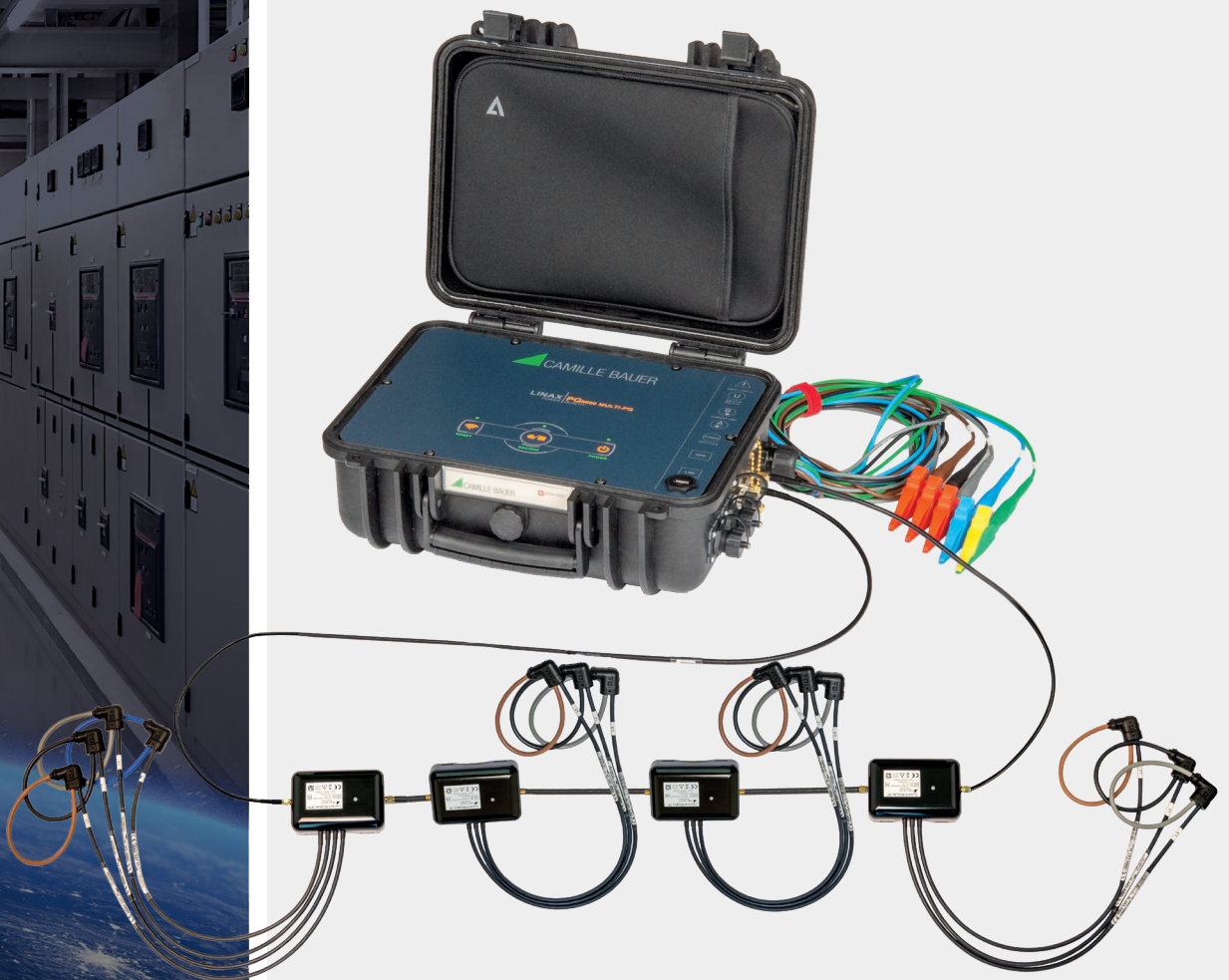


TRANSPARENT ENERGY DISTRIBUTION

OPEN & SCALABLE SYSTEM
FOR ON-SITE GRID ANALYSIS



LINAX® PQ5000MOBCL-MULTI PQ

Grid utilization ■ PQ compliance ■ Events



Mobile, scalable acquisition of power quality and load flows in energy distribution systems



It has long been recognized that the electrical power supply is part of the critical infrastructure and that its disruption or failure can have serious consequences for the economy and the population. Nevertheless, many parts of this supply are hardly monitored, so overload phases or violations of the power quality to be guaranteed by the DSO often go undetected.

Not all transformer stations are networked by far, so that 7/24 monitoring with permanently installed measuring devices can only be implemented

with high expenditure for mobile communication solutions.

A mobile measuring solution for the simultaneous recording of power quality and load profiles of up to 9 measuring points is ideal here as a metrological compass. By measuring over a representative period of time, normally a multiple of a week, a meaningful picture can be obtained for subsystems such as a transformer station, which can be used for the assessment and maintenance of the system.

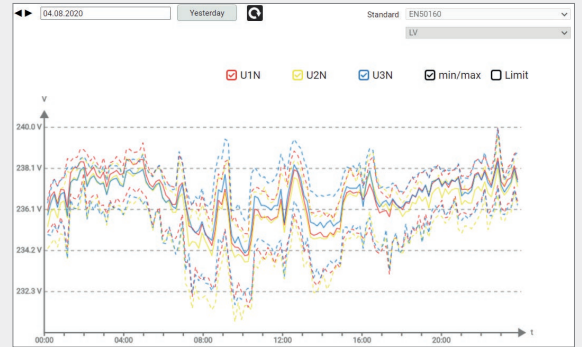
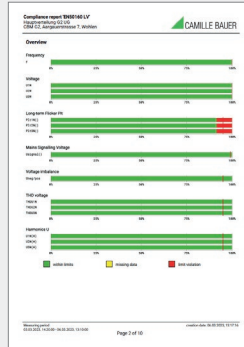


MONITORING OPTIONS AND BENEFITS

POWER QUALITY

In addition to PQ compliance assessment, e.g. acc. EN 50160, the quality of currents (magnitude, unbalance, harmonics, interharmonics) for up to 9 measuring points (36 current channels) is recorded in accordance with IEC 61000-4-30 Ed. 3.

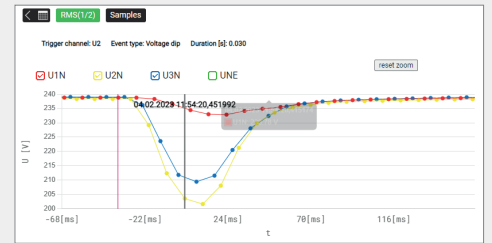
- Review of the energy supply contract
- Proof of compliance
- Time-dependent power quality



EVENTS

For voltage events (dip, swell, interruption, rapid voltage change), current swells or frequency deviations all voltages and concurrently up to 36 currents are recorded. In addition, ripple control sequences can be detected and recorded.

- Disturbance analysis
- Fault localization



LOAD FLOW

Acquisition of the load profiles and power factors, short-term load peaks and meter values for each monitored phase and each of the up to 9 measuring points.

- Transparent temporal energy demand
- Analysis of transformer or feeder load
- Overload phases become visible



#	time	P ST (kW)
1	04.03.2023, 00:00:00.000	48826.05
2	05.03.2023, 00:00:00.000	48922.94
3	04.03.2023, 00:00:00.000	48363.91
4	02.03.2023, 00:00:00.000	48959.23
5	01.03.2023, 00:00:00.000	48129.19
6	28.02.2023, 00:00:00.000	42311.34
7	27.02.2023, 00:00:00.000	44875.15
8	26.02.2023, 00:00:00.000	44253.75
9	25.02.2023, 00:00:00.000	43553.84
10	24.02.2023, 00:00:00.000	42340.31
11	23.02.2023, 00:00:00.000	42299.95
12	22.02.2023, 00:00:00.000	41413.40
13	21.02.2023, 00:00:00.000	40557.90

SCALABLE

Up to 9 measuring points with 3 or 4 currents each can be monitored with one device only.

This way for example the transformer busbar and 8 outgoing feeders can be monitored at the same time.





TRANSPARENCY IN ENERGY DISTRIBUTION

Distribution system operators provide their customers with energy in the agreed quantity and quality in order to be able to check compliance with these services, they need information about the time-dependent load flows and the resulting voltage quality. As long as the grid sections are not overloaded and no power quality limits are violated, there is no need to regulate consumption or for expensive grid reinforcements.

With the LINAX® PQ5000MOBCL-MULTI PQ system, a scalable current measurement in the field was combined with a metrologically certified

power quality monitoring solution in class A in a base unit. The individual current channels of the current link modules are synchronized with the voltage measurement. This not only provides a comprehensive power analysis on all channels, but also a detailed event recording with all voltages and up to 36 currents, if a voltage event or a current swell should occur in one of the monitored channels.



	PQ5000MOBCL-MULTI PQ
Voltage connections	5
Number of Current Link modules	up to 9
Current channels per Current Module	up to 36
Function class acc. IEC 61000-4-30	Class A
Device type acc. IEC 62586-1	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 change (RVC)	▪
Current swell	▪
Frequency anomaly	▪
Ripple control sequences	▪
MEASUREMENT UNCERTAINTY	
Voltage	±0,1%
Current Current Module 3P/3PN	±0,5%
Power Current Module 3P/3PN	±2.0% (typically)
Active energy Current Module 3P/3PN	Class 3 (typically)
COMMUNICATION	
Ethernet: Webserver, NTP	▪
POWER SUPPLY	
Consumption	100...230V AC/DC ≤ 60VA
DESIGN	
Dimensions base unit	360 x 304 x 194mm

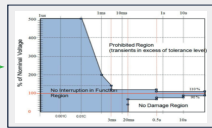
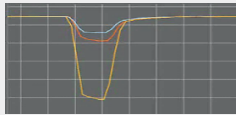


POWER QUALITY



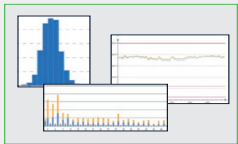
- Class A according IEC 61000-4-30 Ed. 3
- Independently certified by Federal institute of Metrology according IEC 62586-2
- Flicker meter class F1
- Reliable source of information for regulatory agencies, energy suppliers or for internal quality control

Voltage events



Classification using ITIC curve

Compliance assessment



- Reporting via WEB interface of the device
- Tamper-proof PDF format
- Selectable reporting duration
- Selectable reporting scope (overview, statistic details, event overview)
- Direct compliance assessment of standards EN 50160, IEC 61000-2-2 / 2-4 / 2-12 or customer-specific limits
- Customer-specific company logo in report header
- Data export in CSV file format

POWER QUALITY ANALYSIS

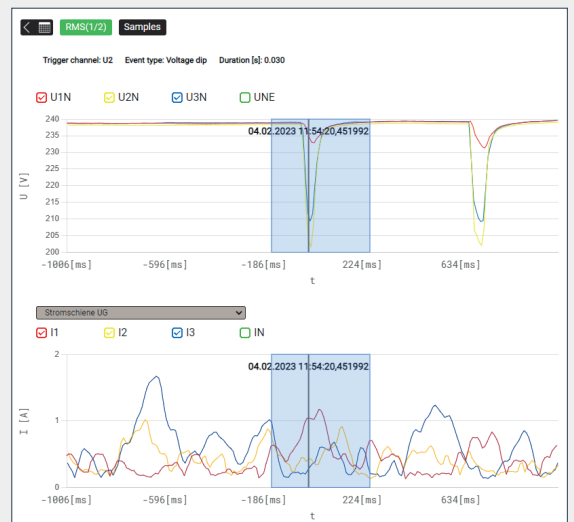
All of the PQ data acquired by the device can be directly visualised and analyzed via the device website. Additional software is not required.

PQ events

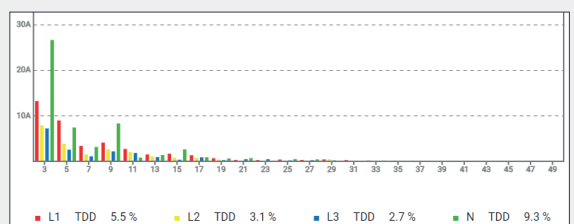
- PQ event list with trigger source, event type, event duration and characteristic event values
- Direct display of event details by selecting an entry in the event list with the option of time zoom and value display
 - RMS 1/2 values for all currents and voltages
 - Waveform of all voltages
- Recording of ripple control sequences to verify the ripple control level and pulse sequences at the receiver

PQ statistics

- Overview of compliance to a selectable standard. Depending on the standard selected, more or less criteria are taken into consideration.
 - Daily progressions of all acquired PQ voltage and current quantities, display with/without limit values and fluctuation range
 - PQ Easy Report: Creation of a compliance report (pdf format) of a selectable extent
- Using the CSV data export, PQ data assessment can also be delegated to software solutions like PQIS.



PQ event recording with zoom option



Harmonic / interharmonic analysis for all 4 currents of each Current Module, also available as 10-min mean-values



ENERGY AND LOAD FLOWS

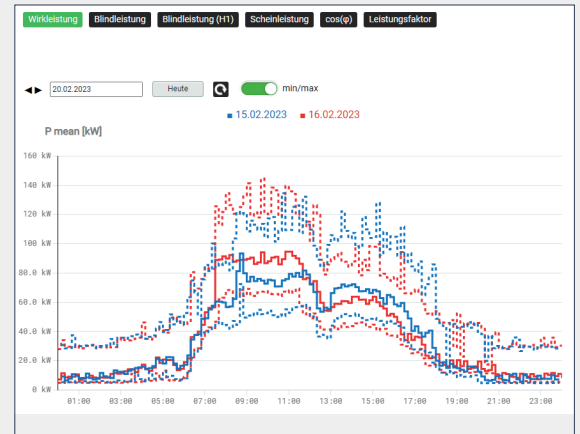
Load flows

For the evaluation of temporal energy flows, load profiles and power factors as well as meter values for each monitored phase and summarized for each of the up to 9 measuring points are recorded.

The device continuously analyzes the load flows on all channels of the current measurement modules and saves this information in the programmable averaging interval for later analysis:

- Load profile: P / Q / Q(H1) / S, total and per phase
- Load factors: cos(Phi) / PF, total and per phase

Since the minimum and maximum values are also recorded for each interval, the entire range of load fluctuations, including short-term peak loads, becomes transparent.



Load profile with range of fluctuation

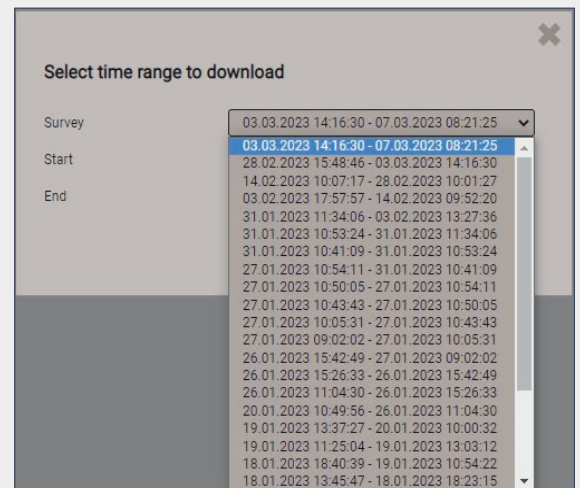
DATA EXPORT OPTIONS

CSV data pool

All measured value information can be queried and evaluated directly via the device website. So that the data analysis can also be delegated to a specific evaluation software, the device also provides the load flow and PQ information in form of CSV daily files in the internal data memory:

- Mean values for power quality assessment
- Mean values for the quality of the currents of each Current Module
- Mean values (configurable interval) of the power quantities of each Current Module for load profile analysis
- PQ event list
- Measured voltages and currents during PQ events
- List of mains signalling events
- Measured values for mains signalling events

These files can be downloaded at any time for a selectable time range, even during an ongoing measurement campaign.

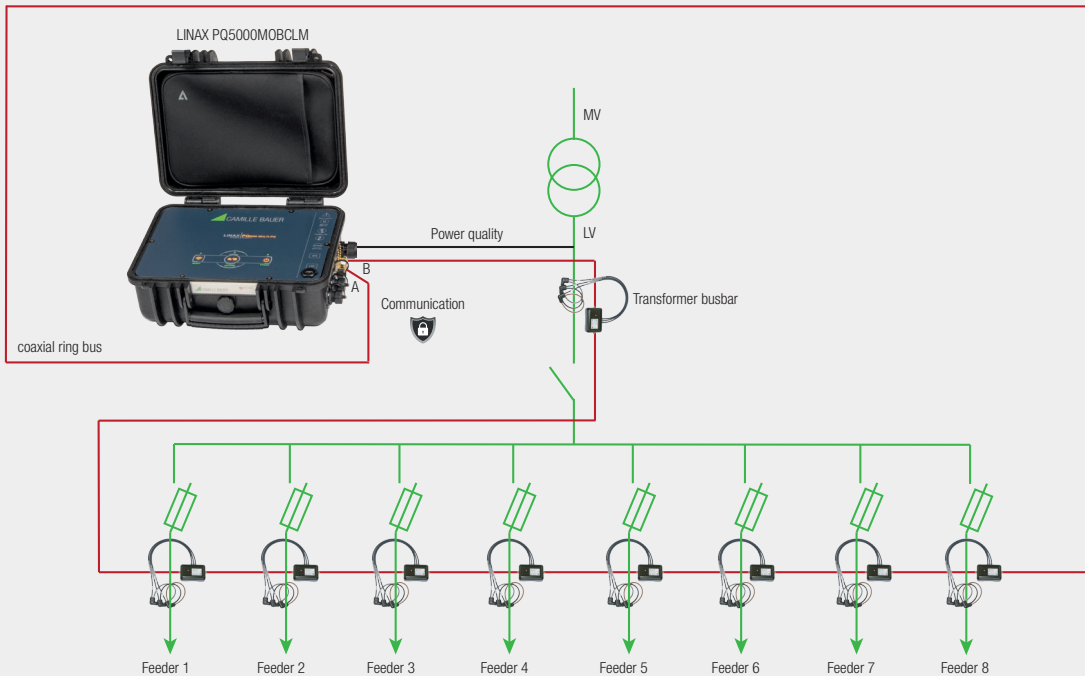


Selection of CSV data to download



EXAMPLE OF A MEASUREMENT SETUP

Concurrent measurement of transformer busbar and 8 feeders



COMMISSIONING AND SERVICE

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

Vector diagram / phase sequence indicator / energy direction

With these displays, you can easily verify at a glance 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 recognized.

Communication tests

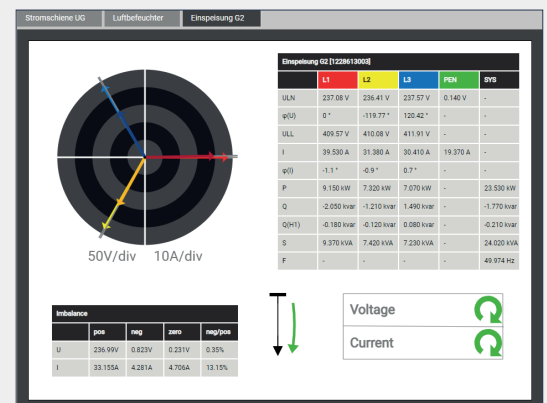
Allow the verification of the network settings made

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 updated during a firmware update thus always documenting the implemented version

Deletion of data

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



Vector diagram to control connections



FAST INSTALLATION

The system not only offers extremely high measurement and data performance, but also enables the hardware components to be installed very quickly in the field while the system is in operation.

The non-invasive Current Link modules with Rogowski technology on the measuring loops ensure smooth and safe installation. The coaxial ring bus line can also be laid easily. Nothing more is required for the current measurement, as the current link modules are also powered via the ring bus line.

The voltages are connected via fused measuring lines. The measuring device is supplied via a 300V OVC IV power pack, directly via a power socket with a protective conductor.



Field installation of Current Link modules

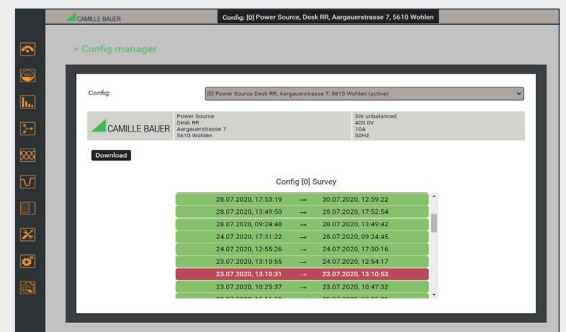
MEASURING CAMPAIGNS

The device supports measuring campaigns, i.e. repeated measurements at the same locations, to observe changes in power quality and system load at these points. Up to 20 configurations can be stored in the device for this purpose and are respectively activated prior to the start of a measurement.

- Configuration manager for up to 20 measurement locations with up to 9 measurement points each
- Any number of campaigns per measurement location
- Delimitation of individual campaigns by recording start / stop
- Data analysis with measured data of the active configuration

The device can thus be used to take measurements at up to 20 locations without having to read out data in the meantime.

The configuration manager shows at which locations and for which periods measurements were made.



Measurement overview in the configuration manager



CYBER SECURITY

Critical infrastructures are increasingly the target of cyber attacks. There is not only the attempt of stealing data by unauthorized access or eavesdropping of communication but also the limitation or even interruption of the energy supply by manipulating data or data traffic. A comprehensive safety concept on plant level comprising each component in the grid is required to repel such attacks. The safety

mechanisms integrated into the LINAX® PQ5000MOBCL-MULTI PQ support such concepts, thus contributing to a safe energy supply.

Even if for mobile measurements there is often no communication network available or it cannot be used for security reasons, the RBAC can ensure that the data and its integrity remain protected on site.

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. 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 (CBM or client certificate)
- **Audit log:** Logging of all activities relevant to security. Option for transferring such logs to a central network monitoring server using the Syslog protocol.
- **Client Whitelist:** Limitation of computers authorised to access the device
- **Digitally signed firmware files** for safe updates

	admin	localgui	anonymous	Operator1	Operator2	Operator3	[API]AccessKey
Local account (no weblogin)	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Instantaneous values	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Energy	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Harmonics	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Phasor diagram	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Waveform	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Events	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
PQ statistic	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Service	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Reset values	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Reset/Update device	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Audit Log	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Use IO simulation	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Settings	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Basic device settings	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Measurement	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Communication	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Security system	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

1 2 3 4 5 +5> Results per page 25

Filter: Emergency Alert Critical Error Warning Notice Info Debug

Time	PID	Priority	IP address	User name	Message
10.09.2020, 14:18:44	cb-gui	Notice	192.168.57.18.61983	admin	User logged in successfully
09.09.2020, 17:40:25	cb-gui	Info	192.168.57.50.62204	admin	User has been logged out due to inactivity
09.09.2020, 17:19:51	cb-pq5000mob	Notice	localhost	system	Logger started on configuration 16
09.09.2020, 17:19:45	cb-pq5000mob	Notice	localhost	system	Logger stopped on configuration 16
09.09.2020, 17:19:39	cb-gui	Notice	192.168.57.50.61450	admin	User logged in successfully
09.09.2020, 17:18:21	runsv	Critical	localhost	system	Process cb-gui(2072) has unexpectedly stopped running
09.09.2020, 08:46:26	cb-gui	Info	192.168.57.50.63721	admin	User has been logged out due to inactivity
09.09.2020, 08:26:27	cb-gui	Notice	192.168.57.50.63483	admin	User reviewed latest security event log (allow)
09.09.2020, 08:26:23	cb-gui	Notice	192.168.57.50.63457	admin	User logged in successfully
08.09.2020,	cb-gui	Info	system	admin	Login session timeout

Audit log with filter option

RBAC access rights of different users



TECHNICAL DATA LINAX® PQ5000MOBCL-MULTI PQ

MEASUREMENT INPUTS

VOLTAGE

Nominal voltage:	57.7...400 V _{LN} (UL: 347 V _{LN}), 100...693 V _{LL}
Measurement range max.:	520 V _{LN} , 900 V _{LL} (sinusoidal)
Measurement category:	600 V CAT IV
Uncertainty:	± 0,1%
Consumption:	≤ U ² / 1.54 MΩ per phase
Impedance:	1.54 MΩ per phase
Overload capacity:	permanent: 520 V _{LN} , 900 V _{LL} 10 x 1 s, interval 10 s: 800 V _{LN} , 1386 V _{LL}

CURRENT LINK MODULE 3P / 3PN

Measurement range 1:	400 A (typ.), 1000 A (max.)
Measurement range 2:	8 kA (typ.), 20 kA (max.);
Measurement category:	600 V CAT IV
Uncertainty:	± 0.5% (with centered conductors and without external field)
Angular error:	± 1.0°
Design:	3 or 4 Rogowski coils
Housing:	Polycarbonate (Makrolon) with impact test according to IEC 61010-1, chapter 8
Diameter:	approx. 6mm (Rogowski coil)
Loop diameter:	75 or 100mm (Rogowski coil)
Connection:	SMA connecting lines
Communication:	Coaxial ring bus with max. 20m

MEASUREMENT UNCERTAINTY

Reference conditions: According to IEC/EN 60688, environment 23°C±1K, sinusoidal input, Rogowski current measurement with centered conductor and without external field.

Voltage	± 0.1 %
Current	± 0.5 %
Power	± 2.0 % (typically)
Power factor	± 1.0°
Frequency	± 0.01 Hz
Active energy	Class 3 (typically)
Reactive energy	Class 3 (typically)

CONNECTION TYPE: 4-wire, unbalanced load

NOMINAL FREQUENCY: 42...50...58Hz

SAMPLING RATE: 18 kHz (U), 54 kHz (I)

DATA MEMORY INTERNAL: 64 GB

POWER SUPPLY

Rated voltage:	100...230 V AC 50/60Hz / DC ±15%
Overvoltage category:	OVC IV 300 V
Consumption:	≤ 55 VA (with 9 Current Modules)

COMMUNICATION

ETHERNET

Standard protocols:	via RJ45 NTP, http, https, IPv4, IPv6
Physics:	Ethernet 100BaseTX
Mode:	10/100 Mbit/s, full/half duplex, autonegotiation

WLAN

Standard protocols:	via USB socket http, https
Access Point:	Up to 10 clients

INTERNAL CLOCK (RTC)

Uncertainty:	± 2 minutes/month (15 to 30°C)
Synchronization:	via Ethernet (NTP protocol) or GPS
Power reserve:	> 10 years

ENVIRONMENTAL CONDITIONS, GENERAL INFORMATION

Operating temperature:	-10 up to 15 up to 30 up to +55 °C
Storage temperature:	-25 up to +70 °C
Temperature influence:	0.5 x basic uncertainty per 10 K
Long-term drift:	0.5 x basic uncertainty per year
Application group:	II (acc. EN 60 688)
Relative air humidity:	<95 % without condensation
Operating altitude:	≤2000 m above NN

MECHANICAL PROPERTIES

Weight base unit:	4.8 kg
Dimensions base unit:	L x W x H = 360 x 304 x 194 mm

SAFETY

Current inputs are galvanically isolated from each other.

Protection class: II (protective insulation, voltage inputs via protective impedance)

Pollution degree: 2

Ingress protection: IP65 (base unit, housing cover closed)

IP67 (Rogowski coils)

IP43 (Current Link module)



ORDER CODE

ORDER CODE PQ5000MOBCLM-

Mobile Power quality analyzer acc. IEC 61000-4-30 class A, CAT IV 600 V, WLAN Access Point, connectivity for GPS receiver, with 5 voltage measurement cables incl. dolphin clamps and device handbook in carrying bag

1. UNINTERRUPTIBLE POWER SUPPLY	
With	1
2. POWER SUPPLY	
Mains adapter 100 ... 230 V AC/DC, OVC IV 300V, CEE 7/7 plug	2
Mains adapter 100 ... 230 V AC/DC, OVC IV 300V, T12 plug	3
3. GPS TIME SYNCHRONIZATION	
With GPS time synchronization, without GPS receiver	1
4. DEVICE HANDBOOK	
German and English	D



Carry bag



Base unit

ACCESSORIES	ARTICLE NO.
Current module 3P, with 3-fold Rogowski converter Ø75mm, approx. 0.5 m connection cable Colors: L1 = brown, L2 = black, L3 = grey	187 593
Current module 3PN, with 4-fold Rogowski converter Ø75mm, approx. 0.5 m connection cable Colors: L1 = brown, L2 = black, L3 = grey, N = blue	187 105
Current module 3P, with 3-fold Rogowski converter Ø100mm, approx. 0.5 m connection cable Colors: L1 = brown, L2 = black, L3 = grey	189 137
Current module 3PN, with 4-fold Rogowski converter Ø100mm, approx. 0.5 m connection cable Colors: L1 = brown, L2 = black, L3 = grey, N = blue	189 129
SMA connection cable BM-RCM, length 0.5 m	187 634
SMA connection cable BM-RCM, length 1 m	188 585
SMA connection cable BM-RCM, length 2 m	190 777
SMA connection cable BM-RCM, length 5 m	187 642
SMA connection cable BM-RCM, length 10m	187 650
GPS receiver 16x-LVS, configured	181 131
Carry bag, 30 x 22 x 33cm, for base unit or accessory	182 634
Drawstring bag green, 25 x 30cm, for Current Module or cables	190 545
RJ45 cable, IP protected, length 5m	183 004
Analysis software PQIS®: License Workstation	190 969
Analysis software PQIS®: DataConverter	190 977
Analysis software PQIS®: Recurring maintenance costs	190 985



Current Module 3P,
with 3-fold Rogowski converter



Current Module 3PN,
with 4-fold Rogowski converter



SMA connection cable BM-RCM



Dolphin clamps





Mains adapter

SPARE PARTS (IN SCOPE OF SUPPLY)	ARTICLE NO.
Mains adapter 100...230 V AC/DC, OVC IV 300V, plug T12	183 038
Mains adapter 100...230 V AC/DC, OVC IV 300V, plug CEE 7/7	183 038
Dolphin clamp red	182 709
Dolphin clamp blue	182 717
Dolphin clamp yellow/green	182 725
WLAN access point dongle	181 701



GMC INSTRUMENTS

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