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

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The content of this publication has been checked for compliance with the described hardware and software. Nevertheless, deviations cannot be excluded completely so that the full compliance is not guaranteed. However, the information in this publication is updated regularly. Required corrections are contained in the following regulations or can be downloaded on the Internet.

The current version is available for download on our web site www.iba-ag.com.

Copyright notice

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 Made in Germany

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

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>
Press keys simultaneously	<Key name> + <Key name> Example: <Alt> + <Ctrl>
Buttons	<Key name> Example: <OK>; <Cancel>
File names, Paths	„File name“ „Test.doc“

1.3 Used symbols

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

⚠ DANGER

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!

⚠ WARNING

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

⚠ CAUTION

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.

Tip

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)
- Phase values (U/I phase angle to the reference voltage)
- Power values (active power, apparent power, reactive power, cos θ, electric energy, power factor for individual lines and for the total grid)
- Symmetrical components (positive, negative and zero sequence component) and supply voltage unbalance
- 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:

- ❑ 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 http://www.iba-ag.com.

- ❑ 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)
- ❑ 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.
3. 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.

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

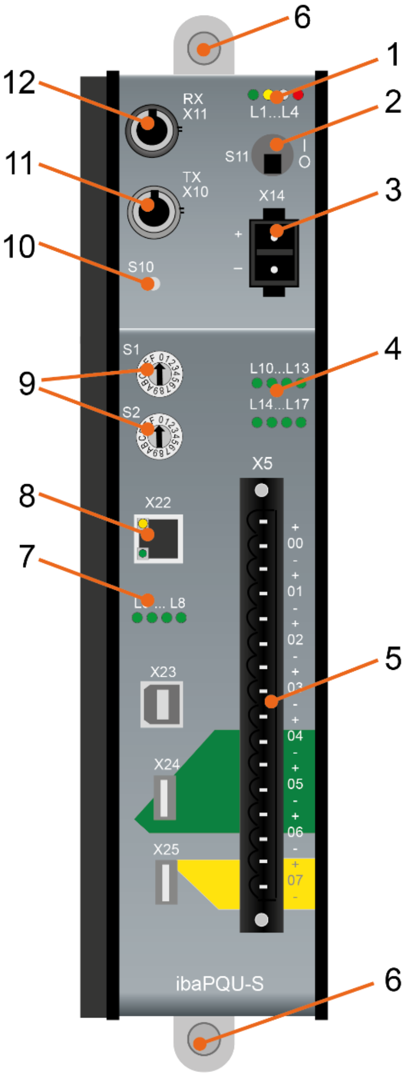
1. Connect the measuring lines connected to the measuring objects to the I/O module inputs. Connection principles are described in chapter 8.
2. Use an ibaNet FO patch cable (duplex) to connect the device to the ibaPDA computer:
   - the RX input (X11) of the device with the TX interface of the ibaFOB-D 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

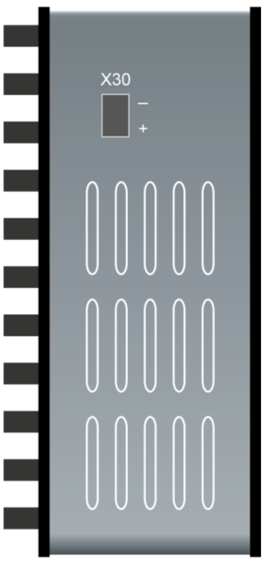
7.1 Views



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 Yellow	Off	No calculation
	Flashing	Calculation running
L3 White	Off	No FO signal detected
	Flashing	FO signal detected, configuration error, the received ibaNet protocol does not match the internally configured protocol
	On	FO signal detected
L4 Red	Off	No error
	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
L10…L17	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
I	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 µm, 62.5/125 µm, 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

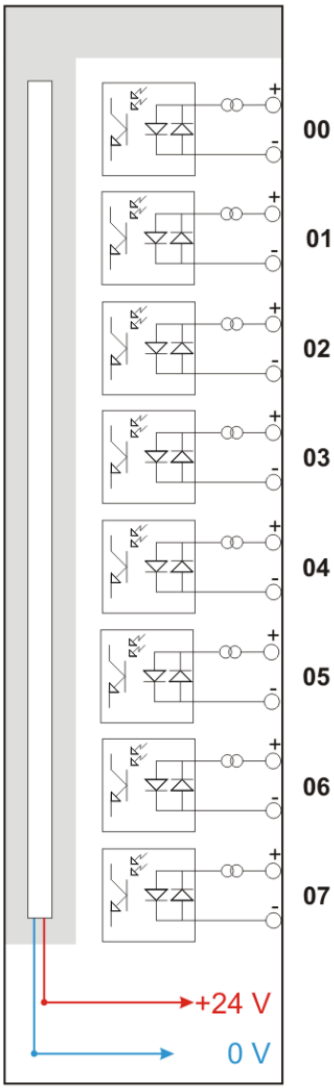
Ethernet interface 10/100 Mbit/s, no function.

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.

➚ 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)
- "Stretch rising edge"
- "Stretch falling edge"
- "Stretch both edges"
- "Delay both edges"

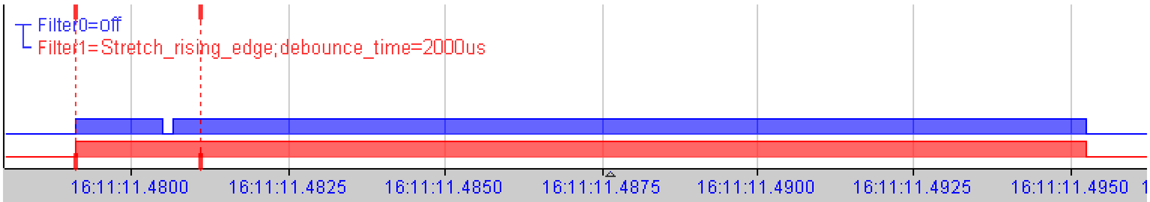
For each filter, a debounce time ranging between [1µs…65535µs] has to be defined in µs.

"Off"

The measured input signal is forwarded directly without filtering.

"Stretch rising edge"

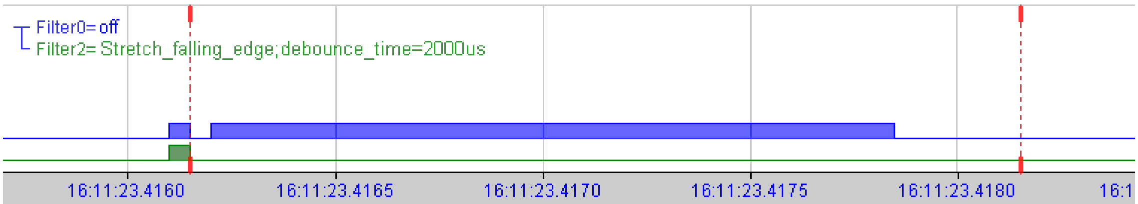
The first rising edge sets the output signal (red) to logical 1 and it remains logical 1 for the set debounce time. Subsequently, the channel is transparent again and waits for the next rising edge.



SignalName	X1	X2	X2 - X1	Y1	Y2	Y2 - Y1
Filter0= off	1.4	11.4	0.002000	1.00	1.00	0.00
Filter1= Stretch_rising_edge;debounce_time=2000us	1.4	11.4	0.002000	1.00	1.00	0.00

"Stretch falling edge"

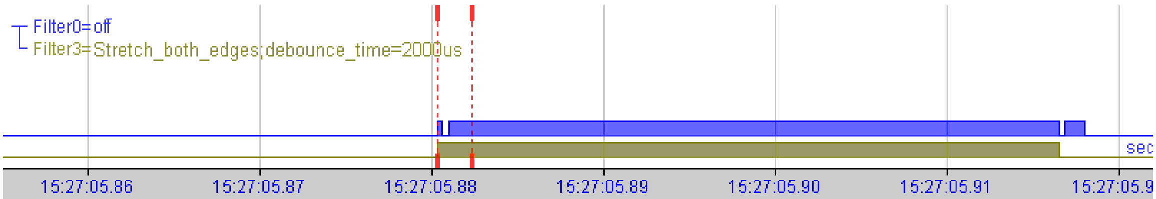
The first falling edge sets the output signal (green) to logical 0 and it remains logical 0 for the set debounce time. Subsequently, the channel is transparent again and waits for the next falling edge.



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_falling_edge;debounce_time=2000us	23.4	23.4	0.002000	0.00	0.00	0.00

"Stretch both edges"

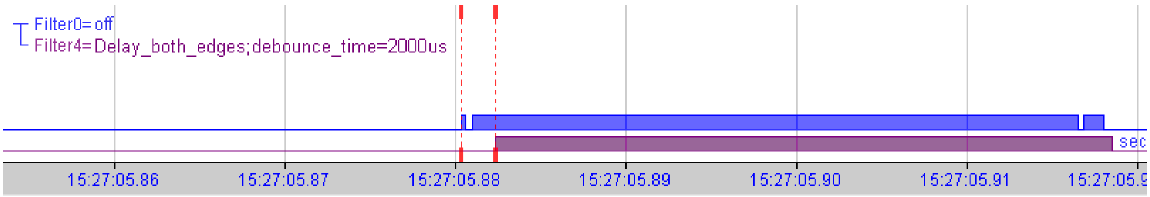
With the first edge, the output signal (ochre) follows the original signal (blue) and keeps the logical level for the duration of the set debounce time. Subsequently, the channel is transparent again and waits for the next (rising or falling) edge.



SignalName	X1	X2	X2 - X1	Y1	Y2	Y2 - Y1	Unit
Filter0= off	:05.	:05.	0.0020	1.00	1.00	0.00	
Filter3= Stretch_both_edges;debounce_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.



	SignalName	X1	X2	X2 - X1	Y1	Y2	Y2 - Y1	Unit
	Filter0= off	:05	:05	0.0020	1.00	1.00	0.00	
▸	Filter4=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 (±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:

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

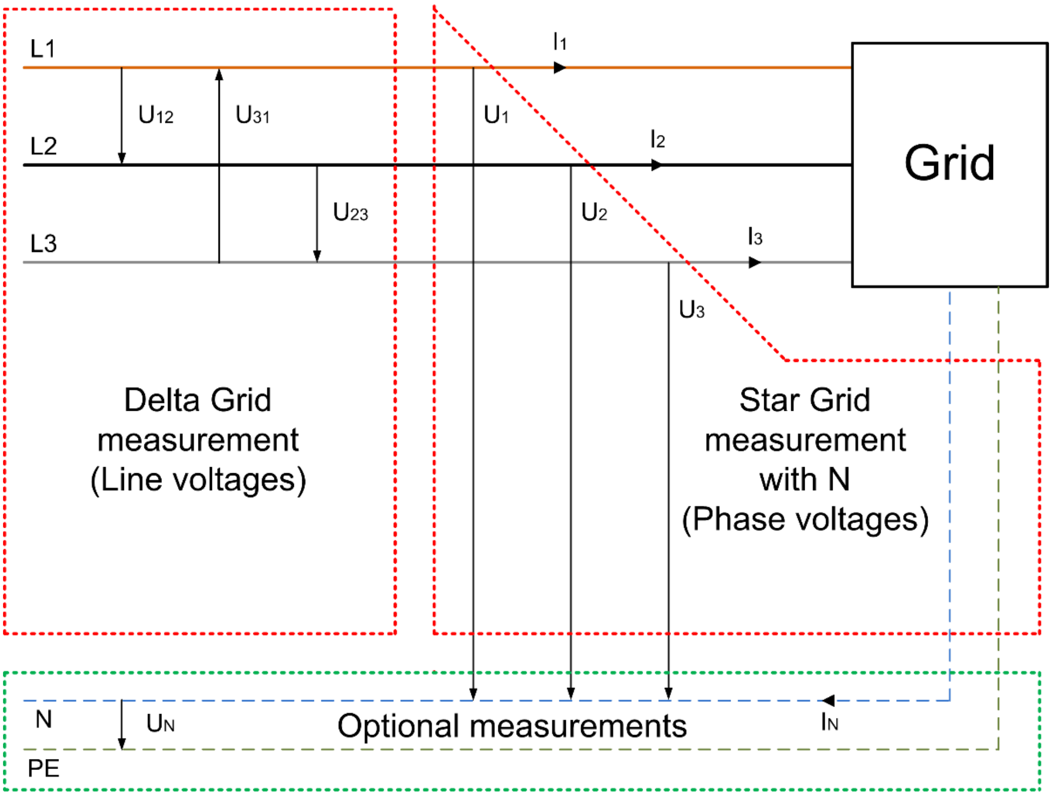
For this purpose, a buffer voltage of typ. 12 V DC (9 V …15 V) is applied at the X30 connector. In case of buffering, the current consumption is approx. 70 mA at 12 V.

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
I1	I1, I2, I3	I1, I2, I3

Calculated characteristic values

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

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

Characteristic values	Calculation time						Available for			Grid type (conductor)			Calculation interval	
	Half period	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]	-	X	X	X	X	X	-	-	X	X	X	X	X	X
Fundamental reactive energy[4]	-	X	X	X	X	X	-	-	X	X	X	X	X	X
Power factor[1]	-	X	X	X	X	X	-	-	X	X	X	X	X	X
Cos φ[1]	-	X	X	X	X	X	-	-	X	X	X	X	X	-
Positive sequence component[1]	-	X	X	X	X	X	X	X	-	-	-	X	-	X
Negative sequence component[1]	-	X	X	X	X	X	X	X	-	-	-	X	-	X
Zero sequence component[1]	-	X	X	X	X	X	X	X	-	-	-	X	-	X
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	-	X
Flicker P_inst[5]	x	-	-	-	-	-	X	X	-	X	X	X	X	-
Flicker P_st[5]	-	-	-	-	X	-	X	X	-	X	X	X	X	-
Flicker P_lt[5]	-	-	-	-	-	X	X	X	-	X	X	X	X	-
Events[5]	-	X	-	-	-	-	X	-	-	X	X	X	-	X
Commutation notches[5]	X	-	-	-	-	-	X	-	-	X	X	X	X	-

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

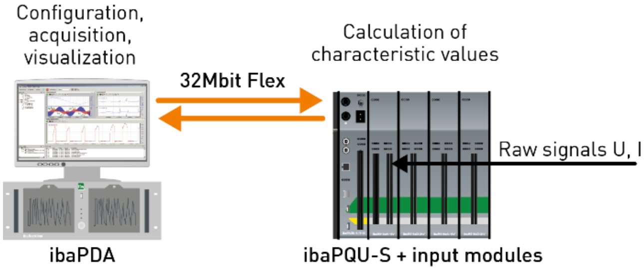
[3] Calculation from the harmonics of the listed calculation time

[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.

➚ 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 result, 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.

The following table shows the filter effect:

Signal used for characteristic 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=12...25 kHz*	0.04 to 0.08 ms
		Analog filter with fc=12...25 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

*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.

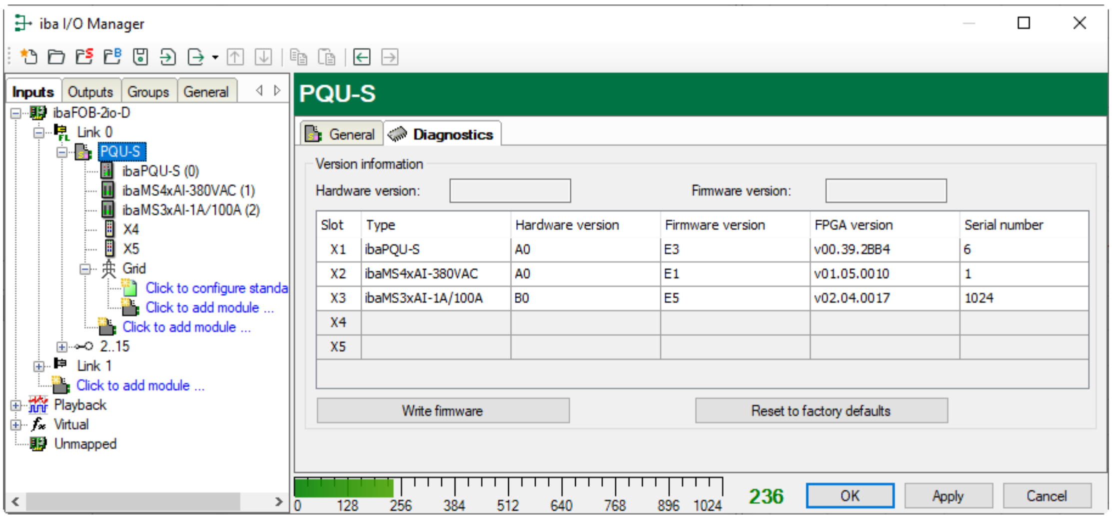
9 Updates

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.



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.

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.

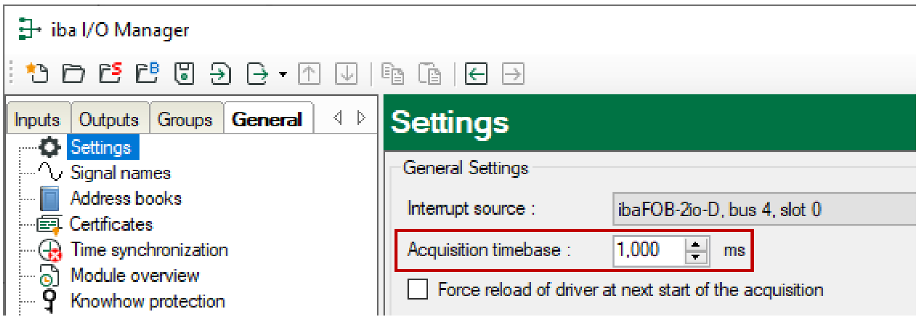
In this case, a new update file has to be installed for the “overall release version“. If you want to get the current update file, please contact the iba support.

10 Configuration with ibaPDA

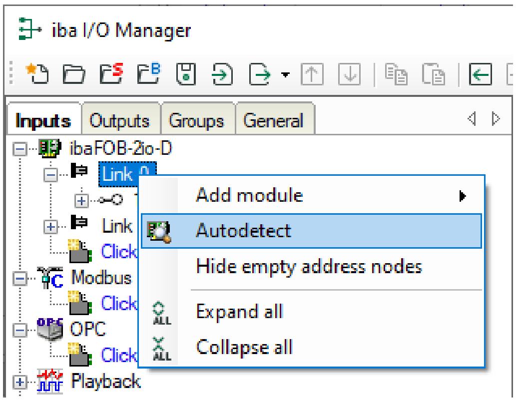
10.1 First steps

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

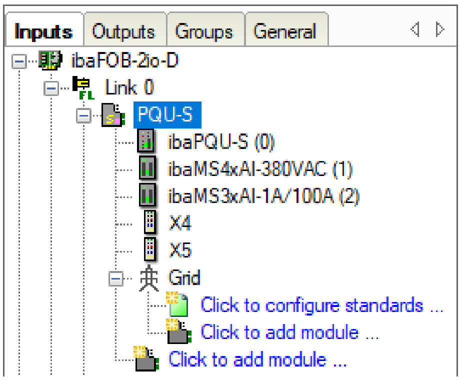
1. Select the "General" tab and the "Settings" node and set the acquisition timebase on the left to 1 ms.



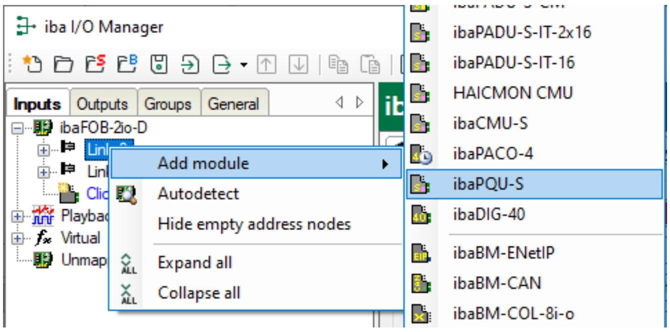
2. Look for the corresponding link of the ibaFOB-D card to which ibaPQU-S is connected in the I/O Manager. Right-click the link to open a submenu. Select "Autodetect".



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

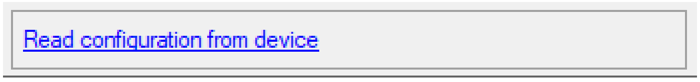


3. To configure the ibaPQU-S system manually, proceed as follows:
4. Right-click the connection (link) of the ibaFOB-io-D card to which the device is connected.
5. Select "Add module". The list of available modules is displayed. Select "ibaPQU-S".

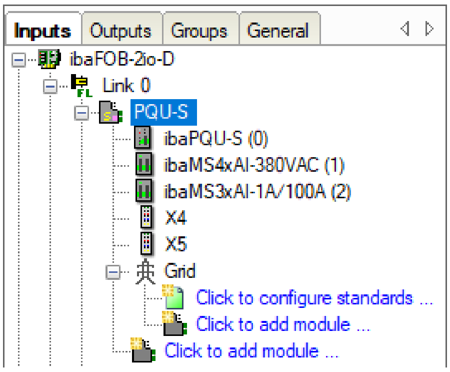


Now, the device is shown in the module tree.
Drag the device to the address that is set on the device with the S1 rotary switch (Link 1 – 15 under the device), while keeping the right mouse button pressed: Position 1 – F corresponds to address 1 – 15.

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



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

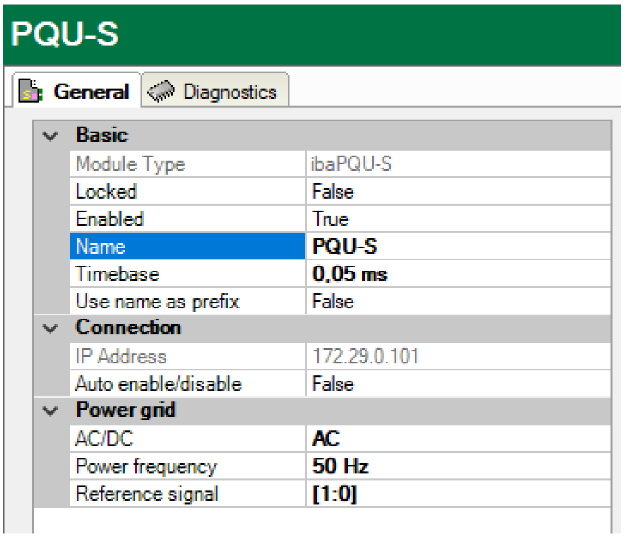


7. The current and voltage inputs required for the measurement are configured in the input modules (see chapter 8 "Measurement principles and measured quantities").
8. Moreover, you can configure additional input signals to be acquired as raw signals.

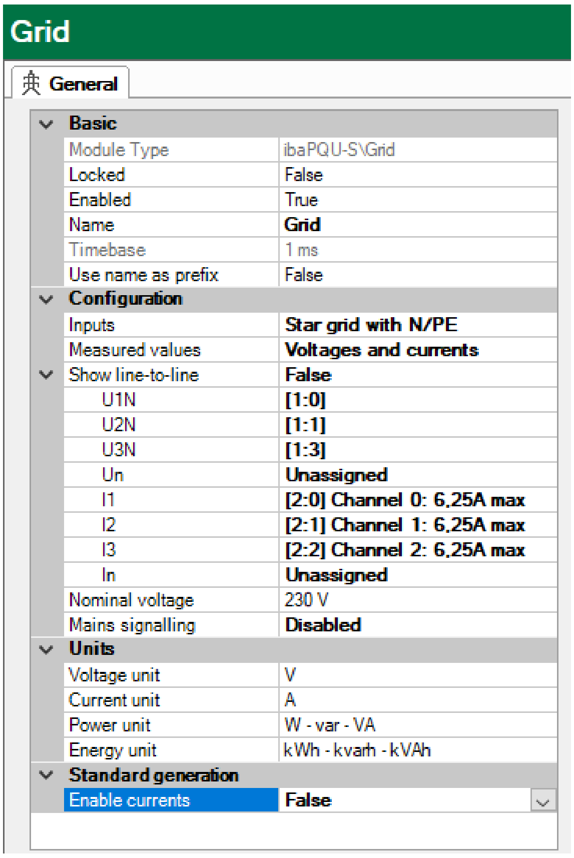
Note

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.

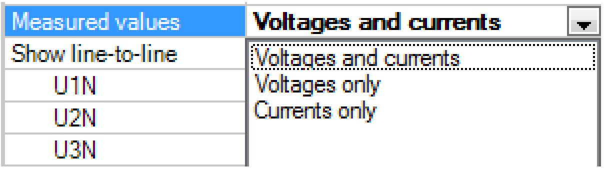


10. ibaPDA provides special modules to measure or calculate the power quality characteristic values. In the “Grid” module you can make general settings, define the grid type (1-phase or 3-phase grid) and assign signals to the inputs that provide the corresponding signals. Depending on the grid in which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

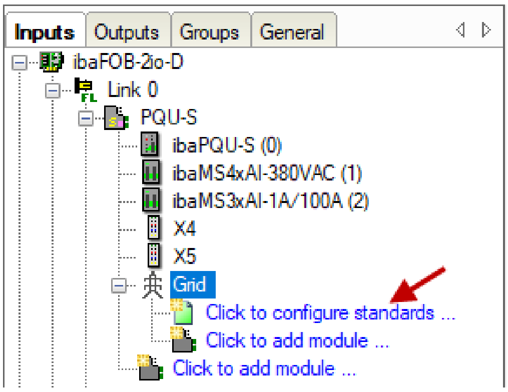


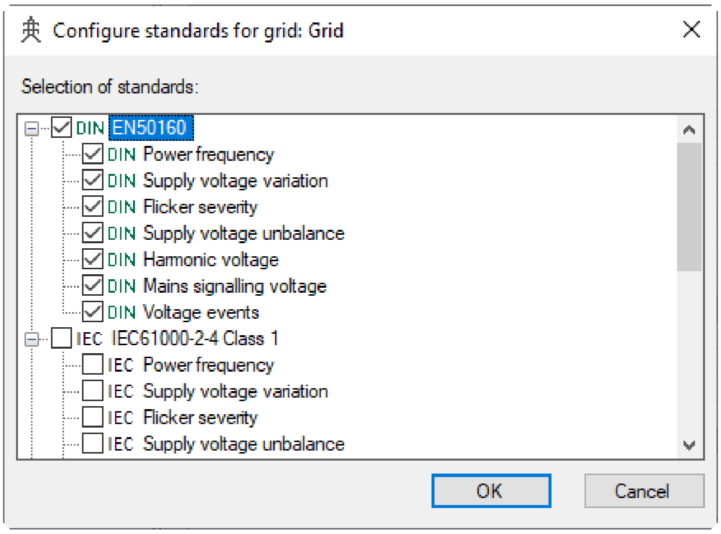
The signals Un and In are optional input signals that do not have to be assigned.
The option “Show line-to-line” allows the voltages U12, U23 and U31 to be provided also in a star system.
If the signals are not assigned, ibaPQU-S calculates these values. If the signals are measured, the raw values serve as the basis for the other calculations.

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



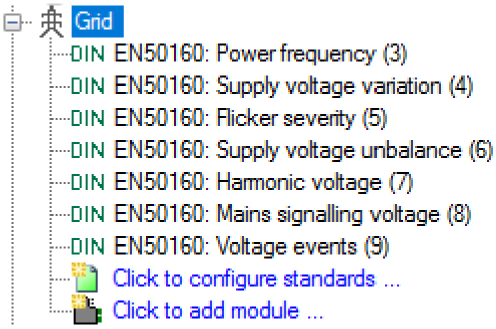
12. To perform measurements according to a defined standard, click the link "Click to configure standards..." and select the desired standard.





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.

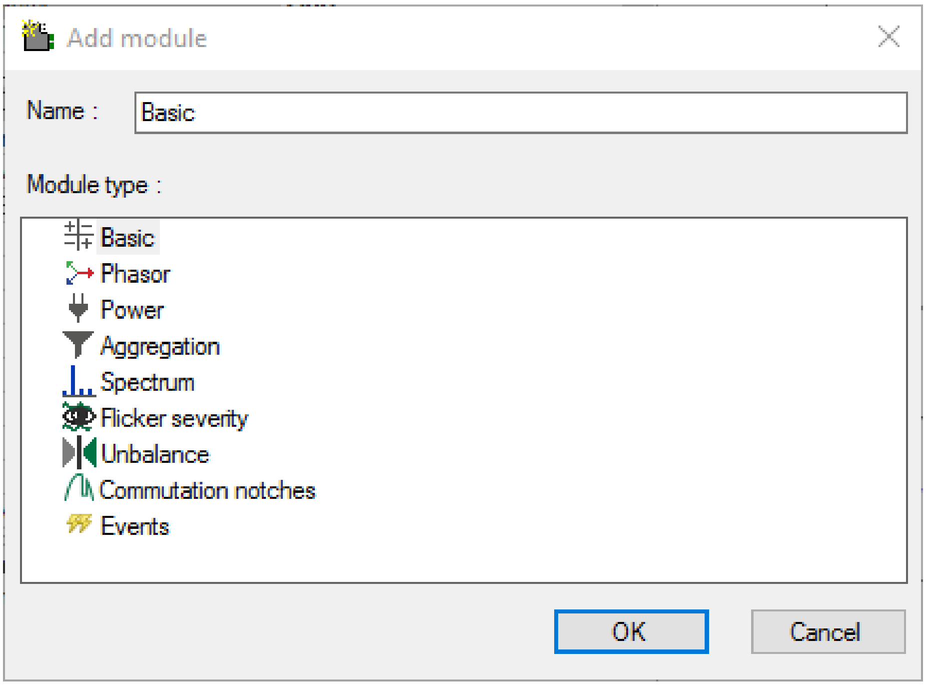
13. If the standard "EN50160" is selected, 7 submodules are displayed which determine all characteristic values required according to DIN EN 50160 (power frequency, supply voltage variation, flicker severity, supply voltage unbalance, harmonic voltage, mains signalling voltage, voltage events).



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_{lt}) 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.



- 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.

10.1.1 Overview of the modules in ibaPDA

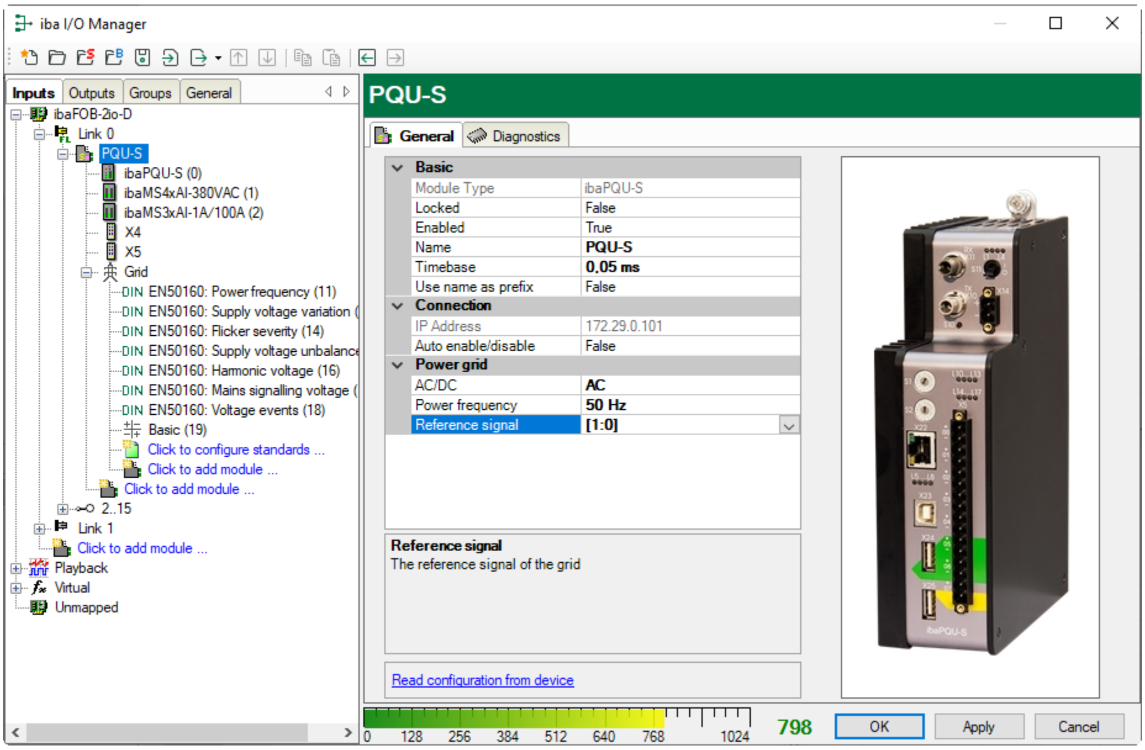
Module	Characteristic values	Measurement interval					
		Half period	200 ms	3 s	10 s	10 min	2 h
EN50160: Power frequency	Frequency (reference signal, all voltage inputs)				x		
EN50160: Slow supply voltage variation	RMS value (all voltage inputs)					x	
EN50160: Harmonic voltage	Fundamental frequency, 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						x
EN50160: Supply voltage unbalance	Calculation of the voltage balance for the negative sequence component					x	
Basic	Frequency (reference signal)	x	x				
	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)		x				
Power	Power and energy calculations per phase and for the overall grid		x				
Flicker severity	Flicker calculations per phase in different time intervals	x				x	x
Asymmetry	Calculation of the symmetrical components		x				
Aggregation	User configurable	User configurable					
Commutation notches	Commutation notches per phase in percent	x					

Module	Characteristic values	Measurement interval					
		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

10.2.1 PQU-S – “General” tab



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

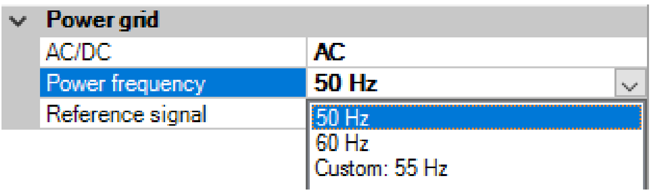
❑ IP address
IP address or host name of the ibaPQU-S device (read only).

❑ 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.



- 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

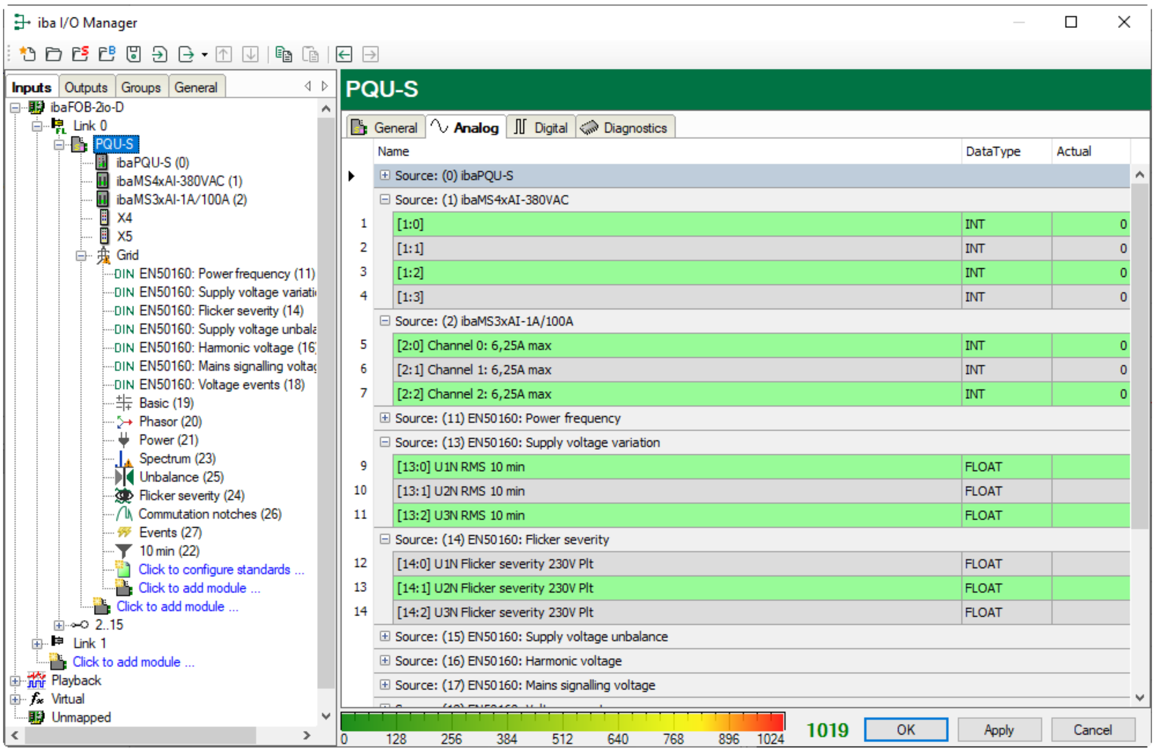
❑ Read configuration from device
Reads the configuration stored most recently from the device.

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.

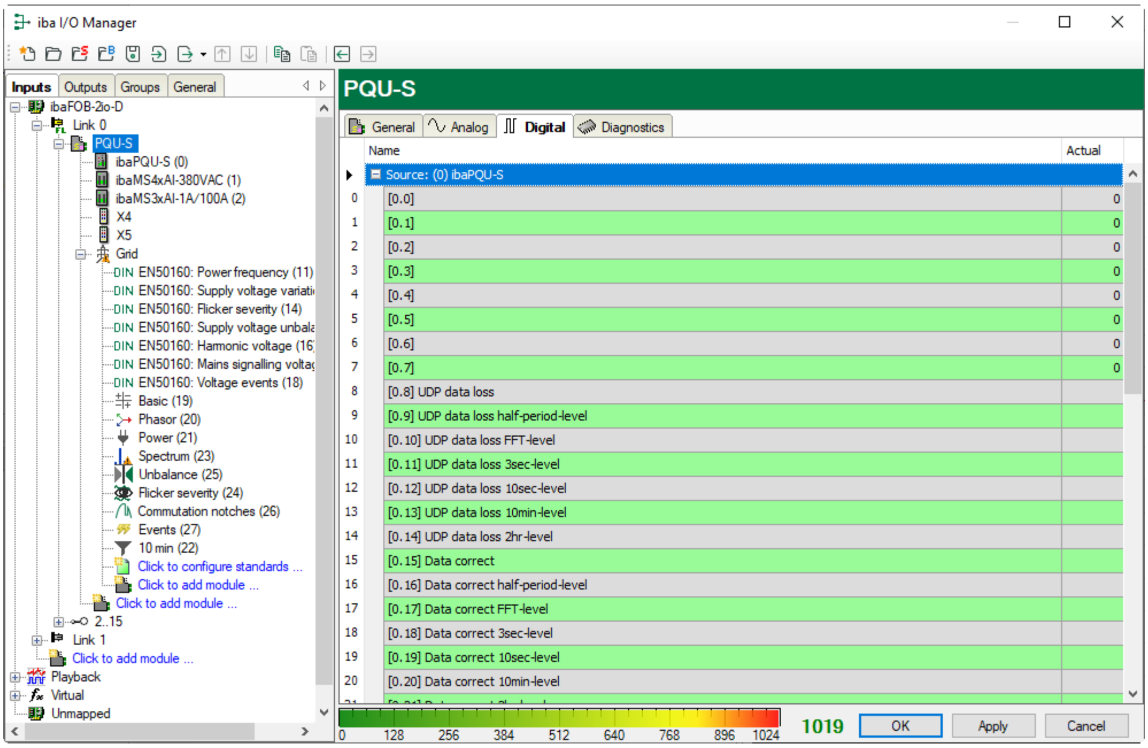
The list shows the configured analog signals of the input modules and of all configured Grid modules and the analog status signals of ibaPQU-S with their current values.



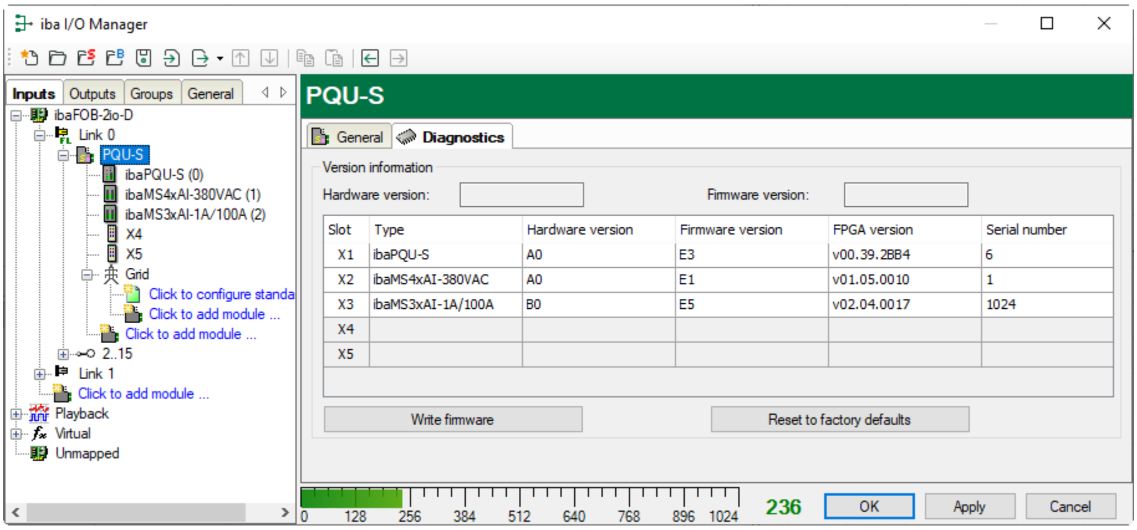
10.2.3 PQU-S – "Digital" tab

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.



10.2.4 PQU-S – "Diagnostics" tab



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

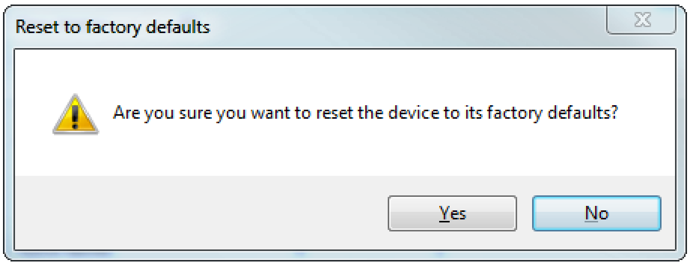
This button allows running firmware updates. Select the update file "pqu_v[xx.yy.zzz].iba" in the browser and start the update by clicking <Ok>.

Important note

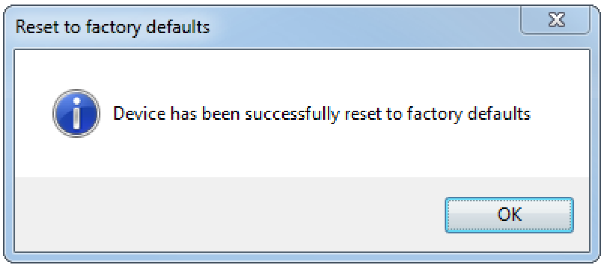
This process may take several minutes and must not be interrupted. After an update, the device will restart automatically.

➚ 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>.

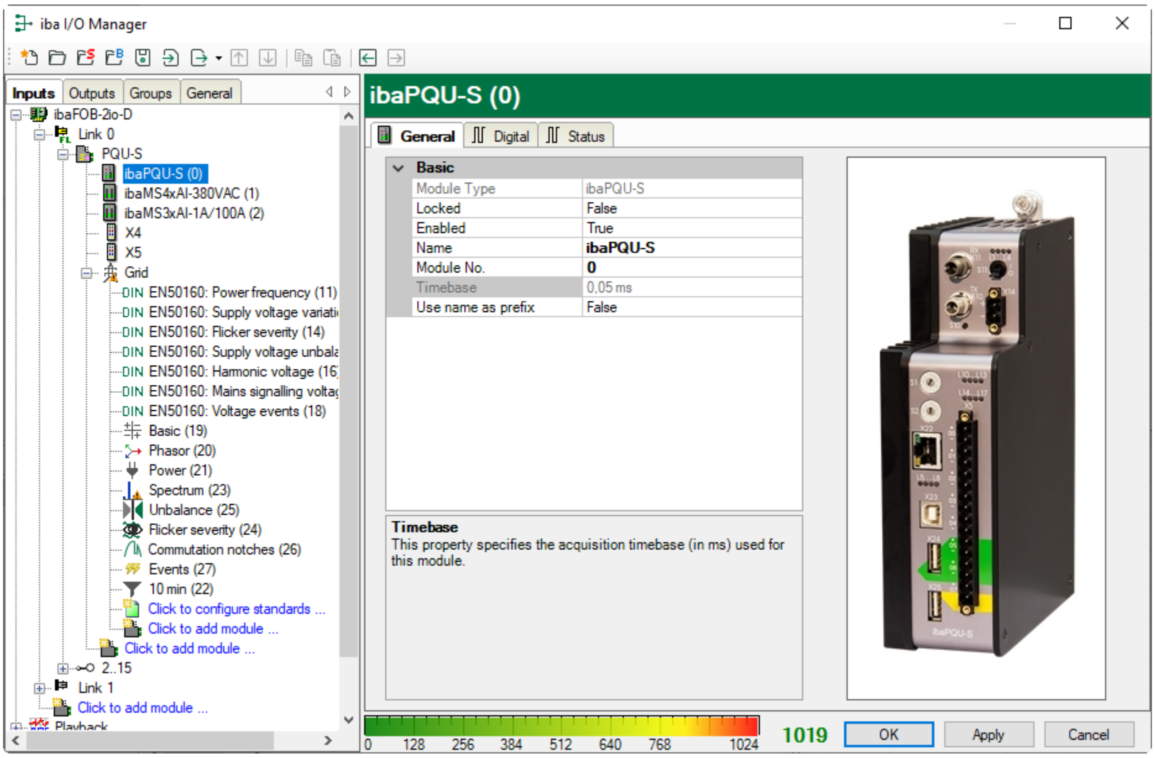


The following message is displayed and the device reinitializes automatically with the deleted I/O settings:



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

10.2.5 ibaPQU-S – “General” tab

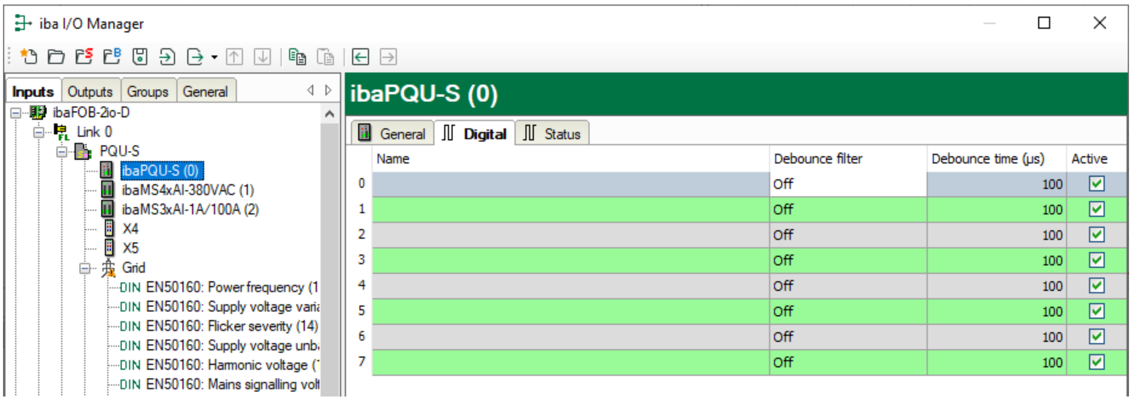


Basic settings

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

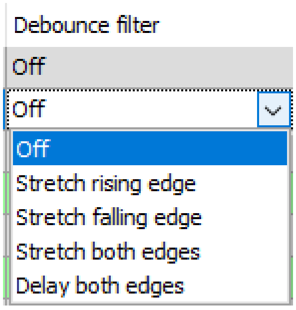
❑ Module No.
Logical module number for the unambiguous referencing of signals, e.g. in expressions and ibaAnalyzer. Is assigned by ibaPDA in ascending order, but can be changed by the user.

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.

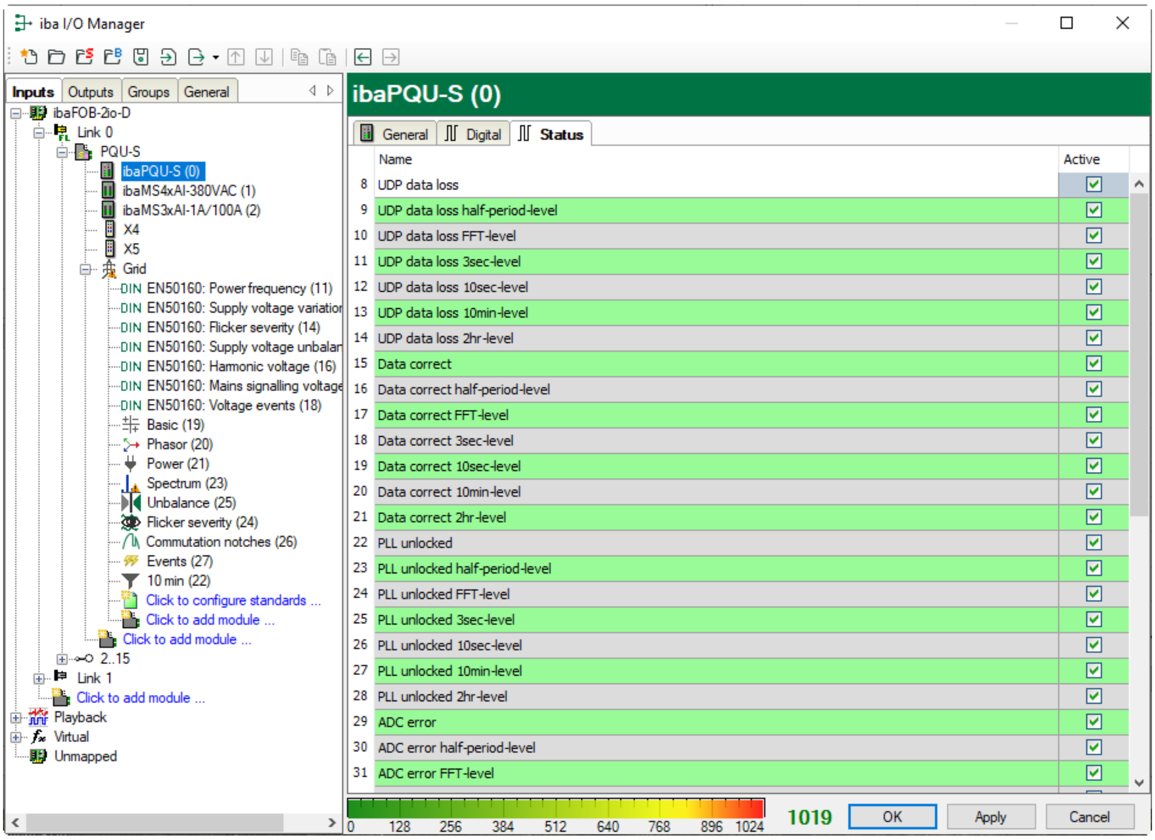


➚ See chapter 7.5.2 “Debounce filter

❑ Debounce time (µs)
Here, you can define the debounce time in µs

❑ Active
Here you can enable or disable the signal.

10.2.7 ibaPQU-S – “Status” tab

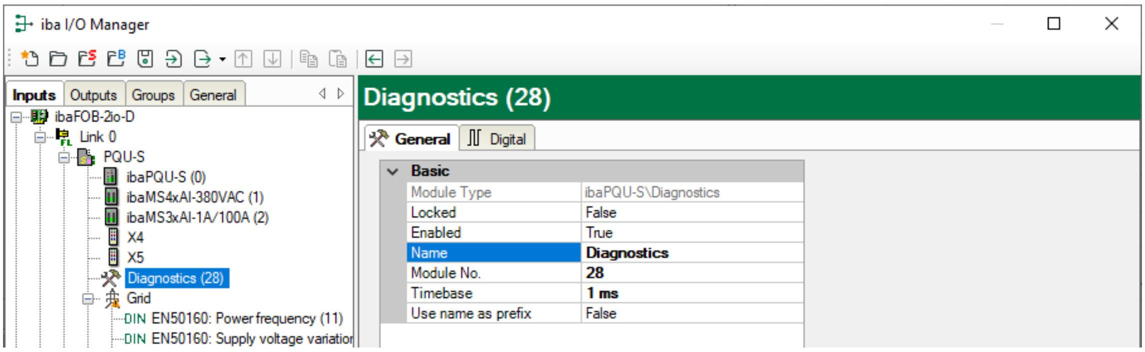


In the Status tab, you can enable status signals:

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

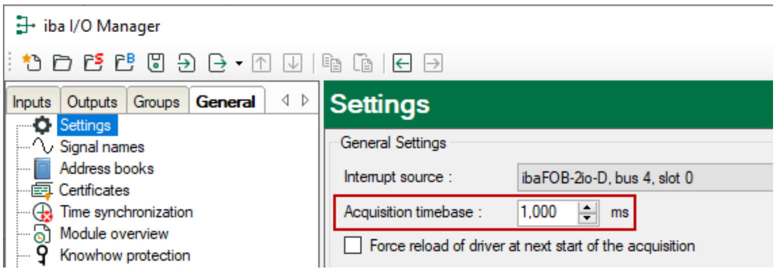
In the “Diagnostics” module, diagnosis signals are available. The module has to be added manually by right-clicking the “PQU-S” module and selecting “Diagnostics” from the context menu.



Basic settings

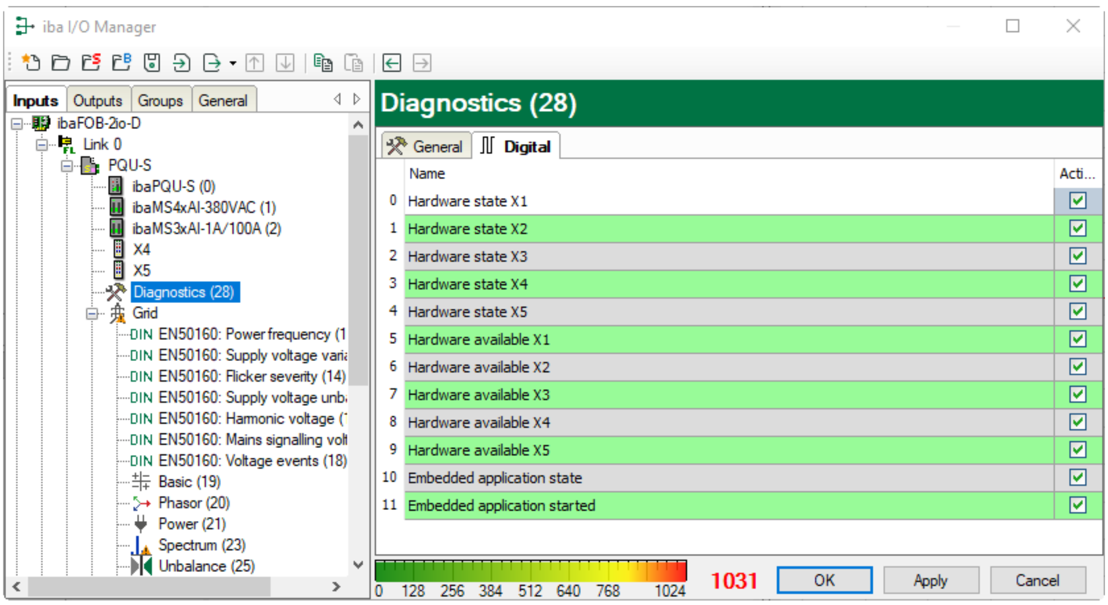
❑ Module Type, Locked, Enabled, Name, Module No., Use name as prefix
see chapter 10.2.1.

❑ 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.

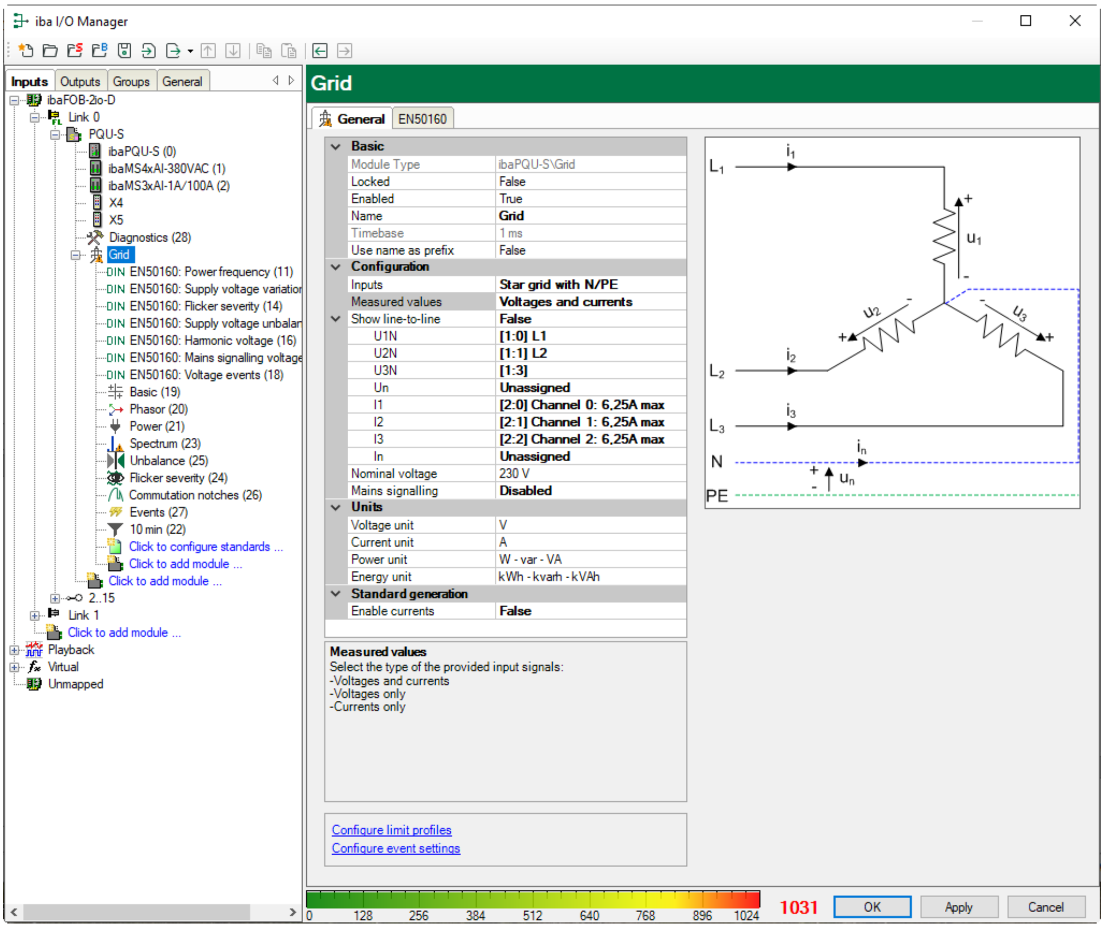


Signal	Meaning
Hardware state X[…]	Module on slot X[…] is OK
Hardware available X[…]	Module on slot X[…] was detected and initialized properly
Embedded application state	Embedded application is currentlty available
Embedded application started	Embedded application has been started. When the embedded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

10.3 Submodules to calculate characteristic values

10.3.1 Grid module

"General" tab



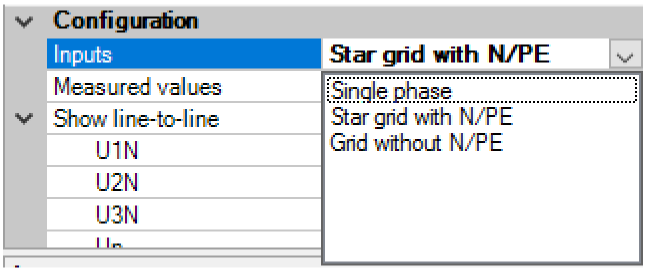
Basic settings

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

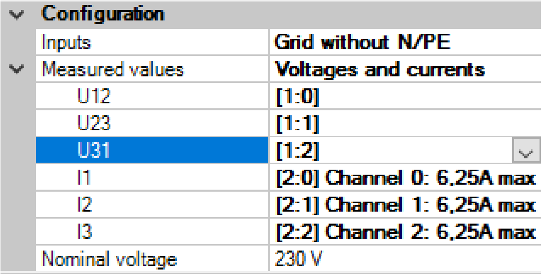
Configuration

❑ Inputs

Select the grid type from the drop-down menu.

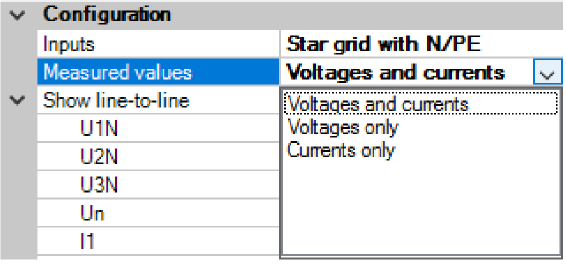


Depending on the grid type, the input measurement signals required for the grid type are displayed in the rows below.
Assign the corresponding input signals to the measurement values.
Example: Grid without N/PE
Required signals: U12, U23, U31, I1, I2, I3



- ❑ Measured values

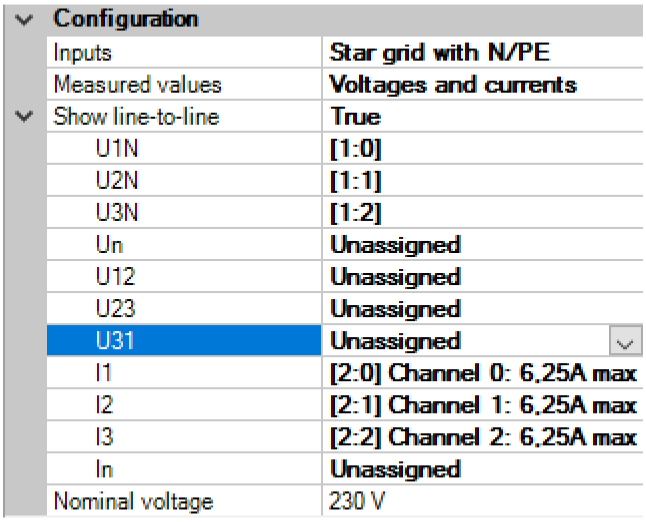
In the drop-down menu, select which raw signals are available.



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.



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

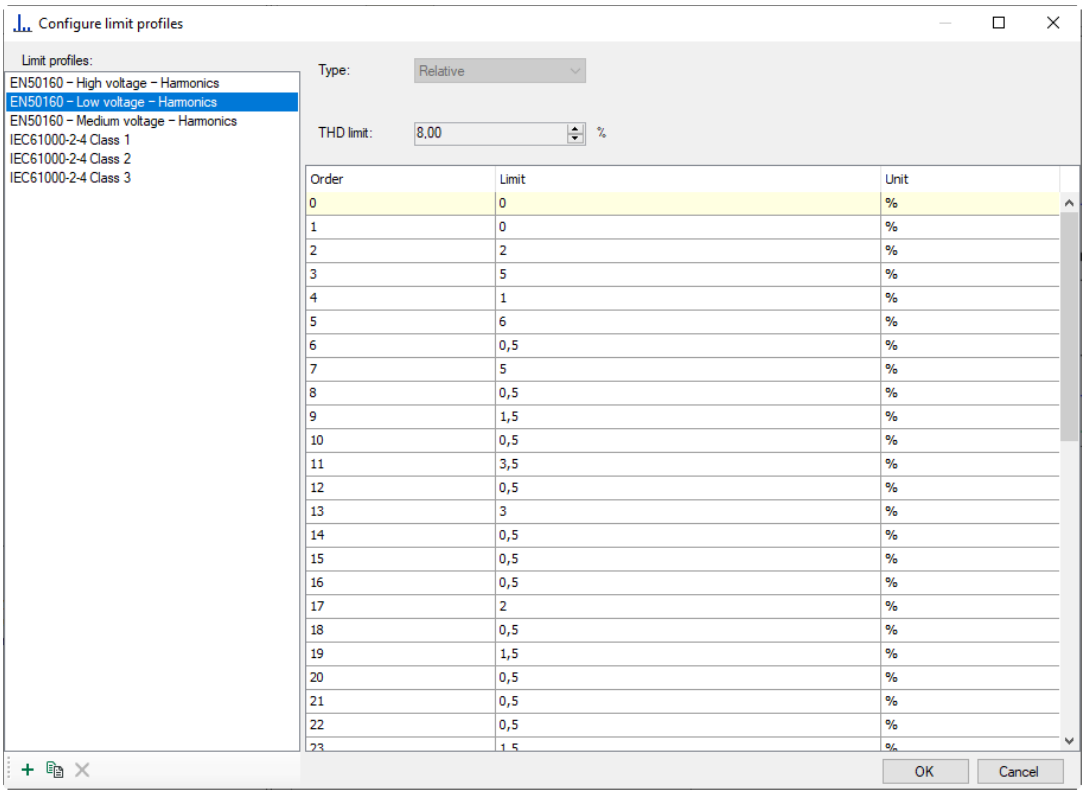
❑ Enable currents

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

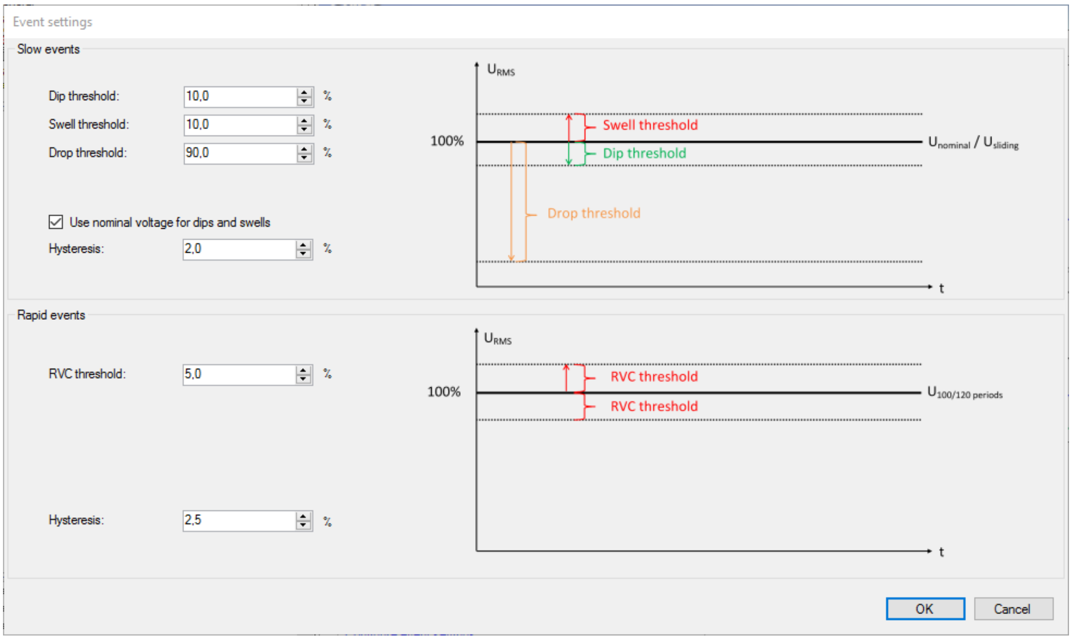
Here you can create and manage limit profiles used in the Spectrum modules or triggers.



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.

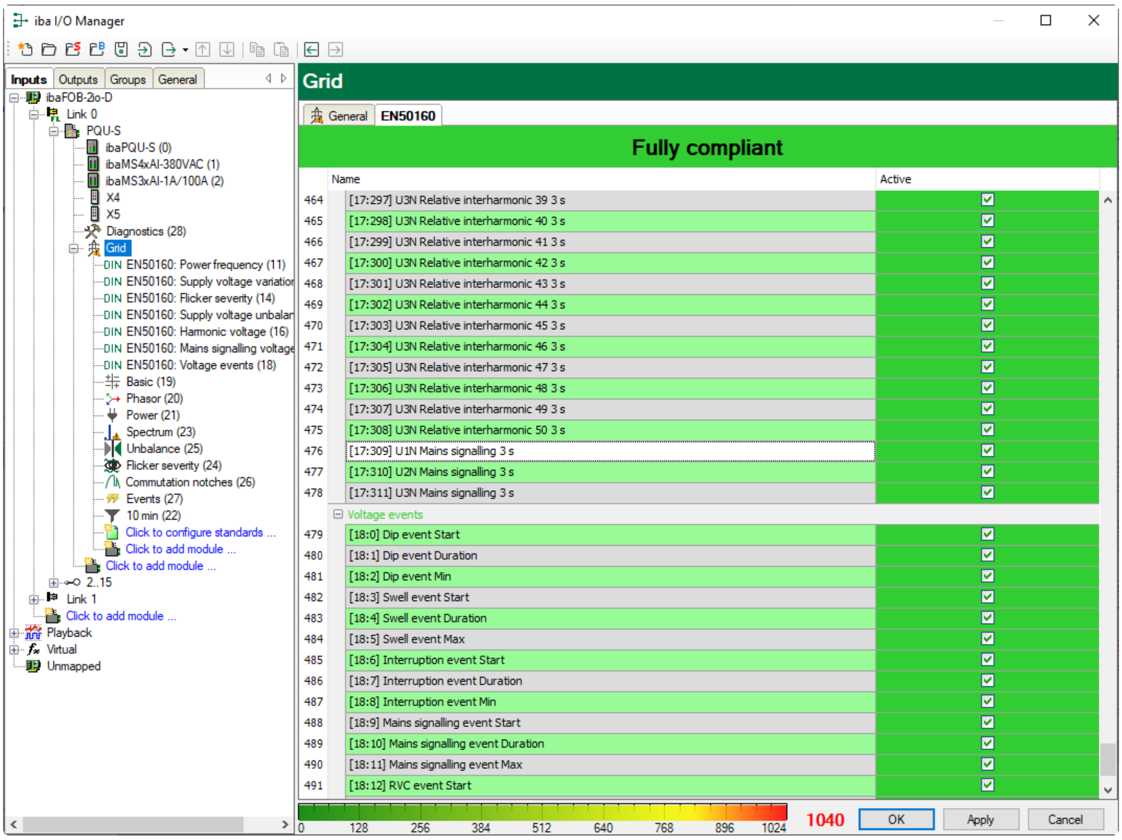


The values preset are taken from the standard IEC 61000-4-30 Ed. 3 class A.

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.

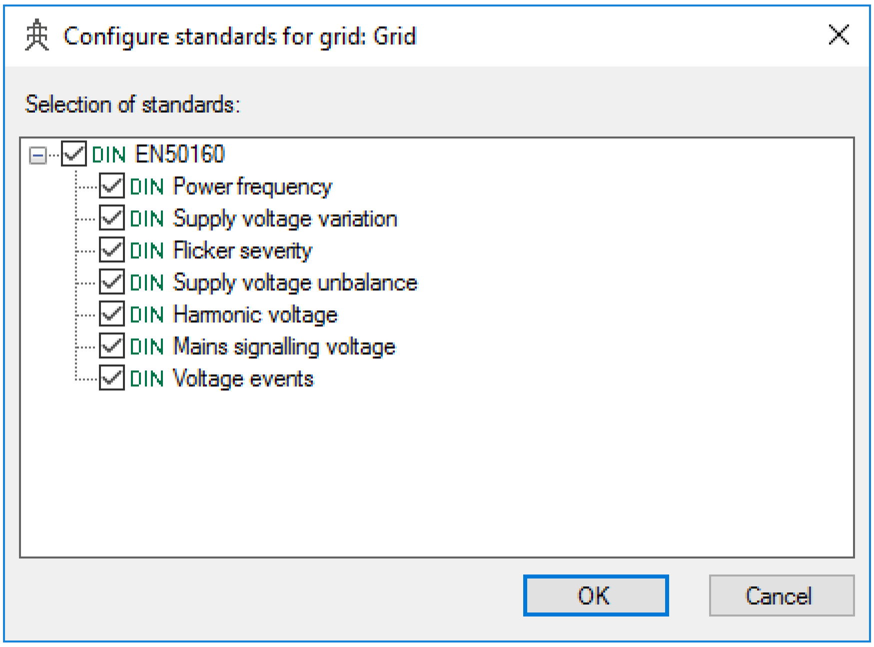
Using the check box “Use nominal voltage for dips and swells” you can set if the threshold values and the hysteresis of the slow events refer to the nominal voltage or to a floating reference value.

EN50160 tab



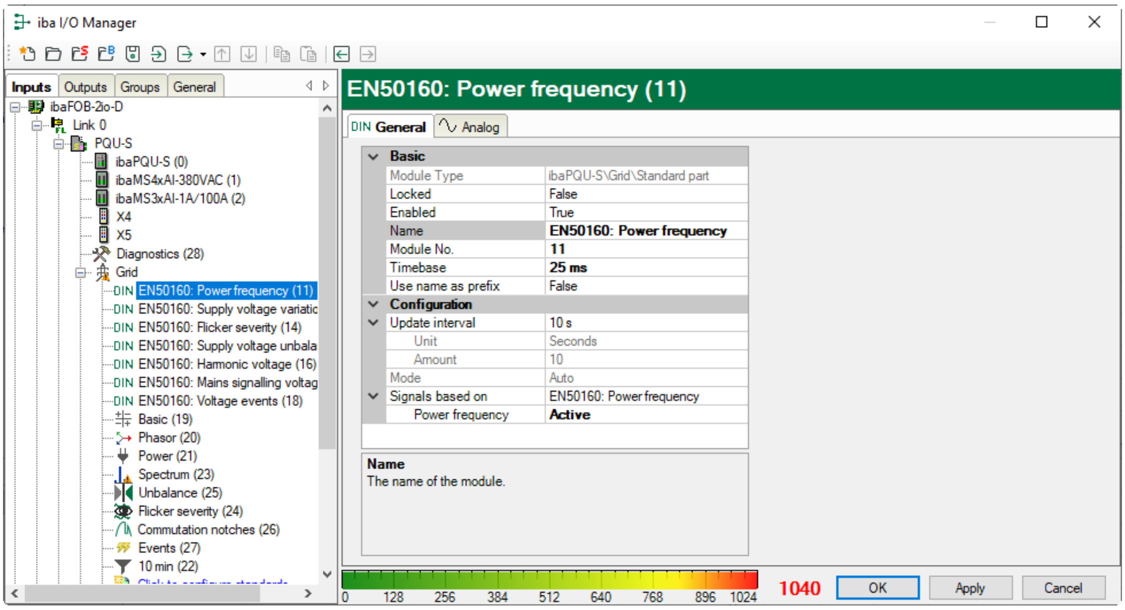
The “EN50160” tab lists all signals calculated in the EN50160-compliant submodules. The message “Fully compliant” against a green background confirms compliance with the standard. If individual signals are disabled, the display changes to “Partially compliant” on a white background.

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



10.3.2 EN50160 submodule: Power frequency

“General” tab



Basic settings

See PQU-S module, “General” tab, chapter 10.2.1

❑ Time base

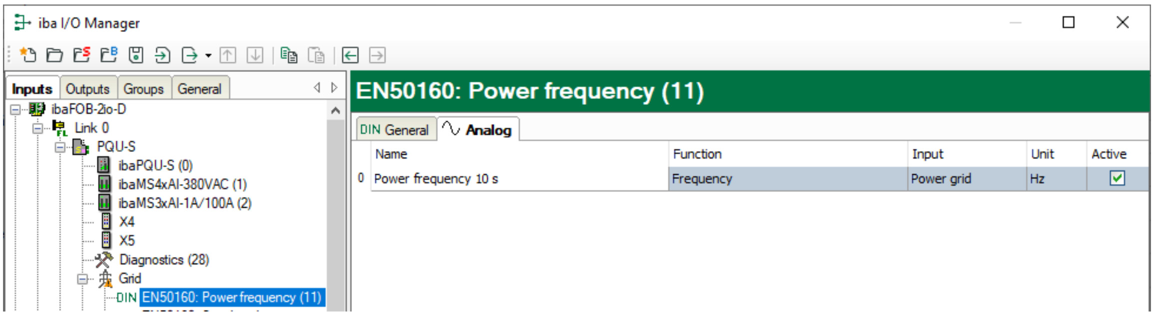
Each submodule has its own time base. The default setting should not be changed.

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



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 icon in the signal name field.

- Function, input, unit

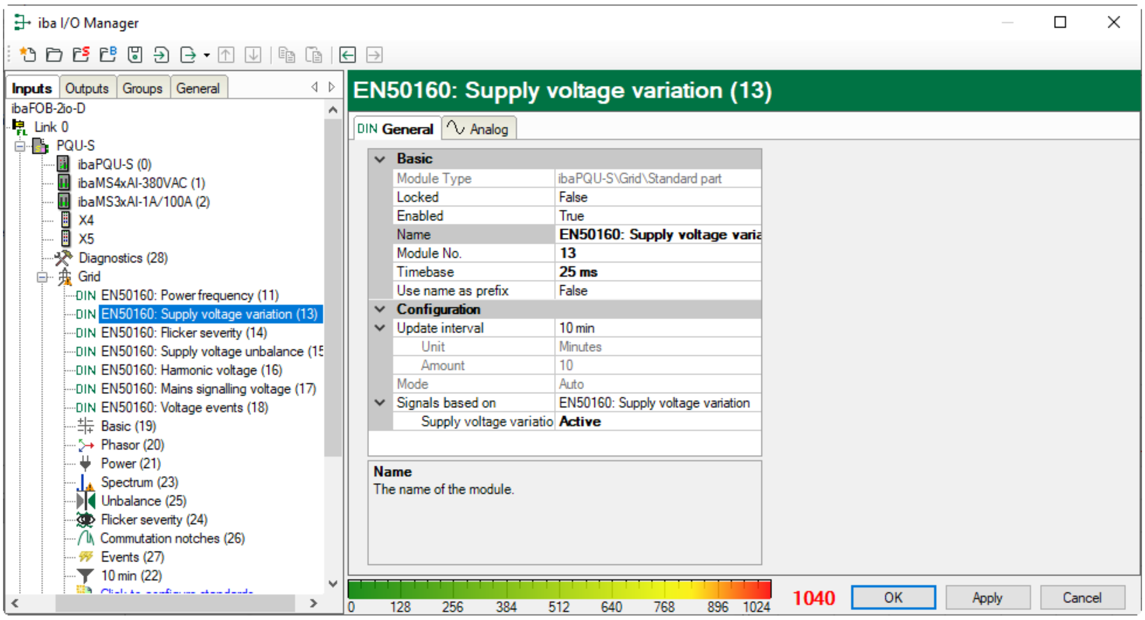
Displays the corresponding property

- Active

Here you can enable or disable the signal.

10.3.3 Submodule EN50160: Supply voltage variation

“General” tab



Basic settings

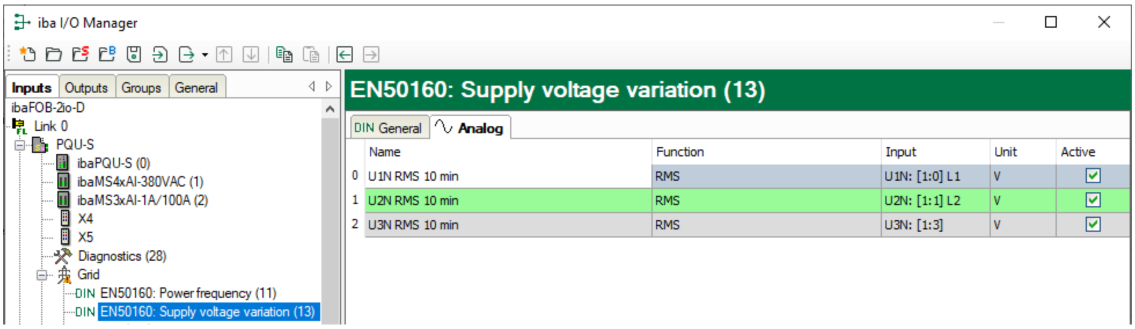
❑ See Power frequency submodule, “General” tab, chapter 10.3.2.

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.

“Analog” tab



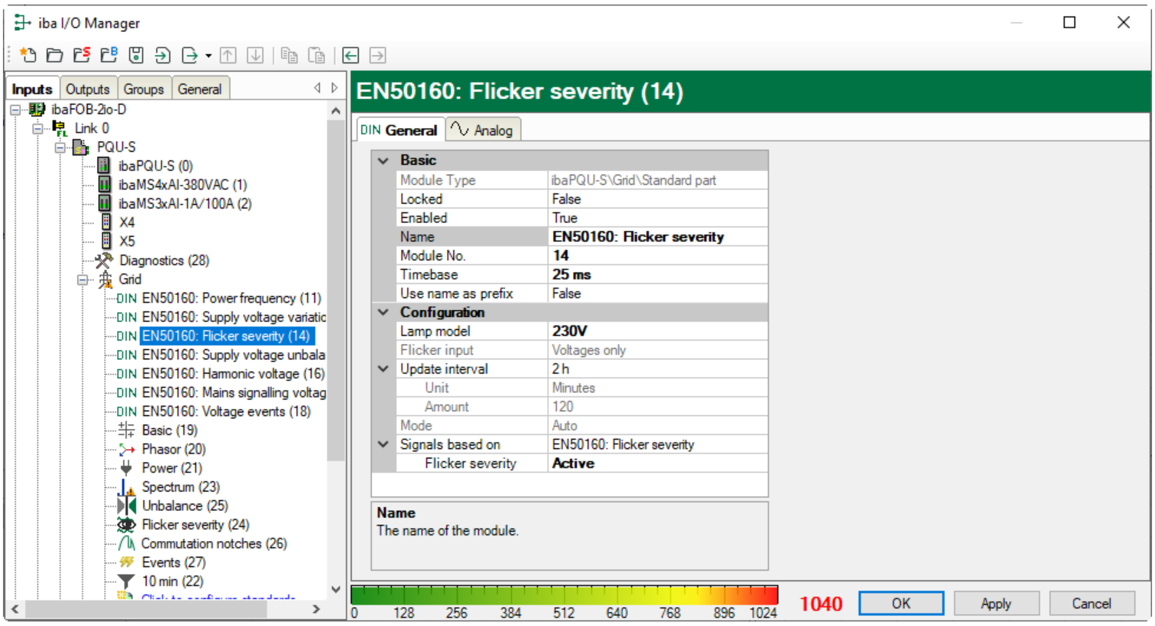
❑ Name
The names are assigned by default. To allow an unambiguous identification, they contain the input channel, the function and the measurement interval. You can additionally assign two comments by clicking the icon in the signal name field.

❑ 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



Basic settings

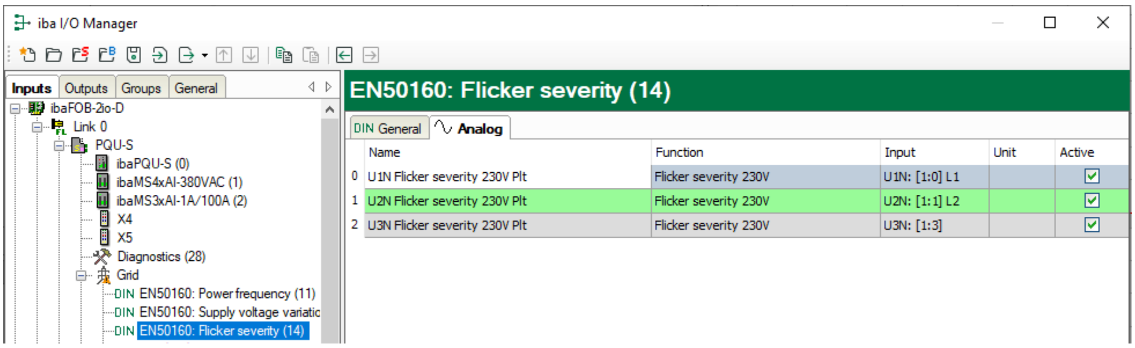
❑ See Power frequency submodule, “General” tab, chapter 10.3.2

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



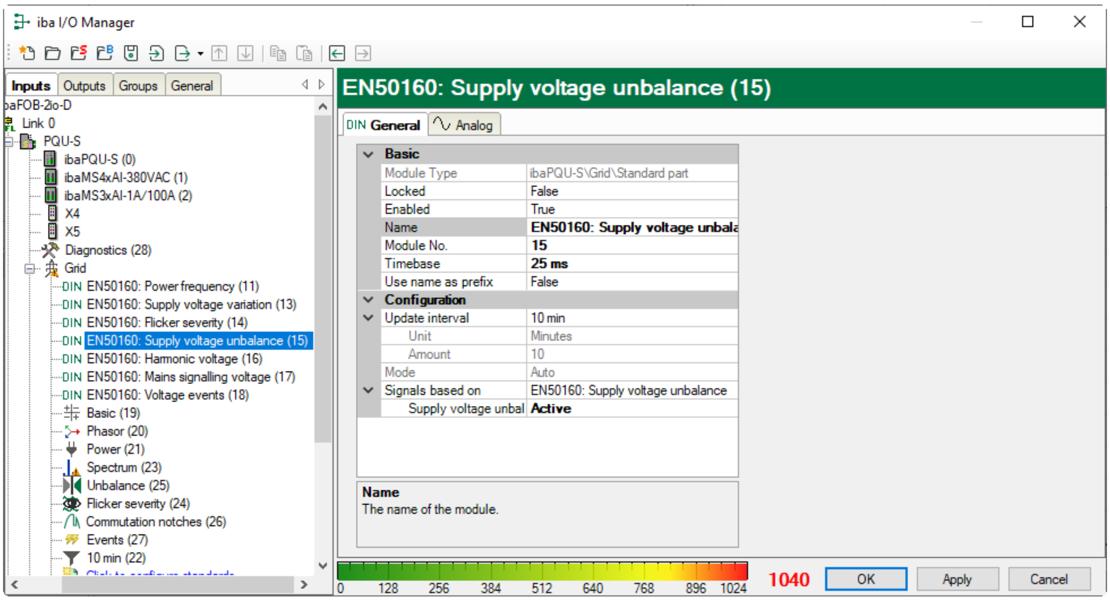
❑ Name
The names are assigned by default. To allow an unambiguous identification, they contain the input channel, the characteristic value and the measurement interval.

❑ Function
Calculation function used by ibaPQU-S.

- ❑ Input
The signal used for calculation.
- ❑ Unit
Display of the relevant unit.
- ❑ Active
Here you can enable or disable the signal.

10.3.5 EN50160 submodule: Supply voltage unbalance

"General" tab

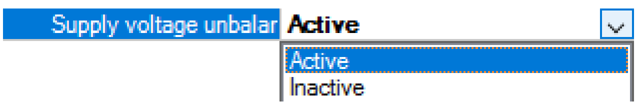


Basic settings

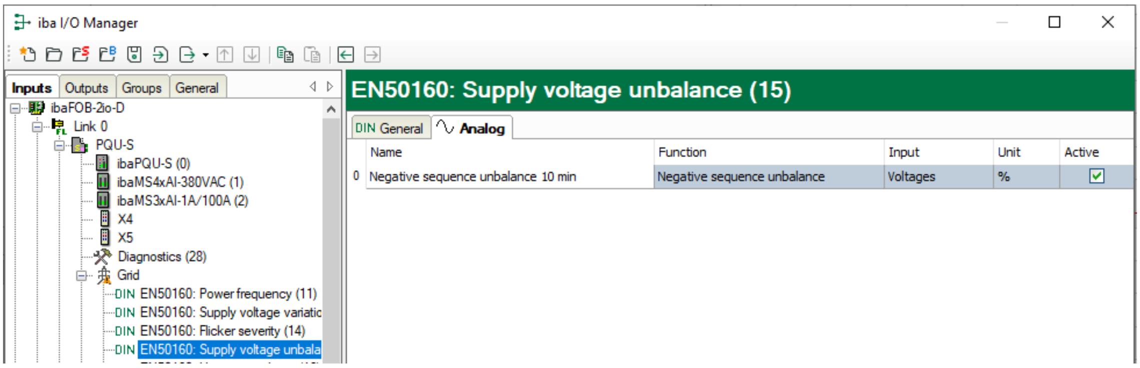
- ❑ See Power frequency submodule, "General" tab, chapter 10.3.2

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.



“Analog” tab



❑ 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.

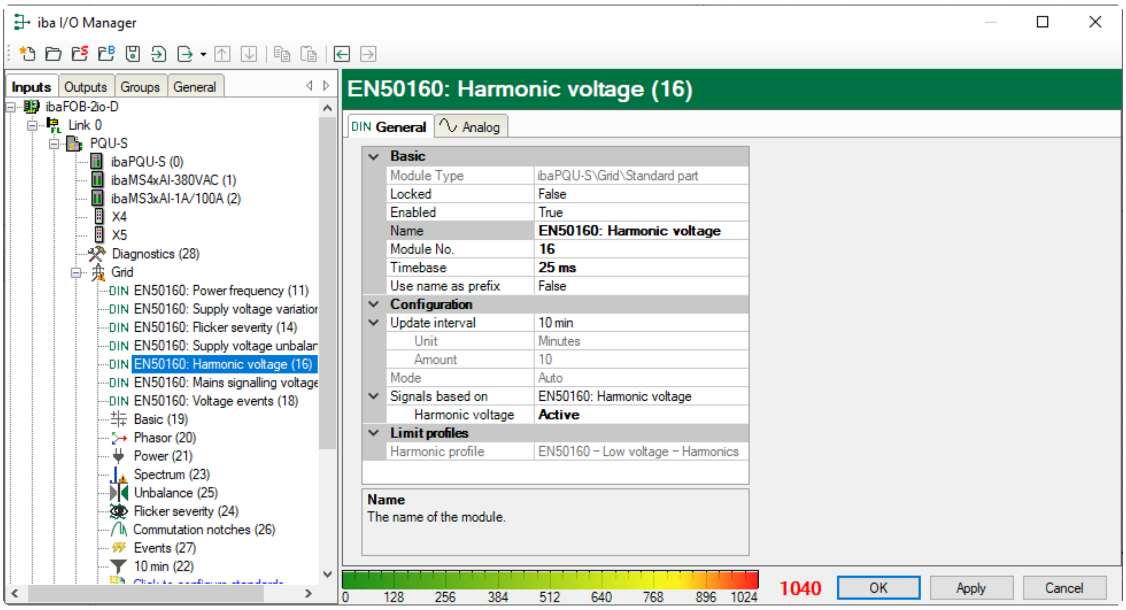
❑ Input
The signals used for calculation.

❑ Unit
Display of the relevant unit.

❑ Active
Here you can enable or disable the signal.

10.3.6 EN50160 submodule: Harmonic voltage

“General” tab



Important note

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

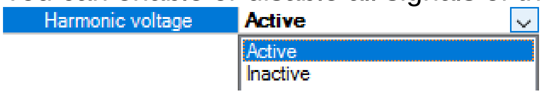
Basic settings

❑ See Power frequency submodule, “General” tab, chapter 10.3.2

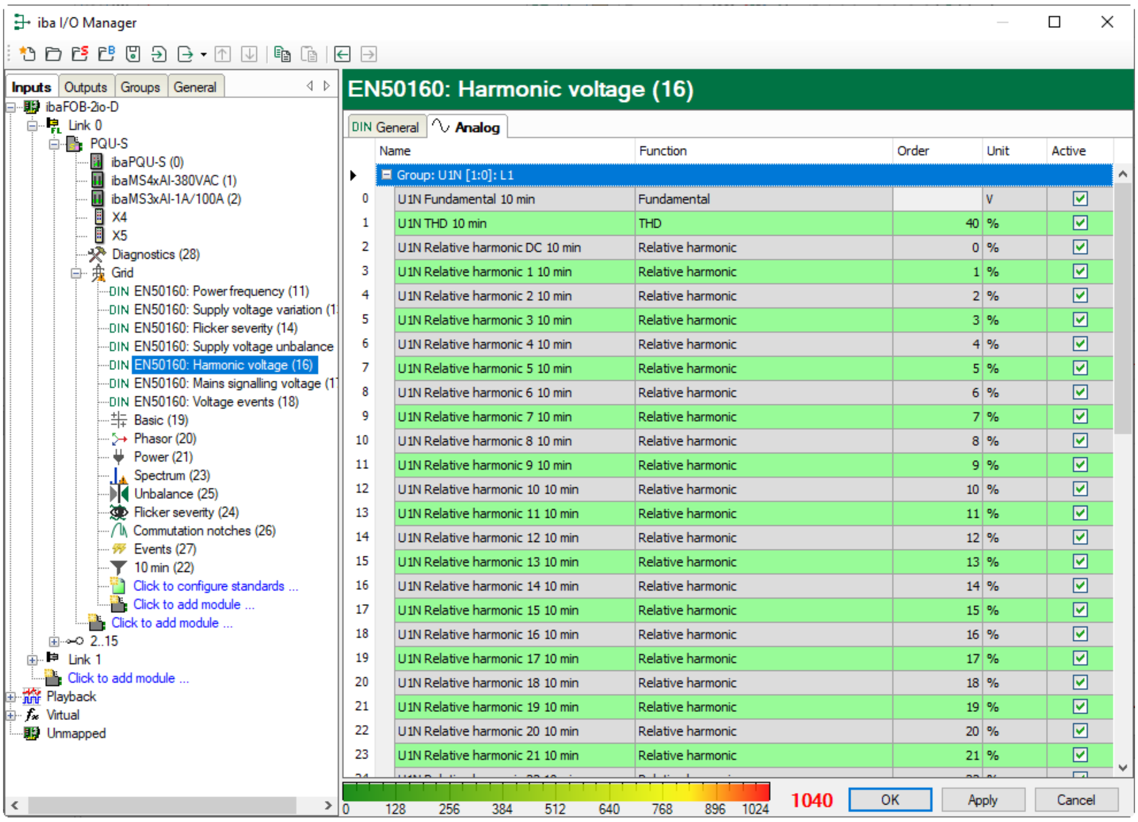
Configuration

❑ 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



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 ✎ icon in the signal name field.

❑ Function, order, unit

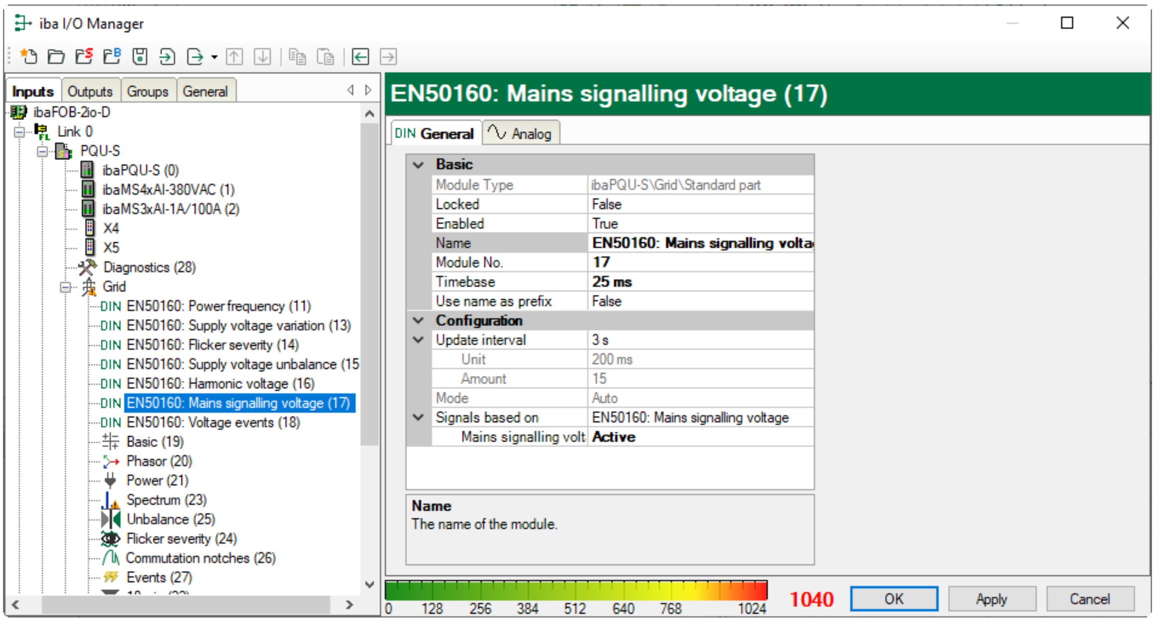
Displays the corresponding property

❑ Active

Here you can enable or disable the signal.

10.3.7 EN50160 submodule: Mains signalling voltage

"General" tab

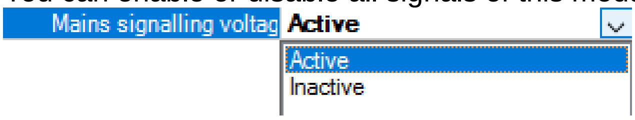


Basic settings

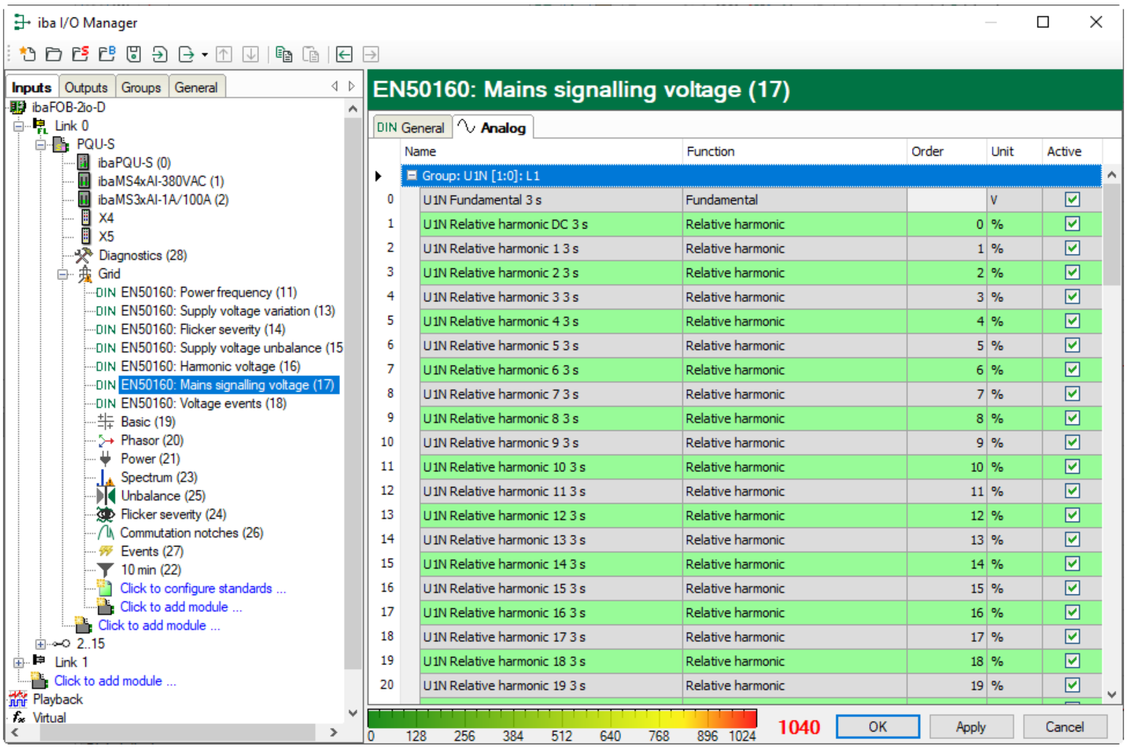
- See Power frequency submodule, "General" tab, chapter 10.3.2

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.



“Analog” tab



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 icon in the signal name field.

❑ Function, order, unit

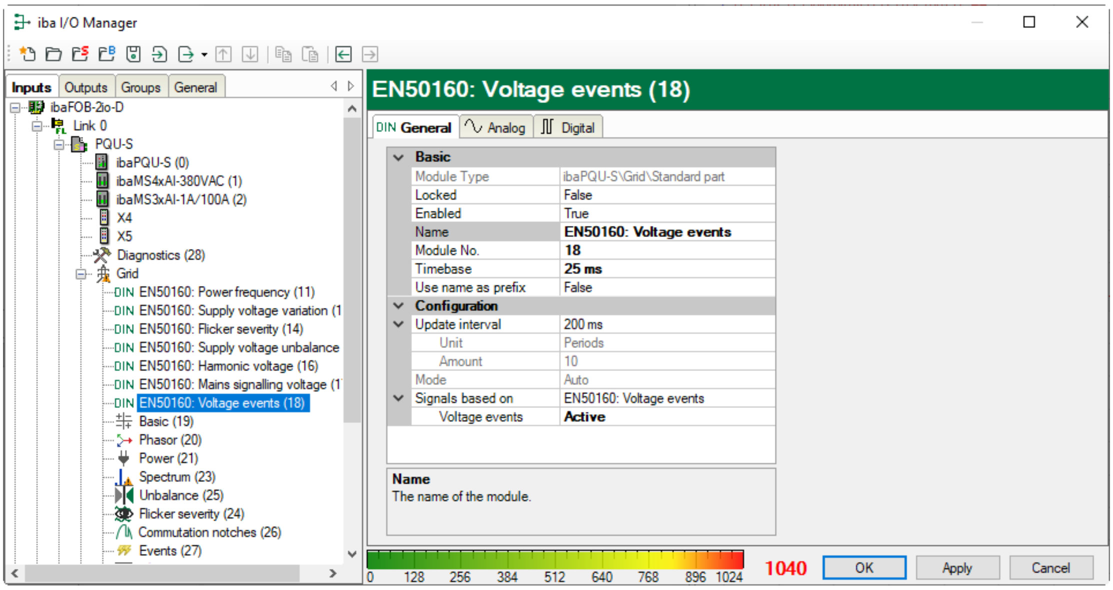
Displays the corresponding property

❑ Active

Here you can enable or disable the signal.

10.3.8 EN50160 submodule: Voltage events

“General” tab

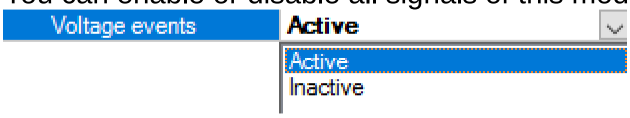


Basic settings

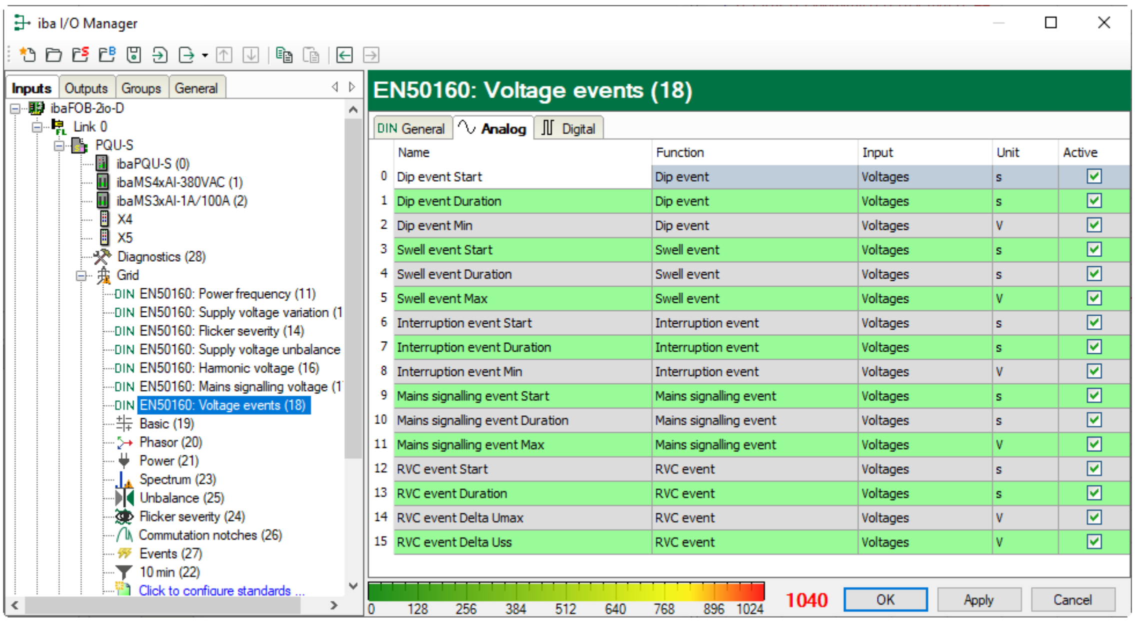
- ❑ See Power frequency submodule, “General” tab, chapter 10.3.2

Configuration

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



“Analog” tab



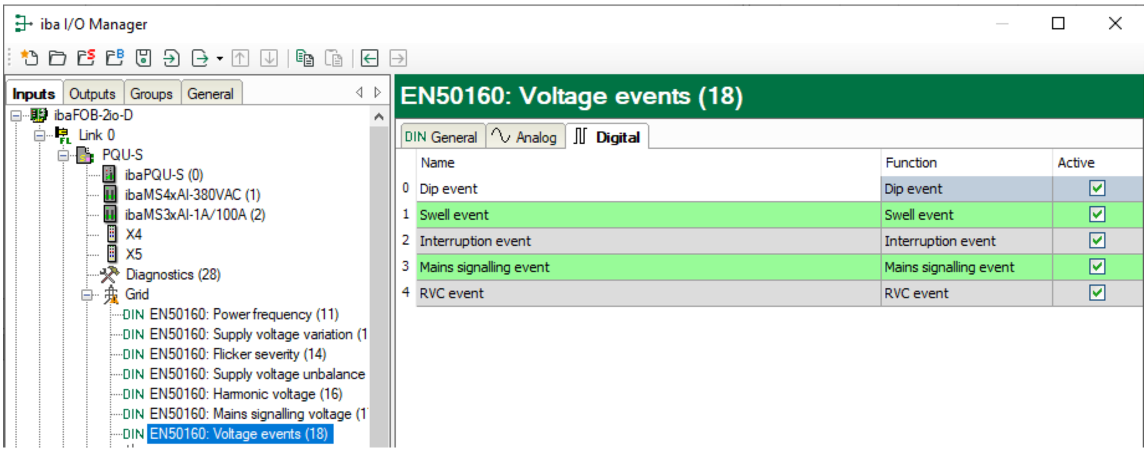
The EN50160 submodule: Voltage events calculates the RMS value for each input channel.

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

❑ Function, input, unit
Displays the corresponding property

❑ Active
Here you can enable or disable the signal.

Digital tab



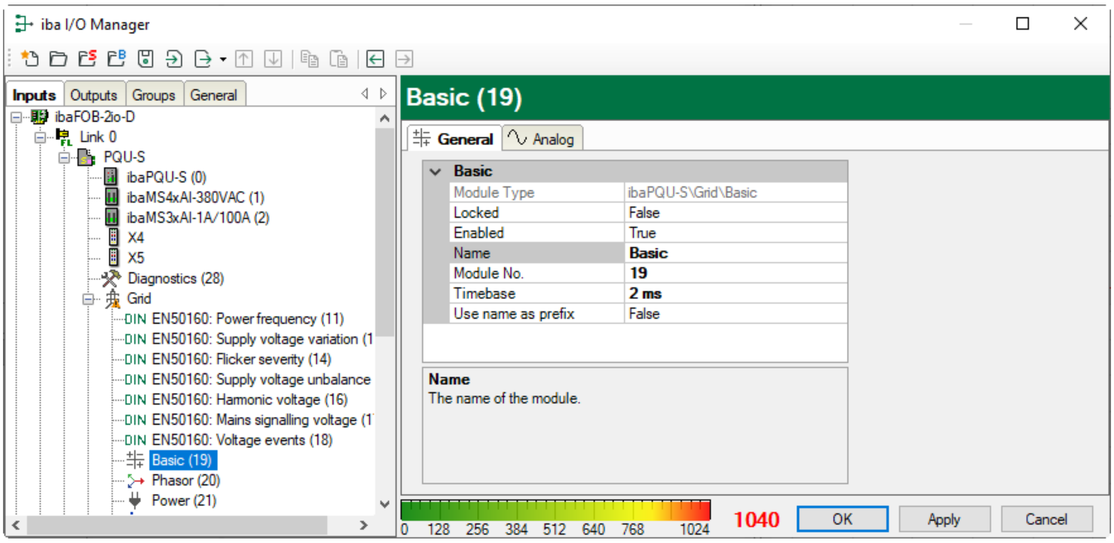
❑ Name
The names of the voltage events are assigned by default. You can additionally assign two comments by clicking the icon in the signal name field.

❑ Function
Displays the corresponding property

❑ Active
Here you can enable or disable the signal.

10.3.9 Basic submodule

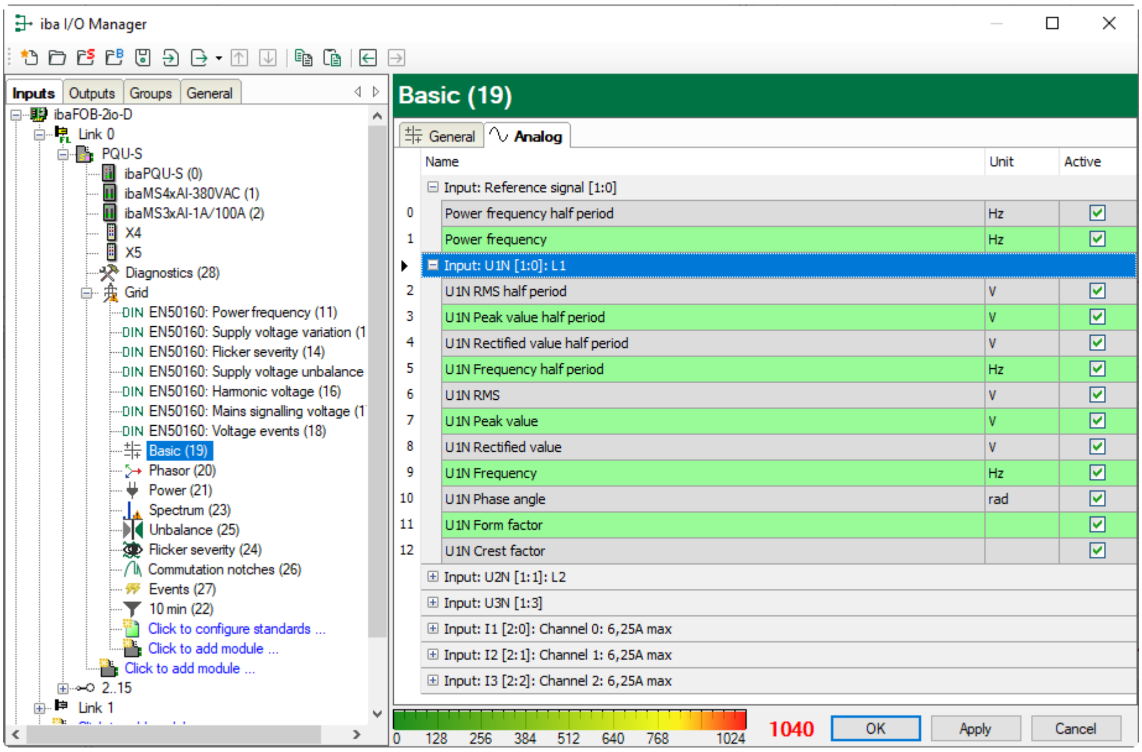
"General" tab



Basic settings

❑ See Power frequency submodule, “General” tab, chapter 10.3.2

“Analog” tab



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.

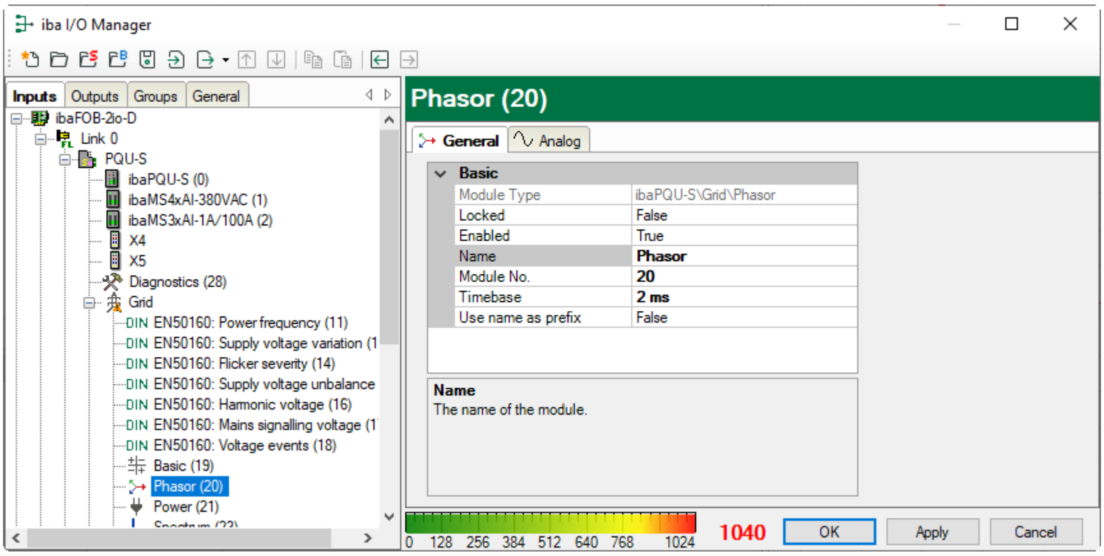
❑ Name
The names are set by default but can be edited. To allow an unambiguous identification, they contain the input channel and the characteristic value. You can additionally assign two comments by clicking the icon in the signal name field.

❑ Unit
Display of the relevant unit.

❑ Active
Here you can enable or disable the signal.

10.3.10 Phasor submodule

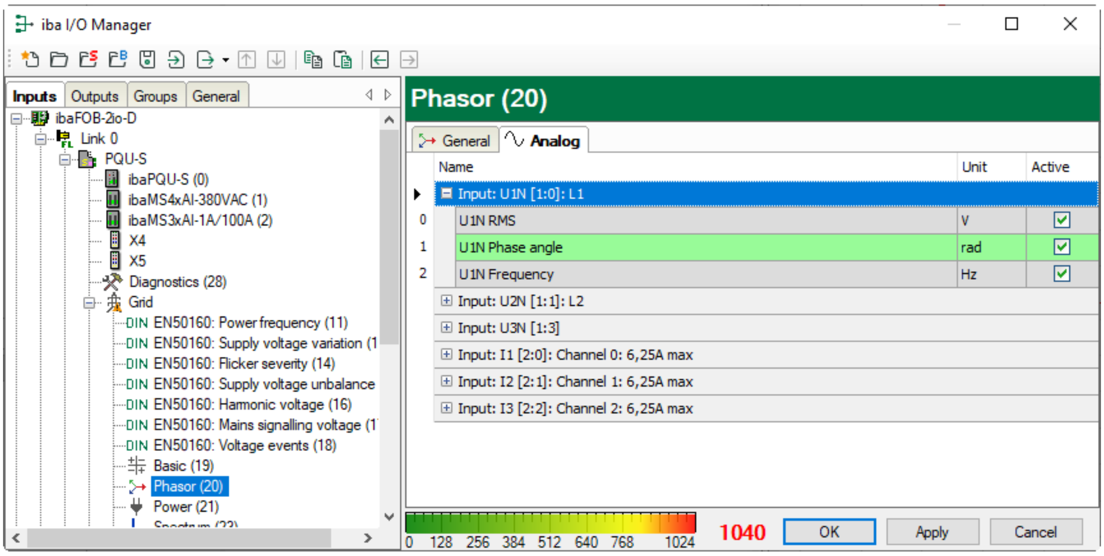
“General” tab



Basic settings

❑ See Power frequency submodule, “General” tab, chapter 10.3.2

“Analog” tab



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 icon in the signal name field.

❑ Unit
Display of the unit.

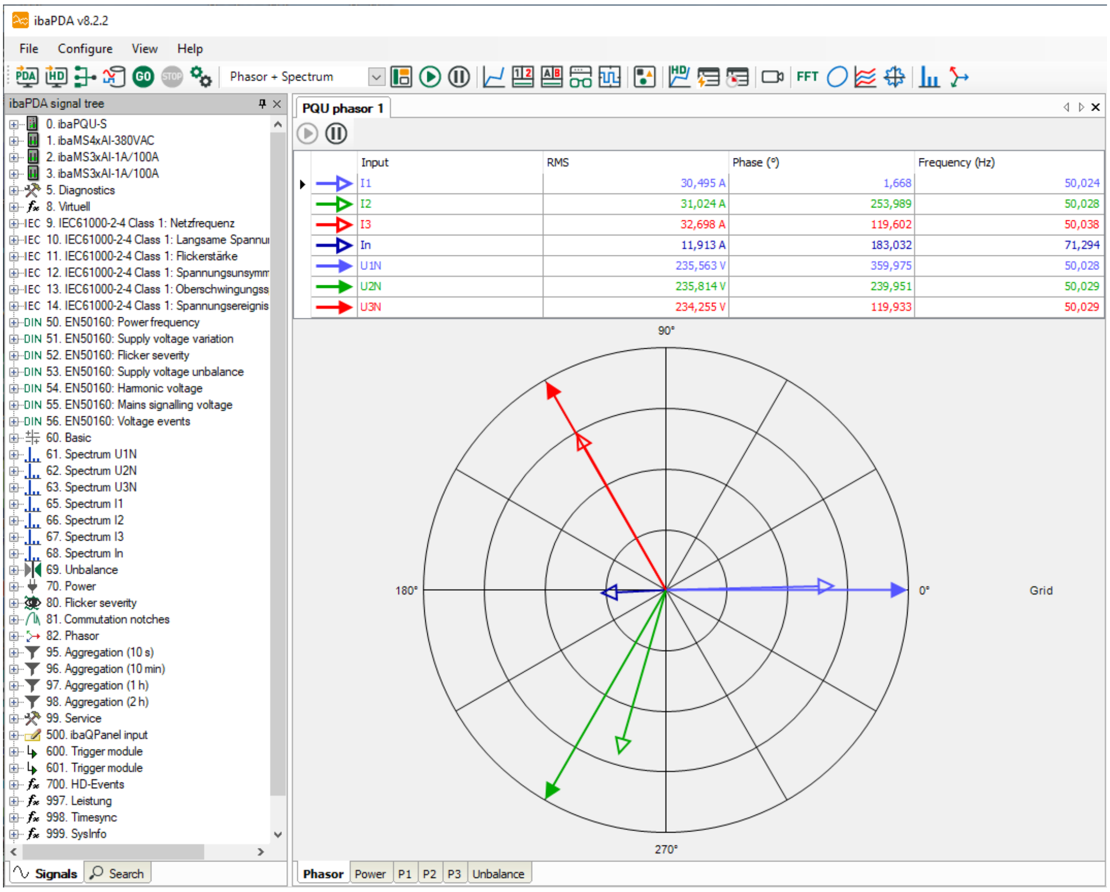
❑ Active
Here you can enable or disable the signal.

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  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.



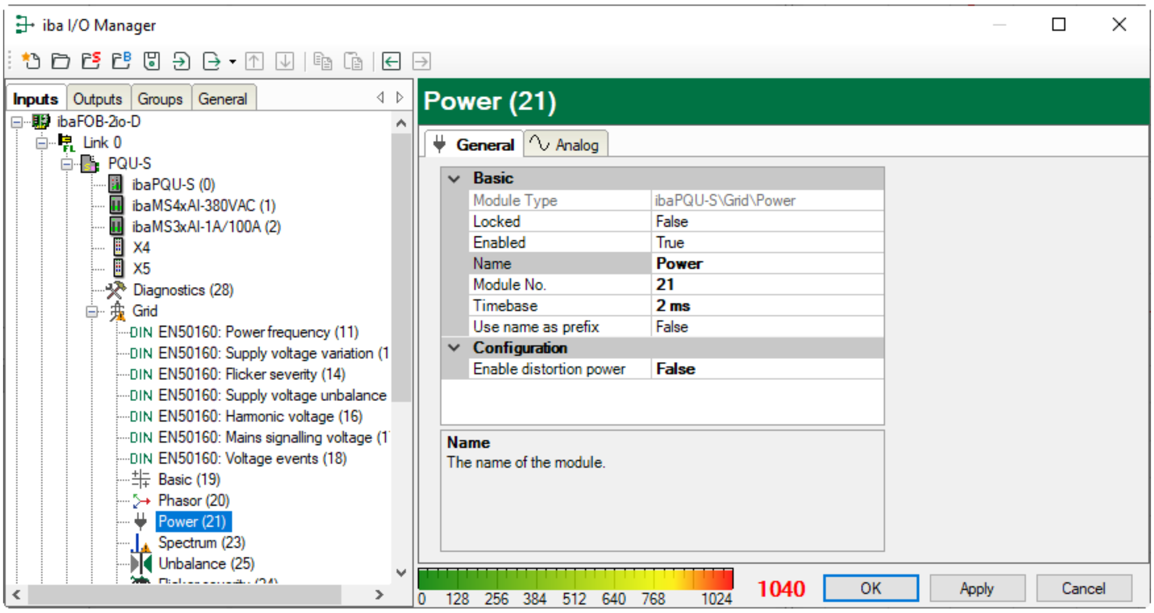
- Filled arrowheads: RMS value of voltage in the corresponding phase angle
- Empty arrowheads: RMS value of current in the corresponding phase angle

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



Basic settings

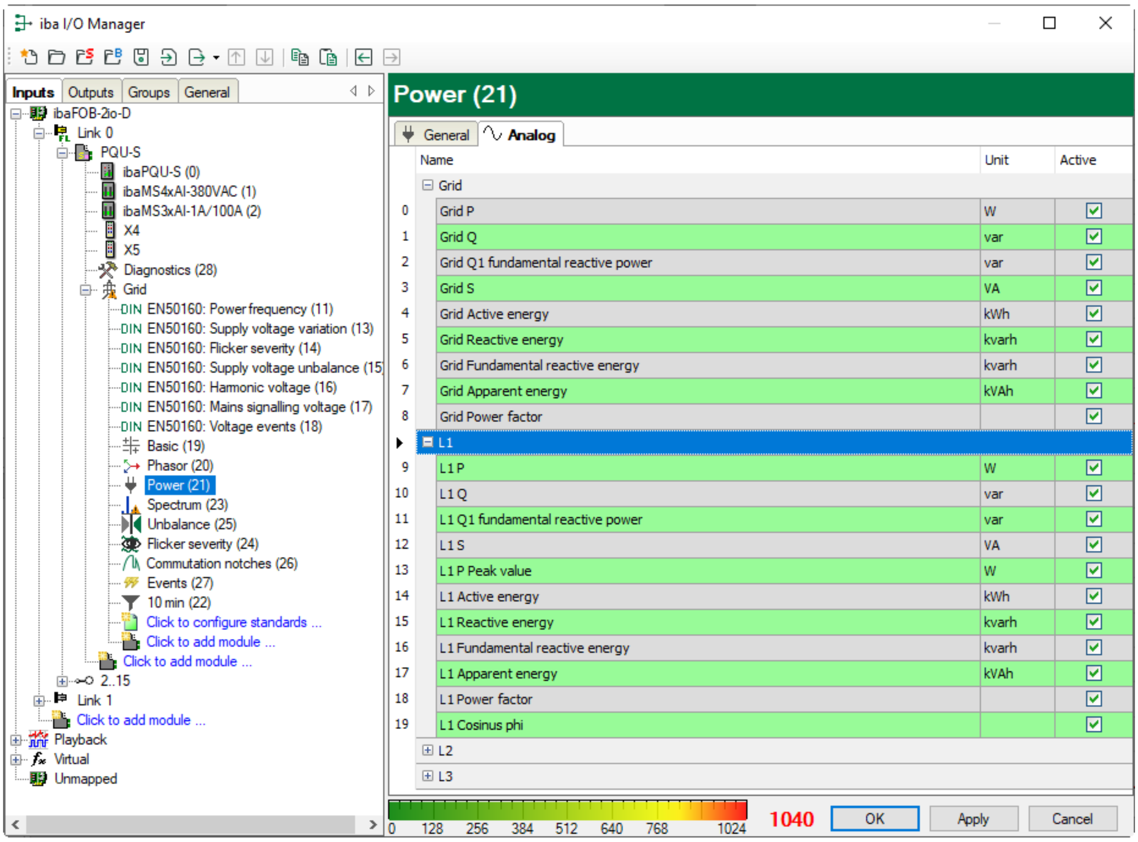
❑ See Power frequency submodule, “General” tab, chapter 10.3.2

Configuration

❑ Enable distortion power

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

“Analog” tab



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 icon in the signal name field.

❑ Unit
Display of the unit.

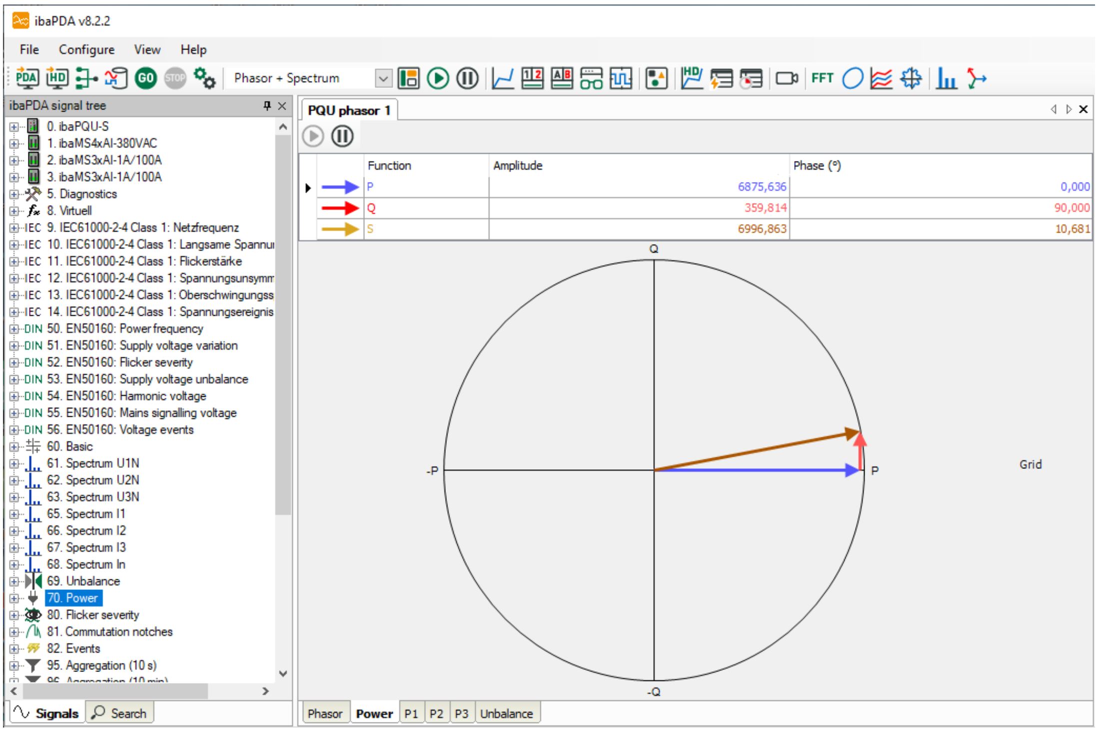
❑ Active
Here you can enable or disable the signal.

Display in the phasor diagram

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

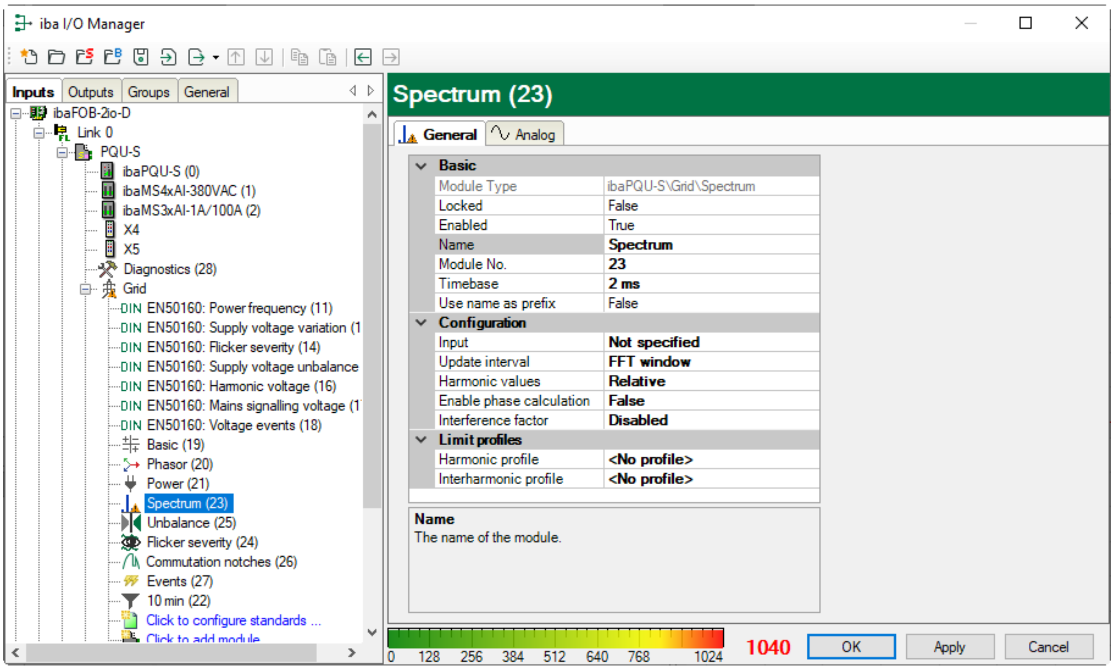
Click the button in the ibaPDA toolbar to display the phasor diagram.

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.

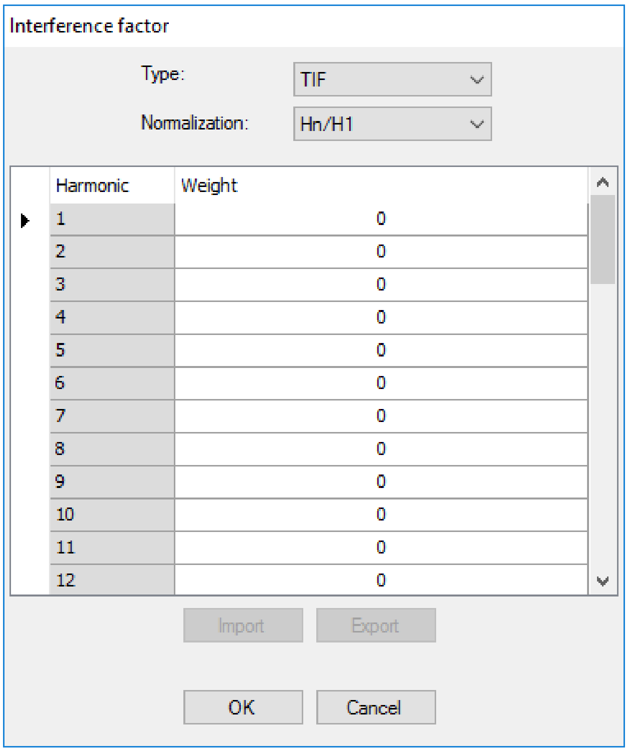
❑ Harmonics values

Select whether to measure relative or absolute harmonics/interharmonics.

❑ Enable phase calculation

The corresponding phases for the harmonic values are also calculated.

❑ Interference factor



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.

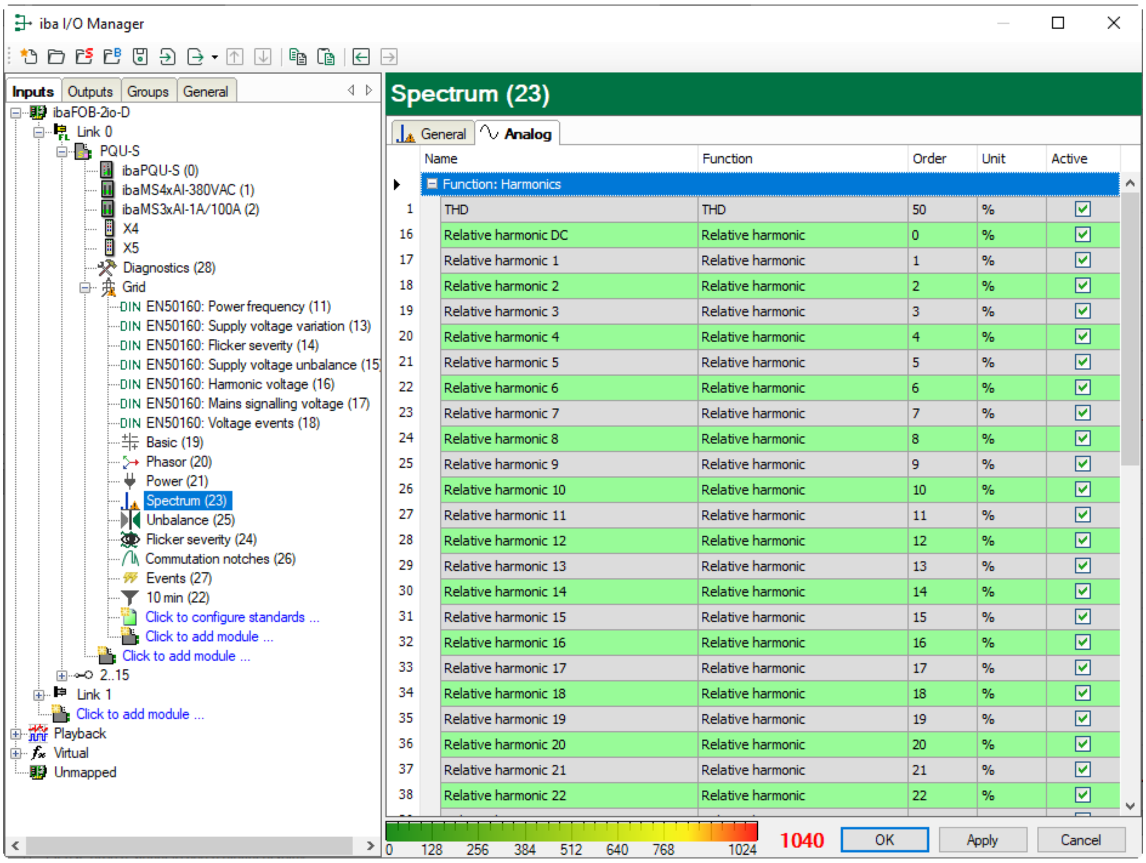
  Hn/RMS: All harmonics are normalized to the RMS value, i.e. divided by the RMS value

  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“.

“Analog” tab



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.

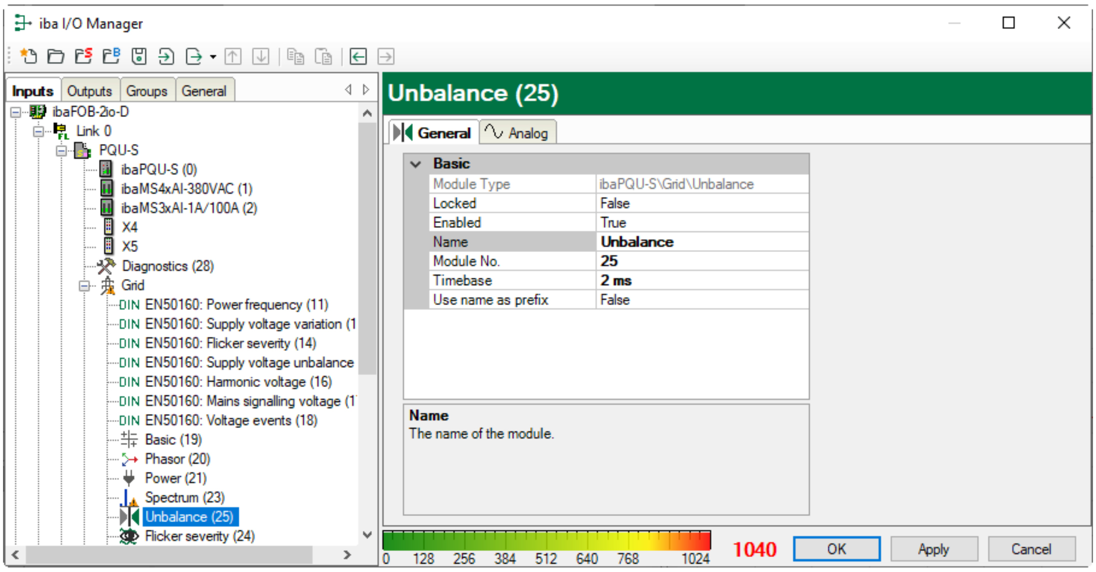
❑ Name
The names are assigned by default. To allow an unambiguous identification, they contain the input channel and the characteristic value. You can additionally assign two comments by clicking the icon in the signal name field.

❑ Function, order, unit
Displays the properties

❑ Active
Here you can enable or disable the signal.

10.3.13 Unbalance submodule

“General” tab



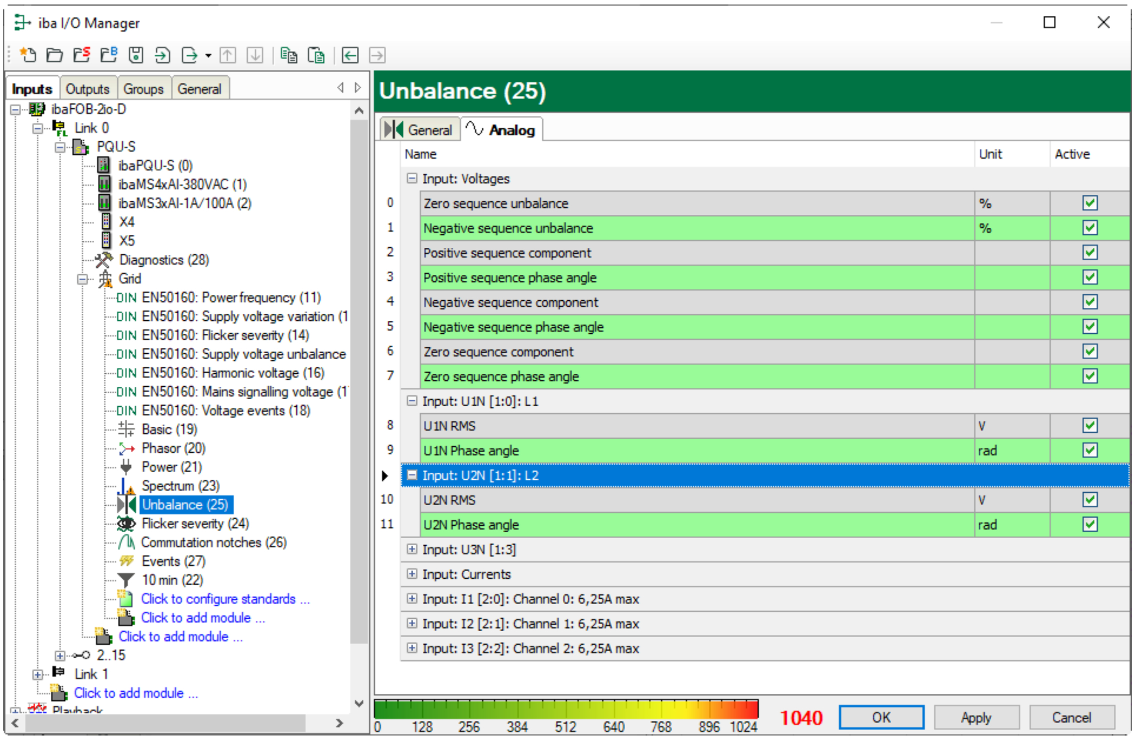
Basic settings

❑ 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  icon in the signal name field.

❑ Unit
Display of the relevant unit.

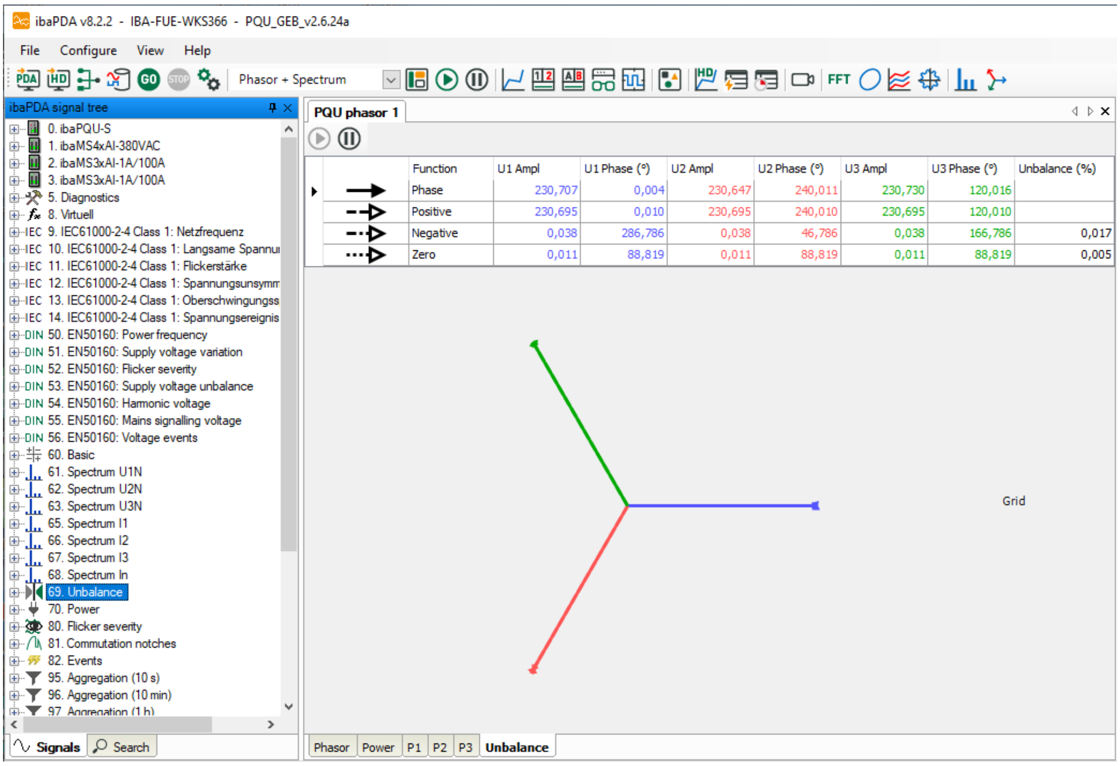
❑ Active
Here you can enable or disable the signal.

Display in the phasor diagram

The voltage unbalance can be visualized using the phasor diagram.

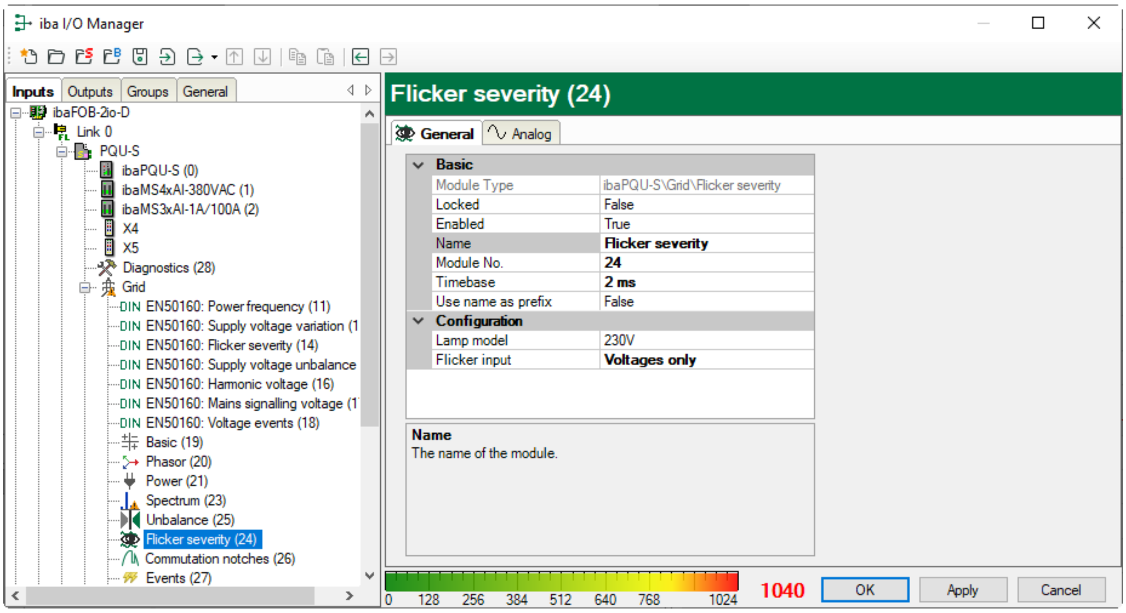
Click the  button on the ibaPDA toolbar to display the phasor diagram.

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.



10.3.14 Flicker severity submodule

"General" tab



Basic settings

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

Configuration

❑ Lamp model

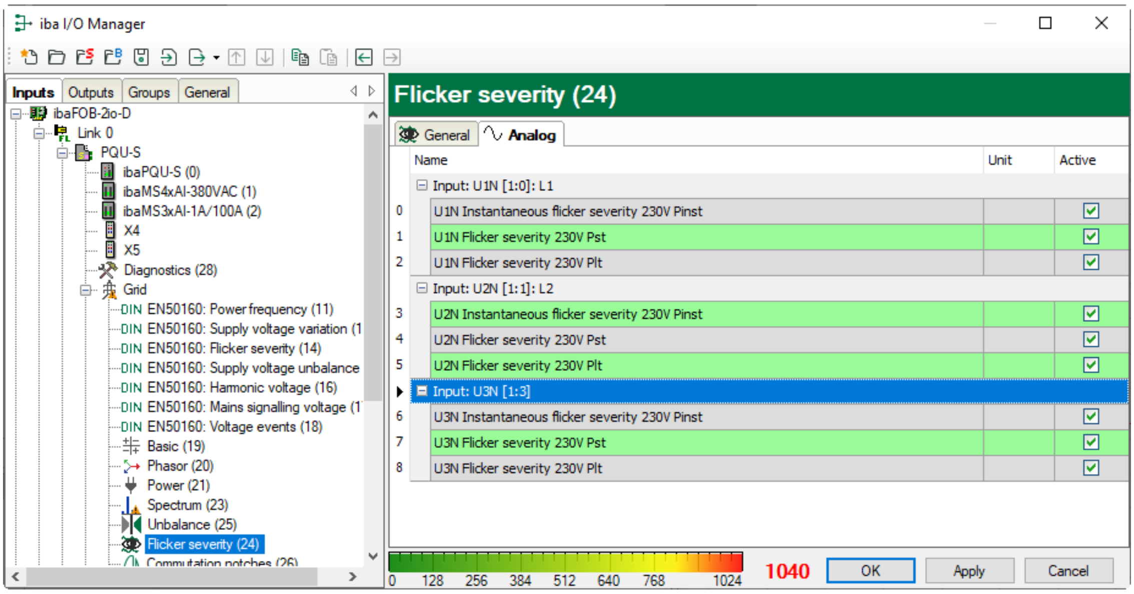
To calculate the flicker, the lamp model to be used, 230V or 120V, has to be specified.

❑ 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 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

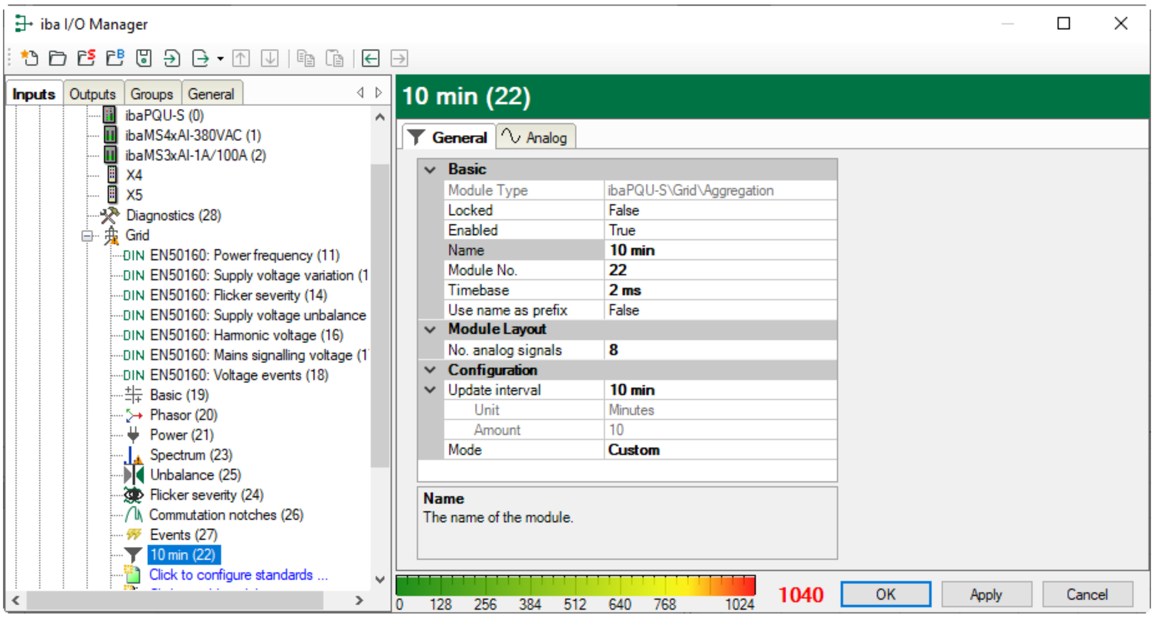
The Aggregation submodule is a freely configurable module in which the measurement interval and the characteristic values can be selected individually. The submodule name is assigned automatically by ibaPDA and is in accordance with the set measurement interval. The default setting is 10 min. If the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



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.

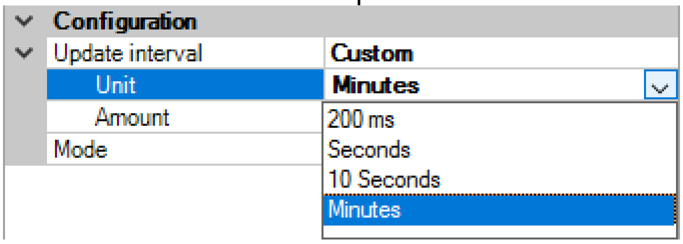
Configuration

❑ Update interval

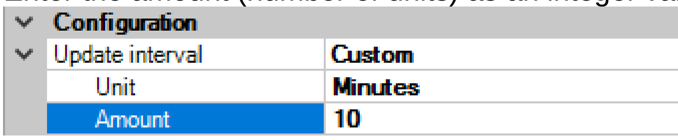
Select the measurement interval here.

- 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.



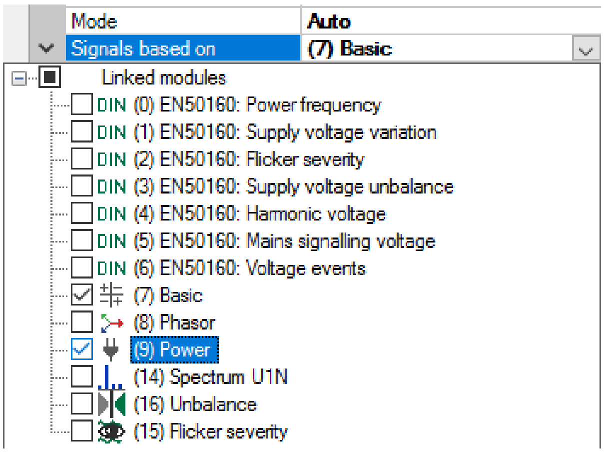
  Enter the amount (number of units) as an integer value into the field.



  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:

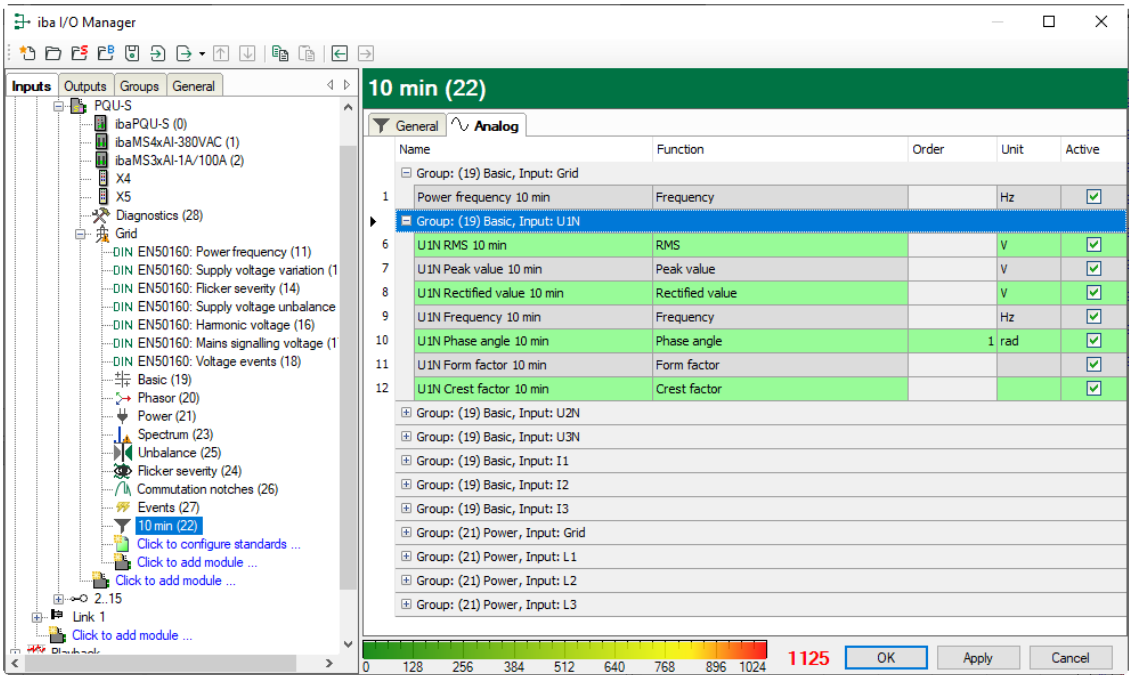


  The submodules can be selected individually. The characteristic values configured in them serve as the basis for the new measurement, however with the measurement interval defined here.

“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.



❑ 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  icon in the signal name field.

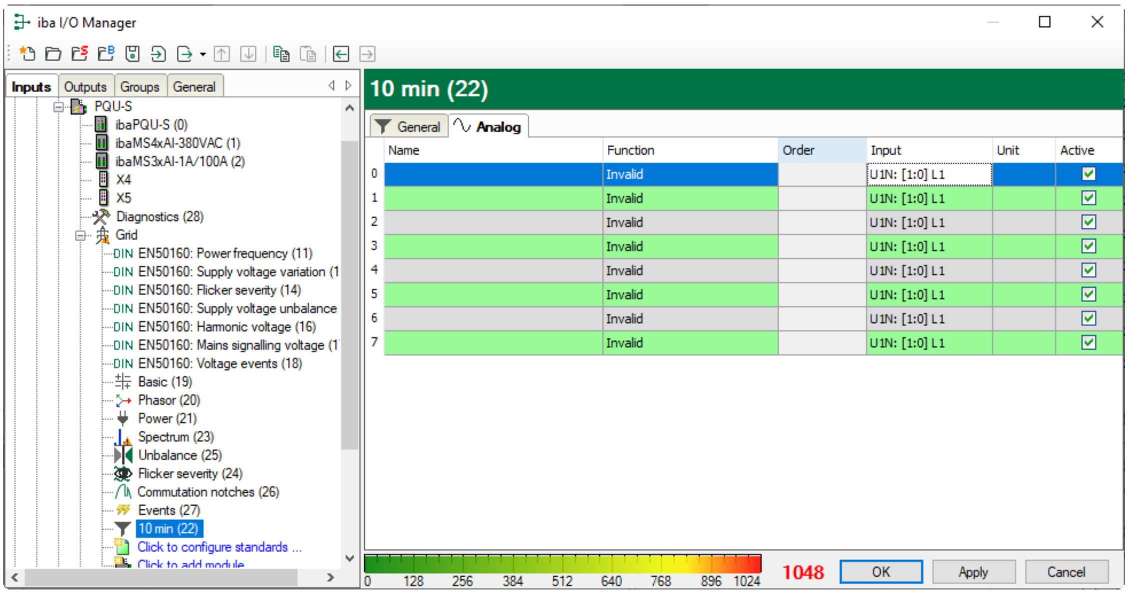
❑ Function, order, unit

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.

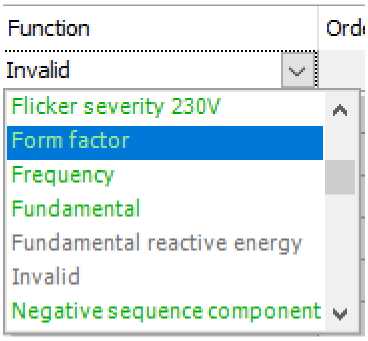


❑ Name

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

❑ Function

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



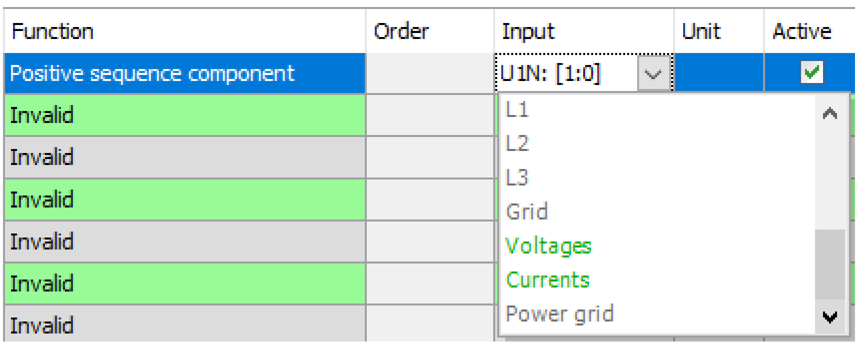
The calculations applicable to the selected input signal are shown in green.

❑ 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:



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.

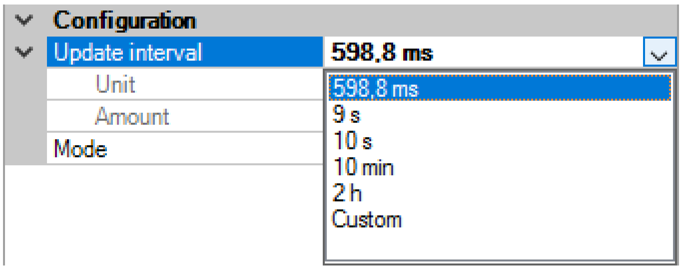
With user-defined power frequencies, 10 or 12 periods are measured accordingly: 10 periods for power frequencies ≥ 10 Hz and < 51 Hz, and 12 periods for power frequencies ≥ 51 Hz and < 80 Hz.

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

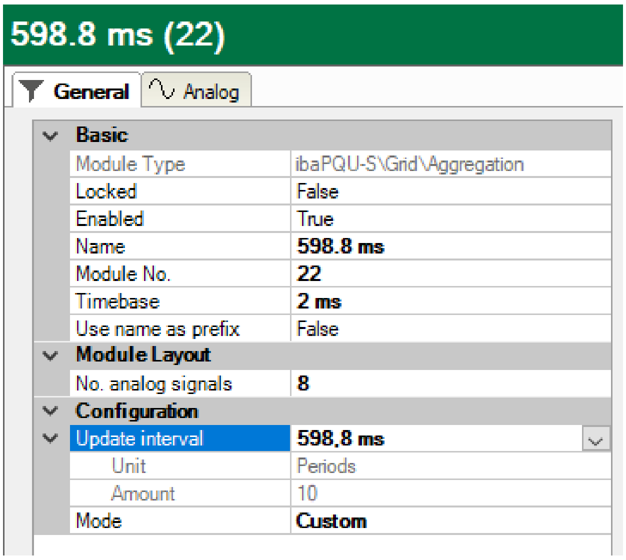
Example:

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.

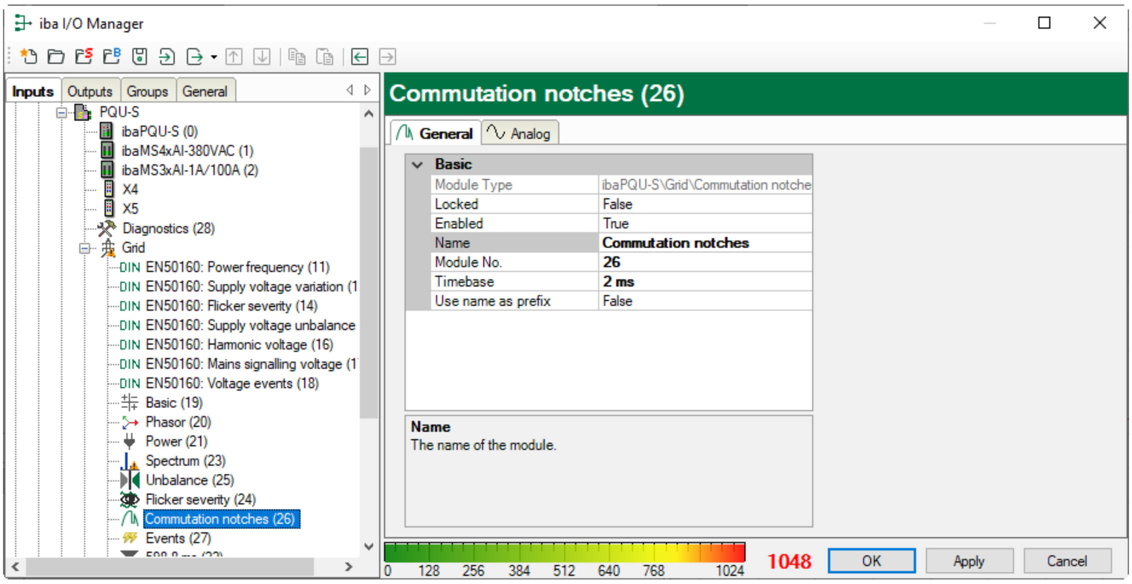


The calculated measurement interval also determines the module name.



10.3.16 Commutation notches submodule

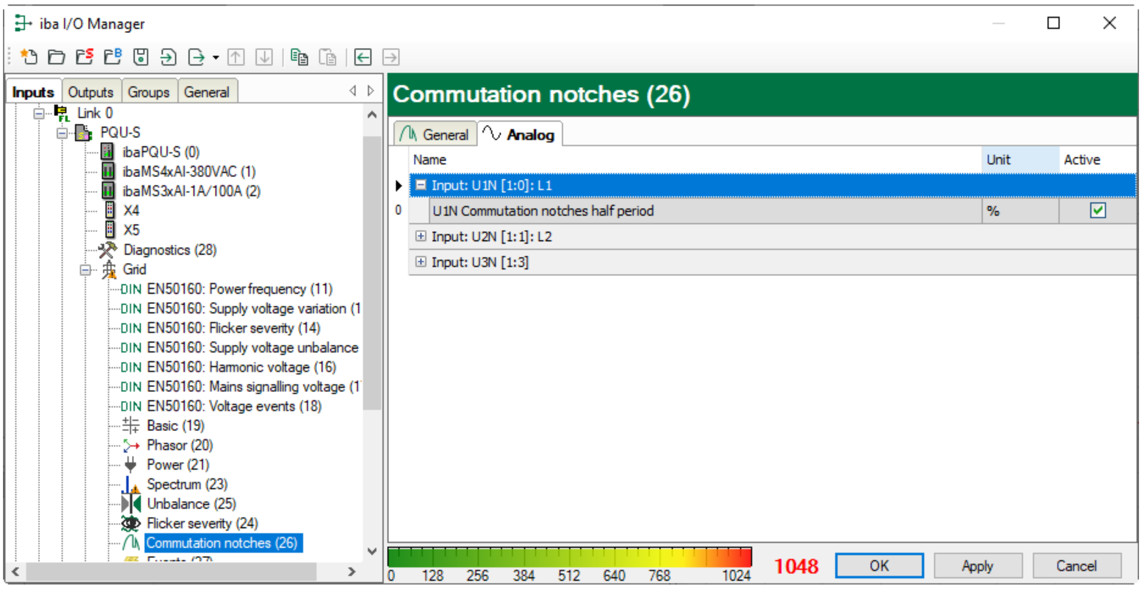
"General" tab



Basic settings

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

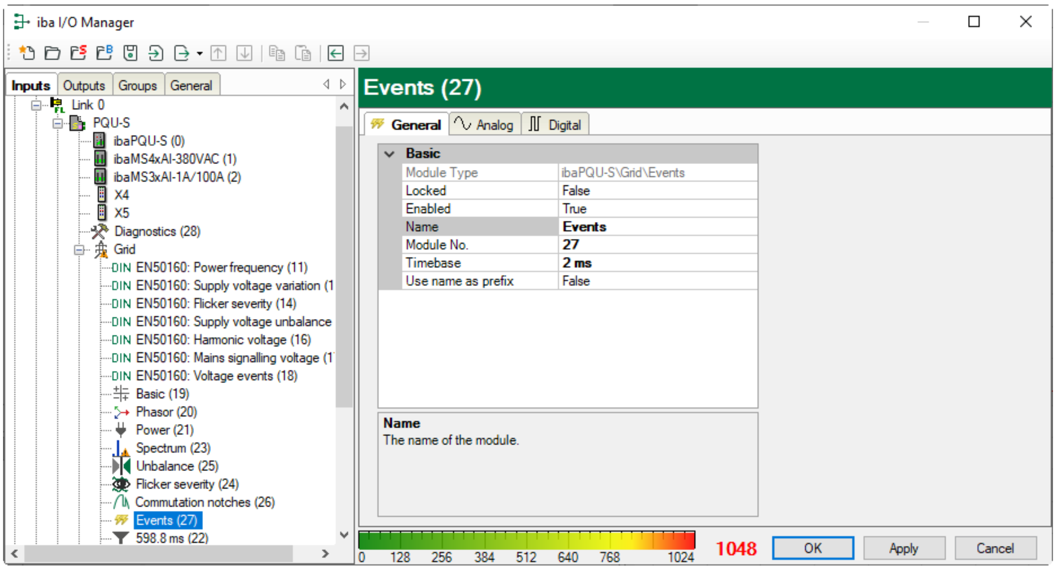
"Analog" tab



❑ Signals: Depth of notch per phase in percent

10.3.17 Events submodule

"General" tab

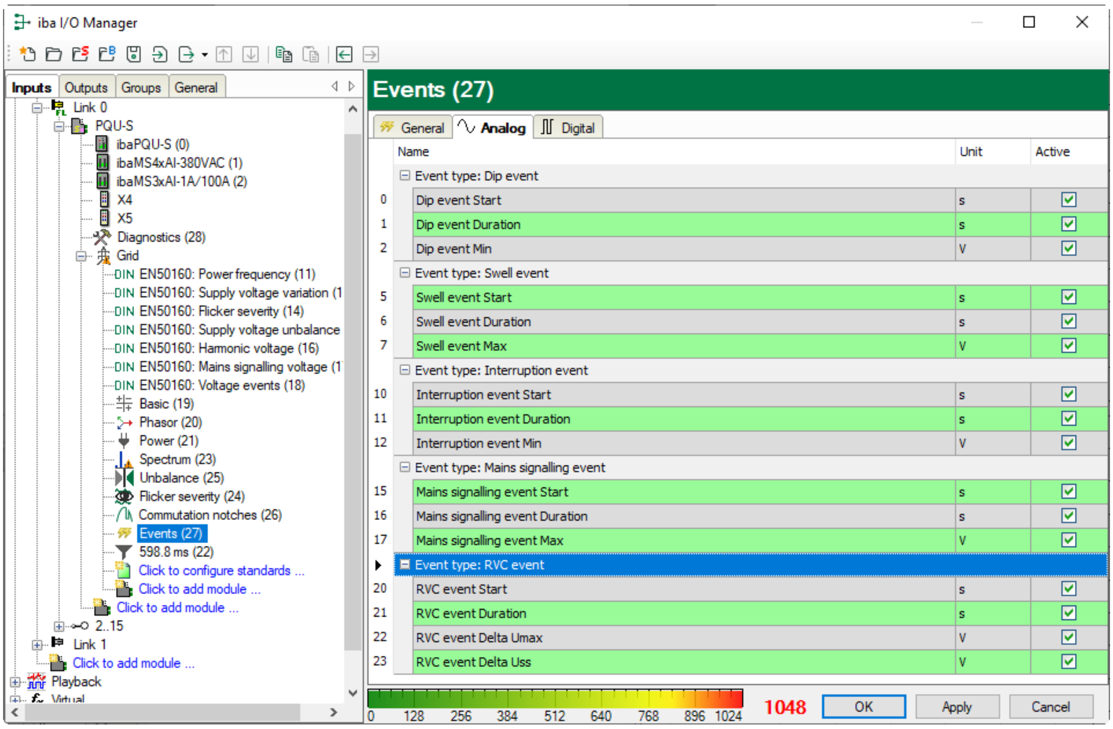


Basic settings

❑ 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".

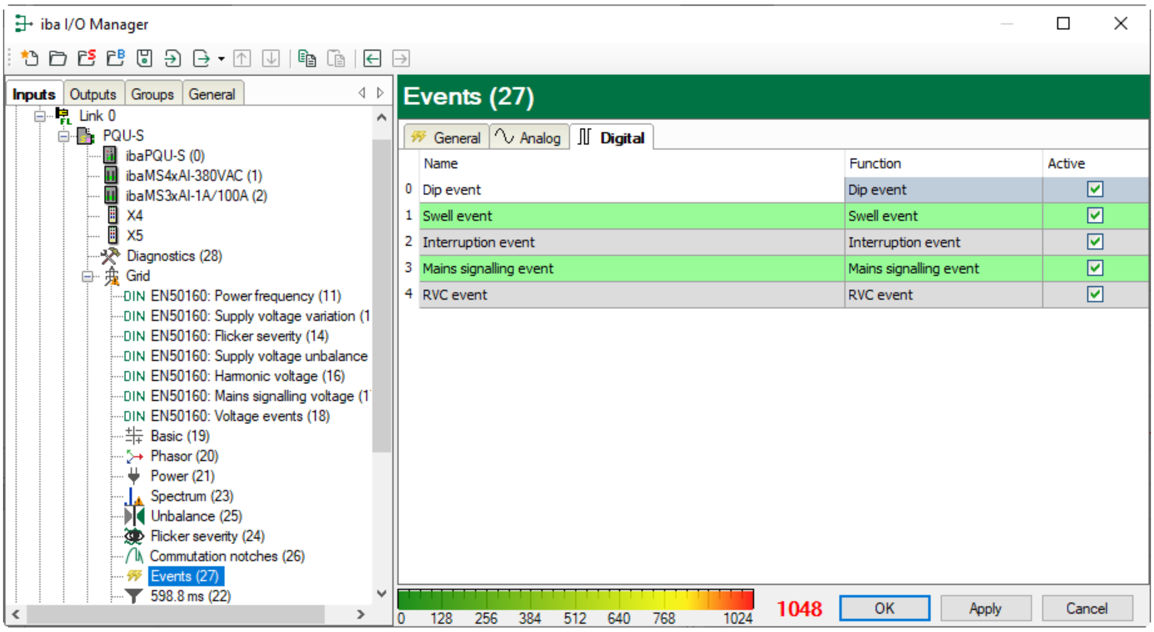
"Analog" tab



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 half period RMS value over 1 second

"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 description	
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 and indicating elements	
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 device 8 LEDs for status of the digital inputs
Operating and environmental conditions	
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
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 µm or 62.5/125 µm; 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 dBm
	200 µm FO cable	-8.5 dBm to -1.5 dBm
Temperature range	-40 °F to 185 °F (-40 °C to 85 °C)	
Light wavelength	850 nm	
Receiving interface (RX)		
Sensitivity[2]	100/140 µm FO cable	-33.2 dBm to -26.7 dBm
Temperature range	-40 °F to 185 °F (-40 °C to 85 °C)	
Additional interfaces		
Ethernet	10/100 Mbit/s	
USB	2x host, 1x device for service purposes	

[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

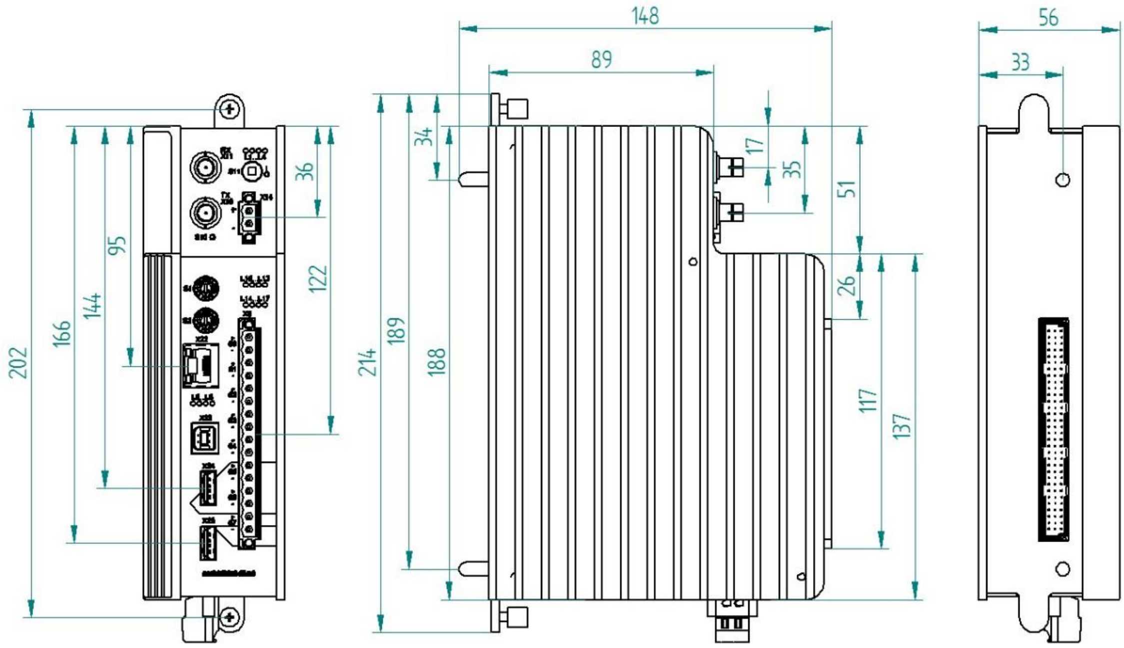
Grid types	1-phase grid, 3-phase grid without N/PE, 3-phase grid with N/PE
Grid frequency	10-80 Hz

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

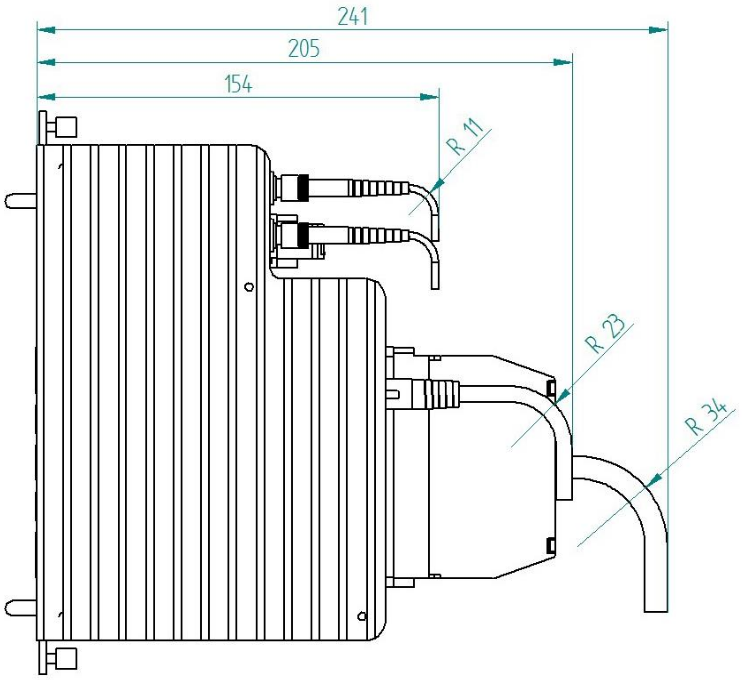
For more detailed information on grid characteristics, please refer to chapter 8.1 ”Grid types” and chapter 8.2 “Signals and calculated characteristic values”.

11.5 Dimensions

ibaPQU-S

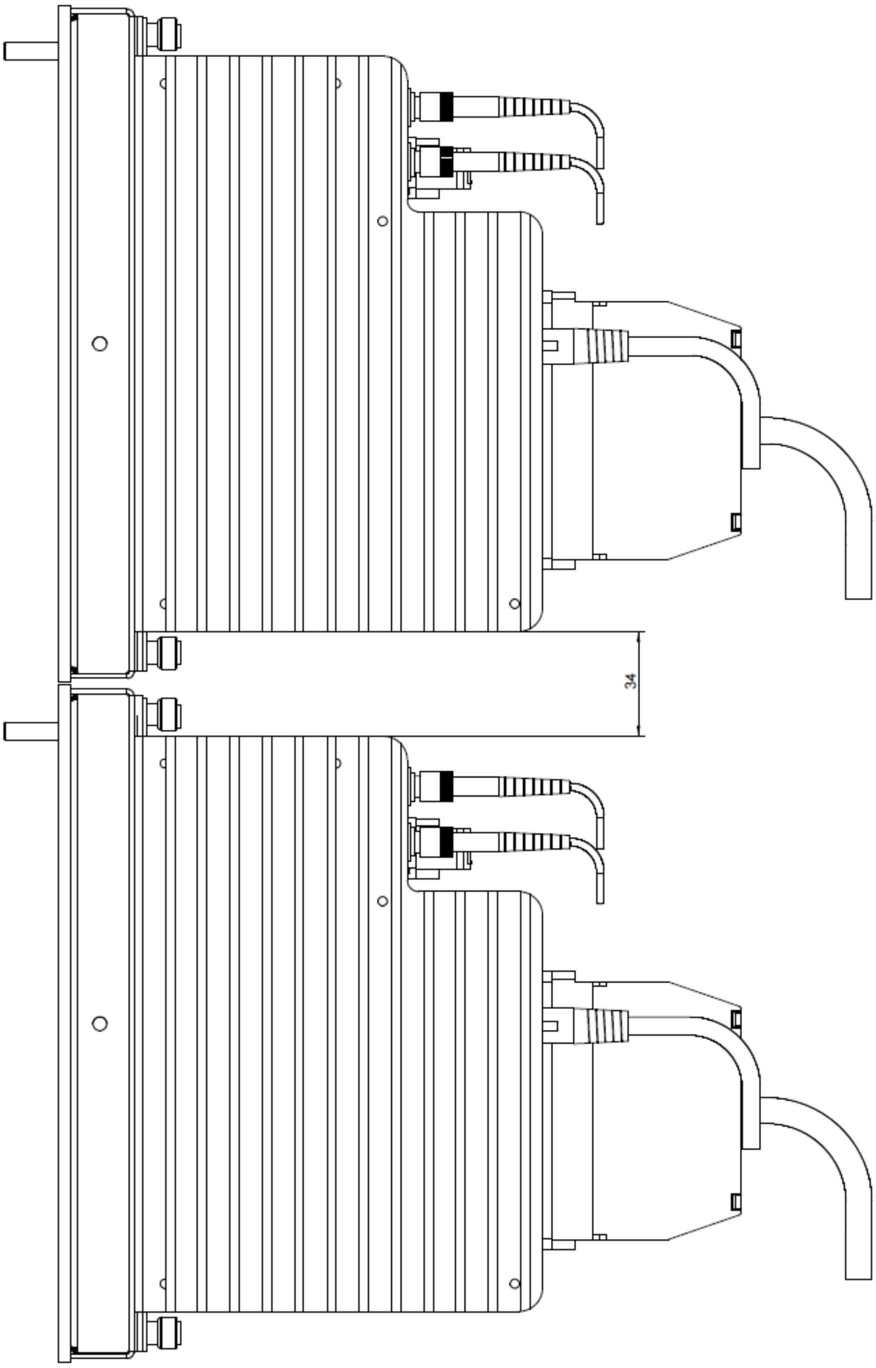


(Dimensions in mm)



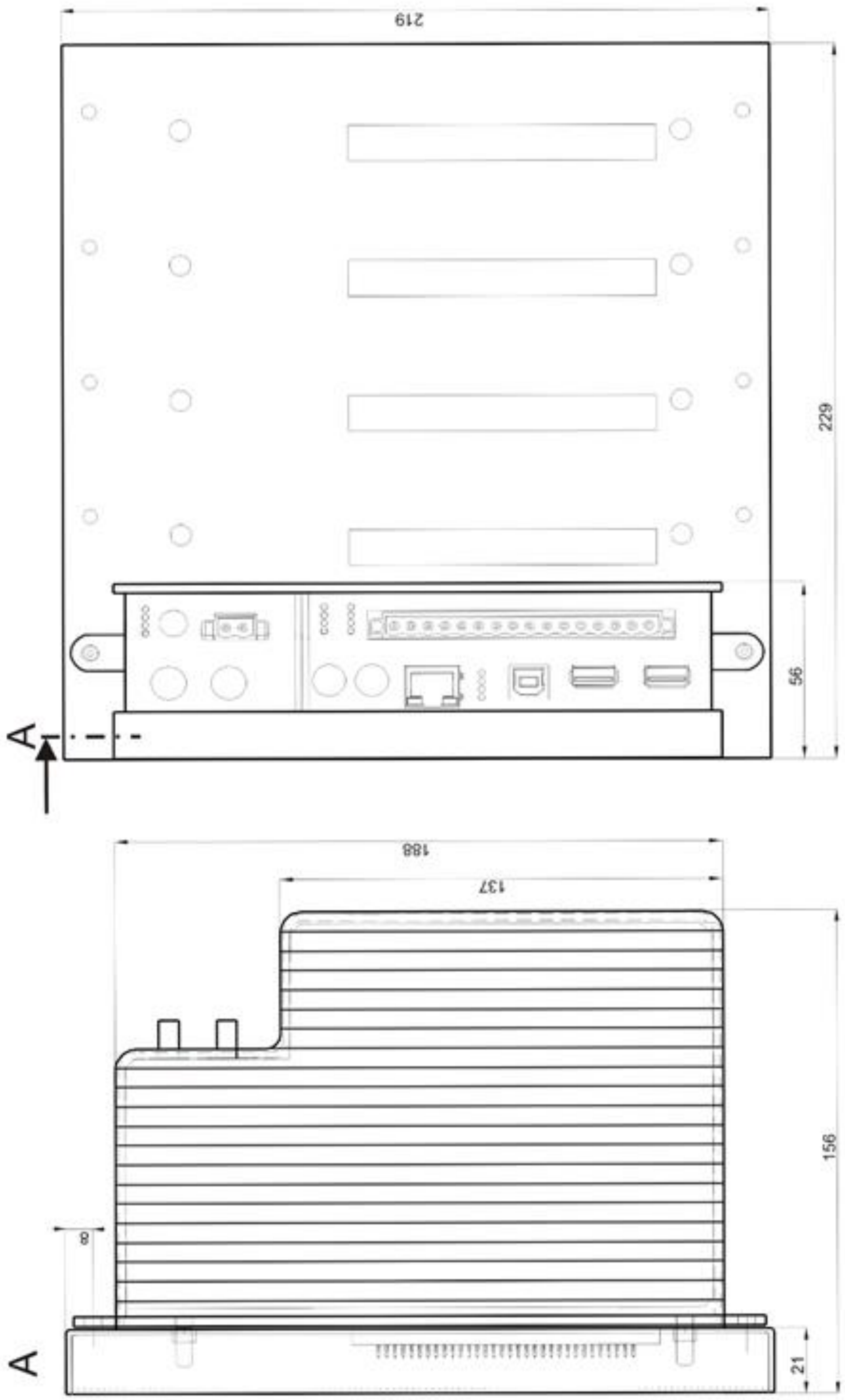
Dimensions of ibaPQU-S with cables (dimensions in mm)

Distance between two ibaPQU-S systems

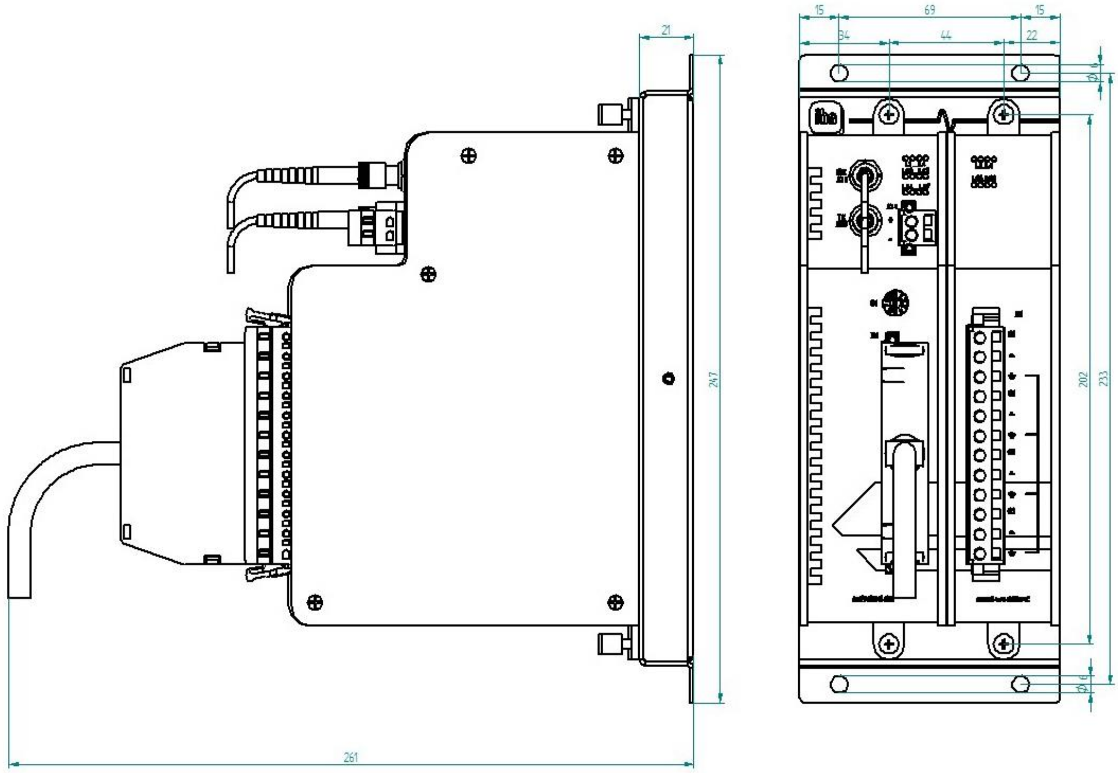


(Dimensions in mm)

ibaPQU-S and backplane



(Dimensions in mm)



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

11.6 Connection diagram

11.6.1 Pin assignment voltage supply X14

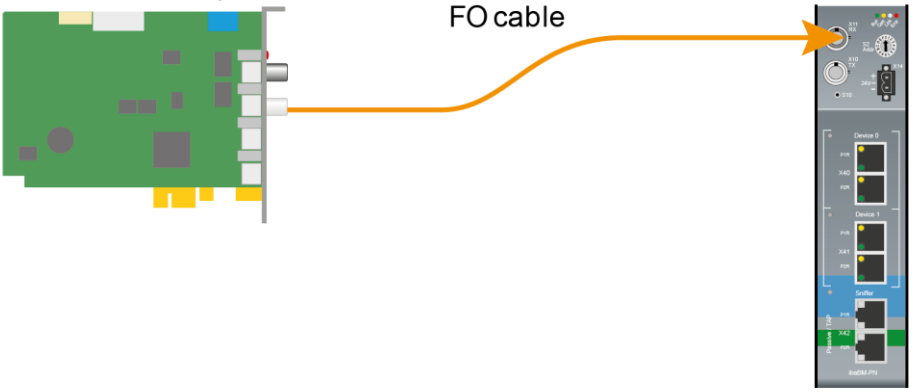
Pin	Connection
1	+ 24 V
2	0 V

11.6.2 Pin assignment digital inputs X5

Pin	Connection
1	Digital input 00 +
2	Digital input 00 -
3	Digital input 01 +
4	Digital input 01 -
5	Digital input 02 +
6	Digital input 02 -
7	Digital input 03 +
8	Digital input 03 -
9	Digital input 04 +
10	Digital input 04 -
11	Digital input 05 +
12	Digital input 05 -
13	Digital input 06 +
14	Digital input 06 -
15	Digital input 07 +
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.



The example refers to a point-to-point connection with an FO cable of type 62.5/125 µm. 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 (l_{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:

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

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

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

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

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

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

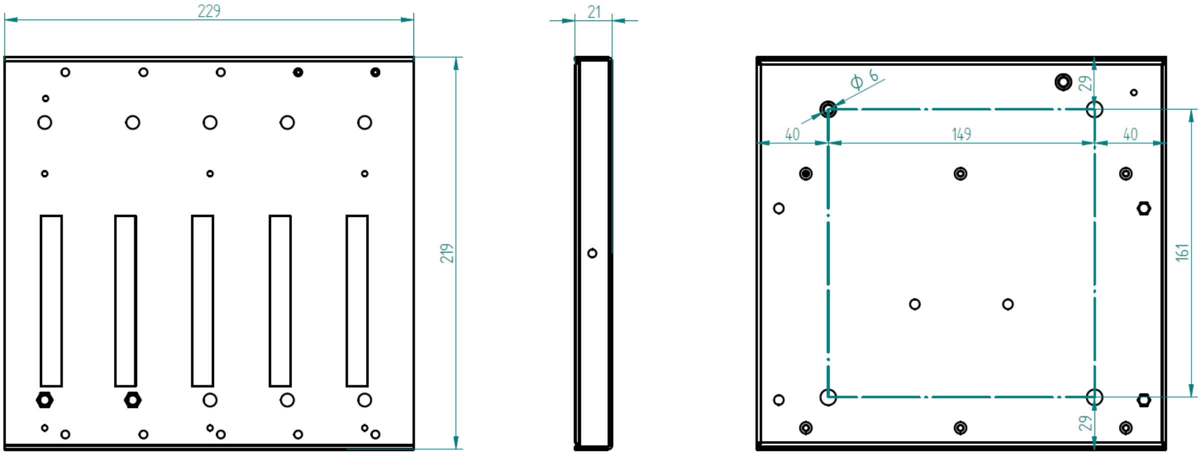
Backplane panel for mounting 1 central unit and up to 4 I/O modules.

12.1.1.1 Scope of delivery

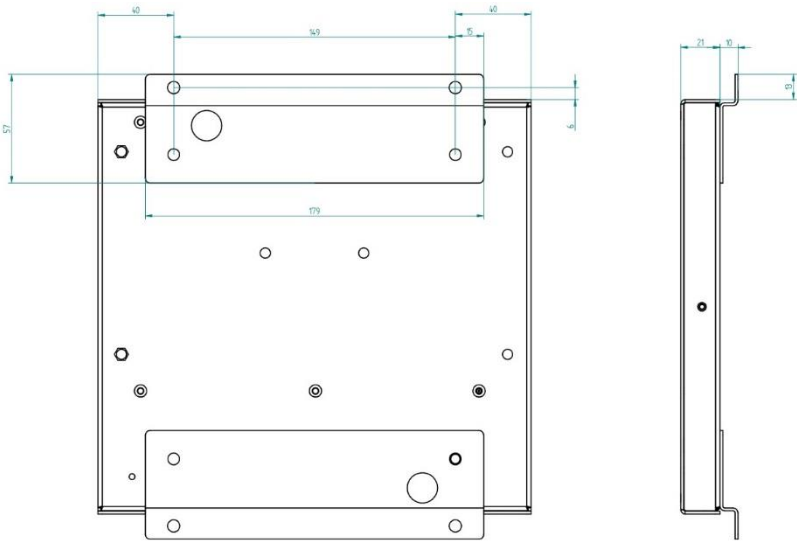
- ❑ Backplane panel
- ❑ Assembly kit

Assembly kit

12.1.1.2 Dimensions



Dimensions in mm



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

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

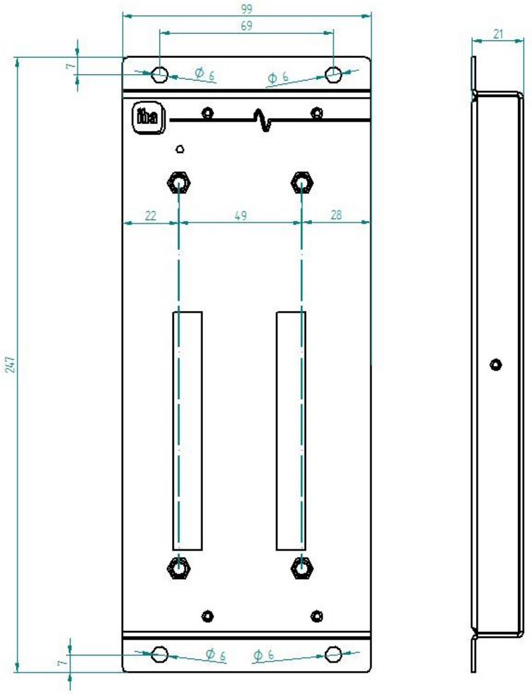
12.1.2 ibaPADU-S-B1S

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

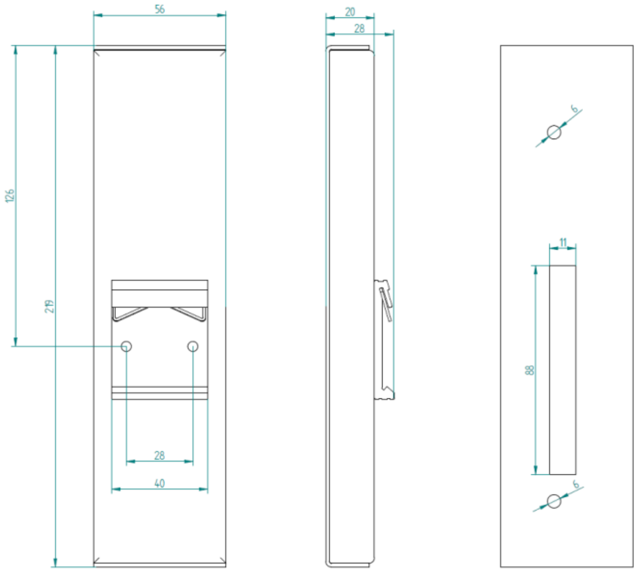
12.2.1 ibaPADU-S-B

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

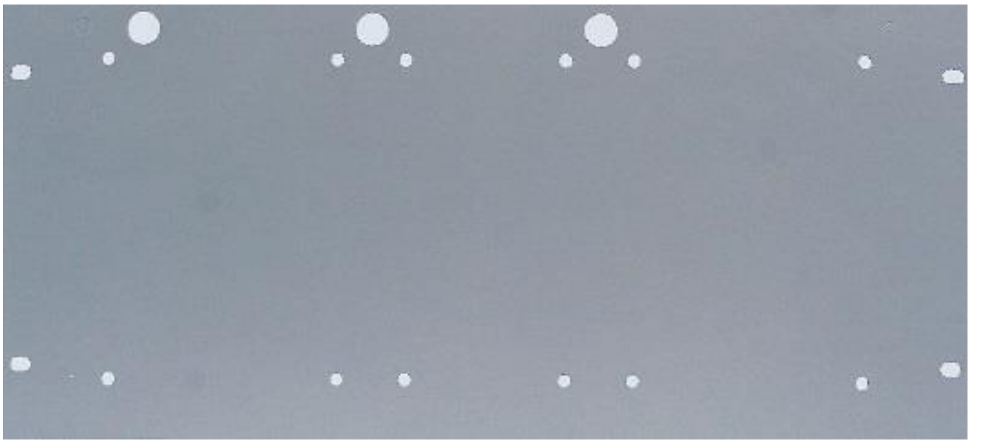
W x h x d: 179 mm x 57 mm x 10 mm

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

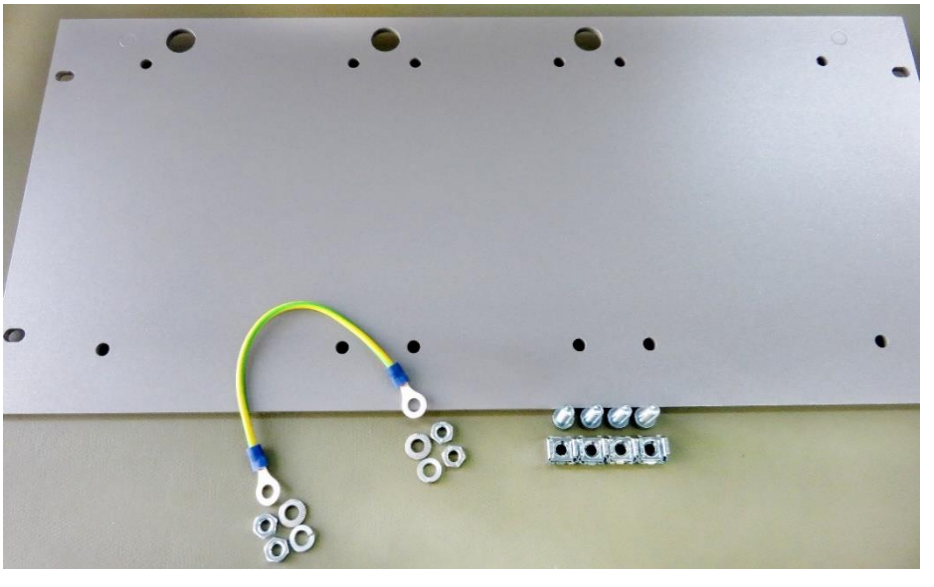
12.3.2 Mounting panel 19“

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



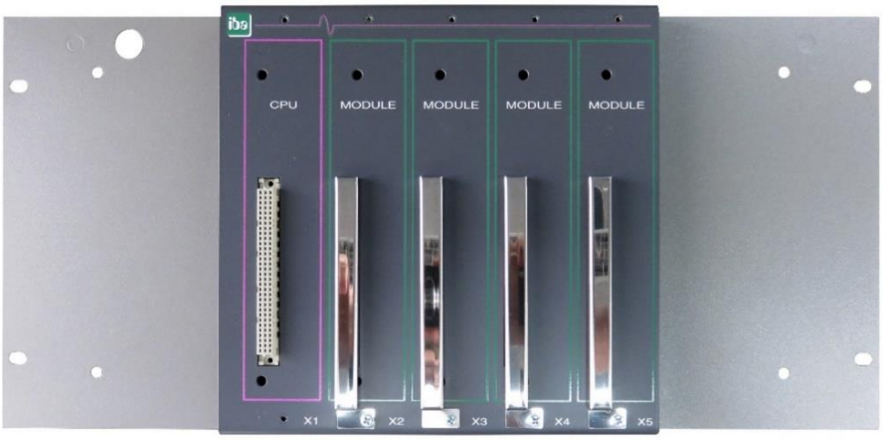
12.3.2.1 Scope of delivery

- ❑ Mounting panel
- ❑ Assembly kit

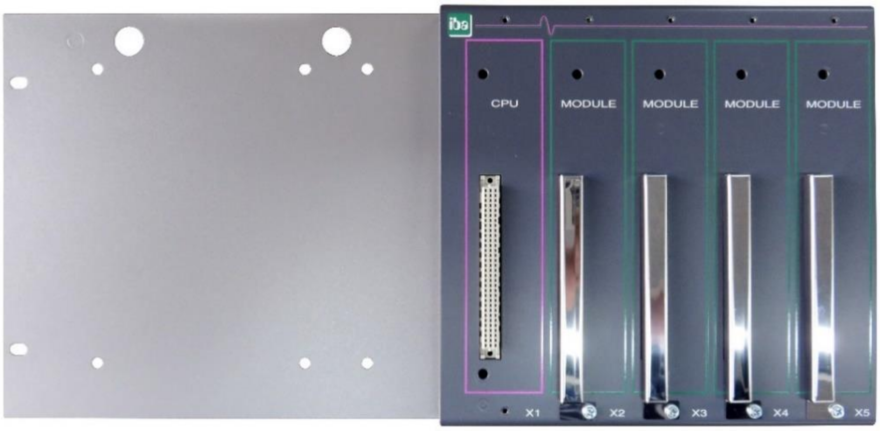


12.3.2.2 Mounting backplane panel

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.

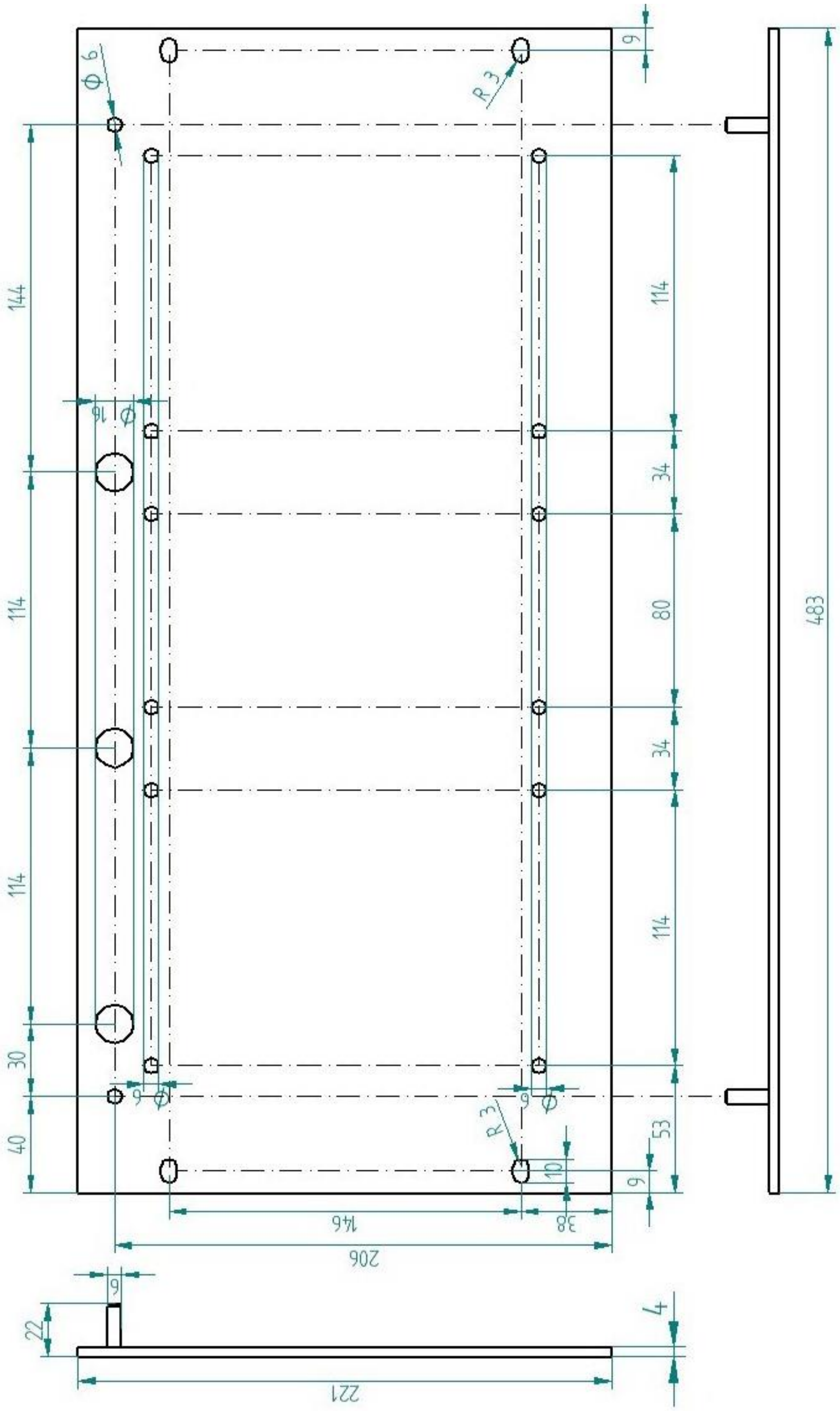


Mounting centered



Mounting on the right

12.3.2.3 Dimensions



Dimensions in mm

12.3.2.4 Grounding

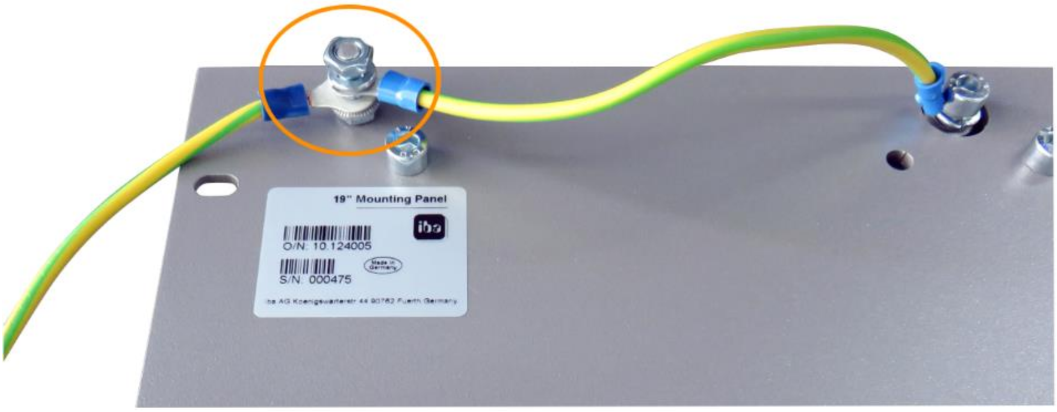
Variation 1:

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.

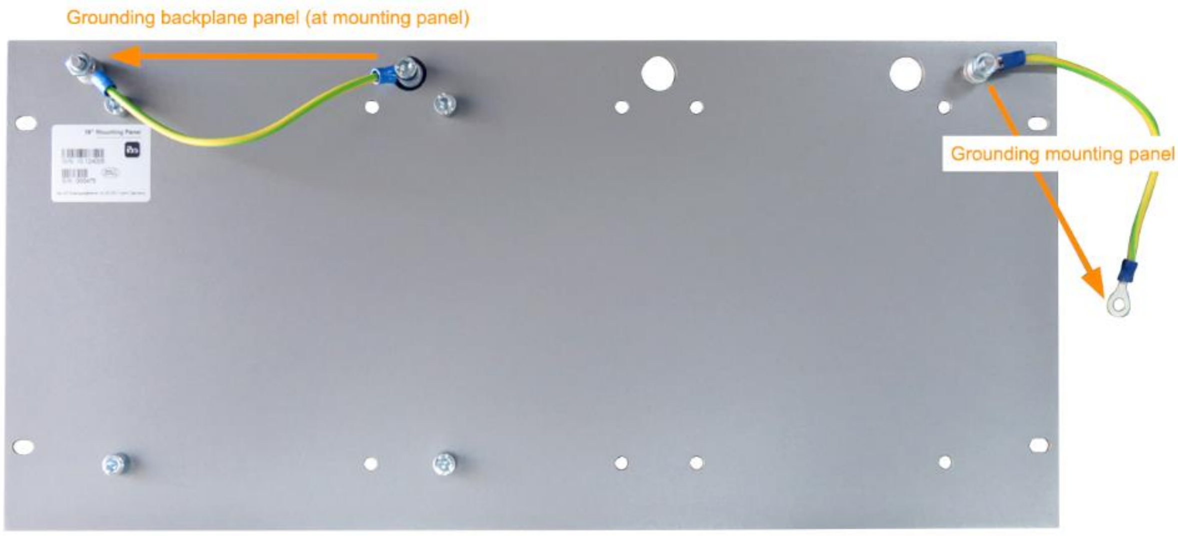
Both grounding cables are attached to the threaded bolt as shown.



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.

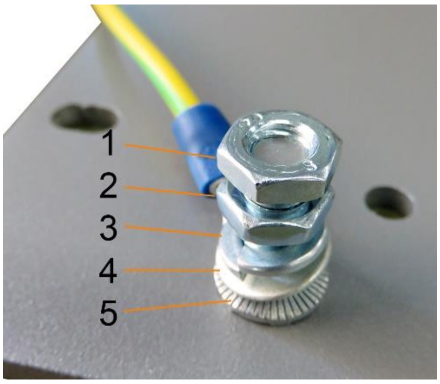


Variation 3:

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
- ❑ Power 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 terminal block WAGO		
Order number	52.000023	

12 pin RM 3.81 terminal block PHOENIX		
Order number	52.000024	

2 pin RM 5.08 terminal block WAGO		
Order number	52.000022	

12.5 I/O modules iba modular system

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
 ibaPDA-1024 ibaPDA-2048	 30.771024 30.772048	Online data acquisition system ibaPDA, license examples: 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

$$U_{peak} = max\,|u(t)| \quad t \in [t_0, t_n]$$

$$I_{peak} = max\,|i(t)| \quad t \in [t_0, t_n]$$

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

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

13.1.10 Power / Energy

- ❑ Two conductors / per phase

Active power

$$P = \frac{1}{t_n - t_0} \int_{t_0}^{t_n} P_x\left(t\right) dt$$

$$P_x\left(t\right) = u_{10}\left(t\right) \cdot i_1\left(t\right)$$

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 φ

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

- ❑ Three conductors

Active power

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

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

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

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

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

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

$$Q_{\varphi\Sigma} = Q_{\varphi 10} + Q_{\varphi 20} + Q_{\varphi 30}$$

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

Total grid: no calculation possible

- Four conductors

Active power

$$P_\Sigma = P_{10} + P_{20} + P_{30} + P_{40}$$

$$P_{40} = U_{40} \cdot I_N$$

$$U_{10} = \tfrac{1}{4}\left(U_{12} + U_{13} + U_{1N}\right)$$

$$U_{20} = \tfrac{1}{4}\left(U_{21} + U_{23} + U_{2N}\right)$$

$$U_{30} = \tfrac{1}{4}\left(U_{31} + U_{32} + U_{3N}\right)$$

$$U_{40} = U_{N0} = -\left(U_{10} + U_{20} + U_{30}\right)$$

$$U_{N0} = \tfrac{1}{4}\left(U_{N1} + U_{N2} + U_{N3}\right)$$

Apparent power

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

Total reactive power

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

Fundamental reactive power

$$Q_{\varphi\Sigma} = Q_{\varphi 10} + Q_{\varphi 20} + Q_{\varphi 30} + Q_{\varphi 40}$$

Distortion reactive power

Per phase: $Q_{D10} = \sqrt{Q_{tot10}^2 - Q_{\varphi 10}^2},\ \ldots$

Total grid:

Power factor

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

Cos φ

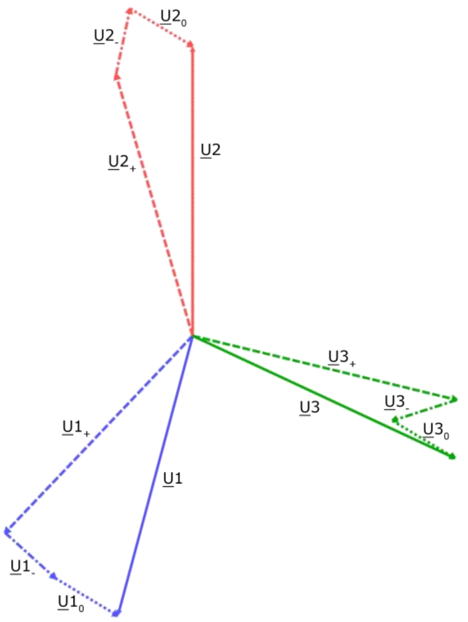
Per phase: $P_{LT} = \sqrt[3]{\frac{\sum_{i=0}^{N-1} P_{st}^3}{N}}$

Total grid: no calculation possible

Neutral conductor current (if physically not available)

$$i_N(t) = -\left(i_1(t) + i_2(t) + i_3(t)\right)$$

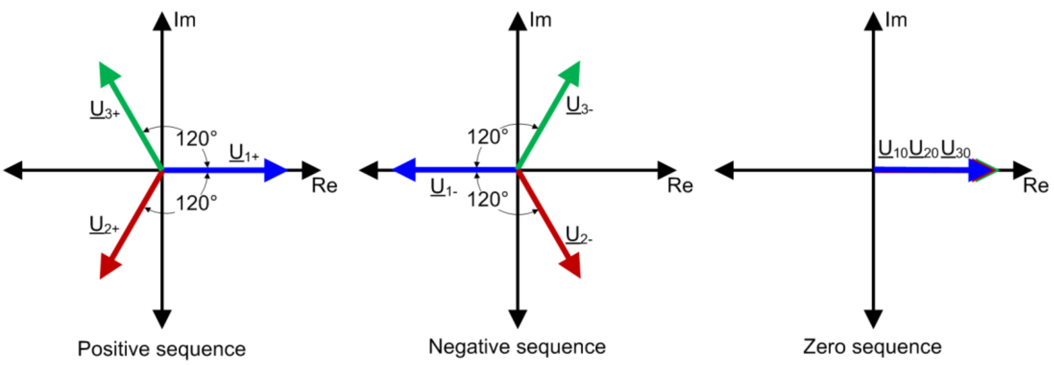
13.1.11 Voltage balance / Unbalance



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#	RMS value of the phase
$U\#_{+}$	Percentage of the positive sequence component
$U\#_{-}$	Percentage of the negative sequence component
$U\#_{0}$	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

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

$\underline{a} = e^{j120°}$

$\underline{a}^2 = e^{j240°}$

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

$$TIF = \sqrt{\sum_{n=1}^{50} (5 \cdot n \cdot f_1 \cdot Factor_n \cdot X_n)^2}$$

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

$$IF\,Square = \sqrt{\sum_{n=1}^{50} Factor_n \cdot X_n^2}$$

$$IF\,Linear = \sum_{n=1}^{50} Factor_n \cdot X_n$$

f_1: Nominal power system frequency (50 Hz or 60 Hz)

$Factor_n$: Weighting factor for $harmonic_n$

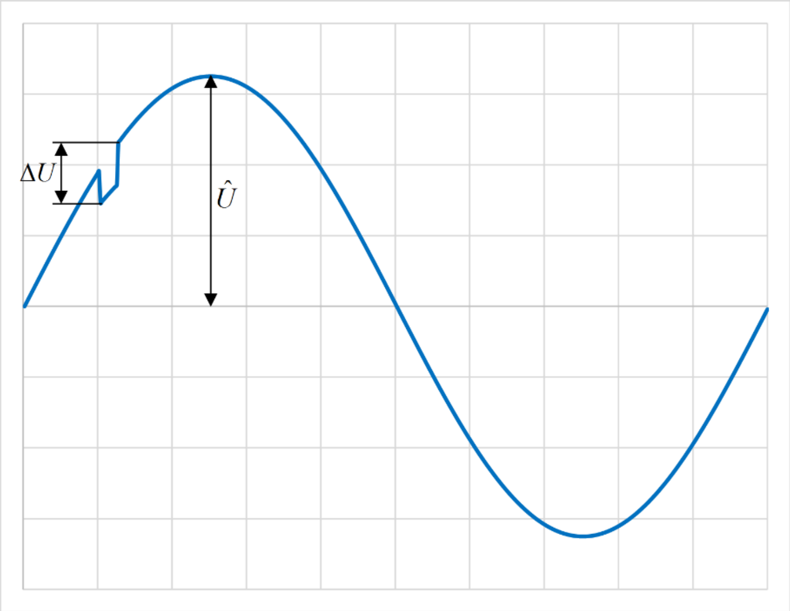
Various methods are available for normalization of X_n

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

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

ΔU= voltage drop

$\hat{U}$= 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.

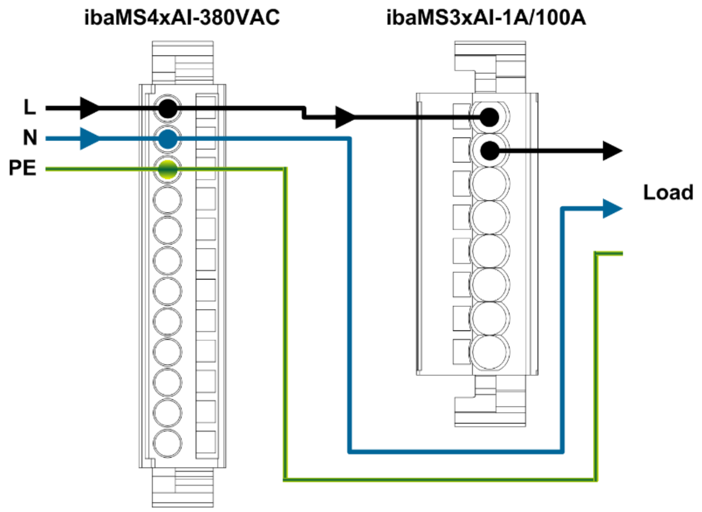
13.2 Connection examples

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

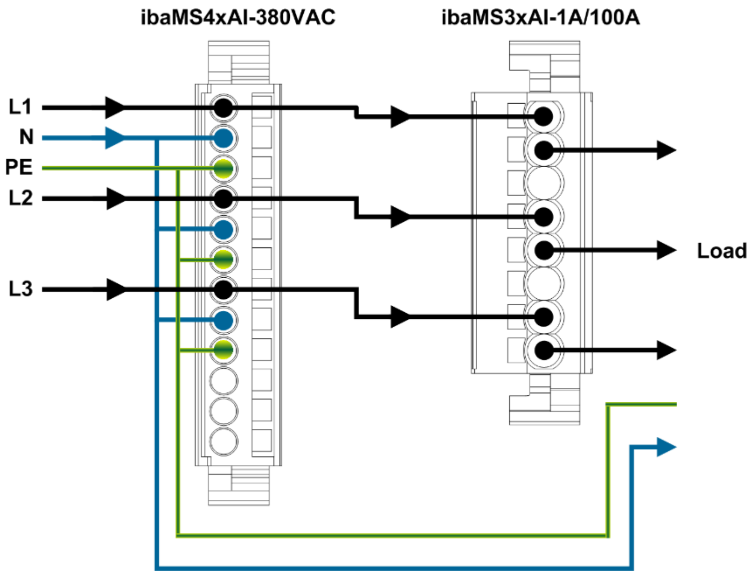
The wiring always needs to be carried out by a qualified electrician in order to guarantee electrical safety.

13.2.1 1-phase



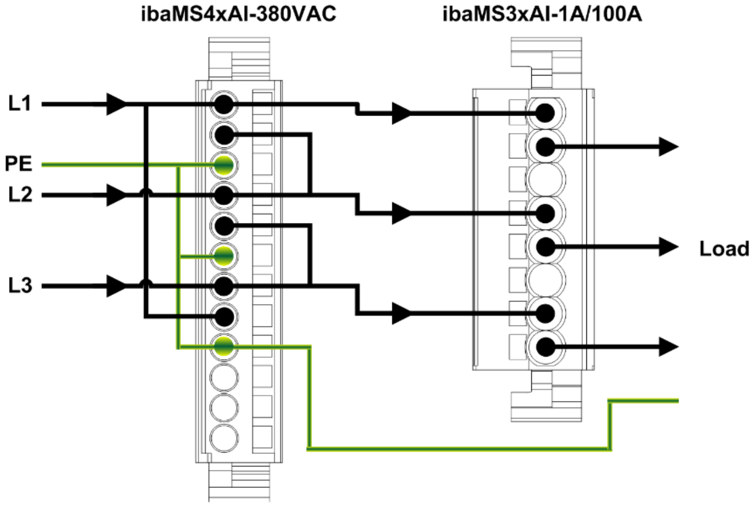
1-phase direct connection

13.2.2 Star connection



Star connection direct connection

13.2.3 Delta connection

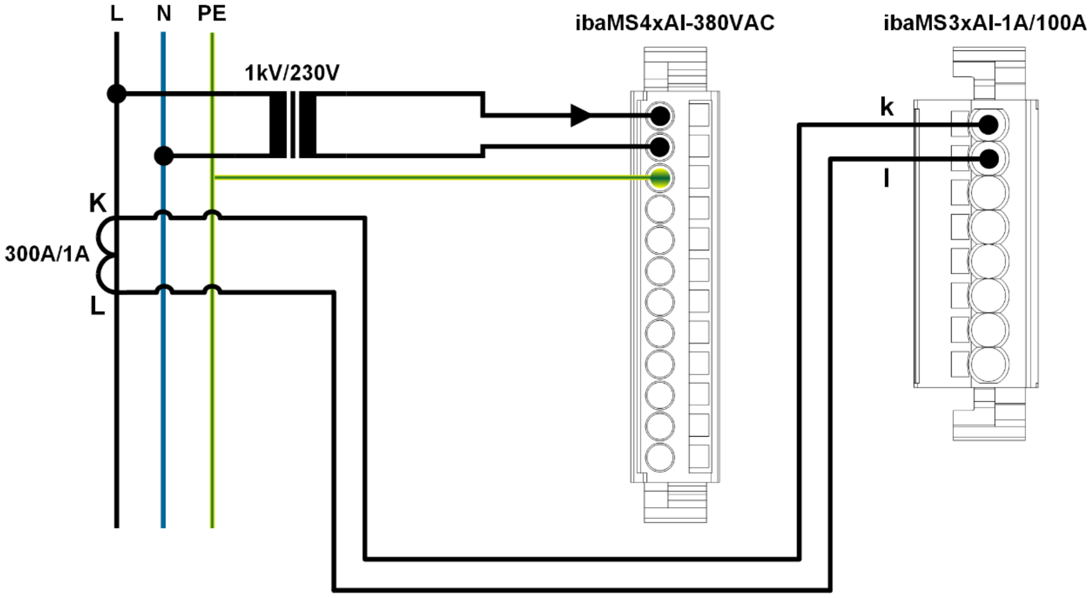


Delta connection direct connection

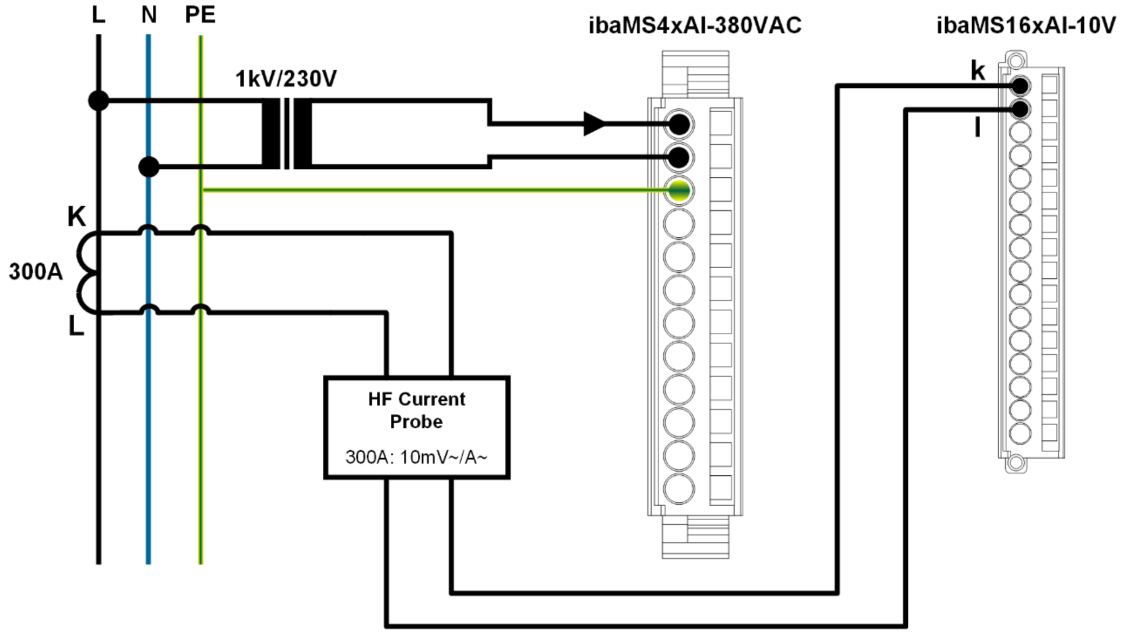
13.2.4 Connection with instrument transformers

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 "l" 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

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15 Certificate

TECHNISCHE UNIVERSITÄT DRESDEN

IEEH

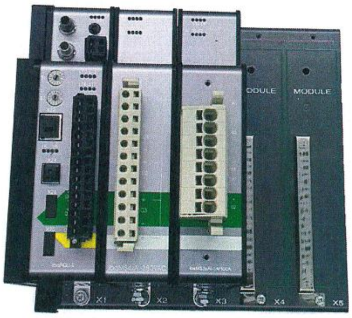
Institute of Electrical Power Systems and High Voltage Engineering

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



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.

Tested by	Reviewed by:	Confirmed by
Dipl.-Ing. Robert Stiegler	Dr.-Ing. Jan Meyer	Prof. Dr.-Ing. Peter Schegner

Dresden, 01.03.2017

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16 Support and contact

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Note

If you require support, specify the serial number (iba-S/N) of the product.

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