

# **User Manual**

# Power Quality Network Analyser

Model PQI-DA smart

Power-Quality Evaluation Software WinPQ smart







#### Note:

Please note that these operating instructions may not always contain the latest information concerning the device. If, for example, you have changed the firmware of the device to a higher version via the Internet, this description will no longer be completely accurate.

In this case, contact us directly or use the latest version of the operating instructions available from our Internet site (<u>www.a-eberle.de</u>).

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### 1. User prompt

### 1.1 Warnings

#### Types of warnings

Warnings are distinguished by the type of risk they represent by the following signal words:

- → Danger warns of a risk of death
- Horizon States State
- **→ Caution** warns of damage to property

#### Structure of the warnings



Nature and source of the danger

 $\overset{\text{\tiny{blue}}}{\longrightarrow}$  Actions to avoid the danger.

#### 1.2 Notes



Notes on appropriate use of the device

### 1.3 Other symbols

#### Instructions

Structure of the instructions:

- 🂖 Guidance for an action.
- ✤ Indication of an outcome, if necessary.

#### Lists

Structure of unstructured lists:

- List level 1
  - List level 2

Structure of numbered lists:

- 1) List level 1
- 2) List level 1
  - 1. List level 2
  - 2. List level 2



# 2. Scope of Delivery/Order Codes

### 2.1 Scope of Delivery

- PQI-DA smart
- User Manual
- TCP-IP Cable
- Cable shoes
- Calibration certificate
- CD WinPQ *smart* Software

### 2.2 Order Codes

#### PQI-DA smart

This version of the device is used as power quality analyser, sequence of events recorder, data logger and power meter

Option IEC61000-4-7 (sampling rate 40.96kHz)		
<ul> <li>10.24kHz sampling rate; without measuring 2kHz to 9kHz</li> </ul>	B0	
<ul> <li>Measuring the frequency of voltage and current from 2 kHz to 9 kHz</li> </ul>		
Oscillograph with 40.96kHz sampling rate		



The 2kHz to 9kHz option (41kHz sampling rate for oscilloscope images) can be upgraded via a licence code.

Characteristic	Code	
<ul> <li>Power Quality Interface for Low and Medium Voltage Networks</li> <li>4 voltage converters, 4 current transformers</li> <li>In accordance with DIN EN-50160 and IEC 61000-4-30 (Class A)</li> <li>2 digital inputs</li> <li>2 relay outputs</li> <li>WinPQ smart software for PQI-DA smart</li> </ul>	PQI-DA smart	
Supply voltage AC 90 V110 V264 V or DC 100 V220 V300 V DC 18 V60 V72 V	H1 H2	
<ul> <li>Current inputs</li> <li>4 current inputs for metering circuit 1A/5A (range 10A)</li> <li>4 current inputs for protection circuit 1A/5A (range 100A)</li> </ul>	C30 C31	
Option communication protocol Modbus RTU & TCP IEC 61870-5-104 (RJ45) IEC61850 (RJ45)	P0 P1 P2	
<ul> <li>Option IEC61000-4-7 (40,96kHz sampling)</li> <li>10,24kHz sampling; without 2kHz to 9kHz measurement</li> <li>Frequency measurement of voltage and current from 2 kHz to 9 kHz 40.96kHz sampling oscilloscope recorder</li> </ul>	B0 B1	
Rated value of the input voltage • 100V / 400 V / 690 V (CAT IV 300V)		
Operating instructions <ul> <li>German</li> <li>English</li> <li>French</li> <li>Spanish</li> <li>Italian</li> <li>Chinese</li> <li>Russian</li> </ul>	G1 G2 G3 G4 G5 G6 G7	



Software WinPQ smart	Code
<b>Software WinPQ smart</b> For parameterising PQI-DA smart, as well as reading PQI-DA smart measurement data and online / offline data – sold as a package	WinPQ smart
WinPQ database	Code
<ul> <li>Software WinPQ</li> <li>For the parameterisation, archiving and analysis of PQI-D/DA measurement data with the following basic functions:</li> <li>32-bit/64-bit Windows program interface</li> <li>Database for storing measurement data for each measurement point Date access via TCP/IP network</li> <li>Possibility of visualization for all measurement variables accessible from a PQI-D/DA as a function of time and as a statistical magnitude</li> <li>A second seat license is included in the price</li> </ul>	WinPQ
<ul> <li>Licences</li> <li>Single-user license for 2 x PQI-D/DA/smart</li> <li>Single-user license for 2 - 10 x PQI-D/DA/smart</li> <li>Single-user license for &gt; 10 x PQI-D/DA/smart</li> </ul>	L0 L1 L2
Operating instructions <ul> <li>German</li> <li>English</li> <li>French</li> </ul>	A1 A2 A3

Additions to PQI-DA smart		Code
SD-memory card (external): 4 GByte industrial standard		900.9099.4
DIN-rail, wall mounted housing Frame for panel mounting		564.0435 564.0433
Radio time clock interface DFC 77		111.9024.01
GPS clock - H1: AC/DC 88 V264 V         D2: RS4           GPS clock - H2: DC 18 V72 V         D2: RS4	85 85	111.9024.45 111.9024.46

# 3. Safety instructions

- $^{\text{W}}$  Follow the operating instructions.
- $^{\textcircled{W}}$  Keep the operating instructions with the device.
- Ensure that the device is operated only in a perfect condition.
- $^{\textcircled{b}}$  Never open the device.
- Ensure that only qualified personnel operate the device.
- $^{\text{W}}$  Connect the device only as specified.
- Ensure that the device is operated only in the original condition.
- <sup>®</sup> Connect the device only with recommended accessories.
- Ensure that the device is not operated outside the design limits. (Refer to the technical data)
- \* Ensure that the original accessories are not operated outside the design limits.
- Do not use the device in environments where explosive gases, dust or fumes occur.
- <sup>1</sup>Clean the device only with commercially available cleaning agents.



# 4. Technical Data

### 4.1 PQI-DA *smart* Description

The new Power Quality Analyser and sequence of events recorder PQI-DA *smart* for low, medium-voltage grids is the central component of a system with which all measurement tasks in electrical grids can be solved. The PQI-DA *smart* can be used as either a Power Quality Interface in accordance with grid quality standards or as a measuring device for all physically defined variables in three-phase grids.

In addition to standard evaluations, the PQI-DA *smart* also features a high speed sequence of events recorder with a recording rate of 40.96kHz/10.24kHz as well as an 10ms RMS recorder. This enables a detailed evaluation of faults in the grid.

In particular, the component is suitable for monitoring, registering, evaluating and recording special reference quantities or quality agreements between the energy supplier and the customer

Modern Power Quality measuring devices operate in accordance with the IEC 61000-4-30 (2008) standard. This standard defines measurement methods in order to create a comparable basis for the user.

Devices from different manufacturers that operate according to this standard must give the same results.

The standard distinguishes two classes of measuring devices:

- Class A devices are used mainly for measurements relating to contracts in customersupplier relationships.
- Class S devices can be used to determine statistical quality values.

The PQI-DA smart meets all demands of the IEC 61000-4-30 (2008) standard for an A-Class device:

Parameter IEC61000-4-30	Class
Power frequency	А
Magnitude of the Supply Voltage	А
Flicker	А
Supply voltage dips and swells	А
Voltage interruptions	А
Supply voltage unbalance	А
Voltage harmonics	А
Voltage interharmonics	А
Mains signaling voltage	А
Underdevation and overdeviation	А
Measurement aggregation intervals	А
Time-clock uncertainty	А
Flagging	А
Transient influence quantities	А

The PQI-DA smart has been developed for measurements perfromed within public grids as well as for recording PQ data within an industrial environment up to 690V (L-L) measurement voltage.

- No moving parts (fans, hard drives etc.)
- CAT IV
- Extensive storage capability (can be extended up to 32 GB by the user, permitting several years recording without connection to database)
- Optional "IEC61000-4-7 2kHz to 9kHz" (B1)
- Frequency measurement of voltage and current according IEC 61000-4-7 from 2 kHz to 9 kHz.
- Standard IEC61000-4-7 describes the measuring of harmonics and interharmonics in power supply grids and connected devices.



### 4.2 Technical Data

- 1.7-inch colour display
- Keypad for basic/direct device configuration
- 1 GB internal memory
- Input channel bandwidth 20 kHz
- 4 voltage inputs Final value of measurement range: 57/230/480V L-N, accuracy < 0.1%
- 4 current inputs 1A/5A nominal, Final value of measurement range: 10A
- Simultaneous processing of sampled and calculated voltages and currents
- Oscilloscopic voltage and current recorder sampling rate : 40.96kHz / 10.24kHz
- Half cycle recorder:
  - power frequency, r.m.s. of voltages and currents, voltage and current phasors
  - power recording rate : ~10ms(50Hz) / ~8.33ms (60Hz)
- Powerful recorder triggering
- Online streaming of voltages and currents at 40.96kHz sampling rate.
- IEC 61000-4-30 Class A Measurement data processing
- Recording of the voltage quality faults in accordance with DIN EN 50160; IEC61000-2-2; -2-12;-2-4.
- Spectral analysis 2 kHz...9 kHz,(35 frequency bands, BW = 200Hz) of voltages and currents according (IEC 61000-4-7)
- Phase of voltage and current harmonics n=2..50
- 2 general purpose digital inputs with 2 input level options
- 2 relay outputs for protection monitoring and alarm
- Complex analysis software WinPQ smart (sold as a package)
- As an option:
  - Analysis of the data on an MYSQL-based database using the WinPQ software package. Permanent communication with up to 500 devices.

#### **Communication Protocols**

- MODBUS RTU
- MODBUS TCP
- IEC60870-5-104 (Option P1)
- IEC61850 (Option P2)

# Time synchronisation protocols (Receive / Slave)

- GPS (NMEA +PPS)
   DCF77
   NTP
  - PTP (IEEE1588)

Interfaces		
Ethernet	RJ45 (10/100 Mbit)	
2 * RS232/RS485 on terminals	switchable	
Dimensions / Weight		
L x B x H	160 x 90 x 58 mm	
Weight	500 g	



@ 1%..100%Un

@ 1%..5% reading ±5% of reading

@ Us = 3%..15% Un

@ Us = 1%..3% Un

Differential, isolated

1 A AC / 5 A AC

C31

100A<sub>AC</sub>

< 0,2% FSR

5% ... 10%

5% ... 10%

5% ... 10%

5% ... 10%

5% ... 10%

±n∙0,2°

±10%

±0,2°

10%

±0.15%

±0.15% Un

11, 12, 13, IN/4 300V CAT III

C30

≤ 4mΩ

 $10A_{AC}$ 

10 A 30 A 100 A 500 A

AC, any

25Hz...20kHz

< 0,1% FSR

5%...100%

5%...100%

5%...100%

5%...100%

5%...100%

±n∙0,1°

±5%

±0,1°

5%

Voltage inputs		Voltage inputs	
Channels	U1, U2, U3, UN/E/4		0
Electrical safety DIN EN 61010	300V CAT IV 600V CAT III	Voltage unbalance	± @
Input reference level	PE	Mains signaling voltage	
Impedance -> PE	10 MΩ    25pF	– (< 3kHz)	0
Nominal input voltage Un	100V AC /230VAC	_	± c
Full scale range (FSR)	0480VAC L-E	Current inputs	
Waveform	Any		
Maximum crest factor @ Un	3		03
Bandwidth	DC20kHz	- Channels	11,
Nominal power frequency fn	50Hz / 60Hz	Electrical safety	30
Frequency range of the	fn ± 15%	DIN EN 61010	+
fundamental	42.55057.5Hz	Input type	Di
	51.06069.0Hz	_ Impedance	≤ 4
Accur		<ul> <li>Nominal input current In</li> </ul>	1/
Fundamental, r.m.s	$\pm 0.1\%$ UN (0 C45 C) $\pm 0.2\%$ Un ( $-25^{\circ}$ C $55^{\circ}$ C)	Full scale range (FSR)	10
	@ 10%150%Un		+
Fundamental, Phase	±0.01°	permanent	10
	@ 10%150%Un	≤ 1s	30
Harmonics n = 250,	±5% of reading	≤ 10ms ≤ 5ms	10 50
r.m.s.	@ Uh ≥ 1% Un +0.05% Up	Waveform	۸(
	@ Uh < 1% Un		
Harmonics n = 250,	±n·0.01°	_ Maximum crest factor @ In	4
Phase	@ Uh ≥ 1% Un	Bandwidth	25
Interharmonics n = 149,	±5% of reading	Accura	icy
r.m.s.	@ Uih = ≥ 1% Un	Fundamental, r.m.s	< (
	±0.05% 011 @ Uih < 1% Un		5%
Power frequency	±10mHz	<ul> <li>Fundamental, Phase</li> </ul>	±0
. ,	@ 10%200%Un	- Harmonics n = 2 E0	57
Flicker	Class F2	r.m.s.	5% 5%
DIN EN 61000-4-15:2011		- Harmonics n = 2 50	+n
Dip residual voltage	±0.2% Un @ 10%_100%Un	Phase	 5%
Din duration	+20ms	 Interharmonics n = 149, r.m.s.	±5
	@ 10%100%Un		5%
Swell residual voltage	±0.2% Un @ 100%150%Un		
Swell duration	±20ms @ 100%150%Un	_	
Interruption duration	+20ms	_	

Storage of measured values		
Internal memory	1024 MB	
SD memory card	1 GByte to 32 GByte	

Binary inputs (BI)	
Range	48250 VAC(/DC)
<ul> <li>H – Level</li> <li>L – Level</li> </ul>	> 35 V < 20 V
Signal frequency	DC 70 Hz
Input resistance	>100kΩ
Electrical isolation	Optocoupler, electrically isolated
Electrical safety DIN EN 61010	300V CAT II

Power supply							
Feature	H1	H2					
AC	90264 V	-					
DC	100300 V	1872 V					
Power consumption.	≤ 10 W < 20VA	≤ 10 Watt					
Frequency	4070Hz	-					
External fuse characteristics	6A B	6A B					

Binary outputs (BO)	
Contact specification (EN60947-4-1, -5-1) : Configuration Rated voltage Rated current Rated load AC1 Rated load AC15, 230VAC	SPDT 250VAC 6A 1500VA 300VA
Breaking capacity DC1, 30/110/220 V	6/0.2/0.12A
No. of switching operations AC1	≥ 60·103 electrical
Electrical isolation	Isolated from all inter- nally potentials
Electrical safety DIN EN 61010	300V CAT II



Environmental parameters	Storage and transport	Operation
Ambient temperature : Limit range of operation	IEC 60721-3-1 / 1K5 -40 +70°C IEC 60721-3-2 / 2K4 -40 +70°C	IEC 60721-3-3 / 3K6 -25 +55°C
Ambient temperature : Rated range of operation		IEC 60721-3-3 / 3K5 mod10 +45°C
Relative humidity: 24h average No condensation or ice	595 %	595 %
Solar radiations		700W/m2
Vibration, earth tremors	IEC 60721-3-1 / 1M1 IEC 60721-3-2 / 2M1	IEC 60721-3-3 / 3M1

Electrical safety	
<ul><li>IEC 61010-1</li><li>IEC 61010-2-030</li></ul>	
Protection class	1
Pollution degree	2
Overvoltage category mains supply option : H1 H2	300V / CAT III 150V / CAT III
High voltage test	Pulse voltage 6 kV 5 sec 5.4kV RMS 1 min 3.6kV RMS
Measurement category	300V / CAT IV 600V / CAT III
Altitude	≤ 2000m

### 4.3 Mechanical design

The PQI-DA *smart* can be wall-mounted (optional DIN-rail), in-panel mounted (optional mounting frame) or used as a DIN-rail housing. All connections are accessible via Phoenix type terminals. The connections are made by using plug-in/clamping technology, except for the current and voltage inputs.

For the TCP/IP interface one RJ 45-connector is available.



Side view of PQI-DA smart



COM 2
1. TxD
2. RTS
3. GND
4. RxD
5. CTS
6. RS485 Neg/B
7. RS485 Pos/A
8. Schirmung

Pin assignments for RS232 / RS485 COM interfaces

### 4.3.1 Power supply for PQI-DA smart





Supply the measuring device in the correct voltage range which corresponds to the power supply unit fitted.

Characteristic	H1	H2
AC	90264 V	-
DC	100300 V	1872 V

### 4.4 Mains connection for PQI-DA smart

### 4.4.1 3-phase / 4-wire connection



#### **Voltage connections**

- Please ensure that the PE conductor (earth) is connected to the PQI-DA smart.
- <sup>™</sup> If no N conductor is available, connect E and N together.
- Ensure that switching (4-wire) is selected. (Setting via display or software)





### 4.4.2 4-wire connection without neutral current

If no neutral current is available in the 3-phase, 4-wire grid, the power inputs of the PQI-DA *smart* are connected as shown in the illustration above.

### 4.4.3 4-wire 1-phase



With the 4-wire grid, 1-phase set-up no conductor-conductor events and 3~grid events are evaluated.

Any voltage with the same earth potential can be connected (e.g. three grids with the L1 phase) and any current can be connected.



### 3-phase / 3-wire connection **Connection to secondary transformer** 11 12 L3 Voltage transducer Ε PE -. -BI1 L1 POI-DA-smar F (780 ..... S1 S2 S1 S2 S1 S2 current L1 L2 L3

#### Connections

- Please ensure that the PE conductor (earth) is connected to the PQI-DA smart.
- <sup>1</sup> Ensure that measurement cable E is connected for each measurement. This is normally the earthing point of the voltage transformer.
- Ensure that switching (3-wire) is selected. (Setting via display or software)
- <sup>™</sup> Set the voltage transformer ratio
- Enter the nominal conductor-conductor voltage
- <sup>™</sup> Set the current transformer ratio

# i

4.4.4

#### Connecting PQI-DA smart Power IN in a 3-wire grid

If in a 3-wire grid power is connected to the IN input, it will be calculated and recorded.

The values measured for IN are not included in the  $3^{\sim}$  power calculations. It is, therefore, possible to use the PQI-DA smart to capture any additional current via the fourth power input.



### 4.4.5 V connection; Aron connection

The V connection or Aron connection can be configured in the device set-up of the software. These connection types are only available in the 3-wire configuration.



- 1) V connection (parameterisation via the evaluation software)
- 2) Aron connection (parameterisation via the evaluation software)

#### Possible connection configurations in 3-wire grids:

- Voltage converter connections: 1, 2, 3, 4,
- Current transformer connections: 1, 2, 3, 4,

The voltage converter and current transformer selection fields can be parameterised. The grounded voltage in each case or the current that has not been connected is calculated by the measuring device.

#### 3-phase voltage converter connections:

		Measuring channel							
Connection configuration	VT	1	2	3	4	Reference po- tential			
Voltage converter: L1, L2, L3, N/E	1	u <sub>1</sub>	u <sub>2</sub>	u <sub>3</sub>	u <sub>N/E</sub>				
V connection, earth L1	2	u <sub>1</sub>	u <sub>2</sub>	u <sub>3</sub>	u <sub>4</sub>	F			
V connection, earth L2	3	<b>u</b> <sub>1</sub>	u <sub>2</sub>	u <sub>3</sub>	u <sub>4</sub>	L			
V connection, earth L3	4	<b>u</b> <sub>1</sub>	u <sub>2</sub>	U <sub>3</sub>	u <sub>4</sub>				

#### **3-phase current transformer connections:**

		Measuring channel					
Connection configuration	СТ	5	6	7	8		
Current transformer: L1, L2, L3, N	1	i <sub>1</sub>	i <sub>2</sub>	i <sub>3</sub>	i <sub>N</sub>		
Current transformer: L2, L3	2	-	i <sub>2</sub>	i <sub>3</sub>	i <sub>4</sub>		
Current transformer: L1, L3	3	i <sub>1</sub>	-	i <sub>3</sub>	i <sub>4</sub>		
Current transformer: L1, L2	4	i <sub>1</sub>	i <sub>2</sub>	-	i <sub>4</sub>		

The values measured for IN are not included in the 3<sup>~</sup> power calculations. It is, therefore, possible to use the PQI-DA smart to capture any additional current via the fourth power input.

### 4.5 Measurement / Functions

PQI-DA smart complies with the automatic event detection and measurement standards, which are: EN50160 (2013) / IEC61000-2-2 / IEC61000-2-12 /IEC61000-2-4 (Class 1; 2; 3) / NRS048 / IEEE519 / IEC61000-4-30 class A / IEC6:1000-4-7 / IEC61000-4-15

#### 4.5.1 Continuous Recording:

Five fixed and two variable measurement time intervals are available for continous recording. All measured values can be freely activated or deactivated in the data classes.

- 10/12 periods (200ms)
- 1 sec
- n\*sec (can be set from 2 seconds to 60 seconds)
- 150/180 periods (3sec)
- n\*min (can be set from 2 seconds to 60 seconds)
- 🕨 10 min
- 2 hrs.

Time Interval Voltage	10/	150/	10	2	1	N*	N*
	12T	180T	min	h	s	S	min
Power frequency	✓	✓	✓	✓	✓	✓	✓
Power frequency, 10s-Value (IEC61000-4-30)			•	•		•	•
Extremes, standard deviation of power frequency (10s)			✓				
r.m.s. values (IEC61000-4-30)	✓	✓	✓	✓	✓	$\checkmark$	✓
Extremes, standard deviation of T/2-values			✓				
Underdeviation [%], Overdeviation [%] (IEC61000-4-30)	✓	✓	✓	✓			
Harmonic subgroups n= 050 (IEC61000-4-7)	✓	✓	✓	✓			
Maximum values of 10/12 T harmonic subgroups n = 250			✓				
Interharmonic subgroups n=049 (IEC61000-4-7)	✓	✓	✓	✓			
Total Harmonic Distortion (THDS) (IEC61000-4-7)	✓	✓	✓	✓	✓	✓	✓
Partial Weighted Harmonic Distortion (PWHD)	✓	✓	✓	✓	✓	$\checkmark$	✓
Unbalance, neative-/positive- sequence, sequence sign	✓	✓	✓	✓	✓	$\checkmark$	✓
Unbalance, zero-/positive- sequence	✓	✓	✓	✓	✓	$\checkmark$	✓
Positive-, negative-, zero sequence phasors	✓	✓	✓	✓	✓	$\checkmark$	✓
Phasors (fundamental)	✓	✓	✓	✓	✓	✓	✓
Flicker (IEC61000-4-15)			✓	✓			
Instant flicker (IEC61000-4-15)	✓		✓				
Mains signaling voltages [%] (IEC61000-4-30)	✓	✓					
Phase angle( zero crossings) of phase voltage harmonics n=250 to fundamental of reference voltage	✓	~	✓	~			
Frequency bands 135, 2kHz9kHz, r.m.s. (IEC61000-4-7)			~	~	$\checkmark$	~	$\checkmark$



Time Interval Current	10/ 12T	150 /18 0T	10 min	2 h	1 s	N* s	N* min
r.m.s. values	✓	✓	✓	✓	✓	✓	✓
Extremes of T/2-values			✓				
Harmonic subgroups n= 050 (IEC61000-4-7)	✓	✓	✓	✓			
Maximum values of 10/12 T harmonic subgroups n = 250			✓				
Interharmonic subgroups n=049 (IEC61000-4-7)	✓	✓	✓	✓			
Total Harmonic Distortion (THDS) (IEC61000-4-7)	✓	✓	✓	✓	✓	✓	✓
Total Harmonic Currents	✓	✓	✓	✓	✓	✓	✓
Partial Weighted Harmonic Distortion (PWHD)	✓	✓	✓	✓	✓	✓	✓
Partial Odd Harmonic Currents (PHC)	✓	✓	✓	✓	✓	✓	✓
K-Factors	✓	✓	✓	✓	✓	✓	✓
Unbalance, neative-/positive- sequence , sequence sign	✓	✓	✓	✓	✓	✓	✓
Unbalance, zero-/positive- sequence	✓	✓	✓	✓	✓	✓	✓
Positive-, negative-, zero sequence phasors	✓	✓	✓	✓	✓	✓	✓
Phasors (fundamental)	✓	✓	✓	✓	✓	✓	✓
Phase angle( zero crossings) of current harmonics n=250 to fundamental of reference voltage	✓	~	~	✓			
Frequency bands 135, 2kHz9kHz, r.m.s. (IEC61000-4-7)			✓	✓	✓	✓	✓

Time Interval Energy	10	2	1	N*	N*
	min	h	S	S	min
Active energy, phase	✓	✓	✓	✓	✓
Active energy, total	✓	✓	✓	✓	✓
Exported active energy, phase	✓	✓	✓	✓	✓
Exported active energy, total	✓	✓	✓	✓	✓
Imported active energy, phase	✓	✓	✓	✓	✓
Imported active energy, total	✓	✓	✓	✓	✓
Reactive energy (inductive), phase	✓	✓	✓	✓	✓
Reactive energy (inductive), total	✓	✓	✓	✓	✓
Exported reactive energy (inductive), phase	✓	✓	✓	✓	✓
Exported reactive energy (inductive), total	✓	✓	✓	✓	✓
Imported reactive energy (inductive), phase	✓	✓	✓	✓	✓
Imported reactive energy (inductive), total	✓	✓	✓	✓	✓

#### We take care of it.

Time Interval Power	10	2	1	N*	N*
	min	h	S	S	min
Active power, phase	✓	✓	✓	✓	✓
Active power, total	✓	✓	✓	✓	✓
Active power extremes	✓				
Reactive power, phase	✓	✓	✓	✓	✓
Reactive power, total	✓	✓	✓	✓	$\checkmark$
Reactive power extremes	✓				
Apparent power, phase	✓	✓	✓	✓	✓
Apparent power, total	✓	✓	✓	✓	✓
Fundamental active power, phase	✓	✓	✓	✓	$\checkmark$
Fundamental active power, total	✓	✓	✓	✓	✓
Fundamental reactive power, phase	✓	✓	✓	✓	✓
Fundamental reactive power (displacement), total	✓	✓	✓	✓	✓
Fundamental apparent power, phase	✓	✓	✓	✓	✓
Phase angle of fundamental apparent power, phase	✓	✓	✓	✓	$\checkmark$
Fundamental apparent power, total	✓	✓	✓	✓	✓
Phase angle of fundamental apparent power, total	✓	✓	✓	✓	✓
Reactive distortion power, phase	✓	✓	✓	✓	✓
Reactive distortion power, total	✓	✓	✓	✓	✓
Active power factors, phase, total	✓	✓	✓	✓	✓
Reactive power factors, phase, total	✓	✓	✓	✓	~
COSφ + sign, phase, total	✓	✓	✓	✓	✓
SINφ + sign, phase, total	✓	✓	<ul> <li>✓</li> </ul>	<ul> <li>✓</li> </ul>	✓
$COS\phi$ + sign of reactive distortion power, phase, total	✓	✓	<ul> <li>✓</li> </ul>	<ul> <li>✓</li> </ul>	✓
Capacitive-, inductive scaling factor of COSφ (-10+1) :	✓	✓	✓	<b>√</b>	<ul> <li>✓</li> </ul>
Triggered interval mean active power, phase					

Triggered interval mean active power, total

Triggered interval mean reactive power, phase

Triggered interval mean reactive power, total



## 4.5.2 PQ Events

trigger quantity	lower	upper
voltage dip (T/2)	<ul> <li>✓</li> </ul>	
voltage swell (T/2)		<ul> <li>✓</li> </ul>
voltage interruption (T/2)	<ul> <li>✓</li> </ul>	
voltage rapid voltage change (T/2)	sliding average	e filter
	mean +/- threshold	
voltage change (10min)	✓	$\checkmark$
voltage unbalance (10min)		<ul> <li>✓</li> </ul>
mains signaling voltage (150/180T)		$\checkmark$
voltage harmonics (10min)		<ul> <li>✓</li> </ul>
voltage THD (10min)		$\checkmark$
voltage short term flicker PST (10min)		<ul> <li>✓</li> </ul>
voltage long term flicker PLT (10min)		$\checkmark$
power frequency (10s)	✓	$\checkmark$

## 4.5.3 Recorder triggering

trigger quantity	lower	upper	step
r.m.s. phase voltages (T/2)	~	~	<b>√</b>
r.m.s. phase-phase voltages (T/2)	<ul> <li>✓</li> </ul>	<ul> <li>✓</li> </ul>	<ul> <li>✓</li> </ul>
r.m.s. residual/neutral-ground voltage (T/2)		<ul> <li>✓</li> </ul>	<ul> <li>✓</li> </ul>
Positive sequence voltage (T/2)	<ul> <li>✓</li> </ul>	<ul> <li>✓</li> </ul>	
Negative sequence voltage (T/2)		~	
Zero sequence voltage (T/2)		<ul> <li>✓</li> </ul>	
Phase voltage phase (T/2)			~
phase voltages wave shapes (wave shape filter)			
phase-phase voltages wave shapes (wave shape filter)	+/- threshold		
residual/neutral-ground voltage wave shape (wave shape filter)			
r.m.s. phase currents (T/2)	✓	✓	$\checkmark$
r.m.s. total / neutral current (T/2)		$\checkmark$	$\checkmark$
Power frequency (T/2)	$\checkmark$	$\checkmark$	$\checkmark$
Binary inputs (debounced)	rising, falling slope		e
Command	external		

#### 4.5.4 Output relays



The functions of the output relays have been defined as follows:

- Relay B01 Watchdog relay
   Self-monitoring of the measuring device
- Relay B02 Reports new sequence of events recording

If a new sequence of events recording is captured and recording and saving has been completed, relay B02 is operated for one second. The message signals that this sequence of events recording can be read out from the device.

#### 4.5.5 Memory management

The PQI-DA *smart* is equipped with an internal memory of one gigabyte.

If a separate SD-card is inserted in the device, it can be formatted and the PQI-DA *smart* will start automatically to copy the internal memory onto the SD card.



The minimum size of an external memory card is one gigabyte. The device can manage memory cards up to a max. of 32gBytes.

In the display menu "memory" the progress of the copy process is shown.



♥ To remove the memory card, operate the "Remove SD card" function.

The "Remove SD card" function stops the copying function for the measuring data of the internal memory to the SD memory card and releases the card for removal.

Memory
Remove SD card
Back



#### Memory allocation

The memory allocation of the PQI-DA *smart* uses the internal 1 gigabyte memory in a circular ring buffer for all measurement data.

The ring buffer is allocated as follows:

- 512 MB circular buffer for long-term measurement data
- 416 MB circular buffer for sequence of events recordings (oscilloscope images; ½ period RMS values)
- 16 MB circular buffer for log files and Power Quality events

# 5. **Operation of the PQI-DA smart**

### 5.1 Display

The colour display of the device provides information about the correct connection of the measuring cables and transducers and shows online data for voltages, currents, total harmonic distortion (THD), power values and energy.



Pressing the "right" and "left" keys on the keypad will change the side of the display.

If no key is operated, the screen will switch to sleep mode after 5 minutes.

#### The following screens provide online information of the measured data:

#### Display page 1

Voltage L-N		
U1E	0.05 V	
U2E	0.04 V	
U3E	0.04 V	
UNE	0.09 V	

Line-Earth voltages

#### Display page 2

Voltage L-L			
U12	0.02 V		
U23	0.01 V		
U31	0.01 V		
F	0.00 Hz		

Line-to-line voltages & grid frequency



#### Display page 3

Current	
11	0.74 mA
12	0.04 mA
13	0.72 mA
IN	0.97 mA

#### Currents L1, L2, L3, N conductor

#### Display page 4

Active	Power
P1	9.07 µW
P2	-0.00 W
P3	-0.00 W
Р	4.34 µ₩

#### Active power including sign

### Display page 5

Apparent Power		
S1	0.04 mVA	
S2	1.63 µVA	
S3	0.03 mVA	
s	0.60 µVA	

#### Apparent output

#### Display page 6

Reactive Power		
Q1	0.04 mVAr	
Q2	1.57 µVAr	
Q3	0.03 MVAr	
Q	0.07 m∀Ar	

Reactive power including sign

#### Display page 7

Power	Factor
PF1	1.000
PF2	1.000
PF3	1.000
PF	1.000

Power factor (active power / apparent output)

#### Display page 8

THD Voltage		
THD U1	0.00 %	
THD U2	0.00 %	
THD U3	0.00 %	

### Total harmonic distortion of voltages The THD calculation H2 to H40 and/or H2 to H50 is adjustable.

#### Display page 9

THD C	urrent
THD I1	0.00 %
THD 12	0.00 %
THD 13	0.00 %
THD IN	0.00 %

### Total harmonic distortion of currents The calculation H2 to H40 and/or H2 to H50 is adjustable

#### Display page 10

Active Energy	
Ep Ep pos. Ep neg.	0.00 kWh 0.00 kWh 0.00 kWh

Ер	= Total active energy
Ep pos.	= Active energy received (positive sign)
Ep neg.	= Active energy supplied (negative sign)

#### Display page 11

Reactive Energy	
Eq	0.00 kvarh
Eq pos.	0.00 kvarh
Eq neg.	0.00 kvarh

Eq	= Total reactive energy
Eq pos.	= Reactive energy received (positive sign)
Eq neg.	= Reactive energy supplied (negative sign)



#### Display page 12

PQ Sma	art
Firmware Date	1856 04.09.14
Time	09:53

Current firmware for PQI-DA smart / Device date and time

#### Display page 13

The number of PQ events that occurred, oscillograph and RMS value recordings for the last day, last week and last month appear on the device display.

Eve	nts		
	1d	7d	30d
Osci	18	21	21
RMS	16	17	17
PQ	86	92	92



The event counter changes over to the following day at 24:00 hours/12 am each day.

### 5.2 Setup display

Pressing the key on the keypad will change the display to the setup menu.
 The following main menus are available in setup mode:

Setup	Setup
Parameter	Interface Config
Time Setup	
Basic Setup	
Memory Management	
	Back

#### 5.2.1 Parameter

#### Parameter page 1

Parameter
Net type
4-Cond,3-phase
Net frequency
[Hz] 50

#### **Grid configuration**

Entering the grid type "3-conductor grid", "4-conductor grid" and/or "4 x 1 conductor grid" will determine how the Power Quality events are recorded.

Switch between 3-conductor and 4-conductor grids.

- In a 3-conductor grid, all events are calculated from the conductor-conductor voltages.
- In a 4-conductor grid and/or a 4 x 1 conductor grid all Power Quality events are determined from the conductor-earth voltages.

#### Grid frequency

Setting grid frequency to 50Hz or 60Hz

#### Parameter page 2



**Voltage converter:** Corresponds to the ratio between the primary and secondary voltage. **Current transformer:** Corresponds to the ratio between the primary and secondary current.

#### Example:

Voltage: primary = 20,000V / secondary = 100V; Conversion factor = 200 primary = 100A / secondary = 5A; Conversion factor = 20


#### Parameter page 3

Parameter		
Nominal Vo	oltage	
[V]	230	
Reference Voltage		
[%]	100	
[V] P-P	398.37	

The displayed value for the nominal voltage is:

- In a 4-conductor grid = 230V conductor-earth voltage
- In a 3-conductor grid = 100V conductor-conductor voltage, multiplied by the conversion factor

The % value is used to set the reference voltage at a different value to the nominal voltage.



Example 1: 20,000V \* 105% = Reference voltage of 21,000V. This is the reference value for all trigger thresholds as well as Power Quality events.

Example 2: 500V grid (conductor-conductor) 230V \* 125% = 287.5V (conductor-earth)

#### Parameter page 4



#### **Rated current**

All trigger thresholds for the current refer to the set nominal current. The nominal current for the system should be entered here.

**Reference channel** defines the measuring channel for frequency measurements and grid synchronisation.

#### Parameter page 5



**Power measurement:** The power calculation in the device firmware can be selected from two measuring functions:

- Power calculation in accordance with DIN 40110, part 2 including the calculation of the imbalance reactive power (factory setting for the device)
- Simplified power calculation without considering the imbalance reactive power in the 3<sup>~</sup> phase power



This setting has an impact on the measured power values on the device display, the online measured values and the recorded measured values.

### 5.2.2 Time settings

### 5.2.2.1 DCF time setting



Time synchronisation to an external DCF77 radio-controlled clock

DCF77 settings on the RS232/RS485 interface and the time zone of the DCF signal.



### 5.2.2.2 Manual time setting



DST change	DST change
Summer > winter	Winter > summer
25.10.	25.03.
Sunday	Sunday
03:00	02:00
	Back

Setting the date and time for changing from summer to winter time.

#### 5.2.2.3 NTP time setting



The PQI-DA smart supports up to four time servers in the network.

The device automatically uses the strongest signal that is available in the network.

### 5.2.2.4 NMEA-ZDA time setting



Setting up the RS232/RS485 interface for the NMEA protocol



#### 5.2.2.5 NMEA-RMC time setting



Setting up the RS232/RS485 interface for the NMEA-RMC protocol

### 5.2.2.6 IRIG-B time setting

IRIG-B formats 0 to 3



IRIG-B formats 4 to 7



zone

### 5.2.2.7 IEEE 1344 time setting



Time synchronisation to an IRIG-B time protocol (in accordance with IEEE1344)

Setting up the interface and the time zone



### 5.2.3 Basic setting

Basic setting page 1



Language: Automatic setup: Select the display language

This function takes you through an automatic device setup. This function is started automatically when the device is put into operation for the first time and does then not appear again. You can go to the guided setup at any time via "Auto Setup".

#### Basic setting page 2

Basic Setup	
Reset Events	
Reset energy cnt.	
Back	

Reset events:

The event counter for sequence of events recordings and PQ events on the device display is reset to 0. All measurement data and PQ events are retained in the device memory.

**Reset energy counter:** The energy counters in the device display and in the device memory are set to 0.

### 5.2.4 Memory management

The "Remove SD card" function stops the copying function for the measuring data of the internal memory to the SD memory card and releases the card for removal.

Memory	
Remove SD card	
Back	

### 5.2.5 Setting up the device interfaces



PQI-DA smart is supplied with the following default IP address:

#### 192.168.56.95 / 255.255.0.0



#### Activating or deactivating DHCP

DHCP deactivated = The device is used with a fixed IP address.

#### Interfaces page 2

Interface Config.	
Subnet mask	
255.255.0.0	L
Gateway	
172.16.0.33	
Back	



# 6. WinPQ smart software

The free WinPQ smart evaluation software has been created exclusively for the Network Analyser PQI-DA smart and includes the following functions:

- Parameterisation of the Network Analyser PQI-DA smart
- Online analysis of the measurement data
- Reading the measurement data from the measuring device
- Evaluating measurement data
- Firmware update for PQI-DA smart

# i

The powerful **database and evaluation software WinPQ** which is available at an extra charge supports all mobile and permanently installed Network Analysers supplied by A. Eberle in one system. Measuring data from different devices can be compared to each other. There is a fully automated and permanent connection to all permanently installed devices. Detailed Power-Quality reports and sequence of events recording are automatically created by the system and can be sent via e-mail. There are separate operating and commissioning instructions for the WinPQ software.

### 6.1 Installing the evaluation software

To start the installation of the evaluation software, place the installation CD in your CD-ROM drive. If the Autostart function is activated, the installation program starts automatically. Otherwise, go to the root directory of your CD-ROM drive and start the program by double-cLicking the file SETUP.EXE.

The installation complies with the Windows standard, including uninstalling the program system via the "Software" option on the Control Panel. The installation location of the program (target directory) can be freely selected during installation.



Install the software in a directory in which you also have read and write rights.



The start icon 🔛

is created automatically on your PC's Desktop.

#### Uninstalling the software via the control panel

The components are removed from the PC using Windows "Control panel".

Under "Software", "WinPQ smart" entry, use the "Remove" button to delete the evaluation software.

All parts of the program, including the generated links, are completely removed after a single confirmation. Before uninstalling the program, the components launched must be closed.

#### Software Update

You can find the evaluation software and all updates and the current device firmware, free of charge, on our website under the product group "Power Quality / Software WinPQ smart":



www.a-eberle.de

Please also install the current device firmware on your measuring device to ensure that you can use any new functions.

#### Start screen for WinPQ smart, example with 6 PQI-DA smart devices





# 6.2 Basic setting for Software



Under the "Settings" menu point, the following changes can be made:

- Language setting for the software (the software must be restarted after any change)
- Visibility of the setup parameters select 0 or 1
  - 0 = Basic user with restricted selection
  - 1 = Expert mode with all setting options displayed

<1>	Visibility
English	
x	OK

### 6.3 Setting up a new PQI-DA smart

A device is set up as a tile on the screen via the "New station" function.



The TCP-IP address of the PQI-DA smart is stored in the "IP" field.

The port number of the device can be allocated any number. The device is delivered with the value "5040" set as the port number.



The values will be adopted by pressing OK, and a station tile for this device is then stored on the software interface. An unlimited number of devices can be set up.

#### Deleting a station tile

Station tiles can be deleted via the "Setup general" station menu.





### 6.4 Device parameterisation



The function "Para" opens the device setup for PQI-DA smart.

The following basic functions are available:

Send

Send device settings (measurement values, limit values, trigger thresholds) to the device



Save all device settings as a template on the PC.

Open
------

Open own settings that have already been saved on the PC (for instance, to send these to another device) – "Open default" provide two standard settings, for low voltage network and medium voltage network.



# 6.4.1 Device designation

In the menu "Device designation", the description of the device is determined.

WinPQSmart 02.02.2015					
Bone Bend Save	e Open own Open default				
device designation	Info	Value			
IP-Settings	Werks Identifikator	Werksidentifikator			
Modbus	Werks Bezeichner	test			
PQ application	Betriebsname	UW Nord			
PQ-parameter	Station name	Station			
General user-settings	street	Strasse			
Trigger-parameter	number	Nr			
Oszilloskope recorder ( User! )	zip code	Plz			
1/2 cylcle -recorder ( User! )	city	Ort			
<ul> <li>Recording parameter</li> </ul>	GPS coordinates	GPS			
► 200ms-interval	Name feeder	Trafo 102			
► 150/180-Perioden-interval	Groupe feeder	Messfeld-Gruppe			
<ul> <li>10min-interval</li> <li>21-interval</li> </ul>	nominal voltage measurement point	Messfeld-Unenn			
<ul> <li>2n-interval</li> <li>1s interval</li> </ul>	nominal power measurement point	Messfeld-Inenn			
<ul> <li>Is-interval</li> <li>10c-interval</li> </ul>	nominal frequency measurement point	Messfeld-f			
	Typ des Verkabelungssystems	Messfeld-Leitersvs			
<ul> <li>M-seconds-interval</li> <li>M-seconds-interval</li> </ul>	device name	Schweighof			
<ul> <li>Oscilloscope recorder</li> </ul>	device typ	PQI-DA smart			
► 1/2 cylcle -recorder	Betriebsressourcen	Betriebsmittelkennzeichen			
► Timedaemon	1				

The fields marked in red describe the station icon as well as all the fault records and data in the archive.



# 6.4.2 PQ Parameter

- In PQ parameter the limits for standard evaluations and for power quality events are set. The limits of EN 50160 for a low voltage system are stored in the default setting of delivery.
- Value: Value of PQI-DA smart this value can be changed
- Default: Default setting
- Minimum: Smallest value
- Maximum: Biggest value

WinPQSmart 02.02.2015						
	Open own Open default					
device designation	Info	Value				
IP-Settings	Total network frequency, nominal value : 50Hz / 60Hz	50				
Modbus	Frequency ripple signal voltage /Hz	168				
▲ PQ application	Flicker: 0 = 120V-lamp, 1 = 230V-lamp	1				
PQ-parameter	Normalized voltage L-L-Sp. [percent from UNOM]	100				
General user-settings	hysteresis 1/2-Perioden-voltage [percent from UC bzw. UC/1.73]	1				
Trigger-parameter	tolerance band fast voltage change RVC, dd [percent from UC bzw. UC/1.73]	1				
Oszilloskope recorder ( User! )	threshold voltage dip (Dip) [percent from UC bzw. UC/1.73]	90				
1/2 cylcle -recorder ( User! )	threshold voltage swell (threshold) [percent from UC bzw. UC/1.73]	110				
A Recording parameter	threshold voltages interruption [percent from UC bzw. UC/1.73]	5				
200ms-interval	lower threshold 10s- network frequency /Hz	49,5				
<ul> <li>100/180-Perioden-Interval</li> <li>10min interval</li> </ul>	higher threshold 10s-Total network frequency /Hz	50,5				
Infiniterval     Activity of the second	lower threshold 10min-voltage [percent from UC bzw. UC/1.73]	90				
<ul> <li>Initerval</li> <li>Initerval</li> </ul>	higher threshold 10min- voltage [percent from UC bzw. UC/1.73]	110				
► 10s-interval	threshold 10min-THD [percent]	8				
<ul> <li>N-seconds-interval</li> </ul>	threshold 10min-voltages unbalance [percent]	2				
<ul> <li>M-seconds-interval</li> </ul>	threshold short time flicker	1				
<ul> <li>Oscilloscope recorder</li> </ul>	threshold long time flicker	1				
<ul> <li>1/2 cylcle -recorder</li> </ul>	threshold 3 Sec -ripple signal voltages [percent from UC bzw. UC/1.73]	9				
► Timedaemon	Trigger-threshold 200ms-ripple signal voltage recorder [percent from UC bzw.	UC/1				

Under "Open default setting" templates are located for a low and a medium-voltage network.

i Öffnen		a)	
Compute	er ► Sj	ystem (C:) ▶ Programme (x86) ▶ WinPQSmart	Templates
Organisieren 🔹 Neue	r Ordne	r	
🚖 Favoriten		Name	Änderungsdatum
📃 Desktop		Smart_EN50160_LowVoltage.xml	15.10.2014 15:04
🐌 Downloads	Ξ	🖹 Smart_EN50160_MediumVoltage.xml	15.10.2014 15:04
# Dronbox			

### 6.4.3 General user settings

WinPQSmart 02.02.2015		\$6,702-01-read (5, 56-803, 51-803) door
Aome Send Save	Open own Open default	
device designation	Info	Value
IP-Settings	connection configuration voltage inputs	1
Modbus	reference voltage input Frequency measurement	1
PQ application	Power calculation, 0 : ohne Qu, 1 : DIN40110-2 mit Qu	0
PQ-parameter	connection configuration current inputs	1
General user-settings	Network connection, 0: 4-wire 3-phase, 1: 4-wire 1-phase, 2: 3-wire	0
Trigger-parameter	interval x-seconds-data class [s], 260	60
Oszilloskope recorder ( User! )	binary input for trigger interval-Power. : 0 (AUS) / 1 / 2	0
1/2 cylcle -recorder ( User! )	interval x-Minuten-data class [min] , 160	15
<ul> <li>Recording parameter</li> </ul>	THD and THC calculation up to harmonic {40, 50}	40
<ul> <li>200ms-interval</li> <li>150(190 Bariadan interval</li> </ul>	Transducer factor voltage	1
<ul> <li>100/100-Perioden-Interval</li> <li>10min interval</li> </ul>	Transducer factor current	120
2h-interval		
► 1s-interval		
1s-interval	1	

The following basic instrument settings can be made in this menu item:

• Connection voltage inputs: 1, 2, 3, 4

		Voltage inputs				
Connection configuration	VT	1	2	3	4	
Voltage : L1, L2, L3, N/E	1	U1	U <sub>2</sub>	U <sub>3</sub>	U <sub>N/E</sub>	DE
V-connection, earth L1	2	U1	U <sub>2</sub>	U <sub>3</sub>	u <sub>4</sub>	r L
V- connection, earth L2	3	<b>u</b> <sub>1</sub>	U <sub>2</sub>	U <sub>3</sub>	u <sub>4</sub>	
V- connection, earth L3	4	u <sub>1</sub>	u <sub>2</sub>	U <sub>3</sub>	<b>u</b> <sub>4</sub>	

Reference voltage: 1 ... 7
 Determining the frequency measurement input channel: U1, U2, U3, Une, U12, U23, U31

• Power calculation:

1 = according DIN40110-2; with calculation of the unbalance reactive power (basic setting of the device)

2 = Simplified power calculation - without calculation of unbalance power

This setting has also an effect on the power values in the display of the PQI-smart

• Connection current inputs:

			Cur	rent	
Connection configuration	СТ	11	12	13	14
Current : L1, L2, L3, N	1	i <sub>1</sub>	i <sub>2</sub>	i <sub>3</sub>	i <sub>N</sub>
Aron connection : L2, L3	2	-	i <sub>2</sub>	i <sub>3</sub>	i <sub>4</sub>
Aron connection : L1, L3	3	i <sub>1</sub>	-	i <sub>3</sub>	i <sub>4</sub>
Aron connection : L1, L2	4	i <sub>1</sub>	i <sub>2</sub>	-	i <sub>4</sub>



- Network connection:
   0 = 4-wire network (3 phase network with earth)
   1 = 4-wire (single phase 4 x L1)
   2 = 3-wire netzwork without earth
- Interval x-seconds data class:
   Free interval 2 seconds to 60 seconds
- Binary input for power intervals:
   0 = Time interval intern
   1 = time interval synchronized to binary input 1
   2 = time interval synchronized to binary input 1
- Interval x-minutes data class:
   Free interval 1 minute to 60 minutes (basic setting 15 minutes)
- Calculation THD / THC: Calculation 2<sup>nd</sup> to 40<sup>th</sup> harmonic or 2<sup>nd</sup> bis 50<sup>th</sup> harmonic
- Voltage transducer factor (basic setting = 1)
- Current transducer factor (basic setting = 1)

### 6.4.4 Trigger parameter for disturbance recorder

In this menue all limits for triggering of fault records can be changed.

These thresholds are independently to the Power Quality thresholds.

Upper and lower trigger thresholds für frequency, voltage, current oder unballance can be set.

WinPQSmart 02.02.2015				\$1,7210 mar. (1, 50-50	A DOMESTIC AND DESCRIPTION
کی مح Home Send	Save C	ipen own	Open default		
device designation		Info		Value	
IP-Settings		trigger signa	I-hold time [s]	1	
Modbus		Frequency-h	ysteresis [Hz]	0,05	
<ul> <li>PQ application</li> </ul>		Frequency : u	upper limit [Hz]	50,5	
PQ-parameter		Frequency : I	ower limit [Hz]	49,5	
General user-settings		Frequency : t	hreshold df 1/2 [Hz/s]	0,5	
Trigger-parameter		voltages-hys	teresis [percent from UC bzw. UC/1.73]	2	
Oszilloskope recorder (User!)		Star voltage:	upper limit [percent from UC/1.73]	110	
1/2 cylcle -recorder (User!)		Star voltage:	lower limit [percent from UC/1.73]	90	
<ul> <li>Recording parameter</li> <li>200 m interval</li> </ul>		Star voltage:	threshold dU 1/2 [percent from UC/1.73]	10	
<ul> <li>200ms-interval</li> <li>150/180 Designed as interval</li> </ul>		Star voltage:	threshold dphi 1/2 /Grad	6	
<ul> <li>100/100-Perioden-Interval</li> <li>10min_interval</li> </ul>		Displacemen	t voltage: upper limit [percent from UC/1.73]	30	
<ul> <li>Ionini-Interval</li> <li>2b-interval</li> </ul>		Displacemen	t voltage: threshold dU 1/2 [percent from UC/1.73]	10	
► 1s-interval		line-to-line v	oltage: upper limit [percent from UC]	110	
► 10s-interval		line-to-line v	oltage: lower limit [percent from UC]	90	
<ul> <li>N-seconds-interval</li> </ul>		line-to-line v	oltage: threshold dU 1/2 [percent from UC]	10	
<ul> <li>M-seconds-interval</li> </ul>		Star voltage:	threshold envelopentrigger [percent from UC/1.73]	20	
<ul> <li>Oscilloscope recorder</li> </ul>		line-to-line v	oltage: threshold envelopentrigger [percent from UC]	20	
► 1/2 cylcle -recorder		Displacemen	t voltage: threshold envelopentrigger [percent from UC/1.73]	20	
▶ Timedaemon		positive sequ	ence voltage: upper limit [percent from UC/1.73]	110	
		positive sequ	ence voltage: lower limit [percent from UC/1.73]	90	
		negative-seq	uence voltage: upper limit [percent from UC/1.73]	10	
		o zero-sequen	ce voltage: upper limit [percent from UC/1.73]	30	
		current-hyste	eresis [percent from kni*inom]	2	
		current: uppe	er limit [percent from INOM]	200	
		current: lowe	er limit [percent from INOM]	1	
		current: three	shold dI 1/2 [percent from INOM]	20	
		neutral curre	nt: upper limit [percent from INOM]	50	
		neutral curre	nt: threshold dI 1/2 [percent from INOM]	20	
1					



### 6.4.5 Oscilloscope recorder

Settings for Oscilloscope recorder can be changed here.

Open of Save         Open own         Open default           device designation         Info         Value           PS-settings         Info         Value           Modbus         Info         Value           PQ application         PQ application         1024           PQ application         Recorder regitin (valuee)         1024           PQ aparameter         Bit 0 lower voltage ULE > Aktive         1           Oxilloxkope recorder (User)         Bit 1 lower voltage ULE > Aktive         1           1/2 cyled -recorder (User)         Bit 3 lower voltage ULE > Aktive         1           1/2 cyled -recorder (User)         Bit 4 lower voltage ULE > Aktive         1           1/2 cyled -recorder (User)         Bit 4 lower voltage ULE > Aktive         1           1/2 cyled -recorder (User)         Bit 4 lower voltage ULE > Aktive         1           1/2 cyled -recorder (User)         Bit 4 lower voltage ULE > Aktive         1           1/2 cyled -recorder (User)         Bit 3 lower voltage ULE > Aktive         1           1/2 cyled -recorder (User)         Bit 3 lower voltage ULE > Aktive         1           1/2 cyled -recorder (User)         Bit 3 lower voltage ULE > Aktive         1           1/2 cyled -recorder         Bit 1 lower voltage ULE > Aktive         1 <th>WinPQSmart 02.02.2015</th> <th></th> <th>Ball Party in some for the latter of the latter way</th>	WinPQSmart 02.02.2015		Ball Party in some for the latter of the latter way
device designation     Info     Value       IP-Settings     minimum recorder length (valuee)     4096       Modbus     maximum recorder length (valuee)     1024       PQ-parameter     Bit 0: lower voltage UE > aktive     1       General user-settings     Bit 1: lower voltage UE > aktive     1       Ozzilackope recorder (Usert)     Bit 2: lower voltage UE > aktive     1       Nz cycle - recorder (Usert)     Bit 2: lower voltage UE > aktive     1       V2 cycle - recorder (Usert)     Bit 2: lower voltage UE > aktive     1       Nz cycle - recorder (Usert)     Bit 2: lower voltage UE > aktive     1       Nz cycle - recorder (Usert)     Bit 2: lower voltage UE > aktive     1       Nz cycle - recorder (Usert)     Bit 3: lower voltage UE > passive     0       Nz cycle - recorder (Usert)     Bit 3: lower voltage UE > passive     0       Nz cycle - recorder     Bit 10: lower voltage UE > passive     0       Nz cycle - recorder     Bit 10: lower voltage UE > passive     0       Nz cycle - recorder     Bit 11: lower voltage UE > passive     0       Nz cycle - recorder     Bit 11: lower voltage UE > passive     0       Nz cycle - recorder     Bit 11: lower voltage UE > passive     0       Nz cycle - recorder     Bit 11: lower voltage UE > passive     0       Nz cycle - recorder     Bit 11:	Nome Send	Save Open own Open default	
IP-Settings         minimum recorder length (valuee)         4096           Modbus         maximum recorder length (valuee)         1024           PQ aparameter         8k 0: 1 lower voltage UE > aktive         1           General user-settings         Bit 1: lower voltage UE > aktive         1           Disalloskope recorder (User!)         Bit 2: lower voltage UE > aktive         1           1/2 cycle - recorder (User!)         Bit 4: lower voltage UE > aktive         1           1/2 cycle - recorder (User!)         Bit 4: lower voltage UE > aktive         1           1/2 cycle - recorder (User!)         Bit 4: lower voltage UE > passive         0           1/2 cycle - recorder (User!)         Bit 4: lower voltage UE > passive         0           1/2 cycle - recorder (User!)         Bit 4: lower voltage UE > passive         0           1/2 cycle - recorder (User!)         Bit 4: lower voltage UE > passive         0           1/2 cycle - recorder (User!)         Bit 1: lower voltage UE > passive         0           1/2 cycle - recorder         Bit 1: lower voltage UE > passive         0           1/2 cycle - recorder         Bit 1: lower voltage UE > passive         0           1/2 cycle - recorder         Bit 1: lower voltage UE > passive         0           1/2 cycle - recorder         Bit 1: lower voltage UE > passive	device designation	Info	Value
Modbusmaximum recorder length (valuee)10240# PQ applicationRekorder pretine (valuee)1024PQ-parameterBit 0: lower voltage UE >> aktive1General user-settingsBit 1: lower voltage UE >> aktive1Trigger-parameterBit 2: lower voltage UE >> aktive1Oscillaskope recorder (User!)Bit 3: lower voltage UE >> aktive1I/2 cycle -recorder (User!)Bit 3: lower voltage UE >> aktive1I/2 cycle -recorder (User!)Bit 3: lower voltage UE >> aktive1I/2 cycle -recorder (User!)Bit 3: lower voltage UE >> passive0I/2 cycle -recorder (User!)Bit 3: lower voltage UE >> passive0I/2 cycle -recorder (User!)Bit 10: lower voltage UE >> passive0I/2 cycle -recorder (User!)Bit 11: lower voltage UE >> passive0I/2 cycle -recorderBit 11: cowr voltage UE >> passive0I/2 cycle -recorderBit 11: cowr voltage UE >> passive0I/2 cycle -recorderBit 11: cowr voltage UE >> passive0I/2 cycle -recorderBit 12: cowr voltage UE >> passive0I/2 cycle -recorderBit 11: cowr voltage UE >> passive0I/2 cycle -recorderBit 12: cowr voltage UE >> passive0I/2 cycle -recorder	IP-Settings	minimum recorder length (valuee)	4096
PQ-papilication     Rekorder pretime (valuee)     1024       PQ-parameter     Bit 0 : lower voltage UE >> aktive     1       General user-settings     Bit 1 : lower voltage UE >> aktive     1       Oszilloskope recorder (User!)     Bit 2 : lower voltage U2 >> aktive     1       Mecording parameter     Bit 4 : lower voltage U2 >> aktive     1       > 200ms-interval     Bit 4 : lower voltage U2 >> aktive     1       > 200ms-interval     Bit 4 : lower voltage U2 >> aktive     1       > 200ms-interval     Bit 4 : lower voltage U2 >> passive     0       > 10min-interval     Bit 1 : lower voltage U2 >> passive     0       > 2h-interval     Bit 1 : lower voltage U2 >> passive     0       > 10s-interval     Bit 1 : lower voltage U2 >> passive     0       > 10s-interval     Bit 1 : lower voltage U2 >> passive     0       > N-seconds-interval     Bit 1 : lower voltage U2 >> passive     0       > N-seconds-interval     Bit 1 : lower voltage U1 >> passive     0       > N-seconds-interval     Bit 1 : lower voltage U2 >> passive     0       > N-seconds-interval     Bit 1 : lower voltage U2 >> passive     0       > N-seconds-interval     Bit 1 : lower voltage U2 >> passive     0       > N-seconds-interval     Bit 1 : lower voltage U2 >> passive     0       > N-seconds-interval     Bit 1 : over	Modbus	maximum recorder length (valuee)	10240
PQ-parameterBit 0: lower voltage ULE > aktive1General user-settingsBit 1: lower voltage UZE > aktive1Trigger-parameterBit 2: lower voltage UZE > aktive1Oxailoskope recorder (User!)Bit 3: lower voltage UZE > aktive1J/2 cycle -recorder (User!)Bit 4: lower voltage UZE >> aktive1> 200ms-intervalBit 5: lower voltage UZE >> passive0> 100min-intervalBit 9: lower voltage UZE >> passive0> 100min-intervalBit 9: lower voltage UZE >> passive0> 10. sintervalBit 11: lower voltage UZE >> passive0> 10. sintervalBit 12: lower voltage UZE >> passive0> N-seconds-intervalBit 12: lower voltage UZE >> passive0> M-seconds-intervalBit 12: lower voltage UZE >> passive0> Voltage UZE >> ditive11> Voltage UZE >> user voltage UZE >> aktive1> 11/2 cycle -recorderBit 13: lower voltage UZE >> aktive1> 11/2 cycle -recorderBit 14: over voltage UZE >> aktive1Bit 21: over voltage UZE >> aktive11Bit 22: over voltage UZE >> aktive11Bit 21: over voltage UZE >> aktive11Bit 22: over voltage UZE >> passive01 <td><ul> <li>PQ application</li> </ul></td> <td>Rekorder pretime (valuee)</td> <td>1024</td>	<ul> <li>PQ application</li> </ul>	Rekorder pretime (valuee)	1024
General user-settingsBit 1: lower voltage U2E -> aktive1Trigger-parameter12: lower voltage U3E -> aktive1U2 cylcle -recorder (User!)Bit 3: lower voltage U12 -> aktive1# Recording parameterBit 5: lower voltage U12 -> aktive1> 200ms-intervalBit 5: lower voltage U12 -> aktive1> 150/180-Perioden-intervalBit 8: lower voltage U12 -> passive0> 10min-intervalBit 1: lower voltage U1E -> passive0> 10s-intervalBit 1: lower voltage U12 -> passive0> N-seconds-intervalBit 1: lower voltage U12 -> passive0> N-seconds-intervalBit 1: lower voltage U12 -> passive0> N-seconds-intervalBit 1: lower voltage U12 -> passive0> 1/2 cylcle -recorderBit 1: lower voltage U12 -> aktive1> 1/2 cylcle -recorderBit 1: lower voltage U12 -> aktive1Bit 2: lower voltage U12 -> aktive1Bit 2: lower voltage U12 -> aktive1Bit 2: over voltage U12 -> passive0Bit 2: over voltage U12 -> passive0Bit 2: over voltage U12 -> passive <t< td=""><td>PQ-parameter</td><td>Bit 0 : lower voltage U1E -&gt; aktive</td><td>1</td></t<>	PQ-parameter	Bit 0 : lower voltage U1E -> aktive	1
Ingger-parameterBit 2: lower voltage U3E > aktive1Ozalioskope recorder (User)Bit 3: lower voltage U2 > aktive1J 2cylcle -recorder (User)Bit 3: lower voltage U3 > aktive1A Recording parameterBit 5: lower voltage U3 > aktive1> 200ms-intervalBit 5: lower voltage U3 > aktive1> 100min-intervalBit 9: lower voltage U2 > passive0> 10min-intervalBit 10: lower voltage U2 >> passive0> 1.5-intervalBit 11: lower voltage U2 >> passive0> 1.5-intervalBit 12: lower voltage U2 >> passive0> 1.5-intervalBit 12: lower voltage U3 >> passive0> 1.5-intervalBit 12: lower voltage U3 >> passive0> 1.5-intervalBit 12: lower voltage U3 >> passive0> N-seconds-intervalBit 13: lower voltage U1 >> passive0> M-seconds-intervalBit 13: lower voltage U1 >> passive0> M-seconds-intervalBit 13: lower voltage U2 >> passive0> M-seconds-intervalBit 13: lower voltage U2 >> passive1> L/2 cylcle -recorderBit 19: over voltage U2 >> aktive1> L/2 cylcle -recorderBit 19: over voltage U2 >> aktive1Bit 2: over voltage U1 >> passive01Bit 2: over voltage U1 >> passive01Bit 2: over voltage U2 >> passive01 <tr< td=""><td>General user-settings</td><td>Bit 1: lower voltage U2E -&gt; aktive</td><td>1</td></tr<>	General user-settings	Bit 1: lower voltage U2E -> aktive	1
Obsilioskope recorder (User!)Bit 3: lower voltage U12 -> aktive11/2 cylcle -recorder (User!)Bit 4: lower voltage U23 -> aktive1> 200ms-intervalBit 5: lower voltage U21 -> passive0> 100mini-intervalBit 8: lower voltage U22 -> passive0> 10mini-intervalBit 9: lower voltage U22 -> passive0> 10-intervalBit 11: lower voltage U22 -> passive0> 10-intervalBit 12: lower voltage U22 -> passive0> 10-intervalBit 11: lower voltage U21 -> passive0> N-seconds-intervalBit 12: lower voltage U21 -> passive0> N-seconds-intervalBit 13: lower voltage U21 -> passive0> Dosilloscope recorderBit 17: over voltage U22 -> aktive1> 1/2 cylcle -recorderBit 19: over voltage U22 -> aktive1> TimedaemonBit 20: over voltage U23 -> aktive1Bit 21: over voltage U23 -> aktive11Bit 22: over voltage U23 -> aktive11Bit 22: over voltage U24 => passive01Bit 22: over voltage U24 => passive01 </td <td>Trigger-parameter</td> <td>Bit 2 : lower voltage U3E -&gt; aktive</td> <td>1</td>	Trigger-parameter	Bit 2 : lower voltage U3E -> aktive	1
J2 cycle -recorder (User)       Bit 4 ; lower voltage U23 -> aktive       1         4 Recording parameter       Bit 5 ; lower voltage U31 -> aktive       1         b 200ms-interval       Bit 8 ; lower voltage U31 -> passive       0         1 150/180-Perioden-interval       Bit 8 ; lower voltage U32 -> passive       0         1 0min-interval       Bit 10 : lower voltage U32 -> passive       0         1 10-interval       Bit 11 : lower voltage U32 -> passive       0         1 10-interval       Bit 12 : lower voltage U32 -> passive       0         1 0s-interval       Bit 12 : lower voltage U32 -> passive       0         N-seconds-interval       Bit 13 : lower voltage U31 -> passive       0         M-seconds-interval       Bit 16 : over voltage U11 -> passive       0         M-seconds-interval       Bit 17 : over voltage U12 -> passive       0         M-seconds-interval       Bit 19 : over voltage U32 -> aktive       1         I 1/2 cylcle -recorder       Bit 19 : over voltage U32 -> aktive       1         Bit 21 : over voltage U32 -> aktive       1       1         Bit 22 : over voltage U32 -> aktive       1       1         Bit 22 : over voltage U32 -> passive       0       1         Bit 22 : over voltage U32 -> passive       0       1       1      1	Oszilloskope recorder ( User! )	Bit 3 : lower voltage U12 -> aktive	1
becording parameter       Bit 5: lower voltage U31 -> aktive       1         200ms-interval       Bit 8: lower voltage U1E -> passive       0         10min-interval       Bit 9: lower voltage U2E -> passive       0         2h-interval       Bit 10: lower voltage U1E -> passive       0         10min-interval       Bit 10: lower voltage U12 -> passive       0         10s-interval       Bit 11: lower voltage U12 -> passive       0         10s-interval       Bit 12: lower voltage U12 -> passive       0         N-seconds-interval       Bit 13: lower voltage U12 -> passive       0         N-seconds-interval       Bit 13: lower voltage U12 -> passive       0         N-seconds-interval       Bit 16: over voltage U12 -> passive       0         N-seconds-interval       Bit 16: over voltage U12 -> passive       0         N-seconds-interval       Bit 16: over voltage U12 -> aktive       1         N-seconder       Bit 18: over voltage U12 -> aktive       1         I/2 cylcle -recorder       Bit 19: over voltage U12 -> aktive       1         Bit 21: over voltage U12 -> aktive       1       Bit 21: over voltage U12 -> aktive       1         Bit 22: over voltage U12 -> passive       0       1       Bit 22: over voltage U12 -> passive       0         Bit 26: over voltage U12 -> pa	1/2 cylcle -recorder ( User! )	Bit 4 : lower voltage U23 -> aktive	1
2 Uums-intervalBit 8: lower voltage U1E -> passive01 100/130: Perioden-intervalBit 9: lower voltage U2E -> passive02 b-intervalBit 10: lower voltage U3E -> passive02 b-intervalBit 11: lower voltage U3E -> passive03 bit 11: lower voltage U12 -> passive004 bit 11: lower voltage U31 -> passive005 bit 11: lower voltage U31 -> passive006 bit 12: lower voltage U31 -> passive006 bit 13: lower voltage U31 -> passive106 bit 13: lower voltage U31 -> passive106 bit 13: lower voltage U32 -> aktive107 bit 2: cylcle -recorderBit 13: lower voltage U32 -> aktive16 bit 2: over voltage U32 -> aktive106 bit 2: over voltage U32 -> aktive106 bit 2: over voltage U32 -> aktive106 bit 2: over voltage U32 -> aktive107 bit 2: over voltage U32 -> aktive108 bit 2: over voltage U32 -> aktive108 bit 2: over voltage U32 -> aktive108 bit 2: over voltage U32 -> passive008 bit 2: over vo	<ul> <li>Recording parameter</li> <li>200ms interval</li> </ul>	Bit 5 : lower voltage U31 -> aktive	1
I for Normal NetworkBit 9 : lower voltage U2E -> passive0bit 10 : lower voltage U3E -> passive0bit 11 : lower voltage U3E -> passive0bit 12 : lower voltage U32 -> passive0bit 13 : lower voltage U32 -> passive0bit 13 : lower voltage U31 -> passive0bit 13 : lower voltage U12 -> aktive1bit 15 : over voltage U1E -> aktive1bit 15 : over voltage U2E -> aktive1bit 19 : over voltage U2E -> aktive1bit 19 : over voltage U3E -> aktive1bit 20 : over voltage U3E -> aktive1bit 21 : over voltage U3E -> aktive1bit 21 : over voltage U3E -> aktive1bit 22 : over voltage U3E -> passive0bit 22 : over voltage U1E -> passive0bit 22 : over voltage U1E -> passive0bit 22 : over voltage U1E -> passive0bit 25 : over voltage U1E -> passive0bit 28 : over voltage U3E -> passive0bit 29 : over voltage U3	<ul> <li>200ms-interval</li> <li>150/180 Pariadan interval</li> </ul>	Bit 8 : lower voltage U1E -> passive	0
• ZommandaBit 10: lower voltage U3E -> passive0• 10:-intervalBit 11: lower voltage U12 -> passive0• 10:-intervalBit 12: lower voltage U23 -> passive0• N-seconds-intervalBit 13: lower voltage U31 -> passive0• M-seconds-intervalBit 16: over voltage U1E -> aktive1• Oscilloscope recorderBit 17: over voltage U1E -> aktive1• 1/2 cylcle -recorderBit 19: over voltage U3E -> aktive1• TimedaemonBit 20: over voltage U3E -> aktive1Bit 20: over voltage U3E -> aktive11Bit 20: over voltage U3E -> aktive11Bit 20: over voltage U3E -> aktive11Bit 21: over voltage U3E -> aktive11Bit 22: over voltage U3E -> passive01Bit 25: over voltage U3E -> passive01Bit 26: over voltage U3E -> passive01Bit 27: over voltage U3E -> passive01Bit 29: over voltage U3E -> passive01Bit 29: over voltage U3E -> passive01Bit 29: over voltage U3E -> passive01Bit 20: over	<ul> <li>100/180-Perioden-Interval</li> <li>10min-interval</li> </ul>	Bit 9 : lower voltage U2E -> passive	0
bit it i	2h-interval	Bit 10 : lower voltage U3E -> passive	0
bit distintervalBit 12 : lower voltage U23 -> passive0N-seconds-intervalBit 13 : lower voltage U31 -> passive0M-seconds-intervalBit 16 : over voltage U1E -> aktive1Oscilloscope recorderBit 17 : over voltage U2E -> aktive11/2 cylcle -recorderBit 18 : over voltage U2 -> aktive1N-medaemonBit 19 : over voltage U2 -> aktive1Bit 21 : over voltage U2 -> aktive11Bit 22 : over voltage U2 -> passive01Bit 22 : over voltage U2 -> passive01Bit 23 : over voltage U1 -> passive01Bit 24 : over voltage U1 -> passive01Bit 25 : over voltage U2 -> passive01Bit 28 : over voltage U2 -> passive01Bit 28 : over voltage U2 -> passive01Bit 28 : over voltage U2 -> passive01Bit 29 : over voltage U2 -> passive01Bit 30 : over voltage U2 -> passive01Bit 30 : over voltage U2 -> passive01Bit 30 : over voltage U3 -> passive <td>► 1s-interval</td> <td>Bit 11 : lower voltage U12 -&gt; passive</td> <td>0</td>	► 1s-interval	Bit 11 : lower voltage U12 -> passive	0
N-seconds-intervalBit 13 : lower voltage U31 -> passive0M-seconds-intervalBit 16 : over voltage U1E -> aktive1Oscilloscope recorderBit 17 : over voltage U2E -> aktive1I // 2 cylcle -recorderBit 18 : over voltage U3E -> aktive1TimedaemonBit 20 : over voltage U2 -> aktive1Bit 21 : over voltage U3 -> aktive11Bit 22 : over voltage U2 -> passive01Bit 23 : over voltage U1E -> passive01Bit 24 : over voltage U1E -> passive01Bit 25 : over voltage U2 -> passive01Bit 26 : over voltage U2 -> passive01Bit 28 : over voltage U2 -> passive01Bit 28 : over voltage U2 -> passive01Bit 29 : over voltage U3 -> passive01Bit 30 : over voltage U3 -> passive01Bit 30 : over voltage U3 -> passive01Bit 30 : over voltage U3 -> passive0	► 10s-interval	Bit 12 : lower voltage U23 -> passive	0
M-seconds-intervalBit 16 : over voltage U1E -> aktive1• Oscilloscope recorderBit 17 : over voltage U2E -> aktive1• 1/2 cylcle -recorderBit 18 : over voltage U3E -> aktive1• TimedaemonBit 19 : over voltage U2 -> aktive1Bit 20 : over voltage U23 -> aktive1Bit 21 : over voltage U31 -> aktive1Bit 22 : over voltage U1E -> passive0Bit 25 : over voltage U1E -> passive0Bit 26 : over voltage U1E -> passive0Bit 27 : over voltage U12 -> passive0Bit 28 : over voltage U12 -> passive0Bit 29 : over voltage U12 -> passive0Bit 30 : over voltage U12 -> passive0	<ul> <li>N-seconds-interval</li> </ul>	Bit 13 : lower voltage U31 -> passive	0
<ul> <li>Oscilloscope recorder         <ul> <li>I/2 cylcle -recorder</li> </ul> </li> <li>Timedaemon         <ul> <li>I 19: over voltage U3E -&gt; aktive</li> <li>I 10: over voltage U12 -&gt; aktive</li> <li>I 10: over voltage U23 -&gt; aktive</li> <li>I 10: over voltage U31 -&gt; aktive</li> <li>I 10: over voltage U31 -&gt; aktive</li> <li>I 10: over voltage U12 -&gt; aktive</li> </ul> </li> <li>I 10: over voltage U21 -&gt; aktive</li> <li>I 10: over voltage U12 -&gt; aktive</li> <li>I 10: over voltage U12 -&gt; passive</li> <li>I 10: over voltage U12 -&gt; passive</li> </ul> <li>I 10: over voltage U12 -&gt; passive</li>	<ul> <li>M-seconds-interval</li> </ul>	Bit 16 : over voltage U1E -> aktive	1
<ul> <li>h 1/2 cylcle - recorder</li> <li>Bit 18 : over voltage U3E -&gt; aktive</li> <li>Bit 19 : over voltage U12 -&gt; aktive</li> <li>Bit 20 : over voltage U23 -&gt; aktive</li> <li>Bit 21 : over voltage U31 -&gt; aktive</li> <li>Bit 22 : over voltage U1E -&gt; passive</li> <li>Bit 25 : over voltage U2E -&gt; passive</li> <li>Bit 26 : over voltage U2E -&gt; passive</li> <li>Bit 26 : over voltage U2E -&gt; passive</li> <li>Bit 27 : over voltage U2E -&gt; passive</li> <li>Bit 27 : over voltage U2E -&gt; passive</li> <li>Bit 27 : over voltage U2E -&gt; passive</li> <li>Bit 28 : over voltage U2E -&gt; passive</li> <li>Bit 29 : over voltage U1E -&gt; passive</li> </ul>	<ul> <li>Oscilloscope recorder</li> </ul>	Bit 17 : over voltage U2E -> aktive	1
<ul> <li>Timedaemon</li> <li>Bit 19 : over voltage U12 -&gt; aktive</li> <li>Bit 20 : over voltage U23 -&gt; aktive</li> <li>Bit 21 : over voltage U31 -&gt; aktive</li> <li>Bit 22 : over voltage U12 -&gt; aktive</li> <li>Bit 22 : over voltage U1E -&gt; passive</li> <li>Bit 25 : over voltage U2E -&gt; passive</li> <li>Bit 26 : over voltage U2E -&gt; passive</li> <li>Bit 27 : over voltage U2E -&gt; passive</li> <li>Bit 28 : over voltage U21 -&gt; passive</li> <li>Bit 28 : over voltage U23 -&gt; passive</li> <li>Bit 29 : over voltage U31 -&gt; passive</li> <li>Bit 29 : over voltage U31 -&gt; passive</li> <li>Bit 29 : over voltage U31 -&gt; passive</li> <li>Bit 29 : over voltage U12 -&gt; passive</li> <li>Bit 30 : over voltage U12 -&gt; passive</li> </ul>	► 1/2 cylcle -recorder	Bit 18 : over voltage U3E -> aktive	1
Bit 20: over voltage U23 -> aktive1Bit 21: over voltage U31 -> aktive1Bit 22: over voltage UNE -> aktive1Bit 24: over voltage U1E -> passive0Bit 25: over voltage U2E -> passive0Bit 26: over voltage U3E -> passive0Bit 27: over voltage U3E -> passive0Bit 28: over voltage U3E -> passive0Bit 29: over voltage U3E -> passive0Bit 30: over voltage UNE -> passive0	► Timedaemon	Bit 19 : over voltage U12 -> aktive	1
Bit 21 : over voltage U31 -> aktive1Bit 22 : over voltage UNE -> aktive1Bit 22 : over voltage U1E -> passive0Bit 25 : over voltage U2E -> passive0Bit 26 : over voltage U3E -> passive0Bit 27 : over voltage U12 -> passive0Bit 28 : over voltage U12 -> passive0Bit 29 : over voltage U12 -> passive0Bit 29 : over voltage U12 -> passive0Bit 29 : over voltage U12 -> passive0Bit 30 : over voltage U12 -> passive0Bit 30 : over voltage U12 -> passive0		Bit 20 : over voltage U23 -> aktive	1
Bit 22 : over voltage UNE -> aktive       1         Bit 22 : over voltage U1E -> passive       0         Bit 25 : over voltage U2E -> passive       0         Bit 26 : over voltage U12 -> passive       0         Bit 27 : over voltage U12 -> passive       0         Bit 28 : over voltage U23 -> passive       0         Bit 29 : over voltage U31 -> passive       0         Bit 30 : over voltage UNE -> passive       0		Bit 21 : over voltage U31 -> aktive	1
Bit 24: over voltage U1E -> passive0Bit 25: over voltage U2E -> passive0Bit 26: over voltage U3E -> passive0Bit 27: over voltage U12 -> passive0Bit 28: over voltage U23 -> passive0Bit 29: over voltage U31 -> passive0Bit 30: over voltage UNE -> passive0		Bit 22 : over voltage UNE -> aktive	1
Bit 25 : over voltage U2E -> passive0Bit 26 : over voltage U3E -> passive0Bit 27 : over voltage U12 -> passive0Bit 28 : over voltage U23 -> passive0Bit 29 : over voltage U31 -> passive0Bit 30 : over voltage UNE -> passive0		Bit 24 : over voltage U1E -> passive	0
Bit 26 : over voltage U3E -> passive     0       Bit 27 : over voltage U12 -> passive     0       Bit 28 : over voltage U23 -> passive     0       Bit 29 : over voltage U31 -> passive     0       Bit 30 : over voltage UNE -> passive     0		Bit 25 : over voltage U2E -> passive	0
Bit 27 : over voltage U12 -> passive     0       Bit 28 : over voltage U23 -> passive     0       Bit 29 : over voltage U31 -> passive     0       Bit 30 : over voltage UNE -> passive     0		Bit 26 : over voltage U3E -> passive	0
Bit 28 : over voltage U23 -> passive     0       Bit 29 : over voltage U31 -> passive     0       Bit 30 : over voltage UNE -> passive     0		Bit 27 : over voltage U12 -> passive	0
Bit 29 : over voltage U31 -> passive     0       Bit 30 : over voltage UNE -> passive     0		Bit 28 : over voltage U23 -> passive	0
Bit 30 : over voltage UNE -> passive 0		Bit 29 : over voltage U31 -> passive	0
		Bit 30 : over voltage UNE -> passive	0

- Minimum recorder length: Setting of the standard faultrecorder length
- Maximum recorder length: If one fault last longer than the minimum recorder length, the PQI-DA smart will
  enlarge the recorder length up to a maximum recorder length. The maximum recorder length of one recorder file
  can be set here.
- Recorder pretime is the time of the recorder file bevore the trigger threshold occurred.



- Active trigger = value exceeds or falls below threshold (start of the event)
- Passive trigger = value comes back to normal (end of the event)

Sampling frequency : 40960Hz / 10240Hz	10240	40960	10240	40960

 Sampling frequency of oscilloscope recorder can be changed from 10240 Hz to 40960 Hz (40960Hz is only available with option B1)

# 6.4.6 ½ cycle recorder

The trigger settings of ½ cycle recorder (10ms at 50Hz) are independend to oscilloscope recorder.

WinPQSmart 02.02.2015		MAN POLICY AND ADDRESS OF THE OWNER ADDRESS OF
Home Send Save	Open own Open default	
device designation	Info	Value
IP-Settings	minimum recorder length (valuee)	1000
Modbus	maximum recorder length (valuee)	3000
<ul> <li>PQ application</li> </ul>	Rekorder pretime (valuee)	250
PQ-parameter	Bit 0 : lower voltage U1E -> aktive	1
General user-settings	Bit 1 : lower voltage U2E -> aktive	1
Trigger-parameter	Bit 2 : lower voltage U3E -> aktive	1
Oszilloskope recorder ( User! )	Bit 3 : lower voltage U12 -> aktive	1
1/2 cylcle -recorder ( User! )	Bit 4 : lower voltage U23 -> aktive	1
Recording parameter	Bit 5 : lower voltage U31 -> aktive	1
200ms-interval	Bit 8 : lower voltage U1E -> passive	0
<ul> <li>10u/180-Perioden-Interval</li> <li>10u/is interval</li> </ul>	Bit 9 : lower voltage U2E -> passive	0
Iumin-Interval     Ab interval	Bit 10 : lower voltage U3E -> passive	0
<ul> <li>In-interval</li> </ul>	Bit 11 : lower voltage U12 -> passive	0
► 10c.interval	Bit 12 : lower voltage U23 -> passive	0
<ul> <li>N-seconds-interval</li> </ul>	Bit 13 : lower voltage U31 -> passive	0
<ul> <li>M-seconds-interval</li> </ul>	Bit 16 : over voltage U1E -> aktive	1
<ul> <li>Oscilloscope recorder</li> </ul>	Bit 17 : over voltage U2E -> aktive	1
► 1/2 cylcle -recorder	Bit 18 : over voltage U3E -> aktive	1
► Timedaemon	Bit 19 : over voltage U12 -> aktive	1
	Bit 20 : over voltage U23 -> aktive	1
	Bit 21 : over voltage U31 -> aktive	1
	Bit 22 : over voltage UNE -> aktive	1
	Bit 24 : over voltage U1E -> passive	0
	Bit 25 : over voltage U2E -> passive	0
	Bit 26 : over voltage U3E -> passive	0

Please see chapter 6.4.4 – explanation trigger thresholds





### 6.4.7 Recordings parameter

At this point, the selection of all permanent measured values within the interval data class is set. The following interval data classes available

- 10/12 cycle (200ms interval)
- 150/180 cycle (3 seconds interval)
- 10 minutes interval
- 2 h interval
- 1 seconds interval
- 10 seconds interval
- N x seconds interval (range 2 to 60)
- N x minutes interval (range 1 to 60 basic setting 15 min.)

WinPQSmart 02.02.2015		34,7931
Nome Send Save C	Open own Open default	
device designation	A	
IP-Settings	Total network frequency	<b>V</b>
Modbus	RMS value u1E / u1N	
<ul> <li>PQ application</li> </ul>	RMS value u2E / u2N	<b>V</b>
PQ-parameter	RMS value u3E / u3N	<b>V</b>
General user-settings	RMS value u0E / uNE	<b>v</b>
Trigger-parameter	RMS value u12	
Oszilloskope recorder ( User! )	RMS value u23	<b>V</b>
1/2 cylcle -recorder ( User! )	RMS value u31	<b>V</b>
Recording parameter	Phasor value u1E / u1N	
► 200ms-interval	Angle from phasor u1E / u1N	
<ul> <li>150/180-Perioden-interval</li> <li>10min interval</li> </ul>	Phasor value u2E / u2N	
	Angle from phasor u2E / u2N	
Voltagesvalues	Phasor value u3E / u3N	
Interharmonic u1E / u1N	Angle from phasor u3E / u3N	
Harmonic u2E / u2N	Phasor value u0E / uNE	
Interharmonic u2E / u2N	Angle from phasor u0E / uNE	
Harmonic u3E / u3N	Phasor value u12	
Interharmonic u3E / u3N	Angle from phasor u12	
Harmonic u0E / uNE	Phasor value u23	
Interharmonic u0E / uNE	Angle from phasor u23	
Harmonic u12	Phasor value u31	
Interharmonic u12	Angle from phasor u31	
Harmonic u23	Value from positive sequence	
Interharmonic u23	Angle from positive sequence	
Harmonic u31	Value from negativ sequence	
Interharmonic u31	Phase from negativ sequence	
Phase der Harm. 250 from u1E / u1N	Value from zero system	
Phase der Harm. 250 from u2E / u2N	Phase from zero system	
Phase der Harm. 250 from u3E / u3N	Inhalance u.2. (negativ/nositiv system) [negativ/nositiv system]	
Frequency bands 2kHz9kHz_u1E / u1N	Unbalance u 2 (regulary positiv system) [percent]	
Frequency bands 2kHz9kHz_u2E / u2N	THD from u1E / u1N [nercent]	
Frequency bands 2kHz9kHz_u3E / u3N	THD from u2E / u2N [percent]	
Frequency bands 2kHz9kHz u0E / uNE	THD from u2E / u2N [percent]	
Frequency bands 2kHz9kHz u12	THD from u0E / uNE [percent]	
Frequency bands 2kHz9kHz u23	The non-decy dive (percent)	

All activated measuring values are permanently recorded in this data class.

### 6.4.8 Disturbance recoder parameter

For oscilloscope recorder and ½ cycle recorder it is possible to activate and deactivate measurement values.



#### Example:

The ½ cycle recorder should also record the power and the frequency during a disturbance record.



# 6.5 Online measurement values



The "Online" function offers extensive analysis functions for online measurement values.

Start screen of the online measurement values:

Measure values	Harmonics 2 - 50	Inter-Harmonics 2 - 50	Frequency bands 2 - 9 kHz	Device panel
Measure values	Voltage L-E	Voltage L-E	Voltage L-E	
Vector-Diagram	Voltage L-L	Voltage L-L	Voltage L-L	Software Trigger
oscilloscope-picture	Current	Current	Current	

### 6.5.1 Measurement values

Display of online measurement values for voltages, currents, power and grid frequency.



### 6.5.2 Vector diagram



In the vector diagram, connection faults are easy to detect. All phase voltages and currents are displayed with phase angles.

### 6.5.3 Oscilloscope image

Online oscilloscope (41.96kHz / 10.24kHz) for the following channels:

- Conductor-earth voltages L1, L2, L3, NE
- Conductor-conductor voltages L12, L23, L31
- Currents L1, L2, L3, N





### 6.5.4 Harmonic

From the "Harmonics" tab page, all of the current and voltage harmonics (2nd to 50th) can be displayed online. The measurement data is calculated by the measuring device in accordance with IEC61000-4-30 Class A and transferred to the PC.

There are three bar charts available:

- Voltage harmonics conductor-earth
- Voltage harmonics conductor-conductor
- Current harmonics

As the EN50160 only specifies limits for harmonics up to the 25th ordinal, the compatibility level of IEC61000-2-2 has been stored for the 26th to the 50th harmonics in the basic settings. Compatibility levels in accordance with EN50160 & IEC61000-2-2 are shown as green limit value bars.



If a harmonic is selected with the mouse pointer, this measurement value is displayed in the field on the top right.

### 6.5.5 Interharmonics

The "Interharmonics" card is used to display all current and voltage interharmonics up to 2,500 Hz online. The measurement data is calculated by the measuring device in accordance with IEC61000-4-30 Class A following the grouping process and transferred to the PC.

There are three bar charts available:

- Interharmonic voltages conductor-earth
- Interharmonic voltages conductor-earth
- Interharmonic currents



If an interharmonic is selected with the mouse pointer, this measurement value is displayed in the field on the top right.

#### Explanation of the grouping process in accordance with the IEC:

To evaluate the interharmonics in the grid, subgroups are created. In each case, all of the interharmonics between two harmonics are combined into one harmonics subgroup.

Example for 50Hz: Interharmonic H2 includes all frequencies from 110Hz to 140Hz.





### 6.5.6 Frequency bands from 2kHz to 9kHz

### **b** The device characteristic "Frequency bands from 2kHz to 9kHz" is a device option

The card "2 to 9kHz" is used to display all current and voltage harmonics in 200Hz groups. Evaluation is in accordance with the IEC61000-4-7 standard.

The centre frequency of the corresponding frequency band is stated.

Example: All frequencies from 8,805Hz to 9,000 Hz are located in the 8.9 kHz band.



If a frequency band is selected with the mouse pointer, this measurement value is displayed in the field on the top right.

### 6.5.7 Device panel

The device panel can be used for the remote control of the device via the 5-key keypad.



Scrolling the measurement value displays (right – left keys)

The left and right keys can be used to scroll the measurement value screens.

#### Setup settings

The Enter key is used to open the setup menu of the device.



### 6.5.8 Software trigger



The "Software Trigger" key can be used to trigger the oscilloscope recorder and ½-period RMS recorder manually. The recorder length corresponds with the settings in the setup menu of the device.



# 6.6 Measurement data import



Import The "Import" function can be used to load all measurement data from the PQI-DA smart to the PC and to evaluate it there.

WinPQSmart 04.02.2015			
Home Imp	oort Delete		
Recorder Data			
200ms TRMS 3s TRMS	Inactive	e Data class not active	e – no measurement data
10min TRMS		_	
► 2h TRMS	Data cla	ass active – measuren	nent data available
<ul> <li>1s TRMS</li> </ul>			
<ul> <li>10s TRMS</li> </ul>			
variable second interval	TRMS		
<ul> <li>variable minute interval</li> </ul>	TRMS		
Async			
<ul> <li>Disturbance recorders</li> </ul>			
PQ-events			

10T	
► 150T	
⊿ 10min	
27.06.2014 14:43:23 - 30.06.2014 11:02:38 - 1715Kb	
30.06.2014 11:02:43 - 30.06.2014 11:16:00 - 41Kb	
30.06.2014 11:16:05 - 30.06.2014 11:18:51 - 37Kb	
30.06.2014 11:18:56 - 30.06.2014 16:07:17 - 156Kb	
30.06.2014 16:07:21 - 01.07.2014 07:08:34 - 405Kb	Colored the Setting of data strange
01.07.2014 07:08:55 - 01.07.2014 08:03:44 - 86Kb	Select the interval data classes
01.07.2014 08:03:50 - 01.07.2014 08:54:07 - 57Kb	8 permanent recorder available
01.07.2014 08:54:17 - 01.07.2014 09:45:14 - 57Kb	
01.07.2014 09:45:22 - 01.01.2000 00:00:01 - 737КЬ	
01.01.2000 00:00:06 - 02.01.2000 02:33:38 - 66Kb	
02.01.2000 02:33:43 - 03.01.2000 07:17:05 - 152Kb	
03.01.2000 07:17:11 - 03.01.2000 07:17:16 - 37Kb	
► 2h	
► 1s	
► 10s	
► Ns	
► Mmin	
⊿ rec	
► OSC	
⊿ HP	
Hp 27.06.2014 13:42:03:651	
Hp 30.06.2014 02:38:34:122	
Hp 30.06.2014 10:52:00:848	
Hp 30.06.2014 11:32:46:143	
Hp 30.06.2014 16:01:50:607	
Hp 30.06.2014 16:05:07:159	Select the number of the triggered
Hp 30.06.2014 16:10:54:873	
Hp 01.07.2014 06:39:44:311	sequence of events recordings (oscillo-
Hp 01.07.2014 06:39:46:839	scope and ½ cycle RMS recorder)
Hp 01.07.2014 07:37:29:474	scope and 72 cycle rivis recorder)
Hp 01.07.2014 07:37:58:921	
Hp 01.07.2014 07:38:42:480	
Hp 01.07.2014 07:50:18:889	
Hp 01.07.2014 07:50:56:561	
Hp 01.07.2014 09:12:20:893	
Hp 01.07.2014 09:14:58:805	
Hp 01.07.2014 09:33:56:707	
Hp 01.07.2014 09:40:19:533	
Hp 01.07.2014 14:57:01:180	



### Level-time diagram of permanent measuring data

When a file is selected this measurement data is saved on the PC immediately and a selection field with all available measurement data appears in the window.

▲ Rekorder Daten
10T
150T
▲ 10min
11.09.2014 13:30:01 - 11.09.2014 16:06:08 - 88Kb
11.09.2014 16:06:12 - 12.09.2014 10:10:01 - 415Kb
▶ 2h
15
► 10s
Ns
► Mmin
Async
⊿ Rec
⊿ Osc
Osc 11.09.2014 13:45:53:72100
▲ HP
Hp 11.09.2014 13:46:08:42500
Ereignissrekorder Daten
•
<ul> <li>Timestamp</li> </ul>
<ul> <li>Status</li> </ul>
Spannungsmessgroessen
i f
u1
🖾 u2
u3
0 u0
🔲 u12
🗆 u23
🛄 u31
<ul> <li>Harmonische u1E / u1N</li> </ul>
<ul> <li>Zwischenharmonische u1E / u1N</li> </ul>
<ul> <li>Harmonische u2E / u2N</li> </ul>
<ul> <li>Zwischenharmonische u2E / u2N</li> </ul>
<ul> <li>Harmonische u3E / u3N</li> </ul>
<ul> <li>Zwischenharmonische u3E / u3N</li> </ul>
<ul> <li>Frequenzbaender 2kHz.9kHz u1E / u1N</li> </ul>
<ul> <li>Frequenzbaender 2kHz.9kHz u2E / u2N</li> </ul>
<ul> <li>E Frequenzbaender 2kHz.9kHz u3E / u3N</li> </ul>
<ul> <li>Spannungs-Extremwerte</li> </ul>
<ul> <li>Spannungs-Statistikgroessen</li> </ul>
<ul> <li>Strommessgroessen</li> </ul>
<ul> <li>Harmonische i1</li> </ul>
<ul> <li>Harmonische i2</li> </ul>
Harmonische i3

If measurement values are selected, they appear as a level-time diagram on the screen.



### Example: Oscilloscope recorder – selecting voltage L1, L2, L3, L12, L23, L31



Right-clicking the graphics with the mouse will open the following menu:

Functions:

- Auto scaling: The Y-axis of the measurement values is scaled automatically
- Data on the clipboard: Measurement data is copied to the clipboard and can be processed further, e.g. in MS Excel.
- Image on the clipboard: Copies the level-time diagram to the Windows clipboard and can then be inserted, e.g. in MS Word.

Stack: This function changes how the measurement data is displayed in stacks. Measurement values can contain grouped or separate y-scales.

With "Import" it is possible to select between:

- Download all measurement files of the recorder (f.e. 10min recorder files)
- Download all disturbance recorder and permanent recorder from PQI-DA smart





# 6.7 Deleting measurement data in the device memory

With the "Delete" function, measurement data can be deleted in the PQI-DA *smart* device memory.

A Home In	nport Delete Cu	rrent
▲ Recorder Data		<b>Delete recorder</b> - only deletes the selected file.
200ms TRMS	Delete recorder	
3s TRMS		All records of this class - deletes f.e. all 10-minute
▲ 10min TRMS	Remove all recorder of this class	data files.
21.01.2015 11:57	Remove an recorder of this class	<b>Delete all records</b> – All disturbance recordings
21.01.2015 11:59	Dalata all recorder	
21.01.2015 12:11	Delete all recorder	and long-term measurement data on the device
22.01.2015 10:29/	A ALL ALL ALL ALL ALL ALL ALL ALL ALL A	memory are deleted.

Rekorder Daten		
Ereignissrekorder Daten		
01.08.2014 15:09:01 - 01.08.2014 15:09:06 -	18Kb	Right-click with the mouse to open
04.08.2014 Event Löschen	19Kb	the menu.
04.08.2014 : Alle Events Löschen	19Kb	
04.08.2014 15:49:49 - 05.08.2014 16:00:21 -	19Kb	Delete event - deletes only the selected event
05.08.2014 16:08:09 - 08.08.2014 18:59:17 -	19Kb	file.
08.08.2014 18:59:35 - 13.08.2014 06:00:00 -	19Kb	
13.08.2014 08:33:41 - 13.08.2014 12:15:03 -	19Kb	Delete all events – all event files on the device
13.08.2014 12:17:10 - 15.08.2014 04:40:00 -	19Kb	are deleted.

### 6.8 Evaluating measurement data offline



Archiv The "Archiv" function can be used to evaluate all measurement data offline.

All measurement data which has been selected in the "Import" function is saved automatically on the PC. These can be evaluated offline without being connected to the measuring device.

Screen: Data folder





When measurement values or measuring channels have been selected, the associated level-time diagram appears

Example: Oscilloscope image – selecting voltage for L1E, L2E, L3E



### 6.8.1 Edit measurement data

With the icon "Chart", the following functions are available:



#### Copy data – copies all the data displayed in the Windows clipboard

Example – measurement values in MS Excel

Di	atei Start	Ei	nfügen Sei	tenlayout F	ormein Da	ten Übe
	<b>*</b>	Cali	bri	• 11 • A	≡ =	<b>**</b>
Einfügen		F K U - 🖾 - 🆄 - 🛓		· = = :	≡ ‡ ‡	
Zwischenablage 🕞		Schriftart		Es.	A	
	F8		<b>-</b> (*	f <sub>x</sub>		
- 24	А		В	С	D	E
1	Time		u1 [V]	u2 [V]	u3 [V]	
2	26.01.2015 1	2:08	229,908829	230,371948	231,529633	
3	26.01.2015 1	2:08	229,95433	230,324997	231,544083	
4	26.01.2015 1	2:08	230,115509	230,450394	231,635376	
5	26.01.2015 1	2:08	230,227463	230,414688	231,666489	
6	26.01.2015 1	2:08	230,21347	230,309494	231,4431	
7	26.01.2015 1	2:08	230,140366	230,290192	231,453842	
8	26.01.2015 1	2:08	230,140869	230,322891	231,519913	
9	26.01.2015 1	2:08	230,231445	230,381744	231,602417	
10	26.01.2015 1	2:08	230,168167	230,458282	231,623047	
11	26.01.2015 1	2:08	230,301575	230,440216	231,705002	
12	26.01.2015 1	2:08	230,420013	230,432693	231,702087	
13	26.01.2015 1	2:08	230,316681	230,510208	231,799652	
14	26.01.2015 1	2:08	230,414185	230,703064	231,960907	
15	26.01.2015 1	2:08	230,387589	230,661697	231,889923	

Copy image – photo is copied to the Windows clipboard

### Stack – associated measurement data can be represented with a common scale or separated

Example: presentation of voltage L1, L2, L3 in two variants




#### Zoom function

To zoom in an area you draw with the left mouse button a window from top left to bottom right. To zoom out is the opposite direction. You can zoom in multiple stages or zoom out an image.



## 6.8.2 EN50160 report



In the 10 minute data class, the EN50160 report is available. If you select one measurement file a multipage report is created.



## 6.8.3 Voltage harmonics - interharmonics



With the Icon "Voltage" you can reach the statistics of the voltage harmonics, voltage interharmonics and frequency bands 2 kHz to 9 kHz.

WinPQSmart 02.	02.2015				
کے Home	Timport from SD card	Voltage	Current	EN-Report	
*					
⊿ Verteilu		Statistik Harmonis			
▲ 14063327: Geraete-Name		Statistic Harmonis			
▲ Recorder Data		Statistik Interharm			
200ms TRMS		Statistic International			
3s TRMS		Statistik 2,0 - 9,0 k			
10min TRMS					
2	4.01.2015 05:39:22 - 26.01.2	010-12-07-02			
2	6.01.2015 12:07:50 - 02.02.2	015 12:08:04			

Example: Statistic voltage harmonic - scaled to the corresponding compatibility level of the power quality standard.





## 6.8.4 Currentharmonics – Interharmonics



Current With the Icon "Voltage" you can reach the statistics of the voltage harmonics, voltage interharmonics and frequency bands 2 kHz to 9 kHz.







## Example: Statistic current harmonics 2<sup>nd</sup> to 50<sup>th</sup> - scaling in ampere

If you select with the cursor a particular harmonic, so the corresponding measured values are displayed for these harmonics in the display.

Index: 3
LIMIT=5 A
L1(95%)=10,58 A
L1(Max)=14,02 A
L2(95%)=7,39 A
L2(Max)=8,47 A
L3(95%)=6,63 A
L3(Max)=8,7 A
L0(95%)=0 A
L0(Max)=0 A

The red bar always shows the 95% values and the blue bar shows the maximum measured value.





# 6.9 Importing measurement data from an SD card



The function "Import from SD" function is used to transfer selected measurement data from the SD memory card to the PC.

- Event Recorder includes all Power Quality events
- srb includes all long-term measurement data and sequence of events recordings



# 7. **Firmware update for PQI-DA smart**



The "General setup" function of the station tile can be used to carry out a firmware update for the PQI-DA *smart* measuring device.

Select the folder where the file for the firmware update is located.

The officent function is used to transfer the firmware to the network analyser.

😋 🕞 🗢 🗼 « Data (D	:) ▶ A-I	Eberle-Produktgruppen 🕨 PQ festinstalli	ert 🕨 PQI-D smart 🕨 Firmwar	e Smart 🕨	<b>▼</b> 49	Firmware Sn	nart durch	s 🔎
Organisieren 🔻 Neue	er Ordne	r					· 🔳	0
🚖 Favoriten	-	Name	Änderungsdatum	Тур	Größe			
E Desktop		👢 PQI-DA_Smart_RC0.zip	22.08.2014 16:45	ZIP-komprimierter	1.270 KB			
Downloads	≡							
Suletzt besucht								
🥞 Bibliotheken								
lider 😽								
Dokumente		$\searrow$						
Musik Videos								
- Videos	Ψ.							
Dateir	name:				▼ Firm	nware (*.zip)		-
						Öffnen	Abbrech	en
								.11

When the transfer of the firmware to the measuring device has been completed, it will automatically restart and install the new version.



# 8. **Modbus**

The following data classes and events are available in the PQI-DA smart about Modbus TCP or Modbus RTU:

- > 200ms data class (frequency, voltage L1, L2, L3)
- 1 sec data class (all measurement values)
- > 10 min data class (all measurement values)
- N x min data class (power measurement values)
- > 2h data class Plt long term flicker value
- Status of two binary inputs
- > Power Quality and disturbance event counter (display PQI-DA smart)
- > Endless counter for disturbance recorder
- > Power Quality settings write Modbus

## 8.1 Modbus data list

Please download the extensive Modbus data point list from our website www.a-Eberle .de

For Modbus are over 5000 measurement values available.

## 8.2 Modbus settings

Settings of the Modbus TCP and Modbus RTU interface can be changed via the device setup.



## 8.2.1 Modbus RTU

You can enable Modbus RTU and assign the interface. (COM1 or COM2)



The interface can be changed to Modbus RTU RS232 or RS485.

Modbus F	RTU	
Baudrate		
	115200	
Parität		L
	NONE	

Modbus	RTU
Slave ID	
	17
Modus	
	RS232
zurück	

## 8.2.2 Modbus TCP

Modbus TCP is deactivated by default and can be enabled at this point. The port number can be parameterized.

Modbus	тср
Status	
	Aktiviert
Port	
	502
zurück	



# 9. Intended use

The product is intended for measuring and evaluating voltage and current signals in the energy grid only.

# 10. Measurement data – measurement methods PQI-DA smart

The aggregation of the measurement values is carried out in accordance with the IEC61000-4-30 (2008) standard for class A devices.

RMS values of the voltages and currents, min. / max. values

## U eff / I eff

The interval value of the voltage or current is the mean of the RMS values of the length of the selected interval.

### U min / max; I min / max

Per measurement period, the highest and lowest 10 ms voltage or current RMS value is saved in addition to the average.

# **Ripple control signal**

### U Ripple Control (200 ms)

In the PQI-DA *smart* setup any interharmonic can be set. This is displayed as the 200 ms maximum value within a measurement interval.

# Flicker levels Pst / Plt

The **Short term flicker levels P**<sub>st</sub> (10 min) and **Long term flicker levels P**<sub>lt</sub> (2 h) are calculated for the star and delta voltages. P<sub>st</sub> and P<sub>lt</sub> are defined in EN 61000-4-15: 2010.

The source for implementation recommendations is "EMV Messung von Spannungsschwankungen und Flickern mit dem IEC-Flickermeter" by W.Mombauer, VDE-Verlag, VDE-Schriftenreihe "Normen verständlich", ISBN 3-8007-2525-8.

The interval length Pst has been fixed to 10 minutes and is independent of the measurement interval set.

Formula for P<sub>lt</sub> calculation:

$$P_{lt} = \sqrt[3]{\frac{1}{12}\sum_{i=1}^{12}P_{st,i}^3}$$

The flickermeter can be parameterised in the device setup for the following grid configurations:

230V/50Hz; 230V/60Hz and 120V/50Hz; 120V/60Hz

#### THD – PWHD – K factor

Total harmonic content, calculated using the following formulae in accordance with IEC61000-4-7.

Calculating the THD values of the voltages and signal sampling:

The voltage and current inputs are filtered with an anti-aliasing filter and digitized with a 24-bit converter.

The sampling rate is at the nominal frequency 40.96 kSamples/s.

#### The aggregation of the measurements is based on IEC61000-4-30 for Class A devices.

# RMS values of the voltages and currents, min. / max. values

#### U eff / I eff

The interval value of the voltage or current is the mean of the RMS values of the length of the selected interval.

#### U min / max; I min / max

Per measurement period, the highest and lowest 10 ms voltage or current RMS value is saved in addition to the average.

# Ripple control signal

#### U Ripple Control (200 ms)

Any interharmonics can be set In the PQ-Box 200 setup. This is displayed as the 200 ms maximum value within a measurement interval.



# Flicker levels Pst / Plt

The **Short term flicker levels P**<sub>st</sub> (10 min) and **Long term flicker levels P**<sub>lt</sub> (2 h) are calculated for the star and delta voltages. Pst and Plt are defined in EN 61000-4-15: 2010.

The measuring interval of the Pst is set to 10 minutes fix and is independently from the free intervall.

Formula for P<sub>lt</sub> calculation:

$$P_{lt} = \sqrt[3]{\frac{1}{12}\sum_{i=1}^{12} P_{st,i}^3}$$

# THD – PWHD – K factor

All calculations are based on a 10/12 cycle averaging interval (50 Hz = 10 cycles / 60 Hz = 12 cycles),

according the formula of IEC61000-4-7 (exactly 2024 sample values will be used for calculation)

THD calculation



The THD calculation of voltage and current can be changed in the settings: 2 – 40th or 2 – 50th

#### THD voltage:

$$THD_{u} = \frac{\sqrt{\sum_{\nu=2}^{40} U_{\nu}^{2}}}{U_{1}}$$

THD current in %:

$$THD_i = \frac{\sqrt{\sum_{\nu=2}^{40} I_{\nu}^2}}{I_1}$$

THD(A) current in Ampere:

$$THC = \sqrt{\sum_{n=2}^{40} I_n^2}$$

#### **PWHD - Partial Weighted Harmonic Distortion**

The partial weighted THD calculates the 14th to 40th harmonics.

$$PWHD = \frac{\sqrt{\sum_{n=14}^{40} n \cdot C_n^2}}{C_1}$$

#### **PHC - Partial Odd Harmonic Current**

The PHC is calculated from the odd current harmonics n = 21..39.

$$PHC = \sqrt{\sum_{n=21,23}^{39} C_n^2}$$

#### **K** Factor

The values of the K-factors for phase currents are calculated from the corresponding RMS values  $C_n$  of the harmonics n = 1..40.

The K factor is a measure that indicates the ability of a transformer to withstand the current harmonics of a system.

Various transformer suppliers offer transformers with, for example, K factors K=4, K=13, K=20 and K=30.

Transformers are heated more by harmonic currents than 50 Hz currents.

A transformer with a higher K-factor withstands this better and is not heated as much as a transformer with a lower K factor.

The device shows the K factor for the current. Only the K values that appear at maximum power are of interest. Just as with the THD of the currents in %, the value is not relevant at very low currents.

$$K = \frac{\sum_{n=1}^{40} (n \cdot C_n)^2}{\sum_{n=1}^{40} C_n^2}$$



# Harmonics / Interharmonics

The determination of the harmonics and interharmonics interval values displayed using the methods of the IEC61000-4-30 Class A standard based on 10/12 period values.

The PQI-DA smart recognizes for all voltage and current channels, respectively, the harmonics up to the 50th ordinal. To evaluate the interharmonics, harmonic subgroups are created. 50 subgroups are recorded for all current and voltage channels.



"IH1" is the first interharmonics group and evaluated the frequency range from 5 Hz to 45 Hz.

The harmonics for n = 0...50 are calculated.

Voltage harmonics (standardized, 10/12 periods):

$$|U_{n-10/12}| = \frac{\sqrt{\frac{1}{2} \cdot \sum_{k=n \cdot N-1}^{n \cdot N+1} |C_k|^2}}{U_{nom}}$$

Current harmonics:

$$|I_{n-10/12}| = \sqrt{\frac{1}{2} \cdot \sum_{k=n \cdot N-1}^{n \cdot N+1} |C_k|^2}$$

## Frequency analysis 2 kHz to 9 kHz

In the frequency analysis 2 kHz to 9 kHz respectively 200 Hz frequency bands are summarized. The specification of each frequency is the center frequency in this 200 Hz band.

$$Y_{\rm b} = \sqrt{\sum_{f={\rm b}-95\,{\rm Hz}}^{{\rm b}+100\,{\rm Hz}} Y_{{\rm C},f}^2}$$

Example: Frequency band 8.9 kHz corresponds to all 5 Hz spectral lines from 8.805Hz to 9.000Hz

# Reactive power / Reactive energy

In the setup of the device two variants of the power calculation are adjustable

#### Simplified power calculation

Reactive power without unbalanced reactive power calculation:

$$Q = \sqrt{Q_V^2 + D^2}$$
 Q  $\Sigma = Q L1 + Q L2 + Q L3$ 

#### Reactive power calculation according DIN40110 part 2

Reactive power calculation with unbalanced power:

$$Q_{L-10/12} = Sgn(\varphi_{L-10/12}) \cdot \sqrt{S_{L-10/12}^2 - P_{L-10/12}^2}$$
$$Q_{10/12} = Sgn(\varphi_{1-10/12}) \cdot \sqrt{S_{10/12}^2 - P_{10/12}^2}$$

Reactive energy:

"Supply reactive energy" inductive reactive energies +EQ.

$$Q_{s}(n) = |Q_{L-10/12}(n)|$$
 für :  $Q_{L-10/12}(n) \ge 0$ 

 $Q_{s}(n) = 0$  für:  $Q_{L-10/12}(n) < 0$ 

"Consumer reactive energy" capacitative reactive energies -EQ.

$$Q_{s}(n) = |Q_{L-10/12}(n)|$$
 für :  $Q_{L-10/12}(n) < 0$ 



# Distortion reactive power - D

The distortion reactive powers are calculated from the voltage and the associated distortion currents:

$$\mathbf{D} = \mathbf{U} \cdot \sqrt{\sum_{\nu=2}^{\infty} \mathbf{I}_{\nu}^2}$$



# **Power Factor PF**

In electrical engineering the power factor or active power factor is calculated as the ratio of real power P to the apparent power S. The power factor can be between 0 and 1.

The ration is expressed in the following equation:

Power Factor PF:  $\lambda = IPI / S$ 

# **Apparent Power - S**

In the setup of the PQ Box 200 two variants of the power calculation are adjustable **Simplified power calculation** 

$$S = \sqrt{P^2 + Q^2}$$

Power calculation according DIN40110 part 2

Conductor apparent power 4-wire system:

$$S_L = U_{LNrms} \cdot I_{Lrms}$$

Conductor apparent power 3-wire system:

$$S_L = U_{L0rms} \cdot I_{Lrms}$$

Collective apparent power in accordance with DIN40110:

$$S_{\Sigma} = U_{\Sigma} \cdot I_{\Sigma} \qquad U_{\Sigma} = \frac{1}{2} \cdot \sqrt{U_{12\,rms}^2 + U_{23\,rms}^2 + U_{31\,rms}^2 + U_{1N\,rms}^2 + U_{2N\,rms}^2 + U_{3N\,rms}^2}$$

4-wire network:

$$I_{\Sigma} = \sqrt{I_{1rms}^2 + I_{2rms}^2 + I_{3rms}^2 + I_{Nrms}^2}$$

3-wire network,  $11 + 12 + 13 \neq 0$ :

$$U_{\Sigma} = \frac{1}{2} \cdot \sqrt{U_{12rms}^{2} + U_{23rms}^{2} + U_{31rms}^{2} + U_{1Erms}^{2} + U_{2Erms}^{2} + U_{3Erms}^{2}}$$
$$I_{\Sigma} = \sqrt{I_{1rms}^{2} + I_{2rms}^{2} + I_{3rms}^{2} + I_{Erms}^{2}}$$

Geometric Fundamental Oscillations - Apparent Power:

$$\underline{S}_{G} = 3 \cdot [\underline{U}_{1\_PS} \cdot \underline{I}_{1\_PS}^{*} + \underline{U}_{1\_NS} \cdot \underline{I}_{1\_NS}^{*} + \underline{U}_{1\_ZS} \cdot \underline{I}_{1\_ZS}^{*}]$$

## Active Power - P

The sign of the active power corresponds with the flow direction of the fundamental oscillation active energy (+: supply, - : consumer).

The values of the conductor - active power are calculated from the samples of a synchronisation cycle.

$$P_{L-10/12} = \frac{\sum_{n=1}^{2048} p_L(n)}{2048}$$

(200 ms values) with conductor index L = {1, 2, 3, E}The 10 min values are calculated as linear averages.The collective effective power is defined for 4-wire systems as

$$P_{\Sigma} = P_1 + P_2 + P_3$$

The collective effective power is defined for 3-wire systems as

$$P_{\Sigma} = P_1 + P_2 + P_3 + P_E$$

Fundamental oscillation - active power (line):

$$P_G = \operatorname{Re}\{\underline{S}_G\}$$

 $\underline{S}_{G}$  = Geometric fundamental oscillation apparent power



# Symmetric Components

The complex symmetrical components are calculated from the corresponding complex spectral components of the fundamental oscillations of the phase voltages and phase currents.

Phase voltage in a <u>4-wire system</u> = <u>Phase-to-Neutral voltage</u>

Phase voltage in a <u>3-wire system</u> = <u>Phase-to-Ground voltage</u>

## Positive sequence:

$$\underline{\underline{U}}_{1\_PS} = \frac{1}{3} \cdot \left( \underline{\underline{U}}_{1N-1} + \underline{\underline{a}} \cdot \underline{\underline{U}}_{2N-1} + \underline{\underline{a}}^2 \cdot \underline{\underline{U}}_{3N-1} \right)$$
$$\underline{\underline{I}}_{1\_PS} = \frac{1}{3} \cdot \left( \underline{\underline{I}}_{1-1} + \underline{\underline{a}} \cdot \underline{\underline{I}}_{2-1} + \underline{\underline{a}}^2 \cdot \underline{\underline{I}}_{3-1} \right)$$

## Negative sequence:

$$\underline{\underline{U}}_{1\_NS} = \frac{1}{3} \cdot \left( \underline{\underline{U}}_{1N-1} + \underline{\underline{a}}^2 \cdot \underline{\underline{U}}_{2N-1} + \underline{\underline{a}} \cdot \underline{\underline{U}}_{3N-1} \right)$$
$$\underline{\underline{I}}_{1\_NS} = \frac{1}{3} \cdot \left( \underline{\underline{I}}_{1N-1} + \underline{\underline{a}}^2 \cdot \underline{\underline{I}}_{2N-1} + \underline{\underline{a}} \cdot \underline{\underline{I}}_{3N-1} \right)$$

# Zero sequence:

$$\underline{U}_{ZS} = \frac{1}{3} \cdot \left( \underline{U}_{1N-1} + \underline{U}_{2N-1} + \underline{U}_{3N-1} \right)$$
$$\underline{I}_{ZS} = \frac{1}{3} \cdot \left( \underline{I}_{1N-1} + \underline{I}_{2N-1} + \underline{I}_{3N-1} \right)$$

# UU Unbalance

The unbalanced voltages are calculated from the corresponding values of the modal positive sequence, negative sequence and zero sequence components.

For the EN50160 (events) only the voltage unbalance  $u_u$  is relevant and corresponds to the ratio of the negative sequence to the positive sequence. The value is expressed in [%].

We take care of it.

# 11. Service

This unit is maintenance-free for customers.

	Danger of electric shock!				
	🖐 Do not open the unit.				
DANGER	$rac{W}{}$ Maintenance of the device must only be carried out by A.Eberle.				

For service, contact A-Eberle. **Service address:** A. Eberle GmbH & Co. KG Frankenstraße 160 D-90461 Nuremberg

Use a short, slightly damp, lint-free cloth. Make sure no liquid gets in the housing. Do not use window cleaner, household cleaners, sprays, dissolvent, cleaners that contain alcohol, ammonia solutions or abrasive cleaning agents.

# 12. **Disposal**

To dispose of the device and its accessories, please return all components to A. Eberle.



# 13. **Product Warranty**

A. Eberle warrants that this product and its accessories shall be free from defects in materials and workmanship for a period of three years from the date of purchase. This warranty does not cover damage caused by accident, misuse or abnormal operating conditions.

To make a claim under this warranty, please contact A.Eberle GmbH & Co KG in Nürnberg, Germany.



A. Eberle GmbH & Co. KG

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