Power quality analyser and fault recorder

Model: PQI-LV

- **as Din-Rail housing**
- **as wall-mounted housing**
- **as panel mounting enclosure**

1. Utilisation

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 low-voltage 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 values in three-phase grids.

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. In addition, the measuring device offers the option of recording up to 16 feeders via I-Sense technology, processing them and transferring them to the higher-level WinPQ and WebPQ software solution!

In addition to the option of standard evaluations in accordance with EN50160, the *PQI-LV* also has a high-speed disturbance recorder with a recording rate of 40.96 kHz / 10.24 kHz and a 10 ms RMS value recorder via an additional licence S1. This enables a detailed analysis of grid faults.

Modern power quality measuring devices work in accordance with the IEC 62586 standard, which describes the complete product characteristics of a power quality analyser. In addition to the intended use, the EMC environment and the ambient conditions, this standard also defines the exact measurement methods (IEC 61000-4-30 - Class A) in order to create a comparable basis for the user.

According to IEC 62586, the *PQI-LV is* a class **PQI-A-FI-G** device.

The measuring device and its development are subject to strict security requirements due to the area of application in critical infrastructure.

With regard to this, active patch management, encrypted communication standards and user rights management (URM as RBAC) via RADIUS are available in the device! This also includes signed firmware updates, security audit logging and active protection against brute force attacks. All this contributes to secure operation in your KRITIS environment!

The *PQI-LV* fulfils the requirements of IEC 61000-4-30:2015 Ed 3 +A1:2021 for Class A measuring devices for 100% of the parameters.

Parameter IEC61000-4-30	Class
Frequency	A
Magnitude of the Supply Voltage	A
Flicker	A
Voltage dips or swells	A
Voltage interruptions	A
Voltage unbalance	A
Voltage harmonics	A
Voltage interharmonics	A
Mains signalling voltage on the supply voltage	A
Underdeviation and overdeviation	A
Clock uncertainty testing	A
Flagging	A
Variations due to external influence quantities	A

2. Layout

The *PQI-LV* was developed for measurements in public grids and measurements in industrial environments with up to 690V (phase / phase) measurement voltage.

- Device for the top-hat rail
- No moving parts (fan, hard drive)
- CAT IV
- Parameterisation via WebServer
- **Optional: "Modbus Master" (P3)**
  Recording of external Modbus signals / Feeders with I-Sense
- **Optional: "Fault recorder " (S1)**
- Voltage and current oscillograph Sampling frequency: 40.96kHz / 10.24kHz with powerful trigger release
- **Optional: "IEC61000-4-7 - 2 kHz to 20 kHz" (B1)**
- Frequency measurement of voltage and current in accordance with IEC 61000-4-7 from 2 kHz to 20 kHz.
- **Optional: "Data format PQDIF" (F1)**
- Open data exchange format in accordance with IEEE1159-3 via MMS / IEC61850 (feature P2) or REST API / HTTPS

2.1 Features of the Power-Quality Interface *PQI-LV*

2.1.1 Technical Data

- WebServer for basic configuration on the device
- 1 GB internal memory
- Input channel bandwidth 20 kHz
- 4 voltage inputs
  Measuring range end value: 480V L-N,
  Accuracy < 0.1%
- 4 current sensor inputs for Rogowski coils or mini current clamps
- Simultaneous processing of sampled and calculated voltages and currents
- IEC 61000-4-30, Class A measurement data processing
- Recording of power quality incidents in accordance with DIN EN 50160; IEC61000-2-2; -2-12; -2-4.
- Energy buffer for grid interruptions of up to 2 seconds
- Spectral analysis 2 kHz...20 kHz, (90 frequency bands, BW = 200Hz) of voltages and currents according to (IEC 61000-4-7) (feature B1)
- Voltage and current harmonics n=2..50
- EDGE function with 32 freely parameterisable monitoring states for monitoring and triggering all measured variables – output via protocol for control tasks on site!
- Free evaluation software WinPQ lite

Communication Protocols
– MODBUS RTU (Master & Slave)
– MODBUS TCP
– IEC60870-5-104 (option P1)
– IEC61850 (option P2)
– Modbus Master / Modbus Gateway for I-Sense - current feeder measurement (option P3)

Time synchronisation Protocols
– IEEE1344 / IRIG-B000..007
– DCF 77
– NTP

Interfaces:	
Ethernet	RJ45 (10/100 Mbit)
RS485	UART (Modbus)

Dimensions	
L x W x H	130 x 90 x 58 mm

Weight:	
Weight	298g

Voltage inputs	
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 VAC
Measuring range end value	0...480 V_{AC} L-E
Overload capacity, permanent	600V_{AC}
Maximum crest factor @ U_{nom}	3
Bandwidth	DC...20 kHz
Rated mains frequency f_n	50 Hz / 60 Hz
Frequency range of the fundamental	f_n ± 15 % 42.5..50..57.5 Hz 51.0..60..69.0 Hz

Accuracy	
Fundamental frequency, r.m.s. $U_1 \leq 150\%\ U_{nom}$ 0°C ≤ T_A ≤ +45°C: -25°C ≤ T_A ≤ +55°C:	 ±0.1% v. U_{nom} ±0.2% of U_{nom}
Fundamental frequency, phase $U_1 \geq 10\%\ U_{nom}$:	±0.02°
Harmonics n = 2...50, r.m.s. $U_h \geq 1\%\ U_{nom}$: $U_h < 1\%\ U_{nom}$:	 ±5.0% v. U_h ±0.05% of U_{nom}
Harmonics n = 2...50, phase $U_h \geq 1\%\ U_{nom}$:	 ±0.5°
Interharmonics n = 1...49, r.m.s. $U_{ih} \geq 1\%\ U_{nom}$: $U_{ih} < 1\%\ U_{nom}$:	 ±5.0% v. U_h ±0.05% of U_{nom}
Mains frequency	±1 mHz @ 10 %...200 % U_n
Flickermeter DIN EN 61000-4-15:2011	Class F1
Dip residual voltage	±0.2 % U_n @ 10 %..100 % U_n
Dip duration	±20 ms @ 10 %..100 % U_n
Swell residual voltage	±0.2 % U_n @ 100 %..150 % U_n

Voltage inputs	
Swell duration	±20 ms @ 100 %..150 % U_n
Interruption duration	±20 ms @ 1 %..100 % U_n
Voltage unbalance	±0.15 % @ 1 %..5 % measured value
Ripple control voltage (< 3kHz)	±5% of the measured value @ Us = 3%..15% U_n ±0.15 % U_n @ Us = 1 %..3 % U_n

Current sensor inputs (switchable)	
Full Scale Range (FSR)	0.35V_{AC} @ 50Hz
Input impedance	2MΩ
Input type	symmetrical
External sensors (switchable)	Rogowski coil, mini current clamp potential-free
Differential overload capacity, permanent	10V_{AC}
Common mode area	±15V
Measuring bandwidth	25Hz...20kHz
Fundamental frequency, r.m.s. $I_1 \geq 10\%$ FSR: $I_1 < 10\%$ FSR:	 ±0.2% of I_1 ±0.02% of FSR
Fundamental frequency, phase $I_1 \geq 10\%$ FSR:	 ±0.2°
Harmonics n = 2...50, r.m.s. $I_h \geq 1\%$ FSR: $I_h < 1\%$ FSR:	 ±5.0% of I_h ±0.05% of FSR
Harmonics n = 2...50, phase $I_h \geq 1\%$ FSR:	 ±1.0°
Interharmonics n = 1...49, r.m.s. $I_{ih} \geq 1\%$ FSR: $I_{ih} < 1\%$ FSR:	 ±5.0% of I_{ih} ±0.05% of FSR

Storage of the measured data	
Internal memory	1024 MB = 130 weeks

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

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

Environmental parameters	Storage and transport	Operation
Ambient temperature: Limit range of operation	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 -25 ... +45°C H1 -25 ... +50°C H2
Relative humidity: 24 hour average No condensation or ice	5...95 %	5...95 %
Solar radiation	---	700W/m2
Vibrations, earth tremors	IEC 60721-3-1 / 1M1 IEC 60721-3-2 / 2M1	IEC 60721-3-3 / 3M1

According to **IEC61557-12**, the PQI-LV corresponds to a PMD type III of class PMD -SD according to table 2 (indirect current measurement, direct voltage measurement) for low voltage or PMD SS (indirect current measurement, indirect voltage measurement) in climate category K55.

Thus a marking according to IEC61557-12 is possible for the measuring device as follows:

PMD SD / K55 / 0.2

PMD SS / K55 / 0.2

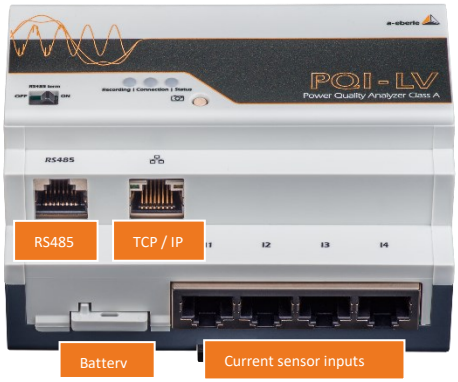
Herewith the PQI-LV fulfils the following accuracies:

Measured variable	C46	With current clamp Class 0.5	With current clamp Class 1
Energy	0.2	< 1	< 2
Active power	0.2	< 1	< 2
Reactive energy	< 2	< 2	2
Reactive power	< 1	1	< 2
Apparent energy	0.2	< 1	< 2
Apparent power	0.2	< 1	< 2
Frequency	< 0.02		
Phase current	0.1	< 1	< 2
Measured IN	< 0.2	< 1	< 2
Calculated IN	0.1	< 1	< 2
Voltage	0.1		
Power factor	< 0.5	< 1	< 2
Flicker	5		
Dips and swells	< 0.5		
Voltage interruption	0.5		
Voltage unbalance	0.2		
Voltage harmonics	1		
Distortion factor of the voltage	1		
Current unbalance	0.2	< 1	< 2
Current - Harmonics	1	< 2	2
THDI	1	1	1

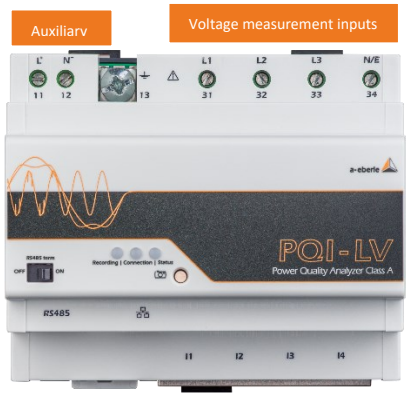
2.1.2 Mechanical layout

The *PQI-LV* can be used both as din rail device or wall mounting and as a panel-mounted device using an adapter. The voltage connections and the auxiliary voltage are accessible from above via screw terminals. All other connections such as current sensors and RS485 are designed as RJ45 sockets to simplify EMC-compliant connection from below. An RJ 45 connection (LAN) is also available for the TCP/IP interface.

Front view

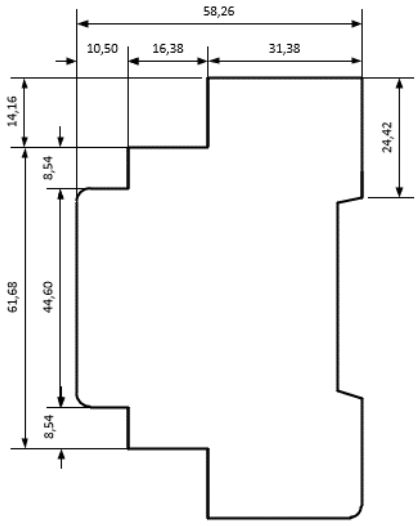


Bottom view PQI-LV

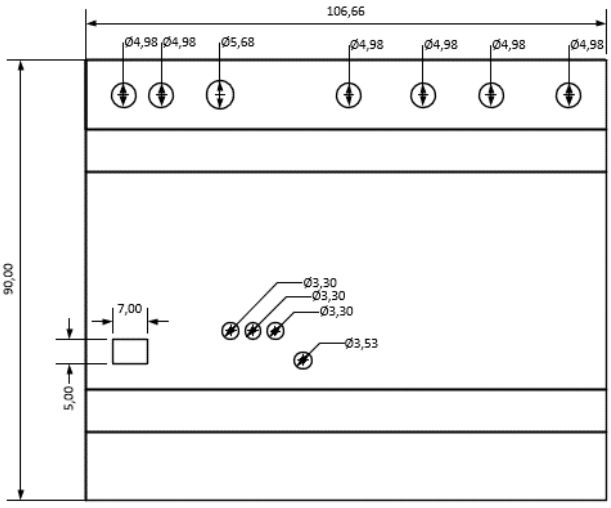


Top view PQI-LV

2.1.3 Dimensions



Sideview



Frontview

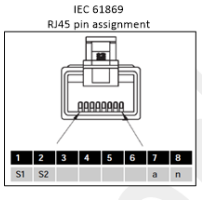
2.1.4 Terminal designations PQI-LV

Connection strip no.	Designation		Function	Terminal no.
X1	Auxiliary voltage	U_H	L (+)	11
			L (-)	12
X1	Reference potential (earth)	GND	E	13
X3	Phase voltage L1	U_1	L1	31
	Phase voltage L2	U_2	L2	32
	Phase voltage L3	U_3	L3	33
	Neutral point voltage	U_4	N	34
X6	Phase current L1 (mV Input)	I1	I1	RJ45
	Phase current L2 (mV Input)	I2	I2	RJ45
	Phase current L3 (mV Input)	I3	I3	RJ45
	Neutral conductor / total current	I4	I4	RJ45

2.1.4.1 Sensor Current Inputs – RJ45

Current inputs are designed as follows in accordance with IEC61689. Suitable accessories can be found in chapter 3.2.

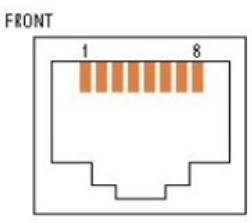
Pin assignment RJ45 - Current	
Pin 1	S1
Pin 2	S2

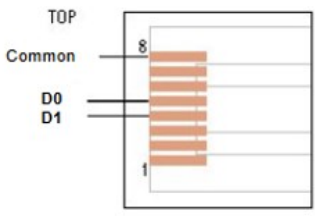


2.1.4.2 RS485 – Modbus – RJ45

The RS485 Modbus interface is designed according to the 2W Modbus standard for RJ45 interfaces as follows:

Pin assignment RJ45 - Modbus	
Pin 4	RS485 Pos (A)
Pin 5	RS485 Neg (B)
Pin 8	Common





2.2 Device Operation

2.2.1 On-site display and controls

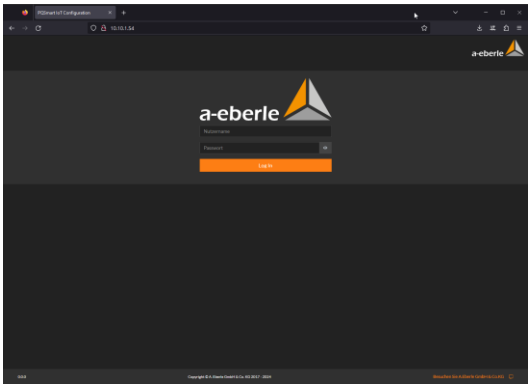
The device has a **button on the** front and **three LED** indicator which represent the status of the device

- **Status LED**
- **Connection LED**
- **Recording LED**
- **Control button / trigger button**

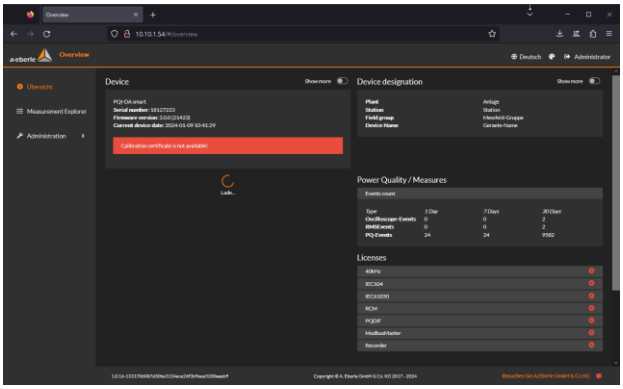
2.3 WebServer & Software

The PQI-LV device has a WebServer for parameterisation and online data visualisation via which the most necessary settings can be made locally and live data for connection testing can be visualised. Compatibility with the WinPQ lite software for offline configuration and offline analysis is also guaranteed. The device also integrates seamlessly into the WinPQ and WebPQ Visualiser software.

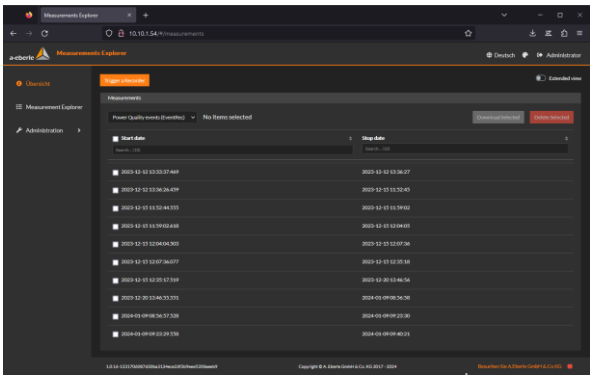
Examples of the Webpages:



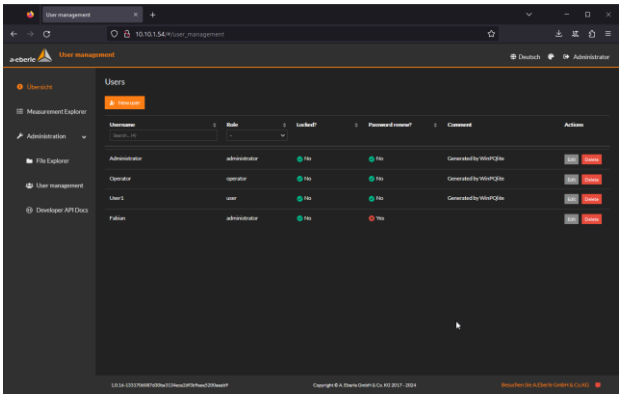
Login Screen



Overview page



Measurement data Explorer



User Management

2.4 Measurement / Functions

The *PQI-LV* is compatible with the following standards:

EN50160:2022/ IEC61000-2-2 / IEC61000-2-4 (Class 1; 2; 3) / NRS048 / IEEE519 / IEC61000-4-30 Class A Ed 3/ IEC 61000-4-7 / IEC61000-4-15 / IEEE1159-3

Permanent recording:

Five fixed and two variable measuring time intervals are available for permanent recording:

10/12 T (200ms), 1 sec, n*sec, 150/180 T (3sec), n*min, 10 min, 2 hrs.

Time Interval Voltage	10/ 12T	150/ 180T	10 min	2 h	1 s	10s	N* s	N* min
PQDIF			✓	✓		✓		
Power frequency	✓	✓	✓	✓	✓	✓	✓	✓
Extremes, standard deviation of power frequency (10s)			✓			✓		
r.m.s. values (IEC61000-4-30)	✓	✓	✓	✓	✓		✓	✓
Extremes, standard deviation of T/2-values			✓					
Underdeviation [%] , Overdeviation [%] (IEC61000-4-30)	✓	✓	✓	✓				
Harmonic subgroups n= 0..50 (IEC61000-4-7)	✓	✓	✓	✓				
Maximum values of 10/12 T harmonic subgroups n = 2..50			✓					
Interharmonic subgroups n=0..49 (IEC61000-4-7)	✓	✓	✓	✓				
Total Harmonic Distortion (THDS) (IEC61000-4-7)	✓	✓	✓	✓	✓		✓	✓
Partial Weighted Harmonic Distortion (PWHD)	✓	✓	✓	✓	✓		✓	✓
Unbalance, negative-/positive- sequence , sequence sign	✓	✓	✓	✓	✓		✓	✓
Unbalance, zero-/positive- sequence	✓	✓	✓	✓	✓		✓	✓
Positive-, negative-, zero sequence phasors	✓	✓	✓	✓	✓		✓	✓
Phasors (fundamental)	✓	✓	✓	✓	✓		✓	✓
Flicker (IEC61000-4-15)			✓	✓				
Instant flicker (IEC61000-4-15)	✓		✓					
Mains signalling voltages [%] (IEC61000-4-30)	✓	✓						
Phase angle(zero crossings) of phase voltage harmonics n=2..50 to fundamental of reference voltage	✓	✓	✓	✓				
Frequency bands 1..90 , 2kHz..20kHz, r.m.s. (IEC61000-4-7)			✓	✓	✓		✓	✓

Time Interval Current	10/ 12T	150 /180T	10 min	2 h	1 s	N* s	N* min
PQDIF			✓	✓			
r.m.s. values	✓	✓	✓	✓	✓	✓	✓
Extremes of T/2-values			✓				
Harmonic subgroups n= 0..50 (IEC61000-4-7)	✓	✓	✓	✓			
Maximum values of 10/12 T harmonic subgroups n = 2..50			✓				
Interharmonic subgroups n=0..49 (IEC61000-4-7)	✓	✓	✓	✓			
Total Harmonic Distortion (THDS) (IEC61000-4-7)	✓	✓	✓	✓	✓	✓	✓
Total Harmonic Currents	✓	✓	✓	✓	✓	✓	✓
Partial Weighted Harmonic Distortion (PWHD)	✓	✓	✓	✓	✓	✓	✓
Partial Odd Harmonic Currents (PHC)	✓	✓	✓	✓	✓	✓	✓
K-Factors	✓	✓	✓	✓	✓	✓	✓
Unbalance, negative-/positive- sequence , sequence sign	✓	✓	✓	✓	✓	✓	✓
Unbalance, zero-/positive- sequence	✓	✓	✓	✓	✓	✓	✓
Positive-, negative-, zero sequence phasors	✓	✓	✓	✓	✓	✓	✓
Phasors (fundamental)	✓	✓	✓	✓	✓	✓	✓
Phase angle(zero crossings) of current harmonics n=2..50 to fundamental of reference voltage	✓	✓	✓	✓			
Frequency bands 1..90 , 2kHz..20kHz, r.m.s. (IEC61000-4-7)			✓	✓	✓	✓	✓

Time Interval Energy	10 min	2 h	1 s	N* s	N* min
PQDIF	✓	✓			
Active energy, phase	✓	✓	✓	✓	✓
Active energy, total	✓	✓	✓	✓	✓
Exported active energy, phase	✓	✓	✓	✓	✓
Exported active energy, total	✓	✓	✓	✓	✓
Imported active energy, phase	✓	✓	✓	✓	✓
Imported active energy, total	✓	✓	✓	✓	✓
Reactive energy (inductive), phase	✓	✓	✓	✓	✓
Reactive energy (inductive), total	✓	✓	✓	✓	✓
Exported reactive energy (inductive), phase	✓	✓	✓	✓	✓
Exported reactive energy (inductive), total	✓	✓	✓	✓	✓
Imported reactive energy (inductive), phase	✓	✓	✓	✓	✓
Imported reactive energy (inductive), total	✓	✓	✓	✓	✓
Total apparent energies, phase& total	✓	✓	✓	✓	✓
Export apparent energies, phase & total	✓	✓	✓	✓	✓
Import apparent energies, phase & total	✓	✓	✓	✓	✓
Distortion reactive energies, phase & total	✓	✓	✓	✓	✓

Time Interval Power	10 min	2 h	1 s	N* s	N* min
PQDIF	✓	✓			
Active power, phase	✓	✓	✓	✓	✓
Active power, total	✓	✓	✓	✓	✓
Active power extremes	✓				
Reactive power, phase	✓	✓	✓	✓	✓
Reactive power, total	✓	✓	✓	✓	✓
Reactive power extremes	✓				
Apparent power, phase	✓	✓	✓	✓	✓
Apparent power, total	✓	✓	✓	✓	✓
Fundamental active power, phase	✓	✓	✓	✓	✓
Fundamental active power, total	✓	✓	✓	✓	✓
Fundamental reactive power, phase	✓	✓	✓	✓	✓
Fundamental reactive power (displacement), total	✓	✓	✓	✓	✓
Fundamental apparent power, phase	✓	✓	✓	✓	✓
Phase angle of fundamental apparent power, phase	✓	✓	✓	✓	✓
Fundamental apparent power, total	✓	✓	✓	✓	✓
Phase angle of fundamental apparent power, total	✓	✓	✓	✓	✓
Reactive distortion power, phase	✓	✓	✓	✓	✓
Reactive distortion power, total	✓	✓	✓	✓	✓
Active power factors, phase, total	✓	✓	✓	✓	✓
Reactive power factors, phase, total	✓	✓	✓	✓	✓
COSφ + sign, phase, total	✓	✓	✓	✓	✓
SINφ + sign, phase, total	✓	✓	✓	✓	✓
COSφ + sign of reactive distortion power, phase, total	✓	✓	✓	✓	✓
Capacitive-, inductive scaling factor of COSφ (-1..0..+1) :	✓	✓	✓	✓	✓
tanφ (L+), Phase, total on imported inductive reactive energy	✓		✓	✓	✓
tanφ (C-),Phase, total on exported capacitive reactive energy	✓		✓	✓	✓
tanφ (L-),Phase, total on exported inductive reactive energy	✓		✓	✓	✓
tanφ (C+),Phase, total on imported capacitve reactive energy	✓		✓	✓	✓
Triggered interval mean active power, phase					
Triggered interval mean active power, total					
Triggered interval mean reactive power, phase					
Triggered interval mean reactive power, total					

2.5 Disturbance Fault Recorder (Option: S1)

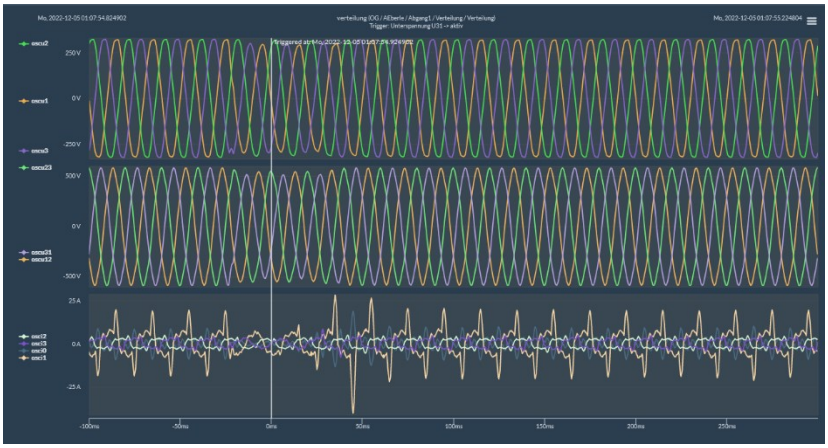
The PQI-LV device can be upgraded with the fault recorder option with feature S1!

2.5.1 Oscillograph

Sampling rate: 40.96kHz / 10.24kHz / 1.024kHz

Max. Recording length: 4sec (40.96kHz) / 16sec (10.24kHz) / 160sec (1.024kHz)

Measured variable	
3-wire system	**4-wire system**
Phase-earth conductor voltages	Phase-neutral voltages
Residual voltage	Neutral conductor earth voltages
Phase-phase voltages	
Phase currents	
Total current	Neutral conductor current

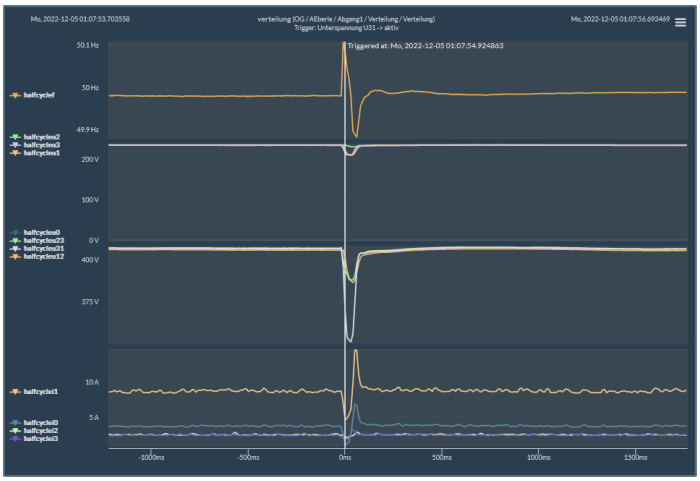


2.5.2 Half-wave recorder

Recording rate: ~10ms (50Hz) or ~8.333ms (60Hz)

Max. Recording length: 6min (50Hz) or 5min (60Hz)

Measured variable
Mains frequency
Effective voltages (RMS)
RMS currents (RMS)
Active power, phase
Reactive power, phase
Active power, total
Total fundamental reactive power
Phase angle of the fundamental apparent power, total
Phase angle Voltages (fundamental)
Phase angle currents (fundamental)
Positive, negative, zero sequence voltage pointer
Positive, negative, zero sequence current pointer



2.5.3 Trigger Options

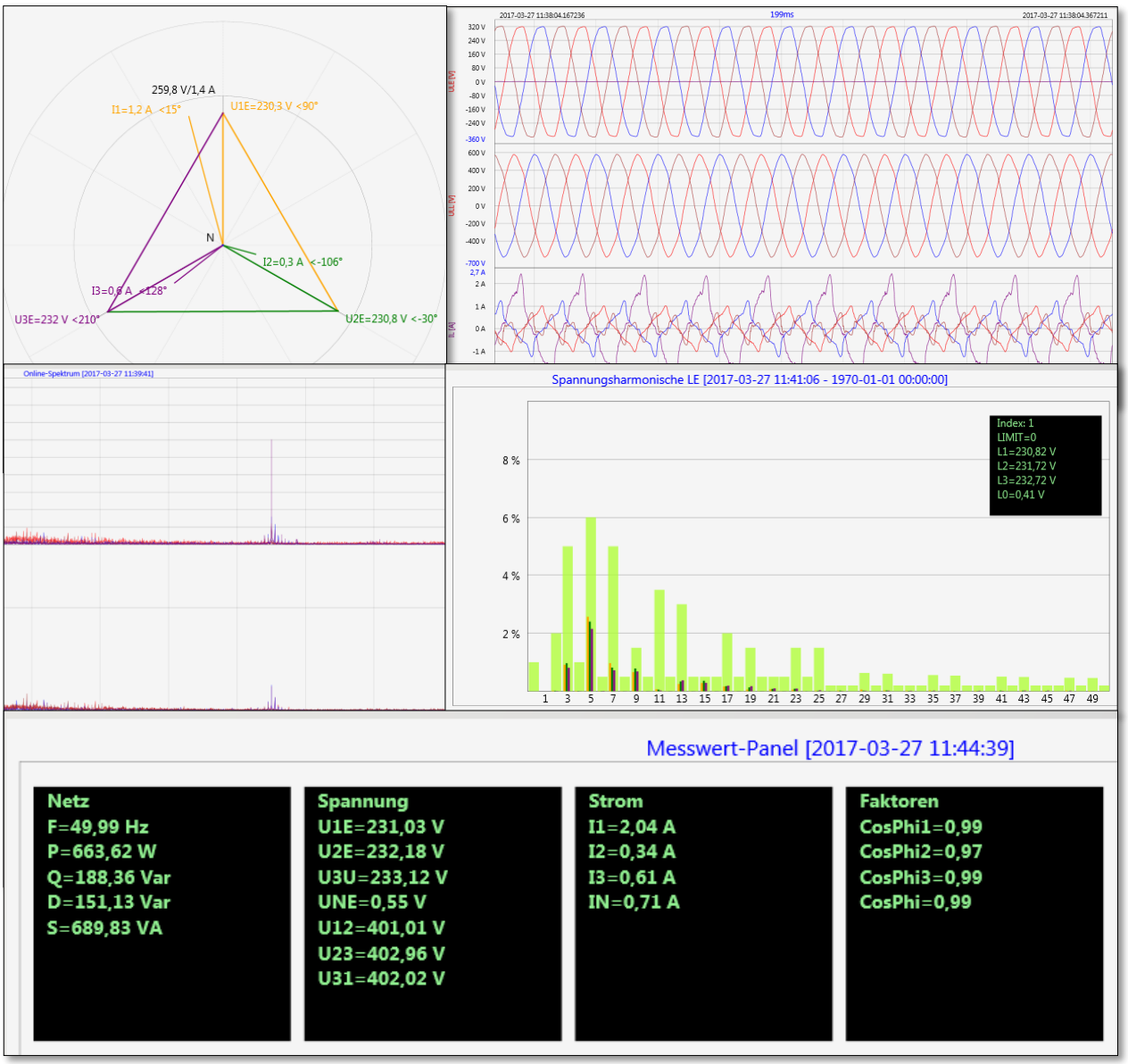
Trigger release	below	upper	Step
(RMS) Phase voltages (T/2)	✓	✓	✓
(RMS) Phase-phase voltages (T/2)	✓	✓	✓
(RMS) Residual/neutral earth conductor voltage (T/2)		✓	✓
Positive sequence voltage (T/2)	✓	✓	
Negative sequence voltage (T/2)		✓	
Zero sequence voltage (T/2)		✓	
Phase voltage Phase (T/2)			✓
Phase voltage waveforms (envelope triggers)	+/- Threshold value		
Phase-phase voltage waveforms (envelope triggers)			
Residual/neutral earth conductor voltage waveform (envelope trigger)			
Effective value (RMS) Phase currents (T/2)	✓	✓	✓
Effective value (RMS) (total/neutral conductor current (T/2)		✓	✓
Mains frequency (T/2)	✓	✓	✓
Binary inputs (debounced)	Rising, falling edge		
Command	external		
32 Monitoring states	✓	✓	

2.6 PQ events

Number of releases	below	upper
Voltage dip (T/2)	✓	
Voltage swell (T/2)		✓
Voltage interruption (T/2)	✓	
Rapid voltage change (T/2)	Filter for moving average Mean +/- threshold value	
Voltage change (10min)	✓	✓
Voltage unbalance (10min)		✓
Mains ripple control voltage (150/180T)		✓
Voltage harmonics (10min)		✓
Total harmonic distortion (THD) (10min)		✓
Short-term voltage fluctuations PST (10min)		✓
Long-term voltage fluctuations PLT (10min)		✓
Mains frequency (10s)	✓	✓

2.7 Online mode for direct readout:

Measurement / Functions
Oscillograph (feature S1)
Phasor diagram
Voltage and current harmonics n=2..50
Voltage and current interharmonics n=0..49
Voltage and current harmonics 2-9kHz (option B1)
Frequency spectra up to 20kHz of voltages and currents (feature S1)
Online streaming of all data classes and all measured values



3. Ordering information *PQI-LV*

The following applies to the determination of the order details:

- Only one of the identifiers with the same capital letter may be selected.
- If the capital letters of the identifier are followed by the number 9, additional information in plain text is required.
- If the capital letters of the identifier are followed only by zeros, this identifier can be omitted from the order details.

Features	Identifier
PQI-LV, permanently installed power quality analyser and power meter as DIN rail device for low-voltage networks in accordance with IEC 61000-4-30, Class A - Ed 3 certified for reports in accordance with EN 50160, IEEE 519 and IEC 61000-2-2/2-4; **4 voltage inputs 230V / 400V / 690V 10MOhm** (CAT IV 300V); **4 sensor current inputs for mini current clamps (0.5 VAC) or Rogowski coils (switchable**); Sampling rate 10.24 kHz / 40.96 kHz (optional); intelligent memory for 144 weeks of recording; Webserver, 1 x Ethernet RJ45; 1 x / RS485 (RJ45) interface, Modbus RTU & TCP/IP; documentation included; calibration certificate; free software WinPQ lite and operating instructions	PQI-LV
Supply voltage	
● AC 90 V..110 V..264 V or DC 120 V..220 V..430V	H1
● DC 12V...60 V...150V	H2
Option IEC61000-4-7 (40.96kHz sampling rate)	
● 10.24kHz sampling rate; without 2kHz to 20 kHz measurement	B0
● Frequency measurement of voltage and current from 2 kHz to 20 kHz Oscillograph with 40.96 kHz sampling rate	B1
Option Communication protocol	
● Modbus RTU & TCP	P0
● IEC 60870-5-104 (RJ45)	P1
● IEC61850 (RJ45)	P2
● Modbus master for I-Sense current feeder measurement and recording	P3
Option Disturbance Fault Recorder	
● Without Disturbance fault recorder (DFR)	S0
● With Disturbance fault recorder (DFR) Voltage and current waveform a sampling frequency: 40.96kHz / 10.24kHz and TRMS recorder with powerful trigger opportunities	S1
Option Data format	
● Without PQDIF export function according to IEEE1159-3	F0
● With PQDIF export function in accordance with IEEE1159-3 Data transfer via feature P2 - IEC61850 / MMS or REST API	F1
● German	G1
● English	G2

3.1 Software Options PQI-LV

Software WinPQ lite	Identifier
Software WinPQ lite ● for parameterising the PQI-LV and for reading out the PQI-LV measurement data and online data as a single user licence **- free of charge**	
Software WinPQ	Identifier
Software WinPQ For parameterisation, archiving and evaluation of PQI-D, PQI-DA, PQI-LV and PQI-DE measurement data with the following basic functions: ● 32-bit/64-bit Windows program interface ● Database for storing the measured values for each measuring point Data access via TCP/IP network ● Visualisation option for all measured variables that can be called up by a PQI-D, PQI-DA, PQI-LV and PQI-DE as a function of time and as a statistical variable ● Automatic reporting in accordance with EN50160 ; IEC61000-2-2 / 2-4; IEEE519 ● Automatic export functions (Comtrade, PQDif (IEEE1159-3), ASCII, PDF) and fault record dispatch ● An additional workstation licence for one Windows user is included in the price	WinPQ
Licences	
● as a single user licence for 2 PQ measuring devices (PQI-D(A), PQI-LV, PQI-DE)	L0
● as a single user licence for 2 to 10 PQ measuring devices (PQI-D(A), PQI-LV, PQI-DE)	L1
● as a single user licence for > 10 PQ measuring devices (PQI-D(A), PQI-LV, PQI-DE)	L2
● as a single user licence for > 100 PQ measuring devices (PQI-D(A), PQI-LV, PQI-DE)	L3

3.2 PQI-LV Accessories

PQI-LV Accessories	Identifier
Top-hat rail for wall mounting	564.0433
Rogowski coil 1000A, 1~, diameter 9cm, 3m connection cable, for PQI-LV with 330mV output on RJ45 plug	111.7087.06

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