the circuit breaker.

Table 4- 67 Format (18) "Control communication module"

Byte	Bit	Meaning
0	2	Resets the maintenance counters
0	3	Resets min./max. values for temperatures
0	4	Resets all min./max. values except for temperatures
0	5	Synchronizes the clock to xx:30:00.000
0	6	Deletes the contents of the trip log and event log

Format (24) "Position in frame"

The table below shows the format (24) "position in frame". Data point 24 states the position of the SENTRON WL in the guide frame.

Table 4- 68 Format (24) "Position in frame"

Byte	Value	Meaning
0	0	Disconnected position
0	1	Connected position
0	2	Test position
0	3	Circuit breaker not available

4.6.5 Data formats 88 to 162

Format (88) "CubicleBUS modules"

The table below shows the format (88) "CubicleBUS modules" that contains the modules connected on the CubicleBUS.

Table 4- 69 Format (88) "CubicleBUS modules"

Byte	Bit	Meaning
0	0	COM15 / COM16 / COM35
0	1	Trip unit ETU
0	2	ZSI module
1	0	Configurable digital output module
1	2	Digital output module No. 2
1	3	Digital input module No. 2
1	4	Breaker Status Sensor BSS
1	5	Digital output module No. 1
1	6	Digital input module No. 1
2	1	BDA PLUS
2	3	Graphical display ETU76B/ETU776
2	4	Analog output module No. 2
2	5	Analog output module No. 1
2	6	Metering function or metering function PLUS

Format (95) "Market"

The table below shows the format (95) "Market" specifying the market for which the circuit breaker has been built and tested.

Table 4- 70 Format (95) "Market"

Byte	Value	Meaning
0	1	IEC
0	2	UL
0	3	ANSI

Format (99) "Interrupting class"

The table below shows the format (99) "Interrupting class" that specifies the maximum level of the breaking current.

Table 4- 71 Format (99) "Interrupting class"

Byte	Value	Meaning
0	2	ECO breaking capacity N / IntClassN
0	3	Standard breaking capacity S / IntClassS
0	4	High breaking capacity H / IntClassH
0	5	Extremely high breaking capacity C / IntClassC

Format (100) "Size"

The table below shows the format (100) "Size". The size is determined by the rated circuit breaker current and the interrupting class.

Table 4- 72 Format (100) "Size"

Byte	Value	Meaning
0	1	Size 1
0	2	Size 2
0	3	Size 3

Format (103) "Article number CB"

The table below shows the format (103) "Article number CB" by which the circuit breaker can be identified.

Table 4- 73 Format (103) "Article number CB"

Byte	Bit	Meaning
0	–	3
1	–	W
2	–	L
3	–	Market
4	–	Size
5 … 6	–	Rated current
7	–	Hyphen
8	–	Interrupting class
9	–	ETU • E = ETU45B without display • F = ETU45B with display • Y = ETU55B, N = ETU76B
10	–	ETU supplement • B = Without ground-fault module • G = With ground-fault module
11	–	Number of poles
12	–	Type of main connections
13	–	Hyphen
14	–	Operating mechanism
15	–	1st auxiliary release
16	–	2nd auxiliary release
17	–	Auxiliary switch
18	0	Option F02
18	2	Option F04
18	3	Option F05
18	6	Option F01
18	7	Options F20 … F22
19	0	Option K01
19	1	Options K10 … K13

Format (107) "Switched-off I²t values"

The table below shows the format (107) "Switched-off I²t values" that contains the total of switched-off I²t values per phase in the format "unsigned long".

Table 4- 74 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)

Format (108) "Number of poles"

The table below shows the format (108) "Number of poles" that specifies the number of protected poles for the main circuit.

Table 4- 75 Format (108) "Number of poles"

Byte	Value	Meaning
0	1	3 poles
0	2	4 poles (with neutral conductor)

Format (111) "Circuit breaker position DI"

The table below shows the format (111) "Circuit breaker position DI" that also distinguishes the circuit breaker position of the digital input module between module 1 and 2.

Table 4- 76 Format (111) "Circuit breaker position DI"

Byte	Value	Meaning
0	1	Parameter set switching (module No. 1)
0	2	6 x digital inputs (module No. 2)

Format (119) "Circuit breaker position DO"

The table below shows the format (119) "Circuit breaker position DO" that specifies which output block is selected with which delay.

Table 4- 77 Format (119) "Circuit breaker position DO"

Byte	Value	Meaning
0	0x01	Module No. 1 Trip instantaneous
0	0x02	Module No. 1 Trip delayed 200 ms
0	0x03	Module No. 1 Trip delayed 500 ms
0	0x04	Module No. 1 Trip delayed 1 s
0	0x05	Module No. 1 Trip delayed 2 s
0	0x06	Module No. 2 Alarm instantaneous
0	0x07	Module No. 2 Alarm delayed 200 ms
0	0x08	Module No. 2 Alarm delayed 500 ms
0	0x09	Module No. 2 Alarm delayed 1 s
0	0x0A	Module No. 2 Alarm delayed 2 s

Format (121) "Control DO outputs"

The table below shows the format (121) "Control DO outputs" for controlling the outputs of the digital output modules with rotary coding switches.

Table 4- 78 Format (121) "Control DO outputs"

Byte	Value	Meaning
0	0	No action
	1	Set output 1 ("1")
	2	Reset output 1 ("0")
	3	Set output 2 ("1")
	4	Reset output 2 ("0")
	5	Set output 3 ("1")
	6	Reset output 3 ("0")
	7	Set output 4 ("1")
	8	Reset output 4 ("0")
	9	Set output 5 ("1")
	10	Reset output 5 ("0")
	11	Set output 6 ("1")
	12	Reset output 6 ("0")
	13	Switch force mode off (overwriting of the valid data)

Format (129) "Configurable output module"

The table below shows the format (129) "Configurable output module". The 1st event of the 1st output provides an example of the assignment for all others.

Table 4- 79 Format (129) "Configurable output module"

Byte	Value	Meaning
0	–	1st event at the 1st output
1	–	2nd event at the 1st output
2	–	3rd event at the 1st output
3	–	4th event at the 1st output
4	–	5th event at the 1st output
5	–	6th event at the 1st output
6	–	1st event at the 2nd output
7	–	2nd event at the 2nd output
8	–	3rd event at the 2nd output
9	–	4th event at the 2nd output
10	–	5th event at the 2nd output
11	–	6th event at the 2nd output
12	–	1st event at the 3rd output
13	–	2nd event at the 3rd output
14	–	3rd event at the 3rd output
15	–	4th event at the 3rd output
16	–	5th event at the 3rd output
17	–	6th event at the 3rd output
18	–	Event at the 4th output
19	–	Event at the 5th output
20	–	Event at the 6th output
0	0x00	Not assigned
0	0x01	Circuit breaker closed
0	0x02	Circuit breaker open
0	0x03	Spring energy store charged
0	0x04	Ready for switching on
0	0x05	Group warning
0	0x06	Group tripped signal
0	0x07	Write protection active
0	0x08	Communication OK
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	Communication bit 1 (#426)
0	0x3F	Communication bit 2 (#426)
0	0x40	Communication bit 3 (#426)

Byte	Value	Meaning
0	0x41	Communication bit 4 (#426)
0	0x42	Communication bit 5 (#426)
0	0x43	Communication bit 6 (#426)
0	0x3A	Trigger event A occurred
0	0x3B	Trigger event B occurred
0	0x3C	Parameter set A active
Warning		
0	0x09	Overload
0	0x0A	Overload neutral conductor
0	0x0B	Load shedding
0	0x0C	Ground fault
0	0x0D	Overtemperature
0	0x0E	µP error
0	0x0F	Phase unbalance current
0	0x10	Load pickup
Trips		
0	0x11	Overload L
0	0x12	Delayed short-circuit I
0	0x13	Instantaneous short-circuit S
0	0x15	Ground fault G
0	0x16	Overload in neutral conductor N
0	0x17	Phase unbalance current
0	0x18	Phase unbalance voltage
0	0x19	Underfrequency
0	0x1A	Overfrequency
0	0x1B	Undervoltage
0	0x1C	Overvoltage
0	0x1D	Active power in normal direction
0	0x1E	Active power in reverse direction
0	0x1F	THD current
0	0x20	THD voltage
0	0x21	Reverse direction of phase rotation
Threshold		
0	0x22	Overcurrent
0	0x23	Overcurrent neutral conductor
0	0x24	Overcurrent ground fault
0	0x25	Phase unbalance current
0	0x26	Phase unbalance voltage
0	0x27	Long-time mean value
0	0x28	Undervoltage
0	0x29	Overvoltage
0	0x2A	THD current

Byte	Value	Meaning
0	0x2B	THD voltage
0	0x2C	Peak factor
0	0x2D	Form factor
0	0x2E	Underfrequency
0	0x2F	Overfrequency
0	0x30	Active power in normal direction
0	0x31	Active power in reverse direction
0	0x32	Apparent power
0	0x33	Reactive power in normal direction
0	0x34	Reactive power in reverse direction
0	0x35	cos φ capacitive
0	0x36	cos φ inductive
0	0x37	Long-time mean value of active power
0	0x38	Long-time mean value of reactive power
0	0x39	Long-time mean value of apparent power

Format (138) "Type of metering function"

The table below shows the format (138) "Type of metering function". It specifies which type of metering function is built in.

Table 4- 80 Format (138) "Type of metering function"

Byte	Value	Meaning
0	0x00	No metering function
0	0x02	Metering function
0	0x03	Metering function PLUS

Format (145) "Direction of incoming supply"

The table below shows the format (145) "Direction of incoming supply". The signs for active power and reactive power depend on the "Direction of incoming supply".

Table 4- 81 Format (145) "Direction of incoming supply"

Byte	Value	Meaning
0	0	From top to bottom
0	1	From bottom to top

Format (146) "Direction of phase rotation"

The table below shows the format (146) "Direction of phase rotation". The normal status of the direction of phase rotation can be set using this.

Table 4- 82 Format (146) "Direction of phase rotation"

Byte	Value	Meaning
0	0	Right (e.g. L1 – L2 – L3)
0	1	Left (e.g. L1 – L3 – L2 or similar)

Format (162) "Voltage transformer"

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 4- 83 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(wye)-connected on the primary side.

4.6.6 Data formats 307 to 373

Format (307) "Tripping by the metering function"

The table below shows the format (307) "Tripping by the metering function" that displays the content of the last tripping operation by the enhanced protection function.

Table 4- 84 Format (307) "Tripping by the metering function"

Byte	Value	Meaning
0 / 1	0x0000	No trip
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 in direction of phase rotation

Format (308) "Threshold warnings"

The table below shows the format (308) "Threshold warnings" that displays the currently pending threshold warnings.

Table 4- 85 Format (308) "Threshold warnings"

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 neutral conductor
3	3	Phase unbalance current
3	4	Long-time mean value of current
3	5	Undervoltage
3	6	Phase unbalance voltage
3	7	Overvoltage

Format (309) "Harmonics analysis"

The table below shows the format (309) "Harmonics analysis". To calculate, the value must be multiplied by the signed exponent.

Table 4- 86 Format (309) "Harmonic analysis"

Harmonic	Byte	Format	Meaning
1st	0	Signed char	Harmonic current: Exponent
	1	Unsigned char	Harmonic current: Value
	2	Signed char	Harmonic voltage: Exponent
	3	Unsigned char	Harmonic voltage: Value
2nd	4	Signed char	Harmonic current: Exponent
	5	Unsigned char	Harmonic current: Value
	6	Signed char	Harmonic voltage: Exponent
	7	Unsigned char	Harmonic voltage: Value
3rd to 28th	8 … 111	…	…
29th	112	Signed char	Harmonic current: Exponent
	113	Unsigned char	Harmonic current: Value
	114	Signed char	Harmonic voltage: Exponent
	115	Unsigned char	Harmonic voltage: Value

Format (328) "Status of the circuit breaker"

The table below shows the format (328) "Status of the circuit breaker".

Table 4- 87 Format (328) "Status of the circuit breaker"

Byte	Bit	Meaning
0	0	Circuit breaker open
0	1	Circuit breaker closed
0	2	Circuit breaker has tripped (trip alarm switch)
0	3	Circuit breaker ready to close
0	4	Spring energy store charged
0	5	Circuit breaker at the 1st auxiliary trip unit operated
0	6	Circuit breaker at the 2nd auxiliary trip unit operated

Format (343) "I²t characteristic for S"

The table below shows the format (343) "I²t characteristic for S" with which the I²t characteristic is switched on and off.

Table 4- 88 Format (343) "I²t characteristic for S"

Byte	Value	Meaning
0	0	I²t characteristic for delayed short-circuit protection switched off.
0	1	I²t characteristic for delayed short-circuit protection switched on.

Format (344) "I²t characteristic for G"

The table below shows the format (344) "I²t characteristic for G" with which the I²t characteristic is switched on and off.

Table 4- 89 Format (344) "I²t characteristic for G"

Byte	Value	Meaning
0	0	I²t characteristic for ground-fault protection switched off.
0	1	I²t characteristic for ground-fault protection switched on.

Format (345) "I⁴t characteristic for L"

The table below shows the format (345) "I⁴t characteristic for L" with which the I⁴t characteristic is switched on and off.

Table 4- 90 Format (345) "I⁴t characteristic for L"

Byte	Value	Meaning
0	0	I⁴t characteristic for overload protection switched off.
0	1	I⁴t characteristic for overload protection switched on.

Format (346) "Thermal memory"

The table below shows the format (346) "Thermal memory" by which the thermal memory is switched on and off.

Table 4- 91 Format (346) "Thermal memory"

Byte	Value	Meaning
0	0	Thermal memory deactivated
0	1	Thermal memory activated

Format (347) "Phase loss sensitivity"

The table below shows the format (347) "Phase loss sensitivity" with which the phase loss sensitivity is switched on and off.

Table 4- 92 Format (347) "Phase loss sensitivity"

Byte	Value	Meaning
0	0	Phase loss sensitivity deactivated
0	1	Phase loss sensitivity activated

Format (370) "Active parameter set"

The table below shows the format (370) "Active parameter set" that specifies which of the parameter sets is active.

Table 4- 93 Format (370) "Active parameter set"

Byte	Value	Meaning
0	0	Parameter set A active
0	1	Parameter set B active

Format (373) "Phase number"

The table below shows the format (373) "Phase number" that specifies the phase number of the phase under the greatest load and the phase of the tripping operation.

Table 4- 94 Format (373) "Phase number"

Byte	Value	Meaning
0	0	Phase L1
0	1	Phase L2
0	2	Phase L3
0	3	Neutral conductor
0	4	Ground fault

4.6.7 Data formats 401 to 478

Format (401) "Trip unit: tripping operations"

The table below shows the format (401) "Trip unit: tripping operations", which shows the last unacknowledged tripping operation of the trip unit.

Table 4- 95 Format (401) "Trip unit: tripping operations"

Byte	Value	Meaning
0	0x00	No trip
0	0x01	Overload (L)
0	0x02	Instantaneous short-circuit (I)
0	0x04	Short-time delayed short-circuit (S)
0	0x08	Ground fault (G)

Format (402) "Trip unit: warnings"

The table below shows the format (402) "Trip unit: warnings" by which the trip unit communicates the currently pending warnings.

Table 4- 96 Format (402) "Trip unit: warnings"

Byte	Bit	Meaning
0	0	Overload
0	1	Overload neutral conductor
0	2	Load shedding
0	3	Load pickup
0	4	Phase unbalance current
0	5	Microprocessor (µP) error
0	6	Ground fault
0	7	Overtemperature
1	0	Leading signal of overload trip
1	1	Short-time mean value current

Format (405) "Contact state"

The table below shows format (405) "Contact state" that is calculated empirically from the maintenance information.

Table 4- 97 Format (405) "Contact state"

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.

Format (406) "Control trip unit"

The table below shows the format (406) "Control trip unit", e.g. in which the statistical information can be reset.

Table 4- 98 Format (406) "Control trip unit"

Byte	Value	Meaning
0 / 1	0x0002	Delete last trip message in trip unit
0 / 1	0x0022	Reset counter and statistical information of the trip unit

Format (410) "Ground-fault detection"

The table below shows the format (410) "Ground-fault detection" with which the ground-fault detection method is set.

Table 4- 99 Format (410) "Ground-fault detection"

Byte	Value	Meaning
0	0	Sensing current to ground using an external transformer
0	1	Calculating current to ground using vectorial summation
0	2	Sensing current to ground using vectorial summation (warning) and an external transformer (tripping)

Format (411) "N transformer"

The table below shows format (411) "N transformer" that indicates whether an N transformer is connected.

Table 4- 100 Format (411) "N transformer"

Byte	Value	Meaning
0	0	No transformer in the neutral conductor
0	1	There is a transformer in the neutral conductor

Format (412) "Trip unit type"

The table below shows the format (412) "'Trip unit type" that indicates which trip unit is used and how it is equipped.

Table 4- 101 Format (412) "Trip unit type" for 3WL

Byte	Value	IEC/UL	Meaning
0	4	IEC	ETU45B
0	5	IEC	ETU45B with display
0	6	IEC	ETU45B with ground-fault protection
0	7	IEC	ETU45B with display and ground-fault protection
0	13	IEC	ETU76B
0	14	IEC	ETU76B with ground-fault protection
0	17	UL	ETU748
0	18	UL	ETU748 with display
0	19	UL	ETU748 with ground-fault protection
0	20	UL	ETU748 with display and ground-fault protection
0	22	UL	ETU776
0	23	UL	ETU745

Format (421) "Parameter ZSI"

The table below shows the format (421) "Parameter ZSI".

Table 4- 102 Format (421) "Parameter ZSI"

Byte	Bit	Meaning	
0	0	ZSI short-circuit active	
0	1	ZSI ground fault active	
0	2	Not used	
0	3	Not used	
0	4 … 5	0	ZSI switched off
		1	ZSI input and output active
		2	ZSI output active
0	6	Not used	
0	7	Not used	

Format (426) "Communication bit"

The table below shows the format (426) "Communication bit" in which signals can be triggered indirectly via the communication system and applied to the configurable output module as a switching specification.

Table 4- 103 Format (426) "Communication bit"

Byte	Bit	Meaning
0	0	Communication bit 1
0	1	Communication bit 2
0	2	Communication bit 3
0	3	Communication bit 4
0	4	Communication bit 5
0	5	Communication bit 6

Format (476) "IPv4 suite"

The table below shows the format (476) "IPv4 suite".

Table 4- 104 Format (476) "IPv4 suite"

Byte	Meaning
0 … 3	IPv4 host address
4 … 7	IPv4 sub net mask
8 … 11	IPv4 gateway address

Format (478) "ControlInOutComBoxEx"

The table below shows the format (478) "ControlInOutComBoxEx" of the COM35.

Table 4- 105 Format (478) "ControlInOutComBoxEx"

OFFSET [byte]	Bit	Meaning	
0	0	Set the user output manually.	
0	1	Reset the user output manually.	
0	2	Open circuit breaker.	
0	3	Close circuit breaker.	
0	4	Switch over user output mode to trip message.	
0	5	Switch over output mode to parameter set message.	
0	6	Switch over user input mode to manual operation.	
0	7	Switch over user input mode to parameter set switchover.	
1	0 1	Status of user output mode	
		00	Trip is output
		01	Control by user (bit 0 set)
		10	Parameter set is output (bit 1 set)
1	2	Status of user output mode	
		0	Parameter set switchover inactive
		1	Parameter set switchover active
1	3	Read status of user output	
1	4	Read status of user input	
1	5	Switch over user output mode to manual operation	
1	6 … 7	Reserved	

4.6.8 Data formats of the basic types

Each basic type starts with a binary status information item the format of which cannot be modified:

Table 4- 106 Binary status information

Bit	Value	SENTRON WL
0 / 1	0 … 3	Position of circuit breaker
	0	Disconnected position
	1	Connected position
	2	Test position
	3	Circuit breaker not available.
2 / 3	0 … 3	Status of the circuit breaker
	0	Not ready.
	1	Off
	2	In
	3	Circuit breaker has tripped.
4		Ready-to-close signal available.
5		Undervoltage release
6		Spring energy store is charged.
7		Overload warning is pending.
8		An activated threshold has been exceeded.
9		A warning messages is pending.
10		Write protection disable deactivated, changes allowed
11		Status of the free user output
12 … 14	0 … 7	Reason for last trip
	0	No tripping operation or last tripping operation acknowledged.
	1	Overload trip (L)
	2	Instantaneous short-circuit (I)
	3	Short-time delayed short-circuit (S)
	4	Ground fault (G)
	5	Tripping operation as a result of enhanced protection function
	6	Overload in neutral conductor
	7	
15		Load shedding warning

The three basic types have the following basic settings:

Basic type 1

Table 4- 107 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	Maximum current in phase under highest load	374
10	PB of data block 1	PB of the current in phase 1	–
11	PB of data block 2	PB of the current in phase 2	–
12	PB of data block 3	PB of the current in phase 3	–
13	PB of data block 4	PB of the maximum current in phase under highest load	–

Basic type 2

Table 4- 108 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	Maximum 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 the current in phase 1	–
19	PB of data block 2	PB of the current in phase 2	–
20	PB of data block 3	PB of the current in phase 3	–
21	PB of data block 4	PB of the maximum 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 3 power factors	–
25	PB of data block 8	PB of total active energy	–

Basic type 3

Table 4- 109 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	Maximum 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 the current in phase 1	–
31	PB of data block 2	PB of the current in phase 2	–
32	PB of data block 3	PB of the current in phase 3	–
33	PB of data block 4	PB of the maximum 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 3 power factors	–
42	PB of data block 13	PB of total active energy	–
43	PB of data block 14	PB of total apparent power	–

ESD Guidelines

A

A.1 Electrostatic sensitive devices (ESD)

ESD components are destroyed by voltage and energy far below the limits of human perception. Voltages of this kind occur as soon as a device or an assembly is touched by a person who is not electrostatically discharged. ESD components which have been subject to such voltage are usually not recognized immediately as being defective, because the malfunction does not occur until after a longer period of operation.

ESD Guidelines

NOTICE

Electrostatic sensitive devices

Electronic modules contain components that can be destroyed by electrostatic discharge. These modules can be easily destroyed or damaged by improper handling.

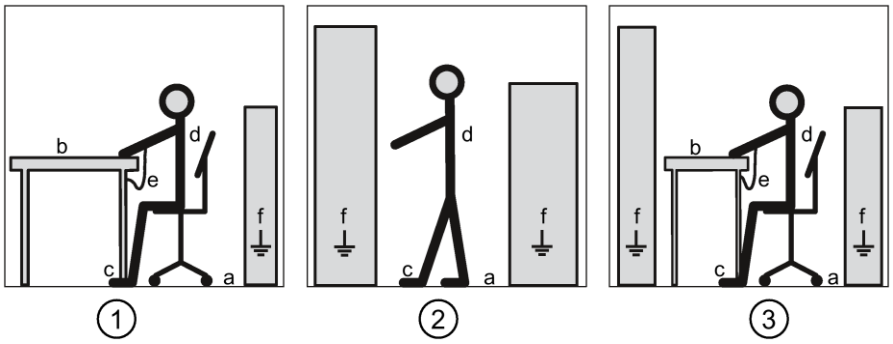
- You must discharge your body electrostatically immediately before touching an electronic module. To do this, touch a conductive, grounded object, e.g., a bare metal part of a switch cabinet or the water pipe.
- Always hold the component by the plastic enclosure.
- Electronic modules should not be brought into contact with electrically insulating materials such as plastic film, plastic parts, insulating table supports or clothing made of synthetic fibers.
- Always place electrostatic sensitive devices on conductive bases.
- Always store and transport electronic modules or components in ESD-safe conductive packaging, e.g. metalized plastic or metal containers. Leave the component in its packaging until installation.

NOTICE

Storage and transport

If you have to store or transport the component in non-conductive packaging, you must first pack the component in ESD-safe, conductive material, e.g., conductive foam rubber, ESD bag.

The diagrams below illustrate the required ESD protective measures for electrostatic sensitive devices.



(1) ESD seat
(2) ESD standing position
(3) ESD seat and ESD standing position

Protective measures

a Conductive floor
b ESD table
c ESD footwear
d ESD smock
e ESD bracelet
f Cubicle ground connection

List of abbreviations

B

You can find more abbreviations, especially with regard to possible settings, in the 3WL Manual.

Table B- 1 List of abbreviations

Abbreviation	Meaning
AC	Alternating Current
AWG	American Wire Gauge
BSS	Breaker Status Sensor
COM35	3WL communication module
CUB −	CubicleBUS, connection "−"
CUB +	CubicleBUS, connection "+"
DAS	Dynamic Arc Sentry
DC	Direct Current
DFP	Dynamic Frame Packing
DI	Digital input module
DIN	German Industry Standard
DO	Digital output module
PB	Property Bytes
ED	ON time; exceeding the permissible ON time results in destruction
ESD	Electrostatic sensitive device
EN	European standard
EMC	Electromagnetic compatibility
ETU	Electronic Trip Unit
EXTEND.	Enhanced protection function
F1	First shunt release
F2	Second shunt release
F3	Undervoltage release
F4	Undervoltage release with delay
F5	Tripping solenoid
F7	Remote reset magnet
FIFO FIFO memory	First In/First Out memory Storage method by which the items that were stored first are the first to be removed from the memory.
GSDML	General Station Description Markup Language
I / O	Input / Output
I tripping	Instantaneous short-circuit trip
ID	Identification number

Abbreviation	Meaning
IEC	International Electrotechnical Commission
Conf. DO	Configurable digital output module
L1	Conductor/phase 1
L2	Conductor/phase 2
L3	Conductor/phase 3
LED	Light emitting diode
LV	Low Voltage
LVSG	(Low Voltage Switch Gear)
M	Motor
MRP	Media redundancy protocol
Meter. fct.	Metering function or metering function PLUS
MV	Medium Voltage
N	Neutral conductor
PNO	PROFIBUS User Organization
PS	Parameter set
OB	Organization blocks (PLC)
Ö	Normally closed contact
S	Normally open contact
S1	Signaling switch, switch position
S10	Electrical ON
S12	Motor cutout switch
S13	Cutout switch for remote reset
S14	Cutout switch for shunt release F1 (overexcited)
S15	Cutout switch for closing coil 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, switch position
S8	Signaling switch, switch position
SW	Threshold warning
ST	Shunt release
T.U. ERROR	Trip unit error, fault in the electronic trip unit (ETU)
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

Abbreviation	Meaning
VDE	Association for Electrical, Electronic and Information Technologies (Germany)
VT	Voltage transformer
X	Terminal marking according to DIN
Y1	Closing coil
ZS	Time stamp
ZSI	Zone Selective Interlocking

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