ibaPDA-Interface-IEC61850-9-2

Data interface for sampled values streams according to IEC 61850-9-2

Manual

Issue 1.1

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1.1	03-2023	GUI new	st	8.0.0

Contents

1 About this documentation

This documentation describes the function and application of the software interface *ibaPDA-Interface-IEC61850-9-2*.

Other documentation

This documentation is a supplement to the *ibaPDA* manual. Information about all the other characteristics and functions of *ibaPDA* can be found in the *ibaPDA* manual or in the online help.

1.1 Target group and previous knowledge

This manual is aimed at qualified professionals who are familiar with handling electrical and electronic modules as well as communication and measurement technology. A person is regarded 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.

This documentation in particular addresses persons who are concerned with the configuration, test, commissioning or maintenance of IEC 61850-compliant devices in the area of substation automation. For the handling of *ibaPDA-Interface-IEC61850-9-2* the following basic knowledge is required and/or useful

- Windows operating system
- Basic knowledge of *ibaPDA*
- Knowledge of configuration and operation of the relevant target system/device

1.2 Notations

In this manual, the following notations are used:

Action	Notation
Menu command	Menu *Logic diagram*
Calling the menu command	*Step 1 – Step 2 – Step 3 – Step x* Example: Select the menu *Logic diagram – Add – New function block*.
Keys	<Key name> Example: <Alt>; <F1>
Press the keys simultaneously	<Key name> + <Key name> Example: <Alt> + <Ctrl>
Buttons	<Key name> Example: <OK>; <Cancel>
Filenames, paths	`Filename`, `Path` Example: `Test.docx`

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:

- Observe the specified measures.

Warning!

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

- Observe the specified measures.

Caution!

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

- Observe the specified measures

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 System requirements

The following system requirements are necessary for the use of the IEC 61850-9-2 data interface:

- *ibaPDA* v8.0.0 or higher
- License for *ibaPDA-Interface-IEC61850-9-2*
- For recording more than 2 streams, you will need additional one-step-up-Interface-IEC61850-9-2 licenses for each additional 2 streams.

For further requirements for the used computer hardware and the supported operating systems, please refer to the *ibaPDA* documentation.

License information

Order no.	Product name	Description
31.001400	ibaPDA-Interface-IEC61850-9-2	Extension license for an ibaPDA system for an IEC61850-9-2 interface Number of streams: 2
31.101400	one-step-up-Interface-IEC61850-9-2	Extension license for an existing interface ibaPDA-Interface-IEC61850-9-2 for another 2 streams, maximum of 3 extension licenses permissible

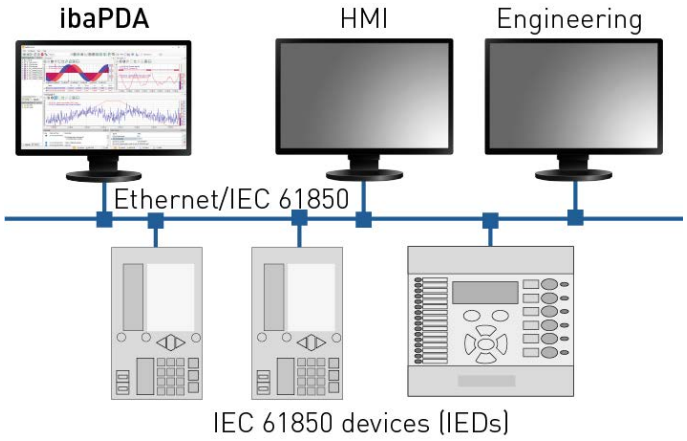
3 IEC 61850-9-2

The standard IEC 61850 of the International Electrotechnical Commission (IEC) describes a general transmission protocol for protection and control technology in electrical switchgear of medium and high-voltage technology (substation automation). Part 9-2 describes the so-called sampled values.

These are currents and voltages that are measured in real time and sent via Ethernet frames. The acquisition of up to two streams is supported with one interface license. In total, a maximum of 4 licenses (=8 streams) can be used.

3.1 System topologies

Sampled values streams are sent by IEC61850 devices as multicast ISO telegrams. *ibaPDA* can receive these via the standard Ethernet interfaces of the computer.



Note

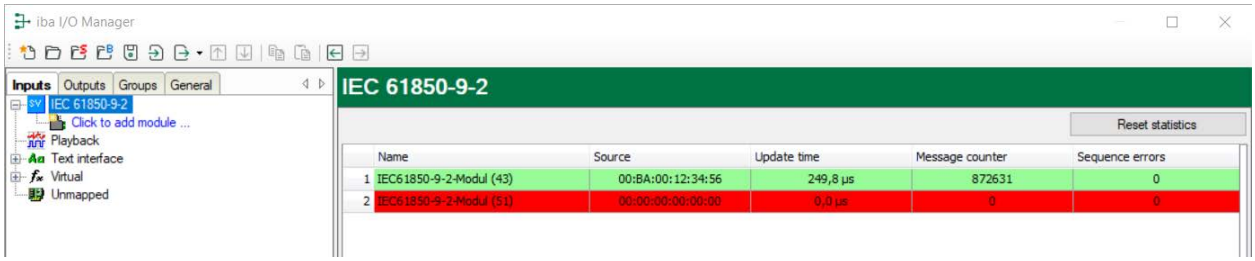
It is recommended carrying out the TCP/IP communication on a separate network segment to exclude a mutual influence by other network components.

3.2 Configuration and engineering ibaPDA

Subsequently, the engineering for *ibaPDA* is described. If all system requirements are met, *ibaPDA* offers the *IEC 61850-9-2* interface in the interface tree of the I/O Manager.

3.2.1 Interface settings

The interface IEC 61850-9-2 has the following functions and configuration options:



Connection table
The table shows different diagnostic values of the individual connections during data acquisition. Click on the <Reset counters> button to reset the update time, the message counter and the sequence errors to zero.

The message counter is a continuous counter that is incremented by one with each received message. A message can contain multiple samples. The update time shows the measured time between the samples. Sequence errors indicate that no consecutive sequence counter was detected in consecutive received telegrams.

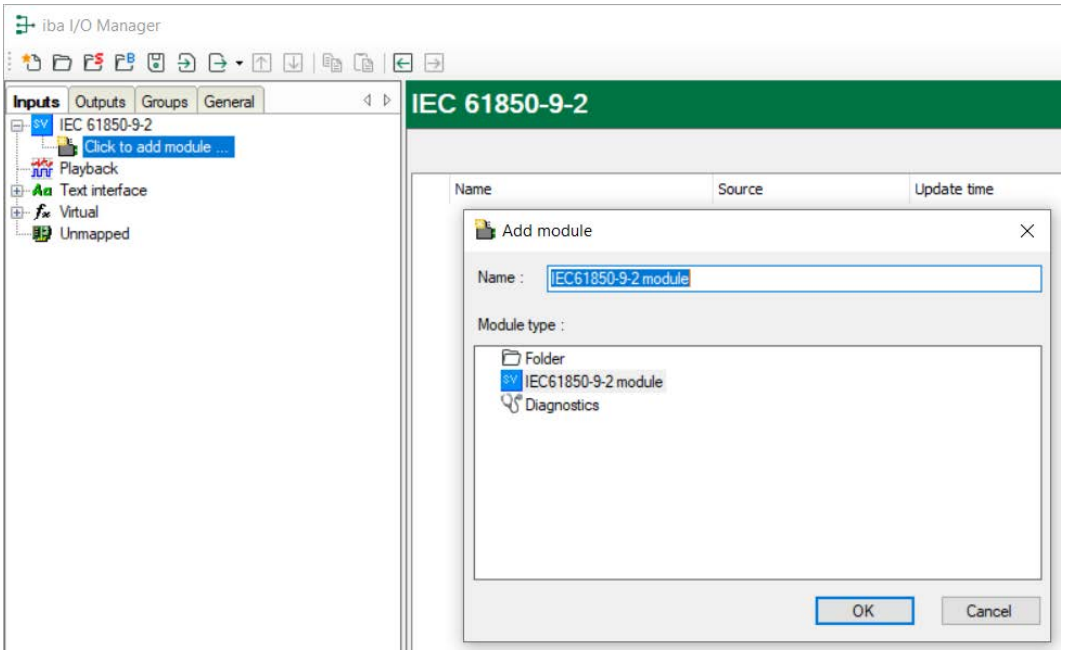
The diagnostic data from this connection table can also be acquired via a diagnostic module. Each diagnostic module can be coupled with a sampled values stream via the *Target module* property. See chapter ↗ *Diagnostic modules*, page 17.

<Reset statistics>
Click this button to reset the calculated times and error counters in the table to 0.

3.2.2 Add module

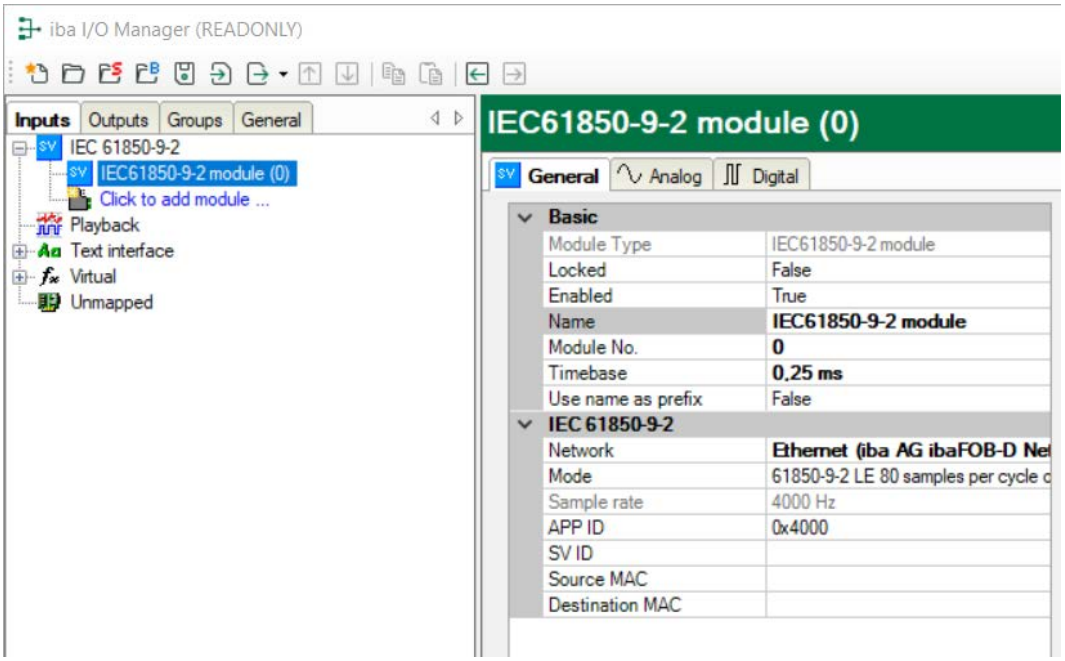
One module is required for every sampled values stream. You can also add one or more diagnostic modules. For more information about the diagnostic modules, see chapter ↗ *Diagnostic modules*, page 17.

Procedure
1. Click on the blue link *Click to add module* located under each data interface in the *Inputs* or *Outputs* tab.
2. Select the desired module type in the dialog box and assign a name via the input field if required.
3. Confirm the selection with <OK>.



3.2.3 General module settings

All modules have the following common settings:



Basic settings

Module Type (information only)
Indicates the type of the current module.

Locked
A module can be locked in order to prevent change of module settings by accident or unauthorized users.

Enabled
Disabled modules are excluded from the signal acquisition.

Name
The plain text name should be entered here as the module designation.

Module No.
Internal reference number of the module. This number determines the order of the modules in the signal tree of *ibaPDA* client and *ibaAnalyzer*.

Timebase
All signals of the module will be sampled on this timebase.

Use name as prefix
Puts the module name in front of the signal names.

Note

The sampled values streams are always resampled with the configured timebase here. Even if the timebase matches the nominal sample time, there are occasionally double or missing samples. This is due to the fact that the sample clock in *ibaPDA* is not 100% the same as the sample clock in the IEC 61850-9-2 device.

IEC 61850-9-2

Network
Select the network card that should be used to receive the IEC 61850-9-2 stream.

Mode
Select the mode for the sampled values. You can use one of the pre-defined standards or configure your own sample rate and signals via the “Custom” setting. The selected mode must correspond to the mode in which the IEC61850-9-2 device sends data. These standard modes are available:

- 61850-9-2 LE 80 samples per cycle on 50Hz
- 61850-9-2 LE 80 samples per cycle on 60Hz
- 61850-9-2 LE 256 samples per cycle on 50Hz
- 61850-9-2 LE 256 samples per cycle on 60Hz
- 61869-9 4800 Hz
- 61869-9 14400 Hz

The sample rate can be set in the “Custom” mode. You can change the number of signals and configure their offset and data types.

Sample rate
Acquisition rate of sampled values. If standard modes were selected, the sample rate is automatically configured and only shown here. In “Custom” mode the sample rate can be set here.

APP ID
Application identifier of the sampled values stream. You must enter this to filter the correct sampled values stream. The APP ID is a 16-bit integer that is sent in every message. The input must be in hexadecimal form. The default value is 0x4000.

SV ID
Identifier for sampled values. The SV identifier is a string with a maximum of 35 characters that is sent in every message. This ID can be used to filter the correct sampled values stream. Leave the field empty to disable the SV ID filter.

Source MAC
The MAC address of the source. This address can be used to filter the correct sampled values stream. Leave the field empty to disable the source MAC address filter.

Destination MAC
The MAC address of the destination. This address can be used to filter the correct sampled values stream. Leave the field empty to disable the destination MAC address filter.

3.2.4 Signal configuration

The data consists of 4 currents and 4 voltages in all standard modes (*Mode* setting in the *General* tab). Every current and every voltage is characterized by a quality value as well. This quality value is automatically decoded by *ibaPDA* in various analog and digital signals.

The signals are already pre-defined in the *Analog* and *Digital* tabs. The signals can be individually enabled or disabled in the *Active* column for acquisition in *ibaPDA*.

Note

Observe the maximum signal number referring to your license.

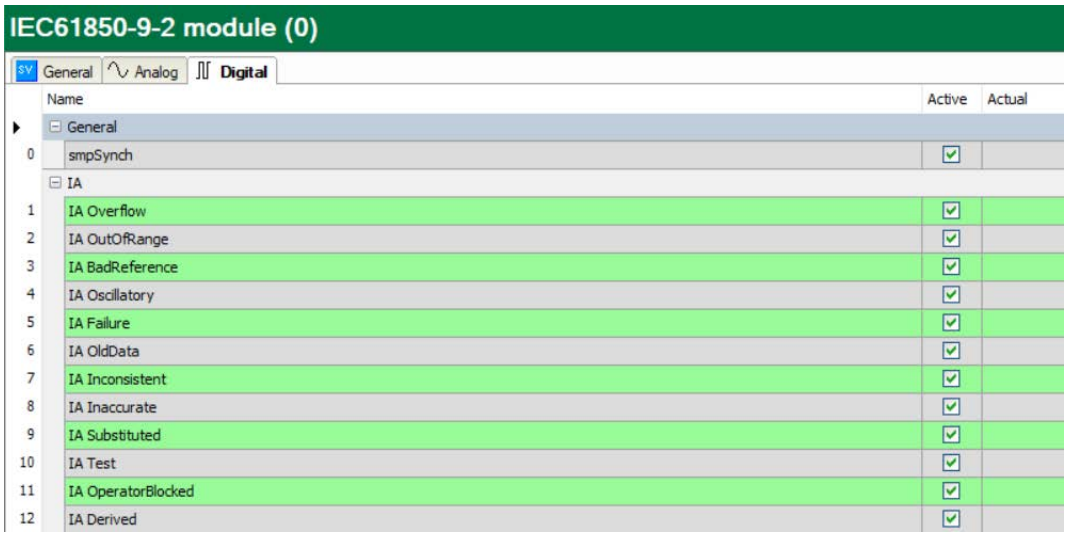
Analog signals:

IEC61850-9-2 module (0)

General | Analog | Digital

	Name	Unit	Gain	Offset	DataType	Active	Actual
	General						
0	smpCnt		1	0	WORD	☑	3241
	IA						
1	IA	A	0,001	0	DINT	☑	-1956518 A
2	IA Validity		1	0	BYTE	☑	0
	IB						
3	IB	A	0,001	0	DINT	☑	-7642 A
4	IB Validity		1	0	BYTE	☑	1
	IC						
5	IC	A	0,001	0	DINT	☑	-29 A
6	IC Validity		1	0	BYTE	☑	0
	IN						
7	IN	A	0,001	0	DINT	☑	0 A
8	IN Validity		1	0	BYTE	☑	0

Digital signals:

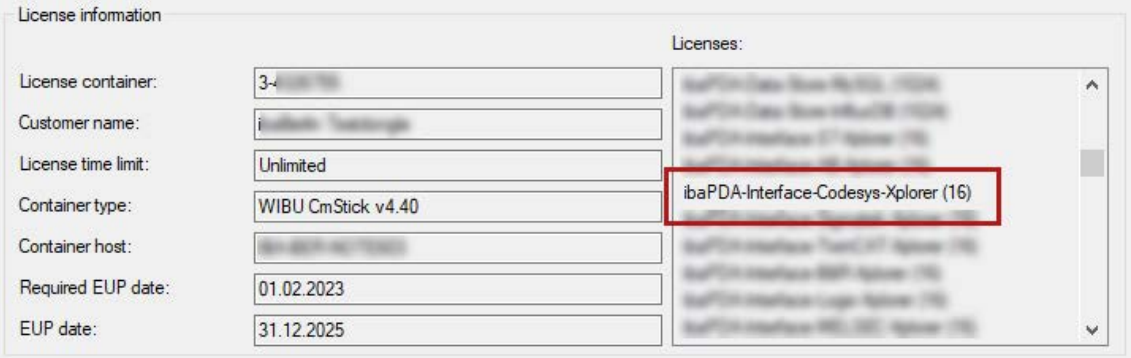


4 Diagnostics

4.1 License

If the interface is not displayed in the signal tree, you can either check in *ibaPDA* in the I/O Manager under *General – Settings* or in the *ibaPDA* service status application whether your license for the interface *ibaPDA-Interface-IEC61850-9-2* has been properly recognized. The number of licensed connections is shown in brackets.

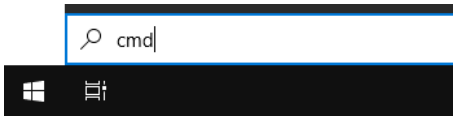
The figure below shows the license for the *Codesys Xplorer* interface as an example.



4.2 Connection diagnostics with PING

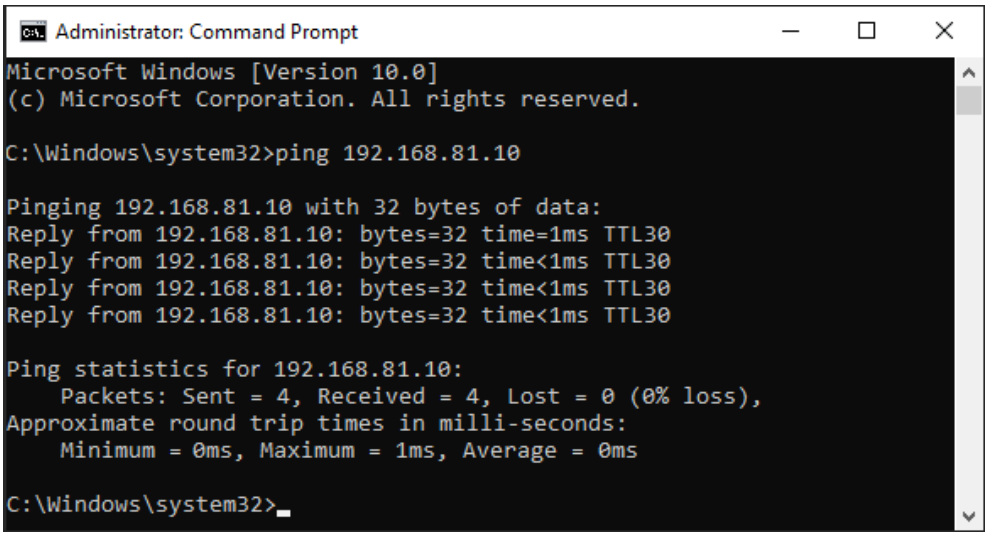
PING is a system command with which you can check if a certain communication partner can be reached in an IP network.

1. Open a Windows command prompt.

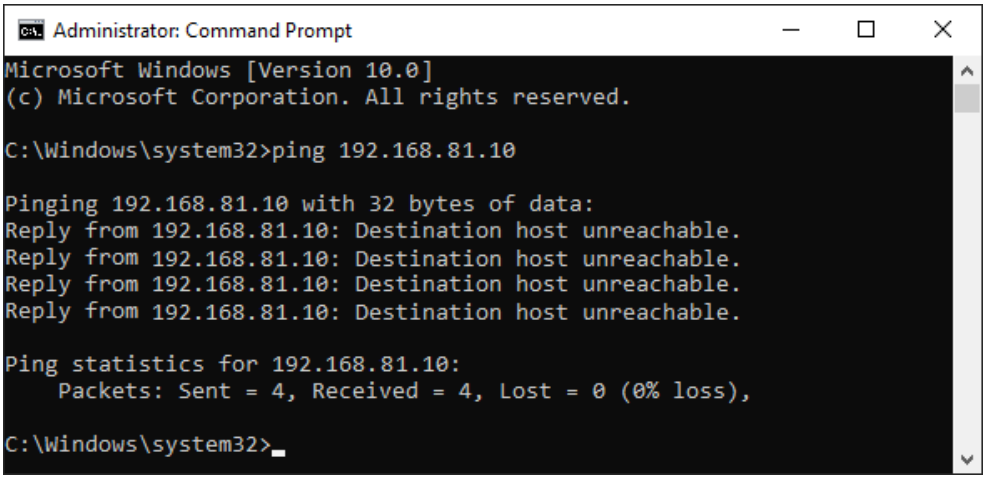


2. Enter the command "ping" followed by the IP address of the communication partner and press <ENTER>.

→ With an existing connection you receive several replies.

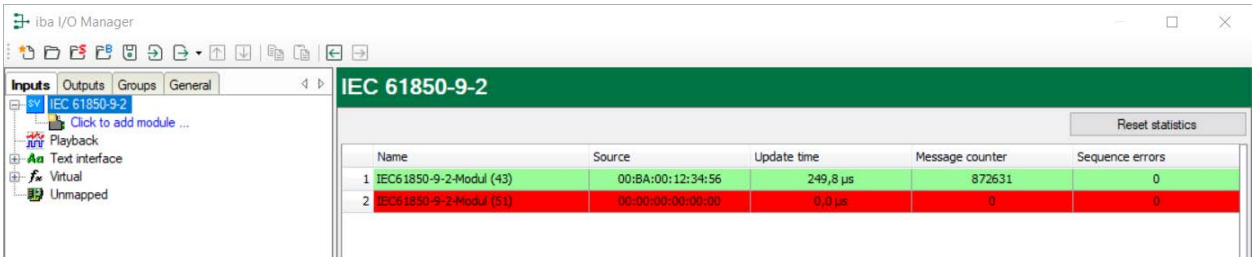


→ With no existing connection you receive error messages.



4.3 Connection table

All Ethernet-based interfaces have a table available in the I/O Manager that shows the status of each connection. Each row represents one connection.



The status of a sampled values stream is shown line-by-line in the connection overview.

The name of the associated module is shown in the *Name* column. *Source* is the MAC address of the sending IEC61850 device. The *Update time* shows the time between individual samples. The *Message counter* specifies the number of messages received. A message may contain several samples, depending on the mode.

The *Sequence errors* counter shows in how many consecutive received messages no consecutive sequence counter was detected.

Click the <Reset counter> button to reset the diagnostic data shown in the connection table.

Additional information is provided by the background color of the table rows:

Color	Meaning
Green	Messages are being received.
Red	No messages are being received.

Table 1: Color code for background colors of the connection table

4.4 Diagnostic modules

Diagnostic modules are available for most Ethernet based interfaces and Xplorer interfaces. Using a diagnostic module, information from the diagnostic displays (e.g. diagnostic tabs and connection tables of an interface) can be acquired as signals.

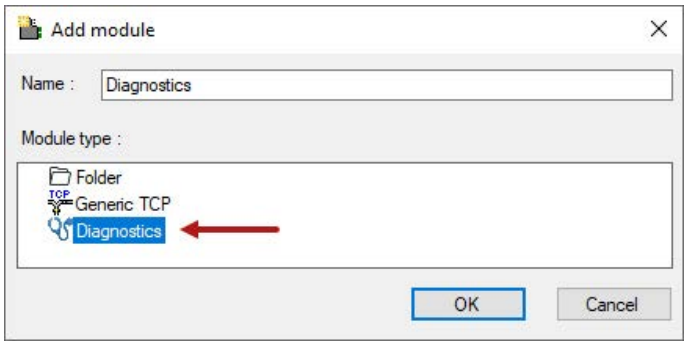
A diagnostic module is always assigned to a data acquisition module of the same interface and supplies its connection information. By using a diagnostic module, you can record and analyze the diagnostic information continuously in the *ibaPDA* system.

Diagnostic modules do not consume any license connections because they do not establish their own connection but refer to another module.

Example for the use of diagnostic modules:

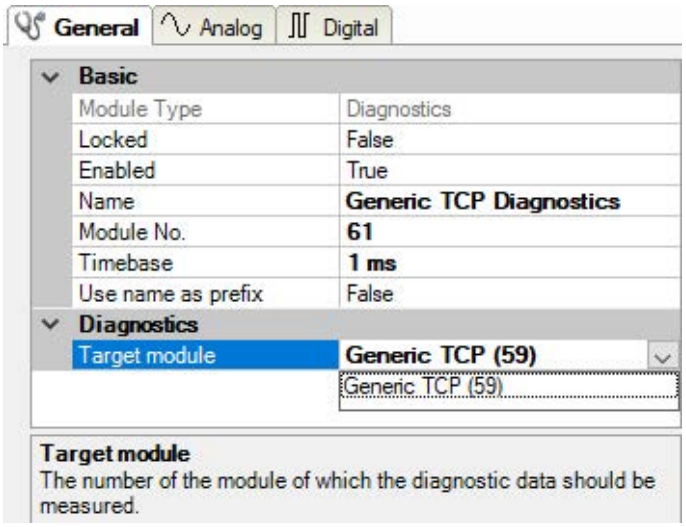
- A notification can be generated, whenever the error counter of a communication connection exceeds a certain value or the connection gets lost.
- In case of a disturbance, the current response times in the telegram traffic may be documented in an incident report.
- The connection status can be visualized in *ibaQPanel*.
- You can forward diagnostic information via the SNMP server integrated in *ibaPDA* or via OPC DA/UA server to superordinate monitoring systems like network management tools.

In case the diagnostic module is available for an interface, a "Diagnostics" module type is shown in the *Add module* dialog (example: Generic TCP).



Module settings diagnostic module

For a diagnostic module, you can make the following settings (example: Generic TCP):



The basic settings of a diagnostic module equal those of other modules.

There is only one setting which is specific for the diagnostic module: the target module.

By selecting the target module, you assign the diagnostic module to the module on which you want to acquire information about the connection. You can select the supported modules of this interface in the drop-down list of the setting. You can assign exactly one data acquisition module to each diagnostic module. When having selected a module, the available diagnostic signals are immediately added to the *Analog* and *Digital* tabs. It depends on the type of interface, which signals exactly are added. The following example lists the analog values of a diagnostic module for a Generic TCP module.

General | Analog | Digital

	Name	Unit	Gain	Offset	Active	Actual
0	IP address (part 1)		1	0	☑	
1	IP address (part 2)		1	0	☑	
2	IP address (part 3)		1	0	☑	
3	IP address (part 4)		1	0	☑	
4	Port		1	0	☑	
5	Message counter		1	0	☑	
6	Incomplete errors		1	0	☑	
7	Packet size (actual)	bytes	1	0	☑	
8	Packet size (max)	bytes	1	0	☑	
9	Time between data (actual)	ms	1	0	☑	
10	Time between data (min)	ms	1	0	☑	

For example, the IP (v4) address of a Generic TCP module (see fig. above) will always be split into 4 parts derived from the dot-decimal notation, for better reading. Also other values are being determined, as there are port number, counters for telegrams and errors, data sizes and telegram cycle times. The following example lists the digital values of a diagnostic module for a Generic TCP module.

General | Analog | Digital

	Name	Active	Actual
0	Active connection mode	☑	
1	Invalid packet	☑	
2	Connecting	☑	
3	Connected	☑	

Diagnostic signals

Depending on the interface type, the following signals are available:

Signal name	Description
Active	Only relevant for redundant connections. Active means that the connection is used to measure data, i.e. for redundant standby connections the value is 0. For normal/non-redundant connections, the value is always 1.
Buffer file size (actual/avg/max)	Size of the file for buffering statements
Buffer memory size (actual/avg/max)	Size of the memory used by buffered statements
Buffered statements	Number of unprocessed statements in the buffer
Buffered statements lost	Number of buffered but unprocessed and lost statements
Connected	Connection is established
Connected (in)	A valid data connection for the reception (in) is available
Connected (out)	A valid data connection for sending (out) is available
Connecting	Connection being established
Connection attempts (in)	Number of attempts to establish the receive connection (in)
Connection attempts (out)	Number of attempts to establish the send connection (out)
Connection ID O->T	ID of the connection for output data (from the target system to *ibaPDA*). Corresponds to the assembly instance number
Connection ID T->O	ID of the connection for input data (from *ibaPDA* to target system). Corresponds to the assembly instance number
Connection phase (in)	Status of the ibaNet-E data connection for reception (in)
Connection phase (out)	Status of the ibaNet-E data connection for sending (out)
Connections established (in)	Number of currently valid data connections for reception (in)
Connections established (out)	Number of currently valid data connections for sending (out)
Data length	Length of the data message in bytes
Data length O->T	Size of the output message in byte
Data length T->O	Size of the input message in byte
Destination IP address (part 1-4) O->T	4 octets of the IP address of the target system Output data (from target system to *ibaPDA*)
Destination IP address (part 1-4) T->O	4 octets of the IP address of the target system Input data (from *ibaPDA* to target system)
Disconnects (in)	Number of currently interrupted data connections for reception (in)
Disconnects (out)	Number of currently interrupted data connections for sending (out)
Error counter	Communication error counter
Exchange ID	ID of the data exchange
Incomplete errors	Number of incomplete messages

Signal name	Description
Incorrect message type	Number of received messages with wrong message type
Input data length	Length of data messages with input signals in bytes (*ibaPDA* receives)
Invalid data points	Number of received data points with missing configuration
Invalid packet	Invalid data packet detected
IP address (part 1-4)	4 octets of the IP address of the target system
Keepalive counter	Number of Keepalive messages received by the OPC UA Server
Lost images	Number of lost images (in) that were not received even after a retransmission
Lost Profiles	Number of incomplete/incorrect profiles
Message counter	Number of messages received
Messages per cycle	Number of messages in the cycle of the update time
Messages received since configuration	Number of received data telegrams (in) since start of acquisition
Messages received since connection start	Number of received data telegrams (in) since the start of the last connection setup. Reset with each connection loss.
Messages sent since configuration	Number of sent data telegrams (out) since start of acquisition
Messages sent since connection start	Number of sent data telegrams (out) since the start of the last connection setup. Reset with each connection loss.
Multicast join error	Number of multicast login errors
Number of request commands	Counter for request messages from *ibaPDA* to the PLC/CPU
Output data length	Length of the data messages with output signals in bytes (*ibaPDA* sends)
Packet size (actual)	Size of the currently received message
Packet size (max)	Size of the largest received message
Ping time (actual)	Response time for a ping telegram
Port	Port number for communication
Producer ID (part 1-4)	Producer ID as 4-byte unsigned integer
Profile Count	Number of completely recorded profiles
Read counter	Number of read accesses/data requests
Receive counter	Number of messages received
Response time (actual/average/max/min)	Response time is the time between measured value request from *ibaPDA* and response from the PLC or reception of the data. Actual: current value Average/max/min: static values of the update time since the last start of the acquisition or reset of the counters.
Retransmission requests	Number of data messages requested again if lost or delayed

Signal name	Description
Rows (last)	Number of resulting rows by the last SQL query (within the configured range of result rows)
Rows (maximum)	Maximum number of resulting rows by any SQL query since the last start of acquisition (possible maximum equals the configured number of result rows)
Send counter	Number of send messages
Sequence errors	Number of sequence errors
Source IP address (part 1-4) O->T	4 octets of the IP address of the target system Output data (from target system to *ibaPDA*)
Source IP address (part 1-4) T->O	4 octets of the IP address of the target system Input data (from *ibaPDA* to target system)
Statements processed	Number of executed statements since last start of acquisition
Synchronization	Device is synchronized for isochronous acquisition
Time between data (actual/ max/min)	Time between two correctly received messages Actual: between the last two messages Max/min: statistical values since start of acquisition or reset of counters
Time offset (actual)	Measured time difference of synchronicity between *ibaPDA* and the ibaNet-E device
Topics Defined	Number of defined topics
Topics Updated	Number of updated topics
Unknown sensor	Number of unknown sensors
Update time (actual/average/ configured/max/min)	Specifies the update time in which the data is to be retrieved from the PLC, the CPU or from the server (configured). Default is equal to the parameter "Timebase". During the measurement the real actual update time (actual) can be higher than the set value, if the PLC needs more time to transfer the data. How fast the data is really updated, you can check in the connection table. The minimum achievable update time is influenced by the number of signals. The more signals are acquired, the greater the update time becomes. Average/max/min: static values of the update time since the last start of the acquisition or reset of the counters.
Write counter	Number of successful write accesses
Write lost counter	Number of failed write accesses

5 Support and contact

Support

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Note

If you need support for software products, please state the number of the license container. For hardware products, please have the serial number of the device ready.

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