

# Power Quality RTU

## QWave POWER CT

## QWave 3U

Providing automated Power Quality Monitoring for power networks

- Records dips, swells and interruptions
- Monitors Power Quality for the Distribution and Transmission Networks according to EN50160 and IEC 61000-3-6/7 or user configurable thresholds
- Automatic printing of compliance reports
- Provides long term statistical analysis
- Allows load profile analysis
- Full GPS or pulse synchronization capability
- Possibility to manage a large number of devices automatically



### General

Whatever the size of the Power network to be monitored, the QWave Power monitors all the Power Quality parameters and generates reports automatically in compliance with the applicable standards or towards user-definable criteria. Its integration in a fully automated system allows the user to focus on the cause of disturbances and the quality of his network directly from an office based PC. The recordings are the basis for detailed evaluations and analysis to assess disturbances and overall Power Quality.

The instrument is basically suited for current, voltage and power measurements through protected inputs.

Connectors feature high security fixing of the connecting cables and screw fixing of the connector to the device to avoid accidental opening of the measurement circuit.

### Measuring Functions

#### Applications

The QWave Power provides following measurements:

- RMS voltage
- RMS current
- Active, reactive, apparent and distorting power
- Power factor
- Dips, swells & interruptions
- Voltage & current harmonics and interharmonics up to the 50<sup>th</sup>.
- Flicker
- Voltage variations
- Imbalance and symmetrical components
- Frequency
- Conformity of signaling voltages

Those measurements can be used simultaneously for:

Recordings with adjustable time resolution from 200ms ... 24h  
Power Quality analysis according to:

- EN50160
- IEC 1000-3-6/7
- User defined thresholds

Incremental recording of dips, swells and interruptions with a resolution of 10 msec

#### Hardware

- 3 full isolated Voltage inputs
- 3 full isolated Current inputs
- PCMCIA-flash memory card for long-term measurements
- GPS-time or pulse synchronization (optional)

#### Communication and data transfer

- Serial interface RS232 & RS485
- MODBUS RTU and ASCII protocols
- Modem (optional)
- GSM Modem (optional)
- Ethernet adaptor (optional)
- Simultaneous on-line and remote operation.

#### Software

- QIS software suite for Power Quality
- OS: Windows 98, Windows ME, Windows NT 4.0 SP4 + Internet Explorer 4.01, Windows 2000 and Windows XP

The QWave Power has been developed in co-operation with electric Utilities focusing on field applications and actual operational requirements.



## Data Analysis

### Analysis towards standards

One device, three measurements-related standards and unlimited freedom ... for distribution and transport network managers.

The **QWave Power** measures all the Power Quality parameters simultaneously and compares them according to the following standards:

- **EN 50160:** Voltage characteristics of electricity supplied by public distribution networks (applies to LV and MV networks)

The **QWave Power** assesses the quality of the supplied electricity. These high accuracy measurements can be used as evidence in case of liability problems.

- **IEC 61000-3-6:** Assessment of emission limits for distorting loads in MV and HV systems (Harmonics, optional)
- **IEC 61000-3-7:** Assessment of emission limits for fluctuating loads in MV and HV systems (Flicker, optional)

The QWave assesses the emission levels and compares them to the planning or compatibility levels. It provides the data needed to evaluate the impact of connecting new disturbing loads on the network. Network managers will appreciate the way data are summarized to provide an overall representation of pollution levels.

### Analysis towards user definable thresholds

If the standard-defined thresholds are not suited, then the user can define his own thresholds. e.g. dips defined at -10% in EN50160 can be changed to -15% as user thresholds.

### Daily Operation

#### • Short term

Every day, any disturbance on the network is automatically reported to your office, with clear description and graphical recordings of dips, swells and other outages.

#### • Medium term

Each week, compliance reports for EN50160, IEC 61000-3-6 and 61000-3-7 are issued automatically.

#### • Long term

Each device installed continuously stores statistical values (MIN, MAX, AVG) of almost all the parameters measured (available intervals are: 1-Hour, 1-Day and 1-Week). In addition, the user can choose to record a given variable continuously (user definable intervals).

#### • Automated data management

The data gathered by the different QWave installed on the power grid can be transferred automatically into one central database. QIS, the management software, allows easy sorting, displaying and comparing data coming from numerous sites. Some examples (not exhaustive) are given here. For more details on QIS, please refer to the QIS brochure.

All the sections of a diagram can be exported as a text table. The charts can be directly imported in reports via the Windows™ clipboard function.

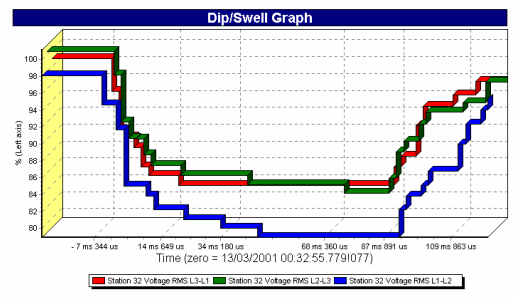
#### • Embedded EN 50160 report

Complete compliance reports are automatically computed every week and can be stored for one year in the device. This analysis provides a rapid overview of the supply quality. Those reports can be summarized and printed with a single mouse click.

#### • Dips and Swells

Dips, swells and interruptions are recorded with a resolution of 10 msec (compliant to 61000-4-30).

The QIS software features easy comparison capabilities for events coming from different locations. Synchronization of the devices can be achieved with GPS (option).



#### • Event List

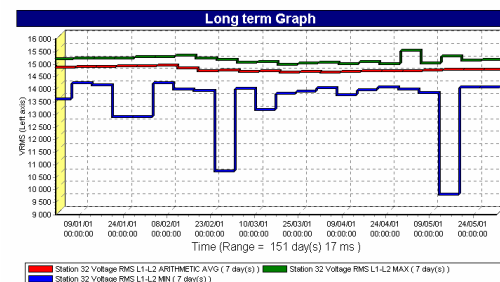
The event list provides a compact overview of all disturbances that occurred. This representation is particularly compact and quick to be read from the QWave.

Easy to use filters help the user to focus on the relevant disturbances. Once an event is selected, it is then easy to filter out all related outages from the complete database.

All	Standard	Dips/Swells	Device	Qis		
Detection						
Device	Date	Disturbance	Module	Duration	Peak	Units
- Detection : End						
Station 32	13/03/2001 00:32:55.877	Dip	EN50160	97 ms 673 us	83.059	%
Station 32	13/03/2001 00:32:55.879	Dip	EN50160	95 ms 232 us	83.569	%
Station 32	13/03/2001 00:32:55.894	Dip	EN50160	112 ms 324 us	78.350	%
+ Detection : Begin						

#### • Statistical Recordings

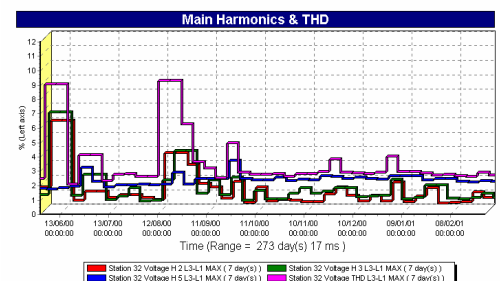
Statistical recordings require no configuration from the user. They are automatically stored for all the measured parameters, the average, max and min levels, summaries are then made by hour, day or week values.



Statistical recording. Overview of the Min, Max and Average RMS Voltages during 6 months

#### • User Recordings

User recordings can be defined to record the measured parameters, with an integration time ranging from 200 msec up to 24 hours. These records feature incremental recording (recording of variations exceeding a dead band). Such incremental recording saves memory, reducing communication time and storage size. Recorded data from different sites can be easily compared on the same charts.



Main Harmonics and THD over a period of 6 months.

## Configuration

### Hardware settings

Only the communication parameters need to be defined on site. Both protocols MODBUS RTU and ASCII can be used to connect the **QWave** directly to a modem or a to a GSM with baud rates up to 56700 baud.

#### Software settings

Before starting measurements as a data logger, the **QWave** is configured remotely via a computer. Configuration files can be stored and loaded. The configuration menu provides for the following settings:

- **Rated voltage and current values**

Rated voltage and current in either delta or star connections are the only parameters that have to be configured.

- **EN50160 Standard campaign start date**

The campaigns start date and the signaling voltages are the sole items to be configured to enable automated generation of EN50160 compliance reports. The beginning of a measurement campaign can be pre-configured to start a new campaign e.g. on Monday 09 August at 00:00 hours. Measurement campaigns will be computed from this starting date and a campaign report will be issued every following week. All the limits defined by EN 50160 are already programmed in the device. the user can choose between the EN50160 and IEC 1000-3-6/7 or even define his own thresholds.

- **Histograms**

Histograms can be computed for most variables measured by the **QWave**. The reference date to start histograms is the EN50160 campaign start date to be configured in the EN50160-configuration tab.

- **10-Minute recordings**

Any of the measured parameter can be selected to be recorded every 10-Minutes with no risk of filling the memory. As the **QWave** already stores hourly and daily statistics, 10-Minute recordings are generally used for more specific analysis on parameters such as THD, RMS value, Flicker or power factor.

- **User Recordings**

The user can define parameters to be recorded incrementally with an integration time starting from 200 msec up to 24 hours. The user can also specify a dead band in order to save memory and communication time.

### Measured Parameters

The **QWave** can act as a data logger collecting data over a longer period of time (months). It can simultaneously analyse the data and compare them to user-defined thresholds or international standards (EN50160, IEC 61000-3-6/7).

The **QWave** measures 3 currents and 3 voltages. The neutral current and voltage neutral point displacement can be computed outside the device if required.

The table below gives an overview of all the electrical parameters currently available.

- **Events and statistics** are automatically computed and stored in the device.
- **Recordings** are only stored depending on the configuration. The acquisition time can be defined independently for each electrical parameter.

Not con- figur- able	User defin- able
EN50160 event	1h, 1day, 1 week, 1 year statistics
	Recordings
	Histograms

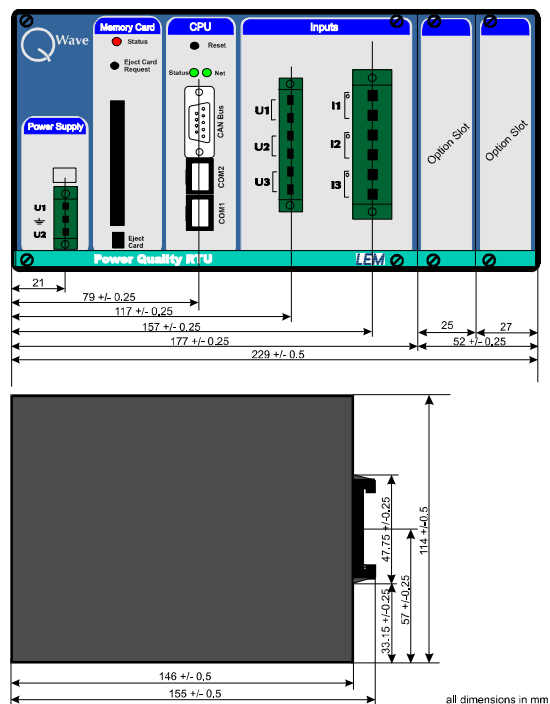
Voltage data	Unit	Phases				
Rms	Vrms	L1, L2, L3	•	•	•	•
Zero Sequence	Vpeak	3 ph	-	•	•	•
Positive Sequence	Vpeak	3 ph	-	•	•	•
Negative Sequence	Vpeak	3 ph	-	•	•	•
Frequency	Hz	L1, L2, L3, & AVG	•	•	•	•
Harmonics (up to 50th)	%Un	L1, L2, L3	•	•	•	•
Interharmonics (up to 49th)	%Un	L1, L2, L3	•	-	•	-
THD	%	L1, L2, L3	•	•	•	•
Interruptions	Nb	L1, L2, L3	•	-	•	-
Dips	Nb	L1, L2, L3	•	-	•	-
Swells	Nb	L1, L2, L3	•	-	•	-
Unbalance	%	3 ph	•	•	•	•
Flicker short term (10 min) Pst	-	L1, L2, L3	-	•	•	•
Flicker long term (2 Hrs) Plt	-	L1, L2, L3	•	•	•	•
Signalling Voltages (3)	V	L1, L2, L3	•	•	•	•

Current data	Unit	Phases				
rms	A	L1, L2, L3	-	•	•	•
Zero Sequence	A	3 ph	-	•	•	•
Positive Sequence	A	3 ph	-	•	•	•
Negative Sequence	A	3 ph	-	•	•	•
Harmonics (up to 50th)	% I rated	L1, L2, L3	-	•	•	•
Interharmonics (up to 49th)	% I rated	L1, L2, L3	-	-	•	-
TDD	% I rated	L1, L2, L3	-	•	•	•

Power data	Unit	Phases				
Real or Active (P)	KW	L1, L2, L3 & 3 ph	-	•	•	•
Reactive (Q)	KVAR	L1, L2, L3 & 3 ph	-	•	•	•
Apparent (S)	VA	L1, L2, L3 & 3 ph	-	•	•	•
Distorting (D)	VA	L1, L2, L3 & 3 ph	-	•	•	•
True Power Factor (PF)		L1, L2, L3 & 3 ph	-	•	•	•
Fund. Power Factor (cos Φ) *		L1, L2, L3 & 3 ph	-	•	•	•

## General technical data

<b>General:</b>	6-Channel Digital Signal Processor (DSP) Sampling rate 10240 Hz @ 50Hz PLL synchronised (Phase-Lock-Loop) - Synchronisation range from 45-55 Hz Precision 10 cycle FFT (Fast Fourier Transform) - Bandwidth 30-2200 Hz Real time through direct PC interface (DASHBOARD) Recorded measurements through modem and PC interface (QIS)
<b>Display:</b>	
<b>Operation/ Configuration:</b>	Through PC interface in direct or modem link
<b>Quality system:</b>	Developed, designed, and manufactured according to DIN ISO 9001:2000
<b>Calibration:</b>	recommended recalibration interval 3 years
<b>Intrinsic error:</b>	0,5% of rdg. for voltage and current inputs refer to the reference conditions and is guaranteed for three years 0,1% of rdg. for voltage can be guaranteed for one year.
<b>Reference Conditions:</b>	23°C ±2K 230V / 50 Hz ±0.1 Hz Interval length: 10 minutes Delta connection (grounded star point) Power supply: 230 V AC / 50 Hz
<b>Temperature Ranges:</b>	Storage -20°C ... +60°C Working -20°C ... +50°C Operating 0°C ... +40°C
<b>Temperature Coefficient:</b>	0,15x0,5%/K
<b>Humidity:</b>	0-85% r.H non condensing
<b>Housing:</b>	Portable metal cabinet with handle
<b>Protection degree:</b>	IP20 according to EN 60529
<b>Safety Class:</b>	Safety class I according to IEC 61140
<b>Weight:</b>	approx. 2.8 kg
<b>Dimension:</b>	H x W x D: 110 x 230 x 160 mm



## EMC

### Emission:

Class A group 1 of CISPR 11

### Immunity:

EN61000-4-2 – 8kVair / 4kV contact – B  
EN61000-4-3 – 10V/m – A  
EN61000-4-4 – 4kV (B)  
EN61000-4-5 – 2kV / 4kV (B)  
EN61000-4-6 - 3V (A)  
EN61000-4-8 - 30A/m (A)  
EN61000-4-11 - 1 period / 100% (A)

## Power supply

### Functional range:

85-265 VAC 45 Hz to 65 Hz,  
100-340 VDC  
Optional DC input 18 – 70 VDC

### Power consumption:

32VA typ.

### Max. Voltage to earth:

300V CATII acc. to IEC/EN61010-1

### Test voltage:

1,5 kV

## Voltage Input

### Input range:

3 x 0-230V AC

### Resolution:

0,01V

### Max voltage to earth:

300V CATIII acc. to IEC/EN61010-1

### Test voltage:

2,3 kV

### Max. overload:

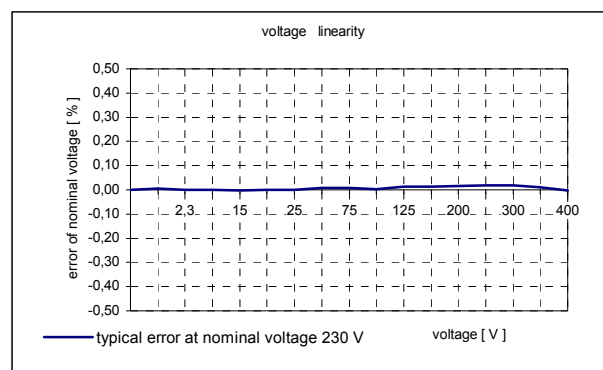
460V AC cont. (2xUn)

### Input impedance:

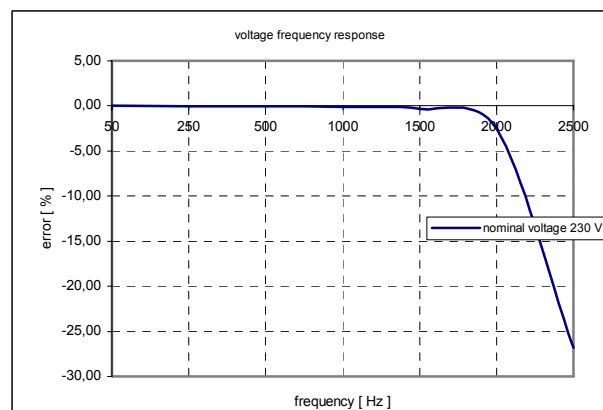
2x4,7 MOhm (+/-10%)

### Voltage Magnitude Class A according to IEC61000-4-30

## Linearity:



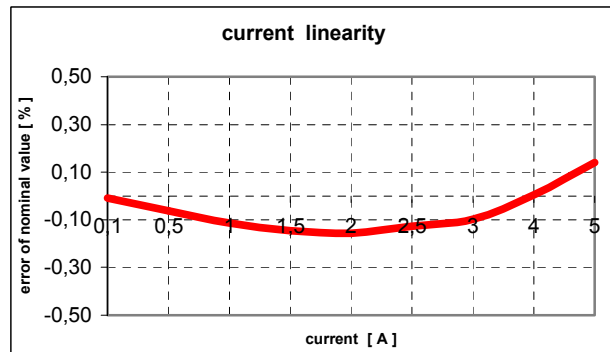
## Frequency response:



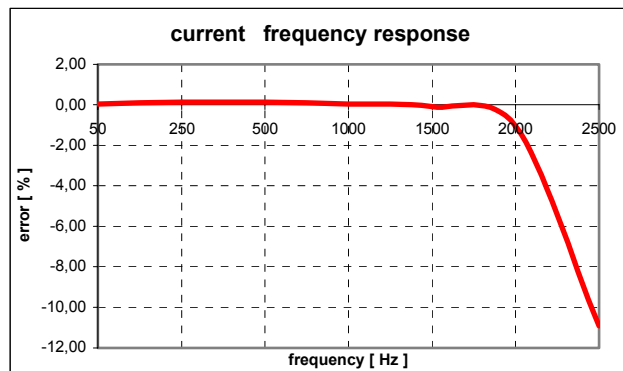
### Current Input

**Input range:** 0-5A  
**Measurement range:** Depending of the current probes  
**Resolution:** 0,01A  
**Max. Voltage to earth:** 30V  
**Max. overload:** 15A continuous (3 x In)  
**Input Impedance:** 20 mΩ (± 15 %)

### Linearity:



### Frequency:



### RMS measurements (slow V/C variations)

**Measuring value:** mean RMS values averaged over 200 msec, 10 min, 1 h, 24 h intervals  
**Settings/analysis:** by QIS software

### Frequency

**Ranges:** 42,5-57,5Hz,  
**Resolution:** 10 mHz  
**Intrinsic error:** 30 mHz  
**Class B according to IEC61000-4-30**

### Sampling rate

10240 Hz synchronized to network frequency (PLL)

### Dips & Swells

**Reference voltage:**  $U_{din}$   
**Measuring value:**  $\frac{1}{2}$  period RMS value  
**Intrinsic error:** <1% of  $U_{din}$   
**Settings/analysis:** by QIS software  
**Class B according to IEC61000-4-30**

### Flicker

**Measuring value:**  $P_{st}$ ,  $P_{it}$  24h value  
**Measurement:** according. to IEC61000-4-15  
**Intrinsic error:** <5% of m.v. acc. to IEC61000-4-15  
**Measuring range:** 0-20  
**Settings/analysis:** by QIS software  
**Class A according to IEC61000-4-30**

### Harmonics

**Voltage Harmonics** 2th-40th

**Measuring value:** 200 msec, 10 min, 1 h, 24 h values  
**Measurement:** according to IEC-61000-4-7 Class I  
**Class A according to IEC61000-4-30**

**Current harmonics** 2th-40th

**Measuring value:** 200 msec, 10 min, 1 h, 24 h values  
**Measurement:** according to IEC-61000-4-7 Class I

### Unbalance

**Class A according to IEC61000-4-30**

### Power with Lem Flex:

**Active power:** according to IEC61036 class 2  
**Reactive power:** according to IEC61268 class 2  
**Distortion power:** according to IEC61036 class 2

### Related Standards

**EN50160** "Voltage characteristics of electricity supplied by public distribution systems"

**EN61000-4-30** "Electromagnetic compatibility (EMC) -- Part 4-30: Testing and measurement techniques - Power quality measurement methods"

**UNPEDE, 230.02** "Measurement guide for voltage characteristics" category 1 (instruments for permanent installation).

**EN50160** "Voltage characteristics of electricity supplied by public distribution systems"

**EN61000-4-30** "Electromagnetic compatibility (EMC) -- Part 4-30: Testing and measurement techniques - Power quality measurement methods"

**UNPEDE, 230.02** "Measurement guide for voltage characteristics" category 1 (instruments for permanent installation).

**IEC 61000-4-15** "Electromagnetic compatibility (EMC) -- Part 4-15: Testing and measurement techniques - Flickermeter - Functional and design specifications"

**IEC 61000-4-6** "Electromagnetic compatibility (EMC) -- Part 4-6: Testing and measurement techniques - Immunity to conducted disturbances, induced by radio-frequency fields"

**IEC 61000-4-7** "Electromagnetic compatibility (EMC) -- Part 4-7: Testing and measurement techniques - General guide on harmonics and interharmonics measurements and instrumentation, for power supply systems and equipment connected thereto"

**IEC 61010 -1 /2001** "Safety regulations for electric measuring, control, automatic control and laboratory instruments".

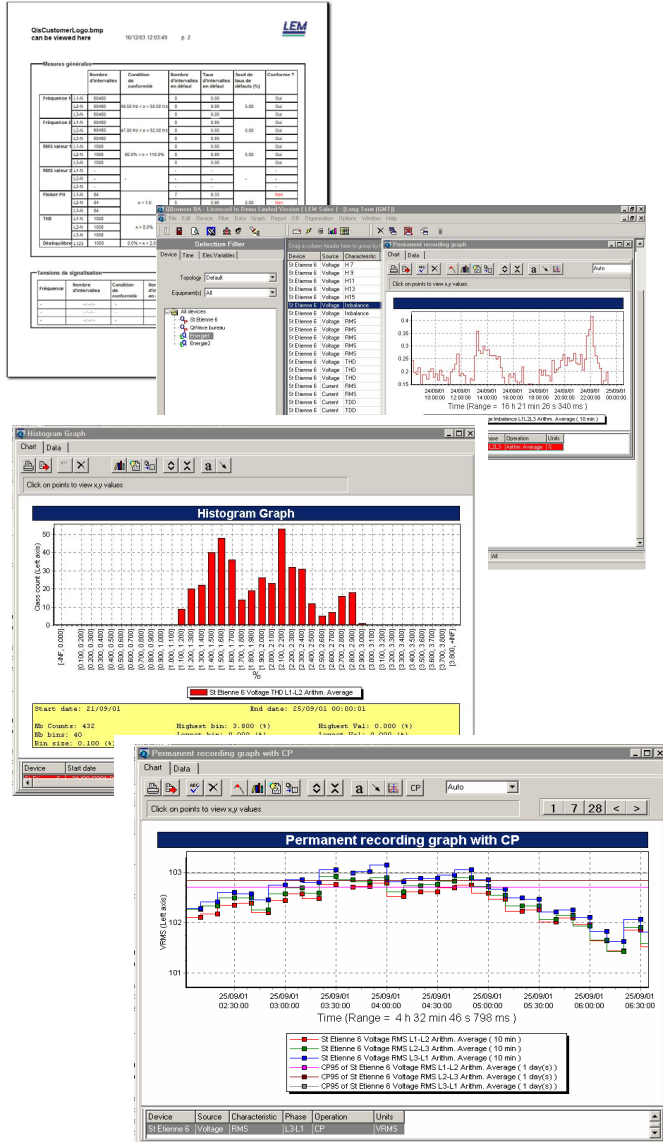


## DATA management

The QIS software suite for Power Quality can manage all the QWave e.i.e.:

- On line mode
- Download data
- Upload data
- Store data on a database
- Analyse and report the data
- Compare data

For more information, refer to the QIS Datasheet.



## Scope of Delivery, Accessories, Service

### Calibration

LEM recommends re-calibrating the QWave every 3 years. Re-calibration can be done on site, provided that properly tooled service is available locally.

### Available options

The embedded modem allow to upload and download data from and to the QWave remotely. One modem can be use for up to 20 QWave allowing the use of only one telephone line.

The embedded GPS or pulse synchronisation boards allow synchronizing the flagging of the data with a very high precision. One board can synchronize up to 3 QWave.

The ETHERNET converter allow to upload and download data from and to the QWave remotely at a baudrate up to 57600 on an ETHERNET network. One converter can manage up to 20 systems.

### Instruments order numbers

EF1511Z/17Z	QWave POWER CT 1A (EF1517Z) / 5A (EF1511Z) 50 Hz, 0-230V. 3 voltage + 3 current inputs.
EF1516Z	QWave 3U voltage only (50Hz, 0-230V) 3 voltage inputs only

### Optional accessories order numbers

EF9078Z	18-70VDC Power supply
EF9079Z	Embedded sharable PSTN modem RS232/485 - 57600 bds
EF9083Z	Embedded UPS for QWave
EF9054Z	PCMCIA Flash memory card 4 MB
EF9055Z	PCMCIA Flash memory card 8 MB
EF9056Z	PCMCIA Flash memory card 20 MB
EF9093Z	TOP TIME GPS synchronisation board
EF9089Z	TOP TIME PULSE synchronisation board
EF9090Z	GPS antenna
EF9085Z	GPS antenna CABLE (20 meters)
EF9085Z	GPS antenna EXTENSION CABLE (50 meters)
EF9100Z	RS232/RS485 ETHERNET CONVERTER
EF1611Z	60Hz Firmware
EF1612Z	61000-3/6-7 Firmware Transmission

### Service

EF1620Z	Test and recalibration validity 3 years
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## PCMCIA flash memory card

Flash memory card for the recording of data (mandatory).

- EF9054Z:** 4Mbytes PCMCIA flash memory card for QWave.  
**EF9055Z:** 8Mbytes PCMCIA flash memory card for QWave.  
**EF9056Z:** 20Mbytes PCMCIA flash memory card for QWave.



## PSTN Modem

Standard telephone line (PSTN) modem .

- RS232, internal BUS or RS485 connexion.
- Sharable modem with RS485 mode; 1 modem for up to 10 QWave.
- 3 status leds.

**EF9079Z:** Embedded sharable modem for QWave.



## UPS

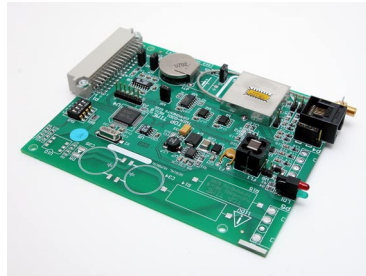
**EF9083Z:** Embedded UPS for QWave.



## Time synchronization

The QWave can be synchronized by GPS or by external 1 minute pulses.

- EF9093Z:** Embedded GPS synchronization board.  
**EF9089Z:** Embedded 1 minute pulses synchronization board.  
**EF9090Z:** External antenna for GPS.  
**EF9085Z:** 20 m GPS antenna cable.



## Firmware 61000-3-6 / 7

The QWave can be delivered with a special firmware managing harmonics histograms following the 61000-3-6 / 7 standards.

**EF1612Z:** 61000-3/6-7 Firmware Transmission.



## QWave – a product family for all your needs.

The QWave range contains different type of instrument.  
This allow to find the right tool for the right job.

			QWave Silver/Power/Nomad				QWave Light	
			EN50160 Configurable	200 msec-24 H recording	1h, 1d, 1S Statistical records	Histograms	EN50160	200 msec-24H recording
<b>Voltage</b>	<b>Unit</b>	<b>Phases</b>						
RMS	V	L1, L2, L3	YES	YES	YES	YES	YES	YES
Zero sequence	V	3 ph	-	YES	YES	YES	-	YES
Positive sequence	V	3 ph	-	YES	YES	YES	-	YES
Negative sequence	V	3 ph	-	YES	YES	YES	-	YES
Frequency	Hz	L1, L2, L3	YES	YES	YES	YES	YES	YES
Harmonics (→50)	%Un	L1, L2, L3	YES	YES	YES	YES	YES	YES
Interharmonics (→ 49)	%Un	L1, L2, L3	YES	YES	-	-	-	YES
THD	%Un	L1, L2, L3	YES	YES	YES	YES	YES	YES
Interruptions	Nn	L1, L2, L3	YES	YES	-	-	YES	YES
Dlps	Nn	L1, L2, L3	YES	YES	-	-	YES	YES
Swells	Nn	L1, L2, L3	YES	YES	-	-	YES	YES
Unbalance	Nn	3 ph	YES	YES	YES	YES	YES	YES
Flicker PST (10 min)	Pst	L1, L2, L3	-	YES	YES	YES	YES	YES
Flicker PLT (2 Hrs)	Plt	L1, L2, L3	YES	YES	YES	YES	-	YES
Signaling voltages (3)	V	L1, L2, L3	YES	YES	YES	YES	YES	YES
<b>Currents</b>	<b>Units</b>	<b>Phases</b>						
RMS	A	L1, L2, L3	-	YES	YES	YES	-	-
Zero sequence	A	3 ph	-	YES	YES	YES	-	-
Positive sequence	A	3 ph	-	YES	YES	YES	-	-
Negative sequence	A	3 ph	-	YES	YES	YES	-	-
Harmonics (→50)		L1, L2, L3	-	YES	YES	YES	-	-
Interharmonics (→ 49)		L1, L2, L3	-	YES	-	-	-	-
TDD	%In	L1, L2, L3	-	YES	YES	YES	-	-
<b>Power</b>	<b>Units</b>	<b>Phases</b>						
Active (P)	KW	L1, L2, L3 & 3 ph	-	YES	YES	YES	-	-
Reactive (Q)	KVAR	L1, L2, L3 & 3 ph	-	YES	YES	YES	-	-
Apparent (S)	VA	L1, L2, L3 & 3 ph	-	YES	YES	YES	-	-
Distorting (D)		L1, L2, L3 & 3 ph	-	YES	YES	YES	-	-
True Power factor (PF)		L1, L2, L3 & 3 ph	-	YES	YES	YES	-	-
Fund. Power factor (Cos Phi )		L1, L2, L3 & 3 ph	-	YES	YES	YES	-	-
<b>Options</b>								
Digital Inputs							0-10V	
Digital Outputs							Relays	
Analog Inputs							0-10V	
Ethernet					Opt		Opt	
GPS					Opt		-	
GSM					Opt		Opt	

Distributor:



[www.lem.com](http://www.lem.com)

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