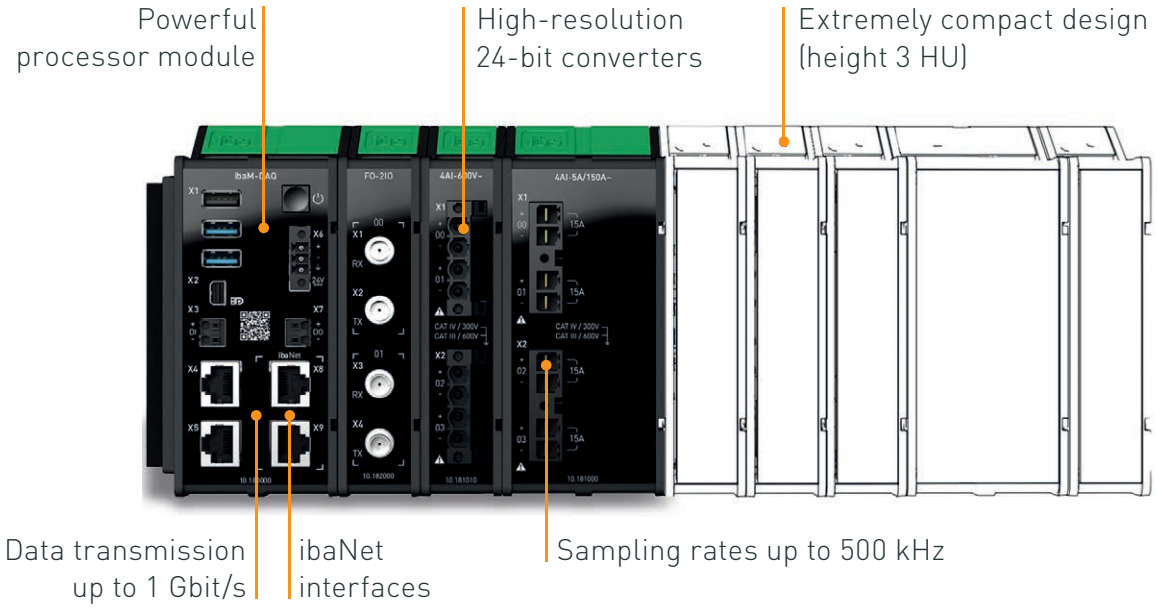
ibaMAQS

**Modular measurement system –
Acquire and analyze signals
synchronously and precisely**

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

Precise acquisition of processes with the innovative measurement system ibaMAQS

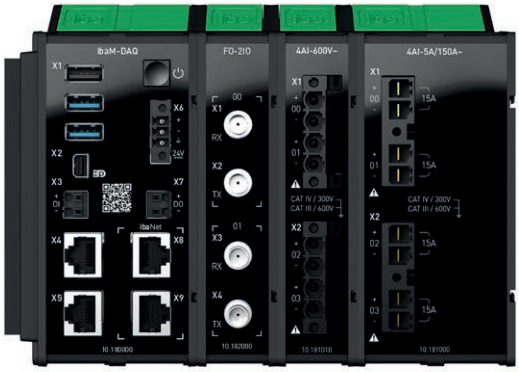
With the ibaMAQS modular system, iba has raised the bar in the field of measurement technology. This flexible system enables user-specific solutions and is both scalable and perfectly tuned for demanding tasks. It impresses with extremely easy handling, 24-bit resolution, calibrated A/D converters, individual electrical isolation per channel and fast, synchronous data acquisition.



At a glance

- Modular system for the acquisition and processing of measurement signals
- Deterministic acquisition of different data types, such as sensor, machine, vibration, energy data, etc.
- Decentralized, local and synchronous data acquisition
- High-precision synchronization with ibaNet
- Suitable for direct acquisition from machines
- Quick module change, DIN-rail mounting
- In the final state, a wide range of modules can be combined as required
- Data transfer over Ethernet with standard network components

Maximum flexibility for diverse applications



Modular concept

The ibaMAQS modular measurement system can be perfectly adapted to the requirements of different measurement applications. The system offers the greatest possible flexibility coupled with exceptional technical innovations.

One processor module can be combined with up to 15 different I/O modules. Modules are available for discrete input and output signals as well as for special technological features.

At the same time, the system can be flexibly extended at any time as requirements grow. The scalable system thus offers a high level of investment security and meets the most challenging requirements.

Universal processor module that can be used as an edge device

The ibaM-DAQ processor module is an extremely compact ibaPDA system that can function as a stand-alone device. Thanks to its compact design, ibaM-DAQ is ideal for use close to the process or plant – and wherever only limited space is available. In addition to the synchronous acquisition and storage of the measurement data, ibaM-DAQ is able to aggregate the data and calculate characteristic values on-board. These characteristic values can also be stored locally or forwarded to other systems. Thanks to the numerous network interfaces, ibaM-DAQ can be integrated into any IT structures.

Technology-specific solutions can be realized in combination with other iba applications, such as ibaInSpectra or ibaInCycle, whereby ibaM-DAQ assumes an important role as an edge device. For detailed information, please refer to page 10.

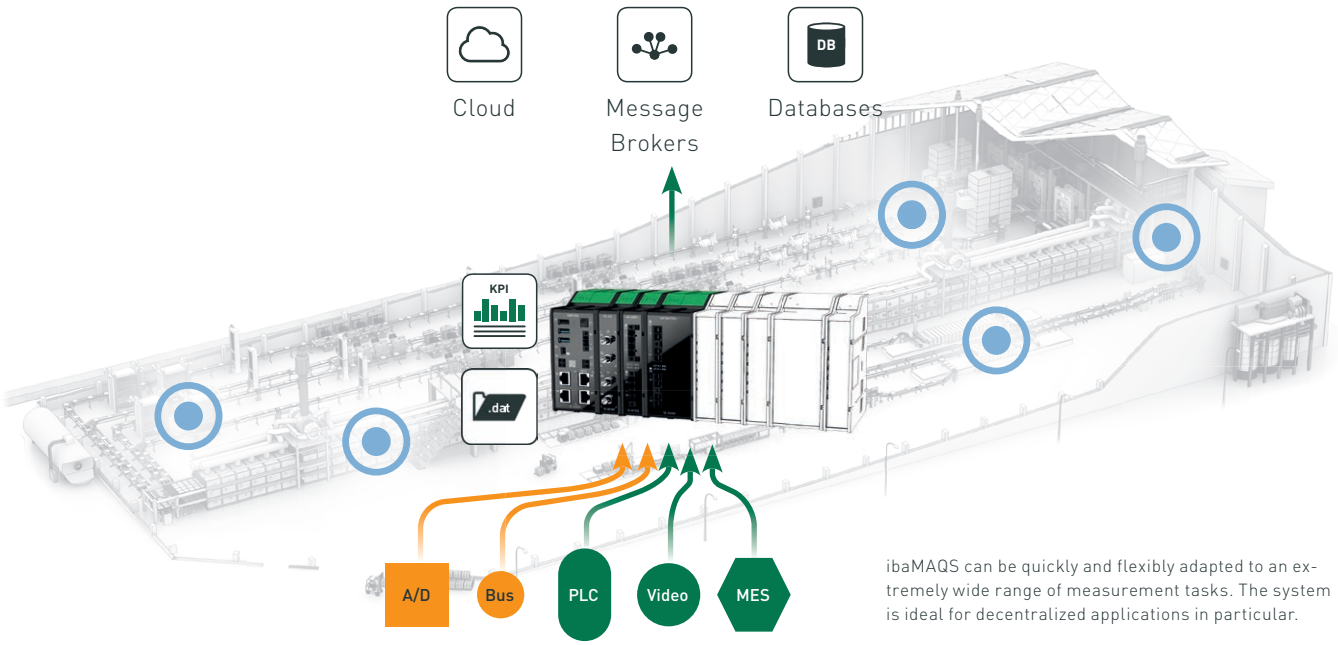
With the ibaM-FO-2I0 interface module you can couple additional iba devices via fiber optics and thus continue to integrate your existing iba systems. The 32Mbit Flex and 32Mbit ibaNet protocols are supported.

Deterministic, highly synchronous data acquisition

A significant advantage of the ibaMAQ system is the deterministic and highly synchronous measurement data acquisition of the different signal sources. The interface module ibaM-FO-2I0 acts as internal clock generator and thus ensures a highly precise acquisition of measurement data.

Typical use cases

- Decentralized measurement data acquisition for local applications, e.g., test stands, injection molding machines, small plants, etc.
- Measurements on mobile equipment, e.g., cranes, special vehicles, etc.
- Measurement applications in electrical power engineering: TFR, PQU
- NVH measurement
- Vibration analysis
- Coupling of highly dynamic sensor data



ibaMAQS can be quickly and flexibly adapted to an extremely wide range of measurement tasks. The system is ideal for decentralized applications in particular.

Synchronous acquisition is not only possible via fiber optics, but also via Ethernet with the ibaNet protocol ibaNet-E. If the ibaNet-E devices are then connected via the ibaNet interfaces, highly synchronous data acquisition is possible, which is required for example for fast TFR applications and applications in the energy sector.

Specific modules extend the scope of functions

In the course of the expansion of ibaMAQS, additional I/O modules, bus sniffers as well as special technology modules will be added step by step, which will continuously extend the system's application spectrum.

Communication module for standard applications

The ibaM-COM communication module is available for applications which do not require local measured value processing and recording. It is used instead of the processor module and allows to transmit decentrally acquired measured values to central ibaPDA systems deterministically in time via Ethernet (ibaNet-E). Several decentralized systems can be acquired synchronously with a common sampling frequency.

An output from a central ibaPDA system via decentralized distributed I/O systems is also possible. The configuration is performed uniformly from the central ibaPDA system (plug and play).

When using the communication module, no processor module is required.

Wide range of modules

The I/O modules of the system will cover all important signal types in the final state, such as analog and digital inputs and outputs, counter inputs and vibration signals. Special modules for acquiring measurements from current and voltage transformers are available for medium and high-voltage technology applications.

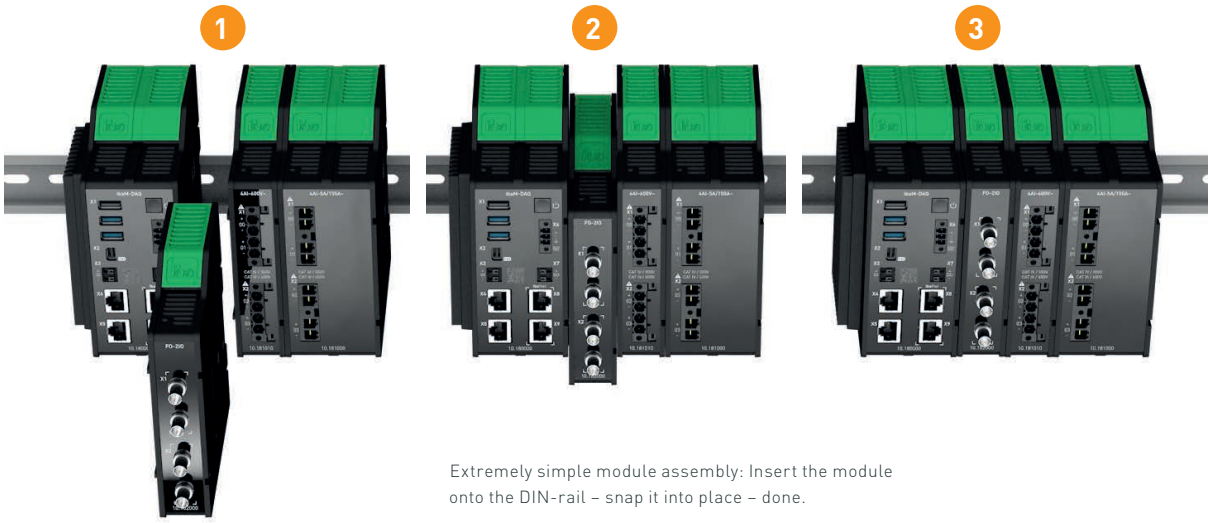
The number of measuring channels per module is deliberately kept small to ensure optimum scalability.

Data exchange in all directions

In addition to the hardware modules, ibaMAQS offers a wide range of Ethernet-based communication protocols for use with the ibaM-DAQ processor module. Thanks to the integrated ibaPDA software, both ibaNet and standard Ethernet interfaces are available.

Using a variety of different protocols, the latter enable data exchange with most PLC and automation systems as well as with a number of databases, cloud providers and message brokers. ibaM-DAQ can both send and receive data. Standard protocols such as OPC DA, OPC UA, SNMP, TCP, UDP, MQTT and other cloud interfaces cover virtually all requirements.

Special protocols, such as IEC 61850 for intelligent protection devices in power engineering, enable data acquisition in industry-specific systems. Manufacturer-specific protocols are also available for communication with selected measurement systems, e.g., temperature scanners, 3D scanners, etc.



Extremely simple module assembly: Insert the module onto the DIN-rail – snap it into place – done.

High-precision acquisition

With a resolution of 24 bits for A/D conversion, the I/O modules are also equipped for very demanding measurement tasks. In addition, the modules offer calibrated A/D converters and galvanically isolated channels. All channels are sampled in parallel and synchronously; the sampling rate can be freely set up to 500 kS/s for some modules.

For more information on the modules, see page 15.

Smart mechanics

ibaMAQS combines high functionality with an innovative mechanical concept in an extremely compact design. During development, the focus was on ensuring easy handling and quick mounting or replacement of the modules.

The modules are simply plugged onto a DIN-rail and are immediately mechanically and electronically connected thanks to the innovative module connection technology. The integrated lever can be used to release the connection again and to remove or replace the module.

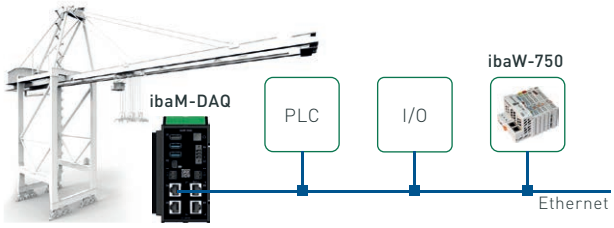
The order of the modules does not matter. The only requirement is that one processor or communication module must always be located on the left at the start of each row – it really couldn't be simpler. Easy assignment and readability of the channels is ensured thanks to the clear labeling as well as the status and diagnostic displays. Depending on the module, errors such as broken wire or short circuit are also displayed.

1 Operating status

2 Channel status

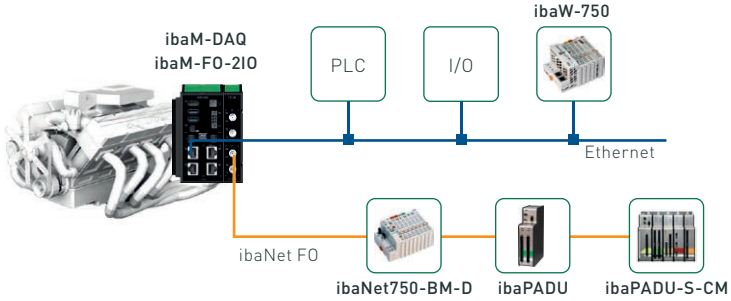
Clearly arranged multi-color LED light bands indicate the operating status of each module and the channel status for each channel.

Application examples



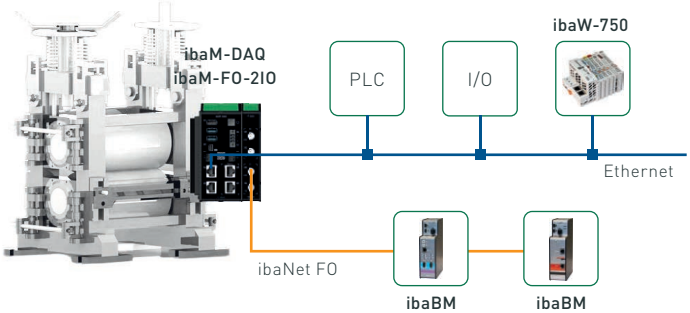
Data acquisition on mobile plants

- Applications with Ethernet-based I/Os
  - Standard Ethernet protocols
  - ibaNet-E
- Use of existing network infrastructure
- Direct access to different control systems
- Connection to the WAGO 750 I/O system via ibaW-750
- Internal recording and KPI calculation
- Applications in cranes, locomotives, special-purpose vehicles



Local acquisition of fast signals

- Applications with Ethernet-based I/Os as above
- Connection of existing iba devices by means of ibaM-FO-2IO via ibaNet FO with the 32Mbit and 32Mbit Flex protocols
- Sampling rates of up to 100 kHz via FO, depending on the iba device
- Applications on test benches, special-purpose machines, in the energy sector, etc.



Connection of classic iba bus monitors

- Applications with Ethernet-based I/Os as above
- Connection of existing iba bus monitors by means of ibaM-FO-2IO via ibaNet FO with the 32Mbit and 32Mbit Flex protocols
- Applications for small to medium-sized plants with fieldbus structures

ibaNet-E – the deterministic protocol for isochronous acquisition

For data acquisition over Ethernet, iba has specially developed the ibaNet-E transmission protocol. It enables fast, efficient and deterministic communication between the acquisition computer and other components involved.

You can use your cost-effective standard Ethernet cabling and standard network infrastructure for data communication. Complex, special fiber-optic cabling is no longer required with the new system.

With ibaNet-E, different applications can be realized, such as data acquisition from multiple data sources and distribution of the data to different acquisition systems to create redundancy. Multiple connections per device with different sampling rates enable the simultaneous connection of different acquisition systems; for example, at the production and control level.

ibaNet-E at a glance

- Automatic device detection
- Module configuration via ibaPDA
- Deterministic transmission of measurement data
- Use of the (existing) Ethernet infrastructure
- Transmission bandwidth max. 1 Gbit/s (device-dependent)
- Scalable in terms of cost and performance
- Transmission of buffered data
- Synchronized sampling; (relative) time synchronization of ibaPDA over Ethernet
- Support of virtual machines

Fast transmission

The transfer rate over Ethernet is significantly higher than via ibaNet fiber optics, which max out at 32 Mbit/s. Depending on the infrastructure, up to 1 Gbit/s can be achieved over Ethernet.

ibaNet-E supports two deterministic acquisitions. Synchronous sampling up to 1 ms is possible with ibaNet-E via standard components, even up to 1 µs via the ibaNet interfaces.

Integration in ibaPDA

You can conveniently configure the system in the ibaPDA software – either at the processor module itself or at a network computer. A novel device-search feature enables automatic detection if the device is located in the same LAN as the ibaPDA computer.

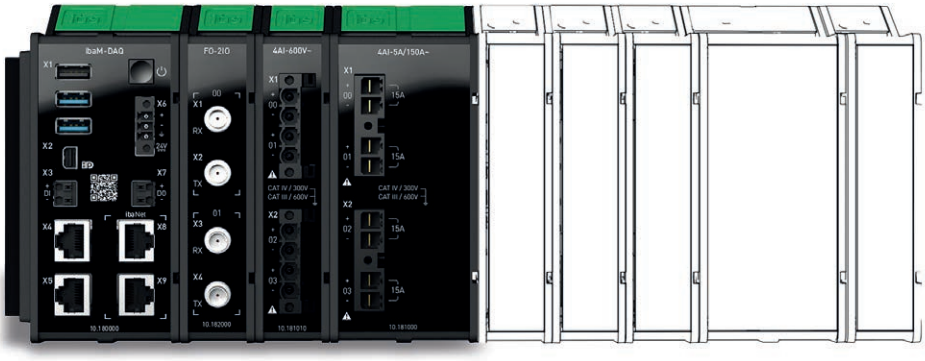
ibaPDA synchronizes all devices connected to it with an accuracy of up to one microsecond, thus enabling isochronous measurement of several decentralized, distributed I/O systems over Ethernet.

Diverse range of modules

The ibaMAQS system offers a wide range of different modules to meet the requirements of a broad range of applications.

The following modules are already available: ibaM-DAQ, ibaM-COM, ibaM-FO-2IO and the I/O modules ibaM-4AI-600V-AC, ibaM-4AI-5A-150A-AC and ibaM-4AI-IEPE.

Subsequently, additional I/O modules as well as interface and technology modules are scheduled.



The modules at a glance

Processor, communication module	I/O modules	Infrastructure
› ibaM-DAQ	› ibaM-4AI-5A-150A-AC	› ibaM-FO-2IO
› ibaM-COM	› ibaM-4AI-600V-AC	› ibaN-2E
	› ibaM-4AI-IEPE	
	› ibaM-4AI-UI	
	› ibaM-4AI-150V-AC	
	› ibaM-8DI	
	› ibaM-2DI-CNT	
	› ibaM-8DO	
	› ibaM-4AO	

(available, planned)

A	analog	O	output
D	digital	UI	voltage/current
I	input	CNT	counter

ibaM-DAQ

- Intelligent processor module for stand-alone data acquisition
- Local data acquisition with full ibaPDA functionality
- Data storage in the device
- Data transfer over Ethernet
- Extremely compact design for on-site installation
- Extensive process and output connectivity
- Automatic calculation of meaningful KPIs within the device
- ibaPDA basic license for 64 signals included, upgrade possible

High-precision measurement – autonomous and flexible

The ibaM-DAQ processor module offers an integrated ibaPDA system, a powerful CPU and hard disk for storing the measurement data, as well as two interfaces each for standard Ethernet and ibaNet-E.

With its independent 1 Gbit/s Ethernet interfaces, ibaM-DAQ can be connected to two independent networks. This allows ibaM-DAQ, for example, to connect to the IT business networkand the PLC network. ibaNet-E-capable devices can be integrated via the ibaNet interfaces, separate from the standard Ethernet.

Operation and configuration as on the PC

A monitor, mouse, and keyboard can be connected to ibaM-DAQ and can be operated as conveniently as an ibaPDA system running on a PC. Moreover, they can also be operated from an ibaPDA client connected via the network.

Users can easily configure their measuring task in the software – and can use the full scope of ibaPDA functions. The data recording can start automatically with the acquisition or be controlled by trigger signals.

Data storage in the device

An internal SSD provides local storage for recorded data. If required, disk space can be expanded by connecting an external hard drive to the USB interface or to a NAS. Recorded data can be transferred via a network connection and can be further processed and analyzed with the license-free ibaAnalyzer software – independently of ibaM-DAQ.

Time synchronization

For global time synchronization, all time sources supported by ibaPDA (DCF77, PTP) as well as NTP can be used. The time is buffered by means of an internal battery.

Monitoring and alarm

A digital input and output are available on the processor module. The latter can be configured as an alarm output, for example. The input can be used to initiate a safe shutdown of the device, for example, from a back-up battery digital signal.

Use of additional iba devices via fiber optics

The ibaM-FO-2I0 module offers the functionality of the proven ibaFOB-io boards and supports the 32Mbit Flex and 32Mbit ibaNet protocols. If corresponding iba devices are already available or if no suitable ibaMAQS modules are available for certain tasks, then devices like the ibaPADU family, iba bus monitors or system interfaces can be connected to ibaMAQS via the ibaM-FO-2I0.

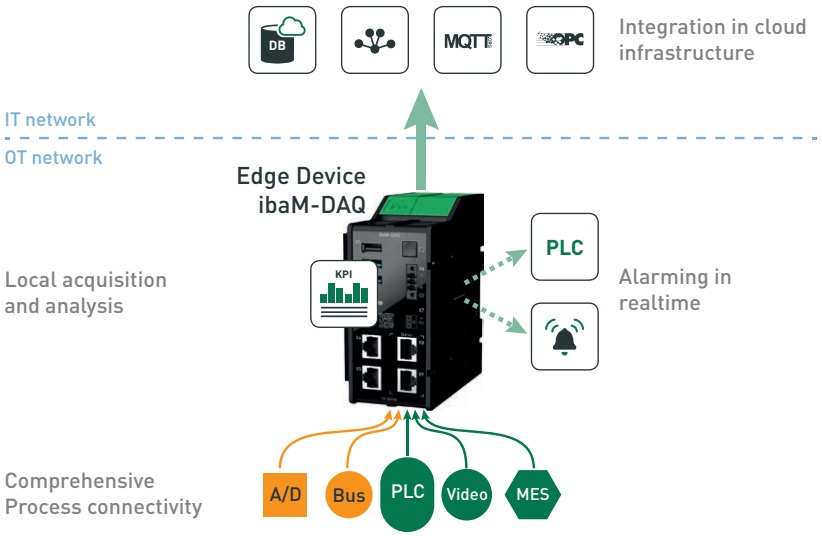
Licenses included

ibaM-DAQ is available with an ibaPDA basic license for up to 64 signals and two data stores.

In addition, ibaM-DAQ includes further licenses. With the license ibaPDA-Interface-PLC-Xplorer, ibaM-DAQ has direct access to different PLC systems. The access to the PLC systems is established via standard interfaces of the systems without additional hardware for measured value acquisition.

The license ibaPDA-OPC-UA-Server+ allows the ibaPDA system to be operated as an OPC UA server and to acquire all signals configured in ibaPDA via an OPC UA client interface. This makes it possible to exchange data directly with other systems that support OPC UA.

With the included ibaPDA-Data-Store-MQTT-16 license, signal data can be streamed to an MQTT broker.



Collect data on the edge device, process it autonomously and automatically

ibaM-DAQ as edge device

In the course of digitalization, automation or operational technology (OT) and information technology (IT) are increasingly converging. ibaM-DAQ can play an important role as an edge device.

The device acts as an interface between hardware-oriented acquisition in the OT sector and the processing and analysis function in the IT sector.

For superordinate systems, the data is also permanently available and traceable in the form of high-resolution raw data and/or aggregated characteristic values.

All software tools needed for these tasks are available with ibaPDA and ibaAnalyzer in the device.

Free analysis included

For the evaluation of the measurement data, the free analysis tool ibaAnalyzer[1] can run directly on the ibaM-DAQ device or be used on a separate computer.

User-specific characteristics

Once the evaluation requirements have been defined, the analysis rule can be saved and reused at any time. Analyses can also be started and performed automatically. Characteristic values, so-called KPIs, can be calculated automatically and on a user-specific basis from the high-resolution data. During the following analysis, a drill-down to the raw data is possible at any time in order to enable a root cause analysis in case of any deviations.

Connect to a database with ibaAnalyzer-DB

If the data needs to be processed in a database, measurement data can be loaded into a database with ibaAnalyzer-DB. It is also possible to analyze data from a database with this application. The main database formats are supported, like Microsoft SQL-Server, Oracle, IBM DB2-UDB, MySQL, PostgreSQL, Microsoft Access.

Direct writing to databases/clouds

Time-based data can also be written directly from ibaPDA to databases/clouds. For this purpose, special data stores subject to licensing are available. Currently, ibaPDA supports interfaces to SAP HANA database/cloud, Oracle, SQL Server, Azure SQL, MySQL, MariaDB, PostgreSQL, Apache Kafka, MQTT as well as Siemens MindSphere.

Integration in SNMP monitoring

The ibaM-DAQ device can be integrated into a company-wide network management system via the SNMP interface (Simple Network Management Protocol) in ibaPDA. In this case, ibaPDA acts as an SNMP server and supports the SNMP protocols V1, V2c and V3.

Diagnostic information about the status of the ibaPDA system can be used in the SNMP server with the base license. If you wish to publish any acquired data in the SNMP server, the ibaPDA-SNMP-Server+ license is required.

[1] ibaAnalyzer is licensed free of charge for editing measurement data generated with the iba system.

Technical data ibaM-DAQ

Short description	
Name	ibaM-DAQ
Module label	ibaM-DAQ
Description	Processor module for stand-alone data acquisition
Order number	10.180000
Processor unit	
Processor	Intel Atom x7-E3950 4x 1.6 GHz (2.0 GHz boost)
Operating system	Windows 10 IoT Enterprise x64 LTSC 2021/v21H2 (Long-Term Servicing Version)
Main memory	8 GB
Flash memory	Solid state drive 512 GB
Clock	Buffered by battery, (3 V, lithium BR2032)
Module-module interface	
Number	1
Connection technol.	2x 8 sliding contacts
No. of modules	15
Bandwidth	1 Gbit/s; together with ibaNet and I/O interfaces
Ethernet interface	
Number	2
Connection technology	2 RJ45 socket; 1GbE, Base-T
ibaNet interface	
Number	2
Design	Copper
Protocol	ibaNet-E
Bandwidth	1 Gbit/s; together with module-module and I/O interfaces
Connection technology	2 RJ45 socket; 1GbE, Base-T, switched
Cable length (P2P)	max. 100 m
Cable type	min. Cat. 5e, UTP
I/O interface	
Digital input	
Number	1
Design	Galvanically isolated, protected against reverse polarity, single ended
Input signal	24 V DC
Max. input voltage	±60 V permanent
Signal level log. 0	> -6 V; < +6 V
Signal level log. 1	< -10 V; > +10 V
Hysteresis	none
Input current	1 mA, constant
Debounce filter[2]	Optional, 4 operating modes
Sampling rate	max. 10 kHz, freely adjustable
Electrical isolation	
Channel - system	Functional isolation: 1 kV AC
Connection technology	2-pin socket, push-in, pitch 5 mm, conductor max. 1.5 mm²
Additional function	Shutdown
Digital output	
Number	1
Design	Galvanically isolated; solid-state DC switch
Switching voltage max.	200 V DC; protection against surge voltages
Switching current max.	350 mA (permanent), overcurrent protection
Switching delay	< 2 ms (at 100 mA)
OFF resistance (log. 0)	> 100 MΩ
ON resistance (log. 1)	< 3,75 Ω (at 100 mA)
Electrical isolation	
Channel - system	Functional isolation: 1 kV AC
Connection technology	2-pin socket, push-in, pitch 5 mm, conductor max. 1.5 mm²
Supply	
Power supply	24 V DC SELV; 4 A; UPS recommended
Voltage range	21.6 V ... 26.4 V DC
Current consumption	
ibaM-DAQ stand-alone	max. 0.7 A
ibaM-DAQ with modules	max. 4 A
Electrical isolation	
Supply - system	none
Connection technology	3-pin multi-pin connector, pitch 3.81 mm
Connector	included in delivery; push-in, conductor max. 1.5 mm², protected against reverse polarity, screw connection
Further interfaces, operating and indicating elements	
Indicators	LEDs for operation, channel states and errors
Switch	1 momentary switch for ON/OFF
Graphics	1 Mini-DisplayPort (4K/UHD)
USB	3 (1x USB 2.0; 2x USB 3.0)
Operating and environmental conditions	
Temperature range	
Operation	14 °F to 131 °F (-10 °C to +55 °C)
Storage	-13 °F to 185 °F (-25 °C to +85 °C)
Mounting	DIN rail according to EN 50022 (TS 35, DIN Rail 35)
Cooling	passive

[2] available in a later firmware version

Relative humidity	15 % ... 95 % (indoor), no condensation
Operating altitude	0 m ... 2000 m above sea level
Protection type	according to IP20; without test certificate according to IEC 60529
Certifications / standards	CE, C-Tick, UKCA, FCC, KC, IEC 61010-1, IEC 61000-6-5 interface range 4
Pollution degree	2
MTBF[3] (+25 °C)	317,489 hours / 36 years
Dimensions	
w x h x d	69 mm x 133 mm x 120 mm
Height, lever open	160 mm
Height units	3

Installation clearances	
top / bottom	30 mm / 30 mm
left / right (system)	10 mm / 10 mm
Mounting position	vertical, lever up
Weight / incl. packaging	0.55 kg / 0.78 kg
Licenses	
Design	WIBU CmDongle (USB; internal)
ibaPDA	ibaPDA-64 with 2 data stores ibaPDA-Interface-PLC-Xplorer ibaPDA-OPC-UA-Server+ ibaPDA-Data-Store-MQTT-16

[3] according to Telcordia 4 SR332 (Reliability Prediction Procedure of Electronic Equipment; Issue Mar. 2016) and NPRD (Non-electronic Parts Reliability Data 2011)

ibaM-COM

- Communication module for the ibaMAQS modular system
- Data acquisition with ibaPDA
- Data transfer over Ethernet / ibaNet-E

The ibaM-COM communication module can be used as an alternative to the ibaM-DAQ processor module to build up a module set. In contrast to ibaM-DAQ, ibaM-COM does not offer an integrated ibaPDA system. The module is designed for applications that do not require local measured value processing and recording as with ibaM-DAQ.

ibaM-COM allows the transmission of decentrally acquired measured values via Ethernet to a central ibaPDA system.

ibaPDA systems with widely branched I/O peripherals can be built up in this way. In addition to measurement data acquisition, ibaM-COM is also used for communication in the output direction as well as for configuration of the individual modules with the ibaPDAI/O-Manager. Thanks to the two ibaNet connections, the iba network can be extended from module node to module node.

Since the communication via ibaNet-E also uses a computer's standard network interface, I/O, bus and technological modules can also be used by a virtual ibaPDA server.

Short description	
Name	ibaM-COM
Module label	ibaM-COM
Description	Communication module for the ibaMAQS modular system
Order number	10.180010
Module-module interface	
Number	1
Connection technology	2x 8 sliding contacts
No. of modules	15
ibaNet interface	
Number	2
Design	Copper
Protocol	ibaNet-E
Connection technology	2 RJ45 socket; 1GbE, Base-T, switched
Cable length (P2P)	max. 100 m
Cable type	min. Cat. 5e, UTP
Supply	
Power supply	24 V DC SELV; 4 A; external buffer module recommended
Voltage range	21.6 V ... 26.4 V DC
Power consumption (with modules)	max. 4 A
Electrical isolation	
Supply - system	none
Connection technology	3-pin multi-pin connector, pitch 3.81 mm
Connector	included in delivery; push-in, conductor max. 1.5 mm², protected against reverse polarity, screw connection
Further interfaces, operating and indicating elements	
Indicators	LEDs for operation and errors
Operating and environmental conditions	
Temperature range	
Operation	14 °F to 131 °F (-10 °C to +55 °C)
Storage	-13 °F to 185 °F (-25 °C to +85 °C)
Mounting	DIN rail according to EN 50022 (TS 35, DIN Rail 35)
Cooling	Passive
Relative humidity	15 % ... 95 % (indoor), no condensation
Operating altitude	0 m ... 2000 m above sea level
Protection type	according to IP20; without test certificate according to IEC 60529
Certifications / standards	CE, C-Tick, UKCA, FCC, IEC 61010-1, IEC 61000-6-5 interface range 4
Pollution degree	2
Dimensions	
w x h x d	28 mm x 133 mm x 120 mm
Height, lever open	160 mm
Height units	3
Installation clearances	
top / bottom	30 mm / 30 mm
left / right (system)	10 mm / 10 mm
Mounting position	vertical, lever up
Weight / incl. packaging	0.25 kg / 0.55 kg

ibaM-FO-2IO

- Interface module for ibaNet 32Mbit
- Connection of classic iba devices via fiber optics
- Supports the 32Mbit Flex and 32Mbit ibaNet protocols
- 2 independent fiber optic interfaces with one input and one output each
- Different sampling rates can be set per interface

The ibaM-FO-2IO interface module is used to connect additional iba devices that communicate via the ibaNet optical fiber. The 32Mbit Flex and 32Mbit ibaNet protocols are supported. Thus, all current devices from the ibaPADU series, the iba modular system as well as different bus modules (ibaBM-DP, ibaBM-PN, etc.) can be connected to ibaMAQS. Users who already have these iba devices can integrate them into a new ibaMAQS.

Even older devices that still use the 3Mbit protocol can be used with the help of an ibaBM-COL-8i-o data concentrator.

This allows an ibaPDA system to be connected to a multitude of I/O devices that are not yet available as ibaMAQS modules.

The combination of ibaM-FO-2IO and ibaM-COM can be used to connect iba devices to virtual ibaPDA servers or to convert from fiber optic to Ethernet.

Short description	
Name	ibaM-FO-2IO
Module label	FO-2IO
Description	Fiber optic interface module for ibaNet 32Mbit
Order number	10.182000
Module-module interface	
Number	2
Connection technol.	4x 8 sliding contacts
ibaNet interface	
Number	2
Design	Optical fiber
Protocol	ibaNet 32Mbit Flex (bidirectional) ibaNet 32Mbit (fixed)
Data transfer rate	32 Mbit/s
Sampling rate	max. 100 kHz, freely adjustable, determined by partner
Connection technology	2x 2 ST-connectors each for RX and TX; iba recommends the use of FO with multimode fibers of type 50/125 µm or 62.5/125 µm; cable length up to 2000 m possible without amplifier, depending on transmitter, receiver, FO and environment.
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	-13 °F to 185 °F (-40 °C to +85 °C)
Light wavelength	850 nm
Laser class	class 1

Receiving interface (RX)	
Sensitivity[4]	100/140 µm FO cable: -24 dBm to -10 dBm
Temperature range	-13 °F to 185 °F (-40 °C to +85 °C)
Supply	
Supply voltage	24 V DC via module-module interface
Current consumption	
Own consumption	0.1 A
Input/output current	max. 4 A
Other interfaces, operating and indicating elements	
Indicators	LEDs for operation and errors
Operating and environmental conditions	
Temperature range	
Operation	14 °F to 131 °F (-10 °C to +55 °C)
Storage	-13 °F to 185 °F (-25 °C to +85 °C)
Mounting	DIN rail according to EN 50022 (TS 35, DIN Rail 35)
Cooling	Passive
Relative humidity	15 % ... 95 % (indoor), no condensation
Operating altitude	0 m ... 2000 m above sea level
Protection type	according to IP20; without test certificate according to IEC 60529
Certifications / standards	CE, C-Tick, UKCA, FCC, KC, IEC 61010-1, IEC 61000-6-5 interface range 4
Pollution degree	2
MTBF[5] (+25 °C)	1,659,212 hours / 189 years
Dimensions	
w x h x d	28 mm x 133 mm x 131 mm
Height, lever open	160 mm
Height units	3
Installation clearances	
top / bottom	30 mm / 30 mm
left / right (system)	10 mm / 10 mm
Mounting position	Vertical, lever up
Weight / incl. pack.	0.24 kg / 0.47 kg

[4] data for other FO cable diameters not specified

[5] according to: Telcordia 4 SR332 (Reliability Prediction Procedure of Electronic Equipment; Issue Mar. 2016) and NPRD (Non-electronic Parts Reliability Data 2011)

The I/O modules

In the ibaMAQS system, up to 15 I/O modules can be combined as desired. The modules are suitable for high-resolution measurement applications with very fast sampling rates, in some cases up to 500 kHz. The signals from all I/O modules are acquired synchronously with the sampling clock.

The I/O modules do not require their own voltage supply since they are powered via the module-module interface. The operating status of the module as well as the status of the individual channels are indicated by LEDs.

Analog input modules

The analog input modules feature galvanically isolated, single-ended channels. Each channel is equipped with a high-resolution, calibrated 24-bit delta-sigma A/D converter.

All analog input modules have different input filters to eliminate noise and interfering signals. A first-order analog R/C low pass filter and a digital anti-aliasing filter (FIR) are permanently active. In addition, another digital anti-aliasing filter can be switched on.

The analog current and voltage modules are additionally able to measure the grid frequency per channel. Frequencies between 10 Hz and 80 Hz are supported.

In addition to the actual measured values, the grid frequency signals are available as separate signals in the signal tree in ibaPDA. They can be displayed, recorded and used for further calculations like any other signal.

Modules for applications in the energy sector

The two modules ibaM-4AI-5A-150A-AC and ibaM-4AI-600V-AC are designed for power-monitoring applications and support a max. sampling rate of 500 kHz. Both modules have two measuring ranges each. The measuring range of the ibaM-4AI-600V-AC module is switched manually by the user, the measuring range of the ibaM-4AI-5A-150A-AC module includes an automatic switchover.

I/O module with variable input ranges

The ibaM-4AI-UI analog input module processes both current and voltage signals in different ranges. The ranges for the current and voltage measurements can be configured in ibaPDA.

Special features of the IEPE module

The IEPE module is designed for the acquisition of mechanical vibrations with IEPE vibration sensors in the fields of wind turbines, condition monitoring, test stands, bearing monitoring, etc. For the analog inputs, different input modes can be set in ibaPDA per channel: IEPE input (±10 V) with 1 Hz or 0.1 Hz high pass filter, 24 V AC input (AI), 24 V DC input (AI).

The module uses an R/C high pass filter, an analog anti-aliasing Butterworth filter and a digital anti-aliasing filter, which are permanently switched on.

The module features broken wire detection for the connected sensors and also indicates if no IEPE sensor is connected. In addition, a short circuit is detected and indicated via an LED.

ibaM-4AI-5A-150A-AC

- Input module with 4 analog current inputs
- Use in power generation and distribution
- General current measurement
- Grid frequency measurement

Short description	
Name	ibaM-4AI-5A-150A-AC
Module label	4AI-5A/150A~
Description	Input module with 4 analog current inputs
Order number	10.181000
Module-module interface	
Number	2
Connection technol.	4x 8 sliding contacts
Analog inputs	
Number	4
Design	Galvanically isolated, single ended, 2 A/D converters per channel
Input signal / nominal current	5 A AC
Resolution	24 bit (Delta-Sigma)
Sampling rate ADC	500 kHz
Timebase ibaPDA (update time)	min. 2 µs; freely adjustable (integer multiple); max. 1 ms for filter signals
Filters	
ADC signal	
analog	R/C low-pass, 1st order, 150 kHz
digital	Anti-aliasing filter (FIR), 84th order; Cut-off frequency = 0.45 x sampling rate ADC; Oversampling = 32 x sampling rate ADC
Filter signal[6]	
Like ADC signal, in addition:	
digital	Anti-aliasing filter (Elliptic/Cauer); 10th order; cut-off frequency = 0.45 / timebase
Protection factor / overload current	30 x nominal current
Nominal measuring range	±15 A
Measurable overload range[7]	-225 A ... -15 A / +15 A ... +225 A
Input current max.	15 A DC; permanent
In overload range[7]	150 A AC; transient for 1 s per minute[7]
Input voltage max.	CAT III 600 V / CAT IV 300 V
Measuring shunt	2.0 mΩ
Accuracy (+25 °C)	
Nominal measuring range	< 0.1 % of double nominal measuring range end value
Overload range[7]	< 0.1 % of double overload range end value

Electrical isolation	
Channel - channel	Basic insulation: CAT III 600 V
Channel - system	Reinforced insulation: CAT III 600 V
Connection technol.	2x 4-pin pin header, pitch 7.62 mm
Connector	2x included in delivery; push-in, conductor max. 6 mm², locking lever (latching), protected against reverse polarity, lockable, screw connection, without jumper
Additional functions	
Phasor Measurement Unit[8]	Integrated
Grid frequency measurem. (10 Hz - 80 Hz)[9]	Interval: 1 s / 10 s (according to IEC 61000-4-30)
Supply	
Supply voltage	24 V DC via module-module interface
Current consumption	
Own consumption	0.3 A
Input/output current	max. 4 A
Other interfaces, operating and indicating elements	
Indicators	LEDs for operation, channel states and errors
Operating and environmental conditions	
Temperature range	
Operation	14 °F to 131 °F (-10 °C to +55 °C)
Storage	-13 °F to 185 °F (-25 °C to +85 °C)
Mounting	On grounded DIN rail according to EN 50022 (TS 35, DIN Rail 35)
Cooling	Passive
Relative humidity	15 % ... 95 % (indoor), no condensation
Operating altitude	0 m ... 2000 m above sea level
Protection type	according to IP20; without test certificate according to IEC 60529
Certifications / standards	CE, C-Tick, UKCA, FCC, IEC 61010-1, IEC 61010-2-030, IEC 61000-6-5 interface range 4
Pollution degree	2
MTBF (+25 °C)	2.986,619 hours / 340 years
Dimensions	
w x h x d	56 mm x 133 mm x 120 mm
Height, lever open	160 mm
Height units	3
Installation clearances	
top / bottom	30 mm / 30 mm
left / right (system)	10 mm / 10 mm
Mounting position	Vertical, lever up
Weight / incl. pack.	0.38 kg / 0.66 kg

[6] For the filter signals, the maximum time base in ibaPDA (update time) is limited to 1 ms for the correct operation of these filters.
[7] Recalibration is recommended after the occurrence of currents in the overload range, as a permanent variation in the measured values may occur.
[8] only available with release of ibaM-PQU
[9] available in a later firmware version

ibaM-4AI-600V-AC

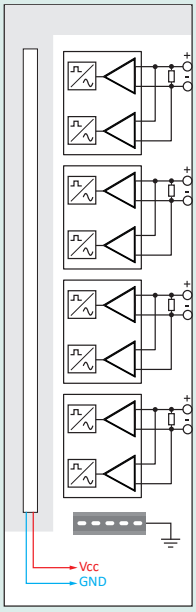
- Input module with 4 analog voltage inputs
- Use in power generation and distribution
- General voltage measurement
- Grid frequency measurement

Short description	
Name	ibaM-4AI-600V-AC
Module label	4AI-600V~
Description	Input module with 4 analog voltage inputs with modes switchable by channel
Order number	10.181010
Module-module interface	
Number	2
Connection tech.	4x 8 sliding contacts
Analog inputs	
Number	4
Design	Galvanically isolated, single ended
Input signal / nominal voltage	600 V AC
Resolution	24 bit (Delta-Sigma)
Sampling rate ADC	500 kHz
Timebase ibaPDA (update time)	min. 2 µs; freely adjustable (integer multiple); max. 1 ms for filter signals
Filters	
ADC signal	
analog	R/C low-pass, 1st order, typ. 150 kHz
digital	Anti-aliasing filter (FIR), 84th order; Cut-off frequency = 0.45 x sampling rate ADC; Oversampling = 32 x sampling rate ADC
Filter signal[10]	
Like ADC signal, in addition:	
digital	Anti-aliasing filter (Elliptic/Cauer); 10th order; cut-off frequency = 0.45 / timebase
Measuring ranges	±360 V / ±1700 V; switchable by channel
Measuring category	CAT III 600 V / CAT IV 300 V
Input impedance	2 MΩ
Input capacity	50 pF
Accuracy (+25 °C)	< 0.1 % of the respective double full scale value
Electrical isolation	
Channel - channel	Basic insulation: CAT III 600 V
Channel - system	Reinforced insulation: CAT III 600 V
Connection technol.	2x 4-pin pin header, pitch 7.62 mm
Connector	2x included in delivery, push-in, conductor max. 2.5 mm², locking clamp/ejection lever, protected against reverse polarity, lockable
Additional functions	
Phasor Measurement Unit[11]	Integrated
Grid frequency measurement (10 Hz ... 80 Hz)[12]	Interval: 1 s / 10 s (according to IEC 61000-4-30)
Supply	
Supply voltage	24 V DC via module-module interface
Current consumption	
Own consumption	0.3 A
Input/output current	max. 4 A
Other interfaces, operating and indicating elements	
Indicators	LEDs for operation, channel states and errors
Operating and environmental conditions	
Temperature range	
Operation	14 °F to 131 °F (-10 °C to +55 °C)
Storage	-13 °F to 185 °F (-25 °C to +85 °C)
Mounting	On grounded DIN rail according to EN 50022 (TS 35, DIN Rail 35)
Cooling	Passive
Relative humidity	15 % ... 95 % (indoor), no condensation
Operating altitude	0 m ... 2000 m above sea level
Protection type	according to IP20; without test certificate according to IEC 60529
Certifications / standards	CE, C-Tick, UKCA, FCC, IEC 61010-1, IEC 61010-2-030, IEC 61000-6-5 interface range 4
Pollution degree	2
MTBF (+25 °C)	3,452,457 hours / 394 years
Dimensions	
w x h x d	28 mm x 133 mm x 120 mm
Height, lever open	160 mm
Height units	3
Installation clearances	
top / bottom	30 mm / 30 mm
left / right (system)	10 mm / 10 mm
Mounting position	Vertical, lever up
Weight / incl. pack.	0.26 kg / 0.52 kg

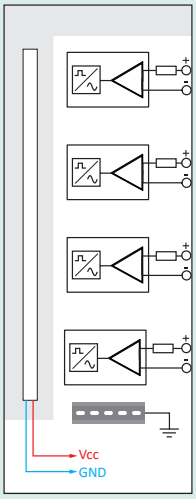
[10] For the filter signals, the maximum time base in ibaPDA (update time) is limited to 1 ms for the correct operation of these filters.
[11] only available with release of ibaM-PQU
[12] available in a later firmware version

Connection diagrams

ibaM-4AI-5A-150A-AC



ibaM-4AI-600V-AC



ibaM-4AI-UI

- Input module with 4 analog inputs for voltage and current measurement
- Different measuring modes switchable per channel
- Expected availability in 2025

Short description	
Name	ibaM-4AI-UI
Module label	4AI-UI
Description	Input module with 4 analog inputs for voltage and current measurements with measuring ranges switchable by channel
Order number	10.181030
Module-module interface	
Number	2
Connection technol.	4x 8 sliding contacts
Analog inputs	
Number	4
Design	Galvanically isolated, single ended; 3 pins per channel (voltage / GND / current)
Input signal	Voltages up to 60 V DC / currents up to 20 mA DC; switchable per channel
Resolution	24 bit (Delta-Sigma)
Sampling rate ADC	100 kHz
Timebase ibaPDA (update time)	min. 10 µs; freely adjustable (integer multiple); max. 1 ms for filter signals
Filters	
ADC signal	
analog	R/C low-pass, 1st order, 50 kHz
digital	Anti-aliasing filter (FIR), 84th order; cut-off frequency = 0.45 x ADC sampling rate; over sampling = 32 x ADC sampling rate
Filter signal[13]	
Like ADC signal, in addition:	
digital	Anti-aliasing filter (Elliptic/Cauer); 10th order; cut-off frequency= 0.45 / timebase
Measuring ranges	
Voltage	±2,5 V / ±10 V / ±24 V / ±60 V
Current	±20 mA / 0...20 mA DC / 4...20 mA DC
Input impedance	
Voltage	100 kΩ / 1 MΩ[14]; switchable
Current	50 Ω
Accuracy (+25 °C)	< 0.1 % of the respective double full scale value
Electrical isolation	
Channel - channel	Functional isolation: 2.5 kV AC
Channel - system	Functional isolation: 2.5 kV AC

Connection technol.	2x 6-pin pin header, pitch 5 mm
Connector	2x included in delivery, push-in, conductor max. 2.5 mm², locking clamp/ejection lever, protected against reverse polarity, lockable
Status functions	
Current measurement	Overrange/underrange; reversed polarity; broken cable
Additional functions	
Grid frequency measurement (10 Hz ... 80 Hz)	Interval: 1 s / 10 s (according to IEC 61000-4-30)
Supply	
Supply voltage	24 V DC via module-module interface
Current consumption	
Own consumption	0.3 A
Input/output current	max. 4 A
Other interfaces, operating and indicating elements	
Indicators	LEDs for operation, channel states and errors
Operating and environmental conditions	
Temperature range	
Operation	14 °F to 131 °F (-10 °C to +55 °C)
Storage	-13 °F to 185 °F (-25 °C to +85 °C)
Mounting	DIN rail according to EN 50022 (TS 35, DIN Rail 35)
Cooling	Passive
Relative humidity	15 % ... 95 % (indoor), no condensation
Operating altitude	0 m ... 2000 m above sea level
Protection type	according to IP20; without test certificate according to IEC 60529
Certifications / standards	CE, C-Tick, UKCA, FCC, IEC 61010-1, IEC 61000-6-5 interface range 4
Pollution degree	2
Dimensions	
w x h x d	28 mm x 133 mm x 120 mm
Height, lever open	160 mm
Height units	3
Installation clearances	
top / bottom	30 mm / 30 mm
left / right (system)	10 mm / 10 mm
Mounting position	Vertical, lever up

[13] For the filter signals, the maximum time base in ibaPDA (update time) is limited to 1 ms for the correct operation of these filters.

[14] 1 MΩ not possible in combination with ±2.5 V

ibaM-4AI-IEPE

- Input module with 4 analog inputs
- Measurement of mechanical vibration by means of IEPE accelerometers

Short description	
Name	ibaM-4AI-IEPE
Module label	4AI-IEPE
Description	Input module with 4 analog inputs for voltage measurements and IEPE sensors with modes switchable by channel
Order number	10.181020
Module-module interface	
Number	2
Connection technol.	4x 8 sliding contacts
Analog inputs	
Number	4
Design	Galvanically isolated, single ended; additionally 2x GND and 2x GND with 50 Ω
Input signal	Voltages up to 24 V DC / IEPE sensors; switchable by channel
Input modes	24 V DC / 24 V AC / IEPE 0.1 Hz / IEPE 1 Hz; switchable by channel
IEPE 0.1 Hz/1 Hz	Integrated constant current source +4 mA (24 V DC)
Resolution	24 bit (Delta-Sigma)
Sampling rate ADC	100 kHz
Timebase ibaPDA (update time)	min. 10 µs; freely adjustable (integer multiple); max. 1 ms for filter signals
Filters	
ADC signal	
24 V DC	
analog	R/C low-pass, 1st order, 50 kHz
digital	Anti-aliasing filter (FIR), 84th order; cut-off frequency = 0.45 x sampling rate ADC; oversampling = 32 x sampling rate ADC
24 V AC	
analog	R/C low-pass, 1st order, 50 kHz R/C high-pass, 1st order, 1 Hz
digital	Anti-aliasing filter (FIR), 84th order; cut-off frequency = 0.45 x sampling rate ADC; oversampling = 32 x sampling rate ADC
IEPE 0.1 Hz	
analog	R/C low-pass, 1st order, 50 kHz
digital	R/C high-pass, 1st order, 0.1 Hz Anti-aliasing filter (FIR), 84th order; cut-off frequency = 0.45 x sampling rate ADC; oversampling = 32 x sampling rate ADC
IEPE 1 Hz	
analog	R/C low-pass, 1st order, 50 kHz
digital	R/C high-pass, 1st order, 1 Hz Anti-aliasing filter (FIR), 84th order; cut-off frequency = 0.45 x sampling rate ADC; oversampling = 32 x sampling rate ADC
Filter signal[15]	
24 V DC/AC / IEPE 0.1 Hz/1 Hz	
Like ADC signal, in addition:	
digital	Anti-aliasing filter (Elliptic/Cauer); 10th order; cut-off frequency = 0.45 / timebase and/or Anti-aliasing filter (Butterworth), 2nd order; cut-off frequency = 0.45 / timebase; switchable
Measuring ranges	
24 V DC/AC	±24 V
IEPE 0.1 Hz/1 Hz	±10 V (at ~160 Hz and BIAS voltage ~12 V DC)
Input gain IEPE	none
Input impedance 24 V DC/AC	1 MΩ
Accuracy (+25 °C)	
24 V DC	< 0.1 % of the double full scale value
24 V AC	< 2 % of the double full scale value
IEPE 0.1 Hz/1 Hz	< 0.1 % of the double full scale value
Electrical isolation	
Channel - channel	Functional isolation: 2.5 kV AC
Channel - system	Functional isolation: 2.5 kV AC
Connection technol.	2x 6-pin pin header, pitch 5 mm
Connector	2x included in delivery, push-in, conductor max. 2.5 mm², locking clamp/ejection lever, protected against reverse polarity, lockable
Sensor cable length	Up to 30 m at 100 pF/m cable capacitance and a bandwidth of used signals up to 50 kHz
Status functions	
Input modes	
24 V DC / AC	Data valid
IEPE 0.1 Hz/1 Hz	Data valid, broken line, short circuit

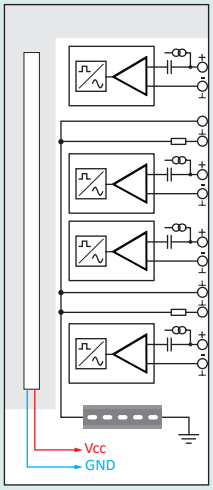
[15] For the filter signals, the maximum time base in ibaPDA (update time) is limited to 1 ms for the correct operation of these filters.

Additional functions	
Statistical values	
Input modes	24 V DC/AC / IEPE 0.1 Hz/1 Hz
Calculation basis	
Interval	100 ms ... 5000 ms, freely adjustable (in 1 ms steps)
Signal	ADC signal
Sampling	ADC sampling rate
General characteristic values	
Characteristic values	Min, Max, Avg, Peak, Peak-to-Peak, aRMS, Crest factor, used range
Bandpass filtered characteristic values[16]	
Number	6 bandpass filters per channel; each freely adjustable
Bandpass filter	Butterworth, 4th order
Characteristic values	vRMS, vPeak-to-peak, vCrest factor and/or aRMS, aPeak-to-peak, aCrest factor; switchable
TEDS[16] (according to IEEE-1451)	
Design	0-wire
Supported EEPROMs	DS2430A, DS2431
Supply	
Supply voltage	24 V DC via module-module interface
Current consumption	
Own consumption	0.3 A
Input/output current	max. 4 A

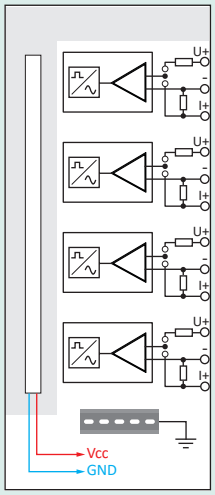
Other interfaces, operating and indicating elements	
Indicators	LEDs for operation, channel states and errors
Operating and environmental conditions	
Temperature range	
Operation	14 °F to 131 °F (-10 °C to +55 °C)
Storage	-13 °F to 185 °F (-25 °C to +85 °C)
Mounting	DIN rail according to EN 50022 (TS 35, DIN Rail 35)
Cooling	passive
Relative humidity	15 % ... 95 % (indoor), no condensation
Operating altitude	0 m ... 2000 m above sea level
Protection type	according to IP20; without test certificate according to IEC 60529
Certifications / standards	CE, C-Tick, UKCA, FCC, IEC 61010-1
Pollution degree	2
Dimensions	
w x h x d	28 mm x 133 mm x 120 mm
Height, lever open	160 mm
Height units	3
Installation clearances	
top / bottom	30 mm / 30 mm
left / right (system)	10 mm / 10 mm
Mounting position	Vertical, lever up
Weight / incl. packaging/connector	0.24 kg / 0.50 kg

Connection diagrams

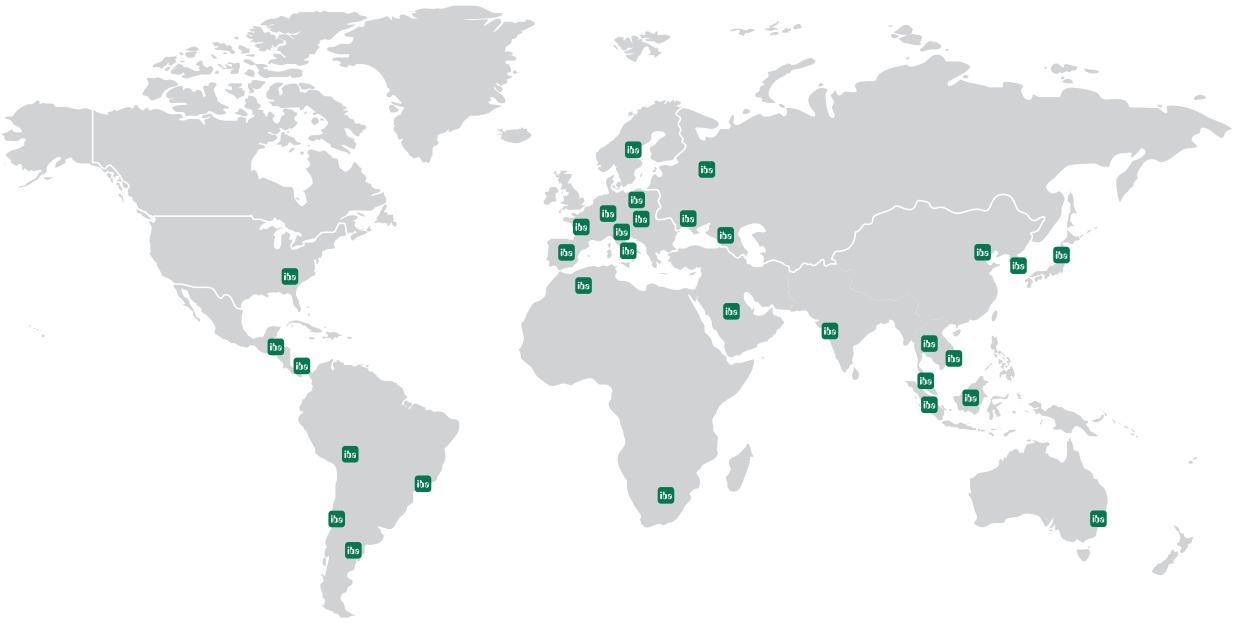
ibaM-4AI-IEPE



ibaM-4AI-UI



[16] available in a later firmware version



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