CAMILLE BAUER
GMC-INSTRUMENTS GROUP

CERTIFIED POWER SYSTEM ANALYSIS

MOBILE POWER QUALITY AND ENERGY CONSUMPTION MONITORING

PQ-EASY REPORT

LINAX PQ5000 MOBILE

IEC 61000-4-30 ED. 3.0 CLASS A METAS

MOBILE POWER QUALITY AND ENERGY CONSUMPTION MONITORING

Power grids ensure that consumers can be supplied with electrical energy. The requirements for the quantity, availability and quality of the energy vary according to the consumer and are therefore contractually agreed between the consumer and the supplier. This way a trouble-free operation of customer installations should be ensured without unduly influencing other energy consumers on the same network.

By means of the mobile measurement solution **LINAX PQ5000-Mobile** the operational aspects of the energy supply can be verified.

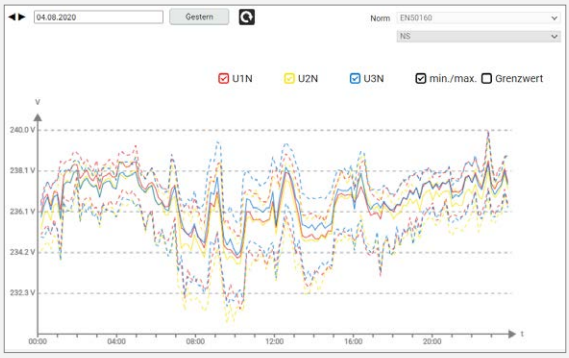
LINAX PQ5000-MOBILE constitutes a metrologically independently certified Class A device according to IEC 61000-4-30 Ed. 3. It is based on standardised interfaces, generates conformity reports directly via the device website and excels with a comprehensive cyber security concept.

MONITORING OPTIONS AND BENEFITS

Statistical evaluation (Quality of supply)

PQ conformity assessment according to EN50160, IEC61000-2-2/2-4/2-12, GB/T, IEEE519, own limits

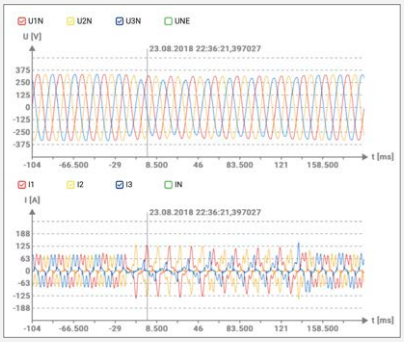
→ Ensure trouble-free operations of the loads
→ Delivery contract complied?

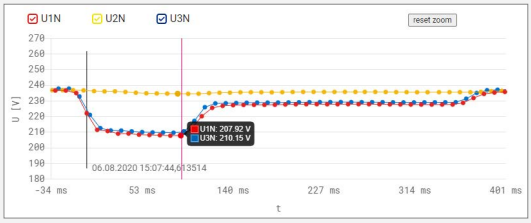


Recording of malfunctions (Availability of supply)

Detection of voltage events (dip, interruption, swell, rapid voltage changes, ripple control)

→ Find the sources of disturbances and correct them
→ Safe thanks to UPS

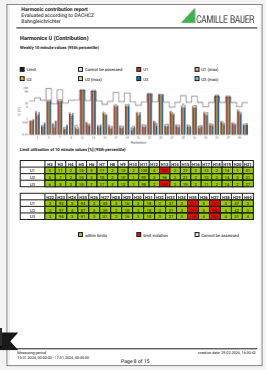


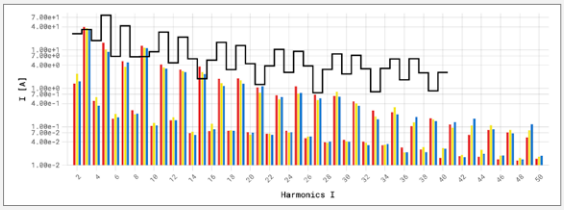


Assessment of harmonic contribution

e. g. according to DACHCZ Ed. 3, IEEE 519, DTR, IEEE 1547, GB/T…

→ Trouble-free due to optimum voltage quality

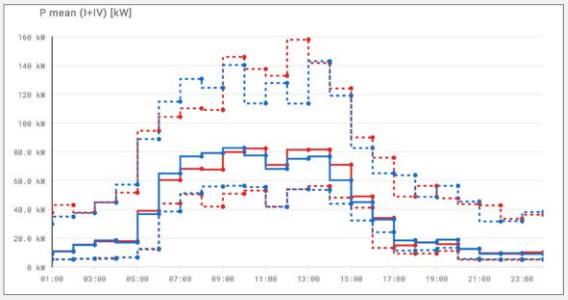




Energy flow - analysis

Acquisition of load profiles, short-term load peaks and metering values

→ Save costs due to energy management



time	P (I+IV) [kW]	min P (I+IV) [kW]	max P (I+IV) [kW]
12.02.2019 00:05:00,000	9.01	5.34	16.64
12.02.2019 00:10:00,000	9.45	5.29	30.01
12.02.2019 00:15:00,000	12.39	5.96	30.73
12.02.2019 00:20:00,000	13.38	5.85	17.93
12.02.2019 00:25:00,000	9.99	5.81	32.74
12.02.2019 00:30:00,000	9.17	5.82	18.2
12.02.2019 00:35:00,000	10.28	5.78	31.24
12.02.2019 00:40:00,000	9.62	5.77	29.61
12.02.2019 00:45:00,000	6.74	5.65	15.95
12.02.2019 00:50:00,000	10.44	5.74	28.92
12.02.2019 00:55:00,000	14.05	5.8	32.1
12.02.2019 01:00:00,000	12.45	5.7	17.48
12.02.2019 01:05:00,000	16.94	12.18	37.18
12.02.2019 01:10:00,000	8.27	5.79	31.4
12.02.2019 01:15:00,000	11.24	7.16	17.69
12.02.2019 01:20:00,000	11.16	7.21	30.85
12.02.2019 01:25:00,000	10.71	7.4	32.33
12.02.2019 01:30:00,000	9.51	5.76	29.22

CONNECTION OPTIONS AND VARIANTS

SECURE COMMUNICATION

- Password
- https
- Client whitelist
- VPN upon request

UPS

5x3 min.

Lockable and waterproof

$U_{1,2,3,N,PE}$

Direct measurement via fused voltage taps

$I_{1,2,3,N}$

Rogowski coils or current clamps

WLAN

Commissioning, configuration, data analysis

LAN

GPS

Time synchronisation

ACCESSORIES

fused voltage taps
(always included)

Current clamps

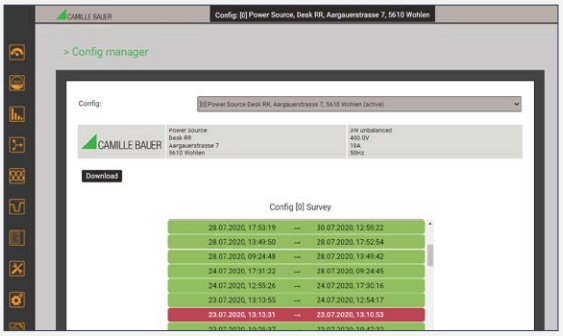
Rogowski coils

GPS receiver
for time synchronisation

MEASURING CAMPAIGNS

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

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



OPERATION AND EVALUATION

No software is required for the parameterization of the device or the evaluation of the measurement results. The **WEB interface** of the device provides all required functions. These can be used via mobile phone, tablet or laptop via the LAN or WLAN interface.

Status bar

- Complete device parameterization
- Measurement data visualization
- Bar with the current status of UPS, memory usage, recording, WLAN, LAN, alarm, RBAC
- Service functions
- PQ Easy-Report for compliance reports
- Complete device parameterization
- Data export in CSV format (load profiles, waveform, event lists)

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.

Vector diagram to control connections

Communication tests

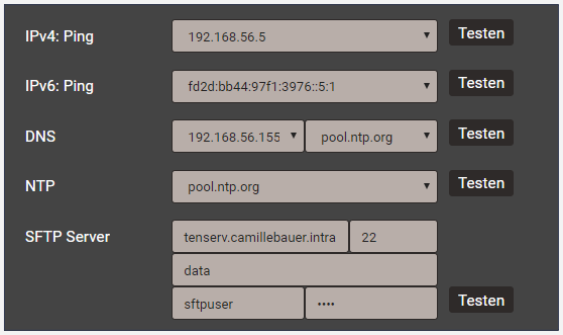
These functions allow the network settings to be checked so that the communication structure functions reliably during operation.

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.



Communication tests: Control of network structure

ASSESSMENT OF HARMONIC CONTRIBUTION (OPTION)

In order for the DSO to keep the power quality at the point of coupling to customer installations within the agreed limits, none of these installations is allowed to emit more interference into the grid than it is entitled to, based on the connection power. Only this way it can be ensured that the provided quality of the supply voltage enables a trouble-free operation of all connected loads.

Before new customer installions are connected to the distribution network, relevant guidelines (e. g. DACHCZ Ed. 3) are used to check whether this installation can be connected to the grid without any restrictions or whether measures, such as the installation of a filter system, are required.

The option for the **assessment of harmonic contribution** allows to provide the metrological proof of compliance with the limits for harmonic emissions after an installation has been connected. Of course, any existing customer installation can also be checked for impermissible emission values.

Procedure of the campaign

1. Input

Plant-specific parameters

Impedance information:
Reference impedance (e. g. DACHCZ, etc.)
or
Real measured
grid impedance parameters (fNI)

Network and connection point
S_K Short circuit power
S_A Connected load
U_{LL} Rated voltage
Z_K Short circuit impedance (magnitude and phase)
Z_N Neutral impedance

2. Measurement on the system

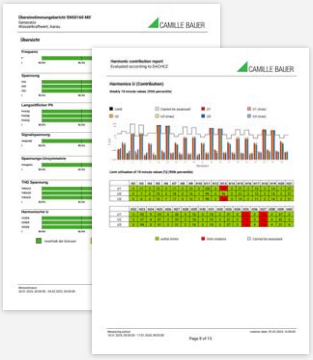
LINAX® PQ5000-Mobile, Class A

Systems such as districts, large photovoltaic parks, large individual consumers, charging parks, large battery storage systems, Combined heat and power unit, etc.

3. Output

Reports

Compliance report (e. g. EN50160)



Report about the emission of harmonics e. g. DACHCZ Ed. 3

Benefits and findings of the harmonic contribution assessment

- Metrological proof of compliance with the harmonic limit values in report form
- Identification of customer installations with impermissible high system perturbation
- Detecting existing interactions between grid and customer installation (e. g. compensation effects)
- Avoiding investments in unnecessary mitigation measures
- Consideration of disturbances in the neutral conductor for customer installations far away from the transformer
- More reliable operation of existing and future networks with more efficient use of the grid infrastructure
- Increased security of supply
- No in-depth knowledge about the assessment of harmonic contribution required
- Unknown system parameters can be replaced with standard values
- Various standards are taken into account (e.g. according to DACHCZ Ed. 3, IEEE 519, DTR, IEEE 1547, GB/T...)

DATA EXPORT OPTIONS

Using the data export scheduler, measured value information can be saved as CSV or PQDIF files in the device or forwarded to an SFTP server if required. This type of communication can also be used to transmit measured value information via secure network structures, for example via smart meter gateways.

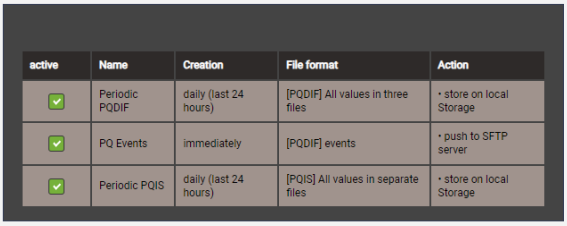
Selection of CSV data to download

CSV data pool

The following load flow and PQ information is stored in the internal data storage in the form of CSV daily files:

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

This data pool can be downloaded at any time for a selectable time range, even during an ongoing measurement campaign. This allows PQ data assessment to be delegated to software solutions like PQIS®.



active	Name	Creation	File format	Action
☑	Periodic PQDIF	daily (last 24 hours)	[PQDIF] All values in three files	• store on local Storage
☑	PQ Events	immediately	[PQDIF] events	• push to SFTP server
☑	Periodic PQIS	daily (last 24 hours)	[PQIS] All values in separate files	• store on local Storage

Overview of data export settings

PQDIF files

The same measurement data can also be saved and transferred in the standardized PQDIF format.

- Periodic PQDIF files include trends and event data for a day or a week
- PQDIF files with event data can be generated after a PQ event and used for immediate alarming

CERTIFIED POWER QUALITY MONITORING

- Independent certification by Federal Institute of Metrology METAS
- Device type PQI-A FI2 acc. IEC 62586-1
- Proven at 230V / 50 Hz and 120V / 60Hz
- Flicker meter class F1
- Flagging concept: Multiphase approach in accordance with IEC 61000-4-30
- Active energy class 0.2S

Thanks to the certification according to IEC 62586-2 (standard for verifying compliance with IEC 61000-4-30) the device can serve as a reliable and comparable source of information for regulatory agencies, for negotiations with energy suppliers or for internal quality control.

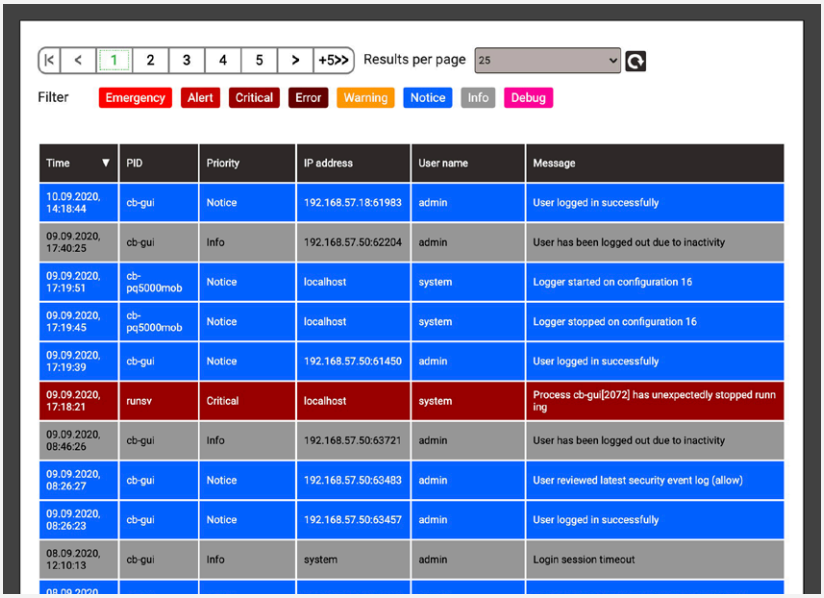
CYBER SECURITY

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.

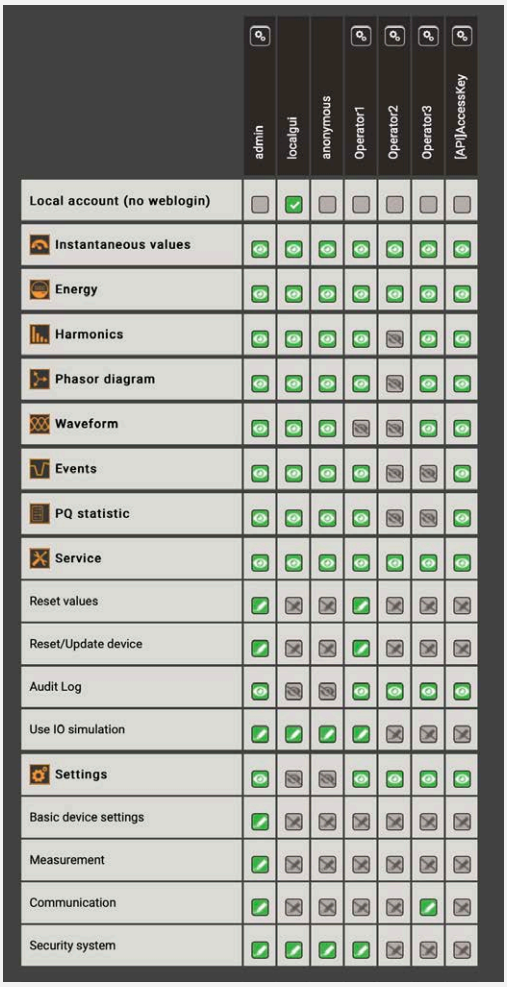
A comprehensive safety concept on plant level comprising each grid component is required to repel such attacks. The safety mechanisms integrated into LINAX PQ5000-MOBILE support such concepts, thus contributing to safe energy supplies.

SAFETY MECHANISMS

- **Role-Based Access Control (RBAC)**
  Only those access rights are granted to users which they need for their activities, no plain-text transmission of login information, increase of the latency period in case of repeated login attempts, software access only via access keys
- **Encoded data transmission via HTTPS**
  using root certificates (CBM or client certificate)
- **Audit log**
  Logging of all activities relevant to safety. Transfer option to central grid monitoring server by Syslog.
- **Client white list**
  Limitation of computers authorised to access on basis of the IPv4/IPv6 address
- **Digitally signed firmware files for safe updates**
  Safe updating due to the prevention of manipulated firmware



Audit log with filter option



RBAC access rights of different users

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.

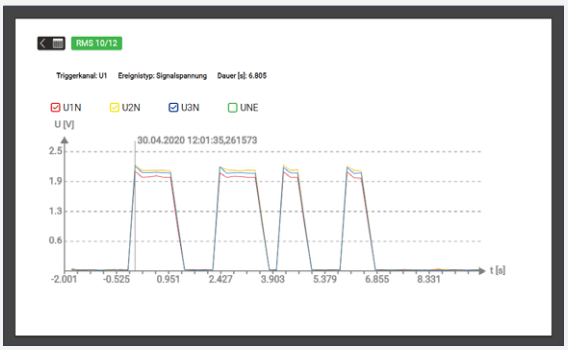
PQ events

- 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 1/2 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

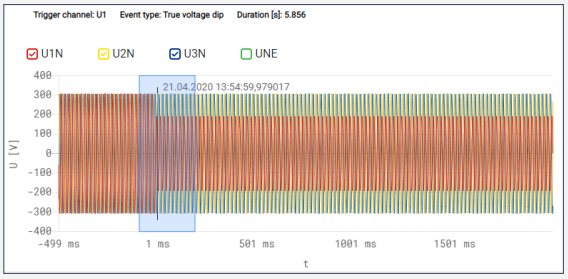
PQ statistics

- 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 and COMTRADE, the analysis of PQ data can also be delegated to a software solution like PQView4. Freely available viewers, e.g. PQDiffractor of Electrotek Concepts, may be used for analysis purposes.



Ripple control sequence acquired as an event



Curve shape recording of an event with zoom option

PQ EASY-REPORT

PQ-EASY REPORT

- Preparation of reports via the device web interface
- Tamper-resistant PDF format
- Selectable report duration (multiples of 10 minutes - recommended for minimum 7 days)
- 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
- Report on compliance with harmonic emission limits, e. g. in accordance with DACHCZ Ed. 3
- Customer specific logo in the report

TECHNICAL DATA

INPUTS

NOMINAL VOLTAGE	57.7 … 400 V_{LN}, 100 … 693 V_{LL}
Maximum	520 V_{LN}, 900 V_{LL} (sinusoidal)
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
CURRENT SENSORS	depends on the device variant
Rogowski coils	Measurement up to 3800 A
Current clamps	10 A , 100 A or 1000 A
Sampling rate	18 kHz
Data memory internal	16 GB
POWER SUPPLY	Standard
Power adapter	100…230 V AC 50/60Hz ±15%
Consumption	≤ 20 VA
POWER SUPPLY	Accessory
Rated voltage	100…230 V AC 50/60Hz ±15%
Overvoltage category	OVC IV 300 V
Consumption	≤ 20 VA

UNINTERRUPTIBLE POWER SUPPLY

Capacity	1150 mAh, 4.5 Wh
Operating duration	5 times 3 minutes
Life time	3 up to 5 Years

TYPES OF CONNECTION

- Single phase
- Split phase (2-phase system)
- 3 or 4-wire balanced load
- 3-wire unbalanced load, Aron connection
- 3 or 4-wire unbalanced load

BASIC UNCERTAINTY

(additional uncertainty due to current sensors not considered)

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/EN 62 053-22)
Reactive energy	Class 0.5S	(IEC/EN 62 053-24)

INTERFACES

ETHERNET	Standard
Physics	Ethernet 100 Base TX; RJ45 socket
Mode	10/100 MBit/s, full/half duplex, autonegotiation
Protocols	Modbus/TCP, http, https, IPv4, IPv6, NTP
WLAN ACCESS POINT	Standard
Connection	via USB socket
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	–10 up to 15 up to 30 up to + 55 °C
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

SAFETY

Protection class	II (protective insulation, voltage inputs via protective impedance)
Pollution degree	2
Protection	IP65 (closed housing)
Measurement category	600 V CAT III / 300 V CAT IV

ORDER CODE

LINAX® PQ5000-MOBILE, Mobile power quality monitor acc. IEC 61000-4-30 Class A

Current measurement		Current sensors	GPS time synchronization		Device handbook	Uninterruptible power supply	Evaluation of the harmonic emission		Type code
Connectors for 4 current clamps (/1V)	Connector for 4 phase Rogowski probe	None	Without	With GPS time synchronization with GPS receiver	Only online	With UPS	Without	With	
•	-	•	•	-	•	•	•	-	PQ5000MOB-2000 10
•	-	•	•	-	•	•	-	•	PQ5000MOB-2000 11
-	•	•	•	-	•	•	•	-	PQ5000MOB-3000 10
-	•	•	•	-	•	•	-	•	PQ5000MOB-3000 11

ACCESSORIES	ART. NO
Current clamp 1 A / 1 V (only for PQ5000MOB-2)	191 169
Current clamp 5 A / 1 V (only for PQ5000MOB-2)	191 177
Current clamp 10 A / 1 V (only for PQ5000MOB-2)	182 775
Current clamp 100 A / 1 V (only for PQ5000MOB-2)	182 808
Current clamp 1000 A / 1 V (only for PQ5000MOB-2)	182 783
4-fold Rogowski current probe 2000 A (only for PQ5000MOB-3)	181 727
Standard power adapter 100-230 V AC (included)	183 038
World plug set	191 873

ACCESSORIES	ART. NO
Power adapter OVC IV, 100-230 VAC-12 VDC, CEE7/7 plug	191 513
Power adapter OVC IV, 100-230 VAC-12 VDC, T12 plug	191 521
Dolphin clamp red (included)	182 709
Dolphin clamp blue (included)	182 717
Dolphin clamp yellow/green (included)	182 725
GPS receiver 16x-LVS for PQ5000MOB, configured	181 131
RJ45 cable, IP protected, length 5m	183 004
WLAN access point dongle (included)	181 701
Carrying case (included)	182 634

DIMENSIONS AND CONNECTIONS

Dimensions W x H x D: 25 cm x 12 cm x 23 cm

Device variant with current measurement via 4-phase Rogowski probe

Device variant with current measurement via current clamps xA/1V

CAMILLE BAUER
GMC-INSTRUMENTS GROUP

Camille Bauer Metrawatt AG
Aargauerstrasse 7 ▪ 5610 Wohlen ▪ Switzerland
TEL +41 56 618 21 11

www.camillebauer.com ▪ sales@camillebauer.com

Subject to change without notice ▪ SM-1049-000-06-EN-04.24
1002161-000-05