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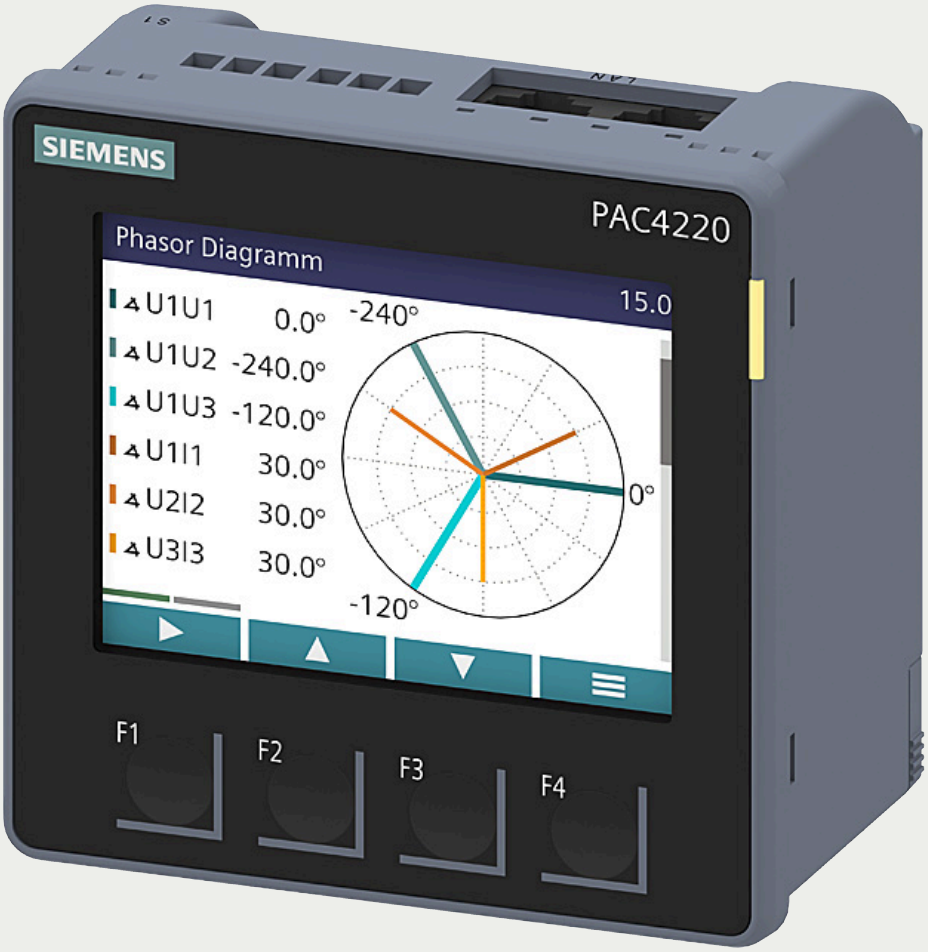

MANUAL

SENTRON

7KM Power Monitoring Device

PAC4220

www.siemens.com/lowvoltage

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SENTRON

7KM Power Monitoring Device PAC4220

Equipment Manual

L1V30827278B-01

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.

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Note the following:

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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-01
Ⓟ 09/2023 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

Available accessories

- SENTRON Powerconfig (https://mall.industry.siemens.com/mall/de/WW/Catalog/Products/10121795) software

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

- 7KM PROFIBUS DP expansion module (7KM9300-0AB01-0AA0)
- 7KM Switched Ethernet PROFINET expansion module (7KM9300-0AE02-0AA0)
- 7KM RS485 expansion module (7KM9300-0AM00-0AA0)
- Compact bracket (7KM9900-0GA00-0AA0)
- 7KM 4DI/2DO expansion module (7KM9200-0AB00-0AA0)
- 7KM I(N), I(Diff), expansion module, analog (7KM9200-0AD00-0AA0)

1.2 Latest information

Up-to-the-minute information

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

1.3 Technical Support

You can find further support on the internet at:
Technical Support (https://www.siemens.com/support-request)

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Siemens AG Smart Infrastructure Electrical Products

Siemensstrasse 109

93055 Regensburg

Germany

Internet: Technical Assistance (https://www.siemens.com/support-request)

Subject: 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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1.5 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/industrialsecurity).

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):

1.6 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 63)
Applying the measuring voltage (Page 62)
Applying the supply voltage (Page 58)
Protection against unauthorized operation (Page 89)

1.7 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.

You can find more information in chapter Protection against tampering (Page 88).

See also

Parameterizing via the operator interface (Page 80)

Performance features (Page 15)

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 single-phase, two-phase or three-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-voltage 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.

Measurement

- Measurement in 2, 3 and 4-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[1)]
- 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 2 stages, which are independent of each other and freely configurable (aggregation)[1)]
- 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 measuring 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 N (neutral) conductor current [2)]

- Measurement of residual current and PE conductor current through external summation current transformer [2)]
- Measurement of physical variables (e.g. temperature, pressure, humidity) with external 0/4 mA to 20 mA transmitter [1) 2)]

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

[2)] Using optionally available 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/document/109746834/ger%C3%A4tehandbuch-7km-pac-erweiterungsmodul-i(n)-i(diff)-analog?dti=0&lc=de-DE)

Counters and power demand

- A total of 50 energy counters capture 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[1)] 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[1)] for monitoring the operating time of a connected load. Counts only in the case of energy counting above an adjustable threshold.
- One apparent energy counter, one active energy counter, and one reactive energy counter for detecting the total energy import, regardless of the active tariff for display on the device.
- One apparent energy counter, one active energy counter, and one reactive energy counter for detecting the power consumption of a manufacturing process. The process energy counters can be started and stopped by means of the available digital inputs.
- Operating hours counter[1)] 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 if the optionally available SENTRON PAC 4DI/2DO expansion modules are used. Consumption (e.g. of gas, water, compressed air, electrical current) can thus 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.

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

Monitoring functions[1)]

The PAC4220 monitors up to 12 limit values (limit value 0 to 11) as well as one limit value (logic limit value) that can be formed by logically combining the other 12 limit values.

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

Event display[1)]

- Recording of events with a time stamp and event-specific information
- Display of events in an events 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 FW update.

Displays and controls

- Color display
- Multicolored LEDs with variable function assignment. The function of the LEDs is user-configurable[1)].
- 4 control keys with variable function assignment
- SENTRON Powerconfig (commissioning and service software)
- SENTRON Powermanager (power monitoring software)
- Web server

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

Interfaces

- 2 Ethernet interfaces
- 2 multifunctional integral passive digital inputs[1)]

- 2 multifunctional integral passive digital outputs[1)]
- 2 slots for operating optional expansion modules
  - PROFIBUS DP (if 7KM PROFIBUS DP expansion module is used)[1)]
  - Modbus RTU (if 7KM RS485 expansion module is used)
  - Switched Ethernet PROFINET (if 7KM Switched Ethernet PROFINET expansion module is used)[1)]
  - Up to 8 plug-in digital inputs (if two 7KM 4DI/2DO expansion modules are used)[1)]
  - Up to 4 plug-in digital outputs (if two 7KM 4DI/2DO expansion modules are used)[1)]
  - 3 analog inputs (if 7KM I(N), I(Diff), analog expansion module is used)[1)]

Note

The PAC4220 supports 2 expansion modules. One of these may be a communications module (e.g. 7KM PROFIBUS DP, 7KM RS485 or 7KM Switched Ethernet PROFINET expansion module).

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

Gateway

- Modbus gateway for integrating purely Modbus RTU devices into an Ethernet network (Ethernet Modbus TCP ⇔ RS485 Modbus RTU). This gateway function[1)] requires an RS485 expansion module.
- Serial gateway for connecting RS 485 devices that support Modbus RTU and similar protocols. This gateway function[1)] requires an RS485 expansion module.

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

Memory

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

[1)] This function will be available at a later time via a FW 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 (high and low 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[1)].
- Tariff switching after synchronization
  When synchronizing the power demand values via the communications interfaces or the digital input, the tariff change will only become effective after expiry of the period. Without synchronization, the tariff change takes effect immediately.
  The synchronization frame contains the length of the demand period in minutes. The synchronization command is ignored if the period length sent to the device with the synchronization frame is different to the length parameterized in the device.

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

Security

- Protection against unauthorized operation through PIN entry[1)]
- Hardware write protection
- Device access control (IP allowlist)[1)]
- Modbus TCP port, configurable[1)]

Using "Protection against unauthorized operation" and "Hardware write protection", you can protect against write access to the device settings of the PAC4220. The data can continue to be read without any restrictions.

The protection takes effect in case of the following actions:

- Modify parameters in device.
- Reset maximum.
- Reset minimum.
- Reset counter.
- Reset device.
- Reset device to factory defaults.
- Reset password.
- Update firmware on the device.

Note

Activating hardware write protection

Irrespective of whether the power monitoring device is connected to a network, we recommend **always** activating hardware write protection.

Note

Using the device in an unprotected network

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

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

See also

Protection against unauthorized operation (Page 89)

2.2 Measuring inputs

Current measurement

NOTICE
Functional impairment of the power monitoring device
Use the device to measure alternating current only.

PAC4220 is designed for:

- Current measurement via external x/1A or x/5A 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 Powerconfig to the current transformers used, see chapter Parameterizing via the operator interface. (Page 80)
- 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 to suit your measuring requirements in the Siemens product portfolio (4NC5x-xxxxx).

For further information, please go to: https://mall.industry.siemens.com/mall/de/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-voltage power supply.** The device is designed for measuring input voltages up to 400 V (347 V for UL) phase-to-neutral and 690 V (600 V for UL) phase-to-phase.

Connection types

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

Table 2-1 Available connection types

Short code	Connection type
3P4W	3 phases, 4 conductors, unbalanced load
3P3W	3 phases, 3 conductors, unbalanced load
3P4Wb	3 phases, 4 conductors, balanced load
3P3Wb	3 phases, 3 conductors, balanced load
1P2W	Single-phase AC

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

Connection examples can be found in chapter Commissioning. (Page 57)

NOTICE
Device damage due to incorrect system connection Before connecting the PAC4220, 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 at startup. You can find the instructions for parameterizing the connection type in chapter Parameterizing (Page 59).

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)
- Web server

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

The table below shows which measured variables can be displayed with each connection type.

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	✓	✓	-	✓	-
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	✓	-	-	-	-
3-phase average apparent power	✓	-	-	-	-
Active power L1	✓	-	-	-	-
Active power L2	✓	-	-	-	-
Active power L3	✓	-	-	-	-
3-phase average active power	✓	-	-	-	-
Total reactive power L1 (Q_{tot}) [1)]	✓	-	-	-	-

Measured variable	Connection type				
	3P4W	3P3W	3P4Wb	3P3Wb	1P2W
Total reactive power L2 (Q_{tot}) [1]	✓	-	-	-	-
Total reactive power L3 (Q_{tot}) [1]	✓	-	-	-	-
Reactive power L1 (Q_1) [1]	✓	-	-	-	-
Reactive power L2 (Q_1) [1]	✓	-	-	-	-
Reactive power L3 (Q_1) [1]	✓	-	-	-	-
3-phase average reactive power [1]	✓	-	-	-	-
Total apparent power over all phases	✓	✓	✓	✓	✓
Total active power over all phases	✓	✓	✓	✓	✓
Total reactive power (Q_{tot}) of all phases [1]	✓	✓	✓	✓	✓
Total reactive power (Q_1) of all phases [1]	✓	✓	✓	✓	✓
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	✓	✓	-	✓	-
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	✓	✓	✓	✓	✓
Unbalance voltage	✓	-	-	-	-
Unbalance current	✓	✓	-	-	-
Amplitude unbalance voltage	✓	-	-	-	-
Amplitude unbalance current	✓	✓	-	-	-
Distortion current L1	✓	✓	✓	✓	✓
Distortion current L2	✓	✓	-	-	-

Measured variable	Connection type				
	3P4W	3P3W	3P4Wb	3P3Wb	1P2W
Distortion current L3	✓	✓	-	-	-
Harmonic content of the 1st, 2nd, 3rd, ... 64th harmonics for the L1-N voltage referred to the fundamental	✓	-	✓	-	✓
Harmonic content of the 1st, 2nd, 3rd, ... 64th harmonics for the L2-N voltage referred to the fundamental	✓	-	-	-	-
Harmonic content of the 1st, 2nd, 3rd, ... 64th harmonics for the L3-N voltage referred to the fundamental	✓	-	-	-	-
Harmonic content of the 1st, 2nd, 3rd, ... 64th harmonics for the L1-L2 voltage referred to the fundamental	✓	✓	-	✓	-
Harmonic content of the 1st, 2nd, 3rd, ... 64th harmonics for the L2-L3 voltage referred to the fundamental	✓	✓	-	✓	-
Harmonic content of the 1st, 2nd, 3rd, ... 64th harmonics for the L3-L1 voltage referred to the fundamental	✓	✓	-	✓	-
Current of the fundamental and current of the 1st, 2nd, 3rd, ... 64th harmonics in L1	✓	✓	✓	✓	✓
Current of the fundamental and current of the 1st, 2nd, 3rd, ... 64th harmonics in L2	✓	✓	-	-	-
Current of the fundamental and current of the 1st, 2nd, 3rd, ... 64th harmonics in L3	✓	✓	-	-	-
Universal counter	✓	✓	✓	✓	✓
Operating hours counter	✓	✓	✓	✓	✓

[1] The reactive power type Q_1 or Q_{tot} that appears on the display is set using the configuration software. All three reactive power types can be called via the interface.

Note

The measured values specified in the table are displayed as instantaneous, minimum and maximum values.

2.3.2 Sliding window demands

Note

This function will be available at a later time via a firmware update.

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

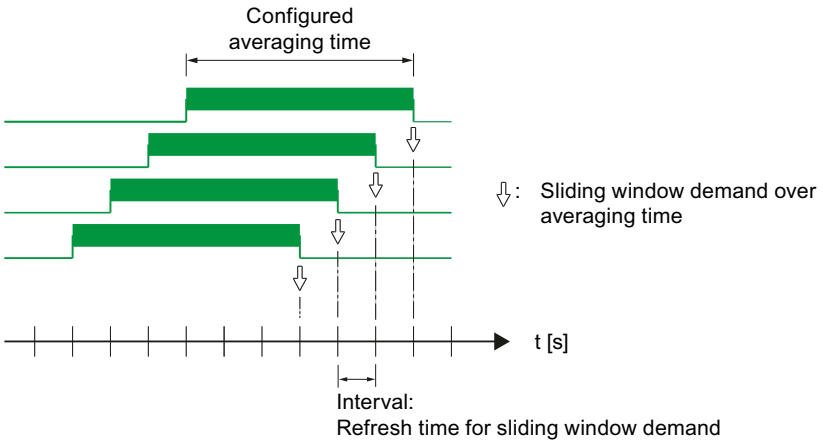


Figure 2-1 Sliding window demand

The PAC4220 supplies sliding window demand values for a large number of measured variables:

- Per phase or as a total value over all phases
- With the maximum and minimum values, and the time stamp of the extreme value

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

The averaging time can be parameterized on the display or via the communication interface.

The following can be set: 3, 5, 10, 30, 60, 300, 600, 900 seconds.

Representation on the display

The average character ∅ next to the measured variable (L1, L2, L3 or a, b, c) indicates that the displayed value is a sliding window demand value.

2.3.3 Averaging measured values

Note

This function will be available at a later time via a firmware update.

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 3 average value generators that can be parameterized independently of one 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).
- Harmonic average (file 3)

The averaging time can be set between 3 seconds and 1 year.

2.3.4 Other properties of measured variable representation

Zero point suppression level

The zero point suppression level 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 indicated on the display with "0" (zero).

Lowest limit of operating hours counter[1)]

The operating hours counter starts as soon as load is measured at the current input. The lowest 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 lowest limit, the operating hours counter is not incremented.

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

2.4 History of active energy consumption

Note

This function will be available at a later time via a firmware update.

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.

This function is available only in conjunction with communications interfaces.

2.5 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.

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.

2.6 Technical features of the network quality

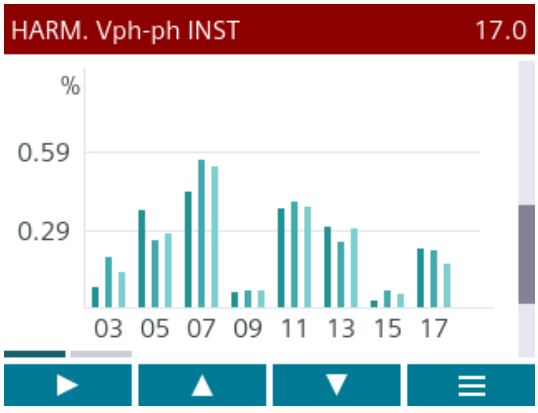
The PAC4220 supplies the following measured variables for evaluating network quality:

- Harmonics up to the 64th harmonic
- THD for voltage and current:
- Displacement angle φ
- Cosine of the displacement angle φ
- Phase angle U
- Unbalance voltage and unbalance current

Measurement of 1st to 64th 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 odd (3rd to 63rd) or all (1st to 64th) integer voltage and current harmonics and display them as a bar diagram on the display.



It is also possible to read out the data using a Modbus command.

The Modbus table can be found in chapter Readout of harmonic components of all harmonics with function codes 0x03 and 0x04 (Page 126).

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 value and the time stamp of the maximum value are supplied.

The values are calculated in accordance with standard IEC 61557-12: 2007. Harmonics up to the 64th harmonic are taken into account.

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 maximum and minimum values for each phase.

The values can be read out via the communications interfaces.

Cosine φ

Cos φ is the cosine of the displacement angle φ of the fundamentals for voltage and current. The possible values of cos φ are between -1 and 1.

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

The values can be read out via the communications interfaces.

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

Phase angle U

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

The values can be called via the communications interfaces.

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.

2.7 Date and time

UTC time and local time

The internal clock of the PAC4220 measures UTC time. All information about the date and time (time stamp) that can be called at the communications interfaces must be interpreted as UTC time.

The PAC4220 display indicates the configured local time corresponding to the time difference due to time zones and daylight saving time.

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

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

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

Example: 3.36 p.m. CEST (local time in Germany) on September 10, 2022 corresponds to 1.36 p.m. (UTC time) on September 10, 2022. Germany is located in the UTC+1 time zone. Daylight saving time applies on the above-mentioned date, so the local time is shifted by one hour ("+1").

Time synchronization[1)]

The internal clock of the PAC4220 can be synchronized with an external time, e.g. using the "Top of minute" pulse, or 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 35).

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

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

2.8 Limit values

Note

This function will be available at a later time via a firmware update.

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 combined with each other using a logic operation. The result of the logic operation can also be used to trigger specific actions in the same way as the individual limit values.

The limit value violations are shown on the display or, depending on how the LEDs are configured, by the LEDs lighting up, flashing or going out.

2.9 Function of the digital inputs and outputs

Note

This function will be available at a later time via a firmware update.

PAC4220 has:

- 2 multifunctional digital inputs
- 2 multifunctional digital outputs
- Optionally up to 8 plug-in digital inputs*
- Optionally up to 4 plug-in digital outputs*

*if two optionally available 4DI/2DO expansion modules (7KM9200-0AB00-0AA0) are used

2.10 Ethernet interface

The PAC4220 has two identical Ethernet interfaces via which the device can be connected to the 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)[1)]
  The protocol can only be used to read out the measured values via a web browser.
- SNTP[1)]
  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.

Autonegotiation is a method used by network communication peers to automatically negotiate the highest possible transmission 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 offers 2 Ethernet ports that are connected internally via the Ethernet switch. This supports Ethernet linear topology for efficient cabling, with no additional cost for external Ethernet switches.

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

2.11 Slots for expansion modules

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

The following expansion modules[1)] 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)

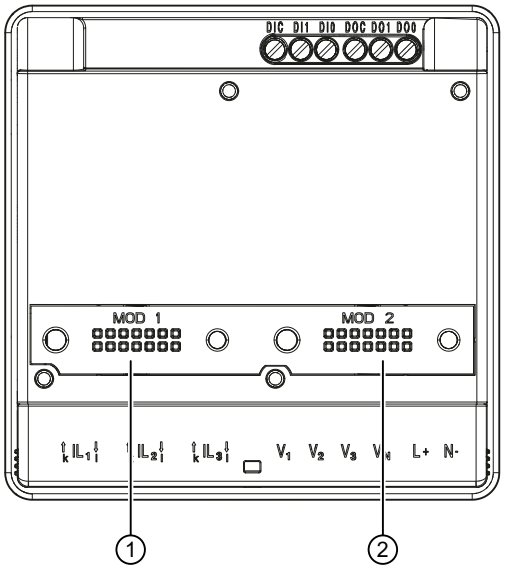
1 expansion module can be operated alone on the device or 2 expansion modules simultaneously.

Note

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 openings 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 openings 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.

[1)] Only the RS485 module is initially supported. The other modules will be supported at a later time via a firmware update.

Installation 3

Mounting location

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

⚠ 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 111) 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 101).

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 111).

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.

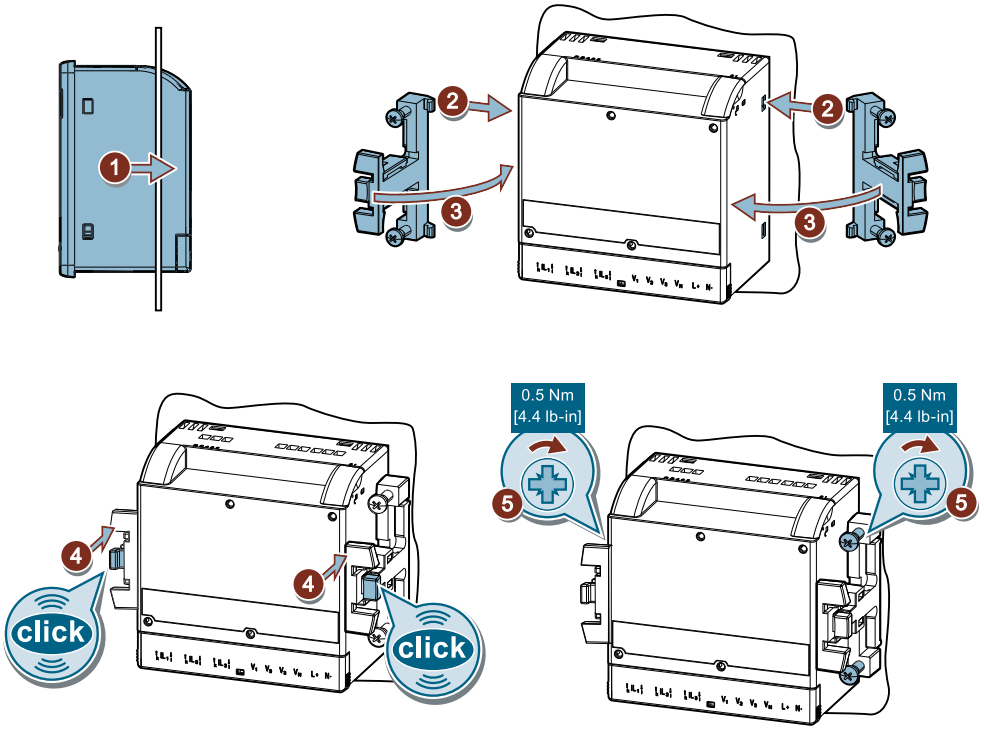


Figure 3-1 Installation

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
- Slotted screwdriver

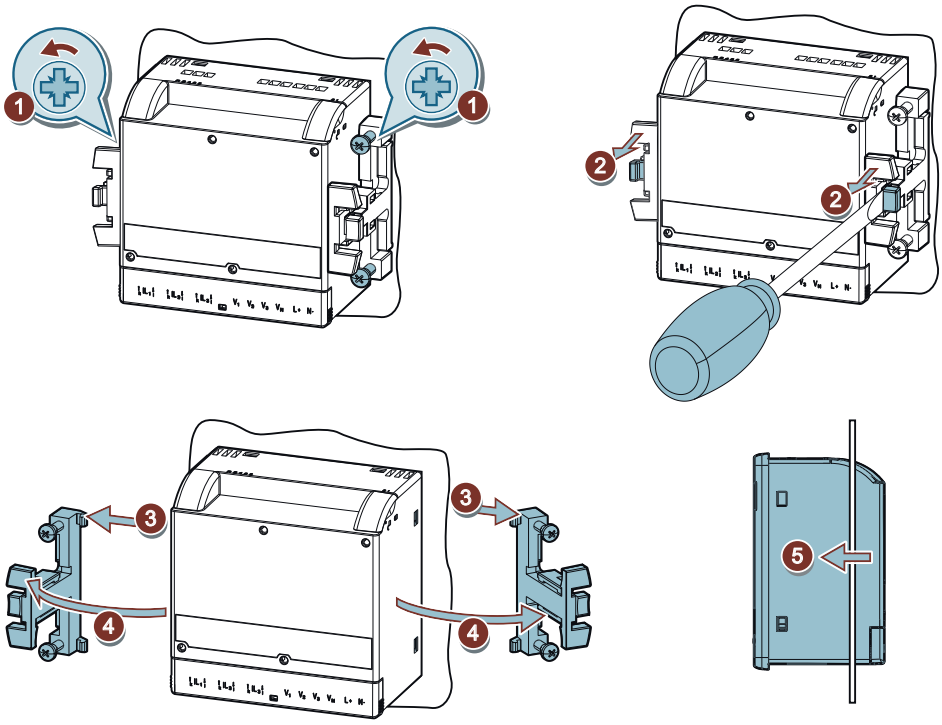


Figure 3-2 Deinstallation

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.

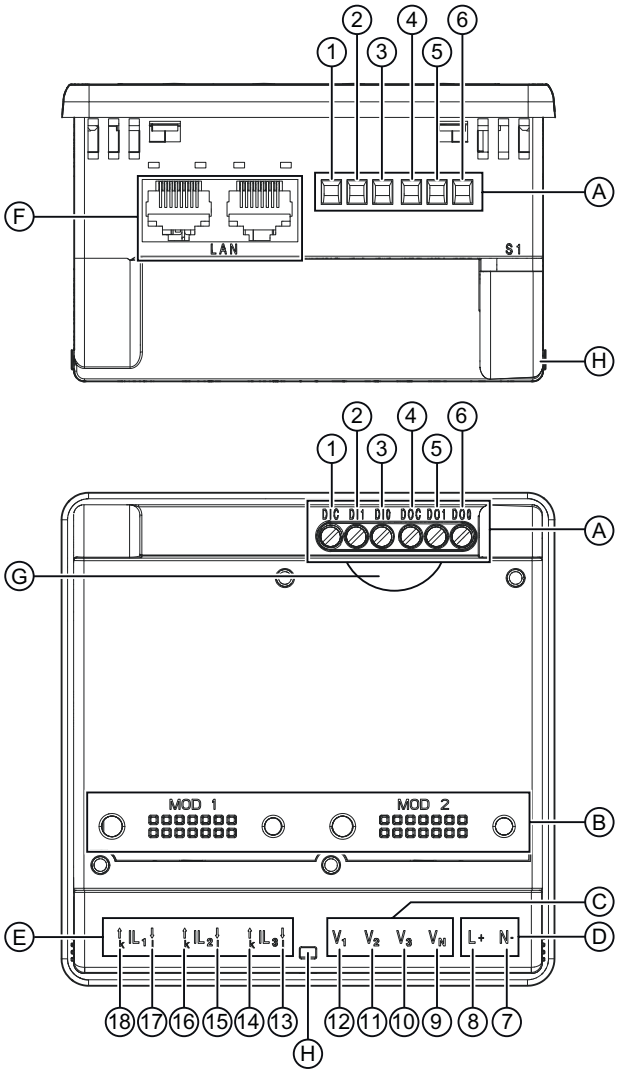
Note

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 (Page 89) (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↓ I	Current I_{L3}, output
⑭	IL_3 ↑ k k	Current I_{L3}, input
⑮	IL_2 I↓ I	Current I_{L2}, output
⑯	IL_2 ↑ k k	Current I_{L2}, input
⑰	IL_1 I↓ I	Current I_{L1}, output
⑱	IL_1 ↑ k 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.

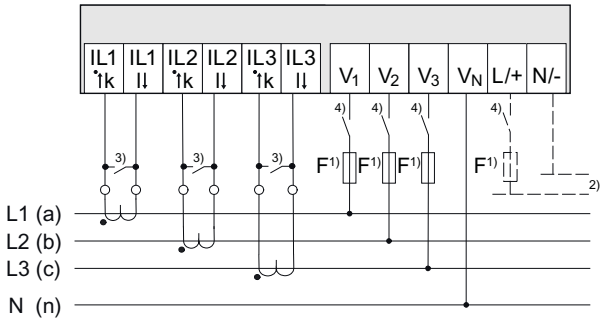
All input or output terminals not required for measuring remain free.

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

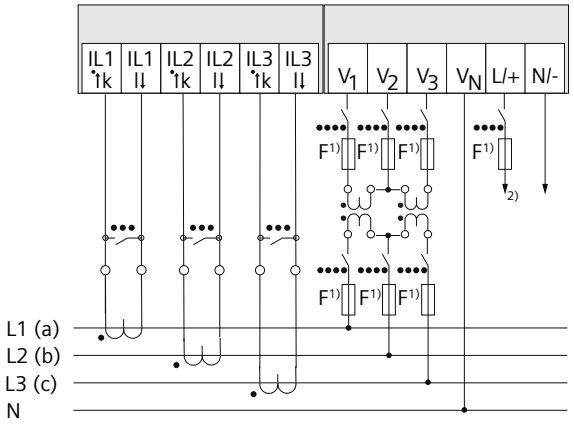
3) Install a short-circuit device. Protection against overvoltage when the secondary transformer circuit is open.

4) Circuit breaker

Figure 4-1 Connection type 3P4W, without voltage transformer, with 3 current transformers

(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

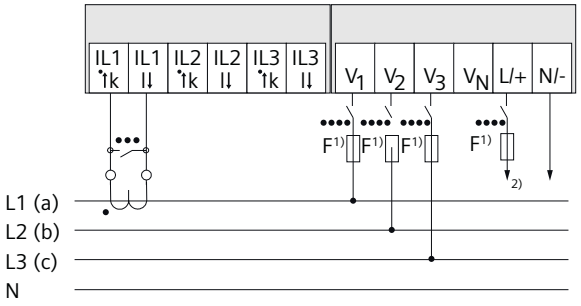
3) Install a short-circuit device. Protection against overvoltage when the secondary transformer circuit is open.

4) Circuit breaker

Figure 4-2 Connection type 3P4W, with voltage transformer, with 3 current transformers

(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

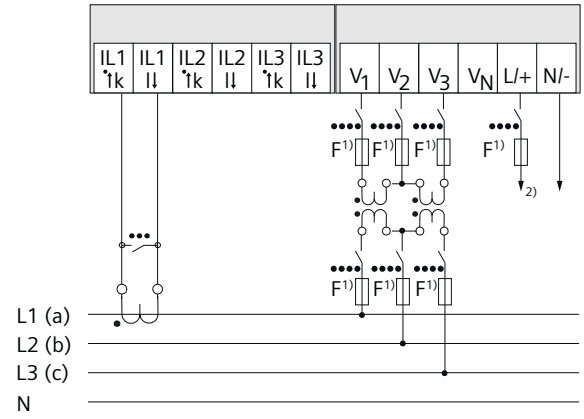
3) Install a short-circuit device. Protection against overvoltage when the secondary transformer circuit is open.

4) Circuit breaker

Figure 4-3 Connection type 3P4WB, without voltage transformer, with 1 current transformer

(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

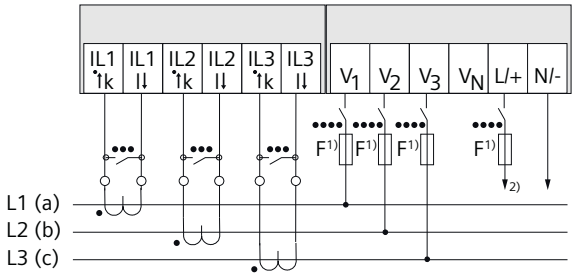
3) Install a short-circuit device. Protection against overvoltage when the secondary transformer circuit is open.

4) Circuit breaker

Figure 4-4 Connection type 3P4WB, with voltage transformer, 1 current transformer

(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

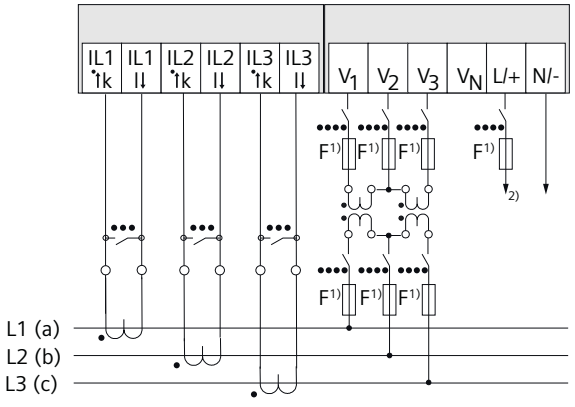
3) Install a short-circuit device. Protection against overvoltage when the secondary transformer circuit is open.

4) Circuit breaker

Figure 4-5 Connection type 3P3W, without voltage transformer, with 3 current transformers

(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

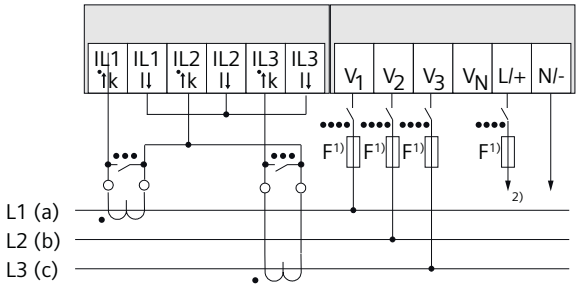
3) Install a short-circuit device. Protection against overvoltage when the secondary transformer circuit is open.

4) Circuit breaker

Figure 4-6 Connection type 3P3W, with voltage transformer, with 3 current transformers

(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

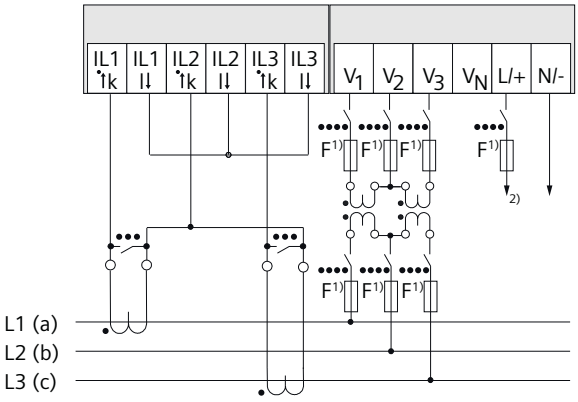
3) Install a short-circuit device. Protection against overvoltage when the secondary transformer circuit is open.

4) Circuit breaker

Figure 4-7 Connection type 3P3W, without voltage transformer, with 2 current transformers

(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

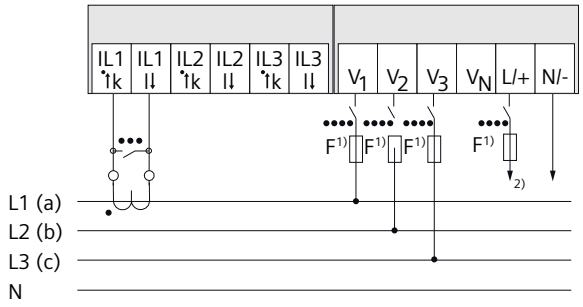
3) Install a short-circuit device. Protection against overvoltage when the secondary transformer circuit is open.

4) Circuit breaker

Figure 4-8 Connection type 3P3W, with voltage transformer, with 2 current transformers

(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

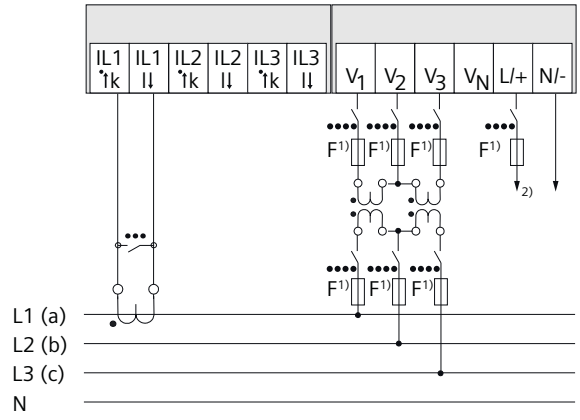
3) Install a short-circuit device. Protection against overvoltage when the secondary transformer circuit is open.

4) Circuit breaker

Figure 4-9 Connection type 3P3WB, without voltage transformer, with 1 current transformer

(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

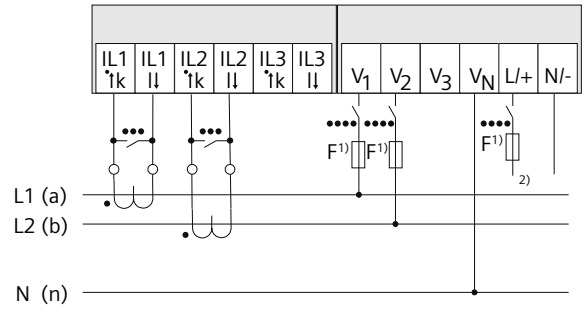
3) Install a short-circuit device. Protection against overvoltage when the secondary transformer circuit is open.

4) Circuit breaker

Figure 4-10 Connection type 3P3WB, with voltage transformer, with 1 current transformer

(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

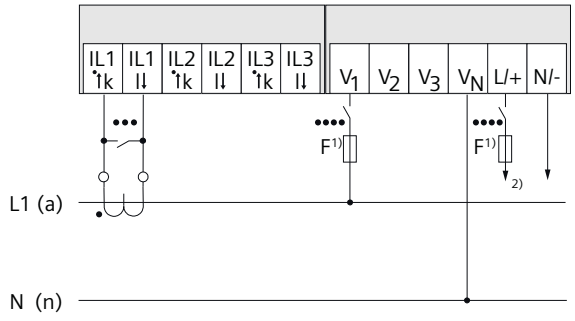
3) Install a short-circuit device. Protection against overvoltage when the secondary transformer circuit is open.

4) Circuit breaker

Figure 4-11 Connection type 3P4W, without voltage transformer, with 2 current transformers

(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 device. Protection against overvoltage when the secondary transformer circuit is open.

4) Circuit breaker

Figure 4-12 Connection type 1P2W, without voltage transformer, with 1 current transformer

See also

Applying the supply voltage (Page 58)

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 (optional for commissioning with 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.

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.

5.3.3 Basic parameters

Set the basic parameters:

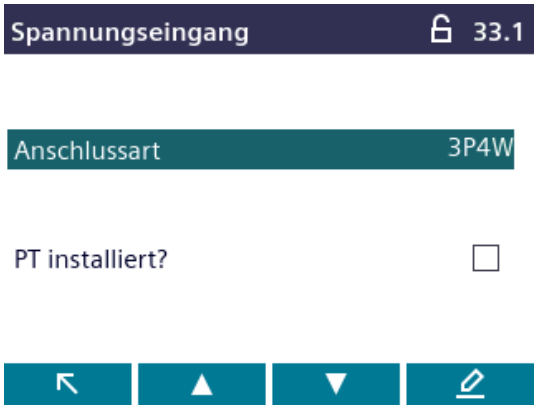
- Connection type
- Voltage
  - Direct measurement on the system or using voltage transformers
  - Measuring input voltage in the case of direct measurement on the system
  - Primary and secondary voltage when measuring using voltage transformers
- Current
  - Primary current
  - Secondary current

Please also note the information in chapters Operation (Page 65) and Parameterizing (Page 79).

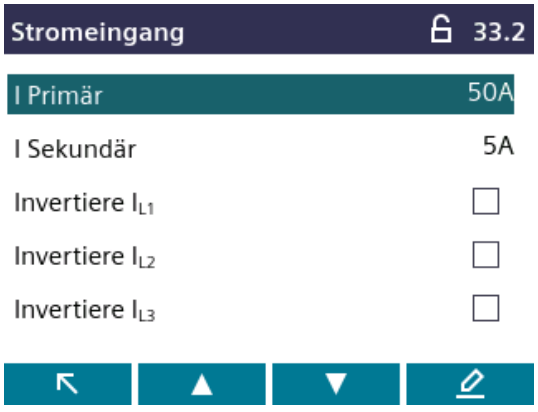
Example:

You want to measure in a 3P4W 10 kV system using voltage transformers (10000 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 "ESC" 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.

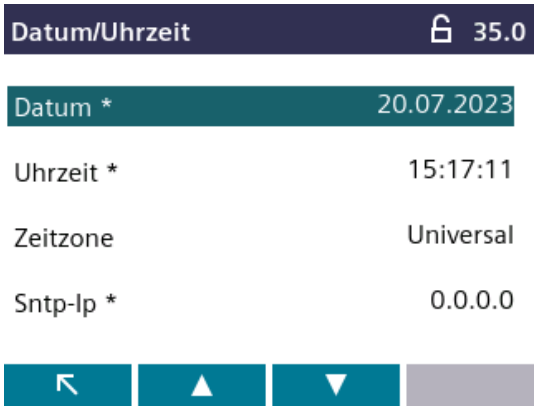
5.3.4 Additional settings

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 88).

Also refer to chapters Operation (Page 65) and Parameterizing (Page 79).

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 58)
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 81) section.

See also

Safety information (Page 43)

Measuring inputs (Page 21)

5.6 Checking the displayed measured values

Correct connection type

With the help of the table "Display of measured variables (Page 23) 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.

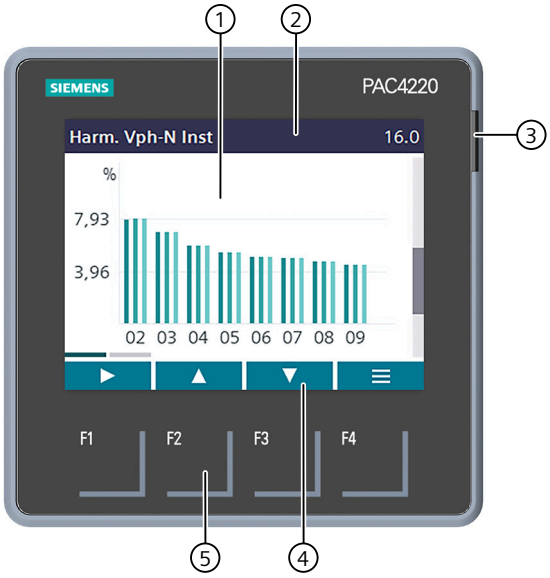
Operation

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.

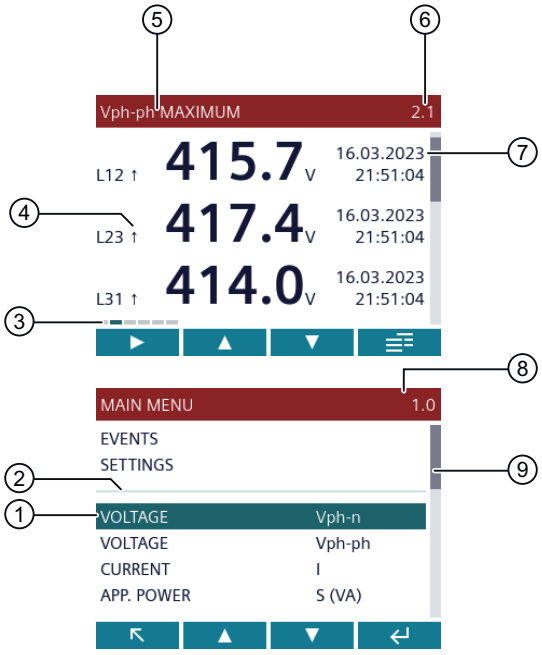
② Header area:
Specifies the information visible in the display area.

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.

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
⑧	Device protection symbol • Open padlock: Protection deactivated • Padlock closed: Protection activated
⑨	Scroll bar (display can be scrolled upwards/downwards)

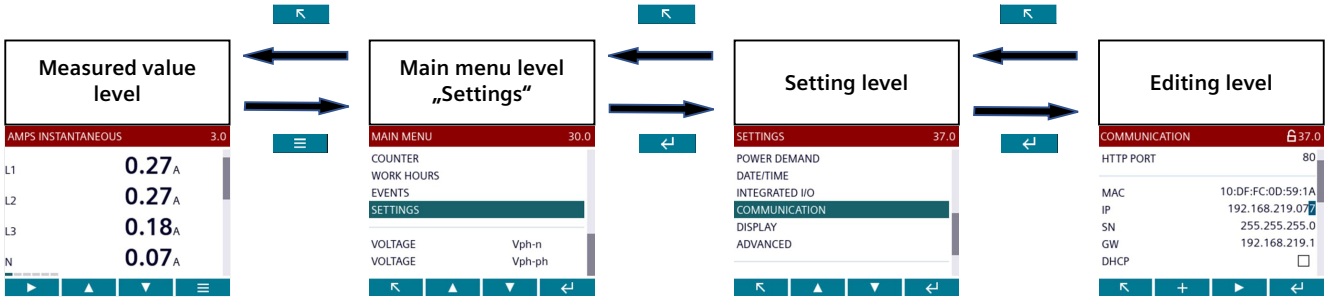
6.1.2 Menu-based navigation

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 79).

The device menu can be subdivided into four menu levels:

- **Measured value level**
- **Main menu level**

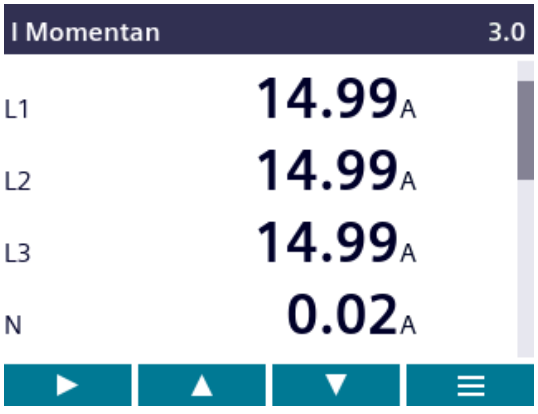
- **Setting level**
- **Editing level**



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 23). 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.
- 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 ENTER 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 settable parameters.
- The ↵ key confirms the required selection and takes the device to the editing level.

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 ⟳ 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	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".
	▼	**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.
	☰	**Measured value level:** This key activates the main menu.
	☰	**Measured value level:** The submenu is currently selected on the device. This key activates the main menu. Holding the key down for a prolonged period activates a context menu in which, for example, it is possible to reset minimum or maximum values.
	↵	**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.

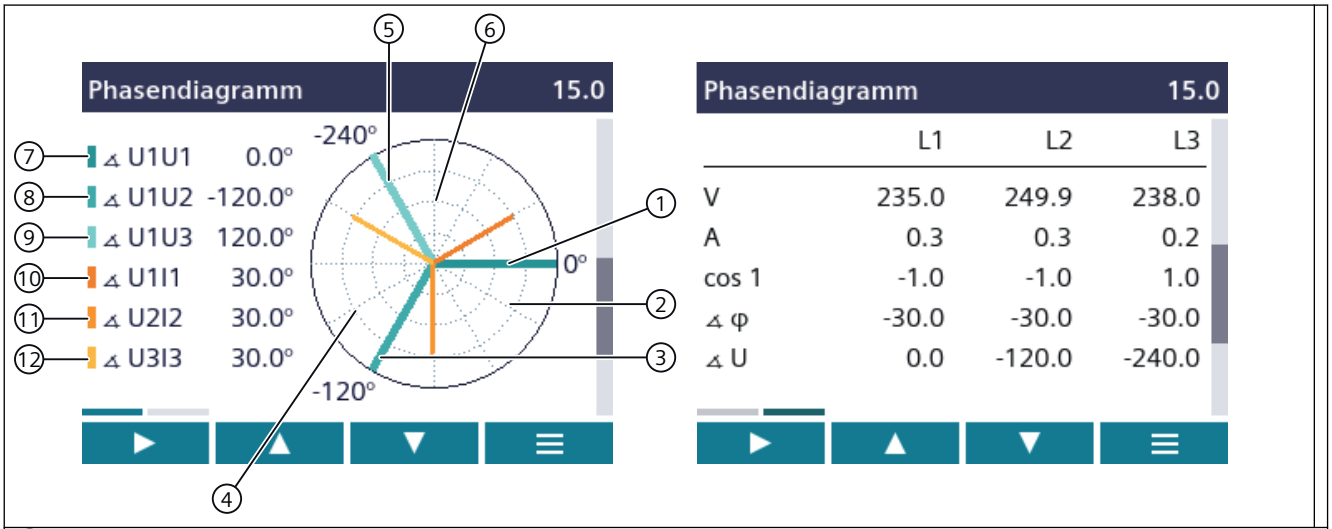
6.2 Special displays

6.2.1 Phasor diagram

The phasor diagram 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 diagram



① Voltage U1
② Current I1
③ Voltage U2
④ Current I2
⑤ Voltage U3
⑥ Current I3
⑦ Phase angle U1
⑧ Phase angle U1U2
⑨ Phase angle U1U3
⑩ Displacement angle U1 |1
⑪ Displacement angle U2 |2
⑫ Displacement angle U3 |3

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

6.2.2 Measurement of 1st to 64th 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 measuring 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 using Modbus command 0xFC20 "Read File Record 0x14".

Bar diagram on device display

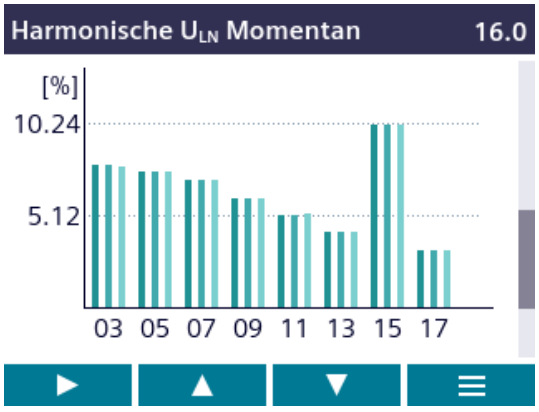
The device gives you the option of displaying only the odd (3rd to 63rd) or all (1st to 64th) the harmonics on the display.

Displaying harmonics on the PAC4220 display:

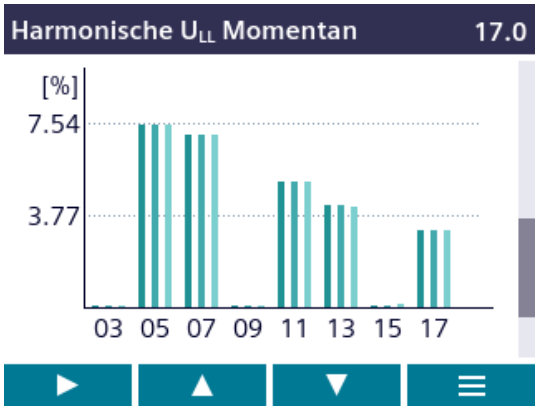
1. Select the "Display" submenu of the "Settings" menu.
2. You can select the display type in the menu option "FFT display type":
   – Harmonics "3, 5, 7 ... 63" (display of odd harmonics)

   – Harmonics "2, 3, 4 ... 64" (display of even and odd harmonics)

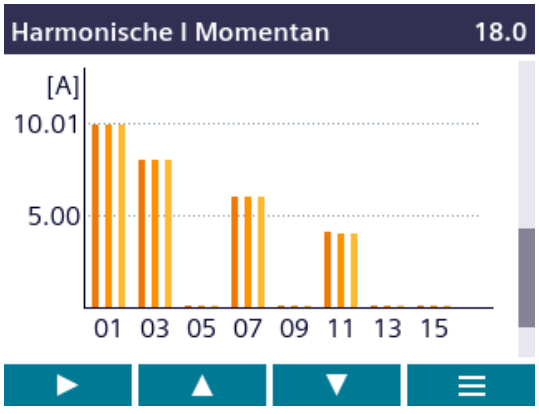
3. The following harmonic displays are available on the device display:
   - Harmonic UL-N



   - Harmonic UL-L

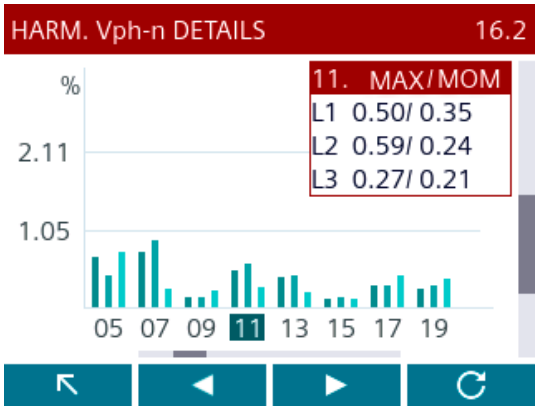


   - Harmonic I



4. You can call the following additional functions using the F1 key ▶ :
   - Max values
   - Delete max values

– Scroll right/left



You can find more information in chapter Readout of harmonic components of all harmonics with function codes 0x03 and 0x04 (Page 126).

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/document/109764480/sentron-energiemanagement-und-energiemonitoring?dti=0&lc=de-DE)
- Powerconfig software (https://mall.industry.siemens.com/mall/de/WW/Catalog/Products/10121795)

- Powermanager software (https://mall.industry.siemens.com/mall/de/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 Powerconfig software is the combined commissioning and service tool for communication-capable power monitoring 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. Power monitoring devices from the 7KM PAC series can be parameterized and operated via various communication interfaces using Powerconfig and measured values can be documented and monitored.

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 and loading of language packs (device-dependent)

Note

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

6.3.3 Advanced training courses

Find out about training courses on offer via the following link:

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

Here you can choose between:
web-based training courses (online, informative, free of charge)
Classroom training courses (in-person event, comprehensive, subject to fee)
Online training courses (with Teams or Adobe Connect, comprehensive, subject to fee)

The popular online training format offers several advantages:
No travel costs
Time saving
No need to travel

You also have the possibility of compiling your own training portfolio via **Learning paths**.

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

As delivered, the device settings are not protected.

The device protection functions must be activated on start-up to guard against unauthorized or inadvertent changes.

7.1 Parameterizing via the operator interface

You can parameterize the PAC4220 via the "Settings" menu option. You can find more information on this in chapter Menu-based navigation (Page 66).

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, averaging time of the sliding window demand, zero point suppression, frequency
- **Power demand**
  Settings for the load profile
- **Date/time**
  Time-related settings
- **Integrated I/Os**
  Settings for using the digital inputs and outputs
- **Communication**
  Network communication settings
- **Display**
  Settings for the display
- **Advanced**
  Password protection, limit values, universal counter, device reset, expansion modules
- **Settings for 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
7KM4220-1BA01-1EC0	Article number of the device
S/N: xxxxxx	Serial number of the device
SW-REV: xxxx	Firmware revision level
BL-REV: xxxx	Bootloader revision level
LP-REV: xxxx	Language pack version

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 input

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, unbalanced 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
Measuring voltage	• 1 V ... 690 V, freely adjustable (max. 600 V for UL)	• 400 V
PT PRIMARY (provided Use PTs? ☑ ON)	• 1 V ... 999999 V, freely adjustable	• 400 V
PT SECONDARY (provided Use PTs? ☑ ON)	• 1 V ... 690 V, freely adjustable (max. 600 V for UL)	• 400 V

Current input

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

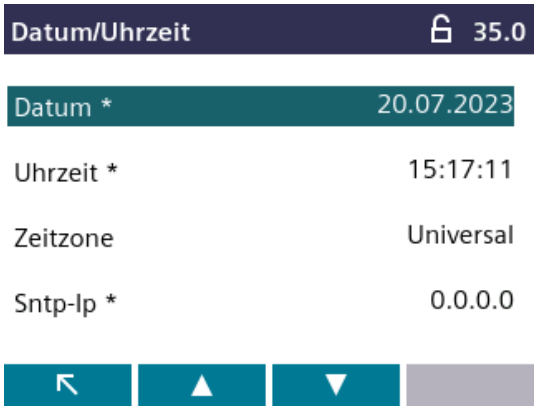
Selection	Range	Factory setting
DISPLAY RANGE	Resolution of current indication Freely adjustable 1 A ... 99999 A	50 A
• CURRENT DIREC L1 • CURRENT DIREC L2 • CURRENT DIREC L3	Inverse evaluation of the current flow direction separately for each phase. • ☑ ON: Direction of current flow is inverted. The device interprets the current flow direction opposite to the wiring. • ☐ OFF: The device interprets the current flow direction in accordance with the wiring.	☐ OFF

Minimum current

Selection	Range	Factory setting
MEASUREMENT	Zero point suppression as a percentage of the primary rated current of the external current transformer: The minimum current measurement is used for zero point suppression so that zero is displayed below this limit. 0 ... 10%	0.0%

7.1.4 Date/time

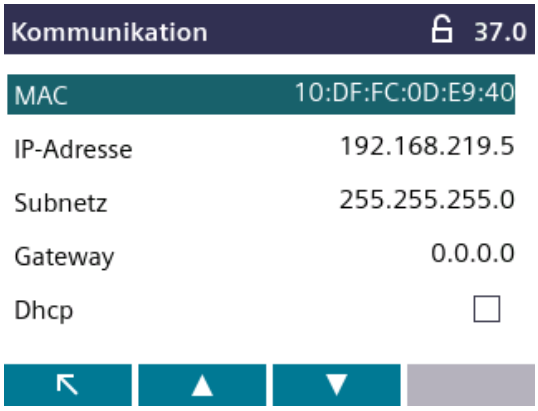
You set the date and time in this menu.



Selection	Range	Factory setting
DATE	Current date The date format is defined in the FORMAT field.	-
TIME	HH:MM:SS	-

Selection	Range	Factory setting
TIME ZONE	Time zone, refers to coordinated universal time (UTC). –12:00 ... +14:00, in 30-minute intervals	00:00
DAYLIGHTSAVING	Automatic time change	AUTO EU

7.1.5 Communication



You configure the communication interface in this menu.

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

Selection	Range	Factory setting
MAC	MAC address. Read only.	-
IP address	Manual setting of the IP address is only possible when DHCP is deactivated. Format: 000.000.000.000	-
Subnet	Manual setting of the subnet is only possible when DHCP is deactivated. Format: 000.000.000.000	-
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	-
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, network configurations cannot be adjusted manually.	ON

7.1.6 Display

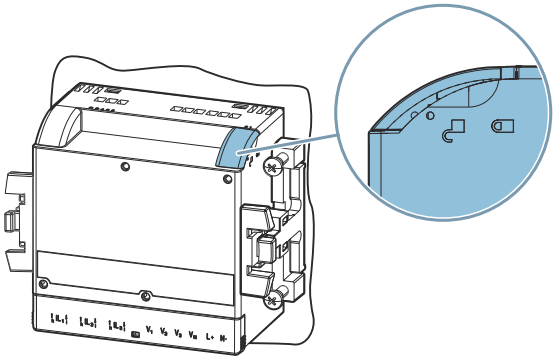
Selection	Range	Factory setting
FFT DISPLAY TYPE	The device gives you the option of displaying the odd (3rd to 63rd) or all (1st to 64th) harmonics on the PAC4220 display. • 3, 5, 7 ... 63: Only odd harmonics • 2, 3, 4 ... 64: All harmonics	3, 5, 7 ... 63
BACKLIGHT LEVEL	Intensity of the backlighting of the LC display. 0 ... 3	3
BACKLIGHT DIMMED	Intensity of the backlighting of the LC display. Set by the device after the display time until dimmed expires. See "TIME UNTIL DIMMED" field 0 (switches backlighting off) ... 3	1
TIME UNTIL DIMMED	Time after which the device switches the backlighting from "BACKLIGHT LEVEL" to "BACKLIGHT DIMMED". 0 min ... 99 min	3 min
DEFAULT MENU	The menu display number for the main menu can be entered here. The device then always starts up with the menu item 1 ... 28 defined here.	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) ... 3600 s	0 s
DISPLAY TEST...	Screen for testing the functional capability of the display. • F3: Selection of test color • F4 closes the display.	-

7.1.7 Advanced

7.1.7.1 Overview

7.1.7.2 Write protection

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, the hardware write protection must be deactivated directly on the device. The hardware write protection cannot be deactivated via a communication port.

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.

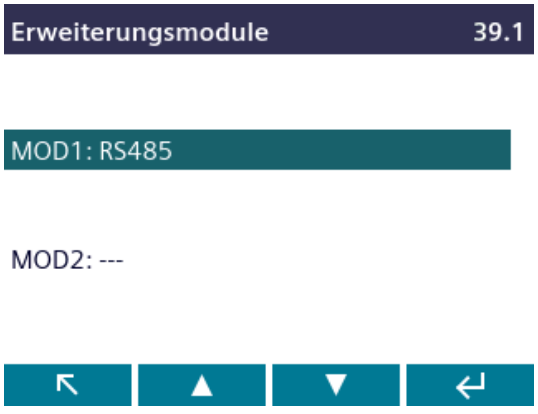
Selection	Range	Factory setting
WRITE PROTECTION	Write access is not possible when the hardware write protection is activated. This parameter is solely a display parameter. The position of the mechanical slider on the rear panel of the device must be adjusted in order to activate or deactivate the protection function.	☐ OFF

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.



7.2 Protection against tampering

7.2.1 Cybersecurity

In order to be able to operate devices of the SENTRON product group in a cybersecure manner, it is necessary to combine the devices/applications into a cybersecure network.

The following link takes you to an application example illustrating the principles of the network technology in which an exemplary cybersecurity configuration structure is shown.

Cybersecurity in low-voltage power distribution

Firmware update

Signed firmware is used to ensure that the PAC4220 complies with cybersecurity requirements.

The ECC Brainpool method with a length of 256 bits is used for secure encryption.

Each firmware update is documented in a non-resettable logbook.

List of communication protocols for the PAC4220

Service	Protocol	Default port	Direction	Property
Web server	HTTP	80	Both directions	Can be changed/switched off with (0)
Modbus TCP	TCP	502	Both directions	Can be changed/switched off with (0)
Identification Service	UDP	17008	Incoming	Cannot be switched off
Identification Service	UDP	17009	Outgoing	Cannot be switched off
DHCP server	UDP	68	Both directions	Can be switched off
Time synchronization NTP	UDP	123	Both directions	Can be switched off

7.2.2 Introduction

The PAC4220 is equipped with a range of mechanisms to protect against deliberate and inadvertent device manipulation:

- Protection against unauthorized operation
- Hardware write protection
- Device access control (IP allowlist)
- Configurable Modbus TCP port

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

- : Device is protected against write access.
- : Device is not protected against write access.

Note

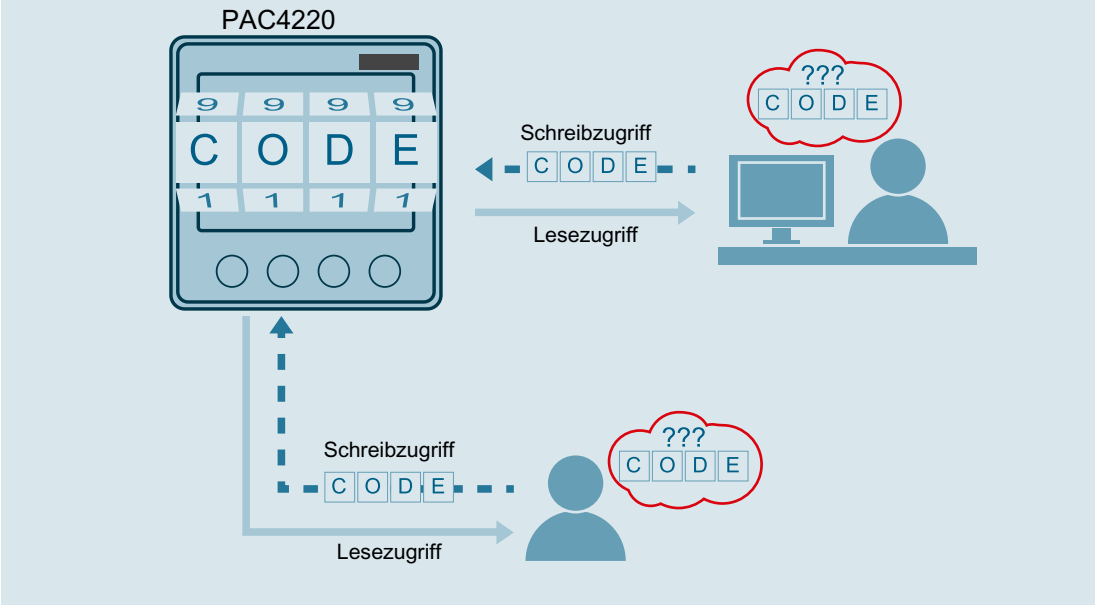
Siemens recommends activating the tamper protection mechanisms in the device.

7.2.3 Protection against unauthorized operation

Protection against unauthorized operation prevents write access via the device interface and the communication interfaces, in particular:

- Changing of device settings, including password
- 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 password protection is active.



As soon as the password has been entered in the device once, the password is not requested again as long as the "SETTINGS" menu level remains active.

Password policy: four-digit number from 0000 to 9999 (default password: 0000)

If no user-specific password has been assigned, the default password must be entered when protection against unauthorized operation is switched on. The currently valid password

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

Note

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

You also require the password to call the "PASSWORD" dialog box again in order to switch off access protection or to change the password.

Note

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

Hardware write protection

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

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

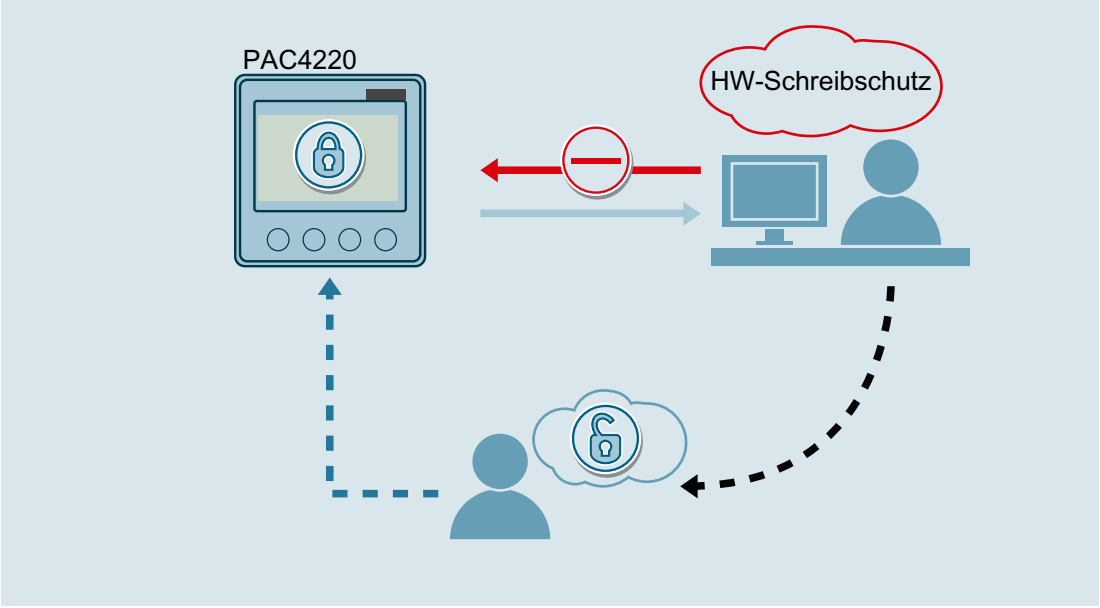
The hardware write protection cannot be deactivated via a communication interface.

The hardware write protection can be activated on the device and parameterized in detail in the "Advanced" submenu of the "Settings" menu. A list of the various setting options can be found in chapter Write protection (Page 86).

Note

Write protection slider

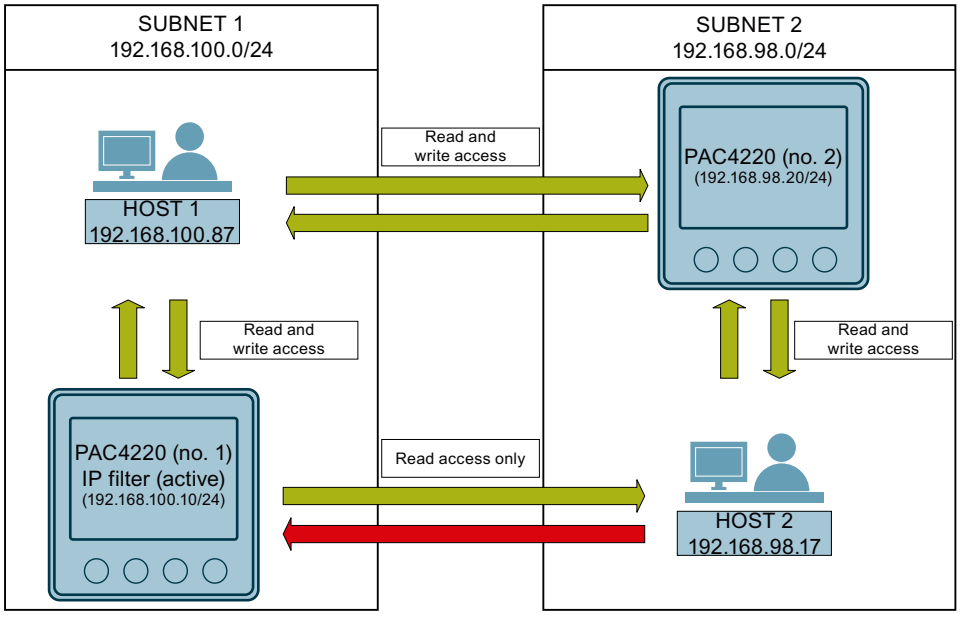
The user must adjust the position of the write protection slider on the rear panel of the device in order to activate or deactivate the hardware write protection function (see chapter Write protection (Page 86)).



7.2.4 Device access control (IP allowlist)

The IP allowlist is a configurable access protection. If the IP allowlist is activated, Modbus TCP write commands are only accepted if the remote station is located in the same subnet.

The IP allowlist can be activated on the device in the "Communication" submenu of the "Settings" menu.



Note

Switching from standard port 502 to a user-defined port makes it more difficult to scan for open ports.

Example

PAC4220 No. 1 **with IP allowlist** is located in subnet 1 (192.168.100.0/24).

PAC4220 No. 2 **without IP allowlist** is located in subnet 2 (192.168.98.0/24).

- Host 1 (IP: 192.168.100.87) in subnet 1 (192.168.100.0/24) has read and write access to PAC No. 1 (192.168.100.10/24), because Host 1 is located in the same subnet as the PAC device.
- Host 1 (IP: 192.168.100.87) in subnet 1 (192.168.100.0/24) has read and write access to PAC No. 2 (192.168.98.20/24) in subnet 2 (192.168.98.0/24), because no IP allowlist is activated on PAC No. 2.
- Host 2 (IP: 192.168.98.17) in subnet 2 (192.168.98.0/24) has read only access to PAC No. 1 (192.168.100.10/24), because the IP allowlist is activated on PAC No. 1 and Host 2 is not located in the same subnet as PAC No. 1.

7.2.5 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 Powerconfig configuration software or the web server (port 9990) for updating the firmware. Additional information on updating the firmware can be found in the online help for Powerconfig. You can find the available firmware versions on the internet (https://mall.industry.siemens.com/mall/de/WW/Catalog/Products/10121795).

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 79))
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 settings (incorrect IP address, incorrect subnet, incorrect Modbus TCP port or gateway?) • Check firewall, if present (possibly preventing communication to the Modbus ports)
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)
Fault indication in the display menu: "VOID"	• The device is defective and cannot be repaired.

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 42).
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 64th harmonic	
	For current measurement	True root mean square measurement (TRMS), zero blind measurement, gapless, up to the 64th harmonic	
Measured value acquisition		• Power • Frequency • Power factor • cos φ	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	Rated voltage	57.7/100 ... 400/690 V (IEC)
	Min. measuring voltage U_{L-N}	57.7/100 ... 347/600 V (UL)
	Max. measuring voltage U_{L-N}	480 V (IEC) 416 V (UL)
Zero point suppression	Voltage L-N	10 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)

Measuring inputs for voltage	
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_I	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 continuous current		10 A
Max. power consumption per phase		300 mVA at 5 A
Zero point suppression		0 ... 10% of rated current

Measuring 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 0.2 (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)/(IEC 62053-21)
Total reactive energy	Class 0.5 (IEC 61557-12)/(IEC 62053-23)
THD voltage referred to fundamental	Class 2 (IEC61557-12)
THD current referred to fundamental	Class 2 (IEC61557-12)
2nd ... 64th harmonic of the voltage referred to the fundamental	Class 2 (IEC61557-12)
2nd ... 64th harmonic of the current referred to the fundamental	Class 2 (IEC61557-12)

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 (thermal overload protection)
	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
	Minimal settable time frame	10 ms
	Max. switching frequency	17 Hz
	Short-circuit protection	Yes

Communication

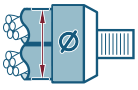
Ethernet interface		
	Number of connections	2
	Type	RJ45
	Suitable cable types	100Base-TX (CAT5)
	Protocols supported	Modbus TCP; web server (HTTP), SNTP; DHCP
	Transfer rates	10/100 Mbit/s, autonegotiation und Auto-MDI-X (Medium Dependent Interface)
	Update time at the interface	500 ms for instantaneous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

Displays and controls

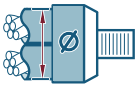
Display		
	Type	LC, graphic color display
	Backlit display	White
	Resolution	320 pixels x 240 pixels
	Size (W x H)	71 mm x 54 mm
Keyboard		
	4 function keys F1 to F4 on the front	

Connection elements

Connection components: Current connection, voltage connection		
Conductor cross-section for copper cable (Cu)	Rigid 	0.2 ... 6 mm² (AWG 24 ... 10)
	Flexible 	0.2 ... 4 mm² (AWG 24 ... 12)
	Flexible with end sleeve, without plastic sleeve 	0.2 ... 4 mm² (AWG 24 ... 12)
	Flexible with end sleeve and plastic sleeve 	0.2 ... 1.5 mm² (AWG 24 ... 16)

Connection components: Current connection, voltage connection		
2-wire, same cross-section	Rigid 	0.2 ... 1.5 mm² (AWG 24 ... 16)
	Flexible 	0.2 ... 1.5 mm² (AWG 24 ... 16)
	Flexible with end sleeve, without plastic sleeve 	0.25 ... 0.75 mm² (AWG 24 ... 19)
	Flexible with TWIN end sleeve and plastic sleeve 	0.5 ... 2.5 mm² (AWG 20 ... 14)

Connection components: Digital inputs and outputs		
Conductor cross-section for copper cable (Cu)	Rigid 	0.14 ... 1.5 mm² (AWG 26 ... 16)
	Flexible 	0.14 ... 1.5 mm² (AWG 26 ... 16)
	Flexible with end sleeve, without plastic sleeve 	0.25 ... 1 mm² (AWG 24 ... 18)
	Flexible with end sleeve and plastic sleeve 	0.25 ... 1.5 mm² (AWG 24 ... 16)

Connection components: Digital inputs and outputs		
2-wire, same cross-section	Rigid 	0.14 ... 0.75 mm² (AWG 26 ... 19)
	Flexible 	0.14 ... 0.75 mm² (AWG 26 ... 19)
	Flexible with end sleeve, without plastic sleeve 	0.25 ... 0.5 mm² (AWG 24 ... 20)
	Flexible with TWIN end sleeve and plastic sleeve 	0.5 ... 1 mm² (AWG 20 ... 18)
	Tightening torque	0.5 ... 0.6 Nm (4.4 ... 5.3 lb-in)

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		Vertical
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.		

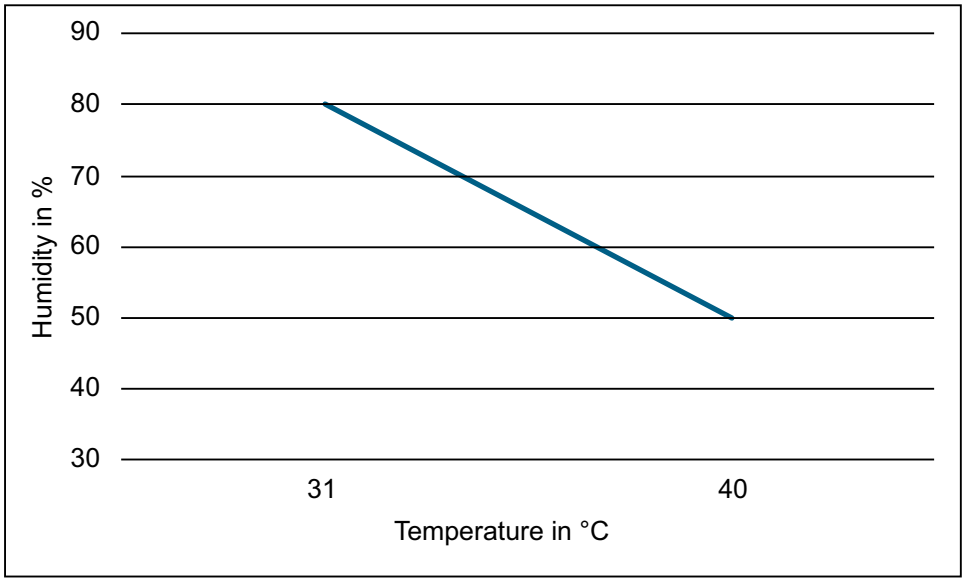
Ambient conditions

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 emission	EN 61326-1
	EN 61000-3-2 (Harmonic currents)
	EN 61000-3-3 (Voltage variations and flicker)
Limit values complied with for interference emission	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.
RCM	**Approval for Australia and New Zealand** Regulatory Compliance Mark
EAC	**Approval for Eurasian Economic Union**

You can download the relevant certificates from the Siemens Support website (https://support.industry.siemens.com/cs/ww/de/view/109764140).

9.2 Labeling

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

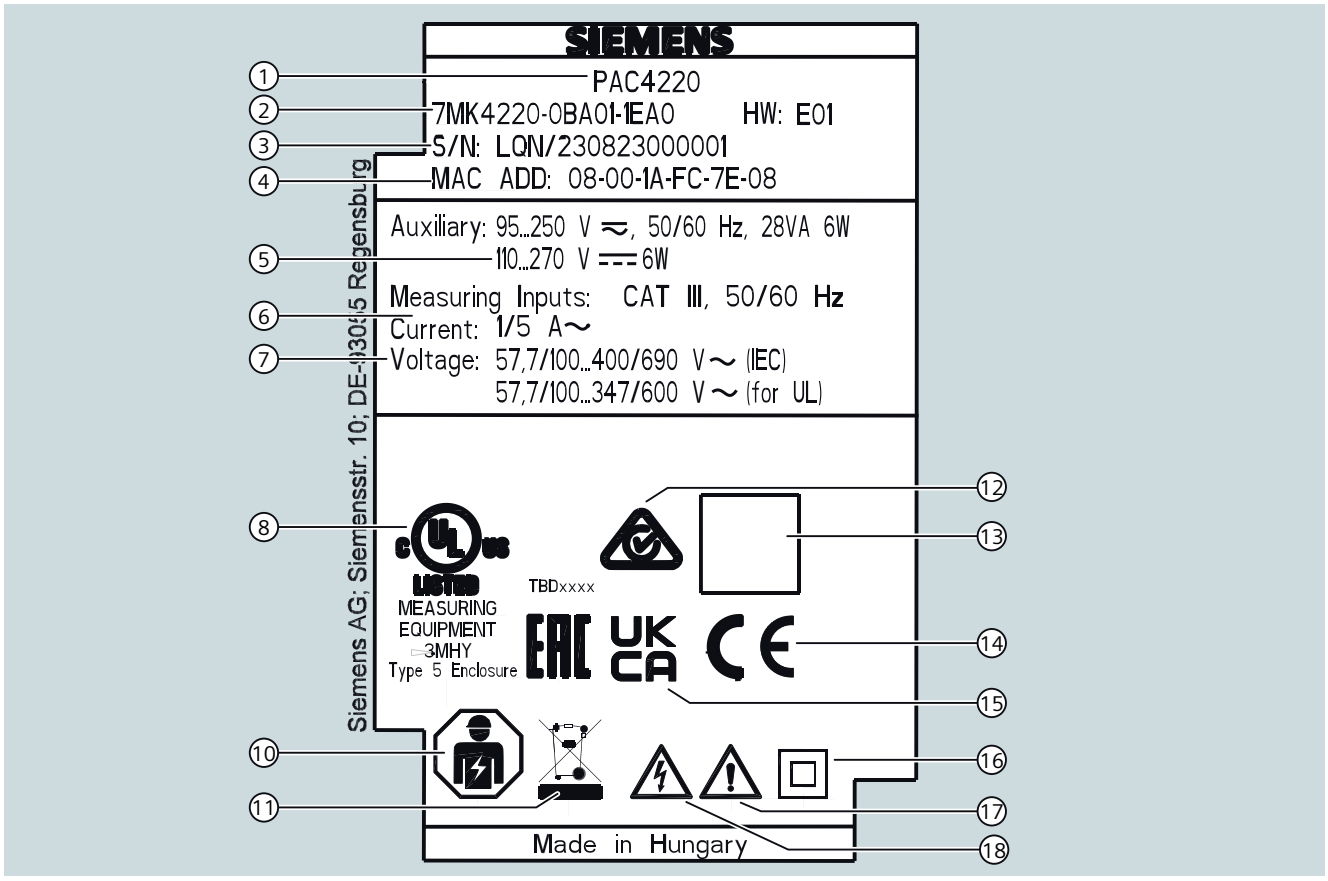


Table 9-1 Legend

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)	c UL us	Products with this mark comply with both the Canadian (CSA) and the American (UL) requirements. (in preparation)

Item	Symbol, label	Explanation
(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)		Protective insulation - class II device
(14)		CE marking (European Union)
(15)		UKCA marking (United Kingdom)
(16)		PV 14
(17)		Safety Alert Symbol
(18)		Risk of electric shock

Dimensional drawings

10

10.1 PAC4220 dimensional drawings

Panel cutout

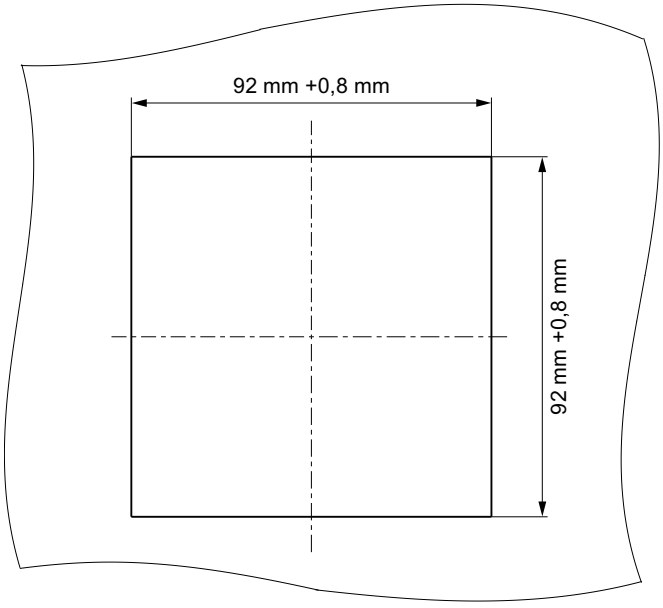


Figure 10-1 Panel cutout

Frame dimensions

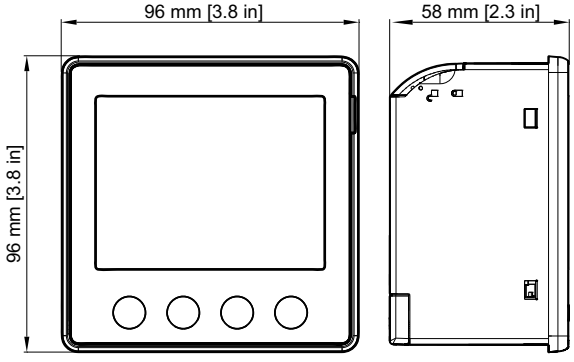
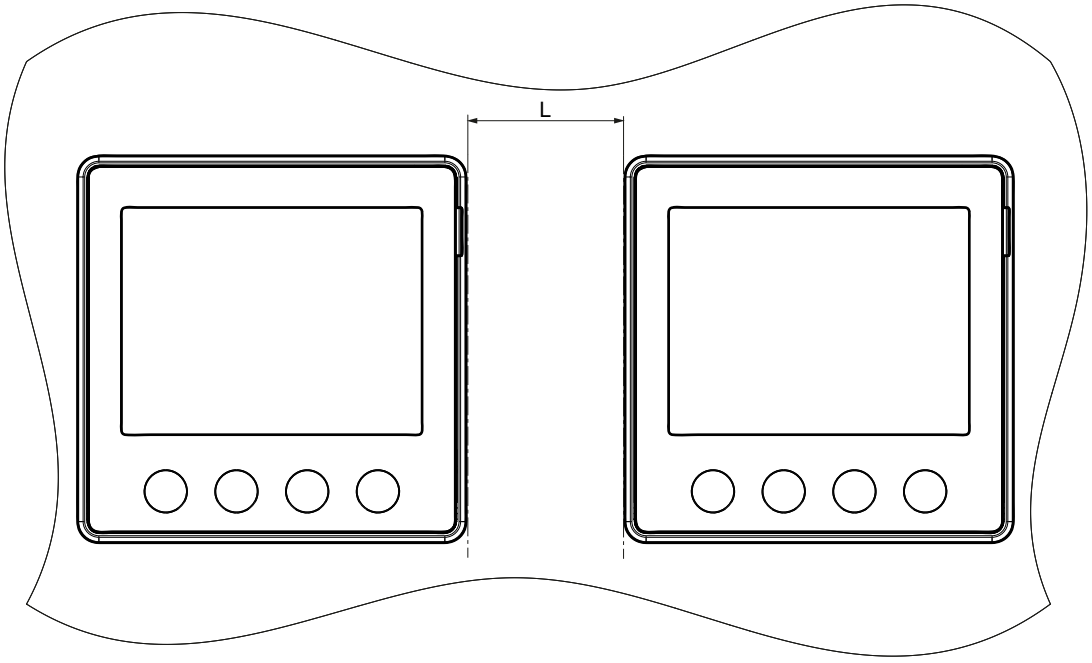


Figure 10-2 Frame dimensions

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
0x14	Read File Record (for average demand values)

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 the write protection is activated.	Deactivate write protection.

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 the start offset of the register is correct when making **read accesses**.

Please ensure the start offset and the number of registers are correct when making **write accesses**.

If a value consists of 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 write operation ends in the middle of a multi-register value.

###Information Markus Braun/Thomas Reisinger: Table not yet final. Final table (Datadictionary) will be supplied at a later time###

Table A-2 Measured variables available 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

Offset	Number of registers	Name	Format	Unit	Value range	Access
47	2	THD voltage L3-L1	Float	%	0 ... 100	R
55	2	Line frequency	Float	Hz	45 ... 65	R
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

Offset	Number of registers	Name	Format	Unit	Value range	Access
151	2	Minimum voltage L1-L2	Float	V	-	R
153	2	Minimum voltage L2-L3	Float	V	-	R
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
181	2	Minimum power factor L1	Float	-	0 ... 1	R
183	2	Minimum power factor L2	Float	-	0 ... 1	R
185	2	Minimum power factor L3	Float	-	0 ... 1	R
187	2	Minimum line frequency	Float	Hz	45 ... 65	R
189	2	Minimum 3-phase average voltage L-N	Float	V	-	R
191	2	Minimum 3-phase average voltage L-L	Float	V	-	R
193	2	Minimum 3-phase 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
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

Offset	Number of registers	Name	Format	Unit	Value range	Access
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	Unbalance voltage	Float	%	0 ... 100	R
293	2	Unbalance current	Float	%	0 ... 100	R
295	2	Neutral current	Float	A	-	R
297	2	Total reactive power (Qtot)	Float	VAR	-	R
299	2	Total reactive power (Q1)	Float	VAR	-	R

[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
W	Write access
RW	Read and write access

A.1.5 Tariff-specific energy values in double format with the function codes 0x03, 0x04, and 0x10

Addressing the tariff-specific energy values

Table A-4 Available tariff-specific measured variables

Offset	Number of registers	Name	Format	Unit	Value range	Access
797	4	Date/time	Time stamp	-	-	RW
801	4	Active energy import tariff 1	Double	Wh	Overflow 1.0e+12	RW
805	4	Active energy import tariff 2	Double	Wh	Overflow 1.0e+12	RW
809	4	Active energy export tariff 1	Double	Wh	Overflow 1.0e+12	RW
813	4	Active energy export tariff 2	Double	Wh	Overflow 1.0e+12	RW
817	4	Reactive energy import tariff 1	Double	VARh	Overflow 1.0e+12	RW
821	4	Reactive energy import tariff 2	Double	VARh	Overflow 1.0e+12	RW
825	4	Reactive energy export tariff 1	Double	VARh	Overflow 1.0e+12	RW
829	4	Reactive energy export tariff 2	Double	VARh	Overflow 1.0e+12	RW

Offset	Number of registers	Name	Format	Unit	Value range	Access
833	4	Apparent energy tariff 1	Double	VAh	Overflow 1.0e+12	RW
837	4	Apparent energy tariff 2	Double	VAh	Overflow 1.0e+12	RW
841	4	Process active energy	Double	Wh	Overflow 1.0e+12	RW
845	4	Process reactive energy	Double	VARh	Overflow 1.0e+12	RW
849	4	Process apparent energy	Double	VAh	Overflow 1.0e+12	RW
853	4	Process active energy – previous measurement	Double	Wh	-	R
857	4	Process reactive energy – previous measurement	Double	VARh	-	R
861	4	Process apparent energy – previous measurement	Double	VAh	-	R
865	4	L1 active energy import tariff 1	Double	Wh	-	RW
869	4	L1 active energy import tariff 2	Double	Wh	-	RW
873	4	L1 active energy export tariff 1	Double	Wh	-	RW
877	4	L1 active energy export tariff 2	Double	Wh	-	RW
881	4	L1 reactive energy import tariff 1	Double	VARh	-	RW
885	4	L1 reactive energy import tariff 2	Double	VARh	-	RW
889	4	L1 reactive energy export tariff 1	Double	VARh	-	RW
893	4	L1 reactive energy export tariff 2	Double	VARh	-	RW
897	4	L1 apparent energy tariff 1	Double	VAh	-	RW
901	4	L1 apparent energy tariff 2	Double	VAh	-	RW
905	4	L2 active energy import tariff 1	Double	Wh	-	RW
909	4	L2 active energy import tariff 2	Double	Wh	-	RW
913	4	L2 active energy export tariff 1	Double	Wh	-	RW
917	4	L2 active energy export tariff 2	Double	Wh	-	RW
921	4	L2 reactive energy import tariff 1	Double	VARh	-	RW
925	4	L2 reactive energy import tariff 2	Double	VARh	-	RW
929	4	L2 reactive energy export tariff 1	Double	VARh	-	RW
933	4	L2 reactive energy export tariff 2	Double	VARh	-	RW
937	4	L2 apparent energy tariff 1	Double	VAh	-	RW
941	4	L2 apparent energy tariff 2	Double	VAh	-	RW
945	4	L3 active energy import tariff 1	Double	Wh	-	RW
949	4	L3 active energy import tariff 2	Double	Wh	-	RW
953	4	L3 active energy export tariff 1	Double	Wh	-	RW
957	4	L3 active energy export tariff 2	Double	Wh	-	RW
961	4	L3 reactive energy import tariff 1	Double	VARh	-	RW
965	4	L3 reactive energy import tariff 2	Double	VARh	-	RW
969	4	L3 reactive energy export tariff 1	Double	VARh	-	RW
973	4	L3 reactive energy export tariff 2	Double	VARh	-	RW
977	4	L3 apparent energy tariff 1	Double	VAh	-	RW
981	4	L3 apparent energy tariff 2	Double	VAh	-	RW

Offset	Number of registers	Name	Format	Unit	Value range	Access
985	4	Secondary total of active energy - import (MID register)	Double	Wh	R	RW
989	4	Secondary total of active energy - export (MID register)	Double	Wh	R	RW
993	4	Total of active energy - import (MID register)	Double	Wh	R	RW
997	4	Total of active energy - export (MID register)	Double	Wh	R	RW

Table A-5 Meaning of the abbreviations in the "Access" column

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

A.1.6 Tariff-specific energy values in float format with the function codes 0x03 and 0x04

Addressing the tariff-specific energy values

Table A-6 Available tariff-specific measured variables

Offset	Number of registers	Name	Format	Unit	Value range	Access
2799	2	Date/time	Unsigned long	-	-	R
2801	2	Active energy import tariff 1	Float	Wh	Overflow 1.0e+12	R
2803	2	Active energy import tariff 2	Float	Wh	Overflow 1.0e+12	R
2805	2	Active energy export tariff 1	Float	Wh	Overflow 1.0e+12	R
2807	2	Active energy export tariff 2	Float	Wh	Overflow 1.0e+12	R
2809	2	Reactive energy import tariff 1	Float	VARh	Overflow 1.0e+12	R
2811	2	Reactive energy import tariff 2	Float	VARh	Overflow 1.0e+12	R
2813	2	Reactive energy export tariff 1	Float	VARh	Overflow 1.0e+12	R
2815	2	Reactive energy export tariff 2	Float	VARh	Overflow 1.0e+12	R
2817	2	Apparent energy tariff 1	Float	VAh	Overflow 1.0e+12	R
2819	2	Apparent energy tariff 2	Float	VAh	Overflow 1.0e+12	R
2821	2	Process active energy	Float	Wh	Overflow 1.0e+12	R
2823	2	Process reactive energy	Float	VARh	Overflow 1.0e+12	R
2825	2	Process apparent energy	Float	VAh	Overflow 1.0e+12	R

Offset	Number of registers	Name	Format	Unit	Value range	Access
2827	2	Process active energy – previous measurement	Float	Wh	-	R
2829	2	Process reactive energy – previous measurement	Float	VARh	-	R
2831	2	Process apparent energy – previous measurement	Float	VAh	-	R
2833	4	L1 active energy import tariff 1	Float	Wh	overflow 1.0e+12	RW
2835	4	L1 active energy import tariff 2	Float	Wh	overflow 1.0e+13	RW
2837	4	L1 active energy export tariff 1	Float	VARh	overflow 1.0e+14	RW
2839	4	L1 active energy export tariff 2	Float	VARh	overflow 1.0e+15	RW
2841	4	L1 reactive energy import tariff 1	Float	Wh	overflow 1.0e+16	RW
2843	4	L1 reactive energy import tariff 2	Float	Wh	overflow 1.0e+17	RW
2845	4	L1 reactive energy export tariff 1	Float	VARh	overflow 1.0e+18	RW
2847	4	L1 reactive energy export tariff 2	Float	VARh	overflow 1.0e+19	RW
2849	4	L1 apparent energy tariff 1	Float	VAh	overflow 1.0e+20	RW
2851	4	L1 apparent energy tariff 2	Float	VAh	overflow 1.0e+21	RW
2853	4	L2 active energy import tariff 1	Float	Wh	overflow 1.0e+22	RW
2855	4	L2 active energy import tariff 2	Float	Wh	overflow 1.0e+23	RW
2857	4	L2 active energy export tariff 1	Float	VARh	overflow 1.0e+24	RW
2859	4	L2 active energy export tariff 2	Float	VARh	overflow 1.0e+25	RW
2861	4	L2 reactive energy import tariff 1	Float	Wh	overflow 1.0e+26	RW
2863	4	L2 reactive energy import tariff 2	Float	Wh	overflow 1.0e+27	RW
2865	4	L2 reactive energy export tariff 1	Float	VARh	overflow 1.0e+28	RW
2867	4	L2 reactive energy export tariff 2	Float	VARh	overflow 1.0e+29	RW
2869	4	L2 apparent energy tariff 1	Float	VAh	overflow 1.0e+30	RW
2871	4	L2 apparent energy tariff 2	Float	VAh	overflow 1.0e+31	RW
2873	4	L3 active energy import tariff 1	Float	Wh	overflow 1.0e+32	RW
2875	4	L3 active energy import tariff 2	Float	Wh	overflow 1.0e+33	RW
2877	4	L3 active energy export tariff 1	Float	VARh	overflow 1.0e+34	RW
2879	4	L3 active energy export tariff 2	Float	VARh	overflow 1.0e+35	RW
2881	4	L3 reactive energy import tariff 1	Float	Wh	overflow 1.0e+36	RW
2883	4	L3 reactive energy import tariff 2	Float	Wh	overflow 1.0e+37	RW
2885	4	L3 reactive energy export tariff 1	Float	VARh	overflow 1.0e+38	RW
2887	4	L3 reactive energy export tariff 2	Float	VARh	overflow 1.0e+39	RW
2889	4	L3 apparent energy tariff 1	Float	VAh	overflow 1.0e+40	RW
2891	4	L3 apparent energy tariff 2	Float	VAh	overflow 1.0e+41	RW
2893	2	Secondary total of active energy - import (MID register)	Float	Wh	overflow 1.0e+12	R
2895	2	Secondary total of active energy - export (MID register)	Float	Wh	overflow 1.0e+12	R

Offset	Number of registers	Name	Format	Unit	Value range	Access
2897	2	Total of active energy - import (MID register)	Float	Wh	overflow 1.0e+12	R
2899	2	Total of active energy - export (MID register)	Float	Wh	overflow 1.0e+12	R

Table A-7 Meaning of the abbreviations in the "Access" column

Abbreviation	Meaning
R	Read access
RW	Read and write access

A.1.7 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:

###Formula representation still to be optimized by Alex Fischer, will be completed at a later time###

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	Length	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	Length	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
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	Length	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

Offset FC0x03 FC0x04	Length	Name	Format	Unit	Access
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.1.8 Odd harmonics with a time stamp with the function codes 0x03 and 0x04

Formula

The offsets of the 5th to 65th 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	Length	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

Offset FC0x03 FC0x04	Length	Name	Format	Unit	Access
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	Length	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	Length	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

A.1.9 Readout of harmonic components of all harmonics with function codes 0x03 and 0x04

For clarity, only the 1st and the 64th 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" (FC0x14):

- 5 + 2 x (3 – 1) = 9
- Offset of "3rd harmonic voltage L1-N" (FC0x14) is 9.

Example 2

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 3

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].

Length	Offset FC0x03 FC0x04	Name	Format	Unit	Access
2	36005	1st harmonic voltage L1-N	FLOAT	V	R
2	See formula	nth Harmonic voltage L1-N	FLOAT	%	R
2	36131	64th harmonic voltage L1-N	FLOAT	%	R
2	36133	1st harmonic voltage L2-N	FLOAT	V	R

Length	Offset FC0x03 FC0x04	Name	Format	Unit	Access
2	See formula	nth Harmonic voltage L2-N	FLOAT	%	R
2	36259	64th harmonic voltage L2-N	FLOAT	%	R
2	36261	1st harmonic voltage L3-N	FLOAT	V	R
2	See formula	nth Harmonic voltage L3-N	FLOAT	%	R
2	36387	64th harmonic voltage L3-N	FLOAT	%	R

File FC0x14	Length	Offset FC0x14	Offset FC0x03 FC0x04	Name	Format	Unit	Access
10	2	389	36389	1st harmonic current L1-N	FLOAT	A	R
10	2	See formula	See formula	nth Harmonic current L1-N	FLOAT	A	R
10	2	515	36515	64th harmonic current L1-N	FLOAT	A	R
10	2	517	36517	1st harmonic current L2-N	FLOAT	A	R
10	2	See formula	See formula	nth Harmonic current L2-N	FLOAT	A	R
10	2	643	36643	64th harmonic current L2-N	FLOAT	A	R
10	2	645	36645	1st harmonic current L3-N	FLOAT	A	R
10	2	See formula	See formula	nth Harmonic current L3-N	FLOAT	A	R
10	2	771	36771	64th harmonic current L3-N	FLOAT	A	R
10	2	773	36773	1st harmonic voltage L1-L2	FLOAT	V	R

File FC0x14	Length	Offset FC0x14	Offset FC0x03 FC0x04	Name	Format	Unit	Access
10	2	See formula	See formula	nth Harmonic voltage L1-L2	FLOAT	%	R
10	2	899	36899	64th harmonic voltage L1-L2	FLOAT	%	R
10	2	901	36901	1st harmonic voltage L2-L3	FLOAT	V	R
10	2	See formula	See formula	nth Harmonic voltage L2-L3	FLOAT	%	R
10	2	1027	37027	64th harmonic voltage L2-L3	FLOAT	%	R
10	2	1029	37029	1st harmonic voltage L3-L1	FLOAT	V	R
10	2	See formula	See formula	nth Harmonic voltage L3-L1	FLOAT	%	R
10	2	1155	37155	64th harmonic voltage L3-L1	FLOAT	%	R

File FC0x14	Length	Offset FC0x14	Offset FC0x03 FC0x04	Name	Format	Unit	Access
11	4	1	37201	1st max. harmonic voltage L1-N	FLOAT+TS32	V	R
11	4	See formula	See formula	nth max. harmonic voltage L1-N	FLOAT	%	R
11	4	53	37453	64th max. harmonic voltage L1-N	FLOAT+TS32	%	R
11	4	257	37457	1st max. harmonic voltage L2-N	FLOAT+TS32	V	R
11	4	See formula	See formula	nth max. harmonic voltage L2-N	FLOAT+TS32	%	R
11	4	509	37709	64th max. harmonic voltage L2-N	FLOAT+TS32	%	R
11	4	513	37713	1st max. harmonic voltage L3-N	FLOAT+TS32	V	R
11	4	See formula	See formula	nth max. harmonic voltage L3-N	FLOAT+TS32	%	R
11	4	765	37965	64th max. harmonic voltage L3-N	FLOAT+TS32	%	R

File FC0x14	Length	Offset FC0x14	Offset FC0x03 FC0x04	Name	Format	Unit	Access
11	4	769	37969	1st max. harmonic current L1-N	FLOAT+TS32	A	R
11	4	See formula	See formula	nth max. harmonic current L1-N	FLOAT+TS32	A	R
11	4	1021	38221	64th max. harmonic current L1-N	FLOAT+TS32	A	R
11	4	1025	38225	1st max. harmonic current L2-N	FLOAT+TS32	A	R
11	4	See formula	See formula	nth max. harmonic current L2-N	FLOAT+TS32	A	R
11	4	1277	38477	64th max. harmonic current L2-N	FLOAT+TS32	A	R
11	4	1281	38481	1st max. harmonic current L3-N	FLOAT+TS32	A	R
11	4	See formula	See formula	nth max. harmonic current L3-N	FLOAT+TS32	A	R
11	4	1533	38733	64th max. harmonic current L3-N	FLOAT+TS32	A	R

File FC0x14	Length	Offset FC0x14	Offset FC0x03 FC0x04	Name	Format	Unit	Access
11	4	1537	38737	1st max. harmonic voltage L1-L2	FLOAT+TS32	V	R
11	4	See formula	See formula	nth max. harmonic voltage L1-L2	FLOAT+TS32	%	R
11	4	1789	38989	64th max. harmonic voltage L1-L2	FLOAT+TS32	%	R
11	4	1793	38993	1st max. harmonic voltage L2-L3	FLOAT+TS32	V	R
11	4	See formula	See formula	nth max. harmonic voltage L2-L3	FLOAT+TS32	%	R

File FC0x14	Length	Offset FC0x14	Offset FC0x03 FC0x04	Name	Format	Unit	Access
11	4	2045	39245	64th max. harmonic voltage L2-L3	FLOAT+TS32	%	R
11	4	2049	39249	1st max. harmonic voltage L3-L1	FLOAT+TS32	V	R
11	4	See formula	See formula	nth max. harmonic voltage L3-L1	FLOAT+TS32	%	R
11	4	2301	39501	64th max. harmonic voltage L3-L1	FLOAT+TS32	%	R

A.1.10 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-8 Configuration settings

Offset	Number of registers	Name	Format	Unit	Value range	Access
49999	2	Rated current display range	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	-	1 ... 999999 V	RW
50007	2	Secondary voltage	Unsigned long	-	1 ... 690 V	RW
50009	2	Voltage transformer Yes/No?	Unsigned long	-	1 = Yes	RW
50011	2	Primary current	Unsigned long	-	1 ... 999999 V	RW
50013	2	Secondary current	Unsigned long	-	1 A, 5 A	RW
50017	2	Line frequency	Unsigned long	-	-	RW
50019	2	Zero point suppression	Float	%	0.0 ... 10.0	RW

[1] Subperiods 0 and 1: Fixed block method; subperiods 0 to 5: Rolling block method

Offset	Number of registers	Name	Format	Unit	Value range		Access
50047	2	Dialog Language	Unsigned long	-	0 =	German	RW
					1 =	English	
50049	2	Phase identifier IEC/UL	Unsigned long	-	0 =	IEC	RW
					1 =	US	
50057	2	Display Backlight Level	Unsigned long	%	0 ... 3		RW
50059	2	Display Backlight Dimmed	Unsigned long	%	0 ... 3		RW
50061	2	Display Time Until Dimmed	Unsigned long	min	0 ... 99		RW

Offset	Number of registers	Name	Format	Unit	Value range		Access
50231	2	Date format	Unsigned long	-	0 =	dd.mm.yyyy	RW
					1 =	mm/dd/yy	
					2 =	yyyy-mm-dd	
50235	2	Time Zone	Long	min	MODULO(30)==0		RW

Offset	Number of registers	Name	Format	Unit	Value range	Access
50261	2	Default menu No.	Unsigned long	-	DISPLAYED MENU NUMBER:	RW
					1 MEAS_VLN	
					2 MEAS_VLL	
					3 MEAS_I	
					4 MEAS_S	
					5 MEAS_P	
					6 MEAS_Q	
					7 MEAS_SPQ	
					8 MEAS_PF	
					9 MEAS_PFSUM	
					10 MEAS_COS	
					11 MEAS_F	
					12 MEAS_THDU	
					13 MEAS_THDI	
					14 MEAS_PHASOR	
					15 HARMONICS_U	
					16 HARMONICS_U_PHPH	
					17 HARMONICS_I	
					18 MEAS_WORK_S	
					19 MEAS_WORK_P	
					20 MEAS_WORK_Q	
					21 MEAS_COUNTER	
					22 MEAS_WORKHOUR	
					23 MEAS_IMBALPHASE	
					24 DIAGNOSTIC	
					25 USER_DEFINED_SCREEN_0	
					26 USER_DEFINED_SCREEN_1	
					27 USER_DEFINED_SCREEN_2	
					28 USER_DEFINED_SCREEN_3	
50263	2	Timeout for Returning to Default Menu	Unsigned long	-	0 ... 3600 s	RW
50265	2	DHCP on/off	Unsigned long	-	0 ... 1	RW
50285	2	IP Filter Allowlist Entry #1 IP Network Address	Unsigned long	-	0..0xFFFFFFFF	RW
50287	2	IP Filter Allowlist Entry #1 IP Network Mask	Unsigned long	-	0..0xFFFFFFFF	RW

Offset	Number of registers	Name	Format	Unit	Value range	Access
50289	2	IP Filter Allowlist Entry #1 Flags	Unsigned long	-	Bit0: Deactivated Bit1: Read MODBUS Bit2: Write MODBUS	RW
50291	2	IP Filter Allowlist Entry #2 IP Network Address	Unsigned long	-	0..0xFFFFFFFF	RW
50293	2	IP Filter Allowlist Entry #2 IP Network Mask	Unsigned long	-	0..0xFFFFFFFF	RW
50295	2	IP Filter Allowlist Entry #2 Flags	Unsigned long	-	Bit0: Deactivated Bit1: Read MODBUS Bit2: Write MODBUS	RW
50297	2	IP Filter Allowlist Entry #3 IP Network Address	Unsigned long	-	0..0xFFFFFFFF	RW
50299	2	IP Filter Allowlist Entry #3 IP Network Mask	Unsigned long	-	0..0xFFFFFFFF	RW
50301	2	IP Filter Allowlist Entry #3 Flags	Unsigned long	-	Bit0: Deactivated Bit1: Read MODBUS Bit2: Write MODBUS	RW
50303	2	IP Filter Allowlist Entry #4 IP Network Address	Unsigned long	-	0..0xFFFFFFFF	RW
50305	2	IP Filter Allowlist Entry #4 IP Network Mask	Unsigned long	-	0..0xFFFFFFFF	RW
50307	2	IP Filter Allowlist Entry #4 Flags	Unsigned long	-	Bit0: Line enabled Bit1: Read MODBUS Bit2: Write MODBUS	RW
50309	2	IP Filter Allowlist Entry #5 IP Network Address	Unsigned long	-	0..0xFFFFFFFF	RW
50311	2	IP Filter Allowlist Entry #5 IP Network Mask	Unsigned long	-	0..0xFFFFFFFF	RW
50313	2	IP Filter Allowlist Entry #5 Flags	Unsigned long	-	Bit0: Deactivated Bit1: Read MODBUS Bit2: Write MODBUS	RW

A.1.11 I&M settings

Addressing the settings for the I&M data

Table A-9 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(W)
64028	89	PAC4220 I&M 1 to I&M 4 data	stIM14	-	• 0x03 • 0x04 • 0x10	-	RW
64117	27	IM Data Module Interface 1	stIM0-	-	• 0x03 • 0x04	-	R(W)
64144	27	IM Data Module Interface 2	stIM0	-	• 0x03 • 0x04	-	R(W)

A.1.12 Commands with the function code 0x06

Addressing the commands

Table A-10 Commands

Offset	Number of registers	Name	Format	Applicable MODBUS function codes	Value range		Access
60000	1	Reset device to factory settings	Unsigned short	0x06	4711		W
60006	1	Switching tariff	Unsigned short	0x06	0 =	On-peak tariff	W
					1 =	Off-peak tariff	
60007	1	Acknowledge diagnostics bits	Unsigned short	0x06	0-ffffh		W

A.1.13 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-11 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

Further Information

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