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Manual

SENTRON

7KM Power Monitoring Device

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SENTRON

7KM Power Monitoring Device PAC1020

Equipment Manual

05/2020

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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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℗ 08/2020 Subject to change

Table of contents

Introduction

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1.1 Components of the product

Scope of supply of PAC1020

The PAC1020 package includes:

- One PAC1020 power monitoring device
- A set of operating instructions for the PAC1020

Available software

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

Available accessories

- Compact bracket (7KM9900-0GA00-0AA0)
- Adapter for mounting on DIN rails, display faces towards DIN rail (7KM9900-0YA00-0AA0)
- Adapter for mounting on DIN rails, display faces forwards (7KM9900-0XA00-0AA0)

1.2 Latest information

Up-to-the-minute information

You can find further support on the Internet (http://www.siemens.de/lowvoltage/technical-assistance).

1.3 General safety notes

General safety notes

DANGER

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

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

WARNING

Impairment of protection will result from improper use.
Can cause death, serious personal injury, or equipment damage.

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 (Page 10) for the information you require.

Safety-related symbols on the device

	Symbol	Meaning
(1)		Danger of electric shock
(2)		General Warning Symbol
(3)		Electrical installation and maintenance by qualified personnel only

1.4 Security information

Siemens provides products and solutions with industrial security 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 security 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.

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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 keep up to date with all the latest product updates, subscribe to the Siemens Industrial Security RSS Feed at (https://www.siemens.com/industrialsecurity).

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

You will find Technical Support under (https://support.industry.siemens.com/cs/us/en/ps).

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

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

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1.6 Protective mechanisms against manipulation

Note

Risk of 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:

- Password protection to protect the device against unintentional adjustment of parameters.

For further information, please refer to chapter Parameterizing via the operator interface (Page 50).

1.7 Technical Support

You can find further support on the Internet at:

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

Description

2

2.1 Features

Area of application

This is a power monitoring device for measuring the basic electrical variables in low-voltage power distribution. The power monitoring device is capable of single-phase, two-phase, or three-phase measurement and can be used in three-wire, four-wire, TN, TT, and IT systems.

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

Thanks to its large measuring voltage range, the power monitoring device can be connected directly in any low-voltage system up to a rated voltage U_{L-L} of 400 V and U_{L-N} of 230 V. It can also be employed in conjunction with voltage transformers to take measurements in medium- or high-voltage systems.

x / 1 A or x / 5 A current transformers can be used to measure current.

The power monitoring device has a large, graphical LC display on which all measured variables are clearly visible. The four function keys combined with the multi-language plaintext displays make intuitive user guidance possible. The experienced operator can also use direct navigation for quicker selection of the desired display menu.

The power monitoring device comes with a range of useful monitoring, diagnostic and service functions, such as active and reactive energy displays and active and reactive energy counters.

The PAC1020 can be configured via the integral RS485 interface. Measured data can be exported for further processing.

The PAC1020 has:

- One digital input
- One digital output

The parameters can be set either directly on the power monitoring device or via the RS485 interface using powerconfig.

Measurement

- Measurement of relevant electrical variables in an AC system
- Measurement of minimum and maximum values of all measured variables

Counters

- Energy counters measure reactive energy and active energy for import and export.

Display and operator control

- LC display
- Four control keys with variable function assignment

Software support

- SENTRON powerconfig

Interfaces

- RS485 interface
- One passive digital input
- One passive digital output

Memory

- Device parameter settings are permanently stored in the internal device memory.
- Extreme values (maximum or minimum) are permanently stored in the internal device memory.

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

Behavior in the case of power failure and power restore

After a power failure, the device starts back at zero with the calculation of total reactive power and total active power.

Security

- Password protection

  "Password protection" allows you to protect write access to the device settings. The protection takes effect in case of the following actions:

  – Modify parameters in device
  – Reset maximum
  – Reset minimum
  – Reset counter
  – Reset device
  – Reset device to factory defaults
  – Reset password
  – Update firmware on device

  The data can be read without any restrictions.

2.2 Measuring inputs

Current measurement

NOTICE
Alternating current measurement only The device is not suitable for measuring DC current.

⚠ DANGER
Danger of electric shock. Will cause death, serious injury or damage to property. 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.

The power monitoring device is designed for:

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

Voltage measurement

NOTICE
AC voltage measurement only The device is not suitable for measuring DC voltage.

The power monitoring device is designed for:

- **Direct measurement on the system or using voltage transformers.** The measuring voltage inputs of the device measure directly via protective impedances. External voltage transformers are required to measure higher voltages than the permissible rated input voltages.
- **Measuring voltage up to U_{L-N} = 280 V.**

Connection types

Two connection types are provided for connecting three-wire and four-wire systems.

Table 2- 1 Available connection types

Short code	Connection type
3P4W	3 phases, 4 conductors
3P3W	3 phases, 3 conductors

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 25).

NOTICE
The wrong system connection can cause irreparable damage to the device. Before connecting the device, make sure that the local power supply conditions match the specifications on the rating plate.

The short code of the connection type must be entered in the device settings on commissioning. You can find the instructions for parameterizing the connection type in chapter Commissioning (Page 37).

Displaying the measured variables depending on the connection type

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

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

Measured variable	**Connection type**	
	3P4W	**3P3W**
Voltage L1	✓	–
Voltage L2	✓	–
Voltage L3	✓	–
Voltage L1-L2	✓	✓
Voltage L2-L3	✓	✓
Voltage L3-L1	✓	✓
Current L1	✓	✓
Current L2	✓	✓
Current L3	✓	✓
Current N	✓	–
Active power L1	✓	–
Active power L2	✓	–
Active power L3	✓	–
Total active power	✓	✓
Reactive power L1 (Q1)	✓	–
Reactive power L2 (Q1)	✓	–
Reactive power L3 (Q1)	✓	–
Total reactive power (Q1)	✓	✓
Power factor PF L1	✓	–
Power factor PF L2	✓	–
Power factor PF L3	✓	–
Total power factor PF	✓	✓
Frequency	✓	✓
Total active energy import	✓	✓

Measured variable	Connection type	
	3P4W	3P3W
Total active energy export	✓	✓
Net total active energy	✓	✓
Total reactive energy import	✓	✓
Total reactive energy export	✓	✓
Net total reactive energy	✓	✓

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

2.3 Energy counters

The power monitoring device features two energy counters. The counters can be programmed independently of each other.

The following options are available:

- Active energy import
- Active energy export
- Net active energy
- Reactive energy import
- Reactive energy export
- Net reactive energy

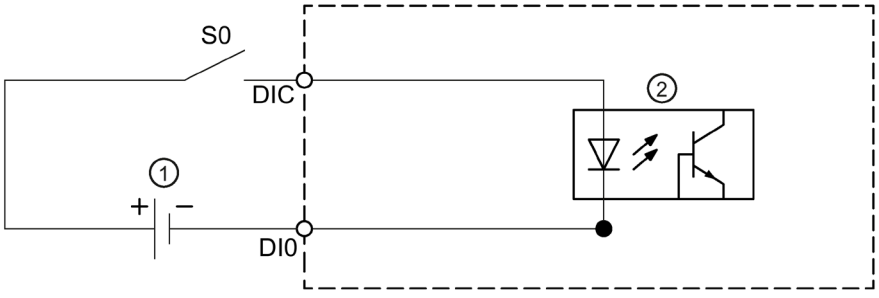
2.4 Digital inputs and outputs

The power monitoring device features:

- One passive digital input
- One passive digital output

2.4.1 Digital input

The integral digital input makes it possible to detect the status of the connected sensor.

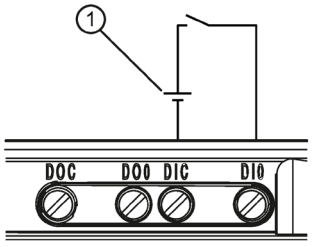


① External power supply
② Input electronics

Figure 2-1 Block diagram: Digital input

Wiring

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



① External voltage

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

2.4.2 Digital output

Functions

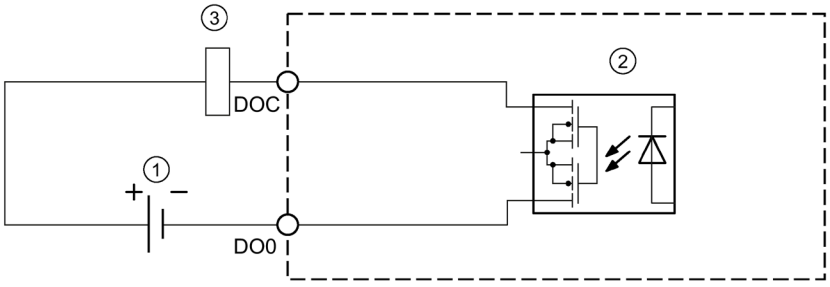
The following function can be assigned to the digital output:

- Switching output for remote control via the interface

  The digital output is remotely controlled via the integral communication interface. The Modbus function codes can be found in chapter Modbus (Page 79).

- Energy pulse output, programmable for active energy pulses or reactive energy pulses

  The digital output issues the parameterized number of pulses per energy unit (e.g. kWh).



① External power supply
② Input electronics
③ Load

Figure 2-3 Block diagram: Digital output

Wiring

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

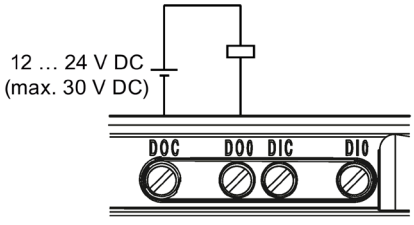
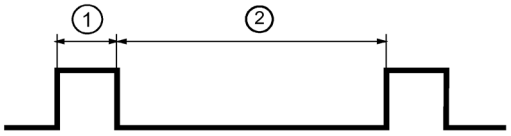


Figure 2-4 Block diagram: Digital output

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 2-5 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.

2.5 RS485 interface

RS485 interface for Modbus RTU communication

The PAC1020 is equipped with an RS485 interface for Modbus RTU communication. The device operates as a Modbus slave.

Application

This interface permits:

- Reading out the measured values
- Reading and writing the device settings
- Use of the SENTRON powerconfig commissioning/parameterization software
- 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

In the as-delivered state, the following default values are set:

Table 2- 3 Default Modbus RTU communication settings

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

Delaying the response time

The response time of the PAC1020 may have to be delayed to enable its operation as a slave device with devices from other manufacturers on the bus. The PAC1020 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. The PAC1020 does not contain polarization resistors.

Installation

3

Mounting location

The device is intended for installation in permanently installed panels within enclosed rooms.

WARNING
Only operate the device in a secure location. **Failure to heed this warning 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.

Note

Mounting on DIN rails

If the optionally available adapters for DIN rail mounting are used, the power monitoring device can also be mounted on DIN rails.

- Adapter for mounting on DIN rails, display faces forwards (7KM9900-0XA00-0AA0)
- Adapter for mounting on DIN rails, display faces towards DIN rail (7KM9900-0YA00-0AA0)

Mounting position

The device must be installed vertically.

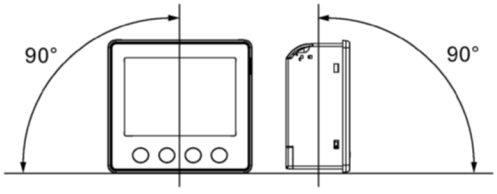


Figure 3-1 Mounting position

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 chapter Dimensional drawings (Page 77).

Deploy the power monitoring device only where environmental conditions permit its operation: A description of permissible operating conditions can be found in chapter Technical data (Page 65).

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 personal injury, or property damage.

Do not install or commission 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.

3.1 Panel mounting

You require the following tool for installation:

- Cutting tool for the panel cutout

Additional installation accessories

- Cable clamp for strain relief of the communication cable and the connecting cables at the digital inputs/outputs.

3.1.1 Mounting dimensions

Mounting and clearance dimensions

You can find information on the cutout dimensions, frame dimensions and clearances in chapter Dimensional drawings (Page 77).

3.1.2 Installation steps

Installation steps

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

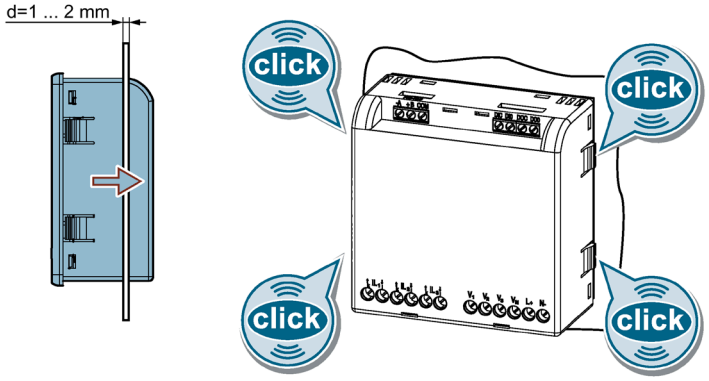


Figure 3-2 Installation

Note

Plate thickness

With plate thicknesses < 1 mm or > 2 mm, the use of optionally available mounting adapters (7KM9900-06A00-0AA0) is recommended.

3.2 Deinstallation

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

Deinstallation steps

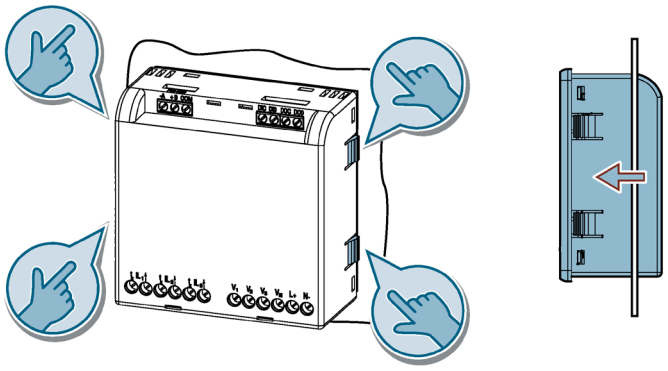


Figure 3-3 Deinstallation

Connection

4

4.1 Safety instructions

Notes

DANGER

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

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

DANGER

Open transformer circuits will result in electric shock and arc flash hazards.
Will cause death, serious personal injury, or equipment damage.

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

CAUTION

Protection of the supply voltage and voltage measuring inputs

The miniature circuit breakers in the supply voltage and the voltage measuring inputs are only used for cable protection. The method of cable protection must be selected according to the design of the supply cable.

You may use miniature circuit breakers up to 20 A (C). Choose a method of cable protection that conforms to the relevant regulations.

WARNING

Hazardous voltage
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.

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.

NOTICE

The direct connection of 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.

NOTICE

Device can be irreparably damaged

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

Note

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

- Wear the prescribed protective clothing. Observe the general equipment regulations and safety regulations for working with high-voltage installations (e.g. DIN VDE, NFPA 70E as well as national or international regulations).
- The limits given in the technical data must not be exceeded even during commissioning or testing 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.
- Prior to commissioning the device, check that all connections are correct.
- Before power is applied to the device for the first time, it must have been located in the operating area for at least two hours in order to reach temperature balance and avoid humidity and condensation.
- Condensation on the device is not permissible during operation.

Note

Grounding of transformers

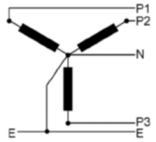
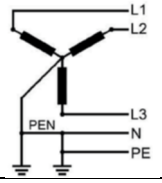
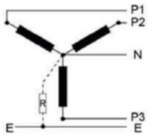
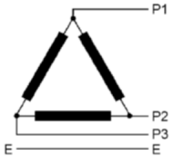
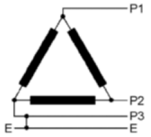
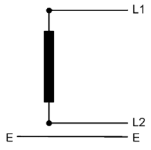
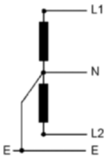
The current transformers must be grounded on the secondary side.

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.

Permissible nominal voltage and tolerance for each of the connection types

Line supply systems and nominal voltages					
Three-phase four-wire systems [a] with grounded neutral conductor TT system  TN-C-S system  	Three-phase four-wire systems [a] with ungrounded neutral conductor (IT systems) [b, c]  	Three-phase three-wire systems ungrounded  	Three-phase three-wire systems with grounded phase  	Single-phase two-wire systems AC or DC  	Split-phase (single-phase three-wire) systems [a] AC or DC 
230 / 400 V (+20 %)	230 / 400 V (+20 %)	400 V (+20 %)	230 V (+20 %)	230 V (+20 %)	230 / 460 V (+20 %)

[a] The two voltage values that are separated by a forward slash (/) stand for the phase-to-neutral (or line-to-neutral) voltage, followed by the voltage between the phases (or line-to-line). For example, "230 / 400" means that the voltage between any phase and the neutral conductor is 230 V and the voltage between any phase and another phase is 400 V. Similarly, "230 / 460" means that the voltage between each phase and the neutral conductor is 230 V and the voltage between the two phases is 460 V.

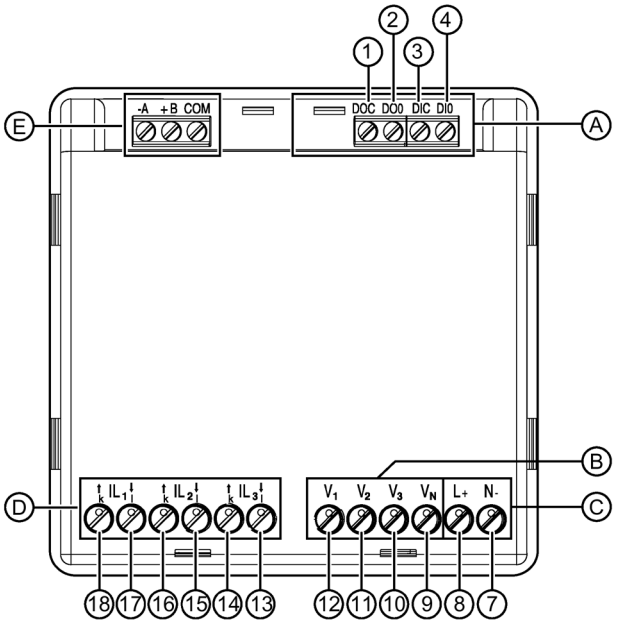
[b] Z is an impedance (usually 1500 Ω) that can be connected between the neutral conductor and ground.

[c] If the insulation is monitored, the neutral conductor is considered to be grounded.

Excerpt from DIN EN 61010-1 (VDE 0411-1): 2020-03

4.2 Connections

Connection designations



No.	Connection	Function	No.	Connection	Function
Ⓐ		Digital inputs and outputs	⑨	V_N	Voltage measuring input - Neutral conductor
Ⓑ	V_1, V_2, V_3, V_N	Voltage measuring inputs	⑩	V_3	Voltage measuring input
Ⓒ	L+, N-	Supply voltage	⑪	V_2	Voltage measuring input
Ⓓ	IL_1, IL_2, IL_3	Current measuring inputs	⑫	V_1	Voltage measuring input
Ⓔ		RS485 communication interface	⑬	I_{L3}	I↓ Current measuring output
①	DOC	Digital output (common)	⑭	I_{L3}	↑k Current measuring input
②	DO0	Digital output 0	⑮	I_{L2}	I↓ Current measuring output
③	DIC	Digital input (common)	⑯	I_{L2}	↑k Current measuring input
④	DI0	Digital input 0	⑰	I_{L1}	I↓ Current measuring output
⑦	N-	AC: Connection: Neutral conductor	⑱	I_{L1}	↑k Current measuring input
⑧	L+	AC: Connection: Conductor (phase voltage)			

Figure 4-1 PAC1020 connection designations (rear view of device)

4.3 Connection examples

The connection examples below show connection in:

- Three-wire or four-wire systems
- With/without voltage transformer

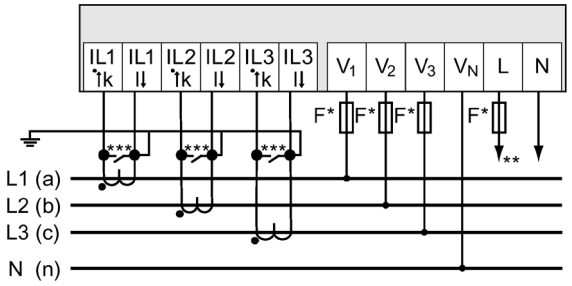
The device can be operated up to the maximum permissible voltage values with or without a voltage measuring transformer.

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

Example connections

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

   Connection type 3P4W



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

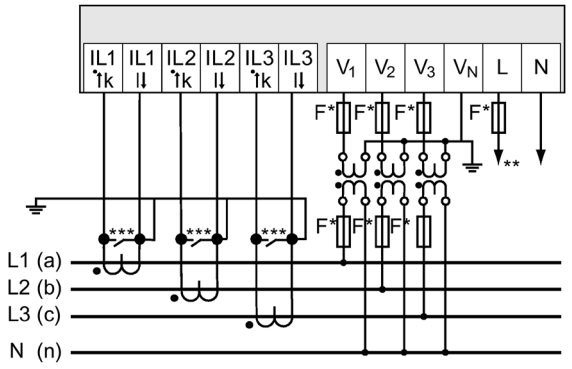
   ** Connection of supply voltage

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

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

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

   Connection type 3P4W



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

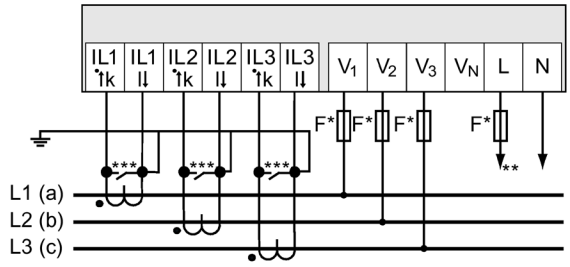
   ** Connection of supply voltage

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

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

3. **3-phase measurement, 3 conductors, unbalanced load, without voltage transformer, with 3 current transformers**

   Connection type 3P3W



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

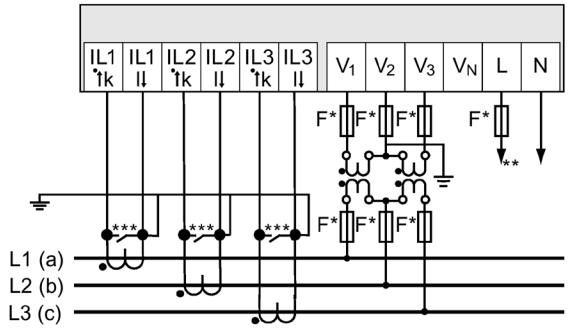
   ** Connection of supply voltage

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

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

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

   Connection type 3P3W



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

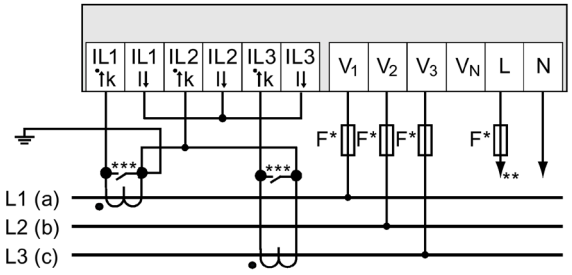
   ** Connection of supply voltage

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

   Figure 4-5 Connection type 3P3W, with voltage transformer, with 3 current transformers

5. **3-phase measurement, 3 conductors, unbalanced load, without voltage transformer, with 2 current transformers**

   Connection type 3P3W



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

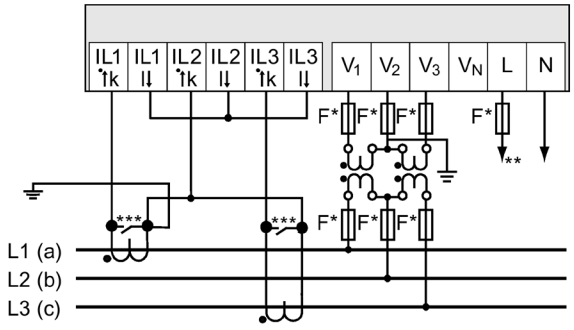
** Connection of supply voltage

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

Figure 4-6 Connection type 3P3W, without voltage transformer, with 2 current transformers

6. **3-phase measurement, 3 conductors, unbalanced load, with voltage transformer, with 2 current transformers**

   Connection type 3P3W



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

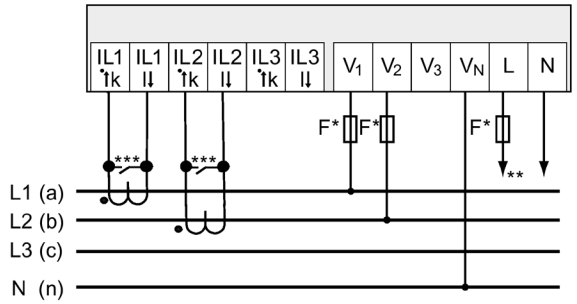
   ** Connection of supply voltage

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

   Figure 4-7 Connection type 3P3W, with voltage transformer, with 2 current transformers

7. **2-phase measurement, 4 conductors, unbalanced load, without voltage transformer, with 2 current transformers**

   Connection type 3P4W



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

   ** Connection of supply voltage

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

   Figure 4-8 Connection type 3P4W, without voltage transformer, with 2 current transformers

See also

Measuring inputs (Page 13)

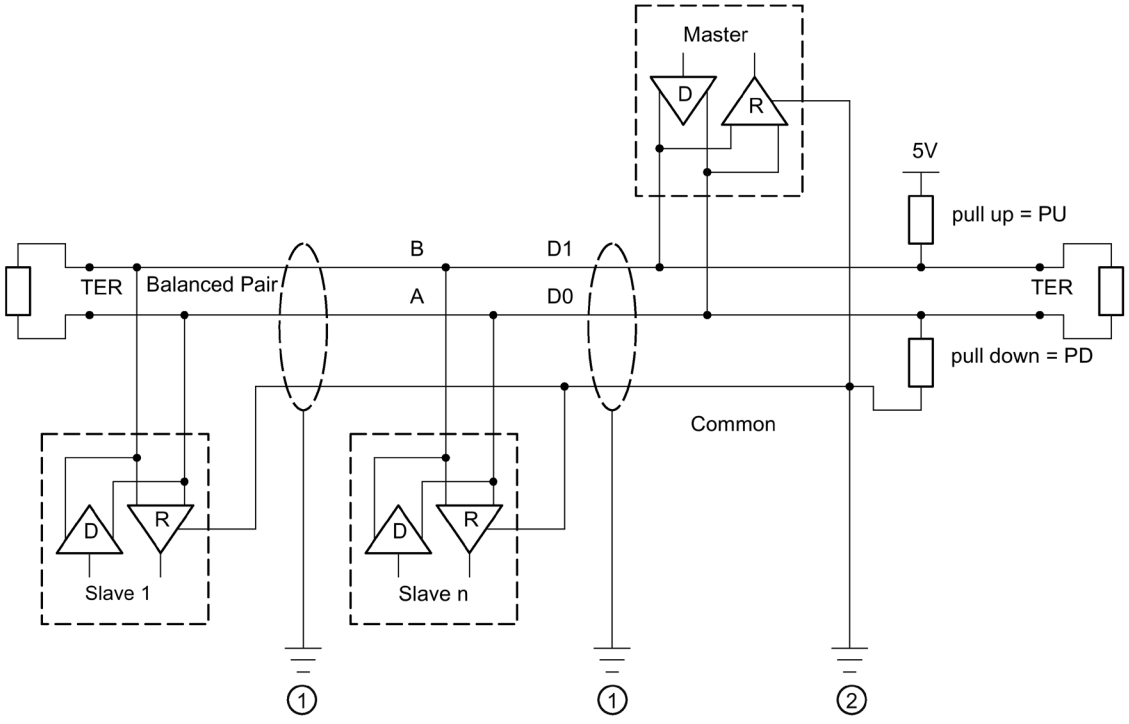
4.4 Connecting to the RS485 bus

Procedure

Connect the PAC1020 power monitoring device to the RS485 bus via the integral 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.

Block diagram



TER Bus termination 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

Figure 4-9 Block diagram: General RS485 topology

Grounding 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 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

The PAC1020 does not support polarization of the RS485 data lines. Polarization must be implemented at another point on the bus. The master 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.

The PAC1020 does not support bus termination. The bus can be terminated using an external resistor ≥ 120 Ω. Connect the resistor to terminals –/A and +/B of the RS485.

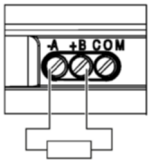


Figure 4-10 Bus termination using external resistor

References

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

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. The RS485 interface has been connected to the bus.

   Note: The RS485 interface must be connected for commissioning via the powerconfig parameterization software.

Steps for commissioning the device

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

NOTICE
Device can be irreparably damaged When performing an insulation test of the entire installation with AC or DC, the device should be disconnected before starting the test.

Note

Check the connections.

Incorrect connection can result in malfunctions and failure of the device.

Prior to commissioning the power monitoring device, check that all connections are correct.

5.2 Applying supply voltage

A supply voltage is required to operate the device. Please consult the Technical data (Page 65) or the rating plate for the permissible supply voltage type and level.

NOTICE
The wrong system connection can destroy the device.
Failure to heed this warning can result in damage to the device and the system. The minimum and maximum limits given in the technical data and on the rating plate must not be exceeded even during startup or testing of the device.

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

First commissioning

The language selection only appears:

- During first commissioning
- After a reset to factory settings
- After a firmware update

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

The menu-based navigation of the device is available in four languages:

- English
- Portuguese
- Spanish
- Chinese

5.3.1 Basic parameters

Set the basic parameters:

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

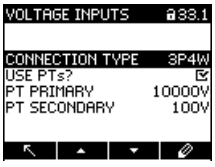
You can find additional information in chapters Operation (Page 43) and Parameterizing (Page 49).

Example

You want to measure in a 3P4W 10 kV system using voltage transformers (10000 V/100 V) and current transformers (100 A/5 A).

1. Select the "BASIC PARAMETERS" submenu of the "SETTINGS" menu.

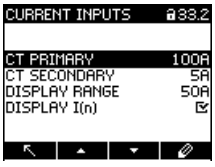
   Specify the connection type and the ratio of the voltage transformers you are using in the "VOLTAGE INPUTS" menu item.



   The ratio of the voltage transformer you are using can be only be adjusted when the setting "USE PTs" is activated.

2. Confirm your entry and press the <F1> key to return to the "BASIC PARAMETERS" submenu.

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



3. 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 first commissioning, the language of the text on the display can be set in the "LANGUAGE" submenu of the "SETTINGS" menu.

Device protection against manipulation

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

For further information, please refer to chapter Security features (Page 61).

Please also note the information in chapters Operation (Page 43) and Parameterizing (Page 49).

5.4 Applying the measuring voltage

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

Rated voltage

- 57.7 V/ 100 V ... 230 V/ 400 V ±20 %

NOTICE
Observe the limit values. 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.
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. Follow the safety instructions for the applied current transformers.

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 52).

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 14)", check whether the measured variables are displayed in accordance with the implemented connection type. Any deviation indicates a wiring fault or configuration error.

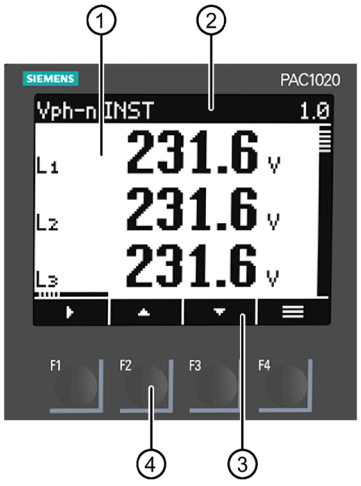
Operation

6

6.1 Device interface

6.1.1 Displays and operator controls

The front of the power monitoring device contains the following display and control elements.



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 Footer area:

Specifies the functions assigned to the function keys.

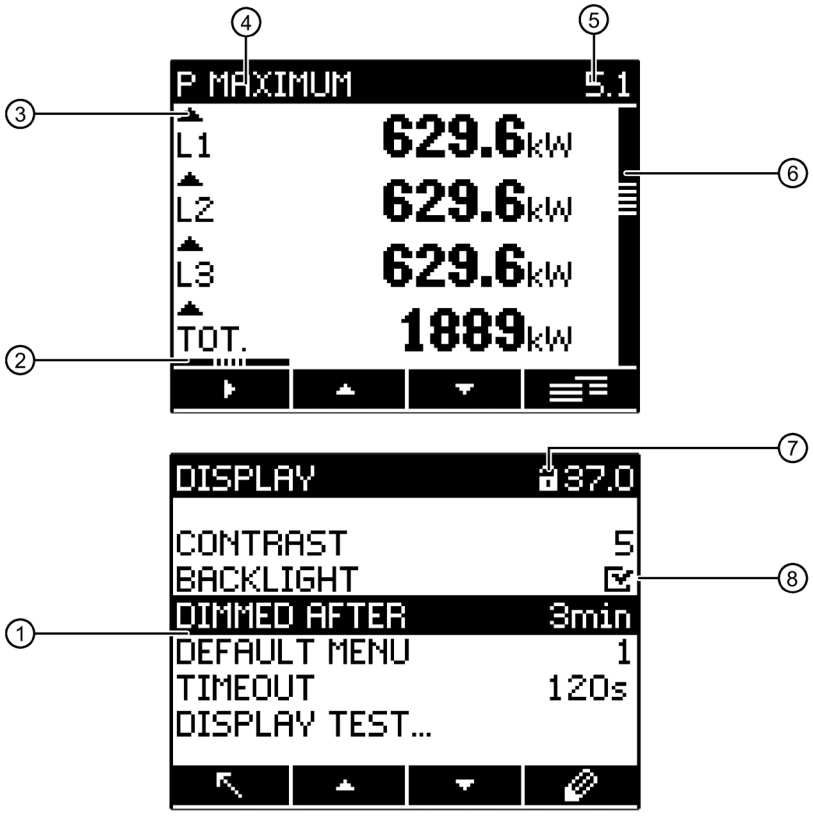
④ Surfaces of the function keys:

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.

Figure 6-1 Device interface

6.1.2 Special display elements



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

⑧ Activation/deactivation symbol
- Symbol with check mark: function activated
- Symbol without check mark: function deactivated

Figure 6-2 Special display elements

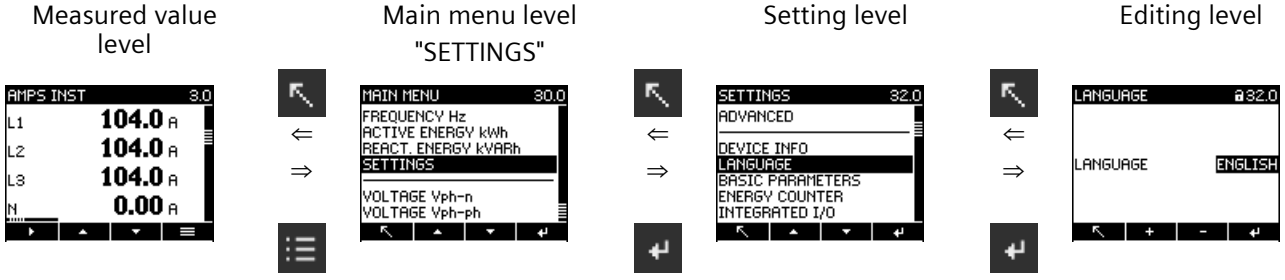
6.1.3 Menu-based navigation

The menu-based navigation is intuitive and largely self-explanatory. Only the basic structure of the menu-based navigation will be explained below. The description and function of the individual parameters can be found in chapter Parameterizing (Page 49).

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.

6.1.3.1 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 13). The selection of measured values depends on the connection type.)

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

6.1.3.2 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 switches the device to the measured value level.

In the "SETTINGS" menu item, the device is set to the setting level by actuating the ↵ key.

6.1.3.3 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**.

6.1.3.4 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 the → and + / − keys are used to change the value.
- The ↵ key confirms the change and switches the device to the measured value level.

6.1.4 Control keys

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

Keys	Possible assignment	Meaning
		**Measured value level:** The user uses this key to navigate to the next submenu. Additional measured data for the selected measured value are displayed in the submenu.
		This key causes all inputs to be discarded and returns the device to the last menu displayed. Any changes made but not confirmed are not transferred to the system.
		**Measured value level:** This key calls the next measured variable to the display. **Main menu and setting levels:** This key moves the selection bar upwards.
		**Editing level:** Displays the next selectable setting or increases the numerical value by "1".
		**Measured value level:** This key calls the next measured variable to the display. **Main menu and setting levels:** This key moves the selection bar downwards.
		**Editing level:** Displays the next selectable setting.
		**Editing level:** Selects the next number from the right for editing.
		**Measured value level:** This key activates the main menu.
		**Measured value level:** The submenu is currently selected on the device. This key activates the main menu. Holding the key down for a prolonged period activates a context menu in which, for example, it is possible to reset minimum or maximum values.
		**Main menu and setting levels:** This key confirms the selection made. **Editing level:** This key confirms the changes made to parameters.
		The key can be used to take the device to the editing level.
		**Editing level:** This key activates or deactivates a function.

Parameterizing

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 communication system
- Country-specific settings, ergonomics, device protection

It is possible to set the device by means of:

- The operator interface of the device
- powerconfig configuration software
- RS485 interface (Modbus)

Note

Protection of the device settings

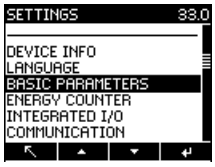
In the as-delivered state, the device settings can be changed. We recommend that you activate password protection on commissioning to safeguard against unauthorized or inadvertent changes.

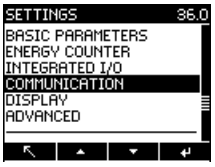
7.2 Parameterizing via the operator interface

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

You can find more information in chapter Menu-based navigation (Page 45).

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





- DEVICE INFO

  Article number and versions
- LANGUAGE

  Language of the display
- BASIC PARAMETERS

  Settings for the measuring inputs
- INTEGRATED I/O

  Settings for using the status display of the digital inputs and outputs
- COMMUNICATION

  Settings for network communication
- DISPLAY

  Settings for the display
- ENERGY COUNTER

  Parameterization of the energy counters
- ADVANCED

  Password protection, resetting the device

7.2.1 Device information

The device information cannot be modified.

Device information	
7KM1020-0BA01-1DA0	Article number of the device
PAC1020 Vx.x.x	Device designation and firmware version
D/T: xxxxxx	Date code
ES: xxx	Hardware revision level
FW: xxxx	Firmware revision level
BL: xxxx	Boot loader revision level

7.2.2 Language

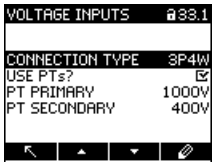
The language of the menu-based operation and the measured value displays can be set in the "LANGUAGE" menu item.

Selection	**Range**	**Factory setting**
Language	• English • Portuguese • Spanish • Chinese	English

7.2.3 Basic parameters

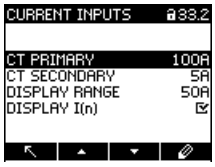
Measuring inputs can be parameterized in the "BASIC PARAMETERS" menu item.

Voltage input



Selection	Range	Factory setting
CONNECTION TYPE	Selection of connection type • 3P4W: 3 phases, 4 conductors • 3P3W: 3 phases, 3 conductors	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)	1 ... 999999 V, freely adjustable	400 V
PT SECONDARY (USE PTs ☑ ON)	1 ... 400 V, freely adjustable	400 V

Current input

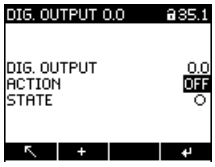


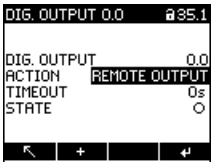
Selection	Range	Factory setting
CT PRIMARY	Primary current of the current transformers 1 ... 99999 A	50 A
CT SECONDARY	Secondary current of the current transformers • 1 A • 5 A	5 A
DISPLAY RANGE	Display range setting Freely adjustable 1 ... 99999 A	50 A
• CURRENT DIREC L1 • CURRENT DIREC L2 • CURRENT DIREC L3	Inverse evaluation of the current flow direction separately for each phase. • ☑ ON: Direction of current flow is inverted. The device interprets the current flow direction as opposite to the wiring. • ☐ OFF: The device interprets the current flow direction to match the wiring.	☐ OFF
DISPLAY I(n)	Display of I(n) current • ☑ ON: I(n) is displayed • ☐ OFF: I(n) is not displayed	☑ ON

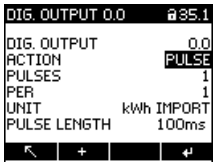
7.2.4 Integrated I/Os

Device settings for using the digital inputs and outputs.

Digital output



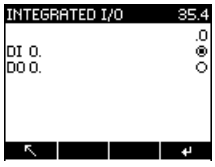




Selection	Range	Factory setting
DIG. OUTPUT	One digital output is available: • 0.0	–
ACTION	• OFF: Output is deactivated. • REMOTE OUTPUT: Output is controlled by remote access. • PULSE: Output issues the parameterized number of pulses or edges per energy unit.	OFF
PULSES	Number of pulses to be issued per unit. The reference unit is defined in the "UNIT" field. 1 ... 4000	1
UNIT (with PULSE only)	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 is output are defined in the fields "UNIT" and "PER" (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

Selection	Range	Factory setting
PER (with PULSE only)	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 (with PULSE only)	Length of the pulse: 30 ... 500 ms The minimum length of the pulse pause corresponds to the pulse duration specified.	100 ms

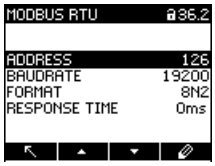
Status



Selection	Range	Factory setting
DI 0.0 DO 0.0	Graphically represents the status of the integrated I/Os on the device display.	–

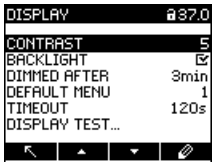
7.2.5

7.2.6 MODBUS RTU communication



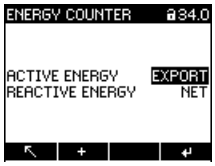
Selection	Range	Factory setting
ADDRESS	Range: 1 ... 247	126
BAUD RATE	Range: • 4800 • 9600 • 19200 • 38400 • 57600 • 115200	19200
FORMAT	• 8N1 - (8 data bits, no parity, 1 stop bit) • 8N2 - (8 data bits, no parity, 2 stop bits) • 8E1 - (8 data bits, even parity, 1 stop bit) • 8O1 - (8 data bits, odd parity, 1 stop bit)	8N2
RESPONSE TIME	Range: 0 ... 255 ms	0 ms

7.2.7 Display



Selection	Range	Factory setting
CONTRAST	Contrast of the LC display. 1 ... 10	5
BACKLIGHT	Switching the display backlighting on and off. • ☑ ON: Backlighting ON • ☐ OFF: Backlighting OFF	☑ ON
DIMMED AFTER	Time after which the device switches off the backlighting. 0 ... 99 min	3 min
DEFAULT MENU	Menu display number for the default menu. The device always starts up with the menu display defined here. 1 ... xx	1
TIMEOUT	When the specified time has elapsed, the device automatically returns to the defined default menu. 0 ... 3600 s (0 = function deactivated)	0
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 ENERGY COUNTER



Selection	Range	Factory setting
ACTIVE ENERGY	Selecting the energy counter displayed on the measured value level • IMPORT: The active energy counter displays the import value. • EXPORT: The active energy counter displays the export value. • NET: The active energy counter displays the net value. (The net value is calculated as import value minus export value.)	NET
REACTIVE ENERGY	Selecting the energy counter displayed on the measured value level • IMPORT: The reactive energy counter displays the import value. • EXPORT: The reactive energy counter displays the export value. • NET: The reactive energy counter displays the net value. (The net value is calculated as import value minus export value.)	NET

7.2.9 Advanced

7.2.9.1 Password

Password protection prevents the following actions:

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

Reading out of measured values and memory content is possible without restriction when password protection is active.

Note

Depending on how the password protection function is configured, the password prevents write access via:

- Device interface
- Communication interface
- Device interface and communication interface

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 communication interfaces. • ☑ ON: Password protection active • ☐ OFF: Password protection deactivated	☐ OFF
PASSWORD	0000 ... 9999	0000

Note

If you have forgotten the password, please contact Technical Support. You will be issued with a new password.

7.2.9.2 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: not active
FACTORY DEFAULTS	All device settings and measured values except the communication parameters and energy secondary values are reset to the as-delivered state. • ☑ Yes: active • ☐ No: not active	☐ No
COMMUNICATION PARAMETERS	All communication settings are reset to the as-delivered state. • ☑ 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.

Security features

8

The device is equipped with a protection mechanism to safeguard against deliberate and inadvertent device manipulation.

- Password protection

The locked padlock symbol in the title header of the display indicates that the "PASSWORD" is activated.

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

Note

It is advisable to activate the manipulation protection mechanisms in the device.

8.1 Password protection

Password protection prevents write access via the device menu and the communication 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

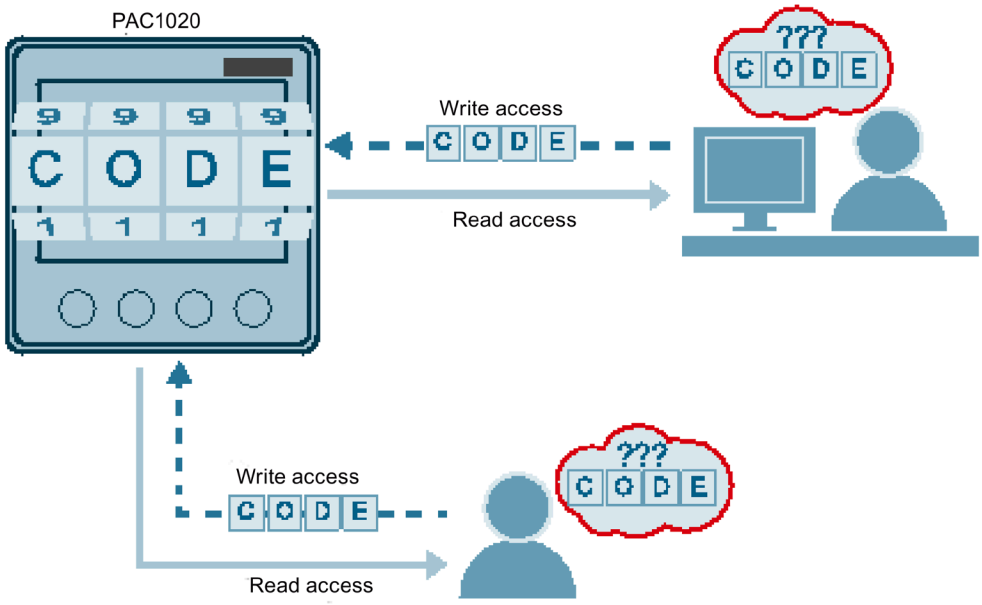
Reading out of measured values and memory content is still possible when password protection is active.

The password can be activated on the device in the "ADVANCED" submenu of the "SETTINGS" menu.

Note

Depending on how the password protection function is configured, the password prevents write access via:

- Device interface
- Communication interface
- Device interface and communication interface



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 password protection is switched on.

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

Note

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

Note

If you have forgotten the password, please contact Technical Support (https://www.siemens.com/lowvoltage/technical-support). You will be issued with a new password.

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 update

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

NOTICE
Power failure during a firmware update renders the device unable to function. The firmware update takes several minutes. Connect the device to a fail-safe power supply before updating the firmware. If the power fails despite this security measure, try to restart the firmware update of the PAC power monitoring device in powerconfig.

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 24).
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 (https://www.siemens.com/lowvoltage/technical-support)

Technical data

10

Device configuration

- 1 optically isolated digital input
- 1 optically isolated digital output
- 1 RS485 interface for connecting to a PC or network

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	Zero blind measurement, gapless
	Waveform	Sinusoidal or distorted
	Frequency of the relative fundamental	50/60 Hz
	Measured value acquisition mode	Automatic line frequency detection

Measuring inputs for voltage

Measuring inputs for voltage		
Measurable voltage	Rated voltage	57.7 V/ 100 V ... 230 V/ 400 V
	Min. measuring voltage U_{L-N}	11.5 V
	Max. measuring voltage U_{L-L}	280 V
Zero point suppression level	Voltage L-N	10 V
	Voltage L-L	17 V
Measuring category (acc. to IEC/UL 61010-2-030)	Category	CAT III
	Impulse withstand voltage	≥ 9.6 kV (1.2/50 µs)
Input resistance (L N)		1.5 MΩ
Max. power consumption per phase		150 mW
Max. voltage at measuring input		U_{L-N} 300 V

Measuring inputs for current

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

Measuring inputs for current		
Input current I_E	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		125 mVA at 5 A
Zero point suppression level		0 ... 10 % of rated current

Measuring accuracy

Measuring accuracy	
Measured variable	Accuracy class
Voltage	0.5
Current	0.5
Neutral conductor current (calculated)	1
Active power	1
Reactive power	2
Total active power over all phases	1
Total reactive power Q1 over all phases	2
Cumulated active power	1
Cumulated reactive power	2
Total power factor	0.5
Line frequency	0.05
Active energy	1
Reactive energy	2

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

Supply voltage

Supply voltage		
Wide-range AC/DC power supply unit	Rated range	100 ... 250 V AC/DC ± 10 %, 50/60 Hz 4 VA
Overvoltage category		OVC III

Digital input

Digital input		
Number		1
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 output

Digital output		
Number		1
Design/function		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 power supply
	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
	Short-circuit protection	Yes

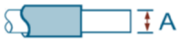
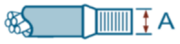
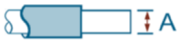
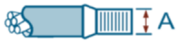
Communication

RS485 interface		
	Electrical interface	RS485, two-wire line + 1 line for Common
	Connection type	Screw terminals
	Supported communication protocol	Modbus RTU
	Functionality	Slave
	Supported baud rate	• 4800 • 9600 • 19200 • 38400 • 57600 • 115200 Default: 19200
	Data format	• 8N1 - (8 data bits, no parity, 1 stop bit) • 8N2 - (8 data bits, no parity, 2 stop bits) • 8E1 - (8 data bits, even parity, 1 stop bit) • 8O1 - (8 data bits, odd parity, 1 stop bit) Default: 8N2
	Supported address area	1 ... 247 Default: 126

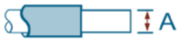
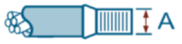
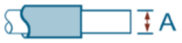
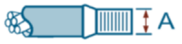
Display and operator control

Display and operator control		
Display	Version	Monochrome, graphical LC display
	Backlighting	White
	Service life of the LEDs	50,000 hours at 25 °C ambient temperature. To increase the life of the backlighting, it is advisable to leave it switched on for no more than 10% of the 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

Connection components: Current connection, voltage connection

Connection components: Current connection, voltage connection		
Conductor cross-section for copper cable (Cu)	Rigid 	0.25 ... 6 mm^2 (AWG 24 ... 10)
	Flexible 	0.25 ... 6 mm^2 (AWG 24 ... 10)
	Flexible with end sleeve, without plastic sleeve 	0.25 ... 4 mm^2 (AWG 24 ... 12)
	Flexible with end sleeve and plastic sleeve 	0.25 ... 4 mm^2 (AWG 24 ... 12)
2 conductors with the same cross-section (only for voltage connections)	Rigid 	0.25 ... 1.5 mm^2 (AWG 24 ... 16)
	Flexible 	0.25 ... 1.5 mm^2 (AWG 24 ... 16)
	Flexible with end sleeve, without plastic sleeve 	0.25 ... 2.5 mm^2 (AWG 24 ... 14)
	Flexible with TWIN end sleeve and plastic sleeve 	0.25 ... 2.5 mm^2 (AWG 24 ... 14)
	Tightening torque	0.85 Nm (6.9 lb-in)

Connection components: Digital inputs/outputs, RS485 interface

Connection components: Digital inputs/outputs, RS485 interface		
Conductor cross-section for copper cable (Cu)	Rigid 	1 x 0.34 ... 2.5 mm² (AWG 22 ... 14)
	Flexible 	1 x 0.34 ... 2.5 mm² (AWG 22 ... 14)
	Flexible with end sleeve, without plastic sleeve 	1x 0.34 ... 1.0 mm² (AWG 22 ... 18)
	Flexible with end sleeve and plastic sleeve 	1x 0.34 ... 1.0 mm² (AWG 22 ... 18)
2 conductors with the same cross-section	Rigid 	2x 0.34 ... 0.5 mm² (AWG 22 ... 20)
	Flexible 	2x 0.34 ... 0.5 mm² (AWG 22 ... 20)
	Flexible with end sleeve, without plastic sleeve 	1x 0.34 ... 0.5 mm² (AWG 22...18)
	Flexible with TWIN end sleeve and plastic sleeve 	1x 0.34 ... 1.0 mm² (AWG 22...20)
	Tightening torque	0.3 Nm (2.6 lb-in)

Dimensions and weights

Dimensions and weights	
Type of mounting	Panel mounting to IEC 61554
Enclosure dimensions W x H x D	96 mm x 96 mm x 46 mm
Cutout (W x H)	92 mm +0.8 mm x 92 mm +0.8 mm
Permissible panel thickness for installation	d = 1 ... 2 mm In the case of panel thicknesses where d ≠ 1 ... 2 mm, installation is possible using optionally available mounting brackets (7KM9900-06A00-0AA0).

Dimensions and weights		
Mounting position		Vertical
Weight	Device without packaging	Approx. 240 g
	Device including packaging	Approx. 300 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	IP40
	Device rear panel	IP20

If a higher degree of protection is required for a specific application, the customer must take suitable measures.

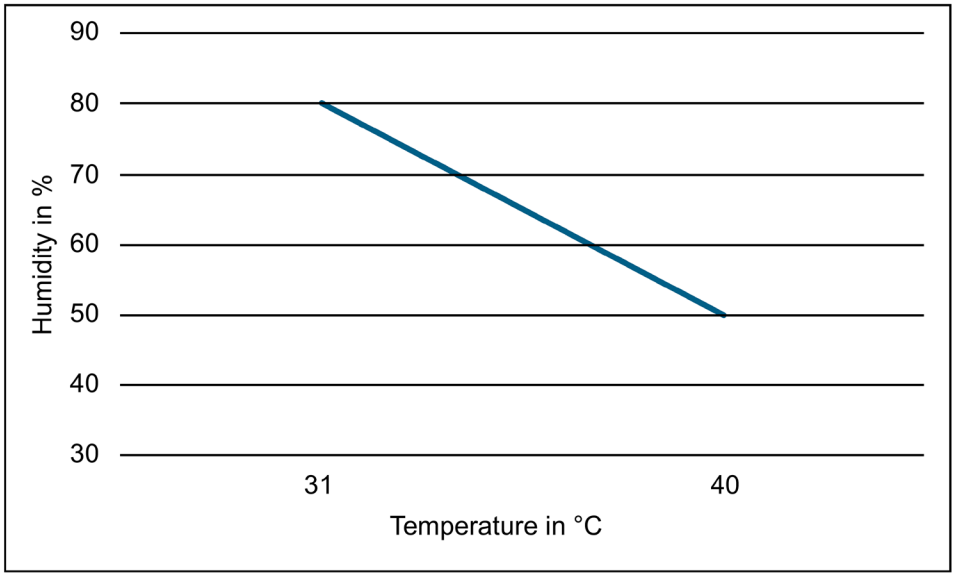
Ambient conditions

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

Ambient conditions		
Temperature range	Ambient temperature during operation	-10 ... +55 °C (K55)
	Ambient temperature during transportation and storage	–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

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.



Electromagnetic compatibility

Electromagnetic compatibility	
Emitted interference	• EN 61323-1 (Class A) • EN 61000-3-2 • EN 61000-3-3
Interference immunity	• EN 61326-1 (Table 2: For use in an industrial electromagnetic environment) • EN 61000-6-2

Approvals

Symbol	Approval
CE	**CE conformity** The applied directives and standards can be found in the EU Declaration of Conformity.
EAC	**Approvals for Eurasian Customs Union** (valid in Russia, Belarus, Kazakhstan, Kyrgyzstan and Armenia)

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

10.1 Labeling

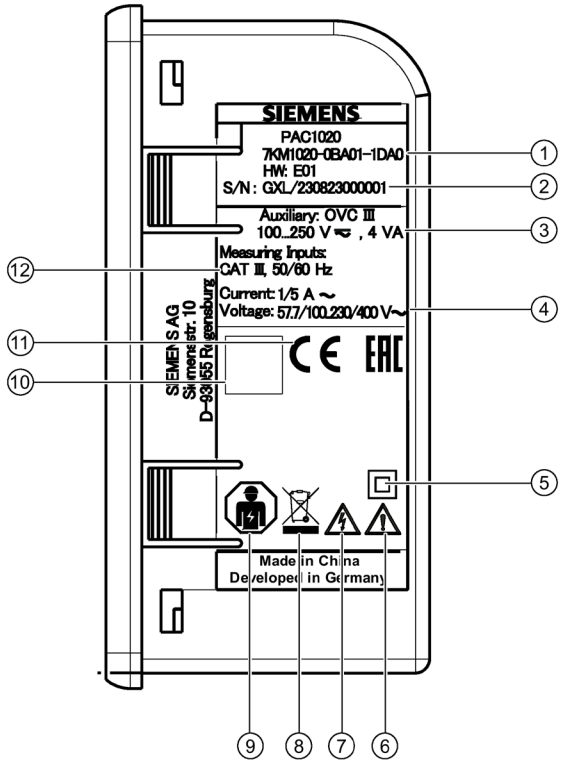


Figure 10-1 Example of a typical rating plate

Item	Symbol, label	Explanation
①	–	Article number
②	–	Serial number of the device
③	–	Device supply voltage
④	–	Data about measuring inputs for voltage
⑤		Protective insulation - class II device
⑥		General warning symbol
⑦		Risk of electric shock
⑧		The device must not be disposed of with general domestic waste.
⑨		Electrical installation and maintenance by qualified personnel only

Item	Symbol, label	Explanation
⑩	–	2D code (serial number of the device)
⑪		CE: CE marking (European Union) EAC: EAC marking (Eurasian Economic Union)
⑫	–	Data about measuring inputs for current

Dimensional drawings

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Panel cutout

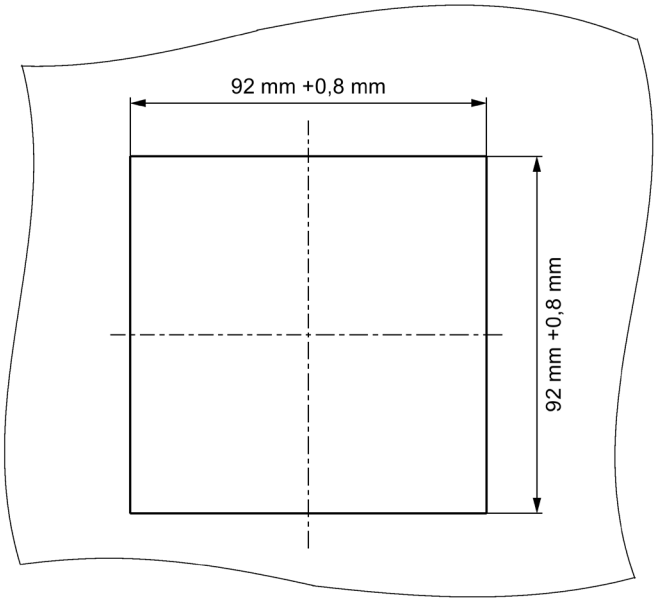


Figure 11-1 Panel cutout

Frame dimensions

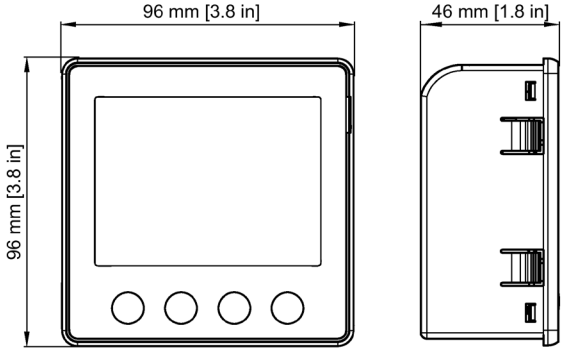
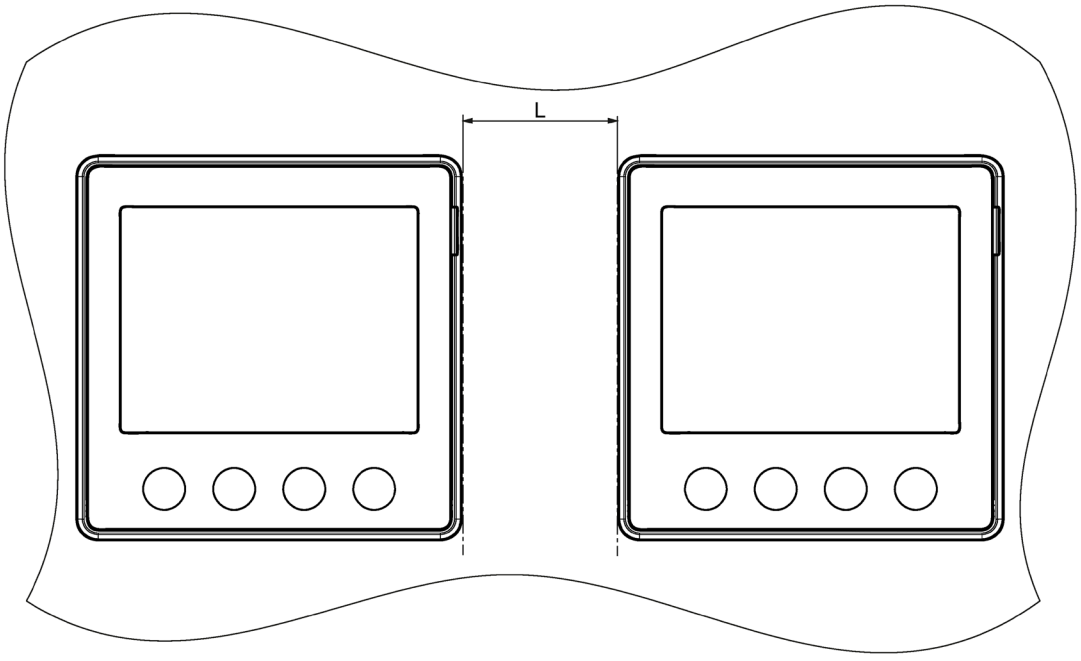


Figure 11-2 Frame dimensions

Clearance measurements



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 slave which 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

Table A- 1 Supported Modbus function codes

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

A.1.2 Exception codes

Overview

Table A- 2 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 slave. • The slave 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 slave. 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 slave. 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	Slave Device Failure	Error in processing the data: An indefinite error occurred when the slave attempted to execute the requested action.	Check that the specified offset and the specified data length in the command are correct.

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- 3 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- 4 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	active power L1	float	W		R
21	2	active power L2	float	W		R
23	2	active power L3	float	W		R
25	2	reactive power L1 (Q1)	float	var		R
27	2	reactive power L2 (Q1)	float	var		R
29	2	reactive power L3 (Q1)	float	var		R
31	2	power factor L1	float		0 - 1	R
33	2	power factor L2	float		0 - 1	R
35	2	power factor L3	float		0 - 1	R
37	2	neutral current	float	A		R
39	2	frequency	float	Hz	45 - 65	R
41	2	collective active power	float	W		R
43	2	collective reactive power (Q1)	float	var		R
45	2	collective power factor	float			R
47	2	max. voltage L1 - N	float	V		R
49	2	max. voltage L2 - N	float	V		R
51	2	max. voltage L3 - N	float	V		R
53	2	max. voltage L1-L2	float	V		R
55	2	max. voltage L2-L3	float	V		R
57	2	max. voltage L3-L1	float	V		R
59	2	max. current L1	float	A		R
61	2	max. current L2	float	A		R
63	2	max. current L3	float	A		R
65	2	max. active power L1	float	W		R
67	2	max. active power L2	float	W		R
69	2	max. active power L3	float	W		R

Offset	Number of registers	Name	Format	Unit	Value range	Access
71	2	max. reactive power L1 (Q1)	float	var		R
73	2	max. reactive power L2 (Q1)	float	var		R
75	2	max. reactive power L3 (Q1)	float	var		R
77	2	max. power factor L1	float		0 - 1	R
79	2	max. power factor L2	float		0 - 1	R
81	2	max. power factor L3	float		0 - 1	R
83	2	max neutral current	float	A		
85	2	max. frequency	float		45 - 65	R
87	2	max. collective active power	float	W		R
89	2	max. collective reactive power (Q1)	float	var		R
91	2	max. collective power factor	float			R
93	2	min. voltage L1 - N	float	V		R
95	2	min. voltage L2 - N	float	V		R
97	2	min. voltage L3 - N	float	V		R
99	2	min. voltage L1-L2	float	V		R
101	2	min. voltage L2-L3	float	V		R
103	2	min. voltage L3-L1	float	V		R
105	2	min. current L1	float	A		R
107	2	min. current L2	float	A		R
109	2	min. current L3	float	A		R
111	2	min. active power L1	float	W		R
113	2	min. active power L2	float	W		R
115	2	min. active power L3	float	W		R
117	2	min. reactive power L1 (Q1)	float	var		R
119	2	min. reactive power L2 (Q1)	float	var		R
121	2	min. reactive power L3 (Q1)	float	var		R
123	2	min. power factor L1	float		0 - 1	R
125	2	min. power factor L2	float		0 - 1	R
127	2	min. power factor L3	float		0 - 1	R
129	2	min neutral current	float	A		
131	2	min. frequency	float	Hz	45-65	R
133	2	min. collective active power	float	W		R
135	2	min. collective reactive power (Q1)	float	var		R
137	2	min. collective power factor	float	var		R
205	2	device diagnostics and status	unsigned long		Byte0 global state Byte1 local state Byte2 global diag. Byte3 local diag.	R
207	2	state binary outputs	unsigned long		Byte3 Bit0 Output 0.0	R
209	2	state binary inputs	unsigned long		Byte3 Bit0 Input 0.0	R
801	4	active energy (import, export, net)	double	Wh	overflow 1.0e+12 set: only >= 0.0	RW
805	4	reactive energy (import, export, net)	double	Wh	overflow 1.0e+12	RW

Offset	Number of registers	Name	Format	Unit	Value range	Access
2803	2	active energy (import, export, net)	float	Wh	overflow 1.0e+12 set: only >= 0.0	R
2805	2	reactive energy (import, export, net)	float	Wh	overflow 1.0e+12 set: only >= 0.0	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- 5 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 inputs status	32 bits	DI 0.0	3	0	0x00000001	R

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

Table A- 6 Modbus offset 205, register 2: Structure device status and device diagnostics

Byte	Bit	Device status	Type	Bit mask	Value range	Access
0	1	local configuration menu is active	status	0x02000000	0 ... 1 • 0 = not active • 1 = active	R
0	2	voltage overload	status	0x04000000		R
0	3	current overload	status	0x08000000		R
0	7	Modbus communication is password-protected	status	0x80000000		R
1	1	pulse output overload	status	0x00020000		R
2	0	relevant parameters changed[1)]	stored	0x00000100		R
2	2	pulse output overload[1)]	stored	0x00000400		R
2	3	device has rebooted[1)]	stored	0x00000800		R
2	4	energy counters changed 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.

Table A- 7 Status parameters

Offset	Number of registers	Name	Format	Value range from ... to	Access
108	1	Bit 0 relevant parameters changed	Bit	0 = not active 1 = active	R
110	1	Bit 2 pulse output overload	Bit		R
111	1	Bit 3 device has rebooted	Bit		R
112	1	Bit 4 energy counters changed by user	Bit		R
117	1	Bit 1 pulse output overload	Bit		R
125	1	Bit 1 local configuration menu is active	Bit		R
126	1	Bit 2 voltage overload	Bit		R
127	1	Bit 3 current overload	Bit		R
200	1	Binary input 0.0	Bit		R
300	1	Binary output 0.0	Bit		R

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	Format	Unit	Value range from ... to	Access to value (software) read only / read write
49999	2	Current nominal display range	unsigned long	A	1 ... 99999	RW
50001	2	Type of connection	unsigned long		0 ... 1 • 0 = 3P4W • 1 = 3P3W	RW
50003	2	Voltage transformer yes/no	unsigned long		0 ... 1 • 0 = No • 1 = Yes	RW
50005	2	Primary voltage	unsigned long		1 ... 999999V	RW
50007	2	Secondary voltage	unsigned long		1 ... 480V	RW

Offset	Number of registers	Name	Format	Unit	Value range from ... to	Access to value (software) read only / read write
50011	2	Primary current	unsigned long		1 ... 99999A	RW
50013	2	Secondary current	unsigned long		1, 5	RW
50019	2	Current direction L1,L2,L3	unsigned long		0 ... 7 bit-coded Bit = 0 means normal, Bit = 1 is inverse .0 L1 .1 L2 .2 L3	RW
50025	2	Energy counter function	unsigned long		0 ... 2 WORD-CODED • 0 = import • 1 = export • 2 = net HIWORD kVARh setting LOWORD kWh setting	RW
50035	2	Digital output 0.0 action	unsigned long		0 ... 2 • 0 = no action • 1 = switching output • 2 = pulse output	RW
50037	2	Output 0.0 pulse type index	unsigned long		0 ... 3 • 0 = import kWh • 1 = export kWh • 2 = import kvarh • 3 = export kvarh	RW
50039	2	Output 0.0 pulse ratio (pulses per kWh/kvarh)	unsigned long		1-4000	RW
50041	2	Output 0.0 pulse length	unsigned long		30-500	RW
50043	2	Digital output 0.0 Timeout	unsigned long		0.1 ... 18000 Digital output remote timeout = 1 ... 18000 seconds 0 = disables timeout (default)	RW
50045	2	Output 0.0 pulse divider	unsigned long		0 ... 3 • 0 = 1kWh • 1 = 10kWh • 2 = 100kWh • 3 = 1000kWh	RW

Offset	Number of registers	Name	Format	Unit	Value range from ... to	Access to value (software) read only / read write
50047	2	Active language	unsigned long		1, 2, 4, 8 • 1 = English • 2 = Portuguese • 4 = Spanish • 8 = Chinese	RW
50059	2	Display contrast	unsigned long		1 ... 10	RW
50061	2	Display illumination level (normal mode)	unsigned long	%	0 ... 1 • 0 = Off • 1 = On	RW
50063	2	Display illumination level (dimmed mode)	unsigned long	%	0 ... 1	RW
50065	2	Display illumination dimm. time	unsigned long	min	0 ... 99	RW
50067	2	I(N) Display	unsigned long		0 ... 1 • 0 = Hide I(N) • 1 = Display calculated I(N), depends on hookup	RW
50069	2	Default menu No.	unsigned long		DISPLAYED MENU NUMBER: 1-12: only existing menus are accepted • 1 = MEAS_VLN • 2 = MEAS_VLL • 3 = MEAS_I • 5 = MEAS_P • 6 = MEAS_Q • 7 = MEAS_SPQ • 8 = MEAS_PF • 9 = MEAS_F • 11 = MEAS_WORK_P • 12 = MEAS_WORK_Q	RW
50071	2	Timeout for returning to default menu	unsigned long		0... 3600s • 0 = No timeout • 10s - 3600s = timeout (1s <= timeout < 10 = timeout is set to 10s)	RW

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

Addressing the communication parameters

Table A- 9 Addressing the communication parameters

Offset	Number of registers	Name	Format	Unit	Value range from ... to	Access
63019	2	ModbusRTU address	unsigned long		1 ... 247	RW
63021	2	ModbusRTU baud rate	unsigned long		0 ... 5 • 0 = 4800 baud • 1 = 9600 baud • 2 = 19200 baud • 3 = 38400 baud • 4 = 57600 baud • 5 = 115200 baud	RW
63023	2	ModbusRTU data bits/parity/stop bits	unsigned long		0 ... 3 • 0 = 8N2 • 1 = 8E1 • 2 = 8O1 • 3 = 8N1	RW
63025	2	ModbusRTU response time	unsigned long	ms	0 ... 255	RW

Addressing the settings for the I&M data

Table A- 10 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
64028	89	I&M 1 data ... I&M 4 data	stIM14	• 0x03 • 0x04 • 0x10	RW

A.1.9 Modbus command parameters

Addressing the command parameters

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

Table A- 11 Command parameters

Offset	Number of registers	Name	Format	Value range	Access
60002	1	reset maxima	unsigned short	0	W
60003	1	reset minima	unsigned short	0	W
60004	1	reset energy counters	unsigned short	• 0 = all • 1 = active energy • 2 = active energy	W
60007	1	acknowledge diagnostics	unsigned short	0-ffffh	W
60008	1	switch outputs (if parameterized)	unsigned short	0ffh-1ffh • Byte0 0 = Output0 • Byte1 0 = Output0 off • Byte1 1 = Output0 on	W

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.

Table A- 12 Modbus standard 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

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