



ibaPQU-S

Power Quality Measurement Unit according to IEC61000-4-30 Ed. 3 Class A

Manual

Issue 1.5

Measurement Systems for Industry and Energy www.iba-ag.com

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Certification

The product is certified according to the European standards and directives. This product meets the general safety and health requirements.

Further international customary standards and directives have been observed.

CE



Note: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

Issue	Date	Revisions	Chapter	Author	Version HW/FW
1.5	04-2023	Accessories, GUI, FO cable			

Table of Contents

1	About	this manual	7
	1.1	Target group	8
	1.2	Notations	8
	1.3	Used symbols	9
2	Introdu	iction	10
	2.1	Modular concept	.11
	2.2	Measurements according to EN50160	12
3	Scope	of delivery	12
4	Safety	instructions	13
	4.1	Intended use	13
	4.2	Special safety instructions	13
5	System	n requirements	14
	5.1	Hardware	14
	5.2	Software	14
	5.3	Firmware	14
6	Mounti	ng, connecting, dismounting	15
	6.1	Mounting	15
	6.2	Connecting	16
	6.3	Dismounting	16
7	Device	description	17
	7.1	Views	17
	7.2	Display elements	18
	7.2.1	Operating state L1L4	18
	7.2.2	LEDs L5L8	18
	7.2.3	Indicators digital inputs L10…L17	19
	7.3	Operating elements	19
	7.3.1	ON/OFF switch S11	19
	7.3.2	Rotary switches S1 and S2	19
	7.4	Communication interfaces	20
	7.4.1	Fiber optic connections X10 and X11	20
	7.4.2	Network interface X22	20
	7.5	Digital inputs X5	20
	7.5.1	Connection diagram / pin assignment	20
	7.5.2	Debounce filter	21
	7.6	Voltage supply	24
	7.6.1	Voltage supply X14	24
-	7.0.2	Buller voltage X30	24
8	Measu	rement principles and measured quantities	25
	8.1	Grid types	25
	8.2	Signals and calculated characteristic values	26
	8.3	System integration	28

3

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	8.4	Time synchronization	. 28
	8.5	Signal processing	. 28
	8.5.1	Sampling rate	. 28
	8.5.2	Signal filtering	. 29
	8.5.3	Automatic range switching	. 29
9	Update	9S	. 31
	9.1	Update via ibaPDA	. 31
	9.2	Update of the modules	. 31
10	Config	uration with ibaPDA	. 33
	10.1	First steps	. 33
	10.1.1	Overview of the modules in ibaPDA	. 40
	10.2	Basic modules in I/O Manager	. 41
	10.2.1	PQU-S – "General" tab	. 41
	10.2.2	PQU-S – "Analog" tab	. 43
	10.2.3	PQU-S – "Digital" tab	. 43
	10.2.4	PQU-S – "Diagnostics" tab	. 44
	10.2.5	ibaPQU-S – "General" tab	. 45
	10.2.6	ibaPQU-S – "Digital" tab	. 46
	10.2.7	ibaPQU-S – "Status" tab	. 47
	10.2.8	Diagnostics - "General" tab	. 48
	10.2.9	Diagnostics - "Digital" tab	. 48
	10.3	Submodules to calculate characteristic values	. 50
	10.3.1	Grid module	. 50
	10.3.2	EN50160 submodule: Power frequency	. 54
	10.3.3	Submodule EN50160: Supply voltage variation	. 56
	10.3.4	EN50160 submodule: Flicker severity	. 57
	10.3.5	EN50160 submodule: Supply voltage unbalance	. 58
	10.3.6	EN50160 submodule: Harmonic voltage	. 59
	10.3.7	EN50160 submodule: Mains signalling voltage	. 61
	10.3.8	EN50160 submodule: Voltage events	. 63
	10.3.9	Basic submodule	. 64
	10.3.10	Phasor submodule	. 66
	10.3.11	Power submodule	. 68
	10.3.12	Spectrum submodule	. 70
	10.3.13	Unbalance submodule	. 73
	10.3.14	Flicker severity submodule	. 75
	10.3.15	Aggregation submodule	. 77
	10.3.16	Commutation notches submodule	. 82
	10.3.17	Events submodule	. 83
11	Techni	cal data	. 85
	11.1	Main data	. 85
	11.2	Interfaces	. 86
	11.3	Digital inputs	. 87
	11.4	Grid characteristics	. 88

	11.5	Dimensions	89
	11.6		93
	11.6.1	Pin assignment voltage supply X14	93
	11.6.2	Pin assignment digital inputs X5	93
	11.7	Example for FO budget calculation	94
12	Access	sories	96
	12.1	Backplane panels	96
	12.1.1	ibaPADU-S-B4S	96
	12.1.2	ibaPADU-S-B1S	99
	12.2	Mounting system for central unit	101
	12.2.1	ibaPADU-S-B	101
	12.3	Mounting systems for ibaPADU-S-B4S	103
	12.3.1	Mounting angles	103
	12.3.2	Mounting panel 19"	104
	12.3.3	Module carrier	109
	12.4	Terminal blocks	.110
	12.5	I/O modules iba modular system	. 111
	12.6	FO cards/cables	.112
	12.7	iba software	.112
13	Appen	dix	113
	13.1	Calculating characteristic values	.113
	13.1.1	RMS (Root Mean Square)	.113
	13.1.2	Rectified value	.113
	13.1.3	Peak value	.113
	13.1.4	Form factor	.113
	13.1.5	Crest factor	.113
	13.1.6	Frequency	.113
	13.1.7	Harmonics, interharmonics, phase angle	.113
	13.1.8	THD (Total Harmonic Distorsion)	.113
	13.1.9	Flicker	.114
	13.1.10	Power / Energy	.114
	13.1.11	Voltage balance / Unbalance	.117
	13.1.12	Interference factor	.118
	13.1.13	Commutation notches	.119
	13.1.14	Events	120
	13.2	Connection examples	122
	13.2.1	1-phase	122
	13.2.2	Star connection	122
	13.2.3	Delta connection	123
	13.2.4	Connection with instrument transformers	123

14	Index	125
15	Certificate	126
16	Support and contact	127

1 About this manual

This manual describes the design, use and operation of the ibaPQU-S. For information on the design, use and operation of the I/O modules, please refer to the dedicated manuals.



Note

The documentation for the iba-modular system is part of the data medium "iba Software & Manuals". The documentation is also available at www.iba-ag.com in the download area.

The documentation of the ibaPQU-S system comprises the following manuals:

ibaPQU-S central unit

The manual contains the following information:

- Scope of delivery
- System requirements
- Device description
- Installation/Removal
- Start-up
- Configuration
- Technical data
- Accessories

Modules

The manuals of the single modules contain specific information about the module. For example:

- Brief description
- Scope of delivery
- Product characteristics
- Configuration
- Description of the functions
- Technical data
- Connection diagram

1.1 Target group

This manual addresses in particular the qualified professionals who are familiar with handling electrical and electronic modules as well as communication and measurement technology. A person is regarded to as professional if he/she is capable of assessing safety and recognizing possible consequences and risks on the basis of his/her specialist training, knowledge and experience and knowledge of the standard regulations.

1.2 Notations

The following designations are used in this manual:

Action	Notations
Menu command	Menu "Logic diagram"
Call of menu command	"Step 1 – Step 2 – Step 3 – Step x" Example: Select menu "Logic diagram – Add – New logic diagram".
Keys	<key name=""> Example: Example: <alt>; <f1></f1></alt></key>
Press keys simultaneously	<key name=""> + <key name=""> Example: <alt> + <ctrl></ctrl></alt></key></key>
Buttons	<key name=""> Example: <ok>; <cancel></cancel></ok></key>
File names, Paths	"File name" "Test.doc"

1.3 Used symbols

If safety instructions or other notes are used in this manual, they mean:



The non-observance of this safety information may result in an imminent risk of death or severe injury:

- By an electric shock!
- Due to the improper handling of software products which are coupled to input and output procedures with control function!

If you do not observe the safety instructions regarding the process and the system or machine to be controlled, there is a risk of death or severe injury!



A WARNING

The non-observance of this safety information may result in a potential risk of death or severe injury!



The non-observance of this safety information may result in a potential risk of injury or material damage!



Note

A note specifies special requirements or actions to be observed.



Тір

Tip or example as a helpful note or insider tip to make the work a little bit easier.



Other documentation

Reference to additional documentation or further reading.

2 Introduction

ibaPQU-S is a modular system to measure power qualitypower parameters using ibaPQU-S as central unit.

ibaPQU-S measures raw values such as current and voltage in sync with the grid and calculates the characteristic values according to IEC 61000-4-30 Ed. 3 Class A. Characteristic values include:

- □ Frequency
- □ RMS and maximum value, rectified value, form factor, crest factor
- □ FFT (harmonics, interharmonics up to 50th order)
- □ THD (Total Harmonic Distortion)
- D Phase values (U/I phase angle to the reference voltage)
- **D** Power values (active power, apparent power, reactive power, $\cos \theta$, electric energy, power factor for individual lines and for the total grid)
- Symmetrical components (positive, negative and zero sequence component) and supply voltage unbalance
- Gilder Flicker (according to IEC 61000-4-15, short-term, long-term)
- Event detection (voltage dip, voltage swell, voltage interruption, rapid voltage changes, ripple control signal)

In addition, ibaPQU-S calculated the following values:

- Commutation notches
- Flicker for currents
- Symmetrical components (positive, negative and zero sequence component) and current unbalance

ibaPQU-S is suitable for the following grids:

- DC 🗆
- 50 Hz
- 🗅 60 Hz
- Modular concept

2.1 Modular concept

The modular concept of the ibaPQU-S system is designed on the basis of a backplane. You can plug on this backplane not only the CPU, but also up to 4 input/output modules. ibaPQU-S is used as a central unit with integrated measurement and calculation algorithms and additionally features 8 digital inputs. The central unit can be expanded by up to 4 current and voltage measurement modules.

The following I/O modules support the measurement and calculation of power quality parameters:

Voltage measurement modules

- □ ibaMS4xAI-380VAC (4 analog inputs for 380 V AC)
- □ ibaMS8xAI-110VAC (8 analog inputs for 110 V AC)
- □ ibaMS16xAI-24V (16 analog inputs for ±24 V)
- □ ibaMS16xAI-24V-HI (16 analog inputs for ±24 V, high impedance)
- □ ibaMS16xAI-10V (16 analog inputs for ±10 V)
- □ ibaMS16xAI-10V-HI (16 analog inputs for ±10 V, high impedance)

Current measurement modules

- □ ibaMS3xAI-1/100A (3 analog inputs for 1 A AC/100 A DC)
- □ ibaMS3xAI-5A (3 analog inputs for 5 A AC)
- □ ibaMS3xAI-1A (3 analog inputs for 1 A AC)
- □ ibaMS16xAI-20mA (16 analog inputs for ±20 mA)

Combination module

ibaMS4xADIO (combination module with 4 analog inputs/outputs and 4 digital inputs/outputs each; the 4 analog inputs are supported for the ibaPQU-S function, voltage or current measurement configurable)

All other I/O modules of the iba modular system are also supported, however, the signals are only transmitted as raw values.

The raw signals and internally calculated characteristic values are sent to the ibaPDA data acquisition system via a bidirectional fiber optic connection for visualization and recording. Signal configuration and characteristic value selection are performed in ibaPDA. Additionally, ibaPDA allows advanced calculations, configuring event-based measurements based on triggers or displaying faults using an alarm function.

2.2 Measurements according to EN50160

The DIN EN 50160 standard specifies the voltage quality in public supply grids. It defines features and characteristic values for the supply voltage quality and limit values. The optional "EN50160" mode in ibaPDA captures all characteristic voltage values defined in the standard. Beyond the requirements of DIN EN 50160, currents can optionally be configured for evaluation.

The ibaAnalyzer software is used for measurement evaluation and generation of reports. Moreover, it is possible to create long-term trending and clearly structured reports that can be used e.g. to prove compliance with the DIN EN 50160 standard.

3 Scope of delivery

After unpacking, check the delivery for completeness and possible damages.

The scope of delivery comprises:

- ibaPQU-S device
- Covering caps for FO cables, USB and Ethernet
- □ 16-pin connector with spring terminals (digital input channels)
- □ 2-pin connector with spring terminals (voltage supply)
- Data medium "iba Software & Manuals"

4 Safety instructions

4.1 Intended use

The device is an electrical apparatus. It is only allowed to use the device for the following applications:

- measurement data acquisition of voltage and current signals in energy grids
- □ applications with ibaPDA

The device must only be used as described in chapter 11.

The current and voltage range is specified by the I/O modules used.

4.2 Special safety instructions



Warning!

This is a Class A device. This equipment may cause radio interference in residential areas. In this case, the operator will be required to take appropriate measures.



ATTENTION!

Observe the safety measures for the I/O modules used!



Strictly observe the operating voltage range!

Never supply the device with a voltage other than 24 V DC ±10%! Excess voltage may destroy the device!



ATTENTION!

Never insert or remove modules and the CPU at the backplane under live conditions!

Switch off ibaPQU-S or disconnect the power supply before inserting or removing modules.



Important note

Do not open the device! Opening the device will void the warranty!



Caution!

Make sure that the cooling fins have sufficient ventilation!



Note

Clean the device only on the outside with a dry or slightly damp and statically discharged cloth.

5 System requirements

5.1 Hardware

For operation

- □ Power supply 24 V DC± 10 %, 3 A (fully equipped)
- Backplane unit, e.g. ibaPADU-B4S (see chap.12, "Technical data")

For device parameterization and measurements:

D PC with the following minimum equipment:

- one free PCI slot, or
- one free PCI Express slot, or
- one ExpressCard(54/34) slot (notebook).

You find suitable computer systems with desktop and industry housing under <u>http://www.iba-ag.com</u>.

- □ One FO input card type ibaFOB-D (firmware version beginning with D4):
 - ibaFOB-io-D / ibaFOB-io-Dexp
 - ibaFOB-2io-D / ibaFOB-2io-Dexp
 - ibaFOB-2i-D / ibaFOB-2i-Dexp with ibaFOB-4o-D add-on module
 - ibaFOB-4i-D / ibaFOB-4i-Dexp with ibaFOB-4o-D add-on module
 - ibaFOB-io-ExpressCard (for notebooks)
- **G** FO cable, bidirectional

5.2 Software

□ ibaPDA beginning with version 6.34.4

5.3 Firmware

ibaPQU-S beginning with version 02.11.014

6 Mounting, connecting, dismounting



Caution!

Only work on the device when it is de-energized!

6.1 Mounting

- 1. Mount the backplane on an appropriate construction.
- 2. Connect the ground terminal.
- Plug the device into the left slot. Make sure that the guiding bolts on the rear side of the device are inserted into the corresponding holes on the backplane.
- 4. Press the device firmly against the backplane and secure it with the fixing screws.
- 5. Remove the covers of the backplane slots in which you want to plug I/O modules.
- **6.** Install one or more I/O modules to the right of the central unit (slots X2 through X5, freely selectable).
- 7. Firmly plug the module into the backplane.
- 8. Screw the module to the backplane using the upper and lower fastening screws.

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Important note

Always screw tight the device and the modules. Otherwise, plugging or unplugging the connectors for the inputs/outputs can cause damage.



6.2 Connecting

- **1.** Connect the measuring lines connected to the measuring objects to the I/O module inputs. Connection principles are described in chapter 8.
- 2. Use an ibaNet FO patch cable (duplex) to connect the device to the ibaPDA computer:
 - the RX input (X11) of the device with the TX interface of the ibaFOB-D card in the ibaPDA computer,
 - the TX output (X10) of the device with the RX interface of the ibaFOB-D card in the ibaPDA computer.
- **3.** Once all required cables have been connected, reconnect the central unit to the power supply.
- 4. Switch on the voltage supply of the central unit.

6.3 Dismounting

- 1. Switch off the device.
- 2. Remove all cables.
- 3. Hold tight the device and remove the upper and lower fixing screw.
- 4. Pull the device or the I/O modules off the backplane.

7 Device description

7.1 Views



- 1 Operating status indicators L1...L4
- 2 On/off switch S11
- 3 Connector power supply 24 V X14
- 4 Indicators digital inputs L10...L17
- 5 Connector digital inputs X5
- 6 Fixing screws
- 7 Indicators L5...L8
- 8 Network interface X22 (no function)
- 9 Rotary switches S1, S2
- 10 System function push button S10 (no function)
- 11 Connection FO output (TX) X10
- 12 Connection FO input (RX) X11

X23 for service purposes only X24, X25 USB host interfaces for future functions



X30 buffer voltage connection 6...60 V DC

7.2 Display elements

7.2.1 Operating state L1...L4

The operating state of the device is shown by colored status LEDs.

LED	Status	Description		
L1 Green	Off	Device down, no power supply Hardware error		
	Flashing (0.5 Hz / 2 s)	Ready for operation Deviations in the flashing period point out overload or booting of the device. Booting can take up to 100 s.		
	Flashing (fast) (approx. 10 Hz / 0.1 s)	System programming mode Firmware update active		
	On	Controller overloaded		
L2	Off	No calculation		
Yellow	Flashing	Calculation running		
L3	Off	No FO signal detected		
White	Flashing	FO signal detected, configuration error, the received ibaNet protocol does not match the internally configured protocol		
	On	FO signal detected		
L4	Off	No error		
Red	Flashing	Malfunction, internal applications do not run		
	On	Hardware error		



Important note

When the LED L4 indicates an error, please contact the iba support.

7.2.2 LEDs L5...L8

The LEDs L5 through L8 show status and progress when installing an update, see chapter 9 "Updates".

7.2.3 Indicators digital inputs L10...L17

The green LEDs indicate whether a digital input is active or not.

LED	Status	Description
L10L17	On	Signal ok, logical 1
	Off	No signal, logical 0

➔ For further information, see chapter 7.5 "Digital inputs X5"

7.3 Operating elements

7.3.1 ON/OFF switch S11

Position	Status	Description
Ι	On	Device switched on
0	Off	Device switched off

By switching the device off and on again, the supply voltage is disconnected and reconnected and the device is rebooted.

7.3.2 Rotary switches S1 and S2

□ The rotary switch S1 is used to set the device address. Two devices can be connected to a ring using the 32Mbit Flex protocol.

Device number in the ring structure	Position of rotary switch S1
Not allowed	0
1. Device	1
2. Device	2

□ S2 is not used (should be zero).



Important note

Unlike other iba devices supporting the 32Mbit Flex protocol, it is only allowed to operate two ibaPQU-S systems in cascade configuration at one free 32Mbit Flex link of an ibaFOB card due to the high sampling rate of 10 - 40 kHz and the high data volume in the network channel of the Flex protocol.



Important note

When starting up the device for the first time, check the status signals of ibaPQU-S (data loss etc.). If multiple signals occur, the time base of the system has to be extended.

7.4 Communication interfaces

7.4.1 Fiber optic connections X10 and X11

The FO cables transmit the process data between the device and the connected iba systems. The 32Mbit Flex transfer protocol also allows configuration data to be transferred via FO cable.

Connection	Description
X10 output (TX)	FO send interface
X11 input (RX)	FO receive interface

Maximum distance of fiber optic connections

The maximum distance of fiber optic connections between 2 devices depends on various influencing factors. This includes, for example, the specification of the fiber (e.g. $50/125 \mu m$, $62.5/125 \mu m$, etc.), or the attenuation of other components in the fiber optic cable plant such as couplers or patch panels.

However, the maximum distance can be estimated on the basis of the output power of the transmitting interface (TX) or the sensitivity of the receiving interface (RX). A model calculation can be found in chapter 11.7.

The specification of the transmitter's output power and the receiver's sensitivity of the fiber optic components installed in the device can be found in chapter "Technical data" 11.2 under "ibaNet interface".

7.4.2 Network interface X22

Ethernet interface 10/100 Mbit/s, no function.

7.5 Digital inputs X5

7.5.1 Connection diagram / pin assignment

You can connect eight input signals (0...7) here, each bipolar and electrically isolated. Each channel is connected by means of two-wire connection. Due to the reverse polarity protection, the measuring signal is indicated logically correct even if the connection is polarity-reversed.

オ See chapter 11 "Technical data"



7.5.2 Debounce filter

There are four debounce filters for each digital input. They can be chosen and configured independently of each other for each signal. The following filters are available:

- "Off" (without filter)
- Generation Stretch rising edge"
- Stretch falling edge
- Stretch both edges
- Delay both edges"

For each filter, a debounce time ranging between $[1\mu s...65535\mu s]$ has to be defined in μs .

"Off"

The measured input signal is forwarded directly without filtering.

"Stretch rising edge"

The first rising edge sets the output signal (red) to logical 1 and it remains logical 1 for the set debounce time. Subsequently, the channel is transparent again and waits for the next rising edge.

Τŗ	ilter0=0ff ilter1=Stretch_risi 16:11:11.4800	ng_edge;debounce	_time=2000us	16:11:11.48	375 16:11:11	1.4900 16:1	1:11.4925	16:11:11.495	0 1
SignalName			X1 X2	X2 - X1	¥1	¥2	Y2 - Y1		
	Filter0= off			1.411.4	0.002000	1.00	1.00	0.00	
	Filter1= Stretch_rising_edge;debounce_time=2000us			1.41.4	0.002000	1.00	1.00	0.00	

"Stretch falling edge"

The first falling edge sets the output signal (green) to logical 0 and it remains logical 0 for the set debounce time. Subsequently, the channel is transparent again and waits for the next falling edge.

ΤF	Filter0= off Filter2= Stretch_fall	ing_edge;debounce_	_time=2000us						
	16:11:23.4160	16:11:23.41	65 16:11:	23.4170	16:11:	23.4175	16:11:23.	4180	16:1
		SignalName		X1 X2	X2 - X1	Y1	Y2	Y2 - Y1	
•	Filter0= off			23.4:23.4	0.002000	0.00	0.00	0.00	
	Filter2=Stretch_fa	alling_edge;debounc	e_time=2000us	23.4:23.4	0.002000	0.00	0.00	0.00	

"Stretch both edges"

With the first edge, the output signal (ochre) follows the original signal (blue) and keeps the logical level for the duration of the set debounce time. Subsequently, the channel is transparent again and waits for the next (rising or falling) edge.

ΤF	ilter0= off ilter3= Stretch_bo	oth_edges;debounce	_time=2000us					
	15:27:05.86	15:27:05.87	15:27:05.88	15:27:05.89	15:27:0	5.90 1	5:27:05.91	15:27:05.9
		SignalName	X1 X2	X2 - X1	¥1	Y2	Y2 - Y1	Unit
	Filter0=off		1:05.1:05.	0.0020	1.00	1.00	0.00	
•	Filter3= Stretch_t	ooth_edges;debounce	e_time=2000us':05.::05.	0.0020	1.00	1.00	0.00	

"Delay both edges"

Beginning with the first edge, the output signal (purple) blocks the input and keeps the logical value of the edge for the duration of the defined debounce time. After the debounce time has elapsed, the channel is transparent again, directly assumes the logical level of the input signal and waits for the next (rising or falling) edge.

Manual

τ _F	ilter0= off ilter4=De	alay_both_edges;c	ebounce_tii	ne=2000us						
										sec
	15:27:	05.86 15	27:05.87	15:27:0	5.88	15:27:05.89	15:27:	05.90	15:27:05.91	15:27:05.9
		Signa	IName		X1 X2	X2 - X1	¥1	Y2	Y2 - Y1	Unit
	Filter0=	off			:05::05	0.0020	1.00	1.00	0.00	
•	Filter4=1	Delay_both_edges	;debounce_	time=2000us	:05:05	0.0020	0.00	1.00	1.00	

7.6 Voltage supply

7.6.1 Voltage supply X14

The external voltage supply is connected with a 2-pin connector.



Caution!

Only connect the device to an external voltage supply 24 V DC (\pm 10 % unregulated)!

Pay attention to the correct polarity!

7.6.2 Buffer voltage X30

The connection of a buffer voltage is supported at the X30 connector (bottom side). The following device functions can be buffered when disconnected from power supply:

G FO line: incoming ibaNet telegrams are transmitted, the FO line is not interrupted.

For this purpose, a buffer voltage of typ. 12 V DC (9 V ...15 V) is applied at the X30 connector. In case of buffering, the current consumption is approx. 70 mA at 12 V.

8 Measurement principles and measured quantities

To determine the power quality parameters, ibaPQU-S measures raw values such as currents and voltages in synch with the grid. The characteristic values relevant for power quality are calculated internally.

8.1 Grid types

The device is suitable for 1-phase grids, 3-phase grids without neutral conductor and 3-phase grids with neutral conductor (N) or protective earth (PE).



1-phase grid

In the 1-phase grid, the voltage U1 and the current I1 are measured.

3-phase grid without N/PE

The phase-to-phase voltages U12, U23, U31 and the phase currents I1, I2 and I3 (see figure above) are measured in this grid.

3-phase grid with N/PE

The phase voltages U1, U2, U3 and the phase currents I1, I2 and I3 are measured in this grid. Optionally, UN and IN can be measured (see figure above).

8.2 Signals and calculated characteristic values

The following table shows the required measured values depending on the grid type. Based on the measurements, all characteristic values are calculated which are needed to assess the power quality.

Measured values

1-phase	3-phase without N/PE	3-phase with N/PE			
U1	U12, U23, U31	U1, U2, U3			
11	11, 12, 13	11, 12, 13			

Calculated characteristic values

Characteristic values	Calculation time				Available for			Grid type (conductor)			Calculation interval			
	Half pe- riod	10 / 12	150 / 180	10 s	10 min	2 h	U	Ι	U*I	1	3	3+N	Phase	Grid
RMS value ¹	х	х	х	х	х	х	х	х	-	х	х	х	х	-
Peak value ¹	х	х	х	х	х	х	х	х	х	х	х	х	х	-
Rectified value ¹	х	х	х	х	х	х	х	х	-	х	х	х	х	-
Form factor ¹	-	х	х	х	х	х	х	х	-	х	х	х	х	-
Crest factor ¹	-	х	х	х	х	х	х	х	-	х	х	х	х	-
Frequency ²	х	Х	х	х	Х	х	х	х	-	х	х	х	Х	х
Phase angle ⁶	-	х	х	х	х	х	х	х	-	х	х	х	х	-
Harmonics ¹	-	х	х	х	х	х	х	х	х	х	х	х	х	-
Interharmonics ¹	-	х	х	х	х	х	х	х	х	х	х	х	х	-
THD ³	-	х	х	х	х	х	х	х	х	х	х	х	х	-
TIF ¹	-	Х	х	х	х	х	х	х	-	х	х	х	Х	-
Mains signalling voltage ¹	-	х	х	х	х	x	x	-	-	х	х	x	х	-
Power ¹	-	Х	х	х	х	х	-	-	х	х	х	х	Х	х
Energy ⁴	-	х	х	х	х	х	-	-	х	х	х	х	Х	х
Apparent power ¹	-	х	х	х	х	х	-	-	х	х	х	х	Х	х
Apparent energy ⁴	-	х	х	х	х	х	1	-	х	х	х	х	Х	х
Reactive power ¹	-	Х	х	х	Х	х	-	-	х	Х	Х	х	Х	Х
Reactive energy ⁴	-	Х	х	х	Х	х	-	-	х	х	х	х	Х	х
Reactive power with sign ¹	-	х	x	x	х	x	-	-	x	х	х	x	х	x

Explanation: X = available - = not available

¹Quadratic average of 10/12 period values

² Direct calculation from raw values for all above-listed calculation times

³Calculation from the harmonics of the listed calculation time

⁴Aggregation based on calculation time

⁵No aggregation

⁶ Phase of the 10/12 FFT sum vector

Manual

Characteristic values	Characteristic Calculation time values			Available for (Grid type (conductor)		Calculation interval					
	Half pe- riod	10 / 12	150 / 180	10 s	10 min	2 h	U	I	U*I	1	3	3+N	Phase	Grid
Reactive energy with sign ⁴	-	х	х	х	х	х	-	-	х	х	x	х	х	х
Fundamental reactive energy ⁴	-	х	х	х	х	х	-	-	х	х	х	х	х	Х
Power factor ¹	-	Х	Х	Х	Х	Х	-	-	Х	Х	Х	Х	Х	Х
Cos φ ¹	-	х	х	х	х	х	-	-	Х	Х	Х	Х	Х	-
Positive sequence component ¹	-	х	х	х	х	х	х	х	-	-	-	х	-	х
Negative sequence component ¹	-	х	х	х	х	х	x	х	-	-	-	х	-	х
Zero sequence component ¹	-	х	х	х	х	х	x	х	-	-	-	x	-	х
Supply voltage unbalance (negative sequence component) ¹	-	x	x	x	x	x	x	-	-	-	x	x	-	x
Supply voltage unbalance (zero sequence component) ¹	-	x	x	x	x	x	x	-	_	_	-	x	_	х
Flicker P_inst ⁵	х	-	-	-	-	-	х	Х	-	Х	х	Х	Х	-
Flicker P_st ⁵	-	-	-	-	х	-	х	Х	-	Х	х	Х	Х	-
Flicker P_lt ⁵	-	-	-	-	-	Х	х	Х	-	Х	х	Х	Х	-
Events ⁵	-	Х	-	-	-	-	Х	-	-	Х	Х	Х	-	Х
Commutation notches ⁵	х	-	-	-	-	-	х	-	-	х	х	х	х	-

Explanation: X = available - = not available

¹ Quadratic average of 10/12 period values

² Direct calculation from raw values for all above-listed calculation times

³ Calculation from the harmonics of the listed calculation time

⁴ Aggregation based on calculation time

⁵ No aggregation

⁶ Phase of the 10/12 FFT sum vector

8.3 System integration



- Acquisition of the raw values of voltage and current at the input modules
- Calculation of the characteristic values in ibaPQU-S
- Configuration of the modules, configuration of data recording, acquisition and visualization of the measured and calculated characteristic values in ibaPDA
- Transferring the configuration and data with 32Mbit Flex
- Analysis, evaluation and if applicable reporting in ibaAnalyzer

8.4 Time synchronization

The ibaPDA computer synchronizes ibaPQU-S with the ibaPDA computer time.

For comparable measurement results which are according to standards, the ibaPDA computer has to be synchronized.

7 For more information, see the ibaPDA manual.

8.5 Signal processing

The signals have to be processed in the modules for the standard-compliant calculation of the characteristic values. This chapter describes the associated effects.

8.5.1 Sampling rate

To calculate the power quality parameters, the ibaPQU-S central unit samples the input signals in synch with the grid and calculates the characteristic values on this basis. For this purpose, a synchronization signal (reference signal in ibaPDA) is used and multiplied to a sampling rate between 30 kHz and 40 kHz. For the nominal frequencies of 50 Hz and 60 Hz, a sampling rate of 30.72 kHz is set by default and corrected according to the synchronization signal.

ibaPDA acquires the raw signals on a synchronized time base. Therefore, the signals are re-sampled internally by ibaPQU-S using the sampling rate set in ibaPDA. As a re-sult, individual values may not be available or repeated.

ibaPDA sampling rate ibaPQU sampling rate		Visible signal distortion				
1 ms = 1 kHz	30.72 kHz	None				
0.1 ms = 10 kHz	30.72 kHz	Slightly varying slope of the sinus signal				
0.05 ms = 20 kHz	30.72 kHz	Varying slope of the sinus signal				
0.025 ms = 40 kHz	30.72 kHz	Values are repeatedly duplicated				

8.5.2 Signal filtering

To calculate the characteristic values, DIN EN 61000-4-7 dictates an anti-aliasing filter to suppress high-frequency interference that would corrupt the calculation of the harmonic components. A digital anti-aliasing filter with a cut-off frequency of approx. 3 kHz is implemented. This filter is also used for the raw values recorded with ibaPDA.

ibaPQU-S activates this anti-aliasing filter with the signals used for characteristic value calculation or as synchronization signal. The configuration of these signals in ibaPDA is ignored in this process.

Signals not used for characteristic value calculation are not changed and the settings in ibaPDA are active.

Signal used for charac- teristic value calculation	Inputs	Filter (cut-off frequency fc)	Delay Total
Yes	Analog U / I	Analog filter with fc=12 25 kHz and digital filter with fc=3 kHz	approx. 0.3 ms
No	Analog	None*	0
		Analog filter with fc=1225 kHz*	0.04 to 0.08 ms
		Analog filter with fc=1225 kHz and digital filter with adjustable fc*	Depends on fc
No	Digital	None or debouncing in mode "stretch rising/falling edge" or "stretch both edges"*	0
		Debouncing in mode "delay both edges"*	Set debounce time in µs

The following table shows the filter effect:

*Setting in ibaPDA



Note

A lot of analog modules allow setting the digital anti-aliasing filter in ibaPDA. The filter is not available in connection with ibaPQU-S.

8.5.3 Automatic range switching

The ibaMS3xAI-1A/100A module has 2 measuring ranges: 1 $A_{nominal}$ (equivalent to 6.25 A_{peak}) and 100 A_{peak} . ibaPQU-S uses both ranges to calculate the characteristic values in this module:

- □ When the current values range between -6.24 and +6.24 A, the 1 A_{nominal} range is used.
- Once a measurement is outside the range, the 100 A range is activated. The 1 A_{nominal} range is only reactivated if no measurement has been outside the range +/- 6.24 A for a period of one second and either zero crossing occurs or another 200 ms have passed. These times are valid for 50 Hz or 60 Hz and have to be increased accordingly at lower frequencies (e.g. 25 Hz means twice the time).

In this context, the range of the set signal (in the network definition) is irrelevant; the algorithm described above will always be used.

For signals captured as raw signals, the range settings in ibaPDA take effect.



9 Updates



Caution!

Do not switch off the device when an update is running. This might damage the device. Installing an update can take several minutes.

9.1 Update via ibaPDA

- Open the ibaPDA I/O Manager and select the PQU-S module in the tree structure.
- Click the <Write firmware> button on the "Diagnostics" tab and select the "pqu_v[xx.yy.zzz].iba" update file.
- □ Click <OK> to start the update.

🗗 iba I/O Manager								×	
: *> 🖻 🖆 🖱 🖨 🕂 🗔 🗎	1 Ce	\leftarrow \rightarrow							
Inputs Outputs Groups General △ ▷ □∰ ibaFOB-2io-D	PQU	-S							
	Versior Hardw	eral Caracteria Diagnostics in information are version:		Firmware version:					
X4	Slot	Туре	Hardware version	Firmware version	FPGA version	Serial n	umber		
- 🛛 ×5	X1	ibaPQU-S	A0	E3	v00.39.2BB4	6			
□	X2	ibaMS4xAI-380VAC	A0	E1	v01.05.0010	1			
Click to configure standa	X3	ibaMS3xAI-1A/100A	B0	E5	v02.04.0017	1024			
Click to add module	X4								
	X5								
🕀 🛱 Link 1									
Ick to add module Image: Click to add module </td									
< >	12	3 256 384 5	12 640 768	896 1024 236	ОК Ар	ply	Cano	el	



Important note

After the update, ibaPQU-S reboots automatically. This can take up to 5 minutes. As soon as the green LED L1 is flashing regularly and none of the LEDs L5 ... L8 is on, the device can be used again.

9.2 Update of the modules

After having mounted the modules and switched on the voltage of the central unit, ibaPQU-S detects the modules and checks the firmware version.

ibaPQU-S has a so-called "overall release version". This version contains the current software version of the central unit as well as the software versions of the modules.

When the software version of a module does not match the "overall release version" of the central unit, ibaPQU-S does an automatic upgrade or downgrade of the module. After that the module is ready for use.

1

Important note

The "overall release version" contains all modules known until then and the corresponding firmware versions. If a module cannot be detected yet (i.e. it is more recent than the firmware version of the CPU), this module is ignored and not displayed in ibaPDA.

In this case, a new update file has to be installed for the "overall release version". If you want to get the current update file, please contact the iba support.



10 Configuration with ibaPDA

10.1 First steps

Start ibaPDA, open the I/O Manager and proceed as follows:

1. Select the "General" tab and the "Settings" node and set the acquisition timebase on the left to 1 ms.

🕂 iba I/O Manager	∃+ iba I/O Manager									
: 🔁 🗗 🔁 🕲 ڪ 🕂 🕖										
Inputs Outputs Groups General 4 b	Settings									
Signal names	General Settings									
	Interrupt source : ibaFOB-2io-D, bus 4, slot 0									
Time synchronization	Acquisition timebase : 1,000 🗭 ms									
Module overview	Force reload of driver at next start of the acquisition									

 Look for the corresponding link of the ibaFOB-D card to which ibaPQU-S is connected in the I/O Manager. Right-click the link to open a submenu. Select "Autodetect".



If ibaPDA detects the device automatically, the device and the connected modules are listed in the module tree.



- 3. To configure the ibaPQU-S system manually, proceed as follows:
- **4.** Right-click the connection (link) of the ibaFOB-io-D card to which the device is connected.
- 5. Select "Add module". The list of available modules is displayed. Select "ibaPQU-S".

		-	Ibarribo o em
iba I/O Mana	ager		ibaPADU-S-IT-2x16
: *3 67 65 65	; 🛛 🕀 🕞 🛨 🖓 🕞 🕞	₿;	ibaPADU-S-IT-16
Inputs Outputs	Groups General 4 b il	6	HAICMON CMU
ibaFOB-2io	-D	6	ibaCMU-S
	Add module	B 3	ibaPACO-4
	Autodetect	₿;	ibaPQU-S
🕀 🃅 Playbad	Hide empty address nodes	.	ibaDIG-40
Unmap	Expand all	₿.	ibaBM-ENetIP
X	Collapse all	<u>-</u>	ibaBM-CAN
		1	ibaBM-COL-8i-o

Now, the device is shown in the module tree.

Drag the device to the address that is set on the device with the S1 rotary switch (Link 1 - 15 under the device), while keeping the right mouse button pressed: Position 1 - F corresponds to address 1 - 15.

6. Click "Read configuration from device" on the "General" tab.



The connected modules are detected automatically and displayed in the module tree



- **7.** The current and voltage inputs required for the measurement are configured in the input modules (see chapter 8 "Measurement principles and measured quantities").
- 8. Moreover, you can configure additional input signals to be acquired as raw signals.

٢	•	ר
	1	
L	-	

Note

The input modules and their configuration is described in the module manuals.

9. In the "PQU-S" basic module, you set the power frequency of your grid and specify a reference signal. One of the connected phases by which sampling is synchronized is used as the reference signal.

PQU-S					
🕒 General 🧼 Diagnostics					
✓ Basic					
	Module Type	ibaPQU-S			
	Locked	False			
	Enabled	True			
	Name	PQU-S			
	Timebase	0,05 ms			
	Use name as prefix	False			
\sim	Connection				
	IP Address	172.29.0.101			
	Auto enable/disable	False			
\sim	Power grid				
	AC/DC	AC			
	Power frequency	50 Hz			
	Reference signal	[1:0]			
	nererense argital	[1:0]			

10. ibaPDA provides special modules to measure or calculate the power quality characteristic values. In the "Grid" module you can make general settings, define the grid type (1-phase or 3-phase grid) and assign signals to the inputs that provide the corresponding signals. Depending on the grid in which the measurements are taken, different voltage and current signals are required (see chapter 8 "Measurement principles and measured quantities").

Grie	d		
庚 G	ieneral		
\sim	Basic		
	Module Type	ibaPQU-S\Grid	
	Locked	False	
	Enabled	True	
	Name	Grid	
	Timebase	1 ms	
	Use name as prefix	False	
\sim	Configuration		
	Inputs	Star grid with N/PE	
	Measured values	Voltages and currents	
\sim	Show line-to-line	False	
	U1N	[1:0]	
	U2N	[1:1]	
	U3N	[1:3]	
	Un	Unassigned	
	11	[2:0] Channel 0: 6,25A max	
	12	[2:1] Channel 1: 6,25A max	
	13	[2:2] Channel 2: 6,25A max	
	In	Unassigned	
	Nominal voltage	230 V	
	Mains signalling	Disabled	
\sim	Units		
	Voltage unit	V	
	Current unit	A	
	Power unit	W - var - VA	
	Energy unit	kWh - kvanh - kVAh	
~	Standard generation		
	Enable currents	False ~	

The signals Un and In are optional input signals that do not have to be assigned. The option "Show line-to-line" allows the voltages U12, U23 and U31 to be provided also in a star system.

If the signals are not assigned, ibaPQU-S calculates these values. If the signals are measured, the raw values serve as the basis for the other calculations.

11. Under "Measured values" select whether voltages only, currents only or voltages and currents are measured.

Measured values	Voltages and currents
Show line-to-line	Voltages and currents
U1N	Voltages only
U2N	Currents only
U3N	

12. To perform measurements according to a defined standard, click the link "Click to configure standards..." and select the desired standard.



乗 Configure standards for grid: Grid				
Selection of standards:				
TOIN EN50160 DIN Power frequency DIN Supply voltage variation DIN Ricker severity DIN Supply voltage unbalance DIN Harmonic voltage DIN Mains signalling voltage DIN Voltage events IEC IEC61000-2-4 Class 1 IEC Power frequency IEC Supply voltage variation IEC Flicker severity IEC Supply voltage unbalance	~			
OK Cance				

By selecting the standard, all characteristic values required for measurement and calculation according to the standard are determined automatically. The selection causes the corresponding submodules comprising the different power quality characteristic values to be added to the "Grid" module.

13. If the standard "EN50160" is selected, 7 submodules are displayed which determine all characteristic values required according to DIN EN 50160 (power frequency, supply voltage variation, flicker severity, supply voltage unbalance, harmonic voltage, mains signalling voltage, voltage events).


÷	贞 Grid	
	DIN	EN50160: Power frequency (3)
	-DIN	EN50160: Supply voltage variation (4)
	-DIN	EN50160: Flicker severity (5)
	-DIN	EN50160: Supply voltage unbalance (6)
	-DIN	EN50160: Harmonic voltage (7)
	-DIN	EN50160: Mains signalling voltage (8)
	-DIN	EN50160: Voltage events (9)
		Click to configure standards
		Click to add module

- 14. Each submodule has its own time base; the default value should not be changed. The signal names in the submodules are already preset. They include the corresponding characteristic value, the measuring input and the measurement interval allowing it to be identified unambiguously in subsequent evaluations. The configuration of the submodules is described in more detail in chapter 10.3.2 "EN50160 submodule: Power frequency" and following chapters. Below you will find a summary of the key properties and the determined characteristic values of the submodules according to EN50160. (see also chapter 10.1.1 "Overview of the modules in ibaPDA").
 - EN50160: Power frequency
 power frequency, interval 10 s
 - EN50160: Supply voltage variation
 RMS value voltage, interval 10 min
 - EN50160: Flicker severity
 long-term flicker (P_{it}) per phase, interval 2 h
 - EN50160: Supply voltage unbalance
 negative sequence unbalance, interval 10 min
 - EN50160: Harmonic voltage, for each voltage input, interval 10 min
 fundamental frequency, 10 min
 - THD up to 40th harmonic
 - relative harmonic 1 50
 - EN50160: Mains signalling voltage for each voltage input, interval 3 s
 - fundamental frequency
 - relative harmonic DC
 - relative harmonic 1 50
 - relative interharmonic 1 50
 - EN50160: Voltage events, interval half period
 RMS value voltage, half period
- **15.** To calculate other parameters, click the "Click to add module..." link to add submodules (Basic, Phasor, Power, Aggregation, Spectrum, Flicker severity, Unbalance, Commutation notches, Events). For a detailed description of the submodules, read chapter 10.3.9 "Basic submodule" and following.

🆀 Add module	×
Name : Basic	
Module type :	
+ - - + Basic	
₩ Power	
Spectrum	
A Commutation notches	
99 Events	
	OK Cancel

Basic, values for each input:

- RMS value, peak value, rectified value, frequency (measurement interval 200 ms and half period)

- phase, form factor, crest factor (peak factor) (measurement interval 200 ms)
- Phasor, values for each input:
 - RMS value, phase angle, frequency (measurement interval 200 ms)
 - used for phasor diagram display (current and voltage values of the 3 phases)
- Power:

values per phase:

- active power, apparent power, reactive power, fundamental reactive power, distortion power, peak power
- active energy, apparent energy, reactive energy, fundamental reactive energy, distortion energy
- power factor, cos phi

Values for the overall grid (3/4 conductor system)

- active power, reactive power, apparent power, distortion power
- active energy, apparent energy, reactive energy, fundamental reactive energy distortion energy
- power factor
- Aggregation:
 - user-configurable module
- Spectrum, harmonic values for a selectable input: measurement adjustable from 200 ms to 2 h:
 - relative or absolute harmonic 1 50
 - relative or absolute interharmonic 1 50
 - phase of harmonic 1 50
 - THD
 - Interference factor (TIF, THFF)
 - Level of the mains signalling voltage

- Flicker severity, values per phase:
 - P_{inst}, P_{st}, P_{lt}
- Unbalance (asymmetry): values for voltages:
 - zero sequence unbalance
 - negative sequence unbalance
 - positive, negative, zero sequence component

- phase angle of the positive sequence component, negative sequence component and zero sequence component

values for currents:

- positive, negative, zero sequence component

- phase angle of the positive sequence component, negative sequence component and zero sequence component

- Commutation notches: depth of notch in percent per phase
- Events:

Values for each event type:

- start
- duration

Every event has additional signals, such as minimum or maximum value.

16. Click <Apply> or <OK> to apply the new configuration.

The next chapter gives an overview of the modules to calculate the power quality characteristics in ibaPDA.

Module	Measurement interval						
		Half period	200 ms	3 s	10 s	10 min	2 h
EN50160: Power frequency	Frequency (reference signal, all voltage inputs)				x		
EN50160: Slow supply voltage variation	RMS value (all voltage inputs)					x	
EN50160: Harmonic voltage	Fundamental frequency, THD up to 40th harmonic, relative harmonic 1 - 50 (all voltage inputs)					x	
EN50160: Mains signalling voltage	Fundamental frequency, DC component, relative harmonic 1 - 50, relative interharmonic 1 - 50 (all voltage inputs)			x			
EN50160: Voltage events	RMS value (all voltage inputs)	x					
EN50160: Flicker severity	Long-term flicker calculation per phase						х
EN50160: Supply voltage unbalance	Calculation of the voltage balance for the negative sequence component					х	
Basic	Frequency (reference signal)	х	х				
	RMS value, peak value, rectified value, frequency (all voltage and current inputs)	x	x				
	Phase angle, form factor, crest factor (peak factor) (all voltage and current inputs)		x				
Spectrum	Fundamental frequency, THD, DC component, absolute or relative harmonic 1 - 50, absolute or relative interharmonic 1 - 50 (for one voltage or current input)		x	x	x	x	x
Phasor	RMS value, phase angle, frequency (all voltage and current inputs)		х				
Power	Power and energy calculations per phase and for the overall grid		х				
Flicker severity	Flicker calculations per phase in different time intervals	х				х	x
Asymmetry	Calculation of the symmetrical components		х				
Aggregation	User configurable	User conf	igurabl	е			
Commutation notches	Commutation notches per phase in percent	x					

10.1.1 Overview of the modules in ibaPDA

Module	Characteristic values	Measure	ment	interv	val		
		Half period	200 ms	3 s	10 s	10 min	2 h
Events	Voltage dip / voltage swell Voltage drop Rapid voltage changes Mains signalling voltage		x				

Green = modules for EN50160-compliant measurement Yellow = modules for additional measurements

10.2 Basic modules in I/O Manager

PQU-S - "General" tab 10.2.1



Basic settings

Module type

Display of the module type (read only)

Locked

A locked module can only be modified by an authorized user.

Enabled

Data acquisition is enabled for this module.

□ Name

You can enter a module name.

Timebase

Specifies the acquisition time base in ms used for ibaPQU-S and the connected modules in order to sample the raw signals.

Smallest time base: 0.025 ms.

Use name as prefix

If "True" is selected, the module name is prefixed to the signal names of this module.

Connection

□ IP address

IP address or host name of the ibaPQU-S device (read only).

□ Auto enable/disable

If this option is enabled and ibaPDA cannot establish a connection to this device when starting the measurement, it will disable this module and start the measurement without the module. During the measurement it tries to restore the connection. If this attempt is successful, the measurement is restarted automatically with the enabled module. If this option is not enabled, ibaPDA will not start the measurement if it cannot establish a connection to the device.

Power grid

AC/DC

Select the grid type to be measured in the drop-down menu.

Power frequency

Select the power system frequency from the drop-down menu.

~	Power grid		
	AC/DC	AC	
	Power frequency	50 Hz	\sim
	Reference signal	50 Hz	
		60 Hz	
		Custom: 55 Hz	I

- Default values: 50 Hz, 60 Hz
- When "custom" is enabled, you can enter a value between 10 Hz and 80 Hz.

Reference signal

Select one of the connected phases used as reference signal to synchronize the sampling.

More functions

□ Read configuration from device

Reads the configuration stored most recently from the device.

Click <OK> or <Apply> to apply the modified settings.

10.2.2 PQU-S – "Analog" tab

The "Analog" tab is only displayed when acquisition with analog input modules has been started.

The list shows the configured analog signals of the input modules and of all configured Grid modules and the analog status signals of ibaPQU-S with their current values.



10.2.3 PQU-S – "Digital" tab

The "Digital" tab is only displayed when acquisition with digital input modules has been started.

The list shows the configured digital signals, the digital status display of ibaPQU-S and the current values.

L ibs I/O Manager				
			- ~	
	← →			
Inputs Outputs Groups General 4 D	PQU	I-S		
🖃 🔢 ibaFOB-2io-D 🖌				
□····································	📑 Ger	neral 🔨 Analog 👖 Digital 🧼 Diagnostics		
ibaPOULS (0)	Nan	ne	Actual	
ibaMS4xAI-380VAC (1)	► Ξ	Source: (0) ibaPQU-S	^	
ibaMS3xAI-1A/100A (2)	0	[0.0]	0	
	1	[0.1]	0	
×5	2	[0.2]	0	
DIN EN50160: Power frequency (11)	3	[0.3]	0	
DIN EN50160: Supply voltage variati	4	[0 4]	0	
DIN EN50160: Flicker severity (14)		[0,7] [0,5]	0	
DIN EN50160: Supply voltage unbala		[0.3]	0	
DIN EN50160: Harmonic voltage (16)		[U.6]	0	
DIN ENSO160: Mains signalling voltag		[0.7]	0	
	8	[0.8] UDP data loss		
>+ Phasor (20)	9	[0.9] UDP data loss half-period-level		
\ Power (21)	10	[0.10] UDP data loss FFT-level		
Spectrum (23)	11	[0.11] UDP data loss 3sec-level		
Flicker severity (24)	12	[0.12] UDP data loss 10sec-level		
···· 1 Commutation notches (26)	13	[0.13] UDP data loss 10min-level		
	14	[0.14] UDP data loss 2hr-level		
10 min (22)	15	[0.15] Data correct		
Click to add module	16	[0 16] Data correct balf-period-level		
Click to add module	17	[0 17] Data correct FET Javal		
	10	[0.12] Data context in Heven		
ink 1	10			
Clock to add module 19 [0.19] Data correct 10sec-level				
	20	[0.20] Data correct 10min-level	~	
Unmapped				
< >	0 1	28 256 384 512 640 768 896 1024 1019 OK Apply	Cancel	

10.2.4 PQU-S – "Diagnostics" tab

∃+ iba I/O Manager						—	×
- * D 🔁 🗗 🖥 🕀 - M 💵	Da (Da	← →					
Inputs Outputs Groups General ↓ ▷ ● </th <th>PQU-</th> <th>-S eral @ Diagnostics</th> <th></th> <th>Simwara yemian :</th> <th></th> <th></th> <th></th>	PQU-	-S eral @ Diagnostics		Simwara yemian :			
	Slot X1 X2 X3 X4 X5	Type ibaPQU-S ibaMS4xAI-380VAC ibaMS3xAI-1A/100A	Hardware version A0 A0 B0	Firmware version E3 E1 E5	FPGA version v00.39.2884 v01.05.0010 v02.04.0017	Serial number 6 1 1024	
Cick to add module ⊕ Ar Playback ⊕ Ar Vitual Unmapped < >>		Write firmware	12 640 768	Reset to 1	factory defaults	ply Cance	1

The "Diagnostics" tab contains information on hardware, firmware and FPGA version as well as the serial number of the central unit and of the connected modules.

□ Write firmware

This button allows running firmware updates. Select the update file "pqu_v[xx.yy.zzz].iba" in the browser and start the update by clicking <Ok>.



44

Important note

This process may take several minutes and must not be interrupted. After an update, the device will restart automatically.

オ See chapter 9.1 "Update via ibaPDA"

Reset to factory defaults

Click this button to reset all settings to the factory defaults after confirming the following prompt with <yes>.



The following message is displayed and the device reinitializes automatically with the deleted I/O settings:



Subsequently, run the "Autodetect" function again as described in chapter 10.1 "First steps".

10.2.5 ibaPQU-S – "General" tab



Basic settings

iba

□ Module type, Locked, Enabled, Name, Timebase, Use name as prefix see chapter 10.2.1 PQU-S – "General" tab.

Module No.

Logical module number for the unambiguous referencing of signals, e.g. in expressions and ibaAnalyzer. Is assigned by ibaPDA in ascending order, but can be changed by the user.

10.2.6 ibaPQU-S – "Digital" tab



Name

Here you can enter a signal name and additionally two comments when clicking the icon in the Name field.

Debounce filter

In the drop-down menu, you can choose the operating mode for the debounce filter. The following settings are available: Off, Stretch rising edge, Stretch falling edge, Stretch both edges, Delay both edges.



オ See chapter 7.5.2 "Debounce filter

Debounce time (µs)

Here, you can define the debounce time in μ s

Active

Here you can enable or disable the signal.

10.2.7 ibaPQU-S – "Status" tab

∃- iba I/O Manager			×
: *• 🗗 📑 💾 🗑 🗲 • 🛧 🗸 🖿 🛅			
Inputs Outputs Groups General 4 >	ibaPQU-S (0)		
ibaFOB-2io-D			
	General JU Digital JU Status		
ibaPQU-S (0)	Name	Active	
ibaMS4xAI-380VAC (1)	8 UDP data loss		^
ibaMS3xAI-1A/100A (2)	9 UDP data loss half-period-level		
x5	10 UDP data loss FFT-level		
🖶 💑 Grid	11 UDP data loss 3sec-level	✓	
-DIN EN50160: Power frequency (11)	12 UDP data loss 10sec-level	 ✓ 	
	13 UDP data loss 10min-level		
DIN EN50160: Supply voltage unbalan	14 UDP data loss 2hr-level		
DIN EN50160: Harmonic voltage (16)	15 Data correct		
DIN EN50160: Mains signalling voltage	16 Data correct half-period-level		
	17 Data correct FFT-level		
+ Phasor (20)	18 Data correct 3sec-level		
🔱 Power (21)	19 Data correct 10sec-level		
Spectrum (23)	20 Data correct 10min-level		
Flicker severity (24)	21 Data correct 2hr-level		
Â Commutation notches (26)	22 PLL unlocked		
	23 PLL unlocked half-period-level		
	24 PLL unlocked FFT-level		
Click to add module	25 PLL unlocked 3sec-level		
Click to add module	26 PLL unlocked 10sec-level		
<u>i</u>	27 PLL unlocked 10min-level		
Click to add module	28 Pi Lunlocked 2hr-level		
Playback	29 ADC error		
🗄 🎜 Virtual	30 ADC error half-period-level		
Unmapped	31 ADC error FFT-level		
			~
< >	0 128 256 384 512 640 768 896 1024 1019 OK Apply	Cance	el

In the Status tab, you can enable status signals:

Signal	Meaning
UDP data loss []	Data packet lost (per measurement interval)
Data correct []	All data transmitted correctly (for different measurement intervals)
PLL unlocked []	Synchronization with reference signal failed (for different measurement intervals)
ADC error []	Central unit does not receive data from the input module (for different measurement intervals)
Calculation error []	Calculation error (in different measurement intervals)
Calculation period incomplete []	Calculation does not comprise the entire measurement interval (for different measurement intervals)

10.2.8 Diagnostics - "General" tab

In the "Diagnostics" module, diagnosis signals are available. The module has to be added manually by right-clicking the "PQU-S" module and selecting "Diagnostics" from the context menu.

- □					×	
: *3 🗗 🔁 🕄 🕄 🕂 - ↑ ↓ 🖻 🕼	←	\rightarrow				
Inputs Outputs Groups General ↓ ↓	Dia	agnostics (28)				
Enk 0	*	General II Digital				
□		 Basic 				
ibaMS4xAI-380VAC (1)		Module Type	ibaPQU-S\Diagnostics			
ibaMS3xAI-1A/100A (2)		Locked	False			
X 4		Enabled	True			
1 X5		Name	Diagnostics			
		Module No.	28			
E- # Grid		Timebase	1 ms			
DIN EN50160: Power frequency (11)		Use name as prefix	False			
DIN EN50160: Supply voltage variation						

Basic settings

□ Module Type, Locked, Enabled, Name, Module No., Use name as prefix see chapter 10.2.1.

Timebase

The timebase is related to the general acquisition timebase of the ibaPDA system. The timebase here cannot be faster than the general acquisition timebase.



10.2.9 Diagnostics - "Digital" tab

In the "Digital" tab, you can activate diagnostic signals.

🗗 iba I/O Manager				\times
: *3 🗗 🔁 🕄 🕄 🕂 - ↑ 🗸 🗎 🖆	←	\ominus		
Inputs Outputs Groups General 4 D	D	iagnostics (28)		
	2	General II Digital Name	,	Acti
ibarQ0-3 (0) ibaMS4xAI-380VAC (1)	0	Hardware state X1		
	2	Hardware state X2 Hardware state X3		
Diagnostics (28)	3	Hardware state X4		
DIN EN50160: Power frequency (1	5	Hardware state x5 Hardware available X1		
DIN EN50160: Supply voltage van: DIN EN50160: Flicker severity (14)	6	Hardware available X2		
DIN EN50160: Supply voltage unb- DIN EN50160: Harmonic voltage (*	8	Hardware available X3 Hardware available X4		
····DIN EN50160: Mains signalling volt ····DIN EN50160: Voltage events (18)	9	Hardware available X5		
	10 11	Embedded application state Embedded application started		
Very Power (21)				
Cunbalance (25)		128 256 384 512 640 768 1024 1031 ОК Арру	Cancel	

Signal	Meaning
Hardware state X[]	Module on slot X[] is OK
Hardware available X[]	Module on slot X[] was detected and initialized properly
Embedded application state	Embedded application is currentlty available
Embedded application started	Embedded application has been started. When the embedded application is finished properly, the signal will change to FALSE.

10.3 Submodules to calculate characteristic values

10.3.1 Grid module

"General" tab



Basic settings

See PQU-S module, "General" tab, chapter 10.2.1

Configuration

Inputs

Select the grid type from the drop-down menu.

✓ Configuration

	Configuration	
	Inputs	Star grid with N/PE 🛛 🗸
	Measured values	Single phase
\sim	Show line-to-line	Star grid with N/PE
	U1N	Grid without N/PE
	U2N	
	U3N	
	Un]

Depending on the grid type, the input measurement signals required for the grid type are displayed in the rows below.

Assign the corresponding input signals to the measurement values.

Example: Grid without N/PE

Required signals: U12, U23, U31, I1, I2, I3

/
x
x
x

Measured values

In the drop-down menu, select which raw signals are available.

\mathbf{v}	Configuration	
	Inputs	Star grid with N/PE
	Measured values	Voltages and currents 🗸 🗸
\mathbf{v}	Show line-to-line	Voltages and currents
	U1N	Voltages only
	U2N	Currents only
	U3N	
	Un	
	11	

Based on the selection, the inputs for voltages or currents are displayed or hidden.

□ Show line-to-line

This option is only available in a star system. It activates the additional inputs for U12, U23 and U31.

\mathbf{v}	Configuration	
	Inputs	Star grid with N/PE
	Measured values	Voltages and currents
\sim	Show line-to-line	True
	U1N	[1:0]
	U2N	[1:1]
	U3N	[1:2]
	Un	Unassigned
	U12	Unassigned
	U23	Unassigned
	U31	Unassigned 🗸
	11	[2:0] Channel 0: 6,25A max
	12	[2:1] Channel 1: 6,25A max
	13	[2:2] Channel 2: 6,25A max
	In	Unassigned
	Nominal voltage	230 V

If the additional inputs are not assigned to any signals, the central unit will calculate the signals and use them for the further calculations.

If signals are assigned, they will be the basis for calculations.

Nominal voltage

The nominal voltage for this grid, e.g.: 230 V

Mains signalling voltage

If this option is activated, the carrier frequency of the mains signalling voltage as well as the percentage signal level needs to be set for the grid.

You can find out the carrier frequency at your local energy supplier. The signal level usually lies between 1-2%.

Units

The set units influence the calculated output values.

If large input signals are combined in a calculation, e.g. kV and kA, this function produces understandable output values.

~	Units						
	Voltage unit	V					
	Current unit	A					
	Power unit	W - var - VA					
	Energy unit	kWh - kvarh - kVAh					

Standard generation

Enable currents

If Enable currents = TRUE, all current values are calculated additionally.

If "Only voltages" are selected under "Measured values", the "Enable currents" option is not available.

Configure limit profiles

Here you can create and manage limit profiles used in the Spectrum modules or triggers.

L. Configure limit profiles						×
Limit profiles: EN50160 - High voltage - Harmonics	Туре:	Relative	~			
EN50160 - Low voltage - Harmonics EN50160 - Medium voltage - Harmonics IEC61000-2-4 Class 1 IEC61000-2-4 Class 2	THD limit:	8,00	×.			
IEC61000-2-4 Class 3	Order		Limit	Unit		
	0		0	%		^
	1		0	%		
	2		2	%		
	3		5	%		
	4		1	%		
	5		6	%		
	6		0,5	%		
	7		5	%		
	8		0,5	%		
	9		1,5	%		
	10		0,5	%		_
	11		3,5	%		
	12		0,5	%		
	13		3	%		
	14		0,5	%		
	15		0,5	%		
	16		0,5	%		_
	17		2	%		_
	18		0,5	%		
	19		1,5	%		_
	20		0,5	%		_
	21		0,5	%		
	22		0,5	%	 	_
	23		15	%		
+ 🖻 🗙				OK	Cance	:

The predefined profiles can be used directly in relative spectra or triggers. To create a user-defined profile, click the button +. This allows creating profiles of the "relative" or "absolute" type.

Configure event settings

In this dialog you can configure the settings for the single events such as voltage dip, voltage swell etc.

secongs					
events			• •		
				٨S	
Dip threshold:	10,0	÷ %			
Swell threshold:	10,0	÷ %		Swell threshold	
Drop threshold:	90,0	* %	100%	Dip threshold	Unominal / Usliding
Use nominal volt	age for dips and swe	lls		- Drop threshold	
Hysteresis:	2,0	* %			
					t
1 events			t.,		
			0	15	
RVC threshold:	5,0	÷ %		RVC threshold	
			100%	RVC threshold	U100/120 periods
Hysteresis:	2,5	€ %			
			L		→ t

The values preset are taken from the standard IEC 61000-4-30 Ed. 3 class A.

Using the threshold values you can set the detection limit from which the corresponding event can be recognized. The hysteresis sets the point of time when the event can be considered as terminated.

Using the check box "Use nominal voltage for dips and swells" you can set if the threshold values and the hysteresis of the slow events refer to the nominal voltage or to a floating reference value.

📴 iba I/O Manager								
* D 🖻 💾 🛛 🗲 🕞 🗸 💷	€ →							
Inputs Outputs Groups General 4	Grid							
🖃 🥵 ibaFOB-2io-D	Cinc							
🖨 🛱 Link 0	身 Ge	neral EN50160						
PQU-S								
ibarQU-S (0)								
ibaMS3xAI-1A/100A (2)	N	ame	Active					
— 🔲 X4	464	[17:297] U3N Relative interharmonic 39 3 s		^				
🔲 ×5	465	[17:298] U3N Relative interharmonic 40 3 s						
Diagnostics (28)	466	[17:299] U3N Relative interharmonic 41 3 s						
DIN EN50160: Power frequency (11)	467	[17:300] U3N Relative interharmonic 42 3 s						
DIN EN50160: Supply voltage variation	468	[17:301] U3N Relative interharmonic 43 3 s						
DIN EN50160: Flicker severity (14)	469	[17:302] U3N Relative interharmonic 44 3 s						
DIN EN50160: Supply voltage unbalan	470	[17:303] U3N Relative interharmonic 45 3 s						
	471	[17:304] U3N Relative interharmonic 46 3 s						
DIN EN50160: Voltage events (18)	472	[17:305] U3N Relative interharmonic 47 3 s						
	473	[17:306] U3N Relative interharmonic 48 3 s						
	474	[17:307] U3N Relative interharmonic 49 3 s						
Spectrum (23)	475	[17:308] U3N Relative interharmonic 50 3 s						
Unbalance (25)	476	[17:309] U1N Mains signalling 3 s						
Flicker severity (24)	477	[17:310] U2N Mains signalling 3 s						
/I\ Commutation notches (26)	478	[17:311] U3N Mains signalling 3 s						
	F	Voltage events						
Click to configure standards	479	[18:0] Dio event Start						
Click to add module	480	[18:1] Dip event Duration						
Click to add module	481	[18:2] Dip event Min						
⊞⊸O 215	482	[18:3] Swell event Start						
Click to add module	483	[18:4] Swell event Duration						
Playback	484	[18:5] Swell event Max						
⊕ f≈ Virtual	485	[18:6] Interruption event Start						
	ped 486 [18:7] Thereington event burstion							
	488 [13:9] Mains signalling event Start							
	491	[18:12] RVC event Start						
				v				
< >	0	128 256 384 512 640 768 896 1024 1040	OK Apply	Cancel				

EN50160 tab

The "EN50160" tab lists all signals calculated in the EN50160-compliant submodules. The message "Fully compliant" against a green background confirms compliance with the standard. If individual signals are disabled, the display changes to "Partially compliant" on a white background.

This tab is only displayed if you have configured the EN50160 standard by clicking "Click to configure standards...".

奂 Configure standards for grid: Grid	×
Selection of standards:	
 DIN EN50160 DIN Power frequency DIN Supply voltage variation DIN Flicker severity DIN Supply voltage unbalance DIN Harmonic voltage DIN Mains signalling voltage DIN Voltage events 	
OK Cancel	

10.3.2 EN50160 submodule: Power frequency

"General" tab

∄+ iba I/O Manager						_		×
: * 🗅 🖆 🖱 🕄 🕀 - 🛧 🖵 🖻 🖆 E -	÷							
Inputs Outputs Groups General 4 D	N	50160: Power	frequency (11)					
ibaFOB-2io-D	N G							
PQU-S		Denia		1				
ibaPQU-S (0)								
ibaMS4xAI-380VAC (1)	ibaPQU-S\Grid\Standard part							
		Locked	False					
II X4		Enabled	True					
- X5		Name	EN50160: Power frequency					
Diagnostics (28)		Module No.	11					
□ ♣ Grid		Timebase	25 ms					
-DIN EN50160: Power frequency (11)		Use name as prefix	False					
DIN EN50160: Supply voltage variatio	~	Configuration						
DIN EN50160: Flicker severity (14)	\sim	Update interval	10 s					
DIN EN50160: Supply voltage unbala		Unit	Seconds					
DIN EN50160: Hamonic voltage (16)		Amount	10					
DIN EN50160: Mains signalling voltage		Mode	Auto					
DIN EN50160: Voltage events (18)	\sim	Signals based on	EN50160: Power frequency					
中 Basic (19)		Power frequency	Active					
- + Basis (10)								
Power (21)]				
Spectrum (23)	Na	me						
Unbalance (25)	The	e name of the module.						
Ficker severty (24)								
() Commutation notches (26)								
We Evente (27)								
10 min (22)				1				
				1040	011			
		128 256 384	512 640 768 896 103	1040	OK	Apply	Can	cel

Basic settings

See PQU-S module, "General" tab, chapter 10.2.1

Time base

Each submodule has its own time base. The default setting should not be changed.

Configuration

The "Configuration" section shows the characteristic value that is determined by this module as well as the measurement interval. Here: Power frequency acc. to EN50160, 10 s

You can enable or disable all signals of this module in a drop-down menu.



"Analog" tab

∃→ iba I/O Manager					×
- • • • • • • • • • • • • • • • • • • •	ϵ \Rightarrow				
Inputs Outputs Groups General 4 b B bibaFOB-20-D	EN50160: Power frequency	(11)			
PQU-S	Name	Function	Input	Unit	Active
II ibaMS4xAI-380VAC (1) II ibaMS3xAI-1A/100A (2)	Power frequency 10 s	Frequency	Power grid	Hz	
X4 X5					
DIN EN50160: Power frequency (11)					

i

Note

All "Analog" tabs display the signals calculated in the corresponding submodule. It is not possible to delete signals or add new signals. However, the listed signals can be enabled or disabled individually.

Name

The names are assigned by default. To allow an unambiguous identification, they contain the input channel, the characteristic value and the measurement interval. You can additionally assign two comments by clicking the \swarrow icon in the signal name field.

Function, input, unit
 Displays the corresponding property

Active

Here you can enable or disable the signal.

10.3.3 Submodule EN50160: Supply voltage variation

"General" tab

🕂 iba I/O Manager								×
: *• 🖻 🖆 🖱 🕀 🕂 🕥 🗎 🖆 (🖬	\rightarrow							
Inputs Outputs Groups General 4 D	N	50160: Supply	voltage variation (13)				
ibaFOB-2io-D				, ,				
·몇 Link 0 DI	IN G	eneral 🔨 Analog						
🖶 📑 PQU-S		Desta						
ibaPQU-S (0)	~	Dasic	4. 2011/01/01/11/01					
ibaMS4xAI-380VAC (1)		Module Type	ibaPQU-S\Grid\Standard part					
ibaMS3xAI-1A/100A (2)		Locked	False					
📕 X4		Enabled						
- 🗄 X5		Name	EN50160: Supply voltage varia					
		Module No.	13					
🚊 🚊 Grid		Timebase	25 ms					
DIN EN50160: Power frequency (11)	~	Use name as prefix	False					
DIN EN50160: Supply voltage variation (13)		Configuration						
DIN EN50160: Flicker severity (14)	~	Update interval	10 min					
-DIN EN50160: Supply voltage unbalance (15		Unit	Minutes					
DIN EN50160: Harmonic voltage (16)		Amount	10					
DIN EN50160: Mains signalling voltage (17)		Mode	Auto					
DIN EN50160: Voltage events (18)	~	Signals based on	EN50160: Supply voltage variation					
		Supply voltage variation	Active					
5 Phasor (20)								
🖶 Power (21)								
Spectrum (23)	Th	me						
Unbalance (25)	10	e name of the module.						
Flicker seventy (24)								
Commutation notches (26)								
10 min (22)				_				
Martin Carlos and State an				1040	OK	Apply	Can	-el
< > 0		128 256 384	512 640 768 896 102	4 1040	OK	, which it	Carr	

Basic settings

See Power frequency submodule, "General" tab, chapter 10.3.2.

Configuration

- The "Configuration" section shows the characteristic values determined by this module as well as the measurement interval. Here: Supply voltage variation acc. to EN50160, 10 min.
- □ You can enable or disable all signals of this module in a drop-down menu.

Supply voltage variatio	Active
	Active Inactive

"Analog" tab

🕂 iba I/O Manager				— (з х					
Inputs Outputs Groups General 4 b ibaFOB-2io-D	EN50160: Supply voltage va	ariation (13)								
ାର୍ମ୍ମ Link 0	DIN General 🔨 Analog									
PQU-S	Name	Function	Input	Unit	Active					
iba/S4xAl-380VAC (1)	0 U1N RMS 10 min	RMS	U1N: [1:0] L1	V						
🚺 ibaMS3xAI-1A/100A (2)	1 U2N RMS 10 min	RMS	U2N: [1:1] L2	V	V					
	2 U3N RMS 10 min	RMS	U3N: [1:3]	V						

Name

The names are assigned by default. To allow an unambiguous identification, they contain the input channel, the function and the measurement interval. You can additionally assign two comments by clicking the \checkmark icon in the signal name field.

G Function, input, unit

Displays the corresponding property

Active

Here you can enable or disable the signal.

10.3.4 EN50160 submodule: Flicker severity

"General" tab

∄+ iba I/O Manager								×
	\rightarrow							
Inputs Outputs Groups General 4 b	N	50160: Flicke	r severity (14)					
iar08-20-D	IN C	ieneral 🔨 Analog						
ibaPQU-S (0) ibaMS4xAl-330VAC (1) ibaMS3xAl-1A/100A (2) ibaMS3xAl-1A/100A (2) X4 if X5 if Grid if Constant (1) if Constant (1)	× × × ×	Basic Module Type Locked Enabled Name Module No. Timebase Use name as prefix Configuration Lamp model Flicker input Update interval Unit Amount Mode Signale based on	ibaPQU-S\Grid\Standard part False True ENSD160: Flicker severity 14 25 ms False 230V Voltages only 2h Minutes 120 Auto					
> Phasor (20) 	Ť	Flicker severity	Active					
	Na Th	ime e name of the module.						
< · · · · · · · · · · · · · · · · · · ·		128 256 384	512 640 768 896 10	24 1040	OK	Apply	Car	ncel

Basic settings

See Power frequency submodule, "General" tab, chapter 10.3.2

Configuration

To calculate the flicker, the lamp model to be used, 230 V or 120 V, has to be specified.

If the "Enable currents" option is "True" in the grid options, you need to indicate for each conductor its impedance in Ohm.

"Analog" tab

∃→ iba I/O Manager					_		\times
: 🔁 🖻 🐮 🕄 🕀 - 🛧 🕔 📭 🖆	←	\rightarrow					
Inputs Outputs Groups General 4 b	E	EN50160: Flicker severity (1	4)				
E-BP ibaFOB-2io-D ∧ E-BP ibk 0		IN General 🔨 Analog					
PQU-S	I	Name	Function	Input	Unit	Acti	ive
ibaPQU-S (0)	0	U1N Flicker severity 230V Plt	Flicker severity 230V	U1N: [1:0] L1			
ibaMS3xAI-1A/100A (2)	1	U2N Flicker severity 230V Plt	Flicker severity 230V	U2N: [1:1] L2			
X4	2	U3N Flicker severity 230V Plt	Flicker severity 230V	U3N: [1:3]			
			1	- -	•		

Name

The names are assigned by default. To allow an unambiguous identification, they contain the input channel, the characteristic value and the measurement interval.

Function

Calculation function used by ibaPQU-S.

InputThe signal used for calculation.

UnitDisplay of the relevant unit.

ActiveHere you can enable or disable the signal.

10.3.5 EN50160 submodule: Supply voltage unbalance

"General" tab

→ iba I/O Manager						_		×
	\rightarrow							
Inputs Outputs Groups General 4 D	EN	50160: Suppl	y voltage unbalance (15)				
P link 0								
B POUS	UNIN C							
ibaPQU-S (0)	\sim	Basic						
ibaMS4xAI-380VAC (1)		Module Type	ibaPQU-S\Grid\Standard part					
baMS3xAI-1A/100A (2)		Locked	False					
X4		Enabled	True					
×5		Name	EN50160: Supply voltage unbala					
Diagnostics (28)		Module No.	15					
Gid		Timebase	25 ms					
DIN EN50160: Power frequency (11)		Use name as prefix	False					
DIN EN50160: Supply voltage variation (13)	\sim	Configuration						
IN EN50160: Elicker severity (14)	\sim	Update interval	10 min					
DIN EN50160: Supply voltage unbalance (15)		Unit	Minutes					
DIN EN50160: Hamonic voltage (16)		Amount	10					
DIN EN50160: Mains signalling voltage (17)		Mode	Auto					
DIN EN50160: Voltage events (18)	\sim	Signals based on	EN50160: Supply voltage unbalance					
++ Basic (19)		Supply voltage un	bal Active					
-i+ Phaeor (20)								
Power (21)								
Spectrum (23)								
Upbalance (25)								
Eicker severity (24)	Na	me						
Commutation potches (26)	Th	e name of the module.						
We Evente (27)								
▼ 10 min (22)								
	111			1040	OK	Annte	C	-
< > > 0		128 256 384	512 640 768 896 102	1040	UK	Apply	Cano	cei

Basic settings

See Power frequency submodule, "General" tab, chapter 10.3.2

Configuration

- The "Configuration" section shows the characteristic values determined by this module as well as the measurement interval. Here: Supply voltage unbalance acc. to EN50160, 10 min.
- □ You can enable or disable all signals of this module in a drop-down menu.

Supply voltage unbalar	Active	\sim
	Active	
	Inactive	

"Analog" tab

<table-of-contents> iba I/O Manager</table-of-contents>				- [⊐ ×
: *> 🗗 🖆 🖱 🗧 🖨 🕂 🗸 📭 🕼					
Inputs Outputs Groups General 4 b	EN50160: Supply voltage u	nbalance (15)			
Eren BarOB-20-D ∧	DIN General 🔨 Analog				
	Name	Function	Input	Unit	Active
ibaPQU-3 (0)	⁰ Negative sequence unbalance 10 min	Negative sequence unbalance	Voltages	%	
ibaMS3xAI-1A/100A (2)					
🗓 X4					
- 🛛 ×5					
🖕 🏂 Grid					
-DIN EN50160: Power frequency (11)					
DIN EN50160: Supply voltage variatic					
DIN EN50160: Flicker severity (14)					
DIN EN50160: Supply voltage unbala					

Name

The names are assigned by default. To allow an unambiguous identification, they contain the input channel, the characteristic value and the measurement interval.

Function

Calculation function used by ibaPQU-S.

Input

The signals used for calculation.

Unit
 Display of the relevant unit.

□ Active

Here you can enable or disable the signal.

10.3.6 EN50160 submodule: Harmonic voltage

"General" tab

🗄 iba I/O Manager								×
:*• 🗗 🖆 🕄 🕀 - 🛧 🗸 🐚 🖆 🧲	\rightarrow							
Inputs Outputs Groups General	EN	50160: Harmo	nic voltage (16)					
iarOB_20-D	DIN C	General 🔨 Analog						
PQU-S	~	Basic						
ibaMS4xAI-380VAC (1)		Module Type	ibaPQU-S\Grid\Standard part					
ibaMS3xAI-1A/100A (2)		Locked	False					
- T X4		Enabled	True					
- X5		Name	EN50160: Harmonic voltage					
		Module No.	16					
🗇 🛱 Grid		Timebase	25 ms					
DIN EN50160: Power frequency (11)		Use name as prefix	False					
DIN EN50160: Supply voltage variation	\sim	Configuration						
DIN EN50160: Flicker severity (14)	\sim	Update interval	10 min					
DIN EN50160: Supply voltage unbalar		Unit	Minutes					
DIN EN50160: Harmonic voltage (16)		Amount	10					
DIN EN50160: Mains signalling voltage		Mode	Auto					
DIN EN50160: Voltage events (18)	\sim	Signals based on	EN50160: Harmonic voltage					
		Harmonic voltage	Active					
>+ Phasor (20)	\sim	Limit profiles						
U Power (21)		Harmonic profile	EN50160 - Low voltage - Harmonics					
Spectrum (23)								
Unbalance (25)	Na	ame						
Flicker severity (24)	Th	e name of the module						
🗥 Commutation notches (26)	1							
99 Events (27)								
				-		 		
				1040	OK	Apply	Can	cel
× 0		128 256 384	512 640 768 896 102	4 .010				



Important note

The total number of Harmonic voltage and Spectrum submodules per ibaPQU must not exceed nine (9) to avoid overloading the system.

Basic settings

See Power frequency submodule, "General" tab, chapter 10.3.2

Configuration

- The "Configuration" section shows the characteristic values determined by this module as well as the measurement interval. Here: Harmonic voltage acc. to EN50160, 10 min.
- □ You can enable or disable all signals of this module in a drop-down menu.



"Analog" tab

∄+ iba I/O Manager					_		×
: *D 🗗 🗗 🖱 Đ Đ + M 🕡 🖻 🖆	← →						
Inputs Outputs Groups General	ENF	0160: Harmonic voltag	e (16)				
ibaFOB-2io-D			e (10)				
🖻 📲 Link 0	DIN Ge	eneral 🔨 Analog					
□	N	ame	Function	Order	Unit	Active	
ibaMS4xAI-380VAC (1)		Group: U1N [1:0]: L1					^
🛄 ibaMS3xAI-1A/100A (2)	0	U1N Fundamental 10 min	Fundamental		v		
	1	U1N THD 10 min	THD	40	%		
Diagnostics (28)	2	U1N Relative harmonic DC 10 min	Relative harmonic	0	%		
🛱 🋱 Grid	3	U1N Relative harmonic 1 10 min	Relative harmonic	1	%		
DIN EN50160: Power frequency (11)	4	U1N Relative harmonic 2 10 min	Relative harmonic	2	%		
INDIN EN50160: Supply voltage variation (1 Indiana Structure Severity (14)	5	U1N Relative harmonic 3 10 min	Relative harmonic	3	%		
DIN EN50160: Supply voltage unbalance	6	U1N Relative harmonic 4 10 min	Relative harmonic	4	%		
DIN EN50160: Harmonic voltage (16)	7	U1N Relative harmonic 5 10 min	Relative harmonic	5	%		
DIN EN50160: Mains signalling voltage (1 DIN EN50160: Voltage events (19)	8	U1N Relative harmonic 6 10 min	Relative harmonic	6	%		
	9	U1N Relative harmonic 7 10 min	Relative harmonic	7	%		
>→ Phasor (20)	10	U1N Relative harmonic 8 10 min	Relative harmonic	8	%		
Power (21)	11	U1N Relative harmonic 9 10 min	Relative harmonic	9	%		
Unbalance (25)	12	U1N Relative harmonic 10 10 min	Relative harmonic	10	%		
Flicker seventy (24)	13	U1N Relative harmonic 11 10 min	Relative harmonic	11	%		
····/\ Commutation notches (26)	14	U1N Relative harmonic 12 10 min	Relative harmonic	12	%		
→ Events (2/)	15	U1N Relative harmonic 13 10 min	Relative harmonic	13	%		
Click to configure standards	16	U1N Relative harmonic 14 10 min	Relative harmonic	14	%		
Click to add module	17	U1N Relative harmonic 15 10 min	Relative harmonic	15	%		
Click to add module	18	U1N Relative harmonic 16 10 min	Relative harmonic	16	%		
	19	U1N Relative harmonic 17 10 min	Relative harmonic	17	%		
Click to add module	20	U1N Relative harmonic 18 10 min	Relative harmonic	18	%		
	21	U1N Relative harmonic 19 10 min	Relative harmonic	19	%		
Unmapped	22	U1N Relative harmonic 20 10 min	Relative harmonic	20	%		
	23	U1N Relative harmonic 21 10 min	Relative harmonic	21	%		
							~
< >	0 1	128 256 384 512 640	768 896 1024 1040 0	K Ap	ply	Cancel	

The EN50160 submodule: Harmonic voltage calculates the harmonics 1 - 50 for each input channel plus the fundamental frequency and the total harmonic distortion (THD) in 10 minute measurement intervals. To calculate the THD, the EN50160 standard only takes harmonics 1-40 into account. In the signal display, the signals are grouped by input. Click the <+> sign before the group name to show the signals of a group.

Name

The names are assigned by default. To allow an unambiguous identification, they contain the input channel, the function, the order and the measurement interval. You can additionally assign two comments by clicking the \swarrow icon in the signal name field.

Function, order, unit

Displays the corresponding property

Active

Here you can enable or disable the signal.

10.3.7 EN50160 submodule: Mains signalling voltage

"General" tab

iba I/O Manager					_		×
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Inputs Outputs Groups General 4 D	EN	50160: Mains s	signalling voltage (17)			
BibFOB-2a-D Access access ibaFOB-2a-D Image: Constant in the image		Sorrow Marines S Seneral A Analog Basic Module Type Locked Enabled Name Module No. Timebase Use name as prefix Configuration Update interval Unit Amount Mode Signals based on Mains signalling volt	ibaPQU-S\Grid\Standard part False True EN50160: Mains signalling volta 17 25 ms False 3 s 200 ms 15 Auto ENS0160: Mains signalling voltage Active	,			
Unbalance (25) Flicker severity (24) Commutation patches (26)	Th	e name of the module.					
Events (27)		28 256 384 512	640 768 1024 10 4	Ю ОК Аррі	у	Canc	el

Basic settings

□ See Power frequency submodule, "General" tab, chapter 10.3.2

Configuration

- The "Configuration" section shows the characteristic values determined by this module as well as the measurement interval. Here: Mains signalling voltage acc. to EN50160, 3 s.
- You can enable or disable all signals of this module in a drop-down menu.
 Mains signalling voltag Active



|--|

∄→ iba I/O Manager				_	
* D C C C U > - • • U h h -	\rightarrow				
Inputs Outputs Groups General	ENF	0160: Mains signalling v	oltage (17)		
B ibaFOB-2io-D		vites mains signaling v			
ė̃⊷ ķ Link 0	DIN Ge	eneral 🔨 Analog			
E PQU-S	N	ame	Function	Order Unit	Active
		Group: U1N [1:0]: L1			^
ibaMS3xAI-14/100A (2)	`o	U1N Eurodamental 3 s	Fundamental	v	
I X4	1	U1N Relative barmonic DC 3 s	Relative barmonic	0 %	
🛛 X5	2	UIN Relative barmonic 1.3 s	Relative barmonic	1 %	
Diagnostics (28)	3	LIN Relative harmonic 2.3 s	Relative harmonic	2 %	
DIN EN50160: Power frequency (11)	4	LIN Pelative harmonic 3.3 s	Pelative harmonic	3 %	
DIN EN50160: Supply voltage variation (13)	5	LIN Pelative harmonic 4.3 s	Relative harmonic	4 %	
DIN EN50160: Flicker severity (14)	6	LIN Pelative harmonic 5.3 s	Relative harmonic	- 70 E 9/	
DIN EN50160: Supply voltage unbalance (15	7	U IN Relative harmonic 5.5 s	Relative harmonic	5 %	
DIN EN50160: Mains signalling voltage (17)		Uth Delative harmonic 6.5 s	Relative harmonic	0 %	
DIN EN50160: Voltage events (18)		UIN Relative narmonic 7.3 s	Relative narmonic	/ %	
	9	U IN Relative narmonic 8 3 s	Relative narmonic	8 %	
Phasor (20)	10	U1N Relative harmonic 9 3 s	Relative harmonic	9 %	
Spectrum (23)	11	U1N Relative harmonic 10 3 s	Relative harmonic	10 %	
Unbalance (25)	12	U1N Relative harmonic 11 3 s	Relative harmonic	11 %	
Flicker severity (24)	13	U1N Relative harmonic 12 3 s	Relative harmonic	12 %	
Fvents (27)	14	U1N Relative harmonic 13 3 s	Relative harmonic	13 %	
10 min (22)	15	U1N Relative harmonic 14 3 s	Relative harmonic	14 %	
Click to configure standards	16	U1N Relative harmonic 15 3 s	Relative harmonic	15 %	
Click to add module	17	U1N Relative harmonic 16 3 s	Relative harmonic	16 %	
Click to add module	18	U1N Relative harmonic 17 3 s	Relative harmonic	17 %	
	19	U1N Relative harmonic 18 3 s	Relative harmonic	18 %	
Click to add module	20	U1N Relative harmonic 19 3 s	Relative harmonic	19 %	
n Playback					¥
<pre>/x virtual < ></pre>	0 1	28 256 384 512 640 768	896 1024 1040 OK	Apply	Cancel

The EN50160 submodule: Mains signalling voltage calculates the harmonics 1-50 and the interharmonics 1-50 for each input channel plus the fundamental frequency and the DC component, in 3 second measurement intervals. In the signal display, the signals are grouped by input. Click the <+> sign before the group name to show the signals of a group.

Name

The names are assigned by default. To allow an unambiguous identification, they contain the input channel, the function and the measurement interval. You can additionally assign two comments by clicking the \swarrow icon in the signal name field.

Function, order, unit

Displays the corresponding property

Active

Here you can enable or disable the signal.

10.3.8 EN50160 submodule: Voltage events

"General" tab

∃- iba I/O Manager						_		×
	÷							
Inputs Outputs Groups General 4 >	EN!	50160: Voltag	e events (18)					
⊡119 ibaFOB-2io-D								
Env 🛃 Link 0	DIN G	ieneral 🗥 Analog 🗍	Digital					
PQU-S	~	Basic						
ibaPQU-S (0)	· ·	Module Type	ibaPOLLS\Grid\Standard.part					
ibaMS4xAI-380VAC (1)		Locked	False	-				
ibaMS3xAI-1A/100A (2)		Enabled	Thie	-				
		Name	EN50160: Voltage events	-				
		Module No.	18	-				
Grid		Timebase	25 ms	-				
DIN EN50160: Power fraguency (11)		Use name as prefix	False					
	\mathbf{v}	Configuration						
IN EN50160: Bicker severity (14)	\sim	Update interval	200 ms					
		Unit	Periods					
		Amount	10					
DIN EN50160: Mains signalling voltage (1		Mode	Auto					
DIN EN50160: Voltage events (18)	~	Signals based on	EN50160: Voltage events					
		Voltage events	Active					
\ Power (21)								
Spectrum (23)	Na	me						
Unbalance (25)	The	e name of the module.						
Flicker severity (24)								
/lλ Commutation notches (26)								
							-	
< >>	0 1	28 256 384 5	512 640 768 896 1024	1040	OK	Apply	Cano	el

Basic settings

□ See Power frequency submodule, "General" tab, chapter 10.3.2

Configuration

Voltage events

- The "Configuration" section shows the characteristic values determined by this module as well as the measurement interval. Here: Voltage events acc. to EN50160, half period.
- □ You can enable or disable all signals of this module in a drop-down menu.

\sim

"Analog" tab

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: *3 f⊃ f5 f2 (3 ∋ ⊖ • f ↓ ¶a fa €	\rightarrow					
Inputs Outputs Groups General 4 b	E	N50160: Voltage events	(18)			
🖃 🤢 ibaFOB-2io-D 🔨			()			
亩曉 Link 0	וס	N General 🔨 Analog 📗 Digital				
🖨 📑 PQU-S		Name	Function	Input	Unit	Active
ibaPQU-S (0)	Ι.		Pi i	input	Onite	
🛄 ibaMS4xAI-380VAC (1)	۱°	Dip event Start	Dip event	Voltages	S	
ibaMS3xAI-1A/100A (2)	1	Dip event Duration	Dip event	Voltages	S	
	2	Dip event Min	Dip event	Voltages	v	
Diagnostics (28)	3	Swell event Start	Swell event	Voltages	s	V
Grid Grid	4	Swell event Duration	Swell event	Voltages	s	
DIN EN50160: Power frequency (11)	5	Swell event Max	Swell event	Voltages	v	
DIN EN50160: Supply voltage variation (1	6	Interruption event Start	Interruption event	Voltages	s	
INDIN EN50160: Plicker seventy (14) INDIN EN50160: Supply voltage unbalance	7	Interruption event Duration	Interruption event	Voltages	s	
DIN EN50160: Harmonic voltage (16)	8	Interruption event Min	Interruption event	Voltages	v	
DIN EN50160: Mains signalling voltage (1	9	Mains signalling event Start	Mains signalling event	Voltages	s	
The second secon	10	Mains signalling event Duration	Mains signalling event	Voltages	s	
→ Phasor (20)	11	Mains signalling event Max	Mains signalling event	Voltages	v	
	1.2			v h		
Spectrum (23)	12	RVC event Start	RVC event	voitages	S	
Unbalance (25)	13	RVC event Duration	RVC event	Voltages	S	
- 🐲 Flicker seventy (24)	14	RVC event Delta Umax	RVC event	Voltages	V	
A Commutation notches (26)	15	RVC event Delta Uss	RVC event	Voltages	v	
77 Events (27)						
10 min (22)						
Click to confidure standards	0	128 256 384 512 640	768 896 1024 1040	OK Appl	y (Cancel

The EN50160 submodule: Voltage events calculates the RMS value for each input channel.

Name

The names of the voltage events are assigned by default. You can additionally assign two comments by clicking the \swarrow icon in the signal name field.

□ Function, input, unit

Displays the corresponding property

Active

Here you can enable or disable the signal.

Digital tab

→ iba I/O Manager		_	
🗄 🔁 🔁 🖱 🕀 🕂 🛧 🚺 🗎 🗎 🗧)		
Inputs Outputs Groups General 4 D	EN50160: Voltage events (18)		
□──闘 ibaFOB-2io-D へ □□── 覧 Link 0	DIN General 🔨 Analog 👖 Digital		
	Name	Function	Active
ibaMS4xAI-380VAC (1)	0 Dip event	Dip event	
🛄 ibaMS3xAI-1A/100A (2)	1 Swell event	Swell event	
	2 Interruption event	Interruption event	
·····································	3 Mains signalling event	Mains signalling event	
i ∰ Grid	4 RVC event	RVC event	
OIN EN50160: Power frequency (11) OIN EN50160: Supply voltage variation (1 OIN EN50160: Flicker severity (14) OIN EN50160: Supply voltage unbalance OIN EN50160: Hamonic voltage (16) OIN EN50160: Mains signaling voltage (1 OIN EN50160: Voltage events (18)			

Name

The names of the voltage events are assigned by default. You can additionally assign two comments by clicking the \swarrow icon in the signal name field.

Function

Displays the corresponding property

Active

Here you can enable or disable the signal.

10.3.9 Basic submodule

"General" tab

∄+ iba I/O Manager			_		×
: *3 🖻 🖆 🖱 🗲 🕂 🗸 🖻 🛅 🧲 -	<i>></i>				
Inputs Outputs Groups General 4 >	Basic (19)				
ibaFOB-2io-D ∧					
	🗄 🛱 General 🗥 Analog				
PQU-S	A Proio				
ibaPQU-S (0)	V Dasic	the POLL CVC set Preside			
ibaMS4xAI-380VAC (1)	Module Type	IDAPQU-S (GIID (Basic	_		
🛄 ibaMS3xAI-1A/100A (2)	Locked	Faise	_		
X4	Enabled	Irue	_		
🗒 X5	Name	Basic	_		
	Module No.	19			
🖨 🛱 Grid	Timebase	2 ms			
DIN EN50160: Power frequency (11)	Use name as prefix	False			
DIN EN50160: Supply voltage variation (1					
	Name		7		
DIN EN50160: Hamonic voltage (16)	The name of the module				
DIN EN50160: Maino rice voltage (10)	The fighte of the filedale.				
DIN ENSOTO: Wains signaling voltage (1					
the provide the second					
→ Phasor (20)					
• Power (21) •		1040			
< >	0 128 256 384 512 64	768 1024 1040	OK Apply	Can	cel

Basic settings

□ See Power frequency submodule, "General" tab, chapter 10.3.2

"Analog"	tab
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The Basic submodule captures the following characteristic values:

- · Power frequency in 200 ms and half period measurement intervals, respectively
- For each input: RMS value, peak value, rectified value and frequency in 200 ms and half period measurement intervals
- For each input: Phase angle, form factor, crest factor, measurement interval 200 ms.

In the signal display, the signals are grouped by input. Click the <+> sign before the group name to show the signals of a group.

Name

The names are set by default but can be edited. To allow an unambiguous identification, they contain the input channel and the characteristic value. You can additionally assign two comments by clicking the \swarrow icon in the signal name field.

🗅 Unit

Display of the relevant unit.

Active

Here you can enable or disable the signal.

10.3.10 Phasor submodule

"General" tab

iba I/O Manager			_		×
: ** 🖻 🖆 🖱 🗲 🗲 🕶 🗇 🕼 🗲 🖻]				
Inputs Outputs Groups General 4 D	Phasor (20)				
ibaFOB-2io-D					
i ink 0	🏳 General 🔨 Analog				
PQU-S	D :				
ibaPQU-S (0)	✓ Basic				
🚺 ibaMS4xAI-380VAC (1)	Module Type	ibaPQU-S\Grid\Phasor			
II ibaMS3xAI-1A/100A (2)	Locked	False			
🛙 X4	Enabled	True			
x5	Name	Phasor			
Diagnostics (28)	Module No.	20			
Grid Grid	Timebase	2 ms			
DIN EN50160: Power frequency (11)	Use name as prefix	False			
UN EN50160: Supply voltage variation (1					
DINI EN50160: Supply Voldge Validion (1					
DIN EN50100: Fucker sevency (14)					
DIN EN50100. Supply Voltage unbalance	Name				
UIN ENSUIGU: Harmonic voitage (16)	The name of the module.				
UIN EN50160: Mains signalling voltage (1					
UIN EN50160: Voltage events (18)					
🔁 Phasor (20)					
Coordinam (22)	129 256 294 512 640	768 1024 1040 OK	Apply	Cano	cel

Basic settings

See Power frequency submodule, "General" tab, chapter 10.3.2

"Analog" tab

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* * D 🖆 🗗 🖱 🕂 🕂 🔺 🗇 👘 🗐	\rightarrow			
Inputs Outputs Groups General d D	Pł	nasor (20)		
⊡	R .	General A: Analog		
PQU-S		Name	Unit	Active
ibaPQU-S (0)	•	🗏 Input: U1N [1:0]: L1		
ibaMS3xAI-1A/100A (2)	0	U1N RMS	V	
	1	U 1N Phase angle	rad	
→ Biagnostics (28)	2	U1N Frequency	Hz	
— 贵 Grid		Input: U2N [1:1]: L2		
DIN EN50160: Power frequency (11)		Input: U3N [1:3]		
INDIN ENSUIGU: Supply voltage variation (1 Indiana Structure Severity (14)		Input: I1 [2:0]: Channel 0: 6,25A max		
-DIN EN50160: Supply voltage unbalance				
DIN EN50160: Harmonic voltage (16)		Input: I3 [2:2]: Channel 2: 6,25A max		
IN EN50160: Mains signalling voltage (1 International Stress St				
>+ Phasor (20)				
Power (21)	TT	1040 0%		
< >	0 1	28 256 384 512 640 768 1024 1040 OK Apply		Jancel

The Phasor submodule captures the following characteristic values for each input:

RMS value, phase angle, frequency, measurement interval 200 ms

In the signal display, the signals are grouped by input. Click the <+> sign before the group name to show the signals of a group.

Name

The names are set by default but can be edited. To allow an unambiguous identification, they contain the input channel and the characteristic value. You can additionally assign two comments by clicking the \checkmark icon in the signal name field.

Unit
 Display of the unit.

Active
 Here you can enable or disable the signal.

Display in the phasor diagram (phasor view)

The voltage and current characteristics of the 3 phases can be visualized in a phasor diagram.

Click the I button in the ibaPDA toolbar to display the phasor diagram.

Hold the mouse button down and drag the Phasor or Basic module from the signal tree on the left onto the display.



- Filled arrowheads: RMS value of voltage in the corresponding phase angle
- Empty arrowheads: RMS value of current in the corresponding phase angle

i

Note

In TN systems (TN-C, TN-S, TN-C-S), measurements are made against the neutral point (neutral conductor N). Since there is no connection to the neutral point in IT systems, a different representation may occur in IT systems.

10.3.11 Power submodule

"General" tab

∃→ iba I/O Manager					_		×
:*2 🗗 🖆 🕃 🗲 🗲 🕶 🖆 🖆 📫	\rightarrow						
Inputs Outputs Groups General 4 D	P	ower (21)					
E	F	General 🔨 Analog					
		 Basic Module Type Locked Enabled Name Module No. Timebase Use name as prefix Configuration Enable distortion power 	ibaPQU-S\Grid\Power False True Power 21 2 ms False False				
DIN ENS0160: Harmonic voltage (16) DIN EN50160: Mains signalling voltage (1 DIN EN50160: Voltage events (18) ±= Basic (19) → Phasor (20) → Phasor (20) → Power (21) → Spectrum (23)		Name The name of the module.					
Unbalance (25) M		128 256 384 512 640	768 1024 1040 OF	(A	pply	Cano	:el

Basic settings

□ See Power frequency submodule, "General" tab, chapter 10.3.2

Configuration

□ Enable distortion power

Set this option to "True" if you want to activate the calculation of the distortion power.

"Analog" ta	ıb
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: *>)) 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	\rightarrow			
Inputs Outputs Groups General 4 D	Po	wer (21)		
│□□□·■ 見 Link 0	₩(General 🔨 Analog		
PQU-S	N	ame	Unit	Active
ibaPQU-S (0)	G	Grid		
ibaMS4xAI-380VAC (1)	0	Grid P	W	
X4			**	
×5			var	
	2	Grid Q1 fundamental reactive power	var	
📄 🏚 Grid	3	Grid S	VA	
-DIN EN50160: Power frequency (11)	4	Grid Active energy	kWh	
IN EN50160: Supply voltage variation (13) IN EN50160: Flicker severity (14)	5	Grid Reactive energy	kvarh	
DIN EN50160: Supply voltage unbalance (15	6	Grid Fundamental reactive energy	kvarh	
DIN EN50160: Harmonic voltage (16)	7	Grid Apparent energy	kVAh	
DIN EN50160: Mains signalling voltage (17)	8	Grid Power factor		
DIN EN50160: Voltage events (18)	Þ 🖪	11		
→ Phasor (20)	9	L1P	w	
\ Power (21)	10	L1Q	var	
Unbalance (25)	11	L1 Q1 fundamental reactive power	var	
Flicker severity (24)	12	LIS	VA	
/l\ Commutation notches (26)	13	L1 P Peak value	w	Image: A start of the start
10 min (22)	14	L1 Active energy	kWh	
Click to configure standards	15	L1 Reactive energy	kvarh	
Click to add module	16	L1 Fundamental reactive energy	kvarh	
	17	L1 Apparent energy	kVAh	
⊕ <mark>⊫ Link 1</mark>	18	L1 Power factor		
Click to add module	19	L1 Cosinus phi		
Hayback	6	12		
		1.3		
		28 256 384 512 640 768 1024 1040 OK Ap	ply	Cancel

Depending on the AC/DC setting and the configured grid inputs, the Analog tab contains different characteristic values.

AC/DC = DC

Only active power, peak value and active energy are calculated.

AC/DC = AC

The following values are calculated for each phase:

- Active power & active energy
- Reactive power & reactive energy (with and without sign)
- Apparent power & apparent energy
- Fundamental reactive power & fundamental reactive energy
- Distortion power & distortion energy
- Peak value
- Power factor
- cos Phi

In a star grid with N/PE and in a grid without N/PE, the above values are also calculated for the overall grid, with the exception of cos phi and peak value.

Name

The names are set by default but can be edited. To allow an unambiguous identification, they contain the input channel and the characteristic value. You can additionally assign two comments by clicking the \swarrow icon in the signal name field.

Unit

Display of the unit.

Active

Here you can enable or disable the signal.

Display in the phasor diagram

The power characteristic values can be visualized phase-wise or for the entire grid using a phasor diagram.

Click the button in the ibaPDA toolbar to display the phasor diagram.

Hold the mouse button down and drag the Power module from the signal tree on the left onto the display.



10.3.12 Spectrum submodule

"General" tab





Important note

The total number of Harmonic voltage and Spectrum submodules per ibaPQU must not exceed nine (9) to avoid overloading the system.

Basic settings

See Power frequency submodule, "General" tab, chapter 10.3.2

Configuration

Input
 Select the input signal.

Update interval

If the spectrum is required in another update time than 200 ms, you can set here as a default which time interval should be used.

Harmonics values

Select whether to measure relative or absolute harmonics/interharmonics.

Enable phase calculation

The corresponding phases for the harmonic values are also calculated.

Interference factor

Inter	ference factor			
	Тур	e:	TIF ~	
	Non	malization:	Hn/H1 ~	
	Harmonic	Weight		^
	1		0	
	2		0	
	3		0	
	4		0	
	5		0	
	6		0	
	7		0	
	8		0	
	9		0	
	10		0	
	11		0	
	12		0	~
		Import	Export	
		OK	Cancel	

Different calculation types can be selected for an interference factor.

Type:

TIF (acc. to IEEE Std. 519): Describes the effects of harmonic voltages or currents on communication systems near transmission lines.

THFF: European version of the TIF defined by the CCITT (Comité Consultatif International Téléphonique et Télégraphique), now ITU-T, in 1978.

Linear. General calculation formula with harmonic values without squaring.

Square: General calculation formula with squared harmonics

Psophometry up to 50th harmonic can be mapped using the type *square* and the normalization *Hn*.

Since ibaPDA supports only one weighting factor per harmonic, the factors have to be multiplied first for psophometry and specified as total weighting factor per harmonic.

Normalization:

Hn/H1: All harmonics are normalized to the value of the fundamental frequency, i.e. divided by this value. This corresponds to the relative values in ibaPDA, however without the factor 100 for percent.

Hn/RMS: All harmonics are normalized to the RMS value, i.e. divided by the RMS value

Hn: absolute value of the harmonics

Limit profiles

With this option you can predefine a limit profile for the harmonics or the interharmonics. This profile can be displayed in the Spectrum view. In addition, the predefined limits are saved as additional information in order to facilitate a later analysis.

You will find further information how to configure additional profiles in the chapter 10.3.1 "Grid module".

∃+ iba I/O Manager					_		×
:*3 🗗 🖱 Ə Ə → 🕂 🔍 🖻 🛅 🖃	\rightarrow						
Inputs Outputs Groups General 4 D	Spe	ectrum (23)					
	. La G	eneral 🔨 Analog					
PQU-S	N	lame	Function	Order	Unit	Active	
ibaPQU-S (U)	<u>ا</u> د	E Function: Harmonics					^
🚺 ibaMS3xAl-1A/100A (2)	1	THD	THD	50	%		
U X4	16	Relative harmonic DC	Relative harmonic	0	%	V	
·····································	17	Relative harmonic 1	Relative harmonic	1	%		
□ · Grid	18	Relative harmonic 2	Relative harmonic	2	%		
DIN EN50160: Power frequency (11)	19	Relative harmonic 3	Relative harmonic	3	%		
IN ENSUIG: Supply voltage valuation (13) IN ENSUIG: Flicker severity (14)	20	Relative harmonic 4	Relative harmonic	4	%		
DIN EN50160: Supply voltage unbalance (15	21	Relative harmonic 5	Relative harmonic	5	%		
DIN EN50160: Harmonic voltage (16)	22	Relative harmonic 6	Relative harmonic	6	%		
	23	Relative harmonic 7	Relative harmonic	7	%		
	24	Relative harmonic 8	Relative harmonic	8	%		
>+ Phasor (20)	25	Relative harmonic 9	Relative harmonic	9	%		
Power (21)	26	Relative harmonic 10	Relative harmonic	10	%		
Unbalance (25)	27	Relative harmonic 11	Relative harmonic	11	%		
Flicker severity (24)	28	Relative harmonic 12	Relative harmonic	12	%		
	29	Relative harmonic 13	Relative harmonic	13	%		
10 min (22)	30	Relative harmonic 14	Relative harmonic	14	%		
Click to configure standards	31	Relative harmonic 15	Relative harmonic	15	%		
Click to add module	32	Relative harmonic 16	Relative harmonic	16	%		
	33	Relative harmonic 17	Relative harmonic	17	%		
	34	Relative harmonic 18	Relative harmonic	18	%		
Click to add module	35	Relative harmonic 19	Relative harmonic	19	%		
	36	Relative harmonic 20	Relative harmonic	20	%		
Unmapped	37	Relative harmonic 21	Relative harmonic	21	%		
	38	Relative harmonic 22	Relative harmonic	22	%		~
< >>	0 12	28 256 384 512 640 768	1024 1040 ок		Apply	Cancel	

The Spectrum submodule calculates the absolute or relative harmonics 1-50 and the absolute or relative interharmonics 1-50 for the selected input channel plus the fundamental frequency and the total harmonic distortion in the 200 ms measurement interval.

Name

The names are assigned by default. To allow an unambiguous identification, they contain the input channel and the characteristic value. You can additionally assign two comments by clicking the \checkmark icon in the signal name field.

Function, order, unit
 Displays the properties

ibə

"Analog" tab
Active

Here you can enable or disable the signal.

10.3.13 Unbalance submodule

"General" tab

iba I/O Manager				- [
: *3 🖻 🖆 🕄 ⋺ 🕞 • 🕥 🖉 🖆 (🕞	\rightarrow				
Inputs Outputs Groups General 4 b	Unbalance (25)				
ibaFOB-2io-D					
E-F Link 0	General 🔨 Analog				
PQU-S	A Basic				
···· 📓 ibaPQU-S (0)	Madula Turas	iba BOLL SVGrid V Jahalanaa			
ibaMS4xAl-380VAC (1)	Looked	Enlag	_		
ibaMS3xAI-1A/100A (2)	Enabled	True	_		
X 4	Name	linhalance	_		
X5	Module No	25	_		
The case of the ca	Timebase	2 ms	_		
	Use name as prefix	False			
DIN EN50160, Power requercy (11)					
DIN EN50160: Supply Voltage Valiation (1					
DIN EN50160: Flicker sevency (14)					
DIN EN50160: Jupply Voltage (16)					
DIN EN50160: Mains signalling voltage (1)					
	Name				
+ Basic (19)	The name of the module.				
_i+ base (10)					
Spectrum (23)					
Unbalance (25)					
Flicker severity (24)					
< > >	0 128 256 384 512	640 768 1024 1040	ОК Арр	bly	Cancel

Basic settings

See Power frequency submodule, "General" tab, chapter 10.3.2

"Analog" tab

The "Analog" tab is only available for star grid with N/PE and a grid without N/PE.

If the submodule is configured for a different grid, it is disabled when starting the measurement and a warning is displayed.



Signal	Meaning
Zero sequence unbalance	Ratio of zero sequence component to positive sequence component in percent
Negative sequence unbalance	Ratio of negative sequence component to positive sequence component in percent
Positive sequence component	Percentage of symmetrical voltage vectors (*) in rotation direction
Angle of the positive sequence component	Phase shift of the positive sequence component percentage of U1 compared to the reference signal
Negative sequence component	Percentage of symmetrical voltage vectors, against the rotation direction
Angle of the negative sequence component	Phase shift of the negative sequence component percentage of U1 compared to the reference signal
Zero sequence component	Percentage of voltage vectors all showing in the same direction
Angle of the zero sequence component	Direction of the zero sequence component of the voltage vectors

^(*) The voltage vector is formed from the RMS value of the voltage (as vector length) and the current phase (as vector angle).

Name

The names are set by default but can be edited. To allow an unambiguous identification, they contain the input channel and the characteristic value. You can additionally assign two comments by clicking the \swarrow icon in the signal name field.

Unit
 Display of the relevant unit.

Active

Here you can enable or disable the signal.

Display in the phasor diagram

The voltage unbalance can be visualized using the phasor diagram.

Click the button on the ibaPDA toolbar to display the phasor diagram.

Hold the mouse button down and drag the Unbalance module from the signal tree on the left onto the display. Switch the display to unbalance.

ibaPDA v8.2.2 - IBA-FUE-WKS366 - PQU_GEB	_v2.6.24a								
File Configure View Help									
Phasor + S	pectrum 🗸				🖪 📖 🚍			₽ I S→	
						031-1		v, ⊨ 111 ×	
	PQU phasor 1								4 ▷ X
the match of the added and th	(I)								
		Function	U1 Ampl	U1 Phase (°)	U2 Ampl	U2 Phase (°)	U3 Ampl	U3 Phase (°)	Unbalance (%)
⊕ III 3. ibaMS3xAI-1A/100A	▶ →	Phase	230,707	0,004	230,647	240,011	230,730	120,016	
Brock 8 Virtuel	b	Positive	230,695	0,010	230,695	240,010	230,695	120,010	
⊕-IEC 9. IEC61000-2-4 Class 1: Netzfrequenz	>	Negative	0,038	286,786	0,038	46,786	0,038	166,786	0,017
IEC 10. IEC61000-2-4 Class 1: Langsame Spannu	····	Zero	0,011	88,819	0,011	88,819	0,011	88,819	0,005
B-IEC 12. IEC61000-2-4 Class 1. Spannungsunsymm									
HEC 14. IEC61000-2-4 Class 1: Spannungsereignis									
DIN 50. EN50160: Power frequency									
DIN 51. EN50160: Supply voltage variation DIN 52. ENE0160. Biology and an anti-									
DIN 52. EN50160: Supply voltage upbalance									
DIN 54. EN50160: Harmonic voltage			· \						
⊕-DIN 55. EN50160: Mains signalling voltage			· · · · · ·						
DIN 56. EN50160: Voltage events				\mathbf{N}					
⊕				\mathbf{X}					
61. Spectrum UIN									
B 63 Spectrum U3N								Gr	id
⊕									
66. Spectrum I2									
⊕									
68. Spectrum In									
⊕-• •									
1. 20 Power									
B- A 81 Commutation notches									
₩ 82. Events									
95. Aggregation (10 s)									
96. Aggregation (10 min)									
⊕-▼ 97 Addregation (1 h)									
O cash	D	D4 D2 D2 H							
V Signals > Search	Phasor Power	PT PZ P3 U	invalance						

10.3.14 Flicker severity submodule

"General" tab

∃→ iba I/O Manager							_		×
: 🔁 🖻 ᢪ 🛢 🗲 🗸 🖓 🖆	\rightarrow								
Inputs Outputs Groups General 4	Þ	lic	ker severity (24)					
🖃 🌃 ibaFOB-2io-D	^		~ ~ ~	,					
🖨 🖳 Link 0		و 👷	ieneral 🔨 Analog						
🖨 📑 PQU-S			D						
ibaPQU-S (0)		~	Basic						
ibaMS4xAI-380VAC (1)			Module Type	IbaPQU-5 \Grid \Flicker seve	enty				
ibaMS3xAI-1A/100A (2)			Locked	False					
			Enabled	Irue					
- U ×5			Name	Hicker seventy					
			Module No.	24					
📄 🏂 Grid			Timebase	2 ms					
DIN EN50160: Power frequency (11)			Use name as prefix	False					
DIN EN50160: Supply voltage variation (1		~	Configuration	0001/					
DIN EN50160: Flicker severity (14)			Lamp model	230V					
DIN EN50160: Supply voltage unbalance			Flicker input	Voltages only					
DIN EN50160: Harmonic voltage (16)									
DIN EN50160: Mains signalling voltage (1									
DIN EN50160: Voltage events (18)									
		Na	me						
>> Phasor (20)		In	a name of the module.						
🖊 Power (21)									
Spectrum (23)									
Unbalance (25)									
Flicker severity (24)									
Commutation notches (26)									
	× 🗖	11							
< >	0	12	28 256 384 512	640 768 1024	1040	OK	Apply	Cano	cel

Basic settings

□ See Power frequency submodule, "General" tab, chapter 10.3.2

Configuration

Lamp model

To calculate the flicker, the lamp model to be used, 230V or 120V, has to be specified.

- Gilling Flicker input
 - Only voltages
 - For the calculation only voltages are being used.

Only currents

For the calculation only currents are being used. For this purpose, you need to indicate for each conductor its impedance in Ohm.

Voltages and currents

The flicker for voltages and currents is calculated. For the current flicker calculation you need to indicate the impedance of the single conductors.

"Analog" tab



Signal	Meaning
U# Instantaneous flicker severity ###V Pinst	Value for the current flicker severity
U# Flicker severity ###V Pst	Short-term flicker level Pst
U# Flicker severity ###V Plt	Flicker value according to a cubic average of Pst values

Name

The names are set by default but can be edited. To allow an unambiguous identification, they contain the input channel and the characteristic value. You can additionally assign two comments by clicking the *l* icon in the signal name field.

🗅 Unit

Display of the relevant unit.

Active

Here you can enable or disable the signal.

10.3.15 Aggregation submodule

The Aggregation submodule is a freely configurable module in which the measurement interval and the characteristic values can be selected individually. The submodule name is assigned automatically by ibaPDA and is in accordance with the set measurement interval. The default setting is 10 min. If the measurement interval is modified, the module name will change accordingly.



Note

Details on the aggregation method:

- For the standard update intervals (200 ms, 3 s, 10 s, 10 min, 2 h) the aggregation method is listed in the table "Calculated characteristic values" in chapter 8.2.
- The following aggregation is applied for the "Custom" update interval:
 - Energy value: total of 10/12 period values
 - Flicker: Cubic average of Pst values
 - For all other calculations the quadratic average is being used.

"General" tab

🕂 iba I/O Manager							×
* D C C C 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0							
Inputs Outputs Groups General 4 b	0 1	min (22)					
ibaRS4xAI-380VAC (1)	6	ieneral 🔨 Analog					
🗓 X4	~	Basic					
- 🛛 X5		Module Type	ibaPQU-S\Grid\Aggregation				
		Locked	False				
i ⊕ · 贵 Grid		Enabled					
DIN EN50160: Power frequency (11)		Name Madula Na	10 min				
DIN EN50160: Supply voltage variation (1		Module No.	2				
DIN EN50160: Flicker severity (14)		limebase	Z ms				
DIN EN50160: Supply voltage unbalance		Module I avout	raise				
····DIN EN50160: Harmonic voltage (16)	Ť	No peolog signals	0				
DIN EN50160: Mains signalling voltage (1	~	Configuration	0				
DIN EN50160: Voltage events (18)	Ŭ	Undate interval	10 min				
		Unit	Minutes				
→ Phasor (20)		Amount	10				
Power (21)		Mode	Custom				
Inholonos (25)							
Picker severity (24) Picker severity (24) Orminutation notches (26) Ficker (27) Picker (Na Th	me e name of the module.]			
<pre>cick to conlight standards > 0</pre>	12	8 256 384 512	640 768 1024 1040	ОК	Apply	Cano	cel

Basic settings

See Power frequency submodule, "General" tab, chapter 10.3.2

Module Layout

No. analog signals

Enter the number of desired signals here. The number determines the length of the signal table in the "Analog" tab.

Configuration

Update interval
 Select the measurement interval here.

- The following default intervals are available: 200 ms, 3 s, 10 s, 10 min or 2 h If you choose a default interval, the Unit and Amount fields will show the matching values and cannot be edited.
- Custom

The "Custom" selection allows you to freely define the measurement interval using the Unit and Amount fields.

Select the unit from the drop-down menu.

\sim	Configuration	
~	Update interval	Custom
	Unit	Minutes 🗸 🗸
	Amount	200 ms
	Mode	Seconds
		10 Seconds
		Minutes

Enter the amount (number of units) as an integer value into the field.

\sim	Configuration	
~	Update interval	Custom
	Unit	Minutes
	Amount	10

The defined amount and the unit determine the measurement interval and automatically the name of the module.

Mode

- Custom: Select "Custom" to configure the analog signals in the "Analog" tab to your preferences.
- Auto: Select "Auto" to show the additional line "Signals based on". Click on the arrow to open a drop-down menu that contains all submodules that have already been created:

		Mode			Auto		
	$\mathbf{\tilde{v}}$	Signals	based on		(7) Basic	\sim]
-		Link	ced modules				l
		- DIN	(0) EN50160: F	Powerf	frequency		l
		DIN:	(1) EN50160: 9	Supply	voltage variation		l
		DIN	(2) EN50160: F	Flicker	severity		l
		DIN	(3) EN50160: 9	Supply	voltage unbalance		
		DIN:	(4) EN50160: H	Harmor	nic voltage		l
		DIN:	(5) EN50160: M	Mains s	signalling voltage		l
		DIN:	(6) EN50160: \	Voltage	events		l
		·⊇‡	(7) Basic				l
		- 🗌 沖	(8) Phasor				
		· 🗹 🖊 .	(9) Power				
			(14) Spectrum	U1N			
			(16) Unbalance	е			l
		🗆 速	(15) Flicker sev	/erity			

The submodules can be selected individually. The characteristic values configured in them serve as the basis for the new measurement, however with the measurement interval defined here.

"Analog" tab

The display in the "Analog" tab depends on the settings in the "General" tab.

In the following example, we selected "Auto" mode and the submodules "Basic" and "Power". The characteristic values defined in the submodules are listed in the "Analog" tab.

∄+ iba I/O Manager													- 0	X
: *> F 🗗 🖱 Ə Ə Ə • M 🕔 🖻 🕞 🗲	\rightarrow													
Inputs Outputs Groups General 4 D	10	min	(22))										
	T	General	^∖ ∧	nalog										
ibaMS4xAI-380VAC (1)		Name					Funct	on			Order		Unit	Active
- X4		🗆 Grou	up: (19) i	Basic, Inp	ut: Grid									
🗉 ×5	1	Pow	er frequ	ency 10 r	nin		Frequ	ency					Hz	
Diagnostics (28)	•	🗏 Gro	Group: (19) Basic, Input: U1N											
Grid Grid DIN EN50160: Power frequency (11)	6	U1N	RMS 10	min			RMS						٧	
DIN EN50160: Supply voltage variation (1	7	U1N	Peak va	lue 10 mi	n		Peak	alue					٧	
DIN EN50160: Flicker severity (14)	8	U1N	Rectifie	d value 1	0 min		Rectif	ed value					٧	
DIN EN50160: Supply voltage unbalance	9	U1N	Frequer	ncy 10 mi	n		Frequ	ency					Hz	
IN EN50160: Harmonic Voltage (16) IN EN50160: Mains signalling voltage (1	10	U1N	Phase a	ingle 10 n	nin		Phase	angle				1	rad	
DIN EN50160: Voltage events (18)	11	U1N	Form fa	ctor 10 m	in		Form	actor						
	12	U1N	Crest fa	actor 10 n	nin		Crest	factor						
→ Phasor (20)		Gro	JD: (19)	Basic. Inc	ut: U2N									
Spectrum (23)		+ Grou	in: (19)	Basic, Inc	ut: U3N									
Unbalance (25)		+ Grou	no: (10)	Basic Inc	ut- T1									
Flicker severity (24)		Cros	.p. (10)	Paois Inc										
/ I) Commutation notches (26)			ир: (19) і	Dasie, Inp	ut: 12									
10 min (22)		Gro	ib: (19)	basic, inp	ut: 15									
Click to configure standards		± Gro	.p: (21)	Power, In	put: Gria									
Click to add module		± Grou	.p: (21)	Power, In	put: L1									
Click to add module		🗄 Grou	.p: (21)	Power, In	put: L2									
		🗄 Grou	.p: (21)	Power, In	put: L3									
Click to add module														
He Daubaak		100	050	-	540		700	000 1001	1125	OK		Apply		Cancel
		128	256	384	512	640	/68	896 1024		-				

Name

The names are assigned by default. To allow an unambiguous identification, they contain the input channel and the characteristic value. You can additionally assign two comments by clicking the \swarrow icon in the signal name field.

□ Function, order, unit Displays the properties

Active

Here you can enable or disable the signal.

In the following example, the "Custom" mode was selected. The "Analog" tab shows no entries at first.

➡ iba I/O Manager										— C) X
: *> 🖻 🖆 🕄 🕀 - 🛧 🖳 🐚 🕞 🖯	\rightarrow										
Inputs Outputs Groups General 4 D	10) min (22	2)								
PQU-S	Ţ	General 🔨	Analog								
ibaMS4xAI-380VAC (1)		Name			Function	on		Order	Input	Unit	Active
	0				Invalid				U1N: [1:0] L1		V
🗓 ×5	1				Invalid	l i			U1N: [1:0] L1		V
Diagnostics (28)	2				Invalid	1			U1N: [1:0] L1		
Grid	3				Invalid	I			U1N: [1:0] L1		
DIN EN50160: Supply voltage variation (1	4				Invalid	1			U1N: [1:0] L1		
DIN EN50160: Flicker severity (14)	5				Invalid				U1N: [1:0] L1		
DIN EN50160: Supply voltage unbalance	6				Invalid	1			U1N: [1:0] L1		
UIN EN50160: Harmonic voltage (16) UIN EN50160: Mains signalling voltage (1	7				Invalid	1			U1N: [1:0] L1		
DIN EN50160: Voltage events (18)											
	1										
>→ Phasor (20)	1										
	11										
Spectrum (23)	11										
Unbalance (25)	11										
Plicker severity (24)	11										
····/ I\ Commutation notches (26)	11										
Events (27)	11										
10 min (22)	11										
Click to configure standards											
<	0	128 256	384	512	640	768	896 1024	1048	OK Appl	у	Cancel

Name

You can select any name. You can additionally assign two comments by clicking the \checkmark icon in the signal name field.

Function

Select the characteristic value to be calculated from the drop-down menu: Phase, Peak value, ...



The calculations applicable to the selected input signal are shown in green.

Order

If one of the harmonics or interharmonics is selected under Function, you can enter the order 1-50 here.

Input

Select the input to be measured form the drop-down menu:

Function	Order	Input	Unit	Active
Positive sequence component		U1N: [1:0] 🗸 🗸		
Invalid		L1		^
Invalid		L2		
Invalid		Grid		
Invalid		Voltages		
Invalid		Currents		
Invalid		Power grid		~

The input signals that match the selected function are displayed in green.

Unit
 The unit is inserted automatically.

Active

Here you can enable or disable the signal.

Special considerations for grids with user-defined nominal frequencies

In addition to grids with 50 Hz and 60 Hz nominal frequency, ibaPQU-S also allows taking measurements in grids with a user-defined frequency. If a user-defined power frequency is set (in the PQU-S module), this will influence the length of the 200 ms measurement interval and the naming in the Aggregation submodule.

With a 200 ms interval, exactly 10 periods are measured in 50 Hz grids and 12 periods in 60 Hz grids, equivalent to exactly 200 ms.

With user-defined power frequencies, 10 or 12 periods are measured accordingly: 10 periods for power frequencies \geq 10 Hz and < 51 Hz, and 12 periods for power frequencies \geq 51 Hz and < 80 Hz.

For the set power frequency, the interval time is then calculated for 10 or 12 periods.

Example:

If 16.7 Hz power frequency is set, 10 periods are measured. The measurement interval is calculated for 10 periods and is 598.8 ms.

The interval of 598.8 ms is then also displayed in the drop-down menu and replaces the 200 ms interval.

\mathbf{v}	Configuration		
\mathbf{v}	Update interval	598,8 ms	\sim
	Unit	598,8 ms	
	Amount	9 s	
	Mode	10 s	
		10 min 12 h	
		Custom	

The calculated measurement interval also determines the module name.

5	98	.8 ms (22)	
5	G	ieneral 🔨 Analog	
	~	Basic	
		Module Type	ibaPQU-S\Grid\Aggregation
		Locked	False
		Enabled	True
		Name	598.8 ms
		Module No.	22
		Timebase	2 ms
		Use name as prefix	False
	✓ Module Layout		
		No. analog signals	8
	\mathbf{v}	Configuration	
	$\mathbf{\sim}$	Update interval	598,8 ms 🗸
		Unit	Periods
		Amount	10
		Mode	Custom

10.3.16 Commutation notches submodule

"General" tab

∃+ iba I/O Manager				
: *• 🖻 🖆 🖱 🗲 🕂 🕡 🖬 🛍 🗲				
Inputs Outputs Groups General 4 D	Commutation notches (2	26)		
PQU-S ibaPQU-S (0)	Analog			
	✓ Basic			
	Module Type ibaPQU-S	Grid\Commutation notche		
	Locked False			
Diagnostics (28)	Enabled True			
⊟ a Grid	Name Commut	ation notches		
DIN EN50160: Power frequency (11)	Module No. 26			
DIN EN50160: Supply voltage variation (1	Timebase 2 ms			
DIN EN50160: Flicker severity (14)	Use name as prefix False			
-DIN EN50160: Supply voltage unbalance				
DIN EN50160: Harmonic voltage (16)				
DIN EN50160: Mains signalling voltage (1				
DIN EN50160: Voltage events (18)				
>+ Phasor (20)	Name			
🖊 Power (21)	The name of the module.			
Spectrum (23)				
Unbalance (25)				
🐲 Flicker severity (24)				
/l\ Commutation notches (26)				
<pre></pre>	128 256 384 512 640 76	8 1024 1048	OK Apply	Cancel

Basic settings

□ See Power frequency submodule, "General" tab, chapter 10.3.2

"Analog" tab

→ iba I/O Manager			o x
: *3 🗗 🔁 🖱 🕄 🕂 🕂 🔍 🛍 🗂			
Inputs Outputs Groups General	Commutation notches (26)		
Link 0 Link 0 Description De	↑	Unit %	Active
-DIN EN50160: Hamonic voltage (16) -DIN EN50160: Mains signalling voltage (-DIN EN50160: Voltage events (18) - ±∓ Basic (19) - >+ Phasor (20) - ₩ Power (21) - Spectrum (23) - ₩ Unbalance (25) - ₩ Finker severity (24) - ₩ Commutation notches (26)	Т	ply	Cancel

□ Signals: Depth of notch per phase in percent

10.3.17 Events submodule

"General" tab

→ iba I/O Manager				- 🗆	×
* • • • • • • • • • • • • • • • • • • •	þ				
Inputs Outputs Groups General 4 D	Events (27)				
i⊡ 🛱 Link 0 ^		ligital			
ibaPQU-S (0)		igitai			
🕕 ibaMS4xAI-380VAC (1)	✓ Basic				
ibaMS3xAI-1A/100A (2)	Module Type	ibaPQU-S\Grid\Events			
- U X4	Locked	Faise			
×5	Name	Evente			
Diagnostics (28)	Module No	27			
DIN EN50160: Power fraguency (11)	Timebase	2 ms			
	Use name as prefix	False			
DIN EN50160: Supply voltage unbalance					
DIN EN50160: Harmonic voltage (16)					
DIN EN50160: Mains signalling voltage (1					
DIN EN50160: Voltage events (18)					
<u>-</u> ∃- Basic (19)					
···· → Phasor (20)	Name				
Power (21)	The name of the module.				
Liphalance (25)					
Ticker severity (24)					
Commutation notches (26)					
🐖 Events (27)					
		1040	01/		
< > 0	128 256 384 512	640 768 1024 1048	ОК Арр	liy Cai	ncei

Basic settings

□ See Power frequency submodule, "General" tab, chapter 10.3.2

You will find the configuration of the event limits in chapter 10.3.1 "Grid module".

"Analog" tab

∃- iba I/O Manager				
: *• 🖻 🖆 🖱 🕀 🕂 🕥 🛛 🛤 🖆 🗲	\rightarrow			
Inputs Outputs Groups General 4 D	Ev	ents (27)		
ink 0 ∧				
■ PQU-S	44	General 'V Analog JU Digital		
iban Q0-3 (0)		lame	Unit	Active
ibaMS3xAI-1A/100A (2)		Event type: Dip event		
🗓 X4	0	Dip event Start	s	
X5	1	Dip event Duration	s	
Diagnostics (28)	2	Dip event Min	V	
DIN EN50160: Power frequency (11)		Event type: Swell event		-
DIN EN50160: Supply voltage variation (1	5	Swell event Start	s	
DIN EN50160: Flicker severity (14)	6	Swell event Duration	c.	
DIN EN50160: Supply voltage unbalance	7	Swell event Max	v	
DIN EN50160: Mains signalling voltage (16)	' -	Sweek brown Februaries a sweek		
DIN EN50160: Voltage events (18)				
+ Basic (19)	10	Interruption event Start	S	
>> Phasor (20)	11	Interruption event Duration	S	
	12	Interruption event Min	V	
Unbalance (25)		Event type: Mains signalling event		
Flicker severity (24)	15	Mains signalling event Start	S	
/1\ Commutation notches (26)	16	Mains signalling event Duration	s	
	17	Mains signalling event Max	V	
598.8 ms (22)		Event type: RVC event		
Click to add module	20	RVC event Start	s	
Click to add module	21	PVC event Duration	-	
<u>.</u>	22	DVC event Balta Linev	у И	
i⊕ link 1	22		v	
Click to add module	23	KVC event Deita Uss	V	
₩ fuguer				0
< >	0	128 256 384 512 640 768 896 1024 1048 OK	фріу	Cancel

Signal	Meaning
Start	How many seconds ago did the event start
Duration	Duration of the event
Min/Max	Minimum / maximum voltage value

Delta Umax / Delta Uss	Delta Umax: RMS value that was furthest from the floating average. Delta Uss: Difference between Uss and the start of the event and Uss and the end of the event.
	Uss: Floating average of the balf period RMS value over 1 second
	ribating average of the nampened rande value even recebind

"Digital" tab



The listed signals here are "True" as soon as the corresponding event is pending. Thus, a simple triggering to the pending event is possible.

11 Technical data

11.1 Main data

Brief	descri	ption
	a00011	P

Description		ibaPQU-S
Description		Central unit for (iba modular system) Power Quality Monitoring applications
Order number		10.150000
Processor unit		
Processor		1.6 GHz Atom processor, dual core CPU
Flash memory		Solid-state drive
Clock		Unbuffered / external buffering possible
Supply, operating a	nd indicating ele	ments
Voltage supply		DC 24 V, ± 10 % not stabilized 1 A (without I/O modules), 3 A (with I/O modules)
Power consumption		Max. 20 W (central unit only)
Displays		4 LEDs for operating status of the device8 LEDs for status of the digital inputs
Operating and envir	onmental condit	ions
Cooling		Passive
Temperature ranges	Operation Storage/transport	32 °F 122 °F (0 °C 50 °C) -13 °F 158 °F (-25 °C 70 °C)
Mounting position		Vertical plugged into backplane

Mounting position	Vertical, plugged into backplane
Installation height	Up to 2000 m
Humidity class acc. to DIN 40040	F, no condensation
Protection class	IP20
Certification/Standards	EMC: IEC 61326-1 FCC part 15 class A IEC 61000-4-30:2015 Class A IEC 61000-4-15:2010 IEC 61000-4-4:2012 IEC 61180:2016 IEC 62586-2:2013
MTBF ¹	255,939 hours / ca. 29 years
Dimensions and weight	
Dimensions (width x height x depth)	56 mm x 214 mm x 148 mm with backplane: 229 mm x 219 mm x 156 mm
Weight	1.5 kg (incl. packaging and documentation)

¹ MTBF (mean time between failure) according to Telcordia 3 SR232 (Reliability Prediction Procedure of Electronic Equipment; Issue 3 Jan. 2011) and NPRD (Non-electronic Parts Reliability Data 2011).

Supplier's Declaration of Conformity 47 CFR § 2.1077 Compliance Information

Unique Identifier: 10.150000 ibaPQU-S

Responsible Party - U.S. Contact Information

iba America, LLC 370 Winkler Drive, Suite C Alpharetta, Georgia 30004

(770) 886-2318-102 www.iba-america.com

FCC Compliance Statement

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

11.2 Interfaces

ibaNet		
Number	1 (e. g. for the connection to ibaPDA)	
ibaNet protocol	32Mbit Flex (bidirectional)	
Connector type	2 ST connectors for RX and TX; iba recommends the use of FO with multimode fibers of type $50/125 \ \mu m$ or $62.5/125 \ \mu m$; For information on cable length, see chap. 11.7.	
Transmitting interface (TX)		
Output power	50/125 µm FO cable	-19.8 dBm to -12.8 dBm
	62.5/125 µm FO cable	-16 dBm to -9 dBm
	100/140 µm FO cable -12.5 dBm to -5.5 dF	
	200 µm FO cable	-8.5 dBm to -1.5 dBm
Temperature range	-40 °F to 185 °F (-40 °C to 85 °C	C)
Light wavelength	850 nm	
Receiving interface (RX)		
Sensitivity ²	100/140 µm FO cable	-33.2 dBm to -26.7 dBm
Temperature range	e -40 °F to 185 °F (-40 °C to 85 °C)	
Additional interfaces		
Ethernet	10/100 Mbit/s	
USB	2x host, 1x device for service pu	irposes

² Data for other FO cable diameters not specified

11.3 Digital inputs

Digital inputs

Number	8
Version	Galvanically isolated, protected against reverse polarity, single ended
Input signal	24 V DC
Max. input voltage	±60 V permanent
Signal level log. 0 Signal level log. 1	> -6 V; < +6 V < -10 V; > +10 V
Input current	1 mA, constant
Debounce filter	Optional with 4 operating modes
Sampling rate	Max. 40 kHz, freely adjustable
Delay	typ. 10 μs
Electrical isolation Channel-channel Channel-housing	2.5 kV AC 2.5 kV AC
Connector type	16-pin connector, connector with clamp-type terminals (0.2 mm ² to 2.5 mm ²), can be screwed, included in delivery

11.4 Grid characteristics

Grid types1-phase grid, 3-phase grid without N/PE, 3-phase grid with N/PEGrid frequency10-80 Hz

Characteristic values	Calculati	on tim	e				Grid t	уре	
	Half period	10/12	150/180	10 s	10 min	2 h	1	3	3+N
RMS	•	•	٠	٠	•	٠	•	٠	٠
Peak	•	٠	•	٠	•	٠	•	•	•
Rectified	•	•	•	٠	•	٠	•	•	٠
Form factor	-	•	٠	٠	٠	٠	•	٠	٠
Crest factor	-	•	•	٠	•	٠	•	•	•
Frequency	•	•	٠	٠	•	٠	•	٠	٠
Phase	-	•	•	٠	•	٠	•	•	٠
Harmonics	-	•	٠	٠	٠	٠	•	٠	٠
Interharmonics	-	•	•	٠	•	٠	•	•	•
THD	-	•	•	٠	•	•	•	•	•
TIF	-	•	•	٠	•	٠	•	•	•
Mains signalling	-	•	٠	٠	٠	٠	•	•	•
Power/energy	-	•	•	٠	•	٠	•	•	•
Power/energy VA	-	•	•	٠	•	٠	•	•	•
Power/energy VAr	-	•	•	٠	•	٠	•	•	•
Fundamental reactive power/energy	-	•	٠	٠	٠	٠	٠	٠	٠
Power factor	-	•	•	٠	•	٠	•	•	•
Cos φ	-	•	•	٠	•	٠	•	•	•
Positive/negative/zero sequence component	-	•	•	٠	•	٠	-	-	٠
Unbalance	-	•	٠	٠	٠	٠	-	٠	٠
Flicker (Pinst, Pst, Plt)	•	-	-	-	•	٠	•	٠	٠
Events	-	•	-	-	-	-	•	٠	٠
Commutation notches	•	-	-	-	-	-	•	•	٠

For more detailed information on grid characteristics, please refer to chapter 8.1 "Grid types" and chapter 8.2 "Signals and calculated characteristic values".

11.5 Dimensions

ibaPQU-S



Dimensions of ibaPQU-S with cables (dimensions in mm)

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Distance between two ibaPQU-S systems

(Dimensions in mm)



ibaPQU-S and backplane

(Dimensions in mm)

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Dimensions of ibaPADU-S-B1S with modules (dimensions in mm)

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11.6 Connection diagram

11.6.1 Pin assignment voltage supply X14

Pin	Connection	
1	+ 24 V	-
2	0 V	_

11.6.2 Pin assignment digital inputs X5

Pin	Connection	
1	Digital input 00 +	
2	Digital input 00 -	\geq_{-}
3	Digital input 01 +	2_
4	Digital input 01 -	<u> </u>
5	Digital input 02 +	<u> </u>
6	Digital input 02 -	<u> </u>
7	Digital input 03 +	(-)
8	Digital input 03 -	$\left - \right $
9	Digital input 04 +	$\left - \right $
10	Digital input 04 -	$\left \right = \left \right $
11	Digital input 05 +	$\left \right\rangle^{-}$
12	Digital input 05 -	$\left \right ^{-}$
13	Digital input 06 +	$\left \right\rangle^{-}$
14	Digital input 06 -	\geq^{-}
15	Digital input 07 +	\geq
16	Digital input 07 -	

11.7 Example for FO budget calculation

As an example, an FO connection from an ibaFOB-io-Dexp card (FO transmitter) to an ibaBM-PN device (FO receiver) is used.

Manual



The example refers to a point-to-point connection with an FO cable of type 62.5/125 μ m. The light wavelength used is 850 nm.

The range of the minimum and maximum values of the output power or receiver sensitivity depends on the component and, among other things, on temperature and aging.

For the calculation, the specified output power of the transmitting device and on the other side the specified sensitivity of the receiving device must be used in each case. You will find the corresponding values in the respective device manual in the chapter "Technical data" under "ibaNet interface".

Specification ibaFOB-io-Dexp:

Output power of FO transmitting interface		
FO cable in µm	Min.	Max.
62.5/125	-16 dBm	-9 dBm

Specification ibaBM-PN:

Sensitivity of FO receiving interface		
FO cable in µm	Min.	Max.
62.5/125	-30 dBm	

Specification FO cable

To be found in the data sheet of the fiber optic cable used:

FO cable	62.5/125 μm
Connector loss	0.5 dB connector
Cable attenuation at 850 nm wavelength	3.5 dB / km

Equation for calculating the FO budget (A_{Budget}):

$$A_{Budget} = |(P_{Receiver} - P_{Sender})|$$

P_{Receiver} = sensitivity of FO receiving interface

P_{Sender} = output power of FO transmitting interface

Equation for calculating the fiber optic cable length (I_{Max}):

$$l_{Max} = \frac{A_{Budget} - (2 \cdot A_{Connector})}{A_{Fiberoptic}}$$

 $A_{Connector} = connector loss$

 $A_{Fiberoptic}$ = cable attenuation

Calculation for the example ibaFOB-io-Dexp -> ibaBM-PN in the best case:

 $A_{Budget} = |(-30 \ dBm - (-9 \ dBm))| = 21 dB$

$$l_{Max} = \frac{21dB - (2 \cdot 0.5dB)}{3.5 \frac{dB}{km}} = 5.71 \text{km}$$

Calculation for the example ibaFOB-io-Dexp -> ibaBM-PN in the worst case:

 $A_{Budget} = |-30 \ dBm - (-16 \ dBm)| = 14 dB$

$$l_{Max} = \frac{14dB - (2 \cdot 0.5dB)}{3.5 \frac{dB}{km}} = 3.71 \text{km}$$



Note

When connecting several devices as daisy chain (e.g. ibaPADU-8x with 3Mbit) or as ring (e.g. ibaPADU-S-CM with 32Mbit Flex), the maximum distance applies to the section between two devices. The FO signals are re-amplified in each device.



Note

When using fiber optics of the 50/125 μm type, a distance reduction of approx. 30-40% must be expected.

12 Accessories

12.1 Backplane panels

12.1.1 ibaPADU-S-B4S

Backplane panel for mounting 1 central unit and up to 4 I/O modules.



12.1.1.1 Scope of delivery

- Backplane panel
- Assembly kit



Issue 1.5



Assembly kit

12.1.1.2 Dimensions



Dimensions in mm



Dimensions ibaPADU-S-B4S with mounting angles (dimensions in mm)

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12.1.1.3 Grounding

For grounding the backplane panel use the enclosed grounding cable and the enclosed grounding screws as shown below.



- 1 Spring lock washer
- 2 Ground wire with cable lug
- 3 Contact washer

12.1.1.4 Technical data

Short description	
Product name	ibaPADU-S-B4S
Description	Backplane panel for 1 central unit and up to 4 I/O modules from the iba modular system
Order number	10.124000
Interface central unit	
Number	1
Connection type	Female header, pole number 3 x 32
Slot	X1
Interface I/O modules	
Number	4
Connection type	Female header, pole number 3 x 32
Slot	X2 - X5
Supply	
Power supply	none
Mounting	
Housing	4 thread M6, rear side
Assembly kit	enclosed
Grounding	1 thread M6, rear side
Assembly kit	enclosed
Design	
Dimensions (width x height x depth)	229 mm x 219 mm x 21 mm
Weight / incl. packaging	0.66 kg / 0.85 kg

12.1.2 ibaPADU-S-B1S

Backplane panel for mounting 1 central unit and 1 I/O module.



12.1.2.1 Scope of delivery

- Backplane panel
- Assembly kit



12.1.2.2 Dimensions



Dimensions in mm

12.1.2.3 Grounding

See chapter 12.1.1.3

12.1.2.4 Technical data

Short description	
Product name	ibaPADU-S-B1S
Description	Backplane panel for 1 central unit and 1 I/O module from the iba modular system; with mounting angles
Order number	10.124002
Interface central unit	
Number	1
Connection type	Female header, pole number 3 x 32
Slot	X1
Interface I/O module	
Number	1
Connection type	Female header, pole number 3 x 32
Slot	X2
Supply	
Power supply	none

Mounting	
Housing	4 through holes M6
Assembly kit	-
Grounding	1 thread M6, rear side
Assembly kit	enclosed
Design	
Dimensions (width x height x depth)	99 mm x 247 mm x 21 mm
Weight / incl. packaging	0.32 kg / 0.43 kg

12.2 Mounting system for central unit

12.2.1 ibaPADU-S-B

Mounting panel with DIN rail clip for 1 central unit (without I/O modules).



12.2.1.1 Scope of delivery

Mounting panel

12.2.1.2 Dimensions



Dimensions in mm

12.2.1.3 Grounding

The grounding must be done via the DIN rail.

12.2.1.4 Technical data

Short description	
Product name	ibaPADU-S-B
Description	Mounting panel for 1 central unit from the iba modular system; with DIN rail clip
Order number	10.124001
Mounting	
Panel	on DIN rail according to EN 50022 (TS 35, DIN Rail 35)
Assembly kit	-
Grounding	via DIN rail
Assembly kit	-
Design	
Dimensions (width x height x depth)	56 mm x 219 mm x 28 mm
Weight / incl. packaging	0.17 kg / 0.26 kg

12.3 Mounting systems for ibaPADU-S-B4S

12.3.1 Mounting angles

Mounting angles for mounting an iba modular system in a cabinet, 2 pieces, matching for ibaPADU-S-B4S (10.124000).

1 set (2 pieces) is needed for one ibaPADU-S-B4S backplane panel.



12.3.1.1 Scope of delivery

□ 2 pieces mounting angles (1 set)

12.3.1.2 Dimensions

W x h x d: 179 mm x 57 mm x 10 mm

12.3.1.3 Technical data

Short description	
Product name	Mounting angles for iba modular system
Description	1 set (2 pieces) mounting angles, matching for backplane panel ibaPADU-S-B4S, for a front side mounting of the backplane
Order number	10.124006
Mounting	
Angle	4 through holes M6
Assembly kit	-
Design	
Dimensions (width x height x depth)	179 mm x 57 mm x 10 mm
Weight / incl. packaging	0.091 kg / 0.092 kg

12.3.2 Mounting panel 19"

Mounting panel (483 mm/19") for up to 2 ibaPADU-S-B4S backplane panels.



12.3.2.1 Scope of delivery

- Mounting panel
- Assembly kit



12.3.2.2 Mounting backplane panel

Up to 2 ibaPADU-S-B4S backplane panels can be mounted on the 19" mounting panel. The mounting of one backplane panel is possible either in the center or on the right or left side.



Mounting centered



Mounting on the right

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114

e

5

483

0 G o 8 0 G 144 91 C П Ю e q Ð 114 q Û ¢ Œ 114

12.3.2.3 Dimensions



Dimensions in mm

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12.3.2.4 Grounding

Variation 1:

One backplane panel and grounding of the mounting panel are on the same side.

After the backplane panel is mounted on the 19" mounting panel, the backplane panel must be grounded via the mounting panel. Screw the grounding cable on the back of the mounting panel to the backplane panel. Use the screw connection as described in chapter 12.1.1.3.



Connect the cable to the next threaded bolt of the mounting panel. The grounding of the mounting panel is also connected to the threaded bolt.



Both grounding cables are attached to the threaded bolt as shown.



Variation 2:

One backplane panel and grounding of the mounting panel are **not on the same side**.

The backplane panel is mounted on the right or left side of the mounting panel, the grounding of the mounting panel is connected on the respective other side. Ground the backplane panel at the next threaded bolt of the mounting panel. The grounding of the mounting panel can then be connected at the opposite side. See figure below.



Variation 3:

Two backplane panels are mounted.

Ground the two backplane panels at the next threaded bolt on the left or right. The grounding of the mounting panel must be connected to one of the threaded bolts.

Connection for grounding the 19" mounting panel



- 1 Hexagon nut/lock nut
- 2 Hexagon nut
- 3 Spring lock washer
- 4 Ground wire with cable lug
- 5 Contact washer
12.3.2.5 Technical data

Short description	
Product name	Mounting panel 19" for iba modular system
Description	Mounting panel (483 mm/19") for up to 2 ibaPADU-S- B4S backplane panels
Order number	10.124005
Mounting	
Panel	4 through holes
Assembly kit	enclosed
Grounding	2 threaded bolts M6, rear side
Assembly kit	enclosed
Design	
Height units (HU)	5
Dimensions (width x height x depth)	483 mm x 221 mm x 22 mm
Weight / incl. packaging	1.2 kg / 1.4 kg

12.3.3 Module carrier

Module carrier for mounting 1 backplane panel ibaPADU-S-B4S.



The included table power supply can be conveniently stored in the bottom of the module carrier.

12.3.3.1 Scope of delivery

- Module carrier
- Dever supply 24 V DC / 5 A

12.3.3.2 Dimensions

W x h x d: 230 mm x 435 mm x 200 mm

12.3.3.3 Technical data

Short description	
Product name	Module carrier for iba modular system
Description	Module carrier for mounting 1 backplane panel ibaPADU-S-B4S; incl. power supply 24 V DC / 5 A (10.800007)
Order number	10.124007
Design	
Dimensions (width x height x depth)	230 mm x 435 mm x 200 mm
Weight	1.8 kg
Accessory	
Power supply 24 V DC / 5 A	10.800007

12.4 Terminal blocks

16 pin RM 5.08 ter	minal block WAGO	
Order number	52.000023	A MARKAN AND A MARKAN
12 pin RM 3.81 ter	minal block PHOEN	IX
Order number	52.000024	9
2 pin RM 5.08 term	ninal block WAGO	
Order number	52.000022	

12.5	I/O modules iba modular system	
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Product	Order No.	Note
ibaMS3xAI-1A	10.124600	3 analog inputs, 1 A AC
ibaMS3xAI-5A	10.124610	3 analog inputs, 5 A AC
ibaMS3xAI-1A/100A	10.124620	3 analog inputs, 1 A AC/100 A DC
ibaMS4xAI-380VAC	10.124521	4 analog inputs, 380 V AC
ibaMS8xAI-110VAC	10.124500	8 analog inputs, 110 V AC
ibaMS16xAI-10V	10.124100	16 analog inputs, ±10 V
ibaMS16xAI-10V-HI	10.124101	16 analog inputs, ± 10 V (high impedance)
ibaMS16xAI-24V	10.124102	16 analog inputs, ±24 V
ibaMS16xAI-24V-HI	10.124103	16 analog inputs, ±24 V (high impedance)
ibaMS16xAI-20mA	10.124110	16 analog inputs, ±20 mA
ibaMS16xDI-220V	10.124200	16 digital inputs, ±220 V
ibaMS16xDI-24V	10.124201	16 digital inputs, ±24 V
ibaMS32xDI-24V	10.124210	32 digital inputs, ±24 V
ibaMS4xUCO	10.124310	Counter module, 4 inputs
ibaMS8xICP	10.124300	8 inputs for ICP/IEPE vibration sensors
ibaMS16xAO-10V	10.124150	16 analog outputs, ±10 V
ibaMS16xAO-20mA	10.124160	16 analog outputs, ±20 mA
ibaMS16xDO-2A	10.124250	16 digital outputs, 2 A
ibaMS32xDO-24V	10.124260	32 digital outputs, 24 V
ibaMS16xDIO-24V	10.124220	16 digital inputs and outputs, respectively, 24 V
ibaMS4xADIO	10.124120	4 analog inputs/outputs respectively + 4 digital inputs/outputs respectively

12.6 FO cards/cables

Product	Order no.	Remark
ibaFOB-io-D	11.115810	PCI card (1 input, 1 output)
ibaFOB-2i-D	11.115710	PCI card (2 inputs)
ibaFOB-2io-D	11.115800	PCI card (2 inputs, 2 outputs)
ibaFOB-4i-D	11.115700	PCI card (4 inputs)
ibaFOB-4o-D - for PCI slot (long) - for rackline slot (short)	11.116201 11.116200	Add-on module (4 outputs) For all ibaFOB-D cards as output module or for mirroring the inputs
ibaFOB-io-Dexp	11.118020	PCI-Express card (1 input, 1 output)
ibaFOB-2i-Dexp	11.118030	PCI-Express card (2 inputs)
ibaFOB-2io-Dexp	11.118010	PCI-Express card (2 inputs, 2 outputs)
ibaFOB-4i-Dexp	11.118000	PCI-Express card (4 inputs)
ibaFOB-io-ExpressCard	11.117000	For measuring with the notebook
ibaFOB-io-USB	11.117010	For measuring with the notebook

iba also offers suitable fiber optic cables in different designs and lengths. Here is an example of a common cable in duplex and 5 m length.

Product	Order no.	Remark
FO/p2-5	50.102050	5 m duplex FO cable

12.7 iba software

Product	Order no.	Remark
		Online data acquisition system ibaPDA, license examples:
ibaPDA-1024 ibaPDA-2048	30.771024 30.772048	For up to 1024 signals For up to 2048 signals
ibaAnalyzer	33.010000	Offline- and online analysis software with free license if used to analyze *.dat files generated by licensed iba software.

For further accessories, please see our online catalog at www.iba-ag.com.

13 Appendix

13.1 Calculating characteristic values

The characteristic values are calculated as follows:

13.1.1 RMS (Root Mean Square)

$$U_{RMS} = \sqrt{\frac{1}{t_n - t_0}} \int_{t_0}^{t_n} u^2(t) dt$$
$$I_{RMS} = \sqrt{\frac{1}{t_n - t_0}} \int_{t_0}^{t_n} i^2(t) dt$$

13.1.2 Rectified value

$$U_{rect} = \frac{1}{t_n - t_0} \int_{t_0}^{t_n} |u(t)| dt$$
$$I_{rect} = \frac{1}{t_n - t_0} \int_{t_0}^{t_n} |i(t)| dt$$

13.1.3 Peak value

$$\begin{split} U_{peak} &= max \left| u\left(t \right) \right| \quad t \in [t_0, t_n] \\ I_{peak} &= max \left| i\left(t \right) \right| \quad t \in [t_0, t_n] \end{split}$$

13.1.4 Form factor

 $U_{Form} = \frac{U_{RMS}}{U_{rect}}$ $I_{Form} = \frac{I_{RMS}}{I_{rect}}$

13.1.5 Crest factor

$$U_{Crest} = \frac{U_{peak}}{U_{RMS}}$$

 $I_{Crest} = \frac{I_{peak}}{I_{RMS}}$

13.1.6 Frequency

$$f_n = \frac{N_{ZC}}{2 \cdot (t_{N_{ZC}} - t_0)}$$

$$N_{ZC} = Number of Zero Crossings$$

13.1.7 Harmonics, interharmonics, phase angle Calculation with FFT algorithm

13.1.8 THD (Total Harmonic Distorsion)

$$THD_U = \sqrt{\sum_{n=2}^{x} \left(\frac{U_{harm_n}}{U_{harm_1}}\right)^2}$$
$$THD_I = \sqrt{\sum_{n=2}^{x} \left(\frac{I_{harm_n}}{I_{harm_1}}\right)^2}$$

13.1.9 Flicker

Short term

Flicker algorithm

Long term

$$P_{LT} = \sqrt[3]{\frac{\displaystyle\sum_{i=0}^{N-1} P_{st}^3}{\frac{\displaystyle\sum_{i=0}^{N-1} P_{st}^3}{N}}}$$

13.1.10 Power / Energy

□ Two conductors / per phase

Active power

$$P = \frac{1}{t_n - t_0} \int_{t_0}^{t_n} P_x(t) dt$$
$$P_x(t) = u_{10}(t) \cdot i_1(t)$$

Apparent power

$$S = U_{10RMS} \cdot I_{1RMS}$$

Total reactive power

$$Q_{tot} = \sqrt{S^2 - P^2}$$

Fundamental reactive power

$$Q_{\varphi} = U_{RMS} \cdot I_{RMS} \cdot sin(\varphi_u - \varphi_i)$$

Distortion reactive power

$$Q_D = \sqrt{Q_{tot}^2 - Q_{\varphi}^2}$$

Power factor

$$\lambda = \frac{P}{S}$$

 $Cos \ \phi$

 $\cos\left(\varphi\right) = \cos\left(\varphi_u - \varphi_i\right)$

Three conductors

Active power

$$P_{\Sigma} = P_{10} + P_{20} + P_{30}$$

$$P_{10} = U_{10} \cdot I_1, \dots$$

$$U_{10} = \frac{1}{3} (u_{12} - u_{31})$$

$$U_{20} = \frac{1}{3} (u_{23} - u_{12})$$

$$U_{30} = \frac{1}{3} (u_{31} - u_{23})$$

Apparent power

$$S_{\Sigma} = \sqrt{(U_{10}^2 + U_{20}^2 + U_{30}^2)} \cdot \sqrt{(I_1^2 + I_2^2 + I_3^2)}$$

Total reactive power

 $Q_{tot\Sigma} = \sqrt{S_{\Sigma}^2 - P_{\Sigma}^2}$

Fundamental reactive power

 $Q_{\varphi\Sigma} = Q_{\varphi10} + Q_{\varphi20} + Q_{\varphi30}$

Distortion reactive power

$$Q_{D\Sigma} = Q_{D10} + Q_{D20} + Q_{D30}$$

Power factor

$$\lambda_{\Sigma} = \frac{P_{\Sigma}}{S_{\Sigma}}$$

Cos φ

Per phase: $\cos(\varphi) = \cos(\varphi_u - \varphi_i)$

Total grid: no calculation possible

Four conductors

Active power

 $P_{\Sigma} = P_{10} + P_{20} + P_{30} + P_{40}$ $P_{40} = U_{40} \cdot I_N$ $U_{10} = \frac{1}{4} (U_{12} + U_{13} + U_{1N})$ $U_{20} = \frac{1}{4} (U_{21} + U_{23} + U_{2N})$ $U_{30} = \frac{1}{4} (U_{31} + U_{32} + U_{3N})$ $U_{40} = U_{N0} = - (U_{10} + U_{20} + U_{30})$ $U_{N0} = \frac{1}{4} (U_{N1} + U_{N2} + U_{N3})$

Apparent power

$$S_{\Sigma} = \sqrt{(U_{10}^2 + U_{20}^2 + U_{30}^2 + U_{40}^2)} \cdot \sqrt{(I_1^2 + I_2^2 + I_3^2 + I_N^2)}$$

Total reactive power

 $Q_{tot\Sigma} = \sqrt{S_{\Sigma}^2 - P_{\Sigma}^2}$

Fundamental reactive power

$$Q_{\varphi\Sigma} = Q_{\varphi10} + Q_{\varphi20} + Q_{\varphi30} + Q_{\varphi40}$$

Distortion reactive power

Per phase:
$$Q_{D10} = \sqrt{Q_{tot10}^2 - Q_{arphi10}^2}, \ ...$$

Total grid:

Power factor

$$\lambda_{\Sigma} = \frac{P_{\Sigma}}{S_{\Sigma}}$$

 $Cos \ \phi$

Per phase:
$$P_{LT} = \sqrt[3]{rac{\sum\limits_{i=0}^{N-1} P_{st}^3}{rac{1}{N}}}$$

Total grid: no calculation possible

Neutral conductor current (if physically not available)

 $i_N(t) = -(i_1(t) + i_2(t) + i_3(t))$

13.1.11 Voltage balance / Unbalance



Example graph from ibaPDA (high asymmetry!)

In a symmetrical grid the arrows of the respective phase are located directly over each other.

Name	Meaning
<u>U</u> #	RMS value of the phase
<u>U</u> #+	Percentage of the positive sequence component
<u>U</u> #-	Percentage of the negative sequence component
<u>U</u> #₀	Percentage of the zero sequence component



Positive sequence component

 $\underline{U}_1 = \frac{1}{3} \left(\underline{U}_R + \underline{U}_S \cdot \underline{a} + \underline{U}_T \cdot \underline{a}^2 \right)$

Negative sequence component

$$\underline{U}_2 = \frac{1}{3} \left(\underline{U}_R + \underline{U}_S \cdot \underline{a}^2 + \underline{U}_T \cdot \underline{a} \right)$$

Zero sequence component

 $\underline{U}_3 = \frac{1}{3} \left(\underline{U}_R + \underline{U}_S + \underline{U}_T \right)$

117

$$\underline{a} = e^{j120^{\circ}}$$
$$\underline{a}^2 = e^{j240^{\circ}}$$

The voltages specified here are complex numbers and consist of an amount and an angle.

Negative sequence unbalance

Negative Sequence Ratio = $\left|\frac{\underline{U}_2}{\underline{U}_1}\right|$

Zero sequence unbalance

$$Zero \, Sequence \, Ratio = \left| \frac{\underline{U}_3}{\underline{U}_1} \right|$$

13.1.12 Interference factor

□ TIF/THFF

$$TIF = \sqrt{\sum_{n=1}^{50} (5 \cdot n \cdot f_1 \cdot Factor_n \cdot X_n)^2}$$
$$THFF = \sqrt{\sum_{n=1}^{50} \left(\frac{n \cdot f_1}{800Hz} \cdot Factor_n \cdot X_n\right)^2}$$
$$IF Square = \sqrt{\sum_{n=1}^{50} Factor_n \cdot X_n^2}$$
$$IF Linear = \sum_{n=1}^{50} Factor_n \cdot X_n$$

f₁: Nominal power system frequency (50 Hz or 60 Hz)

Factor_n: Weighting factor for harmonic_n

Various methods are available for normalization of X_n

a)
$$X_n = \frac{Harmonic_n}{Harmonic_1}$$

b) $X_n = \frac{Harmonic_n}{RMS}$
c) $X_n = \frac{Harmonic_n}{1V o. 1A}$



13.1.13 Commutation notches

Commutation notch

$$d_{Com} = \frac{\Delta U}{\hat{U}} \cdot 100\%$$

 $\Delta U \text{= voltage drop}$

 $\hat{U}\text{=}$ peak value of the fundamental wave of the nominal voltage



13.1.14 Events

Voltage dip

Signal	Meaning
Dip event (digital)	Active, if the half period RMS value of at least one phase is lower than the limit.
Dip event Start	Current time – start_time, in seconds, while the event is running.
Dip event Duration	Previous duration of events, in seconds, while the event is running.
Dip event Min	Minimum half period RMS value, in V, while the event is running.

The limit is increased by the hysteresis, if the event is active.

The limit is calculated as percentage value of the nominal voltage or as percentage value of the floating reference value.

 $U_{sr(n)} = 0,9967 \cdot U_{sr(n-1)} + 0,0033 \cdot U_{(10/12)rms}$

Note: this value is calculated for each phase separately.

Voltage swell

Signal	Meaning
Swell event (digital)	Active, if the half period RMS value of at least one phase is higher than the limit.
Swell event Start	Current time – start_time, in seconds, while the event is running.
Swell event Duration	Previous duration of events, in seconds, while the event is running.
Swell event Max	Maximum half period RMS value, in V, while the event is running.

The limit is reduced by the hysteresis, if the event is active. The limit is calculated as percentage value of the nominal voltage or as percentage value of the floating reference value.

 $U_{sr(n)} = 0,9967 \cdot U_{sr(n-1)} + 0,0033 \cdot U_{(10/12)rms}$

Note: this value is calculated for each phase separately.

Voltage interruption

Signal	Meaning
Interruption event (digital)	Active, if the half period RMS value of all phases of a supply voltage grid is lower than the limit.
Interruption event Start	Current time – start_time, in seconds, while the event is running.
Interruption event Duration	Previous duration of events, in seconds, while the event is running.
Interruption event Min	Minimum half period RMS value, in V, while the event is running.

The limit is increased by the hysteresis, if the event is active. The limit is calculated as percentage value of the nominal voltage.

Mains signalling

Signal	Meaning
Mains signalling event (digital)	Active, if the RMS value of the mains signalling voltage on at least one phase is higher than the limit set.
Mains signalling event Start	Current_time – start_time, in seconds, while the event is running.
Mains signalling event Duration	Previous duration of events, in seconds, while the event is running.
Mains signalling event Max	Maximum RMS value of the mains signalling voltage, in V, while the event is running.

□ Rapid voltage change (RVC)

Signal	Meaning
Rapid voltage change (digital)	Active, if the half period RMS value of at least one phase is beyond the area Floating_average – limit or Floating_average + limit.
RVC event Start	Current_time – start_time in seconds.
RVC event Duration	Duration of the event in seconds.
RVC event Delta Umax	Maximum deviation from the floating average at the starting point of the event, in V.
RVC event Delta Uss	Change in the floating average between start and 1 second after the event, in V.

The floating average is the arithmetic average of the last 100 (at 50 Hz) or 120 (at 60 Hz) half period RMS values. This corresponds to the average of the last second.

The limit is reduced by the hysteresis while the event is active.



Note on RVC values

The event values are issued only about 1 second after the end of an event for a 10/12 period pulse, otherwise, all values are 0. The reason for this is the rule that this event must not be issued, if there is an overvoltage or undervoltage during the event.

13.2 Connection examples

The examples mentioned here refer to a grid with 230 V and 50 Hz. Furthermore, the consumers to be measured are directly connected to the ibaPQU-S system. If the values voltage and current to be measured are higher, appropriate instrument transformers need to be used.



Important note

The wiring always needs to be carried out by a qualified electrician in order to guarantee electrical safety.

13.2.1 1-phase



1-phase direct connection

13.2.2 Star connection



Star connection direct connection

13.2.3 Delta connection



Delta connection direct connection

13.2.4 Connection with instrument transformers

It is important that the instrument transformers are Open Loop transformers. This means that a sinus signal on the primary side also needs to exist on the secondary side. The instrument transformers also need to offer a broadband frequency transmission in order to capture harmonics or interharmonics up to the 50th harmonic.

The terminals of the primary winding are labeled "K" and "L" or "P1" and "P2", the terminals of the secondary winding are labeled "k" and "I" or "S1" and "S2". The polarity must be applied so that the "current flow direction" is from K to L.



Example of 1-phase connection



Example of 1-phase measuring with a Rogowski coil or a current clamp

14 Index

В	
backplane	14
С	
Calculated characteristic values 24 Current measurement	, 78 10
D	
Debounce filter configure in ibaPDA	20 43
configure in ibaPDA DIN EN 50160 11	43 , 34
digital inputs operating state	18 17
F	
FO cables FO input card	19 13
G	
Grid type Grid types Grounding	32 23 14
Н	
Harmonic 35	, 36
I	
I/O Manager I/O modules	30
calculation of power quality parameters Interharmonic Interharmonics	10 36 35

IP address via FO	39
М	
Measurements	24
Ν	
Nominal frequency	32
P	
Phasor diagram Pin assignment	66, 69
digital inputs Power supply	19 13
R	
Reference signal Rotary switch	32 18
S	
Signals and calculated characteristic val	ues 24
т	
Time base in ibaPDA Time synchronization	38 26
U	
Update via ibaPDA	28 28, 41
Updating the modules	28
V	
Voltage measurement Voltage supply	10 22

15 Certificate



Institute of Electrical Power Systems and High Voltage Engineering

COMPLIANCE TEST ACCORDING TO IEC 61000-4-30 Ed.3 (2015)

ibaPQU-S

Measurement accuracy and measurement methods for the following quantities were tested on conformity with IEC 61000-4-30 Ed.3 (2015). This includes all tests as required by IEC 62586-2 Ed.1 (2013) and specific additional tests.

Power Quality Parameter	Class A Compliance
Power frequency	Yes
Magnitude of supply voltage	Yes
Flicker	Yes
Voltage interruptions, dips and swells	Yes
Supply voltage unbalance	Yes
Voltage harmonics	Yes
Voltage interharmonics	Yes
Mains signalling	Yes
Flagging	Yes
Clock uncertainty	Yes
Variations due to external influence quantities	Yes
Magnitude of current	Yes
Current harmonics	Yes
Current interharmonics	Yes



Tested by

Dipl.-Ing. Robert Stiegler

Dresden, 01.03.2017

Technische Universitaet Dresden Faculty of Electrical and Computer Engineering Institute of Electrical Power Systems and High Voltage Engineering 01062 Dresden Germany One sample with serial "000061" and firmware "PQ Core 1.00" was tested with a declared input voltage and current of $U_{din} = 230$ V and $I_{nom} = 2.5$ A and a nominal frequency of $f_{nom} = 50$ Hz.

The external clock synchronization was performed with an external GPS-clock (Meinberg LANTIME M600 and GPS-antenna HF2015 GPS).

The manufacturer states that this sample is representative of the ibaPQU-S series.

Reviewed by: -Ing. Jan Meyer

Confirmed by

Prof. Dr.-Ing. Peter Schegner

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16 Support and contact

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Note

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