Operating instructions at:

www.a-eberle.de/pqi-lv-manual-en

Software WinPQ lite at:

www.a-eberle.de/pqi-lv-software-en

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Installation guidelines

Power quality Analyser

Model: PQI-LV

- **Fitting**
- **Initial commissioning**

1. Notes

1.1 General

These installation instructions contain all the important information for mounting and commissioning. Read the instructions carefully and completely as they contain important information about the product. Observe the instructions and follow the safety instructions and warnings in particular. Keep the instructions in a safe place and ensure that they are always available and can be viewed by the user of the product.

A. Eberle GmbH & Co KG accepts no liability for damage or losses of any kind resulting from non-compliance with the information products or from printing errors or changes in this manual. Similarly, **A. Eberle GmbH & Co. KG** accepts no liability for damage or losses of any kind resulting from faulty devices or devices that have been modified by the user.

1.2 Revisions

Please note that these installation instructions may not always be the most up-to-date version of the device. For example, if you have changed the firmware of the device to a higher firmware version, these installation instructions may no longer apply in every respect.

In this case, either contact us directly or use the latest version of the installation instructions available on our website (www.a-eberle.de) and the other documents available for the device.

1.3 Waste disposal

Directive 2012/19/EU, better known as the WEEE2 Directive, deals with the return and recycling of waste equipment from the electronics and electrical industry in order to recover valuable raw materials. This applies to all A. Eberle products that are labelled with the waste bin symbol shown.

➲ Our WEEE registration number is:

DE 37396879

For old appliances, please also observe the

Information on our homepage:

https://www.a-eberle.de/en/about-us/take-back-recycling/

1.4 Warranty

We guarantee that every product A. Eberle GmbH & Co KG is free from material and manufacturing defects under normal use.

The detailed conditions for the warranty can be found in our general terms and conditions at: https://www.a-eberle.de/en/general-terms/.

2. Security

2.1 Safety instructions

IT IS IMPORTANT FOR THE SAFETY OF PERSONS TO FOLLOW THESE INSTRUCTIONS. THESE INSTRUCTIONS MUST BE KEPT IN A SAFE PLACE!

- ➲ Observe the operating instructions.
- ➲ Always keep the operating instructions with the appliance.
- ➲ Ensure that the device is only operated when it is in perfect working order.
- ➲ Never open the device.
- ➲ Ensure that only qualified personnel operate the device.
- ➲ Only connect the device in accordance with the instructions.
- ➲ Ensure that the device is only operated in its original condition.
- ➲ Only operate the device with recommended accessories.
- ➲ Ensure that the device is not operated above the rated data, see chapter 5 Technical data
- ➲ Ensure that the original accessories are not operated above the rated data.
- ➲ Do not operate the device in environments where explosive gases, dust or vapours are present.

The installation instructions do not constitute a complete list of all safety measures required for operating the device. Special operating conditions may require additional measures. The installation instructions contain information that you must observe for your personal safety and to prevent damage to property.

2.2 Structure of the warnings

Warnings are structured as follows:

⚠ SIGNAL WORD	**Type and source of danger!** Consequences of non-compliance. ➲ Actions to avoid the danger.

2.3 Gradation of the warnings

Warnings differ according to the type of hazard as follows:

⚠ DANGER!	Warns of an imminent danger that will result in death or serious injury if not avoided.
⚠ WARNING!	Warns of a potentially dangerous situation that will result in death or serious injury if not avoided.
⚠ CAUTION!	Warns of a potentially dangerous situation that could lead to moderate or minor injuries if not avoided.
NOTE!	Warns of a potentially dangerous situation that could lead to material or environmental damage if it is not avoided.
ℹ	Refers to procedures that do not present a risk of injury or damage to property, but which must be observed to ensure reliable operation of the device!

2.4 Intended use

The product is intended exclusively for measuring and evaluating voltage and current signals in the power grid. If the measuring device is used in a manner not specified by the manufacturer, the protection provided by the device may be severely impaired. The device is intended for use for measurement in the low voltage range in CAT IV (300 V) up to a maximum of 690 V (conductor / conductor). All technical connection values and rated data must be observed!

The PQI-LV is suitable for the following installation locations and may only be operated in this environment

- Mounting in a switch cabinet and small distribution board on DIN-rail

2.5 Applicable documents

For safe and correct use of the system, also observe the other documents such as the complete operating instructions and additional documents supplied as well as the relevant standards and laws.

2.6 Target group

These installation instructions are intended for trained specialist personnel and trained and tested operating personnel. The contents of these installation instructions must be made accessible to the persons authorised to install and operate the system. In order to avoid damage to property and personal injury, the specialised personnel must be trained electrical engineers with the following knowledge.

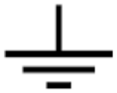
- Knowledge of national accident prevention regulations
- Knowledge of safety engineering standards
- Knowledge of installation, commissioning and operation

2.7 Cleaning

Use a soft, slightly moistened and lint-free towel. Ensure that no moisture penetrates the housing. Do not use window cleaners, household cleaners, sprays, solvents, alcohol-based cleaners, ammonia solutions or scouring agents for cleaning. Please only use water for cleaning.

2.8 Meaning of the symbols used

CAUTION - DANGER! Read the operating instructions and safety instructions



Functional earth of the measuring device

TCP-IP interface

CE labelling guarantees compliance with European directives and regulations regarding electromagnetic compatibility (EMC).

Alternating voltage

DC voltage

3. Commissioning

3.1 PQI-LV Brief description

The PQI-LV power quality analyser and fault recorder for low-voltage grids is the central component of a system that can be used to solve all measurement tasks in electrical grids. The PQI-LV can be used both as a power quality interface in accordance with power quality standards and as a measuring device for all physically defined measured variables in three-phase networks.

In addition to the option of standard analyses and long-term data recording, the PQI-LV can also be extended by a high-speed disturbance recorder with a recording rate of 40.96 kHz / 10.24 kHz and a 10 ms RMS effective value recorder via the "S1 - disturbance recording" feature. This enables a detailed evaluation of mains faults.

The component is particularly suitable for monitoring and recording special supply qualities or quality agreements between the energy supplier and customer and making them available for evaluation or storage. In addition, the device can provide many measured values in parallel for SCADA applications via standardised interfaces such as Modbus. The PQI-LV was developed for measurements in public networks and measurements in industrial environments with a measurement voltage of up to 690 V (L-L).

3.2 Scope of delivery

- PQI-LV
- Installation instructions
- WinPQ lite software www.a-eberle.de/pqi-lv-software-en
- Calibration certificate

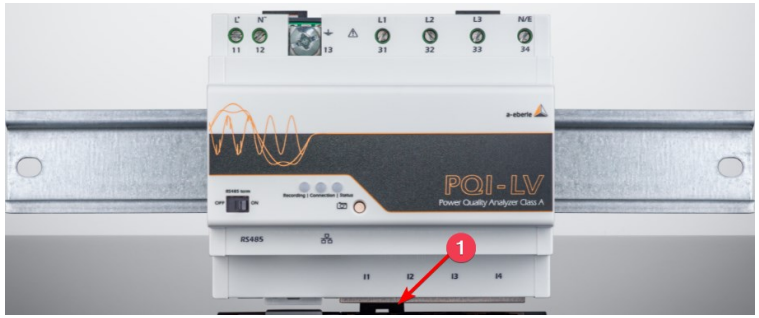
3.3 Fitting

The PQI-LV is suitable for the following installation locations and may only be operated in this environment:

- Installation in a control cabinet, local power supply station and small distribution board on top-hat rail

The PQI-LV can be installed in any position using snap-on fastening with three fastening elements on a 35 mm wide top-hat rail in accordance with EN60715. The device is mounted by guiding it at an angle to the top-hat rail from above and snapping it into place at the bottom. The lower fastening element audibly snaps into place behind the top-hat rail.

The device can be removed from the top-hat rail using a screwdriver by pulling out the lower fastening element (1).



Position of the detachable fastening element

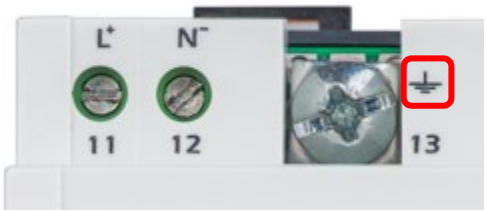
NOTE! **Material damage due to non-observance of the installation instructions!**

Failure to observe the installation instructions or incorrect installation can damage the appliance!

➲ Pay attention to the audible snapping of the fastening elements

3.4 Earthing connection

The device has a functional earth, which also serves as a reference potential for the voltage inputs.



The functional earth is labelled ⏚ and terminal X1 / 13 on the measuring device.

Connect the earthing cable to terminal X1 / 13 of the measuring device and tighten the screw. Use a ring cable lug for the connection and ensure a tight fit!

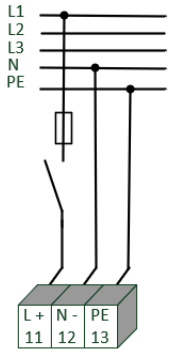
⚠ DANGER! Danger to life due to electric shock

Improper connection of this measuring device can lead to death, serious injury or fire hazard.

- ➲ The functional earth **must always** be connected to PE potential
- ➲ The functional earth must not carry a dangerous voltage under any circumstances.

3.5 Supply voltage

The PQI-LV is available with two different supply voltage characteristics. Please refer to the type plate for the correct supply voltage before connecting.



Example of a connection to 230V AC with feature H1

After connecting and switching on the power supply, the status LED flashes red during initial commissioning (initial commissioning not completed). When restarting after initial commissioning has been completed, the LED changes to green.

⚠ DANGER! Danger to life due to electric shock!

Serious bodily injury or death can be caused by:

- Touching bare or stripped wires that are live.
- Inputs on the device that are dangerous to touch.
- ➲ Ensure that the device is connected in a de-energised state.
- ➲ Ensure that all connecting cables are fixed and strain-relieved.
- ➲ All cable requirements of the terminal blocks must be complied with. (e.g. stripping length of the wires)

NOTE! **Material damage due to non-observance of the connection conditions or impermissible overvoltages!**

Failure to observe the connection conditions or exceeding the permissible voltage range can damage or destroy your device.
Before applying the supply voltage to the device, the following points must be observed:

- Voltage and frequency must correspond to the specifications on type label! Observe the limit values as described in the technical data!
- Note the characteristics of the appliance (H1 / H2)!
- In the building installation, the supply voltage must be provided with a listed circuit breaker and fuse that fulfils the requirements of IEC 60947-1 and IEC 60947-3!
- The circuit breaker must
  - be easily accessible for the user and close to the device.
  - be for the respective device.
- Do not tap the supply voltage at the voltage transformers.
- Provide a fuse for the neutral conductor if the neutral conductor connection of the source is not earthed.

3.6 Connection variants Measurement inputs

The mains connection of the measuring device depends on the type of mains and the ambient conditions in which the measuring device is to be used.

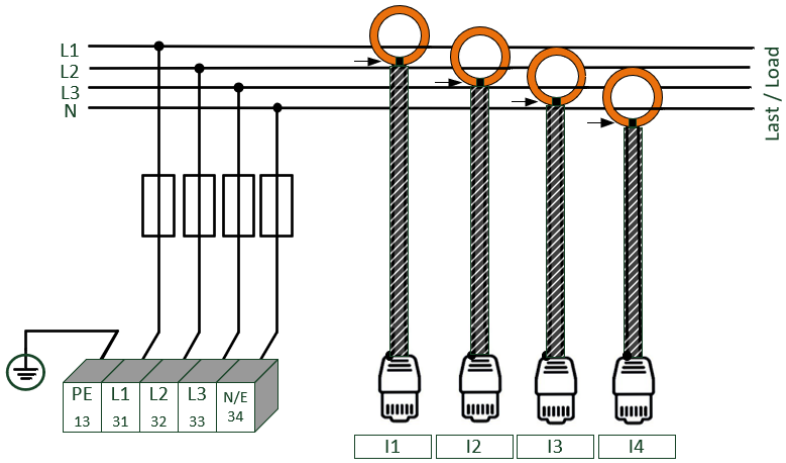
The PQI-LV is intended for direct measurement of voltage in the low voltage (3 phase / 4 conductor connection) for low voltage networks (TN-, TT- and IT networks) and for both residential and industrial applications.
A special form of low-voltage measurement is the 4-conductor / 1-phase connection measurement, which can be used to measure three independent voltage circuits and current circuits with the same earthing conditions.

The current is measured via sensor transformers with voltage output, which are connected via RJ45 with EMC protection. Either Rogowski coils or current transformers with mV outputs can be used. Switching between these two different types of current sensors is carried out in the measuring device via parameters.

⚠ WARNING! **Personal injury and property damage due to non-compliance with safety regulations**

- Please read this manual thoroughly before making any connections and follow the safety measures described here.

3.6.1 3-phase / 4-wire connection with 4 current transformers



Example: Connection of a PQI-LV in a three-phase - four-wire system

▶ Voltage connections

- The voltage connections must be made as shown in the circuit diagram above
- If there is no N conductor connection, connect connections E and N together.

▶ Current connections

The PQI-LV has sensor inputs with feature C46. The sensor inputs are designed as EMC-compliant RJ45 sockets for RJ45 plugs and can be operated either with Rogowski coils or classic current transformers with mV signal output. A parameter in the WebServer can be used to switch between integrated signal (Rogowski coil) or linear input signal (current transformer). The current transformer ratio is factory-set to nominal current (e.g. 350mV / kA). This must be adapted to the current transformer used. The appropriate transformers can be obtained from A.Eberle. The connection of transformers from other manufacturers is possible, provided that the described connection conditions (input range, impedance) are observed.

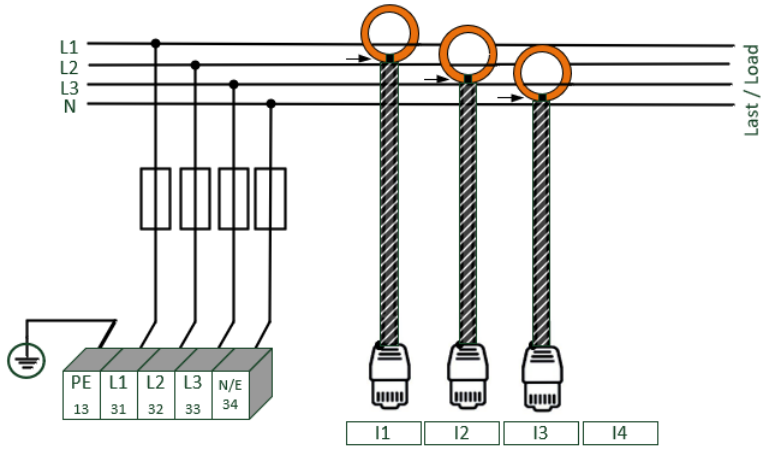
⚠DANGER! Danger to life due to electric shock

Attention dangerous contact voltage!

Flashover and high short-circuit currents in CAT III and CAT IV possible!

- ➲ Ensure that the PE conductor (earthing) is connected to the PQI-LV.
- ➲ Before starting work, check that there is no voltage!
- ➲ Provide protective devices for CAT II, CAT III or CAT IV.
- ➲ High-load fuses >10 kA or >50 kA must be used in accordance with the CAT.
- ➲ Short-circuit the current transformer before starting work.
- ➲ Ensure that all connecting cables are fixed and strain-relieved.
- ➲ All cable requirements of the terminal blocks must be observed (e.g. stripping length of the cables).

3.6.2 3-phase / 4-conductor connection without N conductor Current



PQI-LV without N conductor Current transformer in 4-wire connection

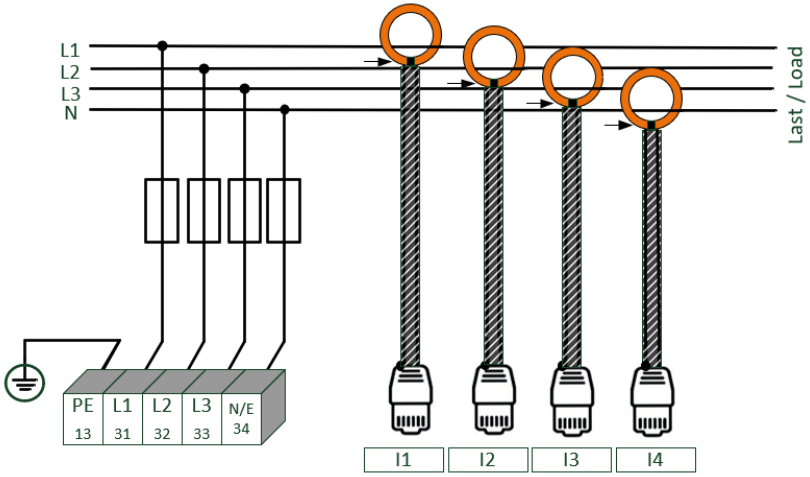
▶ Voltage connections

- If there is no N conductor connection, connect connections E and N together.
- Ensure that the switching mode (4-wire) is set. (Setting via web server or software, the settings are described in chapter 4.1 described)

▶ Current connections

With feature C46, the PQI-LV has switchable sensor inputs. The sensor inputs are designed as EMC-compliant RJ45 sockets for RJ45 plugs and can be operated either with Rogowski coils or classic current transformers with mV signal output. Parameters in the WebServer can be used to switch between integrated signal (Rogowski coil) or linear input signal (current transformer). The current transformer ratio is factory-set to nominal current (e.g. 350mV / kA). This must be adapted to the current transformer used. The appropriate transformers can be obtained from A.Eberle. The connection of transformers from other manufacturers is possible, provided that the described connection conditions (input range, impedance) are observed.

3.6.3 4-wire connection, 1-phase



PQI-LV in 4-wire connection -1 phase

In the 4-conductor system, 1-phase circuit type, no conductor-conductor events and three-phase system events are evaluated. Voltages with the same earth potential and any currents can be recorded.

⚠DANGER! **Danger to life due to electric shock**

Attention dangerous contact voltage!

Flashover and high short-circuit currents in CAT III and CAT IV possible!

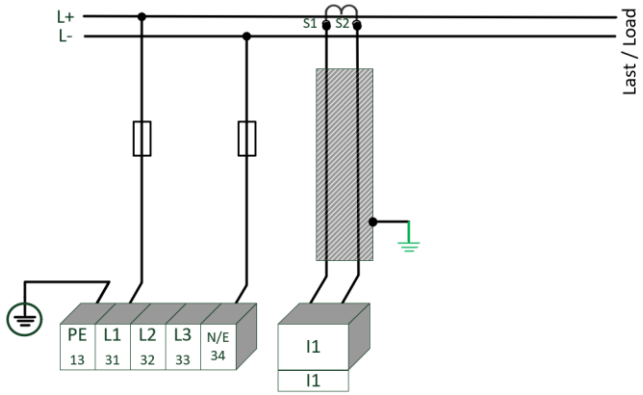
- ➲ Ensure that the PE conductor (earthing) is connected to the PQI-LV.
- ➲ Before starting work, check that there is no voltage!
- ➲ Provide protective devices for CAT II, CAT III or CAT IV.
- ➲ High-load fuses >10 kA or >50 kA must be used in accordance with the CAT.
- ➲ Ensure that all connecting cables are fixed and strain-relieved.
- ➲ All cable requirements of the terminal blocks must be observed (e.g. stripping length of the cables).

3.6.4 DC mains connection

With the aid of an active Hall sensor clamp for current measurement, the PQI-LV can also be used in DC networks under the following conditions.

When measuring DC voltage, a distinction must be made between symmetrically earthed and rigidly earthed systems.

- In the IT system with high-impedance centre grounding, the device is designed for measurements up to ± 600 V. Above ± 300 V, overvoltage protection is mandatory in order to comply with CAT III 600 V.
- In the TN-S system, the device is designed for measurements up to 600 V.



Example of PQI-LV connection with current transformer with small signal output DC mains

Depending on the feature, the device is suitable for direct acting current transformers (e.g. open-loop Hall-effect current transformers) with an analogue output voltage of up to ± 350 mV. The measurable bandwidth on the device is DC...20 kHz. Shielding of the signal lines is recommended but not absolutely necessary.

DANGER! **Danger to life due to electric shock**

Attention dangerous contact voltage!

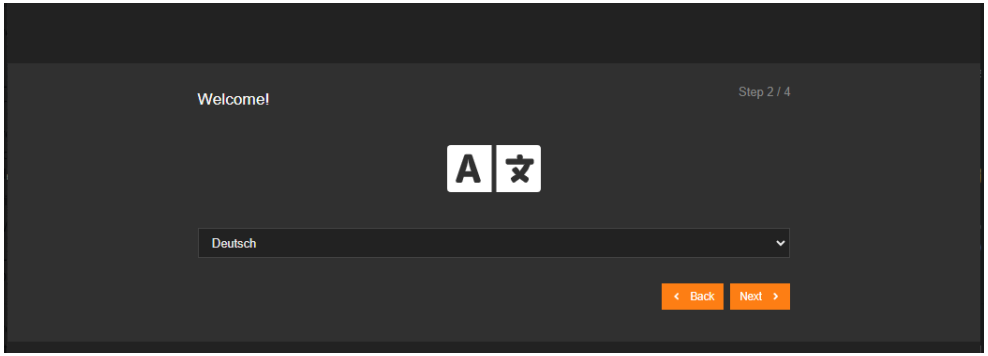
Flashover and high short-circuit currents in CAT III and CAT IV possible!

- ➲ Ensure that the PE conductor (earthing) is connected to the PQI-LV.
- ➲ Before starting work, check that there is no voltage!
- ➲ Provide protective devices for CAT II, CAT III or CAT IV.
- ➲ High-load fuses >10 kA or >50 kA must be used in accordance with the CAT.
- ➲ Ensure that all connecting cables are fixed and strain-relieved.
- ➲ All cable requirements of the terminal blocks must be observed (e.g. stripping length of the cables).

4. Operation of the PQI-LV

4.1 Commissioning wizard

When the PQI-LV power analyser is started for the first time, the device signals that initial commissioning still needs to be carried out by means of the flashing red status LED. For this purpose, the device has a web server that can be reached via the default IP address https://192.168.56.95 in the subnet 255.255.0.0. This requires a connection from any parameterisation PC to the measuring device using a patch cable.



The connected parameterisation PC must have a fixed IP address in the same subnet in order to reach the web server. If you have any questions about changing the IP address of your PC, please contact your IT department.

After logging in for the first time, the operator is guided through the initial commissioning of the measuring device. This wizard must be run once after the PQ measuring device has been fully connected. The wizard guides you through the commissioning process with direct explanations.

In general, commissioning is divided into several subsections, which can also be carried out one after the other by different groups of people in your company.

- Configuration of the communication settings (IP address / DHCP) to reach the device remotely
- Configuration of the users required for login on the web server
- Configuration of power quality parameters and measuring point settings such as transformer parameters and standard templates
-

It is recommended to run the wizard only after all connections have been completed to avoid incorrect measurement data being recorded due to non-existent measurement voltages, currents or parameters that have not been entered.

Measurement data is only recorded once the entire wizard has been completed and the PQI-LV has restarted!

4.2 Reset commissioning wizard

If you as the user no longer know the IP address or you want to start the wizard from the beginning, you can reset the device to the initial state by pressing the button for 7 seconds.

This resets all settings that have already been made within the guided wizard. The users, if any have already been created, are also deleted by this reset.

Reset procedure:

- The device is switched on and the commissioning wizard has not been completed
- Press and hold the button on the front of the housing for 7 seconds
- After the button is released, the device restarts
- You can now put the device back into operation. The device can be reached again via the address https://192.168.56.95 in the subnet 255.255.0.0.

The complete factory reset is described in chapter 4.4 is described.

4.3 LED states during commissioning wizard

During commissioning, the device has several statuses that are indicated by LEDs.

▶ **IP address configuration not completed:**

Status LED	Flashing red
Connection LED	Flashing red: link up
	Red: link down
Recording LED	Off

In this mode, the device can be reached via https://192.168.56.95 with subnet mask 255.255.0.0.

▶ **User & measuring point configuration not completed**

Status LED	Flashing red
Connection LED	Green: connection established.
	Red: link down
Recording LED	Off

In this mode, the device can be reached via the web server with the set connection parameters (IP address & subnet mask).

4.4 Reset device to factory settings

If the device status is unknown, the device can be reset to factory settings on site.

NOTE! **Material damage due to data loss!**

Resetting to factory settings deletes all measurement data and subsequent software licences. To avoid this, the following points must be observed

- ➲ Ensure that licences are stored securely
- ➲ Regularly back up measurement data from the device

The following procedure is required to reset the device:

- Disconnect the power supply to the device and wait until the LEDs go out.
- Press the button on the front of the device and restore the power supply.
- The button must remain pressed until all three LEDs flash yellow quickly, the button can then be released.
- The device starts booting from the internal recovery image. The status LED flashes red and green alternately: The image is being installed, wait at least 5 minutes.
- If the LED only flashes green, the update has been completed
- The device should restart automatically within the next 60 seconds. If this does not happen, briefly disconnect the power supply.

You can now put the device back into operation. The device can be reached again via the address https://192.168.56.95 in the subnet 255.255.0.0.

5. Technical data

5.1 General

Dimensions	
L x W x H	130 x 90 x 58 mm
Weight:	
Weight	298g

5.2 Electrical safety - Ambient conditions

Environmental parameters	Storage and transport	Operation
Ambient temperature: Limit operating range	IEC 60721-3-1 / 1K5 -40 ... +70°C IEC 60721-3-2 / 2K4 -40 ... +70°C	IEC 60721-3-3 / 3K6 -25 ... +55°C
Ambient temperature: Nominal operating range		IEC DIN EN 61010 H1: -25... +45°C H2: -25... +50°C
Relative humidity: 24 hour average No condensation or ice	5...95 %	5...95 %
Solar radiation	---	700 W/m2
Vibrations, earth tremors	IEC 60721-3-1 / 1M1 IEC 60721-3-2 / 2M1	IEC 60721-3-3 / 3M1

⚠ WARNING! **Personal injury and property damage due to non-compliance with safety regulations**

Overheating

- ➲ Risk of overheating and fire
- ➲ Observe the temperature resistance of the connection cables A fixation or strain relief for connection cables must be observed.

Mechanical damage

- ➲ Protection against mechanical damage must be guaranteed.

5.3 Power supply

Auxiliary voltage		
Feature	**H1**	**H2**
AC nominal range [V]	100...240	-
AC operating range [V]	90...264	-
DC nominal range [V]	150...340	24...110
DC operating range [V]	120...430	12...150
Power consumption	≤ 5 W < 7 VA	≤ 7 W
Frequency Nominal range	50...60Hz	DC
Frequency Operating range	40...70Hz	DC
External fuse Characteristic	6A B	6A B
Energy storage	2 sec	2 sec

5.4 Voltage inputs

Feature	
Channels	U_1 , U_2 , U_3 , $U_{N/E/4}$
Electrical safety DIN EN 61010	300V CAT IV 600V CAT III
Input reference	PE
Impedance -> PE	10 MΩ || 25pF
Nominal input voltage U_{nom}	230 V_{AC}
Measuring range end value	0...480 V_{AC} L-E
Waveform	Each AC / DC
Maximum crest factor @ U_{nom}	3
Bandwidth	DC...20 kHz
Rated mains frequency f_n	50 Hz / 60 Hz

5.5 Current inputs

Current sensor inputs (switchable)	
Full Scale Range (FSR)	0.35V_{AC} @ 50Hz
Input impedance	2MΩ
Input type	symmetrical
External sensors (switchable)	Rogowski coils, mini current clamps, transducers with mV output potential-free
Differential overload capacity, permanent	10V_{AC}
Common mode range	±15V
Measuring bandwidth	25Hz...20kHz

5.6 Interfaces

Interfaces	
Ethernet	RJ45 (10/100 Mbit)
COM via RJ45	RS485 / RS232

⚠ WARNING! **Personal injury and property damage due to non-compliance with safety regulations**

- ➲ All COM and LAN connection cables must not fall below the insulation distance to dangerous parts, even if they are disconnected.
- ➲ It must not be possible to release individual wires from the clamping.
- ➲ Pull the plugs directly by the plug housing, never by the cable.
- ➲ Fixing or strain relief for connection cables must be taken into account.

.

5.7 Electrical safety

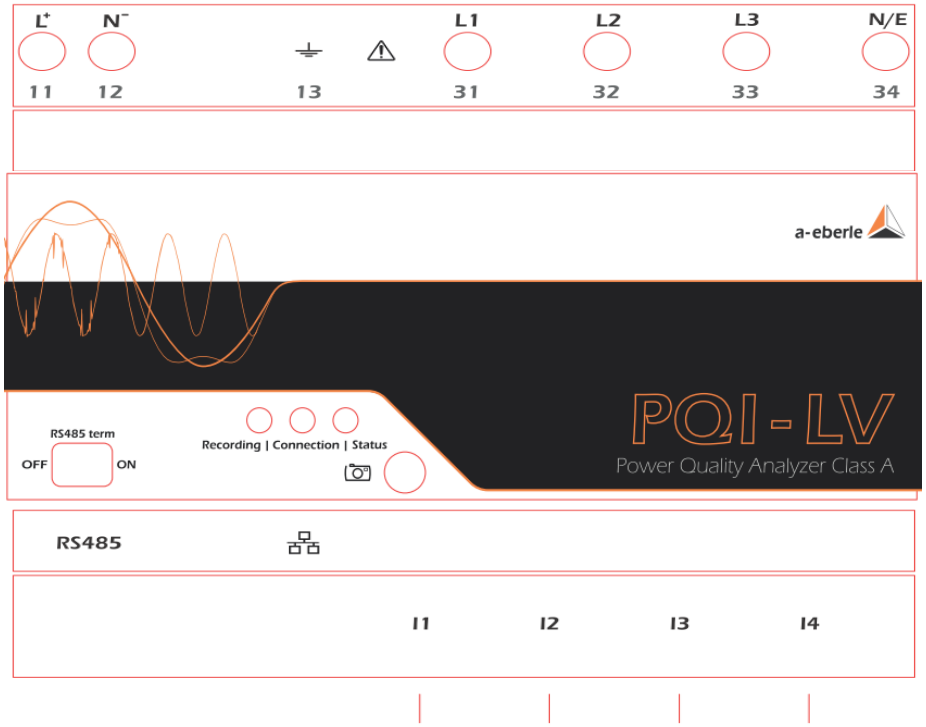
Electrical safety	
– IEC 61010-1 – IEC 61010-2-030	
Protection class	1
Pollution degree	2
Overvoltage category Mains supply option: H1 H2	 300 V / CAT II 150 V / CAT II
Measurement category	300 V / CAT IV 600 V / CAT III
Height	≤ 2000m
IP protection class	IP20

Electromagnetic compatibility
Immunity – IEC 61000-6-5, environment G
emissions – CISPR22 (EN 55022) , Class A

5.8 Connection / terminals

Please observe the safety guidelines and regulations in the "Connection" chapter!

Connection strip no.	Designation		Function	Terminal no.	Cross-section [mm²]	Stripping length in [mm]
X1	Auxiliary voltage	U_H	L (+)	11	0,75 - 1,5	6
			N (-)	12	0,75 - 1,5	6
X1	Reference potential (earth)	GND	E	13	1,5 - 2,5	8
X3	Phase voltage L1	U_1	L1	31	0,75 - 1,5	6
	Phase voltage L2	U_2	L2	32	0,75 - 1,5	6
	Phase voltage L3	U_3	L3	33	0,75 - 1,5	6
	Star point voltage	U_4	N	34	0,75 - 1,5	6
RJ45	Phase current L1	I1	I1	RJ45 AWG 23		
	Phase current L2	I2	II2	RJ45 AWG 23		
	Phase current L3	I3	I3	RJ45 AWG 23		
	Neutral conductor / total current	I4	I4 / N	RJ45 AWG 23		



⚠ WARNING! **Personal injury and property damage due to non-compliance with safety regulations**

- Provide protective devices (fuse) for CAT II.
- No mixing of touchable and dangerous active circuits.
- Connecting cables must be designed for a temperature of at least 62°C.
- Fixing or strain relief for connection cables must be taken into account.

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