

## HV Power hints and tips: PQ-Box 100 Power Quality Recorder

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### Input Voltage Range

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The PQ-Box 100 can be directly connected to 690 Vrms systems, such as found in industrial and wind farm applications.

The upper “nominal” voltage recommendations are:

- 690 Vrms line-to-line, 400 Vrms line-to-earth

As any ‘nominal’ voltage system may exhibit over-voltages, the following maximum permissible ratings are also advised:

- The PQ-Box 100 is rated for a maximum input voltage to earth, of 600 Vrms
- The maximum of the L-L measurement range is 1,100 Vrms

Please refer to operating instructions for important safety information.

**The use of 111.7014 Safety Fused Leads are highly recommended for all applications (500 mA/1000V /50 kA fuses).**

### Battery Life

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The PQ-Box 100 internal battery provides a ride through ensuring continuous measurement if the PQ-Box 100 is recording and briefly loses Aux Power.

- Firmware in 2007-2008 provided 30 seconds operation
- Firmware in 2009-2010 provided 60 seconds
- Firmware in 2011 provides 20 seconds

If the PQ-Box 100 is not recording, and the Aux power supply is removed, the PQ-Box 100 will shut down in approx 10 seconds.

The decision to reduce hold up time in 2011 was based on field experience, where some batteries are exhibiting a very short life time. A.Eberle is currently testing a new type of battery with improved performance.

In addition, the latest PQ-Box 100 firmware includes the following display:

#### **Battery Low indication:**

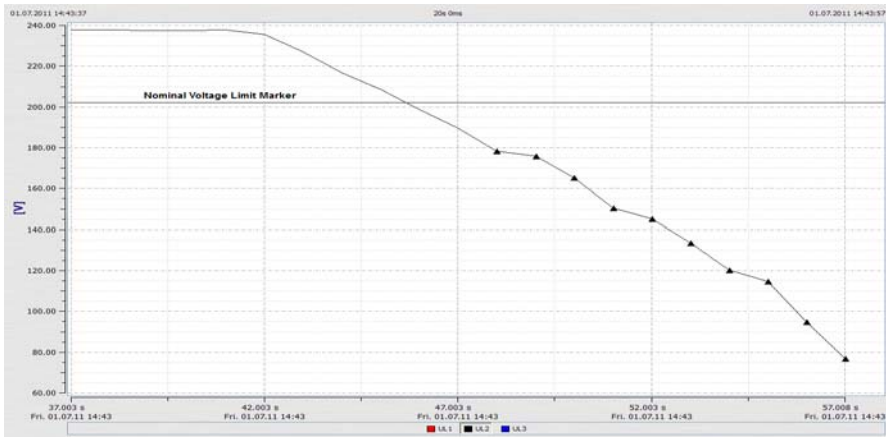
Upon power up the PQ-Box 100 will report “Battery Low, please charge for 2 hours” if the main rechargeable battery is low in charge.

**Divergence**

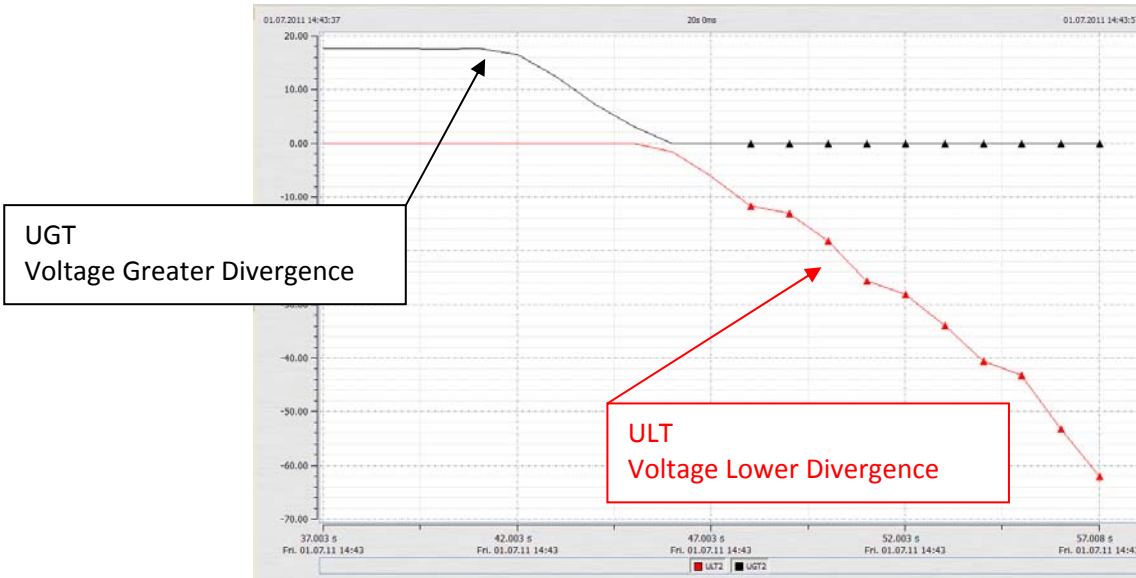
Permanent Recorded data “Divergence”, shows the percentage deviation of the measured voltage from the set PQ-Box 100 “Nominal” voltage setting:

- The trace ULT (Voltage Lower Trace) shows the “negative” deviation from nominal voltage (as a percentage of nominal voltage). Note that if deviation is positive, then ULT will record 0 %
- The trace UGT (Voltage Greater Trace) shows the “positive” deviation from nominal voltage (as a percentage of nominal voltage). Note that if deviation is negative, then UGT will record 0 %

Figure 1 shows a test voltage starting above the nominal voltage and dropping below. The nominal voltage is shown as the horizontal line.



**Figure 1. Applied test voltage.**

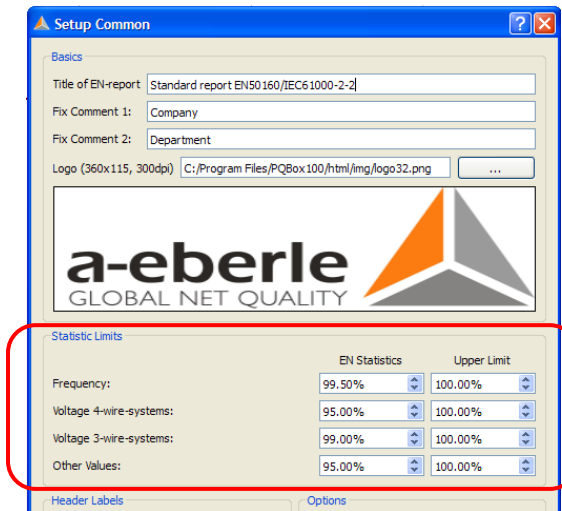


**Figure 2. ULT and UGT permanent recording data.**

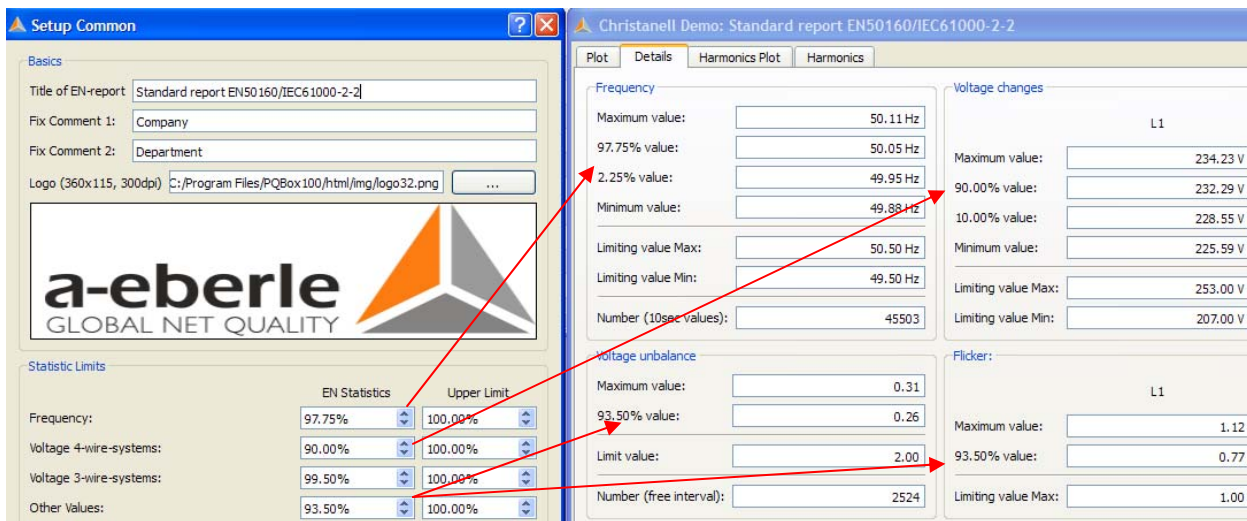
Figure 2 shows the ULT/UGT divergence graph for the applied test voltage. It can be seen that UGT records the amount of positive (greater) divergence, ULT the negative (lower) divergence, but both record zero at the other time.

**Statistics Limits setting**

With Version 1.6.02 of WinPQ mobil the statistic limit settings have been relocated from the PQ-Box 100 Setup section to the “Setup/Common” menu (see Figure 3), thus allowing limit settings to be changed post recording of data. Separate limits are now also definable for 4 wire and 3 wire systems.



**Figure 3. Statistics Limit setup is now defined independent of PQ-Box 100 setup.**

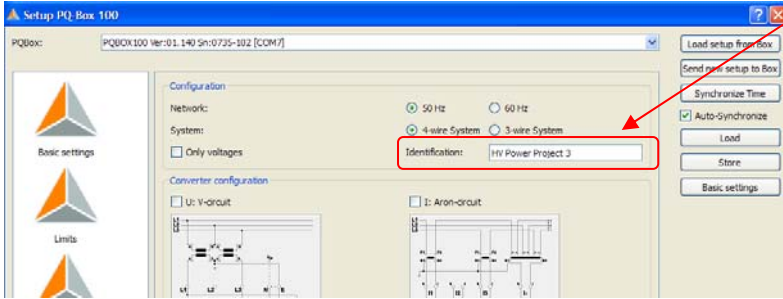


**Figure 4. Example of where Statistic Limit values are used in EN 50160 Evaluation Report.**  
*(Values changed from default [99.5 %, 95.00 %, 99.00 %, 95.00 %] to allow identification of operation)*

**Note:**

- This now allows the Statistic Limits to be changed post recording. Simply change the settings and run a new report to effect the change.
- The Statistics Limits apply to the EN 50160 Report (Evaluation). These settings do not affect the Voltage or Current Harmonic reports.

**Configuration Identification**



“Identification” text box allows up to 32 characters of free form data to be entered saved in the PQ-Box with setting data. This can be later accessed from recorded data using the “more” information button.  
Requires PQ-Box 100 with MCU 1.140 or later.

Figure 5. New setup functions.

Notes on “Identification” function:

- If storing a setting file for later use, such as a standard setup, the identification text is not saved in this file (the .inf file). The identification text needs to be (re) entered prior to sending the new setup to the PQ-Box 100.
- The “Identification” text box is not cleared if new setting file is loaded from hard disk, or the Setup window is reopened during the same WinPQ Mobil session. If the text box is not cleared manually, its contents will be loaded to the PQ-Box 100 if a new setting is loaded to the PQ-Box 100.
- If multiple recordings are made with a setting that included an upload of “identification” information, this “identification” data will be included in all recordings made till a new setting file is loaded to the PQ-Box 100. (Changing setup parameters via PQ-Box 100 keys will not overwrite “Identification” information.
- The “Identification” text also appears in the bottom of the WinPQ mobil screen with the PQ-Box 100 connection information (see example Figure 6).

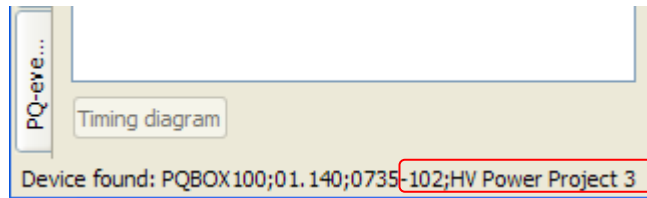


Figure 6. Identification text displayed when connecting to PQ-Box 100 (e.g. “HV Power Project 3” per Figure 5).

**Cursors added to online measurements**

A cursor measurement function has been added to the online Oscilloscope and Spectrum screens.

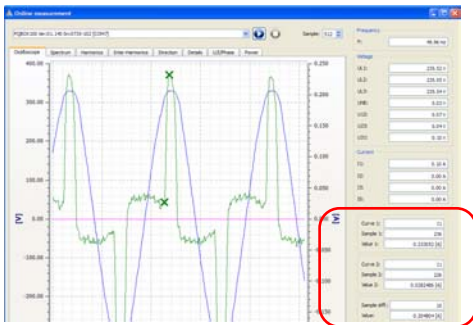


Figure 7. Cursor measurement for online measurements.

Note:

- Time measurements for the online cursors is displayed as the number of samples between the data points. The PQ-Box 100 records 10240 points per second, thus the time between successive points is approx. 0.1 ms
- Hold the shift key if you want to place the second measurement cursor on the same trace as the first cursor

## WinPQ DataConverter

An upgraded version of WinPQ DataConverter is included with WinPQ Mobil. This program is accessible from within WinPQ mobil from the Setup menu, and from an icon on tool bar. It can be used to:

- Correct Permanent Recorded data for an incorrect **nominal** voltage setting (not VT ratio)
- Correct incorrect CT (ratio) transducer setting
- Combine two or more separate data recordings into a new file

WinPQ DataConverter creates new data files, keeping the original source(s) unaltered.

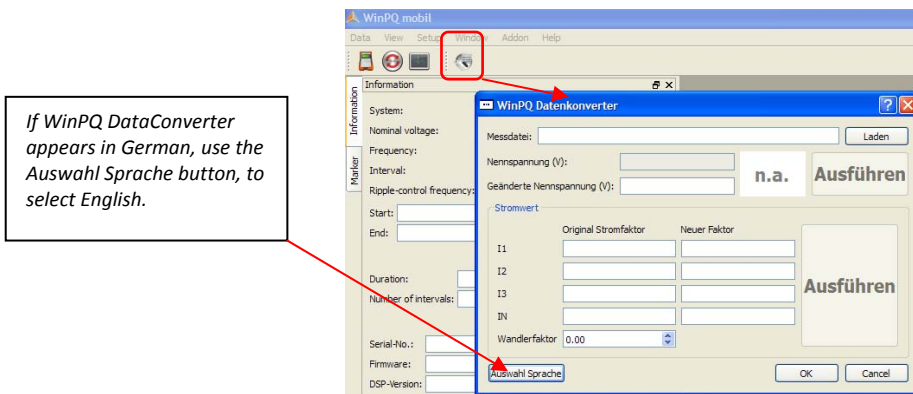


Figure 8. WinPQ data converter (may default install in German).

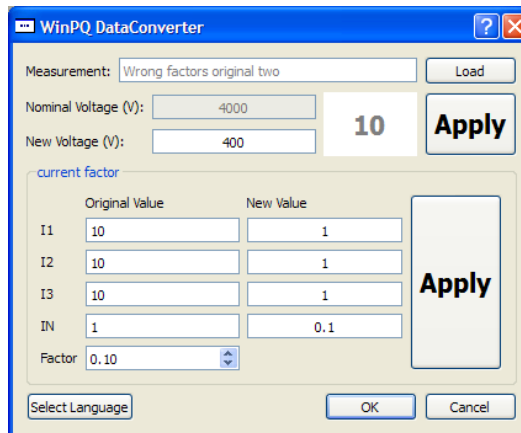


Figure 9. WinPQ data converter.

### Data Conversions:

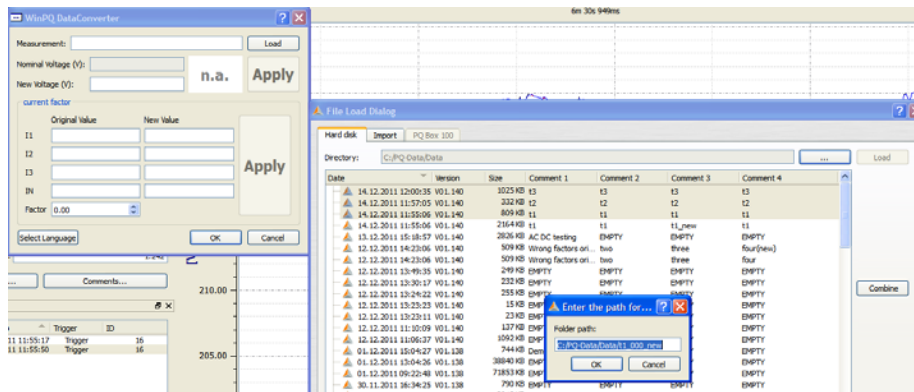
- Applying new factors to a record, copies the data file, and appends “\_new” to the folder name in the data directory. It also appends “(new)” to the Comment 4 data to assist you to identify the changed records. (Using Windows Explorer the new folder file dates will reflect the time of the data conversion. However, in WinPQ mobil with the exception of the “Comment 4” change the recording will appear in the File Load Dialog box to be a duplicate of the original.
- You can not apply Nominal Voltage or CT corrections to the same data file twice, without first changing the folder name of the first corrected data.
- Only one correction factor can be applied to all current values, that is you cannot use a different factor say for I1 and IN.

- You must specifically click the appropriate “Apply button” to change the data (not just the OK button).
- WinPQ DataConverter corrects for incorrect setup of CT ratios by converting the permanent recorded data file (including conversion of power and other calculated data derived from the current values). The results of the Current Harmonics Report will be corrected, as this is derived from Permanent Recorded data. However, the conversion **does not** correct Oscilloscope, 10Ms RMS recordings or Ripple Control data.

**Data Combination;**

To combine two or more records, use the WinPQ mobil “DataConverter”, click the “Load” button to open the “File Load Dialog” window, select the two (or more) files to be combined, and then selected “Combine”. A text entry box will open suggesting a new folder name (the first record folder name, with \_new appended).

- The file is created using Comment Text from the earliest file, so this looks the same in WinPQ file load dialog. However you should be able to identify the new file in WinPQ mobil by looking at the file size as the newly created combination file will be larger.
- The new combination file uses the setting data (i.e. the contents of the more information screen) from the earliest file only.

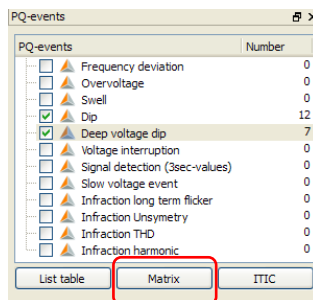


**Figure 10. Combining Data Files.**

**PQ Event Matrix**

In addition to the ITIC graph a Matrix report of PQ Events is now available. The actual Matrix to be used is set via the Common setup menu. The Matrix data bin/classifications available are:

- EN50160 – classifies both voltage dips and swells (increases)
- NRS 048 – classifies voltage dips (NRS 048 = South Africa Quality of Supply document)



**Figure 11. PQ Matrix Report.**

Residual voltage u[%]	Duration t[ms]				
	10 ... 200	200 ... 500	500 ... 1000	1000 ... 5000	5000 ... 60000
90 ... 80	0	0	0	0	0
80 ... 70	0	2	2	0	0
70 ... 40	0	4	6	0	0
40 ... 5	0	0	0	0	0
5 ... 0	0	0	0	0	0

Swell voltage u[%]	Duration t[ms]		
	10 ... 500	500 ... 5000	5000 ... 60000
... 120	0	0	0
120 ... 110	0	0	0

Figure 12. Example EN 50160 Matrix report.

Range of dip depth dU[%]	Range of residual voltage Ur[%]	Duration t[ms]		
		20 ... 150	150 ... 600	600 ... 3000
10 ... 15	90 ... 85	0	0	0
15 ... 20	85 ... 80	0	0	0
20 ... 30	80 ... 70	0	4	0
30 ... 40	70 ... 60	0	2	0
40 ... 60	60 ... 40	0	8	0
60 ... 100	40 ... 0	0	0	0

Legende

Y =  0 events

X1 =  0 events

X2 =  0 events

S =  14 events

T =  0 events

Z1 =  0 events

Z2 =  0 events

Figure 13. Example NRS 048 Classification (using same permanent recording data as used for Figure 12).

Range of residual voltage U [%]	Duration		
	20 < t ≤ 150 (ms)	150 < t ≤ 600 (ms)	0.6 < t ≤ 3 (s)
90 > U ≥ 85	Y		
85 > U ≥ 80			
80 > U ≥ 70	X1	S	Z2
70 > U ≥ 60			
60 > U ≥ 40	X2		
40 > U ≥ 0	T		

Figure 14. NRS 048 Summary Classifications (Y, X1, X2, S, T, Z1 & Z2).

This style of classification of voltage dip versus duration is sometimes referred to as a “UNPEDE” statistic. UNPEDE being the “International Union of Producers and Distributors of Electrical Energy” who have formalised this report format.

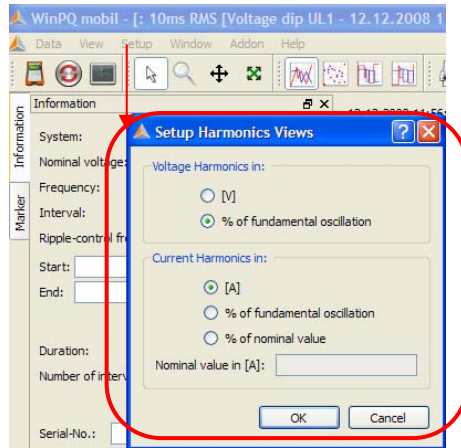
**Keeping you up-to-date with Fundamental Voltage, THD, Harmonic data and “Nominal Voltage”**

**Fundamental Voltage:**

From V1.5.15 of WinPQ mobil software, the fundamental value (H1) of current (and voltage) have been able to be shown as permanent recorded data. However, as individual harmonic voltages were recorded as percentages of the fundamental, the H1 value was always 100 % (\*).

\* Note that prior to 2010 (firmware MCU 1.119/DSP 1.220) the EN standards defined voltage harmonic measurement relative to the set nominal voltage, not the measured fundamental voltage, so for earlier recorded data, the H1 voltage data may be shown as non 100 % values.

With V1.6.02 a new setup menu (see Figure) provides a choice of value for the reported/displayed harmonics, now allowing harmonic voltages to be showed as absolute values (i.e. volts).



**Figure 15. Setup provides ability to alter displayed units of harmonic reports.**

The new Harmonic View setup applies to:

- Permanent Recording information
- “Voltage Harmonics” reports
- “Current Harmonics” reports
- **The setting do not apply to the EN 50160 “Evaluation” report.**

**THD & Harmonic Calculation:**

Since firmware DSP 1.220, THD and harmonic voltage calculations are bases on the measured fundamental voltage (no longer the set nominal voltage).

With firmware version DSP1.242 the method of reference for the reporting of permanently recorded harmonic angles has been changed.

Now	All harmonic current angles are reported relative to U1 fundamental voltage
Was	Harmonic current angles were reported relative to its harmonic voltage

This only affects the Permanent Recording “Power/Phase UI” data. A future software release will update the online current harmonic display to also show all current angles relative to U1 fundamental voltage.





## **POWER AUTOMATION TECHNOLOGIES**

As this change occurs in the PQ-Box 100 firmware, files viewed with WinPQ mobile V1.6.02, but recorded with firmware prior to V.1242 will continue to show the angles per the old method (relative to its harmonic voltage).

### **Nominal Voltage Setting:**

The Nominal Voltage setting of the PQ-Box 100 is no longer used for fundamental voltage calculation, but remains in use for:

- Setting trigger limits for Oscilloscope and 10ms RMS recorders (The Oscilloscope and RMS recorder settings are percentages of the Nominal Voltage setting).
- Calculation of Voltage Divergence. Divergence is the difference in the measured voltage from the preset Nominal Voltage setting, expressed as a percentage of the preset Nominal Voltage setting.