

Documentation | EN

EL6633-0010

EtherCAT Terminal, 2-port communication interface, PROFINET RT, device



Table of contents

1	Foreword	5
1.1	Notes on the documentation	5
1.2	Guide through documentation	6
1.3	Notes on information security	7
1.4	Safety instructions	8
1.5	Documentation issue status	9
1.6	Version identification of EtherCAT devices	10
1.6.1	General notes on marking	10
1.6.2	Version identification of EL terminals	11
1.6.3	Beckhoff Identification Code (BIC)	12
1.6.4	Electronic access to the BIC (eBIC)	14
1.7	Product overview Ethernet Switchport Terminals	16
2	PROFINET system presentation	17
3	Product description EL6633-0010	19
3.1	Introduction	19
3.2	Technical data - PROFINET RT	20
3.3	EL6633-0010 - Technical data	20
3.4	EL6633-0010 - LEDs	21
4	Mounting and wiring	23
4.1	Instructions for ESD protection	23
4.2	UL notice	24
4.3	Note - power supply	25
4.4	Mounting and demounting - top front unlocking	26
4.5	Installation positions	28
4.6	Note on shielding	30
4.7	Disposal	31
5	Commissioning & Configuration	32
5.1	Integration via an EL663x-0010	32
5.2	Configuration	37
5.2.1	Assignment of PROFINET name to a PROFINET Device	37
5.2.2	Creating modules/process data on the PROFINET Device	40
5.2.3	Creating a virtual slave	47
5.2.4	Gigabit switch: Configuration and loss-free data transmission	49
6	Settings and diagnosis	50
6.1	Settings on the PROFINET Device protocol	50
6.1.1	General	50
6.1.2	Adapter	50
6.1.3	PROFINET	53
6.1.4	Sync Task	55
6.2	Diagnosis on the PROFINET Device Protocol	57
6.2.1	Diag History	57
6.2.2	Diagnosis	58
6.2.3	Cyclic diagnosis	59

6.3	Settings on the PROFINET Device	60
6.3.1	General	60
6.3.2	Device	60
6.3.3	ADS	61
6.3.4	EL663x	62
6.3.5	GSDML generator	63
6.4	PROFINET Device diagnosis	65
6.4.1	Diagnosis	65
6.4.2	Status and Ctrl. flags	65
6.4.3	Port diagnostics	66
6.4.4	Further diagnosis	68
7	Profinet Features	70
7.1	Alarms	70
7.2	Record data	70
7.3	PROFINET Shared Device	71
8	Appendix	77
8.1	FAQ	77
8.1.1	Device description file (GSDML) / DAP (DeviceAccessPoint)	77
8.1.2	Task configuration	79
8.1.3	EL663x-00x0 EtherCAT Terminals	80
8.1.4	BoxStates of the PROFINET devices	82
8.1.5	Diagnostic status under TIA	83
8.2	EtherCAT AL Status Codes	84
8.3	Firmware compatibility	85
8.4	Firmware Update EL/ES/EM/ELM/EP/EPP/ERPxxxx	86
8.4.1	Device description ESI file/XML	87
8.4.2	Firmware explanation	90
8.4.3	Updating controller firmware *.efw	91
8.4.4	FPGA firmware *.rbf	93
8.4.5	Simultaneous updating of several EtherCAT devices	97
8.5	Master device file GSDML	98
8.6	Support and Service	99

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 Guide through documentation

NOTICE



Further components of documentation

This documentation describes device-specific content. It is part of the modular documentation concept for Beckhoff I/O components. For the use and safe operation of the device / devices described in this documentation, additional cross-product descriptions are required, which can be found in the following table.

Title	Description
EtherCAT System Documentation (PDF)	• System overview • EtherCAT basics • Cable redundancy • Hot Connect • EtherCAT devices configuration
Infrastructure for EtherCAT/Ethernet (PDF)	Technical recommendations and notes for design, implementation and testing
Software Declarations I/O (PDF)	Open source software declarations for Beckhoff I/O components

The documentations can be viewed at and downloaded from the Beckhoff website (www.beckhoff.com) via:

- the “Documentation and Download” area of the respective product page,
- the [Download finder](#),
- the [Beckhoff Information System](#).

If you have any suggestions or proposals for our documentation, please send us an e-mail stating the documentation title and version number to: documentation@beckhoff.com

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.

In addition, the recommendations from Beckhoff regarding appropriate protective measures should be observed. Further information regarding information security and industrial security can be found in our <https://www.beckhoff.com/secguide>.

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 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.

1.5 Documentation issue status

Version	Comment
1.0.0	• Complements and corrections • First release
0.4.0	• Complements and corrections
0.3.0	• Amendments
0.2.0	• Amendments
0.1.0	• Preliminary version EL6633-0010

Firmware and hardware versions

The software version of the PROFINET device supplement can be taken from the corresponding TwinCAT build number.

For the EL6633-0010, the firmware and hardware versions (delivery state) can be taken from the serial number printed on the side of the terminal.

1.6 Version identification of EtherCAT devices

1.6.1 General notes on marking

Designation

A Beckhoff EtherCAT device has a 14-digit designation, made up of

- family key
- type
- version
- revision

Example	Family	Type	Version	Revision
EL3314-0000-0016	EL terminal 12 mm, non-pluggable 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 mentioned above result in the **technical designation**. EL3314-0000-0016 is used in the example below.
- EL3314-0000 is the order identifier, in the case of “-0000” usually abbreviated to EL3314. “-0016” is the EtherCAT revision.
- The **order identifier** is made up of
 - family key (EL, EP, CU, ES, KL, CX, etc.)
 - type (3314)
 - version (-0000)
- The **revision** -0016 shows the technical progress, such as the extension of features with regard to the EtherCAT communication, and is managed by Beckhoff.
In principle, a device with a higher revision can replace a device with a lower revision, unless specified otherwise, e.g. in the documentation.
Associated and synonymous with each revision there is usually a description (ESI, EtherCAT Slave Information) in the form of an XML file, which is available for download from the Beckhoff web site.
From 2014/01 the revision is shown 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.

1.6.2 Version identification of EL terminals

The serial number/ data 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 of a batch.

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

KK - week of production (CW, calendar week)

YY - year of production

FF - firmware version

HH - hardware version

Example with serial number 12 06 3A 02:

12 - production week 12

06 - production year 2006

3A - firmware version 3A

02 - hardware version 02



Fig. 1: EL2872 with revision 0022 and serial number 01200815

1.6.3 Beckhoff Identification Code (BIC)

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

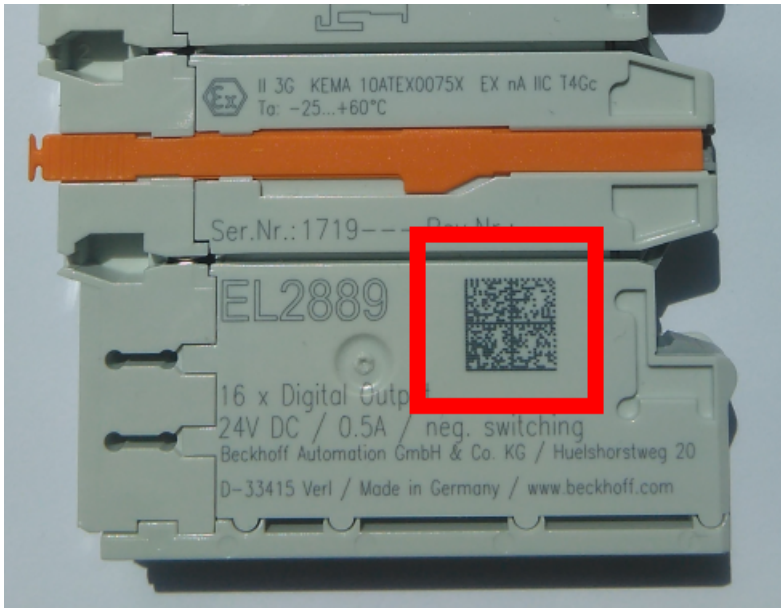


Fig. 2: BIC as data matrix code (DMC, code scheme ECC200)

The BIC will be introduced step by step across all product groups.

Depending on the product, it can be found in the following places:

- 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 also be used by the customer for handling and product management.

Each piece of information can be uniquely identified using the so-called data identifier (ANSI MH10.8.2-2016). The data identifier is followed by a character string. Both together have a maximum length according to the table below. If the information is shorter, spaces are added to it.

Following information is possible, positions 1 to 4 are always present, the other according to need of production:

Position	Type of information	Explanation	Data identifier	Number of digits incl. 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	1K EL1809
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: Present-day serial number system, e.g. with safety products	51S	12	51S 678294
7	Variant number	Optional: Product variant number on the basis of standard products	30P	12	30P F971, 2*K183
...					

Further types of information and data identifiers are used by Beckhoff and serve internal processes.

Structure of the BIC

Example of composite information from positions 1 to 4 and with the above given example value on position 6. The data identifiers are highlighted in bold font:

1P072222**SBTN**k4p562d7**1K**EL1809 **Q1** **51S**678294

Accordingly as DMC:



Fig. 3: Example DMC **1P**072222**SBTN**k4p562d7**1K**EL1809 **Q1** **51S**678294

BTN

An important component of the BIC is the Beckhoff Traceability Number (BTN, position 2). The BTN is a unique serial number consisting of eight characters that will replace all other serial number systems at Beckhoff in the long term (e.g. batch designations on IO components, previous serial number range for safety products, etc.). The BTN will also be introduced step by step, so it may happen that the BTN is not yet coded in the BIC.

NOTICE

This information has been carefully prepared. However, the procedure described is constantly being further developed. We reserve the right to revise and change procedures and documentation at any time and without prior notice. No claims for changes can be made from the information, illustrations and descriptions in this documentation.

1.6.4 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.

K-bus devices (IP20, IP67)

Currently, no electronic storage or readout is planned for these devices.

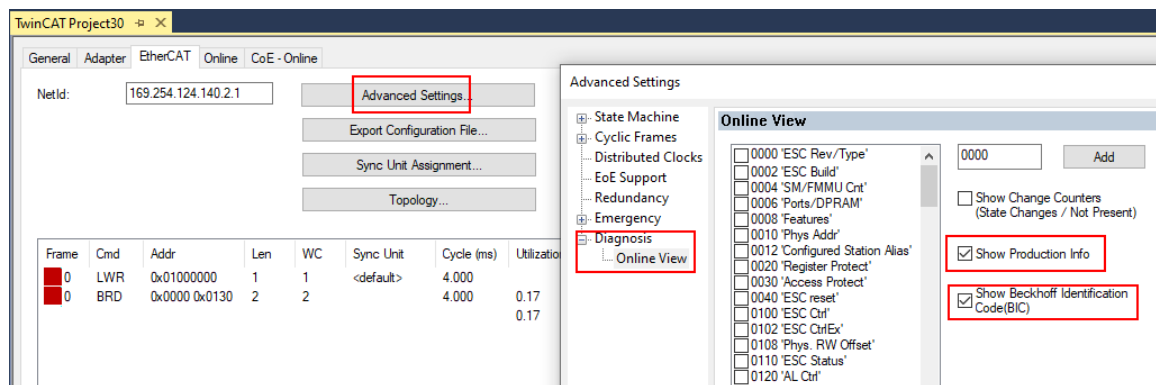
EtherCAT devices (IP20, IP67)

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 stores 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	1P158442SBTN0008jekp1KELM3704 Q1 2P482001000016
10F0:0	Backup parameter handling	RO	> 1 <
10F3:0	Diagnosis History	RO	> 21 <
10F8	Actual Time Stamp	RO	0x170fb277e

- 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_Uutilities* as of TwinCAT 3.1 build 4024.24
 - *F_SplitBIC*: The function splits the Beckhoff Identification Code (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.
- 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
 - If multiple hierarchically arranged ESCs are installed in a 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 the top-level device is located in the CoE object directory 0x10E2:01 and the eBICs of the sub-devices follow in 0x10E2:nn.

PROFIBUS, PROFINET, and DeviceNet devices

Currently, no electronic storage or readout is planned for these devices.

1.7 Product overview Ethernet Switchport Terminals

EL6601

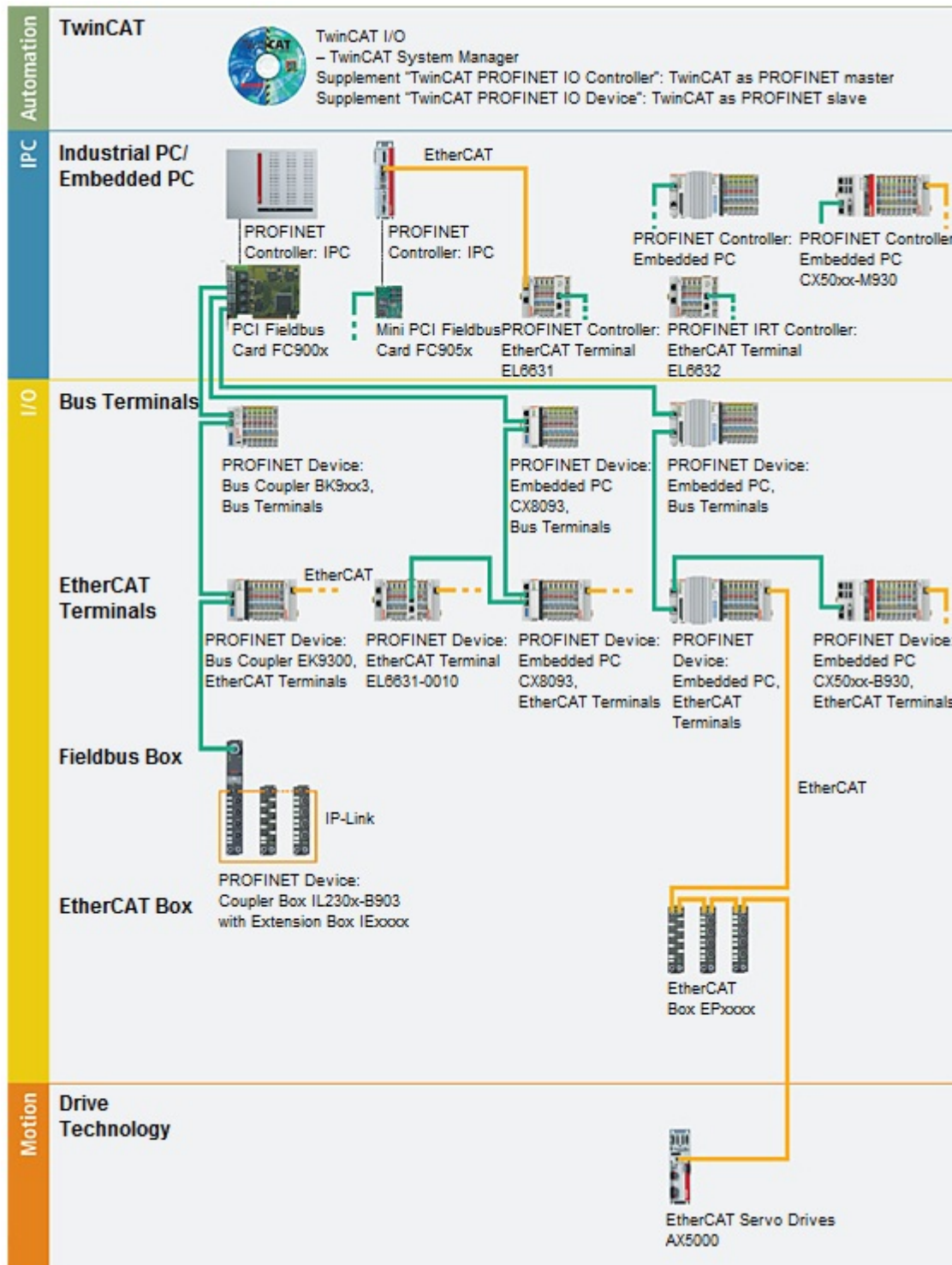
1-port communication interface, Ethernet switch port

EL6614

4-port communication interface, Ethernet switch port

2 PROFINET system presentation

PROFINET is the Industrial Ethernet standard of the PNO (PROFIBUS user organization). Internationally established IT standards such as TCP/IP are used for communication.



PROFINET system description

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.

Beckhoff PROFINET components

Components	Comment
TwinCAT	
TwinCAT PROFINET IO Device	TwinCAT as PROFINET slave
Embedded PCs	
CX8093	Embedded PC with PROFINET RT Device fieldbus interface
CXxxx-B930	Embedded PC with optional PROFINET RT Device interface
EtherCAT Terminals	
EL6631-0010	PROFINET IO device
EL6633-0010	PROFINET IO device
EtherCAT Box	
EP9300	PROFINET Coupler Box for EtherCAT box modules
Fieldbus Box	
IL230x-B903	PROFINET Coupler Box for IP-Link box modules
Bus Coupler	
BK9053	PROFINET "Compact" Bus Coupler for bus terminals
BK9103	PROFINET Bus Coupler for bus terminals
EK9300	PROFINET Bus Coupler for EtherCAT Terminals
PC Fieldbus cards	
FC900x	PCI™ Ethernet card for all Ethernet-based protocols (IEEE 802.3)
FC9x51	Mini PCI Ethernet card for all Ethernet-based protocols (IEEE 802.3)

3 Product description EL6633-0010

3.1 Introduction

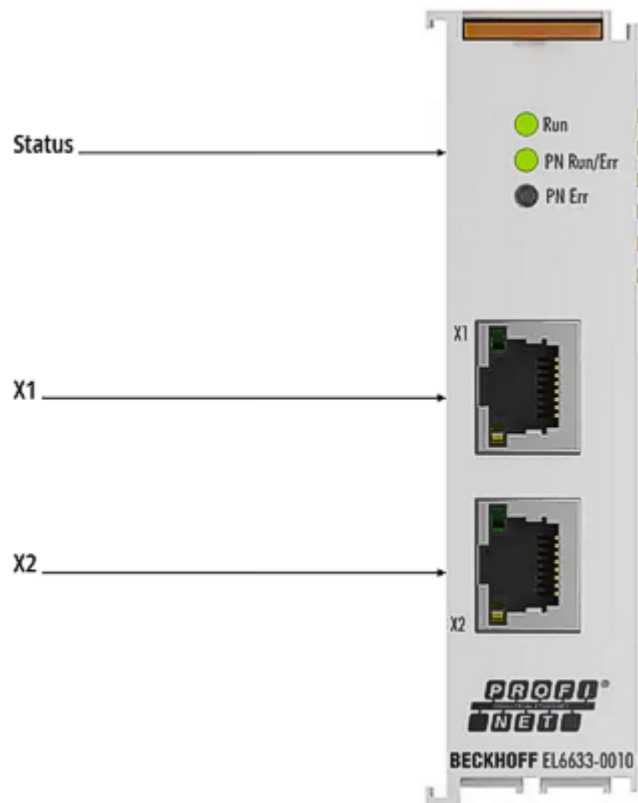


Fig. 4: EL6633-0010

2-port communication interface, PROFINET RT, device

The EL6633-0010 PROFINET RT Device terminal succeeds the EL6631-0010 and enables simple data exchange between EtherCAT and PROFINET RT. It is a device in the EtherCAT segment, which can consist of up to 65,535 devices.

The EL6633-0010 has a 3-port switch. Two ports are fed to the outside on RJ45 sockets. This allows the I/O stations to be structured as a line topology, as a result of which the wiring is simplified. The maximum distance between two devices is 100 m. Protocols such as LLDP or SNMP can be used for network diagnostics.

The EtherCAT Terminal is supported in TwinCAT 3.1 Build 4024 and higher.

3.2 Technical data - PROFINET RT

Technical data	EL6631-0010
PROFINET Version	RT Class 1 ConformanceClassB
Number of device interfaces) ¹	2
Topology	variable
Quantity of user data	1 Kbyte In/Out
Cycle time	≥ 1 ms

)¹ see the chapter on virtual PROFINET devices



Switch functionality

The internal switch is deactivated when switching to bootstrap mode and is not available during a firmware update.

3.3 EL6633-0010 - Technical data

Technical data	EL6633-0010
Technology	PROFINET RT
Number of ports/channels	2 (switched)
Fieldbus	PROFINET RT Device
Max. process data size	1.4 kB input/1.4 kB output data
Ethernet interface	10/100/1000BASE-TX Ethernet with 2 x RJ45
Cable length	up to 100 m twisted pair
Hardware diagnostics	Status LEDs
Power supply	via the E-bus
Electrical isolation	500 V (E-bus/Ethernet)
Protocol	RT
Configuration	via the EtherCAT master from TwinCAT 3.1 Build 4024
Current consumption via E-bus	400 mA typ.
Special features	Conformance class B, supported service protocols RPC and RSI
Weight	approx. 75 g
Permissible ambient temperature range during operation**)	0 °C... + 55 °C
Permissible ambient temperature range during storage	-25 °C ... + 85 °C
Permissible relative air humidity	95%, no condensation
Dimensions (W x H x D)	approx. 26 mm x 100 mm x 52 mm (width aligned: 23 mm)
Installation	on 35 mm mounting rail, conforms to EN 60715
Vibration / shock resistance	conforms to EN 60068-2-6 / EN 60068-2-27
EMC immunity / emission	conforms to EN 61000-6-2 / EN 61000-6-4
Protection rating	IP20
Installation position	see note [► 28]
Approvals/markings*)	CE, cULus [► 24]

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

3.4 EL6633-0010 - LEDs

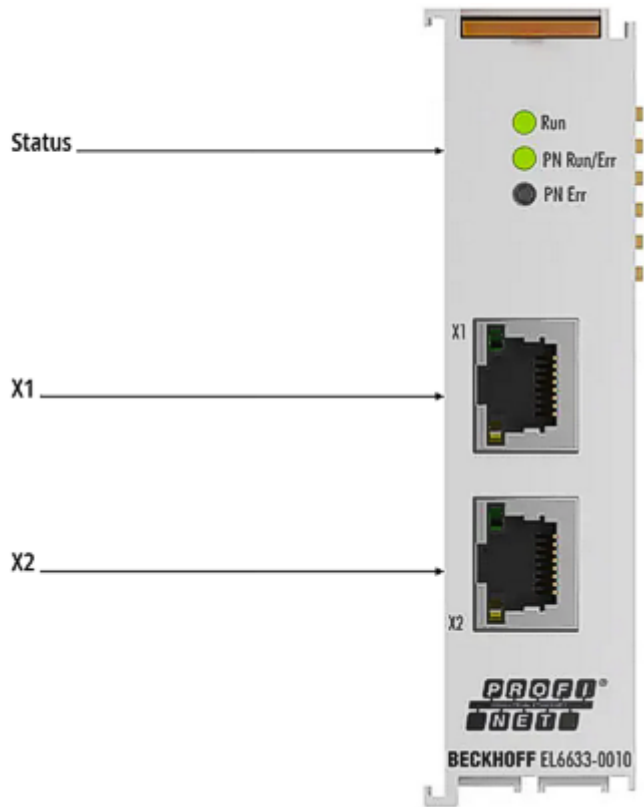


Fig. 5: EL6633-0010 LEDs

LEDs for EtherCAT diagnostics

LED		Display	Description
RUN	green	off	State of the EtherCAT State Machine: INIT = initialization of the terminal; BOOTSTRAP = function for terminal firmware updates
		flashes 200 ms	State of the EtherCAT State Machine: PREOP = function for mailbox communication and different default settings set
		off (1 s) on (200 ms)	State of the EtherCAT State Machine: SAFEOP = verification of the Sync Manager channels and the distributed clocks. Outputs remain in safe state
		on	State of the EtherCAT State Machine: OP = normal operating state; mailbox and process data communication is possible

LED diagnosis PROFINET RUN/Err

Colors green	Colors red	Meaning
on	off	EL terminal is parameterized
off (1 s) on (200 ms)	off	EL6631-0010 does not have an IP address
flashing 200 ms	off	EL6631-0010 still has not received a PROFINET name
off	flashing 200 ms	Terminal starts

LED diagnosis PROFINET Err

Colors green	Colors red	Meaning
on	off	EL terminal is exchanging data
flashing 200 ms	off	EL terminal is exchanging data, but the provider status is stopped
off (1 s) on (200 ms)	off	EL terminal is exchanging data, but the modules are different
off	flashing 500 ms	No AR established, establishment of connection has not been initialized
flashing 500 ms	flashing 500 ms	Identify EL terminal through PROFINET "flashing"

LEDs starting up

Run	PN Run/Err	PN Err	Meaning
off	off	off	No electrical voltage connected to E-bus. The EL6631-0010 must be exchanged if EtherCAT Terminals behind it need to function.
off	off	red on	EL terminal is starting up; after approx. 10 s, the LED should go out. If this does not happen, the EL6631-0010 module must be exchanged.

LED Link (from FW 2.0.x)

Color green	Color yellow	Meaning
on	off	link
Blinkz	off	Activity
Off	On	100 Mbit/s
off	Off	10 or 100 Mbit/s

4 Mounting and wiring

4.1 Instructions for ESD protection

NOTICE

Destruction of the devices by electrostatic discharge possible!

The devices contain components at risk from electrostatic discharge caused by improper handling.

- When handling the components, ensure that there is no electrostatic discharge; also avoid touching the spring contacts directly (see illustration).
- Contact with highly insulating materials (synthetic fibers, plastic films, etc.) should be avoided when handling components at the same time.
- When handling the components, ensure that the environment (workplace, packaging and persons) is properly earthed.
- Each bus station must be terminated on the right-hand side with the [EL9011](#) or [EL9012](#) end cap to ensure the degree of protection and ESD protection.

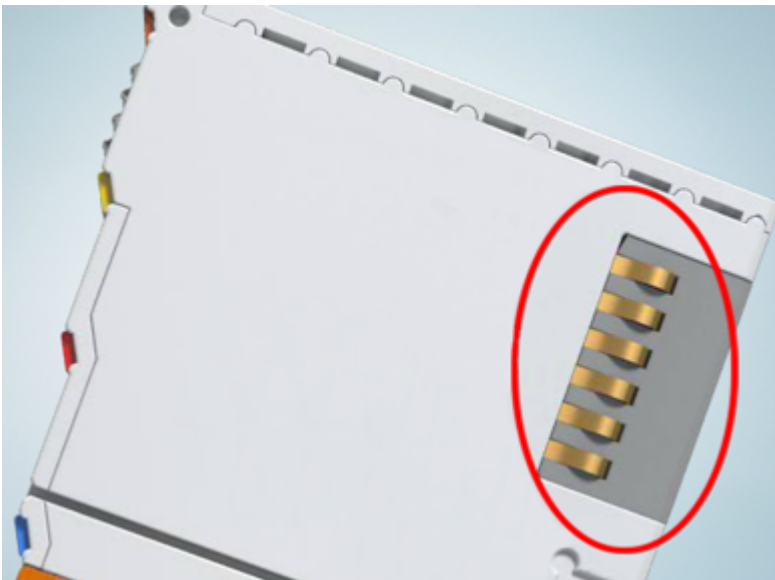


Fig. 6: Spring contacts of the Beckhoff I/O components

4.2 UL notice

⚠ CAUTION	
	Application Beckhoff EtherCAT modules are intended for use with Beckhoff's UL Listed EtherCAT System only.
⚠ CAUTION	
	Examination For cULus examination, the Beckhoff I/O System has only been investigated for risk of fire and electrical shock (in accordance with UL508 and CSA C22.2 No. 142).
⚠ CAUTION	
	For devices with Ethernet connectors Not for connection to telecommunication circuits.

Basic principles

UL certification according to UL508. Devices with this kind of certification are marked by this sign:



4.3 Note - power supply

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.

4.4 Mounting and demounting - top front unlocking

The terminal modules are fastened to the assembly surface with the aid of a 35 mm mounting rail (e. g. mounting rail TH 35-15).

● Fixing of mounting rails

i The locking mechanism of the terminals and couplers extends to the profile of the mounting rail. At the installation, the locking mechanism of the components must not come into conflict with the fixing bolts of the mounting rail. To mount the recommended mounting rails under the terminals and couplers, you should use flat mounting connections (e.g. countersunk screws or blind rivets).

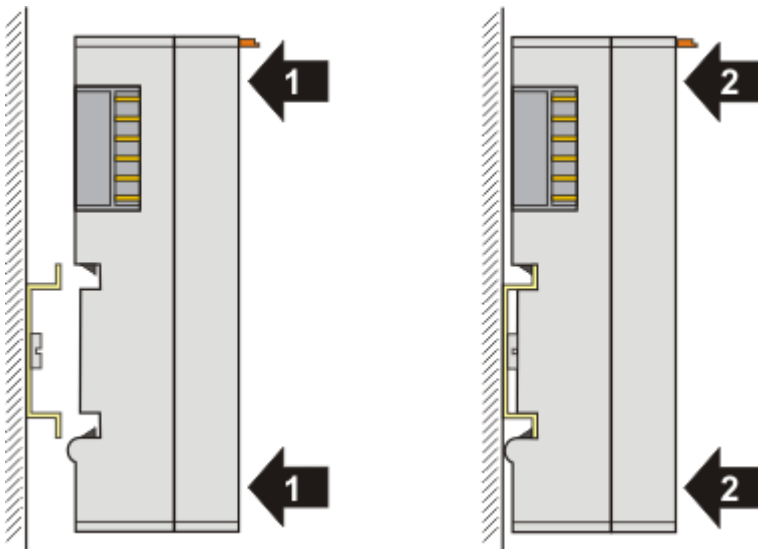
⚠ WARNING

Risk of electric shock and damage of device!

Bring the bus terminal system into a safe, powered down state before starting installation, disassembly or wiring of the Bus Terminals!

Mounting

- Fit the mounting rail to the planned assembly location.

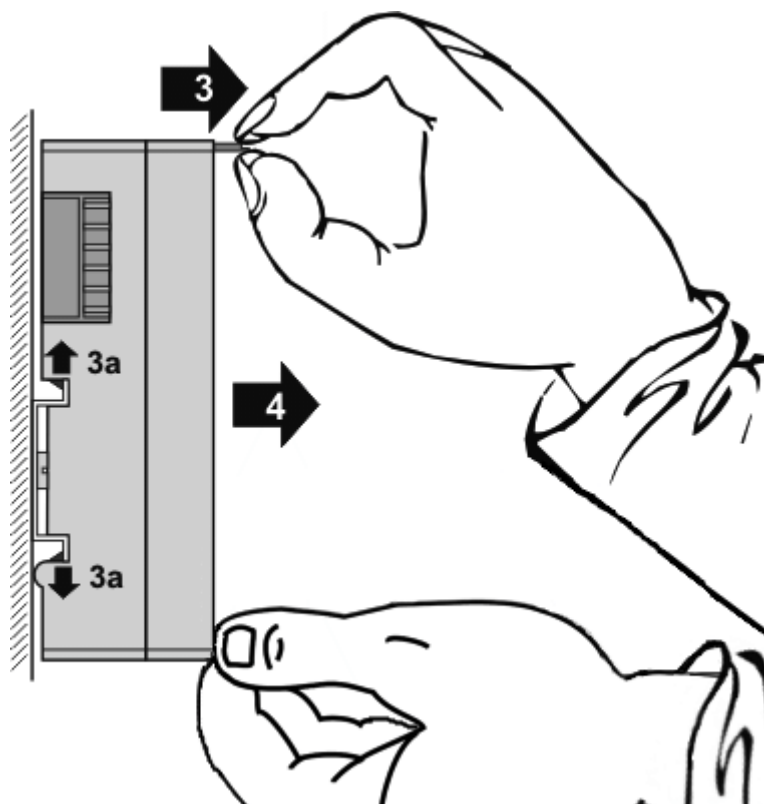


and press (1) the terminal module against the mounting rail until it latches in place on the mounting rail (2).

- Attach the cables.

Demounting

- Remove all the cables.
- Lever the unlatching hook back with thumb and forefinger (3). An internal mechanism pulls the two latching lugs (3a) from the top hat rail back into the terminal module.



- Pull (4) the terminal module away from the mounting surface.
Avoid canting of the module; you should stabilize the module with the other hand, if required.

4.5 Installation positions

NOTICE

Constraints regarding installation position and operating temperature range

Please refer to the technical data for a terminal to ascertain whether any restrictions regarding the installation position and/or the operating temperature range have been specified. When installing high power dissipation terminals ensure that an adequate spacing is maintained between other components above and below the terminal in order to guarantee adequate ventilation!

Optimum installation position (standard)

The optimum installation position requires the mounting rail to be installed horizontally and the connection surfaces of the EL- / KL terminals to face forward (see Fig. "Recommended distances for standard installation position"). The terminals are ventilated from below, which enables optimum cooling of the electronics through convection. "From below" is relative to the acceleration of gravity.

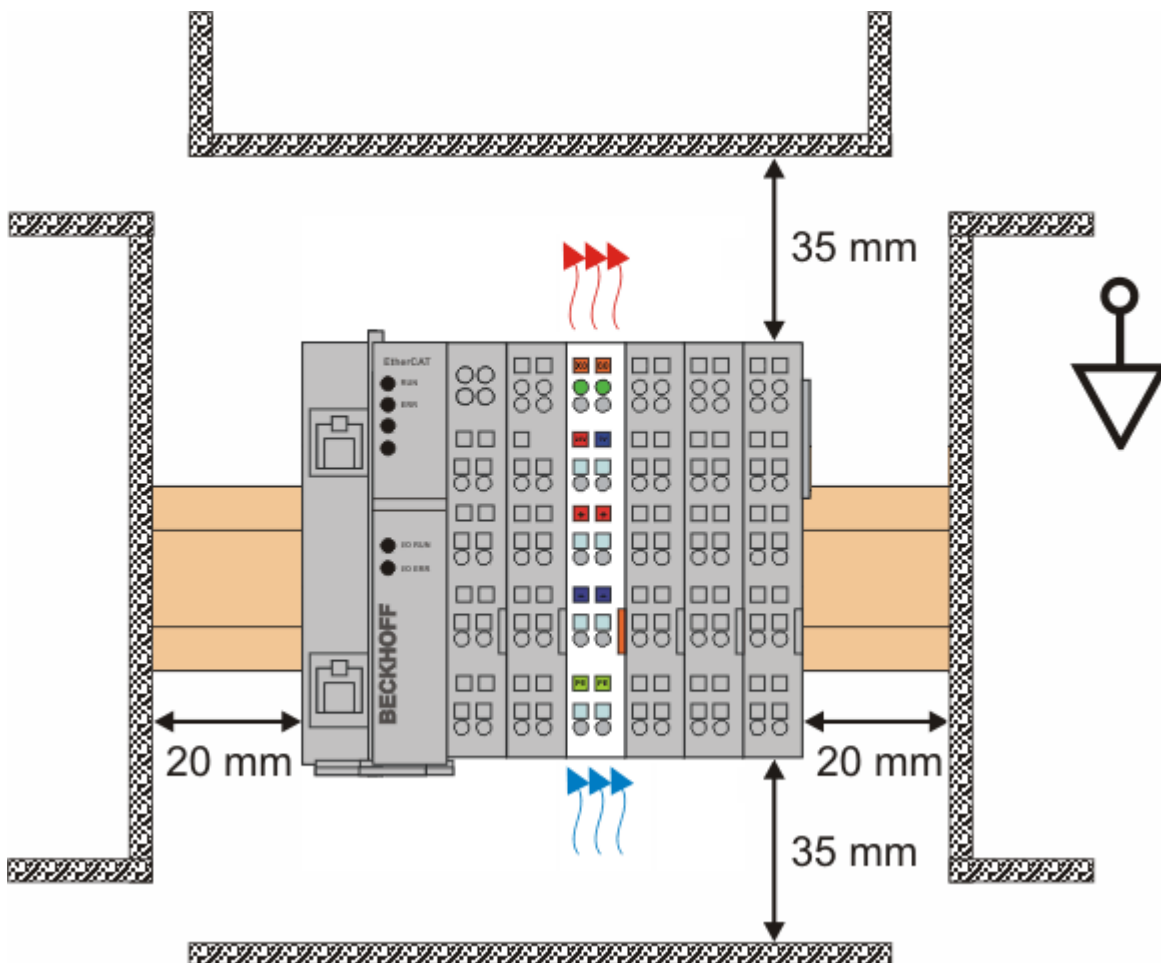


Fig. 7: Recommended distances for standard installation position

Compliance with the distances shown in Fig. "Recommended distances for standard installation position" is recommended.

Other installation positions

All other installation positions are characterized by different spatial arrangement of the mounting rail - see Fig "Other installation positions".

The minimum distances to ambient specified above also apply to these installation positions.

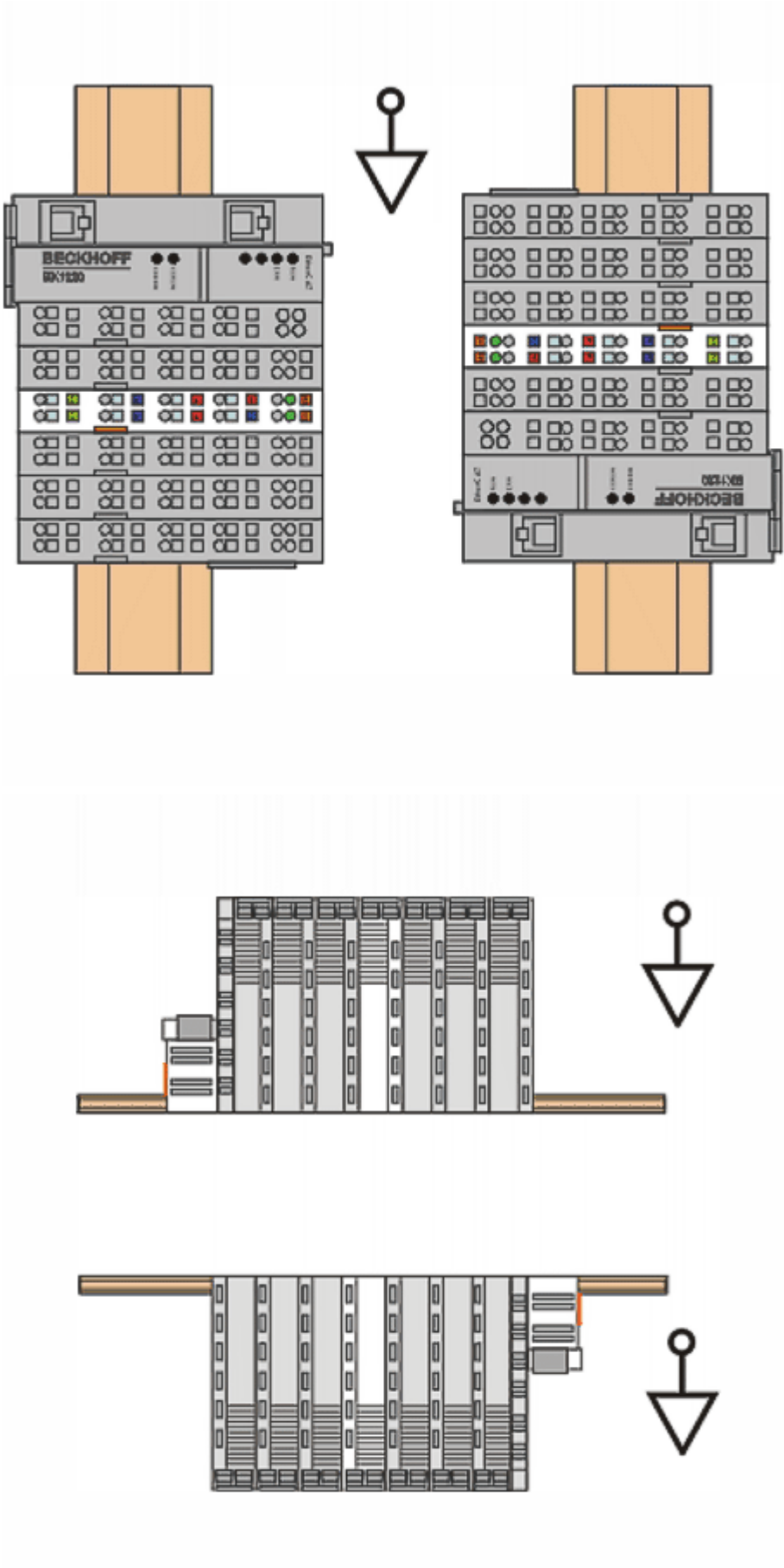


Fig. 8: Other installation positions

4.6 Note on shielding

NOTICE

Low-resistance shielding through external shield connection

The shielding of the EL66xx is capacitively connected to the mounting rail.

If low-resistance shielding is desired or required, the shield must be connected to an external shield support (e.g. with the clamp strap for shield connection [ZB5800](#)).

4.7 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 & Configuration

5.1 Integration via an EL663x-0010

The following section shows how to configure a PROFINET device using the PROFINET Gateway Terminal EL6631-0010 or EL6633-0010, hereinafter referred to as EL663x-0010.

The EL663x-0010 is primarily an EtherCAT slave, which means that it must be included in the TwinCAT configuration because it serves as an adapter for the PROFINET device. As a result, if the EtherCAT bus has an error, the PROFINET adapter will also display errors and therefore will not work.

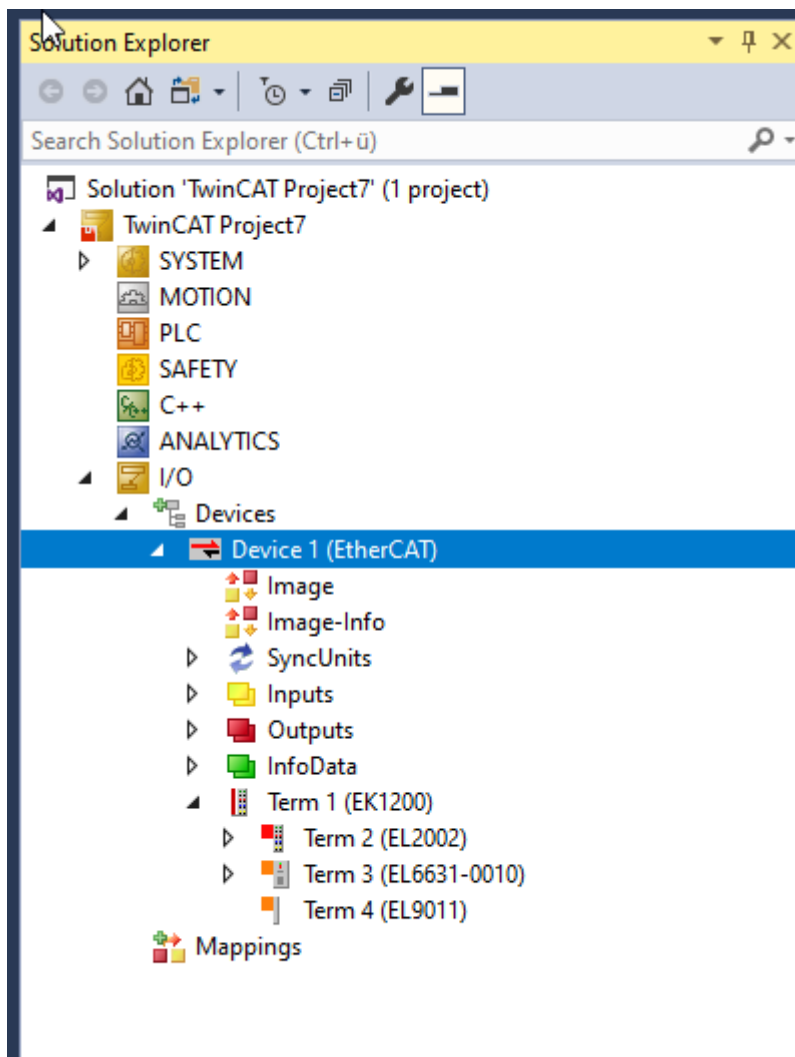


Fig. 9: EL663x-0010 in the TwinCAT tree

- Right-click **Devices** and select **Add New Item**

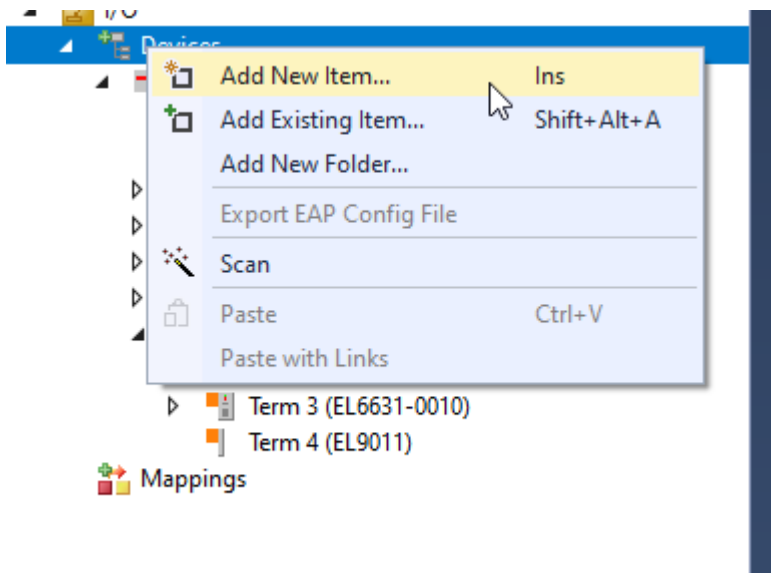


Fig. 10: Add "Add New Item" in the context menu

- Select **PROFINET I/O Device EL663x-0010 (RT), EtherCAT** according to the configuration with the EL663x-0010. If there is a single EL663x-0010 on the projected EtherCAT segment, the associated adapter is entered directly when the protocol is appended. If there are several terminals the corresponding one can be selected.

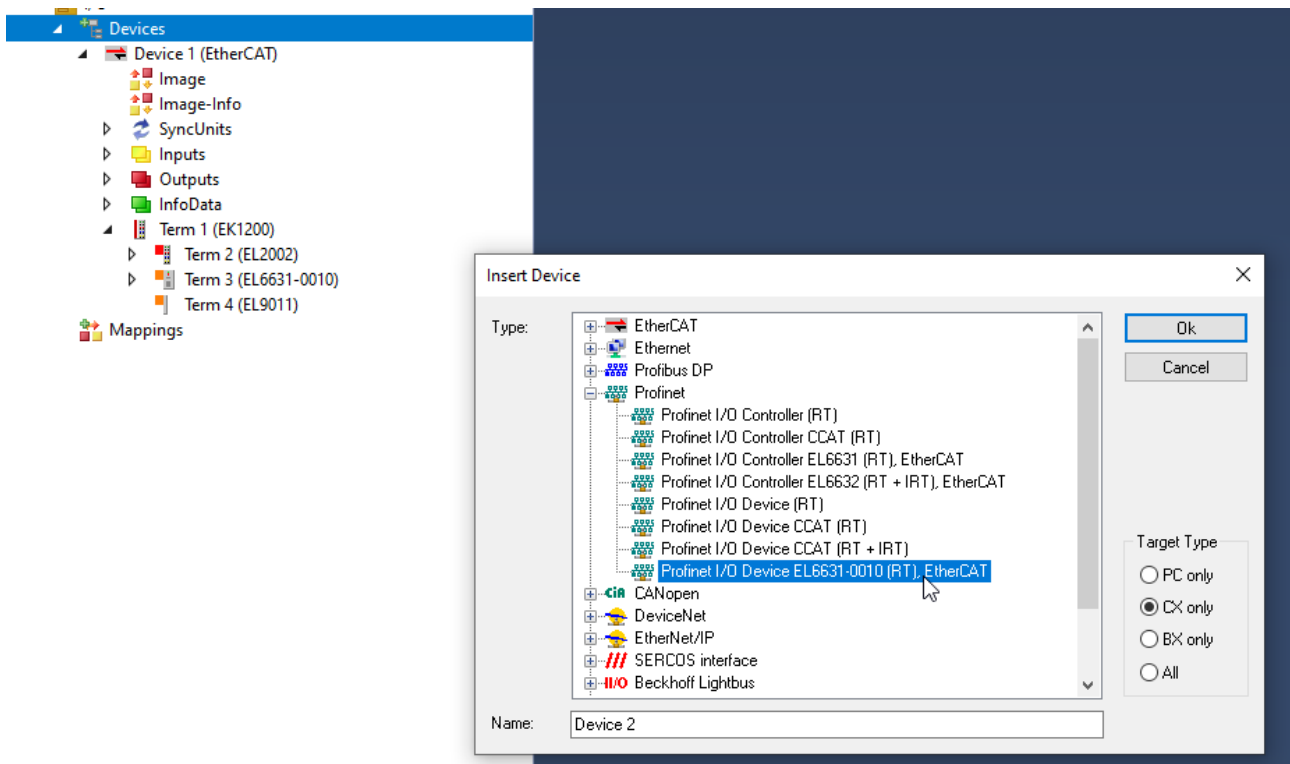


Fig. 11: Insert "PROFINET I/O Device EL663x-0010"

- If the terminal assignment (adapter assignment) is to be changed or checked afterwards, this can be done on the **Adapter** tab.

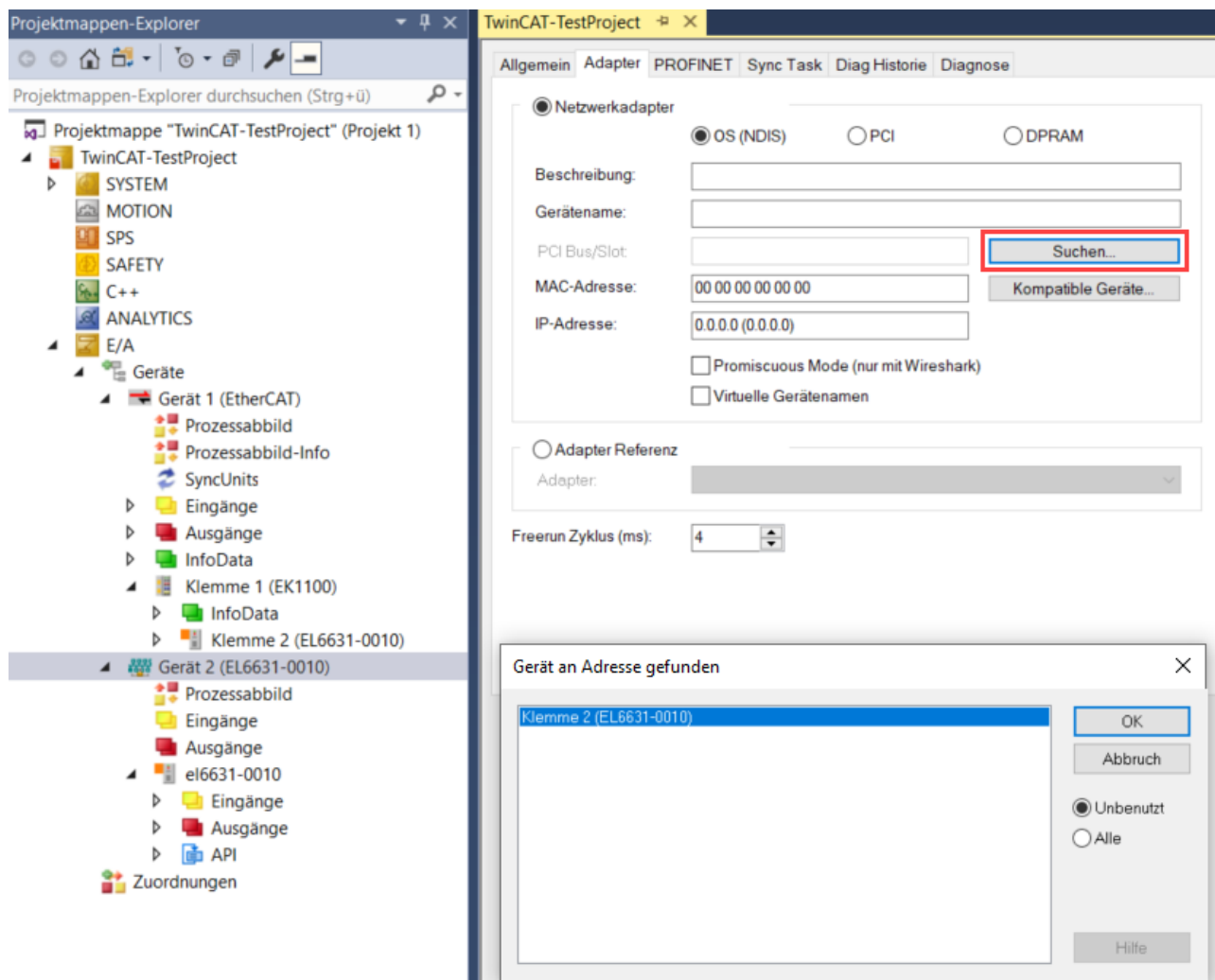


Fig. 12: Modifications -> "Adapter" tab

Next, a box is integrated in the form of a GSDML.

- Right-click on the created PROFINET Device and select **Add New Item**.

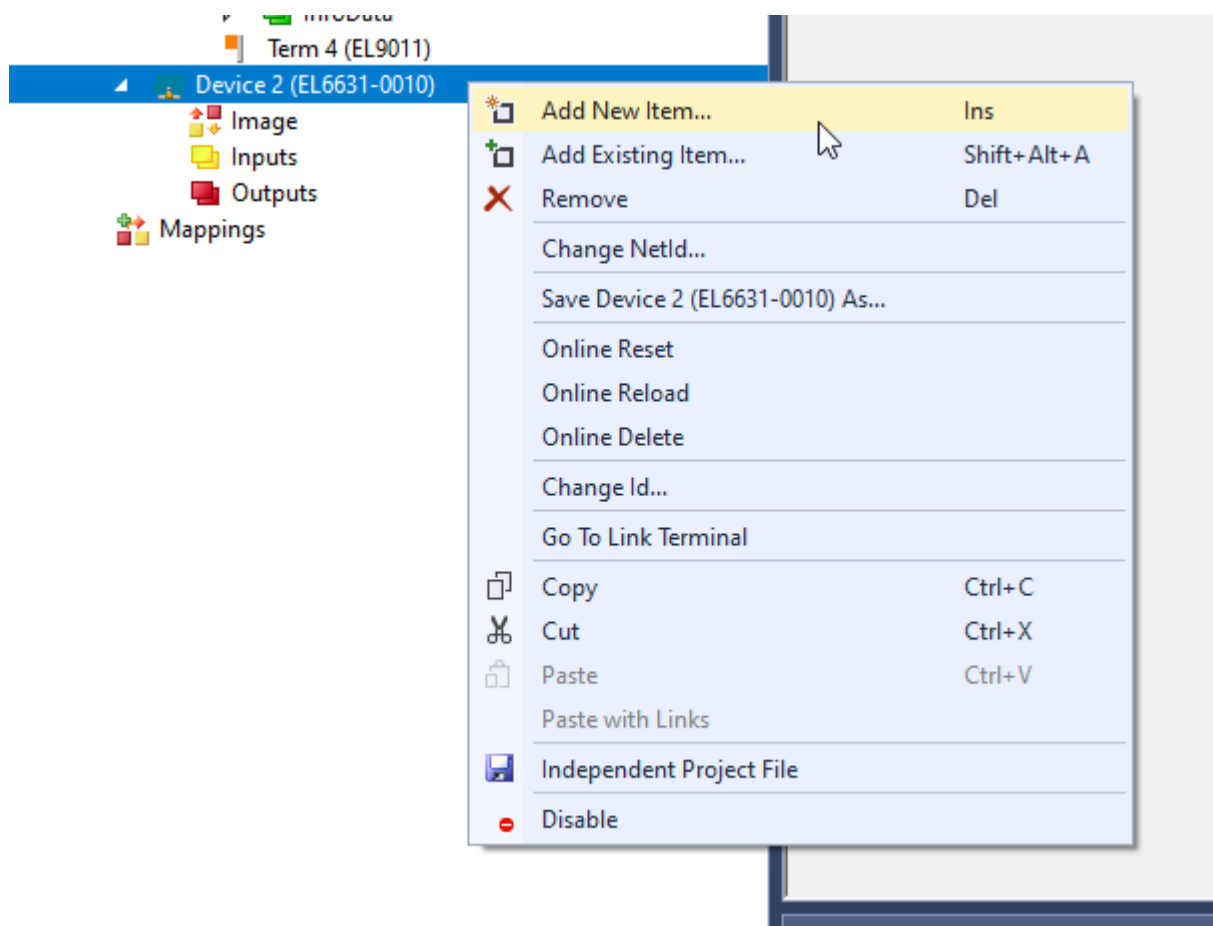


Fig. 13: Select "Add New Item" in the EL663x-0010 device context menu

- In the window that opens, select **EL663x-0010 (EtherCAT terminal)** and confirm with **OK**.

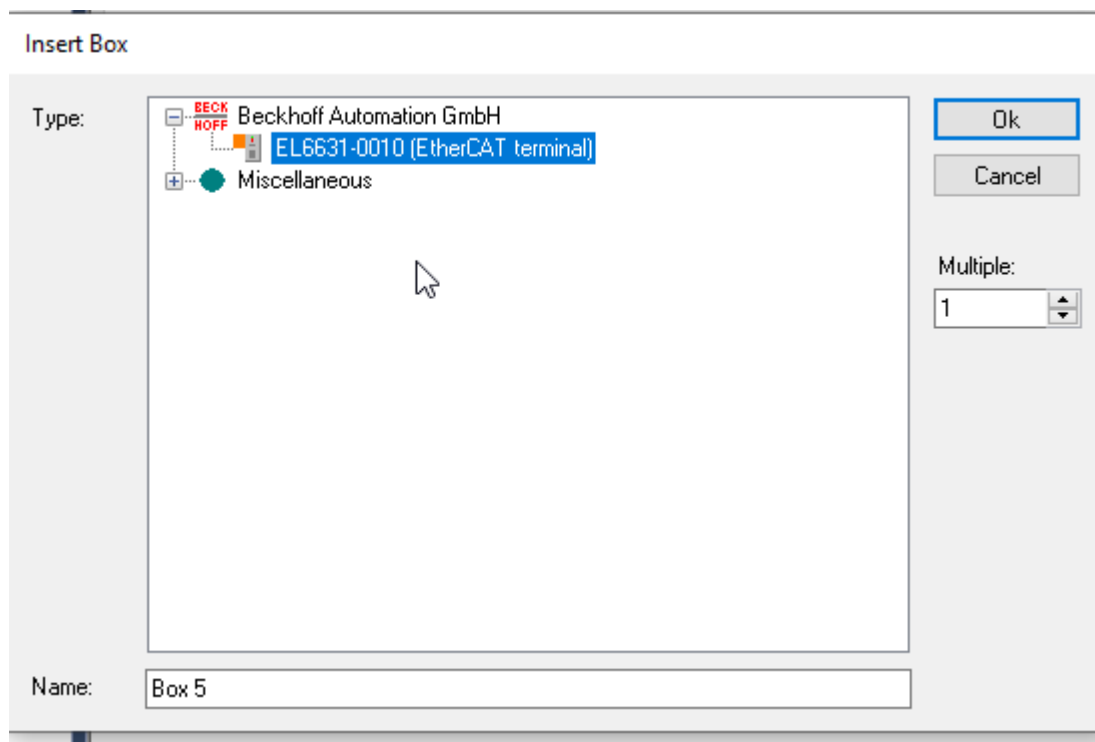


Fig. 14: Select "EL663x-0010 (EtherCAT terminal)" in the "Insert Box" window

- Right-click the EL663x-0010 to open the **Insert Device** dialog, where you specify which version of the EL663x-0010 should be integrated. Confirm your choice with **OK**.

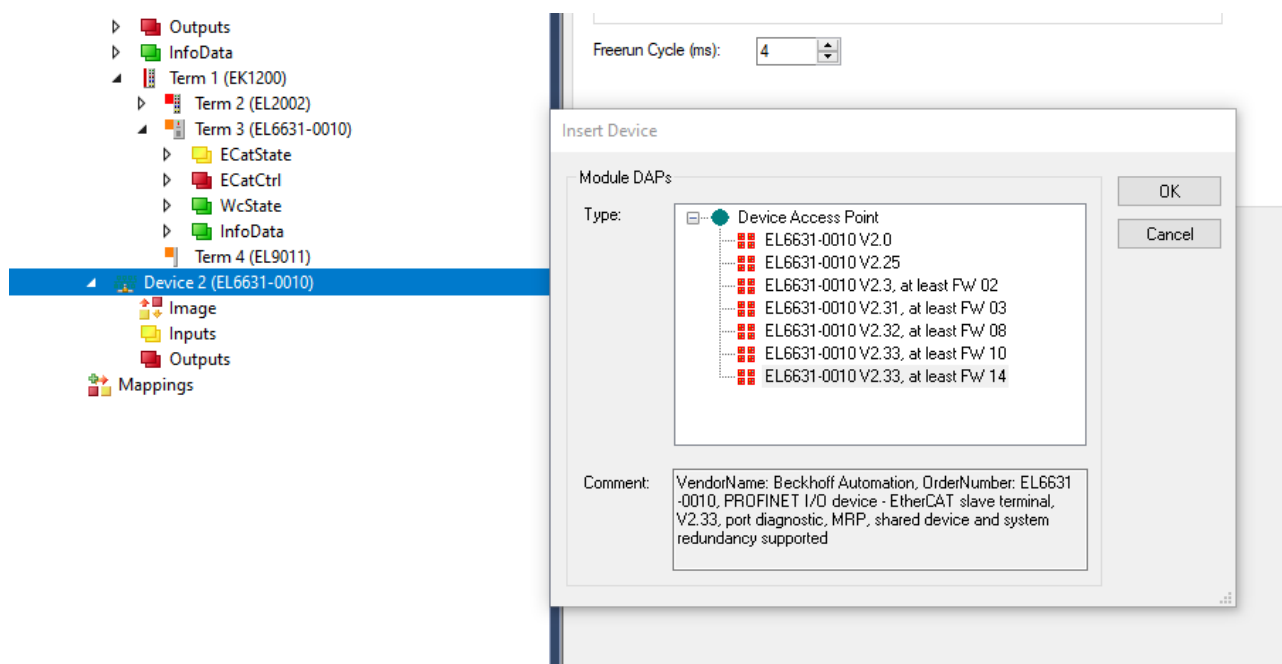


Fig. 15: Choice of version of the EL663x-0010

Further information can be found in chapter [Creating modules/process data on the PROFINET Device](#) [► 40].

5.2 Configuration

5.2.1 Assignment of PROFINET name to a PROFINET Device

For an initial configuration of a PROFINET Device or when the EL663x-0010 is delivered, it does not have a PROFINET name. An empty string is transferred when the devices are configured. There are several ways to assign a name to an EL663x-0010:

1. Assignment via the PROFINET Controller

In this case, the PROFINET Controller assigns the name of the device. Please contact the PROFINET Controller manufacturer for more information.

2. Assignment via the EtherCAT Master, only with the EL663x-0010

An assignment via the controller is then no longer possible.

To do this, activate the checkbox **get PN-Station name from ECAT**. The name used in the Manager tree is then used. In this example **el663x-test-name**.

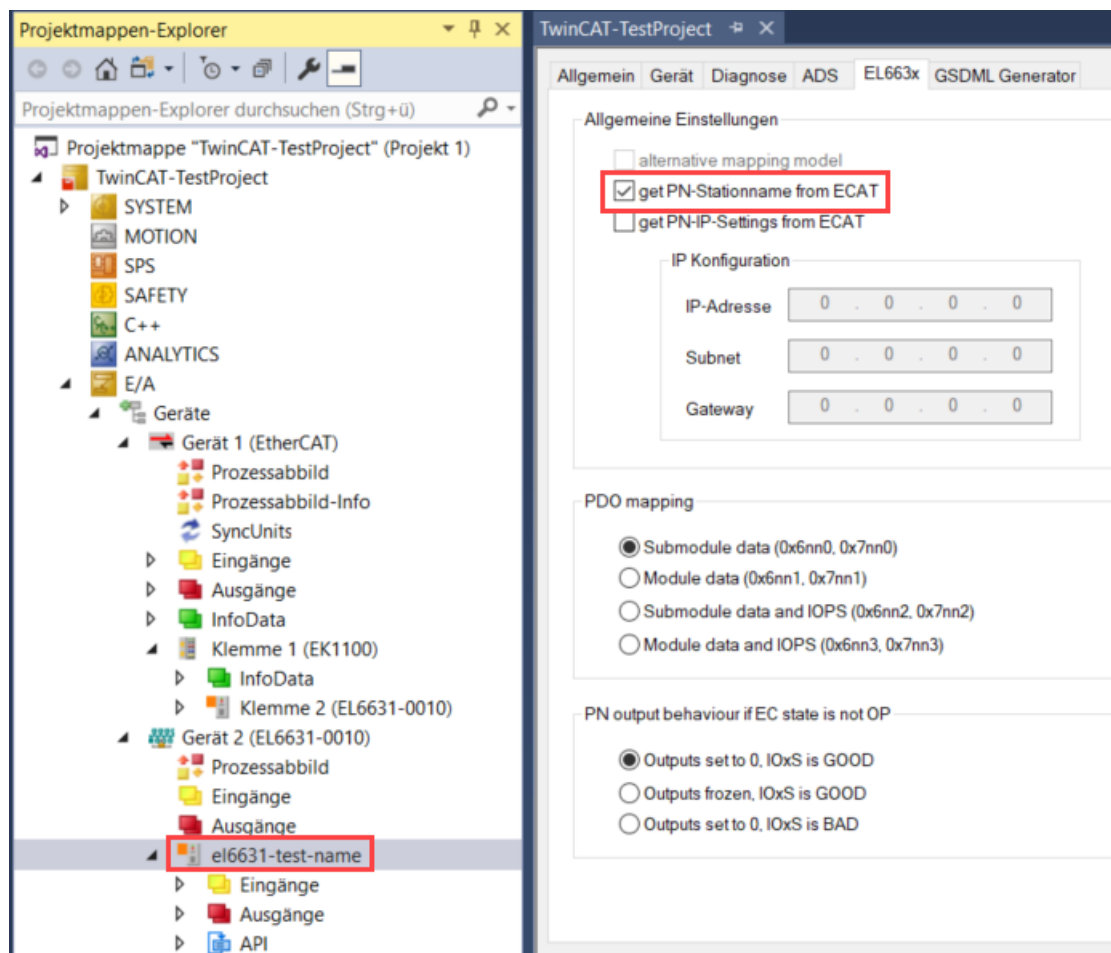


Fig. 16: Tab "EL663x", select "get PN station name from EtherCAT" via checkbox

3. Assignment via a link to the PLC program

An assignment via the controller is then no longer possible.

This is comparable with the DIP switches in the BK9103 and can be carried out via a PLC task. For activation, **Generate Station Name from Control** must be activated.

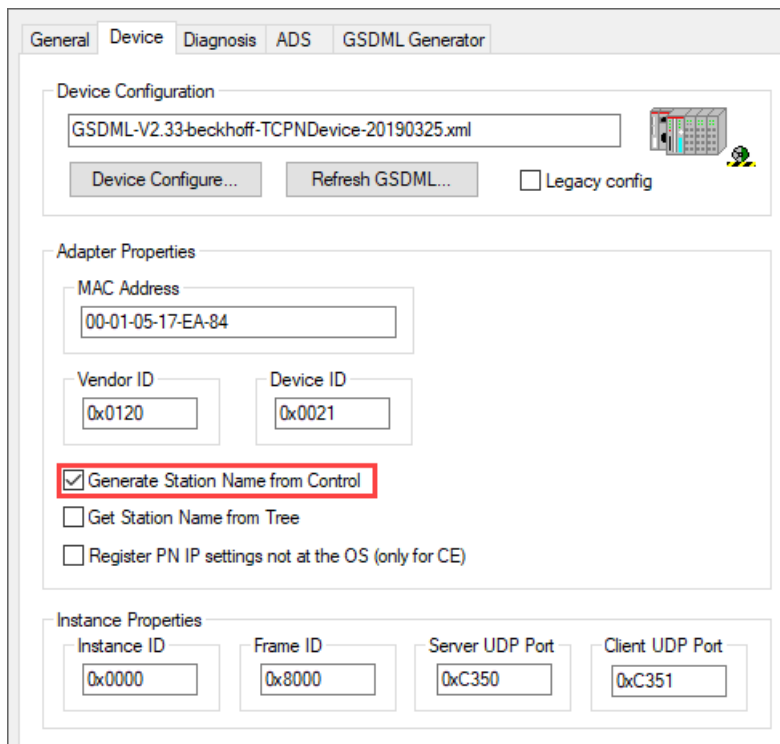


Fig. 17: "Device" tab, assignment of the PN name via checkbox "Generate Station Name from Control"

For clarification, 000 will be appended to the previous tree name (default: **tcpniodevice**). This tree name no longer corresponds to the PROFINET station name!

The Ctrl WORD of the PROFINET protocol is used to help assign a name. This means that the number that is entered (range of values 0 - 255) is appended to the existing station name. In addition, the CtrlWORD must be linked to a task.

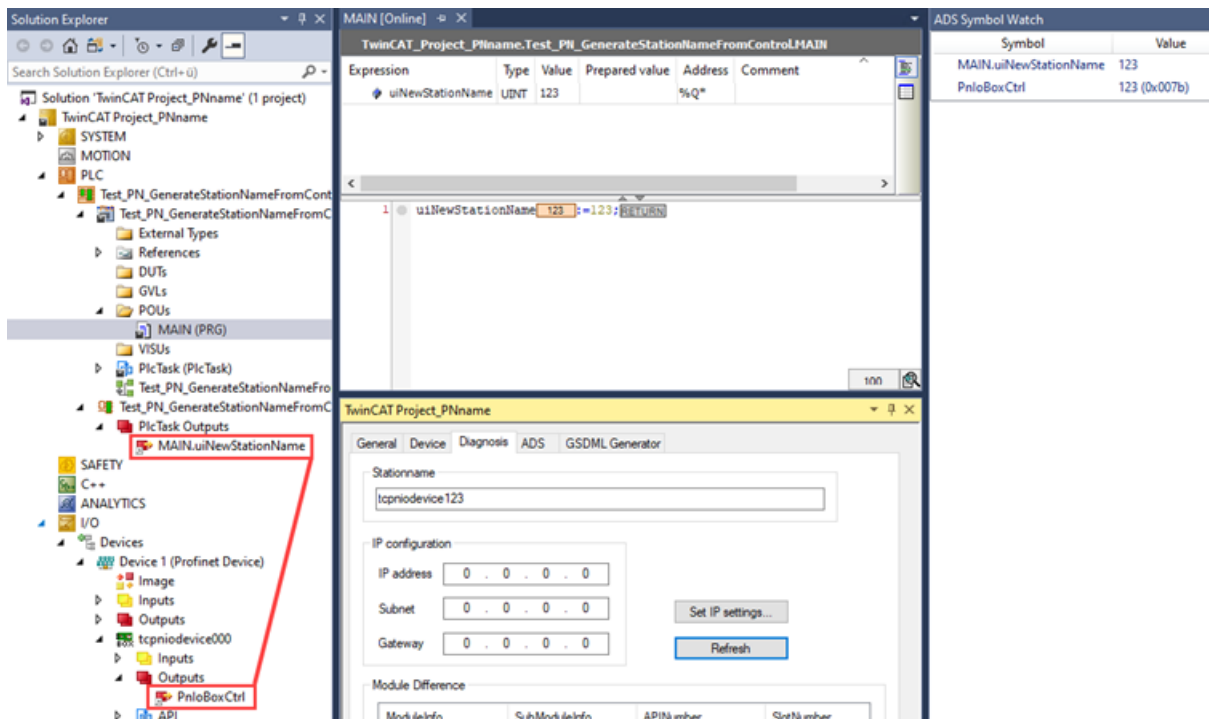


Fig. 18: Link CtrlWORD with task

It is subsequently necessary to restart TwinCAT. If, for example, the linked Ctrl WORD is now given a value of 123 from the task, its previous station name changes, e.g. from **tcpniodevice** to **tcpniodevice123**. The current tree name is still **tcpniodevice000**.

4. Assignment via TwinCAT

An assignment via the controller is then no longer possible.

To do this, activate the checkbox **Get Station Name from Tree**. The PROFINET name that the device has in the TwinCAT tree is then used.

The screenshot shows the 'Device' tab in the TwinCAT configuration software. It is divided into three main sections: 'Device Configuration', 'Adapter Properties', and 'Instance Properties'.
- **Device Configuration:** Includes a text field for the GSDML file path (GSDML-V2.33-beckhoff-TCPNDevice-20190325.xml), buttons for 'Device Configure...' and 'Refresh GSDML...', and an unchecked 'Legacy config' checkbox.
- **Adapter Properties:** Includes a 'MAC Address' field (00-01-05-17-EA-84), 'Vendor ID' (0x0120), and 'Device ID' (0x0021) fields. It also has three checkboxes: 'Generate Station Name from Control' (unchecked), 'Get Station Name from Tree' (checked and highlighted with a red box), and 'Register PN IP settings not at the OS (only for CE)' (unchecked).
- **Instance Properties:** Includes four fields: 'Instance ID' (0x0000), 'Frame ID' (0x8000), 'Server UDP Port' (0xC350), and 'Client UDP Port' (0xC351).

Fig. 19: "Device" tab, assignment of the PN name via checkbox "Generate Station Name from Tree"

5. Automatic device startup via topology specification is supported.

You can obtain more information from your PROFINET Controller

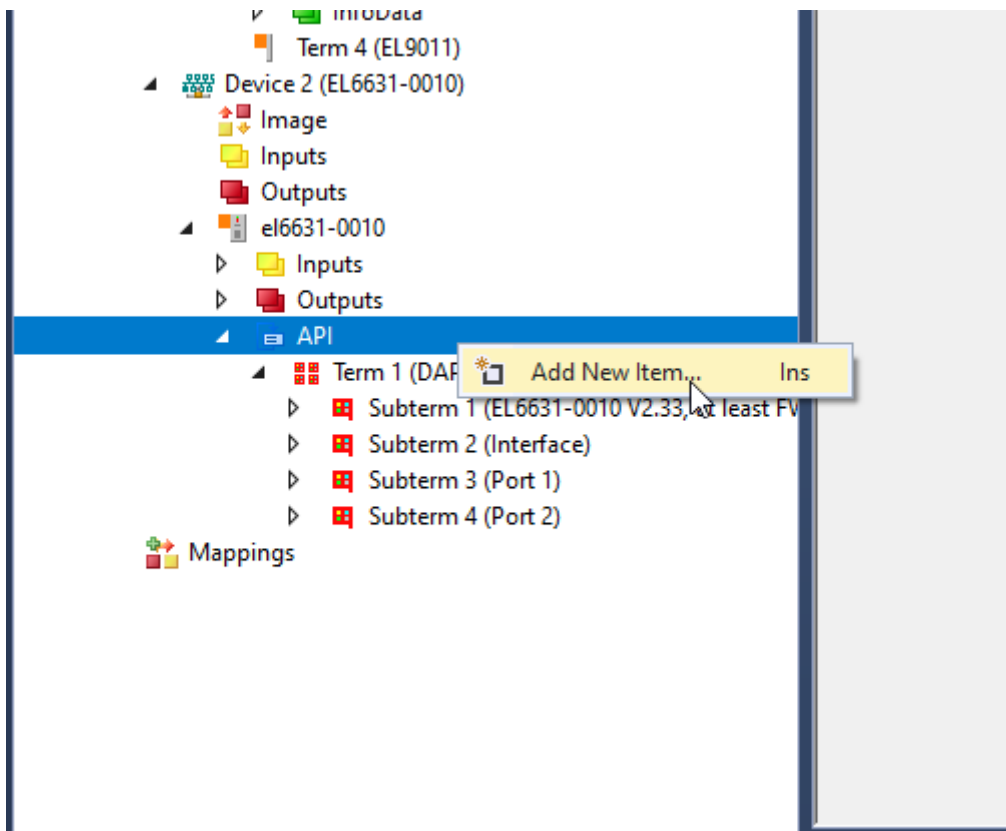
Please contact the PROFINET Controller manufacturer for more information.

5.2.2 Creating modules/process data on the PROFINET Device

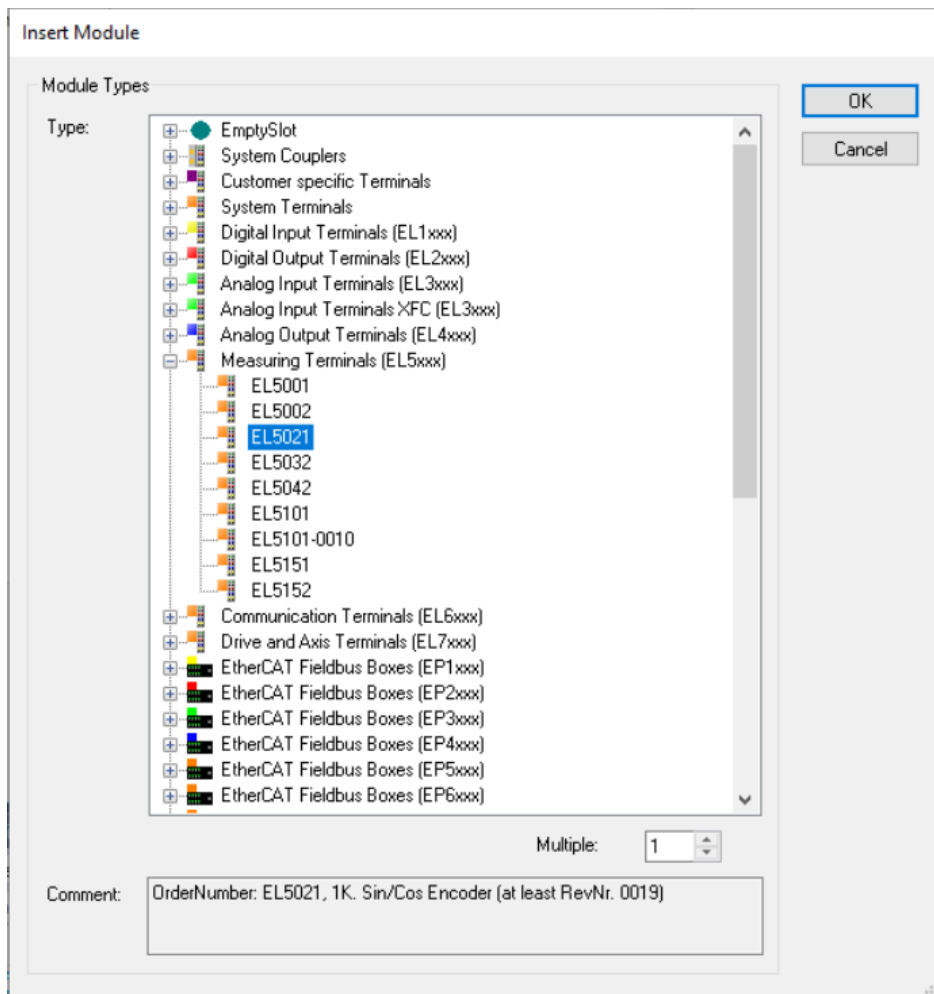
The procedure for creating process data on a PROFINET device is the same for all devices.

5.2.2.1 Up to TwinCAT Version 3.1 Build 4024

The modules can be attached to the API (Application Profile Interface). Open by right-clicking on **Add New Item**



The order of the modules in the tree always corresponds to the populated slot, starting at 0.

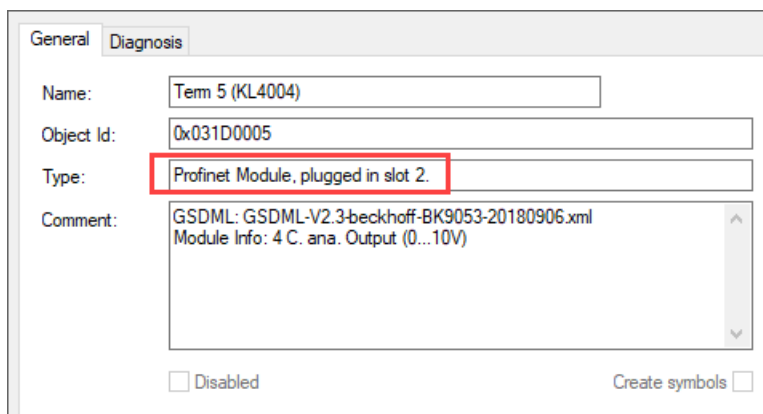


The DAP (DeviceAccessPoint) is added directly with the device. If, according to GSDML, this is not plugged into slot 0, empty placeholder modules are inserted before it. The DAP is a special module that comes with device properties from the GSDML. The PDEV properties are attached to it in the form of sub modules (interface and port). In addition, the DAP can also contain normal sub modules with process data and record data. It is always fixed and cannot be deleted.

Each additional module is assigned to a specific API. The information about which one comes from the GSDML. By default this is always API 0. Alternatively, an API e.g. for the PROFIDRIVE profile or a fieldbus API is also conceivable.

If the modules (described in GSDML) support it, the sub modules can be projected below them. The subslots are also simply numbered continuously, starting at 1 (modules at 0). The PDEV sub modules (interface and port) are exceptions; these are plugged into a fixed subslot specified via the GSDML.

The current slot or subslot can be checked via the associated object.



5.2.2.2 From TwinCAT Version 3.1 Build 4024

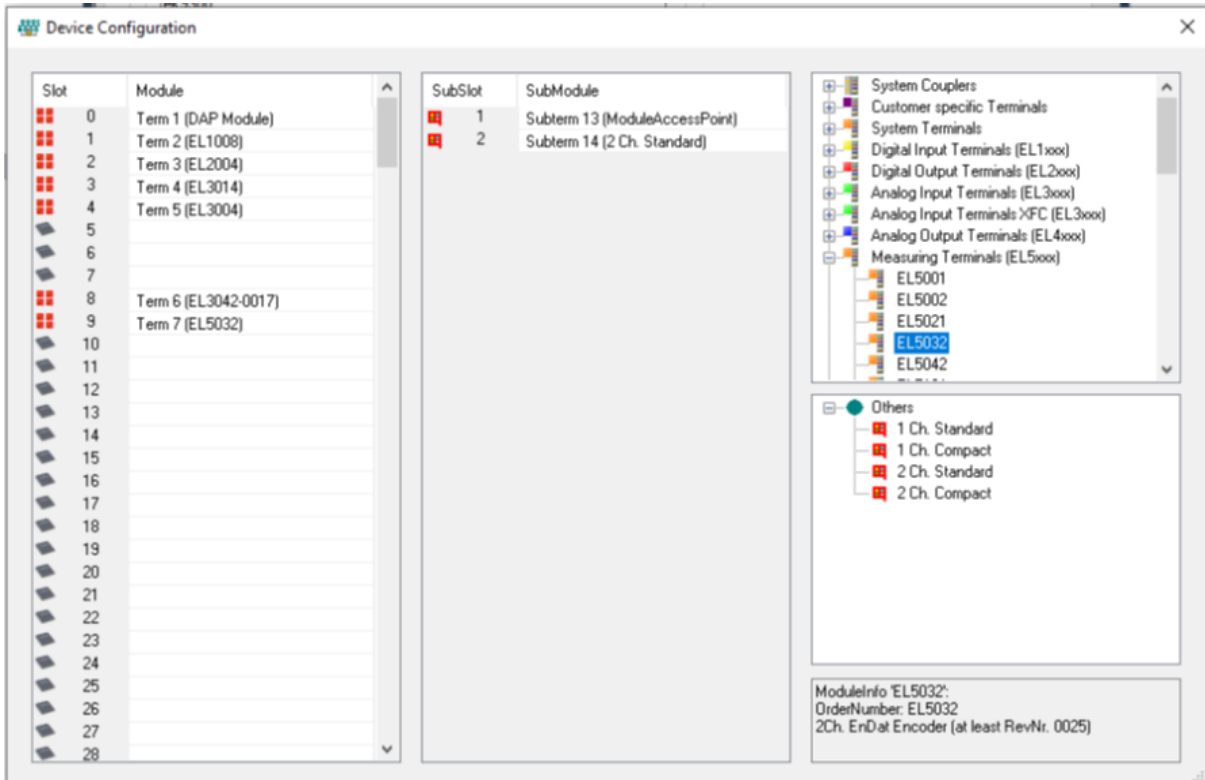
With TwinCAT Version 4024, the classic tree view for module/sub module population was replaced by a rack view.

In this view slots can be populated and removed without shifting the following slots. Empty slots can remain free and do not have to be provided with placeholders.

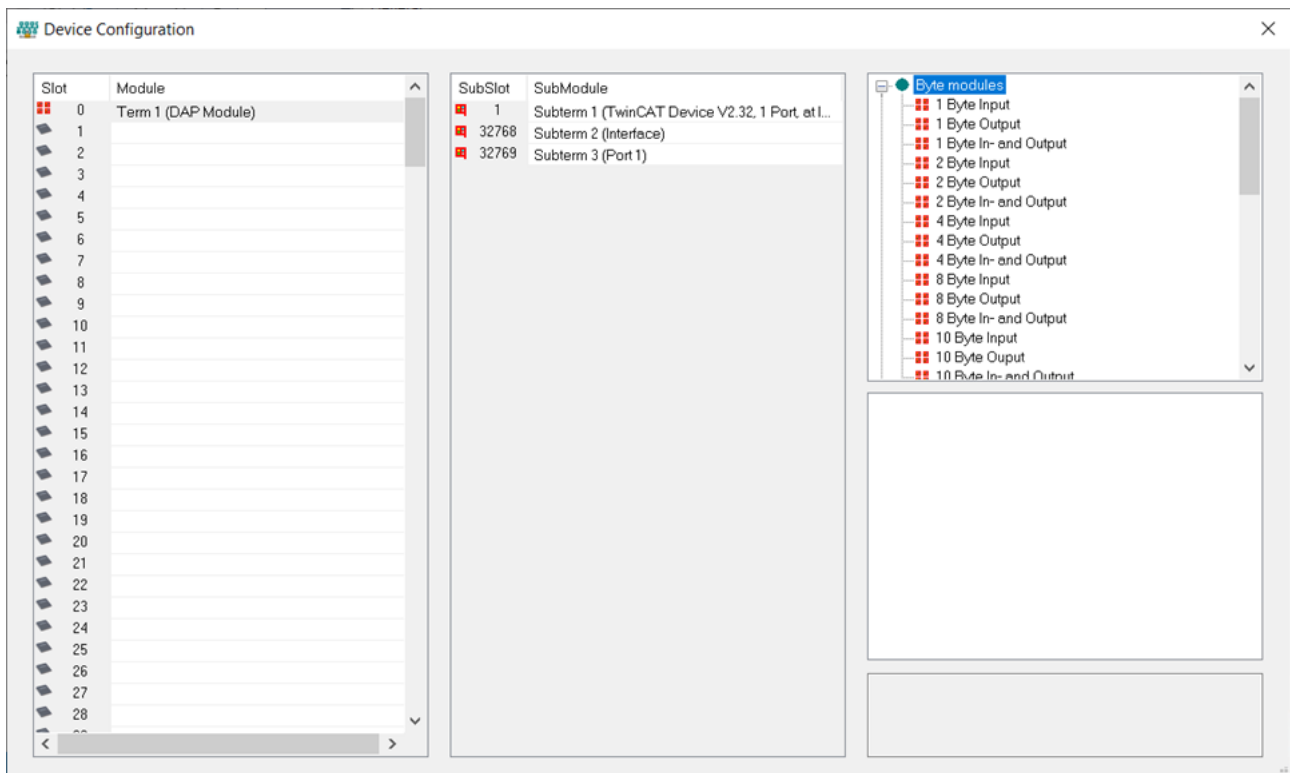
Furthermore, it is possible to generate the created module configuration in a GSDML file using the GSDML Generator. The generated file can then be integrated into the controller. The device configuration is thus fixed and does not have to be reprojected on the controller side.

For more information see chapter [GSDML Generator](#) [► 63].

The new rack view is illustrated below:



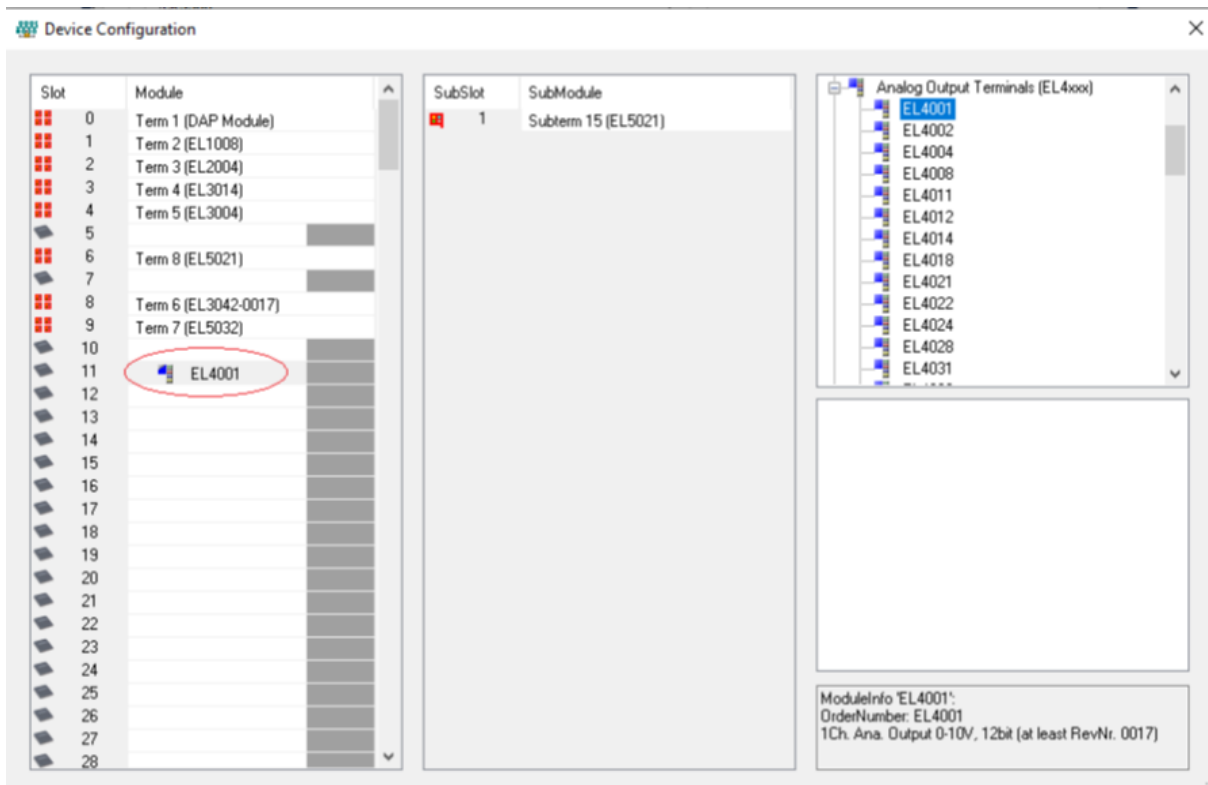
The list on the left shows the available device slots; here you can see which slots are occupied or free. Clicking on a slot updates the list in the center, showing the available subslots at the selected slot. If supported by the module, the sub modules can then be populated here.



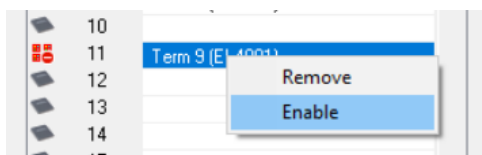
The list on the right shows the available modules and sub modules. The list of sub modules is always updated depending on the selected module.

The slots and subslots can be populated simply by double-clicking or via drag and drop.

- Double-clicking always triggers insertion at the next free and available slot from the cursor position.
- With drag and drop the available slots are selected, and a module can then be dragged to the required slot and released.



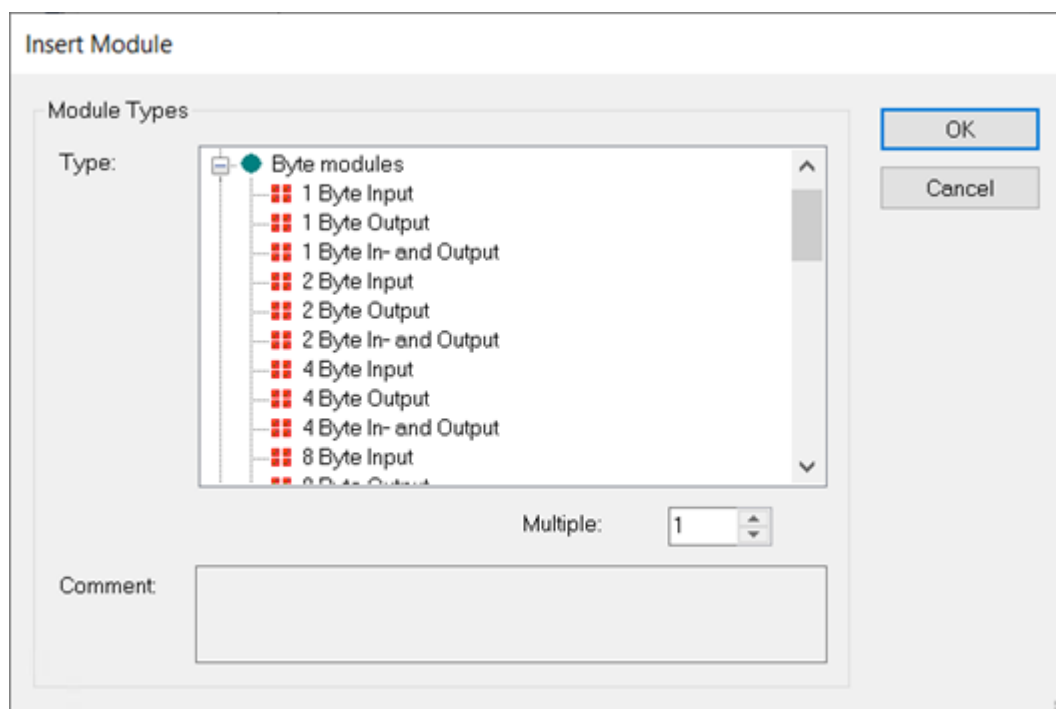
In the slot and subslot list, populated modules or sub modules can be disabled via the context menu (right mouse click).



The icon indicates disabled status, which is also apparent in the module tree. Disabled objects are ignored during configuration, i.e. corresponding slots or subslots are considered empty.

Classic tree view

It is possible to switch to classic tree view for module/sub module population, if required.



To do this, check **Legacy Config** on the **Device** tab of the attached box.

The screenshot shows the Beckhoff TwinCAT configuration interface with the following sections:

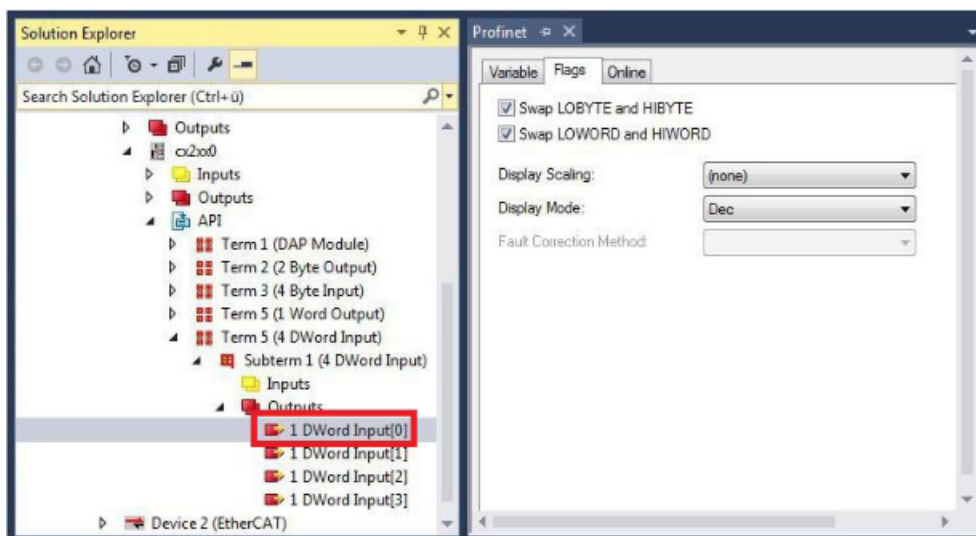
- General** tab selected.
- Device Configuration** section:
 - File path: GSDML-V2.33-beckhoff-TCPNDevice-20190325.xml
 - Buttons: Device Configure..., Refresh GSDML..., Legacy config (highlighted with a red box).
- Adapter Properties** section:
 - MAC Address: 00-01-05-17-EA-84
 - Vendor ID: 0x0120
 - Device ID: 0x0021
 - Checkboxes:
 - ☐ Generate Station Name from Control
 - ☐ Get Station Name from Tree
 - ☐ Register PN IP settings not at the OS (only for CE)
- Instance Properties** section:
 - Instance ID: 0x0000
 - Frame ID: 0x8000
 - Server UDP Port: 0xC350
 - Client UDP Port: 0xC351

5.2.2.3 'Turning' process data

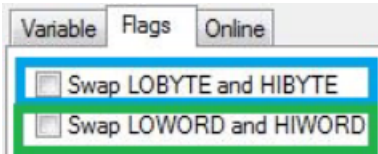
The process data are transferred in Intel format as standard. If the data is required in Motorola format, the data must be rotated accordingly. This step illustrates how to 'turn' the data in TwinCAT.

'Turn' the process data as follows:

1. Click the process data you want to rotate on the right in the tree view.
2. Click on the **Flags** tab



3. Click on the required option. For WORD variables, only LOBYTE and HIBYTE can be swapped. With DWORD process data you can additionally swap the WORD.



⇒ In this way you can 'turn' process data.

Use the following example to see how the data change for the individual options. Example for DWORD.

Controller data	Data received by the device			
Original data	No option selected	Swap Byte (blue)	Swap Word (green)	Swap both (blue and green)
0x01020304	0x01020304	0x02010403	0x03040102	0x04030201

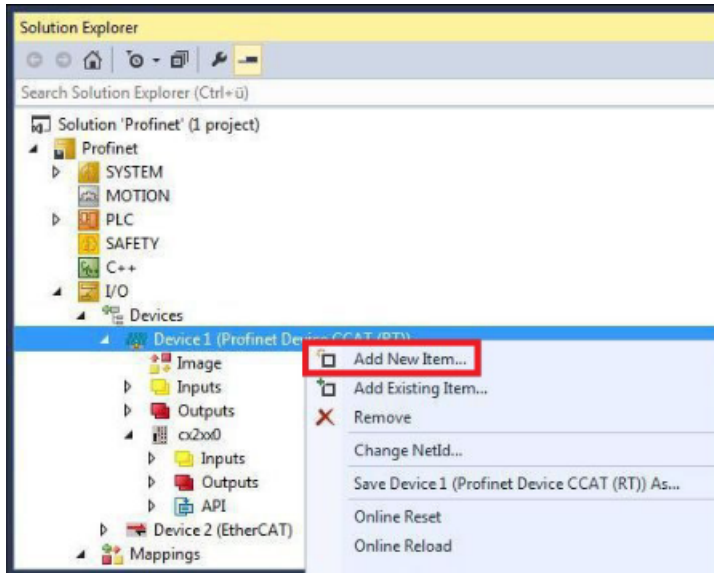
5.2.3 Creating a virtual slave

Additional virtual slaves can be created on the same hardware interface. This enables more data to be exchanged with a PROFINET master, or a connection with a second PROFINET master can be established.

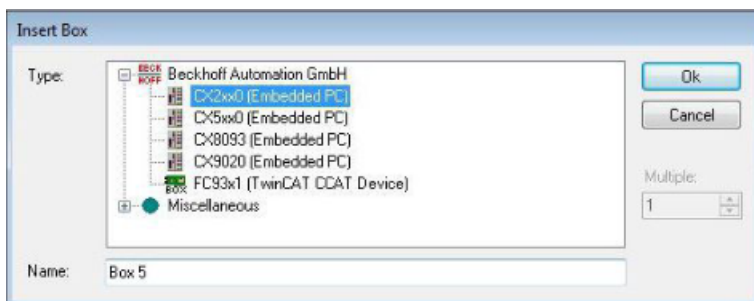
Each virtual slave is assigned a dedicated address via TwinCAT and is configured like an independent device for the PROFINET master.

✓ A PROFINET Device is available in TwinCAT.

1. In the project tree, right-click the created PROFINET Device
2. Click **Add New Item...**

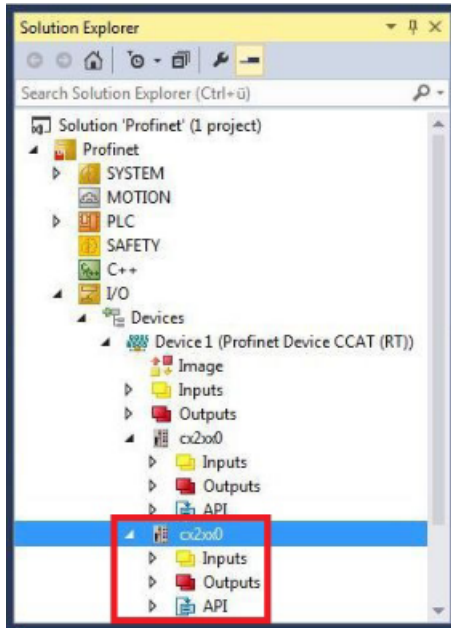


3. Depending on the configuration, select the appropriate box, e.g. the CX2xx0 if you are using a CX20xx Embedded PC with PROFINET optional interface.



⇒ The virtual PROFINET slave is created in the project tree.

4. You can now configure your own process data for the virtual slave.



The last byte of the MAC address of the virtual slave can be edited. Make sure that the MAC address occurs only once in the system. The IP address is assigned by the PROFINET master.

EL6631-0010	Max. one virtual slave (the sum of the process data of both devices must not exceed 1 kB per direction)
EL6633-0010	Max. one virtual slave (the sum of the process data of both devices must not exceed 2 kB per direction)
TF6270	Max. seven virtual slaves
CCAT B930 interface	Max. one virtual slave

5.2.4 Gigabit switch: Configuration and loss-free data transmission

6 Settings and diagnosis

6.1 Settings on the PROFINET Device protocol

6.1.1 General

The screenshot shows the 'General' configuration window for a PROFINET device. It includes tabs for 'General', 'Adapter', 'PROFINET', 'Sync Task', 'Diag History', and 'Diagnosis'. The 'General' tab is selected, displaying the following fields:

- Name:** Device 2 (Profinet Device)
- Id:** 2
- Object Id:** 0x03010020
- Type:** Profinet I/O Device (RT)
- Comment:** A large text area for notes.

At the bottom of the window, there are two checkboxes: ☐ Disabled and ☐ Create symbols.

Name

Identifier for the PROFINET Device protocol object.

Id

The device ID is set by the TwinCAT System Manager during configuration and cannot be configured by the user.

Object Id

Identification number of the PROFINET Device protocol object in the TwinCAT object context.

Type

Shows the selected object type and its property.

Comment

Freely editable comment to describe the object used.

Disabled

This option sets the PROFINET Device to inactive (transparent) for the current configuration. If this option is activated, the corresponding object is ignored in the IO configuration

Create symbols

Creating variables as symbolic names.

6.1.2 Adapter

This dialog specifies and parameterizes the network card to be used for communication with the PROFINET Device.

General Adapter PROFINET Sync Task Diag History Diagnosis

☒ Network Adapter

☒ OS (NDIS) ☐ PCI ☐ DPRAM

Description: Fieldbus (TwinCAT-Intel PCI Ethernet Adapter #2)

Device Name: \DEVICE\{D6DB695F-D100-46DB-8D28-0A71127CEFAC}

PCI Bus/Slot: Search...

MAC Address: 00 01 05 45 ff 8d Compatible Devices...

IP Address: 192.168.1.10 (255.255.255.0)

☐ Promiscuous Mode (use with Wireshark only)

☐ Virtual Device Names

☐ Adapter Reference

Adapter: [Dropdown]

Freerun Cycle (ms): 4

OS (NDIS)

This option uses the operating system (OS) settings for installed network cards. The name of the network card is displayed in **Description**. **Device Name** contains the Device Manager path of the installed network card.

PCI

This option controls the network card via the PCI bus address, which is specified in the **PCI Bus/Slot** field.



The PCIBus/Slot field is not enabled until the PCI option is selected

DPRAM

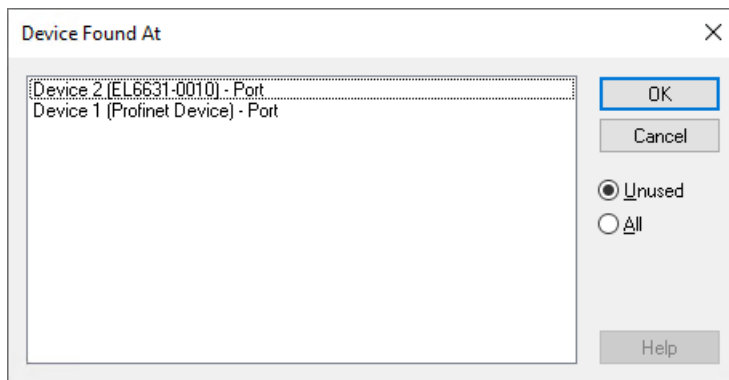
This option controls the network card via the DPRAM address, which is specified in the **Address** field.



The Address field is not enabled until the DPRAM option is selected

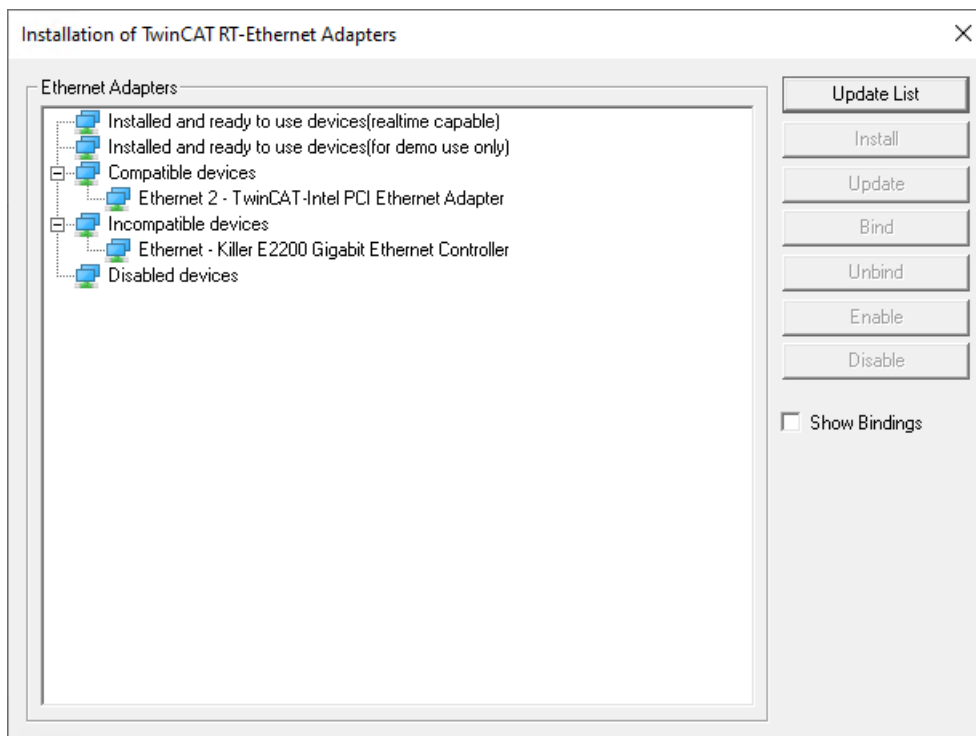
Search... button

This button opens a dialog in which all unused or all compatible devices (adapters) are offered for selection.



Compatible Devices... button

This button opens the same dialog as **TWINCAT! Show Real-time Ethernet Compatible Devices...** in the main menu. Use the dialog box to determine if compatible Ethernet adapters are available on the system.



MAC Address

MAC address of the Ethernet card (read-only)

IP Address

IP address of the card (read-only). The IP address is read from the operating system, and has nothing to do with the PROFINET IP address that will be used later.

Promiscuous Mode

This is required in order to record Ethernet frames, and should normally be switched off.

Virtual Device Names

A virtual name is used for the network card.

Adapter Reference

If the network adapter is referenced to another device, this option must be selected. This is used, for example, when using the "Multiple Protocol Handler".

Free Cycle

Cycle time in Config mode (no real-time).



If TwinCAT is operated in FREERUN mode, care must be taken that the freerun cycle set is no longer than the PROFINET cycle.

6.1.3 PROFINET

General	Adapter	PROFINET	Sync Task	Diag History	Diagnosis
Protocol AMS NetId:	192.168.219.131.2.1	Import GSDML...			
Protocol AMS PortNr.:	65535	Scan PNIO Devices...			
Server AMS NetId:	192.168.219.131.1.1	Topology...			
Server AMS PortNr.:	851	IRT Settings...			
PN SW Version:	n. a.	Interface Settings...			
		Port Settings...			
		I-Device...			
		MRP...			
		ELx663x...			
		☐ Info Data Support			
		☐ Cyclic Receive Timestamp			

Protocol AMS NetId

This is the NetID through which the PROFINET Device protocol can be reached via AMS.

Protocol AMS PortNr

This is the PortNo through which the PROFINET Device protocol can be reached via AMS.

Server AMS NetId

This is the NetID to which certain AMS messages (e.g. PN records within the index range 0x1000 - 0x1FFF) are forwarded by the PROFINET driver. Currently this is always the SystemNetId.

Server AMS PortNr

This is the PortNo to which certain AMS messages (e.g. PN records within the index range 0x1000 - 0x1FFF) are forwarded by the PROFINET driver. By default this is the PLC Port 851 of runtime system 1.

PN SW Version

Firmware version of the device

Import GSDML From TwinCAT 3.1 Build 4026

Imports and verifies GSDML and GSDMX files into the TwinCAT system.

Scan PNIO Devices

Opens a search dialog for PROFINET devices; only available for the controller.

Topology

Opens a dialog to compare the offline topology with the online topology. More information: Topology

IRT Settings From TwinCAT 3.1 Build 4026

Opens a dialog to set IRT-specific parameters. Is only available on an IRT-enabled device. More information: IRT configuration

Interface Settings From TwinCAT 3.1 Build 4026

Opens a dialog with configuration options for the Interface Settings, where settings can be made that run under the topic "Security Class 1". This includes rejecting write DCP and SNMP requests. The SNMP channel can also be secured here via a modified CommunityString. These settings apply to all configured PROFINET devices that support this feature according to GSDML. If only individual devices are to support these features, they can also be configured on the device.

Port Settings From TwinCAT 3.1 Build 4026

Opens a dialog for selecting the connection speed for CCAT or EL6633. Applies from TwinCAT 3.1 Build 4026.

I-Device

Opens a dialog for simultaneous parameterization of a controller and device interface. Only available on CCAT and EL6633-0000. More information: I-Device

MRP From TwinCAT 3.1 Build 4026

Opens a dialog to set MRP-specific parameters. Only available on the controller.

ELx663x From TwinCAT 3.1 Build 4026

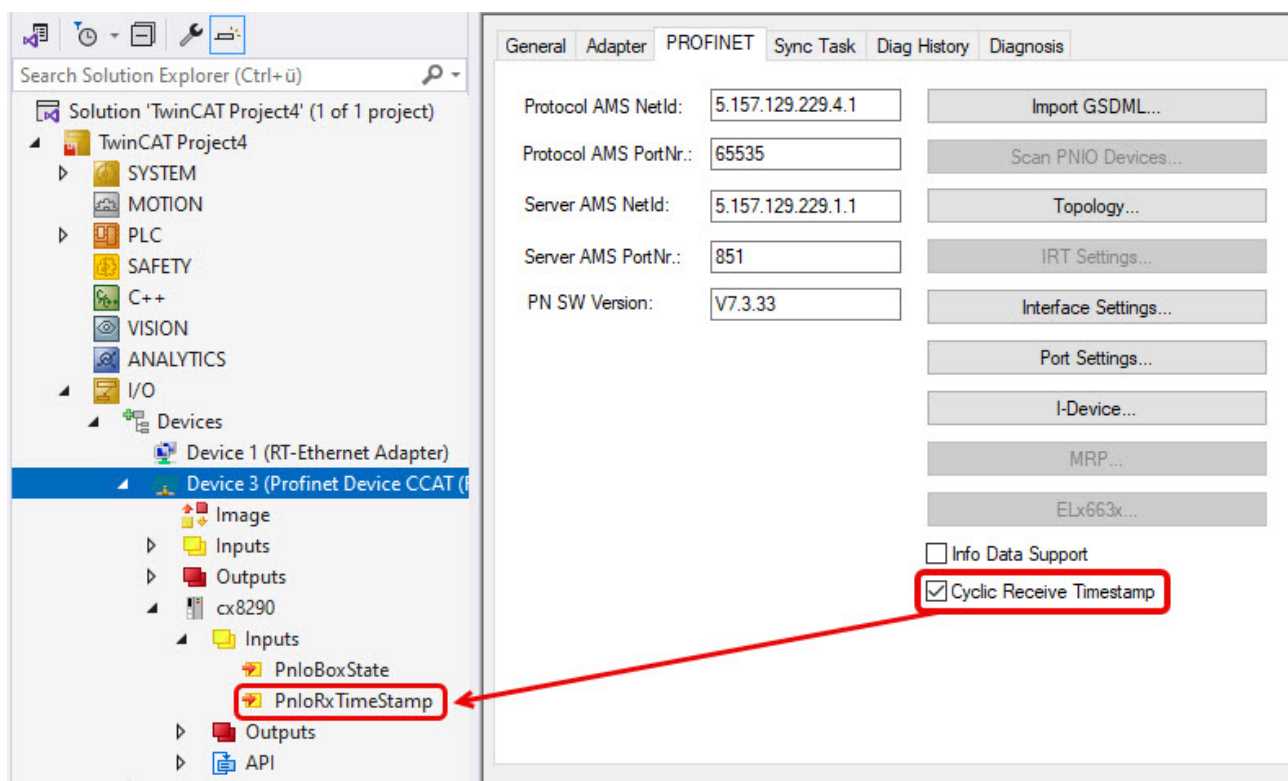
Is only enabled and available on the ELx663x.

Info Data Support

If this option is activated, the AMSNETID is also available in the TwinCAT tree and can then be linked accordingly.

Cyclic Receive Timestamp From TwinCAT 3.1 Build 4026

All projected devices receive a cyclic timestamp. This means that the data received is stamped with the local clock. Only available at CCAT.



6.1.4 Sync Task

The cycle time of the PROFINET communication is specified by the controller. The task on the TwinCAT system must work at at least the same speed. The basic PROFINET clock and the SendClockFactor result in the shortest cycle time of 1 ms. Further reductions take place using the ReductionRatioFactor. This always corresponds to a multiple of the minimum PROFINET clock. This results in a PROFINET cycle time that is always a power of two (1, 2, 4, 8..., 512), i.e. the task should also trigger in this grid.

The screenshot shows the 'Sync Task' configuration window. The 'Sync Task' tab is active. In the 'Settings' section, 'Special Sync Task' is selected. Below it, a dropdown menu shows 'Task 2' and a button 'Create new I/O Task'. In the 'Sync Task' section, the 'Name' field contains 'Task 2'. The 'Cycle ticks' field has a spinner set to '1' and a text box showing '1.000 ms'. There is an unchecked checkbox labeled 'Adjustable by Protocol'. The 'Priority' field has a spinner set to '1'.

Standard (via Mapping)

The device is triggered by the existing mapping. This can then be, for example, the task of the PLC or the NC



Recommended cycle time

With Profinet RTC1, cycle times of 1 ms or higher are possible. The task can always be operated with 1 ms, as long as the system load of your systems permits this.

Special Sync Task

NOTICE

Use a dedicated Sync Task

Use your own sync task (Special Sync Task), or a free-running task, because mapping via the PLC leads, for example at a breakpoint, to the task being stopped and thus the connection to the PROFINET Device being interrupted and no process data being exchanged.

Name

Name of the sync task

Cycle ticks

Sets the sync time of the sync task in ticks (depending on the default TwinCAT base time).

Priority

Sets the priority of the sync task. If a new task is created with the **Create new I/O Task** button, it is assigned the highest possible priority by default.

NOTICE**Using the EL6631-0010**

If the EtherCAT-PROFINET gateway terminal is used, it is important to note that the process data always arrives one cycle late in the PLC, as it requires a cycle to transfer the process data from PROFINET to EtherCAT

6.2 Diagnosis on the PROFINET Device Protocol

6.2.1 Diag History

Logged diagnosis messages can be read from the Profinet protocol via the **Diag History** tab. The diagnosis buffer operates as a ring buffer with a current maximum size of 1000 entries.

General Adapter PROFINET Sync Task Settings Box States Diag History

Update History ☒ Auto Update Clear Diag History Export Diag History

Type	Timestamp	Message	AddInfo	MessageID
Warning	23.09.2011 13:45:56 613 ms	ek9300-1: AR got diagnosis alarm.	Yes	11
Warning	23.09.2011 13:45:56 609 ms	ek9300-1: AR got diagnosis alarm.	Yes	10
Info	23.09.2011 13:45:56 603 ms	ek9300-1: AR is established (got ApplReady).	No	9
Info	23.09.2011 13:45:53 541 ms	ek9300: AR is established (got ApplReady).	No	8
Info	23.09.2011 13:45:52 664 ms	ek9300: Controller send PmEnd.	No	7
Info	23.09.2011 13:45:52 601 ms	ek9300: Controller start the parameterization.	No	6
Info	23.09.2011 13:45:52 468 ms	ek9300: Controller send ConnectReq to device.	No	5
Info	23.09.2011 13:45:52 278 ms	ek9300-1: Controller send PmEnd.	No	4
Info	23.09.2011 13:45:52 245 ms	ek9300-1: Controller start the parameterization.	No	3
Info	23.09.2011 13:45:52 236 ms	ek9300-1: Controller send ConnectReq to device.	No	2
Error	23.09.2011 13:45:44 617 ms	ek9300-1: AR is released.	No	1
Error	23.09.2011 13:45:44 617 ms	ek9300-1: AR send error alarm.	Yes	0

Diagnosis appears alarm (0x0001)
 The diagnosis alarm received from:
 API Number 0x00000000, Slot Number 0x0005, Subslot Number 0x0001

Type

The possible errors are grouped into three types:

- Info: e.g. information on connection establishment
- Warning: e.g. PROFINET diagnosis alarms
- Error: e.g. disconnection

Timestamp

Timestamp of the message

Message

Contains a message text

AddInfo

Indicates whether there is any additional information about the event. If this is marked by **Yes**, the additional information can be fetched and displayed by clicking on the respective message. In the case of a diagnosis alarm (**Diagnosis appears**), the precise diagnosis information can be fetched at the corresponding level (device, API or module).

Clear Diag History

The complete diagnosis buffer is cleared by pressing the button.

Export Diag History

Via this button, you can save the displayed messages in a .TXT file.

6.2.2 Diagnosis

This list contains diagnostics and statistics.

General Adapter PROFINET Sync Task Diag History Diagnosis	
Clear Frame Statistic Export Diagnosis	
Name	Value
LastUpdate	10/15/2019 11:07:58 AM 053 ms
[-] ProtocolSettings	Settings
[-] Name	Device 1 (Profinet Device)
Task Time	1 ms
[-] PortStatistic	1 Port
[-] Port1	FrameRecv = 36490, FrameSend = 36045
PortMAC	0x02 0x01 0x05 0x00 0x00 0x01
OperationState	Up
FrameLengthErrorCnt	0
RxErrorCnt	0
CRCErrorCnt	0
LinkLostErrorCnt	0
RxAlignmentErrorCnt	0
TxDroppedFrameCnt	0
RxDroppedFrameCnt	0
TxFrameCnt	36045
RxFrameCnt	36490
LineDelay	0 ns
+ PeerToPeerFrames	PeerToPeerFrames = 65
+ SyncFrames	SyncFrames = 0
+ NetloadStatistic	No Errors detected!
[-] ProfinetDevices	⚠ Warning tcpnidevice
[-] tcpnidevice	⚠ Warning FrameStatistic
+ FrameStatistic	⚠ FrameCnt = 72036

The "Clear Frame Statistic" button resets the frame statistics and the port frames of the PROFINET device. The port statistics, on the other hand, always count from the time of activation and can only be reset by restarting.

ProtocolSettings

Includes, for example, the name and cycle time of the PROFINET protocol.

PortStatistic

Port-specific statistics and diagnostics.

NetloadStatistic

Percentage display of the expected bus load associated with the cyclic process data. Also diagnosis counter of the internal network load filter to avoid possible frame bursts.

ProfinetDevices

Diagnostics and statistics for the projected PROFINET devices.

6.2.3 Cyclic diagnosis

Directly below the PROFINET controller there are variables containing general information about the state of the PROFINET communication.

Variable	Flags	Online
Name:	DevState	
Type:	UINT ({18071995-0000-0000-0000-000000000005})	
Group:	Inputs	Size: 2.0
Address:	4 (0x4)	User ID: 0
Linked to...		
Comment:	0x0001 = No link at port 1 0x0002 = No link at port 2 0x0010 = Out of send resources (I/O reset required) 0x0080 = I/O reset active	
ADS Info:	Port: 11, IGrp: 0x3040050, IOffs: 0x80000004, Len: 2	
Full Name:	TIID^Device 5 (Profinet Controller)^Inputs^DevState	

These data are exchanged between the PROFINET driver and TwinCAT 3.

The process data **DevState** contains information about the physical communication status of the device, such as the link status or whether the sender resources are still adequate.

The source process data **devCtrl** currently has no function.

The Error variable shows possible problems when establishing a connection and counts the PROFINET devices affected by an error.

The diagnosis variable provides status information about an existing connection. The variable counts the PROFINET device affected by a warning or diagnosis.

6.3 Settings on the PROFINET Device

6.3.1 General

Here you can find general information about the PROFINET device used.

General	Device	Diagnosis	ADS	GSDML Generator
Name:	tcpnidevice			Id: 1
Object Id:	0x03020001			
Type:	TwinCAT PLC PROFINET I/O Device with I/Os, V2.32, 1 port diagnostic suj			
Comment:	GSDML Name: GSDML-V2.33-beckhoff-TCPNDevice-20190325.xml Path: \$(TWINCAT3DIR)Config\Io\Profinet\ VendorName: Beckhoff Automation OrderNumber: TwinCAT PN Device HW Release Version: 1 SW Release Version: V5.00			
☐ Disabled		Create symbols ☐		

The name used can be edited directly here. A change is accepted in the tree. In the case of the controller, this also sets the PROFINET station name. For the device, the PROFINET station name is set only if the corresponding option is selected (**Get StationName from Tree**).

More information about the used GSDML can be found in the comment box.

6.3.2 Device

In this dialog, general information regarding the projected PROFINET Device can be checked and set.

General	Device	Diagnosis	ADS	GSDML Generator
Device Configuration GSDML-V2.33-beckhoff-TCPNDevice-20190325.xml 				
Device Configure... Refresh GSDML... ☐ Legacy config				
Adapter Properties MAC Address 00-01-05-45-FF-8D Vendor ID 0x0120 Device ID 0x0021 ☐ Generate Station Name from Control ☐ Get Station Name from Tree ☐ Register PN IP settings not at the OS (only for CE)				
Instance Properties Instance ID 0x0000 Frame ID 0x8000 Server UDP Port 0xC350 Client UDP Port 0xC351				

Device Configuration

This tab contains options for the device description file (GSDML).

- **Device Configure...**

The configuration button opens the configuration view for the device. For more information, see the chapter

- **Refresh GSDML**

Here you can see the currently used GSDML version, which can be updated via the Refresh button. Modules and sub modules existing in the project remain unchanged, while newly inserted modules and sub modules are integrated according to the updated device description file.

- **Legacy config**

The Legacy option allows device configuration to be performed according to TwinCAT versions smaller than 4024.

Adapter Properties

These settings allow you to check the **MAC Address**, **Vendor ID** and **Device ID** of the device. The following options can also be activated here.

- **Generate Station Name from Control:** The PROFINET name can be generated, for example, via the PLC. This feature is comparable with the DIP switches on the BK9103. The Ctrl WORD of the PROFINET protocol is used to help assign a name. This means that the number that is entered (range of values 0 - 255) is appended to the existing station name. The Ctrl WORD is described via the linked task. If, for example, the Ctrl WORD is given a value of 11 from the PLC, its previous station name changes, for example, from "tcpniodvice" to "tcpniodvice011". However, the current tree name is still "tcpniodvice000"
- **Get Station Name from Tree:** The PROFINET name that the device has in the TwinCAT tree is used.
- **Register PN IP Settings not at the OS:** For Windows CE the PROFINET IP address is additionally registered at the operating system. This means that there is a possibility to access standard IP-based services of the operating system via the PROFINET address. This option can be deselected again here.

Instance Properties

In the instance settings, only the desired **Frame ID** can be set for the output data. This must always lie within the corresponding communication area. The driver adjusts them automatically, i.e. normally no adjustments need to be made here. The Frame ID is automatically set to the appropriate value with the information from the GSDML.



Please change the Frame ID only in consultation with Beckhoff Support.

The other three values (**Instance ID**, **Server UDP Port** and **Client UDP Port**) are displayed here purely for information.

6.3.3 ADS

ADS messages can be sent directly from here. The NetId and the port are taken directly from the corresponding adapter.

A variety of PROFINET functions can be triggered via the correct settings for **Index-Group** and **Index-Offset**. This includes, for example, the setting of alarms or record data.

Example: Read PROFINET name and IP settings, see chapter Further diagnosis via ADS interface.

6.3.4 EL663x

If the protocol is operated via an EL663x, an additional menu will appear on the devices.

General	Device	Diagnosis	ADS	EL663x	GSDML Generator
---------	--------	-----------	-----	--------	-----------------

General settings

☐ alternative mapping model

☐ get PN-Stationname from ECAT

☐ get PN-IP-Settings from ECAT

IP configuration

IP address

Subnet

Gateway

PDO mapping

☒ Submodule data (0x6nn0, 0x7nn0)

☐ Module data (0x6nn1, 0x7nn1)

☐ Submodule data and IOPS (0x6nn2, 0x7nn2)

☐ Module data and IOPS (0x6nn3, 0x7nn3)

PN output behaviour if EC state is not OP

☒ Outputs set to 0, IOxS is GOOD

☐ Outputs frozen, IOxS is GOOD

☐ Outputs set to 0, IOxS is BAD

General settings

In the case of the device (= EL6631-0010), the PROFINET name and IP can be specified via EtherCAT. This means that after a startup, the device has these default settings.

PDO mapping

Via the PDO mapping, you can select the form in which the PROFINET process data is mapped to the EtherCAT-side PDOs.

PN output behaviour IEC state is not OP

The output behavior determines what happens on the PROFINET side if the EtherCAT status of the terminal is not OP. The first two options affect only the process data. The last option results in the transfer of the producer or consumer status, hence associated Profinet alarms and diagnoses are triggered here.

6.3.5 GSDML generator

A GSDML can be created from an existing configuration via this window. The generated file can then be integrated into the controller. The device configuration is thus set and does not need to be reconfigured on the controller side.

General
Device
Diagnosis
ADS
GSDML Generator

Create GSDML from original...

Settings for text descriptions

☐ Get module names from tree
English

Settings for GSDML

Name	Value
Vendor Id	0x0120
Device Id	0x0021
Vendor Name	Beckhoff Automation
Family Description	TwinCAT products
Main Family	I/O
Product Family	TwinCAT Profinet I/O
DNS CompatibleName	tcpniodevice
Order Number	TwinCAT PN Device
HW Release Version	1
SW Release Version	V5.00
Graphic File (.bmp)	GSDML-0120-0021-TCPNDevice
MinDeviceInterval	32
Alternative Language	German

If the names in the tree have been adjusted, this change can be applied here optionally. To do this, the associated language must be selected. The texts are then accepted under this language in the GSDML. If several languages are to be adapted, the generated GSDML must first be reintegrated into the TwinCAT system, then the tree must be re-edited in the desired language and the GSDML must be regenerated with this language.



Existing languages remain unchanged, only the selected language is replaced with the texts.

6.4 PROFINET Device diagnosis

6.4.1 Diagnosis

The current PROFINET station name is displayed on the **Diagnosis** tab.

The screenshot shows the 'Diagnosis' tab in the Beckhoff software interface. It contains three main sections:

- Stationname:** A text field containing 'tcdevice'.
- IP configuration:** Fields for IP address (192 . 168 . 1 . 3), Subnet (255 . 255 . 255 . 0), and Gateway (192 . 168 . 1 . 1). There are buttons for 'Set IP settings...' and 'Refresh'.
- Module Difference:** A table comparing expected modules with actual modules.

ModuleInfo	SubModuleInfo	APINumber	SlotNumber	SubSlotNumber	ModuleState	SubModuleState
No Module	No SubModule	0x00000000	6	0	No Module	No SubModule
2 DWord In- and Output	2 DWord In- and Output	0x00000000	10	1	Wrong Module	

Station name

A controller can assign a device name to the device ("baptize") and thus change the name. An empty string is also allowed here and also the default. However, such a setting is not allowed as a box name. In addition, there are TwinCAT functions that iterate via the tree based on the node names used. This is another reason why the box name is not changed automatically and does not correspond to the PROFINET station name.

IP configuration

The IP settings are also specified by the controller. If the device is not in data exchange (= no existing AR), then the IP address can be set here and is then stored fail-safe. However, during a PROFINET startup, the controller checks the IP settings. If these are different than expected by the controller, they will be overwritten again. Normally, the controller does not make the IP settings remanently; the previously saved IP settings are thus deleted.



When using TF627x, make sure that the IP addresses of the operating system and PROFINET are different.

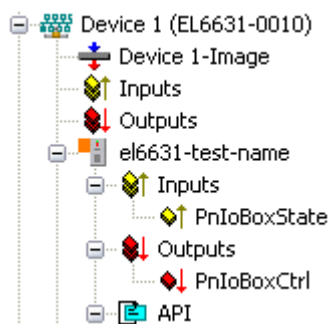
Module Difference

This list shows the module and sub module differences detected by the device. The comparison is made here between the projected modules on the controller side (= Expected) and the actual plugged-in modules on the device side (= Real). Detected differences are transmitted to the controller and shown here.

6.4.2 Status and Ctrl. flags

PnloBoxState

The PnloBoxState can be used to monitor the current status of PROFINET communication.

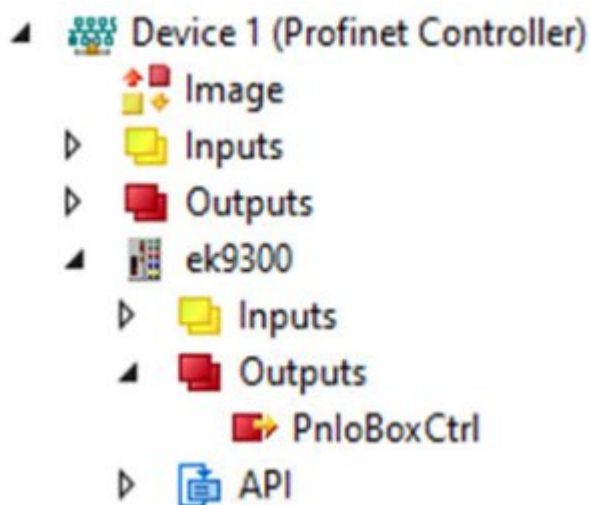


PnIoBoxState	Comment	Meaning
0x0001 (Bit 0)	Device is in I/O exchange	PROFINET Device is exchanging data
0x0002 (Bit 1)	Device is blinking	PROFINET Device is being searched for by identification
0x0004 (Bit 2)	Provider State 0=STOP, 1=RUN	The PROFINET Controller is stopped
0x0008 (Bit 3)	Problem indicator 0=OK, 1=Error	The PROFINET Device has encountered problems

In the absence of an error, the value of PnIoBoxState is "5" - in other words, bits 0 and 2 are set.

PnIoBoxCtrl

PnIoBoxCtrl can be used for assigning names; only the low byte is to be used for this. The high byte must be 0x00.



PnIoBoxCtrl	Comment	Meaning
0x0001	EBusReset	EBusReset on the EK9300/EP9300

6.4.3 Port diagnostics

Port diagnosis can be used to identify the neighboring PROFINET devices. The device's own port can also be diagnosed.

General
Properties
Port Diagnosis

Local Port Data

Name	Value
Port Number	1
Port ID	port-001
Port Description	Ethernet Port 1, Slot 0 PortSubmodule 1, 100...

Get local port data

Remote Port Data

Name	Value
Port ID	port-001
Port Description	ek9300 - port-001
System Name	ek9300
System Description	Beckhoff ECAT Coupler, EK9300, SW V ...

Get remote port data

Port Statistic

Name	Value
Speed	100 MBit/sec
Phys MAC	0x02 0x01 0x05 0x00 0x00 0x01
Operating status	up
Rx octets	6682

Get port statistic

Local Port Data and Remote Port Data

The information here is subdivided into local port information and remote port properties. In PROFINET the LLDP protocol (IEEE Std 802.1AB) is mandatory from conformance class A (CCA). The devices exchange neighborhood IDs via this protocol, so that each port is known to its neighbor. Furthermore, the Simple Network Management Protocol (SNMP) can be used as an aid at this point.

On opening the **Port Diagnosis** tab, TwinCAT acts as a Network Management Station (NMS) and collects the required device information via SNMP. In the previous image, you can see, for example, properties of the local port, data of the neighboring device and port statistics.



For correct topology recognition it is important that only devices are present in the segment that also support the LLDP protocol (this also applies to switches).

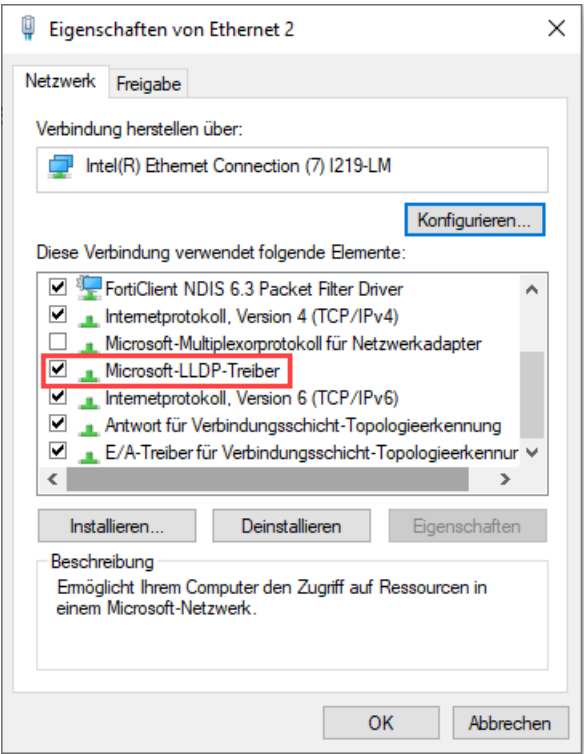


There is a possibility that there may be unwanted behavior in Windows 10. This is reflected in inconsistencies in topology detection.

Inconsistencies in topology detection.

Windows 10 provides an LLDP driver which is active by default. The PROFINET device also contains an LLDP driver. The system then sends two LLDP telegrams from one port to the remaining nodes on the bus. These remaining devices also expect two ports due to two LLDP telegrams, which do not exist.

To prevent this behavior, disable the Windows LLDP driver. To do this, uncheck **Microsoft-LLDP-Driver** (see red rectangle).



6.4.4 Further diagnosis

Additional diagnostic facilities are available through the ADS interface.

Read out the PROFINET name and the IP settings

An ADS READ function block is to be used for this.

ADS WRITE	Comment
AMSNETID	AMS Net ID of the PROFINET Device
PORT	0xFFFF (if a virtual PROFINET Device is used, the port number is formed from 0x1000 + the device ID)
Index group	High word - 0x0000, low word - 0xF804
Index offset	0x0000
Length	257

Data byte offset	Value	Comment
0..3	reserved	reserved
4..7	ARRAY4 of Byte	IP Address
8..11	ARRAY4 of Byte	Sub Net Mask
12..15	ARRAY4 of Byte	Default gateway
16...x	STRING (max. length 240)	PROFINET name

Reading out the module difference

An ADS READ function block is to be used for this.

ADS WRITE	Comment
AMSNETID	AMS Net ID of the PROFINET Device
PORT	0xFFFF (if a virtual PROFINET Device is used, the port number is formed from 0x1000 + the device ID)
Index group	High word - 0x0000, low word - 0xF826
Index offset	0x0000
Length	20882

The modules are identical if the length null is returned. The length can differ, depending on the type (see the ModuleDiffBlock PROFINET specification)

Example of how the data can be constructed:

Data byte offset	Value	Comment
0..3	UINT32	API
4..5	UINT16	Number of Modules
6..7	UINT16	Slot
8..11	UINT32	Module Ident (see GSDML File)
12..13	UINT16	Module State (0-noModul, 1- WrongModule, 2- ProperModule, 3- Substitute)
14..15	UINT16	NumberOfSubModules
16..17	UINT16	SubSlot

7 Profinet Features

7.1 Alarms

PROFINET alarms can also be transmitted through the ADS interface.

PROFINET alarm

An ADS WRITE function block is to be used for this.

ADS WRITE	Comment
AMSNETID	AMS Net ID of the PROFINET Device
PORT	0xFFFF (if a virtual PROFINET Device is used, the port number is formed from 0x1000 + the device ID)
Index group	High word - alarm type (see PROFINET specification), low word - 0xF807
Index offset	High word - slot number, low word - sub slot number

No further data is transmitted.

PROFINET alarm (examples)

ALARMS	Comment
0x0000	reserved
0x0001	Diagnosis appears
0x0002	Process
0x0003	Pull
0x0004	Plug
0x0005	Status
...	further diagnosis messages (see PROFINET specification)



Supported PROFINET alarm types

The alarm types are defined in the structure

7.2 Record data

PROFINET record data

PROFINET record data can also be received directly by means of the PLC. To do this an "indication" is set in the PLC ((READINDICATION for reading and WRITEINDICATION for writing). The RECORD data structure is described in

Record Data

```
WORD    Index;
WORD    Length;           //zum Lesen auf 0
WORD    TransferSequence;
WORD    LengthOfAligned;
```

PROFINET RECORD DATA mapped on ADS

PROFINET	Length in bytes	Comment	ADS
-	String	AMS NET ID of the PROFINET Device	AMSNETID
-	2	0xFFFF When the virtual interface is used, the port number is to be taken from the System Manager	Port
Read/Write	2	0 - Read 1 - Write	Read - ReadIndication Write - WriteIndication
Number of AR	2	0x0000	-
API Application Process Identifier	4	0x00000000	-
Slot	2	Slot number 0x0000-0x7FFF	IndexOffset High Word
SubSlot	2	SubSlot number 0x0000-0x8FFF	IndexOffset Low Word
Record Data Index	2	0x0000-0x1FFF	IndexGroup Low Word
-	2	0x8000	IndexGroup High Word
Record Data Length	2	to be read at "0"	LENGTH
Record Data Transfer Sequence	2	consecutive number	-
Record Data Length of Aligned	2	can be zero	-

Example

Example for reading data; the PROFINET Controller wants to read data from a Beckhoff device via the record data. In this example, all the RecIndex values are accepted, and will return the same data - 10 bytes that are located in the "Data" data array.

```

CASE i OF
0:  ADSREADIND(
    CLEAR:=FALSE ,
    VALID=> ,
    NETID=> ,
    PORT=> ,
    INVOKEID=> ,
    IDXGRP=> ,
    IDXOFFS=> ,
    LENGTH=> );
    IF ADSREADIND.VALID THEN
        IdxGroup:=ADSREADIND.IDXGRP;
        IdxOffset:=ADSREADIND.IDXOFFS ;
        i:=10;
    END_IF
10: ADSREADRES(
    NETID:=ADSREADIND.NETID,
    PORT:=ADSREADIND.PORT,
    INVOKEID:=ADSREADIND.INVOKEID ,
    RESULT:=0 ,
    LEN:=10 ,
    DATAADDR:=ADR(Data) ,
    RESPOND:=TRUE );
    i:=20;
    ADSREADIND(CLEAR:=TRUE);
20: i:=0;
    ADSREADRES(RESPOND:=FALSE);
END_CASE

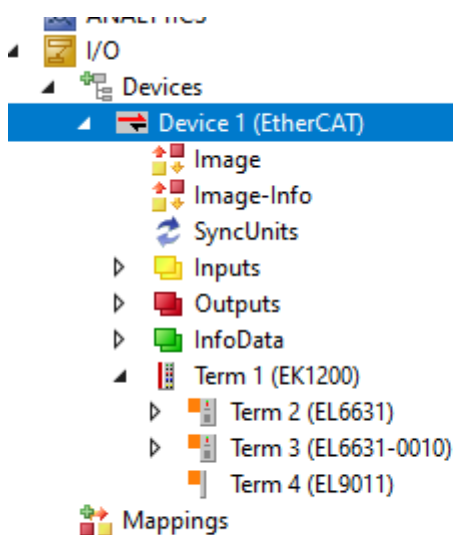
```

7.3 PROFINET Shared Device

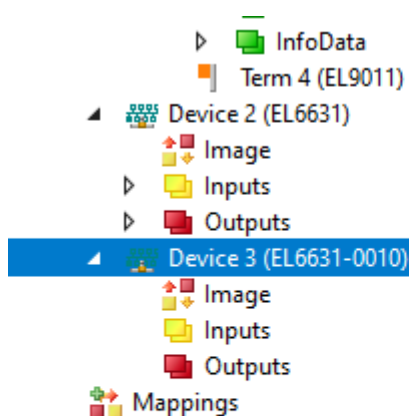
Configuration on the TwinCAT side:

- ✓ Structure -> EL6631>EL6631-0010

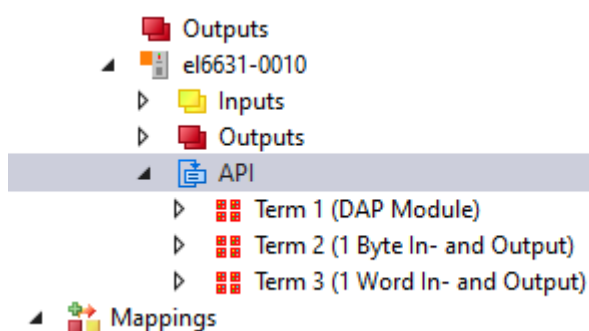
1. Scanning the devices



2. Adding the PROFINET Controller and Device



3. Creating the process data under the PROFINET Device



4. Scanning the controller and adding the device

Scan Devices

Stationname	MAC address	IP address	Subnet
test.test	00:01:05:41:92:6F	192.168. 0. 2	255.255.255. 0
plcxb1.profinet-sc...	28:63:36:AD:EA:2B	192.168. 0. 1	255.255.255. 0

Rescan Devices

Add Devices

Stationname
test.test

Set Stationname

IP configuration

IP address 192 . 168 . 0 . 2 ☐ DHCP enable

Set IP configuration

5. Adjusting the IP address of the controller. The device and controller must be on the same subnet.

General Adapter PROFINET Sync Task Settings Box States Diag History Diagnosis

IP configuration

IP address 192 . 168 . 0 . 10

Subnet 255 . 255 . 255 . 0

Gateway 192 . 168 . 0 . 1

Set IP settings...

Name of PnIo Controller Station
el6631-pncontroller

Set System name...

VendorId 0x0120

DeviceId 0x0025

Server UDP Port 0xEE48

Client UDP Port 0xEA60

StationName settings

☐ Automatic NameOfStation assignment

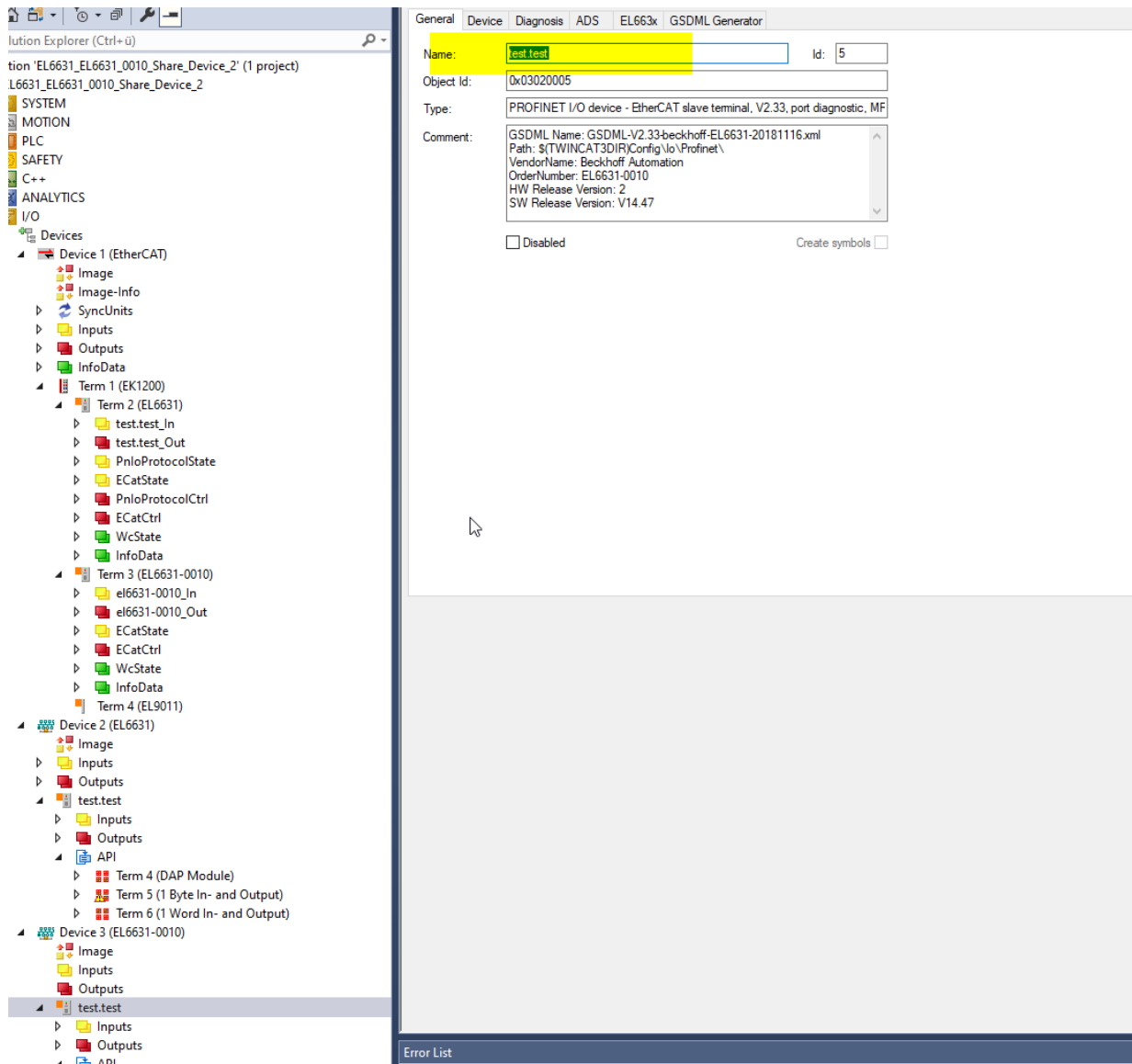
6. Under the device, select the **Shared Device** tab. Here you can set which controller accesses which data. In this example, the EL6631 controller is allowed to access only the 1 Word In and Output process data.

General	Device	Diagnosis	Features	ADS	EL663x	Shared Device	Asset Management
Name		Slot	Subslot	Access	SharedInput		
[-] Term 4 (DAP Module)							
Subterm 7 (EL6631-0010 V2.33, at least FW 14)		0	1	true	has full access		
Subterm 8 (Interface)		0	32768	true	has full access		
Subterm 9 (Port 1)		0	32769	true	has full access		
Subterm 10 (Port 2)		0	32770	true	has full access		
[-] Term 5 (1 Byte In- and Output)							
Subterm 11 (1 Byte In- and Output)		1	1	false	has output data		
[-] Term 6 (1 Word In- and Output)							
Subterm 12 (1 Word In- and Output)		2	1	true	has full access		

7. Activate the checkbox **get PN-Stationname from ECAT** on the **EL663x** tab

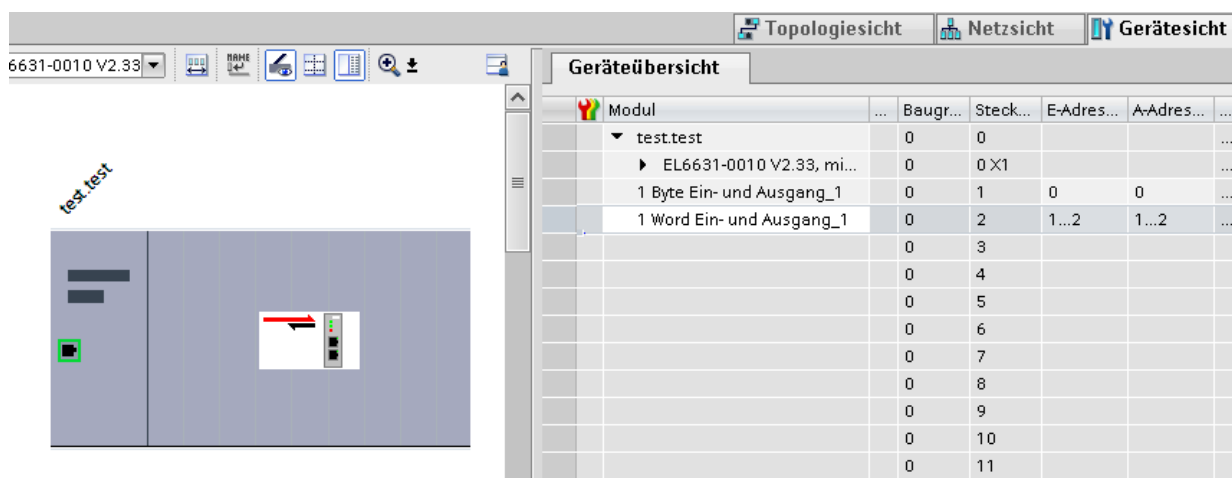
The screenshot displays the Beckhoff Solution Explorer and the configuration window for the EL6631 controller. The Solution Explorer on the left shows a project named 'EL6631_EL6631_0010_Share_Device_2'. The tree structure includes 'SYSTEM', 'MOTION', 'PLC', 'SAFETY', 'C++', 'ANALYTICS', and 'I/O'. Under 'I/O', there are three devices: 'Device 1 (EtherCAT)', 'Device 2 (EL6631)', and 'Device 3 (EL6631-0010)'. 'Device 2 (EL6631)' is selected. The right pane shows the configuration window for 'EL6631_EL6631_0010_Share_Device_2' with tabs: 'General', 'Device', 'Diagnosis', 'ADS', 'EL663x', and 'GSDML Generator'. The 'EL663x' tab is active. Under 'General settings', the checkbox 'get PN-Stationname from ECAT' is checked. Below it, 'IP configuration' fields for IP address, Subnet, and Gateway are shown. Under 'PDO mapping', 'Submodule data (0x6nn0, 0x7nn0)' is selected. Under 'PN output behaviour if EC state is not OP', 'Outputs set to 0, IOxS is GOOD' is selected. At the bottom, an 'Error List' shows 0 Errors, 0 Warnings, and 0 Messages.

8. Changing the name of the device. It must be identical to the name under the controller.

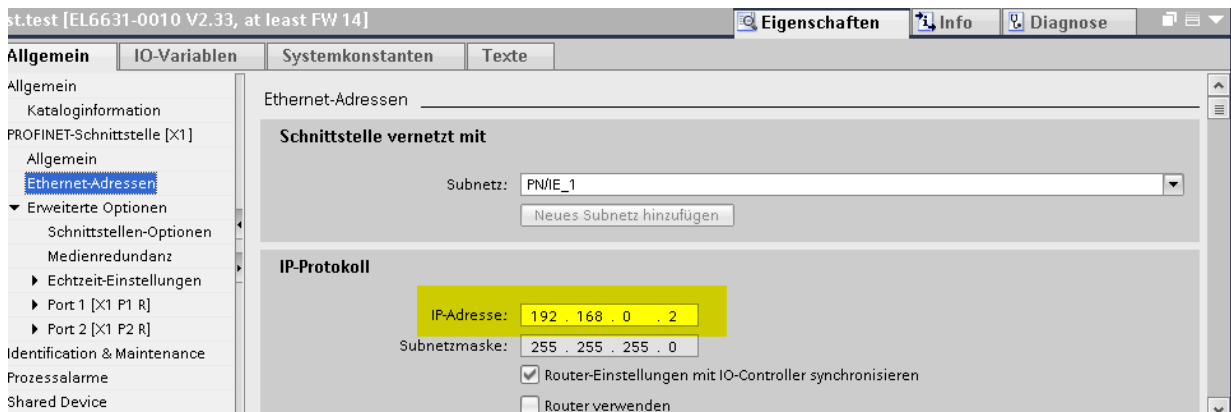


Configuration TIA side:

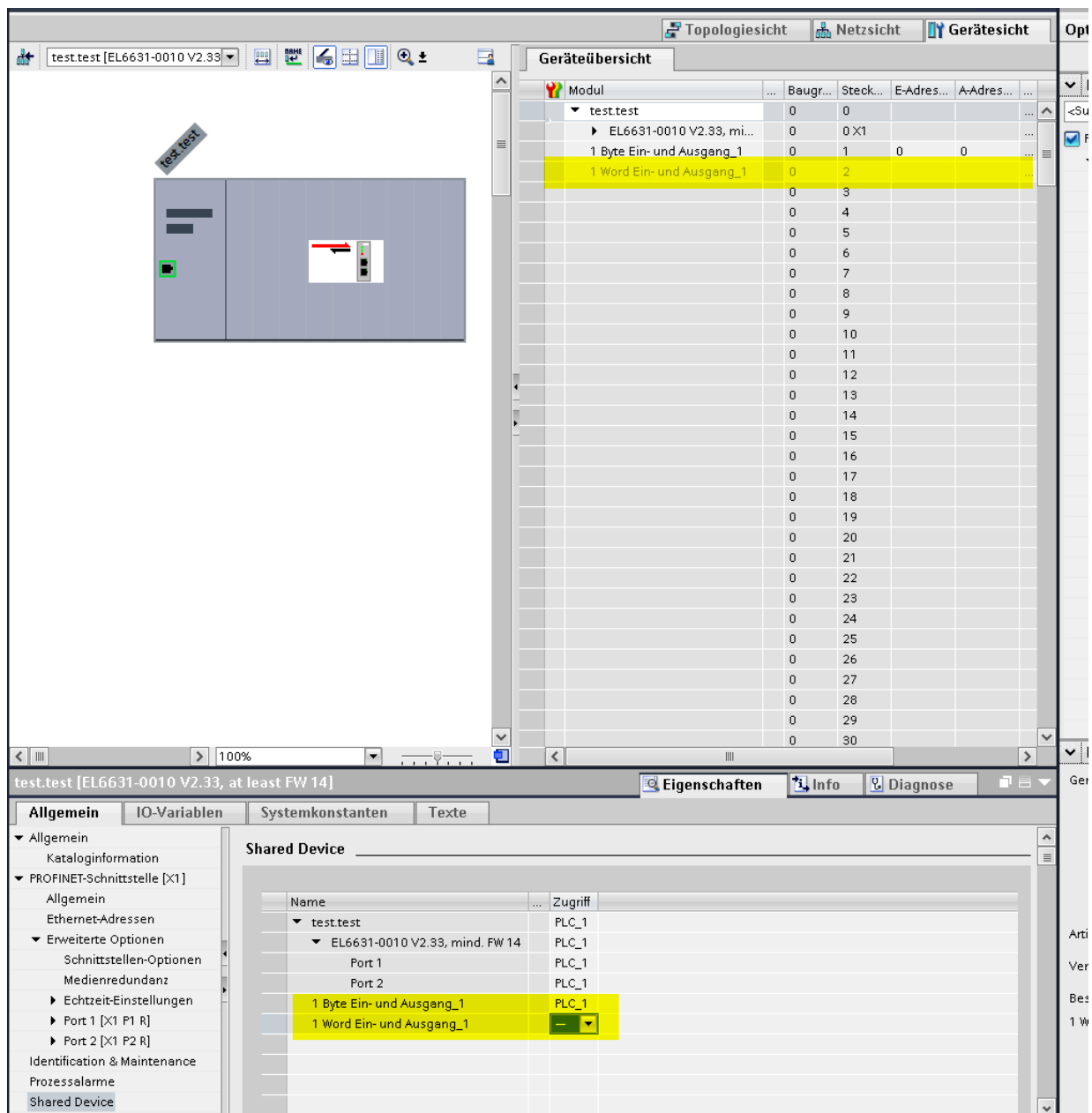
9. Configuration of the Device with the creation of the process data (must be identical with the TC3 side)



10. Check the IP address on the **Ethernet addresses** tab; you may need to adjust the address



11. On the **Shared Device** tab, select the process data that the Siemens controller is allowed to access. The process data that the Siemens controller is not allowed to access are grayed out.



8 Appendix

8.1 FAQ

The following information answers frequently asked questions and gives hints for the configuration of the PROFINET system. If these are not observed, undesired behavior may occur. Here you will find approaches to diagnostics.

8.1.1 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

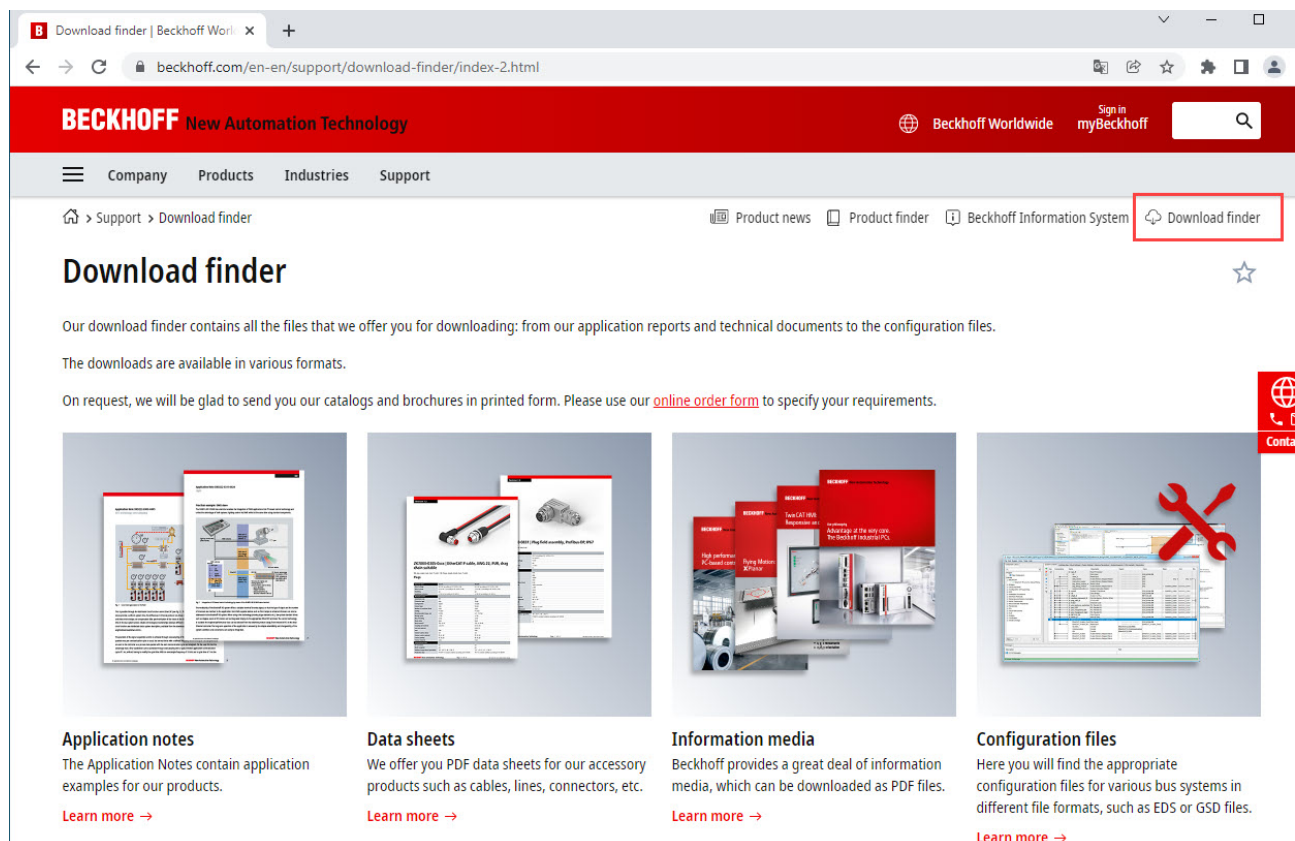


Fig. 20: Website Download finder

The screenshot displays the Beckhoff website's 'Download finder' section. At the top, there's a navigation bar with 'BECKHOFF New Automation Technology' and a search bar. Below this, a breadcrumb trail shows 'Support > Download finder > Configuration files'. The main content area features a search bar and filters for 'Media: Configuration files' and 'File type: GSDML'. A list of configuration files is shown, including 'EL6631-0010 | EtherCAT PROFINET Device', 'CX20x0-B930, CX5xx0-B930, CX8093, CX9020-B930 | PROFINET', 'BK9053 | GSDML für PROFINET V2.3', and 'BK9103 | GSDML for PROFINET V2.3'. Each entry includes a 'Downloads' button. On the right, a dropdown menu is open, showing 'Items per page' options (5, 10, 25, 50) and a 'File type' filter with 'GSDML' selected. A 'Contact' button is also visible on the right side.

Fig. 21: 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.

8.1.2 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 'Sync Task' configuration window with the following elements:

- General** | **Adapter** | **PROFINET** | **Sync Task** | **Diag History** | **Diagnosis**
- Settings**
 - ☐ Standard (via Mapping)
 - ☒ **Special Sync Task**
 - Task_PROFNET (dropdown menu)
 - Create new I/O Task (button)
- Sync Task**
 - Name: Task_PROFNET
 - Cycle ticks: 1 (dropdown) | 1.000 (text box) | ms
 - ☐ Adjustable by Protocol
 - Priority: 1 (dropdown)

Fig. 22: Setting "Special Sync Task"

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

8.1.3 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

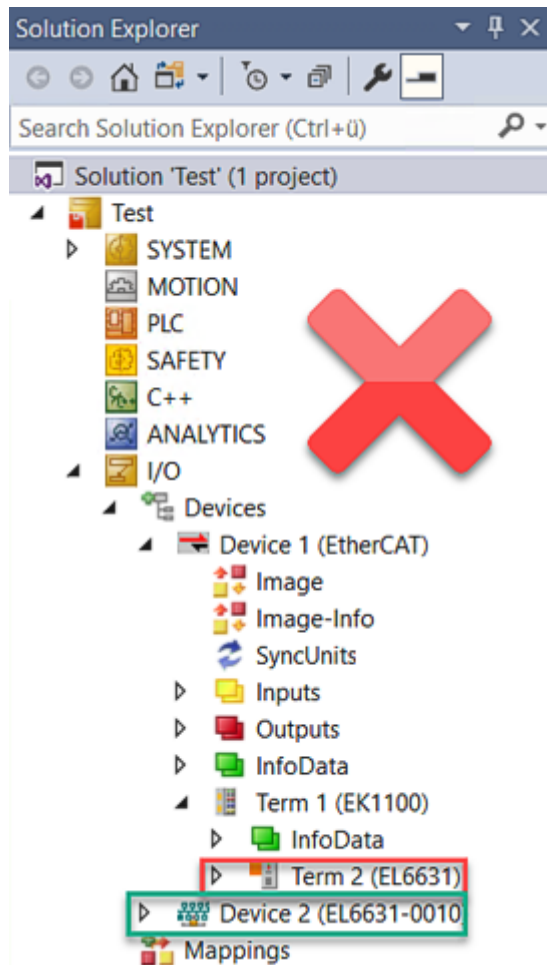


Fig. 23: Wrong configuration

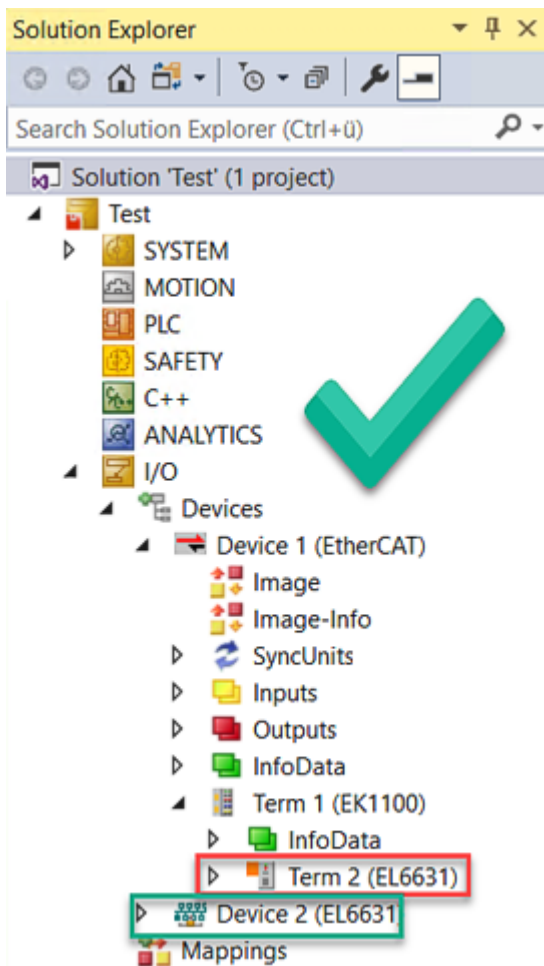


Fig. 24: Correct configuration

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

8.1.4 BoxStates of the PROFINET devices

BoxStates of the PROFINET devices

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

8.1.5 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.

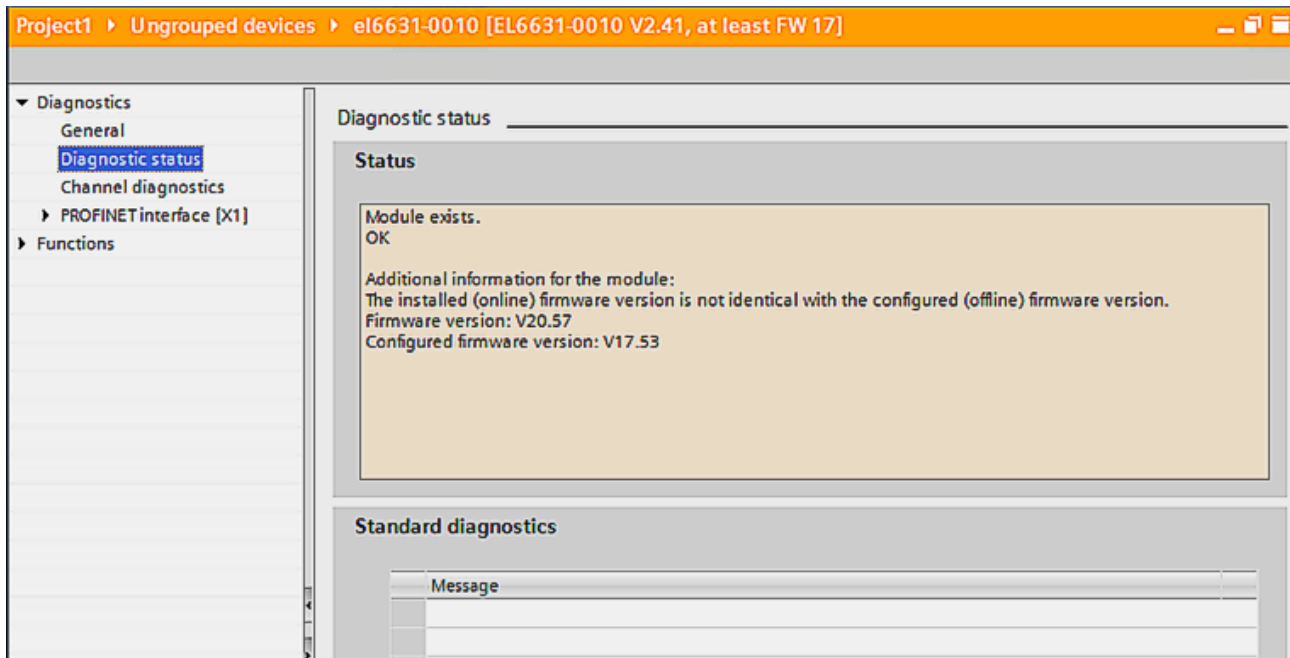


Fig. 25: Note on the firmware in Diagnostic Status

8.2 EtherCAT AL Status Codes

For detailed information please refer to the [EtherCAT system description](#).

8.3 **Firmware compatibility**

Beckhoff EtherCAT devices are delivered with the latest available firmware version. Compatibility of firmware and hardware is mandatory; not every combination ensures compatibility. The overview below shows the hardware versions on which a firmware can be operated.

Note

- It is recommended to use the newest possible firmware for the respective hardware
- Beckhoff is not under any obligation to provide customers with free firmware updates for delivered products.

NOTICE

Risk of damage to the device!

Pay attention to the instructions for firmware updates on the [separate page \[► 86\]](#).
If a device is placed in BOOTSTRAP mode for a firmware update, it does not check when downloading whether the new firmware is suitable.
This can result in damage to the device! Therefore, always make sure that the firmware is suitable for the hardware version!

EL6633-0010			
Hardware (HW)	Firmware	Revision no.	Release date
00 – 03*	01	EL6633-0010/0016	2025/02
	02	EL6633-0010/0017	2025/05
	03*		2025/07

*) This is the current compatible firmware/hardware version at the time of the preparing this documentation.
Check on the Beckhoff web page whether more up-to-date [documentation](#) is available.

8.4 Firmware Update EL/ES/EM/ELM/EP/EPP/ERPxxxx

This section describes the device update for Beckhoff EtherCAT slaves from the EL/ES, ELM, EM, EK, EP, EPP and ERP series. A firmware update should only be carried out after consultation with Beckhoff support.

NOTICE

Only use TwinCAT 3 software!

A firmware update of Beckhoff IO devices must only be performed with a TwinCAT 3 installation. It is recommended to build as up-to-date as possible, available for free download on the [Beckhoff website](#).

To update the firmware, TwinCAT can be operated in the so-called FreeRun mode, a paid license is not required.

The device to be updated can usually remain in the installation location, but TwinCAT has to be operated in the FreeRun. Please make sure that EtherCAT communication is trouble-free (no LostFrames etc.).

Other EtherCAT master software, such as the EtherCAT Configurator, should not be used, as they may not support the complexities of updating firmware, EEPROM and other device components.

Storage locations

An EtherCAT slave stores operating data in up to three locations:

- Each EtherCAT slave has a device description, consisting of identity (name, product code), timing specifications, communication settings, etc.
This device description (ESI; EtherCAT Slave Information) can be downloaded from the Beckhoff website in the download area as a [zip file](#) and used in EtherCAT masters for offline configuration, e.g. in TwinCAT.
Above all, each EtherCAT slave carries its device description (ESI) electronically readable in a local memory chip, the so-called **ESI EEPROM**. When the slave is switched on, this description is loaded locally in the slave and informs it of its communication configuration; on the other hand, the EtherCAT master can identify the slave in this way and, among other things, set up the EtherCAT communication accordingly.

NOTICE

Application-specific writing of the ESI-EEPROM

The ESI is developed by the device manufacturer according to ETG standard and released for the corresponding product.

- Meaning for the ESI file: Modification on the application side (i.e. by the user) is not permitted.
- Meaning for the ESI EEPROM: Even if a writeability is technically given, the ESI parts in the EEPROM and possibly still existing free memory areas must not be changed beyond the normal update process. Especially for cyclic memory processes (operating hours counter etc.), dedicated memory products such as EL6080 or IPC's own NOVDRAM must be used.

- Depending on functionality and performance EtherCAT slaves have one or several local controllers for processing I/O data. The corresponding program is the so-called **firmware** in *.efw format.
- In some EtherCAT slaves the EtherCAT communication may also be integrated in these controllers. In this case the controller is usually a so-called **FPGA** chip with *.rbf firmware.

Customers can access the data via the EtherCAT fieldbus and its communication mechanisms. Acyclic mailbox communication or register access to the ESC is used for updating or reading of these data.

The TwinCAT System Manager offers mechanisms for programming all three parts with new data, if the slave is set up for this purpose. Generally the slave does not check whether the new data are suitable, i.e. it may no longer be able to operate if the data are unsuitable.

Simplified update by bundle firmware

The update using so-called **bundle firmware** is more convenient: in this case the controller firmware and the ESI description are combined in a *.efw file; during the update both the firmware and the ESI are changed in the terminal. For this to happen it is necessary

- for the firmware to be in a packed format: recognizable by the file name, which also contains the revision number, e.g. ELxxxx-xxxx_REV0016_SW01.efw

- for password=1 to be entered in the download dialog. If password=0 (default setting) only the firmware update is carried out, without an ESI update.
- for the device to support this function. The function usually cannot be retrofitted; it is a component of many new developments from year of manufacture 2016.

Following the update, its success should be verified

- ESI/Revision: e.g. by means of an online scan in TwinCAT ConfigMode/FreeRun – this is a convenient way to determine the revision
- Firmware: e.g. by looking in the online CoE of the device

NOTICE

Risk of damage to the device!

✓ Note the following when downloading new device files

a) Firmware downloads to an EtherCAT device must not be interrupted

b) Flawless EtherCAT communication must be ensured. CRC errors or LostFrames must be avoided.

c) The power supply must adequately dimensioned. The signal level must meet the specification.

⇒ In the event of malfunctions during the update process the EtherCAT device may become unusable and require re-commissioning by the manufacturer.

8.4.1 Device description ESI file/XML

NOTICE

Attention regarding update of the ESI description/EEPROM

Some slaves have stored calibration and configuration data from the production in the EEPROM. These are irretrievably overwritten during an update.

The ESI device description is stored locally on the slave and loaded on start-up. Each device description has a unique identifier consisting of slave name (9 characters/digits) and a revision number (4 digits). Each slave configured in the System Manager shows its identifier in the EtherCAT tab:

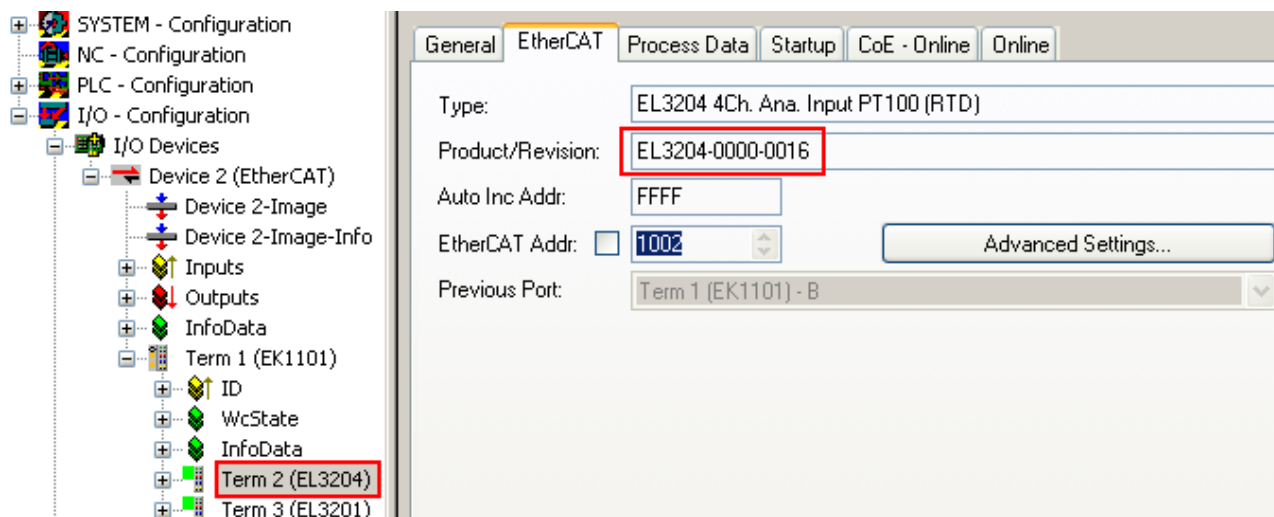


Fig. 26: Device identifier consisting of name EL3204-0000 and revision -0016

The configured identifier must be compatible with the actual device description used as hardware, i.e. the description which the slave has loaded on start-up (in this case EL3204). Normally the configured revision must be the same or lower than that actually present in the terminal network.

For further information on this, please refer to the [EtherCAT system documentation](#).

i Update of XML/ESI description

The device revision is closely linked to the firmware and hardware used. Incompatible combinations lead to malfunctions or even final shutdown of the device. Corresponding updates should only be carried out in consultation with Beckhoff support.

Display of ESI slave identifier

The simplest way to ascertain compliance of configured and actual device description is to scan the EtherCAT boxes in TwinCAT mode Config/FreeRun:

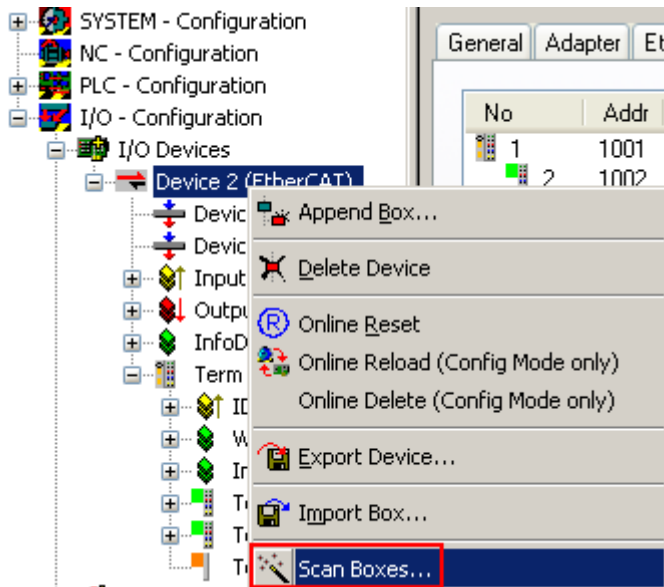


Fig. 27: Scan the subordinate field by right-clicking on the EtherCAT device

If the found field matches the configured field, the display shows



Fig. 28: Configuration is identical

otherwise a change dialog appears for entering the actual data in the configuration.

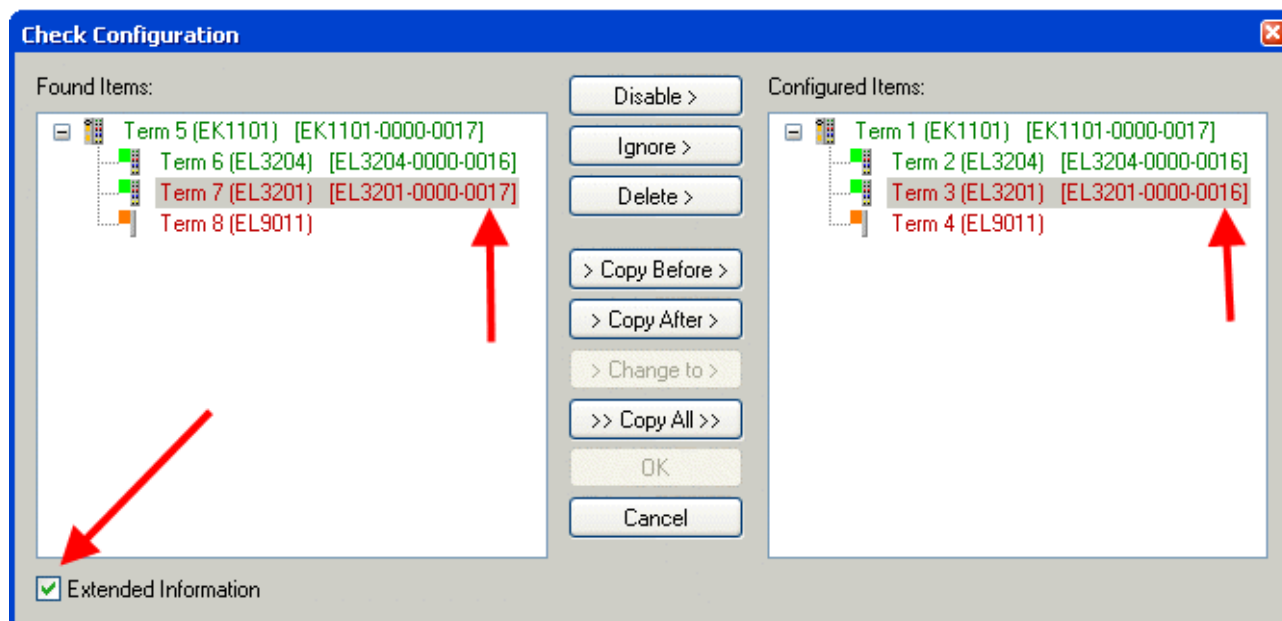


Fig. 29: Change dialog

In this example in Fig. *Change dialog*, an EL3201-0000-**0017** was found, while an EL3201-0000-**0016** was configured. In this case the configuration can be adapted with the *Copy Before* button. The *Extended Information* checkbox must be set in order to display the revision.

Changing the ESI slave identifier

The ESI/EEPROM identifier can be updated as follows under TwinCAT:

- Trouble-free EtherCAT communication must be established with the slave.
- The state of the slave is irrelevant.
- Right-clicking on the slave in the online display opens the *EEPROM Update* dialog, Fig. *EEPROM Update*

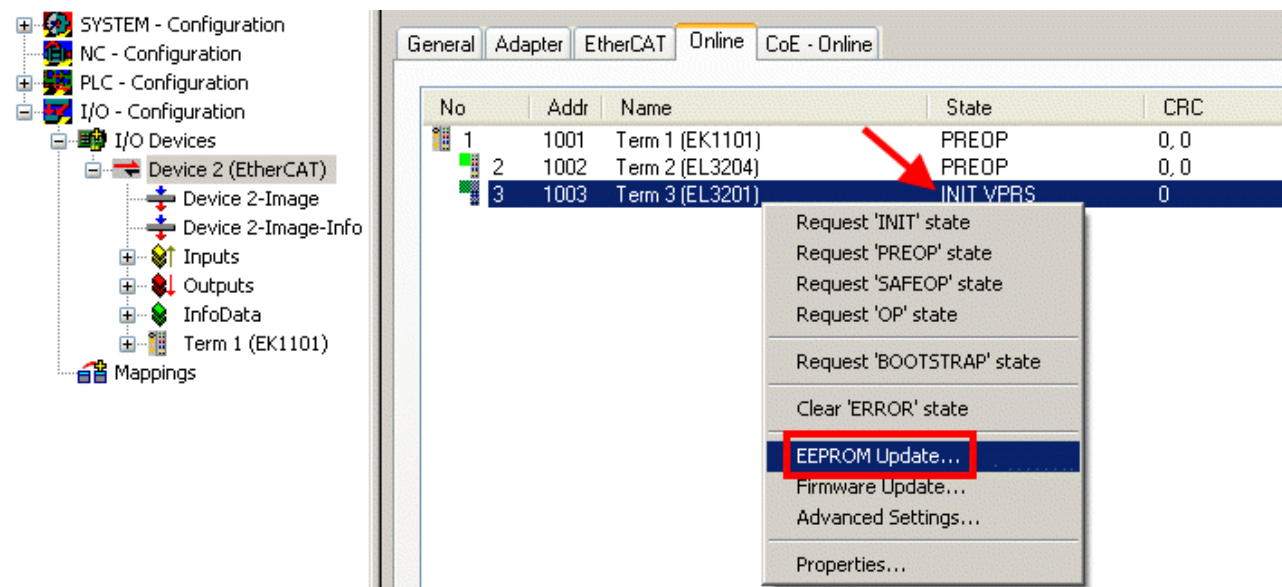


Fig. 30: EEPROM Update

The new ESI description is selected in the following dialog, see Fig. *Selecting the new ESI*. The checkbox *Show Hidden Devices* also displays older, normally hidden versions of a slave.

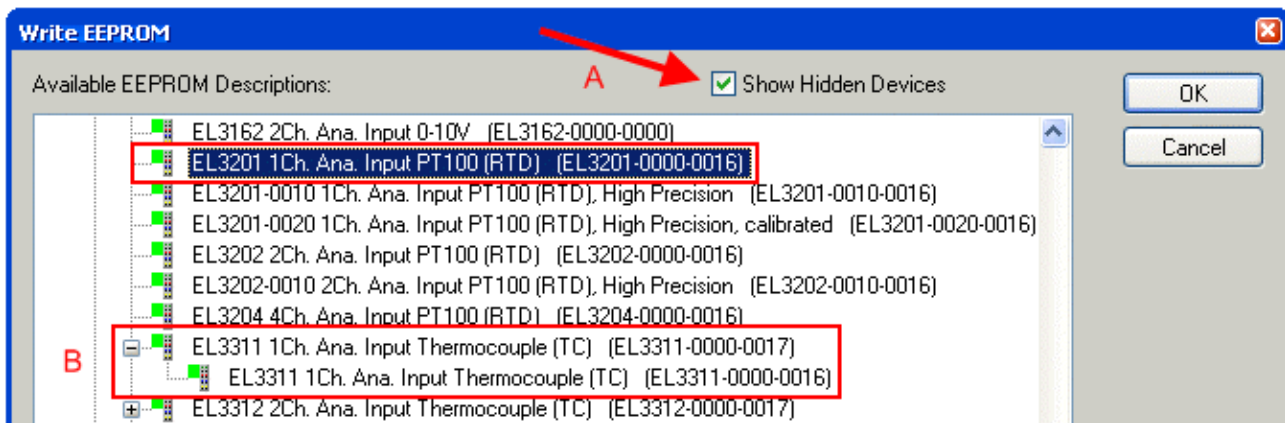


Fig. 31: Selecting the new ESI

A progress bar in the System Manager shows the progress. Data are first written, then verified.



The change only takes effect after a restart.

Most EtherCAT devices read a modified ESI description immediately or after startup from the INIT. Some communication settings such as distributed clocks are only read during power-on. The EtherCAT slave therefore has to be switched off briefly in order for the change to take effect.

8.4.2 Firmware explanation

Determining the firmware version

Determining the version via the TwinCAT System Manager

The TwinCAT System Manager shows the version of the controller firmware if the master can access the slave online. Click on the E-Bus Terminal whose controller firmware you want to check (in the example terminal 2 (EL3204)) and select the tab *CoE Online* (CAN over EtherCAT).



CoE Online and Offline CoE

Two CoE directories are available:

- **online:** This is offered in the EtherCAT slave by the controller, if the EtherCAT slave supports this. This CoE directory can only be displayed if a slave is connected and operational.
- **offline:** The EtherCAT Slave Information ESI/XML may contain the default content of the CoE. This CoE directory can only be displayed if it is included in the ESI (e.g. "Beckhoff EL5xxx.xml").

The Advanced button must be used for switching between the two views.

In Fig. *Display of EL3204 firmware version* the firmware version of the selected EL3204 is shown as 03 in CoE entry 0x100A.

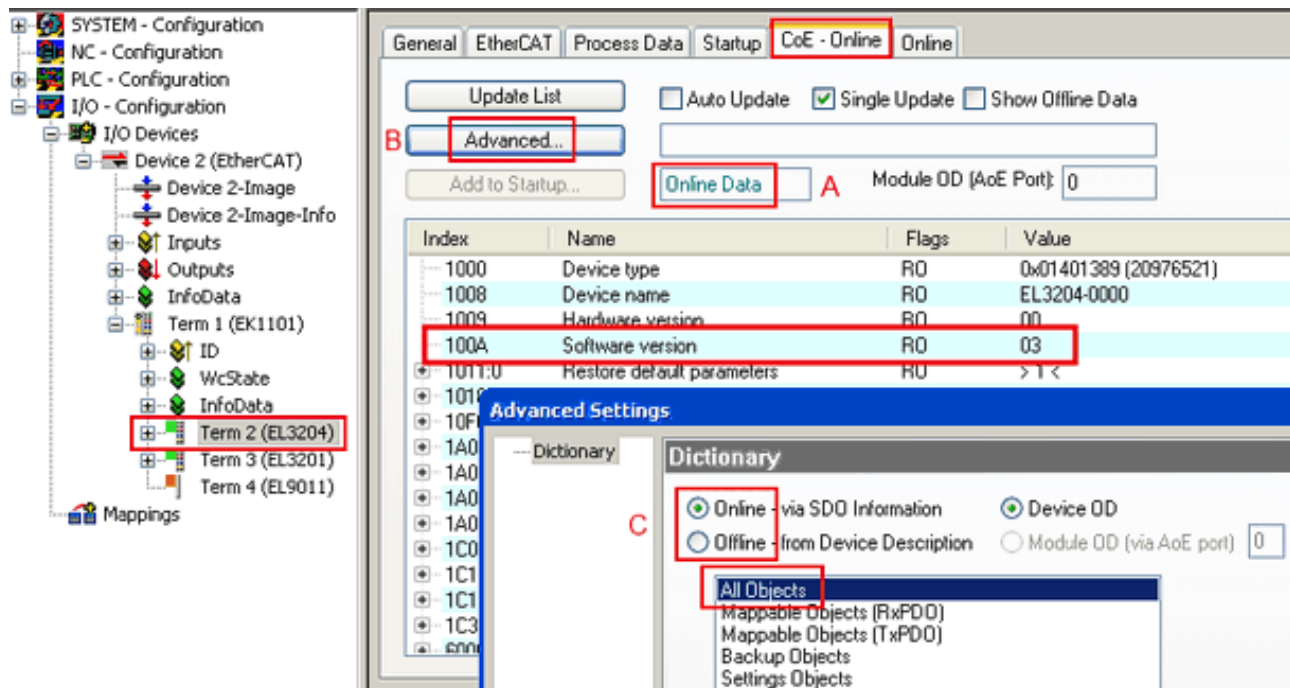


Fig. 32: Display of EL3204 firmware version

In (A) TwinCAT 2.11 shows that the Online CoE directory is currently displayed. If this is not the case, the Online directory can be loaded via the *Online* option in Advanced Settings (B) and double-clicking on *All Objects*.

8.4.3 Updating controller firmware *.efw



CoE directory

The Online CoE directory is managed by the controller and stored in a dedicated EEPROM, which is generally not changed during a firmware update.

Switch to the *Online* tab to update the controller firmware of a slave, see Fig. *Firmware Update*.

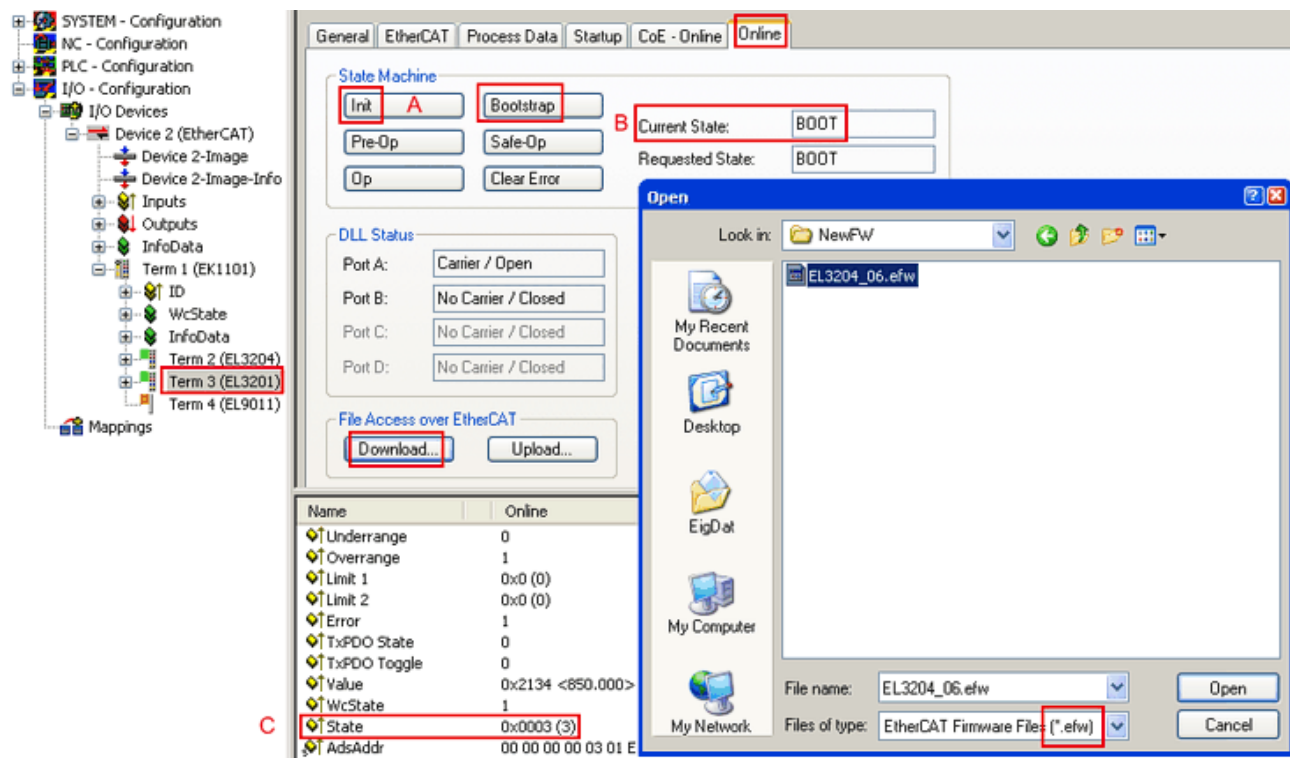
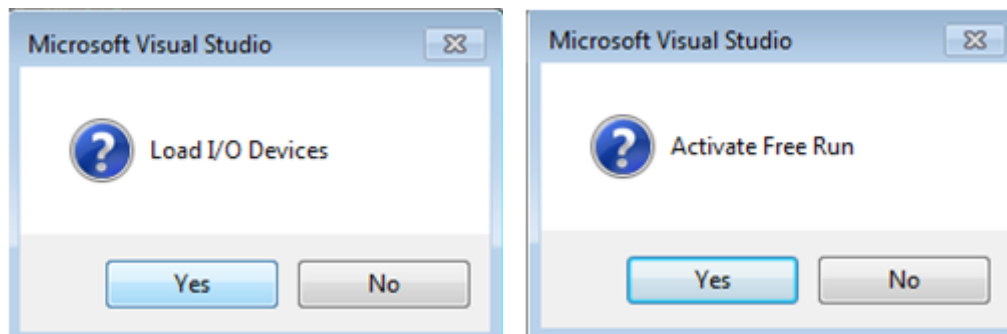


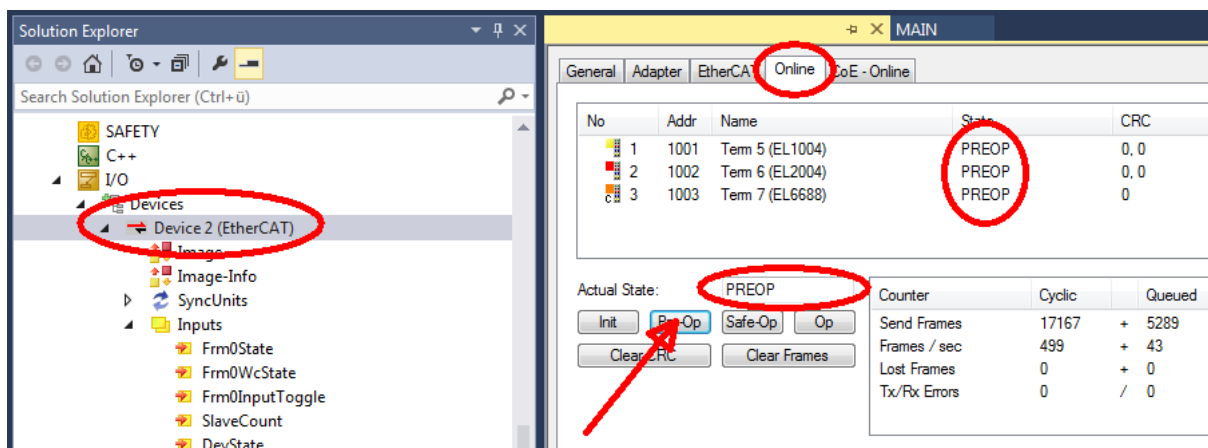
Fig. 33: Firmware Update

Proceed as follows, unless instructed otherwise by Beckhoff support. Valid for TwinCAT 2 and 3 as EtherCAT master.

- Switch TwinCAT system to ConfigMode/FreeRun with cycle time ≥ 1 ms (default in ConfigMode is 4 ms). A FW-Update during real time operation is not recommended.

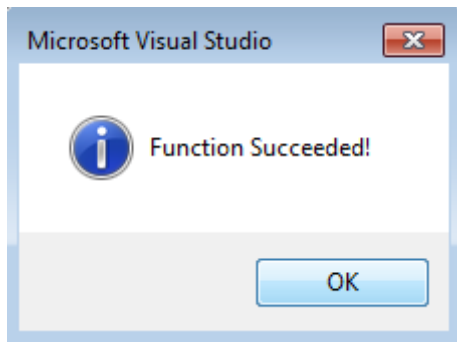


- Switch EtherCAT Master to PreOP



- Switch slave to INIT (A)
- Switch slave to BOOTSTRAP

- Check the current status (B, C)
- Download the new *efw file (wait until it ends). A password will not be necessary usually.



- After the download switch to INIT, then PreOP
- Switch off the slave briefly (don't pull under voltage!)
- Check within CoE 0x100A, if the FW status was correctly overtaken.

8.4.4 FPGA firmware *.rbf

If an FPGA chip deals with the EtherCAT communication an update may be accomplished via an *.rbf file.

- Controller firmware for processing I/O signals
- FPGA firmware for EtherCAT communication (only for terminals with FPGA)

The firmware version number included in the terminal serial number contains both firmware components. If one of these firmware components is modified this version number is updated.

Determining the version via the TwinCAT System Manager

The TwinCAT System Manager indicates the FPGA firmware version. Click on the Ethernet card of your EtherCAT strand (Device 2 in the example) and select the *Online* tab.

The *Reg:0002* column indicates the firmware version of the individual EtherCAT devices in hexadecimal and decimal representation.

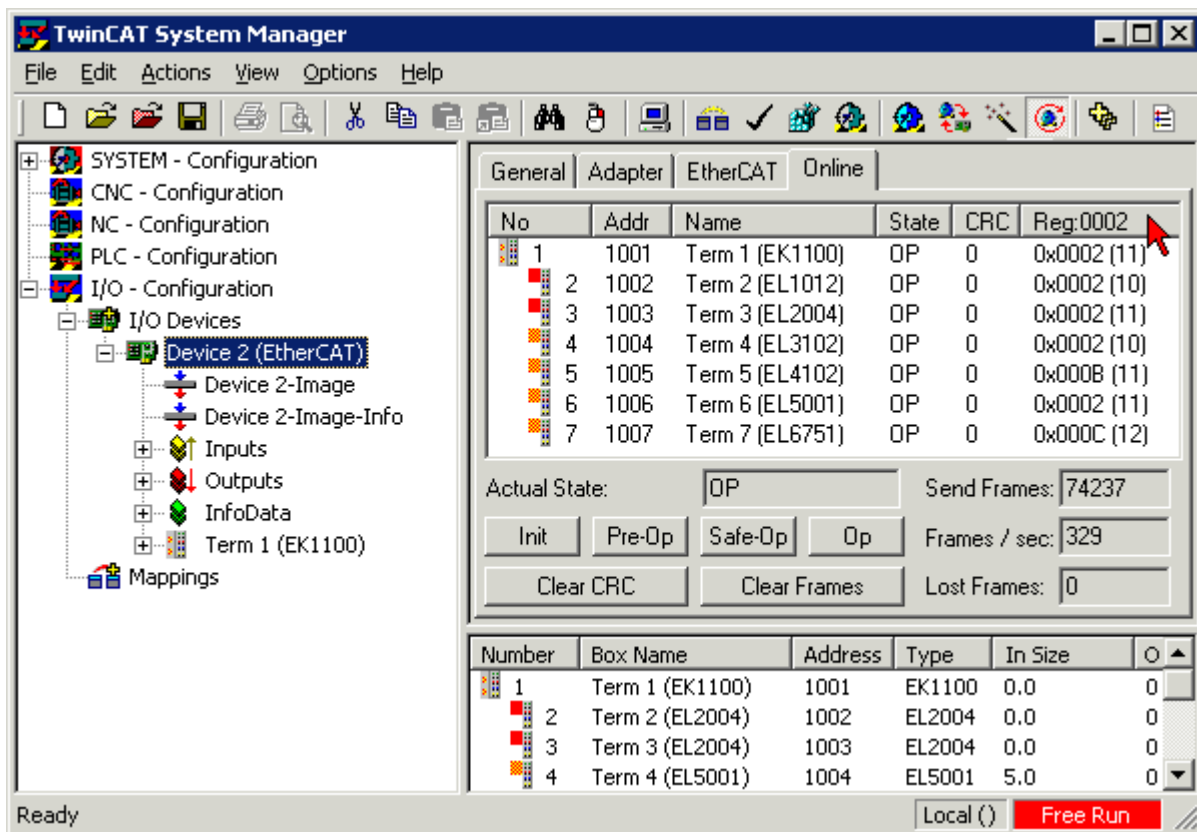
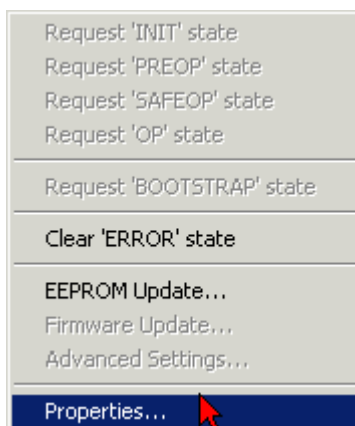


Fig. 34: FPGA firmware version definition

If the column *Reg:0002* is not displayed, right-click the table header and select *Properties* in the context menu.

Fig. 35: Context menu *Properties*

The *Advanced Settings* dialog appears where the columns to be displayed can be selected. Under *Diagnosis/Online View* select the *'0002 ETxxxx Build'* check box in order to activate the FPGA firmware version display.

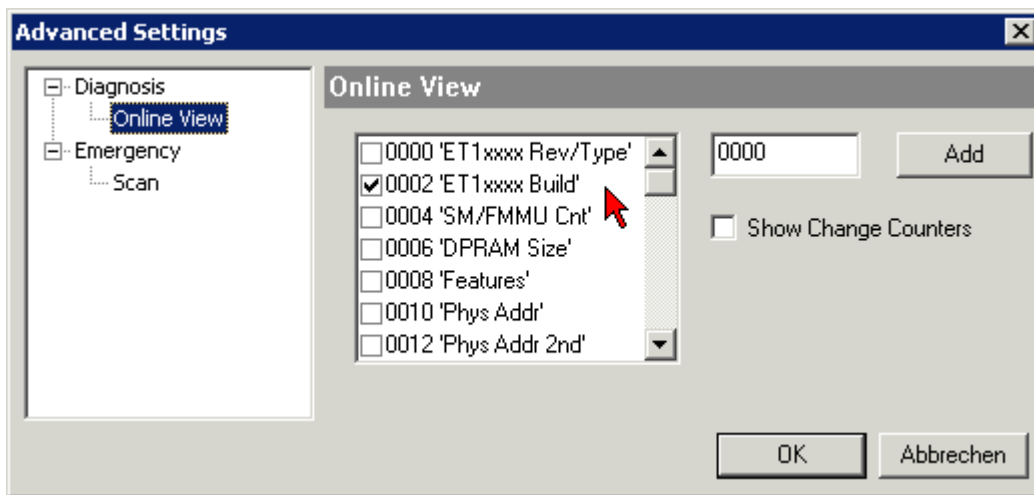


Fig. 36: Dialog *Advanced Settings*

Update

For updating the FPGA firmware

- of an EtherCAT coupler the coupler must have FPGA firmware version 11 or higher;
- of an E-Bus Terminal the terminal must have FPGA firmware version 10 or higher.

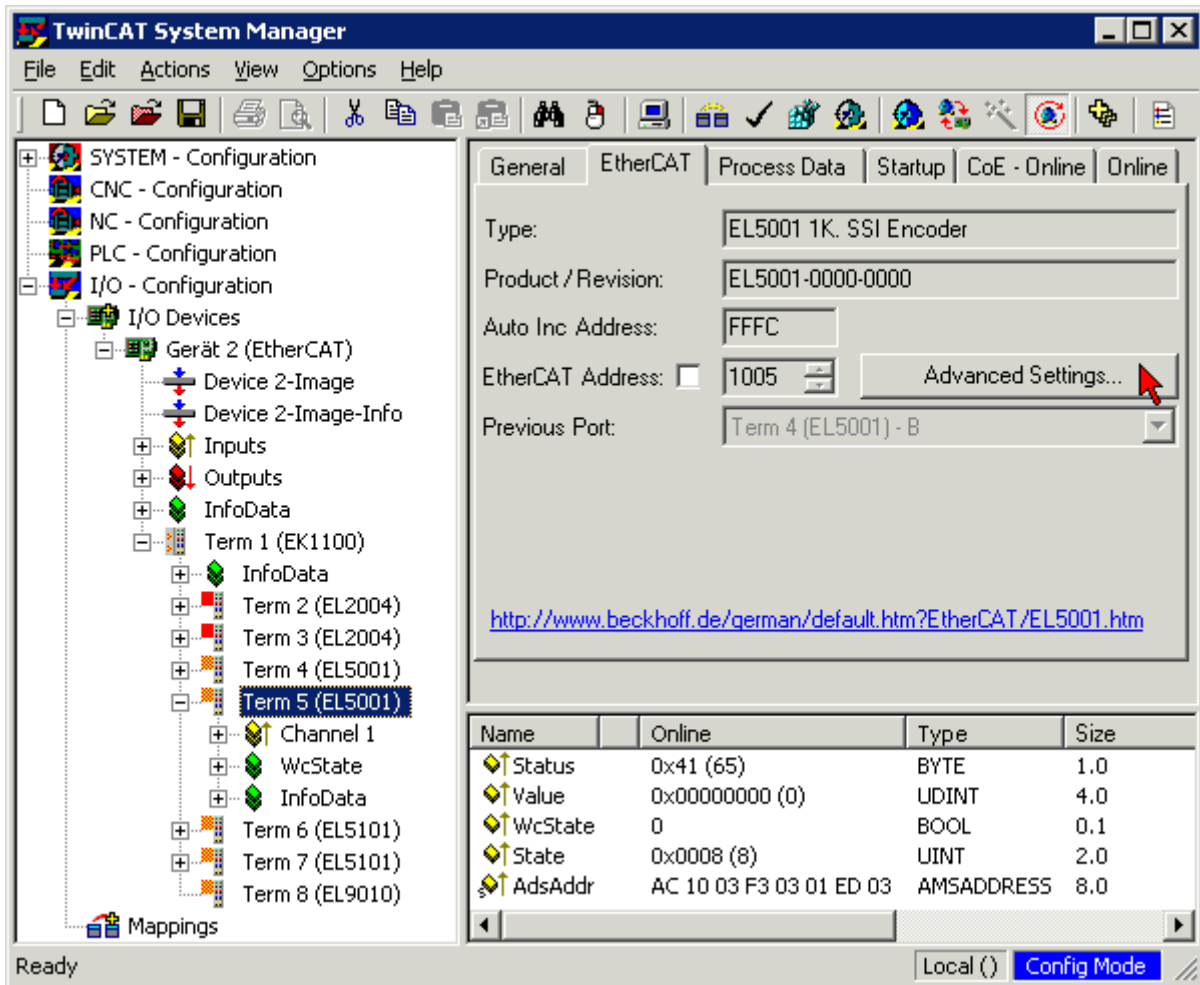
Older firmware versions can only be updated by the manufacturer!

Updating an EtherCAT device

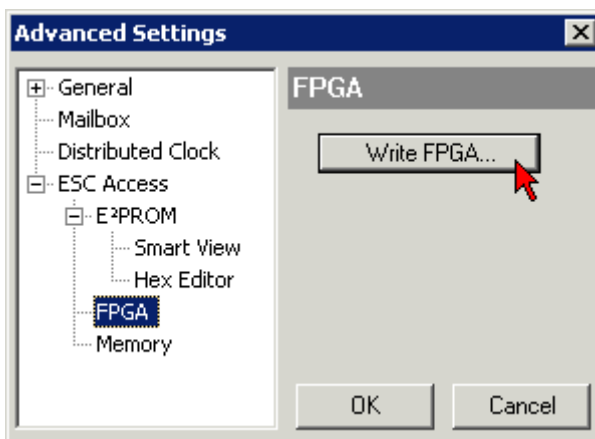
The following sequence order have to be met if no other specifications are given (e.g. by the Beckhoff support):

- Switch TwinCAT system to ConfigMode/FreeRun with cycle time ≥ 1 ms (default in ConfigMode is 4 ms). A FW-Update during real time operation is not recommended.

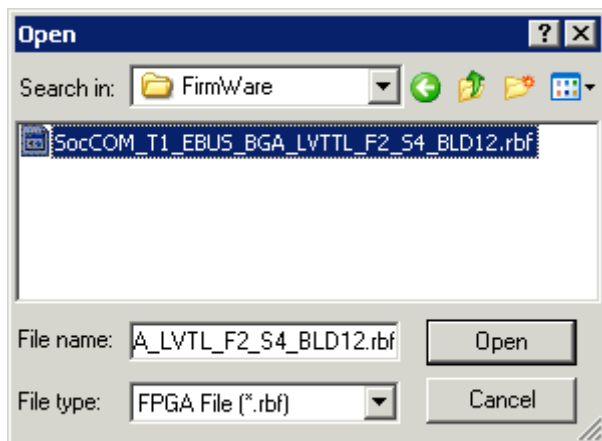
- In the TwinCAT System Manager select the terminal for which the FPGA firmware is to be updated (in the example: Terminal 5: EL5001) and click the *Advanced Settings* button in the *EtherCAT* tab:



- The *Advanced Settings* dialog appears. Under *ESC Access/E²PROM/FPGA* click on *Write FPGA* button:



- Select the file (*.rbf) with the new FPGA firmware, and transfer it to the EtherCAT device:



- Wait until download ends
- Switch slave current less for a short time (don't pull under voltage!). In order to activate the new FPGA firmware a restart (switching the power supply off and on again) of the EtherCAT device is required.
- Check the new FPGA status

NOTICE

Risk of damage to the device!

A download of firmware to an EtherCAT device must not be interrupted in any case! If you interrupt this process by switching off power supply or disconnecting the Ethernet link, the EtherCAT device can only be recommissioned by the manufacturer!

8.4.5 Simultaneous updating of several EtherCAT devices

The firmware and ESI descriptions of several devices can be updated simultaneously, provided the devices have the same firmware file/ESI.

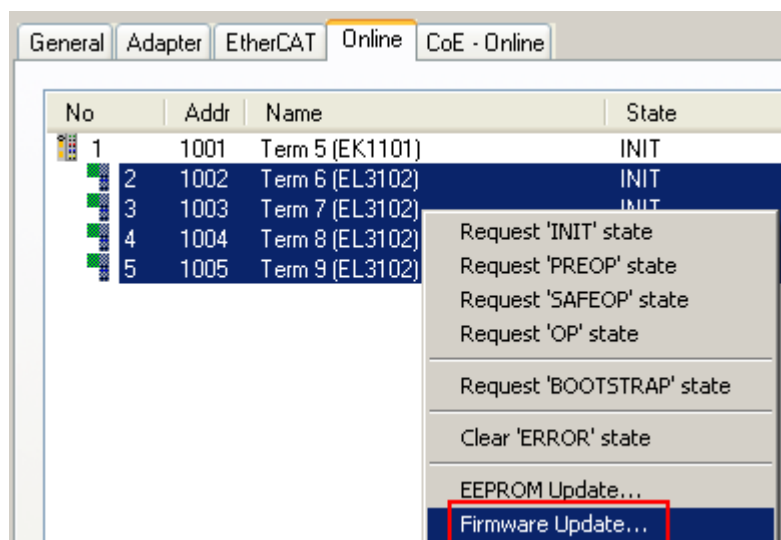


Fig. 37: Multiple selection and firmware update

Select the required slaves and carry out the firmware update in BOOTSTRAP mode as described above.

8.5 Master device file GSDML

The GSDML file describes a PROFINET device. This file is necessary for the PROFINET Controller, and must be integrated in the corresponding configuration software. The necessary GSDML files can be found in the TwinCAT\IO\PROFINET folder or on the [homepage](#).

Comment	GSDML File Name*	PROFINET Device
Supplement PROFINET Device	GSDML-V2.1-beckhoff-TCPNDevice-20091009	PROFINET device for FC9xxx cards with Intel® chipset or Ethernet interfaces with Intel® chipset, for OS with XP, XPemb
Supplement PROFINET Device CE	GSDML-V2.1-beckhoff-TCPNDevice-20091009	PROFINET device for FC9xxx cards with Intel® chipset or Ethernet interfaces with Intel® chipset, for OS CE
EL6631-0010	GSDML-V2.2-beckhoff-EL6631-20100309.xml	EL6631-0010
EL6633-0010	GSDML-V2.44-beckhoff-EL6633-20241219.xml	EL6633-0010

* The file name may change as new features or versions are introduced.

8.6 Support and Service

Beckhoff and their partners around the world offer comprehensive support and service, making available fast and competent assistance with all questions related to Beckhoff products and system solutions.

Beckhoff's branch offices and representatives

Please contact your Beckhoff branch office or representative for local support and service on Beckhoff products!

The addresses of Beckhoff's branch offices and representatives round the world can be found on her internet pages: www.beckhoff.com

You will also find further documentation for Beckhoff components there.

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The Beckhoff Support offers you comprehensive technical assistance, helping you not only with the application of individual Beckhoff products, but also with other, wide-ranging services:

- support
- design, programming and commissioning of complex automation systems
- and extensive training program for Beckhoff system components

Hotline: +49 5246 963 157
e-mail: support@beckhoff.com
web: www.beckhoff.com/support

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- spare parts service
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Hotline: +49 5246 963 460
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web: www.beckhoff.com/service

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