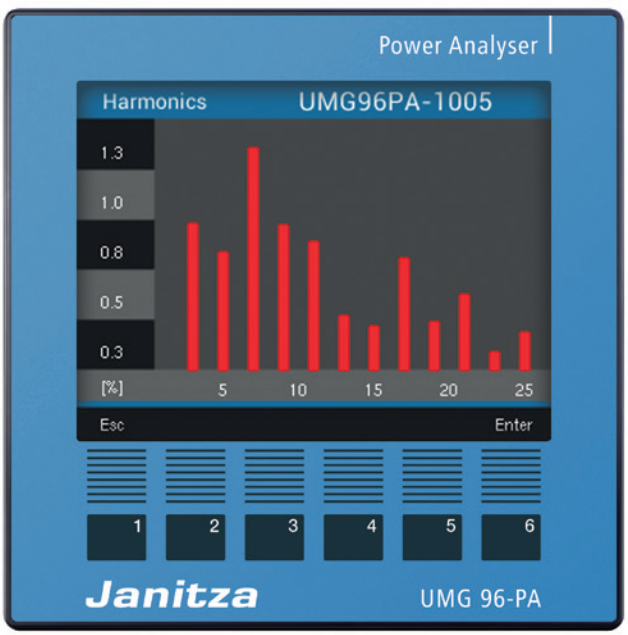
www.janitza.com

Power Quality Analyzer

UMG 96-PA

User Manual and Technical Data



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Content

1. General

1. 1 Disclaimer

Compliance with the information products for the devices is a precondition for the safe operation and for achieving the stated performance and product characteristics. Janitza electronics GmbH does not accept any liability for personal injury, material damage or financial loss incurred as a result of not complying with the information products. Ensure that your information products are kept easily accessible to read.

1. 2 Copyright notice

1. 3 Technical modifications

- Ensure that your device corresponds to the installation guide.
- First, read and understand the documents included with the product.
- Keep the product documents available for the entire life cycle of the product and provide them to any subsequent users.
- Learn about device revisions and the corresponding updates to the product documentation at www.janitza.de.

1. 4 Declaration of Conformity

The laws, norms and guidelines applied by Janitza electronics GmbH in the production of this product can be found in the declaration of conformity at www.janitza.de.

1. 5 Comments on the Manual

We welcome your comments. If anything in this manual seems unclear to you, please let us know by sending an **e-mail** to:
info@janitza.de

2. Safety

Please read this user manual as well as all other publications that must be referred to for working with this product. This applies especially to installation, operation and maintenance.

Please follow all safety instructions and warnings. Not following the instructions may result in personal injury or damage to the product.

Any unauthorized modifications to or use of this device that exceeds its stated mechanical, electric or other operational limits may result in personal injury or damage to the product.

Any such unauthorized modification constitutes "misuse" and/or "negligence" in the meaning of the warranty for this product, and therefore invalidates the warranty for the coverage of possible damages occurring as a result.

The User Manual:

- Read before operating the device.
- Keep available for the entire life cycle of the product and for reference.

Comply with the legal and safety guidelines required additionally for the specific instance of application when using the device.

2. 1 Safety Instructions

Symbols used:

As an addition to the safety instructions, this symbol indicates an electrical hazard.

Together with the word "Instructions," this symbol describes:
- Procedures that do not entail any risk of injury.
- Important information, procedures or actions.

Safety instructions are marked with a warning triangle and depicted as follows depending on the degree of hazard:

HAZARD! Indicates an immediate hazard that results in serious or fatal injury.

WARNING! Indicates a possibly hazardous situation that may result in serious or fatal injury.

CAUTION! Indicates a possibly hazardous situation that may result in minor injury or material damage.

2. 2 Safety Measures

When electrical devices are in operation, certain parts of these devices are necessarily subject to dangerous levels of voltage. Serious bodily harm or material damage may therefore result if they are not handled properly:

WARNING! **Risk of injury from electric voltage!**

Serious bodily harm or death may result from hazardous voltages.
For this reason, please note the following:

- **Before making connections, ground the device on the protective earth terminal, if available.**
- **Hazardous voltages can occur in any of the circuits connected to the voltage supply.**
- **There may be hazardous voltages inside the device even after disconnecting the voltage supply.**
- **Outfit single-wire leads with ferrules.**
- **Only connect screw terminals with the same number of poles that are of the same make.**
- **Before starting to work, de-energize the system.**

2. 3 Qualified Staff

This device is to be operated and maintained only by qualified staff.

Qualified staff are people who are able to recognize risks and avoid possible hazards that the operation or maintenance of the device may cause, based on their specialized training and their experience.

WARNING! **Risk of Injury from Improper Use**

If the device is not operated in accordance with the documentation, safety is no longer ensured and the device may pose a risk.

3. Intended Use

3. 1 Input Check

Proper transport and professional storage, installation and assembly, as well as careful control and maintenance, are all preconditions for the proper and safe operation of this device.

Perform unpacking and packing with the usual care and without the use of force, and only use suitable tools.

Perform a visual inspection of the devices to ensure a proper mechanical condition.

Check the delivery contents for completeness before starting to install the device.

If it is to be assumed that safe operation is no longer possible, the device is to be placed out of order immediately and protected against unintended operation. It is to be assumed that safe operation is no longer possible if the device e.g.:

- shows visible signs of damage,
- no longer functions despite an intact power supply,
- has been exposed to longer periods of adverse conditions (e.g. storage not consistent with the admissible climate limits without an adjustment of the room climate, thawing, etc.) or transport stresses (e.g. fall from a great height even without any outward visible signs of damage, etc.).

3. 2 Intended Use

The device is:

- intended to be built into control cabinets and small distribution boards.
- not intended to be built into vehicles! The use of the device in mobile equipment is considered an exceptional environment condition, and is only admissible with a separate agreement.
- not intended to be built into environments with hazardous oils, acids, gases, fumes, dust, radiation, etc.

ATTENTION!
All of the screw terminals included in the delivery contents are connected to the device.

ATTENTION!
All of the delivered options and design variants are described on the delivery note.

3. 3 Delivery Contents

Number	Art. no.	Name
1	52.32.xxx [1)]	UMG 96-PA
1	33.03.360	Installation Guide
1	33.03.361	"GridVis Software" Quick Start Guide
1	10.01.896	Screw terminal, pluggable, 3-pole (auxiliary energy)
1	10.01.849	Screw terminal, pluggable, 4-pole (voltage measurement)
1	10.01.871	Screw terminal, pluggable, 6-pole (current measurement)
1	10.01.909	Screw terminal, pluggable, 3-pole (RS 485)
1	10.01.865	Screw terminal, pluggable, 10-pole (digital inputs/outputs, analog output)
1	52.22.251	Mounting Kit

[1)] See delivery note for item number

3. 4 Deliverable accessories

Item no.	Name
21.01.058	Lithium battery CR2032, 3 V (Authorization as per UL 1642)
29.01.065	Seal, 96 x 96
15.06.015	Interface converter RS485 <-> RS232
15.06.025	Interface converter RS485 <-> USB

4. Product Description

The device is intended for:

- the measurement and calculation of electrical quantities such as voltage, current, power, energy, harmonics in the building installation, on distributors, circuit breakers and busbar distributors.
- the measurement of measuring voltages and currents originating in the same network.
- measurements in low-voltage networks in which rating voltages of up to 600 V conductor to ground and surges of overvoltage category III may occur.
- Measurement in medium and high-voltage networks usually does not occur through current or voltage transformers.
- being built into non-mobile control cabinets or small distribution boards. The position at which it is built in is arbitrary.
- measurement in medium- and high-voltage networks with current and voltage transformers.
- use in domestic and industrial settings.
- the measurement of current via external ../1 A or ../5 A current transformers.

The measurement results can be displayed and read out via the device interface for further processing.

4. 1 Measurement Procedure

The device:

- continuously measures and calculates all effective values over a 200 ms interval.
- measures the real effective value (TRMS) of the voltages and currents connected to the measurement inputs.

4. 2 Operating Design

You can program the device in many ways and/or recall measurement values.

- **Directly on the device** using the 6 keys and the display.
- Via the programming software **GridVis®.**
- You can change and open data with the help of the Modbus address list via the **Modbus protocol**. You can find this list at www.janitza.de.

This user manual only describes the 6-key operation of the device. The network analysis software GridVis® has its own "Online Help Guide."

4. 3 Network Analysis Software GridVis®

You can program the device and read out the data with the network analysis software GridVis® available at www.janitza.de. To do this, a PC must be connected to the device e.g. via a serial interface (RS485) or via a gateway connection.

With the network analysis software GridVis®, you can:

- program the device.
- configure and read out recordings.
- analyze the data you read out.
- save data in the database.
- display measurement values graphically.
- program client-specific applications.

CAUTION!

Malfunction can result from an improper connection

If the device is connected improperly, it may deliver measurement values with errors.
For this reason, please note the following:

- **Measurement voltages and measurement currents must come from the same network.**
- **Do not use the device to measure direct current.**
- **Earth the conducting patch boards.**

4. 4 Performance characteristics

General
- Front board installation device measuring 96 x 96 mm
- Expansion by modules
- Connection via plug-in terminals with screw connections
- Color graphics display 320 x 240 px
- Control via 6 keys
- 3 voltage measurement inputs (600 V, CAT III)
- 3 current measurement inputs (via current transformer)
- 3 digital outputs
- 3 digital inputs
  (configured as impulse counters with simultaneous power calculation
- 1 analog output (0 - 20 mA)
- Data storage 4 MByte Flash
- RS485 interface (Modbus RTU, Slave, up to 115 kbps)
- Recording of more than 2,000 measurement values
- Clock and battery
- Operating temperature range -10 °C .. +55 °C

Measurement uncertainty
- Active energy, measurement uncertainty class 0.5S for ../5A transformers
- Active energy, measurement uncertainty class 1 for ../1A transformers
- Reactive energy class 1

Measurement
- Recording of more than 800 measurement values
- Measurement in TN and TT networks
- Measurement in networks with rated voltages of up to L-L 720 V_{rms} and L-N 417 V_{rms} (as per IEC)
- Measurement range for current 0.005 .. 6 A_{rms}
- Real active value measurement (TRMS)
- continuous sampling of voltage and current measurement inputs
- Frequency range of the fundamental oscillation 45 Hz .. 65 Hz
- Measurement of the harmonics 1 to 25 for U_{LN} and I
- ULN, ULL, I, P (drawn/delivered), Q (ind./cap.)
- 2 tariffs (switching via Modbus or digital input 1)

4. 5 Product Overview

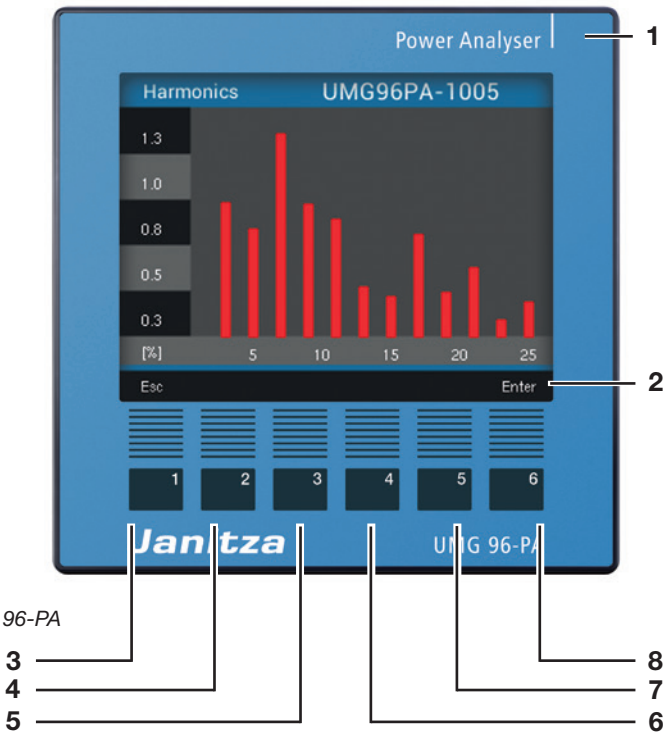


Fig. Front view of UMG 96-PA

1 Device Type
2 Description of the function keys
3 Key 1: Configuration menu, Back (ESC)
4 Key 2: Select digit, set option field (◂)
5 Key 3: Lower digit by 1, select menu item (▾), set option field (▾)
6 Key 4**:** Increase digit by 1, select menu item (▴), set option field (▴)
7 Key 5: Select digit, set option field (▸)
8 Key 6: Open option menu, activate entry, confirm selection (Enter)

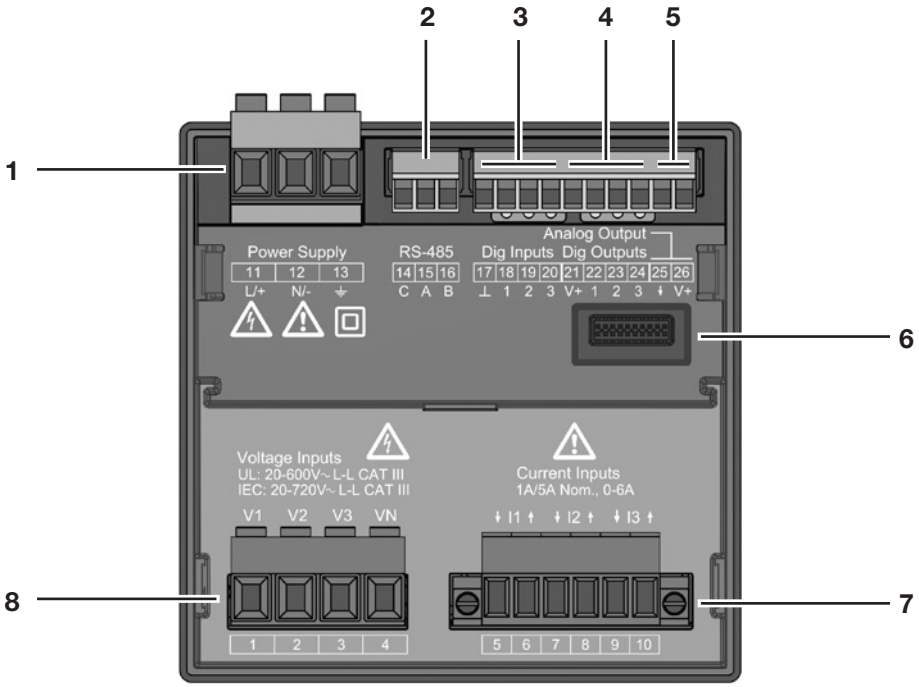


Fig. Back view of UMG 96-PA

1 Supply voltage
2 RS485 interface
3 Digital inputs
4 Digital outputs
5 Analog output
6 Module connector
7 Current measurement inputs I1 to I3
8 Voltage measurement inputs V1 to V3

5. Installation

5. 1 Installation site

The device is suitable for installation in non-mobile and weather-protected control panels in indoor environments.

Plan on an earth for conducting control panels.

CAUTION!

Material damage may result if the installation instructions are not followed!

Not following the installation instructions may damage or destroy your device.
Comply with the details on the installation position in sections „Installation“ and „Technical Data“.

5. 2 Installation position

The cut-out dimensions of the control panel are $92^{+0,8}$ mm x $92^{+0,8}$ mm.

To achieve sufficient ventilation, take the following measures:

- Install the device vertically.
- Maintain a minimum clearance of 50 mm above and below.
- Maintain a minimum clearance of 20 mm on each side.

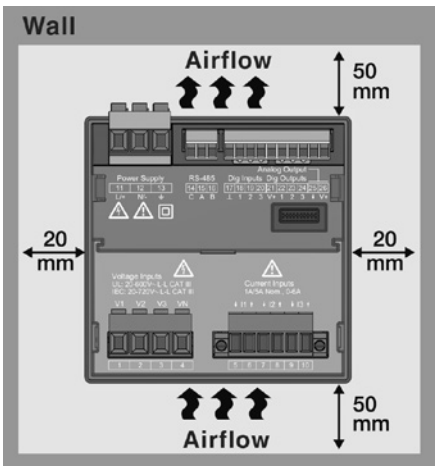


Fig. Back view of the installation position of the UMG 96-PA

5. 3 Securing the device

The device is secured in the control panel with the side mounting brackets. The brackets are to be removed e.g. using a screwdriver as a horizontal level before the device is put in.

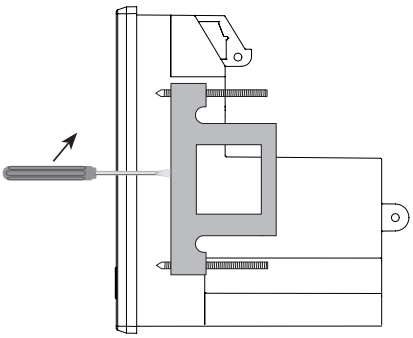
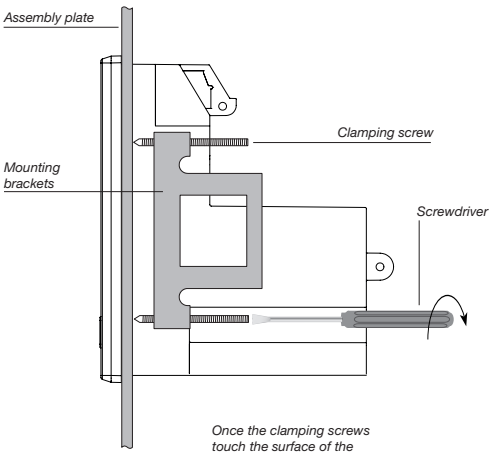


Fig. Side view of UMG 96-PA with mounting brackets. The brackets can be loosened by leveraging them horizontally with a screwdriver.

Then slide in and snap the brackets into place, and finally screw in the screws to secure the device.

- Turn the clamping screws until they just touch the assembly plate.
- Then tighten the clamping screws with two more rotations each (the mounting brackets may be destroyed if the screws are tightened too much).

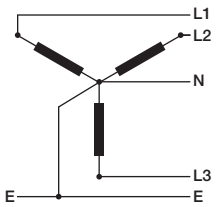


Once the clamping screws touch the surface of the assembly plate: use two further rotations at most to secure the device

6. Network systems

Network systems and maximum rated voltages as per DIN EN 61010-1/A1:

Three-phase four-wire systems
with earthed neutral conductor



IEC	U_{L-N} / U_{L-L}: 417 V_{LN} / 720 V_{LL}
UL	U_{L-N} / U_{L-L}: 347 V_{LN} / 600 V_{LL}

The device can be used in
- TN and TT networks
- domestic and industrial areas.

WARNING!

Risk of injury from electric voltage!

If the device is exposed to measurement voltage surges above the admissible overvoltage category, safety-related insulations in the device may be damaged, whereupon the safety of the product can no longer be guaranteed.
Only use the device in environments in which the admissible measurement surge voltage is not exceeded.

6. 1 Voltage measurement

You can use the UMG 96-PA to measure voltage in TN and TT systems.
Voltage measurement in the UMG 96-PA is designed for the overvoltage category 600V CATIII (measurement surge voltage 6 kV).

In systems without N, the measurement values that require an N are based on a calculated N.

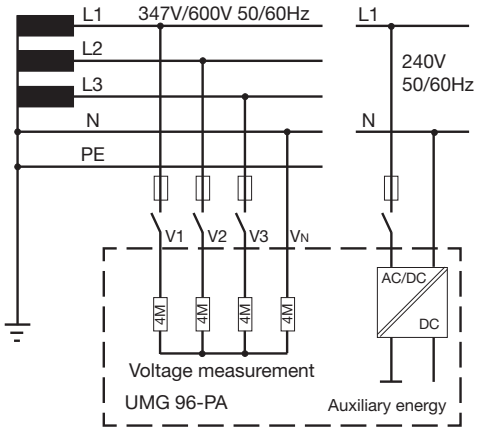


Fig. Principle circuit diagram - Measurement in three-phase 4-wire systems.

WARNING! **Risk of injury from electric voltage!**

If voltage transformers are used, the connections on the secondary side may **not** be short-circuited!
For this reason, please note the following:

- **Check that the voltage transformers have been properly installed. To do this, read the respective information about the voltage transformers.**

6. 2 Rated voltages

The following figures show lists of the networks and the corresponding network rated voltages at which the device can be used.

6. 2. 1 Three-phase 4-wire network with earthed neutral conductor

U_{L-N} / U_{L-L}	
66V / 115V	
120V / 208V	
127V / 220V	
220V / 380V	
230V / 400V	
240V / 415V	
260V / 440V	
277V / 480V	Maximum network voltage of the network as per UL
347V / 600V	
400V / 690V	
417V / 720V	Maximum network voltage of the network

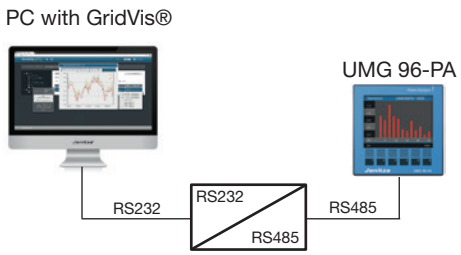
Fig. Network rated voltages as per EN 60664-1:2003 suited for measurement inputs

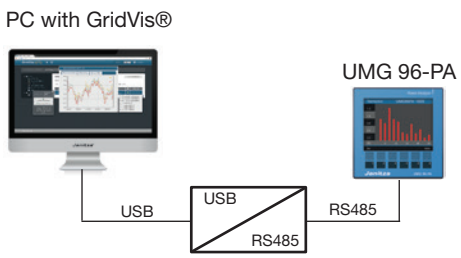
7. Installation

7. 1 Connection to a PC

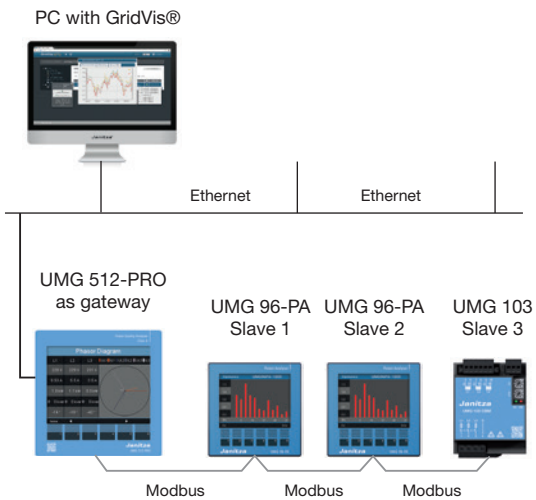
There are various options for connecting the device to a PC:

1. Connection via an interface converter:





2. Use of the UMG 96-PA (slave) via a UMG (master) with gateway functionality (e.g. UMG 512)



7. 2 Circuit breaker

For building installation, plan for a suitable circuit breaker for the supply voltage to de-energise the device.

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

7. 3 Supply voltage

The device needs a supply voltage to operate. The type and amount of supply voltage required for your device can be found on the ratings plate.

The supply voltage is connected on the rear of the device via terminal blocks.

Before connecting the supply voltage, ensure that the voltage and frequency correspond to the details on the ratings plate.

Connect the supply voltage through a UL/IEC approved fuse.

After the supply voltage has been connected, an indicator will appear on the display. If no indicator appears, check that the supply voltage is within the rated voltage range.

WARNING! **Risk of injury from electric voltage!**

Serious bodily harm or death may result from:

- Touching bare or stripped wires that are live.
- Inputs on the device that are dangerous to touch.

For this reason, please note the following:

- **The inputs for supply voltage are dangerous to touch.**
- **De-energise your system before starting work!**

CAUTION! **Material damage may result from failure to comply with the connection requirements.**

Noncompliance with the connection requirements may result in your device being damaged or destroyed.

For this reason, please note the following:

- **Comply with the details on voltage and frequency on the ratings plate.**
- **Connect the supply voltage through a fuse in accordance with the technical specifications.**
- **Do not source the supply voltage on the voltage transformers.**
- **Plan for a fuse for the neutral conductor if the neutral conductor connection to the source is not earthed.**

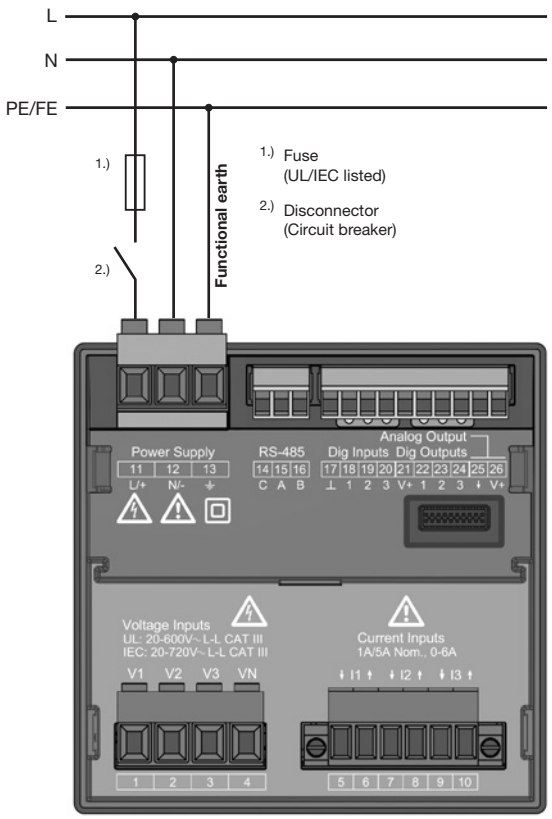


Fig. Connection example for supply voltage

ATTENTION!
If the functional earth is not connected, the device displays a non-applied residual voltage.

Overcurrent protective device for the line protection of the supply voltage

Recommendation for the overcurrent protective device for the line protection of the supply voltage, depending on the variants:

- Option 230 V:
  6 - 16 A (Char. B)
- Option 24 V:
  1 - 6 A (Char. B)

ATTENTION!
The circuit breaker serves only as line protection - it does not provide protection for the device!

Recommendation for the maximum number of devices on one miniature circuit breaker, depending on the variants:

- Option 230 V:
  For one miniature circuit breaker B6A, maximum of 4 devices.
  For one miniature circuit breaker B16A, maximum of 11 devices.
- Option 24 V:
  For one miniature circuit breaker B6A, maximum of 3 devices.
  For one miniature circuit breaker B16A, maximum of 9 devices.

7. 4 Measured voltage

The device has 3 voltage measurement inputs (V1 to V3) on the back of the device.

7. 4. 1 Overvoltage

The voltage measurement inputs are suitable for measurement in networks in which overvoltage of category 600 V CAT III (voltage measurement surge of 6 kV) may occur.

7. 4. 2 Frequency

The device:

- requires the network frequency to measure and calculate the measurement values.
- is suitable for measurement in networks in which the fundamental oscillation of the voltage is within the range of 45 to 65 Hz.

The network frequency is derived from the measured voltage in phase L1. The sampling rate of the voltage and current measurement inputs is derived from the network frequency.

If the measurements have severely distorted voltages, it will no longer be possible to precisely determine the frequency of the fundamental oscillation of the voltage. I.e. the corresponding network frequency should be stipulated for measured voltages that exhibit severe distortions.
(Voltage distortions occur e.g. in measurements of consumers operated with a phase angle control). Current distortions do not affect the determination of the frequency.

More information can be found in Section 12 *Configuration / Rated frequency*"

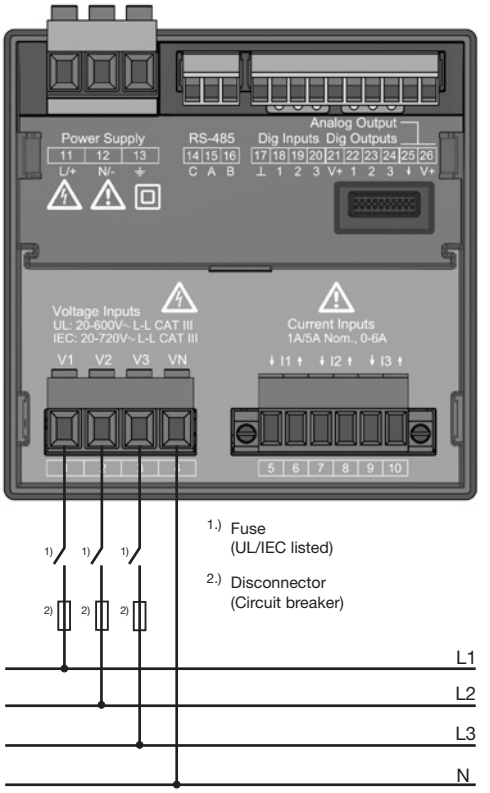


Fig. Connection example for voltage measurement.

WARNING! **Risk of injury from electric voltage!**

Serious bodily harm or death may result from not complying with the connection requirements for the voltage measurement inputs.

For this reason, please note the following:

- **De-energise your system before starting work! Check that it has been de-energised!**
- **Connect voltages that are over the admissible network rated voltages through voltage transformers.**
- **The voltage measurement inputs on the device are dangerous to touch!**
- **Install a circuit breaker as described in Section „7. 2 Trennschalter“.**
- **Use a UL/IEC approved overvoltage protective device with a rating value that is measured for short-circuit current at the point of connection.**

CAUTION! **Malfunction can result from an improper connection**

If the device is connected improperly, it may deliver measurement values with errors.

For this reason, please note the following:

- **Measurement voltages and currents must come from the same network.**
- **The device is not suitable for measuring direct current.**

ATTENTION!

The device can only determine measurement values if there is a voltage L1-N greater than 20 V_{eff} (4-wire measurement) or a voltage L1-L2 greater than 34 V_{eff} (3-wire measurement) at the voltage measurement input V1.

As an overvoltage protective device for the voltage measurement, use a line protection (1 - 10 A) with IEC/UL approval.

7. 4. 3 Connection variants for voltage measurement

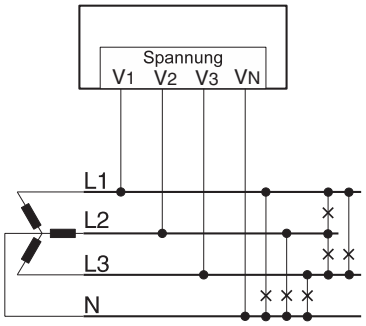


Fig. Voltage measurement in the three-phase four-wire system

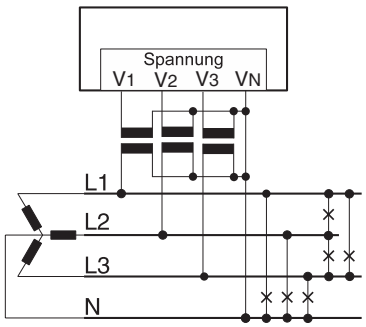


Fig. Voltage measurement in the three-phase four-wire system

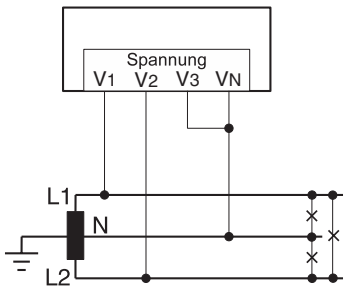


Fig. Voltage measurement in the single-phase three-wire system

7. 5 Current measurement

The device:

- is designed to be connected to current transformers with secondary currents of ../1 A and ../5 A.
- is only approved for measuring current through current transformers.
- does not measure direct currents.

The factory preset current transformer ratio is 5/5 A, and may need to be adjusted to the current transformer in use.

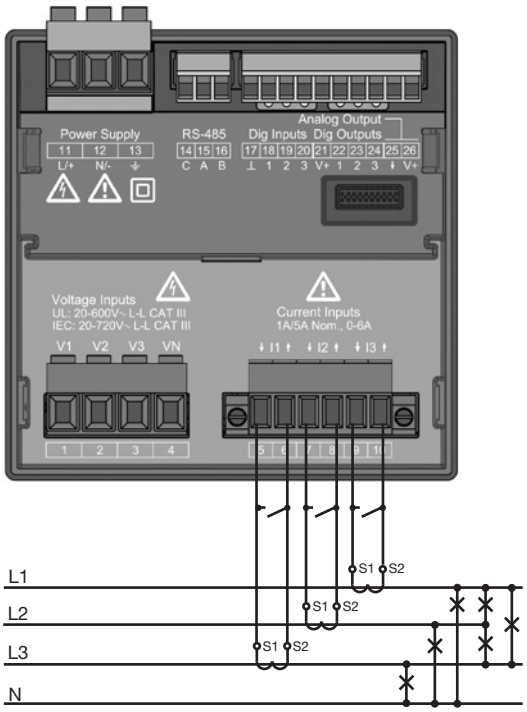


Fig. Connection example "Current measurement through a current transformer."

WARNING!

Risk of injury from electric voltage on the current transformers!

Voltage peaks that are extremely dangerous to touch may occur on current transformers operated with an open secondary side that may result in serious bodily harm or death.

For this reason, please note the following:

- **De-energise your system before starting work! Check that it has been de-energised!**
- **Avoid open operation of the current transformers.**
- **Short-circuit uncharged current transformers.**
- **The secondary terminals of the current transformer must be short-circuited before the power supply lines are disconnected.**
- **If a test switch that automatically short-circuits the current transformer secondary leads is available, it is sufficient to put this into the "test" position provided the short-circuiters have been checked beforehand.**
- **Only use current transformers that have a base insulation as per IEC 61010-1:2010.**
- **Ensure that the attached screw terminal is sufficiently secured to the device with the two screws.**
- **Even "open-safe" current transformers are dangerous to touch if they are operated openly.**

WARNING!

Risk of injury from electric voltage!

At high measurement currents, temperatures of up to 80 °C can develop at the terminals. **Therefore, use leads that are designed to have an operating temperature of at least 80 °C.**

7. 5. 1 Direction of the current

The current direction can be individually corrected on the device or via the serial interfaces for each phase.

In the case of incorrect connection, the current transformer does not need to be subsequently reconnected.

7. 5. 2 Total current measurement

If the current measurement takes place via two current transformers, the total transformer ratio of the current transformer must be programmed on the device. Setting the current transformer ratios is described in Section „Messwandler“.

Example:
The current measurement is performed via two current transformers. Both current transformers have a transformer ratio of 1000/5 A. The total measurement is then carried out with a total current transformer 5+5/5 A .

The device must then be set as follows:

Primary current:
1000 A + 1000 A = 2000 A
Secondary current: 5 A

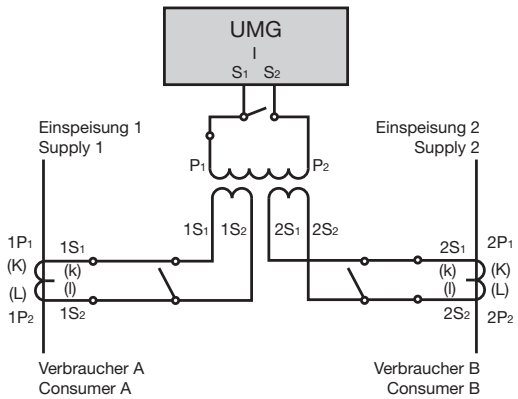


Fig. Example of voltage measurement via a total current transformer

7. 5. 3 Ammeter

If you want to measure the current not only with the UMG but also with the ammeter, the ammeter must be connected in series to the UMG.

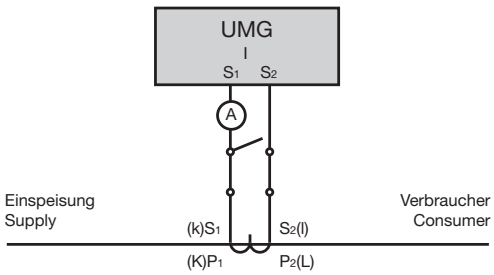


Fig. Circuit diagram with additional ammeter connected in series

8. Interface

The RS485 interface in this device is a 3-pole plug contact that communicates via the Modbus RTU protocol.

Cable types:

- ***Recommendation: Unitronic Li2YCY(TP) 2x2x0.22 (Lapp cable)***

Connection options for the connectors:
- 0.2 - 1.5 mm²
  (see Section "Technical Data")

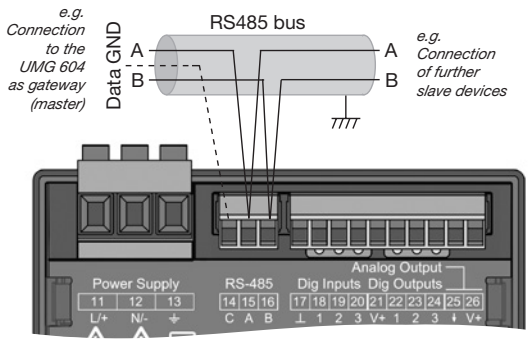


Fig. RS485 interface, 3-pole plug contact

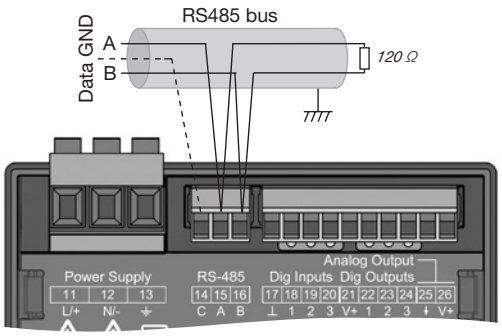


Fig. RS485 interface, 3-pole plug contact with termination resistor (item no. 52.00.008)

ATTENTION!
CAT cables are not suitable for bus wiring. Use the cable types recommended for this purpose.

8. 1 Screening

Use a drilled and shielded cable for the connections via the interface, and observe the following points for the shielding:

- Earth the screens of all cables that lead to the cabinet where they enter the cabinet.
- Connect the screen over a larger area and in a manner that will conduct well, to a low-noise earth.
- Do **NOT** connect the screen to terminal C (GND)
- Gather the cables mechanically above the earthing clamp in order to avoid damage due to cable movement.
- Use suitable cable glands to feed the cables into the cabinet - for example armored conduit couplings.

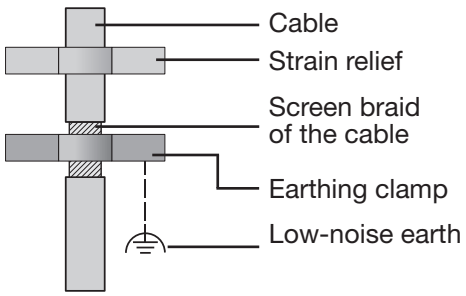


Fig. Screening procedure at cabinet entry.

CAUTION!

Transmission errors and risk of injury result from electrical interference.

Atmospheric discharge may cause transmission errors and hazardous voltages on the device.

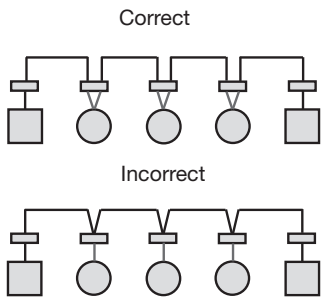
For this reason, please note the following:

- **Place the screening on the functional earth (PE) at least once.**
- **For larger sources of interference, put the frequency inverter in the control cabinet and position the screening as close as possible on the device to the functional earth (PE).**
- **Maintain a maximum cable length of 12000 m at a baud rate of 38.4 k.**
- **Use screened cables.**
- **Position interface leads so they are spatially separated or additionally insulated from the components carrying network voltage.**

8. 2 Termination resistors

The cable is terminated with resistors (120 Ohm, 1/4 W) at the beginning and at the end of a segment.

The device does not contain any termination resistors.



Terminal strip in the cabinet.

Device with RS485 interface. (without termination resistor)

Device with RS485 interface. (with termination resistor on the device)

8. 3 Bus structure

- All devices are connected in a bus structure (line).
- Each device has its own address within the bus (see also Parameter programming).
- Up to 32 subscribers can be connected together in a single segment.
- The cable is terminated with resistors (bus termination 120 Ohm, 1/4 W) at the beginning and at the end of a segment.
- With more that 32 subscribers, repeaters (amplifiers) must be used to connect the individual segments.
- Devices for which the bus connection is switched on must be under current.
- It is recommended that the master be placed at the end of a segment.
- If the master is replaced with a bus connection, the bus must be switched off.
- Replacing a slave with a bus connection that is either switched on or de-energised can destabilise the bus.
- Devices that are not connected to the bus can be replaced without destabilising the bus.

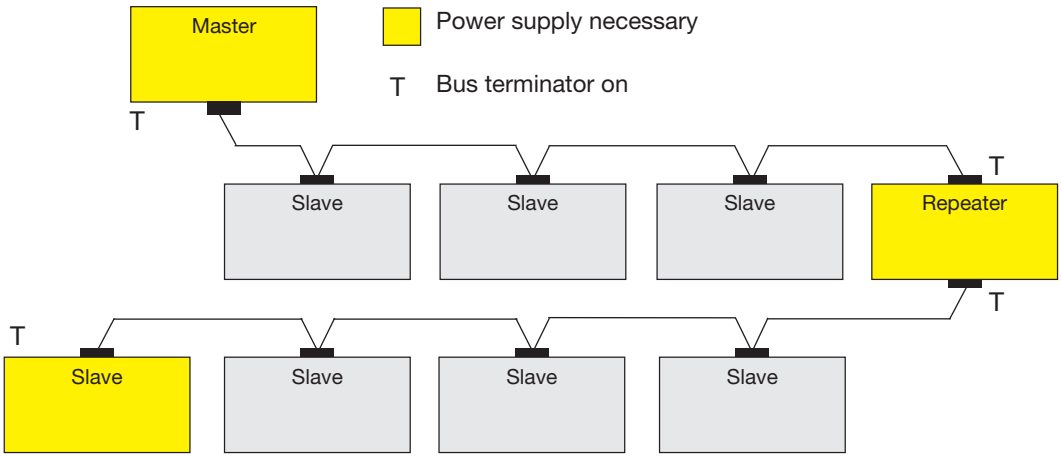


Fig. Bus structure

9. Digital inputs and outputs

The device has
- 3 digital inputs and
- 3 digital outputs.

9. 1 Digital inputs

The UMG96-PA has three digital inputs to each of which you can connect one signal transducer. When a signal is present, the corresponding LED lights up green.

An input signal is detected on a digital input if
- a voltage of at least 18 V and maximum 28 V DC (typically at 4 mA) is applied.
- a current of at least 1 mA and maximum 6 mA flows.

ATTENTION!
Note the correct polarity of the supply voltage.

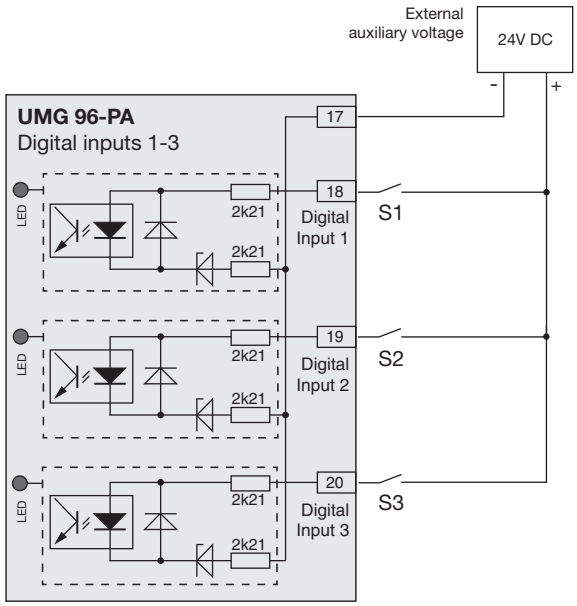


Fig. Example for the connection of external switch contacts S1-S3 to digital inputs 1, 2 and 3.

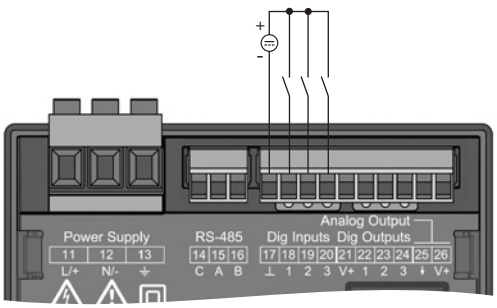


Fig. Connection of digital inputs

CAUTION!

Transmission errors and material damage result from electrical interference.

For wiring over 30 m, there is an increased probability of transmission errors and damage to the device from atmospheric discharge.
Use screened wiring for connections to the digital inputs and outputs.

9. 1. 1 S0 pulse input

You can connect an S0 pulse transducer per DIN EN62053-31 to any digital input.

This requires an auxiliary voltage with an output voltage in the range 18 .. 28V DC and a resistor of 1.5 kOhm.

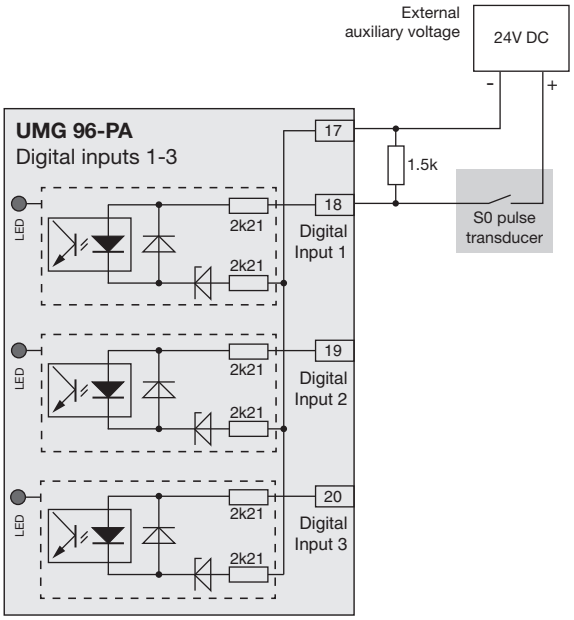


Fig. Example for the connection of an S0 pulse transducer to digital input 1.

9. 2 Digital outputs

The device has three digital outputs which:

- are galvanically separated from the analysis electronics using optocouplers.
- have a joint reference.
- are **not** short-circuit proof.
- require an external auxiliary voltage.
- can be used as impulse outputs.
- can switch between AC and DC loads.
- can be controlled via Modbus.
- can display the results of comparators.

CAUTION!

Material damage from connection errors

The digital outputs are not short-circuit proof! Connection errors may therefor result in damage to the connections.
Pay attention to the correct wiring when connecting to the outputs.

ATTENTION!

Functions for the digital outputs can be adjusted clearly in the GridVis® software (see www.janitza.de).
Use of the GridVis® software requires a connection between the device and the PC via an interface.

CAUTION!

Measurement errors in use as pulse output

When using the digital outputs as a pulse output, measurement errors may result from residual ripple.
So use a power adapter whose residual ripple is less than 5% for the supply voltage (DC) to the digital inputs and outputs.

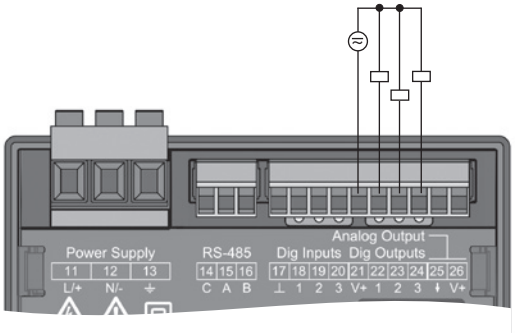


Fig. Connection of digital/pulse outputs

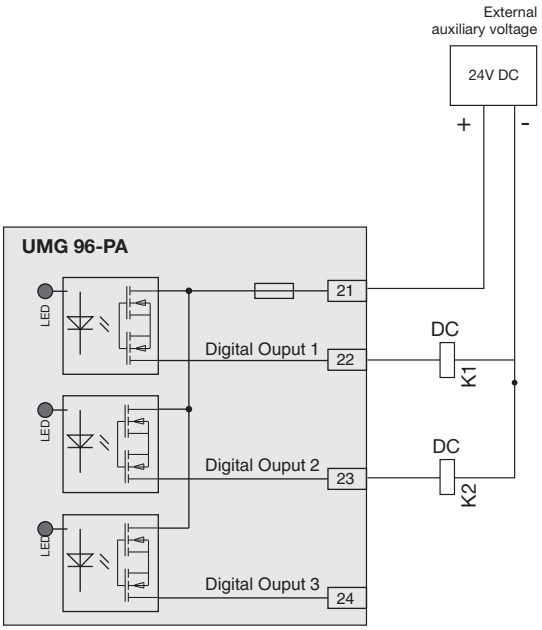


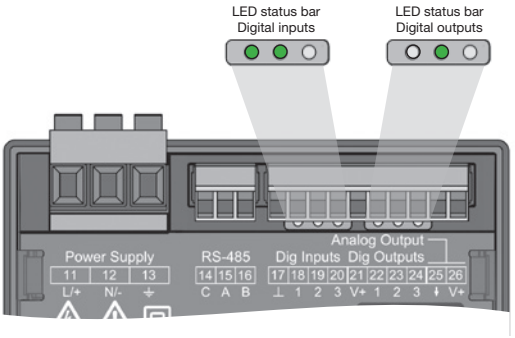
Fig. Example for the connection of two relays to the digital outputs

9. 3 LED status bar

The different statuses of the inputs and outputs are displayed via the LED status bar on the back of the device.

Digital inputs
The LED assigned to a respective input lights up green when a signal of at least 1 mA flows on this interface.

Digital outputs
The LED assigned to a respective output lights up red when the output is set as enabled - regardless of whether there is a continuing connection to this interface.

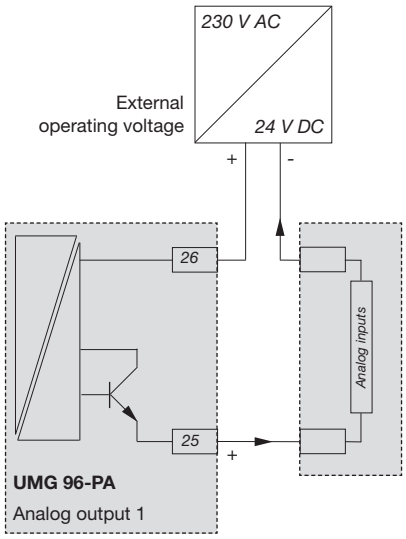


10. Analog output

The device has 1 passive analog output, which can emit current of 0 - 20 mA. An external power adapter (24 V DC) is required for operation.

The connected load impedance may not exceed a resistance of 300 Ohm.
If the analog output is connected to greater resistance, the output range (20 mA) is limited.

The measurement value, initial and final values, and the output range *4 - 20 mA* or *0 - 20 mA* assigned to the analog output can be set using the GridVis® software (cf. Section 13 "*Analog Output*")



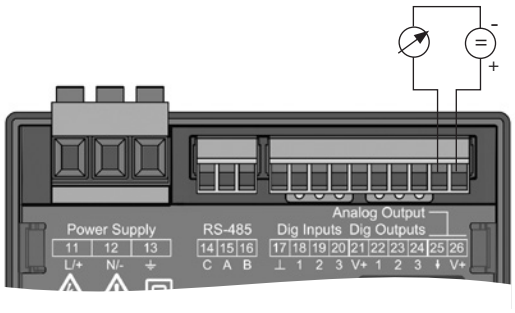


Fig. Analog output connection

11. Operation

The device is operated using six function keys that are assigned to different functions, depending on the context:

- Selection of measurement value displays.
- Navigation in the menu.
- Control of device settings.

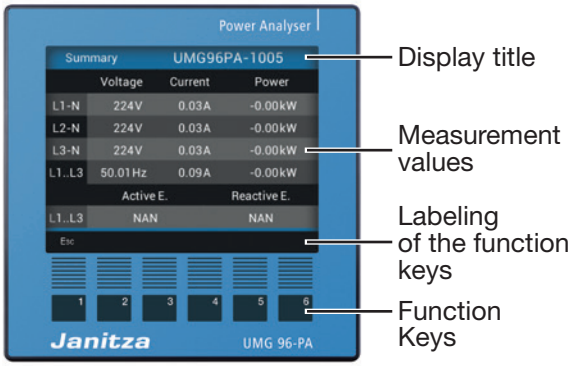


Fig. UMG 96-PA Measurement value display "Overview"

11. 1 Key assignment

Key	Function
1	• Option menu • Leave menu, Back (Esc) • Press multiple times: Back to the measurement value display "*Overview*"
2	• Select digit • Set option field (◀)
3	• Change (Digit -1) • Set option field (▼) • Select menu item (▼)
4	• Change (Digit +1) • Set option field (▲) • Select menu item (▲)
5	• Select digit • Set option field (▶)
6	• Open option menu • Activate entry • Confirm selection (Enter)

11. 2 Measurement value display "Overview"

After returning to the network, the device starts with the measurement value display "*Overview*."

This measurement value display includes the device name and an overview of the important measurement values. In its delivery state, the device name consists of the device type and the serial number of the device.

Press key 1 (Esc) repeatedly to open the measurement value display "*Overview*."

Summary	UMG96PA-1005		
	Voltage	Current	Power
L1-N	224V	0.03A	-0.00kW
L2-N	224V	0.03A	-0.00kW
L3-N	224V	0.03A	-0.00kW
L1..L3	50.01Hz	0.09A	-0.00kW
	Active E.		Reactive E.
L1..L3	NAN		NAN
Esc			

Fig. Measurement value display "Overview"

11. 3 Option menu

If you are in the measurement value display "*Overview*," open the main menu with key 1 (Esc).

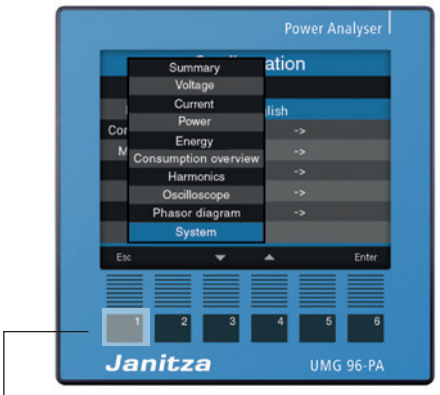
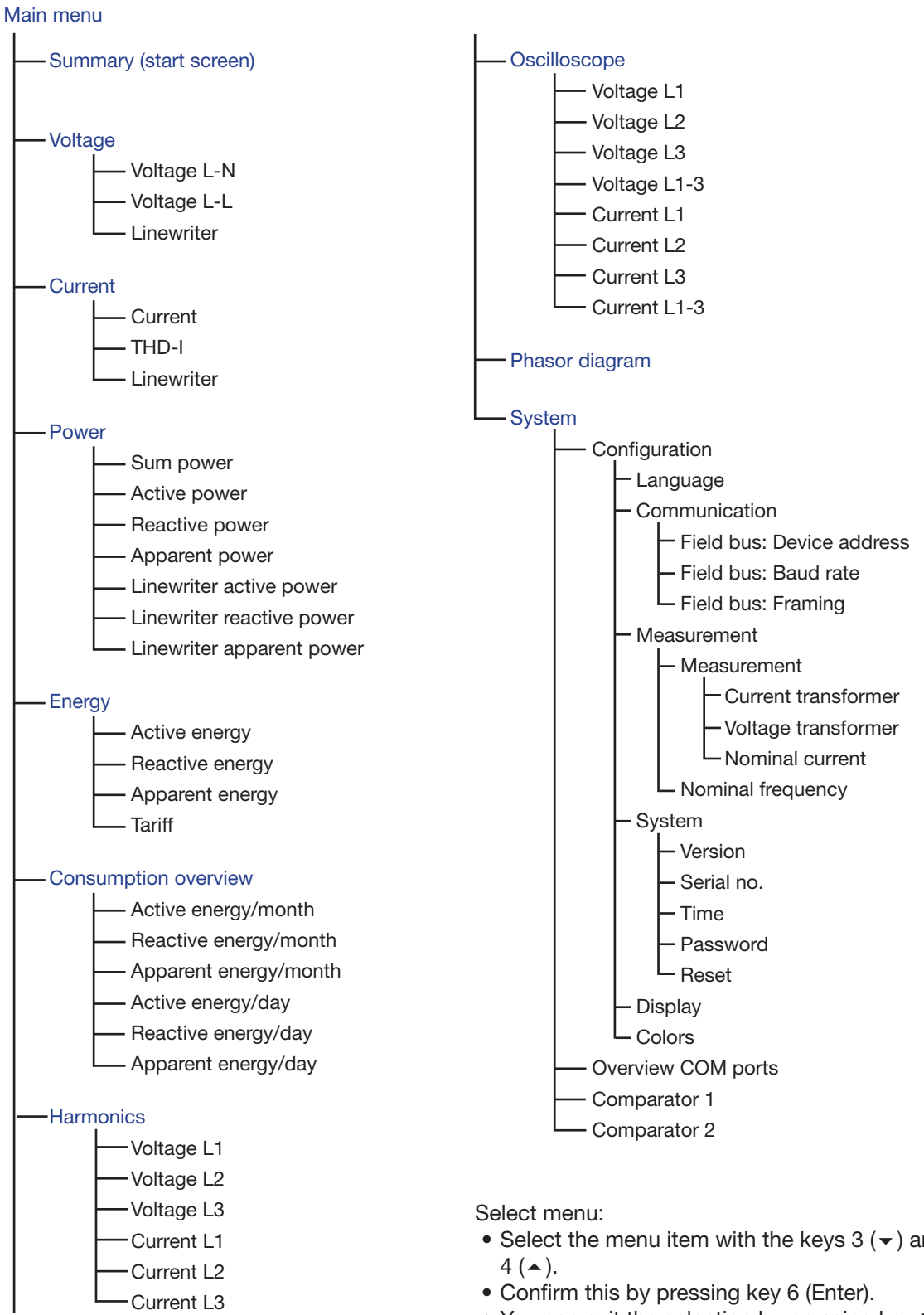


Fig. UMG 96-PA Main menu

11. 4 Overview of menu displays



Select menu:

- Select the menu item with the keys 3 (▼) and 4 (▲).
- Confirm this by pressing key 6 (Enter).
- You can exit the selection by pressing key 1 (Esc).

12. Configuration

The device must be connected to a power supply to configure it. To do so, proceed as described in „13. 1 Versorgungsspannung“.

- If you are **not** in the measurement value display "*Overvie*w," switch to this view by repeatedly pressing key 1 (Esc).
- Open the main menu with key 1 (Esc). With keys 3 (▼) and 4 (▲), select "*System*" and confirm your selection with key 6 (Enter).
- Select "*Configuration*" and confirm by pressing key 6 (Enter).

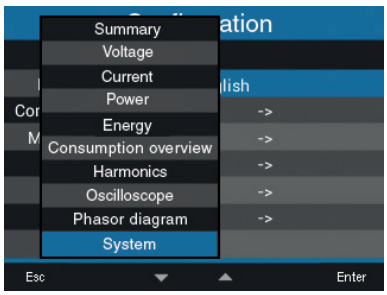


Fig. Main menu, Selection "System"

12. 1 Language

In the configuration menu, you can set the language for the measurement value displays and menus in "*Language*."

- Open the configuration menu (see Section 12 "*Configuration*").
- With keys 3 (▼) and 4 (▲), select the item "*Language*."
- Confirm by pressing key 6 (Enter).

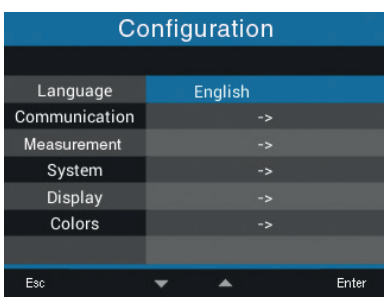


Fig. Configuration menu, Selection "Language"

- With keys 3 (▼) and 4 (▲), select the language you want ("*German*," "*English*").
- Confirm your selection by pressing key 6 (Enter).
- Exit the configuration with key 1 (Esc).
- Open the main menu with key 1 (Esc).
- Select the measurement value display you want with keys 3 (▼) and 4 (▲). Confirm your selection by pressing key 6 (Enter) or jump directly to the measurement value display "*Overview*" by pressing key 1 (Esc).

12. 2 Communication

Set the parameters for the RS485 interface of your device in the configuration menu.

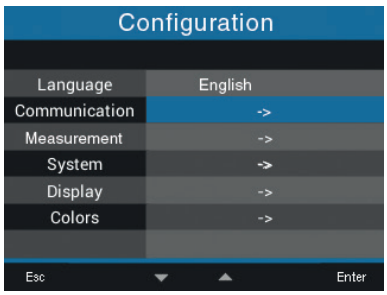


Fig. Configuration menu, Selection "Communication"

- Open the configuration menu (see Section 12 "*Configuration*").
- With keys 3 (▼) and 4 (▲), select the menu item "*Communication*."
- Confirm by pressing key 6 (Enter).
- With keys 3 (▼) and 4 (▲), select the parameter you want
  - Device address,
  - Baud rate
  - Data framework.
- Confirm your selection by pressing key 6 (Enter).
- Change the parameter sizes with keys 3 (▼) and 4 (▲).
  Device address: Set the digit position with keys 2 (◀) and 5 (▶).
- Confirm by pressing key 6 (Enter).
- Exit the menu "*Communication*" with key 1 (Esc).

- Exit the configuration menu with key 1 (Esc).
- Open the main menu with key 1 (Esc).
- Select the measurement value display you want with keys 3 (▼) and 4 (▲). Confirm your selection by pressing key 6 (Enter) or jump directly to the measurement value display "*Overview*" by pressing key 1 (Esc).

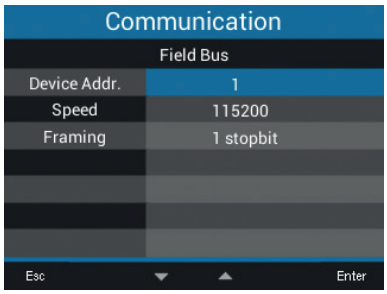


Fig. Menu Communication, Selection "Device address"

Settings:

- Device address:
  Select a device address for the device that the device will be addressed with in the bus. This address must be unique within the bus structure.
  Settings range: *1 - 250*
  Default: *1*
- Baud rate:
  Select a uniform baud rate for all of the devices within the bus structure.
  Settings range: *Auto, 9600, 19200, 38400, 57600, 115200 kbps*
  Default: *Auto*
- Data framework:
  Select a uniform data framework for all of the devices within the bus structure.
  Settings range:
  - "*odd*" (parity odd with 1 stop bit)
  - "*even*" (parity even with 1 stop bit)
  - "*1 stop bit*" (parity none with 1 stop bit)
  - "2 stop bits" (parity none with 2 stop bits)
  - Default: *1 stop bit (no parity)*

CAUTION!

Material damage may result from incorrect network settings.

Incorrect network settings may cause interruptions in the IT network.
Find out about the correct network settings for your device from your network administrator.

12. 3 Measurement

In the menu "*Measurement*," you can set the ratio of the current and voltage transformers (primary-to-secondary side), the rated current and the rated frequency.

12. 3. 1 Rated current

The network frequency is required to measure and calculate the measurement values. The device is suitable for measurements in networks that have a frequency range of 45 - 65 Hz.

- Open the configuration menu (see Section 12 "*Configuration*").
- With keys 3 (▼) and 4 (▲), select the menu item "*Measurement*" from the configuration menu.
- Confirm by pressing key 6 (Enter).
- With keys 3 (▼) and 4 (▲), select the item "*Rated frequency*" and confirm your selection with key 6 (Enter).

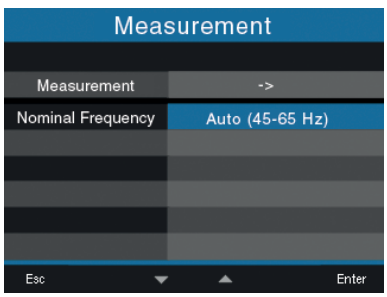


Fig. Menu Measurement, Selection Rated frequency

- With keys 3 (▼) and 4 (▲) select the setting you want, and confirm the selection with key 6 (Enter). You can abort this action by pressing key 1 (Esc).
- Exit the menu "*Measurement*" with key 1 (Esc).
- Exit the configuration menu with key 1 (Esc).
- Open the main menu with key 1 (Esc).
- Select the measurement value display you want with keys 3 (▼) and 4 (▲). Confirm your selection by pressing key 6 (Enter) or jump directly to the measurement value display "*Overview*" by pressing key 1 (Esc).

Settings range:
- *Auto (45-65 Hz)*
- *60 Hz (fixed frequency)*
- *50 Hz (fixed frequency)*

Default
- *Auto (45-65 Hz)*

ATTENTION!
Devices that use automatic frequency
frequency detection will require about 5 seconds to determine the network frequency. During this time, the measurement values do not adhere to the guaranteed measurement uncertainty.

The device can only determine the network frequency if there is a voltage L1-N greater than 20 V_{eff} (4-wire measurement) or a voltage L1-L2 greater than 34 V_{eff} (3-wire measurement) at the voltage measurement input V1.

ATTENTION!
If the network frequency is outside of the range 45-65 Hz
- no error or warning notification will be sent.
- the corresponding setting will be used for the entry of a constant frequency (*50 / 60 Hz*).
- The last determined frequency in the range 45-65 Hz is used for the selection of the automatic frequency detection (*auto*).

ATTENTION!
It takes 10 seconds to determine the frequency. The frequency does **not** represent a 200 ms measurement value!

12. 3. 2 Current and voltage transformers / Nominal current

For the defined operation of the device it is necessary to set the correct current and voltage transformer ratios and the nominal current.

When connecting voltage transformers, observe the measured voltage on the ratings plate!

- Open the configuration menu (see Section 12 "*Configuration*").
- With keys 3 (▼) and 4 (▲), select the menu item "*Measurement*" from the configuration menu.
- Confirm by pressing key 6 (Enter).
- With keys 3 (▼) and 4 (▲), select the sub-menu "*Rated Measurement*" and confirm your selection with key 6 (Enter).
- With keys 2 to 5 (◀) and 4 (▼) select the setting you want, and confirm the selection with key 6 (Enter).
- Set the digit position with keys 2 (◀) and 5 (▶).
- With keys 3 (▼) and 4 (▲) change the digit (-1 / +1).
- Confirm by pressing key 6 (Enter) or abort the action by pressing key 1 (Esc).
- Exit the view "*Measurement L1..L3*" with key 1 (Esc).
- Exit the view "*Measurement*" with key 1 (Esc).
- Exit the configuration menu with key 1 (Esc).
- Open the main menu with key 1 (Esc).
- Select the measurement value display you want with keys 3 (▼) and 4 (▲). Confirm your selection by pressing key 6 (Enter) or jump directly to the measurement value display "*Overview*" by pressing key 1 (Esc).

ATTENTION!
The adjustable value of 0 for the primary current transformer doesn't make any sense and may not be used.

Settings:
- Current transformer (primary):
  Settings range: *0 - 32000 A*
  Default: *5 A*
- Current transformer (secondary):
  Settings range: *0 - 5 A*
  Default: *5 A*
- Voltage transformer (primary):
  Settings range: *0 - 32000 V*
  Default: *400 V*
- Voltage transformer (secondary):
  Settings range: *0 - 999 V*
  Default: *400 V*
- Rated current:
  Settings range: *0 - 999999 A*
  Default: *150 A*

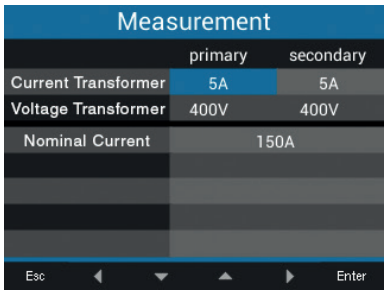


Fig. View "Measurement L1..L3," Configuration of the current and voltage transformer ratios and the rated voltage

12. 4 System

Display of device-specific system settings, password assignment and value reset function.

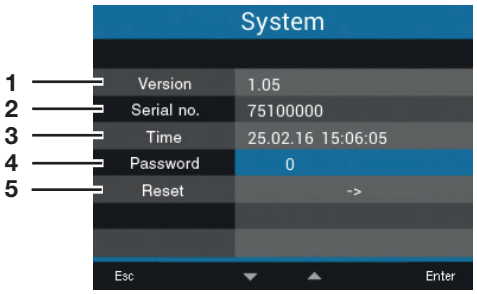


Fig. View "System"

1 Firmware version
2 Device serial number
3 Device time / date
4 Password function
5 Reset settings

View of the display "*System*":
- Open the configuration menu (see Section 12 "*Configuration*").
- With keys 3 (▼) and 4 (▲), select the menu item "*System*" from the configuration menu.
- Confirm by pressing key 6 (Enter).

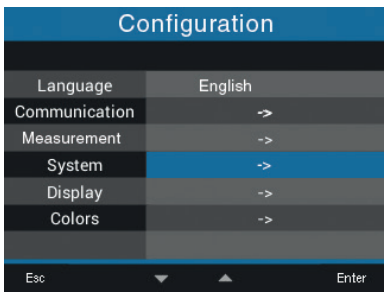


Fig. View "Configuration," Selection "System"

12. 4. 1 Firmware / Serial number

Use the firmware version and the device-specific serial number for possible support requests and to register on the homepage (*www.janitza.de*).

12. 4. 2 Time

Shows the current device time. You can change the settings for Time Synchronization, Date/Time Zones and Clock Time with the GridVis® software or via the corresponding Modbus addresses.

12. 4. 3 Password

You can use a password to block access to the configuration. Then it is only possible to change the configuration directly on the device after entering the password.

The password consists of a 5-digit combination of numbers.

Settings range:
- *1-99999 = with password*
- *0 = without password*

Default:
- *0 = without password*

No password (0) is programmed as the factory preset default setting.

You must know the current password to change a previously created password.

Remember and note the password.

Set password:
- Open the configuration menu (see Section 12 "*Configuration*").
- With keys 3 (▼) and 4 (▲), select the menu item "*System*" from the configuration menu.
- Confirm by pressing key 6 (Enter).
- With keys 3 (▼) and 4 (▲), select the submenu "*Password*" and confirm your selection with key 6 (Enter).

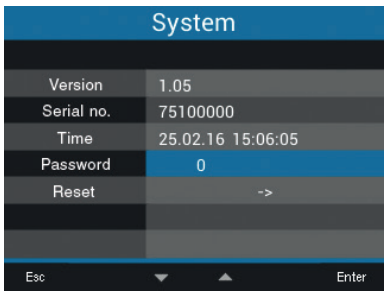


Fig. View "System," Selection "Password"

- With the keys 2 to 5 (◄ ▼ ▲ ►), set the password you would like to use.Use keys 2 (◄) and 5 (►) to set the digit position. With keys 3 (▼) and 4 (▲) change the digit (-1 / +1).
- Confirm by pressing key 6 (Enter) or abort the action by pressing key 1 (Esc).
- Exit the view "*System*" with key 1 (Esc).
- Exit the configuration menu with key 1 (Esc).
- Open the main menu with key 1 (Esc).
- Select the measurement value display you want with keys 3 (▼) and 4 (▲). Confirm your selection by pressing key 6 (Enter) or jump directly to the measurement value display "*Overview*" by pressing key 1 (Esc).

ATTENTION!
Remember and note the password. No device settings can be changed if you do not know the password. If you lose the password, contact support!

12. 4. 4 Reset

This area makes it possible to delete and reset measurement values and device parameters.

Energy
You can delete all of the energy counters in the device at once. It is not possible to select certain energy counters.

- Open the configuration menu (see Section 12 "*Configuration*").
- With keys 3 (▼) and 4 (▲), select the menu item "*System*" from the configuration menu.
- Confirm by pressing key 6 (Enter).
- With keys 3 (▼) and 4 (▲), select the submenu "*Reset*" and confirm your selection with key 6 (Enter).
- With keys 3 (▼) and 4 (▲), select the function you want.

Fig. View "Reset," Reset the energy counters

- Confirm the details by pressing key 6 (Enter).
- With keys 3 (▼) and 4 (▲), select the option you want "*Yes*," or "*No*."
- Confirm by pressing key 6 (Enter) or abort the action by pressing key 1 (Esc).
- Exit the view "*Reset*" with key 1 (Esc).
- Exit the view "*System*" with key 1 (Esc).
- Exit the configuration menu with key 1 (Esc).
- Open the main menu with key 1 (Esc).

- Select the measurement value display you want with keys 3 (▼) and 4 (▲). Confirm your selection by pressing key 6 (Enter) or jump directly to the measurement value display "*Overview*" by pressing key 1 (Esc).

Min./Max. values
You can delete all of the minimum and maximum values in the device at once. It is not possible to select certain energy counters.

> **ATTENTION!**
> Delete any production-related energy counter contents, minimum and maximum values, and recordings prior to putting the device into service.

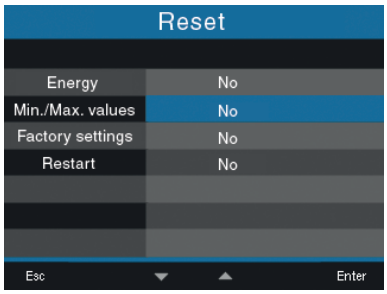


Fig. Menu "Reset,"
Delete min./max. values

- Open the configuration menu (see Section 12 "*Configuration*").
- With keys 3 (▼) and 4 (▲), select the menu item "*System*" from the configuration menu.
- Confirm by pressing key 6 (Enter).
- With keys 3 (▼) and 4 (▲), select the submenu "*Reset*" and confirm your selection with key 6 (Enter).
- With keys 3 (▼) and 4 (▲), select the function "*Min./Max. Values*" and confirm your selection with key 6 (Enter).
- With keys 3 (▼) and 4 (▲), select the option you want "*Yes*," or "*No*."
- Confirm by pressing key 6 (Enter) or abort the action by pressing key 1 (Esc).
- Exit the view "*Reset*" with key 1 (Esc).
- Exit the view "*System*" with key 1 (Esc).
- Exit the configuration menu with key 1 (Esc).
- Open the main menu with key 1 (Esc).
- Select the measurement value display you want with keys 3 (▼) and 4 (▲). Confirm your selection by pressing key 6 (Enter) or jump directly to the measurement value display "*Overview*" by pressing key 1 (Esc).

Factory settings
In "Factory settings" you can reset all settings, as well as the configuration and the recorded data back to the factory presets.

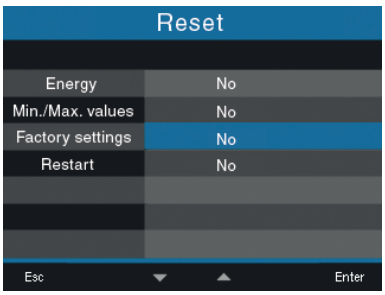


Fig. Menu "Reset,"
Load factory settings

- Open the configuration menu (see Section 12 "*Configuration*").
- With keys 3 (▼) and 4 (▲), select the menu item "*System*" from the configuration menu.
- Confirm by pressing key 6 (Enter).
- With keys 3 (▼) and 4 (▲), select the submenu "*Reset*" and confirm your selection with key 6 (Enter).
- With keys 3 (▼) and 4 (▲), select the function "*Factory settings*" and confirm your selection with key 6 (Enter).
- With keys 3 (▼) and 4 (▲), select the option you want "*Yes*," or "*No*."
- Confirm by pressing key 6 (Enter) or abort the action by pressing key 1 (Esc).
- Confirm the warning notification by pressing key 6 (Enter) or abort the action by pressing key 1 (Esc).
- The device restarts.

Restart
To manually restart the device, proceed as follows:

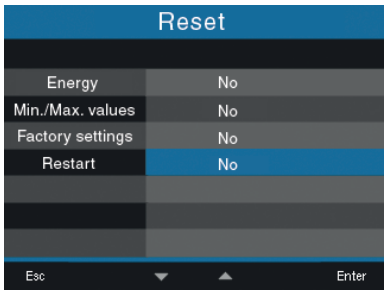


Fig. Menu "Reset," Restart device

- Open the configuration menu (see Section 12 "*Configuration*").
- With keys 3 (▼) and 4 (▲), select the menu item "*System*" from the configuration menu.
- Confirm by pressing key 6 (Enter).
- With keys 3 (▼) and 4 (▲), select the submenu "*Reset*" and confirm your selection with key 6 (Enter).
- With keys 3 (▼) and 4 (▲), select the function "*Restart*" and confirm your selection with key 6 (Enter).
- With keys 3 (▼) and 4 (▲), select the option you want "*Yes*," or "*No*."
- Confirm by pressing key 6 (Enter) or abort the action by pressing key 1 (Esc).
- The device restarts.

12. 5 Display

Use this menu item to adjust the display settings on the device:

- Brightness
- Standby after
- Brightness (standby)

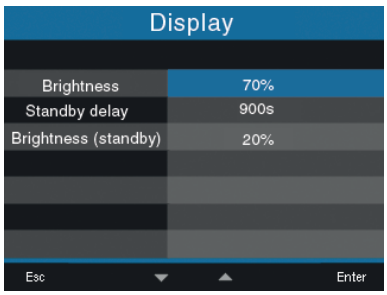


Fig. Menu "Display,"

- Open the configuration menu (see Section 12 "*Configuration*").
- With keys 3 (▼) and 4 (▲), select the menu item "*Display*" from the configuration menu.
- Confirm by pressing key 6 (Enter).
- With keys 3 (▼) and 4 (▲), select the submenu you want and confirm your selection with key 6 (Enter).
- Use keys 2 to 5 (◀ ▼ ▲ ▶) to set the display value.
  Set the digit position with keys 2 (◀) and 5 (▶).
  With keys 3 (▼) and 4 (▲) change the digit (-1 / +1).
- Confirm by pressing key 6 (Enter) or abort the action by pressing key 1 (Esc).
- Exit the menu "*Display*" with key 1 (Esc).
- Exit the configuration menu with key 1 (Esc).
- Open the main menu with key 1 (Esc).
- Select the measurement value display you want with keys 3 (▼) and 4 (▲). Confirm your selection by pressing key 6 (Enter) or jump directly to the measurement value display "*Overview*" by pressing key 1 (Esc).

12. 5. 1 Brightness

Set the display brightness of your device.

- Settings range: *30 - 100*
  Default: *70*

  with 30% = dark
  100 % = very bright

12. 5. 2 Standby

Set the time in seconds after which the display brightness switched to the set standby brightness.

- Settings range: *60 - 3600*
  Default: *900*

12. 5. 3 Brightness (standby)

Set the display brightness that the device will switch to after the standby time has expired.

- Settings range: *20 - 60*
  Default: 30

  with 20% = dark
  60 % = very bright

12. 6 Colors

Set the colors that show the current and voltage in the graphical displays.

Fig. Menu "Colors,"

- Open the configuration menu (see Section 12 "*Configuration*").
- With keys 3 (▼) and 4 (▲), select the menu item "*Colors*" from the configuration menu.
- Confirm by pressing key 6 (Enter).
- With keys 3 (▼) and 4 (▲), select the option you want and confirm your selection with key 6 (Enter).
- Set the color with keys 3 (▼) and 4 (▲) .
- Confirm by pressing key 6 (Enter) or abort the action by pressing key 1 (Esc).
- Exit the menu "*Color*" with key 1 (Esc).
- Exit the configuration menu with key 1 (Esc).
- Open the main menu with key 1 (Esc).
- Select the measurement value display you want with keys 3 (▼) and 4 (▲). Confirm your selection by pressing key 6 (Enter) or jump directly to the measurement value display "*Overview*" by pressing key 1 (Esc).

13. Putting the device into service

This section will explain everything you need to know about putting the device into service for the first time.

13. 1 Supply voltage

To connect the supply voltage, proceed as follows:

1. Connect the supply voltage to a terminal on the back of the device.
2. After connecting the supply voltage, the first measurement value display "Overview" will appear on the display a few seconds later.
3. If no display appears, check whether the supply voltage is within the rated voltage range.

CAUTION!

Material damage may result from failure to comply with the connection requirements.

Noncompliance with the connection requirements may result in your device being damaged or destroyed.

For this reason, please note the following:

- **Comply with the details on voltage and frequency on the ratings plate.**
- **Do not use the device to measure direct voltage.**

ATTENTION!

Delete any production-related energy counter contents, minimum and maximum values, and recordings prior to putting the device into service.

13. 2 Measured voltage

Voltage measurements in networks with rated voltages above the maximum stated rated voltage (cf. Section *6.2 Rated Voltages*) are to be connected via voltage transformers.

To connect the measured voltage, proceed as follows:

1. Connect the supply voltage to a terminal on the back of the device.
2. After the measured voltage has been connected, the measurement values displayed by the device for the voltages L-N and L-L will have to match those at the measurement input.
3. Consider any utilized voltage transformer factors.

WARNING!

Risk of injury from electric voltage!

If the device is exposed to voltage surges above the admissible overvoltage category, safety-related insulations in the device may be damaged, whereupon the safety of the product can no longer be guaranteed.

Only use the device in environments in which the admissible surge voltage is not exceeded.

13. 3 Frequency measurement

To perform this measurement, the device requires the network frequency, which can be either supplied by the user or automatically determined by the device (cf. Section "Configuration").

- The device can only determine the network frequency if there is a voltage L1-N greater than 20 Veff (4-wire measurement) or a voltage L1-L2 greater than 34 Veff (3-wire measurement) at the voltage measurement input V1.
- The network frequency needs to be within the range of 45 Hz to 65 Hz.
- If the measurement voltage is not sufficiently high, the network frequency cannot be determined, and subsequently no measurement can be performed.

More information can be found in Section 12 *Configuration / Rated frequency*"

13. 4 Rotary field direction

Check the direction of the voltage rotary field on the measurement value display of the device.

- A "right" rotary field is usually available.

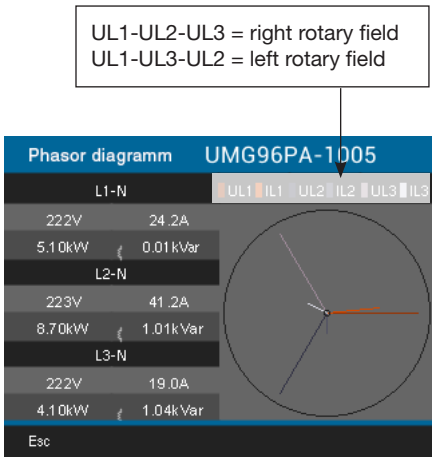


Fig. Presentation of the phase sequence according to the rotary field direction.

To do this, open the menu display "*Phasor diagram*":

- If you are **not** in the measurement value display "*Overview*," switch to this view by repeatedly pressing key 1 (Esc).
- Open the main menu with key 1 (Esc).
- With keys 3 (▼) and 4 (▲), select "*Pointer diagram*" and confirm your selection with key 6 (Enter).

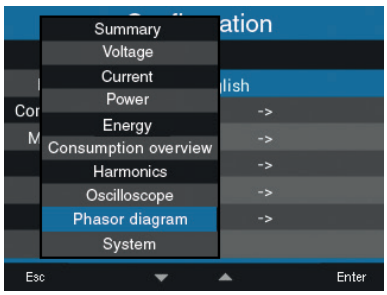
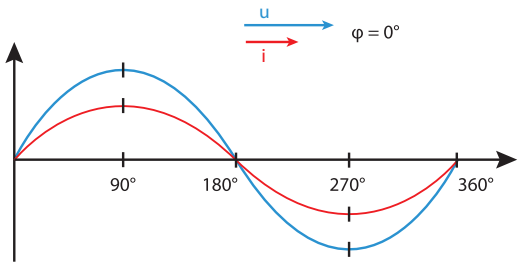


Fig. Main menu, Selection "Phasor diagram"

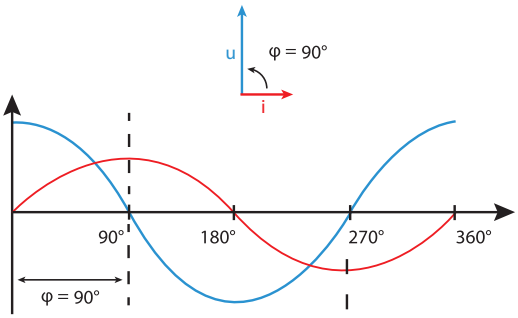
13. 4. 1 Phasor diagram basics

The phasor diagram graphically describes the phase shift / phase angle between the voltage and the current. The pointer rotates around an origin point at a constant speed - proportionally to the frequency of the voltage and the current. The pointer diagram therefore describes the current
status of the quantities in an alternating current circuit.

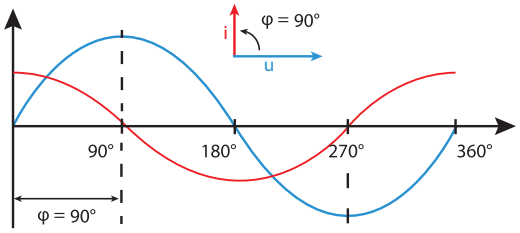
Representation of Ohmic resistance:
- Voltage and current have the same phase



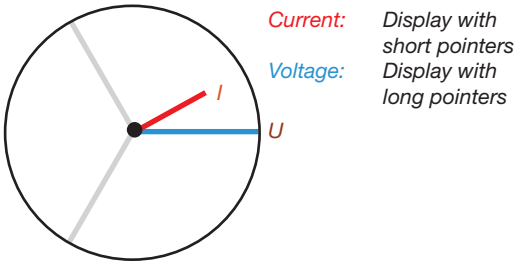
Representation of inductance:
- The voltage rushes ahead of the current
- In an "ideal coil," the phase shift is 90°



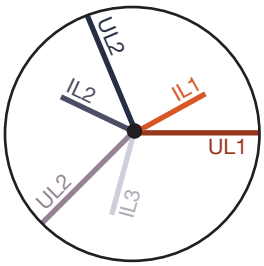
Representation of capacity:
- The current rushes ahead of the voltage
- In an "ideal condenser," the phase shift is 90°



In a combination of states, the phase angle "current to voltage" values can range from -90° to +90°.



Example of a phasor diagram (3-phase)

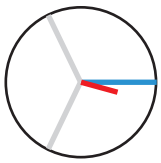


The voltage and the current are pushed against each other. The current rushes ahead of the voltage, i.e. the network has a capacitive load.

Voltage and current input monitoring in pointer diagrams:

The phasor diagram can be used to check for incorrect connections to the voltage and current inputs.

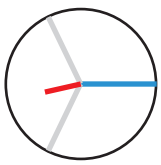
Example 1
Primarily Ohmic load.



Voltage and Current only have minor difference in the phase.

- The current measurement input is assigned to the correct voltage measurement input.

Example 2
Primarily Ohmic load.



Voltage and Current only have a difference of about 180° in the phase.

- The measurement current input is assigned to the correct voltage measurement input.
- In the present current measurement, the connections k and l are switched or energy is being fed back into the supply network.

13. 5 Measurement current

The device:

- is designed to be connected to current transformers with secondary currents of ../1 A and ../5 A.
- does not measure direct currents.
- has current measurement inputs that can be loaded with 60 A (sinusoidal) for 1 second.

The factory preset current transformer ratio is 5/5 A, and may need to be adjusted to the current transformer in use.

1. Short-circuit all of the current transformer outputs except for one.
2. Compare the current indicated on the device with the attached input current.

- The currents must match when the current transformer conversion ratio is accounted for.
- The device must show approx. zero amperes in the short-circuited current measurement inputs.

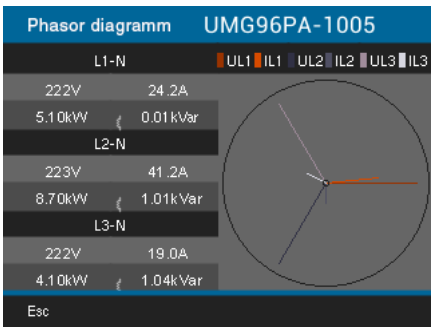


Fig. phasor diagram

ATTENTION!
Voltages and currents outside of the admissible measurement range can destroy the device.

13. 6 Measurement range violation

The device display shows the warning "*Measurement range violation*" in the event of a measurement range violation and indicates the current/voltage path.

Measurement range violations are displayed for as long as they continue and cannot be acknowledged. There is a measurement range violation if at least one of the voltage or current measurement inputs is outside of its specified measurement range.

Thresholds for measurement range violation (200 ms effective values):

I	=	6 A rms
UL-N	=	600 V rms

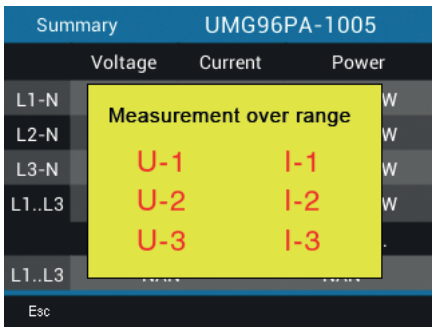


Fig. Warning with measurement range violations in the current and voltage paths I1-I3 and U1-U3

13. 7 Checking the power measurement

Short-circuit all current transformer outputs except one and check the displayed power outputs.

- The device may only display one power output in the phase with the current converter input that is not short-circuited.
- If this does not apply, check the connection of the measurement voltage and measurement current.

If the amount of effective power is correct but the sign of effective power is negative, this may have two causes:

1. The connections S1(k) and S2(l) are switched on the current transformer.
2. Effective power is returned to the network.

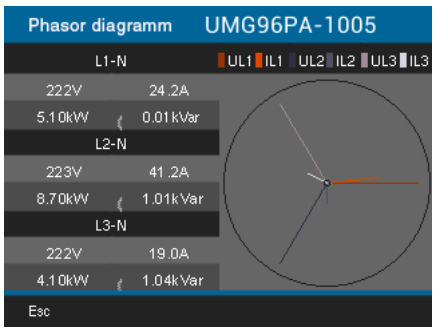


Fig. The pointer diagram displays voltages with long pointers and currents with shorter pointers

Open the pointer diagram with information on the power:

- If you are **not** in the measurement value display "*Overvie*w," switch to this view by repeatedly pressing key 1 (Esc).
- Open the main menu with key 1 (Esc).
- With keys 3 (▼) and 4 (▲), select "*Pointer diagram*" and confirm your selection with key 6 (Enter).

13. 8 Checking communication

The device counts all received (RX), all sent (TX) and all faulty data packages.

In the ideal case, the number of errors shown in the error column is zero.

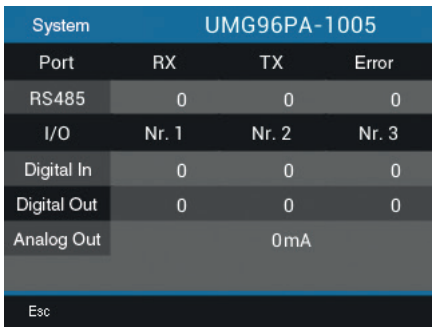


Fig. Menu "Overview" with a view of the communication parameters (Com. View)

- If you are **not** in the measurement value display "*Overvie*w," switch to this view by repeatedly pressing key 1 (Esc).
- Open the main menu with key 1 (Esc).
- With keys 3 (▼) and 4 (▲), select the menu item "*System*" from the main menu.
- Confirm by pressing key 6 (Enter).
- With keys 3 (▼) and 4 (▲), select the sub-menu "COMports Overview" and confirm your selection with key 6 (Enter).

Open the help menu:

- If you are in the view "*COMports Overview*," open the submenu with key 1 (Esc).
- Open the main menu by pressing key 1 (Esc) again.
- Select the measurement value display you want with keys 3 (▼) and 4 (▲). Confirm your selection by pressing key 6 (Enter) or jump directly to the measurement value display "*Overview*" by pressing key 1 (Esc).

13. 9 Delete min./max. values individually

In the measurement displays for voltage, current and power with

- voltage L-N and voltage L-L
- current and THD-I
- total power and
- effective, reactive, and apparent power

the min./max. values for each can be deleted with key 6 (Enter).

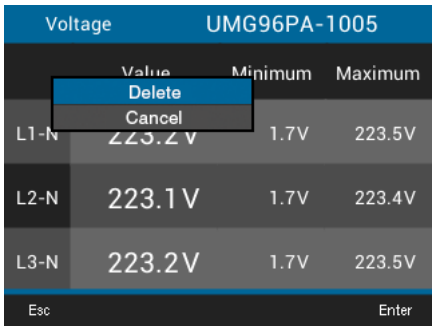


Fig. Measurement display "Voltage L-N" with the menu "Delete/Abort"

- If you are **not** in the measurement value display "*Overvie*w," switch to this view by repeatedly pressing key 1 (Esc).
- Open the main menu with key 1 (Esc).
- With keys 3 (▼) and 4 (▲), select the menu item "*Voltage*" or "*Current*" or "*Power*" from the main menu and confirm with key 6 (Enter).
- With keys 3 (▼) and 4 (▲), select a measurement display (see above) and confirm your selection with key 6 (Enter).
- In the measurement display you can delete the corresponding minimum and maximum values by pressing key 6 (Enter).
- For this, confirm the "*Delete/Abort*" notification with key 6 (Enter). You can abort the action by using the option "Abort" (select with key 3 or 4) and then confirming with key 6 (Enter).

13. 10 Harmonics

Harmonics are caused by equipment with nonlinear characteristics. These additional frequencies are integer multiples of a fundamental oscillation, and show how the equipment affect the power grid.

The possible effects of harmonics include:
- additional heating of equipment.
- additional current on the neutral conductor
- an overload and reduced life cycle of electrical usage

Harmonic loads are the primary cause of invisible voltage quality problems associated with enormous repair costs and investment to replace defective devices.

The device measures the fundamental oscillation of the voltage in the range of 45 - 65 Hz. This fundamental oscillation is the basis for the calculation of the harmonics for the voltages and currents.

The device calculates harmonics up to 25 times the fundamental oscillation.

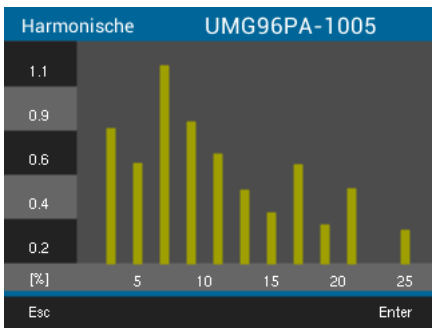


Fig. Measurement value display "Harmonic"

- If you are **not** in the measurement value display "*Overvie*w," switch to this view by repeatedly pressing key 1 (Esc).
- Open the main menu with key 1 (Esc).
- With keys 3 (▼) and 4 (▲), select the menu item "*Harmonic*" and confirm your selection with key 6 (Enter).
- With keys 3 (▼) and 4 (▲), select the harmonics for the respective voltage or current and confirm your selection with key 6 (Enter).

13. 11 Communication in the bus system

13. 11. 1 RS485

The data can be accessed from the parameter and measurement value list (cf. Section "*Configuration / Communication*") via the MODBUS RTU protocol with the CRC check on the RS485 interface.

Modbus functions (Slave)
03 Read Holding Registers
04 Read Input Registers
06 Preset Single Register
16 (10Hex) Preset Multiple Registers
23 (17Hex) Read/Write 4X Registers

The byte order is highbyte before lowbyte (Motorola format).

Transfer parameters

Data bits:	8
Parity:	odd even none (1 Stopbit) none (2 Stopbits)
Stopbits (UMG 96-PA):	1 / 2
Stopbits, external:	1 / 2

Number formats

short	16 bit (-2^{15} .. 2^{15} -1)
float	32 bit (IEEE 754)

For further information about the interface settings, refer to Section 12 "*Configuration / Communication*."

Example: Read-out of voltage L1-N
Voltage L1-N is saved in the measurement value list at the address 19000. Voltage L1-N is available in FLOAT format.
In this example, 01 will be used as the device address.

The "Query Message" will then appear as follows:

Name	Hex	Comment
Device address	01	Address=1
Function	03	"Read Holding Reg"
Starting address Hi	4A	19000dez = 4A38hex
Starting address Lo	38	
Number of values Hi	00	2dez = 0002hex
Number of values Lo	02	
Error Check (CRC)	-	

The "response" of the device may look as follows:

Name	Hex	Comment
Device address	01	Address=1
Function	03	
Byte counter	06	
Data	00	00hex=00dez
Data	E6	E6hex=230dez
Error Check (CRC)	-	

The voltage L1-N read back from the address 19000 is 230 V.

13. 12 Digital inputs/outputs

Your device has three digital inputs and three digital outputs.

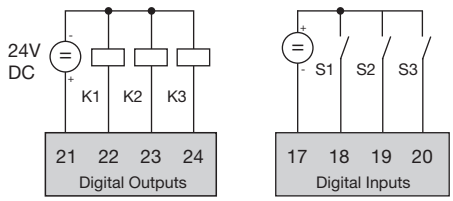


Fig. Digital inputs and outputs

- You can configure the inputs and outputs via the GridVis® software.
- The GridVis® software can be found on the homepage (www.janitza.de) in the download area.

13. 12. 1 Digital inputs

It is possible to transmit information from other devices that have a digital output directly to your device via the digital inputs.

It is still possible to configure the digital inputs as function inputs. In this mode, each digital input has a specific function. In this configuration it is not possible for these inputs to function as pulse counters!

You can set the digital outputs in the "*Periphery*" area via the configuration window of the GridVis® software:

Function mode
- Which function should be assigned to the digital input.

Pulse counter
- Which value type the incoming signal has (e.g. electrical power, gas and water consumption, CO_2 ...)
- Which pulse value should be used for the value.
- How long the transmission time is.

The statuses of the digital inputs are each on their own Modbus address.
For each digital input, the last 16 switching operations (events) are logged with a time stamp.

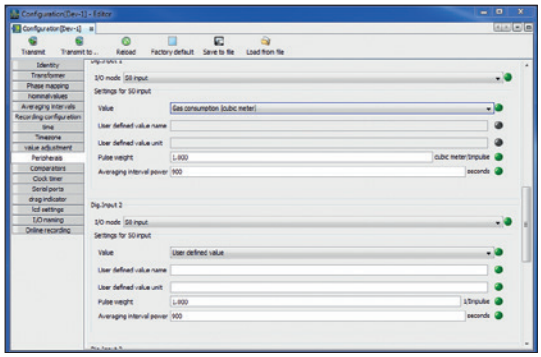


Fig. Configuration of the digital inputs via the GridVis® software

Function mode
Each digital input can be assigned a specific function with:

- Digital input 1
  Configuration as tariff converter (HT/NT) possible.
- Digital input 2
  Synchronization of the internal clock; choosing between minute or hour synchronization is possible.
  However, synchronization is also possible via a Modbus address.
- Digital input 3
  Configuration as reset entry for the synchronization values of the drag indicator function. It is also possible to synchronize the drag indicator via the Modbus address.

Pulse counter
All digital inputs can be operated with a frequency of 25 Hz. Here, the pulse duration and the pulse interval must be greater than 20 ms.
The typical pulse duration for S0 pulses is 30 ms.

The maximum number of pulses per hour is based on the minimum pulse duration and the minimum pulse interval:

Pulse length	Pulse interval	Max. pulses/h
20 ms	20 ms	90 000 pulses/h
30 ms	30 ms	60 000 pulses/h
50 ms	50 ms	36 000 pulses/h
100 ms	100 ms	18 000 pulses/h
500 ms	500 ms	3 600 pulses/h
1 s	1 s	1 800 pulses/h
10 s	10 s	180 pulses/h

Examples of the maximum number of pulses per hour.

The pulse counters can be configured with a simultaneous measurement value or power calculation. The pulses are counted as 64-bit numbers and overflow after approx. 1.17 x 10^{10} years of continuous operation (25 Hz).

Pulse value:
A pulse value can be assigned to each digital input. Use the impulse value to specify the measurement value or power value (e.g. energy) to which a pulse should correspond.

ATTENTION!
The pulse interval is proportional to power within the selected settings.

Calculation of measurement value:

Measurement value = Pulse x Pulse value

Calculation of power value:

$$\text{Power value} = \frac{\text{Pulse x Pulse value}}{\text{Time [sec]}}$$

Since the pulse interval may be very large, continual calculation of the measurement or power values is not possible. For this reason, only the mean values are calculated. For measurement value calculation, the mean values are calculated from the number of pulses per period multiplied by the pulse value. For power value calculation, this value must be divided by the amount of time that can be set.

The period is assigned to the digital input and can be set in a range of 1 to 60 minutes. After the period ends, the value can be called via the Modbus.

For each digital input, an external synchronization can be triggered; in this case, a synchronisation pulse completes one period and starts a new period. A fixed capture period of 30 seconds is preset for external synchronization. If no synchronization pulse exists after the period expires, a maximum of 30 seconds is waited and the software then carries out the synchronization. All further periods are synchronized by the software.

A period of 15 min is the factory setting.

The calculation result for the S0 power value is not available until the end of the cycle.

ATTENTION!
When programming with GridVis®, a selection of energy values that are derived from the power values is received.

13. 12. 2 Digital outputs

Various functions can be assigned to the three digital outputs:

- Digital output 1
  - Pulse output for effective energy
  - Output for the timer
  - ModBus remote output
- Digital output 2
  - Pulse output for reactive energy
  - Output for comparator group 1
  - Output for the timer
  - ModBus remote output
- Digital output 3
  - Output for comparator group 2
  - Output for the timer
  - ModBus remote output

You can set the digital outputs in the "*Periphery*" area via the configuration window of the GridVis® software:

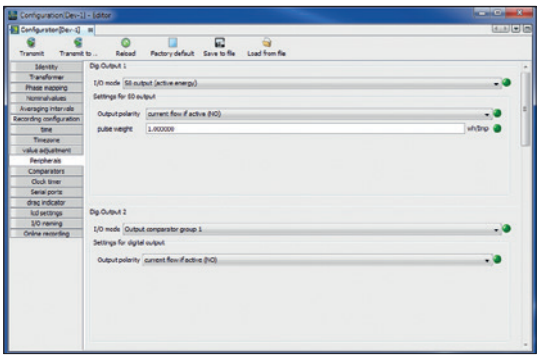


Fig. Configuration of the digital outputs via the GridVis® software

Pulse output
Digital outputs 1 and 2 can be used for the output of pulses for counting effective energy and apparent energy. For this,a pulse is set at the output after a certain adjustable amount of energy has been reached.

To use a digital output can as a pulse output, you must apply two different settings using the GridVis® Software in the configuration menu:

- Mode for the digital input:
  S0 output
- Output polarity: Closer, Opener
- Pulse value

Pulse value
With the pulse value, you indicate how much energy (Wh or varh) one pulse should correspond to.

The pulse value is determined by the maximum connected load and the maximum number of pulses per hour.

If the pulse value is specified with a:

- positive sign, pulses will only be issued if the measured value also has a positive sign.
- negative sign, pulses will only be issued if the measured value also has a negative sign.

ATTENTION!
Since the active energy meter works with a return stop, pulses are only issued during import of electrical energy.

ATTENTION!
Since the reactive energy meter works with a return stop, pulses are only issued under inductive load.

Determine pulse value

1. Set the pulse length according to the requirements of the connected pulse receiver. For a pulse length of e.g. 30 ms, the device can issue a maximum number of 60,000 pulses (see Table "Maximum Pulse Number") per hour.

2. Determining the maximum connected load.

Example:
Current transformer = 150/5 A
Voltage L-N = max. 300 V

Power per phase = 150 A x 300 V
= 45 kW

Power in 3 phases = 45 kW x 3
Maximum connection power = 135 kW

3. Calculate the pulse value:

$$\text{Pulse value} = \frac{\text{Maximum connected load}}{\text{Max. number of pulses/h}} \text{ [Pulses/Wh]}$$

Pulse value = 135 kW / 60000 pulses/h
Pulse value = 0.00225 pulses/kWh
Pulse value = 2.25 pulses/Wh

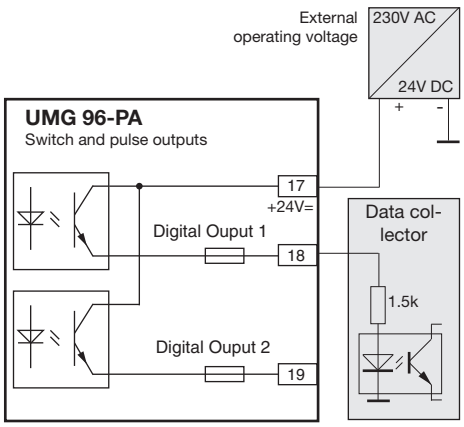


Fig.: Fig.: Connection example for wiring the pulse output.

CAUTION!

Measurement errors in use as pulse output

When using the digital outputs as a pulse output, measurement errors may result from residual ripple.
So use a power adapter whose residual ripple is less than 5% for the supply voltage to the digital inputs and outputs.

Timer output
In the device, 64 independent weekly timers can be set with:

- a resolution of 1 minute.
- a freely defined active period within one day. The active day within the week can be selected.

Example:
9:25 to 11:45 on Sunday, Monday and Friday

The weekly timers can be configured as

- tariff converters (1 and 2)
- Set the digital outputs 1 to 3
- as "inoperable

." The status can always be queried via the Modbus. The statuses of the timers are linked via an "OR" operator at the digital output.

The weekly timers can be configured using the GridVis® software in the "*Timer*" configuration area)

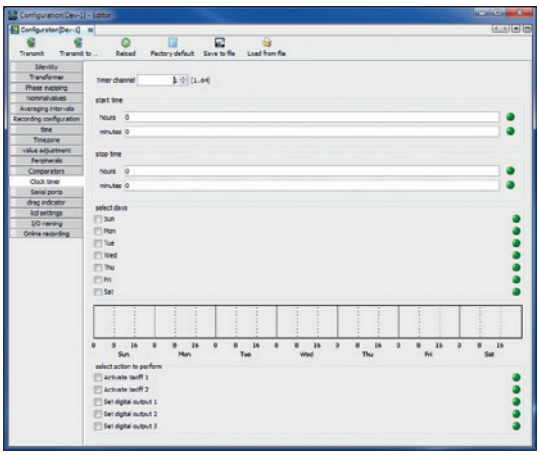


Fig. Configuration of the weekly timer via the GridVis® software

Output for Modbus remote
Enables switching of the outputs via a Modbus address.

This function can be configured via the GridVis® software:

- Open the device configuration in GridVis®.
- Set the mode for the digital outputs under "*Periphery*" to "*Modbus remote output*."
- Determine the output polarity with:
  - Current flow when active (closer)
  - Current flow when inactive (opener)

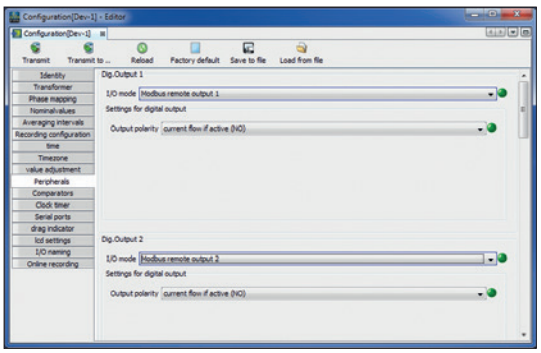


Fig. Configuration of the digital outputs as "Modbus remote" in the GridVis® software

Output for the comparator group
Two comparator groups are available to monitor the thresholds (comparators 1 and 2), each with 3 comparators (A - C).

The results of the comparators A to C can be linked using the "*AND*" or "*OR*" operators.

The linkage result from comparator group 1 can be assigned to digital output 2 and the linkage result from comparator group 2 can be assigned to digital output 3.

The comparators can only be configured using the GridVis® software in the "*Comparator*" configuration area.

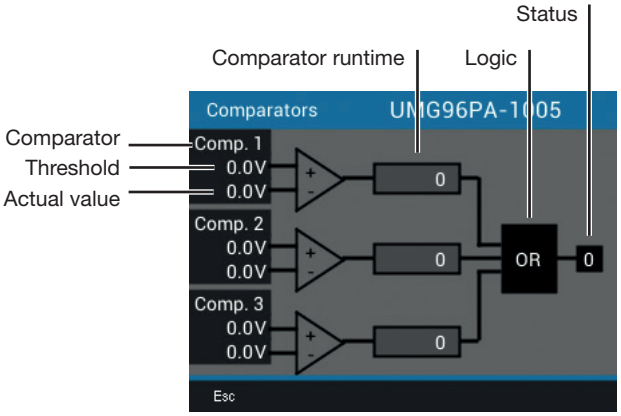


Fig. "Comparators" in the menu "Overview / Comparators"

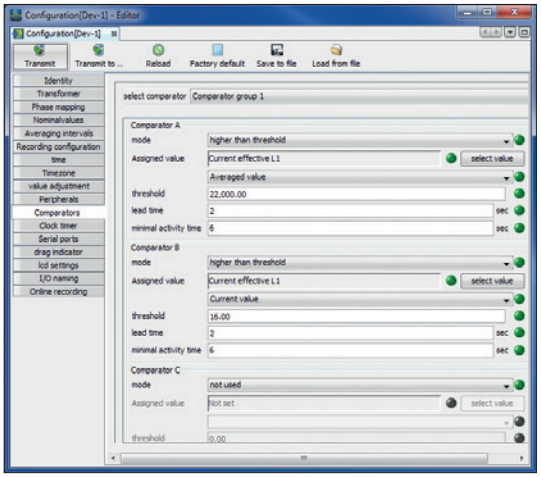


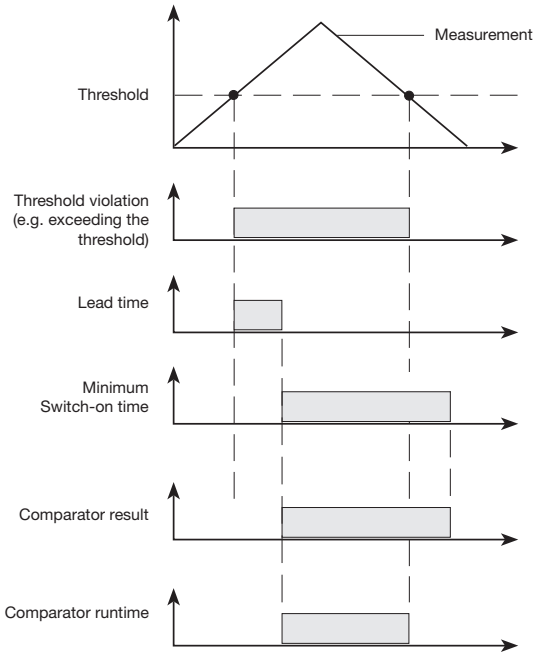
Fig. Configuration of the comparators in the GridVis® software

Read out comparator settings on the device:

- With keys 3 (▼) and 4 (▲), select the menu item "*Overview*" from the main menu.
- Confirm by pressing key 6 (Enter).
- With keys 3 (▼) and 4 (▲) select the submenu "Comparator 1" for the comparator group 1 and "Comparator 2" for the comparator group 2.
- Confirm by pressing key 6 (Enter).

Comparator runtime
Comparator runtimes are time counters that create a total for a set comparator output. I.e. if the condition of the comparator is met and the lead time has expired, the counter increases by the respective amount of time - the minimum switch-on time is not taken into account here!

Comparator with set threshold violation
- The set threshold is compared to the measurement value.
- If there is a threshold violation for at least the duration of the lead time, a change will be made to the comparator result.
- The result remains for at least the duration of the minimum switch-on time and at the most for the duration of the threshold violation. If there is no longer a threshold violation and the minimum switch-on time has expired, the result is reset.



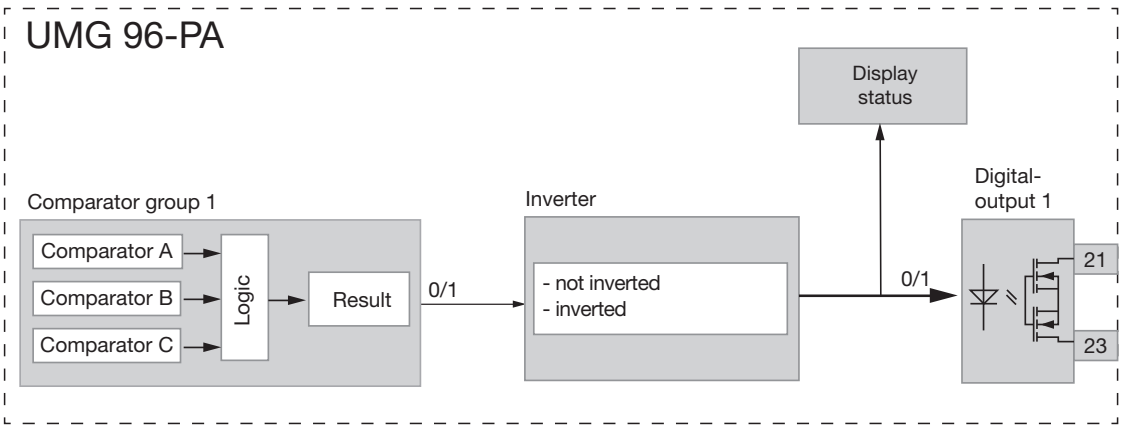


Fig.: Block diagram: Use of the digital output 2 for monitoring the thresholds

13. 13 Analog output

The device has 1 passive analog output, which can output a maximum current of 0 - 20 mA.
An external 24 V DC power adapter is required for operation.

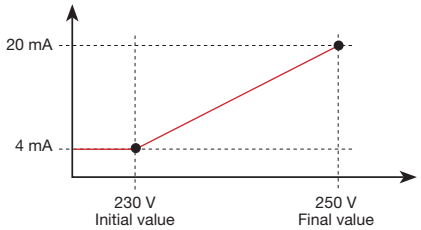


Fig.: Principle of the analog output with voltage monitoring

The analog output can be configured in a user-friendly way via the GridVis® software. To do this, enter the assigned measurement value, the initial and final value and the output range in "*Periphery*."

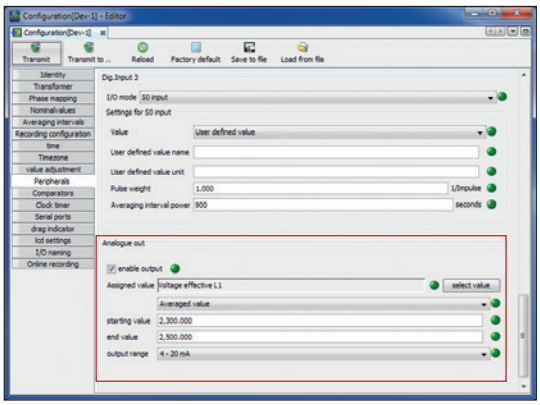
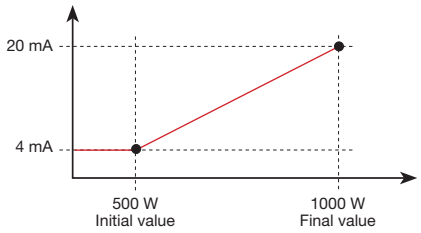


Fig. Configuration of the analog output in the GridVis® software

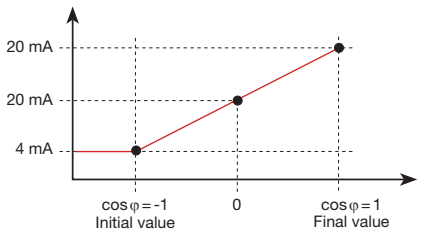
Examples:

Assignment of effective power L1 (output range 4 - 20 mA)



- If the effective power is 500 W, a current of 4 mA is outputted via the analog output. At an effective power of 1000 W, the output is 20 mA.
  The measured effective power is directly proportional to the current of the analog output.

Assignment of the calculated effective power factor cos φ (math.) (output range 4 - 20 mA)



- Monitoring of the effective power factor cos φ (math.) with
  cos φ (math.) > 0
  effective power, consumed
  cos φ (math.) < 0
  effective power, delivered.

13. 14 “Drag indicator” function

The “drag indicator” function describes the three highest mean value of a measured values over a defined period of time (time base).

- The calculated mean values can be retrieved via the GridVis® software and via a parameter with a time stamp.
- The period duration (time base), synchronization and capture time can be set in the GridVis® software by using the corresponding parameters.
- The calculation of the mean values is derived from the measurement values of the following value types:
  - Current L1
  - Current L2
  - Current L3
  - Effective power L1
  - Effective power L2
  - Effective power L3
  - Effective power, total (L1...L3)
  - Apparent power L1
  - Apparent power L2
  - Apparent power L3
  - Apparent power, total (L1...L3)

Period duration (time base):
Individually adjustable period duration in seconds for the calculation of the mean values over this timeframe (duration of the measurement value recording). When an internal synchronization is selected, the mean values are recalculated once the set timeframe has expired.

Synchronization mode:
A synchronization defines a starting time point for the calculation periods of the mean values.
A synchronization is triggered
- by the internal clock (*internal synchronization*),
- by setting a parameter (via Modbus) or
- optionally via the digital input 3 (*external synchronization*)

.

Capture time:
The individually adjustable *Capture time* describes a time window in which an incoming pulse triggers a synchronization of the time point. If the device receives a pulse outside of the capture time, the calculated mean values are deleted and the time is reset.
Attention: The setting for the capture time — e.g. in the GridVis® software — describes half of the time window of the entire capture time!

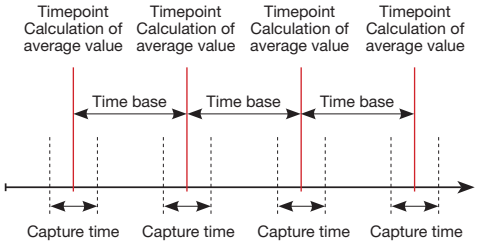


Fig.: Principle of synchronization

13. 14. 1 Internal synchronization

The means are calculated after the adjustable period duration (time base) has expired. The internal synchronization is performed on the full minute if that describes a multiple of the time base.

Time base [min]	Sync 1 (Clock time)	Sync 2 (Clock time)	Sync 3 (Clock time)	Sync 4 (Clock time)
2	09:00:00	09:02:00	09:04:00	09:06:00
5	09:00:00	09:05:00	09:10:00	09:15:00
15	09:00:00	09:15:00	09:30:00	09:45:00

Fig. Examples of an internal synchronization with different time bases

ATTENTION!
The options synchronization via Modbus AND synchronization via the digital output 3 must be deactivated for an internal synchronization!

13. 14. 2 External synchronization

An external synchronization to calculate the 3 highest mean values can be carried out

- via the digital output 3 (e.g. via a pulse transducer) or
- via a Modbus command

Scenarios of external synchronization:

"No pulse despite setting"
If no pulse occurs via the digital output 3 or a Modbus command, the measurement values are saved as they are in an internal synchronization - but on the minute!

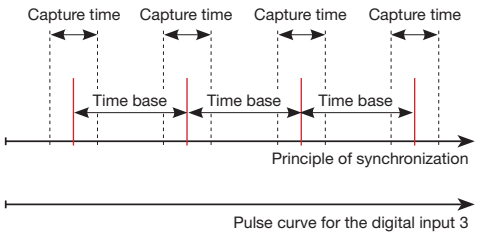


Fig.: Principle of synchronization with "No pulse despite setting"

Example	Maximum value	Value	Time stamp
Effective current L1	Drag indicator 1	3.51 A	09:13:07
Effective current L1	Drag indicator 2	2.52 A	09:08:07
Effective current L1	Drag indicator 3	1.52 A	09:03:07

Fig. Example of drag indicator saving with time stamp (with a set time base of 5 min)

"One pulse"
If the device receives a single pulse or a Modbus command outside the capture time, the measurement values that have been totaled up to that point for the calculation of the mean value and the time are reset. The time point is redefined as a relative null point and a recalculation is carried out!

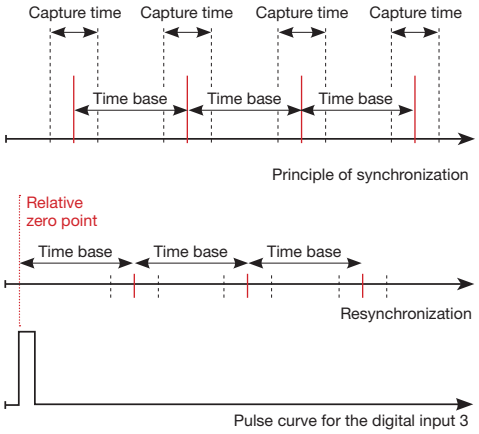


Fig.: Principle of synchronization with "a pulse outside the capture time"

Example:

Example	Maximum value	Value	Time stamp
Effective power L1	Drag indicator Ref. 1	396.73 W	09:18:47
Effective power L1	Drag indicator Ref. 2	207.34 W	09:13:47
Effective power L1	Drag indicator Ref. 3	80.59 W	09:08:47

Fig. Example of drag indicator saving with time stamp (with a set time base of 5 min)

Power increases as the time runs. The values are set back to 0 by the pulse (09:06:47) outside the capture time A new totaling of the interim values starts at that time point. Because no further pulse arrives, the mean value is calculated after the set time (time base).

"Periodic pulses"
Different scenarios may result if the device receives periodic pulses via the digital output 3 or periodic Modbus commands.

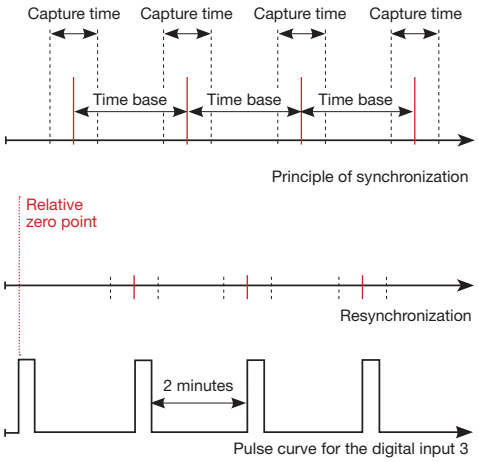
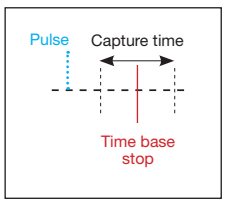
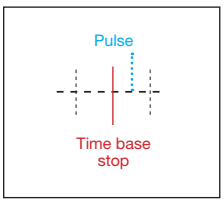


Fig.: Principle of synchronization with "periodic pulses" on the digital input 3

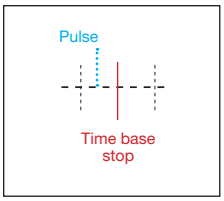
Scenario "pulse outside the capture time"
- Totaled interim values are set to 0
- The time is set to 0 (new relative zero point)
- No value calculation occurs



Scenario "pulse after the time base, but inside the capture time"
- Totaled interim values are set to 0
- The time is set to 0 (new relative zero point)
- No value calculation occurs



Scenario "pulse before the time base, inside the capture time"
- Now perform the value calculation
- The time is set to 0 (new relative zero point)
- Delete the totaled interim values



Attention: The time is synchronized for each pulse in periodic synchronization!

13. 14. 3 Synchronization priority

An external synchronization is carried out according to various priorities:

- *Priority 1: Modbus synchronization*
  For this, use the Modbus tool to set the "Enable Flag" (address.: 822) or select the option "Synchronization via Modbus" in the GridVis® software in the configuration area for the drag indicator.
- *Priority 2: Synchronization via the digital input 3*
  For this, set the Modbus parameter "FUNC_SYNC_RECORD" (address: 30048) to the value 4 or select the option "Drag Indicator Synchronization" in the GridVis® software in the configuration area for the periphery (digital input 3).
  Attention: Ensure that in the configuration for the drag indicator the option "Synchronization via Modbus" is **NOT** selected!
- Priority 3: Internal synchronization

Modbus Address	Function	Settings range
820	Set trigger flag for the Drag indicator synchronization	0 .. 1
821	Time base in seconds	60 .. 65535
822	Enable flag for the Modbus trigger	0 .. 1
823	Capture time in seconds	0 .. 255
30048	Configuration of the inputs	0 .. 4*

** 0 = FUNC_NONE; 1 = FUNC_TARIF; 2 = FUNC_SYNC_CLOCK_MIN; 3 = FUNC_SYNC_CLOCK_H; 4 = FUNC_SYNC_RECORD*

Modbus address table for a synchronization

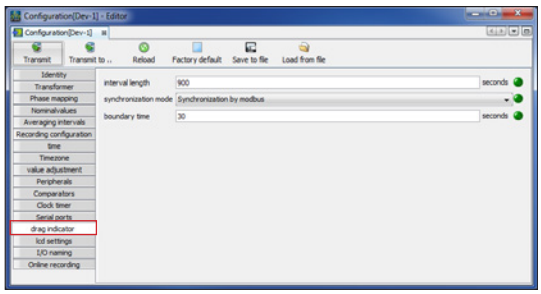


Fig. Drag indicator synchronization in the GridVis® software

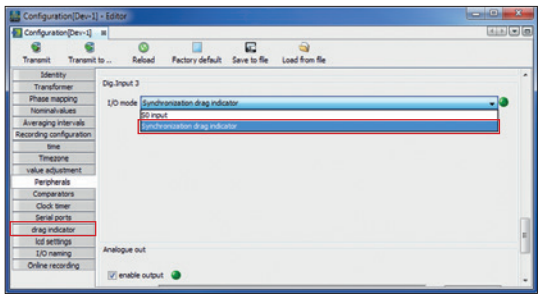


Fig. Configuration "Synchronization via the digital input 3 in the GridVis® software

13. 15 Recordings

2 recording profiles are preconfigured in the default factory setting of the device. Recordings can be adjusted and extended via the GridVis® software.

- The minimum recording time base is 1 minute.
- A maximum of 4 recordings, each with 29 measured values, is possible. If minimum and maximum values are defined additionally, the number is lowered to 19 or 14 values.
- Within the recording configuration, the measurement values are defined via a time base according to the types *Mean Value*, *Sample, Maximum / Minimum*.
  - Type *Mean Value*: Arithmetic mean of the measurement values over a predetermined duration of time.
  - Type *Maximum* and *Minimum*: Maximum / Minimum values over a predetermined duration of time.
  - Type *Sample*: Measurement value at the end of a predetermined duration of time.

    Attention: Recording of operational values can only be done with the type *Sample*.

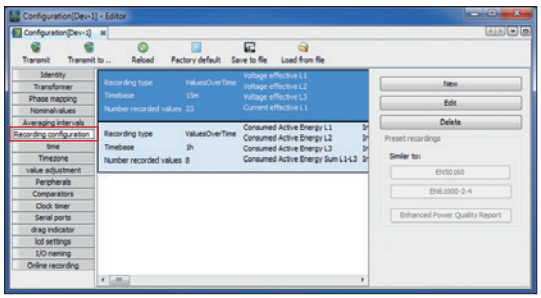


Fig. Recording configuration in the GridVis® software

Recording 1
The following measurement values are recorded with the time base of 15 minutes.

- Effective voltage L1
- Effective voltage L2
- Effective voltage L3
- Effective current L1
- Effective current L2
- Effective current L3
- Effective current total L1..L3
- Effective power L1
- Effective power L2
- Effective power L3
- Effective power total L1..L3
- Apparent power L1
- Apparent power L2
- Apparent power L3
- Apparent power total L1..L3
- cos phi(math.) L1
- cos phi(math.) L2
- cos phi(math.) L3
- cos phi(math.) total L1..L3
- Reactive power fundamental oscillation L1
- Reactive power fundamental oscillation L2
- Reactive power fundamental oscillation L3
- Reactive power fundamental oscillation total L1..L3

Recording 2
The following measurement values are recorded with the time base of 1 hour.

- Drawn effective energy L1
- Drawn effective energy L2
- Drawn effective energy L3
- Drawn effective energy total L1..L3
- Inductive apparent energy L1
- Inductive apparent energy L2
- Inductive apparent energy L3
- Inductive apparent energy total L1..L3

13. 16 Tariff switching

Electrical energy values (effective, reactive and apparent energy) can be recorded via internal counters for two tariffs each.

Switching between the tariffs (HT/NT) is supported by

- Modbus via the
- digital input 1
  (see Section "*Digital Inputs*")
  or via the
- weekly timer
  (see Section "*Timer Output*")

.

Tariff	UMG96PA-1005		
Tariff	Active E. [kWh]	Reactive E. [kVArh]	Apparent E. [kVAh]
1	0	0	0
2	0	10	10
1 + 2	0	10	10
Esc			

Device display of total (L1..L3) effective, reactive and apparent energy by tariffs

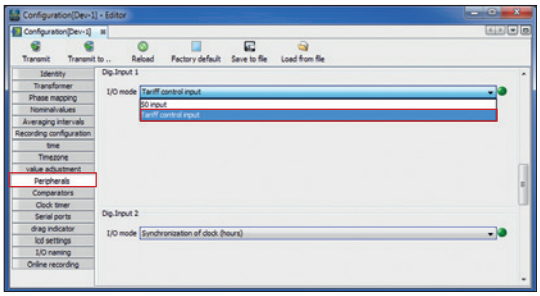


Fig. Configuration of the digital input 1 as the tariff control input in the GridVis® software

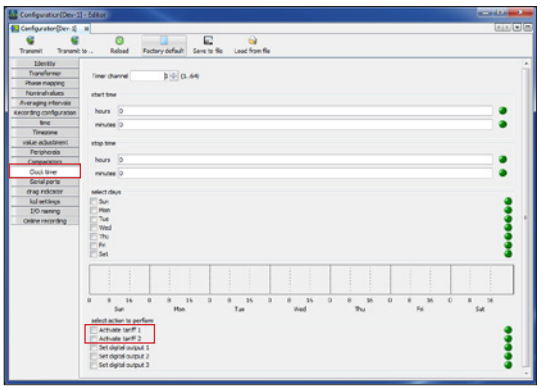
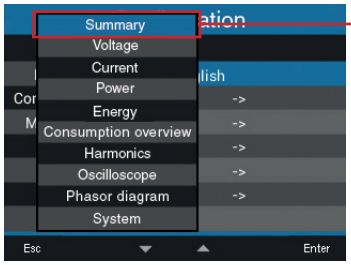


Fig. Timer configuration in the GridVis® software

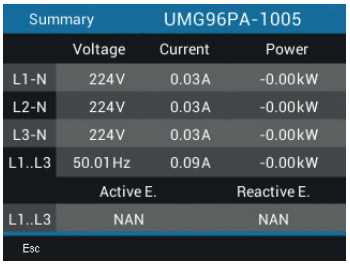
The tariff switching can be configured via the GridVis® software.

14. Overview of measurement value displays

Main menu (Overview)

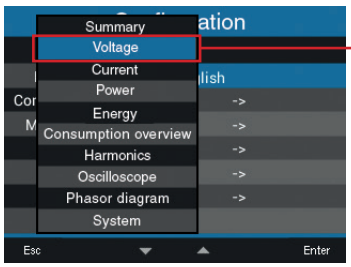


Network analysis (splash page)

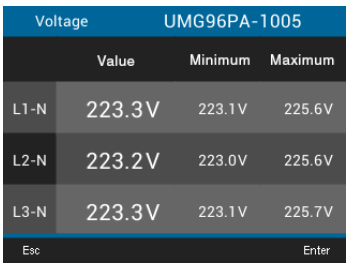


Display of voltage L1, L2, L3-N; current L1, L2, L3; power L1, L2, L3 and effective/apparent energy L1-L3

Main menu (Voltage)

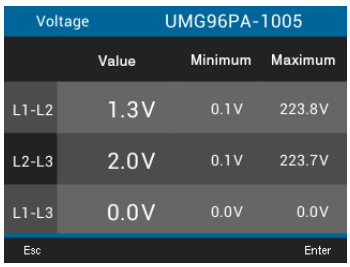


Voltage L-N



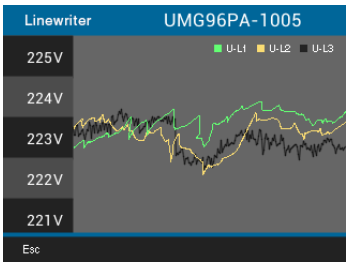
Display of voltage L1-N, L2-N, L3-N and their minimum and maximum values

Voltage L-L



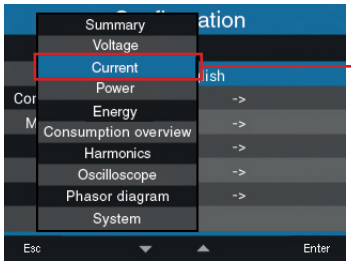
Display of voltage L1-L2, L2-L3, L1-L3 and their minimum and maximum values

Curve

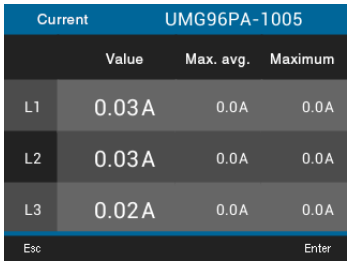


Display of voltage curve for L1-N, L2-N, L3-N

Main menu (Current)

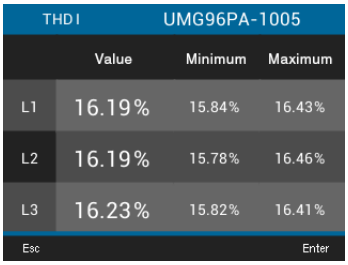


Current



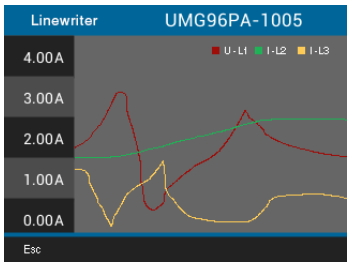
Display of current L1, L2, L3 and their minimum and maximum values

THD-I



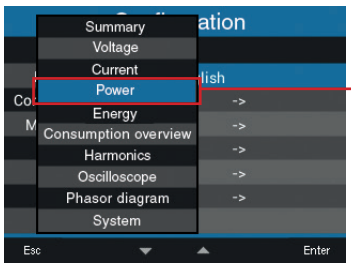
Display of distortion factors for the current (THD-I) L1, L2, L3 and their minimum and maximum values

Curve

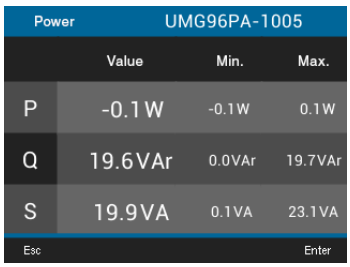


Display of current curve for L1, L2, L3

Main menu (Power)

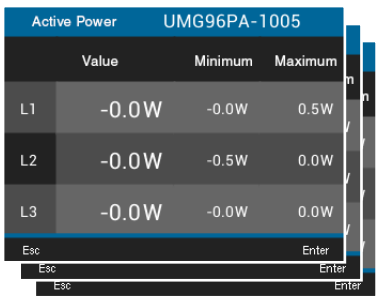


Total powers



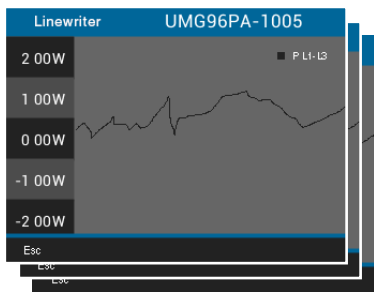
Display of the total (L1..L3) of effective, reactive, apparent power and their minimum and maximum values

Effective / reactive / apparent power



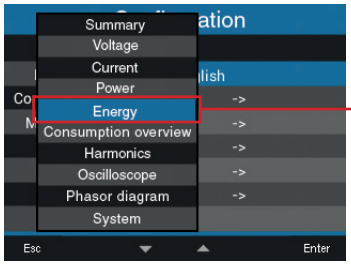
Display of power values (effective, reactive, apparent power) L1-N, L2-N, L3-N and their minimum and maximum values

Effective / reactive / apparent power curves

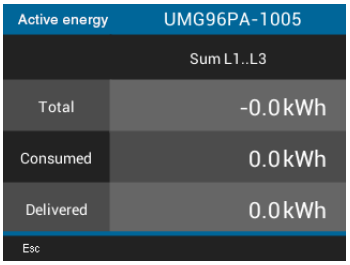


Display of curves for effective, reactive or apparent power (total L1..L3)

Main menu (Energy)

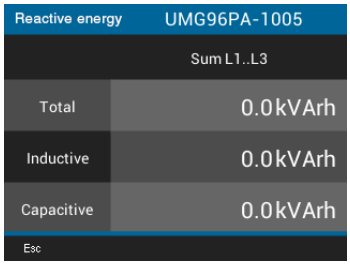


Effective energy



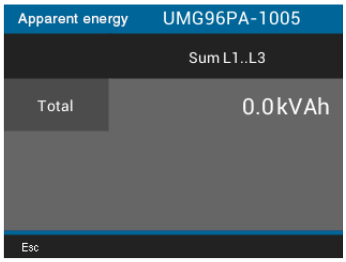
Display of total (L1..L3) effective energy (total/ drawn/delivered)

Reactive energy



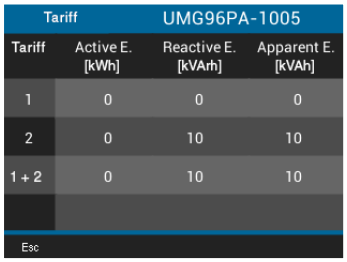
Display of total (L1..L3) reactive energy (total/ inductive/capacitive)

Apparent energy



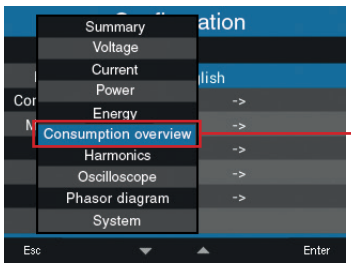
Display of total (L1..L3) apparent energy

Tariff

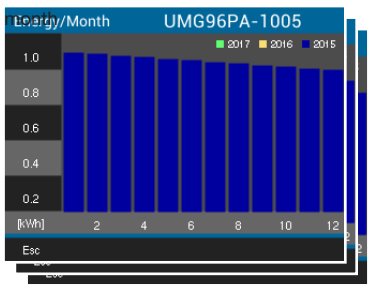


Display of total (L1..L3) effective, reactive and apparent energy by tariffs

Main menu (Consumption Overview)

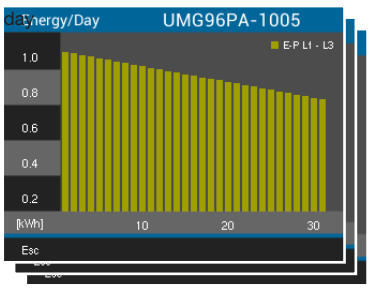


Effective / reactive / apparent power / month



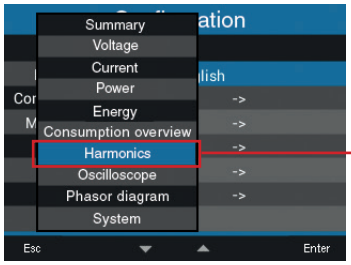
Display of effective, reactive or apparent energy per month (in the last three years)

Effective / reactive / apparent power / day

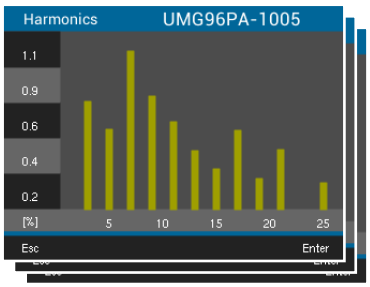


Display of effective, reactive or apparent energy per day (for the current month)

Main menu (Harmonics)

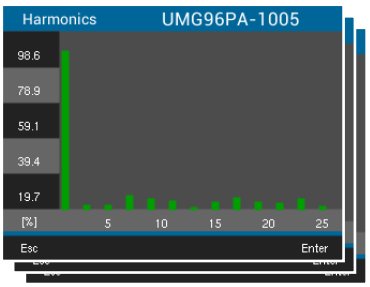


Voltage L1 / L2 / L3



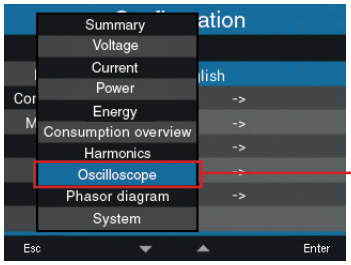
Display of effective, reactive or apparent energy per month (in the last three years)

Current L1 / L2 / L3

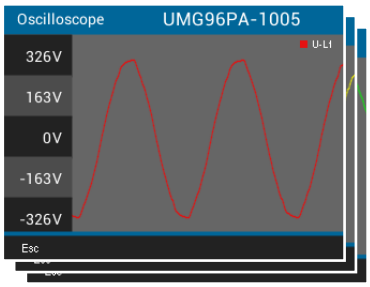


Display of effective, reactive or apparent energy per day (for the current month)

Main menu (Oscilloscope)

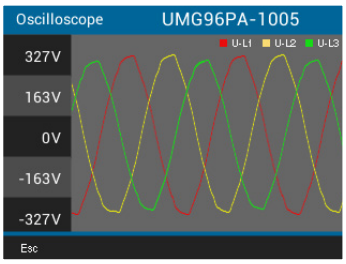


Voltage L1 / L2 / L3



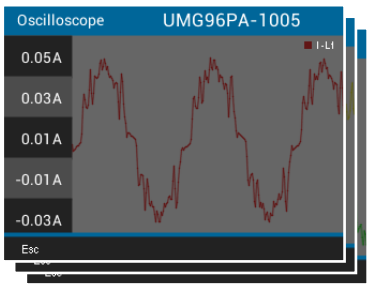
Display of oscillogram for voltage L1, L2 or L3

Voltage L1..L3



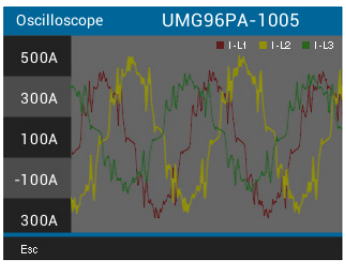
Display of oscillogram for voltages L1, L2 and L3

Current L1 / L2 / L3



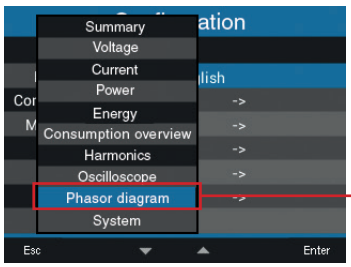
Display of oscillogram for current L1, L2 or L3

Current L1..L3

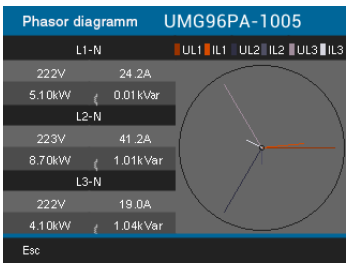


Display of oscillogram for currents L1, L2 and L3

Main menu (Pointer Diagram)

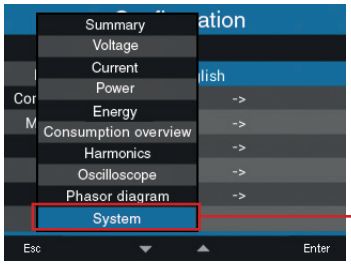


Pointer diagram



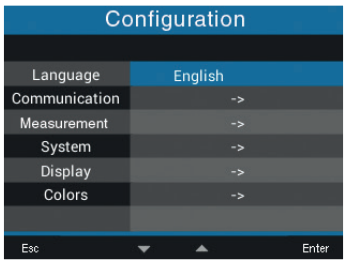
Display of voltages and currents in the pointer diagram

Main menu (System)



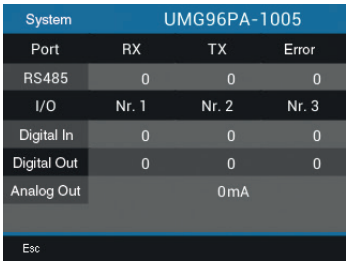
Attention: *Further information on configuration can be found in the Section* ***Operation*** *and* ***Configuration****.*

Configuration



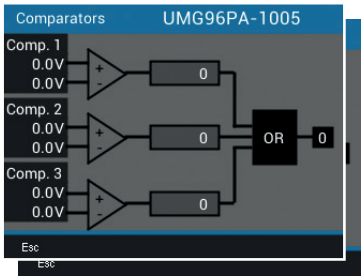
Submenu Device Configuration

COMports Overview



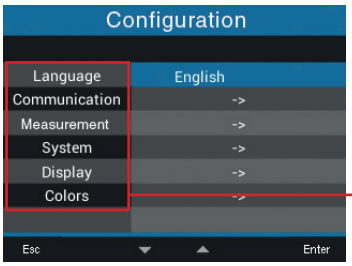
Display of received (RX), sent (TX) and faulty data packages. Switching current analog output

Comparator 1 / Comparator 2



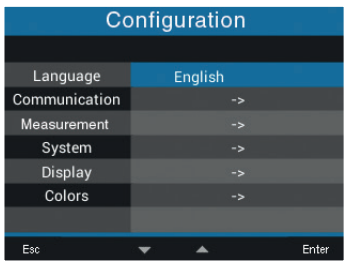
Display of threshold, actual value, comparator runtime, logic and status

Submenu (System / Configuration)



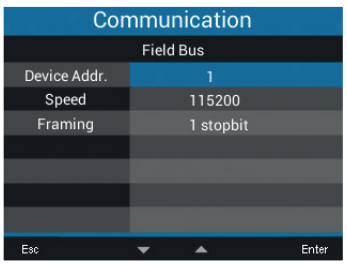
Attention! *Further information on configuration can be found in the Section* ***Operation*** *and* ***Configuration****.*

Language



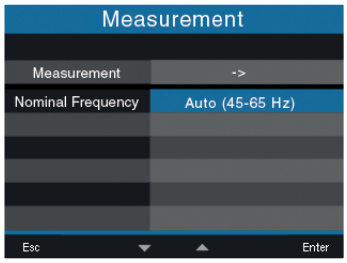
Settings in the device language

Communication



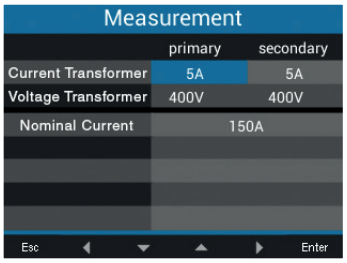
Settings for the parameters device address, baud rate and data framework

Measurement (frequency)



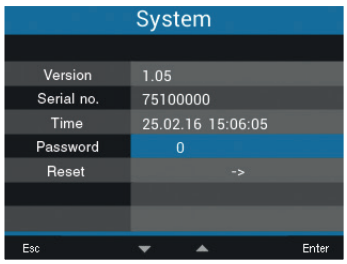
Settings for the standard frequency

Measurement L1..L3



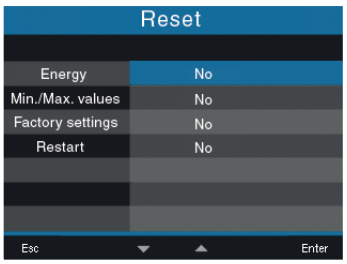
Settings for the current transformer and voltage transformer conversion ratios, and the rated current

System



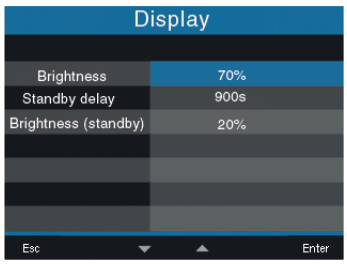
Display of device data, password assignment and ways to reset the device

System (Reset)



Display of device data, password assignment and ways to reset the device

Display



Display settings

Colors

Color settings of the graphs

15. Service and maintenance

The device underwent various safety checks before delivery and is marked with a seal. If a device is open, then the safety checks must be repeated. Warranty claims will only be accepted if the device is unopened.

15. 1 Repairs

Repair work can be carried out by the manufacturer only.

15. 2 Front film

The front film can be cleaned with a soft cloth and standard household cleaning agents. Do not use acids and products containing acid for cleaning.

15. 3 Disposal

Please comply with national regulations! Dispose of individual components, depending on their constitution and the country-specific legal provisions, e.g. as:

- electronic scrap
- plastics
- metals

or commission a certified disposal operation with the scrapping of the device.

15. 4 Service

Should questions arise, which are not described in this manual, please contact the manufacturer directly.
We will need the following information from you to answer any questions:

- Device name (see rating plate)
- Serial number (see rating plate)
- Software release (see system display)
- Measurement voltage and supply voltage
- Precise description of the error.

15. 5 Device calibration

The devices are calibrated by the manufacturer at the factory. It is not necessary to recalibrate the device providing that the environmental conditions are complied with.

15. 6 Re-calibration

We recommend having a re-calibration carried out by the manufacturer or an accredited laboratory approximately every 5 years.

15. 7 Firmware update

To update the firmware, connect the device to a computer and request it via the GridVis® software.

Open the firmware assistant by clicking on "Update Device" in the "Extras" menu.

Select the corresponding update file and perform the update.

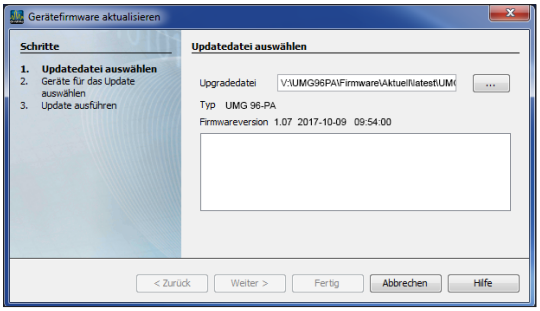


Fig. Updating the device firmware in the GridVis® software

15. 8 Battery

The internal clock is fed from the supply voltage. If the supply voltage fails then the clock is powered by the battery. The clock provides date and time information, e.g. for the recordings and the minimum and maximum values.

The life expectancy of the battery is at least 5 years with a storage temperature of +45 °C. The typical life expectancy of the battery is 8 to 10 years.

The battery is replaced via the battery insert provided on the bottom of the device. Ensure that the correct type of battery is used here and observe correct polarity when changing it (plus pole facing the back of the device, and the minus pole towards the front)!

WARNING! **Risk of injury from electric voltage!**

Serious bodily harm or death may result from hazardous voltages.
For this reason, please note the following:

- **De-energise the system before starting work.**

ATTENTION!
Grease or dirt on the contact surfaces form a transfer resistance that will shorten the life of the battery.
Only touch the battery at the edges.

ATTENTION!
Make sure that the correct type of battery is used and observe correct polarity when changing it.

15. 9 Procedure in the event of an error

Possible error	Cause	Remedy
No display	External fuse for the supply voltage was triggered.	Replace fuse.
No current display.	Measurement voltage not connected.	Connect measurement voltage.
	Measurement current not connected.	Connect measurement current.
Displayed current is too high or too low.	Current measurement in wrong phase.	Check connection and correct as needed.
	Current transformer factor programmed incorrectly.	Read out and program the current transformer conversion ratio on the current transformer.
	The peak current value at the measurement input was exceeded by current harmonics.	Install a current transformer with a larger current transformer conversion ratio.
	The current at the measurement input was exceeded.	Install a current transformer with a smaller current transformer conversion ratio.
Displayed voltage is too high or too low.	Measurement in wrong phase.	Check connection and correct as needed.
	Voltage transformer factor programmed incorrectly.	Read out and program the voltage transformer conversion ratio on the voltage transformer.
Displayed voltage is too low.	Measurement range violation.	Use voltage transformer.
	The peak voltage value at the measurement input was exceeded by harmonics.	**Attention!** Ensure that the measurement inputs are not overloaded.
Phase shift ind./cap.	Current path is assigned to the wrong voltage path.	Check connection and correct as needed.
Effective power drawn/delivered have been switched.	At least one current transformer connection has been switched.	Check connection and correct as needed.
	A current path is assigned to the wrong voltage path.	Check connection and correct as needed.
Effective power is too high or too low.	The programmed current transformer conversion ratio is wrong.	Read out and program the current transformer conversion ratio on the current transformer
	The current path is assigned to the wrong voltage path.	Check connection and correct as needed.
	The programmed voltage transformer conversion ratio is wrong.	Read out and program the voltage transformer conversion ratio on the voltage transformer.
An input/output does not respond.	The input/output was programmed incorrectly.	Check programming and correct as needed.
	The input/output was connected incorrectly.	Check connection and correct as needed.
Display "Measurement range violation"	There is a measurement range violation	Check connection and correct as needed. Correct current /voltage transformer conversion ratio.
No connection to device.	RS485 - Wrong device address. - Different bus speeds (Baud rate) and/or data framework - Wrong protocol. - No termination.	 - Correct device address. - Correct speed (baud rate). Correct data framework. - Correct protocol. - Connect bus to a termination resistor.
Despite taking the above measures, the device does not work.	Device is defective.	Send device back to manufacturer with an exact description of the error/fault.

16. Technical Data

General	
Net weight (with connectors attached)	approx. 250 g
Packaged weight (incl. accessories)	approx. 500g
Battery	Lithium type CR2032, 3V (approved as per UL 1642)
Life cycle of the backlighting	40000h (Backlighting diminishes over this time period to approx. 50%)

Transport and storage The following details apply for devices that are transported and stored in the original packaging.	
Free fall	1m
Temperature	K55 (-25°C to +70°C)
Relative humidity	0 to 90% RH

Environmental conditions for operation	
The device is suitable for weather-protected, non-mobile use. Protection class II as per IEC 60536 (VDE 0106, Part 1).	
Measurement temperature range	K55 (-10°C .. +55°C)
Relative humidity	0 to 75 % RH
Operating height	0 .. 2000m over NN
Pollution degree	2
Installation position	vertical
Ventilation	External ventilation is not required.
Protection from foreign objects and water - Front - Back - Front with seal	 IP40 as per EN60529 IP20 as per EN60529 IP54 as per EN60529

Supply voltage		
Option 230V	Nominal range	AC 90 V - 277 V (50/60 Hz) or DC 90 V - 250 V; 300 V CATIII
	Power consumption	max. 4.5 VA / 2 W
Option 24V	Nominal range	AC 24 V - 90 V (50/60Hz) or DC 24 V - 90 V; 150 V CATIII
	Power consumption	max. 4.5 VA / 2 W
Operating range	+-10% of nominal range	
Internal fuse not exchangeable	Type T1A / 250 V DC / 277 V AC as per IEC 60127	
Recommended overvoltage protective device for the Line protection (UL approval)		Option 230 V: 6 - 16 A (Char. B) Option 24 V: 1 - 6 A (Char. B)

Recommendation for the maximum number of devices on the line circuit breaker:
Option 230V : Line circuit breaker B6A: max. 4 devices / Line circuit breaker B16A: max. 11 devices
Option 24V : Line circuit breaker B6A: max. 3 devices / Line circuit breaker B16A: max. 9 devices

Voltage measurement	
Three-phase 4-wire systems with rated volatges up to	417 V / 720 V (+-10%) as per IEC 347 V / 600 V (+-10%) as per UL
Overvoltage category	600 V CAT III
Rated surge voltage	6 kV
Fuse for voltage measurement	1 - 10 A (with IEC/UL approval)
Measurement range L-N	0[1] .. 600 V_{rms} (max. overvoltage 800 V_{rms})
Measurement range L-L	0[1] .. 1040 V_{rms} (max. overvoltage 1350 V_{rms})
Resolution	0.01V
Crest factor	2.45 (relative to the measurement range)
Impedance	3 MΩ/Phase
Power consumption	approx. 0.1 VA
Sampling rate	8.33 KHz
Frequency of the fundamental oscillation - Resolution	45 Hz.. 65 Hz 0.01Hz

[1] The device can only determine measurement values if there is at the voltage measurement input V1 a voltage L1-N greater than 20 Veff (4-wire measurement) or a voltage L1-L2 greater than 34 Veff (3-wire measurement).

Current measurement I1 - I3	
Rated current	5 A
Measurement range	0.005 .. 6 A_{rms}
Crest factor (based on rated current)	2
Overvoltage category	300 V CAT II
Rated surge voltage	2 KV
Power consumption	approx. 0.2 VA (Ri=5 mΩ)
Overload for 1 sec.	60 A (sinusoidal)
Sampling rate	8.33 KHz

Serial interface	
RS485 - Modbus RTU/Slave	9.6 kbps, 19.2 kbps, 38.4 kbps, 57.6 kbps, 115.2 kbps

Digital outputs 3 digital outputs, semiconductor relay, not short-circuit proof.	
Switching voltage	max. 33 V AC, 60 V DC
Switching current	max. 50 mA_{eff} AC/DC
Response time	approx. 200 ms
Pulse output	max. 50Hz (energy pulses)

Digital inputs 3 digital inputs, semiconductor relay, not short-circuit proof.	
Maximum counter frequency	20 Hz
Input signal is on	18 V.. 28 V DC (typically 4 mA)
Input signal is not on	0 .. 5 V DC, current less than 0.5 mA

Conductor length (digital inputs/outputs)	
up to 30m	not screened
more than 30m	screened

Analog output	
External supply	max. 33 V
Current	0 .. 20 mA
Update time	1 sec
Resolution	10 bit

Connectability of the terminals (supply voltage) Connectable conductors. Only connect one conductor per terminal!	
Single-wire., multiwire, fine-wire	0.08 - 4.0 mm^2, AWG 28-12
Pin terminals, wire-end ferrules	0.2 - 2.5 mm^2
Tightening torque	0.4 - 0.5 Nm
Insulation length	7 mm

Connectability of the terminals (voltage measurement) Connectable conductors. Only connect one conductor per terminal!	
Single-wire., multiwire, fine-wire	0.08 - 4.0 mm^2, AWG 28-12
Pin terminals, wire-end ferrules	0.2 - 2.5 mm^2
Tightening torque	0.4 - 0.5 Nm
Insulation length	7 mm

Connectability of the terminals (current measurement) Connectable conductors. Only connect one conductor per terminal!	
Single-wire., multiwire, fine-wire	0.2 - 2.5 mm^2, AWG 26-12
Pin terminals, wire-end ferrules	0.2 - 2.5 mm^2
Tightening torque	0.4 - 0.5 Nm
Insulation length	7 mm

Connectability of the terminals (serial interface)	
Single-wire., multiwire, fine-wire	0.2 - 1.5 mm^2, AWG 28-16
Pin terminals, wire-end ferrules	0.2 - 1.5 mm^2
Tightening torque	0.2 - 0.25 Nm
Insulation length	7 mm

Connectability of the terminals (digital inputs/outputs, analog output)	
Single-wire., multiwire, fine-wire	0.2 - 1.5 mm^2, AWG 28-16
Pin terminals, wire-end ferrules	0.2 - 1.5 mm^2
Tightening torque	0.2 - 0.25 Nm
Insulation length	7 mm

16. 1 Function performance characteristics

Function	Symbol	Precision class	Measurement range	Display range
Total effective power	P	0,5[5] (IEC61557-12)	0 W .. 12.6 kW	0 W .. 999 GW *
Total reactive power	QA, Qv	1 (IEC61557-12)	0 var .. 16,6 kvar	0 var .. 999 Gvar *
Total apparent power	SA, Sv	0,5[5] (IEC61557-12)	0 VA .. 12,6 kVA	0 VA .. 999 GVA *
Total effective energy	Ea	0,5S[5] [6](IEC61557-12)	0 Wh .. 999 GWh	0 Wh .. 999 GWh *
Total reactive energy	ErA, ErV	1 (IEC61557-12)	0 varh .. 999 Gvarh	0 varh .. 999 Gvarh *
Total apparent energy	EapA, EapV	0.5[5] [6] (IEC61557-12)	0 VAh .. 999 GVAh	0 VAh .. 999 GVAh *
Frequency	f	0.05 (IEC61557-12)	45 Hz.. 65 Hz	45.00 Hz.. 65.00 Hz
Phase current	I	0.2 (IEC61557-12)	0 A_{rms}.. 7 A_{rms}	0 A.. 999 kA
Neutral conductor current, calculated	INc	1.0 (IEC61557-12)	0.03 A.. 25 A	0.03 A.. 999 kA
Voltage	U L-N	0.2 (IEC61557-12)	10 V_{rms}.. 600 V_{rms}	0 V.. 999 kV
Voltage	U L-L	0.2 (IEC61557-12)	18 V_{rms} .. 1040 V_{rms}	0 V.. 999 kV
Power factor	PFA, PFV	0.5 (IEC61557-12)	0.00 .. 1.00	0.00 .. 1.00
Short-term flicker, long-term flicker	Pst, Plt	-	-	-
Voltage dips (L-N)	Udip	-	-	-
Voltage swells (L-N)	Uswl	-	-	-
Transient overvoltages	Utr	-	-	-
Voltage interruptions	Uint	-	-	-
Voltage symmetry (L-N) [1]	Unba	-	-	-
Voltage symmetry (L-N) [2]	Unb	-	-	-
Voltage harmonics	Uh	Cl. 1 (IEC61000-4-7)	1 .. 15 (only odd)	0 V.. 999 kV
Voltage THD [3]	THDu	1.0 (IEC61557-12)	0 % .. 999 %	0 % .. 999 %
Voltage THD [4]	THD-Ru	-	-	-
Current harmonics	Ih	Kl. 1 (IEC61000-4-7)	1 .. 15 (only odd)	0 A.. 999 kA
Current THD [3]	THDi	1.0 (IEC61557-12)	0 % .. 999 %	0 % .. 999 %
Current THD [4]	THD-Ri	-	-	-
Network signal voltage	MSV	-	-	-

1) Reference to amplitude.
2) Reference to phase and amplitude.
3) Reference to fundamental oscillation.
4) Reference to effective value.
5) Accuracy class 0.5 with ../5A transformer. Accuracy class 1 with ../1A transformer.
6) Accuracy class 0.5S as per IEC62053-22

* When the maximum total energy levels have been reached, the device jumps back to 0 W .

16. 2 Modbus address list of frequently used measurement values:

Address	Format	RD/WR	Variable	Unit	Comment
19000	float	RD	_ULN[0]	V	Voltage L1-N
19002	float	RD	_ULN[1]	V	Voltage L2-N
19004	float	RD	_ULN[2]	V	Voltage L3-N
19006	float	RD	_ULL[0]	V	Voltage L1-L2
19008	float	RD	_ULL[1]	V	Voltage L2-L3
19010	float	RD	_ULL[2]	V	Voltage L3-L1
19012	float	RD	_ILN[0]	A	Apparent current, L1
19014	float	RD	_ILN[1]	A	Apparent current, L2
19016	float	RD	_ILN[2]	A	Apparent current, L3
19018	float	RD	_I_SUM3	A	Vector sum; IN=I1+I2+I3
19020	float	RD	_PLN[0]	W	Real power L1
19022	float	RD	_PLN[1]	W	Real power L2
19024	float	RD	_PLN[2]	W	Real power L3
19026	float	RD	_P_SUM3	W	Sum; Psum3=P1+P2+P3
19028	float	RD	_SLN[0]	VA	Apparent power L1
19030	float	RD	_SLN[1]	VA	Apparent power L2
19032	float	RD	_SLN[2]	VA	Apparent power L3
19034	float	RD	_S_SUM3	VA	Sum; Ssum3=S1+S2+S3
19036	float	RD	_QLN[0]	var	Reactive power (mains frequ.) L1
19038	float	RD	_QLN[1]	var	Reactive power (mains frequ.) L2
19040	float	RD	_QLN[2]	var	Reactive power (mains frequ.) L3
19042	float	RD	_Q_SUM3	var	Sum; Qsum3=Q1+Q2+Q3
19044	float	RD	_COS_PHI[0]		Fund.power factor, CosPhi; UL1 IL1
19046	float	RD	_COS_PHI[1]		Fund.power factor, CosPhi; UL2 IL2
19048	float	RD	_COS_PHI[2]		Fund.power factor, CosPhi; UL3 IL3
19050	float	RD	_FREQ	Hz	Measured frequency
19052	float	RD	_PHASE_SEQ		Rotation field; 1=right, 0=none, -1=left
19054*	float	RD	_WH_V[0]	Wh	Real energy L1, consumed
19056*	float	RD	_WH_V[1]	Wh	Real energy L2, consumed
19058*	float	RD	_WH_V[2]	Wh	Real energy L3, consumed
19060	float	RD	_WH_V_HT_SUML13	Wh	Real energy L1..L3
19062	float	RD	_WH_V[0]	Wh	Real energy L1, consumed
19064	float	RD	_WH_V[1]	Wh	Real energy L2, consumed
19066	float	RD	_WH_V[2]	Wh	Real energy L3, consumed
19068	float	RD	_WH_V_HT_SUML13	Wh	Real energy L1..L3, consumed, rate 1
19070	float	RD	_WH_Z[0]	Wh	Real energy L1, delivered
19072	float	RD	_WH_Z[1]	Wh	Real energy L2, delivered
19074	float	RD	_WH_Z[2]	Wh	Real energy L3, delivered
19076	float	RD	_WH_Z_SUML13	Wh	Real energy L1..L3, delivered
19078	float	RD	_WH_S[0]	VAh	Apparent energy L1
19080	float	RD	_WH_S[1]	VAh	Apparent energy L2
19082	float	RD	_WH_S[2]	VAh	Apparent energy L3
19084	float	RD	_WH_S_SUML13	VAh	Apparent energy L1..L3
19086*	float	RD	_IQH[0]	varh	Reactive energy, inductive, L1
19088*	float	RD	_IQH[1]	varh	Reactive energy, inductive, L2
19090*	float	RD	_IQH[2]	varh	Reactive energy, inductive, L3
19092	float	RD	_IQH_SUML13	varh	Reactive energy L1..L3

* The assignment of the marked device addresses does not correspond to the assignment of other devices in the UMG series.

19094	float	RD	_IQH[0]	varh	Reactive energy, inductive, L1
19096	float	RD	_IQH[1]	varh	Reactive energy, inductive, L2
19098	float	RD	_IQH[2]	varh	Reactive energy, inductive, L3
19100	float	RD	_IQH_SUML13	varh	Reactive energy L1..L3, ind.
19102	float	RD	_CQH[0]	varh	Reactive energy, capacitive, L1
19104	float	RD	_CQH[1]	varh	Reactive energy, capacitive, L2
19106	float	RD	_CQH[2]	varh	Reactive energy, capacitive, L3
19108	float	RD	_CQH_SUML13	varh	Reactive energy L1..L3, cap.
19110	float	RD	_THD_ULN[0]	%	Harmonic, THD,U L1-N
19112	float	RD	_THD_ULN[1]	%	Harmonic, THD,U L2-N
19114	float	RD	_THD_ULN[2]	%	Harmonic, THD,U L3-N
19116	float	RD	_THD_ILN[0]	%	Harmonic, THD,I L1
19118	float	RD	_THD_ILN[1]	%	Harmonic, THD,I L2
19120	float	RD	_THD_ILN[2]	%	Harmonic, THD,I L3

16. 3 Number formats

Type	Size	Minimum	Maximum
short	16 bit	-2^{15}	$2^{15}-1$
ushort	16 bit	0	$2^{16}-1$
int	32 bit	-2^{31}	$2^{31}-1$
uint	32 bit	0	$2^{32}-1$
float	32 bit	IEEE 754	IEEE 754

Configuration data are saved immediately!

16. 4 Dimension views

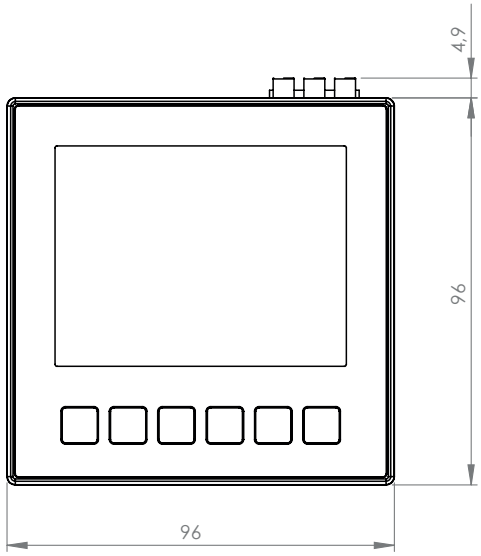


Fig. Front view

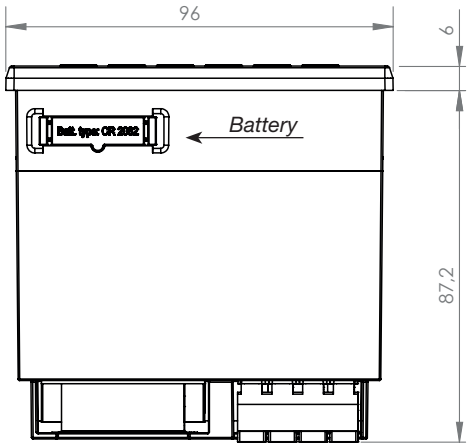


Fig. View from below

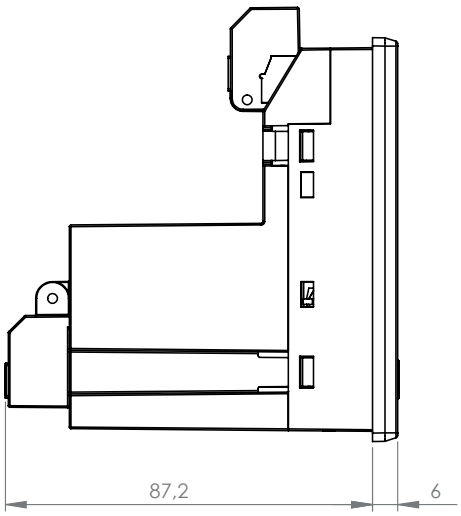


Fig. Side view

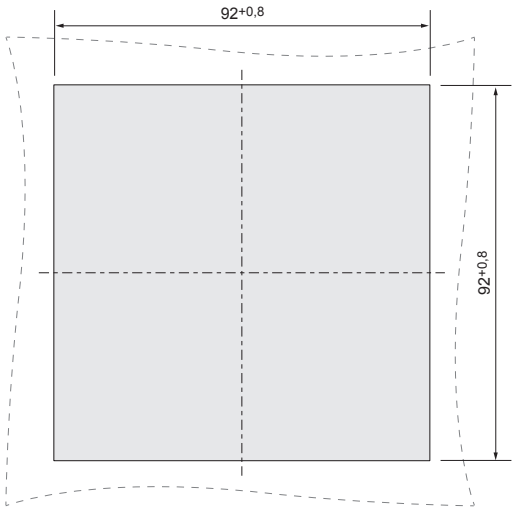
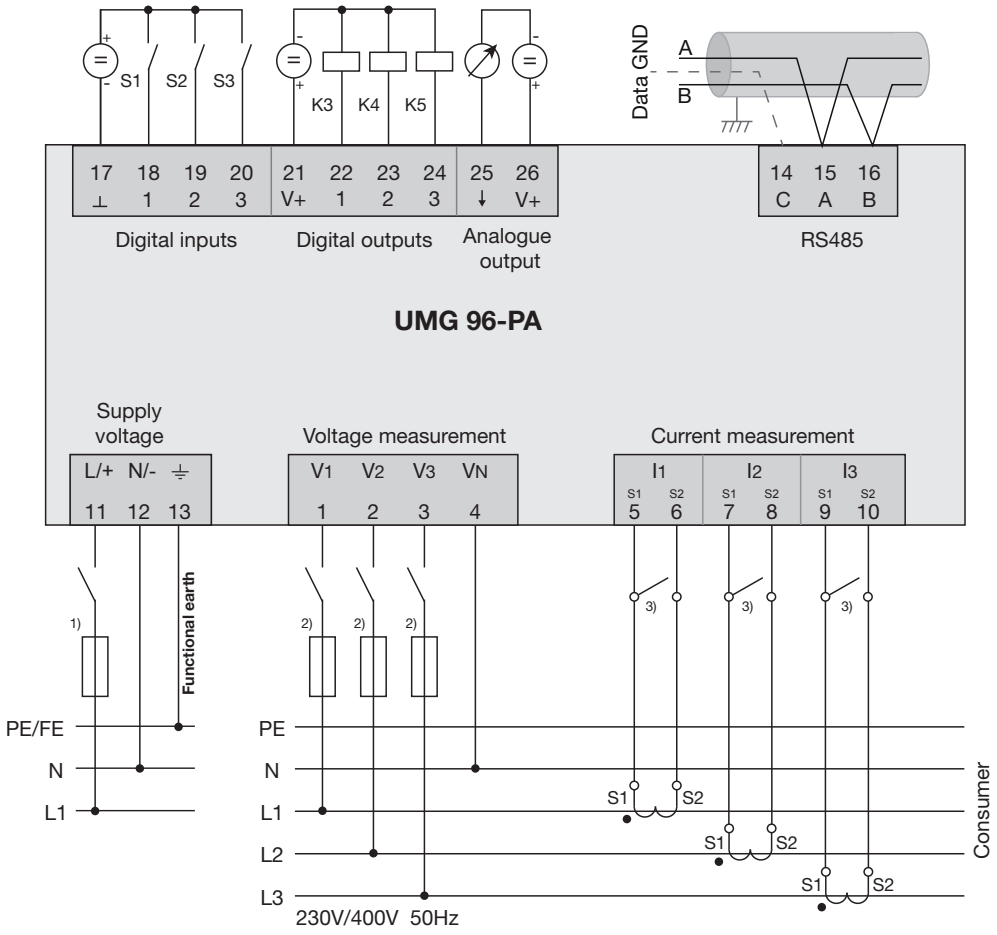


Fig. Cut-out dimensions

16. 5 Connection example 1



1) UL/IEC allowed overcurrent circuit breaker
2) UL/IEC allowed overvoltage circuit breaker
3) Shorting bridges (external)