

Power Quality Analyser

QWave Premium

- **Quality assurance in low and medium voltage systems**
- **Recording of mains disturbances and power quality**
- **Monitoring of protection and substation control systems**
- **Analysis of disturbances and their causes**
- **Determination of load capacity reserves at the transformer and feeders**
- **Acquisition and analysis of transient events**
- **Monitoring of voltage quality according to EN 50160**
- **Detection of interfering mains feedback and expensive power peaks**
- **Functional check of the ripple control system**

General

Measuring System

QWave Premium is a Power Quality Analyser, which offers all functions necessary to perform network analysis, quality assurance evaluations and interference source detections. A large data memory provides a method of effecting long-term recordings. All data is saved even without connection of the instrument to an evaluation computer. No information will be lost. The recordings are the basis for detailed evaluations and analysis to assess disturbances and the mains voltage quality. **QWave Premium** records and provides historical event data, which protective relays or protective switches have induced and how the resources have performed.

QWave Premium combines many different measurement systems – digital recorder, power and frequency logger, and mains quality recorder – all in one instrument. The following measurements can be made with **QWave Premium**:

- RMS values with programmable resolution
- Oscilloscope data
- Voltage, current and power analyses
- Load and energy measurements
- Frequency analysis
- Transient analysis
- Signalling voltage analysis
- Mains voltage quality analysis as per EN50160

In case of disturbances, **QWave Premium** automatically sends the recorded data with the reporting software NOTIFY to a central processing computer, providing the operating personnel with an immediate overview of the interference.

The permanently installed solution for fast and efficient performance of measurements in industrial or energy distribution.



The following measurement and evaluation processes are available

Mains voltage quality measurement as per EN50160

- Harmonics
- Interharmonics
- Flicker
- Voltage variations
- Imbalance
- Frequency

Measurement with adjustable averaging intervals: 10 ms ... 24 h

- r.m.s. values of voltage
- r.m.s. values of current
- Active power
- Apparent power
- Power factor
- Energy

Oscilloscope mode

- Voltage
- Current

Frequency spectrum of

- Voltage
- Current
- Active power
- Reactive power
- Unbalance
- Symmetrical components

Interference source detection

- Flicker sources
- Voltage dips
- Distortion
- Resonances

Analysis of signalling voltage

- Measurement of signalling frequency
- Level measurement
- r.m.s. versus time



Transients

- 100 kHz to 10 MHz sampling rate per channel
- Up to 2 s recording time
- Triggering at voltage level of high-frequency signal components
- 6 kV input voltage

Hardware

- Synchronised sampling
- 19" rack mounting, metal housing
- Large memory for long-term measurements
- GPS time synchronisation

Communication and data transfer

- Ethernet
- Serial interface
- External modem

QWave Premium was developed in conjunction with energy supply companies with a view to field application and the requirements of operating electrical energy supply plants.

QWave Premium is delivered with TOPAS application software:

Hardware

The converter concept enables the registration of the system's currents within 1 A and 5 A. The measuring error from 0 to 5 A is less than 0.2%. The input resistance is very low: 5 mOhms, overload capacity is 100 A for 1 s.

The voltage channels are designed for a recording of 100 V or 400 V. The instrument has a modular set-up and is designed for further upgrades and modifications.

Selftest

QWave Premium features comprehensive functions for system diagnosis. The hard disk, input channels, and interfaces are tested and a diagnosis protocol is output. Measuring the noise voltage and the offset voltage tests especially the analogue channels.

Digital inputs

QWave Premium is equipped with up to 36 digital inputs. They can be used for storing status changes. The digital inputs are recorded in real-time accuracy and allocated to the analogue channels. Two versions are available:

60V version: $V_{in\ low} < 6V$, $V_{in\ high} > 12V$, $V_{in\ max} = 60V$

150V version: $V_{in\ low} < 10V$, $V_{in\ high} > 50V$, $V_{in\ max} = 150V$

Digital outputs

QWave Premium is equipped with 8 isolated digital outputs. They can be used for signalling of trigger events.

Calibration

The calibration of the input channels is made at the factory. The calibration menu shows the calibration factors of all eight analogue channels. This menu can be used to calibrate channels and check the error limits with appropriate reference measuring instruments and signal sources.

Configuration

Before starting measurements **QWave Premium** has to be configured via a computer. Configuration files can be stored, loaded and compiled with menu-guidance.

Triggering can be set for the exceeding of one or more harmonics (1-50). All channels can be triggered if thresholds are exceeded.

The complete start-up including programming can be done via telephone lines.

Nominal values and limit values

All the limits complying with EN 50160 can be set.

Memory management

It is possible to limit the hard disk memory for the various types of files. This will avoid the hard disk being filled unintentionally, e.g., with instantaneous values. The memory management can be "linear" or "circular". In the "linear" mode, no more data is stored on reaching the memory limit. In the "circular" mode, the oldest data records are overwritten.

Interharmonics

The r.m.s. values of the interharmonics are measured. If a threshold level is exceeded, oscillograms are recorded and the intermediate frequency is determined.

Trigger conditions

The user can select all trigger thresholds manually. If the trigger thresholds are exceeded, harmonics, r.m.s. values and powers, oscilloscope data of current and voltage, transients and signalling voltages can be recorded.

Remote diagnosis, modification of instrument settings, failure diagnosis can be performed quickly and effectively without de-installation of the instrument.

Hardware settings

An additional scaling factor can be set for each channel. This allows for, e.g., the consideration of current or voltage transformer ratios.

Functions for QWave Premium and TOPAS software

QWave Premium can act as a data logger collecting measuring data over a long period of time or transferring measuring data online to an analysis computer. Measuring data can be called for during data logger operation without interrupting the measurements via one of the existing interfaces. An online display is also available.

As well as individual voltages and currents, **QWave Premium** can also monitor two complete three-phase systems. The tables below provide an overview of all the measuring functions available.

	Power quality	
	Daily average Free average intervals 10-minute average intervals	
	Events	
	3-second average interval	
	RMS values 10 ms – 1 day	
	Oscilloscope 6,4 kHz/channel for 50 Hz	
	Transients, sample rate : 100 kHz – 10 MHz/channel	
	Ripple control telegrams	
	Online measurements	Oscilloscope Transients Events

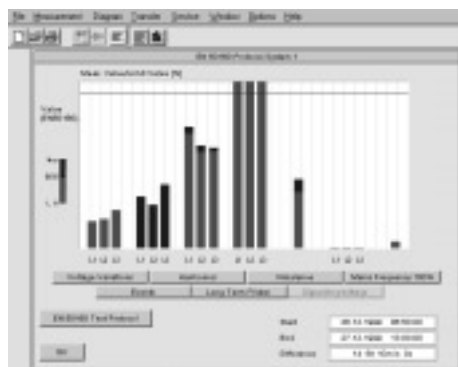
Measuring analysis

The measuring analysis are displayed graphically as variation in time and cumulative probability functions. The data can be superimposed in a diagram. Every data point can be selected by mouse-controlled cursor and its coordinates can be displayed in numerical fields. All the sections of a diagram can be exported as a text table. This table can be used to "Cut & Paste" in Windows® via clipboard or the measured data can be saved as a text file. The table's format allows for importing into spreadsheet programs. Any number of analysis windows can be opened simultaneously. The analysed data is maintained until the respective window is closed again.

EN 50160

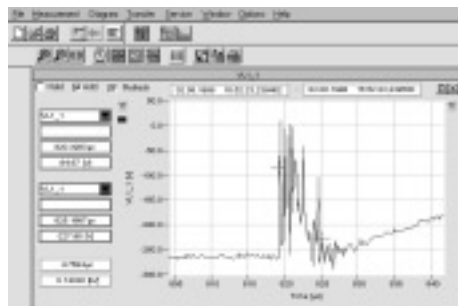
This analysis provides a quick overview of the network conditions. For data recorded according to EN 50160, there are reports available that facilitate immediate decisions about the need for further investigations.

The example below shows the distinction between maximum value and 95%-value. The values are displayed in colour.



Many supplementary measuring functions are available in addition to these clear representations. It is only with these extended evaluation procedures that the cause of limit violations can be determined.

Transients



Transient voltages caused by switching or lightning surges can destroy electronic devices due to the high level of voltage. It is only by monitoring these pulses by means of transients analysis that such influences can be explored.

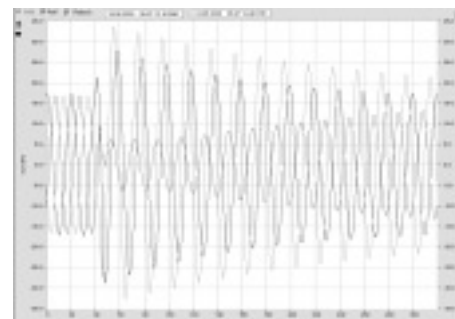
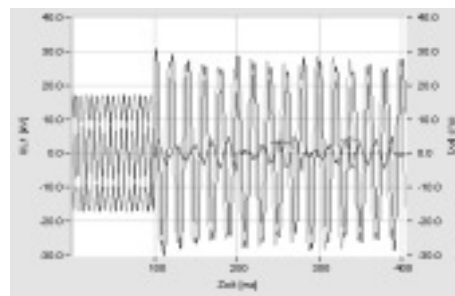
Electronic devices can also be the cause of such interferences. These influences with fairly low voltage levels are frequently the cause of computer failures or malfunctioning equipment. Finding these interference sources is only possible with fast-sampling transient analysis.

Oscilloscope trigger

The oscilloscope function is used to evaluate current and voltage waveforms.

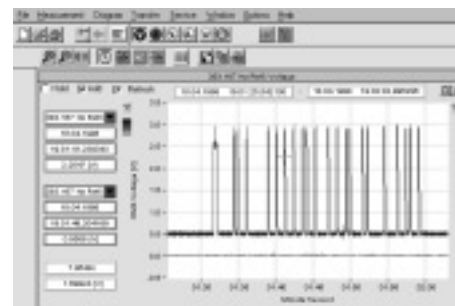
The **QWave Premium** is recording each event phase to phase and also phase to neutral parallel.

Each event can be recorded with different time resolutions in parallel for example 10ms r.m.s. values and 10Ms/s transient recordings.



Ripple control

Some equipments such as street lighting and heating are switched centrally by means of signalling voltages. Multi-tariff meters can also be switched with these signals. Interference may result in comprehensive, time-consuming analysis and economic losses.



This function provides a simple tool to detect the source of interference. All quantities, which could influence these signals, are analysed and displayed.

Events list

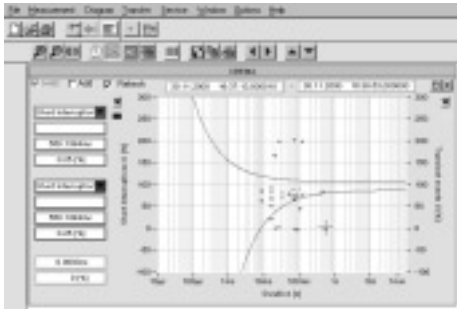
The events list provides a compact overview of all events that occurred. This representation is particularly compact: Thirty thousand events occupy only 1 MB of memory. This list can be transferred without problems even with slow modem connections.



With the sorting functions it is possible to select and analyse the most notable events. From this list you can make an easy and rapid selection of data required for further analysis.

CBEMA Curve

The events list data can also be displayed in the CBEMA or ANSI presentation, the events are evaluated according to their level and duration.



This graph provides an excellent overview of events at the point of connection.

Messaging software NOTIFY

NOTIFY is a messaging software included in the **QWave Premium** delivery. It can permanently display voltage and current levels in the format of a strip chart recorder.

The software automatically transfers detailed data to a central processing computer in the event of a disturbance. Messages can be sent via LAN or modem.

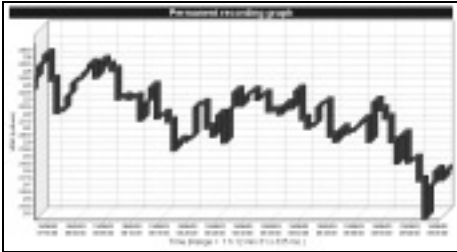
There is an optional software available: QIS

Optional software QIS

Versions

Two versions are available: QIS Basic Access for small applications and QIS Client Server for large measurement applications with a high number of **QWave Premium** instruments.

The measuring results are imported from the **QWave Premium** via PQDIF-data format into a database within the QIS software. Comprehensive filters provide graphical presentations, measurement tables and configurable reports. Different data can be superimposed and synchronised in one diagram for comparative analyses. The design of diagrams can be modified according to individual needs, export functions allow for post processing of measurement values.



Features of QIS software in addition to TOPAS software

- MS SQL database
- Topologies of different Power Quality Analyser
- Embedded communication drivers for direct connections, for modems and for Ethernet/TCP/IP
- Automatic data transfer with Mini-scheduler software
- PQDIF format for measurement data in PQDIF format
- Administration of instruments, users, measurement locations
- Diagrams with user defined design, line diagrams with additional presentation of 95% values
- Synchronisation of different recordings
- Various export functions

General technical Data

The instrument features 8 analogue inputs, which can be configured for either current or voltage measurements (AC/DC). The following sampling frequencies are possible:
for 50 Hz mains systems: 6.4 kHz,
for 60 Hz mains systems: 7.68 kHz.

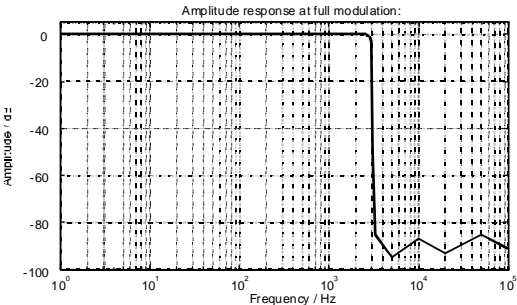
Each channel is equipped with a passive low-pass filter as a protection against voltage transients and to limit high slew rates, an anti-aliasing filter and a 16-bit A/D converter. All channels are sampled synchronously based on a joint, quartz-controlled clock pulse.

High frequency components and especially the noise voltages above half the sampling rate of the A/D converter are reduced by 80dB, thus achieving a very small measuring error in an exceptionally large amplitude range and for transient voltages at the output of converters.

The instrument performs narrow-band measurements with precisely defined frequency response. Between the 3dB-limit frequency at 0.45-fold sampling frequency and the 1.2 higher frequency, the amplitude response falls 80dB below the A/D converter's resolution. Particular attention is paid to mostly identical phase responses of the analogue inputs to avoid errors in power measurement.

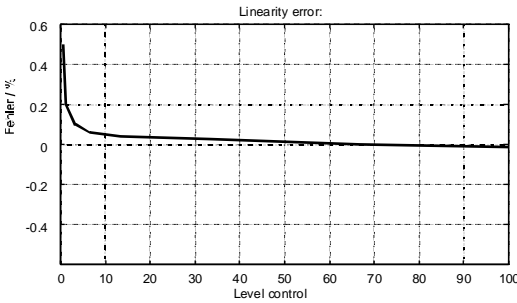
Transient signals are measured without filtering.

Amplitude response from 0 Hz to 100 kHz



Linearity

At a sampling rate $f_s = 6400$ Hz the measured value error at 50 Hz amounts to:



Measuring accuracy

The errors are valid for averaging time >10 ms, warmed up instrument, environment temperature of 25° up the maximum rise time of voltage:

Frequency	Signal level	Errors voltage, current	Error power, PF=1
50Hz	100%	V: $<0.1\%$ of m.v. I: $<0.2\%$ of m.v.	$<0.3\%$ of m.v.
50Hz	$>1\%$	$<0.5\%$ of m.v.	$<1\%$ v. of m.v.
<2500 Hz	100%	$<1\%$ of m.v.	$<2\%$ of m.v.
<2500 Hz	$>1\%$	$<1.2\%$ of m.v.	$<2.4\%$ of m.v.

Measuring errors are far below the error as per class A of the standard EN 61000-4-7.

Temperature drift

Change of amplification through temperature: < 150 ppm/K

Ageing

Change of amplification through ageing: < 0.06 %/year

Sampling

The sampling rate is synchronised to mains frequency and is typically 6400 Hz on a 50 Hz network and 7680 Hz at 60 Hz, respectively. Synchronisation is possible in the range from 45-65 Hz with a resolution of 10 ppm. The maximum error for frequency measurement is 200 ppm.

Measuring intervals

As per IEC/EN 61000-4-7:

- Frequency 10 s, 3 s, 10 min, 1 h, 24 h
- r.m.s. voltage 10 ms, 3 s, 10 min, 1 h, 24 h
- As per IEC/EN 61000-4-15:
- Flicker 20 ms, 10 min, 2 h

Data memory

The measuring instrument is equipped with a 2 GB hard disk or an optional 512MB Compact Flash card. At an averaging time of 15 minutes, recordings can be made over 1 year.

Interfaces

The instrument is accessed with an MS-Windows compatible computer (Windows® 98, NT, ME, XP, 2000) and the network software included in these operating systems, preferably Ethernet. For this purpose, the instrument can be integrated into any Ethernet system.

As an alternative, it is also possible to communicate with the instrument via serial interface (RS 232) or modem.

As an option, GPS can be used for real-time synchronisation and determination of disturbances. The real time is saved with the respective mains period; therefore, instruments installed at different sites can be evaluated together. This method ensures that the time of a disturbance is the same among all instruments used. The phase position of the periods can be accurately determined to $\pm 1\mu\text{s}$ from different instruments. For 50 Hz signals, this means a phase shift of 0.018°. The internal clock has an accuracy of 100 ppm.

Power supply

The instrument is supplied from a wide range power supply and can be operated with the following voltages:

- 85 V - 264 V AC, 45 Hz to 65 Hz or
- 100 V to 375 V DC,
- Special version of **QWave Premium**: 19 V to 72 V DC

Safety Electromagnetic compatibility – EMC

Emission: Class A as per IEC 61326-1

Immunity: as per 61326-1

EN 61000-4-2	8 kV air, 4kV contact (B)
EN 61000-4-3	10 V/m (A)
EN 61000-4-8	100A/m (A)
EN 61000-4-4	2kV (B) ^{*)***)}
EN 61000-4-5	2kV / 4kV (B) ^{*)**)} 1kV (B) ^{***)}
EN 61000-4-6	3V (A)
EN 61000-4-11	1 period / 100% (A)

*) Supply **) Measuring inputs ***) Ethernet

Safety

QWave Premium conforms to CE Marking requirements and complies with EN 61010 "Safety regulations for electric measuring, control, automatic control and laboratory instruments". All relevant standards for the use as a recorder in switching systems have been taken into consideration.

Protection Degree

The design of **QWave Premium** complies with protection degree IP20.

Overvoltage category

Analogue channels: 300V CAT III
Digital Input/Output: 150V CAT II

Operating temperature range

5°C ^{*)} up to 50°C

^{*)} ≤0°C assuming that the instrument is warmed up to at least + 5°C before turning it on.

Climatic class

Humidity according to B2 IEC654-1

Dimensions and weight

Dimensions:

Model with 8 channels for 19" U

Incl. Handles H × W × D (mm): 44 × 482 × 328

Excl. handles H × W × D (mm): 44 × 482 × 266

Weight: approx. 3 kg

Display

QWave Premium has 33 LEDs which are continuous status displays. The mains LED shows the power supply status. There is a separate LED for each channel providing information on accuracy and possible faults regarding the respective channel.

Power-LED

- Continuous light: power supply from mains

Channel-LEDs

- Dark, short flashes: "underload" or "no signal"
- Bright, short dark periods: "overload",
- Continuously on: signal level in nominal range.

Services

Commissioning of the instrument on site, parameter set-up according to customer requirements, customer training, and acceptance confirmation with protocol.

Scope of Delivery, Accessories, Service

Power Quality Analyser

Base instrument

For 8 analogue inputs and up to 36 digital channels without additional analogue and without digital input/output cards incl. Software power supply 83V-264V AC, 100-375V DC	EF6511A
---	---------

Same as EF6511A, but for power supply of 19..72V DC	EF6511Z
---	---------

Analogue inputs

4xU (400V)	4xl (5A)	EP5400A
4xU (400V)	4xl (1A)	EP1400A
4xU (100V)	4xl (5A)	EP5100A
4xU (100V)	4xl (1A)	EP1100A
8xU (400V)		EP0400A
8xU (100V)		EP0100A

Digital I/O

36 x input, no output	EP3600A
24 x input, 8 x output, max. 60V	EP2408A
24 x input, 8 x output, max. 150V	EP2408A.Z

Options

Ripple control analysis (license)	EF6516Z
Transient analysis	EF6515Z
Time synchronisation (license)	EP0500A
Compact Flash card instead of HD	A550500350

Accessories

QIS Basic Access software	EF7001Z
ESI for QWave Premium	EF7051Z
GPS receiver	EF6518Z
Lightning protector for GPS antenna	EP1016A
Antenna connector cable 30m	EP1013A
Antenna connector cable 60m	EP1014A
Antenna connector cable 120m	EP1017A
GPS signal splitter box	EP1018A

Scope of delivery

- 1 QWave Premium base instrument
- 1 Connector for analogue channels incl. cable covers
- 1 Connector for power supply
- 1 RS232 crosslink cable
- 1 Ethernet cross link cable for PC connection
- 1 Ethernet cable for network connection
- 1 Operating instructions for **QWave Premium**
- 1 Operating instructions for TOPAS 1000
- 1 CD with TOPAS software

Distributor:



www.lem.com

LEM NORMA GmbH
Export department
Liebermannstraße F01
CAMPUS 21
A-2345 BRUNN AM GEBIRGE
TEL: +43(0)2236 691 502
FAX: +43(0)2236 691 400
E-mail: lna@lem.com

LEM HEME LTD.
Geneva Court
1 Penketh Place
West Pimbo
Skelmersdale, UK-Lancashire WN8 9QX
TEL: +44(0)1 695 72 07 77
FAX: +44(0)1 695 50 704
E-mail: luk@lem.com

LEM Instruments Inc.
23822 Hawthorne Boulevard #100
US-TORRANCE, CA 90505
TEL: +1 310 373 09 66
FAX: +1 310 373 90 56
E-mail: liu@lem.com

LEM Instruments, Inc.
Camino Real, 871 dpto. 502
San Isidro - Lima 27 - Perú
TEL: +51-1- 422 39 22
Mobile: +51-1- 844 55 59
FAX: +51-1- 221 64 92
E-mail: cpg@lem.com

LEM BE sa/nv
Avenue Newton, 8
B-1300 Wave
TEL: +32 10 22 67 16
FAX: +32 10 22 69 98
E-mail: lbe@lem.com

Printed in Germany
Technical modifications reserved
Publication A23209E