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Power Monitoring Device SENTRON PAC4200

System Manual

09/2010
A5E02316180B-03

Legal information

Warning notice system

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

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

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

⚠ CAUTION
with a safety alert symbol, indicates that minor personal injury can result if proper precautions are not taken.

CAUTION
without a safety alert symbol, indicates that property damage can result if proper precautions are not taken.

NOTICE
indicates that an unintended result or situation can occur if the corresponding information is not taken into account.

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

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

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order number: 3ZX1012-0KM42-3AC0
℗ 11/2010

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Note

Risk of manipulation

We recommend activating the security functions on the device after configuration has been completed:

- Password protection, to protect device against unintentional adjustment of parameters. See Chap. 9.2.11
- Hardware write protection, to effectively prevent changes to the device parameters without physical access to the device.

  A digital input of the device is required for activating or deactivating write protection.

  To activate write protection, an auxiliary voltage of 12 … 24 VDC must be applied to the digital input.

  The HW write protection can now be activated via the menu "Settings → Integrated I/O → dig. input → action".

  The device is write-protected after the auxiliary voltage is removed.

  To deactivate the write protection feature, an auxiliary voltage of 12 … 24 V must again be applied to the parameterized input. The write protection feature can now be deactivated via the menu.

  As an alternative to the digital input on the device, a digital input of an optional module (MLFB: 7KM9200-0AB00-0AA) can also be used.

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1.1 Purpose of this document

This present manual describes the SENTRON PAC4200 Power Monitoring Device.

It is intended for the use of:

- Planners
- Plant operators
- Commissioning engineers
- Service and maintenance personnel

Required basic knowledge

A general knowledge of the field of electrical engineering is required to understand this manual.

Knowledge of the relevant safety regulations and standards is required for installing and connecting the device.

Validity range

This manual applies to the following delivery versions of the device:

SENTRON PAC4200 for panel mounting with

- LC display
- Screw terminal
- Ring lug terminal
- Wide-voltage power supply
- Extra-low voltage power supply

The manual describes those device properties valid at the time of its publication.

1.2 Orientation aids

General information

The manual includes the following orientation aids:

- Table of contents
- List of figures and tables
- List of abbreviations
- Glossary
- Index

1.3 Components of the product

Description

The package includes:

- 1 SENTRON PAC4200 Power Monitoring Device
- 1 battery
- 2 brackets for panel mounting
- 1 SENTRON PAC4200 operating instructions
- 1 data carrier (CD-ROM or DVD)

1.4 Contents of the data carrier

Contents of the data carrier

A data carrier (CD or DVD) is supplied with the SENTRON PAC4200 Power Monitoring Device. You will find the following files on the data carrier:

- Manual and operating instructions for SENTRON PAC4200 in all available languages
- Manuals and operating instructions for optional expansion modules in all available languages
- All files necessary to configure the optional expansion modules, e.g. GSD file.
- SENTRON powerconfig software, including online help in all available languages and README file in English and German
- Certificate of License for SENTRON powerconfig in English and German

1.5 Technical Support

For further assistance, refer to

Technical Support on the Internet:

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

1.6 Further documentation

Overview

You can find further details in the following manuals:

- "SENTRON PAC4200" operating instructions
- Manuals and operating instructions for the optional expansion modules
- SIMATIC NET "PROFIBUS network manual"
- Modbus-IDA.org "MODBUS APPLICATION PROTOCOL SPECIFICATION V1.1a"
- MODBUS.org "MODBUS over Serial Line Specification & Implementation guide V1.02"

Safety instructions

2

2.1 Safety notes

General safety notes

⚠ DANGER

Hazardous Voltage

Will cause death or serious injury.

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

Safety-related symbols on the device

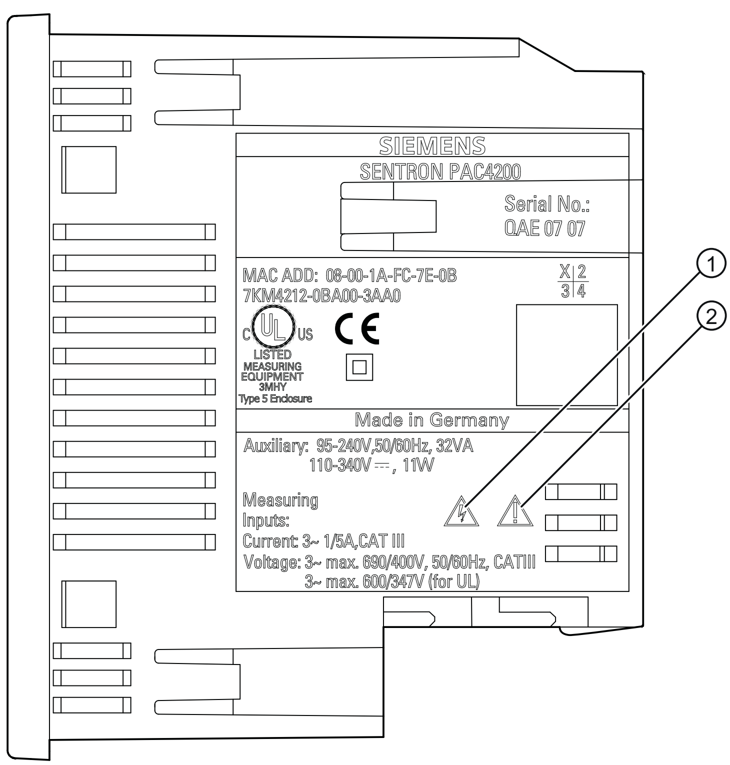


Figure 2-1 Safety-related symbols on the device

	Symbol	Meaning
(1)		Danger of electric shock.
(2)		General Warning Symbol.

CAUTION

An open circuit can result in personal injury and damage to the unit

Short-circuit the secondary connections of intermediate current transformers at the transformers before interrupting the current lines to the device.

See also

Applying the measuring current (Page 110)

Applying the measuring voltage (Page 109)

Applying the supply voltage (Page 100)

Replacing the battery (Page 170)

3 Description

3.1 Performance features of the SENTRON PAC4200

SENTRON PAC4200 is a Power Monitoring Device for displaying, storing, and monitoring all relevant system parameters in low-voltage power distribution. It is capable of single-phase, two-phase, or three-phase measurement and can be used in two-wire, three-wire, four-wire, TN, TT, and IT systems.

Thanks to its compact design in 96 x 96 mm format, it fits into any standard cutout. The SENTRON PAC4200 measures around 200 electrical variables with minimum values, maximum values and demands.

With its large measuring voltage range, SENTRON PAC4200 with a **wide-voltage power supply** can be connected in any low-voltage system up to a rated system voltage of 690 V (max. 600 V for UL).

The device version with an **extra-low voltage power supply** can be directly connected **to systems up to 500 V**.

Higher voltages can be measured using voltage transformers. For measuring current, either x / 1 A or x / 5 A current transformers can be used.

The large graphical LC display permits reading even from a distance. SENTRON PAC4200 has adjustable backlighting for optimal readability even under poor lighting conditions.

The combination of four function keys with the multi-language plaintext displays makes intuitive user prompting possible. The experienced operator can also use direct navigation for quicker selection of the desired display menu.

SENTRON PAC4200 guarantees high measuring accuracy. It can be used to capture and store load profiles according to various methods. It has a range of useful monitoring, diagnostics, and service functions, a two-tariff apparent energy, active energy and reactive energy counter, two universal counters, and an operating hours counter for monitoring connected loads.

The SENTRON PAC4200 saves the apparent, active and reactive energy consumption per day and tariff over one year. In addition, the Power Monitoring Device has an apparent, active and reactive energy counter for recording the energy consumption of a manufacturing process. A separate operating hours counter calculates the duration of this process. The available digital inputs are used to control the process energy counters.

A comprehensive, parameterizable signaling system allows application-specific monitoring of various events, such as limit violations or operator interventions.

The data memory of the device and the internal clock are battery-backed.

The integral 10 / 100 Mbit Ethernet interface or an optional expansion module can be used for communication, e.g. the SENTRON PAC RS485 expansion module or the SENTRON PAC PROFIBUS DP expansion module.

SENTRON PAC4200 has two multifunctional digital inputs and two multifunctional digital outputs.

With optional SENTRON PAC 4DI/2DO expansion modules, it is possible to expand the SENTRON PAC4200 with up to 8 digital inputs and up to 4 digital outputs. This makes a maximum configuration of 10 digital inputs and 6 digital outputs possible. The external digital inputs and digital outputs have the same functions as the integral digital inputs and digital outputs. Thanks to the internal power supply, the digital inputs and digital outputs of the expansion modules can be used as S0 interfaces in accordance with IEC 62053-31. This also enables the use of simple floating contacts for wiring the digital inputs.

The parameters can be set either direct on the device or with the SENTRON powerconfig configuration software.

Password protection is integrated to guard against unauthorized access.

Measurement

- Derivation of more than 300 measured variables from the basic measured variables with maximum and minimum values (min/max pointer function).
- At the voltage terminals, SENTRON PAC4200 with a wide-voltage power supply can be connected direct to 690 V industrial systems (max. 600 V for UL, measuring category III, pollution degree 2). Higher voltages using voltage transformers.
- SENTRON PAC4200 with an extra-low voltage power supply can be connected direct to systems up to 500 V.
- For current transformers x/1 A and x/5 A. Conversion ratio and current direction programmable.
- Can be used in 2-, 3- and 4-wire systems. Suitable for TN, TT and IT systems.
- High measuring accuracy: For instance, accuracy class 0.2 in accordance with IEC 61557-12 for the active energy, in other words accuracy equivalent to 0.2% of the measured value under reference conditions.
- Calculation of genuine r.m.s values for voltage and current to the 63rd harmonic
- 4-quadrant measurement (import and export)
- Lückenlose Abtastung (engl.: zero blind measurement)

Sliding window demand values

- Calculation of the sliding window demand values for
  - Voltages and currents
  - Power factor per phase and total system
  - Apparent, active, and reactive power per phase as well as total power
- Maximum and minimum values of the sliding window demand with the date and time of occurrence since startup, the last reset, or the last deletion
- Demand calculation for reactive power VAR_1, reactive power VAR_n, or total reactive power VAR_{tot}.
- Configurable averaging time.

Average values over all phases

- Calculation of the average voltage and current values over all phases. The average value of a three or four-phase system corresponds to the arithmetic mean for the individual phase values.
- Maximum and minimum average values with date and time.

Counters

- A total of 10 energy counters capture reactive energy, apparent energy, and active energy for off-peak and on-peak, import and export.
- Energy consumption for active energy, reactive energy and apparent energy per day and tariff for 366 days.
- Two configurable universal counters for counting
  - Limit violations
  - Status changes at the digital input
  - Status changes at the digital output
  - Pulses of a connected pulse encoder, such as electricity, gas, or water meters. The pulse shape and dynamic response must correspond to the signal shape described in the IEC 62053-31 standard
- Operating hours counter for monitoring the operating time of a connected load. Counts only in the case of energy counting above an adjustable threshold
- One apparent energy counter, one active energy counter, and one reactive energy counter for detecting the total energy import, regardless of the active tariff for display on the device
- One apparent energy counter, one active energy counter, and one reactive energy counter for detecting the power consumption of a manufacturing process. The process energy counters can be started and stopped by means of the available digital inputs.
- Operating hours counter for recording the duration of a manufacturing process. Starting and stopping is carried out with the start command and the stop command of the digital input that controls the process energy counter.
- Up to 10 counters for detecting the consumption of any media via digital inputs if SENTRON PAC 4DI / 2DO expansion modules are used. The consumption of gas, water, compressed air, electrical current, etc. can thus be recorded using simple media counters with pulse input.

  The display texts can be freely parameterized in a user-friendly way using the *SENTRON powerconfig* configuring software.

Monitoring functions

The following can be monitored:

- 12 limits. The limit values can be logically combined. A group message that indicates the violation of at least one limit value can be generated.
- Direction of rotation.
- Status of the digital inputs.
- Operating status of SENTRON PAC4200.
- Resetting the device and the communication parameters to the factory default settings.
- Deleting recorded load profiles and events
- Resetting counter values
- Reboot after losing the power supply.
- Detection and logging of failures in the measuring voltage and the supply voltage with date and time-of-day
- Monitoring of phase symmetry for voltage and current to avoid load unbalance
- Operating hours counter for monitoring the runtime of connected loads such as motors, pumps or machines, etc.
- Event-driven switching of the digital outputs possible
- Changing the date and the time.
- Changing device parameters.
- Writing a large number of events in the event memory.

Events and messages

- Recording up to 4096 events with a time stamp and event-specific information.
- Displaying the events in an events list.
- Reporting the events on the display.
- Classifying the messages as information, warnings, or alarms.

Displays and controls

- Large backlit graphics LC display for optimal readability even from a distance.
- Menu-driven parameterization and operation with plaintext display.
- Choice of output language for menu and text displays.
- Phase labels selectable (L1, L2, L3 <=> a, b, c).

User-definable display of measurements

- Freely definable display of up to four measurements (digital display or bar diagram).

User-definable display of counters

- Up to 5 displays for counters that can be labeled individually

Interfaces

- Integrated Ethernet interface.
- Two slots for operating optional expansion modules.

  SENTRON PAC4200 supports a maximum of one communication module, e.g. SENTRON PAC PROFIBUS DP or SENTRON PAC RS485. The second slot can be used for other expansion modules.

Gateway

Gateway function:
This allows devices that only support serial communication (RS 485) to be addressed via Ethernet.

- Modbus gateway for integrating purely Modbus RTU slaves into an Ethernet network (Ethernet Modbus TCP <=> RS 485 Modbus RTU)
- Serial gateway for connecting RS 485 devices that support Modbus RTU and similar protocols

Internal clock

- Time stamping of events.
- Synchronization of the load profile as an alternative to external synchronization.
- Battery backup.

Long-term memory

- Storage of load profiles.
- Storage of events.
- Battery backup.

Inputs and outputs

- Two multifunctional integral digital inputs for tariff switching, time synchronization, demand period synchronization, status monitoring, or capturing energy pulses from third-party devices.
- Two multifunctional integral digital outputs, programmable as pulse outputs for active energy or reactive energy pulses, for showing the direction of rotation, indicating the operating hours of SENTRON PAC4200, representing limit violations, or as switching outputs for remote control via PC.
- Up to 2 plug-in SENTRON PAC 4DI/2DO expansion modules with the same functions as the integral digital inputs and digital outputs

  This results in a maximum configuration of 10 digital inputs and 6 digital outputs.

Protection

Password protection by means of a 4-character code.

See also

Measured variables (Page 25)
Technical data (Page 175)
Sliding window demand values (Page 31)

3.2 Measuring inputs

Current measurement

CAUTION
Alternating current measurement only, otherwise the device will become non-functional
Use the device to measure alternating current only.

SENTRON PAC4200 is designed for:

- **Measuring current of 1 A or 5 A for connecting current transformers.** Each current measuring input can take a continuous load of 10 A. Surge withstand capability is possible for currents up to 100 A and a duration of 1 s.

Voltage measurement

CAUTION
Alternating voltage measurement only, otherwise the device will become non-functional
Use the device to measure alternating voltage only.

SENTRON PAC4200 is designed for:

- **Direct measurement on the system or using voltage transformers**. The measuring voltage inputs of the device measure direct via protective impedances. External voltage transformers are required to measure higher voltages than the permissible rated input voltages.
- **Measuring voltage up to 400 V / 690 V (max. 347 V / 600 V for UL) on devices with a wide-voltage power supply.** The device is designed for measuring input voltages up to 400 V (347 V for UL) phase-to-neutral and 690 V (600 V for UL) phase-to-phase.
- **Measuring voltage up to 289 V / 500 V for devices with an extra-low voltage power supply.** The device is designed for measuring input voltages up to 289 V phase-to-neutral and 500 V phase-to-phase.

Connection types

Five connection types have been provided for connecting two-wire, three-wire or four-wire systems with balanced or unbalanced load.

Table 3- 1 Available connection types

Short code	Connection type
3P4W	3 phases, 4 conductors, unbalanced load
3P3W	3 phases, 3 conductors, unbalanced load
3P4WB	3 phases, 4 conductors, balanced load
3P3WB	3 phases, 3 conductors, balanced load
1P2W	Single-phase AC

The input circuit of the device must correspond to one of the connection types listed. Select the suitable connection type for the purpose.

Connection examples can be found in the chapter titled: Connecting (Page 77)

CAUTION
Improper Power Supply May Damage Equipment
Before connecting SENTRON PAC, you must ensure that the local power supply conditions match the specifications on the type plate.

The short code of the connection type must be entered in the device settings at startup. You can find the instructions for parameterizing the connection type in the chapter titled: Startup (Page 99)

See also

Set the connection type (Page 104)

Applying the measuring voltage (Page 109)

Applying the measuring current (Page 110)

3.3 Measured variables

Measured variables - overview

The table below lists all measured variables that the device records or derives from basic variables. You can find more information on measured variables in the Appendix.

Inst	Instantaneous value
Min	Minimum value
Max	Maximum value
DMD	Demand value
Σ	Total

Designation	Root-mean-square value			Average over 3 phases[1)]			Sliding window demand			Σ	Unit
	Inst	Min	Max	Inst	Min	Max	DMD	Min	Max		
Voltage ph-n											
V_{a-n} / V_{b-n} / V_{c-n}	✓	✓	✓	✓	✓	✓	✓	✓	✓		[V]
Voltage ph-ph											
V_{a-b} / V_{b-c} / V_{c-a}	✓	✓	✓	✓	✓	✓	✓	✓	✓		[V]
Current											
I_a / I_b / I_c	✓	✓	✓	✓	✓)	✓	✓	✓	✓		[A]
Neutral current											
I_n	✓	✓	✓				✓	✓	✓		[A]
Apparent power per phase											
VA_a / VA_b / VA_c	✓	✓	✓				✓	✓	✓		[VA]
Active power per phase import/export											
$\pm W_a$ / $\pm W_b$ / $\pm W_c$	✓	✓	✓				✓	✓	✓		[W]
Total reactive power (VARtot) per phase positive / negative											
$VAR_{tot\ a}$; $VAR_{tot\ b}$; $VAR_{tot\ c}$	✓	✓	✓				✓	✓	✓		[VAR]
Reactive power (VAR1) per phase positive / negative											
$VAR_{1\ a}$; $VAR_{1\ b}$; $VAR_{1\ c}$	✓	✓	✓				✓	✓	✓		[VAR]
Reactive power (VARn) per phase positive / negative											
$VAR_{n\ a}$; $VAR_{n\ b}$; $VAR_{n\ c}$	✓	✓	✓				✓	✓	✓		[VAR]
Total apparent power over all phases											
VA	✓	✓	✓				✓	✓	✓		[VA]
Total active power over all phases import / export											
W	✓	✓	✓				✓	✓	✓		[W]
Total reactive power (VARtot) over all phases positive / negative											
VAR_{tot}	✓	✓	✓				✓	✓	✓		[VAR]
Total reactive power VAR1 over all phases positive / negative											
VAR_1	✓	✓	✓				✓	✓	✓		[VAR]
Total reactive power VARn over all phases positive / negative											
VAR_n	✓	✓	✓				✓	✓	✓		[VAR]
Power factor of the fundamental											
$\cos\varphi_a$ / $\cos\varphi_b$ / $\cos\varphi_c$	✓	✓	✓								–
Power factor											
$\|PF_a\|$ / $\|PF_b\|$ / $\|PF_c\|$	✓	✓	✓				✓	✓	✓		–
Total power factor											
PF	✓	✓	✓				✓	✓	✓		–
Line frequency											
f	✓	✓	✓								[Hz]
Displacement angle											
φ_a / φ_b / φ_c	✓	✓	✓								[°]
Phase angle											
X_{a-a} / X_{a-b} / X_{a-c}	✓										[°]

Designation	Root-mean-square value			Average over 3 phases[1)]			Sliding window demand			Σ	Unit
	Inst	Min	Max	Inst	Min	Max	DMD	Min	Max		
THD voltage for ph-n referred to the fundamental											
$THD_{V\,a}$ / $THD_{V\,b}$ / $THD_{V\,c}$	✓		✓								[%]
THD voltage for ph-ph referred to the fundamental											
$THD_{V\,a\text{-}b}$ / $THD_{V\,b\text{-}c}$ / $THD_{V\,c\text{-}a}$	✓		✓								[%]
THD current referred to the fundamental											
$THD_{I\,a}$ / $THD_{I\,b}$ / $THD_{I\,c}$	✓		✓								[%]
Apparent energy											
$E_{ap\,T}$										✓	[VAh]
Active energy import / export											
$E_{a\,T\,imp}$, $E_{a\,T\,exp}$										✓	[Wh]
Reactive energy import / export [2)]											
$E_{r\,T\,imp}$,$E_{r\,T\,exp}$										✓	[VARh]
Unbalance voltage											
$Unbal_V$										✓	[%]
Unbalance current											
$Unbal_I$										✓	[%]
Current distortion											
$I_{d\,a}$, $I_{d\,b}$, $I_{d\,c}$	✓		✓								[A]
Fundamental voltage ph-n											
$h_{1\,a}$, $h_{1\,b}$, $h_{1\,c}$	✓										[V]
Harmonic content of the 3rd, 5th, 7th, ... 31st harmonics for the ph-n voltage referred to the fundamental											
$h_{3\,a\text{-}n}$ … $h_{31\,a\text{-}n}$ $h_{3\,b\text{-}n}$ … $h_{31\,b\text{-}n}$ $h_{3\,c\text{-}n}$ … $h_{31\,c\text{-}n}$	✓		✓								[%]
Fundamental voltage ph-ph											
$h_{1\,a\text{-}b}$, $h_{1\,b\text{-}c}$, $h_{1\,c\text{-}a}$	✓										[V]
Harmonic content of the 3rd, 5th, 7th, ... 31st harmonics for the ph-ph voltage referred to the fundamental											
$h_{3\,a\text{-}b}$ … $h_{31\,a\text{-}b}$ $h_{3\,b\text{-}c}$ … $h_{31\,b\text{-}c}$ $h_{3\,c\text{-}a}$ … $h_{31\,c\text{-}a}$	✓		✓								[%]
Current of the fundamental and current of the 3rd, 5th, 7th, ... 31st harmonics in the phase conductor											
$I_{1\,a}$ … $I_{31\,a}$ $I_{1\,b}$ … $I_{31\,b}$ $I_{1\,c}$ … $I_{31\,c}$	✓		✓								[A]
2 universal counters											
										✓	3)
Operating hours counter											
Oper hours (load runtime)										✓	[s] ([h])[4)]
Process operating hours counter											
Oper hours (load runtime)										✓	[s] ([h])[4)]

Designation		Root-mean-square value			Average over 3 phases1)			Sliding window demand			Σ	Unit
		Inst	Min	Max	Inst	Min	Max	DMD	Min	Max		
Process apparent energy												
	$E_{ap\ prc}$										✓	[VAh]
Process apparent energy – previous measurement												
											✓	[VAh]
Process active energy import												
	$E_{a\ prc\ imp}$,										✓	[Wh]
Process active energy import – previous measurement												
											✓	[Wh]
Process reactive energy import												
	$E_{r\ prc\ imp}$,										✓	[VARh]
Process reactive energy import – previous measurement												
											✓	[VARh]
Day counter for apparent energy												
	$E_{ap\ day}$										✓	[VAh]
Day counter for active energy import / export												
	$E_{a\ day\ imp}$, $E_{a\ day\ exp}$										✓	[Wh]
Day counter for reactive energy import / export												
	$E_{r\ day\ imp}$,$E_{r\ day\ exp}$										✓	[VARh]

1) The average over 3 phases can only be called via the communication interfaces or the user defined display.

2) Optionally calculated for total reactive power (VARtot), reactive power (VARn), or reactive power (VAR1).

3) The unit depends on the settings: User definable unit or "kWh" or "kVARh" for the pulse counter function.

4) The operating hours are available via the bus in seconds. They are displayed in hours on the device display.

See also

Measured variables (Page 199)

Measured variables depending on the connection type

The total set of representable measured variables is restricted by the method of connecting the device.

A measured value that cannot be indicated because of the connection method is shown on the display by means of a broken line "----".

The table below shows which measured values can be represented depending on the connection type.

Table 3- 2 Display of the measured variables depending on the connection type

Connection type / Measured variable	3P4W	3P3W	3P4WB	3P3WB	1P2W
Voltage a-n	✓	-	✓	-	✓
Voltage b-n	✓	-	-	-	-
Voltage c-n	✓	-	-	-	-
3-phase average voltage ph-n	✓	-	-	-	-
Voltage a-b	✓	✓	-	✓	-
Voltage b-c	✓	✓	-	✓	-
Voltage c-a	✓	✓	-	✓	-
3-phase average voltage ph-ph	✓	✓	-	✓	-
Current a	✓	✓	✓	✓	✓
Current b	✓	✓	-	-	-
Current c	✓	✓	-	-	-
3-phase average current	✓	✓	-	-	-
Neutral current	✓	-	-	-	-
Apparent power a	✓	-	-	-	-
Apparent power b	✓	-	-	-	-
Apparent power c	✓	-	-	-	-
Active power a	✓	-	-	-	-
Active power b	✓	-	-	-	-
Active power c	✓	-	-	-	-
Total reactive power a (VARtot)[1)]	✓	-	-	-	-
Total reactive power b (VARtot)[1)]	✓	-	-	-	-
Total reactive power c (VARtot)[1)]	✓	-	-	-	-
Reactive power a (VAR1)[1)]	✓	-	-	-	-
Reactive power b (VAR1)[1)]	✓	-	-	-	-
Reactive power c (VAR1)[1)]	✓	-	-	-	-
Reactive power a (VARn)[1)]	✓	-	-	-	-
Reactive power b (VARn)[1)]	✓	-	-	-	-
Reactive power c (VARn)[1)]	✓	-	-	-	-
Total apparent power over all phases	✓	✓	✓	✓	✓
Total active power over all phases	✓	✓	✓	✓	✓
Total reactive power (VARtot) over all phases[1)]	✓	✓	✓	✓	✓
Total reactive power (VAR1) over all phases[1)]	✓	✓	✓	✓	✓
Total reactive power (VARn) over all phases[1)]	✓	✓	✓	✓	✓
Cos φ a	✓	-	✓	✓	✓
Cos φ b	✓	-	-	-	-
Cos φ c	✓	-	-	-	-
Power factor a	✓	-	-	-	-
Power factor b	✓	-	-	-	-
Power factor c	✓	-	-	-	-
Total Power Factor	✓	✓	✓	✓	✓

Measured variable / Connection type	3P4W	3P3W	3P4WB	3P3WB	1P2W
Line frequency	✓	✓	✓	✓	✓
Displacement angle a	✓	-	✓	✓	✓
Displacement angle b	✓	-	-	-	-
Displacement angle c	✓	-	-	-	-
Phase angle a-a	✓	✓	-	✓	-
Phase angle a-b	✓	✓	-	✓	-
Phase angle a-c	✓	✓	-	✓	-
THD voltage a	✓	-	✓	-	✓
THD voltage b	✓	-	-	-	-
THD voltage c	✓	-	-	-	-
THD voltage a-b	✓	✓	-	✓	-
THD voltage b-c	✓	✓	-	✓	-
THD voltage c-a	✓	✓	-	✓	-
THD current a	✓	✓	✓	✓	✓
THD current b	✓	✓	-	-	-
THD current c	✓	✓	-	-	-
Apparent energy	✓	✓	✓	✓	✓
Active energy import / export	✓	✓	✓	✓	✓
Reactive energy import / export	✓	✓	✓	✓	✓
Unbalance voltage	✓	-	-	-	-
Unbalance current	✓	✓	-	-	-
Amplitude unbalance voltage	✓	-	-	-	-
Amplitude unbalance current	✓	✓	-	-	-
Distortion current a	✓	✓	✓	✓	✓
Distortion current b	✓	✓	-	-	-
Distortion current c	✓	✓	-	-	-
Harmonic content of the 3rd, 5th, 7th, ... 31st harmonics for the a-n voltage referred to the fundamental	✓	-	✓	-	✓
Harmonic content of the 3rd, 5th, 7th, ... 31st harmonics for the b-n voltage referred to the fundamental	✓	-	-	-	-
Harmonic content of the 3rd, 5th, 7th, ... 31st harmonics for the c-n voltage referred to the fundamental	✓	-	-	-	-
Harmonic content of the 3rd, 5th, 7th, ... 31st harmonics for the a-b voltage referred to the fundamental	✓	✓	-	✓	-
Harmonic content of the 3rd, 5th, 7th, ... 31st harmonics for the b-c voltage referred to the fundamental	✓	✓	-	✓	-
Harmonic content of the 3rd, 5th, 7th, ... 31st harmonics for the c-a voltage referred to the fundamental	✓	✓	-	✓	-
Current of the fundamental and current of the 3rd, 5th, 7th, ... 31st harmonics in a	✓	✓	✓	✓	✓
Current of the fundamental and current of the 3rd, 5th, 7th, ... 31st harmonics in b	✓	✓	-	-	-

Measured variable / Connection type	3P4W	3P3W	3P4WB	3P3WB	1P2W
Current of the fundamental and current of the 3rd, 5th, 7th, ... 31st harmonics in c	✓	✓	-	-	-
Universal Counter	✓	✓	✓	✓	✓
Operating Hours Counter	✓	✓	✓	✓	✓
Process operating hours counter	✓	✓	✓	✓	✓
Process apparent energy	✓	✓	✓	✓	✓
Process apparent energy – previous measurement	✓	✓	✓	✓	✓
Process active energy import	✓	✓	✓	✓	✓
Process active energy import – previous measurement	✓	✓	✓	✓	✓
Process reactive energy import	✓	✓	✓	✓	✓
Process reactive energy import – previous measurement	✓	✓	✓	✓	✓

1) You can set which type of reactive power (VAR1, VARtot, or VARn) is displayed with the configuration software. All three reactive power types can be called via the interface.

See also

Connection examples (Page 85)

3.3.1 Sliding window demand values

The sliding window demand value is the arithmetic mean of all measured values that occur within a configurable averaging time. "Sliding" means that the interval for the demand calculation is continuously shifted as a function of time.

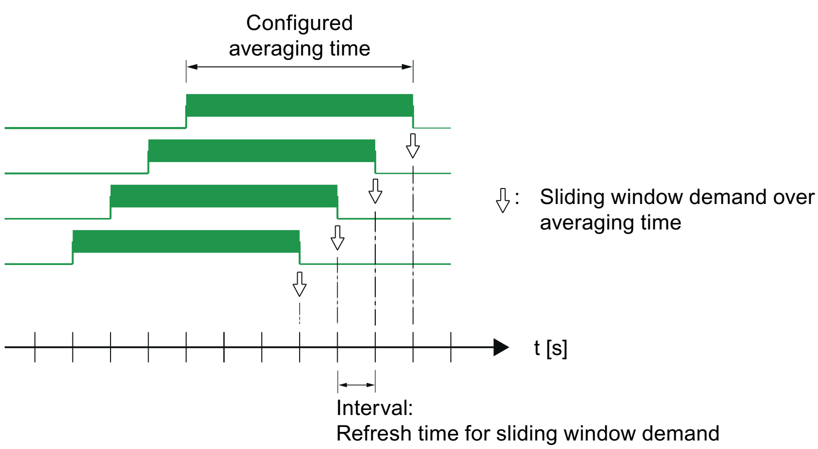


Figure 3-1 Sliding window demand

The sliding window demand values are updated 60 times per set averaging time. A lower limit of 200 ms applies here. If an averaging time of 3, 5 or 10 seconds is set, the demand value is formed with fewer values.

Available sliding window demand values

SENTRON PAC4200 supplies sliding window demand values for a large number of measured variables:

- Per phase or as a total value over all phases
- With the maximum and minimum values as well as the time stamp for the maximum and minimum values

The "Measured variables – overview" table above lists the available sliding window demand values.

The sliding window demand values are represented on the display and can be called via the communication interfaces.

Representation on the display

A stroke (bar) above the phase designation (a, b, c) indicates that the displayed value is a sliding window demand value.

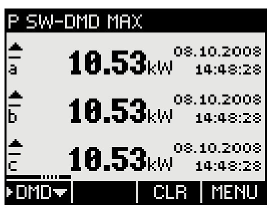


Figure 3-2 Maximum sliding window demand of the active power

You can display the sliding window demand with function key F1: First select the measured variable. Then scroll to the demand display with F1.

Parameterization of the averaging time

The averaging time can be parameterized on the display or via the communication interface. The following can be set: 3, 5, 10, 30, 60, 300, 600, 900 seconds.

See also

Measured variables (Page 25)

Basic parameters (Page 137)

MODBUS (Page 225)

3.3.2 Other properties of measured variable representation

Zero point suppression level

The zero point suppression level can be set via the interface in 1% steps in the range from 0% to 10% of the primary rated value of the external current transformer (default value 0.0%). Currents within this range are indicated on the display with "0" (zero).

Current direction

The current direction can be changed on the device or via the interface individually for each phase. It is not necessary to change the terminal connections of the current transformers in the event of connection errors.

3.4 Load profile

3.4.1 Overview

The load profile records the time history of the electric power and thus documents the distribution of power fluctuations and peaks.

SENTRON PAC4200 supports load profile recording according to the "fixed block" or "rolling block" method. With both methods, the load profile is stored in the device and made available at the communication interfaces.

SENTRON PAC4200 is capable of intelligently interpreting synchronization signals received at irregular intervals. Any deviations from the set times are documented in the load profile.

Accessing the load profile data

Note

Data access via the software

Current and historical load profile data can only be accessed via the communication interfaces. For more information, please see the related documentation.

Configuring load profile recording

You can adapt load profile recording using the configuration software or on the display of the device. The following parameters influence the recording:

- Length of the demand period or subperiod
- Number of subperiods per demand period. This number defines the method for recording the load profile ("fixed block" or "rolling block")
- Type of synchronization

You can also set the following parameter with the configuration software:

- Type of reactive power VAR_{tot}, VAR_1, or VAR_n

You can find more information about parameterization on the device display in the chapter "Parameterizing", "Power demand".

Changing the configuration during operation: If the period length or the number of subperiods is changed, this directly influences the load profile recording. The device stops the current recording and clears all data in the load profile memory. Changing the configuration has no effect on the device counter. The device is not reset.

Load profile recording methods

SENTRON PAC4200 supports the following load profile recording methods:

- Fixed block
- Rolling block

The default setting is the fixed block method with a demand period length of 15 minutes.

Fixed block method

The load profile data is calculated and stored at the end of each demand period.

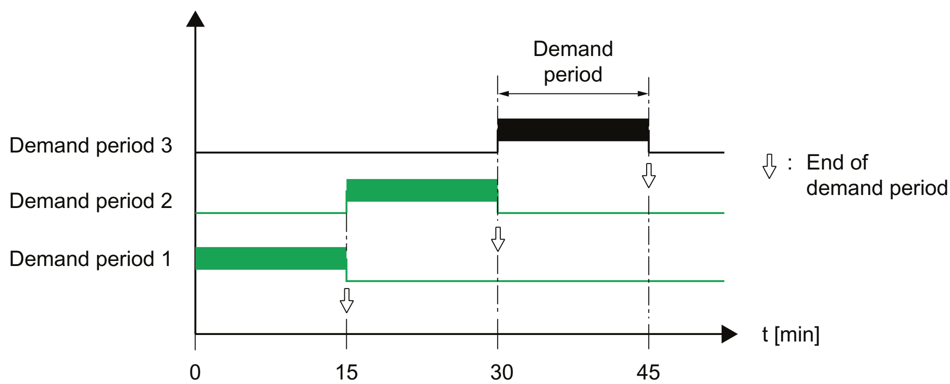


Figure 3-3 Load profile, fixed block method

Rolling block method

The rolling block method divides the demand period into subperiods. The load profile data is calculated and stored at the end of each demand period or subperiod.

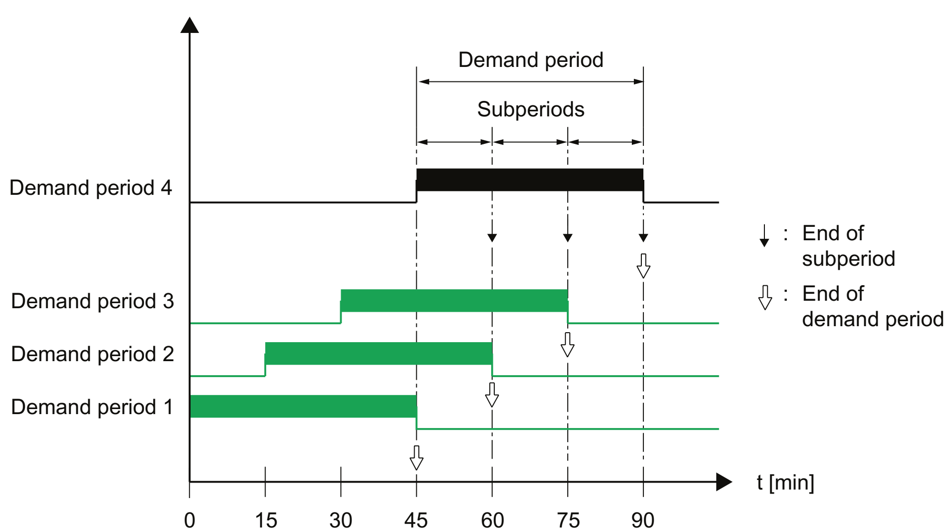


Figure 3-4 Load profile, rolling block method

Parameterizing the fixed block and rolling block methods

SENTRON PAC4200 supports the fixed block method as a special case of the rolling block method. The most important distinguishing feature is the number of subperiods.

Number of subperiods:

The demand period can be divided into a maximum of five subperiods.

- The number "1" defines the fixed block method. In this case, the length of the subperiod is identical to the length of the demand period.
- The numbers "2" to "5" define the rolling block method.

Length of the subperiods:

The length of a subperiod is an integer part of a full hour. The device allows the following lengths in minutes:

1, 2, 3, 4, 5, 6, 10, 12, 15, 20, 30, 60 min

Length of demand period:

The length of the demand period cannot be directly configured. It is defined as the product of the length of a subperiod and the number of subperiods.

$$\text{Length}_{\text{demand\_period}} = n \cdot \text{length}_{\text{subperiod}}; \; n = \text{number of subperiods}$$

Calculation of the power demand and the cumulated power

Arithmetic power demand:

Arithmetic calculation of the power demand referred to the actual length of the demand period. The arithmetic power demand in the instantaneous period remains constant providing the power is constant.

Cumulated power:

Cumulative calculation of the power referred to the configured length of the subperiod. The cumulated power in the instantaneous period increases linearly providing the power is constant.

The energy can be calculated from the cumulated power as follows:

$$\text{Energy} = (\text{cumulated power}) \cdot (\text{configured period length})$$

See also

Power demand (Page 142)

3.4.2 Historical load profile

Measured variables recorded

SENTRON PAC4200 records the following measured variables:

Table 3- 3 Historical load profile

Measured variable	Cumulated power	Power demand	Minimum instantaneous value	Maximum instantaneous value
Active power import	X	X	±X	±X
Active power export	X	X		
Reactive power import	X	X	±X	±X
Reactive power export	X	X		
Apparent power	X	X	X	X

The total power factor import and the total power factor export can be read out via the interface in addition to the measured variables indicated in the table.

The values are recorded per demand period or subperiod:

- Fixed block method

  All values are recorded per demand period.
- Rolling block method

  Arithmetic power demand values are recorded per demand period.

  Cumulated power demand values and maximum / minimum values are recorded per subperiod.

Accessing the load profile memory

- The complete load profile memory can be read out.
- A definable number of periods can be read out starting at a definable period number.
- The complete load profile memory can be cleared.

Storage concept of the load profile memory

The memory of SENTRON PAC4200 is designed as a circular buffer. If the maximum available memory is exceeded, the oldest data is overwritten by the newest data.

Storage capacity of the load profile memory

The data volume that occurs when a load profile is recorded depends on the length of the period.

SENTRON PAC4200 can record load profile data for the following configuration over a period of 40 days:

- Fixed block:

  Length of the demand period: 15 minutes
- Rolling block:

  Length of the subperiods: 15 minutes

This corresponds to a maximum of 3840 recorded periods.

This calculation applies to the ideal case in which the actual period length is identical to the configured length for all periods over the complete load profile recording time. Any deviations between the actual and configured period lengths additionally increase the data volume.

3.4.3 Current load profile data at the communication interfaces

Current load profile data

SENTRON PAC4200 supplies the load profile data for the current and instantaneous periods at the communication interfaces.

- The current period is the last completed period.
- The instantaneous period is the period still in progress and has not yet been completed.

You can find more information on accessing the data via MODBUS in the Appendix.

See also

Measured variables for the load profile with the function codes 0x03 and 0x04 (Page 236)

3.4.4 Synchronization of the load profile

Synchronization time

The device expects the synchronization pulse at the start of the period.

Synchronization types

The device can obtain the synchronization pulse from an external source

- As a signal at the digital input,
- As a command via the communication interfaces.

The device can control the synchronization itself

- By means of the internal clock.

Handling of irregular, external synchronization pulses

SENTRON PAC4200 checks whether the external synchronization pulse is received at the set time, too soon, too late, or not at all. If the deviation from the set time exceeds a defined tolerance, this results in a shorter period.

If the complete time frame for received pulses is offset, SENTRON PAC4200 automatically adapts to the new time frame.

Synchronization via the communication interface

The synchronization frame contains the length of the subperiod in minutes. The synchronization command is ignored if the period length sent to the device with the synchronization frame is different to the length parameterized in the device.

Synchronization with the internal clock

The length of the subperiod, and thus also the demand period, is determined solely by the internal clock.

A subperiod starts on the full hour plus a multiple of the configured subperiod length.

Correction of the time during the current demand period or beyond the end of the demand period results in shorter demand periods. SENTRON PAC4200 marks these periods with the valuation indicator "resynchronized".

It does not record any substitute values for the gaps that are created in the time history.

Response to powering up

All load profiles that have already been recorded remain unchanged.

SENTRON PAC4200 resets the internal clock if it detects load profiles with a date in the future or a time in the past on powering up.

Impact of a tariff change on the load profile

Tariff changes between off-peak and on-peak have an impact on the load profile because all values stored in the profile are uniquely assigned to the applicable tariff.

The old tariff remains valid until the end of the instantaneous period. The new tariff takes effect at the start of the next period. The energy counters of SENTRON PAC4200 are switched to the other tariff at the end of the instantaneous demand period.

Impact of a measuring voltage failure

A failure of the measuring voltage has no effect on the load profile.

Impact of a supply voltage failure

The device records shorter periods if the supply voltage fails and when it is restored.

It does not record any substitute values for the duration of the power failure.

3.4.5 Additional information about the load profile data

SENTRON PAC4200 records the following additional information for each period:

- "Resynchronized"

  The period was prematurely ended by the device owing to a synchronization irregularity. This identifier is set as long as the time is undefined. The time can be undefined if the internal clock could not be backed up by the battery, e.g. because the battery is discharged.
- "Supply voltage failed"

  The period was prematurely ended owing to the failure of the supply voltage.
- "Unreliable"

  The load profile data is unreliable.
  - The measuring current or the measuring voltage is outside the specified range.
  - The reactive power type has changed.

The additional information is stored together with the other load profile data and can be called via the communication interface.

See also

Load profile (Page 225)

3.5 Tariffs

SENTRON PAC4200 supports two tariffs for the integrated energy counters (on-peak and off-peak).

Impact of the tariff change

The tariff change affects all energy counters for active energy, reactive energy, and apparent energy.

Controlling the tariff change

A tariff change between off-peak and on-peak can be requested by means of a digital input or via the communication interfaces.

Time-related switching is only possible using a higher-level system.

Activation of a tariff change at the end of a period

The old tariff remains valid until the end of the instantaneous period. The new tariff takes effect at the start of the next period. The energy counters of SENTRON PAC4200 are switched to the other tariff at the end of the instantaneous demand period.

Without synchronization, the tariff change takes effect immediately.

3.6 Technical features of the supply quality

The SENTRON PAC4200 supplies the following measured variables for evaluating network quality:

1. Harmonics up to the 31st harmonic
2. THD for voltage and current:
3. Displacement angle φ
4. Cosine of the displacement angle φ
5. Phase angle
6. Unbalance voltage and unbalance current

Harmonics up to the 31st harmonic referred to the fundamental

SENTRON PAC4200 measures the 3rd to 31st odd harmonics referred to the fundamental for:

- Voltage ph-ph
- Voltage ph-n
- Current

SENTRON PAC4200 measures the instantaneous and maximum values.

The values are represented on the display and can be called via the communication interfaces.

The display represents the harmonics as a bar diagram and in table form with instantaneous/maximum values and the time stamp of the maximum value.

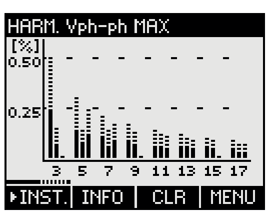


Figure 3-5 Instantaneous and maximum values of the harmonics of the ph-ph voltage referred to the fundamental

The fundamental of the voltage can only be read via the bus.

Harmonics referred to the root-mean-square value

The fundamental of the voltage is specified in volts (V) rather than percent (%). The harmonics of the voltage referred to the root-mean-square value (r.m.s.) can be calculated from this information in the software.

THD

The THD (total harmonic distortion) is used to describe the distortion of the electrical signal. It indicates the ratio of the harmonic content to the fundamental in percent.

SENTRON PAC4200 measures the THD of the voltage and the THD of the current referred to the fundamental. The instantaneous value, the maximum value and the time stamp of the maximum value are supplied.

The values are calculated according to the IEC 61557-12 standard: 2007. Account is taken of harmonics up to the 31st harmonic.

Displacement angle φ

The angle φ (phi) describes the displacement angle between the fundamentals of voltage and current.

SENTRON PAC4200 supplies the instantaneous value of the displacement angle φ, the maximum and minimum values, and the time stamps of the maximum and minimum values for each phase.

The values can be read out via the communication interfaces.

The display represents the phase displacement on several screens:

- Phasor diagram,
  can be called with "MAIN MENU" > "PHASOR DIAGRAM"
- Value table of the phasor diagram, row φ"
  can be called with "MAIN MENU" > "PHASOR DIAGRAM" > F1 TAB.
- Display "φ",
  can be called with "MAIN MENU" > "COSφ/φ" > F1 > F1 > F1

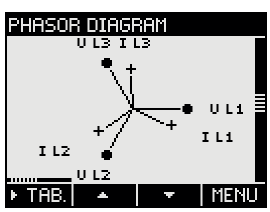


Figure 3-6 Graph of the phasor diagram

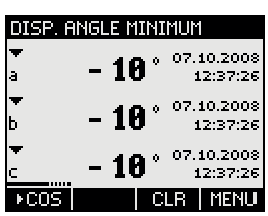


Figure 3-7 Minimum value of the displacement angle φ with time stamp

Cosine phi

cos φ is the cosine of the displacement angle φ of the fundamental. The possible values of cos φ are between -1 and 1.

SENTRON PAC4200 supplies the instantaneous value of cos φ, the maximum and minimum values, and the time stamps of the maximum and minimum time values for each phase.

The values can be read out via the communication interfaces.

The display represents cos φ on several screens:

- Value table of the phasor diagram, row "COS"
  can be called with "MAIN MENU" > "PHASOR DIAGRAM" > F1 ▸TAB.
- Display "COS φ",
  can be called with "MAIN MENU" > "COSφ/∡φ"

An inductive cos φ is marked by a coil symbol in front of the measured value and a capacitive cos φ by a capacitor symbol.

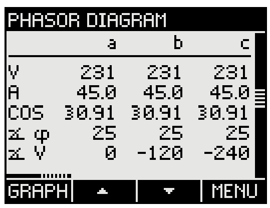


Figure 3-8 Value table for the phasor diagram

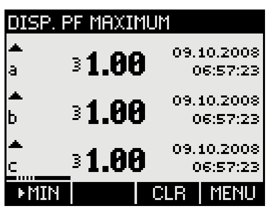


Figure 3-9 Maximum value of the displacement power factor cos φ with time stamp

Phase angle

SENTRON PAC4200 supplies the instantaneous values, the maximum and minimum values, and the time stamps of the maximum and minimum time values for the phase angles L1-L1, L1-L2 and L1-L3.

The values can be called via the communication interfaces.

The display represents the instantaneous value of the phase angle on several screens:

- Phasor diagram,
  can be called with "MAIN MENU" > "PHASOR DIAGRAM"
- Value table of the phasor diagram, row ∡ V"
  can be called with "MAIN MENU" > "PHASOR DIAGRAM" > F1▸TAB.

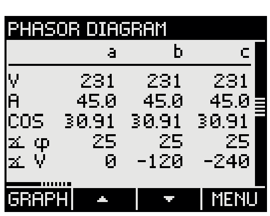


Figure 3-10 Phasor diagram, value table

Unbalance

A three-phase system is referred to as balanced if the three phase-to-phase voltages and phase-to-phase currents have an identical amplitude and are offset 120° from each other.

SENTRON PAC4200 calculates the unbalance for voltage and current according to the EN 61000-4-27:2000 standard.

The display represents the unbalance information on several screens:

- "PHASE UNBAL.", current and voltage unbalance in percent
- "PHASOR DIAGRAM", absolute current, voltage, and phase angle " V" values for each phase

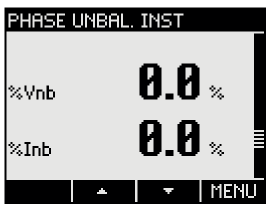


Figure 3-11 Voltage and current unbalance

In addition to the vectorial calculation of the phase unbalance, SENTRON PAC4200 also supplies the amplitude unbalance for current and voltage according to the IEC 61557-12 standard at the communication interfaces. The amplitude unbalance only takes account of the amplitude and not the phase angle.

3.7 Date and time

UTC time and local time

The internal clock of SENTRON PAC4200 measures UTC time. All information about the date and time (time stamp) that can be called at the communication interfaces must be interpreted as UTC time.

The SENTRON PAC4200 display indicates the configured local time corresponding to the time difference due to time zones and daylight saving time.

UTC time: Universal Time Coordinated (UTC) is the international reference time.

Time zone: Geographical areas with the same positive or negative deviation from UTC time are grouped together in time zones.

Local time: Local time is UTC time plus or minus the time difference due to the time zone plus or minus the time difference due to the locally applicable daylight saving time.

Example: 3.36 p.m. CEST (local time in Germany) on September 10, 2008 corresponds to 1.36 p.m. (UTC time) on September 10, 2008. Germany is located in the UTC+1 time zone. Daylight saving time applies on the above-mentioned date, so that the local time difference is increased by one hour ("+1").

Synchronization of the internal clock

The internal clock of SENTRON PAC4200 can be synchronized with an external time, e.g. with the "Top of minute" pulse or with a synchronization command via the available communication interfaces.

Synchronization is relevant for all measured variables where the time of occurrence is also captured, e.g. for recording the load profile.

3.8 Limits

SENTRON PAC4200 monitors up to 12 limit values as well as one limit that can be formed by logically combining the other 12 limits.

Defining the limit values

The number of limit values to be monitored is selectable. The following must be specified for each of the maximum of 12 limit values:

- Limit value monitoring ON/OFF
- Monitored measured variable
- Threshold
- Upper or lower limit violated
- Time delay
- Hysteresis

Combination of the limit values

The limit value formed by the logical combination is called "LIMIT LOGIC".

SENTRON PAC4200 provides parameterizable logic for combining the limit values that supports brackets, takes account of priority rules, and allows logical negation.

The logic is represented on the display using the graphic symbols familiar from digital technology: Four logic function blocks are connected upstream of one higher-level logic function block. Each of the upstream logic function blocks has 4 usable inputs.

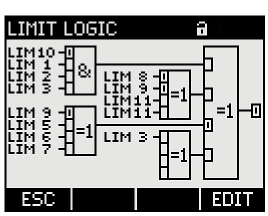


Figure 3-12 LIMIT LOGIC

The following logic operations can be selected for each logic function block:

- AND (AND operation)
- NAND (NOT AND operation)
- OR (OR operation)
- NOR (NOT OR operation)
- XOR (EXCLUSIVE OR operation)
- XNOR (EXCLUSIVE NOT OR operation)

Any limit values and the digital inputs of SENTRON PAC4200 can be selected at the inputs of the upstream logic function blocks. The input value is the truth value of the monitored signal:

- True: Limit value is violated or input is active
- False: Limit value is not violated or input is not active

Displaying limit violations

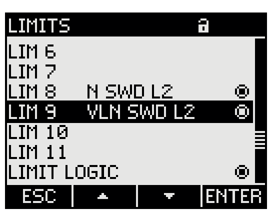
SENTRON PAC4200 outputs limit violations at the digital output or via the interfaces.

Limit violations are countable. One of the limit values can be assigned to the universal counters.

Limit violations are recorded as events with additional information on the monitored measured variable and the monitored threshold.

Limit violations are shown on the following displays:

- MAIN MENU > SETTINGS > ADVANCED > LIMITS
- ... > LIMITS > LIMIT LOGIC



Left column:	Limit value designation
Middle column:	Monitored data source
Right column:	Limit value currently violated: Yes ◉, No ◯

Figure 3-13 Representation of limit violations

3.9 Function of the digital inputs and outputs

SENTRON PAC4200 has:

- Two multifunctional integral digital inputs
- Two multifunctional integral digital outputs
- Optionally up to 8 plug-in digital inputs
- Optionally up to 4 plug-in digital outputs

Functions of the digital outputs

The following functions can be assigned to the digital outputs:

- Energy pulse output, programmable for active or reactive energy
- Signaling the direction of rotation
- Displaying the operating status of SENTRON PAC4200
- Signaling limit violations
- Switching output, remote controlled via the communication interfaces
- Output of the end of a subperiod for synchronizing other devices

Signal output

The digital output supplies a number of pulses or edges proportional to the energy measured.

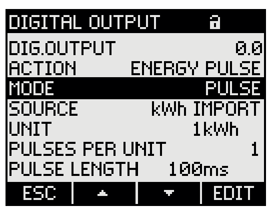


Figure 3-14 Digital output

The output of pulses or edges can be parameterized.

The rising and falling edges are counted.

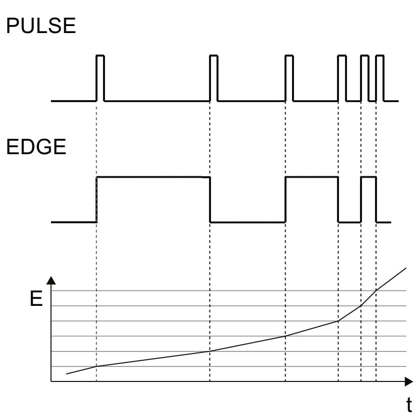
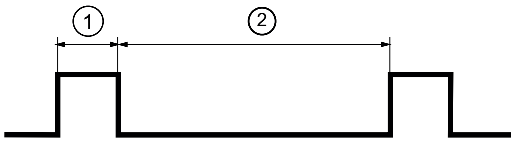


Figure 3-15 Types of count signal

The digital output is passive and implemented exclusively as a switch.

The implementation of the pulse shape corresponds to the IEC 62053-31 standard.

Pulse length, turn-off time



(1) Pulse length

(2) Turn-off time

Figure 3-16 Pulse length and turn-off time

- Pulse length:
  Time for which the signal at the digital output is "high". The minimum pulse length is 30 ms and the maximum 500 ms.
- Turn-off time:
  Time for which the signal at the digital output is "low". The turn-off time depends on the measured energy, for example, and can be days or months.
- Minimum turn-off time:
  The minimum turn-off time is specified by the programmed pulse length.

Functions of the digital inputs

The following functions can be assigned to the digital inputs:

- Tariff switching for on-peak and off-peak.
- Synchronization of the measuring period by means of the synchronization pulse of a system control center or other device.
- Synchronization of the internal clock ("Top of minute").
- Status monitoring: Capturing statuses of connected signal encoders.
- Energy signal for active or reactive energy or freely definable energy types.
- Starting and stopping the process energy counters and the process operating hours counter
- Copying and resetting:
  - All process energy counters
  - The counter for process active energy
  - The counter for process reactive energy
  - The counter for process apparent energy
- Resetting:
  - The process energy counters and the process operating hours counter
  - The counter for process active energy
  - The counter for process reactive energy
  - The counter for process apparent energy
  - All process energy counters, the process operating hours counter and all pulse counters
  - A specific pulse counter

A maximum voltage of 30 V can be applied to the digital input. Higher voltages require an external voltage divider.

Signal input

Either edge or pulse counting.

Data is transferred with the help of weighted pulses or edges, e.g. a parameterizable number of pulses or edges is transferred per kWh.

The countable unit can be defined separately for each application.

The implementation of the pulse shape corresponds to the IEC 62053-31 standard.

3.10 Ethernet port

SENTRON PAC4200 is equipped with an Ethernet interface. This interface facilitates:

- Configuration of the device using the SENTRON powerconfig software
- Communication between the device and the energy management system
- Device firmware updates

Properties of the Ethernet interface

- Transmission rate 10 / 100 Mbit/s
- RJ45 socket (8P8C) on the top of the device for RJ45 connector with EIA/TIA T568B assignment
- Cable type 100Base-TX (CAT5)

  The Ethernet cable must be grounded for data transmission according to the Fast Ethernet standard. You can find information on grounding in the "Connecting" chapter.
- Autonegotiation
- MDI-X auto crossover
- Communication over MODBUS TCP

NOTICE
Interference with other network nodes due to incorrect network settings Incorrect network settings can adversely affect or interfere with the functions of other network nodes The network settings for Ethernet are defined by the system administrator and must be set accordingly on the device. If the settings are not known, the (patch) cable must not be connected.

Autonegotiation is a method used by network communication peers to automatically negotiate the highest possible transmission rate. SENTRON PAC4200 is automatically set to the transmission rate of the communication peer if the latter does not support autonegotiation.

MDI-X auto crossover describes the ability of the interface to autonomously detect the send and receive lines of the connected device and adjust to them. This prevents malfunctions resulting from mismatching send and receive wires. Both crossed and uncrossed cables can be used.

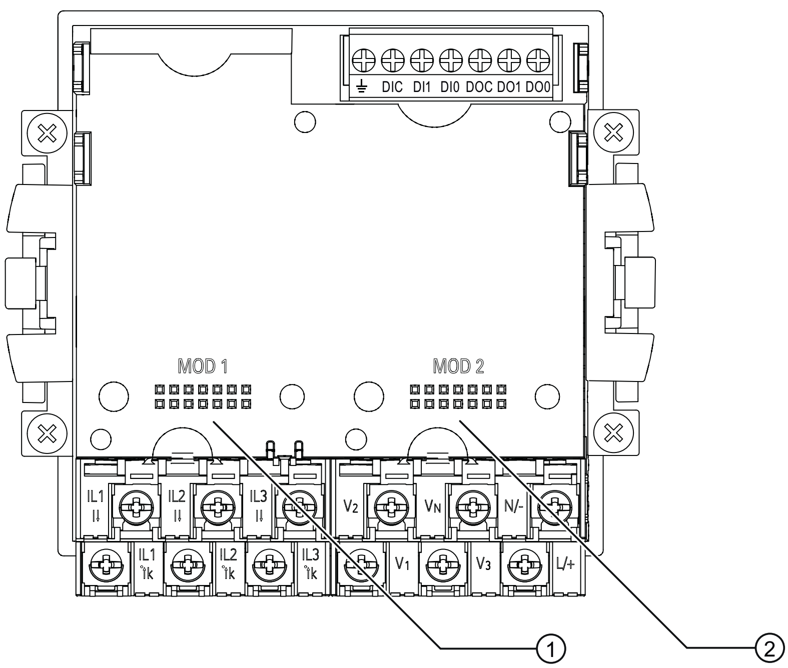
3.11 Slots for expansion modules

Interface

SENTRON PAC4200 has two slots (MOD1 and MOD2) for installing optionally available expansion modules.

Please consult the current catalogs to find out which modules are available for SENTRON PAC4200.

One expansion module can be operated alone on the device or two expansion modules simultaneously.



(1) MOD1 slot

(2) MOD2 slot

Figure 3-17 SENTRON PAC4200, rear

CAUTION
Avoid contamination of the contact areas below the labels "MOD1" and "MOD2", since otherwise the expansion modules cannot be connected or can even be damaged. Insertion of metal pins or wires into the contact openings can result in device failure.

3.12 Gateway

SENTRON PAC4200 can be used as a gateway. This allows devices (slaves) that are connected to the RS485 expansion module of PAC4200 to be connected to a device over Ethernet (master).

Operating principle

Data sent by the master to the addressed target device: The higher-level software packages the serial protocol into TCP/IP packets. SENTRON PAC4200 unpacks the TCP/IP packets and forwards the freed packets of the serial protocol to the serial port (RS485).

Data sent by the addressed target device to the master: SENTRON PAC4200 packages the serial protocol packets into the TCP protocol and forwards the packaged user data to the higher-level software.

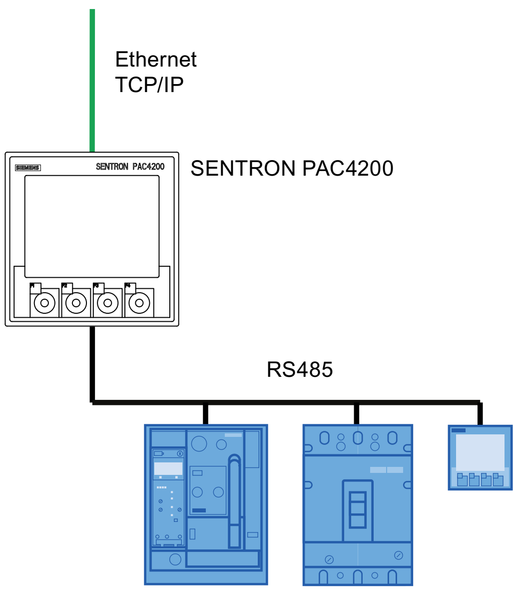


Figure 3-18 SENTRON PAC4200 as a gateway

Requirements and conditions

The SENTRON PAC RS485 expansion module is required to connect the RS485 bus. According to the RS485 bus specification, up to 31 devices can be addressed via the gateway without special RS485 repeaters.

The higher-level software must support the serial protocol of the addressed target device as well as packaging/unpacking the serial protocol into/from TCP/IP.

SENTRON PAC RS485 expansion module

The slot for the SENTRON PAC RS485 expansion module is freely selectable.

Configuration of the gateway

SENTRON PAC4200 must be configured for using the gateway.

- Start up the SENTRON PAC RS485 expansion module on the SENTRON PAC4200.
- Set the communication parameters for operating the RS485 bus below the gateway. These settings are possible on the display of SENTRON PAC4200 or in the software.

You can find information about parameterizing RS 485 in the documentation for the SENTRON PAC RS485 expansion module or under Modbus-IDA (http://www.Modbus-IDA.org).

Addressing the target devices

The following address information is required in the software in order to address a device via the gateway of SENTRON PAC4200:

- IP address of SENTRON PAC4200
- Gateway port
  - Port 17002 if the RS485 bus is connected to the "MOD1" slot
  - Port 17003 if the RS485 bus is connected to the "MOD2" slot
- Bus address of the target device, e.g. MODBUS address

Further information

You will find further information at:
Modbus.org "MODBUS MESSAGING ON TCP/IP IMPLEMENTATION GUIDE".

See also

Modbus IDA (http://www.Modbus-IDA.org)

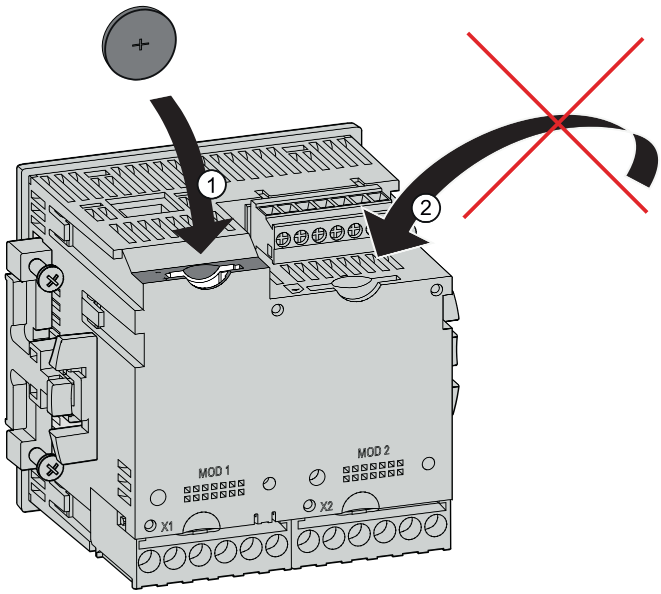
3.13 Slots

Battery compartment

The battery compartment of the SENTRON PAC4200 is accessible from the outside without opening the housing.

Slot for memory card

The card slot of the SENTRON PAC4200 has no function. The device does not contain a card reader.



(1) Battery compartment

(2) Non-functional card slot opening

Figure 3-19 Insertion openings of the SENTRON PAC4200

CAUTION
Foreign body in the unit can trigger a short-circuit
The battery compartment is intended exclusively for holding the battery. Foreign bodies introduced into the unit via the battery compartment or via the insertion opening of the card slot can cause a short-circuit and damage the device. It is not possible to retrieve any foreign bodies once inserted.
Do not insert any foreign bodies into the device.

See also

Replacing the battery (Page 170)

3.14 Password protection

SENTRON PAC4200 can be protected with a password.

Scope

The password protection is activated for write accesses via the user interface or via the integrated Ethernet interface.

Format

A four-digit, numeric password is used.

Default

The default password is: 0000

See also

Password management (Page 160)

Advanced (Page 152)

3.15 User-definable displays

Up to four measurements can be individually configured for SENTRON PAC4200. Four presentational formats can be selected:

- Digital display of two measured variables
- Digital display of four measured variables
- Bar diagram for measured variables
- Bar diagram for three measured variables
- User-definable displays of counters in conjunction with the SENTRON PAC 4DI/2DO expansion module

Digital display

The instantaneous value, the designation, and the unit are shown for each measured variable.

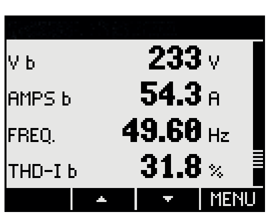


Figure 3-20 Example of a definable display (digital display)

Graphical display

The instantaneous value, designation, unit, and parameterizable value range are shown for each measured variable. The instantaneous value is represented as a bar diagram and digital information.

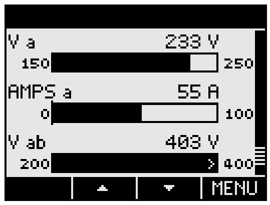


Figure 3-21 Example of a freely definable display (bar diagram)

An outward pointing arrow in the bar means that the instantaneous value displayed is outside the parameterized range.

Displays for counters

Users can define up to 5 displays in conjunction with the SENTRON PAC 4DI/2DO expansion module.

Configuring

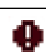
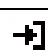
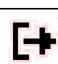
The displays can be configured with the SENTRON powerconfig software.

3.16 Events

The device reports the occurrence of certain events. These events are listed in the event recording undertaken by SENTRON PAC. You can acknowledge acknowledgable events in a popup window on the device.

Displaying events

Table 3- 4 Meaning of the symbols in the events list

Symbol	Meaning
No symbol	Information
!	Warning
	Alarm
	Incoming event
	Outgoing event
	Overcurrent, overvoltage
▶	Changed
Q	Acknowledged event

Symbol	Meaning
#	Interrupt, error, missing
	Upper limit violated, out of range
	Lower limit violated
...= 0	Reset
...= 1	Condition met

The events are divided into the following event classes:

- Operating information
- System information
- Operation

The following information is shown for each event:

- Event
- Event class
- Date and time when the event occurred
- Reason why the event occurred
- Interface (if applicable)
- Measured value affected and corresponding measurement (if applicable)
- Limit value (if applicable)
- Address of the digital output (if applicable)
- Address of the digital input (if applicable)

Table 3- 5 The following events are reported:

Event	Event class	Standard warning level	Reason	Remedy
START PMD	System information	Information	Voltage recovery	-
PMD INFO	System information	Warning	PMD information	Please contact Support.
COMM.FAULT	System information	Warning	A communications fault has occurred at the slot xx interface.	Check the network settings
FW UPDATE #	System information	Warning	Transmission error: The firmware is not suitable.	Make sure you are using the correct firmware version for the update. Restart the firmware update.
TIME CORR:	System information	Information	Top of minute: The time has been corrected.	-

Event	Event class	Standard warning level	Reason	Remedy
TIME SYNC #	System information	Information	The time synchronization has failed. Interface: Slot xx	The "Top of minute" pulses for synchronizing the time are not active. Check the hardware and the settings for transmitting the "Top of minute" pulses.
VOLTAGE #	Operating information	Warning	The supply voltage has been interrupted. Measured variable x	The device has been disconnected from the network in accordance with the schedule. An error has occurred. Check the power supply.
VOLTAGE ⤒	Operating information	Alarm	The voltage is out of range Measured variable x	Danger of serious or fatal injury or of serious damage to the device. Make sure the system is operating under conditions for which SENTRON PAC is approved. It is possible that the measurements are not correctly displayed. Please contact Support.
CURRENT ⤒	Operating information	Alarm	The current is out of range. Measured variable x	
LIMIT ⤒	Operating information	Information	The upper limit value xxxx has been exceeded. Measured variable x, limit value xxxx	-
LIMIT ⤓	Operating information	Information	The lower limit value xxxx has been exceeded. Measured variable x, limit value xxxx	-
LIMIT LOG. OP=1	Operating information	Information	The limit logic operation complies with the limit value xxxx.	-
TARIFF ▶	Operating information	Information	Tariff change to ...	-
STATUS DI ▶	Operating information	Information	The digital input is activated. DI address xx.xx	-
STATUS DO ▶	Operating information	Information	The digital output is activated. DO address xx.xx	-
PULSE FREQ ⤒	Operating information	Information	The pulse frequency is too high. DO address xx.xx	-
TIME ▶	Operating information	Information	The time was set on: Slot xx interface	-
FACT. DEFAULTS	Operating information	Information	The factory defaults have been set. Slot xx interface	-

Event	Event class	Standard warning level	Reason	Remedy
BASIC PARAM	Control	Warning	The basic configuration has been changed. Slot xx interface	-
SETTING	Control	Warning	The configuration has been changed. Slot xx interface	-
COMM.	Control	Information	The communication configuration has been changed. Slot xx interface	-
MAX/MIN=0	Control	Information	The maximum / minimum values have been reset. Slot xx interface	-
OP.HOURS=0	Control	Information	The operating hours counter has been reset. Slot xx interface	-
D ENERGY=0	Control	Information	The day energy counter has been reset. Slot xx interface	-
EVENT=0	Control	Information	The event recordings have been deleted. Slot xx interface	-
LOAD REC.=0	Control	Information	The load profile recording has been deleted. Slot xx interface	-
ENERGY C.=0	Control	Information	All energy counters have been reset. 1) Value 00000000 Slot xx interface	-
UNIV.=0	Control	Information	The universal counters have been reset. Value 00000000 Slot xx interface	-
PASSWORD	Control	Information	Password protection is activated. Slot xx interface	-
PASSWORD ▶	Control	Information	The password has been changed Slot xx interface	-
FIRMWARE	Control	Information	The firmware has been updated. Version PAC4200 Vx.xx Slot xx interface	-

1) Counter = active energy and reactive energy for import and export tariff 1 / 2 , apparent energy tariff 1 / 2

Acknowledging an event

If an event is set to "acknowledgable" in the software, a popup window for this event opens on the device. Acknowledge the event in the popup window with "OK". Acknowledgment closes the popup window. The event is logged in the event memory.

Settings in the SENTRON software

You can make the following settings in the software:

- Change the warning level for an event
- Acknowledge an event
- Entry of an event in the event memory
- Output of the event on the communication module
- Order of appearance on the display

See also

Safety notes (Page 17)

3.17 Performance features of the PAC PROFIBUS DP expansion module

You can use the PAC PROFIBUS DP expansion module to access the SENTRON PAC Power Monitoring Devices during operation.

Overview

Features include:

- Communication based on the PROFIBUS DP master-slave principle:

  The PAC PROFIBUS DP expansion module provides the PROFIBUS DP master with measured values of the SENTRON PAC Power Monitoring Device. It receives information, e.g. commands, from the PROFIBUS DP master, and forwards this information to the SENTRON PAC Power Monitoring Device.
- Function: PROFIBUS DP slave
- Communication with the class 1 master and the class 2 masters
- Cyclic data transfer
- Acyclic data transfer
- Specific GSD file for every Power Monitoring Device type. This allows correct integration into the controller.
- Automatic detection of the baud rate
- Clock synchronization depending on the device type

- Setting the PROFIBUS address:
  - At the device
  - With parameterization software
  - Per PROFIBUS
- Generation of diagnostic interrupts and process interrupts
- Diagnostics also via the local display
- Status display via LED
- To ensure galvanic isolation between the SENTRON PAC Power Monitoring Device and the PROFIBUS.

You can find further information on the PAC PROFIBUS DP expansion module in:

- the manual "SENTRON PAC PROFIBUS DP Expansion Module"
- the operating instructions "SENTRON PAC PROFIBUS DP Expansion Module"

3.18 Performance features of the PAC RS485 expansion module

You can integrate the SENTRON PAC into RS 485 systems with the help of the PAC RS485 expansion module.

Overview

Features include:

- Communication based on the master-slave principle via the serial interface
- Function:
  - Modbus RTU slave
  - Serial gateway
  - Modbus gateway (MB gateway)
- Configuration via:
  - the SENTRON PAC Power Monitoring Device
  - *SENTRON powerconfig*
- Unicast messages
- Broadcast commands with address 0 to the MODBUS slaves

3.19 Performance features of the SENTRON PAC 4DI/2DO expansion module

You expand the digital inputs and digital outputs with the SENTRON PAC 4DI/2DO expansion module.

Overview

- Plug-in expansion module for the SENTRON PAC devices
- Does not require an external power supply
- Configuration via:
  - the SENTRON PAC Power Monitoring Device
  - *SENTRON powerconfig*
- Connected using screw terminals
- Four digital inputs with:
  - Functions as on the SENTRON PAC
  - Active input circuit. This enables optional connection without external power supply.
- Two digital outputs with:
  - Functions as on the SENTRON PAC

Operation planning 4

4.1 Operation planning

Mounting location

The SENTRON PAC4200 device is intended for installation in permanently installed switching panels within closed rooms.

WARNING
Only operate the device in a secure location.
Can cause death, serious injury or considerable property damage.
SENTRON PAC should only be operated in a lockable control cabinet or a lockable room. Ensure only qualified personnel have access to this cabinet or room.

Conductive panels and doors on control cabinets must be grounded. The doors of the control cabinet must be connected to the control cabinet using a grounding cable.

Mounting position

The device must be installed vertically.

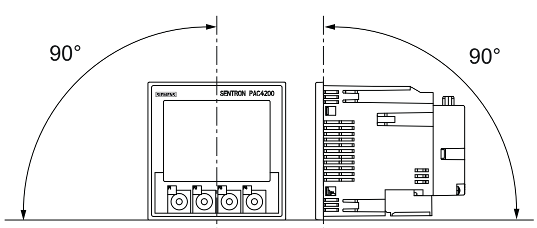


Figure 4-1 Mounting position

The preferred direction of viewing is from below at an angle.

Installation space and ventilation

Sufficient clearance must be maintained between the device and neighboring components in order to comply with the permissible operating temperature. You can find dimension specifications in the "Dimension drawings" chapter.

Plan additional space for:

- Ventilation
- Wiring
- RJ45 plug connector and cable feed on the top of the device
- Optionally connectable expansion modules on the rear of the device, including connector and cable feed

CAUTION
Ensure ventilation Insufficient ventilation may result in damage to the components. Please ensure that the ventilation slots of the housing are not obstructed. The wiring, cable feed or other components must not obstruct ventilation.

NOTICE
Damage due to moisture Moisture or wetness can affect the operating capability of the components. Do not operate the components in an environment affected by high humidity or wetness. Note the environmental requirements of the SENTRON PAC Power Monitoring Device.

Environmental conditions

Use the SENTRON PAC4200 device only where environmental conditions permit its operation:

Temperature range			
	Operating temperature		- 10 °C through + 55 °C
	Storage and transport temperature		- 25 °C through + 70 °C
Relative humidity			95% at 25°C without condensation (normal conditions)
Site altitude above sea level			max. 2000 m
Degree of pollution			2
Degree of protection according to IEC 60529			
	Device front		IP65 Type 5 enclosure acc. to UL50
	Device rear		
		Device with screw terminal	IP20
		Device with ring lug terminal	IP10

Circuit breaker

A suitable circuit breaker must be connected upstream of SENTRON PAC4200 in order to permit disconnection of the device from the power supply.

- The circuit breaker must be mounted close to the device and be easily accessible to the user.
- The circuit breaker must be marked as the circuit breaker for the device.

Temperature compensation

To avoid condensation, the device must be stored at the operating location for at least 2 hours before power is connected.

See also

Dimension drawings (Page 193)

Installation 5

5.1 Unpacking

Observe the ESD Guidelines. Open the packaging carefully. Do not use excessive force.

Check the packaging

Carry out the following checks after receipt of the device and before installation:

- Ensure the packaging is undamaged.
- Make sure that the contents of the package are complete.
- Check the device for external damage.

Please contact your Siemens sales partner in the following cases:

- The packaging is damaged
- The contents of the package are not complete
- The device is damaged.

⚠ WARNING
Do not install or start up damaged devices.
Damaged devices may result in death, serious injury, or property damage.

Storage

Store the components in a dry place.

NOTICE
Avoid condensation
Sudden fluctuations in temperature can lead to condensation. Condensation can affect the function of the device. Store the device in the operating room for at least 2 hours before commencing installation.

5.2 Insert battery

⚠ DANGER
Hazardous Voltage
Will cause death or serious injury.
Turn off and lock out all power supplying this device before working on this device.

For first start-up, use the battery supplied with the device. If you use another battery, this must meet the requirements listed in the chapter "Technical data".

NOTICE
Use only batteries tested in accordance with UL1642.

Procedure

1. Discharge any static from your body. Observe the ESD guidelines in the Appendix.

CAUTION
Electrostatic sensitive devices
Discharge your body of any static electricity. Touch the grounded control cabinet, for example, or a metal part that is connected to the building ground (heater, steel support).

2. Remove the battery from the SENTRON PAC4200 delivery carton.

NOTICE
Reduced service life of the battery
Grease or dirt on the contacts forms a transfer resistance that reduces the service life of the battery. Hold the battery by the edges only.

3. Take note of the polarity indicated at the insertion opening of the battery compartment. Insert the battery into the battery compartment.

Note

Polarity of the battery

The opening of the battery compartment has the same shape as the battery. This determines the alignment of the terminals. It is not possible to insert the battery incorrectly.

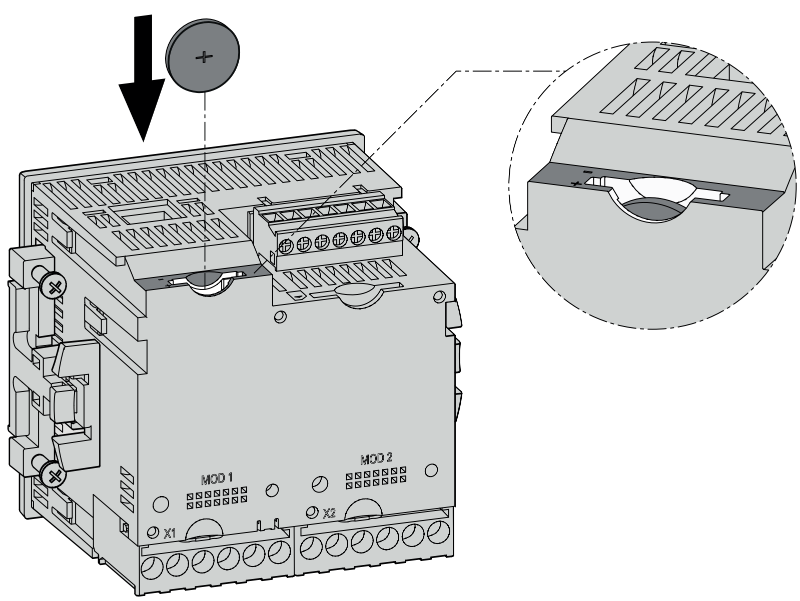


Figure 5-1 Using the battery

See also

Technical data (Page 175)

Electrostatic sensitive devices (ESD) (Page 275)

5.3 Tools

You require the following tools for installation:

- Cutting tool for the panel cutout
- Screwdriver PH2 cal. ISO 6789

Tools for installing the expansion modules

- Cross-tip screwdriver PZ1, ∅ 2.9 mm, 0.5 Nm cal. ISO 6789, also for assembling cables on the terminal block of the PAC RS485 expansion module
- Crimping tool in accordance with EN 60947-1 for assembling cables with core end sleeves on the terminal blocks
- Slotted screwdriver SZS 0.4x2.5 cal. ISO 6789 for assembling cables on the terminal block of the SENTRON PAC 4DI/2DO expansion module

Additional installation tools

- Cable clamp for strain relief on all communication cables if used on the device.

5.4 Mounting on the switching panel

5.4.1 Mounting dimensions

Mounting and clearance dimensions

You can find information on the cutout dimensions, frame dimensions and clearances in the Chapter "Dimension drawings".

See also

Dimension drawings (Page 193)

5.4.2 Installation steps

Proceed as follows to install the SENTRON PAC4200 in the switching panel:

Procedure

1. Cut a hole in the panel measuring $92.0^{+0.8}$ x $92.0^{+0.8}$ mm^2 (if not already available).
2. Discharge any static from your body. Observe the ESD guidelines in the Appendix.

CAUTION
Electrostatic sensitive devices Discharge your body of any static electricity. Touch the grounded control cabinet, for example, or a metal part that is connected to the building ground (heater, steel support).

3. Insert the device into the cutout from outside (Fig. "Installation cutout A").
4. Carry out all other installation steps from the inside of the switching panel.
5. Clamp the device to the switching panel with the two brackets provided (Fig. "Installation step B"). To do this, proceed as follows:
   – Hold the device firmly in position with one hand.
   – Hang the brackets onto the left and right sides of the housing.
   To do so, insert the lugs of the bracket (2) into the slots on the housing (1).
   – Tighten the locking hook. To do so, place the index finger and middle finger on the supports as shown in the figure "Installation step C". Insert the locking hook with the thumb.

   The locking mechanism of both supports enables you to secure the device in the switching panel quickly and without tools. The front of the switching panel is fully sealed with the standard, integrally extruded seal. To achieve degree of protection IP65, the four screws in the supports must be additionally tightened.
6. Tighten the 4 screws evenly in the two brackets; tightening torque 0.3 Nm (Fig. "Installation step D").
7. When using the Ethernet interface:
   – Refer to the information about cable quality and connector design in the chapter "Technical data".
   – Ground the shielding of the Ethernet cable at both ends of the cable. Refer to the "Connecting" chapter for more information.
   – Ensure strain relief for the RJ45 connector.
   Secure the Ethernet cable to the panel for this purpose. Fix the cable in position as shown in the figure "Installation step E" at location (3) using a self-adhesive cable clamp or other suitable small installation accessory.
8. When using optional expansion modules:
   – insert the expansion module into the slots on the rear of the device. You can find the installation instructions in the operating instructions of the relevant expansion module.

Installation is complete.

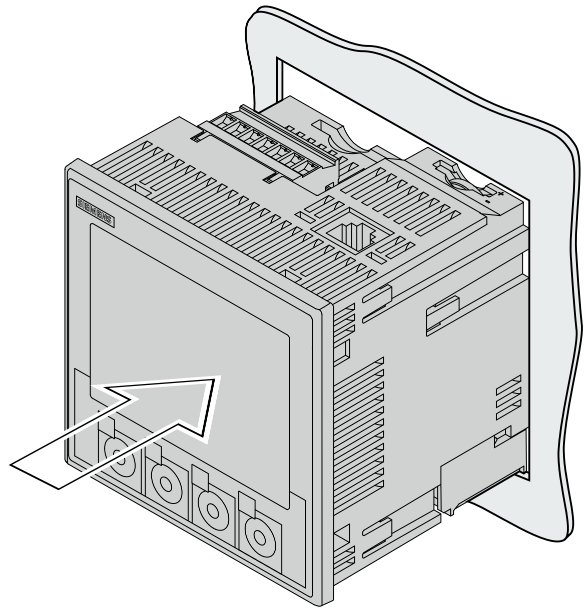


Figure 5-2 Installation step A, device with screw terminals

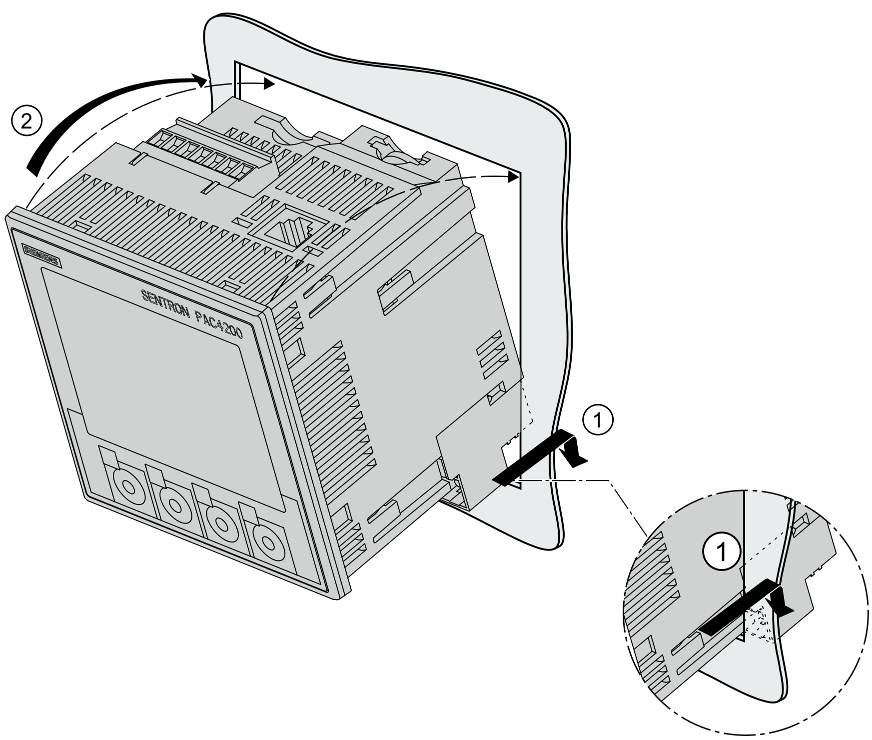
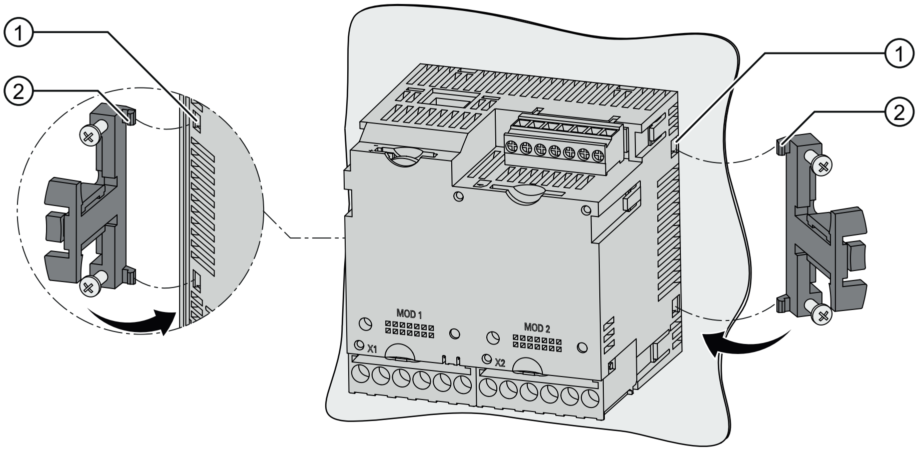
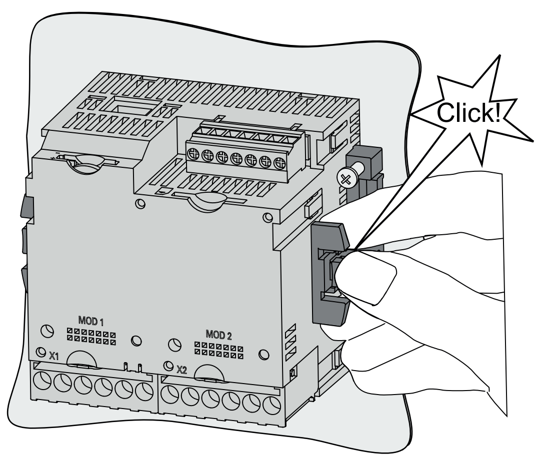


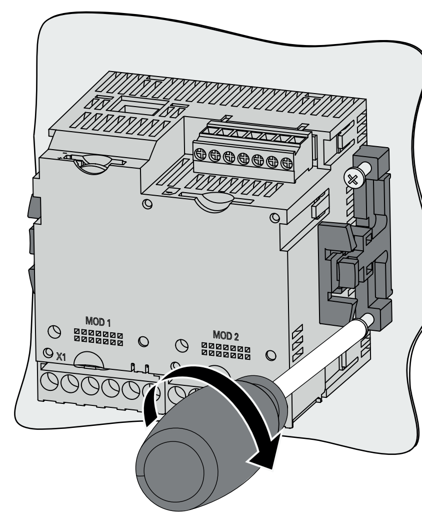
Figure 5-3 Installation step A, device with ring lug terminals



Installation step B



Installation step C



Installation step D

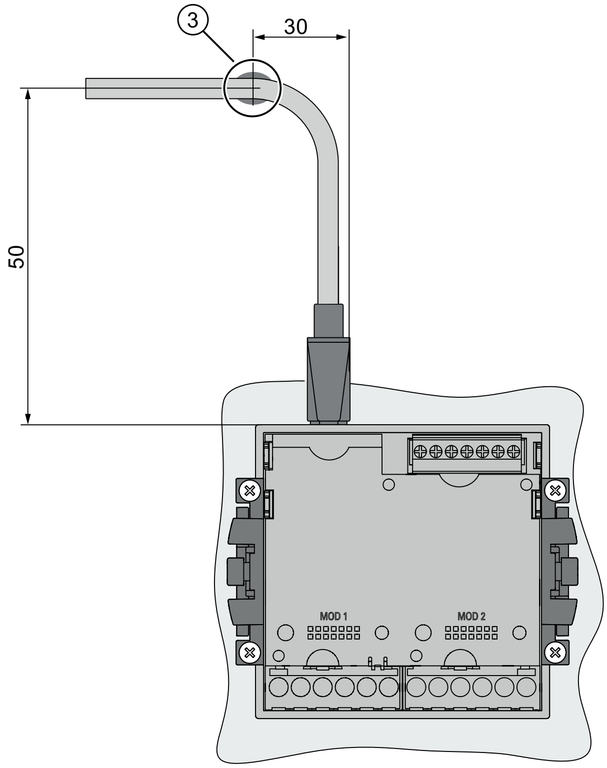


Figure 5-4 Installation step E, strain relief for RJ45 connector

NOTICE
Do not cover the ventilation slots! If the ventilation slots are covered, the components can overheat. Make sure that the ventilation slots are not covered.

NOTICE
Ensure that no tools or other potentially hazardous objects have been left at the installation location.

See also

Grounding of the Ethernet cable (Page 92)

Technical data (Page 175)

Electrostatic sensitive devices (ESD) (Page 275)

5.5 Installing the expansion modules

Assembly

Install the expansion module before starting up the SENTRON PAC. Observe the ESD Guidelines.

CAUTION
Defective connector to SENTRON PAC Power Monitoring Device Dirty or bent pins can affect the function of the connectors. The connectors can be destroyed. Do not allow the pins to become dirty. Make sure that: • There are no metal parts between the pins. • There are no metal parts adhering to the pins. • The pins do not bend. Do not touch the pins.

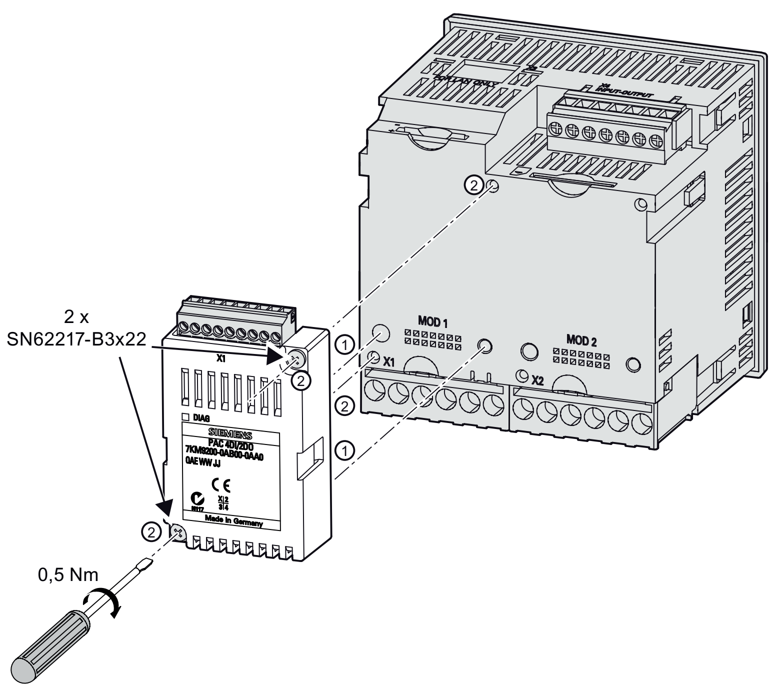


Figure 5-5 Schematic view of assembling the expansion module

1. Ensure safe isolation from supply.
2. Discharge yourself.
3. Mount the SENTRON PAC Power Monitoring Device.
4. Connect the current terminals and voltage terminals to the SENTRON PAC.
5. Always hold the expansion module by the plastic enclosure.

6. Connect the expansion module to the SENTRON PAC. The guide for correct position of the guide pins will help you to plug in the expansion module correctly.
7. Tighten the SN62217-B3x22 screws connecting the expansion module to the SENTRON PAC with a torque of 0.5 Nm.

See also

Electrostatic sensitive devices (ESD) (Page 275)

Operation planning (Page 61)

Tools (Page 68)

Connecting the PAC RS485 expansion module (Page 94)

Mounting on the switching panel (Page 68)

5.6 Deinstalling

Shutting down

Make sure the device has been shut down before you begin to deinstall it.

Tools

You require the following tools to deinstall the device:

- PH2 screwdriver
- Slotted screwdriver

Deinstallation steps

1. Discharge any static from your body in accordance with the ESD guidelines.

CAUTION
Electrostatic sensitive devices Ground your body. Discharge your body of any static electricity.

2. Start deinstallation on the inside of the switching panel.
3. Release the clamping arrangement on the switching panel. To do so, unscrew the four screws on the two brackets. Leave the screws in the brackets.
4. Carefully lever the locking hooks open with the slotted screwdriver or another suitable tool. The bracket releases immediately.
5. Go to the outside of the switching panel and remove the device from the cutout.
6. Pack the device into the original box together with the operating instructions and the delivered components listed in the operating instructions.

Deinstallation is complete.

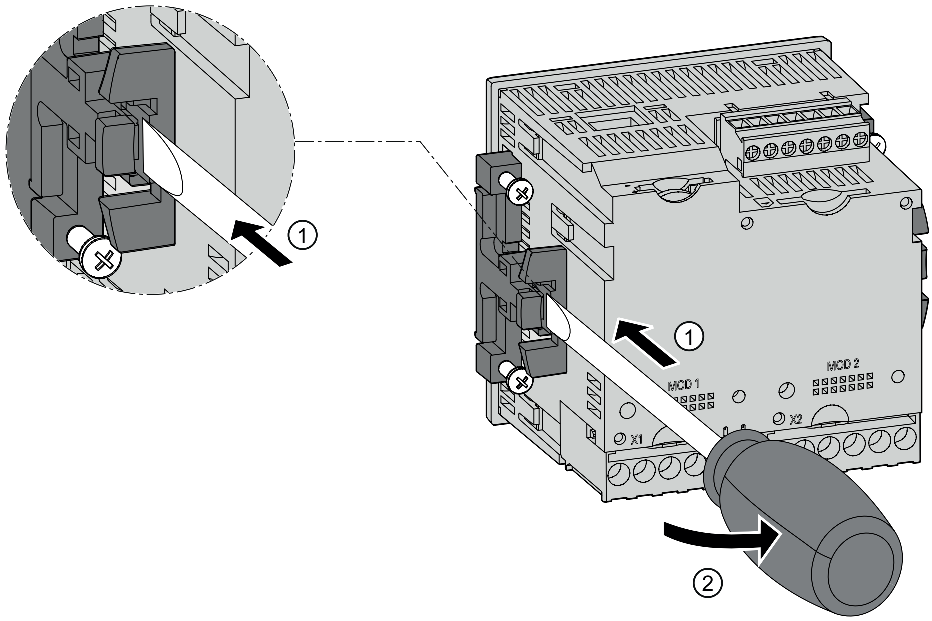


Figure 5-6 Deinstallation, releasing the locking hooks

See also

ESD guidelines (Page 275)

Disassembling an expansion module (Page 75)

Electrostatic sensitive devices (ESD) (Page 275)

5.7 Disassembling an expansion module

Disassembling

1. Ensure safe isolation from supply.
2. Observe the ESD Guidelines. Discharge yourself. Always hold the expansion module by the plastic enclosure.
3. Remove the terminal block from the expansion module, or detach the cable from the terminal block.
4. Unscrew the expansion module from the SENTRON PAC Power Monitoring Device.
5. Remove the expansion module from the SENTRON PAC Power Monitoring Device.
6. If necessary, disassemble the SENTRON PAC Power Monitoring Device.

See also

Electrostatic sensitive devices (ESD) (Page 275)
Tools (Page 68)
Deinstalling (Page 74)

Connecting 6

6.1 Safety notes

Instructions

⚠ DANGER

Hazardous Voltages

Will cause death, serious injury or property damage.

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

NOTICE

Improper power supply may damage equipment

Before connecting the device, check that the system voltage agrees with the voltage specified on the type plate.

Note

Qualified Personnel

In the context of the safety information in the user documentation, a qualified person is a person who is familiar with assembling, installing, commissioning, and operating the product and who has the relevant qualifications, such as:

- Training or instruction/authorization in operating and maintaining devices and systems according to the safety regulations for electrical circuits and devices.
- Is trained in the proper care and use of protective equipment in accordance with established safety practices.
- First aid training.

See also

Applying the measuring voltage (Page 109)

Applying the measuring current (Page 110)

Applying the supply voltage (Page 100)

Safety notes (Page 17)

6.2 Connections

Connection designations

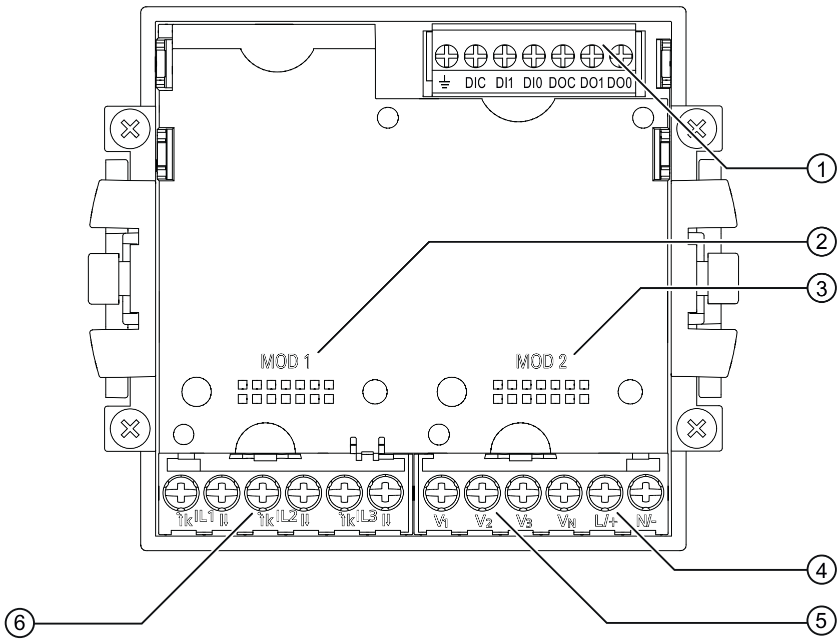


Figure 6-1 Connection designations of the device with screw terminals, rear view

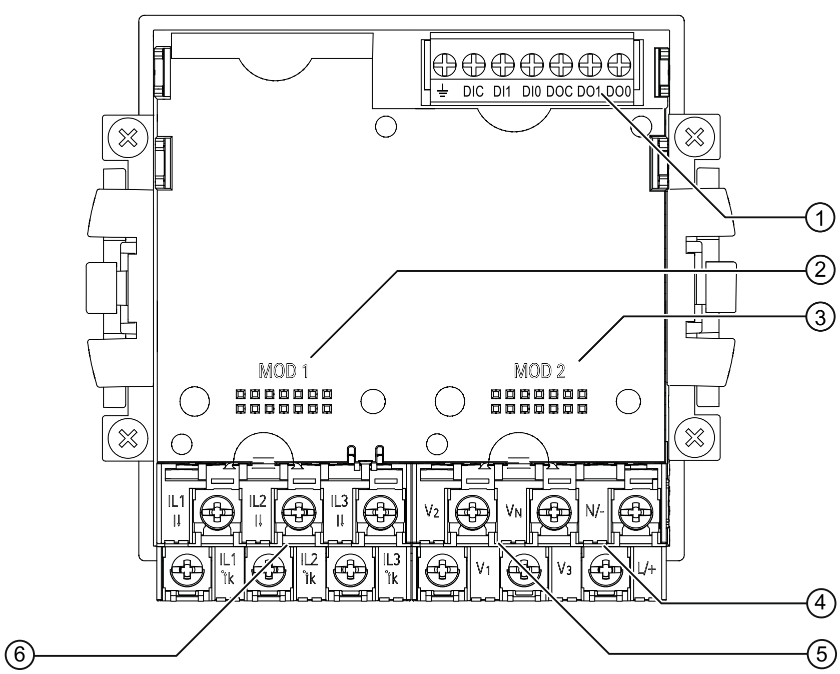


Figure 6-2 Connection designations of the device with ring lug terminals, rear view

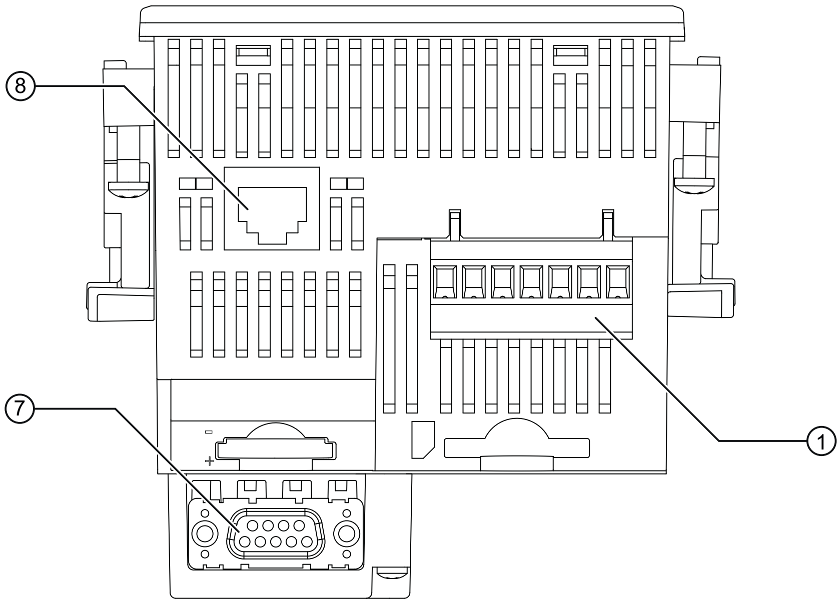


Figure 6-3 Connection designations of the device, top view

(1)	Digital inputs and outputs, reference potential
(2)	1. Slot for optional expansion module
(3)	2. Slot for optional expansion module
(4)	Supply voltage L/+, N/-
(5)	Measuring inputs voltage V_1, V2, V3, VN
(6)	Measuring inputs current IL1, IL2, IL3
(7)	Optional expansion module, not included in scope of supply
(8)	Ethernet port, RJ45

DANGER

Hazardous Voltage

Will cause death, serious injury or considerable property damage.

Observe the safety information on the device and in the operating instructions and the manual.

CAUTION

If excessively high values are created and if the DC supply voltage is connected with the wrong polarity, the device will be destroyed and personnel can be injured.

Ensure you do not create excessivley high values. Observe the correct polarity when connecting DC supply voltage.

Note

Use of devices with ring lug terminals

Designed for use in:

- NAFTA / USA
- Regions in which open terminals are permitted.

Terminal labeling

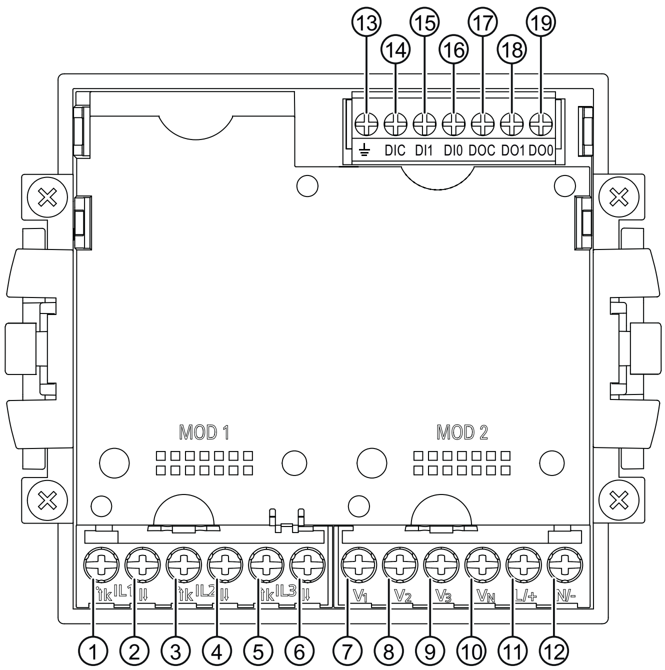


Figure 6-4 Terminal labeling, device with screw terminals

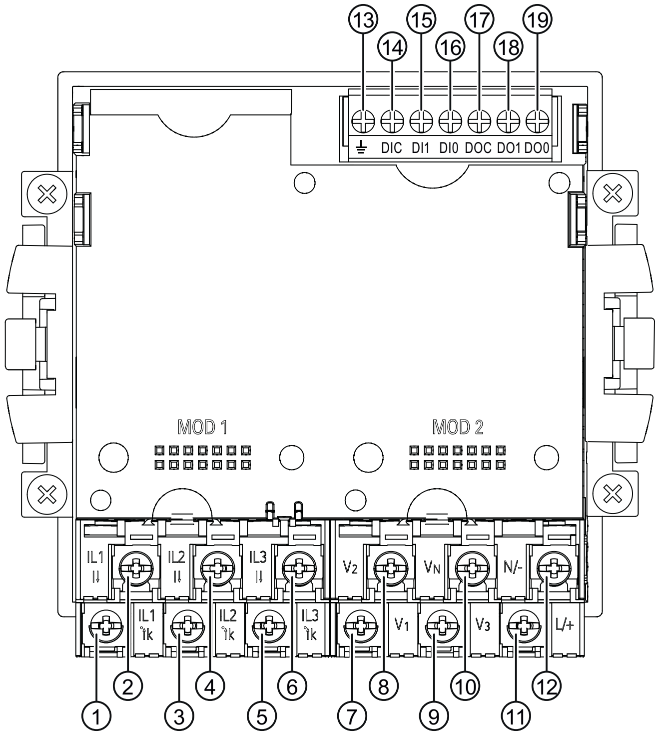


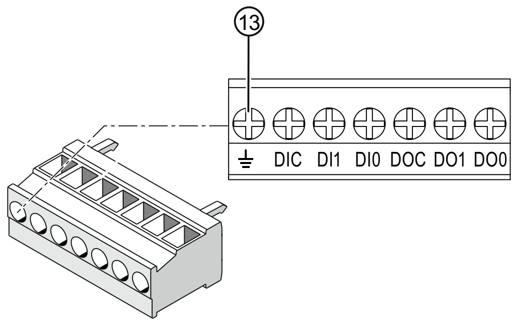
Figure 6-5 Terminal designation, device with ring lug terminals

No.	Terminal	Function
(1)	IL1 °↑k	Current I_a, input
(2)	IL1 l↓	Current I_a, output
(3)	IL2 °↑k	Current I_b, input
(4)	IL2 l↓	Current I_b, output
(5)	IL3 °↑k	Current I_c, input
(6)	IL3 l↓	Current I_c, output
(7)	V_1	Voltage V_{a-n}
(8)	V_2	Voltage V_{b-n}
(9)	V_3	Voltage V_{c-n}
(10)	V_N	Neutral conductor
(11)	L/+	AC: Connection: Conductor (phase-to-neutral voltage) DC: Connection: +
(12)	N/-	AC: Connection: Neutral conductor DC: Connection: -
(13)	⏚	Reference potential
(14)	DIC	Digital input (common)
(15)	DI1	Digital input 1
(16)	DI0	Digital input 0
(17)	DOC	Digital output (common)
(18)	DO1	Digital output 1
(19)	DO0	Digital output 0

Grounding

Conductive panels and doors on control cabinets must be grounded. The doors of the control cabinet must be connected to the control cabinet using a grounding cable.

Reference potential



(13) Reference potential terminal

Figure 6-6 Terminal block: digital input and output, reference potential

The connection ⏚ "reference potential" discharges interference affecting the digital input and output and the RJ45 connector.

Connect the reference potential to the equipotential bonding strip in the control cabinet.

Circuit breaker

A suitable circuit breaker must be connected upstream of SENTRON PAC4200 in order to permit disconnection of the device from the power supply.

- The circuit breaker must be mounted close to the device and be easily accessible to the user.
- The circuit breaker must be marked as the circuit breaker for the device.

Phase-synchronous connection

The phases must be connected phase-synchronously. The specified terminal assignment cannot be changed by changing the parameters.

Supply voltage fuse protection

CAUTION

Non-fused supply voltage may lead to device and equipment damage

Always protect the supply voltage of **SENTRON PAC4200 with a wide-voltage power supply** as follows:

- Acc. to IEC:
  With an approved 0.5 A fuse, tripping characteristic C
- Acc. to UL:
  With a UL listed 0.6 A fuse, CLASS CC

Always protect **SENTRON PAC4200 with an extra-low voltage power supply** as follows:

- Acc. to IEC:
  With an IEC approved 1.0 A fuse, tripping characteristic C
- Acc. to UL:
  With a UL listed 1.0 A fuse, CLASS CC

If a fusible link is used, a suitable IEC approved or UL listed fuse holder has to be used.

Protecting the current measuring inputs

DANGER

Open transformer circuits will result in electric shock and arc flashover

Will cause death, serious injury or considerable property damage.

Only measure current with external **current transformers**. Do not use fuses for circuit protection. Do not open the secondary circuit under load. Short circuit the secondary current terminals of the current transformer before removing this device. The safety information for the current transformers used must be followed.

Protecting the voltage measuring inputs

CAUTION

Non-fused voltage measuring points may lead to device and equipment damage.

Always protect the device with an **IEC approved or UL listed 10 A fuse**, **circuit breaker** or supplementary protector.

Never short circuit the secondary connections of the voltage transformers.

6.3 Connecting the cables to the terminals

Connecting cables to the screw terminal

Tool: PZ2 cal. screwdriver ISO 6789

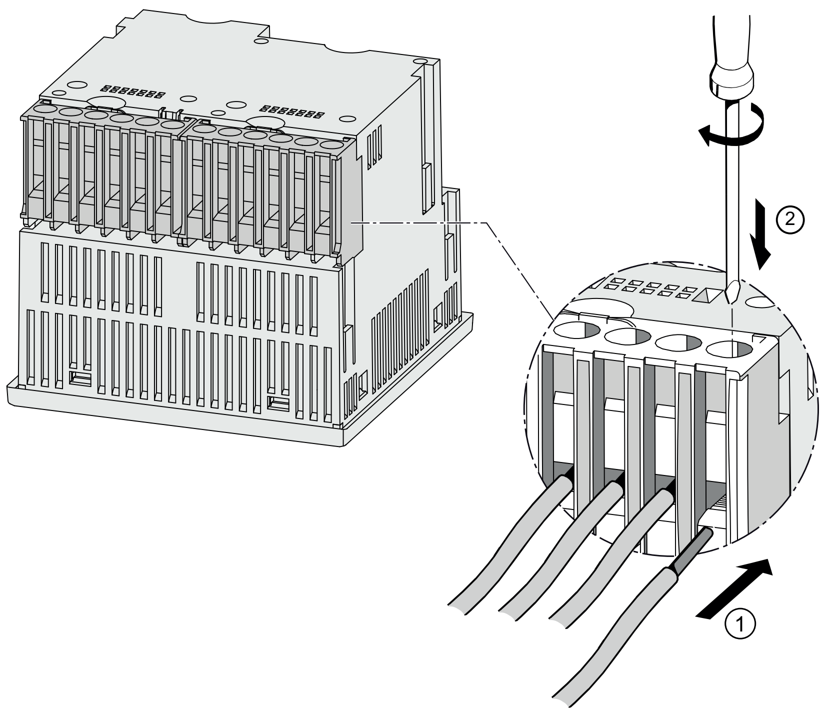


Figure 6-7 Connecting cables to the screw terminal

Connecting the cables to the ring lug terminals:

Note

The **SENTRON PAC4200 with ring lug terminal** is intended for:

- use in NAFTA / USA
- Regions in which open terminals are permitted.

WARNING

Improper connection may result in death, serious injury, or property damage.

Only connect ring lugs to ring lug terminals. Ensure proper attachment of ring lugs to cables.

Tool: PZ2 cal. screwdriver ISO 6789

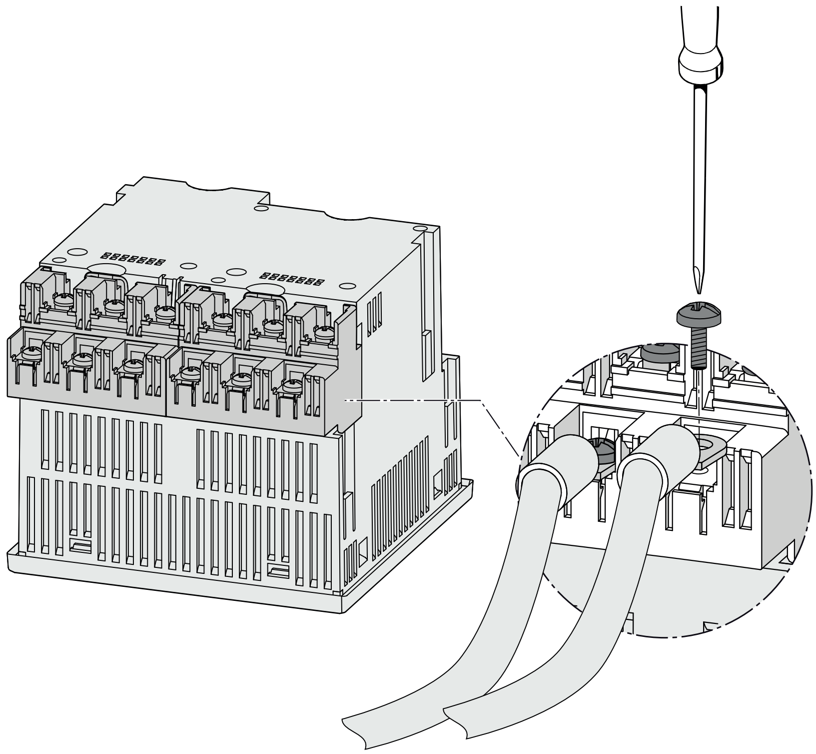


Figure 6-8 Connecting the cables to the ring lug terminals:

6.4 Connection examples

Some connection examples are listed below: They show connection in:

- Two-, three- or four-wire systems
- With balanced or unbalanced load
- With/without voltage transformer
- with current transformer

The device can be operated up to the maximum permissible voltage values with or without voltage measuring transformers.

It is only possible to measure the current with current transformers.

All input or output terminals not required for measuring remain free.

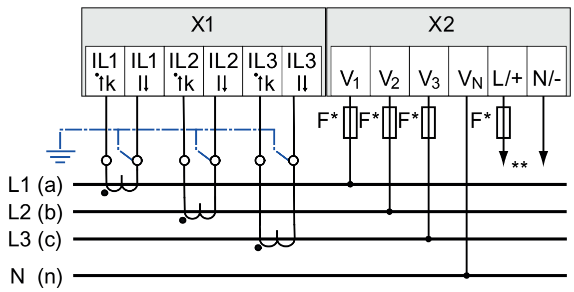
In the connection examples, the secondary side of the transformer is grounded at the "l" terminal. It can be grounded at either the "k" or the "l" terminal. The grounding has no impact on the measurement.

The wiring method must be made known to the device in the device settings. The connection types given below refer to the device parameterization.

Connection examples

(1) Three-phase measuring, four conductors, unbalanced load, without voltage transformers, with three current transformers

Connection type 3P4W

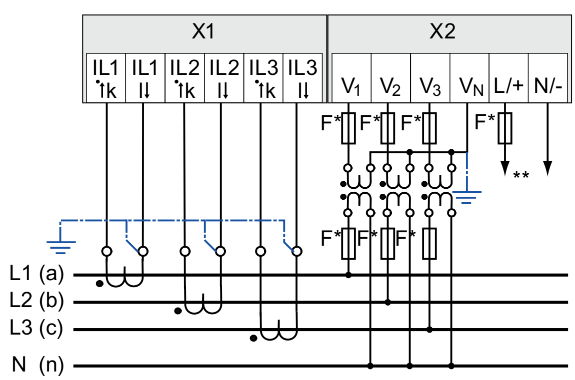


*	Fuses must be provided by the customer.
**	Connection of supply voltage

Figure 6-9 Connection type 3P4W, without voltage transformer, with three current transformers

(2) Three-phase measuring, four conductors, unbalanced load, with voltage transformers, with three current transformers

Connection type 3P4W

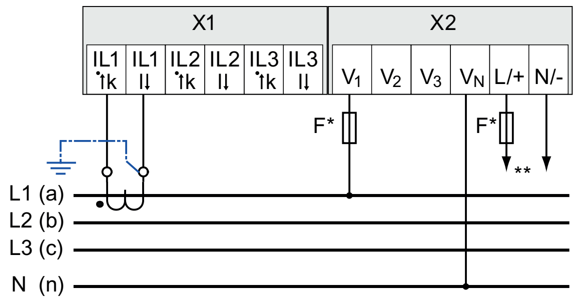


*	Fuses must be provided by the customer.
**	Supply voltage connection

Figure 6-10 Connection type 3P4W, with voltage transformer, with three current transformers

(3) Three-phase measuring, four conductors, balanced load, without voltage transformers, with one current transformer

Connection type 3P4WB



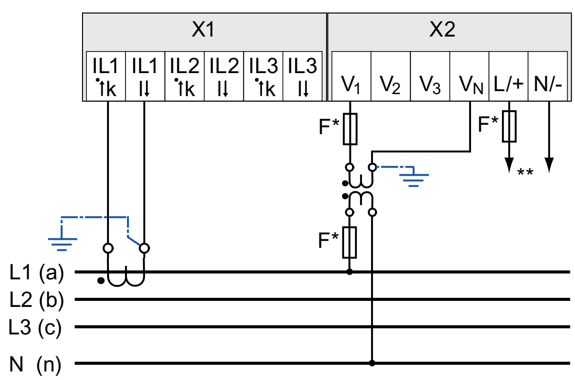
* Fuses must be provided by the customer.

** Supply voltage connection

Figure 6-11 Connection type 3P4WB, without voltage transformer, with one current transformer

(4) Three-phase measuring, four conductors, balanced load, with voltage transformers, with one current transformer

Connection type 3P4WB



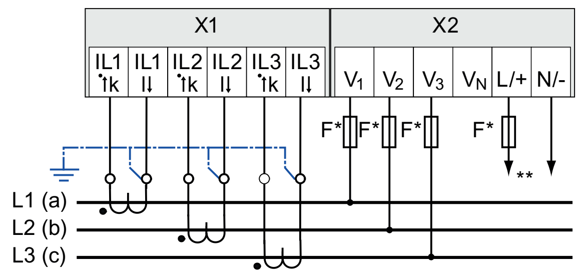
* Fuses must be provided by the customer.

** Supply voltage connection

Figure 6-12 Connection type 3P4WB, with voltage transformer, with one current transformer

(5) Three-phase measuring, three conductors, unbalanced load, without voltage transformers, with three current transformers

Connection type 3P3W



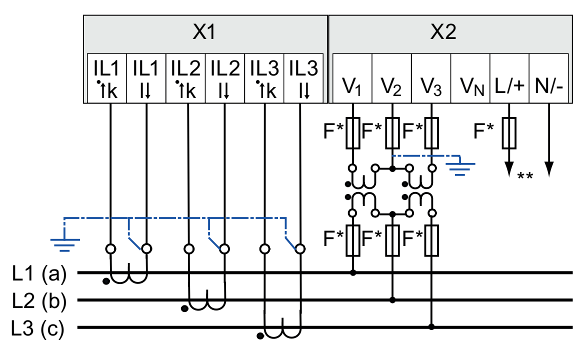
* Fuses must be provided by the customer.

** Supply voltage connection

Figure 6-13 Connection type 3P3W, without voltage transformer, with three current transformers

(6) Three-phase measuring, three conductors, unbalanced load, with voltage transformers, with three current transformers

Connection type 3P3W



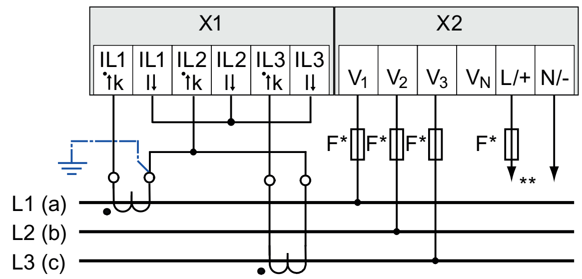
* Fuses must be provided by the customer.

** Supply voltage connection

Figure 6-14 Connection type 3P3W, with voltage transformer, with three current transformers

(7) Three-phase measuring, three conductors, unbalanced load, without voltage transformers, with two current transformers

Connection type 3P3W



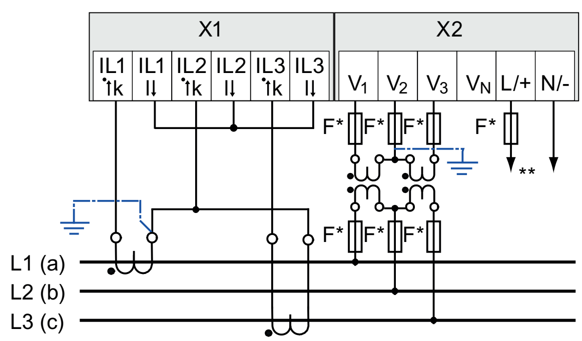
*	Fuses must be provided by the customer.

**	Supply voltage connection

Figure 6-15	Connection type 3P3W, without voltage transformer, with two current transformers

(8) Three-phase measuring, three conductors, unbalanced load, with voltage transformers, with two current transformers

Connection type 3P3W



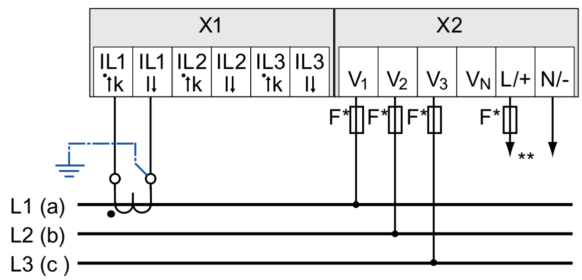
*	Fuses must be provided by the customer.

**	Supply voltage connection

Figure 6-16	Connection type 3P3W, with voltage transformer, with two current transformers

(9) Three-phase measuring, three conductors, balanced load, without voltage transformers, with one current transformer

Connection type 3P3WB



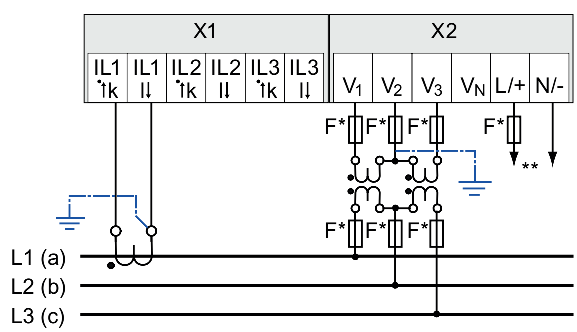
*	Fuses must be provided by the customer.

**	Supply voltage connection

Figure 6-17	Connection type 3P3WB, without voltage transformer, with one current transformer

(10) Three-phase measuring, three conductors, balanced load, with voltage transformers, with one current transformer

Connection type 3P3WB



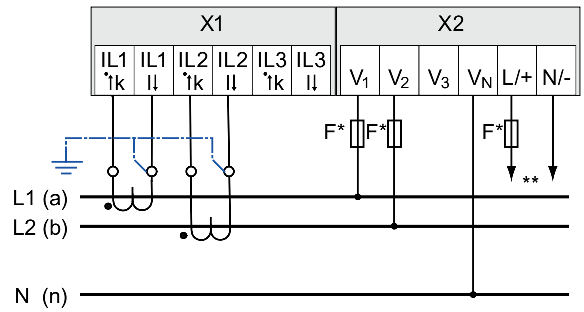
*	Fuses must be provided by the customer.

**	Supply voltage connection

Figure 6-18	Connection type 3P3WB, with voltage transformer, with one current transformer

(11) Two-phase measuring, three conductors, unbalanced load, without voltage transformers, with two current transformers

Connection type 3P4W



* Fuses must be provided by the customer.

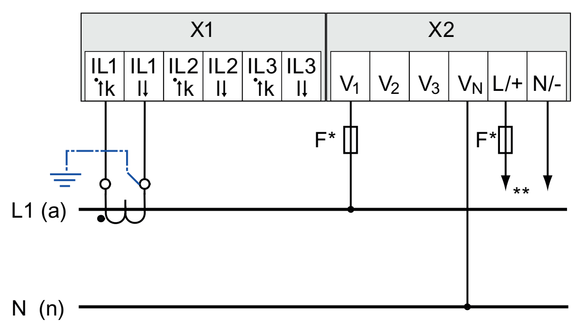
** Supply voltage connection

Figure 6-19 Connection type 3P4W, without voltage transformer, with two current transformers

The device indicates 0 (zero) V for L3.

(12) Single-phase measuring, two conductors, without voltage transformers, with one current transformer

Connection type 1P2W



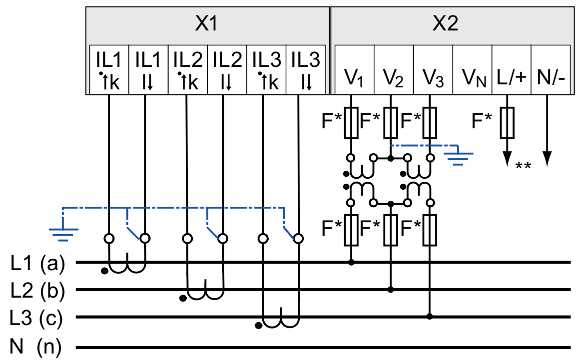
* Fuses must be provided by the customer.

** Supply voltage connection

Figure 6-20 Connection type 1P2W, without voltage transformer, with one current transformer

(13) Three-phase measuring, four conductors, unbalanced load, with voltage transformers, with three current transformers

Connection type 3P3W



* Fuses must be provided by the customer.

** Supply voltage connection

Figure 6-21 Connection type 3P3W, with voltage transformer, with three current transformers

See also

Measured variables (Page 25)

Applying the supply voltage (Page 100)

6.5 Grounding of the Ethernet cable

The Ethernet cable must be grounded for data transmission according to the Fast Ethernet standard.

NOTICE
The upper limit values will be violated if the cable is not grounded Compliance with the technical limit values for noise radiation and noise immunity is only guaranteed if the cable is correctly grounded. The operator of the system is responsible for ensuring compliance with the statutory limit values (CE mark). Make a shield connection on both sides as described here.

Design

Ground the Ethernet cable at both ends. To do this, expose the foil shield of the Ethernet cable. Connect the exposed shield to a suitable grounding point on the control cabinet, preferably a shielding bus.

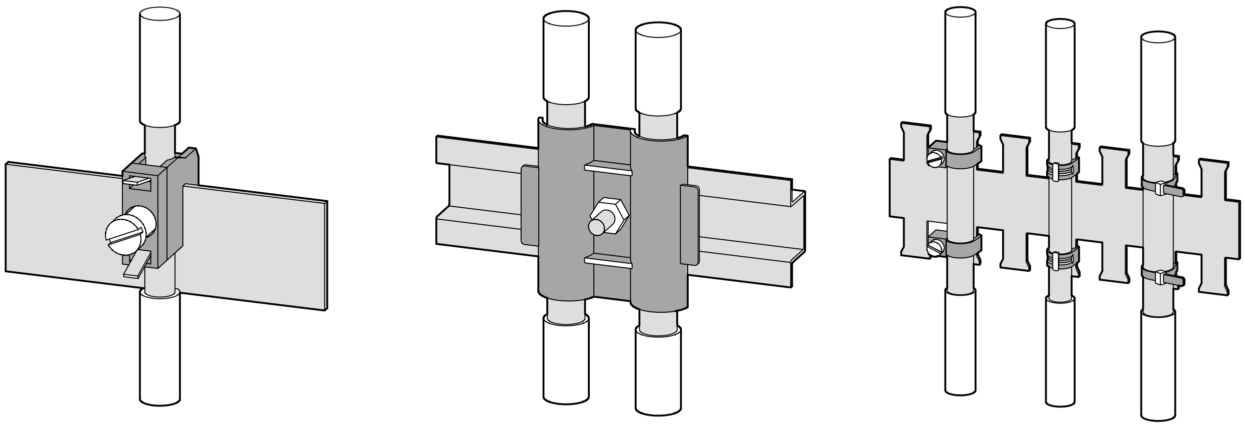


Figure 6-22 Grounding of the Ethernet cable

- Be careful not to damage the foil shield of the cable when removing the cable jacket.
- Fasten the exposed shield with a metal cable clamp or alternatively with a hose tie. The clamp must clasp around a large portion of the shield and provide good contact.
- To allow good contact, a tin-plated or galvanically stabilized surface is ideal. With galvanized surfaces, the contact should be achieved using suitable screws. A painted surface at the contact point is not suitable.

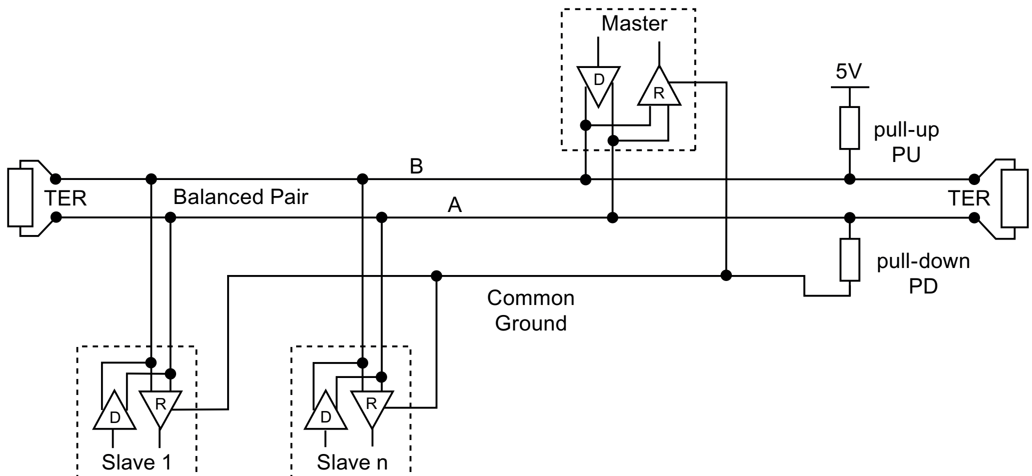
NOTICE
Loss of contact if the shield connection is incorrectly used for strain relief If the shield connection is used for strain relief, the grounding contact can deteriorate or be completely lost. Don't use the contact point on the cable shield for strain relief.

⚠ CAUTION
Damage to Ethernet Cable Shield due to Voltage Difference between Grounding Points. If there is a voltage difference between grounding points, excessive current may flow through the shield which is grounded at both ends. In these cases, install an additional conductor in parallel with the Ethernet cable shield to carry this current. Never interrupt the shield of the Ethernet cable.

6.6 Connecting the PAC RS485 expansion module

Procedure

Connect the PAC RS485 expansion module to the RS 485 bus. Please pay attention to the general topology of the twisted-pair cable.



+/B	B signal; D1
-/A	A signal; D0
COM	Common = Ground
TER	(Line) Termination = bus terminating resistor
PU	Pull-up resistor
PD	Pull-down resistor

Figure 6-23 Block diagram: General topology of the twisted-pair cable

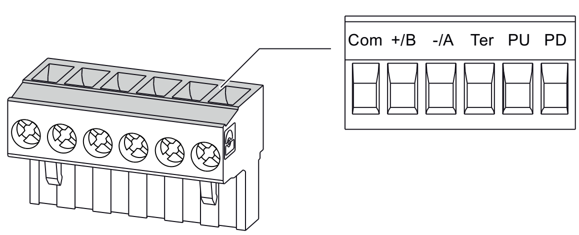


Figure 6-24 Terminal assignment

1. Connect the cables to the appropriate screw terminals on the terminal block. You can find the assignments of the terminals in the figure "Terminal assignment".
2. Connect the cable shield at one end with protective ground PE.
3. Connect the signal Common with protective ground. This grounds the expansion module.

4. On the first and last communication nodes, switch a bus terminating resistor between the positive signal and the negative signal. A 120-Ohm bus terminating resistor is implemented in the PAC RS485 expansion module for this purpose. In the case of other values, use an external bus terminating resistor. Attach this to the first and last communication node.

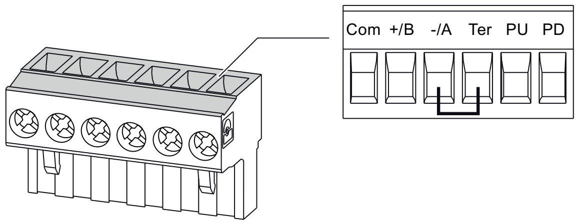


Figure 6-25 Terminal assignment with terminating resistor

NOTICE
Incorrect bus terminator If you switch more than two bus terminating resistors on one bus, this can result, for example, in signal reflections that interfere with communication on the bus. Never attach more than two bus terminators to one bus. Attach one bus terminating resistor at the start of the bus and one terminating resistor at the end of the bus.

5. Make sure that there is sufficient strain relief for the connected cables.

Line polarization

A resistor for line polarization is implemented in the terminal block.

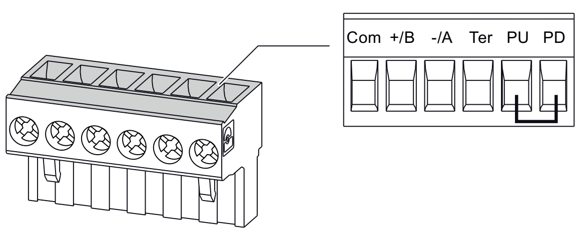


Figure 6-26 Terminal assignment with line polarization

If one or more communication nodes require line polarization, switch a resistor pair PU and PD on the RS 485 twisted-pair cable in the case of a PAC RS485 expansion module. To do so, switch on the resistor in the terminal block of the relevant PAC RS485 expansion module shown in the figure "Terminal assignment with line polarization".

See also

Tools (Page 68)

Installing the expansion modules (Page 73)

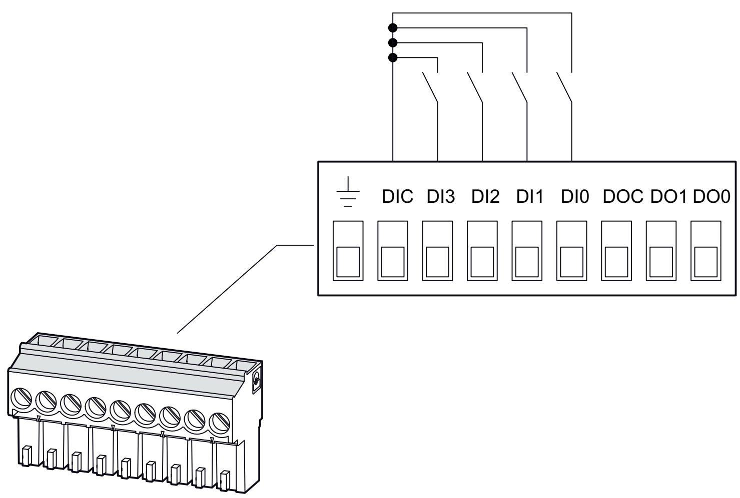
Electrostatic sensitive devices (ESD) (Page 275)

6.7 Connecting the SENTRON PAC 4DI/2DO expansion module

Procedure

1. Connect the reference potential in the control cabinet to the equipotential bonding rail.
2. Connect the cables to the appropriate screw terminals on the terminal block. You can find the assignments of the terminals in the above figures.
3. Connect the cable shield, if available, at one end with the protective conductor.
4. Connect the protective conductor PE to the "reference potential" terminal.
5. Make sure that there is sufficient strain relief for the cables.

Digital inputs



DIC Digital input common

DI3 Digital input 3

DI2 Digital input 2

DI1 Digital input 1

DI0 Digital input 0

Figure 6-27 Terminal assignment with switching of the digital inputs with internal power supply

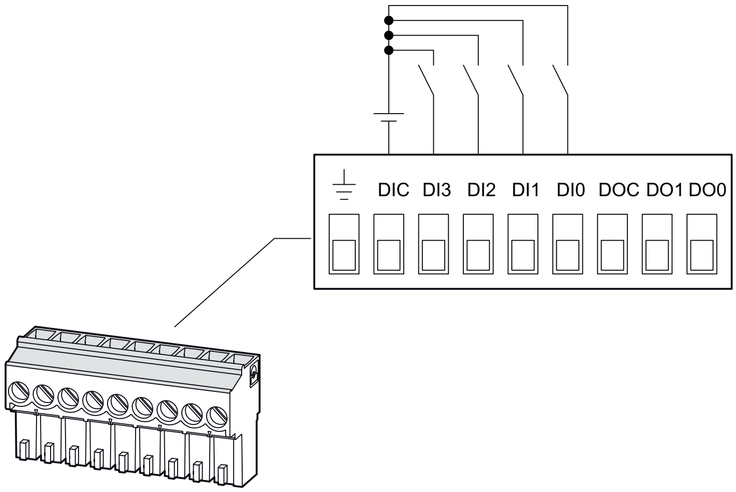
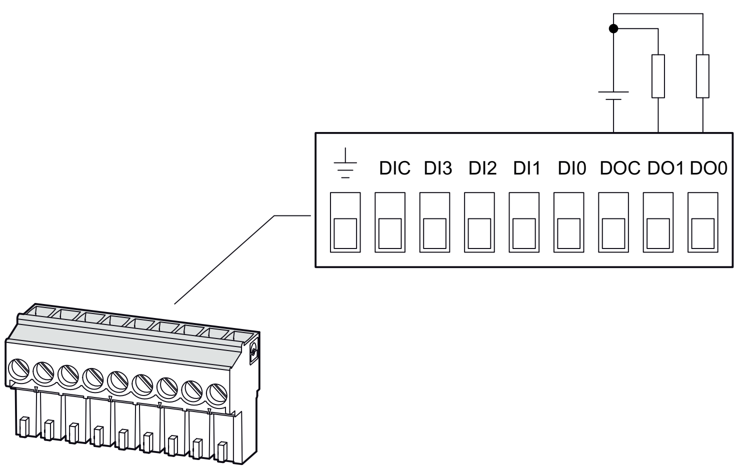


Figure 6-28 Terminal assignment with switching of the digital inputs with external power supply

Digital outputs



⏚	Reference potential
DOC	Digital output common
DO1	Digital output 1
DO0	Digital output 0

Figure 6-29 Terminal assignment with switching of the digital outputs

See also

Technical data of the SENTRON PAC 4DI/2DO expansion module (Page 188)

Electrostatic sensitive devices (ESD) (Page 275)

Tools (Page 68)

Connecting the cables to the terminals (Page 84)

Startup 7

7.1 Overview

Prerequisites

1. The battery has been inserted into the battery compartment.
2. The device has been installed.
3. The device has been connected in accordance with the possible connection methods.
4. The Ethernet cable has been connected.
5. The optional expansion modules have been installed. If the SENTRON PAC4200 is to be operated with one or with two expansion modules, the module(s) must be installed before the SENTRON PAC4200 is started up.

Steps for starting up the device

1. Apply the supply voltage
2. Parameterizing the device
3. Apply the measuring voltage
4. Apply the measuring current
5. Check the displayed measured values
6. Check the polarity and the phase assignment of the measuring transducers.

NOTICE
Check the connections Incorrect connection can result in malfunctions and failure of the device. Before starting up the SENTRON PAC4200, check that all connections are correct.

7.2 Applying the supply voltage

SENTRON PAC4200 can be supplied with:

- A wide-voltage AC / DC power supply
- An extra-low voltage DC power supply

A supply voltage is required to operate the device. Refer to the technical data or the type plate for the type and level of the permissible supply voltage.

CAUTION
Improper Power Supply May Damage Equipment Failure to do so may result in damage to the device and the equipment. The minimum and maximum limits given in the technical data and on the type plate must not be exceeded even at startup or when testing the device. Observe the correct polarity when connecting DC supply voltage.

Supply voltage fuse protection

CAUTION
Non-fused supply voltage may lead to device and equipment damage Always protect the supply voltage of **SENTRON PAC4200 with a wide-voltage power supply** as follows: • Acc. to IEC: With an approved 0.5 A fuse, tripping characteristic C • Acc. to UL: With a UL listed 0.6 A fuse, CLASS CC Always protect **SENTRON PAC4200 with an extra-low voltage power supply** as follows: • Acc. to IEC: With an IEC approved 1.0 A fuse, tripping characteristic C • Acc. to UL: With a UL listed 1.0 A fuse, CLASS CC If a fusible link is used, a suitable IEC approved or UL listed fuse holder has to be used. In addition, a suitable circuit breaker shall be connected upstream in order to permit disconnection of the device from the power supply. Do not use voltage transformers as a power supply.

Procedure

Connect the supply voltage to terminals L/+ and N/-.

Table 7- 1 Connection of supply voltage

Terminal marking	Connection
L/+	AC: Connection: Conductor (phase-to-neutral voltage) DC: Connection: +
N/-	AC: Connection: Neutral conductor DC: Connection: -

See also

Applying the measuring voltage (Page 109)

Safety notes (Page 17)

Technical data (Page 175)

Safety notes (Page 77)

7.3 Parameterizing the device

7.3.1 Procedure

Procedure for parameterizing

To start up the device, you must specify the operating parameters listed below in the device settings:

- Connection type
- Voltage
  - Direct measurement on the system or using voltage transformers
  - Measuring input voltage in the case of direct measurement on the system
  - Primary and secondary voltage when measuring using voltage transformers
- Current
  - Primary and secondary current

The following settings are also useful:

- Language
- Time zone, change to summertime
- Password protection

See also

Password management (Page 160)

7.3.2 Language

Setting the language

Set the language in which the display text is to appear.

The available languages are displayed:

- at initial startup,
- after resetting to factory settings, and
- after updating the firmware.

English is the default language.

Figure 7-1 Language selection

Select the desired language by pressing <F2> ▲ or <F3> ▼.

Apply the desired language with <F4> OK.

Changing the language

The display language can be changed at any time in the device settings.

1. Exit the measured value display and call the "MAIN MENU":
   <F4> MENU
2. In the main menu, go to the "SETTINGS" entry:
   <F2> ▲ or <F3> ▼
3. Call the "SETTINGS" entry:
   <F4> ENTER
4. In the "SETTINGS" menu, go to the "LANGUAGE/REGIONAL" entry:
   <F2> ▲ or <F3> ▼
5. Call the "LANGUAGE/REGIONAL" entry:
   <F4> ENTER
   The display shows the currently valid settings.

6. Open edit mode of the "LANGUAGE" device setting:
   <F4> EDIT

Figure 7-2 "LANGUAGE" edit mode

7. Scroll through the possible values with:
   <F2> +
8. Accept the desired language with:
   <F4> OK
   The language is permanently saved and becomes effective immediately.
   The display returns to display mode.
9. Return to one of the selection menus or to the measured values display:
   <F1> ESC

7.3.3 Date and time

First, set the time zone and summertime. Then enter the date and time of day.

Note

Correct time measurement urgently requires specification of the time zone and a change of time from normal to summertime.

The time zone refers to coordinated universal time (UTC).

"TIME ZONE" examples:

- Value "-06:00" corresponds to UTC-6
- Value "+01:00" corresponds to UTC+1

Procedure

1. Exit the measured value display and call the "MAIN MENU":
   <F4> MENU
2. In the main menu, go to the "SETTINGS" entry:
   <F2> ▲ or <F3> ▼
3. Call the "SETTINGS" entry:
   <F4> ENTER

4. In the "SETTINGS" menu, go to the "DATE/TIME OF DAY" entry:
   <F2> ▲ or <F3> ▼

Figure 7-3 "DATE/TIME" device settings

5. Call the "DATE/TIME OF DAY" entry:
   <F4> ENTER
   The display shows the currently valid settings.
6. Go to the fields "DATE", "FORMAT", "TIME", "TIME ZONE", "DAYLIGHTSAVING":
   <F2> ▲ or <F3> ▼
7. Open edit mode of the device setting:
   <F4> EDIT
8. Set the correct value:
   <F2> + and <F3> →, –.
9. Accept the value with:
   <F4> OK
   The value is permanently saved and becomes effective immediately.
   The display returns to display mode.
10. Return to one of the selection menus or to the measured values display:
    <F1> ESC

See also

Date / time (Page 143)

7.3.4 Voltage input

7.3.4.1 Set the connection type

Inform the device of the connection type executed. To do so, enter the short code for the connection type in the device settings.

Note

Connection type

The connection type executed must agree with the connection type entered in the device!

Table 7- 2 Available connection types

Short code	Connection type
3P4W	3 phases, 4 conductors, unbalanced load
3P3W	3 phases, 3 conductors, unbalanced load
3P4WB	3 phases, 4 conductors, balanced load
3P3WB	3 phases, 3 conductors, balanced load
1P2W	Single-phase AC

You can find further information on the possible connection types, and on how the measured value representation depends on the connection type, in the "Description" chapter.

Procedure

1. Exit the measured value display and call the "MAIN MENU":
   <F4> MENU
2. In the main menu, go to the "SETTINGS" entry:
   <F2> ▲ or <F3> ▼
3. Call the "SETTINGS" entry:
   <F4> ENTER
4. In the "SETTINGS" menu, go to the "BASIC PARAMETERS" entry:
   <F2> ▲ or <F3> ▼
5. Call the "BASIC PARAMETERS" entry:
   <F4> ENTER
6. In the "BASIC PARAMETERS" menu, call the "VOLTAGE INPUTS" entry:
   <F4> ENTER
   The display shows the currently valid settings.

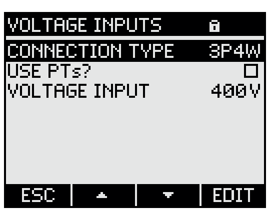
   

   Figure 7-4 "CONNECTION TYPE" device setting

7. Open edit mode of the "CONNECTION TYPE" device setting:
   <F4> EDIT
8. Scroll through the possible values with:
   <F2> +
9. Accept the desired connection type:
   <F4> OK
   The connection type is permanently saved and becomes effective immediately.
   The display returns to display mode.
10. Return to one of the selection menus or to the measured values display:
   <F1> ESC

7.3.4.2 Measurement using voltage transducers

The factory setting is measurement direct on the system. At initial startup, the following steps must be carried out if you want to measure using voltage transducers.

Procedure

1. In the "SETTINGS" menu, call the "BASIC PARAMETERS" entry.
2. In the "BASIC PARAMETERS" menu, open the "VOLTAGE INPUTS" entry:
   <F4> ENTER
   The display shows the currently valid settings.
3. Go to the "USE PTs?" device setting:
   <F2> ▲ or <F3> ▼

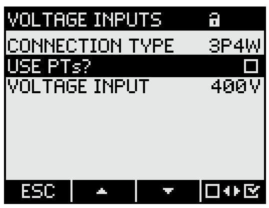


Figure 7-5 "USE PTs?" device settings

4. Switch converter measurement on/off:
   <F4> ☐◂▸☑
   ☑ On: Measurement using voltage transducers.
   ☐ Off: Measurement direct on the low-voltage system.
   The device setting is saved permanently and becomes effective immediately.
   The display remains in display mode.
5. Return to one of the selection menus or to the measured values display:
   <F1> ESC

7.3.4.3 Setting the conversion ratio of the voltage transducer

The factory setting is measurement direct on the system. At initial startup, the following steps must be carried out if you want to measure using voltage transducers.

The conversion ratio can only be set if measurement using voltage transducers is set in the device settings. Only then are the fields for primary and secondary voltage visible on the display.

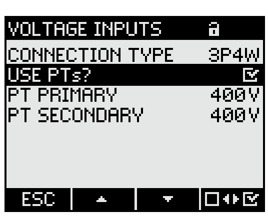


Figure 7-6 Device setting "USE PTs?"

Procedure

1. In the "SETTINGS" menu, call the "BASIC PARAMETERS" entry.

2. In the "BASIC PARAMETERS" menu, open the "VOLTAGE INPUTS" entry:
   <F4> ENTER
   The display shows the current settings.
   If the "PT PRIMARY" and "PT SECONDARY" fields are not visible, direct measurement on the system is set. Switch from direct measurement to measurement using voltage transducers. You can find the instructions for this in the "Measurement using voltage transducers" chapter.
3. Go to the "PT PRIMARY" device setting:
   <F2> ▲ or <F3> ▼
4. Open edit mode of the "PT PRIMARY" device setting:
   <F4> EDIT
5. Set the desired value:
   <F2> + or <F3> →
6. Accept the value:
   <F4> OK
   The value of the primary voltage is permanently saved and becomes effective immediately.
   The display returns to display mode.
7. Go to the "PT SECONDARY" device setting:
   <F2> ▲ or <F3> ▼
   Proceed in exactly the same way as when entering the primary voltage.
   The value of the secondary voltage is permanently saved and becomes effective immediately.
   The display returns to display mode.
8. Return to one of the selection menus or to the measured values display:
   <F1> ESC

Example:

You want to measure using voltage transducers for 10000 V/100 V on a 10 kV system.
For this purpose, enter:

1. USE PTs?: ☑ On:
2. PT PRIMARY: 10000V
3. PT SECONDARY: 100V

7.3.4.4 Setting the voltage input

The factory setting for the measuring reference voltage is 400 V. At initial startup, the following steps must be carried out if the available measuring voltage deviates from this.

Procedure

1. In the "SETTINGS" menu, call the "BASIC PARAMETERS" entry.
2. In the "BASIC PARAMETERS" menu, open the "VOLTAGE INPUTS" entry:
   <F4> ENTER
   The display shows the currently valid settings.

3. Go to the "VOLTAGE INPUTS" device setting:
   <F2> ▲ or <F3> ▼

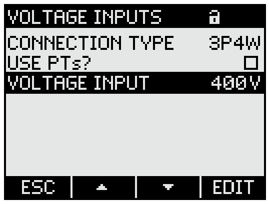


Figure 7-7 "VOLTAGE INPUTS" device setting

4. Open edit mode of the "VOLTAGE INPUTS" device setting:
   <F4> EDIT
5. Set the desired value:
   <F2> + and <F3> →
6. Accept the value:
   <F4> OK
   The value of the voltage input is permanently saved and becomes effective immediately. The display returns to display mode.
7. Return to one of the selection menus or to the measured values display:
   <F1> ESC

7.3.5 Current input

7.3.5.1 Setting the conversion ratio of the current transducer

The conversion ratio must be set before initial startup.

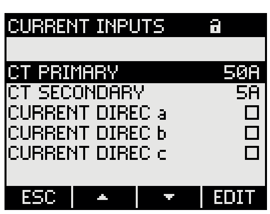


Figure 7-8 "CURRENT INPUTS" device setting

Procedure

1. In the "SETTINGS" menu, call the "BASIC PARAMETERS" entry.
2. In the "BASIC PARAMETERS" menu, open the "CURRENT INPUTS" entry:
   <F4> ENTER
   The display shows the currently valid settings.
3. Open edit mode of the "CT PRIMARY" device setting:
   <F4> EDIT
4. Set the desired value of the primary current:
   <F2> + and <F3> →

5. Accept the value with:
   <F4> OK
   The value of the primary current is permanently saved and becomes effective immediately.
   The display returns to display mode.
6. Go to the "CT SECONDARY" device setting:
   <F2> ▲ or <F3> ▼

   Set the desired value for the secondary current. Proceed in exactly the same way as when entering the primary current.

   The value of the secondary current is saved permanently and becomes effective immediately.
   The display returns to display mode.
7. Return to one of the selection menus or to the measured values display:
   <F1> ESC

Example

You want to measure the current using current transformers for 5000 A/5 A.

For this purpose, enter:

1. CT PRIMARY: 5000A
2. CT SECONDARY: 5A

7.4 Applying the measuring voltage

SENTRON PAC4200 with a wide-voltage power supply is designed for measuring in systems with a rated AC voltage up to:

- 400 V phase-to-neutral (max. 347 V for UL)
- 690 V phase-to-phase (max. 600 V for UL).

SENTRON PAC4200 with an extra-low voltage power supply is designed for measuring in systems with a rated AC voltage up to:

- 289 V phase-to-neutral
- 500 V phase-to-phase

CAUTION
Observe limit values
The maximum limits given in the technical data or on the type plate must not be exceeded even at startup or when testing the device.
Measurement of DC voltage is not possible.
External voltage transformers are required to measure higher voltages than the permissible rated input voltages.

See also

Applying the supply voltage (Page 100)

Measuring inputs (Page 24)

Safety instructions (Page 17)

Safety notes (Page 77)

7.5 Applying the measuring current

The device is designed for connection of current transformers with secondary currents of 1 A and 5 A. It is only possible to measure alternating currents.

The current measuring inputs can each be loaded with 10 A continuously or with 100 A for 1 second.

⚠ DANGER
Open transformer circuits will result in electric shock and arc flashover
Will cause death, serious injury or considerable property damage.
Only measure current with external **current transformers**. Do not use fuses for circuit protection. Do not open the secondary circuit under load. Short circuit the secondary current terminals of the current transformer before removing this device. The safety information for the current transformers used must be followed.

CAUTION
Alternating current measurement only, otherwise the device will become non-functional
Use the device to measure alternating current only.

Direction of current flow

Please take account of the direction of current flow when connecting the current measuring inputs. With inverse connection, the measured values are inverted and receive a negative sign.

To correct the direction of current flow, it is not necessary to reverse the input terminals. Instead, change the interpretation of the direction in the device settings.

You can find information about the device settings in the "Basic parameters" section of the "Parameterization via the user interface" chapter.

See also

Safety instructions (Page 17)

Measuring inputs (Page 24)

Basic parameters (Page 137)

Safety notes (Page 77)

7.6 Check the displayed measured values

Correct connection type

With the help of the table "Displaying the measured variables depending on the connection type", check whether the measured variables are displayed in accordance with the connection type executed. Any deviation indicates a wiring fault or configuration error.

See also

Measured variables (Page 25)

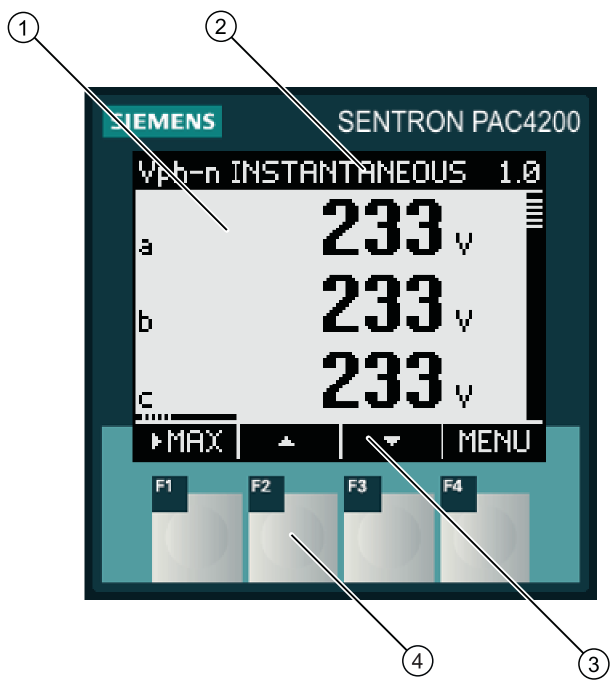
Operator control 8

8.1 Device interface

8.1.1 Displays and operator controls

Displays and operator controls

The front of SENTRON PAC4200 has the following displays and operator controls.



(1) Display of the measured values, device settings, selection menus

(2) Display title

(3) Labeling of the function keys

(4) Surfaces of the function keys

Figure 8-1 User interface of SENTRON PAC4200

Display: Display - Display title - Key labeling

The display is structured as follows:

- Display area - represents the current measured values, device settings and selection menus.
- Header area - specifies the information visible in the display area.
- Footer area - specifies the functions assigned to the function keys.

Function keys: Key labeling - Key surfaces

The four function keys F1 to F4 enable operator input to the device:

- Navigation in the menus
- Selection of the measured value displays
- Display and editing of the device settings

The keys have multiple assignments. Function assignments and key labeling change according to the context of operator input. The designation of the current key function can be seen above the key number in the footer area of the display.

A short press on the key triggers the function once. Holding the key down for longer switches on the autorepeat function after approximately 1 second. The function of the key is triggered repeatedly while the key is held down. Autorepeat is useful, for example, for fast incrementing of values when parameterizing the device.

Organization of information

The display organizes the viewable information as follows:

Measured variables

- Display of the measured variables
  The display shows the measured values of the currently selected measured variable.

Menus

- "MAIN MENU"
  The display lists the viewable measured variables.
- "SETTINGS" menu
  The display lists the device settings.
  The "SETTINGS" menu is a submenu of the "MAIN MENU".
  The "SETTINGS" menu contains further submenus.

Device settings

- Display of the device settings
  The display shows the values of the currently effective device settings.
- Edit mode of the device settings
  The display enables editing of the device settings.

Navigation through the views

Navigation through the measured variables, menus and device settings is assigned throughout to the function keys F1 and F4:

- F1 ESC: Cancels the last operator action. Returns from display of the device settings to display of the menu.
- F4 MENU: Calls the main menu.
- F4 ENTER: Calls the selected menu entry.
- F4 EDIT: Opens edit mode of the device setting.

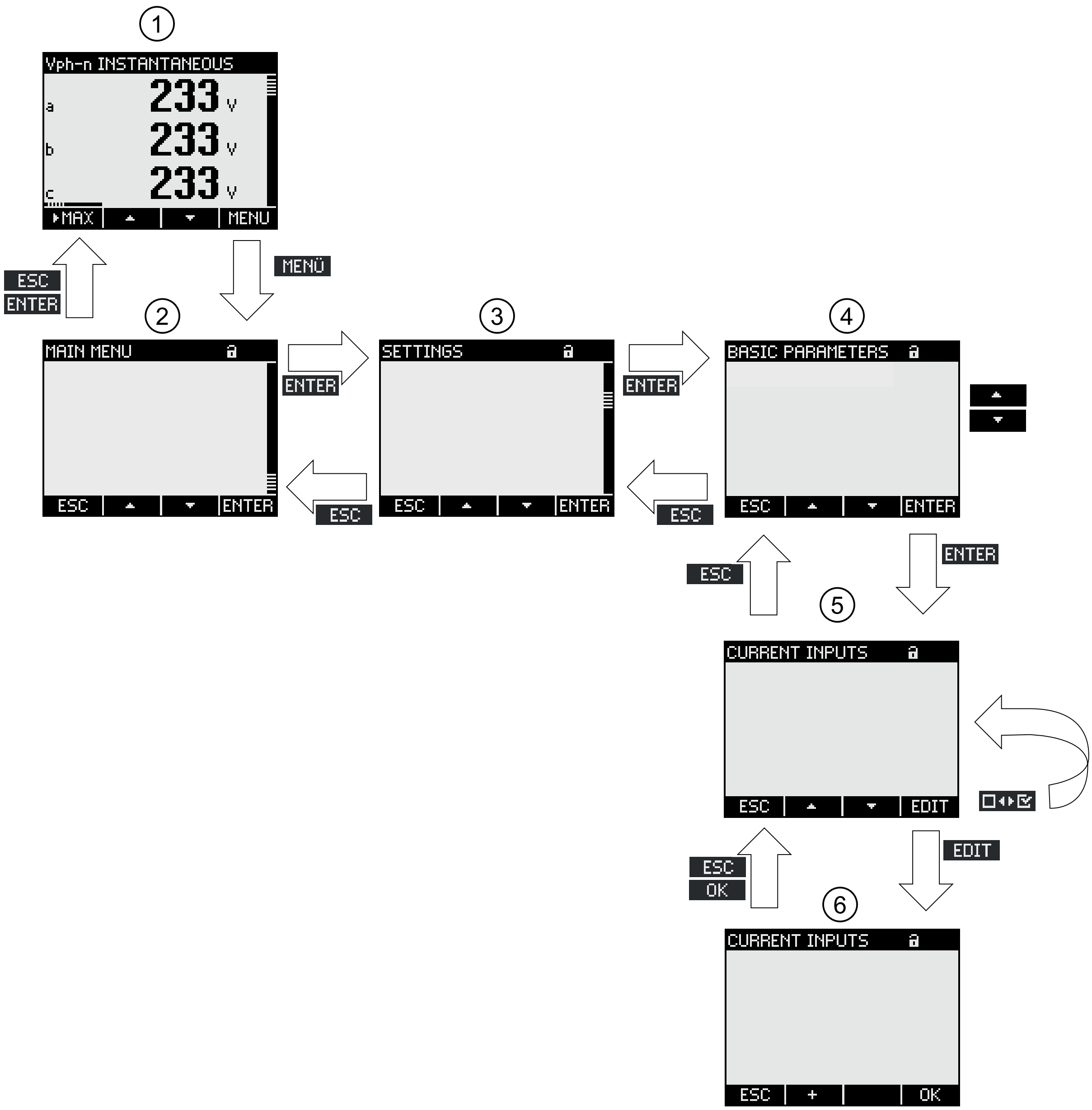
The figure below shows the navigation paths. The display of the measured variables is the starting point and end point of the navigation. Repeated pressing of F1 returns you to the display of the measured variables.

Please note that additional functions are assigned to F4.

F4 OK: Permanently saves the last set value and returns from edit mode to display mode. If no editing is intended, the key closes the display and returns to the menu selection.

F4 ☐◂▸☑: Is an ON/OFF switch.

Information structure and navigation



(1) Displaying measured variables
(2) "MAIN MENU" menu
(3) "SETTINGS" menu
(4) Submenu. Some device settings group the fields in submenus
(5) Displaying the device settings
(6) Edit mode of the device settings

Figure 8-2 Information structure and navigation

Special display elements

Device protection symbol

The padlock symbol in the display title indicates whether the device settings are protected against unauthorized or inadvertent changes or not.

Device is protected.

Device is not protected.

If device protection is switched on, the device demands input of the valid password.

The password can be assigned or modified in the "ADVANCED > PASSWORD PROTECTION" device setting.

Note

Device protection symbol

The device protection symbol appears in all displays with the exception of the measured value display.

Display number

Each display is assigned a display number. The number is located on the right of the header area of the display.

Note

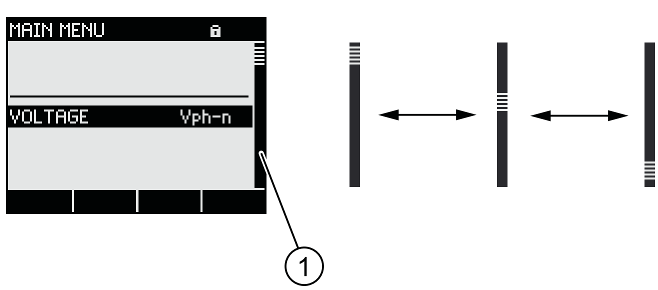
Support requests

If you need to submit a support request, provide the display number if you are referring to a specific display.

Scroll bar

A scroll bar is positioned on the right edge of the display in menu displays. The slide on the bar shows the relative position of the selection bar in the menu list.

- Slide at top position: Start of list
- Slide at bottom position: End of list



(1) Scroll bar of the menu list

Figure 8-3 Scroll bar of the menu list

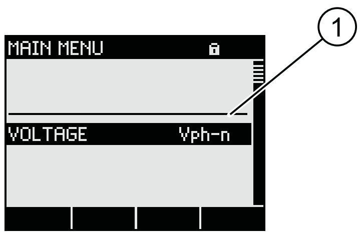
Selection bar

The selection bar indicates the menu entry that can be called with F4 ENTER.

F2 ▲ and F3 ▼ move the selection bar over the menu entries.

- If all entries of the displayed menu can fit on the display, the selection bar moves across the stationary menu entries.
- If the menu list has more entries than can fit on the display, the display switches to scroll mode. The selection bar remains stationary in the middle of the display. The menu list rolls up and down "under" the bar.

Start of the list/end of the list



(1) Separating line between the start of the list and end of the list

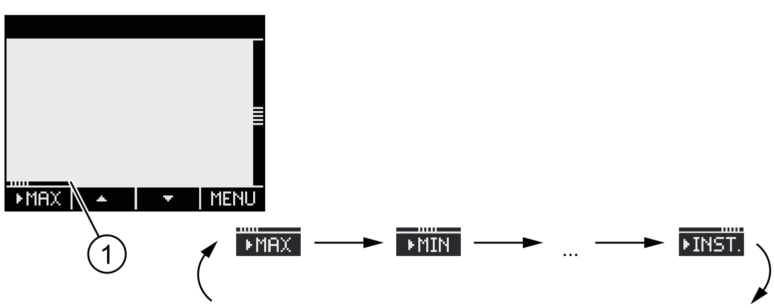
Figure 8-4 Start of the list/end of the list

In all menus, the end of the list is looped back in a circle to the start of the list. F3 ▼ jumps from the end of the list to the start of the list. F2 ▲ jumps from the start of the list to the end of the list.

A separating line indicates the interface between the end of the list and the start of the list if the menu contains more entries than can be shown on the display at one time.

Scroll bar of function key F1

The horizontal bar above function key F1 shows the multiple assignments of the function key. The key assignment changes every time you press the key.



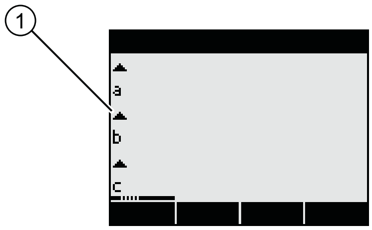
(1) Scroll bar of function key F1

Figure 8-5 Scroll bar

Symbols for maximum and minimum values

Maximum and minimum values are additionally marked by a symbol. An upward or downward pointing arrow appears above the phase or measured variable designation.

-  Maximum
-  Minimum

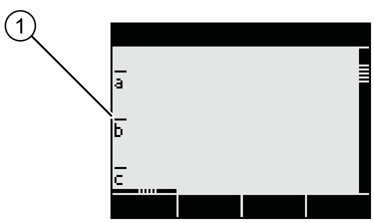


(1) Symbol for maximum value

Figure 8-6 Symbols for displaying maximum and minimum values

Symbol for sliding window demand

Sliding window demand values are additionally marked by a symbol. A stroke (bar) appears above the phase or measured variable designation.



(1) Stroke above the phase designation

Figure 8-7 Symbol for sliding window demand

8.1.2 Display of the measured variables

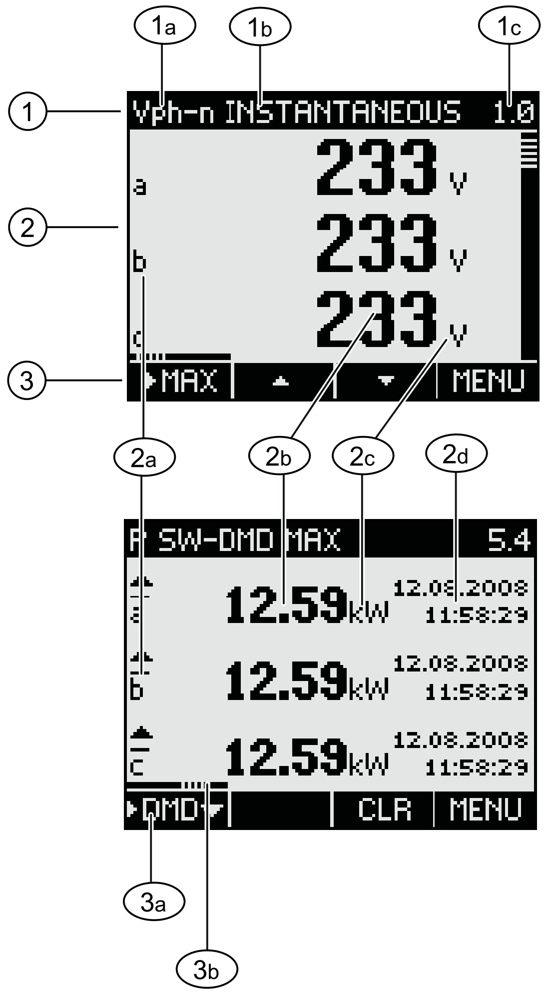


Figure 8-8 Displaying measured variables

(1) Display title
- a) Designation of the measured variable
- b) Designation of the measured value property
- c) Display number of the measured variable

(2) Measured value display
- a) Phase labels
- b) Measured value
- c) Unit of the measured variable
- d) Time stamp

(3) Display footer
- a) Key labeling
- b) Scroll bar of function key F1

Display title

The display title in the header of the display contains the following information:

- Designation of the measured variable
- Designation of the measured value property
- Display number of the measured variable

Designation of the measured variable

The first position in the display title contains the designation of the measured variable displayed. Since the length of the line is restricted, the unit of the measured variable is also used as the name.

Designation of the measured value property

The second position in the display title contains the currently displayed measured value property. The table below lists the measured value properties and their designations:

Designation of the measured value property	Measured value property of the measured variable
INSTANTANEOUS	Instantaneous value
MAXIMUM	Maximum value
MINIMUM	Minimum value
SW DEMAND	Sliding window demand
SW DMD MAX	Maximum value of the sliding window demand
SW DMD MIN	Minimum value of the sliding window demand
IMPORT	Imported energy
EXPORT	Exported energy

Function keys

The function keys have multiple assignments in the measured value display. F2 ▲ and F3 ▼ are only available when the instantaneous value is displayed.

General key functions	F1	F2	F3	F4
Display the instantaneous value	▸INST.			
Display the maximum value	▸MAX			
Display the minimum value	▸MIN			
Display the sliding window demand	▸DMD			
Display the maximum value of the sliding window demand	▸DMD▲			
Display the minimum value of the sliding window demand	▸DMD▼			
Display the imported energy	▸IMP.			
Display the exported energy	▸EXP.			

General key functions	F1	F2	F3	F4
Reset the maximum or minimum value to the instantaneous value			CLR	
Scroll up in the selection list		▲		
Scroll down in the selection list			▼	
Go to the menu selection				MENU

Special key functions	F1	F2	F3	F4
Display the displacement angle φ	▸ φ			
Display the cosine of the displacement angle φ	▸COS			
Display the graph values	▸ TAB.			
Display the graph	GRAPH			
Display the THD of the voltage between the phase conductors	▸VL-L			
Display the THD of the voltage between the phase and neutral conductors	▸VL-N			
Display additional information		INFO		
Scroll to the left		◂		
Scroll to the right			▸	
Display the next additional information				⟳
Display the process	▸PRC			
Display the energy consumption per tariff for a specific period	▸⌀			
Display the energy export per tariff for a specific period		EXP⌀		
Display the energy import per tariff for a specific period		IMP⌀		

See also

Operator input steps in the measured variable display (Page 128)

8.1.3 Display of the "MAIN MENU"

The "MAIN MENU" shows the choice of viewable measured variables. The additional menu entry "SETTINGS" branches to the menu for parameterizing the device.

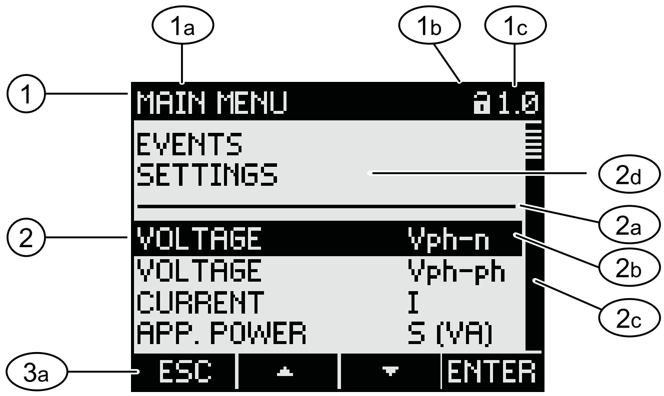


Figure 8-9 "MAIN MENU" display

(1) Display title
  a) "MAIN MENU"
  b) Device protection symbol
  c) Display number
(2) List of viewable measured variables
  a) Line separating the start and end of the list
  b) Selection bar
  c) Scroll bar
  d) Changing to the menu for parameterizing the device
(3) Function keys
  a) Key labeling

Display title

The display title "MAIN MENU" remains.

Display number of the measured variable

The main menu has no visible display number of its own. The display number shown refers to the currently selected measured variable.

List of viewable measured variables

The menu list shows the choice of viewable measured variables.

Selection bar

The selection bar highlights the currently selected measured variable.

Changing to the menu for parameterizing the device

The "SETTINGS" menu entry branches to the menu for parameterizing the device.

Function keys

Table 8- 1 Assignments of the function keys in the "MAIN MENU"

Key function	F1	F2	F3	F4
Reject the menu selection and return to the last displayed measured variable	ESC			
Scroll up in the selection list		▲		
Scroll down in the selection list			▼	
Display the selected measured variable				ENTER

See also

Operator input steps in the "MAIN MENU" (Page 129)

8.1.4 Display of the "SETTINGS" menu

The "SETTINGS" menu shows the choice of device settings. The menu entries designate groups of related settings combined in one display. A menu entry can lead to further submenus.

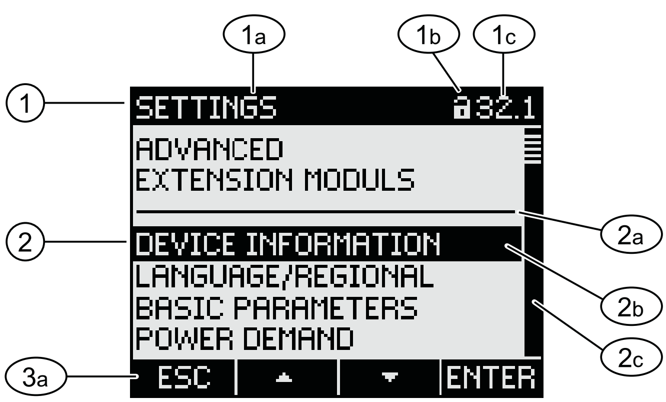


Figure 8-10 "SETTINGS" display

(1) Display title
- a) "SETTINGS"
- b) Device protection symbol
- c) Display number of the device setting

(2) List of device settings
- a) Line separating the start and end of the list
- b) Selection bar
- c) Scroll bar

(3) Function keys
  a) Key labeling

The "SETTINGS" menu contains the same operator controls as the "MAIN MENU".

Function keys

Table 8- 2 Assignments of the function keys in the "SETTINGS" menu

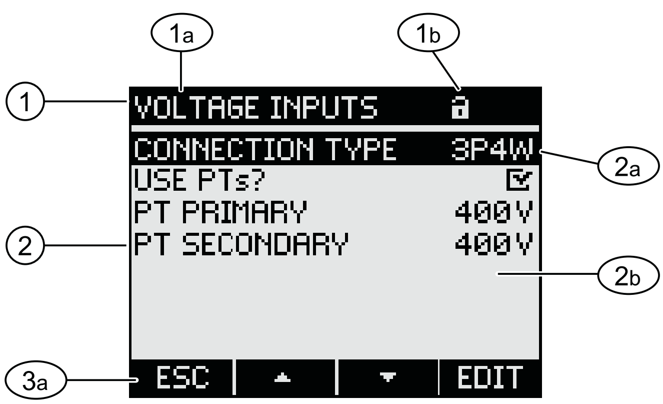
Key function	F1	F2	F3	F4
Reject the menu selection and return to the "MAIN MENU"	ESC			
Scroll up in the selection list		▲		
Scroll down in the selection list			▼	
Display the selected device setting				ENTER

See also

Operator input steps in the "SETTINGS" menu (Page 130)

8.1.5 Display of the device settings

Related device settings are listed under the display title. The currently valid settings are visible.



(1) Display title
  a) Designation of the selected group of device settings
  b) Device protection symbol
(2) List of device settings
  a) Selection bar
  b) Current setting
(3) Function keys
  a) Key labeling

Figure 8-11 Display of the device settings

Display title

Specifies which group of device settings is currently selected.

Function keys

Table 8- 3 Assignments of the function keys in the device settings display

Key function	F1	F2	F3	F4
Return to the menu selection	ESC			
Scroll up in the selection list		▲		
Scroll down in the selection list			▼	
Change to edit mode				EDIT
Switch the setting ON/OFF				☐◂▸☑
Return to the menu selection				OK

F4 EDIT switches edit mode on. The device settings can be changed in edit mode.

F4 ☐◂▸☑ is an ON/OFF switch. The change takes effect immediately. Calling edit mode is no longer applicable.

F4 OK is available when the device setting is displayed but cannot be edited. Like F1, F4 returns to the "SETTINGS" menu from this display.

See also

Operator input steps in device settings display (Page 130)

Edit mode of the device settings (Page 126)

8.1.6 Edit mode of the device settings

To edit the device settings, it is necessary to call edit mode. In display mode, the function for calling edit mode is assigned to F4 EDIT.

You can recognize edit mode because the selection bar reduces to the width of the selected value.

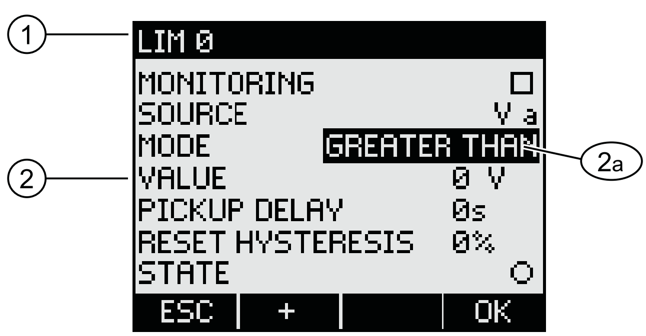


Figure 8-12 Edit mode of the device settings

(1) Group title

(2) List of device settings

a) Device setting in edit mode

Note

Edit functions in display mode

Display mode also includes edit functions! In display mode, F4 ☐◂▸☑ functions as an ON/OFF switch with immediate effect. Calling edit mode is no longer applicable.

Function keys

Table 8- 4 Assignments of the function keys in edit mode of the device settings

Key function	F1	F2	F3	F4
Reject the changes and return to display mode	ESC			
Increment the numerical value by "1" or show the next selectable setting		+		
Decrement the numerical value by "1" or show the previous selectable setting			–	
Go to the next digit to the right in the multi-digit numerical value			→	
Save the changes and return to display mode				OK

See also

Operator input steps in edit mode of the device settings (Page 131)

Display of the device settings (Page 125)

8.2 Operator input steps

8.2.1 Operator input steps in the measured variable display

Selecting the measured variable

When displaying the instantaneous value, it is possible to switch to other measured variables.

F2 ▲ switches to the previous measured variable.

F3 ▼ switches to the next measured variable.

The order of the measured variables corresponds to the order in the main menu.

If the maximum or minimum value is displayed, F2 ▲ and F3 ▼ are not available. In this case, switch first to the display of the instantaneous value.

Note: It is also possible to select the measured variable in the main menu.

Displaying instantaneous values, sliding window demand values, or maximum and minimum values

F1 switches the display on.

F1 ▸MAX: Display of the maximum value

F1 ▸MIN: Display of the minimum value

F1 ▸DMD: Display the sliding window demand

F1 ▸DMD▲: Display the maximum value of the sliding window demand

F1 ▸DMD▼: Display the minimum value of the sliding window demand

F1 ▸INST.: Display of the instantaneous value

Reset the maximum or minimum value to the instantaneous value

F3 CLR resets the last reached maximum/minimum value to the instantaneous value.

Switching between import, export, process and period

F1 switches between import, export, process, and period for active energy and reactive energy. Apart from export, the same selection options exist for apparent energy.

F1 ▸EXP.: Display of export

F1 ▸IMP.: Display of import

F1 ▸PRC: Display of total consumption and display of process consumption with current consumption value and last consumption value.

F1 ▸⌀: Display of the import or the export for a specific period, broken down into on-peak and off-peak

Calling the "MAIN MENU"

F4 MENU calls the menu selection. The selection bar is at the last displayed measured variable in the menu selection.

8.2.2 Operator input steps in the "MAIN MENU"

Selecting the measured variable

The selection bar highlights the currently selected menu entry.

F2 ▲ moves the selection bar up in the menu list.

F3 ▼ moves the selection bar down in the menu list.

Note

Selecting the measured variable

In the measured value display, you can switch to other measured value displays without calling the main menu.

Displaying the measured variable

The selection bar highlights the currently selected menu entry.

F4 ENTER calls the display of the selected measured variable.

Cancel menu selection

F1 ESC cancels menu selection and returns to the last displayed measured variable.

Note

Cancel menu selection

When returning from the main menu to the measured value display, the display switches to showing the instantaneous value.

Calling the "SETTINGS" menu

The "SETTINGS" menu entry calls the menu for parameterizing the device.

See also

Operator input steps in the measured variable display (Page 128)

8.2.3 Operator input steps in the "SETTINGS" menu

Selecting settings

The selection bar highlights the currently selected menu entry.

F2 ▲ moves the selection bar up in the menu list.

F3 ▼ moves the selection bar down in the menu list.

Displaying a setting

The selection bar highlights the currently selected menu entry.

F4 ENTER calls the display of the selected device setting.

Cancel menu selection

F1 ESC returns to the main menu.

8.2.4 Operator input steps in device settings display

Calling edit mode

F4 EDIT switches edit mode on. The device settings can be changed in edit mode.

You can recognize edit mode because the selection bar reduces to the width of the selected value.

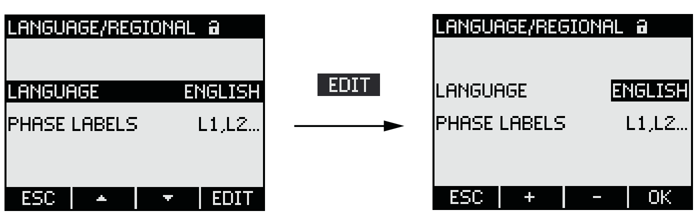


Figure 8-13 Calling edit mode

Exiting the display

F1 ESC closes the display and returns to the "SETTINGS" menu.

8.2.5 Operator input steps in edit mode of the device settings

Entering the password

If device protection is switched on, the device demands input of the valid password.

You can find information on password management in the "Password management" chapter.

Change value

Switching options ON/OFF

F4 [☐↔☑] switches a function or status ON/OFF.

F4 [☐↔☑] switches between several options that cannot be effective at the same time.

The setting takes effect immediately. Saving with F4 [OK] no longer applies.

Selecting from several settings

F2 [+] scrolls up through the range of selectable settings.

F3 [-] scrolls down through the range of selectable settings.

The last value in the available set of values is followed again by the first value.

Incrementing or decrementing a value

F2 [+] increases the value in increments of 1.

F3 [-] decreases the value in decrements of 1.

The highest value of the available set of values is followed again by the lowest.

Defining multi-digit values

If F3 [→] is available, the digits of a value can be changed, e.g. specific address digits of an address value.

F3 [→] runs through the digits of the value from left to right.

F2 [+] increments the value at the selected digit. The highest value of the available set of values is followed again by the lowest.

Saving the value

F4 [OK] saves the set value and returns to display mode.

Canceling editing

F1 [ESC] cancels editing and returns to display mode. All changes are discarded.

See also

Password management (Page 160)

Password protection (Page 52)

8.3 Special displays

8.3.1 Phasor diagram

The phasor diagram provides a coherent picture of the actual unbalance values of the fundamental.

The graphical representation is assigned a value table. F1 ▸ TAB. / GRAPH switches between the two representations.

Graphical representation

- Phase angle and displacement angle
- Amplitude unbalance, expressed as the length of the axes on the graph.

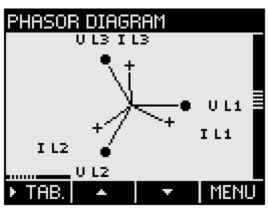


Figure 8-14 Phasor diagram

Table 8- 5 Symbols used in the phasor diagram

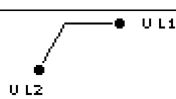
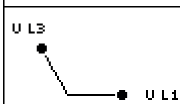
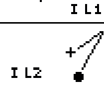
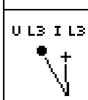
	Current
	Voltage
	Phase angle a-b
	Phase angle a-c
	Displacement angle a
	Displacement angle b
	Displacement angle c

Table of instantaneous values

The table below lists the instantaneous values of the fundamental.

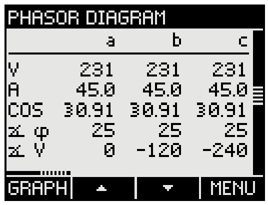


Figure 8-15 Phasor diagram, instantaneous values

Table 8- 6 Values in the phasor diagram

V	Voltage ph-n
A	Current
COS	Cosine of the displacement angle φ
∡ φ	Displacement angle φ
∡ U	Phase angle

Parameterizing 9

9.1 Introduction

Device settings

The "Parameterization" chapter describes the device settings. These functions include:

- Adjustment to the physical conditions of use
- Integration into the communication system
- Country-specific settings, ergonomics, device protection

It is possible to set the device by means of:

- The operator interface of the device
- Configuration software

Note

Protection of the device settings

As delivered, the device settings are not protected. At startup, a password should be assigned and the device protection activated to guard against unauthorized or inadvertent changes.

9.2 Parameterizing the operator interface

9.2.1 Groups of settings

The device settings are arranged into the following groups. The "SETTINGS" menu shows the choice of groups:

- Device information

  Order number and versions.
- Language/Regional

  Display language and designation of the phases on the display.
- Basic parameters

  Settings for the measuring inputs, averaging time of the sliding window demand.
- Power demand

  Settings for the load profile.

- Date/time
  Time-related settings
- Integrated I/Os
  Settings for using the digital inputs and outputs.
- Communication
  Network communication settings.
- Display
  Settings for the display
- Advanced
  Password protection, limit values, universal counter, battery change, device reset.
- Expansion modules
  Settings for expansion modules operated with SENTRON PAC4200.

9.2.2 Device information

The device information cannot be modified. Key F4 OK returns to the "SETTINGS" menu.

Call: "SETTINGS > DEVICE INFORMATION"

DEVICE INFORMATION

PAC4200	Device designation
<Order no.>	Order number of the device.
S/N:	Serial number of the device.
D/T:	Date code.
ES:	Hardware revision level
SW-REV:	Firmware revision level.
BL-REV:	Boot loader revision level.

9.2.3 Language and regional settings

Display language and designation of the phases on the display.

Call: "SETTINGS > ANGUAGE/REGIONAL"

Figure 9-1 "LANGUAGE SETTING" device setting

LANGUAGE/REGIONAL

LANGUAGE	Language of the display.		
		Range:	Chinese, English, French, German, Italian, Portuguese, Polish, Russian, Spanish, Turkish
		Default value:	English
PHASE LABELS	Designation of the phases on the display.		
		Range:	
			L1 L2 L3,
			a b c
		Default value:	
			L1 L2 L3

9.2.4 Basic parameters

Basic parameters are all those settings concerning the measuring inputs.

Call: "SETTINGS > BASIC PARAMETERS"

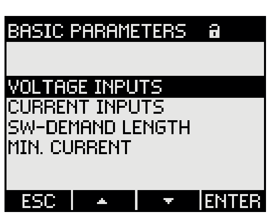


Figure 9-2 "BASIC PARAMETERS" device setting

VOLTAGE INPUTS

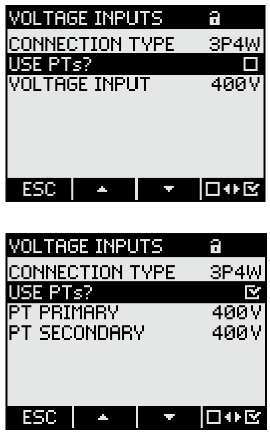


Figure 9-3 "USE PTs?" device settings

CONNECTION TYPE

Connection types:

3P4W: 3 phases,
4 conductors,
unbalanced load

3P3W: 3 phases,
3 conductors,
unbalanced load

3P4WB: 3 phases,
4 conductors,
balanced load

3P3WB: 3 phases,
3 conductors,
balanced load

1P2W: 1 phase,
2 conductors,
unbalanced load

Default value: 3P4W

Use PTs?	Measurement with/without voltage transformer ON/OFF switch: ☑ ON / ▣ OFF. ☑ ON: Measurement using voltage transformers. When measuring via voltage transformer, the device must know the voltage conversion ratio. For this purpose, the primary and secondary voltages must be specified in the fields "PT PRIMARY" and "PT SECONDARY". When changing from direct measurement to measurement using voltage transformers, the device accepts the last set reference measuring voltage as the secondary voltage and as the primary voltage. ▣ OFF: Measurement direct on the low-voltage system. When changing from measurement using voltage transformers to direct measurement, the device accepts the last set secondary voltage as the reference measuring voltage. Default value: ▣ Off
VOLTAGE INPUT	Rated voltage of the measuring system. Must be specified if measuring is done direct on the system without voltage transformers. SENTRON PAC4200 **with a wide-voltage power supply** Range: 1 V to 690 V, freely adjustable (max. 600 V for UL) Default value: 400 V SENTRON PAC4200 **with an extra-low voltage power supply** Range: 1 V to 500 V, freely adjustable Default value: 289 V The property "VOLTAGE INPUT" is only visible, if "USE PTs?" is set to "▣ Off".
PT PRIMARY	Primary voltage. Must be specified if a voltage transformer is used for measuring. Range: 1 V to 999999 V, freely adjustable Default value: 400 V The property "PT PRIMARY" is only visible, if "USE PTs?" is set to "☑ On".

PT SECONDARY — Secondary voltage. Must be specified if a voltage transformer is used for measuring.

SENTRON PAC4200 **with a wide-voltage power supply**
Range: 1 V to 690 V, freely adjustable (max. 600 V for UL)
Default value: 400 V

SENTRON PAC4200 **with an extra-low voltage power supply**
Range: 1 V to 500 V, freely adjustable
Default value: 289 V

The property "PT SECONDARY" is only visible, if "USE PTs?" is set to "☑ ON".

CURRENT INPUT

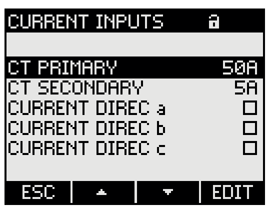


Figure 9-4 "CURRENT INPUTS" device setting

CAUTION
Please note current carrying capacity
Overload can destroy your SENTRON PAC4200.

The device must know the current conversion ratio. For this purpose, the primary and secondary currents must be specified in the fields "CT PRIMARY" and "CT SECONDARY".

CT PRIMARY — Primary current of the current transformers

Range: 1 A to 99999 A

Default value: 50 A

CT SECONDARY — Secondary current of the current transformers

Range: 1 A, 5 A

Default value: 5 A

CURRENT DIREC a
CURRENT DIREC b
CURRENT DIREC c — Inverse evaluation of the current flow direction separately for each phase.

ON/OFF switch: ☑ ON / ▣ OFF.

▣ OFF: The device interprets the current flow direction in accordance with the wiring.

☑ On: Direction of current flow is inverted. The device interprets the current flow direction opposite to the wiring.

Default value: ▣ OFF

AV TIME SW DEMAND

AVERAGING TIME — Averaging time for the sliding window demand.

Range: 3, 5, 10, 30, 60, 300, 600, 900 s

Default value: 600 s

MINIMUM CURRENT

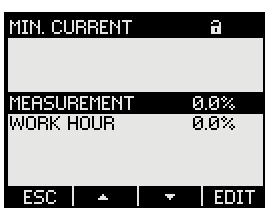


Figure 9-5 Minimum current

MEASUREMENT — Zero point suppression level as a percentage of the primary rated current of the external current transformer:
The minimum current measurement is used for zero point suppression so that zero is displayed below this limit.

WORK HOUR — Measuring threshold for operating hours counter as a percentage of I_N

See also

Voltage input (Page 104)

Current input (Page 108)

9.2.5 Power demand

Settings for the load profile.

Call: "SETTINGS > POWER DEMAND."

POWER DEMAND

SUBPERIOD	Period for calculating the load profile data according to the "fixed block" or "rolling block" method. SENTRON PAC4200 supports the fixed block method as a special case of the rolling block method. The most important distinguishing feature is the number of subperiods. The length of the demand period is defined as the product of the length of a subperiod and the number of subperiods. $Length_{demand\_period} = n * length_{subperiod}$; n = number of subperiods
SUBPERIOD TIME	Length of the subperiods: Range: 1 ,2, 3, 4, 5, 6, 10, 12, 15, 20, 30, 60 min Default value: 15 min
SUBPERIOD #	Number of subperiods Range: 1 to 5 Default value: 1 The number "1" defines the fixed block method. The numbers "2" to "5" define the rolling block method.
SYNC. SOURCE	Source of the synchronization pulse for synchronizing the load profile recording. Range: NONE, BUS, DIG. INPUT, INT. CLOCK NONE: Synchronization is switched off. BUS: Synchronization via the communication interfaces. DIG. INPUT: Synchronization via the digital input. INT. CLOCK: Synchronization via the internal clock. Default value: INT. CLOCK For synchronization via the digital input, the digital input must previously be parameterized for this purpose. ("SETTINGS > INTEGRATED I/O > DIGITAL INPUT", Field "ACTION", value "DEMAND SYNC"). The "SYNC. SOURCE" field is automatically reset to "NONE" if another function is assigned to the digital input.

See also

Load profile (Page 33)

9.2.6 Date / time

Device settings relating to the date and time.

Call: "SETTINGS > DATE/TIME"

Figure 9-6 "DATE/TIME" device settings

DATE/TIME

DATE	Current date. The date format is defined in the FORMAT field.
FORMAT	Date format. Range: DD.MM.YYYY, YYYY-MM-DD, MM/DD/YY Default value: DD.MM.YYYY
TIME	Time format: HH:MM:SS
TIME ZONE	Time zone, refers to coordinated universal time (UTC). Examples: "-06:00" corresponds to UTC-6 "+01:00" corresponds to UTC+1 Range: -12:00 ... +14:00, settable in 30 minute steps. Default value: 00:00

DAYLIGHTSAVING	Automatic change of time from standard time to daylight saving time and from daylight saving time to standard time.

Range:

OFF	Time change is switched off.
AUTO EU	Time change within the European Union Changeover to daylight saving time: The internal clock is put forward from 1 a.m. UTC to 2 a.m. UTC on the last Sunday in March. Changeover to standard time: The internal clock is put back from 2 a.m. UTC to 1 a.m. UTC on the last Sunday in October.
AUTO US	Time change within the USA Changeover to daylight saving time: The internal clock is put forward from 2 a.m. local time to 3 a.m. on the second Sunday in March. Changeover to standard time: The internal clock is put back from 2 a.m. local time to 1 a.m. on the first Sunday in November.
TABLE	Time change can be individually parameterized. The parameters can be set in the software.

Default value: AUTO EU

See also

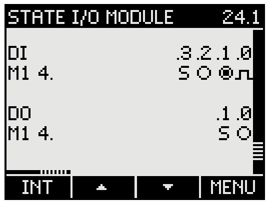
Date and time (Page 103)

9.2.7 Integrated I/Os

Device settings for using the digital inputs and outputs.

Call: "SETTINGS > INTEGRATED I/O".

State I/O



 The digital input or digital output is OFF/INACTIVE/LOW.

 The digital input or digital output is ON/ACTIVE/HIGH.

 The digital input or digital output is configured as a pulse input or a pulse output.

S Sync

Figure 9-7 State I/O module

DIGITAL OUTPUT

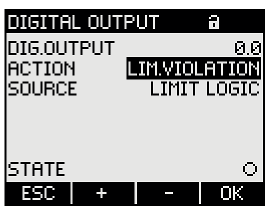


Figure 9-8 "DIGITAL OUTPUT" device settings

DIG.OUTPUT	Digital output	
ACTION	Method of using the digital output:	
	Range:	
	OFF	The digital output is switched off.
	DEVICE ON	The digital output signals that the device is switched on.
	REMOTE OUTPUT	The digital output is controlled by remote access.
	ROTATION	The digital output is activated by a clockwise electrical field and remains active as long as the field's direction of rotation remains unchanged.
	SYNC	Synchronization of other devices.
	LIM.VIOLATION	The digital output is switched on by a limit violation and remains active while the limit violation prevails. The field "SOURCE" selects the limit to be monitored. The definition of the limit is stored in "ADVANCED > LIMITS".

ENERGY PULSE	The digital output outputs the parameterized number of pulses or edges per energy unit.

Default value: OFF.

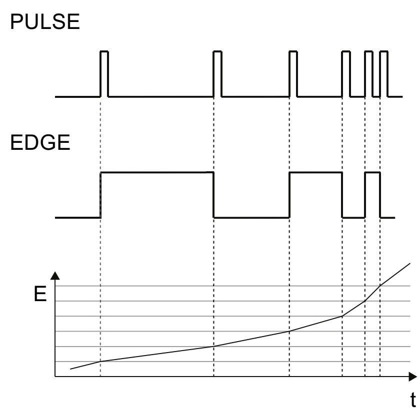
MODE — The field is available when the action "ENERGY PULSE" is selected.

Pulses or edges are output.

PULSE: Pulses are output.

EDGE: Edges are output.

Default value: PULSE



SYNC LENGTH — The field is available when the action "SYNC" is selected.

Length of the synchronization pulse. Time for which the signal at the digital output is "high".

Range: 30 ... 500 ms
Default value: 100 ms

SOURCE — The field is available in the case of the actions "LIM.VIOLATION" and "ENERGY PULSE"

In the case of the action "LIM.VIOLATION":

the field "SOURCE" selects the limit whose status is given at the digital output.

Range: LIMIT LOGIC, LIMIT 0, LIMIT 1, ... LIMIT 11

Default value: LIMIT LOGIC.

In the case of the action "ENERGY PULSE":

The field "SOURCE" selects the type of cumulated power (active energy or reactive energy):

kWh IMPORT
kWh EXPORT
kVARh IMPORT
kVARh EXPORT

The reference values at which a pulse or an edge is output are defined in the fields "UNIT" and "PULSES PER UNIT".

UNIT — The field is available when the action "ENERGY PULSE" is selected.

Value of the cumulated power at which a configurable number of pulses or edges is output. The number of pulses or edges to be output is defined in the field "PULSES PER UNIT" or "EDGES PER UNIT".

Range: 1, 10, 100, 1000 kVARh, or kW
Default value: 1

PULSES PER UNIT — The field is available when the action "ENERGY PULSE" is selected.

Number of pulses to be output per unit. The reference unit is defined in the "UNIT" field.

Range: 1 to 999
Default value: 1

EDGES PER UNIT — The field is available when the action "ENERGY PULSE" is selected.

Number of edges to be output per unit. The reference unit is defined in the "UNIT" field.

Range: 1 to 999
Default value: 1

PULSE LENGTH — The field is available when the action "ENERGY PULSE" is selected.

Length of the pulse.

Range: 30 to 500 ms
Default value: 100 ms

The minimum length of the pulse pause corresponds to the pulse duration specified.

DIGITAL INPUT

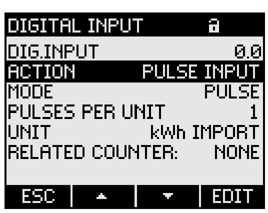


Figure 9-9 "DIGITAL INPUT" device settings

DIG.INPUT — Digital input

ACTION — Method of using the digital input:

Range:

- NONE: The digital input is switched off.
- PULSE INPUT: Counting of input pulses.

  Note:
  A universal counter can be parameterized for pulse counting. In the device settings "ADVANCED > UNIVERSAL COUNTER", set the field "SOURCE" to the value "DIG. INPUT".

ON/OFF-PEAK:	Switching between tariffs. Off-peak if input active.
TIME SYNC:	Synchronization of the internal clock ("Top of minute"). The internal clock is put forward or back, depending on whether the time is up to 30 seconds fast or slow. If a pulse is not received for 20 minutes, an event is recorded. If changes were made in the "Date/Time" screen, the synchronization pulse does not take effect until the screen is closed.
DEMAND SYNC:	Synchronization of power demand.
STATUS:	One event is recorded for each switching operation.
START/STOP	Starts or stops the counters specified under "Target". This depends on whether the associated digital input is active or inactive. If it is active, the action starts. If it is inactive, the action stops.
COPY&RESET	Copies and resets the counters specified under "Target". For this purpose, the associated digital input is switched from inactive to active.
RESET	Copies and resets the counters specified under "Target". For this purpose, the associated digital input is switched from inactive to active.

Default value: NONE

MODE — The field is available when the action "PULSE INPUT" is selected.

Counting of pulses or edges.

Range:

PULSE: Pulses are counted.
EDGE: Edges are counted.

Default value: PULSE

PULSES PER UNIT — The field is available when the action "PULSE INPUT" is selected.

Number of pulses that must be received per unit in order for the counter to be incremented by "1". The reference unit is defined in the "UNIT" field.

Range: 1 to 999
Default value: 1

EDGES PER UNIT	The field is available when the action "ENERGY PULSE" is selected. Number of edges that must be received per unit in order for the counter to be incremented by "1". The reference unit is defined in the "UNIT" field. Range: 1 to 999 Default value: 1
UNIT	Visible when the action "PULSE INPUT" is selected. Unit to be counted when counting the pulses or edges received: kWh (active energy) kVARh (reactive energy) TEXT "TEXT" stands for a user definable unit, e.g. m^3/h or pieces. The text sequence used to name the unit must be defined via the communication interface. The defined text sequence is displayed in the "TEXT" field when you select "TEXT".
TEXT	Text sequence used to name the unit to be counted. See "UNIT" field.
TARGET	You will find more detailed information in the following table.
RELATED COUNTER	The associated user-defined pulse counter is displayed here independently of the action selected. This function is only available if at least one SENTRON PAC 4DI/2DO expansion module is plugged into the SENTRON PAC.

Table 9- 1 Setting options in the field "TARGET" depending on the action selected

Target	Description	START/STOP	COPY/RESET	RESET
PROCESS&PULSE	Relates to: • All process energy counters • The process operating hours counter • All pulse counters	—	—	X
PULSE COUNTER	All pulse counters	—	—	X
PULSECOUNTER 1 ... n	Specific pulse counter	—	—	X
PROCESSCOUNTER	All process energy counters	X	X	X
kWh / kVAR / kVAh PROCESSCNT	Specific process energy counter	—	X	X

9.2.8 Communication

Device settings for network communication.

Call: "SETTINGS > COMMUNICATION"

Figure 9-10 "COMMUNICATION" device setting

A change to the TCP/IP addresses only becomes effective after the device has been restarted.

If you exit the "COMMUNICATION" device setting with the F1 key ESC, the device asks if you want to restart.

- F1 key NO: Do not execute a restart. Address changes are saved on the device but do not become effective.
- F4 key OK: Execute a restart. Address changes become effective.

COMMUNICATION

MAC-ADDR:	MAC address. Read only.
IP-ADDR.:	IP address.
SUBNET:	Subnet mask.
GATEWAY:	Gateway address of a computer that can set up a connection from the network defined in the field "SUBNET" to another network (e.g. a router).
PROTOCOL:	MODBUS TCP

9.2.9 Display

Device settings for the SENTRON PAC4200 display.

Call: "SETTINGS > DISPLAY".

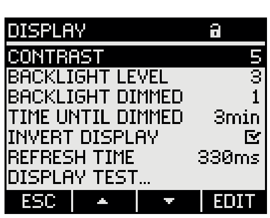


Figure 9-11 "DISPLAY" device setting

DISPLAY

CONTRAST	Contrast of the LC display. Range: 0 to 10. Default: 5
BACKLIGHT LEVEL	Intensity of the backlighting of the LC display. The value "0" switches the backlighting off. Range: 0 to 3. Default value: 3
BACKLIGHT DIMMED	Intensity of the backlighting of the LC display. Set by the device after the display time until dimmed expires. See "TIME UNTIL DIMMED" field The value "0" switches the backlighting off. Range: 0 to 3. Default value: 1
TIME UNTIL DIMMED	Time after which the device switches the backlighting from "BACKLIGHT LEVEL" to "BACKLIGHT DIMMED. Range: 0 to 99 min. Default: 3 min.
INVERT DISPLAY	Inversion of the basic representation of the display. ON/OFF switch: ☑ ON / ▣ OFF. ▣ OFF: Light text on dark background. ☑ On: Dark text on light background. Default: ☑ On:
REFRESH TIME	Refresh rate of the display. Range: 330 to 3000 ms Default: 330 ms. The tolerance of the refresh rate is 100 ms.
DISPLAY TEST	Screen for testing the functional capability of the display. Key F3 inverts the test screen. Key F4 closes the display.

9.2.10 Advanced

Call: "SETTINGS > ADVANCED".

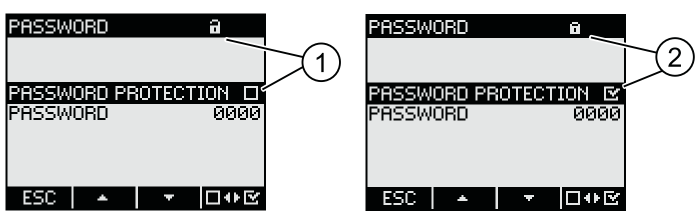
Other device settings.

- Password protection
- Definition of limit values
- Definition of the universal counter
- Battery change
- Minimum/maximum value, counter, and address reset

PASSWORD PROTECTION

You can protect the device settings against write access with a password. The data can be read without any restrictions.

PASSWORD PROTECTION	Switches password protection ☑ ON / ▣ OFF. ☑ ON: Password protection switched on ▣ OFF: Password protection switched off Default value: Switched off
PASSWORD	Four-digit, numeric password. Default value: 0000



(1) Password protection switched **OFF**

(2) Password protection switched **ON**

Figure 9-12 "PASSWORD PROTECTION" device settings

See also

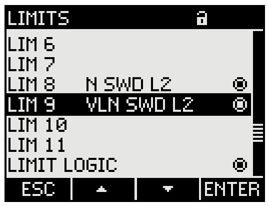
Password protection (Page 52)

Password management (Page 160)

LIMITS

Monitoring of up to 12 limit values "LIM0" to "LIM11" and the limit value "LIMIT LOGIC".

The limit value "LIMIT LOGIC" can be made up of any combination of the limit values "LIM0" to "LIM11" and the digital inputs I0.0 and I0.1.



Left column: Limit designation
Middle column: Monitored data source
Right column: Limit value currently violated: Yes, No

Figure 9-13 Representation of limit violations

LIM0, LIM1, … LIM11 — Limit selection menu. Each limit has the following properties:

MONITORING — Activation of limit monitoring.

- ON/OFF switch: ON / OFF.
- ON: Limit monitoring switched on.
- OFF: Limit monitoring switched off.
- Default value: OFF

SOURCE — Monitored data source.

- Almost all measured variables can be selected as the source.
- The short codes are assigned to the measured variables in the Appendix, in the right column "LIM SOURCE" of the table "MEASURED VARIABLES".
- Default value:
  V a

MODE — Relational operators

- GREATER THAN, LOWER THAN the value in the "VALUE" field.
- Default operator: GREATER THAN

VALUE — Monitored threshold.

PICKUP DELAY — Delay before reporting the limit violation in seconds.

The delay refers to the appearance of the limit violation or the point of exceeding the threshold defined in the "VALUE" field. See the figure below "Effect of delay".

- Range: 0 to 10 s
- Default value: 0 s

HYSTERESIS	Threshold buffer, prolongs the limit violation. The hysteresis refers to the disappearance of the limit violation or the point when the level returns below the defined threshold. Range: 0.0 to 20.0 % Default value: 0,0 % The percentage refers to the threshold value in the "VALUE" field. See the figure below "Effect of delay and hysteresis".
STATUS	Indicates whether the limit value is currently violated. Yes, violation. No, no violation.
LIMIT LOGIC	Refer to the following section "LIMIT LOGIC"

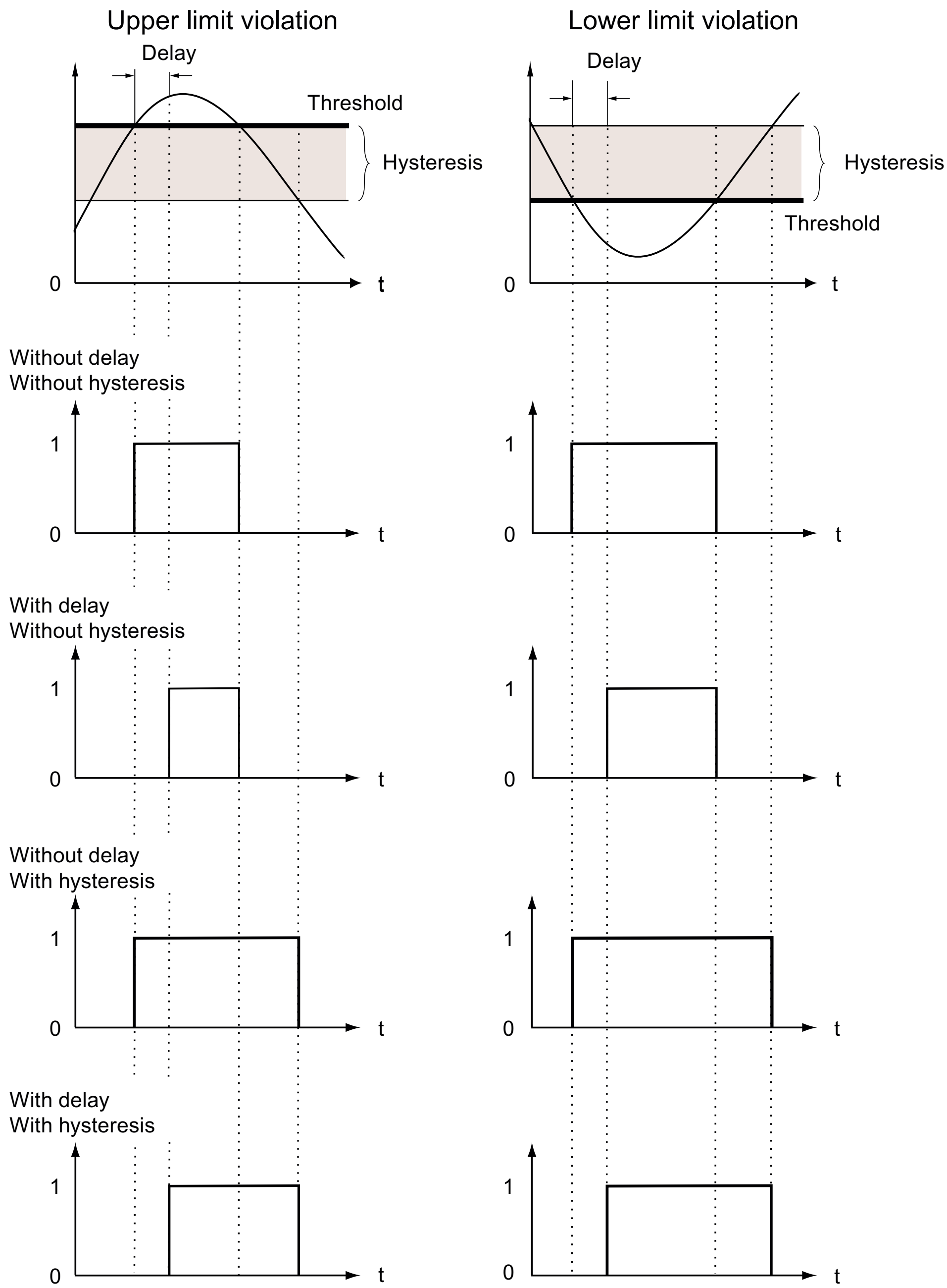


Figure 9-14 Effect of delay and hysteresis on upper and lower limit violations

LIMIT LOGIC

Logical truth value resulting from the combination of up to 12 limit values "LIM0" to "LIM11", taking account of the logical priority rules and allowing logical brackets.

The logic is represented on the display using the graphic symbols familiar from digital technology.

Value "true": A violation has occurred
Value "false": No violation has occurred

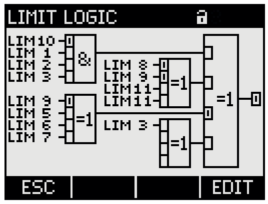
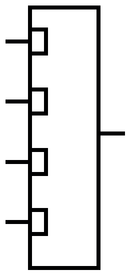


Figure 9-15 "LIMIT LOGIC" device settings

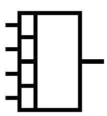
LIM0, LIM1, ..., LIM11

Limit values used to generate the logically combined limit "LIMIT LOGIC".



A higher-level logic function block with four inputs supplies the result of the logic operation "LIMIT LOGIC".

Four logic function blocks, each with four inputs, are connected to these four inputs.



Logic function block with four inputs. Supplies the output value to the input of the higher-level logic function block.

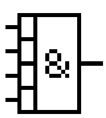
Each of the four inputs can be assigned:

- One of the twelve limit values LIM0 to LIM11
- One of the digital inputs I0.0 or I0.1

Logic operations

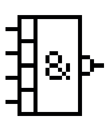
Six logic operations:

AND, OR, XOR and their negations NAND, NOR, XNOR



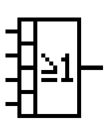
AND

AND logic operation: The output value is only true if all input values are true. The output value is false if any one of the input values or several input values are false.



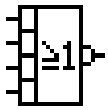
NAND

NOT AND logic operation: The output value is true if any one of the input values or several input values are false. The output value is only false if all input values are true.



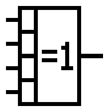
OR

OR logic operation: The output value is true if any one of the input values or several input values are true. The output value is only false if all input values are false.



NOR

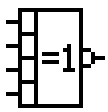
NOT OR logic operation: The output value is only true if all input values are false. The output value is false if any one of the input values or several input values are true.



XOR

EXCLUSIVE OR logic operation: The output value is only true if an odd number of inputs is true and all other inputs are false

The XOR logic is easy to understand if there are only two inputs. The output is true if the two inputs are not simultaneously true or false.



XNOR

EXCLUSIVE NOT OR logic operation: The output value is only true if an even number of inputs is true and all other inputs are false

The XNOR logic is easy to understand if there are only two inputs. The output is true if the two inputs are simultaneously true or false.

Status indicators

The value present at the input or the value to be output at the output is "true".

The value present at the input or the value to be output at the output is "false".

You can find more information on generating the logically combined limit "LIMIT LOGIC" in the "Limits" chapter.

See also

Limits (Page 44)

Measured variables (Page 199)

UNIVERSAL COUNTER

2 configurable universal counters for counting limit violations and status changes at the digital inputs or outputs, for indicating the active energy or reactive energy of a connected pulse encoder, or for counting signals from any source, e.g. a water or gas meter.

SOURCE — Source of the count.

Range:

DIG. INPUT,	Digital input
DIG.OUTPUT	Digital output
LIMIT LOGIC	Limit logic
LIM0, LIM1, LIM11	Limit value 0, limit value … , limit value 11

DIG.INPUT	Selection of an available digital input
DIG.OUTPUT	Selection of an available digital output

BATTERY CHANGE

SENTRON PAC4200 writes data in a battery-backed volatile memory. The data must be backed up prior to removing the battery.

F4 ENTER in the "CHANGE BATTERY" dialog box starts the data backup. The device copies the data from the volatile memory to the internal non-volatile memory. The data does not leave the device.

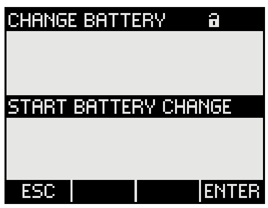


Figure 9-16 Data backup in the "CHANGE BATTERY" dialog box

For detailed information about changing the battery, see the chapter "Maintenance and servicing".

See also

Replacing the battery (Page 170)

RESET

The "RESET" dialog box can be used to reset the device settings to the instantaneous values or the factory default values. The following groups of values can be reset:

- Maximum/minimum values
- Counters
- Universal counter
- Factory settings
- Communication parameters

F4 does not immediately reset a value group but marks the group instead. The "EXECUTE..." menu entry resets the marked value groups.

NOTICE
Rebooting the device Resetting the last two value groups "FACTORY DEFAULTS" and "COMMUNICATION PARAM." causes the device to reboot.

After calling the "EXECUTE" menu entry with F4 ENTER, a safety query appears on the display: "Are you sure you want to execute the selected functions?". Answer this query with F1 or F4.

- F1 NO: Cancels the action. The display returns to display mode. All selected value groups are deselected.
- F4 OK: Resets the selected value groups.

After execution with F4 OK, the confirmation "SELECTION EXECUTED" appears on the screen or the device is rebooted.

Confirm the message "SELECTION EXECUTED" with F4 OK.

CLEAR MIN/MAX VALUES	Resets all minimum and maximum values to the instantaneous value.
RESET COUNTERS	Resets the following counters to zero (0): • Energy counters for active energy, reactive energy, and apparent energy. • Operating hours counter
UNIV.COUNTER RESET	Resets the configurable universal counters to zero (0).
PULSE COUNTER RESET	Resets the pulse counter. This option is only available if at least one SENTRON PAC 4DI / 2DO expansion module is plugged into the SENTRON PAC4200 device.
FACTORY DEFAULTS	Resets all device settings to the default values. Clears minimum/maximum values Resets all counters.

NOTICE
Access protection is switched off Resetting to the factory defaults deactivates device protection. Password protection is switched off. The password is set to the value "0000".

NOTICE
Counter reset Resetting to the factory defaults causes all counters to be reset as well!

COMMUNICATION PARAM.	Resets the entered TCP/IP address to: 0.0.0.0
EXECUTE	Reset function. Resets the selected value groups.

9.2.11 Password management

Default password

The default password is: 0000

If no user-specific password has been assigned, the default password must be entered when password protection is switched on.

9.2.11.1 Calling password management

You can find password management in the device settings under "ADVANCED > PASSWORD"

To access password management:

1. Exit the measured value display. Call the "MAIN MENU":
   F4 MENU
2. In the main menu, go to the "SETTINGS" entry:
   F2 ▲ or F3 ▼
3. Call the "SETTINGS" entry:
   F4 ENTER
4. In the "SETTINGS" menu, go to the "ADVANCED" entry:
   F2 ▲ or F3 ▼
5. Call the "ADVANCED" entry:
   F4 ENTER
6. In the "ADVANCED" menu, call the "PASSWORD PROTECTION" entry:
   F4 ENTER

9.2.11.2 Switch on password protection

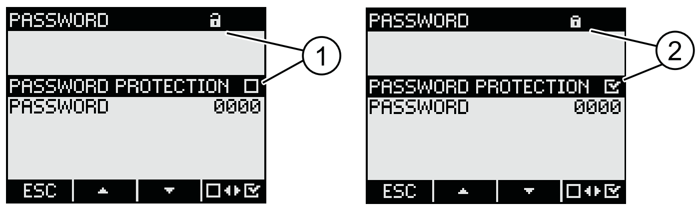
Password protection can be switched on at any time.

> NOTICE
>
> **Password known?**
>
> Before you switch on password protection, make sure you and the group of authorized users are all in possession of the password. If password protection is switched on, the password is mandatory for all changes to the device settings. You also require the password to call the "PASSWORD" dialog box again in order to switch off access protection or to change the password.

Password protection is effective as soon as it is switched on! The password protection symbol in the display title changes from "unprotected" to "protected". While you are in the "PASSWORD PROTECTION" dialog box, you can switch password protection off again or view the password in the "PASSWORD" field.

To switch password protection on, proceed as follows:

1. Call the "PASSWORD PROTECTION" display.
2. Activate the field "PASSWORD PROTECTION" with
   F4



(1) Password protection switched **OFF**

(2) Password protection switched **ON**

Figure 9-17 "PASSWORD PROTECTION" device setting

9.2.11.3 Switch off password protection

If password protection is switched off, there is no protection against unauthorized or inadvertent changes to the device settings.

The currently valid password becomes visible on the display when password protection is switched off. The password remains saved and becomes effective again the next time password protection is switched on.

Note

Password visible on the display

The password becomes visible on the display when password protection is switched off.

To switch off password protection:

1. Call the "PASSWORD PROTECTION" display.
2. Deactivate the "PASSWORD PROTECTION" field with
   F4
   The device opens the "ENTER PASSWORD" dialog box.
3. Enter the password and confirm with
   F4 OK
   The display returns to the "PASSWORD PROTECTION" display. The password is visible on the display.

If you have given the correct password, password protection is switched off.
If you have given an incorrect password, password protection remains active. Start again at Step 2 and enter the correct password.

9.2.11.4 Change password

The password can be changed whether access protection is on or off. If access protection is switched on, the currently valid password is required in order to change the password.

Initial situation: Password protection switched off

If password protection is switched off, the password is also unprotected and can therefore be changed without restriction.

To change the password:

1. Call the "PASSWORD PROTECTION" display.
2. Go to the "PASSWORD" device setting:
   F2 [▲] or F3 [▼]
3. Open edit mode of the "PASSWORD" device setting:
   F4 [EDIT]
4. Change the password with:
   F2 [+] and F3 [→]
5. Accept the new password with:
   F4 [OK]
   The password is permanently saved.
   The display returns to display mode.

Initial situation: Password protection switched on:

If password protection is switched on, the valid password must be entered in order to change the password.

To change the password:

1. Call the "PASSWORD PROTECTION" display.
2. Go to the "PASSWORD" device setting:
   F2 [▲] or F3 [▼]
3. Open edit mode of the "PASSWORD" device setting:
   F4 [EDIT]
4. The device opens the "ENTER PASSWORD" dialog box.
5. Enter the password and confirm with
   F4 [OK]
   If you have entered the correct password, the password becomes visible in the PASSWORD field.
6. Open edit mode of the device setting "PASSWORD" with:
   F4 [EDIT]
7. Change the password with:
   F2 [+] and F3 [→]
8. Accept the new password with:
   F4 [OK]
   The password is permanently saved and becomes effective immediately.
   The display returns to display mode.
   The newly assigned password remains visible until you exit the dialog box with F1 [ESC].

9.2.11.5 Password lost - what to do?

If you have forgotten the password, please contact Technical Support. You will receive a new password from them.

You can find the address of Technical Support under "Technical Support" in the Chapter "Introduction".

Requesting a new password

Please have the following information to hand when phoning or provide it in writing:

- MAC address of the device.
- You can find the MAC address under "SETTINGS > COMMUNICATION"

NOTICE
Change password immediately on receipt
As soon as you receive the new password, you must change it and inform the group of authorized users.

9.2.12 Expansion modules

Calling the device settings

Device settings for expansion modules operated with SENTRON PAC4200.

Call: "SETTINGS > EXPANSION MODULES".

See also

Configuring the PAC RS485 expansion module (Page 164)

Configuring the SENTRON PAC 4DI/2DO expansion module (Page 166)

9.2.13 Configuring the PAC RS485 expansion module

When the PAC RS485 expansion module is mounted on the SENTRON PAC Power Monitoring Device, you can make the configuration settings for the PAC RS485 expansion module on the Power Monitoring Device.

NOTICE
Interrupted communication when the nodes on the bus are configured differently
If the nodes on the bus are configured differently, communication faults will occur on the bus. Ensure that for all nodes on the bus, the same baud rate, the same settings, the same protocol and the same response time are set on the bus and on the master.

Settings on the SENTRON PAC Power Monitoring Device

In the main menu of the SENTRON PAC Power Monitoring Device, call "Settings " > "RS485 Module". You then see the following screen:

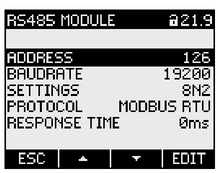


Figure 9-18 Configuring the PAC RS485 expansion module using buttons

"Address":
Each expansion module has a unique address. You set this here. The addresses from 1 to 247 are supported.

NOTICE
Abnormal behavior of the bus with identical addresses
If several expansion modules have the same address, this can result in abnormal behavior of the entire bus. Communication between the master and the slave devices connected to the bus is interrupted. Ensure that every expansion module has a unique address.

"Baud rate":
You set here the data transfer rate for the external communication of the PAC RS485 expansion module. The baud rate is stored in the non-volatile memory of the SENTRON PAC Power Monitoring Device.

"Settings":
This is where you set the data bits, the parity bit and the stop bits for external communication:

- 8E1 = 8 data bits, parity bit is even, 1 stop bit
- 8O1 8 data bits, parity bit is odd, 1 stop bit

- 8N2 = 8 data bits, no parity bit, 2 stop bits
- 8N1 = 8 data bits, no parity bit, 1 stop bit

Table 9- 2 Structure of the setting versions

Digit	Meaning	Possible settings		
1	Number of data bits	8		
2	Parity bits	Even	=	The data bits are rounded up to an even number.
		Odd	=	The data bits are rounded up to an odd number.
		None	=	No parity bit is sent.
3	Number of stop bits	1 or 2		

"Protocol":
You set the communication protocol here:

- MODBUS RTU
- SEAbus

"Response time":
If the Power Monitoring Device communicates over the RS 485 bus with an older MODBUS module from another manufacturer, it may be necessary to delay the response of a slave to a request from the master. The response time corresponds to the set baud rate. At baud rates ≥ 19200 bit/s, the response time corresponds to a character interval of at least 3.5 with regard to the configured baud rate.

Table 9- 3 Setting options

Setting	Meaning
0 = Auto	The device automatically sets a response time suitable to the baud rate. This is the minimal response time.
1 ... 255	Response time in ms

If you change the baud rate to a value that does not suit the response time set, the program sets the response time to "Auto".

Table 9- 4 Performance calculation

Baud rate	Calculated response time
4800 baud	At least 9 ms
9600 baud	At least 5 ms
≥ 19,200 baud	At least 3 ms

See also

Expansion modules (Page 163)

9.2.14 Configuring the SENTRON PAC 4DI/2DO expansion module

When the SENTRON PAC 4DI/2DO expansion module is mounted on the SENTRON PAC Power Monitoring Device, you can make the configuration settings for the external digital inputs and digital outputs on it.

Settings on the SENTRON PAC Power Monitoring Device

Call up the expansion module to be configured in the "EXP.MODULES" menu.

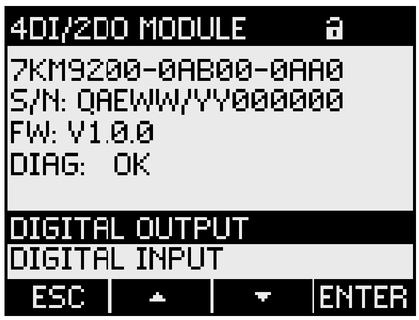


Figure 9-19 Configuring the SENTRON PAC 4DI/2DO expansion module using keys

The external digital inputs and digital outputs are configured like the internal digital inputs and digital outputs.

You will find the following information listed in the upper half of the display:

- The order number
- The serial number of the SENTRON PAC 4DI/2DO expansion module
- The firmware version of the SENTRON PAC 4DI/2DO expansion module
- The "DIAG" field

Table 9- 5 Status in the "DIAG" field with meaning

Status	Meaning	Remedy
INIT	The expansion module is in the initialization phase.	—
OK	The expansion module is ready for operation.	—
FW_UPD	The firmware update of the expansion module has been carried out but not correctly completed.	Wait until the firmware update has been completed, or carry out another firmware update of the expansion module.
COM_ERR	Internal communications error	1. Restart the device. Disconnect the power supply briefly for this purpose. 2. Replace the expansion module and/or the device.
SYS_ERR	The hardware and/or firmware of the SENTRON PAC and the SENTRON PAC 4DI/2DO expansion module do not match.	Please contact Support.

See also

Expansion modules (Page 163)
Integrated I/Os (Page 144)

9.3 Diagnostics LED of the SENTRON PAC 4DI/2DO expansion module

Description

The diagnostics LED indicates the communication status.

Table 9- 6 Status and fault indication by the LED

Color	State	Description	Measures
Green	Static ON	The expansion module is ready for operation.	—
Green	OFF	No voltage applied to the SENTRON PAC 4DI/2DO expansion module.	1. Check that the SENTRON PAC 4DI/2DO expansion module is correctly connected to the SENTRON PAC Power Monitoring Device. 2. Switch on the power supply to the SENTRON PAC4200 Power Monitoring Device. 3. Replace the expansion module and/or the device.

Service and maintenance 10

10.1 Calibration

The device has been calibrated by the manufacturer before shipping. Recalibration is not required provided the environmental conditions are maintained.

10.2 Cleaning

Clean the display and the keypad periodically. Use a dry cloth for this.

CAUTION
Damage due to detergents
Detergents can damage the device. Do not use detergents.

NOTICE
Damage due to moisture
Moisture or wetness can affect the operating capability of the components. Make sure that no moisture or wetness can find its way into the expansion module. Use only a dry, lint-free cloth to clean the components.

10.3 Firmware updates

The SENTRON PAC4200 and the SENTRON PAC 4DI/2DO expansion module support updating of the firmware.

You update the firmware with the *SENTRON powerconfig* configuration software. Additional information on updating the firmware can be found in the online help for *SENTRON powerconfig*. You can find the available and possibly necessary firmware versions on the Internet.

You can protect the update function, like all write accesses, with a password.

CAUTION
Power failure during firmware update disables the functionality of the expansion module
The firmware update lasts several minutes. To update the firmware of the expansion module, connect the SENTRON PAC with SENTRON PAC4DI/2DO expansion module or PAC PROFIBUS DP expansion module to a fail-safe power supply.
If the power fails despite this security measure, try to start the firmware update of the expansion module again in *SENTRON powerconfig*.

NOTICE
Expansion module will not work with the wrong firmware version
Older versions of the SENTRON PAC Power Monitoring Device do not support the SENTRON PAC 4DI/2DO expansion module. Make sure you use the SENTRON PAC firmware version that supports the expansion module.

You can obtain further information on the firmware versions from Technical Support.

See also

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

10.4 Replacing the battery

The battery of the SENTRON PAC4200 must be periodically replaced.

Note

No battery indicator

The SENTRON PAC4200 has no function for determining the charging status of the battery.

Service life of the battery

Refer to the information about the service life of the battery in the chapter "Technical data".

Replacement battery

Use a replacement battery that meets the technical requirements. Please read the instructions in the chapter "Technical data".

NOTICE
Use only batteries tested in accordance with UL1642.

Tools

Use the following tool for replacing the battery:

- Angled pointed pliers with insulated jaws.

Procedure

Follow the steps below to change the battery:

1. Make sure that the replacement battery has the full charging capacity and is available on site when commencing the work.
2. Back up the device's data.
   - Go to the dialog "CHANGE BATTERY".

     SETTINGS > ADVANCED > CHANGE BATTERY

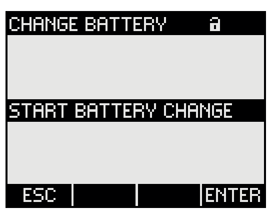
     

     Figure 10-1 "CHANGE BATTERY"

   - Select the "CHANGE BATTERY START" entry:
     key <F4> ENTER

     This will start data back-up. The SENTRON PAC4200 copies the data from the battery-backed memory into the internal non-volatile memory. The data does not leave the device.

     The load profile configuration and the load profile data are saved together with all counter values, e.g. for energy, day energy, operating hours, process counters, universal counters, user defined counters, interrupt counters, event counters, and configuration counters.

     The device indicates completion of data backup.

     The following data could be lost, for instance, when the battery is replaced:

     Event memory, min. / max. values for all measured variables, date and time, sliding window demand values.

     This data can be backed up previously with the software.

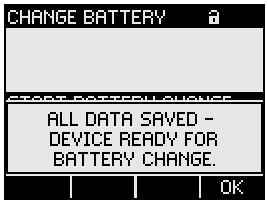


Figure 10-2 Indication of completed data backup

3. Switch the system and the device off-circuit.

DANGER

Hazardous Voltage

Will cause death or serious injury.

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

4. Discharge any static from your body. Observe the ESD guidelines in the Appendix.
5. Replace the battery.

NOTICE

Reduced service life of the battery

Grease or dirt on the contacts forms a transfer resistance that reduces the service life of the battery.

Hold the battery by the edges only.

CAUTION

Short-circuit of the battery

Gripping the battery with metal tools will short-circuit the battery.

Use insulated tools.

– The battery compartment is accessible externally without opening the housing. Remove the battery from the battery compartment. Use angled pointed pliers for this.
– Insert the replacement battery into the battery compartment. Take note of the polarity indicated at the insertion opening of the battery compartment.

Note

Polarity of the battery

The opening of the battery compartment has the same shape as the battery. This determines the alignment of the terminals. It is not possible to insert the battery incorrectly.

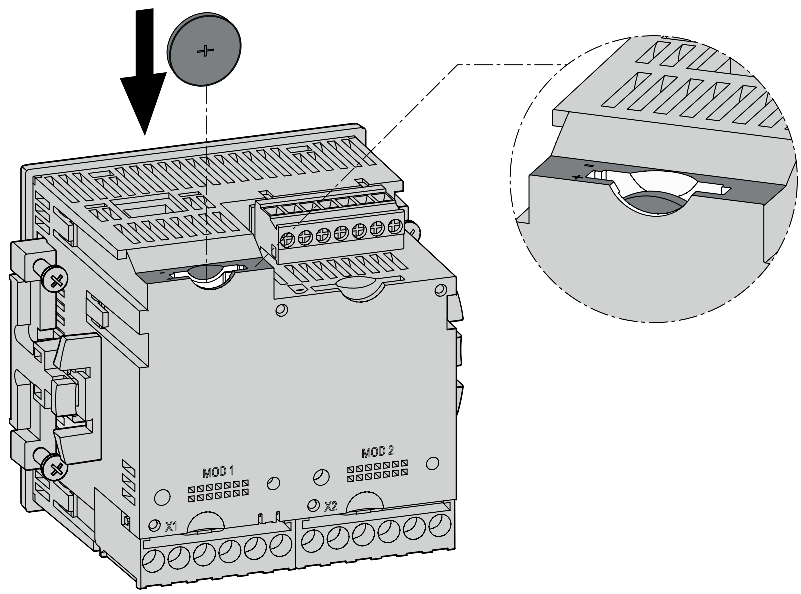


Figure 10-3 Battery change

6. Ensure the old battery is disposed of in accordance with legal requirements.
7. Start the system up again. Restore the supply voltage of the device.

   The backed-up data are available automatically.
8. Reset the clock.
9. Test the functional capability of the SENTRON PAC4200.

See also

ESD guidelines (Page 275)

Technical data (Page 175)

10.5 Repair

Procedure

NOTICE
Loss of certification and warranty If you open the device or an expansion module, the device or the expansion module will lose the certification and the Siemens warranty will lapse. Only the manufacturer is permitted to carry out repairs to the device or the expansion module. Return defective or damaged devices or expansion modules to Siemens for repair or replacement.

If the device or an expansion module is defective or damaged, proceed as follows:

1. Discharge yourself.
2. Remove the device or the expansion module.
3. Pack the device or the expansion module in a suitable manner to prevent it from being damaged during transport.
4. Return the device or the expansion module to Siemens. You can obtain the address from:
   - Your Siemens sales partner
   - Technical Support

See also

Deinstalling (Page 74)

Disassembling an expansion module (Page 75)

10.6 Disposal

The product must be disposed of in the normal recycling process in compliance with national and local regulations.

Technical data 11

11.1 Technical data

Device configuration

- 2 slots for up to 2 optional expansion modules
- 2 opto-isolated digital inputs with one shared terminal
- 2 opto-isolated digital outputs with one shared terminal
- 1 Ethernet interface, RJ45 socket for connecting to the PC or network

Measurement

Only for connection to AC voltage systems		
Measuring method		
	For voltage measurement	TRMS value measurement up to the 63rd harmonic
	for current measurement	TRMS value measurement up to the 63rd harmonic
Measured value acquisition		
	Energy	Contiguous (zero blind measuring)
	Current, voltage	Contiguous (zero blind measuring)
		Settable refresh time for values on the display: 330 to 3000 ms
	Waveform	Sinusoidal or distorted
	Frequency of the relative fundamental	50 / 60 Hz
	Measured value acquisition mode	Automatic mains frequency acquisition

Measuring inputs for voltage

Table 11- 1 Device with wide-voltage power supply

Voltage ph-n	3~ 400 V AC (+20%), max. 347 V for UL	Measuring category CAT III
Voltage ph-ph	3~ 690 V AC (+20%), max. 600 V for UL	Measuring category CAT III

Table 11- 2 Device with extra-low voltage power supply

Voltage ph-n	3~ 289 V AC (+20%)	Measuring category CAT III
Voltage ph-ph	3~ 500 V AC (+20%)	Measuring category CAT III

Table 11- 3 Values for devices with a wide-voltage power supply and devices with an extra-low voltage power supply

Min. measurable voltage	Voltage ph-n	AC 3~ 57 V – 80%
	Voltage ph-ph	AC 3~ 100 V – 80%
Impulse withstand voltage		> 9.5 kV (1.2/50 µs)
Measuring category		Acc. to IEC / UL 61010 Part 1
Input resistance (ph-n)		1.05 Mohms
Power consumption per phase		Max. 220 mW

Measuring inputs for current

Only for connection to AC power systems via external current transformers			
	Input current I_I		
		Rated current 1	AC 3~ x / 1 A
		Rated current 2	AC 3~ x / 5 A
	Measuring range[1)] for current		10% to 120% of rated current
	Measuring range[1)] for power		1 % to 120 % of rated current
	Surge withstand capability		100 A for 1 s
	Max. permissible continuous current		10 A
	Power consumption per phase		4 mVA at 1 A 115 mVA at 5 A
	Zero point suppression		0 to 10% of rated current

1) The measuring range is the range within which the accuracy data applies

Measuring accuracy

Measured variable	Accuracy class acc. to IEC 61557-12
Root-mean-square value of the voltages (ph-ph, ph-n)	0,2
Root-mean-square value of the phase-to-phase currents and the neutral currents	0,2
Apparent power	0,5
Active power	0,2
Total reactive power (VAR_{tot})	1,0
Reactive power (VAR_n)	1,0
Reactive power (VAR_1)	1,0
Cos φ	0,2 % [1)]
Power factor	2,0
Phase angle	+/-1° [1)]
Frequency	0,1
Apparent energy	0,5
Active energy	0,2
Reactive energy	2,0

THD voltage referred to the fundamental	2,0
THD current referred to the fundamental	2,0
Voltage unbalance referred to amplitude and phase	0,5
Current unbalance referred to amplitude and phase	0,5 [1)]
3rd to 31st odd harmonic of the voltage referred to the fundamental	2,0
3rd to 31st odd harmonic of the current referred to the fundamental	2,0

1) The IEC 61557-12 standard does not specify any accuracy class for these variables. The specifications refer to the maximum deviation from the actual value.

When measuring with external current or voltage transformers, the accuracy of the measurement depends crucially on the quality of the transformer.

Supply voltage

Design of the power supply.		Wide-voltage power supply AC / DC
	Rated range	95 to 240 V AC (50 / 60 Hz) or 110 to 340 V DC
Design of the power supply.		Extra-low voltage power supply DC [1)]
	Rated range	24 V, 48 V, and 60 V DC or 22 to 65 V DC
Work area		±10% of rated range
Power consumption		
	Without expansion module	Typically 11 VA AC, 5.5 W DC
	With 2 expansion modules	Max. 32 VA AC, max. 11 W DC
Overvoltage category		CAT III

1) Compliance with the specified impulse withstand voltage – 1 kV line to line and 2 kV line to ground – according to DIN EN 61000-4-5 must be ensured by means of external protective devices.

Battery

Types	BR2032 CR2032 (not rechargeable) Approved in accordance with UL1642
Nominal voltage	3 V
Nominal discharge current	0.2 mA
Minimum permissible reverse current to the battery	5 mA
Ambient temperature	The battery must be designed for at least 70°C.
Service life	5 years under the following conditions: 2 months backup time per year at 23°C, 10 months continuous operation per year at the maximum permissible ambient temperature

Retention of data and time of day in the absence of the supply voltage

The backup time after 5 years operation is approximately 2 months under the following conditions: 2 months backup time per year at 23°C, 10 months continuous operation per year at the maximum permissible ambient temperature.

Memory

The long-term memory is sufficient to save up to four measured variables and their extreme values every 15 minutes for 40 days.

Digital inputs

Number		2 inputs
Input voltage		
	Rated value	24 V DC
	Maximum input voltage	30 V DC (SELV or PELV supply)
	Permissible signal level for signal "0" detection	< 10 V DC
	Permissible signal level for signal "1" detection	> 19 V DC
Input current		
	For signal "1"	typ. 4 mA (24 V)
Max. input delay		
	Signal "0" to "1"	5 ms
	Signal "1" to "0"	5 ms
Pulse rate		
	Maximum pulse rate	20 Hz

Digital outputs

Number			2 outputs
Design/function			Switching output or pulse output
Operating voltage			12 to 24 V DC, max. 30 V DC (SELV or PELV supply)
Output current			
	With "1" signal		Depends on the load and the external power supply
		Continuous load	Max. 100 mA (thermal overload protection)
		Transient overload	max. 300 mA for a duration of 100 ms
		Resistive load	100 mA
	With "0" signal		max. 0.2 mA
Internal resistance			55 Ω
Short-circuit protection			Yes

Overvoltage category		CAT I
Pulse output function		
	Standard for pulse emitter	Signal characteristics in accordance with IEC 62053-31
	Adjustable pulse duration	30 to 500 ms
	Minimal settable time frame	10 ms
Switching function		
	Max. output delay	
	With signal "0" to "1"	5 ms
	With signal "1" to "0"	5 ms
Max. switching frequency		20 Hz

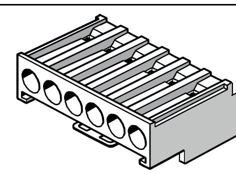
Communication

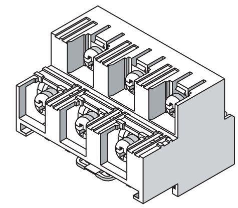
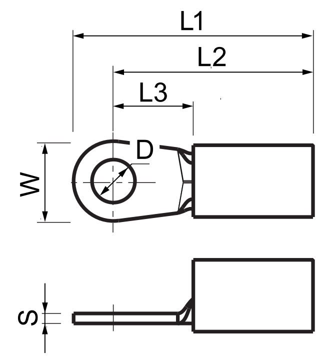
Ethernet ports		
	Number	1
	Type	RJ45 (8P8C)
	Suitable cable types	100Base-TX (CAT5) Grounding of cable required.
	Protocols supported	MODBUS TCP
	Transfer rates	10 / 100 Mbit/s, Autonegotiation and Auto-MDX (Medium Dependent Interface)
	Update time at the interface	200 ms for instantaneous values and energy counters. Sliding window demand values are updated up to 60 times during the configured averaging time, e.g. once every second if the averaging time is set to 60 seconds.
Modbus gateway		
	Function	Modbus gateway for converting Modbus TCP to Modbus RTU
	Requirements for use	SENTRON PAC RS485 expansion module
	Number of devices that can be operated	Max. 31 without repeaters Max. 247 with repeaters
	Port number	17002 if the SENTRON PAC RS485 expansion module is operated at the "MOD1" slot 17003 if the SENTRON PAC RS485 expansion module is operated at the "MOD2" slot

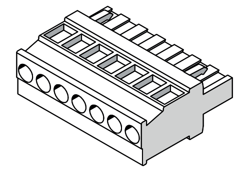
Displays and controls

Display		
	Type	Monochrome, graphics LC display
	Backlit display	White, invertible display
	Resolution	128 x 96 pixels
	Size W x H	72 mm x 54 mm
	Refresh time	0.33 ... 3 sec, adjustable
Keyboard		
	4 function keys F1 to F4 on the front	

Connection elements

Measuring inputs and supply voltage inputs				
	Screw terminals			
		Connection designations		IL1(°↑k, l↓), IL2(°↑k, l↓), IL3(°↑k, l↓) V_1, V2, V3, VN, L/+, N/- 1-wire or 2-wire connection possible
		Conductor cross-section		
			Solid	1 x 0.5 ... 4.0 mm² AWG 1 x 20 ... 12 2 x 0.5 ... 2.5 mm² AWG 2 x 20 ... 14
			Finely stranded with end sleeve	1 x 0.5 ... 2.5 mm² AWG 1 x 20 ... 14 2 x 0.5 ... 1.5 mm² AWG 2 x 20 ... 16
		Stripping length		10 mm
		Connection screws		
			Tightening torque	0.8 ... 1.2 Nm 7 ... 10.3 lbf·in
		Tools		Screwdriver PZ2 cal. ISO 6789 Crimping tool in accordance with EN 60947-1

Ring lug terminals			
Connection designations	IL1(°↑k, l↓), IL2(°↑k, l↓), IL3(°↑k, l↓) V_1, V2, V3, VN, L/+, N/-		
Dimensions of the ring lug	Dimensions	[mm]	[inch]
	D VA W L1 L2 L3	3 ... 4 0,75 ... 1,0 ≤ 8 ≤ 24 ≤ 20 ≥ 8	0.118 ... 0.157 0.029 ... 0.039 ≤ 0.314 ≤ 0.944 ≤ 0.787 ≥ 0.314
			
Connection bolt	M3 to M4	#5 ... #8	
Conductor cross-section depending on the ring lug used	1.0 to 6.0 mm²).	AWG 18 to 10	
	The national standards for ring lugs must be observed, e.g. UL listed under ZMVV /7, CSA, DIN 46237, IEC 60352-2 Please observe the information of the ring lug manufacturer as well as IEC 60352-2 with regard to the creation of suitable crimp connections. The ring lugs must be installed in parallel with each other.		
Connection screws			
Tightening torque	0.8 ... 1.2 Nm 7 ... 10.3 lbf·in		
With vertical screwing force	30 N 6.75 lbf		
Tools	Screwdriver PZ2 cal. ISO 6789 Crimping or pressing tool according to manufacturer's information for ring lugs		

Digital outputs, digital inputs				
	Screw terminal			
		Connection designations		⏚ , DIC, DI1, DI0, DOC, DO1, DO0
		Conductor cross-section		
			Solid	1 x 0.2 ... 2.5 mm² 2 x 0.2 ... 1.0 mm²
			Finely stranded without end sleeve	1 x 0.2 ... 2.5 mm² 2 x 0.2 ... 1.5 mm²
			Single-core with end sleeve, without plastic sleeve	1 x 0.25 ... 2.5 mm² 2 x 0.25 ... 1.0 mm²
			Single-core with end sleeve, with plastic sleeve	1 x 0.25 ... 2.5 mm²
			Finely-stranded with TWIN end sleeve, with plastic sleeve	2 x 0.5 ... 1.5 mm²
			AWG cables	1 x 24 ... 12
		Stripping length		7 mm
		Connection screws		
			Tightening torque	min. 0.5 Nm
		Tools		Screwdriver PZ1 cal. ISO 6789 Crimping tool in accordance with EN 60947-1
RJ45 connector				

Dimensions and weights

Type of fixing		Panel mounting to IEC 61554
Size W x H x D		96 mm x 96 mm x 82 mm
Cutout (W x H)		$92^{+0.8}$ mm x $92^{+0.8}$ mm
Overall depth		
	Without expansion module	77 mm
	With expansion modules	99 mm
Permissible switching panel thickness for installation		max. 4 mm
Mounting position		Vertical
Weight		
	Device without packaging	Approximately 450 g
	Device including packaging	Approximately 550 g

Degree of protection and safety class

Safety class			II
Degree of protection according to IEC 60529			
	Device front		IP65 Type 5 enclosure acc. to UL50
	Device rear		
		Device with screw terminal	IP20
		Device with ring lug terminal	IP10
	If higher degree of protection requirements are placed on the application engineering, the customer must take suitable measures		

Safety regulations

CE conformity
SENTRON PAC4200 complies with the requirements of the following European Directives: DIRECTIVE 2004/108/EC OF THE EUROPEAN PARLIAMENT AND COUNCIL of December 15, 2004, on the approximation of the laws of the Member States relating to electromagnetic compatibility and repealing the Directive 89/336/EEC DIRECTIVE 2006/95/EC OF THE EUROPEAN PARLIAMENT AND COUNCIL of December 12, 2006, on the harmonization of the laws of the Member States relating to electrical equipment designed for use within certain voltage limits. Conformity with these Directives is verified by compliance with the following standards: EN 55011:2007; Group 1, Class A DIN EN 61000-6-2:2006 DIN EN 61000-4-2:2001 DIN EN 61000-4-5:2007 DIN EN 61000-4-6:2001 DIN EN 61000-4-8:2001 DIN EN 61000-4-11:2005 DIN EN 61010-1:2002 DIN EN 61326-1:2006
Approvals for the USA and Canada
SENTRON PAC4200 is approved by UL, File No. E314880. FCC Class A Notice: This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

11.2 Cable

Requirements

Use a serial, shielded, 3-core interface cable:

- Two twisted cores are required for the signals -A and +B
- The third core is required for the Common signal.

The maximum length of the bus cable depends on the following:

- The baud rate
- The properties of the cable used:
  - Thickness
  - Capacitance
  - Characteristic surge impedance
- Number of stations
- The network configuration, e.g. 2-wire cable with shield

Additional information

You can find more information about the cables in the standard ANSI TIA/EIA-485-A-98 and in the "MODBUS over Serial Line Specification and Implementation Guide".

11.3 PAC RS485 expansion module - standards

Description

Table 11- 4 The device meets the following standards

Standard	Title
ANSI TIA/EIA-485-A-98 (R2003) (RS 485)	"Electrical Characteristics of Generators and Receivers for Use in Balanced Digital Multipoint Systems"

Note

Other standards

In addition to the above-mentioned standards, those listed in the manual of the SENTRON PAC Power Monitoring Device also apply.

11.4 Technical data for the PAC RS485 expansion module

Mechanical data

Table 11- 5 Mechanical data for the PAC RS485 expansion module

	Values
Device type	Slave
Dimensions of housing (height x width x depth)	63 mm x 43 mm x 22 mm
Dimensions of housing with terminal block (height x width x depth)	74 mm x 43 mm x 22 mm
Overall depth of SENTRON PAC Power Monitoring Device with mounted PAC RS485 expansion module	73 mm with a maximum plate thickness of 4 mm
Mounting position	Vertical on the SENTRON PAC Power Monitoring Device
Housing design	VDT 3400 structure 36
Tolerances	According to DIN 16901:1982-11
Weight	41 g
Connector to SENTRON PAC Power Monitoring Device	14-pin connector
Non-volatile memory	Vertical on the SENTRON PAC Power Monitoring Device
Power supply	Power supplied by SENTRON PAC
Cooling	Passive air cooling in form of ventilation slots
Class of inflameability	V-0

Electrical data

Table 11- 6 Electrical data for the PAC RS485 expansion module

	Values
ANSI TIA/EIA-485-A[1)] wiring for RS 485 interface, galvanically isolated from the device	5 V ± 5 %
Galvanic isolation between the SENTRON PAC Power Monitoring Device and the RS 485 interface	500 V
Galvanic isolation of the supply voltage	Via an isolated DC-DC converter
Maximum insulating voltage between the RS 485 bus and the SENTRON PAC	500 V
1) Formerly RS 485	

Ambient and environmental conditions

Table 11- 7 Ambient and environmental conditions

Ambient and environmental conditions	Values
Degree of protection	IP20
Permissible degree of pollution	2 in accordance with IEC 61010-1:2001
Recycling symbol	> PC / ABC <

Note

Other technical data

The other mechanical and electrical data and ambient and environmental conditions are identical to those for the SENTRON PAC Power Monitoring Device. You can find more information in the operating instructions and manual for the SENTRON PAC Power Monitoring Device.

11.5 Communications interface of the PAC RS485 expansion module

Technical data

Table 11- 8 Technical data for the communication interface

	Values
Electrical interface	RS 485, twisted-pair cable + 1 cable for Common
Connection type	Terminal block with screw terminals
RS 485 data transfer: supported baud rates in bps	4800 /9600 / 19200 / 38400 / 57600 / 115200 Standard: 19200 The following is supported in conjunction with the SENTRON PAC3200: max. 38,400 bps
Supported address range	1 to 247 [1]
Supported communication protocols[2]	• MODBUS RTU • SEAbus
Bus cycle	The bus cycle depends on: 1. The number of nodes 2. The data volume 3. The baud rate
Supported modes	• Unicast • Broadcast
Stations	Max. 32 including master
Integral bus terminator	120 Ohms resistance

	Values
Integral line polarization	• 560-Ohm pull-up resistor for 5 V voltage3) • 560-Ohm pull-down resistor3)

1) Each device on the bus must have a unique address.
2) The communication protocols supported depend on the SENTRON PAC in each case.
3) If necessary, you can switch on line polarization.

Table 11- 9 Connection types with associated conductor cross-sections

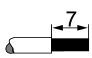
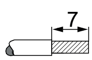
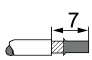
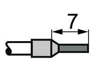
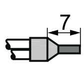
Connection type		Conductor cross-sections
	Solid	1 x 0.2 ... 2.5 mm² 2 x 0.2 ... 1 mm²
	Finely-stranded	1 x 0.2 ... 2.5 mm² 2 x 0.2 ... 1.5 mm²
	Finely-stranded with end sleeve, without plastic sleeve	1 x 0.25 ... 2.5 mm² 2 x 0.25 ... 1 mm²
	Finely-stranded with end sleeve, with plastic sleeve	1 x 0.25 ... 2.5 mm²
-	AWG / kcmil	24 ... 12
	Finely-stranded with TWIN end sleeve, with plastic sleeve	2 x 0.5 ... 1.5 mm²

Table 11- 10 Technical data of the terminal block

	Values
H1L screws	M3x4.9

11.6 Technical data of the SENTRON PAC 4DI/2DO expansion module

Mechanical data

Table 11- 11 Mechanical data of the SENTRON PAC 4DI/2DO expansion module

	Values
Dimensions of housing (height x width x depth)	63 mm x 43 mm x 22 mm
Dimensions of housing with terminal block (height x width x depth)	70.3 mm x 43 mm x 22 mm
Mounting position	Vertical on the SENTRON PAC Power Monitoring Device
Housing design	VDT 3400 structure 36
Tolerances	According to DIN 16901:1982-11
Weight	38 g
Connector to SENTRON PAC Power Monitoring Device	14-pin connector
Power supply	Power supplied by SENTRON PACxxxx
Cooling	Passive air cooling in form of ventilation slots
Flammability class	V-0

Electrical data

Table 11- 12 Electrical data of the SENTRON PAC 4DI/2DO expansion module

	Values
Electrical isolation between the SENTRON PAC and the 4DI/2DO interface	500 V
Insulating voltage	Max. 500 V
Galvanic isolation of the supply voltage	

1) Formerly RS 485

Digital inputs

Table 11- 13 Technical data of the digital inputs

		Values
Number		4
Type		Internal power supply (typically 12 V DC)
External operating voltage		0 ... 30 V DC (optional)
Input resistance	"1" signal detection	≤ 1 kΩ
	"0" signal detection	≥ 100 kΩ

		Values
Input current	"1" signal detection	≥ 2.5 mA
	"0" signal detection	≤ 0.5 mA
Maximum switching rate		20 Hz

Digital outputs

Table 11- 14 Technical data of the digital outputs

			Values
Number			2
Type			Bidirectional
Design/function			Switching output or pulse output in accordance with IEC 62053-31 Class B
Rated voltage			0 ... 30 V DC, typical 24 V DC (SELV or PELV supply)
Output current	For signal "1"		Depends on the load and the external power supply
		Continuous load	≤ 50 mA (= thermal overload protection)
		Transient overload	≤ 130 mA for 100 ms
	For signal "0"		≤ 0,2 mA
Internal resistance			Typically 55 Ω
Maximum switching rate			20 Hz
Short-circuit protection			Yes

11.7 Labeling

Labels on the housing of the SENTRON PAC4200

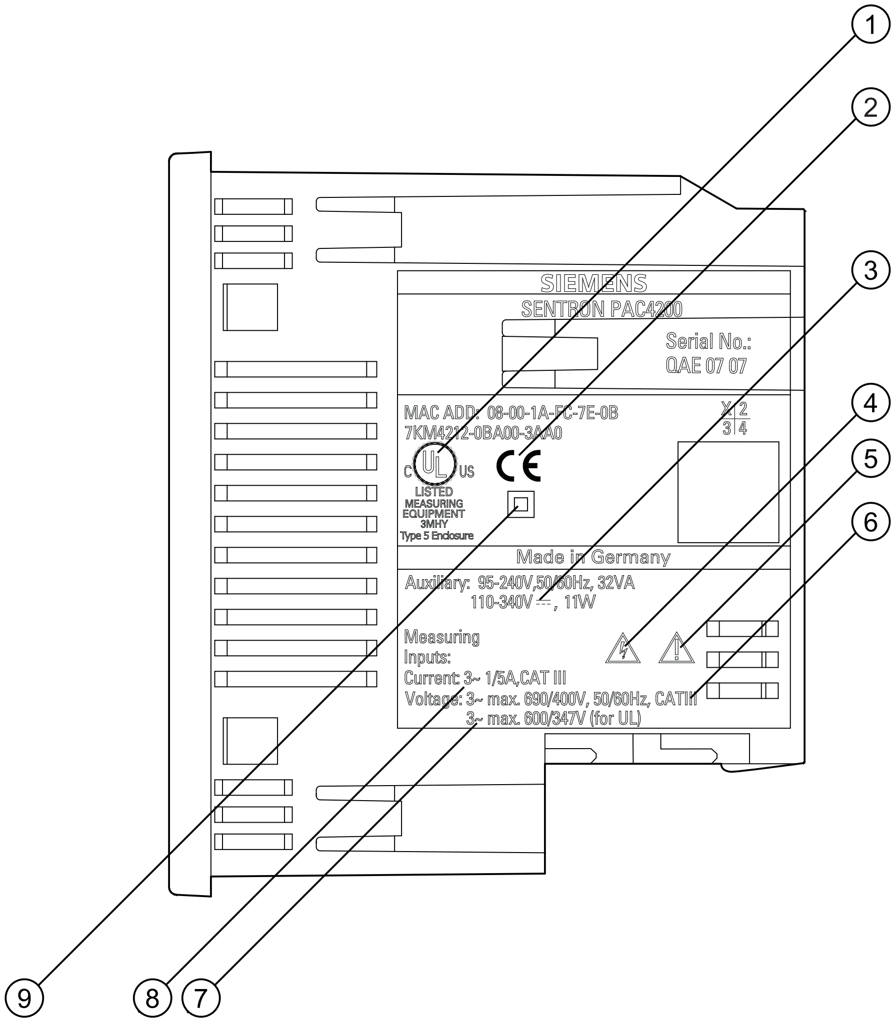
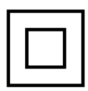


Figure 11-1 Device labeling

	Symbol, label	Explanation
(1)	c UL us	Products with this mark comply with both the Canadian (CSA) and the American (UL) requirements.
(2)	CE	CE mark. Confirmation of conformity of the product with the applicable EU directives and compliance with the essential requirements contained in these directives.
(3)	⎓	DC current.

	Symbol, label	Explanation
(4)		Danger of electric shock.
(5)		General Warning Symbol
(6)	CAT III	Measuring category CAT III for current and voltage inputs.
(7)	~	AC current.
(8)	3~	Three-phase AC.
(9)		Protective insulation, device with protection class II.

11.8 Labeling on the PAC RS485 expansion module

Description

The graphic below shows the positioning of the label on the housing of the PAC RS485 expansion module.

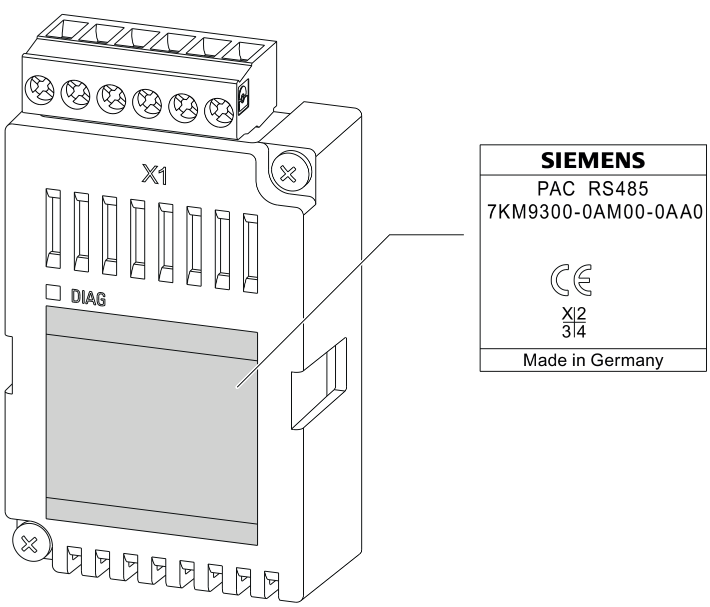


Figure 11-2 PAC RS485 expansion module with type plate

(1) Type plate

11.9 Labeling on the SENTRON PAC 4DI/2DO expansion module

Description

The graphic below shows the positioning of the label on the housing of the SENTRON PAC 4DI/2DO expansion module.

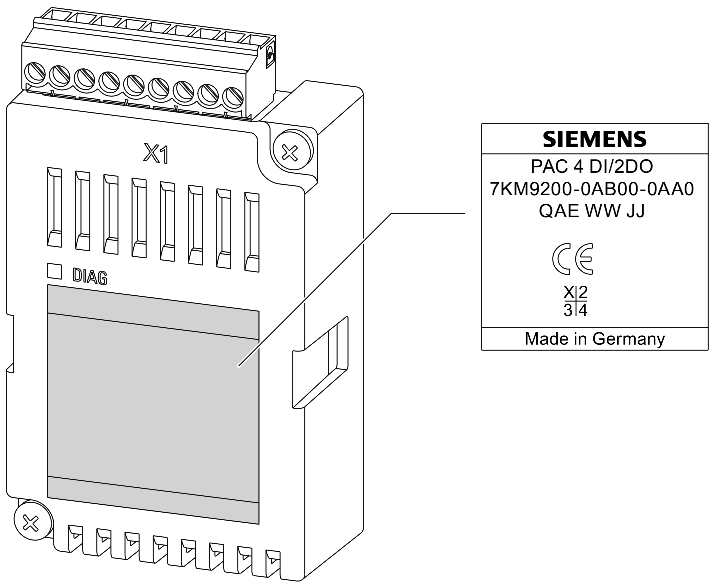


Figure 11-3 SENTRON PAC 4DI/2DO expansion module with type plate

Dimension drawings 12

Note: All dimensions in mm.

Panel cutout

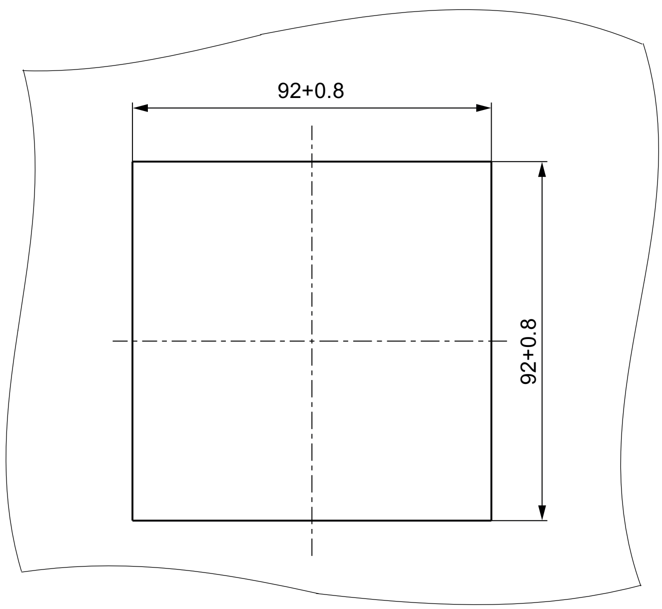


Figure 12-1 Panel cutout

Frame dimensions

Device with screw terminals

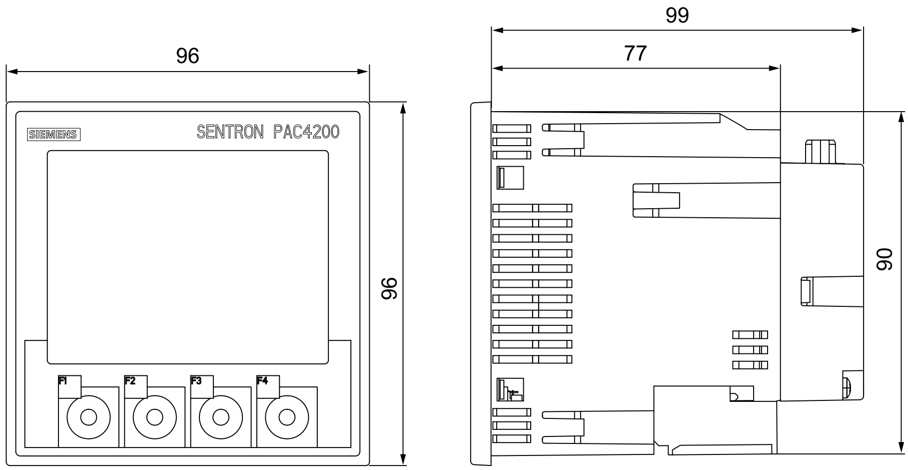


Figure 12-2 Frame dimensions with optional PAC PROFIBUS DP expansion module connected, device with screw terminals

Device with ring lug terminals

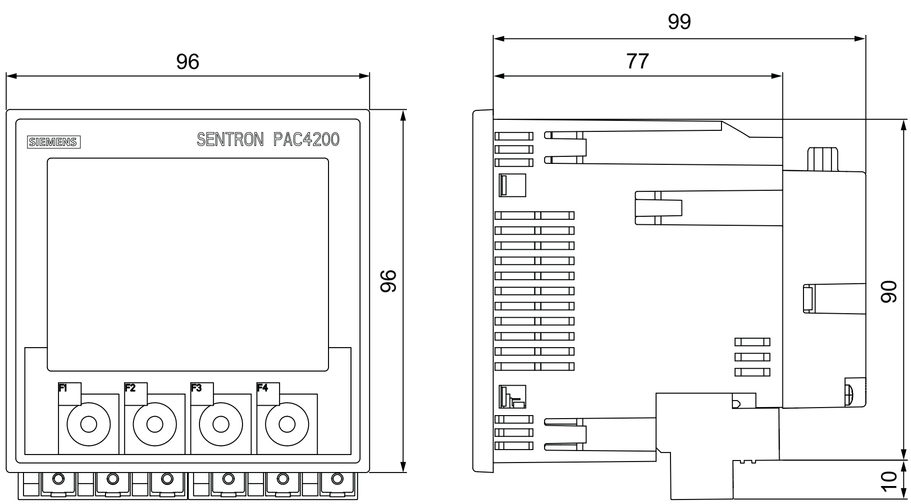


Figure 12-3 Frame dimensions with optional PAC PROFIBUS DP expansion module connected, device with ring lug terminals

Clearance measurements

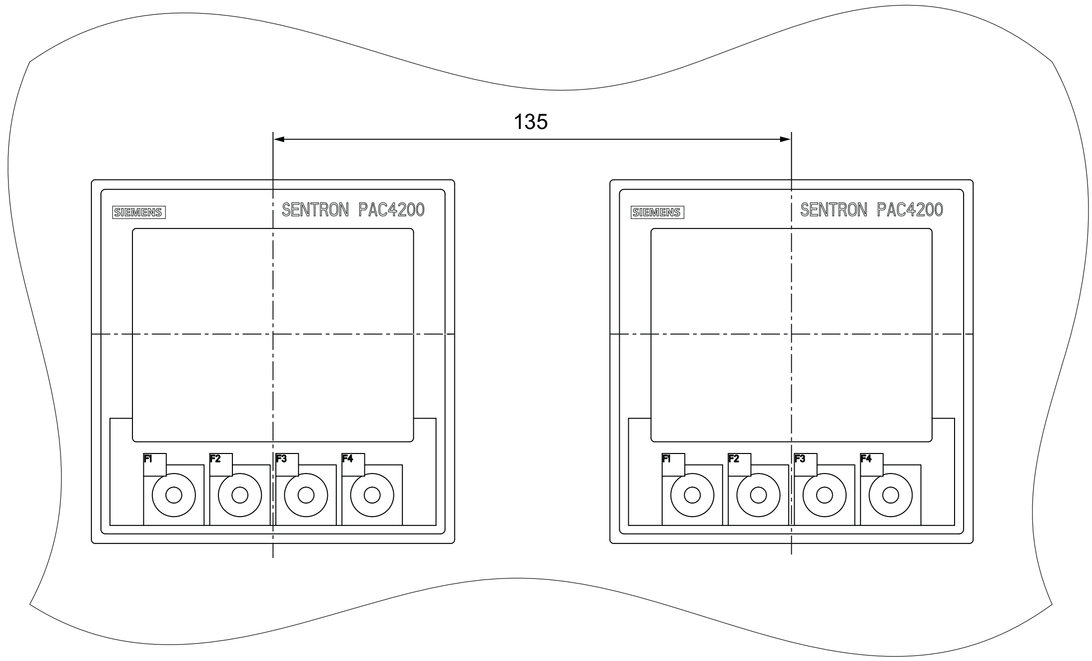


Figure 12-4 Side-by-side installation

Clearances

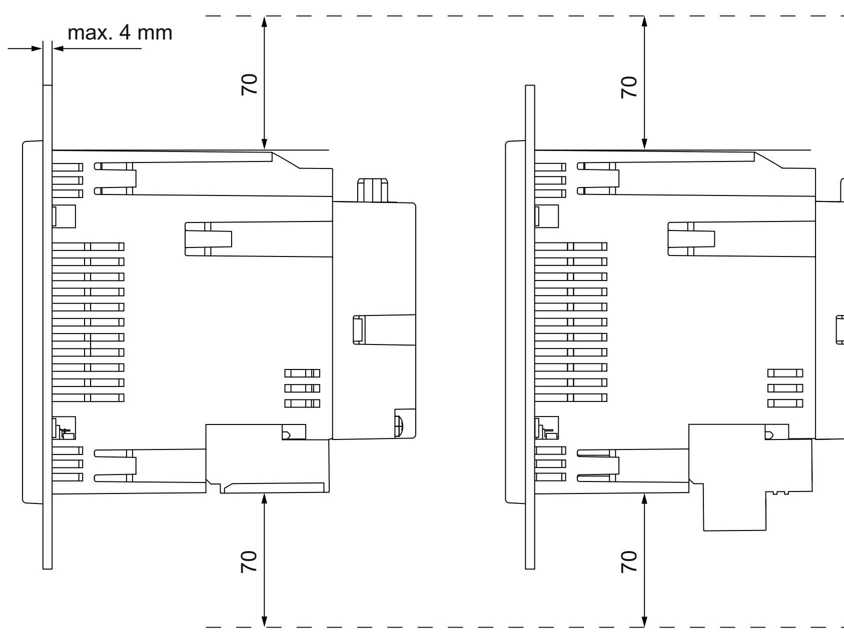


Figure 12-5 Clearances, device with screw terminal (on the left), device with ring lug terminal (on the right)

The clearances specified must be maintained for cable outlets and ventilation.

12.1 Dimension drawings of the PAC RS485 expansion module

PAC RS485 expansion module

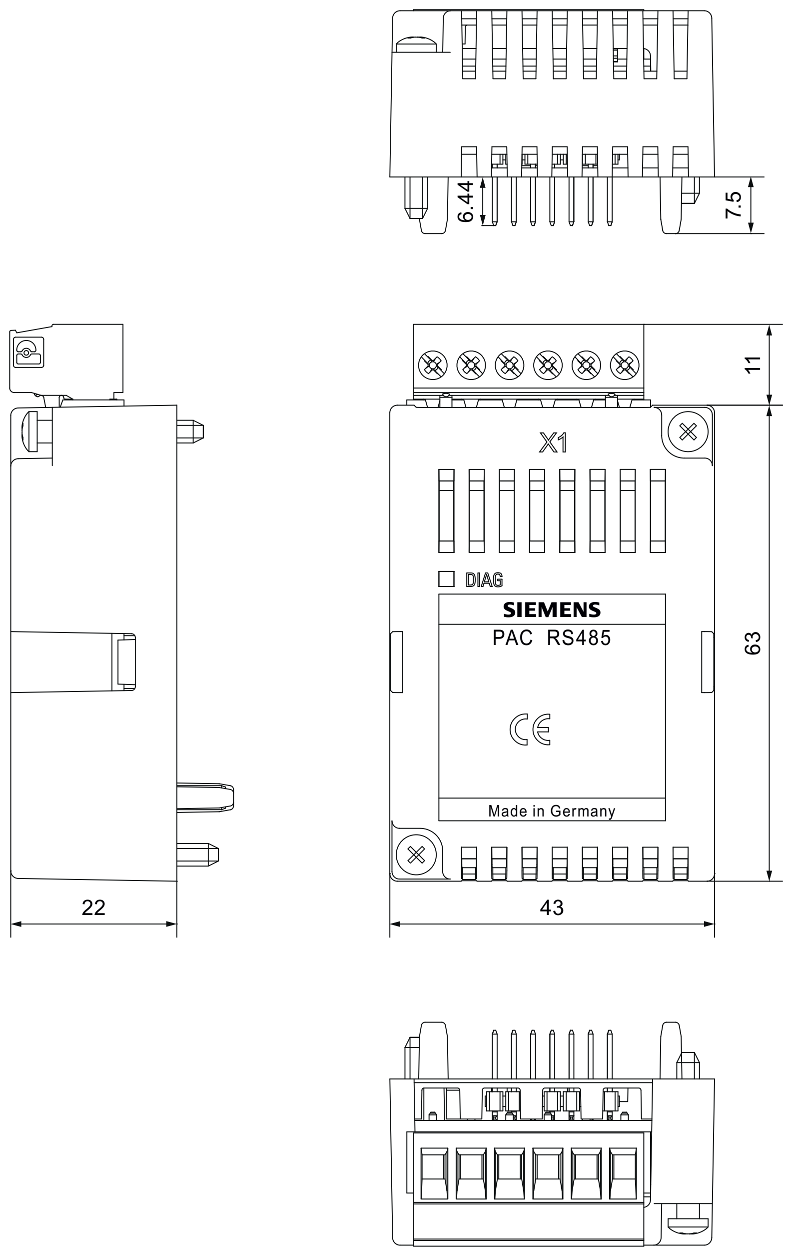


Figure 12-6 View from above with the dimensions of the plug connector between the PAC RS485 expansion module and the SENTRON PAC, side view, front view and view from below with terminal block

All dimensions are specified in mm.

12.2 Dimension drawings of the SENTRON PAC 4DI/2DO expansion module

SENTRON PAC 4DI/2DO expansion module

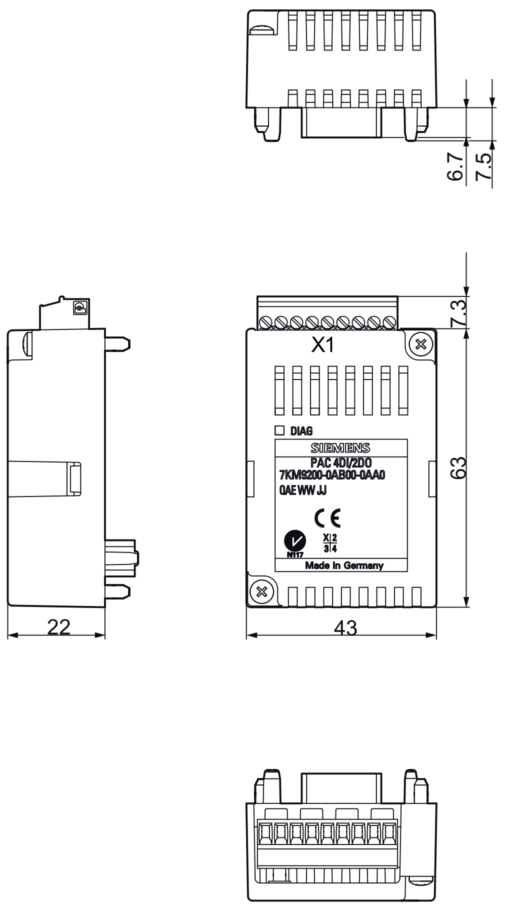


Figure 12-7 View from above with the dimensions of the plug connector between the SENTRON PAC 4DI/2DO expansion module and the SENTRON PAC, side view, front view and view from below with terminal block

All dimensions are specified in mm.

Appendix A

A.1 Measured variables

Measured variables of the SENTRON PAC Power Monitoring Device

Availability via the communication interfaces

SENTRON PAC4200 provides the measured variables listed below via the communication interfaces.

Information on the display

SENTRON PAC4200 shows most, though not all, measured variables on the display. The "Display" column in the tables below shows the number of the screen on which the measured variable is displayed. All measured variables that are not displayed are identified by a hyphen ("-").

Short codes for monitored measured variables

The "LIM SOURCE" column in the tables below lists the measured variables for which limit monitoring is possible. It contains the short codes that are used in the "SOURCE" field of the "ADVANCED " > "LIMITS" > "LIM (0 to 11)" display.

Instantaneous values with maximum and minimum values

Name		Abbrev. DE + IEC	Abbrev. EN + ANSI	Unit	Dis-play	LIM SOURCE
Voltage a-n		U_{L1-N}	V_{a-n}	V	1.0	V a
	Instantaneous value of the voltage between phase conductor a and the neutral conductor					
Maximum voltage a-n		$U_{L1-N\ max}$	$V_{a-n\ max}$	V	1.1	
	Maximum value of the voltage between phase conductor a and the neutral conductor					
Minimum voltage a-n		$U_{L1-N\ min}$	$V_{a-n\ min}$	V	1.2	
	Minimum value of the voltage between phase conductor a and the neutral conductor					
Voltage b-n		U_{L2-N}	V_{b-n}	V	1.0	V b
	Instantaneous value of the voltage between phase conductor b and the neutral conductor					
Maximum voltage b-n		$U_{L2-N\ max}$	$V_{b-n\ max}$	V	1.1	
	Maximum value of the voltage between phase conductor b and the neutral conductor					
Minimum voltage b-n		$U_{L2-N\ min}$	$V_{b-n\ min}$	V	1.2	
	Minimum value of the voltage between phase conductor b and the neutral conductor					
Voltage c-n		U_{L3-N}	V_{c-n}	V	1.0	V c
	Instantaneous value of the voltage between phase conductor c and the neutral conductor					
Maximum voltage c-n		$U_{L3-N\ max}$	$V_{c-n\ max}$	V	1.1	
	Maximum value of the voltage between phase conductor c and the neutral conductor					

Name	Abbrev. DE + IEC	Abbrev. EN + ANSI	Unit	Dis-play	LIM SOURCE
Minimum voltage c-n	$U_{L3\text{-}N\ min}$	$V_{c\text{-}n\ min}$	V	1.2	
Minimum value of the voltage between phase conductor c and the neutral conductor					
Voltage a-b	$U_{L1\text{-}L2}$	$V_{a\text{-}b}$	V	2.0	V ab
Instantaneous value of the voltage between phase conductors a and b					
Maximum voltage a-b	$U_{L1\text{-}L2\ max}$	$V_{a\text{-}b\ max}$	V	2.1	
Maximum value of the voltage between phase conductors a and b					
Minimum voltage a-b	$U_{L1\text{-}L2\ min}$	$V_{a\text{-}b\ min}$	V	2.2	
Minimum value of the voltage between phase conductors a and b					
Voltage b-c	$U_{L2\text{-}L3}$	$V_{b\text{-}c}$	V	2.0	V bc
Instantaneous value of the voltage between phase conductors b and c					
Maximum voltage b-c	$U_{L2\text{-}L3\ max}$	$V_{b\text{-}c\ max}$	V	2.1	
Maximum value of the voltage between phase conductors b and c					
Minimum voltage b-c	$U_{L2\text{-}L3\ min}$	$V_{b\text{-}c\ min}$	V	2.2	
Minimum value of the voltage between phase conductors b and c					
Voltage c-a	$U_{L3\text{-}L1}$	$V_{c\text{-}a}$	V	2.0	V ca
Instantaneous value of the voltage between phase conductors c and a					
Maximum voltage c-a	$U_{L3\text{-}L1\ max}$	$V_{c\text{-}a\ max}$	V	2.1	
Maximum value of the voltage between phase conductors c and a					
Minimum voltage c-a	$U_{L3\text{-}L1\ min}$	$V_{c\text{-}a\ min}$	V	2.2	
Minimum value of the voltage between phase conductors c and a					
Current a	I_{L1}	I_a	A	3.0	I a
Current in phase conductor a					
Maximum current a	$I_{L1\ max}$	$I_{a\ max}$	A	3.1	
Maximum value of the current in phase conductor a					
Minimum current a	$I_{L1\ min}$	$I_{a\ min}$	A	3.2	
Minimum value of the current in phase conductor a					
Current b	I_{L2}	I_b	A	3.0	I b
Current in phase conductor b					
Maximum current b	$I_{L2\ max}$	$I_{b\ max}$	A	3.1	
Maximum value of the current in phase conductor b					
Minimum current b	$I_{L2\ min}$	$I_{b\ min}$	A	3.2	
Minimum value of the current in phase conductor b					
Current c	I_{L3}	I_c	A	3.0	I c
Current in phase conductor c					
Maximum current c	$I_{L3\ max}$	$I_{c\ max}$	A	3.1	
Maximum value of the current in phase conductor c					
Minimum current c	$I_{L3\ min}$	$I_{c\ min}$	A	3.2	
Minimum value of the current in phase conductor c					
Neutral Current	I_N	I_n	A	3.0	I n
Current in the neutral conductor					

Name		Abbrev. DE + IEC	Abbrev. EN + ANSI	Unit	Dis-play	LIM SOURCE
Maximum neutral current		$I_{N\ max}$	$I_{n\ max}$	A	3.1	
	Maximum value of the current in the neutral conductor					
Minimum neutral current		$I_{N\ min}$	$I_{n\ min}$	A	3.2	
	Minimum value of the current in the neutral conductor					
Apparent Power a		VA_{L1}	VA_a	VA	4.0	VA a
	Apparent power in phase conductor a					
Maximum apparent power a		$S_{L1\ max}$	$VA_{a\ max}$	VA	4.1	
	Maximum value of the apparent power in phase conductor a					
Minimum apparent power a		$S_{L1\ min}$	$VA_{a\ min}$	VA	4.2	
	Minimum value of the apparent power in phase conductor a					
Apparent power b		VA_{L2}	VA_b	VA	4.0	VA b
	Apparent power in phase conductor b					
Maximum apparent power b		$S_{L2\ max}$	$VA_{b\ max}$	VA	4.1	
	Maximum value of the apparent power in phase conductor b					
Minimum apparent power b		$S_{L2\ min}$	$VA_{b\ min}$	VA	4.2	
	Minimum value of the apparent power in phase conductor b					
Apparent power c		VA_{L3}	VA_c	VA	4.0	VA c
	Apparent power in phase conductor c					
Maximum apparent power c		$S_{L3\ max}$	$VA_{c\ max}$	VA	4.1	
	Maximum value of the apparent power in phase conductor c					
Minimum apparent power c		$S_{L3\ min}$	$VA_{c\ min}$	VA	4.2	
	Minimum value of the apparent power in phase conductor c					
Active Power a		P_{L1}	W_a	W	5.0	W a
	Active power in phase conductor a as import (+) or export (-)					
Maximum active power a		$P_{L1\ max}$	$W_{a\ max}$	W	5.1	
	Maximum value of the active power in phase conductor a					
Minimum active power a		$P_{L1\ min}$	$W_{a\ min}$	W	5.2	
	Minimum value of the active power in phase conductor a					
Active power b		P_{L2}	W_b	W	5.0	W b
	Active power in phase conductor b as import (+) or export (-)					
Maximum active power b		$P_{L2\ max}$	$W_{b\ max}$	W	5.1	
	Maximum value of the active power in phase conductor b					
Minimum active power b		$P_{L2\ min}$	$W_{b\ min}$	W	5.2	
	Minimum value of the active power in phase conductor b					
Active power c		P_{L3}	W_c	W	5.0	W c
	Active power in phase conductor c as import (+) or export (-)					
Maximum active power c		$P_{L3\ max}$	$W_{c\ max}$	W	5.1	
	Maximum value of the active power in phase conductor c					
Minimum active power c		$P_{L3\ min}$	$W_{c\ min}$	W	5.2	
	Minimum value of the active power in phase conductor c					

Name	Abbrev. DE + IEC	Abbrev. EN + ANSI	Unit	Dis-play	LIM SOURCE
Total Reactive Power a (VARtot)	$Q_{tot\ L1}$	$VAR_{tot\ a}$	VAR	6.0	VARtot a
Total reactive power in phase conductor a referred to the load counting system, fundamental, and harmonics					
Maximum total reactive power a (VARtot)	$Q_{tot\ L1\ max}$	$VAR_{tot\ a\ max}$	VAR	6.1	
Maximum value of the total reactive power in phase conductor a referred to the load counting system, fundamental, and harmonics					
Minimum total reactive power a (VARtot)	$Q_{tot\ L1\ min}$	$VAR_{tot\ a\ min}$	VAR	6.2	
Minimum value of the total reactive power in phase conductor a referred to the load counting system, fundamental, and harmonics					
Total reactive power b (VARtot)	$Q_{tot\ L2}$	$VAR_{tot\ b}$	VAR	6.0	VARtot b
Total reactive power in phase conductor b referred to the load counting system, fundamental, and harmonics					
Maximum total reactive power b (VARtot)	$Q_{tot\ L2\ max}$	$VAR_{tot\ b\ max}$	VAR	6.1	
Maximum value of the total reactive power in phase conductor b referred to the load counting system, fundamental, and harmonics					
Minimum total reactive power b (VARtot)	$Q_{tot\ L2\ min}$	$VAR_{tot\ b\ min}$	VAR	6.2	
Minimum value of the total reactive power in phase conductor b referred to the load counting system, fundamental, and harmonics					
Total reactive power c (VARtot)	$Q_{tot\ L3}$	$VAR_{tot\ c}$	VAR	6.0	VARtot c
Total reactive power in phase conductor c referred to the load counting system, fundamental, and harmonics					
Maximum total reactive power c (VARtot)	$Q_{tot\ L3\ max}$	$VAR_{tot\ c\ max}$	VAR	6.1	
Maximum value of the total reactive power in phase conductor c referred to the load counting system, fundamental, and harmonics					
Minimum total reactive power c (VARtot)	$Q_{tot\ L3\ min}$	$VAR_{tot\ c\ min}$	VAR	6.2	
Minimum value of the total reactive power in phase conductor c referred to the load counting system, fundamental, and harmonics					
Reactive Power a (VARn)	$Q_{n\ L1}$	$VAR_{n\ a}$	VAR	6.0	VARn a
Reactive power of the harmonics in phase conductor a referred to the load counting system, measured according to VARn					
Maximum reactive power a (VARn)	$Q_{n\ L1\ max}$	$VAR_{n\ a\ max}$	VAR	6.1	
Maximum value of the reactive power of the harmonics in phase conductor a referred to the load counting system, measured according to VARn					
Minimum reactive power a (VARn)	$Q_{n\ L1\ min}$	$VAR_{n\ a\ min}$	VAR	6.2	
Minimum value of the reactive power of the harmonics in phase conductor a referred to the load counting system, measured according to VARn					
Reactive power b (VARn)	$Q_{n\ L2}$	$VAR_{n\ b}$	VAR	6.0	VARn b
Reactive power of the harmonics in phase conductor b referred to the load counting system, measured according to VARn					
Maximum reactive power b (VARn)	$Q_{n\ L2\ max}$	$VAR_{n\ b\ max}$	VAR	6.1	
Maximum value of the reactive power of the harmonics in phase conductor b, measured according to VARn					
Minimum reactive power b (VARn)	$Q_{n\ L2\ min}$	$VAR_{n\ b\ min}$	VAR	6.2	
Minimum value of the reactive power of the harmonics in phase conductor b referred to the load counting system, measured according to VARn					

Name		Abbrev. DE + IEC	Abbrev. EN + ANSI	Unit	Dis-play	LIM SOURCE
Reactive power c (VARn)		$Q_{n\ L3}$	$VAR_{n\ c}$	VAR	6.0	VARn c
	Reactive power of the harmonics in phase conductor c referred to the load counting system, measured according to VARn					
Maximum reactive power c (VARn)		$Q_{n\ L3\ max}$	$VAR_{n\ c\ max}$	VAR	6.1	
	Maximum value of the reactive power of the harmonics in phase conductor c, measured according to VARn					
Minimum reactive power c (VARn)		$Q_{n\ L3\ min}$	$VAR_{n\ c\ min}$	VAR	6.2	
	Minimum value of the reactive power of the harmonics in phase conductor c referred to the load counting system, measured according to VARn					
Reactive Power a (VAR1)		$Q_{1\ L1}$	$VAR_{1\ a}$	VAR	6.0	VAR1 a
	Reactive power of the fundamental in phase conductor a referred to the load counting system, measured according to VAR1					
Maximum reactive power a (VAR1)		$Q_{1\ L1\ max}$	$VAR_{1\ a\ max}$	VAR	6.1	
	Maximum reactive power of the fundamental in phase conductor a referred to the load counting system, measured according to VAR1					
Minimum reactive power a (VAR1)		$Q_{1\ L1\ min}$	$VAR_{1\ a\ min}$	VAR	6.2	
	Minimum reactive power of the fundamental in phase conductor a referred to the load counting system, measured according to VAR1					
Reactive power b (VAR1)		$Q_{1\ L2}$	$VAR_{1\ b}$	VAR	6.0	VAR1 b
	Reactive power of the fundamental in phase conductor b referred to the load counting system, measured according to VAR1					
Maximum reactive power b (VAR1)		$Q_{1\ L2\ max}$	$VAR_{1\ b\ max}$	VAR	6.1	
	Maximum reactive power of the fundamental in phase conductor b referred to the load counting system, measured according to VAR1					
Minimum reactive power b (VAR1)		$Q_{1\ L2\ min}$	$VAR_{1\ b\ min}$	VAR	6.2	
	Minimum reactive power of the fundamental in phase conductor b referred to the load counting system, measured according to VAR1					
Reactive power c (VAR1)		$Q_{1\ L3}$	$VAR_{1\ c}$	VAR	6.0	VAR1 c
	Reactive power of the fundamental in phase conductor c referred to the load counting system, measured according to VAR1					
Maximum reactive power c (VAR1)		$Q_{1\ L3\ max}$	$VAR_{1\ c\ max}$	VAR	6.1	
	Maximum reactive power of the fundamental in phase conductor c referred to the load counting system, measured according to VAR1					
Minimum reactive power c (VAR1)		$Q_{1\ L3\ min}$	$VAR_{1\ c\ min}$	VAR	6.2	
	Minimum reactive power of the fundamental in phase conductor c referred to the load counting system, measured according to VAR1					
Total Apparent Power		S	VA	VA	7.0	ΣVA
	Total apparent power in the phase conductors					
Maximum total apparent power		S_{max}	VA_{max}	VA	7.1	
	Maximum value of the total apparent power in the three-phase system					
Minimum total apparent power		S_{min}	VA_{min}	VA	7.2	
	Minimum value of the total apparent power in the three-phase system					
Total Active Power		P	W	W	7.0	ΣW
	Total active power in the phase conductors					

Name		Abbrev. DE + IEC	Abbrev. EN + ANSI	Unit	Dis-play	LIM SOURCE
Maximum total active power		P_{max}	W_{max}	W	7.1	
	Maximum value of the total active power in the three-phase system					
Minimum total active power		P_{min}	W_{min}	W	7.2	
	Minimum value of the total active power in the three-phase system					
Total Reactive Power (VARtot)		Q_{tot}	VAR_{tot}	VAR	7.0	ΣVARtot
	Root of the total squares of the reactive power of the fundamental and harmonics in the phase conductors (VARtot) referred to the load counting system					
Maximum total reactive power (VARtot)		$Q_{tot\ max}$	$VAR_{tot\ max}$	VAR	7.1	
	Maximum value of the total reactive power of the fundamental and harmonics in the three-phase system, measured according to VARtot					
Minimum total reactive power (VARtot)		$Q_{tot\ min}$	$VAR_{tot\ min}$	VAR	7.2	
	Minimum value of the total reactive power of the fundamental and harmonics in the three-phase system, measured according to VARtot					
Total Reactive Power (VAR1)		Q_1	VAR_1	VAR	7.0	ΣVAR1
	Root of the total squares of the reactive power of the fundamental in the phase conductors referred to the load counting system					
Maximum total reactive power (VAR1)		$Q_{1\ max}$	$VAR_{1\ max}$	VAR	7.1	
	Maximum value of the total reactive power of the fundamental in the phase conductors referred to the load counting system					
Minimum total reactive power (VAR1)		$Q_{1\ min}$	$VAR_{1\ min}$	VAR	7.2	
	Minimum value of the total reactive power of the fundamental in the phase conductors referred to the load counting system					
Total Reactive Power (VARn)		Q_n	VAR_n	VAR	7.0	ΣVARn
	Root of the total squares of the reactive power of the harmonics in the phase conductors referred to the load counting system					
Maximum total reactive power (VARn)		$Q_{n\ max}$	$VAR_{n\ max}$	VAR	7.1	
	Maximum value of the total reactive power of the harmonics in the three-phase system, measured according to VARn					
Minimum total reactive power (VARn)		$Q_{n\ min}$	$VAR_{n\ min}$	VAR	7.2	
	Minimum value of the total reactive power of the harmonics in the three-phase system, measured according to VARn					
Cos φ a		$Cos\varphi_{L1}$	Disp. PF_a	–	10.0	COSφ a
	Power factor of the fundamental in phase conductor a (inductive or capacitive)					
Maximum cos φ a		$Cos\varphi_{L1\ max}$	Disp. $PF_{a\ max}$	–	10.1	
	Maximum value of the power factor of the fundamental in phase conductor a (inductive or capacitive)					
Minimum cos φ a		$Cos\varphi_{L1\ min}$	Disp. $PF_{a\ min}$	–	10.2	
	Minimum value of the power factor of the fundamental in phase conductor a (inductive or capacitive)					
Cos φ b		$Cos\varphi_{L2}$	Disp. PF_b	–	10.0	COSφ b
	Power factor of the fundamental in phase conductor b (inductive or capacitive)					
Maximum cos φ b		$Cos\varphi_{L2\ max}$	Disp. $PF_{b\ max}$	–	10.1	
	Maximum value of the power factor of the fundamental in phase conductor b (inductive or capacitive)					
Minimum cos φ b		$Cos\varphi_{L2\ min}$	Disp. $PF_{b\ min}$	–	10.2	
	Minimum value of the power factor of the fundamental in phase conductor b (inductive or capacitive)					

Name		Abbrev. DE + IEC	Abbrev. EN + ANSI	Unit	Dis-play	LIM SOURCE
Cos φ c		$Cos\varphi_{L3}$	Disp. PF_c	–	10.0	COSφ c
	Power factor of the fundamental in phase conductor c (inductive or capacitive)					
Maximum cos φ c		$Cos\varphi_{L3\ max}$	Disp. $PF_{c\ max}$	–	10.1	
	Maximum value of the power factor of the fundamental in phase conductor c (inductive or capacitive)					
Minimum cos φ c		$Cos\varphi_{L3\ min}$	Disp. $PF_{c\ min}$	–	10.2	
	Minimum value of the power factor of the fundamental in phase conductor c (inductive or capacitive)					
Power Factor a		$\|PF_a\|$	$\|PF_a\|$	–	8.0	PF a
	Power factor (arithmetic) in phase a					
Maximum power factor a		$\|PF_a\|$ max	$\|PF_a\|$ max	–	8.1	
	Maximum value of the power factor (arithmetic) in phase conductor a					
Minimum power factor a		$\|PF_a\|$ min	$\|PF_a\|$ min	–	8.2	
	Minimum value of the power factor (arithmetic) in phase conductor a					
Power factor b		$\|PF_b\|$	$\|PF_b\|$	–	8.0	PF b
	Power factor (arithmetic) in phase b					
Maximum power factor b		$\|PF_b\|$ max	$\|PF_b\|$ max	–	8.1	
	Maximum value of the power factor (arithmetic) in phase conductor b					
Minimum power factor b		$\|PF_b\|$ min	$\|PF_b\|$ min	–	8.2	
	Minimum value of the power factor (arithmetic) in phase conductor b					
Power factor c		$\|PF_c\|$	$\|PF_c\|$	–	8.0	PF c
	Power factor (arithmetic) in phase c					
Maximum power factor c		$\|PF_c\|$ max	$\|PF_c\|$ max	–	8.1	
	Maximum value of the power factor (arithmetic) in phase conductor c					
Minimum power factor c		$\|PF_c\|$ min	$\|PF_c\|$ min	–	8.2	
	Minimum value of the power factor (arithmetic) in phase conductor c					
Total Power Factor		PF	PF	–	9.0	TOTAL PF
	Total power factor					
Maximum total power factor		PF_{max}	PF_{max}	–	9.1	
	Maximum total power factor					
Minimum total power factor		PF_{min}	PF_{min}	–	9.2	
	Minimum total power factor					
Line Frequency		f	f	Hz	11.0	FREQ.
	Instantaneous value of the line frequency					
Maximum line frequency		f_{max}	f_{max}	Hz	11.1	
	Maximum value of the line frequency					
Minimum line frequency		f_{min}	f_{min}	Hz	11.2	
	Minimum value of the line frequency					
Displacement Angle a		φ_{L1}	φ_a	°	14.1	φ a
	Displacement angle between voltage and current for the fundamental in phase conductor a					
Maximum displacement angle a		$\varphi_{L1\ max}$	$\varphi_{a\ max}$	°	10.4	
	Maximum displacement angle between voltage and current for the fundamental in phase conductor a					

Name		Abbrev. DE + IEC	Abbrev. EN + ANSI	Unit	Dis-play	LIM SOURCE
Minimum displacement angle a		$\varphi_{L1\ min}$	$\varphi_{a\ min}$	°	10.5	
	Minimum displacement angle between voltage and current for the fundamental in phase conductor a					
Displacement angle b		φ_{L2}	φ_{b}	°	14.1	φ b
	Displacement angle between voltage and current for the fundamental in phase conductor b					
Maximum displacement angle b		$\varphi_{L2\ max}$	$\varphi_{b\ max}$	°	10.4	
	Maximum displacement angle between voltage and current for the fundamental in phase conductor b					
Minimum displacement angle b		$\varphi_{L2\ min}$	$\varphi_{b\ min}$	°	10.5	
	Minimum displacement angle between voltage and current for the fundamental in phase conductor b					
Displacement angle c		φ_{L3}	φ_{c}	°	14.1	φ c
	Displacement angle between voltage and current for the fundamental in phase conductor c					
Maximum displacement angle c		$\varphi_{L3\ max}$	$\varphi_{c\ max}$	°	10.4	
	Maximum displacement angle between voltage and current for the fundamental in phase conductor c					
Minimum displacement angle c		$\varphi_{L3\ min}$	$\varphi_{c\ min}$	°	10.5	
	Minimum displacement angle between voltage and current for the fundamental in phase conductor c					
Phase Angle a-a		X_{L1-L1}	X_{a-a}	°	14.1	V aa
	Reference line for the angle of phases b, c					
Phase angle a-b		X_{L1-L2}	X_{a-b}	°	14.1	V ab
	Angle of the fundamental of the voltage between phase conductor a and phase conductor b					
Maximum phase angle a-b		$X_{L1-L2\ max}$	$X_{a-b\ max}$	°	–	
	Maximum angle of the fundamental of the voltage between phase conductor a and phase conductor b					
Minimum phase angle a-b		$X_{L1-L2\ min}$	$X_{a-b\ min}$	°	–	
	Minimum angle of the fundamental of the voltage between phase conductor a and phase conductor b					
Phase angle a-c		X_{L1-L3}	X_{a-c}	°	14.1	V ac
	Angle of the fundamental of the voltage between phase conductor a and phase conductor c					
Maximum phase angle a-c		$X_{L1-L3\ max}$	$X_{a-c\ max}$	°	–	
	Maximum angle of the fundamental of the voltage between phase conductor a and phase conductor c					
Minimum phase angle a-c		$X_{L1-L3\ min}$	$X_{a-c\ min}$	°	–	
	Minimum angle of the fundamental of the voltage between phase conductor a and phase conductor c					
THD Voltage a		$THD_{U\ L1}$	$THD_{V\ a}$	%	12.0	THD-V a
	Total harmonic distortion of the voltage between phase conductor a and the neutral conductor referred to the fundamental					
Maximum THD voltage a		$THD_{U\ L1\ max}$	$THD_{V\ a\ max}$	%	12.1	
	Maximum total harmonic distortion of the voltage between phase conductor a and the neutral conductor referred to the fundamental					
THD voltage b		$THD_{U\ L2}$	$THD_{V\ b}$	%	12.0	THD-V b
	Total harmonic distortion of the voltage between phase conductor b and the neutral conductor referred to the fundamental					
Maximum THD voltage b		$THD_{U\ L2\ max}$	$THD_{V\ b\ max}$	%	12.1	
	Maximum total harmonic distortion of the voltage between phase conductor b and the neutral conductor referred to the fundamental					
THD voltage c		$THD_{U\ L3}$	$THD_{V\ c}$	%	12.0	THD-V c
	Total harmonic distortion of the voltage between phase conductor c and the neutral conductor referred to the fundamental					

Name		Abbrev. DE + IEC	Abbrev. EN + ANSI	Unit	Dis-play	LIM SOURCE
Maximum THD voltage c		$THD_{U\ L3\ max}$	$THD_{V\ c\ max}$	%	12.1	
	Maximum total harmonic distortion of the voltage between phase conductor c and the neutral conductor referred to the fundamental					
THD Voltage a-b		$THD_{U\ L1-L2}$	$THD_{V\ a-b}$	%	12.2	THD-V ab
	Total harmonic distortion of the voltage between phase conductors a and b referred to the fundamental					
Maximum THD voltage a-b		$THD_{U\ L1-L2\ max}$	$THD_{V\ a-b\ max}$	%	12.3	
	Maximum THD voltage for a-b referred to the fundamental					
THD voltage b-c		$THD_{U\ L2-L3}$	$THD_{V\ b-c}$	%	12.2	THD-V bc
	Total harmonic distortion of the voltage between phase conductors b and c referred to the fundamental					
Maximum THD voltage b-c		$THD_{U\ L2-L3\ max}$	$THD_{V\ b-c\ max}$	%	12.3	
	Maximum THD voltage for b-c referred to the fundamental					
THD voltage c-a		$THD_{U\ L3-L1}$	$THD_{V\ c-a}$	%	12.2	THD-V ca
	Total harmonic distortion of the voltage between phase conductors c and a referred to the fundamental					
Maximum THD voltage c-a		$THD_{U\ L3-L1\ max}$	$THD_{V\ c-a\ max}$	%	12.3	
	Maximum THD voltage for c-a referred to the fundamental					
THD Current a		$THD_{I\ L1}$	$THD_{I\ a}$	%	13.0	THD-I a
	Total harmonic distortion of the current in phase conductor a referred to the fundamental					
Maximum THD current a		$THD_{I\ L1}$	$THD_{I\ a}$	%	13.1	
	Maximum total harmonic distortion of the current in phase conductor a referred to the fundamental					
THD current b		$THD_{I\ L2}$	$THD_{I\ b}$	%	13.0	THD-I b
	Total harmonic distortion of the current in phase conductor b referred to the fundamental					
Maximum THD current b		$THD_{I\ L2}$	$THD_{I\ b}$	%	13.1	
	Maximum total harmonic distortion of the current in phase conductor b referred to the fundamental					
THD current c		$THD_{I\ L3}$	$THD_{I\ c}$	%	13.0	THD-I c
	Total harmonic distortion of the current in phase conductor c referred to the fundamental					
Maximum THD current c		$THD_{I\ L3}$	$THD_{I\ c}$	%	13.1	
	Maximum total harmonic distortion of the current in phase conductor c referred to the fundamental					
Apparent Energy Tariff 1		$E_{ap\ T1}$	VAh	VAh	18.0	
	Apparent energy at tariff 1					
Apparent energy tariff 2		$E_{ap\ T2}$	VAh	VAh	18.0	
	Apparent energy at tariff 2					
Active Energy Import Tariff 1		$E_{a\ T1\ imp}$	$Wh_{T1\ imp}$	Wh	19.0	
	Active energy imported at tariff 1					
Active Energy Import Tariff 2		$E_{a\ T2\ imp}$	$Wh_{T2\ imp}$	Wh	19.0	
	Active energy imported at tariff 2					
Active Energy Export Tariff 1		$E_{a\ T1\ exp}$	$Wh_{T1\ exp}$	Wh	19.1	
	Active energy exported at tariff 1					
Active Energy Export Tariff 2		$E_{a\ T2\ exp}$	$Wh_{T2\ exp}$	Wh	19.1	
	Active energy exported at tariff 2					

Name	Abbrev. DE + IEC	Abbrev. EN + ANSI	Unit	Dis-play	LIM SOURCE
Reactive Energy Import Tariff 1	$E_{r\ T1\ imp}$	VARh	VARh	20.0	
Reactive energy imported at tariff 1					
Reactive Energy Import Tariff 2	$E_{r\ T2\ imp}$	VARh	VARh	20.0	
Reactive energy imported at tariff 2					
Reactive Energy Export Tariff 1	$E_{r\ T1\ exp}$	VARh	VARh	20.1	
Reactive energy exported at tariff 1					
Reactive Energy Export Tariff 2	$E_{r\ T2\ exp}$	VARh	VARh	20.1	
Reactive energy exported at tariff 2					
Amplitude Unbalance Voltage	U_{nba}	Unbal V_{ampl}	%	–	Unbal V
Unbalance calculated from the voltage amplitudes					
Amplitude Unbalance Current	I_{nba}	Unbal I_{ampl}	%	–	Unbal I
Unbalance calculated from the current amplitudes					
Unbalance Voltage	U_{nb}	Unbal V	%	23.0	Unbal V
Unbalance calculated from the magnitude of the current amplitudes and three-phase angles					
Unbalance Current	I_{nb}	Unbal I	%	23.0	Unbal I
Unbalance calculated from the magnitude of the voltage amplitudes and three-phase angles					
Distortion Current a	$I_{d\ L1}$	$I_{d\ a}$	A	–	I D a
Current of all harmonics in phase conductor a					
Maximum distortion current a	$I_{d\ L1\ max}$	$I_{d\ a\ max}$	A	–	
Maximum current of all harmonics in phase conductor a					
Distortion current b	$I_{d\ L2}$	$I_{d\ b}$	A	–	I D b
Current of all harmonics in phase conductor b					
Maximum distortion current b	$I_{d\ L2\ max}$	$I_{d\ b\ max}$	A	–	
Maximum current of all harmonics in phase conductor b					
Distortion current c	$I_{d\ L3}$	$I_{d\ c}$	A	–	I D c
Current of all harmonics in phase conductor c					
Maximum distortion current c	$I_{d\ L3\ max}$	$I_{d\ c\ max}$	A	–	
Maximum current of all harmonics in phase conductor c					
Universal counter 1	–	–	–	33.3	
User-configurable counter for counting events or energy					
Universal counter 2	–	–	–	33.3	
User-configurable counter for counting events or energy					
Operating Hours Counter	–	–	s (h)	22.0	
Operating time of the energy counter in seconds (hours on the display)					
Date / Time	–	–	–	32.5	
Current date and time in SENTRON PAC					
Active Tariff	–	–	–	-	
Currently effective tariff for energy counting					
Process operating hours counter	–	–	s (h)	-	PROCESS HRS.
Operating time of the process energy counter in seconds (hours on the display)					

Name		Abbrev. DE + IEC	Abbrev. EN + ANSI	Unit	Dis-play	LIM SOURCE
Process apparent energy		–	–	VAh	18.1	
	Imported process apparent energy					
Process apparent energy – previous measurement		–	–	VAh	-	
	Imported process apparent energy – previous measurement					
Process active energy import		–	–	Wh	19.2	
	Imported process active energy					
Process active energy import – previous measurement		–	–	Wh	-	
	Imported process active energy – previous measurement					
Process reactive energy import		–	–	VARh	20.2	
	Imported process reactive energy					
Process reactive energy import – previous measurement		–	–	VARh	-	
	Imported process reactive energy – previous measurement					

Harmonic content of the harmonics

Name		Abbrev. DE + IEC	Abbrev. EN + ANSI	Unit	Dis-play	LIM SOURCE
Harmonics Voltage a-n						
Fundamental voltage a-n		$h_{1\ L1}$	$h_{1\ a}$	V	–	H1 V a
	Instantaneous value of the fundamental of the voltage between phase conductor a and the neutral conductor					
3rd harmonic voltage a-n		$h_{3\ L1-N}$	$h_{3\ a-n}$	%	15	H3 V a
5th harmonic voltage a-n		$h_{5\ L1-N}$	$h_{5\ a-n}$	%	15	H5 V a
7th harmonic voltage a-n		$h_{7\ L1-N}$	$h_{7\ a-n}$	%	15	H7 V a
9th harmonic voltage a-n		$h_{9\ L1-N}$	$h_{9\ a-n}$	%	15	H9 V a
11th harmonic voltage a-n		$h_{11\ L1-N}$	$h_{11\ a-n}$	%	15	H11 V a
13th harmonic voltage a-n		$h_{13\ L1-N}$	$h_{13\ a-n}$	%	15	H13 V a
15th harmonic voltage a-n		$h_{15\ L1-N}$	$h_{15\ a-n}$	%	15	H15 V a
17th harmonic voltage a-n		$h_{17\ L1-N}$	$h_{17\ a-n}$	%	15	H17 V a
19th harmonic voltage a-n		$h_{19\ L1-N}$	$h_{19\ a-n}$	%	15.2	H19 V a
21st harmonic voltage a-n		$h_{21\ L1-N}$	$h_{21\ a-n}$	%	15.2	H21 V a
23rd harmonic voltage a-n		$h_{23\ L1-N}$	$h_{23\ a-n}$	%	15.2	H23 V a
25th harmonic voltage a-n		h_{25L1-N}	$h_{25\ a-n}$	%	15.2	H25 V a
27th harmonic voltage a-n		$h_{27\ L1-N}$	$h_{27\ a-n}$	%	15.2	H27 V a
29th harmonic voltage a-n		$h_{29\ L1-N}$	$h_{29\ a-n}$	%	15.2	H29 V a
31st harmonic voltage a-n		$h_{31\ L1-N}$	$h_{31\ a-n}$	%	15.2	H31 V a
	Harmonic content of the 3rd, 5th, 7th, … 31st harmonics for the voltage between a and the neutral conductor referred to the fundamental					
Maximum Harmonics Voltage a-n						
Maximum 3rd harmonic voltage a-n		$h_{3\ L1-N\ max}$	$h_{3\ a-n\ max}$	%	15.1	

Name		Abbrev. DE + IEC	Abbrev. EN + ANSI	Unit	Dis-play	LIM SOURCE
Maximum 5th harmonic voltage a-n		$h_{5\ L1\text{-}N\ max}$	$h_{5\ a\text{-}n\ max}$	%	15.1	
Maximum 7th harmonic voltage a-n		$h_{7\ L1\text{-}N\ max}$	$h_{7\ a\text{-}n\ max}$	%	15.1	
Maximum 9th harmonic voltage a-n		$h_{9\ L1\text{-}N\ max}$	$h_{9\ a\text{-}n\ max}$	%	15.1	
Maximum 11th harmonic voltage a-n		$h_{11\ L1\text{-}N\ max}$	$h_{11\ a\text{-}n\ max}$	%	15.1	
Maximum 13th harmonic voltage a-n		$h_{13\ L1\text{-}N\ max}$	$h_{13\ a\text{-}n\ max}$	%	15.1	
Maximum 15th harmonic voltage a-n		$h_{15\ L1\text{-}N\ max}$	$h_{15\ a\text{-}n\ max}$	%	15.1	
Maximum 17th harmonic voltage a-n		$h_{17\ L1\text{-}N\ max}$	$h_{17\ a\text{-}n\ max}$	%	15.1	
Maximum 19th harmonic voltage a-n		$h_{19\ L1\text{-}N\ max}$	$h_{19\ a\text{-}n\ max}$	%	15.2	
Maximum 21st harmonic voltage a-n		$h_{21\ L1\text{-}N\ max}$	$h_{21\ a\text{-}n\ max}$	%	15.2	
Maximum 23rd harmonic voltage a-n		$h_{23\ L1\text{-}N\ max}$	$h_{23\ a\text{-}n\ max}$	%	15.2	
Maximum 25th harmonic voltage a-n		$h_{25\ L1\text{-}N\ max}$	$h_{25\ a\text{-}n\ max}$	%	15.2	
Maximum 27th harmonic voltage a-n		$h_{27\ L1\text{-}N\ max}$	$h_{27\ a\text{-}n\ max}$	%	15.2	
Maximum 29th harmonic voltage a-n		$h_{29\ L1\text{-}N\ max}$	$h_{29\ a\text{-}n\ max}$	%	15.2	
Maximum 31st harmonic voltage a-n		$h_{31\ L1\text{-}N\ max}$	$h_{31\ a\text{-}n\ max}$	%	15.2	
	Maximum value of the harmonic content of the 3rd, 5th, 7th, … 31st harmonics for the voltage between a and the neutral conductor referred to the fundamental					
Harmonics Voltage b-n						
Fundamental voltage b-n		$h_{1\ L2}$	$h_{1\ b}$	V	–	H1 V b
	Instantaneous value of the fundamental of the voltage between phase conductor b and the neutral conductor					
3rd harmonic voltage b-n		$h_{3\ L2\text{-}N}$	$h_{3\ b\text{-}n}$	%	15	H3 V b
5th harmonic voltage b-n		$h_{5\ L2\text{-}N}$	$h_{5\ b\text{-}n}$	%	15	H5 V b
7th harmonic voltage b-n		$h_{7\ L2\text{-}N}$	$h_{7\ b\text{-}n}$	%	15	H7 V b
9th harmonic voltage b-n		$h_{9\ L2\text{-}N}$	$h_{9\ b\text{-}n}$	%	15	H9 V b
11th harmonic voltage b-n		$h_{11\ L2\text{-}N}$	$h_{11\ b\text{-}n}$	%	15	H11 V b
13th harmonic voltage b-n		$h_{13\ L2\text{-}N}$	$h_{13\ b\text{-}n}$	%	15	H13 V b
15th harmonic voltage b-n		$h_{15\ L2\text{-}N}$	$h_{15\ b\text{-}n}$	%	15	H15 V b
17th harmonic voltage b-n		$h_{17\ L2\text{-}N}$	$h_{17\ b\text{-}n}$	%	15	H17 V b
19th harmonic voltage b-n		$h_{19\ L2\text{-}N}$	$h_{19\ b\text{-}n}$	%	15.2	H19 V b
21st harmonic voltage b-n		$h_{21\ L2\text{-}N}$	$h_{21\ b\text{-}n}$	%	15.2	H21 V b
23rd harmonic voltage b-n		$h_{23\ L2\text{-}N}$	$h_{23\ b\text{-}n}$	%	15.2	H23 V b
25th harmonic voltage b-n		$h_{25\ L2\text{-}N}$	$h_{25\ b\text{-}n}$	%	15.2	H25 V b
27th harmonic voltage b-n		$h_{27\ L2\text{-}N}$	$h_{27\ b\text{-}n}$	%	15.2	H27 V b
29th harmonic voltage b-n		$h_{29\ L2\text{-}N}$	$h_{29\ b\text{-}n}$	%	15.2	H29 V b
31st harmonic voltage b-n		$h_{31\ L2\text{-}N}$	$h_{31\ b\text{-}n}$	%	15.2	H31 V b
	Harmonic content of the 3rd, 5th, 7th, … 31st harmonics for the voltage between b and the neutral conductor referred to the fundamental					
Maximum Harmonics Voltage b-n						
Maximum 3rd harmonic voltage b-n		$h_{3\ L2\text{-}N\ max}$	$h_{3\ b\text{-}n\ max}$	%	15.1	
Maximum 5th harmonic voltage b-n		$h_{5\ L2\text{-}N\ max}$	$h_{5\ b\text{-}n\ max}$	%	15.1	
Maximum 7th harmonic voltage b-n		$h_{7\ L2\text{-}N\ max}$	$h_{7\ b\text{-}n\ max}$	%	15.1	
Maximum 9th harmonic voltage b-n		$h_{9\ L2\text{-}N\ max}$	$h_{9\ b\text{-}n\ max}$	%	15.1	

Name		Abbrev. DE + IEC	Abbrev. EN + ANSI	Unit	Dis-play	LIM SOURCE
Maximum 11th harmonic voltage b-n		$h_{11\ L2\text{-}N\ max}$	$h_{11\ b\text{-}n\ max}$	%	15.1	
Maximum 13th harmonic voltage b-n		$h_{13\ L2\text{-}N\ max}$	$h_{13\ b\text{-}n\ max}$	%	15.1	
Maximum 15th harmonic voltage b-n		$h_{15\ L2\text{-}N\ max}$	$h_{15\ b\text{-}n\ max}$	%	15.1	
Maximum 17th harmonic voltage b-n		$h_{17\ L2\text{-}N\ max}$	$h_{17\ b\text{-}n\ max}$	%	15.1	
Maximum 19th harmonic voltage b-n		$h_{19\ L2\text{-}N\ max}$	$h_{19\ b\text{-}n\ max}$	%	15.2	
Maximum 21st harmonic voltage b-n		$h_{21\ L2\text{-}N\ max}$	$h_{21\ b\text{-}n\ max}$	%	15.2	
Maximum 23rd harmonic voltage b-n		$h_{23\ L2\text{-}N\ max}$	$h_{23\ b\text{-}n\ max}$	%	15.2	
Maximum 25th harmonic voltage b-n		$h_{25\ L2\text{-}N\ max}$	$h_{25\ b\text{-}n\ max}$	%	15.2	
Maximum 27th harmonic voltage b-n		$h_{27\ L2\text{-}N\ max}$	$h_{27\ b\text{-}n\ max}$	%	15.2	
Maximum 29th harmonic voltage b-n		$h_{29\ L2\text{-}N\ max}$	$h_{29\ b\text{-}n\ max}$	%	15.2	
Maximum 31st harmonic voltage b-n		$h_{31\ L2\text{-}N\ max}$	$h_{31\ b\text{-}n\ max}$	%	15.2	
	Maximum value of the harmonic content of the 3rd, 5th, 7th, … 31st harmonics for the voltage between b and the neutral conductor referred to the fundamental					
Harmonics Voltage c-n						
Fundamental voltage c-n		$h_{1\ L2}$	$h_{1\ c}$	V	–	H1 V c
	Instantaneous value of the fundamental of the voltage between phase conductor c and the neutral conductor					
3rd harmonic voltage c-n		$h_{3\ L3\text{-}N}$	$h_{3\ c\text{-}n}$	%	15	H3 V c
5th harmonic voltage c-n		$h_{5\ L3\text{-}N}$	$h_{5\ c\text{-}n}$	%	15	H5 V c
7th harmonic voltage c-n		$h_{7\ L3\text{-}N}$	$h_{7\ c\text{-}n}$	%	15	H7 V c
9th harmonic voltage c-n		$h_{9\ L3\text{-}N}$	$h_{9\ c\text{-}n}$	%	15	H9 V c
11th harmonic voltage c-n		$h_{11\ L3\text{-}N}$	$h_{11\ c\text{-}n}$	%	15	H11 V c
13th harmonic voltage c-n		$h_{13\ L3\text{-}N}$	$h_{13\ c\text{-}n}$	%	15	H13 V c
15th harmonic voltage c-n		$h_{15\ L3\text{-}N}$	$h_{15\ c\text{-}n}$	%	15	H15 V c
17th harmonic voltage c-n		$h_{17\ L3\text{-}N}$	$h_{17\ c\text{-}n}$	%	15	H17 V c
19th harmonic voltage c-n		$h_{19\ L3\text{-}N}$	$h_{19\ c\text{-}n}$	%	15.2	H19 V c
21st harmonic voltage c-n		$h_{21\ L3\text{-}N}$	$h_{21\ c\text{-}n}$	%	15.2	H21 V c
23rd harmonic voltage c-n		$h_{23\ L3\text{-}N}$	$h_{23\ c\text{-}n}$	%	15.2	H23 V c
25th harmonic voltage c-n		$h_{25\ L3\text{-}N}$	$h_{25\ c\text{-}n}$	%	15.2	H25 V c
27th harmonic voltage c-n		$h_{27\ L3\text{-}N}$	$h_{27\ c\text{-}n}$	%	15.2	H27 V c
29th harmonic voltage c-n		$h_{29\ L3\text{-}N}$	$h_{29\ c\text{-}n}$	%	15.2	H29 V c
31st harmonic voltage c-n		$h_{31\ L3\text{-}N}$	$h_{31\ c\text{-}n}$	%	15.2	H31 V c
	Harmonic content of the 3rd, 5th, 7th, … 31st harmonics for the voltage between c and the neutral conductor referred to the fundamental					
Maximum Harmonics Voltage c-n						
Maximum 3rd harmonic voltage c-n		$h_{3\ L3\text{-}N\ max}$	$h_{3\ c\text{-}n\ max}$	%	15.1	
Maximum 5th harmonic voltage c-n		$h_{5\ L3\text{-}N\ max}$	$h_{5\ c\text{-}n\ max}$	%	15.1	
Maximum 7th harmonic voltage c-n		$h_{7\ L3\text{-}N\ max}$	$h_{7\ c\text{-}n\ max}$	%	15.1	
Maximum 9th harmonic voltage c-n		$h_{9\ L3\text{-}N\ max}$	$h_{9\ c\text{-}n\ max}$	%	15.1	
Maximum 11th harmonic voltage c-n		$h_{11\ L3\text{-}N\ max}$	$h_{11\ c\text{-}n\ max}$	%	15.1	
Maximum 13th harmonic voltage c-n		$h_{13\ L3\text{-}N\ max}$	$h_{13\ c\text{-}n\ max}$	%	15.1	
Maximum 15th harmonic voltage c-n		$h_{15\ L3\text{-}N\ max}$	$h_{15\ c\text{-}n\ max}$	%	15.1	

Name		Abbrev. DE + IEC	Abbrev. EN + ANSI	Unit	Dis-play	LIM SOURCE
Maximum 17th harmonic voltage c-n		$h_{17\ L3\text{-}N\ max}$	$h_{17\ c\text{-}n\ max}$	%	15.1	
Maximum 19th harmonic voltage c-n		$h_{19\ L3\text{-}N\ max}$	$h_{19\ c\text{-}n\ max}$	%	15.2	
Maximum 21st harmonic voltage c-n		$h_{21\ L3\text{-}N\ max}$	$h_{21\ c\text{-}n\ max}$	%	15.2	
Maximum 23rd harmonic voltage c-n		$h_{23\ L3\text{-}N\ max}$	$h_{23\ c\text{-}n\ max}$	%	15.2	
Maximum 25th harmonic voltage c-n		$h_{25\ L3\text{-}N\ max}$	$h_{25\ c\text{-}n\ max}$	%	15.2	
Maximum 27th harmonic voltage c-n		$h_{27\ L3\text{-}N\ max}$	$h_{27\ c\text{-}n\ max}$	%	15.2	
Maximum 29th harmonic voltage c-n		$h_{29\ L3\text{-}N\ max}$	$h_{29\ c\text{-}n\ max}$	%	15.2	
Maximum 31st harmonic voltage c-n		$h_{31\ L3\text{-}N\ max}$	$h_{31\ c\text{-}n\ max}$	%	15.2	
	Maximum value of the harmonic content of the 3rd, 5th, 7th, … 31st harmonics for the voltage between c and the neutral conductor referred to the fundamental					
Harmonics Voltage a-b						
Fundamental voltage a-b		$h_{1\ L1\text{-}L2}$	$V_{1\ a\text{-}b}$	V	–	H1 V ab
	Instantaneous value of the fundamental of the voltage between phase conductors a and b					
3rd harmonic voltage a-b		$h_{3\ L1\text{-}L2}$	$h_{3\ a\text{-}b}$	%	16	H3 V ab
5th harmonic voltage a-b		$h_{5\ L1\text{-}L2}$	$h_{5\ a\text{-}b}$	%	16	H5 V ab
7th harmonic voltage a-b		$h_{7\ L1\text{-}L2}$	$h_{7\ a\text{-}b}$	%	16	H7 V ab
9th harmonic voltage a-b		$h_{9\ L1\text{-}L2}$	$h_{9\ a\text{-}b}$	%	16	H9 V ab
11th harmonic voltage a-b		$h_{11\ L1\text{-}L2}$	$h_{11\ a\text{-}b}$	%	16	H11 V ab
13th harmonic voltage a-b		$h_{13\ L1\text{-}L2}$	$h_{13\ a\text{-}b}$	%	16	H13 V ab
15th harmonic voltage a-b		$h_{15\ L1\text{-}L2}$	$h_{15\ a\text{-}b}$	%	16	H15 V ab
17th harmonic voltage a-b		$h_{17\ L1\text{-}L2}$	$h_{17\ a\text{-}b}$	%	16	H17 V ab
19th harmonic voltage a-b		$h_{19\ L1\text{-}L2}$	$h_{19\ a\text{-}b}$	%	16.2	H19 V ab
21st harmonic voltage a-b		$h_{21\ L1\text{-}L2}$	$h_{21\ a\text{-}b}$	%	16.2	H21 V ab
23rd harmonic voltage a-b		$h_{23\ L1\text{-}L2}$	$h_{23\ a\text{-}b}$	%	16.2	H23 V ab
25th harmonic voltage a-b		$h_{25L1\text{-}L2}$	$h_{25\ a\text{-}b}$	%	16.2	H25 V ab
27th harmonic voltage a-b		$h_{27\ L1\text{-}L2}$	$h_{27\ a\text{-}b}$	%	16.2	H27 V ab
29th harmonic voltage a-b		$h_{29\ L1\text{-}L2}$	$h_{29\ a\text{-}b}$	%	16.2	H29 V ab
31st harmonic voltage a-b		$h_{31\ L1\text{-}L2}$	$h_{31\ a\text{-}b}$	%	16.2	H31 V ab
	Harmonic content of the 3rd, 5th, 7th, … 31st harmonics for the voltage between a and b referred to the fundamental					
Maximum Harmonics Voltage a-b						
Maximum 3rd harmonic voltage a-b		$h_{3\ L1\text{-}L2\ max}$	$h_{3\ a\text{-}b\ max}$	%	16.1	
Maximum 5th harmonic voltage a-b		$h_{5\ L1\text{-}L2\ max}$	$h_{5\ a\text{-}b\ max}$	%	16.1	
Maximum 7th harmonic voltage a-b		$h_{7\ L1\text{-}L2\ max}$	$h_{7\ a\text{-}b\ max}$	%	16.1	
Maximum 9th harmonic voltage a-b		$h_{9\ L1\text{-}L2\ max}$	$h_{9\ a\text{-}b\ max}$	%	16.1	
Maximum 11th harmonic voltage a-b		$h_{11\ L1\text{-}L2\ max}$	$h_{11\ a\text{-}b\ max}$	%	16.1	
Maximum 13th harmonic voltage a-b		$h_{13\ L1\text{-}L2\ max}$	$h_{13\ a\text{-}b\ max}$	%	16.1	
Maximum 15th harmonic voltage a-b		$h_{15\ L1\text{-}L2\ max}$	$h_{15\ a\text{-}b\ max}$	%	16.1	
Maximum 17th harmonic voltage a-b		$h_{17\ L1\text{-}L2\ max}$	$h_{17\ a\text{-}b\ max}$	%	16.1	
Maximum 19th harmonic voltage a-b		$h_{19\ L1\text{-}L2\ max}$	$h_{19\ a\text{-}b\ max}$	%	16.2	
Maximum 21st harmonic voltage a-b		$h_{21\ L1\text{-}L2\ max}$	$h_{21\ a\text{-}b\ max}$	%	16.2	
Maximum 23rd harmonic voltage a-b		$h_{23\ L1\text{-}L2\ max}$	$h_{23\ a\text{-}b\ max}$	%	16.2	

Name		Abbrev. DE + IEC	Abbrev. EN + ANSI	Unit	Dis-play	LIM SOURCE
Maximum 25th harmonic voltage a-b		$h_{25\ L1\text{-}L2\ max}$	$h_{25\ a\text{-}b\ max}$	%	16.2	
Maximum 27th harmonic voltage a-b		$h_{27\ L1\text{-}L2\ max}$	$h_{27\ a\text{-}b\ max}$	%	16.2	
Maximum 29th harmonic voltage a-b		$h_{29\ L1\text{-}L2\ max}$	$h_{29\ a\text{-}b\ max}$	%	16.2	
Maximum 31st harmonic voltage a-b		$h_{31\ L1\text{-}L2\ max}$	$h_{31\ a\text{-}b\ max}$	%	16.2	
	Maximum value of the harmonic content of the 3rd, 5th, 7th, … 31st harmonics for the voltage between a and b referred to the fundamental					
Harmonics Voltage b-c						
Fundamental voltage b-c		$h_{1\ L2\text{-}L3}$	$V_{1\ a\text{-}b}$	V	–	H1 V bc
	Instantaneous value of the fundamental of the voltage between phase conductors b and c					
3rd harmonic voltage b-c		$h_{3\ L2\text{-}L3}$	$h_{3\ b\text{-}c}$	%	16	H3 V bc
5th harmonic voltage b-c		$h_{5\ L2\text{-}L3}$	$h_{5\ b\text{-}c}$	%	16	H5 V bc
7th harmonic voltage b-c		$h_{7\ L2\text{-}L3}$	$h_{7\ b\text{-}c}$	%	16	H7 V bc
9th harmonic voltage b-c		$h_{9\ L2\text{-}L3}$	$h_{9\ b\text{-}c}$	%	16	H9 V bc
11th harmonic voltage b-c		$h_{11\ L2\text{-}L3}$	$h_{11\ b\text{-}c}$	%	16	H11 V bc
13th harmonic voltage b-c		$h_{13\ L2\text{-}L3}$	$h_{13\ b\text{-}c}$	%	16	H13 V bc
15th harmonic voltage b-c		$h_{15\ L2\text{-}L3}$	$h_{15\ b\text{-}c}$	%	16	H15 V bc
17th harmonic voltage b-c		$h_{17\ L2\text{-}L3}$	$h_{17\ b\text{-}c}$	%	16	H17 V bc
19th harmonic voltage b-c		$h_{19\ L2\text{-}L3}$	$h_{19\ b\text{-}c}$	%	16.2	H19 V bc
21st harmonic voltage b-c		$h_{21\ L2\text{-}L3}$	$h_{21\ b\text{-}c}$	%	16.2	H21 V bc
23rd harmonic voltage b-c		$h_{23\ L2\text{-}L3}$	$h_{23\ b\text{-}c}$	%	16.2	H23 V bc
25th harmonic voltage b-c		$h_{25L2\text{-}L3}$	$h_{25\ b\text{-}c}$	%	16.2	H25 V bc
27th harmonic voltage b-c		$h_{27\ L2\text{-}L3}$	$h_{27\ b\text{-}c}$	%	16.2	H27 V bc
29th harmonic voltage b-c		$h_{29\ L2\text{-}L3}$	$h_{29\ b\text{-}c}$	%	16.2	H29 V bc
31st harmonic voltage b-c		$h_{31\ L2\text{-}L3}$	$h_{31\ b\text{-}c}$	%	16.2	H31 V bc
	Harmonic content of the 3rd, 5th, 7th, … 31st harmonics for the voltage between b and c referred to the fundamental					
Maximum Harmonics Voltage b-c						
Maximum 3rd harmonic voltage b-c		$h_{3\ L2\text{-}L3\ max}$	$h_{3\ b\text{-}c\ max}$	%	16.1	
Maximum 5th harmonic voltage b-c		$h_{5\ L2\text{-}L3\ max}$	$h_{5\ b\text{-}c\ max}$	%	16.1	
Maximum 7th harmonic voltage b-c		$h_{7\ L2\text{-}L3\ max}$	$h_{7\ b\text{-}c\ max}$	%	16.1	
Maximum 9th harmonic voltage b-c		$h_{9\ L2\text{-}L3\ max}$	$h_{9\ b\text{-}c\ max}$	%	16.1	
Maximum 11th harmonic voltage b-c		$h_{11\ L2\text{-}L3\ max}$	$h_{11\ b\text{-}c\ max}$	%	16.1	
Maximum 13 harmonic voltage b-c		$h_{13\ L2\text{-}L3\ max}$	$h_{13\ b\text{-}c\ max}$	%	16.1	
Maximum 15th harmonic voltage b-c		$h_{15\ L2\text{-}L3\ max}$	$h_{15\ b\text{-}c\ max}$	%	16.1	
Maximum 17th harmonic voltage b-c		$h_{17\ L2\text{-}L3\ max}$	$h_{17\ b\text{-}c\ max}$	%	16.1	
Maximum 19th harmonic voltage b-c		$h_{19\ L2\text{-}L3\ max}$	$h_{19\ b\text{-}c\ max}$	%	16.2	
Maximum 21st harmonic voltage b-c		$h_{21\ L2\text{-}L3\ max}$	$h_{21\ b\text{-}c\ max}$	%	16.2	
Maximum 23rd harmonic voltage b-c		$h_{23\ L2\text{-}L3\ max}$	$h_{23\ b\text{-}c\ max}$	%	16.2	
Maximum 25th harmonic voltage b-c		$h_{25\ L2\text{-}L3\ max}$	$h_{25\ b\text{-}c\ max}$	%	16.2	
Maximum 27th harmonic voltage b-c		$h_{27\ L2\text{-}L3\ max}$	$h_{27\ b\text{-}c\ max}$	%	16.2	
Maximum 29th harmonic voltage b-c		$h_{29\ L2\text{-}L3\ max}$	$h_{29\ b\text{-}c\ max}$	%	16.2	

Name		Abbrev. DE + IEC	Abbrev. EN + ANSI	Unit	Dis-play	LIM SOURCE
Maximum 31st harmonic voltage b-c		$h_{31\ L2\text{-}L3\ max}$	$h_{31\ b\text{-}c\ max}$	%	16.2	
	Maximum value of the harmonic content of the 3rd, 5th, 7th, … 31st harmonics for the voltage between b and c referred to the fundamental					
Harmonics Voltage c-a						
Fundamental voltage c-a		$h_{1\ L3\text{-}L1}$	$V_{1\ c\text{-}a}$	V	–	H1 V ca
	Instantaneous value of the fundamental of the voltage between phase conductors c and a					
3rd harmonic voltage c-a		$h_{3\ L3\text{-}L1}$	$h_{3\ c\text{-}a}$	%	16	H3 V ca
5th harmonic voltage c-a		$h_{5\ L3\text{-}L1}$	$h_{5\ c\text{-}a}$	%	16	H5 V ca
7th harmonic voltage c-a		$h_{7\ L3\text{-}L1}$	$h_{7\ c\text{-}a}$	%	16	H7 V ca
9th harmonic voltage c-a		$h_{9\ L3\text{-}L1}$	$h_{9\ c\text{-}a}$	%	16	H9 V ca
11th harmonic voltage c-a		$h_{11\ L3\text{-}L1}$	$h_{11\ c\text{-}a}$	%	16	H11 V ca
13th harmonic voltage c-a		$h_{13\ L3\text{-}L1}$	$h_{13\ c\text{-}a}$	%	16	H13 V ca
15th harmonic voltage c-a		$h_{15\ L3\text{-}L1}$	$h_{15\ c\text{-}a}$	%	16	H15 V ca
17th harmonic voltage c-a		$h_{17\ L3\text{-}L1}$	$h_{17\ c\text{-}a}$	%	16	H17 V ca
19th harmonic voltage c-a		$h_{19\ L3\text{-}L1}$	$h_{19\ c\text{-}a}$	%	16.2	H19 V ca
21st harmonic voltage c-a		$h_{21\ L3\text{-}L1}$	$h_{21\ c\text{-}a}$	%	16.2	H21 V ca
23rd harmonic voltage c-a		$h_{23\ L3\text{-}L1}$	$h_{23\ c\text{-}a}$	%	16.2	H23 V ca
25th harmonic voltage c-a		$h_{25L3\text{-}L1}$	$h_{25\ c\text{-}a}$	%	16.2	H25 V ca
27th harmonic voltage c-a		$h_{27\ L3\text{-}L1}$	$h_{27\ c\text{-}a}$	%	16.2	H27 V ca
29th harmonic voltage c-a		$h_{29\ L3\text{-}L1}$	$h_{29\ c\text{-}a}$	%	16.2	H29 V ca
31st harmonic voltage c-a		$h_{31\ L3\text{-}L1}$	$h_{31\ c\text{-}a}$	%	16.2	H31 V ca
	Harmonic content of the 3rd, 5th, 7th, … 31st harmonics for the voltage between c and a referred to the fundamental					
Maximum Harmonics Voltage c-a						
Maximum 3rd harmonic voltage c-a		$h_{3\ L3\text{-}L1\ max}$	$h_{3\ c\text{-}a\ max}$	%	16.1	
Maximum 5th harmonic voltage c-a		$h_{5\ L3\text{-}L1\ max}$	$h_{5\ c\text{-}a\ max}$	%	16.1	
Maximum 7th harmonic voltage c-a		$h_{7\ L3\text{-}L1\ max}$	$h_{7\ c\text{-}a\ max}$	%	16.1	
Maximum 9th harmonic voltage c-a		$h_{9\ L3\text{-}L1\ max}$	$h_{9\ c\text{-}a\ max}$	%	16.1	
Maximum 11th harmonic voltage c-a		$h_{11\ L3\text{-}L1\ max}$	$h_{11\ c\text{-}a\ max}$	%	16.1	
Maximum 13th harmonic voltage c-a		$h_{13\ L3\text{-}L1\ max}$	$h_{13\ c\text{-}a\ max}$	%	16.1	
Maximum 15th harmonic voltage c-a		$h_{15\ L3\text{-}L1\ max}$	$h_{15\ c\text{-}a\ max}$	%	16.1	
Maximum 17th harmonic voltage c-a		$h_{17\ L3\text{-}L1\ max}$	$h_{17\ c\text{-}a\ max}$	%	16.1	
Maximum 19th harmonic voltage c-a		$h_{19\ L3\text{-}L1\ max}$	$h_{19\ c\text{-}a\ max}$	%	16.2	
Maximum 21st harmonic voltage c-a		$h_{21\ L3\text{-}L1\ max}$	$h_{21\ c\text{-}a\ max}$	%	16.2	
Maximum 23rd harmonic voltage c-a		$h_{23\ L3\text{-}L1\ max}$	$h_{23\ c\text{-}a\ max}$	%	16.2	
Maximum 25th harmonic voltage c-a		$h_{25\ L3\text{-}L1\ max}$	$h_{25\ c\text{-}a\ max}$	%	16.2	
Maximum 27th harmonic voltage c-a		$h_{27\ L3\text{-}L1\ max}$	$h_{27\ c\text{-}a\ max}$	%	16.2	
Maximum 29th harmonic voltage c-a		$h_{29\ L3\text{-}L1\ max}$	$h_{29\ c\text{-}a\ max}$	%	16.2	
Maximum 31st harmonic voltage c-a		$h_{31\ L3\text{-}L1\ max}$	$h_{31\ c\text{-}a\ max}$	%	16.2	
	Maximum value of the harmonic content of the 3rd, 5th, 7th, … 31st harmonics for the voltage between c and a referred to the fundamental					

Name		Abbrev. DE + IEC	Abbrev. EN + ANSI	Unit	Dis-play	LIM SOURCE
Harmonics Current a						
Fundamental current a		$I_{1\ L1}$	$I_{1\ a}$	A	17	H1 I a
	Value of the current of the fundamental in a					
3rd harmonic current a		$I_{3\ L1}$	$I_{3\ a}$	A	17	H3 I a
5th harmonic current a		$I_{5\ L1}$	$I_{5\ a}$	A	17	H5 I a
7th harmonic current a		$I_{7\ L1}$	$I_{7\ a}$	A	17	H7 I a
9th harmonic current a		$I_{9\ L1}$	$I_{9\ a}$	A	17	H9 I a
11th harmonic current a		$I_{11\ L1}$	$I_{11\ a}$	A	17	H11 I a
13th harmonic current a		$I_{13\ L1}$	$I_{13\ a}$	A	17	H13 I a
15th harmonic current a		$I_{15\ L1}$	$I_{15\ a}$	A	17	H15 I a
17th harmonic current a		$I_{17\ L1}$	$I_{17\ a}$	A	17.2	H17 I a
19th harmonic current a		$I_{19\ L1}$	$I_{19\ a}$	A	17.2	H19 I a
21st harmonic current a		$I_{21\ L1}$	$I_{21\ a}$	A	17.2	H21 I a
23rd harmonic current a		$I_{23\ L1}$	$I_{23\ a}$	A	17.2	H23 I a
25th harmonic current a		I_{25L1}	$I_{25\ a}$	A	17.2	H25 I a
27th harmonic current a		$I_{27\ L1}$	$I_{27\ a}$	A	17.2	H27 I a
29th harmonic current a		$I_{29\ L1}$	$I_{29\ a}$	A	17.2	H29 I a
31st harmonic current a		$I_{31\ L1}$	$I_{31\ a}$	A	17.2	H31 I a
	Value of the current of the 3rd, 5th 7th, … 31st harmonic in a					
Maximum Harmonics Current a						
Maximum fundamental current a		$I_{1\ L1\ max}$	$I_{1\ a\ max}$	A	17.1	
	Maximum value of the current of the fundamental in a					
Maximum 3rd harmonic current a		$I_{3\ L1\ max}$	$I_{3\ a\ max}$	A	17.1	
Maximum 5th harmonic current a		$I_{5\ L1\ max}$	$I_{5\ a\ max}$	A	17.1	
Maximum 7th harmonic current a		$I_{7\ L1\ max}$	$I_{7\ a\ max}$	A	17.1	
Maximum 9th harmonic current a		$I_{9\ L1\ max}$	$I_{9\ a\ max}$	A	17.1	
Maximum 11th harmonic current a		$I_{11\ L1\ max}$	$I_{11\ a\ max}$	A	17.1	
Maximum 13th harmonic current a		$I_{13\ L1\ max}$	$I_{13\ a\ max}$	A	17.1	
Maximum 15th harmonic current a		$I_{15\ L1\ max}$	$I_{15\ a\ max}$	A	17.1	
Maximum 17th harmonic current a		$I_{17\ L1\ max}$	$I_{17\ a\ max}$	A	17.2	
Maximum 19th harmonic current a		$I_{19\ L1\ max}$	$I_{19\ a\ max}$	A	17.2	
Maximum 21st harmonic current a		$I_{21\ L1\ max}$	$I_{21\ a\ max}$	A	17.2	
Maximum 23rd harmonic current a		$I_{23\ L1\ max}$	$I_{23\ a\ max}$	A	17.2	
Maximum 25th harmonic current a		$I_{25L1\ max}$	$I_{25\ a\ max}$	A	17.2	
Maximum 27th harmonic current a		$I_{27\ L1\ max}$	$I_{27\ a\ max}$	A	17.2	
Maximum 29th harmonic current a		$I_{29\ L1\ max}$	$I_{29\ a\ max}$	A	17.2	
Maximum 31st harmonic current a		$I_{31\ L1\ max}$	$I_{31\ a\ max}$	A	17.2	
	Maximum value of the current of the 3rd, 5th 7th, … 31st harmonic in a					
Harmonics Current b						
Fundamental current b		$I_{1\ L2}$	$I_{1\ b}$	A	17	H1 I b
	Value of the current of the fundamental in b					

Name	Abbrev. DE + IEC	Abbrev. EN + ANSI	Unit	Dis-play	LIM SOURCE
3rd harmonic current b	$I_{3\ L2}$	$I_{3\ b}$	A	17	H3 I b
5th harmonic current b	$I_{5\ L2}$	$I_{5\ b}$	A	17	H5 I b
7th harmonic current b	$I_{7\ L2}$	$I_{7\ b}$	A	17	H7 I b
9th harmonic current b	$I_{9\ L2}$	$I_{9\ b}$	A	17	H9 I b
11th harmonic current b	$I_{11\ L2}$	$I_{11\ b}$	A	17	H11 I b
13th harmonic current b	$I_{13\ L2}$	$I_{13\ b}$	A	17	H13 I b
15th harmonic current b	$I_{15\ L2}$	$I_{15\ b}$	A	17	H15 I b
17th harmonic current b	$I_{17\ L2}$	$I_{17\ b}$	A	17.2	H17 I b
19th harmonic current b	$I_{19\ L2}$	$I_{19\ b}$	A	17.2	H19 I b
21st harmonic current b	$I_{21\ L2}$	$I_{21\ b}$	A	17.2	H21 I b
23rd harmonic current b	$I_{23\ L2}$	$I_{23\ b}$	A	17.2	H23 I b
25th harmonic current b	I_{25L2}	$I_{25\ b}$	A	17.2	H25 I b
27th harmonic current b	$I_{27\ L2}$	$I_{27\ b}$	A	17.2	H27 I b
29th harmonic current b	$I_{29\ L2}$	$I_{29\ b}$	A	17.2	H29 I b
31st harmonic current b	$I_{31\ L2}$	$I_{31\ b}$	A	17.2	H31 I b
	Value of the current of the 3rd, 5th 7th, … 31st harmonic in b				
Maximum Harmonics Current b					
Maximum fundamental current b	$I_{1\ L2\ max}$	$I_{1\ b\ max}$	A	17.1	
	Maximum value of the current of the fundamental in b				
Maximum 3rd harmonic current b	$I_{3\ L2\ max}$	$I_{3\ b\ max}$	A	17.1	
Maximum 5th harmonic current b	$I_{5\ L2\ max}$	$I_{5\ b\ max}$	A	17.1	
Maximum 7th harmonic current b	$I_{7\ L2\ max}$	$I_{7\ b\ max}$	A	17.1	
Maximum 9th harmonic current b	$I_{9\ L2\ max}$	$I_{9\ b\ max}$	A	17.1	
Maximum 11th harmonic current b	$I_{11\ L2\ max}$	$I_{11\ b\ max}$	A	17.1	
Maximum 13th harmonic current b	$I_{13\ L2\ max}$	$I_{13\ b\ max}$	A	17.1	
Maximum 15th harmonic current b	$I_{15\ L2\ max}$	$I_{15\ b\ max}$	A	17.1	
Maximum 17th harmonic current b	$I_{17\ L2\ max}$	$I_{17\ b\ max}$	A	17.2	
Maximum 19th harmonic current b	$I_{19\ L2\ max}$	$I_{19\ b\ max}$	A	17.2	
Maximum 21st harmonic current b	$I_{21\ L2\ max}$	$I_{21\ b\ max}$	A	17.2	
Maximum 23rd harmonic current b	$I_{23\ L2\ max}$	$I_{23\ b\ max}$	A	17.2	
Maximum 25th harmonic current b	$I_{25L2\ max}$	$I_{25\ b\ max}$	A	17.2	
Maximum 27th harmonic current b	$I_{27\ L2\ max}$	$I_{27\ b\ max}$	A	17.2	
Maximum 29th harmonic current b	$I_{29\ L2\ max}$	$I_{29\ b\ max}$	A	17.2	
Maximum 31st harmonic current b	$I_{31\ L2\ max}$	$I_{31\ b\ max}$	A	17.2	
	Maximum value of the current of the 3rd, 5th 7th, … 31st harmonic in b				
Harmonics Current c					
Fundamental current c	$I_{1\ L3}$	$I_{1\ c}$	A	17	H1 I c
	Value of the current of the fundamental in c				
3rd harmonic current c	$I_{3\ L3}$	$I_{3\ c}$	A	17	H3 I c
5th harmonic current c	$I_{5\ L3}$	$I_{5\ c}$	A	17	H5 I c
7th harmonic current c	$I_{7\ L3}$	$I_{7\ c}$	A	17	H7 I c

Name		Abbrev. DE + IEC	Abbrev. EN + ANSI	Unit	Dis-play	LIM SOURCE
9th harmonic current c		$I_{9\ L3}$	$I_{9\ c}$	A	17	H9 I c
11th harmonic current c		$I_{11\ L3}$	$I_{11\ c}$	A	17	H11 I c
13th harmonic current c		$I_{13\ L3}$	$I_{13\ c}$	A	17	H13 I c
15th harmonic current c		$I_{15\ L3}$	$I_{15\ c}$	A	17	H15 I c
17th harmonic current c		$I_{17\ L3}$	$I_{17\ c}$	A	17.2	H17 I c
19th harmonic current c		$I_{19\ L3}$	$I_{19\ c}$	A	17.2	H19 I c
21st harmonic current c		$I_{21\ L3}$	$I_{21\ c}$	A	17.2	H21 I c
23rd harmonic current c		$I_{23\ L3}$	$I_{23\ c}$	A	17.2	H23 I c
25th harmonic current c		I_{25L3}	$I_{25\ c}$	A	17.2	H25 I c
27th harmonic current c		$I_{27\ L3}$	$I_{27\ c}$	A	17.2	H27 I c
29th harmonic current c		$I_{29\ L3}$	$I_{29\ c}$	A	17.2	H29 I c
31st harmonic current c		$I_{31\ L3}$	$I_{31\ c}$	A	17.2	H31 I c
	Value of the current of the 3rd, 5th 7th, … 31st harmonic in c					
Maximum Harmonics Current c						
Maximum fundamental current c		$I_{1\ L3\ max}$	$I_{1\ c\ max}$	A	17.1	
	Maximum value of the current of the fundamental in c					
Maximum 3rd harmonic current c		$I_{3\ L3\ max}$	$I_{3\ c\ max}$	A	17.1	
Maximum 5th harmonic current c		$I_{5\ L3\ max}$	$I_{5\ c\ max}$	A	17.1	
Maximum 7th harmonic current c		$I_{7\ L3\ max}$	$I_{7\ c\ max}$	A	17.1	
Maximum 9th harmonic current c		$I_{9\ L3\ max}$	$I_{9\ c\ max}$	A	17.1	
Maximum 11th harmonic current c		$I_{11\ L3\ max}$	$I_{11\ c\ max}$	A	17.1	
Maximum 13th harmonic current c		$I_{13\ L3\ max}$	$I_{13\ c\ max}$	A	17.1	
Maximum 15th harmonic current c		$I_{15\ L3\ max}$	$I_{15\ c\ max}$	A	17.1	
Maximum 17th harmonic current c		$I_{17\ L3\ max}$	$I_{17\ c\ max}$	A	17.2	
Maximum 19th harmonic current c		$I_{19\ L3\ max}$	$I_{19\ c\ max}$	A	17.2	
Maximum 21st harmonic current c		$I_{21\ L3\ max}$	$I_{21\ c\ max}$	A	17.2	
Maximum 23rd harmonic current c		$I_{23\ L3\ max}$	$I_{23\ c\ max}$	A	17.2	
Maximum 25th harmonic current c		$I_{25L3\ max}$	$I_{25\ c\ max}$	A	17.2	
Maximum 27th harmonic current c		$I_{27\ L3\ max}$	$I_{27\ c\ max}$	A	17.2	
Maximum 29th harmonic current c		$I_{29\ L3\ max}$	$I_{29\ c\ max}$	A	17.2	
Maximum 31st harmonic current c		$I_{31\ L3\ max}$	$I_{31\ c\ max}$	A	17.2	
	Maximum value of the current of the 3rd, 5th 7th, … 31st harmonic in c					

Average values over all phases

Name		Abbrev. DE + IEC	Abbrev. EN + ANSI	Unit	Dis-play	LIM SOURCE
3-Phase Average Voltage ph-n		$U_{L\text{-}N\ AVG}$	$V_{ph\text{-}n\ AVG}$	V	–	V PH-N DMD.
	3-phase average value of the voltage between the phase conductors and the neutral conductor					
Maximum 3-phase average voltage ph-n		$U_{L\text{-}N\ AVG\ max}$	$V_{ph\text{-}n\ AVG\ max}$	V	–	
	Maximum 3-phase average value of the voltage between the phase conductors and the neutral conductor					
Minimum 3-phase average voltage ph-n		$U_{L\text{-}N\ AVG\ min}$	$V_{ph\text{-}n\ AVG\ min}$	V	–	
	Minimum 3-phase average value of the voltage between the phase conductors and the neutral conductor					
3-Phase Average Voltage ph-ph		$U_{L\text{-}L\ AVG}$	$V_{ph\text{-}ph\ AVG}$	V	–	V PH-PH DMD.
	3-phase average value of the phase conductor voltages					
Maximum 3-phase average voltage ph-ph		$U_{L\text{-}L\ AVG\ max}$	$V_{ph\text{-}ph\ AVG\ max}$	V	–	
	Maximum 3-phase average value of the voltage between the phase conductors					
Minimum 3-phase average voltage ph-ph		$U_{L\text{-}L\ AVG\ min}$	$V_{ph\text{-}ph\ AVG\ min}$	V	–	
	Minimum 3-phase average value of the voltage between the phase conductors					
3-Phase Average Current		$I_{L\ AVG}$	$I_{ph\ AVG}$	A	–	I DMD
	3-phase average value of the current in the phase conductors					
Maximum 3-phase average current		$I_{L\ AVG\ max}$	$I_{ph\ AVG\ max}$	A	–	
	Maximum 3-phase average value of the current in the phase conductors					
Minimum 3-phase average current		$I_{L\ AVG\ min}$	$I_{ph\ AVG\ min}$	A	–	
	Minimum 3-phase average value of the current in the phase conductors					

Sliding window demand with maximum and minimum values

Name		Abbrev. DE + IEC	Abbrev. EN + ANSI	Unit	Dis-play	LIM SOURCE
Sliding Window Demand Voltage a-n		$U_{L1\text{-}N\ sw\text{-}dmd}$	$V_{a\text{-}n\ sw\text{-}dmd}$	V	1.3	Vphn DMD a
	Sliding window demand of the voltage between phase conductor a and the neutral conductor					
Maximum sliding window demand voltage a-n		$U_{L1\text{-}N\ sw\text{-}dmd\ max}$	$V_{a\text{-}n\ sw\text{-}dmd\ max}$	V	1.4	
	Maximum value of the sliding window demand of the voltage between phase conductor a and the neutral conductor					
Minimum sliding window demand voltage a-n		$U_{L1\text{-}N\ sw\text{-}dmd\ min}$	$V_{a\text{-}n\ sw\text{-}dmd\ min}$	V	1.5	
	Minimum value of the sliding window demand of the voltage between phase conductor a and the neutral conductor					
Sliding window demand voltage b-n		$U_{L2\text{-}N\ sw\text{-}dmd}$	$V_{b\text{-}n\ sw\text{-}dmd}$	V	1.3	Vphn DMD b
	Sliding window demand of the voltage between phase conductor b and the neutral conductor					
Maximum sliding window demand voltage b-n		$U_{L2\text{-}N\ sw\text{-}dmd\ max}$	$V_{b\text{-}n\ sw\text{-}dmd\ max}$	V	1.4	
	Maximum value of the sliding window demand of the voltage between phase conductor b and the neutral conductor					

Name		Abbrev. DE + IEC	Abbrev. EN + ANSI	Unit	Dis-play	LIM SOURCE
Minimum sliding window demand voltage b-n		$U_{L2-N\ sw\text{-}dmd\ min}$	$V_{b-n\ sw\text{-}dmd\ min}$	V	1.5	
	Minimum value of the sliding window demand of the voltage between phase conductor b and the neutral conductor					
Sliding window demand voltage c-n		$U_{L3-N\ sw\text{-}dmd}$	$V_{c-n\ sw\text{-}dmd}$	V	1.3	Vphn DMD c
	Sliding window demand of the voltage between phase conductor c and the neutral conductor					
Maximum sliding window demand voltage c-n		$U_{L3-N\ sw\text{-}dmd\ max}$	$V_{c-n\ sw\text{-}dmd\ max}$	V	1.4	
	Maximum value of the sliding window demand of the voltage between phase conductor c and the neutral conductor					
Minimum sliding window demand voltage c-n		$U_{L3-N\ sw\text{-}dmd\ min}$	$V_{c-n\ sw\text{-}dmd\ min}$	V	1.5	
	Minimum value of the sliding window demand of the voltage between phase conductor c and the neutral conductor					
Sliding Window Demand Voltage a-b		$U_{L1-L2\ sw\text{-}dmd}$	$V_{a-b\ sw\text{-}dmd}$	V	2.3	Vphph DMD ab
	Sliding window demand of the voltage between phase conductors a and b					
Maximum sliding window demand voltage a-b		$U_{L1-L2\ sw\text{-}dmd\ max}$	$V_{a-b\ sw\text{-}dmd\ max}$	V	2.4	
	Maximum value of the sliding window demand of the voltage between phase conductors a and b					
Minimum sliding window demand voltage a-b		$U_{L1-L2\ sw\text{-}dmd\ min}$	$V_{a-b\ sw\text{-}dmd\ min}$	V	2.5	
	Minimum value of the sliding window demand of the voltage between phase conductors a and b					
Sliding window demand voltage b-c		$U_{L2-L3\ sw\text{-}dmd}$	$V_{b-c\ sw\text{-}dmd}$	V	2.3	Vphph DMD bc
	Sliding window demand of the voltage between phase conductors b and c					
Maximum sliding window demand voltage b-c		$U_{L2-L3\ sw\text{-}dmd\ max}$	$V_{b-c\ sw\text{-}dmd\ max}$	V	2.4	
	Maximum value of the sliding window demand of the voltage between phase conductors b and c					
Minimum sliding window demand voltage b-c		$U_{L2-L3\ sw\text{-}dmd\ min}$	$V_{b-c\ sw\text{-}dmd\ min}$	V	2.5	
	Minimum value of the sliding window demand of the voltage between phase conductors b and c					
Sliding window demand voltage c-a		$U_{L3-L1\ sw\text{-}dmd}$	$V_{c-a\ sw\text{-}dmd}$	V	2.3	Vphph DMD ca
	Sliding window demand of the voltage between phase conductors c and a					
Maximum sliding window demand voltage c-a		$U_{L3-L1\ sw\text{-}dmd\ max}$	$V_{c-a\ sw\text{-}dmd\ max}$	V	2.4	
	Maximum value of the sliding window demand of the voltage between phase conductors c and a					
Minimum sliding window demand voltage c-a		$U_{L3-L1\ sw\text{-}dmd\ min}$	$V_{c-a\ sw\text{-}dmd\ min}$	V	2.5	
	Minimum value of the sliding window demand of the voltage between phase conductors c and a					
Sliding Window Demand Current a		$I_{L1\ sw\text{-}dmd}$	$I_{a\ sw\text{-}dmd}$	A	3.3	I DMD a
	Sliding window demand of the current in phase conductor a					
Maximum sliding window demand current a		$I_{L1\ sw\text{-}dmd\ max}$	$I_{a\ sw\text{-}dmd\ max}$	A	3.4	
	Maximum value of the sliding window demand of the current in phase conductor a					
Minimum sliding window demand current a		$I_{L1\ sw\text{-}dmd\ min}$	$I_{a\ sw\text{-}dmd\ min}$	A	3.5	
	Minimum value of the sliding window demand of the current in phase conductor a					
Sliding window demand current b		$I_{L2\ sw\text{-}dmd}$	$I_{b\ sw\text{-}dmd}$	A	3.3	I DMD b
	Sliding window demand of the current in phase conductor b					
Maximum sliding window demand current b		$I_{L2\ sw\text{-}dmd\ max}$	$I_{b\ sw\text{-}dmd\ max}$	A	3.4	
	Maximum value of the sliding window demand of the current in phase conductor b					

Name		Abbrev. DE + IEC	Abbrev. EN + ANSI	Unit	Dis-play	LIM SOURCE
Minimum sliding window demand current b		$I_{L2\ sw\text{-}dmd\ min}$	$I_{b\ sw\text{-}dmd\ min}$	A	3.5	
	Minimum value of the sliding window demand of the current in phase conductor b					
Sliding window demand current c		$I_{L3\ sw\text{-}dmd}$	$I_{c\ sw\text{-}dmd}$	A	3.3	I DMD c
	Sliding window demand of the current in phase conductor c					
Maximum sliding window demand current c		$I_{L3\ sw\text{-}dmd\ max}$	$I_{c\ sw\text{-}dmd\ max}$	A	3.4	
	Maximum value of the sliding window demand of the current in phase conductor c					
Minimum sliding window demand current c		$I_{L3\ sw\text{-}dmd\ min}$	$I_{c\ sw\text{-}dmd\ min}$	A	3.5	
	Minimum value of the sliding window demand of the current in phase conductor c					
Sliding Window Demand Neutral Current		$I_{N\ sw\text{-}dmd}$	$I_{n\ sw\text{-}dmd}$	A	3.3	I DMD N
	Sliding window demand of the current in the neutral conductor					
Maximum sliding window demand of the neutral current		$I_{N\ sw\text{-}dmd\ max}$	$I_{n\ sw\text{-}dmd\ max}$	A	3.4	
	Maximum value of the sliding window demand of the current in the neutral conductor					
Minimum sliding window demand of the neutral current		$I_{N\ sw\text{-}dmd\ min}$	$I_{n\ sw\text{-}dmd\ min}$	A	3.5	
	Minimum value of the sliding window demand of the current in the neutral conductor					
Sliding Window Demand Apparent Power a		$S_{L1\ sw\text{-}dmd}$	$VA_{a\ sw\text{-}dmd}$	VA	4.3	VA DMD a
	Sliding window demand of the apparent power in phase conductor a					
Maximum sliding window demand apparent power a		$S_{L1\ sw\text{-}dmd\ max}$	$VA_{a\ sw\text{-}dmd\ max}$	VA	4.4	
	Maximum value of the sliding window demand of the apparent power in phase conductor a					
Minimum sliding window demand apparent power a		$S_{L1\ sw\text{-}dmd\ min}$	$VA_{a\ sw\text{-}dmd\ min}$	VA	4.5	
	Minimum value of the sliding window demand of the apparent power in phase conductor a					
Sliding window demand apparent power b		$S_{L2\ sw\text{-}dmd}$	$VA_{b\ sw\text{-}dmd}$	VA	4.3	VA DMD b
	Sliding window demand of the apparent power in phase conductor b					
Maximum sliding window demand apparent power b		$S_{L2\ sw\text{-}dmd\ max}$	$VA_{b\ sw\text{-}dmd\ max}$	VA	4.4	
	Maximum value of the sliding window demand of the apparent power in phase conductor b					
Minimum sliding window demand apparent power b		$S_{L2\ sw\text{-}dmd\ min}$	$VA_{b\ sw\text{-}dmd\ min}$	VA	4.5	
	Minimum value of the sliding window demand of the apparent power in phase conductor b					
Sliding window demand apparent power c		$S_{L3\ sw\text{-}dmd}$	$VA_{c\ sw\text{-}dmd}$	VA	4.3	VA DMD c
	Sliding window demand of the apparent power in phase conductor c					
Maximum sliding window demand apparent power c		$S_{L3\ sw\text{-}dmd\ max}$	$VA_{c\ sw\text{-}dmd\ max}$	VA	4.4	
	Maximum value of the sliding window demand of the apparent power in phase conductor c					
Minimum sliding window demand apparent power c		$S_{L3\ sw\text{-}dmd\ min}$	$VA_{c\ sw\text{-}dmd\ min}$	VA	4.5	
	Minimum value of the sliding window demand of the apparent power in phase conductor c					
Sliding Window Demand Active Power a		$P_{L1\ sw\text{-}dmd}$	$W_{a\ sw\text{-}dmd}$	W	5.3	W DMD a
	Sliding window demand of the active power in phase conductor a					
Maximum sliding window demand active power a		$P_{L1\ sw\text{-}dmd\ max}$	$W_{a\ sw\text{-}dmd\ max}$	W	5.4	
	Maximum value of the sliding window demand of the active power in phase conductor a					
Minimum sliding window demand active power a		$P_{L1\ sw\text{-}dmd\ min}$	$W_{a\ sw\text{-}dmd\ min}$	W	5.5	
	Minimum value of the sliding window demand of the active power in phase conductor a					
Sliding window demand active power b		$P_{L2\ sw\text{-}dmd}$	$W_{b\ sw\text{-}dmd}$	W	5.3	W DMD b
	Sliding window demand of the active power in phase conductor b					

Name		Abbrev. DE + IEC	Abbrev. EN + ANSI	Unit	Dis-play	LIM SOURCE
Maximum sliding window demand active power b		$P_{L2\ sw\text{-}dmd\ max}$	$W_{b\ sw\text{-}dmd\ max}$	W	5.4	
	Maximum value of the sliding window demand of the active power in phase conductor b					
Minimum sliding window demand active power b		$P_{L2\ sw\text{-}dmd\ min}$	$W_{b\ sw\text{-}dmd\ min}$	W	5.5	
	Minimum value of the sliding window demand of the active power in phase conductor b					
Sliding window demand active power c		$P_{L3\ sw\text{-}dmd}$	$W_{c\ sw\text{-}dmd}$	W	5.3	W DMD c
	Sliding window demand of the active power in phase conductor c					
Maximum sliding window demand active power c		$P_{L3\ sw\text{-}dmd\ max}$	$W_{c\ sw\text{-}dmd\ max}$	W	5.4	
	Maximum value of the sliding window demand of the active power in phase conductor c					
Minimum sliding window demand active power c		$P_{L3\ sw\text{-}dmd\ min}$	$W_{c\ sw\text{-}dmd\ min}$	W	5.5	
	Minimum value of the sliding window demand of the active power in phase conductor c					
Sliding Window Demand Total Reactive Power a (VARtot)		$Q_{tot\ L1\ sw\text{-}dmd}$	$VAR_{tot\ a\ sw\text{-}dmd}$	VAR	6.3	VARtot DMD a
	Sliding window demand of the total reactive power of the fundamental and harmonics in phase conductor a					
Maximum sliding window demand total reactive power a (VARtot)		$Q_{tot\ L1\ sw\text{-}dmd\ max}$	$VAR_{tot\ a\ sw\text{-}dmd\ max}$	VAR	6.4	
	Maximum value of the sliding window demand of the total reactive power of the fundamental and harmonics in phase conductor a					
Minimum sliding window demand total reactive power a (VARtot)		$Q_{tot\ L1\ sw\text{-}dmd\ min}$	$VAR_{tot\ a\ sw\text{-}dmd\ min}$	VAR	6.5	
	Minimum value of the sliding window demand of the total reactive power of the fundamental and harmonics in phase conductor a					
Sliding window demand total reactive power b (VARtot)		$Q_{tot\ L2\ sw\text{-}dmd}$	$VAR_{tot\ b\ sw\text{-}dmd}$	VAR	6.3	VARtot DMD b
	Sliding window demand of the total reactive power of the fundamental and harmonics in phase conductor b					
Maximum sliding window demand total reactive power b (VARtot)		$Q_{tot\ L2\ sw\text{-}dmd\ max}$	$VAR_{tot\ b\ sw\text{-}dmd\ max}$	VAR	6.4	
	Maximum value of the sliding window demand of the total reactive power of the fundamental and harmonics in phase conductor b					
Minimum sliding window demand total reactive power b (VARtot)		$Q_{tot\ L2\ sw\text{-}dmd\ min}$	$VAR_{tot\ b\ sw\text{-}dmd\ min}$	VAR	6.5	
	Minimum value of the sliding window demand of the total reactive power of the fundamental and harmonics in phase conductor b					
Sliding window demand total reactive power c (VARtot)		$Q_{tot\ L3\ sw\text{-}dmd}$	$VAR_{tot\ c\ sw\text{-}dmd}$	VAR	6.3	VARtot DMD c
	Sliding window demand of the total reactive power of the fundamental and harmonics in phase conductor c					
Maximum sliding window demand total reactive power c (VARtot)		$Q_{tot\ L3\ sw\text{-}dmd\ max}$	$VAR_{tot\ c\ sw\text{-}dmd\ max}$	VAR	6.4	
	Maximum value of the sliding window demand of the total reactive power of the fundamental and harmonics in phase conductor c					
Minimum sliding window demand total reactive power c (VARtot)		$Q_{tot\ L3\ sw\text{-}dmd\ min}$	$VAR_{tot\ c\ sw\text{-}dmd\ min}$	VAR	6.5	
	Minimum value of the sliding window demand of the total reactive power of the fundamental and harmonics in phase conductor c					

Name		Abbrev. DE + IEC	Abbrev. EN + ANSI	Unit	Dis-play	LIM SOURCE
Sliding Window Demand Reactive Power a (VARn)		$Q_{n\ L1\ sw\text{-}dmd}$	$VAR_{n\ a\ sw\text{-}dmd}$	VAR	6.3	VARn DMD a
	Sliding window demand of the reactive power of the harmonics in phase conductor a, measured according to VARn					
Maximum sliding window demand reactive power a (VARn)		$Q_{n\ L1\ sw\text{-}dmd\ max}$	$VAR_{n\ a\ sw\text{-}dmd\ max}$	VAR	6.4	
	Maximum value of the sliding window demand of the reactive power of the harmonics in phase conductor a, measured according to VARn					
Minimum sliding window demand reactive power a (VARn)		$Q_{n\ L1\ sw\text{-}dmd\ min}$	$VAR_{n\ a\ sw\text{-}dmd\ min}$	VAR	6.5	
	Minimum value of the sliding window demand of the reactive power of the harmonics in phase conductor a, measured according to VARn					
Sliding window demand reactive power b (VARn)		$Q_{n\ L2\ sw\text{-}dmd}$	$VAR_{n\ b\ sw\text{-}dmd}$	VAR	6.3	VARn DMD b
	Sliding window demand of the reactive power of the harmonics in phase conductor b, measured according to VARn					
Maximum sliding window demand reactive power b (VARn)		$Q_{n\ L2\ sw\text{-}dmd\ max}$	$VAR_{n\ b\ sw\text{-}dmd\ max}$	VAR	6.4	
	Maximum value of the sliding window demand of the reactive power of the harmonics in phase conductor b, measured according to VARn					
Minimum sliding window demand reactive power b (VARn)		$Q_{n\ L2\ sw\text{-}dmd\ min}$	$VAR_{n\ b\ sw\text{-}dmd\ min}$	VAR	6.5	
	Minimum value of the sliding window demand of the reactive power of the harmonics in phase conductor b, measured according to VARn					
Sliding window demand reactive power c (VARn)		$Q_{n\ L2\ sw\text{-}dmd}$	$VAR_{n\ c\ sw\text{-}dmd}$	VAR	6.3	VARn DMD c
	Sliding window demand of the reactive power of the harmonics in phase conductor c, measured according to VARn					
Maximum sliding window demand reactive power c (VARn)		$Q_{n\ L3\ sw\text{-}dmd\ max}$	$VAR_{n\ c\ sw\text{-}dmd\ max}$	VAR	6.4	
	Maximum value of the sliding window demand of the reactive power of the harmonics in phase conductor c, measured according to VARn					
Minimum sliding window demand reactive power c (VARn)		$VAR_{n\ L3\ sw\text{-}dmd\ min}$	$VAR_{n\ c\ sw\text{-}dmd\ min}$	VAR	6.5	
	Minimum value of the sliding window demand of the reactive power of the harmonics in phase conductor c, measured according to VARn					
Sliding Window Demand Reactive Power a (VAR1)		$VAR_{1\ a\ sw\text{-}dmd}$	$VAR_{1\ a\ sw\text{-}dmd}$	VAR	6.3	VAR1 DMD a
	Sliding window demand of the reactive power of the fundamental in phase conductor a referred to the load counting system, measured according to VAR1					
Maximum sliding window demand reactive power a (VAR1)		$Q_{1\ L1\ sw\text{-}dmd\ max}$	$VAR_{1\ a\ sw\text{-}dmd\ max}$	VAR	6.4	
	Maximum value of the sliding window demand of the reactive power of the fundamental in phase conductor a, measured according to VAR1					
Minimum sliding window demand reactive power a (VAR1)		$VAR_{1\ a\ sw\text{-}dmd\ min}$	$VAR_{1\ a\ sw\text{-}dmd\ min}$	VAR	6.5	
	Minimum value of the sliding window demand of the reactive power of the fundamental in phase conductor a, measured according to VAR1					
Sliding window demand reactive power b (VAR1)		$VAR_{1\ b\ sw\text{-}dmd}$	$VAR_{1\ b\ sw\text{-}dmd}$	VAR	6.3	VAR1 DMD b
	Sliding window demand of the reactive power of the fundamental in phase conductor b referred to the load counting system, measured according to VAR1					

Name	Abbrev. DE + IEC	Abbrev. EN + ANSI	Unit	Dis-play	LIM SOURCE
Maximum sliding window demand reactive power b (VAR1)	$VAR_{1\ b\ sw\text{-}dmd\ max}$	$VAR_{1\ b\ sw\text{-}dmd\ max}$	VAR	6.4	
	Maximum value of the sliding window demand of the reactive power of the fundamental in phase conductor b, measured according to VAR1				
Minimum sliding window demand reactive power b (VAR1)	$VAR_{1\ b\ sw\text{-}dmd\ min}$	$VAR_{1\ b\ sw\text{-}dmd\ min}$	VAR	6.5	
	Minimum value of the sliding window demand of the reactive power of the fundamental in phase conductor b, measured according to VAR1				
Sliding window demand reactive power c (VAR1)	$Q_{1\ L3\ sw\text{-}dmd}$	$VAR_{1\ c\ sw\text{-}dmd}$	VAR	6.3	VAR1 DMD c
	Sliding window demand of the reactive power of the fundamental in phase conductor c referred to the load counting system, measured according to VAR1				
Maximum sliding window demand reactive power c (VAR1)	$VAR_{1\ c\ sw\text{-}dmd\ max}$	$VAR_{1\ c\ sw\text{-}dmd\ max}$	VAR	6.4	
	Maximum value of the sliding window demand of the reactive power of the fundamental in phase conductor c, measured according to VAR1				
Minimum sliding window demand reactive power c (VAR1)	$VAR_{1\ c\ sw\text{-}dmd\ min}$	$VAR_{1\ c\ sw\text{-}dmd\ min}$	VAR	6.5	
	Minimum value of the sliding window demand of the reactive power of the fundamental in phase conductor c, measured according to VAR1				
Sliding Window Demand Total Apparent Power	$S_{sw\text{-}dmd}$	$VA_{sw\text{-}dmd}$	VA	7.3	ΣVA DMD
	Sliding window demand of the total apparent power				
Maximum sliding window demand total apparent power	$S_{sw\text{-}dmd\ max}$	$VA_{sw\text{-}dmd\ max}$	VA	7.4	
	Maximum sliding window demand of the total apparent power				
Minimum sliding window demand total apparent power	$S_{sw\text{-}dmd\ min}$	$VA_{sw\text{-}dmd\ min}$	VA	7.5	
	Minimum sliding window demand of the total apparent power				
Sliding Window Demand Total Active Power	$P_{sw\text{-}dmd}$	$W_{sw\text{-}dmd}$	W	7.3	ΣW DMD
	Sliding window demand of the total active power				
Maximum sliding window demand total active power	$P_{sw\text{-}dmd\ max}$	$W_{sw\text{-}dmd\ max}$	W	7.4	
	Maximum sliding window demand of the total active power				
Minimum sliding window demand total active power	$P_{sw\text{-}dmd\ min}$	$W_{sw\text{-}dmd\ min}$	W	7.5	
	Minimum sliding window demand of the total active power				
Sliding Window Demand Total Reactive Power (VARtot)	$Q_{tot\ sw\text{-}dmd}$	$VAR_{tot\ sw\text{-}dmd}$	VAR	7.3	ΣVARtot DMD
	Sliding window demand of the total reactive power of the fundamental and harmonics (VARtot)				
Maximum sliding window demand total reactive power (VARtot)	$Q_{tot\ sw\text{-}dmd\ max}$	$VAR_{tot\ sw\text{-}dmd\ max}$	VAR	7.4	
	Maximum value of the sliding window demand of the total reactive power of the fundamental and harmonics (VARtot)				
Minimum sliding window demand total reactive power (VARtot)	$Q_{tot\ sw\text{-}dmd\ min}$	$VAR_{tot\ sw\text{-}dmd\ min}$	VAR	7.5	
	Minimum value of the sliding window demand of the total reactive power of the fundamental and harmonics (VARtot)				

Name		Abbrev. DE + IEC	Abbrev. EN + ANSI	Unit	Dis-play	LIM SOURCE
Sliding Window Demand Total Reactive Power (VAR1)		$Q_{1\ AVG}$	$VAR_{1\ AVG}$	VAR	7.3	ΣVAR1 DMD
	Sliding window demand of the total reactive power of the fundamental, measured according to VAR1					
Maximum sliding window demand total reactive power (VAR1)		$Q_{1\ sw\text{-}dmd\ max}$	$VAR_{1\ sw\text{-}dmd\ max}$	VAR	7.4	
	Maximum value of the sliding window demand of the total reactive power of the fundamental, measured according to VAR1					
Minimum sliding window demand total reactive power (VAR1)		$Q_{1\ sw\text{-}dmd\ min}$	$VAR_{1\ sw\text{-}dmd\ min}$	VAR	7.5	
	Minimum value of the sliding window demand of the total reactive power of the fundamental, measured according to VAR1					
Sliding Window Demand Total Reactive Power (VARn)		$Q_{n\ sw\text{-}dmd}$	$VAR_{n\ sw\text{-}dmd}$	VAR	7.3	ΣVARn DMD
	Sliding window demand of the total reactive power of the harmonics, measured according to VARn					
Maximum sliding window demand total reactive power (VARn)		$Q_{n\ sw\text{-}dmd\ max}$	$VAR_{n\ sw\text{-}dmd\ max}$	VAR	7.4	
	Maximum value of the sliding window demand of the total reactive power of the harmonics, measured according to VARn					
Minimum sliding window demand total reactive power (VARn)		$Q_{n\ sw\text{-}dmd\ min}$	$VAR_{n\ sw\text{-}dmd\ min}$	VAR	7.5	
	Minimum value of the sliding window demand of the total reactive power of the harmonics, measured according to VARn					
Sliding Window Demand Power Factor a		$\|PF_a\|_{sw\text{-}dmd}$	$\|PF_a\|_{sw\text{-}dmd}$	–	8.3	PF DMD a
	Sliding window demand of the power factor (arithmetic) a					
Maximum sliding window demand power factor a		$\|PF_a\|_{sw\text{-}dmd\ max}$	$\|PF_a\|_{sw\text{-}dmd\ max}$	–	8.4	
	Maximum value of the sliding window demand of the power factor (arithmetic) a					
Minimum sliding window demand power factor a		$\|PF_a\|_{sw\text{-}dmd\ min}$	$\|PF_a\|_{sw\text{-}dmd\ min}$	–	8.5	
	Minimum value of the sliding window demand of the power factor (arithmetic) a					
Sliding window demand power factor b		$\|PF_b\|_{sw\text{-}dmd}$	$\|PF_b\|_{sw\text{-}dmd}$	–	8.3	PF DMD b
	Sliding window demand of the power factor (arithmetic) b					
Maximum sliding window demand power factor b		$\|PF_b\|_{sw\text{-}dmd\ max}$	$\|PF_b\|_{sw\text{-}dmd\ max}$	–	8.4	
	Maximum value of the sliding window demand of the power factor (arithmetic) b					
Minimum sliding window demand power factor b		$\|PF_b\|_{sw\text{-}dmd\ min}$	$\|PF_b\|_{sw\text{-}dmd\ min}$	–	8.5	
	Minimum value of the sliding window demand of the power factor (arithmetic) b					
Sliding window demand power factor c		$\|PF_c\|_{sw\text{-}dmd}$	$\|PF_c\|_{sw\text{-}dmd}$	–	8.3	PF DMD c
	Sliding window demand of the power factor (arithmetic) c					
Maximum sliding window demand power factor c		$\|PF_c\|_{sw\text{-}dmd\ max}$	$\|PF_c\|_{sw\text{-}dmd\ max}$	–	8.4	
	Maximum value of the sliding window demand of the power factor (arithmetic) c					
Minimum sliding window demand power factor c		$\|PF_c\|_{sw\text{-}dmd\ min}$	$\|PF_c\|_{sw\text{-}dmd\ min}$	–	8.5	
	Minimum value of the sliding window demand of the power factor (arithmetic) c					
Sliding Window Demand Total Power Factor		$\|PF\|_{sw\text{-}dmd}$	$\|PF\|_{sw\text{-}dmd}$	–	9.3	ΣPF DMD
	Sliding window demand of the total power factor, based on the currently selected calculation method					
Maximum sliding window demand total power factor		$\|PF\|_{sw\text{-}dmd\ max}$	$\|PF\|_{sw\text{-}dmd\ max}$	–	9.4	
	Maximum sliding window demand of the total power factor					

Name	Abbrev. DE + IEC	Abbrev. EN + ANSI	Unit	Dis-play	LIM SOURCE
Minimum sliding window demand total power factor	$\|PF\|_{sw\text{-}dmd\ min}$	$\|PF\|_{sw\text{-}dmd\ min}$	–	9.5	
	Minimum sliding window demand of the total power factor				

A.2 Load profile

Additional information about the load profile.

The following flags are part of the load profile. The flags are written per period.

Flag	Value	Meaning	
UNCERTAIN	TRUE	Exception	Load profile values are uncertain
	FALSE	Normal case	Load profile values are certain
AUXILIARY_VOLTAGE_FAILED	TRUE	Exception	The demand period was ended prematurely owing to the failure of the supply voltage
	FALSE	Normal case	
RESYNCHRONIZED	TRUE	Exception	The demand period was ended prematurely owing to a resynchronization or the time is uncertain.
	FALSE	Normal case	

A.3 MODBUS

You can access the following measured variables:

- Via the Ethernet interface with the Modbus TCP protocol
- Via the PAC RS485 expansion module with the Modbus RTU protocol

Further information

You can find further details about the PAC RS485 expansion module and Modus RTU in the "PAC RS485 Expansion Module" manual.

A.3.1 Measured variables without a time stamp with the function codes 0x03 and 0x04

Addressing the measured variables without a time stamp

The SENTRON PAC Power Monitoring Device provides measured variables with or without a time stamp.

> **NOTICE**
>
> **Error in the case of inconsistent access to measured values**
>
> Please ensure the start offset of the register is correct when making **read accesses**.
>
> Please ensure the start offset and the number of registers are correct when making **write accesses**.
>
> If a value consists of two registers, a read command applied in the second register, for example, will generate an error code. SENTRON PAC will also output an error code if, for example, a write operation ends in the middle of a multi-register value.

Table A- 1 Measured variables available without a time stamp

Offset	Number of registers	Name	Format	Unit	Value range	Access
1	2	Voltage a-n	Float	V	-	R
3	2	Voltage b-n	Float	V	-	R
5	2	Voltage c-n	Float	V	-	R
7	2	Voltage a-b	Float	V	-	R
9	2	Voltage b-c	Float	V	-	R
11	2	Voltage c-a	Float	V	-	R
13	2	Current a	Float	A	-	R
15	2	Current b	Float	A	-	R
17	2	Current c	Float	A	-	R
19	2	Apparent Power a	Float	VA	-	R
21	2	Apparent Power b	Float	VA	-	R
23	2	Apparent Power c	Float	VA	-	R
25	2	Active Power a	Float	W	-	R
27	2	Active Power b	Float	W	-	R
29	2	Active Power c	Float	W	-	R
31	2	Reactive Power a (VARn)	Float	VAR	-	R
33	2	Reactive Power b (VARn)	Float	VAR	-	R
35	2	Reactive Power c (VARn)	Float	VAR	-	R
37	2	Power Factor a	Float	-	0 ... 1	R
39	2	Power Factor b	Float	-	0 ... 1	R
41	2	Power Factor c	Float	-	0 ... 1	R
43	2	THD Voltage a-b	Float	%	0 ... 100	R
45	2	THD Voltage b-c	Float	%	0 ... 100	R

Offset	Number of registers	Name	Format	Unit	Value range	Access
47	2	THD Voltage c-a	Float	%	0 ... 100	R
49	2	Reserve				R
51	2	Reserve				R
53	2	Reserve				R
55	2	Line Frequency	Float	Hz	45 ... 65	R
57	2	3-Phase Average Voltage ph-n	Float	V	-	R
59	2	3-Phase Average Voltage ph-ph	Float	V	-	R
61	2	3-Phase Average Current ph-ph	Float	A	-	R
63	2	Total Apparent Power	Float	VA	-	R
65	2	Total Active Power	Float	W	-	R
67	2	Total Reactive Power (VARn)	Float	VAR	-	R
69	2	Total Power Factor	Float	-	-	R
71	2	Amplitude Unbalance Voltage	Float	%	0 ... 100	R
73	2	Amplitude Unbalance Current	Float	%	0 ... 100	R
75	2	Maximum Voltage a-n	Float	V	-	R
77	2	Maximum Voltage b-n	Float	V	-	R
79	2	Maximum Voltage c-n	Float	V	-	R
81	2	Maximum Voltage a-b	Float	V	-	R
83	2	Maximum Voltage b-c	Float	V	-	R
85	2	Maximum Voltage c-a	Float	V	-	R
87	2	Maximum Current a	Float	A	-	R
89	2	Maximum Current b	Float	A	-	R
91	2	Maximum Current c	Float	A	-	R
93	2	Maximum Apparent Power a	Float	VA	-	R
95	2	Maximum Apparent Power b	Float	VA	-	R
97	2	Maximum Apparent Power c	Float	VA	-	R
99	2	Maximum Active Power a	Float	W	-	R
101	2	Maximum Active Power b	Float	W	-	R
103	2	Maximum Active Power c	Float	W	-	R
105	2	Maximum Reactive Power a (VARn)	Float	VAR	-	R
107	2	Maximum Reactive Power b (VARn)	Float	VAR	-	R
109	2	Maximum Reactive Power c (VARn)	Float	VAR	-	R
111	2	Maximum Power Factor a	Float	-	0 ... 1	R
113	2	Maximum Power Factor b	Float	-	0 ... 1	R
115	2	Maximum Power Factor c	Float	-	0 ... 1	R
117	2	Maximum THD Voltage a-b	Float	%	0 ... 100	R
119	2	Maximum THD Voltage b-c	Float	%	0 ... 100	R
121	2	Maximum THD Voltage c-a	Float	%	0 ... 100	R
123	2	Reserve	-	-	-	
125	2	Reserve	-	-	-	
127	2	Reserve	-	-	-	

Offset	Number of registers	Name	Format	Unit	Value range	Access
129	2	Maximum Line Frequency	Float	Hz	45 ... 65	R
131	2	Maximum 3-Phase Average Voltage ph-n	Float	V	-	R
133	2	Maximum 3-Phase Average Voltage ph-ph	Float	V	-	R
135	2	Maximum 3-Phase Average Current ph-ph	Float	A	-	R
137	2	Maximum Total Apparent Power	Float	VA	-	R
139	2	Maximum Total Active Power	Float	W	-	R
141	2	Maximum Total Reactive Power (VARn)	Float	VAR	-	R
143	2	Maximum Total Power Factor	Float	-	-	R
145	2	Minimum Voltage a-n	Float	V	-	R
147	2	Minimum Voltage b-n	Float	V	-	R
149	2	Minimum Voltage c-n	Float	V	-	R
151	2	Minimum Voltage a-b	Float	V	-	R
153	2	Minimum Voltage b-c	Float	V	-	R
155	2	Minimum Voltage c-a	Float	V	-	R
157	2	Minimum Current a	Float	A	-	R
159	2	Minimum Current b	Float	A	-	R
161	2	Minimum Current c	Float	A	-	R
163	2	Minimum Apparent Power a	Float	VA	-	R
165	2	Minimum Apparent Power b	Float	VA	-	R
167	2	Minimum Apparent Power c	Float	VA	-	R
169	2	Minimum Active Power a	Float	W	-	R
171	2	Minimum Active Power b	Float	W	-	R
173	2	Minimum Active Power c	Float	W	-	R
175	2	Minimum Reactive Power a (VARn)	Float	VAR	-	R
177	2	Minimum Reactive Power b (VARn)	Float	VAR	-	R
179	2	Minimum Reactive Power c (VARn)	Float	VAR	-	R
181	2	Minimum Power Factor a	Float	-	0 ... 1	R
183	2	Minimum Power Factor b	Float	-	0 ... 1	R
185	2	Minimum Power Factor c	Float	-	0 ... 1	R
187	2	Minimum Line Frequency	Float	Hz	45 ... 65	R
189	2	Minimum 3-Phase Average Voltage ph-n	Float	V	-	R
191	2	Minimum 3-Phase Average Voltage ph-ph	Float	V	-	R
193	2	Minimum 3-Phase Average Current ph-ph	Float	A	-	R
195	2	Minimum Total Apparent Power	Float	VA	-	R
197	2	Minimum Total Active Power	Float	W	-	R
199	2	Minimum Total Reactive Power (VARn)	Float	VAR	-	R

Offset	Number of registers	Name	Format	Unit	Value range	Access
201	2	Minimum Total Power Factor	Float	VAR	-	R
203	2	Limit Violations*	Unsigned long	-	Byte 3 Bit 0 Limit 0 Byte 3 Bit 1 Limit 1 Byte 3 Bit 2 Limit 2 Byte 3 Bit 3 Limit 3 Byte 3 Bit 4 Limit 4 Byte 3 Bit 5 Limit 5 Byte 3 Bit 6 Limit 6 Byte 3 Bit 7 Limit 7 Byte 2 Bit 0 Limit 8 Byte 2 Bit 1 Limit 9 Byte 2 Bit 2 Limit 10 Byte 2 Bit 3 Limit 11 Byte 0 Bit 0 Limit logic Byte 0 Bit 1 Logic result 1 of limits at inputs 0 ... 3 Byte 0 Bit 2 Logic result 2 of limits at inputs 4 ... 7 Byte 0 Bit 3 Logic result 3 of limits at inputs 8 ... 11 Byte 0 Bit 4 Logic result 4 of limits at inputs 12 ... 15	R
205	2	PMD Diagnostics and Status*	Unsigned long	-	Byte 0 System status Byte 1 Device status Byte 2 Device diagnostics Byte 3 Component diagnostics	R
207	2	Digital Outputs* Status	Unsigned long	-	Byte 3 Bit 0 Output 0 Byte 3 Bit 1 Output 1	R
209	2	Digital Inputs* Status	Unsigned long	-	Byte 3 Bit 0 Input 0 Byte 3 Bit 1 Input 1	R
211	2	Active Tariff	Unsigned long	-	0 = Tariff 1 1 = Tariff 2	R
213	2	Operating Hours Counter**)	Unsigned long	s	0 ... 999999999	RW

Offset	Number of registers	Name	Format	Unit	Value range	Access
215	2	Universal Counter**)	Unsigned long	-	0 ... 999999999	RW
217	2	Relevant Parameter Changes Counter	Unsigned long	-	-	R
219	2	Counter All Parameter Changes	Unsigned long	-	-	R
221	2	Counter Limit Violations	Unsigned long	-	-	R
223	2	Event Counter	Unsigned long	-	-	R
225	2	Alarm Counter	Unsigned long	-	-	R
227	2	Load Profile Counter	Unsigned long	-	-	R
229	2	Misc. Counter	Unsigned long	-	-	R
231	2	Status Digital Outputs Module 1*)	Unsigned long	-	Byte 3 Bit 0 Output 0	R
					Byte 3 Bit 1 Output 1	
233	2	Status Digital Inputs Module 1*)	Unsigned long	-	Byte 3 Bit 0 Input 0	R
					Byte 3 Bit 1 Input 1	
235	2	Status Digital Outputs Module 2*)	Unsigned long	-	Byte 3 Bit 0 Output 0	R
					Byte 3 Bit 1 Output 1	
237	2	Status Digital Inputs Module 2*)	Unsigned long	-	Byte 3 Bit 0 Input 0	R
					Byte 3 Bit 1 Input 1	
243	2	Cos φ a	Float	-	-	R
245	2	Cos φ b	Float	-	-	R
247	2	Cos φ c	Float	-	-	R
249	2	Displacement Angle a	Float	°	-	R
251	2	Displacement Angle b	Float	°	-	R
253	2	Displacement Angle c	Float	°	-	R
255	2	Phase Angle a-a	Float	°	-	R
257	2	Phase Angle a-b	Float	°	-	R
259	2	Phase Angle a-c	Float	°	-	R
261	2	THD Voltage a	Float	%	0 ... 100	R
263	2	THD Voltage b	Float	%	0 ... 100	R
265	2	THD Voltage c	Float	%	0 ... 100	R
267	2	THD Current a	Float	%	0 ... 100	R
269	2	THD Current b	Float	%	0 ... 100	R
271	2	THD Current c	Float	%	0 ... 100	R
273	2	Distortion Current a	Float	A	-	R
275	2	Distortion Current b	Float	A	-	R
277	2	Distortion Current c	Float	A	-	R
279	2	Total Reactive Power a (VARtot)	Float	VAR	-	R
281	2	Total Reactive Power b (VARtot)	Float	VAR	-	R
283	2	Total Reactive Power c (VARtot)	Float	VAR	-	R
285	2	Reactive Power a (VAR1)	Float	VAR	-	R

Offset	Number of registers	Name	Format	Unit	Value range	Access
287	2	Reactive Power a (VAR1)	Float	VAR	-	R
289	2	Reactive Power a (VAR1)	Float	VAR	-	R
291	2	Unbalance Voltage	Float	%	0 ... 100	R
293	2	Unbalance Current	Float	%	0 ... 100	R
295	2	Neutral Current	Float	A	-	R
297	2	Total Reactive Power (VARtot)	Float	VAR	-	R
299	2	Total Reactive Power (VAR1)	Float	VAR	-	R
301	2	Sliding Window Demand Voltage a-n	Float	V	-	R
303	2	Sliding Window Demand Voltage b-n	Float	V	-	R
305	2	Sliding Window Demand Voltage c-n	Float	V	-	R
307	2	Sliding Window Demand Voltage a-b	Float	V	-	R
309	2	Sliding Window Demand Voltage b-c	Float	V	-	R
311	2	Sliding Window Demand Voltage c-a	Float	V	-	R
313	2	Sliding Window Demand Current a	Float	A	-	R
315	2	Sliding Window Demand Current b	Float	A	-	R
317	2	Sliding Window Demand Current c	Float	A	-	R
319	2	Sliding Window Demand Apparent Power a	Float	VA	-	R
321	2	Sliding Window Demand Apparent Power b	Float	VA	-	R
323	2	Sliding Window Demand Apparent Power c	Float	VA	-	R
325	2	Sliding Window Demand Active Power a	Float	W	-	R
327	2	Sliding Window Demand Active Power b	Float	W	-	R
329	2	Sliding Window Demand Active Power c	Float	W	-	R
331	2	Sliding Window Demand Reactive Power a (VARn)	Float	VAR	-	R
333	2	Sliding Window Demand Reactive Power b (VARn)	Float	VAR	-	R
335	2	Sliding Window Demand Reactive Power c (VARn)	Float	VAR	-	R
337	2	Sliding Window Demand Total Reactive Power a (VARtot)	Float	VAR	-	R
339	2	Sliding Window Demand Total Reactive Power b (VARtot)	Float	VAR	-	R
341	2	Sliding Window Demand Total Reactive Power c (VARtot)	Float	VAR	-	R
343	2	Sliding Window Demand Reactive Power a (VAR1)	Float	VAR	-	R
345	2	Sliding Window Demand Reactive Power b (VAR1)	Float	VAR	-	R

Offset	Number of registers	Name	Format	Unit	Value range	Access
347	2	Sliding Window Demand Reactive Power c (VAR1)	Float	VAR	-	R
349	2	Sliding Window Demand Power Factor a	Float	-	0 ... 1	R
351	2	Sliding Window Demand Power Factor b	Float	-	0 ... 1	R
353	2	Sliding Window Demand Power Factor c	Float	-	0 ... 1	R
355	2	Sliding Window Demand Total Apparent Power	Float	VA	-	R
357	2	Sliding Window Demand Total Active Power	Float	W	-	R
359	2	Sliding Window Demand Total Reactive Power (VARn)	Float	VAR	-	R
361	2	Sliding Window Demand Total Reactive Power (VARtot)	Float	VAR	-	R
363	2	Sliding Window Demand Total Reactive Power (VAR1)	Float	VAR	-	R
365	2	Sliding Window Demand Total Power Factor	Float	-	-	R
367	2	Sliding Window Demand Neutral Current	Float	A	-	R
369	2	Process operating hours counter**)	Unsigned long	s	0 … 999 999 999	RW
371	2	universal counter 2**)	Unsigned long	-	0 … 999 999 999	RW
373	2	Pulse counter 0**)	Unsigned long	-	0 … 999 999 999	RW
375	2	Pulse counter 02**)	Unsigned long	-	0 … 999 999 999	RW
377	2	Pulse counter 03**)	Unsigned long	-	0 … 999 999 999	RW
379	2	Pulse counter 04**)	Unsigned long	-	0 … 999 999 999	RW
381	2	Pulse counter 05**)	Unsigned long	-	0 … 999 999 999	RW
383	2	Pulse counter 06**)	Unsigned long	-	0 … 999 999 999	RW
385	2	Pulse counter 07**)	Unsigned long	-	0 … 999 999 999	RW
387	2	Pulse counter 08**)	Unsigned long	-	0 … 999 999 999	RW
389	2	Pulse counter 09**)	Unsigned long	-	0 … 999 999 999	RW
391	2	Pulse counter 10**)	Unsigned long	-	0 … 999 999 999	RW

The following tables contain further details of all measured variables indicated by *).

You can additionally use the Modbus function code 0x10 on all measured variables indicated by **).

Table A- 2 Meaning of the abbreviations in the "Access" column

Abbreviation	Meaning
R	Read access
W	Write access
RW	Read and write access

See also

Structure - Digital inputs status and digital outputs status with the function codes 0x01 and 0x02 (Page 233)

Structure - Limit values with the function codes 0x01 and 0x02 (Page 234)

Structure - PMD diagnostics and status with the function codes 0x03 and 0x04 (Page 235)

A.3.2 Structure - Digital inputs status and digital outputs status with the function codes 0x01 and 0x02

The following are available via MODBUS:

- "Digital Inputs Status"
- "Digital Outputs Status"

Input status and output status of the SENTRON PAC Power Monitoring Device

You can use the function codes 0x05 and 0x0F on the digital outputs in addition to the function codes 0x01 and 0x02.

Table A- 3 Structure - Digital Inputs Status and Digital Outputs Status

Name	Length	Status	Byte	Bit	Bit mask	Access
Digital Outputs Status	32 bits	DO 0.0	3	0	0x00000001	R
Digital Outputs Status	32 bits	DO 0.1	3	1	0x00000010	R
Digital Inputs Status	32 bits	DI 0.0	3	0	0x00000001	R
Digital Inputs Status	32 bits	DI 0.1	3	1	0x00000010	R

Table A- 4 Structure - Digital inputs status and digital outputs status for an expansion module SENTRON PAC 4DI/2DO on slot 1

Name	Length	Status	Byte	Bit	Bit mask	Access
Digital outputs status	32 bits	DO 4.0	7	0	0x00000001	R
Digital outputs status	32 bits	DO 4.1	7	1	0x00000010	R
Digital inputs status	32 bits	DI 4.0	7	0	0x00000001	R
Digital inputs status	32 bits	DI 4.1	7	1	0x00000010	R
Digital inputs status	32 bits	DI 4.2	7	2	0x00000100	R
Digital inputs status	32 bits	DI 4.3	7	3	0x00001000	R

Table A- 5 Structure - Digital inputs status and digital outputs status for an expansion module SENTRON PAC 4DI/2DO on slot 2

Name	Length	Status	Byte	Bit	Bit mask	Access
Digital outputs status	32 bits	DO 8.0	11	0	0x00000001	R
Digital outputs status	32 bits	DO 8.1	11	1	0x00000010	R
Digital inputs status	32 bits	DI 8.0	11	0	0x00000001	R
Digital inputs status	32 bits	DI 8.1	11	1	0x00000010	R
Digital inputs status	32 bits	DI 8.2	11	2	0x00000100	R
Digital inputs status	32 bits	DI 8.3	11	3	0x00001000	R

See also

Measured variables without a time stamp with the function codes 0x03 and 0x04 (Page 226)

A.3.3 Structure - Limit values with the function codes 0x01 and 0x02

Structure of the limit values

Table A- 6 Modbus Offset 203, Register 2: Limit Violations

Byte	Bit	Status	Bit mask	Value range	Access
3	0	Limit 0	0x00000001	0 = No limit violation 1 = Limit violation	R
3	1	Limit 1	0x00000002		R
3	2	Limit 2	0x00000004		R
3	3	Limit 3	0x00000008		R
3	4	Limit 4	0x00000010		R
3	5	Limit 5	0x00000020		R
3	6	Limit 6	0x00000040		R
3	7	Limit 7	0x00000080		R
2	0	Limit 8	0x00000100		R
2	1	Limit 9	0x00000200		R
2	2	Limit 10	0x00000400		R
2	3	Limit 11	0x00000800		R
0	0	Limit Logic	0x01000000		R
0	1	Function block 1 at logic inputs 1 ... 4	0x02000000		R
0	2	Function block 2 at logic inputs 1 ... 4	0x04000000		R
0	3	Function block 3 at logic inputs 1 ... 4	0x08000000		R
0	4	Function block 4 at logic inputs 1 ... 4	0x10000000		R

See also

Measured variables without a time stamp with the function codes 0x03 and 0x04 (Page 226)

A.3.4 Structure - PMD diagnostics and status with the function codes 0x03 and 0x04

Design

Table A- 7 Overview of status and diagnostics bytes

Byte	Meaning
0	System status
1	Device status
2	Device diagnostics
3	Component diagnostics

Table A- 8 Modbus offset 205, tab 2: Structure of PMD diagnostics and status

Byte	Bit	Device status	Type	Bit mask	Value range	Access
0	0	No synchronization pulse	Status	0x01000000	0 = Not active 1 = active	R
0	1	Device Configuration menu is active	Status	0x02000000		R
0	2	Voltage out of range	Status	0x04000000		R
0	3	Current out of range	Status	0x08000000		R
0	4	Device time undefined	Status	0x10000000		R
1	0	Module slot 1	Status	0x00010000		R
1	1	Maximum pulse rate exceeded	Status	0x00020000		R
1	2	Module slot 2	Status	0x00040000		R
1	4	Process counter active	Status	0x00100000		R
2	0	Basic configuration changed[1) 2)]	saving	0x00000100		R
2	1	Upper or lower limit violation[1) 2)]	saving	0x00000200		R
2	2	Maximum pulse rate exceeded[1) 2)]	saving	0x00000400		R
2	3	Device has rebooted[1) 2)]	saving	0x00000800		R
2	4	Energy counters reset[1) 2)]	saving	0x00001000		R
3	0	Bit 0 Slot 1 Parameters changed[2)]	saving	0x00000001		R
3	1	Bit 1 Slot 1 IMDATA changed[2)]	saving	0x00000002		R
3	2	Bit 2 Slot 1 Firmware update active[2)]	saving	0x00000004		R
3	3	Bit 3 Firmware data block available[2)]	saving	0x00000008		R
3	4	Bit 4 Bootloader update flag[2)]	saving	0x00000010		R
3	5	Bit 5 Slot 2 Firmware update active[2)]	saving	0x00000020		R
3	6	Bit 6 Slot 2 Parameters changed[2)]	saving	0x00000040		R
3	7	Bit 7 Slot 2 IMDATA changed[2)]	saving	0x00000080		R

1) Only these device states are to be acknowledged.

2) You can use the function codes 0x05 and 0x0F here in addition to the function codes 0x01 and 0x02.

See also

Measured variables without a time stamp with the function codes 0x03 and 0x04 (Page 226)

Additional information about the load profile data (Page 39)

A.3.5 Measured variables for the load profile with the function codes 0x03 and 0x04

Addressing the measured variables with a time stamp

The current period is the last completed period.
The instantaneous period is the period still in progress and has not yet been completed.

Table A- 9 Measured variables available with a time stamp

Offset	Number of registers	Name	Format	Unit	Value range	Access
479	2	Total power factor import in the current period	Float	-	-	R
481	2	Total power factor export in the current period	Float	-	-	R
483	4	Time stamp for the current period	Time stamp	-	-	R
489	2	Demand apparent power in the current period	Float	VA	-	R
491	2	Demand active power import in the current period	Float	W	-	R
493	2	Demand reactive power import in the current period	Float	VAR	-	R
495	2	Demand active power export in the current period	Float	W	-	R
497	2	Demand reactive power export in the current period	Float	VAR	-	R
499	2	Cumulated apparent power in the current period	Float	VA	-	R
501	2	Cumulated active power import in the current period	Float	W	-	R
503	2	Cumulated reactive power import in the current period	Float	VAR	-	R
505	2	Cumulated active power export in the current period	Float	W	-	R
507	2	Cumulated reactive power export in the current period	Float	VAR	-	R
509	2	Maximum active power in the current period	Float	W	-	R
511	2	Minimum active power in the current period	Float	W	-	R
513	2	Maximum reactive power in the current period	Float	VAR	-	R
515	2	Minimum reactive power in the current period	Float	VAR	-	R
517	2	Length of the current period	Unsigned long	s	-	R
519	2	Time since the start of the instantaneous period	Unsigned long	s	-	R
521	2	Actual Subinterval Time	Unsigned long	s	-	R

Offset	Number of registers	Name	Format	Unit	Value range	Access
523	2	Information on Last Period	Unsigned long	-	Byte 0 Bit 0 Tariff information: 0 = On-peak 1 = Off-peak Byte 1 1) Quality information Byte 2 Reserve Byte 3 1) Reactive power information	R
525	2	Maximum apparent power in the current period	Float	VA	-	R
527	2	Minimum apparent power in the current period	Float	VA	-	R
529	2	Cumulated active power import in the instantaneous period	Float	W	-	R
531	2	Cumulated reactive power import in the instantaneous period	Float	VAR	-	R
533	2	Cumulated active power export in the instantaneous period	Float	W	-	R
535	2	Cumulated reactive power export in the instantaneous period	Float	VAR	-	R
537	2	Max. Active Power Instantaneous Period	Float	W	-	R
539	2	Min. Active Power Instantaneous Period	Float	W	-	R
541	2	Max. Reactive Power Instantaneous Period	Float	VAR	-	R
543	2	Min. Reactive Power Instantaneous Period	Float	VAR	-	R

Table A- 10 Meaning of the abbreviations in the "Access" column

Abbreviation	Meaning
R	Read access
W	Write access
RW	Read and write access

Table A- 11 1) Structure of the value range for offset 523 "Information on Last Period"

Byte	Bit	Meaning
1	7	Uncertain: This bit is set if the measuring voltage or the measuring current is out of range in the period.
	6	Supply voltage failure in the period
	5	This bit is set owing to a resynchronization or if the time is uncertain. Additional information about the load profile data (Page 39)
	4	This bit is set if individual subperiods are not available for computing the values.
	3 … 1	Reserve
	0	Period length is too short
3	7	Period contains Budeanu's reactive power VARn 1)
	6	Period contains fundamental connection reactive power VAR1
	5	Period contains total reactive power VARtot
	4	The reactive power type recorded was changed in the period.
	3 … 0	Reserve

1) Budeanu = offset reactive power

A.3.6 Tariff-specific energy values in double format with the function codes 0x03, 0x04, and 0x10

Addressing the tariff-specific energy values

Table A- 12 Available tariff-specific measured variables

Offset	Number of registers	Name	Format	Unit	Value range	Access
797	4	Date / Time	Time stamp	-	-	RW
801	4	Active Energy Import Tariff 1	Double	Wh	Overflow 1.0e+12	RW
805	4	Active Energy Import Tariff 2	Double	Wh	Overflow 1.0e+12	RW
809	4	Active Energy Export Tariff 1	Double	Wh	Overflow 1.0e+12	RW
813	4	Active Energy Export Tariff 2	Double	Wh	Overflow 1.0e+12	RW
817	4	Reactive Energy Import Tariff 1	Double	VARh	Overflow 1.0e+12	RW
821	4	Reactive Energy Import Tariff 2	Double	VARh	Overflow 1.0e+12	RW
825	4	Reactive Energy Export Tariff 1	Double	VARh	Overflow 1.0e+12	RW
829	4	Reactive Energy Export Tariff 2	Double	VARh	Overflow 1.0e+12	RW
833	4	Apparent Energy Tariff 1	Double	VAh	Overflow 1.0e+12	RW
837	4	Apparent Energy Tariff 2	Double	VAh	Overflow 1.0e+12	RW
841	4	Process active energy	Double	Wh	Overflow 1.0e+12	RW
845	4	Process reactive energy	Double	VARh	Overflow 1.0e+12	RW
849	4	Process apparent energy	Double	VAh	Overflow 1.0e+12	RW

Offset	Number of registers	Name	Format	Unit	Value range	Access
853	4	Process active energy – previous measurement	Double	Wh	—	R
857	4	Process reactive energy – previous measurement	Double	VARh	—	R
861	4	Process apparent energy – previous measurement	Double	VAh	—	R

Table A- 13 Meaning of the abbreviations in the "Access" column

Abbreviation	Meaning
R	Read access
W	Write access
RW	Read and write access

A.3.7 Tariff-specific energy values in float format with the function codes 0x03 and 0x04

Addressing the tariff-specific energy values

Table A- 14 Available tariff-specific measured variables

Offset	Number of registers	Name	Format	Unit	Value range	Access
2799	2	Date / Time	Unsigned long	-	-	R
2801	2	Active Energy Import Tariff 1	Float	Wh	Overflow 1.0e+12	R
2803	2	Active Energy Import Tariff 2	Float	Wh	Overflow 1.0e+12	R
2805	2	Active Energy Export Tariff 1	Float	Wh	Overflow 1.0e+12	R
2807	2	Active Energy Export Tariff 2	Float	Wh	Overflow 1.0e+12	R
2809	2	Reactive Energy Import Tariff 1	Float	VARh	Overflow 1.0e+12	R
2811	2	Reactive Energy Import Tariff 2	Float	VARh	Overflow 1.0e+12	R
2813	2	Reactive Energy Export Tariff 1	Float	VARh	Overflow 1.0e+12	R
2815	2	Reactive Energy Export Tariff 2	Float	VARh	Overflow 1.0e+12	R
2817	2	Apparent Energy Tariff 1	Float	VAh	Overflow 1.0e+12	R
2819	2	Apparent Energy Tariff 2	Float	VAh	Overflow 1.0e+12	R
2821	2	Process active energy	Float	Wh	Overflow 1.0e+12	R
2823	2	Process reactive energy	Float	VARh	Overflow 1.0e+12	R
2825	2	Process apparent energy	Float	VAh	Overflow 1.0e+12	R
2827	2	Process active energy – previous measurement	Float	Wh	—	R

Offset	Number of registers	Name	Format	Unit	Value range	Access
2829	2	Process reactive energy – previous measurement	Float	VARh	—	R
2831	2	Process apparent energy – previous measurement	Float	VAh	—	R

Table A- 15 Meaning of the abbreviations in the "Access" column

Abbreviation	Meaning
R	Read access

A.3.8 Maximum values with a time stamp and the function codes 0x03 and 0x04

Addressing the maximum values with a time stamp

SENTRON PAC4200 provides the maximum values listed below with a time stamp.

Table A- 16 Structure of the "time stamp" format

Byte	Format	Description
0 … 3	Unsigned long	Unix time; seconds since 1 January 1970 0:00 h
4 … 7	Unsigned long	Not used, i.e. always "0"

Table A- 17 Available measured variables: Maximum values with time stamp

Offset	Number of registers	Name	Format	Unit	Value range	Access
3001	6	Maximum Voltage a-n with Time	Float + time stamp	V	-	R
3007	6	Maximum Voltage b-n with Time	Float + time stamp	V	-	R
3013	6	Maximum Voltage c-n with Time	Float + time stamp	V	-	R
3019	6	Maximum Voltage a-b with Time	Float + time stamp	V	-	R
3025	6	Maximum Voltage b-c with Time	Float + time stamp	V	-	R
3031	6	Maximum Voltage c-a with Time	Float + time stamp	V	-	R
3037	6	Maximum Current a with Time	Float + time stamp	A	-	R
3043	6	Maximum Current b with Time	Float + time stamp	A	-	R
3049	6	Maximum Current c with Time	Float + time stamp	A	-	R
3055	6	Maximum Apparent Power a with Time	Float + time stamp	VA	-	R
3061	6	Maximum Apparent Power b with Time	Float + time stamp	VA	-	R
3067	6	Maximum Apparent Power c with Time	Float + time stamp	VA	-	R
3073	6	Maximum Active Power a with Time	Float + time stamp	W	-	R
3079	6	Maximum Active Power b with Time	Float + time stamp	W	-	R
3085	6	Maximum Active Power c with Time	Float + time stamp	W	-	R

Offset	Number of registers	Name	Format	Unit	Value range	Access
3091	6	Maximum Reactive Power a (VARn) with Time	Float + time stamp	VAR	-	R
3097	6	Maximum Reactive Power b (VARn) with Time	Float + time stamp	VAR	-	R
3103	6	Maximum Reactive Power c (VARn) with Time	Float + time stamp	VAR	-	R
3109	6	Maximum Total Reactive Power a (VARtot) with Time	Float + time stamp	VAR	-	R
3115	6	Maximum Total Reactive Power b (VARtot) with Time	Float + time stamp	VAR	-	R
3121	6	Maximum Total Reactive Power c (VARtot) with Time	Float + time stamp	VAR	-	R
3127	6	Maximum Reactive Power a (VAR1) with Time	Float + time stamp	VAR	-	R
3133	6	Maximum Reactive Power b (VAR1) with Time	Float + time stamp	VAR	-	R
3139	6	Maximum Reactive Power c (VAR1) with Time	Float + time stamp	VAR	-	R
3145	6	Maximum Power Factor a with Time	Float + time stamp	-	0 … 1	R
3151	6	Maximum Power Factor b with Time	Float + time stamp	-	0 … 1	R
3157	6	Maximum Power Factor c with Time	Float + time stamp	-	0 … 1	R
3163	6	Maximum THD Voltage a-b referred to Fundamental with Time	Float + time stamp	%	0 ... 100	R
3169	6	Maximum THD Voltage b-c referred to Fundamental with Time	Float + time stamp	%	0 ... 100	R
3175	6	Maximum THD Voltage c-a referred to Fundamental with Time	Float + time stamp	%	0 ... 100	R
3199	6	Maximum cos φ a with Time	Float + time stamp	$\cos \varphi_a$	-	R
3205	6	Maximum cos φ b with Time	Float + time stamp	$\cos \varphi_b$	-	R
3211	6	Maximum cos φ c with Time	Float + time stamp	$\cos \varphi_c$	-	R
3217	6	Maximum Displacement Angle a with Time	Float + time stamp	°	-	R
3223	6	Maximum Displacement Angle b with Time	Float + time stamp	°	-	R
3229	6	Maximum Displacement Angle c with Time	Float + time stamp	°	-	R
3235	6	Maximum phase angle a-a	Float + time stamp	°	-	R
3241	6	Maximum phase angle a-b	Float + time stamp	°	-	R
3247	6	Maximum phase angle a-c	Float + time stamp	°	-	R
3253	6	Maximum THD Voltage a with Time	Float + time stamp	%	0 ... 100	R
3259	6	Maximum THD Voltage b with Time	Float + time stamp	%	0 ... 100	R
3265	6	Maximum THD Voltage c with Time	Float + time stamp	%	0 ... 100	R
3271	6	Maximum THD Current a with Time	Float + time stamp	%	0 ... 100	R
3277	6	Maximum THD Current b with Time	Float + time stamp	%	0 ... 100	R
3283	6	Maximum THD Current c with Time	Float + time stamp	%	0 ... 100	R

Offset	Number of registers	Name	Format	Unit	Value range	Access
3289	6	Maximum Distortion a with Time	Float + time stamp	A	-	R
3295	6	Maximum Distortion b with Time	Float + time stamp	A	-	R
3301	6	Maximum Distortion c with Time	Float + time stamp	A	-	R
3307	6	Maximum Line Frequency with Time	Float + time stamp	-	45 ... 65	R
3313	6	Maximum 3-Phase Average Voltage ph-n with Time	Float + time stamp	V	-	R
3319	6	Maximum 3-Phase Average Voltage ph-ph with Time	Float + time stamp	V	-	R
3325	6	Maximum 3-Phase Average Current with Time	Float + time stamp	A	-	R
3331	6	Maximum Total Apparent Power with Time	Float + time stamp	VA	-	R
3337	6	Maximum Total Active Power with Time	Float + time stamp	W	-	R
3343	6	Maximum Total Reactive Power (VARn) with Time	Float + time stamp	VAR	-	R
3349	6	Maximum Total Power Factor with Time	Float + time stamp	-	-	R
3355	6	Maximum Neutral Current with Time	Float + time stamp	A	-	R
3361	6	Maximum Total Reactive Power (VARtot) with Time	Float + time stamp	VAR	-	R
3367	6	Maximum Total Reactive Power (VAR1) with Time	Float + time stamp	VAR	-	R
3373	6	Max. Sliding Window Demand Voltage a-n with Time	Float + time stamp	V	-	R
3379	6	Max. Sliding Window Demand Voltage b-n with Time	Float + time stamp	V	-	R
3385	6	Max. Sliding Window Demand Voltage c-n with Time	Float + time stamp	V	-	R
3391	6	Max. Sliding Window Demand Voltage a-b with Time	Float + time stamp	V	-	R
3397	6	Max. Sliding Window Demand Voltage b-c with Time	Float + time stamp	V	-	R
3403	6	Max. Sliding Window Demand Voltage c-a with Time	Float + time stamp	V	-	R
3409	6	Max. Sliding Window Demand Current a with Time	Float + time stamp	A	-	R
3415	6	Max. Sliding Window Demand Current b with Time	Float + time stamp	A	-	R
3421	6	Max. Sliding Window Demand Current c with Time	Float + time stamp	A	-	R
3427	6	Max. Sliding Window Demand Apparent Power a with Time	Float + time stamp	VA	-	R
3433	6	Max. Sliding Window Demand Apparent Power b with Time	Float + time stamp	VA	-	R
3439	6	Max. Sliding Window Demand Apparent Power c with Time	Float + time stamp	VA	-	R

Offset	Number of registers	Name	Format	Unit	Value range	Access
3445	6	Max. Sliding Window Demand Active Power a with Time	Float + time stamp	W	-	R
3451	6	Max. Sliding Window Demand Active Power b with Time	Float + time stamp	W	-	R
3457	6	Max. Sliding Window Demand Active Power c with Time	Float + time stamp	W	-	R
3463	6	Max. Sliding Window Demand Reactive Power a (VARn) with Time	Float + time stamp	VAR	-	R
3469	6	Max. Sliding Window Demand Reactive Power b (VARn) with Time	Float + time stamp	VAR	-	R
3475	6	Max. Sliding Window Demand Reactive Power c (VARn) with Time	Float + time stamp	VAR	-	R
3481	6	Max. Sliding Window Demand Total Reactive Power a (VARtot) with Time	Float + time stamp	VAR	-	R
3487	6	Max. Sliding Window Demand Total Reactive Power b (VARtot) with Time	Float + time stamp	VAR	-	R
3493	6	Max. Sliding Window Demand Total Reactive Power c (VARtot) with Time	Float + time stamp	VAR	-	R
3499	6	Max. Sliding Window Demand Reactive Power a (VAR1) with Time	Float + time stamp	VAR	-	R
3505	6	Max. Sliding Window Demand Reactive Power b (VAR1) with Time	Float + time stamp	VAR	-	R
3511	6	Max. Sliding Window Demand Reactive Power c (VAR1) with Time	Float + time stamp	VAR	-	R
3517	6	Max. Sliding Window Demand Power Factor a with Time	Float + time stamp	-	0 … 1	R
3523	6	Max. Sliding Window Demand Power Factor b with Time	Float + time stamp	-	0 … 1	R
3529	6	Max. Sliding Window Demand Power Factor c with Time	Float + time stamp	-	0 … 1	R
3535	6	Max. Sliding Window Demand Total Apparent Power with Time	Float + time stamp	VA	-	R
3541	6	Max. Sliding Window Demand Total Active Power with Time	Float + time stamp	W	-	R
3547	6	Max. Sliding Window Demand Total Reactive Power (VARn) with Time	Float + time stamp	VAR	-	R
3553	6	Max. Sliding Window Demand Total Reactive Power (VARtot) with Time	Float + time stamp	VAR	-	R
3559	6	Max. Sliding Window Demand Total Reactive Power (VAR1) with Time	Float + time stamp	VAR	-	R
3565	6	Max. Sliding Window Demand Total Power Factor with Time	Float + time stamp	-	-	R
3571	6	Max. Sliding Window Demand Neutral Current with Time	Float + time stamp	A	-	R

A.3.9 Minimum values with a time stamp and the function codes 0x03 and 0x04

Addressing the minimum values with a time stamp

Table A- 18 Available measured variables: Minimum values with time stamp

Offset	Number of registers	Name	Format	Unit	Value range	Access
6001	6	Minimum Voltage a-n with Time	Float + time stamp	V	-	R
6007	6	Minimum Voltage b-n with Time	Float + time stamp	V	-	R
6013	6	Minimum Voltage c-n with Time	Float + time stamp	V	-	R
6019	6	Minimum Voltage a-b with Time	Float + time stamp	V	-	R
6025	6	Minimum Voltage b-c with Time	Float + time stamp	V	-	R
6031	6	Minimum Voltage c-a with Time	Float + time stamp	V	-	R
6037	6	Minimum Current a with Time	Float + time stamp	A	-	R
6043	6	Minimum Current b with Time	Float + time stamp	A	-	R
6049	6	Minimum Current c with Time	Float + time stamp	A	-	R
6055	6	Minimum Apparent Power a with Time	Float + time stamp	VA	-	R
6061	6	Minimum Apparent Power b with Time	Float + time stamp	VA	-	R
6067	6	Minimum Apparent Power c with Time	Float + time stamp	VA	-	R
6073	6	Minimum Active Power a with Time	Float + time stamp	W	-	R
6079	6	Minimum Active Power b with Time	Float + time stamp	W	-	R
6085	6	Minimum Active Power c with Time	Float + time stamp	W	-	R
6091	6	Minimum Reactive Power a (VARn) with Time	Float + time stamp	VAR	-	R
6097	6	Minimum Reactive Power b (VARn) with Time	Float + time stamp	VAR	-	R
6103	6	Minimum Reactive Power c (VARn) with Time	Float + time stamp	VAR	-	R
6109	6	Minimum Total Reactive Power a (VARtot) with Time	Float + time stamp	VAR	-	R
6115	6	Minimum Total Reactive Power b (VARtot) with Time	Float + time stamp	VAR	-	R
6121	6	Minimum Total Reactive Power c (VARtot) with Time	Float + time stamp	VAR	-	R
6127	6	Minimum Reactive Power a (VAR1) with Time	Float + time stamp	VAR	-	R
6133	6	Minimum Reactive Power b (VAR1) with Time	Float + time stamp	VAR	-	R
6139	6	Minimum Reactive Power c (VAR1) with Time	Float + time stamp	VAR	-	R
6145	6	Minimum Power Factor a with Time	Float + time stamp	-	0 ... 1	R
6151	6	Minimum Power Factor b with Time	Float + time stamp	-	0 ... 1	R
6157	6	Minimum Power Factor c with Time	Float + time stamp	-	0 ... 1	R
6163	6	Minimum cos φ a with Time	Float + time stamp	$\cos \varphi_a$	-	R
6169	6	Minimum cos φ b with Time	Float + time stamp	$\cos \varphi_b$	-	R

Offset	Number of registers	Name	Format	Unit	Value range	Access
6175	6	Minimum cos φ c with Time	Float + time stamp	cos $φ_c$	-	R
6181	6	Minimum Displacement Angle a with Time	Float + time stamp	°	-	R
6187	6	Minimum Displacement Angle b with Time	Float + time stamp	°	-	R
6193	6	Minimum Displacement Angle c with Time	Float + time stamp	°	-	R
6199	6	Minimum phase angle a-a	Float + time stamp	°	-	R
6205	6	Minimum phase angle a-b	Float + time stamp	°	-	R
6211	6	Minimum phase angle a-c	Float + time stamp	°	-	R
6217	6	Minimum Line Frequency with Time	Float + time stamp	-	45 ... 65	R
6223	6	Minimum 3-Phase Average Voltage ph-n with Time	Float + time stamp	V	-	R
6229	6	Minimum 3-Phase Average Voltage ph-ph with Time	Float + time stamp	V	-	R
6235	6	Minimum 3-Phase Average Current ph-ph with Time	Float + time stamp	A	-	R
6241	6	Minimum Total Apparent Power with Time	Float + time stamp	VA	-	R
6247	6	Minimum Total Active Power with Time	Float + time stamp	W	-	R
6253	6	Minimum Total Reactive Power (VARn) with Time	Float + time stamp	VAR	-	R
6259	6	Minimum Total Power Factor (VARn) with Time	Float + time stamp	-	-	R
6265	6	Minimum Neutral Current with Time	Float + time stamp	A	-	R
6271	6	Minimum Total Reactive Power (VARtot) with Time	Float + time stamp	VAR	-	R
6277	6	Minimum Total Reactive Power (VAR1) with Time	Float + time stamp	VAR	-	R
6283	6	Min. Sliding Window Demand Voltage a-n with Time	Float + time stamp	V	-	R
6289	6	Min. Sliding Window Demand Voltage b-n with Time	Float + time stamp	V	-	R
6295	6	Min. Sliding Window Demand Voltage c-n with Time	Float + time stamp	V	-	R
6301	6	Min. Sliding Window Demand Voltage a-b with Time	Float + time stamp	V	-	R
6307	6	Min. Sliding Window Demand Voltage b-c with Time	Float + time stamp	V	-	R
6313	6	Min. Sliding Window Demand Voltage c-a with Time	Float + time stamp	V	-	R
6319	6	Min. Sliding Window Demand Current a with Time	Float + time stamp	A	-	R
6325	6	Min. Sliding Window Demand Current b with Time	Float + time stamp	A	-	R
6331	6	Min. Sliding Window Demand Current c with Time	Float + time stamp	A	-	R
6337	6	Min. Sliding Window Demand Apparent Power a with Time	Float + time stamp	VA	-	R

Offset	Number of registers	Name	Format	Unit	Value range	Access
6343	6	Min. Sliding Window Demand Apparent Power b with Time	Float + time stamp	VA	-	R
6349	6	Min. Sliding Window Demand Apparent Power c with Time	Float + time stamp	VA	-	R
6355	6	Min. Sliding Window Demand Active Power a with Time	Float + time stamp	W	-	R
6361	6	Min. Sliding Window Demand Active Power b with Time	Float + time stamp	W	-	R
6367	6	Min. Sliding Window Demand Active Power c with Time	Float + time stamp	W	-	R
6373	6	Min. Sliding Window Demand Reactive Power a (VARn) with Time	Float + time stamp	VAR	-	R
6379	6	Min. Sliding Window Demand Reactive Power b (VARn) with Time	Float + time stamp	VAR	-	R
6385	6	Min. Sliding Window Demand Reactive Power c (VARn) with Time	Float + time stamp	VAR	-	R
6391	6	Min. Sliding Window Demand Total Reactive Power a (VARtot) with Time	Float + time stamp	VAR	-	R
6397	6	Min. Sliding Window Demand Total Reactive Power b (VARtot) with Time	Float + time stamp	VAR	-	R
6403	6	Min. Sliding Window Demand Total Reactive Power c (VARtot) with Time	Float + time stamp	VAR	-	R
6409	6	Min. Sliding Window Demand Reactive Power a (VAR1) with Time	Float + time stamp	VAR	-	R
6415	6	Min. Sliding Window Demand Reactive Power b (VAR1) with Time	Float + time stamp	VAR	-	R
6421	6	Min. Sliding Window Demand Reactive Power c (VAR1) with Time	Float + time stamp	VAR	-	R
6427	6	Min. Sliding Window Demand Power Factor a with Time	Float + time stamp	-	0 ... 1	R
6433	6	Min. Sliding Window Demand Power Factor b with Time	Float + time stamp	-	0 ... 1	R
6439	6	Min. Sliding Window Demand Power Factor c with Time	Float + time stamp	-	0 ... 1	R
6445	6	Min. Sliding Window Demand Total Apparent Power with Time	Float + time stamp	VA	-	R
6451	6	Min. Sliding Window Demand Total Active Power with Time	Float + time stamp	W	-	R
6457	6	Min. Sliding Window Demand Total Reactive Power (VARn) with Time	Float + time stamp	VAR	-	R
6463	6	Min. Sliding Window Demand Total Reactive Power (VARtot) with Time	Float + time stamp	VAR	-	R
6469	6	Min. Sliding Window Demand Total Reactive Power (VAR1)	Float + time stamp	VAR	-	R

Offset	Number of registers	Name	Format	Unit	Value range	Access
6475	6	Min. Sliding Window Demand Total Power Factor with Time	Float + time stamp	-	-	R
6481	6	Min. Sliding Window Demand Neutral Current with Time	Float + time stamp	A	-	R

A.3.10 Harmonics without a time stamp with the function codes 0x03 and 0x04

Addressing the harmonics without a time stamp

Table A- 19 Harmonics of the voltage

Offset	Number of registers	Name	Format	Unit	Value range	Access
9001	2	Fundamental Voltage a-n	Float	V	-	R
9003	2	Fundamental Voltage b-n	Float	V	-	R
9005	2	Fundamental Voltage c-n	Float	V	-	R
9007	2	3rd Harmonic Voltage a-n	Float	%	-	R
9009	2	3rd Harmonic Voltage b-n	Float	%	-	R
9011	2	3rd Harmonic Voltage c-n	Float	%	-	R
9013	2	5th Harmonic Voltage a-n	Float	%	-	R
9015	2	5th Harmonic Voltage b-n	Float	%	-	R
9017	2	5th Harmonic Voltage c-n	Float	%	-	R
9019	2	7th Harmonic Voltage a-n	Float	%	-	R
9021	2	7th Harmonic Voltage b-n	Float	%	-	R
9023	2	7th Harmonic Voltage c-n	Float	%	-	R
9025	2	9th Harmonic Voltage a-n	Float	%	-	R
9027	2	9th Harmonic Voltage b-n	Float	%	-	R
9029	2	9th Harmonic Voltage c-n	Float	%	-	R
9031	2	11th Harmonic Voltage a-n	Float	%	-	R
9033	2	11th Harmonic Voltage b-n	Float	%	-	R
9035	2	11th Harmonic Voltage c-n	Float	%	-	R
9037	2	13th Harmonic Voltage a-n	Float	%	-	R
9039	2	13th Harmonic Voltage b-n	Float	%	-	R
9041	2	13th Harmonic Voltage c-n	Float	%	-	R
9043	2	15th Harmonic Voltage a-n	Float	%	-	R
9045	2	15th Harmonic Voltage b-n	Float	%	-	R
9047	2	15th Harmonic Voltage c-n	Float	%	-	R
9049	2	17th Harmonic Voltage a-n	Float	%	-	R
9051	2	17th Harmonic Voltage b-n	Float	%	-	R
9053	2	17th Harmonic Voltage c-n	Float	%	-	R
9055	2	19th Harmonic Voltage a-n	Float	%	-	R

Offset	Number of registers	Name	Format	Unit	Value range	Access
9057	2	19th Harmonic Voltage b-n	Float	%	-	R
9059	2	19th Harmonic Voltage c-n	Float	%	-	R
9061	2	21st Harmonic Voltage a-n	Float	%	-	R
9063	2	21st Harmonic Voltage b-n	Float	%	-	R
9065	2	21st Harmonic Voltage c-n	Float	%	-	R
9067	2	23rd Harmonic Voltage a-n	Float	%	-	R
9069	2	23rd Harmonic Voltage b-n	Float	%	-	R
9071	2	23rd Harmonic Voltage c-n	Float	%	-	R
9073	2	25th Harmonic Voltage a-n	Float	%	-	R
9075	2	25th Harmonic Voltage b-n	Float	%	-	R
9077	2	25th Harmonic Voltage c-n	Float	%	-	R
9079	2	27th Harmonic Voltage a-n	Float	%	-	R
9081	2	27th Harmonic Voltage b-n	Float	%	-	R
9083	2	27th Harmonic Voltage c-n	Float	%	-	R
9085	2	29th Harmonic Voltage a-n	Float	%	-	R
9087	2	29th Harmonic Voltage b-n	Float	%	-	R
9089	2	29th Harmonic Voltage c-n	Float	%	-	R
9091	2	31st Harmonic Voltage a-n	Float	%	-	R
9093	2	31st Harmonic Voltage b-n	Float	%	-	R
9095	2	31st Harmonic Voltage c-n	Float	%	-	R

Table A- 20 Harmonics of the current

Offset	Number of registers	Name	Format	Unit	Value range	Access
11001	2	Fundamental Current a	Float	A	-	R
11003	2	Fundamental Current b	Float	A	-	R
11005	2	Fundamental Current c	Float	A	-	R
11007	2	3rd Harmonic Current a	Float	A	-	R
11009	2	3rd Harmonic Current b	Float	A	-	R
11011	2	3rd Harmonic Current c	Float	A	-	R
11013	2	5th Harmonic Current a	Float	A	-	R
11015	2	5th Harmonic Current b	Float	A	-	R
11017	2	5th Harmonic Current c	Float	A	-	R
11019	2	7th Harmonic Current a	Float	A	-	R
11021	2	7th Harmonic Current b	Float	A	-	R
11023	2	7th Harmonic Current c	Float	A	-	R
11025	2	9th Harmonic Current a	Float	A	-	R
11027	2	9th Harmonic Current b	Float	A	-	R
11029	2	9th Harmonic Current c	Float	A	-	R
11031	2	11th Harmonic Current a	Float	A	-	R
11033	2	11th Harmonic Current b	Float	A	-	R

Offset	Number of registers	Name	Format	Unit	Value range	Access
11035	2	11th Harmonic Current c	Float	A	-	R
11037	2	13th Harmonic Current a	Float	A	-	R
11039	2	13th Harmonic Current b	Float	A	-	R
11041	2	13th Harmonic Current c	Float	A	-	R
11043	2	15th Harmonic Current a	Float	A	-	R
11045	2	15th Harmonic Current a	Float	A	-	R
11047	2	15th Harmonic Current a	Float	A	-	R
11049	2	17th Harmonic Current a	Float	A	-	R
11051	2	17th Harmonic Current a	Float	A	-	R
11053	2	17th Harmonic Current c	Float	A	-	R
11055	2	19th Harmonic Current a	Float	A	-	R
11057	2	19th Harmonic Current b	Float	A	-	R
11059	2	19th Harmonic Current c	Float	A	-	R
11061	2	21st Harmonic Current a	Float	A	-	R
11063	2	21st Harmonic Current b	Float	A	-	R
11065	2	21st Harmonic Current c	Float	A	-	R
11067	2	23rd Harmonic Current a	Float	A	-	R
11069	2	23rd Harmonic Current b	Float	A	-	R
11071	2	23rd Harmonic Current c	Float	A	-	R
11073	2	25th Harmonic Current a	Float	A	-	R
11075	2	25th Harmonic Current b	Float	A	-	R
11077	2	25th Harmonic Current c	Float	A	-	R
11079	2	27th Harmonic Current a	Float	A	-	R
11081	2	27th Harmonic Current b	Float	A	-	R
11083	2	27th Harmonic Current c	Float	A	-	R
11085	2	29th Harmonic Current a	Float	A	-	R
11087	2	29th Harmonic Current b	Float	A	-	R
11089	2	29th Harmonic Current c	Float	A	-	R
11091	2	31st Harmonic Current a	Float	A	-	R
11093	2	31st Harmonic Current b	Float	A	-	R
11095	2	31st Harmonic Current c	Float	A	-	R

Table A- 21 Harmonics of the phase-to-phase voltage

Offset	Number of registers	Name	Format	Unit	Value range	Access
22001	2	Fundamental Voltage a-b	Float	V	-	R
22003	2	Fundamental Voltage b-c	Float	V	-	R
22005	2	Fundamental Voltage c-a	Float	V	-	R
22007	2	3rd Harmonic Voltage a-b	Float	%	-	R
22009	2	3rd Harmonic Voltage b-c	Float	%	-	R
22011	2	3rd Harmonic Voltage c-a	Float	%	-	R

Offset	Number of registers	Name	Format	Unit	Value range	Access
22013	2	5th Harmonic Voltage a-b	Float	%	-	R
22015	2	5th Harmonic Voltage b-c	Float	%	-	R
22017	2	5th Harmonic Voltage c-a	Float	%	-	R
22019	2	7th Harmonic Voltage a-b	Float	%	-	R
22021	2	7th Harmonic Voltage b-c	Float	%	-	R
22023	2	7th Harmonic Voltage c-a	Float	%	-	R
22025	2	9th Harmonic Voltage a-b	Float	%	-	R
22027	2	9th Harmonic Voltage b-c	Float	%	-	R
22029	2	9th Harmonic Voltage c-a	Float	%	-	R
22031	2	11th Harmonic Voltage a-b	Float	%	-	R
22033	2	11th Harmonic Voltage b-c	Float	%	-	R
22035	2	11th Harmonic Voltage c-a	Float	%	-	R
22037	2	13th Harmonic Voltage a-b	Float	%	-	R
22039	2	13th Harmonic Voltage b-c	Float	%	-	R
22041	2	13th Harmonic Voltage c-a	Float	%	-	R
22043	2	15th Harmonic Voltage a-b	Float	%	-	R
22045	2	15th Harmonic Voltage b-c	Float	%	-	R
22047	2	15th Harmonic Voltage c-a	Float	%	-	R
22049	2	17th Harmonic Voltage a-b	Float	%	-	R
22051	2	17th Harmonic Voltage b-c	Float	%	-	R
22053	2	17th Harmonic Voltage c-a	Float	%	-	R
22055	2	19th Harmonic Voltage a-b	Float	%	-	R
22057	2	19th Harmonic Voltage b-c	Float	%	-	R
22059	2	19th Harmonic Voltage c-a	Float	%	-	R
22061	2	21st Harmonic Voltage a-b	Float	%	-	R
22063	2	21st Harmonic Voltage b-c	Float	%	-	R
22065	2	21st Harmonic Voltage c-a	Float	%	-	R
22067	2	23rd Harmonic Voltage a-b	Float	%	-	R
22069	2	23rd Harmonic Voltage b-c	Float	%	-	R
22071	2	23rd Harmonic Voltage c-a	Float	%	-	R
22073	2	25th Harmonic Voltage a-b	Float	%	-	R
22075	2	25th Harmonic Voltage b-c	Float	%	-	R
22077	2	25th Harmonic Voltage c-a	Float	%	-	R
22079	2	27th Harmonic Voltage a-b	Float	%	-	R
22081	2	27 Harmonic Voltage b-c	Float	%	-	R
22083	2	27th Harmonic Voltage c-a	Float	%	-	R
22085	2	29th Harmonic Voltage a-b	Float	%	-	R
22087	2	29 Harmonic Voltage b-c	Float	%	-	R
22089	2	29th Harmonic Voltage c-a	Float	%	-	R
22091	2	31st Harmonic Voltage a-b	Float	%	-	R

Offset	Number of registers	Name	Format	Unit	Value range	Access
22093	2	31st Harmonic Voltage b-c	Float	%	-	R
22095	2	31st Harmonic Voltage c-a	Float	%	-	R

A.3.11 Harmonics with a time stamp and the function codes 0x03 and 0x04

Addressing the harmonics with a time stamp

Table A- 22 Harmonics of the voltage

Offset	Number of registers	Name	Format	Unit	Value range	Access
12999	6	Maximum 3rd Harmonic Voltage a-n with Time	Float + time stamp	%	-	R
13005	6	Maximum 3rd Harmonic Voltage b-n with Time	Float + time stamp	%	-	R
13011	6	Maximum 3rd Harmonic Voltage c-n with Time	Float + time stamp	%	-	R
13017	6	Maximum 5th Harmonic Voltage a-n with Time	Float + time stamp	%	-	R
13023	6	Maximum 5th Harmonic Voltage b-n with Time	Float + time stamp	%	-	R
13029	6	Maximum 5th Harmonic Voltage c-n with Time	Float + time stamp	%	-	R
13035	6	Maximum 7th Harmonic Voltage a-n with Time	Float + time stamp	%	-	R
13041	6	Maximum 7th Harmonic Voltage b-n with Time	Float + time stamp	%	-	R
13047	6	Maximum 7th Harmonic Voltage c-n with Time	Float + time stamp	%	-	R
13053	6	Maximum 9th Harmonic Voltage a-n with Time	Float + time stamp	%	-	R
13059	6	Maximum 9th Harmonic Voltage b-n with Time	Float + time stamp	%	-	R
13065	6	Maximum 9th Harmonic Voltage c-n with Time	Float + time stamp	%	-	R
13071	6	Maximum 11th Harmonic Voltage a-n with Time	Float + time stamp	%	-	R
13077	6	Maximum 11th Harmonic Voltage b-n with Time	Float + time stamp	%	-	R
13083	6	Maximum 11th Harmonic Voltage c-n with Time	Float + time stamp	%	-	R
13089	6	Maximum 13th Harmonic Voltage a-n with Time	Float + time stamp	%	-	R
13095	6	Maximum 13th Harmonic Voltage b-n with Time	Float + time stamp	%	-	R

Offset	Number of registers	Name	Format	Unit	Value range	Access
13101	6	Maximum 13th Harmonic Voltage c-n with Time	Float + time stamp	%	-	R
13107	6	Maximum 15th Harmonic Voltage a-n with Time	Float + time stamp	%	-	R
13113	6	Maximum 15th Harmonic Voltage b-n with Time	Float + time stamp	%	-	R
13119	6	Maximum 15th Harmonic Voltage c-n with Time	Float + time stamp	%	-	R
13125	6	Maximum 17th Harmonic Voltage a-n with Time	Float + time stamp	%	-	R
13131	6	Maximum 17th Harmonic Voltage b-n with Time	Float + time stamp	%	-	R
13137	6	Maximum 17th Harmonic Voltage c-n with Time	Float + time stamp	%	-	R
13143	6	Maximum 19th Harmonic Voltage a-n with Time	Float + time stamp	%	-	R
13149	6	Maximum 19th Harmonic Voltage b-n with Time	Float + time stamp	%	-	R
13155	6	Maximum 19th Harmonic Voltage c-n with Time	Float + time stamp	%	-	R
13161	6	Maximum 21st Harmonic Voltage a-n with Time	Float + time stamp	%	-	R
13167	6	Maximum 21st Harmonic Voltage b-n with Time	Float + time stamp	%	-	R
13173	6	Maximum 21st Harmonic Voltage c-n with Time	Float + time stamp	%	-	R
13179	6	Maximum 23rd Harmonic Voltage a-n with Time	Float + time stamp	%	-	R
13185	6	Maximum 23rd Harmonic Voltage b-n with Time	Float + time stamp	%	-	R
13191	6	Maximum 23rd Harmonic Voltage c-n with Time	Float + time stamp	%	-	R
13197	6	Maximum 25th Harmonic Voltage a-n with Time	Float + time stamp	%	-	R
13203	6	Maximum 25th Harmonic Voltage b-n with Time	Float + time stamp	%	-	R
13209	6	Maximum 25th Harmonic Voltage c-n with Time	Float + time stamp	%	-	R
13215	6	Maximum 27th Harmonic Voltage a-n with Time	Float + time stamp	%	-	R
13221	6	Maximum 27th Harmonic Voltage b-n with Time	Float + time stamp	%	-	R
13227	6	Maximum 27th Harmonic Voltage c-n with Time	Float + time stamp	%	-	R
13233	6	Maximum 29th Harmonic Voltage a-n with Time	Float + time stamp	%	-	R

Offset	Number of registers	Name	Format	Unit	Value range	Access
13239	6	Maximum 29th Harmonic Voltage b-n with Time	Float + time stamp	%	-	R
13245	6	Maximum 29th Harmonic Voltage c-n with Time	Float + time stamp	%	-	R
13251	6	Maximum 31st Harmonic Voltage a-n with Time	Float + time stamp	%	-	R
13257	6	Maximum 31st Harmonic Voltage b-n with Time	Float + time stamp	%	-	R
13263	6	Maximum 31st Harmonic Voltage c-n with Time	Float + time stamp	%	-	R

Table A- 23 Harmonics of the current

Offset	Number of registers	Name	Format	Unit	Value range	Access
19001	6	Maximum Fundamental Current a with Time	Float + time stamp	A	-	R
19007	6	Maximum Fundamental Current b with Time	Float + time stamp	A	-	R
19013	6	Maximum Fundamental Current c with Time	Float + time stamp	A	-	R
19019	6	Maximum 3rd Harmonic Current a with Time	Float + time stamp	A	-	R
19025	6	Maximum 3rd Harmonic Current b with Time	Float + time stamp	A	-	R
19031	6	Maximum 3rd Harmonic Current c with Time	Float + time stamp	A	-	R
19037	6	Maximum 5th Harmonic Current a with Time	Float + time stamp	A	-	R
19043	6	Maximum 5th Harmonic Current b with Time	Float + time stamp	A	-	R
19049	6	Maximum 5th Harmonic Current c with Time	Float + time stamp	A	-	R
19055	6	Maximum 7th Harmonic Current a with Time	Float + time stamp	A	-	R
19061	6	Maximum 7th Harmonic Current b with Time	Float + time stamp	A	-	R
19067	6	Maximum 7th Harmonic Current c with Time	Float + time stamp	A	-	R
19073	6	Maximum 9th Harmonic Current a with Time	Float + time stamp	A	-	R
19079	6	Maximum 9th Harmonic Current b with Time	Float + time stamp	A	-	R
19085	6	Maximum 9th Harmonic Current c with Time	Float + time stamp	A	-	R
19091	6	Maximum 11th Harmonic Current a with Time	Float + time stamp	A	-	R

Offset	Number of registers	Name	Format	Unit	Value range	Access
19097	6	Maximum 11th Harmonic Current b with Time	Float + time stamp	A	-	R
19103	6	Maximum 11th Harmonic Current c with Time	Float + time stamp	A	-	R
19109	6	Maximum 13th Harmonic Current a with Time	Float + time stamp	A	-	R
19115	6	Maximum 13th Harmonic Current b with Time	Float + time stamp	A	-	R
19121	6	Maximum 13th Harmonic Current c with Time	Float + time stamp	A	-	R
19127	6	Maximum 15th Harmonic Current a with Time	Float + time stamp	A	-	R
19133	6	Maximum 15th Harmonic Current b with Time	Float + time stamp	A	-	R
19139	6	Maximum 15th Harmonic Current c with Time	Float + time stamp	A	-	R
19145	6	Maximum 17th Harmonic Current a with Time	Float + time stamp	A	-	R
19151	6	Maximum 17th Harmonic Current b with Time	Float + time stamp	A	-	R
19157	6	Maximum 17th Harmonic Current c with Time	Float + time stamp	A	-	R
19163	6	Maximum 19th Harmonic Current a with Time	Float + time stamp	A	-	R
19169	6	Maximum 19th Harmonic Current b with Time	Float + time stamp	A	-	R
19175	6	Maximum 19th Harmonic Current c with Time	Float + time stamp	A	-	R
19181	6	Maximum 21st Harmonic Current a with Time	Float + time stamp	A	-	R
19187	6	Maximum 21st Harmonic Current b with Time	Float + time stamp	A	-	R
19193	6	Maximum 21st Harmonic Current c with Time	Float + time stamp	A	-	R
19199	6	Maximum 23rd Harmonic Current a with Time	Float + time stamp	A	-	R
19205	6	Maximum 23rd Harmonic Current b with Time	Float + time stamp	A	-	R
19211	6	Maximum 23rd Harmonic Current c with Time	Float + time stamp	A	-	R
19217	6	Maximum 25th Harmonic Current a with Time	Float + time stamp	A	-	R
19223	6	Maximum 25th Harmonic Current b with Time	Float + time stamp	A	-	R
19229	6	Maximum 25th Harmonic Current c with Time	Float + time stamp	A	-	R

Offset	Number of registers	Name	Format	Unit	Value range	Access
19235	6	Maximum 27th Harmonic Current a with Time	Float + time stamp	A	-	R
19241	6	Maximum 27th Harmonic Current b with Time	Float + time stamp	A	-	R
19247	6	Maximum 27th Harmonic Current c with Time	Float + time stamp	A	-	R
19253	6	Maximum 29th Harmonic Current a with Time	Float + time stamp	A	-	R
19259	6	Maximum 29th Harmonic Current b with Time	Float + time stamp	A	-	R
19265	6	Maximum 29th Harmonic Current c with Time	Float + time stamp	A	-	R
19271	6	Maximum 31st Harmonic Current a with Time	Float + time stamp	A	-	R
19277	6	Maximum 31st Harmonic Current b with Time	Float + time stamp	A	-	R
19283	6	Maximum 31st Harmonic Current c with Time	Float + time stamp	A	-	R

A.3.12 Configuration settings with the function codes 0x03, 0x04, and 0x10

Addressing the configuration settings

You can use the MODBUS function codes 0x03 and 0x04 for read accesses and 0x10 for write accesses on all the configuration settings listed below.

Table A- 24 Configuration settings

Offset	Number of registers	Name	Format	Unit	Value range		Access
50001	2	Connection type	Unsigned long	-	0 =	3P4W	RW
					1 =	3P3W	
					2 =	3P4WB	
					3 =	3P3WB	
					4 =	1P2W	
50003	2	Voltage Transformer Yes / No?	Unsigned long	-	0 =	No	RW
					1 =	Yes	
50005	2	Primary Voltage	Unsigned long	-	1 ... 999999 V		RW
50007	2	Secondary Voltage	Unsigned long	-	1 ... 690 V		RW
50009	2	Current Transformer Yes / No?	Unsigned long	-	1 =	Yes	RW
50011	2	Primary Current	Unsigned long	-	1 ... 999999 V		RW
50013	2	Secondary Current	Unsigned long	-	1 A, 5 A		RW
50017	2	Line Frequency	Unsigned long	-	-		RW

<table>
<tr><th>Offset</th><th>Number of registers</th><th>Name</th><th>Format</th><th>Unit</th><th colspan="2">Value range</th><th>Access</th></tr>
<tr><td>50019</td><td>2</td><td>Zero Point Suppression</td><td>Float</td><td>%</td><td colspan="2">0.0 ... 10.0</td><td>RW</td></tr>
<tr><td rowspan="2">50021</td><td rowspan="2">2</td><td rowspan="2">Subperiod Time</td><td rowspan="2">Unsigned long</td><td rowspan="2">-</td><td colspan="2">HIWORD:
Number of subperiods 0 ... 5[1)]</td><td rowspan="2">RW</td></tr>
<tr><td colspan="2">LOWWORD:
Length of the subperiods:
1, 2, 3, 4, 5, 6, 10, 20, 30, 60</td></tr>
<tr><td rowspan="4">50023</td><td rowspan="4">2</td><td rowspan="4">Sync</td><td rowspan="4">Unsigned long</td><td rowspan="4">-</td><td>0 =</td><td>No synchronization</td><td rowspan="4">RW</td></tr>
<tr><td>1 =</td><td>Synchronization via bus</td></tr>
<tr><td>2 =</td><td>Synchronization via DI</td></tr>
<tr><td>3 =</td><td>Internal clock</td></tr>
<tr><td rowspan="9">50025</td><td rowspan="9">2</td><td rowspan="9">DI 0.0 Type of Use</td><td rowspan="9">Unsigned long</td><td rowspan="9">-</td><td>0 =</td><td>None</td><td rowspan="9">RW</td></tr>
<tr><td>1 =</td><td>Pulse input</td></tr>
<tr><td>2 =</td><td>On / off-peak</td></tr>
<tr><td>3 =</td><td>Time synchronization</td></tr>
<tr><td>4 =</td><td>Demand sync</td></tr>
<tr><td>5 =</td><td>Status</td></tr>
<tr><td>6 =</td><td>START / STOP</td></tr>
<tr><td>7 =</td><td>COPY&RESET</td></tr>
<tr><td>8 =</td><td>RESET</td></tr>
<tr><td rowspan="2">50027</td><td rowspan="2">2</td><td rowspan="2">DI 0.0 Pulse / Edge Evaluation</td><td rowspan="2">Unsigned long</td><td rowspan="2">-</td><td>0 =</td><td>Pulse</td><td rowspan="2">RW</td></tr>
<tr><td>1 =</td><td>Edge</td></tr>
<tr><td rowspan="5">50029</td><td rowspan="5">2</td><td rowspan="5">DI 0.0 Use of Counter Information</td><td rowspan="5">Unsigned long</td><td rowspan="5">-</td><td>0 =</td><td>Import kWh</td><td rowspan="5">RW</td></tr>
<tr><td>1 =</td><td>Export kWh</td></tr>
<tr><td>2 =</td><td>Import kVARh</td></tr>
<tr><td>3 =</td><td>Export kVARh</td></tr>
<tr><td>4 =</td><td>Description</td></tr>
<tr><td>50031</td><td>2</td><td>DI 0.0 Significance of of Counter Information</td><td>Unsigned long</td><td>-</td><td colspan="2">1 ... 999</td><td>RW</td></tr>
<tr><td>50033</td><td>2</td><td>DO 0.0 Vector Group Assignment</td><td>Unsigned long</td><td>-</td><td colspan="2">0 ... 99</td><td>RW</td></tr>
</table>

Offset	Number of registers	Name	Format	Unit	Value range		Access
50035	2	DO 0.0 Type of Use	Unsigned long	-	0 =	OFF	RW
					1 =	Device ON	
					2 =	Remote output	
					3 =	Rotation	
					4 =	Lim. violation	
					5 =	Energy pulse	
					6 =	Sync	
50037	2	DO 0.0 Limit Assignment	Unsigned long	-	0 =	Limit logic	RW
					1 =	Limit 0	
					2 =	Limit 1	
					3 =	Limit 2	
					4 =	Limit 3	
					5 =	Limit 4	
					6 =	Limit 5	
50039	2	DO 0.0 Pulse / Edge Evaluation	Unsigned long	-	0 =	Pulse	RW
					1 =	Edge	
50041	2	DO 0.0 Source Count Signal	Unsigned long	-	0 =	Import kWh	RW
					1 =	Export kWh	
					2 =	Import kVARh	
					3 =	Export kVARh	
50043	2	DO 0.0 Significance of of Counter Information	Unsigned long	-	1 ... 999		RW
50045	2	DO 0.0 Pulse Length	Unsigned long	-	30 ... 500		RW
50047	2	Dialog Language	Unsigned long	-	0 =	German	RW
					1 =	English	
					2 =	Portuguese	
					3 =	Turkish	
					4 =	Spanish	
					5 =	Italian	
					6 =	Russian	
					7 =	French	
					8 =	Chinese	
50049	2	Phase labels IEC/UL	Unsigned long	-	0 =	IEC	RW
					1 =	US	

Offset	Number of registers	Name	Format	Unit	Value range	Access
50051	2	Universal counter 1 source	Unsigned long	-	0 = DI 1 = DO 2 = Limit logic 3 = Limit 0 4 = Limit 1 5 = Limit 2 6 = Limit 3 7 = Limit 4 8 = Limit 5 9 = Limit 6 10 = Limit 7 11 = Limit 8 12 = Limit 9 13 = Limit 10 14 = Limit 11	RW
50053	2	Display Refresh Cycle	Unsigned long	ms	330 ... 3000	RW
50055	2	Display Contrast	Unsigned long	-	0 ... 10	RW
50057	2	Display Backlight Level	Unsigned long	%	0 ... 3	RW
50059	2	Display Backlight Dimmed	Unsigned long	%	0 ... 3	RW
50061	2	Display Time Until Dimmed	Unsigned long	min	0 ... 99	RW
50063	2	Limit 0 ON / OFF	Unsigned long	-	0 = OFF 1 = ON	RW
50065	2	Limit 0 Hysteresis	Float	&	0.0 ... 20.0	RW
50067	2	Limit 0 Pickup Delay	Unsigned long	s	0 ... 10	RW
50071	2	Limit 0 Source	Unsigned long	-	0 ... 241[2)]	RW
50073	2	Limit 0 Value	Float	-	-	RW
50075	2	Limit 0 Mode ≥/<	Unsigned long	-	0 = Greater than 1 = Lower than	RW
50077	2	Limit 1 ON / OFF	Unsigned long	-	0 = OFF 1 = ON	RW
50079	2	Limit 1 Hysteresis	Float	%	0.0 ... 20.0	RW
50081	2	Limit 1 Pickup Delay	Unsigned long	s	0 ... 10	RW
50085	2	Limit 1 Source	Unsigned long	-	0 ... 241[2)]	RW
50087	2	Limit 1 Value	Float	-	-	RW
50089	2	Limit 1 Mode ≥/<	Unsigned long	-	0 = Greater than 1 = Lower than	RW
50091	2	Limit 2 ON / OFF	Unsigned long	-	0 = OFF 1 = ON	RW
50093	2	Limit 2 Hysteresis	Float	%	0.0 ... 20.0	RW
50095	2	Limit 2 Pickup Delay	Unsigned long	s	0 ... 10	RW
50099	2	Limit 2 Source	Unsigned long	-	0 ... 241[2)]	RW

Offset	Number of registers	Name	Format	Unit	Value range	Access
50101	2	Limit 2 Value	Float	-	-	RW
50103	2	Limit 2 Mode ≥/<	Unsigned long	-	0 = Greater than 1 = Lower than	RW
50105	2	Limit 3 ON / OFF	Unsigned long	-	0 = OFF 1 = ON	RW
50107	2	Limit 3 Hysteresis	Float	%	0.0 ... 20.0	RW
50109	2	Limit 3 Pickup Delay	Unsigned long	s	0 ... 10	RW
50113	2	Limit 3 Source	Unsigned long	-	0 ... 241[2)]	RW
50115	2	Limit 3 Value	Float	-	-	RW
50117	2	Limit 3 Mode ≥/<	Unsigned long	-	0 = Greater than 1 = Lower than	RW
50119	2	Limit 4 ON / OFF	Unsigned long	-	0 = OFF 1 = ON	RW
50121	2	Limit 4 Hysteresis	Float	%	0.0 ... 20.0	RW
50123	2	Limit 4 Pickup Delay	Unsigned long	s	0 ... 10	RW
50127	2	Limit 4 Source	Unsigned long	-	0 ... 241[2)]	RW
50129	2	Limit 4 Value	Float	-	-	RW
50131	2	Limit 4 Mode ≥/<	Unsigned long	-	0 = Greater than 1 = Lower than	RW
50133	2	Limit 5 ON / OFF	Unsigned long	-	0 = OFF 1 = ON	RW
50135	2	Limit 5 Hysteresis	Float	%	0.0 ... 20.0	RW
50137	2	Limit 5 Pickup Delay	Unsigned long	s	0 ... 10	RW
50141	2	Limit 5 Source	Unsigned long	-	0 ... 241[2)]	RW
50143	2	Limit 5 Value	Float	-	-	RW
50145	2	Limit 5 Mode ≥/<	Unsigned long	-	0 = Greater than 1 = Lower than	RW
50147	2	Limit 6 ON / OFF	Unsigned long	-	0 = OFF 1 = ON	RW
50149	2	Limit 6 Hysteresis	Float	%	0.0 ... 20.0	RW
50151	2	Limit 6 Pickup Delay	Unsigned long	s	0 ... 10	RW
50155	2	Limit 6 Source	Unsigned long	-	0 ... 241[2)]	RW
50157	2	Limit 6 Value	Float	-	-	RW
50159	2	Limit 6 Mode ≥/<	Unsigned long	-	0 = Greater than 1 = Lower than	RW
50161	2	Limit 7 ON / OFF	Unsigned long	-	0 = OFF 1 = ON	RW
50163	2	Limit 7 Hysteresis	Float	%	0.0 ... 20.0	RW
50165	2	Limit 7 Pickup Delay	Unsigned long	s	0 ... 10	RW
50169	2	Limit 7 Source	Unsigned long	-	0 ... 241[2)]	RW
50171	2	Limit 7 Value	Float	-	-	RW

Offset	Number of registers	Name	Format	Unit	Value range	Access
50173	2	Limit 7 Mode ≥/<	Unsigned long	-	0 = Greater than 1 = Lower than	RW
50175	2	Limit 8 ON / OFF	Unsigned long	-	0 = OFF 1 = ON	RW
50177	2	Limit 8 Hysteresis	Float	%	0.0 ... 20.0	RW
50179	2	Limit 8 Pickup Delay	Unsigned long	s	0 ... 10	RW
50183	2	Limit 8 Source	Unsigned long	-	0 ... 241[2)]	RW
50185	2	Limit 8 Value	Float	-	-	RW
50187	2	Limit 8 Mode ≥/<	Unsigned long	-	0 = Greater than 1 = Lower than	RW
50189	2	Limit 9 ON / OFF	Unsigned long	-	0 = OFF 1 = ON	RW
50191	2	Limit 9 Hysteresis	Float	%	0.0 ... 20.0	RW
50193	2	Limit 9 Pickup Delay	Unsigned long	s	0 ... 10	RW
50197	2	Limit 9 Source	Unsigned long	-	0 ... 241[2)]	RW
50199	2	Limit 9 Value	Float	-	-	RW
50201	2	Limit 9 Mode ≥/<	Unsigned long	-	0 = Greater than 1 = Lower than	RW
50203	2	Limit 10 ON / OFF	Unsigned long	-	0 = OFF 1 = ON	RW
50205	2	Limit 10 Hysteresis	Float	%	0.0 ... 20.0	RW
50207	2	Limit 10 Pickup Delay	Unsigned long	s	0 ... 10	RW
50211	2	Limit 10 Source	Unsigned long	-	0 ... 241[2)]	RW
50213	2	Limit 10 Value	Float	-	-	RW
50215	2	Limit 10 Mode ≥/<	Unsigned long	-	0 = Greater than 1 = Lower than	RW
50217	2	Limit 11 ON / OFF	Unsigned long	-	0 = OFF 1 = ON	RW
50219	2	Limit 11 Hysteresis	Float	%	0.0 ... 20.0	RW
50221	2	Limit 11 Pickup Delay	Unsigned long	s	0 ... 10	RW
50225	2	Limit 11 Source	Unsigned long	-	0 ... 241[2)]	RW
50227	2	Limit 11 Value	Float	-	-	RW
50229	2	Limit 11 Mode ≥/<	Unsigned long	-	0 = Greater than 1 = Lower than	RW
50231	2	Date format	Unsigned long	-	0 = dd.mm.yyyy 1 = mm/dd/yy 2 = yyyy-mm-dd	RW

Offset	Number of registers	Name	Format	Unit	Value range		Access
50233	2	Daylight Saving	Unsigned long	-	0 =	No	RW
					1 =	Auto EU	
					2 =	Auto US	
					3 =	Table for individual time change	
50235	2	Time Zone	Long	min	MODULO(30)==0		RW
50237	2	Averaging Time Sliding Window Demands	Unsigned long	s	3.5.10.30.60.300.600. 900		RW
50239	2	Used Type of Reactive Power	Unsigned long	-	0 =	VARn	RW
					1 =	VARtot	
					2 =	VAR1	
50241	2	Universal Counter 1 DI count signal	Unsigned long	-	Byte 2	Port	RW
					Byte 2	0 ... 11	
					Byte 3	Bit	
					Byte 3	0 ... 7	
50243	2	Current Direction a	Unsigned long	-	0 =	Normal	RW
					1 =	Inverted	
50245	2	Current Direction b	Unsigned long	-	0 =	Normal	RW
					1 =	Inverted	
50247	2	Current Direction c	Unsigned long	-	0 =	Normal	RW
					1 =	Inverted	
50249	2	Measuring Threshold Operating Hours Counter	Unsigned long	%	0 ... 10		RW
50251	2	Universal counter 2 source	Unsigned long	-	0 =	DI	RW
					1 =	DO	
					2 =	Limit logic	
					3 =	Limit 0	
					4 =	Limit 1	
					5 =	Limit 2	
					6 =	Limit 3	
					7 =	Limit 4	
					8 =	Limit 5	
					9 =	Limit 6	
					10 =	Limit 7	
					11 =	Limit 8	
					12 =	Limit 9	
					13 =	Limit 10	
					14 =	Limit 11	

<table>
<tr><th>Offset</th><th>Number of registers</th><th>Name</th><th>Format</th><th>Unit</th><th colspan="2">Value range</th><th>Access</th></tr>
<tr><td rowspan="4">50253</td><td rowspan="4">2</td><td rowspan="4">Universal Counter 2 DI count signal</td><td rowspan="4">Unsigned long</td><td rowspan="4">-</td><td>Byte 2</td><td>Port</td><td rowspan="4">RW</td></tr>
<tr><td>Byte 2</td><td>0 ... 11</td></tr>
<tr><td>Byte 3</td><td>Bit</td></tr>
<tr><td>Byte 3</td><td>0 ... 7</td></tr>
<tr><td>61167</td><td>7</td><td>Digital Input Parameters</td><td>Unsigned long</td><td>-</td><td colspan="2">uchar</td><td>RW</td></tr>
<tr><td>61175</td><td>7</td><td>Digital Output Parameters</td><td>stOutputPara</td><td>-</td><td colspan="2">uchar</td><td>RW</td></tr>
<tr><td>62101</td><td>8</td><td>Event Recording Parameters</td><td>stEventPara</td><td>-</td><td colspan="2">uchar</td><td>RW</td></tr>
<tr><td>62301</td><td>27</td><td>Logically Combined Limit Parameters</td><td>stCombLimitPara</td><td>-</td><td colspan="2">-</td><td>RW</td></tr>
</table>

1) Subperiods 0 and 1: Fixed block method; subperiods 0 to 5: Rolling block method

2) More information is given in the chapter under the also-see link.

See also

Value range for limit source (Page 262)

A.3.13 Value range for limit source

Assignment of the value range for the Limit x Source parameter

Table A- 25 Assignment of the values 0 to 241

Value	Assignment
0 =	Voltage a-n
1 =	Voltage b-n
2 =	Voltage c-n
3 =	Voltage a-b
4 =	Voltage b-c
5 =	Voltage c-a
6 =	Current a
7 =	Current b
8 =	Current c
9 =	Apparent Power a
10 =	Apparent Power b
11 =	Apparent Power c
12 =	Active Power a
13 =	Active Power b
14 =	Active Power c
15 =	Reactive Power a (VARn)
16 =	Reactive Power b (VARn)

Value	Assignment
17 =	Reactive Power c (VARn)
18 =	Sliding Window Demand Voltage a-n
19 =	Sliding Window Demand Voltage b-n
20 =	Sliding Window Demand Voltage c-n
21 =	Sliding Window Demand Voltage a-b
22 =	Sliding Window Demand Voltage b-c
23 =	Sliding Window Demand Voltage c-a
24 =	Sliding Window Demand Current a
25 =	Sliding Window Demand Current b
26 =	Sliding Window Demand Current c
27 =	Sliding Window Demand Apparent Power a
28 =	Sliding Window Demand Apparent Power b
29 =	Sliding Window Demand Apparent Power c
30 =	Sliding Window Demand Active Power a
31 =	Sliding Window Demand Active Power b
32 =	Sliding Window Demand Active Power c
33 =	Sliding Window Demand Reactive Power a (VARn)
34 =	Sliding Window Demand Reactive Power b (VARn)
35 =	Sliding Window Demand Reactive Power c (VARn)
36 =	Sliding Window Demand Total Reactive Power a (VARtot)
37 =	Sliding Window Demand Total Reactive Power b (VARtot)
38 =	Sliding Window Demand Total Reactive Power c (Qtot)
39 =	Sliding Window Demand Reactive Power a (VAR1)
40 =	Sliding Window Demand Reactive Power b (VAR1)
41 =	Sliding Window Demand Reactive Power c (VAR1)
42 =	Sliding Window Demand Power Factor a
43 =	Sliding Window Demand Power Factor b
44 =	Sliding Window Demand Power Factor c
45 =	Power Factor a
46 =	Power Factor b
47 =	Power Factor c
48 =	THD Voltage a
49 =	THD Voltage b
50 =	THD Voltage c
51 =	THD Current a
52 =	THD Current b
53 =	THD Current c
54 =	THD Voltage a-b
55 =	THD Voltage b-c
56 =	THD Voltage c-a
57 =	Reactive power a (VAR1)
58 =	Reactive power b (Q1)

Value	Assignment
59 =	Reactive power c (Q1)
60 =	Total Reactive Power a (VARtot)
61 =	Total Reactive Power b (VARtot)
62 =	Total Reactive Power c (VARtot)
63 =	Cos φ a
64 =	Cos φ b
65 =	Cos φ c
66 =	Distortion Current a
67 =	Distortion Current b
68 =	Distortion Current c
69 =	Phase Angle a-a
70 =	Phase Angle a-b
71 =	Phase Angle a-c
72 =	Displacement Angle a
73 =	Displacement Angle b
74 =	Displacement Angle c
75 =	Line Frequency
76 =	3-Phase Average Voltage ph-n
77 =	3-Phase Average Voltage ph-ph
78 =	3-Phase Average Current
79 =	Total Apparent Power
80 =	Total active power
81 =	Total Reactive Power (VARn)
82 =	Total Reactive Power (VAR1)
83 =	Total Reactive Power (VARtot)
84 =	Sliding Window Demand Total Apparent Power
85 =	Sliding Window Demand Total Active Power
86 =	Sliding Window Demand Total Power Factor
87 =	Sliding Window Demand Total Reactive Power (VARn)
88 =	Sliding Window Demand Total Reactive Power (VAR1)
89 =	Sliding Window Demand Total Reactive Power (VARtot)
90 =	Total Power Factor
91 =	Amplitude Unbalance Voltage
92 =	Amplitude Unbalance Current
93 =	Unbalance Voltage
94 =	Unbalance Current
95 =	Neutral Current
96 =	Sliding Window Demand Neutral Current
97 =	Fundamental Voltage a-n
98 =	Fundamental Voltage b-n
99 =	Fundamental Voltage c-n
100 =	3rd Harmonic Voltage a-n

Value	Assignment
101 =	3rd Harmonic Voltage b-n
102 =	3rd Harmonic Voltage c-n
103 =	5th Harmonic Voltage a-n
104 =	5th Harmonic Voltage b-n
105 =	5th harmonic voltage c-n
106 =	7th Harmonic Voltage a-n
107 =	7th Harmonic Voltage b-n
108 =	7th Harmonic Voltage c-n
109 =	9th Harmonic Voltage a-n
110 =	9th Harmonic Voltage b-n
111 =	9th Harmonic Voltage c-n
112 =	11th Harmonic Voltage a-n
113 =	11th Harmonic Voltage b-n
114 =	11th Harmonic Voltage c-n
115 =	13th Harmonic Voltage a-n
116 =	13th Harmonic Voltage b-n
117 =	13th Harmonic Voltage c-n
118 =	15th Harmonic Voltage a-n
119 =	15th Harmonic Voltage b-n
120 =	15th Harmonic Voltage c-n
121 =	17th Harmonic Voltage a-n
122 =	17th Harmonic Voltage b-n
123 =	17th Harmonic Voltage c-n
124 =	19th Harmonic Voltage a-n
125 =	19th Harmonic Voltage b-n
126 =	19th Harmonic Voltage c-n
127 =	21st Harmonic Voltage a-n
128 =	21st Harmonic Voltage b-n
129 =	21st Harmonic Voltage c-n
130 =	23rd Harmonic Voltage a-n
131 =	23rd Harmonic Voltage b-n
132 =	23rd Harmonic Voltage c-n
133 =	25th Harmonic Voltage a-n
134 =	25th Harmonic Voltage b-n
135 =	25th Harmonic Voltage c-n
136 =	27th Harmonic Voltage a-n
137 =	27th Harmonic Voltage b-n
138 =	27th Harmonic Voltage c-n
139 =	29th Harmonic Voltage a-n
140 =	29th Harmonic Voltage b-n
141 =	29th Harmonic Voltage c-n
142 =	31st Harmonic Voltage a-n

Value	Assignment
143 =	31st Harmonic Voltage b-n
144 =	31st Harmonic Voltage c-n
145 =	Fundamental Voltage a-b
146 =	Fundamental Voltage b-c
147 =	Fundamental Voltage c-a
148 =	3rd Harmonic Voltage a-b
149 =	3rd Harmonic Voltage b-c
150 =	3rd Harmonic Voltage c-a
151 =	5th Harmonic Voltage a-b
152 =	5th Harmonic Voltage b-c
153 =	5th Harmonic Voltage c-a
154 =	7th Harmonic Voltage a-b
155 =	7th Harmonic Voltage b-c
156 =	7th Harmonic Voltage c-a
157 =	9th Harmonic Voltage a-b
158 =	9th Harmonic Voltage b-c
159 =	9th Harmonic Voltage c-a
160 =	11th Harmonic Voltage a-b
161 =	11th Harmonic Voltage b-c
162 =	11th Harmonic Voltage c-a
163 =	13th Harmonic Voltage a-b
164 =	13th Harmonic Voltage b-c
165 =	13th Harmonic Voltage c-a
166 =	15th Harmonic Voltage a-b
167 =	15th Harmonic Voltage b-c
168 =	15th Harmonic Voltage c-a
169 =	17th Harmonic Voltage a-b
170 =	17th Harmonic Voltage b-c
171 =	17th Harmonic Voltage c-a
172 =	19th Harmonic Voltage a-b
173 =	19th Harmonic Voltage b-c
174 =	19th Harmonic Voltage c-a
175 =	21st Harmonic Voltage a-b
176 =	21st Harmonic Voltage b-c
177 =	21st Harmonic Voltage c-a
178 =	23rd Harmonic Voltage a-b
179 =	23rd Harmonic Voltage b-c
180 =	23rd Harmonic Voltage c-a
181 =	25th Harmonic Voltage a-b
182 =	25th Harmonic Voltage b-c
183 =	25th Harmonic Voltage c-a
184 =	27th Harmonic Voltage a-b

Value	Assignment
185 =	27th Harmonic Voltage b-c
186 =	27th Harmonic Voltage c-a
187 =	29th Harmonic Voltage a-b
188 =	29th Harmonic Voltage b-c
189 =	29th Harmonic Voltage c-a
190 =	31st Harmonic Voltage a-b
191 =	31st Harmonic Voltage b-c
192 =	31st Harmonic Voltage c-a
193 =	Fundamental Current a
194 =	Fundamental Current b
195 =	Fundamental Current c
196 =	3rd Harmonic Current a
197 =	3rd Harmonic Current b
198 =	3rd Harmonic Current c
199 =	5th Harmonic Current a
200 =	5th Harmonic Current b
201 =	5th Harmonic Current c
202 =	7th Harmonic Current a
203 =	7th Harmonic Current b
204 =	7th Harmonic Current c
205 =	9th Harmonic Current a
206 =	9th Harmonic Current b
207 =	9th Harmonic Current c
208 =	11th Harmonic Current a
209 =	11th Harmonic Current b
210 =	11th Harmonic Current c
211 =	13th Harmonic Current a
212 =	13th Harmonic Current b
213 =	13th Harmonic Current c
214 =	15th Harmonic Current a
215 =	15th Harmonic Current b
216 =	15th Harmonic Current c
217 =	17th Harmonic Current a
218 =	17th Harmonic Current b
219 =	17th Harmonic Current c
220 =	19th Harmonic Current a
221 =	19th Harmonic Current b
222 =	19th Harmonic Current c
223 =	21st Harmonic Current a
224 =	21st Harmonic Current b
225 =	21st Harmonic Current c
226 =	23rd Harmonic Current a

Value	Assignment
227 =	23rd Harmonic Current b
228 =	23rd Harmonic Current c
229 =	25th Harmonic Current a
230 =	25th Harmonic Current b
231 =	25th Harmonic Current c
232 =	27th Harmonic Current a
233 =	27th Harmonic Current b
234 =	27th Harmonic Current c
235 =	29th Harmonic Current a
236 =	29th Harmonic Current b
237 =	29th Harmonic Current c
238 =	31st Harmonic Current a
239 =	31st Harmonic Current b
240 =	31st Harmonic Current c
241 =	Process operating hours counter

See also

Configuration settings with the function codes 0x03, 0x04, and 0x10 (Page 255)

Measured variables (Page 199)

A.3.14 Communication settings with the function codes 0x03, 0x04, and 0x10

Addressing the communication settings

Table A- 26 Communication settings

Offset	Number of registers	Name	Format	Unit	Applicable MODBUS function codes	Value range	Access
63001	2	IP Address	Unsigned long	-	• 0x03 • 0x04 • 0x10	0 ... FFFFFFFFh	RW
63003	2	Subnetmask	Unsigned long	-	• 0x03 • 0x04 • 0x10	0 ... FFFFFFFFh	RW
63005	2	Gateway	Unsigned long	-	• 0x03 • 0x04 • 0x10	0 ... FFFFFFFFh	RW
63007	2	Bootloader Version	Unsigned long	-	• 0x03 • 0x04	char, uchar, uchar, uchar	R

Offset	Number of registers	Name	Format	Unit	Applicable MODBUS function codes	Value range	Access
63009	2	Password Protection ON/OFF	Unsigned long	-	• 0x03 • 0x04	0 = OFF 1 = ON	R
63011	2	Manufacturing Date	Unsigned long	-	• 0x03 • 0x04 • 0x10	[Date information]	R
63015	2	Ethernet Protocol	Unsigned long	-	• 0x03 • 0x04 • 0x10	0 = MODBUS TCP	RW
63017	2	Protocol Module Interface 1	Unsigned long	-	• 0x03 • 0x04 • 0x10	0 = MODBUS TCP 1 = SEAbus serial 2 = Serial gateway 3 = Modbus gateway	RW
63019	2	Address Module Interface 1	Unsigned long	-	• 0x03 • 0x04 • 0x10	1 ... 247	RW
63021	2	Baudrate Module Interface 1	Unsigned long	-	• 0x03 • 0x04 • 0x10	0 = 4800 baud 1 = 9600 baud 2 = 19 200 baud 3 = 38 400 baud	RW
63023	2	Format Module Interface 1	Unsigned long	-	• 0x03 • 0x04 • 0x10	0 = 8N2 1 = 8E1 2 = 8O1 3 = 8N1	RW
63025	2	Response Time Module Interface 1	Unsigned long	ms	• 0x03 • 0x04 • 0x10	0 ... 255	RW
63033	2	Protocol Module Interface 2	Unsigned long	-	• 0x03 • 0x04 • 0x10	0 = MODBUS RTU 1 = SEAbus serial 2 = Serial gateway 3 = Modbus gateway	RW
63035	2	Address Module Interface 2	Unsigned long	-	• 0x03 • 0x04 • 0x10	1 ... 247	RW

Offset	Number of registers	Name	Format	Unit	Applicable MODBUS function codes	Value range		Access
63037	2	Baudrate Module Interface 1	Unsigned long	-	• 0x03 • 0x04 • 0x10	0 =	4800 baud	RW
						1 =	9600 baud	
						2 =	19 200 baud	
						3 =	38 400 baud	
63039	2	Format Module Interface 2	Unsigned long	-	• 0x03 • 0x04 • 0x10	0 =	8N2	RW
						1 =	8E1	
						2 =	8O1	
						3 =	8N1	
63041	2	Response Time Module Interface 1	Unsigned long	ms	• 0x03 • 0x04 • 0x10	0 ... 255		RW
63043	2	TCP/IP port gateway module interface 1	Unsigned long	ms	• 0x03 • 0x04 • 0x10	1-ffffh		RW
63045	2	TCP/IP Port Gateway Module Interface 2	Unsigned long	ms	• 0x03 • 0x04 • 0x10	1-ffffh		RW
63065	2	PROFIBUS ID PAC4200	Unsigned long	-	• 0x03 • 0x04	8173h		R

A.3.15 I&M settings

Addressing the settings for the I&M data

Table A- 27 Settings for the I&M data

Offset	Number of registers	Name	Format	Unit	Applicable MODBUS function codes	Value range	Access
64001	27	IM Data PAC4200	stIM0	-	• 0x03 • 0x04	-	R(W)
64028	89	IM 0 to IM 4 Data PAC4200	stIM14	-	• 0x03 • 0x04 • 0x10	-	RW
64117	27	IM Data Module Interface 1	stIM0-	-	• 0x03 • 0x04	-	R(W)
64144	27	IM Data Module Interface 2	stIM0	-	• 0x03 • 0x04	-	R(W)

A.3.16 Commands with the function code 0x06

Addressing the commands

Table A- 28 Commands

Offset	Number of registers	Name	Format	Applicable MODBUS function codes	Value range		Access
60002	1	Reset maximum values	Unsigned short	0x06	0		W
60003	1	Reset minimum values	Unsigned short	0x06	0		W
60004	1	Reset energy counters	Unsigned short	0x06	0 =	All	W
					1 =	Active energy import tariff 1	
					2 =	Active energy import tariff 2	
					3 =	Active energy export tariff 1	
					4 =	Active energy export tariff 2	
					5 =	Reactive energy import tariff 1	
					6 =	Reactive energy import tariff 2	
					7 =	Reactive energy export tariff 1	
					8 =	Reactive energy export tariff 2	
					9 =	Apparent energy tariff 1	
					10 =	Apparent energy tariff 2	
					11 =	Process active energy	
					12 =	Process reactive energy	
					13 =	Process apparent energy	
60005	1	Synchronization of demand period	Unsigned short	0x06	1 ... 60 min		W
60006	1	Switching tariff	Unsigned short	0x06	0 =	On-peak tariff	W
					1 =	Off-peak tariff	
60007	1	Acknowledge diagnostics bits	Unsigned short	0x06	0-ffffh		W

Offset	Number of registers	Name	Format	Applicable MODBUS function codes	Value range		Access
60008	1	Switching outputs (if parameterized)	Unsigned short	0x06	Byte 0 Bit 4 and Bit 7	Ports 0 ... 11	W
					Byte 0 Bits 0 ... 3	Port bit numbers 0 ... 7	
					Byte 1 = 0	Output port. Port bit number OFF	
					Byte 1 = 1	Output port. Port bit number ON	
60009	1	Switching command for vector group	Unsigned short	0x06	Hi 0 ... 99, Lo 0 ... 1		W
					HiByte	Group assignment	
					LoByte	0 = ON 1 = OFF	
60010	1	Resetting the day energy counter	Unsigned short	0x06	815		W
60011	1	Reset load profile recording	Unsigned short	0x06	815		W
60012	1	Reset event recording	Unsigned short	0x06	815		W
60013	1	Set standard event recording conditions	Unsigned short	0x06	815		W
60014	1	Set standard I/O parameters	Unsigned short	0x06	815		W
65292	2	Increment date / time	Unsigned long	0x10	1-FFFFFFFFh[1)]		W

[1)] Time stamp low → adds the time stamp low to the current date and the current time

A.3.17 MODBUS standard device identification with the function code 0x2B

Addressing the MODBUS standard device identification

You can use MODBUS function code 0x2B on these device identification parameters.

Table A- 29 MODBUS standard device identification parameters

Object ID	Name	Format	Access
OID 0	Manufacturer	String	R
OID 1	Manufacturer device name	String	R
OID 2	Firmware version / bootloader version	String	R

See also

Measured variables without a time stamp with the function codes 0x03 and 0x04 (Page 226)

A.4 Comprehensive suppport from A to Z

For more information, please see the following links:

Useful links

Table A- 30 Product information

Website	The website provides rapid and targeted information on our pioneering products and systems.	Link (http://www.siemens.com/lowvoltage)
Newsletter	Constantly updated information on the subject of low-voltage power distribution.	Link (http://www.siemens.com/lowvoltage/newsletter)

Table A- 31 Product information / product and system selection

Information and Download Center	• Current catalogs • Customer magazines • Brochures • Demonstration software • Promotion packages	Link (http://www.siemens.com/lowvoltage/infomaterial)

Table A- 32 Product and system selection

Industry Mall	Platform for e-business and product information. 24/7 access to a comprehensive information and ordering platform for our complete low-voltage controls and distribution portfolio, including: • Selection tools • Product and system configurators • Availability check • Order tracking	Link (http://www.siemens.com/lowvoltage/mall)

Table A- 33 Product documentation

Service & Support Portal	Comprehensive technical information from the planning phase through configuration to operation. 24/7, 365 days a year. • Product data sheets • Manuals / operating instructions • Certificates • Characteristic curves • Downloads • FAQs	Link (http://www.siemens.com/lowvoltage/support)
CAx DVD	Configuration-relevant CAx data on SENTRON is available on DVD: • Commercial and technical product master data • 2D dimension drawings • Isometric illustrations • 3D models • Product data sheets • Tender specifications	Link (http://www.siemens.com/lowvoltage/mall) Order number: E86060-D1000-A207-A6-6300
Image Database	Free downloads in several different versions are available from the image database: • All current product photos • 2D dimension drawings • Isometric illustrations • 3D models • Device circuit diagrams • Symbols	Link (http://www.siemens.com/lowvoltage/picturedb)

Table A- 34 Product training

SITRAIN Portal	Comprehensive training program to expand your knowledge about our products, systems, and engineering tools	Link (http://www.siemens.com/lowvoltage/training)

ESD guidelines

B

B.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

CAUTION

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.

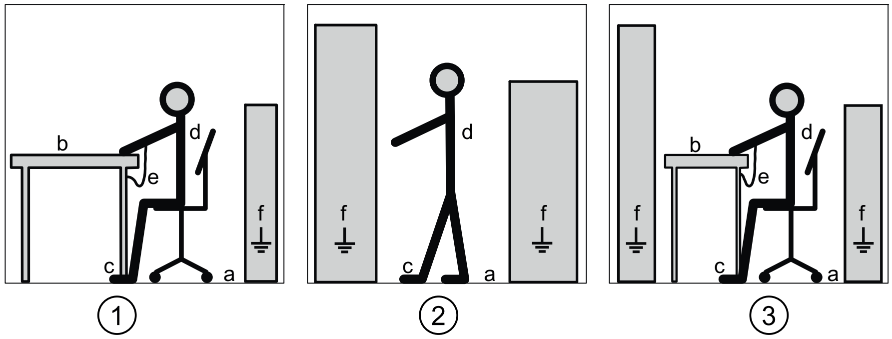
- You must discharge your body electrostatically immediately before touching an electronic component. To do this, touch a conductive, grounded object, e.g., a bare metal part of a switch cabinet or the water pipe.
- Always hold the component by the plastic enclosure.
- Electronic modules should not be 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. metallized plastic or metal containers. Leave the component in its packaging until installation.

CAUTION

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 C

C.1 Abbreviations

Overview

Table C- 1 Meaning of abbreviations

Abbreviation	Meaning
ANSI	American National Standards Institute
AWG	American Wire Gauge
CE	Communautés Européennes (French for "European Union")
CSA	Canadian Standards Association
DIN	Deutsches Institut für Normierung e. V.
DP	Distributed I/Os
EC	European Union
ESD	Electrostatic sensitive devices
EIA	Electronic Industries Alliance
EMC	Electromagnetic compatibility
EN	European Standard
EU	European Union
FCC	Federal Communications Commission
GSD	Device master data
High/Low tariff:	High tariff/low tariff
I&M	Information and Maintenance
ID	Identification number
IEC	International Electrotechnical Commission
IP	International Protection
ISO	International Standardization Organization
MAC	Media Access Control
NAFTA	North American Free Trade Agreement
NEMA	National Electrical Manufacturers Association
CEST	Central European Summertime
PAC	Power Analysis & Control
RJ	Registered Jack
Ring lug terminals	Ring lug terminals
RS	Formerly: Radio Selector; now usually: Recommended Standard
RTU	Remote Terminal Unit
TCP/IP	Transmission Control Protocol/Internet Protocol
THD	Total Harmonic Distortion; German: Gesamte Harmonische Verzerrung

Abbreviation	Meaning
THD-R	Relative THD
TIA	Totally Integrated Automation
TRMS	True Root Mean Square
UL	Underwriters Laboratories Inc.
RLO	Result of logic operation

Glossary

100BaseT

Fast Ethernet standard (100 Mbit/s) for data transmission on twisted-pair cables.

10BaseT

Standard for the transmission of 10 Mbit/s Ethernet on twisted-pair cables.

Autonegotiation

Ability of a device to automatically detect the fastest possible transmission rate, and to send and receive at this rate.

AWG

American Wire Gauge (AWG) is a specification for wire diameters that is mainly used in North America.

Bus

Shared transmission path over which all devices on the communication bus are connected. It has two defined ends. In the case of PROFIBUS, the bus is a twisted pair or optical fiber cable.

Bus system

All nodes physically connected to a bus cable form a bus system.

Demand period

Period to which the calculation of the power demand refers. A demand period is typically 15, 30, or 60 minutes long.

A distinction is made between the current period and the instantaneous period. The current period is the last completed period. The instantaneous period is the period still in progress and has not yet been completed.

Equipotential bonding

Electrical connection (equipotential bonding conductor) which brings the bodies of electronic equipment and foreign conductive bodies to an equal or approximately equal potential. This prevents disruptive or dangerous voltages between these bodies.

Firmware

Device operating software. The firmware is stored in the device's electronic components.

Load profile memory

Device data memory for storing performance data, including associated identifying characteristics such as a time stamp.

MDI-X auto crossover

Ability of the interface to detect the send and receive lines of the connected device autonomously and adjust to them. This prevents malfunctions resulting from mismatching send and receive wires. Both crossed and uncrossed cables can be used.

PROFIBUS

PROCESS FIELDBUS, a European process and fieldbus standard defined in the PROFIBUS standard EN 50170, Volume 2 PROFIBUS. Specifies the functional, electrical and mechanical characteristics of a serial bit stream fieldbus system.

PROFIBUS is a bus system that connects PROFIBUS-compatible automation systems and field devices together at the cell level and field level.

RJ45

Symmetrical connector for data lines that is also known as a Western connector or a Western plug. This is a widely used plug connector in telephone and ISDN technology which is used in LAN installations in the office environment.

RMS

Root-mean-square value of a signal that changes as a function of time.

TCP/IP

Transport Control Protocol / Internet Protocol, the de-facto standard; protocol for worldwide communication over Ethernet.

Twisted pair

Data cable with twisted-wire pairs; the twist in the wire pairs provides good transmission properties and prevents electromagnetic interference. Twisted-pair cables are available in different qualities for different transmission rates.

UTC

Universal Time Coordinated. International reference time to which the worldwide time zone system refers. Has replaced Greenwich Mean Time (GMT).

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SENTRON PAC4200

Functional expansion V2.0.0

Contents

1. User-defined default menu

In the as-delivered state and after a reset to factory settings, the device always starts with menu display "1.0".

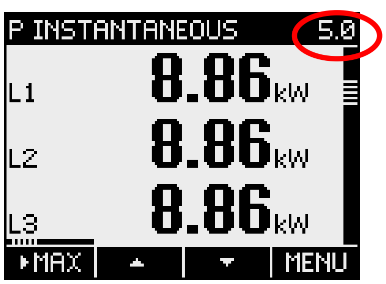
The PAC4200 allows the user to customize the default menu. This menu appears after a restart and after idling.

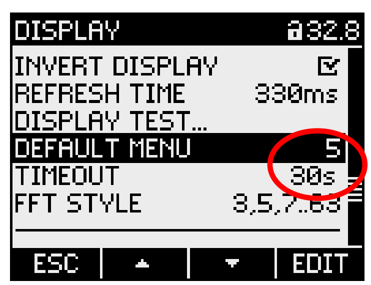
It can be configured under the ***"Display"*** submenu of the ***"Settings"*** menu.

"Default menu" menu item	The menu display number for the default menu can be entered here. The device always starts up with the menu display defined here. 1 – 28 (default setting 1)
"Timeout" menu item	The menu display time can be specified here. When the specified time has elapsed, the device automatically returns to the defined default menu. 0 – 3600s (default setting 0 - function deactivated) Pressing any key restarts the timer.

<u>Example:</u>

1. Menu display number 5.0 is to be defined as the default menu. The device should always return to the defined default menu after 30 seconds.
2. Select menu display number **5** in the "Default menu" menu item.
3. Select **30s** in the "Timeout" menu item.





4. After 30 seconds in the idle state, the device automatically switches to the menu display with the number **5.0**.

1.1 Setting parameters by Modbus command

Offset FC 0x03 FC 0x04 FC 0x10	Number of registers	Name	Format	Value range	Access
50261	2	Default Menu No	unsigned long	DISPLAYED MENU NUMBER: 1 MEAS_VLN 2 MEAS_VLL 3 MEAS_I 4 MEAS_S 5 MEAS_P 6 MEAS_Q 7 MEAS_SPQ 8 MEAS_PF 9 MEAS_PFSUM 10 MEAS_COS 11 MEAS_F 12 MEAS_THDU 13 MEAS_THDI 14 MEAS_PHASOR 15 HARMONICS_U 16 HARMONICS_U_PHPH 17 HARMONICS_I 18 MEAS_WORK_S 19 MEAS_WORK_P 20 MEAS_WORK_Q 21 MEAS_COUNTER 22 MEAS_WORKHOUR 23 MEAS_IMBALPHASE 24 DIAGNOSTIC 25 USER_DEFINED_SCREEN_0 26 USER_DEFINED_SCREEN_1 27 USER_DEFINED_SCREEN_2 28 USER_DEFINED_SCREEN_3	rw
50263	2	Timeout for returning to Default Menu	unsigned long	0..3600s	Rw

2. Protection against manipulation

The PAC4200 is equipped with a range of mechanisms to protect against deliberate and inadvertent device manipulation.

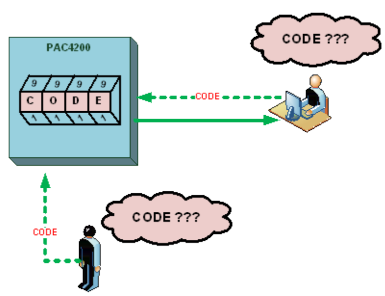
- Password protection
- Hardware write protection
- Device access control (IP filter)
- Configurable Modbus TCP port

2.1 Password protection

Password protection prevents write access via the device interface and the communication ports, in particular:

- Changing of device settings, including password
- Changing and deleting of values/parameters
- Deleting of data and memory content
- Setting and resetting of counts
- Resetting to factory settings

Reading out of measured values and memory content is still possible when password protection is active.



As soon as the password has been entered in the device once, it is not requested again as long as the ***"Settings"*** menu level remains active.

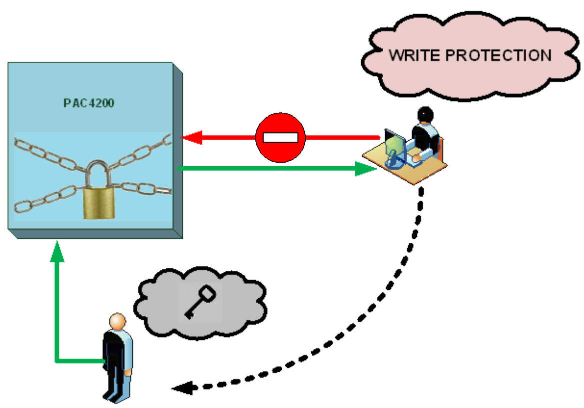
Password policy: four-digit number between 0000 ... 9999 (default setting 0000)

The padlock symbol indicates the status in each settings menu.

Note
If you have forgotten the password, please contact Technical Support.
You will be issued with a new password.

2.2 Hardware write protection

The hardware write protection prevents write access to the device, both via the communication port and on the display.
In order to gain write access, the hardware write protection must be deactivated directly on the device.
The hardware write protection cannot be deactivated via a communication port.



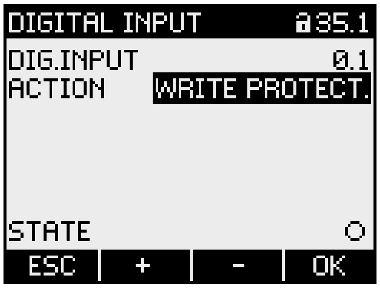
The hardware write protection can be used in two possible ways:

- Using a free digital input (directly at the device or optional expansion module)
- Protection activation via menu

Hardware write protection via digital input:

The hardware write protection can be activated and deactivated via the digital input of the device.

1. The digital input can be configured in the submenu ***"Integrated I/O"*** → ***"Digital input"*** of the ***"Settings"*** menu.
2. Select ***"Write protection"*** in the ***"Action"*** menu item and confirm with ***"OK"***.



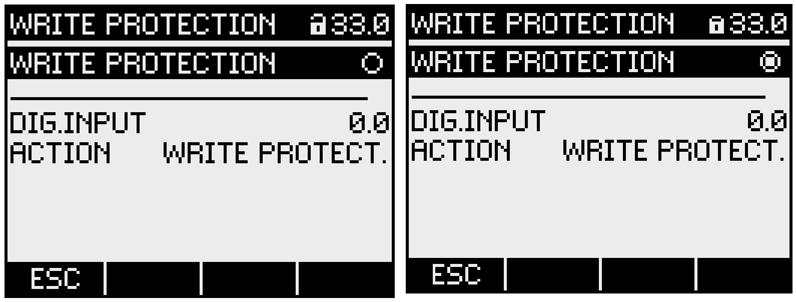
a. To activate write protection, an auxiliary voltage of 12 ... 24 VDC must be applied to the digital input. The device is write-protected after the auxiliary voltage is removed.
b. To deactivate write protection, an auxiliary voltage of 12 … 24 VDC must be applied to the parameterized input once again. The write protection feature can now be deactivated via the menu.
c. Write protection is inactive as long as the input is activated. The padlock symbol indicates the status in each settings menu.

Activating/deactivating the hardware write protection via the menu:

Provided the write protection has not already been activated via the digital input, it is possible to operate the function directly on the display.

1. Select the ***"Adanced"*** submenu of the ***"Settings"*** menu.
2. The hardware write protection can be activated and deactivated in the ***"Write protection"*** menu item.

3. If the hardware write protection has already been set via digital input, information about the digital input used appears. The symbol indicates that the device is already protected via the digital input.

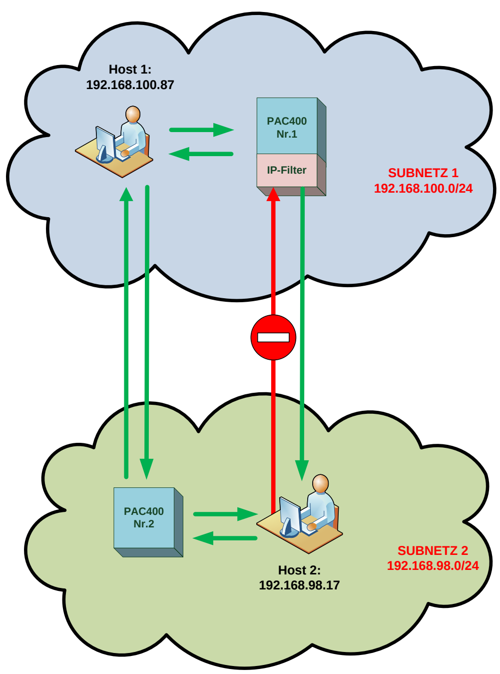


Note

It is recommended to activate the hardware write protection.

2.3 Device access control (IP filter)

The IP filter is a configurable access protection. When the IP filter is activated, MODBUS TCP write commands are only accepted if the remote station is located in the same subnet.



Example:

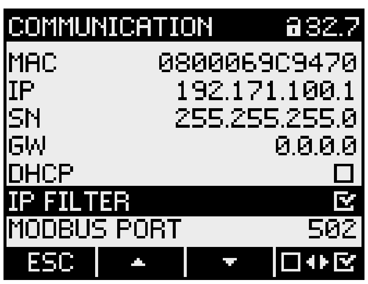
PAC device No. 1 with IP filter is located in subnet 1 (192.168.100.0/24)

PAC device No. 2 without IP filter is located in subnet 2 (192.168.98.0/24)

- **Host 1** (IP: 192.168.100.87) in **subnet 1** (192.168.100.0/24) has read and write access to **PAC No. 1**, as **Host 1** is located in the same subnet as the PAC device.
- **Host 1** (IP: 192.168.100.87) in **subnet 1** (192.168.100.0/24) has read and write access to **PAC No. 2** in **subnet 2** (192.168.98.0/24), as the IP filter is not activated on PAC No. 2.
- **Host 2** (IP: 192.168.98.17) in **subnet 2** (192.168.98.0/24) has read only access to **PAC No. 1**, as Host 2 is not located in the same subnet as PAC No. 1.

Activating / deactivating the IP filter:

1. Select the ***"Communication"*** submenu of the ***"Settings"*** menu.
2. The protection feature can be activated and deactivated in the ***"IP filter"*** menu item.



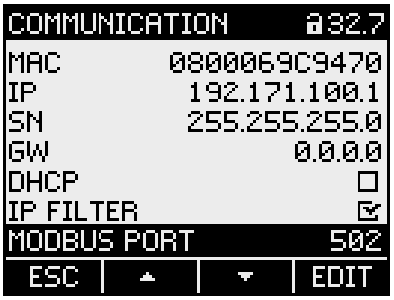
2.4 Configuring the Modbus TCP port

Ports are communication channels which make it possible to access a Modbus-capable device via a network.
Standard IP ports like port 502 are often tested by port scanners. If an open port is discovered by an attacker, it can be used to attack the device.

The PAC4200 allows the Modbus PCP ports to be configured manually. Switching from standard port 502 to a user-defined port makes it more difficult to scan for open ports.

Configuring the Modbus TCP port

1. Select the ***"Communication"*** submenu of the ***"Settings"*** menu.
2. The port can be changed manually in the ***"Modbus port"*** menu item.



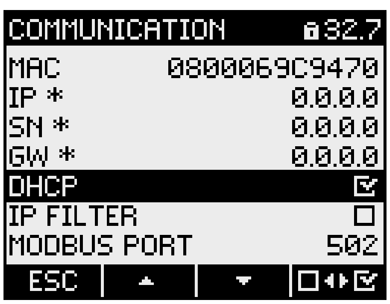
(default setting 502)

Note: Setting the value "0" deactivates the Modbus TCP function.

3. DHCP protocol

Stands for "Dynamic Host Configuration Protocol". Protocol for obtaining network settings from a DHCP server. Network settings are assigned automatically. This enables automatic integration of devices in an existing network.
When DHCP is activated, the network configuration cannot be changed manually.

1. Select the ***"Communication"*** submenu of the ***"Settings"*** menu.
2. Check the ***"DHCP"*** menu item.



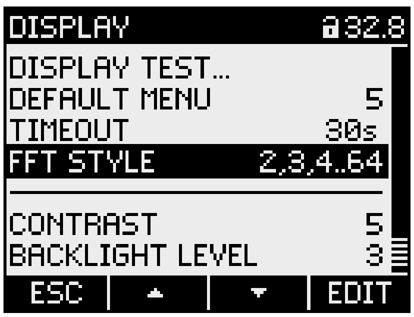
4. Measuring the 1st to 64th harmonics for voltage and current

Harmonics are caused by equipment with a non-linear characteristic, such as fluorescent lamps, transformers and frequency converters. The PAC4200 is capable of measuring and displaying integral voltage and current harmonics. It is also possible to read out the data using Modbus command FC20 "Read File Record 0x14".

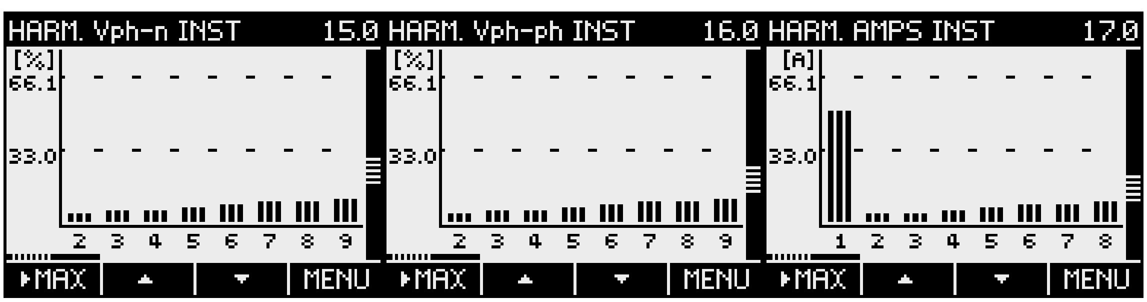
Bar diagram on device display:

The device can show either the odd (3rd to 63rd) or all (1st to 64th) harmonics on the display.

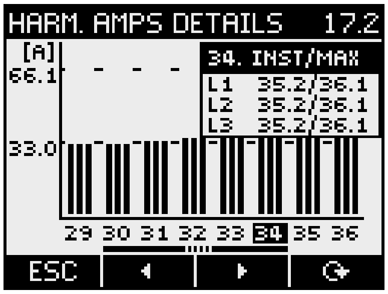
1. Select the ***"Display"*** submenu of the ***"Settings"*** menu.
2. The display type can be selected in the ***"FFT style"*** *menu item:*
    a. Harmonics ***"3,5,7…63"*** (display of odd harmonics)
    b. Harmonics ***"2,3,4…64"*** (display of even and odd harmonics)



3. The following harmonic displays are available for the device display:
    a. Harmonic Vph-n (display 15.0)
    b. Harmonic Vph-ph (display 16.0)
    c. Harmonic amps (display 17.0)



4. Additional functions can be called up using the F1 key ▸MAX (max. values; delete max. values and scroll right/left).



4.1 Reading out the harmonics using the Modbus command

For clarity, only the 1st and the 64th harmonics are listed in the table. The offsets of the 2nd to 63rd harmonics can be calculated using the formula below:

Offset of the nth harmonic = (offset of 1st harmonic) + (length x (n – 1))

Example 1:

Offset of ***"3rd harm. voltage L1"*** (FC0x14) must be calculated.

- ➔ 5 + (2 x (3 – 1) = 9
- ➔ Offset of *"3rd harm. voltage L1"* (FC0x14) is 9.

Example 2:

Offset of ***"3rd harm. voltage L1"*** (FC0x3) must be calculated.

- ➔ 36005 + (2 x (3 – 1) = 36009
- ➔ Offset of *"3rd harm. voltage L1"* (FC0x3) is 36009.

Example 3:

Offset of ***"7th max. harm. for voltage L1"*** (FC0x3) must be calculated.

- ➔ 37201 + (4 x (7 – 1) = 37225
- ➔ Offset of *"7th max. harm. for voltage L1"* (FCx03) is 37225.

Please note that the voltage harmonics are expressed in [%] relative to the fundamental frequency but the fundamental frequency is expressed absolutely in [V]. The current harmonics are all expressed absolutely in [A].

File FC0x14	Length	Offset FC 0x14	Offset FC0x03 FC0x04	Name	Format	Unit	Access
10	2	5	36005	1st harm. voltage L1	float	V	r
10	2	See formula	See formula	nth harm. voltage L1	float	%	r
10	2	131	36131	64th harm. voltage L1	float	%	r
10	2	133	36133	1st harm. voltage L2	float	V	r
10	2	See formula	See formula	nth harm. voltage L2	float	%	r
10	2	259	36259	64th harm. voltage L2	float	%	r
10	2	261	36261	1st harm. voltage L3	float	V	r
10	2	See formula	See formula	nth harm. voltage L3	float	%	r
10	2	387	36387	64th harm. voltage L3	float	%	r
10	2	389	36389	1st harm. amps L1	float	A	r
10	2	See formula	See formula	nth harm. amps L1	float	A	r
10	2	515	36515	64th harm. amps L1	float	A	r
10	2	517	36517	1st harm. amps L2	float	A	r
10	2	See formula	See formula	nth harm. amps L2	float	A	r
10	2	643	36643	64th harm. amps L2	float	A	r
10	2	645	36645	1st harm. amps L3	float	A	r
10	2	See formula	See formula	nth harm. amps L3	float	A	r
10	2	771	36771	64th harm. amps L3	float	A	r
10	2	773	36773	1st harm. voltage ph-ph L12	float	V	r
10	2	See formula	See formula	nth harm. voltage ph-ph L12	float	%	r
10	2	899	36899	64th harm. voltage ph-ph L12	float	%	r
10	2	901	36901	1st harm. voltage ph-ph L23	float	V	r
10	2	See formula	See formula	nth harm. voltage ph-ph L23	float	%	r
10	2	1027	37027	64th harm. voltage ph-ph L23	float	%	r
10	2	1029	37029	1st harm. voltage ph-ph L31	float	V	r
10	2	See formula	See formula	nth harm. voltage ph-ph L31	float	%	r
10	2	1155	37155	64th harm. voltage ph-ph L31	float	%	r
11	4	1	37201	1st max harm. voltage L1	float+TS32	V	r
11	4	See formula	See formula	nth max harm. voltage L1	float+TS32	%	r
11	4	253	37453	64th max harm. voltage L1	float+TS32	%	r
11	4	257	37457	1st max harm. voltage L2	float+TS32	V	r
11	4	See formula	See formula	nth max harm. voltage L2	float+TS32	%	r
11	4	509	37709	64th max harm. voltage L2	float+TS32	%	r
11	4	513	37713	1st max harm. voltage L3	float+TS32	V	r
11	4	See formula	See formula	nth max harm. voltage L3	float+TS32	%	r
11	4	765	37965	64th max harm. voltage L3	float+TS32	%	r
11	4	769	37969	1st max harm. amps L1	float+TS32	A	r
11	4	See formula	See formula	nth max harm. amps L1	float+TS32	A	r
11	4	1021	38221	64th max harm. amps L1	float+TS32	A	r
11	4	1025	38225	1st max harm. amps L2	float+TS32	A	r
11	4	See formula	See formula	nth max harm. amps L2	float+TS32	A	r
11	4	1277	38477	64th max harm. amps L2	float+TS32	A	r
11	4	1281	38481	1st max harm. amps L3	float+TS32	A	r
11	4	See formula	See formula	nth max harm. amps L3	float+TS32	A	r
11	4	1533	38733	64th max harm. amps L3	float+TS32	A	r

11	4	1537	38737	1st max harm. voltage ph-ph L12	float+TS32	V	r
11	4	See formula	See formula	nth max harm. voltage ph-ph L12	float+TS32	%	r
11	4	1789	38989	64th max harm. voltage ph-ph L12	float+TS32	%	r
11	4	1793	38993	1st max harm. voltage ph-ph L23	float+TS32	V	r
11	4	See formula	See formula	nth max harm. voltage ph-ph L23	float+TS32	%	r
11	4	2045	39245	64th max harm. voltage ph-ph L23	float+TS32	%	r
11	4	2049	39249	1st max harm. voltage ph-ph L31	float+TS32	V	r
11	4	See formula	See formula	nth max harm. voltage ph-ph L31	float+TS32	%	r
11	4	2301	39501	64th max harm. voltage ph-ph L31	float+TS32	%	r

5. Averaging measured values (aggregation)

Based on selected recordings of measured values over time, the user can optimize the system in accordance with requirements, e.g. with respect to energy consumption, and comply with normative requirements relating to power and energy recordings. For this purpose, instantaneous values would need to be read out via the communication port, calculated and stored. The uninterrupted recording that is necessary requires a high bandwidth, high availability of communication and high storage capacity. The PAC4200 generates all the measured values every 200 ms approximately. It offers three internal averaging functions that can be assigned parameters independently. The time averages formed in the device are generated continuously based on all the associated instantaneous values.

The aggregation of measured values reduces the data volume and consequently the danger of losing information due to limited communication availability and bandwidth.

The values are updated in time-synchronized parameterized intervals:

- Measured values for average 1 (file 1), default setting for period length = 10 s
- Measured values for average 2 (file 2), default setting for period length = 15 min
- Harmonic average (file 3), default setting for period length = 15 min

The aggregation intervals can be set to anything between 3 seconds and 31536000 seconds (1 year).
The values for each average and the most extreme instantaneous values within the period are available at the end of the period during the runtime of the new period.
The device time must be set (e.g. via an SNTP time server).

5.1 Reading out the measured values using the Modbus command

For clarity, only the 1st and the 64th harmonics are listed in the table. The offsets of the 2nd to 64th harmonics can be calculated using the formula below:

Offset of nth harmonic = (offset of 1st harmonic) + ((length + 4) x (n – 1))

Example 1:

Offset of ***"3rd harm. current L1"*** (FC0x14) must be calculated.

- ➔ 5 + ((2 +4) x (3 – 1) = 17
- ➔ Offset of "*3rd harm. current L1*" (FC0x14) is 17.

Example 2:

Offset of ***"3rd harm. current L3"*** (FC0x14) must be calculated.

- ➔ 9 + ((2 +4) x (3 – 1) = 21
- ➔ Offset of "*3rd harm. current L3*" (FC0x14) is 21.

Example 3:

Offset of ***"3rd harm. current L3"*** (FC0x3) must be calculated.

- ➔ 32009 + ((2 +4) x (3 – 1) = 32021
- ➔ Offset of "*3rd harm. current L3*" (FC0x3) is 32021.

File FC0x14	Offset FC0x14	Offset FC 0x03 FC 0x04	Length	Name	Format	Unit	Access
1	1	30001	2	Time stamp Aggregation Stage n	UNIX_TS	s	r
1	3	30003	2	Flags Aggregation Stage n	uint32		r
1	5	30005	2	voltage PH-N L1	float	V	r
1	7	30007	2	voltage PH-N L2	float	V	r
1	9	30009	2	voltage PH-N L3	float	V	r
1	11	30011	2	voltage PH-PH L1-L2	float	V	r
1	13	30013	2	voltage PH-PH L2-L3	float	V	r
1	15	30015	2	voltage PH-PH L3-L1	float	V	r
1	17	30017	2	current L1	float	A	r
1	19	30019	2	current L2	float	A	r
1	21	30021	2	current L3	float	A	r
1	23	30023	2	apparent power L1	float	VA	r
1	25	30025	2	apparent power L2	float	VA	r
1	27	30027	2	apparent power L3	float	VA	r
1	29	30029	2	active power L1	float	W	r
1	31	30031	2	active power L2	float	W	r
1	33	30033	2	active power L3	float	W	r

1	35	30035	2	reactive power L1 (Qn)	float	var	r
1	37	30037	2	reactive power L2 (Qn)	float	var	r
1	39	30039	2	reactive power L3 (Qn)	float	var	r
1	41	30041	2	power factor L1	float		r
1	43	30043	2	power factor L2	float		r
1	45	30045	2	power factor L3	float		r
1	47	30047	2	THD voltage L1	float	%	r
1	49	30049	2	THD voltage L2	float	%	r
1	51	30051	2	THD voltage L3	float	%	r
1	53	30053	2	THD current L1	float	%	r
1	55	30055	2	THD current L2	float	%	r
1	57	30057	2	THD current L3	float	%	r
1	59	30059	2	THD voltage L12	float	%	r
1	61	30061	2	THD voltage L23	float	%	r
1	63	30063	2	THD voltage L31	float	%	r
1	65	30065	2	reactive power L1 (Q1)	float	var	r
1	67	30067	2	reactive power L2 (Q1)	float	var	r
1	69	30069	2	reactive power L3 (Q1)	float	var	r
1	71	30071	2	reactive power L1 (Q_{tot})	float	var	r
1	73	30073	2	reactive power L2 (Q_{tot})	float	var	r
1	75	30075	2	reactive power L3 (Q_{tot})	float	var	r
1	77	30077	2	cos φ_{L1}	float		r
1	79	30079	2	cos φ_{L2}	float		r
1	81	30081	2	cos φ_{L3}	float		r
1	83	30083	2	distortion current L1	float	A	r
1	85	30085	2	distortion current L2	float	A	r
1	87	30087	2	distortion current L3	float	A	r
1	89	30089	2	voltage system angle U_{L1}-U_{L1}	float	°	r
1	91	30091	2	voltage system angle U_{L1}-U_{L2}	float	°	r
1	93	30093	2	voltage system angle U_{L1}-U_{L3}	float	°	r
1	95	30095	2	phase angle φ_{L1}	float	°	r
1	97	30097	2	phase angle φ_{L2}	float	°	r
1	99	30099	2	phase angle φ_{L3}	float	°	r
1	101	30101	2	frequency	float	Hz	r
1	103	30103	2	average voltage PH-N	float	V	r
1	105	30105	2	average voltage PH-PH	float	V	r
1	107	30107	2	average current	float	A	r
1	109	30109	2	collective apparent power	float	VA	r
1	111	30111	2	collective active power	float	W	r
1	113	30113	2	collective reactive power (Qn)	float	var	r
1	115	30115	2	collective reactive power (Q1)	float	var	r
1	117	30117	2	collective reactive power (Q_{tot})	float	var	r
1	119	30119	2	collective power factor	float		r
1	121	30121	2	amplitude unbalance voltage	float	%	r

1	123	30123	2	amplitude unbalance current	float	%	r
1	125	30125	2	unbalance voltage	float	%	r
1	127	30127	2	unbalance current	float	%	r
1	129	30129	2	neutral current	float	A	r
1	201	30201	2	Time stamp Aggregation Stage n	UNIX_TS	s	r
1	203	30203	2	Flags Aggregation Stage n	uint32		r
1	205	30205	2	max voltage PH-N L1	float	V	r
1	207	30207	2	max voltage PH-N L2	float	V	r
1	209	30209	2	max voltage PH-N L3	float	V	r
1	211	30211	2	max voltage PH-PH L1-L2	float	V	r
1	213	30213	2	max voltage PH-PH L2-L3	float	V	r
1	215	30215	2	max voltage PH-PH L3-L1	float	V	r
1	217	30217	2	max current L1	float	A	r
1	219	30219	2	max current L2	float	A	r
1	221	30221	2	max current L3	float	A	r
1	223	30223	2	max apparent power L1	float	VA	r
1	225	30225	2	max apparent power L2	float	VA	r
1	227	30227	2	max apparent power L3	float	VA	r
1	229	30229	2	max active power L1	float	W	r
1	231	30231	2	max active power L2	float	W	r
1	233	30233	2	max active power L3	float	W	r
1	235	30235	2	max reactive power L1 (Qn)	float	var	r
1	237	30237	2	max reactive power L2 (Qn)	float	var	r
1	239	30239	2	max reactive power L3 (Qn)	float	var	r
1	241	30241	2	max power factor L1	float		r
1	243	30243	2	max power factor L2	float		r
1	245	30245	2	max power factor L3	float		r
1	247	30247	2	max THD voltage L1	float	%	r
1	249	30249	2	max THD voltage L2	float	%	r
1	251	30251	2	max THD voltage L3	float	%	r
1	253	30253	2	max THD current L1	float	%	r
1	255	30255	2	max THD current L2	float	%	r
1	257	30257	2	max THD current L3	float	%	r
1	259	30259	2	max THD voltage L12	float	%	r
1	261	30261	2	max THD voltage L23	float	%	r
1	263	30263	2	max THD voltage L31	float	%	r
1	265	30265	2	max reactive power L1 (Q1)	float	var	r
1	267	30267	2	max reactive power L2 (Q1)	float	var	r
1	269	30269	2	max reactive power L3 (Q1)	float	var	r
1	271	30271	2	max reactive power L1 (Qtot)	float	var	r
1	273	30273	2	max reactive power L2 (Qtot)	float	var	r
1	275	30275	2	max reactive power L3 (Qtot)	float	var	r
1	277	30277	2	max cos φL1	float		r
1	279	30279	2	max cos φL2	float		r
1	281	30281	2	max cos φL3	float		r
1	283	30283	2	max distortion current L1	float	A	r
1	285	30285	2	max distortion current L2	float	A	r
1	287	30287	2	max distortion current L3	float	A	r

1	289	30289	2	max voltage system angle UL1-UL1	float	°	r
1	291	30291	2	max voltage system angle UL1-UL2	float	°	r
1	293	30293	2	max voltage system angle UL1-UL3	float	°	r
1	295	30295	2	max phase angle φL1	float	°	r
1	297	30297	2	max phase angle φL2	float	°	r
1	299	30299	2	max phase angle φL3	float	°	r
1	301	30301	2	max frequency	float	Hz	r
1	303	30303	2	max average voltage PH-N	float	V	r
1	305	30305	2	max average voltage PH-PH	float	V	r
1	307	30307	2	max average current	float	A	r
1	309	30309	2	max collective apparent power	float	VA	r
1	311	30311	2	max collective active power	float	W	r
1	313	30313	2	max collective reactive power (Qn)	float	var	r
1	315	30315	2	max collective reactive power (Q1)	float	var	r
1	317	30317	2	max collective reactive power (Qtot)	float	var	r
1	319	30319	2	max collective power factor	float		r
1	321	30321	2	max amplitude unbalance voltage	float	%	r
1	323	30323	2	max amplitude unbalance current	float	%	r
1	325	30325	2	max unbalance voltage	float	%	r
1	327	30327	2	max unbalance current	float	%	r
1	329	30329	2	max neutral current	float	A	r
1	401	30401	2	Time stamp Aggregation Stage n	UNIX_TS	s	r
1	403	30403	2	Flags Aggregation Stage n	uint32		r
1	405	30405	2	min voltage PH-N L1	float	V	r
1	407	30407	2	min voltage PH-N L2	float	V	r
1	409	30409	2	min voltage PH-N L3	float	V	r
1	411	30411	2	min voltage PH-PH L1-L2	float	V	r
1	413	30413	2	min voltage PH-PH L2-L3	float	V	r
1	415	30415	2	min voltage PH-PH L3-L1	float	V	r
1	417	30417	2	min current L1	float	A	r
1	419	30419	2	min current L2	float	A	r
1	421	30421	2	min current L3	float	A	r
1	423	30423	2	min apparent power L1	float	VA	r
1	425	30425	2	min apparent power L2	float	VA	r
1	427	30427	2	min apparent power L3	float	VA	r
1	429	30429	2	min active power L1	float	W	r
1	431	30431	2	min active power L2	float	W	r
1	433	30433	2	min active power L3	float	W	r
1	435	30435	2	min reactive power L1 (Qn)	float	var	r
1	437	30437	2	min reactive power L2 (Qn)	float	var	r
1	439	30439	2	min reactive power L3 (Qn)	float	var	r
1	441	30441	2	min power factor L1	float		r
1	443	30443	2	min power factor L2	float		r
1	445	30445	2	min power factor L3	float		r
1	447	30447	2	min THD voltage L1	float	%	r
1	449	30449	2	min THD voltage L2	float	%	r
1	451	30451	2	min THD voltage L3	float	%	r
1	453	30453	2	min THD current L1	float	%	r

1	455	30455	2	min THD current L2	float	%	r
1	457	30457	2	min THD current L3	float	%	r
1	459	30459	2	min THD voltage L12	float	%	r
1	461	30461	2	min THD voltage L23	float	%	r
1	463	30463	2	min THD voltage L31	float	%	r
1	465	30465	2	min reactive power L1 (Q1)	float	var	r
1	467	30467	2	min reactive power L2 (Q1)	float	var	r
1	469	30469	2	min reactive power L3 (Q1)	float	var	r
1	471	30471	2	min reactive power L1 (Qtot)	float	var	r
1	473	30473	2	min reactive power L2 (Qtot)	float	var	r
1	475	30475	2	min reactive power L3 (Qtot)	float	var	r
1	477	30477	2	min cos φL1	float		r
1	479	30479	2	min cos φL2	float		r
1	481	30481	2	min cos φL3	float		r
1	483	30483	2	min distortion current L1	float	A	r
1	485	30485	2	min distortion current L2	float	A	r
1	487	30487	2	min distortion current L3	float	A	r
1	489	30489	2	min voltage system angle UL1-UL1	float	°	r
1	491	30491	2	min voltage system angle UL1-UL2	float	°	r
1	493	30493	2	min voltage system angle UL1-UL3	float	°	r
1	495	30495	2	min phase angle φL1	float	°	r
1	497	30497	2	min phase angle φL2	float	°	r
1	499	30499	2	min phase angle φL3	float	°	r
1	501	30501	2	min frequency	float	Hz	r
1	503	30503	2	min average voltage PH-N	float	V	r
1	505	30505	2	min average voltage PH-PH	float	V	r
1	507	30507	2	min average current	float	A	r
1	509	30509	2	min collective apparent power	float	VA	r
1	511	30511	2	min collective active power	float	W	r
1	513	30513	2	min collective reactive power (Qn)	float	var	r
1	515	30515	2	min collective reactive power (Q1)	float	var	r
1	517	30517	2	min collective reactive power (Qtot)	float	var	r
1	519	30519	2	min collective power factor	float		r
1	521	30521	2	min amplitude unbalance voltage	float	%	r
1	523	30523	2	min amplitude unbalance current	float	%	r
1	525	30525	2	min unbalance voltage	float	%	r
1	527	30527	2	min unbalance current	float	%	r
1	529	30529	2	min neutral current	float	A	r
2	1	31001	2	Time stamp Aggregation Stage n	UNIX_TS	s	r
2	3	31003	2	Flags Aggregation Stage n	uint32		r
2	5	31005	2	voltage PH-N L1	float	V	r
2	7	31007	2	voltage PH-N L2	float	V	r
2	9	31009	2	voltage PH-N L3	float	V	r
2	11	31011	2	voltage PH-PH L1-L2	float	V	r
2	13	31013	2	voltage PH-PH L2-L3	float	V	r
2	15	31015	2	voltage PH-PH L3-L1	float	V	r
2	17	31017	2	current L1	float	A	r

2	19	31019	2	current L2	float	A	r
2	21	31021	2	current L3	float	A	r
2	23	31023	2	apparent power L1	float	VA	r
2	25	31025	2	apparent power L2	float	VA	r
2	27	31027	2	apparent power L3	float	VA	r
2	29	31029	2	active power L1	float	W	r
2	31	31031	2	active power L2	float	W	r
2	33	31033	2	active power L3	float	W	r
2	35	31035	2	reactive power L1 (Qn)	float	var	r
2	37	31037	2	reactive power L2 (Qn)	float	var	r
2	39	31039	2	reactive power L3 (Qn)	float	var	r
2	41	31041	2	power factor L1	float		r
2	43	31043	2	power factor L2	float		r
2	45	31045	2	power factor L3	float		r
2	47	31047	2	THD voltage L1	float	%	r
2	49	31049	2	THD voltage L2	float	%	r
2	51	31051	2	THD voltage L3	float	%	r
2	53	31053	2	THD current L1	float	%	r
2	55	31055	2	THD current L2	float	%	r
2	57	31057	2	THD current L3	float	%	r
2	59	31059	2	THD voltage L12	float	%	r
2	61	31061	2	THD voltage L23	float	%	r
2	63	31063	2	THD voltage L31	float	%	r
2	65	31065	2	reactive power L1 (Q1)	float	var	r
2	67	31067	2	reactive power L2 (Q1)	float	var	r
2	69	31069	2	reactive power L3 (Q1)	float	var	r
2	71	31071	2	reactive power L1 (Q_{tot})	float	var	r
2	73	31073	2	reactive power L2 (Q_{tot})	float	var	r
2	75	31075	2	reactive power L3 (Q_{tot})	float	var	r
2	77	31077	2	cos φ_{L1}	float		r
2	79	31079	2	cos φ_{L2}	float		r
2	81	31081	2	cos φ_{L3}	float		r
2	83	31083	2	distortion current L1	float	A	r
2	85	31085	2	distortion current L2	float	A	r
2	87	31087	2	distortion current L3	float	A	r
2	89	31089	2	voltage system angle U_{L1}-U_{L1}	float	°	r
2	91	31091	2	voltage system angle U_{L1}-U_{L2}	float	°	r
2	93	31093	2	voltage system angle U_{L1}-U_{L3}	float	°	r
2	95	31095	2	phase angle φ_{L1}	float	°	r
2	97	31097	2	phase angle φ_{L2}	float	°	r
2	99	31099	2	phase angle φ_{L3}	float	°	r
2	101	31101	2	frequency	float	Hz	r
2	103	31103	2	average voltage PH-N	float	V	r

2	105	31105	2	average voltage PH-PH	float	V	r
2	107	31107	2	average current	float	A	r
2	109	31109	2	collective apparent power	float	VA	r
2	111	31111	2	collective active power	float	W	r
2	113	31113	2	collective reactive power (Qn)	float	var	r
2	115	31115	2	collective reactive power (Q1)	float	var	r
2	117	31117	2	collective reactive power (Q_{tot})	float	var	r
2	119	31119	2	collective power factor	float		r
2	121	31121	2	amplitude unbalance voltage	float	%	r
2	123	31123	2	amplitude unbalance current	float	%	r
2	125	31125	2	unbalance voltage	float	%	r
2	127	31127	2	unbalance current	float	%	r
2	129	31129	2	neutral current	float	A	r
2	201	31201	2	Time stamp Aggregation Stage n	UNIX_TS	s	r
2	203	31203	2	Flags Aggregation Stage n	uint32		r
2	205	31205	2	max voltage PH-N L1	float	V	r
2	207	31207	2	max voltage PH-N L2	float	V	r
2	209	31209	2	max voltage PH-N L3	float	V	r
2	211	31211	2	max voltage PH-PH L1-L2	float	V	r
2	213	31213	2	max voltage PH-PH L2-L3	float	V	r
2	215	31215	2	max voltage PH-PH L3-L1	float	V	r
2	217	31217	2	max current L1	float	A	r
2	219	31219	2	max current L2	float	A	r
2	221	31221	2	max current L3	float	A	r
2	223	31223	2	max apparent power L1	float	VA	r
2	225	31225	2	max apparent power L2	float	VA	r
2	227	31227	2	max apparent power L3	float	VA	r
2	229	31229	2	max active power L1	float	W	r
2	231	31231	2	max active power L2	float	W	r
2	233	31233	2	max active power L3	float	W	r
2	235	31235	2	max reactive power L1 (Qn)	float	var	r
2	237	31237	2	max reactive power L2 (Qn)	float	var	r
2	239	31239	2	max reactive power L3 (Qn)	float	var	r
2	241	31241	2	max power factor L1	float		r
2	243	31243	2	max power factor L2	float		r
2	245	31245	2	max power factor L3	float		r
2	247	31247	2	max THD voltage L1	float	%	r
2	249	31249	2	max THD voltage L2	float	%	r
2	251	31251	2	max THD voltage L3	float	%	r
2	253	31253	2	max THD current L1	float	%	r
2	255	31255	2	max THD current L2	float	%	r
2	257	31257	2	max THD current L3	float	%	r
2	259	31259	2	max THD voltage L12	float	%	r
2	261	31261	2	max THD voltage L23	float	%	r
2	263	31263	2	max THD voltage L31	float	%	r
2	265	31265	2	max reactive power L1 (Q1)	float	var	r
2	267	31267	2	max reactive power L2 (Q1)	float	var	r
2	269	31269	2	max reactive power L3 (Q1)	float	var	r

2	271	31271	2	max reactive power L1 (Qtot)	float	var	r
2	273	31273	2	max reactive power L2 (Qtot)	float	var	r
2	275	31275	2	max reactive power L3 (Qtot)	float	var	r
2	277	31277	2	max cos φL1	float		r
2	279	31279	2	max cos φL2	float		r
2	281	31281	2	max cos φL3	float		r
2	283	31283	2	max distortion current L1	float	A	r
2	285	31285	2	max distortion current L2	float	A	r
2	287	31287	2	max distortion current L3	float	A	r
2	289	31289	2	max voltage system angle UL1-UL1	float	°	r
2	291	31291	2	max voltage system angle UL1-UL2	float	°	r
2	293	31293	2	max voltage system angle UL1-UL3	float	°	r
2	295	31295	2	max phase angle φL1	float	°	r
2	297	31297	2	max phase angle φL2	float	°	r
2	299	31299	2	max phase angle φL3	float	°	r
2	301	31301	2	max frequency	float	Hz	r
2	303	31303	2	max average voltage PH-N	float	V	r
2	305	31305	2	max average voltage PH-PH	float	V	r
2	307	31307	2	max average current	float	A	r
2	309	31309	2	max collective apparent power	float	VA	r
2	311	31311	2	max collective active power	float	W	r
2	313	31313	2	max collective reactive power (Qn)	float	var	r
2	315	31315	2	max collective reactive power (Q1)	float	var	r
2	317	31317	2	max collective reactive power (Qtot)	float	var	r
2	319	31319	2	max collective power factor	float		r
2	321	31321	2	max amplitude unbalance voltage	float	%	r
2	323	31323	2	max amplitude unbalance current	float	%	r
2	325	31325	2	max unbalance voltage	float	%	r
2	327	31327	2	max unbalance current	float	%	r
2	329	31329	2	max neutral current	float	A	r
2	401	31401	2	Time stamp Aggregation Stage n	UNIX_TS	s	r
2	403	31403	2	Flags Aggregation Stage n	uint32		r
2	405	31405	2	min voltage PH-N L1	float	V	r
2	407	31407	2	min voltage PH-N L2	float	V	r
2	409	31409	2	min voltage PH-N L3	float	V	r
2	411	31411	2	min voltage PH-PH L1-L2	float	V	r
2	413	31413	2	min voltage PH-PH L2-L3	float	V	r
2	415	31415	2	min voltage PH-PH L3-L1	float	V	r
2	417	31417	2	min current L1	float	A	r
2	419	31419	2	min current L2	float	A	r
2	421	31421	2	min current L3	float	A	r
2	423	31423	2	min apparent power L1	float	VA	r
2	425	31425	2	min apparent power L2	float	VA	r
2	427	31427	2	min apparent power L3	float	VA	r
2	429	31429	2	min active power L1	float	W	r
2	431	31431	2	min active power L2	float	W	r
2	433	31433	2	min active power L3	float	W	r
2	435	31435	2	min reactive power L1 (Qn)	float	var	r

2	437	31437	2	min reactive power L2 (Qn)	float	var	r
2	439	31439	2	min reactive power L3 (Qn)	float	var	r
2	441	31441	2	min power factor L1	float		r
2	443	31443	2	min power factor L2	float		r
2	445	31445	2	min power factor L3	float		r
2	447	31447	2	min THD voltage L1	float	%	r
2	449	31449	2	min THD voltage L2	float	%	r
2	451	31451	2	min THD voltage L3	float	%	r
2	453	31453	2	min THD current L1	float	%	r
2	455	31455	2	min THD current L2	float	%	r
2	457	31457	2	min THD current L3	float	%	r
2	459	31459	2	min THD voltage L12	float	%	r
2	461	31461	2	min THD voltage L23	float	%	r
2	463	31463	2	min THD voltage L31	float	%	r
2	465	31465	2	min reactive power L1 (Q1)	float	var	r
2	467	31467	2	min reactive power L2 (Q1)	float	var	r
2	469	31469	2	min reactive power L3 (Q1)	float	var	r
2	471	31471	2	min reactive power L1 (Qtot)	float	var	r
2	473	31473	2	min reactive power L2 (Qtot)	float	var	r
2	475	31475	2	min reactive power L3 (Qtot)	float	var	r
2	477	31477	2	min cos φL1	float		r
2	479	31479	2	min cos φL2	float		r
2	481	31481	2	min cos φL3	float		r
2	483	31483	2	min distortion current L1	float	A	r
2	485	31485	2	min distortion current L2	float	A	r
2	487	31487	2	min distortion current L3	float	A	r
2	489	31489	2	min voltage system angle UL1-UL1	float	°	r
2	491	31491	2	min voltage system angle UL1-UL2	float	°	r
2	493	31493	2	min voltage system angle UL1-UL3	float	°	r
2	495	31495	2	min phase angle φL1	float	°	r
2	497	31497	2	min phase angle φL2	float	°	r
2	499	31499	2	min phase angle φL3	float	°	r
2	501	31501	2	min frequency	float	Hz	r
2	503	31503	2	min average voltage PH-N	float	V	r
2	505	31505	2	min average voltage PH-PH	float	V	r
2	507	31507	2	min average current	float	A	r
2	509	31509	2	min collective apparent power	float	VA	r
2	511	31511	2	min collective active power	float	W	r
2	513	31513	2	min collective reactive power (Qn)	float	var	r
2	515	31515	2	min collective reactive power (Q1)	float	var	r
2	517	31517	2	min collective reactive power (Qtot)	float	var	r
2	519	31519	2	min collective power factor	float		r
2	521	31521	2	min amplitude unbalance voltage	float	%	r
2	523	31523	2	min amplitude unbalance current	float	%	r
2	525	31525	2	min unbalance voltage	float	%	r
2	527	31527	2	min unbalance current	float	%	r
2	529	31529	2	min neutral current	float	A	r

3	1	32001	2	Time stamp Aggregation Stage n	UNIX_TS	s	r
3	3	32003	2	Flags Aggregation Stage n	uint32		r
3	5	32005	2	1. harm. current L1	float	A	r
3	7	32007	2	1. harm. current L2	float	A	r
3	9	32009	2	1. harm. current L3	float	A	r
3	See formula	See formula	2	n. harm. current L1	float	A	r
3	See formula	See formula	2	n. harm. current L2	float	A	r
3	See formula	See formula	2	n. harm. current L3	float	A	r
3	383	32383	2	64. harm. current L1	float	A	r
3	385	32385	2	64. harm. current L2	float	A	r
3	387	32387	2	64. harm. current L3	float	A	r
3	389	32389	2	1. harm. Voltage PH-N L1	float	V	r
3	391	32391	2	1. harm. Voltage PH-N L2	float	V	r
3	393	32393	2	1. harm. Voltage PH-N L3	float	V	r
3	See formula	See formula	2	n. harm. Voltage PH-N L1	float	%	r
3	See formula	See formula	2	n. harm. Voltage PH-N L2	float	%	r
3	See formula	See formula	2	n. harm. Voltage PH-N L3	float	%	r
3	767	32767	2	64. harm. Voltage PH-N L1	float	%	r
3	769	32769	2	64. harm. Voltage PH-N L2	float	%	r
3	771	32771	2	64. harm. Voltage PH-N L3	float	%	r
3	773	32773	2	1. harm. Voltage PH-PH L12	float	V	r
3	775	32775	2	1. harm. Voltage PH-PH L23	float	V	r
3	777	32777	2	1. harm. Voltage PH-PH L31	float	V	r
3	See formula	See formula	2	n. harm. Voltage PH-PH L12	float	%	r
3	See formula	See formula	2	n. harm. Voltage PH-PH L23	float	%	r
3	See formula	See formula	2	n. harm. Voltage PH-PH L31	float	%	r
3	1151	33151	2	64. harm. Voltage PH-PH L12	float	%	r
3	1153	33153	2	64. harm. Voltage PH-PH L23	float	%	r
3	1155	33155	2	64. harm. Voltage PH-PH L31	float	%	r
3	1201	33201	2	Time stamp Aggregation Stage n	UNIX_TS	s	r
3	1203	33203	2	Flags Aggregation Stage n	uint32		r
3	1205	33205	2	1. max harm. current L1	float	A	r
3	1207	33207	2	1. max harm. current L2	float	A	r
3	1209	33209	2	1. max harm. current L3	float	A	r
3	See formula	See formula	2	n. max harm. current L1	float	A	r
3	See formula	See formula	2	n. max harm. current L2	float	A	r
3	See formula	See formula	2	n. max harm. current L3	float	A	r
3	See formula	See formula	2	64. max harm. current L1	float	A	r
3	1585	33585	2	64. max harm. current L2	float	A	r
3	1587	33587	2	64. max harm. current L3	float	A	r
3	1589	33589	2	1. max harm. Voltage PH-N L1	float	V	r
3	1591	33591	2	1. max harm. Voltage PH-N L2	float	V	r
3	1593	33593	2	1. max harm. Voltage PH-N L3	float	V	r
3	See formula	See formula	2	n. max harm. Voltage PH-N L1	float	%	r
3	See formula	See formula	2	n. max harm. Voltage PH-N L2	float	%	r
3	See formula	See formula	2	n. max harm. Voltage PH-N L3	float	%	r
3	1967	33967	2	64. max harm. Voltage PH-N L1	float	%	r
3	1969	33969	2	64. max harm. Voltage PH-N L2	float	%	r

3	1971	33971	2	64. max harm. Voltage PH-N L3	float	%	r
3	1973	33973	2	1. max harm. Voltage PH-PH L12	float	V	r
3	1975	33975	2	1. max harm. Voltage PH-PH L23	float	V	r
3	1977	33977	2	1. max harm. Voltage PH-PH L31	float	V	r
3	See formula	See formula	2	n. max harm. Voltage PH-PH L12	float	%	r
3	See formula	See formula	2	n. max harm. Voltage PH-PH L23	float	%	r
3	See formula	See formula	2	n. max harm. Voltage PH-PH L31	float	%	r
3	2351	34351	2	64. max harm. Voltage PH-PH L12	float	%	r
3	2353	34353	2	64. max harm. Voltage PH-PH L23	float	%	r
3	2355	34355	2	64. max harm. Voltage PH-PH L31	float	%	r
3	2401	34401	2	Time stamp Aggregation Stage n	UNIX_TS	s	r
3	2403	34403	2	Flags Aggregation Stage n	uint32		r
3	2405	34405	2	1. min harm. current L1	float	A	r
3	2407	34407	2	1. min harm. current L2	float	A	r
3	2409	34409	2	1. min harm. current L3	float	A	r
3	See formula	See formula	2	n. min harm. current L1	float	A	r
3	See formula	See formula	2	n. min harm. current L2	float	A	r
3	See formula	See formula	2	n. min harm. current L3	float	A	r
3	2783	34783	2	64. min harm. current L1	float	A	r
3	2785	34785	2	64. min harm. current L2	float	A	r
3	2787	34787	2	64. min harm. current L3	float	A	r
3	2789	34789	2	1. min harm. Voltage PH-N L1	float	V	r
3	2791	34791	2	1. min harm. Voltage PH-N L2	float	V	r
3	2793	34793	2	1. min harm. Voltage PH-N L3	float	V	r
3	See formula	See formula	2	n. min harm. Voltage PH-N L1	float	%	r
3	See formula	See formula	2	n. min harm. Voltage PH-N L2	float	%	r
3	See formula	See formula	2	n. min harm. Voltage PH-N L3	float	%	r
3	3167	35167	2	64. min harm. Voltage PH-N L1	float	%	r
3	3169	35169	2	64. min harm. Voltage PH-N L2	float	%	r
3	3171	35171	2	64. min harm. Voltage PH-N L3	float	%	r
3	3173	35173	2	1. min harm. Voltage PH-PH L12	float	V	r
3	3175	35175	2	1. min harm. Voltage PH-PH L23	float	V	r
3	3177	35177	2	1. min harm. Voltage PH-PH L31	float	V	r
3	See formula	See formula	2	n. min harm. Voltage PH-PH L12	float	%	r
3	See formula	See formula	2	n. min harm. Voltage PH-PH L23	float	%	r
3	See formula	See formula	2	n. min harm. Voltage PH-PH L31	float	%	r
3	3551	35551	2	64. min harm. Voltage PH-PH L12	float	%	r
3	3553	35553	2	64. min harm. Voltage PH-PH L23	float	%	r
3	3555	35555	2	64. min harm. Voltage PH-PH L31	float	%	r