# Measuring device 7KM

## PAC3100

Manual · 05/2012


Low-Voltage Power Distribution and Electrical Installation Technology

Answers for infrastructure.

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# Measuring device PAC3100

Manual




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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**

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

**CAUTION**

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

**NOTICE**

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

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

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

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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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# Table of contents

# Introduction 1

## 1.1 Purpose of this document

This manual describes the PAC3100 measuring device.

It is intended for the use of:

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

### Required basic knowledge

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

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

### Validity range

Those device properties valid at the time of publication of the manual are described.

## 1.2 Orientation aids

### General information

The manual includes the following orientation aids:

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

## 1.3 Components of the product

### Description

The package includes:

- 1 PAC3100
- 2 brackets for panel mounting
- 1 plug-in terminal block for RS 485 connection
- 1 set of PAC3100 Operating Instructions

## 1.4 Latest information

### Up-to-the-minute information

You can obtain further assistance by calling the following numbers:

**Technical Assistance:**

Phone: +49 (0) 911-895-5900 (8:00 – 17:00 CET)
Fax: +49 (0) 911-895-5907

**On the Internet at:**

E-mail: Technical Assistance (mailto:technical-assistance@siemens.com)

Internet: Technical Assistance (http://www.siemens.de/lowvoltage/technical-assistance)

## 1.5 Further documentation

### Overview

You can find more information in the PAC3100 Operating Instructions and on the Internet.

### See also

Latest information (Page 8)

# Safety notes

# 2

## General safety notes

**DANGER**

**Hazardous Voltage**

**Will cause death or serious injury.**

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

## Safety-related symbols on the device

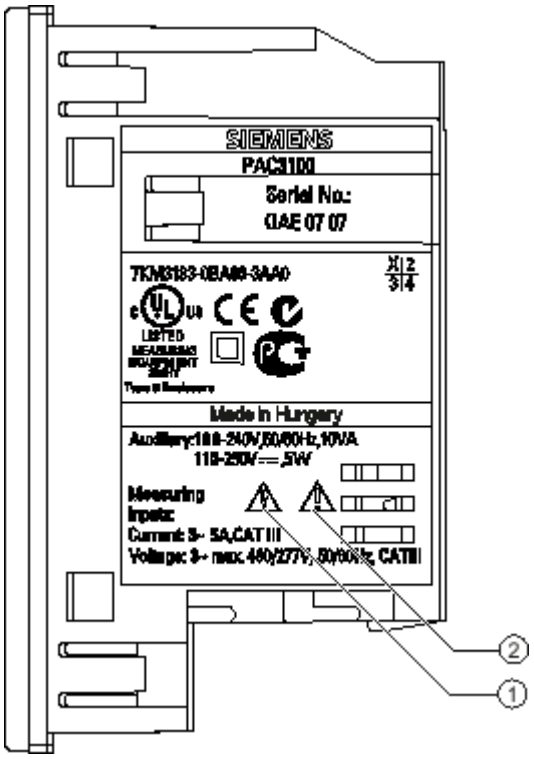



Figure 2-1 Safety-related symbols on the device

| | Symbol | Meaning |
|---|---|---|
| (1) |  | Risk of electric shock |
| (2) |  | General Warning Symbol |

## See also

Applying the supply voltage (Page 54)

Applying the measuring voltage (Page 66)

Applying the measuring current (Page 67)

# Description

# 3

## 3.1 Features

The PAC3100 is a measuring device for displaying the basic electrical variables in low-voltage power distribution. It 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.

Thanks to its compact design in 96 x 96 mm format, it is an ideal replacement for all conventional analog indicating instruments.

Thanks to its large measuring voltage range, the **PAC3100** can be connected direct in any low-voltage system up to a **rated voltage $U_{ph-ph}$ of 480 V**.

Higher voltages can be measured using voltage transformers.

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

The large graphical LC display permits reading even from a distance.

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

The integrated RS 485 interface can be used for communication.

In addition, the PAC3100 has 2 digital inputs and 2 digital outputs. The parameters can be set either direct on the device or via the RS 485 interface.

Password protection is integrated via the front of the device to guard against unauthorized access.

### Device versions

The device is available in the following version:

Table 3- 1 Device versions

| PAC3100 measuring device | |
|---|---|
| **Order No.** | **Description** |
| 7KM3133-0BA00-3AA0 | PAC3100 with wide-range power supply and screw terminals |

## Measurement

- Derivation of more than 30 measured variables from the basic measured variables for voltages and currents.
- The PAC3100 can be **connected direct to 480 V industrial systems** (measuring category III, pollution degree 2). Higher voltages using voltage transformers.
- Suitable for current transformers x / 5 A. Programmable conversion ratio and direction of current.
- Can be used in 3 and 4-wire systems. Suitable for TN, TT and IT systems.
- Measuring accuracy: Class 1 for voltages, currents, active power, apparent power, and active energy (in accordance with IEC 61557-12)
- TRMS up to the 15th harmonic

## Counters and power demand

- 4 energy counters record active energy and reactive energy. Optional display of 2 counters on the display.
- Calculation and storage of the last demand period mean value for active power and reactive power for simple generation of load profiles using software. Programmable demand period from 1 to 60 mins.

## Display and operator control

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

## Power supply

- AC/DC wide-range power supply:
  Supply by 100 to 240 V AC ±10% / 50/60 Hz or
  110 to 250 V DC ±10%.

## Installation format

- Panel-mounting format 96 x 96 mm.
- Only 51 mm overall depth.

## Interface

- Integral RS 485 Modbus RTU interface.

### Inputs and outputs

- 2 digital inputs with internal power supply for status monitoring.
- 2 digital outputs, programmable as energy pulse outputs for active energy pulses or reactive energy pulses, or as switching outputs for remote control via the RS 485 interface.

### Protection

Password protection on the device by means of 4-character code.

### See also

Measured variables (Page 18)

Technical data (Page 117)

## 3.2 Measuring inputs

### Current measurement

| CAUTION |
| --- |
| **AC current measurement only**<br>The device is not suitable for measuring DC current. |

PAC3100 is designed for:

- **Measuring current of 5 A for connecting standard current transformers.** Each current measuring input can take a continuous load of 10 A (max. 300 V). Surge withstand capability is possible for currents up to 100 A and a duration of 1 s.

## Voltage measurement

| CAUTION |
| --- |
| **AC voltage measurement only**<br>The device is not suitable for measuring DC voltage. |

PAC3100 is designed for:

- **Direct measurement on the system or using voltage transformers**. The measuring voltage inputs of the device measure direct via protective impedances. External voltage transformers are required to measure higher voltages than the permissible rated input voltages.
- **Measuring voltage up to 277 V / 480 V**. The device is designed for measuring input voltages up to 277 V to the neutral conductor and 480 V to the external conductor.

## Connection types

Two connection types have been provided for connecting three-wire or four-wire systems with unbalanced load.

Table 3- 2 Available connection types

| Short code | Connection type |
| --- | --- |
| 3P4W | 3 phases, 4 conductors, unbalanced load |
| 3P3W | 3 phases, 3 conductors, unbalanced load |

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

You can find connection examples in the chapter "Connection".

| CAUTION |
| --- |
| **The wrong system connection can destroy the device**<br>Before connecting the PAC3100, you must ensure that the local power supply conditions agree with the specifications on the rating plate. |

The short code of the connection type must be entered in the device settings at startup. You can find the instructions for parameterizing the connection type in the chapter "Commissioning".

## Display of the measured variables depending on the connection type

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

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

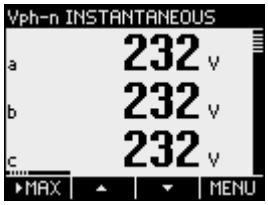



Figure 3-1 Display of the measured voltage in the case of connection type 3P4W


Figure 3-2 Display of the measuring voltage in the case of connection type 3P3W

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

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

| Connection type<br>Measured variable | 3P4W | 3P3W |
|---|---|---|
| Voltage a-n | ✓ | |
| Voltage b-n | ✓ | |
| Voltage c-n | ✓ | |
| Voltage a-b | ✓ | ✓ |
| Voltage b-c | ✓ | ✓ |
| Voltage c-a | ✓ | ✓ |
| Current a | ✓ | ✓ |
| Current b | ✓ | ✓ |
| Current c | ✓ | ✓ |
| Neutral current | ✓ | |
| Apparent power a | ✓ | |
| Apparent power b | ✓ | |
| Apparent power c | ✓ | |
| Active power a | ✓ | |
| Active power b | ✓ | |
| Active power c | ✓ | |
| Reactive power a (VAR1) | ✓ | |
| Reactive power b (VAR1) | ✓ | |
| Reactive power c (VAR1) | ✓ | |
| Total apparent power over all phases | ✓ | ✓ |
| Total active power over all phases | ✓ | ✓ |
| Total reactive power VAR1 over all phases | ✓ | ✓ |
| Total power factor | ✓ | ✓ |
| Line frequency | ✓ | ✓ |
| Active energy | ✓ | ✓ |
| Reactive energy | ✓ | ✓ |
| Cumulated active power | ✓ | ✓ |
| Cumulated reactive power | ✓ | ✓ |

## Overload display

Voltage or current overload are indicated on the display:

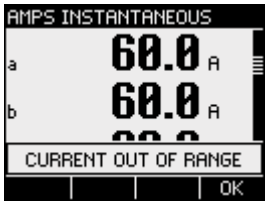



Figure 3-3 Indicating overload on the display

The display shows the message "... OUT OF RANGE". The message can be confirmed and hidden with function key <F4>.

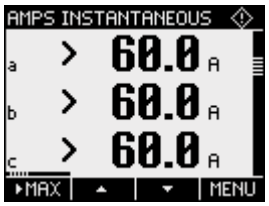



Figure 3-4 Display of the measurable maximum value at overload

The character ">" and the measurable maximum value (physical measuring range multiplied by scaling) are displayed instead of the measured values for affected phases.

The symbol ◈ in the header indicates overload. The symbol can be seen in all measured value displays.

## Current direction

The current direction can be changed on the device for all phases individually. It is not necessary to change the terminal connections of the current transformers in the event of connection errors.

## See also

Connection examples (Page 46)

Setting the connection type (Page 58)

Connection (Page 39)

Applying the measuring voltage (Page 66)

Applying the measuring current (Page 67)

# 3.3 Measured variables

## Measured variables – overview

The table below lists all measured variables that the device records or derives from basic variables.

Table 3- 4 Measured variables

| Measured variable | Abbreviation | Instantaneous value | Min | Max | Mean value | Total value | Unit |
|---|---|---|---|---|---|---|---|
| Voltage ph-n | $V_{a-n}$ / $V_{b-n}$ / $V_{c-n}$ | ✓ | ✓ | ✓ | | | [V] |
| Voltage ph-ph | $V_{a-b}$ / $V_{b-c}$ / $V_{c-a}$ | ✓ | ✓ | ✓ | | | [V] |
| Current | $I_a$ / $I_b$ / $I_c$ | ✓ | ✓ | ✓ | | | [A] |
| Neutral current | $I_N$ | ✓ | ✓ | ✓ | | | [A] |
| Apparent power per phase | $VA_a$ / $VA_b$ / $VA_c$ | ✓ | ✓ | ✓ | | | [VA] |
| Active power per phase import/export | $W_a$ / $W_b$ / $W_c$ | ✓ | ✓ | ✓ | | | [W] |
| Reactive power (VAR1) per phase positive / negative | $VAR_{1\,a}$ / $VAR_{1\,b}$ / $VAR_{1\,c}$ | ✓ | ✓ | ✓ | | | [VAR] |
| Total apparent power over all phases | VA | ✓ | ✓ | ✓ | | | [VA] |
| Total active power over all phases import / export | P | ✓ | ✓ | ✓ | ✓1) | | [W] |
| Total reactive power VAR1 over all phases positive / negative | $Q_1$ | ✓ | ✓ | ✓ | ✓1) | | [VAR] |
| Total power factor | PF | ✓ | ✓ | ✓ | | | |
| Line frequency | f | ✓ | ✓ | ✓ | | | [Hz] |
| Active energy import/export/balance | $E_a$ | | | | | ✓ | [Wh] |
| Reactive energy import/export/balance | $E_r$ | | | | | ✓ | [VARh] |

1) Power demand of the last completed period for import and export, as well as minimum and maximum instantaneous value. Can only be called via RS 485 interface. See the chapter "Power demand".

## See also

Measured variables (Page 133)

Power demands and counters (Page 19)

# 3.4 Power demands and counters

## 3.4.1 Acquisition of power demand

### Values that can be read out

PAC3100 supplies the power demand of the last completed measuring period:

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

  **Example:** Period length and length of the demand period
  Period length: 15 minutes; time of day: 13:03; time in seconds: 180 s.
  The following can be calculated from this: The last demand period ended at 13:00. The active demand period will end at 13:15 or in 12 minutes.

### Availability

**Note**

The power demand of the last measuring period can only be fetched during the current measuring period.

**Note**

The power demand can only be read out via the RS 485 interface. The values are not shown on the display.

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

### Adjustable parameters

- Time interval in minutes: 1 to 60 min adjustable, default 15 min
- Synchronization via RS 485 interface

### See also

Modbus RTU (Page 141)

## 3.4.2 Energy counters

### Energy counters

PAC3100 has energy counters for counting

- Active energy import
- Active energy export
- Reactive energy import
- Reactive energy export

The device also calculates the energy balance

- Active energy balance
- Reactive energy balance

The energy balance is calculated from: Import minus export.

### Availability

Two of the 6 variables can be represented on the display and read out via the interface. The selection can be made when parameterizing the device.

## 3.4.3 Behavior in the case of power failure and power restore

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

Counter statuses and maximum/minimum values are written from the volatile to the non-volatile memory at the following intervals:

| | |
|---|---|
| Counter values | Every 5 mins. |
| Maximum/minimum values | Every 5 secs., if available |

# 3.5 Digital inputs and outputs

The PAC3100 has:

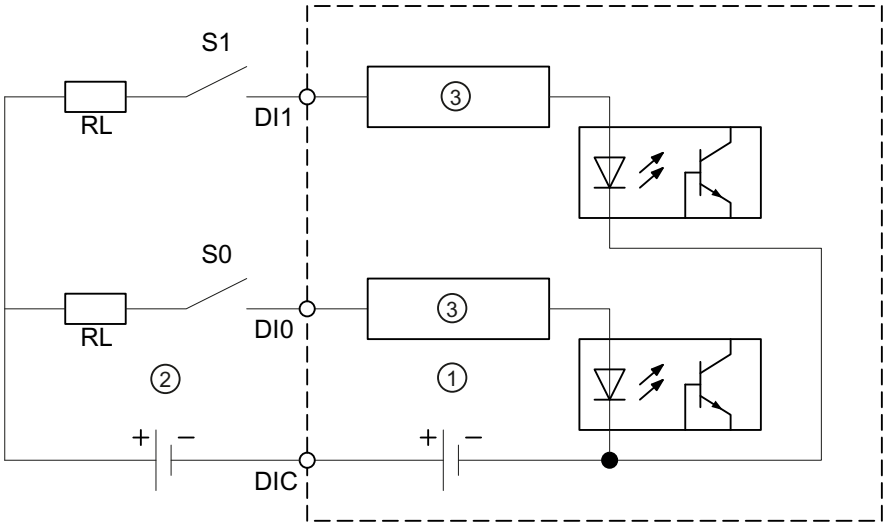
- 2 digital inputs
- 2 digital outputs

## 3.5.1 Digital inputs

### Function

Both digital inputs have the following function:

- Status monitoring: Capturing statuses of connected signal encoders




(1) Internal power supply
(2) Optional additional voltage power supply, max. 30 V, typically 24 V
(3) Input electronics

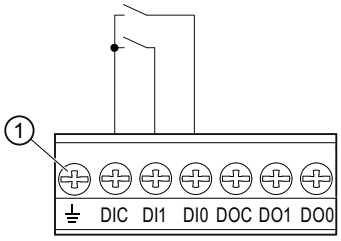
Figure 3-5 Block diagram: Digital inputs

## Wiring

Both digital inputs have an internal power supply. They can be operated optionally with or without an external power supply.

### Switch with internal power supply

Internal power supply on terminal DIC.

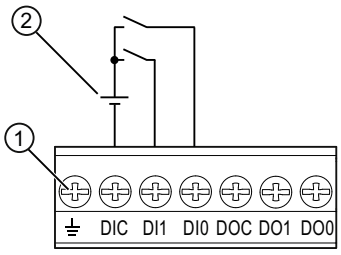



(1) Functional ground terminal

Figure 3-6 Digital inputs with switch and internal power supply on terminal DIC

### Switch with external power supply

In addition to the internal voltage on terminal DIC, and external voltage up to 30 V (typically 24 V) can be applied to terminal DIC.




(1) Functional ground terminal

(2) External voltage

Figure 3-7 Digital inputs with switch, internal power supply, and additional external power supply on terminal DIC

## 3.5.2 Digital outputs

### Functions

The following functions can be assigned to both digital outputs:

- Energy pulse output, programmable for active or reactive energy
- Switching output for remote control via the RS 485 interface

### Energy pulse output

The digital output supplies a number of pulses proportional to one of the following energies:

- Active energy import
- Active energy export
- Reactive energy import
- Reactive energy export

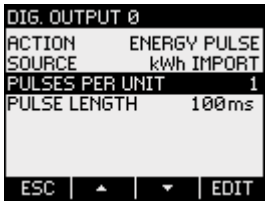



Figure 3-8 Energy pulse output

### Remote control via the RS 485 interface

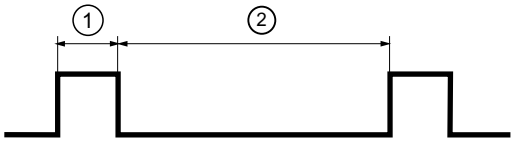
The integral RS 485 interface enables remote control of the digital outputs. The Modbus function codes are listed in the Appendix.

## Wiring

Both digital outputs are passive and implemented exclusively as switches.

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 3-9 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.

## See also

Modbus RTU (Page 141)

# 3.6 RS 485 interface

## RS 485 interface for Modbus RTU communication

The PAC3100 is equipped with an RS 485 interface for Modbus RTU communication.

## Application

This interface permits:

- Reading out the measured values
- Reading and writing the device settings
- Device firmware updates
- Update of the languages available on the device

The Modbus function codes are listed in the Appendix.

## Function

The device operates as a Modbus slave.

## 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 3- 5 Default Modbus RTU communication settings

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

## Response time delay

The response time of the PAC3100 may have to be delayed to enable its operation as a slave device with devices from other manufacturers on the bus. The PAC3100 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 and 255 milliseconds.

## Polarization

Polarization of the RS 485 data lines must be implemented at another point on the bus. The PAC3100 does not contain polarization resistors.

## Status LED

Two LEDs signal status information:

Table 3- 6 Meaning of the LED signals

| Color | State | Description |
|---|---|---|
| Green and yellow | Off | No activity on the bus. |
| Green | Flashing | Other devices are communicating on the bus. |
| Yellow | Flashing | The PAC3100 is sending data. |

## See also

Connecting to the RS 485 bus (Page 49)

Modbus RTU (Page 141)

# 3.7 Slots on the rear of the device

## Slot on the rear of the device

| CAUTION |
| --- |
| **The device can be destroyed if objects are inserted**<br>Do not insert any objects into the housing slots on the rear of the device. |

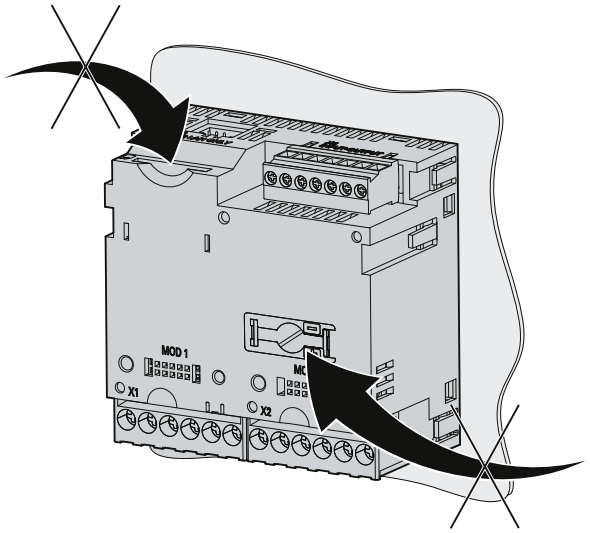



Figure 3-10 Non-usable housing openings

# Operation planning

# 4

## Mounting location

The PAC3100 device is intended for installation in permanently installed switching panels within closed rooms.

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

## Mounting position

The device must be installed vertically.

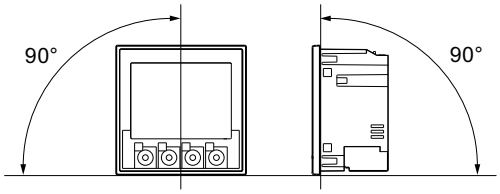



Figure 4-1 Mounting position

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

## Installation space and ventilation

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

Plan additional space for:

- Ventilation
- Wiring
- RS 485 terminal block and cable infeed on the top of the device

| CAUTION |
| --- |
| **Ensure ventilation**<br>Please ensure that the ventilation slots of the housing are not obstructed. The wiring, cable feed or other components must not obstruct ventilation. |

## Environmental conditions

Use the PAC3100 device only where environmental conditions permit its operation:

Table 4- 1 Environmental conditions

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

## Circuit breaker

A suitable circuit breaker must be connected upstream of PAC3100 in order to permit disconnection of the device from the power supply!

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

## Temperature compensation

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

## See also

Dimensional drawings (Page 129)

# Mounting

# 5

## 5.1 Unpacking

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

### Check the packaging

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

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

Please contact your Siemens sales partner in the following cases:

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

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

### Storage

Store the PAC3100 in dry conditions.

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

# 5.2 Mounting on the switching panel

## 5.2.1 Tools

You require the following tools for installation:

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

### Additional installation tools

- Cable clamp for strain relief on the RS 485 connection.

## 5.2.2 Mounting dimensions

### Mounting and clearance dimensions

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

### See also

Dimensional drawings (Page 129)

## 5.2.3 Installation steps

Proceed as follows to install the PAC3100 in the switching panel:

### Procedure

1. Cut a hole in the panel measuring $92.0^{+0.8}$ x $92.0^{+0.8}$ mm² (if not already available).
2. Discharge any static from your body. Observe the ESD guidelines in the Appendix.

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

3. Insert the device into the cutout from outside (Fig. "Installation cutout A").
4. Carry out all other installation steps from the inside of the switching panel.
5. Clamp the device to the switching panel with the two brackets provided (Fig. "Installation step B"). To do this, proceed as follows:
   - Hold the device firmly with one hand
   - Hang the brackets onto the left and right sides of the housing.
     To do so, insert the lugs of the bracket (2) into the slot on the housing (1).
   - Tighten the locking hook.
     To do so, place your index finger and middle finger on the support arms as shown in the Fig. "Installation step C" and engage the locking hook with your thumb.
     The engage mechanism of both brackets enables the installation engineer to secure the device in the switching panel quickly and without tools.
     To achieve degree of protection IP65, the four screws in the supports must be additionally tightened.
6. Tighten the 4 screws evenly in the two brackets; tightening torque 0.5 Nm (Fig. "Installation step D"). The front of the switching panel is fully sealed with the standard, integrally extruded seal.
7. When using the RS 485 interface:

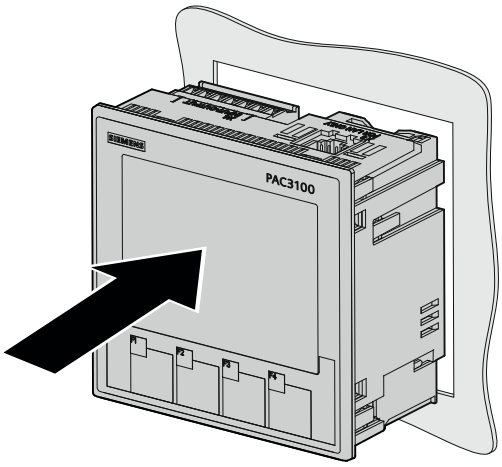
   Ensure strain relief for the connected RS 485 lines.

   Secure the RS 485 cable to the panel for this purpose. Fix the cable in position as shown in the Fig. "Installation step E" at location (3) using a self-adhesive cable clamp or other suitable small installation accessory.

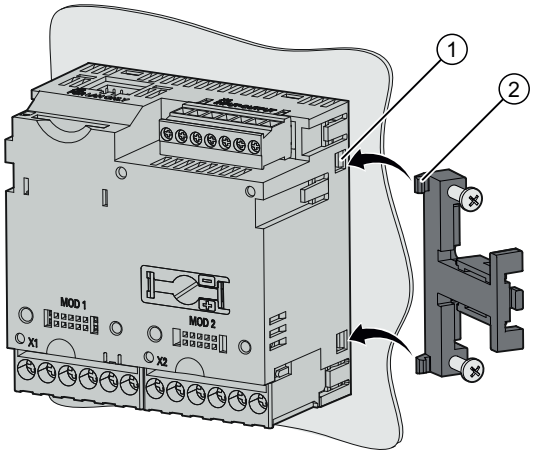
Installation is complete.

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

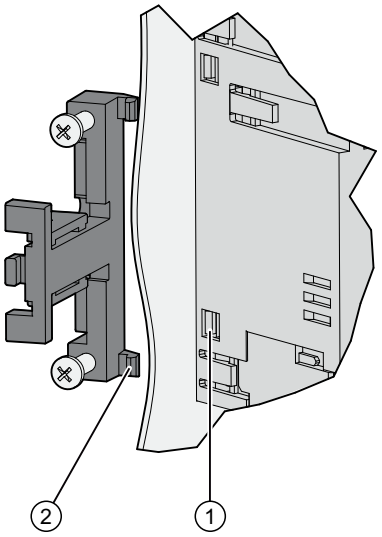
## Installation steps



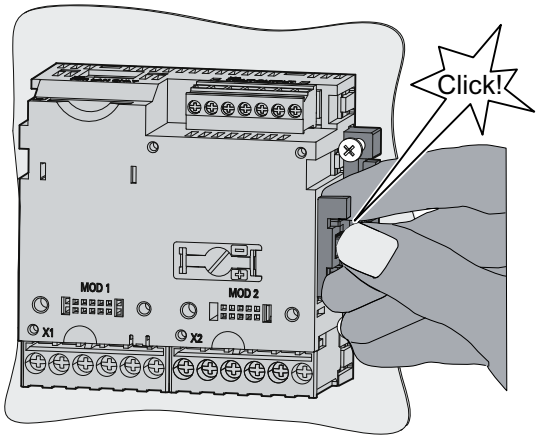

Installation step A



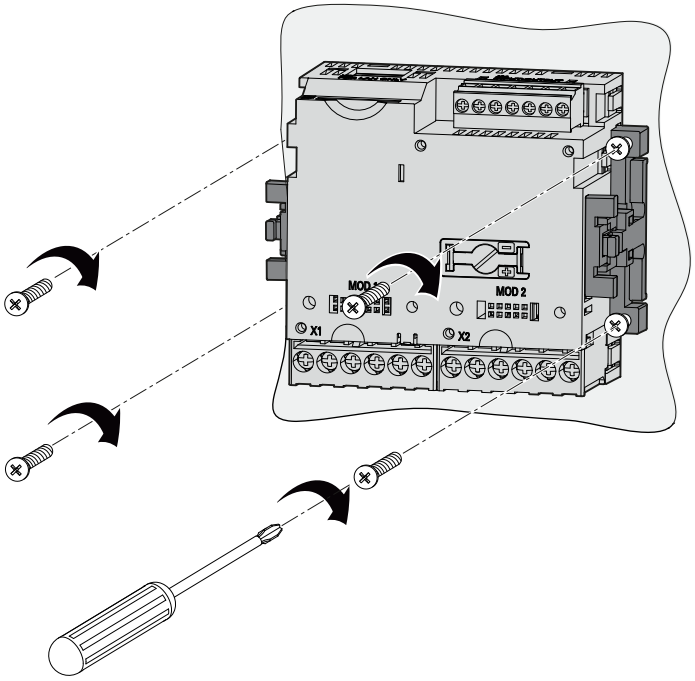

Installation step B



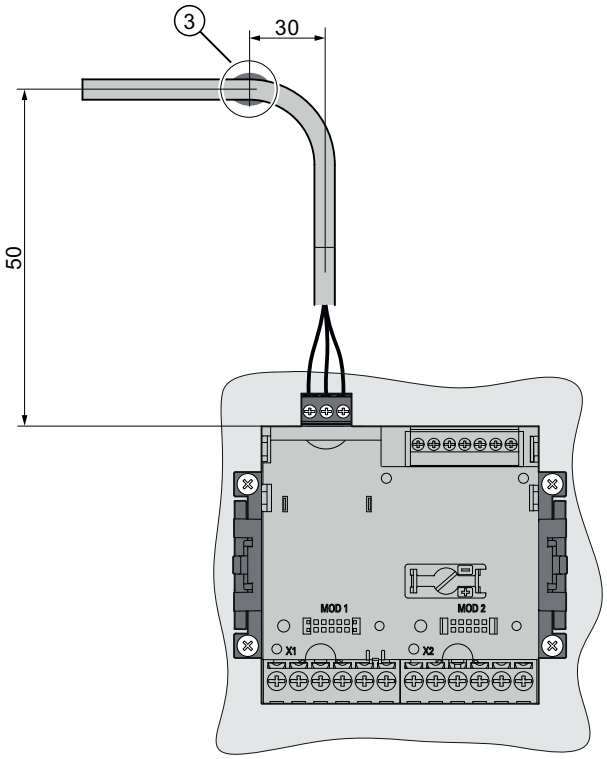

Installation step B, detail




Installation step C




Installation step D




Installation step E – Strain relief of the RS 485 connection

## See also

ESD guidelines (Page 161)

# 5.3 Deinstallation

## Tools

You require the following tools to deinstall the device:

- PH2 screwdriver
- Slotted screwdriver

## Deinstallation steps

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

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

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

Deinstallation is complete.

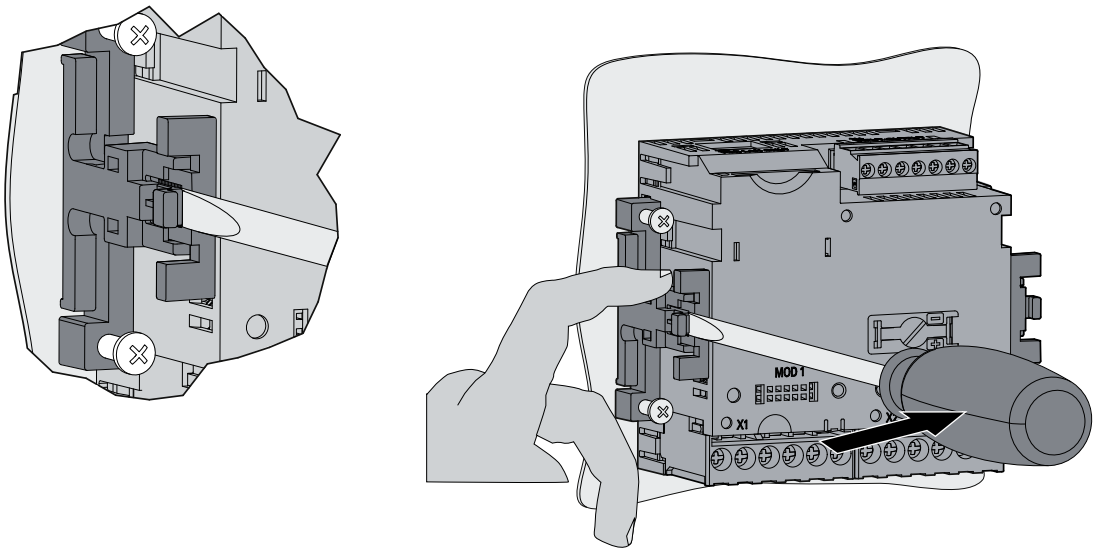



Figure 5-1 Deinstallation, releasing the locking hooks

## See also

ESD guidelines (Page 161)

# Connection

# 6

## 6.1 Safety notes

### Instructions

**DANGER**

**Hazardous Voltage**

**Will cause death, serious injury or property damage.**

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

**Note**

The following tasks are partly carried out when hazardous voltage is present. For this reason, they must only be carried out by qualified personnel who are familiar with and follow the safety regulations and cautionary measures.

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 at startup or when testing the device.

The secondary connections of intermediate current transducers must be short-circuited at the transducers before the current lines to the device are interrupted.

The polarity and phase assignment of the measuring transducer must be tested.

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

Check that all connections are correctly made before startup.

Ensure the polarity is correct when connecting a DC supply voltage.

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**

**Qualified Personnel**

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

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

**See also**

Safety notes (Page 9)

Applying the supply voltage (Page 54)

Applying the measuring voltage (Page 66)

Applying the measuring current (Page 67)

## 6.2 Connections

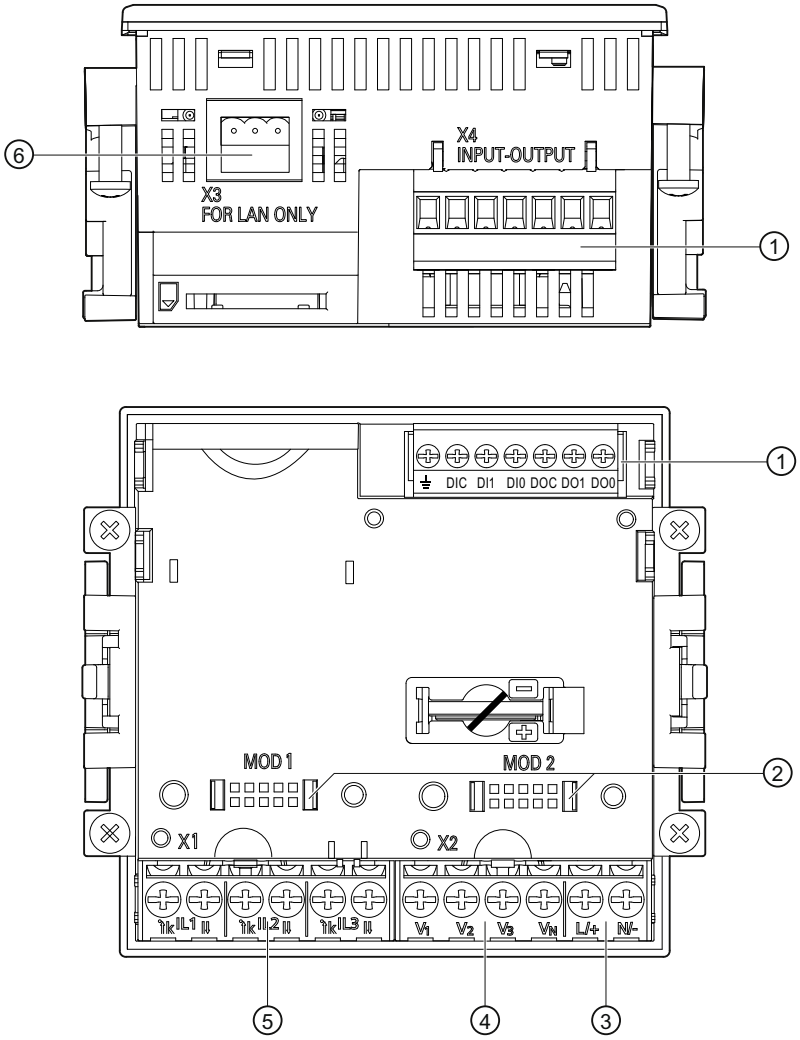
**⚠ DANGER**

**Hazardous Voltage**

**Will cause death, serious injury or considerable property damage.**

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

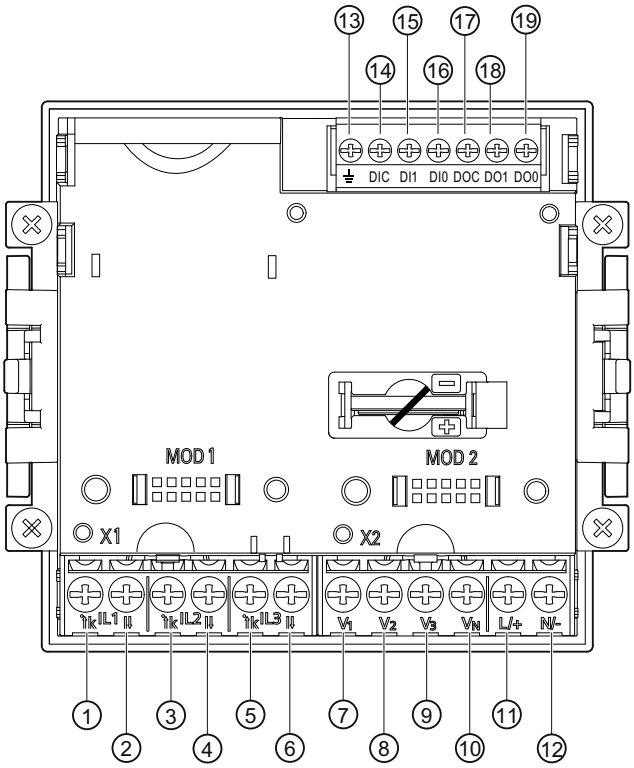
## Connection designations




(1) Digital inputs and outputs, functional ground
(2) Dummy connections. Cannot be used as slots!
(3) Supply voltage L/+, N/-
(4) Measuring inputs voltage $V_1$, V2, V3, VN
(5) Measuring inputs current IL1, IL2, IL3
(6) RS 485 connector

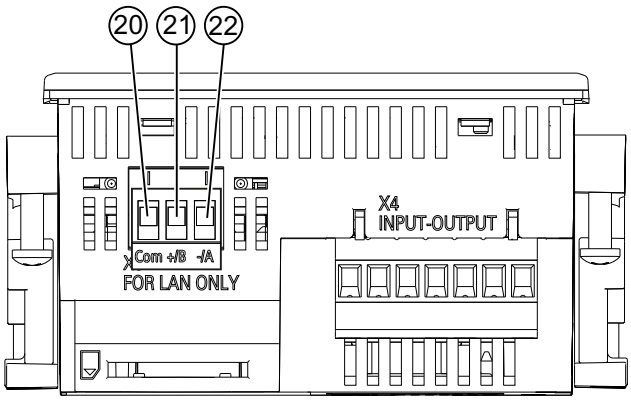
Figure 6-1 Connection designations, view of the rear and top of the device

## Terminal labeling




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

Figure 6-2 Terminal labeling



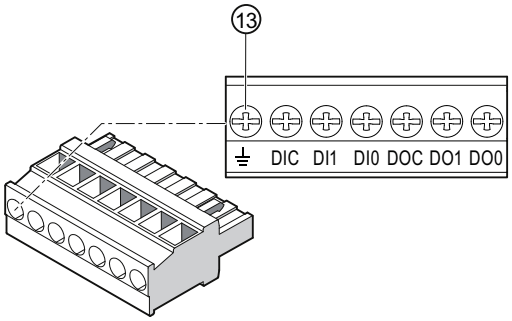

| No. | Terminal | Function |
|---|---|---|
| (20) | Com | Common = Ground |
| (21) | +/B | B signal; D1 |
| (22) | -/A | A signal; D0 |

Figure 6-3 Terminal labeling

## Grounding

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

## Functional ground




(13) Functional ground terminal

Figure 6-4 Terminal block with 2 digital inputs and outputs, functional ground

The connection ⏚ "functional ground" discharges interference affecting the digital inputs and outputs and the RS 485 interface.

Connect the functional ground to the equipotential bonding strip in the control cabinet.

The maximum cable length for connecting the functional ground is 3 meters.

### Supply voltage fuse protection

**⚠ CAUTION**

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

Damage to the device and the equipment may occur.

Always protect the device with an IEC approved or UL listed **CLASS CC 0.6 A** fuse.

If a fusible link is used, a suitable IEC approved or UL listed fuse holder has to be used. In addition, a suitable isolating device shall be connected upstream in order to permit disconnection of the device from the power supply.

### Protecting the current measuring inputs

**⚠ DANGER**

**Open transformer circuits will result in electric shock and arc flashover**

**Will cause death, serious injury or considerable property damage.**

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

### Protecting the voltage measuring inputs

**⚠ CAUTION**

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

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

Never short circuit the secondary connections of the voltage transformers.

# 6.3 Connecting the cables to the terminals

## Connecting cables to the screw terminal

**Tool:** PZ2 cal. screwdriver ISO 6789

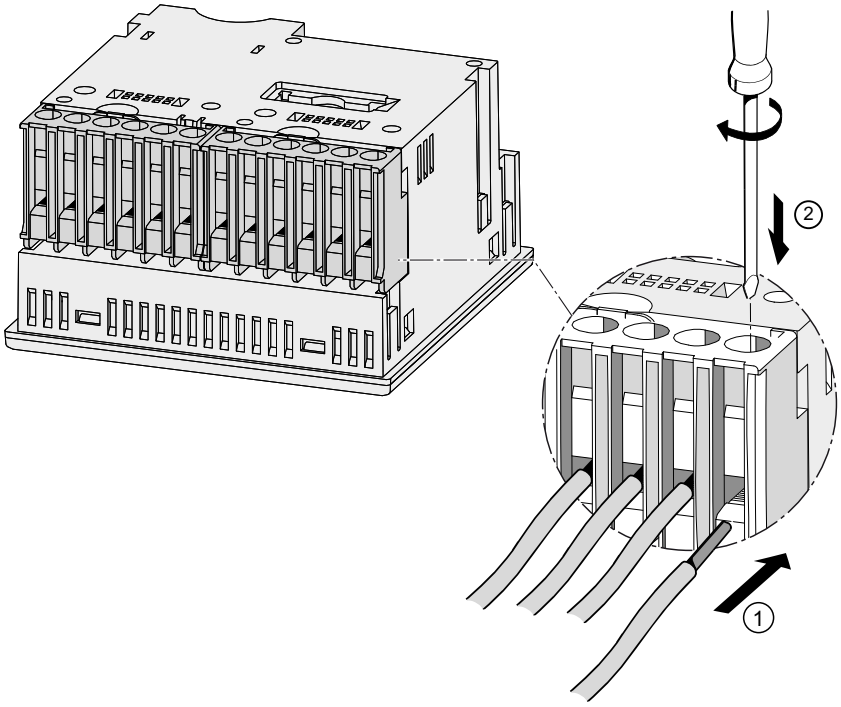



Figure 6-5 Connecting cables to the screw terminal

# 6.4 Connection examples

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

- Three-wire or four-wire systems
- with unbalanced load
- With/without voltage transformer
- with current transformer

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

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

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

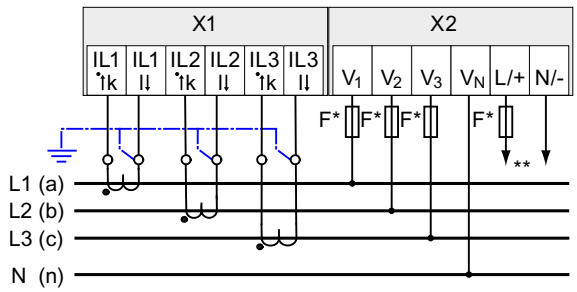
In the connection examples, the secondary side of the transformer is grounded at the "l" terminal. It can be grounded at either the "k" or the "l" terminal. The grounding has no impact on the measurement.

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

## Connection examples

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

Connection type 3P4W



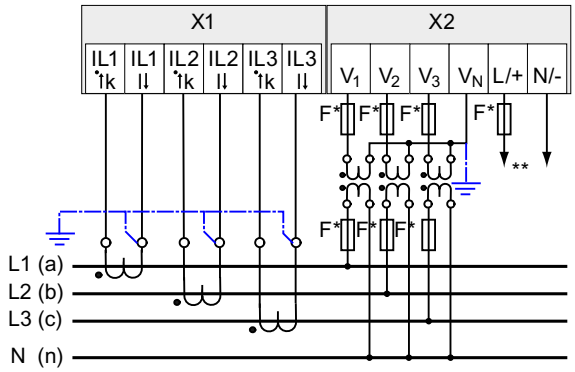

* Fuses must be provided by the customer.

** Connection of supply voltage

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

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

Connection type 3P4W



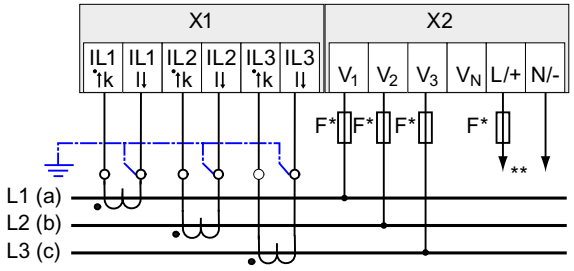

* Fuses must be provided by the customer.

** Connection of supply voltage

Figure 6-7 Connection type 3P4W, with voltage transformer, with three current transformers

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

Connection type 3P3W



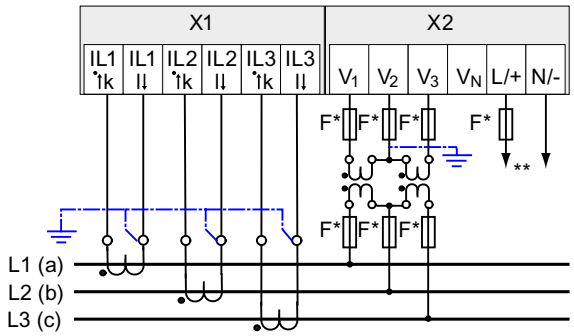

* Fuses must be provided by the customer.

** Connection of supply voltage

Figure 6-8 Connection type 3P3W, without voltage transformer, with three current transformers

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

Connection type 3P3W



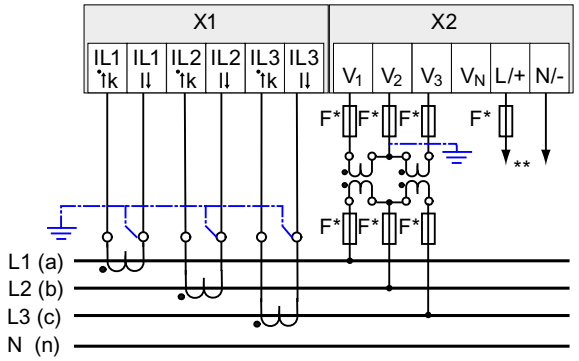

* Fuses must be provided by the customer.

** Connection of supply voltage

Figure 6-9 Connection type 3P3W, with voltage transformer, with three current transformers

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

Connection type 3P3W




* Fuses must be provided by the customer.

** Connection of supply voltage

Figure 6-10 Connection type 3P3W, with voltage transformer, with three current transformers

## See also

Measuring inputs (Page 13)

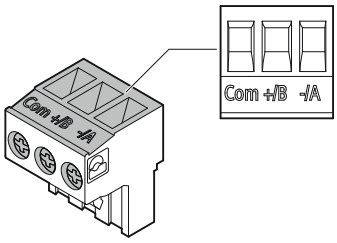
# 6.5 Connecting to the RS 485 bus

## Procedure

Connect the PAC3100 to the RS 485 bus via the integral interface. Please pay attention here to the general topology of the two-wire line.

1. Connect the RS 485 cables to the screw terminals of the terminal block.
2. Connect the cable shield at one end with protective ground PE.
3. Connect the signal Common with protective ground.
4. Ensure a bus terminating resistance is set at the first and last communication node.

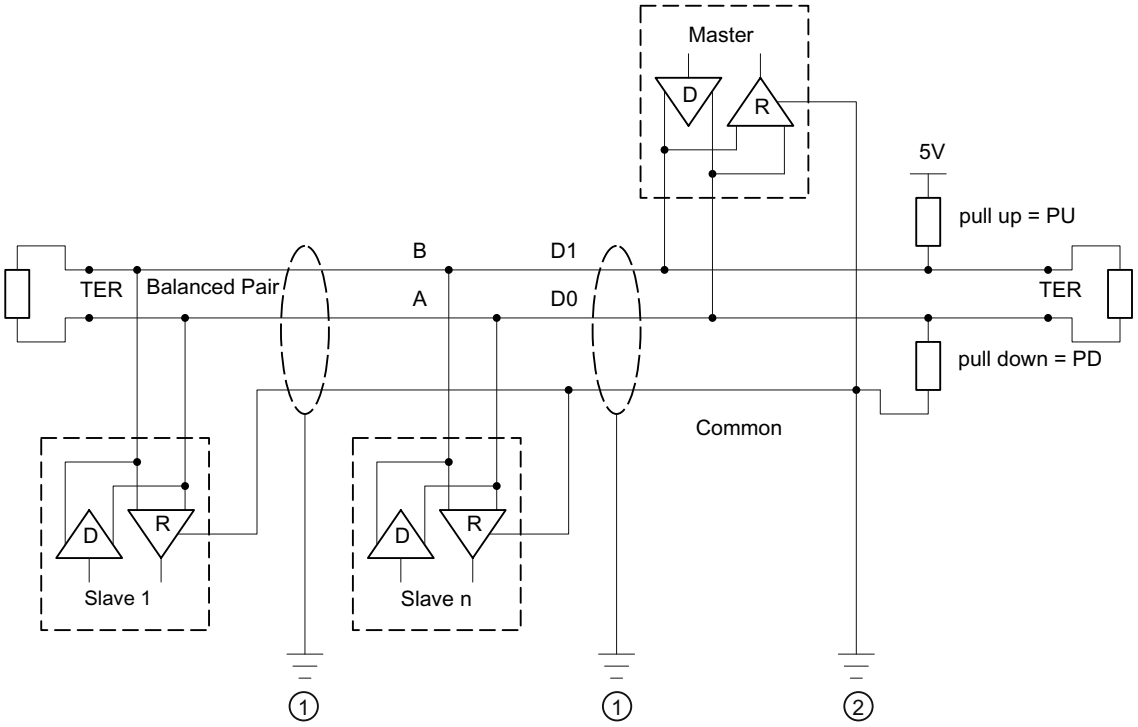
## RS 485 terminal block




| | |
|---|---|
| COM | Common = Ground |
| +/B | B signal; D1 |
| -/A | A signal; D0 |

Figure 6-11 RS 485 terminal block

## Block diagram




TER Bus termination resistor (termination)

PU Pull-up resistor

PD Pull-down resistor

(1) Grounding of the cable shielding

(2) Grounding of the common line, preferably only at one point for the whole bus

Figure 6-12 Block diagram: General RS 485 topology

## Grounding of the cable shielding

The serial Modbus data line must be shielded. The shielding must be connected to protective ground at one end of the cable. The shielding is grounded at one end only.

## Grounding of the common line

The common line must be applied direct to protective ground, preferably at only one point for the whole bus.

## Polarization

The PAC3100 does not support polarization of the RS 485 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 PAC3100 does not support bus termination. The bus can be terminated using an external resistor ≥ 60 Ω. The resistor must be connected to terminals -/A and -/B of the RS 485 terminal block.

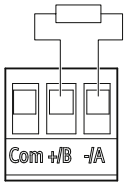



Figure 6-13 Bus termination using external resistor

# Commissioning

# 7

## 7.1 Overview

### Prerequisites

1. The device has been installed.
2. The device has been connected in accordance with the possible connection methods.

The device must be connected to the bus for communication via the RS 485 interface.

### Steps for starting up the device

1. Apply the supply voltage
2. Parameterize the device
3. Apply the measuring voltage
4. Apply the measuring current
5. Check the displayed measured values

| NOTICE |
| --- |
| **Check the connections**<br>Incorrect connection can result in malfunctions and failure of the device.<br>Before starting up the PAC3100, check that all connections are correct. |

**Note**

The insulation strength of the PAC3100 has been surge tested in accordance with IEC 61010-1.

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

## 7.2 Applying the supply voltage

A supply voltage is required to operate the device. Please consult the technical data or the type plate for the type and level of the possible supply voltage.

**⚠ WARNING**

**Do not apply voltage in excess of the rated voltage limit**

**Failure to do so may result in death, serious injury, or property damage**

The limits given in the technical data and on the type plate must not be exceeded even at startup or when testing the device.

### Supply voltage fuse protection

**⚠ CAUTION**

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

Always protect the device with an IEC approved or UL listed **CLASS CC 0.6 A** fuse.

If a fusible link is used, a suitable IEC approved or UL listed fuse holder has to be used. In addition, a suitable isolating device shall be connected upstream in order to permit disconnection of the device from the power supply.

Do not use voltage transformers as a power supply.

### Procedure

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

Table 7- 1 Connection of supply voltage

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

### See also

Safety notes (Page 9)

Safety notes (Page 39)

Applying the measuring voltage (Page 66)

Technical data (Page 117)

# 7.3 Parameterizing the device

## Procedure

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

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

When using the RS 485 interface:

- Communication settings

The following settings are also useful:

- Language
- Phase labels
- Password protection

## See also

Password management (Page 108)

## 7.3.1 Setting the language

First, set the language in which the display text is to appear.

The available languages are displayed:

- at initial startup,
- after resetting to factory settings

English is the default language.


Figure 7-1 Language setting

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

Apply the desired language with <F4> OK.

## Changing the language

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

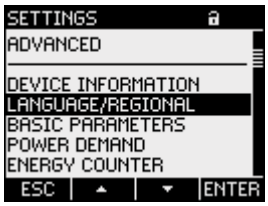



Figure 7-2 "SETTINGS" menu

5. Call the "LANGUAGE/REGIONAL" entry:
   <F4> ENTER
   The display shows the currently valid settings.
6. Open edit mode of the "LANGUAGE" device setting:
   <F4> EDIT


Figure 7-3 "LANGUAGE" edit mode

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

## 7.3.2 Voltage input

### 7.3.2.1 Setting the connection type

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

**Note**

**Connection type**

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

Table 7- 2 Available connection types

| Short code | Connection type |
|---|---|
| 3P4W | 3 phases, 4 conductors, unbalanced load |
| 3P3W | 3 phases, 3 conductors, unbalanced load |

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

## Procedure

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

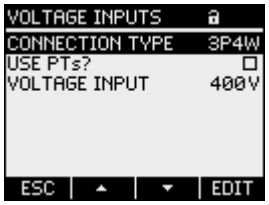



Figure 7-4 "CONNECTION TYPE" device setting

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

## See also

Measuring inputs (Page 13)

### 7.3.2.2 Measurement using voltage transformers

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

## Procedure

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

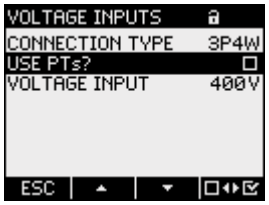



Figure 7-5 "USE PTs?" device setting

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

### 7.3.2.3 Setting the conversion ratio of the voltage transformer

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

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

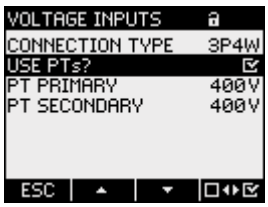



Figure 7-6 "USE PTs?" device setting switched on

## Procedure

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

## Example:

You want to measure using voltage transformers for 1000 V/100 V on a 690 V system. For this purpose, enter:

1. USE PTs?: ☑ On:
2. PT PRIMARY: 690 V
3. PT SECONDARY: 69 V

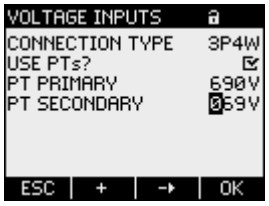



Figure 7-7 "VOLTAGE INPUTS" device setting

## See also

Measurement using voltage transformers (Page 60)

### 7.3.2.4 Setting the voltage input

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

## Procedure

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

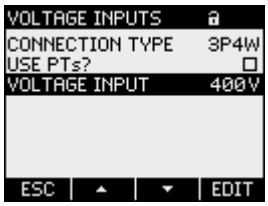



Figure 7-8 "VOLTAGE INPUTS" device setting

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

## 7.3.3 Current input

### 7.3.3.1 Setting the conversion ratio of the current transformer

The conversion ratio must be set before initial startup.

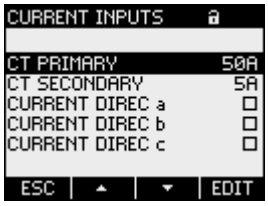



Figure 7-9 "CURRENT INPUTS" device setting

**Procedure**

1. In the "SETTINGS" menu, call the "BASIC PARAMETERS" entry.
2. In the "BASIC PARAMETERS" menu, open the "CURRENT INPUTS" entry:
   <F4> ENTER
   The display shows the currently valid settings.
3. Open edit mode of the "CT PRIMARY" device setting:
   <F4> EDIT
4. Set the desired value of the primary current:
   <F2> + and <F3> →
5. Accept the value with:
   <F4> OK
   The value of the primary current is permanently saved and becomes effective immediately.
   The display returns to display mode.
6. The value "CT SECONDARY" is fixed at 5 A and is skipped with the key F3 ▼.
7. Specify the direction of current flow for the individual phases a, b and c:
   Key <F2> ▲ or key <F3> ▼
   With inverse connection, the measured values are inverted and receive a negative sign. Reconnection of the terminals is not necessary. Invert only the direction of current flow of the relevant phase.
   On/off switch: ☑ ON/☐ OFF
   The setting is saved permanently and is immediately effective.
8. Return to one of the selection menus or to the measured values display:
   <F1> ESC

### Example

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

For this purpose, enter:

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

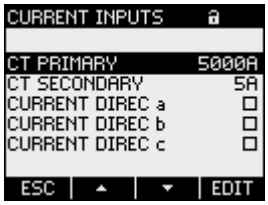



Figure 7-10 Device setting "CURRENT INPUTS - CT PRIMARY?"

## 7.3.4 RS 485 interface

The Modbus communication parameters have to be set on the device for initial startup of the integral RS 485 interface.

### Procedure

1. In the "SETTINGS" menu, call the "COMMUNICATION" entry:
   <F4> ENTER
   The display shows the currently valid settings.
2. Go to the communication settings that you want to change:
   <F2> ▲ or <F3> ▼
3. Open edit mode of the communication setting:
   <F4> EDIT
4. Set the desired value:
   <F2> + and <F3> -
5. Accept the value with:
   <F4> OK
   The value is permanently saved and becomes effective immediately. The display returns to display mode.
6. Change other settings.
7. Return to one of the selection menus or to the measured values display:
   <F1> ESC

## 7.4 Applying the measuring voltage

The PAC3100 is designed for measuring in systems with rated AC voltages to

- 277 V phase-to-neutral and
- 480 V phase-to-phase.

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

### See also

Measuring inputs (Page 13)
Safety notes (Page 9)
Safety notes (Page 39)
Applying the supply voltage (Page 54)

## 7.5 Applying the measuring current

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

The current measuring inputs can each be loaded with 10 A (max. 300 V) continuously or with 100 A for 1 second.

**⚠ DANGER**

**Open transformer circuits will result in electric shock and arc flashover**

**Will cause death, serious injury or considerable property damage.**

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

**CAUTION**

**Do not measure direct currents**

Direct currents cannot be measured with the device.

### Direction of current flow

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

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

You can find more information in the chapter "Basic parameters", "CURRENT DIREC" fields.

### See also

Measuring inputs (Page 13)

Safety notes (Page 9)

Safety notes (Page 39)

Basic parameters (Page 96)

# 7.6 Checking the displayed measured values

## Correct connection type

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

## See also

Measuring inputs (Page 13)

# Operator control

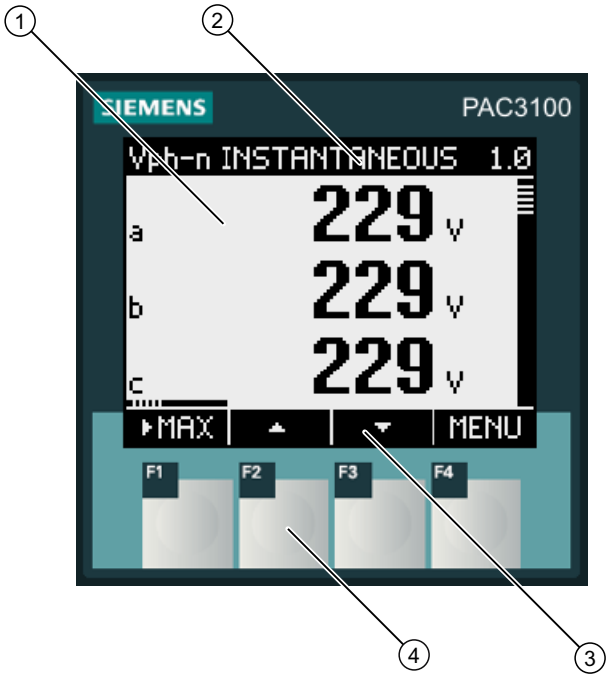
# 8

## 8.1 Device interface

### 8.1.1 Displays and operator controls

#### Displays and operator controls

The front of the PAC3100 contains the following displays and operator elements.




(1) Display of the measured values, device settings, selection menus
(2) Display title
(3) Labeling of the function keys
(4) Surfaces of the function keys

Figure 8-1 Device interface

**Display: Display - Display title - Key labeling**

The display is structured as follows:

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

**Function keys: Key labeling - Key surfaces**

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

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

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

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

## Organization of information

The display organizes the viewable information as follows:

**Measured variables**

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

**Menus**

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

**Device settings**

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

## Navigation through the views

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

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

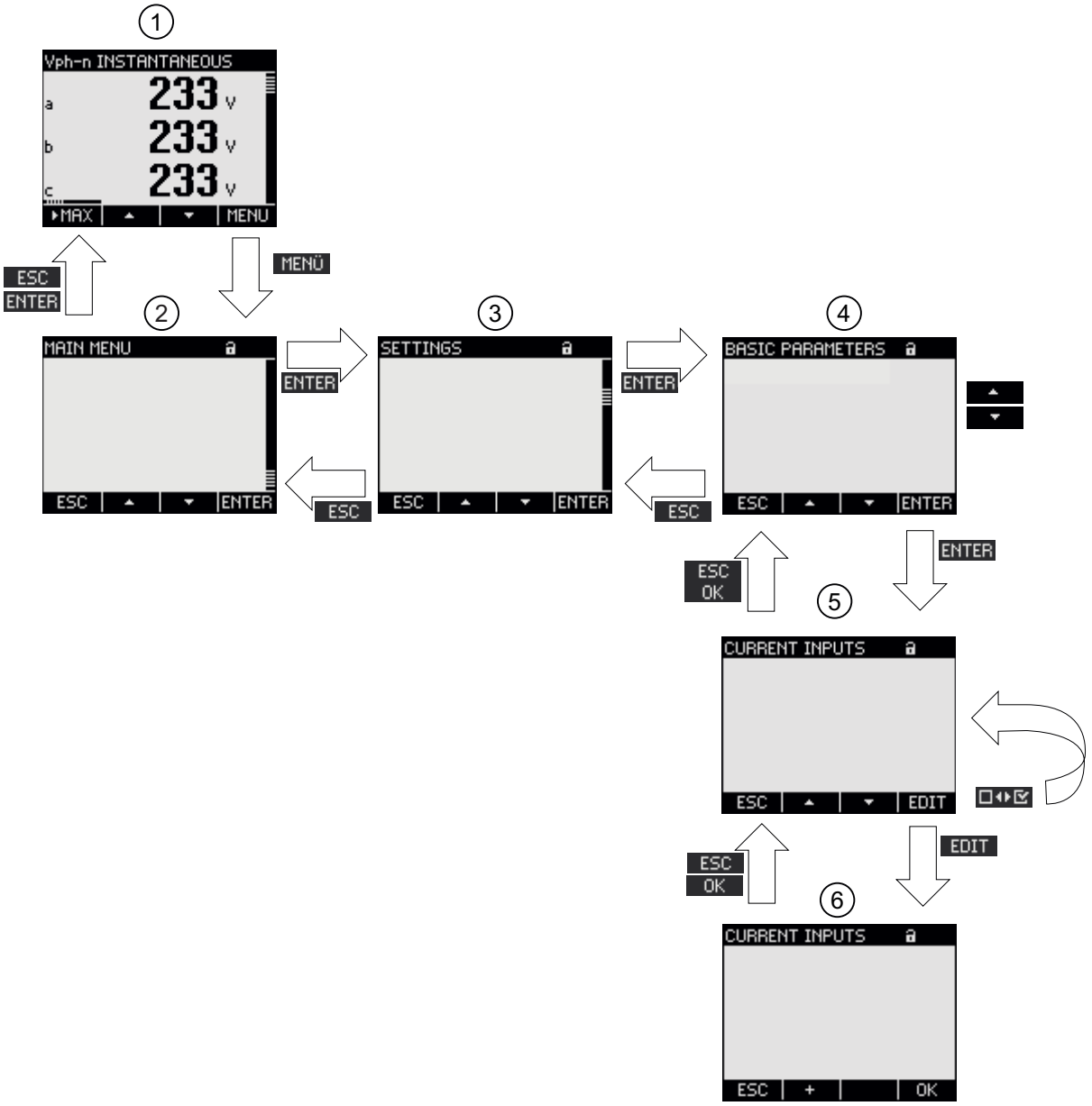
The figure below shows the navigation paths. The display of the measured variables is the starting point and end point of the navigation. Repeated pressing of F1 returns you to the display of the measured variables.

Please note that additional functions are assigned to F4.

F4 OK: Permanently saves the last set value and returns from edit mode to display mode.

If no editing is intended, the key closes the display and returns to the menu selection.

F4 ☐◂▸☑: Is an ON/OFF switch.




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

Figure 8-2 Information structure and navigation

## Special display elements

### Device protection symbol

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

Device is protected.

Device is not protected.

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

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

---

**Note**

**Device protection symbol**

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

---

### Display number

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

---

**Note**

**Support requests**

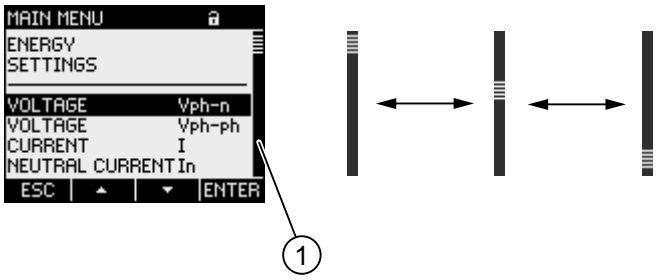
If you need to submit a support request, provide the display number if you are referring to a specific display.

---

### Scroll bar

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

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




(1) Scroll bar of the menu list

Figure 8-3 Scroll bar of the menu list

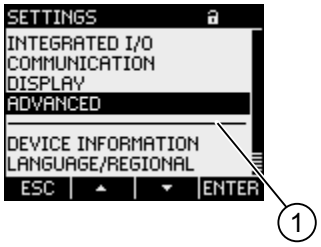
### Selection bar

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

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

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

### Start of the list/end of the list




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

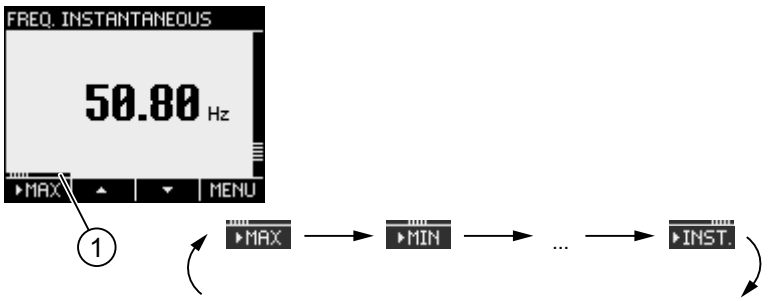
Figure 8-4 Start of the list/end of the list

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

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

### Scroll bar of function key F1

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



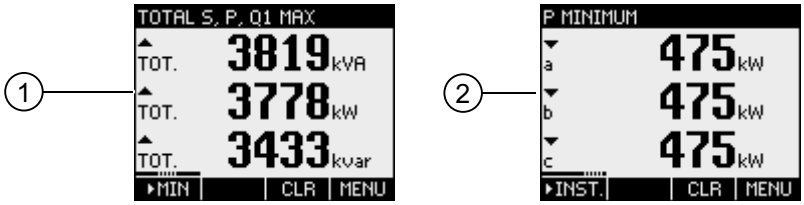

(1) Scroll bar of function key F1

Figure 8-5 Scroll bar

### Maximum/minimum value symbol

When displaying the maximum and minimum values, the measured variable designation is assigned a symbol to indicate the maximum or minimum value:

- ▲ Maximum
- ▼ Minimum




(1) Maximum symbol

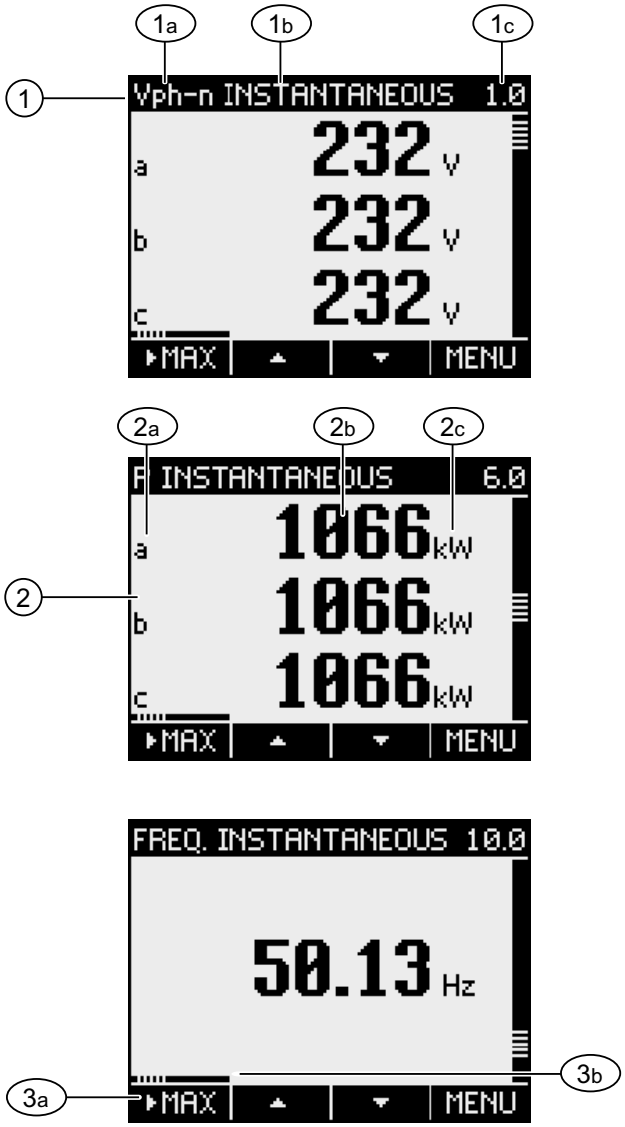
(2) Minimum symbol

Figure 8-6 Maximum/minimum symbols

## See also

Latest information (Page 8)

## 8.1.2 Display of the measured variables




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

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

(3) Function keys
- a) Key labeling
- b) Scroll bar of function key F1

Figure 8-7 Display of the measured variables

## Display title

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

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

## Designation of the measured variable

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

For an overview, see the Appendix.

## Designation of the measured value property

The second position in the display title contains the currently displayed measured value property.

For an overview, see the Appendix.

## Function keys

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

| Key function | F1 | F2 | F3 | F4 |
|---|---|---|---|---|
| Display the instantaneous value | ▸INST. | | | |
| Display the maximum value | ▸MAX | | | |
| Display the minimum value | ▸MIN | | | |
| Reset the maximum or minimum value to the instantaneous value | | | CLR | |
| Scroll up in the selection list | | ▲ | | |
| Scroll down in the selection list | | | ▼ | |
| Go to the menu selection | | | | MENU |

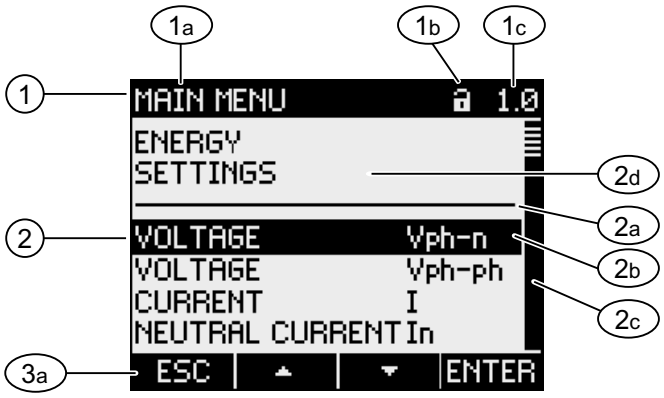
## See also

Operator input steps in the measured variable display (Page 84)

Measured variables (Page 133)

## 8.1.3 Display of the "MAIN MENU"

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




(1) Display title
- a) "MAIN MENU"
- b) Device protection symbol
- c) Display number

(2) List of viewable measured variables
- a) Line separating the start and end of the list
- b) Selection bar
- c) Scroll bar
- d) Changing to the menu for parameterizing the device

(3) Function keys
- a) Key labeling

Figure 8-8 Display of main menu

### Display title

The display title "MAIN MENU" remains.

### Display number of the measured variable

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

### List of viewable measured variables

The menu list shows the choice of viewable measured variables.

### Selection bar

The selection bar highlights the currently selected measured variable.

## Changing to the menu for parameterizing the device

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

## Function keys

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

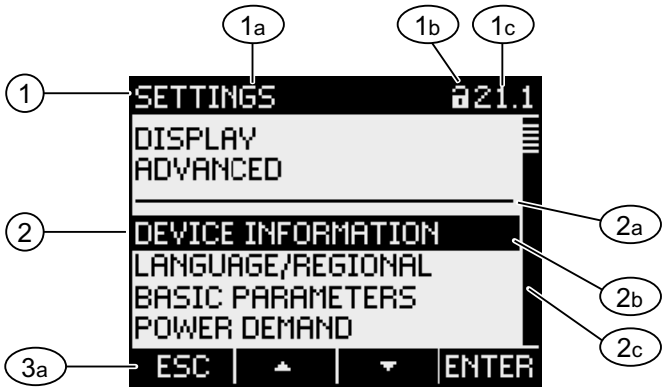
| Key function | F1 | F2 | F3 | F4 |
|---|---|---|---|---|
| Reject the menu selection and return to the last displayed measured variable | ESC | | | |
| Scroll up in the selection list | | ▲ | | |
| Scroll down in the selection list | | | ▼ | |
| Display the selected measured variable | | | | ENTER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

## See also

Operator input steps in the "MAIN MENU" (Page 85)

## 8.1.4 Display of the "SETTINGS" menu

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




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

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

(3) Function keys
- a) Key labeling

Figure 8-9 Display of the "SETTINGS" menu

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

### Function keys

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

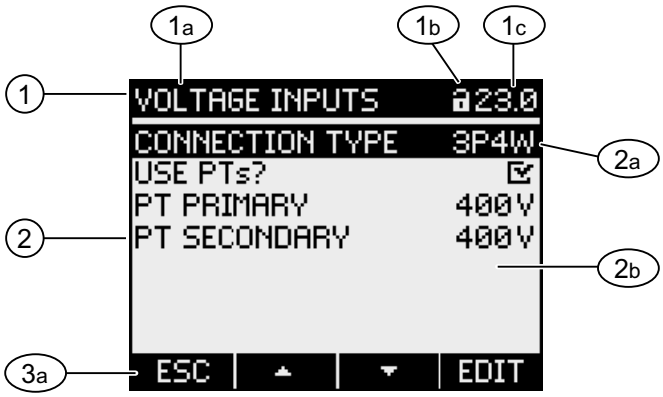
| Key function | F1 | F2 | F3 | F4 |
|---|---|---|---|---|
| Reject the menu selection and return to the "MAIN MENU" | ESC | | | |
| Scroll up in the selection list | | ▲ | | |
| Scroll down in the selection list | | | ▼ | |
| Display the selected device setting | | | | ENTER |

### See also

Operator input steps in the "SETTINGS" menu (Page 87)

## 8.1.5 Display of the device settings

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




(1) Display title
- a) Designation of the selected group of device settings
- b) Device protection symbol
- c) Display number of the device setting

(2) List of device settings
- a) Selection bar
- b) Current setting

(3) Function keys
- a) Key labeling

Figure 8-10 Display of the device settings

### Display title

Specifies which group of device settings is currently selected.

## Function keys

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

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

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

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

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

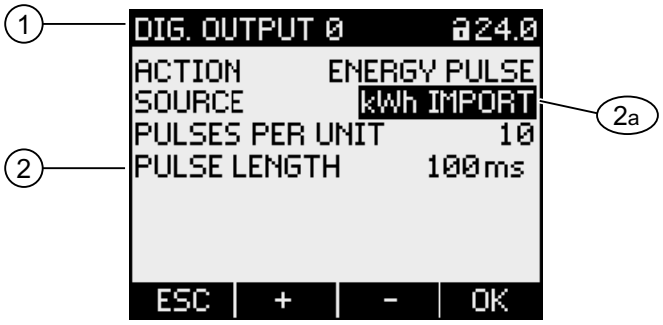
## See also

Edit mode of the device settings (Page 83)
Operator input steps in device settings display (Page 88)

## 8.1.6 Edit mode of the device settings

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

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




(1) Group title

(2) List of device settings

a) Device setting in edit mode

Figure 8-11 Edit mode of the device settings

**Note**

**Edit functions in display mode**

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

### Function keys

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

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

### See also

Display of the device settings (Page 81)

Operator input steps in device settings display (Page 88)

# 8.2 Steps

## 8.2.1 Operator input steps in the measured variable display

### Selecting the measured variable

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

F2 ▲ switches to the previous measured variable.

F3 ▼ switches to the next measured variable.

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

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

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

### Display minimum, maximum, and instantaneous value

F1 switches the display on.

F1 ▸MAX: Display of the maximum value

F1 ▸MIN: Display of the minimum value

F1 ▸INST: Display of the instantaneous value

### Reset the maximum or minimum value to the instantaneous value

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

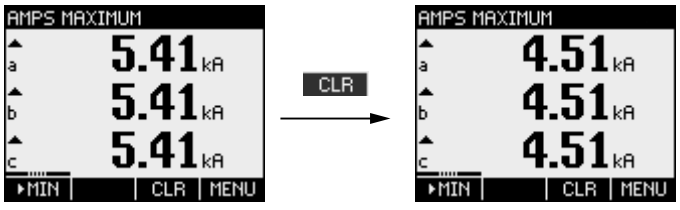



Figure 8-12 Reset the maximum or minimum value to the instantaneous value

### Calling the "MAIN MENU"

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

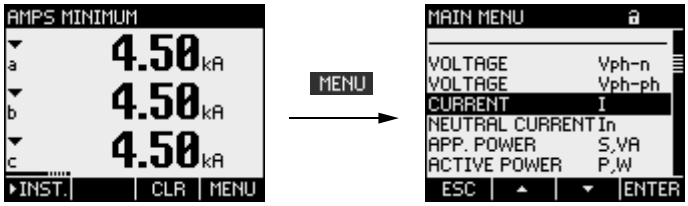



Figure 8-13 Calling the "MAIN MENU"

### See also

Operator input steps in the "MAIN MENU" (Page 85)

## 8.2.2 Operator input steps in the "MAIN MENU"

### Selecting the measured variable

The selection bar highlights the currently selected menu entry (white text on a black background).

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

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

**Note**

**Selecting the measured variable**

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

### Displaying the measured variable

The selection bar highlights the currently selected menu entry (white text on a black background).

F4 ENTER calls the display of the selected measured variable.

## Cancel menu selection

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

**Note**

**Cancel menu selection**

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

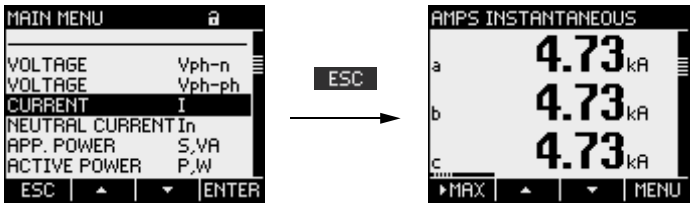



Figure 8-14 Cancel menu selection

## Calling the "SETTINGS" menu

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

## See also

Operator input steps in the measured variable display (Page 84)

## 8.2.3 Operator input steps in the "SETTINGS" menu

### Selecting settings

The selection bar highlights the currently selected menu entry (white text on a black background).

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

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

### Displaying a setting

The selection bar highlights the currently selected menu entry (white text on a black background).

F4 ENTER calls the display of the selected device setting.

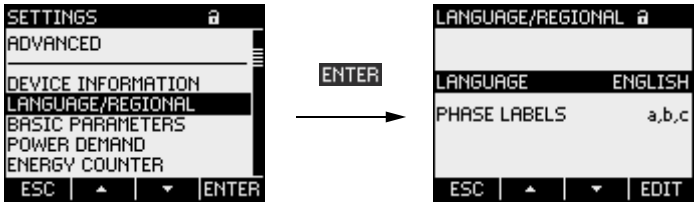



Figure 8-15 Displaying settings

### Cancel menu selection

F1 ESC returns to the main menu.

## 8.2.4 Operator input steps in device settings display

### Calling edit mode

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

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

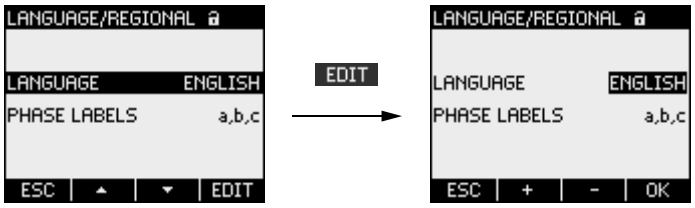



Figure 8-16 Calling edit mode

### Exiting the display

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

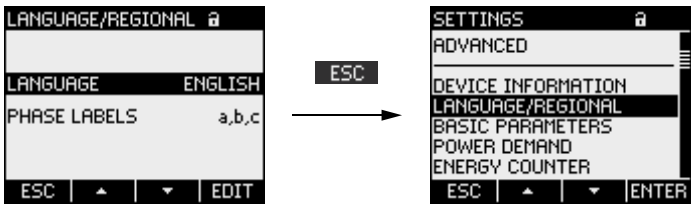



Figure 8-17 Exiting the display

## 8.2.5 Operator input steps in edit mode of the device settings

### Enter password

If device protection is switched on, the PAC3100 demands input of the valid password.


Figure 8-18 Enter password

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

### Change value

#### Switching a device setting ON/OFF

F4 ☐◐☑ switches a function or status ON/OFF. The setting takes effect immediately. Saving with F4 OK no longer applies.

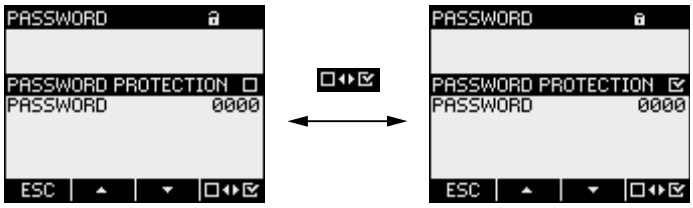



Figure 8-19 Switching a device setting ON/OFF

#### Switching between several options

F4 ☐◐☑ switches between options that cannot be in effect at the same time. When an option is switched on, the last valid option is switched off.

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

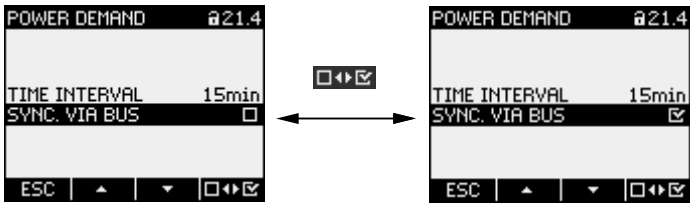



Figure 8-20 Switching the device setting

### Selecting from several settings

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

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

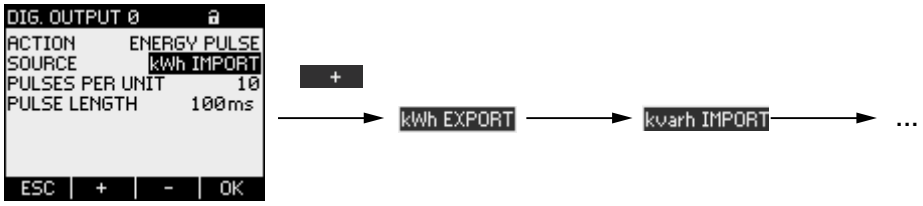



Figure 8-21 Selecting from several settings

### Incrementing or decrementing a value

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

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

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

### Defining multi-digit values

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

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

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

## Saving the value

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

## Canceling editing

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

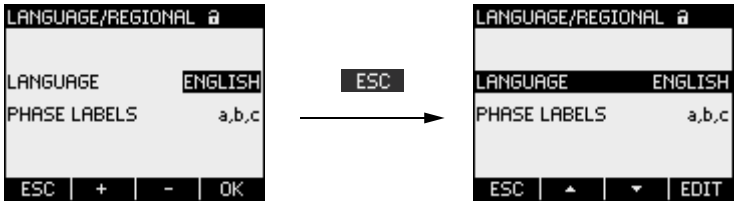



Figure 8-22 Exiting edit mode

## See also

Password management (Page 108)

# Parameterizing

# 9

## 9.1 Introduction

### Device settings

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

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

It is possible to set the device by means of:

- The operator interface of the device
- Configuration software
- RS 485 interface

**Note**

**Protection of the device settings**

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

# 9.2 Parameterizing the operator interface

## 9.2.1 Groups of settings

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

- Device information
  Device-specific numbers and versions.
- Language/Regional
  Display language and designation of the phases on the display.
- Basic parameters
  Settings for measuring inputs for voltage and current.
- Power demand
  Setting of the period duration and synchronization.
- Energy counter
  Settings for active energy and reactive energy.
- Integral I/O
  Settings for using the digital outputs.
- Communication
  Settings for Modbus RTU communication.
- Display
  Settings for the display.
- Advanced
  Password protection, resetting the device.

## 9.2.2 Device information

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

Call: "SETTINGS > DEVICE INFORMATION"


Figure 9-1 Device setting "DEVICE INFORMATION"

### Device information

| | |
|---|---|
| PAC3100 V1.00 | Device designation and version |
| 7KM31 . . - . . . . . - . . . . | Order number of the device. |
| S/N: | Serial number of the device. |
| D/T: | Date code. |
| ES: | Hardware revision level. |
| SW-REV: | Firmware revision level. |
| BL-REV: | Boot loader revision level. |
| LP-REV: | Language pack revision level. |

## 9.2.3 Language and regional settings

Display language and designation of the phases on the display.

Call: "SETTINGS > LANGUAGE/REGIONAL"


Figure 9-2 "LANGUAGE SETTING" device setting

### Language and regional settings

LANGUAGE — Language of the display.

- Range: German, English, Portuguese, Turkish, Spanish, Italian, French, Chinese, Russian[1)], Polish[1)]
  - [1)] in a separate language pack, installable with the powerconfig configuration software Version V2.1 and higher
- Default value: English

PHASE LABELS — Designation of the phases on the display.

- Range:
  - L1 L2 L3,
  - a b c
- Default value:
  - L1 L2 L3

## 9.2.4 Basic parameters

Basic parameters are all those settings concerning the measuring inputs.

Call: "SETTINGS > BASIC PARAMETERS"

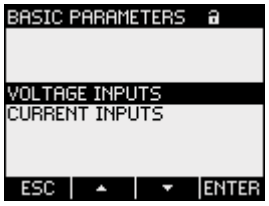



Figure 9-3 "BASIC PARAMETERS" device setting

## VOLTAGE INPUTS

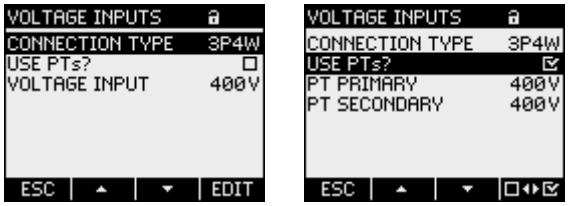



Figure 9-4 "VOLTAGE INPUTS" device setting

CONNECTION TYPE — Connection types:

- 3P4W: 3 phases, 4 conductors, unbalanced load
- 3P3W: 3 phases, 3 conductors, unbalanced load

Default value: 3P4W

Use PTs? — Measurement with/without voltage transformer

ON/OFF switch: ☑ ON / ☐ OFF.

☑ ON: Measurement using voltage transformers.

When measuring via voltage transformer, the device must know the voltage conversion ratio. For this purpose, the primary and secondary voltages must be specified in the fields "PT PRIMARY" and "PT SECONDARY".

When changing from direct measurement to measurement using voltage transformers, the device accepts the last set reference measuring voltage as the secondary voltage and as the primary voltage.

☐ OFF: Measurement direct on the low-voltage system.

When changing from measurement using voltage transformers to direct measurement, the device accepts the last set secondary voltage as the reference measuring voltage.

Default value: ☐ Off

VOLTAGE INPUT — Rated voltage of the measuring system. Must be specified if measuring is done direct on the system without voltage transformers.

Range: 1 V to 480 V, freely adjustable
Default value: 400 V

The property "VOLTAGE INPUT" is only visible, if "USE PTs?" is set to "☐ Off".

| | |
|---|---|
| PT PRIMARY | Primary voltage. Must be specified if a voltage transformer is used for measuring.<br>Range: 1 V to 999999 V, freely adjustable<br>Default value: 400 V<br>The property "PT PRIMARY" is only visible, if<br>"USE PTs?" is set to "☑ On". |
| PT SECONDARY | Secondary voltage. Must be specified if a voltage transformer is used for measuring.<br>Range: 1 V to 480 V, freely adjustable<br>Default value: 400 V<br>The property "PT SECONDARY" is only visible, if<br>"USE PTs?" is set to "☑ ON". |

## CURRENT INPUT

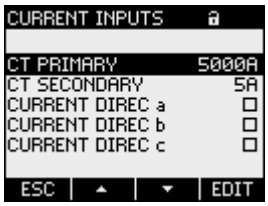



Figure 9-5 "CURRENT INPUTS" device setting

| CAUTION |
| --- |
| **Please note current carrying capacity** |
| Overload can destroy the PAC3100. |

The device must know the current conversion ratio. The primary current must be set in the "CT PRIMARY" field for this purpose. The secondary current is fixed. The "CT SECONDARY" field is a display field.

CT PRIMARY — Primary current of the current transformers.

Range: 1 A to 99999 A, freely adjustable.

Default value: 50 A

CT SECONDARY — Secondary current of the current transformers.

Range: 5 A

Cannot be changed.

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

ON/OFF switch: ☑ ON / ☐ OFF.

☐ OFF: PAC3100 interprets the direction of current flow in accordance with the wiring.

☑ On: Direction of current flow is inverted.
PAC3100 interprets the direction of current flow opposite to the wiring.

Default value: ☐ OFF

### See also

Voltage input (Page 58)

Current input (Page 64)

## 9.2.5 Power demand

Device settings for acquiring the power demand.

Call: "SETTINGS > POWER DEMAND."

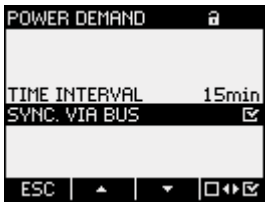



Figure 9-6 "POWER DEMAND" device setting

### Power demand

| | |
|---|---|
| TIME INTERVAL | Time interval in minutes<br>Range: 1 to 60 min.<br>Default value: 15 min. |
| SYNC. VIA BUS | Synchronization via bus<br>ON/OFF switch: ☑ ON / ☐ OFF.<br>Default value: ☑ OFF. |

### See also

Acquisition of power demand (Page 19)

## 9.2.6 Energy counters

Device settings for energy counting.

Call: "SETTINGS > ENERGY COUNTERS"

### Energy counters

ACTIVE ENERGY — Counter for active energy

Range:

- BALANCE — Balance of imported and exported active energy.
- IMPORT — Imported active energy.
- EXPORT — Exported active energy.

Default value: BALANCE

REACTIVE ENERGY — Counter for reactive energy

Range:

- BALANCE — Balance of imported and exported reactive energy.
- IMPORT — Imported reactive energy.
- EXPORT — Exported reactive energy.

Default value: BALANCE

### See also

Energy counters (Page 20)

## 9.2.7 Integrated I/Os

Device settings for using the digital inputs and outputs.

Call: "SETTINGS > INTEGRATED I/O".

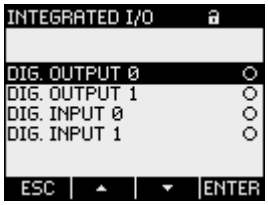



Figure 9-7 "INTEGRATED I/O" device setting

## "DIG. OUTPUT 0"

Digital output DO0 (terminal labeling).

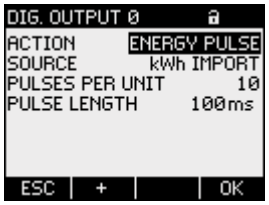



Figure 9-8 Device setting "DIG. OUTPUT 0"

ACTION — Method of using the digital output:

- OFF — The digital output is switched off.
- REMOTE OUTPUT — The digital output is controlled via the RS 485 interface.
- ENERGY PULSE — The digital output outputs the parameterized number of pulses per energy unit. For this purpose, the energy counter specified in the "SOURCE" field and the "PULSES PER UNIT" field are evaluated.
- Default value: OFF.

SOURCE — The field is available with the action "ENERGY PULSE".

The field selects the type of cumulated power: Active energy or reactive energy, import or export of energy.

Range:

- kWh IMPORT
- kWh EXPORT
- kVARh IMPORT
- kVARh EXPORT

Default value: kWh IMPORT

The subdivision of the import value is defined in the field "PULSES PER UNIT".

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

Number of pulses per unit. The unit is defined in the "SOURCE" field.

- Range: 1 to 999
- Default value: 10

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

Pulse length.

- Range: 30 to 500 ms
- Default value: 100 ms

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

### "DIG. OUTPUT 1"

Digital output DO1 (terminal labeling).

All fields as digital output "DIG. OUTPUT 0".

### "DIG. INPUT 0"

Digital input DI0 (terminal labeling).

Status display only. No parameter assignment provided.

- ◉ Digital input switched
- ○ Digital input not switched

### "DIG. INPUT 1"

Digital input DI1 (terminal labeling).

All fields as digital input "DIG. OUTPUT 0".

### See also

Digital inputs and outputs (Page 21)

## 9.2.8 Communication

Device settings of the RS 485 interface.

Call: "SETTINGS > COMMUNICATION"

### RS 485 interface

The device can be parameterized via the RS 485 interface. The following settings are possible on the display.

| | | | |
|---|---|---|---|
| ADDRESS | Supported address area. | | |
| | | Range: | 1 … 247<br>(Each device on the bus must have a unique address). |
| | | Default value: | 126 |
| BAUD RATE | Supported baud rates in baud. | | |
| | | Range: | 4800, 9600, 19200, 38400 |
| | | Default value: | 19200 |
| FORMAT | Data bits / Parity bits / Stop bits | | |
| | | Range: | 8N2, 8E1, 8O1, 8N1 |
| | | Default value: | 8N2 |
| RESPONSE TIME | Response time | | |
| | | Range: | 0 to 255 ms<br>0 = Auto |
| | | Default value: | 0 |

You can find the function codes for access via the RS 485 interface in the Appendix.

### See also

RS 485 interface (Page 25)

Modbus RTU (Page 141)

## 9.2.9 Display

Device settings for the PAC3100 display.

Call: "SETTINGS > DISPLAY"


Figure 9-9 "DISPLAY" device setting

### Device settings of the display

| | |
|---|---|
| CONTRAST | Contrast of the LC display.<br>Range: 0 to 10.<br>Default value: 5 |
| BACKLIGHT LEVEL | Backlighting of the LC display.<br>ON/OFF switch: ☑ ON / ☐ OFF.<br>☐ OFF: Backlighting switched off<br>☑ On: Backlighting switched on<br>Default value: ☑ ON.<br>**Note:** Switching the backlighting off increases the service life of the display. To achieve a service life of more than 10 years, the backlighting should be switched on no more than 10% of the device operating time. |
| TIME UNTIL DIMMED | Time after which the device switches off the backlighting.<br>Range: 0 to 99 min.<br>0 = Backlighting remains switched on<br>Default value: 3 min. |
| INVERT DISPLAY | Inversion of the basic representation of the display.<br>ON/OFF switch: ☑ ON / ☐ OFF.<br>☐ OFF: Light text on dark background.<br>☑ ON: Dark text on light background.<br>Default value: ☑ ON. |
| REFRESH TIME | Refresh rate of the display.<br>Range: 330 to 3000 ms<br>Default value: 330 ms.<br>The tolerance of the refresh rate is 100 ms. |

| | |
|---|---|
| DISPLAY TEST | Screen for testing the functional capability of the display.<br>Key F3 inverts the test screen.<br>Key F4 closes the display. |

## 9.2.10 Advanced

Call: "SETTINGS > ADVANCED".

Other device settings.

- Password protection
- Resetting of minimum/maximum values, counters, and communication parameters

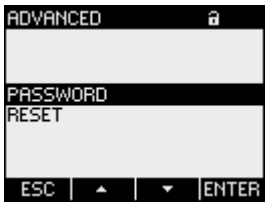
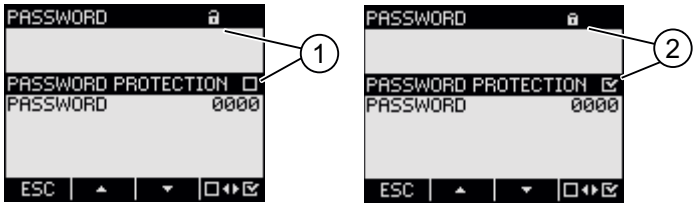



Figure 9-10 "ADVANCED" device setting

### PASSWORD PROTECTION

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

| | |
|---|---|
| PASSWORD PROTECTION | Switches password protection ☑ ON / ☐ OFF.<br>☑ ON: Password protection switched on<br>☐ OFF: Password protection switched off<br>Default value: switched off |
| PASSWORD | Four-digit, numeric password.<br>Default value: 0000 |




(1) Password protection switched **off**

(2) Password protection switched **on**

Figure 9-11 "PASSWORD PROTECTION" device setting

## See also

Password management (Page 108)

## RESET

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

- Maximum/minimum values
- Counters
- Factory defaults
- Communication parameters

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

| NOTICE |
| --- |
| **Restart of the device**<br>Resetting to the factory defaults results in restart of the device. |

| NOTICE |
| --- |
| **Access protection is switched off**<br>Resetting to the factory defaults deactivates device protection. Password protection is switched off. The password is set to the value "0000". |

| NOTICE |
| --- |
| **Counter - Reset**<br>Resetting to the factory defaults has the effect of resetting all counters! |

After calling the "EXECUTE" menu entry with F4 ENTER, a safety query appears on the display:

- "ARE YOU SURE YOU WANT TO EXECUTE THE SELECTED FUNCTIONS?"
- "ARE YOU SURE YOU WANT TO EXECUTE THE SELECTED FUNCTIONS? RESTART REQUIRED"

Answer this query with F1 or F4:

- F1 NO: Cancels the execution. The display returns to display mode. All selected value groups are deselected.
- F4 OK: Yes, execute.

After execution with F4 OK, the message "SELECTION EXECUTED" appears on the screen. Confirm the message with F4 OK.

If the device is reset to the factory settings, the message "SELECTION EXECUTED" does not appear. Instead, the device immediately restarts.

| | |
|---|---|
| CLEAR MIN/MAX VALUES | Resets all minimum and maximum values to the instantaneous value. |
| RESET COUNTERS | Resets the energy counters to 0 (zero). |
| FACTORY DEFAULTS | Resets all device settings to the default values, with the exception of the communication parameters. |
| COMMUNICATION PARAM. | Resets the entered Modbus RTU parameters. |
| EXECUTE | Reset function. Resets the selected value groups. |

## 9.2.11 Password management

### Default password

The default password is: 0000

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

### 9.2.11.1 Calling password management

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

**To access password management:**

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

### 9.2.11.2 Switch on password protection

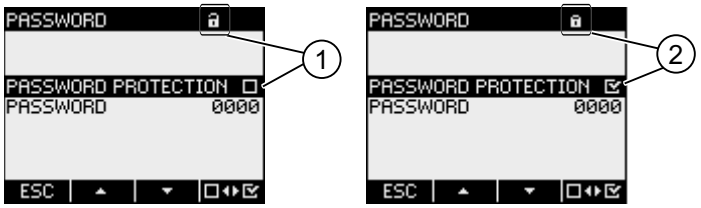
Password protection can be switched on at any time.

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

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

### To switch password protection on, proceed as follows:

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




(1) Password protection switched **off**

(2) Password protection switched **on**

Figure 9-12 "PASSWORD PROTECTION" device setting

## 9.2.11.3 Switch off password protection

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

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

**Note**

**Password visible on the display**

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

### To switch off password protection:

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

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

### 9.2.11.4 Change password

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

#### Initial situation: Password protection switched off

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

#### To change the password:

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

#### Initial situation: Password protection switched on:

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

### To change the password:

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

# Service and maintenance

# 10

## 10.1 Calibration

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

## 10.2 Cleaning

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

| CAUTION |
| --- |
| **Damage due to detergents**<br>Detergents can damage the device. Do not use detergents. |

## 10.3 Firmware updates

The PAC3100 supports firmware updates.

Use the powerconfig software, Version V2.1 or higher, to install all updates. For update instructions, please see the related documentation.

The update function is password protected.

The last devices settings made remain unchanged.

### Repeating the firmware update after cancellation

| NOTICE |
| --- |
| **Cancellation of a firmware update puts the device out of commission**<br>Please ensure there is uninterrupted power supply. Ensure the configuration software completes the update properly. |

The device loses the current firmware if the update operation is cancelled. The device cannot function without firmware. It is necessary to repeat the update to restore functionality of the device.

After cancellation of an update operation, the firmware of the device can no longer be read out. The configuration software must therefore obtain the currently set communication parameters of the device from another source, e.g. by manual input.

**Communication parameters are known**

1. Inform the configuration software of the communication parameters necessary for accessing the device.
2. Start the firmware update.

**Communication parameters are not known**

1. Reset the communication parameters of the device to the factory defaults:
   - Interrupt the power supply of the device.
   - Press <F1>, <F2> and <F4> simultaneously on the device while reapplying the supply voltage.
2. Set up the configuration software in such a way that the device can be accessed with the default communication parameters. The default values are listed in the Technical Data.
3. Start the firmware update.

### See also

Technical data (Page 117)

## 10.4 Repair

### Procedure

| NOTICE |
| --- |
| **Loss of warranty**<br>If you open the device, it loses its Siemens warranty. Only the manufacturer may carry out repairs to the device. Return faulty or damaged devices to Siemens for repair or replacement. |

If the device is faulty or damaged, proceed as follows:

1. Deinstall the device.
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

### See also

Latest information (Page 8)

Deinstallation (Page 37)

## 10.5 Disposal

### Disposal and recycling

Dispose of or recycle the module in accordance with the applicable laws and regulations in your country.

# Technical data

# 11

## 11.1 Technical data

### Device configuration

- 2 opto-isolated digital inputs
- 2 opto-isolated digital outputs
- 1 RS 485 interface for connecting to the PC or network

### Measurement

| Only for connection to AC voltage systems | |
|---|---|
| **Measuring method** | |
| For voltage measurement | True root-mean-square measurement (TRMS) |
| For current measurement | True root-mean-square measurement (TRMS) |
| **Measured value acquisition** | |
| Energy | Contiguous (zero blind measuring) |
| Current, voltage | Contiguous (zero blind measuring) |
| Waveform | Sinusoidal or distorted |
| Frequency of the relative fundamental | 50/60 Hz |
| Measured value acquisition mode | Automatic mains frequency acquisition |

## Measuring inputs for voltage

| | |
|---|---|
| Voltage ph-n | 277 V 3 AC (+ 20%) |
| Voltage ph-ph | 480 V 3 AC (+ 20%) |
| Min. measurable voltage | |
| Voltage ph-n | 58 V 3 AC (- 80 %) |
| Voltage ph-ph | 100 V 3 AC (- 80 %) |
| Zero point suppression level | |
| Voltage ph-n | 10 V |
| Voltage ph-ph | 17 V |
| Impulse withstand voltage | ≤ 6.5 kV (1.2/50 µs) |
| Measuring category | (in accordance with IEC/UL 61010 Part 1) |
| Input voltage $V_I$ | CAT III |
| Input resistance (ph-n) | 0.84 MΩ |
| Max. power consumption per phase | 131 mW |

## Measuring inputs for current

Only for connection to AC power systems via external current transformers

| | |
|---|---|
| Input current $I_I$ | x / 5 A 3 AC (+ 20%) |
| Max. permissible continuous current | 10 A |
| Current impulse overload capability | 100 A for 1 s |
| Zero point suppression level | |
| throughout phases | 10 mA |
| in the neutral conductor | 45 mA |
| Max. power consumption per phase | 500 mVA at 6 A |

## Measuring accuracy

| Measured variable | Accuracy class in accordance with IEC 61557-12:2007-08 (K55) |
|---|---|
| Voltage | 1 |
| Current | 1 |
| Apparent power | 1 |
| Active power | 1 |
| Reactive power | 3 |
| Total apparent power over all phases | 1 |
| Total active power over all phases | 1 |
| Total reactive power VAR1 over all phases | 3 |
| Cumulated active power | 1 |
| Cumulated reactive power | 3 |
| Total power factor | 2 |
| Line frequency | 0.1 |
| Active energy | 1 |
| Reactive energy | 3 |

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

## Power supply

| | |
|---|---|
| Design of the power supply | Wide-range power supply AC / DC |
| Rated range | 100 … 240 V AC (45 … 65 Hz) or<br>110 … 250 V DC |
| Work area | ± 10% of AC/DC rated range |
| Power consumption | 5 W DC / 10 VA AC |
| Overvoltage category | CAT III |

## Digital inputs

| | |
|---|---|
| Number | 2 |
| Type | Internal power supply |
| External operating voltage | 0 ... 30 V DC (optional) |
| Contact resistor | |
| "1" signal detection | ≤ 1 kΩ |
| "0" signal detection | ≥ 100 kΩ |
| Input current | |
| "1" signal detection | 2.5 … 10 mA |
| "0" signal detection | ≤ 0.5 mA |

## Digital outputs

| | |
|---|---|
| Number | 2 |
| Type | Bidirectional |
| Design/function | Switching output or pulse output |
| Rated voltage | 0 ... 30 V DC, typical 24 V DC<br>(SELV or PELV supply) |
| Output current | |
| For signal "1" | Depends on the load and the external power supply |
| Continuous load | ≤ 50 mA (thermal overload protection) |
| Transient overload | ≤ 130 mA for 100 ms |
| For signal "0" | ≤ 0.2 mA |
| Internal resistance | 55 Ω |
| Overvoltage category | CAT I |
| 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

| **RS 485 interface** | |
|---|---|
| Electrical interface | RS 485, two-wire line + 1 line for Common |
| Connection type | Terminal block with screw terminals |
| Supported communication protocol | Modbus RTU |
| Functionality | Slave |
| Supported baud rate | 4800, 9600, 19200, 38400<br>Default value: 19200 |
| Data format | 8N1, 8N2, 8E1, 8O1<br>Default value: 8N2 |
| Supported address area | 1 to 247<br>Default value: 126 |

## Retention of data in the absence of the supply voltage

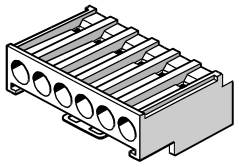
Measured values and counters are monitored for minimum and maximum values at specific intervals and only saved to the non-volatile memory in the event of a change.
This means the age of the data before the power failure is as follows:

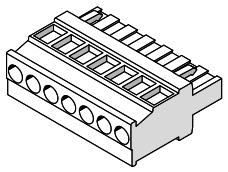
- Minimum and maximum values max. 5 s
- Counters max. 5 min

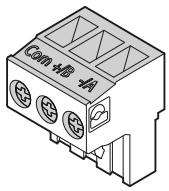
## Display and operator control

| **Display** | |
|---|---|
| Type | Monochrome, graphical LC display, light backlighting, dark text and digits |
| Backlighting | White, invertible display |
| Service life of the LEDs | 25,000 hours at 25 °C ambient temperature.<br>To achieve a service life of at least 10 years, the backlighting should be switched on no more than 10% of the device operating time. |
| Resolution | 128 x 96 pixels |
| Size W x H | 72 mm x 54 mm |
| Refresh time | 0.33 ... 3 s, adjustable |
| **Keyboard** | |
| 4 function keys F1 to F4 on the front, multiple assignments | |

## Connection elements

| **Measuring inputs and supply voltage inputs** | |
|---|---|
| Screw terminal |  |
| Connection designations | IL1(°↑k, I↓), IL2(°↑k, I↓), IL3(°↑k, I↓)<br>$V_1$, V2, V3, VN, L/+, N/-<br>1-wire or 2-wire connection possible |
| Conductor cross section | |
| Solid | 1 x 0.5 ... 4.0 mm²<br>AWG 1 x 20 ... 12<br>2 x 0.5 ... 2.5 mm²<br>AWG 2 x 20 ... 14 |
| Finely stranded with end sleeve | 1 x 0.5 ... 2.5 mm²<br>AWG 1 x 20 ... 14<br>2 x 0.5 ... 1.5 mm²<br>AWG 2 x 20 ... 16 |
| Stripping length | 10 mm |
| Connection screws | |
| Tightening torque | 0.8 ... 1.2 Nm<br>7 ... 10.3 lbf·in |
| Tool | Screwdriver PZ2<br>cal. ISO 6789<br>Crimping tool in accordance with EN 60947-1 |

| **Digital outputs, digital inputs** | |
|---|---|
| Screw terminal |  |
| Connection designations | ⏚ , DIC, DI1, DI0, DOC, DO1, DO0 |
| Conductor cross section | |
| Solid | 1 x 0.2 ... 2.5 mm²<br>2 x 0.2 ... 1.0 mm² |
| Finely stranded without end sleeve | 1 x 0.2 ... 2.5 mm²<br>2 x 0.2 ... 1.5 mm² |
| Finely stranded with end sleeve, without plastic sleeve | 1 x 0.25 ... 2.5 mm²<br>2 x 0.25 ... 1.0 mm² |
| Finely stranded with end sleeve, with plastic sleeve | 1 x 0.25 ... 2.5 mm² |
| Finely-stranded with TWIN end sleeve, with plastic sleeve | 2 x 0.5 ... 1.5 mm² |
| AWG cables | 1 x 24 ... 12 |
| Stripping length | 7 mm |
| Connection screws | |
| Tightening torque | 0.5 ... 0.6 Nm |
| Tool | Screwdriver PZ1<br>cal. ISO 6789<br>Crimping tool in accordance with EN 60947-1 |

| RS 485 connector | |
|---|---|
| Screw terminal |  |
| Connection designations | Com, +/B, -/A |
| Conductor cross section | |
| Solid | 1 x 0.2 ... 2.5 mm²<br>2 x 0.2 ... 1.0 mm² |
| Finely stranded without end sleeve | 1 x 0.2 ... 2.5 mm²<br>2 x 0.2 ... 1.5 mm² |
| Finely stranded with end sleeve, without plastic sleeve | 1 x 0.25 ... 2.5 mm²<br>2 x 0.25 ... 1.0 mm² |
| Finely stranded with end sleeve, with plastic sleeve | 1 x 0.25 ... 2.5 mm² |
| Finely-stranded with TWIN end sleeve, with plastic sleeve | 2 x 0.5 ... 1.5 mm² |
| AWG cables | 1 x 24 ... 12 |
| Stripping length | 7 mm |
| Connection screws | |
| Tightening torque | 0.5 ... 0.6 Nm |
| Tool | Screwdriver PZ1<br>cal. ISO 6789<br>Crimping tool in accordance with EN 60947-1 |

## Dimensions and weights

| | |
|---|---|
| Type of fixing | Panel mounting to IEC 61554 |
| Housing dimensions W x H x D | 96 mm x 96 mm x 56 mm |
| Cutout (W x H) | $92^{+0.8}$ mm x $92^{+0.8}$ mm |
| Overall depth | 51 mm |
| Permissible switching panel thickness for installation | ≤ 4 mm |
| Mounting position | Vertical |
| Weight | |
| Device without packaging | Approximately 325 g |
| Device including packaging | Approximately 460 g |

## Degree of protection and protection class

| | |
|---|---|
| Protection class | Protection class II when installed |
| Degree of protection according to IEC 60529 | |
| Device front | IP65<br>Type 5 enclosure acc. to UL50 |
| Device rear | IP20 |
| If higher degree of protection requirements are placed on the application engineering, the customer must take suitable measures | |

## Environmental conditions

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

| | |
|---|---|
| Temperature range | |
| Ambient temperature during operating phase | - 10 °C to + 55 °C |
| Ambient temperature during transport and storage | - 25 °C to + 70 °C |
| Relative humidity | 95% at 25°C without condensation (normal conditions) |
| Installation altitude above sea level | max. 2000 m |
| Degree of pollution | 2 |
| Environmental tests | In accordance with IEC 60068 |

## Safety regulations

### CE conformity

The PAC3100 complies with the requirements of the following European Directives:

DIRECTIVE 2004/108/EC OF THE EUROPEAN PARLIAMENT AND COUNCIL of December 15, 2004, on the approximation of the laws of the Member States relating to electromagnetic compatibility and repealing the Directive 89/336/EEC

DIRECTIVE 2006/95/EC OF THE EUROPEAN PARLIAMENT AND COUNCIL of December 12, 2006, on the harmonization of the laws of the Member States relating to electrical equipment designed for use within certain voltage limits

Conformity with these Directives is verified by compliance with the following standards:

EN 55011:2007; Group 1, Class A
DIN EN 61000-6-2:2006
DIN EN 61000-4-2:2001
DIN EN 61000-4-5:2007
DIN EN 61000-4-6:2001
DIN EN 61000-4-8:2001
DIN EN 61000-4-11:2005
DIN EN 61010-1:2002
DIN EN 61326-1:2006

### Approvals for the USA and Canada

The PAC3100 is approved by UL, File No. E314880.

FCC Class A Notice: This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

### Approvals for Australia and New Zealand

C-Tick Australian Radiocommunications Act,
compliant with AS/NZS CISPR 11; Industrial Emissions

### Approvals for the Russian Federation

# 11.2 Labeling

## Labels on the housing of the PAC3100

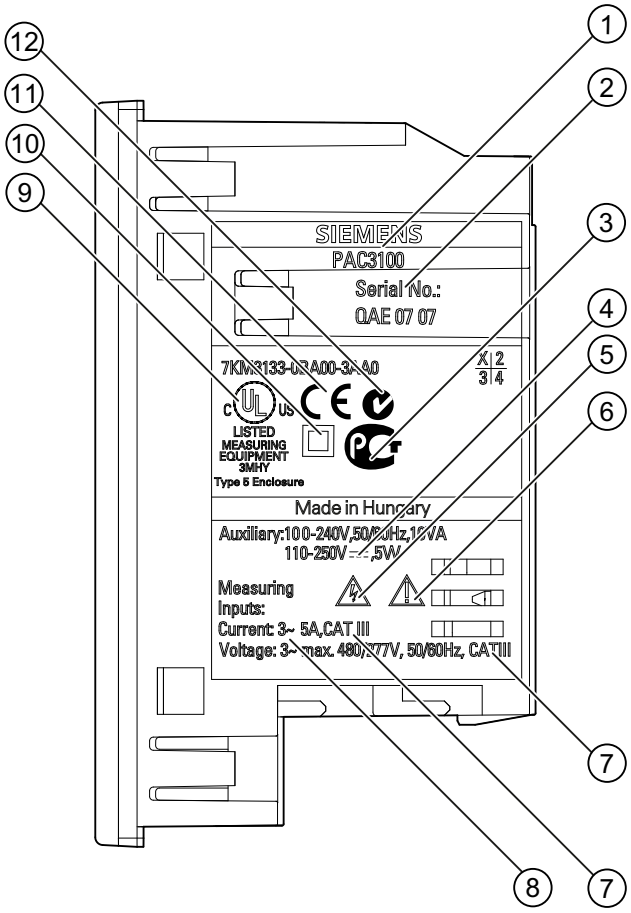
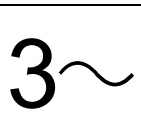



Figure 11-1 Device labeling

| | Symbol, label | Explanation |
|---|---|---|
| (1) | | Product designation |
| (2) | | Serial number of the device |
| (3) | | GOST-R certification |
| (4) | | DC voltage |
| (5) | | Risk of electric shock |

| | Symbol, label | Explanation |
|---|---|---|
| (6) |  | General Warning Symbol |
| (7) | CAT III | Overvoltage category CAT III for current and voltage inputs |
| (8) |  | Three-phase AC |
| (9) |  | Products with this mark comply with both the Canadian (CSA) and the American (UL) requirements |
| (10) |  | Protective insulation, device with protection class II |
| (11) |  | CE mark. Confirmation of conformity of the product with the applicable EU directives and compliance with the essential requirements contained in these directives |
| (12) |  | C-Tick certification |

# Dimensional drawings

# 12

**Note:** All dimensions in mm.

## Panel cutout

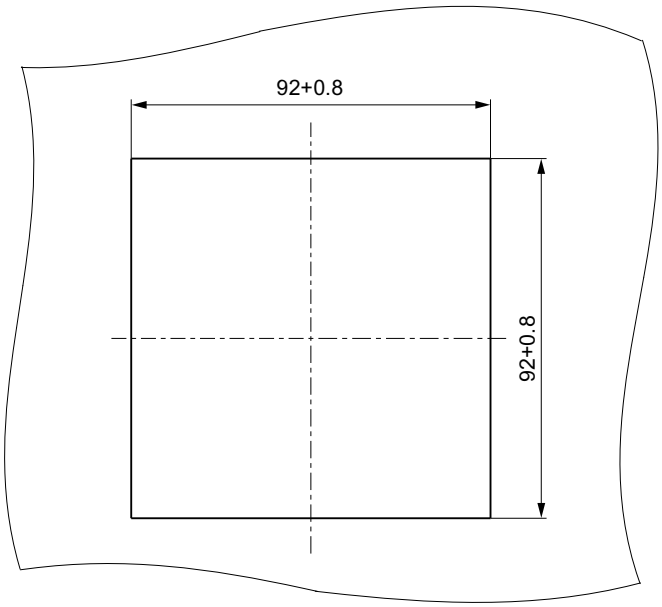



Figure 12-1 Panel cutout

## Frame dimensions

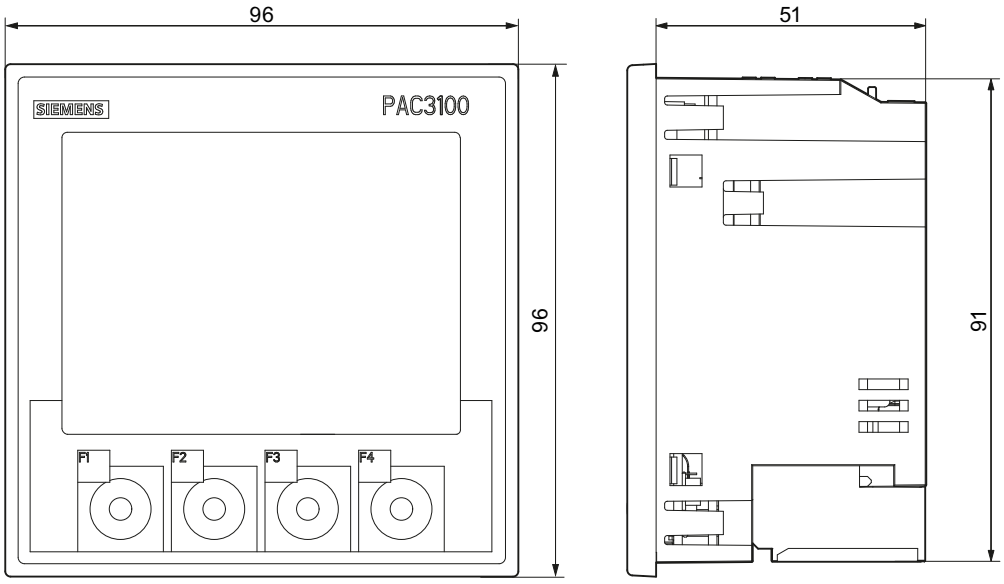



Figure 12-2 Frame dimensions

## Clearance measurements

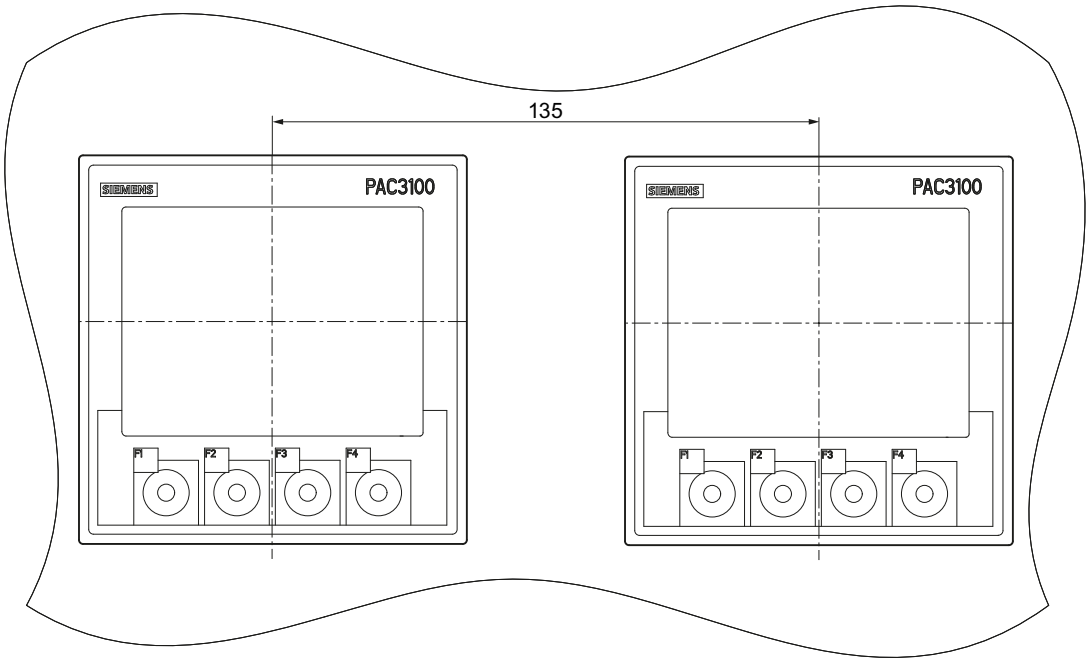



Figure 12-3 Side-by-side installation

## Clearances

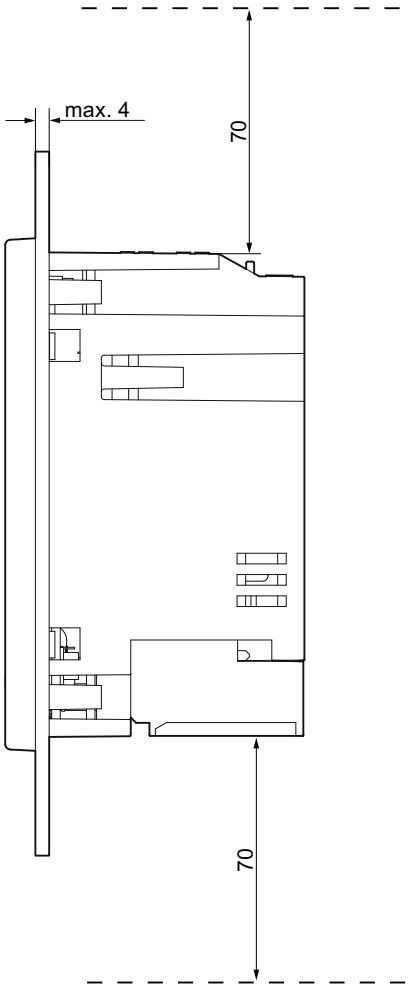



Figure 12-4 Clearances

The clearances specified must be maintained for cable outlets and ventilation.

# Appendix

# A

## A.1 Measured variables

### Measured variables of the PAC3100 measuring device

The PAC3100 provides the measured variables listed below.

| Name | | Abbrev. DE + IEC | Abbrev. EN + ANSI | Unit | Display |
|---|---|---|---|---|---|
| **Voltage a-n** | | $U_{L1-N}$ | $V_{a-n}$ | V | 1.0 |
| | Instantaneous value of the voltage between phase conductor a and the neutral conductor | | | | |
| Maximum voltage a-n | | $U_{L1-N\ max}$ | $V_{a-n\ max}$ | V | 1.1 |
| | Maximum value of the voltage between phase conductor a and the neutral conductor | | | | |
| Minimum voltage a-n | | $U_{L1-N\ min}$ | $V_{a-n\ min}$ | V | 1.2 |
| | Minimum value of the voltage between phase conductor a and the neutral conductor | | | | |
| Voltage b-n | | $U_{L2-N}$ | $V_{b-n}$ | V | 1.0 |
| | Instantaneous value of the voltage between phase conductor b and the neutral conductor | | | | |
| Maximum voltage b-n | | $U_{L2-N\ max}$ | $V_{b-n\ max}$ | V | 1.1 |
| | Maximum value of the voltage between phase conductor b and the neutral conductor | | | | |
| Minimum voltage b-n | | $U_{L2-N\ min}$ | $V_{b-n\ min}$ | V | 1.2 |
| | Minimum value of the voltage between phase conductor b and the neutral conductor | | | | |
| Voltage c-n | | $U_{L3-N}$ | $V_{c-n}$ | V | 1.0 |
| | Instantaneous value of the voltage between phase conductor c and the neutral conductor | | | | |
| Maximum voltage c-n | | $U_{L3-N\ max}$ | $V_{c-n\ max}$ | V | 1.1 |
| | Maximum value of the voltage between phase conductor c and the neutral conductor | | | | |
| Minimum voltage c-n | | $U_{L3-N\ min}$ | $V_{c-n\ min}$ | V | 1.2 |
| | Minimum value of the voltage between phase conductor c and the neutral conductor | | | | |

| Name | | Abbrev. DE + IEC | Abbrev. EN + ANSI | Unit | Display |
|---|---|---|---|---|---|
| **Voltage a-b** | | $U_{L1-L2}$ | $V_{a-b}$ | V | 2.0 |
| | Instantaneous value of the voltage between phase conductors a and b | | | | |
| Maximum voltage a-b | | $U_{L1-L2\ max}$ | $V_{a-b\ max}$ | V | 2.1 |
| | Maximum value of the voltage between phase conductors a and b | | | | |
| Minimum voltage a-b | | $U_{L1-L2\ min}$ | $V_{a-b\ min}$ | V | 2.2 |
| | Minimum value of the voltage between phase conductors a and b | | | | |
| Voltage b-c | | $U_{L2-L3}$ | $V_{b-c}$ | V | 2.0 |
| | Instantaneous value of the voltage between phase conductors b and c | | | | |
| Maximum voltage b-c | | $U_{L2-L3\ max}$ | $V_{b-c\ max}$ | V | 2.1 |
| | Maximum value of the voltage between phase conductors b and c | | | | |
| Minimum voltage b-c | | $U_{L2-L3\ min}$ | $V_{b-c\ min}$ | V | 2.2 |
| | Minimum value of the voltage between phase conductors b and c | | | | |
| Voltage c-a | | $U_{L3-L1}$ | $V_{c-a}$ | V | 2.0 |
| | Instantaneous value of the voltage between phase conductors c and a | | | | |
| Maximum voltage c-a | | $U_{L3-L1\ max}$ | $V_{c-a\ max}$ | V | 2.1 |
| | Maximum value of the voltage between phase conductors c and a | | | | |
| Minimum voltage c-a | | $U_{L3-L1\ min}$ | $V_{c-a\ min}$ | V | 2.2 |
| | Minimum value of the voltage between phase conductors c and a | | | | |
| **Current a** | | $I_{L1}$ | $I_a$ | A | 3.0 |
| | Current in phase conductor a | | | | |
| Maximum current a | | $I_{L1\ max}$ | $I_{a\ max}$ | A | 3.1 |
| | Maximum value of the current in phase conductor a | | | | |
| Minimum current a | | $I_{L1\ min}$ | $I_{a\ min}$ | A | 3.2 |
| | Minimum value of the current in phase conductor a | | | | |
| Current b | | $I_{L2}$ | $I_b$ | A | 3.0 |
| | Current in phase conductor b | | | | |
| Maximum current b | | $I_{L2\ max}$ | $I_{b\ max}$ | A | 3.1 |
| | Maximum value of the current in phase conductor b | | | | |
| Minimum current b | | $I_{L2\ min}$ | $I_{b\ min}$ | A | 3.2 |
| | Minimum value of the current in phase conductor b | | | | |
| Current c | | $I_{L3}$ | $I_c$ | A | 3.0 |
| | Current in phase conductor c | | | | |
| Maximum current c | | $I_{L3\ max}$ | $I_{c\ max}$ | A | 3.1 |
| | Maximum value of the current in phase conductor c | | | | |
| Minimum current c | | $I_{L3\ min}$ | $I_{c\ min}$ | A | 3.2 |
| | Minimum value of the current in phase conductor c | | | | |

| Name | | Abbrev. DE + IEC | Abbrev. EN + ANSI | Unit | Display |
|---|---|---|---|---|---|
| **Neutral current** | | $I_N$ | $I_n$ | A | 4.0 |
| | Current in the neutral conductor | | | | |
| Maximum neutral current | | $I_{N\ max}$ | $I_{n\ max}$ | A | 4.1 |
| | Maximum value of the current in the neutral conductor | | | | |
| Minimum neutral current | | $I_{N\ min}$ | $I_{n\ min}$ | A | 4.2 |
| | Minimum value of the current in the neutral conductor | | | | |
| **Apparent power a** | | $VA_{L1}$ | $VA_a$ | VA | 5.0 |
| | Apparent power in phase conductor a | | | | |
| Maximum apparent power a | | $S_{L1\ max}$ | $VA_{a\ max}$ | VA | 5.1 |
| | Maximum value of the apparent power in phase conductor a | | | | |
| Minimum apparent power a | | $S_{L1\ min}$ | $VA_{a\ min}$ | VA | 5.2 |
| | Minimum value of the apparent power in phase conductor a | | | | |
| Apparent power b | | $VA_{L2}$ | $VA_b$ | VA | 5.0 |
| | Apparent power in phase conductor b | | | | |
| Maximum apparent power b | | $S_{L2\ max}$ | $VA_{b\ max}$ | VA | 5.1 |
| | Maximum value of the apparent power in phase conductor b | | | | |
| Minimum apparent power b | | $S_{L2\ min}$ | $VA_{b\ min}$ | VA | 5.2 |
| | Minimum value of the apparent power in phase conductor b | | | | |
| Apparent power c | | $VA_{L3}$ | $VA_c$ | VA | 5.0 |
| | Apparent power in phase conductor c | | | | |
| Maximum apparent power c | | $S_{L3\ max}$ | $VA_{c\ max}$ | VA | 5.1 |
| | Maximum value of the apparent power in phase conductor c | | | | |
| Minimum apparent power c | | $S_{L3\ min}$ | $VA_{c\ min}$ | VA | 5.2 |
| | Minimum value of the apparent power in phase conductor c | | | | |

| Name | | Abbrev. DE + IEC | Abbrev. EN + ANSI | Unit | Display |
|---|---|---|---|---|---|
| **Active power a** | | $P_{L1}$ | $W_a$ | W | 6.0 |
| | Active power in phase conductor a as import (+) or export (-) | | | | |
| Maximum active power a | | $P_{L1\ max}$ | $W_{a\ max}$ | W | 6.1 |
| | Maximum value of the active power in phase conductor a | | | | |
| Minimum active power a | | $P_{L1\ min}$ | $W_{a\ min}$ | W | 6.2 |
| | Minimum value of the active power in phase conductor a | | | | |
| Active power b | | $P_{L2}$ | $W_b$ | W | 6.0 |
| | Active power in phase conductor b as import (+) or export (-) | | | | |
| Maximum active power b | | $P_{L2\ max}$ | $W_{b\ max}$ | W | 6.1 |
| | Maximum value of the active power in phase conductor b | | | | |
| Minimum active power b | | $P_{L2\ min}$ | $W_{b\ min}$ | W | 6.2 |
| | Minimum value of the active power in phase conductor b | | | | |
| Active power c | | $P_{L3}$ | $W_c$ | W | 6.0 |
| | Active power in phase conductor c as import (+) or export (-) | | | | |
| Maximum active power c | | $P_{L3\ max}$ | $W_{c\ max}$ | W | 6.1 |
| | Maximum value of the active power in phase conductor c | | | | |
| Minimum active power c | | $P_{L3\ min}$ | $W_{c\ min}$ | W | 6.2 |
| | Minimum value of the active power in phase conductor c | | | | |

| Name | | Abbrev. DE + IEC | Abbrev. EN + ANSI | Unit | Display |
|---|---|---|---|---|---|
| **Reactive power a (VAR1)** | | $Q_{1\ L1}$ | $VAR_{1\ a}$ | var | 7.0 |
| | Reactive power of the fundamental in phase conductor a, referred to the load counting system, measured according to VAR1 | | | | |
| Maximum reactive power a (VAR1) | | $Q_{1\ L1\ max}$ | $VAR_{1\ a\ max}$ | var | 7.1 |
| | Maximum reactive power of the fundamental in phase conductor a referred to the load counting system, measured according to VAR1 | | | | |
| Minimum reactive power a (VAR1) | | $Q_{1\ L1\ min}$ | $VAR_{1\ a\ min}$ | var | 7.2 |
| | Minimum reactive power of the fundamental in phase conductor a, referred to the load counting system, measured according to VAR1 | | | | |
| Reactive power b (VAR1) | | $Q_{1\ L2}$ | $VAR_{1\ b}$ | var | 7.0 |
| | Reactive power of the fundamental in phase conductor b, referred to the load counting system, measured according to VAR1 | | | | |
| Maximum reactive power b (VAR1) | | $Q_{1\ L2\ max}$ | $VAR_{1\ b\ max}$ | var | 7.1 |
| | Maximum reactive power of the fundamental in phase conductor b, referred to the load counting system, measured according to VAR1 | | | | |
| Minimum reactive power b (VAR1) | | $Q_{1\ L2\ min}$ | $VAR_{1\ b\ min}$ | var | 7.2 |
| | Minimum reactive power of the fundamental in phase conductor b, referred to the load counting system, measured according to VAR1 | | | | |
| Reactive power c (VAR1) | | $Q_{1\ L3}$ | $VAR_{1\ c}$ | var | 7.0 |
| | Reactive power of the fundamental in phase conductor c, referred to the load counting system, measured according to VAR1 | | | | |
| Maximum reactive power c (VAR1) | | $Q_{1\ L3\ max}$ | $VAR_{1\ c\ max}$ | var | 7.1 |
| | Maximum reactive power of the fundamental in phase conductor c, referred to the load counting system, measured according to VAR1 | | | | |
| Minimum reactive power c (VAR1) | | $Q_{1\ L3\ min}$ | $VAR_{1\ c\ min}$ | var | 7.2 |
| | Minimum reactive power of the fundamental in phase conductor c, referred to the load counting system, measured according to VAR1 | | | | |
| **Total apparent power** | | S | VA | VA | 8.0 |
| | Total apparent power in the phase conductors | | | | |
| Maximum total apparent power | | $S_{max}$ | $VA_{max}$ | VA | 8.1 |
| | Maximum value of the total apparent power in the three-phase system | | | | |
| Minimum total apparent power | | $S_{min}$ | $VA_{min}$ | VA | 8.2 |
| | Minimum value of the total apparent power in the three-phase system | | | | |
| **Total active power** | | P | W | W | 8.0 |
| | Total active power in the phase conductors | | | | |
| Maximum total active power | | $P_{max}$ | $W_{max}$ | W | 8.1 |
| | Maximum value of the total active power in the three-phase system | | | | |
| Minimum total active power | | $P_{min}$ | $W_{min}$ | W | 8.2 |
| | Minimum value of the total active power in the three-phase system | | | | |

| Name | | Abbrev. DE + IEC | Abbrev. EN + ANSI | Unit | Display |
|---|---|---|---|---|---|
| **Total reactive power (VAR1)** | | $Q_1$ | $VAR_1$ | var | 8.0 |
| | Root of the total squares of the reactive power of the fundamental in the phase conductors referred to the load counting system | | | | |
| Maximum total reactive power (VAR1) | | $Q_{1\ max}$ | $VAR_{1\ max}$ | var | 8.1 |
| | Maximum value of the total reactive power of the fundamental in the phase conductors referred to the load counting system | | | | |
| Minimum total reactive power (VAR1) | | $Q_{1\ min}$ | $VAR_{1\ min}$ | var | 8.2 |
| | Minimum value of the total reactive power of the fundamental in the phase conductors referred to the load counting system | | | | |
| **Total power factor** | | PF | PF | – | 9.0 |
| | Total power factor | | | | |
| Maximum total power factor | | $PF_{max}$ | $PF_{max}$ | – | 9.1 |
| | Maximum total power factor | | | | |
| Minimum total power factor | | $PF_{min}$ | $PF_{min}$ | – | 9.2 |
| | Minimum total power factor | | | | |
| **Line frequency** | | f | f | Hz | 10.0 |
| | Instantaneous value of the line frequency | | | | |
| Maximum line frequency | | $f_{max}$ | $f_{max}$ | Hz | 10.1 |
| | Maximum value of the line frequency | | | | |
| Minimum line frequency | | $f_{min}$ | $f_{min}$ | Hz | 10.2 |
| | Minimum value of the line frequency | | | | |
| **Active energy** | | $E_a$ | Wh | Wh | 11.0 |
| | Active energy, imported, exported or balance | | | | |
| **Reactive energy** | | $E_r$ | VARh | varh | 11.0 |
| | Reactive energy, imported, exported or balance | | | | |
| **PMD diagnostics and status** | | | | | – |
| | Information on the PMD status, messages, and configuration changes | | | | |
| **Digital outputs status** | | | | | 24.0 |
| | Status of the digital outputs of the PMD | | | | |
| **Digital inputs status** | | | | | 24.0 |
| | Status of the digital inputs of the PMD | | | | |
| **Relevant parameter changes counter** | | | | | – |
| | Number of changes to the default settings | | | | |
| **Counter all parameter changes** | | | | | – |
| | Parameter: Number of changes to the settings | | | | |

Table A- 1 Load profile

| Name | | Abbrev. DE + IEC | Abbrev. EN + ANSI | Unit | Display |
|---|---|---|---|---|---|
| Cumulated active power import | | $P_{cum\text{-}dmd\ imp}$ | $W_{cum\text{-}dmd\ imp}$ | W | – |
| | Cumulated active power imported in the last period | | | | |
| Cumulated reactive power import | | $Q_{cum\text{-}dmd\ imp}$ | $VAR_{cum\text{-}dmd\ imp}$ | var | – |
| | Cumulated reactive power imported in the last period | | | | |
| Cumulated active power export | | $P_{cum\text{-}dmd\ exp}$ | $W_{cum\text{-}dmd\ exp}$ | W | – |
| | Cumulated active power delivered in the last period | | | | |
| Cumulated reactive power export | | $Q_{cum\text{-}dmd\ exp}$ | $VAR_{cum\text{-}dmd\ exp}$ | var | – |
| | Cumulated reactive power exported in the last period | | | | |
| Max. active power in last period | | $P_{intv\ max}$ | $W_{interval\ max}$ | W | – |
| | Maximum instantaneous value of the active power in the last period | | | | |
| Min. active power in last period | | $P_{intv\ min}$ | $W_{interval\ min}$ | W | – |
| | Minimum instantaneous value of the active power in the last period | | | | |
| Max. reactive power in last period | | $Q_{intv\ max}$ | $VAR_{interval\ max}$ | var | – |
| | Maximum instantaneous value of the reactive power in the last period | | | | |
| Min. reactive power in last period | | $Q_{intv\ min}$ | $VAR_{interval\ min}$ | var | – |
| | Minimum instantaneous value of the reactive power in the last period | | | | |
| Length of last period | | | | s | – |
| | Actual length of the last completed demand period | | | | |
| Time since last period | | | | s | – |
| | Time since the end of the last completed demand period | | | | |

## Designations of the measured variables on the display

Table A- 2 Designations of the measured variables on the display

| Measured variable | Designations of the measured variable in the | | Display |
|---|---|---|---|
| | Display title | Main menu | Number |
| Voltage ph-n | Vph-n | VOLTAGE | 1.0 |
| Voltage ph-ph | Vph-ph | VOLTAGE | 2.0 |
| Current | AMPS | CURRENT | 3.0 |
| Neutral current | In | CURRENT N-CONDUCTOR | 4.0 |
| Apparent power per phase | VA | APPARENT POWER | 5.0 |
| Active power per phase | P | ACTIVE POWER | 6.0 |
| Reactive power (VAR1) per phase | Q1 | REACTIVE POWER | 7.0 |
| Collective power values:<br>Total apparent power over all phases<br>Total active power over all phases<br>Total reactive power VAR1 over all phases | TOTAL VA, W, VAR1 | TOTAL POWER | 8.0 |
| Total power factor | TOTAL PF | TOTAL POWER FACTOR | 9.0 |
| Line frequency | FREQUENCY | FREQUENCY | 10.0 |
| Active energy<br>Reactive energy | ENERGY | ENERGY | 11.0 |
| Device settings | SETTINGS | SETTINGS | 20.1 |

## Designations of the measured value properties on the display

Table A- 3 Designations of the measured value properties on the display

| Designation of the measured value property | Measured value property of the measured variable |
|---|---|
| INSTANTANEOUS | Measured instantaneous value |
| MAXIMUM | Measured maximum value |
| MINIMUM | Measured minimum value |
| AVERAGE | Calculated average value |

# A.2 Modbus RTU

## A.2.1 Structure of the job message frame

### Structure

Data traffic between the master and the slave and between the slave and the master begins with the address of the slave. The job message frame consists of the following elements:

1. Address of the MODBUS slave
2. Function code
3. Data of the message frame
4. Checksum of the message frame (CRC)

The structure of the data field depends on the function code used.

Table A- 4 Structure of the message frame

| Address | Function code | data | CRC |
|---|---|---|---|
| Byte | Byte | n byte | 2 bytes |

### Cyclic Redundancy Check (CRC)

The Cyclic Redundancy Check checks the data flow. The CRC consists of 2 Bytes:

- one LSB
- One MSB

The transmitting device calculates the CRC and appends it to the message. The receiving device calculates the CRC again and compares the newly calculated value with the received CRC. If the two values do not agree, an error has occurred.

### End of a message frame

If no characters are transferred for the space of 3.5 bytes this is taken as the end of the message frame. A check is made to determine the validity of the message frame.

### Validity of the message frame

Gaps in the message frame are filled with 0xFFFFFFFF. FFFFFFFF means the message frame contains no measured values. This means it is invalid. If the message frame has a different content it is in principle valid.

### See also

Function codes (Page 142)

## A.2.2 Character frame

The Modbus RTU specification defines the data format. The user can change the data format.

### Structure of the character frame

The data is transferred between the PAC3100 measuring device and the Modbus master via the serial interface in an 11-bit character frame. In exceptional cases, only 10 bits are used.

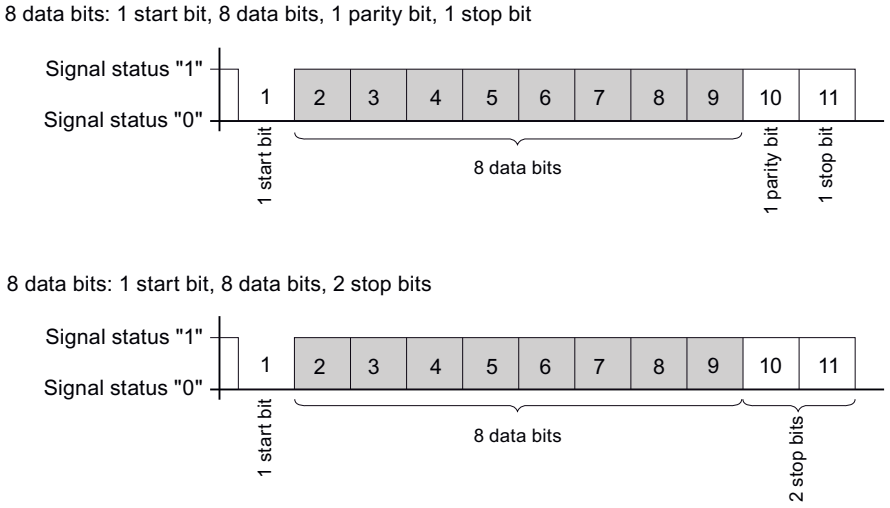



Figure A-1 11-bit character frame

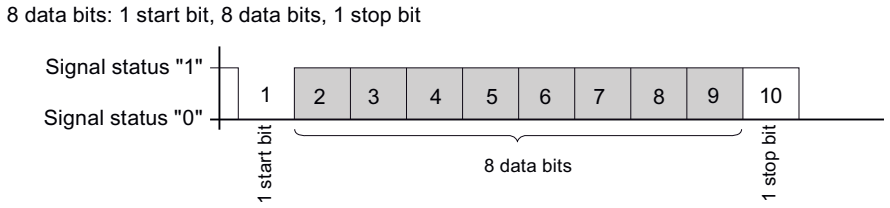



Figure A-2 10-bit character frame

The least significant bit (LSB) is sent at the start of the eight data bits, and the most significant bit (MSB) is sent at the end.

## A.2.3 Function codes

Function codes control the data exchange. In doing so, 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- 5 Supported function codes

| FC | Function in accordance with MODBUS specification | Data Type | | Access |
|---|---|---|---|---|
| 02 | Read Discrete Inputs | Bit | Input | R |
| 03 | Read Holding Registers | Register | Output | R |
| 04 | Read Input Registers | Register | Input | R |
| 06 | Write Single Register | Register | Output | RW |
| 10 | Write Multiple Registers | Register | - | RW |
| 2B | Read Device Identification | - | - | R |

### FC 02

This function code reads individual bits from the slave.

| | |
|---|---|
| Corresponding exception codes: | 01, 02, 03 or 04 |
| Corresponding error code: | 0x82 |
| Status: | 0 = OFF<br>1 = ON |

### FC 03

You can read out device registers with this function code.

| | |
|---|---|
| Number of requested registers: | At least 1 to maximum 125 |
| Corresponding exception codes: | 01, 02, 03 or 04 |
| Corresponding error code: | 0x83 |

### FC 04

You can read out device registers with this function code.

| | |
|---|---|
| Number of requested registers: | At least 1 to maximum 125 |
| Corresponding exception codes: | 01, 02, 03 or 04 |
| Corresponding error code: | 0x84 |

## FC 06

This function code overwrites a slave register with a new value.

| | |
|---|---|
| Corresponding exception codes: | 01, 02, 03 or 04 |
| Corresponding error code: | 0x86 |

## FC 10

This function code writes a block of one to a maximum of 123 connected registers into the device.

| | |
|---|---|
| Corresponding exception codes: | 01, 02, 03 or 04 |
| Corresponding error code: | 0x90 |

## FC 2B

This function code reads a string. In conjunction with the MEIType 14 (0x0E), it reads the Device Identification. The ReadDevID code 01 controls reading of the Basic Device Identification. The object ID specifies whether the manufacturer, the manufacturer's device name, or the firmware version/bootloader version is to be read.

| | |
|---|---|
| Corresponding exception codes: | 01, 02, 03 or 04 |
| Corresponding error code: | 0xAB |
| MODBUS Encapsulated Interface type (MEItype) | 0x0E |
| ReadDevID code[1)] | 01 |

1) Read Device Identification code

## A.2.4 Exception codes

### Overview

Table A- 6 MODBUS exception codes

| Exception codes | Name | Meaning | Remedy |
|---|---|---|---|
| 01 | Illegal Function | Illegal function:<br>• The function code in the request is not a permissible action for the slave.<br>• The slave is in a status 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<br>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:<br>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:<br>An indefinite error occurred when the slave attempted to execute the requested action. | Check that the specified offset and the specified data length are correct. |

## A.2.5 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.

| NOTICE |
| --- |
| **Error in the case of inconsistent access to measured values**<br>Please ensure the start offset of the register is correct when making **read accesses**.<br>Please ensure the start offset and the number of registers are correct when making **write accesses**.<br>If a value consists of two registers, a read command applied in the second register, for example, will generate an error code. The PAC3100 will also output an error code if, for example, a write operation ends in the middle of a multi-register value. |

Table A- 7 Available measured variables

| Abbr. in the "Access" column | Abbreviation |
|---|---|
| R | Read; read access |
| W | Write; write access |
| RW | Read Write; read and write access |

| Offset | Number of registers | Name | Format | Unit | Value range | Access |
|---|---|---|---|---|---|---|
| 1 | 2 | Voltage a-n | Float | V | - | R |
| 3 | 2 | Voltage b-n | Float | V | - | R |
| 5 | 2 | Voltage c-n | Float | V | - | R |
| 7 | 2 | Voltage a-b | Float | V | - | R |
| 9 | 2 | Voltage b-c | Float | V | - | R |
| 11 | 2 | Voltage c-a | Float | V | - | R |
| 13 | 2 | Current a | Float | A | - | R |
| 15 | 2 | Current b | Float | A | - | R |
| 17 | 2 | Current c | Float | A | - | R |
| 19 | 2 | Apparent power a | Float | VA | - | R |
| 21 | 2 | Apparent power b | Float | VA | - | R |
| 23 | 2 | Apparent power c | Float | VA | - | R |
| 25 | 2 | Active power a | Float | W | - | R |
| 27 | 2 | Active power b | Float | W | - | R |
| 29 | 2 | Active power c | Float | W | - | R |
| 31 | 2 | Reactive power a (VAR1) | Float | var | - | R |
| 33 | 2 | Reactive power b (VAR1) | Float | var | - | R |
| 35 | 2 | Reactive power c (VAR1) | Float | var | - | R |
| 37 | 2 | Neutral current | Float | A | - | R |
| 39 | 2 | Frequency | Float | Hz | 45 ... 65 | R |
| 47 | 2 | Total apparent power | Float | VA | - | R |
| 49 | 2 | Total active power | Float | W | - | R |
| 51 | 2 | Total reactive power (VAR1) | Float | var | - | R |
| 53 | 2 | Total power factor | Float | | - | R |
| 55 | 2 | Maximum voltage a-n | Float | V | - | R |
| 57 | 2 | Maximum voltage b-n | Float | V | - | R |
| 59 | 2 | Maximum voltage c-n | Float | V | - | R |
| 61 | 2 | Max. voltage a-b | Float | V | - | R |
| 63 | 2 | Max. voltage b-c | Float | V | - | R |
| 65 | 2 | Max. voltage c-a | Float | V | - | R |
| 67 | 2 | Maximum current a | Float | A | - | R |
| 69 | 2 | Maximum current b | Float | A | - | R |
| 71 | 2 | Maximum current c | Float | A | - | R |
| 73 | 2 | Maximum apparent power a | Float | VA | - | R |

| Offset | Number of registers | Name | Format | Unit | Value range | Access |
|---|---|---|---|---|---|---|
| 75 | 2 | Maximum apparent power b | Float | VA | - | R |
| 77 | 2 | Maximum apparent power c | Float | VA | - | R |
| 79 | 2 | Maximum active power a | Float | W | - | R |
| 81 | 2 | Maximum active power b | Float | W | - | R |
| 83 | 2 | Maximum active power c | Float | W | - | R |
| 85 | 2 | Max. reactive power a (VAR1) | Float | var | - | R |
| 87 | 2 | Max. reactive power b (VAR1) | Float | var | - | R |
| 89 | 2 | Max. reactive power c (VAR1) | Float | var | - | R |
| 91 | 2 | Max. neutral current | Float | A | - | R |
| 93 | 2 | Max. frequency | Float | Hz | 45 ... 65 | R |
| 101 | 2 | Max. total apparent power | Float | VA | - | R |
| 103 | 2 | Max. total active power | Float | W | - | R |
| 105 | 2 | Max. total reactive power (VAR1) | Float | var | - | R |
| 107 | 2 | Max. total power factor | Float | | - | R |
| 109 | 2 | Minimum voltage a-n | Float | V | - | R |
| 111 | 2 | Minimum voltage b-n | Float | V | - | R |
| 113 | 2 | Minimum voltage c-n | Float | V | - | R |
| 115 | 2 | Min. voltage a-b | Float | V | - | R |
| 117 | 2 | Min. voltage b-c | Float | V | - | R |
| 119 | 2 | Min. voltage c-a | Float | V | - | R |
| 121 | 2 | Minimum current a | Float | A | - | R |
| 123 | 2 | Minimum current b | Float | A | - | R |
| 125 | 2 | Minimum current c | Float | A | - | R |
| 127 | 2 | Minimum apparent power a | Float | VA | - | R |
| 129 | 2 | Minimum apparent power b | Float | VA | - | R |
| 131 | 2 | Minimum apparent power c | Float | VA | - | R |
| 133 | 2 | Minimum active power a | Float | W | - | R |
| 135 | 2 | Minimum active power b | Float | W | - | R |
| 137 | 2 | Minimum active power c | Float | W | - | R |
| 139 | 2 | Min. reactive power a (VAR1) | Float | var | - | R |
| 141 | 2 | Min. reactive power b (VAR1) | Float | var | - | R |
| 143 | 2 | Min. reactive power c (VAR1) | Float | var | - | R |
| 145 | 2 | Min. neutral current | Float | A | - | R |
| 147 | 2 | Min. frequency | Float | Hz | 45 ... 65 | R |
| 155 | 2 | Min. total apparent power | Float | VA | - | R |
| 157 | 2 | Min. total active power | Float | W | - | R |
| 159 | 2 | Min. total reactive power (VAR1) | Float | var | - | R |
| 161 | 2 | Min. total power factor | Float | | - | R |
| 205 | 2 | Device diagnostics and device status* | Unsigned long | - | Byte 1 system status | R |

| Offset | Number of registers | Name | Format | Unit | Value range | Access |
|---|---|---|---|---|---|---|
| 207 | 2 | Status of the digital outputs* | Unsigned long | - | Byte 3<br>Bit 0 = output 0<br>Bit 1 = output 1 | R |
| 209 | 2 | Status of the digital inputs* | Unsigned long | - | Byte 3<br>Bit 0 = input 0<br>Bit 1 = input 1 | R |
| 217 | 2 | Relevant parameter changes counter | Unsigned long | - | - | R |
| 219 | 2 | Counter all parameter changes | Unsigned long | - | - | R |
| 501 | 2 | Cumulated active power import in the current period | Float | W | - | R |
| 503 | 2 | Cumulated reactive power import in the current period | Float | var | - | R |
| 505 | 2 | Cumulated active power export in the current period | Float | W | - | R |
| 507 | 2 | Cumulated reactive power export in the current period | Float | var | - | R |
| 509 | 2 | Maximum active power in the current period | Float | W | - | R |
| 511 | 2 | Minimum active power in the current period | Float | W | - | R |
| 513 | 2 | Maximum reactive power in the current period | Float | var | - | R |
| 515 | 2 | Minimum reactive power in the current period | Float | var | - | R |
| 517 | 2 | Length of the current period | Unsigned long | s | - | R |
| 519 | 2 | Time since the start of the instantaneous period | Unsigned long | s | - | R |
| 801 | 4 | Active energy (import, export, balance) | Double | Wh | Overflow 1.0e+12 | RW |
| 805 | 4 | Reactive energy (import, export, balance) | Double | varh | Overflow 1.0e+12 | RW |
| 2803 | 4 | Active energy (import, export, balance) | Float | Wh | Overflow 1.0e+12 | RW |
| 2805 | 4 | Reactive energy (import, export, balance) | Float | varh | Overflow 1.0e+12 | RW |

## A.2.6 Structure - Digital input status and digital output status with the function codes 0x03 and 0x04

The following are available via Modbus:

- "Status of the Digital Inputs"
- "Status of the Digital Outputs"

### Input status and output status of the PAC3100 Power Monitoring Device

Table A- 8 Structure - Status of the digital inputs and outputs, Modbus Offset 207 and 209

| Name | Length | Status | Byte | Bit | Bit mask | Access |
|---|---|---|---|---|---|---|
| Status: Digital output 0 | 32 bits | DO | 3 | 0 | 0x00000001 | R |
| Status: Digital output 1 | 32 bits | DO | 3 | 1 | 0x00000010 | R |
| Status: Digital input 0 | 32 bits | DI | 3 | 0 | 0x00000001 | R |
| Status: Digital input 1 | 32 bits | DI | 3 | 1 | 0x00000010 | R |

## A.2.7 Structure - Device diagnostics and device status with the function codes 0x03 and 0x04

### Structure

Table A- 9 Modbus offset 205, tab 2: Structure device status and device diagnostics

| Byte | Bit | Device status | Type | Bit mask | Value range | Access |
|---|---|---|---|---|---|---|
| 0 | 0 | No synchronization pulse | Status | 0x01000000 | 0 = Not active<br>1 = active | R |
| 0 | 1 | Device Configuration menu is active | Status | 0x02000000 | | R |
| 0 | 2 | Voltage overload | Status | 0x04000000 | | R |
| 0 | 3 | Current overload | Status | 0x08000000 | | R |
| 1 | 1 | Maximum pulse rate exceeded | Status | 0x00020000 | | R |
| 2 | 0 | Relevant parameter changes[1)] | saving | 0x00000100 | | R |
| 2 | 2 | Maximum pulse rate exceeded[1)] | saving | 0x00000400 | | R |
| 2 | 3 | Restart of the device[1)] | saving | 0x00000800 | | R |
| 2 | 4 | Resetting of energy counter by user[1)] | saving | 0x00001000 | | R |
| 1) Only these device statuses are to be acknowledged. | | | | | | |

## A.2.8 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- 10 Status parameters

| Offset | Number of registers | Name | Format | Value range | Access |
|---|---|---|---|---|---|
| 108 | 0 | Relevant parameter changes | Bit | 0 = Not active<br>1 = active | R |
| 110 | 0 | Maximum pulse rate exceeded | Bit | | R |
| 111 | 0 | Restart of the device | Bit | | R |
| 112 | 0 | Resetting of energy counter by user | Bit | | R |
| 117 | 0 | Maximum pulse rate exceeded | Bit | | R |
| 124 | 0 | No synchronization pulse | Bit | | R |
| 125 | 0 | Device Configuration menu is active | Bit | | R |
| 126 | 0 | Voltage overload | Bit | | R |
| 127 | 0 | Current overload | Bit | | R |
| 200 | 0 | Digital input 0 | Bit | | R |
| 201 | 0 | Digital input 1 | Bit | | R |
| 400 | 0 | Digital output 0 | Bit | | R |
| 401 | 0 | Digital output 1 | Bit | | R |

## A.2.9 Modbus settings with the function codes 0x03, 0x04 and 0x10

### Addressing the settings

You can use the MODBUS function codes 0x03, 0x04 for read accesses and 0x10 for write accesses on all the settings parameters listed below.

Table A- 11 Settings parameters

| Offset | Number of registers | Name | Unit | Format | Value range | | Access |
|---|---|---|---|---|---|---|---|
| 50001 | 2 | Connection type | - | unsigned long | 0 = | 3P4W | RW |
| | | | | | 1 = | 3P3W | |
| 50003 | 2 | Voltage measurement using voltage transformers? | - | unsigned long | 0 = | No | RW |
| | | | | | 1 = | Yes | |
| 50005 | 2 | Primary voltage | - | unsigned long | 1 ... 999999 V | | RW |
| 50007 | 2 | Secondary voltage | - | unsigned long | 1 ... 480 V | | RW |
| 50011 | 2 | Primary current | - | unsigned long | 1 ... 99999 A | | RW |
| 50013 | 2 | Secondary current | - | unsigned long | 5 A | | R |
| 50019 | 2 | Invert CT polarity by phase | - | unsigned long | 0 = | Normal direction | RW |
| | | | | | 1 = | Inverted direction | |
| | | | | | Bit 0 | L1 | |
| | | | | | Bit 1 | L2 | |
| | | | | | Bit 2 | L3 | |
| 50021 | 2 | Demand period | Min. | unsigned long | 1 ... 60 | | RW |
| 50023 | 2 | Synchronization | - | unsigned long | 0 = | No synchronization | RW |
| | | | | | 1 = | Synchronization via bus | |
| 50025 | 2 | Energy counting | - | unsigned long | LOWORD: kWh HIWORD: kVARh 0-2 | | RW |
| | | | | | 0 = | Import | |
| | | | | | 1 = | Export | |
| | | | | | 2 = | Balance | |

Table A- 12 Settings parameter for the digital output DO 0.0

| Offset | Number of registers | Name | Unit | Format | Value range | | Access |
|---|---|---|---|---|---|---|---|
| 50033 | 2 | DO 0.0 Vector Group Assignment | - | unsigned long | 0 ... 99 | | RW |
| 50035 | 2 | DO 0.0 Type of Use | - | unsigned long | 0 = | Off | RW |
| | | | | | 1 = | Remote output | |
| | | | | | 2 = | Energy pulse | |
| 50037 | 2 | DO 0.0 Source Count Signal | - | unsigned long | 0 = | Import kWh | RW |
| | | | | | 1 = | Export kWh | |
| | | | | | 2 = | Import kVARh | |
| | | | | | 3 = | Export kVARh | |
| 50039 | 2 | Pulses per unit (pulses per 1000 Wh / VARh) | - | unsigned long | 1 ... 999 | | RW |
| 50041 | 2 | Pulse length | ms | unsigned long | 30 ... 500 | | RW |

Table A- 13 Settings parameter for the digital output DO 0.1

| Offset | Number of registers | Name | Unit | Format | Value range | | Access |
|---|---|---|---|---|---|---|---|
| 50043 | 2 | DO 0.1 Vector Group Assignment | - | unsigned long | 0 ... 99 | | RW |
| 50045 | 2 | DO 0.0 Type of Use | - | unsigned long | 0 = | Off | RW |
| | | | | | 1 = | Remote output | |
| | | | | | 2 = | Energy pulse | |
| 50047 | 2 | DO 0.0 Source Count Signal | - | unsigned long | 0 = | Import kWh | RW |
| | | | | | 1 = | Export kWh | |
| | | | | | 2 = | Import kVARh | |
| | | | | | 3 = | Export kVARh | |
| 50049 | 2 | Pulses per unit (pulses per 1000 Wh / VARh) | - | unsigned long | 1 ... 999 | | RW |
| 50051 | 2 | Pulse length | ms | unsigned long | 30 ... 500 | | RW |

Table A- 14 Settings parameter for the language and the phase labels

| Offset | Number of registers | Name | Unit | Format | Value range | | Access |
|---|---|---|---|---|---|---|---|
| 50053 | 2 | Active language | - | unsigned long | 0 = | German | RW |
| | | | | | 1 = | English | |
| | | | | | 2 = | Portuguese | |
| | | | | | 3 = | Turkish | |
| | | | | | 4 = | Spanish | |
| | | | | | 5 = | Italian | |
| | | | | | 6 = | Russian | |
| | | | | | 7 = | French | |
| | | | | | 8 = | Chinese | |
| | | | | | 9 = | Polish | |
| 50055 | 2 | Phase labels IEC / ANSI | - | unsigned long | 0 = | IEC | RW |
| | | | | | 1 = | ANSI | |

Table A- 15 Settings parameter for the display

| Offset | Number of registers | Name | Unit | Format | Value range | | Access |
|---|---|---|---|---|---|---|---|
| 50057 | 2 | Refresh time | ms | unsigned long | 330 ... 3000 | | RW |
| 50059 | 2 | Contrast | - | unsigned long | 0 ... 10 | | RW |
| 50061 | 2 | Lighting | - | unsigned long | 0 = | OFF | RW |
| | | | | | 1 = | ON | |
| 50065 | 2 | Lighting duration until automatic shutdown | Min. | unsigned long | 0 ... 99<br>0 = no shutdown | | RW |

## A.2.10 MODBUS communication parameter with the function codes 0x03, 0x04 and 0x10

### Addressing the communication parameters

Table A- 16 Communication parameters

| Offset | Number of registers | Name | Unit | Format | Applicable MODBUS function codes | Value range from ... to | Access |
|---|---|---|---|---|---|---|---|
| 63007 | 2 | Bootloader version | - | unsigned long | • 0x03<br>• 0x04 | char, uchar, uchar, uchar | R |
| 63009 | 2 | Password protection ON/OFF | - | unsigned long | • 0x03<br>• 0x04 | 0, 1 | R |
| 63019 | 2 | MODBUS address | - | unsigned long | • 0x03<br>• 0x04<br>• 0x10 | 1 ... 247 | RW |
| 63021 | 2 | Baud rate | - | unsigned long | • 0x03<br>• 0x04<br>• 0x10 | 0 = 4,800 baud<br>1 = 9,600 baud<br>2 = 19,200 baud<br>3 = 38,400 baud | RW |
| 63023 | 2 | Data bits / Parity bits / Stop bits | - | unsigned long | • 0x03<br>• 0x04<br>• 0x10 | 0 = 8N2<br>1 = 8E1<br>2 = 8O1<br>3 = 8N1 | RW |
| 63025 | 2 | Response time | ms | unsigned long | • 0x03<br>• 0x04<br>• 0x10 | 0 ... 255<br>0 = Auto | RW |

## A.2.11 Modbus device information with the function codes 0x03, 0x04 and 0x10

### Addressing the device information parameters

You access the following device information parameters block-by-block only, e.g. read from Offset 64001 27 Register.

**NOTICE**

**Error in the case of inconsistent access to I&M data**

Please ensure the start offset and the number of registers are correct when making **read accesses** and **write accesses**. Always read or write the entire block.

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

If a value consists of several registers, a read command applied in the second register, for example, will generate an error code. The PAC3100 will also output an error code if, for example, a write operation ends in the middle of a multi-register value.

Table A- 17 I&M 0 parameters with the function codes 0x03 and 0x04

| Offset | Total registers | Number of registers per parameter | Name | Format | Value range from ... to | Access |
|---|---|---|---|---|---|---|
| **Start offset 64001** | **27** | [1] | Manufacturer's ID | unsigned short | 42*) | R |
| [64002] | | [10] | Order No. | Char 20 | ASCII | R |
| [64012] | | [8] | Serial number | Char 16 | ASCII | R |
| [64020] | | [1] | Hardware version | unsigned short | 0 ... 65535 | R |
| [64021] | | [2] | Firmware version | 1 char, 3 unsigned char | V 0.0.0 ... V 255.255.255 | R |
| [64023] | | [1] | Counter for changes | unsigned short | 1 ... 65535 | R |
| [64024] | | [1] | Profile ID | unsigned short | 3A00 ... F6FF | R |
| [64025] | | [1] | Specific Profile ID | unsigned short | - | R |
| [64026] | | [1] | Version of the I&M data | 2 unsigned char | 0.0 ... 255.255 | R |
| [64027] | | [1] | Supported I&M data | unsigned short | 00 ... FF | R |
| *) 42 stands for Siemens AG | | | | | | |

Table A- 18 I&M 1-4 parameters with the function codes 0x03, 0x04 and 0x10

| Offset | Total registers | Number of registers per parameter | Name | Format | Value range from ... to | Access |
|---|---|---|---|---|---|---|
| **Start offset 64028** | **89** | [16] | Plant identifier | Char 32 | ASCII | RW |
| [64044] | | [11] | Location identifier | Char 22 | ASCII | RW |
| [64055] | | [8] | Installation date | Char 16 | ASCII | RW |
| [64063] | | [27] | Comment | Char 54 | ASCII | RW |
| [64090] | | [27] | Signature | Char 54 | - | RW |

## A.2.12 Modbus command parameters

### Addressing the command parameters

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

Table A- 19 Command parameters

| Offset | Number of registers | Name | Unit | Format | Value range from ... to | | Access |
|---|---|---|---|---|---|---|---|
| 60000 | 1 | Reset the device to the factory settings | - | unsigned short | - | | W |
| 60001 | 1 | Device reset (without changing the Modbus address) | - | unsigned short | - | | W |
| 60002 | 1 | Reset maximum values | - | unsigned short | 0 | | W |
| 60003 | 1 | Reset minimum values | - | unsigned short | 0 | | W |
| 60004 | 1 | Reset energy counter | - | unsigned short | 0 = | All | W |
| | | | | | 1 = | Imported active energy | |
| | | | | | 2 = | Exported active energy | |
| | | | | | 3 = | Imported reactive energy | |
| | | | | | 4 = | Exported reactive energy | |
| 60005 | 1 | Synchronization of the demand period | Min. | unsigned short | 1 ... 60 | | W |
| 60007 | 1 | Acknowledge the diagnostics bit[1] (cf. stored bits in unsigned long beginning offset 205) | - | unsigned short | 0 ... ffffh | | W |
| 60008 | 1 | Switching outputs (if parameterized) | - | unsigned short | 0ffh ... 1ffh | | W |
| | | | | | Byte 0 = 0 | Digital output 0.0 | |
| | | | | | Byte 0 = 1 | Digital output 0.1 | |
| | | | | | Byte 1 = 0 | OFF | |
| | | | | | Byte 1 = 1 | ON | |
| 60009 | 1 | Switching command for vector group | - | unsigned short | High 0 ... 99, Low 0 ... 1<br>High byte group assignment<br>Low byte 1 = ON, 0 = OFF | | W |

1) The MODBUS master must acknowledge these diagnostics bits.

## A.2.13 MODBUS standard device identification with the function code 0x2B

### Addressing the MODBUS standard device identification

You can use MODBUS function code 0x2B on these device identification parameters.

Table A- 20 MODBUS standard device identification parameters

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

# ESD guidelines

# B

## B.1 Electrostatic sensitive devices (ESD)

ESD components are destroyed by voltage and energy far below the limits of human perception. Voltages of this kind occur as soon as a device or an assembly is touched by a person who is not electrostatically discharged. ESD components which have been subject to such voltage are usually not recognized immediately as being defective, because the malfunction does not occur until after a longer period of operation.

### ESD guidelines

**⚠ CAUTION**

**Electrostatic sensitive devices**

Electronic modules contain components that can be destroyed by electrostatic discharge. These modules can be easily destroyed or damaged by improper handling.

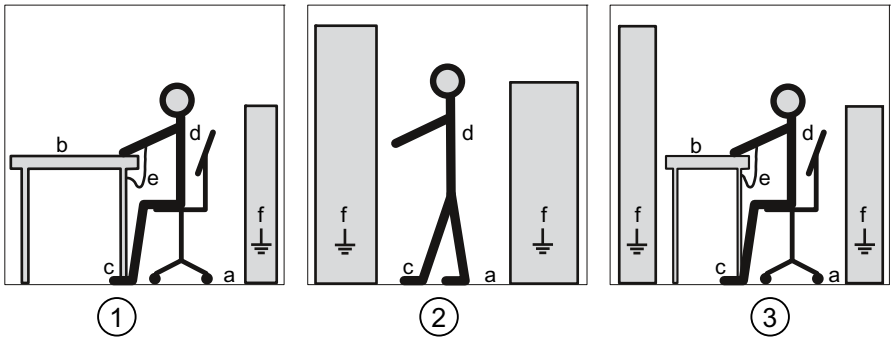
- You must discharge your body electrostatically immediately before touching an electronic component. To do this, touch a conductive, grounded object, e.g., a bare metal part of a switch cabinet or the water pipe.
- Always hold the component by the plastic enclosure.
- Electronic modules should not be brought into contact with electrically insulating materials such as plastic film, plastic parts, insulating table supports or clothing made of synthetic fibers.
- Always place electrostatic sensitive devices on conductive bases.
- Always store and transport electronic modules or components in ESD-safe conductive packaging, e.g. metallized plastic or metal containers. Leave the component in its packaging until installation.

**CAUTION**

**Storage and transport**

If you have to store or transport the component in non-conductive packaging, you must first pack the component in ESD-safe, conductive material, e.g., conductive foam rubber, ESD bag.

The diagrams below illustrate the required ESD protective measures for electrostatic sensitive devices.




(1) ESD seat

(2) ESD standing position

(3) ESD seat and ESD standing position

Protective measures

a Conductive floor

b ESD table

c ESD footwear

d ESD smock

e ESD bracelet

f Cubicle ground connection

# List of abbreviations

C

## C.1 Abbreviations

### Overview

Table C- 1 Meaning of abbreviations

| Abbreviation | Meaning |
|---|---|
| ANSI | American National Standards Institute |
| AWG | American Wire Gauge |
| CE | Communautés Européennes (French for "European Union") |
| CISPR | Comité international spécial des perturbations radioélectriques |
| CSA | Canadian Standards Association |
| DIN | Deutsches Institut für Normierung e. V. |
| EC | European Union |
| ESD | Electrostatic sensitive devices |
| EIA | Electronic Industries Alliance |
| EMC | Electromagnetic compatibility |
| EN | European Standard |
| EU | European Union |
| FCC | Federal Communications Commission |
| I&M | Information and Maintenance |
| ID | Identification number |
| IEC | International Electrotechnical Commission |
| IP | International Protection |
| ISM | Industrial, Scientific and Medical |
| ISO | International Standardization Organization |
| LCD | Liquid crystal display |
| LED | Light Emitting Diode |
| NAFTA | North American Free Trade Agreement |
| NEMA | National Electrical Manufacturers Association |
| PAC | Power Analysis & Control |
| PMD | Power Monitoring Device |
| RS | Formerly: Radio Selector; now usually: Recommended Standard |
| TCP/IP | Transmission Control Protocol/Internet Protocol |
| TRMS | True Root Mean Square |
| UL | Underwriters Laboratories Inc. |
| VDE | Association of Electrical Engineering, Electronics and Information Technology (Germany) |

# Glossary

### American Wire Gauge

American Wire Gauge is a number assigned to a specific conductor or wire cross-section.

### Balance

The PAC3100 calculates the energy balance for active energy and reactive energy. Balance equals import minus export.

### Baud rate

The baud rate is the rate of data transmission. It indicates the number of bits transferred in one second.

### Modbus RTU

Modbus RTU is a master/slave protocol which runs on a serial channel. On a Modbus RTU bus, only one device can assume the function of the bus master.

# Index

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