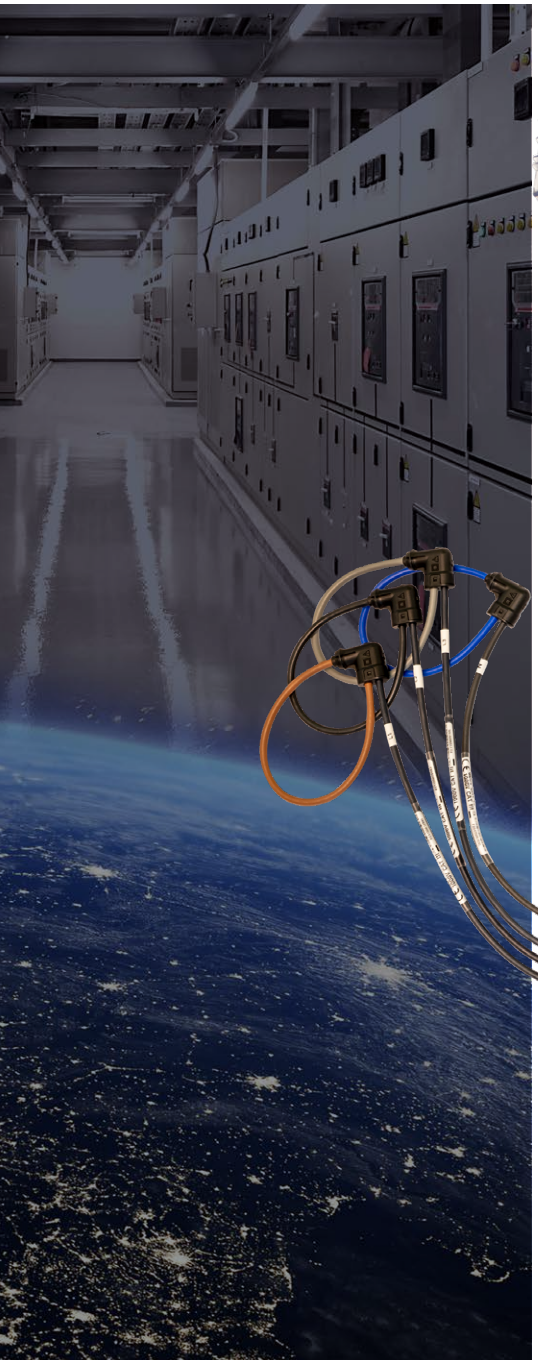
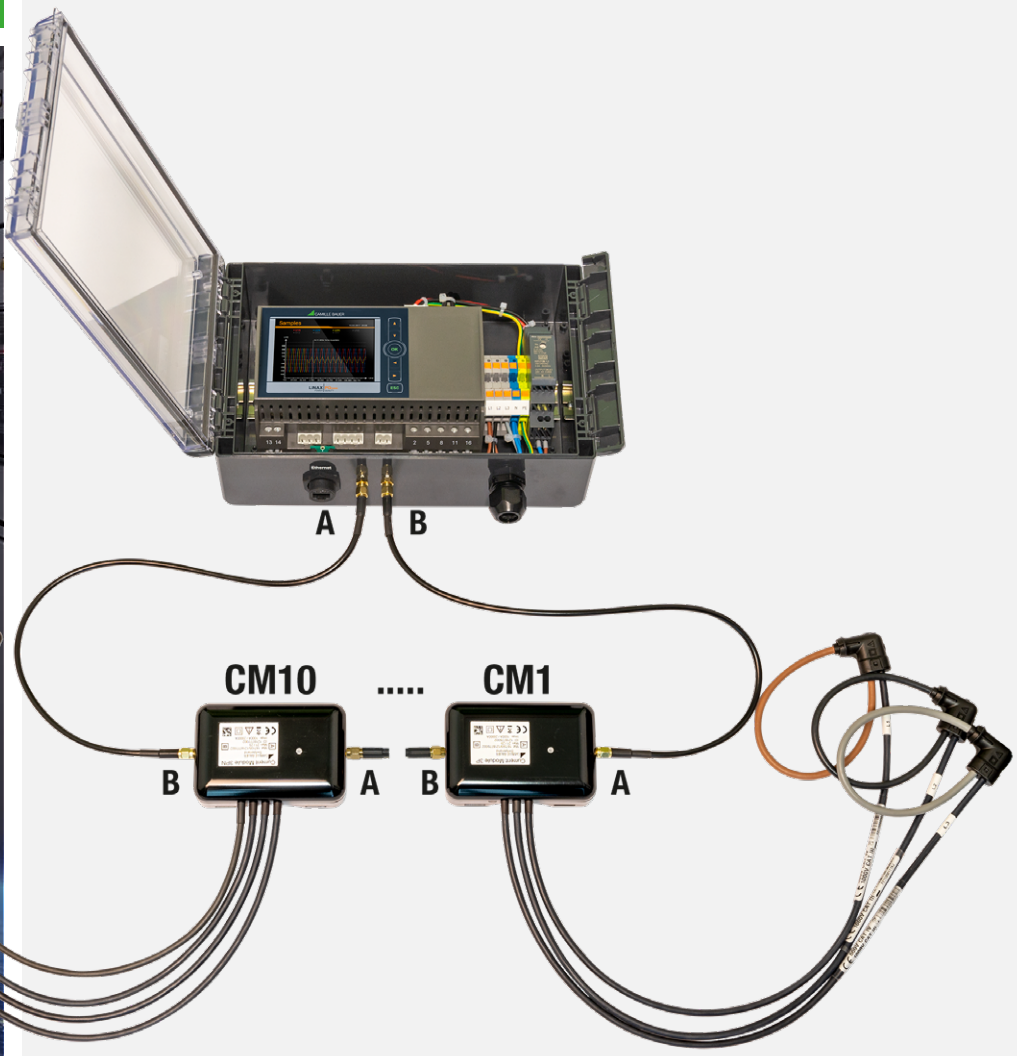
CAMILLE BAUER

TRANSPARENCY IN THE SMART GRID

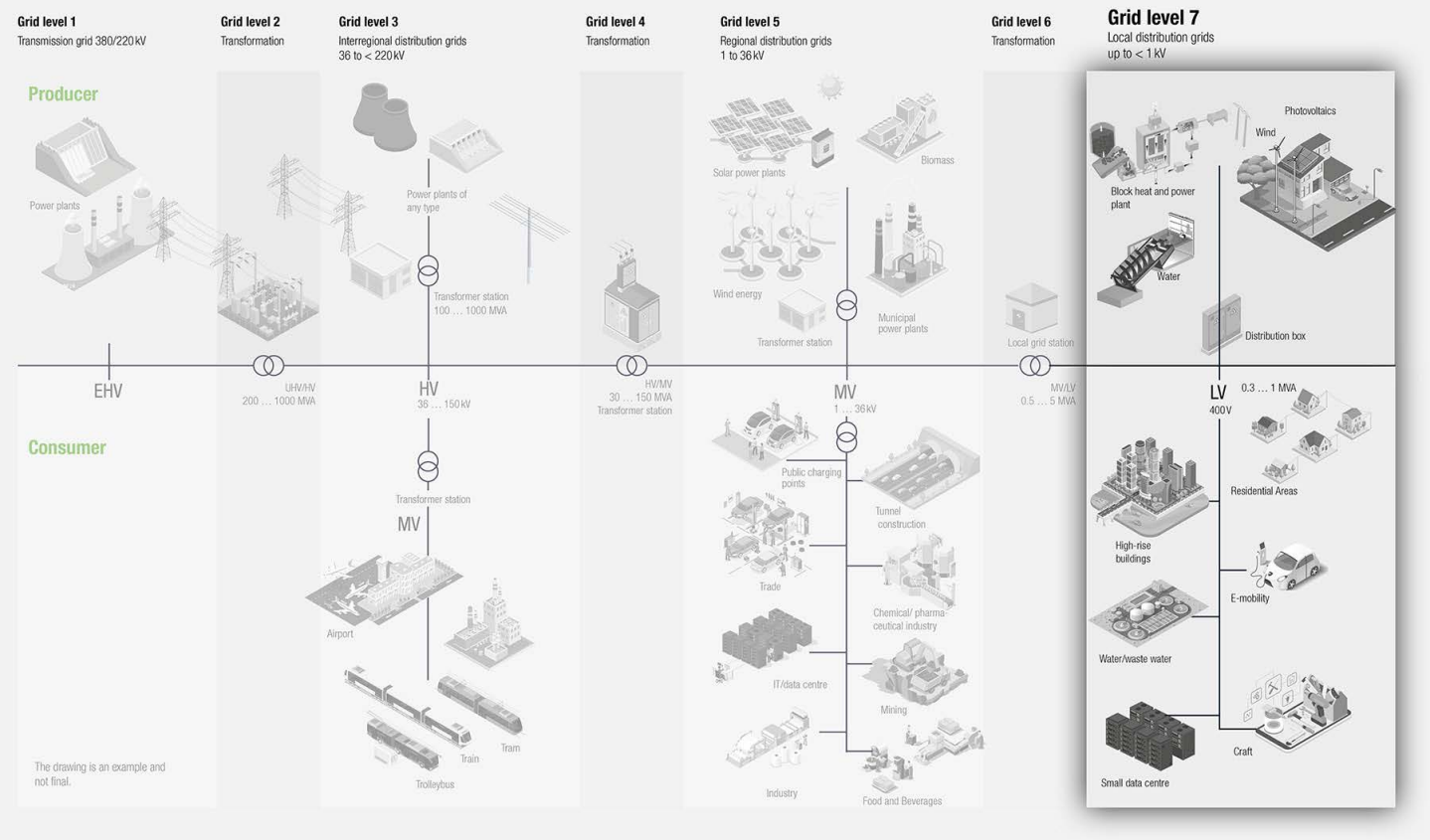
SOLUTIONS WITH AN OPEN & SCALABLE MEASUREMENT SYSTEM





LINAX® PQ5000CL

Power quality assessment with scalable load flow information



Due to the increasing changes in electrical networks, load flow information is becoming more and more important, for distribution network operators in particular also in combination with power quality data. For many distribution network operators, corresponding information at network level 7 (low voltage) is either not available at all or only insufficient. Without a proper smart grid solution, this would be equivalent to «flying blind».

Since many consumers are increasingly also producers, i.e. so-called prosumers, new technical as well as commercial solutions are increasingly in demand. Intelligent metering systems (smart meters) are of no help here, as they are only suitable for grid management to a limited extent due to data protection rules and also insufficient performance, among other things.

WHAT DOES SMART GRID ACTUALLY MEAN

The challenge

One of the great challenges is that the formerly centralized electrical energy world has developed into a highly dynamic as well as very complex decentralized system. In this context, it must be possible to systemically process new but relevant information in a targeted handling of data.

Definition Smart Grid

A smart grid is an electrical system that intelligently ensures the exchange of electrical energy from various sources with consumers of different demand characteristics by incorporating measurement and mostly digital information and communication technologies. Such a system should take into account the needs of all market players and society. The use and operation of the system can thus be optimized and made more efficient, costs and environmental impact can be minimized, and the quality and security of supply can be guaranteed to a sufficiently high degree.

Source: Swiss Federal Office of Energy SFOE

Effects of a smart grid on measurement technology

Basically, the common measurement data of voltage, current and frequency as well as their derived quantities are still required. However, and here comes the possible challenge for the smart grid application: The metering data will be combined and related to new customer needs (e.g., scalability, real-time, connection to existing control systems, integration into new platform solutions, connectivity, distinct technical consulting needs, cyber security, additional costs, etc.). Thus, the traditional IEC groupings of electrical instrumentation will possibly change and overlap even more.

In addition, it certainly makes sense to continue to use analog indicators (electro-mechanical) redundantly for essential functions. These will withstand any failure and/or attack of a data communication. This is also very clear from the matrix shown below.

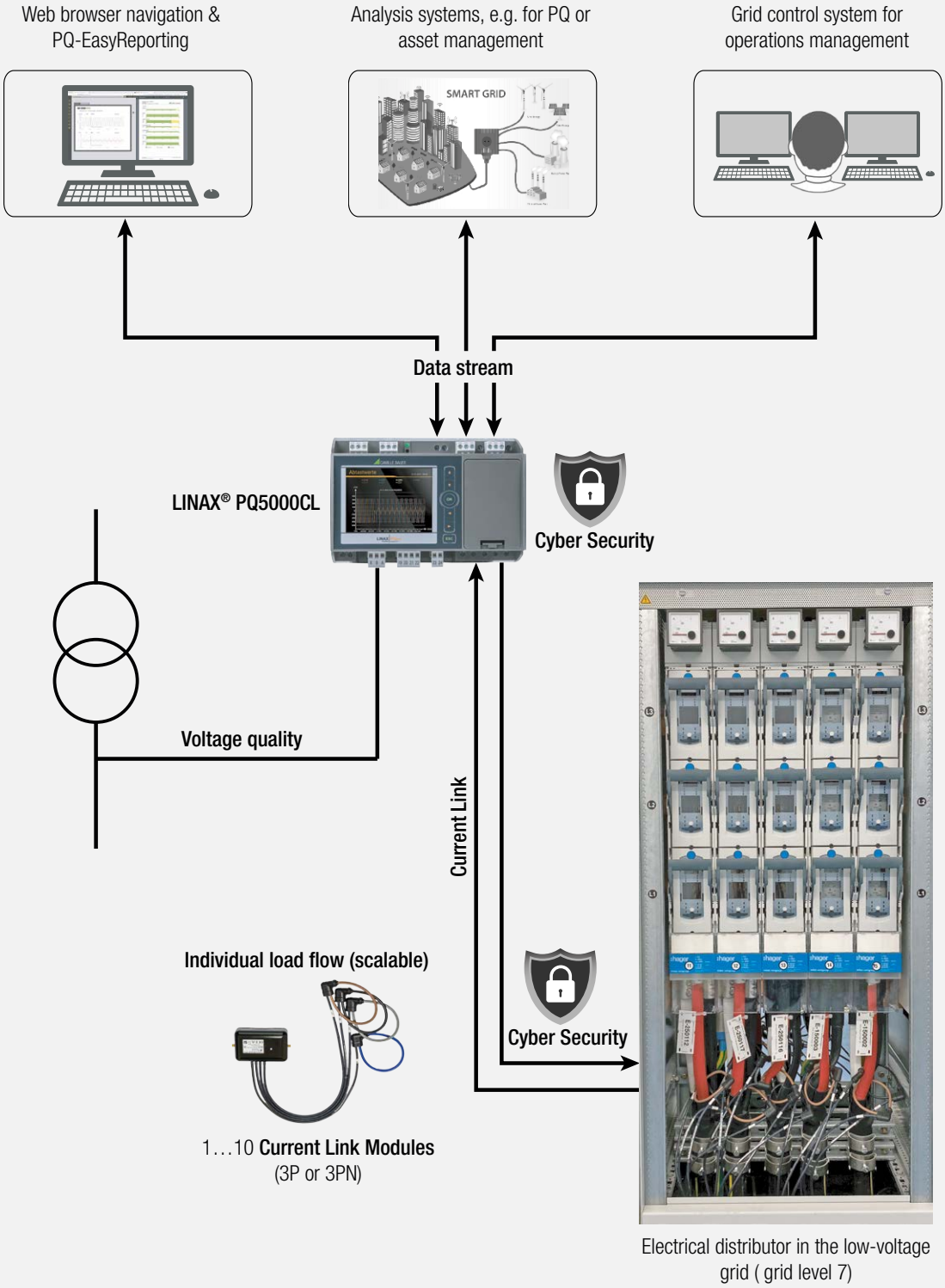
Classical distinction matrix of measuring devices in the context of application

Terminology:	**Analog Indicator**	**Energy Meter**	**Transducer**	**Power Metering and Monitoring Devices**	**Power Quality Instruments**
Short:	AM	EM	TRD	PMD	PQI
IEC Standard:	IEC60051	IEC62053-2x	IEC60688	IEC61557-12	IEC62586-1
Example:					
Legal Billing		✓			
Energy Management		✓		✓	✓
Energy Monitoring, Power Monitoring, Plant Engineering	✓		✓	✓	✓
Power Quality Monitoring				✓	✓
Smart Grid	✓	✓	✓	✓	✓
					

THE NEED FOR TRANSPARENCY

Distribution system operators have a contractual obligation to provide their customers with energy in the agreed quantity and quality. In order for them to be able to verify compliance with these services, «transparency in the cable» must first be established. With the information about the current load flows, these become controllable at network level (6) 7 and thus also enable efficient utilization of the grid quality limits. The aim here is to be able to avoid expensive grid expansion and the associated high costs. This also promotes the issue of general resource conservation (e.g., dispensing with additional quantities of copper).

Schematic representation



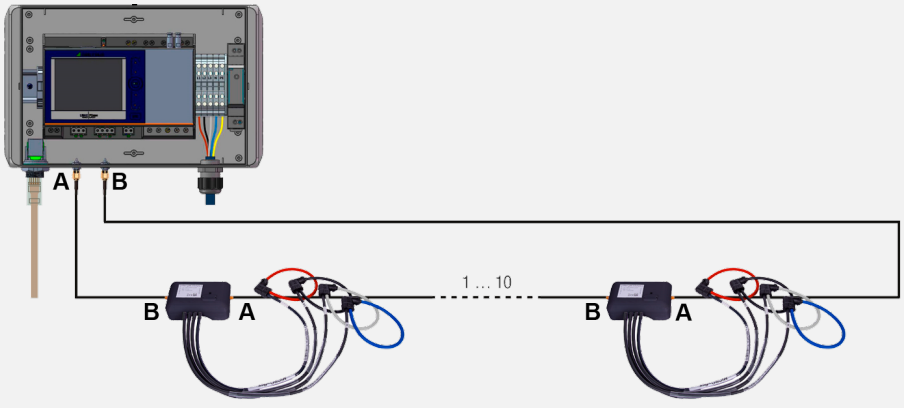
Electrical distributor in the low-voltage grid (grid level 7)

THE BASIS: A METROLOGICAL COMPASS

Fundamental measurement technology from the «bottom up» forms the basis for cellular energy systems and thus also smart grids in order to be able to stabilize grids (e.g. due to prosumer behavior, switching off grid mass, etc.). Here, not only scalability is important, but also absolute future viability, e.g., through flexible connectivity, function adaptations, etc.
We propose a certified power quality measurement and power analysis up to 32 channels in the sub-distribution. The signal processing is implemented on the measuring device of the LINAX® PQ5000CL series. There, the respective current measured values of the so-called Current Link modules are processed. Thanks to the Current Link technology, the individual Current Link modules and their sensors (Rogowski) are networked in a scalable manner by means of a signal loop via coaxial cables. This reduces the installation effort to an absolute minimum and ensures proper cable routing. In addition, this measuring system for determining power quality and load flows is extremely cost-efficient and metrologically certified on top. Thus, the scalable measuring instrument virtually combines the areas of transducers according to IEC 60688, power metering and monitoring according to IEC 61557-12 as well as power quality instruments according to IEC 62586-1.

LINAX® PQ5000CL

- Metrologically certified PQI according to IEC61000-4-30 Ed. 3 class A as basic device
- A scalable system for the areas of certified power quality as well as for load and efficiency management for up to 10 feeders
- An optional basic current measurement (e.g. directly after the transformer) with a high accuracy due to current transformer sensors
- 3 or 4 channels via Current Link per feeder (max. 32 currents)
- One measurement campaign time-synchronized for multiple feeders as opposed to the traditional measurement campaign per feeder
- Direct compliance reporting and event display by PQEasy reporting via web browser (e.g. according to EN50160)
- Time-synchronous fault recording of voltage events with currents of the individual channels (IEC61000-4-30 Ed. 3)
- Time synchronous load management for U/I/P/Q/cosϕ
- Current measurement per Current Link channel up to 1’000A and overcurrents up to 20’000A
- Network tariff meter P & Q (purchase & delivery)
- Upgrade to control task in smart grid (e.g. PQ grid utilization)
- System management by means of a user-friendly multi-device tool for easy commissioning and efficient maintenance
- Large distribution systems (feeders) are continuously monitored with only one metrologically certified measurement system
- Low space requirement due to single voltage measurement
- No need to shut down the plant for installation of the measuring system due to the non-invasive Rogowski measuring technique (Attention: observe occupational health & safety)
- Very high robustness due to proven coaxial principle (for advantages, see page 9)
- Current values are time synchronous to voltage (IEC61000-4-30)
- Various communication interfaces (Modbus TCP/IP, Modbus RTU, REST API, IEC61850, Cloud with MQTT, Webbrowser) allow high connectivity flexibility to parallel as well as higher-level systems
- Fast roll-out with robust measurement technology



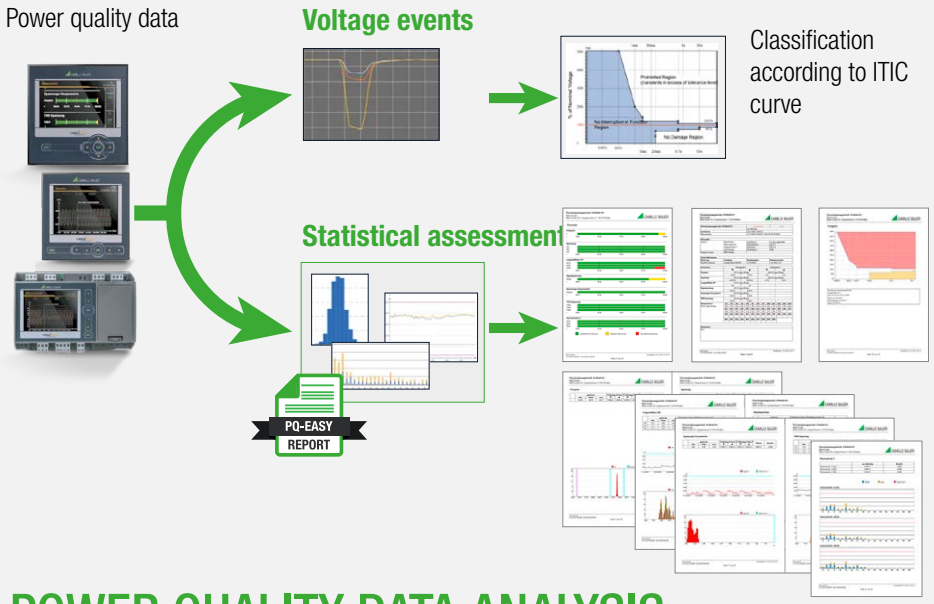
LINAX® PQ5000CL-3 in field housing with connected Current Modules 3PN

	PQ5000CL - DIN rail mounting	PQ5000CL - Field housing
Voltage inputs	4	4
Current inputs base unit	4 (optional)	–
Current inputs of the Current Module	up to 32	up to 32
Function class according to IEC 61000-4-30	Class A	Class A
Device type according to IEC 62586-1	PQI-A FI1	PQI-A FI1
PQ COMPLIANCE MONITORING		
Mains frequency	▪	▪
Voltage / current changes	▪	▪
Unbalance voltage / current	▪	▪
THDS of mains voltages	▪	▪
Harmonic voltage / current	▪	▪
Flicker Pst / Plt	▪	▪
Signal transmission voltages	▪	▪
Interharmonic voltage	▪	▪
PQ EVENT RECORDING		
Voltage dip	▪	▪
Voltage dip	▪	▪
Voltage overshoot	▪	▪
Rapid Voltage Change (RVC)	▪	▪
Homopolar voltage (unbalance)	▪	▪
Current overshoot	▪	▪
Frequency anomaly	▪	▪
Ripple control sequences	▪	▪
MEASUREMENT UNCERTAINTY		
Voltage	±0,1%	±0,1%
Current Base Unit	±0,1%	–
Power base unit	±0,5%	–
Active energy Basic unit	Class 0.5S (IEC 62053-22)	–
Current Current Module 3P/3PN	±0,5%	±0,5%
Power Current Module 3P/3PN	±2.0% (typical)	±2.0% (typical)
Active energy Current Module 3P/3PN	Class 3 (typical)	Class 3 (typical)
COMMUNICATION		
Ethernet: Modbus/TCP, Webserver, NTP	(Standard)	(Standard)
IEC 61850	(Option)	(Option)
MQTT (on special request)	(Option)	(Option)
AUXILIARY ENERGY	100…230V AC 50/60Hz / DC ±15%	100…230V AC 50/60Hz /(internal)
	Separate 24 VDC supply required for Current Link	–
Power consumption	≤ 27VA, ≤ 12W	≤ 60VA
STRUCTURE		
Color display (optional)	TFT 3,5” (320x240px)	TFT 3,5” (320x240px)
Dimensions	160 x 110 x 70 mm	271 x 170 x 90 mm
Mounting	DIN rail	Wall mounting

CERTIFIED POWER QUALITY MONITORING

- Independent certification by the Swiss Federal Institute of Metrology according to IEC 62586-2 (standard for testing compliance with IEC 61000-4-30)
- Proven at 230V / 50 Hz and 120V / 60Hz
- Flicker meter class F1
- Marking concept: Multiphase approach according to IEC 61000-4-30

The devices use measurement methods for class A devices according to IEC 61000-4-30 and can thus serve as a reliable and comparable source of information for regulatory authorities, for negotiations with energy suppliers or for internal quality control.



- Preparation of reports via the device web interface
- Tamper-resistant PDF format
- Selectable report duration
- Selectable report 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 logo in the report

POWER QUALITY DATA ANALYSIS

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

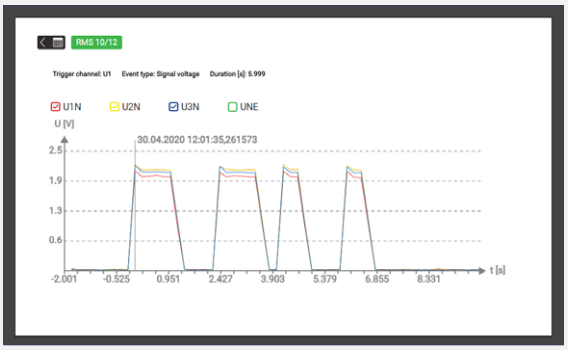
Power Quality events

- Power Quality 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

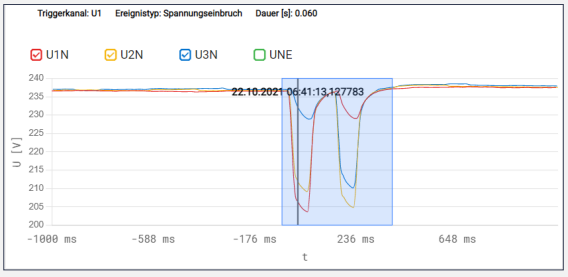
Power Quality statistics

- 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 solutions like SMARTCOLLECT PM20 or 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

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)

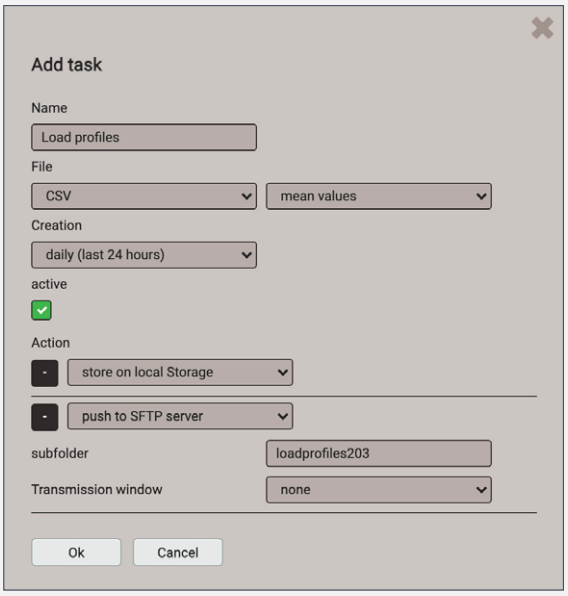
Tasks may be prepared for the generation of files which will then run automatically and are linked to the actions of save locally and / or send to SFTP server. Data locally saved in the device may be transferred to a computer via the device website or the REST interface.

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

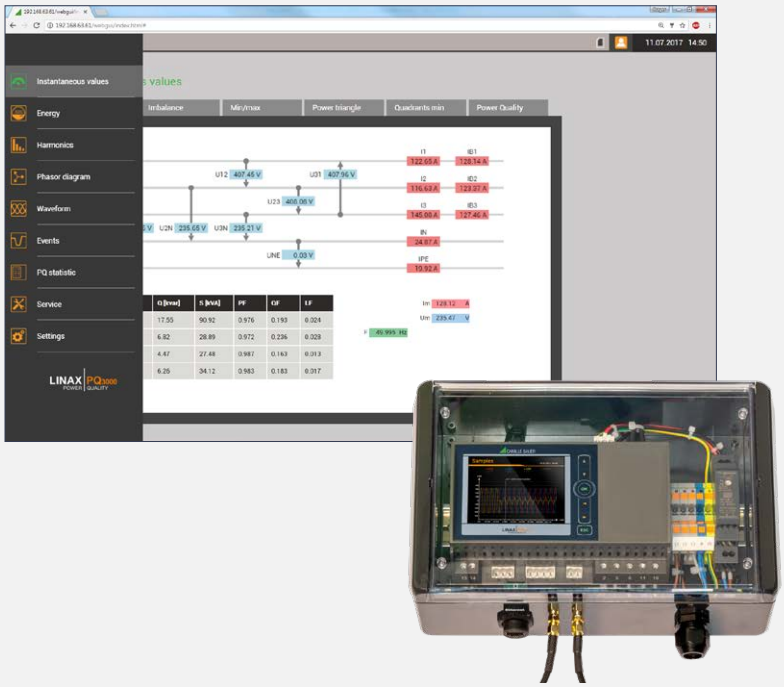


Task for daily saving / forwarding of average data

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 order 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.

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.

Communication tests

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

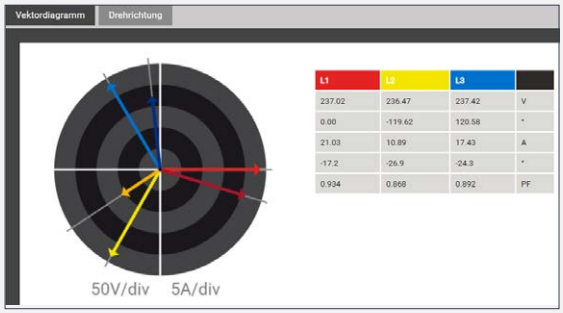
- Can the gateway be reached?
- Can the URL of the NTP server be cancelled via DNS?
- Is NTP a time server and is the time synchronisation working?
- Does the data storage on the SFTP server work?

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.



Vector diagram to control connections

Communication tests: Control of network structure

ADVANTAGES OF COAXIAL LINES

Coaxial cables are two-pole cables with a concentric structure. They consist of an inner conductor (also called core), which is surrounded at a constant distance by a hollow cylindrical outer conductor. The outer conductor shields the inner conductor from interference radiation. Coaxial lines are suitable for transmitting high-frequency, broadband signals in the frequency range from a few kHz to a few GHz. Due to their physical properties and simple nature, coaxial lines are very well suited for scalable current link technology. The high-frequency signals are transmitted cleanly and with high performance. In addition, interference from outside as well as interference to the outside is very well shielded. The coaxial technology also makes it possible to set up ring lines with a maximum total length of 20m as a „quasi-bus“, which in turn reduces the wiring effort enormously. The auxiliary power supply of the Current Link modules and the signals are transmitted in one cable. This eliminates the need to feed many confusing individual cables into a distribution cabinet. In addition, the existing IT infrastructure is not additionally burdened, since the hard cabling is insensitive to radio signals. Hacker attacks via or even into the ring bus are also eliminated.

TECHNICAL DATA PQ5000CL

MEASURING INPUTS

VOLTAGE BASE UNIT PQ5000CL-0/-1

Rated voltage:	57,7…400 V_{LN} (UL: 347 V_{LN}), 100…693 V_{LL} (UL: 600 V_{LL});
Measuring range max:	520 V_{LN}, 900 V_{LL} (Sinus)
Measurement category:	600V CAT III
Measurement uncertainty:	± 0,1%
Self-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 10s: 800 V_{LN}, 1386 V_{LL}

VOLTAGE BASE UNIT PQ5000CL-2/-3

Rated voltage:	100…230 V_{LN} , 173...400 V_{LL}
Measuring range max:	265 V_{LN}, 460 V_{LL} (Sinus)
Measurement category:	300V CAT III
Measurement uncertainty:	± 0,1%
Self-consumption:	≤ U^2 / 1,54 MΩ per phase
Impedance:	1,54 MΩ per phase
Overload capacity:	Interval: 265 V_{LN}, 460 V_{LL}

CURRENT MEASUREMENT BASIC DEVICE PQ5000CL-0/-1 (OPTIONAL)

Nominal current:	1…5 A; max. 7,5 A (sinusoidal)
Measurement category:	300V CAT III
Measurement uncertainty:	± 0,1%
Own consumption:	≤ I^2 x 0,01 Ω per phase
Overload capacity:	10 A permanent 100 A, 5 x 1 s, Interval 300 s

CURRENT LINK MODUL 3P / 3PN

Measurement category:	up to 1000 A; (programmable)
Maximum current:	20 x Rated current;
Measurement category:	600V CAT IV
Measurement uncertainty:	± 0,5% (with centered conductor and without external field)
Angular error:	± 1,0°
Design:	3 or 4 Rogowski coils
Housing:	Polycarbonate (Makrolon) with impact test according to IEC61010-1, chapter 8
Diameter:	approx. 8mm (Rogowski coil)
Loop diameter:	approx. 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.

Size	Current measurement via...	
	Base unit (optional)	Current-Modul 3P / 3PN
Voltage	± 0,1 %	± 0,1 %
Current	± 0,1 %	± 0,5 %
Performance	± 0,5 %	± 2,0 % (typical)
Power factor	± 0,2°	± 1,0°
Frequency	± 0,01 Hz	± 0,01 Hz
Active energy	Class 0,2S, EN 62053-22	Class 3 (typical)
Reactive energy	Class 0,5S, EN 62053-24	Class 3 (typical)

CONNECTION TYPE:	4-wire, unequal load
NOMINAL FREQUENCY:	42…50…58Hz
SAMPLING RATE:	18 kHz (U), 54 kHz (I)
DATA MEMORY INTERNAL:	16 GB
AUXILIARY ENERGY	via terminals 13-14 (PQ5000CL-0/-1), internal (PQ5000CL-2/-3)
Nominal voltage:	100…230V AC 50/60Hz / DC ±15% (PQ5000CL-0/-1) 100…230V AC 50/60Hz ±15% (PQ5000CL-2/-3)
Overvoltage category:	OVC III
Power consumption:	≤ 27VA, ≤ 12W (PQ5000CL-0/-1) ≤ 60VA (PQ5000CL-2/-3)

I/O-INTERFACE

DIGITAL INPUT	via plug-in terminals (PQ5000CL-0/-1)
Nominal voltage:	12 / 24 V DC (30 V max.)
Input current:	< 7 mA
Logical zero:	-3 to +5 V
Logical One:	8 to 30 V
Minimum pulse width:	70…250 ms
DIGITAL OUTPUTS	via plug-in terminals (PQ5000CL-0/-1)
Nominal voltage:	12 / 24 V DC (30 V max.)
Nominal current:	50 mA (60 mA max.)

COMMUNICATION

ETHERNET	via RJ45 jack
Standard protocols:	Modbus/TCP, NTP, http, https, IPv4, IPv6
Optional protocol:	IEC 61850
Physics:	Ethernet 100BaseTX
Mode:	10/100 Mbit/s, full/half duplex, autonegotiation
MODBUS/RTU	via plug-in terminal (A, B, C/X), only PQ5000CL-0/-1
Protocol:	Modbus/RTU
Physics:	RS-485, max. 1200m (4000 ft)
Baud rate:	9‘600, 19‘200, 38‘400, 57‘600, 115‘200 Baud
Number of participants:	≤ 32

INTERNAL CLOCK (RTC)

Uncertainty:	± 2 minutes/month (15 to 30°C)
Synchronization:	none, 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

Only to be used in buildings!

MECHANICAL PROPERTIES

Flammability class	V-0 according UL94, self-extinguishing, not dripping, free of halogen
Weight	600g (PQ5000CL-0/-1)

SAFETY

Current inputs are galvanically isolated from each other.

Protection class	II (protective insulation, voltage inputs via protective impedance)
Pollution degree	2
Protection	IP40 (front), IP30 (housing), IP20 (terminals)

ORDER CODE AND DIMENSION DRAWING PQ5000CL-DIN RAIL HOUSING

ORDER CODE PQ5000CL-	
1. DESIGN & DISPLAY	
DIN rail housing **without display**	0
DIN rail housing **with TFT display**	1
2. NOMINAL FREQUENCY	
50 Hz	1
3. CURRENT MEASUREMENT IN THE BASE UNIT	
Without	0
4 Current transformers 1 / 5 A (High Precision Input)	1
4. AUXILIARY ENERGY	
Rated voltage 100 … 230 V AC/DC	1
via measuring input L1-N, nominal voltage 100 ... 230V AC	3
5. CONNECTION FOR GPS TIME SYNCHRONIZATION	
Without	0
With	1
6. FUNCTION USB PORT	
None	0
7. IEC 61850 PROTOCOL	
Without	0
With	1
8. MQTT PROTOCOL (on special request)	
Without	0
With	1
9. CURRENT-LINK RMS1/2 DISTURBANCE RECORDER	
Without	0
Disturbance dec. for RMS1/2 conductor currents	1
10. TEST REPORT	
Without	0
Protocol german	D
Protocol english	E

PQ5000CL as DIN rail housing with TFT display

ACCESSORIES	ARTICLE NO.
Current module 3P, with 3-fold Rogowski converter Imax. Nominal: 1000A / Imax. Overrange: 20000 AØ75mm, approx. 0,5 m connection cable Colors: L1 = brown, L2 = black, L3 = grey	187 593
Current module 3PN, with 4-fold Rogowski converter Imax. Nominal: 1000A / Imax. Overrange: 20000A Ø75mm, approx. 0,5 m connection cable Colors: L1 = brown, L2 = black, L3 = grey, N = blue	187 105
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 5 m	187 642
SMA connection cable BM-RCM, length 10 m	187 650
Other lengths on request	
Power supply 100...240 VAC / 24 VDC for supply Current Link	187 501

*Current module **3P**, with 3-fold Rogowski converter*

Current module 3PN, with 4-fold Rogowski converter

SMA connection cable BM-RCM

ORDER CODE AND DIMENSION DRAWING PQ5000CL FIELD HOUSING

ORDER CODE PQ5000CL-	
1. DESIGN & DISPLAY	
in field housing IP23, **without display**	2
in field housing IP23, **with TFT display**	3
2. NOMINAL FREQUENCY	
50 Hz	1
3. CURRENT MEASUREMENT IN THE BASE UNIT	
Without	0
4 Current transformers 1 / 5 A (High Precision Input)	1
4. AUXILIARY ENERGY	
Rated voltage 100 … 230 V AC/DC	1
via measuring input L1-N, nominal voltage 100 ... 230V AC	3
5. CONNECTION FOR GPS TIME SYNCHRONIZATION	
Without	0
With	1
6. FUNCTION USB PORT	
None	0
7. IEC 61850 PROTOCOL	
Without	0
With	1
8. MQTT PROTOCOL (on special request)	
Without	0
With	1
9. CURRENT-LINK RMS1/2 DISTURBANCE RECORDER	
Without	0
Disturbance dec. for RMS1/2 conductor currents	1
10. TEST REPORT	
Without	0
Protocol german	D
Protocol english	E

PQ5000CL in field housing with TFT display

ACCESSORIES	ARTICLE NO.
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SMA connection cable BM-RCM, length 5 m	187 642
SMA connection cable BM-RCM, length 10 m	187 650
Other lengths on request	

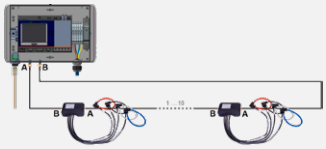
*Current module **3P**, with 3-fold Rogowski converter*

Current module 3PN, with 4-fold Rogowski converter

SMA connection cable BM-RCM

TRANSPARENCY IN THE SMART GRID

Exemplary holistic approach of the smart grid solution



1. Real-time measurement with LINAX® PQ5000CL

- Load flow
- Power reserves
- PQ Reserves (U/I)

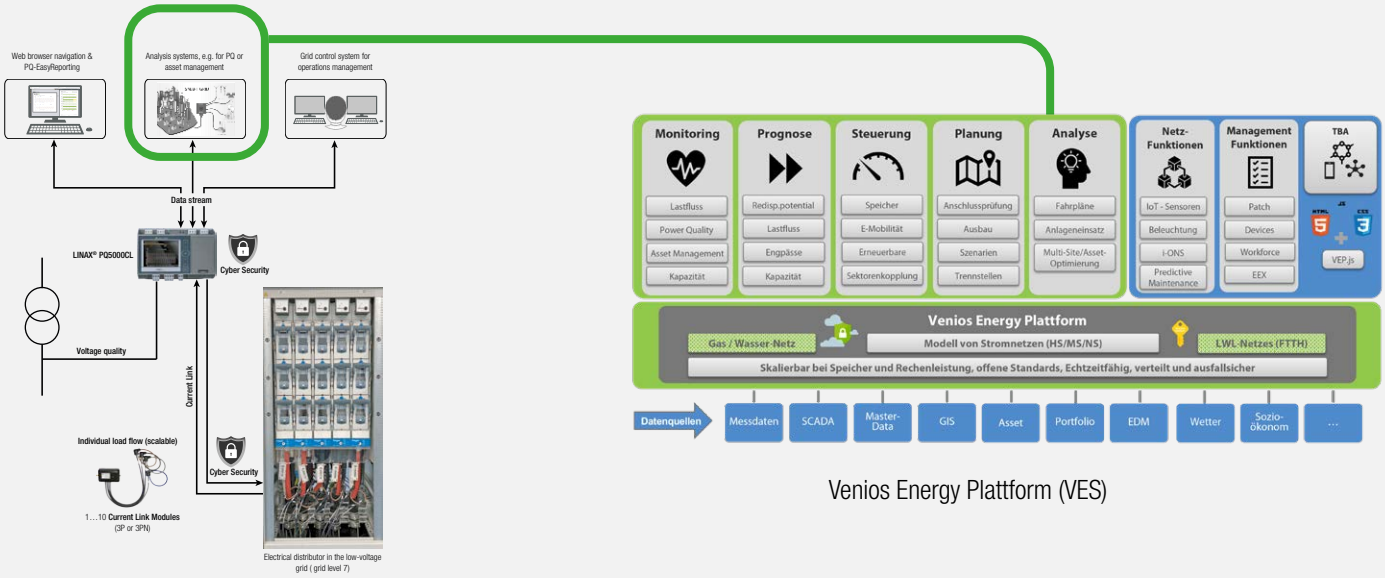
2. Analyze / Decide

- Reduce power peaks
- Optimize ripple control
- Ensure voltage/current quality

3. Act

- Load management (heat pumps, batteries, e-mobility, etc.)
- Production management / redispatch (PV, batteries, CHP, etc.)
- Grid expansion - only according to necessity

Implementation by means of IT high-performance platform



Venios Energy Plattform (VES)

Aspects of the Venios Energy Platform

1. Transparency

Link data from individual applications. Create computable networks and recognize sources of error in the upstream systems. Combine model data and measured values as desired. Visualize network structure and network state in real time.

2. Taxes

Optimized control of flexibilities. Controllable local network transformers for voltage adjustment. Control of charging stations via load forecasts. Counteracting grid bottlenecks by calling up flexibilities.

3. Forecast

Load forecasts for the next day. Network condition forecasts to detect bottlenecks at an early stage. Create scenarios for future network situations incl. simulation of switching operations. Precise forecasts based on measurement data and algorithms. Basis for planning.

4. Planning

Automate processes. Plant connection: simple handling, precise output. Detect network bottlenecks early and act intelligently. Asset manager: derive actions from current conditions.

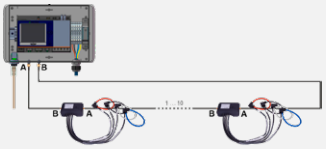
5. Partner applications

The Venios ecosystem offers a multitude of use cases, whose enormous added value only arises from the intelligent networking of partner and customer applications with different functions.

Further details on the exemplary system approach can be found at: https://smartgridsolutions.ch

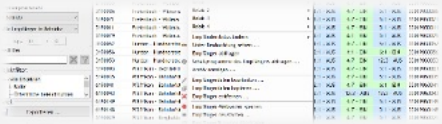
TRANSPARENCY IN THE SMART GRID

Exemplary holistic approach of Swistec



1. Real-time measurement with LINAX® PQ5000CL

- Load flow
- Power Quality



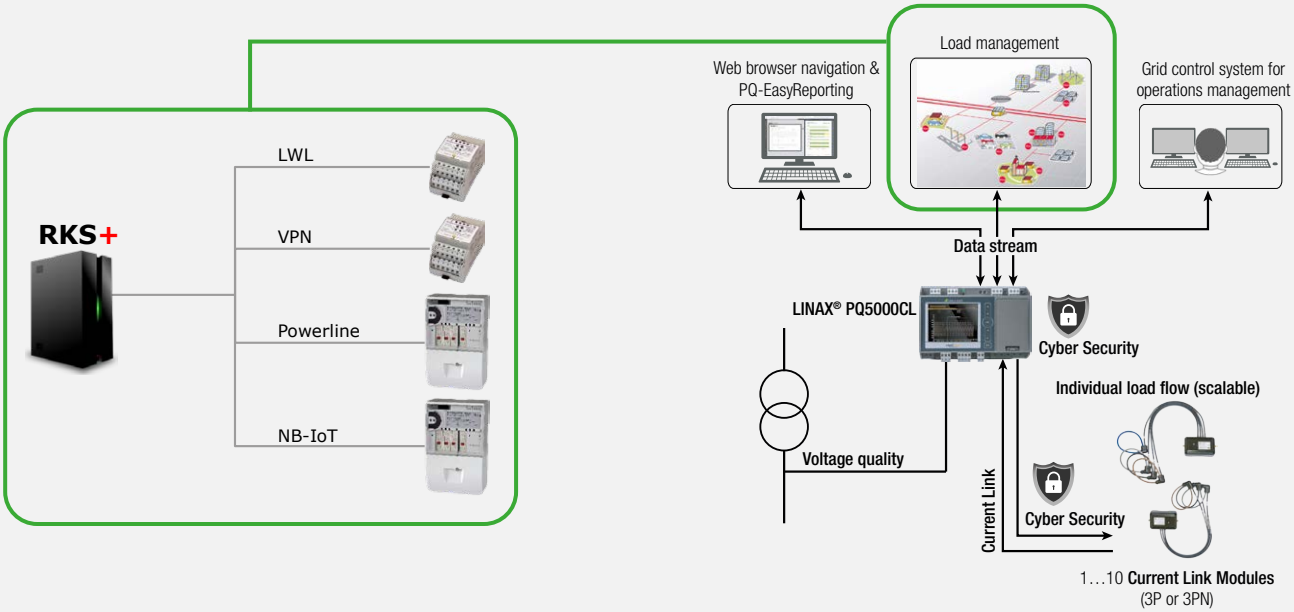
2. Manage

- Grouping of loads and generators
- Lifecycle management of the load control units

3. Taxes

- Measuring devices in transformer stations trigger events
- Ripple control system triggers fine granular control commands

Grid-serving control by means of fine-granular load control



The accuracy and versatility of the Camille Bauer meters extend the RKS load management system into an intelligent, fine-granular network control system. In the event of critical network conditions, the measuring devices in the transformer stations generate events that are sent to the RKS system, where they are converted into fine-granular load control commands. The RKS+ addresses the affected load control devices via secure IP communication and thus ensures that the network state returns to normal by switching flexibilities.

Aspects of load control with IP ripple control

1. Open system architecture

With various interfaces such as IEC 60870-5-101/104, the RKS system is open for communication with control systems. In addition, .NET DLL and web server are available as further interfaces.

2. Modern communication

The measuring devices communicate with the ripple control center via MQTT, a proven and freely scalable IoT communication.

3. Steering groups

In a control group, the IP-based load control devices can be addressed via 4 address levels. In addition, each load control device has an individual address via which it can be controlled.

4. Lifecycle Management

Categorization and management of load controllers by operating status (not installed / in test mode / in operation).

5. Security

Depending on the load controller used, the switching and parameterization commands are encrypted via TLS1.2 or AES-GCM-256.

6. Audio frequency ripple control

With Swistra, the advantages of fine-granular control can also be realized for audio-frequency ripple control.

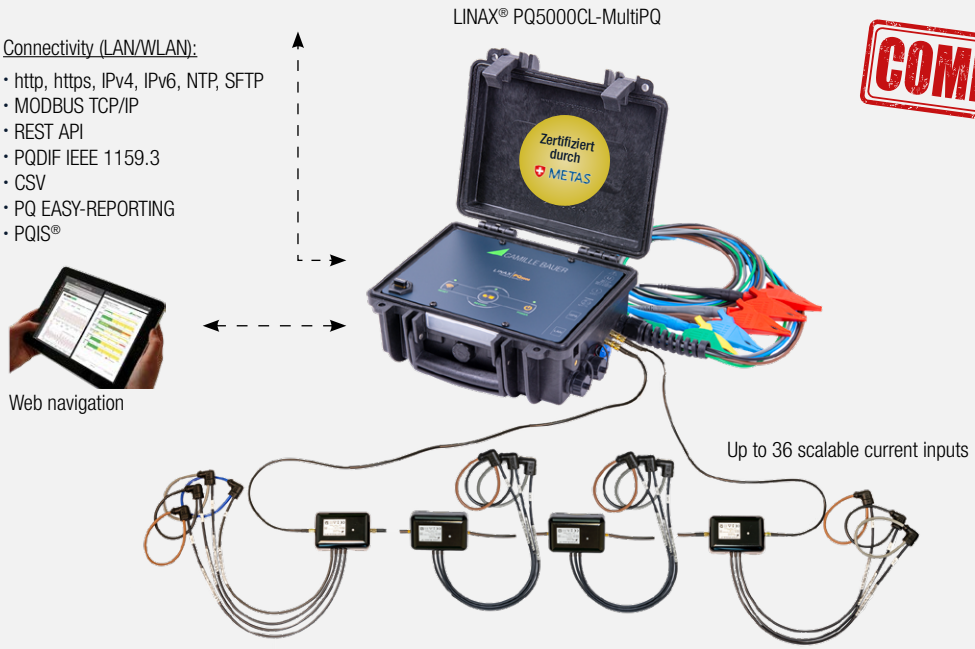
For more information, visit https://swistec.ch

MEASUREMENT COMPASS FOR MOBILE USE

Mobile device for evaluating load profiles and power quality in low voltage (grid level 7). Also very well suited as a precursor to a permamant smart grid application.

LINAX® PQ5000CL-MultiPQ

- Portable industrialized PQI multichannel meter according to 61000-4-30 Ed. 3 of class A
- Metrological certification IEC61000-4-30 of METAS according to IEC62586-2
- Integrated WebGUI as HMI, incl. comprehensive cyber security
- Hard case with IP65 with closed housing
- Auxiliary power (supply voltage) 230VAC via mains adapter according to 300V CAT IV
- nominal frequency 42…50…58 Hz
- Security requirement 600V CAT IV (measuring inputs current & voltage)
- 64GB SD memory
- Maximum 36 current measurement inputs per device (9 x L1/L2/L3/N)
- 1 x voltage tap L1/L2/L3/N/PE by means of voltage measuring leads
- Fault recorder for current and voltage events
- Display and evaluation via WEB interface of the device
- Event list with trigger source, event type, event duration and characteristic event values
- RMS½ values: up to 1 second before and max. 3 minutes after the event
- Zoom options & data points for on-site analysis
- Load profile recording
- Time synchronization via NTP server
- Data export via csv (formatable)
- Current values are time-synchronized to voltage (IEC61000-4-30)
- UPS on capacitor basis (max. 3 seconds bridging)
- Data protocols: Modbus/TCP, http, https, IPv4, IPv6, NTP, SFTP, REST API
- Data communication via LAN or WLAN access point to various end devices
- Switzerland: analogy and evaluation via PQIS® possible



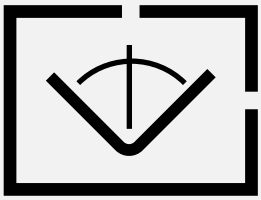
COMING SOON

OUR PORTFOLIO

Measuring and Displaying

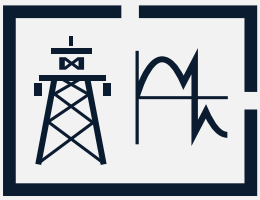
Grid management and equipment monitoring require precise and reliable information of different grid variables. For this purpose, we offer a wide range of high-quality instruments to acquire all variables of the electrical grid.

Position sensors



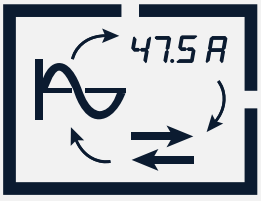
With our portfolio of POSITION SENSORICS we offer solutions for angle, position and inclination measurement. Here, the offer ranges from simple built-in devices to the robust devices for applications in harsh environments. The angle and inclination measuring systems serve as an important link between mechanics and control.

Power Quality

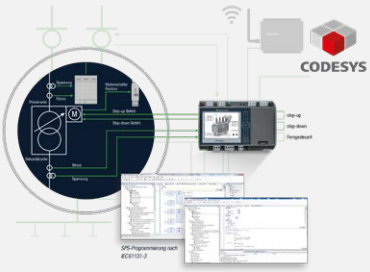


Modern power electronics and non-linear consumers increasingly impair the electrical grid which is the reason why alternating current has not shown the original sinusoidal characteristic already for a long time.
This bears heavily on electrical devices and machines and extends to higher thermal losses, increased energy consumption through to the disturbance and downtime of plants. Our solutions ensure that problems are early recognised, even before they occur.

Monitoring and controlling



We offer the unique possibility of not only acquiring all variables of the electrical grid precisely and reliably, but also processing them directly via a PLC integrated into the device and controlling processes. This enables us to realise process controls directly at the measuring point. You thus save a separate PLC or you realise an autarkicly working redundant solution.



Software and Systems

We design modular customer-specific solutions and systems which can be extended at any time regardless of manufacturer.
Through our non-proprietary interfaces is also an integration in already existing applications and systems with components from different manufacturers no problem.

GMC INSTRUMENTS

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CAMILLE BAUER

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