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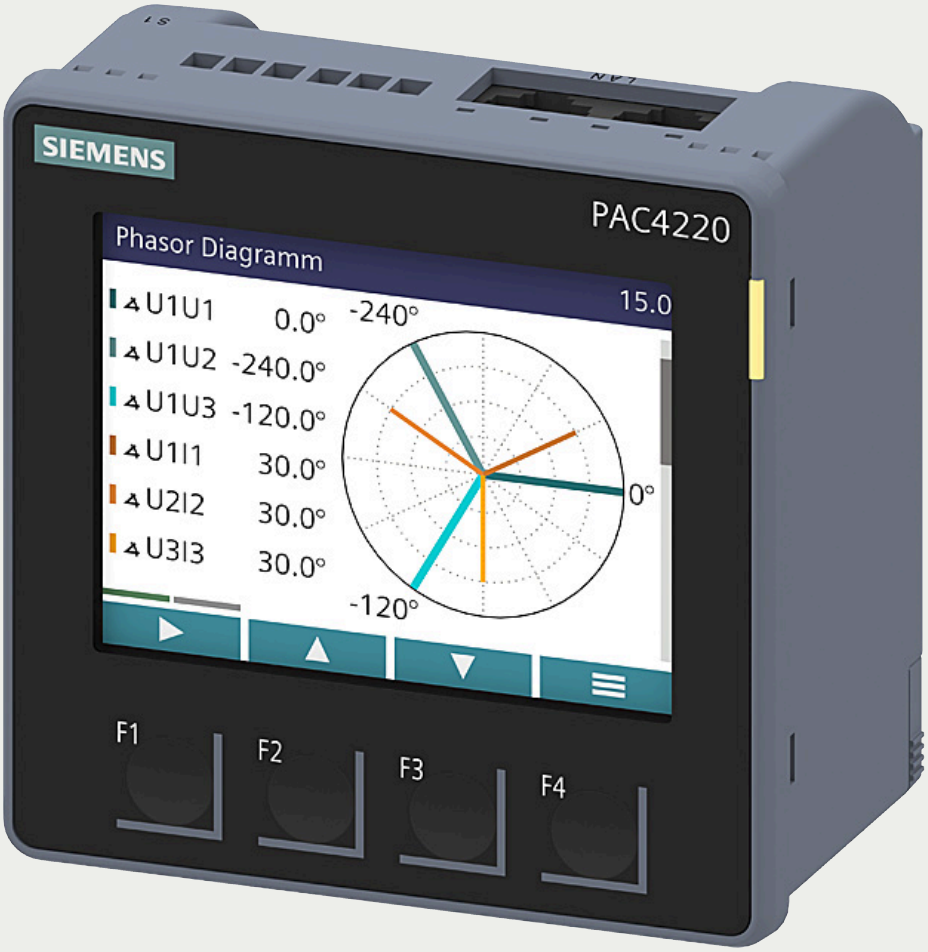

MANUAL

SENTRON

7KM Power Monitoring Device

PAC4220

www.siemens.com/lowvoltage

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SENTRON

7KM Power Monitoring Device PAC4220

Equipment Manual

11/2024 (from firmware 3.3.0)
L1V30827278B_RS-AB_004

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

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

NOTICE

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

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

Qualified Personnel

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

Proper use of Siemens products

Note the following:

⚠ WARNING

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

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

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L1V30827278B_RS-AB_004
Ⓟ 01/2025 Subject to change

Table of contents

Introduction

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1.1 Components

The package includes:

- One PAC4220 Power Monitoring Device
- Two brackets for panel mounting
- One set of operating instructions for the PAC4220 (https://support.industry.siemens.com/cs/ww/en/view/109816835)

Available accessories

- SENTRON Powerconfig (https://support.industry.siemens.com/cs/ww/en/view/63452759) software

- SENTRON Powermanager (https://mall.industry.siemens.com/mall/en/WW/Catalog/Products/10057619) software

- 7KM PROFIBUS DP (https://mall.industry.siemens.com/mall/en/WW/Catalog/Product/7KM9300-0AB01-0AA0) expansion module (7KM9300-0AB01-0AA0)
- 7KM Switched Ethernet PROFINET (https://mall.industry.siemens.com/mall/en/WW/Catalog/Product/7KM9300-0AE02-0AA0) expansion module (7KM9300-0AE02-0AA0)
- 7KM RS485 (https://mall.industry.siemens.com/mall/en/WW/Catalog/Product/7KM9300-0AM00-0AA0) expansion module (7KM9300-0AM00-0AA0)
- 7KM 4DI/2DO (https://mall.industry.siemens.com/mall/en/ww/Catalog/Product?mlfb=7KM9200-0AB00-0AA0) expansion module (7KM9200-0AB00-0AA0)
- 7KM I(N), I(Diff), analog expansion module (https://mall.industry.siemens.com/mall/en/ww/Catalog/Product?mlfb=7KM9200-0AD00-0AA0) (7KM9200-0AD00-0AA0)
- Compact bracket (https://mall.industry.siemens.com/mall/en/ww/Catalog/Product/7KM9900-0GA00-0AA0) (7KM9900-0GA00-0AA0)
- Adapter for mounting on DIN rails (display faces forward) (https://mall.industry.siemens.com/mall/en/ww/Catalog/Product/7KM9900-0XA00-0AA0) (7KM9900-0XA00-0AA0)
- Adapter for mounting on DIN rails (display faces toward DIN rail) (https://mall.industry.siemens.com/mall/en/ww/Catalog/Product/7KM9900-0YA00-0AA0) (7KM9900-0YA00-0AA0)

1.2 Latest information

Up-to-the-minute information

You can find further support on the internet (https://sieportal.siemens.com/en-ww/home).

1.3 Revision documentation

Document identification number	Revisions
L1V30827278B_RS-AA_004	New functions: • Additional configuration options (e.g. activation and deactivation of services) • Additional counters have been implemented (e.g. universal and process counters) • Limit value monitoring 1-11 has been implemented • 4DI/2DO expansion module is supported • Selection of supported languages has been extended

1.4 Technical Support

You can find further support on the Internet at:

TechnicalSupport (https://www.siemens.com/support-request)

1.5 Open Source Software

This product, solution or service ("Product") contains third-party software components. These components are Open Source Software licensed under a license approved by the Open Source Initiative (https://www.opensource.org) or similar licenses as determined by SIEMENS ("OSS") and/or commercial or freeware software components. With respect to the OSS components, the applicable OSS license conditions prevail over any other terms and conditions covering the Product. The OSS portions of this Product are provided royalty-free and can be used at no charge.

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Siemens AG
Smart Infrastructure
Electrical Products
Technical Support
Postfach 10 09 53
93009 Regensburg
Germany

You will find Technical Support under (https://www.siemens.com/support-request).

Keyword: Open Source Request (please specify Product name and version, if applicable)

SIEMENS may charge a handling fee of up to 5 EUR to fulfil the request.

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1.6 Cybersecurity information

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

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

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

For additional information on industrial cybersecurity measures that may be implemented, please visit (https://www.siemens.com/global/en/products/automation/topic-areas/industrial-cybersecurity.html).

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

To stay informed about product updates, subscribe to the Siemens Industrial Cybersecurity RSS Feed at (https://www.siemens.com/cert):

1.7 General safety notes

⚠ DANGER

Hazardous voltage

Will cause death, serious personal injury, or equipment damage.

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

⚠ WARNING

Impairment of protection as a result of improper use

Unsuitable or improper use and opening or manipulating the device can cause death, serious personal injury, equipment damage or device failure.

The effectiveness of the protective systems integrated in the device may be undermined if it is not used in the proper way.

The device may be used only for the applications described in the catalog and the associated technical documentation.

Note

More information

These operating instructions do not purport to cover all details or variations in equipment. Neither do they provide for every possible contingency in connection with installation, operation, or maintenance. Should additional information be desired, or should particular problems arise that are not discussed in enough detail in the operating instructions, please contact Technical Support (https://www.siemens.com/support-request) for the information you require.

Safety-related symbols on the device

	Symbol	Meaning
(1)		Risk of electric shock
(2)		Safety Alert Symbol
(3)		Electrical installation and maintenance by qualified personnel only

See also

Applying the measuring current (Page 60)

Applying the measuring voltage (Page 59)

Applying the supply voltage (Page 56)

1.8 Protective mechanisms against manipulation

Note

Risk of tampering

Several protective mechanisms can be activated in the device.

In order to reduce the risk of tampering occurring on the device, we recommend activating the protective mechanisms available in the device.

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

You can find more information in chapter Protection against tampering (Page 99).

See also

Parameterizing via the operator interface (Page 77)

Performance features (Page 13)

Description

2

2.1 Performance features

The PAC4220 is a Power Monitoring Device for measuring the basic electrical variables in low-voltage power distribution. The device is capable of 1-phase, 2-phase or 3-phase measurement and can be used in 2, 3 or 4-wire TN, TT and IT systems.

The PAC4220 is designed for panel mounting. It is also possible to mount it on a DIN rail using the DIN rail support brackets available as an option.

Thanks to its large measuring voltage range, the PAC4220 with a wide-range power supply can be connected in any low-voltage system up to a rated line voltage of 690 V (max. 600 V for UL). Higher voltages can be measured using voltage transformers.

Either x/1 A or x/5 A current transformers can be used for measuring current.

The large graphical color display is used to read off all the measured values and to configure the device.

The integral Ethernet interface or the interface of an expansion module available as an option can be used for communication, e.g. SENTRON PAC RS485 expansion module or SENTRON PAC PROFIBUS DP expansion module or PAC SWITCHED ETHERNET PROFINET module. The functions of the device can be expanded using other expansion modules available as options. The PAC4220 has 2 interfaces which can accommodate up to 2 external expansion modules simultaneously.

The PAC4220 features an integrated web server. This can be used to read out measured values using a web browser.

Measurement

- Measurement in two, three or four-wire systems. Suitable for TN, TT and IT systems
- Measurement of all relevant electrical variables in a 50/60 Hz AC system
- Measurement of minimum and maximum values of all measured variables
- Calculation of genuine rms values for voltage and current to the 64th harmonic
- 4-quadrant measurement (import and export)
- Averaging of all measured values directly on the device in two stages, which are independent of each other and freely configurable (aggregation)
- Measurement of 1st to 63rd harmonics for voltage and current
- Calculation of the average voltage and current values over all phases
- Zero blind measurement
- High measurement accuracy: for instance, accuracy class 0.2 in accordance with IEC 61557-12 for active energy This means: an accuracy of 0.2% relative to the measured value under reference conditions
- Measurement of the neutral current [1)]

- Measurement of residual current and PE conductor current via external summation current transformer [1)]
- Measurement of physical variables (e.g. temperature, pressure, humidity) with external 0/4 mA to 20 mA transmitters [1)]

[1)] When using the optional expansion module "I(N), I(Diff), Analog" (MLFB: 7KM9200-0AD00-0AA0)

Manual 7KM PAC expansion module I(N), I(Diff), analog (https://support.industry.siemens.com/cs/ww/en/view/109746834)

Counters and power demand

- A total of 50 energy counters record reactive energy, apparent energy, and active energy for off-peak and on-peak, import and export on a phase-specific basis.
- Energy consumption for active energy, reactive energy and apparent energy per day and tariff.
- 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 (e.g. from electricity, gas, or water meters). The pulse shape and time 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 recording 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 recording 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. The start and stop commands of the digital input that controls the process energy counter start and stop the operating hours counter. Up to 10 counters can be used for detecting the consumption of any media via digital inputs. Consumption (e.g. of gas, water, compressed air, electrical current) can therefore be recorded using simple media counters with a pulse output.

The display texts can be freely parameterized in a user-friendly way using the SENTRON Powerconfig (https://mall.industry.siemens.com/mall/en/WW/Catalog/Products/10121795) configuration software.

Monitoring functions

The PAC4220 monitors up to 12 limit values (limit values 0 to 11), as well as one limit value (logic limit value)[1)] that can be formed by gating the 12 limit values[1)].

[1)] This function will be available at a later time via a firmware update.

Event display[1)]

- Recording of events with a time stamp and event-specific information
- Display of events in an event list
- Reporting of events on the display
- Classification of messages as follows:
  - Information
  - Warning
  - Alarm

[1)] This function will be available at a later time via a firmware update.

Displays and controls

- Color display
- Multicolored LED with variable function assignment. The LED function can be configured by the user.
- 4 control keys with variable function assignment
- SENTRON Powerconfig (commissioning and service software)
- SENTRON Powermanager (power monitoring software)
- Web server

Interfaces

- 2 Ethernet interfaces
- 2 multifunctional integral passive digital inputs
- 2 multifunctional integral passive digital outputs
- 2 slots for operating optional expansion modules
  - PROFIBUS DP (if 7KM PROFIBUS DP expansion module is used)
  - Modbus RTU (if 7KM RS485 expansion module is used)
  - Switched Ethernet PROFINET (if 7KM Switched Ethernet PROFINET expansion module is used)
  - Up to 8 plug-in digital inputs (if two 7KM 4DI/2DO expansion modules are used)
  - Up to 4 plug-in digital outputs (if two 7KM 4DI/2DO expansion modules are used)
  - 3 analog inputs (if 7KM I(N), I(Diff), analog expansion module is used)

Note

The SENTRON PAC4220 supports two expansion modules. One of these may be a communications module (e.g. 7KM Switched Ethernet PROFINET, 7KM PROFIBUS DP or 7KM RS485). Only one "I(N), I(Diff), analog expansion module" may be connected to the device.

Gateway

- Modbus gateway for integrating purely Modbus RTU devices into an Ethernet network (Ethernet Modbus TCP ⇔ RS485 Modbus RTU). This gateway function requires an RS485 expansion module.

Memory

- Adjusted device parameters are permanently stored in the device memory.
- Min/max (minimum or maximum) values are permanently stored in the internal device memory. Values can be reset via SENTRON Powerconfig, the communications interface or directly on the device via the menu.
- Internal clock in the device (retains values during brief interruptions)
- Storage of load profiles
- Storage of events[1)]

[1)] This function will be available at a later time via a firmware update.

Response in the case of power failure and power restore

In the event of a power failure, the power information recorded up to that point is not lost.

Tariffs

The PAC4220 supports 2 tariffs for the integrated energy counter (on-peak and off-peak tariff).

- Control of tariff switching
  Switching between off-peak and on-peak can be controlled via the digital input or the communications interfaces.
  Time-related switching is only possible using a higher-level system.
- Tariff switching after synchronization
  When synchronizing the power demand, the tariff change only becomes effective after expiry of the period.

Security

- Operating protection by means of a PIN entry protects the device against improper use. Write access using the keys on the device is blocked if the incorrect PIN is entered.
- Configurable hardware write protection
- Device access control (IP allowlist)
- Modbus TCP port, configurable

You can use "Hardware write protection" to configure and, where necessary, protect write access to the device settings of the PAC4220. The data can continue to be read without any restrictions.

Protection, where configured, takes effect in case of the following actions:

- Modify parameters in device.
- Reset min/max values.
- Reset counters.
- Reset device to factory settings.
- Reset PIN.
- Reset long-term data.
- Update firmware on the device.

Note

Activating hardware write protection

Irrespective of whether the Power Monitoring Device is connected to a network, hardware write protection must **always** be activated in order to provide the best possible security against manipulation.

Note

Using the device in an unprotected network

Deactivate the SNTP protocol if using the device in an unprotected network.

2.2 Measuring inputs

Current measurement

NOTICE
Functional impairment of the Power Monitoring Device
Use the device to measure alternating current only.

The power monitoring device is designed for:

- Current measurement via external x/1 A or x/5 A current transformers.
- The measurement of direct currents is not possible.
- It may be necessary to adjust the current transformer ratio via the device menu or in SENTRON Powerconfig to the current transformers used, see chapter Parameterizing via the operator interface. (Page 77)
- Follow the installation instructions for the current transformers used.
- The current direction can be changed for each phase individually. It is not necessary to change the terminal connections of the current transformers in the event of connection errors.

NOTICE
Directly connecting the current measuring inputs to the low-voltage system can cause irreparable damage to the device The device is designed for connection to the low-voltage system via external current transformers. Only connect the current measuring inputs to the low-voltage system via suitable current transformers. Use the UL-listed current transformers if the device is to be used on the UL market.

Note

Suitable current transformers

You will find Siemens current transformers (4NC5x-xxxxx) to suit your measuring requirements in the Siemens product portfolio.

You can find more detailed information under:

SiePortal current transformer (https://mall.industry.siemens.com/mall/en/WW/Catalog/Products/8230427)

Voltage measurement

NOTICE
Functional impairment of the Power Monitoring Device Use the device to measure alternating voltage only.

PAC4220 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-range 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.

Connection types

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

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

Short code	Connection type
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 chapter Commissioning. (Page 55)

NOTICE
Device damage due to incorrect system connection
Before connecting the power monitoring device, you must ensure that the local power supply conditions match the specifications on the rating plate.

The short code of the connection type must be entered in the device settings on startup. You can find the instructions for parameterizing the connection type in chapter Parameterizing (Page 77).

2.3 Measured variables

2.3.1 Measured variables

The total set of representable measured variables is restricted by the method of connecting the device. The availability of the measured variables depends on the type of readout.

Depending on the device configuration, several different readout types are available:

- Device display
- Modbus TCP
- Modbus RTU (via optional expansion module)
- Profibus (via optional expansion module)
- Profinet (via optional expansion module)
- Web server

A measured variable that cannot be indicated due to the connection method is hidden on the display.

Measured variable	Connection type				
	3P4W	3P3W	3P4WB	3P3WB	1P2W
Voltage L1-N	✓	-	✓	-	✓
Voltage L2-N	✓	-	-	-	-
Voltage L3-N	✓	-	-	-	-
3-phase average voltage L-N	✓	-	-	-	-
Voltage L1-L2	✓	✓	-	✓	-

Measured variable	Connection type				
	3P4W	3P3W	3P4WB	3P3WB	1P2W
Voltage L2-L3	✓	✓	-	✓	-
Voltage L3-L1	✓	✓	-	✓	-
3-phase average voltage L-L	✓	✓	-	✓	-
Current L1	✓	✓	✓	✓	✓
Current L2	✓	✓	-	-	-
Current L3	✓	✓	-	-	-
3-phase average current	✓	✓	-	-	-
Neutral current	✓	-	-	-	-
Apparent power L1	✓	-	-	-	-
Apparent power L2	✓	-	-	-	-
Apparent power L3	✓	-	-	-	-
Active power L1	✓	-	-	-	-
Active power L2	✓	-	-	-	-
Active power L3	✓	-	-	-	-
Total reactive power L1 (Q_{tot})	✓	-	-	-	-
Total reactive power L2 (Q_{tot})	✓	-	-	-	-
Total reactive power L3 (Q_{tot})	✓	-	-	-	-
Reactive power L1 (Q_1)	✓	-	-	-	-
Reactive power L2 (Q_1)	✓	-	-	-	-
Reactive power L3 (Q_1)	✓	-	-	-	-
Total apparent power over all phases	✓	✓	✓	✓	✓
Total active power over all phases	✓	✓	✓	✓	✓
Total reactive power (Q_{tot}) over all phases	✓	✓	✓	✓	✓
Total reactive power (Q_1) over all phases	✓	✓	✓	✓	✓
Cos φ L1	✓	-	✓	✓	✓
Cos φ L2	✓	-	-	-	-
Cos φ L3	✓	-	-	-	-
Power factor L1	✓	-	-	-	-
Power factor L2	✓	-	-	-	-
Power factor L3	✓	-	-	-	-
Total power factor	✓	✓	✓	✓	✓
Line frequency	✓	✓	✓	✓	✓
Displacement angle L1	✓	-	✓	✓	✓
Displacement angle L2	✓	-	-	-	-
Displacement angle L3	✓	-	-	-	-
Phase angle L1-L1	✓	✓	-	✓	-
Phase angle L1-L2	✓	✓	-	✓	-
Phase angle L1-L3	✓	✓	-	✓	-
THD voltage L1	✓	-	✓	-	✓
THD voltage L2	✓	-	-	-	-
THD voltage L3	✓	-	-	-	-
THD voltage L1-L2	✓	✓	-	✓	-

Measured variable	Connection type				
	3P4W	**3P3W**	**3P4WB**	**3P3WB**	**1P2W**
THD voltage L2-L3	✓	✓	-	✓	-
THD voltage L3-L1	✓	✓	-	✓	-
THD current L1	✓	✓	✓	✓	✓
THD current L2	✓	✓	-	-	-
THD current L3	✓	✓	-	-	-
Apparent energy	✓	✓	✓	✓	✓
Active energy import / export	✓	✓	✓	✓	✓
Reactive energy import / export	✓	✓	✓	✓	✓
Voltage amplitude unbalance L-N/L-L	✓	✓	✓	✓	-
Amplitude unbalance current	✓	✓	✓	✓	-
Distortion current L1	✓	✓	✓	✓	✓
Distortion current L2	✓	✓	-	-	-
Distortion current L3	✓	✓	-	-	-
Harmonic content of the 1st, 2nd, 3rd, ... 63rd harmonics for the L1-N voltage referred to the fundamental	✓	-	✓	-	✓
Harmonic content of the 1st, 2nd, 3rd, ... 63rd harmonics for the L2-N voltage referred to the fundamental	✓	-	-	-	-
Harmonic content of the 1st, 2nd, 3rd, ... 63rd harmonics for the L3-N voltage referred to the fundamental	✓	-	-	-	-
Harmonic content of the 1st, 2nd, 3rd, ... 63rd harmonics for the L1-L2 voltage referred to the fundamental	✓	✓	-	✓	-
Harmonic content of the 1st, 2nd, 3rd, ... 63rd harmonics for the L2-L3 voltage referred to the fundamental	✓	✓	-	✓	-
Harmonic content of the 1st, 2nd, 3rd, ... 63rd harmonics for the L3-L1 voltage referred to the fundamental	✓	✓	-	✓	-
Current of the fundamental and current of the 1st, 2nd, 3rd, ... 63rd harmonics in L1	✓	✓	✓	✓	✓
Current of the fundamental and current of the 1st, 2nd, 3rd, ... 63rd harmonics in L2	✓	✓	-	-	-
Current of the fundamental and current of the 1st, 2nd, 3rd, ... 63rd harmonics in L3	✓	✓	-	-	-

Note

The measured values specified in the table are displayed as instantaneous, minimum and maximum values. There are no minimum values for harmonic measured values.

2.3.2 Averaging measured values

Instantaneous values are averaged over defined time periods in order to generate measured value profiles. The average values can be read out and stored for this purpose. This reduces the communication load and the storage requirements on downstream servers.
The PAC4220 has two average value generators that can be parameterized independently of each another. The aggregation of the measured values reduces the bus load without risk of losing information. Average values are calculated contiguously from all underlying values.

The values are updated at time-synchronized, parameterizable intervals:

- A default period length of 10 seconds is set for the measured values of average 1 (file 1).
- A default period length of 15 minutes is set for the measured values of average 2 (file 2).

The averaging time can be set between three seconds and one day.

2.3.3 Other properties of measured variable representation

Lower limit for current measurement ("Minimal current")

The lower limit for current measurement can be set in 0.1% steps in the range from 0% to 10% of the primary rated current of the external current transformer (default value 0.0%). Currents within this range are not included in the measurement.

Lower limit for operating hours counter

The operating hours counter starts as soon as load is measured at the current input. The lower limit can be set in 0.1% steps in the range from 0% to 10% of the primary rated current of the external current transformer (default value 0.0%).

As long as the current value remains below the defined lower limit, the operating hours counter is not incremented.

2.4 History of active energy consumption

Based on selected recordings of energy consumption over time, users can perform a targeted analysis of their energy consumption for the purpose of optimizing their energy usage.

The Power Monitoring Devices have a daily energy counter, a monthly energy counter and an annual energy counter.

- The daily energy counter records the active energy in a ring buffer with a depth of 3650 days.
- The monthly energy counter records the active energy in a ring buffer with a depth of 240 months.
- The annual energy counter records the active energy in a ring buffer with a depth of 100 years.

A list of available measured values can be found in chapters Active energy history with the Modbus function codes 0x03, 0x04 and 0x64.

2.5 Load profile

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

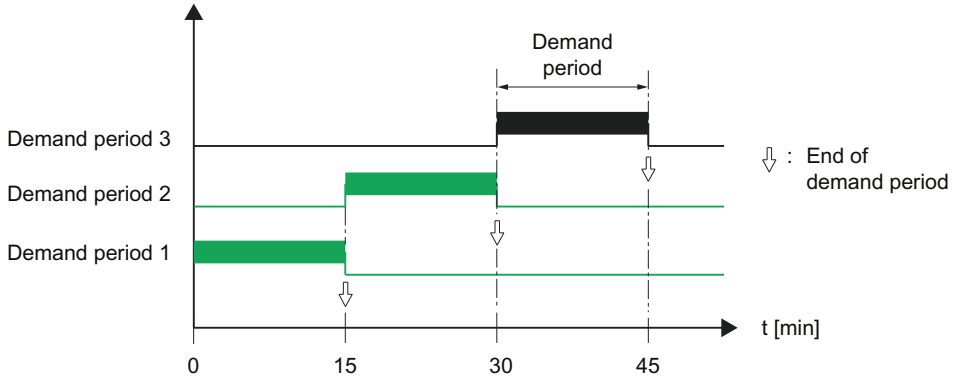
Note

Data access via the software

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

Load profile determination

The "fixed block" method is used for determining the load profile.



You can configure load profile recording using the configuration software or on the display of the device.

The default setting for the length of the demand period is 15 min.

The demand period can be changed if required however.

Possible lengths for demand period: 1, 2, 3, 4, 5, 6, 10, 12, 15, 20, 30, 60 min

The start point of the demand period depends on the configured length and is synchronized by the internal device clock.

The start point of the demand period is the full hour plus a multiple of the configured length of the demand period.

Examples:

Device was started up at 07:03.

Demand period: 15 min	Demand period: 20 min
1st demand period: 07:03 - 07:15 (incomplete demand period)	1st demand period: 07:03 - 07:20 (incomplete demand period)
2nd demand period: 07:15 - 07:30 (complete demand period)	2nd demand period: 07:20 - 07:40 (complete demand period)

Demand period: 15 min	Demand period: 20 min
3rd demand period: 07:30 - 07:45 (complete demand period)	3rd demand period: 07:40 - 08:00 (complete demand period)
4th demand period: 07:45 - 08:00 (complete demand period)	4th demand period: 08:00 - 08:20 (complete demand period)
5th demand period: 08:00 - 08:15 (complete demand period)	5th demand period: 08:20 - 08:40 (complete demand period)

Calculation of the power demand and the cumulated power value

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 value:

Cumulative calculation of the power values based on the configured length of the demand period. The cumulated power value in the instantaneous period increases linearly providing the power is constant.

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

Energy = (cumulated power) • (configured period length)

2.5.1 Historical load profile

Measured variables recorded

Measured variable	Cumulated power values	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.

Values are recorded per demand period.

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 PAC4220 memory takes the form of a ring buffer. If the maximum available memory is exceeded, the most recent data overwrite the oldest data.

Storage capacity of the load profile memory

The Power Monitoring Device can record a maximum of 35040 periods.

If a demand period of 15 min is configured, the load profile can be stored for 365 days.

Behavior on device startup

Any load profiles that have already been recorded remain unchanged.

The Power Monitoring Device resets the internal clock if it detects load profiles with a date in the future or a time in the past on startup.

Impact of a tariff change on the load profile

The tariff change between off-peak and on-peak has an impact on the load profile, because all values stored in the load profile are uniquely assigned to the currently valid tariff.

The last 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 the PAC4220 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 impact on the load profile.

Impact of a supply voltage failure

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

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

2.5.2 Current load profile data at the communication interfaces

Current load profile data

The Power Monitoring Device outputs the load profile data for the current and instantaneous periods to the communications interfaces.

- The actual 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 (Page 123).

2.5.3 Additional information about the load profile data

The PAC4220 records the following additional information for each period:

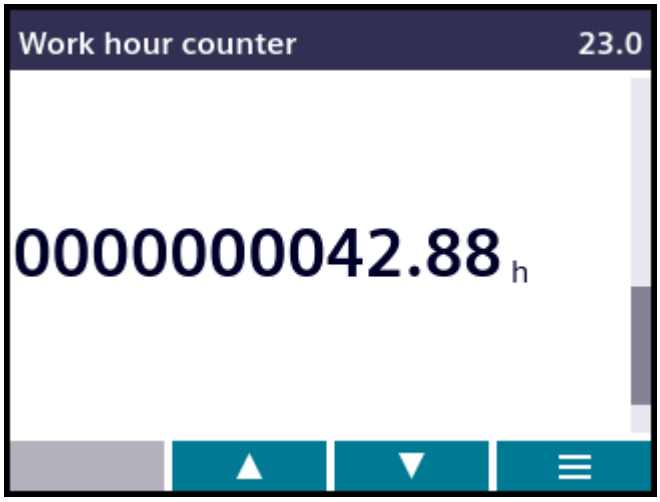
- **"Resynchronized"**
  The period was prematurely ended by the device due to a synchronization irregularity. This identifier is set as long as the time is undefined.
- **"Supply voltage failed"**
  The period was prematurely ended due to failure of the supply voltage.
- **"Unreliable"**
  The load profile data are not reliable when the device is operated outside the specified range.

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

2.6 Counters

2.6.1 Operating hours counter

The operating hours counter is used for monitoring the runtime of a connected load (only functions when energy counting is implemented).

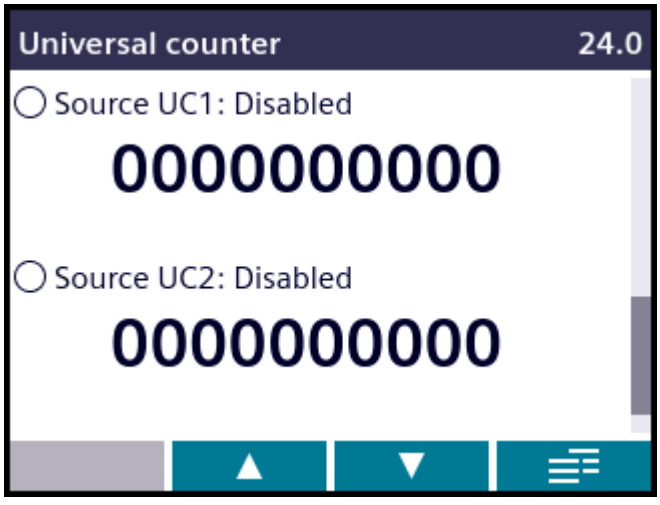


2.6.2 Universal counters

The PAC4220 features 2 configurable universal counters.

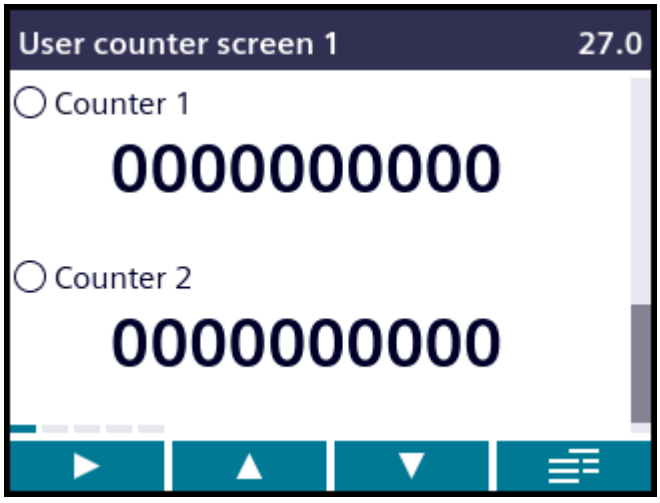
Both universal counters can be configured for the following parameters if required:

- Status changes at the digital input (rising edge only)
- Status changes at the digital output (rising edge only)
- Limit violations (limit values 0 to 11)



2.6.3 User counters

The PAC4220 features 10 freely configurable counters that can be assigned to the digital inputs of the PAC4220 or the 4DI/2DO expansion module.

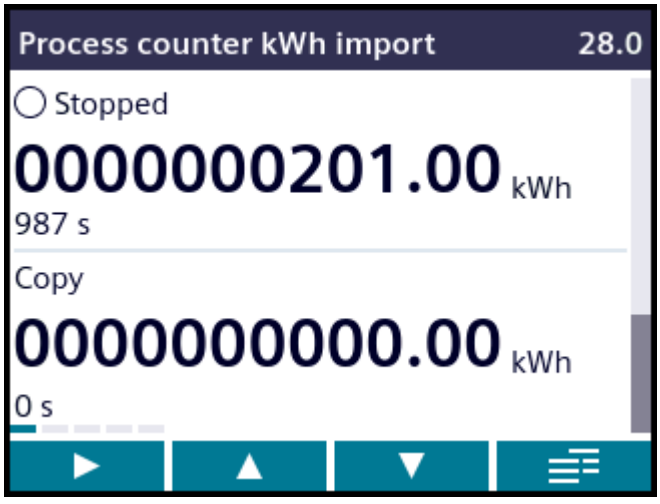


2.6.4 Process counters

The Start/Stop function of the digital inputs for active energy, reactive energy, apparent energy and process hours is used for starting and stopping the process counters by means of a status change at the digital input.

The Copy/Reset function of the digital inputs can be used to reset counters. In this case, a copy of the counter reading is created before the reset and shown on the display.

Counters are reset using the Reset function of the digital inputs.



2.7 Tariffs

PAC4220 supports two tariffs for the integrated energy counters (on-peak and off-peak).

A tariff change between off-peak and on-peak can be requested by means of a digital input or via the communications interfaces. When a tariff change is performed via digital input, a parallel tariff change via the communications interface is not possible.

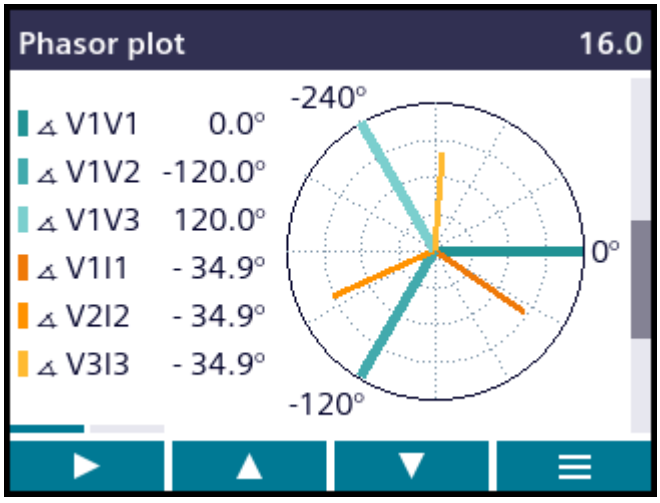
Time-related switching is only possible using a higher-level system.

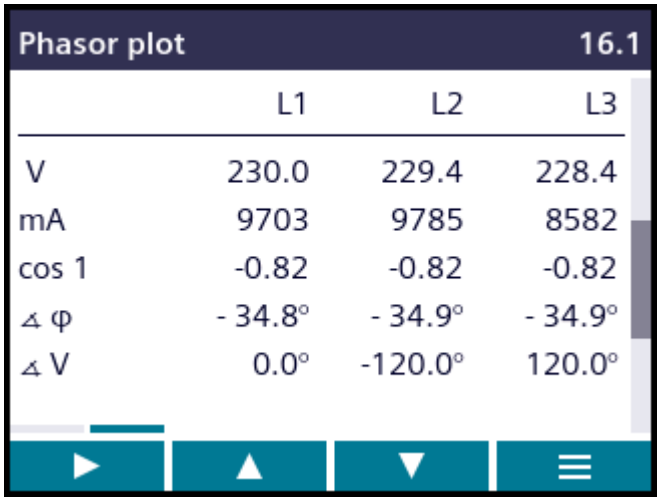
The last tariff remains valid until the end of the instantaneous period. The new tariff takes effect at the start of the next period. The energy counters of the PAC4220 are switched to the other tariff at the end of the instantaneous demand period.

2.8 Technical features of the network quality

The PAC4220 supplies the following measured variables for evaluating network quality:

- Harmonics up to the 63rd harmonic
- THD for voltage and current:
- Displacement angle φ
- Cosine of the displacement angle φ
- Phase angle U
- Voltage unbalance and current unbalance

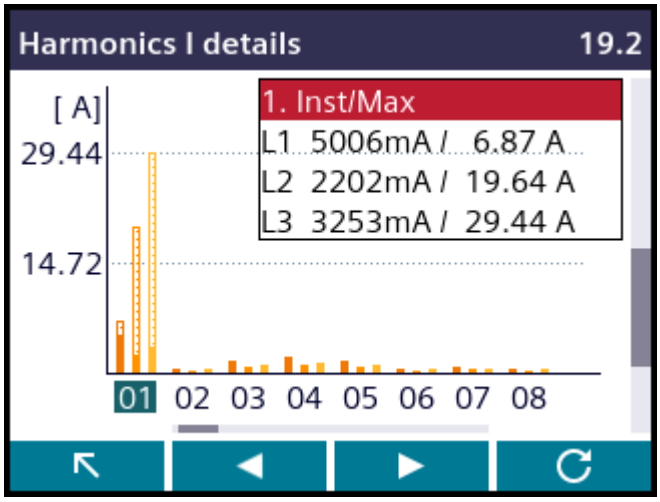




Measurement of 1st to 63rd harmonics for voltage and current

Harmonics are mainly caused by equipment with a non-linear characteristic, such as fluorescent lamps, transformers and frequency converters. They are integer multiples of a fundamental.

The PAC4220 can calculate voltage harmonics (2nd to 63rd) and current harmonics (1st to 63rd) and display them in the form of a bar diagram.



It is also possible to read out the data via Modbus or web server.

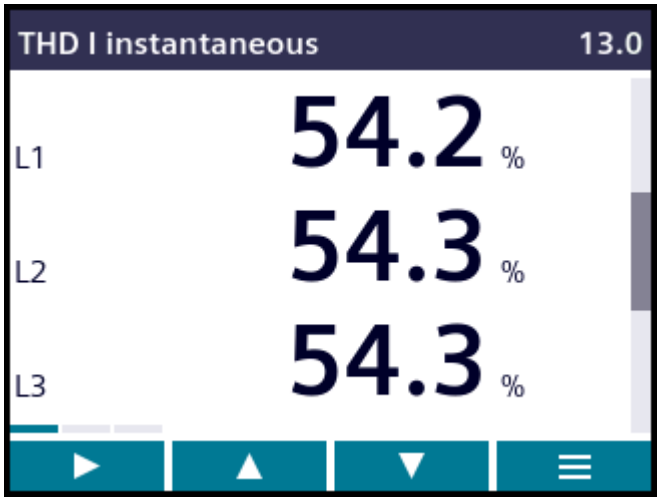
The Modbus table can be found in chapter Readout of harmonic components of all harmonics with function codes 0x03 and 0x04 (Page 150).

Harmonics referred to the root-mean-square value

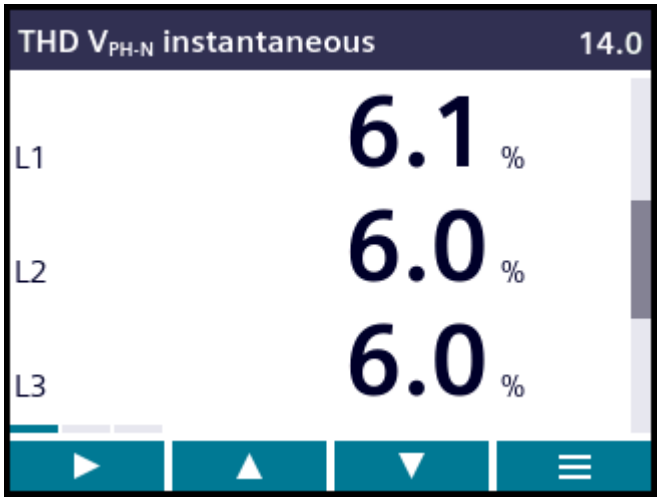
The fundamental of the voltage is specified in volts (V) rather than percent (%). The harmonics of the voltage referred to the root-mean-square value (rms) can be calculated from this information in the software.

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.



The PAC4220 measures the THD of the voltage and the THD of the current referred to the fundamental. The instantaneous value, the maximum/minimum values and the time stamps of the maximum/minimum values are supplied for both variables.



The values are calculated in accordance with standard IEC 61557-12: 2007. Account is taken of harmonics up to the 63rd harmonic.

Displacement angle φ

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

The PAC4220 supplies the instantaneous value of the displacement angle φ, the maximum and minimum values, and the time stamps of the min/max values for each phase.

Cosine φ

Cos φ is the cosine of the displacement angle φ of the fundamentals for voltage and current. The value range of cos φ is [0.0 ... -1, +1 ... +0.0]. A negative value signifies capacitive (leading current) and a positive value inductive (lagging current).

The PAC4220 supplies the instantaneous value of cos φ, the maximum and minimum values, and the time stamps of the min/max values for each phase.

Phase angle U

The PAC4220 supplies the instantaneous values, the maximum and minimum values, and the time stamps of the min/max values for phase angles L1-L1, L1-L2 and L1-L3.

Unbalance

A 3-phase system is referred to as balanced if the 3 phase-to-phase voltages and phase-to-phase currents have an identical amplitude and are offset 120° from each other.

The PAC4220 calculates the unbalance for voltage and current according to the EN 61000-4-27:2000 standard.

2.9 Date and time

UTC time and local time

The internal clock of the PAC4220 can be freely configured by the user.

UNIVERSAL: Coordinated Universal Time (UTC). The international reference time.

Time zone: Select from "Time Zone Database". This option allows the precise local time to be set by location.

Synchronization of the internal clock

The internal clock of the PAC4220 can be synchronized with an external time, by means of a synchronization command via the available communications interfaces, or automatically via SNTP (Simple Network Time Protocol).

You can find more information in chapter Ethernet interface (Page 33).

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

2.10 Limit values

The Power Monitoring Device has a function for monitoring up to 12 limit values. These can be monitored for violation of the upper or lower limit.

In addition, the limit values can be gated in a logic operation. The result of the logic operation can be used to trigger specific actions in the same way as the individual limit values[1)].

The limit violations are shown on the display, via the communications interface, at the digital output, in the web server[1)] or, depending on how the LEDs are configured, by an LED lighting up, going off or flashing.

[1)] This function will be available at a later time via a firmware update.

Defining the limit values

The following must be specified for each of the 12 limit values in order to define limit value monitoring:

- Limit value monitoring on/off
- Monitored measured variable
- Upper or lower limit violated
- Limit
- Time delay
- Hysteresis

2.11 Function of the digital inputs and outputs

PAC4220 has:

- 2 multifunctional digital inputs
- 2 multifunctional digital outputs
- Optionally up to 8 plug-in digital inputs[1)]
- Optionally up to 4 plug-in digital outputs[1)]

[1)] If two optionally available 4DI/2DO expansion modules (7KM9200-0AB00-0AA0 (https://mall.industry.siemens.com/mall/en/WW/Catalog/Product/7KM9200-0AB00-0AA0)) are used.

2.12 Ethernet interface

The PAC4220 has two identical Ethernet interfaces which can be used to connect the device to Modbus TCP communication.

The Ethernet interface facilitates communication via the following protocols:

- Modbus TCP
  The device can be configured via Modbus TCP.
- Web server (HTTP)
  The protocol can only be used to read out the measured values via a web browser.
- SNTP
  The SNTP (Simple Network Time Protocol) is used to automatically synchronize the internal clock with a time server within the network.

- DHCP
  Stands for "Dynamic Host Configuration Protocol". Protocol for obtaining network settings from a DHCP server. Network settings are assigned automatically.
- ICMP
  Stands for "Internet Control Message Protocol". This protocol is used for the ping command in the PAC4220.
- Discovery Service
  A proprietary protocol for device identification

Autonegotiation is a method used by network communication peers to automatically negotiate the highest possible transfer rate. The PAC4220 is automatically set to the transmission rate of the communication peer if the latter does not support autonegotiation.

MDI-X autocrossover 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 lines. Both crossed and uncrossed cables can be used.

2-port Ethernet switch

PAC4220 features 2 Ethernet ports that are configured as switches. This supports Ethernet linear topology for efficient cabling, with no additional cost for external Ethernet switches.

2.13 Slots for expansion modules

The PAC4220 has 2 identical slots (MOD1 and MOD2) for installing optionally available expansion modules.

The following expansion modules are available:

- 7KM PROFIBUS DP expansion module (7KM9300-0AB01-0AA0)
- 7KM RS485 expansion module (7KM9300-0AM00-0AA0)
- 7KM 4DI/2DO expansion module (7KM9200-0AB00-0AA0)
- 7KM I(N), I(Diff) expansion module, analog (7KM9200-0AD00-0AA0)
- 7KM Switched Ethernet PROFINET expansion module (7KM9300-0AE02-0AA0)

1 expansion module can be operated alone on the device or 2 expansion modules simultaneously.

Note

Use of two expansion modules simultaneously

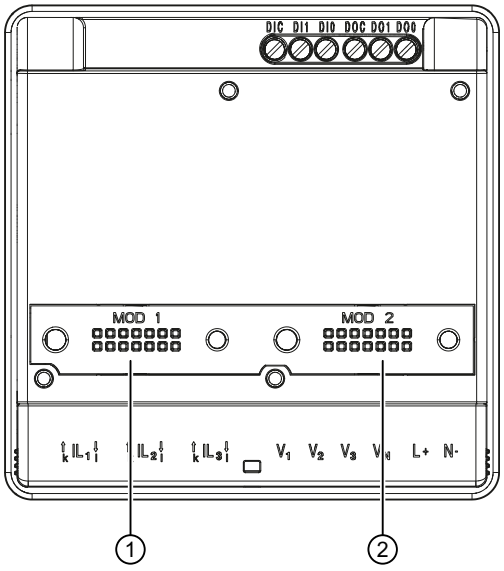
The SENTRON PAC4220 supports two expansion modules. One of these may be a communications module (e.g. 7KM Switched Ethernet PROFINET, 7KM PROFIBUS DP or 7KM RS485). Only one "I(N), I(Diff), analog expansion module" may be connected to the device.

Note

Using 7KM PROFIBUS and 7KM 4DI/2DO expansion modules

Operating the PAC4220 Power Monitoring Device in conjunction with 7KM PROFIBUS or 7KM 4DI/2DO expansion modules can cause radio frequency interference in residential areas.

The 7KM PROFIBUS and 7KM 4DI/2DO expansion modules comply with the EMC emission limits in accordance with EN55032 (Class A).



(1) Slot MOD1

(2) Slot MOD2

WARNING

Hazardous voltage

May cause death, serious personal injury, or equipment damage.

Never insert wires or metal pins into the contact gaps of the module interface below the labels "MOD1" and "MOD2", as otherwise hazardous voltage may cause death or serious personal injury. Furthermore, inserting metal pins or wires into the contact gaps can cause the device to fail.

NOTICE

Device damage caused by attaching the expansion modules while the device is switched on.

The optionally available expansion modules may only be attached to the device while it is switched off.

NOTICE
Device damage due to contamination
Avoid contamination of the contact areas below the labels "MOD1" and "MOD2", otherwise the expansion modules cannot be properly connected or may even be damaged.

2.14 Gateway

SENTRON PAC4220 can be used as a gateway. This allows devices (slaves) that are connected to the RS485 expansion module of PAC4220 to be connected to a device on the 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 PAC4220 unpacks the TCP/IP packets and forwards the freed packets of the serial protocol to the serial interface (RS 485).

Data sent by the addressed target device to the master: SENTRON PAC4220 packs the serial protocol packets into the TCP protocol and forwards the packed user data to the higher-level software.

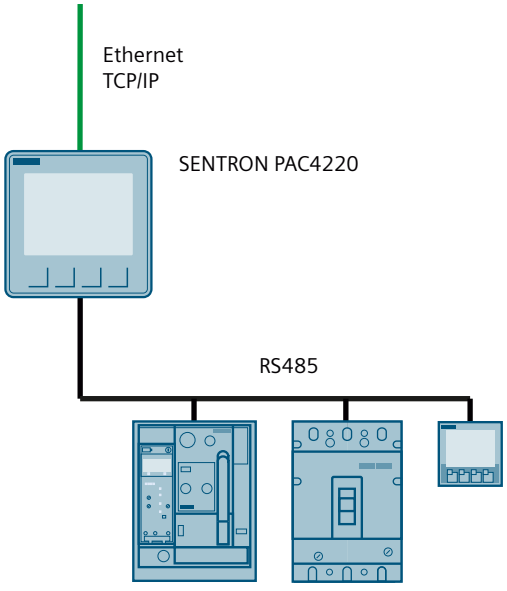


Figure 2-1 SENTRON PAC4220 as a gateway

Requirements and conditions

The SENTRON PAC RS485 expansion module is required to connect the RS 485 bus. According to the RS485 bus specification, up to 31 devices can be addressed via the gateway without special RS 485 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.

Configuration of the gateway

SENTRON PAC4220 must be configured for using the gateway.

- Start up the SENTRON PAC RS485 expansion module on the SENTRON PAC4220.
- Set the communication parameters for operating the RS485 bus below the gateway. It is possible to enter these settings on the display of SENTRON PAC4220 or in the software.

You can find information about parameterizing RS485 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 PAC4220:

- IP address of SENTRON PAC4220
- 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
- Gateway type
  - Modbus gateway for integrating pure Modbus RTU slaves into an Ethernet network (Ethernet Modbus TCP ⇔ RS485 Modbus RTU).
  - Serial gateway for connecting RS485 devices that support Modbus RTU and similar protocols.

More information

You can find more information under:
Modbus.org "MODBUS MESSAGING ON TCP/IP IMPLEMENTATION GUIDE"

See also

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

Installation

3

Mounting location

The PAC4220 is intended for installation in permanently installed control panels within closed, dry rooms.

The device can be mounted on a DIN rail using
optional DIN-rail adapters (7KM9900-0XA00-0AA0 (https://mall.industry.siemens.com/mall/en/ww/Catalog/Product/7KM9900-0XA00-0AA0) and 7KM9900-0YA00-0AA0 (https://mall.industry.siemens.com/mall/en/ww/Catalog/Product/7KM9900-0YA00-0AA0)).

⚠ WARNING

Only operate the device in a secure location.

Can cause death, serious injury or property damage.

The PAC4220 should only be operated in a lockable control cabinet or in a lockable room. Ensure only qualified personnel have access to this cabinet or room.

Conductive control 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 Power Monitoring Device can be mounted in any position. The device can be mounted in a horizonal or in a vertical position.

For ergonomic reasons, we recommend mounting the device with the user interface in a horizontal position at the user's eye level.

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 Dimensional drawings (Page 121) chapter.

Deploy the Power Monitoring Device only where ambient conditions permit its operation: A description of permissible operating conditions can be found in chapter Technical data (Page 111).

Plan additional space for:

- Ventilation
- Wiring
- Connection of the communication cable and cable infeed on the top of the device
- Connecting the expansion modules to the back of the device

⚠ WARNING

The use of a damaged device may result in death, serious personal injury, or property damage.

Do not install or use damaged devices.

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 two hours before commencing installation.

Circuit breaker

Connect a suitable circuit breaker upstream of the PAC4220 in order to disconnect the device from the power supply.

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

3.1 Panel mounting

Tools

You require the following tools for installation:

- Cutting tool for the panel cutout
- PH2 cal. screwdriver ISO 6789
- Cable grips for strain relief on all connecting cables

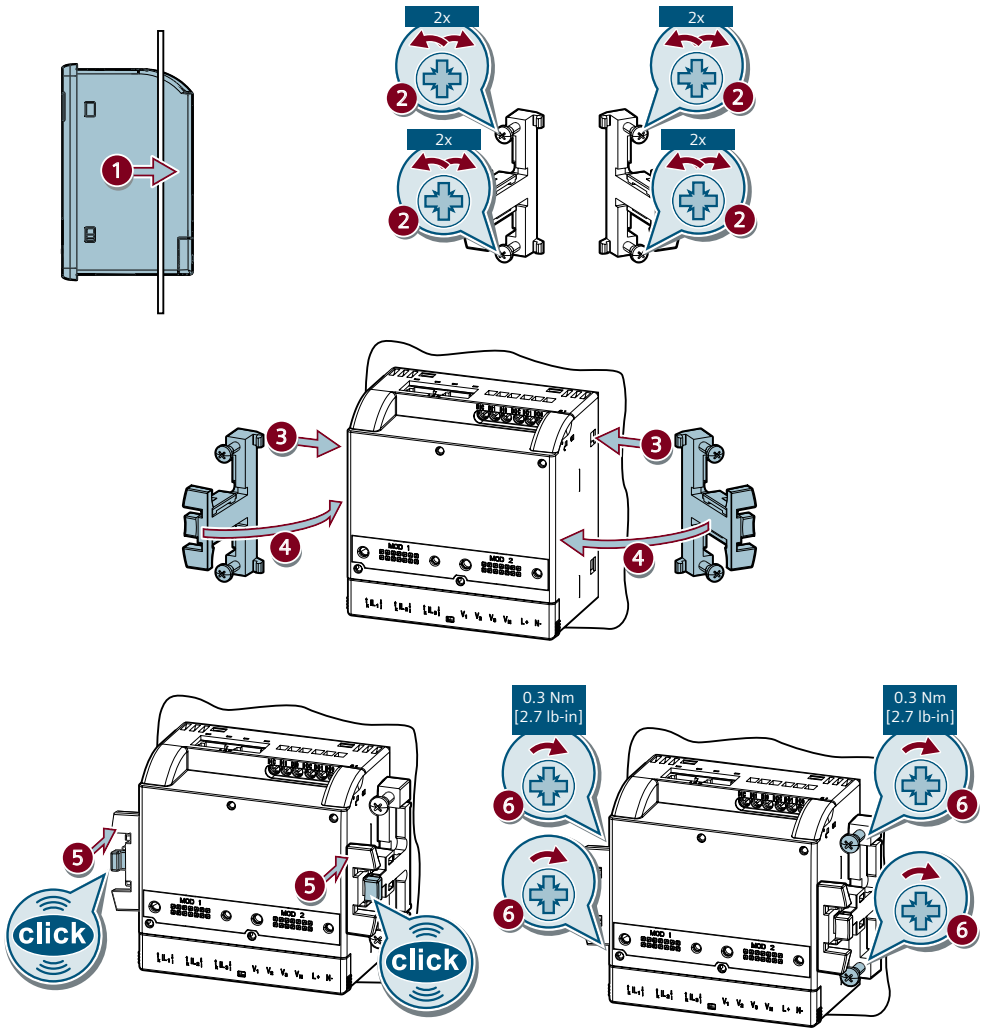
Mounting and clearance dimensions

You can find information on the cutout dimensions, frame dimensions and clearance dimensions in the chapter Dimensional drawings (Page 121).

Installation steps

Proceed as follows to install the PAC4220 in the control panel:

1. Open the packaging and carefully remove the device.
2. Read the enclosed operating instructions.
3. Carry out the following installation steps.



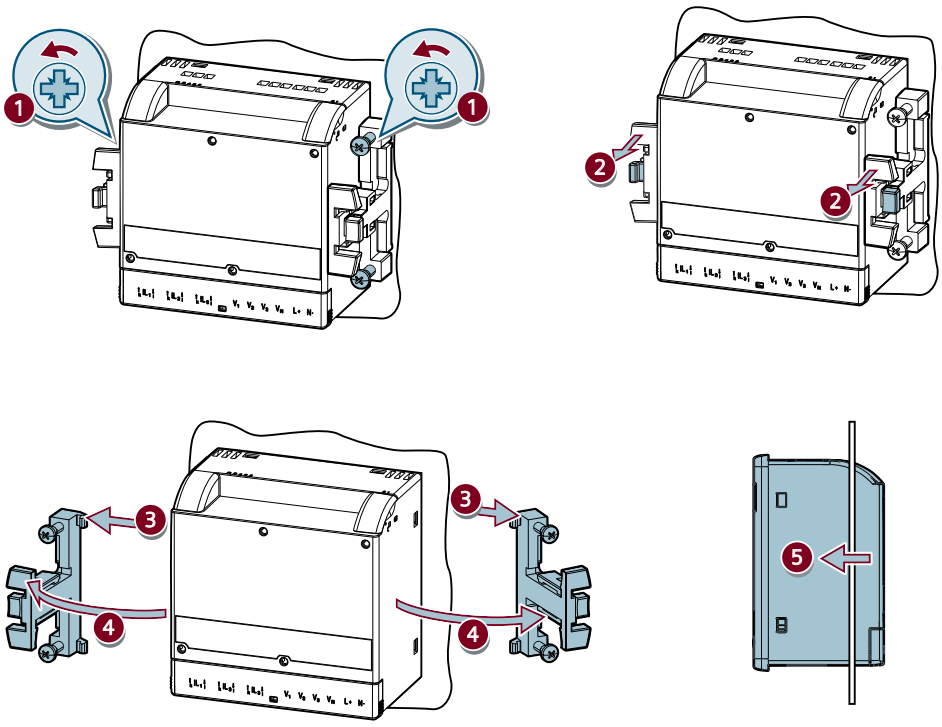
3.2 Deinstallation

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


1
1
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2
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5

Connection

4

4.1 Safety information

Instructions

⚠ DANGER

Hazardous voltages

Will cause death, serious injury or property damage.

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

⚠ DANGER

Open transformer circuits will result in electric shock and arc flash hazards

Will cause death, serious injury or property damage.

When using the current transformers, the circuit is not protected by a fuse.

- Do not open the secondary circuit of the current transformers under load.
- Short circuit the secondary current terminals of the current transformer before removing this device.
- It is imperative that you follow the safety instructions for the current transformers used.

⚠ CAUTION

Protection of the supply voltage and voltage measuring inputs

The fuses in the supply voltage and the voltage measuring inputs are only used for cable protection. Selection of the fuse depends on the supply cable dimensioning. All commercially available fuses and automatic circuit breakers up to 16 A (C) or 20 A (C) can be used. Choose a fuse that conforms to the relevant regulations.

We recommend 5SY miniature circuit breakers, 3RV motor starter protectors, or 5SB/3NA fuses, depending on the cable requirements, connection conditions, and the local codes and standards requirements.

NOTICE

Use only as intended

Siemens products may be used only for the applications described in the catalog and the associated technical description.
The protection supported by the device can be impaired if the device is used in a manner not defined by Siemens AG.

NOTICE

Device damage due to contamination

Avoid contamination of the contact areas below the labels "M0D1" and "M0D2", otherwise the expansion modules cannot be properly connected and can even be damaged.

NOTICE

Connection to the wrong supply voltage can cause irreparable damage to the device

Before connecting the device, make sure that the line voltage matches the specifications on the rating plate.

⚠ DANGER

Short-circuit hazard

Take the maximum possible ambient temperature into account when selecting the connecting cables.

The cables must be suitable for operation at a temperature that is 20 °C higher than the maximum ambient temperature or as local codes and standards require.

NOTICE

Short-circuit hazard

Ensure appropriate strain relief for all cables connected to the device.

NOTICE

Device can be irreparably damaged

When performing an insulation test of the entire installation with AC or DC, disconnect the device before starting the test.

Note

Only qualified personnel are permitted to install, commission or service this device.

- Wear the prescribed protective clothing. Observe the general equipment regulations and safety regulations for working with high-voltage installations (e.g. DIN VDE, NFPA 70E as well as national or international regulations).
- The limits given in the technical data must not be exceeded even during commissioning or testing.
- The secondary connections of intermediate current transformers must be short-circuited at the transformers before the power supply lines to the device are interrupted.
- Check the polarity and the phase assignment of the instrument transformers.
- Before connecting the device, check that the system voltage matches the voltage specified on the rating plate.
- Before you start commissioning the device, check that all connections are correct.
- Before power is applied to the device for the first time, it must have been located in the operating area for at least 2 hours in order to reach temperature balance and avoid humidity and condensation.
- Condensation on the device is not permissible during operation.

Note

Integration into a system

Responsibility for the safety of the system into which the PAC4220 is integrated lies with the person setting up the system.

Note

Grounding of current transformers optional

Always connect the transformers and ground them on the secondary side in accordance with the applicable regulations. Grounding of the current transformers on the secondary side is not necessary for use in low-voltage switchboards for performing measuring tasks.

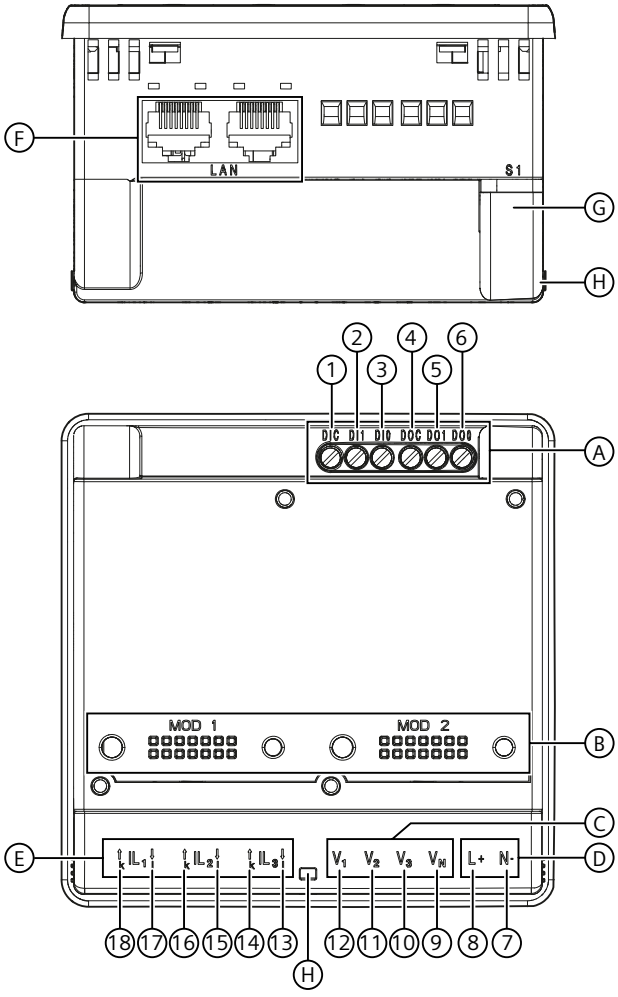
Note

Prevent capacitive and inductive interference

Make sure that all data and signal lines are routed separately from control and power supply lines. In order to avoid the risk of capacitive and inductive interference, these cables must never be routed in parallel.

4.2 Connections

Terminal labeling



No.	Connection	Function
(A)		Digital inputs and outputs
(B)		Slots for expansion modules
(C)		Measuring inputs voltage V_1, V_2, V_3, V_N
(D)		Supply voltage L/+, N/-
(E)		Measuring inputs current IL_1, IL_2, IL_3
(F)		Ethernet interface
(G)		Hardware write protection (slide switch)
(H)		Sealing points

No.	Connection	Function
①	DIC	Digital input (common)
②	DI1	Digital input 1
③	DI0	Digital input 0
④	DOC	Digital output (common)
⑤	DO1	Digital output 1
⑥	DO0	Digital output 0
⑦	N-	AC: Connection: Neutral conductor DC: Connection -
⑧	L+	AC: Connection: Conductor (phase voltage) DC: Connection: +
⑨	V_N	Neutral conductor
⑩	V_3	Voltage measurement connection phase L3
⑪	V_2	Voltage measurement connection phase L2
⑫	V_1	Voltage measurement connection phase L1
⑬	IL_3 I↓	Current I_{L3}, output
⑭	IL_3 ↑ k	Current I_{L3}, input
⑮	IL_2 I↓	Current I_{L2}, output
⑯	IL_2 ↑ k	Current I_{L2}, input
⑰	IL_1 I↓	Current I_{L1}, output
⑱	IL_1 ↑ k	Current I_{L1}, input

4.3 Connection examples

The connection examples below show connection in:

- Two, three or four-wire systems
- With balanced or unbalanced load
- With and without voltage transformer

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

Note

x/1A or x/5A current transformers are always required for current measurement.

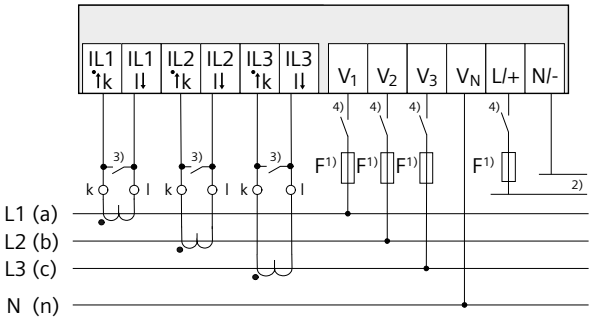
All input or output terminals not required for measuring remain free.

NOTICE
Grounding of current transformers optional The transformers must always be connected and therefore always grounded on the secondary side according to the applicable regulations. Grounding of the current transformers on the secondary side is not necessary for use in low-voltage switchboards for performing measuring tasks.

Connection examples

(1) 3-phase measurement, 4 conductors, unbalanced load, without voltage transformer, with 3 current transformers

Connection type 3P4W



1) The fuses are only used for cable protection.
All commercially available miniature circuit breakers up to 20 A (C) can be used.

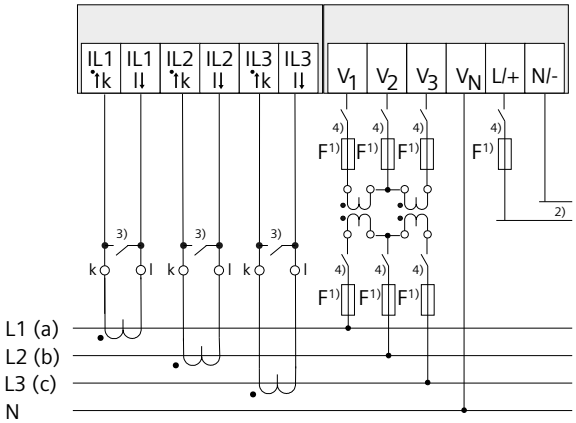
2) Connection of supply voltage

3) Install a short-circuit detection device. Protection against overvoltage when the secondary transformer circuit is open.

4) Circuit breaker

(2) 3-phase measurement, 4 conductors, unbalanced load, with voltage transformer, with 3 current transformers

Connection type 3P4W



1) The fuses are only used for cable protection.
All commercially available miniature circuit breakers up to 20 A (C) can be used.

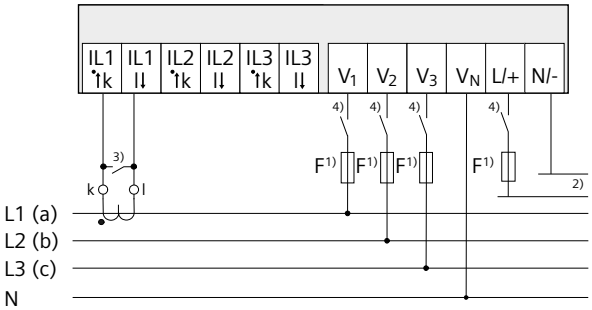
2) Connection of supply voltage

3) Install a short-circuit detection device. Protection against overvoltage when the secondary transformer circuit is open.

4) Circuit breaker

(3) 3-phase measurement, 4 conductors, balanced load, without voltage transformer, with 1 current transformer

Connection type 3P4WB



1) The fuses are only used for cable protection.
All commercially available miniature circuit breakers up to 20 A (C) can be used.

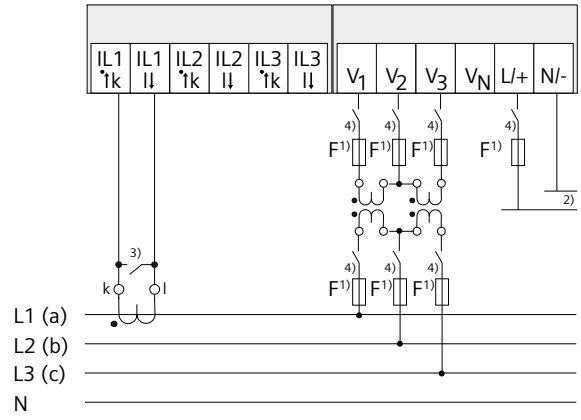
2) Connection of supply voltage

3) Install a short-circuit detection device. Protection against overvoltage when the secondary transformer circuit is open.

4) Circuit breaker

(4) 3-phase measurement, 4 conductors, balanced load, with voltage transformer, with 1 current transformer

Connection type 3P4WB



1) The fuses are only used for cable protection.
All commercially available miniature circuit breakers up to 20 A (C) can be used.

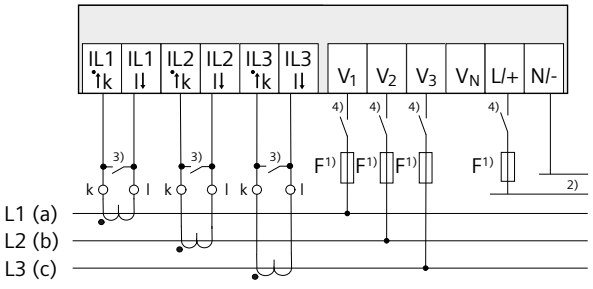
2) Connection of supply voltage

3) Install a short-circuit detection device. Protection against overvoltage when the secondary transformer circuit is open.

4) Circuit breaker

(5) 3-phase measurement, 3 conductors, unbalanced load, without voltage transformer, with 3 current transformers

Connection type 3P3W



1) The fuses are only used for cable protection.
All commercially available miniature circuit breakers up to 20 A (C) can be used.

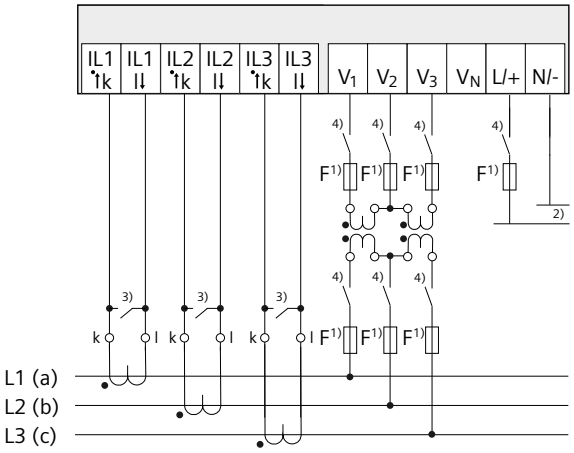
2) Connection of supply voltage

3) Install a short-circuit detection device. Protection against overvoltage when the secondary transformer circuit is open.

4) Circuit breaker

(6) 3-phase measurement, 3 conductors, unbalanced load, with voltage transformer, with 3 current transformers

Connection type 3P3W



1) The fuses are only used for cable protection.
All commercially available miniature circuit breakers up to 20 A (C) can be used.

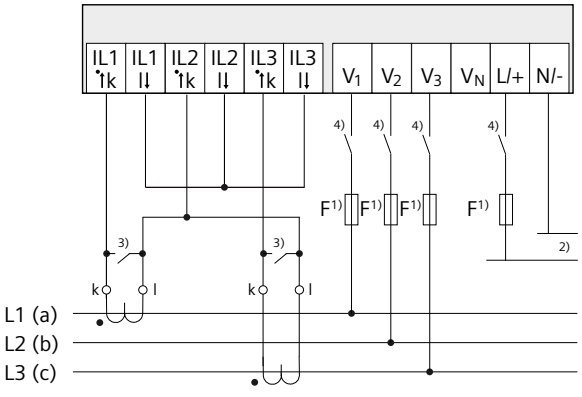
2) Connection of supply voltage

3) Install a short-circuit detection device. Protection against overvoltage when the secondary transformer circuit is open.

4) Circuit breaker

(7) 3-phase measurement, 3 conductors, unbalanced load, without voltage transformer, with 2 current transformers

Connection type 3P3W



1) The fuses are only used for cable protection.
All commercially available miniature circuit breakers up to 20 A (C) can be used.

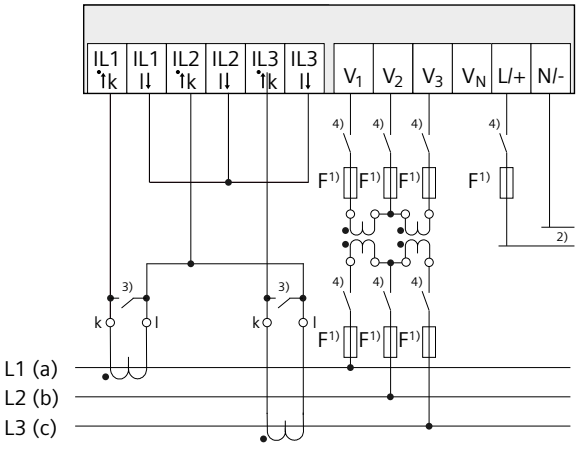
2) Connection of supply voltage

3) Install a short-circuit detection device. Protection against overvoltage when the secondary transformer circuit is open.

4) Circuit breaker

(8) 3-phase measurement, 3 conductors, unbalanced load, with voltage transformer, with 2 current transformers

Connection type 3P3W



1) The fuses are only used for cable protection.
All commercially available miniature circuit breakers up to 20 A (C) can be used.

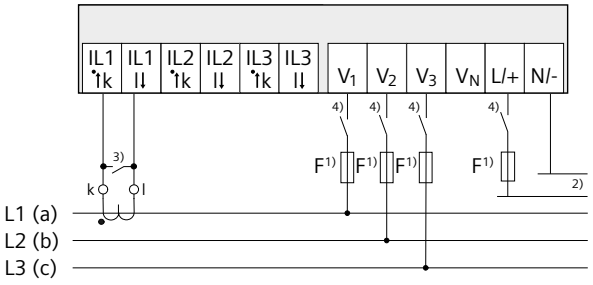
2) Connection of supply voltage

3) Install a short-circuit detection device. Protection against overvoltage when the secondary transformer circuit is open.

4) Circuit breaker

(9) 3-phase measurement, 3 conductors, balanced load, without voltage transformer, with 1 current transformer

Connection type 3P3WB



1) The fuses are only used for cable protection.
All commercially available miniature circuit breakers up to 20 A (C) can be used.

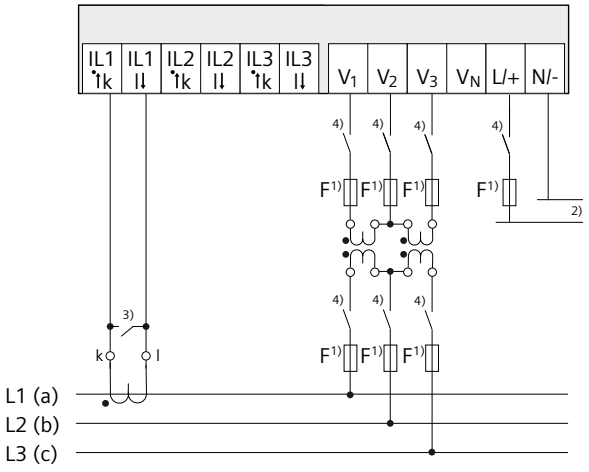
2) Connection of supply voltage

3) Install a short-circuit detection device. Protection against overvoltage when the secondary transformer circuit is open.

4) Circuit breaker

(10) 3-phase measurement, 3 conductors, balanced load, with voltage transformer, with 1 current transformer

Connection type 3P3WB



1) The fuses are only used for cable protection.
All commercially available miniature circuit breakers up to 20 A (C) can be used.

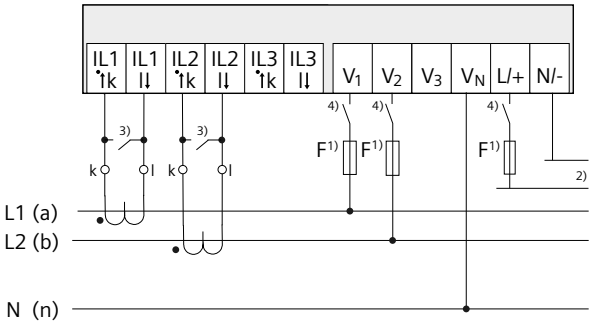
2) Connection of supply voltage

3) Install a short-circuit detection device. Protection against overvoltage when the secondary transformer circuit is open.

4) Circuit breaker

(11) 2-phase measurement, 3 conductors, unbalanced load, without voltage transformer, with 2 current transformers

Connection type 3P4W



1) The fuses are only used for cable protection.
All commercially available miniature circuit breakers up to 20 A (C) can be used.

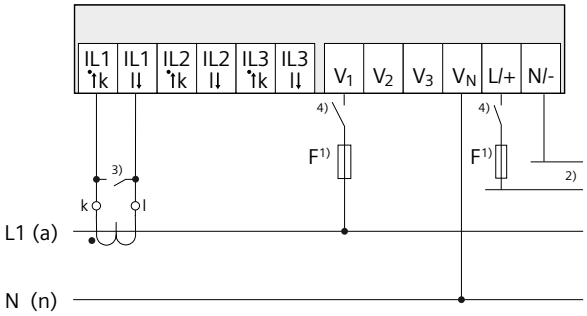
2) Connection of supply voltage

3) Install a short-circuit detection device. Protection against overvoltage when the secondary transformer circuit is open.

4) Circuit breaker

(12) 1-phase measurement, 2 conductors, without voltage transformer, with 1 current transformer

Connection type 1P2W



1) The fuses are only used for cable protection.
All commercially available miniature circuit breakers up to 20 A (C) can be used.

2) Connection of supply voltage

3) Install a short-circuit detection device. Protection against overvoltage when the secondary transformer circuit is open.

4) Circuit breaker

See also

Applying the supply voltage (Page 56)

Commissioning

5

5.1 Overview

Prerequisites

- The device has been installed.
- The device has been connected in accordance with the possible connection methods.
- The Ethernet cable has been connected to the PAC4220 (optional for commissioning with SENTRON Powerconfig).
- A communications expansion module (RS485, PROFIBUS or Ethernet expansion module) has been connected to the rear of the device (optional for commissioning with SENTRON Powerconfig).

Steps for starting up the device

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

NOTICE
Disconnect device prior to insulation test When performing an insulation test of the entire installation with AC and DC, the device should be disconnected before starting the test.

1. Apply the supply voltage.
2. Parameterize 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 instrument transformers.

Note

Activating hardware write protection

Irrespective of whether the Power Monitoring Device is connected to a network, hardware write protection must **always** be activated in order to provide the best possible security against manipulation.

5.2 Applying the supply voltage

The power monitoring device 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 rating plate for the type and level of the permissible supply voltage.

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

5.3 Parameterizing the device

5.3.1 Procedure

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

- Basic parameters

The following settings are also useful:

- Language
- Date/time
- Device protection against tampering

5.3.2 First start-up

- Select the required language and confirm your selection.
- Hardware write protection, which is enabled as standard when the device is supplied, must be disabled using the slide switch at the back of the device to allow other settings to be configured at the device.

5.3.3 Basic parameters

Set the basic parameters:

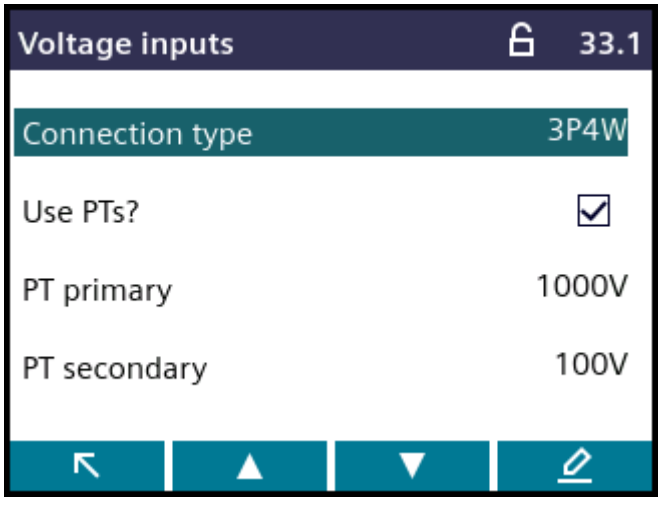
- Connection type
- Voltage
  - Direct measurement on the system or using voltage transformers
  - Measurement input voltage in the case of direct measurement on the system
  - Primary and secondary voltage when measuring using voltage transformers
- Current
  - Primary current
  - Secondary current

Please also note the information in chapters Operation (Page 63) and Parameterizing (Page 77).

Example:

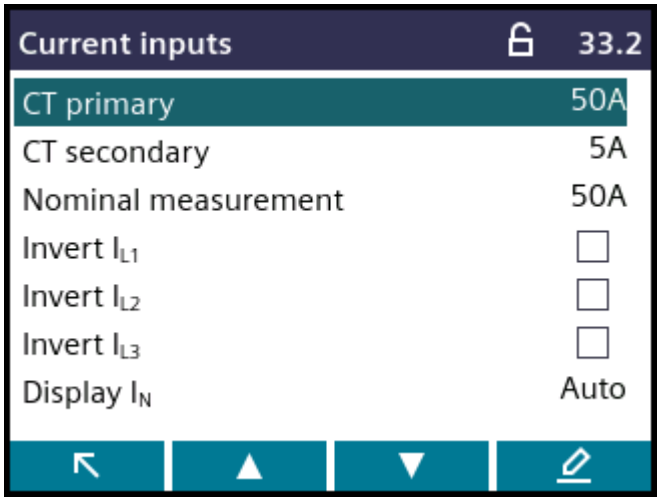
You want to measure in a 3P4W 1 kV system using voltage transformers (1 000 V/100 V) and current transformers (100 A/5 A).

1. Select the "Basic Parameters" submenu of the "Settings" menu.
2. Specify the connection type and the ratio of the voltage transformers you are using in the "Voltage Input" menu item.



3. Confirm your entry and press "F1" to return to the "Basic Parameters" submenu.

4. Specify the ratio of the current transformers you are using in the "Current Input" menu item.

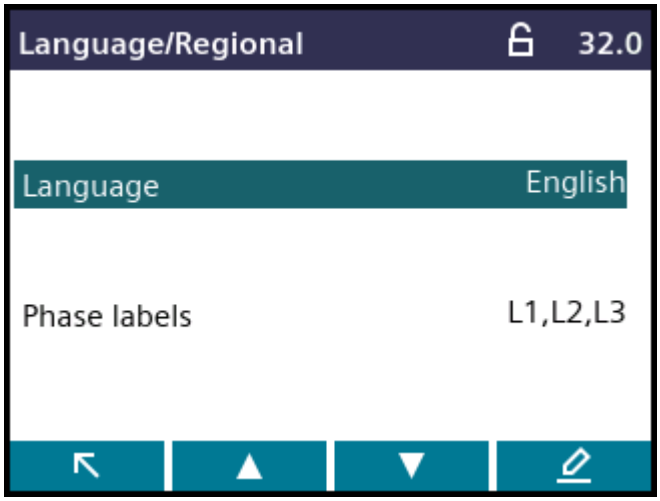


5. You can configure the resolution of the current display in the "Display Range" menu item. The setting has no impact on the measurement accuracy of the device. The recommended setting is the current that is usually flowing in the system. If the usual current is 50 A, set the display range to 50 A. In this case, the current is displayed with one decimal place.

5.3.4 Additional settings

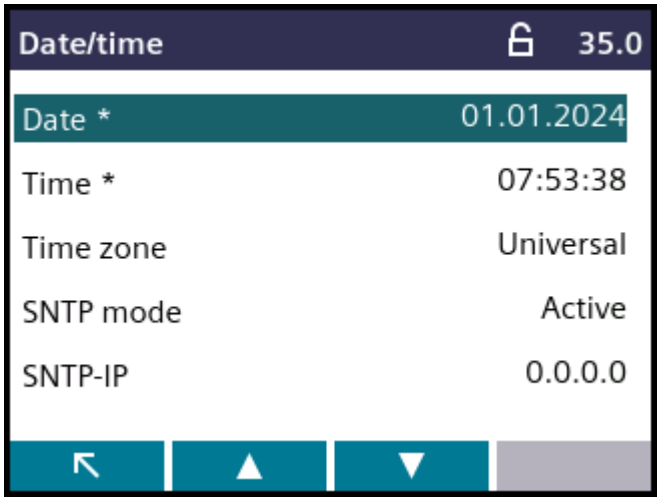
Language

After first start-up, the language of the text on the display can be set in the "Language/Regional" submenu of the "Settings" menu.



Date/time

Date and time can be set in the "Date/Time" submenu of the "Settings" menu.



Device protection against tampering

Activate the protective mechanisms available in the device to reduce the risk of tampering occurring on the device.

You can find more detailed information in chapter Security features (Page 99).

Also refer to chapters Operation (Page 63) and Parameterizing (Page 77).

5.4 Applying the measuring voltage

The Power Monitoring Device is designed for operation with the following measuring voltages:

Rated voltage

- 57.5/100 ... 400/690 V (IEC)
- 57.5/100 ... 347/600 V (UL)

NOTICE
Observe limit values The maximum limits given in the technical data or on the rating 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 56)
Safety information (Page 43)

5.5 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 flash hazards

Will cause death, serious injury or property damage.

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

- Do not use fuses for circuit protection.
- Do not open the secondary circuit of the current transformers 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.

NOTICE

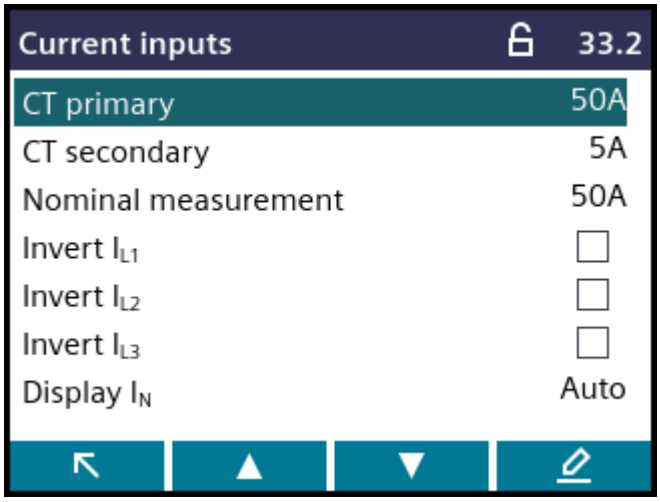
Alternating current measurement only, otherwise the device will become non-functional

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 will find information about device settings in the Basic parameters (Page 80) section.

See also

Safety information (Page 43)

Measuring inputs (Page 17)

5.6 Checking the displayed measured values

Correct connection type

With the help of the table "Display of measured variables (Page 19) depending on the connection type", check whether the measured variables are displayed in accordance with the implemented connection type. Any deviation indicates a wiring fault or configuration error.

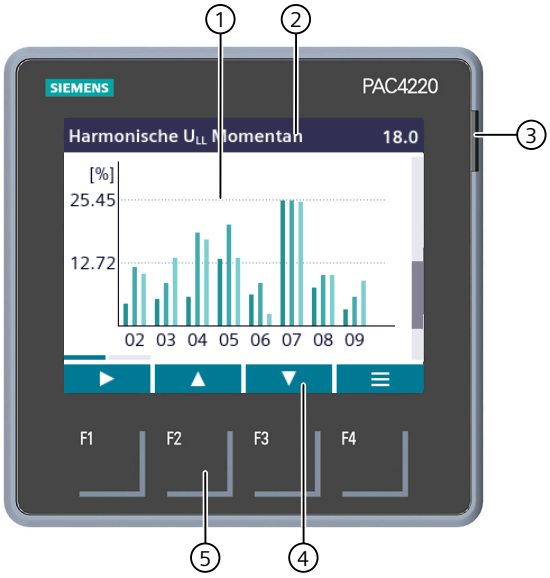
Operation

6

6.1 Device interface

Displays and operator controls

The front of the PAC4220 contains the following displays and operator controls.



① Display area:
Represents the current measured values, device settings and selection menus.

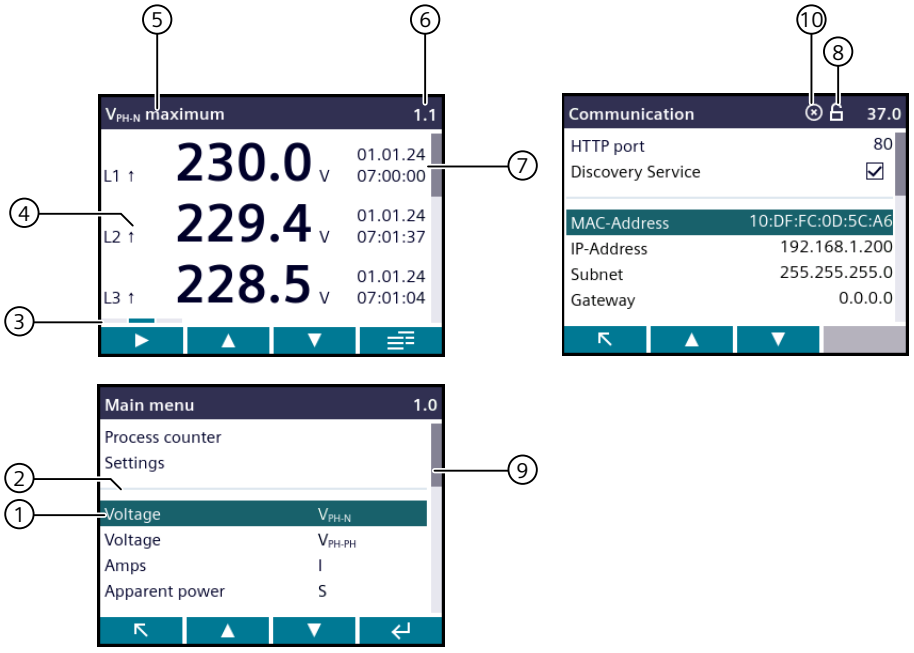
② Header area:
Specifies the information visible in the display area.

③ Multicolored LED:
Works like a normal digital output. Function and color can be configured by the user.

④ Footer area:
Specifies the functions assigned to the function keys.

⑤ Surfaces of the function keys:
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.
In the selection window for min/max values or counters, a long press of the F4 key calls up the clear menu for min/max values.

6.1.1 Special display elements



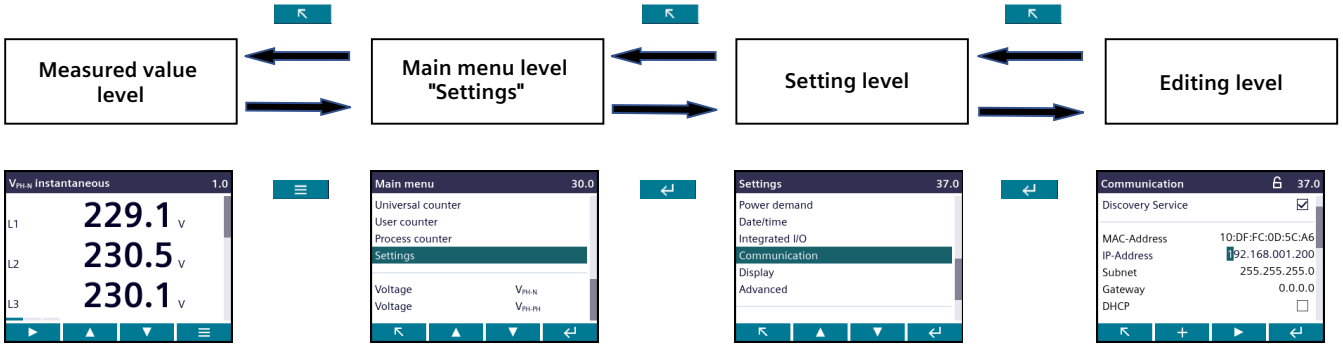
Symbol	Meaning
①	Selection bar
②	Separating line between start of list/end of list
③	Scroll bar of function key F1 (scroll bar for subwindows)
④	• Arrow up: Maximum value • Arrow down: Minimum value
⑤	Menu name
⑥	Menu number
⑦	Time stamp in local time
⑧	Device protection symbol • Open padlock: Protection deactivated • Padlock closed: Protection activated
⑨	Scroll bar (display can be scrolled upwards/downwards)
⑩	Operation off-specification. The voltage or current at the measuring input is too high. The measured values will not be calculated correctly.

6.1.2 Menu-based navigation

The menu-based navigation is intuitive and largely self-explanatory. Only the basic structure of the menu-based navigation will be explained for this reason. The description and function of the individual parameters can be found in chapter Parameterizing (Page 77).

The device menu can be subdivided into four menu levels:

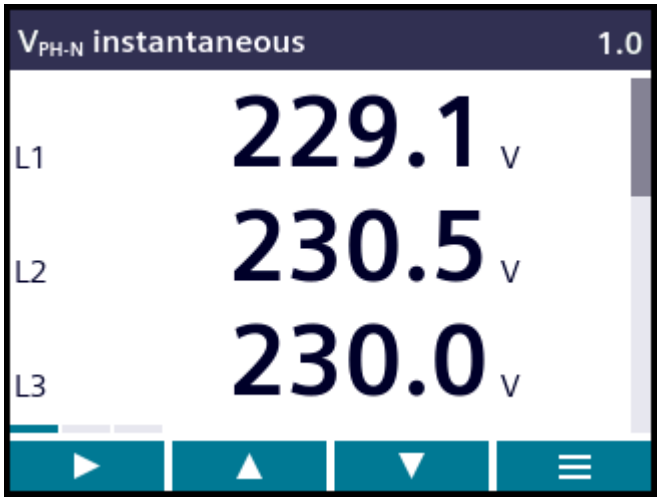
- **Measured value level**
- **Main menu level**
- **Setting level**
- **Editing level**



Depending on the device version and firmware status, the availability of the measured values may vary in the measured value and main menu levels. The parameter selection options at the setting and editing levels also depend on the device version and firmware status.

6.1.3 Measured value level

By default, the device is at the **measured value level**.

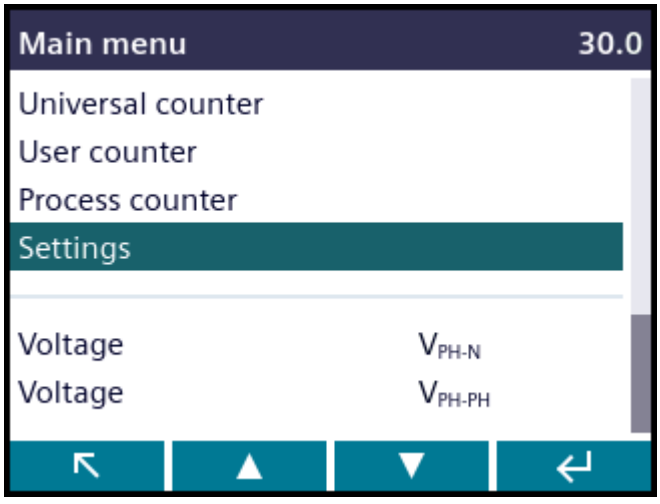


At the **measured value level**, the available measured values can be read off. All possible measured values are listed in the table in chapter Measured variables (Page 19). The selection of measured values depends on the device version and connection type.

- The ▲ and ▼ keys can be used to scroll through the measured values.
- The ▶ key can be used to call additional information (min/max values).
- The ≡ key can be used to switch the device to the main menu level.

6.1.4 Main menu level

In this menu level, all available measured variables are listed without measured values.
The **main menu level** also has a "Settings" selection menu item which can be used to configure the device.

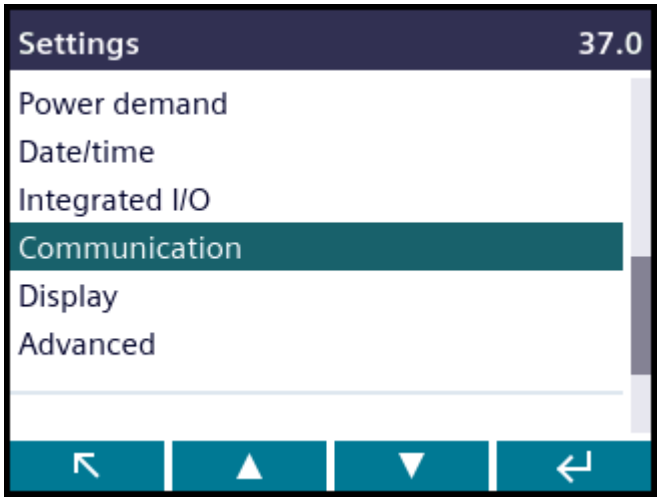


- The ↖ key returns the device to the measured value level.
- The ▲ and ▼ keys can be used to scroll between menu items.
- The ↵ key confirms the selection made and switches the device to the measured value level.

In the "Settings" menu item, you set the device to the **setting level** by actuating the ↵ key.

6.1.5 Setting level

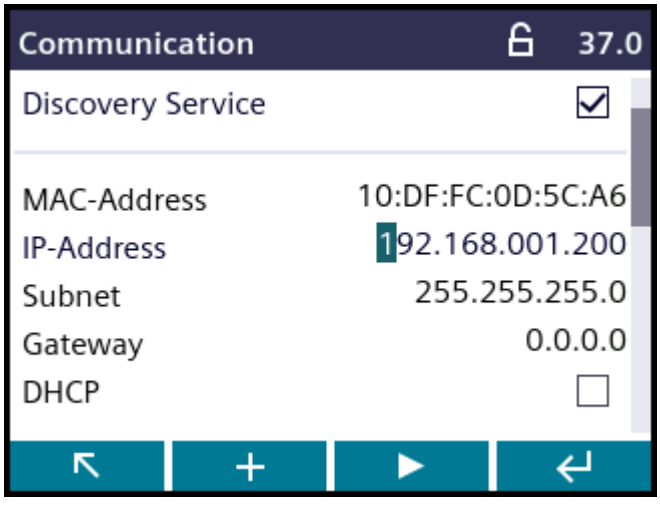
At the **setting level**, the device can be configured. All settable parameters are listed at this menu level.



- The key returns the device to the main menu level.
- The and keys can be used to scroll through the setting parameters.
- The key confirms the selection made and takes the device to the editing level or to a further submenu.

6.1.6 Editing level

You can change device parameters in the **editing level**.



- The key returns the device to the setting level.
- The and keys can be used to navigate to the value to be changed.

- The [C] or [✎] key can be used to select a value for editing.
- The [▲] and [▼] keys, or [▶] and [+] keys are used to alter the value.
- The [↵] key confirms the change and switches the device to the measured value level.

6.1.7 Control keys

The device can be operated by means of four keys. The keys are assigned different functions. The functions of the keys depend on the menu level currently in use.

Keys that have no function assigned to them are grayed.

Keys	Possible assignment	Meaning
	[▶]	**Measured value level:** The user uses this key to navigate to the next submenu. Additional measured data for the selected measured value are displayed in the submenu.
	[↖]	This key causes all inputs to be discarded and returns the device to the last menu displayed. Any changes made but not confirmed are not transferred to the system.
	[▲]	**Measured value level:** This key calls the next measured variable to the display. **Main menu and setting levels:** This key moves the selection bar upwards.
	[+]	**Editing level:** Displays the next selectable setting or increases the numerical value by "1".
	[ⓘ]	**Editing level:** This key calls additional information to the display.
	[▼]	**Measured value level:** This key calls the next measured variable to the display. **Main menu and setting levels:** This key moves the selection bar downwards.
	[−]	**Editing level:** Displays the next selectable setting.
	[▶]	**Editing level:** Selects the next number from the right for editing.
	[⊗]	**Editing level:** This key deletes the values.

F4	≡	**Measured value level:** This key activates the main menu.
	≡	**Measured value level:** The submenu is currently selected on the device. Pressing this key activates the main menu. A long press activates a context menu in which it is possible to reset min/max values, for example.
	↵	**Main menu and setting levels:** This key confirms the selection made. **Editing level:** This key confirms the changes made to parameters.
	✎	The key can be used to take the device to the editing level.
	↻	**Editing level:** This key activates or deactivates a function.

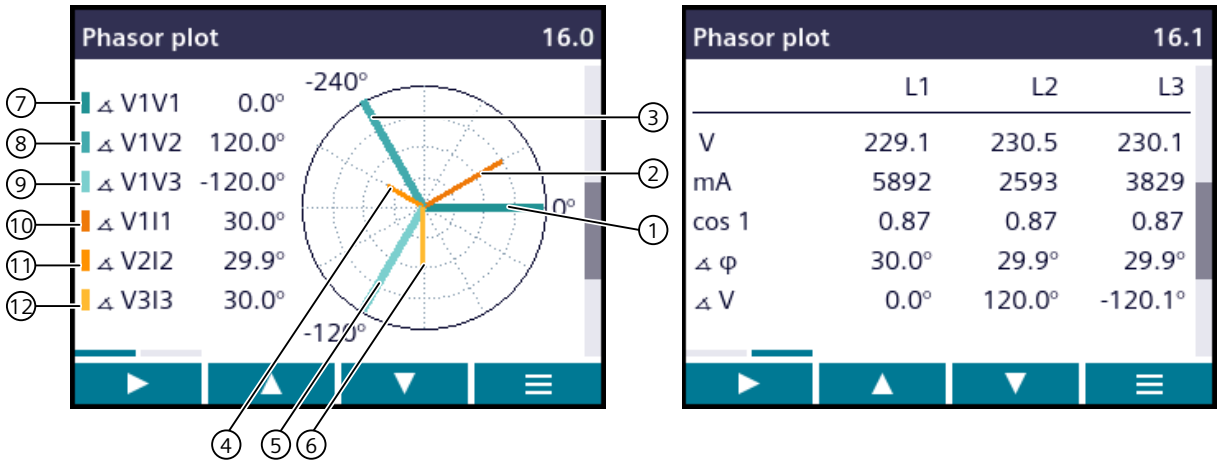
6.2 Special displays

6.2.1 Phasor diagram

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

The graphical representation is assigned a value table. F1 ▶ switches between the two representations.

Special displays of the phasor plot



① Voltage U1	⑦ Phase angle U1
② Current I1	⑧ Phase angle U1U2
③ Voltage U2	⑨ Phase angle U1U3
④ Current I2	⑩ Displacement angle U1-I1

⑤ Voltage U3	⑪ Displacement angle U2-I2
⑥ Current I3	⑫ Displacement angle U3-I3

The length of graphical axes in the diagram symbolizes the amplitude unbalance.

6.2.2 Measurement of 1st to 63rd harmonics for voltage and current

Harmonics are mainly caused by equipment with a non-linear characteristic, such as fluorescent lamps, transformers and frequency converters. They are integer multiples of a fundamental.

The harmonics place a thermal load on the network. As well as causing functional impairments, they can shorten the service life of the devices or cause irreparable device damage.
Expensive repairs, production stoppages or functional failures can be avoided by recording and eliminating the harmonics.

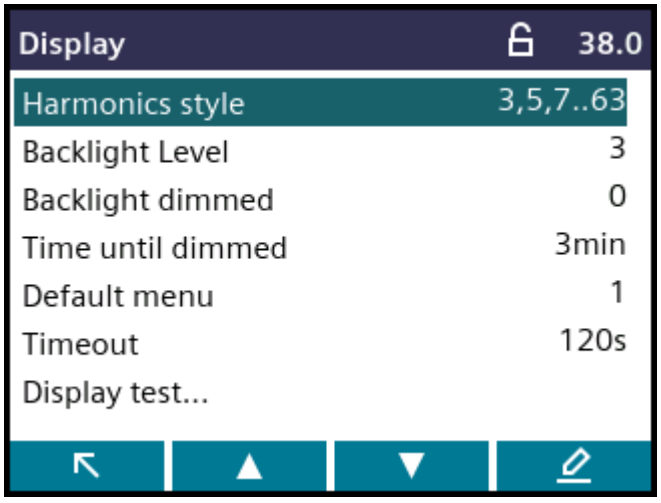
The PAC4220 measures integer voltage and current harmonics and shows the results on the display. It is also possible to read out the data via Modbus and web server.

Bar diagram on device display

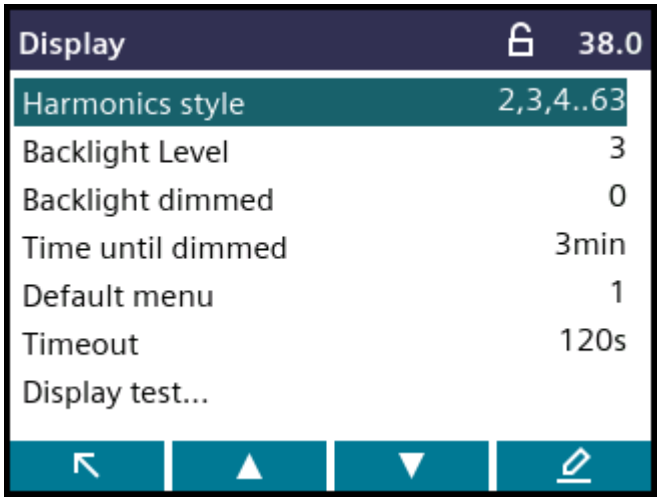
The PAC4220 can display odd (3rd to 63rd) or even (2nd to 63rd) integer voltage harmonics and current harmonics (1st to 63rd) in the form of a bar diagram.

Displaying harmonics on the PAC4220 display:

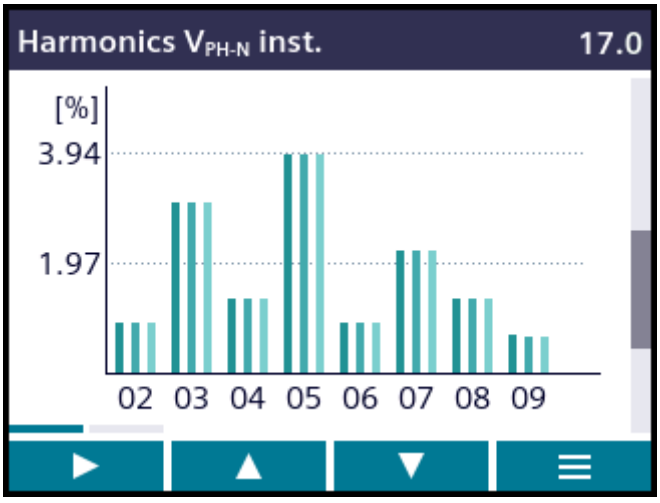
1. Select the "Display" submenu of the "Settings" menu.
2. You can select the display type in the "Harmonics style" menu item:
   – Harmonics "3, 5, 7 ... 63" (display of odd harmonics)



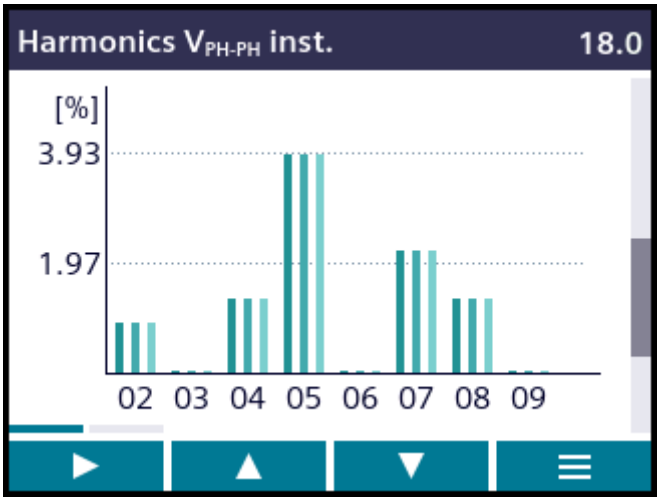
   – Harmonics "2, 3, 4 ... 63" (display of even and odd harmonics)



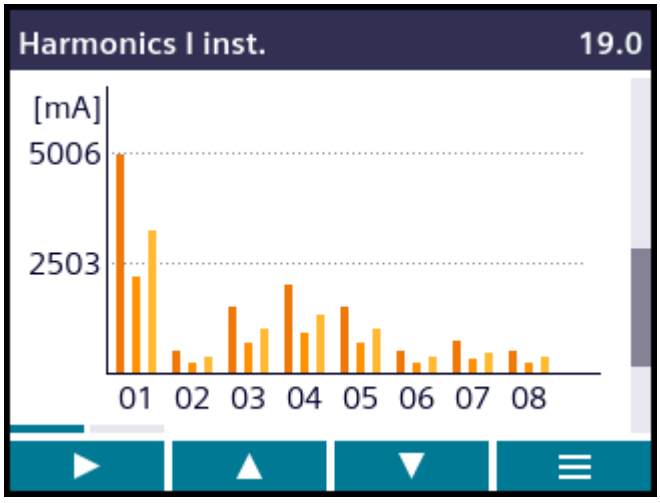
3. The following harmonic displays are available on the device display:
   - Harmonic UL-N



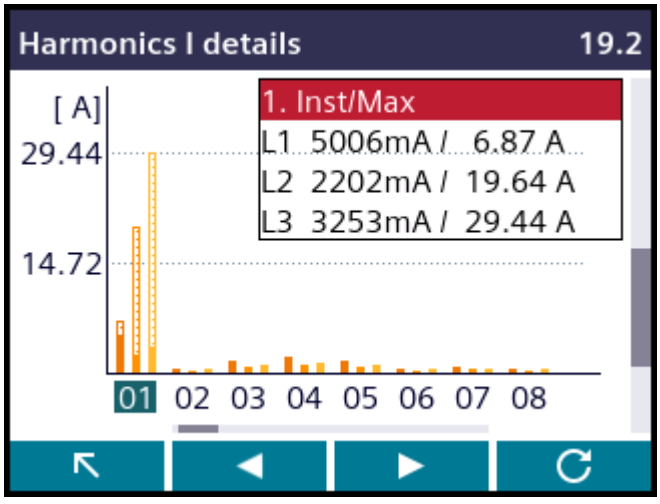
   - Harmonic UL-L



– Harmonic I



4. You can call the following additional functions using the F1 key ▸:
   – Display max. values
   – F2 key ⓘ, show details
   – F3 key ↻, delete maximum values
   – Scroll right/left



The F4 key allows you to switch between the maximum value and the time stamp of the maximum value.

You can find more information in chapter Readout of harmonic components of all harmonics with function codes 0x03 and 0x04 (Page 150).

6.3 Supporting software

The power monitoring system from the SENTRON portfolio allows you to introduce energy management according to the ISO 50001 and ISO 50003 standards and permanently reduce energy costs.

In addition to cost savings through optimized consumption, you ensure increased resilience with the monitoring of power supply systems and network quality in infrastructure and industrial plants.

You can find more information on the internet.

- Website (https://support.industry.siemens.com/cs/ww/en/view/109764480)
- SENTRON Powerconfig software (https://mall.industry.siemens.com/mall/en/ww/Catalog/Products/10121795?tree=CatalogTree)

- SENTRON Powermanager software (https://mall.industry.siemens.com/mall/en/WW/Catalog/Products/10057619)

6.3.1 SENTRON Powermanager

The SENTRON Powermanager energy management software enables energy data of the PAC4220 Power Monitoring Device to be acquired, monitored, evaluated, displayed and archived.

SENTRON Powermanager offers the following functions:

- Tree view of the customer's system (project tree)
- Measured value displays with pre-defined user views
- Alarm management
- Demand curve
- Reporting, different report types (e.g. cost center report)
- Load monitoring of reaction plans
- Power peak analysis (available as of SENTRON Powermanager V3.0 SP1)
- Support of distributed plants (systems)
- Archiving system
- User administration

6.3.2 SENTRON Powerconfig

The SENTRON Powerconfig software is the combined commissioning and service tool for communication-capable measuring devices and circuit breakers from the SENTRON family.

The PC-based tool facilitates parameterization of the devices, resulting in substantial time savings, particularly when several devices have to be set up. SENTRON Powerconfig can be used to parameterize and operate 7KM PAC-series power monitoring devices via various communications interfaces and to document and monitor measured values.

SENTRON Powerconfig provides the following functions:

- Parameterization, documentation, operation and monitoring in one software
- User-friendly documentation of settings and measured values
- Clear presentation of the available parameters including plausibility testing of the input values
- Display of the available device statuses and measured values in standardized views
- Project-oriented storage of device data
- Consistent operation and usability
- Support of the various communications interfaces (MODBUS-RTU, MODBUS-TCP, PROFIBUS, PROFINET)
- Updating of device firmware

Note

Launch the Online Help in SENTRON Powerconfig by pressing the F1 key.

6.3.3 Advanced training courses

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

Training for Industry (https://www.siemens.com/sitrain-lowvoltage)

Here you can choose from:

- Web-based training courses (online, informative, free)
- Classroom training courses (course attendance, comprehensive, subject to fee)

If the correct training course is not shown, you can also get information from your local sales representative.

Parameterizing

7

Device settings

The "Parameterizing" chapter describes the device settings. This includes:

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

It is possible to set the device by means of:

- the operator interface of the device
- the configuration software

Note

Protection of the device settings

In the as-delivered condition, hardware write protection is activated.

Hardware write protection must be deactivated in order to parameterize the device.

The device protection functions must be activated on startup to guard against unauthorized or inadvertent changes to settings.

7.1 Parameterizing via the operator interface

You can parameterize the PAC4220 via the "Settings" menu item. You can find more information on this in chapter Menu-based navigation (Page 64).

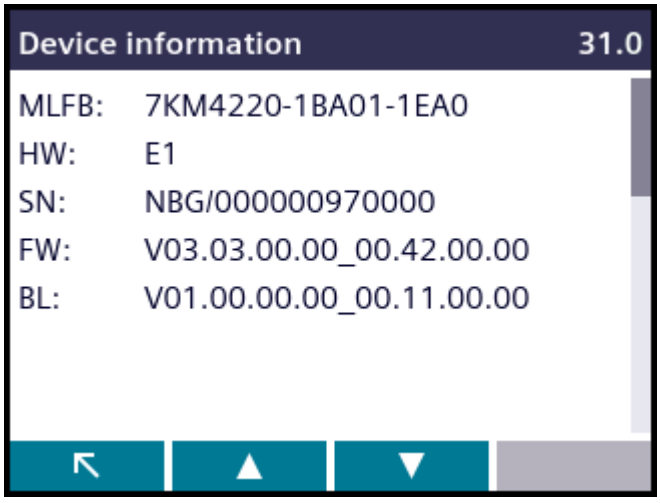
The device settings are arranged into the following groups. The "Settings" menu shows the choice of groups:

- **Device information**
  Article number and versions
- **Language/Regional**
  Display language and designation of the phases on the display
- **Basic parameters**
  Settings for the measuring inputs, zero point suppression
- **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 and configuration of the IP filter (IP allowlist), activating and deactivating Discovery Service.
- **Display**
  Settings for the display
- **Advanced**
  Write protection, limit values, universal counters, device reset
- **Expansion modules (only if an expansion module is used)**
  Functions for expansion modules available as options

7.1.1 Device information

The device information cannot be modified.



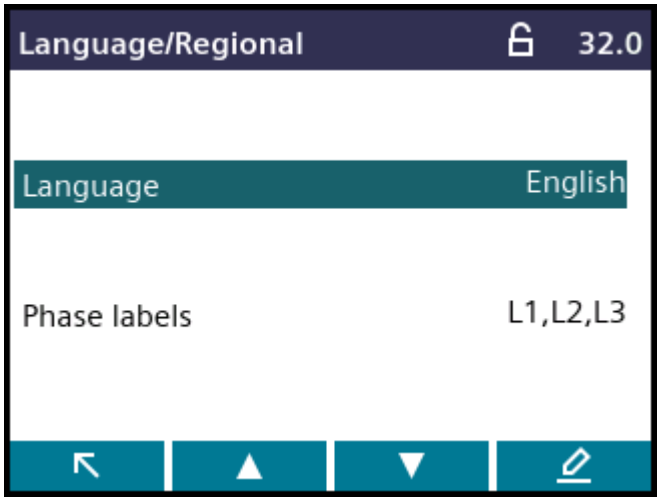
PAC4220	Device designation
MLFB: 7KM4220-xBA01-1EC0	Article number of the device
HW: xx	
SN: xxxxxx	Serial number of the device
FW: xxxx	Firmware revision level
BL: xxxx	Bootloader revision level

The F2/F3 keys call up the ID-Link.

Scanning this ID-Link QR code takes the user to a web page containing comprehensive information about the product. This can take the form of data sheets, manuals, Declarations of Conformity, certificates, downloads and further information.

7.1.2 Language/Regional

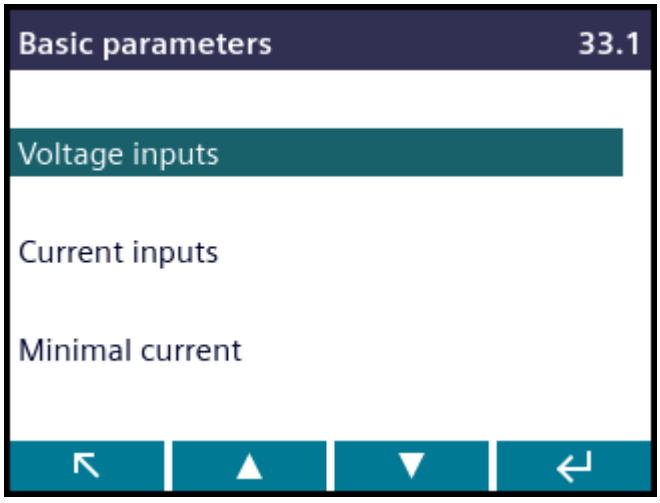
You set the language of menu-based operation and of the measured value displays in the "Language/Regional" menu item.



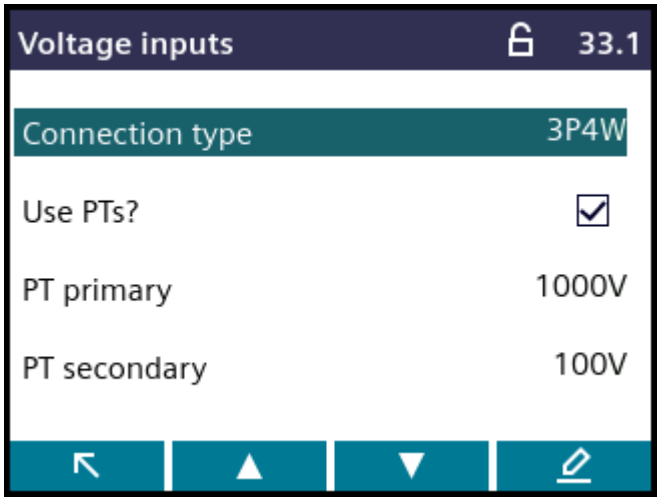
Selection	Range	Factory setting
Language	English, German	English
Phase labels	• L1, L2, L3 • a b c	L1, L2, L3

7.1.3 Basic parameters

You parameterize the measuring inputs in the "Basic parameters" menu item.

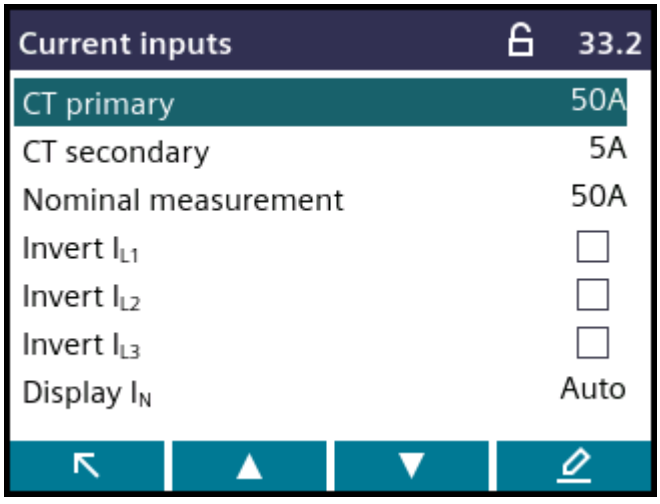


Voltage inputs



Selection	Range	Factory setting
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: 1 phase, 2 conductors, unbalanced load	3P4W
Use PTs?	• ☑ On: Measurement using voltage transformers. When measuring via voltage transformer, the device must know the voltage transformation 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 directly 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.	☐ Off
PT primary (provided Use PTs? ☑ On)	• 1 V ... 999999 V	• 400 V
PT secondary (provided Use PTs? ☑ On)	• 1 V ... 690 V (max. 600 V for UL)	• 400 V

Current inputs



Selection	Range	Factory setting
CT primary	Primary current of the current transformers 1 A ... 99999 A	50 A
CT secondary	Secondary current of the current transformers • 1 A • 5 A	5 A
Nominal measurement	Resolution of current indication 1 A ... 99999 A	50 A
• Invert I_{L1} • Invert I_{L2} • Invert I_{L3}	Inverted evaluation of the current flow direction, can be specified separately for each phase. • ☑ On: Direction of current flow is inverted. The device interprets the current flow direction opposite to the wiring. • ☐ Off: The device interprets the current flow direction in accordance with the wiring.	☐ Off
I_N, I_{Diff} analog expansion module - display	Current in neutral conductor I_n • Auto: If the I_N, I_{Diff} analog expansion module (7KM9200-0AD00-0AA0) is connected, the measured current is displayed. Otherwise, the I_n current calculated by the PAC4220 is displayed. • I_n current is displayed. • Off: I_n current is not displayed.	Auto

Minimal current

Selection	Range	Factory setting
Measurement	Zero point suppression as a percentage of the primary rated current of the external current transformer: The lower limit for current measurement is used for zero point suppression so that zero is displayed below this limit. 0 ... 10%	0.0%
Operating hours	Minimal current for operating hours counter as a percentage of I_N 0 ... 10%	0.0%

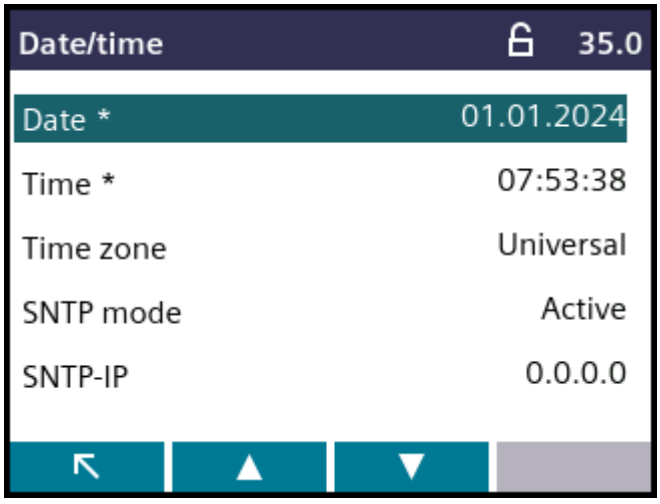
7.1.4 Power demand

Settings for the load profile can be defined in the "Power demand" menu item.

Selection	Range	Factory setting
Duration	• 1 min • 2 min • 3 min • 4 min • 5 min • 6 min • 10 min • 12 min • 15 min • 20 min • 30 min • 60 min	15 min

7.1.5 Date/time

You set the date and time in this menu.

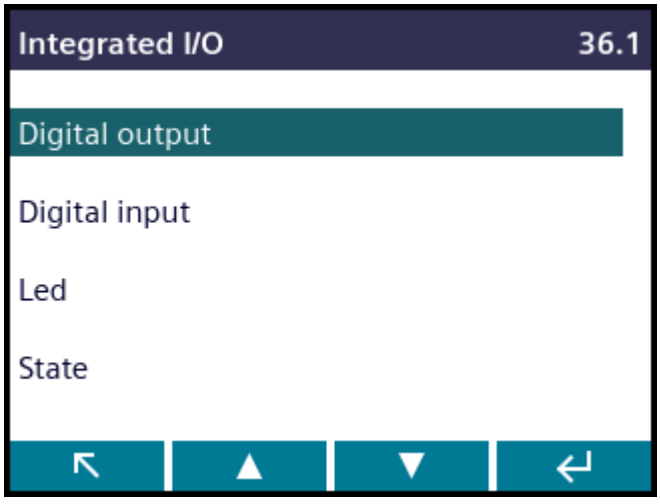


Selection	Range	Factory setting
Date	Current date	-
Time of day	HH:MM:SS	-
Time zone	- Universal: UTC - Time zone database per IANA, with TZ identifier.	00:00

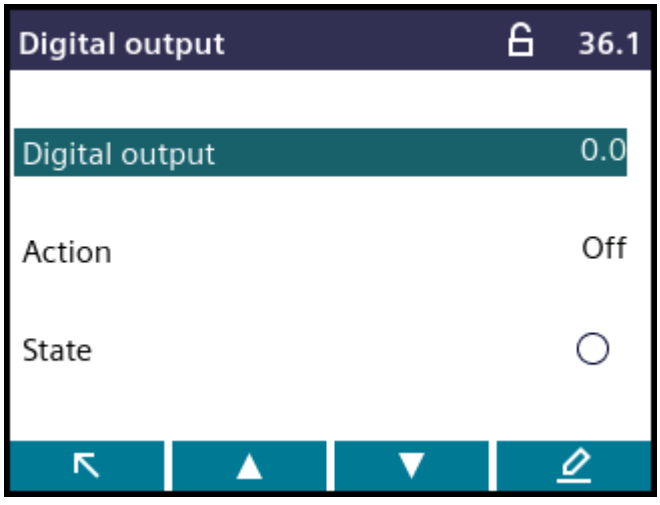
Selection	Range	Factory setting
SNTP mode	Protocol used for transmitting the time and for synchronization. • Off: SNTP function deactivated. • Active: The device automatically requests the time from the NTP server. If the function is activated, the date and time are marked with an asterisk (*). This means that the entries cannot be changed manually.	Active
SNTP-IP (only if SNTP is activated)	If an SNTP IP address is configured, only data from this IP address is accepted. If the DHCP server supplies an NTP server address, this is automatically entered.	0.0.0.0

7.1.6 Integrated I/Os

Device settings for using the digital inputs and outputs.



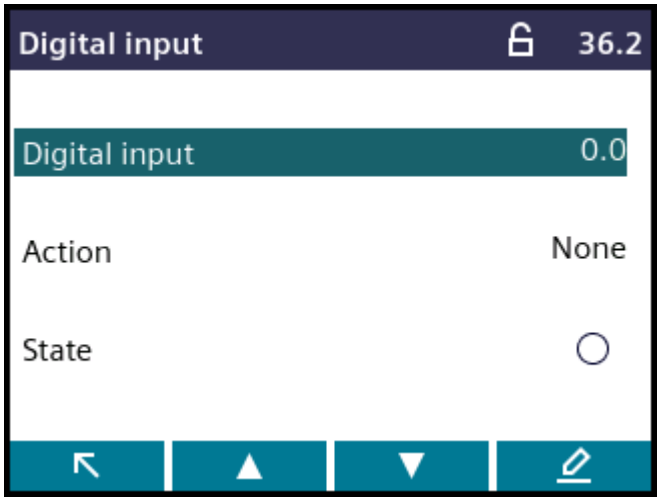
Digital output



Selection	Range	Factory setting
Digital output	Two digital outputs are available: • 0.0 • 0.1 If two additional 4DI/DO expansion modules are used, further outputs are available in addition: • 4.0 (4DI/2DO expansion module on MOD1) • 4.1 (4DI/2DO expansion module on MOD1) • 8.0 (4DI/2DO expansion module on MOD2) • 8.1 (4DI/2DO expansion module on MOD2)	-
Action	• Off: Output is deactivated. • DEVICE ON: Output signals that the device is switched on. • REMOTE CONTROL: Output is controlled by remote access. • DIRECTION OF ROTATION: The digital output is activated by a counter-clockwise rotating electrical field and remains active for as long as the field is rotating in this direction. • PULSE: Output outputs the parameterized number of pulses or edges per energy unit.	OFF
PULSES (only for PULSE)	Number of pulses to be output per unit. The reference unit is defined in the "UNIT" field. 1 ... 4000	1
PER (only for PULSE)	Value of the cumulated power for which a configurable number of pulses is output. The number of pulses to be output is defined in the "PER" field. • 1 • 10 • 100 • 1000	1

Selection	Range	Factory setting
UNIT (only for PULSE)	Selects the type of cumulated power (active energy or reactive energy): • kWh import • kWh export • kvarh import • kvarh export The import values at which a pulse or an edge is output are defined in the fields "UNIT" and "PULSES PER UNIT". Value of the cumulated power for which a configurable number of pulses is output. The number of pulses to be output is defined in the "PER" field. • 1 kvarh or kW • 10 kvarh or kW • 100 kvarh or kW • 1000 kvarh or kW	kWh import
PULSE LENGTH (only for PULSE)	Length of the pulse: 30 ... 500 ms The minimum length of the interpulse period corresponds to the pulse duration specified.	100 ms
Timeout (only for remote control)	Remote control is deactivated after the set time has elapsed 0 ... 18000 s	0 s

Digital input

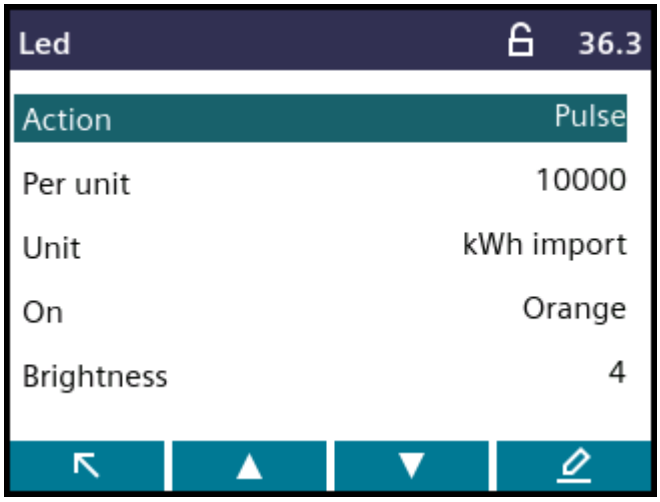


Selection	Range	Factory setting
Digital input	Two digital inputs are available: • 0.0 • 0.1 If two additional 4DI/DO expansion modules are used, further inputs are available in addition: • 4.0 (4DI/2DO expansion module on MOD1) • 4.1 (4DI/2DO expansion module on MOD1) • 4.2 (4DI/2DO expansion module on MOD1) • 4.3 (4DI/2DO expansion module on MOD1) • 8.0 (4DI/2DO expansion module on MOD2) • 8.1 (4DI/2DO expansion module on MOD2) • 8.2 (4DI/2DO expansion module on MOD2) • 8.3 (4DI/2DO expansion module on MOD2)	-
Action	• NONE: Input is deactivated. • 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 "SOURCE" field to the value "DIG. INPUT". • ON-PEAK/OFF-PEAK: Tariff switching. Off-peak tariff if input is active. • Display: Backlighting is activated with the rising edge. Deactivation takes place after the delay time has elapsed. The delay time can be specified in the "Display" menu by selecting "Time until dimmed". • COPY&RESET: Copies and resets the counters specified under "Associated counter". For this purpose, the associated digital input is switched from inactive to active. • RESET: Resets the counters specified under "Target". For this purpose, the associated digital input is switched from inactive to active. • STATUS: One event is recorded for each switching operation. If it is active, the action starts. If it is inactive, the action stops.	
MODE (only for PULSE INPUT)	Counting of pulses or edges. • PULSE: Pulses are counted. • EDGE: Edges are counted.	PULSE
PER UNIT (only for PULSE INPUT)	Number of pulses that must be received per unit in order for the counter to be incremented by "1". 1 ... 999 The reference unit is defined in the "UNIT" field.	**1**
UNIT (only for PULSE INPUT)	Unit to be counted when counting the pulses or edges received: • kWh (active energy) • kvarh (reactive energy)	-

Selection	Range	Factory setting
Associated counter	The associated user-defined pulse counter is displayed here independently of the action selected.	-
TARGET (only after reset)	You will find more detailed information in the table below.	-

Target	Description
PROCESS&PULSES	Relates to: • All process energy counters • The process operating hours counter • All pulse counters
User counters	All pulse counters
User counters 1 ... 10	Specific pulse counter
Process counters	All process energy counters
Process counters kWh/kVAR/kVAh	Specific process energy counter
Universal counters	All universal counters
Universal counters 1 ... 2	Specific universal counter

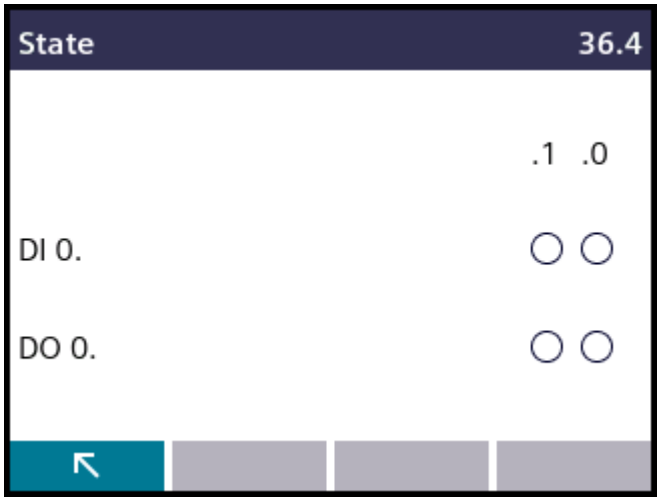
LED



Selection	Range	Factory setting
Action	• OFF: The LED is switched off. • DEVICE ON: The LED signals that the device is switched on. The color of the LED can be freely chosen from a selection of colors. The brightness of the LED changes gradually. • REMOTE CONTROL: The LED signals remote access to the device. The color of the LED can be freely chosen from a selection of colors. The lighting behavior of the LED can be selected from a range of options. • DIRECTION OF ROTATION: The LED reacts to the direction of rotation of the electrical field. The color of the LED can be freely chosen from a selection of colors. The lighting behavior of the LED can be selected from a range of options. • LIM. VIOLATION: The LED signals the status of the limit violation. The color of the LED can be freely chosen from the available colors. The lighting behavior of the LED can be selected from a range of options. • PULSE: The LED outputs 10000 LED pulses per energy unit. • REMOTE COLOR: The LED can be switched on by a Modbus command. • DI STATUS: The LED signals the status of the digital input. The color of the LED can be freely chosen from a selection of colors. The lighting behavior of the LED can be selected from a range of options.	PULSE
Per unit (only for PULSE)	Number of pulses to be output per unit. The reference unit is defined in the "UNIT" field. 10000 (not variable)	10000
UNIT (only for PULSE)	Selects the type of cumulated power (active energy or reactive energy): • kWh import • kWh export • kvarh import • kvarh export	kWh import
TIMEOUT (only for REMOTE CONTROL and REMOTE COLOR)	The LED switches off at the end of the defined timeout period. 0 ... 18000 s	0 s
Brightness	Luminous intensity of the LED 0 ... 4	4

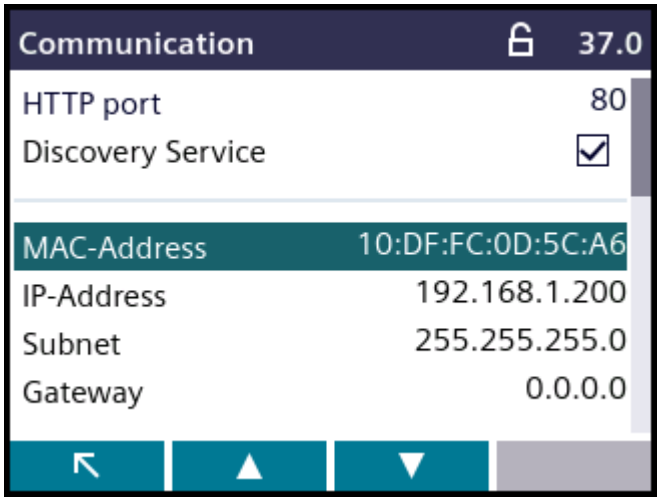
Selection	Range		Factory setting
On (colors)	• ORANGE • GREEN • CYAN • BLUE • VIOLET • WHITE • RED • YELLOW		ORANGE
Lighting behavior	OFF	LED is continuously OFF.	ON
	ON	LED is continuously ON.	
		LED flashes quickly with varying brightness.	
		LED flashes slowly with varying brightness.	
		LED flashes quickly with constant brightness.	
		LED flashes slowly with constant brightness.	

Status



Selection	Range	Factory setting
DI 0. DO 0.	Outputs the status of the integrated I/Os in graphical form on the device display.	–

7.1.7 Communication

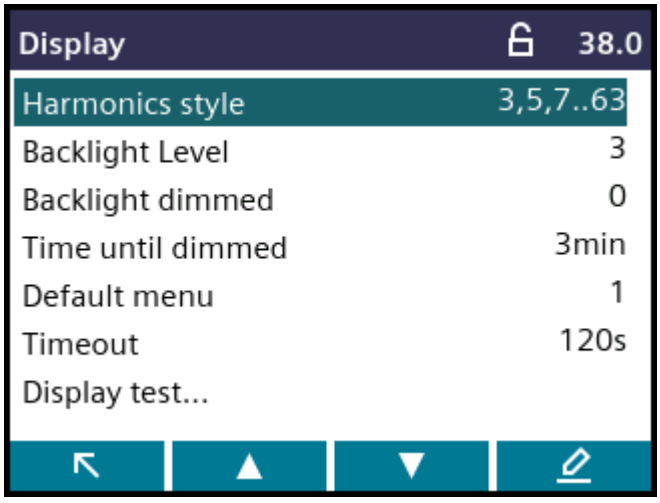


You configure the communications interface in this menu.

Selection	Range	Factory setting
MAC address	MAC address. Read only.	-
IP address	Manual setting of the IP address is only possible when DHCP is deactivated. Format: 000.000.000.000	0.0.0.0
Subnet	Manual setting of the subnet is only possible when DHCP is deactivated. Format: 000.000.000.000	0.0.0.0
Gateway	Manual setting of the gateway is only possible when DHCP is deactivated. In the case of data exchange with an IP address which is not in the home subnet, the data can be transmitted via a gateway. The gateway interconnects different networks. Format: 000.000.000.000	0.0.0.0
DHCP	(Dynamic Host Configuration Protocol) If DHCP is activated, network configurations are automatically assigned. This enables automatic integration of devices in an existing network. If DHCP is activated, the IP address, subnet and gateway are marked with an asterisk (*). This means that the network configurations cannot be adjusted manually.	☑ On
HTTP port	Manual setting of the HTTP port (web server). The setting HTTP port = 0 deactivates the web server.	80
Discovery Service	A proprietary protocol for device identification	☐ Off
IP filter config.	It is possible to enter up to ten IP addresses or IP address ranges. The IP address range is defined by a start IP address and an end IP address. The start IP address and the end IP address and all the IP addresses between them are approved.	-

Selection	Range	Factory setting
Entry (only if IP filter config. is activated)	Up to 10 IP ranges can be defined. 1...10	-
Active (only if IP filter config. is activated)	• ☑ The entry is activated and can be configured if required. • ☐ The IP entry is deactivated.	☐ Off
Lower limit (only if the entry is activated)	Lowest IP address of the approved range Format: 000.000.000.000	-
Upper limit (only if the entry is activated)	Highest IP address of the approved range Format: 000.000.000.000	-
Access (only if the entry is activated)	Definition of access rights • Read/write: The approved IP address/IP addresses have read and write access. • Read: The approved IP address/IP addresses have read access only.	Read/write

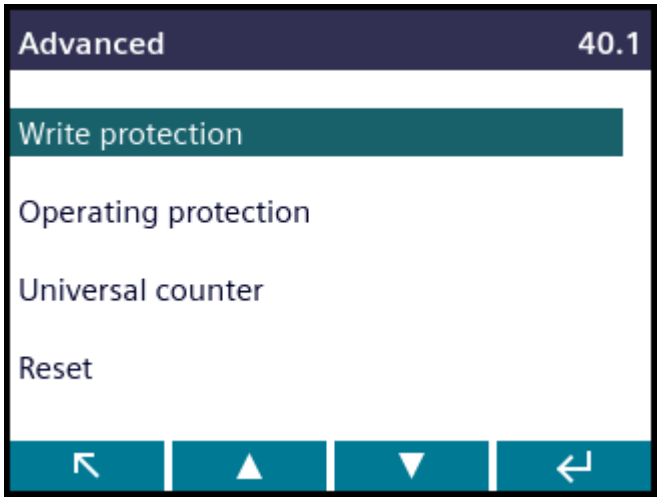
7.1.8 Display



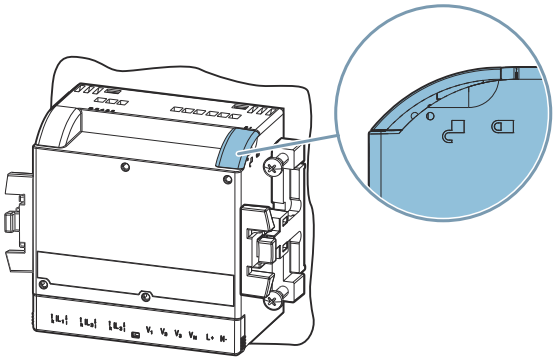
Selection	Range	Factory setting
Harmonics style	The device gives you the option of displaying the odd (3rd to 63rd) or all (2nd to 63rd) harmonics on the PAC4220 display. • 3, 5, 7 ... 63: Only odd harmonics • 2,3,4 ... 63: All harmonics	3, 5, 7 ... 63
Backlight level	Intensity of the backlight of the display. 0 ... 3	3

Selection	Range	Factory setting
Backlight dimmed	Intensity of the backlight of the display. Set by the device after the time until dimmed expires. See "Time until dimmed" field 0 ... 3 0 reduces the backlighting to the minimum. It is not possible to deactivate it completely.	0
Time until dimmed	Time after which the device switches the backlighting from "Backlight level" to "Backlight dimmed". 0 min ... 99 min 0 deactivates backlight dimming.	3 min
Default menu	The menu display number for the main menu can be entered here. The device always starts up with the menu item defined here. 1 ... 28	1
Timeout	The menu display time can be specified here. When the specified time has elapsed, the device automatically returns to the defined main menu. 0 s (function deactivated) 10 ... 3 600 s	120 s
Display test...	Screen for testing the functional capability of the display. • F3: Selection of test color • F4 key: Exits the display	-

7.1.9 Advanced



7.1.9.1 Write protection



The hardware write protection prevents write access to the device, both via the communications interface and on the display.

In order to gain write access, hardware write protection must be deactivated directly on the device. The hardware write protection cannot be deactivated via a communications interface. The user must adjust the position of the write protection slider on the rear panel of the device in order to activate or deactivate the hardware write protection function.

The write protection slider has a sealing point. This can be used to permanently activate hardware write protection with a seal.

Write protection is a parameterizable protection function. The write protection parameters can be configured to withdraw write access to the device for the user either completely or just for certain areas.

Selection	Range	Factory setting
Measurement*	Write protection prevents write access to the "Basic parameters" menu item. The measured value parameters cannot be modified when hardware write protection is active. ☐ Yes: Active ☐ No: Not active	☑ On
Counters*	Write protection prevents write access to the "Reset counters" menu item. Energy values cannot be reset when hardware write protection is active. ☐ Yes: Active ☐ No: Not active	☑ On
Communication*	Write protection prevents write access to the "Communication" menu item. The communication parameters cannot be modified when hardware write protection is active. ☐ Yes: Active ☐ No: Not active	☑ On

Selection	Range	Factory setting
Display*	Write protection prevents write access to the "Display" menu item. The display parameters cannot be modified when hardware write protection is active. □ Yes: Active □ No: Not active	☑ On
Date/time*	Write protection prevents write access to the "Date/time" menu item. The date, time and SNTP parameters cannot be modified when hardware write protection is active. □ Yes: Active □ No: Not active	☑ On
Min/max values*	Write protection prevents write access to the "Reset min/max values" menu item. Min/max values cannot be deleted when hardware write protection is active. □ Yes: Active □ No: Not active	☑ On
IOs*	Write protection prevents write access to the "Integrated I/Os" menu item. Digital inputs/outputs and LEDs cannot be configured when hardware write protection is activated. □ Yes: Active □ No: Not active	☑ On
Firmware update*	Write protection prevents firmware updates. □ Yes: Active □ No: Not active	☑ On
Long-term data*	Write protection prevents write access to the "Reset long-term data" menu item. Long-term data (load profiles) cannot be deleted when hardware write protection is activated. □ Yes: Active □ No: Not active	☑ On

* Parameters can only be set when hardware write protection is deactivated (write protection slider in the "Open" position).

Note

Sealing of the write protection switch

The lead seal (to be applied by authorized persons) prevents operation of the write protection switch. The write protection switch is equipped with a hole for threading the seal for this purpose.

Note

Changing the configuration or software update

If activated, write protection must be deactivated before changing the device configuration or starting a firmware update. The seal (if present) must be broken for this purpose. After the update, write protection must be reactivated and a new seal must be applied. This is a manual step which can only be performed by an authorized person.

7.1.9.2 Operating protection

Operating protection blocks write access via the device interface:

- Changing of device settings, including PIN
- Changing and deletion of values/parameters
- Deletion of data and memory content
- Resetting to factory settings

Reading out of measured values and memory content is still possible when PIN protection is active.

Selection	Range	Factory setting
Operating protection	☑ On: Operating protection is deactivated ☐ Off: Operating protection is activated	☐ Off
Pin	PIN policy: Four-digit number from 0000 to 9999	Default PIN: 0000

7.1.9.3 Universal counters

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.

Selection	Range	Factory setting
Source UC1	Universal counter 1: • Deactivated Universal counter is switched off • Dig.input Parameterization for digital input • Dig.output Parameterization for digital output • Limit Parameterization for limit value 0 ... 11	Deactivated
Source UC2	Universal counter 2 • Deactivated Universal counter is switched off • Dig.input Parameterization for digital input • Dig.output Parameterization for digital output • Limit Parameterization for limit value 0 ... 11	Deactivated

7.1.9.4 Resetting

Selection	Range	Factory setting
Min/max values	Resets all minimum and maximum values to the instantaneous value. • ☑ Yes: Active • ☐ No: Not active	☐ No
Energy counters	Resets all energy counters to 0 (zero).	

Selection	Range	Factory setting
Counters	Resets the following counters to zero (0): • Active energy • Reactive energy • Apparent energy • Operating hours counter • Universal counters • User counters • Process counters • ☑ Yes: Active • ☐ No: Not active	☐ No
Factory settings	All device settings and measured values except the communication parameters and energy secondary values are reset to the as-delivered condition. • ☑ Yes: Active • ☐ No: Not active	☐ No
Communication	All communication settings are reset to the as-delivered condition. • ☑ Yes: Active • ☐ No: Not active	☐ No
Long-term data	All long-term data, such as load profiles (daily, monthly and actual energy counters), are reset to the as-delivered condition. • ☑ Yes: Active • ☐ No: Not active	☐ No
Execute	Confirmation of the reset	–

Note

Restart of the device

The reset must be confirmed by selecting "Execute". Otherwise the device reset is not executed.

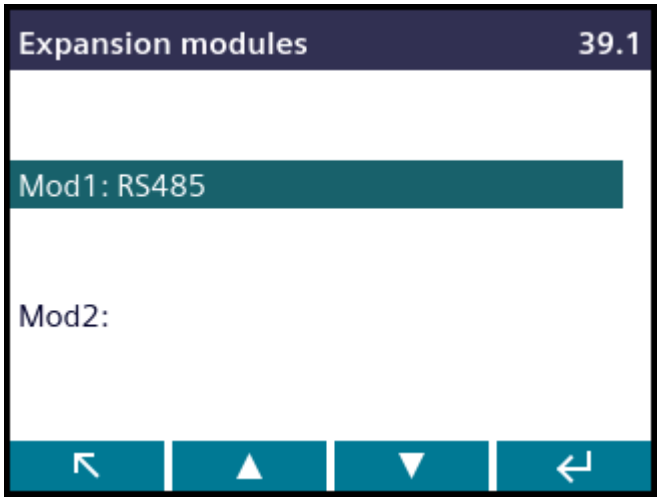
7.1.10 Expansion modules

Expansion modules

When the expansion module is mounted on the PAC4220 Power Monitoring Device, you can enter the configuration settings for the expansion module in this menu item.

Expansion modules expand the functionality of the PAC4220.

The expansion modules are not included in the scope of delivery. They can be ordered as options. See Components (Page 7)



You can find more information on the expansion modules in the Documentation for the expansion modules (https://sieportal.siemens.com/su/bkEUP)

7.2 Cybersecurity

7.2.1 Cybersecurity

7.2.1.1 Further information on the defense-in-depth strategy

In order to protect technical infrastructures, systems, machines and networks against cyber threats, it is essential to implement and consistently support a holistic, state-of-the-art IT security concept. Siemens products and solutions constitute just one element of such a concept.

You can find more information on the Industrial Cybersecurity web page https://www.siemens.com/industrialsecurity (https://www.siemens.com/global/en/products/automation/topic-areas/industrial-cybersecurity.html).

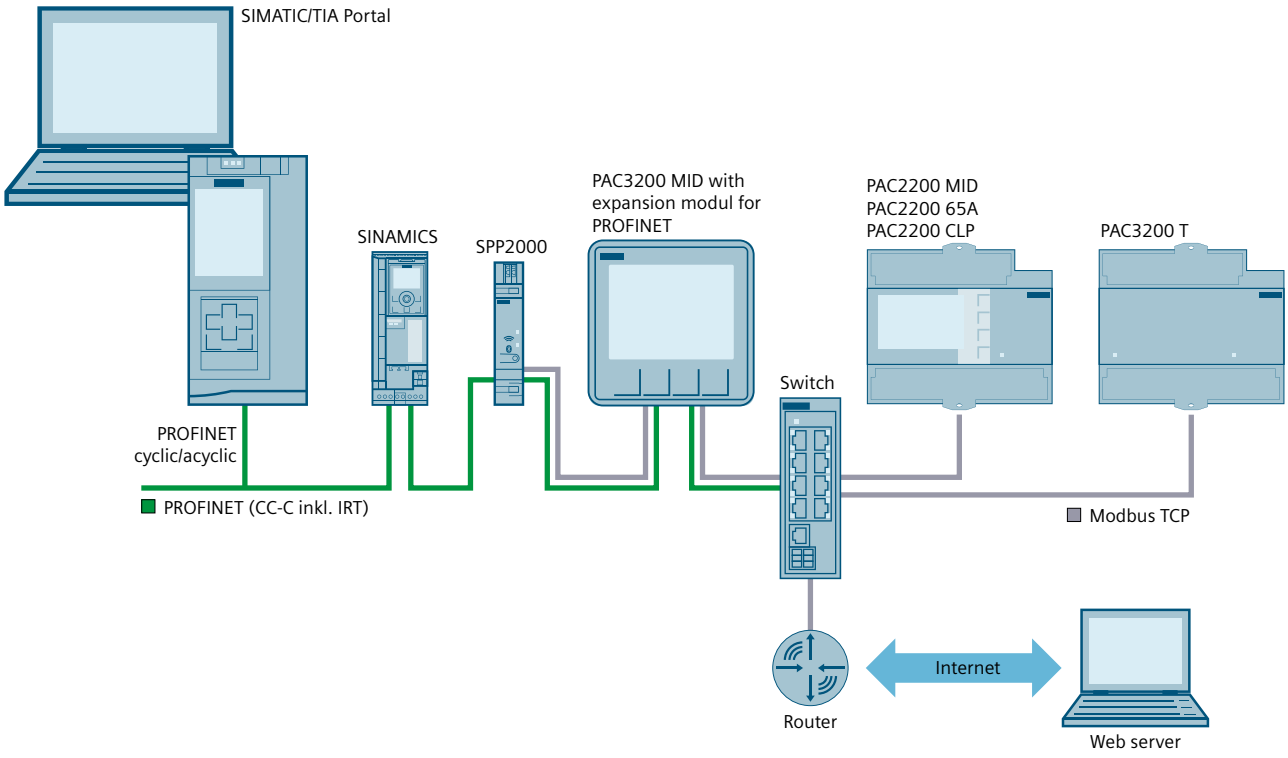
7.2.1.2 Overview

In order to be able to operate devices in a cybersecure manner, it is necessary to combine the devices/applications to form a cybersecure network.

Use the following link to view an Application examples (https://support.industry.siemens.com/cs/ww/en/view/109804583) illustrating the basic structure of a network and a possible cybersecurity configuration.

The SENTRON PAC4220 Power Monitoring Device specializes in precise energy metering and is particularly suitable for the process and manufacturing industries, as well as for demanding commercial operations.

The layout diagram below illustrates an application example and integration of the Power Monitoring Device into an existing system with other Siemens products.



The devices are equipped with a range of protections mechanisms.

- Operating protection - protection against improper use
- Hardware write protection - protection against unwanted write access
- Device access control (IP filter)
  - Protection against unwanted write access from a particular network
- Sealing of the connections and the hardware write protection slider
  - Protection against unnoticed hardware manipulation

The closed padlock symbol in the display title indicates whether "operating protection" or "hardware write protection" is activated.


Device is protected against write access.


Device is not protected against write access.

Note

We recommend that you only deactivate manipulation protection in the device during parameterization of the device. After the device has been successfully parameterized, manipulation protection must be reactivated.

7.2.1.3 Firmware update

Signed firmware is used in order to ensure that the device complies with cybersecurity requirements.

The device does not permit downgrades due to cybersecurity requirements.

The PAC4220 supports firmware updates.

Use the SENTRON Powerconfig configuration software or the web server (http://<device IP>/update) to update the firmware.

Additional information on updating the firmware can be found in the SENTRON Powerconfig online help.

You can find the available firmware versions at SENTRON Powerconfig (https://mall.industry.siemens.com/mall/en/ww/Catalog/Products/10121795?tree=CatalogTree)

Always use the latest firmware version. You can download the latest firmware version from the Siemens SiePortal: (https://sieportal.siemens.com/su/bkBw8)

7.2.1.4 Communication protocols

Service	Protocol	Default port	Attributes
Web server	TCP	80	• Configurable • Can be switched off with (0)
Time synchronization NTP	UDP	123	• Not configurable • Can be switched off
Modbus TCP	TCP	502	• Configurable • Can be switched off with (0)
Modbus gateway Mod1	TCP	17002	• Configurable • Can be switched off with (0)
Modbus gateway Mod2	TCP	17003	• Configurable • Can be switched off with (0)
Discovery Service	UDP UDP	17008 17009	• Not configurable • Can be switched off

7.2.1.5 Removing the device from service

Reset the device to the factory settings before removing it from service to prevent the possible disclosure of confidential data.

For more information, search the document for factory settings or as-delivered condition.

Resetting to the factory settings deletes the following data:

- Device name
- IP addresses
- Ports
- Access data
- Other configurations

Once all confidential data has been removed, the device can be disposed of in accordance with the current local regulations.

7.2.1.6 Cybersecurity guidelines for secure operation: Cybersecurity guidelines for cybersecurity hardening

The following points are designed to help the operator to keep the device in operation even in the event of cyberattacks. Perform checks at regular intervals to ensure that the implemented cybersecurity guidelines are still effective.

- **Sensitization of personnel**
  Regular trainings with respect to cybersecurity and continuous testing of the success of training are essential in order to ensure that cybersecurity measures in processes and work procedures are fully embraced. Moreover, the topic of cybersecurity should always be included in trainings with respect to means of production and software.

- **Install the latest firmware version**
  Keep your product software up to date. New versions should be installed without delay.

Details of the concrete implementation can be found in chapter Firmware update (Page 107).

- **Set up a backup and restore process**
  Set up a backup and restore process so that operation can be resumed as quickly as possible after an incident. This entails the regular creation of backups, testing of the functionality of backups, safe storage of backups and the creation of a recovery plan for use in an emergency.
- **Reduce the attack surface**
  Deactivate functions that are not necessary for operation before startup.
- **Use PINs**
  Allocate PINs if the product features an option for PIN allocation.

  Note

  PIN allocation locally on the device

  The sole purpose of a PIN is to protect against improper use of the device.

- **Restrict physical access**
  Ensure that only authorized personnel have physical access to the device. This can be implemented by means of access restriction in the form of a lockable environment, for example.

- **Restrict physical network access**
  Ensure that only authorized persons have access to the communication network.

7.2.1.7 Security by default

Security measures are activated on the device in the as-delivered condition:

- Hardware write protection is activated by default

7.2.1.8 Vulnerability monitoring

You can read about potential vulnerabilities in Siemens products on the public and freely accessible web page Siemens CERT/RSS (https://www.siemens.com/cert).

Siemens provides information about known vulnerabilities relating to Siemens products on this web page. Siemens Security Advisories (SSAs) are published for this purpose.

Each SSA contains a description of the vulnerability and its solution.

7.2.1.9 Reporting cybersecurity vulnerabilities

You can contact us at any time with security-related queries about the Siemens portfolio or the Siemens infrastructure. This is especially important if you would like to report a security issue. Please note that we can only process emails in English or German.

You can find our contact details on the internet under Siemens CERT/RSS (https://www.siemens.com/cert).

Email: productcert@siemens.com

7.2.2 Protection against manipulation

7.2.2.1 Operating protection (PIN)

Operating protection (PIN) is a measure to protect against improper use. The PIN prevents write access via the device interface, in particular:

- Changing of device settings, including PIN
- Changing and deletion of values/parameters
- Deletion of data and memory content
- Resetting to factory settings

Reading out of measured values and memory content is still possible when PIN protection is active.

After the PIN has been entered once on the device, it is not requested again while the "Settings" menu level is active.

PIN policy: Four-digit number from 0000 to 9999 (default PIN: 0000)

If no user-specific PIN has been assigned, the default PIN must be entered when operating protection is switched on. The currently valid PIN becomes visible on the display when operating protection is switched off. The PIN remains saved and becomes effective again the next time operating protection is switched on.

Note

Before you switch on operating protection, make sure that you and the group of authorized users are all in possession of the PIN. If password protection is switched on, the PIN is mandatory for all changes to the device settings.

You also require the PIN to call the "Password Protection" dialog box again in order to switch off access protection or to change the PIN.

Note

If you have forgotten the PIN, please contact technical support.

7.2.2.2 Hardware write protection

Hardware write protection

Hardware write protection prevents write access to the device, both via the communications interface and on the display.

In order to gain write access, hardware write protection must be deactivated directly on the device.

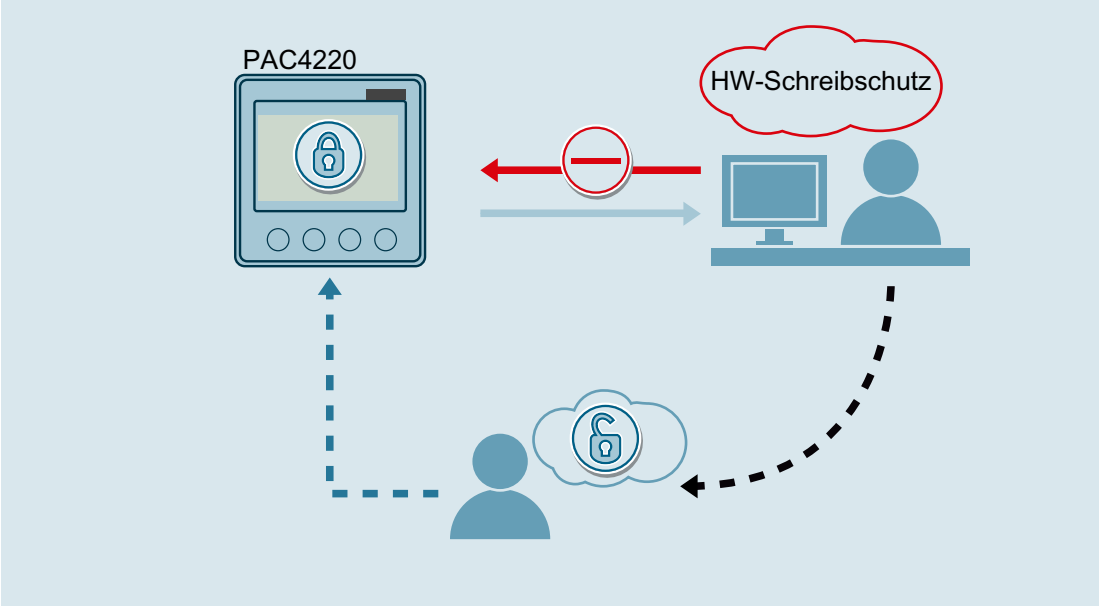
Hardware write protection cannot be deactivated via a communications interface.

Hardware write protection can be parameterized in the "Advanced" submenu of the "Settings" menu. A list of the various setting options can be found in chapter Write protection.

Note

Write protection slider

The user must adjust the position of the write protection slider on the rear panel of the device in order to activate or deactivate the hardware write protection function (see chapter Write protection).



7.2.2.3 IP filter (Modbus TCP allowlist)

The Modbus TCP allowlist is a security function that can prevent communication via Modbus TCP for addresses which have not been approved. Only IP addresses which have been entered in the Modbus TCP allowlist and have therefore been approved have access to the PAC4220.

In this way, the Modbus TCP allowlist prevents not only reading of data and measured values but also changes to parameters.

IP addresses

It is possible to enter up to ten IP addresses or IP address ranges. The IP address range is defined by a start IP address and an end IP address. The start IP address and the end IP address and all the IP addresses between them are approved.

Note

IP address approval

If only one IP address is to be approved, the start IP address and the end IP address must be identical.

Roles

Two different access rights (roles) can be assigned to the approved IP addresses.

Based on the assigned role, the following access right is defined for the approved IP address or IP address range:

- Read-only
- Read and write (no restrictions)

Structure of the allowlist

The allowlist contains the following information and entries:

- Entry
  It is possible to enter up to ten IP addresses or IP address ranges. The entry number (1-10) is defined here.
- Active
  Indicates whether the filter entry in the allowlist is active. The allowlist is active if at least one filter entry is active. The allowlist is deactivated if there is no filter entry active.
- Lower limit
  Defines the lowest IP address in the IP range to be approved.
- Upper limit
  Defines the highest IP address in the IP range to be approved.
- Access
  Defines the access rights for approved IP addresses or IP ranges.

Note

Modbus TCP IP filter

The Modbus TCP IP filter is deactivated on delivery and can be activated and parameterized using the SENTRON Powerconfig configuration software or via the device display.

The Modbus TCP IP filter is active if at least one filter entry is active.

Note

Incorrectly configured TCP IP filter

An incorrectly configured TCP IP filter can result in the disabling of communication. In this case, the configuration error in the TCP IP filter can be re-enabled via the device display.

7.2.2.4 Seal

The device has a sealing eyelet for sealing the terminals.

The sealing of the connections prevents the manipulation of connections and thus also possible manipulations of the measurement being carried out.

Service and maintenance

8

Intended use

The device may be used only if it is in full working order and in a safe state.

It must not be operated in the following situations:

- Unauthorized modifications or repairs
- Disassembly or bypassing of safety features
- Use of spare parts that are not original spare parts from SIEMENS AG
- Mounting of the device with mounting clamps not originally supplied by SIEMENS AG
- Use of expansion modules not originally supplied by SIEMENS AG
- Use of SIEMENS components not approved or recommended for use with PAC4220

8.1 Calibration

The device requires no maintenance.

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

8.2 Cleaning

Clean the display and keys as required. Use a dry cloth for this.

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

8.3 Firmware update

The PAC4220 supports firmware updates.

Use the SENTRON Powerconfig configuration software or the web server (http://<device IP>/update) to update the firmware. Additional information on updating the firmware can be found in the SENTRON Powerconfig online help. You can find the available firmware versions on the internet (https://support.industry.siemens.com/cs/ww/en/view/109810687).

8.4 Troubleshooting guide

Remedies for the resolution of faults

Fault	Remedies
Device is not working	• Check power supply • Check fuse
Voltage or current measured values are not displayed	• Check fuse • Check configuration (see Parameterizing the device (Page 77))
Voltage values are not plausible	• If voltage transformers are available, check the settings and the connection of the voltage transformers and correct if necessary
Current values are not plausible	• Check the settings and the wiring of the current transformer (if present) and correct if necessary
No communication	• Check the communication connection (correct connection, damaged Ethernet cable) • Check the communication settings (incorrect IP address, incorrect subnet, incorrect gateway or incorrect port?) • Check the allowlist • Check firewall, if present
Power values are incorrect, although voltage and current are correctly applied	• Check voltages and currents of the phases, if present • Check the polarity of the current transformers (for incorrect polarity)

If the device fault cannot be remedied by the measures given above, the device is probably defective.

More help is available on the internet. (https://www.siemens.de/lowvoltage/support-request)

8.5 Warranty

Procedure

Note

Loss of warranty

Opening the device will invalidate the Siemens warranty. Only the manufacturer is permitted to carry out repairs to the devices.

If the device is faulty or damaged, proceed as follows (only during the warranty period):

1. Uninstall the device; refer to chapter Deinstallation (Page 41).
2. Pack the device such that it cannot be damaged during transport.
3. Return the device to Siemens. You can obtain the address from:
   - Your Siemens sales partner
   - Technical Assistance

If the device has become defective outside the warranty period, then the device must be disposed of in accordance with local disposal regulations.

8.6 Disposal of waste electronic equipment

Disposal of waste electronic equipment

Waste electronic equipment must not be disposed of as unsorted municipal waste, e.g. household waste. When disposing of waste electronic equipment, the current local national/ international regulations must be observed.

Technical data

9

9.1 PAC4220 technical data

Device configuration

- 2 slots for up to 2 optional expansion modules
- 2 opto-isolated digital inputs
- 2 opto-isolated digital outputs
- 2 Ethernet interfaces for connecting to the PC or network

Measurement

Only for connection to alternating voltage systems			
Measuring method			
	For voltage measurement	True root-mean-square measurement (TRMS), zero blind measurement, gapless, up to the 63rd harmonic	
	For current measurement	True root-mean-square measurement (TRMS), zero blind measurement, gapless, up to the 63rd harmonic	
Measured value acquisition		Zero blind measurement, gapless	
		Waveform	Sinusoidal or distorted
		Frequency of the relative fundamental	50/60 Hz
		Measured value acquisition mode	Automatic line frequency detection

Measuring inputs for voltage

Measuring inputs for voltage		
Measurable voltage	Nominal voltage range	57.7/100 ... 400/690 V (IEC) 57.7/100 ... 347/600 V (UL)
	Min. measuring voltage U_{L-N} Max. measuring voltage U_{L-N}	11.5 V 480 V (IEC) 416 V (UL)
Zero point suppression	Voltage L-N	8 V
	Voltage L-L	17 V
Measuring category (acc. to IEC/UL 61010-2-030)	Category	CAT III
	Impulse withstand voltage	≥ 9.6 kV (1.2/50 µs)
Input resistance (L N)		1.5 MΩ
Max. power consumption per phase		150 mW

Measuring inputs for current

Measuring inputs for current		
Input current I_l	Rated current 1	x/1 A
	Rated current 2	x/5 A
Measuring range of current		10 ... 120% of rated current
Measuring range for power and energy measurement		1 ... 120% of rated current
Surge withstand capability		100 A for 1 s
Max. permissible uninterrupted current		10 A
Max. power consumption per phase		300 mVA at 5 A
Zero point suppression		0 ... 10% of rated current

Measurement accuracy

Measured variable	**Accuracy class**
Voltage	Class 0.2 (IEC 61557-12)
Current	Class 0.2 (IEC 61557-12)
Neutral conductor current (calculated)	Class 0.2 (IEC 61557-12)
Apparent power	Class 0.5 (IEC 61557-12)
Active power	Class 0.5 (IEC 61557-12)
Reactive power	Class 0.5 (IEC 61557-12)
Total apparent power	Class 0.5 (IEC 61557-12)
Total active power	Class 0.2 (IEC 61557-12)
Total reactive power	Class 0.5 (IEC 61557-12)
Total power factor	Class 1 (IEC 61557-12)
Line frequency	Class 0.05 (IEC 61557-12)
Total active energy	Class 0.2 (IEC 61557-12), Class 0.2s (IEC 62053-22)
Total reactive energy	Class 0.5 (IEC 61557-12), Class 0.5s (IEC 62053-24)
THD voltage referred to fundamental	Class 2 (IEC61557-12)
THD current referred to fundamental	Class 2 (IEC61557-12)
2nd ... 63rd harmonic of the voltage referred to the fundamental	Class 2 (IEC61557-12)
2nd ... 63rd harmonic of the current referred to the fundamental	Class 2 (IEC61557-12)

Note

Accuracy

The measuring accuracy (intrinsic uncertainty) of PAC4220 depends on the quality of the external current transformers used.

Supply voltage

Supply voltage		
Wide-range AC/DC power supply unit	7KM4220-0BA01-1EA0	AC: 95 ... 250 V (+/-10%), max. 28 VA / 6 W DC: 110 ... 270 V (+/-10%), max. 6 W
Extra-low voltage DC power supply unit	7KM4220-1BA01-1EA0	DC: 24 ... 48 V (+/-25%), max. 6 W
Overvoltage category		OVC III

Digital inputs

Number		2
Type		Opto-isolated
Input voltage	Rated value	24 V DC
	Maximum input voltage	30 V DC
	Switching thresh. signal "1"	> 11 V DC
Input current	For signal "1"	Typ. 7 mA

Digital outputs

Number		2
Type		Opto-isolated
Design/function		Switching output or pulse output
Rated voltage		0 ... 30 V DC, typically 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
	Transient overload	≤ 130 mA for 100 ms
	With "0" signal	≤ 0.2 mA
	Internal resistance	55 Ω
Pulse output function	Standard for pulse emitter	Signal characteristics in accordance with IEC 62053-31
	Adjustable pulse duration	30 ms ... 500 ms

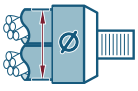
Communication

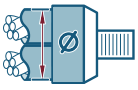
Ethernet interface		
	Number of connections	2
	Type	RJ45
	Suitable cable types	100Base-TX (CAT5)
	Protocols supported	Modbus TCP; HTTP; SNTP; DHCP
	Transfer rates	10/100 Mbps, autonegotiation and Auto-MDI-X (Medium-Dependent Interface)
	Update time at the interface	Approx. 500 ms for instantaneous values and energy counters

Displays and controls

Display		
	Type	TFT display
	Backlighting	White
	Resolution	320 pixels x 240 pixels
	Size (W x H)	71 mm x 54 mm
Keyboard		
	4 function keys F1 to F4 on the front	

Connection elements

Connection components: Current connection, voltage connection		
Conductor cross-section for copper cable (Cu)  0.6 x 3.5 mm 0.5 ... 0.6 Nm [4.4 ... 5.3 lb-in]	Solid 	0.2 ... 6 mm² (AWG 24 ... 10)
	Stranded 	0.2 ... 4 mm² (AWG 24 ... 12)
	Stranded with end sleeve, without insulation 	0.2 ... 4 mm² (AWG 24 ... 12)
	Stranded with end sleeve, with insulation 	0.2 ... 1.5 mm² (AWG 24 ... 16)
2-wire, same cross-section  0.6 x 3.5 mm 0.5 ... 0.6 Nm [4.4 ... 5.3 lb-in]	Solid 	0.2 ... 1.5 mm² (AWG 24 ... 16)
	Stranded 	0.2 ... 1.5 mm² (AWG 24 ... 16)
	Stranded with end sleeve, without insulation 	0.25 ... 0.75 mm² (AWG 24 ... 19)
	Stranded with TWIN end sleeve, with insulation 	0.5 ... 2.5 mm² (AWG 20 ... 14)

Connection components: Digital inputs and outputs		
Conductor cross-section for copper cable (Cu)  0.6 x 3.5 mm 0.5 ... 0.6 Nm [4.4 ... 5.3 lb-in]	Solid 	0.14 ... 1.5 mm² (AWG 26 ... 16)
	Stranded 	0.14 ... 1.5 mm² (AWG 26 ... 16)
	Stranded with end sleeve, without insulation 	0.25 ... 1 mm² (AWG 24 ... 18)
	Stranded with end sleeve, with insulation 	0.25 ... 1.5 mm² (AWG 24 ... 16)
2-wire, same cross-section  0.6 x 3.5 mm 0.5 ... 0.6 Nm [4.4 ... 5.3 lb-in]	Solid 	0.14 ... 0.75 mm² (AWG 26 ... 19)
	Stranded 	0.14 ... 0.75 mm² (AWG 26 ... 19)
	Stranded with end sleeve, without insulation 	0.25 ... 0.5 mm² (AWG 24 ... 20)
	Stranded with TWIN end sleeve, with insulation 	0.5 ... 1 mm² (AWG 20 ... 18)

Dimensions and weights

Type of fixing		Panel mounting to IEC 61554
Size W x H x D		96 mm x 96 mm x 56 mm
Cutout (W x H)		$92^{+0.8}$ mm x $92^{+0.8}$ mm
Mounting depth (without expansion module)		51 mm
Permissible control panel thickness for installation		≤ 4 mm
Mounting position		Any
Weight		
	Device without packaging	Approx. 325 g
	Device including packaging	Approx. 460 g

Degree of protection and safety class

Safety class		Protection class II when installed
Degree of protection according to IEC 60529		
	Device front	IP65
	Device rear	IP20
If a higher degree of protection is required for a specific application, the customer must take suitable measures.		

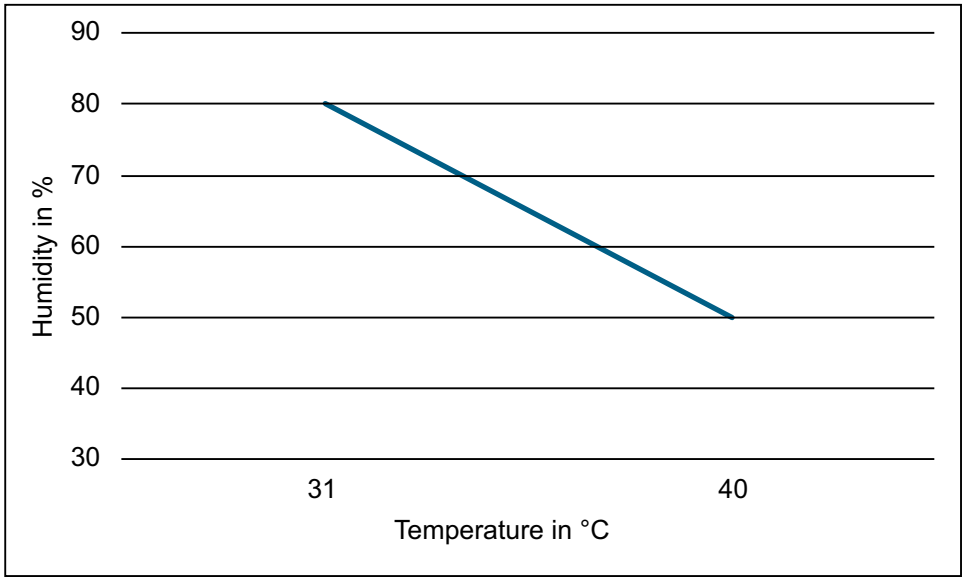
Ambient conditions

The device is suitable for panel mounting in accordance with IEC 61554. Operation is only permissible inside an enclosed, dry room.

Ambient conditions		
Temperature range		
	Ambient temperature while in operation	-25 °C ... +55 °C (K55)
	Ambient temperature during transportation and storage	-25 °C ... +70 °C
Relative humidity		< 75% RH
Installation altitude above sea level		Max. 2000 m
Pollution degree		2
Environmental tests		• EN 60068-2-27 • EN 60068-2-6 • EN 60068-3-3

Relative humidity in relation to ambient temperature

The maximum relative humidity is 80% at temperatures up to 31 °C, decreasing linearly down to 50% relative humidity at 40 °C.



EMC tests

Interference	EN 61326-1
	EN 61000-3-2 (Harmonic currents)
	EN 61000-3-3 (Voltage fluctuations and flicker)
Interference limit values complied with	Class B, used in the household sector
Immunity	EN 61326-1 (Use in an industrial environment)
Standards considered for immunity	EN 61000-4-2 (Electrostatic discharge)
	EN 61000-4-3 (Electromagnetic HF fields)
	EN 61000-4-4 (Rapid transients - burst)
	EN 61000-4-5 (Surge voltages)
	EN 61000-4-6 (Conducted FH fields)
	EN 61000-4-8 (Magnetic fields)
	EN 61000-4-11 (Voltage dips)

Safety tests

Standards	EN 61010-1
	EN 61010-2-30

Approvals

Symbol	Approval
CE	**CE conformity** The applied directives and standards can be found in the EU Declaration of Conformity.
UK CA	**Approval for United Kingdom**

Symbol	Approval
	Approval for Australia and New Zealand Regulatory Compliance Mark
	Approval for Eurasian Economic Union
	Approval for UL and Canada Products with this symbol meet both UL and Canadian requirements.

You can download the relevant certificates from the Siemens Support website (https://support.industry.siemens.com).

9.2 Labeling

View of a typical rating plate illustrated by the example of a PAC4220 (230 V) device

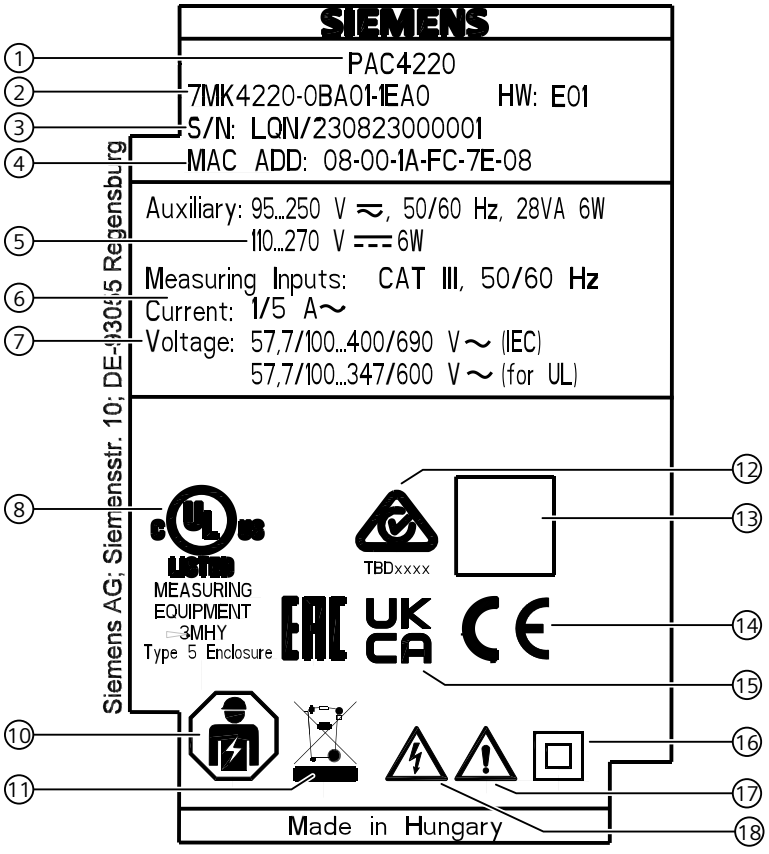


Table 9-1 Legend

Item	Symbol, label	Explanation
(1)	–	Name of the device
(2)	–	Article number of the device
(3)	–	Serial number of the device
(4)	–	MAC address
(5)	-	Device supply voltage
(6)	-	Data about measuring inputs for current
(7)		Data about measuring inputs for voltage
(8)		Products with this mark comply with both the Canadian (CSA) and the American (UL) requirements.
(10)		Electrical installation and maintenance by qualified personnel only
(11)		The device must not be disposed of with general domestic waste.
(12)		RCM test symbol (Australia and New Zealand) (in preparation)
(13)		2D code (serial number of the device)
(14)		CE marking (European Union)
(15)		UKCA marking (United Kingdom)
(16)		Protective insulation - class II device
(17)		Safety Alert Symbol
(18)		Risk of electric shock

Dimensional drawings

10

10.1 PAC4220 dimensional drawings

Panel cutout

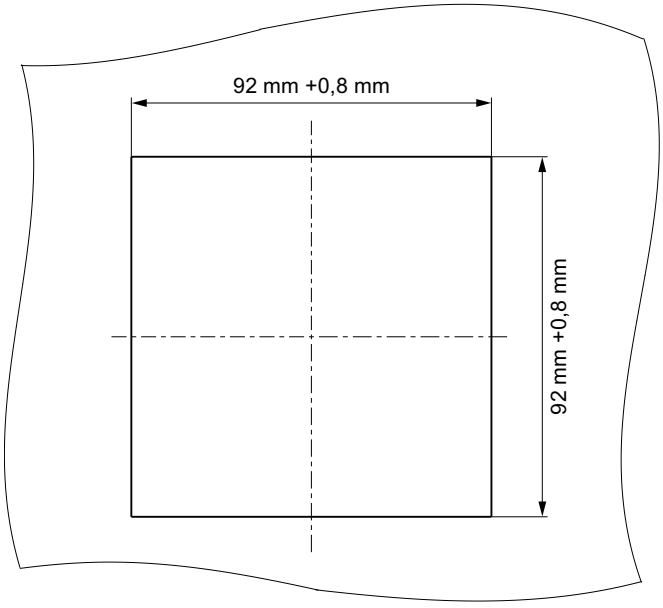


Figure 10-1 Panel cutout

Frame dimensions

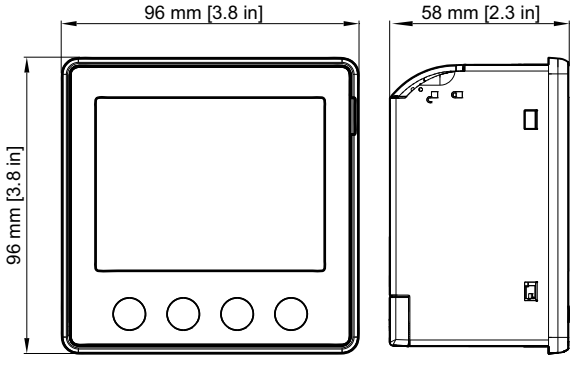
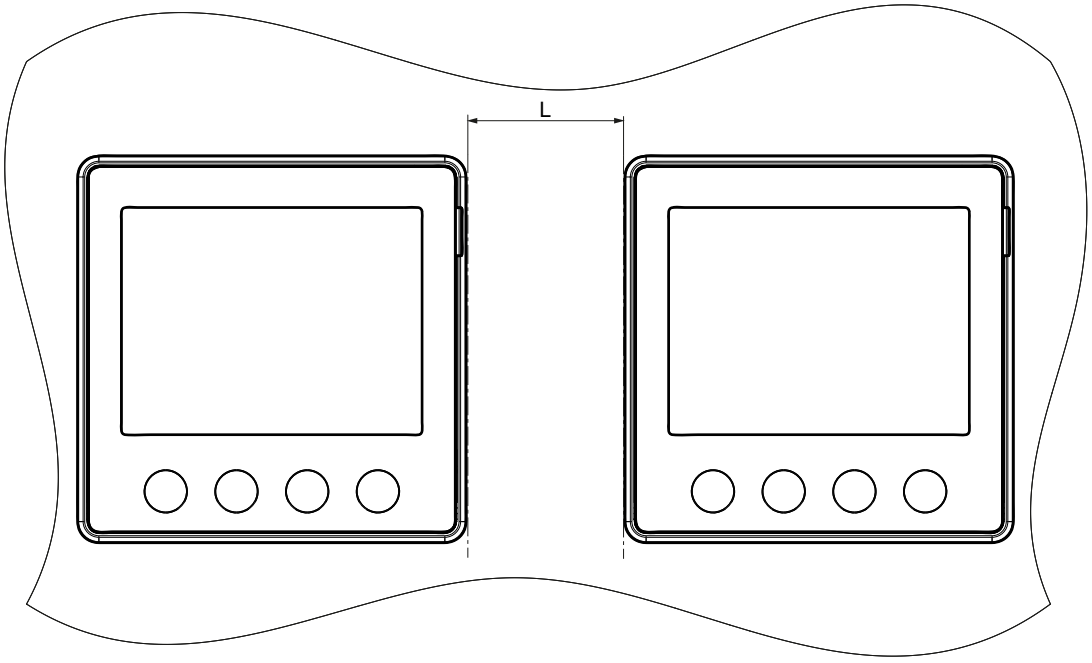


Figure 10-2 Frame dimensions

Clearance measurements



L = 30 mm if mounting brackets supplied with the device are used

L = 5 mm if compact brackets available to order as separate components are used (article number: 7KM9900-0GA00-0AA0)

Appendix

A

A.1 Modbus

A.1.1 Modbus

Detailed information about Modbus can be found at the Modbus website (https://modbus.org/).

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

More information

You can find further details about the PAC RS485 expansion module and Modus RTU in the "PAC RS485 Expansion Module" equipment manual.

A.1.2 Function codes

Function codes control the data exchange. To do this, a function code tells the device what action it is to take.

If an error occurs, the most significant bit (MSB) is set in the FC byte of the response frame.

Supported Modbus function codes

FC	Function in accordance with Modbus specification
0x01	Read Coils
0x02	Read Discrete Inputs
0x03	Read Holding Registers
0x04	Read Input Registers
0x05	Write Single Coil
0x06	Write Single Register
0x0F	Write Multiple Coils
0x10	Write Multiple Registers
0x2B	Read Device Identification
0x64	Historical data

A.1.3 Exception codes

Overview

Table A-1 Modbus exception codes

Exception code	Name	Meaning	Remedy
01	Illegal Function	Illegal function: • The function code in the request is not a permissible action for the device. • The device is in a state in which it cannot process a request of this type. This is the case, for example, if it has not yet been configured and is requested to return register values.	Check which function codes are supported.
02	Illegal Data Address	Illegal data address: This address is not permissible for the device. This is the case, for example, if the combination of start offset and transfer length is invalid.	Check the offset and the number of registers.
03	Illegal Data Value	Illegal data value: The request contains a data value that is not permissible for the device. This indicates an error in the remaining structure of a complex request, e.g. an incorrect data length.	Check that the specified offset and the specified data length in the command are correct.
04	Subordinate Device Failure	Error in processing the data: An indefinite error occurred when the device attempted to execute the requested action.	Check that the specified offset and the specified data length are correct.
F0	Write Protection ON	The action has been rejected because write protection is activated.	Deactivate write protection or exclude the feature from write protection.
0B	Gateway target device failed to respond	When used in conjunction with gateway: This is displayed if no response has been received from the target device. It means that the device has not been integrated in the network.	Check the network configuration and the cabling.

See also

Modbus website (https://modbus.org/)

A.1.4 Measured variables without a time stamp with the function codes 0x03 and 0x04

Addressing the measured variables without a time stamp

The PAC4220 Power Monitoring Device provides measured variables with or without a time stamp.

Note

Error in the case of inconsistent access to measured values

Please ensure that the start offset and the number of registers are correct for **read access/write access operations**.

If a value consists of 2 registers, a read command applied in the second register, for example, will generate an error code. The PAC4220 will also output an error code if, for example, a read operation/write operation ends in the middle of a multi-register value.

Table A-2 Available measured variables without a time stamp

Offset	Number of registers	Name	Format	Unit	Value range	Access
1	2	Voltage L1-N	Float	V	-	R
3	2	Voltage L2-N	Float	V	-	R
5	2	Voltage L3-N	Float	V	-	R
7	2	Voltage L1-L2	Float	V	-	R
9	2	Voltage L2-L3	Float	V	-	R
11	2	Voltage L3-L1	Float	V	-	R
13	2	Current L1	Float	A	-	R
15	2	Current L2	Float	A	-	R
17	2	Current L3	Float	A	-	R
19	2	Apparent power L1	Float	VA	-	R
21	2	Apparent power L2	Float	VA	-	R
23	2	Apparent power L3	Float	VA	-	R
25	2	Active power L1	Float	W	-	R
27	2	Active power L2	Float	W	-	R
29	2	Active power L3	Float	W	-	R
37	2	Power factor L1	Float	-	0 ... 1	R
39	2	Power factor L2	Float	-	0 ... 1	R
41	2	Power factor L3	Float	-	0 ... 1	R
43	2	THD voltage L1-L2	Float	%	0 ... 100	R
45	2	THD voltage L2-L3	Float	%	0 ... 100	R
47	2	THD voltage L3-L1	Float	%	0 ... 100	R
55	2	Line frequency	Float	Hz	45 ... 65	R

Offset	Number of registers	Name	Format	Unit	Value range	Access
57	2	3-phase average voltage L-N	Float	V	-	R
59	2	3-phase average voltage L-L	Float	V	-	R
61	2	3-phase average current	Float	A	-	R
63	2	Total apparent power	Float	VA	-	R
65	2	Total active power	Float	W	-	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 L1-N	Float	V	-	R
77	2	Maximum voltage L2-N	Float	V	-	R
79	2	Maximum voltage L3-N	Float	V	-	R
81	2	Maximum voltage L1-L2	Float	V	-	R
83	2	Maximum voltage L2-L3	Float	V	-	R
85	2	Maximum voltage L3-L1	Float	V	-	R
87	2	Maximum current L1	Float	A	-	R
89	2	Maximum current L2	Float	A	-	R
91	2	Maximum current L3	Float	A	-	R
93	2	Maximum apparent power L1	Float	VA	-	R
95	2	Maximum apparent power L2	Float	VA	-	R
97	2	Maximum apparent power L3	Float	VA	-	R
99	2	Maximum active power L1	Float	W	-	R
101	2	Maximum active power L2	Float	W	-	R
103	2	Maximum active power L3	Float	W	-	R
111	2	Maximum power factor L1	Float	-	0 ... 1	R
113	2	Maximum power factor L2	Float	-	0 ... 1	R
115	2	Maximum power factorL3	Float	-	0 ... 1	R
117	2	Maximum THD voltage L1-L2	Float	%	0 ... 100	R
119	2	Maximum THD voltage L2-L3	Float	%	0 ... 100	R
121	2	Maximum THD voltage L3-L1	Float	%	0 ... 100	R
129	2	Maximum line frequency	Float	Hz	45 ... 65	R
131	2	Maximum 3-phase average voltage L-N	Float	V	-	R
133	2	Maximum 3-phase average voltage L-L	Float	V	-	R
135	2	Maximum 3-phase average voltage	Float	A	-	R
137	2	Maximum total apparent power	Float	VA	-	R
139	2	Maximum total active power	Float	W	-	R
143	2	Maximum total power factor	Float	-	-	R
145	2	Minimum voltage L1-N	Float	V	-	R
147	2	Minimum voltage L2 -N	Float	V	-	R
149	2	Minimum voltage L3-N	Float	V	-	R
151	2	Minimum voltage L1-L2	Float	V	-	R
153	2	Minimum voltage L2-L3	Float	V	-	R

Offset	Number of registers	Name	Format	Unit	Value range	Access
155	2	Minimum voltage L3-L1	Float	V	-	R
157	2	Minimum current L1	Float	A	-	R
159	2	Minimum current L2	Float	A	-	R
161	2	Minimum current L3	Float	A	-	R
163	2	Minimum apparent power L1	Float	VA	-	R
165	2	Minimum apparent power L2	Float	VA	-	R
167	2	Minimum apparent power L3	Float	VA	-	R
169	2	Minimum active power L1	Float	W	-	R
171	2	Minimum active power L2	Float	W	-	R
173	2	Minimum active power L3	Float	W	-	R
175	2	Minimum reactive power L1 (VARn)	Float	VAR	-	R
177	2	Minimum reactive power L2 (VARn)	Float	VAR	-	R
179	2	Minimum reactive power L3 (VARn)	Float	VAR	-	R
181	2	Minimum power factor L1	Float	-	-	R
183	2	Minimum power factor L2	Float	-	-	R
185	2	Minimum power factor L3	Float	-	-	R
187	2	Minimum frequency	Float	Hz	-	R
189	2	Minimum average voltage UL	Float	V	-	R
191	2	Minimum average voltage UL-L	Float	V	-	R
193	2	Minimum average current	Float	A	-	R
195	2	Minimum total apparent power	Float	VA	-	R
197	2	Minimum total active power	Float	W	-	R
201	2	Minimum total power factor	Float	VAR	-	R

Offset	Number of registers	Name	Format	Unit	Value range	Access
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 = Logic result limit 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 2 ... 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	-	Byte3 Bit0 Output 0.0 Byte3 Bit1 Output 0.1	R
209	2	Digital inputs status	unsigned long	-	Byte3 Bit0 Input 0.0 Byte3 Bit1 Input 0.1	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
215		Universal counters	unsigned long		0 ... 999 999 999	RW

Offset	Number of registers	Name	Format	Unit	Value range	Access
227	2	Load profile counter	unsigned long	-	0	R
231	2	Status digital outputs module 1	unsigned long		Byte 3 Bit 0 = Output 0 Byte 3 Bit 1 = Output 1	R
233	2	Status digital inputs module 1	unsigned long		Byte 3 Bit 0 = Input 0 Byte 3 Bit 1 = Input 1	R
235	2	Status digital outputs module 1	unsigned long		Byte 3 Bit 0 = Output 0 Byte 3 Bit 1 = Output 1	R
237	2	Status digital inputs module 1	unsigned long		Byte 3 Bit 0 = Input 0 Byte 3 Bit 1 = Input 1	R
241	2	Cos φ Sum	Float	-	-	R
243	2	Cos φ L1	Float	-	-	R
245	2	Cos φ L2	Float	-	-	R
247	2	Cos φ L3	Float	-	-	R
249	2	Displacement angle L1	Float	°	-	R
251	2	Displacement angle L2	Float	°	-	R
253	2	Displacement angle L3	Float	°	-	R
255	2	Phase Angle L1-L1	Float	°	-	R
257	2	Phase Angle L1- L2	Float	°	-	R
259	2	Phase Angle L1- L3	Float	°	-	R
261	2	THD voltage L1	Float	%	0 ... 100	R
263	2	THD voltage L2	Float	%	0 ... 100	R
265	2	THD voltage L3	Float	%	0 ... 100	R
267	2	THD current L1	Float	%	0 ... 100	R
269	2	THD current L2	Float	%	0 ... 100	R
271	2	THD current L3	Float	%	0 ... 100	R
273	2	Distortion current L1	Float	A	-	R
275	2	Distortion current L2	Float	A	-	R
277	2	Distortion current L3	Float	A	-	R
279	2	Total reactive power L1 (Qtot)	Float	VAR	-	R
281	2	Total reactive power L2 (Qtot)	Float	VAR	-	R
283	2	Total reactive power L3 (Qtot)	Float	VAR	-	R
285	2	Reactive power L1 (Q1)	Float	VAR	-	R
287	2	Reactive power L1 (Q1)	Float	VAR	-	R
289	2	Reactive power L1 (Q1)	Float	VAR	-	R
291	2	Voltage unbalance	Float	%	0 ... 100	R
295	2	Neutral current	Float	A	-	R
297	2	Total reactive power (Qtot)	Float	VAR	-	R
299	2	Total reactive power (Q1)	Float	VAR	-	R

Offset	Number of registers	Name	Format	Unit	Value range	Access
371	2	Universal counter 2	unsigned long	-	0 ... 999 999 999	RW
373	2	User counter 1	unsigned long	-	0 ... 999 999 999	RW
375	2	User counter 2	unsigned long	-	0 ... 999 999 999	RW
377	2	User counter 3	unsigned long	-	0 ... 999 999 999	RW
379	2	User counter 4	unsigned long	-	0 ... 999 999 999	RW
381	2	User counter 5	unsigned long	-	0 ... 999 999 999	RW
383	2	User counter 6	unsigned long	-	0 ... 999 999 999	RW
385	2	User counter 7	unsigned long	-	0 ... 999 999 999	RW
387	2	User counter 8	unsigned long	-	0 ... 999 999 999	RW
389	2	User counter 9	unsigned long	-	0 ... 999 999 999	RW
391	2	User counter 10	unsigned long	-	0 ... 999 999 999	RW
399	2	GET_DAY_PROFILE_HIGHEST_OID	unsigned long	-	0 ... 999 999 999	RW
401	2	GET_MONTH_PROFILE_HIGHEST_OID	unsigned long	-	0 ... 999 999 999	RW
403	2	GET_YEAR_PROFILE_HIGHEST_OID	unsigned long	-	0 ... 999 999 999	RW
405	2	GET_USER_COUNTER_1_WEIGHTED_VALUE	unsigned long	-	0 ... 999 999 999	RW
407	2	GET_USER_COUNTER_2_WEIGHTED_VALUE	unsigned long	-	0 ... 999 999 999	RW
409	2	GET_USER_COUNTER_3_WEIGHTED_VALUE	unsigned long	-	0 ... 999 999 999	RW
411	2	GET_USER_COUNTER_4_WEIGHTED_VALUE	unsigned long	-	0 ... 999 999 999	RW
413	2	GET_USER_COUNTER_5_WEIGHTED_VALUE	unsigned long	-	0 ... 999 999 999	RW
415	2	GET_USER_COUNTER_6_WEIGHTED_VALUE	unsigned long	-	0 ... 999 999 999	RW
417	2	GET_USER_COUNTER_7_WEIGHTED_VALUE	unsigned long	-	0 ... 999 999 999	RW
419	2	GET_USER_COUNTER_8_WEIGHTED_VALUE	unsigned long	-	0 ... 999 999 999	RW
421	2	GET_USER_COUNTER_9_WEIGHTED_VALUE	unsigned long	-	0 ... 999 999 999	RW
423	2	GET_USER_COUNTER_10_WEIGHTED_VALUE	unsigned long	-	0 ... 999 999 999	RW
425	2	ProcessCounter_Copy	unsigned long	-	0 ... 999 999 999	RW

[1] The following tables contain further details of all the measured variables indicated by this superscript.

[2] You can additionally use the Modbus function code 0x10 on all measured variables indicated by this superscript.

Table A-3 Meaning of the abbreviations in the "Access" column

Abbreviation	Meaning
R	Read access
RW	Read and write access

A.1.5 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 PAC4200 Power Monitoring Device

You can use the function codes 0x05 and 0x0F on the digital outputs in addition to the function codes 0x03 and 0x04.

Table A-4 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-5 Structure - Digital inputs status and digital outputs status for a SENTRON PAC 4DI/2DO expansion module in slot MOD 1

Name	Length	Status	Byte	Bit	Bit mask	Access
Digital outputs status	32 bits	DO 4.0	3	0	0x00000001	R
Digital outputs status	32 bits	DO 4.1	3	1	0x00000010	R
Digital inputs status	32 bits	DI 4.0	3	0	0x00000001	R
Digital inputs status	32 bits	DI 4.1	3	1	0x00000010	R
Digital inputs status	32 bits	DI 4.2	3	2	0x00000100	R
Digital inputs status	32 bits	DI 4.3	3	3	0x00001000	R

Table A-6 Structure - Digital inputs status and digital outputs status for a SENTRON PAC 4DI/2DO expansion module in slot MOD 2

Name	Length	Status	Byte	Bit	Bit mask	Access
Digital outputs status	32 bits	DO 8.0	3	0	0x00000001	R
Digital outputs status	32 bits	DO 8.1	3	1	0x00000010	R
Digital inputs status	32 bits	DI 8.0	3	0	0x00000001	R
Digital inputs status	32 bits	DI 8.1	3	1	0x00000010	R
Digital inputs status	32 bits	DI 8.2	3	2	0x00000100	R
Digital inputs status	32 bits	DI 8.3	3	3	0x00001000	R

A.1.6 Structure – Limit values with the function codes 0x01 and 0x02

Structure of the limit values

Table A-7 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 violated	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

A.1.7 Structure – PMD diagnostics and status with the function codes 0x03 and 0x04

Design

Table A-8 Overview of status and diagnostics bytes

Byte	Meaning
0	System status
1	Device status
2	Device diagnostics
3	Component diagnostics

Table A-9 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
0	6	Hardware write protection is active	Status	0x40000000		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		RW
2	1	Upper or lower limit violation[1) 2)]	saving	0x00000200		RW
2	2	Maximum pulse rate exceeded[1) 2)]	saving	0x00000400		RW
2	3	Device has rebooted[1) 2)]	saving	0x00000800		RW
2	4	Energy counters reset[1) 2)]	saving	0x00001000		RW
2	5	Power quality	saving	0x00002000		RW
3	0	Bit 0 Slot 1 Parameters changed[2)]	saving	0x00000001		RW
3	1	Bit 1 Slot 1 IMDATA changed[2)]	saving	0x00000002		RW
3	2	Bit 2 Slot 1 Firmware update active[2)]	saving	0x00000004		RW
3	3	Bit 3 Firmware data block available[2)]	saving	0x00000008		RW
3	4	Bit 4 Bootloader update flag[2)]	saving	0x00000010		RW
3	5	Bit 5 Slot 2 Firmware update active[2)]	saving	0x00000020		RW
3	6	Bit 6 Slot 2 Parameters changed[2)]	saving	0x00000040		RW
3	7	Bit 7 Slot 2 IMDATA changed[2)]	saving	0x00000080		RW

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.

A.1.8 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-10 Available measured variables 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

Offset	Number of registers	Name	Format	Unit	Value range	Access
521	2	Actual Subinterval Time	Unsigned long	s	-	R
523	2	Information on Last Period	Unsigned long	-	Byte 0, Bit 1 Tariff information: 0 = On-peak 1 = Off-peak	R
					Byte 1 **1)** Quality information:	
					Byte 2 Reserve	
					Byte 3 **1)** Reactive power information	
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-11 Meaning of the abbreviations in the "Access" column

Abbreviation	Meaning
R	Read access
W	Write access
RW	Read and write access

Table A-12 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 26)
	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 Qn[1)]
	6	Period contains fundamental connection reactive power VAR1
	5	Period contains total reactive power Qtot
	4	The reactive power type recorded was changed in the period.
	3 ... 0	Reserve

[1)] Budeanu = Offset reactive power

A.1.9 Measured variables with a time stamp and the function codes 0x03 and 0x04

Addressing the measured variables with a time stamp

Note

Error in the case of inconsistent access to measured values

Please ensure that the start offset and the number of registers are correct for **read access/write access operations**.

If a value consists of 2 registers, a read command applied in the second register, for example, will generate an error code. The PAC4220 will also output an error code if, for example, a read operation/write operation ends in the middle of a multi-register value.

Table A-13 Available measured variables with a time stamp

Offset	Number of registers	Name	Format	Unit	Value range	Access
3001	6	Maximum voltage L1-N	Float + time stamp*	V		R
3007	6	Maximum voltage L2-N	Float + time stamp*	V		R
3013	6	Maximum voltage L3-N	Float + time stamp*	V		R

Offset	Number of registers	Name	Format	Unit	Value range	Access
3019	6	Maximum voltage L1-L2	Float + time stamp*	V		R
3025	6	Maximum voltage L2-L3	Float + time stamp*	V		R
3031	6	Maximum voltage L3-L1	Float + time stamp*	V		R
3037	6	Maximum current L1	Float + time stamp*	A		R
3043	6	Maximum current L2	Float + time stamp*	A		R
3049	6	Maximum current L3	Float + time stamp*	A		R
3055	6	Maximum apparent power L1	Float + time stamp*	VA		R
3061	6	Maximum apparent power L2	Float + time stamp*	VA		R
3067	6	Maximum apparent power L3	Float + time stamp*	VA		R
3073	6	Maximum active power L1	Float + time stamp*	W		R
3079	6	Maximum active power L2	Float + time stamp*	W		R
3085	6	Maximum active power L3	Float + time stamp*	W		R
3109	6	Maximum total reactive power L1 (Qtot)	Float + time stamp*	VAR		R
3115	6	Maximum total reactive power L2 (Qtot)	Float + time stamp*	VAR		R
3121	6	Maximum total reactive power L3 (Qtot)	Float + time stamp*	VAR		R
3127	6	Maximum reactive power L1 (Q1)	Float + time stamp*	VAR		R
3133	6	Maximum reactive power L2 (Q1)	Float + time stamp*	VAR		R
3139	6	Maximum reactive power L3 (Q1)	Float + time stamp*	VAR		R
3145	6	Maximum power factor L1	Float + time stamp*			R
3151	6	Maximum power factor L2	Float + time stamp*			R
3157	6	Maximum power factor L3	Float + time stamp*			R
3163	6	Maximum THD voltage L1-L2	Float + time stamp*	%	0 ... 100	R
3169	6	Maximum THD voltage L2-L3	Float + time stamp*	%	0 ... 100	R

Offset	Number of registers	Name	Format	Unit	Value range	Access
3175	6	Maximum THD voltage L3-L1	Float + time stamp*	%	0 ... 100	R
3199	6	Maximum cos φ L1	Float + time stamp*			R
3205	6	Maximum cos φ L2	Float + time stamp*			R
3211	6	Maximum cos φ L3	Float + time stamp*			R
3217	6	Maximum displacement angle L1	Float + time stamp*	°	0 ... 259	R
3223	6	Maximum displacement angle L2	Float + time stamp*	°	0 ... 259	R
3229	6	Maximum displacement angle L3	Float + time stamp*	°	0 ... 259	R
3235	6	Maximum phase angle L1-L1	Float + time stamp*	°	0 ... 259	R
3241	6	Maximum phase angle L1-L2	Float + time stamp*	°	0 ... 259	R
3247	6	Maximum phase angle L1-L3	Float + time stamp*	°	0 ... 259	R
3253	6	Maximum THD voltage L1	Float + time stamp*	%	0 ... 100	R
3259	6	Maximum THD voltage L2	Float + time stamp*	%	0 ... 100	R
3265	6	Maximum THD voltage L3	Float + time stamp*	%	0 ... 100	R
3271	6	Maximum THD current L1	Float + time stamp*	%	0 ... 100	R
3277	6	Maximum THD current L2	Float + time stamp*	%	0 ... 100	R
3283	6	Maximum THD current L3	Float + time stamp*	%	0 ... 100	R
3289	6	Maximum distortion current L1	Float + time stamp*	A		R
3295	6	Maximum distortion current L2	Float + time stamp*	A		R
3301	6	Maximum distortion current L3	Float + time stamp*	A		R
3307	6	Maximum line frequency	Float + time stamp*	Hz	45 ... 65	R
3313	6	Maximum 3-phase average voltage L-N	Float + time stamp*	V		R
3319	6	Maximum 3-phase average voltage L-L	Float + time stamp*	V		R
3325	6	Maximum 3-phase average current	Float + time stamp*	A		R

Offset	Number of registers	Name	Format	Unit	Value range	Access
3331	6	Maximum total apparent power	Float + time stamp*	VA		R
3337	6	Maximum total active power	Float + time stamp*	W		R
3349	6	Maximum total power factor	Float + time stamp*			R
3355	6	Maximum neutral current	Float + time stamp*	A		R
3361	6	Maximum total reactive power (Qtot)	Float + time stamp*	VAR		R
3367	6	Maximum reactive power (Q1)	Float + time stamp*	VAR		R
3373	6	Maximum cos φ	Float + time stamp*			R
3379	6	Max. amplitude unbalance current	Float + time stamp*	%	0 ... 100	R
3385	6	Max. amplitude unbalance voltage	Float + time stamp*	%	0 ... 100	R
3391	6	Max. amplitude unbalance phase	Float + time stamp*	%	0 ... 100	R
6001	6	Minimum voltage L1-N	Float + time stamp*	V		R
6007	6	Minimum voltage L2-N	Float + time stamp*	V		R
6013	6	Minimum voltage L3-N	Float + time stamp*	V		R
6019	6	Minimum voltage L1-L2	Float + time stamp*	V		R
6025	6	Minimum voltage L2-L3	Float + time stamp*	V		R
6031	6	Minimum voltage L3-L1	Float + time stamp*	V		R
6037	6	Minimum current L1	Float + time stamp*	A		R
6043	6	Minimum current L2	Float + time stamp*	A		R
6049	6	Minimum current L3	Float + time stamp*	A		R
6055	6	Minimum apparent power L1	Float + time stamp*	VA		R
6061	6	Minimum apparent power L2	Float + time stamp*	VA		R
6067	6	Minimum apparent power L3	Float + time stamp*	VA		R

Offset	Number of registers	Name	Format	Unit	Value range	Access
6073	6	Minimum active power L1	Float + time stamp*	W		R
6079	6	Minimum active power L2	Float + time stamp*	W		R
6085	6	Minimum active power L3	Float + time stamp*	W		R
6109	6	Minimum total reactive power L1 (Qtot)	Float + time stamp*	VAR		R
6115	6	Minimum total reactive power L2 (Qtot)	Float + time stamp*	VAR		R
6121	6	Minimum total reactive power L3 (Qtot)	Float + time stamp*	VAR		R
6127	6	Minimum reactive power L1 (Q1)	Float + time stamp*	VAR		R
6133	6	Minimum reactive power L2 (Q1)	Float + time stamp*	VAR		R
6139	6	Minimum reactive power L3 (Q1)	Float + time stamp*	VAR		R
6145	6	Minimum power factor L1	Float + time stamp*			R
6151	6	Minimum power factor L2	Float + time stamp*			R
6157	6	Minimum power factor L3	Float + time stamp*			R
6163	6	Minimum THD voltage L1-L2	Float + time stamp*	%	0 ... 100	R
6169	6	Minimum THD voltage L2-L3	Float + time stamp*	%	0 ... 100	R
6175	6	Minimum THD voltage L3-L1	Float + time stamp*	%	0 ... 100	R
6199	6	Minimum cos φ L1	Float + time stamp*			R
6205	6	Minimum cos φ L2	Float + time stamp*			R
6211	6	Minimum cos φ L3	Float + time stamp*			R
6217	6	Minimum displacement angle L1	Float + time stamp*	°	0 ... 259	R
6223	6	Minimum displacement angle L2	Float + time stamp*	°	0 ... 259	R
6229	6	Minimum displacement angle L3	Float + time stamp*	°	0 ... 259	R
6235	6	Minimum phase angle L1-L1	Float + time stamp*	°	0 ... 259	R
6241	6	Minimum phase angle L1-L2	Float + time stamp*	°	0 ... 259	R

Offset	Number of registers	Name	Format	Unit	Value range	Access
6247	6	Minimum phase angle L1-L3	Float + time stamp*	°	0 ... 259	R
6253	6	Minimum THD voltage L1	Float + time stamp*	%	0 ... 100	R
6259	6	Minimum THD voltage L2	Float + time stamp*	%	0 ... 100	R
6265	6	Minimum THD voltage L3	Float + time stamp*	%	0 ... 100	R
6271	6	Minimum THD current L1	Float + time stamp*	%	0 ... 100	R
6277	6	Minimum THD current L2	Float + time stamp*	%	0 ... 100	R
6283	6	Minimum THD current L3	Float + time stamp*	%	0 ... 100	R
6289	6	Minimum distortion current L1	Float + time stamp*	A		R
6295	6	Minimum distortion current L2	Float + time stamp*	A		R
6301	6	Minimum distortion current L3	Float + time stamp*	A		R
6307	6	Minimum line frequency	Float + time stamp*	Hz	45 ... 65	R
6313	6	Minimum 3-phase average voltage L-N	Float + time stamp*	V		R
6319	6	Minimum 3-phase average voltage L-L	Float + time stamp*	V		R
6325	6	Minimum 3-phase average current	Float + time stamp*	A		R
6331	6	Minimum total apparent power	Float + time stamp*	VA		R
6337	6	Minimum total active power	Float + time stamp*	W		R
6349	6	Minimum total power factor	Float + time stamp*			R
6355	6	Minimum neutral current	Float + time stamp*	A		R
6361	6	Minimum total reactive power (Qtot)	Float + time stamp*	VAR		R
6367	6	Minimum reactive power (Q1)	Float + time stamp*	VAR		R
6373	6	Minimum cos φ	Float + time stamp*			R
6379	6	Min. amplitude unbalance current	Float + time stamp*	%	0 ... 100	R

Offset	Number of registers	Name	Format	Unit	Value range	Access
6385	6	Min. amplitude unbalance voltage	Float + time stamp*	%	0 ... 100	R
6391	6	Min. amplitude unbalance phase	Float + time stamp*	%	0 ... 100	R

*) **Format used to identify a date/time with extra information**			
Timestamp32	0:4 TSUnix32	uint32_t	
	5:6 millisends	uint16_t	
	7: TimeOffset		indicates local time offset to UTC in 15 minute steps
	8: TimeFlags	Bit 0:2 0: clock not set 1: clock not accurate 2: daylight saving time active	Flag field containing extra information for a time stamp 0: No 1: Yes

Table A-14 Meaning of the abbreviations in the "Access" column

Abbreviation	Meaning
R	Read access
W	Write access
RW	Read and write access

A.1.10 Tariff-specific energy values in double format with the function codes 0x03, 0x04, and 0x10

Addressing the tariff-specific energy values

Table A-15 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

Offset	Number of registers	Name	Format	Unit	Value range	Access
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	L1 active energy import tariff 1	double	Wh	-	RW
845	4	L1 active energy import tariff 2	double	Wh	-	RW
849	4	L1 active energy export tariff 1	double	Wh	-	RW
853	4	L1 active energy export tariff 2	double	Wh	-	RW
857	4	L1 reactive energy import tariff 1	double	VARh	-	RW
861	4	L1 reactive energy import tariff 2	double	VARh	-	RW
865	4	L1 reactive energy export tariff 1	double	VARh	-	RW
869	4	L1 reactive energy export tariff 2	double	VARh	-	RW
873	4	L1 apparent energy tariff 1	double	VAh	-	RW
877	4	L1 apparent energy tariff 2	double	VAh	-	RW
881	4	L2 active energy import tariff 1	double	Wh	-	RW
885	4	L2 active energy import tariff 2	double	Wh	-	RW
889	4	L2 active energy export tariff 1	double	Wh	-	RW
893	4	L2 active energy export tariff 2	double	Wh	-	RW
898	4	L2 reactive energy import tariff 1	double	VARh	-	RW
901	4	L2 reactive energy import tariff 2	double	VARh	-	RW
905	4	L2 reactive energy export tariff 1	double	VARh	-	RW
909	4	L2 reactive energy export tariff 2	double	VARh	-	RW
913	4	L2 apparent energy tariff 1	double	VAh	-	RW
917	4	L2 apparent energy tariff 2	double	VAh	-	RW
921	4	L3 active energy import tariff 1	double	Wh	-	RW
925	4	L3 active energy import tariff 2	double	Wh	-	RW
929	4	L3 active energy export tariff 1	double	Wh	-	RW
933	4	L3 active energy export tariff 2	double	Wh	-	RW
937	4	L3 reactive energy import tariff 1	double	VARh	-	RW
941	4	L3 reactive energy import tariff 2	double	VARh	-	RW
945	4	L3 reactive energy export tariff 1	double	VARh	-	RW
949	4	L3 reactive energy export tariff 2	double	VARh	-	RW
953	4	L3 apparent energy tariff 1	double	VAh	-	RW
957	4	L3 apparent energy tariff 2	double	VAh	-	RW
961	4	Secondary total of active energy - import	double	Wh	-	R
965	4	Secondary total of active energy - export	double	Wh	-	R
969	4	Total active energy - import	double	Wh	-	R
973	4	Total active energy - export	double	Wh	-	R

Offset	Number of registers	Name	Format	Unit	Value range	Access
977	4	Process counter - Total active energy - import	double	Wh	-	RW
981	4	Process counter - Total reactive energy - import	double	VARh	-	RW
985	4	Process counter - Total apparent energy	double	VAh	-	RW
989	4	Copy of process counter - Total active energy - import	double	Wh	-	RW
993	4	Copy of process counter - Total reactive energy - import	double	VARh	-	RW
997	4	Copy of process counter - Total apparent energy	double	VAh	-	RW
1001	4	Process counter - Total active energy - export	double	Wh	-	RW
1005	4	Process counter - Total reactive energy - export	double	VARh	-	RW
1009	4	Copy of process counter - Total active energy - export	double	Wh	-	RW
1013	4	Copy of process counter - Total reactive energy - export	double	VARh	-	RW

*) **Format for identifying the date/time with additional information**			
Timestamp32	0:4 TSUnix32	uint32_t	
	5:6 milliseconds	uint16_t	
	7: TimeOffset		Displays the difference between the UTC and the local time in 15-minute increments.
	8: TimeFlags	Bit 0:2 0: Time not set 1: Time not accurate 2: Daylight saving active	Flag with additional information for a time stamp 0: No 1: Yes

Table A-16 Meaning of the abbreviations in the "Access" column

Abbreviation	Meaning
R	Read access
W	Write access
RW	Read and write access

A.1.11 Tariff-specific energy values in float format with the function codes 0x03 and 0x04

Addressing the tariff-specific energy values

Table A-17 Available tariff-specific measured variables

Offset	Number of registers	Name	Format	Unit	Value range	Access
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	L1 active energy import tariff 1	Float	Wh	overflow 1.0e+12	R
2823	2	L1 active energy import tariff 2	Float	Wh	overflow 1.0e+12	R
2825	2	L1 active energy export tariff 1	Float	VARh	overflow 1.0e+12	R
2827	2	L1 active energy export tariff 2	Float	VARh	overflow 1.0e+12	R
2829	2	L1 reactive energy import tariff 1	Float	Wh	overflow 1.0e+12	R
2831	2	L1 reactive energy import tariff 2	Float	Wh	overflow 1.0e+12	R
2833	2	L1 reactive energy export tariff 1	Float	VARh	overflow 1.0e+12	R
2835	2	L1 reactive energy export tariff 2	Float	VARh	overflow 1.0e+12	R
2837	2	L1 apparent energy tariff 1	Float	VAh	overflow 1.0e+12	R
2839	2	L1 apparent energy tariff 2	Float	VAh	overflow 1.0e+12	R
2841	2	L2 active energy import tariff 1	Float	Wh	overflow 1.0e+12	R
2843	2	L2 active energy import tariff 2	Float	Wh	overflow 1.0e+12	R
2845	2	L2 active energy export tariff 1	Float	VARh	overflow 1.0e+12	R
2847	2	L2 active energy export tariff 2	Float	VARh	overflow 1.0e+12	R
2849	2	L2 reactive energy import tariff 1	Float	Wh	overflow 1.0e+12	R
2851	2	L2 reactive energy import tariff 2	Float	Wh	overflow 1.0e+12	R
2853	2	L2 reactive energy export tariff 1	Float	VARh	overflow 1.0e+12	R
2855	2	L2 reactive energy export tariff 2	Float	VARh	overflow 1.0e+12	R
2857	2	L2 apparent energy tariff 1	Float	VAh	overflow 1.0e+12	R
2859	2	L2 apparent energy tariff 2	Float	VAh	overflow 1.0e+12	R
2861	2	L3 active energy import tariff 1	Float	Wh	overflow 1.0e+12	R
2863	2	L3 active energy import tariff 2	Float	Wh	overflow 1.0e+12	R
2865	2	L3 active energy export tariff 1	Float	VARh	overflow 1.0e+12	R
2867	2	L3 active energy export tariff 2	Float	VARh	overflow 1.0e+12	R

Offset	Number of registers	Name	Format	Unit	Value range	Access
2869	2	L3 reactive energy import tariff 1	Float	Wh	overflow 1.0e+12	R
2871	2	L3 reactive energy import tariff 2	Float	Wh	overflow 1.0e+12	R
2873	2	L3 reactive energy export tariff 1	Float	VARh	overflow 1.0e+12	R
2875	2	L3 reactive energy export tariff 2	Float	VARh	overflow 1.0e+12	R
2877	2	L3 apparent energy tariff 1	Float	VAh	overflow 1.0e+12	R
2879	2	L3 apparent energy tariff 2	Float	VAh	overflow 1.0e+12	R
2881	2	Secondary total of active energy - import	Float	Wh	-	R
2883	2	Secondary total of active energy - export	Float	Wh	-	R
2885	2	Total active energy - import	Float	Wh	-	R
2887	2	Total active energy - export	Float	Wh	-	R
2889	2	Process counter - Total active energy - import	Float	Wh	-	RW
2891	2	Process counter - Total reactive energy - import	Float	VARh	-	RW
2893	2	Process counter - Total apparent energy	Float	VAh	-	RW
2895	2	Copy of process counter - Total active energy - import	Float	Wh	-	RW
2897	2	Copy of process counter - Total reactive energy - import	Float	VARh	-	RW
2899	2	Copy of process counter - Total apparent energy	Float	VAh	-	RW
2901	2	Process counter - Total active energy - export	Float	Wh	-	RW
2903	2	Process counter - Total reactive energy - export	Float	VARh	-	RW
2905	2	Copy of process counter - Total active energy - export	Float	Wh	-	RW
2907	2	Copy of process counter - Total reactive energy - export	Float	VARh	-	RW

Table A-18 Meaning of the abbreviations in the "Access" column

Abbreviation	Meaning
R	Read access
RW	Read and write access

A.1.12 Odd harmonics without a time stamp with the function codes 0x03 and 0x04

For clarity, only the fundamental and the 3rd harmonic are listed in the tables.

Formula

The offsets of the 5th to 63rd odd harmonics can be calculated using the formula below:

Offset of nth harmonic = (offset of fundamental) + (length + 1) x (n − 1)

nth - stands for the number of the harmonic

Example 1

Calculation of "5th harmonic voltage L1-N":

- 9001 + (2 + 1) x (5 – 1) = 9013
- Offset of "5th harmonic voltage L1-N" is 9013.

Example 2

Calculation of offset of "31st harmonic voltage L3-N":

- 9005 + (2 +1) x (31 – 1) = 9095
- Offset of "3rd harmonic voltage L3-N" is 9095.

Tables

Offset FC0x03 FC0x04	Number of registers	Name	Format	Unit	Access
9001	2	Fundamental voltage L1-N	Float	V	R
9003	2	Fundamental voltage L2-N	Float	V	R
9005	2	Fundamental voltage L3-N	Float	V	R
9007	2	3rd harmonic voltage L1-N	Float	%	R
9009	2	3rd harmonic voltage L2-N	Float	%	R
9011	2	3rd harmonic voltage L3-N	Float	%	R
See formula	2	nth Harmonic voltage L1-N	Float	%	R
See formula	2	nth Harmonic voltage L2-N	Float	%	R
See formula	2	nth Harmonic voltage L3-N	Float	%	R

Offset FC0x03 FC0x04	Number of registers	Name	Format	Unit	Access
11001	2	Fundamental current L1	Float	A	R
11003	2	Fundamental current L2	Float	A	R
11005	2	Fundamental current L3	Float	A	R
11007	2	3rd harmonic current L1	Float	A	R
11009	2	3rd harmonic current L2	Float	A	R

Offset FC0x03 FC0x04	Number of registers	Name	Format	Unit	Access
11011	2	3rd harmonic current L3	Float	A	R
See formula	2	nth Harmonic voltage L1	Float	A	R
See formula	2	nth Harmonic voltage L2	Float	A	R
See formula	2	nth Harmonic voltage L3	Float	A	R

Offset FC0x03 FC0x04	Number of registers	Name	Format	Unit	Access
22001	2	Fundamental voltage L1-L2	Float	V	R
22003	2	Fundamental voltage L2-L3	Float	V	R
22005	2	Fundamental voltage L3-L1	Float	V	R
22007	2	3rd harmonic voltage L1-L2	Float	%	R
22009	2	3rd harmonic voltage L2-L3	Float	%	R
22011	2	3rd harmonic voltage L3-L1	Float	%	R
See formula	2	nth Harmonic voltage L1-L2	Float	%	R
See formula	2	nth Harmonic voltage L2-L3	Float	%	R
See formula	2	nth Harmonic voltage L3-L1	Float	%	R

A.1.13 Odd harmonics with a time stamp with the function codes 0x03 and 0x04

Formula

The offsets of the 5th to 63rd odd harmonics can be calculated using the formula below:

Offset of nth harmonic = (offset of 3rd harmonic) + (length + 3) x (n − 3)

nth - stands for the number of the harmonic

Example 1

Calculation of offset "Max. 5th harmonic voltage L1-N with time":

- 12999 + (6 + 3) x (5 – 3) = 13017
- Offset of "Max. 5th harmonic voltage L1-N with time" is 13017.

Example 2

Calculation of offset of "Max. 31st harmonic voltage L3-N with time":

- 13011 + (6 + 3) x (31 – 3) = 13263
- Offset of "Max. 31st harmonic voltage L3-N with time" is 13263.

Tables

Offset FC0x03 FC0x04	Number of registers	Name	Format	Unit	Access
12999	6	Max. 3rd harmonic voltage L1-N with time	Float + time stamp*	%	R
13005	6	Max. 3rd harmonic voltage L2-N with time	Float + time stamp*	%	R
13011	6	Max. 3rd harmonic voltage L3-N with time	Float + time stamp*	%	R
See formula	6	Max. nth harmonic voltage L1-N with time	Float + time stamp*	%	R
See formula	6	Max. nth harmonic voltage L2-N with time	Float + time stamp*	%	R
See formula	6	Max. nth harmonic voltage L3-N with time	Float + time stamp*	%	R

Offset FC0x03 FC0x04	Number of registers	Name	Format	Unit	Access
19001	6	Maximum fundamental current L1 with time	Float + time stamp*	A	R
19007	6	Maximum fundamental current L2 with time	Float + time stamp*	A	R
19013	6	Maximum fundamental current L3 with time	Float + time stamp*	A	R
19019	6	Max. 3rd harmonic current L1 with time	Float + time stamp*	A	R
19025	6	Max. 3rd harmonic current L1 with time	Float + time stamp*	A	R
19031	6	Max. 3rd harmonic current L1 with time	Float + time stamp*	A	R
See formula	6	Max. nth harmonic current L1 with time	Float + time stamp*	A	R
See formula	6	Max. nth harmonic current L1 with time	Float + time stamp*	A	R
See formula	6	Max. nth harmonic current L1 with time	Float + time stamp*	A	R

Offset FC0x03 FC0x04	Number of registers	Name	Format	Unit	Access
24001	6	Max. 3rd Harmonic voltage L1-L2	Float + time stamp*	%	R
24007	6	Max. 3rd Harmonic voltage L2-L3	Float + time stamp*	%	R
24013	6	Max. 3rd Harmonic voltage L3-L1	Float + time stamp*	%	R
See formula	6	Max. nth harmonic voltage L1-L2	Float + time stamp*	%	R
See formula	6	Max. nth harmonic voltage L2-L3	Float + time stamp*	%	R
See formula	6	Max. nth harmonic voltage L3-L1	Float + time stamp*	%	R

*) **Format for identifying the date/time with additional information**			
Timestamp32	0:4 TSUnix32	uint32_t	
	5:6 milliseconds	uint16_t	
	7: TimeOffset		Displays the difference between the UTC and the local time in 15-minute increments.
	8: TimeFlags	Bit 0:2 0: Time not set 1: Time not accurate 2: Daylight saving active	Flag with additional information for a time stamp 0: No 1: Yes

A.1.14 Readout of harmonic components of all harmonics with function codes 0x03 and 0x04

For clarity, only the 1st and 63rd harmonics are listed in the table.

Formula

The offsets of the 2nd to 63rd harmonics can be calculated using the formula below:

Offset of nth harmonic = (offset of 1st harmonic) + length x (n − 1)

nth - stands for the number of the harmonic

Example 1

Calculation of offset of "3rd harmonic voltage L1-N" (FC0x3):

- 36005 + 2 x (3 – 1) = 36009
- Offset of "3rd harmonic voltage L1-N" (FC0x3) is 36009.

Example 2

Calculation of offset of "7th max. harmonic voltage L1-N" (FC0x3):

- 37201 + 4 x (7 – 1) = 37225
- Offset of "7th max. harmonic voltage L1-N" (FCx03) is 37225.

Table

Note the following:

- The voltage harmonics are expressed in [%] relative to the fundamental.
- The fundamental is expressed absolutely in [V].
- The current harmonics are expressed absolutely in [A].

Offset FC0x03 FC0x04	Number of registers	Name	Format	Unit	Access
36005	2	1st harmonic voltage L1-N	Float	V	R
See formula	2	nth Harmonic voltage L1-N	Float	%	R
36131	2	63rd harmonic voltage L1-N	Float	%	R
36133	2	1st harmonic voltage L2-N	Float	V	R
See formula	2	nth Harmonic voltage L2-N	Float	%	R
36259	2	63rd harmonic voltage L2-N	Float	%	R
36261	2	1st harmonic voltage L3-N	Float	V	R
See formula	2	nth Harmonic voltage L3-N	Float	%	R
36387	2	63rd harmonic voltage L3-N	Float	%	R

Offset FC0x03 FC0x04	Number of registers	Name	Format	Unit	Access
36389	2	1st harmonic current L1-N	Float	A	R
See formula	2	nth Harmonic current L1-N	Float	A	R
36515	2	63rd harmonic current L1-N	Float	A	R
36517	2	1st harmonic current L2-N	Float	A	R
See formula	2	nth Harmonic current L2-N	Float	A	R

Offset FC0x03 FC0x04	Number of registers	Name	Format	Unit	Access
36643	2	63rd harmonic current L2-N	Float	A	R
36645	2	1st harmonic current L3-N	Float	A	R
See formula	2	nth Harmonic current L3-N	Float	A	R
36771	2	63rd harmonic current L3-N	Float	A	R
36773	2	1st harmonic voltage L1-L2	Float	V	R

Offset FC0x03 FC0x04	Number of registers	Name	Format	Unit	Access
See formula	2	nth Harmonic voltage L1-L2	Float	%	R
36899	2	63rd harmonic voltage L1-L2	Float	%	R
36901	2	1st harmonic voltage L2-L3	Float	V	R
See formula	2	nth Harmonic voltage L2-L3	Float	%	R
37027	2	63rd harmonic voltage L2-L3	Float	%	R
37029	2	1st harmonic voltage L3-L1	Float	V	R
See formula	2	nth Harmonic voltage L3-L1	Float	%	R
37155	2	63rd harmonic voltage L3-L1	Float	%	R

Offset FC0x03 FC0x04	Number of registers	Name	Format	Unit	Access
37201	4	1st max. harmonic voltage L1-N	Float+TS32	V	R
See formula	4	nth max. harmonic voltage L1-N	Float	%	R
37453	4	63rd max. harmonic voltage L1-N	Float+TS32	%	R
37457	4	1st max. harmonic voltage L2-N	Float+TS32	V	R
See formula	4	nth max. harmonic voltage L2-N	Float+TS32	%	R
37709	4	63rd max. harmonic voltage L2-N	Float+TS32	%	R
37713	4	1st max. harmonic voltage L3-N	Float+TS32	V	R
See formula	4	nth max. harmonic voltage L3-N	Float+TS32	%	R
37965	4	63rd max. harmonic voltage L3-N	Float+TS32	%	R

Offset FC0x03 FC0x04	Number of registers	Name	Format	Unit	Access
37969	4	1st max. harmonic current L1-N	Float+TS32	A	R
See formula	4	nth max. harmonic current L1-N	Float+TS32	A	R
38221	4	63rd max. harmonic current L1-N	Float+TS32	A	R
38225	4	1st max. harmonic current L2-N	Float+TS32	A	R
See formula	4	nth max. harmonic current L2-N	Float+TS32	A	R
38477	4	63rd max. harmonic current L2-N	Float+TS32	A	R
38481	4	1st max. harmonic current L3-N	Float+TS32	A	R
See formula	4	nth max. harmonic current L3-N	Float+TS32	A	R
38733	4	63rd max. harmonic current L3-N	Float+TS32	A	R

Offset FC0x03 FC0x04	Number of registers	Name	Format	Unit	Access
38737	4	1st max. harmonic voltage L1-L2	Float+TS32	V	R
See formula	4	nth max. harmonic voltage L1-L2	Float+TS32	%	R
38989	4	63rd max. harmonic voltage L1-L2	Float+TS32	%	R
38993	4	1st max. harmonic voltage L2-L3	Float+TS32	V	R
See formula	4	nth max. harmonic voltage L2-L3	Float+TS32	%	R
39245	4	63rd max. harmonic voltage L2-L3	Float+TS32	%	R
39249	4	1st max. harmonic voltage L3-L1	Float+TS32	V	R
See formula	4	nth max. harmonic voltage L3-L1	Float+TS32	%	R
39501	4	63rd max. harmonic voltage L3-L1	Float+TS32	%	R

A.1.15 Readout of average values (aggregation) with function codes 0x03 and 0x04

The values are updated at time-synchronized, parameterizable intervals:

- Measured values for average 1 (file 1)
  Default setting: Period length = 10 s
- Measured values for average 2 (file 2)
  Default setting: Period length = 15 min

Current values file 1

Offset FC 0x03 FC 0x04	File	Number of registers	Name	Format	Unit	Access
30001	1	2	Time stamp aggregation stage n	Time-stamp32	s	R
30003	1	2	Flag aggregation stage n	UINT32	-	R
30005	1	2	Voltage PH-N L1	Float	V	R
30007	1	2	Voltage PH-N L2	Float	V	R
30009	1	2	Voltage PH-N L3	Float	V	R
30011	1	2	Voltage PH-PH L1-L2	Float	V	R
30013	1	2	Voltage PH-PH L2-L3	Float	V	R
30015	1	2	Voltage PH-PH L3-L1	Float	V	R
30017	1	2	Current L1	Float	A	R
30019	1	2	Current L2	Float	A	R
30021	1	2	Current L3	Float	A	R
30023	1	2	Apparent power L1	Float	VA	R
30025	1	2	Apparent power L2	Float	VA	R
30027	1	2	Apparent power L3	Float	VA	R
30029	1	2	Active power L1	Float	W	R
30031	1	2	Active power L2	Float	W	R
30033	1	2	Active power L3	Float	W	R
30041	1	2	Power factor L1	Float	-	R
30043	1	2	Power factor L2	Float	-	R
30045	1	2	Power factor L3	Float	-	R
30047	1	2	THD voltage L1	Float	%	R
30049	1	2	THD voltage L2	Float	%	R
30051	1	2	THD voltage L3	Float	%	R
30053	1	2	THD current L1	Float	%	R
30055	1	2	THD current L2	Float	%	R
30057	1	2	THD current L3	Float	%	R
30059	1	2	THD voltage L12	Float	%	R
30061	1	2	THD voltage L23	Float	%	R
30063	1	2	THD voltage L31	Float	%	R
30065	1	2	Reactive power L1 (Q_1)	Float	VAR	R
30067	1	2	Reactive power L2 (Q_1)	Float	VAR	R
30069	1	2	Reactive power L3 (Q_1)	Float	VAR	R
30071	1	2	Reactive power L1 (Q_{tot})	Float	VAR	R
30073	1	2	Reactive power L2 (Q_{tot})	Float	VAR	R
30075	1	2	Reactive power L3 (Q_{tot})	Float	VAR	R
30077	1	2	Cos φL1	Float	-	R
30079	1	2	Cos φL2	Float	-	R
30081	1	2	Cos φL3	Float	-	R

Offset FC 0x03 FC 0x04	File	Number of registers	Name	Format	Unit	Access
30083	1	2	Distortion current L1	Float	A	R
30085	1	2	Distortion current L2	Float	A	R
30087	1	2	Distortion current L3	Float	A	R
30089	1	2	Voltage system angle U_{L1}-U_{L1}	Float	°	R
30091	1	2	Voltage system angle U_{L1}-U_{L2}	Float	°	R
30093	1	2	Voltage system angle U_{L1}-U_{L3}	Float	°	R
30095	1	2	Phase angle φ_{L1}	Float	°	R
30097	1	2	Phase angle φ_{L2}	Float	°	R
30099	1	2	Phase angle φ_{L3}	Float	°	R
30101	1	2	Frequency	Float	Hz	R
30103	1	2	Average voltage PH-N	Float	V	R
30105	1	2	Average voltage PH-PH	Float	V	R
30107	1	2	Average current	Float	A	R
30109	1	2	Collective apparent power	Float	VA	R
30111	1	2	Collective active power	Float	W	R
30115	1	2	Collective reactive power (Q_1)	Float	VAR	R
30117	1	2	Collective reactive power (Q_{tot})	Float	VAR	R
30119	1	2	Collective power factor	Float	-	R
30121	1	2	Amplitude voltage unbalance	Float	%	R
30123	1	2	Amplitude current unbalance	Float	%	R
30125	1	2	Voltage unbalance	Float	%	R
30127	1	2	Current unbalance	Float	%	R
30129	1	2	Neutral current	Float	A	R
30131	1	2	In_Mod1	Float	A	R
30133	1	2	I5_Mod1	Float	A	R
30135	1	2	I6_Mod1	Float	A	R
30137	1	2	In_Mod2	Float	A	R
30139	1	2	I5_Mod2	Float	A	R
30141	1	2	I6_Mod2	Float	A	R
30143	1	2	Cos φ	Float	%	R
30145	1	2	Flag aggregation stage n	meteringflag	%	R

Maximum values file 1

Offset FC 0x03 FC 0x04	File	Number of registers	Name	Format	Unit	Access
30201	1	2	Time stamp aggregation stage n	Time-stamp32	s	R
30205	1	2	Max. voltage PH-N L1	Float	V	R
30207	1	2	Max. voltage PH-N L2	Float	V	R
30209	1	2	Max. voltage PH-N L3	Float	V	R

Offset FC 0x03 FC 0x04	File	Number of registers	Name	Format	Unit	Access
30211	1	2	Max. voltage PH-PH L1-L2	Float	V	R
30213	1	2	Max. voltage PH-PH L2-L3	Float	V	R
30215	1	2	Max. voltage PH-PH L3-L1	Float	V	R
30217	1	2	Max. current L1	Float	A	R
30219	1	2	Max. current L2	Float	A	R
30221	1	2	Max. current L3	Float	A	R
30223	1	2	Max. apparent power L1	Float	VA	R
30225	1	2	Max. apparent power L2	Float	VA	R
30227	1	2	Max. apparent power L3	Float	VA	R
30229	1	2	Max. active power L1	Float	W	R
30231	1	2	Max. active power L2	Float	W	R
30233	1	2	Max. active power L3	Float	W	R
30241	1	2	Max. power factor L1	Float	-	R
30243	1	2	Max. power factor L2	Float	-	R
30245	1	2	Max. power factor L3	Float	-	R
30247	1	2	Max. THD voltage L1	Float	%	R
30249	1	2	Max. THD voltage L2	Float	%	R
30251	1	2	Max. THD voltage L3	Float	%	R
30253	1	2	Max. THD current L1	Float	%	R
30255	1	2	Max. THD current L2	Float	%	R
30257	1	2	Max. THD current L3	Float	%	R
30259	1	2	Max. THD voltage L12	Float	%	R
30261	1	2	Max. THD voltage L23	Float	%	R
30263	1	2	Max. THD voltage L31	Float	%	R
30265	1	2	Max. reactive power L1 (Q_1)	Float	VAR	R
30267	1	2	Max. reactive power L2 (Q_1)	Float	VAR	R
30269	1	2	Max. reactive power L3 (Q_1)	Float	VAR	R
30271	1	2	Max. reactive power L1 (Q_{tot})	Float	VAR	R
30273	1	2	Max. reactive power L2 (Q_{tot})	Float	VAR	R
30275	1	2	Max. reactive power L3 (Q_{tot})	Float	VAR	R
30277	1	2	Max. cos φ_{L1}	Float	-	R
30279	1	2	Max. cos φ_{L2}	Float	-	R
30281	1	2	Max. cos φ_{L3}	Float	-	R
30283	1	2	Max. distortion current L1	Float	A	R
30285	1	2	Max. distortion current L2	Float	A	R
30287	1	2	Max. distortion current L3	Float	A	R
30289	1	2	Max. voltage system angle U_{L1}-U_{L1}	Float	°	R
30291	1	2	Max. voltage system angle U_{L1}-U_{L2}	Float	°	R
30293	1	2	Max. voltage system angle U_{L1}-U_{L3}	Float	°	R
30295	1	2	Max. phase angle φ_{L1}	Float	°	R
30297	1	2	Max. phase angle φ_{L2}	Float	°	R

Offset FC 0x03 FC 0x04	File	Number of registers	Name	Format	Unit	Access
30299	1	2	Max. phase angle φ_{L3}	Float	°	R
30301	1	2	Max. frequency	Float	Hz	R
30303	1	2	Max. average voltage PH-N	Float	V	R
30305	1	2	Max. average voltage PH-PH	Float	V	R
30307	1	2	Max. average current	Float	A	R
30309	1	2	Max. collective apparent power	Float	VA	R
30311	1	2	Max. collective active power	Float	W	R
30315	1	2	Max. collective reactive power (Q_1)	Float	VAR	R
30317	1	2	Max. collective reactive power (Q_{tot})	Float	VAR	R
30319	1	2	Max. collective power factor	Float	-	R
30321	1	2	Max. amplitude voltage unbalance	Float	%	R
30323	1	2	Max. amplitude current unbalance	Float	%	R
30325	1	2	Max. voltage unbalance	Float	%	R
30327	1	2	Max. current unbalance	Float	%	R
30329	1	2	Max. neutral current	Float	A	R
30331	1	2	Max. In_Mod1	Float	A	R
30333	1	2	Max. I5_Mod1	Float	A	R
30335	1	2	Max. I6_Mod1	Float	A	R
30337	1	2	Max. In_Mod2	Float	A	R
30339	1	2	Max. I5_Mod2	Float	A	R
30341	1	2	Max. I6_Mod2	Float	A	R
30343	1	2	Max. cos φ	Float	%	R
30345	1	2	Flag aggregation stage n	meteringflag	%	R

Minimum values file 1

Offset FC 0x03 FC 0x04	File	Number of registers	Name	Format	Unit	Access
30401	1	2	Time stamp aggregation stage n	Time-stamp32	s	R
30405	1	2	Min. voltage PH-N L1	Float	V	R
30407	1	2	Min. voltage PH-N L2	Float	V	R
30409	1	2	Min. voltage PH-N L3	Float	V	R
30411	1	2	Min. voltage PH-PH L1-L2	Float	V	R
30413	1	2	Min. voltage PH-PH L2-L3	Float	V	R
30415	1	2	Min. voltage PH-PH L3-L1	Float	V	R
30417	1	2	Min. current L1	Float	A	R
30419	1	2	Min. current L2	Float	A	R
30421	1	2	Min. current L3	Float	A	R
30423	1	2	Min. apparent power L1	Float	VA	R

Offset FC 0x03 FC 0x04	File	Number of registers	Name	Format	Unit	Access
30425	1	2	Min. apparent power L2	Float	VA	R
30427	1	2	Min. apparent power L3	Float	VA	R
30429	1	2	Min. active power L1	Float	W	R
30431	1	2	Min. active power L2	Float	W	R
30433	1	2	Min. active power L3	Float	W	R
30441	1	2	Min. power factor L1	Float	-	R
30443	1	2	Min. power factor L2	Float	-	R
30445	1	2	Min. power factor L3	Float	-	R
30447	1	2	Min. THD voltage L1	Float	%	R
30449	1	2	Min. THD voltage L2	Float	%	R
30451	1	2	Min. THD voltage L3	Float	%	R
30453	1	2	Min. THD current L1	Float	%	R
30455	1	2	Min. THD current L2	Float	%	R
30457	1	2	Min. THD current L3	Float	%	R
30459	1	2	Min. THD voltage L12	Float	%	R
30461	1	2	Min. THD voltage L23	Float	%	R
30463	1	2	Min. THD voltage L31	Float	%	R
30465	1	2	Min. reactive power L1 (Q_1)	Float	VAR	R
30467	1	2	Min. reactive power L2 (Q_1)	Float	VAR	R
30469	1	2	Min. reactive power L3 (Q_1)	Float	VAR	R
30471	1	2	Min. reactive power L1 (Q_{tot})	Float	VAR	R
30473	1	2	Min. reactive power L2 (Q_{tot})	Float	VAR	R
30475	1	2	Min. reactive power L3 (Q_{tot})	Float	VAR	R
30477	1	2	Min. cos φL1	Float	-	R
30479	1	2	Min. cos φL2	Float	-	R
30481	1	2	Min. cos φL3	Float	-	R
30483	1	2	Min. distortion current L1	Float	A	R
30485	1	2	Min. distortion current L2	Float	A	R
30487	1	2	Min. distortion current L3	Float	A	R
30489	1	2	Min. voltage system angle U_{L1}-U_{L1}	Float	°	R
30491	1	2	Min. voltage system angle U_{L1}-U_{L2}	Float	°	R
30493	1	2	Min. voltage system angle U_{L1}-U_{L3}	Float	°	R
30495	1	2	Max. phase angle φ_{L1}	Float	°	R
30497	1	2	Min. phase angle φ_{L2}	Float	°	R
30499	1	2	Min. phase angle φ_{L3}	Float	°	R
30501	1	2	Min. frequency	Float	Hz	R
30503	1	2	Min. average voltage PH-N	Float	V	R
30505	1	2	Min. average voltage PH-PH	Float	V	R
30507	1	2	Min. average current	Float	A	R
30509	1	2	Min. collective apparent power	Float	VA	R

Offset FC 0x03 FC 0x04	File	Number of registers	Name	Format	Unit	Access
30511	1	2	Min. collective active power	Float	W	R
30515	1	2	Min. collective reactive power (Q_1)	Float	VAR	R
30517	1	2	Min. collective reactive power (Q_{tot})	Float	VAR	R
30519	1	2	Min. collective power factor	Float	-	R
30521	1	2	Min. amplitude voltage unbalance	Float	%	R
30523	1	2	Min. amplitude current unbalance	Float	%	R
30525	1	2	Min. voltage unbalance	Float	%	R
30527	1	2	Min. current unbalance	Float	%	R
30529	1	2	Min. neutral current	Float	A	R
30531	1	2	Min. In_Mod1	Float	A	R
30533	1	2	Min. I5_Mod1	Float	A	R
30535	1	2	Min. I6_Mod1	Float	A	R
30537	1	2	Min. In_Mod2	Float	A	R
30539	1	2	Min. I5_Mod2	Float	A	R
30541	1	2	Min. I6_Mod2	Float	A	R
30543	1	2	Min. cos φ	Float	%	R
30545	1	2	Flag aggregation stage n	metering-flag	%	R

Current values file 2

Offset FC 0x03 FC 0x04	File	Number of registers	Name	Format	Unit	Access
31001	2	2	Time stamp aggregation stage n	Time-stamp32	s	R
31005	2	2	Voltage PH-N L1	Float	V	R
31007	2	2	Voltage PH-N L2	Float	V	R
31009	2	2	Voltage PH-N L3	Float	V	R
31011	2	2	Voltage PH-PH L1-L2	Float	V	R
31013	2	2	Voltage PH-PH L2-L3	Float	V	R
31015	2	2	Voltage PH-PH L3-L1	Float	V	R
31017	2	2	Current L1	Float	A	R
31019	2	2	Current L2	Float	A	R
31021	2	2	Current L3	Float	A	R
31023	2	2	Apparent power L1	Float	VA	R
31025	2	2	Apparent power L2	Float	VA	R
31027	2	2	Apparent power L3	Float	VA	R
31029	2	2	Active power L1	Float	W	R
31031	2	2	Active power L2	Float	W	R

Offset FC 0x03 FC 0x04	File	Number of registers	Name	Format	Unit	Access
31033	2	2	Active power L3	Float	W	R
31041	2	2	Power factor L1	Float	-	R
31043	2	2	Power factor L2	Float	-	R
31045	2	2	Power factor L3	Float	-	R
31047	2	2	THD voltage L1	Float	%	R
31049	2	2	THD voltage L2	Float	%	R
31051	2	2	THD voltage L3	Float	%	R
31053	2	2	THD current L1	Float	%	R
31055	2	2	THD current L2	Float	%	R
31057	2	2	THD current L3	Float	%	R
31059	2	2	THD voltage L12	Float	%	R
31061	2	2	THD voltage L23	Float	%	R
31063	2	2	THD voltage L31	Float	%	R
31065	2	2	Reactive power L1 (Q_1)	Float	VAR	R
31067	2	2	Reactive power L2 (Q_1)	Float	VAR	R
31069	2	2	Reactive power L3 (Q_1)	Float	VAR	R
31071	2	2	Reactive power L1 (Q_{tot})	Float	VAR	R
31073	2	2	Reactive power L2 (Q_{tot})	Float	VAR	R
31075	2	2	Reactive power L3 (Q_{tot})	Float	VAR	R
31077	2	2	Cos φ_{L1}	Float	-	R
31079	2	2	Cos φ_{L2}	Float	-	R
31081	2	2	Cos φ_{L3}	Float	-	R
31083	2	2	Distortion current L1	Float	A	R
31085	2	2	Distortion current L2	Float	A	R
31087	2	2	Distortion current L3	Float	A	R
31089	2	2	Voltage system angle U_{L1}-U_{L1}	Float	°	R
31091	2	2	Voltage system angle U_{L1}-U_{L2}	Float	°	R
31093	2	2	Voltage system angle U_{L1}-U_{L3}	Float	°	R
31095	2	2	Phase angle φ_{L1}	Float	°	R
31097	2	2	Phase angle φ_{L2}	Float	°	R
31099	2	2	Phase angle φ_{L3}	Float	°	R
31101	2	2	Frequency	Float	Hz	R
31103	2	2	Average voltage PH-N	Float	V	R
31105	2	2	Average voltage PH-PH	Float	V	R
31107	2	2	Average current	Float	A	R
31109	2	2	Collective apparent power	Float	VA	R
31111	2	2	Collective active power	Float	W	R
31115	2	2	Collective reactive power (Q_1)	Float	VAR	R
31117	2	2	Collective reactive power (Q_{tot})	Float	VAR	R
31119	2	2	Collective power factor	Float	–	R

Offset FC 0x03 FC 0x04	File	Number of registers	Name	Format	Unit	Access
31121	2	2	Amplitude voltage unbalance	Float	%	R
31123	2	2	Amplitude current unbalance	Float	%	R
31125	2	2	Voltage unbalance	Float	%	R
31127	2	2	Current unbalance	Float	%	R
31129	2	2	Neutral current	Float	A	R
31131	1	2	In_Mod1	Float	A	R
31133	1	2	I5_Mod1	Float	A	R
31135	1	2	I6_Mod1	Float	A	R
31137	1	2	In_Mod2	Float	A	R
31139	1	2	I5_Mod2	Float	A	R
31141	1	2	I6_Mod2	Float	A	R
31143	2	2	Cos φ	Float	%	R
31145	2	2	Flag aggregation stage n	metering-flag	%	R

Maximum values file 2

Offset FC 0x03 FC 0x04	File	Number of registers	Name	Format	Unit	Access
31201	2	2	Time stamp aggregation stage n	Time-stamp32	s	R
31205	2	2	Max. voltage PH-N L1	Float	V	R
31207	2	2	Max. voltage PH-N L2	Float	V	R
31209	2	2	Max. voltage PH-N L3	Float	V	R
31211	2	2	Max. voltage PH-PH L1-L2	Float	V	R
31213	2	2	Max. voltage PH-PH L2-L3	Float	V	R
31215	2	2	Max. voltage PH-PH L3-L1	Float	V	R
31217	2	2	Max. current L1	Float	A	R
31219	2	2	Max. current L2	Float	A	R
31221	2	2	Max. current L3	Float	A	R
31223	2	2	Max. apparent power L1	Float	VA	R
31225	2	2	Max. apparent power L2	Float	VA	R
31227	2	2	Max. apparent power L3	Float	VA	R
31229	2	2	Max. active power L1	Float	W	R
31231	2	2	Max. active power L2	Float	W	R
31233	2	2	Max. active power L3	Float	W	R
31241	2	2	Max. power factor L1	Float	-	R
31243	2	2	Max. power factor L2	Float	-	R
31245	2	2	Max. power factor L3	Float	-	R
31247	2	2	Max. THD voltage L1	Float	%	R

Offset FC 0x03 FC 0x04	File	Number of registers	Name	Format	Unit	Access
31249	2	2	Max. THD voltage L2	Float	%	R
31251	2	2	Max. THD voltage L3	Float	%	R
31253	2	2	Max. THD current L1	Float	%	R
31255	2	2	Max. THD current L2	Float	%	R
31257	2	2	Max. THD current L3	Float	%	R
31259	2	2	Max. THD voltage L12	Float	%	R
31261	2	2	Max. THD voltage L23	Float	%	R
31263	2	2	Max. THD voltage L31	Float	%	R
31265	2	2	Max. reactive power L1 (Q_1)	Float	VAR	R
31267	2	2	Max. reactive power L2 (Q_1)	Float	VAR	R
31269	2	2	Max. reactive power L3 (Q_1)	Float	VAR	R
31271	2	2	Max. reactive power L1 (Q_{tot})	Float	VAR	R
31273	2	2	Max. reactive power L2 (Q_{tot})	Float	VAR	R
31275	2	2	Max. reactive power L3 (Q_{tot})	Float	VAR	R
31277	2	2	Max. cos φ_{L1}	Float	-	R
31279	2	2	Max. cos φ_{L2}	Float	-	R
31281	2	2	Max. cos φ_{L3}	Float	-	R
31283	2	2	Max. distortion current L1	Float	A	R
31285	2	2	Max. distortion current L2	Float	A	R
31287	2	2	Max. distortion current L3	Float	A	R
31289	2	2	Max. voltage system angle U_{L1}-U_{L1}	Float	°	R
31291	2	2	Max. voltage system angle U_{L1}-U_{L2}	Float	°	R
31293	2	2	Max. voltage system angle U_{L1}-U_{L3}	Float	°	R
31295	2	2	Max. phase angle φ_{L1}	Float	°	R
31297	2	2	Max. phase angle φ_{L2}	Float	°	R
31299	2	2	Max. phase angle φ_{L3}	Float	°	R
31301	2	2	Max. frequency	Float	Hz	R
31303	2	2	Max. average voltage PH-N	Float	V	R
31305	2	2	Max. average voltage PH-PH	Float	V	R
31307	2	2	Max. average current	Float	A	R
31309	2	2	Max. collective apparent power	Float	VA	R
31311	2	2	Max. collective active power	Float	W	R
31315	2	2	Max. collective reactive power (Q_1)	Float	VAR	R
31317	2	2	Max. collective reactive power (Q_{tot})	Float	VAR	R
31319	2	2	Max. collective power factor	Float	-	R
31321	2	2	Max. amplitude voltage unbalance	Float	%	R
31323	2	2	Max. amplitude current unbalance	Float	%	R
31325	2	2	Max. voltage unbalance	Float	%	R
31327	2	2	Max. current unbalance	Float	%	R
31329	2	2	Max. neutral current	Float	A	

Offset FC 0x03 FC 0x04	File	Number of registers	Name	Format	Unit	Access
31331	1	2	Max. In_Mod1	Float	A	R
31333	1	2	Max. I5_Mod1	Float	A	R
31335	1	2	Max. I6_Mod1	Float	A	R
31337	1	2	Max. In_Mod2	Float	A	R
31339	1	2	Max. I5_Mod2	Float	A	R
31341	1	2	Max. I6_Mod2	Float	A	R
31343	2	2	Max. cos φ	Float	%	R
31345	2	2	Flag aggregation stage n	metering-flag	%	R

Minimum values file 2

Offset FC 0x03 FC 0x04	File	Number of registers	Name	Format	Unit	Access
31401	2	2	Time stamp aggregation stage n	Time-stamp32	s	R
31405	2	2	Min. voltage PH-N L1	Float	V	R
31407	2	2	Min. voltage PH-N L2	Float	V	R
31409	2	2	Min. voltage PH-N L3	Float	V	R
31411	2	2	Min. voltage PH-PH L1-L2	Float	V	R
31413	2	2	Min. voltage PH-PH L2-L3	Float	V	R
31415	2	2	Min. voltage PH-PH L3-L1	Float	V	R
31417	2	2	Min. current L1	Float	A	R
31419	2	2	Min. current L2	Float	A	R
31421	2	2	Min. current L3	Float	A	R
31423	2	2	Min. apparent power L1	Float	VA	R
31425	2	2	Min. apparent power L2	Float	VA	R
31427	2	2	Min. apparent power L3	Float	VA	R
31429	2	2	Min. active power L1	Float	W	R
31431	2	2	Min. active power L2	Float	W	R
31433	2	2	Min. active power L3	Float	W	R
31441	2	2	Min. power factor L1	Float	-	R
31443	2	2	Min. power factor L2	Float	-	R
31445	2	2	Min. power factor L3	Float	-	R
31447	2	2	Min. THD voltage L1	Float	%	R
31449	2	2	Min. THD voltage L2	Float	%	R
31451	2	2	Min. THD voltage L3	Float	%	R
31453	2	2	Min. THD current L1	Float	%	R
31455	2	2	Min. THD current L2	Float	%	R
31457	2	2	Min. THD current L3	Float	%	R

Offset FC 0x03 FC 0x04	File	Number of registers	Name	Format	Unit	Access
31459	2	2	Min. THD voltage L12	Float	%	R
31461	2	2	Min. THD voltage L23	Float	%	R
31463	2	2	Min. THD voltage L31	Float	%	R
31465	2	2	Min. reactive power L1 (Q_1)	Float	VAR	R
31467	2	2	Min. reactive power L2 (Q_1)	Float	VAR	R
31469	2	2	Min. reactive power L3 (Q_1)	Float	VAR	R
31471	2	2	Min. reactive power L1 (Q_{tot})	Float	VAR	R
31473	2	2	Min. reactive power L2 (Q_{tot})	Float	VAR	R
31475	2	2	Min. reactive power L3 (Q_{tot})	Float	VAR	R
31477	2	2	Min. cos φL1	Float	-	R
31479	2	2	Min. cos φL2	Float	-	R
31481	2	2	Min. cos φL3	Float	-	R
31483	2	2	Min. distortion current L1	Float	A	R
31485	2	2	Min. distortion current L2	Float	A	R
31487	2	2	Min. distortion current L3	Float	A	R
31489	2	2	Min. voltage system angle U_{L1}-U_{L1}	Float	°	R
31491	2	2	Min. voltage system angle U_{L1}-U_{L2}	Float	°	R
31493	2	2	Min. voltage system angle U_{L1}-U_{L3}	Float	°	R
31495	2	2	Max. phase angle φ_{L1}	Float	°	R
31497	2	2	Min. phase angle φ_{L2}	Float	°	R
31499	2	2	Min. phase angle φ_{L3}	Float	°	R
31501	2	2	Min. frequency	Float	Hz	R
31503	2	2	Min. average voltage PH-N	Float	V	R
31505	2	2	Min. average voltage PH-PH	Float	V	R
31507	2	2	Min. average current	Float	A	R
31509	2	2	Min. collective apparent power	Float	VA	R
31511	2	2	Min. collective active power	Float	W	R
31515	2	2	Min. collective reactive power (Q_1)	Float	VAR	R
31517	2	2	Min. collective reactive power (Q_{tot})	Float	VAR	R
31519	2	2	Min. collective power factor	Float	-	R
31521	2	2	Min. amplitude voltage unbalance	Float	%	R
31523	2	2	Min. amplitude current unbalance	Float	%	R
31525	2	2	Min. voltage unbalance	Float	%	R
31527	2	2	Min. current unbalance	Float	%	R
31529	2	2	Min. neutral current	Float	A	
31531	1	2	Min. In_Mod1	Float	A	R
31533	1	2	Min. I5_Mod1	Float	A	R
31535	1	2	Min. I6_Mod1	Float	A	R
31537	1	2	Min. In_Mod2	Float	A	R
31539	1	2	Min. I5_Mod2	Float	A	R

Offset FC 0x03 FC 0x04	File	Number of registers	Name	Format	Unit	Access
31541	1	2	Min. I6_Mod2	Float	A	R
31543	2	2	Min. cos φ	Float	%	R
31545	2	2	Flag aggregation stage n	metering-flag	%	R

A.1.16 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 to all the configuration settings listed below.

Table A-19 Configuration settings

Offset	Number of registers	Name	Format	Unit	Value range	Access
49999	2	Rated current nominal measurement	Unsigned long	A	1 ... 99999	RW
50001	2	Connection type	Unsigned long	-	0 = 3P4W 1 = 3P3W 2 = 3P4Wb 3 = 3P3Wb 4 = 1P2W	RW
50003	2	Voltage transformer Yes/No	Unsigned long	-	0 = No 1 = Yes	RW
50005	2	Primary voltage	Unsigned long	V	1 ... 999999	RW
50007	2	Secondary voltage	Unsigned long	V	1 ... 690	RW
50011	2	Primary current	Unsigned long	V	1 ... 999999	RW
50013	2	Secondary current	Unsigned long	-	1 = 1 A 5 = 5 A	RW
50019	2	Zero point suppression	Float	%	0.0 ... 10.0	RW
50021	2	Load profile demand period	Float	Unsigned long	1;2;3;4;5;6;10;12;15;20;30;60	RW

Offset	Number of registers	Name	Format	Unit	Value range	Access
50047	2	Dialog language	Unsigned long	-	0 = German 1 = English 2= Portuguese 3 = Turkish 4 = Spanish 5 = Italian 6 = Russian 7 = French 8 = Chinese 9 = Polish	RW
50049	2	Phase identifier IEC/UL	Unsigned long	-	0 = IEC 1 = US	RW
50051	2	Universal counter 1 source	Unsigned long	-	0 ... 15 0 = digital input 1 = digital output 2 = comb. limit 3 = limit0 4 = limit1 5 = limit2 6 = limit3 7 = limit4 8 = limit5 9 = limit6 10 = limit7 11 = limit8 12 = limit9 13 = limit10 14 = limit11 15 = deactivated	RW
50057	2	Display backlight level	Unsigned long	%	0 ... 3	RW
50059	2	Display backlight dimmed	Unsigned long	%	0 ... 3	RW
50061	2	Time until dimmed	Unsigned long	min	0 ... 99	RW
50063	2	Limit 0 ON/OFF	–	Unsigned long	0 ... 1 0 = Off 1 = On	RW
50065	2	Limit 0 Hysteresis	%	Float	0.0 ... 20.0	RW
50067	2	Limit 0 Pickup delay	s	Unsigned long	0 ... 10	RW
50069		Reserve				
50071	2	Limit 0 Index of data list	–	Unsigned long	See Value ranges for offset 50071 (Page 192)	RW
50073	2	Limit 0 Source	–	Float	–	RW

Offset	Number of registers	Name	Format	Unit	Value range	Access
50075	2	Limit 0 Type ≥/<	–	Unsigned long	0 ... 1 0 = greater than 1 = smaller than	RW
50077	2	Limit 1 ON/OFF	–	Unsigned long	0 ... 1 0 = Off 1 = On	RW
50079	2	Limit 1 Hysteresis	%	Float	0.0 ... 20.0	RW
50081	2	Limit 1 Pickup delay	s	Unsigned long	0 ... 10	RW
50083		Reserve				
50085	2	Limit 1 Index of data list	–	Unsigned long	0 ... 247 (see limit 0)	RW
50087	2	Limit 1 Source	–	Float	–	RW
50089	2	Limit 1 Type ≥/<	–	Unsigned long	0 ... 1 0 = greater than 1 = smaller than	RW
50091	2	Limit 2 ON/OFF	–	Unsigned long	0 ... 1 0 = Off 1 = On	RW
50093	2	Limit 2 Hysteresis	%	Float	0.0 ... 20.0	RW
50095	2	Limit 2 Pickup delay	s	Unsigned long	0 ... 10	RW
50097		Reserve				
50099	2	Limit 2 Index of data list	–	Unsigned long	0 ... 247 (see limit 0)	RW

Offset	Number of registers	Name	Format	Unit	Value range	Access
50101	2	Limit 2 Source	–	Float	–	RW
50103	2	Limit 2 Type ≥/<	–	Unsigned long	0 ... 1 0 = greater than 1 = smaller than	RW
50105	2	Limit 3 ON/OFF	–	Unsigned long	0 ... 1 0 = Off 1 = On	RW
50107	2	Limit 3 Hysteresis	%	Float	0.0 ... 20.0	RW
50109	2	Limit 3 Pickup delay	s	Unsigned long	0 ... 10	RW
50111		Reserve				
50113	2	Limit 3 Index of data list	–	Unsigned long	0 ... 247 (see limit 0)	RW
50115	2	Limit 3 Source	–	Float	–	RW
50117	2	Limit 3 Type ≥/<	–	Unsigned long	0 ... 1 0 = greater than 1 = smaller than	RW
50119	2	Limit 4 ON/OFF	–	Unsigned long	0 ... 1 0 = Off 1 = On	RW
50121	2	Limit 4 Hysteresis	%	Float	0.0 ... 20.0	RW
50123	2	Limit 4 Pickup delay	s	Unsigned long	0 ... 10	RW

Offset	Number of registers	Name	Format	Unit	Value range	Access
50125		Reserve				
50127	2	Limit 4 Index of data list	–	Unsigned long	0 ... 247 (see limit 0)	RW
50129	2	Limit 4 Source	–	Float	–	RW
50131	2	Limit 4 Type ≥/<	–	Unsigned long	0 ... 1 0 = greater than 1 = smaller than	RW
50133	2	Limit 5 ON/OFF	–	Unsigned long	0 ... 1 0 = Off 1 = On	RW
50135	2	Limit 5 Hysteresis	%	Float	0.0 ... 20.0	RW
50137	2	Limit 5 Pickup delay	s	Unsigned long	0 ... 10	RW
50139		Reserve				
50141	2	Limit 5 Index of data list	–	Unsigned long	0 ... 247 (see limit 0)	RW
50143	2	Limit 5 Source	–	Float	0 ... N	RW
50145	2	Limit 5 Type ≥/<	–	Unsigned long	0 ... 1 0 = greater than 1 = smaller than	RW
50147	2	Limit 6 ON/OFF	–	Unsigned long	0 ... 1 0 = Off 1 = On	RW
50149	2	Limit 6 Hysteresis	%	Float	0.0 ... 20.0	RW
50151	2	Limit 6 Pickup delay	s	Unsigned long	0 ... 10	RW
50153		Reserve				
50155	2	Limit 6 Index of data list	–	Unsigned long	0 ... 247 (see limit 0)	RW
50157	2	Limit 6 Source	–	Float	–	RW
50159	2	Limit 6 Type ≥/<	–	Unsigned long	0 ... 1 0 = greater than 1 = smaller than	RW
50161	2	Limit 7 ON/OFF	–	Unsigned long	0 ... 1 0 = Off 1 = On	RW
50163	2	Limit 7 Hysteresis	%	Float	0.0 ... 20.0	RW
50167		Reserve				
50169	2	Limit 7 Index of data list	–	Unsigned long	0 ... 247 (see limit 0)	RW
50171	2	Limit 7 Source	–	Float	–	RW
50173	2	Limit 7 Type ≥/<	–	Unsigned long	0 ... 1 0 = greater than 1 = smaller than	RW
50175	2	Limit 8 ON/OFF	–	Unsigned long	0 ... 1 0 = Off 1 = On	RW
50177	2	Limit 8 Hysteresis	%	Float	0.0 ... 20.0	RW
50179	2	Limit 8 Pickup delay	s	Unsigned long	0 ... 10	RW
50181		Reserve				
50183	2	Limit 8 Index of data list	–	Unsigned long	0 ... 247 (see limit 0)	RW

Offset	Number of registers	Name	Format	Unit	Value range	Access
50185	2	Limit 8 Source	–	Float	–	RW
50187	2	Limit 8 Type ≥/<	–	Unsigned long	0 ... 1 0 = greater than 1 = smaller than	RW
50189	2	Limit 9 ON/OFF	–	Unsigned long	0 ... 1 0 = Off 1 = On	RW
50191	2	Limit 9 Hysteresis	%	Float	0.0 ... 20.0	RW
50193	2	Limit 9 Pickup delay	s	Unsigned long	0 ... 10	RW
50195		Reserve				
50197	2	Limit 9 Index of data list	–	Unsigned long	0 ... 247 (see limit 0)	RW
50199	2	Limit 9 Source	–	Float	–	RW

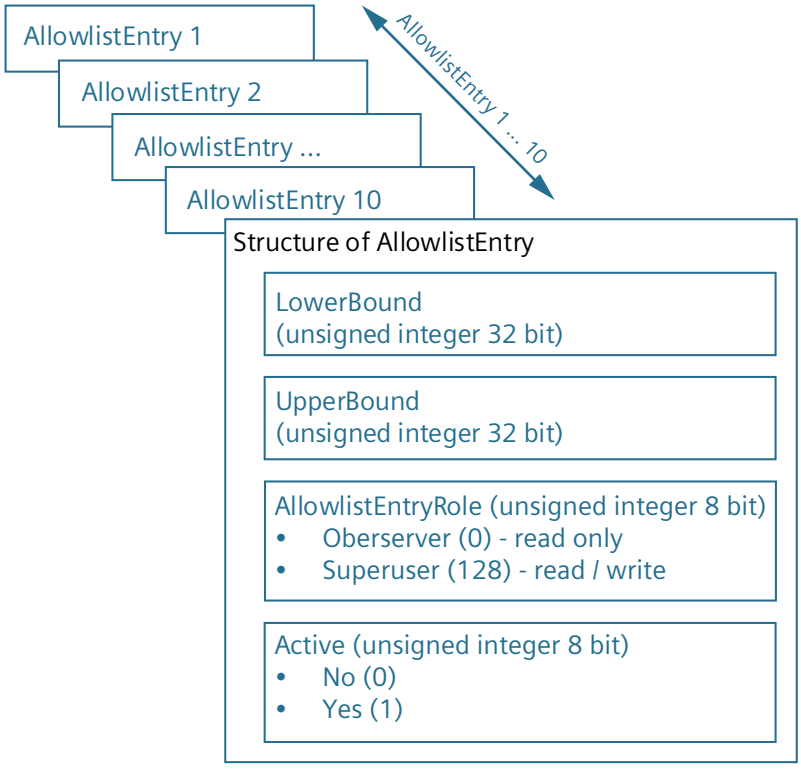
Offset	Number of registers	Name	Format	Unit	Value range	Access
50201	2	Limit 9 Type ≥/<	–	Unsigned long	0 ... 1 0 = greater than 1 = smaller than	RW
50203	2	Limit 10 ON/OFF	–	Unsigned long	0 ... 1 0 = Off 1 = On	RW
50205	2	Limit 10 Hysteresis	%	Float	0.0 ... 20.0	RW
50207	2	Limit 10 Pickup delay	s	Unsigned long	0 ... 10	RW
50209		Reserve				
50211	2	Limit 10 Index of data list	–	Unsigned long	0 ... 247 (see limit 0)	RW
50213	2	Limit 10 Source	–	Float	–	RW
50215	2	Limit 10 Type ≥/<	–	Unsigned long	0 ... 1 0 = greater than 1 = smaller than	RW
50217	2	Limit 11 ON/OFF	–	Unsigned long	0 ... 1 0 = Off 1 = On	RW
50219	2	Limit 11 Hysteresis	%	Float	0.0 ... 20.0	RW
50221	2	Limit 11 Pickup delay	s	Unsigned long	0 ... 10	RW
50223		Reserve				
50225	2	Limit 11 Index of data list	–	Unsigned long	0 ... 247 (see limit 0)	RW
50227	2	Limit 11 Source	–	Float	–	RW
50229	2	Limit 11 Type ≥/<	–	Unsigned long	0 ... 1 0 = greater than 1 = smaller than	RW
50235	2	Time zone	Long	min	Time zone* See description of value range (time zone) at the end of the table.	RW

Offset	Number of registers	Name	Format	Unit	Value range	Access
50241	2	Universal counter_0_Port	Unsigned long	-	Byte 2 = port Byte 2 = 0 - 11 Byte 3 = bit Byte 3 = 0 - 7	RW
50243	2	Invert current L1	Unsigned long	-	0 = No 1 = Yes	RW
50245	2	Invert current L2	Unsigned long	-	0 = No 1 = Yes	RW
50247	2	Invert current L3	Unsigned long	-	0 = No 1 = Yes	RW
50249		Measuring threshold for operating hours counter	Float	% of I_n	0 - 10	RW
50251	2	Universal counter 2 source	Unsigned long	-	0 ... 15 0 = digital input 1 = digital output 2 = comb. limit 3 = limit0 4 = limit1 5 = limit2 6 = limit3 7 = limit4 8 = limit5 9 = limit6 10 = limit7 11 = limit8 12 = limit9 13 = limit10 14 = limit11 15 = deactivated	RW
50253		Universal counter 2 port	Unsigned long	-	Byte 2 = port Byte 2 = 0-11 Byte 3 = bit Byte 3 = 0-7	RW
50257	2	SNTP IP address	Unsigned long	-	0 ... 0xFFFFFFFF	RW
50259	2	SNTP mode	Unsigned long	-	0 = SNTP off 1 = SNTP active	RW
50261	2	Default menu No.	Unsigned long	-	DISPLAYED MENU NUMBER: 1 - 23	RW
50263	2	Timeout for returning to default menu	Unsigned long	-	0, [10 ... 3600]	RW

Offset	Number of registers	Name	Format	Unit	Value range	Access
50265	2	DHCP Yes/No	Unsigned long	-	0 = off 1 = on	RW
50315		Show neutral current in the display	Unsigned long	-	0 = Auto 1= Calculated 2 = Do not display	RW
50317	50	IP filter (allowlist)	Allowlist*	-	-	RW

*) Structure and description of the allowlist format:

Allowlist (includes 10 AllowlistEntries)



*Value range (time zone) for offset 50235

Format name	Value		Format name	Value		Format name	Value
Africa_Abidjan	0		Africa_Djibouti	18		Africa_Malabo	36
Africa_Accra	1		Africa_Douala	19		Africa_Maputo	37
Africa_Addis_Ababa	2		Africa_El_Aaiun	20		Africa_Maseru	38
Africa_Algiers	3		Africa_Freetown	21		Africa_Mbabane	39
Africa_Asmara	4		Africa_Gaborone	22		Africa_Mogadishu	40
Africa_Bamako	5		Africa_Harare	23		Africa_Monrovia	41
Africa_Bangui	6		Africa_Johannesburg	24		Africa_Nairobi	42
Africa_Banjul	7		Africa_Juba	25		Africa_Ndjamena	43
Africa_Bissau	8		Africa_Kampala	26		Africa_Niamey	44
Africa_Blantyre	9		Africa_Khartoum	27		Africa_Nouakchott	45
Africa_Brazzaville	10		Africa_Kigali	28		Africa_Ouagadougou	46
Africa_Bujumbura	11		Africa_Kinshasa	29		Africa_Porto_Novo	47
Africa_Cairo	12		Africa_Lagos	30		Africa_Sao_Tome	48
Africa_Casablanca	13		Africa_Libreville	31		Africa_Tripoli	49
Africa_Ceuta	14		Africa_Lome	32		Africa_Tunis	50
Africa_Conakry	15		Africa_Luanda	33		Africa_Windhoek	51
Africa_Dakar	16		Africa_Lubumbashi	34			
Africa_Dar_es_Salaam	17		Africa_Lusaka	35			

Format name	Value	Format name	Value	Format name	Value
America_Adak	52	America_El_Salvador	101	America_Nassau	150
America_Anchorage	53	America_Fort_Nelson	102	America_New_York	151
America_Anguilla	54	America_Fortaleza	103	America_Nipigon	152
America_Antigua	55	America_Glace_Bay	104	America_Nome	153
America_Araguaina	56	America_Goose_Bay	105	America_Noronha	154
America_Argentina_Buenos_Aires	57	America_Grand_Turk	106	America_North_Dakota_Beulah	155
America_Argentina_Catamarca	58	America_Grenada	107	America_North_Dakota_Center	156
America_Argentina_Cordoba	59	America_Guadeloupe	108	America_North_Dakota_New_Salem	157
America_Argentina_Jujuy	60	America_Guatemala	109	America_Nuuk	158
America_Argentina_La_Rioja	61	America_Guayaquil	110	America_Ojinaga	159
America_Argentina_Mendoza	62	America_Guyana	111	America_Panama	160
America_Argentina_Rio_Gallegos	63	America_Halifax	112	America_Pangnirtung	161
America_Argentina_Salta	64	America_Havana	113	America_Paramaribo	162
America_Argentina_San_Juan	65	America_Hermosillo	114	America_Phoenix	163
America_Argentina_San_Luis	66	America_Indiana_Indianapolis	115	America_Port_au_Prince	164
America_Argentina_Tucuman	67	America_Indiana_Knox	116	America_Port_of_Spain	165
America_Argentina_Ushuaia	68	America_Indiana_Marengo	117	America_Porto_Velho	166
America_Aruba	69	America_Indiana_Petersburg	118	America_Puerto_Rico	167
America_Asuncion	70	America_Indiana_Tell_City	119	America_Punta_Arenas	168
America_Atikokan	71	America_Indiana_Vevay	120		
America_Bahia	72	America_Indiana_Vincennes	121	America_Rainy_River	169
America_Bahia_Banderas	73	America_Indiana_Winamac	122	America_Rankin_Inlet	170
America_Barbados	74	America_Inuvik	123	America_Recife	171
America_Belem	75	America_Iqaluit	124	America_Regina	172
America_Belize	76	America_Jamaica	125	America_Resolute	173
America_Blanc_Sablon	77	America_Juneau	126	America_Rio_Branco	174
America_Boa_Vista	78	America_Kentucky_Louisville	127	America_Santarem	175
America_Bogota	79	America_Kentucky_Monticello	128	America_Santiago	176
America_Boise	80	America_Kralendijk	129	America_Santo_Domingo	177
America_Cambridge_Bay	81	America_La_Paz	130	America_Sao_Paulo	178
America_Campo_Grande	82	America_Lima	131	America_Scoresbysund	179
America_Cancun	83	America_Los_Angeles	132	America_Sitka	180
America_Caracas	84	America_Lower_Princes	133	America_St_Barthelemy	181
America_Cayenne	85	America_Maceio	134	America_St_Johns	182
America_Cayman	86	America_Managua	135	America_St_Kitts	183
America_Chicago	87	America_Manaus	136	America_St_Lucia	184
America_Chihuahua	88	America_Marigot	137	America_St_Thomas	185

Format name	Value		Format name	Value		Format name	Value
America_Costa_Rica	89		America_Martinique	138		America_St_Vincent	186
America_Creston	90		America_Matamoros	139		America_Swift_Current	187
America_Cuiaba	91		America_Mazatlan	140		America_Tegucigalpa	188
America_Curacao	92		America_Menominee	141		America_Thule	189
America_Danmarkshavn	93		America_Merida	142		America_Thunder_Bay	190
America_Dawson	94		America_Metlakatla	143		America_Tijuana	191
America_Dawson_Creek	95		America_Mexico_City	144		America_Toronto	192
America_Denver	96		America_Miquelon	145		America_Tortola	193
America_Detroit	97		America_Moncton	146		America_Vancouver	194
America_Dominica	98		America_Monterrey	147		America_Whitehorse	195
America_Edmonton	99		America_Montevideo	148		America_Winnipeg	196
America_Eirunepe	100		America_Montserrat	149		America_Yakutat	197
						America_Yellowknife	198
Antarctica_Casey	199		Antarctica_Mawson	203		Antarctica_Syowa	207
Antarctica_Davis	200		Antarctica_McMurdo	204		Antarctica_Troll	208
Antarctica_DumontDUrville	201		Antarctica_Palmer	205		Antarctica_Vostok	209
Antarctica_Macquarie	202		Antarctica_Rothera	206			
Arctic_Longyearbyen	210						

Format name	Value		Format name	Value		Format name	Value
Asia_Aden	211		Asia_Hong_Kong	239		Asia_Pyongyang	267
Asia_Almaty	212		Asia_Hovd	240		Asia_Qatar	268
Asia_Amman	213		Asia_Irkutsk	241		Asia_Qostanay	269
Asia_Anadyr	214		Asia_Jakarta	242		Asia_Qyzylorda	270
Asia_Aqtau	215		Asia_Jayapura	243		Asia_Riyadh	271
Asia_Aqtobe	216		Asia_Jerusalem	244		Asia_Sakhalin	272
Asia_Ashgabat	217		Asia_Kabul	245		Asia_Samarkand	273
Asia_Atyrau	218		Asia_Kamchatka	246		Asia_Seoul	274
Asia_Baghdad	219		Asia_Karachi	247		Asia_Shanghai	275
Asia_Bahrain	220		Asia_Kathmandu	248		Asia_Singapore	276
Asia_Baku	221		Asia_Khandyga	249		Asia_Srednekolymsk	277
Asia_Bangkok	222		Asia_Kolkata	250		Asia_Taipei	278
Asia_Barnaul	223		Asia_Krasnoyarsk	251		Asia_Tashkent	279
Asia_Beirut	224		Asia_Kuala_Lumpur	252		Asia_Tbilisi	280
Asia_Bishkek	225		Asia_Kuching	253		Asia_Tehran	281
Asia_Brunei	226		Asia_Kuwait	254		Asia_Thimphu	282
Asia_Chita	227		Asia_Macau	255		Asia_Tokyo	283
Asia_Choibalsan	228		Asia_Magadan	256		Asia_Tomsk	284
Asia_Colombo	229		Asia_Makassar	257		Asia_Ulaanbaatar	285
Asia_Damascus	230		Asia_Manila	258		Asia_Urumqi	286
Asia_Dhaka	231		Asia_Muscat	259		Asia_Ust_Nera	287
Asia_Dili	232		Asia_Nicosia	260		Asia_Vientiane	288
Asia_Dubai	233		Asia_Novokuznetsk	261		Asia_Vladivostok	289
Asia_Dushanbe	234		Asia_Novosibirsk	262		Asia_Yakutsk	290
Asia_Famagusta	235		Asia_Omsk	263		Asia_Yangon	291
Asia_Gaza	236		Asia_Oral	264		Asia_Yekaterinburg	292
Asia_Hebron	237		Asia_Phnom_Penh	265		Asia_Yerevan	293
Asia_Ho_Chi_Minh	238		Asia_Pontianak	266			
Atlantic_Azores	294		Atlantic_Cape_Verde	297		Atlantic_Reykjavik	300
Atlantic_Bermuda	295		Atlantic_Faroe	298		Atlantic_South_Georgia	301
Atlantic_Canary	296		Atlantic_Madeira	299		Atlantic_St_Helena	302
						Atlantic_Stanley	303
Australia_Adelaide	304		Australia_Eucla	308		Australia_Melbourne	312
Australia_Brisbane	305		Australia_Hobart	309		Australia_Perth	313
Australia_Broken_Hill	306		Australia_Lindeman	310		Australia_Sydney	314
Australia_Darwin	307		Australia_Lord_Howe	311			

Format name	Value		Format name	Value		Format name	Value
Europe_Amsterdam	315		Europe_Kaliningrad	335		Europe_San_Marino	355
Europe_Andorra	316		Europe_Kiev	336		Europe_Sarajevo	356
Europe_Astrakhan	317		Europe_Kirov	337		Europe_Saratov	357
Europe_Athens	318		Europe_Lisbon	338		Europe_Simferopol	358
Europe_Belgrade	319		Europe_Ljubljana	339		Europe_Skopje	359
Europe_Berlin	320		Europe_London	340		Europe_Sofia	360
Europe_Bratislava	321		Europe_Luxembourg	341		Europe_Stockholm	361
Europe_Brussels	322		Europe_Madrid	342		Europe_Tallinn	362
Europe_Bucharest	323		Europe_Malta	343		Europe_Tirane	363
Europe_Budapest	324		Europe_Mariehamn	344		Europe_Ulyanovsk	364
Europe_Busingen	325		Europe_Minsk	345		Europe_Uzhgorod	365
Europe_Chisinau	326		Europe_Monaco	346		Europe_Vaduz	366
Europe_Copenhagen	327		Europe_Moscow	347		Europe_Vatican	367
Europe_Dublin	328		Europe_Oslo	348		Europe_Vienna	368
Europe_Gibraltar	329		Europe_Paris	349		Europe_Vilnius	369
Europe_Guernsey	330		Europe_Podgorica	350		Europe_Volgograd	370
Europe_Helsinki	331		Europe_Prague	351		Europe_Warsaw	371
Europe_Isle_of_Man	332		Europe_Riga	352		Europe_Zagreb	372
Europe_Istanbul	333		Europe_Rome	353		Europe_Zaporozhye	373
Europe_Jersey	334		Europe_Samara	354		Europe_Zurich	374
Indian_Antananarivo	375		Indian_Comoro	379		Indian_Mauritius	383
Indian_Chagos	376		Indian_Kerguelen	380		Indian_Mayotte	384
Indian_Christmas	377		Indian_Mahe	381		Indian_Reunion	385
Indian_Cocos	378		Indian_Maldives	382			
Pacific_Apia	386		Pacific_Guadalcanal	399		Pacific_Pago_Pago	412
Pacific_Auckland	387		Pacific_Guam	400		Pacific_Palau	413
Pacific_Bougainville	388		Pacific_Honolulu	401		Pacific_Pitcairn	414
Pacific_Chatham	389		Pacific_Kiritimati	402		Pacific_Pohnpei	415
Pacific_Chuuk	390		Pacific_Kosrae	403		Pacific_Port_Moresby	416
Pacific_Easter	391		Pacific_Kwajalein	404		Pacific_Rarotonga	417
Pacific_Efate	392		Pacific_Majuro	405		Pacific_Saipan	418
Pacific_Enderbury	393		Pacific_Marquesas	406		Pacific_Tahiti	419
Pacific_Fakaofo	394		Pacific_Midway	407		Pacific_Tarawa	420
Pacific_Fiji	395		Pacific_Nauru	408		Pacific_Tongatapu	421
Pacific_Funafuti	396		Pacific_Niue	409		Pacific_Wake	422
Pacific_Galapagos	397		Pacific_Norfolk	410		Pacific_Wallis	423
Pacific_Gambier	398		Pacific_Noumea	411			
Universal	424						

Offset	Number of registers	Name	Format	Value range	Access
51199	1	DI 0.0 – Action	unsigned short	0 = No action 1 = Pulse input 2 = Tariff switching 4 = Display backlight 6 = Process counting 7 = Copy/Reset 8 = Reset	RW
51200	1	DI 0.0 – Type	unsigned short	0 = edge 1 = pulse	RW
51201	1	DI 0.0 – Unit	unsigned short	0 = kWh_IMPORT 1 = kWh_EXPORT 2 = kvarh_IMPORT 3 = kvarh_EXPORT 4 = CUSTOMIZATION	RW
51202	1	DI 0.0 – Pulses per unit	unsigned short	1-4000	RW
51204	1	DI 0.1 – Action	unsigned short	0 = No action 1 = Pulse input 2 = Tariff switching 4 = Display backlight 6 = Process counting 7 = Copy/Reset 8 = Reset	RW
51205	1	DI 0.1 – Type	unsigned short	0 = edge 1 = pulse	RW
51206	1	DI 0.1 – Unit	unsigned short	0 = kWh_IMPORT 1 = kWh_EXPORT 2 = kvarh_IMPORT 3 = kvarh_EXPORT 4 = CUSTOMIZATION	RW
51207	1	DI 0.1 – Pulses per unit	unsigned short	1-4000	RW
51209	1	DI 4.0 – Action	unsigned short	0 = No action 1 = Pulse input 2 = Tariff switching 4 = Display backlight 6 = Process counting 7 = Copy/Reset 8 = Reset	RW
51210	1	DI 4.0 – Type	unsigned short	0 = edge 1 = pulse	RW

Offset	Number of registers	Name	Format	Value range	Access
51211	1	DI 4.0 – Unit	unsigned short	0 = kWh_IMPORT 1 = kWh_EXPORT 2 = kvarh_IMPORT 3 = kvarh_EXPORT 4 = CUSTOMIZATION	RW
51212	1	DI 4.0 – Pulses per unit	unsigned short	1-4000	RW
51214	1	DI 4.1 – Action	unsigned short	0 = No action 1 = Pulse input 2 = Tariff switching 4 = Display backlight 6 = Process counting 7 = Copy/Reset 8 = Reset	RW
51215	1	DI 4.1 – Type	unsigned short	0 = edge 1 = pulse	RW
51216	1	DI 4.1 – Unit	unsigned short	0 = kWh_IMPORT 1 = kWh_EXPORT 2 = kvarh_IMPORT 3 = kvarh_EXPORT 4 = CUSTOMIZATION	RW
51217	1	DI 4.1 – Pulses per unit	unsigned short	1-4000	RW
51219	1	DI 4.2 – Action	unsigned short	0 = No action 1 = Pulse input 2 = Tariff switching 4 = Display backlight 6 = Process counting 7 = Copy/Reset 8 = Reset	RW
51220	1	DI 4.2 – Type	unsigned short	0 = edge 1 = pulse	RW
51221	1	DI 4.2 – Unit	unsigned short	0 = kWh_IMPORT 1 = kWh_EXPORT 2 = kvarh_IMPORT 3 = kvarh_EXPORT 4 = CUSTOMIZATION	RW
51222	1	DI 4.2 – Pulses per unit	unsigned short	1-4000	RW
51224	1	DI 4.3 – Action	unsigned short	0 = No action 1 = Pulse input 2 = Tariff switching 4 = Display backlight 6 = Process counting 7 = Copy/Reset 8 = Reset	RW
51225	1	DI 4.3 – Type	unsigned short	0 = edge 1 = pulse	RW

Offset	Number of registers	Name	Format	Value range	Access
51226	1	DI 4.3 – Unit	unsigned short	0 = kWh_IMPORT 1 = kWh_EXPORT 2 = kvarh_IMPORT 3 = kvarh_EXPORT 4 = CUSTOMIZATION	RW
51227	1	DI 4.3 – Pulses per unit	unsigned short	1-4000	RW
51229	1	DI 8.0 – Action	unsigned short	0 = No action 1 = Pulse input 2 = Tariff switching 4 = Display backlight 6 = Process counting 7 = Copy/Reset 8 = Reset	RW
51230	1	DI 8.0 – Type	unsigned short	0 = edge 1 = pulse	RW
51231	1	DI 8.0 – Unit	unsigned short	0 = kWh_IMPORT 1 = kWh_EXPORT 2 = kvarh_IMPORT 3 = kvarh_EXPORT 4 = CUSTOMIZATION	RW
51232	1	DI 8.0 – Pulses per unit	unsigned short	1-4000	RW
51234	1	DI 8.1 – Action	unsigned short	0 = No action 1 = Pulse input 2 = Tariff switching 4 = Display backlight 6 = Process counting 7 = Copy/Reset 8 = Reset	RW
51235	1	DI 8.1 – Type	unsigned short	0 = edge 1 = pulse	RW
51236	1	DI 8.1 – Unit	unsigned short	0 = kWh_IMPORT 1 = kWh_EXPORT 2 = kvarh_IMPORT 3 = kvarh_EXPORT 4 = CUSTOMIZATION	RW
51237	1	DI 8.1 – Pulses per unit	unsigned short	1-4000	RW
51239	1	DI 8.2 – Action	unsigned short	0 = No action 1 = Pulse input 2 = Tariff switching 4 = Display backlight 6 = Process counting 7 = Copy/Reset 8 = Reset	RW
51240	1	DI 8.2 – Type	unsigned short	0 = edge 1 = pulse	RW

Offset	Number of registers	Name	Format	Value range	Access
51241	1	DI 8.2 – Unit	unsigned short	0 = kWh_IMPORT 1 = kWh_EXPORT 2 = kvarh_IMPORT 3 = kvarh_EXPORT 4 = CUSTOMIZATION	RW
51242	1	DI 8.2 – Pulses per unit	unsigned short	1-4000	RW
51244	1	DI 8.3 – Action	unsigned short	0 = No action 1 = Pulse input 2 = Tariff switching 4 = Display backlight 6 = Process counting 7 = Copy/Reset 8 = Reset	RW
51245	1	DI 8.3 – Type	unsigned short	0 = edge 1 = pulse	RW
51246	1	DI 8.3 – Unit	unsigned short	0 = kWh_IMPORT 1 = kWh_EXPORT 2 = kvarh_IMPORT 3 = kvarh_EXPORT 4 = CUSTOMIZATION	RW
51247	1	DI 8.3 – Pulses per unit	unsigned short	1-4000	RW
51252	1	DI 0.0 – Start/Stop target	unsigned short	Process counter with process hours counter	RW
51253	1	DI 0.0 – Copy/Reset target	unsigned short	Process counter with process hours counter	RW
51254	1	DI 0.0 – Reset target	unsigned short	0 = All process counters + process hours counters 4 = All process counters + process hours counters + user counters 5 = All user counters 6 = User counter 1 7 = User counter 2 8 = User counter 3 9 = User counter 4 10 = User counter 5 11 = User counter 6 12 = User counter 7 13 = User counter 8 14 = User counter 9 15 = User counter 10 16 = All universal counters 17 = Universal counter 0 18 = Universal counter 1	RW

Offset	Number of registers	Name	Format	Value range	Access
51255	1	DI 0.0 – User counter index	unsigned short	0 = No selection 1 = User counter 1 2 = User counter 2 3 = User counter 3 4 = User counter 4 5 = User counter 5 6 = User counter 6 7 = User counter 7 8 = User counter 8 9 = User counter 9 10 = User counter 10	RW
51259	1	DI 0.1 – Start/Stop target	unsigned short	Process counter with process hours counter	RW
51260	1	DI 0.1 – Copy/Reset target	unsigned short	Process counter with process hours counter	RW
51261	1	DI 0.1 – Reset target	unsigned short	0 = All process counters + process hours counters 4 = All process counters + process hours counters + user counters 5 = All user counters 6 = User counter 1 7 = User counter 2 8 = User counter 3 9 = User counter 4 10 = User counter 5 11 = User counter 6 12 = User counter 7 13 = User counter 8 14 = User counter 9 15 = User counter 10 16 = All universal counters 17 = Universal counter 0 18 = Universal counter 1	RW

Offset	Number of registers	Name	Format	Value range	Access
51262	1	DI 0.1 – User counter index	unsigned short	0 = No selection 1 = User counter 1 2 = User counter 2 3 = User counter 3 4 = User counter 4 5 = User counter 5 6 = User counter 6 7 = User counter 7 8 = User counter 8 9 = User counter 9 10 = User counter 10	RW
51266	1	DI 4.0 – Start/Stop target	unsigned short	Process counter with process hours counter	RW
51267	1	DI 4.0 – Copy/Reset target	unsigned short	Process counter with process hours counter	RW
51268	1	DI 4.0 – Reset target	unsigned short	0 = All process counters + process hours counters 4 = All process counters + process hours counters + user counters 5 = All user counters 6 = User counter 1 7 = User counter 2 8 = User counter 3 9 = User counter 4 10 = User counter 5 11 = User counter 6 12 = User counter 7 13 = User counter 8 14 = User counter 9 15 = User counter 10 16 = All universal counters 17 = Universal counter 0 18 = Universal counter 1	RW

Offset	Number of registers	Name	Format	Value range	Access
51269	1	DI 4.0 – User counter index	unsigned short	0 = No selection 1 = User counter 1 2 = User counter 2 3 = User counter 3 4 = User counter 4 5 = User counter 5 6 = User counter 6 7 = User counter 7 8 = User counter 8 9 = User counter 9 10 = User counter 10	RW
51273	1	DI 4.1 – Start/Stop target	unsigned short	Process counter with process hours counter	RW
51274	1	DI 4.1 – Copy/Reset target	unsigned short	Process counter with process hours counter	RW
51275	1	DI 4.1 – Reset target	unsigned short	0 = All process counters + process hours counters 4 = All process counters + process hours counters + user counters 5 = All user counters 6 = User counter 1 7 = User counter 2 8 = User counter 3 9 = User counter 4 10 = User counter 5 11 = User counter 6 12 = User counter 7 13 = User counter 8 14 = User counter 9 15 = User counter 10 16 = All universal counters 17 = Universal counter 0 18 = Universal counter 1	RW

Offset	Number of registers	Name	Format	Value range	Access
51276	1	DI 4.1 – User counter index	unsigned short	0 = No selection 1 = User counter 1 2 = User counter 2 3 = User counter 3 4 = User counter 4 5 = User counter 5 6 = User counter 6 7 = User counter 7 8 = User counter 8 9 = User counter 9 10 = User counter 10	RW
51280	1	DI 4.2 – Start/Stop target	unsigned short	Process counter with process hours counter	RW
51281	1	DI 4.2 – Copy/Reset target	unsigned short	Process counter with process hours counter	RW
51282	1	DI 4.2 – Reset target	unsigned short	0 = All process counters + process hours counters 4 = All process counters + process hours counters + user counters 5 = All user counters 6 = User counter 1 7 = User counter 2 8 = User counter 3 9 = User counter 4 10 = User counter 5 11 = User counter 6 12 = User counter 7 13 = User counter 8 14 = User counter 9 15 = User counter 10 16 = All universal counters 17 = Universal counter 0 18 = Universal counter 1	RW

Offset	Number of registers	Name	Format	Value range	Access
51283	1	DI 4.2 – User counter index	unsigned short	0 = No selection 1 = User counter 1 2 = User counter 2 3 = User counter 3 4 = User counter 4 5 = User counter 5 6 = User counter 6 7 = User counter 7 8 = User counter 8 9 = User counter 9 10 = User counter 10	RW
51287	1	DI 4.3 – Start/Stop target	unsigned short	Process counter with process hours counter	RW
51288	1	DI 4.3 – Copy/Reset target	unsigned short	Process counter with process hours counter	RW
51289	1	DI 4.3 – Reset target	unsigned short	0 = All process counters + process hours counters 4 = All process counters + process hours counters + user counters 5 = All user counters 6 = User counter 1 7 = User counter 2 8 = User counter 3 9 = User counter 4 10 = User counter 5 11 = User counter 6 12 = User counter 7 13 = User counter 8 14 = User counter 9 15 = User counter 10 16 = All universal counters 17 = Universal counter 0 18 = Universal counter 1	RW

Offset	Number of registers	Name	Format	Value range	Access
51290	1	DI 4.3 – User counter index	unsigned short	0 = No selection 1 = User counter 1 2 = User counter 2 3 = User counter 3 4 = User counter 4 5 = User counter 5 6 = User counter 6 7 = User counter 7 8 = User counter 8 9 = User counter 9 10 = User counter 10	RW
51294	1	DI 8.0 – Start/Stop target	unsigned short	Process counter with process hours counter	RW
51295	1	DI 8.0 – Copy/Reset target	unsigned short	Process counter with process hours counter	RW
51296	1	DI 8.0 – Reset target	unsigned short	0 = All process counters + process hours counters 4 = All process counters + process hours counters + user counters 5 = All user counters 6 = User counter 1 7 = User counter 2 8 = User counter 3 9 = User counter 4 10 = User counter 5 11 = User counter 6 12 = User counter 7 13 = User counter 8 14 = User counter 9 15 = User counter 10 16 = All universal counters 17 = Universal counter 0 18 = Universal counter 1	RW

Offset	Number of registers	Name	Format	Value range	Access
51297	1	DI 8.0 – User counter index	unsigned short	0 = No selection 1 = User counter 1 2 = User counter 2 3 = User counter 3 4 = User counter 4 5 = User counter 5 6 = User counter 6 7 = User counter 7 8 = User counter 8 9 = User counter 9 10 = User counter 10	RW
51301	1	DI 8.1 – Start/Stop target	unsigned short	Process counter with process hours counter	RW
51302	1	DI 8.1 – Copy/Reset target	unsigned short	Process counter with process hours counter	RW
51303	1	DI 8.1 – Reset target	unsigned short	0 = All process counters + process hours counters 4 = All process counters + process hours counters + user counters 5 = All user counters 6 = User counter 1 7 = User counter 2 8 = User counter 3 9 = User counter 4 10 = User counter 5 11 = User counter 6 12 = User counter 7 13 = User counter 8 14 = User counter 9 15 = User counter 10 16 = All universal counters 17 = Universal counter 0 18 = Universal counter 1	RW

Offset	Number of registers	Name	Format	Value range	Access
51304	1	DI 8.1 – User counter index	unsigned short	0 = No selection 1 = User counter 1 2 = User counter 2 3 = User counter 3 4 = User counter 4 5 = User counter 5 6 = User counter 6 7 = User counter 7 8 = User counter 8 9 = User counter 9 10 = User counter 10	RW
51308	1	DI 8.2 – Start/Stop target	unsigned short	Process counter with process hours counter	RW
51309	1	DI 8.2 – Copy/Reset target	unsigned short	Process counter with process hours counter	RW
51310	1	DI 8.2 – Reset target	unsigned short	0 = All process counters + process hours counters 4 = All process counters + process hours counters + user counters 5 = All user counters 6 = User counter 1 7 = User counter 2 8 = User counter 3 9 = User counter 4 10 = User counter 5 11 = User counter 6 12 = User counter 7 13 = User counter 8 14 = User counter 9 15 = User counter 10 6 = All universal counters 17 = Universal counter 0 18 = Universal counter 1	RW

Offset	Number of registers	Name	Format	Value range	Access
51311	1	DI 8.2 – User counter index	unsigned short	0 = No selection 1 = User counter 1 2 = User counter 2 3 = User counter 3 4 = User counter 4 5 = User counter 5 6 = User counter 6 7 = User counter 7 8 = User counter 8 9 = User counter 9 10 = User counter 10	RW
51315	1	DI 8.3 – Start/Stop target	unsigned short	Process counter with process hours counter	RW
51316	1	DI 8.3 – Copy/Reset target	unsigned short	Process counter with process hours counter	RW
51317	1	DI 8.3 – Reset target	unsigned short	0 = All process counters + process hours counters 4 = All process counters + process hours counters + user counters 5 = All user counters 6 = User counter 1 7 = User counter 2 8 = User counter 3 9 = User counter 4 10 = User counter 5 11 = User counter 6 12 = User counter 7 13 = User counter 8 14 = User counter 9 15 = User counter 10 16 = All universal counters 17 = Universal counter 0 18 = Universal counter 1	RW

Offset	Number of registers	Name	Format	Value range	Access
51318	1	DI 8.3 – User counter index	unsigned short	0 = No selection 1 = User counter 1 2 = User counter 2 3 = User counter 3 4 = User counter 4 5 = User counter 5 6 = User counter 6 7 = User counter 7 8 = User counter 8 9 = User counter 9 10 = User counter 10	RW
51712	1	DO 0.0 – Action	unsigned short	0 = Off 1 = Device on 2 = Remote control 3 = Direction of rotation 5 = Pulse output	RW
51715	1	DO 0.0 – Pulse type	unsigned short	0 = kWh_IMPORT 1 = kWh_EXPORT 2 = kvarh_IMPORT 3 = kvarhh_EXPORT	RW
51716	1	DO 0.0 – Pulses per unit	unsigned short	1…4000	RW
51717	1	DO 0.0 – Pulse length	unsigned short	30…500 ms	RW
51718	1	DO 0.0 – Timeout	unsigned short	0 … 18000 s	RW
51719	1	DO 0.0 – Pulse divider	unsigned short	0 = per 1 kWh 1 = per 10 kWh 2 = per 100 kWh 3 = per 1000 kWh	RW
51721	1	DO 0.1 – Action	unsigned short	0 = Off 1 = Device on 2 = Remote control 3 = Direction of rotation 5 = Pulse output	RW
51724	1	DO 0.1 – Pulse type	unsigned short	0 = kWh_IMPORT 1 = kWh_EXPORT 2 = kvarh_IMPORT 3 = kvarhh_EXPORT	RW
51725	1	DO 0.1 – Pulses per unit	unsigned short	1…4000	RW
51726	1	DO 0.1 Pulse length	unsigned short	30…500 ms	RW
51727	1	DO 0.1 Timeout	unsigned short	0 … 18000 s	RW

Offset	Number of registers	Name	Format	Value range	Access
51728	1	DO 0.1 – Pulse divider	unsigned short	0 = per 1 kWh 1 = per 10 kWh 2 = per 100 kWh 3 = per 1000 kWh	RW
51730	1	DO 4.0 – Action	unsigned short	0 = Off 1 = Device on 2 = Remote control 3 = Direction of rotation 5 = Pulse output	RW
51733	1	DO 4.0 – Pulse type	unsigned short	0 = kWh_IMPORT 1 = kWh_EXPORT 2 = kvarh_IMPORT 3 = kvarhh_EXPORT	RW
51734	1	DO 4.0 – Pulses per unit	unsigned short	1...4000	RW
51735	1	DO 4.0 – Pulse length	unsigned short	30...500 ms	RW
51736	1	DO 4.0 – Timeout	unsigned short	0 ... 18000 s	RW
51737	1	DO 4.0 – Pulse divider	unsigned short	0 = per 1 kWh 1 = per 10 kWh 2 = per 100 kWh 3 = per 1000 kWh	RW
51739	1	DO 4.1 – Action	unsigned short	0 = Off 1 = Device on 2 = Remote control 3 = Direction of rotation 5 = Pulse output	RW
51742	1	DO 4.1 – Pulse type	unsigned short	0 = kWh_IMPORT 1 = kWh_EXPORT 2 = kvarh_IMPORT 3 = kvarhh_EXPORT	RW
51743	1	DO 4.1 – Pulses per unit	unsigned short	1...4000	RW
51744	1	DO 4.1 – Pulse length	unsigned short	30...500 ms	RW
51745	1	DO 4.1 – Timeout	unsigned short	0 ... 18000 s	RW
51746	1	DO 4.1 – Pulse divider	unsigned short	0 = per 1 kWh 1 = per 10 kWh 2 = per 100 kWh 3 = per 1000 kWh	RW
51748	1	DO 8.0 – Action	unsigned short	0 = Off 1 = Device on 2 = Remote control 3 = Direction of rotation 5 = Pulse output	RW

Offset	Number of registers	Name	Format	Value range	Access
51751	1	DO 8.0 – Pulse type	unsigned short	0 = kWh_IMPORT 1 = kWh_EXPORT 2 = kvarh_IMPORT 3 = kvarhh_EXPORT	RW
51752	1	DO 8.0 – Pulses per unit	unsigned short	1...4000	RW
51753	1	DO 8.0 – Pulse length	unsigned short	30...500 ms	RW
51754	1	DO 8.0 – Timeout	unsigned short	0 ... 18000 s	RW
51755	1	DO 8.0 – Pulse divider	unsigned short	0 = per 1 kWh 1 = per 10 kWh 2 = per 100 kWh 3 = per 1000 kWh	RW
51757	1	DO 8.1 – Action	unsigned short	0 = Off 1 = Device on 2 = Remote control 3 = Direction of rotation 5 = Pulse output	RW
51760	1	DO 8.1 – Pulse type	unsigned short	0 = kWh_IMPORT 1 = kWh_EXPORT 2 = kvarh_IMPORT 3 = kvarhh_EXPORT	RW
51761	1	DO 8.1 – Pulses per unit	unsigned short	1...4000	RW
51762	1	DO 8.1 – Pulse length	unsigned short	30...500 ms	RW
51763	1	DO 8.1 – Timeout	unsigned short	0 ... 18000 s	RW
51764	1	DO 8.1 – Pulse divider	unsigned short	0 = per 1 kWh 1 = per 10 kWh 2 = per 100 kWh 3 = per 1000 kWh	RW

A.1.17 Value ranges for offset 50071

V_L1	0		HARM_19_V_L1	124
V_L2	1		HARM_19_V_L2	125
V_L3	2		HARM_19_V_L3	126
V_L12	3		HARM_21_V_L1	127
V_L23	4		HARM_21_V_L2	128
V_L31	5		HARM_21_V_L3	129
I_L1	6		HARM_23_V_L1	130
I_L2	7		HARM_23_V_L2	131
I_L3	8		HARM_23_V_L3	132

VA_L1	9		HARM_25_V_L1	133
VA_L2	10		HARM_25_V_L2	134
VA_L3	11		HARM_25_V_L3	135
P_L1	12		HARM_27_V_L1	136
P_L2	13		HARM_27_V_L2	137
P_L3	14		HARM_27_V_L3	138
VARQN_L1	15		HARM_29_V_L1	139
VARQN_L2	16		HARM_29_V_L2	140
VARQN_L3	17		HARM_29_V_L3	141
V_RA_L1	18		HARM_31_V_L1	142
V_RA_L2	19		HARM_31_V_L2	143
V_RA_L3	20		HARM_31_V_L3	144
V_RA_L12	21		HARM_1_V_L12	145
V_RA_L23	22		HARM_1_V_L23	146
V_RA_L31	23		HARM_1_V_L31	147
I_RA_L1	24		HARM_3_V_L12	148
I_RA_L2	25		HARM_3_V_L23	149
I_RA_L3	26		HARM_3_V_L31	150
VA_RA_L1	27		HARM_5_V_L12	151
VA_RA_L2	28		HARM_5_V_L23	152
VA_RA_L3	29		HARM_5_V_L31	153
P_RA_L1	30		HARM_7_V_L12	154
P_RA_L2	31		HARM_7_V_L23	155
P_RA_L3	32		HARM_7_V_L31	156
VARQN_RA_L1	33		HARM_9_V_L12	157
VARQN_RA_L2	34		HARM_9_V_L23	158
VARQN_RA_L3	35		HARM_9_V_L31	159
VARQTOT_RA_L1	36		HARM_11_V_L12	160
VARQTOT_RA_L2	37		HARM_11_V_L23	161
VARQTOT_RA_L3	38		HARM_11_V_L31	162
VARQ1_RA_L1	39		HARM_13_V_L12	163
VARQ1_RA_L2	40		HARM_13_V_L23	164
VARQ1_RA_L3	41		HARM_13_V_L23	164
PF_RA_L1	42		HARM_13_V_L31	165
PF_RA_L2	43		HARM_15_V_L12	166
PF_RA_L3	44		HARM_15_V_L23	167
PF_L1	45		HARM_15_V_L31	168
PF_L2	46		HARM_17_V_L12	169
PF_L3	47		HARM_17_V_L23	170
THDV_L1	48		HARM_17_V_L31	171
THDV_L2	49		HARM_19_V_L12	172
THDV_L3	50		HARM_19_V_L23	173
THDI_L1	51		HARM_19_V_L31	174
THDI_L2	52		HARM_21_V_L12	175

THDI_L3	53		HARM_21_V_L23	176
THDV_L12	54		HARM_21_V_L31	177
THDV_L23	55		HARM_23_V_L12	178
THDV_L31	56		HARM_23_V_L23	179
VARQ1_L1	57		HARM_23_V_L31	180
VARQ1_L2	58		HARM_25_V_L12	181
VARQ1_L3	59		HARM_25_V_L23	182
VARQTOT_L1	60		HARM_25_V_L31	183
VARQTOT_L2	61		HARM_27_V_L12	184
VARQTOT_L3	62		HARM_27_V_L23	185
COSPHI_L1	63		HARM_27_V_L31	186
COSPHI_L2	64		HARM_29_V_L12	187
COSPHI_L3	65		HARM_29_V_L23	188
I_D_L1	66		HARM_29_V_L31	189
I_D_L2	67		HARM_31_V_L12	190
I_D_L3	68		HARM_31_V_L23	191
SYSANGLE_L11	69		HARM_31_V_L31	192
SYSANGLE_L12	70		HARM_1_I_L1	193
SYSANGLE_L13	71		HARM_1_I_L2	194
PHI_L1	72		HARM_1_I_L3	195
PHI_L2	73		HARM_3_I_L1	196
PHI_L3	74		HARM_3_I_L2	197
FREQ	75		HARM_3_I_L3	198
V_LN_AVG	76		HARM_5_I_L1	199
V_LL_AVG	77		HARM_5_I_L2	200
I_AVG	78		HARM_5_I_L3	201
VA_SUM	79		HARM_7_I_L1	202
P_SUM	80		HARM_7_I_L2	203
VARQN_SUM	81		HARM_7_I_L3	204
VARQ1_SUM	82		HARM_9_I_L1	205
VARQTOT_SUM	83		HARM_9_I_L2	206
VA_SUM_RA	84		HARM_9_I_L3	207
P_SUM_RA	85		HARM_11_I_L1	208
PF_SUM_RA	86		HARM_11_I_L2	209
VARQN_SUM_RA	87		HARM_11_I_L3	210
VARQ1_SUM_RA	88		HARM_13_I_L1	211
VARQTOT_SUM_RA	89		HARM_13_I_L2	212
PF_SUM	90		HARM_13_I_L3	213
V_BAL	91		HARM_15_I_L1	214
I_BAL	92		HARM_15_I_L2	215
V_PHASE_BAL	93		HARM_15_I_L3	216
I_PHASE_BAL	94		HARM_17_I_L1	217
I_N	95		HARM_17_I_L2	218
I_N_RA	96		HARM_17_I_L3	219

HARM_1_V_L1	97		HARM_19_I_L1	220
HARM_1_V_L2	98		HARM_19_I_L2	221
HARM_1_V_L3	99		HARM_19_I_L3	222
HARM_3_V_L1	100		HARM_21_I_L1	223
HARM_3_V_L2	101		HARM_21_I_L2	224
HARM_3_V_L3	102		HARM_21_I_L3	225
HARM_5_V_L1	103		HARM_23_I_L1	226
HARM_5_V_L2	104		HARM_23_I_L2	227
HARM_5_V_L3	105		HARM_23_I_L3	228
HARM_7_V_L1	106		HARM_25_I_L1	229
HARM_7_V_L2	107		HARM_25_I_L2	230
HARM_7_V_L3	108		HARM_25_I_L3	231
HARM_9_V_L1	109		HARM_27_I_L1	232
HARM_9_V_L2	110		HARM_27_I_L2	233
HARM_9_V_L3	111		HARM_27_I_L3	234
HARM_11_V_L1	112		HARM_29_I_L1	235
HARM_11_V_L2	113		HARM_29_I_L2	236
HARM_11_V_L3	114		HARM_29_I_L3	237
HARM_13_V_L1	115		HARM_31_I_L1	238
HARM_13_V_L2	116		HARM_31_I_L2	239
HARM_13_V_L3	117		HARM_31_I_L3	240
HARM_15_V_L1	118		PROC_COUNTER	241
HARM_15_V_L2	119		I_N_SLOT_1	242
HARM_15_V_L3	120		I_5_SLOT_1	243
HARM_17_V_L1	121		I_6_SLOT_1	244
HARM_17_V_L2	122		I_N_SLOT_2	245
HARM_17_V_L3	123		I_5_SLOT_2	246
			I_6_SLOT_2	247

A.1.18 LED - Remote control

Offset	Number of registers	Name	Unit	Format	Value range	Access
53249	2	LED - Remote control	–	Unsigned long	if(byte[3] < 128) ... byte[0] (LSB) : Blue byte[1] Green byte[2] Red byte[3] (MSB) ColorMode else byte[0] (LSB) ColorName byte[1] ColorMode byte[2] 0 byte[3] (MSB) 0x80	RW

A.1.19 I&M settings

Addressing the settings for the I&M data

Table A-20 Settings for the I&M data

Offset	Number of registers	Name	Format	Unit	Applicable MODBUS function codes	Value range	Access
64001	27	PAC4220 I&M 0 data	stIM0	-	• 0x03 • 0x04	-	R
64028	89	PAC4220 I&M 1 to I&M 4 data	stIM14	-	• 0x03 • 0x04 • 0x10	-	RW
64117	27	I&M data module interface 1	stIM0	-	• 0x03 • 0x04	-	R
64144	27	I&M data module interface 2	stIM0	-	• 0x03 • 0x04	-	R

A.1.20 Commands with the function codes 0x06 and 0x10

Addressing the commands

Offset	Number of registers	Name	Format	Value range	Access
60000	1	Reset the device to the factory settings	Unsigned short	4711	W
60001	1	Device reset (without changing the Modbus address)	Unsigned short	4711	W
60002	1	Reset maximum values	Unsigned short	0	W
60003	1	Reset minimum values	Unsigned short	0	W
60004	1	Reset energy counters	Unsigned short	0 = All energy counters 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	W
60005	1	Synchronization of the demand period	Unsigned short	1 ... 60 min	W
60006	1	Tariff switchover	Unsigned short	0 = ON-PEAK 1 = OFF-PEAK	W
60007	1	Acknowledge the diagnostic bits[1)] (cf. stored bits in unsigned long beginning at offset 205)	Unsigned short	0 ... ffffh	W
60008	1	Switch outputs (if parameterized)	Unsigned short	Value range for offset 60008 Byte0 0 = Output 0.0 Byte0 1 = Output 0.1 Byte 0 2 = Output 0.2 (LED) Byte0 64 = Output 4.0 Byte0 65 = Output 4.1 Byte0 128 = Output 8.0 Byte0 129 = Output 8.1 Byte1 0 = off Byte1 1 = on	W

Offset	Number of registers	Name	Format	Value range	Access
60009	1	Switching command for vector group	Unsigned short	High 0 ... 99, Low 0 ... 1 High byte group assignment Low byte 1 = ON, 0 = OFF	W
60010		Reset the operating hours counters		0	W
60011		Reset the load profile memory		0	W
65300		Activate IP settings		0	W
65304		Set device screen via menu number		–	W
65310	1	Reboot	-	-	W
65322	1	Process counter Start/Stop	-	0 = Stop 1 = Start	
65323	1	Process counter Copy/Reset	-	-	W
65324	1	Process counter Reset	-	-	W
65325	1	Activate flashing mode	-	0 = Off 1 = On	W

[1] The Modbus server must acknowledge these diagnostic bits.

Offset	Number of registers	Name	Value range	Access
62983	2	Aggregation file 1 (period length)	3 = three_seconds 4 = four_seconds 5 = five_seconds 6 = six_seconds 10 = ten_seconds 12 = twelve_seconds 15 = fifteen_seconds 20 = twenty_seconds 30 = thirty_seconds 60 = one_minute 120 = two_minutes 1 80 = three_minutes 240 = four_minutes 300 = five_minutes 360 = six_minutes 600 = ten_minutes 720 = twelve_minutes 900 = fifteen_minutes 1200 = twenty_minutes 1800 = thirty_minutes 3600 = one_hour 7200 = two_hours 10800 = three_hours 14400 = four_hours 21600 = six_hours 28800 = eight_hours 43200 = twelve_hours 86400 = one_day	RW
62987	2	Aggregation file 2 (period length)	Same as offset 62983	RW
63001	2	IP address	0 ... FFFFFFFFh	RW
63003	2	Subnet	0 ... FFFFFFFFh	RW
63005	2	Gateway	0 ... FFFFFFFFh	RW
63007	2	BL-SW revision	char, uchar, uchar, uchar	R
63017	2	Module slot 1 - Modbus protocol	0 = MODBUS_RTU 3 = MODBUS_GATEWAY	RW
63019	2	Module slot 1 - Modbus address	1 ... 247	RW

Offset	Number of registers	Name	Value range	Access
63021	2	Module slot 1 - Baud rate	0 = 4800 baud 1 = 9600 baud 2 = 19200 baud 3 = 38400 baud 4 = 57600 baud 5 = 115200 baud	RW
63023	2	Module slot 1 - Setting	0 = 8N2 1 = 8E1 2 = 8O1 3 = 8N1	RW
63025	2	Module slot 1 - Response time		RW
63033	2	Module slot 2 - Modbus protocol	0 = MODBUS_RTU 3 = MODBUS_GATEWAY	RW
63035	2	Module slot 2 - Modbus address	1 ... 247	RW
63037	2	Module slot 2 - Baud rate	0 = 4800 baud 1 = 9600 baud 2 = 19200 baud 3 = 38400 baud 4 = 57600 baud 5 = 115200 baud	RW
63039	2	Module slot 2 - Setting	0 = 8N2 1 = 8E1 2 = 8O1 3 = 8N1	RW
63041	2	Module slot 2 - Response time		RW
63053	2	Module slot 1 - Input-Mask		RW
63055	2	Module slot 1 - Output-Mask		RW
63057	2	Module slot 2 - Input-Mask		RW
63059	2	Module slot 2 - Output-Mask		RW
63065	2	Profibus_ID		R
63067	2	FW revision		R
63085	2	MODBUS PORT		RW
63087	2	WEB SERVER HTTP PORT		RW
63089	2	Indicator for harmonics in the display	0 = Even 1 = All	RW
63091	2	IP address		R
63093	2	Subnet		R
63095	2	Gateway		R
63097	2	Gateway slot 1		RW

Offset	Number of registers	Name	Value range	Access
63099	2	Gateway slot 2		
63101	2	Discovery Service	0 = Inactive 1 = Active	RW

A.1.21 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-21 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

A.1.22 User-defined Modbus function code 0x64

Function code 0x64 was defined in order to make it possible to read historical data, such as the load profile or events stored in a logbook, out of a PAC device via Modbus.

A.1.22.1 Profile data memory

Modbus frame structure

1 byte	1 byte	1 byte	5 bytes
Function code 0x64	Data Log Identifier	Data Identifier	Advanced Data Identifiers

The "data log identifier" is defined system-wide for all PAC devices. The data memory to be read out of the PAC device can be selected using this identifier. The "data identifier" and the "advanced data identifier" determine which data from the selected data memory are sent in the response data records.

Definition "Data Log Identifier"

Description	Number
Load profile	0x00
Daily profile memory	0x04
Monthly profile memory	0x05
Annual profile memory	0x06

Definition "Data Identifier"

The "data identifier" determines which collection of measured values (or events) are sent in the data records of the response frame.

- Measuring channel 1: Active energy or active power import
- Measuring channel 2: Active energy or active power export
- Measuring channel 3: Reactive power import
- Measuring channel 4: Reactive power export
- Measuring channel 5: Apparent power

Description	Number	Can be used on " Data Log Identifier"
Measuring channel 1 (average values and cumulated values) with min/max values	0x01	0x01
Measuring channel 2 (average values and cumulated values) with min/max values	0x02	0x01
Measuring channel 3 (average values and cumulated values) with min/max values	0x03	0x01
Measuring channel 4 (average values and cumulated values) with min/max values	0x04	0x01
Measuring channel 5 (average values and cumulated values) with min/max values	0x05	0x01
Measuring channels 1 to 5 (average values and cumulated values) with min/max values and power factor import/export	0x06	0x01
Measuring channels 1 to 5 (average values) with min/max values	0x10	0x01
Measuring channel 1 (average values) with min/max values	0x11	0x01
Measuring channel 2 (average values) with min/max values	0x12	0x01
Measuring channel 3 (average values) with min/max values	0x13	0x01
Measuring channel 4 (average values) with min/max values	0x14	0x01
Measuring channel 5 (average values) with min/max values	0x15	0x01
Measuring channels 1 to 5 (average values) with min/max values and power factor import/export	0x16	0x01
Measuring channels 1 to 5 (cumulated values) with min/max values	0x20	0x01
Measuring channel 1 (cumulated values) with min/max values	0x21	0x01
Measuring channel 2 (cumulated values) with min/max values	0x22	0x01
Measuring channel 3 (cumulated values) with min/max values	0x23	0x01

Description	Number	Can be used on " Data Log Identifier"
Measuring channel 4 (cumulated values) with min/max values	0x24	0x01
Measuring channel 5 (cumulated values) with min/max values	0x25	0x01
Measuring channels 1 to 5 (cumulated values) with min/max values and power factor import/export	0x26	0x01
Measuring channels 1 to 5 (average value and cumulated values) without min/max values	0x30	0x01
Measuring channel 1 (average value and cumulated values) without min/max values	0x31	0x01
Measuring channel 2 (average value and cumulated values) without min/max values	0x32	0x01
Measuring channel 3 (average value and cumulated values) without min/max values	0x33	0x01
Measuring channel 4 (average value and cumulated values) without min/max values	0x34	0x01
Measuring channel 5 (average value and cumulated values) without min/max values	0x35	0x01
Measuring channels 1 to 5 (average value and cumulated values) without min/max values and power factor import/export	0x36	0x01
Measuring channels 1 to 5 (average values) without min/max values	0x40	0x01
Measuring channel 1 (average values) without min/max values	0x41	0x01
Measuring channel 2 (average values) without min/max values	0x42	0x01
Measuring channel 3 (average values) without min/max values	0x43	0x01
Measuring channel 4 (average values) without min/max values	0x44	0x01
Measuring channel 5 (average values) without min/max values	0x45	0x01
Measuring channels 1 to 5 (average value) without min/max values and power factor import/export	0x46	0x01
Measuring channels 1 to 5 (cumulated values) without min/max values	0x50	0x01
Measuring channel 1 (cumulated values) without min/max values	0x51	0x01
Measuring channel 2 (cumulated values) without min/max values	0x52	0x01
Measuring channel 3 (cumulated values) without min/max values	0x53	0x01
Measuring channel 4 (cumulated values) without min/max values	0x54	0x01
Measuring channel 5 (cumulated values) without min/max values	0x55	0x01

Description	Number	Can be used on " Data Log Identifier"
Measuring channels 1 to 5 (cumulated values) without min/max values and power factor import/export	0x56	0x01
Measuring channels 1 and 2 (energy quantity)	0x69	0x04, 0x05, 0x06
Measuring channel 1 (energy quantity)	0x6A	0x04, 0x05, 0x06
Measuring channel 2 (energy quantity)	0x6B	0x04, 0x05, 0x06
Measuring channels 1 and 2 (energy quantity), in addition 4 counter readings (import T1, import T2, export T1, export T2)	0x6C	0x04, 0x05, 0x06
Measuring channels 1 and 2 (energy quantity), in addition 2 counter readings (total import T1+T2, total export T1+T2)	0x6D	0x04, 0x05, 0x06
4 counter readings (import T1 and T2, export T1 and T2)	0x70	0x04, 0x05, 0x06
2 counter readings (import T1, export T1)	0x71	0x04, 0x05, 0x06
2 counter readings (import T2, export T2)	0x72	0x04, 0x05, 0x06

Definition "Advanced Data Identifier"

The "advanced data identifier" has a length of 5 bytes. It consists of an object ID (4 bytes, format "unsigned long" big endian) and the number (1 byte) of data records required in the response frame.

Every data record of a historical data memory in the PAC device can be addressed by this object ID (OID) which is unique in the device. A special entry (or a number of entries which are inserted in the frame one after the other) can be read.

The highest OID in existence is available for every data memory in associated Modbus registers (see table "Data memory and associated Modbus registers").

If OID 0x00000000 is requested, the PMD returns the oldest valid OID with the associated data record. If a non-existent OID (other than 0) is requested, the PAC device returns the Modbus exception code 0x04. A syntax error in the Modbus frame also results in a Modbus exception response.

Data memory and associated Modbus registers

Description "Data Log Identifier"	Offset of the Modbus registers of the highest OID in existence	Data format	Length
Load profile	227	Unsigned long	2 registers
Daily profile memory	399	Unsigned long	2 registers
Monthly profile memory	401	Unsigned long	2 registers
Annual profile memory	403	Unsigned long	2 registers

Reading out the profile data memory (load profile, daily profile, monthly profile, annual profile)

Each of the profile data memories contains 2 measuring channels:

- Measuring channel 1: Active energy or active power import
- Measuring channel 2: Active energy or active power export
- Measuring channel 3: Reactive power import

- Measuring channel 4: Reactive power export
- Measuring channel 5: Apparent power

Each entry in the profile data memories has a bit-coded status word in the information about the events or status changes that occurred in the period.

This information helps the user to identify occurrences during the demand periods.

Description of the "information flag bytes":

FLAG_TARIFF_T1	0x00xxxxxx
FLAG_TARIFF_T2	0x01xxxxxx
FLAG_TARIFF_UNKNOWN	0xFFxxxxxx
FLAG_QUALITY_UNSECURE	0x00800000
FLAG_QUALITY_AUXPOWER_FAIL	0x00400000
FLAG_QUALITY_PERIOD_TO_SHORT	0x00010000
FLAG_QUALITY_TIME_UNSECURE	0x00200000
FLAG_MULTIPLE_TIMECHANGE	0x00040000
FLAG_CURRENT_TRANSFORMER	0x00080000
FLAG_Q1	0x00000040
FLAG_BAD_QUALITY_MARKER	0x00000001

Description of "Log Entry Data" (energy profile)

Log Entry Data	Description	Length in Byte	Offset in Bytes
TS	Time stamp active period (UTC)	4	0
TZO	Timezone-Offset to UTC in seconds	4	4
OID	OID active period	4	8
Act.W. Im.	Active energy Import act. period in Wh	4	12
Act.W. Ex.	Active energy Export act. period in Wh	4	16
Act.W.C. Im.	Active energy counter reading Import T1+T2 act. period in Wh	8	20
Act.W.C. Ex.	Active energy counter reading Export T1+T2 act. period in Wh	8	28
RLP	Real load profile period length act. period in ms	4	36
Flag	Information flag bytes act. period	4	40

"Log Entry Data" as binary frame

0x00	TS_{MSB}			TS_{LSB}	TZO_{MSB}			TZO_{LSB}
0x08	OID_{MSB}			OID_{LSB}	$Act.W.Im._{MSB}$			$Act.W.Im._{LSB}$
0x10	$Act.W.Ex._{MSB}$			$Act.W.Ex._{LSB}$	$Act.W.C.Im_{MSB}$			
0x18				$Act.W.C.Im_{LSB}$	$Act.W.C.Ex_{MSB}$			
0x20				$Act.W.C.Ex_{LSB}$	RLP_{MSB}			RLP_{LSB}
0x28	$FLAG_{MSB}$			$FLAG_{LSB}$				

Example of request frame (load profile)

1 byte	1 byte	1 byte	N bytes
Function code 0x64	Data log identifier (load profile memory)	Data identifier (all channels with min/max values)	Advanced data identifiers (4 byte OID and 1 byte number of records)
0x64	0x00	0x00	0x00012345 0x02

The data records are copied into the frame buffer according to data point list 0x1E4 to 0x210. Because unselected data (depending on the data identifier) are skipped, the data record size can vary.

Example of response frame

Bytes in hex	Description	Length
64	Modbus user-defined function code	1
CA	Payload length in bytes (starting with the following byte to the end, excluding CRC)	1
0	Data log identifier -> load profile memory	1
0	Data identifier -> all channels (average values and cumulated values) with min/max values	1
0x00012345	Set the read pointer to OID 0x00005723 of the load profile memory	1
2	Number of records inserted in this frame (may be smaller than requested)	1
59	Length of first record in bytes (including this byte)	1
.....	0x59 data bytes of record with OID 0x00012345 timestamp act. period Time offset in seconds OID act. period (unique period entry identification index) average active power import act. period average active power export act. period average reactive power import act. period average reactive power export act. period average apparent power act. period cumulated active power import act. period cumulated active power export act. period cumulated reactive power import act. period cumulated reactive power export act. period cumulated apparent power act. period Max. value active power act. period Min. value active power act. period Max. value reactive power act. period Min. value reactive power act. period Max. value apparent power act. period Min. value apparent power act. period real load profile period length act. period real load profile subinterval length act. period information flag bytes act. period	1 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4

Bytes in hex	Description	Length
59	Length of second record in bytes (including this byte)	1
.....	0x59 data bytes of record with OID (0x00012346)	
	timestamp act.period	4
	Time offset in seconds	4
	OID act. period (unique period entry identification index)	4
	average active power import act. period	4
	average active power export act. period	4
	average reactive power import act. period	4
	average reactive power export act. period	4
	average apparent power act. period	4
	cumulated active power import act. period	4
	cumulated active power export act. period	4
	cumulated reactive power import act. period	4
	cumulated reactive power export act. period	4
	cumulated apparent power act. period	4
	Max. value active power act. period	4
	Min. value active power act. period	4
	Max. value reactive power act. period	4
	Min. value reactive power act. period	4
	Max. value apparent power act. period	4
	Min. value apparent power act. period	4
	real load profile period length act. period	4
	real load profile subinterval length act. period	4
	information flag bytes act. period	4

Example of request frame

1 byte	1 byte	1 byte	N bytes
Function code 0x64	Data log identifier (day profile memory)	Data identifier (measuring channel 1 & 2)	Advanced data identifiers (4 byte OID and 1 byte number of records)
0x64	0x04	0x6D	0x00002CE2 0x02

Example of response frame

Bytes in hex	Description	Length
64	Modbus user-defined function code	1
61	Payload length in bytes (starting with the following byte to the end, excluding CRC)	1
04	Data log identifier → day profile memory	1
6D	Data identifier → channels 1 + 2 (active energy) and readings of energy counters T1+T2	1
00 00 2C E2	Set the read pointer to OID 0x00002CE2 of the day profile memory	1
02	Number of records inserted in this frame (may be smaller than requested)	1
2D	Length of first record in bytes (including this byte)	1

Bytes in hex	Description	Length
	0x2D data bytes of 1st record with OID 0x00002CE2	
5E 84 CF 98	Time stamp act. period	4
00 00 0E 10	Time offset in seconds	4
00 00 2C E2	OID act. period (unique period entry identification index)	4
41 90 D1 A4	Active energy import act. period in Wh	4
00 00 00 00	Active energy export act. period in Wh	4
41 41 B4 EB 44 67 2E 00	Active energy counter reading import T1+T2 act. period in Wh	8
00 00 00 00 00 00 00 00	Active energy counter reading export T1+T2 act. period in Wh	8
00 00 07 7E	Real load profile period length act. period in ms	4
00 01 00 40	Information flag bytes act. period	4
2D	Length of 2nd record in a row starting with OID 0x2CE3 in bytes (including this byte)	1
	0x2D data bytes of record 0x02 with OID 0x2CE3	
5E 84 D3 1C	Time stamp act. period	4
00 00 0E 10	Time zone offset in s	4
00 00 2C E3	OID act. period (unique period entry identification index)	4
41 90 D1 A5	Active energy import act. period in Wh	4
00 00 00 00	Active energy export act. period in Wh	4
41 41 B4 F4 51 81 7A 00	Active energy counter reading import T1+T2 act. period in Wh	8
00 00 00 00 00 00 00 00	Active energy counter reading export T1+T2 act. period in Wh	8
00 00 07 7E	Real load profile period length act. period in milliseconds	4
00 01 00 40	Information flag bytes act. period	4

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