Manual

PCD1.P1001-J30

Power Quality Analyzer (PQA)

Document 27-650 | Edition ENG04 | 2017-03-31

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7. Menu structure

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0.1 Document History

Version	Changes	Published	Comments
ENG01	2016-07-12	2016-07-12	- New document
ENG02	2016-08-16	2016-08-16	- Diverse feedbacks
ENG03	2016-08-30	2016-08-30	- Diverse feedbacks
ENG04	2017-01-19	2017-03-31	- Feedbacks from the development

0.2 Trademarks

Saia PCD® is a registered trademark of Saia-Burgess Controls AG.

Technical changes are subject to the state of technology.

Published in Switzerland

1. Product description

The PCD1.P1001-J30 Power Quality Analyzer (PQA) is a device for measuring and checking the quality of the power system, manufactured as DIN rail equipment in industrial quality. In addition to basic values such as current, voltage and power, the power analyzer also has extensive analysis capabilities for detection of harmonics, dips and swells, spikes, transients, etc.

The versatile measurement capabilities allow analysis of any disturbances with cyclical / event-oriented data recording and automatic notification if a measured quantity should be outside the tolerance limits.

In an installation without proper power quality electrical equipment, loads can be disturbed, not work or they even can be destroyed. There are many types of poor network quality and as many kinds of reasons for a poor power quality. A PQA helps to avoid such situations. A measure that will help to extend the life cycle of a machine.

The compact E-line design allows space-saving use in electrical cabinets.
The integrated RS-485 interface is available in S-Bus / Modbus and enables communication with Saia PCD® controller or other master devices. The engineering is through a comprehensive FBox Library with web templates very efficiently and quickly.

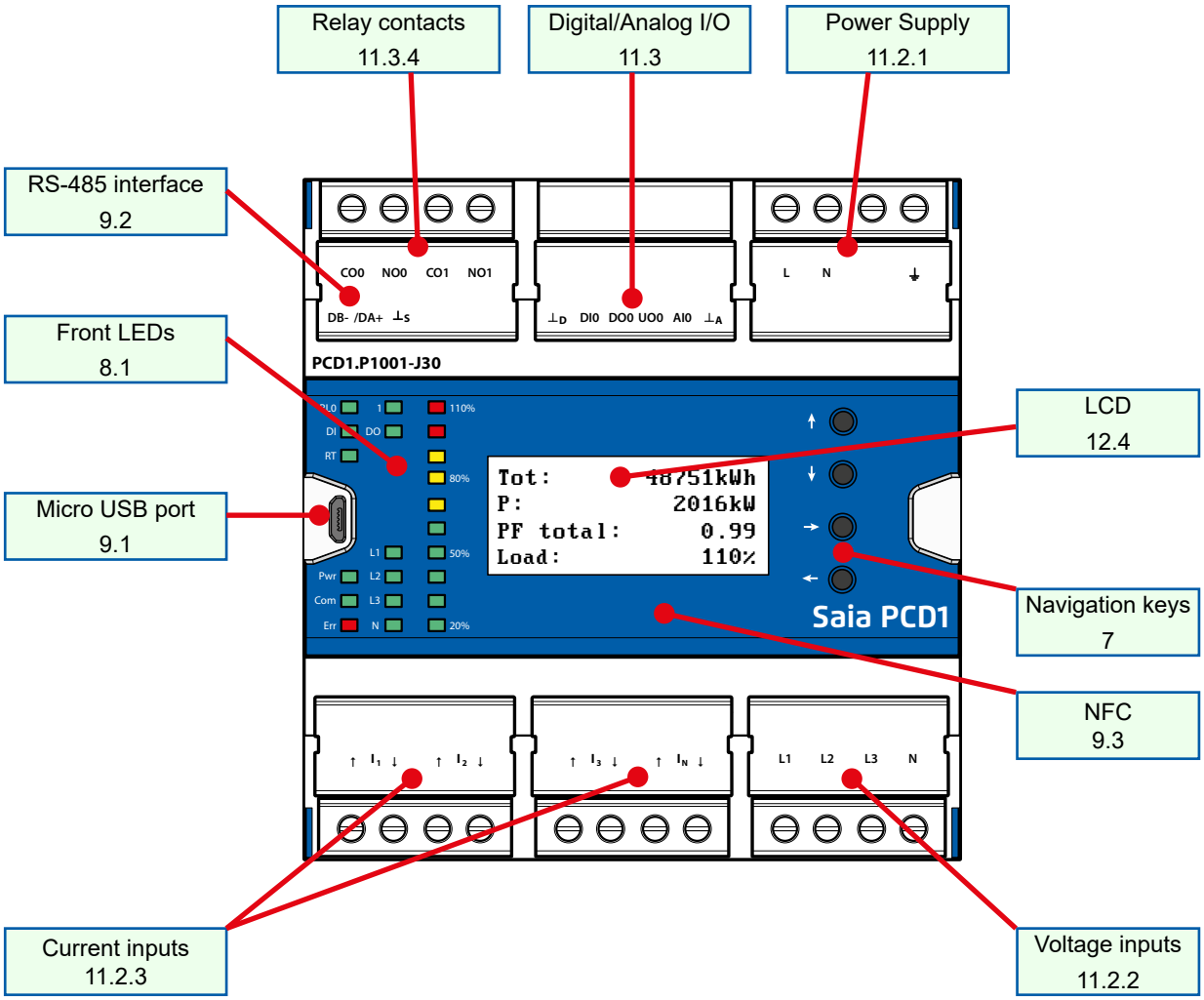
The main features are:

- ► Power analyzer with 0.5% accuracy
- ► Measure the 3 phases and neutral
- ► Current inputs for current transformer connection
- ► Peasurement data storage (Event / cyclic) to internal memory
- ► 1.9 inch LCD display
- ► Galvanically separated measuring inputs
- ► Temperature input
- ► Electrically isolated RS-485 interface for S-Bus / Modbus (switchable)
- ► 105 mm wide DIN rail devices (6 TE)
- ► Digital input/output
- ► Delays

2 Graphical Overview

The graphical overview shows some of the main topics covered in the Operating Manual of the PCD1.P1001-J30.

By clicking on the highlighted components and/or connections, you can jump directly to the corresponding chapter in the document.
The numbers separated by dots indicate the relevant chapter numbers.



3 Norms

Product norm			
EN 61557	Electrical safety in low voltage distribution systems up to 1000 V a.c. and 1500 V d.c. – Equipment for testing, measuring or monitoring of protective measures –		
Part 1:	General requirements		
	Power supply	300 V CAT III, protection class II	
	Measurement inputs	120…240 V CAT II, protection class II	
Part 12:	Performance measuring and monitoring devices Class 0.5		
Electromagnetic compatibility			
EN 61000	Generic standards		
Part 6-3:	Emission standard for residential environments		
	EN55022	Conducted emission	
	EN55022	Radiated emission	
Part 6-2:	Immunity for Industrial environments		
	IEC 61000-4-4	Voltage burst main power circuit	2 kV, direct
		Voltage burst on I/O ports	1 kV, capacitive
	IEC 61000-4-5	Voltage Surge main power circuit	2 kV, 1.2/50 us
		Voltage Surge on I/O ports	1 kV, 1.2/50 us
	IEC 61000-4-2	ESD	8 kV Air 4 kV Contact
	IEC 61000-4-6	Conducted radio frequency	0.15…80 MHz 10 Vrms
	IEC 61000-4-3	Radiated Electromagnetic field	80…2700 MHz 10 V/m

4. Data logging

Data logging is done in the internal memory of the device. There are two different set of logged values:

- cycling logging of pre-defined values
- event logging

Maximal file size is 2 MB, when this value is reached a new file will be generated with a new index.

The CSV files are stored on the internal flash memory and can be accessed with the following procedure:

- Go to menu point “Storage”
- Take menu “mass storage”
- Change to “yes”
- Press right key to activate the mass storage mode
- The LCD backlight is blinking, to signalize that the mass storage is activated and the micro-USB port can be accessed with a normal PC like a memory stick.

	**The device is not measuring while it is in the mass storage mode**

- To deactivate the mass storage mode, change the status on “yes”
- The device will reboot and is ready for measurement

Average: Used by the device to make calculations for the average power

Events: Event logging files (Events logging)

Measure: Data logging files (Cycling data logging)

	**The device is not measuring while it is in the mass storage mode**

4.1 Cycling data logging

Following values will be logged with a cycle time that can be defined by the user:

- Active energy L1, L2 & L3
- Reactive energy L1, L2 & L3
- Active power L1, L2 & L3
- Reactive power L1, L2 & L3
- Max active power sum
- Max reactive power sum
- URMS 1, 2 & 3
- IRMS 1, 2, 3 & N
- Power factor 1, 2 & 3
- THD U1, U2 & U3
- THD I1, I2 & I3
- Frequency
- External temperature
- Active energy sum
- Reactive energy sum
- Apparent energy sum

Data is saved in csv files in a folder named “MEASURE” with a Unix timestamp and local date and time information.

4.1.1 Data structure

Example of file opened in Excel.

Unix Timestamp	Date	Time	Active Energy L1	Active Energy L2	Active Energy L3	Reactive Energy L1	Reactive Energy L2	...
1457076351	04.03.2016	08:25:51	0	0	0	5726.6	4581.28	...
1457076412	04.03.2016	08:26:52	0	0	0	5726.6	4581.28	...
1457076472	04.03.2016	08:27:52	0	0	0	5726.6	4581.28	...
1457076533	04.03.2016	08:28:53	0	0	0	5726.6	4581.28	...
1457076594	04.03.2016	08:29:54	0	0	0	5726.6	4581.28	...
1457076654	04.03.2016	08:30:54	0	0	0	5726.6	4581.28	...
1457076715	04.03.2016	08:31:55	0	0	0	5726.6	4581.28	...

4.2 Events logging

Data is saved in csv files in a folder named “EVENTS” with a Unix timestamp and local date and time information.

4.2.1 Data structure

Example of file opened in Excel.

Unix Timestamp	Date	Time	Event Type	Event ID	Event Name	Value	Duration
1457602286	10.03.2016	10:31:26	START	18	Over THD U1	30.6	0
1457602286	10.03.2016	10:31:26	START	19	Over THD U2	30.9	0
1457602286	10.03.2016	10:31:26	START	20	Over THD U3	32.1	0
1457602287	10.03.2016	10:31:27	END	20	Over THD U3	32.1	1
1457602287	10.03.2016	10:31:27	END	18	Over THD U1	3999.9	1
1457602287	10.03.2016	10:31:27	END	19	Over THD U2	3999.9	1
1457602319	10.03.2016	10:31:59	START	0	SAG U1	24.9	0
1457602319	10.03.2016	10:31:59	START	1	SAG U2	24.8	0
1457602319	10.03.2016	10:31:59	START	2	SAG U3	24.9	0

Events

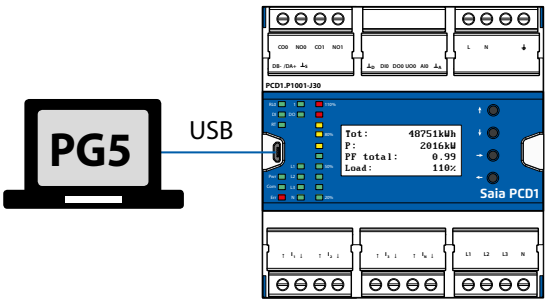
Event ID	Event		Event ID	Event
0	PQA_LOG_EVENT_SAG_U1		20	PQA_LOG_EVENT_THD_U3
1	PQA_LOG_EVENT_SAG_U2		21	PQA_LOG_EVENT_PEAK_I1_1
2	PQA_LOG_EVENT_SAG_U3		22	PQA_LOG_EVENT_PEAK_I1_2
3	PQA_LOG_EVENT_LOW_U1		23	PQA_LOG_EVENT_PEAK_I2_1
4	PQA_LOG_EVENT_LOW_U1		24	PQA_LOG_EVENT_PEAK_I2_2
5	PQA_LOG_EVENT_LOW_U3		25	PQA_LOG_EVENT_PEAK_I3_1
6	PQA_LOG_EVENT_PEAK_U1_1		26	PQA_LOG_EVENT_PEAK_I3_2
7	PQA_LOG_EVENT_PEAK_U1_2		27	PQA_LOG_EVENT_OVER_I1
8	PQA_LOG_EVENT_PEAK_U2_1		28	PQA_LOG_EVENT_OVER_I2
9	PQA_LOG_EVENT_PEAK_U2_2		29	PQA_LOG_EVENT_OVER_I3
10	PQA_LOG_EVENT_PEAK_U3_1		30	PQA_LOG_EVENT_OVER_IN
11	PQA_LOG_EVENT_PEAK_U3_2		31	PQA_LOG_EVENT_THD_I1
12	PQA_LOG_EVENT_SWELL_U1		32	PQA_LOG_EVENT_THD_I2
13	PQA_LOG_EVENT_SWELL_U2		33	PQA_LOG_EVENT_THD_I3
14	PQA_LOG_EVENT_SWELL_U3		34	PQA_LOG_EVENT_TEMP_EXT
15	PQA_LOG_EVENT_OVER_U1		35	PQA_LOG_EVENT_TEMP_INT
16	PQA_LOG_EVENT_OVER_U2		36	PQA_LOG_EVENT_PQA_START
17	PQA_LOG_EVENT_OVER_U3			
18	PQA_LOG_EVENT_THD_U1			
19	PQA_LOG_EVENT_THD_U2			

4.3 Data holding time

Internal memory (1 GB) is big enough to log measurements for years even with a 1 min cyclic log config and events happening every few seconds.

5. Firmware update

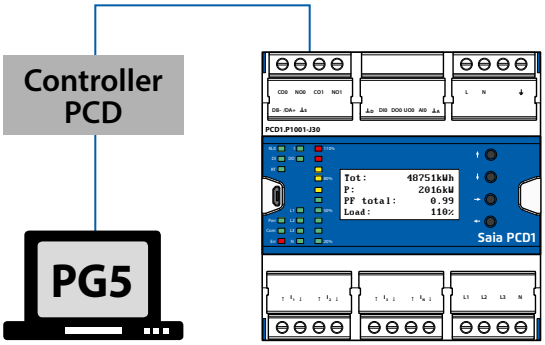
5.1 Over the micro-USB port on the frontplate:



Update direct via USB

The module is updated with Saia PG5® directly via micro-USB.

5.2 Over the RS-485 interface:



Update via a master controller (PCDx.Mxxxx)

The master controller connected to the PQA module uses the RS-485 bus (S-Bus) to load the firmware update on the corresponding modules. Here the master controller is used as a gateway.

If the PCD1.P1001-J30 is configured as Modbus slave, Firmware update is only available through micro-USB port! To load a new Firmware into the PQA we offer a free “FW Downloader” available on the sbc support page in the free “Service Online Tools for PG5”:

https://www.sbc-support.com/en/product-index/pg5-controls-suite/pg5-22-suite/parts-of-pg5-22-suite/

6. Technical data

6.1 Accuracy

6.1.1 Voltage and current accuracy according to IEC61557-12

Value	Range	Tolerance
Voltage	20% Vn ≤ V < Vmax	± 0.5%
Current	10% In ≤ V < Vmax	± 0.5%

6.1.2 Active power and energy accuracy according IEC61557-12

Current value	Power factor	Tolerance
1% In ≤ I < 5% In	1	± 1 %
5% In ≤ I < Imax	1	± 0.5 %
2% In ≤ I 10% In	0.5 inductive	± 1 %
	0.8 capacitive	± 1 %
10% In ≤ I < Imax	0.5 inductive	± 0.6 %
	0.8 capacitive	± 0.6 %

6.1.3 Reactive power and energy accuracy according IEC61557-12

Current value	Sinus phi (inductive/capacitive)	Tolerance
2% In ≤ I < 5% In	1	± 1.25 %
5% In ≤ I < Imax	1	± 1 %
2% In ≤ I 10% In	0.5 inductive	± 1.25 %
10% In ≤ I < Imax	0.5 inductive	± 1 %
10% In ≤ I < Imax	0.25	± 1.25 %

6.1.4 Apparent power and energy accuracy according IEC61557-12

Current value	Tolerance
2% In ≤ I < 5% In	± 1 %
5% In ≤ I < Imax	± 0.5 %

6.1.5 Harmonics and THD accuracy

Value	Tolerance
Voltage harmonics	± 5 %
Current harmonics	± 5 %
THD (0% - 20%)	± 0.6 %
TDD (0% - 100%)	± 0.6 %

6.1.6 Frequency and angles

Value	Tolerance
Frequency	± 0.5 %
Phase angles	± 0.5 %

6.1.7 Power factor and cos Phi

Value	Tolerance
Power factor	± 0.05 %
Phase angles	± 0.05 %

6.1.8 Temperature accuracy

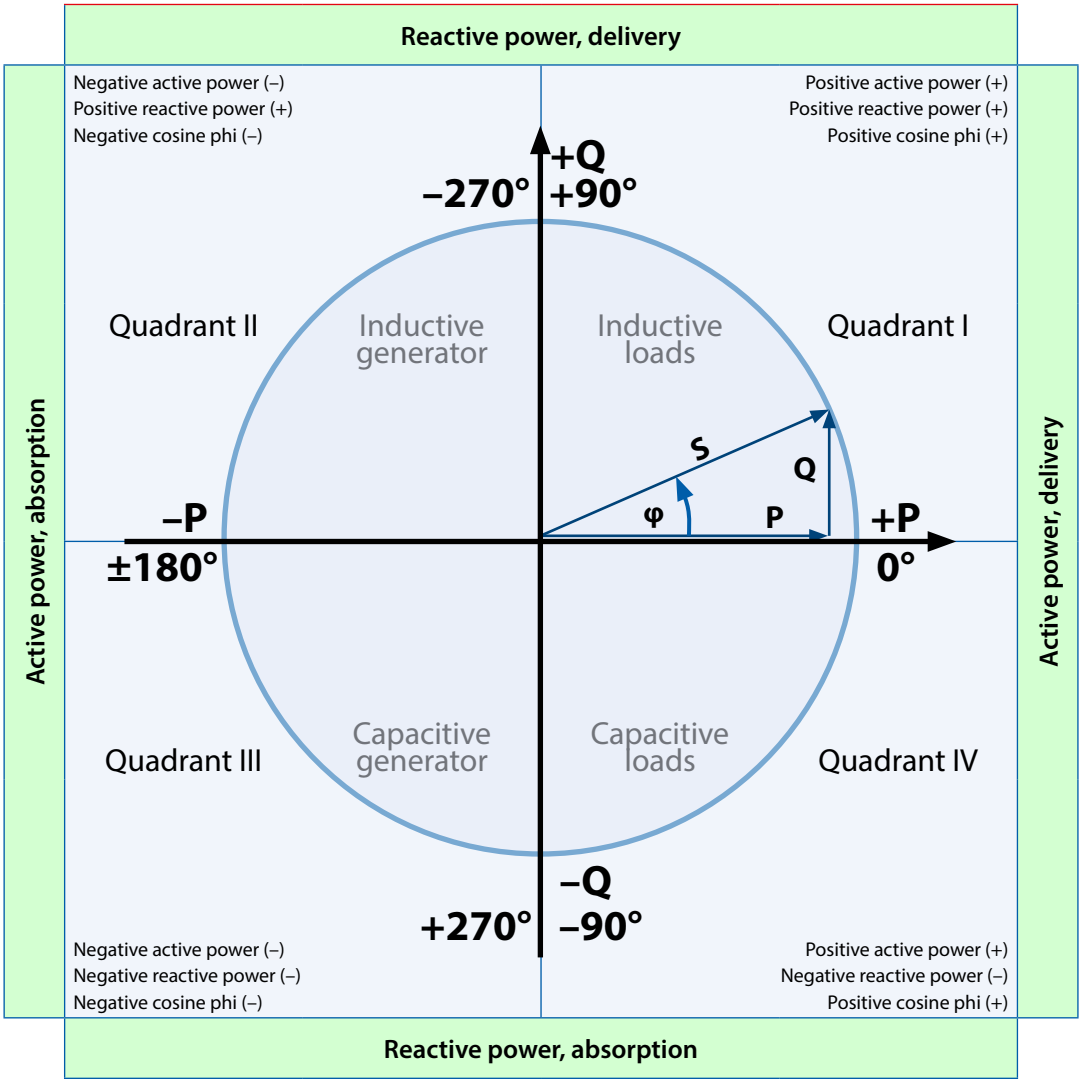
Value	Tolerance	
Internal temperature	± 5 %	
External temperature	± 1 °C	–50 °C ≤ … ≤ +400 °C

6.1.9 Refresh time

Measure	Max. refresh time
Voltage	330 ms
Current	330 ms
Power	330 ms
Energy	330 ms
Power factor	330 ms
Cos Phi, Cos φ	330 ms
Frequency	330 ms
Phase angles	330 ms
THD/TDD	330 ms
Harmonics	6 s
Neutral current mismatch	12 s

6.2 Energy measurement 4 quadrant

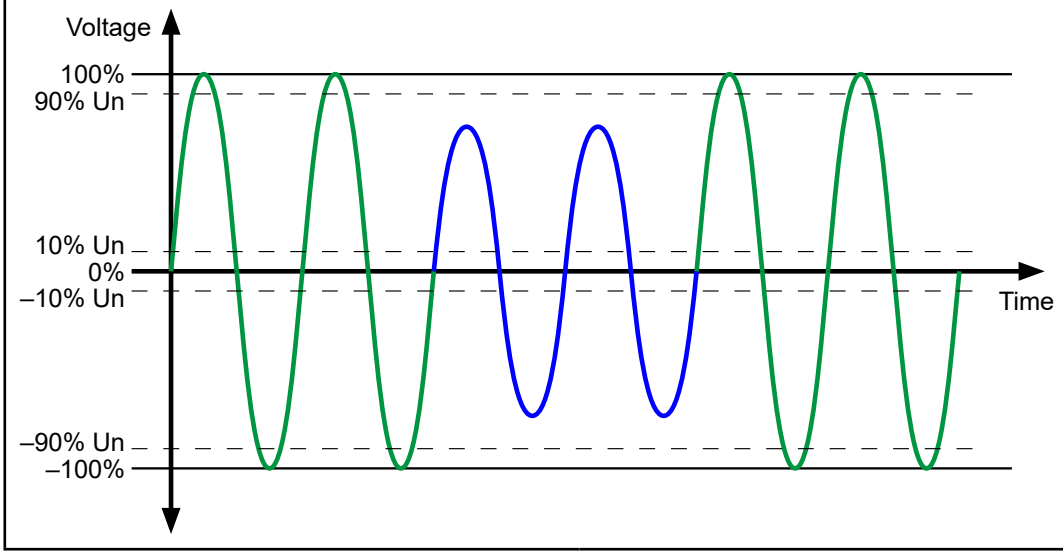
The PQA can measure in all 4 quadrants. To understand if the charge is capacitive or inductive the following diagram shows the energy directions/flows. The signs of the power measurements give the indication in which quadrant the energy flows.



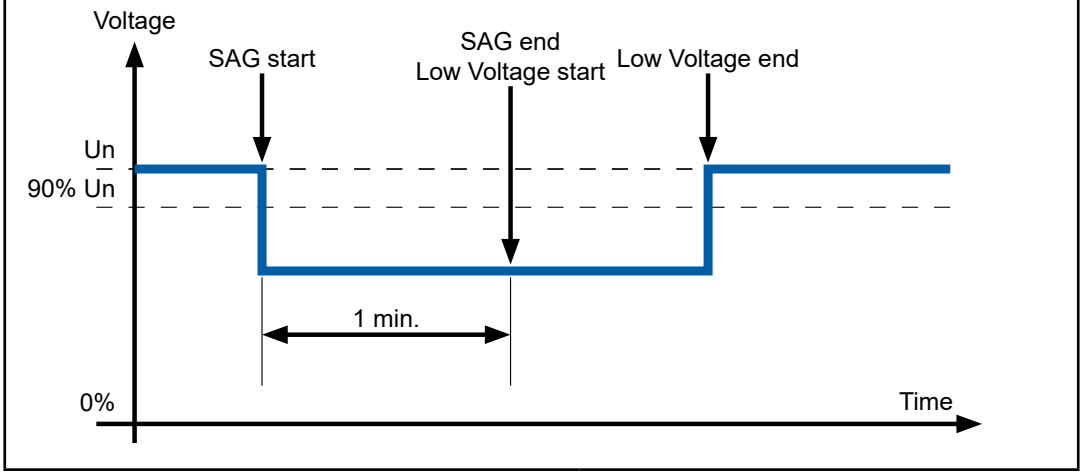
6.3 Events

The PCD1.P1001 device has a detection for the following events:

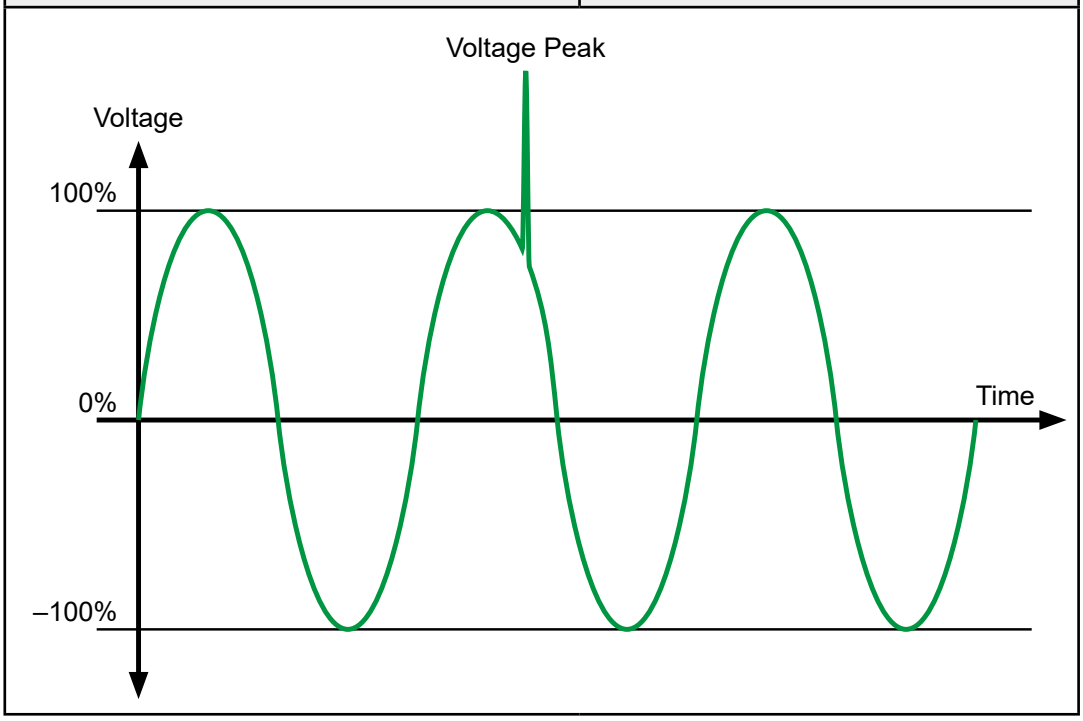
SAG/DIP	Bits in event register (SBUS 77 / Modbus 154)
A voltage sag (U.S.) or voltage dip (British) is a short duration reduction in RMS voltage which can be caused by a short circuit, overload or starting of electric motors. A voltage sag happens when the rms voltage decreases between 10 and 90 percent of nominal voltage for one-half cycle to one minute.	0 SAG U1 event 1 SAG U2 event 2 SAG U3 event



Low Voltage	
A Sag ends after one minute, after this time it becomes a low voltage.	3 Low-voltage U1 event 4 Low-voltage U2 event 5 Low-voltage U3 event



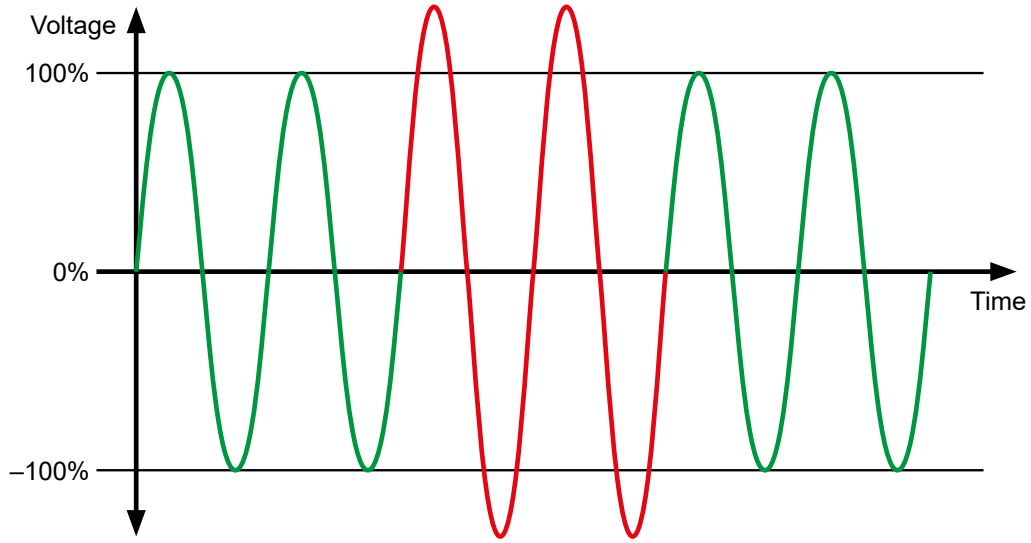
Voltage Peak	
A voltage peak is a extremely short over-voltage like an ESD or Surge. Minimal detection time of the PQA is 125 us (8 kHz) If the RMS voltage reaches the peak threshold level, peak events are ignored to avoid continuous writes to the events log file	6 Peak U1 event 7 Peak U2 event 8 Peak U3 event



SWELL Voltage

A voltage swells is defined as a rise in rms voltage which is between 10 and 80 percent for a limited period between 0.5 cycles to 1 minute.

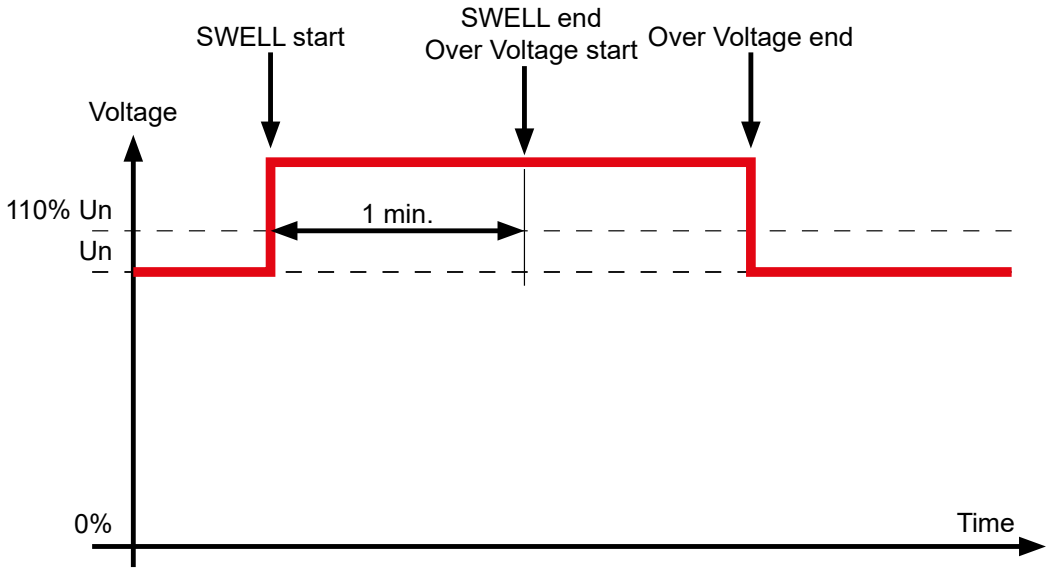
9	SWELL U1 event
10	SWELL U2 event
11	SWELL U3 event



Overvoltage

A Swell ends after one minute, after this time it becomes an over voltage.

12	Over-voltage U1 event
13	Over-voltage U2 event
14	Over-voltage U3 event

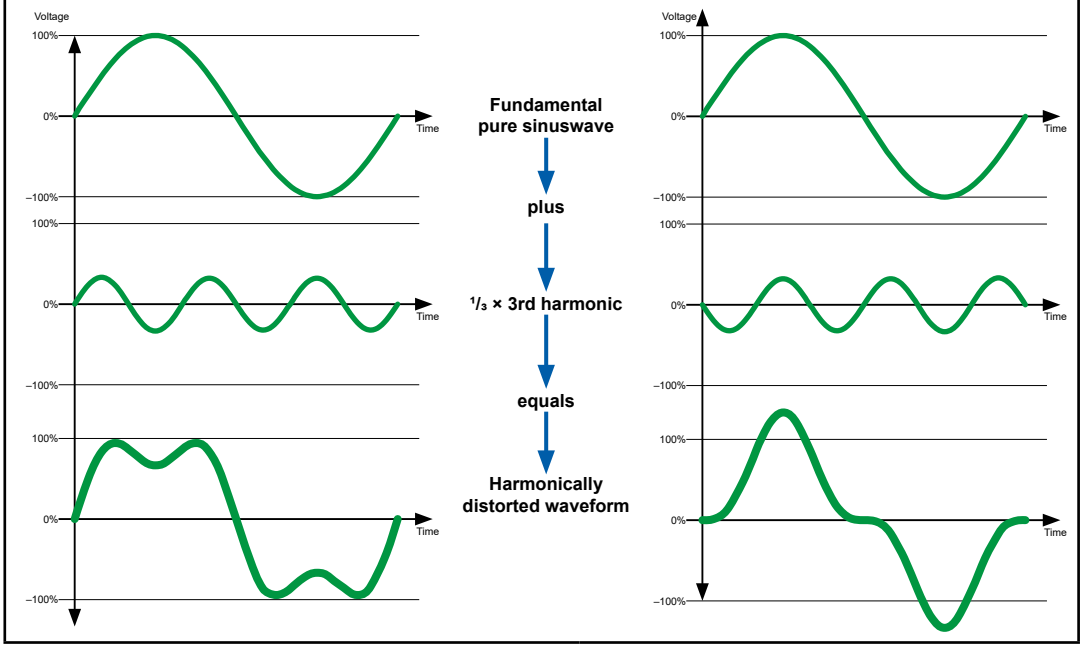


Voltage THD

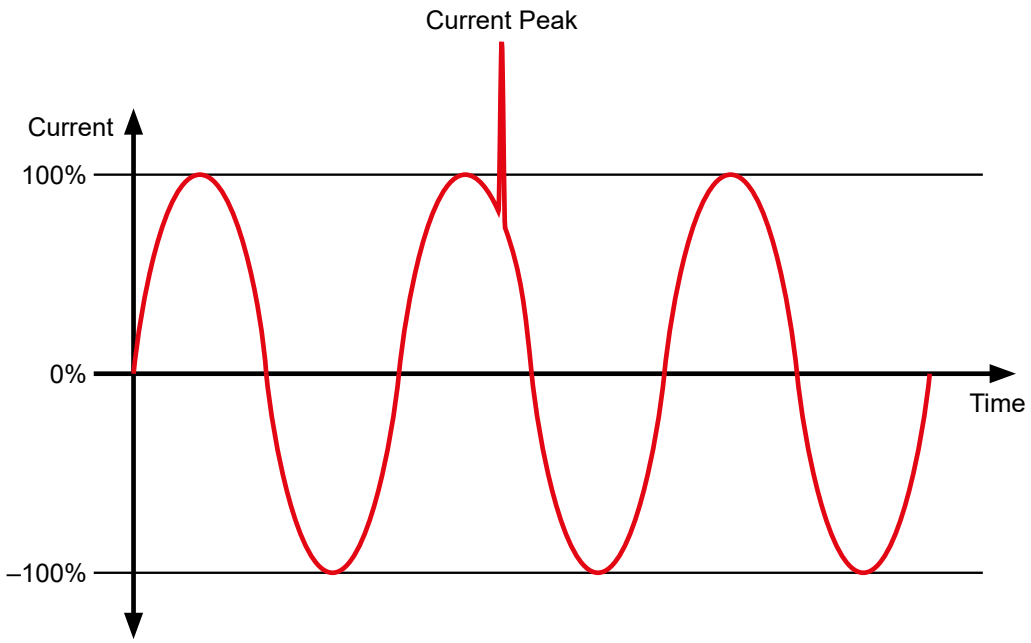
Voltage waveforms with a non-sinusoidal shape corresponds to the sum of different sine-waves with different magnitude and phase, having frequencies that are multiples of power-system frequency (harmonics).

THD (Total Harmonic Distortion) is the percent ratio of the sum of the powers of all harmonic components to the power of the fundamental frequency

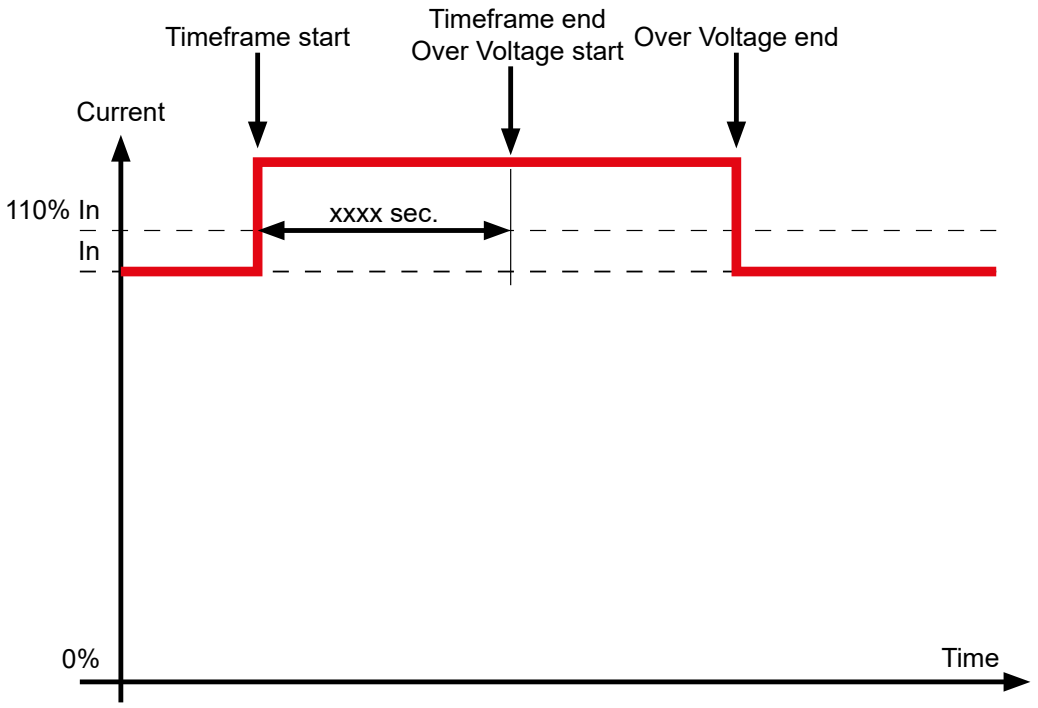
15	Over-THD U1 event
16	Over-THD U2 event
17	Over-THD U3 event



Current Peak	
A current peak is extremely short overcurrent and comes from switching of loads. Minimal detection time of the PQA is 125 us (8 kHz). If the RMS current reaches the peak threshold level, peak evens are ignored to avoid continuous writes to the event log file.	18 Peak I1 event 19 Peak I2 event 20 Peak I3 event

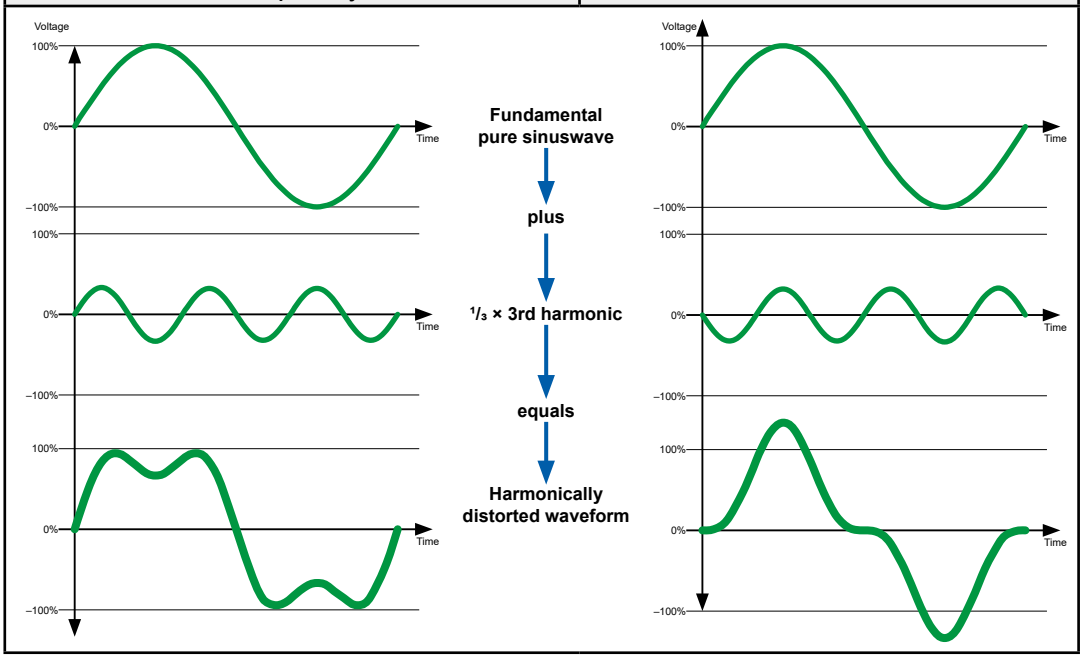


Overcurrent		
Overcurrent into the connector, which is specified for 1 A/5 A. timeframe of xxxx seconds.	21	Over-current I1 event
	22	Over-current I2 event
	23	Over-current I3 event
	24	Over-current IN event



6

Current THD	
Voltage or current waveforms with a non-siVoltage waveforms with a non-sinusoidal shape corresponds to the sum of different sine-waves with different magnitude and phase, having frequencies that are multi-ples of power-system frequency (harmon-ics). THD (Total Harmonic Distortion) is the percent ratio of the sum of the powers of all harmonic components to the power of the fundamental frequency.	25 Over-THD I1 event 26 Over-THD I2 event 27 Over-THD I3 event



Temperature	
Temperature sensor value of internal or external is to high, relative to the thresh-old.	28 Over-temp. Sensor event 29 Over-temp. Internal event

Ongoing event	
This bit is det to 1 as long as an event is still ongoing	30 Ongoing event

7. Menu structure

User can navigate through the menu with the four keys on the front.

Key functions:

↑ Navigate up or in home screen switch to next screen

↓ Navigate down or in home screen switch to previous screen

➔ Enter menu or validate input or in home screen enter Main menu

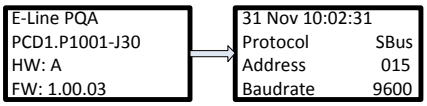
← Exit menu or back key

To help with the navigation in the different menus a scroll bar on the right of the display shows where the actual selection is compared to the whole menu.

User can access multiple data and measurement (energy, voltage, current, power, power factor & frequency, harmonics, temperature and also events related to those measurements).

Events can be cleared per category or all together (note that when clearing an event it disappears from the LCD and the linked LED becomes green until next event but the event logged in the memory card remains)

At power on the following two screens are displayed:

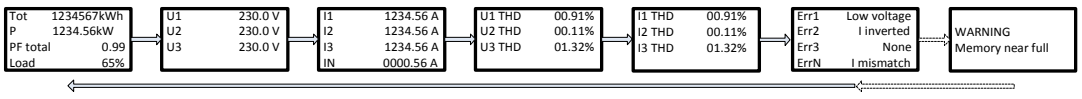


7.1 Home screen

The home screen is composed of 6 different screens. Plus, if applicable, a warning screen about memory being nearly full.

The different screens are looped with a holding time that can be configured in the System setup menu.

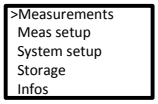
Information showed in those screens is as follow:



7.2 Main menu

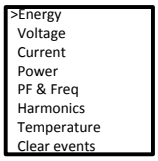
Main menu gives the access to all measurements (including events), device configuration (including event detection threshold) and diverse informations about the PQA.

It is organized as follows:



7.3 Measurements

This menu gives access to all measurement done by the PQA and also the possibility to clear all events at once.

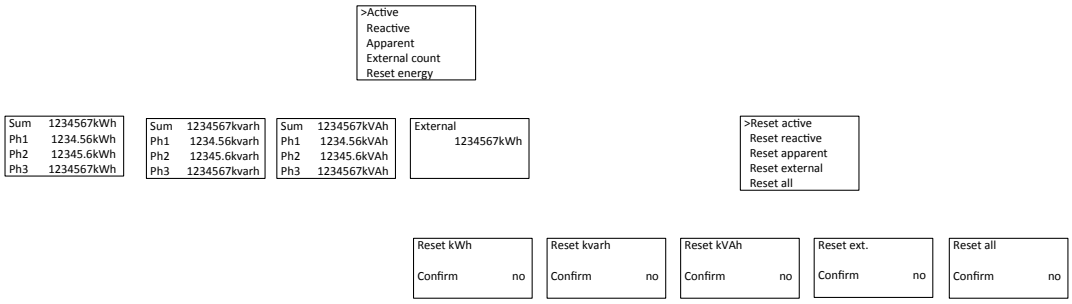


7.3.1 Energy

Here are the active, reactive and apparent accumulated energies (individual phases and phases sum).

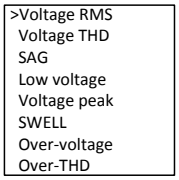
Also the external counted energy (digital input needs to be configured as pulse counter) is shown here.

All accumulated energies can be reset form this menu too.



7.3.2 Voltage

Here is the access to all voltage measurements as follows.

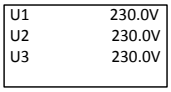


Voltage RMS and Voltage THD are “real time” readings.

The other measurements are events only occurring if the value measured goes beyond the threshold configured in the Meas setup menu.

7.3.2.1 Voltage RMS

Shows RMS voltage for the three phases.



Voltage measurement with different wiring configurations:

4 wire Star:

U1 = voltage between L1 & N

U2 = voltage between L2 & N

U3 = voltage between L3 & N

4 wire Delta:

U1 = voltage between L1 & N

U2 = voltage between L2 & N

U3 = voltage between L3 & N

3 wire Delta:

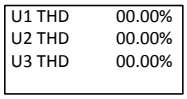
U1 = voltage between L1 & L2

U2 = voltage between L2 & L3

U3 = voltage between L3 & L1

7.3.2.2 Voltage THD

Total harmonic distortion of the voltage inputs

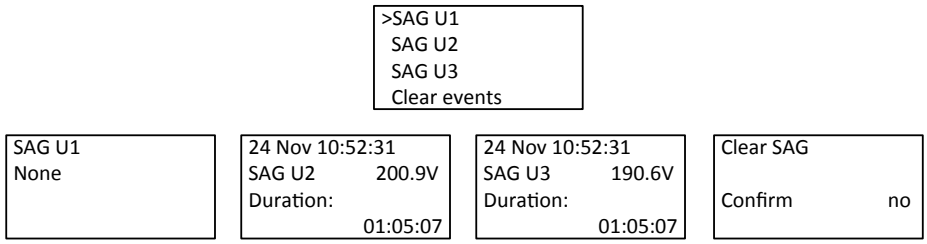


7.3.2.3 SAG

If SAGs happened they will be showed here, if not “None” will be displayed.

SAG information provided: Start date and time, lowest amplitude during the SAG and duration. In case of multiple events, only last one will appear here.

User can clear all SAG events from this menu.

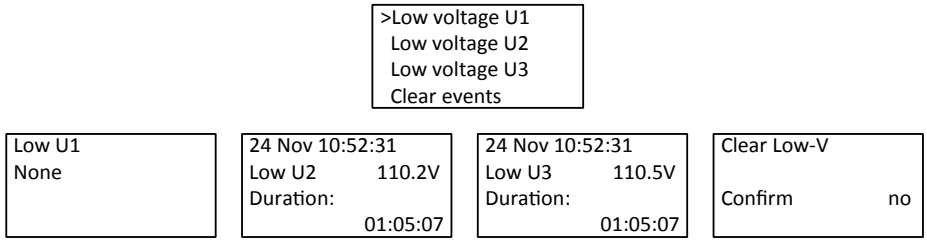


7.3.2.4 Low voltage

If voltage peaks events are detected they will de displayed here, if not “None” will be displayed.

Event information provided: Start date and time, lowest amplitude during the low voltage event and duration. In case of multiple events, only last one will appear here.

User can clear all low voltage events from this menu.

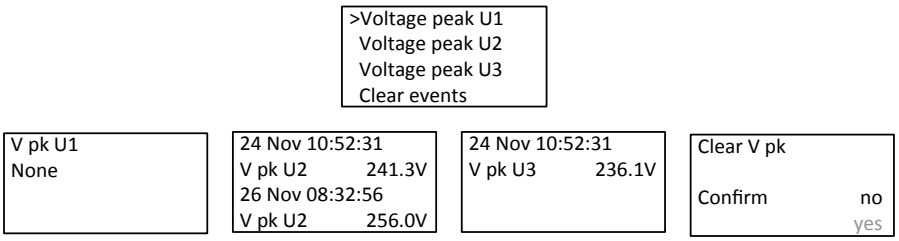


7.3.2.5 Voltage peak

If voltage peaks events are detected they will de displayed here, if not “None” will be displayed.

Event information provided: Event date, time and amplitude. In case of multiple events, only last two will appear here.

User can clear all voltage peak events from this menu.

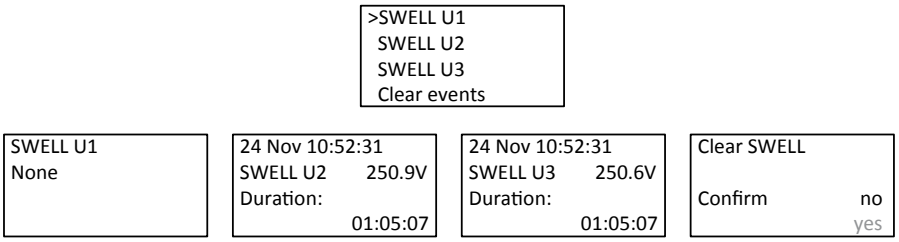


7.3.2.6 SWELL

If SWELLs happened they will be showed here, if not “None” will be displayed.

SWELL information provided: Start date and time, highest amplitude during the SWELL and duration. In case of multiple events, only last one will appear here.

User can clear all SWELL events from this menu.

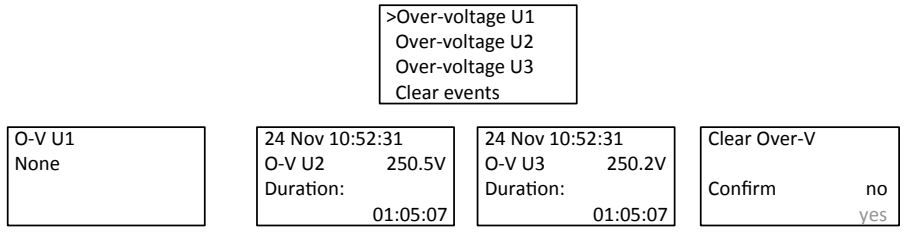


7.3.2.7 Over-voltage

If Over-voltage events happened they will be showed here, if not “None” will be displayed.

Over-voltage information provided: Start date and time, highest amplitude during the Over-voltage and duration. In case of multiple events, only last one will appear here.

User can clear all Over-voltage events from this menu.

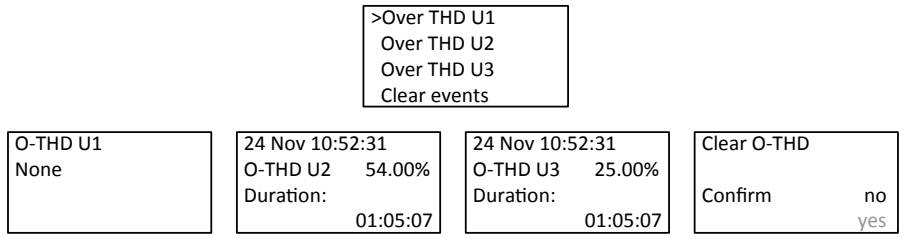


7.3.2.8 Over-THD

If Over-THD events happened they will be showed here, if not “None” will be displayed.

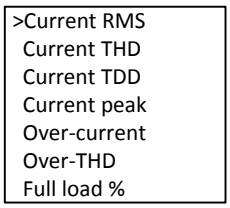
Over-THD information provided: Start date and time, highest distortion during the Over-THD and duration. In case of multiple events, only last one will appear here.

User can clear all Over-THD events from this menu.



7.3.3 Current

Here is the access to all current measurements as follows.

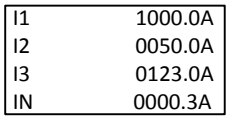


Current RMS, current THD, current TDD and Full load % are “real time” readings.

The other measurements are events only occurring if the value measured goes beyond the threshold configured in the Meas setup menu.

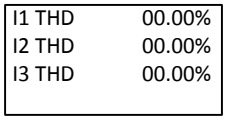
7.3.3.1 Current RMS

Shows RMS current for the three phases.



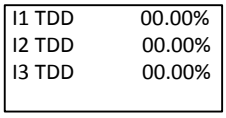
7.3.3.2 Current THD

Total harmonic distortion of the current inputs



7.3.3.3 Current TDD

Total demand distortion of the current inputs

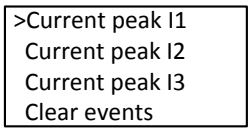


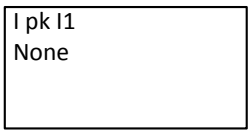
7.3.3.4 Current peak

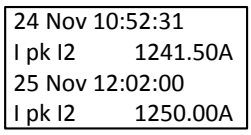
If current peak events are detected they will de displayed here, if not “None” will be displayed.

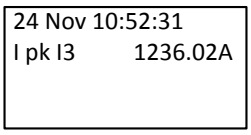
Event information provided: Event date, time and amplitude. In case of multiple events, only last two will appear here.

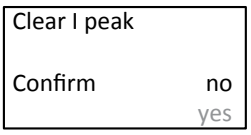
User can clear all current peak events from this menu.











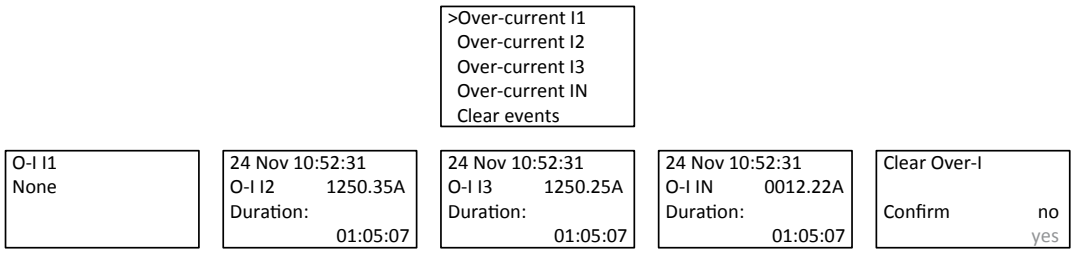
7.3.3.5 Over-current

If Over-current events happened they will be showed here, if not “None” will be displayed.

Over-current information provided: Start date and time, highest amplitude during the Over-current and duration. In case of multiple events, only last one will appear here.

Note that this menu gives also access to the over-current events on the neutral line if the device has been configured to measure it.

User can clear all Over-current events from this menu.

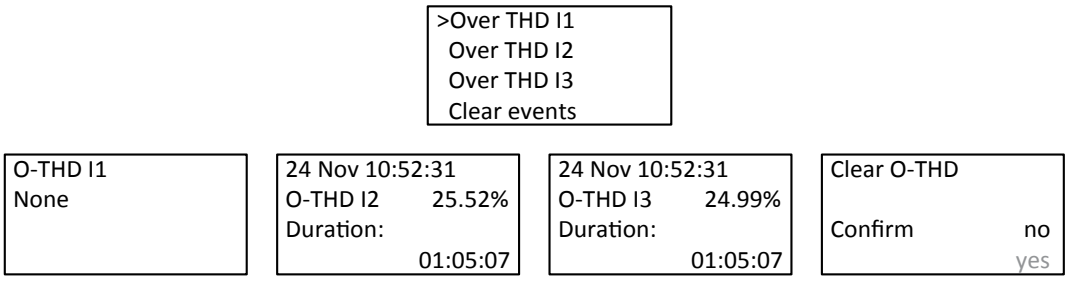


7.3.3.6 Over-THD

If Over-THD events happened they will be showed here, if not “None” will be displayed.

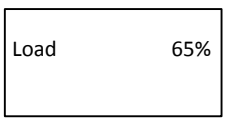
Over-THD information provided: Start date and time, highest distortion during the Over-THD and duration. In case of multiple events, only last one will appear here.

User can clear all Over-THD events from this menu.



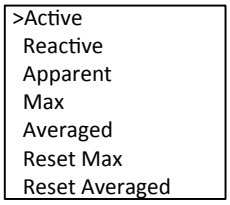
7.3.3.7 Full load %

Load in % of the current inputs (total of the three phases)



7.3.4 Power

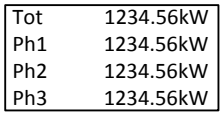
Here is the access to all power measurements as follows.



Averaging window can be changed in Meas setup menu (default is 15 min).

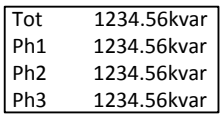
7.3.4.1 Active power

Shows the active power per phase and the sum of the three phases.



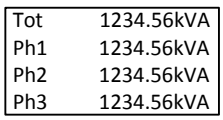
7.3.4.2 Reactive power

Shows the reactive power per phase and the sum of the three phases.



7.3.4.3 Apparent power

Shows the apparent power per phase and the sum of the three phases.



7.3.4.4 Max power

Shows the maximal value (of the sum of the three phases) for the active, reactive and apparent powers. This is the maximal value measured by the device since last Max reset.

Power sum max	
Act	5234.56kW
Ract	6234.56kvar
App	2234.56kVA

7.3.4.5 Averaged power

Shows the averaged value (of the sum of the three phases) for the active, reactive and apparent powers. The averaging window can be configured in Meas setup menu (default is 15 min). Measurement is only updated at the end of the averaging window.

Power sum avg	
Act	1234.56kW
Ract	1234.56kvar
App	1234.56kVA

7.3.4.6 Reset Max

User can reset the Max power measurement here.

Reset max	
Confirm	no

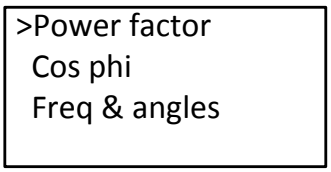
7.3.4.7 Reset Averaged

User can reset the averaged power measurement here.

Reset avg	
Confirm	no

7.3.5 PF & Freq

Here is the access to power factor measurements, cos phi, line frequency and phases angles.



Tot PF	0.941
PF1	0.993
PF2	0.900
PF3	0.959

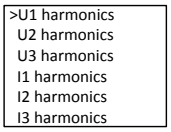
Tot cos phi	0.940
Cos phi 1	0.996
Cos phi 2	0.905
Cos phi 3	0.954

Freq	50.00Hz
Angle 1-2	120,1°
Angle 2-3	119.9°
Angle 1-3	240.0°

7

7.3.6 Harmonics

User can access here the harmonics measurements for every phase voltage or current.



H0 U1	98.5%
H1 U1	01.0%
H2 U1	00.5%
H3 U1	00.0%
...	
H8 U1	00.0%
H9 U1	00.0%
H10 U1	00.0%
H11 U1	00.0%
...	
H40 U1	00.0%

H0 U2	98.5%
H1 U2	01.0%
H2 U2	00.5%
H3 U2	00.0%
...	
H8 U2	00.0%
H9 U2	00.0%
H10 U2	00.0%
H11 U2	00.0%
...	
H40 U2	00.0%

H0 U3	98.5%
H1 U3	01.0%
H2 U3	00.5%
H3 U3	00.0%
...	
H8 U3	00.0%
H9 U3	00.0%
H10 U3	00.0%
H11 U3	00.0%
...	
H40 U3	00.0%

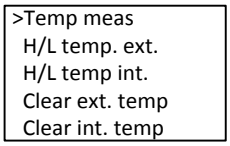
H0 I1	98.5%
H1 I1	01.0%
H2 I1	00.5%
H3 I1	00.0%
...	
H8 I1	00.0%
H9 I1	00.0%
H10 I1	00.0%
H11 I1	00.0%
...	
H40 I1	00.0%

H0 I2	98.5%
H1 I2	01.0%
H2 I2	00.5%
H3 I2	00.0%
...	
H8 I2	00.0%
H9 I2	00.0%
H10 I2	00.0%
H11 I2	00.0%
...	
H40 I2	00.0%

H0 I3	98.5%
H1 I3	01.0%
H2 I3	00.5%
H3 I3	00.0%
...	
H8 I3	00.0%
H9 I3	00.0%
H10 I3	00.0%
H11 I3	00.0%
...	
H40 I3	00.0%

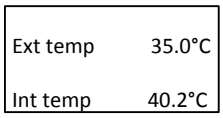
7.3.7 Temperature

Here is the access to all temperature measurements.



7.3.7.1 Temp meas

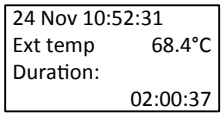
Shows both actual temperature values (external and internal).



7.3.7.2 H/L temp ext.

If H/L temperature external events happened they will be showed here, if not “None” will be displayed.

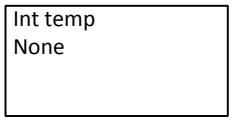
Event information provided: Start date and time, highest value during the event and duration. In case of multiple events, only last one will appear here.



7.3.7.3 H/L temp int.

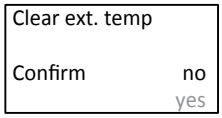
If H/L temperature internal events happened they will be showed here, if not “None” will be displayed.

Event information provided: Start date and time, highest value during the event and duration. In case of multiple events, only last one will appear here.



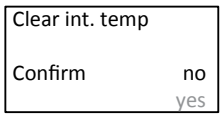
7.3.7.4 Clear ext. temp

User can clear the H/L temp ext. event here



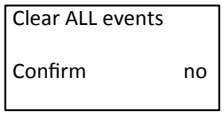
7.3.7.5 Clear int. temp

User can clear the H/L temp int. event here



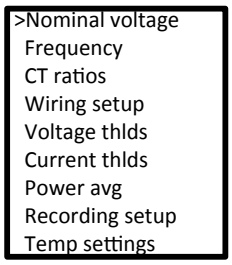
7.3.8 Clear events

User can clear ALL events at the same time in this menu



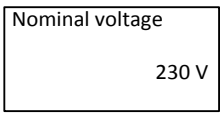
7.4 Measurement setup

This menu gives access to all measurement configuration.



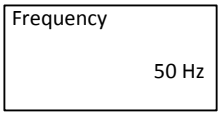
7.4.1 Nominal voltage

Nominal voltage can be chosen between 230 and 110 VAC



7.4.2 Frequency

Nominal frequency can be chosen between 50 and 60 Hz



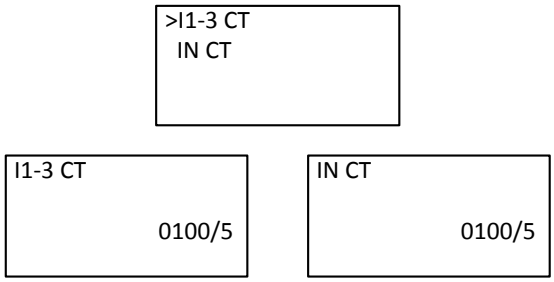
7.4.3 Current transformers ratio

User can select which external current transformers he wants to use with the PQA.

Primary current can be chosen from 5 to 6000 A with steps of 1 A

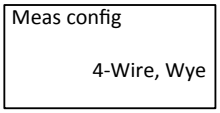
Secondary current can be either 5 or 1 A

Phases and Neutral CTs can be chosen independently.



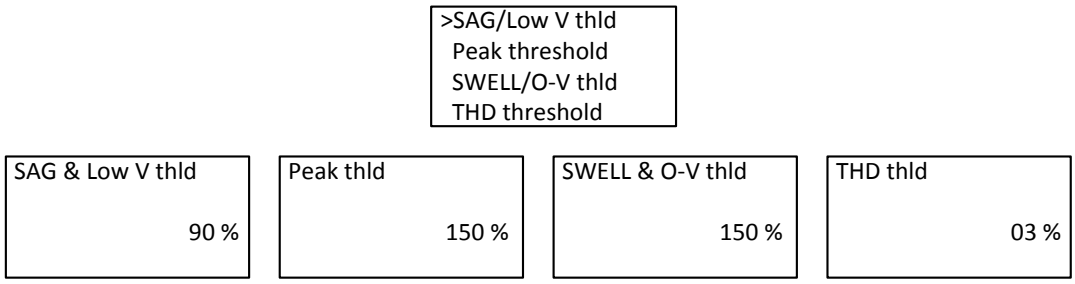
7.4.4 Wiring setup

The wiring of the device must be chosen in this menu between 4 wires star (Wye) with or without neutral current measurement, 3 wire delta or 4 wire delta.



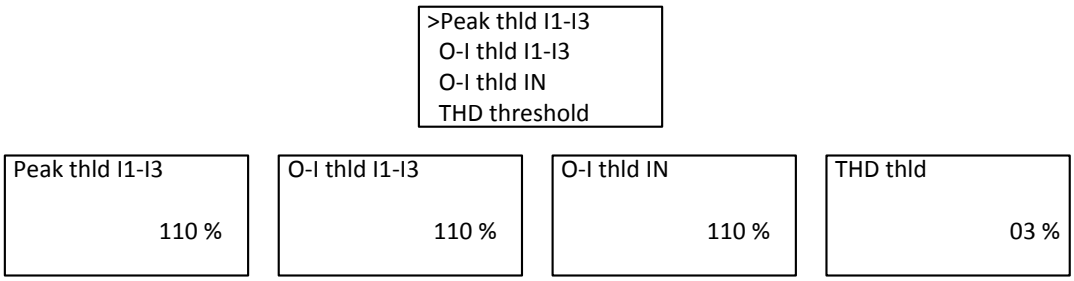
7.4.5 Voltage thresholds

Thresholds for SAGs & low voltage, voltage peaks, SWELLs & over-voltage and voltage THDs can be configured here.



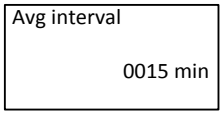
7.4.6 Current thresholds

Thresholds for current peaks, over-currents and current THDs can be configured here.



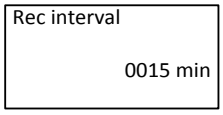
7.4.7 Power averaging

User can configure the averaging window for the power calculations from 1 to 1440 min.



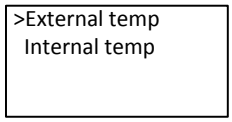
7.4.8 Recording setup

User can configure the cyclic recording interval from 1 to 1440 min.



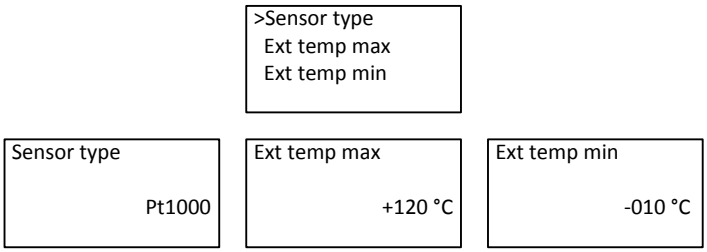
7.4.9 Temperature settings

Access to external and internal temperature measurement settings



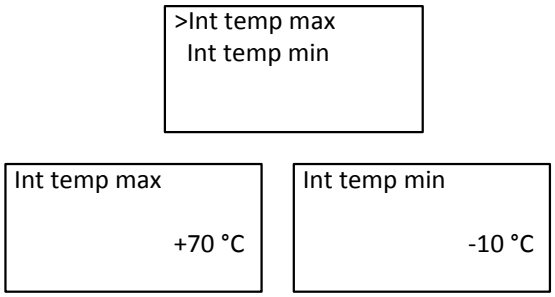
7.4.9.1 External temperature

User can choose which sensor is used (Pt1000 or Ni1000) and also the threshold detection for high and low temperatures.



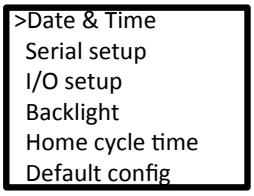
7.4.9.2 Internal temperature

User can configure the threshold detection for high and low temperatures.



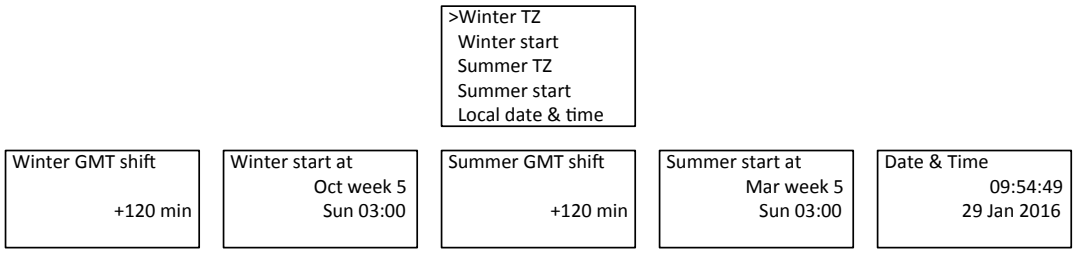
7.5 System setup

Through this menu can system configurations been made and for exempl Date & time, LCD behavior or reset to default config.



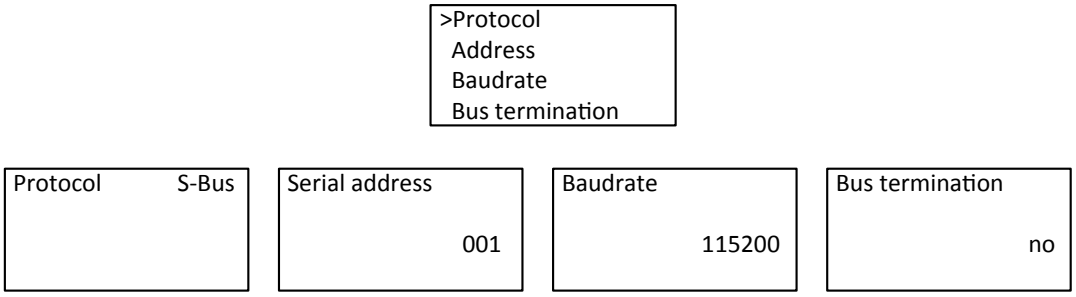
7.5.1 Date & time

Here is the configuration of the date and time with the time zone offsets.



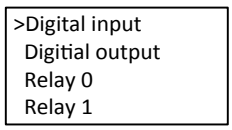
7.5.2 Serial setup

User can choose between S-Bus or Modbus, serial address, baudrate, bus termination state.



7.5.3 I/O setup

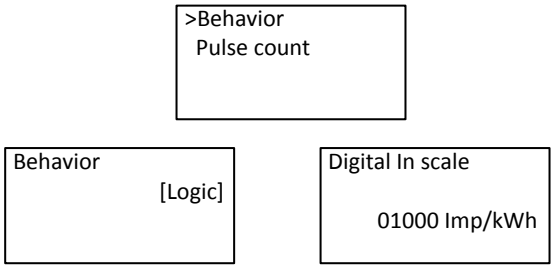
User can configure I/Os behavior, default state and triggers.



7.5.3.1 Digital input

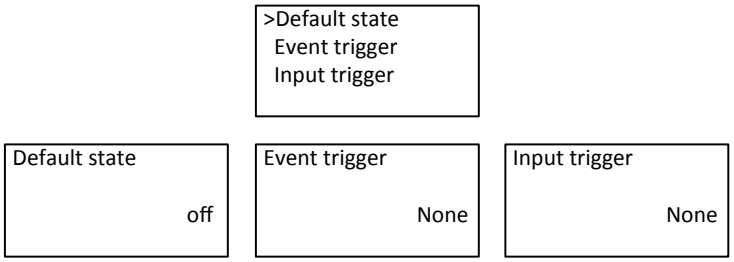
Digital input can be select as pulse count or as input triggered by an event (logic)

If selected as pulse count the ratio can be chosen from 100 to 10000 imp/kWh



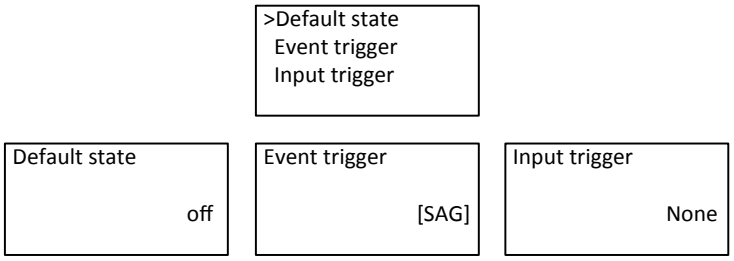
7.5.3.2 Digital output

Default state, event trigger and input trigger (L1-L3) can be configured.



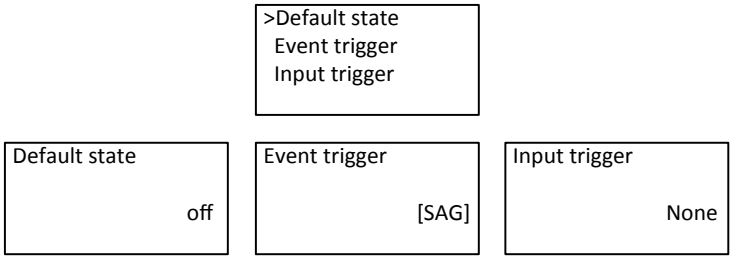
7.5.3.3 Relay 0

Default state, event trigger and input trigger (L1-L3) can be configured.



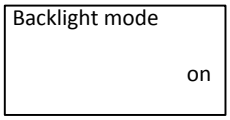
7.5.3.4 Relay 1

Default state, event trigger and input trigger (L1-L3) can be configured.



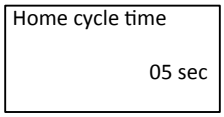
7.5.4 Backlight

Backlight behavior can be: ON, OFF or Auto (on when switches pressed and off after a 20 seconds).



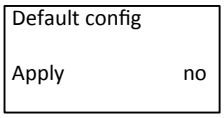
7.5.5 Home cycle time

Cycling time for the home screen (8.1) can be chosen from 2 to 10 seconds.



7.5.6 Default config

Reset all configuration to default state



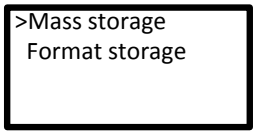
7.6 Storage

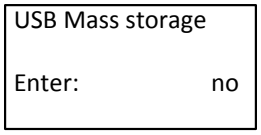
User can enter in mass storage mode or format the internal memory

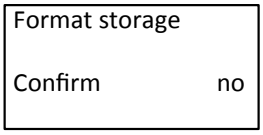
In mass storage mode the backlight is blinking and data can be retrieved though the front USB, connecting the PQA to a computer with an micro-USB cable.

Once the data is copied the user has to exit the mass storage mode.

In mass storage mode no measurements are performed by the device.

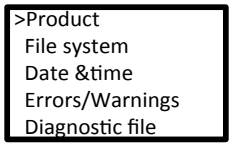




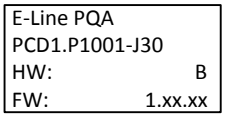


7.7 Info

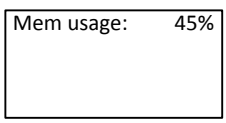
Diverse information as for example file system status or errors and warnings can be accessed though this menu. User can also generate a diagnostic file in case of problems.



7.7.1 Product

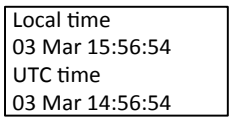


7.7.2 File system



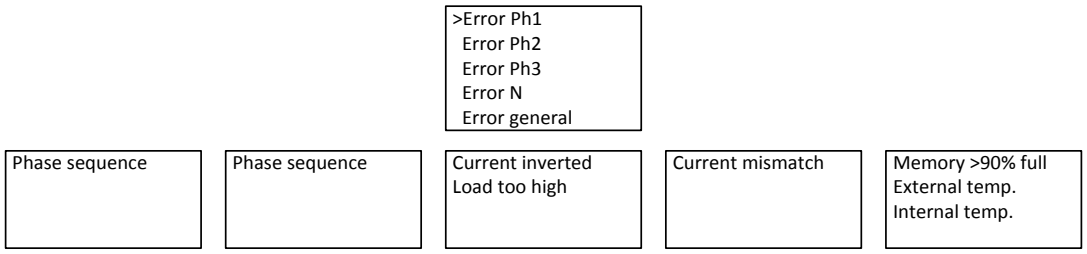
7.7.3 Date & time

Local time and UTC time



7.7.4 Errors/Warnings

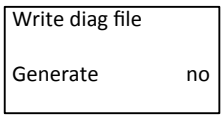
User can access different errors and warnings related to the measurement or the device state (following picture is an example).



Error warnings that can be displayed are:

Wrong phase sequence, current direction, Over-load, current mismatch also warnings about the temperature measurement and the internal memory being nearly full.

7.7.5 Diagnostic file

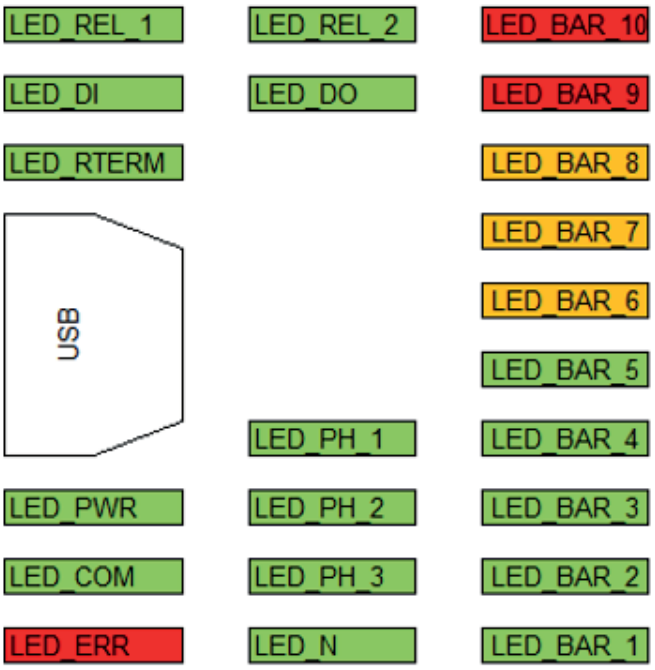


The Diagnostic file contains helpful information about the status of the PQA for the SBC support Team.

8. LED behavior

LEDs on the front give diverse information on the device state (I/Os, measurements, communication…)

8.1. LED function



Terminator (RT):	Is the active bus termination ON or OFF
Relay 0 (RL0):	State of the first relay (open / closed)
Relay 1 (RL1):	State of the second relay (open / closed)
Digital in (DI):	State of the digital in (high / low)
Digital out (DO):	State of the digital out (high / low)
Ph1 (L1):	General status of Ph1 (OK / not OK / alarm)
Ph2 (L2):	General status of Ph2 (OK / not OK / alarm)
Ph3 (L3):	General status of Ph3 (OK / not OK / alarm)
N (N):	General status of N (OK / not OK / alarm)
Power (Pwr):	Power supply PQA OK
Comm (Com):	Active communication
Error (Err):	PQA general error
Bar graph:	Showing the load in percent (each LED 10%) vs maximum value calculated with the selected current transformers.

8.1.1 Ph1-3 & N LED behavior

8.1.1.1 Ph1-3:

Green: everything OK

Orange: event has occurred
(SAG, Low voltage, voltage peak, SWELL, over-voltage, voltage over-THD, current peak, over-current or current over-THD)

Red: error (Phase seq, current direction, Over-load or event ongoing)

Off: Not connected

8.1.1.2 N:

Green: everything OK

Orange: event has occurred (Over-current)

Red: error (current mismatch or event ongoing)

OFF: No phase voltage connected

9. Communication

9.1 USB Communication

This interface supports S-Bus, it allows firmware and booter update with PG5.

End user can choose to switch to mass storage to read the contents of the SD card (logged data). How to enter and exit the mass storage mode is described in the menu navigation.

Protocols	S-Bus
Address	1-247 (same as RS-485)

9.2 RS-485 Communication

This interface supports S-Bus and Modbus (it allows firmware and booter update with PG5 (only S-Bus)).

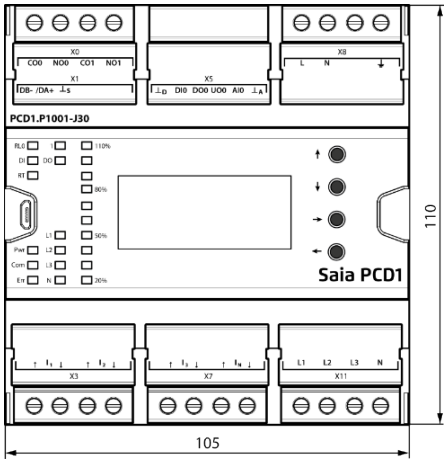
Baudrate	Baudrate: 4800, 9600, 19’200, 38’400, 57’600, 115’200 bps
Protocols	S-Bus or Modbus
Configuration	Modbus only Parity: 8N1, 8E1, 8O1, 8N2
Address	1-247 (same as USB)
Bus termination	Integrated, can be switched ON and OFF.

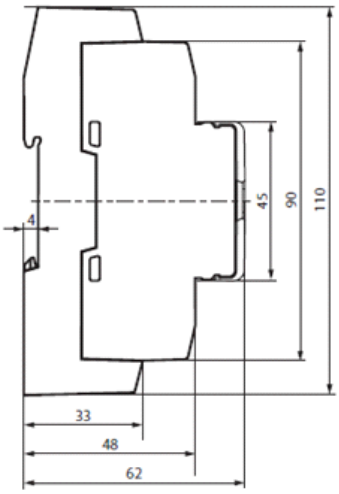
A detailed register list is available in the appendix.

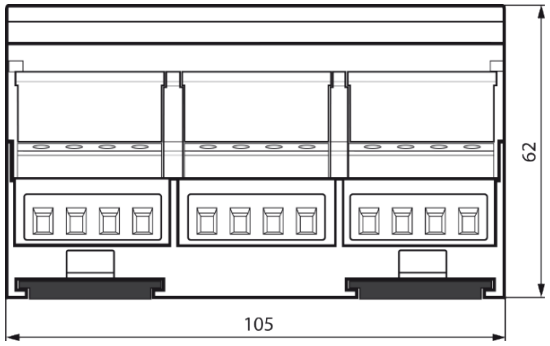
9.3 NFC Communication

The NFC functions will be available for customers through the Android application (at first only to read production data)

10. Mechanical dimensions







- Housing width 6 TE (105 mm)
- Electrical cabinet
  (according to DIN 43880, frame size 2 × 55 mm)
- For 35 mm DIN Rail
  (according to DIN EN 60715 TH 35)

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11. Installation

11.1 Connection technology

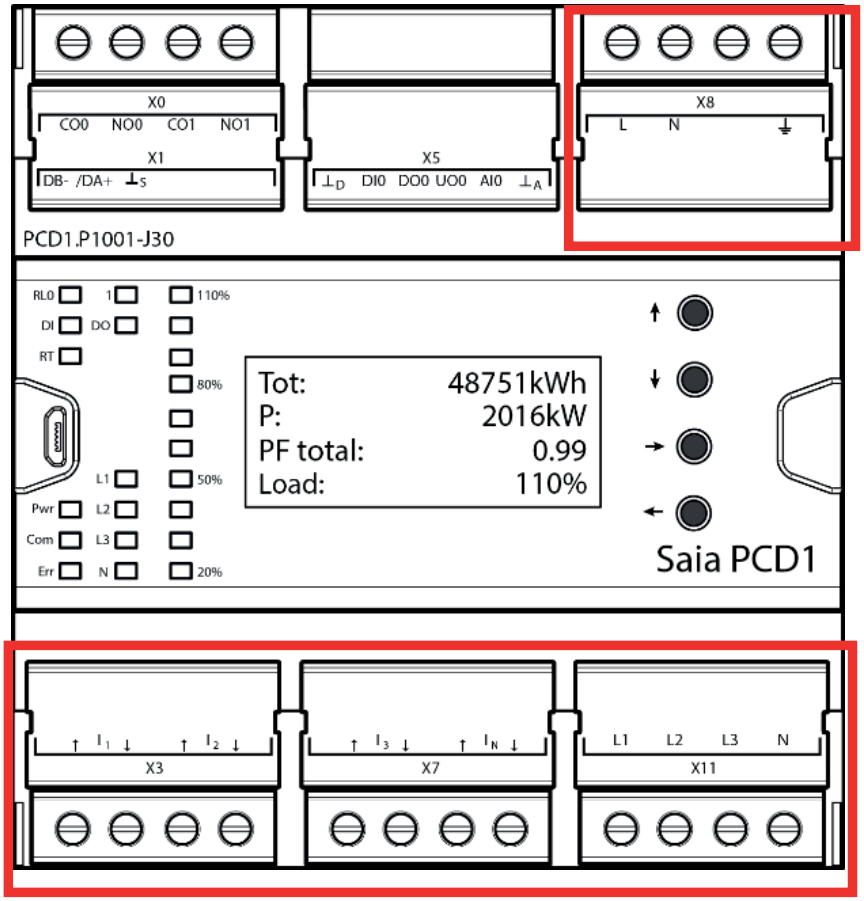
For the installation, we recommend a screwdriver no. 1

Push-in spring-cage terminals are fitted to the upper rows of terminals for the digital part. These terminals enable the wiring with rigid or flexible tubes containing up to 1.5 mm² in cross section. With ferrules are max. 1 mm² permitted.

Screw terminals are fitted to the lower rows of terminals for all connections with the mains voltage. Cable cross-sections up to 2.5 mm² can be connected

The network analyzer is equipped with additional inputs and outputs to enable the customer additional functionality. The additional functions are described in the chapter “Configuration / Parameter”.

11.2 Occupancy measuring inputs and power supply:



Name	Connection designation	Technology
Power supply 110-230VAC	L, N,	screw
Messuring inputs voltage	L1, L2, L3, N	screw
Messuring inputs current	↑I1↓, ↑I2↓, ↑I3↓, ↑IN↓	screw

11.2.1 Power supply

Voltage and frequency	110-230 VAC, +15% -20%, 50/60 Hz
Insulation	4000 VAC
Power input	Max: 6 W Avg: 1.5 W

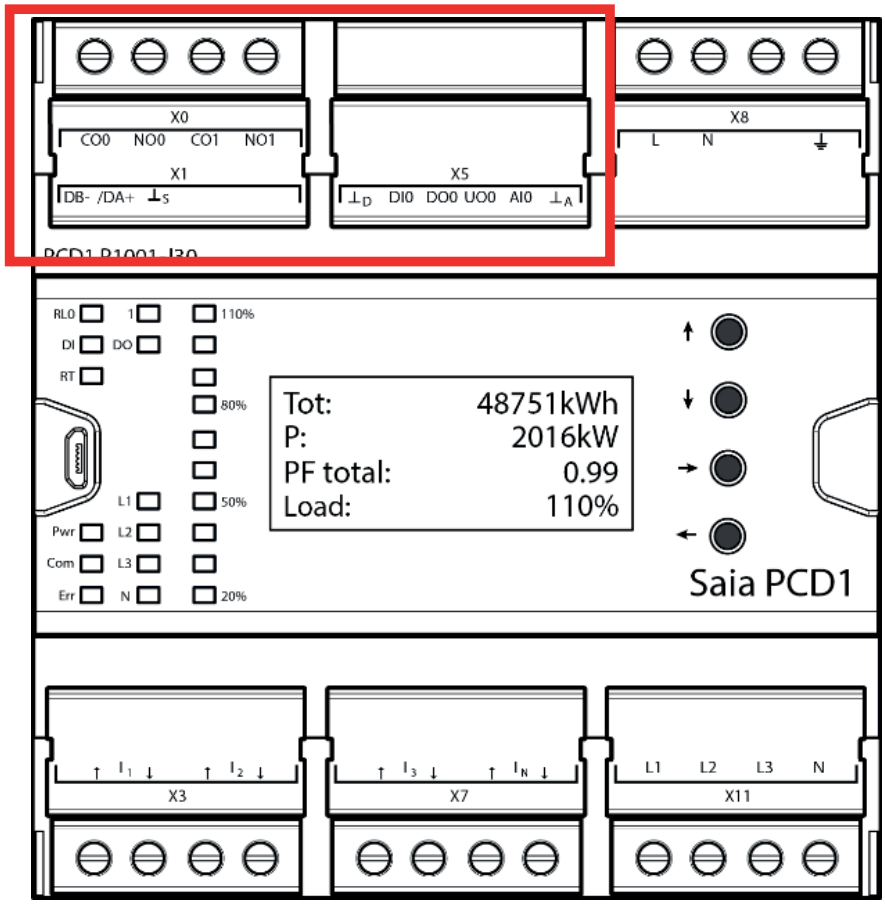
11.2.2 Voltage measurement input

Number voltage inputs	4 (L1, L2, L3, N)
Nominal voltage	110 or 230 VAC between L1, L2, L3 and N
Voltage measurement range	L-N: 2 … 700 VAC L-L : 4 … 1200 VAC
Frequency Range	45 … 65 Hz
Sampling rate	8 kHz
Input impedance	2 MΩ
Insulation	4000 VAC

11.2.3 Current measurement input

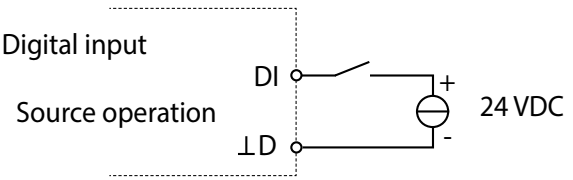
Number current inputs	8 (2 per Phase and Neutral)
Current measurement range	1 A / 5 A (configurable))
Max current	6 A
Current transformer ratios	Adjustable per phase, in steps of 1: 5 A: 5:5 – 6000:5 1 A: 1:1 – 6’00:1
Sampling rate	8 kHz
Input impedance	15 mΩ
Insulation	4000 VAC

11.3 Occupancy digital part:

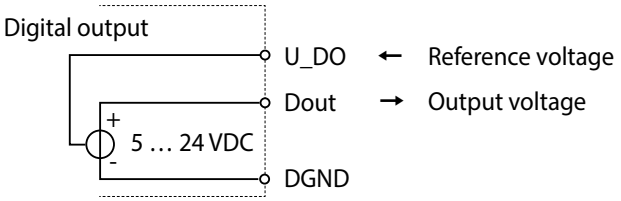


Name	Connection designation	Technology
Digital Input	DI0, D	Push-In
Digital Output	DO0	Push-In
Analogue Input	AI0, UO0, A	Push-In
Relay contact	CO0, NO0, CO1, NO1	screw
Interface	DB-, /DA+, S	Push-In

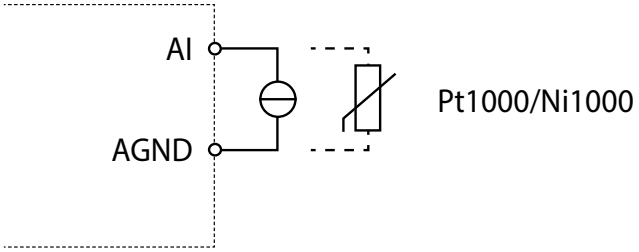
11.3.1 Digital input

Connection diagram	
Voltage range	5 … 30 VDC
Switching thresholds	Low: 0 … 1.3 VDC, High: 1.4 … 30 VDC
Current draw	Typicaly 2 mA
Read freq	>= 13 Hz (needed when configured as S0 input)

11.3.2 Digital output

Connection diagram	
Voltage range to be connected to U_DO	5 … 30 VDC
Voltage output	U_DO
Current output	Max 500 mA
Protection	None
Switching delay when linked to events	=< 150 ms
Switching frequency	max. 50 Hz (20 ms)

11.3.3 Analog input for temperature measuring

Connection diagram	
Measurement range	Internal: –40 °C … +85 °C External: Pt1000: –50 °C … +400 °C Ni1000: –50 °C … +210 °C
Precision	Internal: ±5 °C External: ±1/2°C, (See Measurement specification chapter)
External update delay time	=< 10 sec
External refresh rate	200 ms
Internal refresh rate	330 ms

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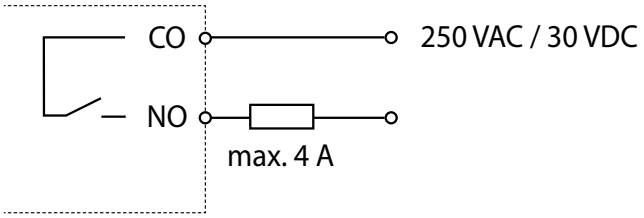
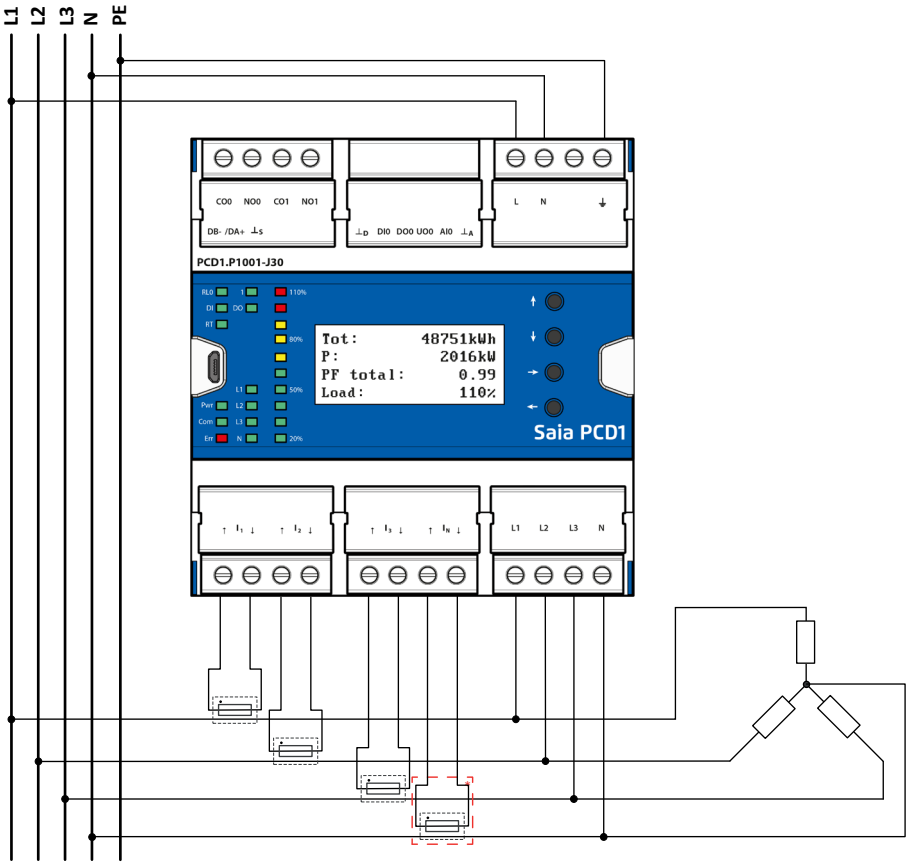
11.3.4 Relay contact

Connection diagram	
Max. switching voltage	250 VAC / 24 VDC
Max. switching current	5 A, 250 VAC
Protection	None
Isolation	Primary to secondary: 4000 VAC Between relays: 2200 VAC
Switching delay when linked to events	=< 150 ms
Switching frequency	max. 50 Hz (20 ms)

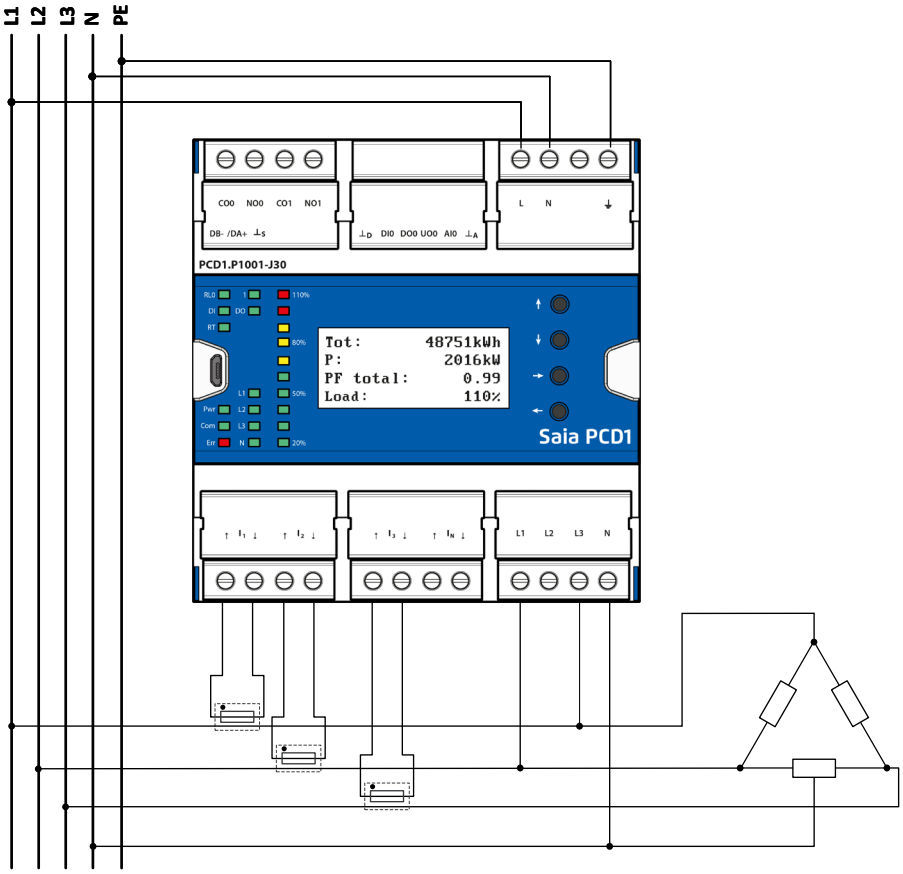
11.4 Installation

11.4.1 4 wire system, star-connection with neutral current measurement



3 phases with neutral conductor as a star connection 230/400 VAC. The measurement of the neutral conductor current is optional.

11.4.2 4-wire system, delta connection with neutral conductor



3 phase 4 wire system as a delta connection. Neutral reference voltage is connected to the measuring input for neutral wire on the PQA.

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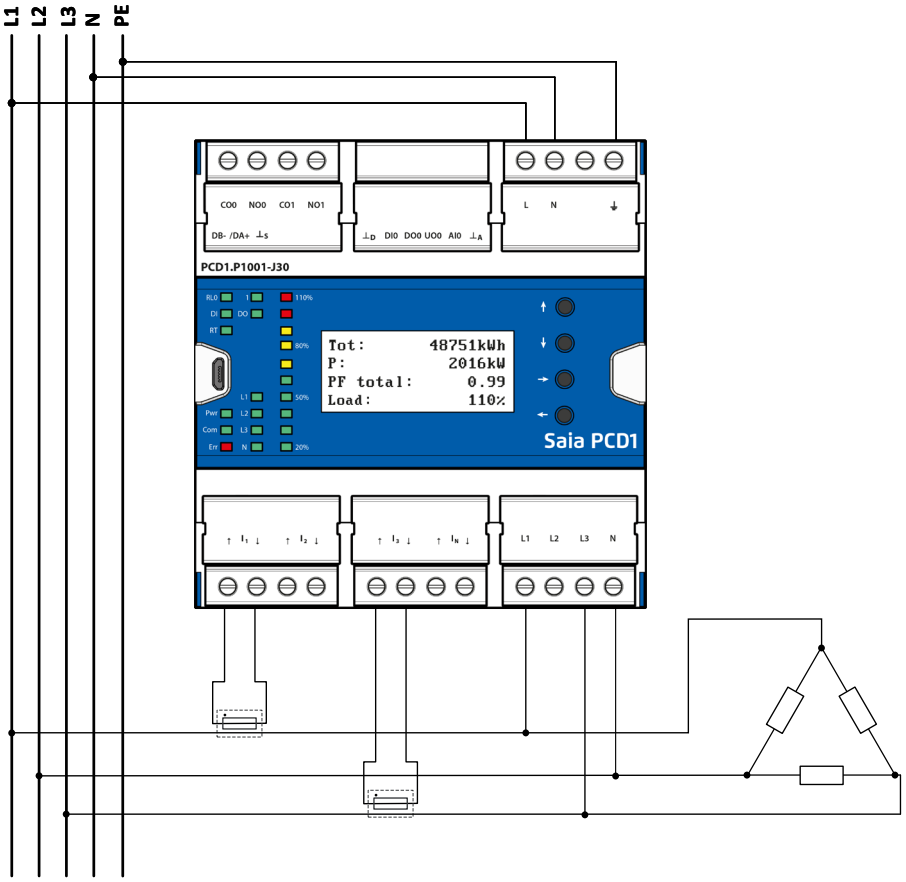
11.4.3 3-wire system delta connection



3-wire system as a delta connection. Phase 2 is connected as a reference voltage at the voltage measuring input for neutral.

	- Note, that in this configuration U1, U2 and U3 correspond to U1-2, U1-3 and U3-2 respectively. - For energies, powers, power factors and cos Phi only the total value is available, the phase values are 0. - The angle 1…4 corresponds to the angle between U1-2 and U3-2 and should be 300°.

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12. Device configuration / parameterization

The inputs and outputs of the network analyzer can be configured, in which event they are switched on and off.

The network analyzer can be configured in the following ways:

- LCD, with the keys
- Over the RS-485 interface; Protocol S-Bus (DB's or registry) or Modbus (Register)
- USB port (DB's, S-Bus)

12.1 Configuring the measuring inputs

Parameter	Description
Measurement configuration 0: 4 wire wye 1: 3 wire wye 2: 2 wire delta 3: 3 wire delta	Measurement can be done as following: 0: 4 wire wye (with neutral current) 1: 3 wire wye (without neutral current) 2: 2 wire delta 3: 3 wire delta
L1-3 secondary current 0: 5 A, 1: 1 A	L1-3 secondary current can be selected between 5 A (0) or 1 A (1)
L1-3 primary current 100 A, 1-6000 A	L1-3 primary current can be selected between 1 A and 6000 A (1 A steps)
N secondary current 0 : 5 A, 1 : 1 A	N secondary current can be selected between 5 A (0) or 1 A (1)
N primary current 100 A, 1-6000 A	N primary current can be selected between 1 A and 6000 A (1 A steps)
Nominal Voltage 0: 230 VAC, 1: 110 VAC	Nominal mains voltage can be 230 VAC (0) or 110 VAC (1)
Nominal Frequency 0: 50 Hz, 1: 60 Hz	Nominal mains frequency can be 50 Hz (0) or 60 Hz (1)

Parameter	Description
Recording interval 15 min; 1 – 1440 min	Recording interval in the internal flash memory. The interval range is 1 to 1440 min (1 day). Measurements recorded: Active energy L1 [kWh] Active energy L2 [kWh] Active energy L3 [kWh] Reactive energy L1 [kvarh] Reactive energy L2 [kvarh] Reactive energy L3 [kvarh] Active power L1 [kW] Active power L2 [kW] Active power L3 [kW] Reactive power L1 [kvar] Reactive power L2 [kvar] Reactive power L3 [kvar] Max active power sum [kW] Max reactive power sum [kvar] URMS 1 [V] URMS 2 [V] URMS 3 [V] IRMS 1 [A] IRMS 2 [A] IRMS 3 [A] IRMS N [A] Power factor 1 Power factor 2 Power factor 3 THD U1 [%] THD U2 [%] THD U3 [%] THD I1 [%] THD I2 [%] THD I3 [%] Network frequency [Hz] Sensor temperature [°C]
Averaging window 15 min; 1 – 1440 min	Averaging sliding window with 1 minute refresh time. The interval range is 1 to 1440 min (1 day). Measurements averaged: Average active power sum Average reactive power sum Average apparent power sum
External temperature sensor 0 : Pt1000, 1 : Ni1000	Temperature sensor can be chosen between Pt1000 and Ni1000.
External temp higher det. thld 55 °C, –50-400 °C	Higher temperature threshold on the external temperature sensor. This value defines the detection threshold for which an event will happen in the PQA.

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Parameter	Description
External temp lower det. thld –10 °C, –50-400 °C	Lower temperature threshold on the external temperature sensor. This value defines the detection threshold for which an event will happen in the PQA.
Internal temp higher det. thld 55 °C, –40-85 °C	Higher temperature threshold on the internal temperature sensor. This value defines the detection threshold for which an event will happen in the PQA.
Internal temp lower det. thld –10 °C, –40-85 °C	Lower temperature threshold on the internal temperature sensor. This value defines the detection threshold for which an event will happen in the PQA.

12.1.1 Averaging principle:

The minimal averaging interval is 1 min. This value is always calculated.

The sampling rate is 100 msec meaning 600 values averaged every minute.

At every power off → power on, the averaging restarts from 0.

At every configuration change of the interval, the averaging restarts from 0.

In addition, when in mass storage mode the averaging is disabled.

The available setting for the user is the averaging window.

The reported averaged values are the average for the last N minutes (N being the average window configurable).

The reported values are refreshed once a minute.

12.2 Configuring the I/O's

Parameter	Description
Isolated DI input mode 0: DI, 1: pulse counter	The digital input behavior can be selected as following: 0: Digital input 1: S0 impulse counter
Isolated DI Imp/kWh 100-10000	Number of impulses corresponding to 1 kWh when using the Digital input as S0 impulse counter.
Output 0 (DO) (default) state 0 : Low, 1 : High	Digital output (default) state can be active / set high (1) or inactive / set low (0). Per default the value is 0

Parameter	Description
Output 0 (DO) event 0: None, 1: SAG, 2: Low V, 3: V Peak, 4: SWELL, 5: Over V, 6: V THD, 7: I peak 1-3, 8: Not used, 9: Over I1-3, 10: -Over IN, 11: I THD, 12:I mismatch, 13: Ext Temp, 14: Int. Temp., 15: Digital input, 16: Phase error, 17: Neutral error, 18: S0 output	Digital output can be triggered by different events: 0: None (The output can be controlled from PLC program) 1: SAG 2: Low voltage 3: Voltage peak 4: SWELL 5: Over voltage 6: Voltage THD 7: Current peak 1-3 8: Not used 9: Over current 1-3 10: Over current N 11: Current THD 12: Current mismatch 13: External Temperature 14: Internal Temperature 15: Digital input 16: Phase error 17: Neutral error OR defined as an impulse output 18: S0 output (100 imp/kWh)
Output 0 (DO) phase 0: None, 1: Ph1, 2: Ph2, 3: Ph3, 4: Ph1-3	Digital output can be triggered by different phases configuration: 0: None 1: Ph1 2: Ph2 3: Ph3 4: Ph1-3
Output 1 (REL 0) (default) state 0 : Open, 1 : Closed	Relay 0 (default) state can be switched ON / closed (1) or OFF / open (0). Per default the value is 0

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Parameter	Description
Output 1 (REL 0) event 0: None, 1: SAG, 2: Low V, 3: V Peak, 4: SWELL, 5: Over V, 6: V THD, 7: I peak 1-3, 8: Not Used, 9: Over I1-3, 10: -Over IN, 11: I THD, 12:I mismatch, 13: Ext Temp, 14: Int. Temp., 15: Digital input, 16: Phase error, 17: Neutral error	Relay 0 can be triggered by different events: 0: None (The output can be controlled from PLC program) 1: SAG 2: Low voltage 3: Voltage peak 4: SWELL 5: Over voltage 6: Voltage THD 7: Current peak 1-3 8: Not Used 9: Over current 1-3 10: Over current N 11: Current THD 12: Current mismatch 13: External Temperature 14: Internal Temperature 15: Digital input 16: Phase error 17: Neutral error
Output 0 (REL 0) phase 0: None, 1: Ph1, 2: Ph2, 3: Ph3, 4: Ph1-3	Relay 0 can be triggered by different phases configuration: 0: None 1: Ph1 2: Ph2 3: Ph3 4: Ph1-3
Output 2 (REL 1) (default) state 0 : Open, 1 : Closed	Relay 1 (default) state can be switched ON / closed (1) or OFF / open (0). Per default the value is 0
Output 2 (REL 1) event 0: None, 1: SAG, 2: Low V, 3: V Peak, 4: SWELL, 5: Over V, 6: V THD, 7: I peak 1-3, 8: Not Used, 9: Over I1-3, 10: -Over IN, 11: I THD, 12:I mismatch, 13: Ext Temp, 14: Int. Temp., 15: Digital input, 16: Phase error, 17: Neutral error	Relay 1 can be triggered by different events: 0: None (The output can be controlled from PLC program) 1: SAG 2: Low voltage 3: Voltage peak 4: SWELL 5: Over voltage 6: Voltage THD 7: Current peak 1-3 8: Not used 9: Over current 1-3 10: Over current N 11: Current THD 12: Current mismatch 13: External Temperature 14: Internal Temperature 15: Digital input 16: Phase error 17: Neutral error

Parameter	Description
Output 2 (REL 1) phase 0: None, 1: Ph1, 2: Ph2, 3: Ph3, 4: Ph1-3	Relay 1 can be triggered by different phases configuration: 0: None 1: Ph1 2: Ph2 3: Ph3 4: Ph1-3
Output 3 (RTerm) safe state value 0 : Open, 1 : Closed	Termination resistor for the RS-485 can be switched ON (1) or OFF (0)

12.2.1 I/O functional description:

12.2.1.1 Digital input

When configured as Digital input the Imp/kWh configuration has no effect. The digital input can be used to trigger a digital output or a relay with a reaction time =< 100 msec.

When configured as pulse counter, the Imp/kWh setting defines the incrementing rate of the external count value (from 100 to 10000 Imp/kWh)

12.2.1.2 Digital output and relays contact

When not linked to an event (= 0) the state of the output can be changed by changing the (default) state, the phase trigger configuration has no effect in that case.

When linked to an event (= 1-17) the state of the output will change, from 0 to 1 if the default state is set to 0 or from 1 to 0 if the default state is 1, when the event occurs.

The reaction time for events is ≤ 100msec.

The event needs to be cleared with the corresponding flag so that the output goes back to its default state. You can configure the output to be triggered by an event occurring on a single phase or on any of the 3 phases.

Over current N, Current mismatch and Neutral error are not influenced by the choice of the phase trigger because they are related to events occurring on the neutral line.

Additionally the digital output can be configured as S0 output (=18), in that case it will generate pulse at 100 imp/kWh corresponding to the energy measured al all 3 phases.

12.3 Configuring thresholds for Events

SAG detection thld 90 %, 10-99 %	SAG is a decrease between 10 and 99 % in RMS voltage for durations of 0.5 cycles to 1 minute. This value defines the detection threshold for which an event will happen in the PQA.
SWELL detection thld 110 %, 101-200 %	SWELL is an increase between 101 and 200% in RMS voltage for durations of 0.5 cycles to 1 minute. This value defines the detection threshold for which an event will happen in the PQA.
Overvoltage detection thld 110 %, 101-200 %	Overvoltage is an increase between 101 and 200% in RMS voltage for a duration bigger as 1 minute. This value defines the detection threshold for which an event will happen in the PQA.
Low voltage detection thld 90 %, 10-99 %	Low voltage is a decrease between 10 and 99 % in RMS voltage for a duration bigger as 1 minute. This value defines the detection threshold for which an event will happen in the PQA.
Voltage peak detection thld 110 %, 101-200 %	Voltage peak is an increase in voltage for a short duration (< 0.5 cycles) This value defines the detection threshold for which an event will happen in the PQA.
Voltage THD detection thld 3 %, 1-99 %	THD is a measurement of the harmonic distortion. It is the ratio of the sum of all harmonic components to the fundamental frequency. This value defines the detection threshold for which an event will happen in the PQA.
L1-L3 current peak det. thld 110 %, 101-120 %	Current peak is an increase in current for a short duration (< 0.5 cycles) This value defines the detection threshold for which an event will happen in the PQA.
L1-L3 overcurrent det. thld 110 %, 101-120 %	Overcurrent is sustained increase between 101 and 120% in RMS current This value defines the detection threshold for which an event will happen in the PQA.
N overcurrent detection thld 110 %, 101-120 %	Overcurrent is sustained increase between 101 and 120% in RMS current This value defines the detection threshold for which an event will happen in the PQA.
Current THD detection thld 3 %, 1-99 %	THD is a measurement of the harmonic distortion. It is the ratio of the sum of all harmonic components to the fundamental frequency. This value defines the detection threshold for which an event will happen in the PQA.

12.4 Configure the LCD

LCD backlight 0: OFF, 1: ON, 2: Auto OFF	The backlight can be selected as follows: 0: Backlight is always OFF 1: Backlight is always ON 2: Backlight turned on when a key is pressed, after 20 seconds the lighting switches off automatically.
Homescreen cycle time 5 sec; 2-10 sec	The basic information (Home) of the screen are changed automatically, the rate per ad may range from 2 - to select 10 seconds.

13. Commissioning of the PQA

Important settings, before you can use the Power Quality Analyzer.

The following steps should be made prior to the normal use:

- Set the correct date
- Set the correct measurement connection
- Set the correct nominal voltage
- Set the correct nominal frequency
- Set the correct CT-ratios (primary and secondary current)

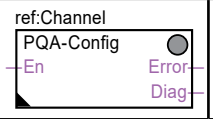
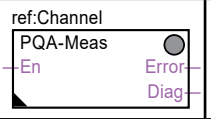
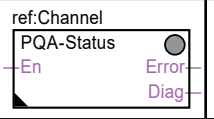
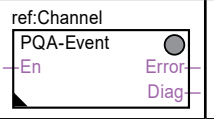
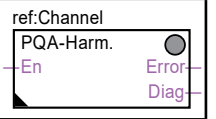
With these basic settings, you can use the PQA and start your measurements.

13.1 Factory default settings

Are available under appendix chapter

14. FBoxes

SBC is delivering to the Power Quality Analyzer a set of F-Boxes for an easy integration into the Saia PCD World. These are available in PG5.

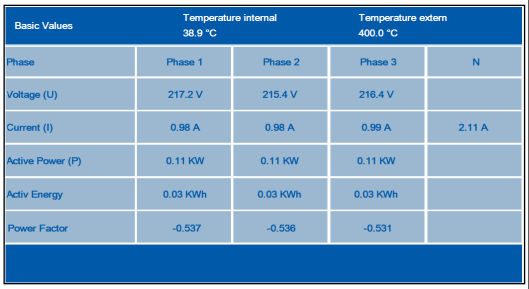
Configure FBox	Measurement FBox	Status FBox	Events FBox	Harmonics FBox
				
Configures all PQA settings	Provides “live” measurements and can reset meas	Provides PQA status	Provides events detected by the PQA and can clear events	Provides the harmonics information (1per phase/ current/voltage)
	63 registers 30 flags	2 registers 30 flags	103 registers 45 flags	6 registers 41 flags

The register lists for the different FBoxes are available in appendix.

15. Templates

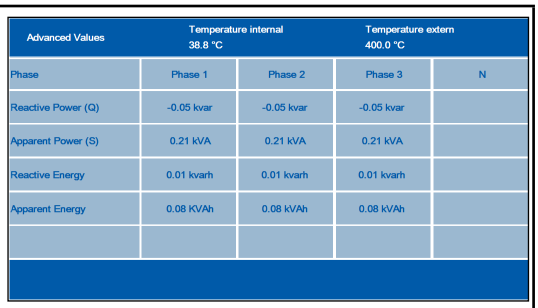
SBC is delivering to the Power Quality Analyzer a set of Templates, made for WebEditor8.

These are available in PG5.



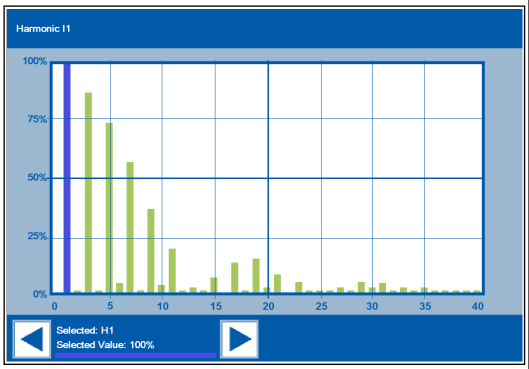
Basic Values	Temperature internal 38.9 °C		Temperature extern 400.0 °C	
Phase	Phase 1	Phase 2	Phase 3	N
Voltage (U)	217.2 V	215.4 V	216.4 V	
Current (I)	0.98 A	0.98 A	0.99 A	2.11 A
Active Power (P)	0.11 KW	0.11 KW	0.11 KW	
Activ Energy	0.03 KWh	0.03 KWh	0.03 KWh	
Power Factor	-0.537	-0.536	-0.531	

Display of the basic values like voltage, current

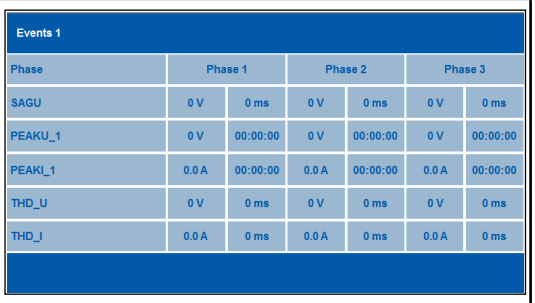


Advanced Values	Temperature internal 38.8 °C		Temperature extern 400.0 °C	
Phase	Phase 1	Phase 2	Phase 3	N
Reactive Power (Q)	-0.05 kvar	-0.05 kvar	-0.05 kvar	
Apparent Power (S)	0.21 kVA	0.21 kVA	0.21 kVA	
Reactive Energy	0.01 kvarh	0.01 kvarh	0.01 kvarh	
Apparent Energy	0.08 KVAh	0.08 kVAh	0.08 kVAh	

Display of the advanced values like reactive power, apparent power



Display the harmonic I or U from phase 1 to 3



Events 1						
Phase	Phase 1		Phase 2		Phase 3	
SAGU	0 V	0 ms	0 V	0 ms	0 V	0 ms
PEAKU_1	0 V	00:00:00	0 V	00:00:00	0 V	00:00:00
PEAKI_1	0.0 A	00:00:00	0.0 A	00:00:00	0.0 A	00:00:00
THD_U	0 V	0 ms	0 V	0 ms	0 V	0 ms
THD_I	0.0 A	0 ms	0.0 A	0 ms	0.0 A	0 ms

Display the events like TDD, SAG

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A Annex

A.1 Icons

	In manuals, this symbol refers the reader to further information in this manual or other manuals or technical information documents. As a rule there is no direct link to such documents.
	This symbol warns the reader of the risk to components from electrostatic discharges caused by touch. Recommendation: Before coming into contact with electrical components, you should at least touch the system's negative pole (cabinet of PGU connector). However, it is better to use a grounding wrist strap with its cable permanently attached to the system's negative pole.
	This sign accompanies instructions that must always be followed.
	Explanations beside this sign are valid only for the Saia PCD® Classic series.
	Explanations beside this sign are valid only for the Saia PCD® xx7 series.

A.2 Communication registers SBus/Modbus

S-Bus register	Register number corresponding to the value to read/write
Modbus register	Start register for the Modbus value, all values have to be read across two registers. 4 means the value has to be read across reg 4 & 5.
Read	It is a read register
Write	It is a write register
Description	Description of the value

S-Bus regis-ter	Modbus register	Read	Write	Description	# floating carac	Default value	Range
0	0	X		FW version			
1	2	X		Number of supported registers			
2	4	X		Number of supported flags			
3	6	X		NOT USED			
4	8	X		NOT USED			
5	10	X		ASN (carac. 1-4)		PCD1	
6	12	X		ASN (carac. 5-8)		.P10	
7	14	X		ASN (carac. 9-12)		01-J	
8	16	X		ASN (carac. 13-14)		30	
9	18	X		HW version		A	A-Z
10	20	X		NOT USED			
11	22	X		Serial number			
12	24	X		Serial number			
13	26	X		Active energy L1	2		0000.00 - 9999999.99
14	28	X		Active energy L2	2		0000.00 - 9999999.99
15	30	X		Active energy L3	2		0000.00 - 9999999.99
16	32	X		Reactive energy L1	2		0000.00 - 9999999.99
17	34	X		Reactive energy L2	2		0000.00 - 9999999.99
18	36	X		Reactive energy L3	2		0000.00 - 9999999.99
19	38	X		Active power L1	2		0000.00 - 9999.99
20	40	X		Active power L2	2		0000.00 - 9999.99
21	42	X		Active power L3	2		0000.00 - 9999.99
22	44	X		Reactive power L1	2		0000.00 - 9999.99
23	46	X		Reactive power L2	2		0000.00 - 9999.99
24	48	X		Reactive power L3	2		0000.00 - 9999.99
25	50	X		Max active power sum	2		0000.00 - 9999.99
26	52	X		Max reactive power sum	2		0000.00 - 9999.99
27	54	X		URMS 1	1		000.0 - 700.0
28	56	X		URMS 2	1		000.0 - 700.0
29	58	X		URMS 3	1		000.0 - 700.0
30	60	X		IRMS 1	2		0000.00 - 1800.00
31	62	X		IRMS 2	2		0000.00 - 1800.00
32	64	X		IRMS 3	2		0000.00 - 1800.00
33	66	X		IRMS N	2		0000.00 - 1800.00
34	68	X		Power factor 1	3		0.000 - 1.000
35	70	X		Power factor 2	3		0.000 - 1.000
36	72	X		Power factor 3	3		0.000 - 1.000
37	74	X		THD U1	2		00.00 - 20.00
38	76	X		THD U2	2		00.00 - 20.00
39	78	X		THD U3	2		00.00 - 20.00
40	80	X		THD I1	2		00.00 - 20.00
41	82	X		THD I2	2		00.00 - 20.00
42	84	X		THD I3	2		00.00 - 20.00
43	86	X		Frequency	2		45.00 - 65.00
44	88	X		Sensor temperature	1		-50.0 - 400.0
45	90	X		Active energy sum	2		0000.00 - 9999999.99
46	92	X		Reactive energy sum	2		0000.00 - 9999999.99
47	94	X		Apparent energy sum	2		0000.00 - 9999999.99
48	96	X		Apparent energy L1	2		0000.00 - 9999999.99

S-Bus register	Modbus register	Read	Write	Description	# floating carac	Default value	Range
49	98	X		Apparent energy L2	2		0000.00 - 9999999.99
50	100	X		Apparent energy L3	2		0000.00 - 9999999.99
51	102	X		External count	2		0000.00 - 9999999.99
52	104	X		Active power sum	2		0000.00 - 9999.99
53	106	X		Reactive power sum	2		0000.00 - 9999.99
54	108	X		Apparent power sum	2		0000.00 - 9999.99
55	110	X		Apparent power L1	2		0000.00 - 9999.99
56	112	X		Apparent power L2	2		0000.00 - 9999.99
57	114	X		Apparent power L3	2		0000.00 - 9999.99
58	116	X		Max apparent power sum	2		0000.00 - 9999.99
59	118	X		Average active power sum	2		0000.00 - 9999.99
60	120	X		Average reactive power sum	2		0000.00 - 9999.99
61	122	X		Average apparent power sum	2		0000.00 - 9999.99
62	124	X		Full load percentage	0		0 -100
63	126	X		Total power factor	3		0.000 - 1.000
64	128	X		Total cos phi	3		0.000 - 1.000
65	130	X		Cos phi 1	3		0.000 - 1.000
66	132	X		Cos phi 2	3		0.000 - 1.000
67	134	X		Cos phi 3	3		0.000 - 1.000
68	136	X		TDD I1	2		00.00 - 100.00
69	138	X		TDD I2	2		00.00 - 100.00
70	140	X		TDD I3	2		00.00 - 100.00
71	142	X		Wrong phase sequence	0		0 - 3
72	144	X		Angle U Phase 1-2	1		000.0 - 359.9
73	146	X		Angle U Phase 2-3	1		000.0 - 359.9
74	148	X		Angle U Phase 1-3	1		000.0 - 359.9
75	150	X		Internal temperature	0		-40 - 85
76	152	X		% memory full	0		0 - 100
77	154	X		Measurement events bit # 0 SAG U1 event 1 SAG U2 event 2 SAG U3 event 3 Low-voltage U1 event 4 Low-voltage U2 event 5 Low-voltage U3 event 6 Peak U1 event 7 Peak U2 event 8 Peak U3 event 9 SWELL U1 event 10 SWELL U2 event 11 SWELL U3 event 12 Over-voltage U1 event 13 Over-voltage U2 event 14 Over-voltage U3 event 15 Over-THD U1 event 16 Over-THD U2 event 17 Over-THD U3 event 18 Peak I1 event 19 Peak I2 event 20 Peak I3 event 21 Over-current I1 event 22 Over-current I2 event 23 Over-current I3 event 24 Over-current IN event 25 Over-THD I1 event 26 Over-THD I2 event 27 Over-THD I3 event 28 Over-temp. Sensor event 29 Over-temp. Internal event 30 NOT USED 31 NOT USED	0		0 – 1073741824
78	156	X		Date&time SAG U1 (POSIX timestamp)	0		1454339248 - 4294967296
79	158	X		SAG U1	1		000.0 - 230.0
80	160	X		Duration SAG U1	0		1454339248 - 4294967296
81	162	X		Date&time SAG U2 (POSIX timestamp)	1		000.0 - 230.0
82	164	X		SAG U2	0		1454339248 - 4294967296
83	166	X		Duration SAG U2	1		000.0 - 230.0

A

S-Bus regis-ter	Modbus register	Read	Write	Description	# floating carac	Default value	Range
84	168	X		Date&time SAG U3 (POSIX timestamp)	0		1454339248 - 4294967296
85	170	X		SAG U3	1		000.0 - 230.0
86	172	X		Duration SAG U3	0		1454339248 - 4294967296
87	174	X		Date&time Low voltage U1 (POSIX timestamp)	0		1454339248 - 4294967296
88	176	X		Low voltage U1	1		000.0 - 230.0
89	178	X		Duration Low voltage U1	0		0 - 9999
90	180	X		Date&time Low voltage U2 (POSIX timestamp)	0		1454339248 - 4294967296
91	182	X		Low voltage U2	1		000.0 - 230.0
92	184	X		Duration Low voltage U2	0		0 - 9999
93	186	X		Date&time Low voltage U3 (POSIX timestamp)	0		1454339248 - 4294967296
94	188	X		Low voltage U3	1		000.0 - 230.0
95	190	X		Duration Low voltage U3	0		0 - 9999
96	192	X		Date&time Peak U1 #1 (POSIX timestamp)	0		1454339248 - 4294967296
97	194	X		Peak U1 #1	1		230.0 - 700.0
98	196	X		Date&time Peak U1 #2 (POSIX timestamp)	0		1454339248 - 4294967296
99	198	X		Peak U1 #2	1		230.0 - 700.0
100	200	X		Date&time Peak U2 #1 (POSIX timestamp)	0		1454339248 - 4294967296
101	202	X		Peak U2 #1	1		230.0 - 700.0
102	204	X		Date&time Peak U2 #2 (POSIX timestamp)	0		1454339248 - 4294967296
103	206	X		Peak U2 #2	1		230.0 - 700.0
104	208	X		Date&time Peak U3 #1 (POSIX timestamp)	0		1454339248 - 4294967296
105	210	X		Peak U3 #1	1		230.0 - 700.0
106	212	X		Date&time Peak U3 #2 (POSIX timestamp)	0		1454339248 - 4294967296
107	214	X		Peak U3 #2	1		230.0 - 700.0
108	216	X		Date&time SWELL U1 (POSIX times-tamp)	0		1454339248 - 4294967296
109	218	X		SWELL U1	1		230.0 - 700.0
110	220	X		Duration SWELL U1	0		0 - 9999
111	222	X		Date&time SWELL U2 (POSIX times-tamp)	0		1454339248 - 4294967296
112	224	X		SWELL U2	1		230.0 - 700.0
113	226	X		Duration SWELL U2	0		0 - 9999
114	228	X		Date&time SWELL U3 (POSIX times-tamp)	0		1454339248 - 4294967296
115	230	X		SWELL U3	1		230.0 - 700.0
116	232	X		Duration SWELL U3	0		0 - 9999
117	234	X		Date&time Over-voltage U1 (POSIX timestamp)	0		1454339248 - 4294967296
118	236	X		Over-voltage U1	1		230.0 - 700.0
119	238	X		Duration Over-voltage U1	0		0 - 9999
120	240	X		Date&time Over-voltage U2 (POSIX timestamp)	0		1454339248 - 4294967296
121	242	X		Over-voltage U2	1		230.0 - 700.0
122	244	X		Duration Over-voltage U2	0		0 - 9999
123	246	X		Date&time Over-voltage U3 (POSIX timestamp)	0		1454339248 - 4294967296
124	248	X		Over-voltage U3	1		230.0 - 700.0

S-Bus register	Modbus register	Read	Write	Description	# floating carac	Default value	Range
125	250	X		Duration Over-voltage U3	0		0 - 9999
126	252	X		Date&time Over-THD U1 (POSIX timestamp)	0		1454339248 - 4294967296
127	254	X		Over-THD U1	2		00.00 - 20.00
128	256	X		Duration Over-THD U1	0		0 - 9999
129	258	X		Date&time Over-THD U2 (POSIX timestamp)	0		1454339248 - 4294967296
130	260	X		Over-THD U2	2		00.00 - 20.00
131	262	X		Duration Over-THD U2	0		0 - 9999
132	264	X		Date&time Over-THD U3 (POSIX timestamp)	0		1454339248 - 4294967296
133	266	X		Over-THD U3	2		00.00 - 20.00
134	268	X		Duration Over-THD U3	0		0 - 9999
135	270	X		Date&time Peak I1 #1 (POSIX timestamp)	0		1454339248 - 4294967296
136	272	X		Peak I1 #1	2		0000.00 - 9999.99
137	274	X		Date&time Peak I1 #2 (POSIX timestamp)	0		1454339248 - 4294967296
138	276	X		Peak I1 #2	2		0000.00 - 9999.99
139	278	X		Date&time Peak I2 #1 (POSIX timestamp)	0		1454339248 - 4294967296
140	280	X		Peak I2 #1	2		0000.00 - 9999.99
141	282	X		Date&time Peak I2 #2 (POSIX timestamp)	0		1454339248 - 4294967296
142	284	X		Peak I2 #2	2		0000.00 - 9999.99
143	286	X		Date&time Peak I3 #1 (POSIX timestamp)	0		1454339248 - 4294967296
144	288	X		Peak I3 #1	2		0000.00 - 9999.99
145	290	X		Date&time Peak I3 #2 (POSIX timestamp)	0		1454339248 - 4294967296
146	292	X		Peak I3 #2	2		0000.00 - 9999.99
147	294	X		Date&time Over-current I1 (POSIX timestamp)	0		1454339248 - 4294967296
148	296	X		Over-current I1	2		0000.00 - 9999.99
149	298	X		Duration Over-current I1	0		0 - 9999
150	300	X		Date&time Over-current I2 (POSIX timestamp)	0		1454339248 - 4294967296
151	302	X		Over-current I2	2		0000.00 - 9999.99
152	304	X		Duration Over-current I2	0		0 - 9999
153	306	X		Date&time Over-current I3 (POSIX timestamp)	0		1454339248 - 4294967296
154	308	X		Over-current I3	2		0000.00 - 9999.99
155	310	X		Duration Over-current I3	0		0 - 9999
156	312	X		Date&time Over-current IN (POSIX timestamp)	0		1454339248 - 4294967296
157	314	X		Over-current IN	2		0000.00 - 9999.99
158	316	X		Duration Over-current IN	0		0 - 9999
159	318	X		Date&time Over-THD I1 (POSIX timestamp)	0		1454339248 - 4294967296
160	320	X		Over-THD I1	2		00.00 - 20.00
161	322	X		Duration Over-THD I1	0		0 - 9999
162	324	X		Date&time Over-THD I2 (POSIX timestamp)	0		1454339248 - 4294967296
163	326	X		Over-THD I2	2		00.00 - 20.00
164	328	X		Duration Over-THD I2	0		0 - 9999
165	330	X		Date&time Over-THD I3 (POSIX timestamp)	0		1454339248 - 4294967296
166	332	X		Over-THD I3	2		00.00 - 20.00

S-Bus regis-ter	Modbus register	Read	Write	Description	# floating carac	Default value	Range
167	334	X		Duration Over-THD I3	0		0 - 9999
168	336	X		Date&time High/Low Sensor Ext (POSIX timestamp)	1454339248		
169	338	X		High/Low Sensor ext temp	1		-50.0 - 400.0
170	340	X		Duration High/Low Sensor ext	0		0 - 9999
171	342	X		Date&time High/Low Sensor int (POSIX timestamp)	1454339248		
172	344	X		High/Low Sensor int temp	0		-40 - 85
173	346	X		Duration High/Low Sensor int	0		0 - 9999
174	348	X		H0 U1	1		0 - 99.9
175	350	X		H1 U1	1		100.0
176	352	X		H2 U1	1		0 - 99.9
177	354	X		H3 U1	1		0 - 99.9
…	…	X		…			
214	428	X		H40 U1	1		0 - 99.9
215	430	X		H0 U2	1		0 - 99.9
216	432	X		H1 U2	1		100.0
217	434	X		H2 U2	1		0 - 99.9
218	436	X		H3 U2	1		0 - 99.9
…	…	X		…			
255	510	X		H40 U2	1		0 - 99.9
256	512	X		H0 U3	1		0 - 99.9
257	514	X		H1 U3	1		100.0
258	516	X		H2 U3	1		0 - 99.9
259	518	X		H3 U3	1		0 - 99.9
…	…	X		…			
296	592	X		H40 U3	1		0 - 99.9
297	594	X		H0 I1	1		0 - 99.9
298	596	X		H1 I1	1		100.0
299	598	X		H2 I1	1		0 - 99.9
300	600	X		H3 I1	1		0 - 99.9
…	…	X		…			
337	674	X		H40 I1	1		0 - 99.9
338	676	X		H0 I2	1		0 - 99.9
339	678	X		H1 I2	1		100.0
340	680	X		H2 I2	1		0 - 99.9
341	682	X		H3 I2	1		0 - 99.9
…	…	X		…			
378	756	X		H40 I2	1		0 - 99.9
379	758	X		H0 I3	1		0 - 99.9
380	760	X		H1 I3	1		100.0
381	762	X		H2 I3	1		0 - 99.9
…	…	X		…			
419	838	X		H40 I3	1		0 - 99.9
420	840	X		Memory card manufacturer ID	0		?
421	842	X		File System status: bit # 0: SD-CARD NOT_INSERTED 1: SD-CARD MEDIA_ERROR 2: SD-CARD NOT_FORMATTED 3: SD-CARD CORRUPTED	0		?
422	844	X		Serial protocol	0		
423	846	X		Serial baudrate	0		
424	848	X		Serial parity	0		

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S-Bus register	Modbus register	Read	Write	Description	# floating carac	Default value	Range
425	850	X		Serial address	0		
426	852	X		Internal voltage	1		?
427	854	X		production tests error			
428	856	X		up-time [sec]	0		0 - 2^{32}
…	…	…	…	…	…	…	…
480	960	X	X	CT prim current I1-3	0	100	1 - 1500
481	962	X	X	CT prim current IN	0	100	1 - 1500
482	964	X	X	Wye or Delta measurement	0	0	0 - 3
483	966	X	X	Averaging interval	0	15	1 - 1440
484	968	X	X	Recording interval	0	15	1 - 1440
485	970	X	X	SAG & Low-V threshold %	0	90	10 - 99
486	972	X	X	Peak U threshold %	0	110	101 - 200
487	974	X	X	SWELL & Over-V threshold %	0	110	101 - 200
488	976	X	X	THD U threshold %	0	3	1 - 99
489	978	X	X	Peak I1-I3 threshold %	0	110	101 - 120
490	980	X	X	Over-current I1-I3 threshold %	0	110	101 - 120
491	982	X	X	Over-current IN threshold %	0	110	101 - 120
492	984	X	X	THD I threshold %	0	3	1 - 99
493	986	X	X	Temp Sensor type: 0: Pt1000 / 1: Ni1000	0	0	0 - 1
494	988	X	X	External temp max threshold	0	55	-50 - 400
495	990	X	X	External temp min threshold	0	-10	-50 - 400
496	992	X	X	Internal temp max threshold	0	55	-50 - 85
497	994	X	X	Internal temp min threshold	0	-10	-50 - 85
498	996	X	X	LCD backlight behaviour	0	2	0 - 2
499	998	X	X	Home cycle time	0	5	2 - 10
500	1000	X	X	Digital input pulse ratio	0	100	100 - 10000
501	1002	X	X	Digital output event trigger	0	0	0 - 18
502	1004	X	X	Digital output phase trigger	0	0	0 - 4
503	1006	X	X	Relay 0 event trigger	0	0	0 - 17
504	1008	X	X	Relay 0 phase trigger	0	0	0 - 4
505	1010	X	X	Relay 1 event trigger	0	0	0 - 17
506	1012	X	X	Relay 1 phase trigger	0	0	0 - 4
507	1014	X	X	Current date/time (POSIX timestamp)	0	0x5685C180	0 - 0xFFFFFFFF
508	1016	X	X	Winter UTC offset [min]	0	60	-720 - 720
509	1018	X	X	Start of Winter time: Month	0	10	1 - 12
510	1020	X	X	Start of Winter time: Week of Month	0	5	1 - 5
511	1022	X	X	Start of Winter time: Day of Week	0	0	0 - 6 (Sunday - Saturday)
512	1024	X	X	Start of Winter time: Local Hour	0	3	0 - 23
513	1026	X	X	Summer UTC offset [min]	0	120	-720 - 720
514	1028	X	X	Start of Summer time: Month	0	3	1 - 12
515	1030	X	X	Start of Summer time: Week of Month	0	5	1 - 5
516	1032	X	X	Start of Summer time: Day of Week	0	0	0 - 6 (Sunday - Saturday)
517	1034	X	X	Start of Summer time: Local Hour	0	2	0 - 23

A

A.3 Flags for SBus/Modbus

Flag	Flag number corresponding to the value to read/write
Read	It is a read flag
Write	It is a write flag
Description	Description of the value

# flag	Read	Write	Description	Default value
0	X		Switch 1 pressed	0
1	X		Switch 2 pressed	0
2	X		Switch 3 pressed	0
3	X		Switch 4 pressed	0
4	X		Digital input state	0
5	X		Phase A connected	1
6	X		Phase B connected	1
7	X		Phase C connected	1
8	X		N connected	1
9	X		Current mismatch	0
10	X		Load Ph1 too hign	0
11	X		Load Ph2 too hign	0
12	X		Load Ph3 too hign	0
13	X		I1 inverted	0
14	X		I2 inverted	0
15	X		I3 inverted	0
16	X		Ph1 error	0
17	X		Ph2 error	0
18	X		Ph3 error	0
19	X		N error	0
20	X		Digital output current state	0
21	X		Relay 1 current state	0
22	X		Relay 2 current state	0
…			Reserved for future read-only flags	
40	X	X	Digital output (default) state	0
41	X	X	Relay 1 (default) state	0
42	X	X	Relay 2 (default) state	0
43	X	X	Bus termination state	0
44	X	X	Digital input mode	0
45	X	X	CT sec current L1-3 (1 or 5 A)	0
46	X	X	CT sec current N (1 or 5 A)	0
47	X	X	Main Frequency	0
48	X	X	Main Voltage	0
49		X	RESET all energy meas	0
50		X	RESET active energy mes	0
51		X	RESET reactive energy meas	0
52		X	RESET apparent energy meas	0
53		X	RESET external count	0
54		X	RESET all max meas	0

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# flag	Read	Write	Description	Default value
55		X	RESET all average meas	0
56		X	CLEAR all events	0
57		X	CLEAR all SAG events	0
58		X	CLEAR SAG U1 event	0
59		X	CLEAR SAG U2 event	0
60		X	CLEAR SAG U3 event	0
61		X	CLEAR all Low-voltage events	0
62		X	CLEAR low-voltage U1 event	0
63		X	CLEAR low-voltage U1 event	0
64		X	CLEAR low-voltage U1 event	0
65		X	CLEAR all Peak U events	0
66		X	CLEAR peak U1 event	0
67		X	CLEAR peak U2 event	0
68		X	CLEAR peak U3 event	0
69		X	CLEAR all SWELL events	0
70		X	CLEAR SWELL U1 event	0
71		X	CLEAR SWELL U2 event	0
72		X	CLEAR SWELL U3 event	0
73		X	CLEAR all Over-voltage events	0
74		X	CLEAR Over-voltage U1 event	0
75		X	CLEAR Over-voltage U2 event	0
76		X	CLEAR Over-voltage U3 event	0
77		X	CLEAR all Over-THD U events	0
78		X	CLEAR over-THD U1 event	0
79		X	CLEAR over-THD U2 event	0
80		X	CLEAR over-THD U3 event	0
81		X	CLEAR all Peak I events	0
82		X	CLEAR peak I1 event	0
83		X	CLEAR peak I2 event	0
84		X	CLEAR peak I3 event	0
85		X	CLEAR all Over-current events	0
86		X	CLEAR over-current I1 event	0
87		X	CLEAR over-current I2 event	0
88		X	CLEAR over-current I3 event	0
89		X	CLEAR over-current IN event	0
90		X	CLEAR all Over-THD I events	0
91		X	CLEAR over-THD I1 event	0
92		X	CLEAR over-THD I2 event	0
93		X	CLEAR over-THD I3 event	0
94		X	CLEAR over-temp. Sensor event	0
95		X	CLEAR over-temp. Internal event	0

A

A.4 FBoxes

A.4.1 Configuration FBox

Description	Group adjust window	Text adjust window	Text help
Isolated DI input mode **0: DI, 1:** pulse counter	I/Os	Digital input behavior	The digital input behavior can be selected as following: 0: Digital input 1: S0 impulse counter
Isolated DI Imp/kWh 100-10000	I/Os	Counting impulses per kWh	Number of impulses corresponding to 1 kWh when using the Digital input as S0 impulse counter.
External temperature sensor **0 : PT1000**, 1: NI1000,	Temperature settings	Temperature sensor	Temperature sensor can be chosen between PT1000 and NI1000.
Output 0 (DO) default state **0 : Low**, 1 : High	I/Os	Digital output default state	Digital output default state can be active / set high (1) or inactive / set low (0). Per default the value is 0
Output 0 (DO) event **0: None** 1: SAG 2: Low V 3: V Peak 4: SWELL 5: Over V 6: V THD 7: I peak 1-3 8: Not used 9: Over I1-3 10: Over IN 11: I THD 12:I mismatch 13: Ext Temp 14: Int. Temp 15: Digital input 16: Phase error 17: Neutral error 18: S0 output	I/Os	Digital output event trigger	Digital output can be triggered by different events: 0: None (The output can be controlled from PLC program) 1: SAG 2: Low voltage 3: Voltage peak 4: SWELL 5: Over voltage 6: Voltage THD 7: Current peak 1-3 8: Not used 9: Over current 1-3 10: Over current N 11: Current THD 12: Current mismatch 13: External Temperature 14: Internal Temperature 15: Digital input 16: Phase error 17: Neutral error OR defined as an impulse output 18: S0 output (100 imp/kWh)
Output 0 (DO) phase	I/Os	Digital output phase trigger	Digital output can be triggered by different phases configuration:
0: None 1: Ph1 2: Ph2 3: Ph3 4: Ph1-3			0: None 1: Ph1 2: Ph2 3: Ph3 4: Ph1-3
Output 1 (REL 0) default state **0 : Open**, 1 : Closed	I/Os	Relay 0 default state	Relay 0 default state can be switched ON / closed (1) or OFF / open (0). Per default the value is 0
Output 1 (REL 0) event **0: None** 1: SAG 2: Low V 3: V Peak 4: SWELL 5: Over V 7: I peak 1-3 8: Not used 8: Not used 9: Over I1-3 10: Over IN 11: I THD 12:I mismatch 13: Ext Temp 14: Int. Temp 15: Digital input 16: Phase error 17: Neutral error	I/Os	Relay 0 event trigger	Relay 0 can be triggered by different events: 0: None (The output can be controlled from PLC program) 1: SAG 2: Low voltage 3: Voltage peak 4: SWELL 5: Over voltage 6: Voltage THD 7: Current peak 1-3 8: Not used 9: Over current 1-3 10: Over current N 11: Current THD 12: Current mismatch 13: External Temperature 14: Internal Temperature 15: Digital input 16: Phase error 17: Neutral error

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Description	Group adjust window	Text adjust window	Text help
Output 0 (REL 0) phase **0: None**, 1: Ph1, 2: Ph2, 3: Ph3, 4: Ph1-3	I/Os	Relay 0 phase trigger	Relay 0 can be triggered by different phases configuration: 0: None 1: Ph1 2: Ph2 3: Ph3 4: Ph1-3
Output 2 (REL 1) default state **0 : Open**, 1 : Closed	I/Os	Relay 1 default state	Relay 1 default state can be switched ON / closed (1) or OFF / open (0). Per default the value is 0
Output 2 (REL 1) event **0: None** 1: SAG 2: Low V 3: V Peak 4: SWELL 5: Over 6: V THD 7: I peak 1-3 8: Not used 9: Over I1-3 10: Over IN 11: I THD 12:I mismatch 13: Ext Temp 14: Int. Temp 15: Digital input 16: Phase error 17: Neutral error	I/Os	Relay 1 event trigger	Relay 1 can be triggered by different events: 0: None (The output can be controlled from PLC program) 1: SAG 2: Low voltage 3: Voltage peak 4: SWELL 5: Over voltage 6: Voltage THD 7: Current peak 1-3 8: Not used 9: Over current 1-3 10: Over current N 11: Current THD 12: Current mismatch 13: External Temperature 14: Internal Temperature 15: Digital input 16: Phase error 17: Neutral error
Output 2 (REL 1) phase **0: None**, 1: Ph1, 2: Ph2, 3: Ph3, 4: Ph1-3	I/Os	Relay 1 phase trigger	Relay 1 can be triggered by different phases configuration: 0: None 1: Ph1 2: Ph2 3: Ph3 4: Ph1-3
Output 3 (RTerm) safe state value **0 : Open**, 1 : Closed	I/Os	RS-485 termination resistor	Termination resistor for the RS-485 can be switched ON (1) or OFF (0)
Measurement configuration **0: 4 wire wye with N** 1: 4 wire wye without N 2: 3 wire delta 3: 4 wire delta	Measurement settings	PQA measurement configuration	Measurement can be done as following: 0: 4 wire wye (with neutral current) 1: 4 wire wye (without neutral current) 2: 3 wire delta 3: 4 wire delta
Nominal Voltage **0: 230 VAC**, 1: 110 VAC	Measurement settings	Nominal AC voltage	Nominal mains voltage can be 230 VAC (0) or 110 VAC (1)
Nominal Frequency 0: 50 Hz, 1: 60 Hz	Measurement settings	Nominal measurement frequency	Nominal mains frequency can be 50 Hz (0) or 60 Hz (1)
Recording interval **15 min**; 1 – 1440 min	Measurement settings	Recording interval [minutes]	Recording interval in the internal flash memory. The interval range is 1 to 1440 min (1 day). If 0 is selected the recording is OFF Measurements recorded: Active energy L1 [kWh] Active energy L2 [kWh] Active energy L3 [kWh] Reactive energy L1 [kvarh] Reactive energy L2 [kvarh] Reactive energy L3 [kvarh] Active power L1 [kW] Active power L2 [kW] Active power L3 [kW] Reactive power L1 [kvar] Reactive power L2 [kvar] Reactive power L3 [kvar] Max active power sum [kW] Max reactive power sum [kvar] URMS 1 [V] URMS 2 [V] URMS 3 [V] IRMS 1 [A]

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Description	Group adjust window	Text adjust window	Text help
			IRMS 2 [A] IRMS 3 [A] IRMS N [A] Power factor 1 Power factor 2 Power factor 3 THD U1 [%] THD U2 [%] THD U3 [%] THD I1 [%] THD I2 [%] THD I3 [%] Network frequency [Hz] Sensor temperature [°C]
Averaging window **15 min**; 1 – 1440 min	Measurement settings	Power sum averaging window [minutes]	Averaging sliding window with 1 minute refresh time. The interval range is 1 to 1440 min (1 day). Measurements averaged: Average active power sum Average reactive power sum Average apparent power sum
LCD backlight behavior 0: OFF, 1: ON, **2: Auto OFF**	Display behavior	Backlight behavior	The backlight behavior can be selected as following: 0: Backlight is always OFF 1: Backlight is always ON 2: Backlight switches ON when button pressed and switches OFF automatically after a predefined delay.
Home cycle time **5 sec**; 2-10 sec	Display behavior	LCD menu scrolling speed	Principal (Home) display scrolling speed can be selected in a range of 2 – 10 seconds.

Bold values are always de default values!

A

PCD1.P1001-J30 Time zone configuration (Module type = 0x0C)

Description	Group adjust window	Text adjust window	Text help
UTC offset **60 min**; –720 - +720 min	Time zone	UTC/GMT offset for Winter time	UTC/GMT time offset in minutes for Winter
Start time: Month **10**; 1 – 12 1: January, 2: February, 3: March, 4: April, 5: May, 6: June, 7: July, 8: August, 9: September, **10: October**, 11: November, 12: December	Time zone	Winter time start month	Month when the winter timer starts
Start time: Week of month **5**; 1 – 5	Time zone	Winter time start week	Week of the month when the winter timer starts
Start time: Day of week **0: Sunday**, 1: Monday, 2: Tuesday, 3: Wednesday, 4: Thursday, 5: Friday, 6: Saturday	Time zone	Winter time start day	Day of the week when the winter timer starts (Sunday = 0)
Start time: Local Hour **3**; 0 – 23	Time zone	Winter time start hour	Hour when the winter timer starts
Input identifier 1: (Summer time zone)			
UTC offset **120 min**; –720 - +720 min	Time zone	UTC/GMT offset for Summer time	UTC/GMT time offset in minutes for Summer
Start time: Month 1: January, 2: February, **3: March**, 4: April, 5: May, 6: June, 7: July, 8: August, 9: September, 10: October, 11: November, 12: December	Time zone	Summer time start month	Month when the summer timer starts
Start time: Week of month **5**; 1 – 5	Time zone	Summer time start week	Week of the month when the summer timer starts
Start time: Day of week **0: Sunday**, 1: Monday, 2: Tuesday, 3: Wednesday, 4: Thursday, 5: Friday, 6: Saturday	Time zone	Summer time start day	Day of the week when the summer timer starts (Sunday = 0)
Start time: Local Hour **2**; 0 – 23	Time zone	Summer time start hour	Hour when the summer timer starts

Bold values are always de default values!

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PCD1.P1001-J30 specific configuration (Module type = 0x0C)

Description	Group adjust window	Text adjust window	Text help
Secondary current **0 : 5 A**, 1 : 1 A	Current input settings	L1-3 transformers sec. current	L1-3 secondary current can be selected between 5 A (0) or 1 A (1)
Primary current **100 A**, 1-1500 A	Current input settings	L1-3 transformer primary current	L1-3 primary current can be selected between 1 A and 1500 A (5 A steps)
Secondary current **0 : 5 A**, 1 : 1 A	Current input settings	N transformer sec. current	N secondary current can be selected between 5 A (0) or 1 A (1)
Primary current **100 A**, 1-1500 A	Current input settings	N transformer primary current	N primary current can be selected between 1 A and 1500 A (5 A steps)
Level **110 %**, 101-200 %	Events thresholds	SWELL/Overvoltage detection thld	SWELL is an increase between 101 and 200% in RMS voltage for durations of 0.5 cycles to 1 minute. Overvoltage is an increase between 101 and 200% in RMS voltage for a duration bigger as 1 minute. This value defines the detection threshold for which an event will happen in the PQA.
Threshold level SAG/ Low voltage **90 %**, 10-99 %	Events thresholds	SAG/Low voltage detection thld	SAG is a decrease between 10 and 99 % in RMS voltage for durations of 0.5 cycles to 1 minute. Low voltage is a decrease between 10 and 99 % in RMS voltage for a duration bigger as 1 minute. This value defines the detection threshold for which an event will happen in the PQA.
Threshold level voltage peak **110 %**, 101-200 %	Events thresholds	Voltage peak detection thld	Voltage peak is an increase in voltage for a short duration (< 0.5 cycles) This value defines the detection threshold for which an event will happen in the PQA.
Threshold level Voltage THD **3 %**, 1-99 %	Events thresholds	Voltage THD detection thld	THD is a measurement of the harmonic distortion. It is the ratio of the sum of all harmonic components to the fundamental frequency. This value defines the detection threshold for which an event will happen in the PQA.
Threshold level Current Peak Ph1-3 **110 %**, 101-120 %	Events thresholds	L1-L3 current peak det. thld	Current peak is an increase in current for a short duration (< 0.5 cycles) This value defines the detection threshold for which an event will happen in the PQA.
Threshold level Over current Ph1-3 **110 %**, 101-120 %	Events thresholds	L1-L3 overcurrent det. thld	Overcurrent is sustained increase between 101 and 120% in RMS current This value defines the detection threshold for which an event will happen in the PQA.
Threshold level Over current N **110 %**, 101-120 %	Events thresholds	N overcurrent detection thld	Overcurrent is sustained increase between 101 and 120% in RMS current This value defines the detection threshold for which an event will happen in the PQA.
Threshold level Current THD **3 %**, 1-99 %	Events thresholds	Current THD detection thld	THD is a measurement of the harmonic distortion. It is the ratio of the sum of all harmonic components to the fundamental frequency. This value defines the detection threshold for which an event will happen in the PQA.

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Description	Group adjust window	Text adjust window	Text help
Threshold level External temperature high **55 °C**, -50-400 °C	Temperature settings	External temp higher det. thld	Higher temperature threshold on the external temperature sensor. This value defines the detection threshold for which an event will happen in the PQA.
Threshold level External temperature low **-10 °C**, -50-400 °C	Temperature settings	External temp lower det. thld	Lower temperature threshold on the external temperature sensor. This value defines the detection threshold for which an event will happen in the PQA.
Threshold level Internal temperature high **55 °C**, -40-85 °C	Temperature settings	Internal temp higher det. thld	Higher temperature threshold on the internal temperature sensor. This value defines the detection threshold for which an event will happen in the PQA.
Threshold level Internal temperature low **-10 °C**, -40-85 °C	Temperature settings	Internal temp lower det. thld	Lower temperature threshold on the internal temperature sensor. This value defines the detection threshold for which an event will happen in the PQA.

Bold values are always de default values!

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A.4.2 Measurement FBox

Provides “live” measurements like energy, voltage, THD and can reset some measurements Registers 13-75 (63 Registers) & Flags 9, 13-15, 49-55 (11 Flags):

PQA Reg#	Flag#	Read	Write	Symbol	Comment
Energy					
13		X		Energy.L1_kWh	Active energy L1
14		X		Energy.L2_kWh	Active energy L2
15		X		Energy.L3_kWh	Active energy L3
45		X		Energy.Tot_kWh	Active energy sum
16		X		Energy.L1_kvarh	Reactive energy L1
17		X		Energy.L2_kvarh	Reactive energy L2
18		X		Energy.L3_kvarh	Reactive energy L3
46		X		Energy.Tot_kvarh	Reactive energy sum
48		X		Energy.L1_kVAh	Apparent energy L1
49		X		Energy.L2_kVAh	Apparent energy L2
50		X		Energy.L3_kVAh	Apparent energy L3
47		X		Energy.Tot_kVAh	Apparent energy sum
51		X		Energy.Ext_cnt_kWh	External impulse count active energy
	49	X	X	Energy.Energy.RST_all_energy	RESET all energy meas
	50	X	X	Energy.RST_kWh	RESET active energy mes
	51	X	X	Energy.RST_kvarh	RESET reactive energy meas
	52	X	X	Energy.RST_kVAh	RESET apparent energy meas
	53	X	X	Energy.RST_ext_cnt	RESET external active energy count
Power					
19		X		Power.L1_kW	Active power L1
20		X		Power.L2_kW	Active power L2
21		X		Power.L3_kW	Active power L3
52		X		Power.Tot_kW	Active power sum
25		X		Power.Max_tot_kW	Max active power sum
59		X		Power.Avg_tot_kW	Average active power sum
62		X		Power.Load_Percentage	Full load percentage
22		X		Power.L1_kvar	Reactive power L1
23		X		Power.L2_kvar	Reactive power L2
24		X		Power.L3_kvar	Reactive power L3
53		X		Power.Tot_kvar	Reactive power sum
26		X		Power.Max_tot_kvar	Max reactive power sum
60		X		Power.Avg_tot_kvar	Average reactive power sum
55		X		Power.L1_kVA	Apparent power L1
56		X		Power.L2_kVA	Apparent power L2
57		X		Power.L3_kVA	Apparent power L3
54		X		Power.Tot_kVA	Apparent power sum
58		X		Power.Max_tot_kVA	Max apparent power sum
61		X		Power.Avg_tot_kVA	Average apparent power sum
	54	X	X	Power.RST_all_max	RESET all max meas
	55	X	X	Power.RST_all_avg	RESET all average meas
Voltage					
27		X		Voltage.U1_rms	URMS 1
28		X		Voltage.U2_rms	URMS 2
29		X		Voltage.U3_rms	URMS 3

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PQA Reg#	Flag#	Read	Write	Symbol	Comment
Current					
30		X		Current.I1_rms	IRMS 1
31		X		Current.I2_rms	IRMS 2
32		X		Current.I3_rms	IRMS 3
33		X		Current.IN_rms	IRMS N
	13	X		Current.I1_inverted	I1 inverted
	14	X		Current.I2_inverted	I2 inverted
	15	X		Current.I3_inverted	I3 inverted
	9	X		Current.Current_mismatch	Current mismatch
PF & freq					
43		X		PF_and_freq.Freq	Network frequency
34		X		PF_and_freq.PF1	Power factor 1
35		X		PF_and_freq.PF2	Power factor 2
36		X		PF_and_freq.PF3	Power factor 3
63		X		PF_and_freq.Tot_PF	Total power factor
65		X		PF_and_freq.cos_phi_1	Cos phi 1
66		X		PF_and_freq.cos_phi_2	Cos phi 2
67		X		PF_and_freq.cos_phi_3	Cos phi 3
64		X		PF_and_freq.Tot_cos_phi	Total cos phi
THD & TDD					
37		X		THD_and_TDD.U1_THD	U1 total harmonic distortion
38		X		THD_and_TDD.U2_THD	U2 total harmonic distortion
39		X		THD_and_TDD.U3_THD	U3 total harmonic distortion
40		X		THD_and_TDD.I1_THD	I1 total harmonic distortion
41		X		THD_and_TDD.I2_THD	I2 total harmonic distortion
42		X		THD_and_TDD.I3_THD	I3 total harmonic distortion
68		X		THD_and_TDD.I1_TDD	I1 total demand distortion
69		X		THD_and_TDD.I2_TDD	I2 total demand distortion
70		X		THD_and_TDD.I3_TDD	I3 total demand distortion
Temperature					
44		X		Temperature.Ext_temp	External temperature
75		X		Temperature.Int_temp	Internal temperature
Phase angle & sequ					
72		X		Phase_angle_and_sequ.U1_2_angle	Angle U Phase 1-2
73		X		Phase_angle_and_sequ.U2_3_angle	Angle U Phase 2-3
74		X		Phase_angle_and_sequ.U1_3_angle	Angle U Phase 1-3
71		X		Phase_angle_and_sequ.Phase_seq	Wrong phase sequence

Bold values are always de default values!

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A.4.3 Status FBox

Provides switches, I/Os, device connections, memory and events status Registers 76-77 (2 Registers) & Flags 0-8, 10-12 and 20-22 (16 Flags):

PQA Reg#	Flag#	Read	Write	Symbol	Comment
Events and status					
	5	X		Events_and_status.L1_conn	Phase 1 connected
	6	X		Events_and_status.L2_conn	Phase 2 connected
	7	X		Events_and_status.L3_conn	Phase 3 connected
	8	X		Events_and_status.N_conn	N connected
	10	X		Events_and_status.L1_too_high	Load Ph1 too high
	11	X		Events_and_status.L2_too_high	Load Ph2 too high
	12	X		Events_and_status.L3_too_high	Load Ph3 too high
	16	X		Events_and_status.L1_error_event	Error or event on Ph1
	17	X		Events_and_status.L2_error	Error or event on Ph2
	18	X		Events_and_status.L3_error	Error or event on Ph3
	19	X		Events_and_status.N_error	Error or event on N
77		X		Events_and_status.Events	Measurement events
76		X		Events_and_status.Mem_Percentage	% memory full
I_O and R term					
	4	X		IO_and_R_term.DigitalInput	Digital input
	20	X		IO_and_R_term.DigitalOutput	Digital output
	21	X		IO_and_R_term.Relay0	Relay 0
	22	X		IO_and_R_term.Relay1	Relay 1
Switches status					
	0	X		Switches_status.Switch1	Switch 1 pressed
	1	X		Switches_status.Switch2	Switch 2 pressed
	2	X		Switches_status.Switch3	Switch 3 pressed
	3	X		Switches_status.Switch4	Switch 4 pressed

Bold values are always de default values!

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A.4.4 Events FBox

Provides events measurements like SAGs, low-voltage and can clear those events and switches status.

These values are only read if there has been a change in the reg 77 of “Status FBox” (new event) and no more after a clear of the corresponding flag.

Registers 77,78-173 (97 Registers) & Flags 56-95 (40 Flags):

PQA Reg#	Flag#	Read	Write	Symbol	Comment	PCD Symbol
SAG						
78		X		SAG.POSIX_time_SAG_U1	POSIX timestamp SAG U1	SAR_Read[78-77]
-				SAG.Local_Date_SAG_U1	Local Date SAG U1	SAR_StampDate [0]
-				SAG.Local_Time_SAG_U1	Local Time SAG U1	SAR_StampTime[0]
79		X		SAG.SAG_U1	Amplitude SAG U1	
80		X		SAG.Duration_SAG_U1	Duration SAG U1	
	58	X	X	SAG.Clear_SAG_U1	CLEAR SAG U1 event	
81		X		SAG.POSIX_time_SAG_U2	POSIX timestamp SAG U2	SAR_Read[81-77]
-				SAG.Local_Date_SAG_U2	Local Date SAG U2	SAR_StampDate [1]
-				SAG.Local_Time_SAG_U2	Local Time SAG U2	SAR_StampTime[1]
82		X		SAG.SAG_U2	Amplitude SAG U2	
83		X		SAG.Duration_SAG_U2	Duration SAG U2	
	59	X	X	SAG.Clear_SAG_U2	CLEAR SAG U2 event	
84		X		SAG.POSIX_time_SAG_U3	POSIX timestamp SAG U3	SAR_Read[84-77]
-				SAG.Local_Date_SAG_U3	Local Date SAG U2	SAR_StampDate [2]
-				SAG.Local_Time_SAG_U3	Local Time SAG U2	SAR_StampTime[2]
85		X		SAG.SAG_U3	Amplitude SAG U3	
86		X		SAG.Duration_SAG_U3	Duration SAG U3	
	60	X	X	SAG.Clear_SAG_U3	CLEAR SAG U3 event	
	57	X	X	SAG.Clear_all_SAGs	CLEAR all SAG events	
Low voltage						
87		X		Low_voltage.POSIX_time_ Low_U1	POSIX timestamp low volt-age U1	SAR_Read[87-77]
-				Low_voltage.Local_Date_ Low_U1	Local Date low voltage U1	SAR_StampDate [3]
-				Low_voltage.Local_Time_ Low_U1	Local Time low voltage U1	SAR_StampTime[3]
88		X		Low_voltage.Low_U1	Amplitude low voltage U1	
89		X		Low_voltage.Duration_ Low_U1	Duration low voltage U1	
	62	X	X	Low_voltage.Clear_low_U1	CLEAR low-voltage U1 event	
90		X		Low_voltage.POSIX_time_ Low_U2	POSIX timestamp low volt-age U2	SAR_Read[90-77]
-				Low_voltage.Local_Date_ Low_U2	Local Date low voltage U2	SAR_StampDate [4]
-				Low_voltage.Local_Time_ Low_U2	Local Time low voltage U2	SAR_StampTime[4]
91		X		Low_voltage.Low_U2	Amplitude low voltage U2	
92		X		Low_voltage.Duration_ Low_U2	Duration low voltage U2	
	63	X	X	Low_voltage.Clear_low_U2	CLEAR low-voltage U2 event	
93		X		Low_voltage.POSIX_time_ Low_U3	POSIX timestamp low volt-age U3	SAR_Read[93-77]
-				Low_voltage.Local_Date_ Low_U3	Local Date low voltage U3	SAR_StampDate [5]

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PQA Reg#	Flag#	Read	Write	Symbol	Comment	PCD Symbol
-				Low_voltage.Local_Time_Low_U3	Local Time low voltage U3	SAR_StampTime[5]
94		X		Low_voltage.Low_U3	Amplitude low voltage U3	
95		X		Low_voltage.Duration_Low_U3	Duration low voltage U3	
	64	X	X	Low_voltage.Clear_low_U3	CLEAR low-voltage U3 event	
	61	X	X	Low_voltage.Clear_all_Low_U	CLEAR all low-voltage events	
Voltage peak						
96		X		Voltage_peak.POSIX_time_peak_U1_1	POSIX timestamp Peak U1 #1	SAR_Read[96-77]
-				Voltage_peak.Local_Date_peak_U1_1	Local Date Peak U1 #1	SAR_StampDate [6]
-				Voltage_peak.Local_Time_peak_U1_1	Local Time Peak U1 #1	SAR_StampTime[6]
97		X		Voltage_peak.Peak_U1_1	Amplitude peak U1 #1	
98		X		Voltage_peak.POSIX_time_peak_U1_2	POSIX timestamp Peak U1 #2	SAR_Read[98-77]
-				Voltage_peak.Local_Date_peak_U1_2	Local Date Peak U1 #2	SAR_StampDate [7]
-				Voltage_peak.Local_Time_peak_U1_2	Local Time Peak U1 #2	SAR_StampTime[7]
99		X		Voltage_peak.Peak_U1_2	Amplitude peak U1 #2	
	66	X	X	Voltage_peak.Clear_peaks_U1	CLEAR peak U1 events	
100		X		Voltage_peak.POSIX_time_peak_U2_1	POSIX timestamp Peak U2 #1	SAR_Read[100-77]
-				Voltage_peak.Local_Date_peak_U2_1	Local Date Peak U2 #1	SAR_StampDate [8]
-				Voltage_peak.Local_Time_peak_U2_1	Local Time Peak U2 #1	SAR_StampTime[8]
101		X		Voltage_peak.Peak_U2_1	Amplitude peak U2 #1	
102		X		Voltage_peak.POSIX_time_peak_U2_2	POSIX timestamp Peak U2 #2	SAR_Read[101-77]
-				Voltage_peak.Local_Date_peak_U2_2	Local Date Peak U2 #2	SAR_StampDate [9]
-				Voltage_peak.Local_Time_peak_U2_2	Local Time Peak U2 #2	SAR_StampTime[9]
103		X		Voltage_peak.Peak_U2_2	Amplitude peak U2 #2	
	67	X	X	Voltage_peak.Clear_peaks_U2	CLEAR peak U2 events	
104		X		Voltage_peak.POSIX_time_peak_U3_1	POSIX timestamp Peak U3 #1	SAR_Read[104-77]
-				Voltage_peak.Local_Date_peak_U3_1	Local Date Peak U3 #1	SAR_StampDate [10]
-				Voltage_peak.Local_Time_peak_U3_1	Local Time Peak U3 #1	SAR_StampTime[10]
105		X		Voltage_peak.Peak_U3_1	Amplitude peak U3 #1	
106		X		Voltage_peak.POSIX_time_peak_U3_2	POSIX timestamp Peak U3 #2	SAR_Read[106-77]
-				Voltage_peak.Local_Date_peak_U3_2	Local Date Peak U3 #2	SAR_StampDate [11]
-				Voltage_peak.Local_Time_peak_U3_2	Local Time Peak U3 #2	SAR_StampTime[11]
107		X		Voltage_peak.Peak_U3_2	Amplitude peak U3 #2	
	68	X	X	Voltage_peak.Clear_peaks_U3	CLEAR peak U3 events	
	65	X	X	Voltage_peak.Clear_all_peaks_U	CLEAR all voltage peak events	

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PQA Reg#	Flag#	Read	Write	Symbol	Comment	PCD Symbol
SWELL						
108		X		SWELL.POSIX_time_ SWELL_U1	POSIX timestamp SWELL U1	SAR_Read[108-77]
-				SWELL.Local_Date_ SWELL_U1	Local Date SWELL U1	SAR_StampDate [12]
-				SWELL.Local_Time_ SWELL_U1	Local Time SWELL U1	SAR_StampTime[12]
109		X		SWELL.SWELL_U1	Amplitude SWELL U1	
110		X		SWELL.Duration_SWELL_ U1	Duration SWELL U1	
	70	X	X	SWELL.Clear_SWELL_U1	CLEAR SWELL U1 event	
111		X		SWELL.POSIX_time_ SWELL_U2	POSIX timestamp SWELL U2	SAR_Read[111-77]
-				SWELL.Local_Date_ SWELL_U2	Local Date SWELL U2	SAR_StampDate [13]
-				SWELL.Local_Time_ SWELL_U2	Local Time SWELL U2	SAR_StampTime[13]
112		X		SWELL.SWELL_U2	Amplitude SWELL U2	
113		X		SWELL.Duration_SWELL_ U2	Duration SWELL U2	
	71	X	X	SWELL.Clear_SWELL_U2	CLEAR SWELL U2 event	
114		X		SWELL.POSIX_time_ SWELL_U3	POSIX timestamp SWELL U3	SAR_Read[114-77]
-				SWELL.Local_Date_ SWELL_U3	Local Date SWELL U3	SAR_StampDate [14]
-				SWELL.Local_Time_ SWELL_U3	Local Time SWELL U3	SAR_StampTime[14]
115		X		SWELL.SWELL_U3	Amplitude SWELL U3	
116		X		SWELL.Duration_SWELL_ U3	Duration SWELL U3	
	72	X	X	SWELL.Clear_SWELL_U3	CLEAR SWELL U3 event	
	69	X	X	SWELL.Clear_all_SWELLs	CLEAR all SWELL events	
Over-voltage						
117		X		Over_voltage.POSIX_time_ Over_U1	POSIX timestamp Over-voltage U1	SAR_Read[117-77]
-				Over_voltage.Local_Date_ Over_U1	Local Date Over-voltage U1	SAR_StampDate [15]
-				Over_voltage.Local_Time_ Over_U1	Local Time Over-voltage U1	SAR_StampTime[15]
118		X		Over_voltage. Over_U1	Amplitude over-voltage U1	
119		X		Over_voltage.Duration_ Over_U1	Duration Over-voltage U1	
	74	X	X	Over_voltage.Clear_Over_ U1	CLEAR Over-voltage U1 event	
120		X		Over_voltage.POSIX_time_ Over_U2	POSIX timestamp Over-voltage U2	SAR_Read[120-77]
-				Over_voltage.Local_Date_ Over_U2	Local Date Over-voltage U2	SAR_StampDate [16]
-				Over_voltage.Local_Time_ Over_U2	Local Time Over-voltage U2	SAR_StampTime[16]
121		X		Over_voltage.Over_U2	Amplitude over-voltage U2	
122		X		Over_voltage.Duration_ Over_U2	Duration Over-voltage U2	
	75	X	X	Over_voltage.Clear_Over_ U2	CLEAR Over-voltage U2 event	
123		X		Over_voltage.POSIX_time_ Over_U3	POSIX timestamp Over-voltage U3	SAR_Read[123-77]
-				Over_voltage.Local_Date_ Over_U3	Local Date Over-voltage U3	SAR_StampDate [17]

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PQA Reg#	Flag#	Read	Write	Symbol	Comment	PCD Symbol
-				Over_voltage.Local_Time_Over_U3	Local Time Over-voltage U3	SAR_StampTime[17]
124		X		Over_voltage.Over_U3	Amplitude over-voltage U3	
125		X		Over_voltage.Duration_Over_U3	Duration Over-voltage U3	
	76	X	X	Over_voltage.Clear_Over_U3	CLEAR Over-voltage U3 event	
	73	X	X	Over_voltage.Clear_all_Over_U	CLEAR all Over-voltage events	
Voltage THD						
126		X		Voltage_THD.POSIX_time_THD_U1	POSIX timestamp Over-THD U1	SAR_Read[126-77]
-				Voltage_THD.Local_Date_THD_U1	Local Date Over-THD U1	SAR_StampDate [18]
-				Voltage_THD.Local_Time_THD_U1	Local Time Over-THD U1	SAR_StampTime[18]
127		X		Voltage_THD.THD_U1	Amplitude Over-THD U1	
128		X		Voltage_THD.Duration_THD_U1	Duration Over-THD U1	
	78	X	X	Voltage_THD.Clear_THD_U1	CLEAR over-THD U1 event	
129		X		Voltage_THD.POSIX_time_THD_U2	POSIX timestamp Over-THD U2	SAR_Read[129-77]
-				Voltage_THD.Local_Date_THD_U2	Local Date Over-THD U2	SAR_StampDate [19]
-				Voltage_THD.Local_Time_THD_U2	Local Time Over-THD U2	SAR_StampTime[19]
130		X		Voltage_THD.THD_U2	Amplitude Over-THD U2	
131		X		Voltage_THD.Clear_THD_U2	Duration Over-THD U2	
	79	X	X	Voltage_THD.Clear_THD_U2	CLEAR over-THD U2 event	
132		X		Voltage_THD.POSIX_time_THD_U3	POSIX timestamp Over-THD U3	SAR_Read[132-77]
-				Voltage_THD.Local_Date_THD_U3	Local Date Over-THD U3	SAR_StampDate [20]
-				Voltage_THD.Local_Time_THD_U3	Local Time Over-THD U3	SAR_StampTime[20]
133		X		Voltage_THD.THD_U3	Amplitude Over-THD U3	
134		X		Voltage_THD.Clear_THD_U3	Duration Over-THD U3	
	80	X	X	Voltage_THD.Clear_THD_U3	CLEAR over-THD U3 event	
	77	X	X	Voltage_THD.Clear_all_THD_U	CLEAR all Over-THD U events	
Current peak						
135		X		Current_peak.POSIX_time_peak_I1_1	POSIX timestamp Peak I1 #1	SAR_Read[135-77]
-				Current_peak.Local_Date_peak_I1_1	Local Date Peak I1 #1	SAR_StampDate [21]
-				Current_peak.Local_Time_peak_I1_1	Local Time Peak I1 #1	SAR_StampTime[21]
136		X		Current_peak.Peak_I1_1	Amplitude peak I1 #1	
137		X		Current_peak.POSIX_time_peak_I1_2	POSIX timestamp Peak I1 #2	SAR_Read[136-77]
-				Current_peak.Local_Date_peak_I1_2	Local Date Peak I1 #2	SAR_StampDate [22]
-				Current_peak.Local_Time_peak_I1_2	Local Time Peak I1 #2	SAR_StampTime[22]
138		X		Current_peak.Peak_I1_2	Amplitude peak I1 #2	
	82	X	X	Current_peak.Clear_peaks_I1	CLEAR peak I1 events	
139		X		Current_peak.POSIX_time_peak_I2_1	POSIX timestamp Peak I2 #1	SAR_Read[139-77]

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PQA Reg#	Flag#	Read	Write	Symbol	Comment	PCD Symbol
-				Current_peak.Local_Date_peak_I2_1	Local Date Peak I2 #1	SAR_StampDate [23]
-				Current_peak.Local_Time_peak_I2_1	Local Time Peak I2 #1	SAR_StampTime[23]
140		X		Current_peak.Peak_I2_1	Amplitude peak I2 #1	
141		X		Current_peak.POSIX_time_peak_I2_2	POSIX timestamp Peak I2 #2	SAR_Read[141-77]
-				Current_peak.Local_Date_peak_I2_2	Local Date Peak I2 #2	SAR_StampDate [24]
-				Current_peak.Local_Time_peak_I2_2	Local Time Peak I2 #2	SAR_StampTime[24]
142		X		Current_peak.Peak_I2_2	Amplitude peak I2 #2	
	83	X	X	Current_peak.Clear_peaks_I2	CLEAR peak I2 events	
143		X		Current_peak.POSIX_time_peak_I3_1	POSIX timestamp Peak I3 #1	SAR_Read[143-77]
-				Current_peak.Local_Date_peak_I3_1	Local Date Peak I3 #1	SAR_StampDate [25]
-				Current_peak.Local_Time_peak_I3_1	Local Time Peak I3 #1	SAR_StampTime[25]
144		X		Current_peak.Peak_I3_1	Amplitude peak I3 #1	
145		X		Current_peak.POSIX_time_peak_I3_2	POSIX timestamp Peak I3 #2	SAR_Read[145-77]
-				Current_peak.Local_Date_peak_I3_2	Local Date Peak I3 #2	SAR_StampDate [26]
-				Current_peak.Local_Time_peak_I3_2	Local Time Peak I3 #2	SAR_StampTime[26]
146		X		Current_peak.Peak_I3_2	Amplitude peak I3 #2	
	84	X	X	Current_peak.Clear_peaks_I3	CLEAR peak I3 events	
	81	X	X	Current_peak.Clear_all_peaks_I	CLEAR all current peak events	
Over-current						
147		X		Over_current.POSIX_time_Over_I1	POSIX timestamp Over-current I1	SAR_Read[147-77]
-				Over_current.Local_Date_Over_I1	Local Date Over-current I1	SAR_StampDate [27]
-				Over_current.Local_Time_Over_I1	Local Time Over-current I1	SAR_StampTime[27]
148		X		Over_current.Over_I1	Amplitude over-current I1	
149		X		Over_current.Duration_Over_I1	Duration Over-current I1	
	86	X	X	Over_current.Clear_Over_I1	CLEAR Over-current I1 event	
150		X		Over_current.POSIX_time_Over_I2	POSIX timestamp Over-current I2	SAR_Read[150-77]
-				Over_current.Local_Date_Over_I2	Local Date Over-current I2	SAR_StampDate [28]
-				Over_current.Local_Time_Over_I2	Local Time Over-current I2	SAR_StampTime[28]
151		X		Over_current.Over_I2	Amplitude over-current I2	
152		X		Over_current.Duration_Over_I2	Duration Over-current I2	
	87	X	X	Over_current.Clear_Over_I2	CLEAR Over-current I2 event	
153		X		Over_current.POSIX_time_Over_I3	POSIX timestamp Over-current I3	SAR_Read[153-77]
-				Over_current.Local_Date_Over_I3	Local Date Over-current I3	SAR_StampDate [29]
-				Over_current.Local_Time_Over_I3	Local Time Over-current I3	SAR_StampTime[29]
154		X		Over_current.Over_I3	Amplitude over-current I3	

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PQA Reg#	Flag#	Read	Write	Symbol	Comment	PCD Symbol
155		X		Over_current.Duration_ Over_I3	Duration Over-current I3	
	88	X	X	Over_current.Clear_Over_I3	CLEAR Over-current I3 event	
156		X		Over_current.POSIX_time_ Ove_IN	POSIX timestamp Over-current IN	SAR_Read[156-77]
-				Over_current.Local_Date_ Over_IN	Local Date Over-current IN	SAR_StampDate [30]
-				Over_current.Local_Time_ Over_IN	Local Time Over-current IN	SAR_StampTime[30]
157		X		Over_current.Over_IN	Amplitude over-current IN	
158		X		Over_current.Duration_ Over_IN	Duration Over-current IN	
	89	X	X	Over_current.Clear_Over_IN	CLEAR Over-current IN event	
	85	X	X	Over_current.Clear_all_ Over_I	CLEAR all Over-current events	
Current THD						
159		X		Current_THD.POSIX_time_ THD_I1	POSIX timestamp Over-THD I1	SAR_Read[159-77]
-				Current_THD.Local_Date_ THD_I1	Local Date Over-THD I1	SAR_StampDate [31]
-				Current_THD.Local_Time_ THD_I1	Local Time Over-THD I1	SAR_StampTime[31]
160		X		Current_THD.THD_I1	Amplitude Over-THD I1	
161		X		Current_THD.Duration_ THD_I1	Duration Over-THD I1	
	91	X	X	Current_THD.Clear_THD_I1	CLEAR over-THD I1 event	
162		X		Current_THD.POSIX_time_ THD_I2	POSIX timestamp Over-THD I2	SAR_Read[162-77]
-				Current_THD.Local_Date_ THD_I2	Local Date Over-THD I2	SAR_StampDate [32]
-				Current_THD.Local_Time_ THD_I2	Local Time Over-THD I2	SAR_StampTime[32]
163		X		Current_THD.THD_I2	Amplitude Over-THD I2	
164		X		Current_THD.Clear_THD_I2	Duration Over-THD I2	
	92	X	X	Current_THD.Clear_THD_I2	CLEAR over-THD I2 event	
165		X		Current_THD.POSIX_time_ THD_I3	POSIX timestamp Over-THD I3	SAR_Read[165-77]
-				Current_THD.Local_Date_ THD_I3	Local Date Over-THD I3	SAR_StampDate [33]
-				Current_THD.Local_Time_ THD_I3	Local Time Over-THD I3	SAR_StampTime[33]
166		X		Current_THD.THD_I3	Amplitude Over-THD I3	
167		X		Current_THD.Clear_THD_I3	Duration Over-THD I3	
	93	X	X	Current_THD.Clear_THD_I3	CLEAR over-THD I3 event	
	90	X	X	Current_THD.Clear_all_ THD_I	CLEAR all Over-THD I events	
Temperature						
168		X		Temperature.POSIX.time. ext.temp	POSIX timestamp external temperature	SAR_Read[168-77]
-				Temperature.Local_Date. ext.temp	Local Date external temperature	SAR_StampDate [34]
-				Temperature.Local_Time. ext.temp	Local Time external temperature	SAR_StampTime[34]
169		X		Temperature.Ext_temp	Value external temperature	
170		X		Temperature.Duration_ext_ temp	Duration external temperature	
	94	X	X	Temperature.CLEAR_ext_ temp	CLEAR external temperature event	

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PQA Reg#	Flag#	Read	Write	Symbol	Comment	PCD Symbol
171		X		Temperature.POSIX.time.int.temp	POSIX timestamp internal temperature	SAR_Read[171-77]
-				Temperature.Local_Date.int.temp	Local Date internal temperature	SAR_StampDate[35]
-				Temperature.Local_Time.int.temp	Local Time internal temperature	SAR_StampTime[35]
172		X		Temperature.int.temp	Value internal temperature	
173		X		Temperature.Duration.int.temp	Duration internal temperature	
	95	X	X	Temperature.CLEAR.int.temp	CLEAR internal temperature event	
Clear all events						
	56	X	X	Clear_all_events.Clear_all_events	CLEAR all events	

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A.4.5 Harmonics FBox

Provides voltages and currents harmonics

Registers, U1 as example, other adressranges as shown in the table:

- U1: reg 174-214
- U2: reg 215-255
- U3: reg 256-296
- I1: reg 297-337
- I2: reg 338-378
- I3: reg 379-419

User can place multiple FBoxes if he is interested in different voltages or currents harmonics.

Reg#	Flag#	Read	Write	Symbol	Comment
174		X		H0_U1	DC component U1
175		X		H1_U1	Harmonic 1 (fundamental) U1
176		X		H2_U1	Harmonic 2 U1
177		X		H3_U1	Harmonic 3 U1
178		X		H4_U1	Harmonic 4 U1
179		X		H5_U1	Harmonic 5 U1
180		X		H6_U1	Harmonic 6 U1
181		X		H7_U1	Harmonic 7 U1
182		X		H8_U1	Harmonic 8 U1
183		X		H9_U1	Harmonic 9 U1
184		X		H10_U1	Harmonic 10 U1
185		X		H11_U1	Harmonic 11 U1
186		X		H12_U1	Harmonic 12 U1
187		X		H13_U1	Harmonic 13 U1
188		X		H14_U1	Harmonic 14 U1
189		X		H15_U1	Harmonic 15 U1
190		X		H16_U1	Harmonic 16 U1
191		X		H17_U1	Harmonic 17 U1
192		X		H18_U1	Harmonic 18 U1
193		X		H19_U1	Harmonic 19 U1
194		X		H20_U1	Harmonic 20 U1
195		X		H21_U1	Harmonic 21 U1
196		X		H22_U1	Harmonic 22 U1
197		X		H23_U1	Harmonic 23 U1
198		X		H24_U1	Harmonic 24 U1
199		X		H25_U1	Harmonic 25 U1
200		X		H26_U1	Harmonic 26 U1
201		X		H27_U1	Harmonic 27 U1
202		X		H28_U1	Harmonic 28 U1
203		X		H29_U1	Harmonic 29 U1
204		X		H30_U1	Harmonic 30 U1
205		X		H31_U1	Harmonic 31 U1
206		X		H32_U1	Harmonic 32 U1

207		X		H33_U1	Harmonic 33 U1
208		X		H34_U1	Harmonic 34 U1
209		X		H35_U1	Harmonic 35 U1
210		X		H36_U1	Harmonic 36 U1
211		X		H37_U1	Harmonic 37 U1
212		X		H38_U1	Harmonic 38 U1
213		X		H39_U1	Harmonic 39 U1
214		X		H40_U1	Harmonic 40 U1

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