

BECKHOFF New Automation Technology

Manual | EN

TF6270

TwinCAT 3 | PROFINET RT Device

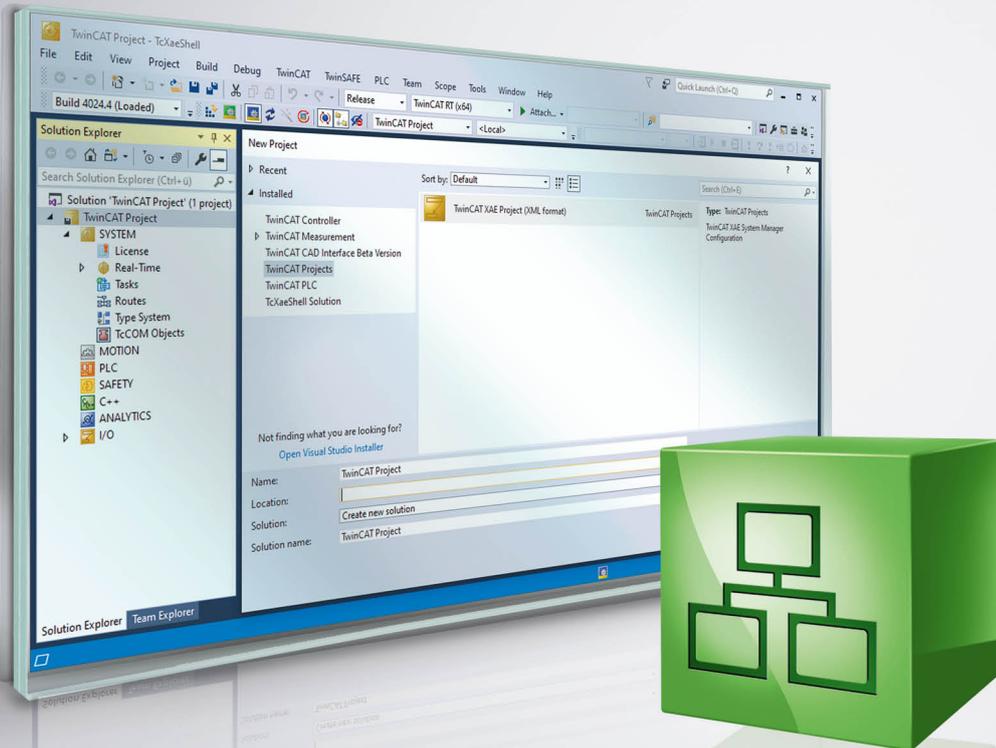


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1 Foreword

1.1 Notes on the documentation

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

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

It is the duty of the technical personnel to use the documentation published at the respective time of each installation and commissioning.

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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Patent Pending

The EtherCAT Technology is covered, including but not limited to the following patent applications and patents:

EP1590927, EP1789857, EP1456722, EP2137893, DE102015105702
with corresponding applications or registrations in various other countries.



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1.2 Safety instructions

Safety regulations

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

Exclusion of liability

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

Personnel qualification

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

Description of symbols

In this documentation the following symbols are used with an accompanying safety instruction or note. The safety instructions must be read carefully and followed without fail!

DANGER

Serious risk of injury!

Failure to follow the safety instructions associated with this symbol directly endangers the life and health of persons.

WARNING

Risk of injury!

Failure to follow the safety instructions associated with this symbol endangers the life and health of persons.

CAUTION

Personal injuries!

Failure to follow the safety instructions associated with this symbol can lead to injuries to persons.

NOTE

Damage to the environment or devices

Failure to follow the instructions associated with this symbol can lead to damage to the environment or equipment.



Tip or pointer

This symbol indicates information that contributes to better understanding.

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.

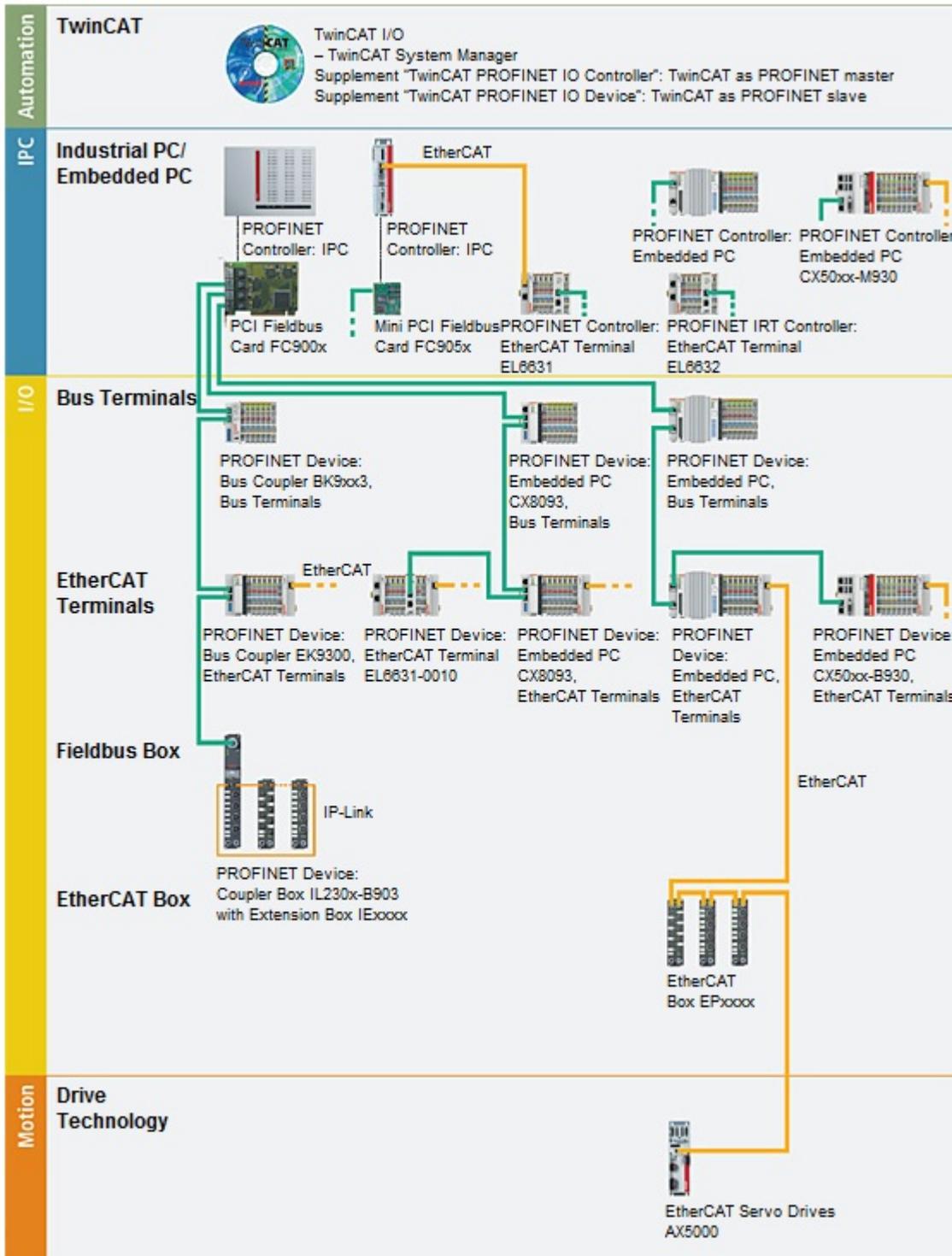
In addition, the recommendations from Beckhoff regarding appropriate protective measures should be observed. Further information regarding information security and industrial security can be found in our <https://www.beckhoff.com/secguide>.

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>.

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 exchange of data between controllers and field devices in several real-time classes: RT (software-based real-time) and IRT (hardware-supported 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
CX50xx-B930	Embedded PC with optional PROFINET RT Device interface
EtherCAT Terminals	
EL6631-0010	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 overview

3.1 Function TF6270

The TwinCAT PROFINET RT Device (slave) is a supplement that turns any PC-based controller with an Intel® chipset and the real-time Ethernet driver developed by Beckhoff into a PROFINET-RT device. A standard Ethernet interface becomes a PROFINET slave.

3.1.1 Technical data

Technical data	TF6270																
Runtime	TC1100																
Target system	Windows XP, Windows 7/8/10, Windows CE																
PROFINET version	Conformance class B, optionally conformance class C																
Number of channels	2 (switched)																
Ethernet interfaces	100BASE-TX Ethernet with 2 x RJ45																
Number of device interfaces	Supplement 8, CCAT or EL663x-0010 2																
Topology	variable																
Quantity of user data	Maximum of one Ethernet frame length, approx. 1500 bytes of user data incl. IOPS and IOCS per device																
Cycle time (min.)	RTC1 1 ms, RTC3 250 us																
Performance class (pp)	<table border="1"> <tr> <td>20</td> <td>30</td> <td>40</td> <td>50</td> <td>60</td> <td>70</td> <td>80</td> <td>90</td> </tr> <tr> <td>–</td> <td>–</td> <td>x</td> <td>x</td> <td>x</td> <td>x</td> <td>x</td> <td>x</td> </tr> </table>	20	30	40	50	60	70	80	90	–	–	x	x	x	x	x	x
20	30	40	50	60	70	80	90										
–	–	x	x	x	x	x	x										

Ordering information

TF6270-00pp	TC3 PROFINET RT Device
-------------	------------------------

3.1.2 Requirements

Software

TF6270 is included from the TwinCAT 3.1 Build 4018 version

Hardware

For using the TF6270, the target system has to have an Intel® network chipset. (See: Checking the hardware requirements)



Beckhoff PC

Beckhoff PC systems are usually preconfigured for the operation of Profinet devices

3.1.3 Licensing

The TwinCAT 3 function can be activated as a full version or as a 7-day test version. Both license types can be activated via the TwinCAT 3 development environment (XAE).

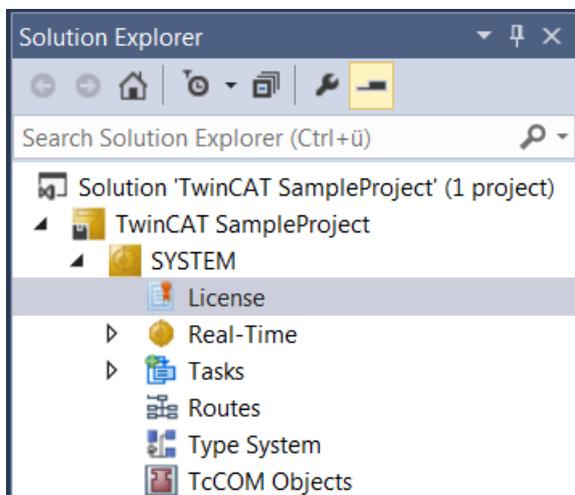
Licensing the full version of a TwinCAT 3 Function

A description of the procedure to license a full version can be found in the Beckhoff Information System in the documentation "[TwinCAT 3 Licensing](#)".

Licensing the 7-day test version of a TwinCAT 3 Function

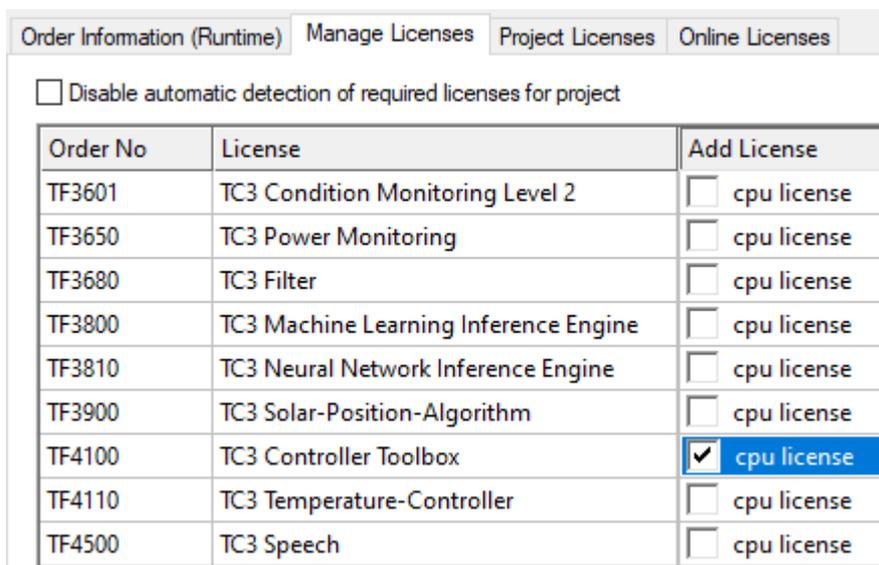
i A 7-day test version cannot be enabled for a TwinCAT 3 license dongle.

1. Start the TwinCAT 3 development environment (XAE).
2. Open an existing TwinCAT 3 project or create a new project.
3. If you want to activate the license for a remote device, set the desired target system. To do this, select the target system from the **Choose Target System** drop-down list in the toolbar.
 - ⇒ The licensing settings always refer to the selected target system. When the project is activated on the target system, the corresponding TwinCAT 3 licenses are automatically copied to this system.
4. In the **Solution Explorer**, double-click **License** in the **SYSTEM** subtree.



⇒ The TwinCAT 3 license manager opens.

5. Open the **Manage Licenses** tab. In the **Add License** column, check the check box for the license you want to add to your project (e.g. "TF4100 TC3 Controller Toolbox").



6. Open the **Order Information (Runtime)** tab.

⇒ In the tabular overview of licenses, the previously selected license is displayed with the status "missing".

7. Click **7-Day Trial License...** to activate the 7-day trial license.

The screenshot shows a software interface with several sections:

- Order Information (Runtime)**: Includes tabs for 'Manage Licenses', 'Project Licenses', and 'Online Licenses'.
- License Device**: A dropdown menu set to 'Target (Hardware Id)' with an 'Add...' button.
- System Id**: A text field containing '2DB25408-B4CD-81DF-5488-6A3D9B49EF19'.
- Platform**: A dropdown menu set to 'other (91)'.
- License Request**: Includes a 'Provider' dropdown set to 'Beckhoff Automation', a 'Generate File...' button, and empty fields for 'License Id', 'Customer Id', and 'Comment'.
- License Activation**: Contains two buttons: '7 Days Trial License...' (highlighted with a red box) and 'License Response File...'.

⇒ A dialog box opens, prompting you to enter the security code displayed in the dialog.

The dialog box titled 'Enter Security Code' contains:

- A prompt: 'Please type the following 5 characters:'
- A text field containing the code 'Kg8T4'.
- An 'OK' button (highlighted with a red box) and a 'Cancel' button.
- Below the text field, there are two empty input boxes (one highlighted with a red box) for entering the characters.

8. Enter the code exactly as it is displayed and confirm the entry.

9. Confirm the subsequent dialog, which indicates the successful activation.

⇒ In the tabular overview of licenses, the license status now indicates the expiry date of the license.

10. Restart the TwinCAT system.

⇒ The 7-day trial version is enabled.

3.2 Optional Interface, -B930

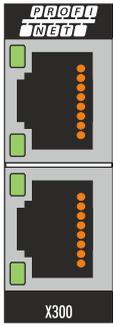
It is possible to order Embedded PCs with a fieldbus or serial interface such as the "PROFINET RT, Device, Ethernet (2 x RJ-45 switch)". The optional interface must be ordered ex factory and cannot be retrofitted retrospectively.

3.2.1 Technical data

Technical data	-B930
Fieldbus	PROFINET RT Device
Data transfer rate	100 Mbaud
Bus interface	2 x RJ45 switched
Extendable process image	1 virtual slave in addition
Max. process image	2 slaves x (1440 bytes in / 1440 bytes out)
Properties	RTClass 1

3.2.2 PROFINET connection

The optional interface is identified as "X300" on the devices and has as black border to identify it.



LAN assignment (x300)



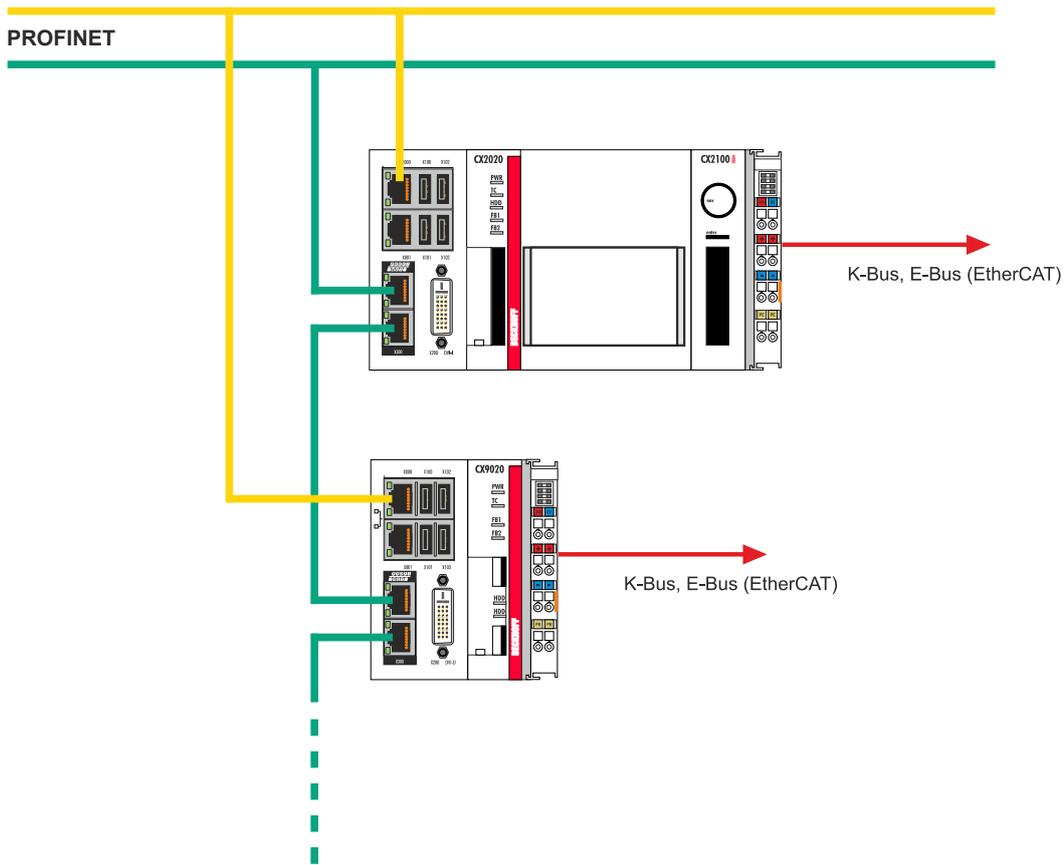
PIN	Signal	Description
1	TD +	Transmit +
2	TD -	Transmit -
3	RD +	Receive +
4	connected	reserved
5		
6	RD -	Receive -
7	connected	reserved
8		

3.2.3 Topology

Example for a PROFINET topology:

Ethernet

PROFINET



3.3 EtherCAT Terminal, EL6631-0010



The EL6631-0010 PROFINET-IO device (slave) terminal allows easy data exchange between EtherCAT and PROFINET IO. It is a device in the EtherCAT segment, which can consist of up to 65,535 devices. The EL6631-0010 has a 3-port switch. Two ports are fed to the outside on RJ-45 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.

3.3.1 Technical data EL6631-0010

Technical data	EL6631-0010
Bus system	PROFINET RT Device
Number of Ethernet ports	2
Ethernet interface	100BASE-TX Ethernet with 2 x RJ45
Cable length	up to 100 m twisted pair
Data transfer rate	100 Mbit/s, IEEE 802.3u auto-negotiation full duplex at 10 and 100 Mbit/s possible, settings automatic
Diagnosis	Status LEDs
Power supply	via the E-bus
Current consumption via E-bus	typ. 400 mA
Electrical isolation	500 V (E-bus/Ethernet)
Bit width in process image	variable (max. 2 kB for inputs and outputs)
Configuration	via the TwinCAT System Manager
Weight	approx. 75 g
Permissible ambient temperature range during operation	0 °C ... + 55 °C (aligned in horizontal installation position) 0 °C ... + 45 °C (all other installation positions, see notice)
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)
Mounting	on 35 mm support rail according 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 class	IP20
Installation position	see notice
Approval	CE ATEX cULus

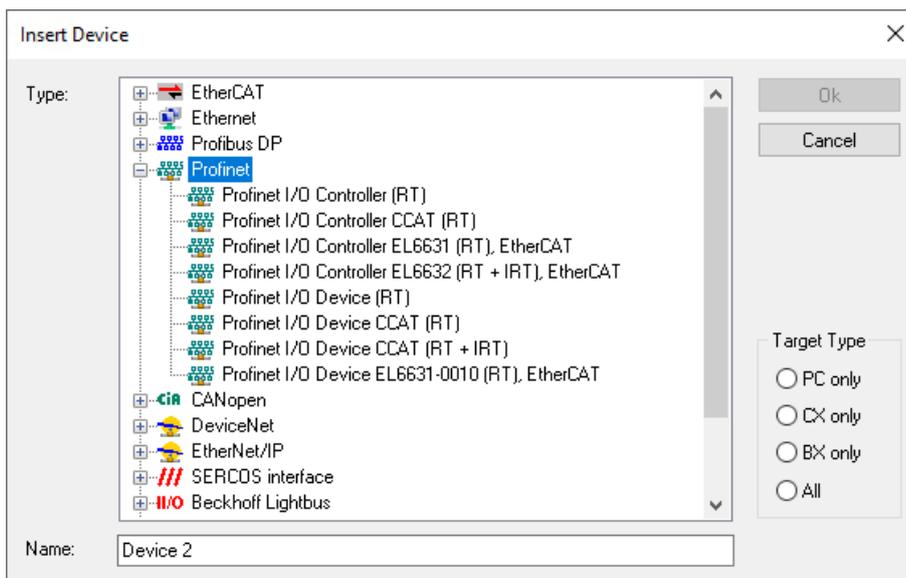
4 Commissioning

The following steps are necessary for the initial commissioning of a data exchange with a PROFINET Device.

4.1 Protocol selection

PROFINET devices must be attached directly to the I/O device, whether controller or device. Exceptions are optional interfaces (-B930, -M930), which can be added via the Scan function (CCAT).

Right-click **I/O – Devices** > **Add New Item...** and you can choose between four different PROFINET I/O device protocols.

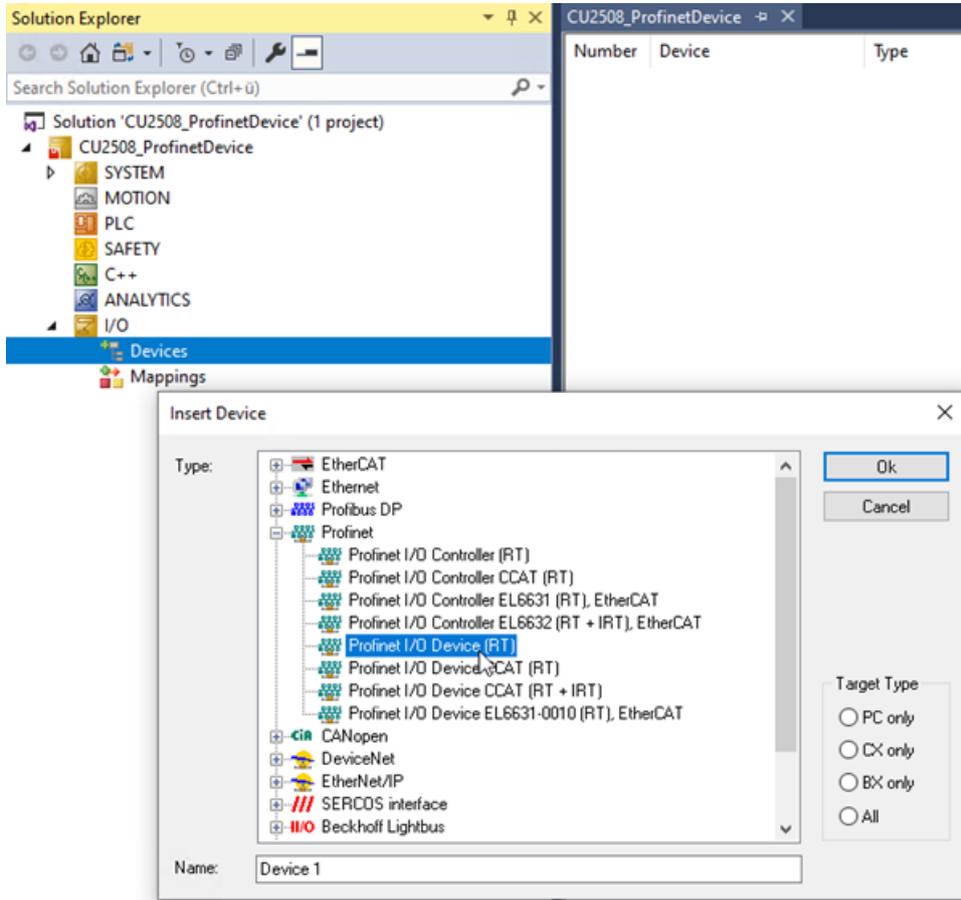


with the purposes described below.

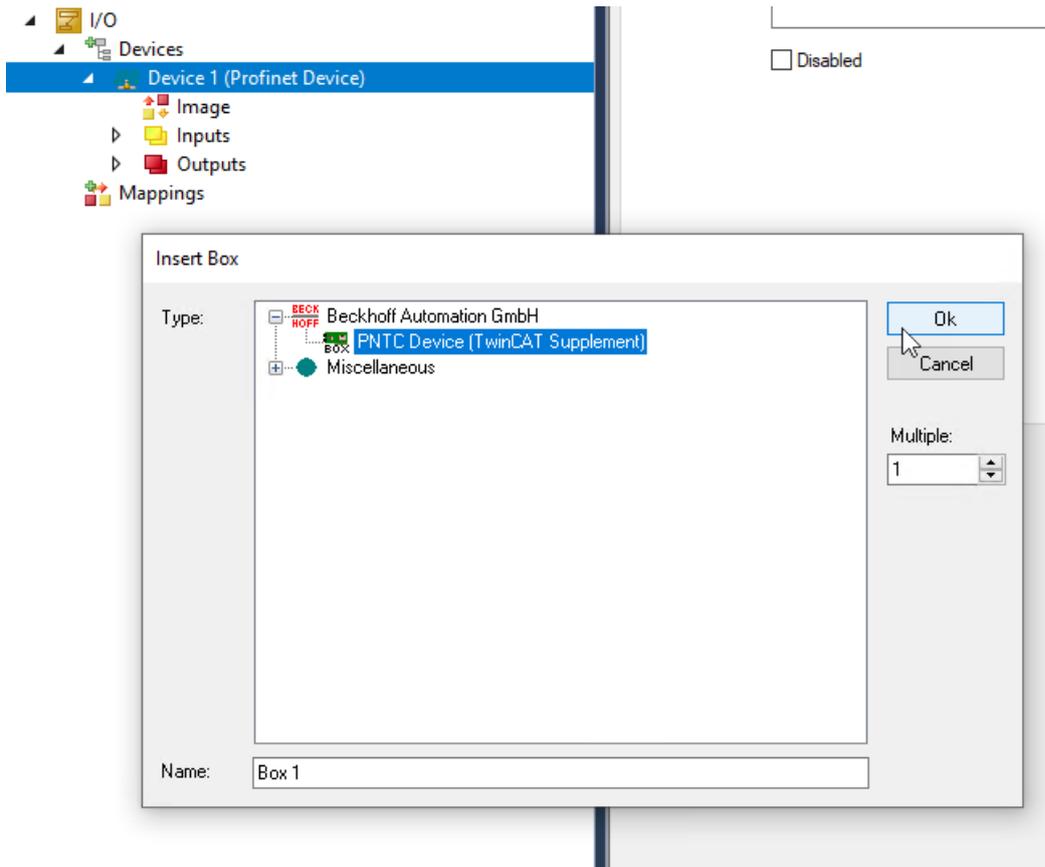
- **Profinet I/O Device (RT):** Use of the TF6720 function in conjunction with an Intel chipset
- **Profinet I/O Device CCAT (RT):** Uses CCAT-based hardware (e.g. CXxxxx or FC932x) with RT (RTC1) ordering option
- **Profinet I/O Device CCAT (RT + IRT):** Uses CCAT-based hardware (e.g. CXxxxx or FC932x) with IRT (RTC3) ordering option
- **Profinet I/O Device EL6631-0010 (RT):** Uses the EL6631-0010 EtherCAT Profinet gateway terminal

4.1.1 Integration via a Real-Time Ethernet interface

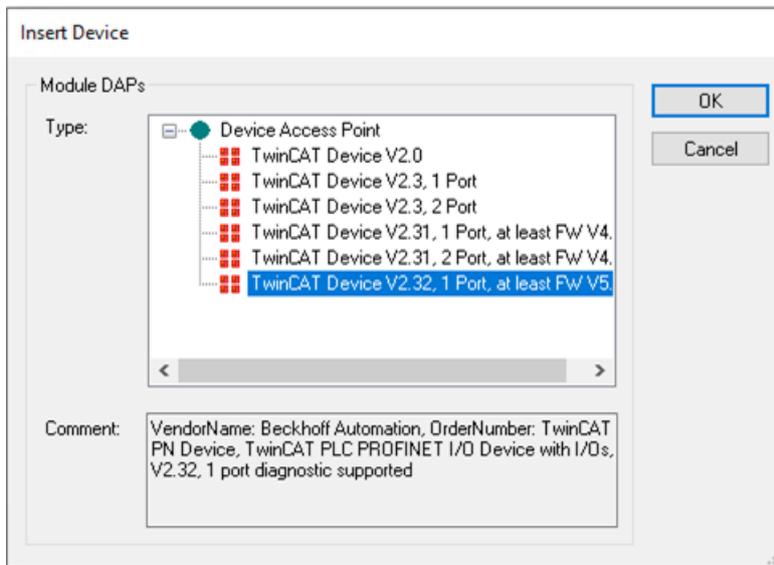
1. Select the PROFINET I/O device (RT) according to the configuration. The available adapters are displayed directly when appended and are now available for selection. If these are to be modified or checked afterwards, this can take place on the Adapter tab.



- Right-click the created PROFINET Device and select **Add New Item** to integrate a box in the form of a GSDML. The following window will then open. At this point, select **PNTC Device (TwinCAT Supplement)** and confirm with **OK**.



- In the dialog that opens, **Insert Device**, you define the version with which the PROFINET Device should be integrated. Confirm your choice with **OK**



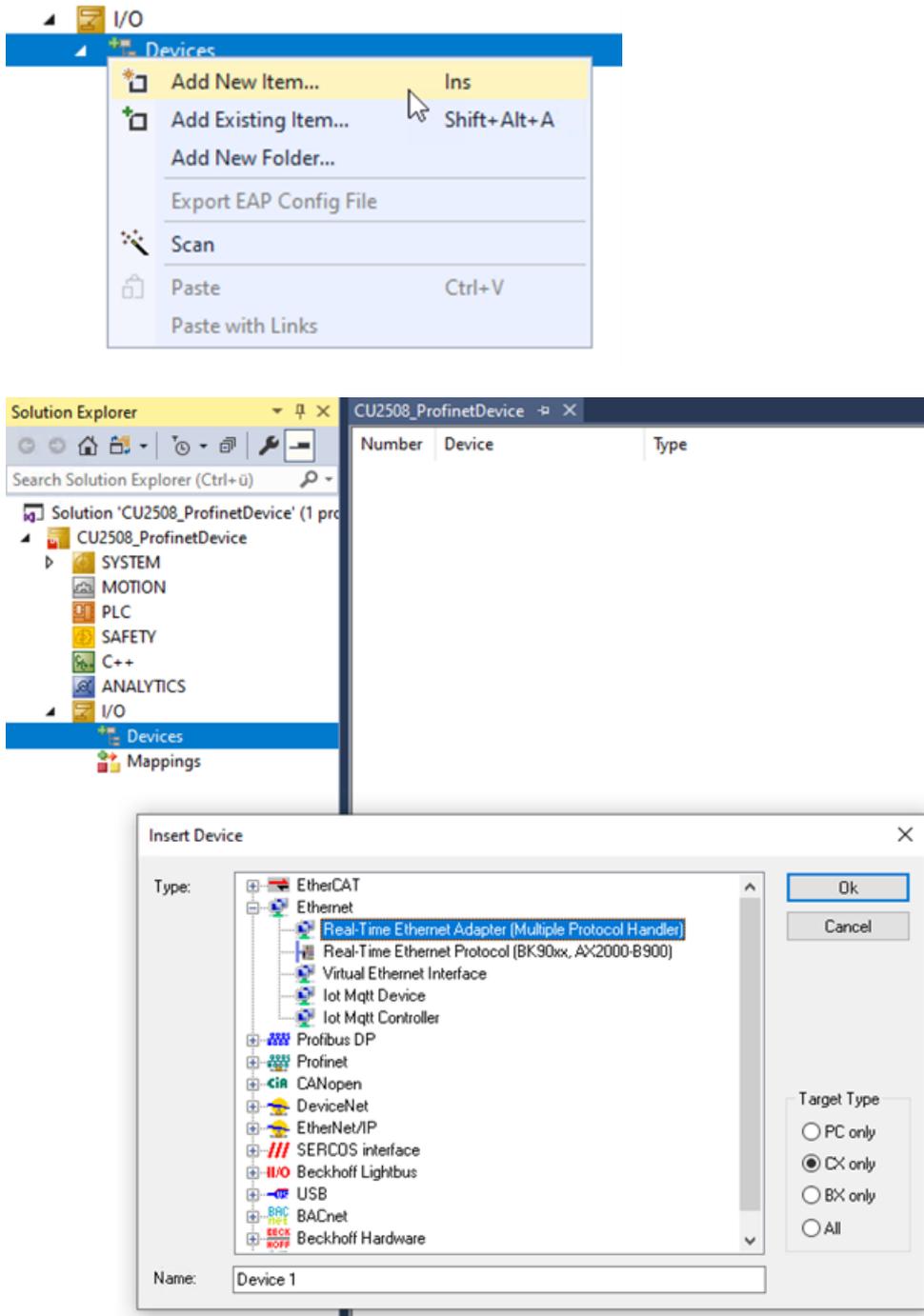
Further information can be found in the chapter [Creating modules/process data on the PROFINET Device](#) [▶ 32]

4.1.2 Integration via a CU2508 real-time Ethernet port multiplier (Real-Time Ethernet interface)

Below, we show you how to configure a PROFINET Device using the CU2508 real-time Ethernet port multiplier.

However, you can use only one controller or device, if they are in a unique network. If the networks are physically separated, it is possible to use more than one controller or device supplemented with one CU2508. This is due to the fact, that the CU2508 uses only one MAC address. The function of several PROFINET segments can only be secured, if the MAC address in a network segment is unique and there is no connection to other networks.

1. Add the CU2508 real-time Ethernet port multiplier to your TwinCAT project by right-clicking on **I/O - Devices > Add New Item** and adding the Real-Time Ethernet Adapter (Multiple Protocol Handler) in the window that opens.



2. Furthermore, the following settings on the **Ports** tab are necessary for the operation of the CU2508
Virtual Port Selection via:
EtherCAT Switch Link Protocol (ESL) (CU25xx required)

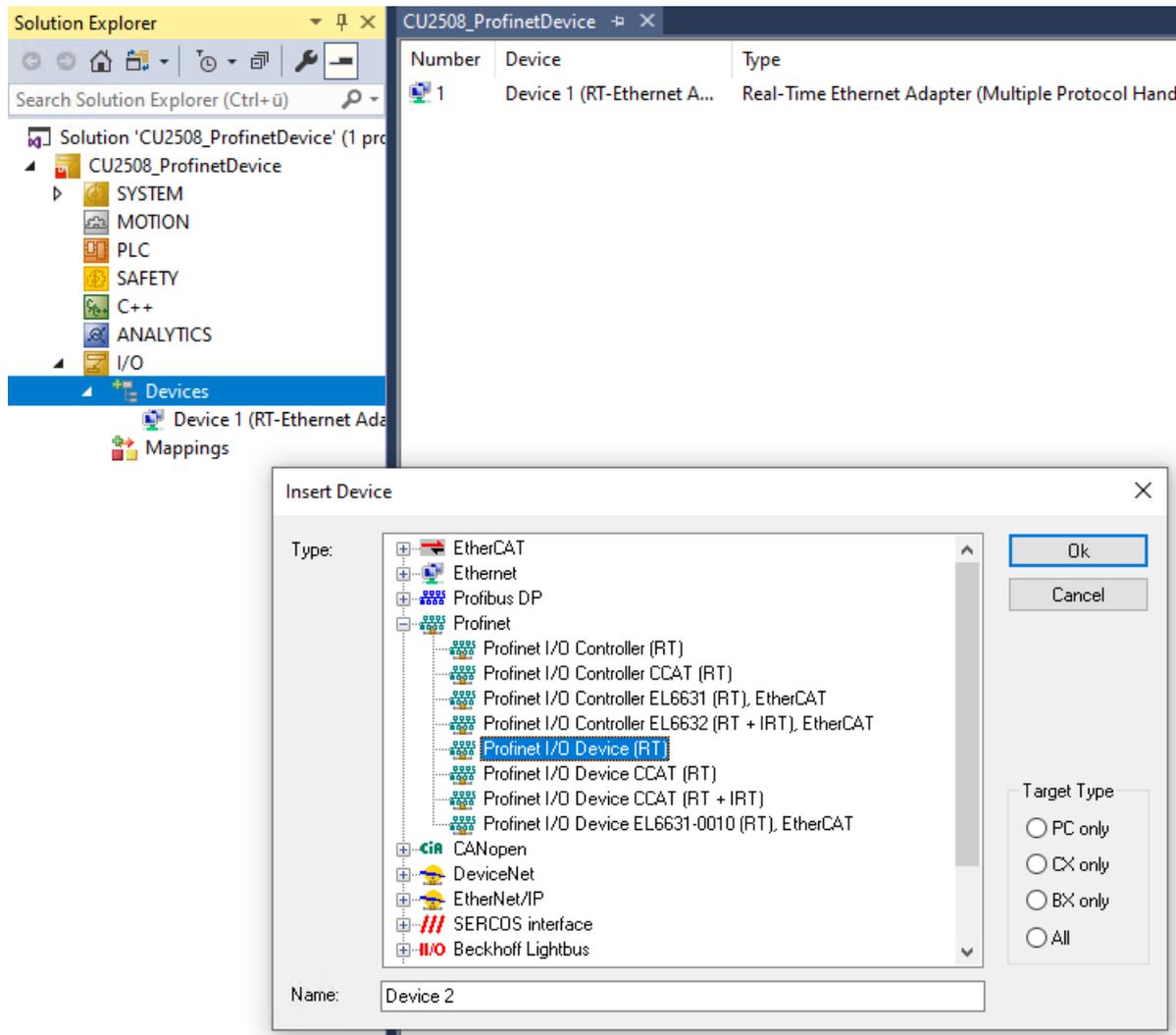
The screenshot shows the 'Ports' configuration window with the following settings:

- Virtual Port Count: 8
- TCP/IP Port: via EoE
- Virtual Port Selection via:
 - None
 - 802.1q Vlan Id
 - EtherCAT Switch Link Protocol (ESL) (CU25xx required)

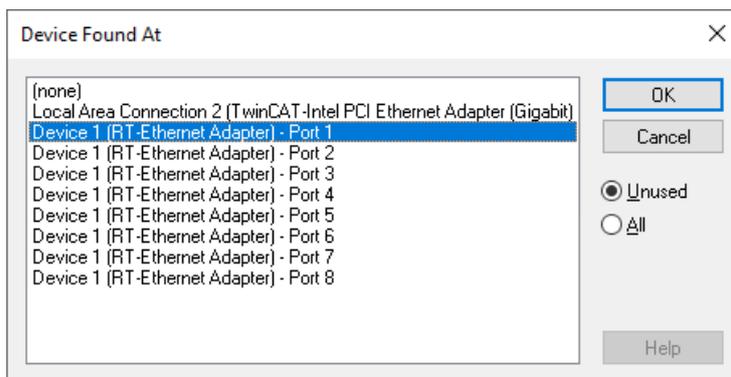
Below the settings is a table with the following data:

Port	Id
Port 1	10
Port 2	20
Port 3	30
Port 4	40
Port 5	50
Port 6	60
Port 7	70

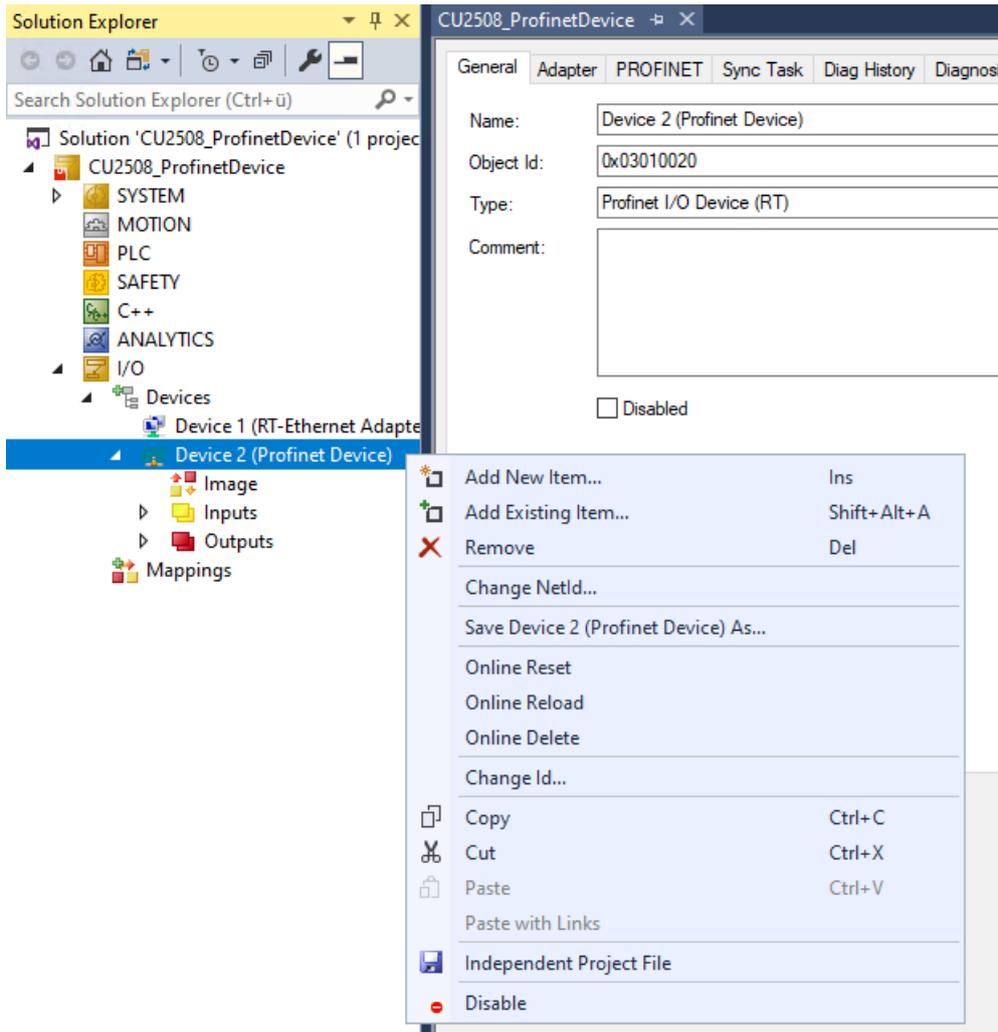
- The PROFINET protocol is directly added to the I/O device. Four different PROFINET I/O devices are available for selection. Select **PROFINET I/O Device (RT)** according to the configuration with the CU2508.



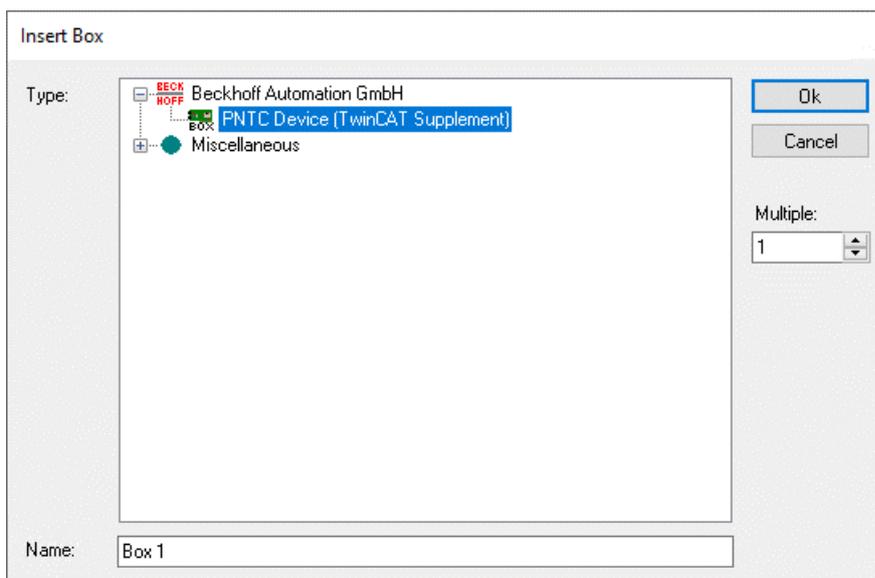
⇒ The available adapters are displayed directly when appended and are now available for selection. If these are to be modified or checked afterwards, this can take place on the Adapter tab.



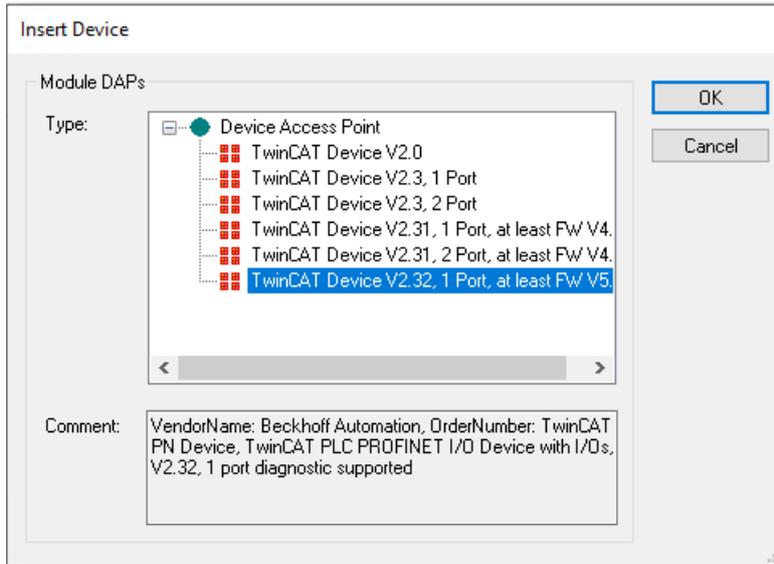
- Right-click the created PROFINET Device and select **Add New Item** to integrate a box in the form of a GSDML.



- The following window then opens. At this point, select the PNTC Device (TwinCAT Supplement) and confirm with **OK**.



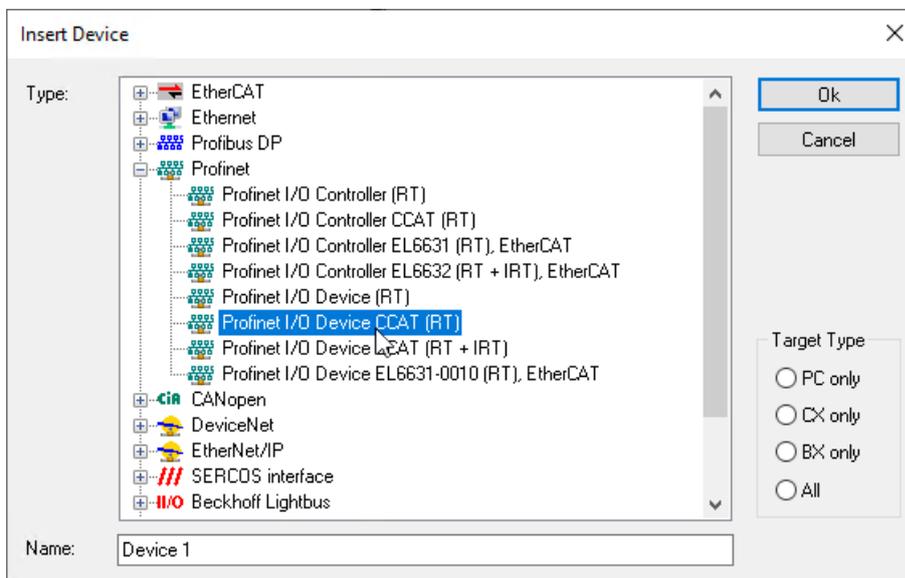
- In the dialog that opens, **Insert Device**, you define the version with which the PROFINET Device should be integrated. Confirm your choice with **OK**.



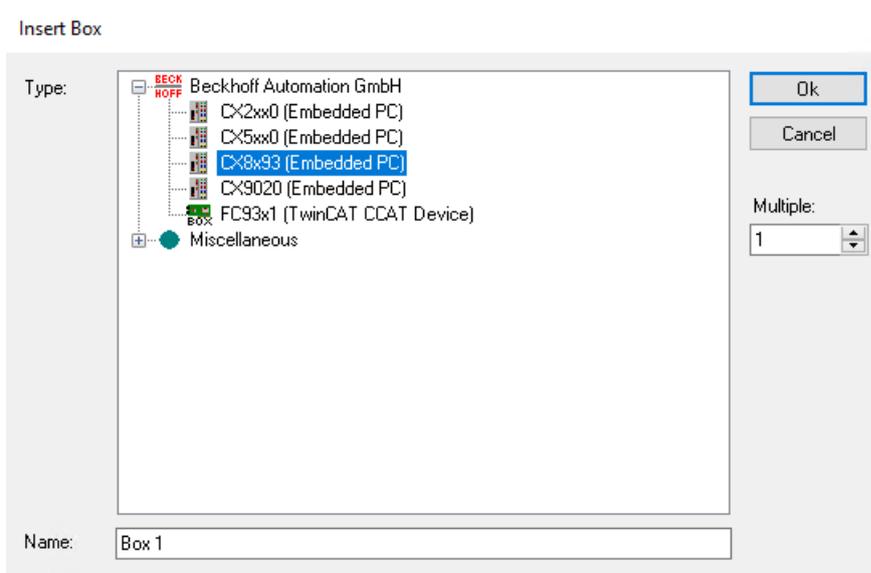
Further information can be found in the chapter [Creating modules/process data on the PROFINET Device](#) [► 32].

4.1.3 Integration via an optional interface, -B930

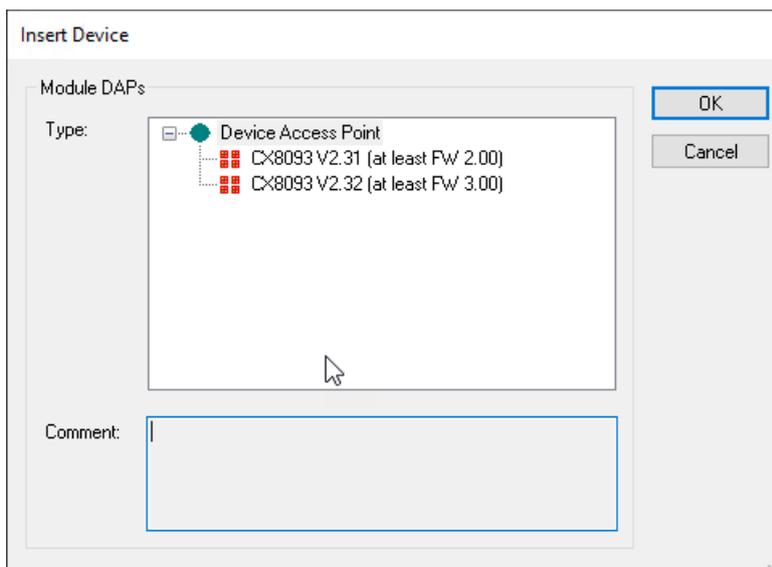
- Select one of the two PROFINET I/O Device CCAT options according to the configuration. The procedure is the same in each case. Below, the following the PROFINET I/O Device CCAT (RT) is taken as an example. The available adapters are displayed directly when appended and are now available for selection. If these are to be modified or checked afterwards, this can take place on the Adapter tab.



- Right-click the created PROFINET Device and select **Add New Item** to integrate a box in the form of a GSDML. The following window then opens. At this point, select your hardware accordingly and confirm the selection with **OK**.



- In the dialog that opens, **Insert Device**, you define the version with which the PROFINET Device should be integrated. Confirm your choice with **OK**.

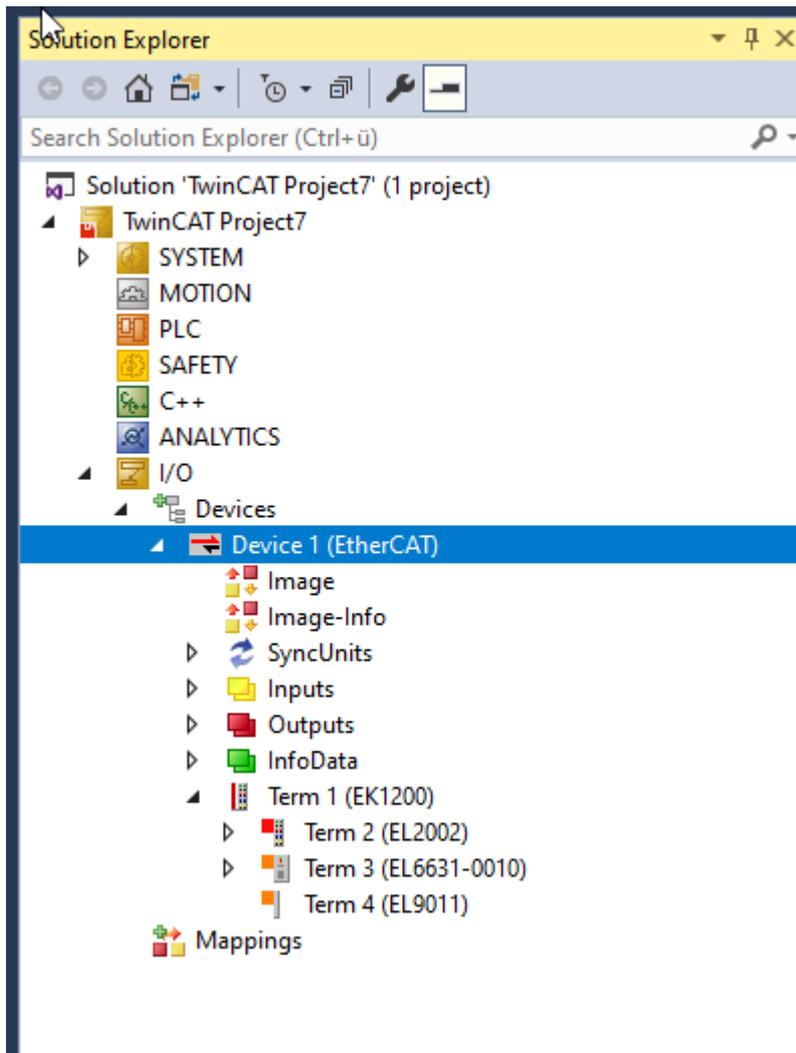


Further information can be found in the chapter [Creating modules/process data on the PROFINET Device](#) [► 32].

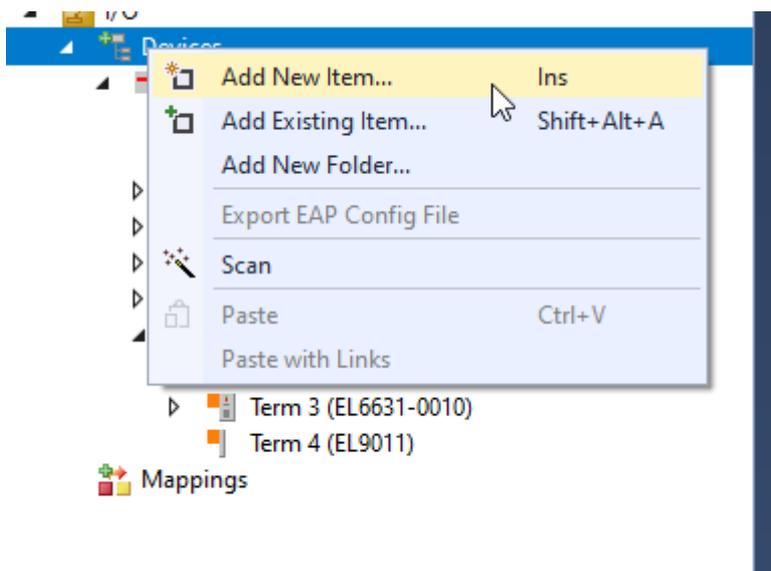
4.1.4 Integration via an EL6631-0010

Below, we show you how to configure a PROFINET device with the help of the EL6631-0010 PROFINET Gateway terminal.

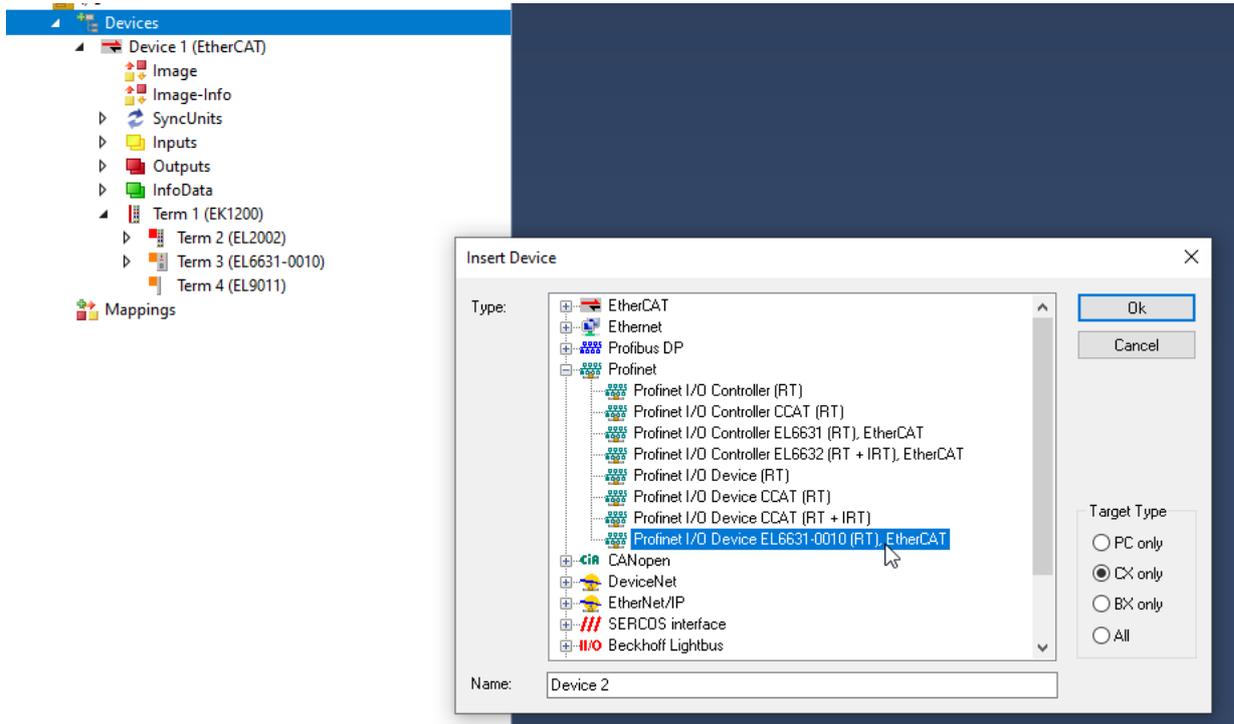
- ✓ The EL6631-0010 is primarily an EtherCAT slave, which means that it must be included in the TwinCAT configuration because it serves as an adapter for the PROFINET device. As a result, if the EtherCAT bus has an error, the PROFINET adapter will also display errors and therefore will not work.



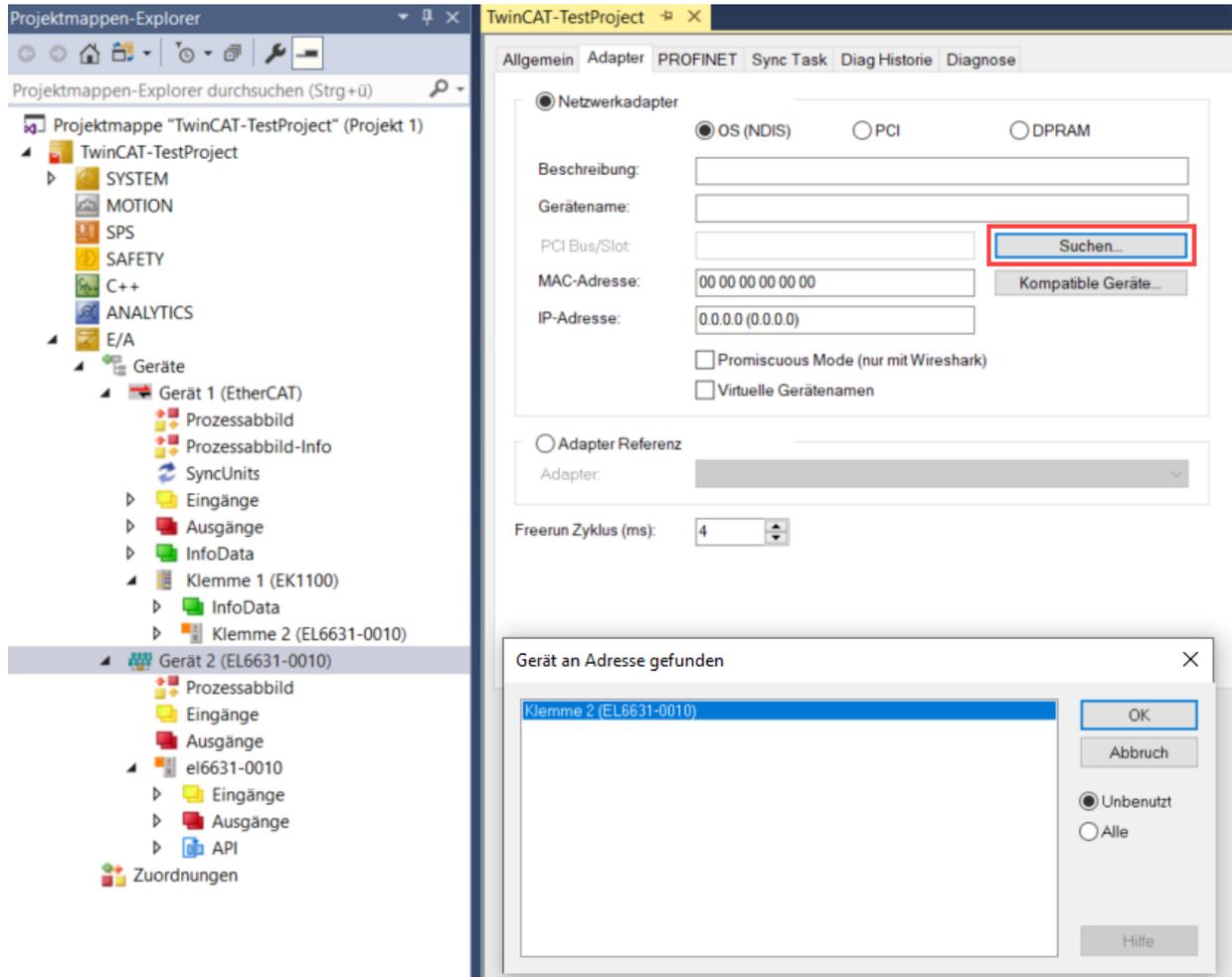
1. Right-click **Devices** and select **Add New Item**.



2. Select **PROFINET I/O Device EL6631-0010 (RT), EtherCAT** according to the configuration with the EL6631-0010. If there is a single EL6631-0010 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.

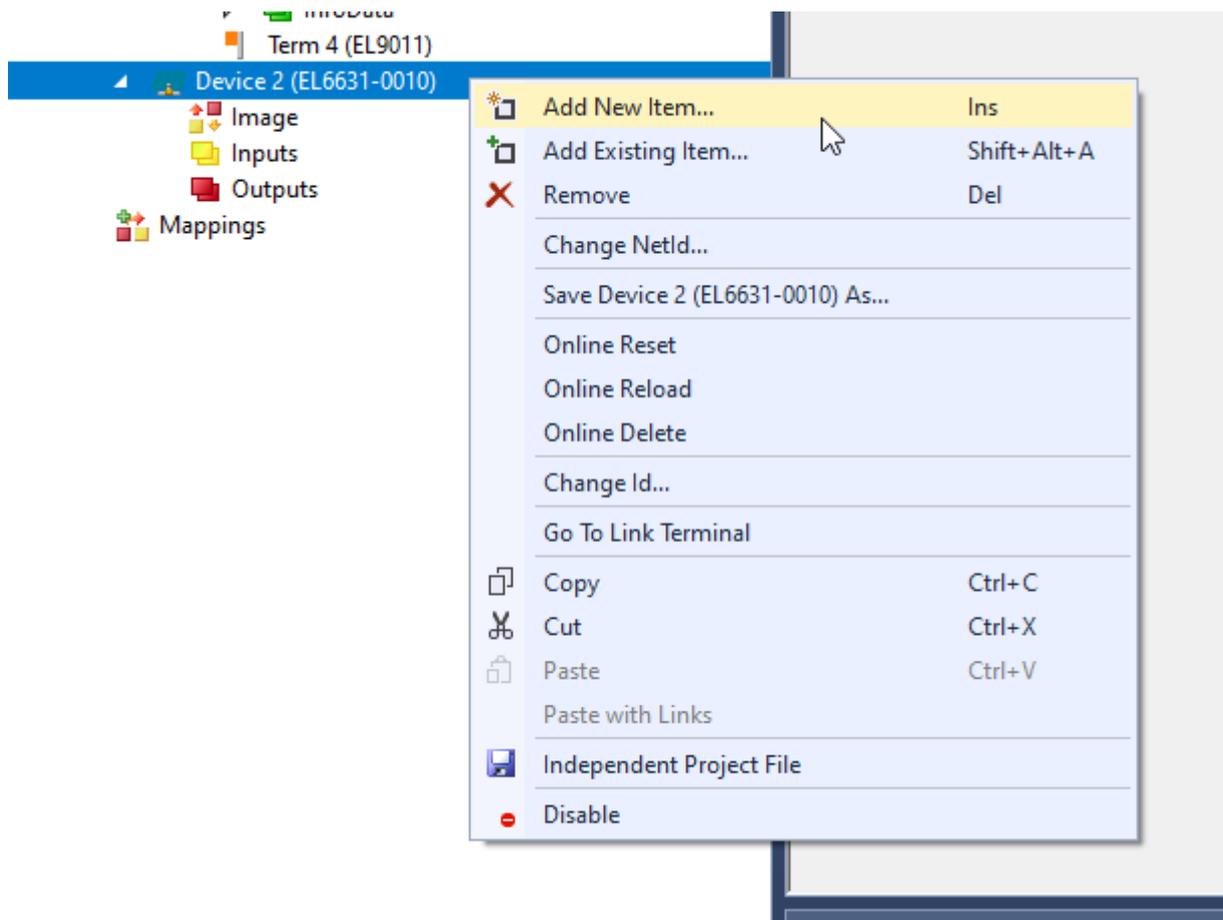


- If the terminal assignment (adapter assignment) is to be changed or checked afterwards, this can be done on the **Adapter** tab.

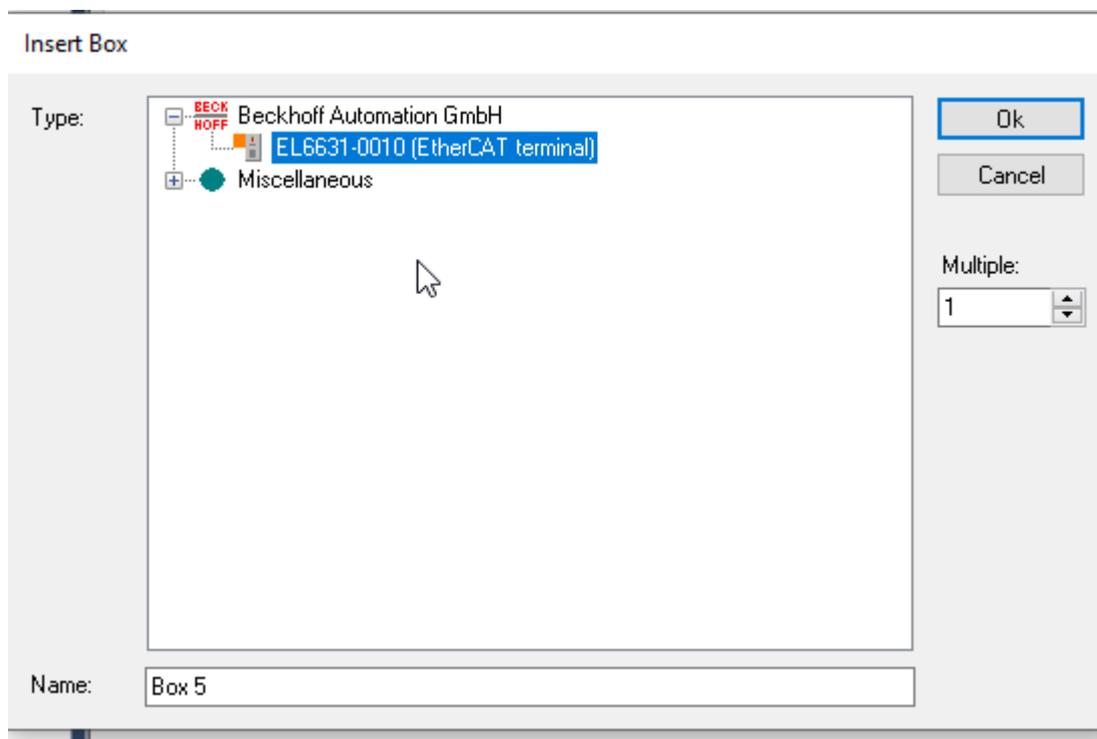


Next, a box is integrated in the form of a GSDML.

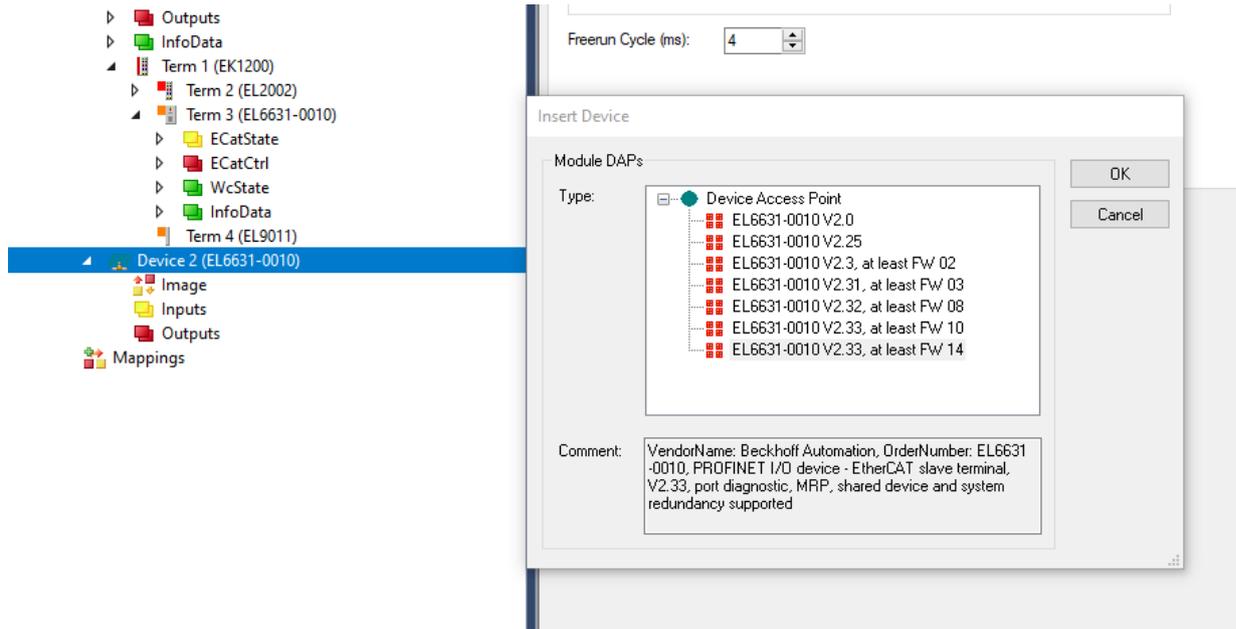
4. Right-click on the created PROFINET Device and select **Add New Item**.



5. In the window that opens, select **EL6631-0010 (EtherCAT terminal)** and confirm with **OK**.



- Right-click the EL6631-0010 to open the **Insert Device** dialog, where you specify which version of the EL6631-0010 should be integrated. Confirm your choice with **OK**.



Further information can be found in the chapter [Creating modules/process data on the PROFINET Device](#) [▶ 32].

4.2 Configuration

4.2.1 Assignment of PROFINET name to a PROFINET Device

For an initial configuration of a PROFINET Device or when the EL6631-0010 is shipped, 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 EL6631-0010:

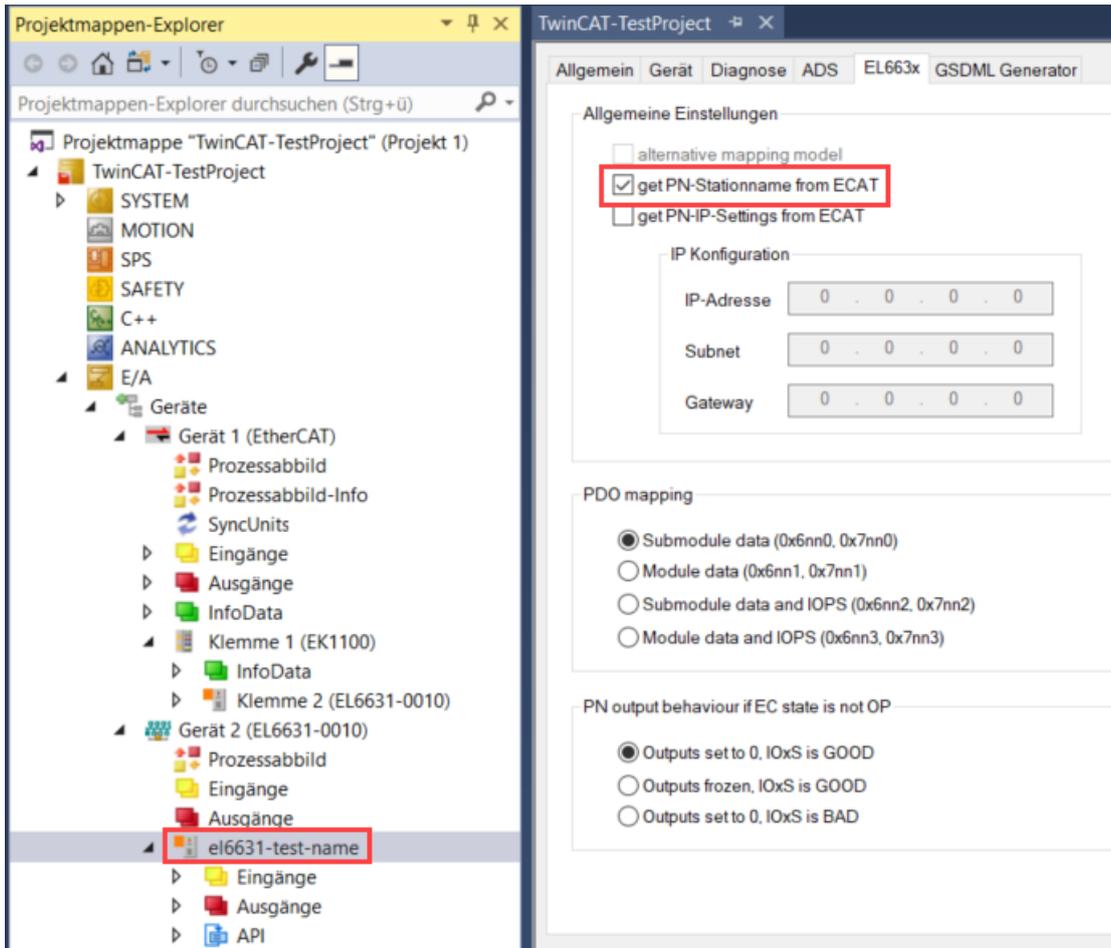
- Assignment through the PROFINET Controller

In this case, the PROFINET Controller assigns the name of the device. You can learn about this from the manufacturer of your PROFINET Controller.

- Assignment via the EtherCAT Master, only with the EL6631-0010

An assignment via the controller is then no longer possible.

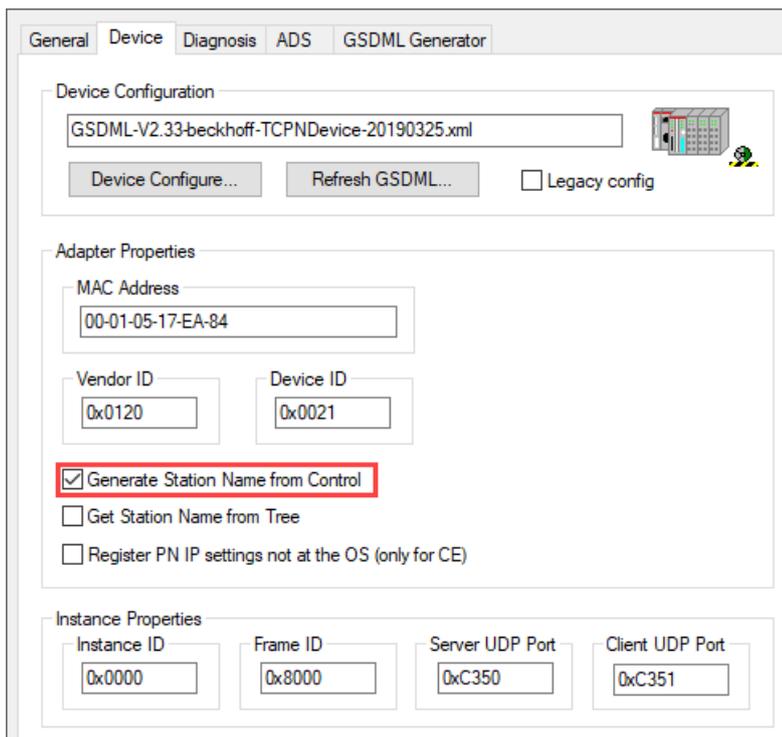
To do this, activate the checkbox **get PN-Station name from ECAT**. The name used in the Manager tree is then used. In this example **el6631-test-name**.



3. Assignment through a link to the PLC program

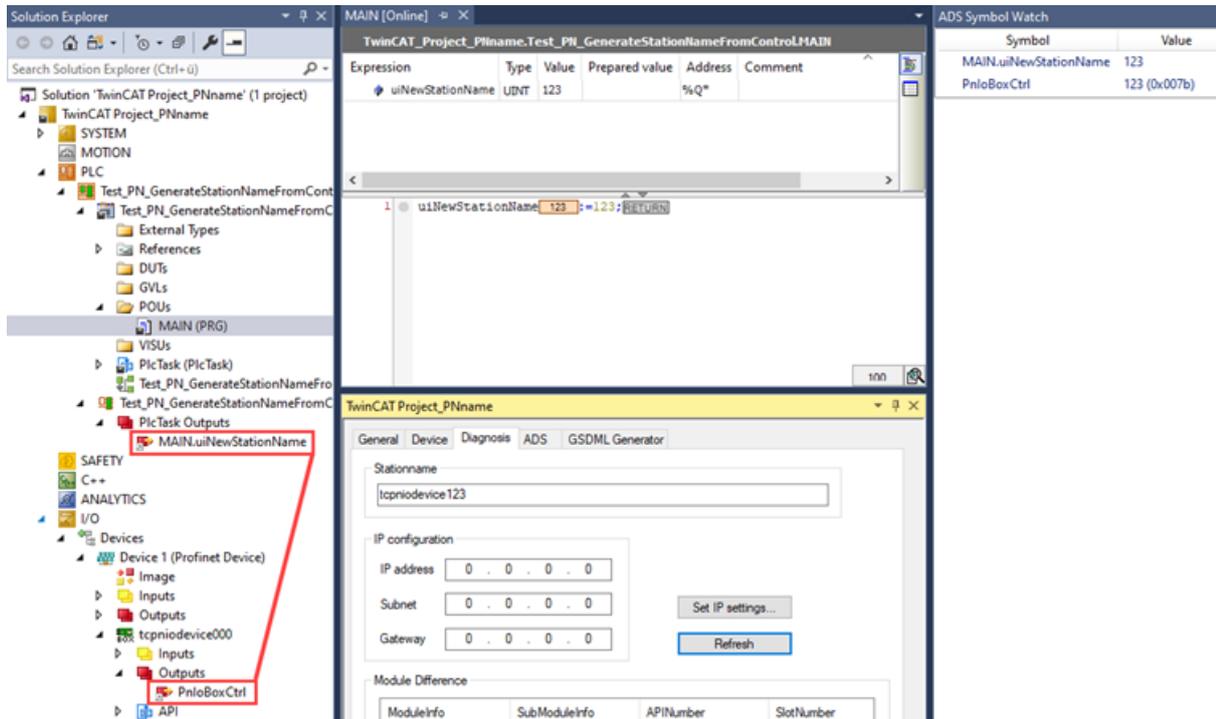
An assignment via the controller is then no longer possible.

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.



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.



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 'GSDML Generator' window with the 'Device' tab selected. The interface is divided into three main sections:

- Device Configuration:** Contains a text field with the filename 'GSDML-V2.33-beckhoff-TCPNDevice-20190325.xml', a 'Device Configure...' button, a 'Refresh GSDML...' button, and an unchecked 'Legacy config' checkbox.
- Adapter Properties:** Contains a 'MAC Address' field with '00-01-05-17-EA-84', 'Vendor ID' and 'Device ID' fields with '0x0120' and '0x0021' respectively, a checked 'Get Station Name from Tree' checkbox (highlighted with a red box), an unchecked 'Generate Station Name from Control' checkbox, and an unchecked 'Register PN IP settings not at the OS (only for CE)' checkbox.
- Instance Properties:** Contains four fields: 'Instance ID' (0x0000), 'Frame ID' (0x8000), 'Server UDP Port' (0xC350), and 'Client UDP Port' (0xC351).

5. Automatic device startup through topology specification is supported.

You can obtain more information from your PROFINET Controller

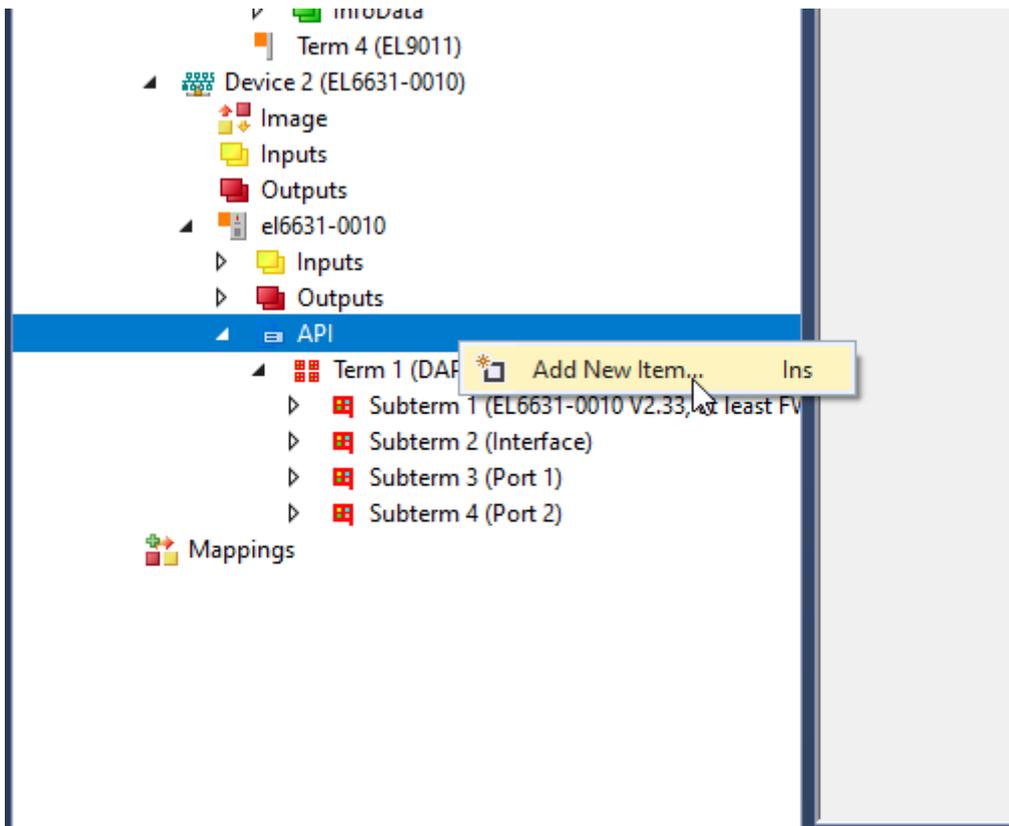
You can learn about this from the manufacturer of your PROFINET Controller.

4.2.2 Creating modules/process data on the PROFINET Device

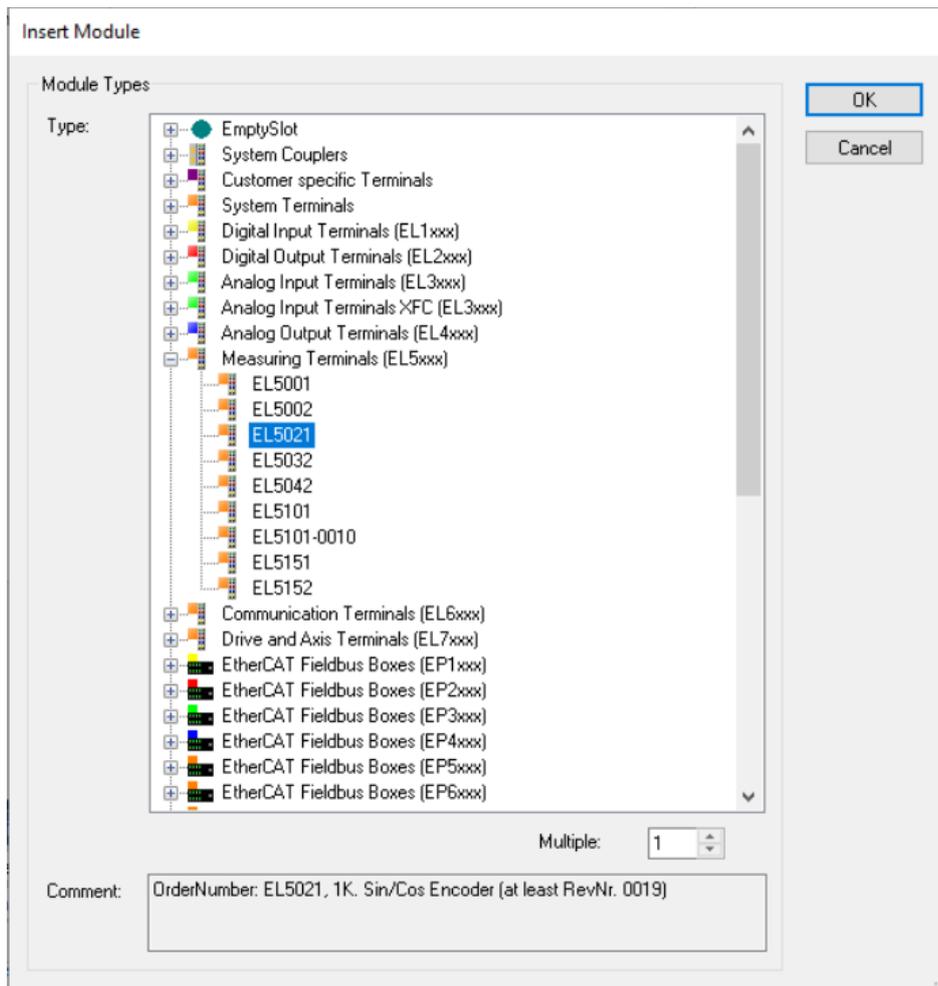
The procedure for creating process data on a PROFINET device is the same for all devices.

4.2.2.1 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.

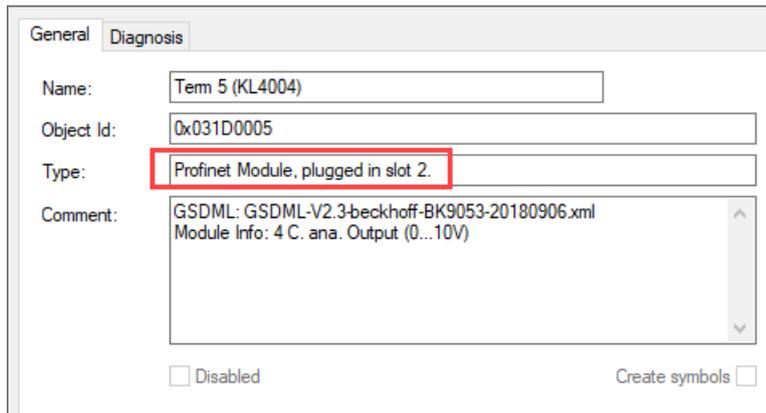


The DAP (DeviceAccessPoint) is added directly with the device. If, according to GSMDL, this is not plugged into slot 0, empty placeholder modules are inserted before it. The DAP is a special module that comes with device properties from the GSDML. The PDEV properties are attached to it in the form of 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.



4.2.2.2 From TwinCAT Version 3.1 Build 4024

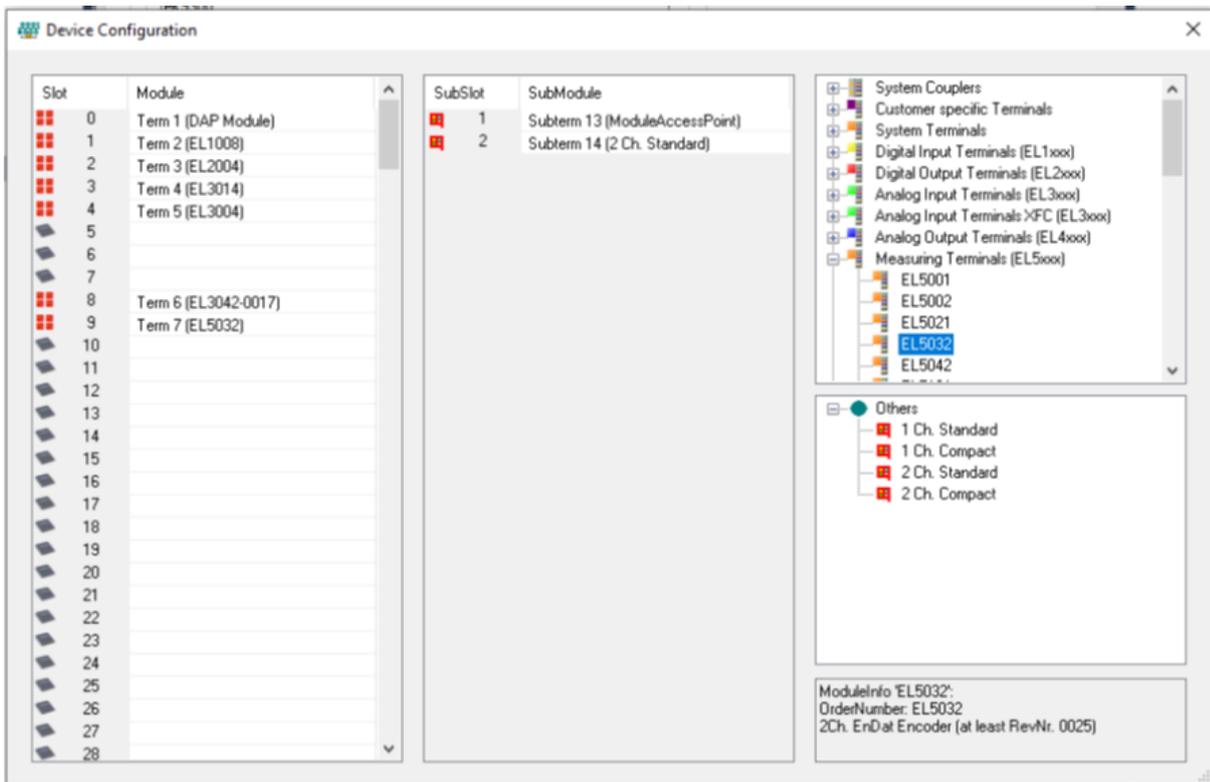
With TwinCAT Version 4024, the classic tree view for module/sub module population was replaced by a rack view.

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.

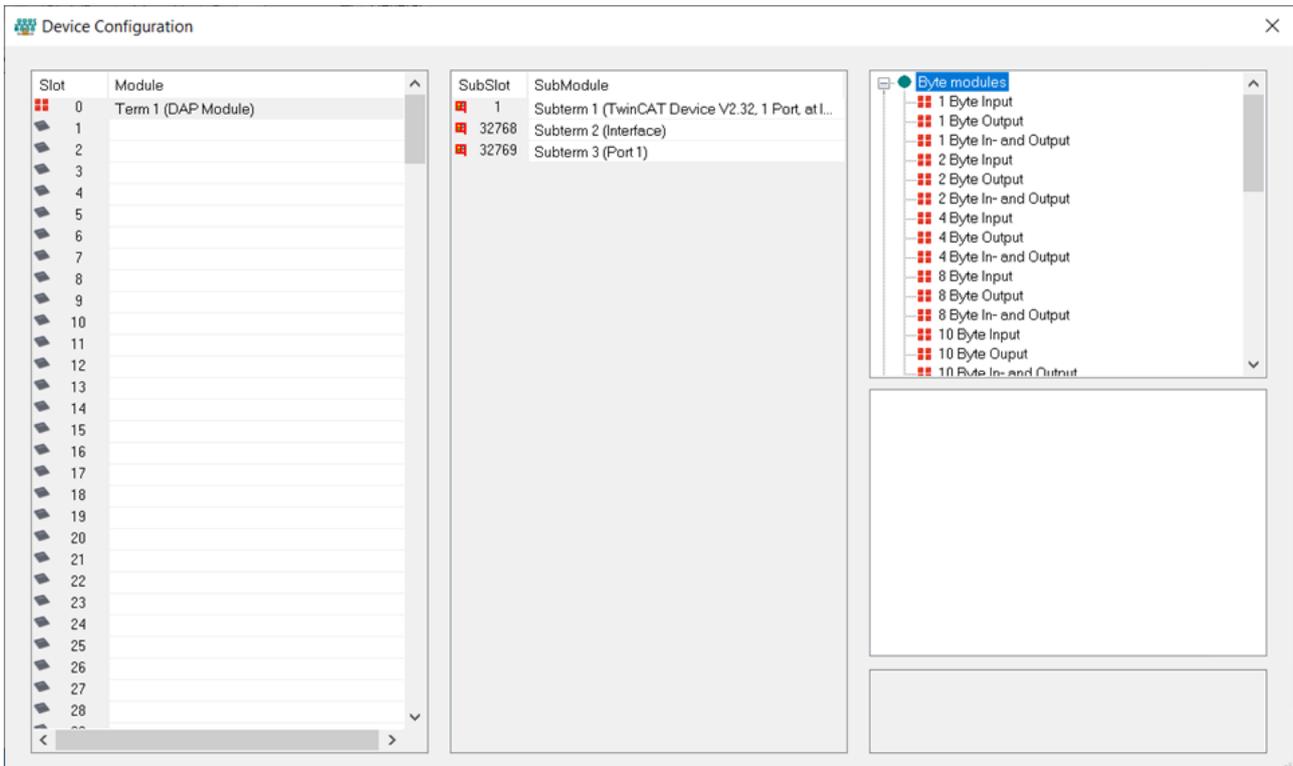
Furthermore, it is possible to generate the created module configuration in a GSDML file using the GSDML Generator. The generated file can then be integrated into the controller. The device configuration is thus fixed and does not have to be reprojected on the controller side.

For more information see chapter [GSDML Generator](#) [► 54].

The new rack view is illustrated below:



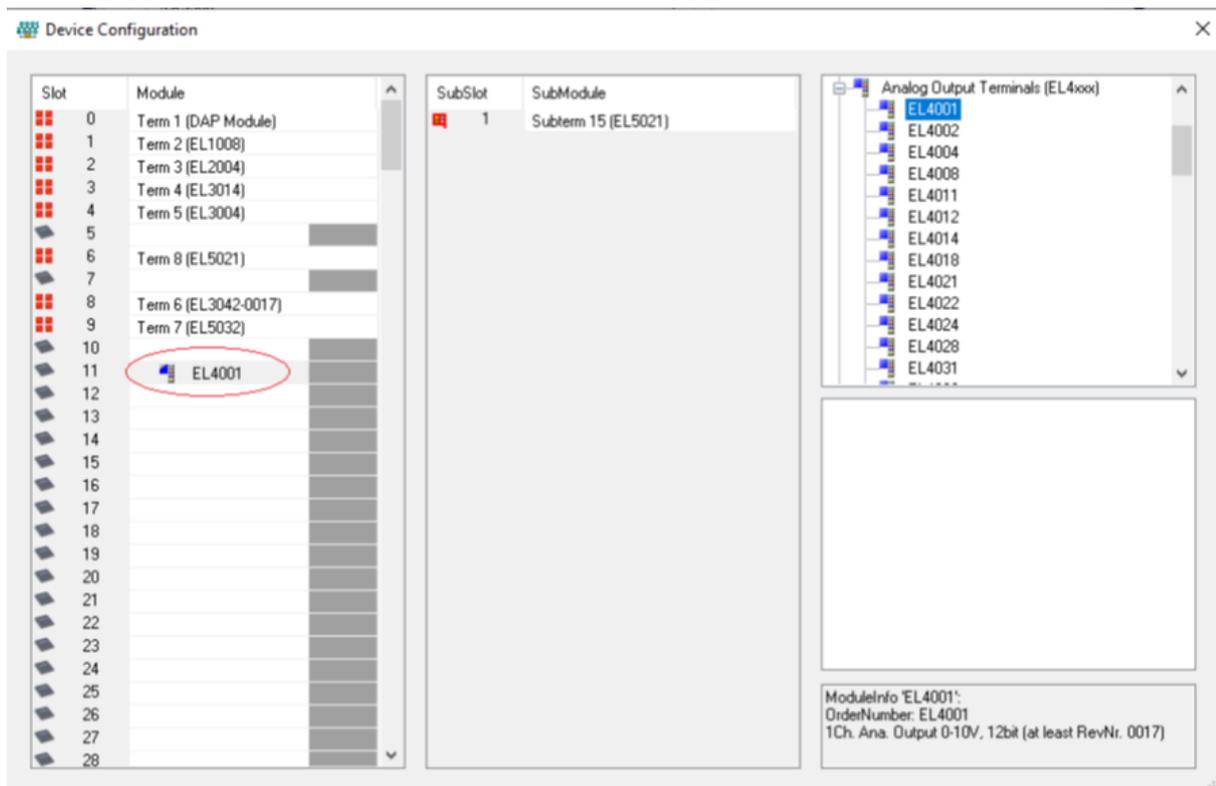
The list on the left shows the available device slots; here you can see which slots are occupied or free. Clicking on a slot updates the list in the center, showing the available subslots at the selected slot. If supported by the module, the sub modules can then be populated here.



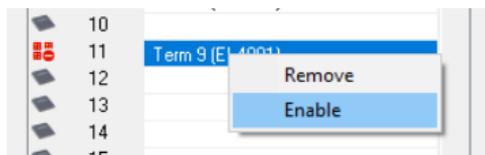
The list on the right shows the available modules and sub modules. The list of sub modules is always updated depending on the selected module.

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.



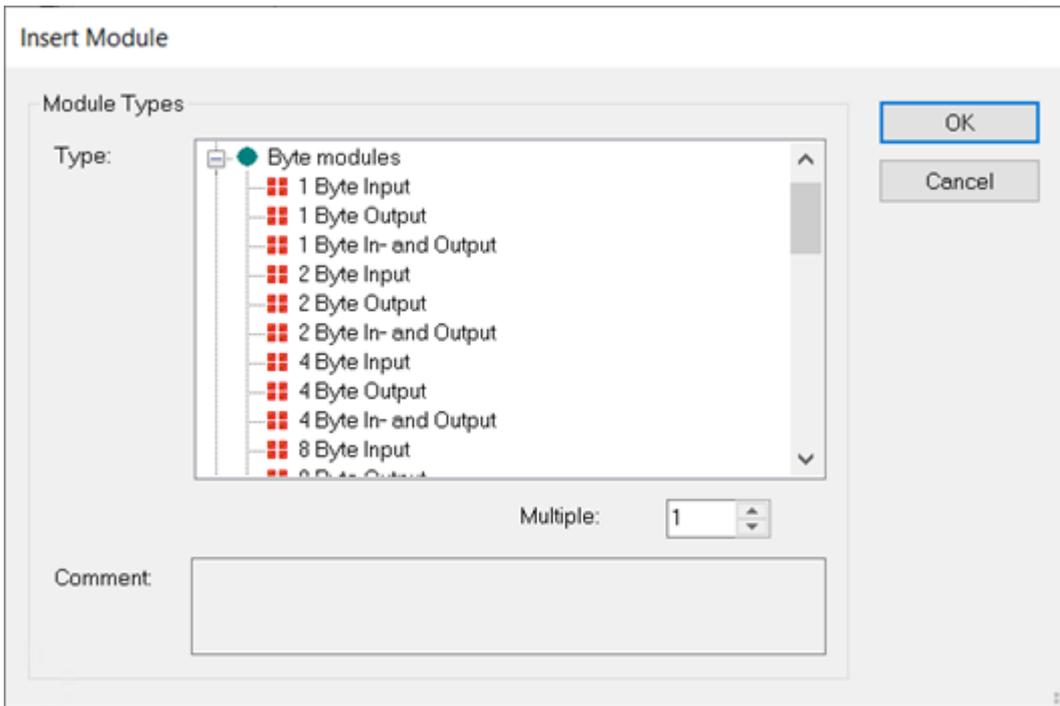
In the slot and subslot list, populated modules or sub modules can be disabled via the context menu (right mouse click).



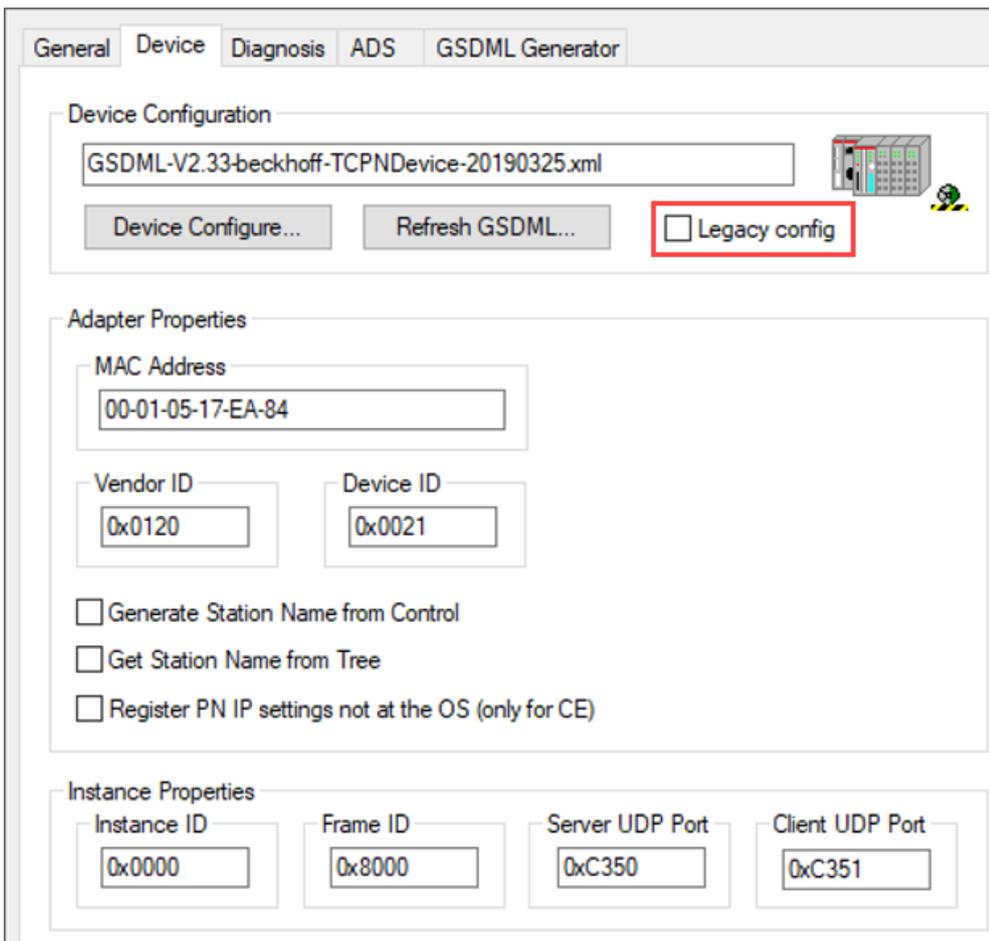
The icon indicates disabled status, which is also apparent in the module tree. Disabled objects are ignored during configuration, i.e. corresponding slots or subslots are considered empty.

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.

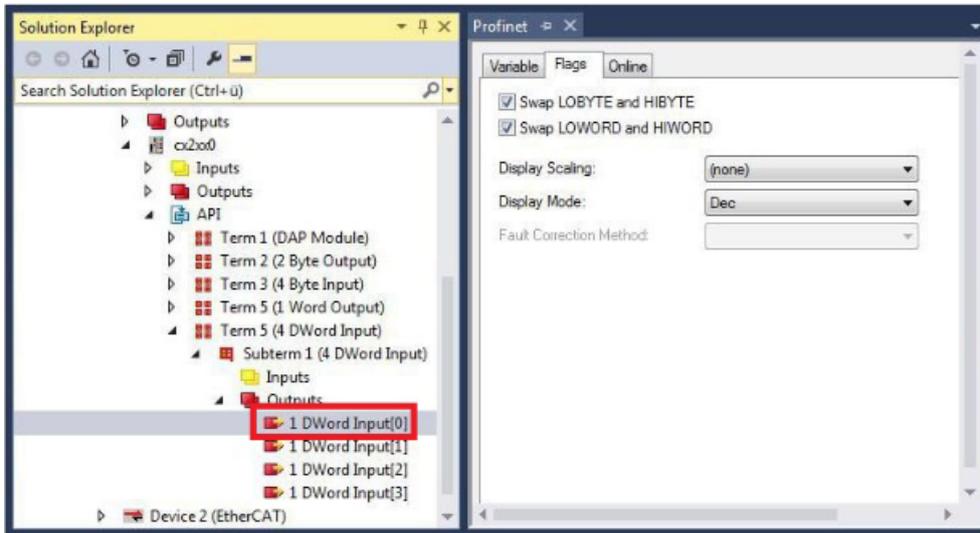


4.2.2.3 'Turning' process data

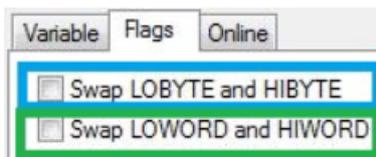
The process data are transferred in Intel format as standard. If the data is required in Motorola format, the data must be rotated accordingly. This step illustrates how to 'turn' the data in TwinCAT.

'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

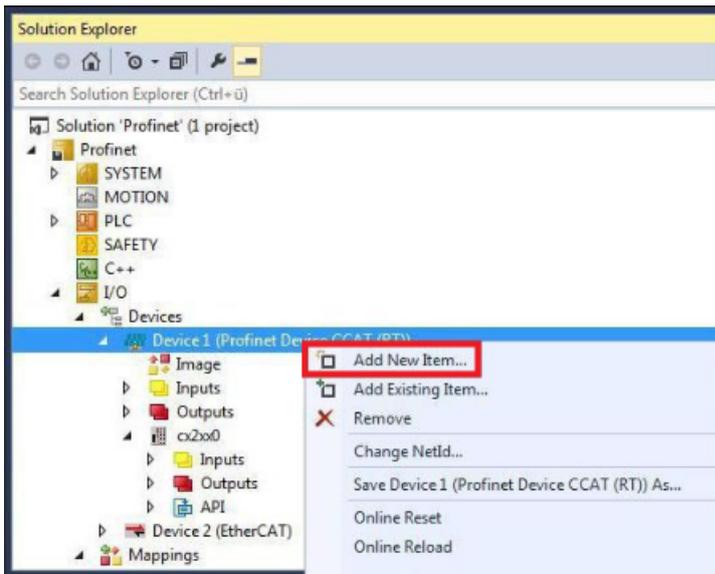
4.2.3 Creating a virtual slave

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.

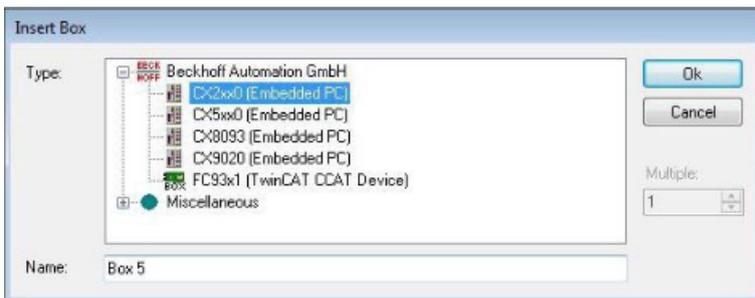
Each virtual slave is assigned a dedicated address via TwinCAT and is configured like an independent device for the PROFINET master.

- ✓ A PROFINET Device is available in TwinCAT.
1. In the project tree, right-click the created PROFINET Device

2. Click **Add New Item...**

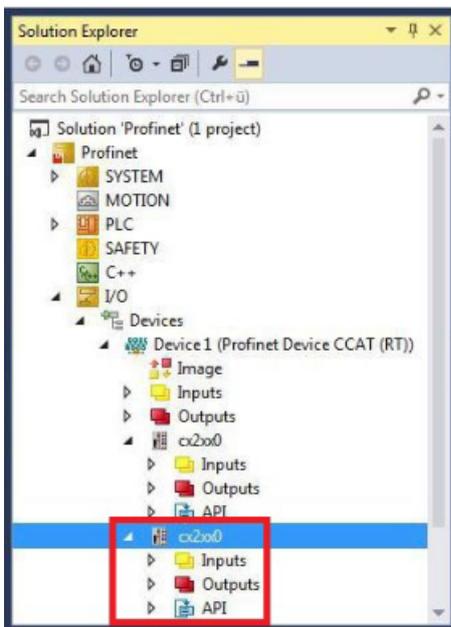


3. Depending on the configuration, select the appropriate box, e.g. the CX2xx0 if you are using a CX20xx Embedded PC with PROFINET optional interface.



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

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



The MAC address of the virtual slave is editable. Make sure that the MAC address occurs only once in the system. The IP address is assigned by the PROFINET master.

5 Settings and diagnosis

5.1 Settings on the PROFINET Device protocol

5.1.1 General

The screenshot shows a configuration dialog for a PROFINET Device protocol object. The 'General' tab is selected, and the following fields are visible:

- Name:** Device 2 (Profinet Device)
- Id:** 2
- Object Id:** 0x03010020
- Type:** Profinet I/O Device (RT)
- Comment:** (Empty text area)
- Disabled
- 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.

5.1.2 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:

Device Name:

PCI Bus/Slot:

MAC Address:

IP Address:

Promiscuous Mode (use with Wireshark only)

Virtual Device Names

Adapter Reference

Adapter:

Freerun Cycle (ms):

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.

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

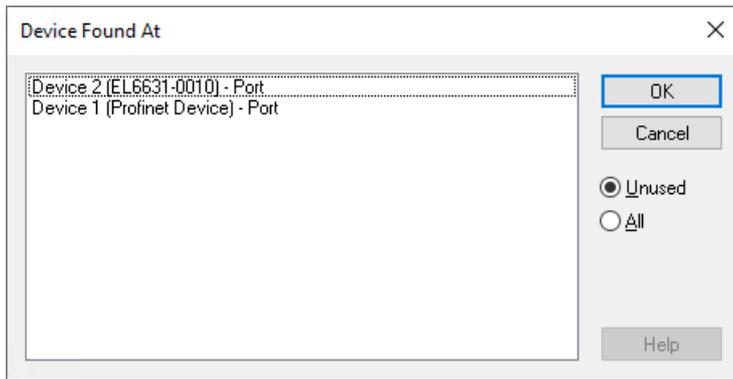
DPRAM

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

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

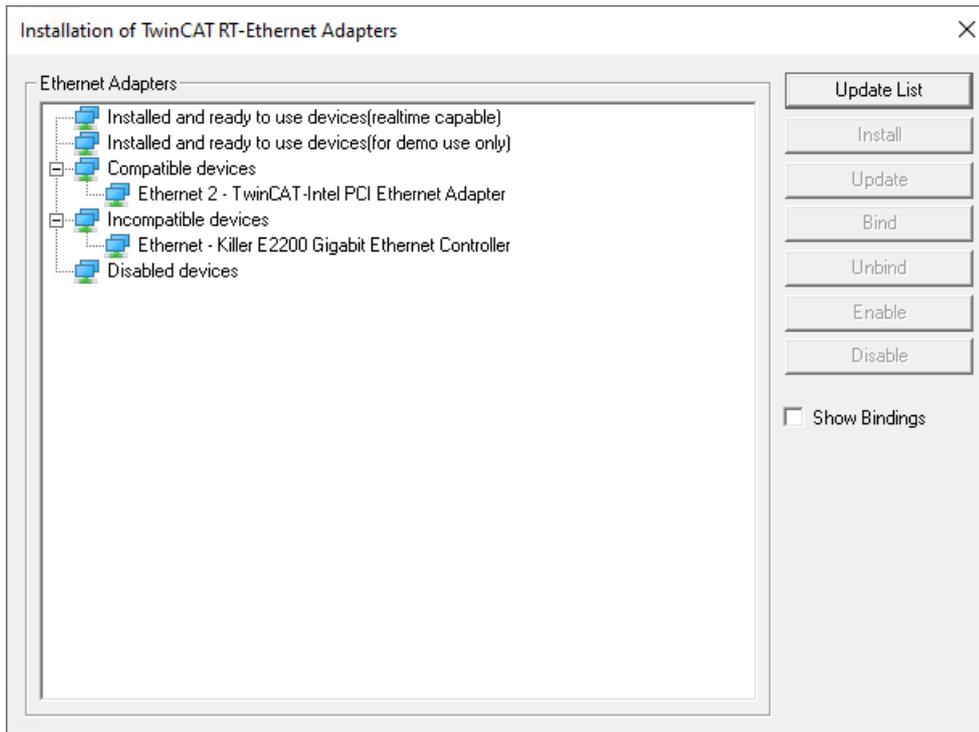
Search... button

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.

5.1.3 PROFINET

General	Adapter	PROFINET	Sync Task	Diag History	Diagnosis
Protocol AMS NetId:	<input type="text" value="192.168.234.1.2.1"/>	<input type="button" value="Port Settings..."/>			
Protocol AMS PortNr.:	<input type="text" value="65535"/>	<input type="button" value="Scan PNIO Devices..."/>			
Server AMS NetId:	<input type="text" value="192.168.234.1.1.1"/>	<input type="button" value="Topology..."/>			
Server AMS PortNr.:	<input type="text" value="851"/>	<input type="button" value="IRT Config..."/>			
PN SW Version:	<input type="text" value="06 (V00.19)"/>	<input type="button" value="I-Device..."/>			
<input type="checkbox"/> Info Data Support					

Protocol AMS NetId

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

AMS PortNo protocol

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.

AMS PortNo server

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

Port Settings

Opens a dialog to parameterize another PROFINET port. Available only for the function, not for CCAT or EL663x. Further information in: [Port settings](#) [▶ 44]

Scan PNIO Devices

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

Topology

Opens a dialog to compare the offline topology with the online topology. Further information in: [Topology](#) [▶ 44]

IRT Config

Opens a dialog to set IRT-specific parameters. Is only available on an IRT-enabled device. Further information in: [IRT configuration](#) [▶ 45]

I-Device

Opens a dialog for simultaneous parameterization of a controller and device interface. Only available at CCAT. Further information in: [I-Device](#) [▶ 46]

Info Data Support

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

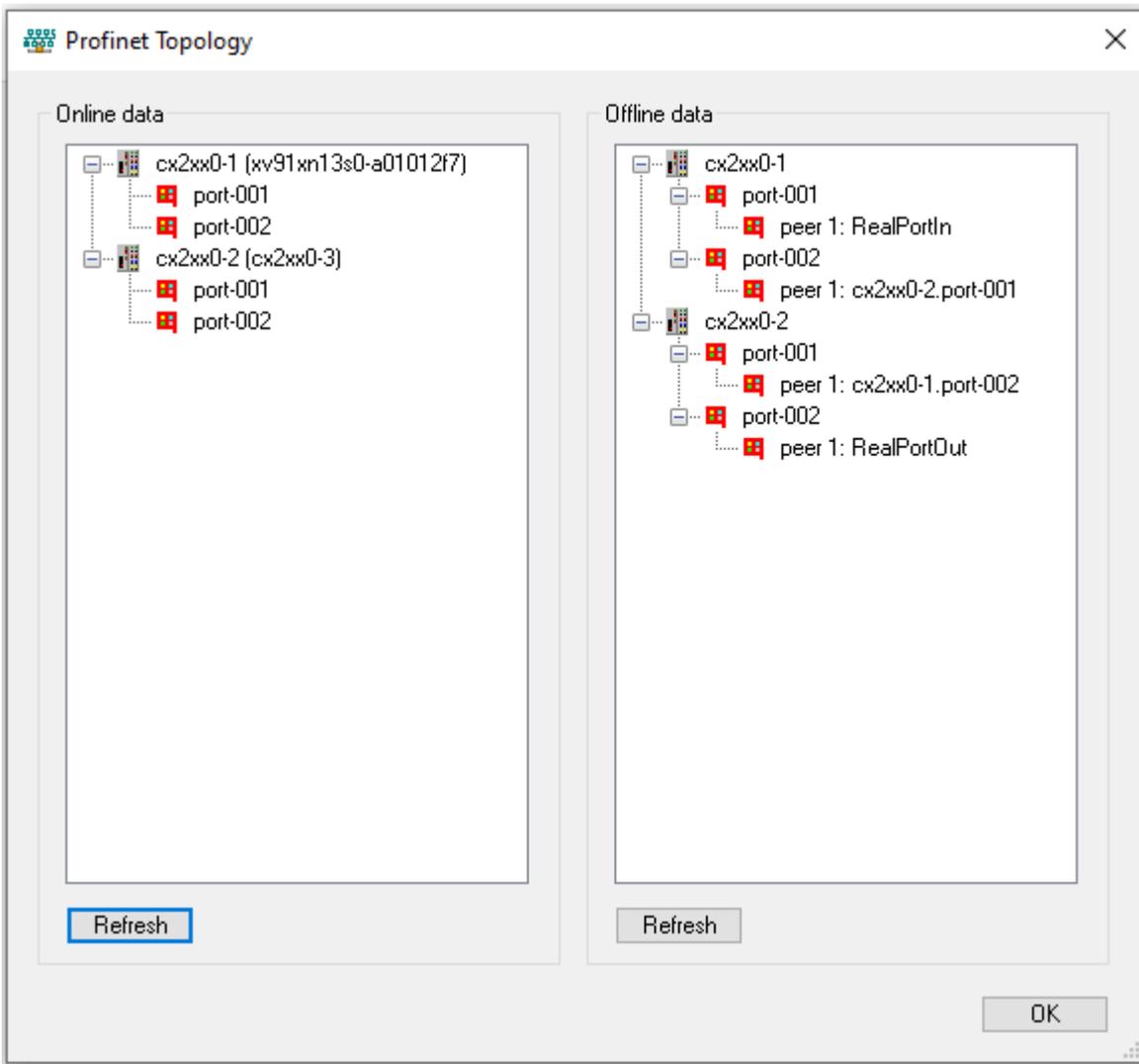
5.1.3.1 Port settings

This feature is only available for the real-time Ethernet protocol (no EL663x or CCAT). With this a second PROFINET port and an intelligent switch can thus be realized with a second network card (Intel chipset). It is intended to repeat this feature x times; however, it is presently limited to one additional port.

For support, the MRP (Media Redundancy Protocol) function can also be activated via this menu; various settings can be made for this.

5.1.3.2 Topology

The online topology can be compared with the offline topology via this dialog.



Starting with build 4024 on the PROFINET Device, it is also possible to simulate a port interconnection when using virtual devices. For this purpose, interconnection between the projected devices can take place offline and be checked in this dialog. The online window displays the interconnection projected by the controller. For more information, see the chapter

5.1.3.3 IRT configuration

This menu is only available for an IRT-capable device.

For the device, it is currently only possible to determine whether the TwinCAT time should be adjusted to the PROFINET time. All other settings are projected by the controller.

5.1.3.4 I-Device

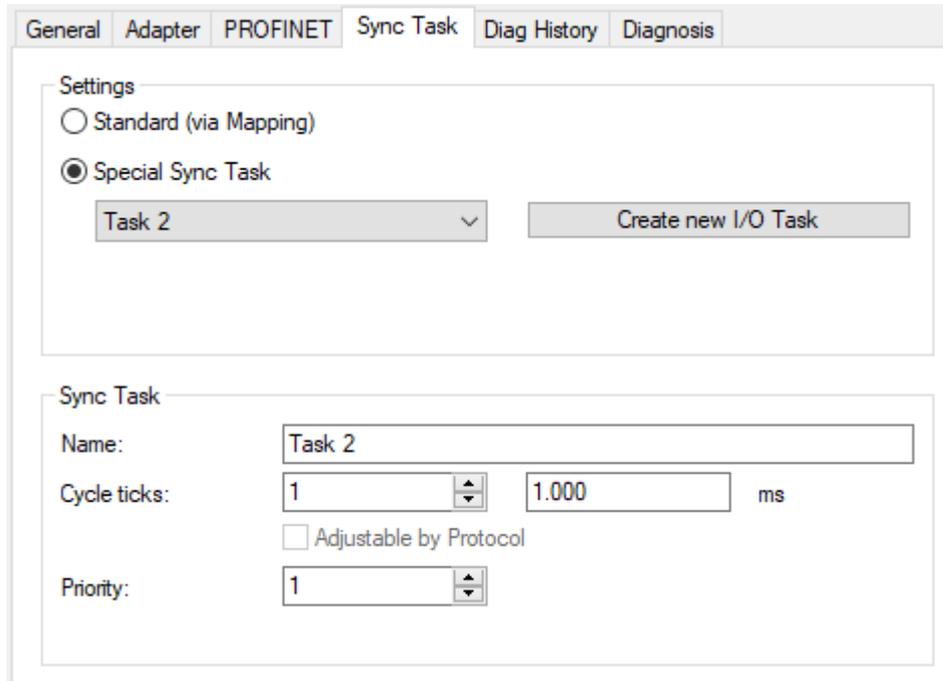
If a controller is also to be operated simultaneously via the same physical interface as a device, then the device can be coupled to the controller via this dialog.

The I-Device feature is only approved for operation on CCAT-based hardware.

Creating an I-Device

5.1.4 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.



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

NOTE

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.

NOTE**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

5.2 Diagnosis on the PROFINET Device Protocol

5.2.1 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.

5.2.2 Diagnosis

This list contains diagnoses and statistics.

Name	Value
LastUpdate	10/15/2019 11:07:58 AM 053 ms
ProtocolSettings	Settings
Name	Device 1 (Profinet Device)
TaskTime	1 ms
PortStatistic	1 Port
Port1	FrameRecv = 36490, FrameSend = 36045
PortMAC	0x02 0x01 0x05 0x00 0x00 0x01
OperationState	Up
FrameLengthErrorCnt	0
RxErrorCnt	0
CRCErrCnt	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

These can be reset or exported using the corresponding buttons; they are divided into the following sections.

ProtocolSettings

Include the name and cycle time of the PROFINET protocol.

PortStatistic

Port-specific statistics and diagnoses.

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

Diagnosis and statistics for the projected PROFINET devices.

5.2.3 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.

5.3 Settings on the PROFINET Device

5.3.1 General

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

General	Device	Diagnosis	ADS	GSDML Generator
Name:	<input type="text" value="tcpniodevice"/>			Id: <input type="text" value="1"/>
Object Id:	<input type="text" value="0x03020001"/>			
Type:	<input type="text" value="TwinCAT PLC PROFINET I/O Device with I/Os, V2.32, 1 port diagnostic su"/>			
Comment:	<input type="text" value="GSDML Name: GSDML-V2.33-beckhoff-TCPNDevice-20190325.xml"/> <input type="text" value="Path: \$(TWINCAT3DIR)Config\Io\Profinet\"/> <input type="text" value="VendorName: Beckhoff Automation"/> <input type="text" value="OrderNumber: TwinCAT PN Device"/> <input type="text" value="HW Release Version: 1"/> <input type="text" value="SW Release Version: V5.00"/>			
<input type="checkbox"/> Disabled		<input type="checkbox"/> 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.

5.3.2 Device

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

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

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 "tcpniodevice" to "tcpniodevice011". However, the current tree name is still "tcpniodevice000"
- **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.

5.3.3 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.

5.3.4 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.

5.3.5 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
Procut 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.

5.4 PROFINET Device diagnosis

5.4.1 Diagnosis

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

General Device **Diagnosis** ADS GSDML Generator

Stationname

IP configuration

IP address
 Subnet
 Gateway

Module Difference

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.

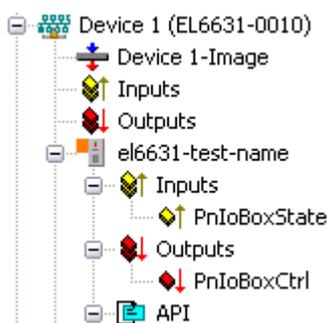
Module Difference

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.

5.4.2 Status and Ctrl. flags

PnIoBoxState

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

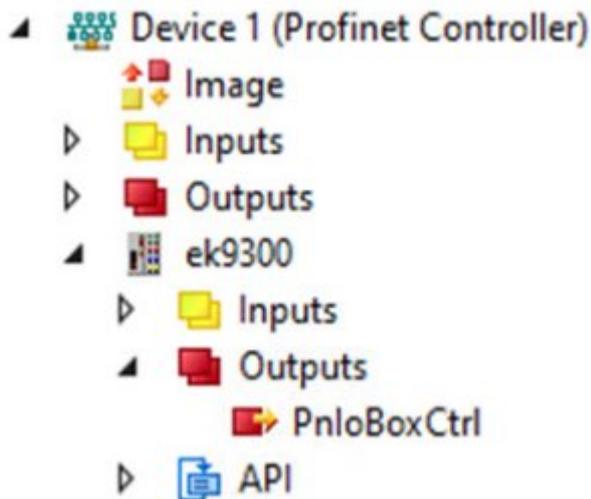


PnloBoxState	Comment	Meaning
0x0001 (Bit 0)	Device is in I/O exchange	PROFINET Device is exchanging data
0x0002 (Bit 1)	Device is blinking	PROFINET Device is being searched for by identification
0x0004 (Bit 2)	Provider State 0=STOP, 1=RUN	The PROFINET Controller is stopped
0x0008 (Bit 3)	Problem indicator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

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

PnloBoxCtrl

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



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

5.4.3 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.

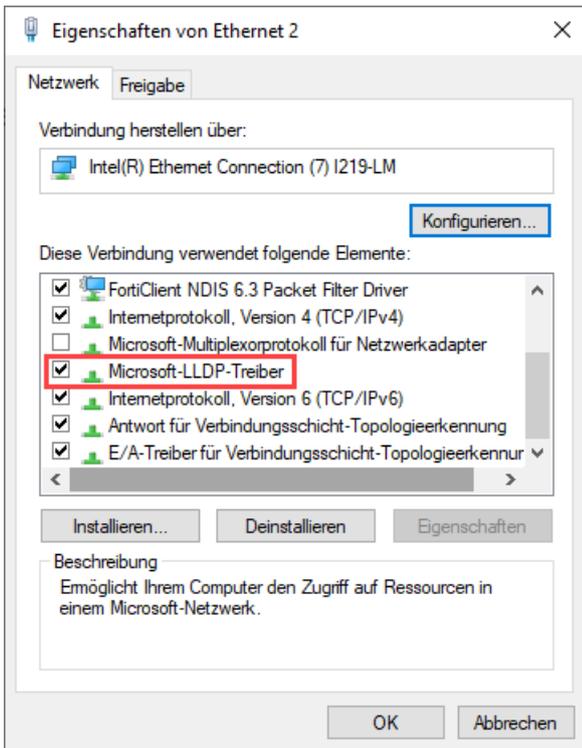
i For correct topology recognition it is important that only devices are present in the segment that also support the LLDP protocol (this also applies to switches).

i 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).



5.4.4 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

6 Profinet Features

6.1 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

6.2 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

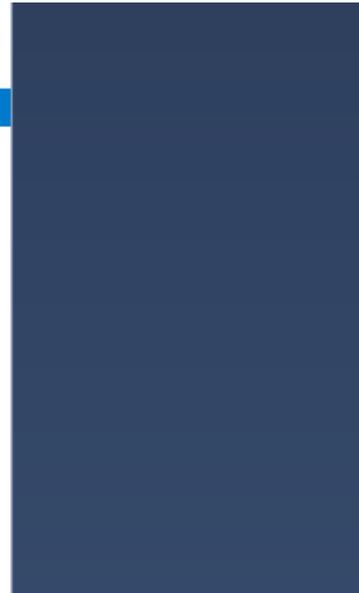
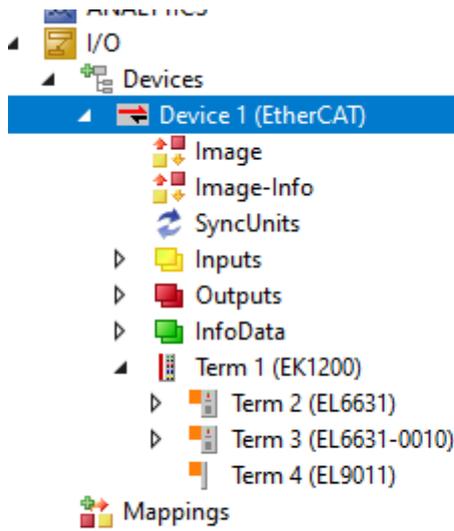
```

6.3 PROFINET Shared Device

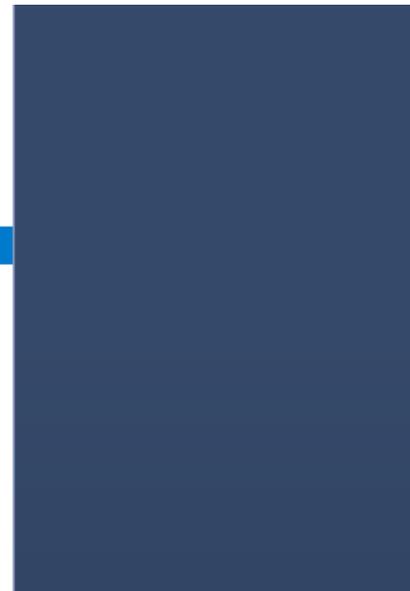
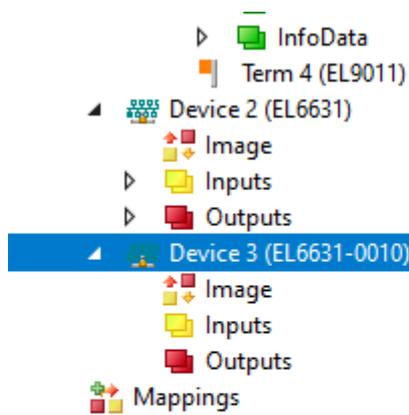
Configuration on the TwinCAT side:

- ✓ Structure -> EL6631>EL6631-0010

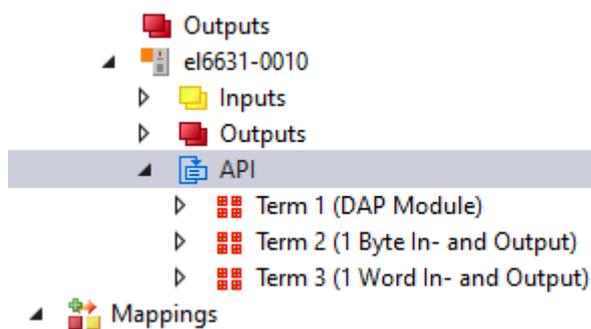
1. Scanning the devices



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

The screenshot shows a software interface for scanning and configuring devices. At the top, there is a table with the following data:

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

Below the table, there are configuration fields:

- Stationname:** A text input field containing "test.test".
- IP configuration:** Includes an IP address input field with "192 . 168 . 0 . 2" and a checkbox for "DHCP enable".

On the right side, there are several buttons: "Rescan Devices", "Add Devices" (highlighted in yellow), "Set Stationname", and "Set IP configuration".

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

The screenshot shows the "Settings" tab of the software interface. The "IP configuration" section is highlighted in yellow and contains the following fields:

- IP address:** 192 . 168 . 0 . 10
- Subnet:** 255 . 255 . 255 . 0
- Gateway:** 192 . 168 . 0 . 1

Below the IP configuration, there are other settings:

- Name of PnIo Controller Station:** el6631-pncontroller
- VendorId:** 0x0120
- DeviceId:** 0x0025
- Server UDP Port:** 0xEE48
- Client UDP Port:** 0xEA60
- StationName settings:** Includes a checkbox for "Automatic NameOfStation assignment" which is currently unchecked.

Buttons for "Set IP settings..." and "Set System name..." are visible next to their respective sections.

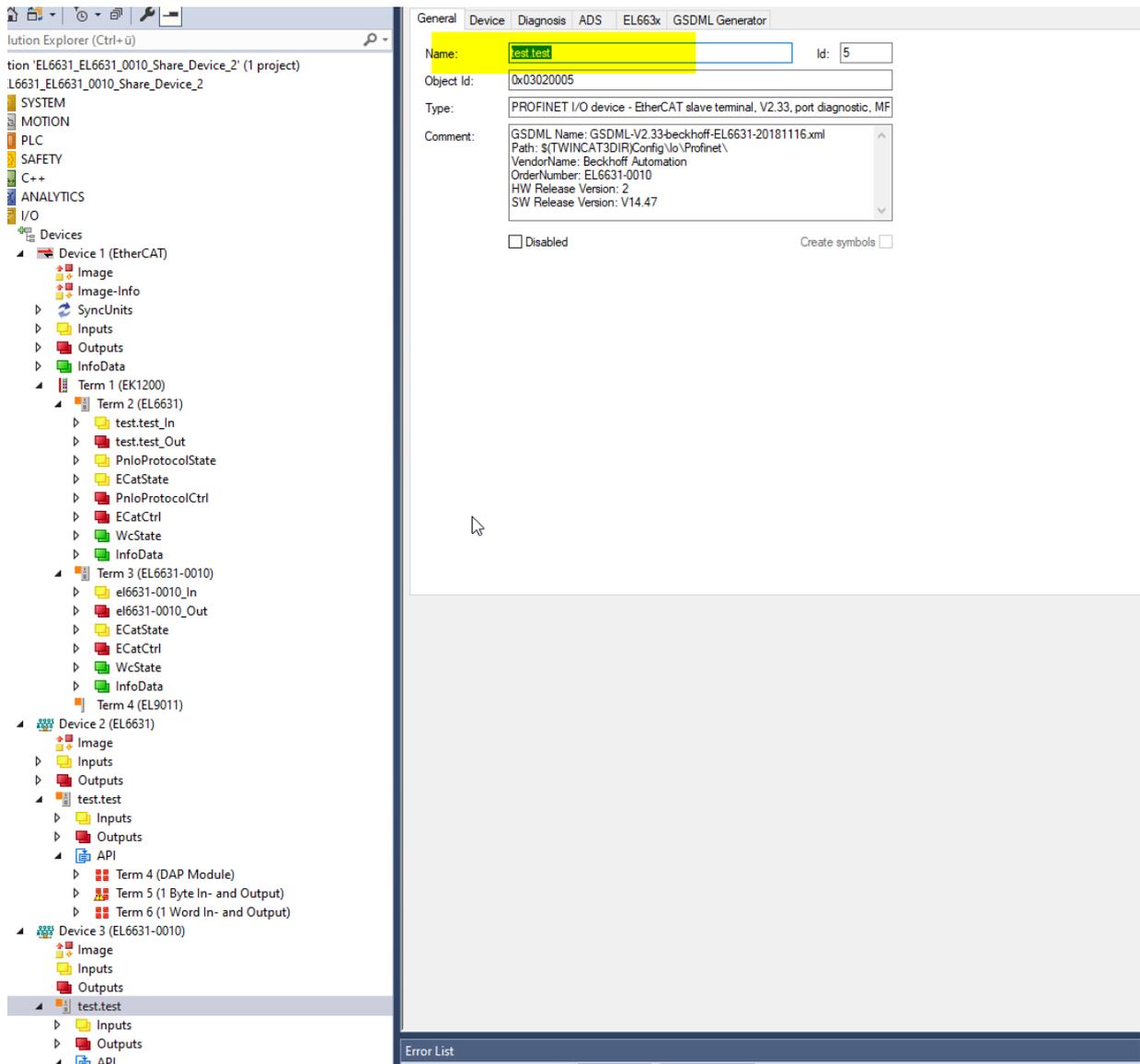
- Under the device, select the **Shared Device** tab. Here you can set which controller accesses which data. In this example, the EL6631 controller is allowed to access only the 1 Word In and Output process data.

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

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

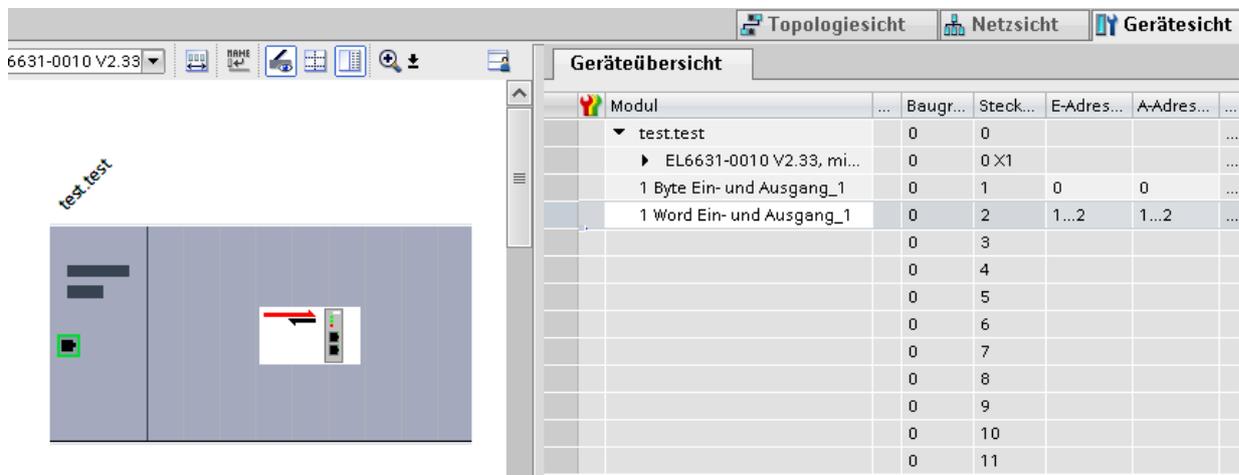
The screenshot shows the configuration interface for a Beckhoff device. On the left is the 'Solution Explorer' showing a project structure with 'Devices' expanded to show 'Device 1 (EtherCAT)', 'Device 2 (EL6631)', and 'Device 3 (EL6631-0010)'. The 'test.test' subproject is selected under Device 2. On the right, the 'Shared Device' configuration window is open, showing the 'EL663x' tab. Under 'General settings', the checkbox 'get PN-Stationname from ECAT' is checked. Other settings include IP configuration (IP address, Subnet, Gateway) and PDO mapping options. The 'Error List' at the bottom 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.

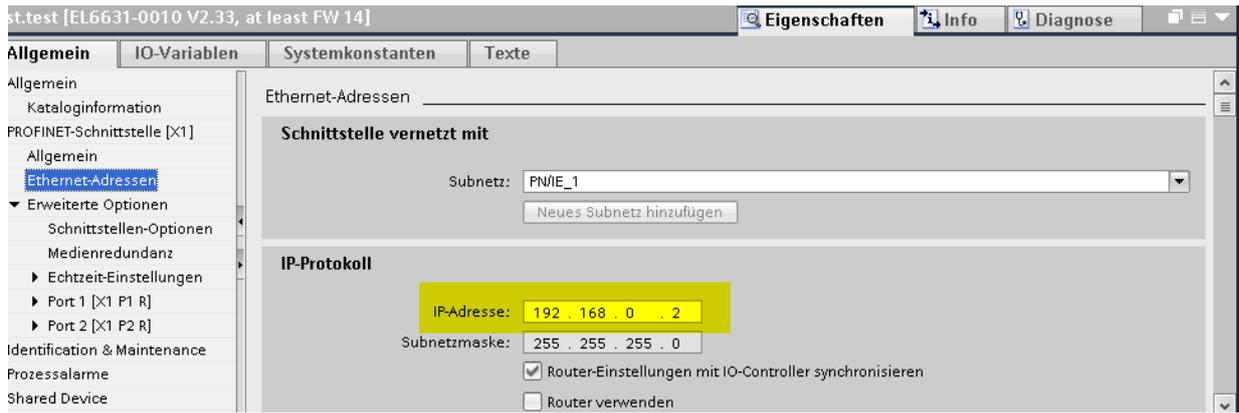


Configuration TIA side:

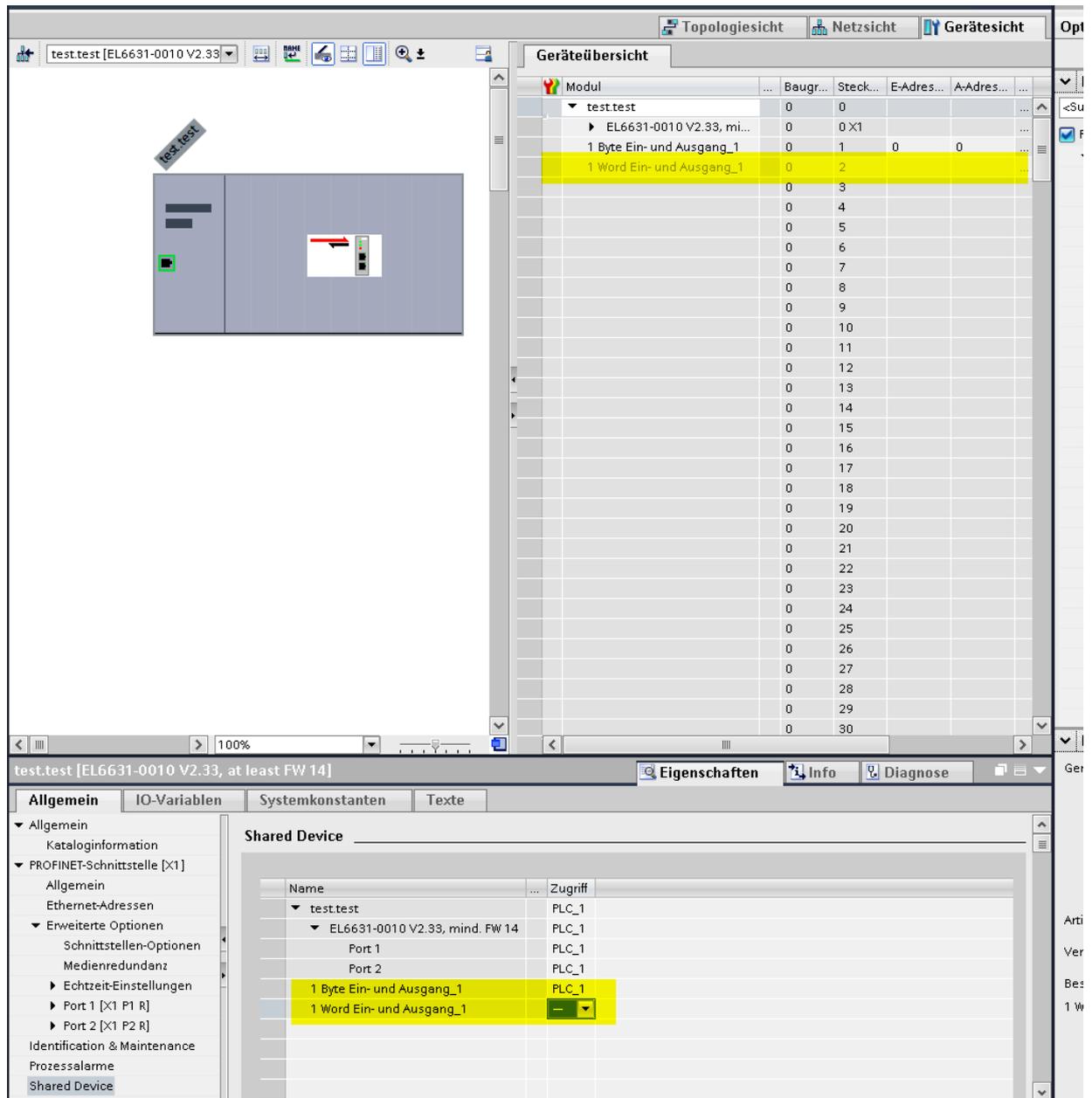
9. Configuration of the Device with the creation of the process data (must be identical with the TC3 side)



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.



7 Appendix

7.1 Troubleshooting

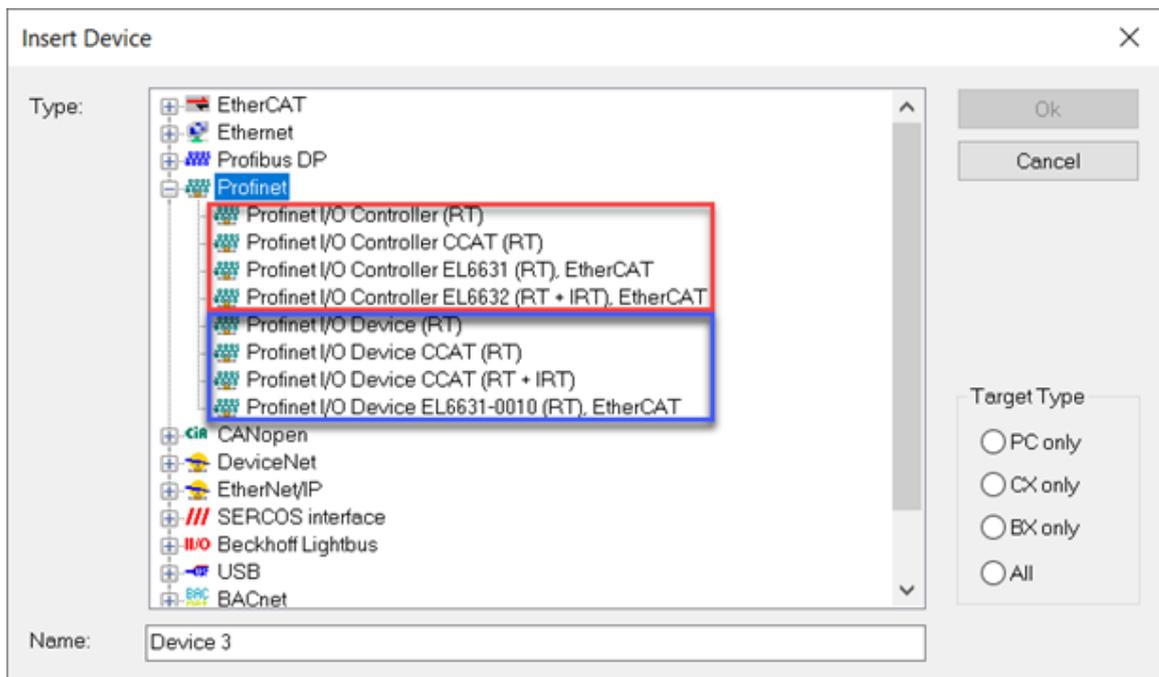
The different points indicate settings in the configuration of the PROFINET system which, if ignored, can lead to undesirable behavior; we also explain how to diagnose the behavior.

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 being used?
 - Version
 - It may be necessary to contact the vendor/manufacturer or search for the appropriate GSDML on the vendor's website.

Has the correct PROFINET adapter been created?

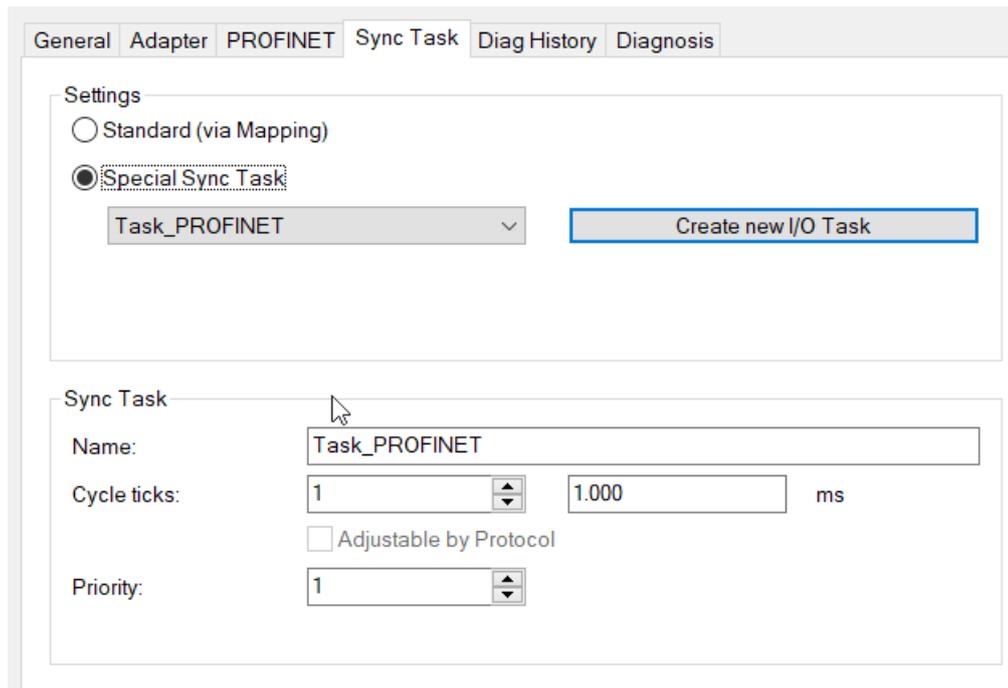
- Controller or device (master or slave)?



- Example, wrong / correct

Task configuration

- Was a free running task created?
 - Or was a special Sync Task used?
- Cycle time to base 2?
 - 1 ms, 2 ms, 4 ms, 8 ms,



- Further information in chapter [Sync Task \[► 47\]](#)

TF6270 – TwinCAT System Message

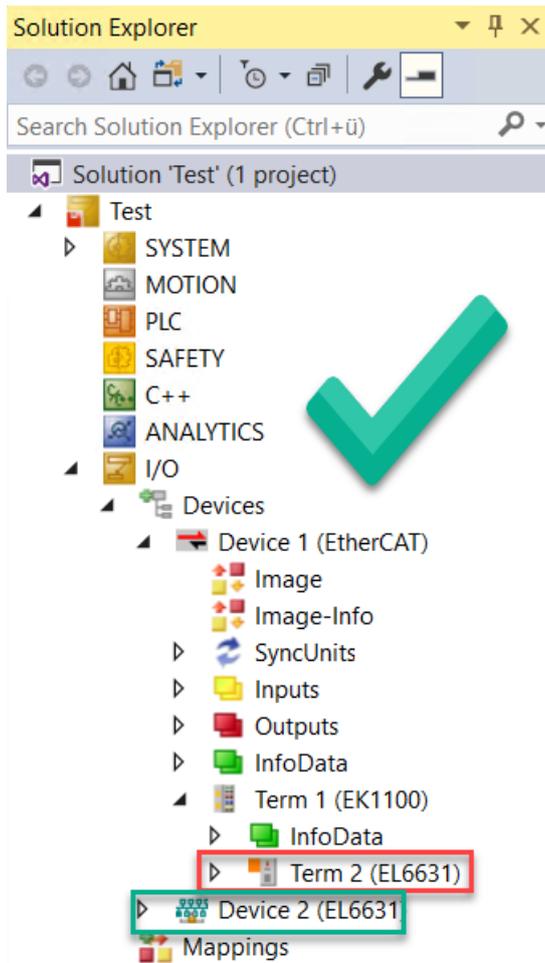
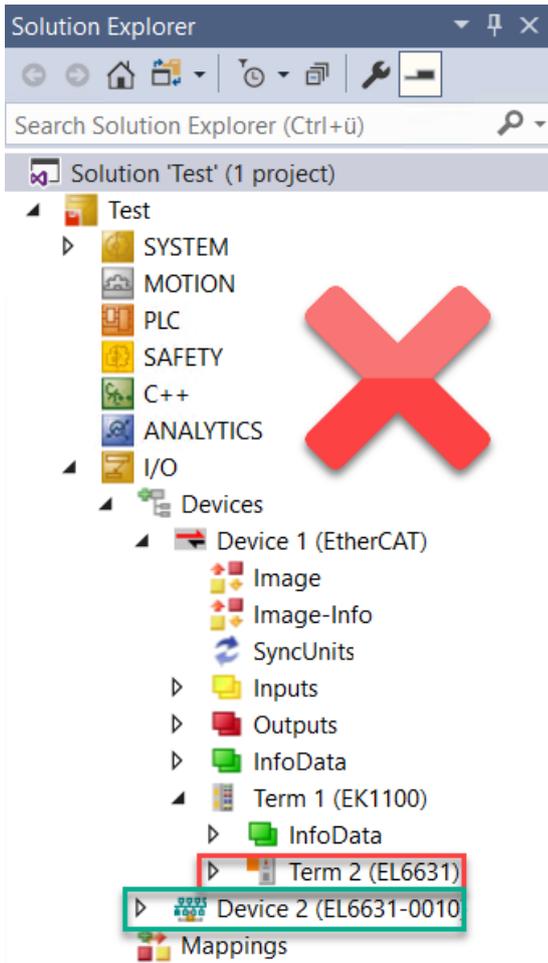
If the following warning is displayed when activating the project using the TF6270...

“TwinCAT System Message: Source: TCOM Server; Timestamp: 2/12/2021 9:05:40AM 809 ms Message: Boot data not found (file: Profinet_Parameters_3010060)”

... this can be ignored, because data of the connection establishment are stored for the PROFINET communication. If no PN connection has been established, no file is created. This warning will automatically disappear as soon as a PROFINET communication has been established.

EtherCAT Terminals EL663x-00x0

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



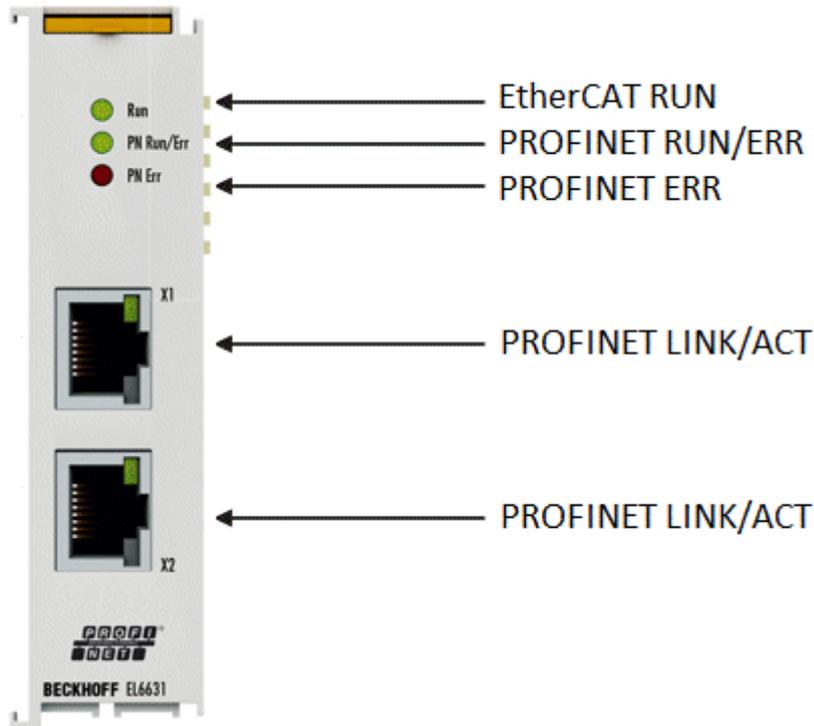
- EtherCAT diagnostics
 - EtherCAT status = operational (OP)
 - WcState = 0 (data valid)

BoxStates of the PROFINET devices

- Communication established?

7.1.1 Diagnostic LEDs

7.1.1.1 EL6631-0010 – LEDs



LEDs for EtherCAT diagnosis

LED	Display	Description
RUN	green	off
		flashing 200 ms
		off (1 s) on (200 ms)
		on
		State of the EtherCAT State Machine: INIT = initialization of the terminal; BOOTSTRAP = function for terminal firmware updates State of the EtherCAT State Machine: PREOP = function for mailbox communication and different standard-settings set State of the EtherCAT State Machine: SAFEOP = verification of the sync manager channels and the distributed clocks. Outputs remain in safe state 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

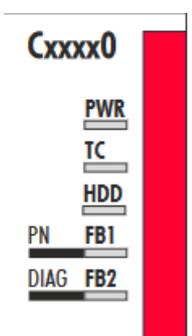
LED diagnosis PROFINET Err

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 seconds, the LED should go out. If this does not happen, the EL6631-0010 module must be exchanged.

7.1.1.2 Optional interface B930 - LEDs

Display	LED	PROFINET status		Meaning
		green	red	
	PN	Off	200 ms flashing	Power on, startup phase
		200 ms flashing	off	No PROFINET name
		1 s off, 200 ms flash on	off	No IP address
		on	off	RUN
	DIAG	500 ms flashing	500 ms flashing	PN controller identification. The PN controller is transmitting an identification signal.
		off	200 ms flashing	The establishment of a connection with the controller has not been completed.
		1 s off, 200 ms flash on	off	Problem when establishing a connection, or the actual and target configurations are different.
		200 ms on	off	The device is in data exchange but the PLC is in Stop mode.
		on	off	The device is in data exchange.

If a virtual PROFINET slave was projected, this is also covered by the LEDs in the event of an error. The physical device always has higher priority. The status of the virtual slave is only displayed once everything is OK with the physical device.

7.2 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.

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