

Documentation | EN

ER9320-0022

EtherCAT Box, PROFINET RT, zinc die-cast



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1 Foreword

1.1 Notes on the documentation

Intended audience

This description is only intended for the use of trained specialists in control and automation engineering who are familiar with the applicable national standards.

It is essential that the documentation and the following notes and explanations are followed when installing and commissioning these components.

The qualified personnel is obliged to always use the currently valid documentation.

The responsible staff must ensure that the application or use of the products described satisfy all the requirements for safety, including all the relevant laws, regulations, guidelines and standards.

Disclaimer

The documentation has been prepared with care. The products described are, however, constantly under development.

We reserve the right to revise and change the documentation at any time and without prior announcement.

No claims for the modification of products that have already been supplied may be made on the basis of the data, diagrams and descriptions in this documentation.

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1.2 Safety instructions

Safety regulations

Please note the following safety instructions and explanations!

Product-specific safety instructions can be found on following pages or in the areas mounting, wiring, commissioning etc.

Exclusion of liability

All the components are supplied in particular hardware and software configurations appropriate for the application. Modifications to hardware or software configurations other than those described in the documentation are not permitted, and nullify the liability of Beckhoff Automation GmbH & Co. KG.

Personnel qualification

This description is only intended for trained specialists in control, automation and drive engineering who are familiar with the applicable national standards.

Signal words

The signal words used in the documentation are classified below. In order to prevent injury and damage to persons and property, read and follow the safety and warning notices.

Personal injury warnings

DANGER

Hazard with high risk of death or serious injury.

WARNING

Hazard with medium risk of death or serious injury.

CAUTION

There is a low-risk hazard that could result in medium or minor injury.

Warning of damage to property or environment

NOTICE

The environment, equipment, or data may be damaged.

Information on handling the product



This information includes, for example:
recommendations for action, assistance or further information on the product.

1.3 Notes on information security

The products of Beckhoff Automation GmbH & Co. KG (Beckhoff), insofar as they can be accessed online, are equipped with security functions that support the secure operation of plants, systems, machines and networks. Despite the security functions, the creation, implementation and constant updating of a holistic security concept for the operation are necessary to protect the respective plant, system, machine and networks against cyber threats. The products sold by Beckhoff are only part of the overall security concept. The customer is responsible for preventing unauthorized access by third parties to its equipment, systems, machines and networks. The latter should be connected to the corporate network or the Internet only if appropriate protective measures have been set up.

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Beckhoff products and solutions undergo continuous further development. This also applies to security functions. In light of this continuous further development, Beckhoff expressly recommends that the products are kept up to date at all times and that updates are installed for the products once they have been made available. Using outdated or unsupported product versions can increase the risk of cyber threats.

To stay informed about information security for Beckhoff products, subscribe to the RSS feed at <https://www.beckhoff.com/secinfo>.

1.4 Documentation Issue Status

Version	Comment
1.0	• First release

Firmware and hardware versions

This documentation refers to the firmware and hardware version that was applicable at the time the documentation was written.

The module features are continuously improved and developed further. Modules having earlier production statuses cannot have the same properties as modules with the latest status. However, existing properties are retained and are not changed, so that older modules can always be replaced with new ones.

The firmware and hardware version (delivery state) can be found in the batch number (D-number) printed on the side of the EtherCAT Box.

Syntax of the batch number (D-number)

D: WW YY FF HH

WW - week of production (calendar week)

YY - year of production

FF - firmware version

HH - hardware version

Example with D no. 29 10 02 01:

29 - week of production 29

10 - year of production 2010

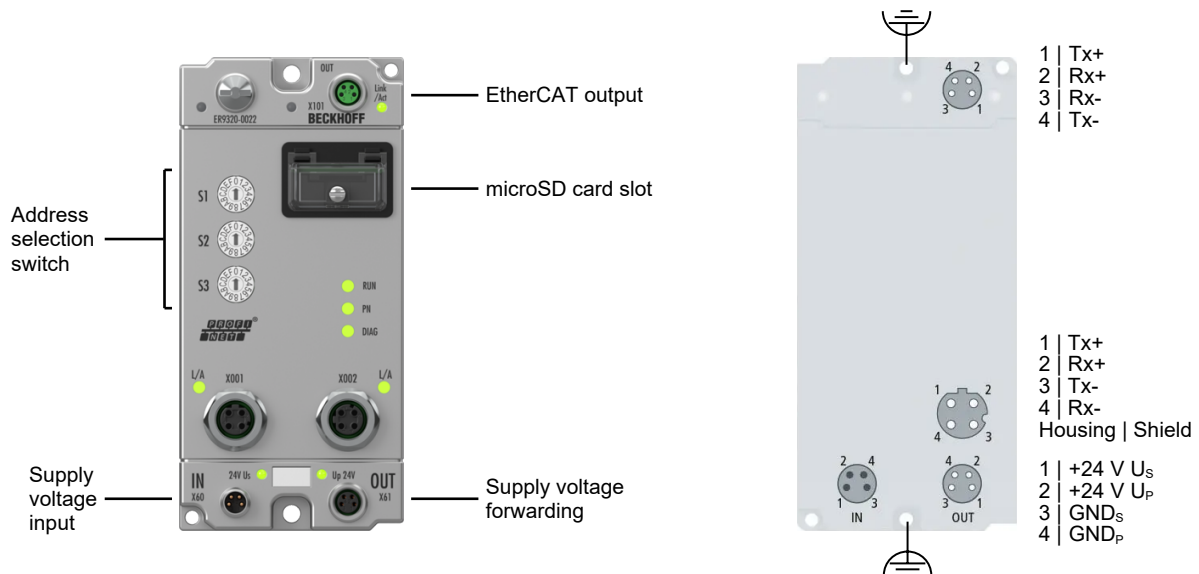
02 - firmware version 02

01 - hardware version 01

Further information on this topic: [Version identification of EtherCAT devices \[► 65\]](#).

2 Product overview

2.1 Introduction



The ER9320-0022 EtherCAT Box connects PROFINET RT networks to the EtherCAT Box modules (EPxxxx, ERxxxx and EQxxxx) and converts the telegrams from PROFINET RT to EtherCAT. One station consists of an ER9320-0022 and any number of EtherCAT Box modules. The box is connected to PROFINET via a D-coded M12 socket (in/out). With EtherCAT, the PROFINET RT box can use the lower-level, powerful, and ultra-fast I/O system with a large selection of modules. The ER9320-0022 supports the PROFINET profile and fits seamlessly into PROFINET RT networks.

Quick links

[Technical data \[► 10\]](#)

[Dimensions \[► 15\]](#)

[Connections \[► 17\]](#)

[Commissioning \[► 28\]](#)

2.2 Technical data

All values are typical values over the entire temperature range, unless stated otherwise.

PROFINET	
Protocol	PROFINET RT
Connection	2x M12 socket, D-coded, 4-pin, black (switched)
Auto-negotiation	Yes
Auto-crossover	Yes
Data transfer medium	CAT 5 twisted pair copper cable
Cable length	max. 100 m
Data transfer rate	100 Mbit/s

EtherCAT output	
Connection	1x M8 socket, 4-pin, green
Electrical isolation	500 V
Number of EtherCAT devices	dependent on the process data size
Type and number of peripheral signals	dependent on the process data size

Supply voltages	
Connection	Input: M8 connector, 4-pin, A-coded Downstream connection: M8 socket, 4-pin, A-coded
U _S nominal voltage	24 V DC (-15 %, +20 %)
U _S sum current: I _{S,sum}	max. 4 A
Current consumption from U _S	200 mA
Rated voltage U _P	24 V DC (-15 %, +20 %)
U _P sum current: I _{P,sum}	max. 4 A
Current consumption from U _P	None. U _P is only forwarded.

Housing data	
Dimensions W × H × D	60 mm × 126 mm × 26.5 mm (without plug connectors)
Weight	approx. 450 g
Installation position	variable
Material	zinc die-cast

Approvals/markings	
Approvals/markings *)	CE, cURus [► 26]

*) Real applicable approvals/markings see type plate on the side (product marking).

Additional tests

The devices have undergone the following additional tests:

Test	Explanation
Vibration	10 frequency sweeps in 3 axes
	5 Hz < f < 60 Hz displacement 0.35 mm, constant amplitude
	60.1 Hz < f < 500 Hz acceleration 5 g, constant amplitude
Shocks	1000 shocks in each direction, in 3 axes
	35 g, 11 ms

2.2.1 PROFINET

Protocol	
PROFINET IO device	Yes
ADS Interface	Yes

Services	
IRT	No
Shared device	Yes
Prioritized start-up	No
MRP	Yes
SNMP	Yes
LLDP	Yes
ARP	Yes
DHCP	Yes

2.3 Scope of supply

Make sure that the following components are included in the scope of delivery:

- 1x ER9320-0022
- 1x protective cap for EtherCAT socket, M8, green (pre-assembled)
- 2x blanking plugs for PROFINET socket, M12, black (preassembled)
- 1x protective cap for supply voltage input, M8, transparent (pre-assembled)
- 1x protective cap for supply voltage output, M8, black (pre-assembled)
- 10x labels, blank (1 strip of 10)



Pre-assembled protective caps do not ensure IP67 protection

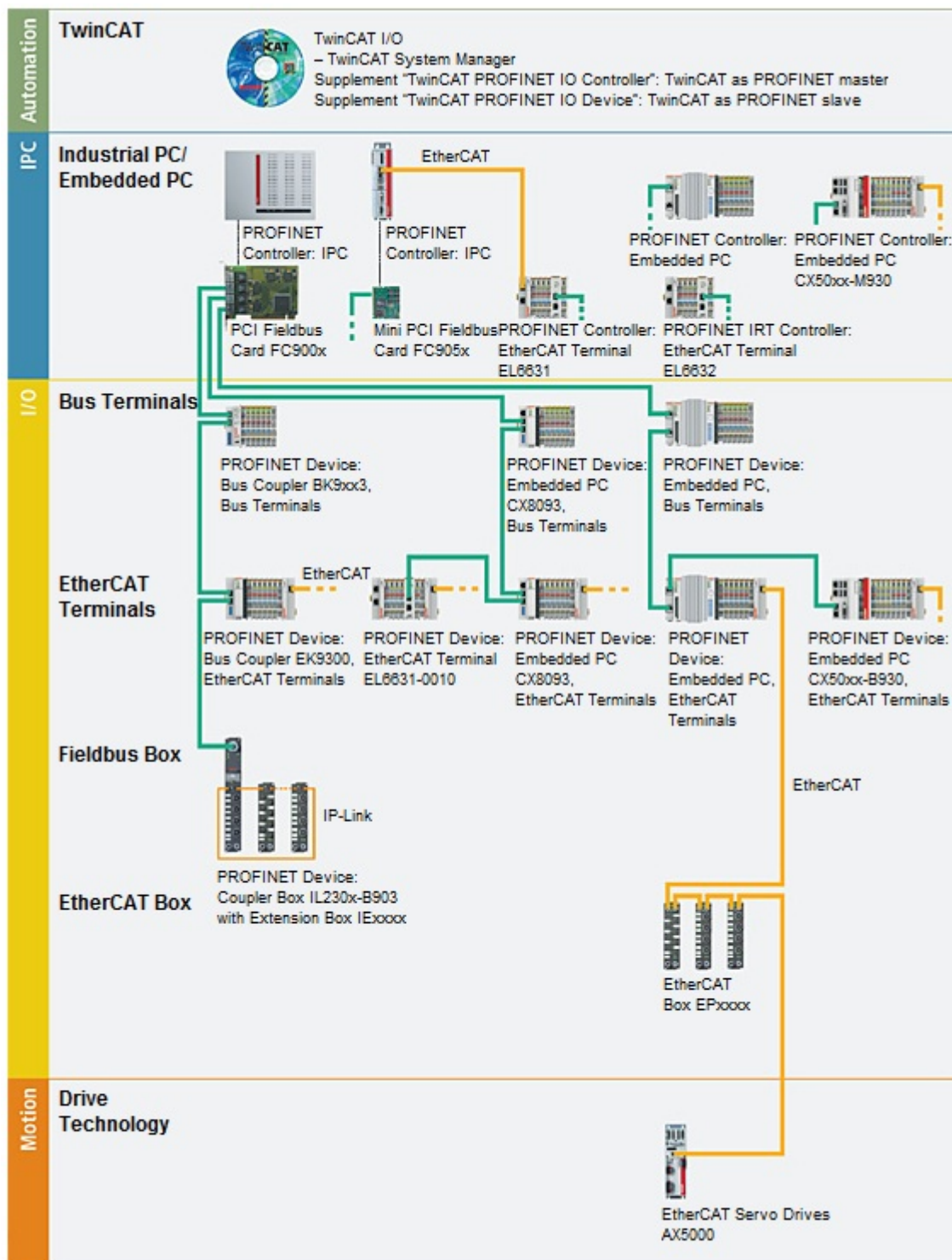
Protective caps are pre-assembled at the factory to protect connectors during transport. They may not be tight enough to ensure IP67 protection.

Ensure that the protective caps are correctly seated to ensure IP67 protection.

3 Basic function principles

3.1 PROFINET system presentation

PROFINET is the Industrial Ethernet standard of the PNO (PROFIBUS user organization). PROFINET IO describes the data exchange between controllers and field devices in several real-time classes: RT (software-based Real-Time) and IRT (hardware-based Isochronous Real-Time). In addition, further Ethernet traffic can be transmitted in the NRT (non-real-time) time slot of the PROFINET cycle. RT can be networked with commercially available switches; switches with corresponding hardware support are required for IRT.



Components	Comment
Embedded PCs	
CX8093	Embedded PC with PROFINET RT Device fieldbus interface
CXxxx-M930	Embedded PC with optional PROFINET RT Controller interface
CXxxx-B930	Embedded PC with optional PROFINET RT Device interface
EtherCAT Terminals	
EL6631	PROFINET IO controller
EL6631-0010	PROFINET IO device
EL6632	PROFINET-IRT controller
Bus Coupler	
BK9053	PROFINET "Compact" Bus Coupler for Bus Terminals
BK9103	PROFINET Bus Coupler for Bus Terminals
EK9300	PROFINET Bus Coupler for EtherCAT Terminals
EK9320	PROFINET Bus Coupler for EtherCAT Terminals
EtherCAT Box	
EP9300	PROFINET Coupler Box for EtherCAT box modules
Fieldbus Box	
IL230x-B903	PROFINET Coupler Box for IP-Link box modules
PC Fieldbus cards	
FC900x	PCI-Ethernet card for all Ethernet (IEEE 802.3)-based protocols
FC9x51	Mini PCI-Ethernet card for all Ethernet (IEEE 802.3)-based protocols
TwinCAT	
TwinCAT PROFINET IO Controller	TwinCAT as PROFINET master
TwinCAT PROFINET IO Device	TwinCAT as PROFINET slave

3.2 Representation of EtherCAT devices in PROFINET

The ER9320-0022 maps EtherCAT devices as PROFINET modules. This allows EtherCAT devices to be integrated into a PROFINET environment and addressed by a PROFINET controller.

EtherCAT process data (PDO)

The process data contains the cyclic input and output data of an EtherCAT device. Their size and structure are device-specific.

Only predefined process data variants ("Predefined PDO Assignments") are available when using an EtherCAT device on the ER9320-0022. These are stored in the GSDML file.

EtherCAT device parameters (CoE)

Parameter data from EtherCAT devices is managed via CoE (CANopen over EtherCAT). These parameters are accessed from the PROFINET system via acyclic services (record data).

Project planning

During project planning, you must ensure that the order of the modules in the PROFINET project corresponds to the physical topology of the EtherCAT devices.

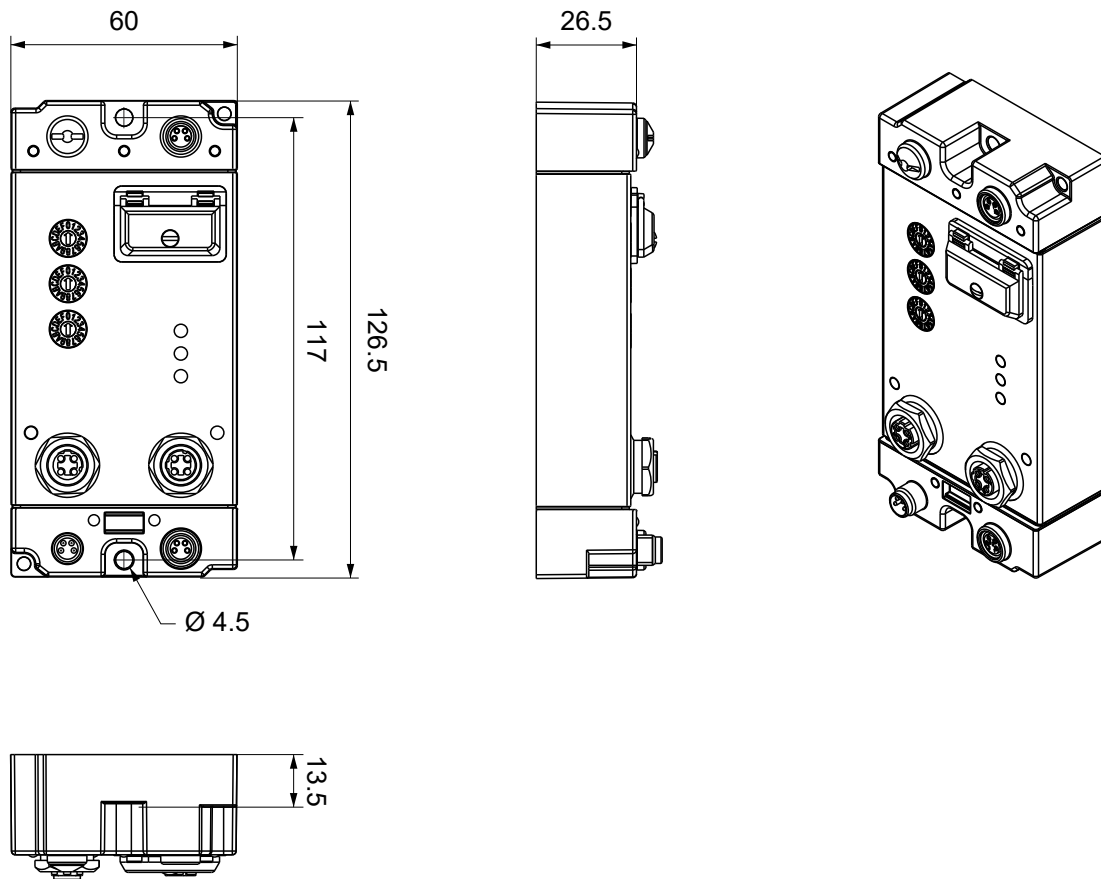
Restrictions

- Support for EtherCAT devices depends on the GSDML file; not all EtherCAT devices are supported.
- Individual or freely definable PDO mappings are not possible; only predefined variants can be used.
- A CX8093 from Beckhoff may be required for extended or device-specific functions.

4 Mounting and connection

4.1 Mounting

4.1.1 Dimensions



All dimensions are given in millimeters.
The drawing is not true to scale.

4.1.2 Fixing

NOTICE

Dirt during assembly

Dirty connectors can lead to malfunctions. Protection rating IP67 can only be guaranteed if all cables and connectors are connected.

- Protect the plug connectors against dirt during the assembly.

Mount the module with two M4 screws in the centrally located mounting holes.

4.1.3 Functional earth (FE)

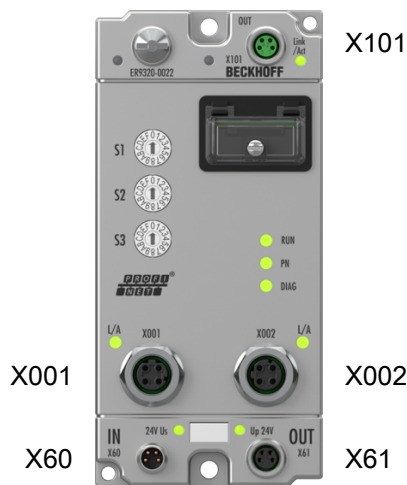
The [mounting holes](#) [► 16] also serve as connections for the functional earth.

Make sure that the box is grounded with low impedance via both fastening screws. You can achieve this, for example, by mounting the box on a grounded machine bed.



4.2 Connections

4.2.1 Connector overview



Name	Function	Connector type	Tightening torque
X001	PROFINET input [► 18]	M12 socket, D-coded	0.6 Nm ¹⁾
X002	PROFINET forwarding [► 18]	M12 socket, D-coded	0.6 Nm ¹⁾
X60	Supply voltage input [► 22]	M8 plug connector	0.4 Nm ¹⁾
X61	Supply voltage downstream connection [► 22]	M8 socket	0.4 Nm ¹⁾
X101	EtherCAT output [► 20]	M8	0.4 Nm ¹⁾

¹⁾ Mount plugs on these connectors using a torque wrench, e.g. ZB8801 from Beckhoff.

Protective caps

- Seal unused connectors with protective caps.
- Ensure the correct seating of pre-assembled protective caps.
Protective caps are pre-assembled at the factory to protect connectors during transport. They may not be tight enough to ensure IP67 protection.

4.2.2 PROFINET

4.2.2.1 Connector

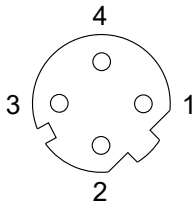


Fig. 1: M12 socket, D-coded

Pin	Core color ¹⁾	Signal
1	Yellow	Tx +
2	White	Rx +
3	orange	Tx -
4	blue	Rx -
Housing	-	Shield

¹⁾ The core colors apply to Ethernet/EtherCAT cables with M12 connections from Beckhoff.

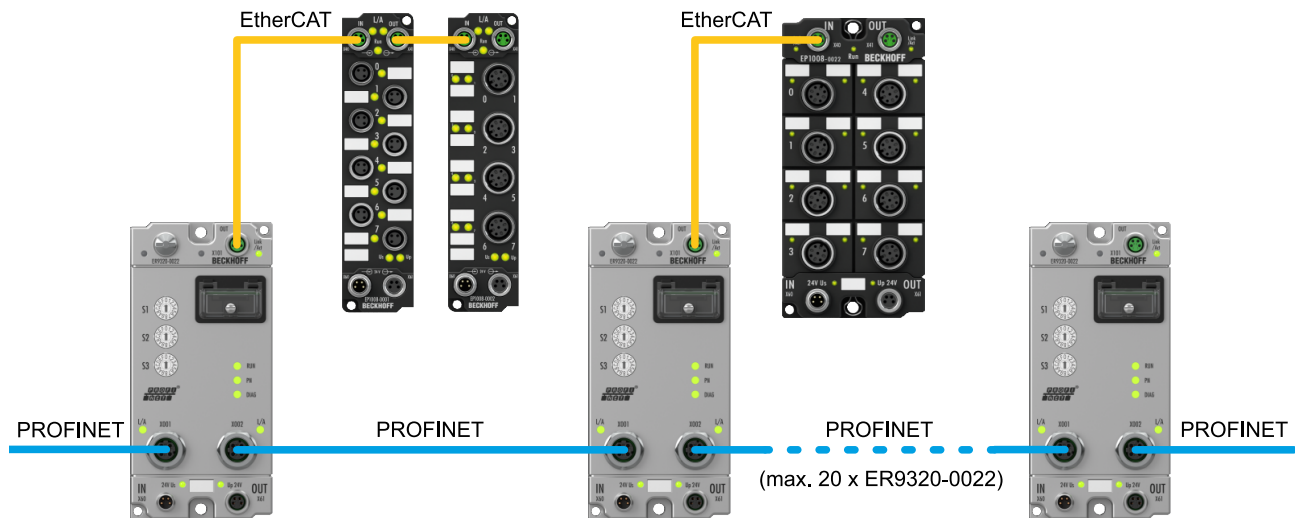
4.2.2.2 Status LEDs

See chapter [LED display](#) [► 53].

4.2.2.3 Topology example

The PROFINET network can be set up with a line structure. The following limits should be adhered to:

- maximum 20 ER9320-0022 in series.
- no switches should be used in the line.



i Use of switches without LLDP

PROFINET uses the LLDP protocol for the topology recognition. The topology recognition and the associated PROFINET services will not work properly if the switch used does not support the LLDP protocol. In addition, this results in increased network traffic, which is multiplied further with each switch port and connected PROFINET device. This can result in communication disruptions and even the aborting of communication with individual PROFINET devices.

4.2.3 EtherCAT output

4.2.3.1 Connectors

NOTICE

Risk of confusion: supply voltages and EtherCAT

Defect possible through incorrect insertion.

- Observe the color coding of the connectors:
black: Supply voltages
green: EtherCAT

The EtherCAT output is implemented as a green M8 socket.



Connection

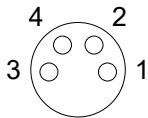


Fig. 2: M8 socket

Assignment

There are various different standards for the assignment and colors of connectors and cables for EtherCAT.

EtherCAT	Plug connector			Cable		Standard
Signal	M8	M12	RJ45 ¹	ZB9010, ZB9020, ZB9030, ZB9032, ZK1090-6292, ZK1090-3xxx-xxxx	ZB9031 and old versions of ZB9030, ZB9032, ZK1090-3xxx-xxxx	TIA-568B
Tx +	Pin 1	Pin 1	Pin 1	yellow ²	orange/white ³	white/orange
Tx -	Pin 4	Pin 3	Pin 2	orange ²	orange ³	orange
Rx +	Pin 2	Pin 2	Pin 3	white ²	blue/white ³	white/green
Rx -	Pin 3	Pin 4	Pin 6	blue ²	blue ³	green
Shield	Housing		Shroud	Shield	Shield	Shield

¹⁾ colored markings according to EN 61918 in the four-pin RJ45 connector ZS1090-0003

²⁾ wire colors according to EN 61918

³⁾ wire colors

**Assimilation of color coding for cable ZB9030, ZB9032 and ZK1090-3xxxx-xxxx (with M8 connectors)**

For unification, the prevalent cables ZB9030, ZB9032 and ZK1090-3xxx-xxxx were changed to the colors of EN61918 (yellow, orange, white, blue). So different color coding exists. But the electrical properties are absolutely identical.

4.2.3.2 Status LEDs

See chapter [LED display](#) [► 53].

4.2.3.3 Cables

For connecting EtherCAT devices only shielded Ethernet cables that meet the requirements of at least category 5 (CAT5) according to EN 50173 or ISO/IEC 11801 should be used.

EtherCAT uses four wires for signal transmission.

Thanks to automatic line detection ("Auto MDI-X"), both symmetrical (1:1) or cross-over cables can be used between Beckhoff EtherCAT.

Detailed recommendations for the cabling of EtherCAT devices

4.2.4 Supply voltages

WARNING

Power supply from SELV / PELV power supply unit!

SELV / PELV circuits (safety extra-low voltage / protective extra-low voltage) according to IEC 61010-2-201 must be used to supply this device.

Notes:

- SELV / PELV circuits may give rise to further requirements from standards such as IEC 60204-1 et al, for example with regard to cable spacing and insulation.
- A SELV supply provides safe electrical isolation and limitation of the voltage without a connection to the protective conductor, a PELV supply also requires a safe connection to the protective conductor.

CAUTION

Observe the UL requirements

- When operating under UL conditions, observe the warnings in the chapter [UL Requirements](#) [► 26].

The EtherCAT Box is supplied with two supply voltages. The supply voltages are electrically isolated in the EtherCAT Box.

- Control voltage U_s
- Peripheral voltage U_p

Redirection of the supply voltages

The IN and OUT power connections are bridged in the module (not IP204x-Bxxx and IE204x). The supply voltages U_s and U_p can thus easily be transferred from EtherCAT Box to EtherCAT Box.

NOTICE

Pay attention to the maximum permissible current!

Pay attention also for the redirection of the supply voltages U_s and U_p , the maximum permissible current for M8 connectors of 4 A must not be exceeded!

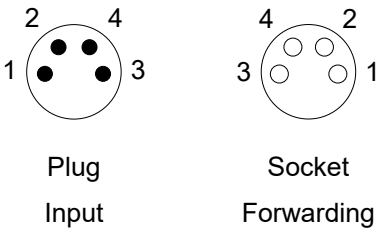
4.2.4.1 Connectors

NOTICE

Risk of confusion: supply voltages and EtherCAT

Defect possible through incorrect insertion.

- Observe the color coding of the connectors:
black: Supply voltages
green: EtherCAT



Contact	Function	Description	Core color ¹⁾
1	U _S	Control voltage	Brown
2	U _P	Peripheral voltage	White
3	GND _S	GND to U _S	Blue
4	GND _P	GND to U _P	Black

¹⁾ The core colors apply to cables of the type: Beckhoff ZK2020-3xxx-xxxx

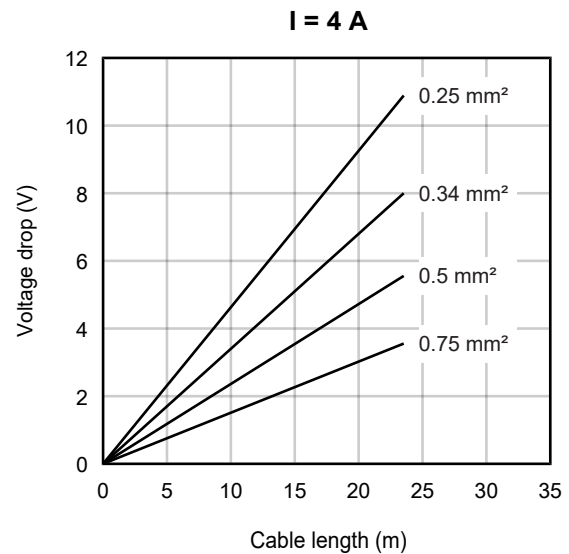
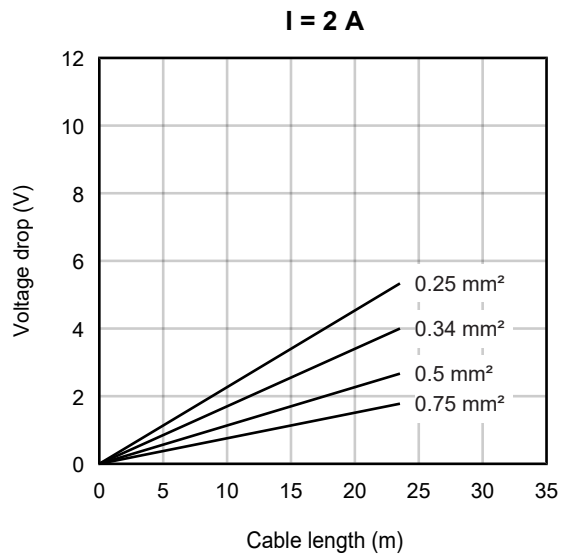
4.2.4.2 Status LEDs

See chapter [LED display](#) [► 53].

4.2.4.3 Conductor losses

Take into account the voltage drop on the supply line when planning a system. Avoid the voltage drop being so high that the supply voltage at the box lies below the minimum nominal voltage. Variations in the voltage of the power supply unit must also be taken into account.

Voltage drop on the supply line



4.2.5 Firmware memory

The firmware is loaded from a microSD card. The corresponding card slot is located on the front of the housing:



4.3 UL Requirements

The installation of the EtherCAT Box Modules certified by UL has to meet the following requirements.

Supply voltage

⚠ CAUTION

These UL requirements are valid for all supply voltages of all marked EtherCAT Box Modules.

For the compliance of the UL requirements the EtherCAT Box Modules should only be supplied

- by a 24 V DC supply voltage, supplied by an isolating source and protected by means of a fuse (in accordance with UL248), rated maximum 4 Amp, or
- by a 24 V DC power source, that has to satisfy *NEC class 2*.

A *NEC class 2* power supply shall not be connected in series or parallel with another (class 2) power source

⚠ CAUTION

To meet the UL requirements, the EtherCAT Box Modules must not be connected to unlimited power sources

Networks

⚠ CAUTION

To meet the UL requirements, EtherCAT Box Modules must not be connected to telecommunication networks.

Ambient temperature range

⚠ CAUTION

To meet the UL requirements, EtherCAT Box Modules have to be operated only at an ambient temperature range of -25 °C to +55 °C.

Marking for UL

All EtherCAT Box Modules certified by UL (Underwriters Laboratories) are marked with the following label.



Fig. 3: UL label

4.4 Disposal



Products marked with a crossed-out wheeled bin shall not be discarded with the normal waste stream. The device is considered as waste electrical and electronic equipment. The national regulations for the disposal of waste electrical and electronic equipment must be observed.

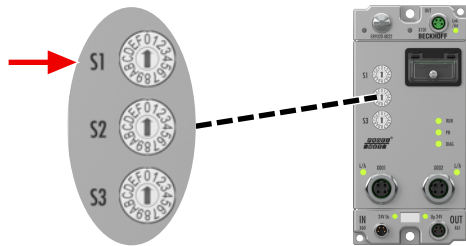
5 Commissioning

5.1 Setting the IP address

The ER9320-0022 has no predefined IP address. The IP address can be assigned by any of the following network devices:

- PROFINET controller (normal case)
- DHCP server

Before commissioning, use the S1 rotary switch to set the network device that should assign the IP address.



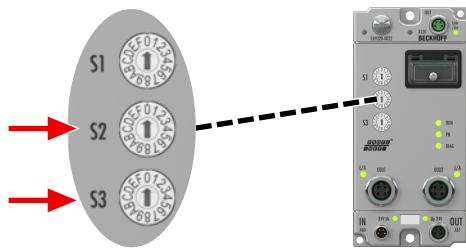
S1	Source of the IP address
1	DHCP server
3	PROFINET controller

The setting of the rotary switch is only applied during start-up. If you adjust the rotary switch during operation, the new value will only take effect upon the next start.

5.2 Setting the PROFINET device name

The PROFINET device name of the ER9320-0022 is "er9320-0022-x". "x" is an adjustable decimal number between 1 and 255.

Set the desired device name before commissioning using the rotary switches S2 and S3.



S2	S3	PROFINET device name
0	1	er9320-0022-1
0	2	er9320-0022-2
0	3	er9320-0022-3
...	...	...
F	D	er9320-0022-253
F	E	er9320-0022-254
F	F	er9320-0022-255

The rotary switch setting is only applied during start-up. If you adjust the rotary switches during operation, the new setting will not take effect until the next start.

6 Configuration

6.1 PROFINET configuration

● Supported EtherCAT devices

i The ER9320-0022 supports only EtherCAT devices listed in the GSDML file; however, extensions are possible. GSDML supports submodules. Find out whether your PROFINET controller supports submodules; if not, some EtherCAT devices cannot be used. Alternatively, the CX8093 can be used; this generally supports all EtherCAT devices.

The ER9320-0022 is integrated into the PROFINET controller using a GSDML file. The GSDML file contains all the parameterization data required for the operation of the ER9320-0022 on the PROFINET controller. The configuration tool reads this file and provides the data to the user.

The EtherCAT devices that can be operated on the ER9320-0022 are also specified in the GSDML file. Not all EtherCAT devices are supported. Therefore, inform yourself first whether the EtherCAT devices that you wish to use are also supported by the ER9320-0022.

Data in the DAP (Device Access Point)

2 x 2 bytes of data are located in the DAP of the GSDML file:

- ECCycleCounter (2 bytes). This is incremented with each EtherCAT cycle (1 ms), provided the EtherCAT Master is in the "OP" state.
- Status (2 bytes). This indicates individual status information bit by bit. These are occupied as follows:
 - Bit 0 "IsSynchron": is set when the ER9320-0022 is operated as a PTP slave or IRT device and is synchronous.
 - Bit 1 "IsPTPMaster": is set when the ER9320-0022 is operated as a PTP Master.
 - Bit 2 "ECFrameError": is set when a problem is detected at the EtherCAT output. The PROFINET diagnostics or the alarms must be read in order to obtain further information.

Parameters in the DAP

- "Activate PN Fallback Value"
 - "Off": EtherCAT data is written to zero.
 - "On": A different default value can be used with outputs. With digital outputs, for example, the current output process value can be frozen or set to 0 or 1 in case of a PROFINET communication error.
- "Data Presentation"
 - "Intel Format": data is displayed in Intel® format.
 - "Motorola Format": data is displayed in Motorola format. In Word variables, for example, the high and low bytes are exchanged.
- "EBus error behaviour"
 - "Set IOs to 0": in the event of an EtherCAT error, input data and output data are set to zero.
 - "Legacy": input data retain their last state, but are no longer updated; output data can still be set (depending on the position of the EtherCAT device).

Mapping

The ER9320-0022 is typically used in a group with EtherCAT devices that are connected to the EtherCAT output. The EtherCAT devices are a component of the GSDML; the EtherCAT devices are parameterized from the PROFINET controller.

Enter the EtherCAT devices in the hardware configurator in the same order as they are physically connected. If EtherCAT star hubs and/or EtherCAT junctions are used, it is important to know the order in which the other EtherCAT devices were entered in the process image (see [EtherCAT Mapping \[► 33\]](#)).

i Behavior when starting the ER9320-0022

All EtherCAT devices must be present when starting or resetting the ER9320-0022. This means that all connected EtherCAT devices must be powered up before startup or at the same time so that the ER9320-0022 starts up properly on the PROFINET. A solution can be constructed more flexibly with the CX8093.

Configuration of the EtherCAT devices

There are 4 types of EtherCAT devices:

- EtherCAT devices without process data
- EtherCAT devices with "simple" process data without parameterization (as a rule, simple EtherCAT devices with digital inputs or outputs)
- EtherCAT devices with "simple" process data with parameters (as a rule, EtherCAT devices with analog inputs or outputs)
- EtherCAT devices with different process data and parameters (for example incremental encoders)

The rule for all of them is: they must be entered in the configuration.

Grouping digital inputs and outputs (pack terminals)

The digital input and output terminals can also be grouped according to their process data. This option can be used with 2 or 4-channel terminals. To do this a 2 or 4-channel pack terminal (without asterisk) must be appended to the GSDML file. In order to fill the byte, a 2 or 4-channel pack terminal (with asterisk) must be appended next. The terminals must be physically and systematically plugged in one behind the other or logically. The byte limit must not be exceeded.

Example

2-channel pack (without asterisk), after that 3 modules from 2-channel pack terminals (with asterisk) may be appended.

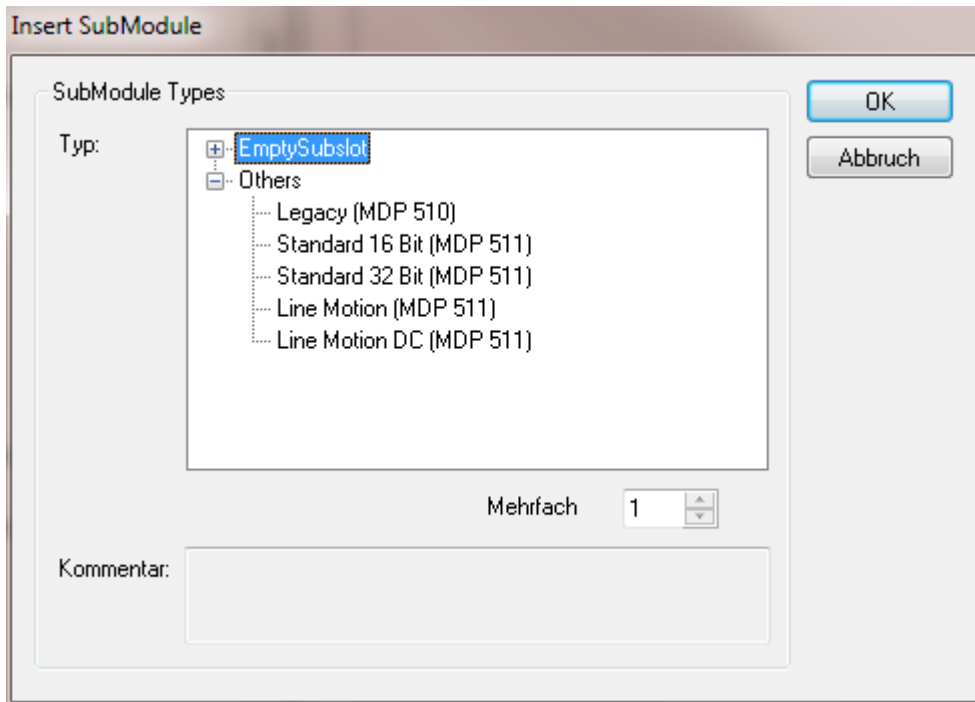
Not permitted:

2-channel pack (without asterisk), then 2 modules from 4-channel pack terminals (with asterisk). This exceeds the byte limit.

EtherCAT devices with different process data mappings

Some EtherCAT devices offer the option to represent different process data ("Predefined PDO Assignments"). In the PROFINET controller, the Predefined PDO Assignments are represented by submodules. The standard mapping is always integrated. If you want to use a process data mapping other than the standard one, delete the standard submodule and insert the desired submodule. It may be that not all mappings can be used under ER9320-0022, contrary to the documentation of the EtherCAT devices.

The following figure shows the insertion of a submodule using the example of an EL5101 EtherCAT Terminal:



6.1.1 Device-specific restrictions

EtherCAT gateways

EtherCAT gateways support multiple submodules.

The first module or basic module is loaded immediately. Create the modules for the process data and parameterize them on the master side of the corresponding gateway.

Not all features of an EtherCAT gateway can be used on the ER9320-0022.

EL6631-0010

The PROFINET device terminal makes it possible to connect two PROFINET networks with each other. You can set the default station name and the IP settings via parameterization data (GSDML).

Note that the complete maximum data length of the EL6631-0010 cannot be used. The length depends on other EtherCAT devices that are connected to the ER9320-0022.

EL6731-0010

The PROFIBUS slave terminal enables communication with a PROFIBUS master. Set the PROFIBUS address using the terminal's parameter settings (in the GSDML). Only process data can be exchanged.

EL6692

The EtherCAT slave terminal enables communication with an EtherCAT master. Only process data can be exchanged.

EL6652-0010

The EtherNet/IP™ slave terminal enables communication with an EtherNet/IP™ master. Set the IP address and the subnet mask via the parameters (in the GSDML file) of the EL6652-0010. Only process data can be exchanged.

6.2 EtherCAT configuration

The ER9320-0022 is an EtherCAT master with automatic configuration. This means that all EtherCAT slaves must already be connected and in operation when switching on. Since the boot-up of the ER9320-0022 generally takes considerably longer than the start-up of the connected EtherCAT devices, the latter can be operated on the same power supply.

For decentralized EtherCAT devices, make sure that the supply voltage of these EtherCAT devices is switched on earlier or at the same time as the supply voltage of the ER9320-0022.

Switching EtherCAT devices on or off during operation

If one or more EtherCAT devices fail during operation, the ER9320-0022 sends a PROFINET alarm of the type "Pull"; the data exchange continues. The input data of all EtherCAT devices are invalid and are set to FALSE or ZERO; the output data are no longer accepted. This also applies to the devices that are still in operation on the ER9320-0022.

If you want to connect and disconnect EtherCAT devices during runtime, you must configure an additional "Sync Unit". This is not possible with ER9320-0022. In this case use a CX8093.

EtherCAT devices that don't exist in the GSDML

Some EtherCAT devices are not included in the GSDML and thus cannot be used (yet). The CX8093 can be used here, since it supports all EtherCAT devices in principle.

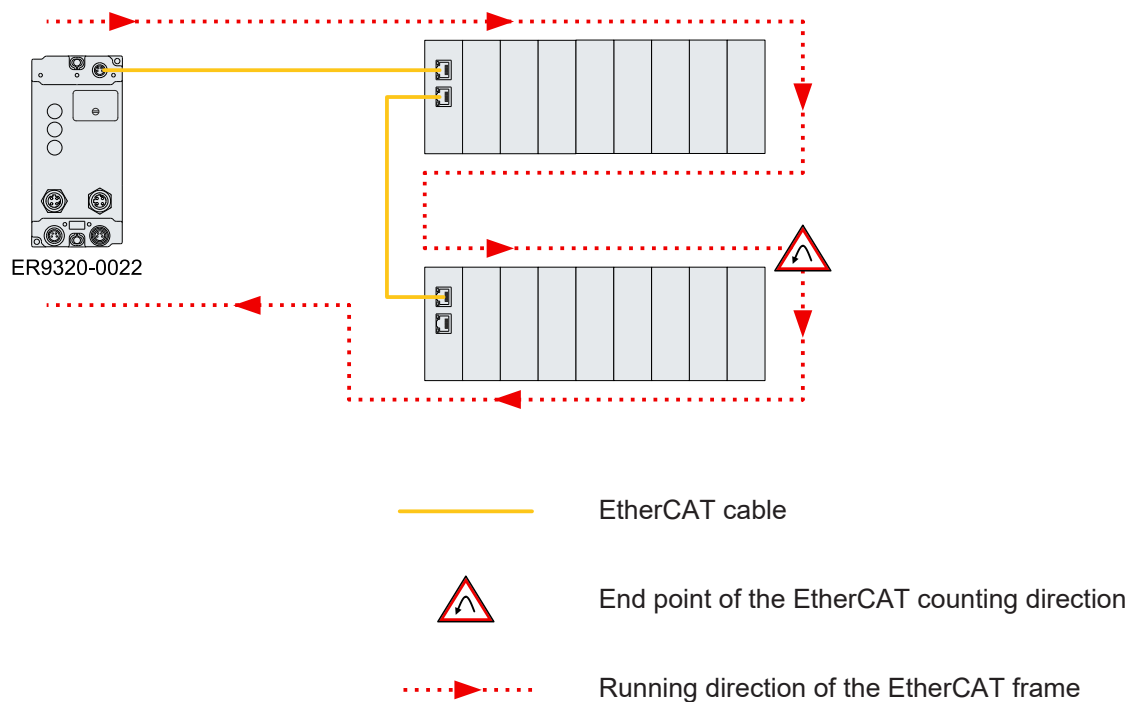
EtherCAT topology

All EtherCAT devices must be entered in the order in which they are arranged in the EtherCAT network.

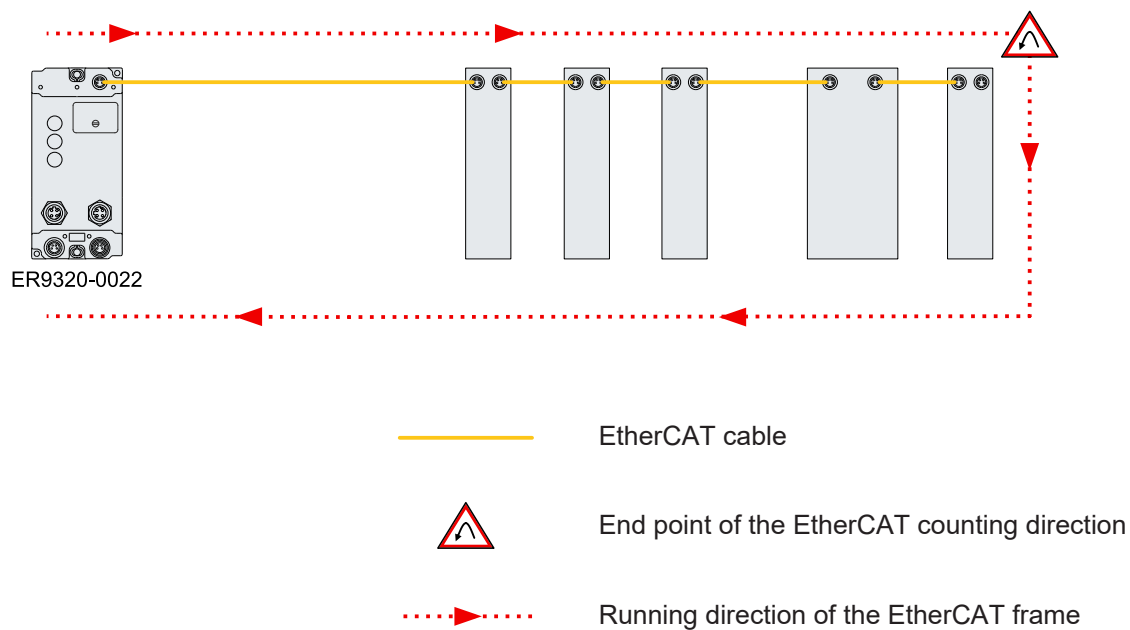
EtherCAT devices are addressed automatically. With a few exceptions all EtherCAT devices are equipped with an EtherCAT ASIC, which must also be entered in the system, i.e. the PROFINET controller. EtherCAT devices without an ASIC are, for example, EL9400, EL9070 and other EL9xxx. You can recognize these EtherCAT devices by the "Message to E-bus" entry in their technical data: If there is a "-" here, the EtherCAT device does not have to be entered in the PROFINET controller either.

EtherCAT devices are registered in the running direction of the EtherCAT telegram.

Topology example with the EK1100 EtherCAT Coupler

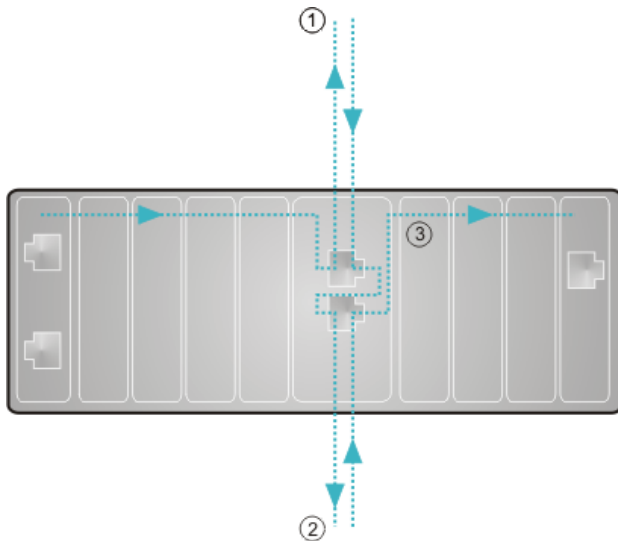


Topology example with EtherCAT Box modules



Example configuration with EK1122 2-port EtherCAT junction

The counting direction is to be observed when using an EK1122. If EtherCAT junction 1 on the EK1122 is connected, then the EtherCAT frame is forwarded here first (1). If junction 1 is not connected the frame on junction 2 is sent (2), only after that does the sequence continue with the E-bus on the right-hand side (3).

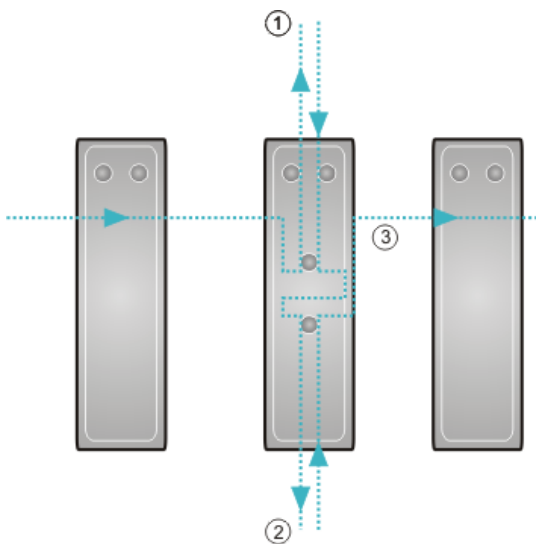


If both junctions are not used, then junction 1 and 2 are short-circuited as it were and the EtherCAT frame continues directly from the terminal to the right.

Note that in the PROFINET controller the modules are entered in the direction of the EtherCAT frame.

Example configuration with EP1122 2-port EtherCAT junction

The counting direction is to be observed when using an EP1122; it is comparable with the EK1122. If EtherCAT junction 1 on the EP1122 is connected, then the EtherCAT frame is forwarded here first (1); if junction 1 is not connected the frame on junction 2 is sent (2), only after that does the sequence continue with the EC-bus on the right-hand side (3).



If both junctions are not used, then junction 1 and 2 are short-circuited as it were and the EC frame continues directly from the terminal to the right.

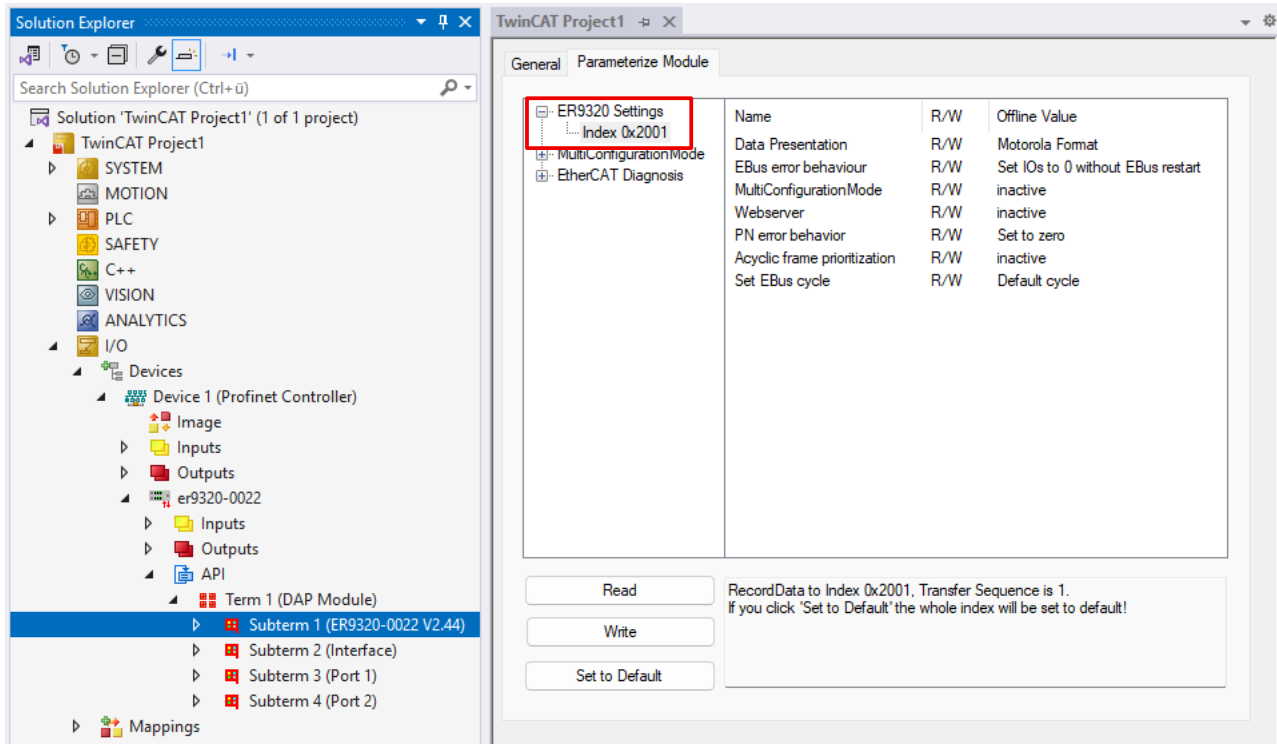
Note that in the PROFINET controller the modules are entered in the direction of the EtherCAT frame.

i Connection during operation

You cannot use the EP1122 and EK1122 for Hot Swap or connect or disconnect them during operation.

The EP1122 and EK1122 are suitable in conjunction with the EK coupler only as topology extensions (star).

6.2.1 Settings



"Data Presentation"

By default, the process data is transmitted in Motorola format. If your controller requires the data in Intel® format, you can reverse the byte order with this setting.

"EBus error behaviour"

See chapter ["EBus Error Behavior" \[► 38\]](#)

"Set EBus cycle"

If there are problems in the establishment of PROFINET communication when using a higher number of complex terminals on the ER9320-0022, the combination of adjusting the "Set EBus cycle" setting from "Default cycle" (1 ms) to "Profinet cycle" and adjusting the PROFINET cycle time can provide a remedy. It is usually sufficient to set the PROFINET cycle time to 2 ms or 4 ms.

● PROFINET cycle time and EtherCAT cycle time

i If the "Profinet cycle" option is activated and the PROFINET cycle time is higher than 64 ms, the EtherCAT cycle will continue to run at 64 ms. This prevents the internal watchdog of the EtherCAT devices from responding (100 ms).

If, for example, a PROFINET cycle time of 128 ms is set in the PROFINET controller, the EtherCAT network is operated with a cycle time of 64 ms.

"MultiConfigurationMode"

See chapter [Multi-configuration mode \[► 39\]](#)

"Webserver"

See chapter [Activating the web page](#)

"PN error behavior"

Defines the behavior in the event of PROFINET errors:

- "Set to zero" (default): All data will be set to "0"
- "Defined fallback": Data is set to a defined value.
- "Frozen": Data is frozen at its current value at the moment of the error.
This setting applies to all channels of the EtherCAT device; a channel-by-channel setting is not possible.
- "Stop EBus": No further EtherCAT frames pass through the coupler and its devices. The EtherCAT state machine is in "INIT"

"Acyclic frame prioritization"

If required for the application, you can set a prioritization of the acyclic frames (data set data) here.

6.2.2 "EBus Error Behavior"

General		Parameterize Module		
EP9300 Settings		Name	R/W	Offline Value
Index 0x2001				Online Value
MultiConfigurationMode		Data Presentation	R/W	Intel Format
		EBus error behaviour	R/W	Set I/Os to 0 without EBus restart
		Set EBus cycle	R/W	1ms
		MultiConfigurationMode	R/W	inactive
		Webserver	R/W	inactive
		PN error behavior	R/W	Set to zero
		Acyclic frame prioritization	R/W	inactive

You can use this parameter to set the reaction to an EtherCAT error.

The following parameters can be set:

Legacy	Output data is still written, input data is frozen and therefore no longer current.
Set I/Os to 0	Output data is written to zero, input data is written to zero. As soon as the EtherCAT network is error-free, the data exchange starts automatically.
Set I/Os to 0 without EBus restart (default setting)	Output data is written to zero, input data is written to zero. As soon as the EtherCAT network is error-free, the E-bus can be enabled again via the record data (see below).

Enabling EtherCAT communication following an EtherCAT error

Information about the EtherCAT state can be obtained in the DAP via the DWord "Status".

- Subterm 1 (EP9300 V2.33 (at least FW 6.00)) - Inputs - ECCycleCounter - Status - Reserved - Reserved - EcFrameError - Reserved - NeedEBusReset
--

If an error is detected in the EtherCAT network, the "EcFrameError" bit is set. When the error has been rectified and the ER9320-0022 is ready to start EtherCAT communication again, the "EcFrameError" bit is reset and the "NeedEBusReset" bit is set.

The reset is issued via Record Data Write and is structured as follows.

PROFINET record data (write request)	Value	Meaning
Slot	0	Slot number
SubSlot	1	Sub slot number
Index	0x2013	Reset index
Length	2	Data length
Data	0x1234	Value

Once the reset has been issued, the "NeedEBusReset" bit is reset.

6.3 Multi-configuration mode

The multi-configuration mode enables the ER9320-0022 to be operated with the same configuration but varying EtherCAT devices.

Task

The machine manufacturer has a machine, which is to be sold with different options. The options are usually additional signals to be processed and logged, for which additional terminals are required.

For all these options the project configuration should be retained and only be varied via the software. The actual machine options are included in the parameterization.

Solution

The multi-configuration mode is used to configure the maximum number of options in the project configuration. If the machine is ordered with fewer than the maximum number of options, you can deactivate individual EtherCAT devices whose signals are not required. Although unused EtherCAT devices remain included in the maximum project configuration, they can be disabled by the controller, so that the hardware and the parameterized configuration match again. As soon as this is done, the ER9320-0022 switches to normal data exchange.

Advantage

Less effort for creating and maintaining projects, since the same project configuration can be used for different hardware.

6.3.1 Example

The basic configuration of a machine, without options, consists of the following EtherCAT devices:

- 1 x ER9320-0022
- 2 x EP2008-0001
- 2 x EP1008-0001
- 1 x EP5101-0002

The following options can be added:

- "Automatic adjustable axis" option: 1 x EP7041-0002
- "Temperature measurement" option: 1 x EP3314-0002

The maximum expansion therefore contains the following EtherCAT devices:

- 1 x ER9320-0022
- 2 x EP2008-0001
- 2 x EP1008-0001
- 1 x EP5101-0002
- 1 x EP7041-0002 (option)
- 1 x EP3314-0002 (option)

Project this maximum expansion in the hardware configuration.

If the machine is ordered without options, deactivate the EtherCAT devices EP7041-0002 and EP3314-0002 in the project planning. To do this, inform ER9320-0022 via record data (acyclic communication) which EtherCAT devices are omitted. The EtherCAT devices are identified via their position:

Position	EtherCAT device
1	ER9320-0022
2	EP2008-0001
3	EP1008-0001
4	EP5101-0002
5	EP7041-0002
6	EP3314-0002

- If the machine is ordered without options, deactivate the devices at positions 5 and 6.
- If the machine is ordered with the "automatic adjustable axis" option, only deactivate the EtherCAT device at position 7

i Position of optional EtherCAT devices

Optional EtherCAT devices can be present at any position in the EtherCAT network. As shown in the example, they do not have to be inserted at the end.

6.3.2 Configuration

To use the multi-configuration mode, set the "MultiConfigurationMode" parameter to "active" in the DAP (Device Access Point) under "ER9320 Settings".

There are two ways to activate or deactivate EtherCAT devices:

Option 1

This is perhaps a version for testing, since the hardware configuration must be adjusted, which should preferably be avoided.

In the DAP there is a multi-configuration mode setting with the slots. Here you can disable EtherCAT Terminals, which are configured but not present.

For some PROFINET controllers this must happen on startup, while other PROFINET controllers enable it to occur at runtime, which simplifies testing significantly. Disabling/enabling of terminals at runtime is a feature of the PROFINET controller and may or may not be possible in practice, depending on the manufacturer of the PROFINET controller.

Option 2

The configuration is sent by the PLC via the record data. Here too, the manufacturers offer different options. Contact the manufacturer of your PROFINET controller, if you have any queries.

A requirement for option 2 is that your PROFINET controller allows and supports access to the record data.

PROFINET record data (write request)	Value	Meaning
Slot*	0	Slot number, always "0"
SubSlot*	1	Sub-slot number, always "1"
Index	0#2010	PROFINET index number
Length	variable	Length of the following data
Data	Each Bus Terminal requires 2 bits: 00 _{bin} terminal present 10 _{bin} terminal not present	Enabling/disabling of the EtherCAT devices

* For some PROFINET controllers these data are automatically taken from the GSDML and do not have to be configured.

Procedure

Once the station has been configured, the following steps are required.

If the machine is ordered with the maximum configuration (with all options), generally no action is required, since the hardware matches the project configuration.

If one of the options is not included, then hardware and project planning differ. The PROFINET coupler indicates this via the message "Module difference".

Now disable the terminals, which are not present. When this is done, the message "Module Difference" is removed from the coupler. If the message "Module Difference" remains, you may have the wrong slot or too few slots disabled.



No subslots

Subslots are not counted and cannot be used for the multi-configuration mode. Only slots can be used, irrespective of a module using subslots or not.



No Shared Device

The Shared Device feature cannot be used when the multi-configuration mode is used.

**No pack or (*) terminals**

Pack or (*) terminals cannot be used in multi-configuration mode.

6.4 CoE access via PROFINET

Description

CoE means **Can over EtherCAT**. It enables access to all parameters of an EtherCAT device. The CoE data model is based on the principles of CANopen and uses index and subindex for reading from and writing to parameters, if the corresponding access is enabled.

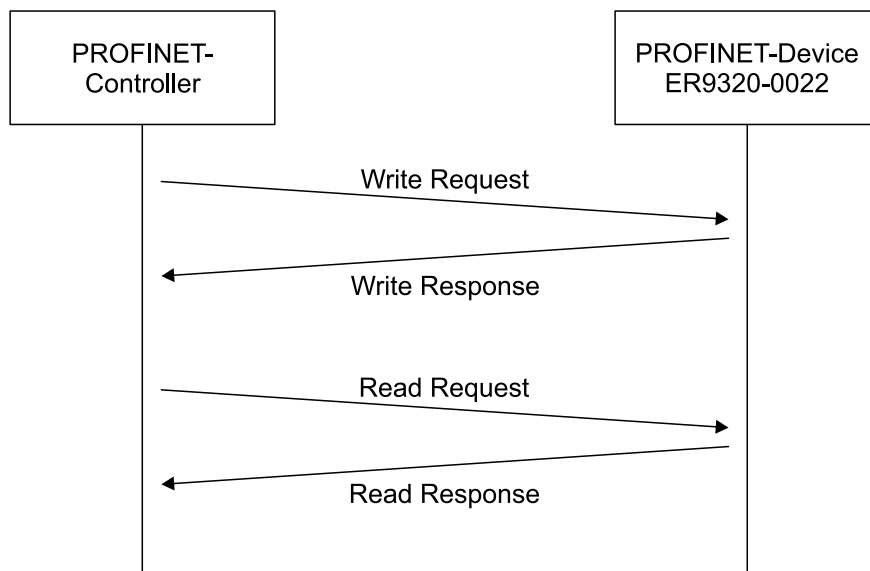
Further information can be found here: [System Documentation](#)

Task

Parameters of an EtherCAT device can generally be set and parameterized via the parameters of the GSDML file. However, in some applications it is necessary to change certain parameters at runtime or to carry out optimizations during operation.

Solution

The CoE data are sent via acyclic PROFINET services (PROFINET index 0x200F). The position of the EtherCAT device is specified via the slot number. The CoE data are then entered in the record data. During reading they consist of CoE index and CoE subindex, during writing they consist of CoE index, CoE subindex and the data to be sent.



Observe data format

During reading and writing, observe the data size and the format of the corresponding SDO parameters. We recommend reading the SDO data first, then interpret them and use the read data format also for writing the CoE data (perhaps swap High/Low BYTE/WORD).

6.4.1 Read CoE parameters

1. Send a "Write Request" with the content specified below
 - ⇒ The ER9320-0022 sends a "Write Response"
2. Wait 100 to 250 ms
3. Send a "Read Request" with the content specified below
 - ⇒ The ER9320-0022 sends a "Read Response". The "Read Response" contains the requested data.

Wireshark® example for reading: <https://infosys.beckhoff.com/content/1033/er9320-0022/Resources/2609011595.zip>

Write Request

PROFINET record data	Value	Meaning
Slot	Position of the EtherCAT device (1...255)	Slot number, position of the EtherCAT device
SubSlot	1	Sub slot number, always "1"
Index	0x200F	PROFINET index number
Length	4	Length of the following data
Data	• Bytes 1...2: CoE index • Byte 3: CoE subindex • Byte 4: "0", reserved	CoE data

Read Request

PROFINET record data	Value	Meaning
Slot	Position of the EtherCAT device (1...255)	Slot number, position of the EtherCAT device
SubSlot	1	Sub slot number, always "1"
Index	0x200F	PROFINET index number
Length	4	Length of the following data
Data	• Byte 1: "1" • Byte 2: "0" • Byte 3: "0" • Byte 4: "0"	CoE data

Read Response

PROFINET record data	Value	Meaning
Slot	Position of the EtherCAT device (1...255)	Slot number, position of the EtherCAT device
SubSlot	1	Sub slot number, always "1"
Index	0x200F	PROFINET index number
Length	4 bytes + x bytes	Length of the following data
Data	• Bytes 1...4: ADS return code • Bytes 4...x: CoE data value	CoE data

The ADS return code is "0" if the response is error-free. A list of ADS return codes can be found in the "ADS basics" manual: https://infosys.beckhoff.com/content/1033/tc3_ads_intro/index.html

6.4.2 Write CoE parameters

1. Send a "Write Request" with the content specified below
 - ⇒ The ER9320-0022 sends a "Write Response"
2. Wait 250 to 500 ms
3. Send a "Read Request" with the content specified below
 - ⇒ The ER9320-0022 sends a "Read Response". The "Read Response" contains the information as to whether the write process was successful.

Wireshark® example for writing: <https://infosys.beckhoff.com/content/1033/er9320-0022/Resources/2609013771.zip>

Write Request

PROFINET record data	Value	Meaning
Slot	Position of the EtherCAT device (1...255)	Slot number, position of the EtherCAT device
SubSlot	1	Sub slot number, always "1"
Index	0x200F	PROFINET index number
Length	4	Length of the following data
Data	- Bytes 1...2: CoE index - Byte 3: CoE subindex - Byte 4: "1", constant - Bytes 5...8: length as DWORD - Bytes 9...x: CoE data value	CoE data

Read Request

PROFINET record data	Value	Meaning
Slot	Position of the EtherCAT device (1...255)	Slot number, position of the EtherCAT device
SubSlot	1	Sub slot number, always "1"
Index	0x200F	PROFINET index number
Length	0	Length of the following data
Data	-	CoE data

Read Response

PROFINET record data	Value	Meaning
Slot	Position of the EtherCAT device (1...255)	Slot number, position of the EtherCAT device
SubSlot	1	Sub slot number, always "1"
Index	0x200F	PROFINET index number
Length	4	Length of the following data
Data	ADS return code	CoE data

The ADS return code is "0" if the response is error-free. A list of ADS return codes can be found in the "ADS basics" manual: https://infosys.beckhoff.com/content/1033/tc3_ads_intro/index.html



Start-up parameters overwrite CoE data

CoE data are typically not stored in the EtherCAT device. Make sure that the CoE data are overwritten again by the Start-up parameters (GSDML) when starting the ER9320-0022.

6.5 IO-Link access via PROFINET

Task

Connection of an IO-Link sensor to the ER9320-0022.

Configuration of the process data

Each IO-Link device is inserted as a submodule of the IO-Link master. A SubSlot is used for each IO-Link device. The process data sizes of the submodule must be equal to or greater than those of the IO-Link device.

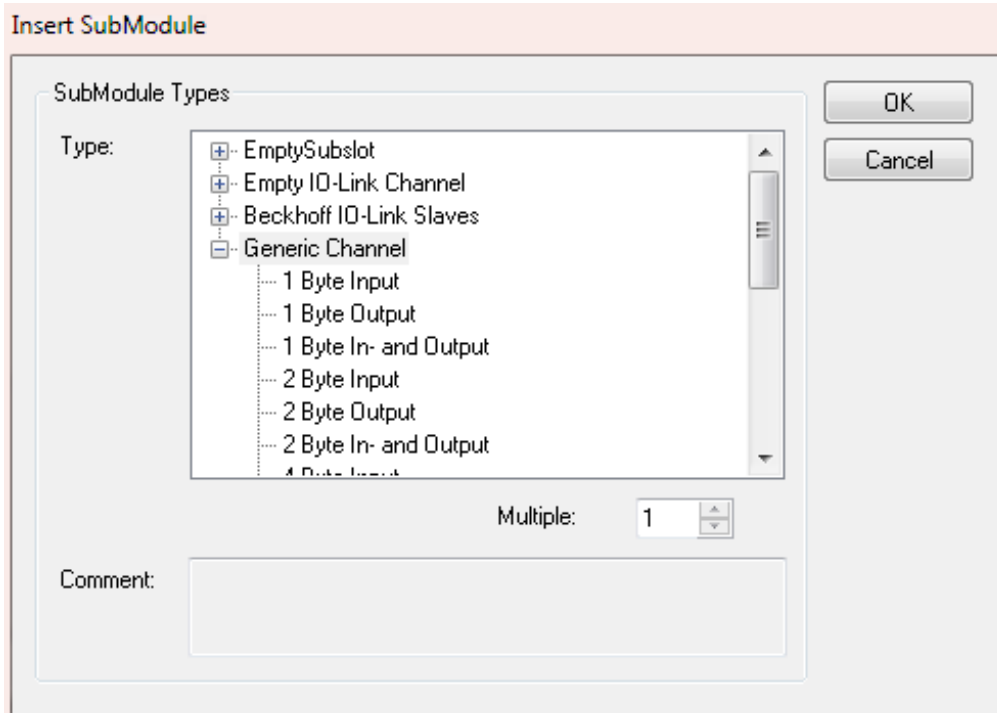
If you are not using all IO-Link channels, insert a submodule "Empty Channel" in each of the unused SubSlots.

The first submodule of the IO-Link master is a diagnostic module. This submodule contains the status of all connected IO-Link devices. If an IO-Link device is in IO-Link data exchange, the corresponding byte contains the value 0x03.

Information on the status byte:

0x_0 = Port disabled
0x_1 = Port in std dig in
0x_2 = Port in std dig out
0x_3 = Port in communication OP
0x_4 = Port in communication COMSTOP / dig in Bit (only in std. I/O mode)
0x_8 = Process Data Invalid Bit
0x1_ = Watchdog detected
0x2_ = internal Error
0x3_ = invalid Device ID
0x4_ = invalid Vendor ID
0x5_ = invalid IO-Link Version
0x6_ = invalid Frame Capability
0x7_ = invalid Cycle Time
0x8_ = invalid PD in length
0x9_ = invalid PD out length
0xA_ = no Device detected
0xB_ = error PreOP/Data storage

IO-Link devices from competitors



IO-Link devices from Beckhoff are automatically added with the required parameters.

To use IO-Link devices from other manufacturers, use a "Generic Channel" and select the process data size. For the process data size of the IO-Link device, refer to the documentation or contact the manufacturer.

Configuration of the IO-Link device

The minimum settings required for operating an IO-Link device are:

IO-Link version: Generally 1.1; enter 11

Frame capability: Generally 1

Min. cycle time: Generally 2.3 ms, i.e. 23

Process data in / Out length: Variable (number in bits), for a size of 2 bytes input enter 16 for "Process data in length".

If the IO-Link slave has more than 16 bits, the high bit is set (BIT 7 TRUE), then the data length is specified in bytes + 1, example 4 bytes of process data, a 0x83 (131 dec) must be specified, 0x8x then stands for counting bytes and the length is then 3 (=4 bytes). A maximum of 32 bytes is then possible here.

Master control: set to IO-Link

All other settings are optional.

General		Parameterize Module			
Channel settings Index 0x3000		Name	R/W	Offline Value	Online Value
		Device ID	R/W	0	0
		Vendor ID	R/W	0	0
		IO-Link Revision	R/W	11	11
		Frame capability	R/W	1	1
		Min cycle time	R/W	23	23
		Offset time	R/W	0	0
		Process data in length	R/W	16	16
		Process data out length	R/W	0	0
		Compatible ID	R/W	0	0
		Reserved	R/W	0	0
		Master Control	R/W	IO-Link	IO-Link
		Enable Datastorage	R/W	disabled	disabled
		Enable Datastorage Upload	R/W	disabled	disabled
		Error Reaction	R/W	Freeze	Freeze

Fig. 4: Configuration of the IO-Link device

Read and write parameters

Each IO-Link device has parameters that can be read or written. The ER9320-0022 does not support this function. No parameters can be read or written. The communication of the ER9320-0022 with an IO-Link device is limited to the process data.

To access parameters of the IO-Link devices, use a Beckhoff controller (e.g. CX8093). Here you can read the IODD file (IO-Link device description) and read or write the sensor data via the PLC.

6.6 Gigabit switch: Configuration and loss-free data transmission

The ER9320-0022 has an internal 2-port Ethernet Switch that supports baud rates of 10 Mbit/s, 100 Mbit/s and 1000 Mbit/s.

The baud rate of each port can be set to a fixed value via PROFINET. Autonegotiation is active by default. The switch uses the Cut-Through method to transmit frames with minimal latency.

For optimum performance, both ports should be operated at the same baud rate. At different speeds, the switch automatically adapts to the store-and-forward method. To avoid frame loss, it is advisable to adjust the data rate to a lower speed in this case.

First example: Different baud rates with data loss

- **Port 1:** 100 Mbit/s
- **Port 2:** 1000 Mbit/s

An industrial PC connected to port 2 sends large amounts of data to an industrial PC connected to port 1 of the switch. Due to different port speeds, the switch cannot operate in Cut-Through mode and must buffer the frames. However, the buffer capacity (e.g. in the EL6633) is not sufficient for the amount of data generated.

Result: Frames are discarded → retries by the protocol → increased network load → lower overall performance.

Second example: Different baud rates without problems

A pure PROFINET network without additional Ethernet services:

- **Port 1:** PROFINET controller with 100 Mbit/s
- **Port 2:** PROFINET devices with 1000 Mbit/s

As the data is transferred from the slower (100 Mbit/s) to the faster (1000 Mbit/s) network segment - i.e. from the PROFINET controller to various PROFINET devices - there are no bottlenecks. The network load is already limited by the 100 Mbit/s segment. Example: A utilization of 25% at 100 Mbit/s corresponds to only 2.5% utilization on the gigabit side.

Setting a fixed baud rate

The baud rate is set via the PROFINET controller in the manufacturer's project engineering tool. The "Adjustable MauType" function must be supported for this; the manufacturer of the PROFINET controller should be checked to see whether this is the case.

- The setting requires active PROFINET communication
- When setting for the first time, the link can be briefly interrupted (restart of the Ethernet port)
- The baud rate is retained after the restart
- 10 Mbit/s is only available via autonegotiation

Recommendation: Keep the default setting Autonegotiation.

Table 1: Baud rate configuration and behavior of the switch.

Port 1 (Mbit/s)	Port 2 (Mbit/s)	Transmission direction	Procedure	Possible effects	Recommendation
100	100	both directions	Cut-Through	Optimum performance, no buffering problems	OK
1000	1000	both directions	Cut-Through	Optimum performance, no buffering problems	OK
100	1000	100 → 1000	Cut-Through	No bottlenecks, load is limited by the slower port	OK
1000	100	1000 → 100	Store-and-Forward	Buffer overflow possible → frame losses → higher network load	Adjust speeds or limit data rate
10	variable	both directions	Autonegotiation required	Very low speed, potential bottleneck	Not recommended
variable	10	both directions	Autonegotiation required	Very low speed, potential bottleneck	Not recommended

6.7 Commissioning examples

The documentation for the EK9320 PROFINET coupler contains examples of commissioning with various EtherCAT devices. These examples can be transferred to ER9320-0022.

[EK9320 documentation](#)

7 Decommissioning

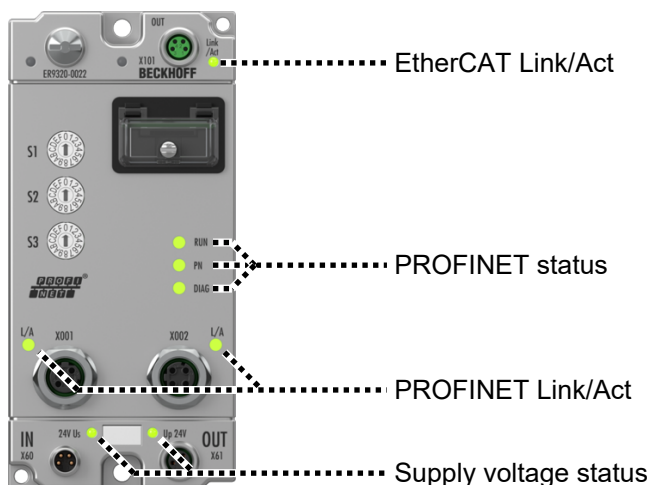
WARNING

Risk of electric shock!

Bring the bus system into a safe, de-energized state before starting disassembly of the devices!

8 Error handling and diagnosis

8.1 LED display



EtherCAT Link/Act

LED	Display	Meaning
Link/Act	off	No connection to the following EtherCAT module.
	green illuminated	Link: connection to the following EtherCAT module.
	green flashing	Act: Communication with the following EtherCAT module.

PROFINET status

LED	Signal	Meaning
RUN	green on	The ER9320-0022 is ready
	red on	May only light up during the start-up phase
PN	flashing red (200 ms)	Start-up phase
	flashing green (200 ms)	No PROFINET name, see chapter Setting the PROFINET device name [► 28].
	flashing green (1 s off, 200 ms on)	No IP address, see chapter Setting the IP address [► 28].
	green on	OK
DIAG	flashing red and green (500 ms)	PROFINET controller identification: The PROFINET controller sends an identification signal
	flashing red (200 ms)	"No AR established": The establishment of a connection with the PROFINET controller has not been completed
	flashing green (1 s off, 200 ms on)	Problem with establishment of a connection or actual and set configuration differ.
	flashing green (200 ms)	The coupler is exchanging data, but the PLC is in a stopped state
	green on	OK

PROFINET Link/Act

LED	Display	Meaning
L/A	off	no connection to the next PROFINET module
	green illuminated	Link: connection to the next PROFINET module
	green flashing	Activity: communication with the next PROFINET module

Supply voltage status

LED	Display	Meaning
Us 24 V	off	The power supply voltage Us is not present
	green illuminated	The power supply voltage Us is present
Up 24 V	off	The power supply voltage Up is not present
	green illuminated	The power supply voltage Up is present

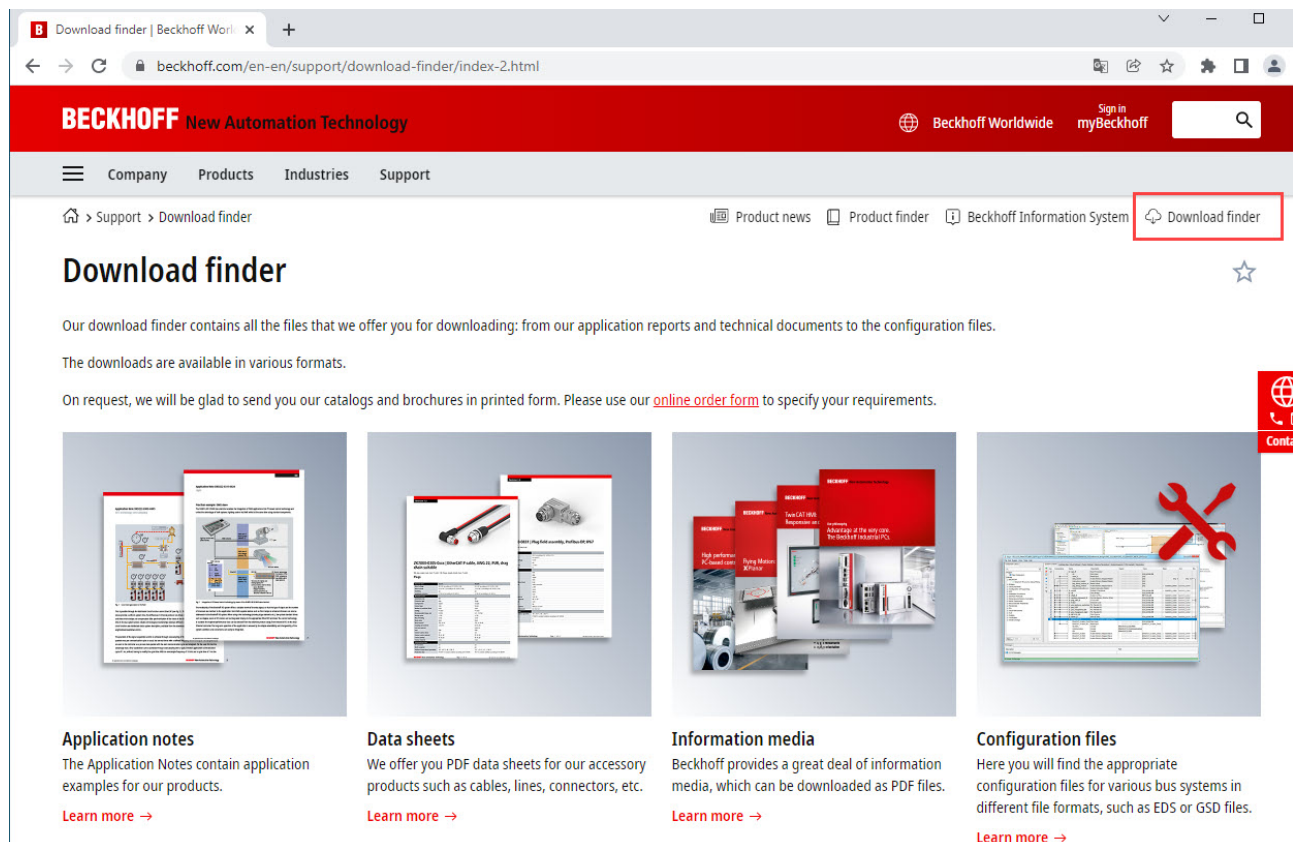
8.2 FAQ

The following points provide answers to frequently asked questions and notes on settings in the configuration of the PROFINET system. If they are not observed, this can lead to undesired behavior. Here you will find approaches to diagnosis.

8.2.1 Device description file (GSDML) / DAP (DeviceAccessPoint)

Device description file (GSDML) / DAP (DeviceAccessPoint)

- Is the GSDML available on the system?
- Do the versions of both systems match?
 - It is recommended to use the same GSDML/DAP versions on both systems.
 - Is the latest version used?
- Is the GSDML in the correct path?
 - TwinCAT 2: TwinCAT2: C:\TwinCAT\Io\ProfiNet
 - TwinCAT 3: C:\TwinCAT\3.1\Config\Io\Profinet
- Is the correct GSDML used?
 - Version
 - It may be necessary to contact the vendor/manufacturer or search for the appropriate GSDML on the vendor's website.
- Where can I find GSDML files?
 - From Beckhoff products the GSDML files are usually delivered with the installation of TwinCAT.
 - On the [Beckhoff website](#), use the "Download Finder" and its filter options for this purpose



Download finder

Our download finder contains all the files that we offer you for downloading: from our application reports and technical documents to the configuration files.

The downloads are available in various formats.

On request, we will be glad to send you our catalogs and brochures in printed form. Please use our [online order form](#) to specify your requirements.

Application notes

The Application Notes contain application examples for our products.

[Learn more →](#)

Data sheets

We offer you PDF data sheets for our accessory products such as cables, lines, connectors, etc.

[Learn more →](#)

Information media

Beckhoff provides a great deal of information media, which can be downloaded as PDF files.

[Learn more →](#)

Configuration files

Here you will find the appropriate configuration files for various bus systems in different file formats, such as EDS or GSD files.

[Learn more →](#)

Fig. 5: Website Download finder

The screenshot displays the Beckhoff Download finder interface. At the top, the Beckhoff logo and navigation menu are visible. The main content area shows a search bar and filters. The 'Your selection' section indicates 'Media: Configuration files' and 'File type: GSDML'. Below this, a list of products is shown, each with a 'Downloads' button. The products listed are:

- EL6631-0010 | EtherCAT PROFINET Device** (Configuration files, GSDML (17 kB))
- CX20x0-B930, CX5xx0-B930, CX8093, CX9020-B930 | PROFINET** (Configuration files, GSDML (20 kB))
- BK9053 | GSDML für PROFINET V2.3** (Configuration files, GSDML (58 kB))
- BK9103 | GSDML for PROFINET V2.3** (Configuration files, GSDML (58 kB))

Each product entry includes a 'Valid for the following products' section with a list of compatible product numbers. A sidebar on the right provides additional filtering options:

- Items per page:** 5 items, 10 items, 25 items (selected), 50 items.
- Category:** Information media (174), Configuration files (227) (checked), Macros (3), Environmental product compliance (12), Software and tools (165), Technical documentations (2853), Technical drawings (11446), Certificates, approvals (136).
- File type:** EDS (87), GSE (28), GSD (23), XML (20), GSDML (12) (checked), GSG (12).

Fig. 6: Website Download finder (filtered)

- For products from other suppliers/manufacturers, the supplier must be contacted or the GSDML files can be downloaded from the website.

8.2.2 Task configuration

Task configuration

- Has a free-running task been created?
 - Or a "special sync task" used?
- Cycle time to base 2?
 - 1ms, 2ms, 4ms, 8ms,

The screenshot shows the Beckhoff task configuration interface with the following elements:

- Navigation Tabs:** General, Adapter, PROFINET, Sync Task (selected), Diag History, Diagnosis.
- Settings Section:**
 - ☐ Standard (via Mapping)
 - ☒ Special Sync Task
 - Below the selected option is a dropdown menu showing "Task_PROFINET" and a button labeled "Create new I/O Task".
- Sync Task Section:**
 - Name:** Task_PROFINET
 - Cycle ticks:** A spinner set to 1, followed by a text box containing 1.000 and the unit ms.
 - ☐ Adjustable by Protocol
 - Priority:** A spinner set to 1.

Fig. 7: Setting "Special Sync Task"

- Further notes in chapter [Sync Task](#)

8.2.3 EL663x-00x0 EtherCAT Terminals

EL663x-00x0 EtherCAT Terminals

- Was the correct terminal used?
 - EL663x-0000 cannot be used as device
 - EL6631-0010 cannot be used as controller

EL663x-00x0 EtherCAT Terminals

- Was the correct terminal used?
 - EL663x-0000 cannot be used as device
 - EL6631-0010 cannot be used as controller

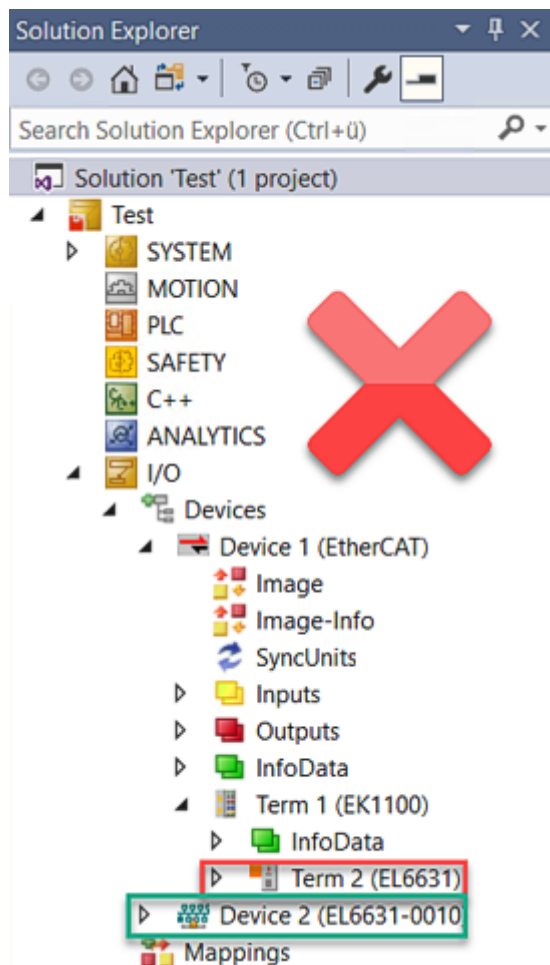


Fig. 8: Wrong configuration

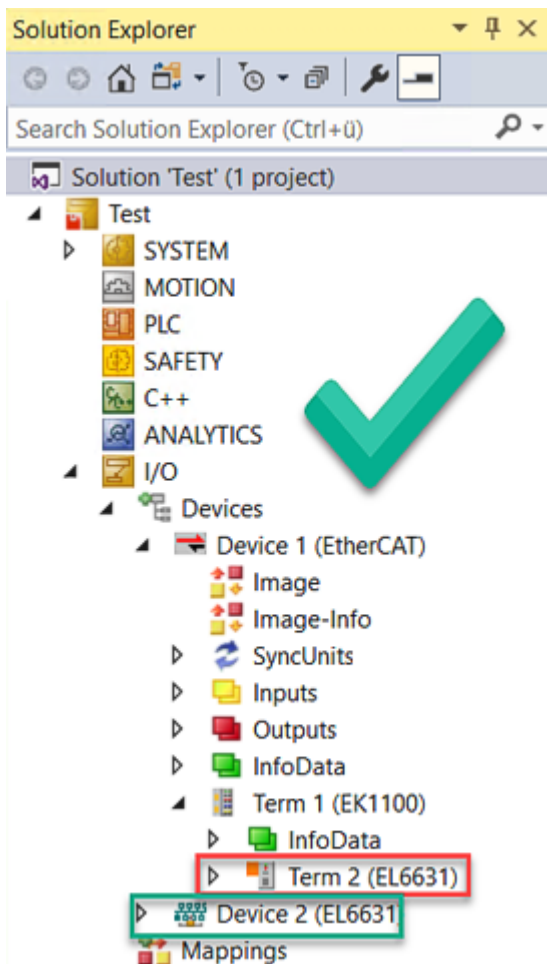


Fig. 9: Correct configuration

- EtherCAT diagnostics
 - EtherCAT state = Operational (OP)
 - WcState = 0 (Data valid)
- EtherCAT diagnostics
 - EtherCAT state = Operational (OP)
 - WcState = 0 (Data valid)

8.2.4 BoxStates of the PROFINET devices

BoxStates of the PROFINET devices

- Communication established?
 - See [Box States](#)

8.2.5 FAQ

How can I leave the outputs in the current state in the event of a PROFINET error?

See the "PN error behavior" parameter in chapter [Settings](#) [► 36].

I would like to change the mapping of an EtherCAT module. Why doesn't it offer me this option?

The standard mapping is always by default. If other mappings are possible you must delete the standard mapping from your configurator first and then insert the new sub module.

Where can I get the GSDML file?

You can find the GSDML file at www.beckhoff.com.

Where can I find the MAC address of the ER9320-0022?

The MAC address is printed on the box.

What is the microSD card slot for?

Firmware updates can be installed via the microSD card slot.

I have an EtherCAT device from a third-party vendor, can I connect it too?

No, devices from other vendors can only be used with a CX: CX8093 or similar products.

I would like to operate drive terminals/drives on the ER9320-0022, is this possible?

No, use a CX with a suitable performance for this, e.g. CX9020 or higher.

I would like to operate TwinSAFE components at ER9320-0022, is that possible?

No, the TwinSAFE components require a TwinCAT system for configuration. Use the CX8093.

How can I tell whether there is an EtherCAT error?

There is a status word in the DAP of the ER9320-0022. A bit is set here if an EtherCAT error occurs. Further information about the error can be obtained through the PROFINET alarms.

8.2.6 Diagnostic status under TIA

- I get a message that the installed firmware is not identical to the version of the configured firmware, what should I do?
 - If this message appears under the TIA software (see illustration), it can be ignored. The products are always downward compatible, i.e. the old GSDML file can still be used with newer software without having to update it. There is no technical reason to take action here.

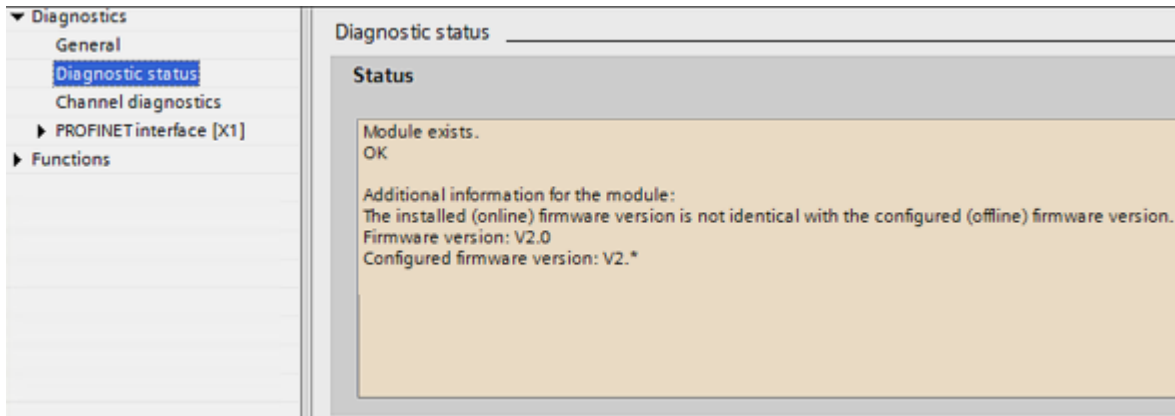


Fig. 10: Note on the firmware in Diagnostic Status

9 Appendix

9.1 Firmware Update

NOTICE

Defect if the update is interrupted

If the firmware update is interrupted, the bootloader may be damaged. This renders the ER9320-0022 unusable.

- Ensure that the power supply is stable and not interrupted during firmware updates.

Firmware images are provided by Beckhoff Service. Perform the update only after consulting with [Beckhoff Service](#) [► 71].

Requirements

- Card reader for microSD cards.

Procedure

1. Switch off the supply voltage
 2. Remove the microSD card from the card slot of the ER9320-0022
 3. Insert the microSD card into a microSD card slot on the PC
 4. Delete all files and folders on the microSD card
 5. Copy all files and folders of the new firmware image to the empty microSD card
 6. Insert the microSD card back into the ER9320-0022
 7. Switch on the supply voltage
- ⇒ The ER9320-0022 starts and saves the current hardware configuration. The data structure required for operation is generated and stored on the microSD card. The image has now been successfully updated.

9.2 General operating conditions

Protection rating according to IP code

The degrees of protection are defined and divided into different classes in the IEC 60529 standard (EN 60529). Degrees of protection are designated by the letters "IP" and two numerals: **IPxy**

- Numeral x: Dust protection and contact protection
- Numeral y: Protection against water

x	Meaning
0	Not protected
1	Protected against access to dangerous parts with the back of the hand. Protected against solid foreign objects of 50 mm Ø
2	Protected against access to dangerous parts with a finger. Protected against solid foreign objects of 12.5 mm Ø
3	Protected against access to dangerous parts with a tool. Protected against solid foreign objects of 2.5 mm Ø
4	Protected against access to dangerous parts with a wire. Protected against solid foreign objects of 1 mm Ø
5	Protection against access to dangerous parts with a wire. Dust-protected. Ingress of dust is not prevented completely, although the quantity of dust able to penetrate is limited to such an extent that the proper function of the device and safety are not impaired
6	Protection against access to dangerous parts with a wire. Dust-tight. No ingress of dust

y	Meaning
0	Not protected
1	Protection against vertically falling water drops
2	Protection against vertically falling water drops when enclosure tilted up to 15°
3	Protection against spraying water. Water sprayed at an angle of up to 60° on either side of the vertical shall have no harmful effects
4	Protection against splashing water. Water splashed against the enclosure from any direction shall have no harmful effects
5	Protection against water jets.
6	Protection against powerful water jets.
7	Protected against the effects of temporary immersion in water. Ingress of water in quantities causing harmful effects shall not be possible when the enclosure is immersed in water at a depth of 1 m for 30 minutes

Chemical resistance

The resistance refers to the housing of the IP67 modules and the metal parts used. In the table below you will find some typical resistances.

Type	Resistance
Water vapor	unstable at temperatures > 100 °C
Sodium hydroxide solution (ph value > 12)	stable at room temperature unstable > 40 °C
Acetic acid	unstable
Argon (technically pure)	stable

Key

- resistant: Lifetime several months
- non inherently resistant: Lifetime several weeks
- not resistant: Lifetime several hours resp. early decomposition

9.3 Accessories

Mounting

Ordering information	Description	Link
ZS5300-0011	Mounting rail	Data sheet

Labeling material, protective caps

Ordering information	Description	
ZS5000-0010	Blanking plug for M8 sockets, IP67 (50 pieces)	Website

Ordering information	Description	
ZS5000-0020	Protective cap for M12 sockets, IP67 (50 pcs.)	

Ordering information	Description	Link
ZS5100-0000	Inscription labels, unprinted, 4 strips of 10	Data sheet
ZS5000-xxxx	Printed inscription labels on enquiry	n/a

Tools

Ordering information	Description	Link
ZB8801-0000	Torque wrench for plugs, 0.4...1.0 Nm	Website
ZB8801-0001	Torque cable key for M8/wrench size 9 for ZB8801-0000	Website

Ordering information	Description	
ZB8801-0002	Torque cable key for M12 / wrench size 13 for ZB8801-0000	
ZB8801-0003	Torque cable key for M12 field assembly / wrench size 18 for ZB8801-0000	



Further accessories

You can find further accessories at <https://www.beckhoff.com/accessories>.

9.4 Version identification of EtherCAT devices

9.4.1 General notes on marking

Name

A Beckhoff EtherCAT device has a 14-digit technical designation consisting of

- Family key
- Type
- Version
- Revision

Example	Family	Type	Version	Revision
EL3314-0000-0016	EL Terminal 12 mm, fixed connection level	3314 4-channel thermocouple terminal	0000 basic type	0016
ES3602-0010-0017	ES Terminal 12 mm, pluggable connection level	3602 2-channel voltage measurement	0010 high-precision version	0017
CU2008-0000-0000	CU device	2008 8-port Fast Ethernet switch	0000 basic type	0000

Notes

- The elements stated above result in the **technical designation**. EL3314-0000-0016 is used in the example below.
- EL3314-0000 is the order identifier, for “-0000” usually abbreviated to EL3314. “-0016” is the EtherCAT revision.
- The **order identifier** is composed of
 - family key (EL, EP, CU, ES, KL, CX, etc.)
 - type (3314)
 - version (0000)
- The **revision** -0016 reflects the technical progress such as feature enhancement with regard to EtherCAT communication and is managed by Beckhoff.
In principle, a device with a higher revision can replace a device with a lower revision, unless otherwise specified, e.g. in the documentation.
There is usually a description (ESI, EtherCAT Slave Information) in the form of an XML file which is associated and synonymous with each revision, and this is available for download from the Beckhoff website.
Since January 2014, the revision has been marked on the outside of the IP20 terminals; see Fig. *“EL2872 with revision 0022 and serial number 01200815.”*
- The type, version, and revision are read as decimal numbers, even if they are technically saved in hexadecimal.

9.4.2 Version identification of IP67 modules

The serial number/date code for Beckhoff IO devices is usually the 8-digit number printed on the device or on a sticker. The serial number indicates the configuration in delivery state and therefore refers to a whole production batch, without distinguishing the individual modules within a batch.

Structure of the serial number: **KK YY FF HH**

KK – week of production (calendar week)

YY – year of production

FF – firmware version

HH – hardware version

Example with serial number 12 06 3A 02:

12 – week of production 12

06 – year of production 2006

3A – firmware version 3A

02 – hardware version 02

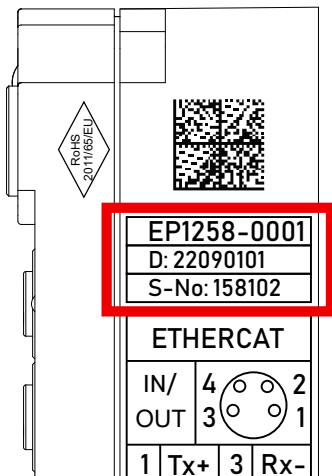


Fig. 11: EP1258-00001 IP67 EtherCAT Box with batch number/DateCode 22090101 and unique serial number 158102

9.4.3 Beckhoff Identification Code (BIC)

The Beckhoff Identification Code (BIC) is increasingly being applied to Beckhoff products to uniquely identify them. The BIC is represented as a Data Matrix code (DMC, code schema ECC200); its content is based on ANSI standard MH10.8.2-2016.

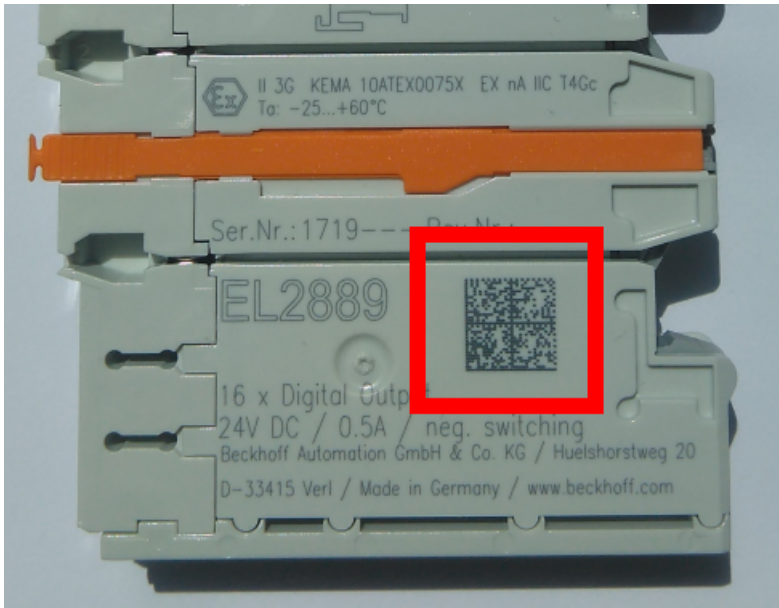


Fig. 12: BIC as a Data Matrix code (DMC, ECC200 code scheme)

The BIC is being introduced gradually across all product groups. Depending on the product, it can be found in the following locations:

- on the packaging unit
- directly on the product (if space suffices)
- on the packaging unit and the product

The BIC is machine-readable and contains information that can be used for handling and product management by the customer.

Each item of information is clearly identifiable with the data identifier (ANSI MH10.8.2-2016). The data identifier is followed by a character string. Both together have a maximum length stated by the following table. If the items of information are shorter, spaces are added.

The following information may be present; items 1 through 4 are always included, while the others depend on the product family's requirements:

Item no.	Type of information	Explanation	Data identifier	Number of characters including the data identifier	Example
1	Beckhoff order number	Beckhoff order number	1P	8	1P 072222
2	Beckhoff Traceability Number (BTN)	Unique serial number, see note below	SBTN	12	SBTN k4p562d7
3	Article description	Beckhoff article description, e.g. EL1008	1K	32	1KEL 1809
4	Quantity	Quantity in packaging unit, e.g. 1, 10, etc.	Q	6	Q1
5	Batch number	Optional: Year and week of production	2P	14	2P 401503180016
6	ID/serial number	Optional: Previous serial number system, e.g., for safety products or calibrated terminals	51S	12	51S 678294
7	Variant	Optional: Product variant number on the basis of standard products	30P	12	30P F971, 2*K183
...					

Beckhoff uses additional types of information and data identifiers for internal processes.

Structure of the BIC

Example of composite information consisting of items 1 through 4 and the example value mentioned above in item 6. The data identifiers are highlighted in bold:

1P072222**SBTN**k4p562d7**1KEL**1809 **Q1** **51S**678294

The same number as a DMC:



Fig. 13: Example DMC **1P**072222**SBTN**k4p562d7**1KEL**1809 **Q1** **51S**678294

BTN

An important component of the BIC is the Beckhoff Traceability Number (BTN, item no. 2). The BTN is a unique 8-character serial number that will replace all other serial number systems at Beckhoff in the future (e.g. batch designations on IO components, previous serial number circle for safety products, etc.). The BTN is also being introduced gradually, so it may not yet be coded in the BIC.

NOTICE

This information has been carefully prepared. However, the method described is constantly being refined. We reserve the right to revise and change procedures and documentation at any time and without notice. No claims for modification may be made on the basis of the data, diagrams, and descriptions in this documentation.

9.4.4 Electronic access to the BIC (eBIC)

Electronic BIC (eBIC)

The Beckhoff Identification Code (BIC) is applied to the outside of Beckhoff products in a visible place. If possible, it should also be electronically readable.

The interface that the product can be electronically addressed by is crucial for the electronic readout.

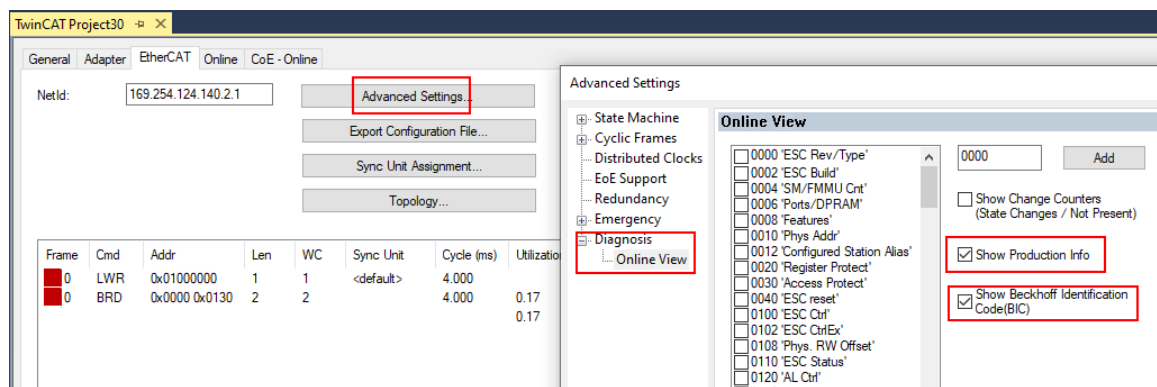
EtherCAT devices (IP20, IP67)

All Beckhoff EtherCAT devices have an ESI-EEPROM which contains the EtherCAT identity with the revision number. The EtherCAT slave information, also colloquially known as the ESI/XML configuration file for the EtherCAT master, is stored in it. See the corresponding chapter in the EtherCAT system manual ([Link](#)) for the relationships.

Beckhoff also writes the eBIC in the ESI-EEPROM. The eBIC was introduced into Beckhoff IO production (terminals, box modules) in 2020; as of 2023, implementation is largely complete.

The user can electronically access the eBIC (if present) as follows:

- With all EtherCAT devices, the EtherCAT master (TwinCAT) can read the eBIC from the ESI-EEPROM:
 - From TwinCAT 3.1 build 4024.11, the eBIC can be displayed in the online view.
 - To do this, check the “Show Beckhoff Identification Code (BIC)” checkbox under EtherCAT → Advanced Settings → Diagnostics:



- The BTN and its contents are then displayed:

No	Addr	Name	State	CRC	Fw	Hw	Production Data	ItemNo	BTN	Description	Quantity	BatchNo	SerialNo
1	1001	Term 1 (EK1100)	OP	0, 0	0	0	—	—	—	—	—	—	—
2	1002	Term 2 (EL1018)	OP	0, 0	0	0	2020 KW36 Fr	072222	k4p562d7	EL1809	1	—	678294
3	1003	Term 3 (EL3204)	OP	0, 0	7	6	2012 KW24 Sa	—	—	—	—	—	—
4	1004	Term 4 (EL2004)	OP	0, 0	0	0	—	072223	k4p562d7	EL2004	1	—	678295
5	1005	Term 5 (EL1008)	OP	0, 0	0	0	—	—	—	—	—	—	—
6	1006	Term 6 (EL2008)	OP	0, 0	0	12	2014 KW14 Mo	—	—	—	—	—	—
7	1007	Term 7 (EK1110)	OP	0	1	8	2012 KW25 Mo	—	—	—	—	—	—

- Note: As shown in the figure, the production data HW version, FW version, and production date, which have been programmed since 2012, can also be displayed with “Show production info”.
- Access from the PLC: From TwinCAT 3.1. build 4024.24, the functions *FB_EcReadBIC* and *FB_EcReadBTN* for reading into the PLC are available in the Tc2_EtherCAT library from v3.3.19.0.
- EtherCAT devices with a CoE directory may also have the object 0x10E2:01 to display their own eBIC, which can also be easily accessed by the PLC:

- The device must be in PREOP/SAFEOP/OP for access

Index	Name	Flags	Value
1000	Device type	RO	0x015E1389 (22942601)
1008	Device name	RO	ELM3704-0000
1009	Hardware version	RO	00
100A	Software version	RO	01
100B	Bootloader version	RO	J0.1.27.0
+ 1011:0	Restore default parameters	RO	> 1 <
+ 1018:0	Identity	RO	> 4 <
- 10E2:0	Manufacturer-specific Identification C...	RO	> 1 <
- 10E2:01	SubIndex 001	RO	1P158442SBTN0008jckp1KELM3704 Q1 2P482001000016
+ 10F0:0	Backup parameter handling	RO	> 1 <
+ 10F3:0	Diagnosis History	RO	> 21 <
- 10F8	Actual Time Stamp	RO	0x170bfb277e

- The object 0x10E2 will be preferentially introduced into stock products in the course of necessary firmware revision.
- From TwinCAT 3.1. build 4024.24, the functions *FB_EcCoEReadBIC* and *FB_EcCoEReadBTN* for reading into the PLC are available in the Tc2_EtherCAT library from v3.3.19.0
- The following auxiliary functions are available for processing the BIC/BTN data in the PLC in *Tc2_Uilities* as of TwinCAT 3.1 build 4024.24
 - *F_SplitBIC*: The function splits the BIC sBICValue into its components using known identifiers and returns the recognized substrings in the ST_SplittedBIC structure as a return value
 - *BIC_TO_BTN*: The function extracts the BTN from the BIC and returns it as a return value
- Note: If there is further electronic processing, the BTN is to be handled as a string(8); the identifier "SBTN" is not part of the BTN.
- On the technical background:
The new BIC information is written as an additional category in the ESI-EEPROM during device production. The structure of the ESI content is largely dictated by the ETG specifications, therefore the additional vendor-specific content is stored using a category in accordance with the ETG.2010. ID 03 tells all EtherCAT masters that they may not overwrite these data in the event of an update or restore the data after an ESI update.
The structure follows the content of the BIC, see here. The EEPROM therefore requires approx. 50... 200 bytes of memory.
- Special cases
 - In a hierarchical configuration of multiple ESCs (EtherCAT Slave Controllers) within a single device, only the top-level ESC carries the eBIC information.
 - If multiple non-hierarchically arranged ESCs are installed in a device, all ESCs carry the eBIC information.
 - If the device consists of several sub-devices which each have their own identity, but only the top-level device is accessible via EtherCAT, the eBIC of that ESC is located in the CoE object directory 0x10E2:01 and the eBICs of the sub-devices follow in 0x10E2:nn.

9.5 Support and Service

Beckhoff Support and Service provides assistance with questions regarding Beckhoff products and system solutions, as well as with their planning, commissioning, and operation.

Beckhoff subsidiaries and representative offices

Please contact your Beckhoff subsidiary or your representative office for local support and service for Beckhoff products. You can find the addresses of Beckhoff subsidiaries and representative offices at: www.beckhoff.com/worldwide.

For Beckhoff products and technologies, we offer [Training programs](#), [tutorials](#), and [webinars](#).

Beckhoff Support

Beckhoff Support provides assistance with technical questions regarding the use, planning, programming, and commissioning of Beckhoff products.

☎ Hotline: +49 5246 963-157
✉ Email: support@beckhoff.com, [Support form](#)
Web page: www.beckhoff.com/support

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☎ Hotline: +49 5246 963-460
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