Comprehensive instrument for power quality monitoring in electric mains



Power quality monitoring is frequently only considered after equipment failures, plant breakdowns, process interruptions or communication failures. Continuous monitoring analyses breakdowns immediately and eliminates their causes in a sustainable manner. In addition, long-term acquisition permits the early recognition of changes in order to improve supply security and thus system availability.

The products of the LINAX PQ3000, PQ5000 and PQ5000-RACK series are independently certified Class A measurement devices according to IEC 61000-4-30 Ed. 3. They provide reliable and comparable information for regulatory authorities, negotiations with energy suppliers or internal quality control.

The LINAX PQ1000, as a more cost-effective class S device, is designed to be used within facilities, where the primary concern is ensuring energy availability and efficiency as well as trouble-free operation. In various designs, it provides all the data required for monitoring the Demand Side Power Quality (DSPQ).

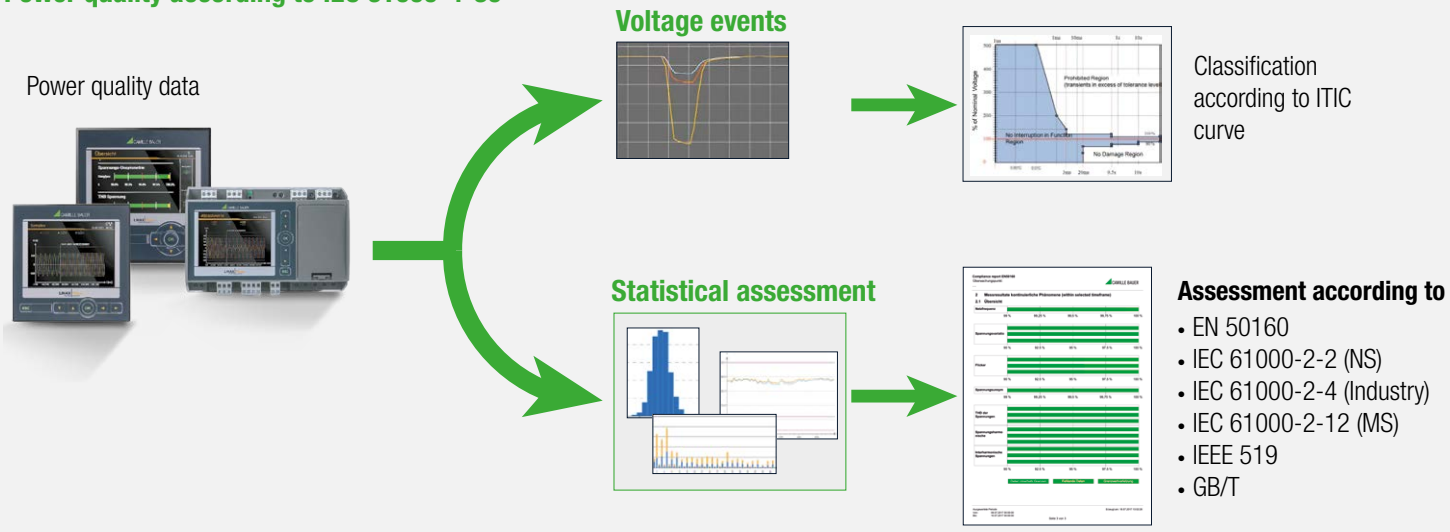
The consistent, flexible and software-free approach of all PQx000 devices excels both in autarchy and flexible integration options in software systems. It is based on standardised interfaces, generates conformity reports directly via the device website and excels with a comprehensive cyber security concept.

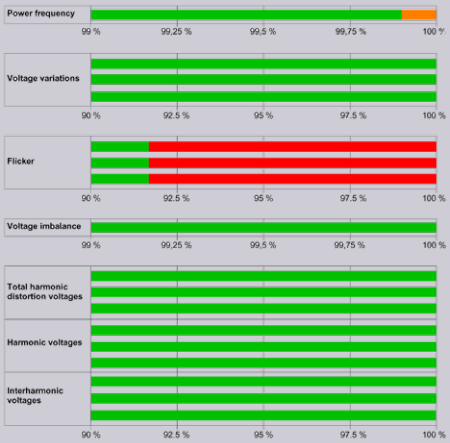
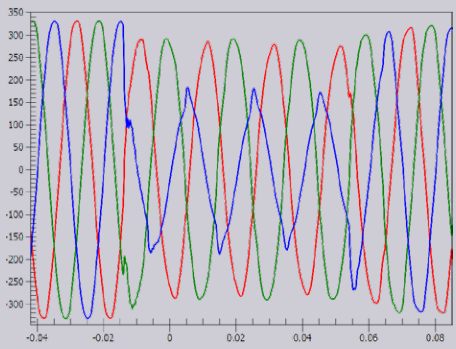
AVOIDING POWER QUALITY PROBLEMS - THROUGH CONTINUOUS MONITORING

Disruptions of the energy supply may result in production or equipment outages. Often people do not react until great financial damage has been caused. Yet, many of these incidents could be avoided if the signs were recognised in the continuous monitoring of the situation.

Any power quality monitoring provides both trend analyses for statistical PQ assessment permitting a comparison with standards (e.g. EN 50160) or supply contracts and recording of grid events (e.g. voltage dip) to enable the analysis of causes and consequences.

Power quality according to IEC 61000-4-30



POWER QUALITY EVALUATION	DESCRIPTION	BENEFIT
Statistical evaluation 	Relevant supply voltage parameters are monitored, statistically averaged and compared to the limit values of a standard or specified values. This way, one can either prove compliance or call attention to possible problems. In addition to the voltages, also magnitude, harmonic content and unbalance of currents are recorded. But, a statistical evaluation is carried out only if corresponding limit values exist, for example for harmonics in IEEE 519.	Verification of the compliance with standards (e.g. EN 50160) or contracts between energy suppliers and energy consumers. Users may adapt the specified values as they desire. By observing changes in the results, one can detect any deterioration of power quality early on and identify the causes. Introduced improvements can be verified immediately.
Recording of malfunctions 	All voltages are monitored for disturbances, such as dip, interruption or swell. These incidents are registered as events. A statistical evaluation is not required because there is no limitation for such events. For a configurable period of time, any event recording contains for all voltages and currents: • The curve shape • The progression of RMS half-cycle values	The evaluation of malfunction recording lets you identify the cause of the malfunction and - at best - establish a correlation with the events witnessed (such as outage of control systems or equipment). Suitable remedies may then be derived. Note: In addition to the requirements of IEC61000-4-30 also current, frequency and unbalance events may trigger the same recordings.





	PQ1000	PQ3000
Voltage inputs	4	5
Input channels current	3	4
Function class acc. IEC 61000-4-30	Class S	Class A
Device type acc. IEC 62586-1	PQI-S FI1	PQI-A FI1
PQ COMPLIANCE MONITORING		
Power frequency	▪	▪
Voltage / current variations	▪	▪
Unbalance voltage / current	▪	▪
THDS of voltages	▪	▪
Harmonics voltage / current	▪	▪
Flicker Pst / Plt	–	▪
Mains signalling voltages	–	▪
Interharmonics voltage / current	–	▪
PQ EVENT RECORDING		
Voltage dip	▪	▪
Voltage interruption	▪	▪
Voltage swell	▪	▪
Rapid voltage changes (RVC)	–	▪
Homopolar voltage (unbalance)	▪	▪
Current swell	▪	▪
Frequency anomaly	▪	▪
Ripple control sequences	–	▪
State change of digital inputs	–	–
MEASUREMENT UNCERTAINTY		
Voltage, current	±0,2%	±0,1%
Active, reactive, apparent power	±0,5%	±0,2%
Active energy	Class 0.2S (/5A)	Class 0.2S
COMMUNICATION		
Ethernet: Modbus/TCP, Webserver, NTP	(Standard)	(Standard)
IEC 61850	(Option)	(Option)
PROFINET IO	(Option)	(Option)
RS485: Modbus/RTU	(Standard)	(Standard)
Standard I/Os	1 Dig. OUT ; 1 Dig. IN/OUT	1 Dig. IN ; 2 Dig. OUT
Extension modules (optional)	See order codes	See order codes
POWER SUPPLY	100-230V AC/DC or 24-48V DC	110-230V AC/130-230V DC or 110-200V AC/DC or 24-48V DC
Consumption	≤18 VA, ≤8 W	≤30 VA, ≤13 W
DESIGN		
Colour display	TFT 3,5” (320x240px)	TFT 5,0” (800x480px)
Dimensions	96 x 96 x 85 mm	144 x 144 x 65,2 mm
Mounting	Panel or DIN rail with/without diplay	Panel installation

	*Special versions only on request and for large quantities* 	*Special versions only on request and for large quantities* 
PQ5000	**PQ5000R-2...**	**PQ5000R-3...**
5 4 Class A PQI-A FI1	5 4 (5 A or 3 V) Class A PQI-A FI1	2 x 5 2 x 4 (5 A or 3 V) Class A PQI-A FI1
▪ ▪ ▪ ▪ ▪ ▪ ▪ ▪	▪ ▪ ▪ ▪ ▪ ▪ ▪ ▪	▪ ▪ ▪ ▪ ▪ ▪ ▪ ▪
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(for version with CT inputs) ±0,1% ±0,2% Class 0.2S	±0,1% ±0,2% Class 0.2S	±0,1% ±0,2% Class 0.2S
(Standard) (Option) (Option) (Standard) 1 Dig. IN ; 2 Dig. OUT See order codes	(Standard) (Option) – (Standard) – See order codes	(Standard) – – (Standard) – See order codes
100-230V AC/DC or 24-48V DC ≤27 VA, ≤12 W	100-230V AC/DC ≤40 VA	100-230V AC/DC ≤60 VA
Option: TFT 3,5” (320x240px) 160 x 110 x 70 mm Top-hat rail with/without diplay	TFT 3,5” (320x240px) 482,6 x 132,6 x 270,1 mm Installation in 19“ rack	2 x TFT 3,5” (320x240px) 482,6 x 132,6 x 270,1 mm Installation in 19“ rack

MEASURED VALUES

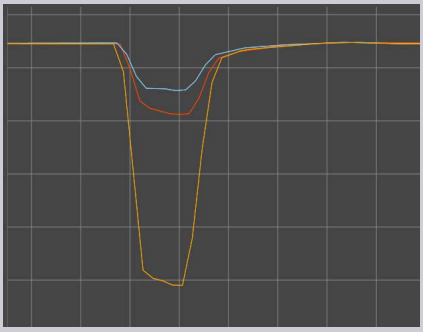
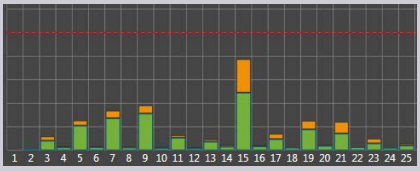
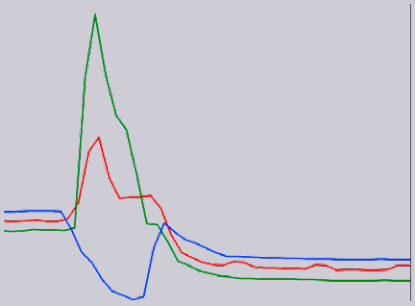
MEASURED VALUE GROUP	APPLICATION
INSTANTANEOUS VALUES	
• U, I, IMS, P, Q, S, PF, LF, QF ...	» Transparent monitoring of present system state
• Angle between voltage phasors	» Fault detection, connection check, sense of rotation check
• Min/max of instantaneous values with time stamp	» Determination of grid variable variance with time reference
EXTENDED REACTIVE POWER ANALYSIS	
• Total reactive power, fundamental frequency, harmonics	» Reactive power compensation
• cosϕ, tanϕ of fundamental frequency with min values in all quadrants	» Verification of specified power factor
HARMONICS ANALYSIS (ACCORDING TO IEC 61000-4-7)	
• Total harmonics content THD U/I and TDD I	» Evaluation of the thermic load of equipment
• Individual harmonics / interharmonics U/I	» Analysis of system perturbation and consumer structure
IMBALANCE ANALYSIS	
• Symmetrical components (positive, negative, zero sequence system)	» Equipment overload protection
• Imbalance (derived from symmetrical components)	» Failure/earth fault detection
• Deviation from U/I mean value	
ENERGY BALANCE ANALYSIS	
• Meter for acquisition/supply of active/reactive energy, high/low-rate tariff, meter with selectable base variable	» Preparation of (internal) energy billing
• Power mean values active/reactive power, demand and supply, freely definable mean values (e.g. phase power, voltage, current and much more)	» Determination of energy consumption versus time (load profile) for energy management or energy efficiency verification
• Mean value trends	» Energy consumption trend analysis for load management
OPERATING HOURS	
• 3 operating hour counters with programmable running condition	» Monitoring of service and maintenance intervals
• Operating hours of the device	

CERTIFIED POWER QUALITY MONITORING

- Independent certification by Federal Institute of Metrology acc. IEC 62586-2 (standard for verifying compliance with IEC 61000-4-30)
- Proven at 230V / 50 Hz and 120V / 60Hz
- Flicker meter class F1
- Flagging concept: Multiphase approach in accordance with IEC 61000-4-30



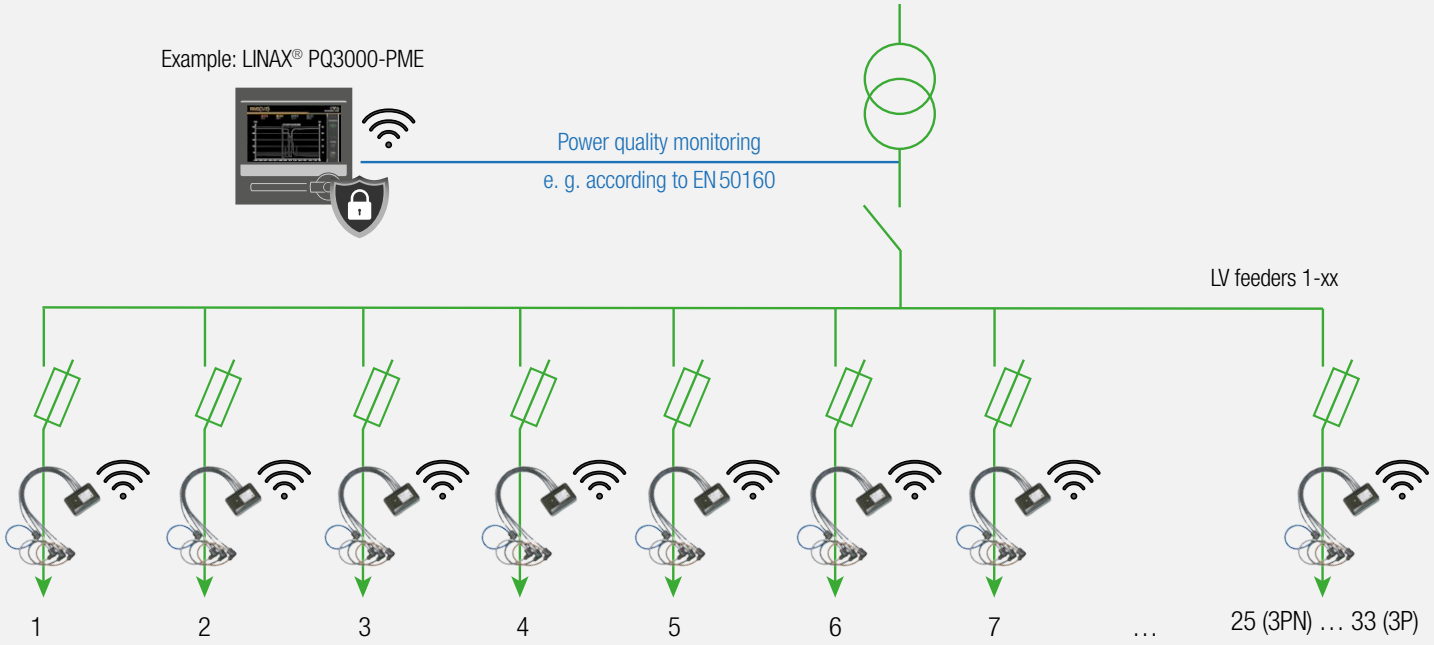
All devices, also the PQ1000, use measurement methods for class A devices according to IEC 61000-4-30 and therefore can serve as a reliable and comparable source of information for regulatory agencies, for negotiations with energy suppliers or for internal quality control.

MONITORED PHENOMENA	CAUSES	POSSIBLE CONSEQUENTIAL PROBLEMS
Mains frequency	• Loss of power generators • Large load changes	• Instability of the mains power supply
Magnitude of supply voltage 	• Changes in grid load	• Disruption of equipment • System shut-down • Loss of data
Flicker and rapid voltage changes (RVC)	• Frequent load changes • Start of engines	• Flickering lighting • Impairment of the performance of exposed people
Supply voltage dips and swells 	• Large load changes • Short circuit, contact to earth • Thunderstorm • Power supply overload • Feed-in of renewable energies such as wind or photovoltaic energy	• Disruption of equipment such as control or drive systems • Operational interruption • Data loss in control systems and computers
Voltage interruptions	• Short circuit • Blown fuses • Component failures • Planned supply interruption	• Production stoppage • Process interruptions • Data loss in control systems and computers
Supply voltage unbalance	• Uneven load on phases due to one or two-phase consumers • One or multi-phase short circuits to earth	• Current in the neutral conductor • Overload / overheating of equipment • Increase of harmonics
Voltage harmonics 	• Non-linear loads such as frequency converters, rectifiers, switching power supplies, arc furnaces, computers, fluorescent tubes etc.	• Reduction of machine efficiency • Increased energy losses • Overload / overheating of equipment • Current in the neutral conductor
Voltage interharmonics, mains signalling voltage on the supply voltage	• Frequency converters and similar control devices	• Flicker • Malfunction of ripple control
Excessive currents 	• Start-up currents of consumers • Switching operations • Voltage drops	• Fuse activation • Voltage drop • Plant shutdown

OPTION PME RADIO CENTER

This option extends the functionality of the base unit into an energy center by collecting via radio communication additional information about the distribution of energy or the consumption of individual loads. This scalable solution makes energy flows transparent and creates the basis for comprehensive energy management. Radio modules based on Rogowski coils are used as sensors.

Without additional wiring effort, up to 100 currents can be monitored synchronized to the voltage measurement of the base unit. These currents are made up of PME sensors (Power Monitoring Energy) for 3 or 4 wire each. Current and power quantities are then determined once per second and load profiles and energy meter values are derived from them.



Base station with SINEAX® AM, SINEAX® DM5000, LINAX® PQ or CENTRAX® CU series, incl. integrated Power Monitoring Energy Module (PME) and PME sensors for acquisition of max. 100 currents via radio signal.

PME characteristics

- Base unit SINEAX® AM, SINEAX® DM5000, LINAX® PQ or CENTRAX® CU
- PME sensors with 3 or 4 Rogowski coils each (max. 100 currents) and configurable measurement ranges (250 A, 500 A or 1000 A)
- Radio frequency 2.4 GHz, range 10 m
- Secure protocol for communication between current sensors and central unit (Advanced Encryption Standard AES-128, standard for WLAN communication)
- Fast installation due to easy sensor registration via QR code
- Power supply via battery (runtime up to 10 years) or USB-C
- Thanks to anti-collision detection up to 5 PME systems at the same location
- Access to sensor data via Modbus/RTU, Modbus/TCP, REST API, CSV export
- Measurements: I, THD_I, TDD_I, P, Q, Q(H1), S, cosϕ, PF
- Current measurement ± 0.5%, active / reactive energy class 3
- Measurement interval 1 s
- Sampling rate per sensor 6 kHz



Daily load profile with previous day values for a PME sensor via web page of the base unit

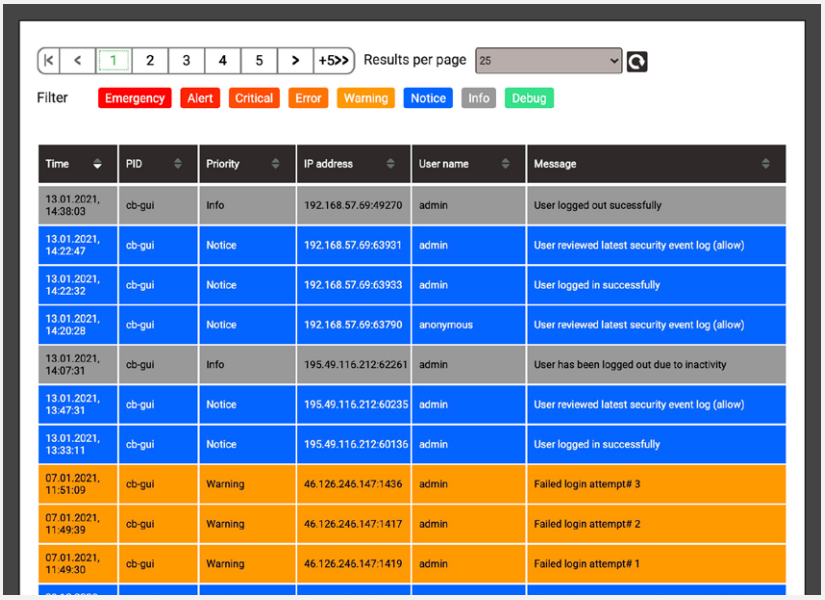
CYBER SECURITY

Critical infrastructures - and this undoubtedly includes the supply of electrical energy - are increasingly the target of cyber attacks. There is not only the attempt of stealing data by unauthorised access or eavesdropping of communication but also the limitation or even interruption of energy supplies by manipulating data or data traffic.

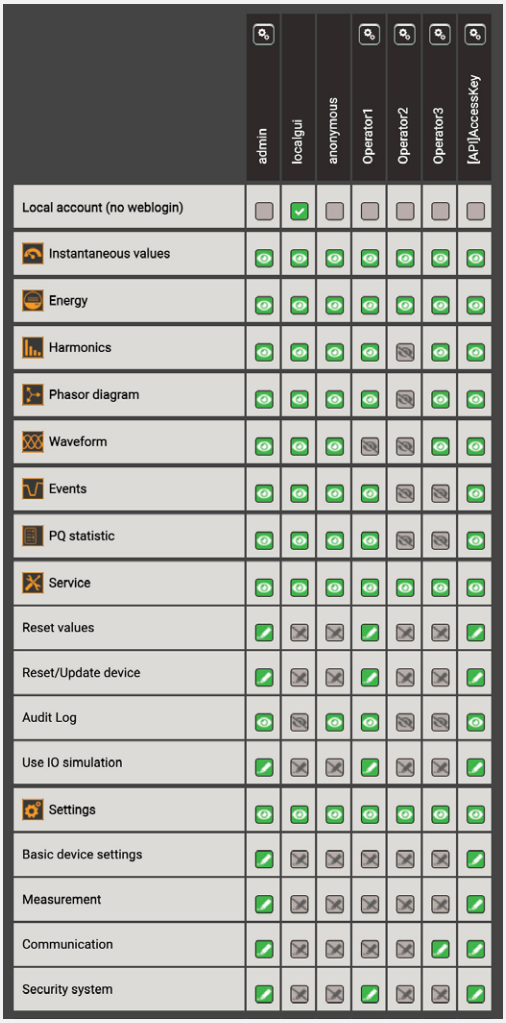
A comprehensive security concept on plant level comprising each grid component is required to repel such attacks. The security mechanisms integrated into LINAX PQx000 support such concepts, thus contributing to safe energy supplies.

SECURITY MECHANISMS

- **Role-Based Access Control (RBAC)**: Allows different users to be granted individual rights or to restrict them to those activities that correspond to their role. Each available menu item, whether measured value, setting value or service function, can thus be displayed, hidden, changeable or locked. As soon as the RBAC is active, even software can only access data of the device via access keys.
  During the login process, information is never transmitted in plain text, and the latency time is constantly increased in the event of repeated, unsuccessful login attempts.
- **Encoded data transmission via HTTPS** using root certificates
- **Audit log**: Logging of all activities relevant to security. Transfer option to central grid monitoring server by Syslog.
- **Client white list**: Limitation of computers with access authorisation
- **Digitally signed firmware files** for secure updates



Audit log with filter option



RBAC access rights of different users

DATA RECORDING

The device features different recording options to provide historical data for the assessment of power quality, energy management or grid management.

- **POWER QUALITY STATISTICS**
  All of the trend values required for a Class A device according to IEC 61000-4-30 Ed.3 are automatically recorded. They permit the subsequent verification of standard conformity.

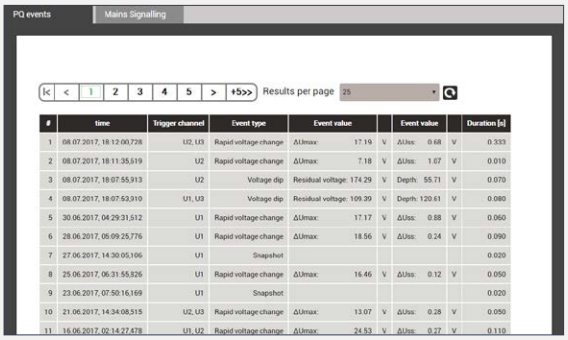
- **POWER QUALITY EVENTS**
  Power quality events serve the proof of temporary grid availability limitations, fault analyses and the discovery of the causes of disturbances. PQ events are available in lists containing the most important details. The selection of an entry takes you directly to the graphic representation of the event. Depending on the configured recording time, the following items may be assessed for all voltages and currents:
  - Curve shape: Up to 1 second before and 5 seconds after the event
  - RMS ½ values: Up to 1 second before and 3 minutes after the event

- **PERIODIC DATA**
  Periodic data, in particular for energy management, is acquired. The data is based on power averages and meter readings which are saved in regular intervals.
  Typical applications are the acquisition of load profiles (intervals of 10s to 1h) or the determination of the energy consumption from the difference of meter readings.
  Averages are respectively acquired with a range of fluctuation, i.e. maximum and minimum RMS values per interval. Averages may also be acquired for freely selectable base variables.
  Further base variables can also be monitored for meter readings, e.g. per phase or only related to the basic cycle.

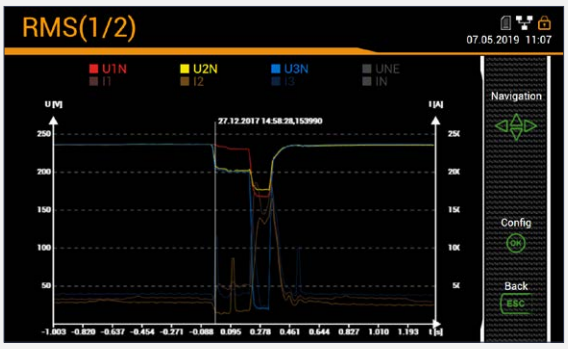
- **EVENTS**
  Events or alarms - which users have determined in addition to continually monitored power quality events - are stated in lists including time information. State transitions or the activation or deactivation of limit value states or monitoring functions, which users have classified as alarms or events, or the infringement on pre-alarm or alarm limits of optional temperature and fault current inputs are respectively registered.

- **AUDIT-LOG**
  This list of the service area logs all activities relevant to security which might impair data consistency or endanger IT security. It replaces the operator list of older firmware versions and cannot be deleted or changed by users. Any connection to the device, any login attempt (be it successful or not), any logoff (be it active or by timeout), any change in the device configuration, any reset of data, any firmware update, any display of the audit log and much more is respectively registered including user information. The content of the audit log may also be forwarded to a central grid monitoring server by Syslog.

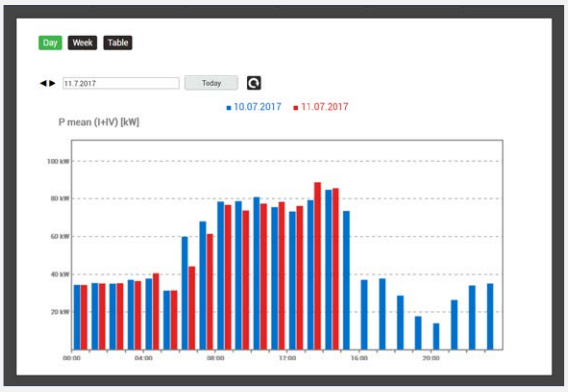
The memory used (16 GB) permits saving data under normal application conditions for several years. Once the memory share allocated to the data groups has been fully used, the oldest data of this group is deleted.



PQ event list via device website



Voltage drop shown on local display



Current load profile of the day with values of the previous day via the device website



Progression of short-time flicker Pst during a day via the device website

PQ DATA ANALYSIS

All of the PQ data acquired by the device can be directly visualised and analysed via the device website. Additional software is not required.

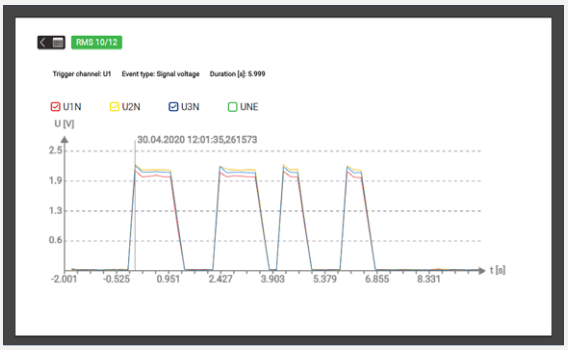
PQ events

- PQ event list with trigger source, event type, event duration and characteristic event values
- Direct display of event details by selecting an entry in the event list: Measured value progressions of RMS ½ values and curve shapes for all currents and voltages with time zoom and value display
- Recording of ripple control sequences to verify the ripple control level and pulse sequences at the receiver

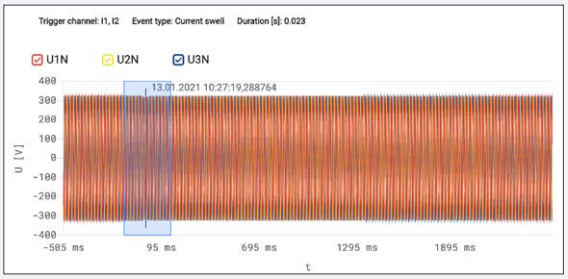
PQ statistics

- Overview of conformity with a selectable standard. Depending on the standard selected, more or less criteria are taken into consideration.
- Daily progressions of all acquired PQ trend values, display with/without limit values and fluctuation range
- PQ easy report: Preparation of a conformity report (pdf format) of a selectable extent

Using the data export options and due to standardised formats like PQDIF, the analysis of PQ data can also be delegated to software solution like PQView4 or freely available viewers like PQDiffractor of Electrotek Concepts may be used.



Ripple control sequence acquired as an event



Curve shape recording of an event with zoom option

PQ EASY-REPORT



- Preparation of reports via the device web interface
- Tamper-resistant PDF format
- Selectable report scope (overview, statistic details, event overview)
- Direct compliance assessment of standards EN 50160, IEC 61000-2-2 / 2-4 / 2-12, GB/T, IEEE 519 or customer specific limits
- Customer specific logo in the report



DATA EXPORT

Automated

Measured value information may not only be monitored directly but can also be saved in files in the device or forwarded to an SFTP server using a data export scheduler. The following systems are supported:

- CSV files: To make average progressions, load profiles or meter readings available
- PQDIF for event-controlled forwarding / saving of PQ event recordings
- PQDIF for periodic forwarding / saving of all PQ data (trends and events)

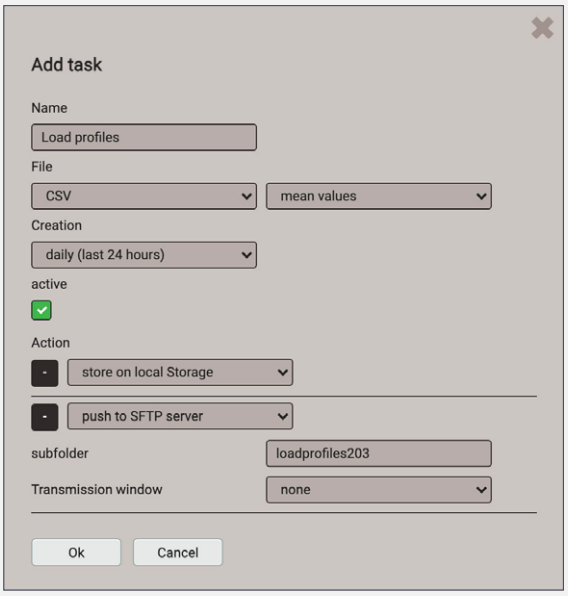
Tasks may be prepared for the generation of files which will then run automatically and are linked to the actions of save locally and / or send to SFTP server. Data locally saved in the device may be transferred to a computer via the device website or the REST interface.

The Secure File Transfer Protocol (SFTP) facilitates the encoded transfer of files. It may also be used for the transmission of measured value information via secured network structures, e.g. via Smart Meter Gateways.

Manually

If a network structure is not available, it may make sense to prepare files manually via the device website and to save them on the PC:

- CSV files: For event lists, average progressions, curve shape representation, PQ event recordings
- PQDIF files of all PQ data of a selectable day or the current day

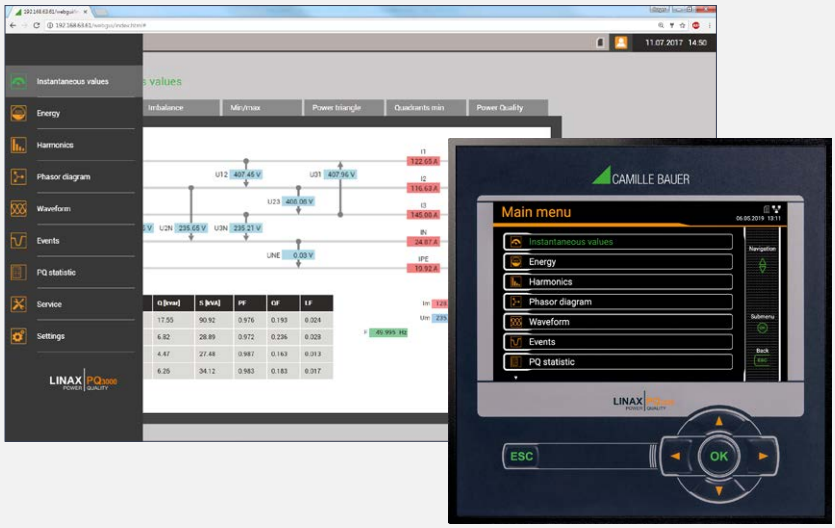


Task for daily saving / forwarding of average data

File formats

- ***CSV**: Comma Separated Value*
- ***PQDIF**: Power Quality Data Interchange Format according to IEEE 1159.3*

OPERATION AND ANALYSIS



OPERATION

The local operation at the device itself and the access via web interface are structured identically. The access to

- Measured data
- Service functions
- Settings of the measuring device

can thus be intuitively effected via a topically arranged, language-specific menu structure.

The extent of the indicated menu structure may be different for the local display and the device website, if this has been respectively determined via the access control system (RBAC). It might also be necessary that users first log in to have a menu displayed.

The top-right status bar informs on the current states of alarm monitoring as well as network, access control system, data memory and UPS and also indicates the time and date of the device.

SPECIAL FUNCTIONS PQ5000-RACK

Special versions only on request and for large quantities

Collect grid information in case of events

All PQ devices monitor the power quality at a point in the grid. When power quality events occur, a recording of all voltages and currents is initiated in each case.

The PQ5000-RACK additionally monitors up to 12 states of digital inputs (option), for example the status of circuit breakers, disconnectors or protection devices. Any change of state on one of these inputs also initiates a PQ event recording, supplemented with the status information of all inputs during the selected recording period. The same status information is also collected for «normal» voltage, current or frequency events and integrated into the fault recording.

With this extended fault recording, important grid status information can be collected for later analysis of the event, as the data can be related to events in the grid in this way.



Event recording (here without status information of the digital inputs)

Message via relay output

In case of events, an alarm may be required on site via the (optional) relay output. This is particularly useful in the case of faults that persist over a longer period of time, such as a persistent undervoltage on a single phase, but also in the case of operationally relevant causes.

The following events can be reported via the relay output:

- Continuous voltage or current events
- Loss of time synchronization via NTP or GPS
- Memory full (oldest information is deleted)
- Device ready for operation

With this device based on the **LINAX PQ5000 in 19" rack design according to EN 60297**, several measuring points (double busbar, transformer) can also be monitored.

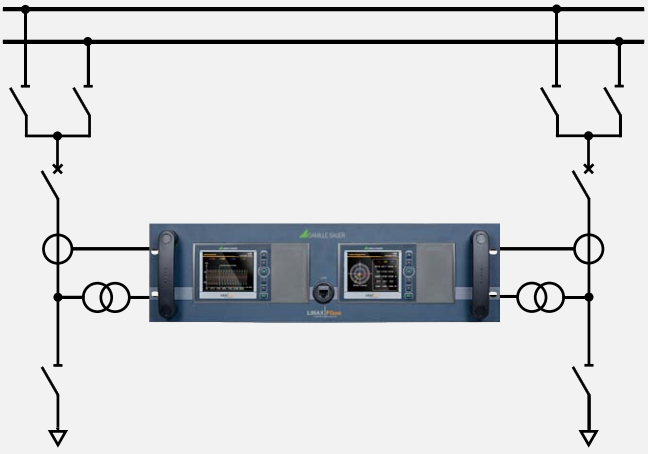
Other special features include:

Design

- Current inputs available for 5A (conventional current transformer) or 3V (small signal converter)
- 4 analog outputs or Modbus/RTU interface (option)
- Input for GPS time synchronization as standard

Communication

- Commissioning, configuration and data analysis via LAN (front and rear): Modbus/TCP, NTP, http, https, IPv4, IPv6
- 3G/4G router (option)
- IEC 61850 (option)
- Comprehensive cyber security protection



Monitoring of double busbar systems

COMMISSIONING AND SERVICE

The device provides versatile tools for safe and easy commissioning and maintenance. Some are listed below:

Vector diagram / phase sequence indicator

With these displays, you can easily verify whether the measuring inputs have been correctly connected. Non-conforming rotational directions of voltages and currents, reverse polarity current connections and interchanged current or voltage connections are immediately recognised.

Simulation

Output values of analog and digital outputs can be simulated during commissioning to test downstream circuits.

Communication tests

Permit the verification of effected network settings and provide quick answers to these questions:

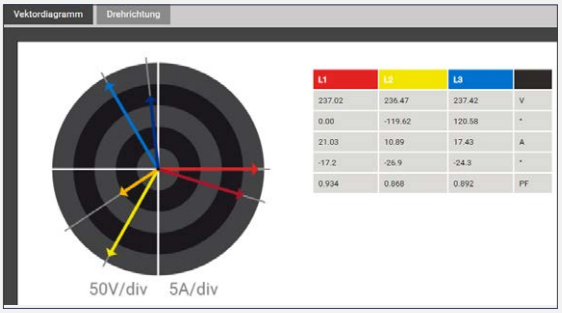
- Can the gateway be reached?
- Can the URL of the NTP server be cancelled via DNS?
- Is NTP a time server and is the time synchronisation working?
- Does the data storage on the SFTP server work?

Operating instructions

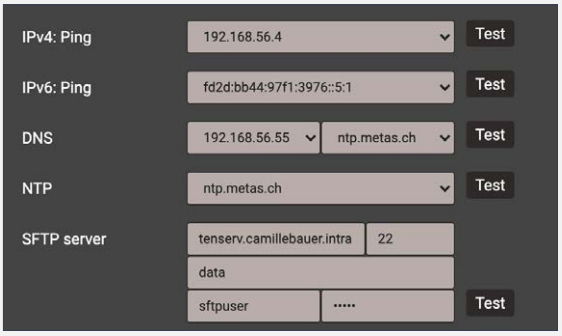
The operating instructions are stored in the device as a PDF file and can be opened in the browser or downloaded to a PC at any time. The instructions are respectively updated in any firmware update thus always documenting the implemented state.

Deletion of data

Recordings of measured data may be selectively deleted or reset. Every one of these activities can be protected via the Role Based Access Control system (RBAC) and is logged with the user identification upon execution.



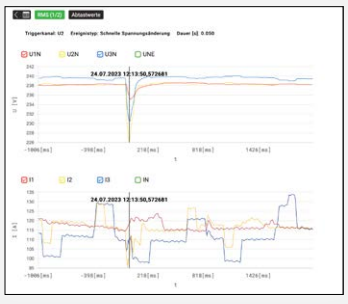
Phasor diagram to control connections



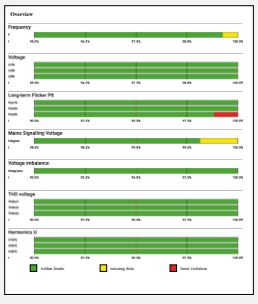
Communication tests: Control of network structure

MONITORING SOFTWARE WITH POWER QUALITY FUNCTIONS

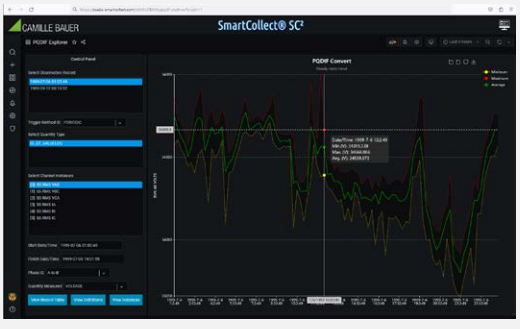
If power quality devices are to be integrated into an eco-system or software infrastructure, we recommend SmartCollect® SC². SmartCollect® SC² is a scalable HMI/SCADA software for visualizing electrical distribution and other physical and power quality parameters. The following functions are available specifically for displaying power quality information:



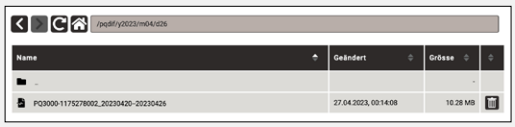
LINAX PQ event driver



LINAX PQEasy report driver



Analyze with PQ(DIF) Explorer



LINAX PQDIF driver

For details, please refer to our website under SmartCollect® SC²

TECHNICAL DATA PQ1000 / PQ3000 / PQ5000

Some of the technical features are only available on request.

INPUTS

NOMINAL CURRENT 1 … 5 A (max. 7.5 A)
Maximum 7.5 A
Overload capacity 10 A permanent
100 A, 5x1 s, interval 300 s

Current measurement via Rogowski coils (PQ5000)
Measurement range 0…3000A (max. 3800A)
See operating instructions of Rogowski coil ACF 3000 for further information

NOMINAL VOLTAGE 57.7 … 400 V_{LN}, 100 … 693 V_{LL}
Maximum PQ1000 / PQ3000: 480 V_{LN}, 832 V_{LL} (sinusoidal)
PQ5000: 520 V_{LN}, 900 V_{LL} (sinusoidal)
Overload capacity PQ1000 / PQ3000: 480 V_{LN}, 832 V_{LL} permanent
PQ5000: 520 V_{LN}, 900 V_{LL} permanent
800 V_{LN}, 1386 V_{LL}, 10x1 s, interval 10 s
Nominal frequency 42 … 50 … 58 Hz, 50.5 … 60 … 69.5 Hz

Sampling rate 18 kHz

Data memory 16 GB

POWER SUPPLY VARIANTS

Nominal voltage 100...230 V AC/DC (PQ1000 / PQ5000)
110…230 V AC, 130…230 V DC (PQ3000)
110…200 V AC, 110…200 V DC (PQ3000)
24…48 V DC (PQ1000 / PQ3000 / PQ5000)
Consumption ≤ 18 VA, ≤ 8 W (PQ1000); ≤ 27 VA, ≤ 12 W (PQ5000);
≤ 30 VA, ≤ 13 W (PQ3000)

UNINTERRUPTIBLE POWER SUPPLY (UPS)

Availability optional, PQ3000 / PQ5000 only
Operating duration 5 times 3 minutes

TYPES OF CONNECTION

- Single phase or split phase (2-phase system)
- 3 or 4-wire balanced load
- 3-wire balanced load [2U, 1I]
- 3-wire unbalanced load, Aron connection
- 3 or 4-wire unbalanced load
- 4-wire unbalanced load, Open-Y

I/O-INTERFACE

ANALOG OUTPUTS (optional)
Linearisation Linear, kinked
Range ± 20 mA (24 mA max.), bipolar
Accuracy ± 0.2 % von 20 mA
Burden ≤ 500 Ω (max. 10 V/20 mA)

RELAYS (optional)
Contacts Changeover contact
Load capacity 250 V AC, 2 A, 500 VA; 30 V DC, 2 A, 60 W

DIGITAL INPUTS PASSIVE
Nominal voltage 12/24 V DC (30 V max.)

DIGITAL INPUTS ACTIVE (optional)
Open circuit voltage ≤ 15 V

DIGITAL OUTPUTS 2, Standard
Nominal voltage 12/24 V DC (30 V max.)

FAULT CURRENT MONITORING
For grounded systems (optional)

Number of meas. channels 2 (2 measurement ranges each)
Measurement range 1 (1A) Earth current measurement
• Measuring transformer 1/1 up to 1/1000 A
• Alarm limit 30 mA up to 1000 A
Measurement range 2 (2mA) RCM with connection monitoring
• Measuring transformer Residual current transf. 500/1 up to 1000/1 A
• Alarm limit 30 mA up to 1 A

TEMPERATURE INPUTS (optional)
Number of channels 2
Measurement sensor Pt100 / PTC; 2-wire

BASIC UNCERTAINTY ACCORDING IEC/EN 60688

VERSION WITH ROGOWSKI CURRENT INPUTS (PQ5000)
The additional uncertainty of the Rogowski coils ACF 3000 is not included in the following specifications: See operating instructions of Rogowski coil ACF 3000_x/24.

	PQ1000	PQ3000/PQ5000	
Voltage, current	±0.2 %	±0.1 %	
Power	±0.5 %	±0.2 %	
Power factor	±0.2°	±0.1°	
Frequency	±0.01 Hz	±0.01 Hz	
Imbalance U, I	±0.5 %	±0.5 %	
Harmonic	±0.5 %	±0.5 %	
THD U, I	±0.5 %	±0.5 %	
Active energy	Class 0.2S (/5A)	Class 0.2S	(IEC 62053-22: 2003)
Reactive energy	Class 0.5S	Class 0.5S	(IEC 62053-24: 2014)

INTERFACES

ETHERNET Standard
Physics Ethernet 100Base TX; RJ45 socket
Protocols Modbus/TCP, http, https, NTP, IPv4, IPv6
IEC61850 **optional**
Physics Ethernet 100BaseTX, RJ45 sockets, 2 ports
Protocols IEC61850, NTP
PROFINET IO **optional**
Conformance class CC-B
Physics Ethernet 100BaseTX, RJ45-Buchsen, 2 ports
Protocols PROFINET, LLDP, SNMP
MODBUS/RTU Standard (PQ5000), optional (PQ1000, PQ3000)
Physics RS-485, max. 1200 m (4000 ft)
Baud rate 9.6 to 115.2 kBaud
TIME REFERENCE Internal clock
Clock accuracy ± 2 minutes/month (15 to 30°C)
Synchronisation via NTP server, GPS or IRIG-B (TTL)

ENVIRONMENTAL CONDITIONS, GENERAL INFORMATION

Operating temperature without UPS: –10 up to 15 up to 30 up to + 55 °C
with UPS: 0 up to 15 up to 30 up to + 35 °C
(Condition for battery pack loading)
Storage temperature –25 to +70 °C
Temperature influence 0.5 x basic uncertainty per 10 K
Long-term drift 0.5 x basic uncertainty per year
Others Application group II (IEC/EN 60 688)
Relative air humidity <95 % without condensation
Operating altitude ≤2000 m above NN
Only to be used in buildings!

MECHANICAL PROPERTIES

Mounting panel / hat rail
Housing material Polycarbonate (Makrolon)
Flammability class V-0 according UL94
Weight 400 g (PQ1000), 800 g (PQ3000), 600g (PQ5000)

SAFETY

Current inputs are galvanically isolated from each other.
Protection class II (protective insulation, voltage inputs via protective impedance)
Pollution degree 2
Protection IP54 (front), IP30 (housing), IP20 (terminals)
Measurement category U: 600 V CAT III, I: 300 V CAT III

TECHNICAL DATA PQ5000-RACK

Special versions only on request and for large quantities

INPUTS

CURRENT	HARDWARE VERSIONS 3V OR 5A
• 3 V 50/60 Hz	max. 6,0V (sinusoidal)
• 5 A 50/60 Hz	1 … 5 A; max. 7,5 A (sinusoidal)
Overload capacity	10 A permanent 100 A, 5x1 s, interval 300 s
Measurement category	300 V CAT III

NOMINAL VOLTAGE	57,7 … 400 V_{LN}, 100 … 693 V_{LL}
Maximum	520 V_{LN}, 900 V_{LL} (sinusoidal)
Measurement category	600 V CAT III, 300 V CAT IV
Overload capacity	520 V_{LN}, 900 V_{LL} permanent 800 V_{LN}, 1386 V_{LL}, 10x1 s, interval 10 s
Nominal frequency	42 … 50 … 58 Hz; 50,5 … 60 … 69,5 Hz
Sampling rate	18 kHz
Data storage	32 GB

POWER SUPPLY VARIANTS

Nominal voltage	100 … 230 V AC/DC
Consumption	≤ 40 VA (Single rack), ≤ 60 VA (Double rack)

UNINTERRUPTIBLE POWER SUPPLY (UPS)

Avaialability	optional
Typ (3,7 V)	VARTA Easy Pack EZPAckL, UL listed MH16707
Bridging time	5 times 3 minutes

TYPES OF CONNECTION

- Single phase or split phase (2-phase system)
- 3 or 4-wire balanced load
- 3-wire balanced load [2U, 1I]
- 3-wire unbalanced load, Aron connection
- 3 or 4-wire unbalanced load
- 4-wire unbalanced load, Open-Y

I/O-INTERFACE

ANALOG OUTPUTS	(optional)
Linearisation	Linear, kinked
Range	± 20 mA (24 mA max.), bipolar
Accuracy	± 0.2 % von 20 mA
Burden	≤ 500 Ω (max. 10 V/20 mA)

RELAYS	(optional)
Load capacity	250 V AC, 2 A, 500 VA; 30 V DC, 2 A, 60 W

DIGITAL INPUTS PASSIVE (optional)

Rated voltage	**24-130 V DC**	**110-220 V DC**
Input current	< 5 mA	< 1 mA
Logical zero	-3 to +5V DC	0 to 25 V DC
Logical one	11 to 130 V DC	50 to 264 V DC

BASIC UNCERTAINTY ACCORDING IEC/EN 60688

Voltage, current	±0,1 %
Power	±0,2 %
Power factor	±0,1°
Frequency	±0,01 Hz
Imbalance U, I	±0,5 %
Harmonic	±0,5 %
THD U, I	±0,5 %
Active energy	Class 0.2S (IEC 62053-22: 2003)
Reactive energy	Class 0.5S (IEC 62053-24: 2014)

INTERFACES

ETHERNET	Standard
Physics	Ethernet 100Base TX; RJ45 socket
Mode	10/100 MBit/s, full/half duplex, autonegotiation
Protocols	Modbus/TCP, http, https, NTP, IPv4, IPv6

IEC61850	**optional**
Physics	Ethernet 100BaseTX, RJ45 sockets, 2 ports
Mode	10/100 Mbit/s, full/half duplex, auto-negotiation
Protocol	IEC61850, NTP

MODBUS/RTU	optional
Physik	RS-485, max. 1200 m (4000 ft)
Baud rate	9.6 up to 115.2 kBaud

TIME REFERENCE	Internal clock
Clock accuracy	± 2 minutes/month (15 to 30°C)
Synchronisation	via NTP server or GPS

ENVIRONMENTAL CONDITIONS, GENERAL INFORMATION

Operating temperature	without UPS: –10 up to 15 up to 30 up to + 55 °C with UPS: 0 up to 15 up to 30 up to + 35 °C (Condition for battery pack loading)
Storage temperature	–25 to +70 °C
Temperature influence	0.5 x basic uncertainty per 10 K
Long-term drift	0.5 x basic uncertainty per year
Others	Application group II (IEC/EN 60 688)
Relative air humidity	<95 % without condensation
Operating altitude	≤2000 m above NN

Only to be used in buildings!

MECHANICAL PROPERTIES

Mounting	19“ Rack
Weight	4.2 kg (Single rack), 5.0 kg (Double rack)

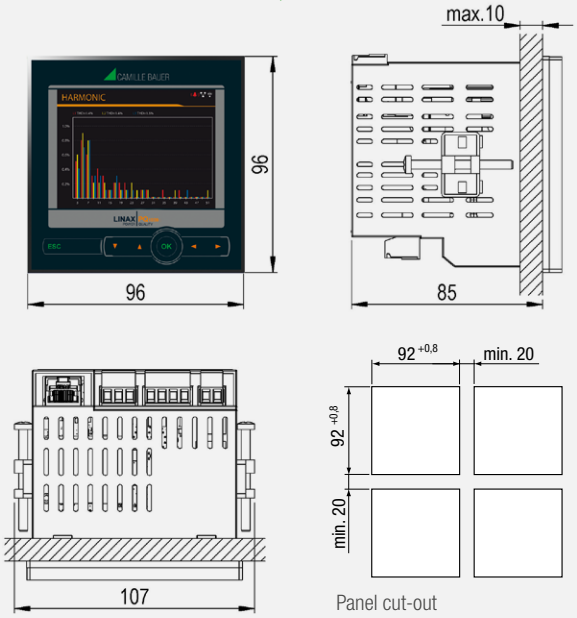
SAFETY

Current inputs are galvanically isolated from each other.

Protection class	II (protective insulation, voltage inputs via protective impedance)
Pollution degree	2
Protection	IP54 (front), IP30 (housing), IP20 (terminals)

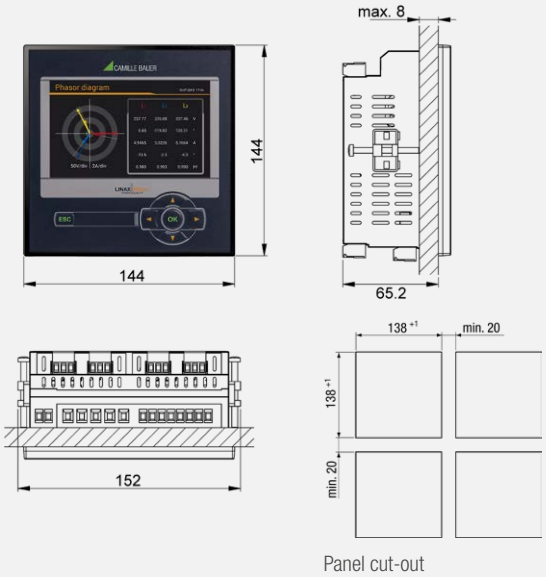
DIMENSION DRAWINGS

DIMENSIONAL DRAWING PQ1000



Panel cut-out

DIMENSIONAL DRAWING PQ3000

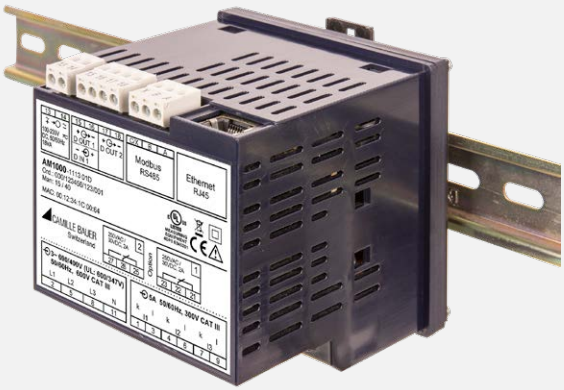


Panel cut-out

The LINAX PQ1000 is also available in versions for DIN rail mounting, with or without display.

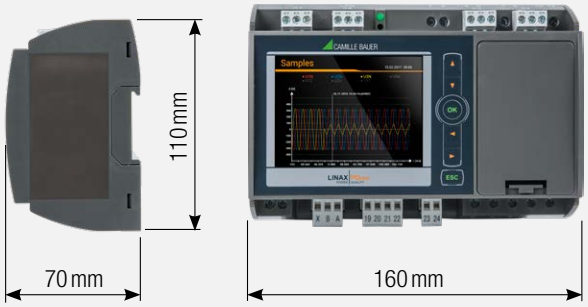


Standard version with top-hat rail adapter (article no. 193 353)



Special version only on request and for large quantities

DIMENSIONAL DRAWING PQ5000



DIMENSIONAL DRAWING PQ5000-RACK



ORDER CODES

LINAX® PQ1000, Multifunctional Power Quality Analyzer, Class S, 96 x 96 mm

Basic device	Input frequency range	Power supply		Bus connection	Standard protocol	Standard I/Os		Extension									Test certificate	Article number
With TFT display, for instrument panel mounting	3 current inputs, 42..50/60..69.5Hz	Nominal voltage 100...230 V AC/DC	Nominal voltage 24...48 V DC	Ethernet (TCP/IP) + RS485 (RTU)	REST Interface + Modbus	1 digital output passive	1 digital input / output passive	Without extension	4 analog outputs +/-20mA	4 digital inputs active	Fault current detection, 2 channels	Profinet interface	IEC61850 interface	Temperature monitoring, 2 channels	PME central unit	IRIG-B connection module	Test certificate English	
●	●	●	-	●	●	●	●	●	-	-	-	-	-	-	-	-	●	192897
●	●	●	-	●	●	●	●	-	-	●	-	-	-	-	-	-	●	192905
●	●	●	-	●	●	●	●	-	-	-	-	-	-	-	●	-	●	193417
●	●	-	●	●	●	●	●	●	-	-	-	-	-	-	-	-	●	192913
●	●	-	●	●	●	●	●	-	-	●	-	-	-	-	-	-	●	192921
●	●	-	●	●	●	●	●	-	-	-	-	-	-	-	●	-	●	193425

LINAX® PQ3000, Multifunctional Power Quality Analyzer, Class A, 144 x 144 mm

Basic device	Input frequency range	Power supply		Bus connection	Standard protocol	Standard I/Os		Extension 1 (in and output)					Extension 2 (Connectivity)							Extention 3 (Extra feature)					Test certificate	Article number
With TFT display, for instrument panel mounting	4 current inputs, 42..50/60..69.5Hz	110...230 V AC, 130...230 V DC	24...48 V DC	Ethernet (TCP/IP) + RS485 (RTU)	REST Interface + Modbus	1 digital input passive	2 digital outputs passive	Without extesion 1	2 relays (change-over contact)	4 analog outputs +/-20mA	4 digital inputs active	Fault current detection, 2 channels	Without Extension 2	2 analog outputs +/-20mA	Fault current detection, 2 channels	Profinet interface	IEC61850 interface	PME central unit	IRIG-B connection module	Without extension 3	4 analog outputs +/-20mA	Fault current detection, 2 channels	Uninterruptible power supply	Temperature monitoring, 2 channels	Test certificate English	
●	●	●	-	●	●	●	●	●	-	-	-	-	●	-	-	-	-	-	-	●	-	-	-	-	●	192929
●	●	●	-	●	●	●	●	●	-	-	-	-	-	-	-	●	-	-	-	-	-	-	●	-	●	192937
●	●	●	-	●	●	●	●	●	-	-	-	-	-	-	-	-	●	-	-	-	-	-	●	-	●	192945
●	●	●	-	●	●	●	●	-	●	-	-	-	●	-	-	-	-	-	-	●	-	-	-	-	●	192953
●	●	-	●	●	●	●	●	●	-	-	-	-	●	-	-	-	-	-	-	●	-	-	-	-	●	192961
●	●	-	●	●	●	●	●	●	-	-	-	-	-	-	-	-	-	●	-	●	-	-	-	-	●	194193
●	●	●	-	●	●	●	●	●	-	-	-	-	-	-	-	-	-	●	-	●	-	-	-	-	●	192969
●	●	●	-	●	●	●	●	-	●	-	-	-	●	-	-	-	-	-	-	-	-	-	-	●	●	192977
●	●	●	-	●	●	●	●	-	-	-	●	-	●	-	-	-	-	-	-	-	-	-	-	●	●	192985
●	●	●	-	●	●	-	-	●	-	-	-	-	●	-	-	-	-	-	-	-	-	-	●	-	●	192993
●	●	●	-	●	●	-	-	-	●	-	-	-	-	-	●	-	-	-	-	-	●	-	-	-	●	193001

LINAX® PQ5000, Multifunctional Power Quality Analyzer, Class A

Basic device		Input frequency range		Power supply		Bus interface	Standard protocol	Standard I/Os		Uninterruptible power supply		Extension 1							Type code	Extention 3 (Extra feature)	Article number
Whitout display, for top-hat rail mounting	With TFT display, for instrument panel mounting	4 current inputs, 42..50/60..69.5Hz	Rogowski inputs, 50/60 Hz	Nominal voltage 100...230 V AC/DC	Nominal voltage 24...48 V DC	Ethernet (TCP/IP) + RS485 (RTU)	REST Interface + Modbus	1 digital input passive	2 digital outputs passive	Without UPS	With UPS	Without extesion 1	4 analog outputs +/-20mA	Profinet interface	IEC61850 interface	Temperature monitoring, 2 channels	PME central unit	IRIG-B connection module	Without Extension 2	Test certificate English	
●	-	●	-	●	-	●	●	●	●	●	-	●	-	-	-	-	-	-	●	●	193057
●	-	-	●	●	-	●	●	●	●	●	-	-	-	-	-	-	●	-	●	●	193065
-	●	●	-	●	-	●	●	●	●	●	-	●	-	-	-	-	-	-	●	●	193073
-	●	-	●	●	-	●	●	●	●	●	-	●	-	-	-	-	-	-	●	●	193081
-	●	●	-	●	-	●	●	●	●	-	●	-	●	-	-	-	-	-	●	●	193089
-	●	●	-	●	-	●	●	●	●	●	-	-	-	-	●	-	-	-	●	●	193097
-	●	●	-	●	-	●	●	●	●	●	-	-	-	●	-	-	-	-	●	●	193105

LINAX® PQ5000-Rack on request

ACCESSORIES PQ1000, PQ3000, PQ5000	ARTICLE NO
Rogowski coil, single-phase, ACF3000_4/24, Ø 200mm, 2m	172 718
Rogowski coil, single-phase, ACF3000_31/24, Ø 200mm, 5m	173 790
Rogowski coil, single-phase, ACF3000_67/13_L1, Ø 100mm, 2.5m	191 585
Rogowski coil, single-phase, ACF3000_67/13_L2, Ø 100mm, 2.5m	191 593
Rogowski coil, single-phase, ACF3000_67/13_L3, Ø 100mm, 2.5m	191 601
Rogowski coil, single-phase, ACF3000_67/13_N, Ø 100mm, 2.5m	191 609
Interface converter USB <> RS485	163 189
Transformers for fault current detection see accessory current transformers	
PME Rogowski wireless sensor 3P, 3-channel, Ø 75 mm, without batteries	189 281
PME Rogowski wireless sensor 3PN, 4-channel, Ø 75 mm, without batteries	189 273
DIN rail adapter PQ1000	193 353