

Network Analyzer for Low-, Medium- and High-Voltage Networks

Model PQ-Box 100

- ▶ **Fault detection**
- ▶ **Evaluation of voltage quality according to EN50160 and IEC61000-2-2 (2-4)**
- ▶ **Fault recorder functions**
- ▶ **Load analyses; energy measurements**
- ▶ **Ripple control signal analysis**
- ▶ **Ripple control frequency measurements**



1. Application

The PQ-100 Box is a high-performance, portable network-analyzer, power meter and transient recorder. User-friendliness was one of the main objectives of the device development.

The PQ-100 Box has been developed for mobile operation (degree of protection IP65); it is applicable for measurements in public networks (CAT IV) as well as for measurements in industrial environment up to 690V measurement voltage.

The PQ-Box 100 meets 100% of the demands of the IEC 61000-4-30 (2008) for a class-A device:

Parameters	Class
Accuracy of voltage measurement	A
Determination of time intervals	A
Marking of measured values at events	A
Harmonics, interharmonics	A
Flicker	A
Frequency	A
Voltage asymmetry	A
Event recording	A
Time synchronization	A

Its compact dimension enables the device to be installed in small-sized spaces and switchgear cabinets, even directly next to current-carrying components. The device is very easy to handle, due to the power supply via measuring lines and the application-oriented presetting of all trigger conditions.

In order to quickly identify the cause of a grid disturbance, the PQ-Box 100 is equipped with a large number of trigger options.

An USB 2.0 interface is available for a quick data transfer.

In the case of a supply interruption the integrated UPS continues the operation.

2. Measurement functions

The PQ-100 Box is available in different versions:

▶ **PQ-Box 100 basic (B0)**

The device is suitable for power analyses, as a data logger for the fault detection and for online-measurements.

▶ **PQ-Box 100 light (B1)**

This version is additionally equipped with a manual trigger for oscilloscope images and 10ms r.m.s. values; standard evaluations according to EN50160, IEC61000-2-2/2-4 for public and industrial power systems are automatically generated.

▶ **PQ-Box 100 expert (B2)**

In addition to the version “light” this option features comprehensive trigger functions. Fast oscilloscope images and 10ms r.m.s. values are recorded independently.

▶ **Option “Ripple control signals” (R1)**

Using this function, triggering to ripple control signaling in the network is possible. These signals can be evaluated by means of software as fast r.m.s. values for voltages and currents.

Each version can easily be upgraded via a licence.

We take care of it.

The PQ-Box 100 registers more than 2.250 different measurement values in one continuous recording: voltage, current, frequency, power, energy consumption, asymmetry, flicker, harmonics and interharmonics.

The measuring interval for the permanent recording can be set to a minimum of one second, without reduction of the number of parameters recorded.

Performance			
PQ-Box 100	basic (B0)	light (B1)	expert (B2)
Statistic EN50160/IEC 61000-2-2/IEC 61000-2-4		x	x
PQ-events		x	x
Recording free interval (1sec...30min):			
Voltage: min. max. average	x	x	x
Current: min. max. average	x	x	x
Power: P, Q, S, PF, cos phi, sin phi, tan phi	x	x	x
Distortion power D	x	x	x
Energy: P, Q, P+, P-, Q+, Q-	x	x	x
Flicker according IEC61000-4-15 (2010) (Pst, Plt,Ps5)		x	x
Unbalanced voltage, current	x	x	x
Voltage harmonics		till 50.	till 50.
Current harmonics		till 50.	till 50.
Phase-angle of harmonics		till 50.	till 50.
THD voltage, current; PWHD, PHC	x	x	x
Interharmonics – voltage, current		DC till 5kHz	DC till 5kHz
Ripple control signal		x	x
Frequency: min. max. average	x	x	x
15/30 min interval – P, Q, S, D, cos phi, sin phi ...	x	x	x
Online mode:			
Oscilloscope recorder	x	x	x
10 ms r.m.s recorder	x	x	x
Voltage, current harmonics	x	x	x
Interharmonics (U, I)	x	x	x
Direction of harmonics	x	x	x
Triggerfunctions			
Manual trigger		x	x
10 ms recorder (U, I, P, Q, S, frequency)			x
Oscilloscope recorder (U, I)			x
Option ripple signal voltage recorder – possible		x	x

3. Design

The rugged mechanical design and the class of protection IP65, as well as the lack of rotating parts such as fans or hard discs, make the device suitable for the use even under severe operating conditions.

The PQ-Box 100 is equipped with a data memory of 2GB. Therefore, measured values can be stored for a long time, even up to one year. In case of power failure an internal UPS substitutes the power supply unit of the net analyzer.

A power outlet is not necessary for the voltage supply; the device can be supplied directly from the measurement cables. With a theft protection the PQ-Box 100 can be secured on site.

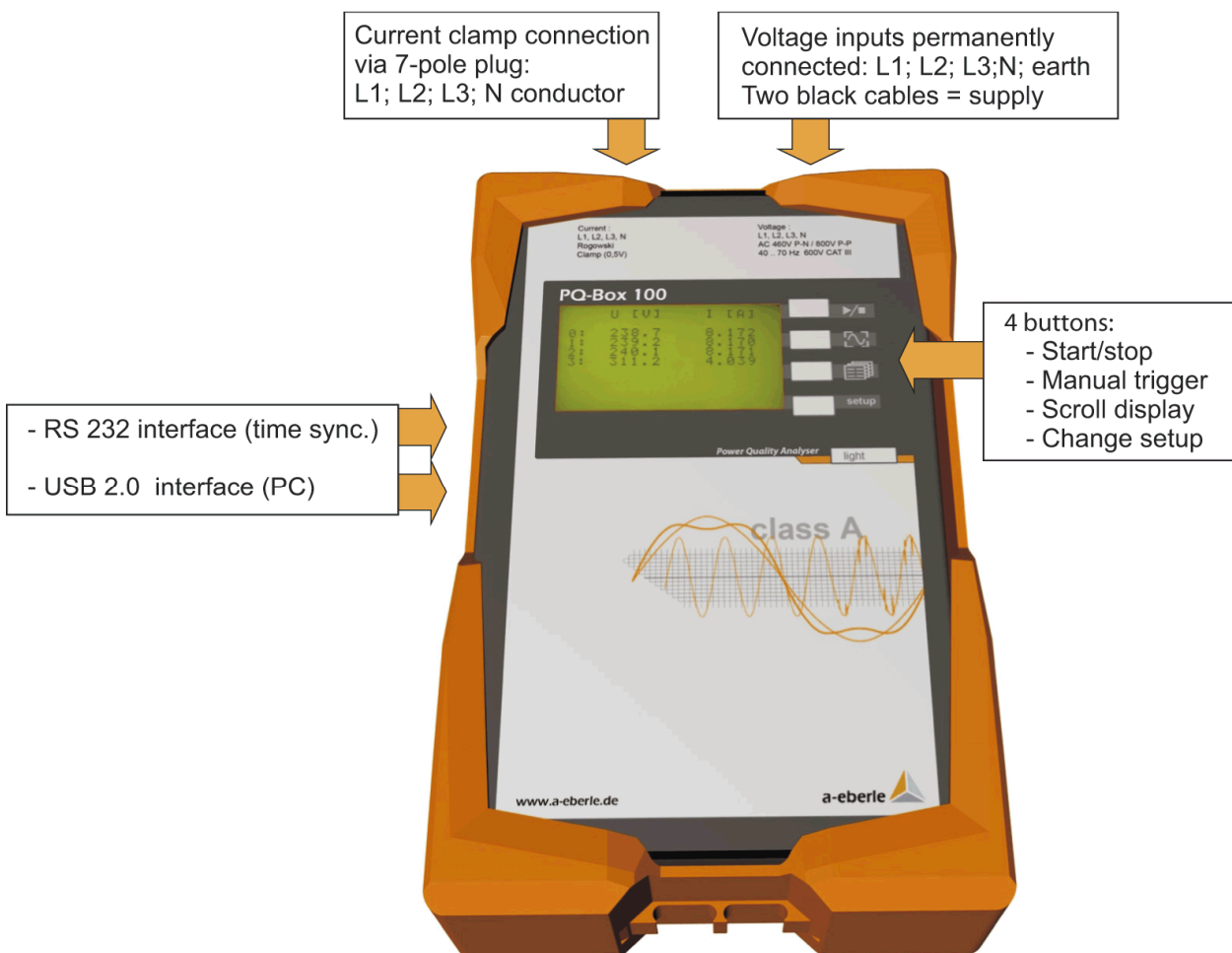
3.1 Evaluating measured data

Recorded data is transferred to the analyzing-PC via a high-speed USB interface. During readout the device doesn't need additional power supply; it is supplied via the USB interface. The practice-oriented analysis software is included in delivery and can be installed on any number of PCs.

The software provides a wide range of analysis options such as load analyses or the detection of the cause of a grid disturbance. Reports according to EN50160/IEC61000-2-2 (2-4) are automatically generated and comprehensive online-functions are available.

Updates of the analysis software can be downloaded via Internet free of charge (www.a-eberle.de).

3.2 Device front panel



We take care of it.

3.3 Display

The display of the device provides information about the correct connection of measuring cables and current clamps and indicates online-data of voltage, current, THD and power.

The number of occurred events, as well as the recorded time period are shown on the display.

Rec. = OFF	0d 00:00:00
free Memory:	487MB
Oscilloscope Rec.	0
RMS Recorder	0
Signal voltage	0
PQ events	0

A keyboard lock can be activated, to avoid manipulation on the device by unauthorized persons.

Rec. = OFF	0d 00:00:00
free Memory:	487MB
U1N 0.027 V	I1 0.000 A
U2N 0.031 V	I2 0.000 A
U3N 0.029 V	F 0.000 Hz
Rec. = OFF	0d 00:00:00
free Memory:	487MB
P1 +0.000 W	Q1 +0.000 VAR
P2 +0.000 W	Q2 +0.000 VAR
P3 +0.000 W	Q3 +0.000 VAR
Rec. = OFF	0d 00:00:00
free Memory:	487MB
Oscilloscope Rec.	0
RMS Recorder	0
Signal voltage	0
PQ events	0
Rec. = OFF	0d 00:00:00
free Memory:	487MB
S1 0.000 VA	PF 1.000 %
S2 0.000 VA	PF 1.000 %
S3 0.000 VA	PF 1.000 %
Rec. = OFF	0d 00:00:00
free Memory:	487MB
THD U1 0.000 %	THD I1 0.000 %
THD U2 0.000 %	THD I2 0.000 %
THD U3 0.000 %	THD I3 0.000 %
	THD IN 0.000 %

3.4 Pushbuttons

Using the Start/Stop-button the measurement is started or stopped. Any number of measurements can be recorded consecutively, without reading out the device previously.

The button "manual trigger" enables to image the actual state of a system as oscilloscope picture as well as r.m.s. value recording.

By "scrolling", a number of measurement data is indicated on the display. So the correct connection of the device can be tested.

The button "setup" allows to modify for example, configurations for current- or voltage transformer, the sampling interval or the nominal voltage, directly at the PQ-Box 100.

3.5 Time synchronization

To adjust measurement data of different devices time synchronization is essential. For this purpose, a radio controlled clock for GPS signals is available.

3.6 EN 50160/IEC 61000-2-2 Evaluation

- Overview of the power quality statistic. Bar chart provides automatic summary of relevant metrics.
- Automated reporting in accordance with EN50160 / IEC61000-4-15 / IEC61000-4-7 / IEC61000-2-2 / -2-12 (public networks), IEC61000-2-4 (industrial networks), NRS048, IEEE519, or your own defined limits.
- Company logo in the report and as well as main text fields can be customized.

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Auswertung nach EN50160/IEC61000-2-2

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Firma Abteilung: Fuhrlander Aktiengesellschaft
Fuhrlander In Anlage FL 625
Ab 18.05. 21:31 UTC Anlagenstillstand wg. Windmangel
Rückwirkung Harmonische

Kunde: Fuhrlander Aktiengesellschaft
Adresse: 56477 Walgandshain
Grund: Wiederholte Zerstörung von Elektronik Komponenten
SW-Version: 1.6.13
Reihennummer Gerät: 1105119
SW-Version: 1.6.13
Spannungssystem: 4 Leiter-Netz
Spannung L-L / L-N: 693V / 400V
Messintervall: 600s
Frequenz: 50Hz
Rundsteuerfrequenz: 168Hz
Messung Beginn: 16.05.2011 09:29:13
Messung Ende: 24.05.2011 07:50:00
Messdauer: 76 22h 20m 47s
Anzahl Messintervalle: 1142
Firmware: 1.130
DSP-Version: 1.233

L1 - Harmonische

L2 - Harmonische

L3 - Harmonische

Übersicht

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Harmonische

	Grenzwert	L1 - 95.00%	L1 - Max	L2 - 95.00%	L2 - Max	L3 - 95.00%	L3 - Max
THD	8.0000	0.7850	1.1981	0.7696	1.1159	0.7886	1.0899
2	2.0000	0.0366	0.0412	0.0324	0.0371	0.0327	0.0394
3	5.0000	0.1427	0.2186	0.1102	0.2071	0.1608	0.2544
4	1.0000	0.0388	0.0501	0.0466	0.0585	0.0388	0.0544
5	6.0000	0.6123	1.0947	0.6093	1.0053	0.6063	0.9833
6	0.5000	0.0295	0.0299	0.0295	0.0327	0.0267	0.0312
7	5.0000	0.4257	0.6109	0.3881	0.5600	0.4319	0.6293
8	0.5000	0.0390	0.0578	0.0379	0.0587	0.0393	0.0622
9	1.5000	0.0704	0.1196	0.0843	0.1132	0.0961	0.1295
10	0.5000	0.0423	0.0534	0.0327	0.0439	0.0250	0.0351
11	3.5000	0.2192	0.2857	0.2318	0.2889	0.2354	0.3151
12	0.5000	0.0400	0.0760	0.0397	0.0770	0.0399	0.0765
13	3.0000	0.2173	0.3048	0.1818	0.2608	0.1939	0.3098
14	0.5000	0.0471	0.0946	0.0517	0.0987	0.0506	0.0993
15	0.5000	0.0250	0.0439	0.0260	0.0373	0.0240	0.0500
16	0.5000	0.0598	0.0694	0.0645	0.0735	0.0618	0.0682
17	2.0000	0.2994	0.3812	0.2957	0.4002	0.1878	0.2866
18	0.5000	0.0371	0.0485	0.0381	0.0494	0.0390	0.0520
19	1.5000	0.0547	0.1453	0.0595	0.1746	0.0577	0.1672
20	0.5000	0.1822	0.2202	0.1766	0.2104	0.1782	0.2177
21	0.5000	0.1484	0.2830	0.1398	0.2648	0.1409	0.2761
22	0.5000	0.2981	0.3761	0.4498	0.5758	0.4026	0.4146
23	1.5000	0.2075	0.3596	0.2555	0.4447	0.2136	0.3795
24	0.5000	0.3196	0.3705	0.3635	0.4226	0.3182	0.3720
25	1.5000	0.1312	0.1903	0.1510	0.2194	0.1370	0.1983
26	0.3500	0.3033	0.3478	0.3650	0.4171	0.3424	0.3882
27	0.2000	0.1152	0.1888	0.1396	0.2287	0.1320	0.2102
28	0.3400	0.0960	0.1517	0.1142	0.1831	0.1142	0.1857
29	1.0600	0.0640	0.1126	0.0787	0.1340	0.0765	0.1403
30	0.3300	0.0552	0.0827	0.0663	0.0980	0.0630	0.1051
31	0.9700	0.0509	0.0710	0.0591	0.0840	0.0561	0.0893
32	0.3300	0.0700	0.1660	0.0714	0.1770	0.0638	0.1159
33	0.2000	0.0559	0.2127	0.0497	0.2059	0.0527	0.1495
34	0.3000	0.0522	0.1488	0.0456	0.1603	0.0529	0.1311
35	0.8300	0.0494	0.1464	0.0430	0.1312	0.0447	0.1432
36	0.3200	0.0261	0.0612	0.0231	0.0543	0.0245	0.0595
37	0.7700	0.0388	0.0535	0.0343	0.0473	0.0367	0.0513
38	0.3200	0.0395	0.0602	0.0362	0.0554	0.0364	0.0548
39	0.2000	0.0400	0.0675	0.0382	0.0627	0.0374	0.0623
40	0.3100	0.0337	0.0679	0.0322	0.0635	0.0333	0.0628
41	0.6700	0.2416	0.2601	0.2334	0.2518	0.2293	0.2503
42	0.3100	0.0283	0.0597	0.0270	0.0578	0.0272	0.0539
43	0.6300	0.3611	0.4134	0.3465	0.3941	0.3466	0.3949
44	0.3100	0.0584	0.1239	0.0566	0.1217	0.0561	0.1208
45	0.2000	0.3716	0.4553	0.3567	0.4362	0.3606	0.4345
46	0.3000	0.0598	0.1527	0.0489	0.1442	0.0498	0.1516
47	0.5500	0.2841	0.3408	0.2797	0.3358	0.2764	0.3289
48	0.3000	0.0215	0.0575	0.0205	0.0577	0.0206	0.0573
49	0.5200	0.1613	0.1725	0.1546	0.1680	0.1555	0.1698
50	0.3000	0.0150	0.0363	0.0159	0.0337	0.0155	0.0361

PQ-Ereignisse

305 Rundsteuersignal (3sec):	0	
Überspannung:	0 Langsame Spannungsabweichung:	0
SpW-Schwankung positiv (10ms):	3 Überschreitung Langzeitflicker:	6
SpW-Schwankung negativ (10ms):	22 Überschreitung Unsymmetrie:	0
Tiefer Spannungseinbruch:	12 Überschreitung THD:	0
Versorgungsunterbrechung:	0 Überschreitung Harmonische:	1470

ITIC Auswertung

Ereignis-Matrix

Restspannung u[%]	Dauer [ms]			
	10 ... 200	200 ... 500	500 ... 1000	1000 ... 60000
90 ... 80	7	10	5	0
80 ... 70	0	0	0	0
70 ... 40	0	0	0	0
40 ... 5	0	0	0	0
5 ... 0	0	0	0	0

Einbruch Spannung u[%]	Dauer [ms]	
	10 ... 500	500 ... 60000
... 120	0	0
120 ... 110	0	0

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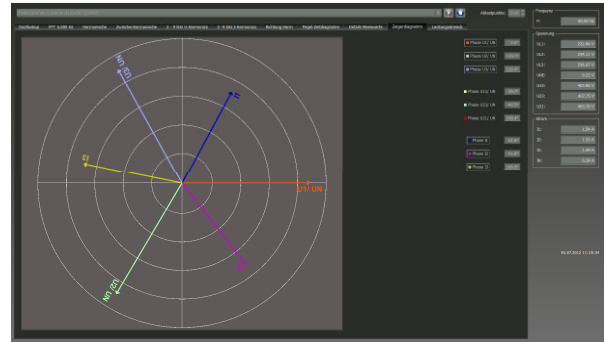
Automatic standard report

We take care of it.

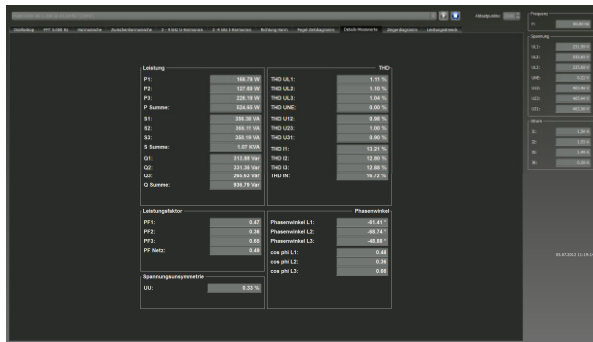
3.7 Online analysis-software

A comprehensive online analysis-software depicts the actual waveform of the current- and voltage signals as well as harmonics and interharmonics from DC to 5.000 Hz.

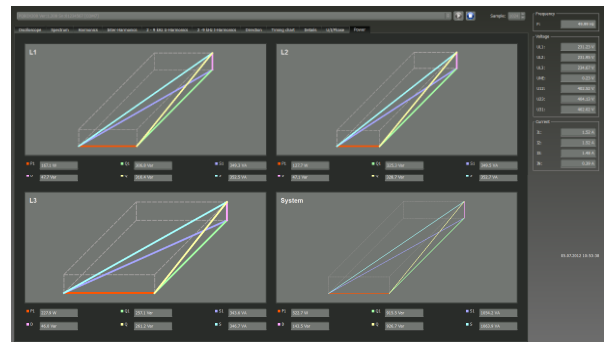
The power flow direction of the harmonics at the measuring point as well as the actual power values (active power, reactive power, distorted reactive power, cos-phi, phase angle, power factor) are displayed.



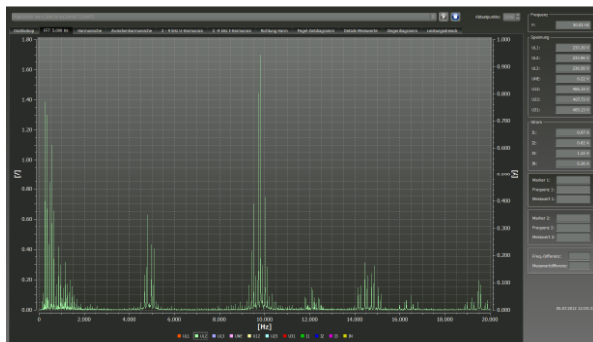
Online phasor diagram



Online measured-values table



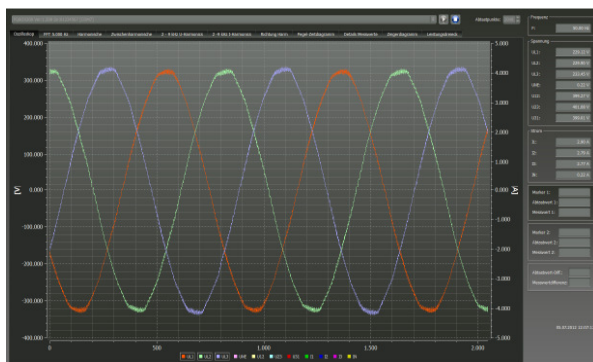
Online power-cube



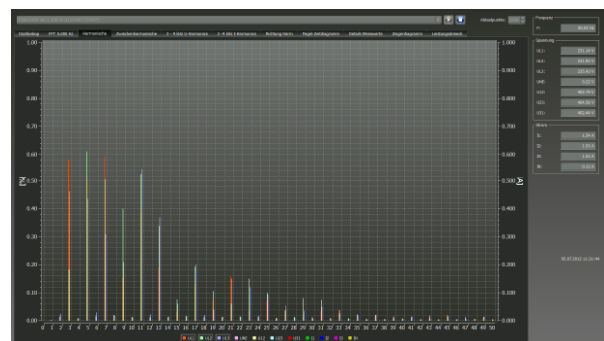
FFT-Analysis DC up to 5 kHz



Online time level diagram



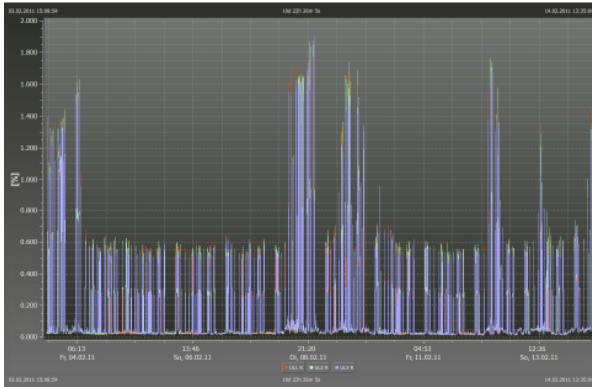
Online oscilloscope-recorder



Spectrum voltage and current harmonics

3.8 Analysis of ripple control signals

In addition to the harmonics, the PQ-Box 100 is able to record any frequency between 100Hz and 4700Hz. This feature can be used to evaluate the signal amplitude of ripple control signals.



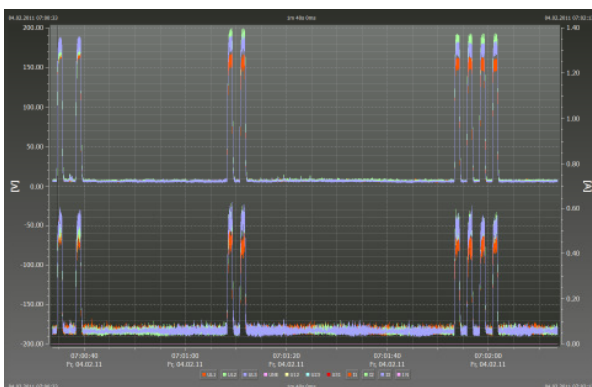
Ripple control level over a few days

Option: analysis of ripple control signals

In addition to the ripple control level measurement (PQ-Box 100 light & expert), using this function it is possible to trigger to a ripple control frequency. The complete message up to 210 seconds for voltages and currents is displayed and disturbances in the signal form can be analyzed. It is possible to record more than 500 telegrams per measurement.

The following parameters can be set:

- Triggering threshold
- Length of recording
- Ripple control frequency
- Bandwidth of the filter curve



Ripple control telegram of voltage and current (option)

3.9 Trigger functions

The version "PQ-Box 100 expert" offers comprehensive trigger functions. Triggering thresholds, length of recording and pre-event history of the record can be freely adjusted by the user. If the automatic trigger is activated, an autonomous intervention to each trigger condition and its adjustment to the actual network condition is made by the device. Therefore, an operating error of the trigger setting is impossible.

Trigger conditions for voltage (phase to phase; phase to neutral; neutral to earth)

- Lower/ upper threshold
- Voltage step
- Wave shape trigger
- Phase angle step

Trigger conditions for current (L1, L2, L3, neutral)

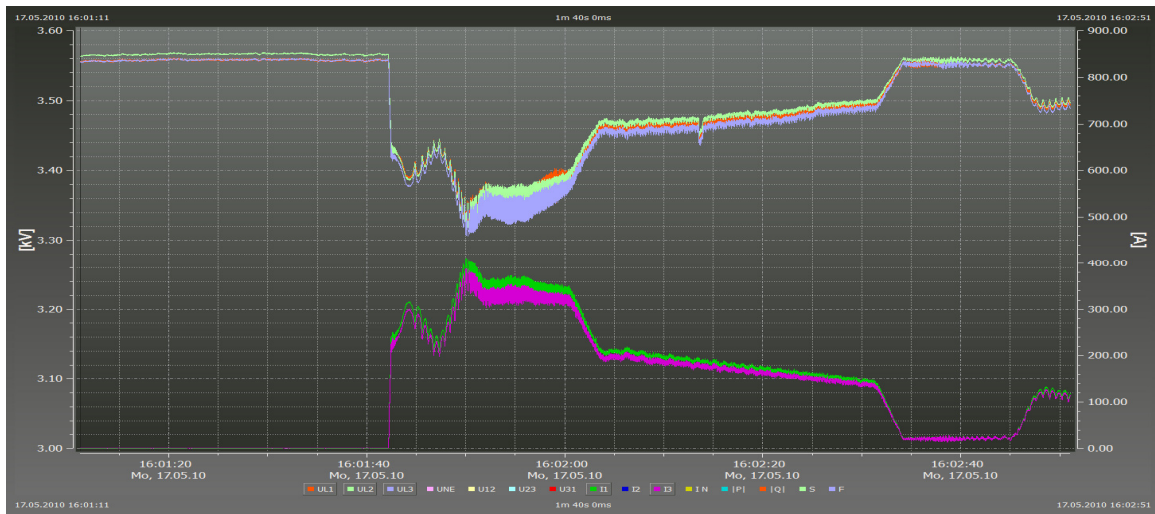
- Lower/ upper threshold
- Current step

3.10 Data memory

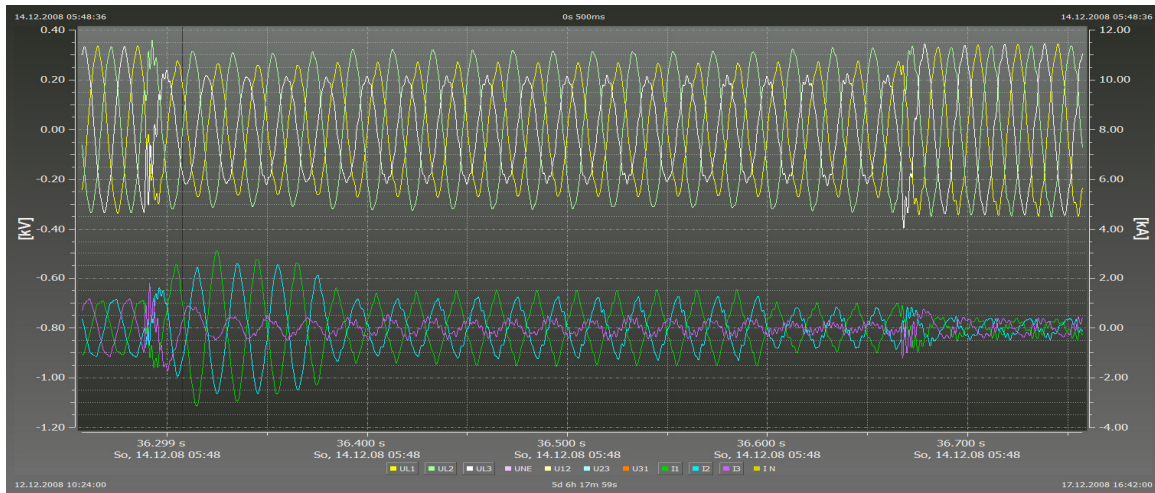
The available memory (1GByte) is organized automatically and smart by the device. Numbers of measurements can be recorded consecutively without having rerecorded the data to a PC. At the beginning of a new measurement the free memory is split reasonably for long-time measurement values and recordings.

We take care of it.

3.11 Fault records as oscilloscope image and 10ms r.m.s. record

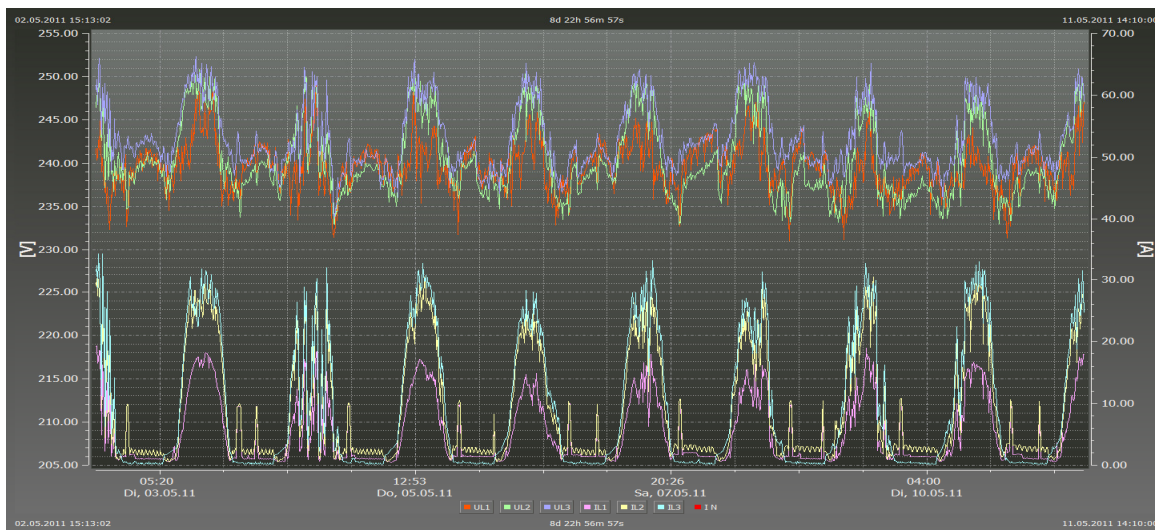


10 ms r.m.s. – record (machine start-up)



Oscilloscope record

Continuous recording



Spannung, Strom 3-phasig

3.12 Version

PQ Box100 (4U/4I)	
4 voltage inputs (AC/DC):	L1, L2, L3, N, E; 500V AC/700V DC L-N; 830V AC/1000V DC L-L 1 MΩ impedance
4 current inputs (AC/DC):	1000mV input for mini clamp and 330mV for Rogowski current probes 10 kΩ impedance
Sampling rate:	10,24kHz at 50Hz
Automatic synchronization to fundamental oscillation:	45Hz to 65Hz
Measurement intervals:	freely adjustable from 1 sec. to 30 min.
Data memory:	2 GB
Interfaces:	USB 2.0
Time synchronization:	GPS radio controlled clock
Dimensions:	220 x 146 x 57mm
Mass:	1,7kg
Degree of protection:	IP 65
IEC 61000-4-30:	class A
Accuracy:	< 0,1%
Insulation class:	CAT III / 600V, CAT IV / 300V
A/D converter:	24 Bit
Climate-proofness / temperature:	Function: -20°60°C Storage:-30°80°C
Display:	illuminated

PQ Box100 (4U/4I)	
Power supply:	100 V...280 V AC or 140 V...240 V DC

EMC	
CE- conformity	
<ul style="list-style-type: none"> ● Interference immunity <ul style="list-style-type: none"> — EN 61326 — EN 61000-6-2 ● Emitted interference <ul style="list-style-type: none"> — EN 61326 — EN 61000-6-4 	
ESD	
<ul style="list-style-type: none"> — IEC 61000-4-2 — IEC 60 255-22-2 	8 kV / 16 kV
Electromagnetic fields	
<ul style="list-style-type: none"> — IEC 61000-4-3 — IEC 60 255-22-3 	10 V/m
Burst	
<ul style="list-style-type: none"> — IEC 61000-4-4 — IEC 60 255-22-4 	4 kV / 2 kV
Surge	
<ul style="list-style-type: none"> — IEC 61000-4-5 	2 kV / 1 kV
HF conducted disturbances	
<ul style="list-style-type: none"> — IEC 61000-4-6 	10 V, 150 kHz ... 80 MHz
Voltage dips	
<ul style="list-style-type: none"> — IEC 61000-4-11 	100 % 1min
<ul style="list-style-type: none"> ● Housing at a distance of 10 m ● AC supply connection at a distance of 10 m 	30...230 MHz, 40 dB 230...1000 MHz, 47 dB 0,15...0,5 MHz, 79 dB 0,5...5 MHz, 73 dB 5...30 MHz, 73 dB

4. Current accessories

- Standard accessories are automatically recognized by the meter..
- The conversion factor is automatically adjusted for the connected accessory.

- **Rogowski current clamp 4~: Ident-No. 111.7001**

Current range: 5A to 3000A RMS; Accuracy: 1%
Rogowski clamp length= 610mm;
Diameter = 194mm; Rogowski clamp head = 9,9mm
Frequency range: 10Hz to 20kHz

- **Rogowski current clamp 4~: Ident-No. 111.7006**

Current range: 10A to 6000A RMS; Accuracy: 1%
Rogowski clamp length = 910mm;
Diameter = 290mm; Rogowski clamp head = 9,9mm
Frequency range: 10Hz to 20kHz

- **Mini- Rogowski current clamp 4~: Ident-No. 111.7030**

Current range: 2A to 1500A RMS; Accuracy: 1%
Rogowski clamp length = 400mm;
Diameter = 125mm; Rogowski clamp head = 8,3mm
Frequency range: 10Hz to 20kHz

The MU-metal clamp is especially applicable for small current measurements on secondary transformers in medium- and high-voltage networks. High accuracy and small angle errors are combined.

- **Mu-Metal Current clamps 3~: Ident-No. 111.7003**

Current range: 10mA to 20A
Frequency range: 40Hz to 20kHz

- **Mu-Metal Current clamps 4~: Ident-No. 111.7015**

Current range: 10mA to 20A/200A AC RMS (two ranges)
Frequency range: 40Hz to 20kHz

- **Mu-Metal Current clamps 0...5A 1~: Ident-No. 111.7043**

Current range: 5mA to 5A AC RMS
Frequency range: 40Hz to 20kHz
Free current adapter set necessary

- **AC/DC Current clamp 1~: Ident-No. 111.7020**

AC/DC hall sensor clamp. Set with power supply and 2 pcs. 4mm connectors
Current range 60A/600A (two ranges)

- **Current-shunt 2A: Ident-No.: 111.7055**

Measurement of AC- and DC-currents. Current range = 2A / 200mV output signal

- **Free Adapter set for connecting 4 clamps: Ident-No.: 111.7004**

Adapter set for connecting 4 clamps or shunt with 4mm connectors

- **Current clamp cable extension: Ident-No.: 111.7025**

Cable extension 5 m for current clamps or Rogowski coils.

5. Order details

When ordering please note:

CHARACTERISTICS	CODE
Fault recorder and network analyzer according to DIN EN 50160 and IEC 61000-3-40 class A Mobile power-quality-network analyzer and power-meter for low-, medium- and high voltage networks according to DIN EN-50160/IEC 61000-4-30 class A <ul style="list-style-type: none"> ● 2 GB flash memory ● USB interface ● Display ● IP65; with uninterruptible power supply ● USB-cable set; Ethernet cable set ● Voltage connecting cable ● 2 power supply lines ● 5 Dolphin clips ● 3 pcs high current fuses for voltage leads ● Hardcase for current clamps and measurement cables incl. analysis software 	PQ-Box 100
Version <ul style="list-style-type: none"> ● PQ-Box 100 (4U/4I) basic ● PQ-Box 100 (4U/4I) light ● PQ-Box 100 (4U/4I) expert 	B0 B1 B2
Operating manual and display <ul style="list-style-type: none"> ● German ● English ● French ● Spanish ● Italian ● Dutch ● Czech ● Russian ● Polish 	G1 G2 G3 G4 G5 G6 G7 G8 G9

UPGRADES	IDENT-NO.
Ausführung <ul style="list-style-type: none"> ● Upgrade version „basic“ (B0) to „light“ (B1) ● Upgrade version „light“ (B1) to „expert“ (B2) ● Upgrade version „basic“ (B0) to „expert“ (B2) 	900.9090 900.9091 900.9093
<ul style="list-style-type: none"> ● Upgrade R0 to R1 (ripple control recorder) 	900.9092

ACCESSOIRES	IDENT-NO.
<ul style="list-style-type: none"> ● Voltage tap on insulated cable; contact support 1 ~, connected for 35-240mm² 	111.7037
<ul style="list-style-type: none"> ● Cable set 4 phase, 1.5 mm², 2m long, 4x 16A fuse, 4x 4mm safety plugs 	111.7038
<ul style="list-style-type: none"> ● Network adapter connector socket for 1 ~; 4mm safety plugs 	582.0511
<ul style="list-style-type: none"> ● Calibration set for PQ-Box 100/200; calibration software and adapter box 	111.7039
<ul style="list-style-type: none"> ● Lemp rubber case for fuse box 	111.7012
<ul style="list-style-type: none"> ● Silex Box, SX-3000GB; USB to TCP-IP converter 	111.9030.43
<ul style="list-style-type: none"> ● Kit of magnetic voltage taps 	111.7008
<ul style="list-style-type: none"> ● GPS radio clock (230V – RS 232) 	111.9024.47
<ul style="list-style-type: none"> ● CAT-Booster (600V CAT IV) voltage adapter for PQ-Box 100 / 200 	111.7026



PQ-Box 100 with accessories and case

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Software - Version:

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Network Analyzer – PQ-Box 100