www.janitza.com

Energy Analyzer

UMG 96-EL

as of firmware version 1.1.0

User manual and technical data

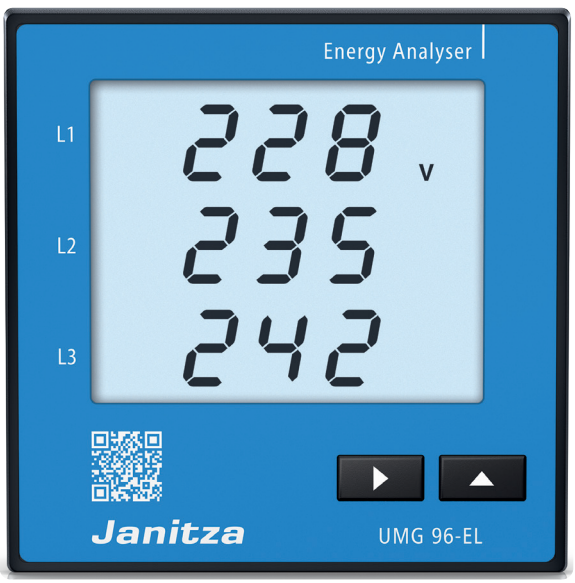

Image may differ from the original!

Doc. no. 2.067.005.2.a 10/2025

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Janitza®

UMG 96-EL

Compact energy analyzer with Ethernet

Doc. no. 2.067.005.2.a
10/2025
The German version is the original version of the documentation.

Subject to technical alterations.

The contents of our documentation have been compiled with great care and reflect the current state of the information available to us. Nonetheless, we wish to point out that updates of this document are not always possible at the same time as technical refinements are implemented in our products. Information and specifications are subject to change without notice.
Please check for the latest version at **www.janitza.com**.

Information about the GridVis® software.

Janipedia: wiki.janitza.de

Tutorials: youtube.com/@gridvis

INHALTSVERZEICHNIS

1. Information on the device and the user manual

1.1 Disclaimer

Compliance with the usage information for the devices is a prerequisite for safe operation and attaining the stated performance characteristics and product features.

Janitza electronics GmbH assumes no liability for bodily injury, material damage or financial losses which result from disregard of the usage information.

Make sure that your usage information is readily available and legible.

1.2 Copyright notice

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All trademarks and the rights arising from them are the property of the respective owners of these rights.

1.3 Technical changes

- Make sure that your device matches the user manual.
- This user manual applies to the UMG 96-EL measurement device.
  Separate validities and distinctions are marked.
- First make sure you have read and understood the usage information accompanying the product.
- Keep the usage information associated with the product available for the entire service life and pass it on to any possible subsequent users.
- Find out about device revisions and the associated modifications of the usage information associated with your product at www.janitza.com.
- This manual is also valid for alternative device fronts.

1.4 About this user manual

If you have questions, suggestions or ideas for improvement of the user manual, please let us know via email at: info@janitza.com.

INFORMATION

This user manual describes the UMG 96-EL device and provides information on its operation.
In addition to this user manual, please refer to additional usage information for your device, such as:
· Installation manual.
· “Safety Information” supplement.

Furthermore, online help for the **GridVis software** is available at wiki.janitza.com.

The illustrations and figures in this user manual may differ from the actual state of the device delivered!

INFORMATION

Our usage information uses the grammatical masculine form in a gender-neutral sense!
This form always refers equally to women, men and diverse. In order to make the texts more readable, distinctions are not made. We ask for your understanding for these simplifications.

1.5 Defective device/disposal

Before sending **defective devices, modules or components** back to the manufacturer for testing:
· Contact the manufacturer's Support department.
· Send devices, modules or components complete with all accessories.
· When doing so, please bear the terms for transportation in mind.

INFORMATION

Please return defective or damaged devices to Janitza electronics GmbH in accordance with the shipping instructions for air or road freight (complete with accessories).
This device does not contain any batteries or rechargeable batteries.

Do not attempt to open or repair the device (the component) on your own because otherwise all warranty claims become invalid!

For the **Disposal** of the device please observe national regulations! Dispose of individual parts, as applicable, depending on their composition and existing country-specific regulations, e.g. as
· Electronic waste,
· Plastics,
· Metals.
Engage a certified disposal company to handle scrapping as needed.

Information on servicing and maintenance of your device can be found in „19. Service and maintenance“ on page 72.

2. Safety

The chapter on Safety contains information which must be observed to ensure your personal safety and avoid material damage.

2.1 Display of warning notices and safety information

The warning notices shown below
· are found throughout all of the documentation,
· can be found on the devices themselves.
· indicate potential risks and hazards,
· underscore aspects of the information provided that clarifies or simplifies procedures.

The additional symbol on the device itself indicates an electrical danger that can result in serious injuries or death.

This general warning symbol draws attention to a possible risk of injury. Be certain to observe all of the information listed under this symbol in order to avoid possible injury or even death.

2.2 Hazard levels

Warning and safety information is marked by a warning symbol, and the hazard levels are shown as follows, depending on the degree of hazard:

⚠ DANGER
Warns of an imminent danger which, if not avoided, results in serious or fatal injury.

⚠ WARNING
Warns of a potentially hazardous situation which, if not avoided, could result in serious injury or death.

⚠ CAUTION
Warns of an immediately hazardous situation which, if not avoided, can result in minor or moderate injury.

ATTENTION
Warns of an immediately hazardous situation which, if not avoided, can result in material or environmental damage.

INFORMATION

Indicates procedures in which there is **no** hazard of personal injury or material damage.

2.3 Product safety

The device reflects current engineering practice and accepted safety standards, but hazards can nonetheless arise.

Observe the safety regulations and warning notices. If notices are disregarded, this can lead to personal injury and/or damage to the product.

Every type of tampering with or use of this device,
· which goes beyond the mechanical, electrical or other operating limits can lead to personal injury and/or damage to the product;
· constitutes “misuse” and/or “negligence” under the product’s warranty and thus voids the warranty for any possible resulting damage.

Read and understand the user manual and, if applicable, the usage information before installing, operating, maintaining and using the device.

Only operate the device when in perfect condition and in compliance with this user manual and the usage information that is included. Send defective devices back to the manufacturer in compliance with proper transport conditions.
Retain the user manual throughout the service life of the device and keep it at hand for consultation.

When using the device, also observe the legal and safety regulations for your system that are applicable for the respective use case.

2.4 Dangers when handling the device

When operating electric devices, it is unavoidable for certain parts of these devices to conduct hazardous voltage. Consequently, severe bodily injury or material damage can occur if they are not handled properly.
Therefore, when handling our devices, always observe the following:

· do not exceed the limit values specified in the user manual and on the rating plate! This must also be observed during testing and commissioning!
· Take note of the safety and warning notices in all usage information that belongs to the device!

⚠ WARNING

Disregarding the connection conditions of the Janitza measurement devices or their components can lead to injuries and even death or to material damage!

· Do not use Janitza measurement devices or components for critical switching, control or protection applications where the safety of persons and property depends on this function.
· Do not carry out switching operations with the Janitza measurement devices or components without prior inspection by your plant manager with specialist knowledge! In particular, the safety of persons, material assets and the applicable standards must be taken into account!

⚠ WARNING

Life-threatening danger due to electrical voltage if installed incorrectly!
Incorrect connection or exposed cable ends can result in parts being live.

· **Check the wiring before switching on for the first time.**

⚠ WARNING

Risk of injury due to electrical voltage!
Severe bodily injury or death can result! Therefore please abide by the following:

· Switch off your installation before commencing work! Secure it against being switched on again! Check to be sure it is de-energized! Ground and short circuit! Cover or block off adjacent live parts!
· During operation and troubleshooting (especially for DIN rail devices), check your system for dangerous voltages and switch these off if necessary!
· Wear protective clothing and protective equipment in accordance with applicable guidelines when working on electrical systems!
· Before making connections to the device/the component, ground the device by means of the ground wire connection, if present.
· Do not touching bare or stripped leads that are energized! Equip stranded conductors with wire ferrules!
· Hazardous voltages can be present in all circuitry parts that are connected to the power supply.
· Protect wires, cables and devices with a suitable line circuit breaker/fuse!
· Never switch off, remove or tamper with safety devices!
· There can still be hazardous voltages present in the device or in the component even after it has been disconnected from the supply voltage (capacitor storage).
· Do not operate equipment with current transformer circuits when open.
· Only connect screw terminals with the same number of poles and design!
· Do not exceed the limit values specified in the user manual and on the rating plate! This must also be observed during testing and commissioning.
· Take note of the safety and warning notices in the documents that belong to the device!

2.5 Electrically qualified personnel

To avoid bodily injury and material damage, only electrically qualified personnel are permitted to work on the devices and their components, modules, assemblies, systems and current circuits who have knowledge of:

- The national and international accident prevention regulations.
- Safety technology standards.
- Installation, commissioning, operation, disconnection, grounding and marking of electrical equipment.
- The requirements concerning personal protective equipment.

Electrically qualified persons within the scope of the technical safety information of all usage information associated with the device and its components are persons who can furnish proof of qualification as an electrically skilled person.

⚠ WARNING

Warning against unauthorized manipulation or improper use of the device or its components!
Opening, dismantling or unauthorized manipulation of the device and its components which goes beyond the mechanical, electrical or other operating limits indicated can lead to material damage or injury, up to and including death.

- Only electrically qualified personnel are permitted to work on the devices and their components, assemblies, systems and current circuits.
- Always use your device or component only in the manner described in the associated documentation.
- If there is discernible damage, send the device or the component back to the manufacturer!

2.6 Warranty in the event of damage

Any unauthorized tampering with or use of the device constitutes "misuse" and/or "negligence" under the product's warranty and thus voids the warranty for any possible resulting damage. In this regard, please take note of section „4.3 Intended use“ on page 17.

2.7 Safety information for handling current transformers and measurement devices with residual current measurement

⚠ WARNING

Risk of injury due to large currents and high electrical voltage on the current transformers!
Current transformers operated while open on the secondary side (high voltage peaks pose a hazard when touched) can result in severe bodily injury or death.

- Avoid operating the current transformers while open; short circuit the unloaded transformers!
- Before interrupting the current supply, short circuit the secondary connections of the current transformers. Set the test switches that automatically short-circuit the secondary lines of the current transformers to the "Test" status (check test switch/short-circuiting device beforehand)!
- Only use current transformers with basic insulation in accordance with IEC 61010-1!
- Caution, even current transformers rated as safe for open operation can pose a hazard when touched during operation while open!
- Make sure to mount screw terminals for the current transformer connection on the meter and, if necessary, fasten them with the enclosed screws!
- Comply with the information and provisions in the documentation of your current transformers!

⚠ CAUTION

Risk of injury or damage to the meter due to high measurement currents at the connections of the current transformers!
High measurement currents can cause temperatures of up to 80 °C (176 °F) on the connections of the current transformers
· Use wiring that is designed for an operating temperature of at least 80 °C (176 °F)!
· The current transformers can be hot even after the power supply has been switched off. Allow the connections of the current transformers and the connecting cables to cool down before touching them!

⚠ WARNING

Risk of injury or damage to the meter due to improper use!
Meters with residual current measurement can trigger warning pulses if limit values are exceeded, and these are used exclusively for monitoring residual currents or failure monitoring. Use of the warning pulses as a stand-alone protective device against electrical shock can lead to injury and even death!
· Do not use devices with residual current measurement as a stand-alone protective device. Employ suitable protective devices for your system!

⚠ CAUTION

Risk of injury or damage to the meter/your system due to short circuit!
Inadequate insulation of the operating equipment at the residual current measurement input with respect to the supply circuits can cause voltages at the measurement input which represent a hazard when touched or damage to your device or system.
· Ensure reinforced or double insulation with respect to the supply circuits!
· Ensure galvanic isolation of the residual current measurement inputs from each other!

3. Cybersecurity – safe operation of the device

3.1 Modbus TCP

The Modbus TCP protocol allows complete configuration of the device without authentication. This means that unauthorized third parties can gain access to the configuration and also manipulate measured values. This manipulation can have serious consequences for the accessibility of the device and the integrity of the measurement results. The Modbus TCP interface cannot be switched off and must be secured accordingly by the operator (see „3.5 Measures for safe operation“ on page 15).

3.2 MQTT

You can freely combine authentication and encryption methods by means of the configuration. Each setting becomes active automatically as soon as the relevant data are entered. Tokens can also be stored instead of a password.

Examples of MQTT login options:

Selection	Result
Connection data only	No encryption or authentication
Username/password only	Unencrypted authentication
Username/password + TLS	Encrypted authentication **(recommended at least)**
TLS + client certificate/key	Encrypted, certificate-based authentication
Username/password + client certificate/key + TLS + CA check	Connection with maximum security

- See also section „14.3 Setting up an MQTT connection“ on page 56.

3.3 Display protection

The device is equipped with a display that can be protected by a three-digit PIN. This PIN can be changed at any time via Modbus TCP. Unauthorized changes to the PIN or the configuration can create potentials for security vulnerabilities and manipulation.

- See also section „12.1 Setting the user password (PIN, address 050)“ on page 44.

3.4 Firmware updates

Only download the firmware from a trusted source, for example **https://www.janitza.com/de-de/downloads/firmware.**

Always check the integrity of the file before installation, for example by comparing the checksum.

- See also section „19.5 Performing a firmware update“ on page 73.

3.5 Measures for safe operation

To ensure the security and integrity of your systems, you as the owner are obliged to adequately secure the network and access to the device.

We recommend the following measures for this purpose:

1. Firewall use: Implement firewalls to control access to the network and block unauthorized connections.
2. Set up VLANs: Use virtual local area networks (VLANs) to segment data traffic and isolate sensitive devices from other network areas.
3. Manage access rights: Restrict access to the network and devices to authorized persons.
4. Perform regular audits: Regularly review your network security and perform security audits to identify potential vulnerabilities.
5. Update firmware and software: Keep the device and all associated systems up to date to close security gaps.
6. Continuous monitoring: Implement monitoring systems to detect unusual activity on the network and to respond quickly.
7. Secure MQTT configuration: Ensure that you use authentication and encryption options (TLS) wherever possible to increase the security of MQTT connections.
8. Use PIN protection: Enable PIN protection for the display and change the PIN regularly to prevent unauthorized access. Ensure that the PIN is distributed via a secure network and that the Modbus TCP connection is protected accordingly.
9. Before decommissioning or returning: Perform a *secure deletion* of all stored data. This ensures that all sensitive information has been removed from the device (see section „15.5 Secure deletion and reset to factory settings“ on page 63).

Establish all recommended measures to prevent unauthorized access and manipulation. Your responsibility for network security is crucial for the safe operation of the device. Pay particular attention to the potential risks associated with manipulation of configuration and measured values via Modbus TCP.

4. Product description

4.1 Device description

The measurement device is a multifunctional network analyzer that:

- Is designed to measure the power quality in low-voltage systems.
- Measures and calculates electrical variables such as voltage, current, frequency, power, work, harmonics, etc. in building installations, on distribution boards, circuit breakers and busbar trunking systems.
- Records energy consumption for cost center analysis.
- Displays and saves measurement results and transmits them via Ethernet, e.g. to the building management system.

Measured voltages and currents must originate from the same network. External ../5 A or ../1 A current transformers (inductive current transformers) must be used for current measurement.

Measurements in medium voltage networks are always carried out via current and voltage transformers!

4.2 Incoming goods inspection

Safe and trouble-free operation of this device and its components presupposes proper transport, proper storage, set-up and assembly as well as operation and maintenance in addition to compliance with the safety information and warning notices.

Exercise due caution when unpacking and packing the device, do not use force and only use suitable tools.

Before installing the device, please check the following:

- Its flawless mechanical condition by visual inspection.
- The scope of delivery for completeness.

If it can be assumed that safe operation of the device is no longer possible:

- Disconnect the device from operation immediately!
- Secure the device against being switched on again!

It can be assumed that safe operation is no longer possible if the device, for example:

- Has visible damage.
- No longer functions despite an intact power supply.
- Was subjected to extended periods of unfavorable conditions (e.g. storage outside of the permissible climate thresholds without adjustment to the room climate, condensation, etc.) or transport stress (e.g. falling from an elevated position, even without visible external damage, etc.).

4.3 Intended use

The device is intended for the following uses:
· Use in residential and industrial areas
· Installation in weather-protected switchboard cabinets or small distribution boards
· Current measurement via external current transformers
· Measurement in 2, 3 and 4-conductor networks and TN, TT and IT networks

The device is **not** intended for:
· Operation outside the technical data range (measurement/operating voltage, overvoltage category, climatic conditions, back-up fuse, etc.)
· Installation in vehicles: Use of the device in non-stationary equipment constitutes an exceptional environmental condition and is only permissible by special agreement.
· Installation in environments with harmful oils, acids, gases, vapors, dusts, radiation, etc. or in potentially explosive atmospheres.

Safe and trouble-free operation of the device requires proper transport, storage, assembly, installation, operation and maintenance.

Furthermore, please note that Janitza measurement devices and components are **not** to be used for critical switching, control or protection applications (protective relays)! Observe the safety information and warnings in the "Safety" chapter!

4.4 Performance characteristics

General
· Front panel installation device with dimensions of 96 x 96 mm (3.78 x 3.78 in).
· Installation depth: 45 mm (1.77 in)
· Connection via screw terminals
· Supply voltage:
Option 230 V: 90 .. 277 V (50/60 Hz) or
DC 90 .. 250 V; 300 V CAT III
Option 24 V: 24 .. 90 V AC/DC; 150 V CAT III
· 3 voltage measurement inputs (300 V, CAT III)
· 3 current measurement inputs (via inductive ../5 A or ../1 A current transformers)
· Storage of minimum and maximum values (without time stamp)
· Frequency range: 45 .. 65 Hz

Measurement
· Measurement in TN, TT and IT networks
· Measurement in networks with nominal voltages up to L-L 480 V or L-N 277 V.
· Measuring range, current 0.005 .. 6 A_{eff}
· True effective value measurement (TRMS)
· Continuous sampling of the voltage and current measurement inputs
· Harmonics: Measurement of the 1st to 40th harmonics for U_{LN} and I
· Energy meter for 7 tariffs and total quantity:
Active energy (consumption)
Active energy (delivered)
Active energy (without backstop)
Reactive energy (inductive)
Reactive energy (capacitive)
Reactive energy (without backstop)
Apparent energy
each for L1, L2, L3 and sum of L1..L3

Measurement uncertainty
· Active energy:
Class 0.5/0.5S with ../5 A current transformers
Class 1/1S with ../1 A current transformers
· Reactive energy class 2
· Measuring accuracy 0.2% (voltage, current)

4.5 Conformity declaration

The laws, standards and directives applied by Janitza electronics GmbH for the devices can be found in the declarations of conformity at www.janitza.com.

4.6 FCC Declaration of Conformity

The device:
- complies with Part 15 of the FCC Rules for Class B digital devices (limit values to protect against harmful interference in a residential installation).
- generates, uses and can radiate high-frequency energy
- can cause harmful interference to radio communications if not installed and used properly. There is no guarantee that interference will not occur in a particular installation.

If there is radio or television reception interference, which can be determined by turning the device on and off, proceed as follows:
- Align or reposition the receiving antenna.
- Increase the distance between the device and the radio/television receiver.
- Connect the device and the radio/television receiver in different circuits.
- if necessary, contact Janitza support or a radio/television technician.

Code of Federal Regulations, Title 47, Part 15, Subpart B - Unintentional Radiators.

4.7 Scope of delivery

Quantity	Part. no.	Designation
1	5235xxx [1]	UMG 96-EL
1	3303908	Installation manual
1	3303342	"Safety Information" supplement
1	5235250	UMG 96-EL accessory pack (plug-in screw terminals and housing terminals)

1) For part number see delivery note
Tab. Scope of delivery

4.8 Accessories

Quantity	Part. no.	Designation
1	5222251	Retaining clip set
1	2901065	Silicone seal, 96 x 96

INFORMATION

All supplied options and design variants are described on the delivery note.

4.9 Measuring method

The device measures
· Continuously and calculates all effective values using in a 200 ms interval.
· The true RMS value (TRMS) of the voltages and currents applied to the measurement inputs.

4.10 Transformers

Use only "Current transformers for measuring purposes" for Janitza measurement devices and components!
"Protection transformers" must not be used!

4.11 Operating concept

The operating concept of the measurement device incorporates the following methods:
· 2 function buttons with display for configuring the device.
· The GridVis network analysis and programming software for programming and analysis of data.
· The Modbus protocol and the Modbus address list to configure and read out data. The Modbus address list is available in the download area at www.janitza.com.

This user manual describes how to operate the measurement device using the 2 function buttons and how to use the Modbus editor.

4.12 GridVis network analysis software

The GridVis software (download at www.janitza.com) is the perfect tool for configuring, reading and analyzing measurement data.

GridVis software performance characteristics
· Configure and read out data from your measurement device.
· Graphic display of measured values.
· Store measurement data in databases.
· Analyze measurement data that has been read out.
· Create reports.

Connections to the PC (GridVis software)
Connections for communication between the PC and the measurement device can be found in section „9. Connection and PC connections“ on page 34.

5. Structure of the device

5.1 Front panel - Display and controls

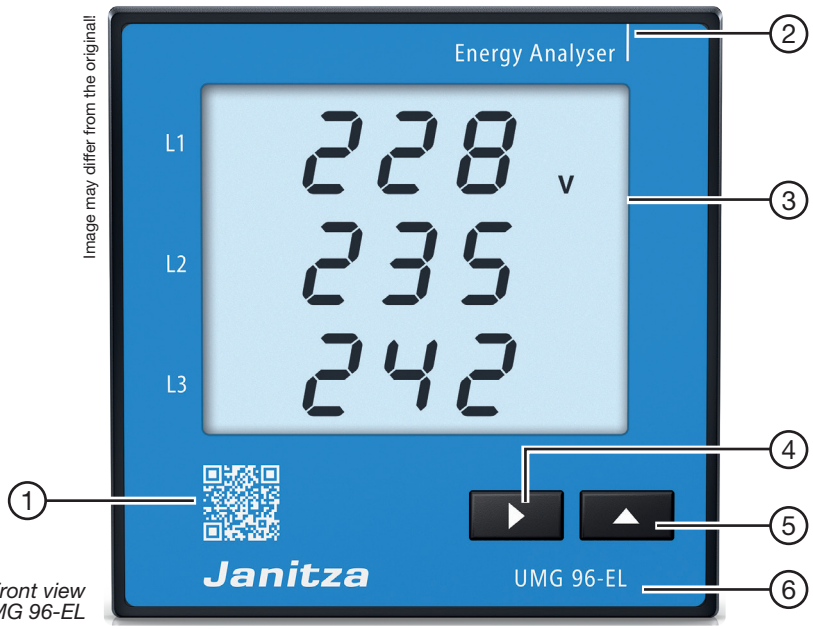
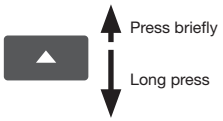


Fig. Front view of UMG 96-EL

Item	Function/Designation
1	QR code (link to the website of the device)
2	Device type
3	Display
4	Button 1: " ▸ " · Forward: press briefly · Backward: long press · In programming mode: Confirm selection: press briefly 
5	Button 2: " ▲ " · Upward: press briefly · Downward: long press · In programming mode: Value +1: press briefly Value -1: long press 
6	Device designation

Tab. Front view - display and controls

5.2 Rear of the device - Connections

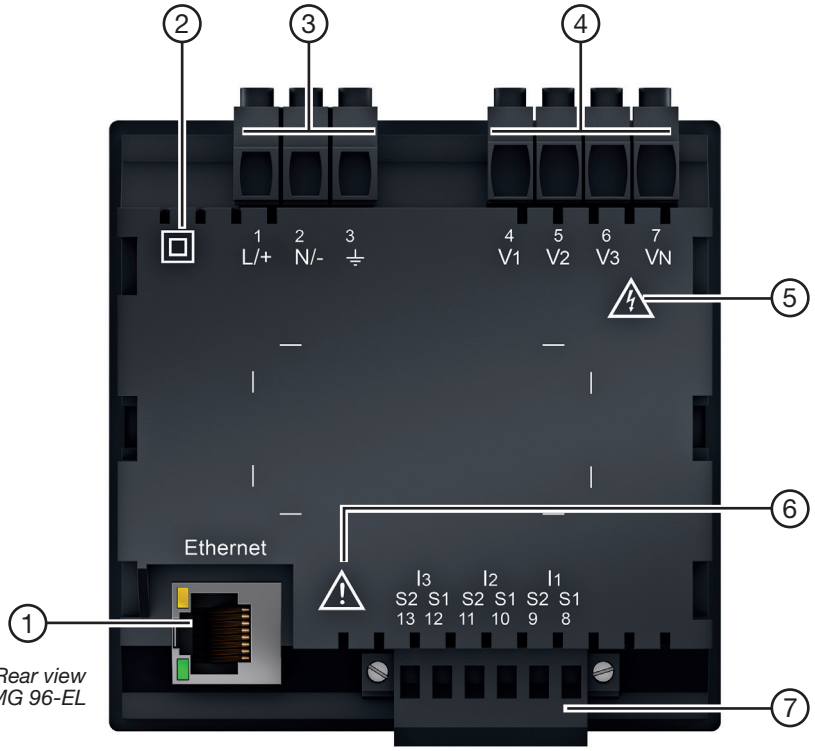
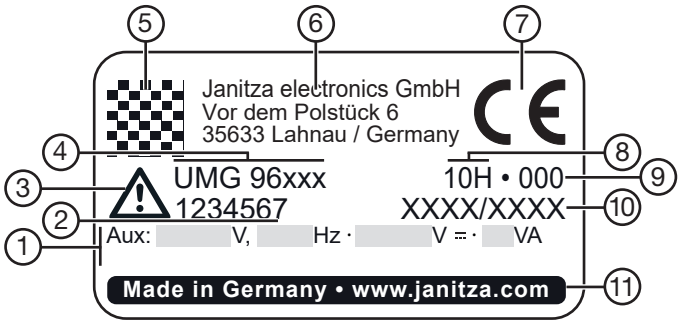


Fig. Rear view of UMG 96-EL

Item	Function/Designation
1	Ethernet port RJ45
2	Symbol, protection class II (reinforced or double insulation) according to IEC 60536 (VDE 0106, Part 1)
3	Connection of supply voltage and functional earth
4	Voltage measurement inputs V_1 to V_3 and V_N
5	Warning symbol indicating an electrical hazard. Observe the warnings to avoid possible injury or even death.
6	General warning symbol. Observe the warnings to avoid possible injury or even death.
7	Current measurement inputs I_1 to I_3

Tab. Rear of the device - Connections

5.3 Rating plate



Item	Designation	Description
1	Operational data	· Supply voltage, AC in V · Nominal frequency in Hz · Supply voltage, DC in V · Power consumption in VA · Overvoltage category
2	Part number	Manufacturer's part number
3	Symbol for "Danger sign"	General hazard symbol. Be certain to observe the warning notices applied to the device and shown in the documentation in order to avoid possible injury or even death.
4	Device type	Device designation
5	Data matrix code	Coded manufacturer data
6	Manufacturer	Address of the device manufacturer
7	CE conformity marking	See section „4.5 Conformity declaration“ on page 18.
8	Manufacturer-specific data	Manufacturer data
9	Hardware version	Hardware version of your device
10	Type/serial number	Number for identification of the device
11	Designation of origin/web address	Country of origin and manufacturer's web address

Tab. Rating plate

6. Mounting

6.1 Installation location

⚠ DANGER

Danger of electric shock!
Electric shocks lead to serious injuries, including death.
· Disconnect your system from the power supply before mounting and connecting the device!
· Secure it against being switched on again!
· Check to be sure it is de-energized!
· Ground and short circuit!
· Cover or block off adjacent live parts!
· The installation must only be carried out by qualified personnel with electrical training!

The measurement device is suitable for installation in stationary and weather-protected indoor switchboards. Ground conductive switchboards!

ATTENTION

Material damage due to disregard of the installation instructions!
Disregard of the installation instructions can damage or destroy the device.
· **Observe the information on the mounting orientation in the sections "Mounting" and "Technical Data".**
· **Provide adequate air circulation in your installation environment and, as needed, cooling when the temperatures are high!**

6.2 Mounting orientation

The mounting orientation is arbitrary. The break-out dimensions in the switchboard are $92^{+0.8}$ mm x $92^{+0.8}$ mm ($3.62^{+0.03}$ x $3.62^{+0.03}$ in). Minimum clearances for adequate ventilation:

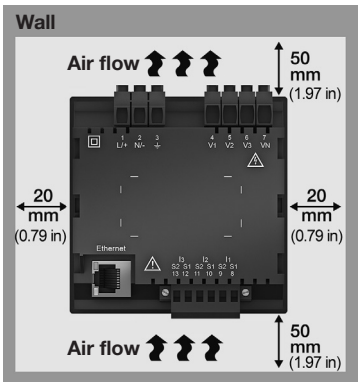


Fig. Mounting orientation of the meter (rear view)

6.3 Securing

Secure the device inside the switchboard (mounting plate) with the retaining clips on the side. To do so, proceed as follows:

· Remove the retaining clips on the device, e.g. by levering with a screwdriver.

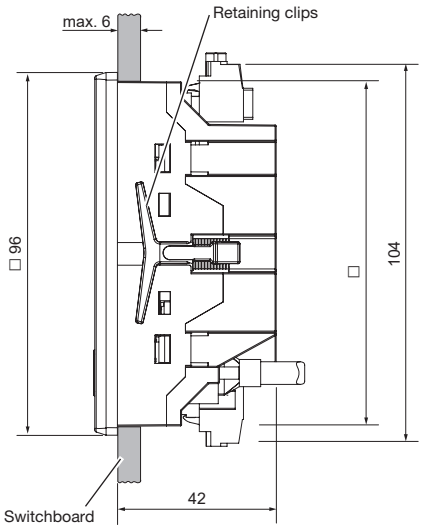
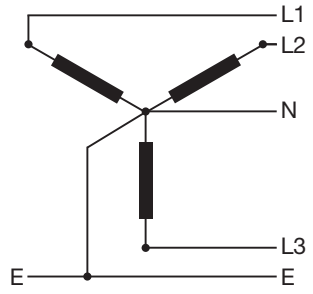
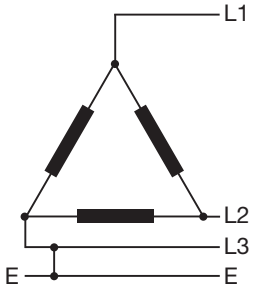
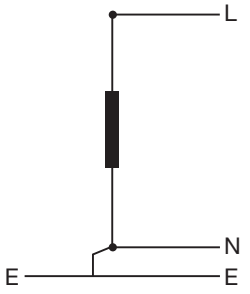


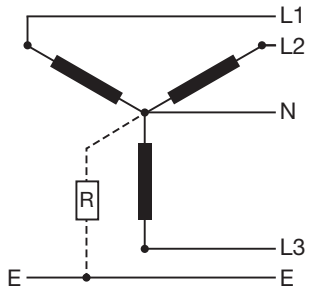
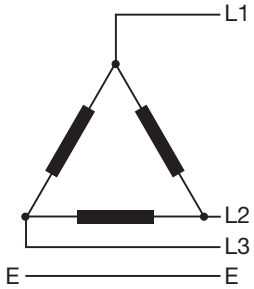
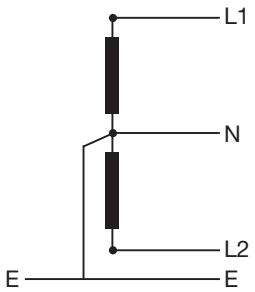
Fig. Side view of the measurement device with retaining clip.

· Insert the device from the front into the recess ($92^{+0.8}$ mm x $92^{+0.8}$ mm) in the switchboard.
· Slide the retaining clips onto the grid provided until the device audibly clicks into place and is firmly seated in the switchboard.

7. Grid systems

Grid systems and maximum rated voltages according to DIN EN 61010-1/A1:

Three-phase 4-conductor systems with grounded neutral conductor (TN/TT)	**Three-phase 3-conductor systems** with grounded phase (TN/TT)	**Single-phase 2-conductor systems** with grounded neutral conductor (TN/TT)
		
IEC UL U_{L-N} / U_{L-L}: 277 V_{LN} / 480 V_{LL}	U_{L-L}: 480 V_{LL}	U_{L-N}: 230 V_{LN}

Three-phase 4-conductor systems with non-grounded neutral conductor (IT)	**Three-phase 3-conductor systems** non-grounded (IT)	**Split single-phase 3-conductor system** with grounded neutral conductor (TN/TT)
		
IEC UL U_{L-N} / U_{L-L}: 277 V_{LN} / 480 V_{LL}	U_{L-L}: 480 V_{LL}	U_{L-N} / U_{L-L}: 240 V_{LN} / 480 V_{LL}

⚠ WARNING

Risk of injury due to electrical voltage!
Rated surge voltages above the permitted overvoltage category can damage the insulation in the device. This impairs the safety of the device. This can result in serious injury or death.
· Only use the device in environments which comply with the permissible rated surge voltage.
· Observe the limit values specified in the user manual and on the rating plate.

The measurement device can be used:
· in 2, 3 and 4-conductor networks (TN, TT and IT networks)
· in residential and industrial areas.

8. Installation

Use the measurement device for voltage measurement in TN, TT or IT grid systems with the approved overvoltage category of 300 V CAT III.

⚠ WARNING

Disregard of the connection conditions of the transformers to Janitza measurement devices or their components can lead to injuries or even death or to material damage!

- Do not use the outputs of the Janitza measurement devices or their components for switching protective devices or protective relays! Do not use "transformers for protection purposes"!
- For Janitza measurement devices and their components use only “Transformers for measurement purposes” which are suitable for the energy monitoring of your system.
- Observe the information, regulations and limit values in the usage information on "Transformers for measuring purposes", including during testing and commissioning of the Janitza measurement device, the Janitza component and your system.

⚠ CAUTION

Malfunction and damage of the device or risk of injury due to improper connection.
Improperly connected devices can deliver incorrect measured values, damage the device or pose a risk of injury to persons.
Observe the following:

- Measured voltages and currents must originate from the same network.
- Do not use the measurement device for measuring direct current!
- Ground current-conducting switchboards!

8.1 Nominal voltages

8.1.1 Three-phase four-conductor network with grounded neutral conductor

Networks and nominal voltages suitable for your measurement device:

U_{L-N} / U_{L-L}	
66 V / 115 V	
120 V / 208 V	
127 V / 220 V	
220 V / 380 V	
230 V / 400 V	
240 V / 415 V	
260 V / 440 V	Maximum nominal voltage of the network according to IEC and UL
277 V / 480 V	

Fig. Nominal network voltages suitable for measurement inputs according to EN 60664-1 (valid in three-phase 4-conductor systems with grounded neutral conductor - see section “Grid systems”).

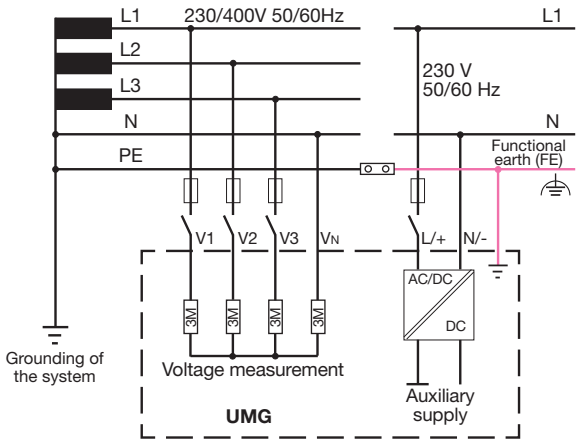


*Fig. Example, schematic diagram (**UMG 96-EL**) - Measurement in three-phase 4-conductor systems.*

8.1.2 Three-phase three-conductor system

Networks and nominal voltages suitable for your device:

U_{L-L}	
100 V	
120 V	
200 V	
240 V	
347 V	
380 V	
400 V	
415 V	
440 V	
480 V	Maximum nominal voltage of the network according to IEC and UL

Fig. Nominal network voltages suitable for measurement inputs according to EN 60664-1 (valid in three-phase 3-conductor systems - see section "Grid systems").

8.2 Circuit breaker

Install a suitable circuit breaker for the supply voltage in the building installation in order to disconnect the device from voltage and current.

· Install the circuit breaker near the device and within reach of the user.
· Mark the circuit breaker as the isolation device for this piece of equipment.

8.3 Supply voltage

⚠ WARNING

Risk of injury due to electrical voltage!
Severe bodily injury or death can result from:
· Touching bare or stripped leads that are energized.
· Device inputs that pose a hazard when touched.
· **Disconnect your system from the power supply before mounting and connecting the device!**
· **Secure it against being switched on again!**
· **Check to be sure it is de-energized!**
· **Ground and short circuit!**
· **Cover or block off adjacent live parts!**

Operation of the device requires a supply voltage. The type and level of the supply voltage for your device can be found on the rating plate. Also note:

· Before applying the supply voltage, ensure that the voltage and frequency match the specifications on the rating plate.
· Connect the supply voltage via a UL/IEC approved fuse to the plug-in terminals on the rear of the device.
· After connecting the supply voltage, the display appears.

INFORMATION

Note that the device requires an initialization phase (boot time) at startup!

If no display appears, check:

· The connection of your device.
· The supply voltage.

CAUTION

Material damage due to disregard of the connection instructions!
Disregard of the connection instructions can damage or destroy your device.

Therefore please abide by the following:
· Observe the voltage and frequency specifications on the rating plate!
· Connect the supply voltage via a fuse according to the technical data!
· Do not tap the supply voltage from the voltage transformers!
· Provide a fuse for the neutral conductor if the neutral conductor terminal of the source is not grounded!

The supply voltage must be connected via an overcurrent protective device (fuse) in accordance with the technical data.

Recommendation for the overcurrent protective device of the supply voltage line protection (dependent on the device variants):
· Option 230 V --> 6 - 16 A (Char. B)
· Option 24 V --> 1 - 6 A (Char. B)

INFORMATION

The fuse is a line protection, **not** a device protection!

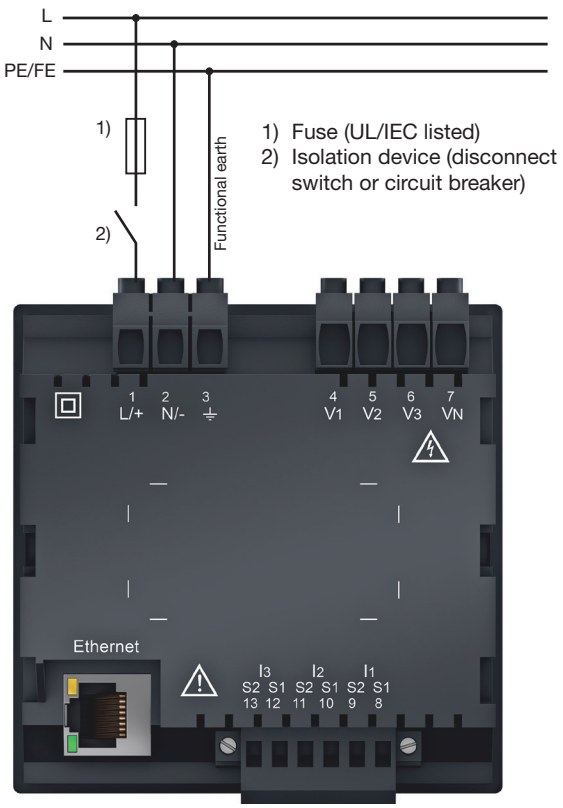


Fig. "Supply voltage" connection example

INFORMATION

Without a functional earth, the device indicates a residual voltage that is not applied.

8.4 Voltage measurement

There are 3 voltage measurement inputs (V1 to V3) on the rear of the device.

WARNING

Risk of injury due to electrical voltage!
Serious bodily injury or death can result from failure to observe the connection conditions for the voltage measurement inputs.
Therefore please abide by the following:
· Switch off your installation before commencing work! Check to be sure it is de-energized!
· Connect voltages above the permitted nominal network voltages via voltage transformers.
· The voltage measurement inputs on the device are dangerous to touch!
· Install a circuit breaker (see Sect. 8.2 on page 26).
· Use a UL/IEC approved overcurrent protective device with a nominal value rated for the short circuit current at the connection point.

INFORMATION

· The device only determines measured values if a voltage L1-N of greater than 20 V_{eff} (4-conductor measurement) or a voltage L1-L2 of greater than 34 V_{eff} (3-conductor measurement) is applied to voltage measurement input V1. If the voltage at V1 is too low, the error "EEE 500" is displayed.
· Use a line protection (1-10 A) with IEC/UL approval as an overcurrent protective device for voltage measurement.

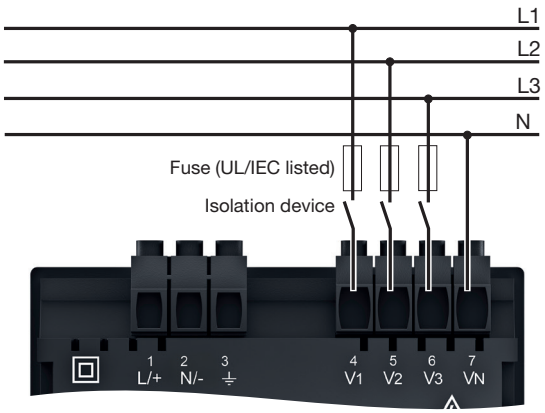


*Fig. Voltage measurement connection variant **3p 4w** (addr. 509 = 0, factory setting)*

8.4.1 Voltage transformers

If the nominal network voltage exceeds the measuring range, use voltage transformers and configure the device's transformer ratio accordingly.

The following applies when using voltage transformers:

WARNING

Risk of injury due to electrical voltage!
Do not short-circuit secondary connections of voltage transformers! This can result in serious injury or death.
· Connect voltage transformers according to their documentation!
· Check your installation!
· Before switching on, you must set the voltage transformer ratio in the measurement device!

The device only allows the setting of **one voltage transformer ratio** for **all phases!**

INFORMATION

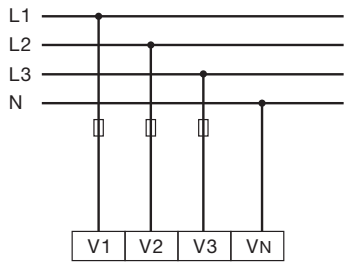
The voltage transformer ratios can be conveniently configured via:
· The device menu.
· Via the GridVis software.
For information on voltage transformer configuration, see section „11.5 Setting the voltage transformer (VT)“ on page 41.
For more information, see section „17.1 Overrange measurements“ on page 68.

8.4.2 Overvoltage

The voltage measurement inputs are suitable for measurement in networks where overvoltages of category 300 V CAT III (rated surge voltage 4 kV) can occur.

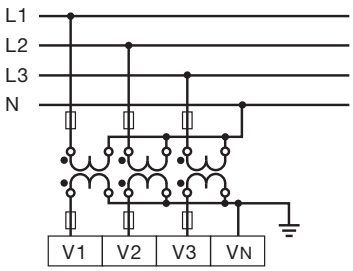
8.4.3 Connection variants for voltage measurement

3p 4w
(addr. 509 = 0, factory setting)



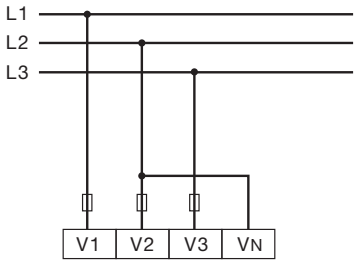
Measurement with 3 phase conductors and neutral conductor.

3p 4wu
(addr. 509 = 1)



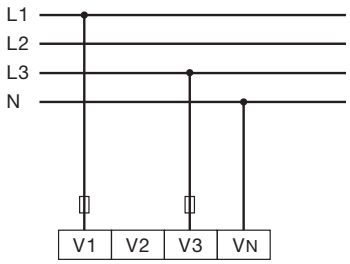
Measurement via voltage transformer with 3 phase conductors and neutral conductor.

3p 4u
(addr. 509 = 2)



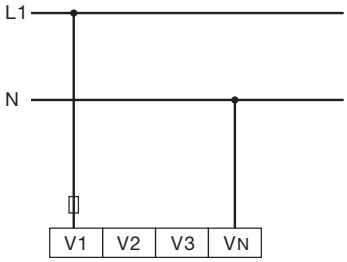
Measurement with 3 phase conductors without neutral conductor. Measured values that require an N use a calculated N.

2p 4w
(addr. 509 = 3)



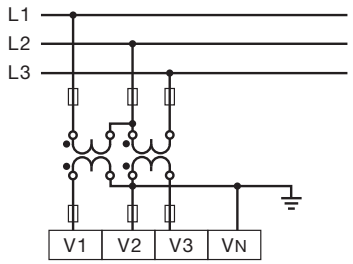
System with equal loading of the phases. Measured values of voltage measurement input V2 are calculated.

1p 2w1
(addr. 509 = 4)



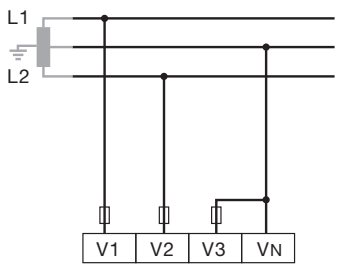
Measured values derived from voltage measurement inputs V2 and V3 are assumed to be 0 and are not calculated.

3p 2u
(addr. 509 = 5)



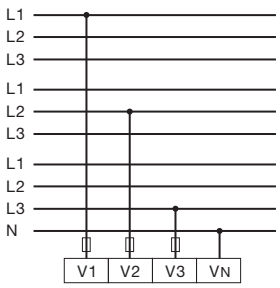
Measurement via voltage transformer with 3 phase conductors without neutral conductor. Measured values that require an N use a calculated N.

1p 2w
(addr. 509 = 6)



Single-phase three-conductor network: Measured values derived from voltage measurement input V3 are assumed to be 0 and are not calculated.

3p 1w
(addr. 509 = 7)



3 systems with equal loading of the phases. Per system, the power and energy of a phase are multiplied by 3. One of the neutral conductors must be connected.

Recommendation for all variants:
Short-circuit unused voltage measurement inputs with input V_N.

⚠ CAUTION

Malfunction due to improper connection.
Improper connection of the device can result in incorrect measured values.
· Measured voltages and currents must originate from the same network.
· The device is not suitable for measuring DC voltage.

Connection variant “Voltage measurement with functional earthing (FE)”

For a measurement in a grounded 3-phase system without N, connect the PE as a functional earth (FE) to the voltage measurement input V_N of the device. Make sure to use the color "pink" (DIN EN 60445/ VDE 0197) for the functional earth conductor and to observe the limits for the voltage measurement.

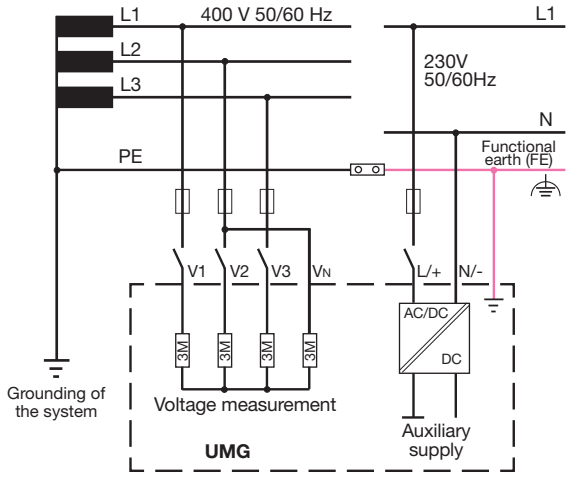


Fig. Connection variant - Voltage measurement in a grounded 3-phase system.

Do not use the protective earthing present in your system as functional a earthing!

8.4.4 Frequency

The device:
- Requires the mains frequency for the measurement and calculation of measured values.
- Is suitable for measurement in networks in which the fundamental oscillation of the voltage is in the range from 45 Hz to 65 Hz.
- Determines the frequency automatically (factory setting).

The mains frequency is determined from the measured voltage of phase L1. The sampling frequency of the voltage and current measurement inputs results from the mains frequency.

When measuring with strongly distorted voltages, the frequency of the voltage fundamental oscillation can no longer be determined exactly. This means that for strongly distorted measured voltages, the corresponding mains frequency should have a fixed specification. Voltage distortions occur, for example, during measurements on consumers that are operated with phase-angle control. Distortions of the current do not influence the frequency determination.

You can find information on how to set a fixed frequency in section „12.2 Mains frequency (addr. 034)“ on page 45.

8.5 Current measurement

The device:
· Is designed for the connection of current transformers with secondary currents of ../1 A and ../5 A.
· Is only approved for current measurement via current transformers.
· Does not measure DC currents.

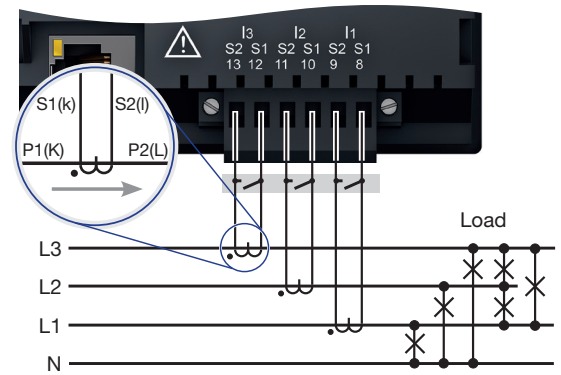


Fig. Connection "Current measurement via current transformer"

The factory-set current transformer ratio is 5/5 A and must be adapted to the current transformers used before the first current measurement.

INFORMATION

The device only allows the setting of **one current transformer ratio** for **all phases!**
You can configure current transformer ratios conveniently via
· The device menu.
· Via the GridVis software.
For information on current transformer configuration, see section „11.4 Setting the current transformer (CT)“ on page 40.

WARNING

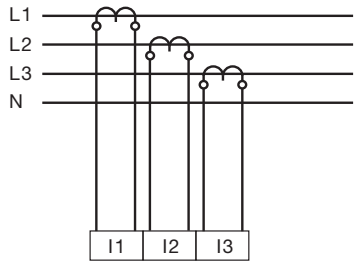
Risk of injury due to electrical voltage!
Severe bodily injury or death can result from:
· Touching bare or stripped leads that are energized.
· Device inputs that pose a hazard when touched.
Disconnect your system from the power supply before starting work! Check to be sure there is no voltage! Ground the system!
Use the ground connection points with the ground symbol to do so!

WARNING

Risk of injury due to electrical voltage at current transformers!
Current transformers which are operated exposed on the secondary side can carry hazardous live high voltage peaks which can lead to serious bodily injury or death.
Therefore please abide by the following:
· Switch off your installation before commencing work! Check to be sure it is de-energized!
· Avoid exposed operation of the current transformers.
· Short circuit unloaded current transformers.
· Before interrupting the supply of power, it is essential to short the secondary connections of the current transformers.
· If there is a test switch which automatically short-circuits the secondary current transformer lines, it is sufficient to set it to the “Test” position, provided that the short-circuiters have been checked beforehand.
· Only use current transformers that have basic insulation in accordance with IEC 61010-1.
· Make sure to mount the screw terminals for the current transformer connection, which are included in the scope of delivery, on the meter and fasten them with the enclosed screws!
· Even current transformers rated as safe for exposed operation are dangerous to touch if they are operated exposed.
· Observe the documentation for the current transformers!

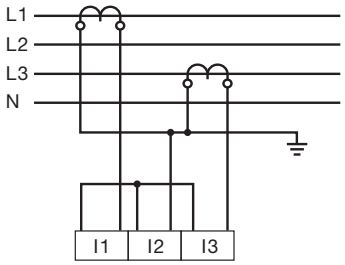
8.5.1 Connection variants for current measurement

3p 4w
(addr. 510 = 0, factory setting)



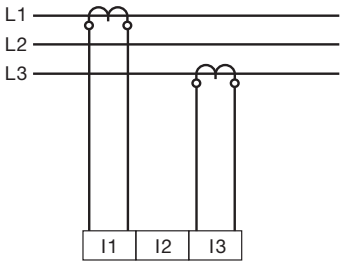
Measurement with 3 phase conductors and neutral conductor.

3p 2i
(addr. 510 = 1)



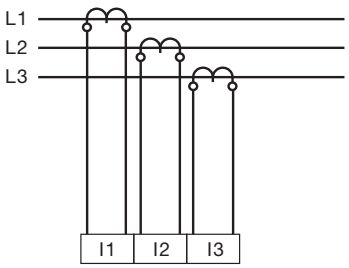
System with equal loading of the phases. Measured values of current measurement input I2 are measured.

3p 2i0
(addr. 510 = 2)



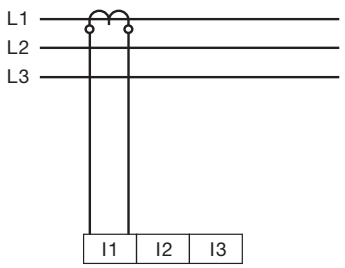
Measurement in three-phase 3-conductor system. Measured values for current I2 are calculated (Aron circuit).

3p 3w3
(addr. 510 = 3)



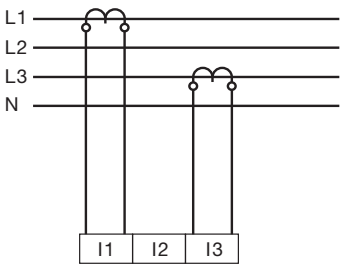
Measurement in three-phase 3-conductor system with unequal load.

3p 3w
(addr. 510 = 4)



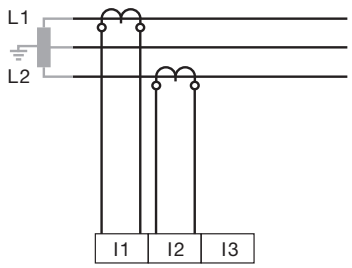
Measurement in a three-phase 3-conductor system with a balanced load. Measured values for I2 and I3 are calculated.

2p 4w
(addr. 510 = 5)



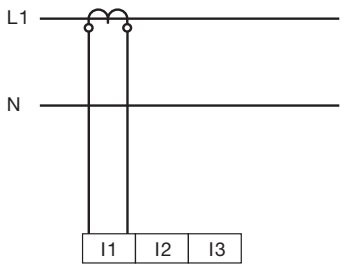
System with equal loading of the phases. Measured values for I2 are calculated.

1p 2i
(addr. 510 = 6)



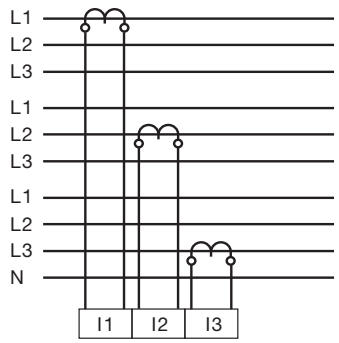
Single-phase three-conductor network: Measured values derived from the current measurement input I3 are assumed to be 0 and are not calculated.

1p 2w
(addr. 510 = 7)



Measured values derived from current measurement inputs I2 and I3 are assumed to be 0 and are not calculated.

3p 1w
(addr. 510 = 8)



3 systems with equal loading of the phases. Per system, the power and energy of a phase are multiplied by 3.

⚠ WARNING

Risk of injury or damage to the meter due to high measurement currents at the connections of the current transformers!
High measurement currents can cause temperatures of up to 80 °C (176 °F) on the connections of the current transformers.
- **Use wiring that is designed for an operating temperature of at least 80 °C (176 °F)!**
- **The current transformers can be hot even after the power supply has been switched off. Allow the connections of the current transformers and the connecting cables to cool down before touching them!**

Grounding of current transformers
If a connection is provided for grounding the secondary winding, this must be connected to ground.

Overrange
If the measuring range is exceeded, the device display shows "EEE" with an indication of the current or voltage circuit.
For more information, see section „17.1 Overrange measurements“ on page 68.

8.5.2 Current direction

You can correct the current direction for each phase individually in the device configurator of the GridVis software. This means that in the case of incorrect connection, no subsequent reconnection of the current transformers is necessary.

8.5.3 Summation current measurement

For a summation current measurement via two current transformers, first set their total ratio on the device.

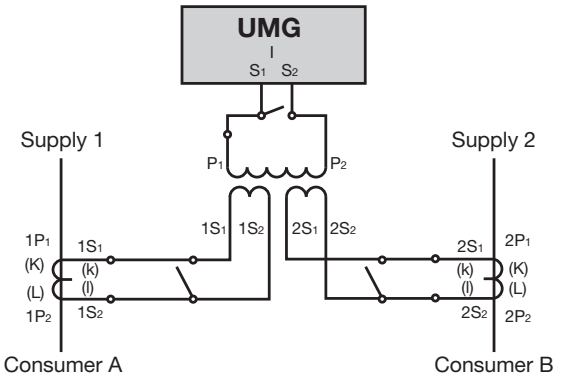


Fig. Example for current measurement via a summation current transformer

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

The device must then be adjusted as follows:
Primary current: 1000 A + 1000 A = 2000 A
Secondary current: 5 A

8.5.4 Ammeter

If you want to measure the current not only with the UMG, but also with an ammeter, connect the ammeter to the UMG in series.

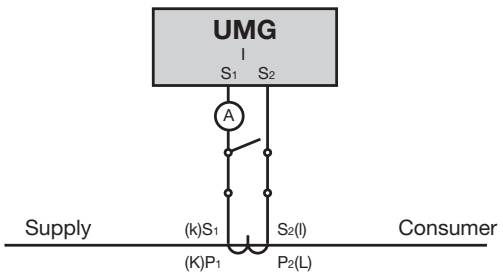


Fig. Circuit diagram with additional ammeter connected in series

9. Connection and PC connections

9.1 Ethernet port

You can use the Ethernet interface to connect the device directly to a PC (e.g. for device configuration via the GridVis PC software) or to a network.

⚠ CAUTION

Material damage due to incorrect network settings.
Incorrect network settings can cause faults in the IT network.
Ask your network administrator about the correct network settings for your device.

ATTENTION

Material damage due to security vulnerabilities in programs, IT networks and protocols.
Security vulnerabilities can lead to data misuse and faults and even the standstill of your IT infrastructure.
To protect your IT system, network, data communications and measurement devices:
· Inform your network administrator and/or IT representative.
· Always keep the meter firmware up to date and protect the communication to the meter with an external firewall. Close unused ports.
· Take protective measures against viruses and cyber attacks from the Internet, e.g. through firewall solutions, security updates and virus protection programs.
· Eliminate security vulnerabilities and update or renew existing protection for your IT infrastructure.

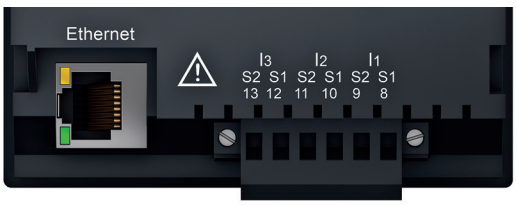


Fig. Ethernet interface on the back of the device

Meaning of the LEDs

LED	Function
Green	Is illuminated when there is a connection (link)
Yellow	Blinks during network activity

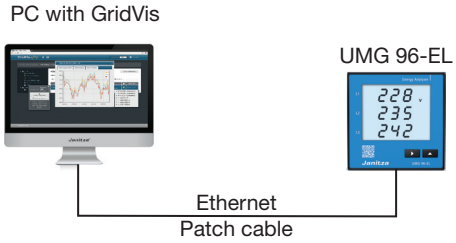
.

· Use at least CAT5 cable!
· Make the network settings for the device in accordance with the network administrator's specifications. If the network settings are not known, the device must not be integrated into the network.
· The factory setting is DHCP (dynamic assignment of the IP address), see section „11.7 Dynamic or static IP address“ on page 42.
· The device supports IPv4.
· Please refer to the chapter on cybersecurity (see section „3. Cybersecurity – safe operation of the device“ on page 14).

9.2 Connection variants

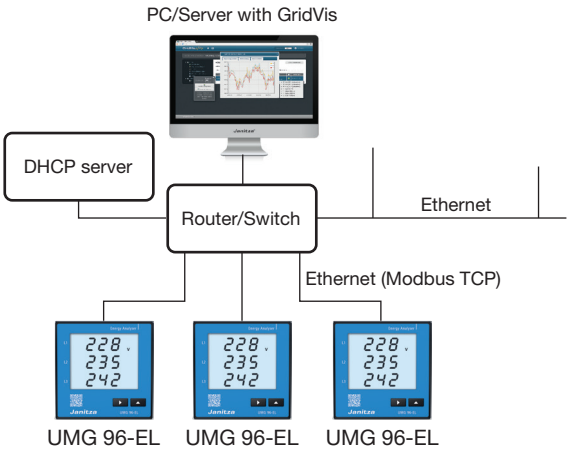
There are various connection options:

1. Direct connection:



The device requires a fixed IP address, or the PC's network connection must be configured so that the device is assigned an IP address via DHCP.

2. Connection to a router or switch:



The DHCP server automatically assigns an IP address to the device, which can be shown on the display (see section „11. Configuration“ on page 39).

9.3 GridVis Quick Guide

Explains how to create a new project in the GridVis software after connecting the PC, and how to add and configure the device:

wiki.janitza.de/x/jgIgCQ

9.4 Ports used

When setting the firewall, please note that the measurement device uses the following ports:

Port	Meaning
502	**Modbus** Standard: automatic switching between typical displays
1111	**Identity Port** Janitza's own discovery service to find devices on the network.

10. Operation and button functions

10.1 Operation

The device displays measured values and programming data on a liquid crystal display (LCD).

Buttons 1 and 2 are used for operation with the following distinctions:
· Press button 1 or 2 briefly:
  Next step (+1).
· Long press on button 1 or 2:
  Previous step (-1)

The device distinguishes between the *Display mode* and the *Programming mode*.

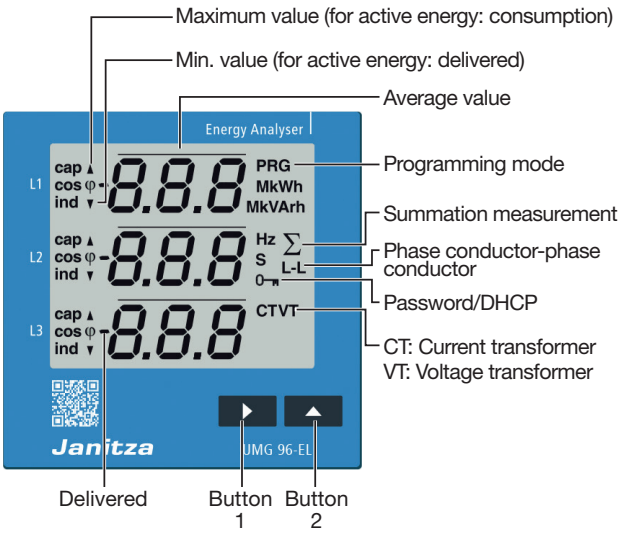


Fig. Display UMG 96-EL

Display mode
· Use button 1 and button 2 to scroll between the measuring displays.
· The measuring display shows up to 3 measured values.
· In the GridVis software, a time can be configured for automatically changing the display between the measuring displays.

Changing the mode
· Press and hold buttons 1 and 2 simultaneously for approx. 1 second to switch between the **display mode** and **programming mode**.
· The text **PRG** appears on the display while the programming mode is active.

The device switches from **programming mode** back to **display mode** when
· You press and hold buttons 1 and 2 simultaneously for approx. 1 second, or
· No buttons are pressed for 60 seconds.

Programming mode
Use programming mode to configure the settings required to operate the device.
· The programming mode can be protected against unauthorized changes with a password (PIN) (only on the device).
· Press button 2 to switch between the 7 programming menus:

PRG	Programming menu
1	Current transformer
2	Voltage transformer
3	Parameter list
4	IP device address
5	Subnet mask
6	Gateway address
7	Dynamic IP addressing

INFORMATION

Changes only take effect once you exit the programming mode.

10.2 Button functions

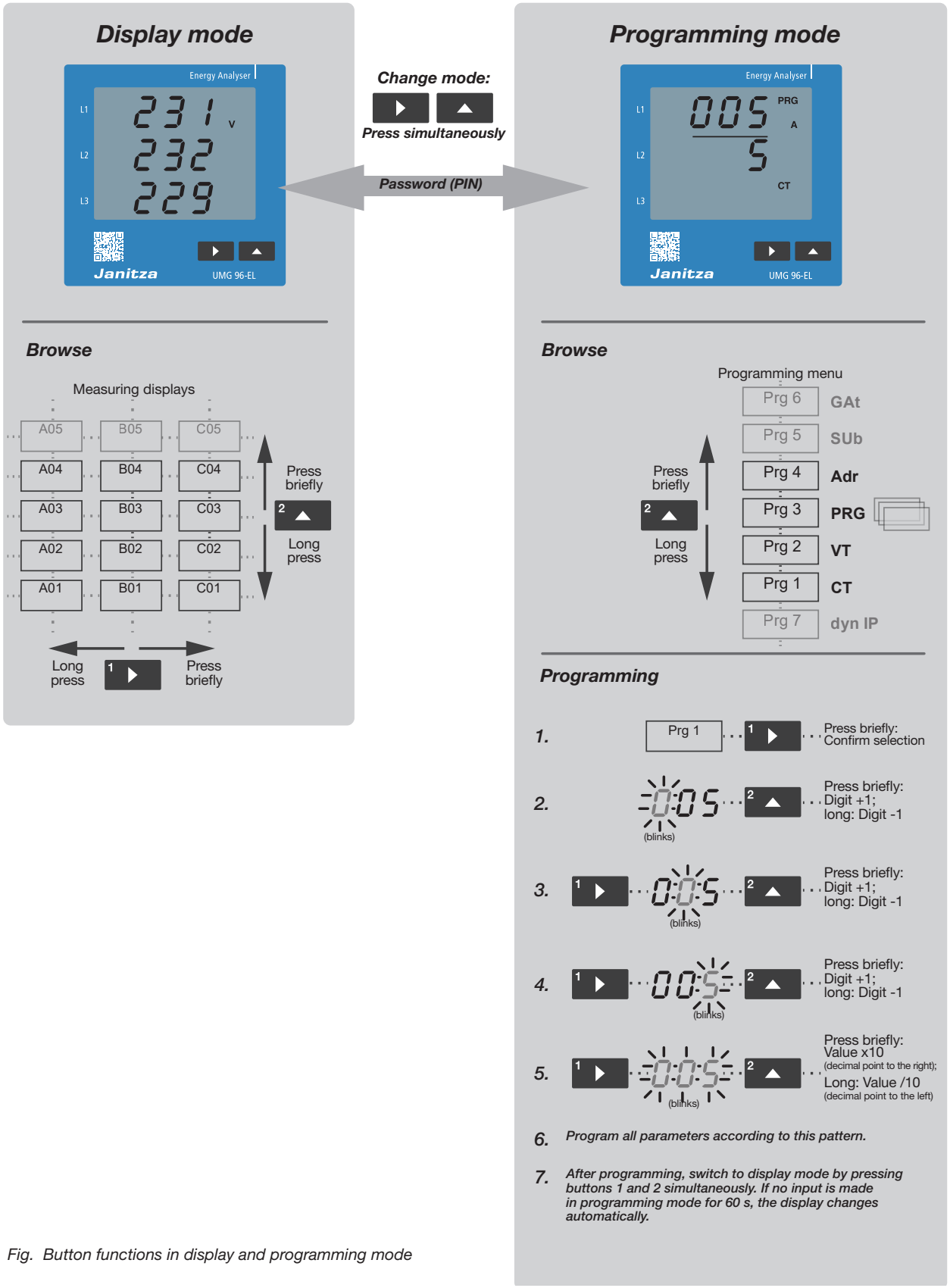


Fig. Button functions in display and programming mode

10.3 Measuring display (examples)

You can display various measured values in display mode.
In this example, the display shows the voltages L against N at 230 V each.

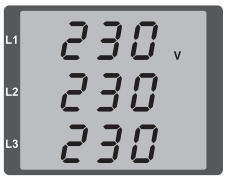
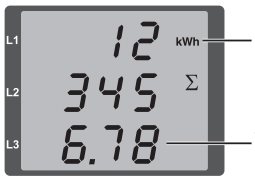


Fig. Example display: Mains voltage per phase

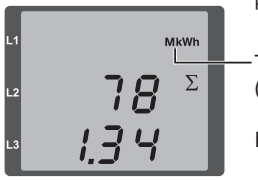
The display only shows the first 3 significant digits of a value, but for all 3 phases simultaneously.

Exception: The energy meters for active energy, reactive energy and apparent energy use all display lines to show the large numerical values.



Example, active energy: 123456.78 kWh

Energy meters usually display values with 2 decimal places.
Exception: Very large numbers with more than 7 digits before the decimal point have only 1 or no decimal places.



The display "Mk" means giga (1000 x mega)

Example: 781.34 GWh

Fig. Example displays: Reading the energy meter

Configurable measuring displays
The measuring displays can be adapted to suit your requirements:

- **Display change**: After an adjustable time has elapsed, the display can consecutively switch between measuring displays (see section „12.7 Changeover time (addr. 039)“ on page 46).
- **Display profiles** define which measured values are displayed. Profile 1 is preset. Several predefined profiles with additional measuring displays (e.g. harmonics) are available for selection.

10.4 Parameter display (example)

In programming mode, there is a submenu for displaying and setting the Modbus parameters. The parameter settings are stored in Modbus registers, which are addressed via addresses.

The example illustration shows the value of address "036" (backlighting, 0= dark, 9= bright).

1. Line: Address ("036") of the parameter

2. Line: Value of the parameter (="006")

Fig. Example display in "Parameter" programming mode (for Modbus addresses up to approx. 800)

You can only enter the first 3 significant digits of a value on the device.
Values with more digits can be configured via Modbus.

11. Configuration

11.1 Applying the supply voltage

Only the supply voltage needs to be connected to configure the meter.

CAUTION

Material damage due to disregard of the connection instructions!
Disregard of the connection instructions can damage or destroy your device.
Observe the following:
· Observe the voltage and frequency specifications on the rating plate!
· Do not use the device for measuring DC voltage!

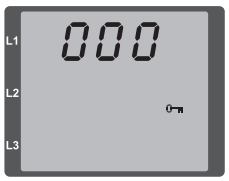
· If no display appears, check whether the supply voltage is within the nominal voltage range.

11.2 Programming menu – Overview

You can configure the device using the device's programming menu or more conveniently using the GridVis software.

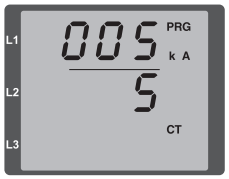
PRG Programming menu

Open the programming menu: Press button 1+2.



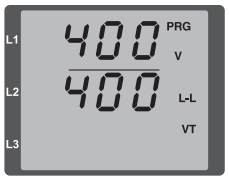
\- Password prompt (PIN) if the programming menu is password-protected.

Automatically if password is correct



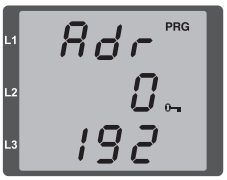
1 **CT**: Current transformer ratio, primary/secondary

Long press 2 Press briefly



2 **VT**: Voltage transformer ratio, primary/secondary

3 **Parameters**: Submenu for setting Modbus parameters



4 **Adr**: IP device address (IPv4) (4 displays)

5 **SUb**: Subnet mask (4 displays)

6 **GAt**: Gateway (4 displays)

7 **dYn IP**: Dynamic/static address assignment

Exit the programming menu: Press button 1+2.

INFORMATION

The following pages explain the individual settings.

11.3 Opening programming mode and password (PIN) entry

If a user password has been set, the password is requested when switching to programming mode.

Open programming mode

· Press buttons 1 and 2 simultaneously until "**PRG**" appears at the top right of the display.
· If the password must be entered, the key symbol and "**000**" are displayed.

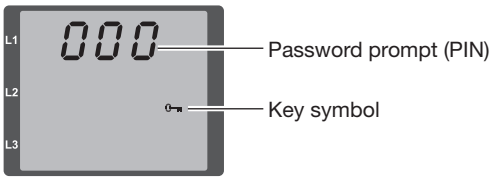


Fig. Enter password

Enter password (PIN)

· The first digit of the password "**000**" blinks.
· Press button 2 to enter the first digit of the password.
· Press the button 1 to switch to the next digit.
· Once all 3 digits of the password have been entered correctly, the display automatically switches to the current transformer setting "**CT**".

INFORMATION

You can find out how to set a password in section „12.1 Setting the user password (PIN, address 050)“ on page 44.

Exit programming mode

· Press buttons 1 and 2 simultaneously. The settings are saved and the measured values are displayed again (display mode).

11.4 Setting the current transformer (CT)

The measurement device must know the transformation ratio of the current transformers used. Enter the primary and secondary current.

· In programming mode (section 11.3), press button 2 until "**CT**" is displayed.
· Press button 1. The first digit of the primary current blinks.
· Use button 2 to set the blinking digit. Long press button 2 to reduce the value.
· Press button 1 to move to the next digit.

· When all 3 digits of the primary current are blinking:
  - Pressing button 2 briefly increases by a factor of 10 (example: 50 A -> 500 A -> 5 kA).
  - Long press button 2 to reduce by a factor of 10.

· Press button 1 until the secondary current blinks. Use button 2 to select between 1 A or 5 A.
· Press button 1 to complete the entry.

· Press buttons 1 and 2 simultaneously to save the setting.

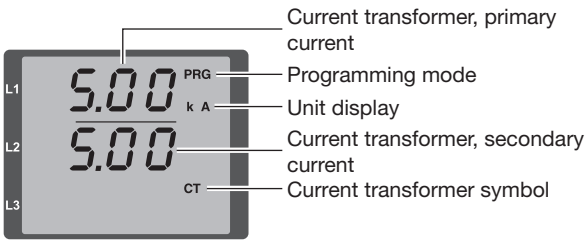


Fig. Setting the current transformer ratio

The factory setting is 5 A/5 A (primary/secondary).

INFORMATION

In the device display there is only **one** transformer ratio for the current measurement inputs I1-I3.
If you set different transformer ratios for the current measurement inputs in the GridVis software, the display shows "---".

11.5 Setting the voltage transformer (VT)

You only need to change the preset voltage transformer ratio if voltage transformers are connected.
When connecting voltage transformers, observe the measured voltage specified on the rating plate!

· Open the programming mode with buttons 1+2.
· Press button 2 several times until "**VT**" is displayed.
· Use button 1 to select the blinking digit and button 2 to set the value, as with the current transformer setting.

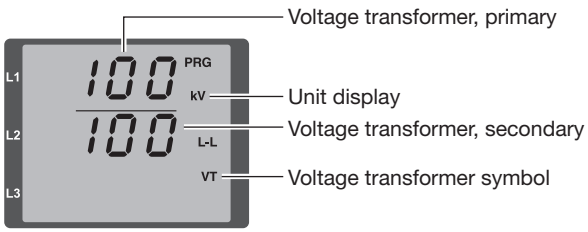


Fig. Set the voltage transformer ratio

INFORMATION

In the device display there is only **one** transformer ratio for the voltage measurement inputs V1-V3.
If you set different transformer ratios for the voltage measurement inputs in the GridVis software, the display shows "---".

11.6 Set parameters

Use the third submenu to display and set Modbus parameters (Modbus editor).

The device parameters can also be configured without a network connection using the Modbus editor. However, parameter configuration is more convenient with the GridVis PC software.

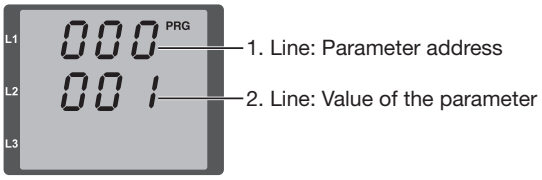


Fig. Programming parameters

Parameter configuration with the Modbus editor is described in section „12. Configuration“ on page 44.

INFORMATION

A complete overview of all parameters and Modbus addresses can be found in the Modbus address list of the device available for download at **www.janitza.com**.

11.7 Dynamic or static IP address

Each device in the network has a unique IP address, which is assigned either manually or by a DHCP server.

The factory setting of DHCP means that the measurement device is automatically assigned an IP address in the network by the DHCP server when the device is started.

Check/activate dynamic address assignment

· Open the programming mode with buttons 1+2.
· Press button 2 (1x long) until "**dYn IP**" is displayed.

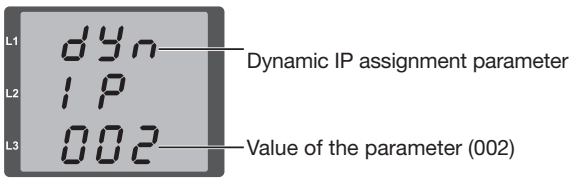


Fig. Dynamic IP assignment (DHCP) active

· Press button 1. The current setting blinks.
· Use button 2 to change the value to one of the values in the table:

Address assignment mode (parameter dYn IP)	
000	Static IP address Assign a fixed address to the device.
001	Static IP address with Gratuitous ARP The device sends an ARP packet to the network once after switching on or if the network configuration is changed. Application, for example, in networks in which a switch enables the port via the MAC address.
002	DHCP (**Factory setting**) After switching on, the device dynamically obtains an IP address from a DHCP server.

· Press button 1 to accept the setting.
· Press buttons 1 and 2 simultaneously to save the setting.

11.8 Configuring IP address manually

If you are not using a DHCP server that automatically assigns the IP address to the measurement device, you must enter the IP address and the additional parameters **SUb** and **GAt** manually.

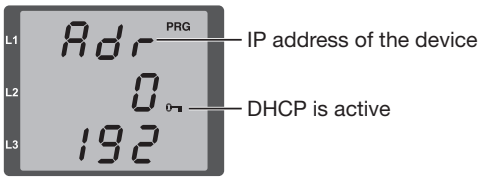


Fig. Device address, byte 0

The key symbol for the parameters **Adr**, **SUb** and **GAt** indicates that dynamic address assignment with DHCP is active and the parameters are locked.
You must first deactivate and save the dynamic assignment before starting the manual configuration.

Deactivating dynamic address assignment

· Open the programming mode with buttons 1+2.
· Press button 2 (1x long) until "**dYn IP**" is displayed.

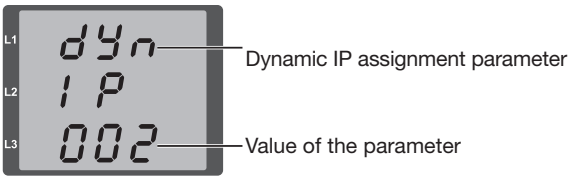


Fig. Dynamic IP assignment (DHCP) active

· Press button 1. The setting "002" blinks.
· Use button 2 to change the value to "000" or "001".
· Press button 1 to accept the setting.
· Press buttons 1 and 2 simultaneously to save the setting.
Alternatively, you can continue with the setting of **Adr**, **SUb** and **GAt** and then save at the end.

INFORMATION

The device saves **dyn IP**, **Adr**, **SUb** and **GAt** only when the programming mode is exited and only activates these settings then.
It is therefore not necessary to exit the programming mode in between.

11.8.1 Configuring a static IP address (Adr)

Ask the network administrator which IP addresses and other settings should be used.
An IP address consists of 4 bytes with the following structure (example):

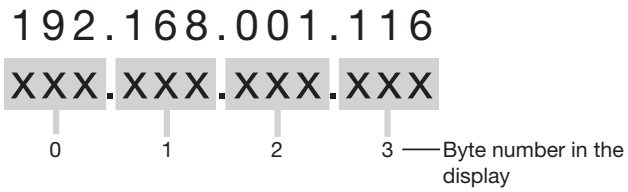


Fig. Example of an IPv4 device address

Bytes 0 to 3 are divided into 4 displays. Press button 1 to display them one after the other.

Prerequisite: The key symbol is not displayed (= DHCP is deactivated, see section „11.8 Configuring IP address manually“ on page 42).

· Open the programming mode with buttons 1+2.
· Press button 2 several times until "**Adr**" is displayed.

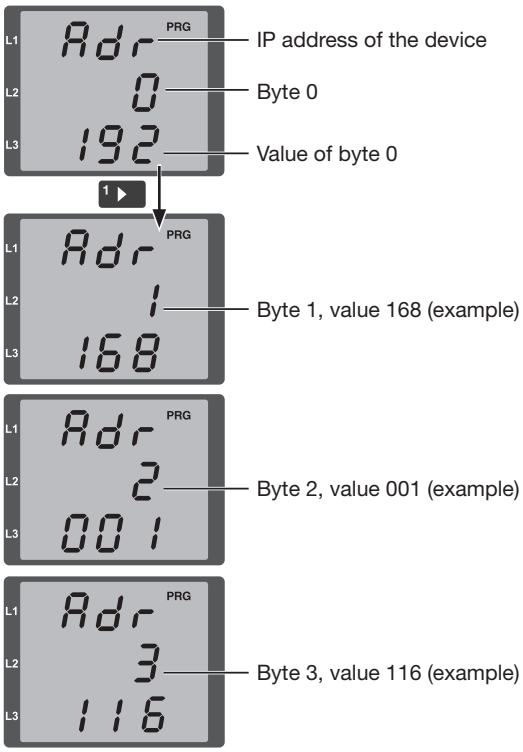


Fig. Device address, bytes 0 to 3

· Press button 1 several times to display all bytes of the address.
· Use button 2 to change the value of the blinking digit if required.
· Press buttons 1 and 2 simultaneously to save the setting.

11.8.2 Configuring the subnet mask (SUb) and gateway (GAt)

The subnet mask and the gateway each consist of 4 bytes. Configure these identically to the IP address with separate displays for each byte.

Prerequisite: DHCP is deactivated.

· Open the programming mode with buttons 1+2.
· Press button 2 several times until "**SUb**" or "**GAt**" is displayed.

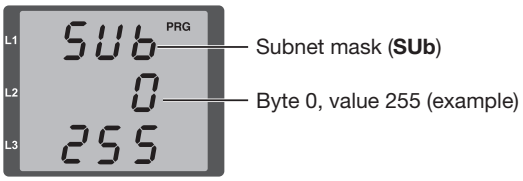


Fig. Subnet mask (4 displays)

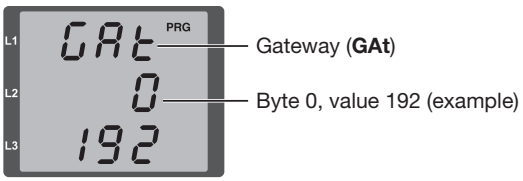


Fig. Gateway address (4 displays)

· Press button 1 several times to display all bytes of the address.
· Use button 2 to change the value of the blinking digit if required.
· Press buttons 1 and 2 simultaneously to save the setting.

12. Configuration

You can use Modbus parameters to make further settings.
You can display and configure many parameters directly on the device by entering the specified Modbus address. The following sections explain the most important parameters and their settings.

Configuration on the device
· Press buttons 1 and 2 simultaneously to open the programming mode. The display shows "**PRG**" and "**CT**".
· Press button 2 several times until only "**PRG**" is displayed next to the three-digit numbers.

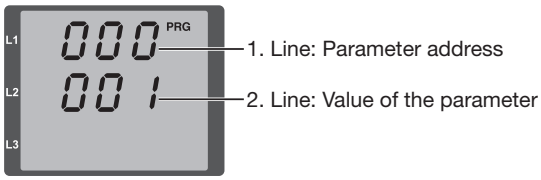


Fig. Programming parameters

Select parameter (1st line)
· Press button 1. The first digit of the parameter address blinks.
· Press button 1 to move to the next digit.
· Use button 2 to set the blinking digit. Long press button 2 to reduce the digit.

Set value (2nd line)
The 2nd line shows the current value of the parameter selected in the 1st line.
· Press button 1 again until the first digit of the value blinks.
· Use buttons 1 and 2 to change the value of the parameter.
· Press button 1 to complete the entry.

· Press buttons 1 and 2 simultaneously to save the setting.

INFORMATION

· Use the GridVis PC software for convenient configuration of all parameters.
· A complete overview of all parameters and Modbus addresses can be found in the Modbus address list of the device available for download at **www.janitza.com**.

12.1 Setting the user password (PIN, address 050)

A user password (PIN) can protect the programming menu from unauthorized changes. No user password is assigned at the factory.

Set the password (addr. 050)
· In programming mode, press button 2 several times until the parameter display is shown.
· Enter address "050" on the first line.
· Enter the desired password consisting of 3 digits on the second line.
· The value "000" in the password means that there is no password and none is requested when the configuration is opened.

Forgotten password
If you no longer know the password, you can only delete it using the GridVis PC software.
To do this, connect the measurement device to the PC via the Ethernet interface. Further information can be found in the GridVis online help.

12.2 Mains frequency (addr. 034)

The measurement device can automatically determine the mains frequency if a voltage L1-N of greater than 20 V_{eff} (or 34 V_{eff} in a 3-wire system) is present at the voltage measurement input V1.
The sampling frequency for the current and voltage inputs is then calculated from the mains frequency.
The meter requires approx. 5 s after switching on to automatically determine the frequency. During this time, the measured values do not meet the specified accuracy.

If the measurement device cannot determine the frequency (in the case of poor power quality, the sine wave of the voltage may be distorted to such an extent that double zero crossings occur, for example), you can set a fixed nominal frequency.

Mains frequency (addr. 034):

Setting	Meaning
0	Automatic frequency detection: The mains frequency is determined from the measured voltage.
45 .. 65	Fixed frequency: A fixed mains frequency is preset and is not measured.

INFORMATION

For a setting of 0 (automatic frequency detection), the following apply:
- If there is no measured voltage at V1, the measurement device cannot determine the mains frequency and therefore cannot calculate a sampling frequency (error "EEE 500" is displayed).
- Voltage, current and all other resulting values are calculated on the basis of 50 Hz. Consequently, during the error state, the measured values no longer comply with the specified accuracy.
- When the frequency can once again be measured, the correct measured values are displayed again automatically.
- The EEE 500 error is not displayed if a fixed frequency is set.

12.3 LCD contrast (addr. 035)

The contrast of the LCD display can be adjusted in dependence on the viewing angle. The contrast can be set from 0 to 9 in steps of 1:
· 0 = Character very bright
· 9 = Character very dark
Factory setting = 5

12.4 LCD brightness

The brightness of the backlight makes the display easy to read even in poor visibility conditions.
The brightness can be set in a range from 0 to 9 in steps of 1. Different brightness values can be set for the operation and standby modes.

Operating backlight (addr. 036)
The operating backlight is activated when a button is pressed or when there is a restart.

Standby backlight (addr. 747)
If no button is pressed within a selectable period of time, the device switches to standby mode. When a button is pressed, the device switches to the operating backlight and the defined period is restarted.

Addr.	Description	Setting range	Standard factory setting
036	Brightness with operating backlight	0 ..9	6
746	Time period after which the system switches to standby	60 .. 9999 s	900 s
747	Brightness with standby backlight	0 ..9	0

0 = minimum brightness, 9 = maximum brightness

If the brightness values of both types of lighting are the same, there is no visible change between the operating and standby backlighting.

12.5 Display profile (addr. 037)

After a restoration of power, the meter displays the first measured value from the display profile currently activated. To keep the number of measuring displays manageable, only some of the possible measuring displays are included in the standard profile.
If you also want to display harmonics, select the other fixed display profile.

Display profile (addr. 037):

Setting	Meaning
0	Display profile 1 **Standard:** typical displays can be shown, but no harmonic displays
1	Display profile 2 **Maximum:** all displays can be shown, including harmonics and the comparator

Profile selection
An overview of all displays in profiles 1 and 2 can be found in section „16. Overview of measuring displays – display profiles 1 and 2“ on page 64.

12.6 Display change profile (addr. 038)

Address 038 specifies which measured values are automatically displayed in a fixed order if a changeover time > 0 s (addr. 039) is set.

For this *Display switching*, select only the most important displays to achieve better clarity for the operator.
All displays from the display profile can be called up at any time by pressing a button.

Display change profile (addr. 038):

Setting	Meaning
0	Display change profile 1 **Standard:** automatic switching between typical displays
1	Display change profile 2 **Maximum:** all displays are used for automatic switching
2	Display change profile 3 **Minimal:** automatic switching between only a few displays

12.7 Changeover time (addr. 039)

This parameter specifies whether and after what time the display automatically switches to the next display.
The display changeover starts when no button has been pressed for 60 seconds.

· Setting range: 0 .. 60 seconds per display

For a *Measured value rotation* of the selected measuring displays to take place (addr. 038) requires that a time > 0 s be set.
If 0 seconds is set, the last display selected is shown continuously.

12.8 Averaging time for average values

Average values are marked on the display with a horizontal bar above the measured value.
The meter calculates moving average values for current, voltage and power measurements.
You can select the averaging time from a list of 9 fixed times separately for each of the following:
· Current values (addr. 040)
· Power values (addr. 041)
· Voltage values (addr. 042)

Setting	Averaging time/seconds
0	5
1	10
2	15
3	30
4	60
5	300
6	480 (factory setting)
7	600
8	900

Averaging method
After the set averaging time, the average value has reached at least 95% of the measured value when using the exponential method.

12.9 TDD nominal current (addr. 043)

TDD stands for Total Demand Distortion and is similar to THD (Total Harmonic Distortion). TDD is a characteristic parameter for the harmonic current distortions that occur in relation to the maximum current of the system that occurs.

To determine the TDD, you must enter the maximum current that occurs in the system (nominal current under full load).
While the TDD value is fixed in relation to the nominal current entered, THD is a dynamic parameter for the harmonic distortion in relation to the actual measured current.

12.10 Minimum and maximum values

All measured values are measured and calculated every 200 ms, i.e. 10 measured values/period at 50 Hz and 12 at 60 Hz. Minimum and maximum values are determined for most measured values.
The minimum value is the smallest measured value that has been determined since the last deletion.
The maximum value is the largest measured value that has been determined since the last deletion.
All minimum and maximum values are compared with the corresponding measured values and are overwritten if they are exceeded or undershot.

The minimum and maximum values, including the maximum values of the average values, are stored persistently every 2 minutes without date and time. This means that the values are retained even after a failure of the operating voltage and at most the values from the last 2 minutes can be lost.

Note: Simple average values are not stored persistently, but are recalculated after a power failure.

Clear min. and max. values (addr. 506)
If a "001" is written to address 506, all minimum and maximum values are cleared at the same time.

Maximum values of the average current values (D 03)
You can clear these directly in display menu D 03 by long pressing button 2 as an alternative to clearing via addr. 506. The maximum average current values per phase are set to 0 (the display remains 0 as long as the button is pressed). When button 2 is released, the device adopts the present average current values for each phase as the maximum average current values.
The Back function triggered by a long press of button 2 does not work in D 03.

12.11 Energy meters and tariffs

The meter can be used to record active, reactive and apparent energy separately in up to 7 tariffs (e.g. for each day of the week or for shift operation). The device display shows the total quantity for each energy meter independently of the tariff, i.e. the total across all tariffs.
You can read out the meter readings for the individual tariffs and the totals via the GridVis software or via Modbus addresses.

Tariff change
You can activate a different tariff for an energy meter via Modbus addresses.

Example:
· Address 619 specifies which tariff is active for the "Consumed active energy" meter.
· To switch to tariff 3 for this meter, set bit 2 in addr. 619 to the value 1.

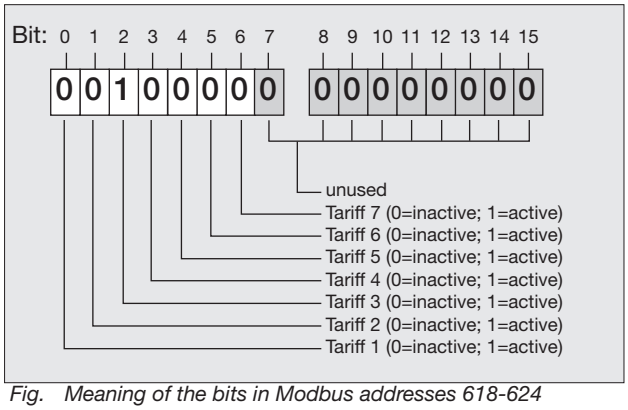


Fig. Meaning of the bits in Modbus addresses 618-624

If you set 2 bits of the same address to the value 1, the more significant bit is ignored.
Example: Bits 2 and 4 are set to 1, so tariff 3 is activated. Bit 4 (tariff 5) is ignored.

12.12 Clear energy meter (addr. 507)

The active, reactive and apparent energy meters can only be cleared together.
To clear the contents of the energy meters, write "001" to address 507.

INFORMATION

· Clearing the energy meters causes this data to be lost in the device. To avoid possible data loss, you should read out and save these measured values with the GridVis software before clearing them.
· We recommend clearing the energy meters and the min/max values at the end of commissioning.

12.13 Firmware version

The device firmware is improved and expanded on an ongoing basis. The version is distributed via three Modbus addresses in the format (example):

01 . **07** . **02**
Major version Minor version Patch version

	Main version	Subversion	Patch version
Application	**743**	**744**	**745**
Stage 0 bootloader	737	738	739
Stage 1 bootloader	740	741	742

Tab. Modbus addresses of the firmware version (format ushort)

12.14 Serial number (addr. 754)

The serial number displayed in the meter has 6 digits and is part of the serial number displayed on the rating plate.
The serial number cannot be changed.

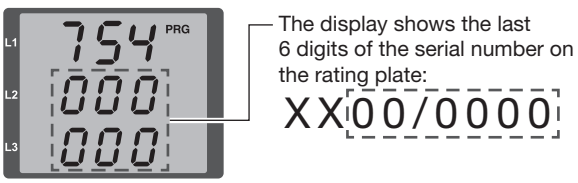


Fig. Serial number display

12.15 Comparator for limit value monitoring

Two comparator groups (1 - 2), each with 3 comparators (A - C) are available for monitoring limit values. The results of comparators A to C can be linked with AND or OR.

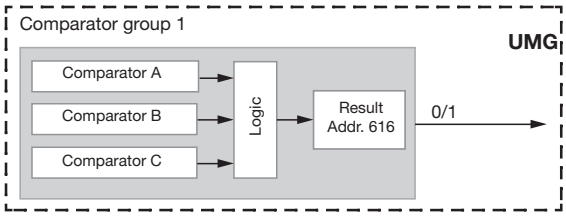


Fig. Block diagram for comparator group 1

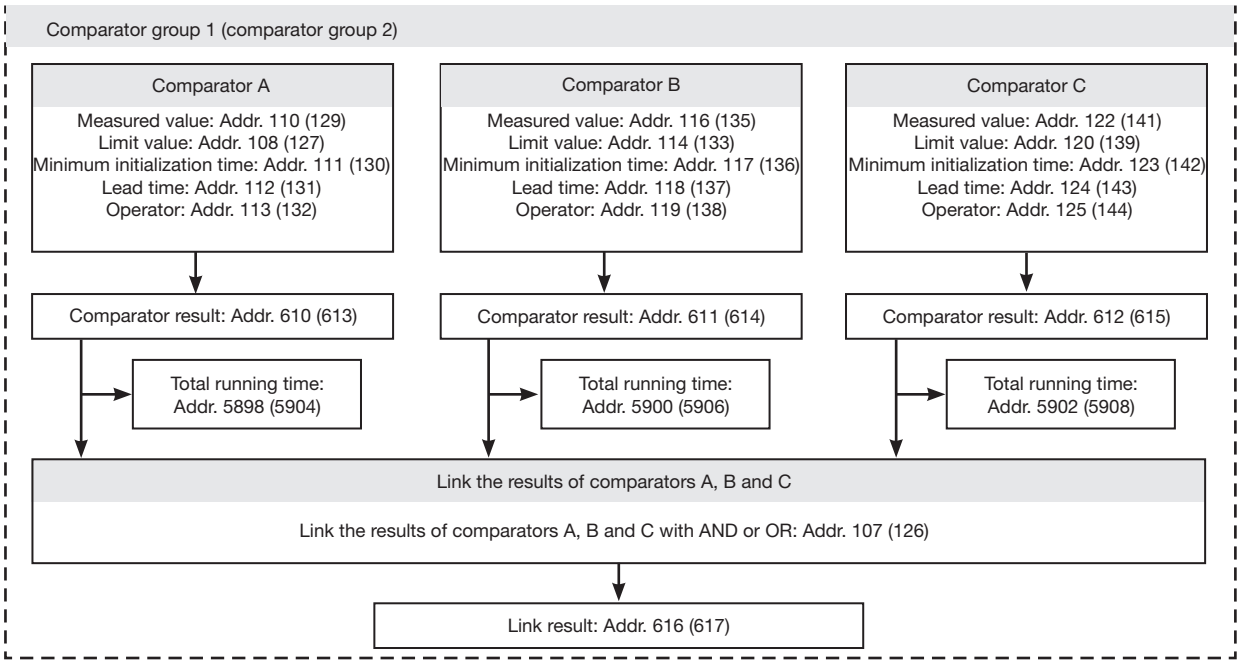


Abb. Parameter addresses of comparator group 1 (comparator group 2)

Parameters	Explanation
Measured value: Addr. 110, 116, 122 (129, 135, 141)	The address of the measured value to be monitored. Measured value = 0, the comparator is inactive.
Limit value: Addr. 108, 114, 120 (127, 133, 139)	The value with which the measured value is to be compared.
Min. initialization time: Addr. 111, 117, 123 (130, 136, 142)	The comparator result (e.g. addr. 610) is retained for the duration of the minimum initialization time. Setting range: 1 .. 32000 s
Lead time: Addr. 112, 118, 124 (131, 137, 143)	A limit violation must exist for at least the duration of the lead time before the comparator result is changed. Setting range: 1 .. 32000 s
Operator ">=" or "<": Addr. 113, 119, 125 (132, 138, 144)	For the comparison of the measured value and limit value: Operator = 0 corresponds to greater than or equal to (>=) Operator = 1 corresponds to smaller (<)
Comparator result: Addr. 610, 611, 612 (613, 614, 615)	The result of the comparison between the measured value and the limit value: 0 = There is no limit violation. 1 = There is a limit violation.
Total running time: Addr. 5898, 5900, 5902 (5904, 5906, 5908)	The sum of all comparator running times, i.e. the times for which a limit violation was present in the comparator result. The total running times of the comparators can be reset using the GridVis software.
Link: Addr. 107 (126)	Link the results of comparators A, B and C with AND (=1) or OR (=0).

Tab. Explanation of addresses for comparator group 1 (comparator group 2)

Parameters	Explanation
Link result: Addr. 616 (617)	Total result of the linked comparators A, B and C.

Tab. Explanation of addresses for comparator group 1 (comparator group 2)

How the comparators work

- The set limit value is compared with the measured value.
- If there is a limit violation for at least the duration of the lead time, the comparator result is changed.
- The result of the comparator is retained during the limit violation, but at least for the duration of the minimum activity time (minimum initialization time).
- The comparator result is reset as soon as there is no longer a limit violation and the minimum activity time has expired.

Comparator running time (total running time)

The comparator running time is a time counter for each comparator that adds up the total time that the comparator output was set to active. This means that if the condition of the comparator is fulfilled and the lead time has expired, the counter increases by the corresponding amount of time.
The minimum initialization time is taken into account here.

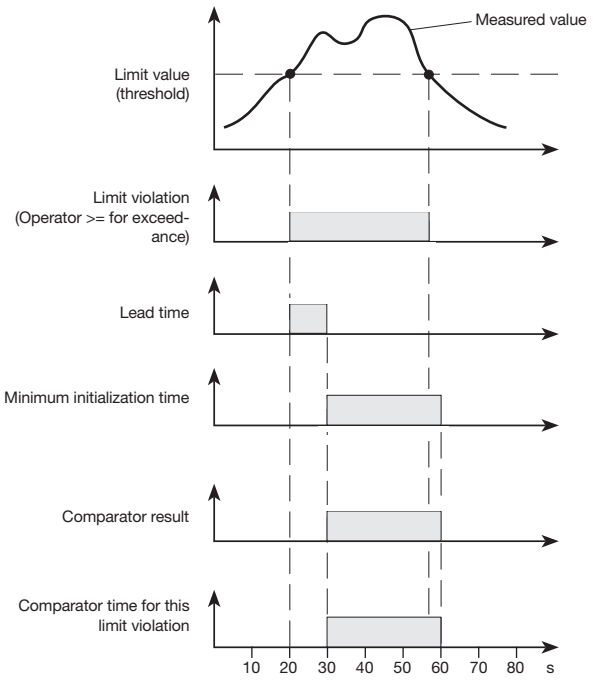


Fig. Comparator (example with 10 s lead time and 30 s minimum activity time)

Example: Neutral conductor current monitoring with a comparator

If the neutral conductor current I_N exceeds 100 A for 60 seconds, the result of comparator group 1 should be set for at least 2 minutes.

The following programming steps must be carried out:

1. **Comparator group 1**
We select comparator group 1 for the limit value monitoring. As only one limit value is being monitored, we select comparator A and program it as follows:

The address of the measured value to be monitored from comparator A:

Addr. 110 = 866 (address of the calculated neutral conductor current)

The measured values for comparators B and C are assigned 0:

Addr. 116 = 0 (The comparator is inactive)

Addr. 122 = 0 (The comparator is inactive)

The limit value to be complied with:

Addr. 108 = 100 (100 A)

For a minimum initialization time of 2 minutes, the result of comparator group 1 if the limit value is exceeded should be set:

Addr. 111 = 120 (120 s)

For the lead time of 60 seconds, the overrun must be present for at least:

Addr. 112 = 60 (60 s)

The operator for the comparison between the measured value and the limit value:

Addr. 113 = 0 (corresponds to >=)

2. **Link comparators**
The comparators B and C were not set and are equal to zero.
The OR link or the comparators A, B and C causes the result of comparator A to be output as the comparator result:

Addr. 107 = 0 (OR link)

Result
If the neutral conductor current exceeds 100 A for more than 60 seconds, the result of comparator group 1 is set for at least 2 minutes.

INFORMATION

- You can view the results of the comparators on the displays B20-G20 on the device.
- Use the GridVis software to conveniently evaluate the comparators and set them up using the device configurator.

13. Commissioning

Ensure that the following steps are carried out before commissioning:
· Mounting
· Installation
· Configuration and parametrization

13.1 Applying the supply voltage

⚠ WARNING

Life-threatening danger due to electrical voltage if installed incorrectly!
Incorrect connection or exposed cable ends can result in parts being live.
· **Check the wiring before switching on for the first time.**

1. Connect the supply voltage to the back of the device.
2. The start screen appears on the display of the measurement device.
3. If no display appears, check whether the supply voltage is within the nominal voltage range.

⚠ CAUTION

Material damage due to disregard of the connection instructions!
Disregard of the connection instructions can damage or destroy your device.
Observe the following:
· Observe the voltage and frequency specifications on the rating plate!
· Do not use the device for measuring DC voltage!

13.2 Apply measured voltage

⚠ WARNING

Risk of injury due to electrical voltage!
If the device is exposed to surge voltages above the permissible overvoltage category, safety-relevant areas of insulation in the device can be damaged. This means that the safety of the product can no longer be guaranteed.
Only use the device in environments in which the permissible overvoltage category is not exceeded.

INFORMATION

In networks with nominal voltages that exceed the specified nominal voltages, connect the voltage measurement inputs via voltage transformers (see section „8.1 Nominal voltages“ on page 25)!

Apply measured voltage:
1. Connect the measured voltage to the terminals of the voltage measurement inputs.
2. Check the measured values displayed by the device for the voltages L-N and L-L.
   Take into account any voltage transformer factors that may be set!

13.3 Applying the measured current

The device
· Is designed for the connection of current transformers with secondary currents of ../1 A and ../5 A.
· Does not measure DC currents.

1. Make sure that the current transformer ratio has been adapted for the current transformers used.
2. Short-circuit all current transformer outputs except one.
3. Compare the current displayed on the device with the applied input current.
   - The currents must match after taking the current transformer ratio into account.
   - In the short-circuited current measurement inputs, the device must indicate approx. 0 amperes.

13.4 Checking the frequency and direction of rotary field

The meter measures the frequency automatically with the factory settings.

1. Use button 1 to scroll through the measuring display until the frequency is displayed.
2. If the frequency cannot be determined, make a fixed setting for it (see section „12.2 Mains frequency (addr. 034)“ on page 45).
3. The movement of the character string on the third line of the display indicates the direction of the rotary field.
   A "right" rotating field at the voltage measurement inputs is present when the character string moves clockwise. Usually it is a "right" rotating field.

Fig. Display of the mains frequency (50.0) and the direction of the rotary field

Fig. No direction of the rotary field can be determined ("---").

INFORMATION

The direction of the rotary field is only determined when all measured voltages are applied. If a phase is missing or two identical phases are connected, the direction of rotary field is not determined and the character string in the display does not move.

13.5 Checking the phase assignment

1. Short-circuit a current transformer on the secondary side.
   The current displayed in the meter must drop to 0 A in the corresponding phase.
2. Repeat this for the other phases.
3. If a phase is reversed, correct the wiring or the phase assignment in the GridVis software.

13.6 Checking the active power measurement

1. Short-circuit all but one of the current transformers on the secondary side.
2. The meter must only show power in the phase that is not short-circuited.
3. If this is not the case, check the connection of the measured voltage and the measured current.
4. If the amount of active power is correct, but the sign of the active power is negative, this can have two causes:
   - The connections S1(k) and S2(l) on the current transformer are reversed. Swapped connections can be corrected in GridVis as an option.
   - Active energy is returned to the grid.

Correctly connected voltage and current measurement inputs result in correctly calculated and displayed individual and summation power readings.

13.7 Checking the apparent power measurement

If a current transformer is assigned to the wrong phase, the corresponding power will be measured and displayed incorrectly.

The phase conductor and current transformer are correctly assigned on the device if there is no voltage between the phase conductor and the associated current transformer (primary).

1. To ensure that a phase conductor at the voltage measurement input is assigned to the correct current transformer, short-circuit the respective current transformer on the secondary side.
   The **apparent power** displayed by the device must then be zero in this phase conductor.
2. If the apparent power is displayed correctly but the active power has a negative (“-”) sign, then the current transformer terminals are reversed or power is being supplied to the electric utility.

13.8 Checking summation power

If all voltages, currents and powers for the respective phase conductors are correctly displayed, the summation powers measured by the device are also correct.

1. For confirmation, compare the summation power measured by the device with the work values of the active and reactive power meters located in the feeder.

13.9 Checking the communication

1. Check the LEDs to see if there is any network activity.

Meaning of the LEDs

LED	Function
Green	Is illuminated when there is a connection (link)
Yellow	Blinks during network activity

13.10 Clear meter readings

We recommend clearing any production-related content from the following meters:

· Meter readings for active, apparent and reactive energy
· Meter readings of the minimum and maximum values for all measured values (see measuring displays)

1. Clear min/max values by writing "001" to parameter address 506 (see section „12. Configuration“ on page 44).
2. Clear energy meters by writing "001" to parameter address 507,

14. MQTT communication

The measurement device supports the MQTT protocol (Message Queuing Telemetry Transport) from firmware version 1.1.0 onwards. MQTT is a lightweight, open communication protocol based on a publish/subscribe model.

MQTT is particularly suitable for applications in industrial networks, energy management systems, or IoT environments where reliability in data transmission and low bandwidth are important.

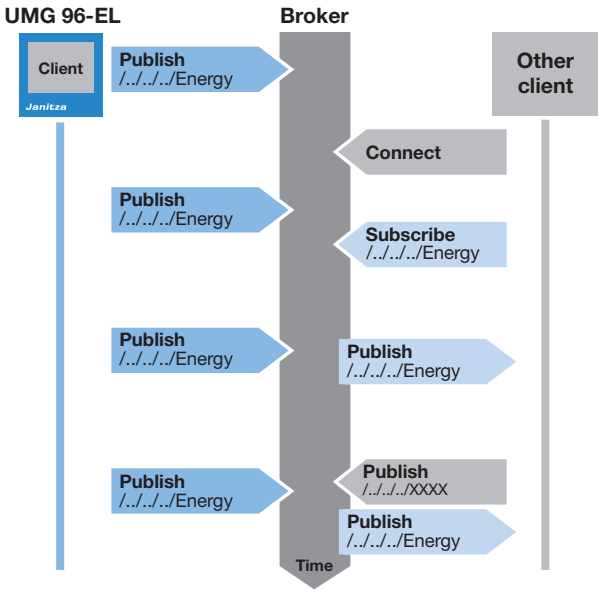


Fig. Principle of MQTT communication according to the publish/subscribe model

After setting up MQTT communication, the measurement device sends the configured data, such as energy values, to the broker as message packets at regular intervals. The UMG 96-EL can only send (publish) data.

Another client can subscribe to the topic of "Energy values" with the broker. From this point on, the broker sends all messages on the topic of "Energy" to this client.

Definition of terms

- **Client:** An end device that sends or receives messages. This role in communication is performed by measurement devices as well as mobile devices or higher-level systems.
- **Broker** (also "MQTT server"): An intermediary that receives messages from all clients and forwards them to the clients that have subscribed to the corresponding topics.
- **Message** (also "packet"): A message consists of the topic, the payload, and flags.
- **Topic:** A category or subject assigned to a message that helps filter messages. Clients can subscribe to specific topics to receive messages on that topic
- **Payload:** The useful content of the message (measured values) in JSON format.
- **Flags:** Flags mark messages for the broker (e.g., retain) and are invisible to users.
- **Last Will:** Message that the broker sends to other clients if the connection to a client is lost, e.g., due to network loss or a keep alive timeout.
- **Retain:** If a message is marked as "retain," it is stored by the broker and sent to every client that subsequently subscribes to this topic.
- **QoS (Quality of Service)**: QoS defines the reliability of message delivery.
- **Keep Alive:** Keep Alive is a mechanism whereby clients periodically send signals to the broker to maintain their connection.
- **Connect:** There are different login procedures for brokers. The most common ones include: Anonymous, user/password, TLS+anonymous, TLS+user/password, and TLS with client certificate.

14.1 Tips and tools for MQTT setup

The connection and topic settings as well as the selection of measured values for the payloads can be configured in the GridVis PC software.

Further information on configuration can be found in the following sources:
· Configuring the connection and the topics: Tooltips in GridVis
· Payload configuration: Variable names for DATA in the Modbus address list (as of V1.1.0)

During commissioning, Explorer tools such as **MQTT Explorer** or **Mosquitto Client** are useful for checking the transmitted MQTT messages.

14.2 Protocol features

The measurement device supports the following features:

Feature	UMG 96-EL
Protocol version	MQTT v3.1.1
QoS level	0 = "at most once delivery", 1 = "at least once delivery"
Clean session	Each connection starts with a clean session with no data from the previous session.
Retain flag	Can be optionally activated for each measured value payload, Enabled by default for device payload
Payload format	JSON
TCP/IP connection	Ports freely configurable (depending on broker configuration)
Encryption	TLS 1.3 possible
Authentication	Optional (username/password or client certificates)

14.3 Setting up an MQTT connection

The MQTT settings for the measurement device can be configured in the GridVis device configurator under *System* > *Communication* > *MQTT*.
The following settings are available:

Configuration options	
MQTT mode	On/Off
Client ID	Max. 23 characters
Devices topic	Max. 127 characters
Keep Alive	Interval configurable (0 - 65535 s, factory setting 60 s) 0 = Keep Alive is inactive
Broker hostname/ IP address	Text field with FQDN or IP address (max. 127 characters)
Port	1 - 65535
Username, Password	· Login with authentication is strongly recommended · If the fields are left blank = login without authentication · Username: max. 63 characters · Password: up to 1024 characters for token-based login
TLS	· On/Off · If active: the following optional fields (automatic use if field is filled in)
· Client key	· Private key · max. 2048 bytes
· Client certificate	· Max. 4096 bytes
· Server CA	· TLS server CA certificate · Max. 4096 bytes

Recommendations for communication security:
· Use at least authentication with TLS encryption.
· Enter the broker's CA in the *Server CA* field.
· Brokers should not be freely accessible.
· Only operate the measurement devices in trusted networks and behind a firewall.
· For details, see section: „3. Cybersecurity – safe operation of the device“ on page 14.

14.4 Topics

Topics are used to categorize messages by subject. Topics are freely definable and consist of two parts. The entire topic consists of:

1. Device topic (max. 127 characters)
2. Name (topic suffix, max. 31 characters)

The *Device Topic* applies to all payloads of the device, while the *Name* applies specifically to one payload.

Permitted characters in the entire topic:
"0-9", "a-z", "A-Z", _-%/"

Supported placeholders for the device topic:

- %t – Device type (e.g., UMG96EL)
- %s – Serial number
- %m – MAC address (without colons, e.g. 000e6b071234)
- The placeholders "%t_%s" for device type and serial number are predefined.

Example of a topic:

Devices topic	Name (topic suffix)
json / janitza / %t_%s /	...
json / janitza / UMG96EL_68000287 /	Energy

Note:

- Slashes can be used to add additional nodes (levels) in both the device topic and the topic suffix. This allows you to organize messages logically, e.g., according to the spatial arrangement of measurement devices in buildings. Nodes between the placeholders %t and %s are also possible.
- The placeholders in the device topic allow the same topic definition to be distributed across multiple devices.
- Use the MQTT topic filters # and + to filter messages in an Explorer tool according to your needs based on the topics. These characters must not be used in the topic.
- A missing slash at the end of the device topic is automatically added.

14.5 Payload

You can freely configure the payload of messages transmitted via MQTT.

This free configurability offers the following advantages:

- Data can be calculated together, which eliminates the need for storage and accessing other payloads.
- Separate payloads for different applications are possible, e.g., for energy management and load monitoring.
- Payloads can be published with different transmission intervals.
- Content can be distributed to users according to their permissions.

14.5.1 Setting up payloads

Use the device configurator under *System* > *MQTT measured values* to configure up to 8 different payloads. Payloads 1-3 are preconfigured.

Rules for payload names (topic suffix):

- Max. 31 characters: "A-Z", "a-z", "0-9", "_-/"
- The slash "/" allows subdivision into further levels.
- No spaces or other special characters.
- The topic suffix may be left blank.

Possible settings per payload:

- Payload publication active (can be temporarily deactivated)
- Retain flag, can be activated
- Quality of Service, Level 0 or 1 (see section „14.6 Quality of Service (QoS)“ on page 60)
- Measured values (up to 40 measured values per payload)
- Data transmission interval (e.g., 60 s; configurable from 1 to 65535 s)
- Averaging: Arithmetic, RMS, sample (see section „14.5.3 Defining measured values in the payload“ on page 58)

14.5.2 Payload header

All payloads are structured according to the same framework and have a header. The header consists of at least 3 fields:

- **Unique identifier (uid):** Unique identification of the individual device according to the following scheme: <deviceType>_<serialNumber>
  The uid is identical across all topics. Payloads can therefore also be assigned to a device at a later point in time.
- **Time stamp (ticks):** In the UMG 96-EL, a counter is incremented in ms from the time the measurement device is switched on as a substitute for a time stamp.
  Messages can be sorted chronologically based on the time stamp.
- **Sequence number (seq):** The sequence number is incremented continuously. This enables the application to determine whether packets have been lost. Each payload has its own sequence number.

Example header:

```
{
   "uid": "umg96el_68000287",
   "ticks": 87873,
   "seq": 1,
   ...
   ...
}
```

14.5.3 Defining measured values in the payload

All measured values from the 19000 Modbus address range can be transmitted in payloads.

In the payload, a short MQTT variable name is used to identify the measured values.

The variable names are explained in section „21.1 Modbus addresses of frequently used measured values“ on page 78.

Use the GridVis device configurator under *System* > *MQTT Measured Values* to select which values are to be transmitted in the payload.

Measured value calculation: The settings are usually used as follows:

- *Average value (arithmetic)* type: Average value over the specified time interval. Used for all values for which an average value is desired (e.g., power, cos phi, power factor).
- *Average value (RMS)* type: Effective value over the specified time interval. Used for voltages and currents.
- *Sample* type: Instantaneous value at the end of the time interval. Used for values that do not have a meaningful average value (e.g., energy values, comparators), or when no average value is desired.

Time interval: The device calculates these average values on the time basis of the *transmission interval* of the respective payload.

In addition to the measured values, the corresponding minimum and maximum values in the time interval can be integrated into the payload.

14.5.4 Standard payloads

The first 3 payloads are preconfigured:

Payload name (topic suffix)	Contents	Transmission interval [1]
Voltage_ Current_RMS	Voltages, currents, Powers, Power factors, Frequency, THD-U, THD-I	1 min
Power_AVG	Active and apparent powers (average values), Power factors	1 min
Energy	Energy meters (Consumption/supply)	15 min.
DATA4 – DATA8	For additional measured values, Inactive by default, Not preconfigured	–
DEVICE	Device status after logging in to the broker, Not configurable	–

1) Preset transmission interval

DEVICE
This is a fixed payload that the measurement device sends immediately after logging in to the broker. It specifies the requirements for communication with the device. The DEVICE payload is sent by default with QoS 1 and the retain flag.

If the measurement device is no longer accessible, the broker distributes the DEVICE payload to the clients that have subscribed to the topics of the failed device as the **LASTWILL**.

A LASTWILL message contains the following information:
- **Unique identifier (uid):** Unique ID with device type and serial number
- **Time stamp:** Time of last registration with the broker (last connection established), specified in ticks (ms) since the measurement device was switched on
- **Sequence number (seq):** same sequence number as for the registration
- **Connection:** offline

14.5.5 Example of a payload

The following Modbus addresses are selected:
19000, 19002, 19004, 19006, 19008, 19010, 19012, 19014, 19016, 19018, 19020, 19022, 19024, 19026


```
{
"uid": "umg96el_68000287",
"ticks": 5012,
"seq": 124,
"ULNRms_L1": { "avg": 0.0, "max": 0.0, "min": 0.0
,"unit": "V"},
"ULNRms_L2": { "avg": 0.0, "max": 0.0, "min": 0.0
,"unit": "V"},
"ULNRms_L3": { "avg": 0.0, "max": 0.0, "min": 0.0
,"unit": "V"},
"ULLRms_L12": { "avg": 0.0, "max": 0.0, "min": 0.0
,"unit": "V"},
"ULLRms_L23": { "avg": 0.0, "max": 0.0, "min": 0.0
,"unit": "V"},
"ULLRms_L31": { "avg": 0.0, "max": 0.0, "min": 0.0
,"unit": "V"},
"IRms_L1": { "avg": 0.0, "max": 0.0, "min": 0.0
,"unit": „A"},
"IRms_L2": { "avg": 0.0, "max": 0.0, "min": 0.0
,"unit": „A"},
"IRms_L3": { "avg": 0.0, "max": 0.0, "min": 0.0
,"unit": „A"},
"IRms_Sum": { "avg": 0.0, "max": 0.0, "min": 0.0
,"unit": „A"},
"P_L1": { "avg": 0.0, "max": 0.0, "min": 0.0
,"unit": „W"},
"P_L2": { "avg": 0.0, "max": 0.0, "min": 0.0
,"unit": „W"},
"P_L3": { "avg": 0.0, "max": 0.0, "min": 0.0
,"unit": „W"},
"P_Sum": { "avg": 0.0, "max": 0.0, "min": 0.0
,"unit": „W"},
```


The variable names are explained in section „21.1 Modbus addresses of frequently used measured values“ on page 78.

14.6 Quality of Service (QoS)

The measurement device supports the following transmission reliability levels:

· **QoS 0:** "at most once".
The measurement device sends the message only once and does not expect a confirmation of receipt. The reliability of delivery depends on the stability of the TCP connection. No messages can arrive twice at the broker.

· **QoS 1:** "at least once".
The measurement device sends the message and the broker sends a confirmation of receipt. If the measurement device does not receive a confirmation of receipt, it sends the message again once every second until the next transmission interval begins or until receipt has been confirmed by the broker. If only the confirmation of receipt has been lost, a message may arrive at the broker several times.

Behavior in case of connection failure
If the TCP connection to the broker is interrupted, the measurement device continues to record the measured values (including minimum, maximum, and average values:

· **QoS 0:** Measured values from the time period of the interruption are lost. The device creates new payloads with the latest measured values for each transmission interval.

· **QoS 1:** The measurement device resends data payloads until it receives a confirmation of receipt from the broker.
Retries are performed every second. Each retry receives the sequence number of the original message and is thus marked as a duplicate.
The retries continue until the end of the transmission interval.
In the next transmission interval, the measurement device sends new messages with current measured values as the original message (new sequence number).

INFORMATION

QoS 2 ("exactly once") is not supported. However, duplicates can be easily identified by the sequence number.

14.7 Diagnosis of errors

The device has a Modbus register for the MQTT connection status (uint16).

Register: Connection status (21300)

Code	Status	Meaning
0	disabled	MQTT functionality disabled in the client: · MQTT mode in GridVis is turned off. · MQTT could not be initialized. Read error register 21301 (ushort) to find the cause.
1	disconnected	Connection interrupted: The measurement device client was unable to establish a connection to the broker.
2	connected	The measurement device client is connected to the broker.
3	init	Status between saving the connection data and the first attempt to connect to the broker.

Register: Last error code (21301)

Code	Meaning	Cause (possible action)
0	No error	
105	INVALID_SYNTAX	Transmission to device failed. > Check configuration in GridVis and transfer to device again.
202	CONNECTION_ REFUSED	Broker refuses the connection. Authorization failed.
220	TIMEOUT	Broker not accessible.
304	ERROR_END_OF_FILE	Transmission to device failed. > Check configuration in GridVis and transfer to device again.
522	WRITE_FAILED	Client key is faulty.
532	NO_CERTIFICATE	Transmission to device failed. > Check configuration in GridVis and transfer to device again.
533	BAD_CERTIFICATE	
540	DECRYPTION_FAILED	Do not use password-protected keys

Possible causes for connection breakdowns:

Error category	Possible causes
Broker availability	· Hostname could not be resolved · IP address cannot be accessed
Authentication	· Invalid username or password
Safety	· Invalid certificate in device memory (e.g., too large, incomplete transfer) · Broker certificate invalid · Broker or device certificate expired · Different TLS settings between broker and device · Client key or client certificate invalid

15. Operation

15.1 Time recording

The measurement device does not have a built-in clock, but the operating time is recorded with the help of the processor. The measurement device records the operating hours and the total running time of each comparator.

- Operating hours are measured with a resolution of 0.1 h.
- The time is displayed in seconds (when 999999 s is reached, the time is displayed in hours).

The measuring display shows a maximum of 99999.9 h (= 11.4 years).

15.2 Reading out the operating hours meter

The operating hours meter measures the time during which the measurement device records and displays measured values.
The operating hours are measured with a resolution of 0.1 h and are displayed in hours. The operating hours meter cannot be reset.

Fig. Operating hours meter display (measuring display A20), example 140.8 h

Example: The operating hours meter displays 140.8 hours. This corresponds to 140 hours and 80 industry minutes. Since 100 industry minutes correspond to 60 minutes, the 80 industry minutes in this example are 48 minutes.

15.3 Reading out the total running time of the comparators

The total running time of a comparator is the sum of all times for which there was a limit violation in the comparator result (see section „12.15 Comparator for limit value monitoring“ on page 49).

You can read the total running time of each comparator as a measured value on the display. The running time is displayed in seconds (s) or hours (h).

The comparators are marked on the display with the numbers 1 to 6:

Display	Display 1. Line	Meaning
B20	1	Total running time, comparator 1A
C20	2	Total running time, comparator 2A
D20	3	Total running time, comparator 1B
E20	4	Total running time, comparator 2B
F20	5	Total running time, comparator 1C
G20	6	Total running time, comparator 2C

Tab. Measuring displays B20 .. G20)

INFORMATION

The total running times of the comparators can be reset by resetting the device to the factory settings.

15.4 Displaying harmonics

Harmonics are caused, for example, by equipment with non-linear characteristics. These additional frequencies represent the integral multiple of a fundamental oscillation and show how the equipment affects the mains. Possible effects of harmonics are, for example:

· Additional heating of operating equipment.
· An additional current on the neutral conductor.
· Overloading and a reduced service life of electrical equipment.

Harmonic loads are the main cause of invisible power quality problems involving enormous costs for repair and investment for the replacement of defective equipment.

The fundamental oscillation of the voltage must be in the range 45 .. 65 Hz. The calculated harmonics of the voltages and currents are referenced to the fundamental oscillation and specified in volts or amperes.

The measurement device calculates harmonics up to 40 times the fundamental oscillation (40th harmonic). The display shows the harmonics up to the 15th harmonic; the measured values for higher harmonics can be read out via Modbus.

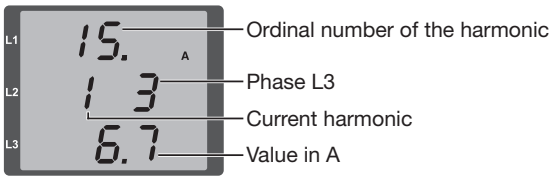


Fig. Display of the 15th harmonic of the current in phase L3 (example).

> ***INFORMATION***
>
> To display the harmonics of voltages or currents in volts or amperes on the display, select display profile 2.

Harmonics content, THD

THD (*total harmonic distortion*) is the performance characteristic for the total harmonic distortion. THD is the ratio of the RMS value of the harmonics to the RMS value of the *Fundamental oscillation* in percent. THD can be determined for voltages or currents.

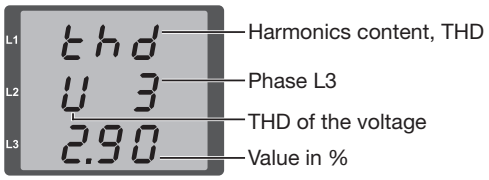


Fig. Display of the harmonics content, THD, of the voltage from phase L3 (example).

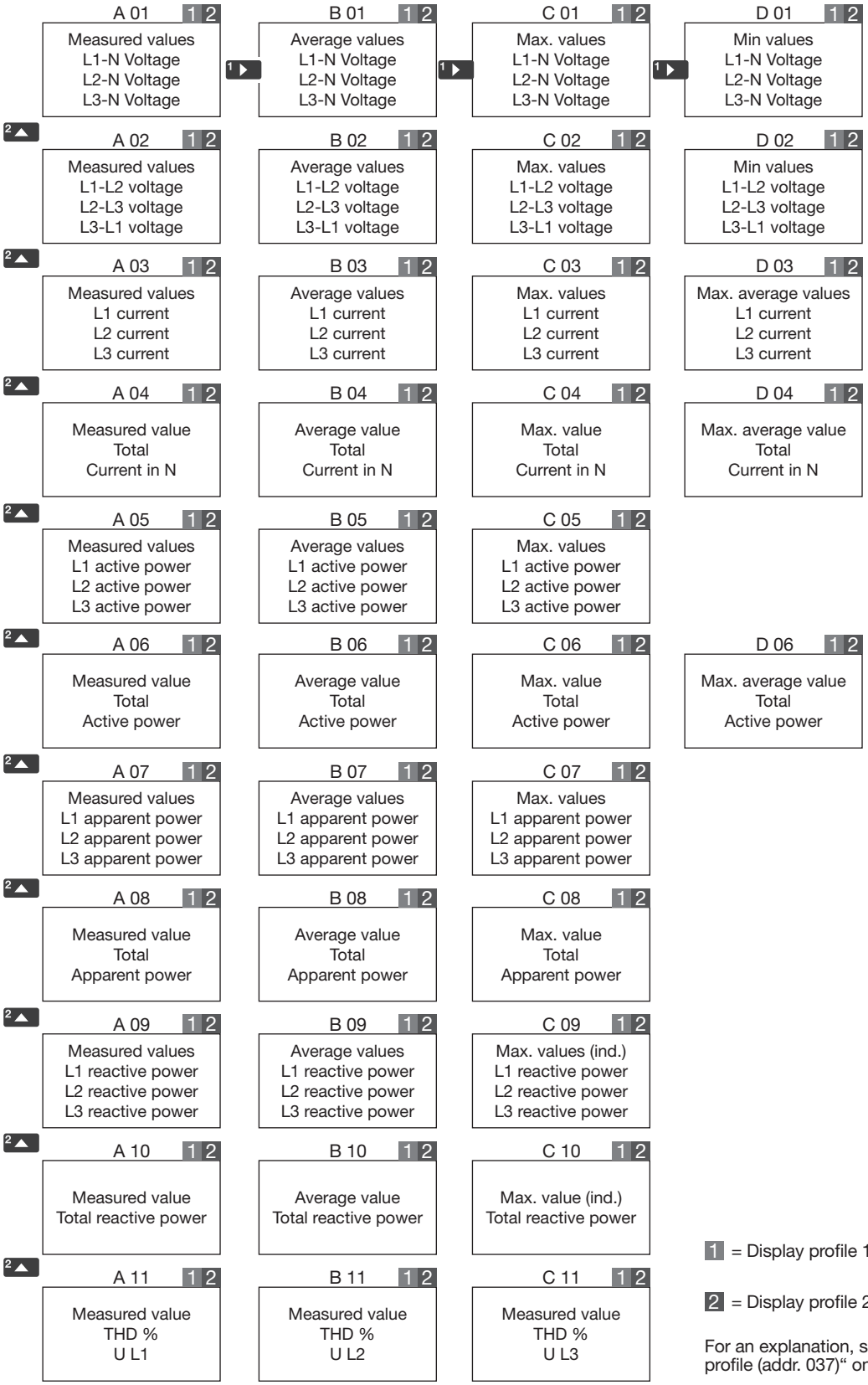
THD is also referred to colloquially as distortion factor, although distortion factor is the ratio of the harmonics relative to the *total signal*. With alow harmonic content, the two variables therefore approach each other.

15.5 Secure deletion and reset to factory settings

The device can be reset by writing a value to Modbus registers 48 or 49. Register 49 can only be written via Modbus/GridVis, not on the device itself.

Modbus register	Value	Function
48	001	Secure deletion of all settings and measured values except production data (MAC, serial number, etc.) and operating hours meter, e.g., before the device is put to a new use. The device performs a restart.
49	001	Reset to factory settings, Exception: Network settings are retained
	002	Reset to factory settings (All settings are overwritten)

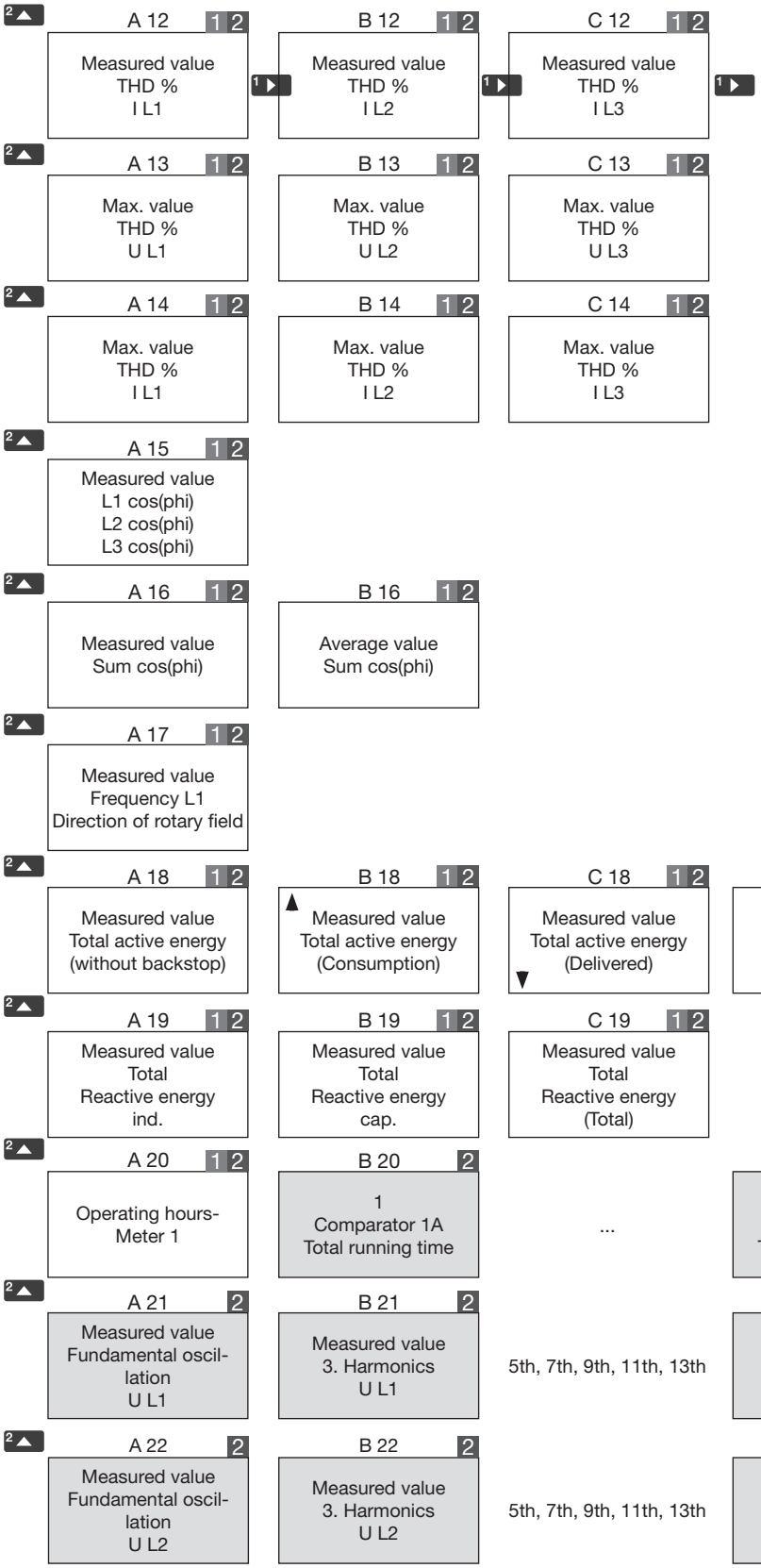
16. Overview of measuring displays – display profiles 1 and 2



1 = Display profile 1, standard

2 = Display profile 2, with harmonics

For an explanation, see section „12.5 Display profile (addr. 037)“ on page 46.

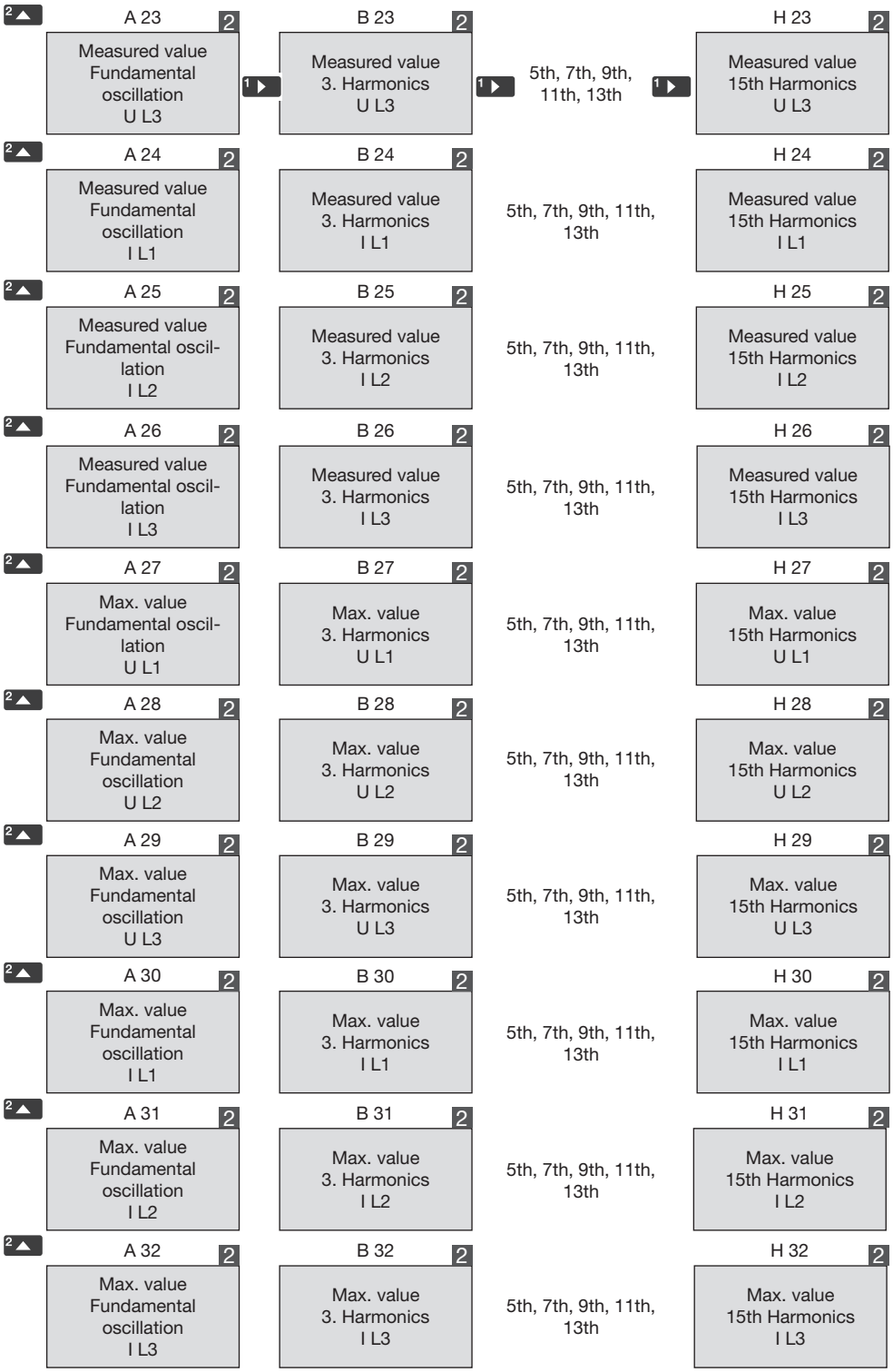


Present display
You can use the Modbus address 26000 to query which display is presently being shown. A string in the format "A01", "H21", etc. is returned (at least 4 bytes).

Comparator
Running time: Page 62
Function: Page 49

Harmonics
Page 63

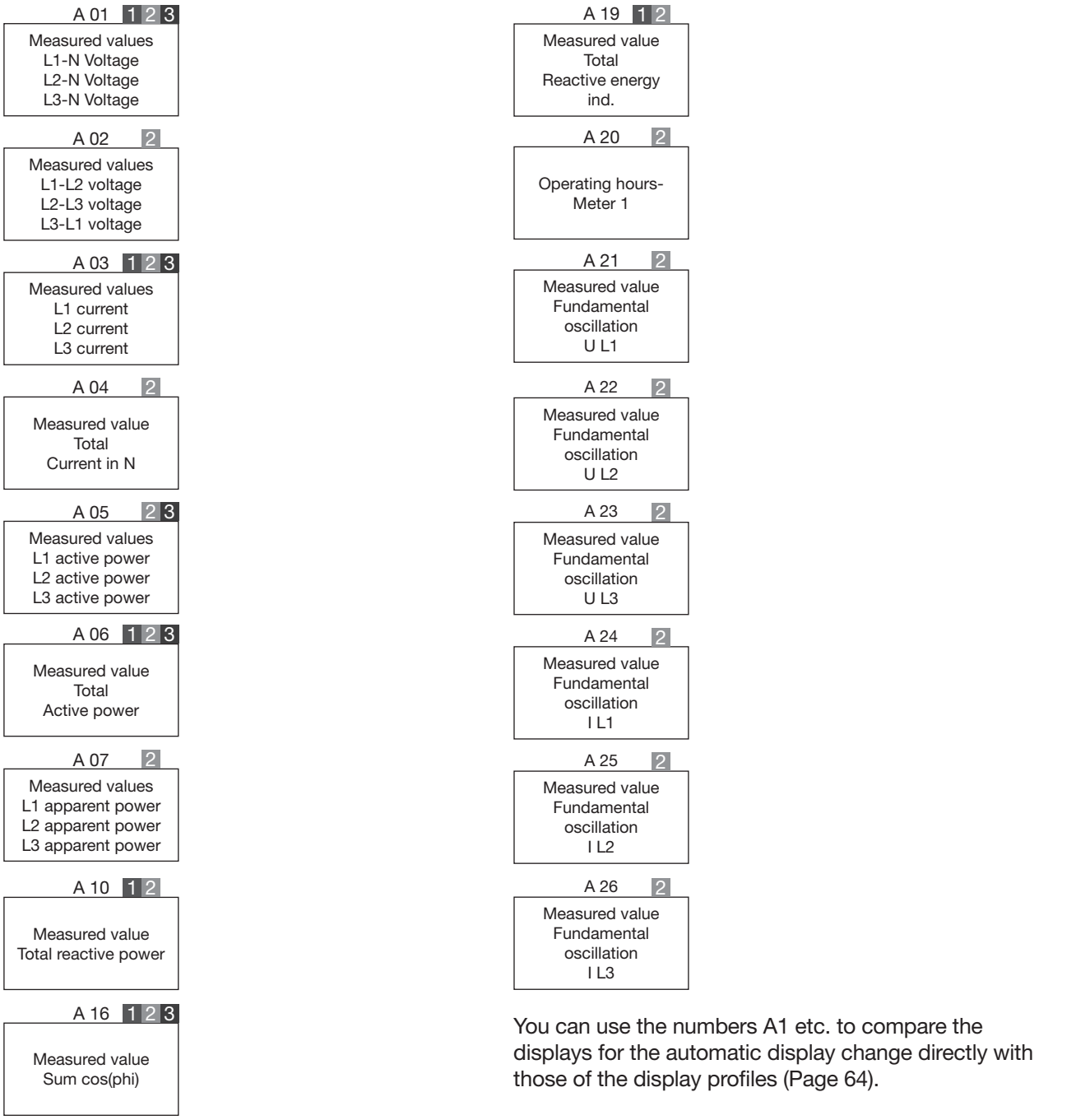
Even and odd harmonics of the voltages and currents of the 1st to 40th harmonics can be retrieved and visualized using the GridVis software.


A 23
Measured value Fundamental oscillation U L3
B 23
Measured value 3. Harmonics U L3
5th, 7th, 9th, 11th, 13th
H 23
Measured value 15th Harmonics U L3
A 24
Measured value Fundamental oscillation I L1
B 24
Measured value 3. Harmonics I L1
5th, 7th, 9th, 11th, 13th
H 24
Measured value 15th Harmonics I L1
A 25
Measured value Fundamental oscillation I L2
B 25
Measured value 3. Harmonics I L2
5th, 7th, 9th, 11th, 13th
H 25
Measured value 15th Harmonics I L2
A 26
Measured value Fundamental oscillation I L3
B 26
Measured value 3. Harmonics I L3
5th, 7th, 9th, 11th, 13th
H 26
Measured value 15th Harmonics I L3
A 27
Max. value Fundamental oscillation U L1
B 27
Max. value 3. Harmonics U L1
5th, 7th, 9th, 11th, 13th
H 27
Max. value 15th Harmonics U L1
A 28
Max. value Fundamental oscillation U L2
B 28
Max. value 3. Harmonics U L2
5th, 7th, 9th, 11th, 13th
H 28
Max. value 15th Harmonics U L2
A 29
Max. value Fundamental oscillation U L3
B 29
Max. value 3. Harmonics U L3
5th, 7th, 9th, 11th, 13th
H 29
Max. value 15th Harmonics U L3
A 30
Max. value Fundamental oscillation I L1
B 30
Max. value 3. Harmonics I L1
5th, 7th, 9th, 11th, 13th
H 30
Max. value 15th Harmonics I L1
A 31
Max. value Fundamental oscillation I L2
B 31
Max. value 3. Harmonics I L2
5th, 7th, 9th, 11th, 13th
H 31
Max. value 15th Harmonics I L2
A 32
Max. value Fundamental oscillation I L3
B 32
Max. value 3. Harmonics I L3
5th, 7th, 9th, 11th, 13th
H 32
Max. value 15th Harmonics I L3

16.1 Overview of automatic display changes, profiles 1 to 3

If no button is pressed, the display can automatically switch between the following measuring displays according to the selected profile (addr. 038).

The display duration can be set in the changeover time parameter (addr. 039).



You can use the numbers A1 etc. to compare the displays for the automatic display change directly with those of the display profiles (Page 64).

17. Error messages and overrange measurements

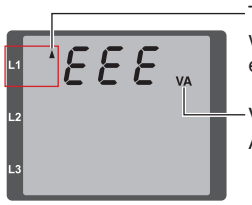
The device shows three types of messages on the display:

1. Overrange measurements
2. Warnings (simple errors)
3. Serious errors

In all three cases, the display shows "EEE".
Errors can be recognized in that the "EEE" symbol is followed by an error code.

17.1 Overrange measurements

The measuring range is exceeded if at least one of the three voltage or current measurement inputs lies outside its specified measuring range.
The overrange message is displayed as long as the condition is present and cannot be acknowledged.



The arrow marks the phase in which the measuring range is exceeded *(L1/L2/L3)*.

V = Voltage circuit
A = Current path

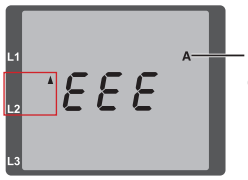
Fig. Display of a measuring overrange

The phase in which the measuring range was exceeded is marked with an "up" arrow.
The "V" and "A" symbols show whether the overrange has occurred in the current or voltage circuit.

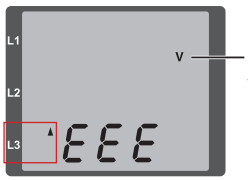
Measuring overrange limit values:		
I	=	Approx. 7.1 A_{eff}
U_{L-N}	=	Approx. 310 V_{eff}
U_{L-L}	=	Approx. 510 V_{eff} with 3p 4u and 3p 2u (voltage measurement connection variants)

Remedy if the measuring range is exceeded:
see „18. Procedure in the event of a malfunction“ on page 70.

Examples:



Measuring overrange of the current in phase L2 (I2).



Measuring overrange of the voltage in phase L3.

Fig. Example displays for measuring overrange

Measuring overrange parameter:
A measuring overrange can also be read out in addr. 600 in the following format:

0x	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Phase 1:	1		1					
Phase 2:	2		2					
Phase 3:	4		4					
	Current		U_{L-N}					

Fig. Measuring overrange parameter (addr. 600)

Examples of values in addr. 600

Measuring overrange ...		
0x**0000 0000**	:	Is not available
0x**0200 0000**	:	Current in L2
0x**0700 0000**	:	Current in all three phases
0x**0004 0000**	:	Voltage in L3
0x**0205 0000**	:	Current in L2, Voltage in L1 and L3

17.2 Error messages

The device displays both simple and serious errors as follows:

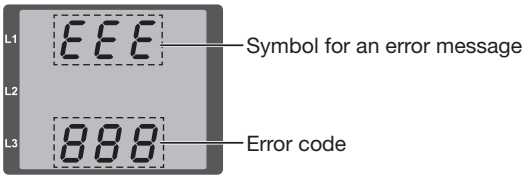


Fig. Error message

Warnings (simple errors)
Simple errors can be acknowledged by pressing button 1 or 2. However, simple errors also reset themselves automatically as soon as a valid state is reached.

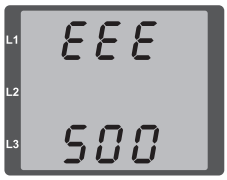


Fig. Error 500 (mains frequency)

- In some cases, the EEE 500 error is displayed again shortly after acknowledgment. Possible causes for the rapid recurrence of the error may be excessive interference signals on the lines or operation at the limit of the frequency or voltage measuring range.
- If a simple error is still present after switching back on, it will be displayed again.

Error	Error description
EEE 500	The mains frequency could not be determined. Possible causes: · The voltage at L1 is too low (see voltage measuring range in section „20. Technical data“ on page 74). · The mains frequency is not in the range of 45 to 65 Hz. Solution: · Check the voltage and connection of the measurement inputs. · Check the mains frequency. · Select a fixed frequency on the device.
EEE 810	The device has detected an error in the configuration, therefore all settings have been reset to the factory settings and a restart has been performed. Possible cause: · Configuration settings were contradictory or otherwise incorrect. Solution: · Acknowledge the error and reconfigure the device.

Serious error
If serious error 910 occurs, you must send the device to the manufacturer for inspection.

Fig. Serious error 910

Error	Error description
EEE 910	Error when reading the internal memory (production data, master data, or settings, etc.). Solution: · Send the device and error description to the manufacturer for inspection.

18. Procedure in the event of a malfunction

Failure mode	Cause	Remedy
No display	External fuse for the supply voltage has tripped.	Replace fuse.
No current display.	No measured voltage connected.	Connect measured voltage.
	No measured current connected.	Connect measured current.
Displayed current is too great or too small.	Current measurement on the wrong phase.	Check connection and correct if necessary.
	Current transformer factor incorrectly programmed.	Set the transformer ratio of the current transformer correctly.
	The peak current value at the measurement input was exceeded by current harmonics.	Install current transformers with a larger transformer ratio.
	The current at the measurement input is too low.	Install current transformers with a smaller transformer ratio.
	Frequency could not be determined or is set incorrectly.	Set the frequency correctly.
Displayed voltage is too low or too high.	Measurement on the wrong phase.	Check connection and correct if necessary.
	Voltage transformer programmed incorrectly.	Set the transformer ratio of the voltage transformer correctly.
	Frequency could not be determined or is set incorrectly.	Set the frequency correctly.
Displayed voltage is too low.	Overrange.	Use a voltage transformer.
	The voltage peak value at the measurement input was exceeded due to harmonics current.	Attention! Make sure that the measurement inputs are not overloaded.
Phase shift, ind./cap.	Current path is assigned to the wrong voltage circuit.	Check connection and correct if necessary.
Active power consumption / delivered is interchanged.	At least one current transformer connection is reversed.	Check connection and correct if necessary.
	A current path is assigned to the wrong voltage circuit.	Check connection and correct if necessary.
Active power too small or too great.	The programmed current transformer ratio is incorrect.	Set the transformer ratio of the current transformer correctly.
	The current path is assigned to the wrong voltage circuit.	Check connection and correct if necessary.
	The programmed voltage transformer ratio is incorrect.	Set the transformer ratio of the voltage transformer correctly.
Display of "EEE" with error code.	See error messages.	See „17.2 Error messages“ on page 69.
Display "EEE" with arrow pointing upwards (measuring range exceeded)	The measuring range has been exceeded (see „17.1 Overrange measurements“ on page 68).	· Check connection and correct if necessary. · Set the connection variant for voltage measurement correctly (see „8.4.3 Connection variants for voltage measurement“ on page 29). · Set the current or voltage transformer correctly (see „11.4 Setting the current transformer (CT)“ on page 40).
No connection to the device.	· Incorrect IP address or the IP address is already assigned in the network. · A network switch requires authentication.	· Correct the device IP address. · Contact the network administrator.
Despite the above measures, the device does not function.	Device defective.	Send the device and error description to the manufacturer for inspection.

19. Service and maintenance

Prior to outbound delivery, the device is subjected to various safety tests and is marked with a seal. If a device is opened, the safety tests must be repeated. A warranty is only assumed for unopened devices.

19.1 Repair and calibration

Repair and calibration of the device must only be carried out by the manufacturer or an accredited laboratory! The manufacturer recommends calibrating the device every 5 years!

⚠ WARNING

Warning of unauthorized tampering or improper use of the device.
Opening, dismantling or unauthorized manipulation of the device which goes beyond the mechanical, electrical or other operating limits indicated can lead to material damage or injury, up to and including death.
· Only electrically qualified personnel are permitted to work on the devices and their components, assemblies, systems and current circuits!
· Always use your device or component only in the manner described in the associated documentation.
· In the event of visible damage, or for the purpose of repair and calibration, return the device to the manufacturer!

19.2 Front panel foil and display

Please note the following for the care and cleaning of the front foil and the display:

INFORMATION

Material damage due to improper care and cleaning of the device.
The use of water or other solvents, such as denatured alcohol, acids, acidic agents for the front foil or the display can damage or destroy the device during cleaning. Water can, for example, penetrate into the device housing and destroy the device.
· Clean the device, the front foil or the display with a soft cloth.
· Use a cloth moistened with clear water for heavy soiling.
· Clean the front panel foil and the display, e.g., fingerprints, with a special LCD cleaner and a lint-free cloth.
· Do not use acids or acidic agents to clean the devices.

19.3 Service

For questions not answered or described in this manual, please contact the manufacturer. Please be certain to have the following information ready to answer any questions:
· Device designation (see rating plate)
· Serial number (see rating plate)
· Firmware version (see system display)
· Measured voltage and supply voltage
· An exact error description.

19.4 Device adjustment

The manufacturer adjusts the devices before delivery. No readjustment is required when the environmental conditions are complied with.

19.5 Performing a firmware update

To update the firmware, connect your device to a PC and access it via the **GridVis software**:

· Download the firmware from the download area of **www.janitza.com**.
· Ensure that the checksum of the downloaded ZIP file matches the checksum on the homepage (see „Calculating the checksum“ on page 73).
· Open the firmware update wizard in GridVis by clicking on "Update device" in the "Extras" menu.
· Select the update file (.ZIP) and carry out the update.

A firmware update consists of several deletion and installation procedures. The display changes for each procedure and shows the progress as a percentage:

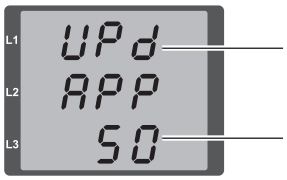


Fig. Updating the device application

· The device then restarts (display: "reboot") and connects to the network.
· Make sure that the firmware update was successful: the symbol must be displayed in GridVis.
· The device will be available again shortly afterwards.

Calculating the checksum
The checksum of the downloaded ZIP file can be calculated using special tools or a tool integrated in Windows. This allows you to detect any changes to the firmware.

· Open the command prompt in Windows.
· Navigate to the folder where the downloaded ZIP file is located, or move the ZIP file to the current folder of the command prompt.
· In the command prompt, execute the Windows command
`certutil -hashfile <path\filename> MD5`.
Example:
`certutil -hashfile um-g96el-1.0.3_9199615c_build76.zip MD5`

· Only install the firmware if the calculated checksum is identical to the one specified on the homepage.

20. Technical data

General	
Net weight (with attached plug-in connectors)	approx. 300 g (0.66 lbs)
Package weight (incl. accessories)	approx. 600 g (1.32 lbs)
Data memory	8 MB
Backlight service life	40,000 h (backlighting reduces to approx. 50% over this period)
Battery	None
Impact resistance	6.8 joules according to UL 61010-1
Cleaning the front panel	Wipe with a dry cloth, if necessary moistened with LCD cleaner, no other solvents

Transport and storage The following information applies to devices that are transported or stored in their original packaging.	
Free fall	1 m (39.37 in)
Temperature	-25 .. +70° C (-13 .. +158° F)
Relative humidity	0 .. 90% non-condensing

Environmental conditions during operation	
The UMG 96-EL is intended for weather-protected, stationary use. Protection class II according to IEC 60536 (VDE 0106, Part 1).	
Rated temperature range	-10 .. +55° C (+14 .. +131° F)
Relative air humidity as a function of the ambient temperature	Descending linearity: at 31 °C (88 °F) max. 80% at 40 °C (104 °F) max. 50% (no condensation)
Operating elevation	0 .. 2000 m (6562 ft) above sea level
Pollution degree	2
Mounting orientation	As desired
Ventilation	No forced ventilation required
Foreign body/water protection - Front - Rear - Front with seal	 IP40 according to EN60529 IP20 according to EN60529 IP54 according to EN60529

Supply voltage		
Option 230 V	Nominal range	AC 90 V .. 277 V (50/60 Hz) or DC 90 V .. 250 V; 300 V Overvoltage category III
	Power consumption	max. 4.0 VA / 1.5 W
Option 24 V	Nominal range	AC 24 V .. 90 V (50/60 Hz) or DC 24 V .. 90 V; 150 V Overvoltage category III
	Power consumption	max. 2.5 VA / 1.5 W
Operating range	±10% of nominal range	
Internal fuse, not replaceable	Type T1A / 250 V/277 V in accordance with IEC 60127	
Recommended overcurrent protective device for line protection (IEC/UL approval)		6 .. 16 A, characteristic B

Recommendation for the maximum number of devices on a line circuit breaker:
Option 230 V: Line circuit breaker B 6A: max. 5 devices / Line circuit breaker B 16A: max. 13 devices
Option 24 V: Line circuit breaker B 6A: max. 3 devices / Line circuit breaker B 16A: max. 10 devices

Voltage measurement	
Three-phase 4-conductor systems with rated voltages up to	277 V / 480 V (+10%) (TN/TT)
Three-phase 3-conductor systems, grounded or non-grounded, with rated voltages up to	IT 480 V (+10%) (TN/TT, IT)
Measurement category	300 V CAT III
Rated surge voltage	4 kV
Protection of the voltage measurement	1 .. 10 A tripping characteristic B (with IEC/UL approval)
Measuring range L-N	0[1)] .. 300 V_{eff} (max. overvoltage 520 V_{eff})
Measuring range L-L	0[1)] .. 510 V_{eff} (max. overvoltage 900 V_{eff})
Resolution	0.01 V
Crest factor	2.45 (related to the measuring range)
Impedance	3 MΩ/phase
Power consumption	approx. 0.1 VA
Sampling frequency (per measurement channel)	21.33 kHz (50 Hz), 25.6 kHz (60 Hz)
Frequency of the fundamental oscillation - Resolution	45 Hz .. 65 Hz 0.01 Hz
Fourier analysis	1st .. 40th Harmonics

[1)] The UMG 96-EL can only determine measured values if a voltage L1-N of greater than 20 V_{eff} (4-wire measurement) or a voltage L1-L2 of greater than 34 V_{eff} (3-wire measurement) is present at voltage measurement input V1.

Current measurement	
Nominal current	5 A
Measuring range	0.005 .. 6 A_{eff}
Crest factor	1.98
Resolution	0.1 mA (display 0.01 A)
Measurement category	300 V CAT II
Rated surge voltage	2 kV
Power consumption	approx. 0.2 VA (Ri =5 mΩ)
Overload for 1 s	120 A (sinusoidal)
Sampling frequency (per measurement channel)	21.33 kHz (50 Hz), 25.6 kHz (60 Hz)
Fourier analysis	1st .. 40th Harmonics

Terminal connection capacity (supply voltage) Connectible conductors. Only one conductor may be connected per terminal point!	
Single core, multi-core, fine-stranded	0.2 .. 4 mm^2, AWG 24 .. 12
Terminal pins, wire ferrules	0.2 .. 2.5 mm^2
Tightening torque	0.4 .. 0.5 Nm (3.54 .. 4.43 lbf in)
Strip length	7 mm (0.276 in)

Connection capacity of the terminal points (voltage and current measurement)
Connectible conductors. Only one conductor may be connected per terminal point!

	Current	Voltage
Single core, multi-core, fine-stranded	0.2 .. 4 mm^2, AWG 24 .. 12	0.2 .. 4 mm^2, AWG 24 .. 12
Wire ferrules without collar	0.2 .. 4 mm^2	0.2 .. 2.5 mm^2
Wire ferrules with plastic collar	0.2 .. 2.5 mm^2	0.2 .. 2.5 mm^2
Tightening torque	0.4 .. 0.5 Nm (3.54 .. 4.43 lbf in)	0.4 .. 0.5 Nm (3.54 .. 4.43 lbf in)
Strip length	7 mm (0.275 in)	7 mm (0.276 in)

Ethernet interface	
Connection	RJ45
Protocols and services	TCP/IPv4, ICMP, DHCP client (BootP), Modbus/TCP (port 502), Identity port (port 1111), MQTT as of firmware 1.1.0 (port configurable)

Potential isolation and electrical safety of the interfaces
The Ethernet interface has double insulation to the voltage and current measurement inputs and to the supply voltage. The interfaces of the connected devices require double or reinforced insulation to mains voltages (according to IEC 61010-1).

20.1 Performance characteristics of functions

Function	Symbol	Accuracy class	Measuring range
Frequency	f	0.05 (IEC61557-12)	45 .. 65 Hz
Voltage	U_{L-N}	0.2 (IEC61557-12)	0[1] .. 300 V_{eff}
Voltage	U_{L-L}	0.2 (IEC61557-12)	0[2] .. 510 V_{eff}
Voltage harmonics	Uh	Cl. 1 (IEC61000-4-7)	Up to 2.5 kHz
THD of the voltage	THDu	1 (IEC61557-12)	Up to 2.5 kHz

[1] A voltage of > 20 V_{eff} must be applied to voltage input V1.
[2] A voltage of > 34 V_{eff} must be applied to voltage input V1.

Accuracy classes with ../5A current transformers (nominal current 5 A)

Function	Symbol	Accuracy class	Measuring range
Total active power	P	0.5 (IEC61557-12)	0 .. 5.4kW [3]
Total reactive power	QA, Qv	1 (IEC61557-12)	0 .. 5.4 kvar [3]
Total apparent power	SA, Sv	0.5 (IEC61557-12)	0 .. 5.4 kVA [3]
Total active energy	Ea	0.5 (IEC61557-12) 0,5S (IEC62053-22)	0 .. 999,999,999 GWh
Total reactive energy	ErA, ErV	2 (IEC61557-12)	0 .. 999,999,999 Gvarh
Total apparent energy	EapA, EapV	0.5 (IEC61557-12)	0 .. 999,999,999 GVAh
Phase current	I	0.2 (IEC61557-12)	0.005 .. 6 A_{eff}
Neutral conductor current calculated	INc	1 (IEC61557-12)	0.03 .. 25 A
Power factor	PFA, PFV	0.5 (IEC61557-12)	0.00 .. 1.00
Current harmonics	Ih	Cl. 1 (IEC61000-4-7)	Up to 2.5 kHz
THD of the current	THDi	1 (IEC61557-12)	Up to 2.5 kHz

[3] At the measurement inputs, i.e., without taking current and voltage transformer ratios into account.

Accuracy classes with ../1A current transformers (nominal current 1 A)

Function	Symbol	Accuracy class	Measuring range
Total active power	P	1 (IEC61557-12)	0 .. 5.4kW [3]
Total reactive power	QA, Qv	1 (IEC61557-12)	0 .. 5.4 kvar [3]
Total apparent power	SA, Sv	1 (IEC61557-12)	0 .. 5.4 kVA [3]
Total active energy	Ea	1 (IEC61557-12) 1S (IEC62053-22)	0 .. 999,999,999 GWh
Total reactive energy	ErA, ErV	2 (IEC61557-12)	0 .. 999,999,999 Gvarh
Total apparent energy	EapA, EapV	1 (IEC61557-12)	0 .. 999,999,999 GVAh
Phase current	I	0.5 (IEC61557-12)	0.005 .. 6 A_{eff}
Neutral conductor current calculated	INc	1 (IEC61557-12)	0.03 .. 25 A
Power factor	PFA, PFV	0.5 (IEC61557-12)	0.00 .. 1.00
Current harmonics	Ih	Cl. 1 (IEC61000-4-7)	Up to 2.5 kHz
THD of the current	THDi	1 (IEC61557-12)	Up to 2.5 kHz

[3] At the measurement inputs, i.e., without taking current and voltage transformer ratios into account.

21. Appendix

21.1 Modbus addresses of frequently used measured values

Address	Format	Description	Access right	Unit	MQTT variable name
19000	float	Voltage L1-N	RD	V	ULNRms_L1
19002	float	Voltage L2-N	RD	V	ULNRms_L2
19004	float	Voltage L3-N	RD	V	ULNRms_L3
19006	float	Voltage L1-L2	RD	V	ULLRms_L12
19008	float	Voltage L2-L3	RD	V	ULLRms_L23
19010	float	Voltage L3-L1	RD	V	ULLRms_L31
19012	float	Current I L1	RD	A	IRms_L1
19014	float	Current I L2	RD	A	IRms_L2
19016	float	Current I L3	RD	A	IRms_L3
19018	float	Vector sum; IN=I1+I2+I3	RD	A	IRms_Sum
19020	float	Real power P1 L1N	RD	W	P_L1
19022	float	Real power P2 L2N	RD	W	P_L2
19024	float	Real power P3 L3N	RD	W	P_L3
19026	float	Sum; Psum3=P1+P2+P3	RD	W	P_Sum
19028	float	Apparent power S1 L1N	RD	VA	S_L1
19030	float	Apparent power S2 L2N	RD	VA	S_L2
19032	float	Apparent power S3 L3N	RD	VA	S_L3
19034	float	Sum; Ssum3=S1+S2+S3	RD	VA	S_Sum
19036	float	Fund. reactive power Q1 L1N	RD	var	Q0_L1
19038	float	Fund. reactive power Q2 L2N	RD	var	Q0_L2
19040	float	Fund. reactive power Q3 L3N	RD	var	Q0_L3
19042	float	Fund. Sum; Qsum3=Q1+Q2+Q3	RD	var	Q0_Sum
19044	float	Cos(ϕ); UL1 I1 (fundamental comp.)	RD		CosPhi0_L1
19046	float	Cos(ϕ); UL2 I2 (fundamental comp.)	RD		CosPhi0_L2
19048	float	Cos(ϕ); UL3 I3 (fundamental comp.)	RD		CosPhi0_L3
19050	float	Measured frequency 10 sec	RD	Hz	Freq
19052	float	Rotation field; 1=right, 0=none, -1=left	RD		Rotation
19054	float	Real energy L1	RD	Wh	WP_L1
19056	float	Real energy L2	RD	Wh	WP_L2
19058	float	Real energy L3	RD	Wh	WP_L3
19060	float	Real energy L1..L3	RD	Wh	WP_Sum
19062	float	Real energy L1, consumed	RD	Wh	WPCons_L1
19064	float	Real energy L2, consumed	RD	Wh	WPCons_L2
19066	float	Real energy L3, consumed	RD	Wh	WPCons_L3
19068	float	Real energy L1..L3, consumed	RD	Wh	WPCons_Sum
19070	float	Real energy L1, delivered	RD	Wh	WPDel_L1
19072	float	Real energy L2, delivered	RD	Wh	WPDel_L2
19074	float	Real energy L3, delivered	RD	Wh	WPDel_L3
19076	float	Real energy L1..L3, delivered	RD	Wh	WPDel_Sum
19078	float	Apparent energy L1	RD	VAh	WS_L1
19080	float	Apparent energy L2	RD	VAh	WS_L2
19082	float	Apparent energy L3	RD	VAh	WS_L3
19084	float	Apparent energy L1..L3	RD	VAh	WS_Sum
19086	float	Fund. reactive energy L1	RD	varh	WQ_L1
19088	float	Fund. reactive energy L2	RD	varh	WQ_L2
19090	float	Fund. reactive energy L3	RD	varh	WQ_L3
19092	float	Fund. reactive energy L1..L3	RD	varh	WQ_Sum
19094	float	Fund. reactive energy ind. L1	RD	varh	WQInd_L1
19096	float	Fund. reactive energy ind. L2	RD	varh	WQInd_L2
19098	float	Fund. reactive energy ind. L3	RD	varh	WQInd_L3
19100	float	Fund. reactive energy ind. L1..L3	RD	varh	WQInd_Sum

Address	Format	Description	Access right	Unit	MQTT variable name
19102	float	Fund. reactive energy cap. L1	RD	varh	WQCap_L1
19104	float	Fund. reactive energy cap. L2	RD	varh	WQCap_L2
19106	float	Fund. reactive energy cap. L3	RD	varh	WQCap_L3
19108	float	Fund. reactive energy cap. L1..L3	RD	varh	WQCap_Sum
19110	float	THD, U L1-N	RD	%	ThdU_L1
19112	float	THD, U L2-N	RD	%	ThdU_L2
19114	float	THD, U L3-N	RD	%	ThdU_L3
19116	float	THD, I1	RD	%	ThdI_L1
19118	float	THD, I2	RD	%	ThdI_L2
19120	float	THD, I3	RD	%	ThdI_L3

21.2 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

21.3 Note on saving measured values and configuration data

INFORMATION

Saving measured values and configuration data
In the event of an **operating voltage failure**, the recording could be interrupted for a maximum of 2 minutes. The following **measured valuesare saved by the device every 2 minutes** in a non-volatile memory:

- Comparator runtimes
- Minimum/maximum values and maximum values of the average values (without date and time)
- Energy meters
- Operating hours

The device saves configuration data immediately!

21.4 Dimensional drawings

The figures are for illustration purposes only and are not to scale.

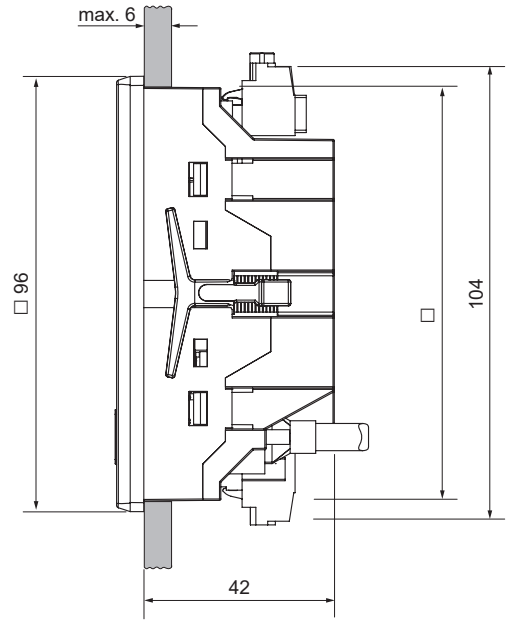


Fig. Side view

All dimensions in mm

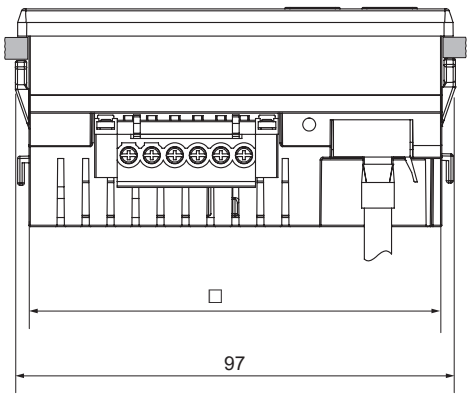


Fig. Bottom view

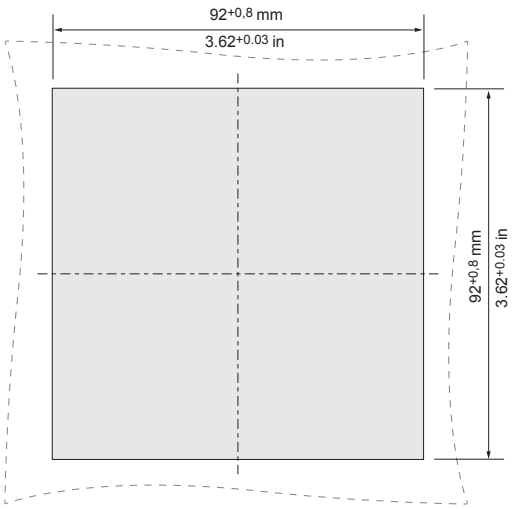
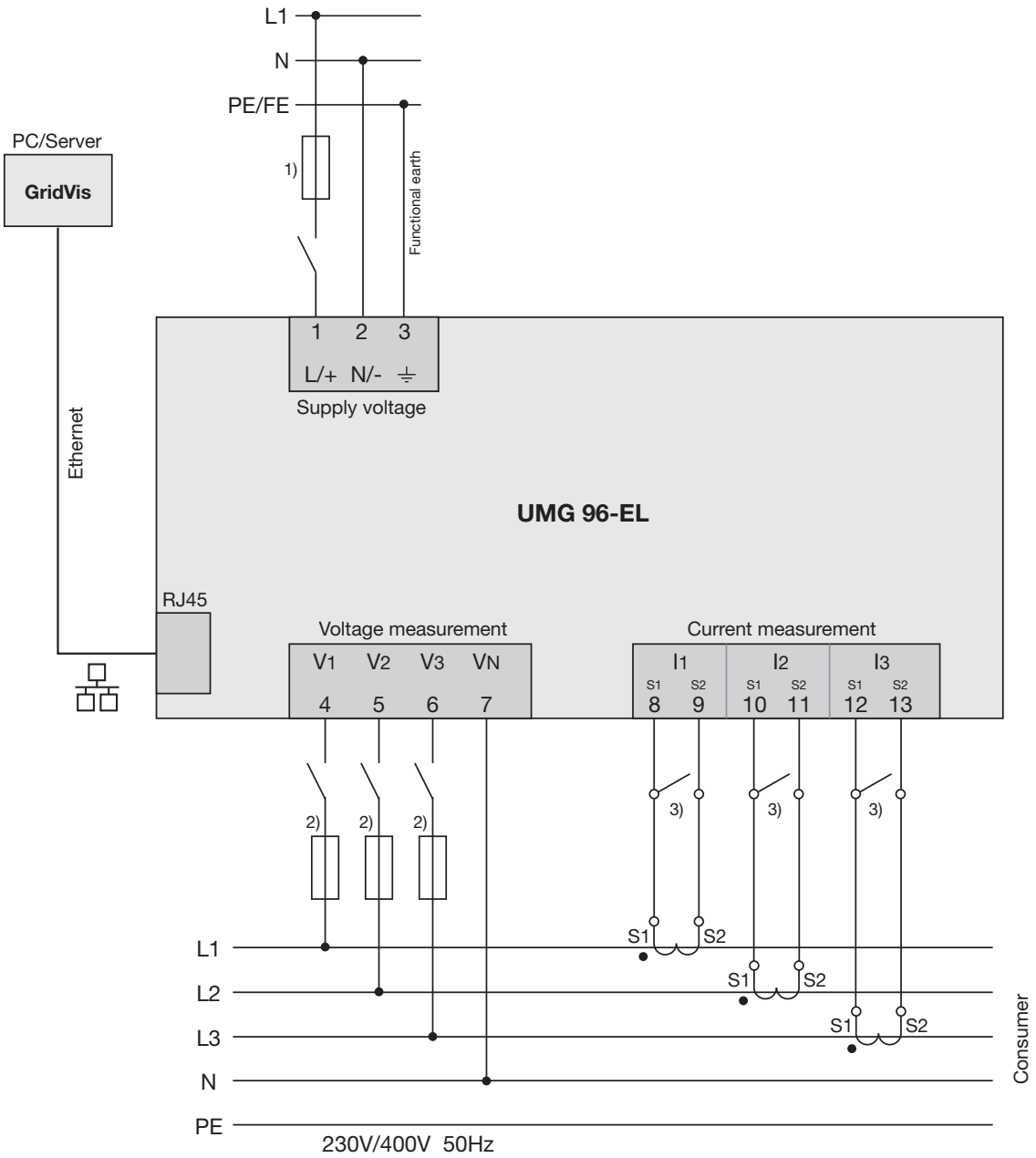


Fig. Cutout dimensions

21.5 Connection example



1) UL/IEC approved overcurrent protective device
2) UL/IEC approved overcurrent protective device
3) Short circuit bridges (external)

21.6 Quick guide to operation

Changing current transformer setting

Go to the programming mode:
· Press and hold buttons 1 and 2 simultaneously for approx. 1 second.
· The symbols for programming mode **PRG** and for the current transformer **CT** appear.

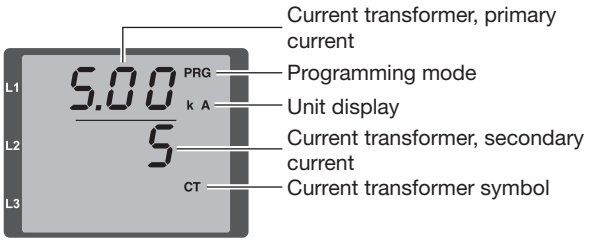


Fig. Setting the current transformer ratio

· Press button 1 to confirm the selection. The first digit of the input area for the primary current blinks.

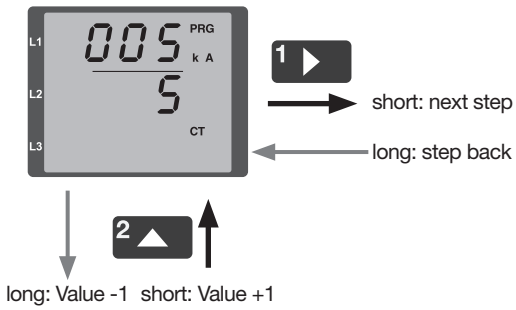


Fig. Button functions in programming mode

Change the primary current
· Press button 2 to change the blinking digit.
· Press button 1 to select the next digit to be changed. The digit selected for a change blinks.
· Note: If the entire number is blinking, the decimal point can be moved using button 2.

Change the secondary current
· Only 1 A or 5 A can be set as the secondary current.
· Use button 1 to select the secondary current.
· Press button 2 to change the blinking digit.

Exit the programming mode
· Press buttons 1 and 2 simultaneously to save the change and go to display mode.

Retrieving measured values

Go to the display mode:
· If programming mode is still active (**PRG** symbol on the display), go to the display mode by pressing buttons 1 and 2 simultaneously for approx. 1 second.
· A measuring display, e.g. for the voltage, appears.

Control via the buttons
· Press button 1 to display measured values that relate to the currently displayed measured value (average values, maximum values, etc.).
· Press button 2 to switch to go to *other* measured values (voltage, current, power, etc.).

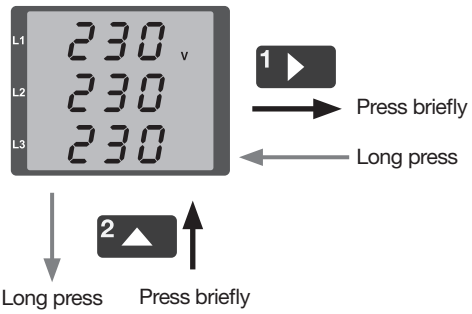


Fig. Button functions in display mode

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