ibaBM-eCAT

Bus monitor for EtherCAT®

Manual

Issue 2.1

Measurement Systems for Industry and Energy

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2.1	06-2024	Troubleshooting in case of error message	st	02.05.005

Certification

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

Other international and national standards were observed.

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.

Contents

1 About this documentation

This documentation describes the construction, the use and the operation of the device *ibaBM-eCAT*.

1.1 Target group and previous knowledge

This documentation 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 Programmable Logic Controllers of the supported products. For the handling *ibaBM-eCAT* the following basic knowledge is required and/or useful:

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

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 Introduction

The device *ibaBM-eCAT* can be used for reading and recording data transmitted over an EtherCAT bus with *ibaPDA*. For this purpose, the *ibaBM-eCAT* device is directly integrated into the bus after the EtherCAT MainDevice.

Diagnostics and monitoring of the EtherCAT bus is also possible using the diagnostic signals integrated in the device and the EtherCAT browser.

The settings for the device as well as the configuration of the data to be acquired are performed in the I/O Manager of the program *ibaPDA*. For this purpose a bidirectional fiber optic connection to a computer is required, which is provided by a FO input card of the *ibaFOB-D* familiy (e. g. *ibaFOB-io-D*).

The signal configuration can be retrieved from the EtherCAT configuration of the EtherCAT MainDevice. An export function in the EtherCAT MainDevice is required to generate a configuration file in XML format. This EtherCAT configuration file is imported into *ibaPDA*, allowing the signals to be selected comfortably in the symbol browser of *ibaPDA* with a mouse click.

If no EtherCAT configuration file is available, the values for the acquisition can be selected directly from the EtherCAT bus using an EtherCAT browser.

The EtherCAT browser also contains diagnostic functions for the bus. For example, the individual frames can be analyzed and the cycle and circulation time displayed. A large number of diagnostic signals describing the EtherCAT bus are available to be acquired in *ibaPDA*.

In addition, *ibaBM-eCAT* can be integrated as a SubDevice into the EtherCAT bus configuration and can then be addressed specifically by the EtherCAT MainDevice. In this way, user data can be sent directly from the EtherCAT MainDevice to the bus for being recorded in *ibaPDA*. Those signals are regarded as "outputs" from the EtherCAT bus' view.

The following signal configurations are possible:

- 512 analog signals in each direction (input and output)

  The data formats BYTE, SINT, WORD, INT, DWORD, DINT, REAL, FLOAT and LREAL are supported.

- 512 digital signals in each direction (input and output)

Notes when using as EtherCAT SubDevice

- The maximum number of analog and digital signals is limited to 512 each (outputs), whereby the LREAL data format (64 bit) has to be count as 2 analog signals.
- The overall data volume of the analog and the digital channels 0-7 is limited to 1360 bytes.
- The overall data volume of the analog and the digital channels 8-15 is limited to 1360 bytes.

These three restrictions only apply if the MTU (maximum transmission unit) size is set to the maximum value of 1514 bytes.

A brief overview

- Compact device for recording the communication of an EtherCAT bus
- Integration into the EtherCAT bus directly after the MainDevice, no additional adapters required
- Configuration as EtherCAT SubDevice
- 2 EtherCAT interfaces (MainDevice and SubDevice)
- Configuration with *ibaPDA*
- Transfer of the signal configuration from the EtherCAT configuration file
- Selection of signals directly from the bus via EtherCAT browser
- Maximum of 512 digital and 512 analog signals per direction can be measured exactly with the bus cycle time.
- Support of measured values of the data types BYTE, SINT, WORD, INT, DWORD, DINT, REAL, FLOAT and LREAL
- Rugged housing, DIN-rail mounting

3 EtherCAT – The Ethernet Fieldbus

EtherCAT is a high-performance, low-cost, easy to use Industrial Ethernet technology with a flexible topology. It was introduced in 2003 and has been an international standard since 2007. The EtherCAT Technology Group promotes EtherCAT and is responsible for its continued development. EtherCAT is an open technology: Anyone can implement and use it.

Functional principle

EtherCAT's key functional principle lies in how its nodes processes Ethernet frames: Eeach node reads the data addressed to it and writes its data back to the frame all while the frame is moving downstream. This leads to improved bandwidth utilization (one frame per cycle is often sufficient for communication). There is no need for switches or hubs.

Performance

The special functional principle makes EtherCAT the fastest Industrial Ethernet technology: No other approach can surpass the bandwidth utilization and thus the performance of EtherCAT.

Topology

EtherCAT supports up to 65,535 devices with a completely free choice of topology:

line, branch, tree, star - in any combination. Fast Ethernet physics allows two devices to be up to 100 m (330 ft) apart, and greater distances are possible with the use of fiber optics. EtherCAT also has additional features that offer further topological flexibility, such as Hot Connect and Hot Swap for devices, and added redundancy through a ring topology.

It's versatile

EtherCAT is suitable for both centralized and decentralized system architectures. It can support MainDevice-to-MainDevice, MainDevice-to-SubDevice and SubDevice-to-SubDevice communication as well as incorporate subordinate fieldbuses. At the factory level, the EtherCAT Automation Protocol has communication covered – all with the existing infrastructure.

It's easy

When compared to a classic fieldbus system, EtherCAT is the obvious choice: node addresses can be set automatically, there's no need for network tuning, and onboard diagnostics with fault localization make pinpointing errors a snap. Despite these advanced features, EtherCAT is also easier to use than Industrial Ethernet: there are no switches to configure, and no complicated handling of MAC or IP addresses is required.

It's low-cost

EtherCAT delivers all of the advantages of Industrial Ethernet at fieldbus prices. How? Firstly, EtherCAT doesn't require any active infrastructure components.

The controlling device doesn't require a special interface card and the connected devices use highlyintegrated, cost-effective chips available from a variety of suppliers. Additionally, there's no need for costly IT experts to commission or maintain the system.

Industrial Ethernet

EtherCAT also supports common internet technologies without jeopardizing the network's real-time capability. Its Ethernet over EtherCAT protocol transports FTP, HTTP, TCP/IP, etc.

Functional safety

Safety over EtherCAT is just like EtherCAT itself – lean and fast. Functional safety is built directly into the bus with options for both centralized and decentralized safety logic. Thanks to the Black Channel approach, it is also available for other bus systems.

Open technology

EtherCAT is an internationally standardized open technology, meaning anyone is free to use the technology in a compatible form. However, being an open technology doesn't mean that anyone can arbitrarily change EtherCAT to suit his or her needs. This would be the end of interoperability. The EtherCAT Technology Group, the world's largest fieldbus organization, is responsible for the further development of EtherCAT so it remains both open and interoperable.

It's proven in use

EtherCAT is used worldwide. The variety of providers is unique. EtherCAT is used in machine control, measurement equipment, medical devices, automobiles and mobile machines, as well as in innumerable embedded systems.

4 Scope of delivery

After having unpacked the delivery, please check it for completeness and possible damages.

The scope of delivery comprises:

- Device *ibaBM-eCAT*
- 2-pin plug for power supply
- Data medium "iba Software & Manuals"

5 Safety instructions

Observe the following safety instructions for *ibaBM-eCAT*.

5.1 Intended Use

The device is electrical equipment and may only be used for the following applications:

- Measurement data acquisition and measurement data analysis
- Applications of iba software products (*ibaPDA*, *ibaAnalyzer* etc.)

The device may only be operated in conditions as specified in the technical data, see chapter ↗ *Main data*, page 56.

5.2 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 mearures.

Caution!

Observe the operating voltage range
The device may not be operated at voltages exceeding +24 V DC (±10%). An overly high operating voltage destroys the device!

Caution!

Before working on or dismounting the device, disconnect it from the power supply.

Note

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

Note

To clean the device, use a dry or slightly moistened cloth.

6 System requirements

Observe the following requirements for using the device *ibaBM-eCAT*.

Hardware

For operation

1. 24 V DC (±10%) power supply

For parametrization of the device and for measuring

- PC as recommended for use with *ibaPDA*:
  - At least 1 free PCI/PCIe slot (PC) or ExpressCard slot (notebook)
  - Alternatively: Multicore CPU 2 GHz, 2048 MB RAM, 100 GB HDD

On the iba homepage http://www.iba-ag.com you find suitable computer systems with desktop and industry housing.

- At least one FO input card of type *ibaFOB-D* (firmware version V2.00 build 172 (C2) or later):
  - *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)
  - *ibaFOB-io-USB adapter*
- One *ibaNet* fiber optic patch cable (duplex) for connecting *ibaBM-eCAT* and *ibaPDA*-PC (suitable FO patch cables are also available from iba).

Software

- *ibaPDA* version 8.4.1 or later for measuring and recording data

Firmware

- *ibaBM-eCAT* as of version ·02.05.005

IO Device File (ESI)

- Device-specific ESI file for bus configuration (IBA_eCAT-monitor.xml) Version·1.9 / Revision = 17 or later

7 Mounting and dismounting

In the following, you will learn how to *ibaBM-eCAT* install, connect and remove the device. Also refer to the notes in chapter ↗ *Safety instructions*, page 14.

7.1 Mounting and connecting

Follow the steps below to install and connect the device *ibaBM-eCAT*.

1. Insert the mounting rail clip attached to the device into the DIN-rail.
2. Press the device down in such a way that the clip of the DIN-rail engages with a click.
3. If there is a rule to ground the device, connect the device to the ground.
4. Connect the power supply. Observe the correct polarity.
5. Connect the device to the *ibaPDA* computer via a *ibaNet* fiber optic patch cable (duplex):
   a.) the RX input (X11) of the device with the TX interface of the *ibaFOB-D* card in the *ibaPDA*-PC
   b.) the TX output (X10) of the device with the RX interface of the *ibaFOB-D* card in the *ibaPDA*-PC
6. Connect the EtherCAT MainDevice to the EtherCAT MainDevice interface of the device (X40) via Ethernet cable.
7. Connect the first EtherCAT SubDevice to the EtherCAT SubDevice interface of the device (X41) via Ethernet cable.
8. When all cables are connected, switch on the device.

7.2 Dismounting

Follow the steps below to dismount the device *ibaBM-eCAT*.

Caution!

Before working on or dismounting the device, disconnect it from the power supply.

1. Disconnect the grounding.
2. Remove all cables.
3. Close the free inputs and outputs of the fiber optics connection with a cover.
4. Secure the device to prevent it from falling down and press the device down slightly.
5. Pull the device towards you and lift it up.

→ The clip of the DIN-rail will disengage with a click.

6. Remove the device.

Note

When storing or transporting the device observe the values specified in the technical data, see ↗ *Main data*, page 56.

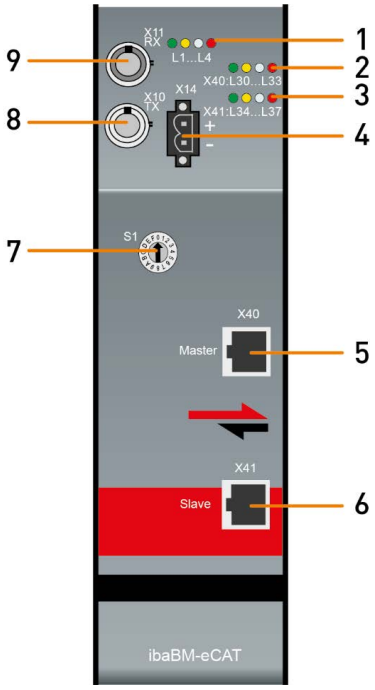
8 Device description

Here you will find views and descriptions of the device *ibaBM-eCAT*.

8.1 Views

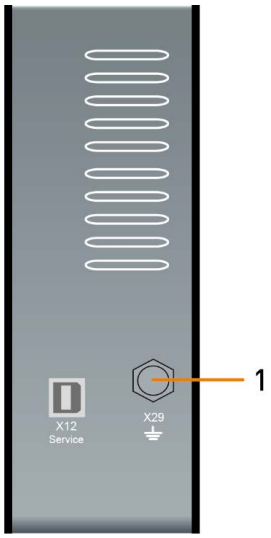
The following views show the operating and display elements, as well as the connections of the device *ibaBM-eCAT*.

Front view



1	Operating status indicator L1…L4	6	Connection EtherCAT SubDevice X41
2	Display EtherCAT bus L30…L33	7	Rotary switch S1
3	Display device functions L34…L37	8	Connection FO output (TX) X10
4	Connection power supply 24 V X14	9	Connection FO input (RX) X11
5	Connection EtherCAT MainDevice X40		

Bottom view



1 Grounding screw X29

(USB interface X12 for service purposes only)

8.2 Operating and indicating elements

LED indicators with different colors show the operating status and the state of the EtherCAT connections.

8.2.1 Operating status

The following overview shows the possible operating states of the device *ibaBM-eCAT*.

LED	State	Description
L1 (green/ red)	off	Out of operation, no power supply
	flashes green (1 Hz)	Ready for operation
	on (red)	Start-up sequence; once the device has booted, the LED changes to green
L2 (yellow)	off	no measurement
	on	Measurement in progress
L3 (white)	off	no data reception at X11
	on	data reception at X11 OK
	flashing	data reception at X11, but signal is wrong
L4 (red)	off	Normal state, everything OK
	flashing	Error occurred within the device

8.2.2 EtherCAT bus

The following overview shows the possible states of the EtherCAT bus.

LED	State	Description
L30	off	device not active
	flashing	device active
L31	on	plausible EtherCAT frames recognized
L32	off	no measuring values requested
	flashing rapidly	measuring values requested, but none found
	flashing slowly	measuring values requested, but not all found
	on	measuring values requested, all are available
L33	on	faulty EtherCAT frames detected

8.2.3 Device functions

The following overview shows the possible states of the device functions for the device *ibaBM-eCAT*.

LED	Display	State
L34	off	device not enabled as EtherCAT SubDevice
	on	device enabled as EtherCAT SubDevice
L35	off	EtherCAT SubDevice status "INIT"
	flashing rapidly	EtherCAT SubDevice status "PRE-operational"
	flashing slowly	EtherCAT SubDevice status "SAFE-operational"
	on	EtherCAT SubDevice status "Operational"
L36	off	no optimization of data extraction
	on	Optimization of data extraction
L37		reserved for future functions

8.2.4 Rotary switch S1

With *ibaNet* 32Mbit Flex protocol, it is possible to connect up to 15 devices to a ring topology. The devices are addressed via the S1 rotary switch.

Device number in the cascade	Position of the rotary switch
not permitted	0
1. device	1*
2. device	2
…	…
14. device	E
15. device	F

* factory setting

Note

If the rotary switch position is "0", the connection is interrupted in delivery state.

However, it is possible to configure the device with a predefined FO signal configuration using the *ibaNet* protocol 32Mbit when the rotary switch position is "0".

For further information see chapter ↗ *FO configuration using 32Mbit ibaNet protocol (StaticFO)*, page 63.

8.3 Connections

You will find the following connections and interfaces on the device *ibaBM-eCAT*.

8.3.1 Power supply X14

The *ibaBM-eCAT* device requires an external 24 V DC (±10%) power supply (unregulated) and should be operated at a maximum of 0.7 A. The operating voltage should be run through the provided 2-pin Phoenix threaded coupling connector. If desired, you can order DIN-rail or plug-in power supply units from iba.

8.3.2 EtherCAT MainDevice and EtherCAT SubDevice X40, X41

EtherCAT connections to the MainDevice and to the first SubDevice:

- X40 for the connection to the MainDevice
- X41 for the connection to the first SubDevice

Connection technology: EtherCAT 100 Mbit/s with RJ45 plug.

8.3.3 Fiber optic connections X10, X11

The following fiber optic connections are available for the connection to the *ibaPDA* system:

- X11 (RX): FO- receive interface
- X10 (TX): FO- send interface

The device supports the 32Mbit Flex fiber optic transmission protocol. A bidirectional FO connection is required to the *ibaPDA*. A fiber optic card of type *ibaFOB-D* or *ibaFOB-Dexp* must be installed in the *ibaPDA* computer in order to receive and transmit data.

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 ↗ *Example for FO budget calculation*, page 60.

The specification of the transmitter's output power and the receiving sensitivity of the fiber optic components installed in the device can be found in chapter ↗ *Main data*, page 56 "Technical data" under "ibaNet interface".

8.3.4 Grounding screw X29

For interference reasons, it may be necessary to connect the overall shield of the input cable or input cables to the grounding screw (M6) on the underside of the device. Use an M6 cable lug for the connection.

Caution

Only connect the shields to the device **on one side**, e. g. to avoid earth loops via the sensor housing.

Always ground the DIN-rail on which the device is installed.

9 System integration

To use the full range of functions, *ibaBM-eCAT* is integrated into the EtherCAT bus. For further information see chapter ↗ *Integration into the EtherCAT bus*, page 23.

In addition, there are other integration options with the corresponding advantages.

- ↗ *Integration as single/last EtherCAT device*, page 24
- ↗ *Integration without interference*, page 25
  - as sniffer
  - as SubDevice
  - as sniffer and SubDevice

Note the special features of each option.

Note

iba ensures perfect acquisition of EtherCAT data only for systems with a single EtherCAT cycle.

EtherCAT bus with multiple bus cycles
For an EtherCAT bus with two or more bus cycles, the data of all bus cycles can be acquired in most cases if the signals are selected via an EtherCAT configuration file (see chapter ↗ *First steps for the configuration in ibaPDA*, page 28, step 3).

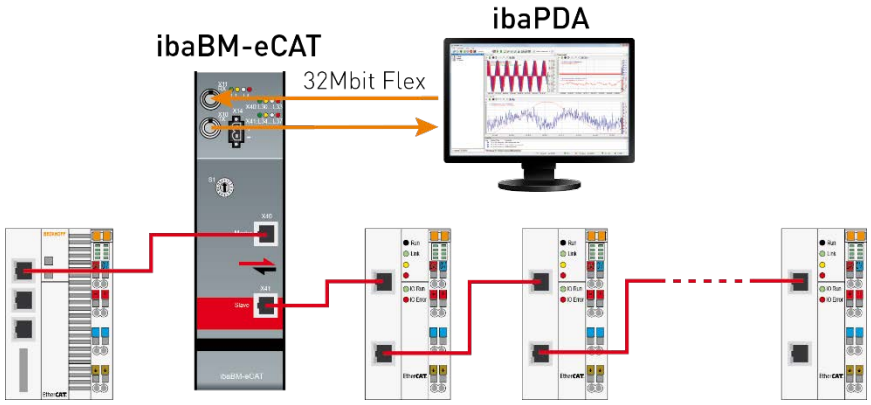
Only one EtherCAT cycle can be displayed in the EtherCAT browser!

Usually, always the cycle with the shortest cycle time is displayed. In rare cases, however, the display in the EtherCAT browser can also flicker between bus cycles.

9.1 Integration into the EtherCAT bus

The *ibaBM-eCAT* device is integrated into the EtherCAT bus directly after the EtherCAT MainDevice. The device provides 2 EtherCAT connections that are galvanically isolated from each other. The EtherCAT interface X40 is connected to the EtherCAT MainDevice, the EtherCAT interface X41 to the first SubDevice.

In this configuration, up to 512 analog and 512 digital signals can be acquired in each direction (in total max. 4096 bytes). If more signals are required, several *ibaBM-eCAT* devices can be connected in series directly after the MainDevice into the EtherCAT bus.



Caution

Switching off the *ibaBM-eCAT* device interrupts the EtherCAT connection between the MainDevice and the SubDevices.

Note

If it is not possible to integrate the device between the MainDevice and the first SubDevice, it can also be integrated elsewhere in the bus or even at the end.

However, not all I/O signals of the bus can be acquired with this configuration.

9.2 Integration as single/last EtherCAT device

Note

ibaBM-eCAT can only be operated at the bus end if it has been configured as an EtherCAT SubDevice and the option "Single/last device" has been enabled.

The *ibaBM-eCAT* device is connected to another free EtherCAT interface of the MainDevice system at the end of the bus as the last or the only device.

The EtherCAT connection X40 is connected to the last SubDevice / the last EtherCAT coupler or to the EtherCAT MainDevice, the EtherCAT connection X41 remains unconnected.

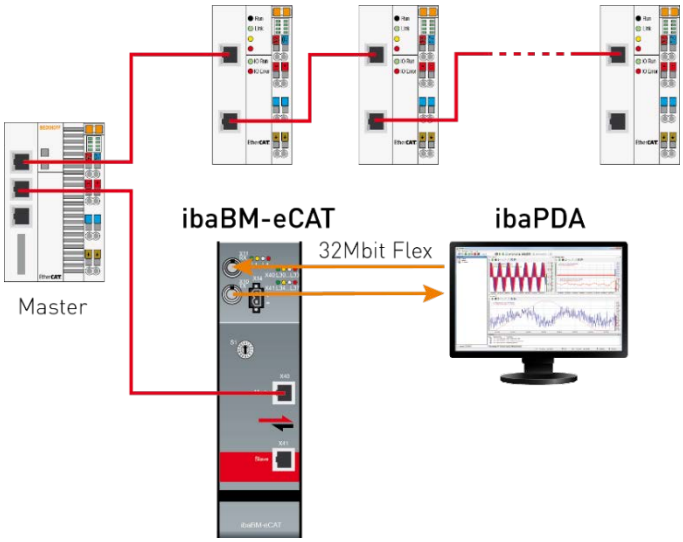
Note

An existing EtherCAT bus is not changed here.

However, not all I/O signals from this EtherCAT bus can be acquired in this configuration "as last device".

All signal, that are to be reliably recorded via *ibaBM-eCAT* must be addressed directly to the device as output signals in the control system. To do this, *ibaBM-eCAT* must be configured as EtherCAT SubDevice and integrated into the EtherCAT configuration..

This allows 512 analog and 512 digital output signals to be acquired (max. 2 x 1360 bytes).



(The figure only shows the integration as "single device").

9.3 Integration without interference

The integration into the EtherCAT bus is not completely without interference for the bus.

For further information on the integration see chapter ↗ *Integration into the EtherCAT bus*, page 23.

Even if the device is only configured and used as a sniffer, *ibaBM-eCAT* behaves like an EtherCAT device. The device refreshes the bus signal and also interrupts the bus when it is switched off.

If *ibaBM-eCAT* still needs to be used without interference for the EtherCAT bus, it is possible to integrate an Ethernet TAP.

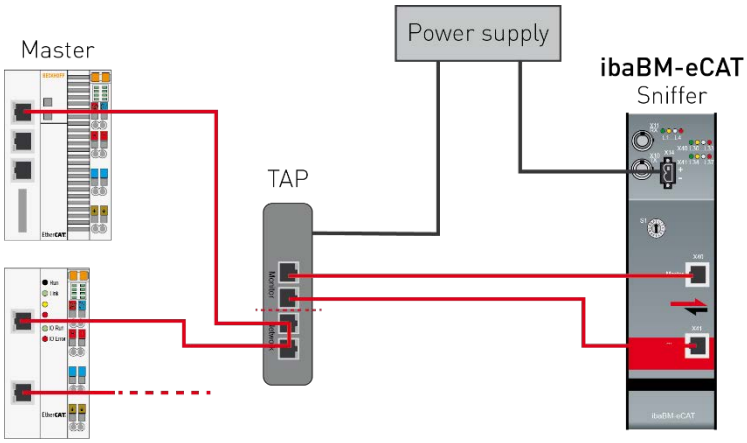
iba AG recommends the Ethernet TAP from Profitap:

iba order no.	Description
19.000030	Network TAP device / Profitap Copper TAP C1D-100

9.3.1 Integration without interference as sniffer

For an integration without interference as sniffer, the Ethernet TAP is integrated into the EtherCAT bus directly after the EtherCAT MainDevice instead of the *ibaBM-eCAT* device.

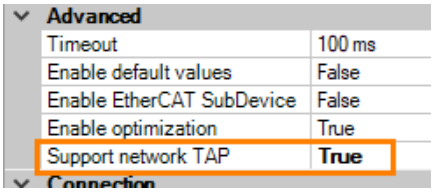
ibaBM-eCAT is connected to the two free monitor ports of the TAP:



If the supply voltage of the *ibaBM-eCAT* device and/or the Ethernet TAP is switched off, the EtherCAT bus continues to work without restrictions.

Note

The option *Support network TAP* must be activated in the *ibaPDA* configuration for a reliable operation:



This ensures that after a restart of the MainDevice the send and receive directions of the EtherCAT bus are detected at the corresponding ports of the *ibaBM-eCAT*.

In this case, the "Switching for network TAP" diagnostic signal indicates whether a switchover has taken place for correct detection.

9.3.2 Integration without interference as SubDevice

With *ibaBM-eCAT* as a SubDevice, there can be no integration without interference, as the device becomes a participant in the EtherCAT bus.

If *ibaBM-eCAT* is integrated as the only or last device, it is almost without interference for the EtherCAT bus.

For further information see chapter ↗ *Integration as single/last EtherCAT device*, page 24.

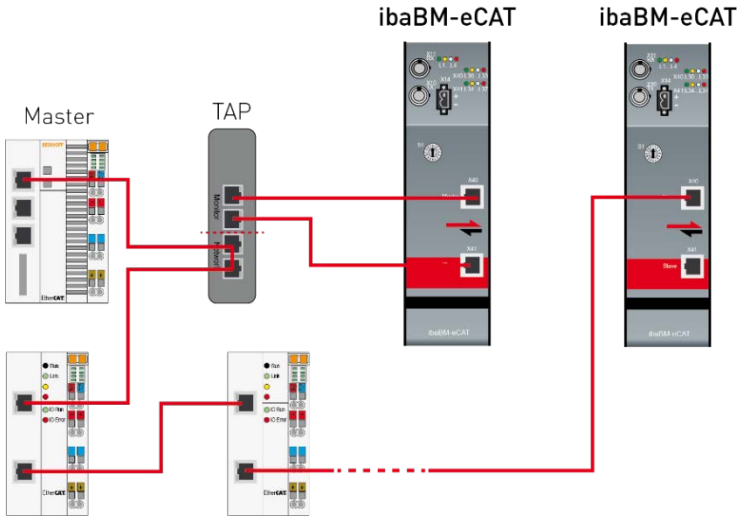
Note

With this integration, not all I/O signals from the EtherCAT bus can be acquired. Only the signals (outputs) directly addressed to *ibaBM-eCAT* are reliably acquired.

9.3.3 Integration without interference as sniffer and SubDevice

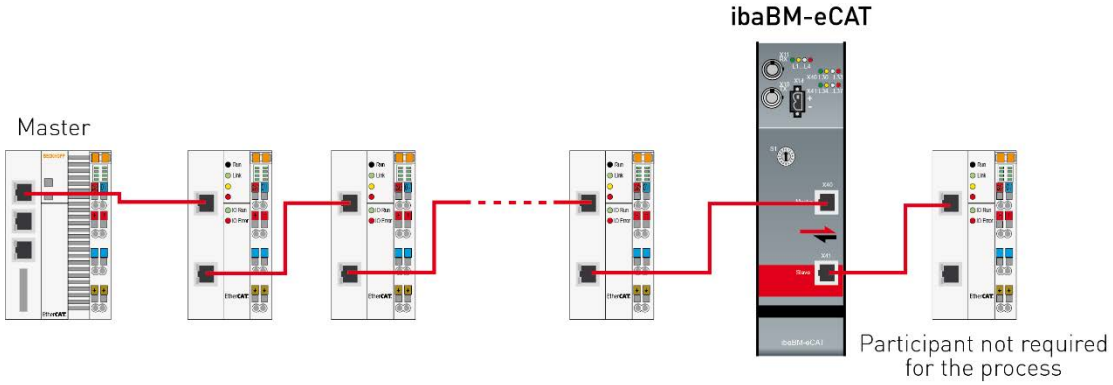
In order to acquire all I/O signals without interference (sniffer) and to integrate the device almost without interference as EtherCAT SubDevice, two *ibaBM-eCAT* devices can be used as first alternative.

One of the devices is connected as a sniffer via an Ethernet TAP, the other device is attached to the end of the bus with the SubDevice functionality:



For further information see chapter ↗ *Integration as single/last EtherCAT device*, page 24.

As a second alternative, the integration without interference is also possible with an *ibaBM-eCAT* device and additional EtherCAT hardware. *ibaBM-eCAT* is connected to the last EtherCAT port of the system with a participant that is not required for the process:



If *ibaBM-eCAT* is switched off, the EtherCAT coupler in front of the *ibaBM-eCAT* device ensures that the EtherCAT bus continues to work without interference.

Note

With this integration, not all I/O signals from the EtherCAT bus can be acquired.

10 Configuration with ibaPDA

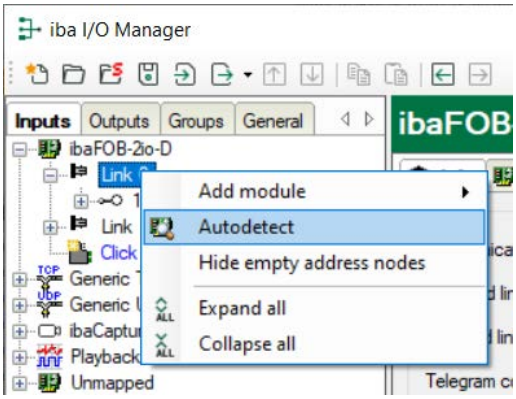
ibaPDA is used to configure the analog and digital signals that are to be captured and recorded.

10.1 First steps for the configuration in ibaPDA

Use the following instructions to add *ibaBM-eCAT* to *ibaPDA* and make basic settings. You will find a detailed description of the device module "ibaBM-eCAT" and the different modules starting with chapter ↗ *Modules in the I/O Manager*, page 36.

1. Start *ibaPDA* and open the I/O Manager.
2. In the I/O Manager, search for the corresponding FOB-D card to which *ibaBM-eCAT* is connected. Click on the link with the right mouse button and select *Autodetect*.

→ If the device is connected correctly, the “ibaBM-eCAT" module is displayed below the link of your *ibaFOB-D* card. The slot number corresponds to the device address, which is set on the rotary switch S1.



Note

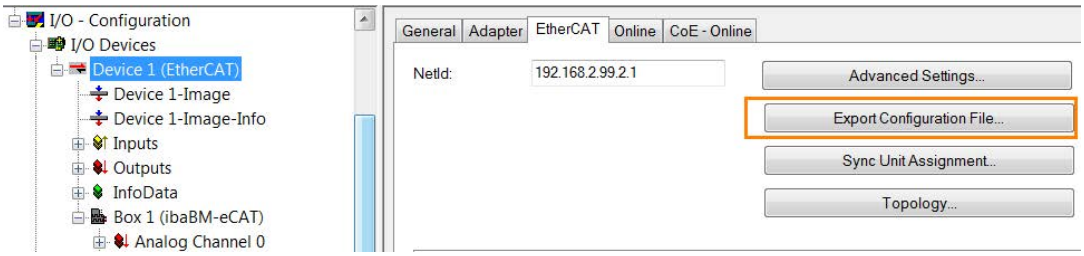
If a configuration has already been saved in the device, it is read out with the "Autodetect" function.

If there is no connection to the *ibaBM-eCAT* device at the time of configuration, you can add the device module and the modules manually (*Add module*) and parameterize them.

3. If your EtherCAT MainDevice provides an export function for the EtherCAT configuration, export it. The EtherCAT configuration file must be in XML format.

   This step is necessary if the symbol browser is to be used for convenient signal selection.

   For example, you will find the export function for Beckhoff TwinCAT V2 at the following location:

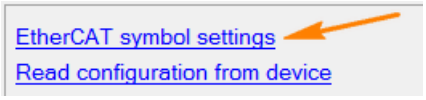


Note

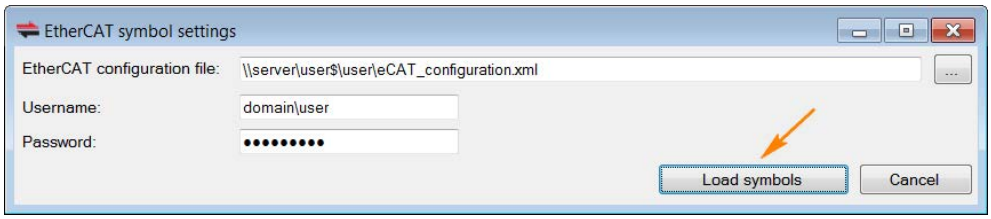
If *ibaBM-eCAT* is to be used as EtherCAT SubDevice, the device must be integrated into the EtherCAT configuration before export, see chapter ↗ *Configuration as EtherCAT SubDevice*, page 31.

If no EtherCAT configuration file is available, you can use the EtherCAT browser to select signals for acquisition, see chapter ↗ *Selecting signals in the EtherCAT browser*, page 45.

4. To load the EtherCAT configuration file into *ibaPDA*, click on the "EtherCAT symbol settings" link in the *General* tab of the added "ibaBM-eCAT" module.



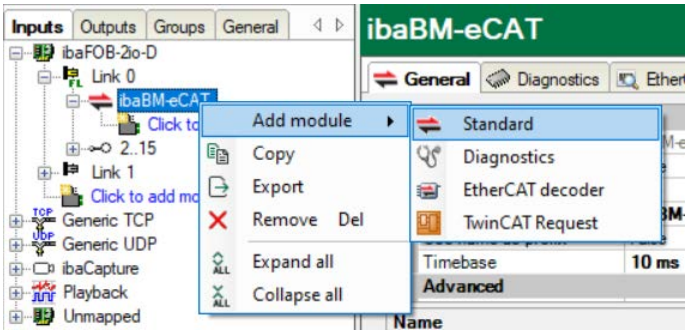
5. Select the EtherCAT configuration file. Either enter the path directly or open the file browser using the <...> button to select the file.



If the EtherCAT configuration file is located on an external computer and a user ID is required for access, enter the UNC path, user name and password.

6. Confirm your entries with <Load symbols>.
7. Add a “Standard“ module. To do this, right-click on the "ibaBM-eCAT" link and select *Add module - Standard*.

   Alternatively, click on the link "Click to add module..." and select *Standard*.

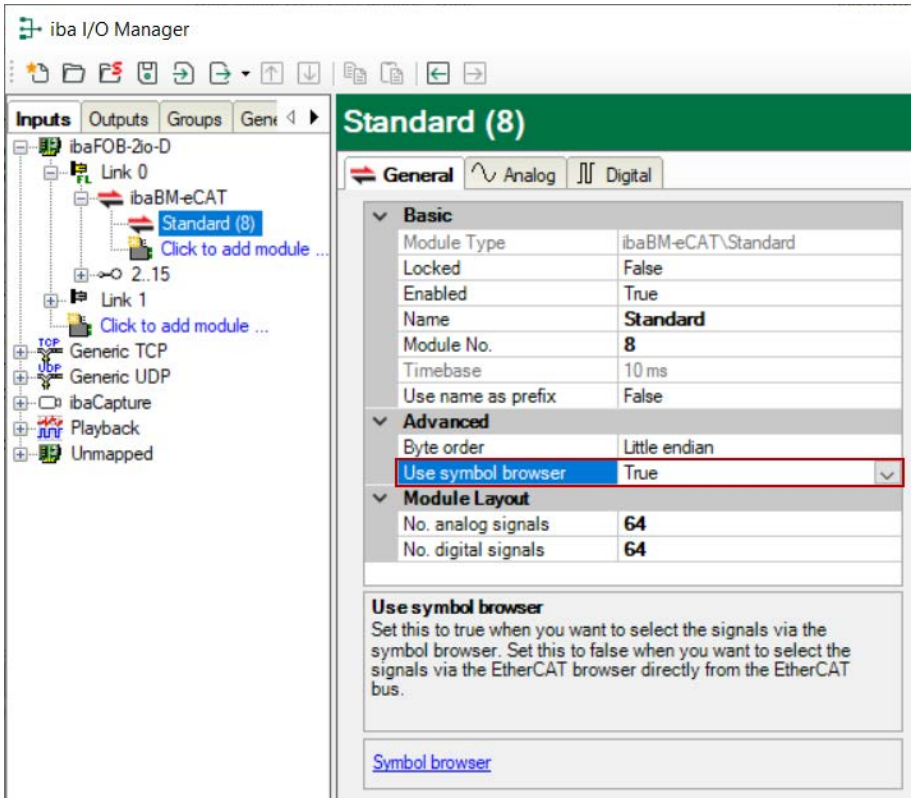


10.2 Configuration as EtherCAT sniffer

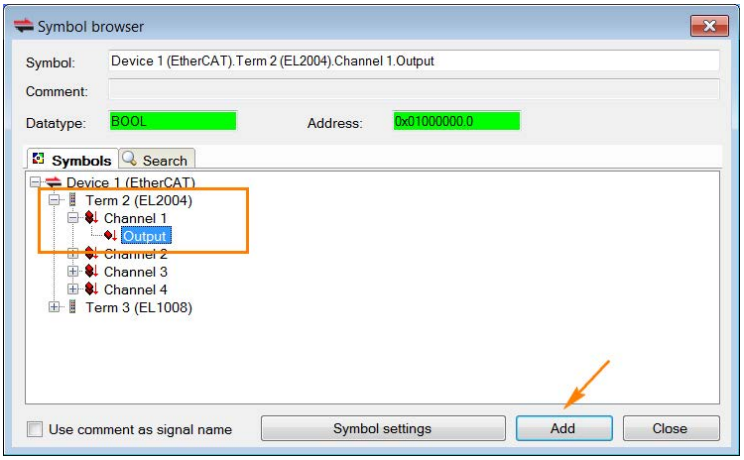
By default *ibaBM-eCAT* is preset for the sniffer functionality and the “Standard” module for signal selection via symbol browser.

The following further steps are based on this:

1. To select the signals to be acquired with the symbol browser, click on the "Symbol browser" link in the *General* tab of the "Standard" module.



→ The symbol browser window will be opened:



2. In the tree structure, select the terminals whose signals should be recorded.
   a.) Open the terminal symbol and select the signal.
   b.) Double-click on the signal or click on the <Add> button to add the signals to the corresponding signal list (analog or digital) of the "Standard" module.

Note

A signal must not be selected twice, otherwise you will receive an error message when validating the I/O configuration in *ibaPDA*.

3. When you have selected all desired signals, close the window with <Close>. If required, you can add further signals later at any time.
4. To apply the settings, click <OK>.

→ *ibaPDA* validates the configuration. If the configuration is free of errors, it is applied by *ibaPDA* and transferred to the device. Now, the selected signals can be displayed and recorded by *ibaPDA* as usual.

10.3 Configuration as EtherCAT SubDevice

The option *EtherCAT SubDevice* must be enabled in *ibaPDA* and the device must be integrated into the EtherCAT configuration to configure the device as an EtherCAT SubDevice. For this the "IO-Device-File", also called ESI file, is imported from the supplied data medium into the EtherCAT MainDevice. The signals are then configured and linked so that they are also available for selection in the EtherCAT configuration file.

The IO-Device file can be found on the data medium "iba Software & Manuals" in the directory `02_iba_Hardware\ibaBM-eCAT\01_IO-Device-File`.

10.3.1 Integration into EtherCAT configuration

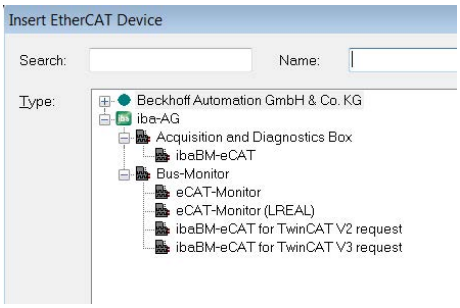
The following description refers to the EtherCAT MainDevice "TwinCAT System Manager V2" from Beckhoff. The procedure for other EtherCAT systems is similar.

1. Import the IO device file into your EtherCAT MainDevice.

   In the following example it is copied into the program directory under `...\IO\EtherCAT\`.

2. Restart EtherCAT MainDevices.

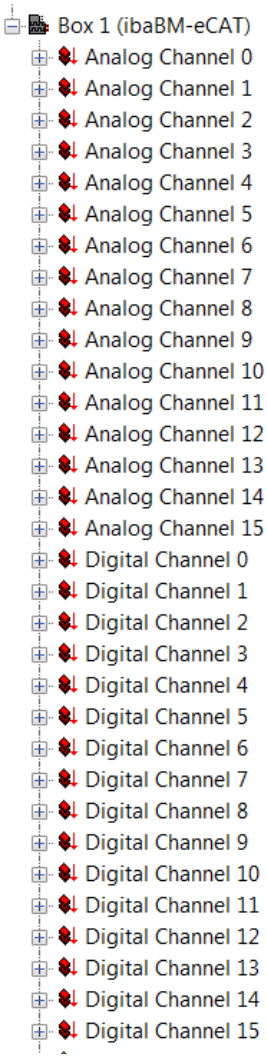
   ibaBM-eCAT is available as an EtherCAT SubDevice for integration into the EtherCAT configuration.

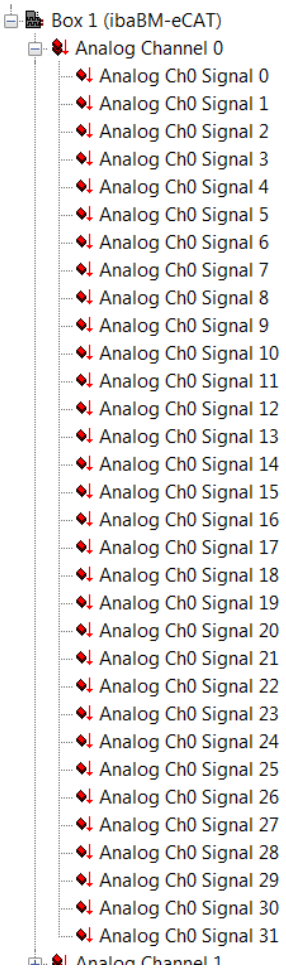


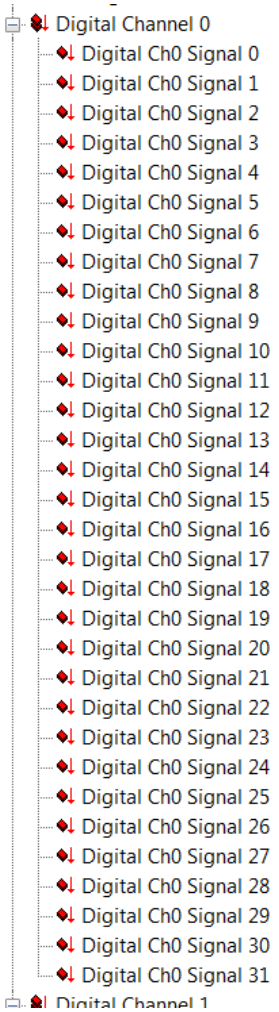
All devices below the group "Bus Monitor" are special types of our bus monitor and are not required for standard operation.

3. Select "ibaBM-eCAT" and integrate the device into the EtherCAT bus by clicking on <OK>.

   16 analog (Analog Channel 0...15) and 16 digital (Digital Channel 0...15) channels with 32 signals each are now available per device.



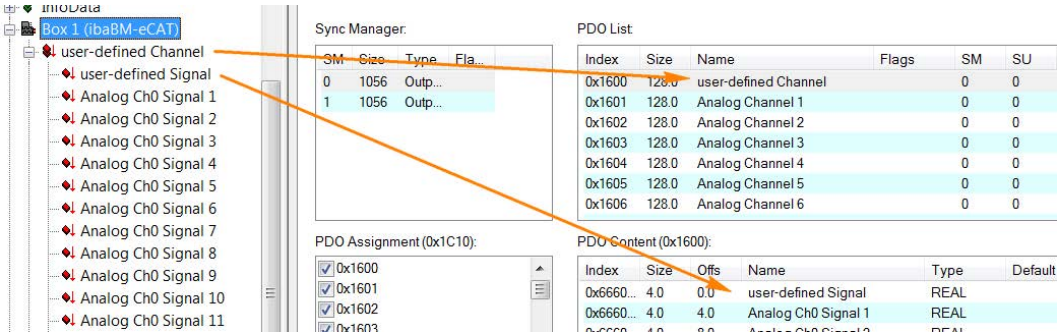




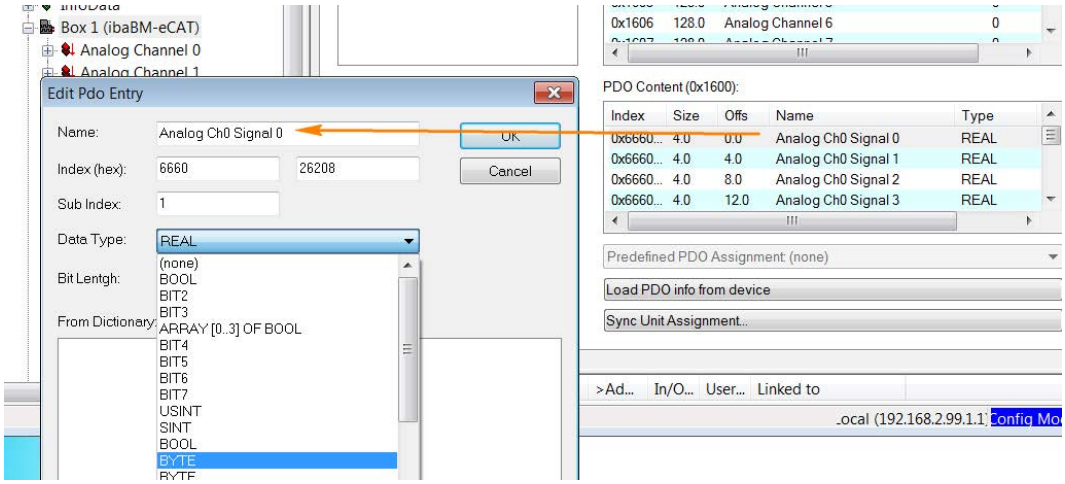
4. You can reduce the number of signals channel by channel. To do this, deactivate the respective channel at the corresponding point in the EtherCAT configuration.

   In our example: Disabling the PDO assignment 0x1600 deletes the Analog Channel 0.

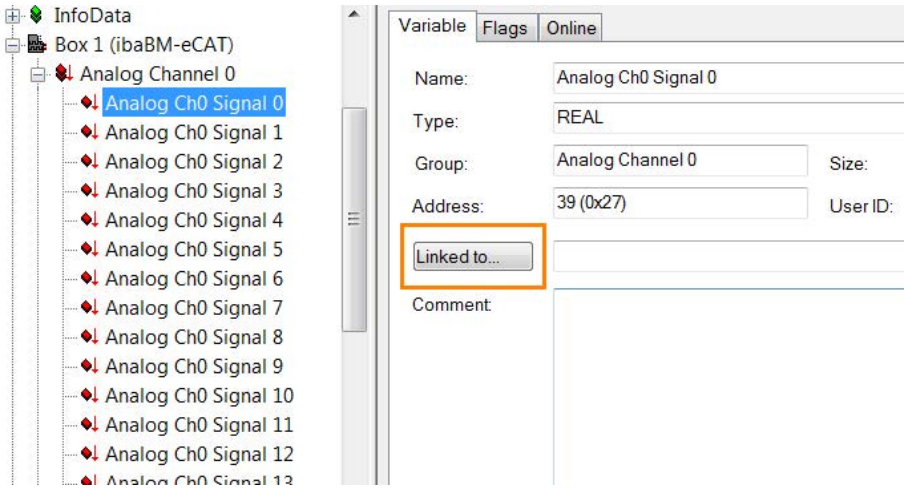
5. Optionally change the channel and signal names.



6. If you require a data type other than the default (REAL) for the analog signals, you can change the data type.



7. Configure and link the signals as for the other SubDevices. Refer to the notes in chapter ↗ *IO Device File (ESI) < Version 1.7*, page 63.

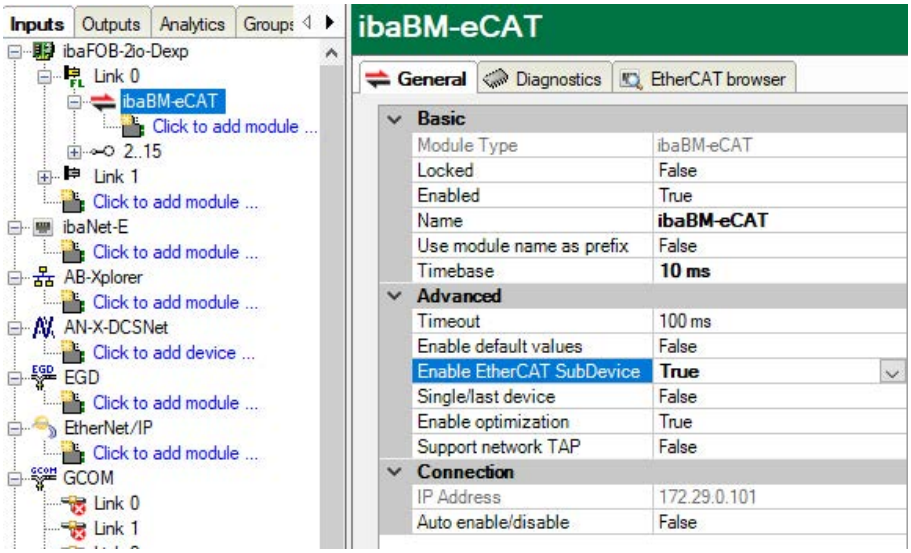


8. For a comfortable signal selection using the symbol browser, export the finished EtherCAT configuration by clicking on <Export configuration file...> and import it into *ibaPDA*, see chapter ↗ *Integration into the EtherCAT bus*, page 23.

10.3.2 Enabling in ibaPDA

For the operation of *ibaBM-eCAT* as EtherCAT SubDevice the device must be enabled.

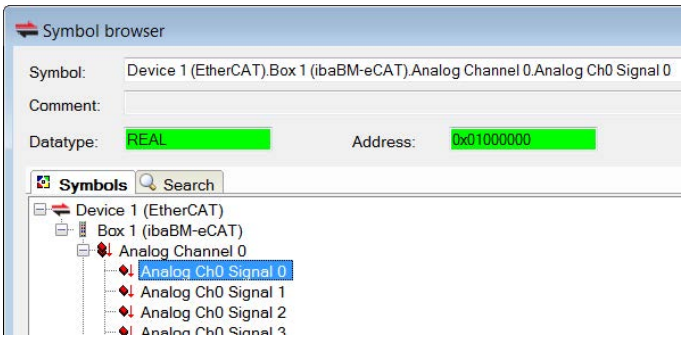
➲ In the I/O Manager, open the *General* tab of the "ibaBM eCAT" device module and select the "True" option in the *Enable EtherCAT SubDevice* field.



When the SubDevice functionality is activated, the configuration field of the single or last EtherCAT device is displayed.

If you want to operate *ibaBM-eCAT* with this type of integration, also set this option to "True". For further information see chapter ↗ *System integration*, page 23.

→ The signals previously exported from the EtherCAT MainDevice are now available in the "Standard" module via symbol browser and can be selected as described in chapter ↗ *Configuration as EtherCAT sniffer*, page 30.



10.4 Modules in the I/O Manager

Below you find a description of the device module “ibaBM-eCAT” and the modules “Standard”, “EtherCAT decoder” and “Diagnostics”.

Other documentation

The description for the "TwinCAT Request" module can be found in the manual for the software product *ibaPDA-Request-TwinCAT*.

Further operating options can be found in the corresponding chapter in the manual for *ibaPDA*.

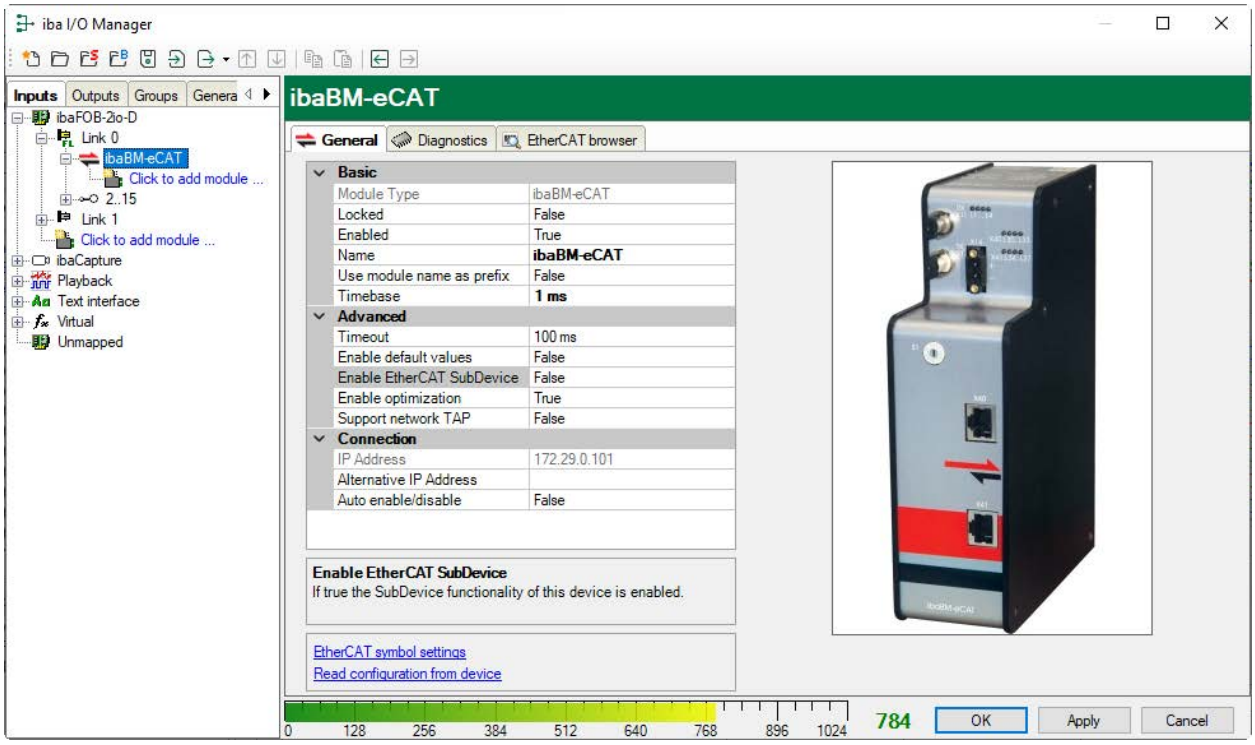
10.4.1 Device module ibaBM-eCAT

To operate *ibaBM-eCAT* with *ibaPDA*, the device must be set up in the I/O Manager of *ibaPDA*. For further information see chapter ↗ *First steps for the configuration in ibaPDA*, page 28.

The device module "ibaBM-eCAT" has 5 different tabs. The *General*, *Diagnostics* and *EtherCAT browser* tabs are always visible. The *Analog* and the *Digital* tab contain dynamic online views of the analog and digital signals acquired by the device. Both tabs are only visible after modules have been added.

10.4.1.1 ibaBM-eCAT – General tab

In the *General* tab, make the basic settings, advanced settings and connection settings for the "ibaBM-eCAT" device module.



Basic settings

Module type
Indicates the type of the current module.

Locked
A module can be locked in order to prevent accidental or unauthorized changes in the module settings.

Enabled
Disabled modules are excluded from signal acquisition.

Name
Module name By default, the name corresponds to the module type.

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

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

Advanced

Timeout
The *Timeout* specifies the maximum time between two EtherCAT frames before the connection is considered to be broken. If the *Timeout* is set to 0, monitoring is disabled and the last value remains valid.

Enable default values
If this option is enabled (True), the device will send the default values in the event of a connection failure of the EtherCAT bus. The default values can be specified in the *Analog* and *Digital* tabs of the "Standard" module (see also chapter ↗ *Standard – Analog and Digital tab*, page 47). If the option is not enabled (False), the last signal value received will be sent repeatedly.

Enable EtherCAT SubDevice
If this option is enabled (True), the SubDevice functionality will be enabled in *ibaBM-eCAT*. This allows the device to be addressed directly by the EtherCAT MainDevice, provided it has been integrated into the EtherCAT configuration, see chapter ↗ *Configuration as EtherCAT sniffer*, page 30. If this option is not enabled (False), *ibaBM-eCAT* is operated as an EtherCAT sniffer.

Single/last device
Only available with enabled EtherCAT SubDevice.

Enable this option (True), if you want to use the device as a single SubDevice in the EtherCAT bus or as the last in the bus.

Enable optimization
By default, data extraction optimization is enabled. Disable this option (False) if you do not want to or cannot use the optimization, e. g. for a Hot Connect or other flexible EtherCAT configurations. See also chapter ↗ *Optimization of data extraction*, page 54.

Support network TAP
Enable this option when a TAP is used to connect the device to the EtherCAT network.

Connection

IP address
The IP address is determined by the slot number, the link number of the *ibaFOB* card and the device number the device is set to. *ibaPDA* sends configuration data and reads diagnostic data via a TCP/IP connection, which is realized in the FO protocol. The IP address cannot be changed.

Auto enable/disable
If the value is TRUE, the data acquisition is started even though the device is miss-ing. The missing device is temporarily disabled in the configuration. During the measurement process, *ibaPDA* tries to re-establish the connection to the missing device. If this is successful, the measurement is restarted automatically including the device that has been missing.

If the value is FALSE, the measurement will not be started, in case *ibaPDA* cannot establish a connection to the device.

Several links are available in the field at the bottom of the *General* tab:

- "EtherCAT symbol settings"

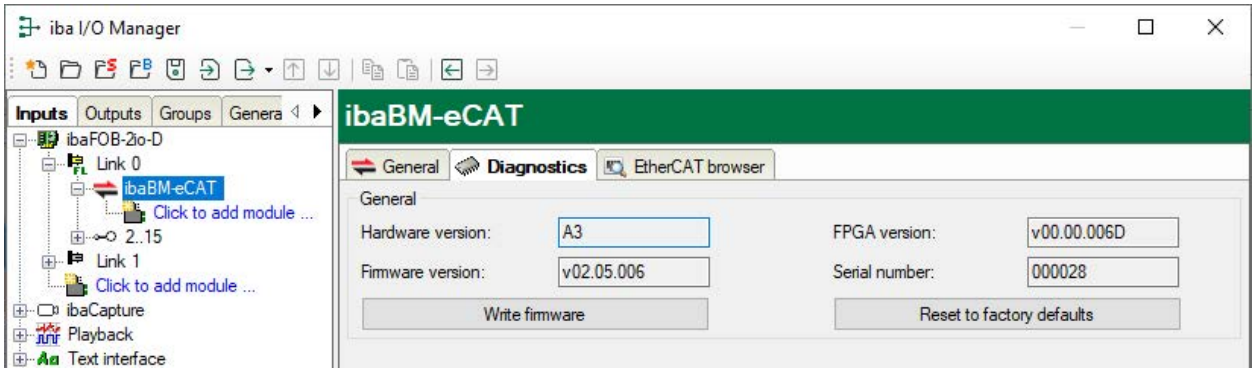
  Using this link you can import the EtherCAT configuration file. See also chapter ↗ *First steps for the configuration in ibaPDA*, page 28.

- "Read configuration from device"

  With this command it is possible to read a configuration for ibaBM-eCAT directly from the device.

10.4.1.2 ibaBM-eCAT – Diagnostics tab

The *Diagnostics* tab contains information on the hardware, firmware and FPGA version of your device as well as the serial number.



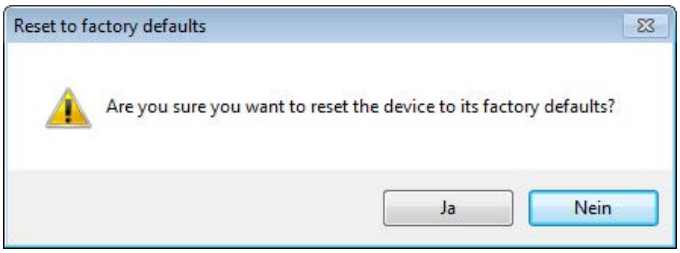
Write firmware
With this button it is possible to perform firmware updates. Select the update file `bmecat_xxx.iba` in the browser and start the update with <OK>.

Note

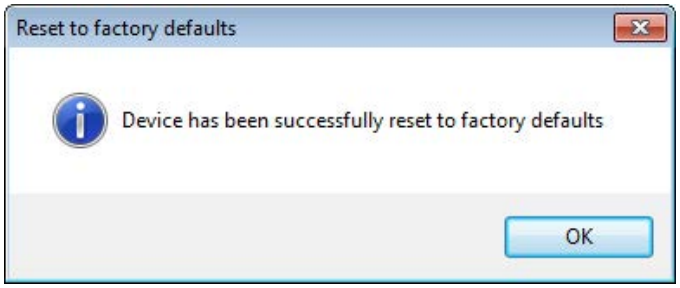
The update takes approx. 30 s and must not be interrupted. After an update the device will be automatically rebooted.

Reset to factory defaults
This button resets all settings to the factory settings.

1. To reset the settings to the factory settings, confirm the following query with <Yes>.



→ You will receive the following message.

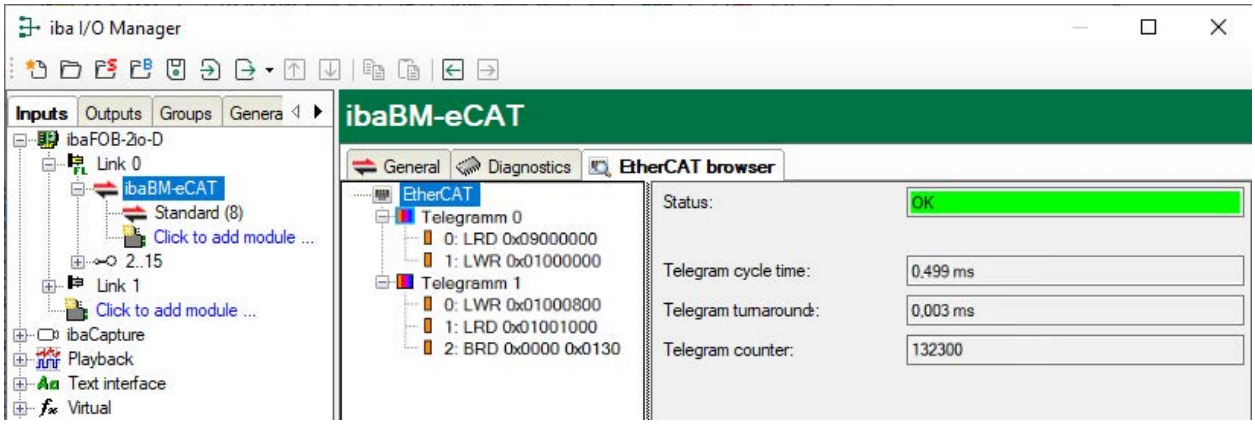


2. Exit the procedure with <OK>.

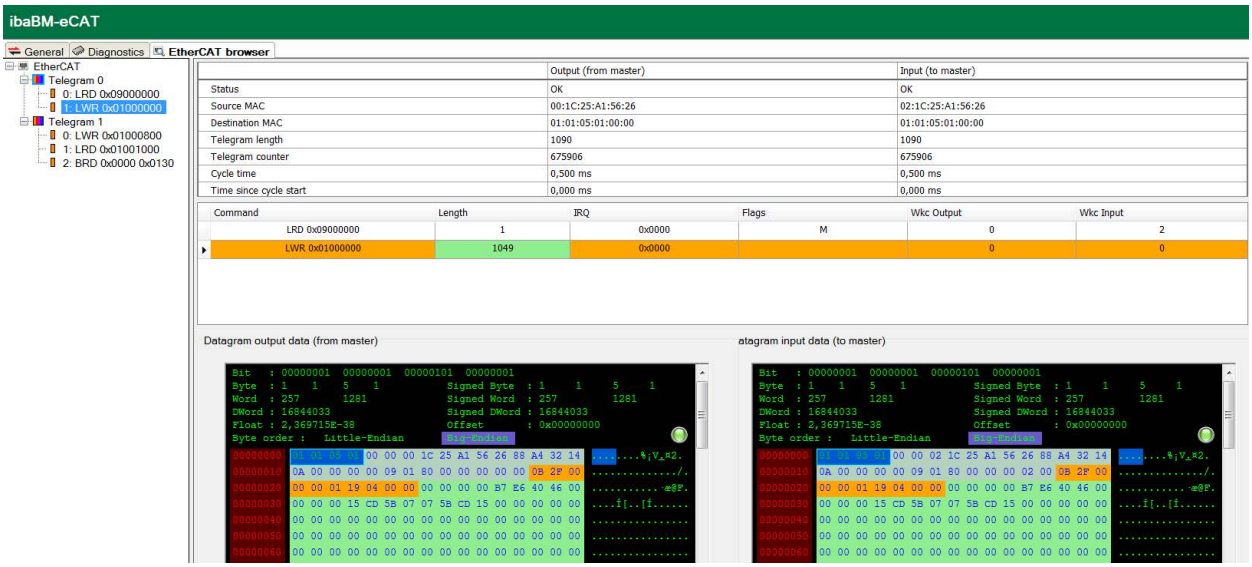
→ The device restarts automatically.

10.4.1.3 ibaBM-eCAT – EtherCAT browser tab

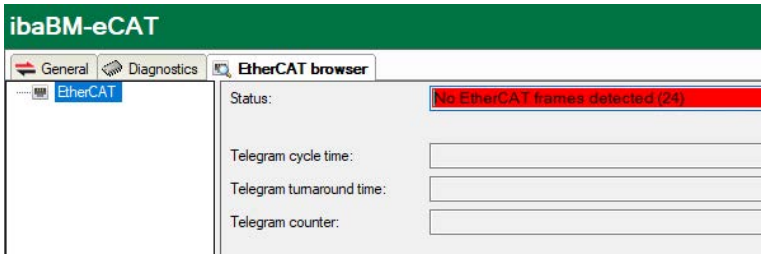
The *EtherCAT browser* tab shows the structure of the frame on the left and information such as cycle time, turnaround time and frame counter on the right. However, only cyclic frames are acquired.



The following figure shows the detailed display of an EtherCAT frame down to structure or byte level.



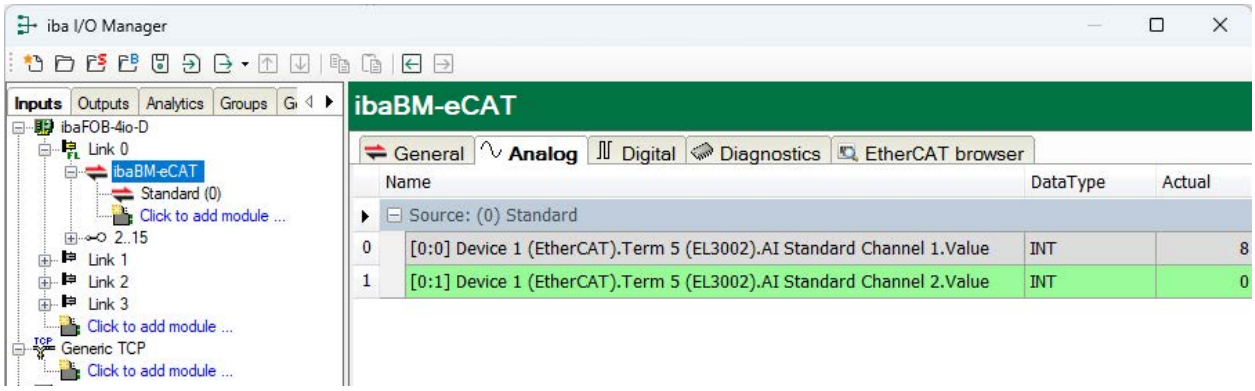
If no cyclic frame traffic is detected, the following figure appears:

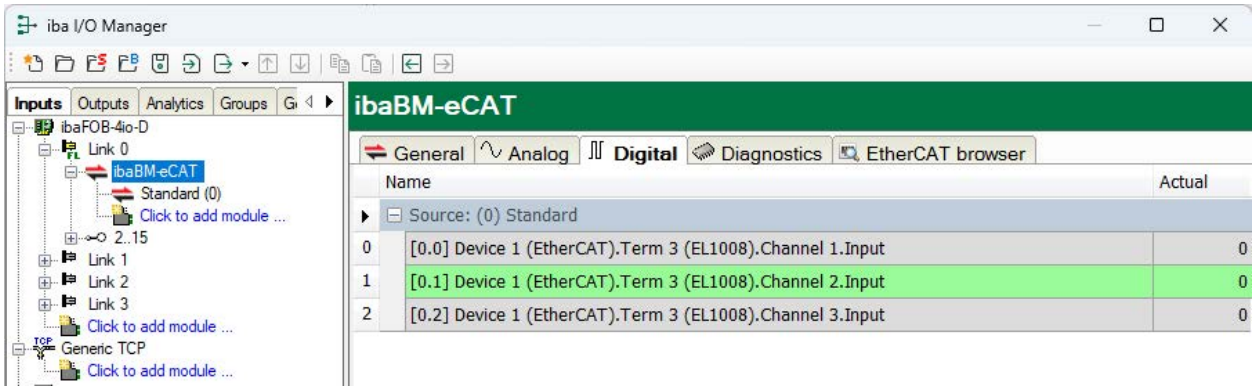


For diagnostic purposes it is also possible to set the first frame in the cycle manually in the *EtherCAT browser* if this could not be done correctly by the automatic detection. See chapter ↗ *EtherCAT diagnostic signals*, page 67.

10.4.1.4 ibaBM-eCAT – Analog and Digital tab

The *Analog* and *Digital* tabs are only created for the "ibaBM-eCAT" device module after a module and signal configuration has been successfully transferred to *ibaPDA*.





Both tabs provide an overview of all acquired analog and digital signals with an online display of the currently acquired values (Actual).

10.4.2 Standard module

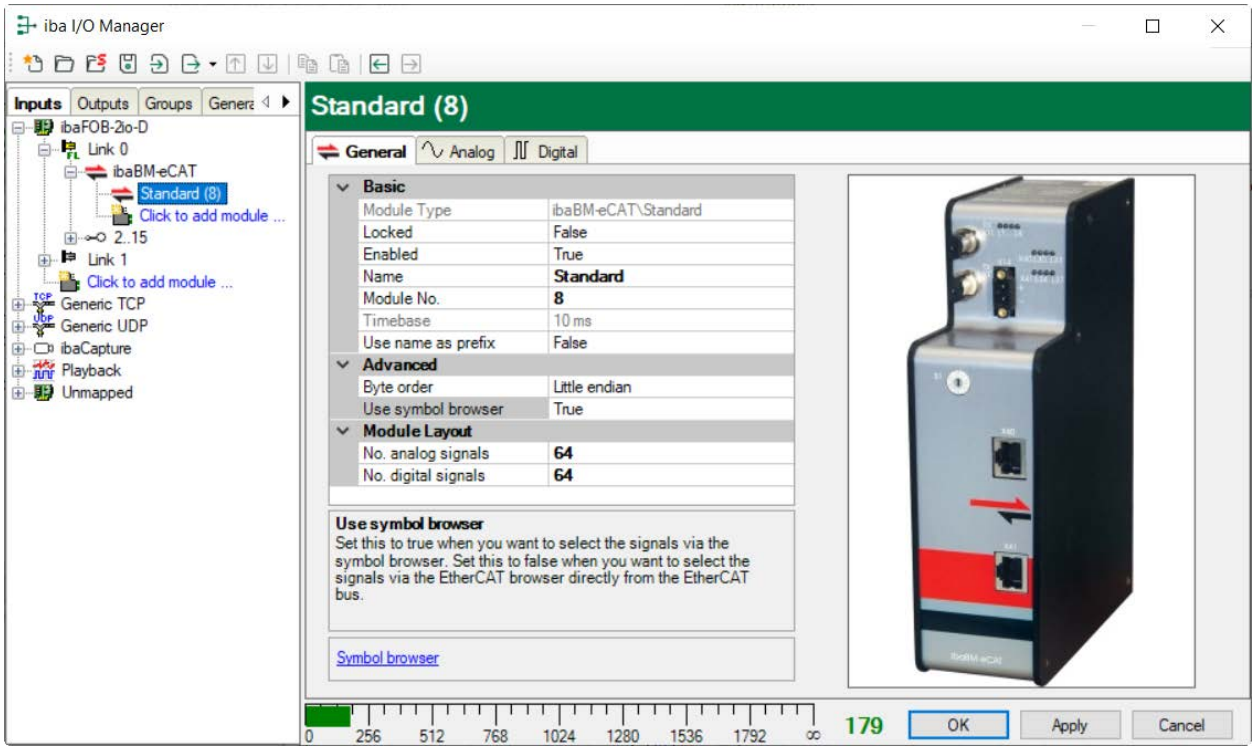
You can add almost unlimited "standard" modules. Note, however, that signals can only be requested once, i. e. not several times in several modules.

By default, the comfortable signal selection is enabled via the symbol browser. If you do not want this or if no EtherCAT configuration file is available, you can enable access to the EtherCAT browser in the *General* tab (*Use symbol browser* = False).

Both browser variants for signal selection are described in more detail in this chapter.

10.4.2.1 Standard – General tab

In the *General* tab, make the basic settings, advanced settings and settings for the module layout of the "Standard" modules.



Basic settings

See chapter ↗ *ibaBM-eCAT – General tab*, page 36.

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*.

Advanced

Byte order
Select the byte order that is used by the signals defined in this module. Possible settings: “Little Endian” or “Big Endian”.

- 16 bit:

  Little Endian: Byte A – Byte B

  Big Endian: Byte B – Byte A

- 32 bit:

  Little Endian: Byte A – Byte B – Byte C – Byte D

  Big Endian: Byte D – Byte C – Byte B – Byte A

Use symbol browser

- True:

  The signals can be selected via the symbol browser. Open the symbol browser with the "Select Browser" link at the bottom of this tab.

- False:

  The signals can be selected via the "EtherCAT browser" instead of the symbol browser. This is the case if no EtherCAT configuration file is available for the signal selection. Open the "EtherCAT browser" via the "EtherCAT browser" link at the bottom of this tab.

Module layout

No. analog signals (max. 1000)
Enter the number of analog signals of this module (max. 512 signals in each direction).

No. digital signals (max. 1000)
Enter the number of digital signals of this module (max. 512 signals in each direction)

Link to the symbol browser or EtherCAT browser

“Symbol browser” / “EtherCAT browser”

This link opens either the symbol browser or the EtherCAT browser, depending on the setting under *Use symbol browser* in this tab.

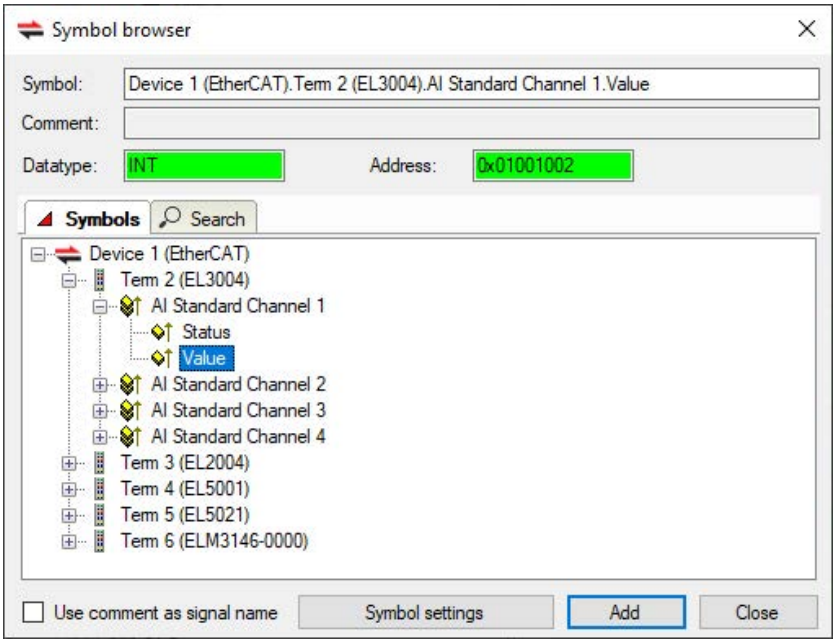
10.4.2.2 Selecting signals in the Symbol browser

1. In the tree structure, select the terminals whose signals should be recorded.
2. Open the terminal symbol and select the signal.

   You can also select several several signals of a terminal together.

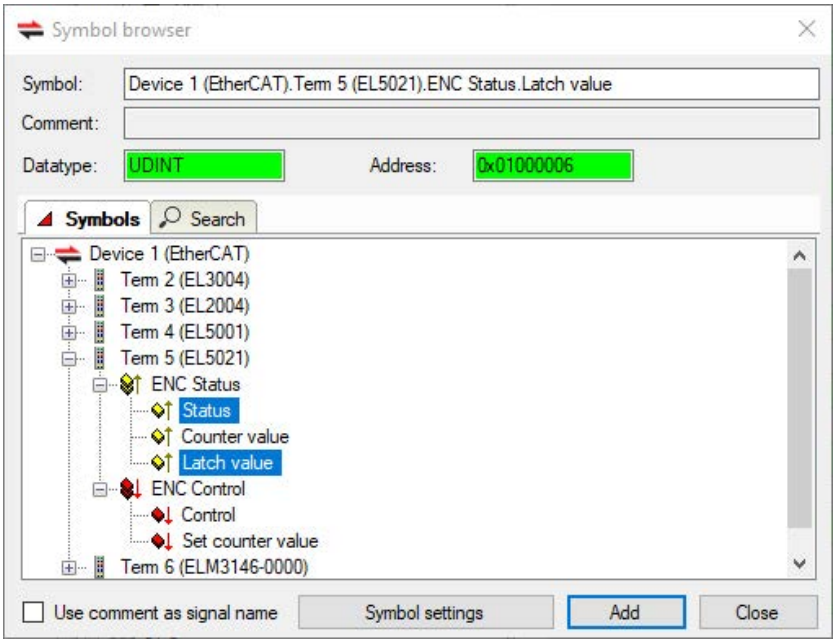
→ The corresponding symbol name, the data type, the logical address and if applicable a comment are displayed in the upper section.

3. To add the signals individually to the selection list, double-click on the signal or click <Add>.



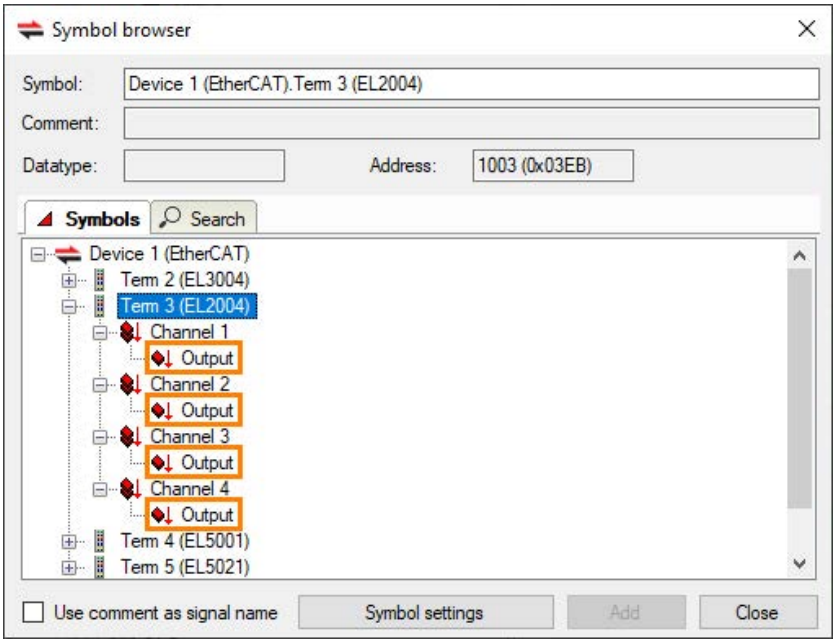
4. To add several signals, proceed as follows:

   a.) If there are several signals on the same level, select additional signals by using the <Shift> or <Ctrl> key.



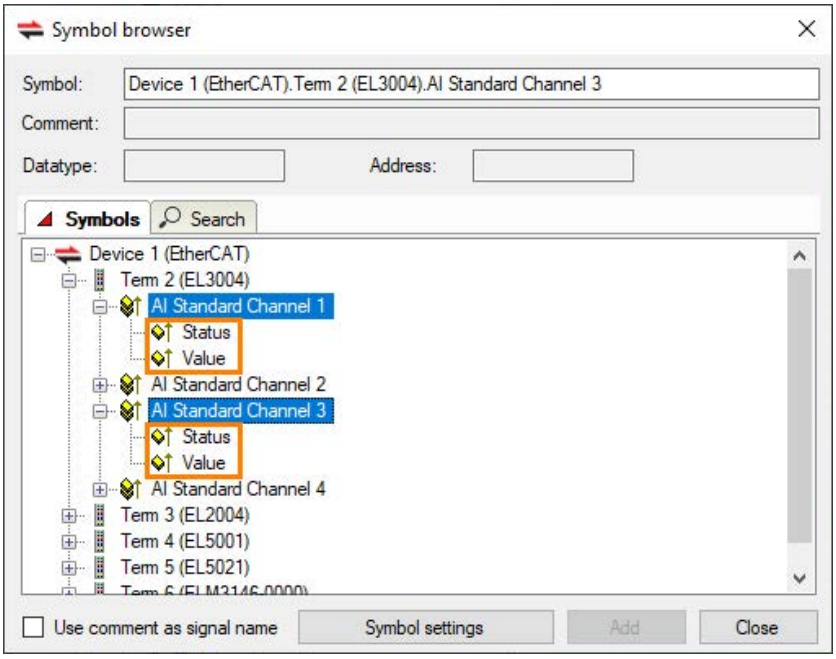
b.) To select all signals of a higher-level node, select the higher-level node.

→ All sub-signals are selected for acquisition.



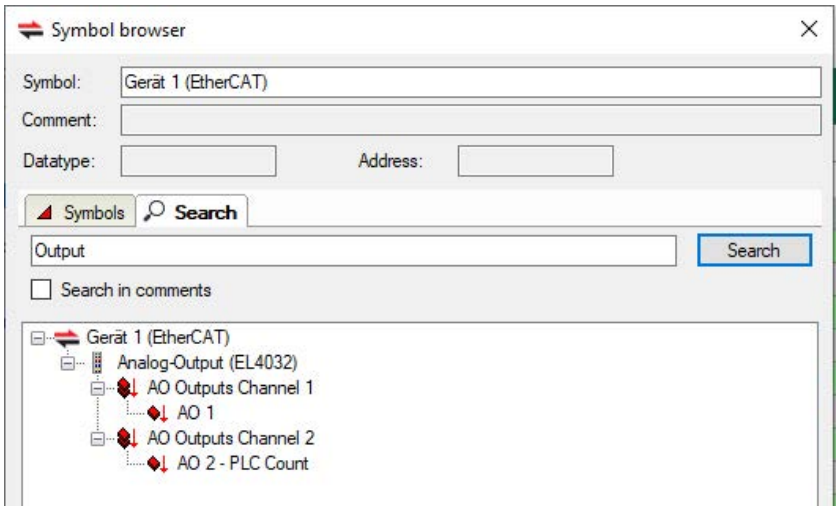
You can also select several higher-level nodes on the same level.

→ All sub-signals of the selected nodes are selected for acquisition.



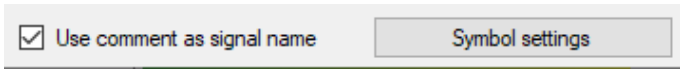
c.) To search for the signals to be added, enter a search term in the *Search* tab and tap <Search>

→ All matching signals are listed.



d.) If the EtherCAT configuration file contains comments for the signals, it is possible to search for comment terms as well. To do this, activate the *Search in comments* option.

Comments can also be used as signal names in *ibaPDA*. To do this, activate the option *Add comment as signal name*.



5. When all desired signals are selected, close the window with the <Close> button.

   If required, you can add further signals later at any time.

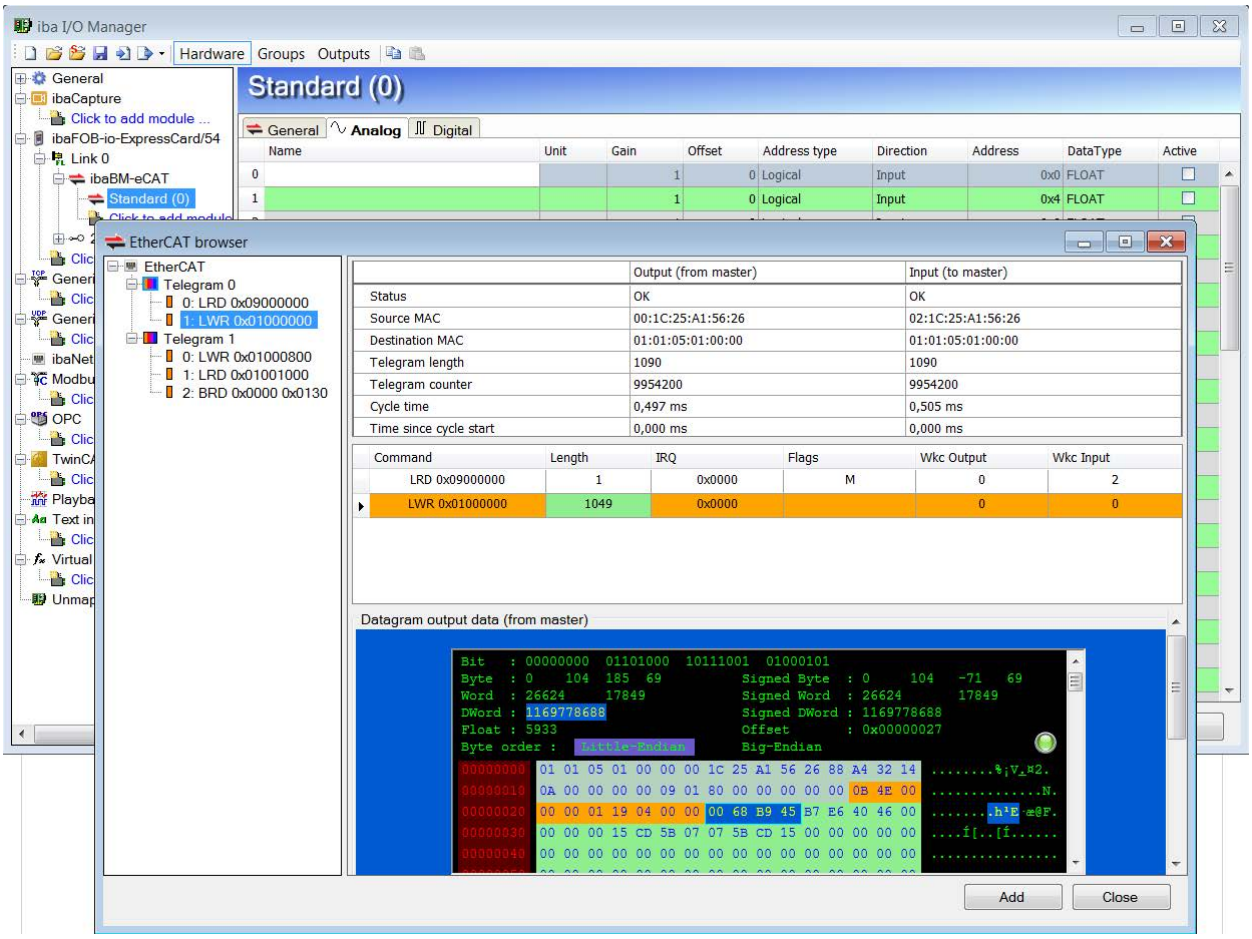
6. A new EtherCAT configuration file can be loaded by clicking the <Symbol settings> button.

→ The same menu for the EtherCAT symbol settings is opened, see chapter ↗ *First steps for the configuration in ibaPDA*, page 28.

10.4.2.3 Selecting signals in the EtherCAT browser

1. In the frame tree on the left, select the EtherCAT frame or the EtherCAT datagram that contains the signals to be acquired.

→ The right side shows information on the frame/datagram, such as the input/output direction and the byte representation. Header information of the datagrams is displayed in orange, the relevant user data is highlighted in green.



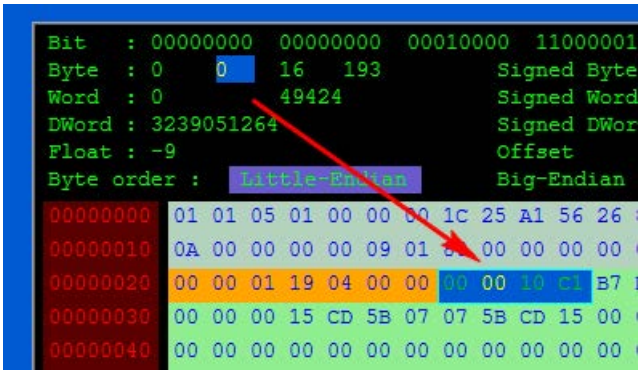
2. In the byte representation, select the initial value of the signal (offset) from the user data (green).

→ Starting with this offset, 4 bytes are always highlighted in blue. The blue frame around the byte representation indicates whether your selection is in the input or output data.

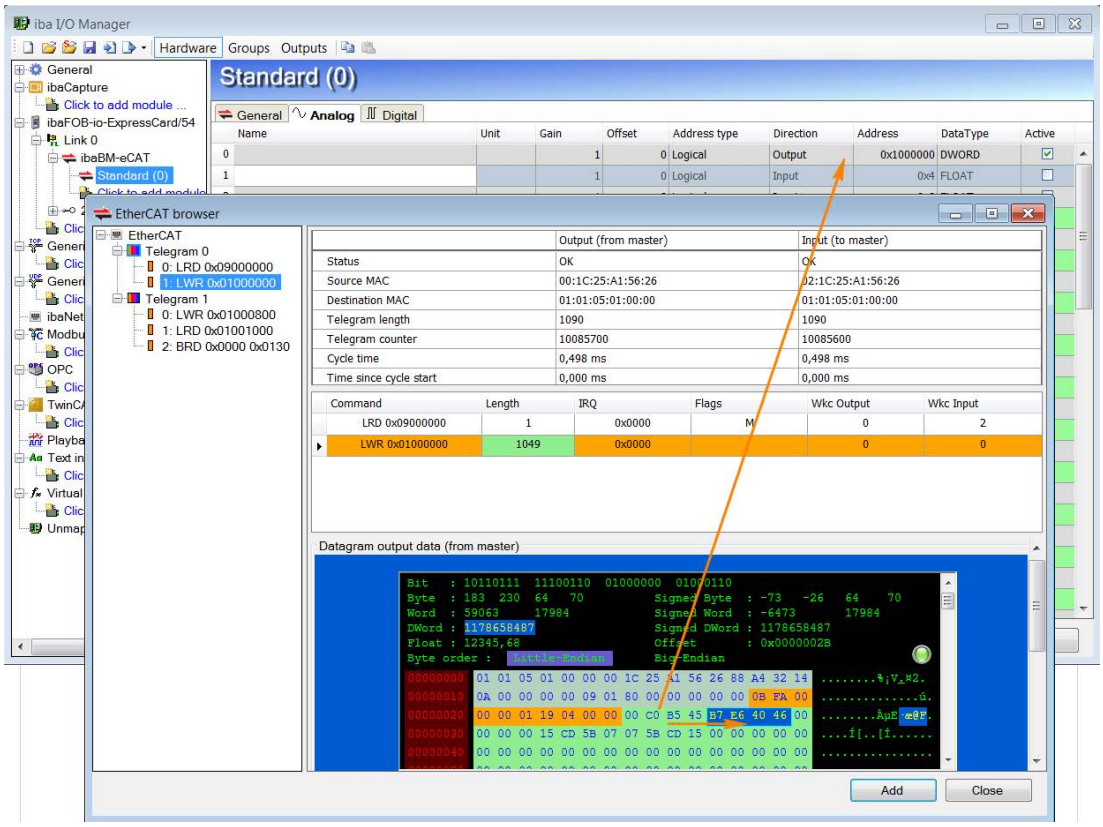
3. Select the data type of the signal to be recorded in the upper area of the byte representation on the left side.

→ To the right, the selected value is displayed in various formats.

→ Depending on the selected data type, the corresponding bytes within the blue marking are displayed in yellow. This way you can also select values within the blue marking.



4. To add the signal to the signal list of the *Analog* or *Digital* tab, click <Add>.



The subsequent signal with the same data type is automatically selected and can be immediately added to the same signal list (continuously) with <Add>.

5. When all desired signals are selected, exit the EtherCAT browser with <Close>.

   If required, you can add further signals later at any time.

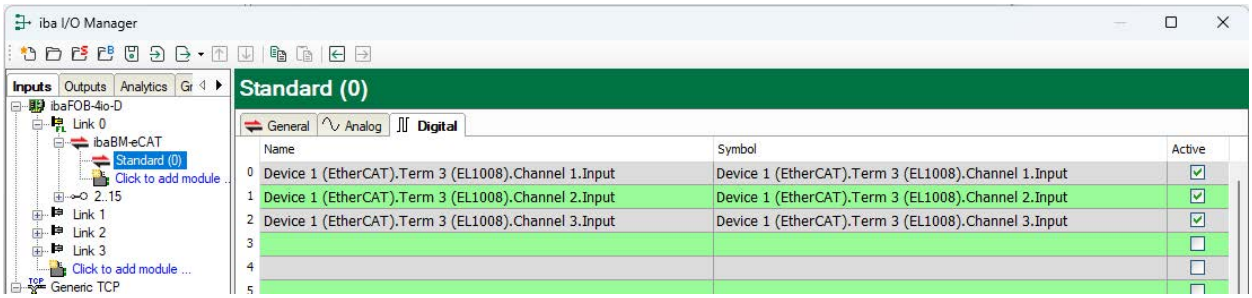
6. Finally, assign a corresponding signal name to the selected signals in the signal list.

10.4.2.4 Standard – Analog and Digital tab

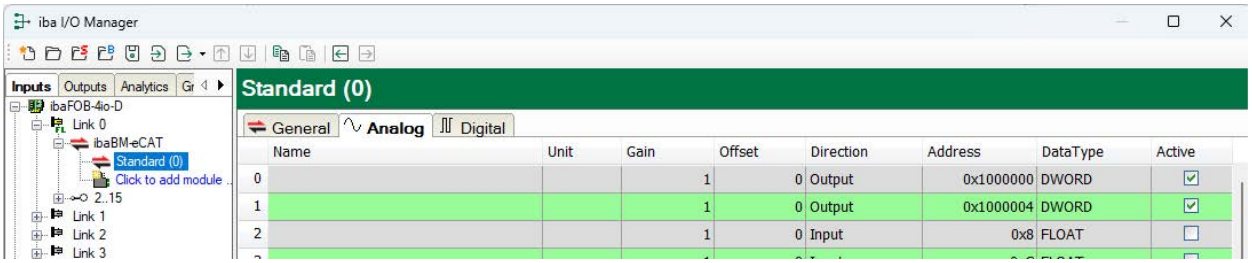
Depending on whether you have selected the signals via the symbol browser or the EtherCAT browser, different columns within both registers are displayed.

■ Module "Standard" - *Analog* tab – signal selection via symbol browser

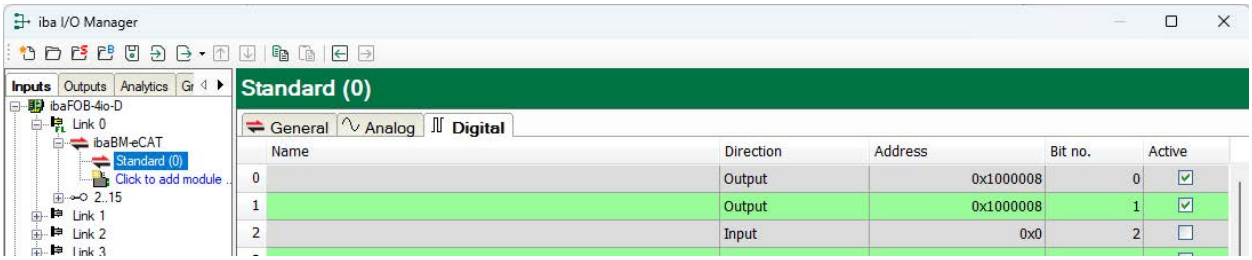
■ Module "Standard" – *Digital* tab – signal selection via symbol browser



■ Module "Standard" - *Analog* tab – signal selection via EtherCAT browser



■ Module “Standard" – *Digital* tab – signal selection via EtherCAT browser



Name
When selecting signals via the symbol browser, the signal name is automatically imported. Otherwise you can enter a signal name here or change the existing one.

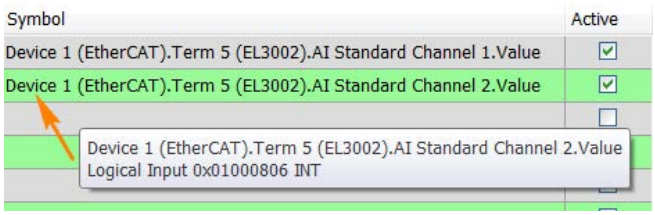
In addition, two comments are possible, if you click on the symbol in the *Signal name* field.

Unit
You can enter a physical unit.

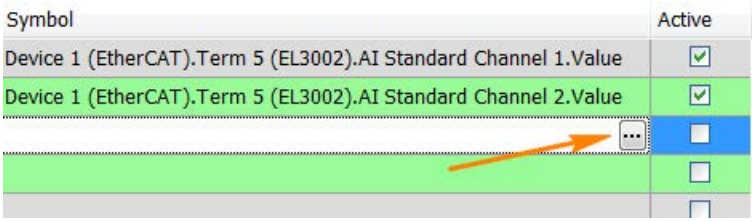
Gain / Offset
The settings in the columns *Gain* and *Offset* are used to scale normalized values to physical values.

Symbol
The entry will be imported automatically and contains the name of the EtherCAT MainDevice, the terminal name, the channel and the measured value, each separated by a dot.

The complete information will be displayed as a tooltip, including the actual physical or logical address, the direction and the data type.



It is also possible to add new signals from this view. To do this, click in a cell in the *Symbol* column and then on the browse button.



→ The symbol browser opens and displays only analog or digital signals.

Direction
Direction of the selected signal

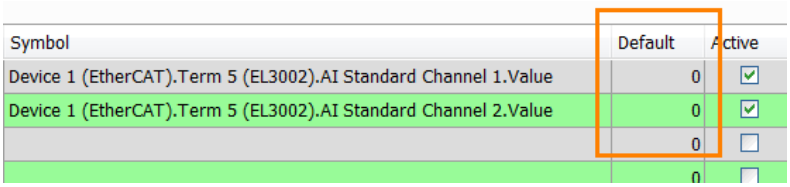
Address
Byte address of the selected signal

Bit No.
For digital signals, this is the bit number within the defined byte.

Data type
If the value to be acquired is an analog value, the corresponding data type is displayed here.

Default
If the *Enable default values* option is enabled (true) in the *General* tab of the device module "ibaBM-eCAT", the additional column *Default* appears. See chapter ↗ *ibaBM-eCAT – General tab*, page 36.

You can enter default values here in case the EtherCAT bus connection is broken.



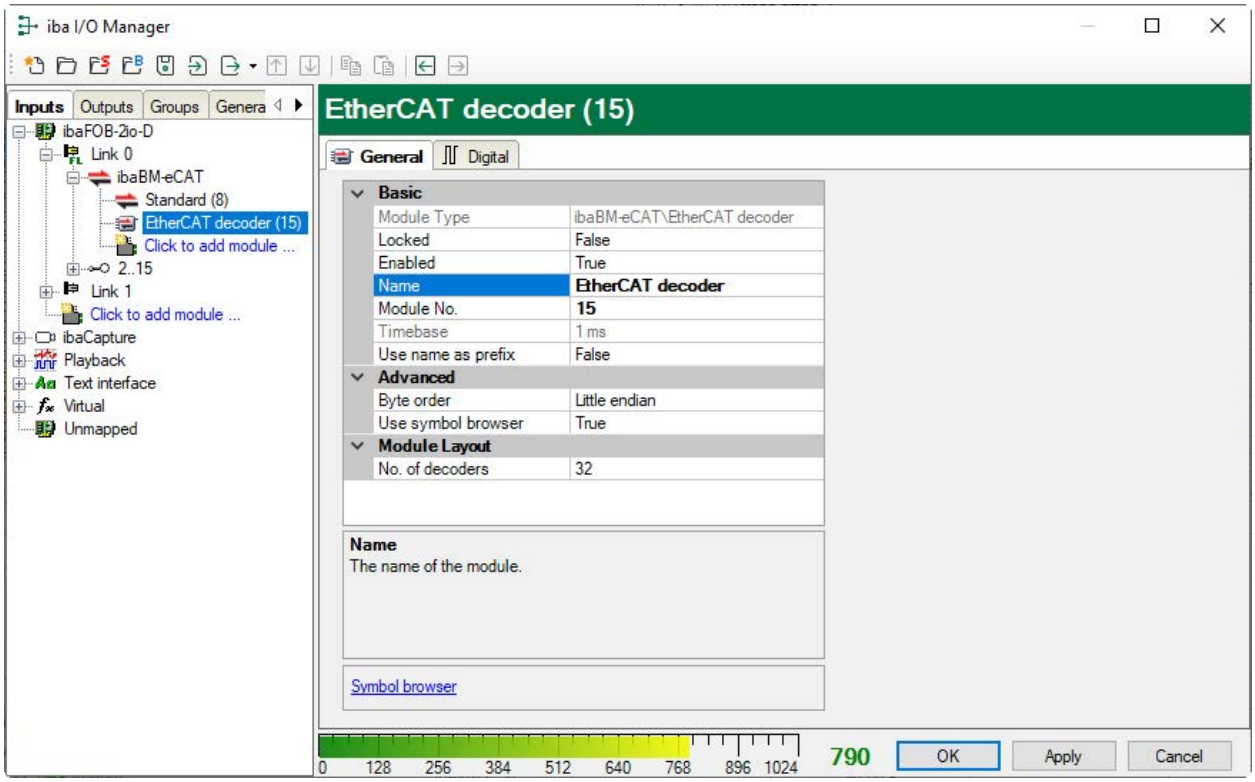
Active
Activate/deactivate the signal for acquisition in *ibaPDA*.

10.4.3 EtherCAT decoder module

The "EtherCAT decoder" is especially suited for acquiring large amounts of digital signals, which are present on the EtherCAT bus as words.

10.4.3.1 EtherCATdecoder – General tab

In the *General* tab, make the basic settings, advanced settings and settings for the module layout of the "EtherCAT decoder" module.



Basic settings, Advanced

See chapter ↗ *Standard – General tab*, page 41.

Module layout

No. of decoders

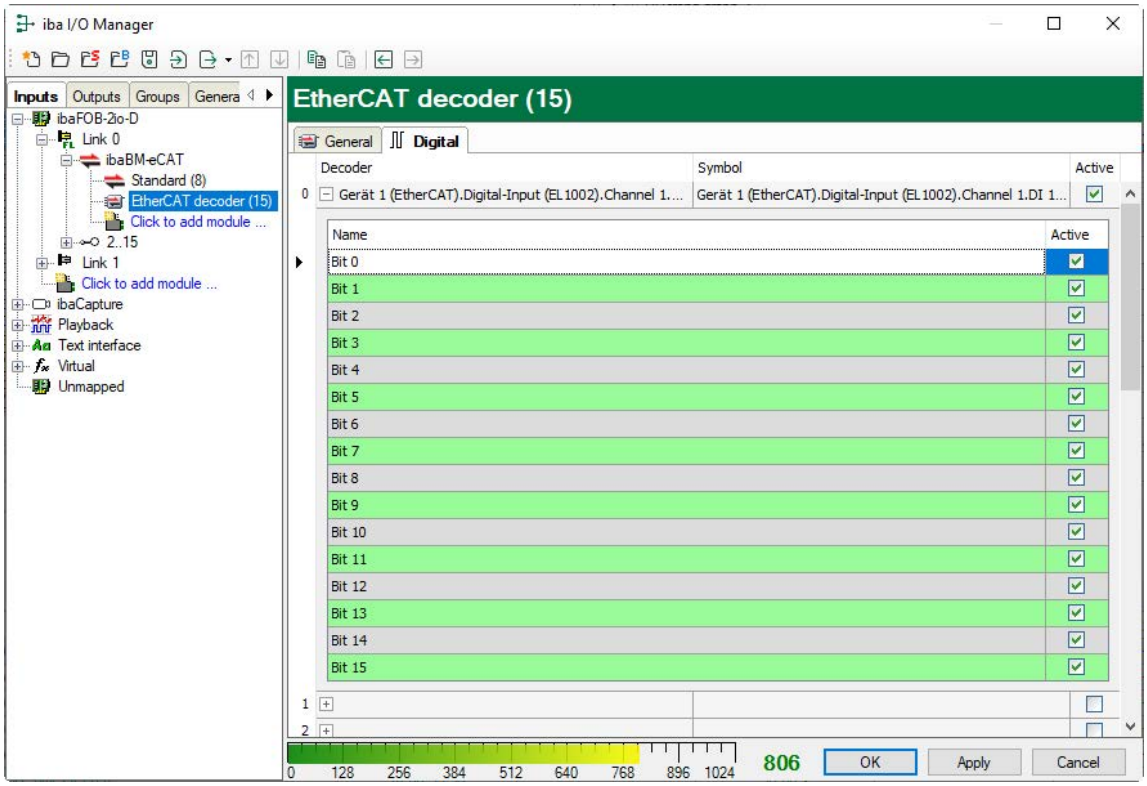
Configure the number of WORDs that can be decoded into digital signals.

10.4.3.2 EtherCAT decoder – Digital tab

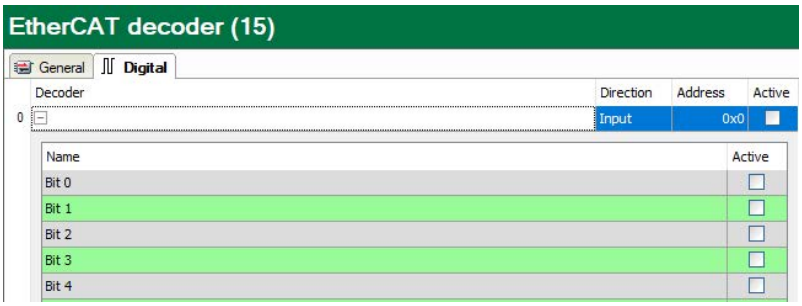
The signals are declared in two steps. First of all, the words (WORDs) you want to acquire as source for the digital signals have to be defined in sequential order.

Depending on whether you use the symbol browser or EtherCAT browser for signal selection, different tabs are displayed. For further information see chapter ↗ *Selecting signals in the Symbol browser*, page 43 or ↗ *Selecting signals in the EtherCAT browser*, page 45.

■ *Digital* tab – signal selection with symbol browser



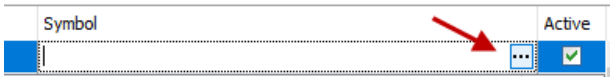
■ *Digital* tab – signal selection with EtherCAT browser



Decoder
When selecting via the symbol browser, the name is automatically entered. Otherwise, you can enter a meaningful name for the source word here or change the existing one.

Symbol
The entry is entered automatically and includes the name of the source word.

With the browse button at the end of this row you can also open the symbol browser for signal selection. In this case only the word signals are displayed for selection.



Direction
Direction of the selected signal

Address
Byte address of the selected signal

For every source word, the corresponding list of 16 digital signals can be opened by clicking on the plus sign. Here, the single bits of the source word are defined.

Name
Enter a meaningful name to the individual digital signals.

Active
Only when enabled, the signal is acquired and also considered when checking the number of licensed signals.

Note

Only the activated digital signals are considered when counting the number of licensed signals, hence no additional signal for the source word.

ibaBM-eCAT only acquires one analog value, which is then decoded by *ibaPDA*. The range of analog values in *ibaBM-eCAT* is therefore used to acquire large amounts of digital signals.

10.4.4 Diagnostics module

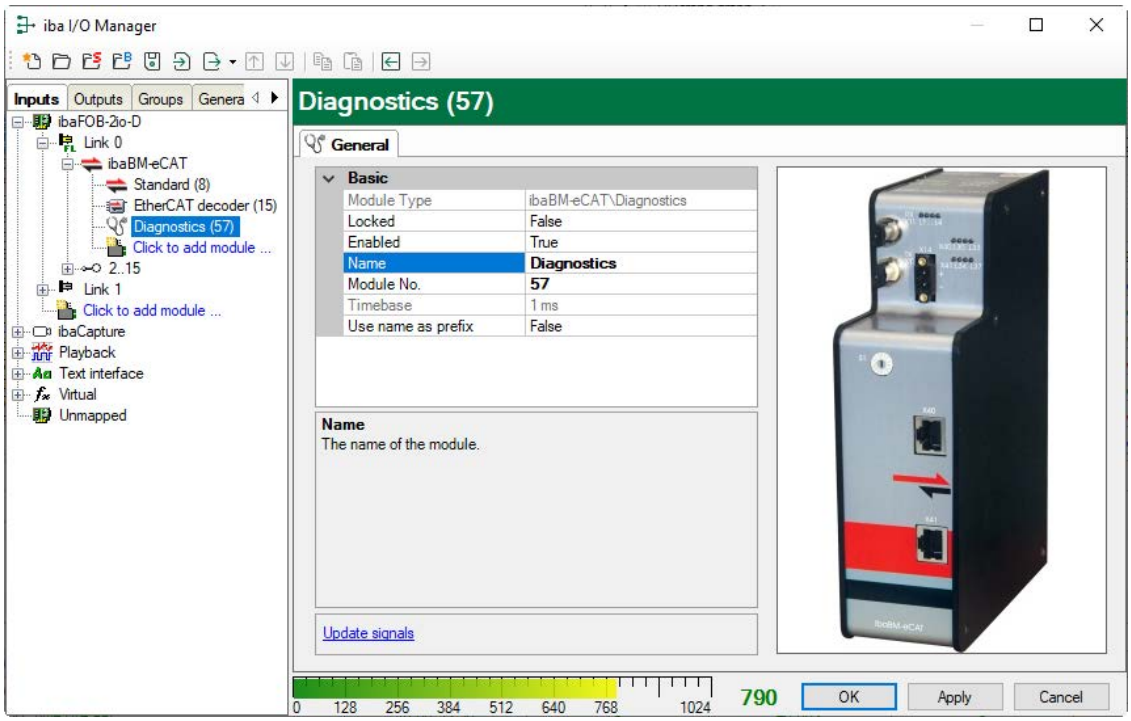
The "Diagnostics" module should only be added if *ibaBM-eCAT* is connected correctly to the *ibaPDA* system via fiber optics.

Otherwise, a corresponding message is displayed and the signal lists are not created.

Via the "Update signals" link in the *General* tab of this module, the diagnostic signals can also be loaded, updated or reset at a later point in time.

10.4.4.1 Diagnostics – General tab

In the *General* tab make the basic settings for “Diagnostic” modules.



Basic settings

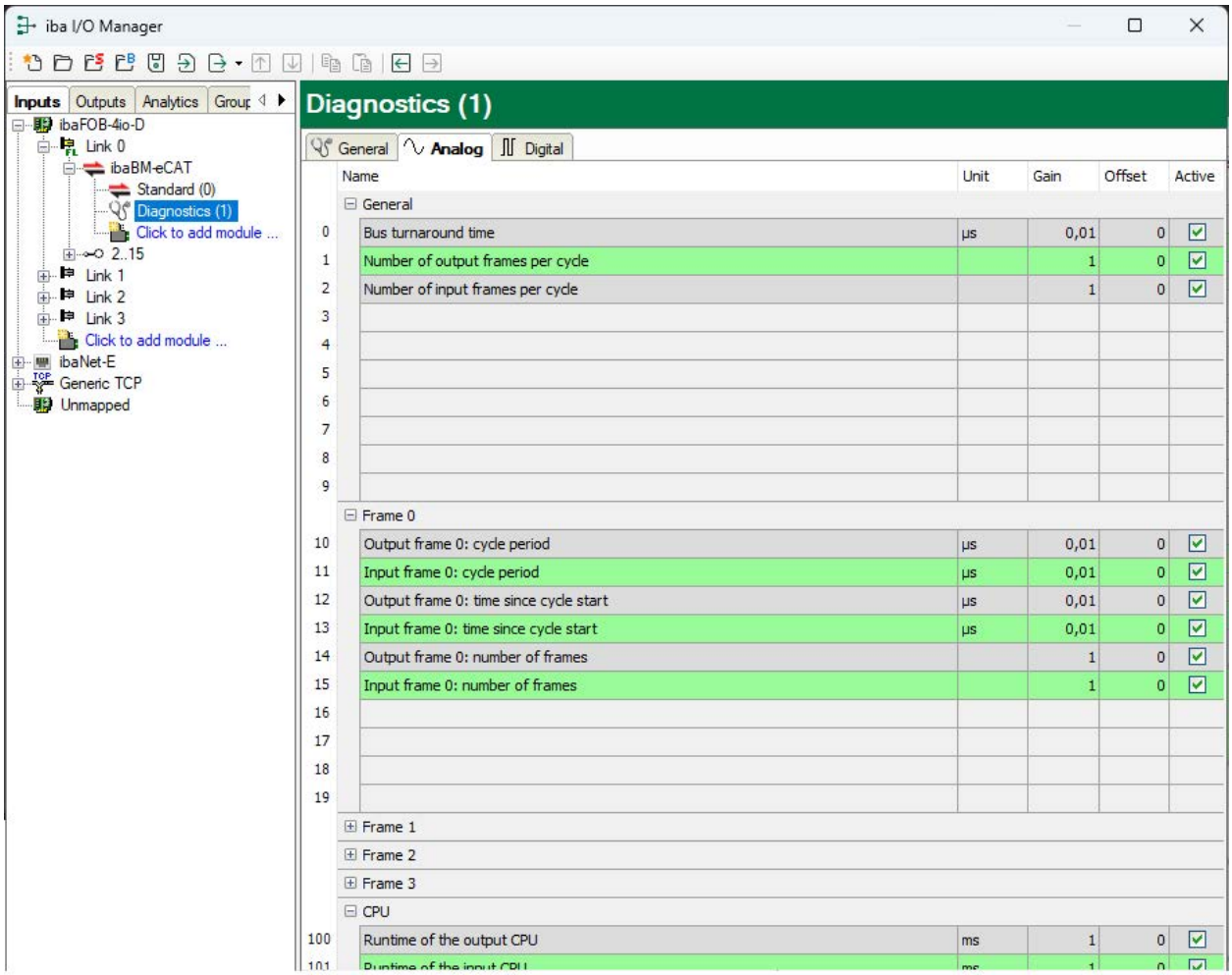
See chapter ↗ *Standard – General tab*, page 41.

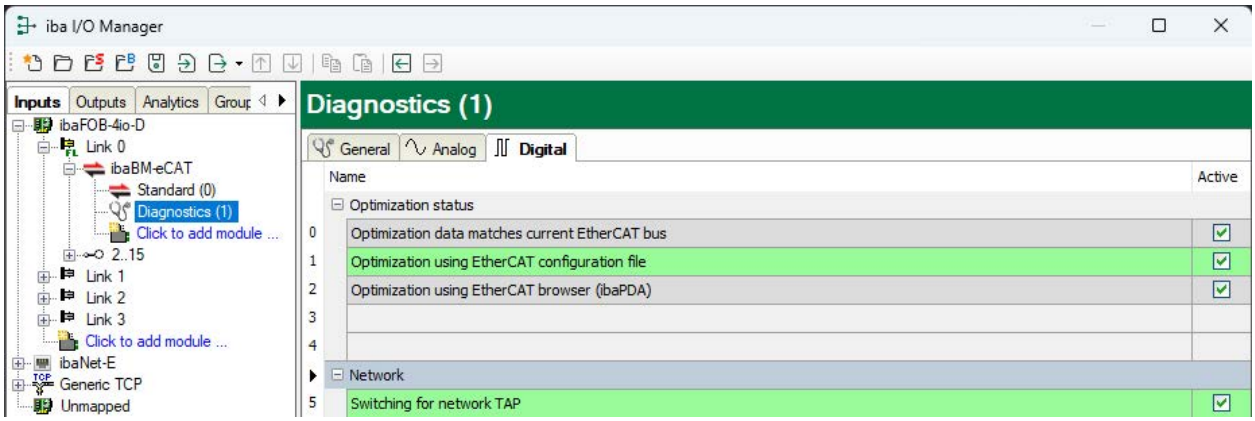
"Update signals" link

The "Update signals" link is used to read the list of diagnostic signals from the device, for example if you want to load or reset the list.

10.4.4.2 Diagnostics – Analog and Digital tab

The *Analog* and *Digital* tab contain general and specific diagnostic signals divided into groups. By default, all diagnostic signals are activated and preset with the corresponding parameters.





For an explanation of the columns, see chapter ↗ *Standard – Analog and Digital tab*, page 47.

A detailed description of the diagnostic signals can be found in chapter ↗ *EtherCAT diagnostic signals*, page 67.

10.4.5 TwinCAT Request module

Other documentation

The description for the "TwinCAT Request" module can be found in the *ibaPDA* supplementary manual for the request function for TwinCAT.

The *ibaPDA-Request-TwinCAT* function is an optional product for *ibaPDA* that requires additional licenses.

10.5 Optimization of data extraction

The signals or data selected in *ibaPDA* are extracted from the data stream of the EtherCAT bus for acquisition in the device.

The data should be extracted in an optimized way so that large amounts of data can be acquired even with low bus cycles.

10.5.1 Optimization modes

Two types of optimization can be used for optimized extraction of data from the EtherCAT bus data stream.

Using the EtherCAT configuration file
This is the case by default if an EtherCAT configuration file has been added to the device and the EtherCAT bus has not been changed since the export of this file from the EtherCAT MainDevice.

Using the last analysis of the EtherCAT bus by the EtherCAT browser
If no EtherCAT configuration file is available, optimization can also be achieved by using the EtherCAT browser once. Usually, without an EtherCAT configuration file the EtherCAT browser should always be used to select the signals to be acquired, thus enabling this optimization mode. However, the EtherCAT bus must not be changed later on.

If one of the two optimizations is used, the LED L36 on the device lights up.

10.5.2 Disable optimization

The optimized data extraction requires that for both optimization modes the EtherCAT configuration is not changed during the running acquisition.

With flexible EtherCAT configurations, such as Hot Connect, it is usually necessary to disable this optimization.

This can be done via the general option *Enable optimization*, see chapter ↗ *ibaBM-eCAT – General tab*, page 36.

Note

Note, that after a correct *ibaPDA* signal configuration any change at the EtherCAT bus during the running acquisition may result in an undefined signal state between the bus and the data extraction. There is no longer any comparison between the extraction and the actual bus.

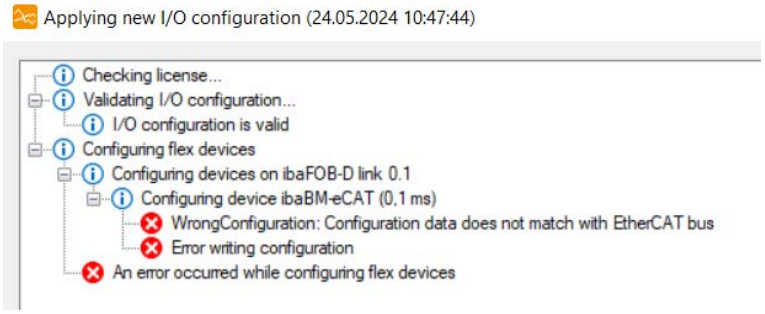
10.6 Troubleshooting

In the following you will find help on possible errors when using *ibaBM-eCAT*. If you have any further questions, please contact iba support.

10.6.1 Configuration data does not match

Data extraction optimization is activated by default (see also chapter ↗ *Optimization of data extraction*, page 54). *ibaPDA* then checks whether the data stream of the EtherCAT bus matches the signals or data selected in *ibaPDA* each time the acquisition is started.

If this is not the case, this error message appears in *ibaPDA* during validation:



This can occur in particular with flexible EtherCAT configurations, such as Hot Connect. However, it can also occur in other cases.

This optimization of data extraction is recommended so that large amounts of data can be recorded even with low bus cycles. If this is not the case or if anomalies occur during operation with this option enabled, it can also be disabled (see chapter ↗ *Disable optimization*, page 55 and ↗ *ibaBM-eCAT – General tab*, page 36).

11 Technical data

In the following you will find the technical data and dimensions for *ibaBM-eCAT*.

11.1 Main data

Refer to the following table for the technical data for *ibaBM-eCAT*.

Short description

Name	*ibaBM-eCAT*
Description	Bus module for EtherCAT buses
Order number	13.127000

Supply, operating and indicating elements

Power supply	24 V DC (±10 %), not stabilized
Power consumption	max. 8 W
Indicators	4 LEDs for operating status of the device 4 LEDs for the two EtherCAT channels 4 LEDs for the SubDevice function

Operating and environmental conditions

Operating temperature	-40 °F to 185 °F (0 °C to +50 °C)
Storage and transport temperature	-40 °F to 185 °F (-25 °C to +70 °C)
Mounting	DIN-rail mounting , vertical
Cooling	Passive
Humidity class acc. to DIN 40040	F, no condensation
Protection class	IP20
Certificates EMC	EN 61326-1, FCC part 15 class A
MTBF [1)]	1,765,555 hours / 201 years

Dimensions and weight

Dimensions (Width x height x depth)	2.1 in x 7.4 in x 5.6 in (54 mm x 188 mm x 141 mm), including DIN-rail clip
Weight (incl. box and documentation)	approx. 2.2 lb (ca. 1.1 kg)

[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

11.2 Interfaces

Refer to the following table for the interface data for *ibaBM-eCAT*.

Bus interfaces (EtherCAT)

Number	2 (1x MainDevice, 1x SubDevice) for 1 EtherCAT bus
Signal recording	
Sniffer	Without additional bus configuration
SubDevice (optional)	Additional direct addressing of signals with a device-specific ESI file (IO device file) for the bus configuration
Data volume	
Sniffer	Max. 512 analog and 512 digital values in each direction (up to 4096 bytes) at a minimum ibaNet sampling rate
SubDevice	Addressing of mac. 512 analog and 512 digital outputs (≤ 32 bit) on the bus, max. 2 x 1360 bytes (also for values > 32 bit)
Sampling rate	According to bus cycle time (if cycle time is below 500 µs, there are restrictions on the number of values)
Signal delay	355 ns to 570 ns
Supported EtherCAT address space	4 GByte for both logical and physical allocation
Supported signal types	Digital with 1 bit Analog as integer values with 8 bit, 16 bit or 32 bit (signed and unsigned) or as IEEE 32 bit and 64 bit floating point values
Connection technology	2 x RJ45 socket (EtherCAT 100 Mbit/s)

ibaNet interface (fiber optics)

Number	1 (e. g. for the connection to *ibaPDA*)
ibaNet protocol	32Mbit Flex protocol Allows the simultaneous connection of up to 15 devices in a fiber optics ring Can be used for data, settings and service purposes (e. g. updates)
Data transfer rate	32 Mbit/s
Sampling rate	max. 40 kHz, freely adjustable
Connection technology	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. ↗ *Example for FO budget calculation*, page 60.

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	
Laser class	Class 1	
Receiving interface (RX)		
Receiving sensibility[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)	

11.3 Declaration of conformity

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

Unique Identifier: 13.127000 ibaBM-eCAT

Responsible Party - U.S. Contact Information
iba America, LLC
370 Winkler Drive, Suite C
Alpharetta, Georgia
30004

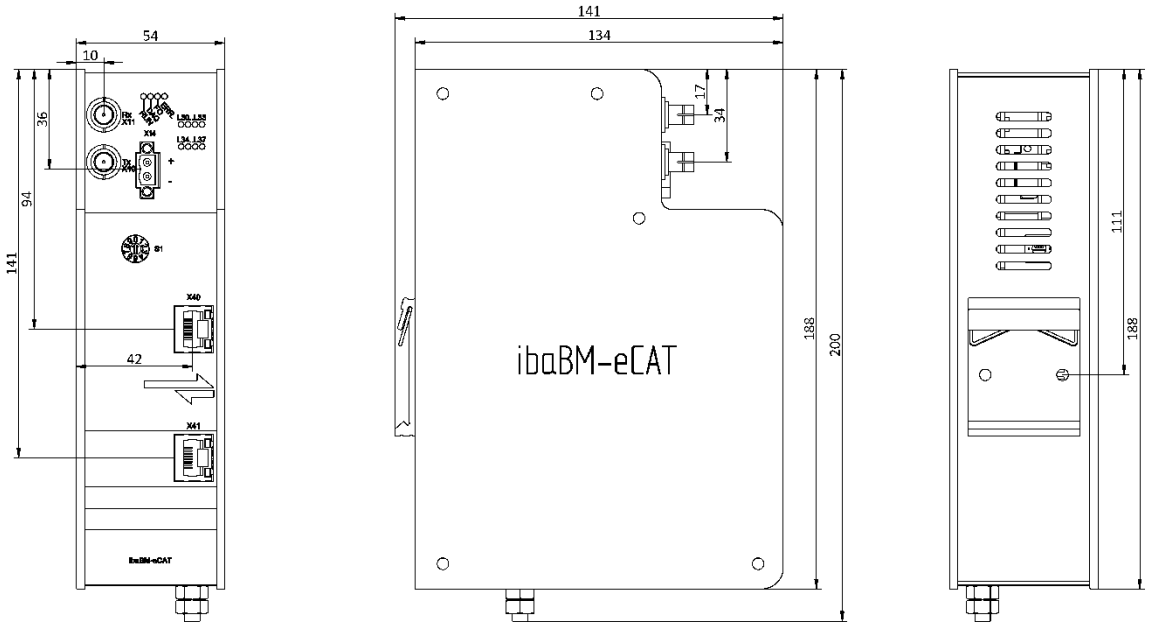
(770) 886-2318-102
www.iba-america.com

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.

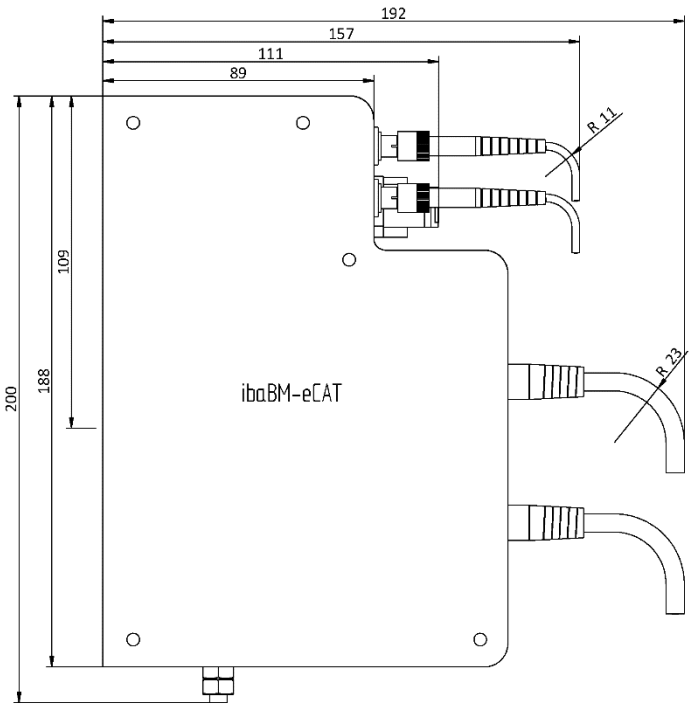
[2)] Information on other fiber optic cable diameters not specified

11.4 Dimensions

The following drawings show the dimensions of the device *ibaBM-eCAT*.



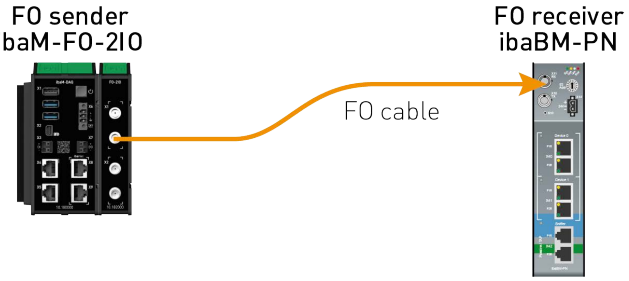
Dimensions in mm



Device with cable, dimensions in mm

11.5 Example for FO budget calculation

A fiber optic link from an *ibaM-FO-2IO* module (FO transmitter) to an *ibaBM-PN* device (FO receiver) is used as an example.



The example refers to a P2P 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 relevant device manual in the chapter "Technical data" under "ibaNet interface".

ibaM-FO-2IO specification

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

ibaBM-PN specification

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

Specification FO cable
Refer to the data sheet for 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 ibaM-FO-2IO -> ibaBM-PN in the best case:

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

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

Calculation for the example ibaM-FO-2IO -> ibaBM-PN in the worst case:

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

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

Note

When connecting several devices as a daisy chain or as a 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 reduced distance (by approx. 30–40%) must be expected.

Note

In addition to conventional multimode cable types OM1 (62.5/125 µm) and OM2 (50/125 µm), the other cable types OM3, OM4 and OM5 of the 50/125 µm fiber can also be used.

12 Accessories

Below you will find a list of the recommended accessories and the corresponding ordering information. If required, please contact iba AG.

Network TAP device		
Order number	19.000030	
Profitap Copper TAP C1D-100 Fast Ethernet Network TAP (10/100 Mbps), Network TAP for operation of the *ibaBM-eCAT* without interference		

13 Appendix

In the appendix you will find further useful information for operating the device *ibaBM-eCAT*.

13.1 IO Device File (ESI) < Version 1.7

When using ESI files up to version 1.5 for *ibaBM-eCAT* the following limitation occurs with the TwinCAT version v2.11.1555 (System Manager Version v2.11.0):

If the ESI file of *ibaBM-eCAT* is added to the EtherCAT configuration, conflicts occur with the EtherCAT configuration in

- Signalgroup_11, from signal_11_19 to signal_11_31.

The TwinCAT System Manager reaches the maximum size of an EtherCAT frame here (default size: 1514 bytes) and thus ends the first frame and starts the second. The System Manager overwrites the signals in this area.

As a consequence, those signals cannot be used and **must not** be linked in the System Manager!

All following signals, i. e. from signal_12_0, may properly be used.

Please note also:

- If signals, which are before the above mentioned signals, are disabled in the PDO assignment, then signals behind must not be used, depending on when the maximum size of an EtherCAT frame is reached.
- This restriction takes only effect, if the *ibaBM-eCAT* SubDevice is configured as first SubDevice after the MainDevice and before all other SubDevices (as recommended by iba).

13.2 FO configuration using 32Mbit ibaNet protocol (StaticFO)

The bus monitor *ibaBM-eCAT* supports basically the ibaNet protocol 32Mbit Flex. The rotary switch position can be 1…15 (1…F) depending on the device address.

When the rotary switch is set to "0", it is possible to use the FO connection with 32Mbit *ibaNet* protocol and copy a fixed signal configuration, which has been predefined in *ibaPDA*, to the device. This function is also called "StaticFO" in short.

Using the 32Mbit *ibaNet* protocol, it is possible to connect to an *ibaLogic*-V5 system or another iba-hardware in 32Mbit mode, e. g. *ibaBM-DP*.

13.2.1 Configuration of 32Mbit ibaNet protocol

The configuration is first performed with *ibaPDA* via the *ibaNet* protocol 32Mbit Flex (rotary switch S1 not equal to 0, see chapter ↗ *Rotary switch S1*, page 20).

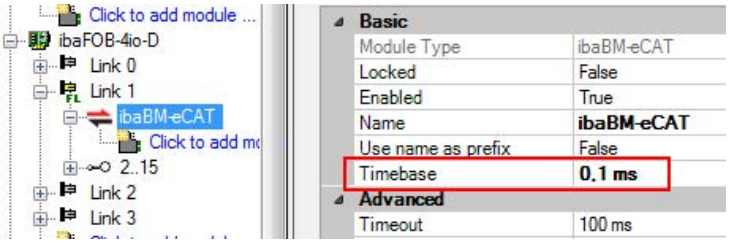
For further information see chapter ↗ *System integration*, page 23.

It is to be noted, that only the following 32Mbit protocols can be adjusted:

- 32Mbit 50µs (Real32)
- 32Mbit 100µs (Real64)

- 32Mbit 200µs (Real128)
- 32Mbit 400µs (Real256)
- 32Mbit 1000µs (Real512)

Therefore only these values may be used as timebase: 0.05 ms, 0.1 ms, 0.2 ms, 0.4 ms or 1 ms.



When the configuration with *ibaPDA* has been successfully completed, the rotary switch S1 can be set to zero (S1 = 0) in order to enable the 32Mbit protocol.

A signal list is then created on the device, which shows clearly the signal mapping on the fiber optic cable including the signal names configured in *ibaPDA*.

13.2.2 FTP connection to the device

An FTP connection to the device must be established to download the signal list file.

In order to establish an FTP connection to the device proceed as follows:

1. Connect the device to the computer via an USB cable. The USB interface is located at the bottom of the device.

   A type A to B USB cable is required. A suitable cable is available at iba on request.

2. As soon as the computer is connected for the first time to the device, the "Found New Hardware Wizard" will show up and the driver for the USB connection has to be installed.

   You find the driver on the data medium "iba Software & Manuals" in this directory:

   `\02_iba_Hardware\ibaBM-eCAT\02_USB-Driver\`

3. After having installed successfully, an additional network connection is available with the device name "IBA AG USB Remote NDIS Network Device".

4. A fixed IP address must be assigned to this interface. The address has to be from this range: 192.168.0.n with n = 2…254 and the subnet mask 255.255.255.0.

   Example:

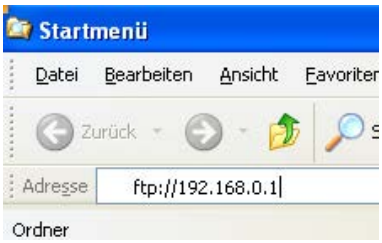
   IP: 192.168.0.2

   SubNet: 255.255.255.0

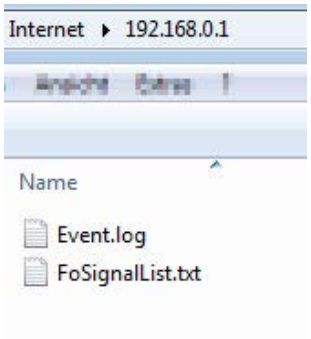
5. Now, you can establish an FTP connection to the device.

   Use either a special FTP client or the Windows File Explorer. In both cases, the address is "192.168.0.1" and the user is "anonym" without any password.

Example: Windows File Explorer:



→ The following files are displayed in the file window:



13.2.3 Signal list file

The signal list file contains the FO configuration and the signal mapping including the signal names from the *ibaPDA* configuration.

The following figure shows an example of a signal list file:

```
****************************
*** Fiber optic settings ***
****************************
Mode: 32 Mbit Real 128A + 128D, Period: 200 us


****************************
***     Signal lists     ***
****************************

*** Fiber optic output, list of digital signals (called DI in the modules) ***
                                    Signal|Len|Fiber optic|PDA setting|
                                          |bit|     Signal|Address|bit|
---------------------------------------+---+-----------+-------+---+
                                InSwitch1|  1|        D32|  0x244|  0|
                                InSwitch2|  1|        D33|  0x244|  1|
                                InSwitch3|  1|        D34|  0x244|  2|
                     Signalgruppe_16.Switch 1|  1|         D0|  0x240|  0|
                     Signalgruppe_16.Switch 2|  1|         D1|  0x240|  1|
                     Signalgruppe_16.Switch 3|  1|         D2|  0x240|  2|
Signalgruppe_31.TriggerWhenCounterReset|  1|         D3|  0x240|  3|
       Signalgruppe_31.CounterZw0und250|  1|         D4|  0x240|  4|
     Signalgruppe_31.CounterZw250und500|  1|         D5|  0x240|  5|
     Signalgruppe_31.CounterZw500und750|  1|         D6|  0x240|  6|
... - Input From DO 1 (Reset PLC Count)|  1|        D35|  0x244|  3|
...- Input From DO 2 (PLC Ten Task Bit)|  1|        D36|  0x244|  4|

*** Fiber optic output, list of analog signals (called AI in the modules) ***
                                    Signal|Len|   Type|Fiber optic   |PDA setting|
                                          |bit|       |Signal|Offset |    Address|
---------------------------------------+---+-------+------+-------+-----------+
                         SourceSignalSinus| 16|    INT|   A86|0 Bytes|      0x198|
                      SourceSignalSinusKBus| 16|    INT|   A86|2 Bytes|      0x19A|
                                  OutSinus| 16|    INT|    A0|0 Bytes|       0x40|
                      PlcSignal01MalEinHalb| 16|    INT|    A0|2 Bytes|       0x42|
                    SIGNALGRUPPE_0.PlcSinus| 32|  FLOAT|    A1|0 Bytes|       0x44|
                  SIGNALGRUPPE_0.PlcSinus*2| 32|  FLOAT|    A2|0 Bytes|       0x48|
                  SIGNALGRUPPE_1.PlcSinus*4| 32|  FLOAT|    A3|0 Bytes|       0x4C|
                  SIGNALGRUPPE_1.PlcSinus*8| 32|  FLOAT|    A4|0 Bytes|       0x50|
                    SIGNALGRUPPE_15.Counter| 32|  FLOAT|    A5|0 Bytes|       0x54|
                SIGNALGRUPPE_15.Counter+100| 32|  FLOAT|    A6|0 Bytes|       0x58|
```

The selected *ibaNet* protocol 32Mbit is displayed under "Fiber optic settings".

The mapping of the IO signals and the FO configuration is shown in the signal list. The signals are grouped by digital and analog signals.

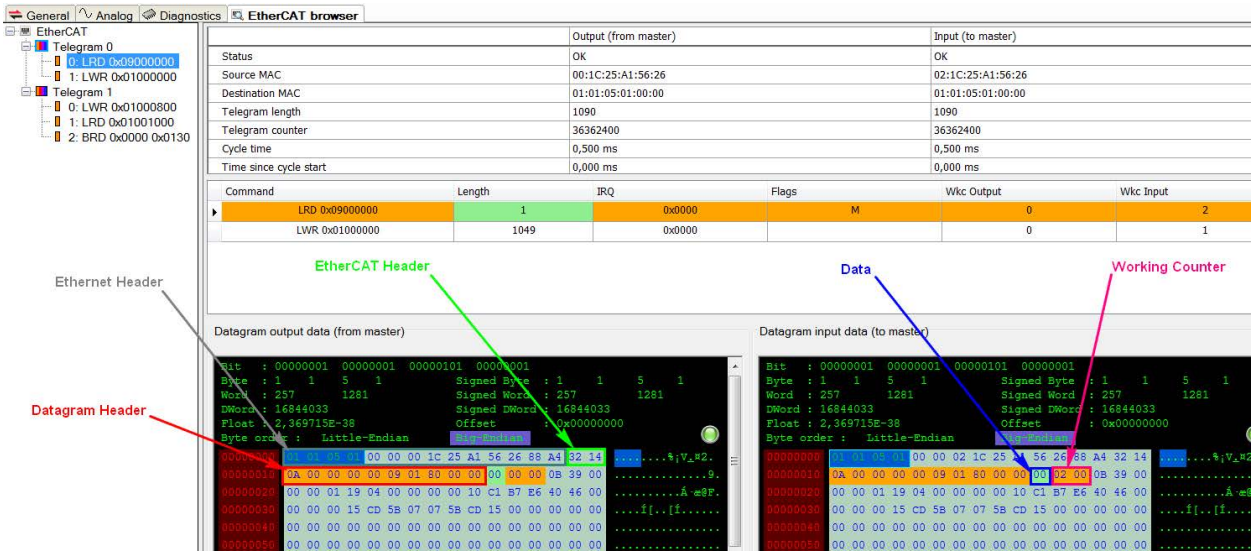
The column "Fiber optic Signal" (blue frame in the following figure) shows the corresponding allocation on the fiber optic cable for each signal. This may be used for the connectivity to *ibaLogic* or other iba-hardware.

```
*** Fiber optic output, list of digital signals (called DI in the modules) ***
                                    Signal|Len|Fiber optic|PDA setting|
                                          |bit|     Signal|Address|bit|
---------------------------------------+---+-----------+-------+---+
                                InSwitch1|  1|        D32|  0x244|  0|
                                InSwitch2|  1|        D33|  0x244|  1|
                                InSwitch3|  1|        D34|  0x244|  2|
```

The given address with the corresponding offset, shown in the cloumn "PDA setting" (green frame), is an additional information for the use with *ibaPDA*. The FOB fast module can be configured in advanced mode with this setting.

13.3 EtherCAT browser overview

The following figure provides an overview of the frame or datagram structure of an EtherCAT frame:

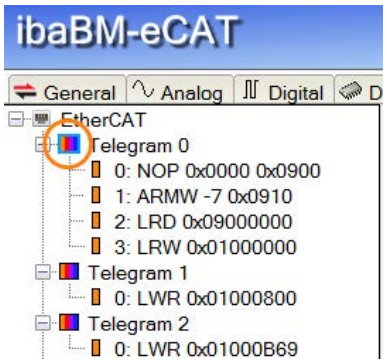


13.4 EtherCAT diagnostic signals

The diagnostic signals are version-dependent and can be added to newer versions if required. The following digital and analog signals are currently available.

13.4.1 Sequence with several frames

Some diagnostic values require the sequence of the frames and thus the "first frame in the cycle" if there are several frames within one cycle. The EtherCAT browser detects the first frame automatically and displays it with a blue marking:

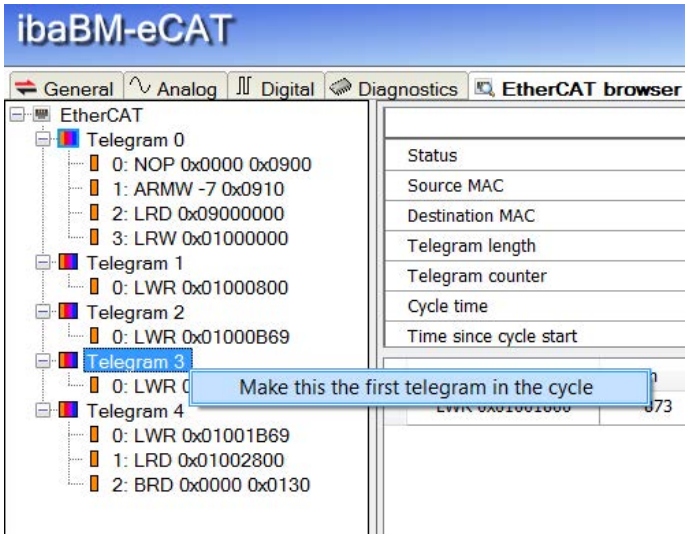


Note

This marking remains during the manual change so that you can still track later which frame was originally recognized automatically as the first.

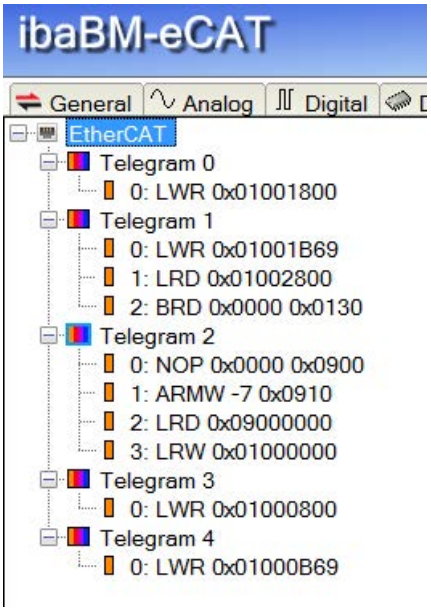
However, it is possible to specify the "first frame in the cycle" manually in the EtherCAT browser.

1. Select the frame that is to be set as the first frame.
2. With a right mouse click open the context menu and select <Make this the first telegram in the cycle>.



The sequence of the frames cannot be changed. The sequence remains fixed and is related to the "first frame in the cycle".

Example
Frame 3 is set to be the "first in the cycle", then the frames follow that were previously 4, 0, 1 and 2.



13.4.2 Digital diagnostic signals

Optimization status group

Optimization data matches current EtherCAT bus
The detected EtherCAT frames match the configuration stored in the device. An optimization of the data extraction is carried out.

Optimization using EtherCAT configuration file
The EtherCAT configuration file loaded into the device is used for the optimization.

Optimization using EtherCAT browser (ibaPDA)
The last data created via the call of the EtherCAT browser are used for the optimization.

Network group

Switching due to network TAP
If the network TAP support is activated to integrate the *ibaBM-eCAT* without interference as sniffer with an Ethernet TAP into the EtherCAT bus, this signal indicates a network switch-over due to the send and receive directions of the EtherCAT bus. See also chapter ↗ *Integration without interference as sniffer*, page 25.

13.4.3 Analog diagnostic signals

General group

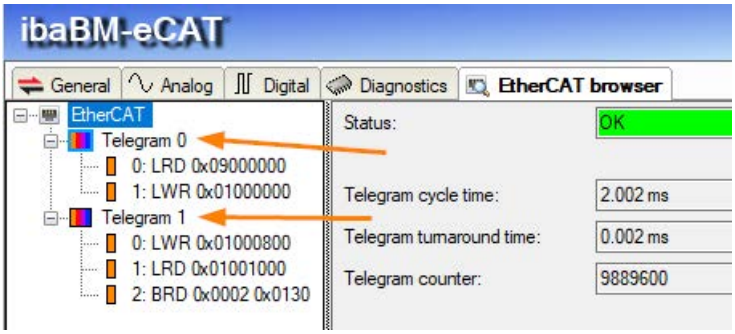
Bus cycle time
The turnaround time of the bus per cycle. Measured at the first EtherCAT frame from the output and back to the input.

Number of output frames per cycle
The number of output frames per cycle

Number of input frames per cycle
The number of input frames per cycle

Example:

The EtherCAT browser shows that there are two frames in circulation per bus cycle.



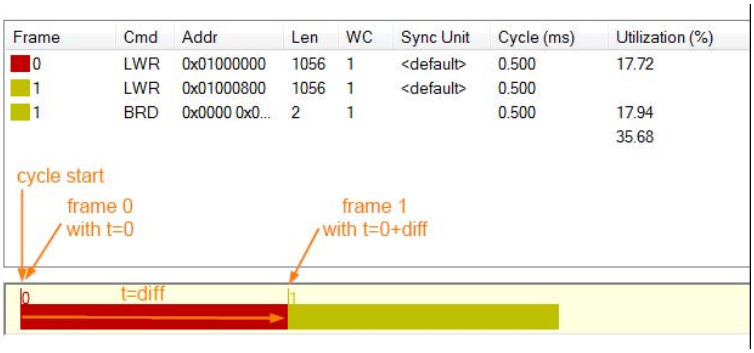
Frame X group

Output frame X: Cycle period
The cycle time of the output frames with the number X

Input frame X: Cycle period
The cycle time of the input frames with the number X

Output frame X: Time since start of cycle
The time difference of the output frames at the start time of the cycle

Input frame X: Time since start of cycle
The time difference of the input frames at the start time of the cycle



Output frame X: Number of frames
The total number of output frames since the start of acquisition

Input frame X: Number of frames
The total number of input frames since the start of acquisition

Explanation:

If frames are correctly detected as EtherCAT and they also contain datagrams with logical addressing for process data exchange (e. g. LRD, LWR, LRW), these diagnostic signals are incremented. CPU group

CPU group

Runtime of the output CPU since start
The runtime of the output controller since its start.

Runtime of the input CPU since start
The runtime of the input controller since its start.

Additional group

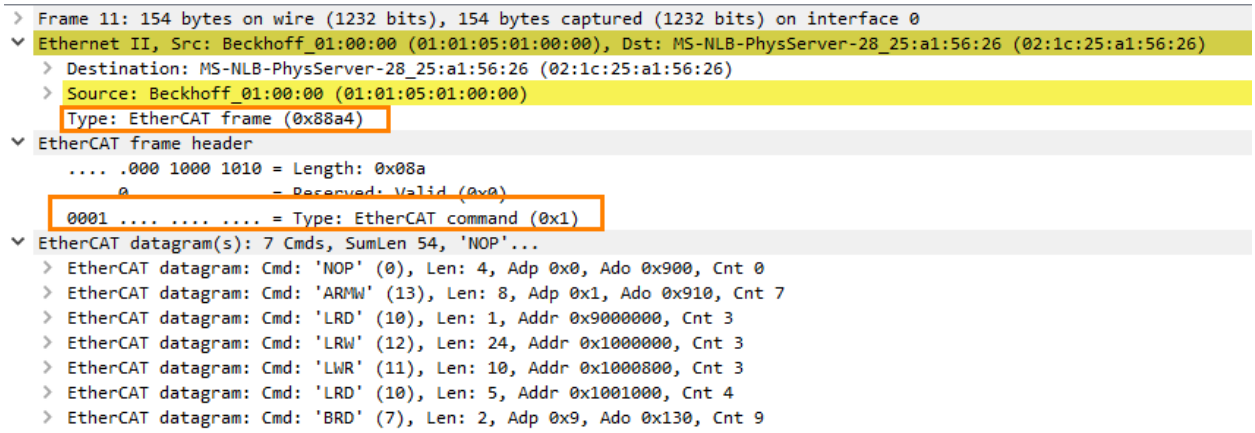
Number of detected output frames
The number of correctly detected EtherCAT output frames.

Number of detected input frames
The number of correctly detected EtherCAT input frames.

Explanation:

To ensure that a frame is detected as EtherCAT, two criteria must be met in the Ethernet frame structure.

- The Ethernet frame type is "EtherCAT" (0x88a4).
- The EtherCAT header contains the identifier "EtherCAT command (0x1)".



Number of undetected output frames
The number of output frames not detected as EtherCAT.

Number of undetected input frames
The number of input frames not detected as EtherCAT.

14 Support and contact

Support

Phone: +49 911 97282-14

Email: support@iba-ag.com

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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