



ibaBM-eCAT

Bus monitor for EtherCAT®

Manual

Issue 2.0

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The current version is available for download on our web site <http://www.iba-ag.com>.

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Windows® is a label and registered trademark of the Microsoft Corporation. EtherCAT® is registered trademark and patented technology, licensed by Beckhoff Automation GmbH, Germany. Other product and company names mentioned in this manual can be labels or registered trademarks of the corresponding owners.

Certification

The device is certified according to the European standards and directives. This device corresponds to the general safety and health requirements. Further international customary standards and directives have been observed.



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

| Issue | Date | Revisions | Chapter/pages | Author | Version HW / FW |
|-------|---------|---------------|---------------|--------|-----------------|
| 2.0 | 08-2023 | FO cable, GUI | | | |

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1 About this manual

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

1.1 Target group

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

1.2 Notations

The following designations are used in this manual:

| Action | Notations |
|---------------------------|--|
| Menu command | Menu <i>Logic diagram</i> |
| Call of menu command | <i>Step 1 – Step 2 – Step 3 – Step x</i> Example: Select menu <i>Logic diagram – Add – New logic diagram</i> |
| Keys | <Key name> Example: <Alt>; <F1> |
| Press keys simultaneously | <Key name> + <Key name> Example: <Alt> + <Ctrl> |
| Buttons | <Button name> Example: <OK>; <Cancel> |
| File names, Paths | „File name“, „Path” Example: „Test.doc“ |

1.3 Used symbols

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



⚠ DANGER

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

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

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



⚠ WARNING

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



⚠ CAUTION

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



Note

A note specifies special requirements or actions to be observed.



Tip

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



Other documentation

Reference to additional documentation or further reading.

2 Introduction

The device ibaBM-eCAT can be used for reading and recording of 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 PC is required, which is provided by a fiber optic card of the ibaFOB-D family (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 provides diagnostic functions for the bus. For example, the individual frames can be analyzed and the cycle and turnaround time can be 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).

Note 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 restrictions mentioned above apply only, when 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.
- Supported 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 also an open technology: anyone is allowed to implement or use it.



How it works

EtherCAT's key functional principle lies in how its nodes process Ethernet frames: each 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) while also eliminating the need for switches or hubs.

Network performance

The unique way EtherCAT processes frames makes it the fastest Industrial Ethernet technology; no other technology can top EtherCAT's bandwidth utilization or the corresponding performance.

Flexible topology

In addition to its speed, an EtherCAT network can support up to 65,535 devices without placing restrictions on their topology: line, bus, tree, star – or any combination thereof. 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 highly integrated, 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 currently in use across the globe in an unrivaled range of applications. 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 unpacking check the completeness and intactness of the delivery.

The scope of delivery includes:

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

5 Safety instructions

5.1 Designated use

The device is an electrical equipment. It may be used only in the following applications:

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

The device may only be operated in conditions as specified in the technical data.

5.2 Special advices



Warning!

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



CAUTION

Observe the operating voltage range

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



Important note

Do not open the device!

There are no serviceable parts inside the device.

Opening the device will void the warranty.



Note

Cleaning

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

6 System requirements

6.1 Hardware

For operation:

- 24 V DC ($\pm 10\%$) power supply

To set the device's parameters and for measuring:

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

On our website <http://www.iba-ag.com>, you find suitable industry-type and desktop-type PC systems.

- At least one fiber optic 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 extension module ibaFOB-4o-D
 - ibaFOB-4i-D / ibaFOB-4i-Dexp with extension module ibaFOB-4o-D
 - ibaFOB-io-ExpressCard (for notebooks)
 - ibaFOB-io-USB adapter
- One ibaNet fiber optic patch cable (duplex) for connecting ibaBM-eCAT and ibaPDA-PC (fiber optic patch cables are available at iba too)

6.2 Software

- ibaPDA version 8.4.1 or later for measuring and recording data

6.3 Firmware

- ibaBM-eCAT version 02.05.005 or later

6.4 IO Device File (ESI)

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

7 Assembly and disassembly

The device is provided with a mounting rail clip for installation.

7.1 Assembly

1. Place the mounting rail clip attached to the device on the mounting rail.
2. Press the device down in such a way that the clip of the mounting rail engages with a click.

7.2 Connecting

1. If there is a rule to ground the device, connect the device to the ground.
2. Connect the power supply. Observe the correct polarity.
3. Connect the device to the ibaPDA-PC via a ibanet fiber optic patch cable (duplex):
 - the RX input (X11) of the device with the TX interface of the ibaFOB-D card in the ibaPDA-PC,
 - the TX output (X10) of the device with the RX interface of the ibaFOB-D card in the ibaPDA-PC.
4. Connect the EtherCAT MainDevice to the EtherCAT MainDevice interface of the device (X40) via Ethernet cable
5. Connect the first EtherCAT SubDevice to the EtherCAT SubDevice interface of the device (X41) via Ethernet cable
6. When all cables are connected, switch on the device.

7.3 Disassembly

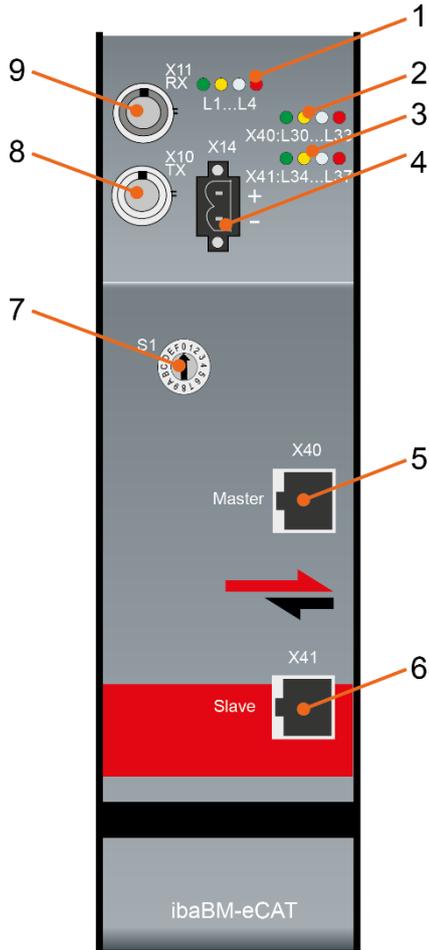


Disconnect the power supply before disassembly!

1. Disconnect the power supply.
2. Disconnect the ground.
3. Disconnect all cables.
4. Close the open fiber optic inputs and outputs with a cover.
5. Hold the device to prevent it from falling down and press it slightly downwards.
6. After that pull the device and lift it up. The clip of the mounting rail will disengage with a click.
7. Remove the device.
8. When storing or transporting the device observe the values specified in the technical data.

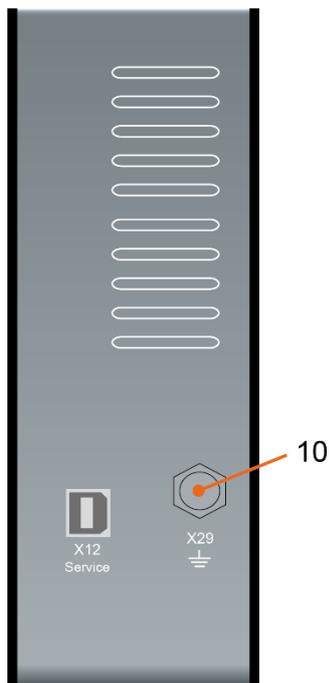
8 Device description

8.1 Views



- 1 Operating status indication L1...L4
- 2 Indication EtherCAT bus L30...L33
- 3 Indication device functions L34...L37
- 4 Connector power supply 24 V X14
- 5 Interface EtherCAT MainDevice X40
- 6 Interface EtherCAT SubDevice X41
- 7 Rotary switch S1
- 8 Interface fiber optic output TX, X10
- 9 Interface fiber optic input RX, X11

Front view



- 10 Grounding screw X29

(USB interface X12 for service purposes only)

Bottom view

8.2 Operating and indicating elements

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

8.2.1 Operating status

| LED | Display | Status |
|-------------------|-----------------------------------|---|
| L1 (green/red) | off blinking green on (red) | Out of operation, no voltage supply ready for operation device is booting; once the device has booted, the LED changes to green |
| L2 (yellow) | off on | no measuring device is measuring |
| L3 (white) | off on blinking | no data reception at X11 data reception at X11 OK data reception at X11, but signal is wrong |
| L4 (red) | off blinking | Normal, everything OK Error occurred within the device |

8.2.2 EtherCAT bus

| LED | Display | Status |
|-----|--|---|
| L30 | off blinking | device not active device is working |
| L31 | on | EtherCAT messages are recognized |
| L32 | off blinking quickly blinking slowly on | no measuring values requested measuring values requested, but none can be found measuring values requested, but not all can be found measuring values requested, all are available |
| L33 | on | a failure is recognized within the EtherCAT message |

8.2.3 Device functions

| LED | Display | Status |
|-----|--|--|
| L34 | off on | device not enabled as EtherCAT SubDevice device enabled as EtherCAT SubDevice |
| L35 | off blinking quickly blinking slowly on | EtherCAT SubDevice status „INIT“ EtherCAT SubDevice status „PRE-operational“ EtherCAT SubDevice status „SAFE-operational“ EtherCAT SubDevice status „Operational“ |
| L36 | off on | no optimization of data extraction 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 rotary switch S1.

| Device number within the cascade | Rotary switch setting |
|----------------------------------|-----------------------|
| not allowed | 0 |
| 1 st device | 1 |
| 2 nd device | 2 |
| ⋮ | ⋮ |
| 14 th device | E |
| 15 th device | F |



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 appendix, chapter 13.2.

8.3 Connections

8.3.1 Power supply X14

The ibaBM-eCAT device requires an external 24 V DC ($\pm 10\%$) 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 rails or plug-in power supply units from iba.

8.3.2 EtherCAT MainDevice and SubDevice X40, X41

EtherCAT interfaces for the connection 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

Fiber optic interfaces for connection to the ibaPDA system

- X10 (TX) for the transmission direction to ibaPDA
- X11 (RX) for the reception from ibaPDA

ibaPDA requires a fiber optic card of the ibaFOB-D or ibaFOB-Dexp family 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 11.3.

The specification of the transmitter's output power and the receiver's sensitivity of the fiber optic components installed in the device can be found in chapter "Technical data" 11.1 under "ibaNet interface".

8.3.4 Grounding screw X29

Proper connection of cable shielding to the device should be ensured. The shield connector (M6 screw) found on the bottom of the device should be connected with any total shield that serves for all sensor cables. Use a M6 cable lug for the connection.



Important note!

Connect shield on one cable side only to avoid ground loops!

Always ground the DIN rail on which the device is installed!

9 System integration

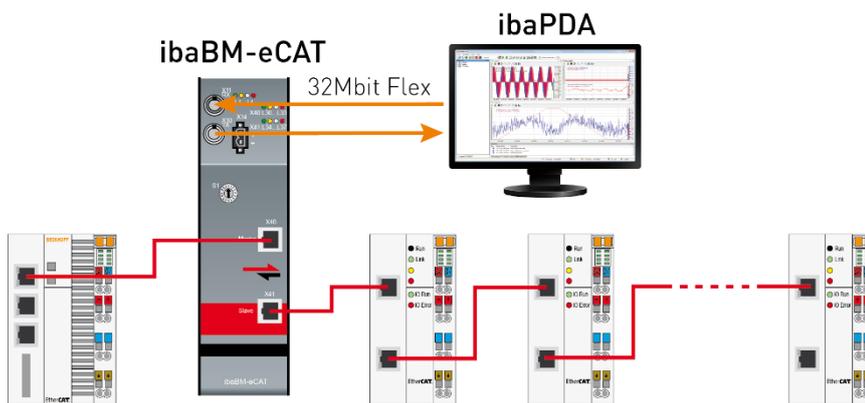
The complete range of functions can be used by integrating ibaBM-eCAT into the EtherCAT bus as described in chapter 9.1.

In addition, there are other integration options with the corresponding advantages. However, their special features must be taken into account.

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 interfaces, which 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

When ibaBM-eCAT is switched off, the EtherCAT connection between the MainDevice and the SubDevices will be interrupted!



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.



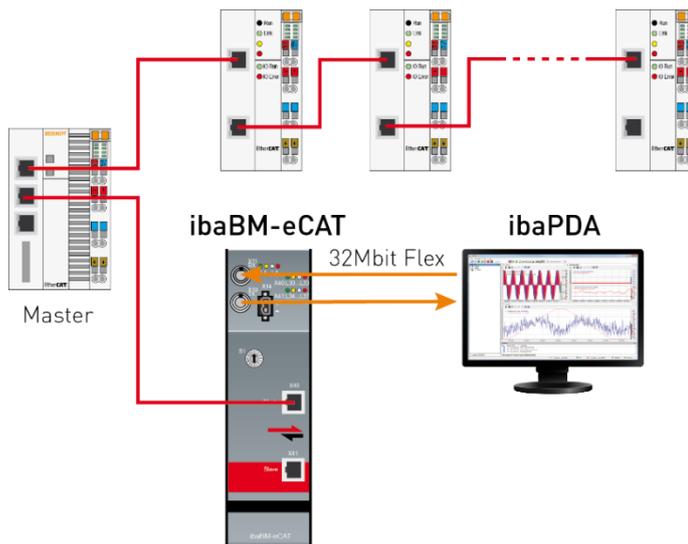
Note

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 signals that are to be reliably acquired via ibaBM-eCAT must be addressed directly in the controller as output signals to the device. ibaBM-eCAT must therefore be configured as an 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 described in chapter 9.1 is not completely without interference for the bus.

ibaBM-eCAT behaves like an EtherCAT device, even if the device is configured as a sniffer.

On the one hand the device refreshes the bus signal, on the other hand it interrupts the bus when it is switched off.

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

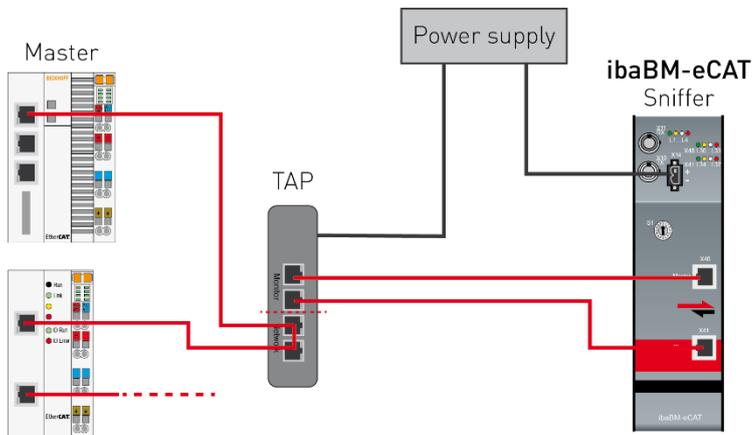
iba recommends the Ethernet TAP from Profitap:

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

9.3.1 Integration without interference as sniffer

Instead of the ibaBM-eCAT device described in chapter 9.1, the Ethernet TAP is now integrated into the EtherCAT bus directly after the EtherCAT MainDevice.

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:

| Advanced | |
|---------------------------|--------|
| Timeout | 100 ms |
| Enable default values | False |
| Enable EtherCAT SubDevice | False |
| Enable optimization | True |
| Support network TAP | True |
| Connection | |

This always 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

As described before, ibaBM-eCAT cannot be integrated as SubDevice without interference, because it becomes a device of the EtherCAT bus.

If ibaBM-eCAT is integrated as the only or last device (chapter 9.2), it is almost without interference for the EtherCAT bus.



Note

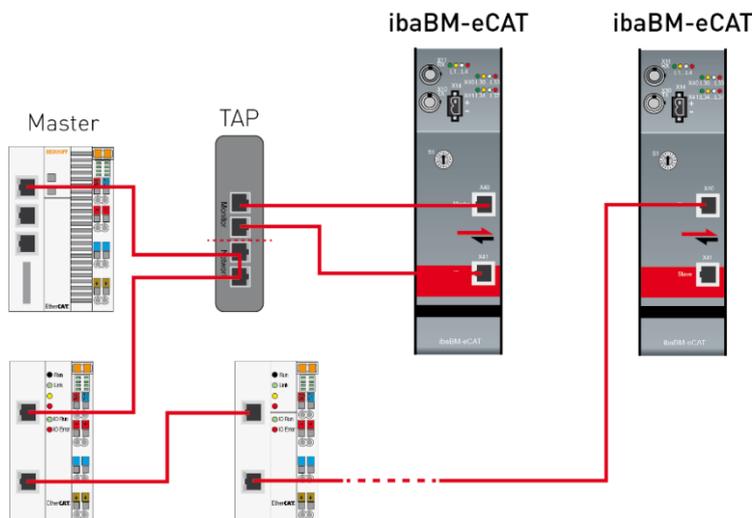
However, not all I/O signals from the EtherCAT bus can be acquired.

Only the signals (outputs) directly addressed to ibaBM-eCAT are reliably acquired.

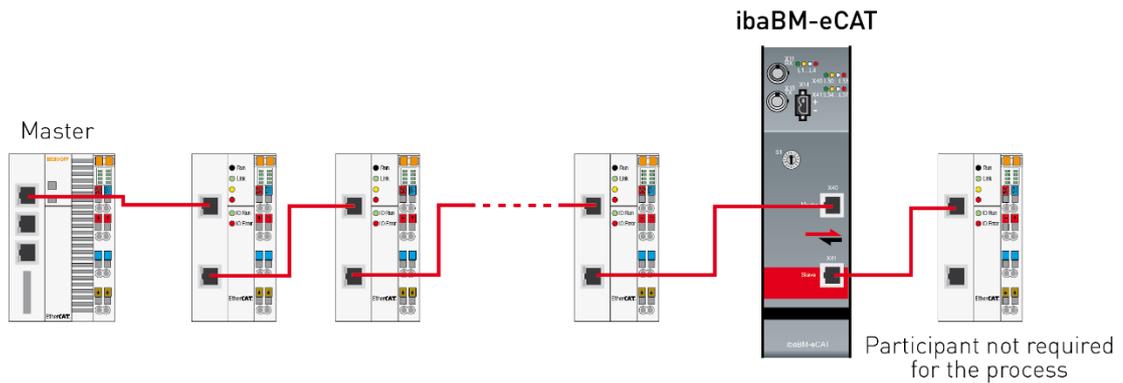
9.3.3 Integration without interference as sniffer and SubDevice

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 device that is connected as sniffer via the Ethernet TAP described in chapter 9.3.1 and one device that is attached to the bus end with the SubDevice functionality:



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

However, not all I/O signals can be acquired from the EtherCAT bus.

10 Configuration with ibaPDA

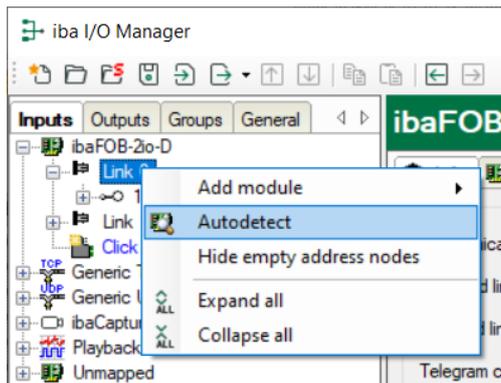
10.1 First Steps in ibaPDA

The following instructions show you how to integrate ibaBM-eCAT into ibaPDA and to configure the signals. You will find a detailed description of the device module "ibaBM-eCAT" and the different modules starting with chapter 10.4.

1. Start ibaPDA on the PC and open the I/O Manager.

Find the appropriate link of the ibaFOB card to which ibaBM-eCAT is connected. Click on the link with the right mouse button and select „Autodetect“.

If the device is correctly connected, "ibaBM-eCAT" will be shown below the link of your ibaFOB card. The slot number corresponds to the device address, which is set at the rotary switch.



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, it is possible to manually add the device module and the modules ("Add module") and parameterize them.

2. 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.

The export function for Beckhoff TwinCAT V2, for example, can be found at the following location:



Please note, that if ibaBM-eCAT is to be used as EtherCAT SubDevice, the device must be integrated into the EtherCAT configuration before exporting (see chapter

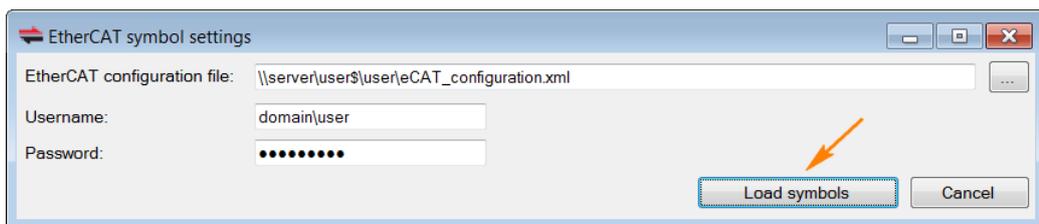
10.3)

If no EtherCAT configuration file is available, signals can be selected for acquisition using the EtherCAT browser (see chapter 10.4.2.3)

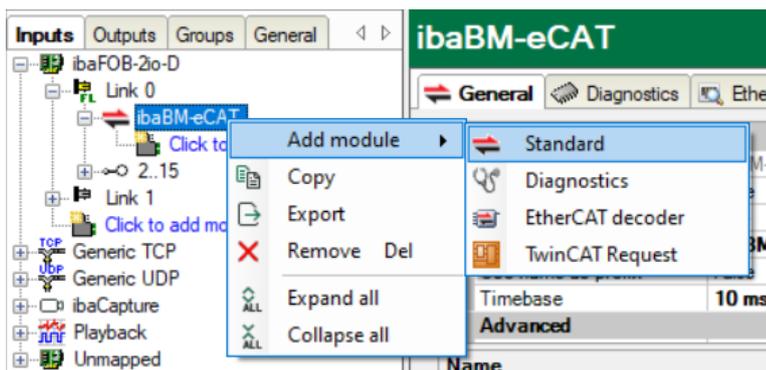
- Now load the EtherCAT configuration file into ibaPDA by clicking on the link "EtherCAT symbol settings" in the "General" tab of the just added module "ibaBM-eCAT".



In the appearing window select the EtherCAT configuration file (either enter directly or select via the button ). If the EtherCAT configuration file is located on a different computer and a user ID is required, enter the UNC path, user name and password here. Exit this window with <Load symbols>.



- Add a module "Standard". Click on the link "ibaBM-eCAT" with the right mouse button and select "Add module" and the module "Standard". Alternatively you can click on the link "Click to add module..." and then select "Standard".

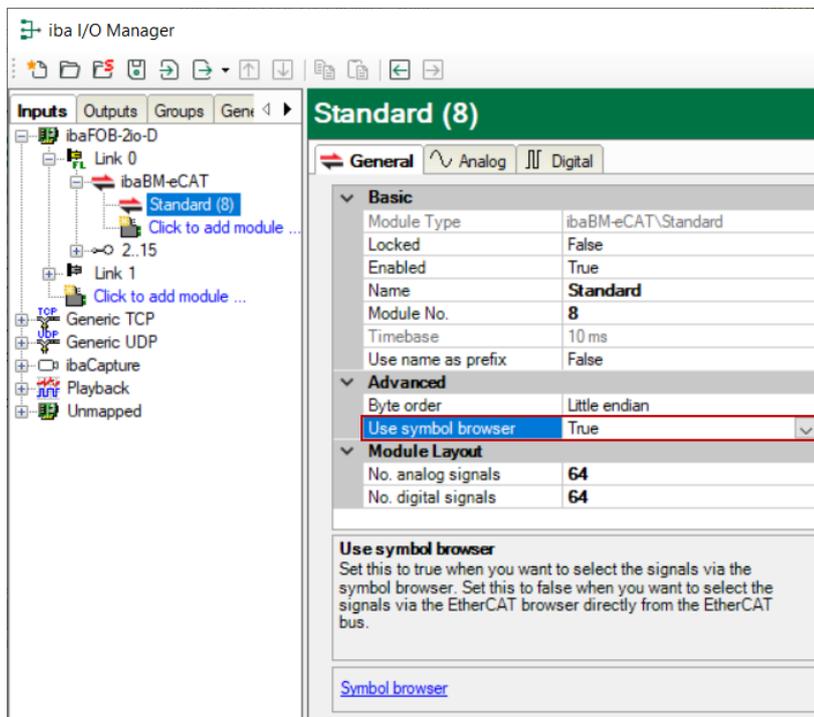


10.2 Configuration as EtherCAT sniffer

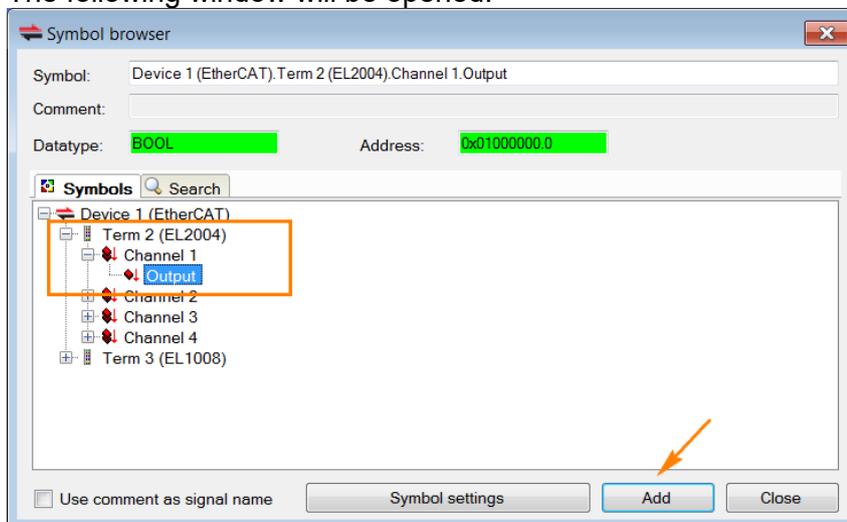
By default, ibaBM-eCAT is preset for the sniffer functionality and the "Standard" module for signal selection via symbol browser.

The following further steps are based on this:

- 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 following window will be opened:



2. In the tree structure, select the terminals whose signals should be recorded. Open the terminal symbol and select the signal. The signal is added to the appropriate signal table (analog or digital) by double clicking on the desired signal or clicking on the button <Add>.



Note

A signal must not be added twice. If a signal is added twice to the signal table, an error message appears when the configuration is validated by ibaPDA.

3. When all desired signals are selected close the window with a click on the button <Close>. If required, you can add further signals later.
4. In order to apply the settings click on <OK>. Then ibaPDA checks the configuration. If the configuration is OK, it will be applied by ibaPDA and written to the device. Now the selected signals can be displayed and recorded by ibaPDA as usual.

10.3 Configuration as EtherCAT SubDevice

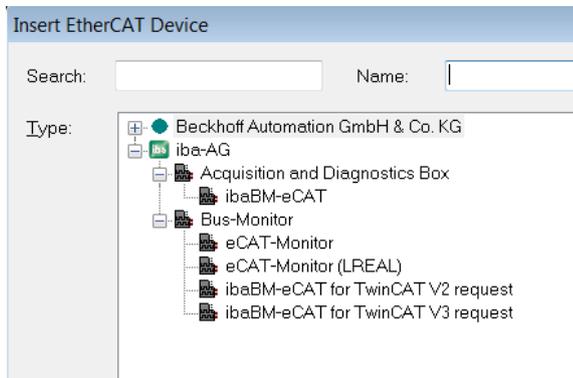
The option "EtherCAT SubDevice" must be enabled in ibaPDA and the device must be integrated into the EtherCAT configuration to configure the device as an EtherCAT Sub-Device. For this the "IO-Device-File", also called ESI file, is imported from the supplied data medium into the EtherCAT MainDevice. The 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

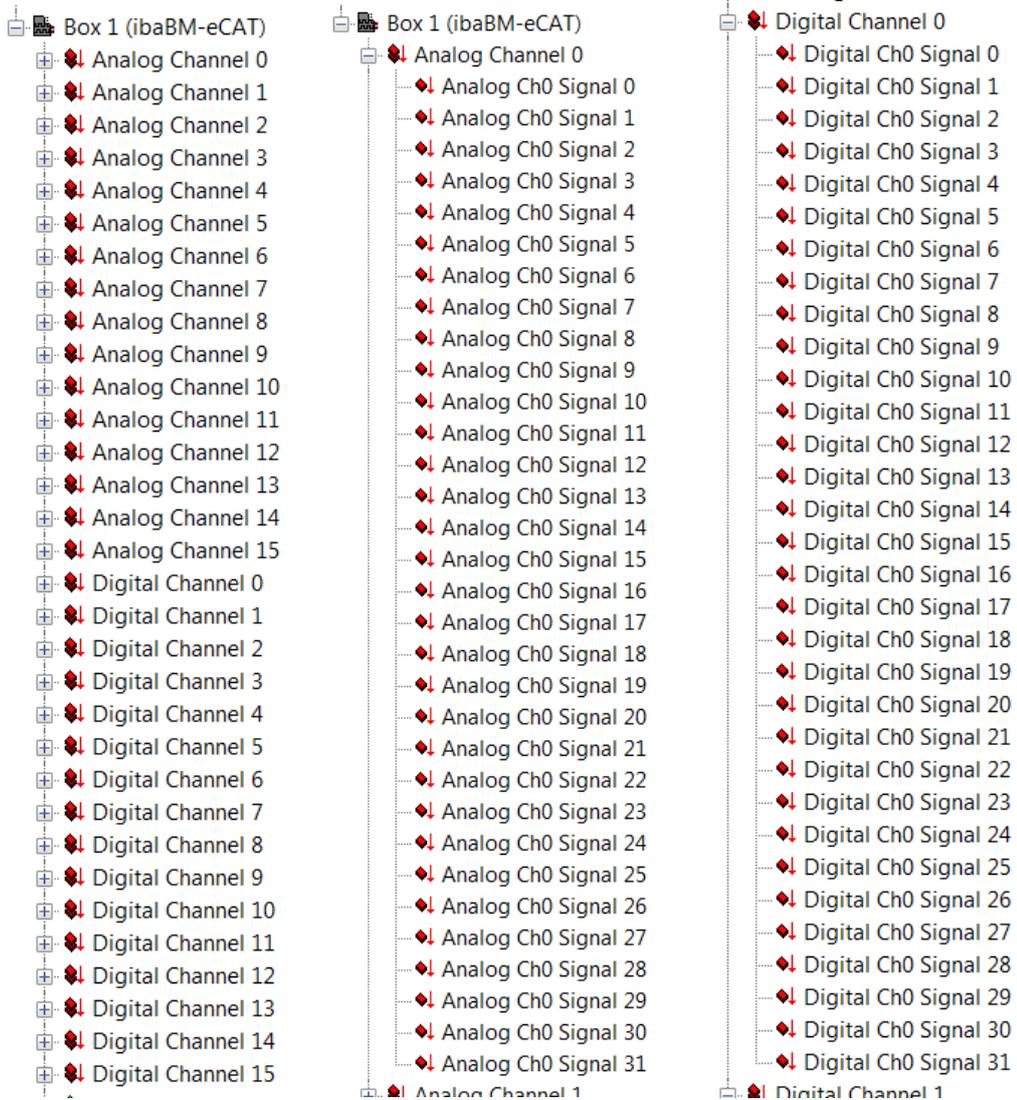
The following description refers to the EtherCAT MainDevice "TwinCAT System Manager V2" from Beckhoff. The procedure for other EtherCAT systems is similar.

1. Import the IO-Device file into your EtherCAT MainDevice.
In this example it is copied into the program directory under "...\\IO\\EtherCAT\\".
2. After having restarted the EtherCAT MainDevice, ibaBM-eCAT is available as EtherCAT SubDevice for integration into the EtherCAT configuration:

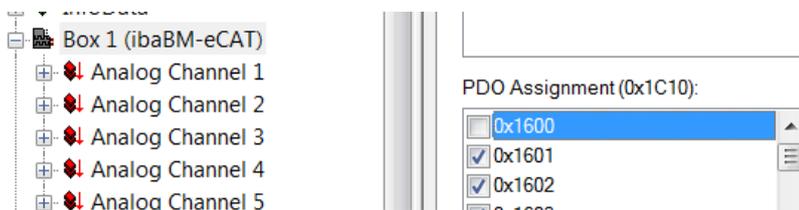


All devices below the group "Bus Monitor" are special types of our bus monitor and are not required for standard operation.

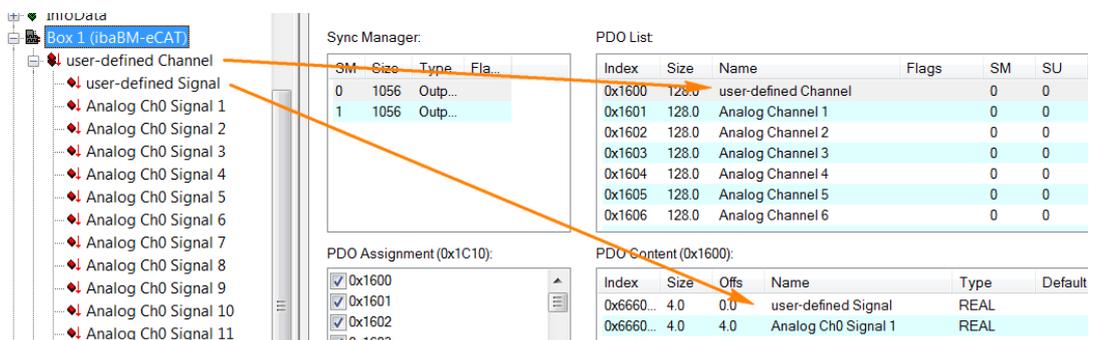
3. Choose „ibaBM-eCAT“ and integrate the device into the EtherCAT bus by clicking on <OK>.
4. 16 analog (Analog Channel 0...15) and 16 digital (Digital Channel 0...15) channels with 32 signals each are now available per device:



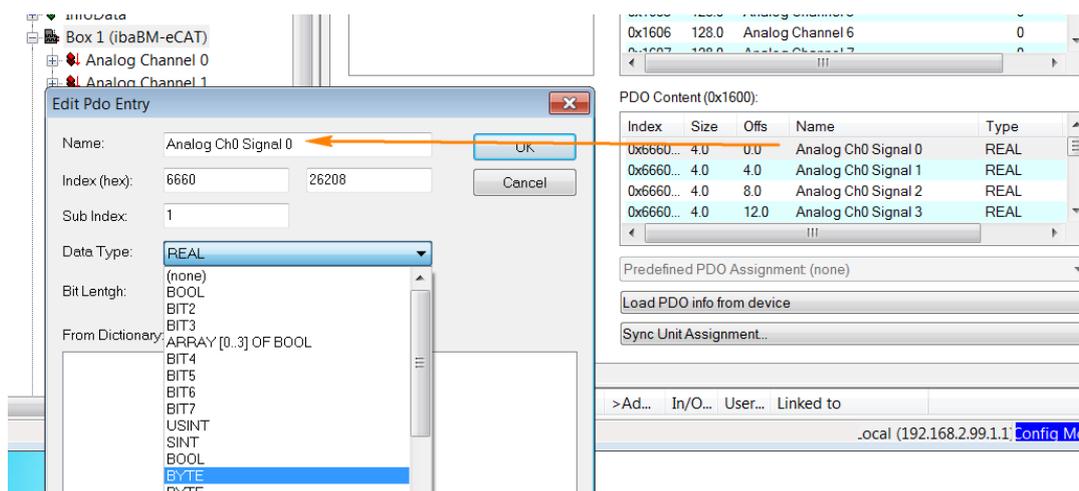
- The number of signals can be reduced channel by channel. The channel has to be disabled in the EtherCAT configurator. In our example, disabling the PDO assignment 0x1600 deletes the Analog Channel 0.



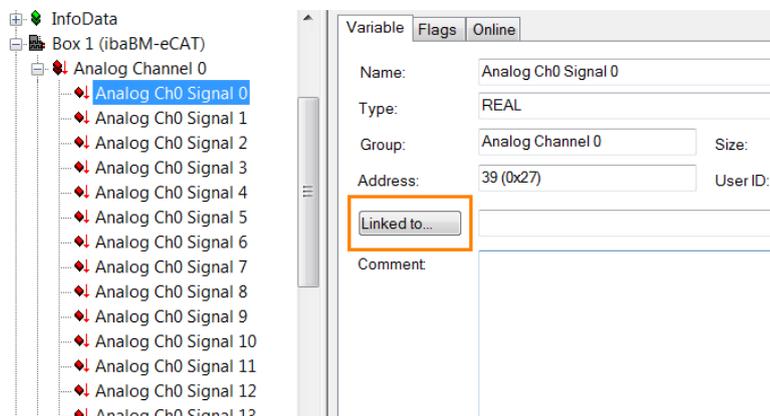
- You can also change the names of channels and signals:



- If another data type is required for the analog signals than the preset one, it is possible to modify the data type here.



- Configure and link the signals as for the other SubDevices (please observe additional notes in the appendix, chapter 13.1):



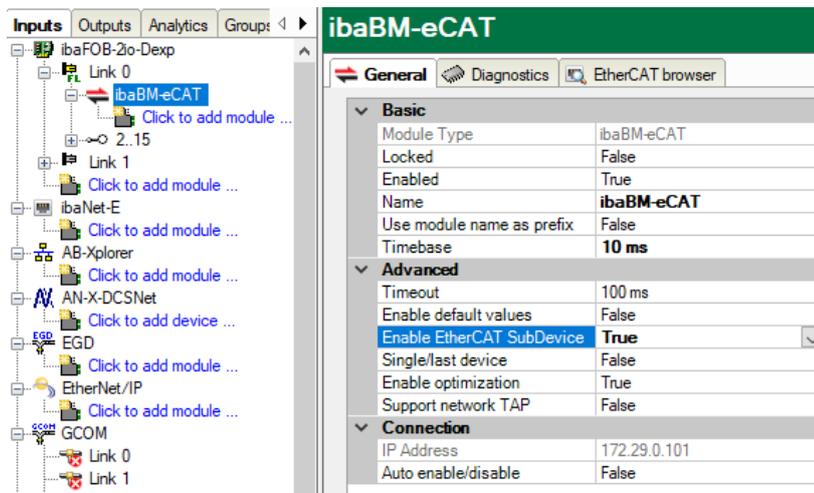
- Finally export the completed EtherCAT configuration with a click on <Export configuration file...> and import it into ibaPDA as described in chapter 10.1 for a comfortable signal selection via symbol browser.



10.3.2 Enabling in ibaPDA

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

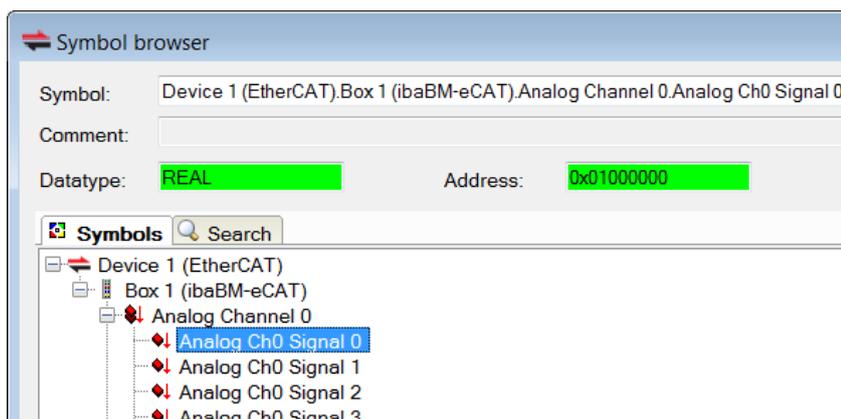
1. Open the "General" tab of the device module "ibaBM eCAT" in the I/O manager and select the option "True" in the field "Enable EtherCAT SubDevice".



With the activation of the SubDevice functionality the configuration field of the single or last EtherCAT device is displayed.

If you want to operate ibaBM-eCAT with this type of integration (see chapter 9), also set this option to "True".

2. 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 10.2.



10.4 Modules and tabs

Below you find a description of the device module “ibaBM-eCAT” and the modules “Standard”, “EtherCAT decoder” and “Diagnostics”. The description for the “TwinCAT Request” module can be found in the ibaPDA supplementary manual for the request function for TwinCAT.

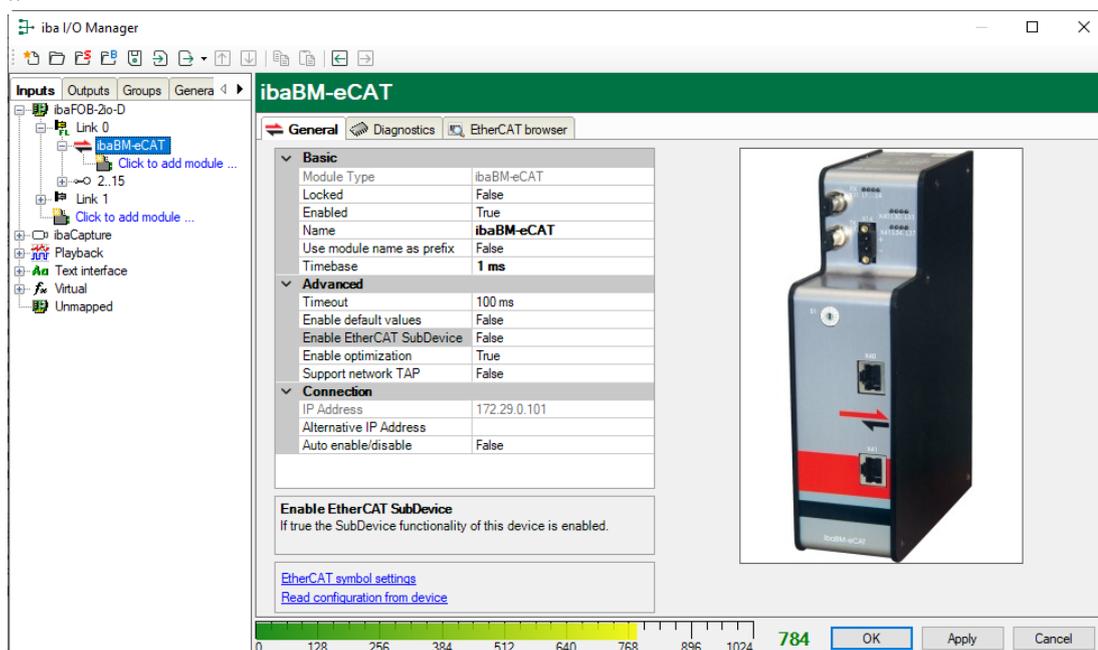
Please refer to the corresponding chapter in the ibaPDA manual for further operating options.

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. Please follow the instructions in chapter 10.1.

The device module „ibaBM-eCAT“ has 5 different tabs. The “General”, “Diagnostics” and “EtherCAT browser” tabs are always visible. The “Analog” and “Digital” tabs contain dynamic online views on the captured analog and digital signals. Both tabs are only visible after modules have been added.

10.4.1.1 „General“ tab



Basic

Module Type

Display of module type (read only)

Locked

A module can be locked for preventing accidental or unauthorized changes of the module settings.

Enabled

Disabled modules are excluded from signal acquisition.

Name

Name of the module, by default, the name corresponds to the module type.

Use name as prefix

Puts the module name in front of the signal name.

Timebase

All signals of this module are acquired with this timebase.

Advanced Timeout

The timeout specifies the maximum time between EtherCAT messages 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), then the device will send the default signal value when the EtherCAT connection is broken. The default values can be set in the analog and digital signal tabs of the submodules (see also chapter 10.4.2.4).

If the default value option is not enabled (False) then the last received signal value will be repeated.

 Enable EtherCAT SubDevice

In case, this option is enabled (True), the “SubDevice” function will be switched on. Hence, the controller can address directly the device, provided that it is integrated in the configuration (see chapter 9.2). If this option is not enabled (False) ibaBM-eCAT can work only in sniffer mode.

 Single/last device

Only available with enabled EtherCAT SubDevice.

Enable this option (True), if you want to use ibaBM-eCAT as a single SubDevice or as the last SubDevice in an EtherCAT segment.

 Enable optimization

By default, data extraction optimization is enabled. Disable this option (False) if you do not want to use the optimization or rather you cannot use it, e.g. for a Hot Connect or other flexible EtherCAT configurations. See also chapter 10.5.

 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 fiber optic protocol. The IP address cannot be changed.

 Auto enable/disable

When this option is enabled and ibaPDA cannot connect to this device during the start of the acquisition then it will disable this module and start the acquisition without it. During the acquisition it will try to reconnect to the device. When it succeeds it will automatically restart the acquisition with this module enabled. If this option is not enabled then ibaPDA won't start the acquisition when it cannot connect to the device.

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

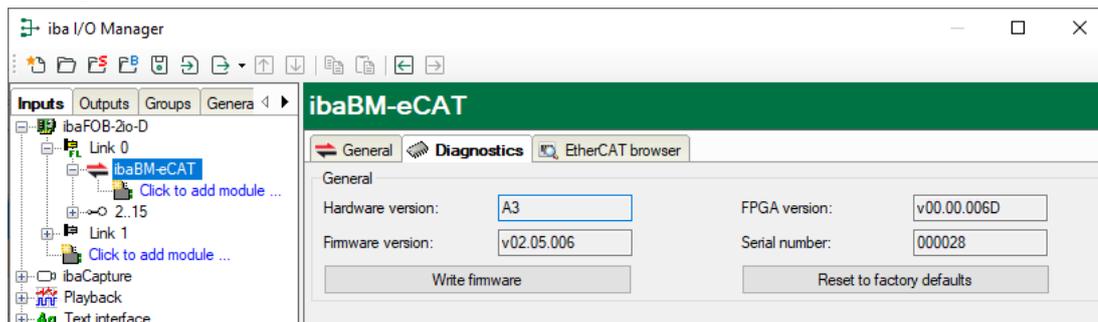
 EtherCAT symbol settings

Using this link you can import the EtherCAT configuration file, see also chapter 10.1.

 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 „Diagnostics“ tab



Here, you find information about the hardware version, firmware version, FPGA version and the serial number of your device.

Write firmware

Using this button you can install a firmware update. Select the update file „bm-ecat_xxx.iba“ in the browser and start the update with <OK>.

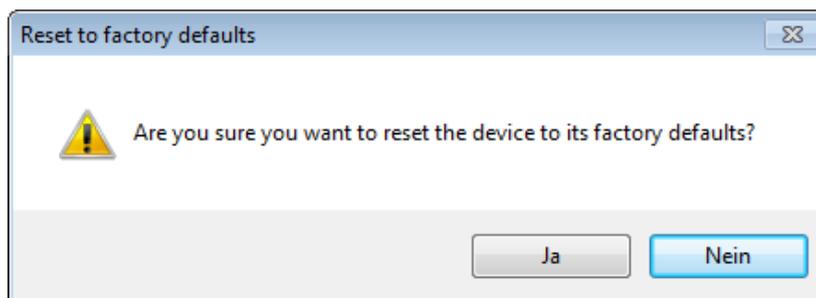


Important note

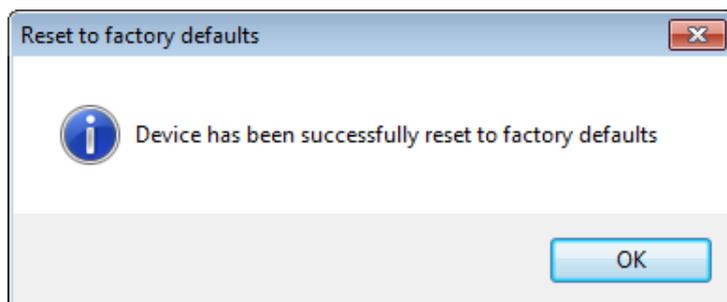
The update may take approx. 30 s and must not be interrupted. After an update the device will be automatically rebooted.

Reset to factory defaults

Using this button all settings are reset to factory defaults after having confirmed the following request with <Yes>.

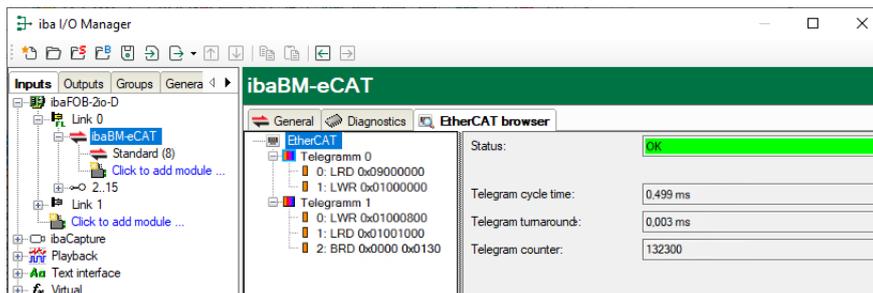


After the reset the following message appears and the device will be automatically rebooted.

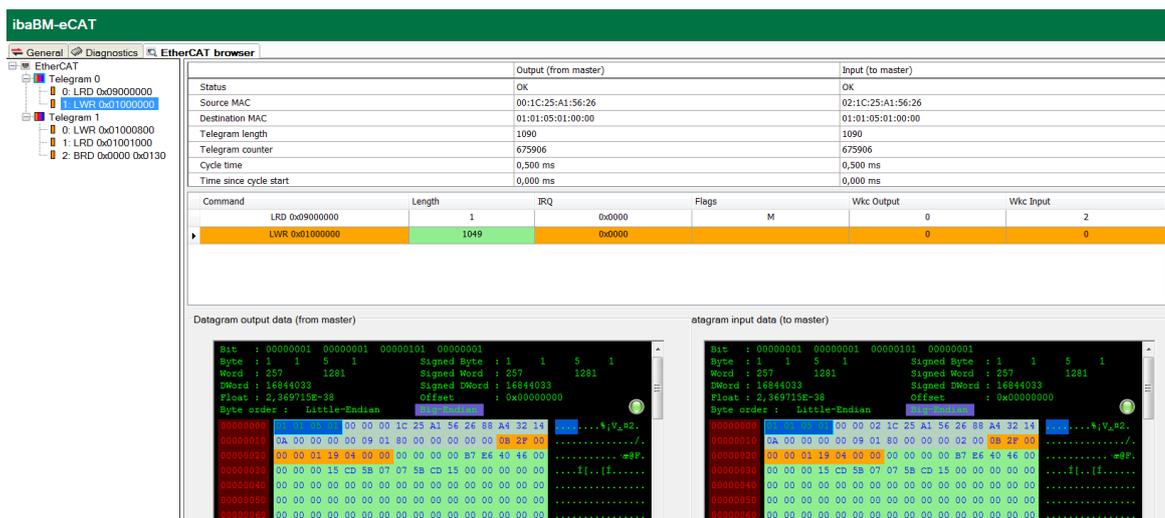


10.4.1.3 „EtherCAT browser“ tab

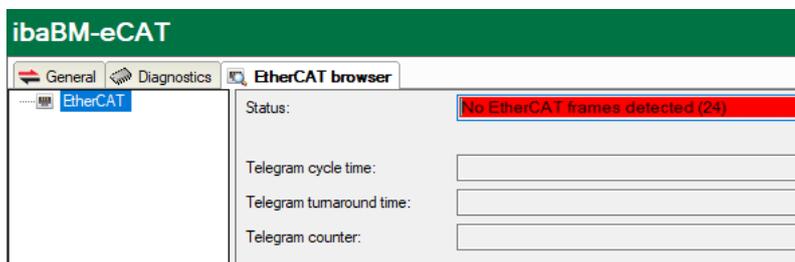
On the left side of the "EtherCAT Browser" tab the structure of the frame is displayed. However, only cyclic frames are acquired. The right side shows information such as cycle time, turnaround time and frame counter.



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



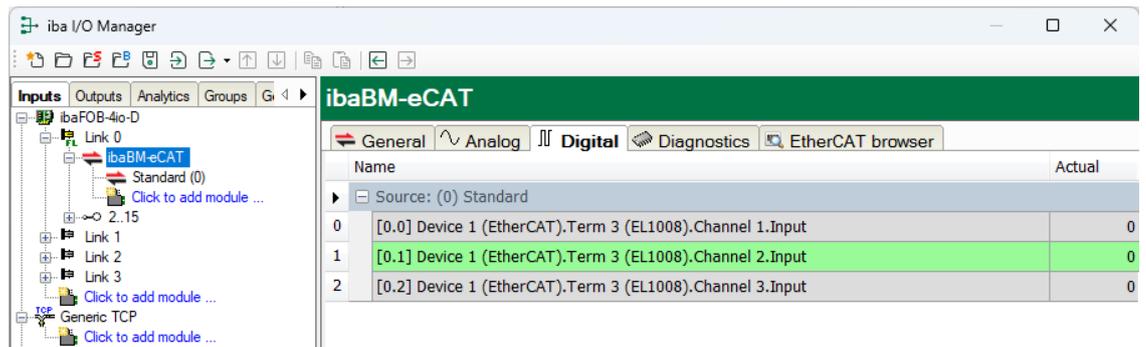
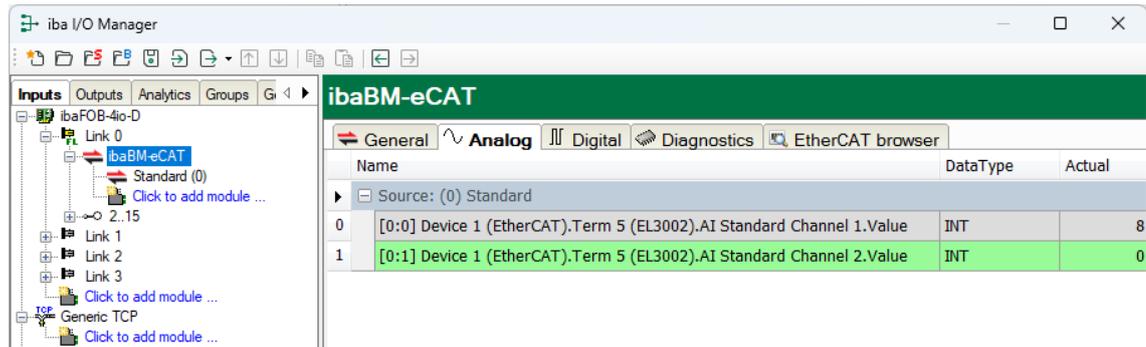
If no cyclic frame traffic is detected, the following figure appears:



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 13.4.

10.4.1.4 „Analog“ and „Digital“ tab

These tabs are only available after a module and signal configuration has been successfully applied to ibaPDA.



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

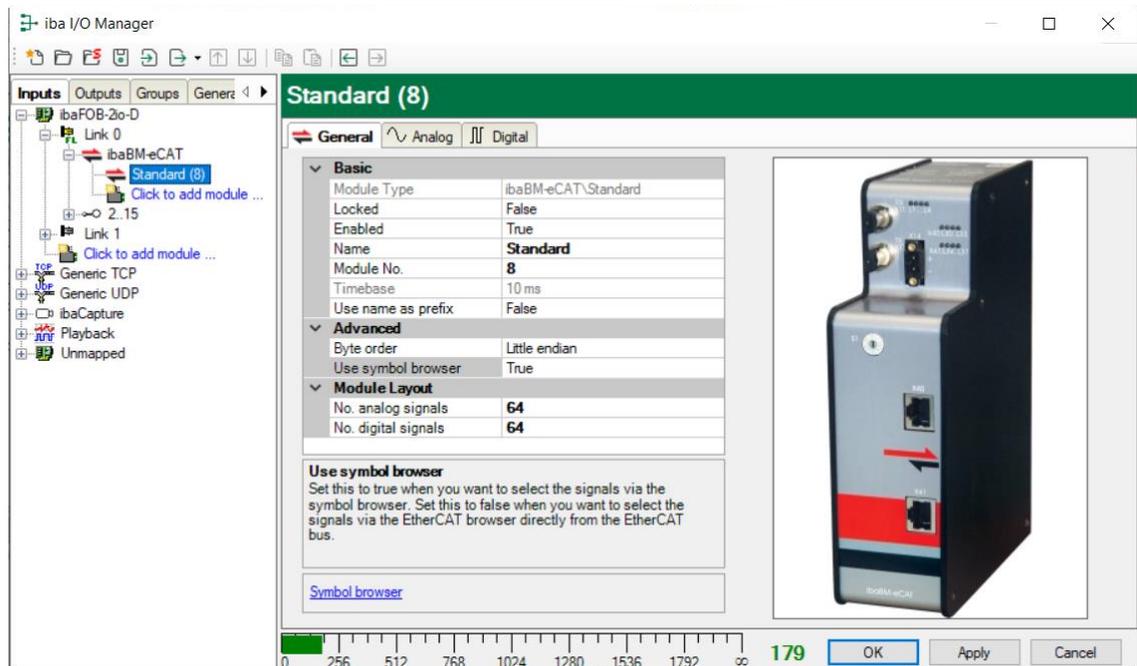
10.4.2 „Standard“ module

"Standard" modules can be added almost without limit. However, it has to be observed that each signal can be requested only 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 “General” tab



Basic

See chapter 10.4.1.1

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 (up to 1000)

Enter the number of analog signals of this module (up to 512 signals in each direction).

No. digital signals (up to 1000)

Enter the number of digital signals of this module (up to 512 signals in each direction)

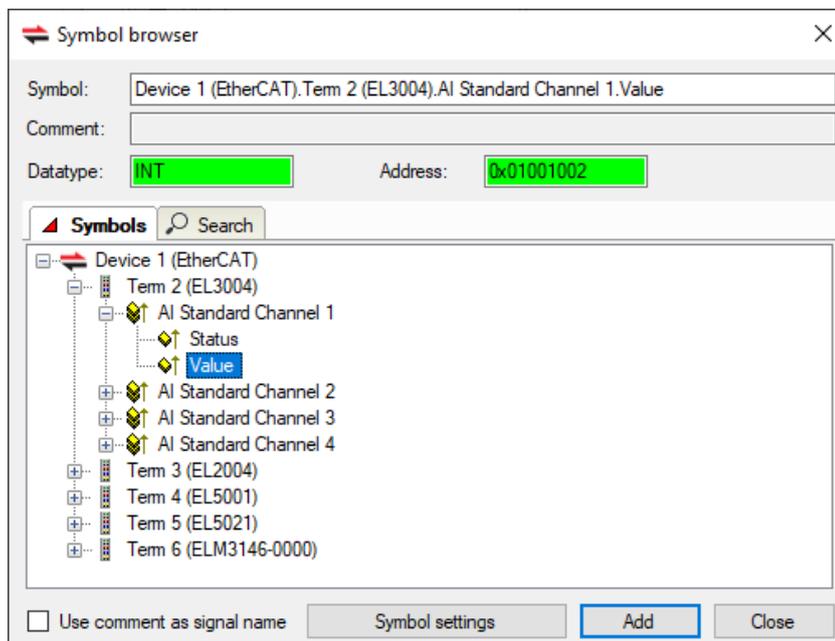
Link to the symbol browser or EtherCAT browser

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.

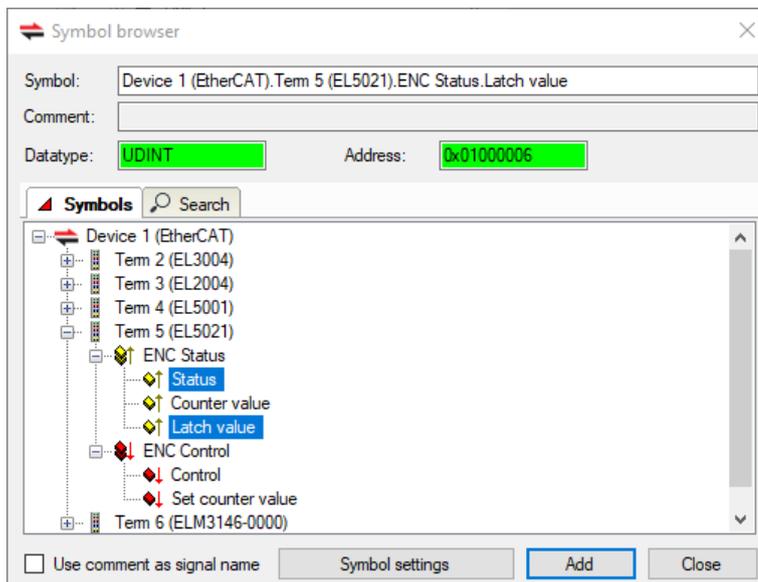
10.4.2.2 Symbol browser

In the tree structure, select the terminals, whose signals are to be recorded. Open the terminal symbol and select the signal. The corresponding symbol name, the data type, the logical address and if applicable a comment are displayed in the upper section. It is also possible to select several signals of a terminal together. The signals are added to the selection list with a double-click on the signal or with a click on the <Add> button.

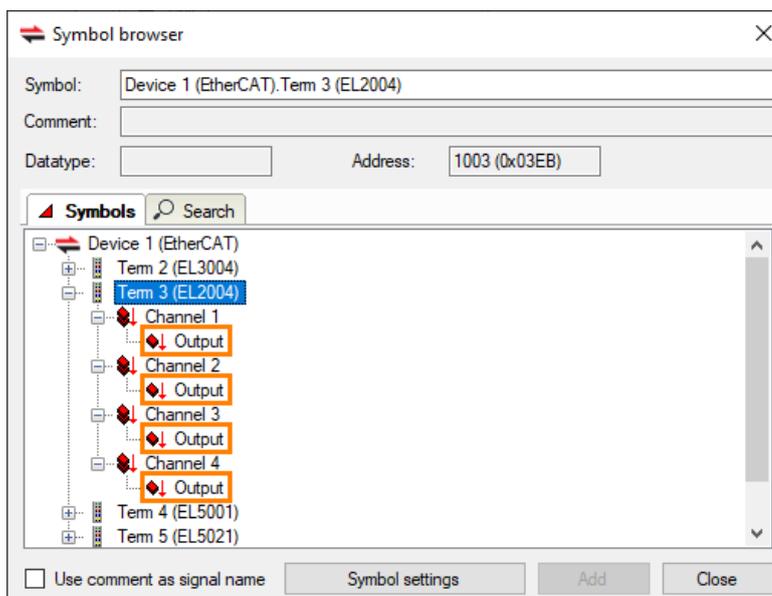


If several signals are to be selected, you have the following options:

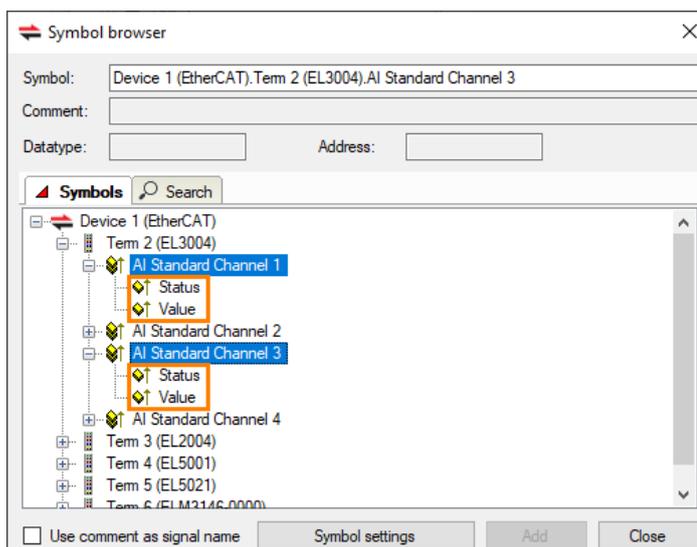
If there are several signals on the same layer, you can use <Shift> and <Ctrl> to select additional signals.



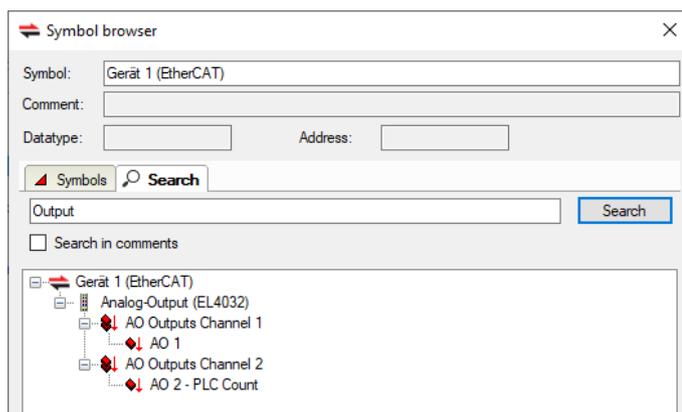
All signals of a parent node are to be selected. Select the parent node and all sub-signals will be selected for acquisition.



Even if you select one or more parent nodes on the same level, all sub-signals of the selected nodes will be selected for acquisition.

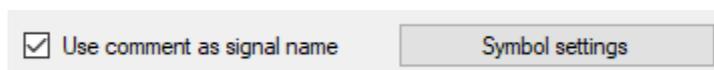


The EtherCAT symbol browser also offers a search function that makes it easier to select signals. Enter a search term in the “Search” tab and when clicking on the <Search> button all matching signals are listed.



If the EtherCAT configuration file contains comments for the signals, it is possible to search for comment terms as well. To do so, mark the checkbox “Search in comments” with a tick.

Comments can also be used as signal names in ibaPDA. To do this, mark the "Use comment as signal name" checkbox at the bottom of the window with a tick.



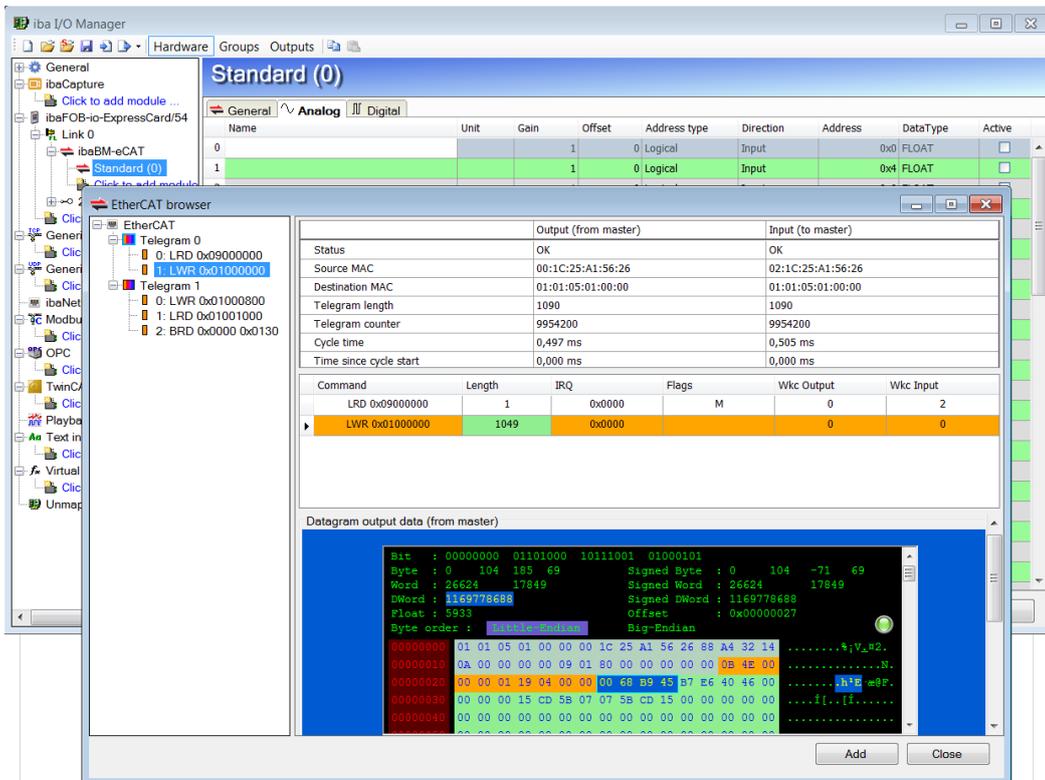
If all desired signals are selected, close the window with the <Close> button. If required, further signals can be added later at any time.

A new EtherCAT configuration file can be loaded by clicking the <Symbol settings> button. The same menu for the EtherCAT symbol settings is opened as described in chapter 10.1 under item 3.

10.4.2.3 EtherCAT browser

Select the EtherCAT frame or datagram that contains the signals to be acquired in the frame tree on the left. The right side shows information about this tele/datagram, such as the input/output direction and the byte representation.

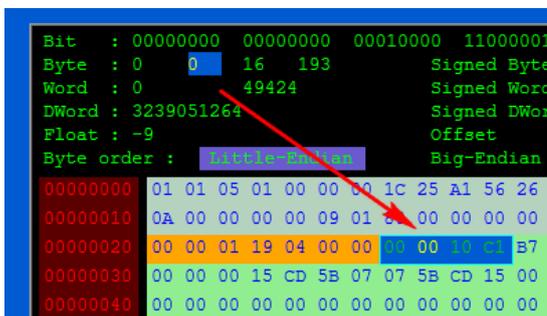
Header information of the datagrams is displayed in orange, the relevant user data is highlighted in green.



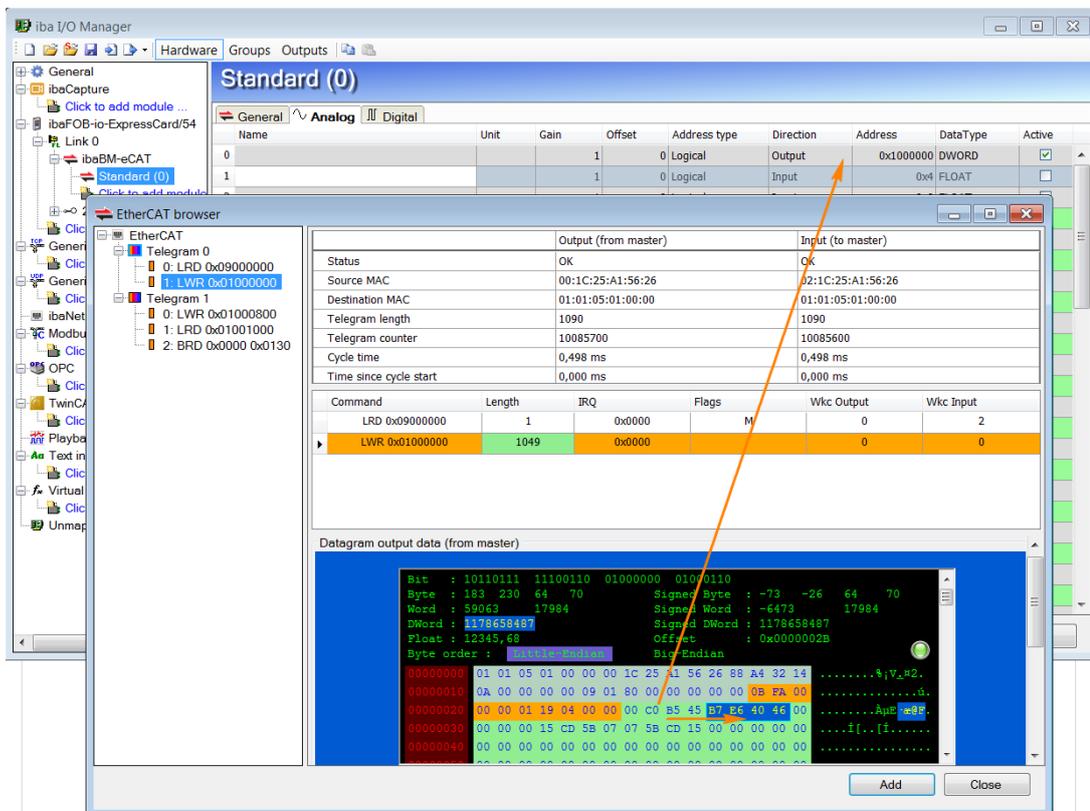
In the byte representation, select the initial value of the signal (offset) from the user data (green). Starting with this offset, 4 bytes are always highlighted in blue. The blue frame around the byte representation indicates whether you are in the input or output data with your selection.

In the upper area of the byte representation, the data type of the signal to be acquired is selected on the left side. On 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.



Click on <Add> to add the signal to the corresponding signal list in the tabs „Analog“ or „Digital“.



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

When all desired signals are selected, quit the EtherCAT browser with <Close>. If necessary, further signals can be added later at any time.

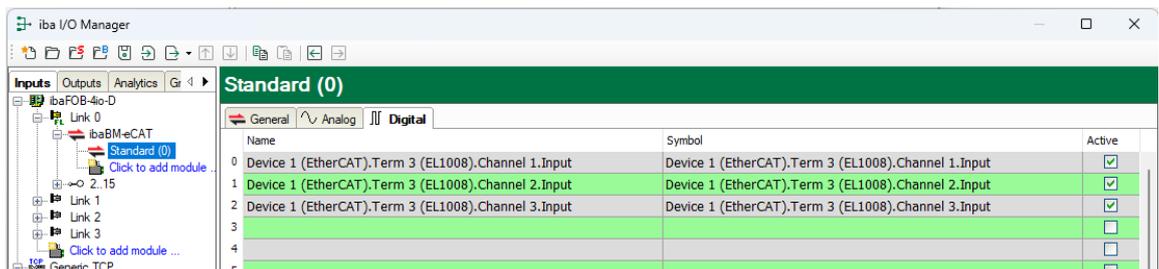
Finally, you only have to assign a corresponding signal name to the selected signals in the signal list.

10.4.2.4 „Analog“ and „Digital“ tab

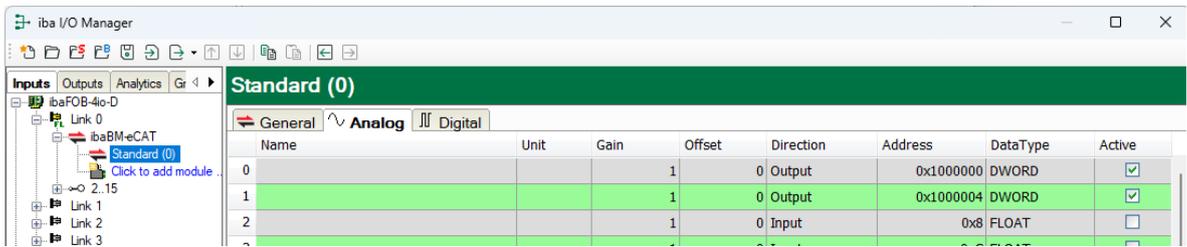
Depending on whether you have selected the signals via the symbol browser or the EtherCAT browser, different columns within both registers are displayed.



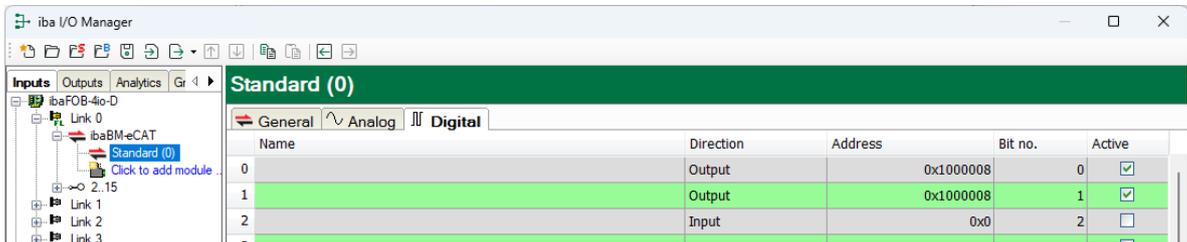
Module “Standard” - “Analog” tab – signal selection via symbol browser



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, when clicking on the  symbol.

Unit

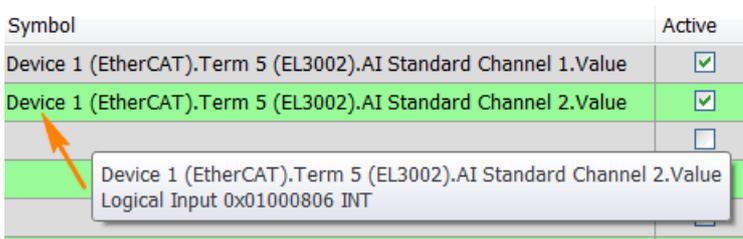
You can enter a physical unit.

Gain / Offset

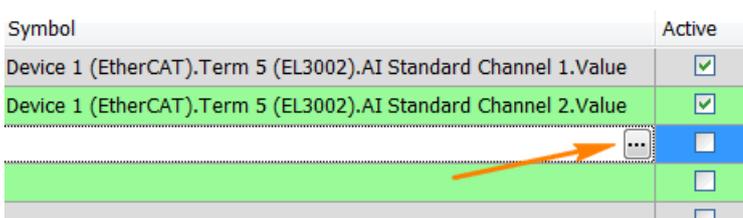
The settings in the columns Gain and Offset are useful to scale normalized values to physical values.

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. Just click in a field 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.

This is the bit number within the defined byte in digital signals

Data Type

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

Default

If the option „Enable default values“ is enabled (true) in the "General" tab of the device module "ibaBM-eCAT" (see chapter 10.4.1.1), the additional column "Default" appears. Default values can be entered here, in case the EtherCAT connection is broken.

| Symbol | Default | Active |
|---|---------|-------------------------------------|
| Device 1 (EtherCAT).Term 5 (EL3002).AI Standard Channel 1.Value | 0 | <input checked="" type="checkbox"/> |
| Device 1 (EtherCAT).Term 5 (EL3002).AI Standard Channel 2.Value | 0 | <input checked="" type="checkbox"/> |
| | 0 | <input type="checkbox"/> |
| | 0 | <input type="checkbox"/> |

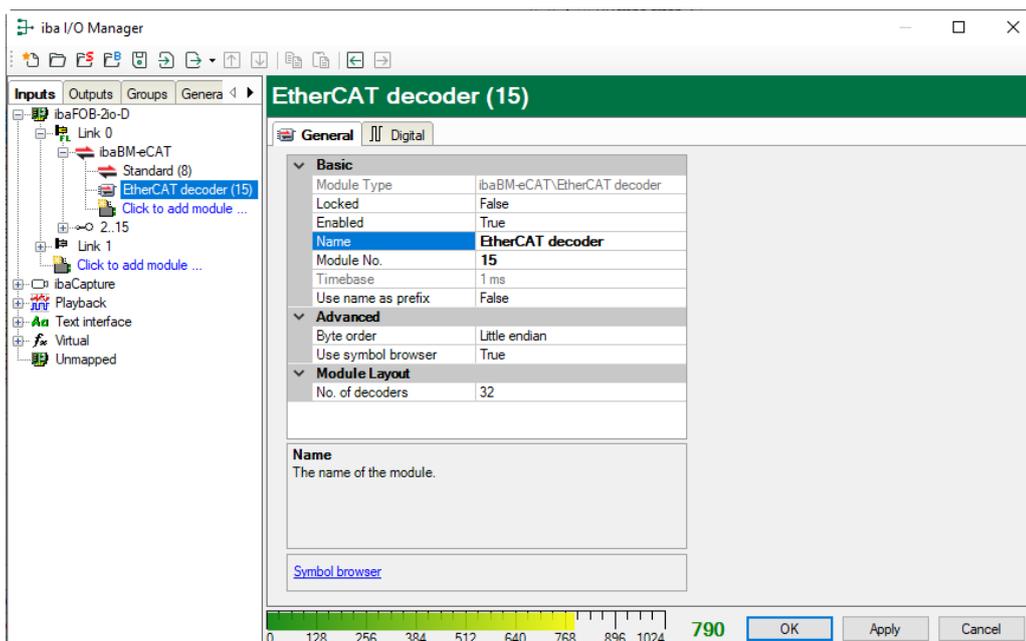
Active

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 “General” tab



Basic settings, Advanced

See chapter 10.4.2.1

Module Layout

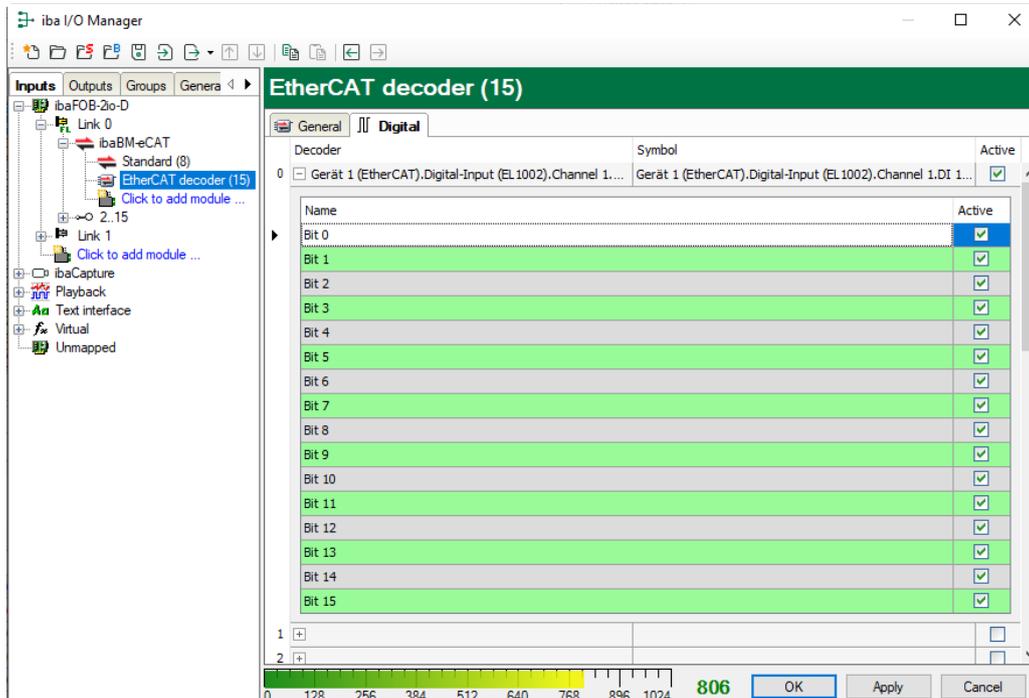
No. of decoders

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

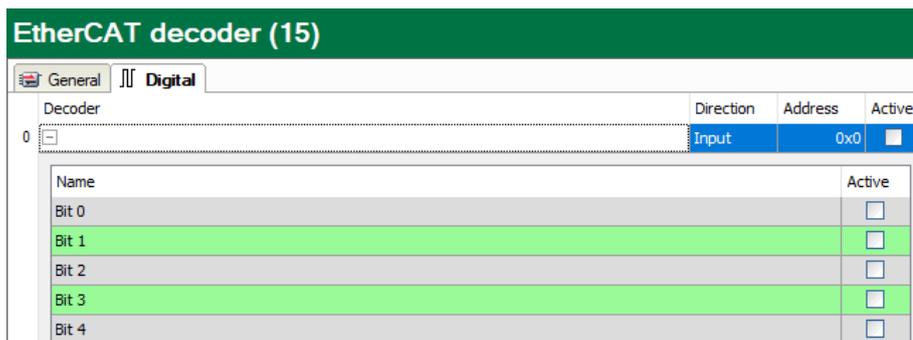
10.4.3.2 “Digital” tab

The signals are declared in two steps. First of all, the 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 (see chapter 10.4.2.2 or 10.4.2.3) for signal selection, different tabs are displayed.



“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

The direction of the selected signal

❑ Address

The byte address of the selected signal

For every source word, the 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

Assign a meaningful name to the individual digital signals.

Active

Only when this option is selected, the signal is being acquired and considered when checking the number of the 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. Thus, the range of analog values is used in ibaBM-eCAT for acquiring large amounts of digital signals.

10.4.4 “Diagnostics” module

The "Diagnostics" module should only be added if ibaBM-eCAT is correctly connected 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 “General” tab

The screenshot shows the 'iba I/O Manager' window with the 'Diagnostics (57)' module selected. The 'General' tab is active, showing the following settings:

| | |
|--------------------|------------------------|
| Module Type | ibaBM-eCAT.Diagnostics |
| Locked | False |
| Enabled | True |
| Name | Diagnostics |
| Module No. | 57 |
| Timebase | 1 ms |
| Use name as prefix | False |

Below the table is a 'Name' field with the description 'The name of the module.' and an 'Update signals' link. At the bottom of the window, a progress bar shows a value of 790, and there are 'OK', 'Apply', and 'Cancel' buttons.

Basic settings

See chapter 10.4.1.1.

"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 “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.

| Name | Unit | Gain | Offset | Active |
|---|------|------|--------|-------------------------------------|
| 0 Bus turnaround time | µs | 0,01 | 0 | <input checked="" type="checkbox"/> |
| 1 Number of output frames per cycle | | 1 | 0 | <input checked="" type="checkbox"/> |
| 2 Number of input frames per cycle | | 1 | 0 | <input checked="" type="checkbox"/> |
| 3 | | | | |
| 4 | | | | |
| 5 | | | | |
| 6 | | | | |
| 7 | | | | |
| 8 | | | | |
| 9 | | | | |
| 10 Output frame 0: cycle period | µs | 0,01 | 0 | <input checked="" type="checkbox"/> |
| 11 Input frame 0: cycle period | µs | 0,01 | 0 | <input checked="" type="checkbox"/> |
| 12 Output frame 0: time since cycle start | µs | 0,01 | 0 | <input checked="" type="checkbox"/> |
| 13 Input frame 0: time since cycle start | µs | 0,01 | 0 | <input checked="" type="checkbox"/> |
| 14 Output frame 0: number of frames | | 1 | 0 | <input checked="" type="checkbox"/> |
| 15 Input frame 0: number of frames | | 1 | 0 | <input checked="" type="checkbox"/> |
| 16 | | | | |
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| 99 | | | | |
| 100 Runtime of the output CPU | ms | 1 | 0 | <input checked="" type="checkbox"/> |
| 101 Runtime of the input CPU | ms | 1 | 0 | <input checked="" type="checkbox"/> |

Module “Diagnostics” – “Analog” tab

| Name | Active |
|--|-------------------------------------|
| 0 Optimization data matches current EtherCAT bus | <input checked="" type="checkbox"/> |
| 1 Optimization using EtherCAT configuration file | <input checked="" type="checkbox"/> |
| 2 Optimization using EtherCAT browser (ibaPDA) | <input checked="" type="checkbox"/> |
| 3 | |
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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. Two modes of optimization are used for this purpose.

10.5.1 Optimization modes

- 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 property "Enable optimization" (see chapter 10.4.1.1).



Note

Please 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 more comparison between the extraction and the actual bus.

11 Technical Data

11.1 Main data

| Short description | | | | | | | |
|--|---|-------------------------|--|---------------------------|--|--------------------------|-----------------------|
| Designation | ibaBM-eCAT | | | | | | |
| Description | Bus monitor for EtherCAT buses | | | | | | |
| Order number | 13.127000 | | | | | | |
| Bus interfaces (EtherCAT) | | | | | | | |
| Number | 2 (1x MainDevice, 1x SubDevice) for 1 EtherCAT bus | | | | | | |
| Data recording | <table border="0"> <tr> <td style="text-align: right;">Sniffer</td> <td>without additional bus configuration</td> </tr> <tr> <td style="text-align: right;">SubDevice, optional</td> <td>additional direct addressing of signals with a device-specific ESI file (IO device file) for the bus configuration</td> </tr> </table> | 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 | | |
| 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 | <table border="0"> <tr> <td style="text-align: right;">Sniffer</td> <td>Up to 512 analog and 512 digital values in each direction (up to 4096 Bytes) at min. ibaNNet sampling rate</td> </tr> <tr> <td style="text-align: right;">SubDevice</td> <td>Addressing of up to 512 analog and 512 digital outputs (≤ 32 Bit) on the bus, up to 2 x 1360 Bytes (also when values > 32 Bit)</td> </tr> </table> | Sniffer | Up to 512 analog and 512 digital values in each direction (up to 4096 Bytes) at min. ibaNNet sampling rate | SubDevice | Addressing of up to 512 analog and 512 digital outputs (≤ 32 Bit) on the bus, up to 2 x 1360 Bytes (also when values > 32 Bit) | | |
| Sniffer | Up to 512 analog and 512 digital values in each direction (up to 4096 Bytes) at min. ibaNNet sampling rate | | | | | | |
| SubDevice | Addressing of up to 512 analog and 512 digital outputs (≤ 32 Bit) on the bus, up to 2 x 1360 Bytes (also when values > 32 Bit) | | | | | | |
| Sampling rate | According to bus cycle time (if cycle time is below 500 μ s, there are restrictions on the number of values) | | | | | | |
| Signal delay | 355 ns to 570 ns | | | | | | |
| Supported EtherCAT address range | 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 | | | | | | |
| Connector type | 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 connecting up to 15 devices at a time in ring topology Can be used for measured data, setup data and service (e. g. updates) | | | | | | |
| Data transmission rate | 32 Mbit/s | | | | | | |
| Sampling rate | Up to 40 kHz, freely adjustable | | | | | | |
| Connector type | 2 ST connectors for RX and TX; iba recommends the use of FO with multimode fibers of type 50/125 μ m or 62.5/125 μ m. For information on cable length, see chap. 11.3. | | | | | | |
| Transmitting interface (TX) | | | | | | | |
| Output power | <table border="0"> <tr> <td>50/125 μm FO cable</td> <td>-19.8 dBm to -12.8 dBm</td> </tr> <tr> <td>62.5/125 μm FO cable</td> <td>-16 dBm to -9 dBm</td> </tr> <tr> <td>100/140 μm FO cable</td> <td>-12.5 dBm to -5.5 dBm</td> </tr> </table> | 50/125 μ m FO cable | -19.8 dBm to -12.8 dBm | 62.5/125 μ m FO cable | -16 dBm to -9 dBm | 100/140 μ m FO cable | -12.5 dBm to -5.5 dBm |
| 50/125 μ m FO cable | -19.8 dBm to -12.8 dBm | | | | | | |
| 62.5/125 μ m FO cable | -16 dBm to -9 dBm | | | | | | |
| 100/140 μ m FO cable | -12.5 dBm to -5.5 dBm | | | | | | |

| | | |
|--|---|------------------------|
| | 200 µm FO cable | -8.5 dBm to -1.5 dBm |
| Temperature range | -40 °F to 185 °F (-40 °C to 85 °C) | |
| Light wavelength | 850 nm | |
| Receiving interface (RX) | | |
| Sensitivity ¹ | 100/140 µm FO cable | -33.2 dBm to -26.7 dBm |
| Temperature range | -40 °F to 185 °F (-40 °C to 85 °C) | |
| Supply, operating and indicating elements | | |
| Power supply | 24 V DC (±10 %), not stabilized | |
| Power consumption | Max. 8 W | |
| Indicators | 4 LEDs for device status 4 LEDs for the two EtherCAT channels 4 LEDs for the SubDevice function | |
| Operating and environmental conditions | | |
| Cooling | passive | |
| Operating temperature | 32 °F to 122 °F (0 °C to +50 °C) | |
| Storage and transport temperature | -13 °F to 158 °F (-25 °C to +70 °C) | |
| Mounting | DIN rail mounting , vertical | |
| Humidity class (DIN 40040) | F, no condensation | |
| Protection class | IP20 | |
| Certificates | EMC: EN 61326-1, FCC part 15 class A | |
| MTBF ² | 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 mounting rail clip | |
| Weight (incl. box and documentation) | Approx 2.43 lbs (1.1 kg) | |

¹ Data for other FO cable diameters not specified

² MTBF (mean time between failure) according to Telcordia 3 SR232 (Reliability Prediction Procedure of Electronic Equipment; Issue 3 Jan. 2011 and NPRD, Non-electronic Parts Reliability Data 2011

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

Unique Identifier: 13.127000 ibaBM-eCAT

Responsible Party - U.S. Contact Information

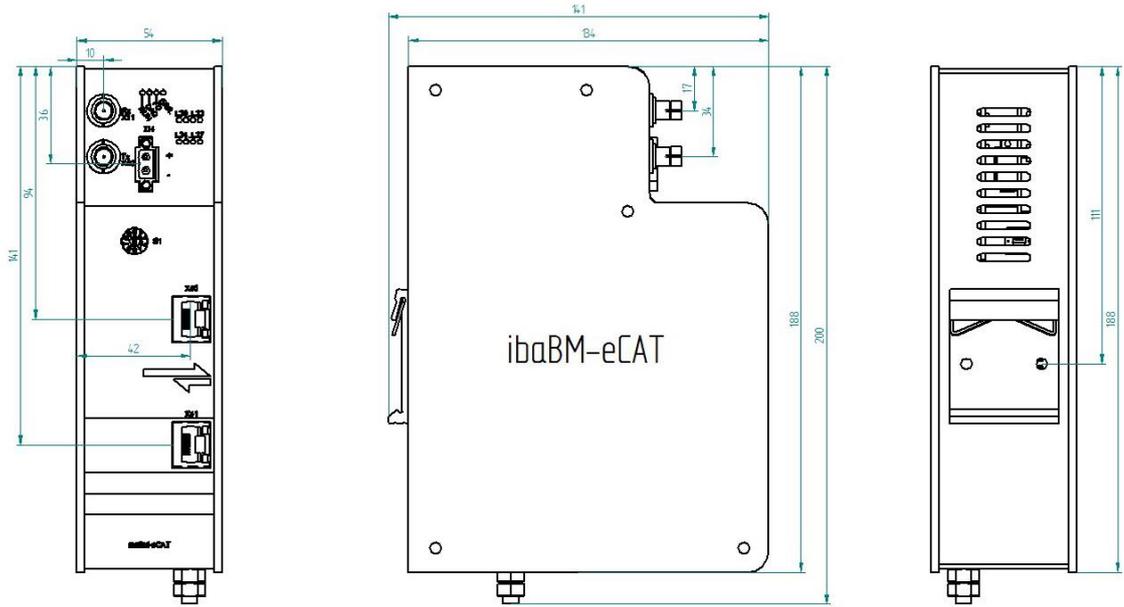
iba America, LLC
370 Winkler Drive, Suite C
Alpharetta, Georgia
30004

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

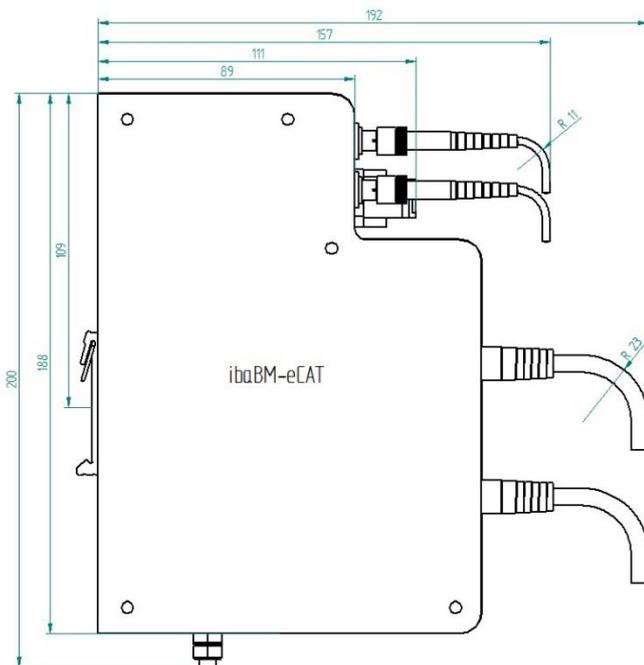
FCC Compliance Statement

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.

11.2 Dimension sheet



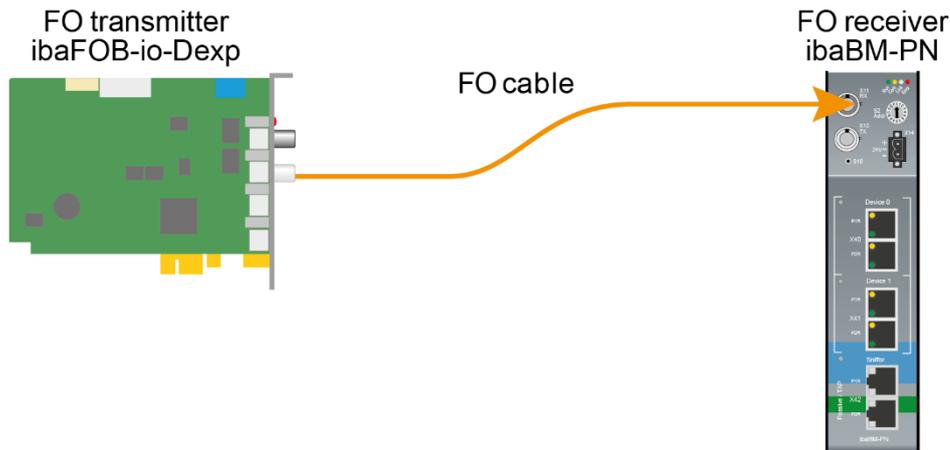
(dimensions in mm)



Dimension sheet device with cables (dimensions in mm)

11.3 Example for FO budget calculation

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



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

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

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

Specification ibaFOB-io-Dexp:

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

Specification ibaBM-PN:

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

Specification FO cable

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

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

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

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

$P_{Receiver}$ = sensitivity of FO receiving interface

P_{Sender} = output power of FO transmitting interface

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

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

$A_{Connector}$ = connector loss

$A_{Fiberoptic}$ = cable attenuation

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

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

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

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

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

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

**Note**

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

**Note**

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

12 Accessories

Network TAP device

| | |
|-----------|-----------|
| Order no. | 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

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):

When the ESI file of ibaBM-eCAT is integrated in the EtherCAT configuration a conflict occurs 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 (default size 1514 bytes). Hence, it terminates the first frame and starts with the second frame and the System Manager overwrites those signals.

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, when 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 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.

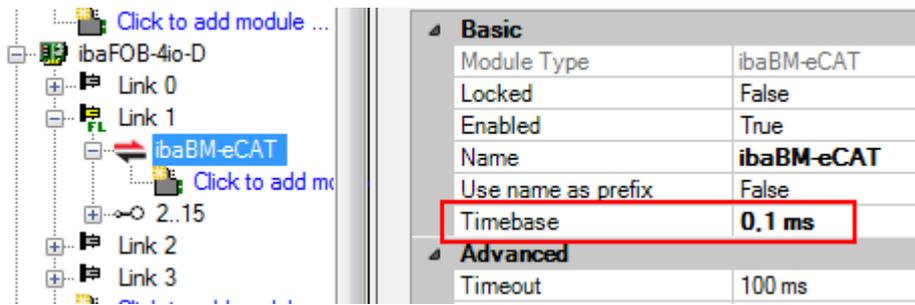
13.2.1 Configuration of 32Mbit ibaNet protocol

First of all, the configuration is performed in ibaPDA, when the device is set to 32Mbit Flex ibaNet protocol (rotary switch unequal zero), configuration description see chapter 8.2.4.

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 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 is required to download the signal list file. In order to establish an FTP connection to the device proceed as follows:

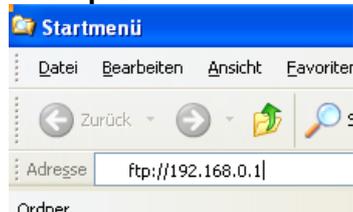
1. Connect the device to the PC via an USB cable.
The USB interface is located at the bottom of the device. A USB cable of A to B type is required.
A suitable cable is available at iba on request.
2. As soon as the computer is connected for the first time to the device, the "Found New Hardware Wizard" 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 $n = 2 \dots 254$ and the subnetmask 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. You may use an 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 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 bit | Fiber optic Signal | PDA setting 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 column „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:

The screenshot shows the EtherCAT browser interface. On the left, a tree view displays the telegram structure. The main area is divided into several sections:

- Status:** A table showing 'Output (from master)' and 'Input (to master)' with fields like Status, Source MAC, Destination MAC, Telegram length, Telegram counter, Cycle time, and Time since cycle start.
- Command:** A table with columns for Command, Length, IRQ, Flags, Wkc Output, and Wkc Input. It shows a command 'LRD 0x9000000' with length 1 and IRQ 0x0000.
- Datagram output data (from master):** A hex dump window showing the structure of the outgoing datagram. Annotations point to the Ethernet Header, EtherCAT Header, Data, Working Counter, and Datagram Header.
- Datagram input data (to master):** A hex dump window showing the structure of the incoming datagram.

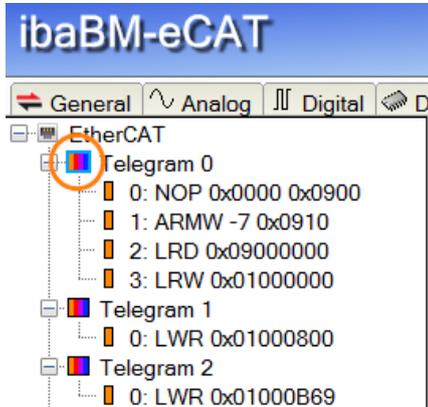
Structure of an EtherCAT frame

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:

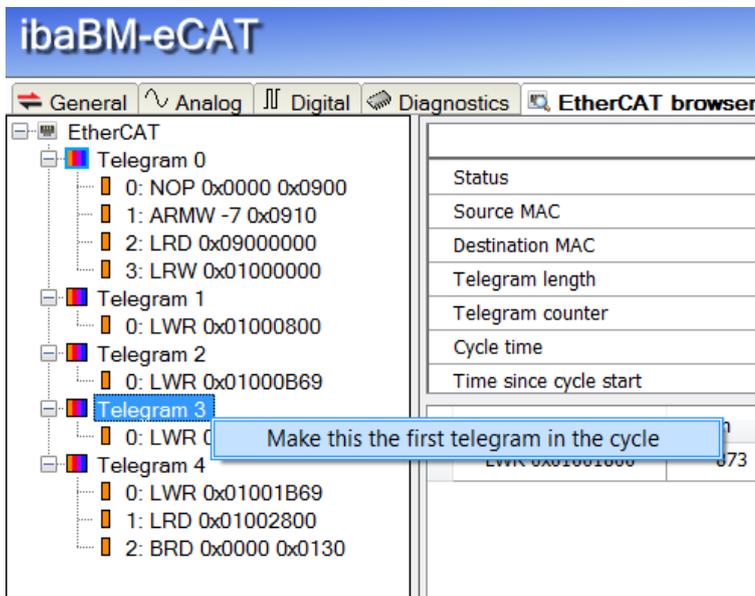


Note

When you change the first frame manually, this marking remains, so that it is possible later to track which frame was originally automatically detected as the first.

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

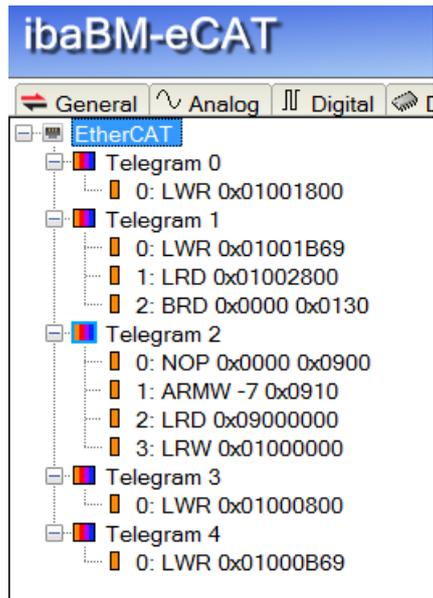
Select the frame that is to be set as the first frame. With a right mouse click open the context menu and select "Make this the first telegram in the cycle".



The sequence of the frames to each other 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 for 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 9.3.1.

13.4.3 Analog diagnostic signals

General group

- Bus turnaround 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

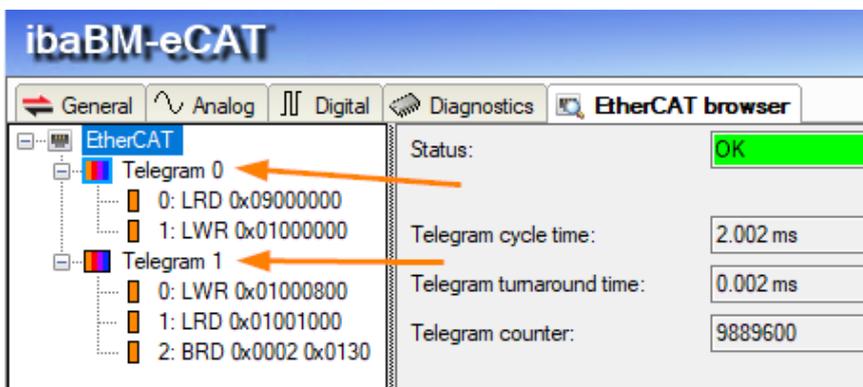
The number of output frames per cycle

- 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

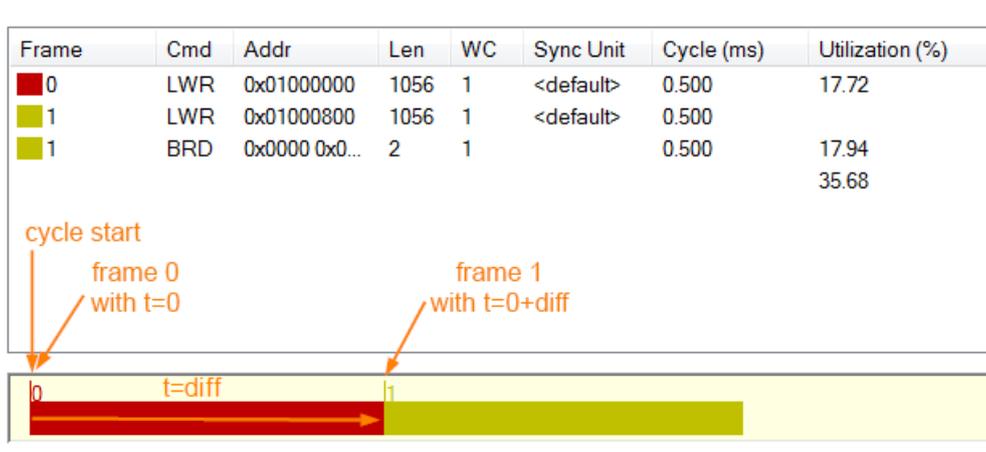
The cycle time of the input frames with the number X

- Output frame X: time since cycle start

The time difference of the output frames at the start time of the cycle

- Input frame X: time since cycle start

The time difference of the input frames at the start time of the cycle



Time difference

- 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

- Runtime of the output CPU

The runtime of the output controller since its start

Runtime of the input CPU

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)".

```
> Frame 11: 154 bytes on wire (1232 bits), 154 bytes captured (1232 bits) on interface 0
  > Ethernet II, Src: Beckhoff_01:00:00 (01:01:05:01:00:00), Dst: MS-NLB-PhysServer-28_25:a1:56:26 (02:1c:25:a1:56:26)
    > Destination: MS-NLB-PhysServer-28_25:a1:56:26 (02:1c:25:a1:56:26)
    > Source: Beckhoff_01:00:00 (01:01:05:01:00:00)
    > Type: EtherCAT frame (0x88a4)
  > EtherCAT frame header
    .... .000 1000 1010 = Length: 0x08a
    0 = Received: Valid (0x0)
    0001 .... .... = Type: EtherCAT command (0x1)
  > EtherCAT datagram(s): 7 Cmds, SumLen 54, 'NOP'...
    > EtherCAT datagram: Cmd: 'NOP' (0), Len: 4, Adp 0x0, Ado 0x900, Cnt 0
    > EtherCAT datagram: Cmd: 'ARMW' (13), Len: 8, Adp 0x1, Ado 0x910, Cnt 7
    > EtherCAT datagram: Cmd: 'LRD' (10), Len: 1, Addr 0x9000000, Cnt 3
    > EtherCAT datagram: Cmd: 'LRW' (12), Len: 24, Addr 0x1000000, Cnt 3
    > EtherCAT datagram: Cmd: 'LWR' (11), Len: 10, Addr 0x1000800, Cnt 3
    > EtherCAT datagram: Cmd: 'LRD' (10), Len: 5, Addr 0x1001000, Cnt 4
    > EtherCAT datagram: Cmd: 'BRD' (7), Len: 2, Adp 0x9, Ado 0x130, Cnt 9
```

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

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Note

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

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