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MANUAL

SENTRON

7KM Power Monitoring Devices

PAC3120 MID
PAC3220 MID

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SENTRON

7KM Power Monitoring Devices PAC3120 MID and PAC3220 MID

Equipment Manual

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Appendix A

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Legal information

Warning notice system

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

⚠ DANGER

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

⚠ WARNING

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

⚠ CAUTION

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

NOTICE

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

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

Qualified Personnel

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

Proper use of Siemens products

Note the following:

⚠ WARNING

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

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Disclaimer of Liability

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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Introduction

1

1.1 Components of the product

Scope of supply of PAC3120 MID

The package includes:

- One PAC3120 MID or PAC3220 MID Power Monitoring Device
- Two brackets for panel mounting
- One set of Operating Instructions (https://support.industry.siemens.com/cs/de/de/view/109818033/en)

Available software

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



- Powermanager (https://support.industry.siemens.com/cs/document/64850998) software



Available accessories

- Compact bracket (https://support.industry.siemens.com/cs/de/de/view/109478534/en) (7KM9900-0GA00-0AA0)
- Adapter for DIN-rail mounting (display faces forwards) (https://support.industry.siemens.com/cs/ww/en/pv/7KM9900-0XA00-0AA0/pi?dl=de) (7KM9900-0XA00-0AA0)
- Adapter for DIN-rail mounting (display faces towards DIN rail) (https://support.industry.siemens.com/cs/ww/en/pv/7KM9900-0YA00-0AA0/pi?dl=en) (7KM9900-0YA00-0AA0)

Accessories available only for PAC3220 MID

- 7KM PROFIBUS DP expansion module (https://support.industry.siemens.com/cs/de/de/view/26504884/en) (7KM9300-0AB00-0AA0; 7KM9300-0AB01-0AA0)

- 7KM RS485 expansion module
  (https://support.industry.siemens.com/cs/de/de/view/67463517/en)
  (7KM9300-0AM00-0AA0)

- 7KM 4DI/2DO expansion module
  (https://support.industry.siemens.com/cs/de/de/view/67414265/en)
  (7KM9200-0AB00-0AA0)

- 7KM I(N), I(Diff), analog expansion module
  (https://support.industry.siemens.com/cs/de/de/view/109748116/en)
  (7KM9200-0AD00-0AA0)

- 7KM Switched Ethernet PROFINET expansion module
  (https://support.industry.siemens.com/cs/de/de/view/49742527/en)
  (7KM9300-0AE02-0AA0)

1.2 Technical Support

You can find further support on the Internet at:

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

1.3 Open Source Software

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

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See also

Industry Online Support (https://support.industry.siemens.com/cs/us/en/ps)

www.opensource.org (http://www.opensource.org)

1.4 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.

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:

1.5 General safety notes



⚠ DANGER

Hazardous voltage
Failure to heed this notice 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

These operating instructions do not purport to cover all details or variations in equipment, or to 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 Follow the safety instructions in the manual.
(3)		Electrical installation and maintenance by qualified personnel only

1.6 Protective mechanisms against manipulation

Note

Risk of manipulation

Several protective mechanisms can be activated in the device.

In order to reduce the risk of manipulation occurring on the device, it is recommended that the protective mechanisms available in the device are activated:

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

For further information, please refer to chapter Security features (Page 91).

Description

2

2.1 Features

Area of application

These are power monitoring devices for measuring the basic electrical variables in low-voltage power distribution.

The device can be used with the following connection types:

- 3P4W (three-phase, four-wire)
- 1P2W (single-phase, two-wire) - (MID available soon)
- 3P3W (three-phase, three-wire) - without MID approval

The power monitoring devices are designed for panel mounting. It is also possible to mount them on a DIN rail using the DIN rail support brackets available as an option.

The power monitoring devices are suitable for installation in residential and industrial environments.

Thanks to their large measuring voltage range, the devices can be directly connected in any low-voltage system up to a rated voltage U_{L-N} of 230 V L-N. They can also be employed in conjunction with voltage transformers to take measurements in medium- or high-voltage systems.

It is only possible to measure the current with external x / 1 A or x / 5 A current transformers.

The power monitoring devices have a range of useful monitoring, diagnostics and service functions, a two-tariff active energy and reactive energy counter, a universal counter, and an operating hours counter for monitoring the running time of connected loads.

The parameters can be set either directly on the power monitoring device or via the communications interface.

Measurement

- Measurement of all relevant electrical variables in an AC system
- Measurement of minimum and maximum values of all measured variables
- Averaging of all measured values directly on the device in two stages, which are independent of each other and freely configurable (aggregation)

Counters and average power demand values

- A number of energy counters capture active energy, reactive energy, apparent energy for off-peak and on-peak, import and export.
- Calculation and storage of the average value for active power and reactive power from the last demand period to allow simple generation of load profiles using software.
- Daily energy counter for active energy for each day of the preceding two months.
- Monthly energy counter for active energy for each month of the preceding two years.
- Configurable universal counter for counting limit violations and status changes at the digital input or output, or for indicating the active energy or reactive energy of a connected incremental encoder.
- Operating hours counter for monitoring the runtime of a connected load.
- MID-certified active energy counter for import and export (Measuring Instruments Directive 2014/32/EU)
- Annual consumption of active energy for import and export over 7 years
- Display of load profile data via web server in the form of a bar chart
- Logbook for storing up to 1000 events relevant to statutory calibration regulations
- Convenient display of logbook data on the device or via web server
- Download of the logbook via Modbus TCP or in the form of a csv file via the integral web server
- Internal device clock with high accuracy and time synchronization function via time server

Display and operator control

The power monitoring devices have a large, graphical LC display on which all measured variables are clearly visible. The four function keys combined with the multilingual plain text displays make intuitive user guidance possible. The experienced operator can also use direct navigation for quicker selection of the desired display menu.

After 120 s in the idle state, the display automatically switches to the default menu "kWh IMPORT - sum of T1 + T2 kWh".

Software support

- SENTRON Powerconfig
- SENTRON Powermanager

Interfaces

PAC3120 MID

- RS485 interface
- Two multifunctional integral passive digital inputs
- Two multifunctional integral passive digital outputs

PAC3220 MID

- Two identical Ethernet interfaces
- Two multifunctional integral passive digital inputs
- Two multifunctional integral passive digital outputs
- Two slots for operating optional expansion modules[1)]
- RS485 (when a 7KM RS485 expansion module is used)
- PROFIBUS (when a 7KM PROFIBUS DP expansion module is used)
- Two optional modules, each with four active digital inputs and two digital outputs (when 4DI/2DO expansion module is used)

[1)] The SENTRON PAC3220 MID supports two expansion modules. One of these may be a communications module (e.g. 7KM Switched Ethernet PROFINET, 7KM PROFIBUS DP or 7KM RS485). Only one "I(N), I(Diff), analog expansion module" may be connected to the device.

Supply voltage

No separate, external power supply is necessary. The devices draw their power supply via the connected voltage measuring lines L1, L2, L3 and N.
The devices also feature a separate U_{aux} voltage connection which is not required for device operation. This connection can be used as an option (e.g. for an uninterruptible power supply, UPS) in order to keep the device in operation in the event of a possible power failure on the main lines or a voltage interruption on the measuring lines.

This offers the following advantages compared to a device that is supplied purely from the measuring voltage itself:

- The device can also be configured, commissioned and read out when the measuring voltage is not connected.
- The device does not switch off in the event of a power failure and can issue a warning signal/alarm regarding the power failure, for example.
- Wide-range AC/DC power supply unit (optional: not required for operation, can be used as an option, e.g. for a UPS)
- No battery is required.

Memory

- Adjusted device parameters are permanently stored in the device memory.
- Extreme values (maximum or minimum) are permanently stored in the internal device memory.
- Logbook for over 1000 events relevant to statutory calibration regulations (cannot be reset)

Values can be reset via SENTRON Powerconfig, Modbus command or directly on the device via the menu.

Behavior following loss of the supply voltage

Following loss of the supply voltage, the device starts back at zero with calculation of the average power demand values for total active power and total reactive power.

Time synchronization

When the SNTP server is set and activated, time synchronization takes place automatically immediately after the device reboot.

Security

- Hardware write protection
- Protection against unauthorized operation
- Device access control (IP filter) (PAC3220 MID only)
- Configurable Modbus TCP port (PAC3220 MID only)
- DHCP protocol included (PAC3220 MID only)
- SNTP protocol included (PAC3220 MID only)
- Lead seals can be attached

You can protect against write access to the device settings using "Protection against unauthorized operation" and "Hardware write protection". 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 settings
- Reset password for protection against unauthorized operation
- Update firmware on device

The data can be read without any restrictions.

Note

Use of different terms in the manual and in the device menu

In the device menu, the term "password protection" is used to refer to protection against unauthorized operation.

Note

Activation of the hardware write protection

When the power monitoring device is connected to a network, it is recommended that the hardware write protection is activated.

Note

Using the device in an unprotected network

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

Tariffs

The devices support 2 tariffs for the integral energy counters (on-peak and off-peak tariffs). These tariffs are for information only and are not intended for billing purposes.

Control of tariff switching

Off-peak/on-peak tariff switching can be controlled via the digital input or via the communications interfaces. Time-related switching is only possible using a higher-level system.

Tariff switching at the start of the next demand period

Tariff switching only becomes effective after the end of the period. 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.

MID approval

Devices with MID approval are suitable for billing the active energy.

For legal reasons, the following actions cannot be carried out on MID-approved devices:

- Reset of the energy values
- Parameterization of the voltage input
- Inversion of the direction of current flow
- Deletion of existing logbook entries

The set current transformer ratios have no effect on the secondary total energy value. The energy counters may already display a counter value upon delivery as a result of factory device testing.

2.2 Measuring inputs

Current measurement

NOTICE
AC current measurement only The devices are not suitable for measuring direct current.

The devices are designed for:

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

Note

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

Further information on the current transformers can be found in the Industry Mall (https://mall.industry.siemens.com/mall/en/ww/Catalog/Products/8230427).

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. We recommend the use of nationally calibrated current transformers for billing purposes.

Voltage measurement

NOTICE
AC voltage measurement only
The devices are not suitable for measuring DC voltage.

The devices are designed for:

- **Direct measurement on the system or using voltage transformers.** The measuring voltage inputs of the devices measure directly via protective impedances. External voltage transformers are required to measure higher voltages than the permissible rated input voltages.
- **Line supplies with rated voltages up to 230 V / 400 V**. The device is designed for connection to low-voltage networks with rated line voltages of 400 V / 230 V (UL-L/UL-N).

Connection types

The following connection types have been provided for connecting two-wire or four-wire systems with balanced or unbalanced load.

Table 2- 1 Available connection types

Short code	Connection type
3P4W*)	Three-phase, four-wire
3P3W	Three-phase, three-wire
1P2W	1-phase, two-wire

*) suitable for billing purposes

If the devices are used in the 1P2W system, the validity of the measured values must be considered. See table "Display of measured variables on the device display depending on the set connection type".

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 Connection (Page 41).

NOTICE
The wrong system connection can cause irreparable damage to the devices.
Before connecting the device, make sure that the local power supply conditions match the specifications on the rating plate. An N conductor must always be connected. If the U_{aux} voltage connection is used, it must be ensured that the N terminal is connected to the same N conductor with the same electrical potential as the N terminal of the measuring line.

Display of measured variables depending on the connection type

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

The availability of the measured variables depends on the type of readout. Depending on the device version, several different readout types are available:

- Device display
- Modbus TCP
- Modbus RTU
- Web server

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

Measured variable	Connection type		
	3P4W	3P3W	1P2W
Voltage L1	✓	–	✓
Voltage L2	✓	–	–
Voltage L3	✓	–	–
Voltage L1-L2	✓	✓	–
Voltage L2-L3	✓	✓	–
Voltage L3-L1	✓	✓	–
Current L1	✓	✓	✓
Current L2	✓	✓	–
Current L3	✓	✓	✓
Apparent power L1	✓	–	✓
Apparent power L2	✓	–	–
Apparent power L3	✓	–	–
Total apparent power	✓	✓	✓
Active power L1	✓	–	✓
Active power L2	✓	–	–
Active power L3	✓	–	–
Total active power	✓	✓	✓
Reactive power L1 (VAR1)	✓	–	✓
Reactive power L2 (VAR1)	✓	–	–
Reactive power L3 (VAR1)	✓	–	–
Total reactive power (VAR1)	✓	✓	✓
Power factor PF L1	✓	–	✓
Power factor PF L2	✓	–	–
Power factor PF L3	✓	–	–
Total power factor PF	✓	✓	✓
Cos φ L1	✓	–	✓
Cos φ L2	✓	–	–
Cos φ L3	✓	–	–
Total cos φ	✓	✓	✓
Frequency	✓	✓	✓
Unbal. voltage	✓	✓	–

Measured variable	Connection type		
	3P4W	3P3W	1P2W
Unbal. current	✓	✓	–
THD current L1	✓	✓	✓
THD current L2	✓	✓	–
THD current L3	✓	✓	–
THD voltage L1	✓	–	✓
THD voltage L2	✓	–	–
THD voltage L3	✓	–	–
THD voltage L1-L2	✓	✓	–
THD voltage L2-L3	✓	✓	–
THD voltage L3-L1	✓	✓	–
Total apparent energy T1	✓	✓	✓
Total apparent energy T2	✓	✓	✓
Apparent energy T1 (L1)	✓	–	✓
Apparent energy T2 (L1)	✓	–	✓
Apparent energy T1 (L2)	✓	–	–
Apparent energy T2 (L2)	✓	–	–
Apparent energy T1 (L3)	✓	–	–
Apparent energy T2 (L3)	✓	–	–
Total apparent energy T1+T2	✓	✓	✓
Total apparent energy T1+T2 (secondary)	✓	✓	✓
Total active energy import T1	✓	✓	✓
Total active energy import T2	✓	✓	✓
Active energy import T1 (L1)	✓	–	✓
Active energy import T2 (L1)	✓	–	✓–
Active energy import T1 (L2)	✓	–	–
Active energy import T2 (L2)	✓	–	–
Active energy import T1 (L3)	✓	–	–
Active energy import T2 (L3)	✓	–	–
Total active energy export T1	✓	✓	✓
Total active energy export T2	✓	✓	✓
Active energy export T1 (L1)	✓	–	✓
Active energy export T2 (L1)	✓	–	✓
Active energy export T1 (L2)	✓	–	–
Active energy export T2 (L2)	✓	–	–
Active energy export T1 (L3)	✓	–	–
Active energy export T2 (L3)	✓	–	–
Total active energy import T1+T2 (MID)	✓	✓	✓
Total active energy export T1+T2	✓	✓	✓
Total active energy import T1+T2 (secondary) (MID)	✓	✓	✓
Total active energy export T1+T2 (secondary) (MID)	✓	✓	✓
Total reactive energy import T1	✓	✓	✓
Total reactive energy import T2	✓	✓	✓
Reactive energy import T1 (L1)	✓	–	✓
Reactive energy import T2 (L1)	✓	–	✓

Measured variable	Connection type		
	3P4W	3P3W	1P2W
Reactive energy import T1 (L2)	✓	–	–
Reactive energy import T2 (L2)	✓	–	–
Reactive energy import T1 (L3)	✓	–	–
Reactive energy import T2 (L3)	✓	–	–
Total reactive energy export T1	✓	✓	✓
Total reactive energy export T2	✓	✓	✓
Reactive energy export T1 (L1)	✓	–	✓
Reactive energy export T2 (L1)	✓	–	✓
Reactive energy export T1 (L2)	✓	–	–
Reactive energy export T2 (L2)	✓	–	–
Reactive energy export T1 (L3)	✓	–	–
Reactive energy export T2 (L3)	✓	–	–
Total reactive energy import T1+T2	✓	✓	✓
Total reactive energy export T1+T2	✓	✓	✓
Total reactive energy import T1+T2 (secondary)	✓	✓	✓
Total reactive energy export T1+T2 (secondary)	✓	✓	✓
Universal counter	✓	✓	✓
Operating hours counter	✓	✓	✓

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

See also

Commissioning (Page 53)

2.3 Logbook

Important changes which could influence the measurement or the storage of data are recorded in this logbook. The reason, time and the OID of the affected demand period are stored for every entry along with the counter readings for import and export at the time of the event.

The device can store over 1000 logbook entries.
In the unlikely case that the permissible number of logbook entries has been completely exhausted, no further current transformer parameterization can be performed and no further firmware updates are possible.

The logbook can be viewed via the web server and can also be exported in .csv format.

Event	Reason
LOGBOOK FULL	The maximum number of logbook entries has been reached. No further settings for the current transformer ratio are possible. Please note that conformance with statutory calibration regulations is no longer upheld in this case and time adjustments can no longer be logged. The device must be replaced.
PARAMETER	Setting of the current or voltage transformer ratio. The setting for the primary or secondary value of the transformers has been changed.
FW-UPDATE	A firmware update has been performed.
FW-UPDATE FAILED	Firmware update has failed.

2.4 Average values and counters

2.4.1 Averaging measured values

Based on selected recordings of measured values over time, the user can optimize the system in accordance with requirements (e.g. with respect to energy consumption), and comply with normative requirements relating to power and energy recordings. For this purpose, instantaneous values need to be read out via the communication port, calculated and stored. The uninterrupted recording that is necessary requires a high bandwidth, high availability of communication and high storage capacity.

The power monitoring device generates all the measured values every 200 ms approximately. The device therefore features two internal average value generators which can be parameterized independently of each other. The time averages formed in the device are generated continuously based on all the associated values.

The values are updated after expiry of the set time period in each case.

- The default setting for average value 1 is a period of 10 seconds.
- The default setting for average value 2 is a period of 15 minutes.

The period length can be set to anything between 3 seconds and 1 year.

The function is available only via communications interfaces.

A list of available measured values can be found in chapter Demand value measured variables with Modbus function code 0x14 (Page 149).

2.4.2 Acquisition of power demand

Values that can be read out

The power monitoring devices supply the average power demand values of the last completed demand period:

- Average values for active power and reactive power, separated in each case for import and export
- Minimum and maximum within the period
- Length of the demand period in seconds. The period may be shorter due to external synchronization.
- Time in seconds since the last synchronization or since completion of the last period

Note

The average power demand values can only be read out via the interface (they are not shown on the display).

The average values of the last demand period can only be retrieved during the active demand period.

Example: Period length and length of the demand period
Period length: 15 min; time of day: 13:03; time in seconds: 180 s.

The following can be calculated from this: The last demand period ended at 13:00. The active demand period will end at 13:15 or in 12 min.

Adjustable parameters

- Time interval in minutes: 1 to 60 min adjustable, default 15 min
- Synchronization via bus or digital input

2.4.3 Energy counters

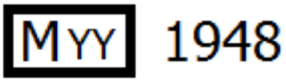
Available energy counters:

			Tariff 1	Tariff 2	Total (T1 + T2)
Active energy kWh	**Import**	Total	X	X	X (MID)
		L1	X	X	
		L2	X	X	
		L3	X	X	
		Secondary value			X (MID)
	Export	Total	X	X	X (MID)
		L1	X	X	
		L2	X	X	
		L3	X	X	
		Secondary value			X (MID)
Reactive energy kvarh	**Import**	Total	X	X	X
		L1	X	X	
		L2	X	X	
		L3	X	X	
		Secondary value			X
	Export	Total	X	X	X
		L1	X	X	
		L2	X	X	
		L3	X	X	
		Secondary value			X
Apparent energy kVAh		Total	X	X	X
		L1	X	X	
		L2	X	X	
		L3	X	X	
		Secondary value			X

Secondary values: Non-resettable energy counters. Transformer ratio is not taken into account in the calculation.

MID: MID registers are indicated by the MID mark in the menu. Marked registers are suitable for billing purposes.

The set transformer ratio is stored in the logbook.



YY Indicates the year the MID mark was affixed

1948 Identification number of conformity assessment body

2.4.4 History of active energy consumption

Based on selected recordings of energy consumption over time, users can perform a targeted analysis of their energy consumption for the purpose of optimizing their energy usage. The power monitoring devices have a daily energy counter and a monthly energy counter.

- The daily energy counter records the active energy in a ring buffer with a depth of 221 days.
- The monthly energy counter records the active energy in a ring buffer with a depth of 25 months.
- The annual energy counter records the active energy in a ring buffer with a depth of 7 years.

This function is available only in conjunction with communications interfaces.
A list of available measured values can be found in chapters Active energy history with Modbus function code 0x14 (Page 156) and User-defined Modbus function code 0x64 (Page 164).

2.4.5 Configurable universal counter

The devices provide one configurable counter. The following counting options are available:

- Pulse counting via the digital input for kWh/kvarh
- Status changes at the digital input (rising edge only)
- Status changes at the digital output (rising edge only)
- Limit violations

2.4.6 Operating hours counter

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

2.4.7 Limits

The power monitoring devices have a function for monitoring up to six limit values. These can be monitored for violation of the upper or lower limit. If a limit value is violated, specific actions can be triggered.

- Setting of the digital output
- Activation or deactivation of the LEDs
- Activation of the universal counter

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.

Defining the limit values

Nearly all measured variables can be selected as the source of the limit values. Extreme values (minimum/maximum measured values) cannot be defined as limit values. The measured variable is compared to a defined limit value.

Two comparison operators are available, "GREATER THAN" and "LOWER THAN". If the result of the comparison is "true", the limit value is also set to "true".

Combining the limit values

Limit values "LIM0" to "LIM5" can be combined by means of logic operators to form a "LIMIT LOGIC".

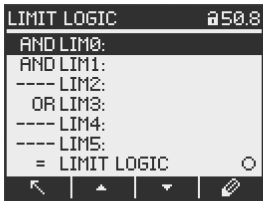


Figure 2-1 Device setting "LIMIT LOGIC"

The following operators are available:

- AND
- OR

The placeholder "----" means: This limit value is not combined with any other limit value.

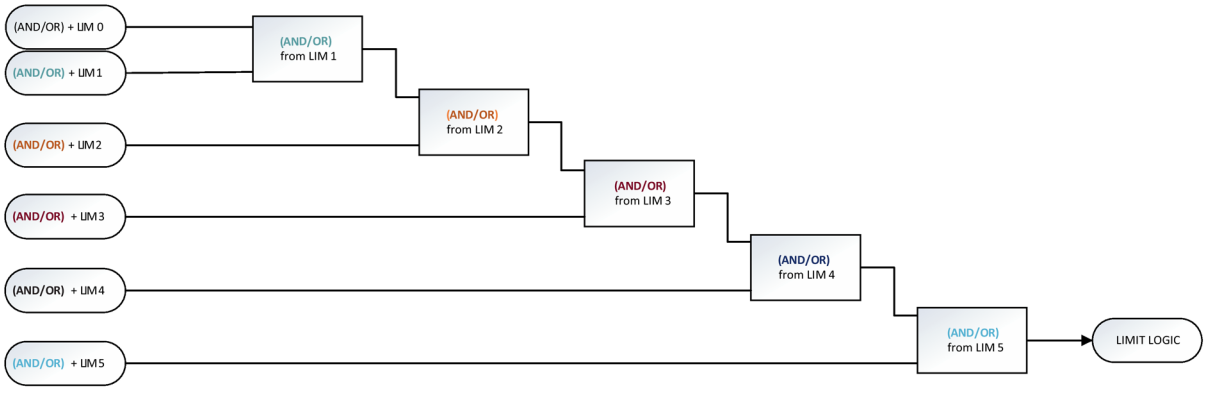
The logic combines limit values 0 to 5 as follows:

(((((opLIM0 LIM0 opLIM1 LIM1) opLIM2 LIM2) opLIM3 LIM3) opLIM4 LIM4) opLIM5 LIM5)

LIM0 represents limit value 0
LIM1 represents limit value 1
op represents the logic operator AND/OR in the formula

The brackets in the formula show that the AND/OR priority rule does not apply.

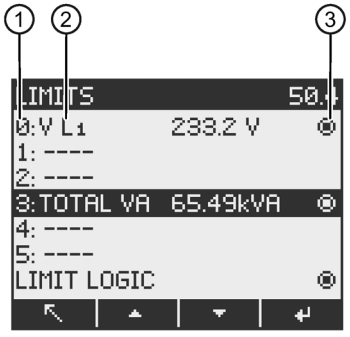
The result of the logic operation is the "LIMIT LOGIC".



Output of limit violations

- Indication of limit violation on the display:

  "MAIN MENU > SETTINGS > ADVANCED > LIMITS > LIMIT LOGIC"



① Limit value designation
② Monitored data source
③ Limit value currently violated (= yes, = no)

Figure 2-2 Display of limit violation

- Output of the limit violation at the digital output
- Output of limit violations via the interface
- Counting limit violations with the universal counter

2.5 Digital inputs and outputs

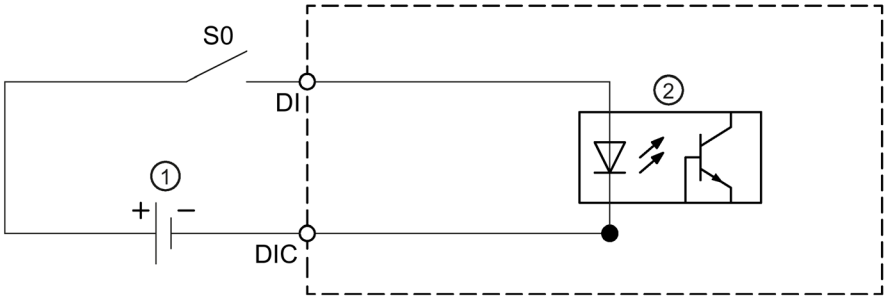
The power monitoring device features:

- Two multifunctional digital passive inputs
- Two multifunctional digital outputs

2.5.1 Digital inputs

The following functions can be assigned to the digital inputs:

- Tariff switching for two-tariff active and reactive energy counters
- Synchronization of the demand period by means of the synchronization pulse of a system control center or other device
- Status monitoring: Acquisition of statuses and messages of connected signal transmitters
- Energy pulse input for active or reactive energy pulses. Data is transferred with the help of weighted pulses, e.g. a parameterizable number of pulses is transferred for each kWh.



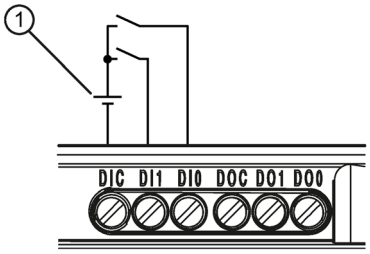
① External power supply
② Input electronics

Figure 2-3 Circuit diagram: Digital inputs

Wiring

Switch with external power supply

An external voltage of up to max. 30 V DC (typically 24 V DC) must be connected to terminal DIC.



① External voltage

Figure 2-4 Digital inputs with switch and external power supply at terminal DIC

2.5.2 Digital outputs

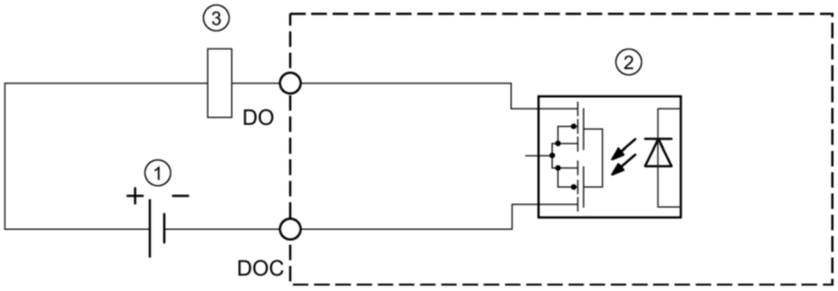
Functions

The following functions can be assigned to the digital outputs:

- Energy pulse output, programmable for active energy pulses or reactive energy pulses
- Indication of the direction of rotation
- Operating state display of the device
- Signaling of limit violations
- Switching output for remote control via the interface

The following functions can be assigned to both digital outputs:

- Remote control
  The digital output is remotely controlled via the integral communications interface. The Modbus function codes can be found in chapter Modbus (Page 117).
- Direction of rotation
  The digital output is switched on by a counter-clockwise rotating electrical field and remains active while the direction of rotation of the field remains unchanged.
- Energy pulse
  The digital output outputs the parameterized number of pulses per energy unit (e.g. kWh). The specified energy counter is evaluated here.



① External power supply
② Input electronics
③ Load

Figure 2-5 Circuit diagram: Digital outputs

Wiring

Both digital outputs are passive and implemented exclusively as switches.

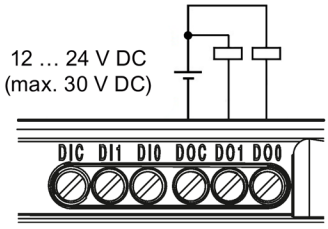
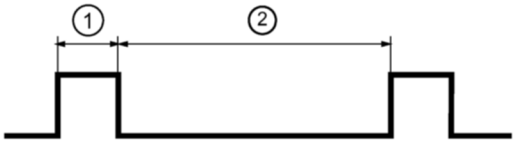


Figure 2-6 Circuit diagram: Digital outputs

Implementation of the pulse function corresponds to the IEC 62053-31 standard.

Pulse length, turn-off time



① Pulse length
② Turn-off time

Figure 2-7 Pulse length and turn-off time

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

2.6 RS485 interface

RS485 interface for Modbus RTU communication

Only PAC3120 MID is equipped with an RS485 interface for Modbus RTU communication. The device operates as a Modbus client.

PAC3220 MID is not equipped with an internal RS485 interface. The device can be connected to Modbus RTU communication using an RS485 expansion module however.

Application

This interface permits:

- Reading out the measured values
- Reading and writing the device settings
- Updating the device firmware

The Modbus function codes are listed in the Appendix.

Conditions for operation

To use the interface, the device must be parameterized in accordance with the existing Modbus infrastructure. The communication parameters can be set on the device and via the Modbus RTU interface.

Default communication settings

The default settings in the as-delivered state are as follows:

Table 2- 3 Default Modbus RTU communication settings

Setting	Default
Address	126
Baud rate	19200
Data format	8N2
Response time	0 (automatic)

Delaying the response time

The response time of PAC3120 MID may have to be delayed to enable its operation as a client device with devices from other manufacturers on the bus. PAC3120 MID can automatically calculate the response time to suit the baud rate. This automatic calculation is set at the factory. The delay time is individually adjustable between 1 ms and 255 ms.

Polarization

Polarization of the RS485 data lines must be implemented at another point on the bus. PAC3120 MID does not contain polarization resistors.

PAC3220 MID with RS485 expansion module

You can find information about parameterization of the RS485 interface in the documentation for the SENTRON PAC RS485 expansion module (https://support.industry.siemens.com/cs/ww/en/view/28865965) under www.modbus.org (http://www.modbus.org) in the following specification: Modbus over Serial Line (http://modbus.org/docs/Modbus_over_serial_line_V1_02.pdf).

2.7 Ethernet interface (PAC3220 MID only)

PAC3220 MID has two identical Ethernet interfaces which can be used to connect the device to Modbus TCP communication.
PAC3120 MID is not equipped with an integral Ethernet interface. The device cannot be connected to Modbus TCP and has no option for the connection of an expansion module.

Note

PAC3120 MID can be connected to the Ethernet using PAC4200 combined with an RS485 expansion module (gateway function).

You can find more detailed information on this in the System Manual SENTRON PAC4200 Power Monitoring Device (https://support.industry.siemens.com/cs/de/de/view/34261595/en).

Protocols

The Ethernet interface (PAC3220 MID only) allows communication via the following protocols:

- Modbus TCP
  The device can be configured via Modbus TCP.
- Web server (HTTP)
  The protocol can only be used to read out the measured values via web browser.
- SNTP
  The SNTP (Simple Network Time Protocol) is used to automatically synchronize the internal clock with a time server within the network. Three function modes are available:
  - No synchronization
  - Date/time synchronization via device request

    The IP address of an NTP server must be configured. With this, the SENTRON PAC3220 MID automatically requests the current time from the server and resets its internal clock, if necessary.
  - Date/time synchronization via SNTP server (BCST)

    PAC3220 MID receives broadcast time frames which are sent from an NTP server. This is useful if the internal clocks of several devices in the same network need to remain synchronized.

  If the IP address of the NTP server has been configured, PAC3220 MID only responds to these frames. It can also send a request to the server, if necessary.
- DHCP

  DHCP stands for "Dynamic Host Configuration Protocol". Protocol for obtaining network settings from a DHCP server. Network settings are assigned automatically.

Autonegotiation

Autonegotiation is a method used by network communication partners to automatically negotiate the highest possible transfer rate.

PAC3220 MID is automatically set to the transfer rate of the communication partner if the latter does not support autonegotiation.

MDI-X auto crossover

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

2 Port Ethernet Switch

PAC3220 MID has 2 Ethernet interfaces that are internally connected via the Ethernet switch. This means that each Ethernet frame received at one of the ports is forwarded to the other port, as well as to PAC3220 MID of course. This supports Ethernet linear topology for efficient cabling, with no additional cost for external Ethernet switches.

Note

Note for PROFINET

The failure of one of the devices interrupts communication to the devices behind it.
This Ethernet switch is not suitable either in the PROFINET IRT environment or for the ring topology.
The Switched Ethernet PROFINET expansion module (7KM9300-0AE02-0AA0) can be used for both.

2.8 Slots for expansion modules

PAC3220 MID has two identical slots (MOD1 and MOD2) for mounting optionally available expansion modules.

Please consult the current catalogs to find out which modules are available for PAC3220 MID.

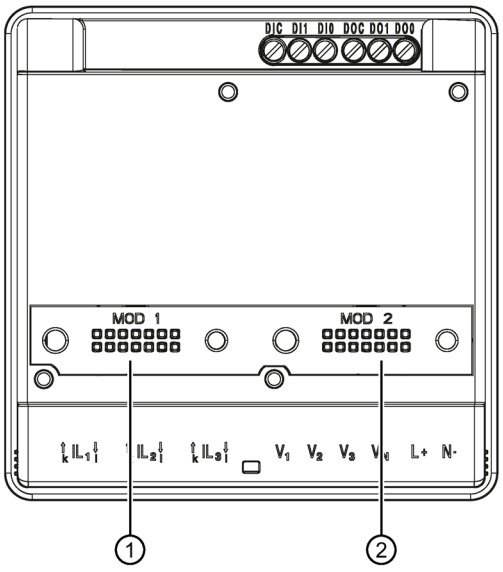
One expansion module can be operated alone on the device or two expansion modules simultaneously.

Note

Use of two expansion modules

If two expansion modules are used, only one of these may be a communications module (PROFINET, PROFIBUS or RS485 expansion module).

Simultaneous connection of two "I(N), I(Diff), analog" expansion modules is not supported.



① Slot MOD1
② Slot MOD2

Figure 2-8 PAC3220, rear of the device

NOTICE
Device can be irreparably damaged The optionally available expansion modules may only be fitted while the device is switched off.

WARNING
Hazardous voltage. **Failure to heed this notice 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 voltages may cause serious personal injury or death. Furthermore, inserting metal pins or wires into the contact openings can cause the device to fail.

NOTICE
Property damage due to contamination Avoid contamination of the contact areas below the labels "MOD1" and "MOD2", otherwise the expansion modules cannot be inserted and may even sustain damage.

You will find further information on the expansion modules in the relevant operating instructions and equipment manuals.

Mounting 3

3.1 Mounting

Mounting location

The devices are intended for installation in permanently installed control panels with a protective enclosure with degree of protection IP51 within enclosed rooms.

⚠ WARNING

Only operate the device in a secure location.
Failure to heed this notice may cause death, serious personal injury, or equipment damage.

The power monitoring device must always be operated in a lockable control cabinet or a lockable room. Ensure that only qualified personnel have access to this cabinet or room.

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

Mounting position

The power monitoring device can be mounted in any position. The device can be mounted in a horizontal 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 115) chapter.

Deploy the power monitoring device only where environmental conditions permit its operation: A description of permissible operating conditions can be found in chapter Technical specifications (Page 103).

Plan additional space for:

- Ventilation
- Wiring
- Connection of the communication cable and cable infeed on the top of the device

⚠ WARNING

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

Do not install or start up damaged devices.

Note

Avoid condensation.

Sudden fluctuations in temperature can lead to condensation. Condensation can affect the proper functioning of the device. Store the device in the operating room for at least two hours before commencing installation.

3.2 Mounting on the switching panel

You will require the following tools to install the device:

- Cutting tool for the panel cutout
- PH2 cal. screwdriver acc. to ISO 6789

Additional installation tools

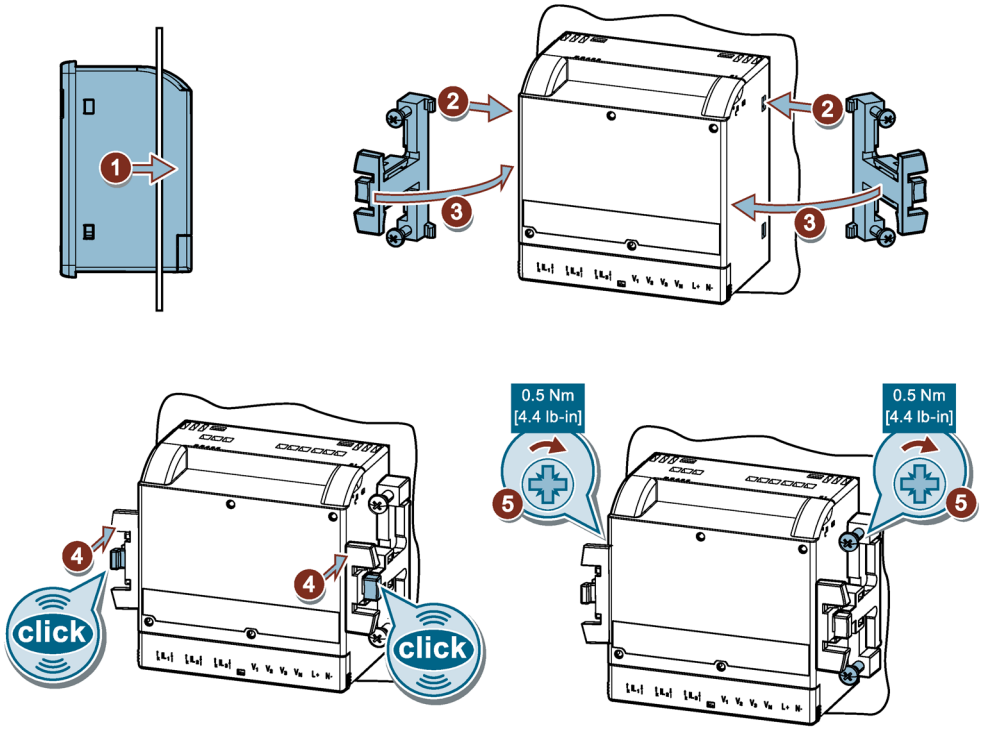
- Cable clamp for strain relief of the connection cables.

Mounting and clearance dimensions

You can find information on the cutout dimensions, frame dimensions and clearances in chapter Dimensional drawings (Page 115).

Installation steps

Proceed as follows to install the power monitoring device in the control panel:



3.3 Deinstallation

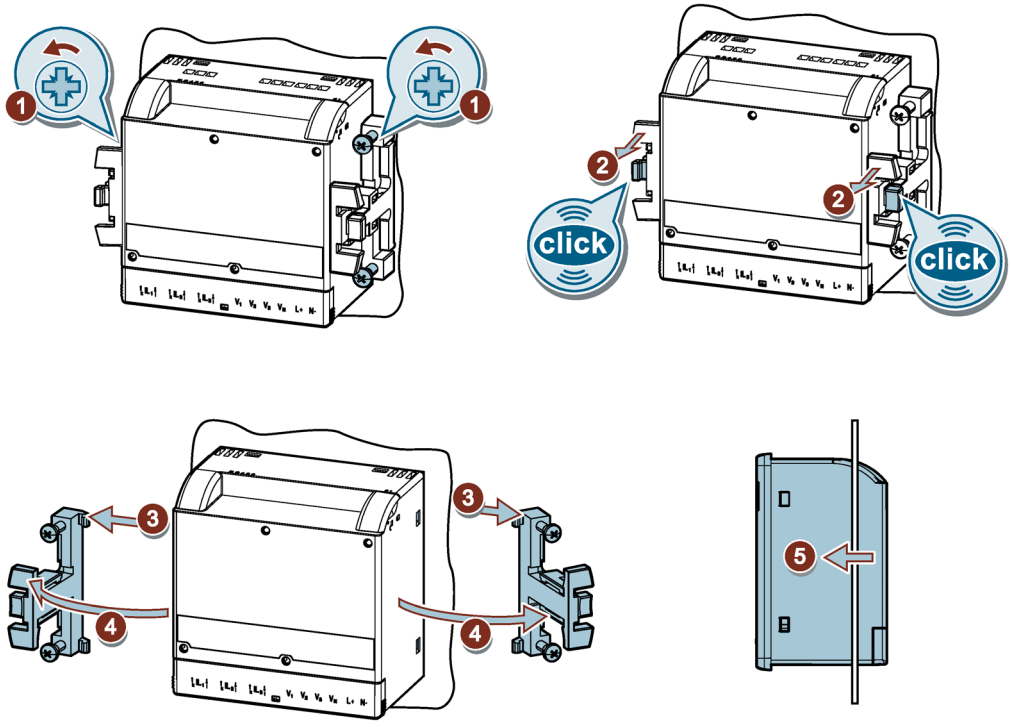
Make sure the device has been shut down before you begin to deinstall it.

Tool

You require the following tools to deinstall the device:

- PH2 screwdriver

Deinstallation steps



Connection

4

4.1 Safety instructions

Notes



⚠ DANGER

Hazardous voltage.
Failure to heed this notice will cause death, serious personal injury, or equipment 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.
Failure to heed this notice will cause death, serious personal injury, or equipment damage.

With the 5 A device, it is only possible to measure the current with external current transformers. The current transformer 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. The safety instructions for the current transformers used must be followed.

⚠ CAUTION

Protection of the supply voltage and voltage measuring inputs

The fuses in the voltage 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 (B)
can be used.

The applicable regulations must be observed when selecting the fuse. We recommend 5SY miniature circuit breakers, 3RV motor starter protectors, or 5SB/3NA fuses, depending on the cable requirements and connection conditions.
Voltage input conductors must be protected.

NOTICE

Device can be irreparably damaged

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

⚠ WARNING

Hazardous voltage
Failure to heed this notice may cause death, serious personal injury, or equipment damage.

- Always open or disconnect circuit from power distribution system (or server) of building before installing or servicing current transformers.
- The current transformers my not be installed in equipment where they exceed 75 percent of the wiring space of any cross-sectional area within the equipment.
- Restrict installation of current transformers in an area where it would block ventilation openings.
- Restrict installation of current transformers in an area of breaker arc venting.
- Not suitable for Class 2 wiring methods and not intended for connection to Class 2 equipment.
- Secure current transformers and route conductors so that they do not directly contact live terminals or bus.

⚠ WARNING

Hazardous voltage.
Failure to heed this notice 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 voltages may cause serious personal injury or death. Furthermore, inserting metal pins or wires into the contact openings can cause the device to fail.

NOTICE

Property damage due to contamination

Avoid contamination of the contact areas below the labels "MOD1" and "MOD2", otherwise the expansion modules cannot be inserted and may even sustain damage.

NOTICE

Incorrect line voltage may damage the device.

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

NOTICE

Short-circuit hazard

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

The cables must be suitable for operation in a temperature that is 20 °C higher than the maximum ambient temperature.

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 startup or testing of the device.
- The secondary connections of intermediate current transformers must be short-circuited at the transformers before the current feeder cables to the device are interrupted.
- Check the polarity and the phase assignment of the instrument transformers.
- Before connecting the device, make sure that the line voltage matches the specifications on the rating plate.
- Before you start up 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 two hours in order to reach temperature balance and avoid humidity and condensation.
- Condensation on the device is not permissible during operation.

Note

Optional grounding of current transformers

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 cables are routed separately from control and power supply cables. In order to avoid the risk of capacitive or inductive interference, these cables must never be routed in parallel.

Note

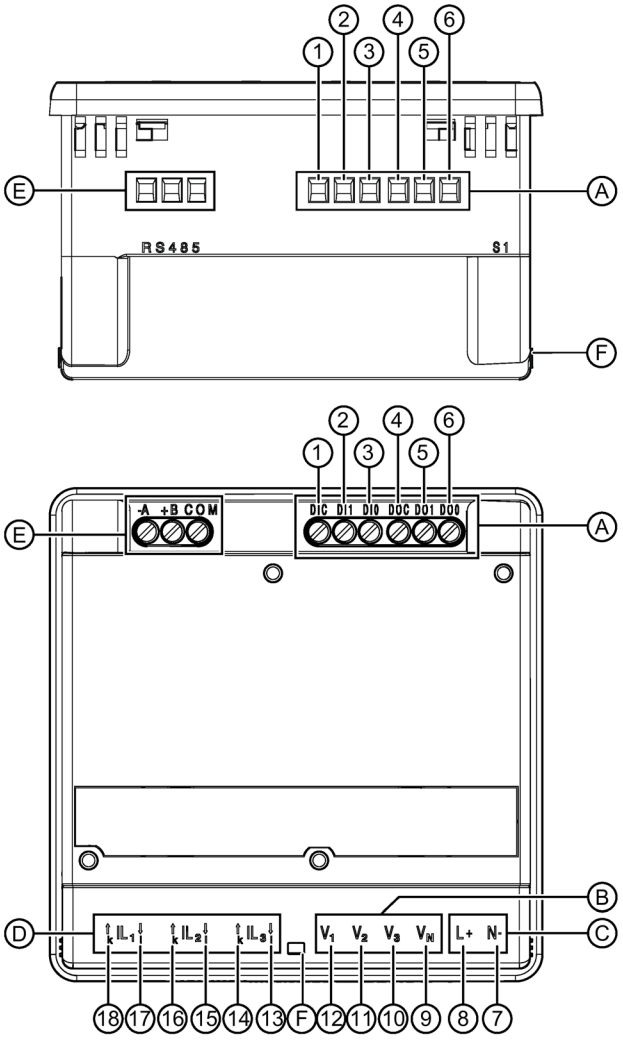
Selection of current transformers

Please note that I-Prim x U-Prim x 3 must be ≤ 200 MVA.

4.2 Connections

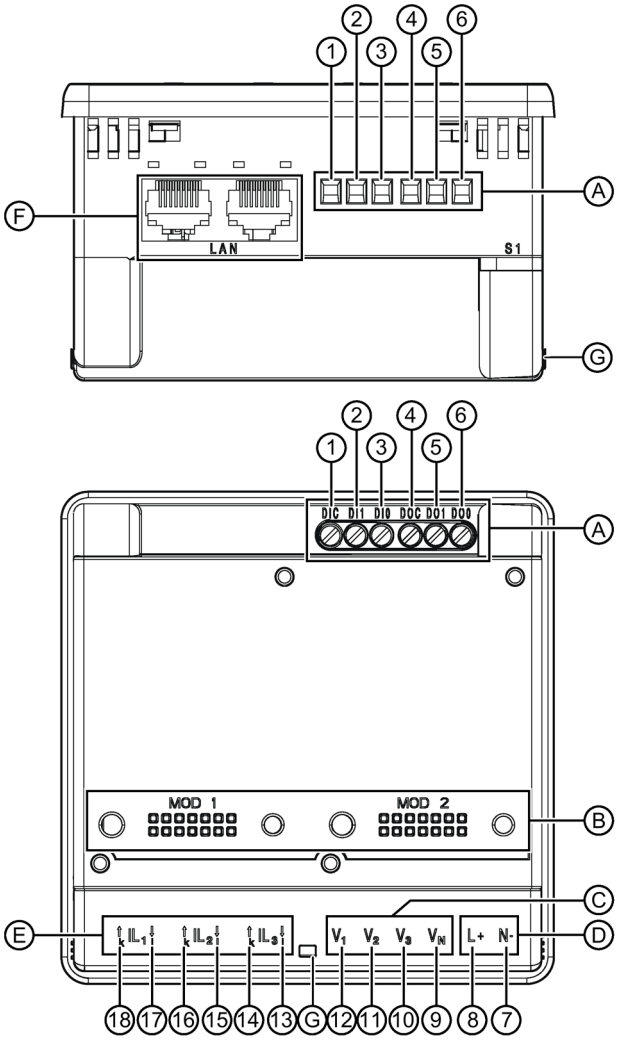
Terminal designations

Terminal designations of PAC3120 MID



Ⓐ			Digital inputs and outputs
Ⓑ			Measuring inputs voltage V_1, V_2, V_3, V_N
Ⓒ			Optional auxiliary voltage L/+, N/–
Ⓓ			Measuring inputs current IL_1, IL_2, IL_3
Ⓔ			RS485 connection
Ⓕ			Sealing point
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 (connected internally to VN (9)) DC: Connection: -
⑧	L+		AC: Connection: Conductor (phase voltage) DC: Connection: +
⑨	V_N		Neutral conductor
⑩	V_3		Voltage U_{L3-N}
⑪	V_2		Voltage U_{L2-N}
⑫	V_1		Voltage U_{L1-N}
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

Terminal designations of PAC3220 MID



Ⓐ			Digital inputs and outputs
Ⓑ			Slots for expansion modules
Ⓒ			Measuring inputs voltage V_1, V_2, V_3, V_N
Ⓓ			Optional auxiliary voltage L/+, N/–
Ⓔ			Measuring inputs current IL_1, IL_2, IL_3
Ⓕ			Ethernet interface (two identical connections)
✓			Sealing point
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 (connected internally to VN (9)) DC: Connection: -
⑧	L+		AC: Connection: Conductor (phase voltage) DC: Connection: +
⑨	V_N		Neutral conductor
⑩	V_3		Voltage U_{L3-N}
⑪	V_2		Voltage U_{L2-N}
⑫	V_1		Voltage U_{L1-N}
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-wire systems (1P2W)
- Three-wire systems (3P3W)
- Four-wire systems (3P4W)

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

Note

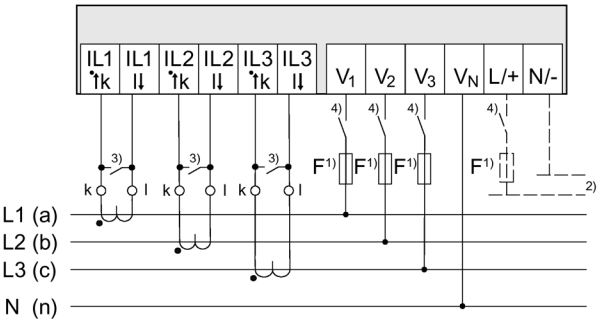
Optional grounding of current transformers

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.

Example connections

1. **3-phase measurement, 4 conductors, without voltage transformer, with 3 current transformers**

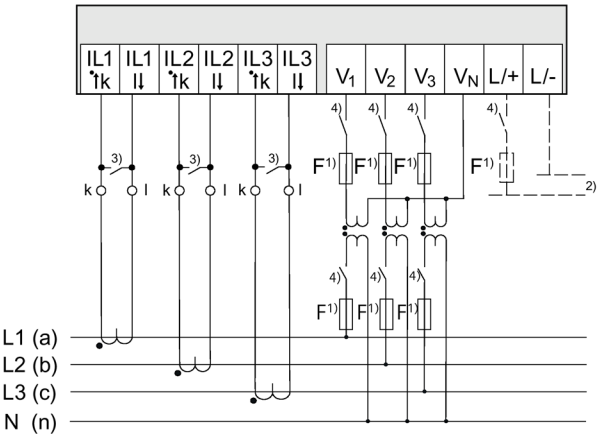
   Connection type 3P4W



   1) The fuses are only used for cable protection.
   All commercially available miniature circuit breakers up to 20 A (C) can be used.
   2) Auxiliary voltage connection (optional)
   3) Install a short-circuit detection device. Protection against overvoltage when the secondary transformer circuit is open.
   4) Circuit breaker

2. **3-phase measurement, 4 conductors, with voltage transformer, with 3 current transformers**

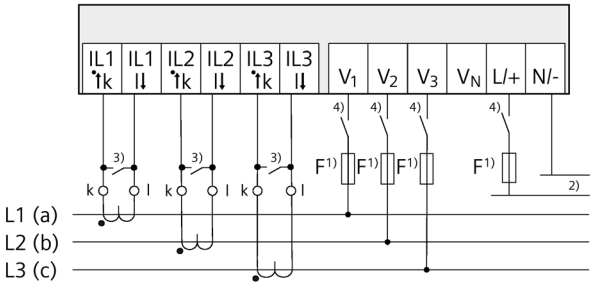
   Connection type 3P4W



   1) The fuses are only used for cable protection.
   All commercially available miniature circuit breakers up to 20 A (C) can be used.
   2) Auxiliary voltage connection (optional)
   3) Install a short-circuit detection device. Protection against overvoltage when the secondary transformer circuit is open.
   4) Circuit breaker

3. **3-phase measurement, 3 conductors, without voltage transformer, with 3 current transformers. Only possible with external power supply on the auxiliary voltage connection.**

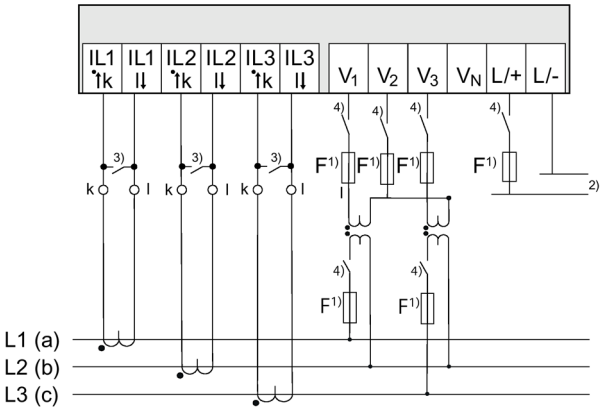
   Connection type 3P3W (not MID-compliant)



   1) The fuses are only used for cable protection.
   All commercially available miniature circuit breakers up to 20 A (C) can be used.
   2) Auxiliary voltage connection (required)
   3) Install a short-circuit detection device. Protection against overvoltage when the secondary transformer circuit is open.
   4) Circuit breaker

4. **3-phase measurement, 3 conductors, with 2 voltage transformers, with 3 current transformers**

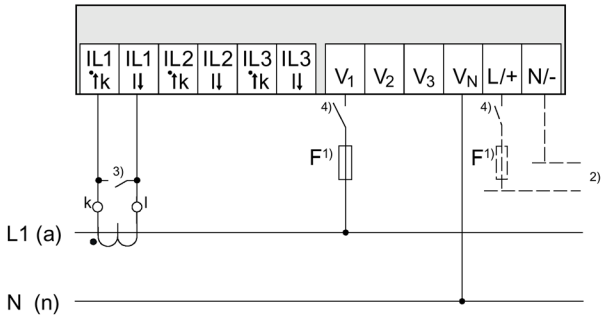
   Connection type 3P3W (not MID-compliant)



   1) The fuses are only used for cable protection.
   All commercially available miniature circuit breakers up to 20 A (C) can be used.
   2) Auxiliary voltage connection (required)
   3) Install a short-circuit detection device. Protection against overvoltage when the secondary transformer circuit is open.
   4) Circuit breaker

5. **1-phase measurement, 2 conductors, with 1 current transformer**

   Connection type 1P2W (MID available soon)



1) The fuses are only used for cable protection.
   All commercially available miniature circuit breakers up to 20 A (C) can be used.
2) Auxiliary voltage connection (optional)
3) Install a short-circuit detection device. Protection against overvoltage when the secondary transformer circuit is open.
4) Circuit breaker

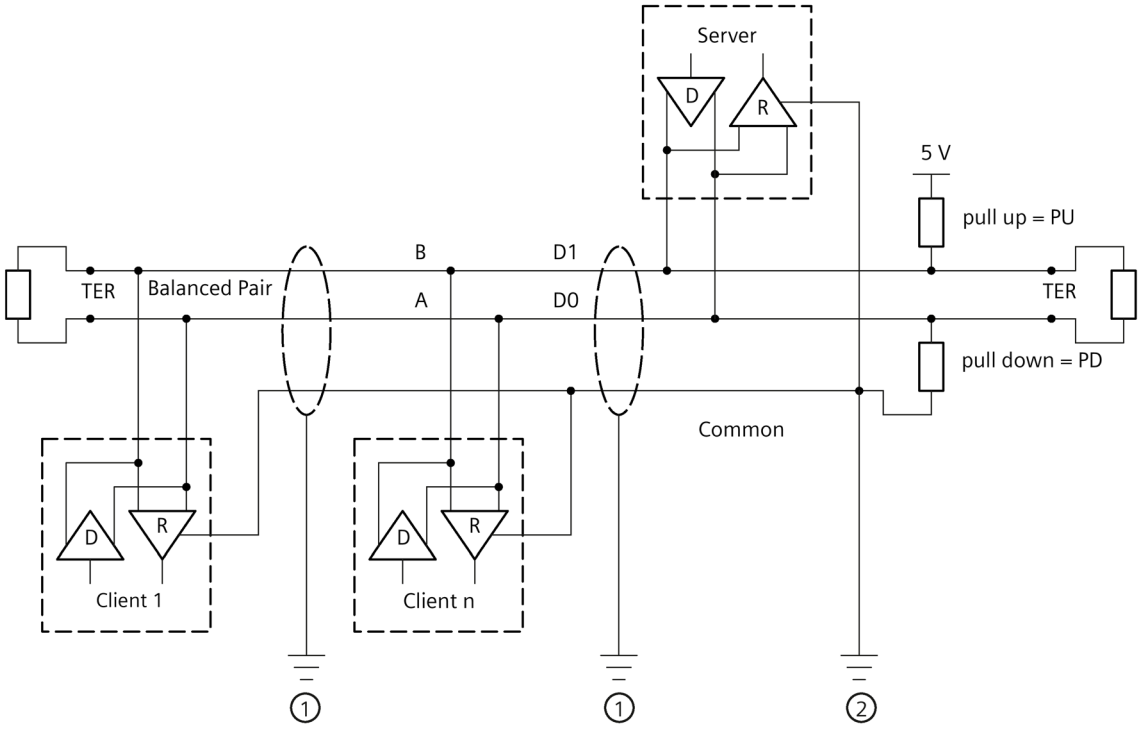
4.4 Connecting to the RS485 bus

Procedure

Connect PAC3120 MID to the RS485 bus via the integrated interface. Please pay attention here to the general topology of the two-wire line.

1. Connect all three lines to the screw terminals.
2. Ensure a bus terminating resistance is set at the first and last communication node.

Circuit diagram



TER	Bus terminating resistor (termination)
PU	Pull-up resistor
PD	Pull-down resistor
①	Grounding of the cable shield
②	Grounding of the common line, preferably only at one point for the whole bus

Grounding of the cable shield

The serial Modbus data line must be shielded. The shield must be connected to protective ground at one end of the line at least. Strive to achieve grounding of the shield on both sides.

Grounding of the common line

The common line must be applied direct to protective ground, preferably at only one point for the whole bus. It must be ensured that the common signal is routed as a dedicated line.

Polarization

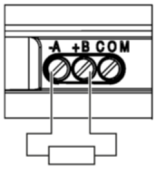
PAC3120 MID does not support polarization of the RS485 data lines. Polarization must be implemented at another point on the bus. The server device usually performs the polarization.

We recommend polarization with supply of 5 V DC, pull-up resistor with 560 Ω, pull-down resistor with 560 Ω.

Bus terminator

The first and last node in the bus segment must terminate the bus with a terminating resistor.

PAC3120 MID does not support the bus terminator. The bus can be terminated using an external resistor ≥ 120 Ω. Connect the resistor to terminals –/A and +/B of the RS485.



References

You can find more information in the following specification and the guidelines on the website of the Modbus Organization (https://www.modbus.org).

PAC3220 MID with RS485 expansion module

You can find information about parameterization of the RS485 interface in the documentation for the SENTRON PAC RS485 expansion module (https://support.industry.siemens.com/cs/ww/de/view/28865965/en).

Commissioning

5

5.1 Overview

Prerequisites

1. The device has been installed.
2. The device has been connected in accordance with the possible connection methods.
3. PAC3120 MID: The RS485 interface has been connected to the bus.
   PAC3220 MID: The Ethernet cable has been connected.
   Note: Optional for commissioning with SENTRON Powerconfig.

Steps for starting up the device

1. Connect the supply voltage.
2. Parameterize the device.
3. Connect the measuring voltage.
4. Connect the measuring current.
5. Check the displayed measured values.
6. Check the polarity and the phase assignment of the instrument transformers.

NOTICE
Check the connections Incorrect connection can result in malfunctions and failure of the device. Before starting up the power monitoring 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 must be disconnected before starting the test.

5.2 Applying supply voltage

A supply voltage is required to operate the device.

The device is supplied with 1-phase to 3-phase power via measuring voltages L1/L2/L3 - N. An additional AC/DC auxiliary voltage can be connected for a redundant supply.

Consult the technical specifications or the rating plate for the permissible supply voltage type and level.

NOTICE
Connection to the wrong supply voltage can cause irreparable damage to the device. Failure to heed this notice can result in damage to the device and the system. The minimum and maximum limits given in the technical specifications and on the rating plate must not be exceeded, even during startup or testing of the device. When connecting the auxiliary supply voltage, make sure to use the correct phase and neutral conductor terminals on the device. Note that the V_N terminal of the measuring input is internally connected to the N terminal of the auxiliary voltage.

5.3 Parameterizing the device

For commissioning the device, you must specify the operating parameters listed below in the device settings:

- Basic parameters

The following settings are also useful:

- Language
- Device protection against manipulation

Initial startup



The language selection only appears:

- During initial startup
- After a reset to factory settings
- After a firmware update

Select the required language and confirm your selection by choosing "OK".

5.3.1 Basic parameters

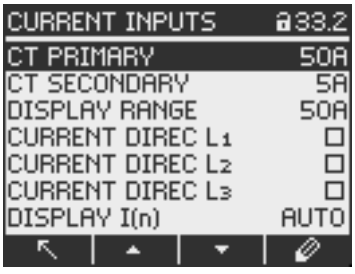
Set the basic parameters:

- Voltage input
  - Connection type
  - For voltage transformer measurement
    - Primary voltage
    - Secondary voltage
- Current input
  - Primary current
  - Secondary current

You can find additional information in chapters Operator control (Page 59) and Parameter assignment (Page 69).

Example

1. Specify the ratio of the current transformers you are using in the "CURRENT INPUT" menu item.



2. 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.

5.3.2 Additional settings

Language

After initial startup, 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.

Set the time according to specifications prior to first use.
Do not use SNTP time synchronization in unprotected networks.

Device protection against manipulation

In order to reduce the risk of manipulation occurring on the device, it is recommended that the protective mechanisms available in the device are activated.

For further information, please refer to chapter Security features (Page 91).

Please also note the information in chapters Operator control (Page 59) and Parameter assignment (Page 69).

5.4 Applying the measuring voltage

The power monitoring device is designed for operation with the following measuring voltages:

Rated voltage for direct connection

- 57.7/100 ... 230/400V ±20% 50 Hz

Possible voltage transformer ratio if voltage transformers are used

- Primary voltage 100 ... 100000 V
- Secondary voltage 100 ... 400 V

NOTICE
Observe the technical ratings. The limits given in the technical data or on the rating plate must not be exceeded. Measurement of DC voltage is not possible. External voltage transformers are required to measure higher voltages than the permissible rated input voltages.

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 s.



⚠ DANGER

Open transformer circuits will result in electric shock and arc flash hazards. Failure to heed this notice will cause death, serious personal injury, or equipment 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 instructions for the current transformers used must be followed.

NOTICE

Selection of current transformers

Please note that I-Prim x U-Prim x 3 must be ≤ 200 MVA.

NOTICE

Alternating current measurement only

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 direction of current flow in the device settings.

You will find information about device settings in chapter Basic parameters (Page 72).

5.6 Checking the displayed measured values

Correct connection type

With the help of the table "Display of measured variables depending on the connection type (Page 18)", check whether the measured variables are displayed in accordance with the implemented connection type. Any deviation indicates a wiring or configuration error.

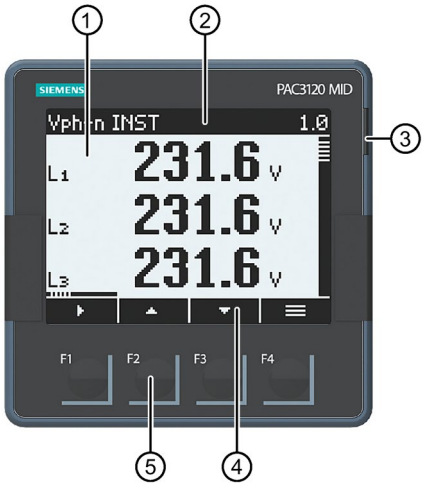
Operator control

6

6.1 Device interface

6.1.1 Displays and operator controls

The following display elements and operator controls can be found on the front panel of the power monitoring devices (figure shows PAC3220 MID, but the same applies to PAC3120 MID).



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

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

③ Multi-colored LED:
Works like a normal digital output. The functions 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 s. 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.

6.1.2 Default menu

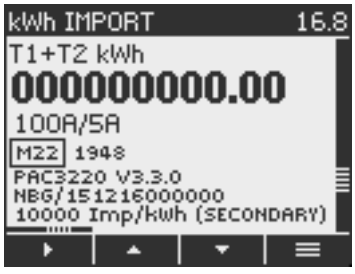
The default menu of MID devices is permanently programmed and cannot be changed.

These are MID-relevant displays. All MID-relevant displays show the MID mark.

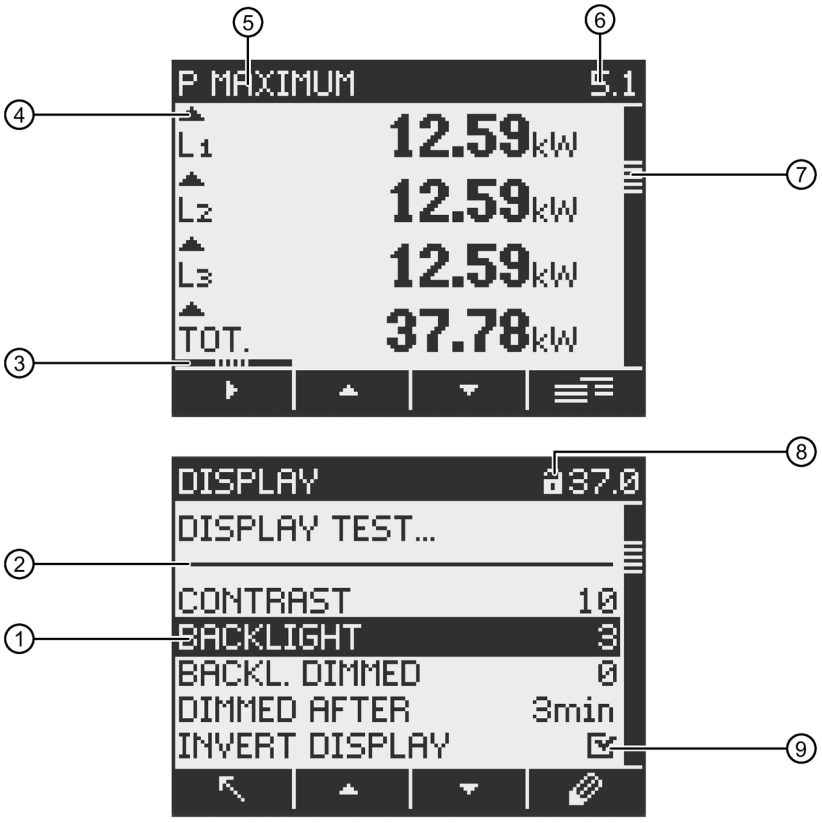


After 120 s in the idle state, the display automatically switches to the default menu "kWh IMPORT - sum of T1 + T2 kWh".

The timer setting for display switchover cannot be changed.



6.1.3 Special display elements



① Selection bar
② Line separating the start and end of the list
③ Scroll bar of function key F1 (multiple assignments of key F1)
④ Arrow up: Maximum value
Arrow down: Minimum value
⑤ Menu name
⑥ Menu number
⑦ Scroll bar (display can be scrolled upwards/downwards)
⑧ Device protection symbol
- Open padlock: Protection deactivated
- Closed padlock: Protection activated

⑨ Activation/deactivation symbol
- Symbol with check mark: function activated
- Symbol without check mark: function deactivated

6.1.4 LED

The primary function of the LED is to display energy pulses (10000 pulses / kWh secondary). The multi-colored LED also functions like a normal digital output. The user can configure the function, the color and the brightness of the LED.
The configured function can be switched back to the primary function at any time by selecting "TEST LED ON", even if write protection is activated.

Function

Functions	
Device ON	The brightness of the LED changes gradually.
Remote control	The LED signals remote access to the device. The LED remains illuminated for as long as remote access to the device is active, or until the set time expires. TIMEOUT: 0 ... 18000 s (Timeout 0 s: the LED remains illuminated while remote access is active.)
Direction of rotation	The LED reacts to the direction of rotation of the electrical field. ●: Counter-clockwise rotating field ○: Clockwise rotating field The color and lighting behavior of the LED can be adjusted individually. Possible lighting behavior: • OFF • ON • Flashing fast/slow • Flashing with variation in brightness
Energy pulse	LED flashes 10000 times / kWh (secondary)
LIM.VIOLATION	LED signals limit violation. Possible monitoring: • LIM 0 ... 5 • LIMIT LOGIC (operation) The color and lighting mode of the LEDs can be set individually.
Remote-controlled color	The LED can be switched on by a Modbus command. The LED remains illuminated until the OFF command is registered, or until the set time expires. TIMEOUT: 0 ... 18000 s (Timeout 0 s: the LED remains illuminated until the OFF command is received.)
DI status	The LED reacts to changes in the status of the digital input. The color and lighting behavior of the LED can be adjusted individually. Possible lighting behavior: • OFF • ON • Flashing fast/slow • Flashing with variation in brightness

Color

- White
- Yellow
- Green
- Blue
- Red
- Orange
- Cyan
- Violet

Lighting mode

Lighting behavior	
OFF	LED is continuously OFF.
ON	LED is continuously ON.
	LED flashes quickly with varying brightness level.
	LED flashes slowly with varying brightness level.
	LED flashes quickly with constant brightness.
	LED flashes slowly with constant brightness.

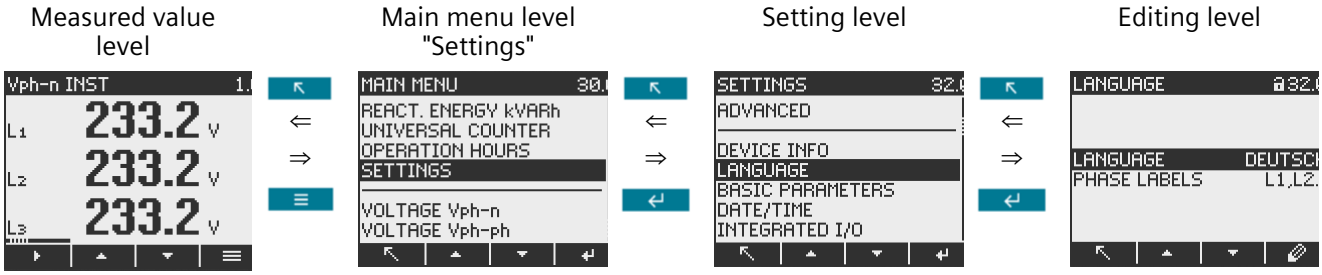
6.1.5 Menu navigation

The menu-based navigation is intuitive and largely self-explanatory. Only the basic structure of the menu-based navigation will be explained below. The description and function of the individual parameters can be found in chapter Parameter assignment (Page 69).

Menu levels

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.

6.1.5.1 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. The display shows the measured values of the currently selected measured variable. (All possible measured values are listed in the table in chapter Measuring inputs (Page 18). 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 take the device to the main menu level.

6.1.5.2 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 takes the device to the measured value level.

In the "SETTINGS" menu option, the device is taken to the "Setting level" by means of the ↵ key.

6.1.5.3 Setting level

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

- 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 selection made and takes the device to the **editing level**.

6.1.5.4 Editing level

At the **editing level**, it is possible to modify the device parameters.

- 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 takes the device to the measured value level.

6.1.6 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
F1	▶	**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.
F2	▲	**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".
F3	▼	**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.
F4	≡	**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 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 further information on SENTRON energy management and power monitoring (https://support.industry.siemens.com/cs/ww/en/view/109764480) on the internet.



6.2.1 SENTRON Powermanager

The SENTRON Powermanager energy management software allows you to acquire, monitor, evaluate, display and archive the energy data of the power monitoring device.

SENTRON Powermanager provides the following functions:

- Tree view of the customer's system (project tree)
- Measured value display 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 with Powermanager V3.0 SP1 and higher)
- Support of distributed plants (systems)
- Archiving system
- User administration

6.2.2 SENTRON Powerconfig

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

The PC-based tool facilitates parameterization of the devices, resulting in substantial time savings, particularly when several devices have to be set up. Power monitoring devices from the 7KM PAC series can be parameterized and operated via various communications interfaces using SENTRON 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 measured values and settings
- Clear presentation of the available parameters including validity 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

You launch the Online Help in SENTRON Powerconfig by pressing the *F1* key.

6.2.3 Web server (PAC3220 MID only)

The device can be read out with a PC/notebook via a website using the web server integrated in the device. Communication takes place via HTTP.

The web server provides the following functions:

- Device information such as serial number, firmware version, etc.
- View and evaluation of the measured values

Starting the web server:

1. Connect the device to the PC or network via the Ethernet interface.
2. Make sure that the PAC3220 MID and the configuration computer are in the same subnet.
3. Enter the IP address of the device in the browser.

HTTP port: 80 (default setting)

Note

The web server can be deactivated with the "HTTP port: 0" setting.

6.2.4 Advanced training courses

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

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

Here you can choose from:

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

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

Parameter assignment

7

7.1 Introduction

Device settings

The chapter headed "Parameterizing" describes the device settings. These include:

- 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
- SENTRON Powerconfig configuration software

Note

Protection of the device settings

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

7.2 Parameterizing via the operator interface

The power monitoring device can be parameterized via the "Settings" menu option.

You can find more information in chapter Menu navigation (Page 63).

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

- Device information

  Article number and versions
- Language

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

  Settings for the measuring inputs
- Date/time

  Time-related settings

- Integrated I/Os

  Setting for use of the digital inputs/outputs and LEDs on the front of the device.
- Communication

  Network communication settings
- Display

  Settings for the display
- Energy counters

  Energy counter settings (balance, import or export)
- Advanced

  Password protection, device reset, write protection, universal counter and limit values

7.2.1 Device information

The device information cannot be modified.

Device information	
7KM3x20-xBA01-1xA0	Article number of the device
PAC3x20 MID	Device designation
S/N: LQN/xxxxxxxxxxxx	Serial number of the device
D/T: xxxxxx	Date code
ES: xxx	Hardware revision level
SW-REV: xxxx	Firmware revision level
BL-REV: xxxx	Boot loader revision level
LP-REV: xxxx	Language pack revision level

7.2.2 Language

The language of menu-based operation and of the measured value displays can be set in the "Language" menu item.

Selection	Range	Factory setting
Language	• Chinese • German • English • French • Italian • Portuguese • Polish • Russian • Spanish • Turkish	English
Phase labels	• L1 L2 L3 • a b c	L1 L2 L3

7.2.3 Basic parameters

Measuring inputs can be parameterized in the "Basic parameters" menu item.

Voltage input

Selection	Range	Factory setting
Connection type	• 3P4W: Three-phase, four-wire • 3P3W: Three-phase, three-wire • 1P2W: Single-phase, two-wire	3P4W
Use PTs?	• ☑ ON: Measurement using voltage transformers. When measuring via voltage transformers, the device must know the voltage transformation ratio. For this purpose, the primary and secondary voltages must be specified in the fields "PT PRIMARY" and "PT SECONDARY". When changing from direct measurement to measurement using voltage transformers, the device accepts the last set reference measuring voltage as the secondary voltage and as the primary voltage. • ☐ OFF: Measurement directly on the low-voltage system. When changing from measurement using voltage transformers to direct measurement, the device accepts the last set secondary voltage as the reference measuring voltage.	☐ OFF
PT PRIMARY (Use PTs? ☑ ON)	100 ... 100000 V	400 V
PT SECONDARY (Use PTs? ☑ ON)	100 ... 400 V	400 V

Current input

Selection	Range	Factory setting
CT PRIMARY	Primary current of the current transformers 1 ... 10000 A	50 A
CT SECONDARY	Secondary current of the current transformers • 1 A • 5 A	5 A
DISPLAY RANGE:	Freely adjustable 1 ... 99999 A	50 A
I(n) display	Current in neutral conductor I_n • AUTO: When the "I_n, I(diff), analog" expansion module (7KM9200-0AD00-0AA0) is connected, the measured current is displayed. Otherwise, the calculated I_n current is displayed. • PAC3220 MID: I_n current is displayed (calculated) • OFF: I_n current is not displayed	AUTO

Note

Selection of current transformers

Please note that I-Prim x U-Prim x 3 must be ≤ 200 MVA.

TEST LED

Selection	Range	Factory setting
TEST LED ON	When you press ↵ to confirm, the set LED function is immediately switched to energy pulse 10000 / kWh (SECONDARY).	–

7.2.4 Date/time

Setting the date and time

Selection	Range	Factory setting
DATE	Current date. The date format is defined in the FORMAT field.	–
FORMAT	• DD.MM.YYYY • YYYY-MM-DD • MM/DD/YY	DD.MM.YYYY
TIME	HH:MM:SS	–
TIME ZONE	Time zone, refers to coordinated universal time (UTC). –12:00 ... +14:00, in 30-minute intervals Examples: • "–06:00" corresponds to UTC-6 • "+01:00" corresponds to UTC+1	00:00
DAYL.SAVING	Automatic time change. • OFF: Time change is deactivated. • AUTO EU: Time change within the European Union The internal clock is put forward from 1 a.m. UTC to 2 a.m. UTC on the last Sunday in March. Changeover to standard time: The internal clock is put back from 2 a.m. UTC to 1 a.m. UTC on the last Sunday in October. • AUTO US: Time change within the USA The internal clock is put forward from 2 a.m. local time to 3 a.m. on the second Sunday in March. Changeover to standard time: The internal clock is put back from 2 a.m. local time to 1 a.m. on the first Sunday in November. • TABLE: Time change can be individually parameterized. The parameters can be set in the software.	AUTO EU

Selection	Range	Factory setting
SNTP (only for PAC3220 MID)	Protocol is used for transmitting the time and for synchronization. • OFF: SNTP function deactivated. • ACTIVE: The device automatically requests the time from the NTP server. • BCST Client: The device receives time frames which are sent from an NTP server.	OFF
IP (only when SNTP is activated) (only for PAC3220 MID)	If an SNTP IP address is configured, only data from this IP address is accepted. 0.0.0.0	0.0.0.0

7.2.5 Integrated I/Os

Device settings for using the digital inputs and outputs.

Digital output

Selection	Range	Factory setting
DIG. OUTPUT	Two digital outputs are available: • 0.0 • 0.1	0.0
ACTION	• OFF: Output is deactivated. • DEVICE ON: Output signals that the device is switched on. • REMOTE CONTROL: Output is controlled by remote access. • DIRECTION OF ROTATION: Output is switched on by an electric counter-clockwise rotating field and remains active for as long as the field is rotating in this direction. • LIM. VIOLATION: Output is switched on by a limit violation and remains active for as long as the limit violation persists. • PULSE: Output outputs the parameterized number of pulses or edges per energy unit.	OFF
TIMEOUT (only for REMOTE CONTROL)	• TIMEOUT: Remote control is deactivated after set time has elapsed 0 - 18000 s	0 s
PULSES	Number of pulses to be output per unit. The reference unit is defined in the "UNIT" field. 1 ... 4000	1

Selection	Range	Factory setting
UNIT (only for PULSE)	Selects the type of cumulated power (active energy or reactive energy): • kWh IMPORT • kWh EXPORT • kVarh IMPORT • kVarh EXPORT The import values at which a pulse or an edge is output are defined in the fields "UNIT" and "PULSES PER UNIT". Value of the cumulated power for which a configurable number of pulses is output. The number of pulses to be output is defined in the field "PER". • 1 kVarh or kW • 10 kVarh or kW • 100 kVarh or kW • 1000 kVarh or kW	kWh IMPORT
PER (only for PULSE)	Value of the cumulated power for which a configurable number of pulses is output. The number of pulses to be output is defined in the field "PER". • 1 • 10 • 100 • 1000	1
PULSE LENGTH	Length of the pulse: 30 ... 500 ms The minimum length of the interpulse period corresponds to the pulse duration specified.	100 ms
LIM CH. (only for LIM.VIOLATION)	Selects the limit whose status is output to the digital output. • LIMIT LOGIC • LIM 0 ... 5	LIMIT LOGIC
STATUS	Indicates whether the output is active • ☑ Yes: Active • ☐ No: Not active	–

Digital input

Selection	Range	Factory setting
DIG. INPUT	Two digital inputs are available: • 0.0 • 0.1	0.0
ACTION	• NONE: Input is deactivated. • PULSE INPUT: Counting of input pulses. (Note: A universal counter can be parameterized for pulse counting. In the device settings "ADVANCED > UNIVERSAL COUNTER", set the field "SOURCE" to the value "DIG. INPUT".) • ON/OFF-PEAK: Tariff switching. Off-peak tariff if input active. • SYNC: Synchronization of average power demand values. • DISPLAY: Backlighting is activated with the rising edge. Deactivation takes place after the delay time has elapsed. Delay time can be specified in the "DISPLAY" menu by selecting "DIM AFTER".	NONE
PULSES (only for PULSE INPUT)	Number of pulses to be output per unit. The reference unit is defined in the "UNIT" field. 1 ... 4000	1
PER (only for PULSE)	Value of the cumulated power for which a configurable number of pulses is output. The number of pulses to be output is defined in the field "PER". • 1 • 10 • 100 • 1000	1

Selection	Range	Factory setting
UNIT (only for PULSE)	Selects the type of cumulated power (active energy or reactive energy): • kWh IMPORT • kWh EXPORT • kVarh IMPORT • kVarh EXPORT The import values at which a pulse or an edge is output are defined in the fields "UNIT" and "PULSES PER UNIT". • 1 kVarh or kW • 10 kVarh or kW • 100 kVarh or kW • 1000 kVarh or kW	kWh IMPORT
STATUS	Indicates whether the input is active • ☑ Yes: Active • ☐ No: Not active	–

LED

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

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

Status

Selection	Range	Factory setting
DI 0. DO 0.	Graphically represents the status of the integrated I/Os on the device display.	–

7.2.6 Communication

RS485 interface (only for PAC3120 MID or PAC3220 MID with RS485 expansion module)

Selection	Range	Factory setting
ADDRESS	Range: 1 ... 247	126
BAUD RATE	Range: • 4800 • 9600 • 19200 • 38400 • 57600 • 115200	19200
FORMAT	• 8N1 • 8N2 • 8E1 • 8O1	8N2
RESPONSE TIME	Range: 0 ... 255 ms	0 ms

Ethernet interface (only applies to PAC3220 MID)

Selection	Range	Factory setting
MAC	MAC address. Read only.	–
IP	Manual setting of the IP address is only possible when DHCP is deactivated. Format: 000.000.000.000	–
SN	Manual setting of the subnet is only possible when DHCP is deactivated. Format: 000.000.000.000	–
DHCP	(Dynamic Host Configuration Protocol) • ☑ ON: If DHCP is activated, network configurations are automatically assigned. This enables automatic integration of devices into an existing network. • ☐ OFF: If DHCP is activated, network configurations cannot be adjusted manually.	☑ ON
IP FILTER	The IP filter is a configurable access protection. When the IP filter is activated, Modbus TCP write commands are only accepted if the remote station is located in the same subnet. • ☑ ON: Access to the device is refused if the request comes from an uncleared host. • ☐ OFF: IP filter deactivated	☐ OFF
Modbus PORT	0 ... 65534 The setting Modbus port = 0 deactivates the Modbus TCP server.	502

Selection	Range	Factory setting
HTTP PORT	Manual setting of the HTTP port (web server). With the HTTP port = 0 setting, the web server is deactivated.	80
GW	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. It interconnects different networks. Format: 000.000.000.000	--

7.2.7 Display

Selection	Range	Factory setting
CONTRAST	Contrast of the LC display. 0 ... 10	5
BACKLIGHT	Intensity of the backlighting of the LC display. 0 ... 3	3
BACKL.DIMMED	Intensity of the backlighting of the LC display. Set by the device after the "time until dimmed" expires. See "TIME UNTIL DIMMED" field. 0 ... 3 ("0" switches the backlighting off.)	1
DIM AFTER	Time after which the device switches the backlighting from "BACKLIGHT LEVEL" to "BACKL.DIMMED". 0 ... 99 min	3 min
INVERT DISPLAY	Inversion of the basic representation of the display. • ☑ ON: Dark text on light background • ☐ OFF: Light text on dark background	☑ ON
DISPLAY TEST...	Screen for testing the functional capability of the display. • Key F3 inverts the test screen. • Key F4 closes the display.	–

7.2.8 Advanced

7.2.8.1 Password

Note

This is a 4-digit PIN designed to protect against inadvertent operating errors.
We recommend that you change the PIN that was set at the factory and that you notify the necessary personnel to that effect.

Protection against unauthorized operation prevents the following actions:

- Changing of device settings, including password
- Changing and deletion of values/parameters
- Deletion of data and memory content
- Setting and resetting of counts
- Resetting to factory settings

Reading out of measured values and memory content is still possible when protection against unauthorized operation is active.

Note

It is possible to define in the menu whether the password protects only the display or the communications interfaces, or whether it simultaneously protects the display and the communications interfaces.

Selection	Range	Factory setting
DISPLAY	Password protection prevents write access via the device interface. • ☑ ON: Password protection active • ☐ OFF: Password protection deactivated	☐ OFF
COMMUNICATION	Password protection prevents write access via the communications interfaces. • ☑ ON: Password protection active • ☐ OFF: Password protection deactivated	☐ OFF
PASSWORD	Four-digit PIN 0000 ... 9999	0000

Note

If you have forgotten the PIN, please contact Technical Support. You will obtain a new PIN.

7.2.8.2 Resetting

Selection	Range	Factory setting
CLEAR MIN/MAX VALUES	Resets all minimum and maximum values to the instantaneous value. • ☑ Yes: Active • ☐ No: Not active	☐ No
UNIV. COUNTER RESET	Resets the configurable universal counters to 0 (zero). • ☑ Yes: Active • ☐ No: Not active	☐ No
FACTORY SETTINGS	All device settings and measured values except the communication parameters and energy secondary values are reset to the as-delivered condition. • ☑ Yes: Active • ☐ No: Not active	☐ No
COMMUNICATION PARAMETERS	All communication settings are reset to the as-delivered condition. • ☑ Yes: Active • ☐ No: Not active	☐ No
LONG-TERM DATA	Load profile entries are reset. • ☑ Yes: Active • ☐ No: Not active	☐ No
EXECUTE	Confirmation of the reset	–

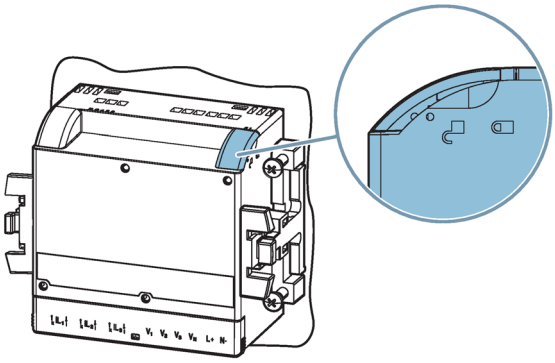
Note

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

7.2.8.3 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.



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

Note

Sealing of the write protection switch

The lead seal (to be applied by the metering point operator) prevents operation of the write protection switch. For this purpose, the write protection switch is equipped with a hole for threading the seal.

The customer is the metering point operator and the person authorized to break the seal.

Note

Changing the configuration or software update

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

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 of the device must be adjusted in order to activate or deactivate the protection function.	–
DISPLAY*	Write protection prevents write access via the device interface. • ON: Write protection active • OFF: Write protection deactivated	OFF
CLEAR MIN/MAX VALUES*	Minimum/maximum values are protected by the write protection function. • ON: Write protection active • OFF: Write protection deactivated	OFF
DATE/TIME*	The date and time are protected by the write protection function. • ON: Write protection active • OFF: Write protection deactivated	OFF
PASSWORD*	The password is protected by the write protection function. • ON: Write protection active • OFF: Write protection deactivated	OFF
COMMUNICATION*	Write protection prevents write access via the communications interface. • ON: Write protection active • OFF: Write protection deactivated	OFF
LIMITS*	Limits are protected by the write protection function. • ON: Write protection active • OFF: Write protection deactivated	OFF

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

7.2.8.4 Universal counter

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

Selection	Range	Factory setting
SOURCE	Source of the count: • Digital input • Digital output • Limit logic • Limit value LIM0 • Limit value LIM1 • Limit value LIM2 • Limit value LIM3 • Limit value LIM4 • Limit value LIM5	Digital input 0.0

7.2.8.5 Limit values

Monitoring of 6 limit values "LIM0" to "LIM5" and of the limit logic operation "LIMIT LOGIC".

The limit logic operation "LIMIT LOGIC" can be formed from any of the limit values "LIM0" to "LIM5".

Selection	Range	Factory setting
LIM0 ... LIM5	Menu selection for limit values. Each limit value has the following properties.	-
MONITORING	Activation of limit value monitoring. • ☑ ON: Limit value monitoring activated. • ☐ OFF: Limit value monitoring deactivated.	☐ OFF
SOURCE	Monitored data source. Almost all measured variables can be selected as the source.	U L1
MODE	The comparison operators refer to the value in the "VALUE" field. • GREATER THAN • LOWER THAN	GREATER THAN
VALUE	Monitored threshold	-
PICKUP DELAY	Delay before reporting the limit violation in seconds. The pickup delay refers to the occurrence of the limit violation or the point of exceeding the threshold defined in the "Value" field. See the figure below "Effect of pickup delay and hysteresis". 0 s ... 10 s	0 s
HYSTERESIS	Threshold buffer. This prolongs the limit violation. The hysteresis refers to the disappearance of the limit violation or the point when the level returns below the defined threshold. 0.0% ... 20.0% The percentage refers to the threshold value in the "VALUE" field. See the figure below "Effect of pickup delay and hysteresis".	0.0%

Selection	Range	Factory setting
STATUS	Indicates whether the limit value is currently violated. • ☑ Yes, violation. • ☐ No, no violation.	-
LIMIT LOGIC	Refer to the following section "LIMIT LOGIC".	-

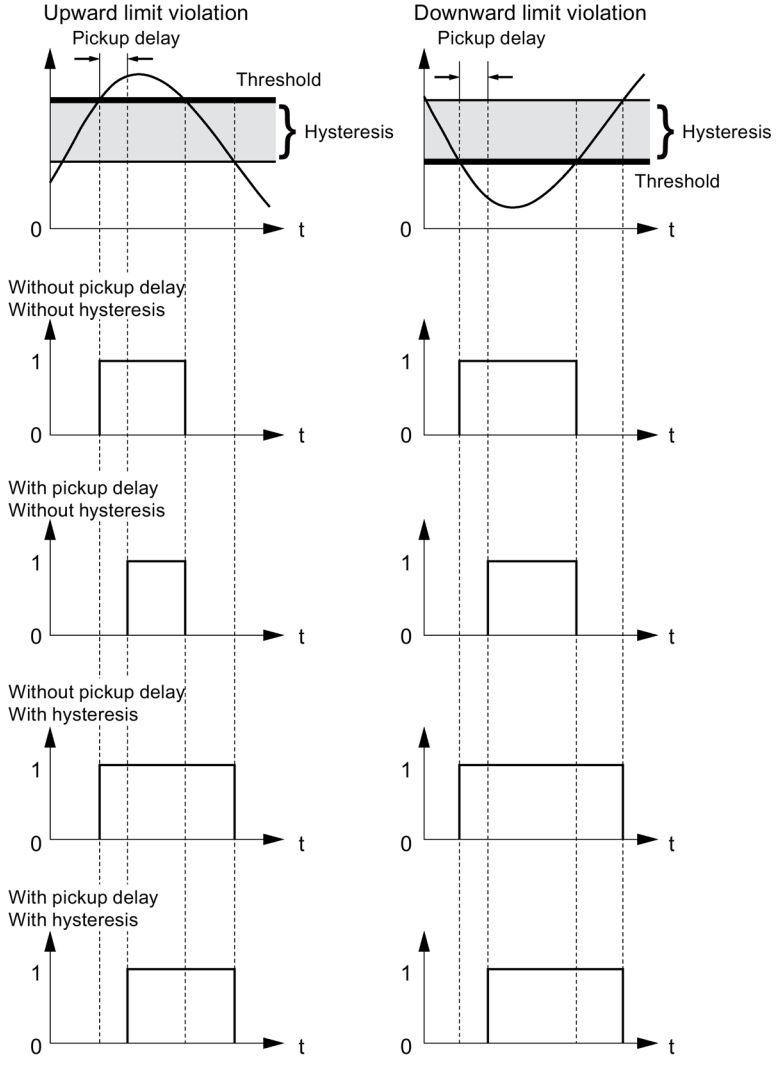
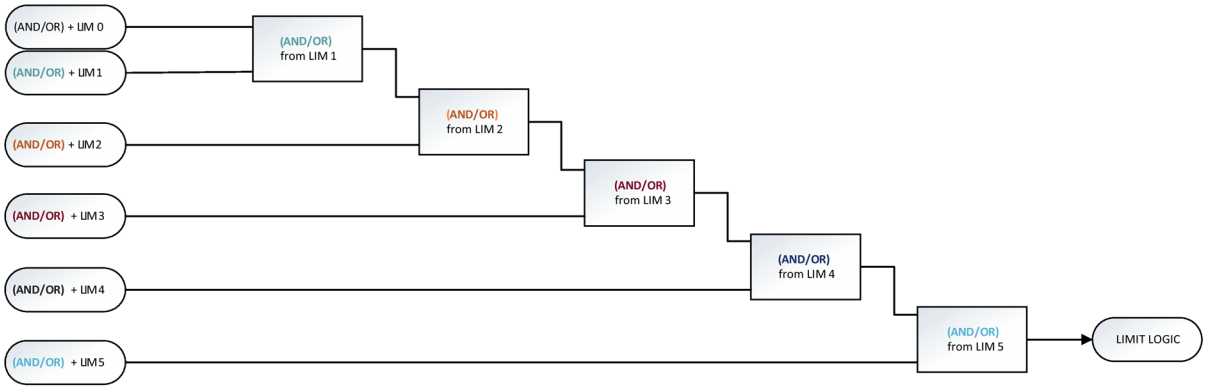


Figure 7-1 Effect of pickup delay and hysteresis in the event of upper and lower limit violations

Limit logic

Logical truth value resulting from the combination of up to 6 limit values "LIM0" to "LIM5". Two logic operators are available. The result is formed sequentially.

Operator	Description
AND	AND logic operation: • The output value is true if all input values are true. • The output value is false if one of the input values is false.
OR	OR logic operation: • The output value is true if any one of the input values or several input values are true. • The output value is only false if all input values are false.
----	Logic operation deactivated. This limit value is not combined with any other limit value.



Security features

8

8.1 Cybersecurity

8.1.1 Introduction

This document is designed to support system administrators and system engineers in the setup of cybersecure networks and to help users to operate PAC SENTRON systems in a cybersecure manner.

8.1.2 Further information on the defense-in-depth strategy

In order to protect technical infrastructures, systems, machines and networks against cyber threats, it is essential to implement and consistently support

a holistic, state-of-the-art IT security concept. Siemens products and solutions constitute just one element of such a concept.

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

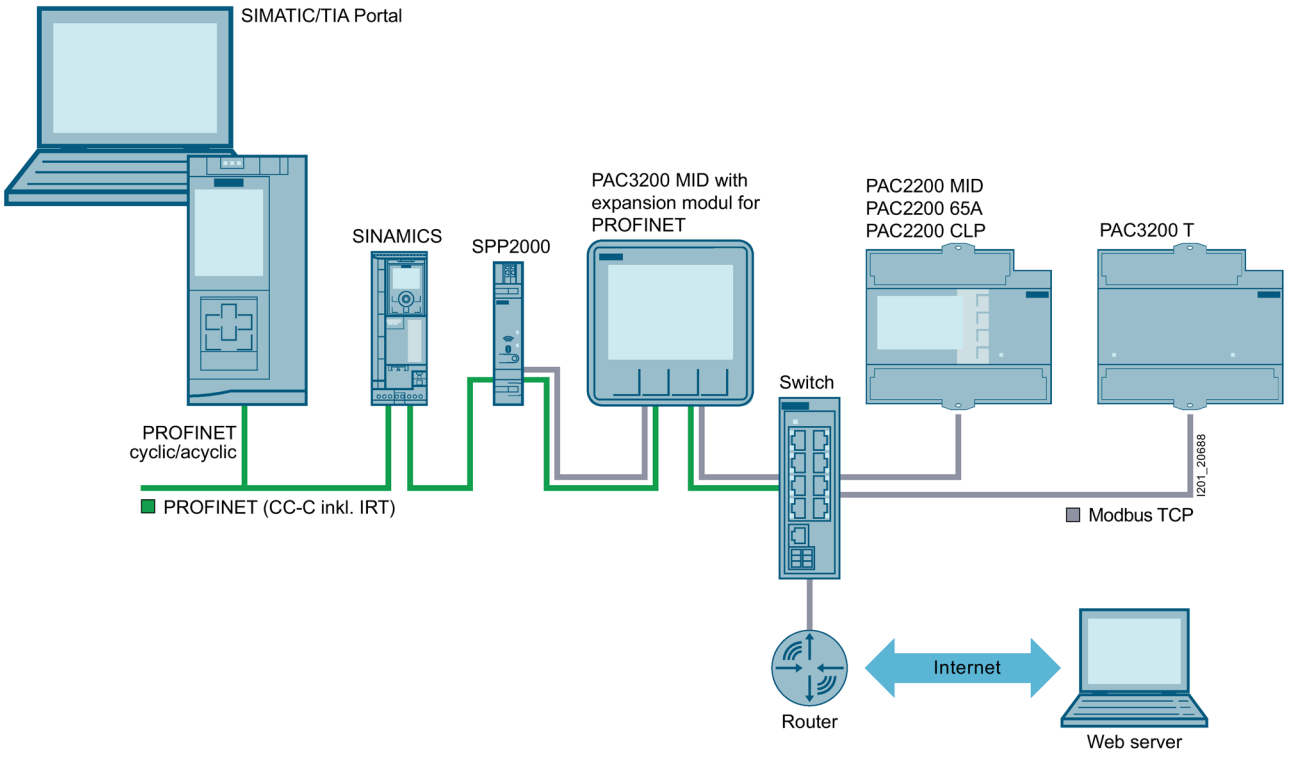
8.1.3 Overview

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

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

The SENTRON 7KM PAC3x20 Power Monitoring Device specializes in precise energy metering and is particularly suitable for the process and manufacturing industries, as well as for demanding commercial operations.

The layout diagram below illustrates an application example and the integration of the 7KM PAC3x20 Power Monitoring Device into an existing system with other Siemens products.



The devices are equipped with a range of mechanisms to protect against deliberate and inadvertent device manipulation.

- Protection against unauthorized operation (PIN)
- Hardware write protection
- Device access control (IP filter) (PAC3220 MID only)
- Configurable Modbus TCP port (PAC3220 MID only)
- Housing seal and sealing of the connections and the hardware write protection slide switch.

The closed padlock symbol in the display title indicates whether "protection against unauthorized operation" 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.

8.1.4 Firmware update

The device uses signed firmware to ensure that the cybersecurity requirements are satisfied. The ECC Brainpool method with a length of 256 bits is used for secure encryption.

The power monitoring device supports firmware updates.

Use the Powerconfig configuration software to update 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:

- PAC3120 MID (https://support.industry.siemens.com/cs/ww/en/view/109820593)
- PAC3220 MID (https://support.industry.siemens.com/cs/ww/en/view/109820594)

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

8.1.5 Communication protocols

Service	Protocol	Port	Properties
Web server (PAC3220)	HTTP	80	• Configurable • Can be switched off (0)
Modbus TCP (PAC3220)	TCP	502	• Configurable • Can be switched off (0)
Identification service (PAC3220)	UDP	17008	• Cannot be switched off
Identification service (PAC3220)	UDP	17009	• Cannot be switched off
DHCP server (PAC3220)	UDP	68	• Configurable • Can be switched off
Time synchronization NTP (PAC3220)	UDP	123	• Configurable • Can be switched off
Modbus RTU (PAC3120)	RTU	---	• Configurable • Cannot be switched off

8.1.6 Secure device disposal

Reset the device to the factory settings before disposing of it to prevent the possible disclosure of confidential data.

Resetting to the factory settings clears the following data:

- device name
- IP addresses
- ports
- access data
- other configurations

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

8.1.7 Guideline for secure operation and commissioning

In order to ensure operation of the device in a cybersecure manner, we recommend that you observe the following points:

- Ensure that only authorized personnel are allowed physical access to the device. This can be implemented by means of access restrictions such as a lockable room or control cabinet.
- Always use the latest firmware version. The latest firmware version may only be downloaded from the Siemens Industry Online Portal (SIOS) (https://sieportal.siemens.com/su/bjATu)
- Change the default settings such as IP addresses and port number in the network settings.
- Ensure that only authorized personnel have access to communication settings and access data.
- Switch off services/protocols that are not in use.

Note

Individual RJ45 interfaces cannot be switched off.

8.1.8 Cybersecurity guidelines

The following points are designed to help the user to keep the device in operation without disturbances even in the event of cyberattacks.

- **Install the latest firmware version.**

  Set up a patch management process that guarantees that the latest security patch for the operating system is installed and enabled. A patched operating system rectifies all known vulnerabilities. It offers greater security against cyberattacks.

- **Set up a backup and restore process**

  Use the operating system functionality to create backups of the operating system. Use the SENTRON Powerconfig functionality to create a backup of the SENTRON Powerconfig project file. Keep the backups in a safe place and keep the backups up to date. Draw up a recovery plan for emergencies.

- **Create account and user management if available**

  Enable account and user management on the operating system level. Do not work with an administrator account during the operating phase. Do not create a single account for a user group in which a password is shared by several members of personnel. Work with user accounts or groups with minimal rights.

- **Only use secure passwords**

  Do not use "12345678", "12password34" or other passwords that are easy to guess. Keep your passwords secret. Do not share your password with anyone. Change the default passwords of all relevant devices and users whenever a password is required. Only use secure passwords.

- **Enable security functions**

  Enable all the cybersecurity functions of the device.

- **Disable/delete/uninstall all services, users and applications that are not required**

  All services that are not required must be disabled. If a printer is not in use, for example, disable the printer service in the operating system. Delete or disable all users that are not required and uninstall unnecessary software from the operating system.

- **Personnel policies**

  Members of personnel must be conscious of their responsibilities with respect to cybersecurity. The device with the SENTRON Powerconfig software must not be used for surfing the internet or for leisure purposes. The device with the SENTRON Powerconfig software must only be used for configuring SENTRON devices.

  No unauthorized applications may be installed on the device with the SENTRON Powerconfig installation. External mass storage device and media may only be connected to the operating system if it is guaranteed that the data are free of malicious code.

- **Physical security**

  Protect the device with the SENTRON Powerconfig installation against unauthorized physical access and theft.

- **Continuing training of personnel**

  Members of personnel who use SENTRON Powerconfig must attend annual training courses on the topic of cybersecurity.

8.1.9 Security by default

The Security by Default concept has been implemented to minimize data loss and potential manipulation risks.

- Modbus TCP and NTP are switched off by default
- Hardware write protection is activated by default

8.1.10 Overview of detected vulnerabilities

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

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

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

8.1.11 Reporting cybersecurity vulnerabilities

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

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

Email: productcert@siemens.com

8.2 Protection against unauthorized operation

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

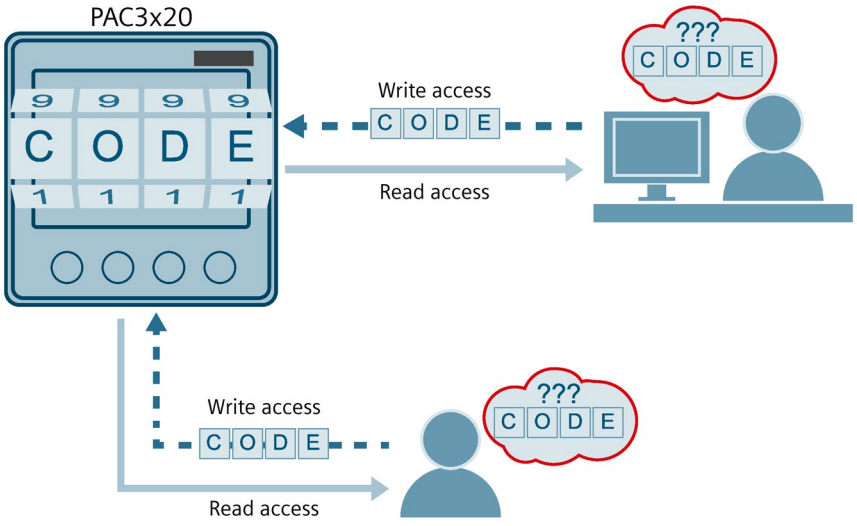
- Changing of device settings, including password
- Changing and deletion of values/parameters
- Deletion of data and memory content
- Setting and resetting of counts
- Resetting to factory settings

Reading out of measured values and memory content is still possible when protection against unauthorized operation is active.

Protection against unauthorized operation can be activated on the device in the "Advanced" submenu of the "Settings" menu.

Note

Protection against unauthorized operation is not a security mechanism; it is simply protection against inadvertent operating errors.



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

Password policy: four-digit number 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 switching on protection against unauthorized operation, make sure that you and the group of authorized users are all in possession of the password.

If device protection is switched on, you need the password 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 for the protection against unauthorized operation, please contact Technical Support (https://www.siemens.com/support-request). You will be issued with a new password.

8.3 Hardware write protection

The hardware write protection prevents write access to the device, both via the communications interface and on the display. It is one of the cybersecurity functions.

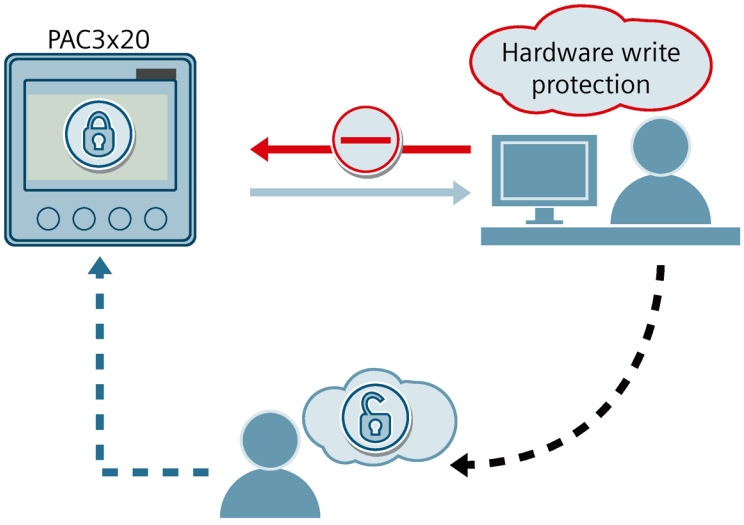
In order to gain write access, the hardware write protection must be deactivated directly on the device.

The hardware write protection cannot be deactivated via a communications 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 84).

Note

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 84)).



Note

We recommend that you activate the hardware write protection on the device.

Seal

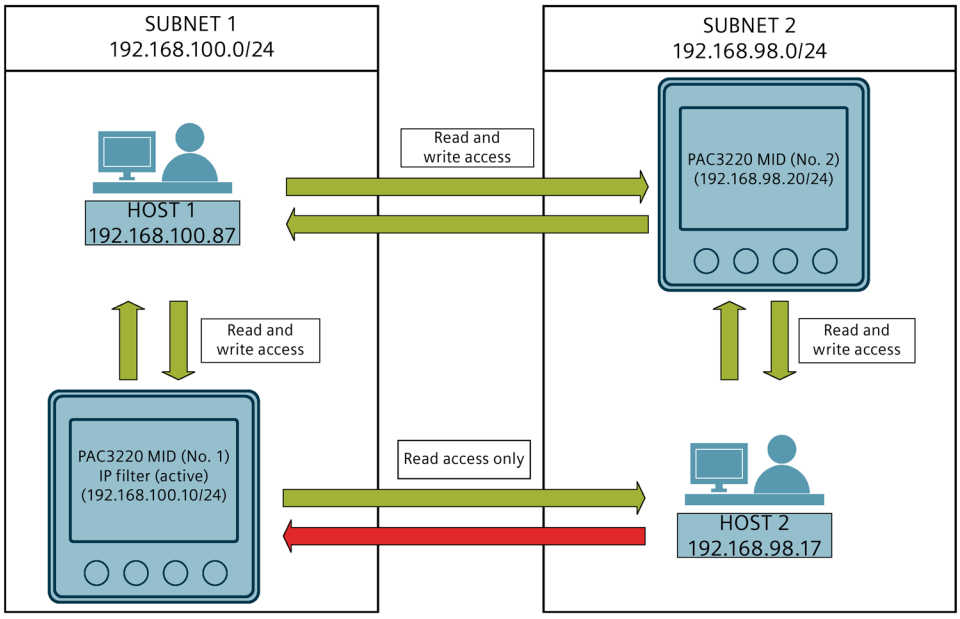
The device has a sealing eyelet for sealing the hardware write protection slider. Sealing prevents unauthorized deactivation of the hardware write protection from going unnoticed.

8.4 Device access control (IP filter) (PAC3220 MID only)

This function is only available for PAC3220 MID.

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

The IP filter can be activated on the device in the "Communication" submenu of the "Settings" menu. It is one of the cybersecurity functions.



Note

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

Example

PAC3220 MID No. 1 **with IP filter** is located in subnet 1 (192.168.100.0/24).

PAC3220 MID No. 2 **without IP filter** is located in subnet 2 (192.168.98.0/24).

- Host 1 (IP: 192.168.100.87) in subnet 1 (192.168.100.0/24) has read and write access to PAC3220 MID 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 PAC3220 MID No. 2 (192.168.98.20/24) in subnet 2 (192.168.98.0/24), because the IP filter is not activated on PAC3220 MID No. 2.
- Host 2 (IP: 192.168.98.17) in subnet 2 (192.168.98.0/24) only has read access to PAC3220 MID No. 1 (192.168.100.10/24), because the IP filter is activated on PAC3220 MID No. 1 and Host 2 is not located in the same subnet as PAC3220 MID No. 1.

8.5 Configuring the Modbus TCP port (PAC3220 MID only)

This function is only available for PAC3220 MID.

Ports are communication channels which make it possible to access a Modbus-capable device via a network. Standard IP ports like port 502 are often tested by port scanners. If an open port is discovered by an attacker, it can be used to attack the device.

For this reason, PAC3220 MID allows the Modbus TCP port to be configured manually.

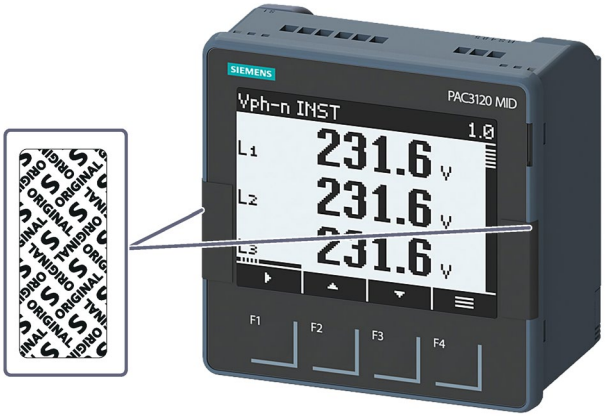
The IP filter can be activated on the device in the "Communication" submenu of the "Settings" menu. It is one of the cybersecurity functions.

8.6 Housing seal and sealing

Seal label

The seal label protects the device against unauthorized access that may go unnoticed, thus preventing possible manipulation inside the device.

The device is sealed with two seal labels at the front.



Note

Voiding of the warranty due to damage or removal of the seal label

If the seal label is damaged or removed, the warranty is voided.

In this case, the device is no longer certified for billing purposes.

Seal

The device has a sealing eyelet for sealing the terminals. Sealing of the connections prevents the manipulation of connections from going unnoticed and thus also possible energy theft.

Service and maintenance

9

9.1 Cleaning

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

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

9.2 Firmware updates

The device is suitable for updating according to German Metering and Calibration Law (MessEG, MessEV).

The number of updates is limited.

When updating, always use the latest version of the SENTRON Powerconfig configuration software.
For update instructions, please refer to the associated documentation and the online help for the configuration software.
The most recent device settings and counter readings remain unchanged after the update.

9.3 Warranty

Procedure

Note

Loss of warranty

Opening the device invalidates the Siemens warranty. Only the manufacturer is permitted to carry out repairs to the device.

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

1. Deinstall the device. You can find more information in chapter Deinstallation (Page 39).
2. Pack the device in a suitable manner to prevent it from being damaged during transport.
3. Return the device to Siemens. You can obtain the address from:
   - Your Siemens sales partner
   - Technical Assistance

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

10

Device configuration

- 2 opto-isolated digital inputs
- 2 opto-isolated digital outputs
- 1 RS485 interface for connecting to a PC or network (PAC3120 MID only)
- 1 Ethernet interface with 2 ports for connecting to a PC or network (PAC3220 MID only)

Measurement

Only for connection to AC voltage systems

Measurement		
Measuring method	Voltage measurement	True RMS measurement (TRMS), zero blind measurement, gapless
	Current measurement	True RMS measurement (TRMS), zero blind measurement, gapless
Measured value acquisition	• Power • Frequency • Power factor • cos φ	Zero blind measurement, gapless
	Waveform	Sinusoidal or distorted
	Frequency of the fundamental	50/60 Hz (60 Hz without MID approval)
	Measured value acquisition mode	Automatic line frequency detection

Measuring inputs for voltage

Measuring inputs for voltage		
Measurable voltage	Rated voltage	57.7/100 ... 230/400 V AC
	Min. measuring voltage U_{L-N}	11.5 V
	Max. measuring voltage U_{L-N}	276 V AC
Zero point suppression	Voltage L-N	10 V
	Voltage L-L	17 V
Rated impulse voltage		4 kV
Input resistance L-N		1.5 MΩ
Max. power consumption per phase		150 mW

Measuring inputs for current

Only for connection to AC power systems via external current transformers.

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

Measurement accuracy

Applied standards:

- IEC 61557-12
- IEC 62053-11
- IEC 62053-21
- IEC 62053-22
- IEC 62053-24
- EN 50470-3

Measured variable	**Accuracy class**
Voltage	Class 0.2 (IEC 61557-12)
Current	Class 0.2 (IEC 61557-12)
Neutral conductor current (calculated)	Class 0.2 (IEC 61557-12)
Apparent power	Class 0.5 (IEC 61557-12)
Active power	Class 0.5 (IEC 61557-12)
Reactive power	Class 1 (IEC 61557-12)
Total apparent power	Class 0.5 (IEC 61557-12)
Total active power	Class 0.5 (IEC 61557-12)
Total reactive power	Class 1 (IEC 61557-12)
Total power factor	Class 0.5 (IEC 61557-12)
Line frequency	Class 0.05 (IEC 61557-12)
Total active energy	Class 0.5 (IEC 61557-12) (IEC 62053-21)
Total reactive energy	Class 2 (IEC 61557-12) (IEC 62053-24)
Total active energy	Class C to 0.5% (EN 50470-3)

When measuring on external current transformers or voltage transformers, the accuracy of the measurement depends on the quality of the transformer.

Supply voltage (Optional. Not required for Measuring Instruments Directive device function)

Supply voltage		
Wide-range AC/DC power supply unit (Optional: Not required for operation. For optional use, e.g. for UPS)	Rated range PAC3220 MID	100 ... 250 V AC/DC ± 10%, 50/60 Hz 8 VA (max. 14 VA with two expansion modules)
	Rated range PAC3120 MID	100 ... 250 V AC/DC ± 10%, 50/60 Hz 4 VA
Overvoltage category		OVC III

Digital inputs

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

Digital outputs

Digital outputs		
Number		2
Type		Bidirectional
Design/function		Switching output or pulse output
Rated voltage		0 ... 30 V DC, typical 24 V DC (SELV or PELV supply)
Output current	For "1" signal	Depends on the load and the external supply voltage
	Continuous load	≤ 50 mA (thermal overload protection)
	Transient overload	≤ 130 mA for 100 ms
	For "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 ... 500 ms
	Min. settable time frame	10 ms
	Max. switching frequency	17 Hz

PAC3120 MID communication

PAC3120 MID communication		
RS485 interface	Electrical interface	RS485, two-wire line + 1 line for Common
	Connection type	Screw terminals
	Supported communication protocol	Modbus RTU
	Functionality	Client
	Supported baud rate	• 4800 • 9600 • 19200 • 38400 • 57600 • 115200 Default: 19200
	Data format	• 8N1 • 8N2 • 8E1 • 8O1 Default: 8N2
	Supported address area	1 ... 247 Default: 126

PAC3220 MID communication

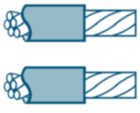
PAC3220 MID communication		
Ethernet interface	Number of interfaces	2
	Version	RJ45
	Protocol	• Modbus TCP • Web server (HTTP) • SNTP • DHCP
	Number of simultaneous communication connections	3 Modbus TCP connections + web server
	Data rate	10 / 100 Mbps, autonegotiation and auto-MDI-X (medium-dependent interface)

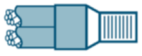
Display and operator control

Display and operator control		
Display	Version	Monochrome, graphical LC display
	Backlighting	White, invertible display

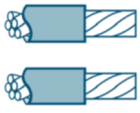
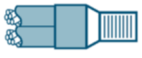
Display and operator control		
	LED service life	25,000 hours at 25 °C ambient temperature. To achieve a service life of at least 10 years, the backlighting should be switched on for no more than 10 % of the device operating time.
	Resolution	128 x 96 pixels
	Size W x H	74 mm x 56 mm
Keypad	Version	4 function keys on the front, multiple assignments
Write protection switch	Version	Mechanical slide switch on the rear of the device

Connection components: Current connection, voltage connection

Connection components: Current connection, voltage connection		
Conductor cross-section for copper cable (Cu)	Rigid 	0.2 ... 6 mm^2 (AWG 24 ... 10)
	Flexible 	0.2 ... 4 mm^2 (AWG 24 ... 12)
	Flexible with end sleeve, without plastic sleeve 	0.2 ... 4 mm^2 (AWG 24 ... 12)
	Flexible with end sleeve and plastic sleeve 	0.25 ... 4 mm^2 (AWG 24 ... 12)
Two wires with the same cross-section	Rigid 	0.2 ... 1.5 mm^2 (AWG 24 ... 16)
	Flexible 	0.2 ... 1.5 mm^2 (AWG 24 ... 16)
	Flexible with TWIN end sleeve, without plastic sleeve 	0.25 ... 0.75 mm^2 (AWG 24 ... 19)

Connection components: Current connection, voltage connection		
	Flexible with TWIN end sleeve and plastic sleeve 	0.5 ... 2.5 mm² (AWG 20 ... 14)
	Tightening torque	0.5 ... 0.6 Nm (4.4 ... 5.3 lb-in)

Connection components: PAC3120 MID communication ports

Connection components: PAC3120 MID communication ports		
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)
Two wires with the same cross-section	Rigid 	0.14 ... 0.75 mm² (AWG 26 ... 19)
	Flexible 	0.14 ... 0.75 mm² (AWG 26 ... 19)
	Flexible with TWIN 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)

Connection components: PAC3120 MID communication ports		
	Tightening torque	0.5 ... 0.6 Nm (4.4 ... 5.3 lb-in)

Dimensions and weights

Dimensions and weights		
Type of mounting		Panel mounting to IEC 61554
Housing dimensions W x H x D		96 mm x 96 mm x 56 mm
Cutout (W x H)		92 mm +0.8 mm x 92 mm +0.8 mm
Mounting depth (without expansion modules)		51 mm
Permissible control panel thickness for installation		≤ 4 mm
Mounting position		Any
Weight	Device without packaging	Approx. 360 g
	Device including packaging	Approx. 455 g

Degree of protection and protection class

Degree of protection and protection class		
Protection class		Protection class II when installed
Degree of protection according to IEC 60529	Device front panel	IP65
	Rear of the device	IP20

If higher degree of protection requirements are placed on the application engineering, the customer must take suitable measures. This includes installation in a protective enclosure with degree of protection IP51 or higher.

Ambient conditions

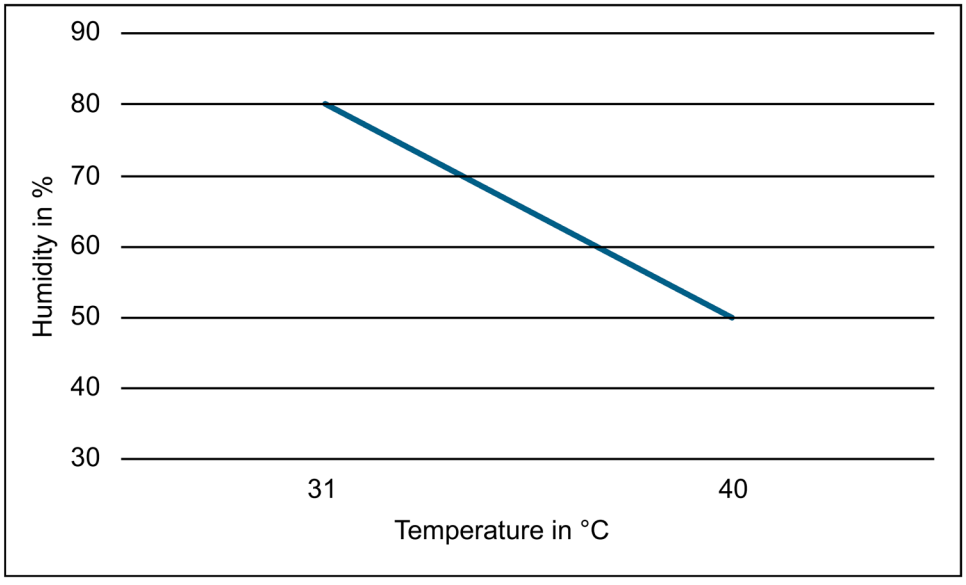
The device is suitable for panel mounting in accordance with IEC 61554. The device may only be operated within enclosed dry rooms.

Ambient conditions		
Temperature range	Operating range	–20 ... +55 °C
	Range limits for operation	–25 ... +55 °C
	Range limits for storage and transport	–25 ... +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
EMC tests		
	Interference emission	• EN 50470-1

Ambient conditions		
	Limit values complied with for interference emission	Class B, used in the household sector
	Immunity	EN 50470-1
	Standards considered for immunity:	• EN 61000-4-2 (electrostatic discharge) • EN 61000-4-3 (electromagnetic HF fields) • EN 61000-4-4 (fast transients - burst) • EN 61000-4-5 (surge immunity) • EN 61000-4-6 (conducted FH fields) • EN 61000-4-8 (magnetic fields) • EN 61000-4-11 (voltage dips) • EN 61000-4-18 (damped oscillatory waves) • EN 61000-4-19 (immunity to conducted, differential mode disturbances and signaling in the frequency range 2 kHz to 150 kHz at AC power ports)

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.



Approvals

Symbol	Approval
CE	**CE conformity** The applied directives and standards can be found in the EU Declaration of Conformity.
M YY 1948	MID conformity

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

As per the Measuring Instruments Directive (MID), Annex 1, Point 10, the following displays and the functions that cause them are within the MID application range and therefore formed part of the conformity assessment procedures according to MID, Annex II, Module B.

Energy for the overall measured values formed from all the existing measuring systems, OBIS code	Short code Energy	Phase angle range of the offset between current and voltage	Revision
Positive active, 1.8.0 T1 + T2 kWh Secondary side (menu item kWh IMPORT 16.10)	+A	> 270° to < 90°	0
Positive active, 1.8.0 T1 + T2 kWh Primary side (menu item kWh IMPORT 16.8)	+A	> 270° to < 90°	0
Negative active, 2.8.0 T1 + T2 kWh Primary side (menu item kWh EXPORT 16.9)	-A	> 90° to < 270°	0
Negative active, 2.8.0 T1 + T2 kWh Secondary side (menu item kWh EXPORT 16.11)	-A	> 90° to < 270°	0

Not included in the application range are in particular:

- Outputs with the exception of the test LED
- Ethernet data interfaces as well as digital inputs and outputs
- Apparent energy
- Reactive energy
- Instantaneous values (voltage, current, apparent power, active power, reactive power, power factors, frequency, totals)
- Tariff switching
- Password protection and hardware write protection
- Reset function

- Load profile values (daily, monthly, annual values)
- Calculation of average values for active and reactive power of the last completed demand period for import and export

10.1 Labeling

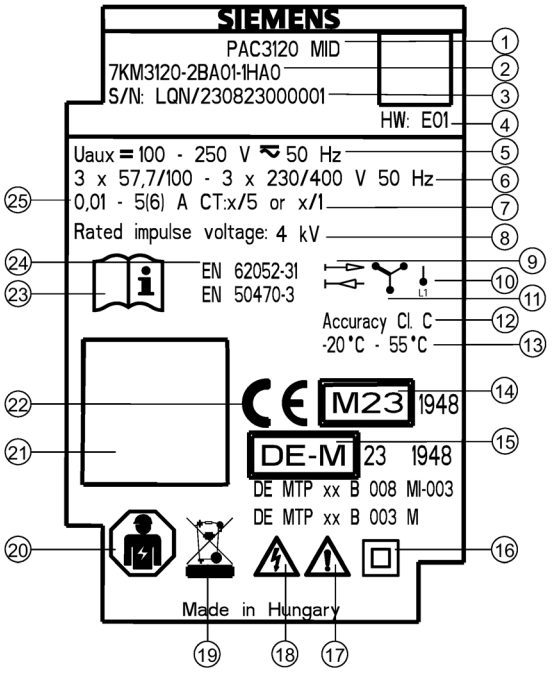


Figure 10-1 Example of a typical rating plate for PAC3120 MID (230 V)

Item	Explanation	Item	Explanation
1	Device designation	14	MID mark with the year the mark was affixed (23 stands for 2023) 1948 = Notified body (CSA Group Bayern GmbH)
2	Article number	15	DE-M - Metrology symbol for national approval in Germany (DE= Germany; M= Metrology) 23 = Year of manufacture, in this example 2023. The year shown after the metrology mark is the year in which the mark was affixed (see Metering and Calibration Act §14 (4)) 1948 = Notified body (CSA Group Bayern GmbH) DE MTP xxxxxxxx = Approval number
3	Serial number of the device	16	Protective insulation - Class II device
4	Hardware version	17	Safety alert symbol (observe the safety instructions in the accompanying documentation and the operating manual)
5	Auxiliary supply voltage (can be connected as an option)	18	Risk of electric shock

Item	Explanation	Item	Explanation
6	Information about the measuring voltage connection	19	The device must not be disposed of with general domestic waste.
7	Information about the current transformers that can be connected to the current measuring connection	20	Electrical installation and maintenance by qualified personnel only
8	Rated impulse voltage	21	Public key
9	Bidirectional counter	22	CE mark
10	Network type (1P2W) – Connection L1/N (available soon)	23	Refer to the operating manual
11	Network type (3P4W)	24	Reference to standards
12	Measurement accuracy class	25	Information about the current measuring connection
13	Permissible temperature range during operation		

Dimensional drawings

11

Panel cutout

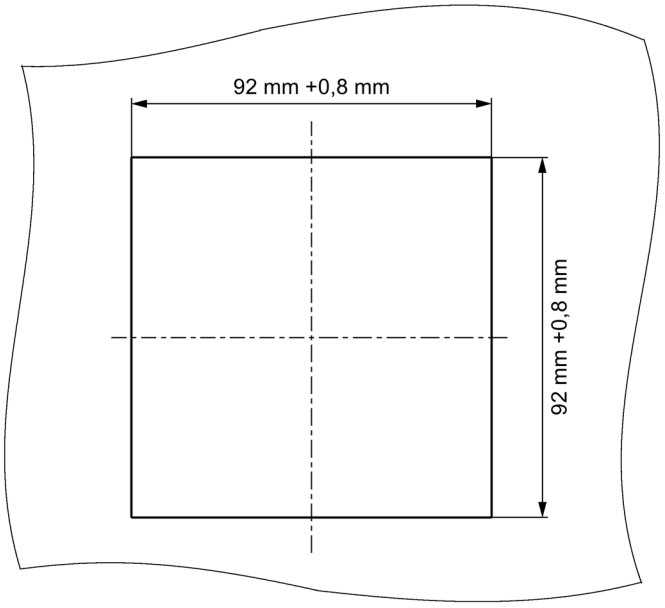


Figure 11-1 Panel cutout

Frame dimensions

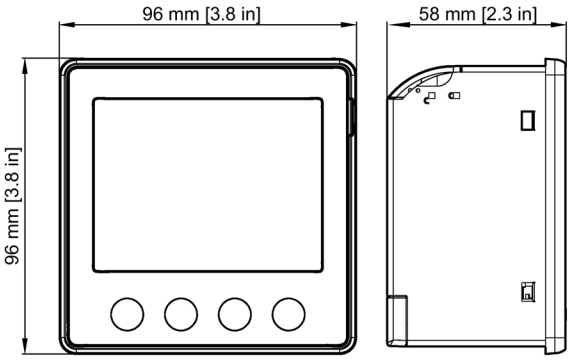
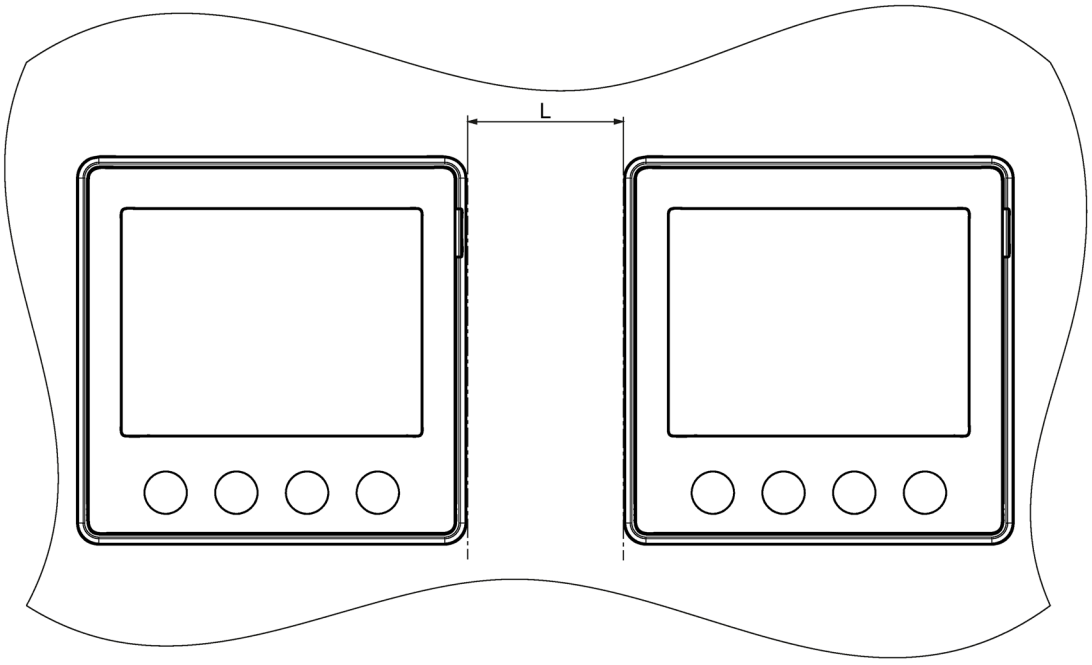


Figure 11-2 Frame dimensions

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

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

A.1.1 Function codes

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

If an error occurs, the MSB bit is set in the response frame in the FC byte.

Supported Modbus function codes

FC	Function in accordance with Modbus specification
0 x 01	Read Coils
0 x 02	Read Discrete Inputs
0 x 03	Read Holding Registers
0 x 04	Read Input Registers
0 x 05	Write Single Coil
0 x 06	Write Single Register
0 x 0F	Write Multiple Coils
0 x 10	Write Multiple Registers
0 x 2B	Read Device Identification
0 x 14	Read File Record (for demand values)

A.1.2 Exception codes

Overview

Table A- 1 Modbus exception codes

Exception codes	Name	Meaning	Remedy
01	Illegal Function	Illegal function: • The function code in the request is not a permissible action for the client. • The client 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 client. 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 client. 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	Client Device Failure	Error in processing the data: An indefinite error occurred when the client attempted to execute the requested action.	Check that the specified offset and the specified data length in the command are correct.
F0	Write Protection ON	The action has been rejected because the write protection is set.	Deactivate the write protection.

A.1.3 Modbus measured variables with the function codes 0x03 and 0x04

Addressing the measured variables

You can use the Modbus function codes 0x03 and 0x04 on all the measured variables listed below.

Note

Error in the case of inconsistent access to measured values

Please ensure the start offset of the register is correct for **read access operations**.

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

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

Table A- 2 Meaning of the abbreviations in the "Access" column of the table headed "Available measured variables" below

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

Table A- 3 Available measured variables

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

Offset	Number of registers	Name	Format	Unit	Value range	Access
31	2	Reactive power L1 (VAR1)	Float	var	–	R
33	2	Reactive power L1 (VAR1)	Float	var	–	R
35	2	Reactive power L1 (VAR1)	Float	var	–	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-R voltage L1	Float	%	0 ... 100	R
45	2	THD-R voltage L2	Float	%	0 ... 100	R
47	2	THD-R voltage L3	Float	%	0 ... 100	R
49	2	THD-R current L1	Float	%	0 ... 100	R
51	2	THD-R current L2	Float	%	0 ... 100	R
53	2	THD-R current L3	Float	%	0 ... 100	R
55	2	Frequency	Float	Hz	45 ... 65	R
57	2	Average voltage UL-N	Float	V	–	R
59	2	Average voltage UL-L	Float	V	–	R
61	2	Average current	Float	A	–	R
63	2	Total apparent power	Float	VA	–	R
65	2	Total active power	Float	W	–	R
67	2	Total reactive power	Float	var	–	R
69	2	Total power factor	Float	–	–	R
71	2	Amplitude unbalance voltage	Float	%	0 ... 100	R
73	2	Amplitude unbalance current	Float	%	0 ... 200	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-L1	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
105	2	Maximum reactive power L1 (VARn)	Float	var	–	R
107	2	Maximum reactive power L1 (VARn)	Float	var	–	R
109	2	Maximum reactive power L1 (VARn)	Float	var	–	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 factor L3	Float	–	0 ... 1	R
117	2	Maximum THD-R voltage L1-L2	Float	%	0 ... 100	R

Offset	Number of registers	Name	Format	Unit	Value range	Access
119	2	Maximum THD-R voltage L2-L3	Float	%	0 ... 100	R
121	2	Maximum THD-R voltage L3-L1	Float	%	0 ... 100	R
123	2	Maximum THD-R current L1	Float	%	0 ... 100	R
125	2	Maximum THD-R current L2	Float	%	0 ... 100	R
127	2	Maximum THD-R current L3	Float	%	0 ... 100	R
129	2	Maximum frequency	Float	–	45 ... 65	R
131	2	Maximum average voltage UL-N	Float	V	–	R
133	2	Maximum average voltage UL-L	Float	V	–	R
135	2	Maximum average current	Float	A	–	R
137	2	Maximum total apparent power	Float	VA	–	R
139	2	Maximum total active power	Float	W	–	R
141	2	Maximum total reactive power (VARn)	Float	var	–	R
143	2	Maximum total power factor	Float	–	–	R
145	2	Minimum voltage L1-N	Float	V	–	R
147	2	Minimum voltage L2-N	Float	V	–	R
149	2	Minimum voltage L3-N	Float	V	–	R
151	2	Minimum voltage L1-L2	Float	V	–	R
153	2	Minimum voltage L2-L1	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
175	2	Minimum reactive power L1 (VARn)	Float	var	–	R
177	2	Minimum reactive power L1 (VARn)	Float	var	–	R
179	2	Minimum reactive power L1 (VARn)	Float	var	–	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 frequency	Float	Hz	45 ... 65	R
189	2	Minimum average voltage UL	Float	V	–	R
191	2	Minimum average voltage UL-L	Float	V	–	R
193	2	Minimum average current	Float	A	–	R
195	2	Minimum total apparent power	Float	VA	–	R
197	2	Minimum total active power	Float	W	–	R
199	2	Minimum total reactive power (VARn)	Float	var	–	R
201	2	Minimum total power factor	Float	var	–	R

Offset	Number of registers	Name	Format	Unit	Value range	Access
203	2	Limit violations	Unsigned long	–	Byte3 Bit0 Limit 0 Byte3 Bit1 Limit 1 Byte3 Bit2 Limit 2 Byte3 Bit3 Limit 3 Byte3 Bit4 Limit 4 Byte3 Bit5 Limit 5 Byte0 Bit0 Limit comb.	R
205	2	PMD diagnostics and status	Unsigned long	–	Byte0 global state Byte1 local state Byte2 global diag. Byte3 local diag.	R
207	2	Digital outputs status	Unsigned long	–	Byte3 Bit0 Output 0.0 Byte3 Bit1 Output 0.1	R
209	2	Digital inputs status	Unsigned long	–	Byte3 Bit0 Input 0.0 Byte3 Bit1 Input 0.1	R
211	2	Active tariff	Unsigned long	–	0 = Tariff 1 1 = Tariff 2	R
213	2	Operating hours counter	Unsigned long	s	0 ... 999999999	RW
215	2	Counter (configurable)	Unsigned long	–	0 ... 999999999	RW
217	2	Counter basic parameter changes	Unsigned long	–	–	R
219	2	Counter all parameter changes	Unsigned long	–	–	R
221	2	Counter limit value changes	Float	–	–	R
223	2	Current N	Float	A	–	R
225	2	Maximum current N	Float	A	–	R
227	2	Minimum current N	Float	A	–	R
231	2	Configurable energy counter	Float	kWh, kVarh	–	R
233	2	Status digital outputs module 1	Unsigned long	–	Byte3 Bit0 Output 4.0 Byte3 Bit0 Output 4.1	R
235	2	Status digital inputs module 1	Unsigned long	–	Byte3 Bit0 Input 4.0 Byte3 Bit1 Input 4.1 Byte3 Bit2 Input 4.2 Byte3 Bit3 Input 4.3	R
237	2	Status digital outputs module 2	Unsigned long	–	Byte3 Bit0 Output 8.0 Byte3 Bit0 Output 8.1	R
239	2	Status digital inputs module 2	Unsigned long	–	Byte3 Bit0 Input 8.0 Byte3 Bit1 Input 8.1 Byte3 Bit2 Input 8.2 Byte3 Bit3 Input 8.3	R
241	2	Displacement factor L1 ("cosine phi")	Float	-	0.0-1.0	R
243	2	Displacement factor L2 ("cosine phi")	Float	-	0.0-1.0	R
245	2	Displacement factor L3 ("cosine phi")	Float	-	0.0-1.0	R

Offset	Number of registers	Name	Format	Unit	Value range	Access
247	2	Displacement factor SUM ("cosine phi")	Float	-	0.0-1.0	R
249	2	Max. displacement factor L1 ("cosine phi")	Float	-	0.0-1.0	R
251	2	Max. displacement factor L2 ("cosine phi")	Float	-	0.0-1.0	R
253	2	Max. displacement factor L3 ("cosine phi")	Float	-	0.0-1.0	R
255	2	Max. displacement factor SUM ("cosine phi")	Float	-	0.0-1.0	R
257	2	Min. displacement factor L1 ("cosine phi")	Float	-	0.0-1.0	R
259	2	Min. displacement factor L2 ("cosine phi")	Float	-	0.0-1.0	R
261	2	Min. displacement factor L3 ("cosine phi")	Float	-	0.0-1.0	R
263	2	Min. displacement factor SUM ("cosine phi")	Float	–	0.0-1.0	R
265	2	Daily profile counter	Unsigned long	–	–	R
267	2	Monthly profile counter	Unsigned long	–	–	R
269	2	Annual profile counter	Unsigned long	–	–	R
271	2	THD-V L1-L2	Float	%	0.0-100.0	R
273	2	THD-V L2-L3	Float	%	0.0-100.0	R
275	2	THD-V L3-L1	Float	%	0.0-100.0	R
277	2	Max. THD-V L1-L2	Float	%	0.0-100.0	R
279	2	Max. THD-V L2-L3	Float	%	0.0-100.0	R
281	2	Max. THD-V L3-L1	Float	%	0.0-100.0	R
501	2	Cumulated average active power import	Float	W	–	R
503	2	Cumulated average reactive power import	Float	var	–	R
505	2	Cumulated average active power export	Float	W	–	R
507	2	Cumulated average reactive power export	Float	var	–	R
509	2	Maximum active power reading during demand period	Float	W	–	R
511	2	Minimum active power reading during demand period	Float	W	–	R
513	2	Maximum reactive power reading during demand period	Float	var	–	R
515	2	Minimum reactive power reading during demand period	Float	var	–	R
517	2	Length of the current demand period	Unsigned long	s	–	R
519	2	Time since start of current demand period	Unsigned long	s	–	R
545	2	Time stamp for the current period (UTC)	unix_ts			R
547	2	OID current period (unique period ID)	Unsigned long			R
549	2	Active energy - import current period	Float	Wh		R
551	2	Reactive energy - import current period	Float	VARh		R
553	2	Active energy - export current period	Float	Wh		R
555	2	Reactive energy - export current period	Float	VARh		R

Offset	Number of registers	Name	Format	Unit	Value range	Access
557	2	Length of demand period (measurement duration)	Unsigned long	ms		R
559	2	Status information	Unsigned long	–	BYTE 0 0x00 TARIFF 1 BYTE 0 0x01 TARIFF 2 Bit 23: Measurement input out of range Bit 22: Power failure Bit 21: Time inaccurate Bit 19: Current transformer Bit 18: Multi-synchronization Bit 13: Logbook full Bit 12: New event in logbook Bit 6: Reactive power type VAR1 Bit 0: Period is invalid	R
561	4	Total active energy - import tariff 1, current period	double	Wh		R
565	4	Total active energy - import tariff 2, current period	double	Wh		R
569	4	Total reactive energy - import tariff 1, current period	double	Wh		R
573	4	Total reactive energy - import tariff 2, current period	double	Wh		R
577	4	Total active energy - export tariff 1, current period	double	VARh		R
581	4	Total active energy - export tariff 2, current period	double	VARh		R
585	4	Total reactive energy - export tariff 1, current period	double	VARh		R
589	4	Total reactive energy - export tariff 2, current period	double	VARh		R
593	4	Total active energy - import tariff 1 + 2, current period	double	Wh		R
597	4	Total active energy - export tariff 1 + 2, current period	double	Wh		R
799	2	Date/time	Unix_ts	–	–	RW
801	4	Total active energy import tariff 1	Double	Wh	Overflow 1.0e+12	RW
805	4	Total active energy import tariff 2	Double	Wh	Overflow 1.0e+12	RW
809	4	Total active energy export tariff 1	Double	Wh	–	RW
813	4	Total active energy export tariff 2	Double	Wh	Overflow 1.0e+12	RW
817	4	Total reactive energy import tariff 1	Double	VARh	Overflow 1.0e+12	RW
821	4	Total reactive energy import tariff 2	Double	VARh	Overflow 1.0e+12	RW
825	4	Total reactive energy export tariff 1	Double	VARh	Overflow 1.0e+12	RW
829	4	Total reactive energy export tariff 2	Double	VARh	Overflow 1.0e+12	RW
833	4	Total apparent energy tariff 1	Double	VAh	Overflow 1.0e+12	RW

Offset	Number of registers	Name	Format	Unit	Value range	Access
837	4	Total apparent energy tariff 2	Double	VAh	Overflow 1.0e+12	RW
841	4	L1 active energy import tariff 1	Double	Wh	Overflow 1.0e+12	RW
845	4	L1 active energy import tariff 2	Double	Wh	Overflow 1.0e+12	RW
849	4	L1 active energy export tariff 1	Double	Wh	Overflow 1.0e+12	RW
853	4	L1 active energy export tariff 2	Double	Wh	Overflow 1.0e+12	RW
857	4	L1 reactive energy import tariff 1	Double	VARh	Overflow 1.0e+12	RW
861	4	L1 reactive energy import tariff 2	Double	VARh	Overflow 1.0e+12	RW
865	4	L1 reactive energy export tariff 1	Double	VARh	Overflow 1.0e+12	RW
869	4	L1 reactive energy export tariff 2	Double	VARh	Overflow 1.0e+12	RW
873	4	L1 apparent energy tariff 1	Double	VAh	Overflow 1.0e+12	RW
877	4	L1 apparent energy tariff 2	Double	VAh	Overflow 1.0e+12	RW
881	4	L2 active energy import tariff 1	Double	Wh	Overflow 1.0e+12	RW
885	4	L2 active energy import tariff 2	Double	Wh	Overflow 1.0e+12	RW
889	4	L2 active energy export tariff 1	Double	Wh	Overflow 1.0e+12	RW
893	4	L2 active energy export tariff 2	Double	Wh	Overflow 1.0e+12	RW
897	4	L2 reactive energy import tariff 1	Double	VARh	Overflow 1.0e+12	RW
901	4	L2 reactive energy import tariff 2	Double	VARh	Overflow 1.0e+12	RW
905	4	L2 reactive energy export tariff 1	Double	VARh	Overflow 1.0e+12	RW
909	4	L2 reactive energy export tariff 2	Double	VARh	Overflow 1.0e+12	RW
913	4	L2 apparent energy tariff 1	Double	VAh	Overflow 1.0e+12	RW
917	4	L2 apparent energy tariff 2	Double	VAh	Overflow 1.0e+12	RW
921	4	L3 active energy import tariff 1	Double	Wh	Overflow 1.0e+12	RW
925	4	L3 active energy import tariff 2	Double	Wh	Overflow 1.0e+12	RW
929	4	L3 active energy export tariff 1	Double	Wh	Overflow 1.0e+12	RW
933	4	L3 active energy export tariff 2	Double	Wh	Overflow 1.0e+12	RW
937	4	L3 reactive energy import tariff 1	Double	VARh	Overflow 1.0e+12	RW
941	4	L3 reactive energy import tariff 2	Double	VARh	Overflow 1.0e+12	RW
945	4	L3 reactive energy export tariff 1	Double	VARh	Overflow 1.0e+12	RW
949	4	L3 reactive energy export tariff 2	Double	VARh	Overflow 1.0e+12	RW
953	4	L3 apparent energy tariff 1	Double	VAh	Overflow 1.0e+12	RW
957	4	L3 apparent energy tariff 2	Double	VAh	–	RW
961	4	Secondary total of active energy - import (MID register)	double	Wh	-	R
965	4	Secondary total of active energy - export (MID register)	double	Wh	-	R
969	4	Total active energy - import (MID register)	double	Wh	-	R
973	4	Total active energy - export (MID register)	double	Wh	-	R
2801	2	Total active energy - import tariff 1	Float	Wh	-	R
2803	2	Total active energy - import tariff 2	Float	Wh	-	R
2805	2	Total active energy - export tariff 1	Float	Wh	-	R
2807	2	Total active energy - export tariff 2	Float	Wh	-	R
2809	2	Total reactive energy - import tariff 1	Float	VARh	-	R
2811	2	Total reactive energy - import tariff 2	Float	VARh	-	R
2813	2	Total reactive energy - export tariff 1	Float	VARh	-	R

Offset	Number of registers	Name	Format	Unit	Value range	Access
2815	2	Total reactive energy - export tariff 2	Float	VARh	-	R
2817	2	Total apparent energy - tariff 1	Float	VAh	-	R
2819	2	Total apparent energy - tariff 2	Float	VAh	-	R
2821	2	L1 active energy - import tariff 1	Float	Wh	-	R
2823	2	L1 active energy - import tariff 2	Float	Wh	-	R
2825	2	L1 active energy - export tariff 1	Float	Wh	-	R
2827	2	L1 active energy - export tariff 2	Float	Wh	-	R
2829	2	L1 reactive energy - import tariff 1	Float	VARh	-	R
2831	2	L1 reactive energy - import tariff 2	Float	VARh	-	R
2833	2	L1 reactive energy - export tariff 1	Float	VARh	-	R
2835	2	L1 reactive energy - export tariff 2	Float	VARh	-	R
2837	2	L1 apparent energy - tariff 1	Float	VAh	-	R
2839	2	L1 apparent energy - tariff 2	Float	VAh	-	R
2841	2	L2 active energy - import tariff 1	Float	Wh	-	R
2843	2	L2 active energy - import tariff 2	Float	Wh	-	R
2845	2	L2 active energy - export tariff 1	Float	Wh	-	R
2847	2	L2 active energy - export tariff 2	Float	Wh	-	R
2849	2	L2 reactive energy - import tariff 1	Float	VARh	-	R
2851	2	L2 reactive energy - import tariff 2	Float	VARh	-	R
2853	2	L2 reactive energy - export tariff 1	Float	VARh	-	R
2855	2	L2 reactive energy - export tariff 2	Float	VARh	-	R
2857	2	L2 apparent energy - tariff 1	Float	VAh	-	R
2859	2	L2 apparent energy - tariff 2	Float	VAh	-	R
2861	2	L3 active energy - import tariff 1	Float	Wh	-	R
2863	2	L3 active energy - import tariff 2	Float	Wh	-	R
2865	2	L3 active energy - export tariff 1	Float	Wh	-	R
2867	2	L3 active energy - export tariff 2	Float	Wh	-	R
2869	2	L3 reactive energy - import tariff 1	Float	VARh	-	R
2871	2	L3 reactive energy - import tariff 2	Float	VARh	-	R
2873	2	L3 reactive energy - export tariff 1	Float	VARh	-	R
2875	2	L3 reactive energy - export tariff 2	Float	VARh	-	R
2877	2	L3 apparent energy - tariff 1	Float	VAh	-	R
2879	2	L3 apparent energy - tariff 2	Float	VAh	-	R
2881	2	Secondary total of active energy - import (MID register)	Float	Wh	-	R
2883	2	Secondary total of active energy - export (MID register)	Float	Wh	-	R
2885	2	Total active energy - import (MID register)	Float	Wh	-	R
2887	2	Total active energy - export (MID register)	Float	Wh	-	R

A.1.4 Structure - Digital input status and digital output status with the function codes 0x03 and 0x04

The following are available via Modbus:

- "Digital Inputs Status"
- "Digital Outputs Status"

Table A- 4 Structure - status of the digital inputs (Modbus offset 209) and digital outputs (Modbus offset 207)

Name	Length	Status	Byte	Bit	Bit mask	Access
Digital outputs status	32 bits	DO 0.0	3	0	0x00000001	R
Digital outputs status	32 bits	DO 0.1	3	1	0x00000002	R
Digital inputs status	32 bits	DI 0.0	3	0	0x00000001	R
Digital inputs status	32 bits	DI 0.1	3	1	0x00000002	R

Table A- 5 Structure - status of the digital inputs (Modbus offset 235) and digital outputs (Modbus offset 233) for a PAC 4DI/2DO expansion module at slot MOD 1 (PAC3220 MID only)

Name	Length	Status	Byte	Bit	Bit mask	Access
Digital outputs status	32 bits	DO 4.0	3	0	0x00000001	R
Digital outputs status	32 bits	DO 4.1	3	1	0x00000002	R
Digital inputs status	32 bits	DI 4.0	3	0	0x00000001	R
Digital inputs status	32 bits	DI 4.1	3	1	0x00000002	R
Digital inputs status	32 bits	DI 4.2	3	2	0x00000004	R
Digital inputs status	32 bits	DI 4.3	3	3	0x00000008	R

Table A- 6 Structure - status of the digital inputs (Modbus offset 239) and digital outputs (Modbus offset 237) for a PAC 4DI/2DO expansion module at slot MOD 2 (PAC3220 MID only)

Name	Length	Status	Byte	Bit	Bit mask	Access
Digital outputs status	32 bits	DO 8.0	3	0	0x00000001	R
Digital outputs status	32 bits	DO 8.1	3	1	0x00000002	R
Digital inputs status	32 bits	DI 8.0	3	0	0x00000001	R
Digital inputs status	32 bits	DI 8.1	3	1	0x00000002	R
Digital inputs status	32 bits	DI 8.2	3	2	0x00000004	R
Digital inputs status	32 bits	DI 8.3	3	3	0x00000008	R

A.1.5 Structure - Device diagnostics and device status with the function codes 0x03 and 0x04

Design

Table A- 7 Modbus offset 205, register 2: Structure device status and device diagnostics

Byte	Bit	Device status	Type	Bit mask	Value range	Access
0	0	No synchronization pulse	Status	0x01000000	0 = Not active 1 = Active	R
0	1	Device configuration menu is active	Status	0x02000000		R
0	2	Voltage overload	Status	0x04000000		R
0	3	Current overload	Status	0x08000000		R
1	1	Maximum pulse rate exceeded	Status	0x00020000		R
2	0	Relevant parameter changes[1)]	Stored	0x00000100		R
2	2	Maximum pulse rate exceeded[1)]	Stored	0x00000400		R
2	3	Restart of the device[1)]	Stored	0x00000800		R
2	4	Resetting of energy counters by user[1)]	Stored	0x00001000		R

1) Only these device states must be acknowledged.

A.1.6 Modbus status parameters with the function code 0x02

Status parameters

You can use the Modbus function code 0x02 on all the status parameters listed below.

Offset	Number of registers	Name	Format	Value range	Access
0	0	Limit 0	Bit	0 = Not active	R
1	0	Limit 1	Bit	1 = Active	R
2	0	Limit 2	Bit		R
3	0	Limit 3	Bit		R
4	0	Limit 4	Bit		R
5	0	Limit 5	Bit		R
50	0	Limit logic	Bit		R
108	0	Bit 0 Relevant parameter changes	Bit		R
109	0	Bit 1 Upper or lower limit violation	Bit		R
110	0	Bit 2 Maximum pulse rate exceeded	Bit		R
111	0	Bit 3 Restart of the device	Bit		R
112	0	Bit 4 Resetting of energy counters by user	Bit		R
116	0	Bit 0 Module slot 1	Bit		R
117	0	Bit 1 Maximum pulse rate exceeded	Bit		R
118	0	Bit 2 Module slot 2	Bit		R
123	0	Bit 7 Waiting for user input	Bit		R
124	0	Bit 0 No synchronization pulse	Bit		R
125	0	Bit 1 Device configuration menu is active	Bit		R
126	0	Bit 2 Voltage overload	Bit		R
127	0	Bit 3 Current overload	Bit		R
128	0	Bit 4 Date/time of device not secure	Bit		R
129	0	Bit 5 Device update in progress	Bit		R
130	0	Bit 6 Hardware write protection is active	Bit		R
131	0	Bit 7 Modbus communication protected by password	Bit		R
200	0	Digital input 0.0	Bit		R
201	0	Digital input 0.1	Bit		R
232	0	Digital input 4.0[1)]	Bit		R
233	0	Digital input 4.1[1)]	Bit		R
234	0	Digital input 4.2[1)]	Bit		R
235	0	Digital input 4.3[1)]	Bit		R
264	0	Digital input 8.0[1)]	Bit		R
265	0	Digital input 8.1[1)]	Bit		R
266	0	Digital input 8.2[1)]	Bit		R
267	0	Digital input 8.3[1)]	Bit		R
400	0	Digital output 0.0	Bit		R
401	0	Digital output 0.1	Bit		R
432	0	Digital output 4.0[1)]	Bit		R
433	0	Digital output 4.1[1)]	Bit		R
464	0	Digital output 8.0[1)]	Bit		R
465	0	Digital output 8.1[1)]	Bit		R

[1)] Only applies to PAC3220 MID and 4DI/2DO expansion module

A.1.7 Modbus settings with the function codes 0x03, 0x04 and 0x10

Addressing the settings

You can use the Modbus function codes 0x03 and 0x04 for read access operations and 0x10 for write access operations on all the setting parameters listed below.

Table A- 8 Setting parameters

Offset	Number of registers	Name	Unit	Format	Value range	Access
49999	2	Rated current display range	A	Unsigned long	1 - 10000	RW
50001	2	Connection type	–	Unsigned long	0 ... 4 0 = 3P4W 1 = 3P3W 4 = 1P2W	RW
50003	2	Voltage measurement using voltage transformer yes/no	–	Unsigned long	0 ... 1 0 = No 1 = Yes	RW
50005	2	Primary voltage	V	Unsigned long	1 ... 999999	RW
50007	2	Secondary voltage	V	Unsigned long	1 ... 480	RW
50011	2	Primary current	A	Unsigned long	1 ... 99999	RW
50013	2	Secondary current	A	Unsigned long	1 ... 5	RW
50019	2	Zero point suppression	%	Float	0.0 ... 10.0	RW
50021	2	Load profile demand period	min	Unsigned long	1;2;3;4;5;6;10;12;15;20;30;60	RW
50023	2	Synchronization	–	Unsigned long	0 ... 2 0 = No synchronization 1 = Synchronization via bus 2 = Synchronization via digital input	RW
50025	2	DI 0.0 Type of use	–	Unsigned long	0 no action 1 pulse interface 2 switching on/off peak 3 not allowed 4 display backlight	RW
50029	2	DI 0.0 Index	–	Unsigned long	0 ... 1 0 = kWh 1 = kvarh	RW
50031	2	DI 0.0 Pulses per unit	–	Unsigned long	1 ... 4000	RW
50033	2	DO 0.0 Vector group assignment	–	Unsigned long	0 ... 99	RW

Offset	Number of registers	Name	Unit	Format	Value range	Access
50035	2	DO 0.0 Type of use	–	Unsigned long	0 ... 5 0 = no action 1 = device active 2 = switching output 3 = direct. of rotation 4 = limit value 5 = pulse output	RW
50037	2	DO 0.0 Limit value	–	Unsigned long	0 ... 6 0 = comb. limit 1 = limit0 2 = limit1 3 = limit2 4 = limit3 5 = limit4 6 = limit5	RW
50041	2	DO 0.0 Index	–	Unsigned long	0 ... 3 0 = import kWh 1 = export kWh 2 = import kvarh 3 = export kvarh	RW
50043	2	DO 0.0 Pulses per kWh/kvarh	–	Unsigned long	1 ... 4000	RW
50045	2	DO 0.0 Pulse length	–	Unsigned long	30 ... 500	RW
50047	2	Dialog language	–	Unsigned long	0 German 1 English 2 Portuguese 3 Turkish 4 Spanish 5 Italian 6 Russian 7 French 8 Chinese 9 Polish	RW
50049	2	Phase labels EU/US	–	Unsigned long	0 ... 1 0 = IEC 1 = US	RW
50051	2	Configurable counter source	–	Unsigned long	0 ... 8 0 = digital input 1 = digital output 2 = comb. limit 3 = limit0 4 = limit1 5 = limit2 6 = limit3 7 = limit4 8 = limit5	RW
50053	2	Display refresh cycle	–	Unsigned long	Byte 0 → 0 Byte 1 → 0 Byte 2 → Port 0 ... 11 Byte 3 → Portbit 0 ... 7	RW
50055	2	Display contrast	–	Unsigned long	0 ... 10	RW
50057	2	Display backlight level	%	Unsigned long	0 ... 3	RW

Offset	Number of registers	Name	Unit	Format	Value range	Access
50059	2	Display backlight dimmed	%	Unsigned long	0 ... 3	RW
50061	2	Display time until dimmed	min	Unsigned long	0 ... 99	RW
50063	2	Limit 0 ON/OFF	–	Unsigned long	0 ... 1 0 = Off 1 = On	RW
50065	2	Limit 0 Hysteresis	%	Float	0.0 ... 20.0	RW
50067	2	Limit 0 Pickup delay	s	Unsigned long	0 ... 10	RW
50069	2	Limit 0 Index (NO/AND/OR)	–	Unsigned long	0 ... 2 0 = NO 1 = AND 2 = OR	RW

Offset	Number of registers	Name	Unit	Format	Value range	Access
50071	2	Limit 0 Index of data list	–	Unsigned long	0 = V_L1 1 = V_L2 2 = V_L3 3 = V_L12 4 = V_L23 5 = V_L31 6 = I_L1 7 = I_L2 8 = I_L3 9 = VA_L1 10 = VA_L2 11 = VA_L3 12 = P_L1 13 = P_L2 14 = P_L3 15 = VARQ1_L1 16 = VARQ1_L2 17 = VARQ1_L3 18 = PF_L1 19 = PF_L2 20 = PF_L3 21 = THDV_L1 22 = THDV_L2 23 = THDV_L3 24 = THDI_L1 25 = THDI_L2 26 = THDI_L3 27 = THDV_L12 28 = THDV_L23 29 = THDV_L31 30 = COS1_L1 31 = COS1_L2 32 = COS1_L3 33 = FREQ 34 = V_LN_AVG 35 = V_LL_AVG 36 = I_AVG 37 = VA_SUM 38 = P_SUM 39 = VARQ1_SUM 40 = PF_SUM 41 = V_BAL 42 = I_BAL 43 = V_PHASE_BAL 44 = I_N 45 = COS1_SUM 46 = I(N) Module Slot 1 47 = I5 Module Slot 1 48 = I6 Module Slot 1 49 = I(N) Module Slot 2 50 = I5 Module Slot 2 51 = I6 Module Slot 2	RW
50073	2	Limit 0 Source	–	Float	–	RW
50075	2	Limit 0 Type ≥/<	–	Unsigned long	0 ... 1 0 = greater than 1 = smaller than	RW

Offset	Number of registers	Name	Unit	Format	Value range	Access
50077	2	Limit 1 ON/OFF	–	Unsigned long	0 ... 1 0 = Off 1 = On	RW
50079	2	Limit 1 Hysteresis	%	Float	0.0 ... 20.0	RW
50081	2	Limit 1 Pickup delay	s	Unsigned long	0 ... 10	RW
50083	2	Limit 1 Index (NO/AND/OR)	–	Unsigned long	0 ... 2 0 = NO 1 = AND 2 = OR	RW
50085	2	Limit 1 Index of data list	–	Unsigned long	0 ... 51 (see limit 0)	RW
50087	2	Limit 1 Source	–	Float	–	RW
50089	2	Limit 1 Type ≥/<	–	Unsigned long	0 ... 1 0 = greater than 1 = smaller than	RW
50091	2	Limit 2 ON/OFF	–	Unsigned long	0 ... 1 0 = Off 1 = On	RW
50093	2	Limit 2 Hysteresis	%	Float	0.0 ... 20.0	RW
50095	2	Limit 2 Pickup delay	s	Unsigned long	0 ... 10	RW
50097	2	Limit 2 Index (NO/AND/OR)	–	Unsigned long	0 ... 2 0 = NO 1 = AND 2 = OR	RW
50099	2	Limit 2 Index of data list	–	Unsigned long	0 ... 51 (see limit 0)	RW
50101	2	Limit 2 Source	–	Float	–	RW
50103	2	Limit 2 Type ≥/<	–	Unsigned long	0 ... 1 0 = greater than 1 = smaller than	RW
50105	2	Limit 3 ON/OFF	–	Unsigned long	0 ... 1 0 = Off 1 = On	RW
50107	2	Limit 3 Hysteresis	%	Float	0.0 ... 20.0	RW
50109	2	Limit 3 Pickup delay	s	Unsigned long	0 ... 10	RW
50111	2	Limit 3 Index (NO/AND/OR)	–	Unsigned long	0 ... 2 0 = NO 1 = AND 2 = OR	RW
50113	2	Limit 3 Index of data list	–	Unsigned long	0 ... 51 (see limit 0)	RW
50115	2	Limit 3 Source	–	Float	–	RW
50117	2	Limit 3 Type ≥/<	–	Unsigned long	0 ... 1 0 = greater than 1 = smaller than	RW
50119	2	Limit 4 ON/OFF	–	Unsigned long	0 ... 1 0 = Off 1 = On	RW

Offset	Number of registers	Name	Unit	Format	Value range	Access
50121	2	Limit 4 Hysteresis	%	Float	0.0 ... 20.0	RW
50123	2	Limit 4 Pickup delay	s	Unsigned long	0 ... 10	RW
50125	2	Limit 4 Index (NO/AND/OR)	–	Unsigned long	0 ... 2 0 = NO 1 = AND 2 = OR	RW
50127	2	Limit 4 Index of data list	–	Unsigned long	0 ... 51 (see limit 0)	RW
50129	2	Limit 4 Source	–	Float	–	RW
50131	2	Limit 4 Type ≥/<	–	Unsigned long	0 ... 1 0 = greater than 1 = smaller than	RW
50133	2	Limit 5 ON/OFF	–	Unsigned long	0 ... 1 0 = Off 1 = On	RW
50135	2	Limit 5 Hysteresis	%	Float	0.0 ... 20.0	RW
50137	2	Limit 5 Pickup delay	s	Unsigned long	0 ... 10	RW
50139	2	Limit 5 Index (NO/AND/OR)	–	Unsigned long	0 ... 2 0 = NO 1 = AND 2 = OR	RW
50141	2	Limit 5 Index of data list	–	Unsigned long	0 ... 51 (see limit 0)	RW
50143	2	Limit 5 Source	–	Float	0 ... N	RW
50145	2	Limit 5 Type ≥/<	–	Unsigned long	0 ... 1 0 = greater than 1 = smaller than	RW
50147	2	DO 0.0 Timeout	–	Unsigned long	0.1 ... 18000 Digital output remote timeout 1 ... 18000 s, 0 = disables timeout (default)	RW
50231	2	Date format	–	Unsigned long	0 ... 2 0 = dd.mm.yyyy 1 = mm/dd/yy 2 = yyyy-mm-dd	RW
50233	2	Daylight saving	–	Unsigned long	0 ... 3 0 = No 1 = Auto EU 2 = Auto US 3 = daylight saving table	RW
50235	2	Time zone	min	Long	MODULO(30)==0	RW
50237	2	DO 0.0 Pulse divider	–	Unsigned long	0 ... 3 0 = 1 kWh 1 = 10 kWh 2 = 100 kWh 3 = 1000 kWh	RW
50239	2	DI 0.0 Pulse divider	–	Unsigned long	0 ... 3 0 = 1 kWh 1 = 10 kWh 2 = 100 kWh 3 = 1000 kWh	RW

Offset	Number of registers	Name	Unit	Format	Value range	Access
50249	2	I(N) on display	–	Unsigned long	0: Auto (I_n measured if module plugged, I_n calculated if no module plugged) 1: show I_n calculated 2: hide I_n in amps screen	RW
51199	1	DI 0.0 Type of use	–	Unsigned short	0 ... 3 0 = no action 1 = pulse interface 2 = switching on/off peak 3 = synchronization	RW
51201	1	DI 0.0 Index	–	Unsigned short	0 ... 1 0 = kWh 1 = kvarh	RW
51202	1	DI 0.0 Pulses per kWh/kvarh	–	Unsigned short	1 ... 4000	RW
51203	1	DI 0.0 Pulse divider	–	Unsigned short	–	RW
51204	1	DI 0.1 Type of use	–	Unsigned short	0 ... 3 0 = no action 1 = pulse interface 2 = switching on/off peak 3 = synchronization	RW
51206	1	DI 0.1 Index	–	Unsigned short	0 ... 1 0 = kWh 1 = kvarh	RW
51207	1	DI 0.1 Pulses per kWh/kvarh	–	Unsigned short	1 ... 4000	RW
51208	1	DI 0.1 Pulse divider	–	Unsigned short	–	RW
51209	1	DI 4.0 Type of use	–	Unsigned short	0 ... 3 0 = no action 1 = pulse interface 2 = switching on/off peak 3 = synchronization	RW
51211	1	DI 4.0 Index	–	Unsigned short	0 ... 1 0 = kWh 1 = kvarh	RW
51212	1	DI 4.0 Pulses per kWh/kvarh	–	Unsigned short	1 ... 4000	RW
51213	1	DI 4.0 Pulse divider	–	Unsigned short	–	RW
51214	1	DI 4.1 Type of use	–	Unsigned short	0 ... 3 0 = no action 1 = pulse interface 2 = switching on/off peak 3 = synchronization	RW
51216	1	DI 4.1 Index	–	Unsigned short	0 ... 1 0 = kWh 1 = kvarh	RW
51217	1	DI 4.1 Pulses per kWh/kvarh	–	Unsigned short	1 ... 4000	RW
51218	1	DI 4.1 Pulse divider	–	Unsigned short	–	RW

Offset	Number of registers	Name	Unit	Format	Value range	Access
51219	1	DI 4.2 Type of use	–	Unsigned short	0 ... 3 0 = no action 1 = pulse interface 2 = switching on/off peak 3 = synchronization	RW
51221	1	DI 4.2 Index	–	Unsigned short	0 ... 1 0 = kWh 1 = kvarh	RW
51222	1	DI 4.2 Pulses per kWh/kvarh	–	Unsigned short	1 ... 4000	RW
51223	1	DI 4.2 Pulse divider	–	Unsigned short	–	RW
51224	1	DI 4.3 Type of use	–	Unsigned short	0 ... 3 0 = no action 1 = pulse interface 2 = switching on/off peak 3 = synchronization	RW
51226	1	DI 4.3 Index	–	Unsigned short	0 ... 1 0 = kWh 1 = kvarh	RW
51227	1	DI 4.3 Pulses per kWh/kvarh	–	Unsigned short	1 ... 4000	RW
51228	1	DI 4.3 Pulse divider	–	Unsigned short	–	RW
51229	1	DI 8.0 Type of use	–	Unsigned short	0 ... 3 0 = no action 1 = pulse interface 2 = switching on/off peak 3 = synchronization	RW
51231	1	DI 8.0 Index	–	Unsigned short	0 ... 1 0 = kWh 1 = kvarh	RW
51232	1	DI 8.0 Pulses per kWh/kvarh	–	Unsigned short	1 ... 4000	RW
51233	1	DI 8.0 Pulse divider	–	Unsigned short	–	RW
51234	1	DI 8.1 Type of use	–	Unsigned short	0 ... 3 0 = no action 1 = pulse interface 2 = switching on/off peak 3 = synchronization	RW
51236	1	DI 8.1 Index	–	Unsigned short	0 ... 1 0 = kWh 1 = kvarh	RW
51237	1	DI 8.1 Pulses per kWh/kvarh	–	Unsigned short	1 ... 4000	RW
51238	1	DI 8.1 Pulse divider	–	Unsigned short	–	RW
51239	1	DI 8.2 Type of use	–	Unsigned short	0 ... 3 0 = no action 1 = pulse interface 2 = switching on/off peak 3 = synchronization	RW

Offset	Number of registers	Name	Unit	Format	Value range	Access
51241	1	DI 8.2 Index	–	Unsigned short	0 ... 1 0 = kWh 1 = kvarh	RW
51242	1	DI 8.2 Pulses per kWh/kvarh	–	Unsigned short	1 ... 4000	RW
51243	1	DI 8.2 Pulse divider	–	Unsigned short	–	RW
51244	1	DI 8.3 Type of use	–	Unsigned short	0 ... 3 0 = no action 1 = pulse interface 2 = switching on/off peak 3 = synchronization	RW
51246	1	DI 8.3 Index	–	Unsigned short	0 ... 1 0 = kWh 1 = kvarh	RW
51247	1	DI 8.3 Pulses per kWh/kvarh	–	Unsigned short	1 ... 4000	RW
51248	1	DI 8.3 Pulse divider	–	Unsigned short	–	RW
51711	1	DO 0.0 Group assignment	–	Unsigned short	0 ... 99	RW
51712	1	DO 0.0 Type of use	–	Unsigned short	0 ... 5 0 = no action 1 = device active 2 = switching output 3 = direct. of rotation 4 = limit value 5 = pulse output	RW
51713	1	DO 0.0 Limit value index	–	Unsigned short	0 ... 6 0 = comb. limit 1 = limit0 2 = limit1 3 = limit2 4 = limit3 5 = limit4 6 = limit5	RW
51715	1	DO 0.0 Index	–	Unsigned short	0 ... 3 0 = import kWh 1 = export kWh 2 = import kvarh 3 = export kvarh	RW
51716	1	DO 0.0 Pulses per kWh/kvarh	–	Unsigned short	1 ... 4000	RW
51717	1	DO 0.0 Pulse length	–	Unsigned short	30 ... 500	RW
51718	1	DO 0.0 Timeout	–	Unsigned short	0.1 ... 18000 Digital output remote timeout 1 ... 18000 s, 0 = disables timeout (default)	RW
51719	1	DO 0.0 Pulse divider	–	Unsigned short	0 ... 3 0 = 1 kWh 1 = 10 kWh 2 = 100 kWh 3 = 1000 kWh	RW

Offset	Number of registers	Name	Unit	Format	Value range	Access
51720	1	DO 0.1 Group assignment	–	Unsigned short	0 ... 99	RW
51721	1	DO 0.1 Type of use	–	Unsigned short	0 ... 5 0 = no action 1 = device active 2 = switching output 3 = direction of rotation 4 = limit value 5 = pulse output	RW
51722	1	DO 0.1 Limit value index	–	Unsigned short	0 ... 6 0 = comb. limit 1 = limit0 2 = limit1 3 = limit2 4 = limit3 5 = limit4 6 = limit5	RW
51724	1	DO 0.1 Index	–	Unsigned short	0 ... 3 0 = import kWh 1 = export kWh 2 = import kvarh 3 = export kvarh	RW
51725	1	DO 0.1 Pulses per kWh/kvarh	–	Unsigned short	1 ... 4000	RW
51726	1	DO 0.1 Pulse length	–	Unsigned short	30 ... 500	RW
51727	1	DO 0.1 Timeout	–	Unsigned short	0.1 ... 18000 Digital output remote timeout 1 ... 18000 s, 0 = disables timeout (default)	RW
51728	1	DO 0.1 Pulse divider	–	Unsigned short	0 ... 3 0 = 1 kWh 1 = 10 kWh 2 = 100 kWh 3 = 1000 kWh	RW
51729	1	DO 4.0 Group assignment	–	Unsigned short	0 ... 99	RW
51730	1	DO 4.0 Type of use	–	Unsigned short	0 ... 5 0 = no action 1 = device active 2 = switching output 3 = direct. of rotation 4 = limit value 5 = pulse output	RW
51731	1	DO 4.0 Limit value index	–	Unsigned short	0 ... 6 0 = comb. limit 1 = limit0 2 = limit1 3 = limit2 4 = limit3 5 = limit4 6 = limit5	RW

Offset	Number of registers	Name	Unit	Format	Value range	Access
51733	1	DO 4.0 Index	–	Unsigned short	0 ... 3 0 = import kWh 1 = export kWh 2 = import kvarh 3 = export kvarh	RW
51734	1	DO 4.0 Pulses per kWh/kvarh	–	Unsigned short	1 ... 4000	RW
51735	1	DO 4.0 Pulse length	–	Unsigned short	30 ... 500	RW
51736	1	DO 4.0 Timeout	–	Unsigned short	0.1 ... 18000 Digital output remote timeout 1 ... 18000 s, 0 = disables timeout (default)	RW
51737	1	DO 4.0 Pulse divider	–	Unsigned short	0 ... 3 0 = 1 kWh 1 = 10 kWh 2 = 100 kWh 3 = 1000 kWh	RW
51738	1	DO 4.1 Group assignment	–	Unsigned short	0 ... 99	RW
51739	1	DO 4.1 Type of use	–	Unsigned short	0 ... 5 0 = no action 1 = device active 2 = switching output 3 = direct. of rotation 4 = limit value 5 = pulse output	RW
51740	1	DO 4.1 Limit value index	–	Unsigned short	0 ... 6 0 = comb. limit 1 = limit0 2 = limit1 3 = limit2 4 = limit3 5 = limit4 6 = limit5	RW
51742	1	DO 4.1 Index	–	Unsigned short	0 ... 3 0 = import kWh 1 = export kWh 2 = import kvarh 3 = export kvarh	RW
51743	1	DO 4.1 Pulses per kWh/kvarh	–	Unsigned short	1 ... 4000	RW
51744	1	DO 4.1 Pulse length	–	Unsigned short	30 ... 500	RW
51745	1	DO 4.1 Timeout	–	Unsigned short	0.1 ... 18000 Digital output remote timeout 1 ... 18000 s, 0 = disables timeout (default)	RW
51746	1	DO 4.1 Pulse divider	–	Unsigned short	0 ... 3 0 = 1 kWh 1 = 10 kWh 2 = 100 kWh 3 = 1000 kWh	RW
51747	1	DO 8.0 Group assignment	–	Unsigned short	0 ... 99	RW

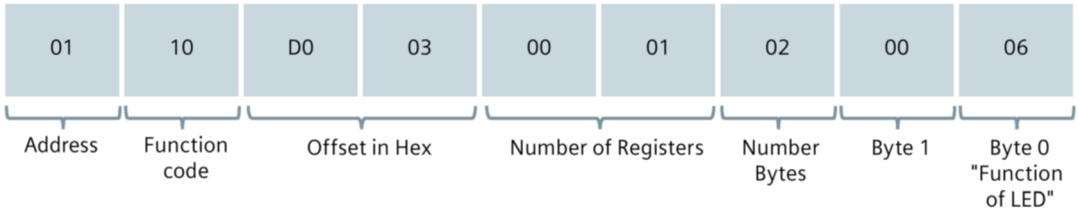
Offset	Number of registers	Name	Unit	Format	Value range	Access
51748	1	DO 8.0 Type of use	–	Unsigned short	0 ... 5 0 = no action 1 = device active 2 = switching output 3 = direct. of rotation 4 = limit value 5 = pulse output	RW
51749	1	DO 8.0 Limit value index	–	Unsigned short	0 ... 6 0 = comb. limit 1 = limit0 2 = limit1 3 = limit2 4 = limit3 5 = limit4 6 = limit5	RW
51751	1	DO 8.0 Index	–	Unsigned short	0 ... 3 0 = import kWh 1 = export kWh 2 = import kvarh 3 = export kvarh	RW
51752	1	DO 8.0 Pulses per kWh/kvarh	–	Unsigned short	1 ... 4000	RW
51753	1	DO 8.0 Pulse length	–	Unsigned short	30 ... 500	RW
51754	1	DO 8.0 Timeout	–	Unsigned short	0.1 ... 18000 Digital output remote timeout 1 ... 18000 s, 0 = disables timeout (default)	RW
51755	1	DO 8.0 Pulse divider	–	Unsigned short	0 ... 3 0 = 1 kWh 1 = 10 kWh 2 = 100 kWh 3 = 1000 kWh	RW
51756	1	DO 8.1 Group assignment	–	Unsigned short	0 ... 99	RW
51757	1	DO 8.1 Type of use	–	Unsigned short	0 ... 5 0 = no action 1 = device active 2 = switching output 3 = direct. of rotation 4 = limit value 5 = pulse output	RW
51758	1	DO 8.1 Limit value index	–	Unsigned short	0 ... 6 0 = comb. limit 1 = limit0 2 = limit1 3 = limit2 4 = limit3 5 = limit4 6 = limit5	RW
51760	1	DO 8.1 Index	–	Unsigned short	0 ... 3 0 = import kWh 1 = export kWh 2 = import kvarh 3 = export kvarh	RW

Offset	Number of registers	Name	Unit	Format	Value range	Access
51761	1	DO 8.1 Pulses per kWh/kvarh	–	Unsigned short	1 ... 4000	RW
51762	1	DO 8.1 Pulse length	–	Unsigned short	30 ... 500	RW
51763	1	DO 8.1 Timeout	–	Unsigned short	0.1 ... 18000 Digital output remote timeout 1 ... 18000 s, 0 = disables timeout (default)	RW
51764	1	DO 8.1 Pulse divider	–	Unsigned short	0 ... 3 0 = 1 kWh 1 = 10 kWh 2 = 100 kWh 3 = 1000 kWh	RW
53249	2	LED - Remote control	–	Unsigned long	if(byte[3] < 128) ... byte[0] (LSB) : Blue byte[1] Green byte[2] Red byte[3] (MSB) ColorMode else byte[0] (LSB) ColorName byte[1] ColorMode byte[2] 0 byte[3] (MSB) 0x80	RW
53251	2	LED - Function	–	Unsigned short	0..7 0 Off: Led is switched off 1 Device On: Led is slowly breathing in configurable color ("ON" color) 2 Remote: Binary output (Q0.2) but with two colors (Range1..2) 3 Rotation: Binary output (Q0.2) but with two colors (Range1..2) 4 Limit Violation: Binary output (Q0.2) but with two colors (Range1..2) 5 Pulse Output: Binary output (Q0.2) but with configurable color ("ON" color) Pulse Length and Ratio are calculated by device dependent on the secondary values (actual value shown on screen) 6 Remote Color: Color and state remotely controlled (via Modbus register) 7 DI State: Reflect digital input state with two colors (Range1..2)	RW
53253	1	LED - Limit value index	–	Unsigned short	0 comb. limit 1 limit0 2 limit1 3 limit2 4 limit3 5 limit4 6 limit5	RW
53254	1	LED RGB group assignment	–	Unsigned short	0 ... 99	RW

Offset	Number of registers	Name	Unit	Format	Value range	Access
53255	1	LED - Digital output timeout	–	Unsigned short	Digital output remote timeout 1..18000 seconds, 0 disables timeout (default)	RW
53256	1	LED - Digital input	–	Unsigned short	Byte 0: Port 0-11 Byte 1: Portbit 0-7 Possible values can only be 0x0000,0x0001 With DidoModule on Mod1: 0x0400,0x0401,0x0402,0x0403 With DidoModule on Mod2: 0x0800,0x0801,0x0802,0x0803	RW
53271	1	LED - Brightness	–	Unsigned short	1: dark – 4: bright	RW

Example - LED remote control

The following command switches the LED function to remote control.

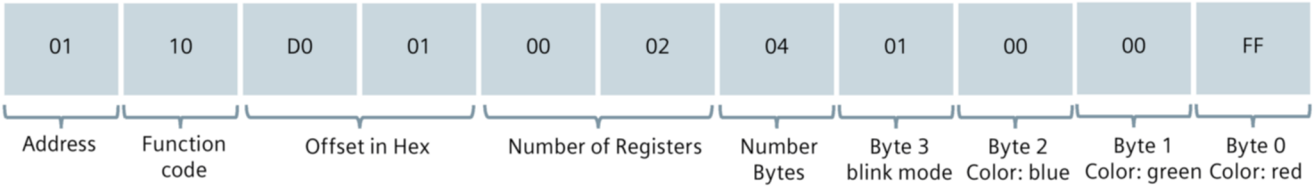


Function of LED (byte 0):

00 LED is switched off
01 Device is ON: LED flashes slowly in configurable color (color "ON")
02 Digital output: Binary output (O0.2), but with two colors (range of values 1 ... 2)
03 Direction of rotation: Binary output (O0.2), but with two colors (range of values 1 ... 2)
04 Upper limit violation: Binary output (O0.2), but with two colors (range of values 1 ... 2)
05 Energy pulse: Binary output (O0.2), but with configurable color (color "ON")
Pulse length and ratio are calculated by the device dependent on the secondary values (actual value is shown on the display)
06 Remote control of LED: Color and status remotely controlled (via Modbus register)
07 Digital input: Reflects the status of the digital input with two colors (range of values 1 ... 2)

Example - LED flashing (blinking) mode and color

The following command configures the color and the flashing mode of the LED.



Flashing mode (byte 3):

00 - OFF	LED is continuously OFF.
01 - ON	LED is continuously ON.
02 - BLINK_SLOW	LED flashes slowly with varying brightness level.
03 - BLINK_FAST	LED flashes quickly with varying brightness level.
04 - BREATH_SLOW	LED flashes slowly with constant brightness.
05 - BREATH_FAST	LED flashes quickly with constant brightness.

Color (bytes 0-2):

00 - FF	Setting for intensity of the basic color (red / green / blue)
00	Color OFF
FF	Maximum intensity

Further colors can be set by mixing the colors.

A.1.8 Modbus communication parameters with the function codes 0x03, 0x04 and 0x10

Addressing the communication parameters

Offset	Number of registers	Name	Format	Value range	Access
62983	2	Aggregation file 1 (period length)	Unsigned long	> 3 s	RW
62985	2	Aggregation file 1 (method)	Unsigned long	0 = AUTO 1 = RMS 2 = ARITHMETIC	RW
62987	2	Aggregation file 2 (period length)	Unsigned long	Preferred integer multiplier of stage (–1) period length Integer divider of a minute, or an hour or a day	RW

Offset	Number of registers	Name	Format	Value range	Access
62989	2	Aggregation file 2 (method)	Unsigned long	0 = AUTO 1 = RMS 2 = ARITHMETIC	RW
62991	2	DHCP ON/OFF[2)]	Unsigned long	0 ... 1	RW
62993	2	SNTP server IP address[2)]	Unsigned long	0 ... 0xFFFFFFFF	RW
62995	2	SNTP mode[2)]	Unsigned long	0 = SNTP client OFF 1 = SNTP active client 2 = SNTP broadcast client	RW
62999	2	IP port number[2)]	Unsigned long	1 ... 0xFFFF	RW
63001	2	IP address[2)]	Unsigned long	0 ... FFFFFFFFh	RW
63003	2	Subnet[2)]	Unsigned long	0 ... FFFFFFFFh	RW
63005	2	Gateway	Unsigned long	0 ... FFFFFFFFh	RW
63019	2	Modbus address[1)]	Unsigned long	1 ... 247	RW
63021	2	Baud rate[1)]	Unsigned long	0 = 4800 baud 1 = 9600 baud 2 = 19200 baud 3 = 38400 baud 4 = 57600 baud 5 = 115200 baud	RW
63023	2	Data bits Parity bits Stop bits[1)]	Unsigned long	0 = 8N2 1 = 8E1 2 = 8O1 3 = 8N1	RW
63025	2	Response time[1)]	Unsigned long	0 ... 255	RW

1) Only for the PAC RS485 expansion module
2) Only for PAC3220 MID

Addressing the settings for the I&M data

Offset	Number of registers	Name	Format	Applicable Modbus function codes	Access
64001	27	I&M 0 data	stIM0	• 0x03 • 0x04	R(W)
64028	89	I&M 1 data ... I&M 4 data	stIM14	• 0x03 • 0x04 • 0x10	RW
64117	27	I&M data module interface 1[1)]	stIM0	• 0x03 • 0x04	R(W)
64144	27	I&M data module interface 2[1)]	stIM0	• 0x03 • 0x04	R(W)

[1)] Only for PAC3220 MID

A.1.9 Modbus command parameters

Addressing the command parameters

You can use Modbus function code 0x06 on the command parameters.

Offset	Number of registers	Name	Unit	Format	Value range		Access
60000	1	Reset the device to the factory settings	–	Unsigned short	4711		W
60001	1	Device reset (without changing the Modbus address)	–	Unsigned short	4711		W
60002	1	Reset maximum values	–	Unsigned short	0		W
60003	1	Reset minimum values	–	Unsigned short	0		W
60004	1	Reset energy counters	–	Unsigned short	0 =	all	W
					1 =	Active energy import tariff 1	
					2 =	Active energy import tariff 2	
					3 =	Active energy export tariff 1	
					4 =	Active energy export tariff 2	
					5 =	Reactive energy import tariff 1	

Offset	Number of registers	Name	Unit	Format	Value range		Access
					6 =	Reactive energy import tariff 2	
					7 =	Reactive energy export tariff 1	
					8 =	Reactive energy export tariff 2	
					9 =	Apparent energy tariff 1	
					10 =	Apparent energy tariff 2	
60005	1	Synchronization of the demand period	min	Unsigned short	1 ... 60		W
60006	1	Tariff switchover	–	Unsigned short	0 = On-peak 1 = Off-peak		W
60007	1	Acknowledge the diagnostic bits[1] (cf. stored bits in unsigned long beginning offset 205)	–	Unsigned short	0 ... ffffh		W
60008	1	Switch outputs (if parameterized)	–	Unsigned short	Byte0 0 = Output 0.0 Byte0 1 = Output 0.1 Byte0 2 = Output 0.2 (LED) Byte0 64 = Output 4.0 Byte0 65 = Output 4.1 Byte0 128 = Output 8.0 Byte0 129 = Output 8.1 Byte1 0 = off Byte1 1 = on		W
60009	1	Switching command for vector group	–	Unsigned short	High 0 ... 99, Low 0 ... 1 High byte group assignment Low byte 1 = ON, 0 = OFF		W

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

A.1.10 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.

Object ID	Name	Format	Access
OID 0	Manufacturer	String	R
OID 1	Manufacturer device name	String	R
OID 2	FW version/bootloader version	String	R

A.1.11 Demand value measured variables with Modbus function code 0x14

The measured variables listed below can be read out via Modbus function code 0x14 "Read File Record" in two stages.

- Stage 1 (File Number 1), preset to 10 s
- Stage 2 (File Number 2), preset to 15 min

File (FC0x14)	Offset Address	Address FC 0x03 FC 0x04	Length	Name	Format	Access
1	1	30001	2	Time stamp aggregation stage n	UNIX_TS	R
1	3	30003	2	Flags aggregation stage n	Uint32	R
1	5	30005	2	V_L1	Float	R
1	7	30007	2	V_L2	Float	R
1	9	30009	2	V_L3	Float	R
1	11	30011	2	V_L12	Float	R
1	13	30013	2	V_L23	Float	R
1	15	30015	2	V_L31	Float	R
1	17	30017	2	I_L1	Float	R
1	19	30019	2	I_L2	Float	R
1	21	30021	2	I_L3	Float	R
1	23	30023	2	VA_L1	Float	R
1	25	30025	2	VA_L2	Float	R
1	27	30027	2	VA_L3	Float	R
1	29	30029	2	P_L1	Float	R
1	31	30031	2	P_L2	Float	R
1	33	30033	2	P_L3	Float	R
1	35	30035	2	VARQ1_L1	Float	R
1	37	30037	2	VARQ1_L2	Float	R
1	39	30039	2	VARQ1_L3	Float	R
1	41	30041	2	PF_L1	Float	R
1	43	30043	2	PF_L2	Float	R
1	45	30045	2	PF_L3	Float	R
1	47	30047	2	THDV_L1	Float	R
1	49	30049	2	THDV_L2	Float	R
1	51	30051	2	THDV_L3	Float	R
1	53	30053	2	THDI_L1	Float	R
1	55	30055	2	THDI_L2	Float	R
1	57	30057	2	THDI_L3	Float	R
1	59	30059	2	FREQ	Float	R
1	61	30061	2	V_LN_AVG	Float	R
1	63	30063	2	V_LL_AVG	Float	R
1	65	30065	2	I_AVG	Float	R
1	67	30067	2	VA_SUM	Float	R
1	69	30069	2	P_SUM	Float	R
1	71	30071	2	VARQ1_SUM	Float	R

File (FC0x14)	Offset Address	Address FC 0x03 FC 0x04	Length	Name	Format	Access
1	73	30073	2	PF_SUM	Float	R
1	75	30075	2	V_BAL	Float	R
1	77	30077	2	I_BAL	Float	R
1	79	30079	2	I_N	Float	R
1	81	30081	2	COS1_L1	Float	R
1	83	30083	2	COS1_L2	Float	R
1	85	30085	2	COS1_L3	Float	R
1	87	30087	2	COS1_SUM	Float	R
1	89	30089	2	I4_MOD1	Float	R
1	91	30091	2	I5_MOD1	Float	R
1	93	30093	2	I6_MOD1	Float	R
1	95	30095	2	I4_MOD2	Float	R
1	97	30097	2	I5_MOD2	Float	R
1	99	30099	2	I6_MOD2	Float	R
1	101	30101	2	THDV_L12	Float	R
1	103	30103	2	THDV_L23	Float	R
1	105	30105	2	THDV_L31	Float	R
1	257	30257	2	Time stamp aggregation stage n	UNIX_TS	R
1	259	30259	2	Flags aggregation stage n	Uint32	R
1	261	30261	2	max_V_L1	Float	R
1	263	30263	2	max_V_L2	Float	R
1	265	30265	2	max_V_L3	Float	R
1	267	30267	2	max_V_L12	Float	R
1	269	30269	2	max_V_L23	Float	R
1	271	30271	2	max_V_L31	Float	R
1	273	30273	2	max_I_L1	Float	R
1	275	30275	2	max_I_L2	Float	R
1	277	30277	2	max_I_L3	Float	R
1	279	30279	2	max_VA_L1	Float	R
1	281	30281	2	max_VA_L2	Float	R
1	283	30283	2	max_VA_L3	Float	R
1	285	30285	2	max_P_L1	Float	R
1	287	30287	2	max_P_L2	Float	R
1	289	30289	2	max_P_L3	Float	R
1	291	30291	2	max_VARQ1_L1	Float	R
1	293	30293	2	max_VARQ1_L2	Float	R
1	295	30295	2	max_VARQ1_L3	Float	R
1	297	30297	2	max_PF_L1	Float	R
1	299	30299	2	max_PF_L2	Float	R
1	301	30301	2	max_PF_L3	Float	R
1	303	30303	2	max_THDV_L1	Float	R
1	305	30305	2	max_THDV_L2	Float	R
1	307	30307	2	max_THDV_L3	Float	R

File (FC0x14)	Offset Address	Address FC 0x03 FC 0x04	Length	Name	Format	Access
1	309	30309	2	max_THDI_L1	Float	R
1	311	30311	2	max_THDI_L2	Float	R
1	313	30313	2	max_THDI_L3	Float	R
1	315	30315	2	max_FREQ	Float	R
1	317	30317	2	max_V_LN_AVG	Float	R
1	319	30319	2	max_V_LL_AVG	Float	R
1	321	30321	2	max_I_AVG	Float	R
1	323	30323	2	max_VA_SUM	Float	R
1	325	30325	2	max_P_SUM	Float	R
1	327	30327	2	max_VARQ1_SUM	Float	R
1	329	30329	2	max_PF_SUM	Float	R
1	331	30331	2	max_V_BAL	Float	R
1	333	30333	2	max_I_BAL	Float	R
1	335	30335	2	max_I_N	Float	R
1	337	30337	2	max_COS1_L1	Float	R
1	339	30339	2	max_COS1_L2	Float	R
1	341	30341	2	max_COS1_L3	Float	R
1	343	30343	2	max_COS1	Float	R
1	345	30345	2	max_I4_MOD1	Float	R
1	347	30347	2	max_I5_MOD1	Float	R
1	349	30349	2	max_I6_MOD1	Float	R
1	351	30351	2	max_I4_MOD2	Float	R
1	353	30353	2	max_I5_MOD2	Float	R
1	355	30355	2	max_I6_MOD2	Float	R
1	357	30357	2	max_THDV_L12	Float	R
1	359	30359	2	max_THDV_L23	Float	R
1	361	30361	2	max_THDV_L31	Float	R
1	513	30513	2	Time stamp aggregation stage n	UNIX_TS	R
1	515	30515	2	Flags aggregation stage n	Uint32	R
1	517	30517	2	min_V_L1	Float	R
1	519	30519	2	min_V_L2	Float	R
1	521	30521	2	min_V_L3	Float	R
1	523	30523	2	min_V_L12	Float	R
1	525	30525	2	min_V_L23	Float	R
1	527	30527	2	min_V_L31	Float	R
1	529	30529	2	min_I_L1	Float	R
1	531	30531	2	min_I_L2	Float	R
1	533	30533	2	min_I_L3	Float	R
1	535	30535	2	min_VA_L1	Float	R
1	537	30537	2	min_VA_L2	Float	R
1	539	30539	2	min_VA_L3	Float	R
1	541	30541	2	min_P_L1	Float	R
1	543	30543	2	min_P_L2	Float	R

File (FC0x14)	Offset Address	Address FC 0x03 FC 0x04	Length	Name	Format	Access
1	545	30545	2	min_P_L3	Float	R
1	547	30547	2	min_VARQ1_L1	Float	R
1	549	30549	2	min_VARQ1_L2	Float	R
1	551	30551	2	min_VARQ1_L3	Float	R
1	553	30553	2	min_PF_L1	Float	R
1	555	30555	2	min_PF_L2	Float	R
1	557	30557	2	min_PF_L3	Float	R
1	559	30559	2	min_THDV_L1	Float	R
1	561	30561	2	min_THDV_L2	Float	R
1	563	30563	2	min_THDV_L3	Float	R
1	565	30565	2	min_THDI_L1	Float	R
1	567	30567	2	min_THDI_L2	Float	R
1	569	30569	2	min_THDI_L3	Float	R
1	571	30571	2	min_FREQ	Float	R
1	573	30573	2	min_V_LN_AVG	Float	R
1	575	30575	2	min_V_LL_AVG	Float	R
1	577	30577	2	min_I_AVG	Float	R
1	579	30579	2	min_VA_SUM	Float	R
1	581	30581	2	min_P_SUM	Float	R
1	583	30583	2	min_VARQ1_SUM	Float	R
1	585	30585	2	min_PF_SUM	Float	R
1	587	30587	2	min_V_BAL	Float	R
1	589	30589	2	min_I_BAL	Float	R
1	591	30591	2	min_I_N	Float	R
1	593	30593	2	min_COS1_L1	Float	R
1	595	30595	2	min_COS1_L2	Float	R
1	597	30597	2	min_COS1_L3	Float	R
1	599	30599	2	min_COS1	Float	R
1	601	30601	2	min_I4_MOD1	Float	R
1	603	30603	2	min_I5_MOD1	Float	R
1	605	30605	2	min_I6_MOD1	Float	R
1	607	30607	2	min_I4_MOD2	Float	R
1	609	30609	2	min_I5_MOD2	Float	R
1	611	30611	2	min_I6_MOD2	Float	R
1	613	30613	2	min_THDV_L12	Float	R
1	615	30615	2	min_THDV_L23	Float	R
1	617	30617	2	min_THDV_L31	Float	R
2	1	31001	2	Time stamp aggregation stage n	UNIX_TS	R
2	3	31003	2	Flags aggregation stage n	Uint32	R
2	5	31005	2	V_L1	Float	R
2	7	31007	2	V_L2	Float	R
2	9	31009	2	V_L3	Float	R
2	11	31011	2	V_L12	Float	R

File (FC0x14)	Offset Address	Address FC 0x03 FC 0x04	Length	Name	Format	Access
2	13	31013	2	V_L23	Float	R
2	15	31015	2	V_L31	Float	R
2	17	31017	2	I_L1	Float	R
2	19	31019	2	I_L2	Float	R
2	21	31021	2	I_L3	Float	R
2	23	31023	2	VA_L1	Float	R
2	25	31025	2	VA_L2	Float	R
2	27	31027	2	VA_L3	Float	R
2	29	31029	2	P_L1	Float	R
2	31	31031	2	P_L2	Float	R
2	33	31033	2	P_L3	Float	R
2	35	31035	2	VARQ1_L1	Float	R
2	37	31037	2	VARQ1_L2	Float	R
2	39	31039	2	VARQ1_L3	Float	R
2	41	31041	2	PF_L1	Float	R
2	43	31043	2	PF_L2	Float	R
2	45	31045	2	PF_L3	Float	R
2	47	31047	2	THDV_L1	Float	R
2	49	31049	2	THDV_L2	Float	R
2	51	31051	2	THDV_L3	Float	R
2	53	31053	2	THDI_L1	Float	R
2	55	31055	2	THDI_L2	Float	R
2	57	31057	2	THDI_L3	Float	R
2	59	31059	2	FREQ	Float	R
2	61	31061	2	V_LN_AVG	Float	R
2	63	31063	2	V_LL_AVG	Float	R
2	65	31065	2	I_AVG	Float	R
2	67	31067	2	VA_SUM	Float	R
2	69	31069	2	P_SUM	Float	R
2	71	31071	2	VARQ1_SUM	Float	R
2	73	31073	2	PF_SUM	Float	R
2	75	31075	2	V_BAL	Float	R
2	77	31077	2	I_BAL	Float	R
2	79	31079	2	I_N	Float	R
2	81	31081	2	COS1_L1	Float	R
2	83	31083	2	COS1_L2	Float	R
2	85	31085	2	COS1_L3	Float	R
2	87	31087	2	COS1_SUM	Float	R
2	89	31089	2	I4_MOD1	Float	R
2	91	31091	2	I5_MOD1	Float	R
2	93	31093	2	I6_MOD1	Float	R
2	95	31095	2	I4_MOD2	Float	R
2	97	31097	2	I5_MOD2	Float	R

File (FC0x14)	Offset Address	Address FC 0x03 FC 0x04	Length	Name	Format	Access
2	99	31099	2	I6_MOD2	Float	R
2	101	31101	2	THDV_L12	Float	R
2	103	31103	2	THDV_L23	Float	R
2	105	31105	2	THDV_L31	Float	R
2	257	31257	2	Time stamp aggregation stage n	UNIX_TS	R
2	259	31259	2	Flags aggregation stage n	Uint32	R
2	261	31261	2	max_V_L1	Float	R
2	263	31263	2	max_V_L2	Float	R
2	265	31265	2	max_V_L3	Float	R
2	267	31267	2	max_V_L12	Float	R
2	269	31269	2	max_V_L23	Float	R
2	271	31271	2	max_V_L31	Float	R
2	273	31273	2	max_I_L1	Float	R
2	275	31275	2	max_I_L2	Float	R
2	277	31277	2	max_I_L3	Float	R
2	279	31279	2	max_VA_L1	Float	R
2	281	31281	2	max_VA_L2	Float	R
2	283	31283	2	max_VA_L3	Float	R
2	285	31285	2	max_P_L1	Float	R
2	287	31287	2	max_P_L2	Float	R
2	289	31289	2	max_P_L3	Float	R
2	291	31291	2	max_VARQ1_L1	Float	R
2	293	31293	2	max_VARQ1_L2	Float	R
2	295	31295	2	max_VARQ1_L3	Float	R
2	297	31297	2	max_PF_L1	Float	R
2	299	31299	2	max_PF_L2	Float	R
2	301	31301	2	max_PF_L3	Float	R
2	303	31303	2	max_THDV_L1	Float	R
2	305	31305	2	max_THDV_L2	Float	R
2	307	31307	2	max_THDV_L3	Float	R
2	309	31309	2	max_THDI_L1	Float	R
2	311	31311	2	max_THDI_L2	Float	R
2	313	31313	2	max_THDI_L3	Float	R
2	315	31315	2	max_FREQ	Float	R
2	317	31317	2	max_V_LN_AVG	Float	R
2	319	31319	2	max_V_LL_AVG	Float	R
2	321	31321	2	max_I_AVG	Float	R
2	323	31323	2	max_VA_SUM	Float	R
2	325	31325	2	max_P_SUM	Float	R
2	327	31327	2	max_VARQ1_SUM	Float	R
2	329	31329	2	max_PF_SUM	Float	R
2	331	31331	2	max_V_BAL	Float	R
2	333	31333	2	max_I_BAL	Float	R

File (FC0x14)	Offset Address	Address FC 0x03 FC 0x04	Length	Name	Format	Access
2	335	31335	2	max_I_N	Float	R
2	513	31513	2	Time stamp aggregation stage n	UNIX_TS	R
2	515	31515	2	Flags aggregation stage n	Uint32	R
2	517	31517	2	min_V_L1	Float	R
2	519	31519	2	min_V_L2	Float	R
2	521	31521	2	min_V_L3	Float	R
2	523	31523	2	min_V_L12	Float	R
2	525	31525	2	min_V_L23	Float	R
2	527	31527	2	min_V_L31	Float	R
2	529	31529	2	min_I_L1	Float	R
2	531	31531	2	min_I_L2	Float	R
2	533	31533	2	min_I_L3	Float	R
2	535	31535	2	min_VA_L1	Float	R
2	537	31537	2	min_VA_L2	Float	R
2	539	31539	2	min_VA_L3	Float	R
2	541	31541	2	min_P_L1	Float	R
2	543	31543	2	min_P_L2	Float	R
2	545	31545	2	min_P_L3	Float	R
2	547	31547	2	min_VARQ1_L1	Float	R
2	549	31549	2	min_VARQ1_L2	Float	R
2	551	31551	2	min_VARQ1_L3	Float	R
2	553	31553	2	min_PF_L1	Float	R
2	555	31555	2	min_PF_L2	Float	R
2	557	31557	2	min_PF_L3	Float	R
2	559	31559	2	min_THDV_L1	Float	R
2	561	31561	2	min_THDV_L2	Float	R
2	563	31563	2	min_THDV_L3	Float	R
2	565	31565	2	min_THDI_L1	Float	R
2	567	31567	2	min_THDI_L2	Float	R
2	569	31569	2	min_THDI_L3	Float	R
2	571	31571	2	min_FREQ	Float	R
2	573	31573	2	min_V_LN_AVG	Float	R
2	575	31575	2	min_V_LL_AVG	Float	R
2	577	31577	2	min_I_AVG	Float	R
2	579	31579	2	min_VA_SUM	Float	R
2	581	31581	2	min_P_SUM	Float	R
2	583	31583	2	min_VARQ1_SUM	Float	R
2	585	31585	2	min_PF_SUM	Float	R
2	587	31587	2	min_V_BAL	Float	R
2	589	31589	2	min_I_BAL	Float	R
2	591	31591	2	min_I_N	Float	R

A.1.12 Active energy history with Modbus function code 0x14

The active energy counters listed below can be read out via Modbus function code 0x14 "Read File Record".

- The daily energy counter (file number 90) records the active energy for each day of the preceding two months.
- The monthly energy counter (file number 91) records the active energy for each month of the preceding two years.

Note

Modbus queries for "Work portion Tariff 1" or "Work portion Tariff 2" must always be performed as a whole in a package (TS, Work portion T1, Work portion T2) with the start address at TS (e.g. 32003, 32009, 32015).

File (FC0x14)	Offset address	Address FC0x03 FC0x04	Length	Name	Format	Access
90	1	32001	2	Error state	Bool	R
90	3	32003	2	TS actual period	UNIX_TS (UTC)	R
90	5	32005	2	Work portion today Tariff 1	Float	R
90	7	32007	2	Work portion today Tariff 2	Float	R
90	9	32009	2	TS of day – 1	UNIX_TS (UTC)	R
90	11	32011	2	Work portion Tariff 1	Float	R
90	13	32013	2	Work portion Tariff 2	Float	R
90	15	32015	2	TS of day – 2	UNIX_TS (UTC)	R
90	17	32017	2	Work portion Tariff 1	Float	R
90	19	32019	2	Work portion Tariff 2	Float	R
90	21	32021	2	TS of day – 3	UNIX_TS (UTC)	R
90	23	32023	2	Work portion Tariff 1	Float	R
90	25	32025	2	Work portion Tariff 2	Float	R
90	27	32027	2	TS of day – 4	UNIX_TS (UTC)	R
90	29	32029	2	Work portion Tariff 1	Float	R
90	31	32031	2	Work portion Tariff 2	Float	R
90	33	32033	2	TS of day – 5	UNIX_TS (UTC)	R
90	35	32035	2	Work portion Tariff 1	Float	R
90	37	32037	2	Work portion Tariff 2	Float	R
90	39	32039	2	TS of day – 6	UNIX_TS (UTC)	R
90	41	32041	2	Work portion Tariff 1	Float	R
90	43	32043	2	Work portion Tariff 2	Float	R

File (FC0x14)	Offset address	Address FC0x03 FC0x04	Length	Name	Format	Access
90	45	32045	2	TS of day – 7	UNIX_TS (UTC)	R
90	47	32047	2	Work portion Tariff 1	Float	R
90	49	32049	2	Work portion Tariff 2	Float	R
90	51	32051	2	TS of day – 8	UNIX_TS (UTC)	R
90	53	32053	2	Work portion Tariff 1	Float	R
90	55	32055	2	Work portion Tariff 2	Float	R
90	57	32057	2	TS of day – 9	UNIX_TS (UTC)	R
90	59	32059	2	Work portion Tariff 1	Float	R
90	61	32061	2	Work portion Tariff 2	Float	R
90	63	32063	2	TS of day – 10	UNIX_TS (UTC)	R
90	65	32065	2	Work portion Tariff 1	Float	R
90	67	32067	2	Work portion Tariff 2	Float	R
90	69	32069	2	TS of day – 11	UNIX_TS (UTC)	R
90	71	32071	2	Work portion Tariff 1	Float	R
90	73	32073	2	Work portion Tariff 2	Float	R
90	75	32075	2	TS of day – 12	UNIX_TS (UTC)	R
90	77	32077	2	Work portion Tariff 1	Float	R
90	79	32079	2	Work portion Tariff 2	Float	R
90	81	32081	2	TS of day – 13	UNIX_TS (UTC)	R
90	83	32083	2	Work portion Tariff 1	Float	R
90	85	32085	2	Work portion Tariff 2	Float	R
90	87	32087	2	TS of day – 14	UNIX_TS (UTC)	R
90	89	32089	2	Work portion Tariff 1	Float	R
90	91	32091	2	Work portion Tariff 2	Float	R
90	93	32093	2	TS of day – 15	UNIX_TS (UTC)	R
90	95	32095	2	Work portion Tariff 1	Float	R
90	97	32097	2	Work portion Tariff 2	Float	R
90	99	32099	2	TS of day – 16	UNIX_TS (UTC)	R
90	101	32101	2	Work portion Tariff 1	Float	R
90	103	32103	2	Work portion Tariff 2	Float	R
90	105	32105	2	TS of day – 17	UNIX_TS (UTC)	R
90	107	32107	2	Work portion Tariff 1	Float	R
90	109	32109	2	Work portion Tariff 2	Float	R
90	111	32111	2	TS of day – 18	UNIX_TS (UTC)	R
90	113	32113	2	Work portion Tariff 1	Float	R

File (FC0x14)	Offset address	Address FC0x03 FC0x04	Length	Name	Format	Access
90	115	32115	2	Work portion Tariff 2	Float	R
90	117	32117	2	TS of day – 19	UNIX_TS (UTC)	R
90	119	32119	2	Work portion Tariff 1	Float	R
90	121	32121	2	Work portion Tariff 2	Float	R
90	123	32123	2	TS of day – 20	UNIX_TS (UTC)	R
90	125	32125	2	Work portion Tariff 1	Float	R
90	127	32127	2	Work portion Tariff 2	Float	R
90	129	32129	2	TS of day – 21	UNIX_TS (UTC)	R
90	131	32131	2	Work portion Tariff 1	Float	R
90	133	32133	2	Work portion Tariff 2	Float	R
90	135	32135	2	TS of day – 22	UNIX_TS (UTC)	R
90	137	32137	2	Work portion Tariff 1	Float	R
90	139	32139	2	Work portion Tariff 2	Float	R
90	141	32141	2	TS of day – 23	UNIX_TS (UTC)	R
90	143	32143	2	Work portion Tariff 1	Float	R
90	145	32145	2	Work portion Tariff 2	Float	R
90	147	32147	2	TS of day – 24	UNIX_TS (UTC)	R
90	149	32149	2	Work portion Tariff 1	Float	R
90	151	32151	2	Work portion Tariff 2	Float	R
90	153	32153	2	TS of day – 25	UNIX_TS (UTC)	R
90	155	32155	2	Work portion Tariff 1	Float	R
90	157	32157	2	Work portion Tariff 2	Float	R
90	159	32159	2	TS of day – 26	UNIX_TS (UTC)	R
90	161	32161	2	Work portion Tariff 1	Float	R
90	163	32163	2	Work portion Tariff 2	Float	R
90	165	32165	2	TS of day – 27	UNIX_TS (UTC)	R
90	167	32167	2	Work portion Tariff 1	Float	R
90	169	32169	2	Work portion Tariff 2	Float	R
90	171	32171	2	TS of day – 28	UNIX_TS (UTC)	R
90	173	32173	2	Work portion Tariff 1	Float	R
90	175	32175	2	Work portion Tariff 2	Float	R
90	177	32177	2	TS of day – 29	UNIX_TS (UTC)	R
90	179	32179	2	Work portion Tariff 1	Float	R
90	181	32181	2	Work portion Tariff 2	Float	R
90	183	32183	2	TS of day – 30	UNIX_TS (UTC)	R

File (FC0x14)	Offset address	Address FC0x03 FC0x04	Length	Name	Format	Access
90	185	32185	2	Work portion Tariff 1	Float	R
90	187	32187	2	Work portion Tariff 2	Float	R
90	189	32189	2	TS of day – 31	UNIX_TS (UTC)	R
90	191	32191	2	Work portion Tariff 1	Float	R
90	193	32193	2	Work portion Tariff 2	Float	R
90	195	32195	2	TS of day – 32	UNIX_TS (UTC)	R
90	197	32197	2	Work portion Tariff 1	Float	R
90	199	32199	2	Work portion Tariff 2	Float	R
90	201	32201	2	TS of day – 33	UNIX_TS (UTC)	R
90	203	32203	2	Work portion Tariff 1	Float	R
90	205	32205	2	Work portion Tariff 2	Float	R
90	207	32207	2	TS of day – 34	UNIX_TS (UTC)	R
90	209	32209	2	Work portion Tariff 1	Float	R
90	211	32211	2	Work portion Tariff 2	Float	R
90	213	32213	2	TS of day – 35	UNIX_TS (UTC)	R
90	215	32215	2	Work portion Tariff 1	Float	R
90	217	32217	2	Work portion Tariff 2	Float	R
90	219	32219	2	TS of day – 36	UNIX_TS (UTC)	R
90	221	32221	2	Work portion Tariff 1	Float	R
90	223	32223	2	Work portion Tariff 2	Float	R
90	225	32225	2	TS of day – 37	UNIX_TS (UTC)	R
90	227	32227	2	Work portion Tariff 1	Float	R
90	229	32229	2	Work portion Tariff 2	Float	R
90	231	32231	2	TS of day – 38	UNIX_TS (UTC)	R
90	233	32233	2	Work portion Tariff 1	Float	R
90	235	32235	2	Work portion Tariff 2	Float	R
90	237	32237	2	TS of day – 39	UNIX_TS (UTC)	R
90	239	32239	2	Work portion Tariff 1	Float	R
90	241	32241	2	Work portion Tariff 2	Float	R
90	243	32243	2	TS of day – 40	UNIX_TS (UTC)	R
90	245	32245	2	Work portion Tariff 1	Float	R
90	247	32247	2	Work portion Tariff 2	Float	R
90	249	32249	2	TS of day – 41	UNIX_TS (UTC)	R
90	251	32251	2	Work portion Tariff 1	Float	R
90	253	32253	2	Work portion Tariff 2	Float	R

File (FC0x14)	Offset address	Address FC0x03 FC0x04	Length	Name	Format	Access
90	255	32255	2	TS of day – 42	UNIX_TS (UTC)	R
90	257	32257	2	Work portion Tariff 1	Float	R
90	259	32259	2	Work portion Tariff 2	Float	R
90	261	32261	2	TS of day – 43	UNIX_TS (UTC)	R
90	263	32263	2	Work portion Tariff 1	Float	R
90	265	32265	2	Work portion Tariff 2	Float	R
90	267	32267	2	TS of day – 44	UNIX_TS (UTC)	R
90	269	32269	2	Work portion Tariff 1	Float	R
90	271	32271	2	Work portion Tariff 2	Float	R
90	273	32273	2	TS of day – 45	UNIX_TS (UTC)	R
90	275	32275	2	Work portion Tariff 1	Float	R
90	277	32277	2	Work portion Tariff 2	Float	R
90	279	32279	2	TS of day – 46	UNIX_TS (UTC)	R
90	281	32281	2	Work portion Tariff 1	Float	R
90	283	32283	2	Work portion Tariff 2	Float	R
90	285	32285	2	TS of day – 47	UNIX_TS (UTC)	R
90	287	32287	2	Work portion Tariff 1	Float	R
90	289	32289	2	Work portion Tariff 2	Float	R
90	291	32291	2	TS of day – 48	UNIX_TS (UTC)	R
90	293	32293	2	Work portion Tariff 1	Float	R
90	295	32295	2	Work portion Tariff 2	Float	R
90	297	32297	2	TS of day – 49	UNIX_TS (UTC)	R
90	299	32299	2	Work portion Tariff 1	Float	R
90	301	32301	2	Work portion Tariff 2	Float	R
90	303	32303	2	TS of day – 50	UNIX_TS (UTC)	R
90	305	32305	2	Work portion Tariff 1	Float	R
90	307	32307	2	Work portion Tariff 2	Float	R
90	309	32309	2	TS of day – 51	UNIX_TS (UTC)	R
90	311	32311	2	Work portion Tariff 1	Float	R
90	313	32313	2	Work portion Tariff 2	Float	R
90	315	32315	2	TS of day – 52	UNIX_TS (UTC)	R
90	317	32317	2	Work portion Tariff 1	Float	R
90	319	32319	2	Work portion Tariff 2	Float	R
90	321	32321	2	TS of day – 53	UNIX_TS (UTC)	R
90	323	32323	2	Work portion Tariff 1	Float	R

File (FC0x14)	Offset address	Address FC0x03 FC0x04	Length	Name	Format	Access
90	325	32325	2	Work portion Tariff 2	Float	R
90	327	32327	2	TS of day – 54	UNIX_TS (UTC)	R
90	329	32329	2	Work portion Tariff 1	Float	R
90	331	32331	2	Work portion Tariff 2	Float	R
90	333	32333	2	TS of day – 55	UNIX_TS (UTC)	R
90	335	32335	2	Work portion Tariff 1	Float	R
90	337	32337	2	Work portion Tariff 2	Float	R
90	339	32339	2	TS of day – 56	UNIX_TS (UTC)	R
90	341	32341	2	Work portion Tariff 1	Float	R
90	343	32343	2	Work portion Tariff 2	Float	R
90	345	32345	2	TS of day – 57	UNIX_TS (UTC)	R
90	347	32347	2	Work portion Tariff 1	Float	R
90	349	32349	2	Work portion Tariff 2	Float	R
90	351	32351	2	TS of day – 58	UNIX_TS (UTC)	R
90	353	32353	2	Work portion Tariff 1	Float	R
90	355	32355	2	Work portion Tariff 2	Float	R
90	357	32357	2	TS of day – 59	UNIX_TS (UTC)	R
90	359	32359	2	Work portion Tariff 1	Float	R
90	361	32361	2	Work portion Tariff 2	Float	R
90	363	32363	2	TS of day – 60	UNIX_TS (UTC)	R
90	365	32365	2	Work portion Tariff 1	Float	R
90	367	32367	2	Work portion Tariff 2	Float	R
90	369	32369	2	TS of day – 61	UNIX_TS (UTC)	R
90	371	32371	2	Work portion Tariff 1	Float	R
90	373	32373	2	Work portion Tariff 2	Float	R
90	375	32375	2	TS of day – 62	UNIX_TS (UTC)	R
90	377	32377	2	Work portion Tariff 1	Float	R
90	379	32379	2	Work portion Tariff 2	Float	R
90	381	32381	2	TS of day – 63	UNIX_TS (UTC)	R
90	383	32383	2	Work portion Tariff 1	Float	R
90	385	32385	2	Work portion Tariff 2	Float	R
90	387	32387	2	TS of day – 64	UNIX_TS (UTC)	R
90	389	32389	2	Work portion Tariff 1	Float	R
90	391	32391	2	Work portion Tariff 2	Float	R
91	1	32401	2	Error state	Bool	R

File (FC0x14)	Offset address	Address FC0x03 FC0x04	Length	Name	Format	Access
91	3	32403	2	TS actual period	UNIX_TS (UTC)	R
91	5	32405	2	Work portion this month Tariff 1	Float	R
91	7	32407	2	Work portion this month Tariff 2	Float	R
91	9	32409	2	TS of month – 1	UNIX_TS (UTC)	R
91	11	32411	2	Work portion Tariff 1	Float	R
91	13	32413	2	Work portion Tariff 2	Float	R
91	15	32415	2	TS of month – 2	UNIX_TS (UTC)	R
91	17	32417	2	Work portion Tariff 1	Float	R
91	19	32419	2	Work portion Tariff 2	Float	R
91	21	32421	2	TS of month – 3	UNIX_TS (UTC)	R
91	23	32423	2	Work portion Tariff 1	Float	R
91	25	32425	2	Work portion Tariff 2	Float	R
91	27	32427	2	TS of month – 4	UNIX_TS (UTC)	R
91	29	32429	2	Work portion Tariff 1	Float	R
91	31	32431	2	Work portion Tariff 2	Float	R
91	33	32433	2	TS of month – 5	UNIX_TS (UTC)	R
91	35	32435	2	Work portion Tariff 1	Float	R
91	37	32437	2	Work portion Tariff 2	Float	R
91	39	32439	2	TS of month – 6	UNIX_TS (UTC)	R
91	41	32441	2	Work portion Tariff 1	Float	R
91	43	32443	2	Work portion Tariff 2	Float	R
91	45	32445	2	TS of month – 7	UNIX_TS (UTC)	R
91	47	32447	2	Work portion Tariff 1	Float	R
91	49	32449	2	Work portion Tariff 2	Float	R
91	51	32451	2	TS of month – 8	UNIX_TS (UTC)	R
91	53	32453	2	Work portion Tariff 1	Float	R
91	55	32455	2	Work portion Tariff 2	Float	R
91	57	32457	2	TS of month – 9	UNIX_TS (UTC)	R
91	59	32459	2	Work portion Tariff 1	Float	R
91	61	32461	2	Work portion Tariff 2	Float	R
91	63	32463	2	TS of month – 10	UNIX_TS (UTC)	R
91	65	32465	2	Work portion Tariff 1	Float	R
91	67	32467	2	Work portion Tariff 2	Float	R
91	69	32469	2	TS of month – 11	UNIX_TS (UTC)	R
91	71	32471	2	Work portion Tariff 1	Float	R

File (FC0x14)	Offset address	Address FC0x03 FC0x04	Length	Name	Format	Access
91	73	32473	2	Work portion Tariff 2	Float	R
91	75	32475	2	TS of month – 12	UNIX_TS (UTC)	R
91	77	32477	2	Work portion Tariff 1	Float	R
91	79	32479	2	Work portion Tariff 2	Float	R
91	81	32481	2	TS of month – 13	UNIX_TS (UTC)	R
91	83	32483	2	Work portion Tariff 1	Float	R
91	85	32485	2	Work portion Tariff 2	Float	R
91	87	32487	2	TS of month – 14	UNIX_TS (UTC)	R
91	89	32489	2	Work portion Tariff 1	Float	R
91	91	32491	2	Work portion Tariff 2	Float	R
91	93	32493	2	TS of month – 15	UNIX_TS (UTC)	R
91	95	32495	2	Work portion Tariff 1	Float	R
91	97	32497	2	Work portion Tariff 2	Float	R
91	99	32499	2	TS of month – 16	UNIX_TS (UTC)	R
91	101	32501	2	Work portion Tariff 1	Float	R
91	103	32503	2	Work portion Tariff 2	Float	R
91	105	32505	2	TS of month – 17	UNIX_TS (UTC)	R
91	107	32507	2	Work portion Tariff 1	Float	R
91	109	32509	2	Work portion Tariff 2	Float	R
91	111	32511	2	TS of month – 18	UNIX_TS (UTC)	R
91	113	32513	2	Work portion Tariff 1	Float	R
91	115	32515	2	Work portion Tariff 2	Float	R
91	117	32517	2	TS of month – 19	UNIX_TS (UTC)	R
91	119	32519	2	Work portion Tariff 1	Float	R
91	121	32521	2	Work portion Tariff 2	Float	R
91	123	32523	2	TS of month – 20	UNIX_TS (UTC)	R
91	125	32525	2	Work portion Tariff 1	Float	R
91	127	32527	2	Work portion Tariff 2	Float	R
91	129	32529	2	TS of month – 21	UNIX_TS (UTC)	R
91	131	32531	2	Work portion Tariff 1	Float	R
91	133	32533	2	Work portion Tariff 2	Float	R
91	135	32535	2	TS of month – 22	UNIX_TS (UTC)	R
91	137	32537	2	Work portion Tariff 1	Float	R
91	139	32539	2	Work portion Tariff 2	Float	R
91	141	32541	2	TS of month – 23	UNIX_TS (UTC)	R

File (FC0x14)	Offset address	Address FC0x03 FC0x04	Length	Name	Format	Access
91	143	32543	2	Work portion Tariff 1	Float	R
91	145	32545	2	Work portion Tariff 2	Float	R
91	147	32547	2	TS of month – 24	UNIX_TS (UTC)	R
91	149	32549	2	Work portion Tariff 1	Float	R
91	151	32551	2	Work portion Tariff 2	Float	R

A.1.13 User-defined Modbus function code 0x64

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

A.1.13.1 Profile data memory

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

Modbus frame structure

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

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

Definition "Data Log Identifier"

Description	Number
Daily profile memory	0x04
Monthly profile memory	0x05
Annual profile memory	0x06
Logbook (event memory)	0x01

Definition "Data Identifier"

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

Measuring channel 1: Active energy import

Measuring channel 2: Active energy export

Description	Number	Can be used on " Data Log Identifier"
All events	0x00	0x01
Measuring channels 1 and 2 (energy quantity)	0x69	0x04, 0x05, 0x06
Measuring channel 1 (energy quantity)	0x6A	0x04, 0x05, 0x06
Measuring channel 2 (energy quantity)	0x6B	0x04, 0x05, 0x06
Measuring channels 1 and 2 (energy quantity), in addition 4 counter readings (import T1, import T2, export T1, export T2)	0x6C	0x04, 0x05, 0x06
Measuring channels 1 and 2 (energy quantity), in addition 2 counter readings (total import T1+T2, total export T1+T2)	0x6D	0x04, 0x05, 0x06
4 counter readings (import T1 and T2, export T1 and T2)	0x70	0x04, 0x05, 0x06
2 counter readings (import T1, export T1)	0x71	0x04, 0x05, 0x06
2 counter readings (import T2, export T2)	0x72	0x04, 0x05, 0x06

Definition "Advanced Data Identifier"

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

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

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

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

Data memory und associated Modbus registers

Description "Data Log Identifier"	Modbus register of the highest OID in existence	Data format	Length
Daily profile memory	0x010A	Unsigned long	2 registers
Monthly profile memory	0x010C	Unsigned long	2 registers
Annual profile memory	0x010E	Unsigned long	2 registers
Logbook (event memory)	0x011C	Unsigned long	2 registers

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

Each of the profile data memories contains 2 measuring channels:

- Measuring channel 1: Active energy import
- Measuring channel 2: Active energy export

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

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

Description of the "information flag bytes":

FLAG_TARIFF_T1	0x00xxxxxx
FLAG_TARIFF_T2	0x01xxxxxx
FLAG_TARIFF_UNKNOWN	0xFFxxxxxx
FLAG_QUALITY_UNSECURE	0x00800000
FLAG_QUALITY_AUXPOWER_FAIL	0x00400000
FLAG_QUALITY_PERIOD_TO_SHORT	0x00010000
FLAG_QUALITY_TIME_UNSECURE	0x00200000
FLAG_MULTIPLE_TIMECHANGE	0x00040000
FLAG_CURRENT_TRANSFORMER	0x00080000
FLAG_LOGENTRY	0x00001000
FLAG_LOGBOOK_FULL	0x00002000
FLAG_Q1	0x00000040
FLAG_BAD_QUALITY_MARKER	0x00000001

Description of Log Entry Data (energy profile)

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

"Log Entry Data" as binary frame

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

Example of request frame

1 byte	1 byte	1 byte	5 bytes
Function code 0x64	Data log identifier (Tagesprofilspeicher)	Data identifier (all channels energy)	Advanced data identifiers (4 byte OID and 1 byte number of records.)
0x64	0x04	0x6D	0x00002CE2 0x02

Example of response frame

Bytes in hex	Description	Length
	0x2D data bytes of 1st record with OID 0x00002CE2	
5E 84 CF 98	Time stamp act. period	4
00 00 0E 10	Time offset in seconds	4
00 00 2C E2	OID act. period (unique period entry identification index)	4
41 90 D1 A4	Active energy import act. period in Wh	4
00 00 00 00	Active energy export act. period in Wh	4
41 41 B4 EB 44 67 2E 00	Active energy counter reading import T1+T2 act. period in Wh	8
00 00 00 00 00 00 00 00	Active energy counter reading export T1+T2 act. period in Wh	8
00 00 07 7E	Real load profile period length act. period in ms	4
00 01 00 40	Information flag bytes act. period	4

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

A.1.13.2 Logbook (event memory)

The logbook data are transferred as "Binary Stream" without prior sorting and stored in "Little Endian" format. This means "Low-Byte" before "High-Byte".

Description of "Log Entry Data"

Log Entry Data	Description	Length in Byte	Offset in Byte
OID	Object Identifier	4	0
TS	Time stamp of records (UTC)	4	4
TZO	Timezone-Offset to UTC in minutes	2	8
Type	LogEntryType (Parameter settings, FW-update or FW-Update-failed)	1	10
LV	Logbook version	1	11
DATA	LogData	32	12
WH-Im.	Counter primary energy import [Wh]	8	44
WH-Ex.	Counter primary energy export [Wh]	8	52
CRC	CRC value	4	60

"Log Entry Data" as binary frame

0x00	OID_{LSB}			OID_{MSB}	TS_{LSB}			TS_{MSB}
0x08	TZO_{LSB}	TZO_{MSB}	Type	LV	DATA[0]			
0x10								
0x18								
0x20								
0x28				DATA[31]	$WH\text{-}Im._{LSB}$			
0x30				$WH\text{-}Im._{MSB}$	$WH\text{-}Ex._{LSB}$			
0x38				$WH\text{-}Ex._{MSB}$	CRC_{LSB}			CRC_{MSB}

Description of event types ("Log Entries Type")

Event type	Description	Length in bytes
1	Parameter settings • Current transformer settings CTpri, CTsec • Voltage transformer settings PTpri, PTsec • Connection type 0: 3P4W 1: 3P3W 4: 1P2W	1
2	Reserved	1
3	Reserved	1
4	Reserved	1
5	Reserved	1
6	Reserved	1
7	Successful FW update is logged. Data.sha stores the hash of the new firmware. • new version • old version • sha-checksum of new FW (first 16 bytes)	1
8	FW update failed	1
9	Reserved	1

PARAM_SETTING

Logging of parameter changes.

Parameter	Description	Length in bytes
CTpri	Current transformer - Primary	4
CTsec	Current transformer - Secondary	4
PTpri	Voltage transformer - Primary	4
PTsec	Voltage transformer - Secondary	4
Hookup	Connecting type: 0: 3P4W 1: 3P3W 4: 1P2W	4

FW_UPDATED

Successful firmware update is logged. Data.sha stores the hash of the new firmware.

Data	Description	Length in bytes
New Version	Number of the new firmware version Vx.x.x	4
New Release	Number of the new release x.x.x.x	4
Old Version	Number of the old firmware version Vx.x.x	4
Old Release	Number of the old release x.x.x.x	4
SHA	SHA checksum of the new firmware (The first 16 bytes are logged)	16

FW_UPDATE_FAILED

Logging of an unsuccessful firmware update. No accompanying data are present.

Reading the logbook via Modbus

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

Modbus frame structure (request frame)

1 byte	1 byte	1 byte	5 bytes
Function code	Data log identifier	Data identifier	Advanced data identifiers

Example: Request frame

1 byte	1 byte	1 byte	5 bytes
Function code 0x64	Data log identifier (event memory)	Data identifier (all events)	Advanced data identifiers (4 byte OID and 1 byte number of records)
0x64	0x01	0x00	0x00000000 0x02

Example: Response frame

Bytes in hex	Description	
01	Modbus address	Protocol (Big Endian)
64	Modbus Custom FC64	
47	Payload length in bytes (starting with the following byte to the end, excluding CRC)	
01	Data log identifier → event memory	
00	Data identifier → all events	
00 00 00 0C	Set the read pointer to 13th OID of the event memory	
01	Number of records inserted in this telegram (may be smaller than requested)	Logbook Entry Data Blob (Little Endian)
0C 00 00 00	OID of logbook record	
DB FC 9B 65	Time stamp (UTC)	
3C 00	Actual timezone offset to UTC in minutes	
01	Log entry type (PARAM_SETTING)	
03	LogEntryVersion	
32 00 00 00	50 A CT_{pri}	
05 00 00 00	5 A CT_{sec}	
90 01 00 00	400 V PT_{pri}	
90 01 00 00	400 V PT_{sec}	
00 00 00 00	3P4W	
FF FF FF FF FF FF FF FF FF FF FF FF	Reserved	
3A EE AD A9 19 B6 62 41	Energy counter value import (T1+T2) at logging time	
00 00 00 00 00 00 00 00	Energy counter value export (T1+T2) at logging time	
EB 75 CE 7A	CRC	

Further Information

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