

Quick start guide | EN

IO configuration in TwinCAT

EtherCAT Box modules



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1 Foreword

1.1 Notes on the documentation

Intended audience

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

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

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.

The logo for EtherCAT, featuring the word "EtherCAT" in a bold, black, sans-serif font. A red arrow points from the top of the "A" towards the right, ending above the "T". A registered trademark symbol (®) is located to the right of the "T".

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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 instructions

In this documentation the following instructions are used.
These instructions must be read carefully and followed without fail!

DANGER

Serious risk of injury!

Failure to follow this safety instruction directly endangers the life and health of persons.

WARNING

Risk of injury!

Failure to follow this safety instruction endangers the life and health of persons.

CAUTION

Personal injuries!

Failure to follow this safety instruction can lead to injuries to persons.

NOTE

Damage to environment/equipment or data loss

Failure to follow this instruction can lead to environmental damage, equipment damage or data loss.



Tip or pointer

This symbol indicates information that contributes to better understanding.

1.3 Documentation issue status

Version	Comment
1.1	<ul style="list-style-type: none">• Screenshots updated
1.0	<ul style="list-style-type: none">• First release

2 Introduction

The IO configuration is the prerequisite for the use of the functions of IO modules in a PLC program. It covers the appending and parameterization of IO modules in TwinCAT.

This quick start guide describes the basic IO configuration in TwinCAT 3 for IO modules of the type:

- EtherCAT Box (EPxxxx)
- EtherCAT P Box (EPPxxxx)



Link

The complete [documentation for TwinCAT 3](#).

3 Distinction between Online and Offline

The distinction between online and offline refers to the existence of the actual I/O environment (drives, terminals, box modules).

If the configuration is to be prepared in advance of the system configuration as a programming system, e.g. on a laptop, this is only possible in "Offline configuration" mode. In this case all components have to be entered manually in the configuration, e.g. based on the electrical design (as described under TwinCAT configuration setup, manual).

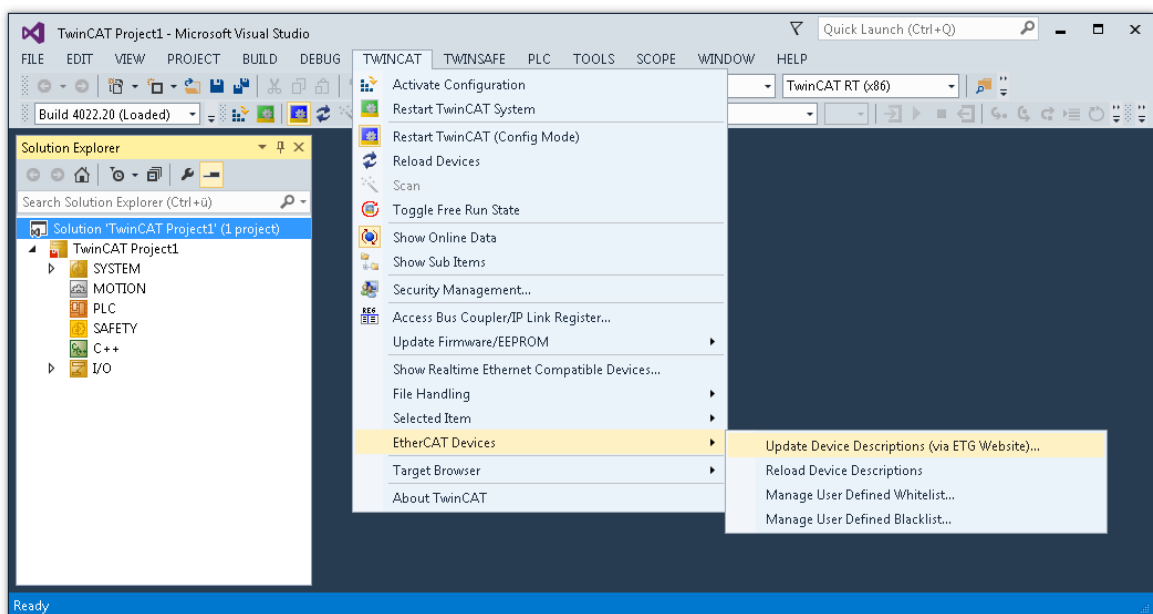
If the designed control system is already connected to the EtherCAT system and all components are energized and the infrastructure is ready for operation, the TwinCAT configuration can simply be generated through "scanning" from the runtime system. This is referred to as online configuration.

In any case, during each startup the EtherCAT master checks whether the devices it finds match the configuration.

To ensure that the latest features/settings of the master can be used, always download the latest ESI file. Please note the following information.

i Installation of the latest ESI-XML device description

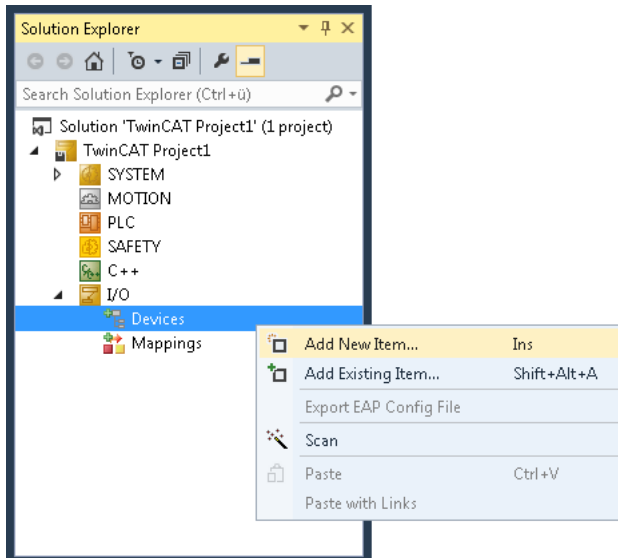
The TwinCAT System Manager needs the device description files for the devices to be used in order to generate the configuration in online or offline mode. The device descriptions are contained in the so-called ESI files (EtherCAT Slave Information) in XML format. These files can be requested from the respective vendor and are made available for download. The ESI files for Beckhoff EtherCAT/EtherCAT P devices are available on the Beckhoff website (<https://www.beckhoff.de/english/download/elconfg.htm?id=1983920606140>). The ESI files should be stored in the TwinCAT installation directory (default: C:\TwinCAT\IO\EtherCAT). The files are read (once) when a new System Manager window is opened. A TwinCAT installation includes the Beckhoff ESI files that were current at the time when the TwinCAT build was created. From TwinCAT 2.11 and in TwinCAT 3 the ESI directory can be updated from the System Manager, if the programming PC is connected to the internet (TwinCAT → EtherCAT Devices → Update Device Description...)



4 Offline IO configuration

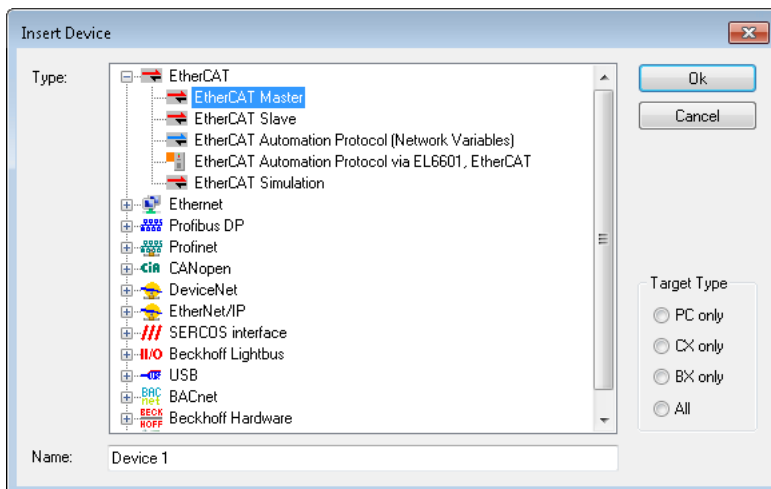
The manual configuration of an EtherCAT Box/EtherCAT P Box in TwinCAT is described in this part of the documentation.

1. Open the section "I/O" in the "Solution Explorer".
2. Right click on „Devices“ and click on „Add new Item“.



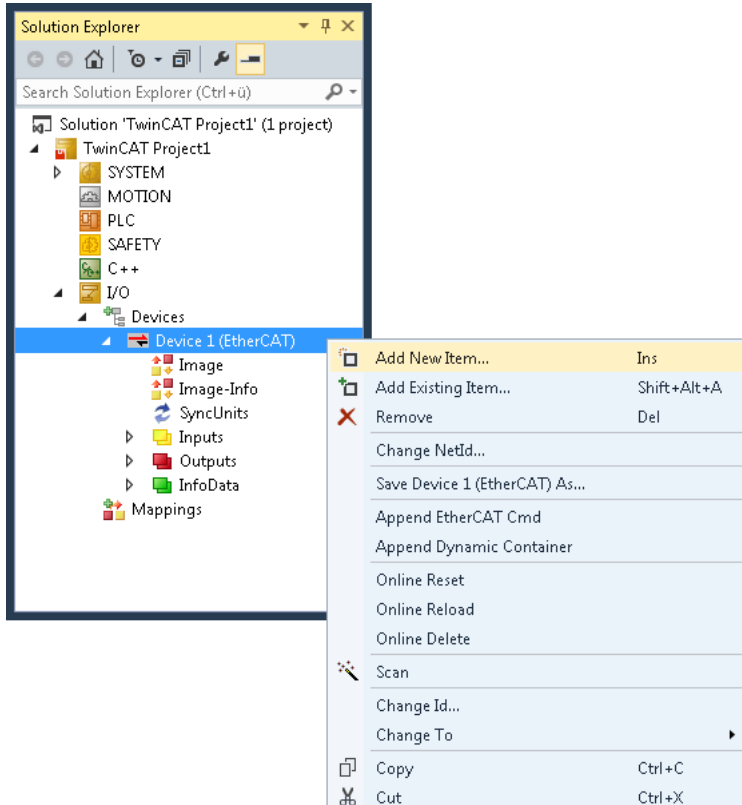
⇒ A dialog window opens.

3. Select the entry "EtherCAT Master" in the dialog window and click on "OK".



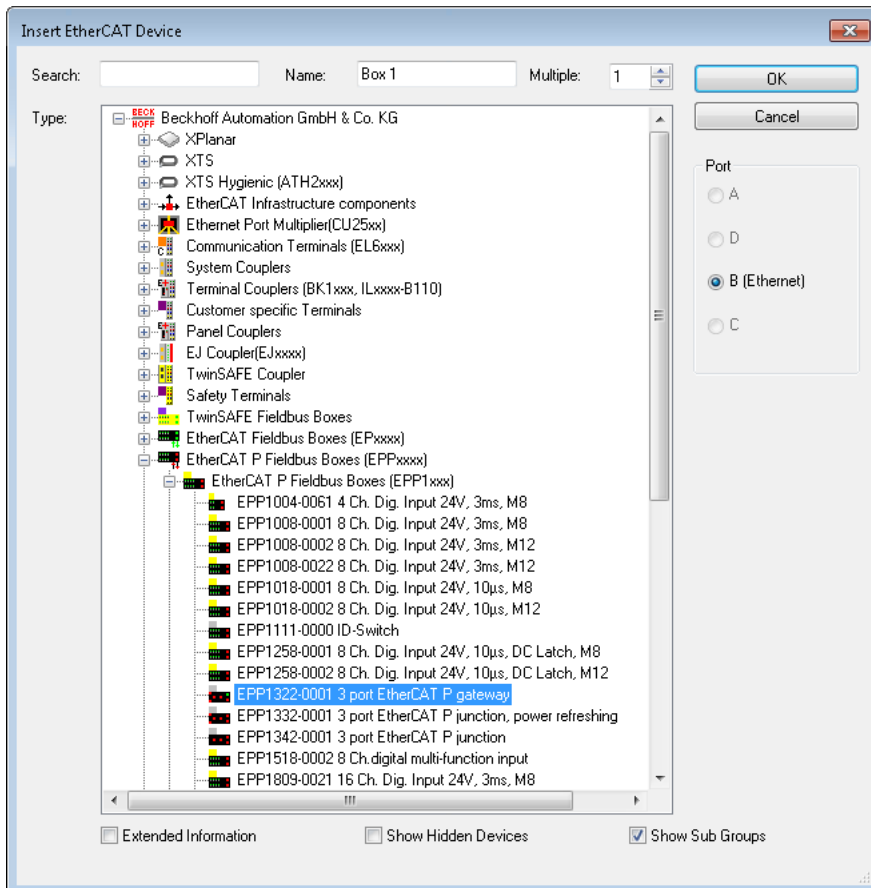
⇒ An entry "Device 1 (EtherCAT)" appears.

- Right click on "Device 1 (EtherCAT)" and click on „Add new Item“.



⇒ A dialog window opens.

- Choose the desired box in the dialog window, e.g. EPP1322-0001. Click on "OK".



⇒ Result: The desired box was appended.

5 Online IO configuration

The configuration of a physically existing EtherCAT Box/EtherCAT P Box in TwinCAT is described in this part of the documentation.

For the creation of the configuration

- the real EtherCAT/EtherCAT P and IO-Link hardware (devices, couplers, drives) must be present and installed.
- the devices/modules must be connected via EtherCAT/EtherCAT P or IO-Link cables in the same way as they are to be used later.
- the devices/modules must be connected to the power supply and ready for communication.
- TwinCAT must be in CONFIG mode on the target system.

The online scan process consists of:

- Detection of the EtherCAT/EtherCAT P device (Ethernet port on the IPC)
- Detection of the connected EtherCAT/EtherCAT P devices. This step can be carried out independently of the preceding step.
- Troubleshooting

The scan with existing configuration can also be carried out for comparison.

Detecting/scanning the EtherCAT/EtherCAT P device

The online device search can be used if the TwinCAT system is in Config mode (blue TwinCAT icon or blue indication in the System Manager).

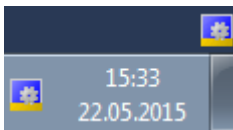


Fig. 1: TwinCAT Config mode display

i Online scanning in Config mode

The online search is not available in RUN mode (production operation).

Note the differentiation between TwinCAT programming system and TwinCAT target system. The TwinCAT icon next to the Windows clock always shows the TwinCAT mode of the local IPC. The System Manager window shows the TwinCAT state of the target system.



Right-clicking on "I/O Devices" in the configuration tree opens the search dialog.

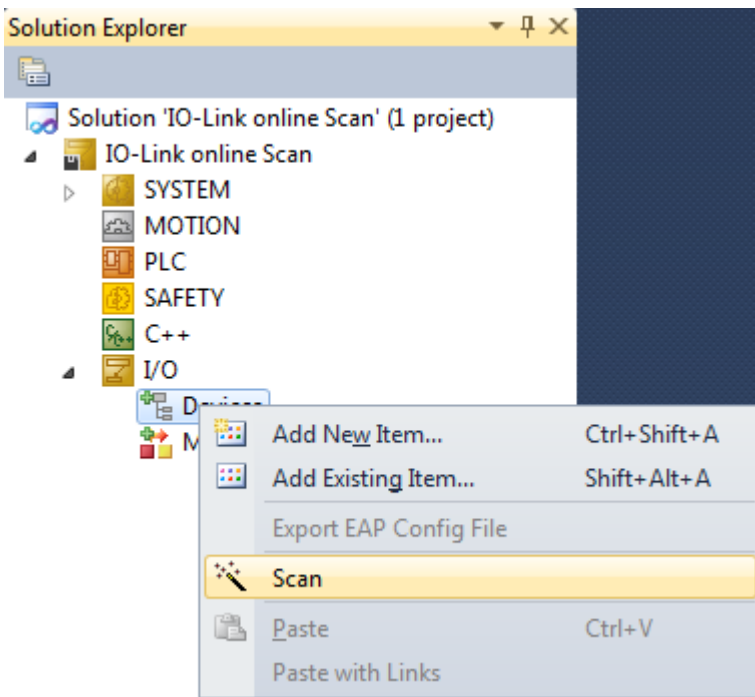


Fig. 2: Scan Devices

This scan mode not only tries to find EtherCAT/EtherCAT P devices (or Ethernet ports that can be used as such), but also NOVRAAM, fieldbus cards, SMB etc. However, not all devices can be found automatically.

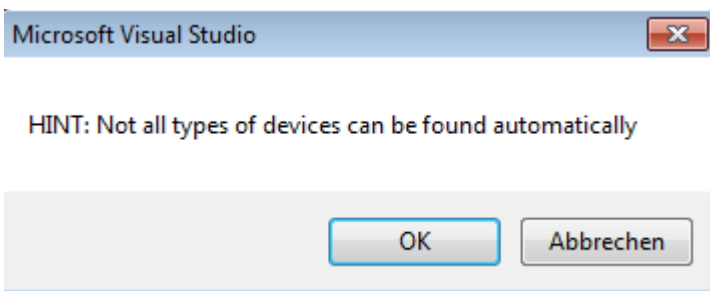


Fig. 3: Note for automatic device scan

Ethernet ports with installed TwinCAT real-time driver are shown as "RT Ethernet" devices. An EtherCAT frame is sent to these ports for testing purposes. If the scan agent detects from the response that an EtherCAT/EtherCAT P device is connected, however, then the port is immediately shown as an "EtherCAT Device".

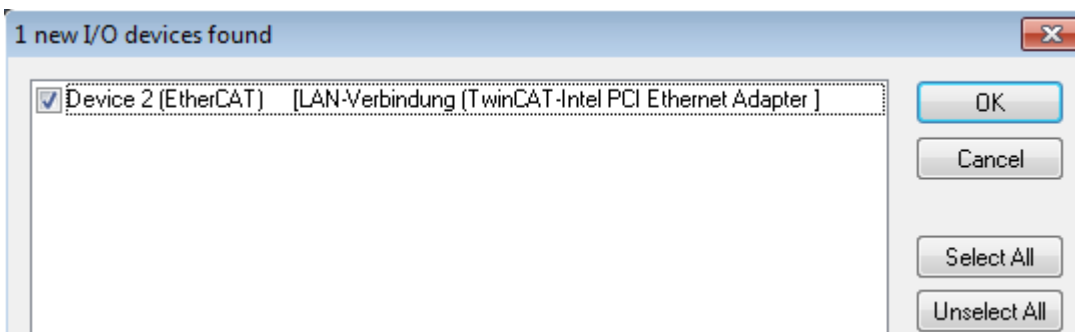


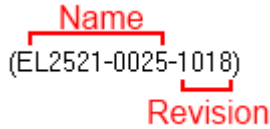
Fig. 4: detected Ethernet devices

After confirmation with "OK" a device scan is suggested for all selected devices (see the illustration below).

Detecting/Scanning the EtherCAT devices

i Online scan functionality

When scanning, the master queries the identity information of the EtherCAT/EtherCAT P device from the device's EEPROM. The name and revision are used for determining the type. The respective devices are located in the stored ESI data and integrated in the configuration tree in the default state defined there.



If an EtherCAT device was created in the configuration (manually or through a scan), the I/O field can be scanned for devices/slaves.

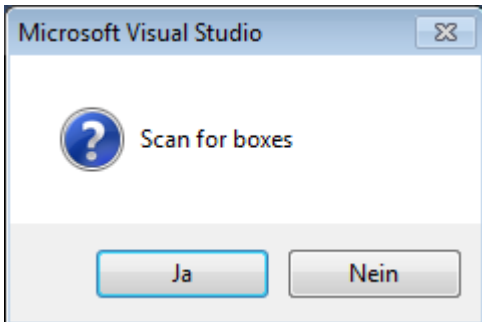


Fig. 5: Scan query after automatic creation of an EtherCAT/EtherCAT P device

The configuration was established and switched directly to the online state (operational). The EtherCAT system should be in a cyclic operational state, as shown in the following illustration.

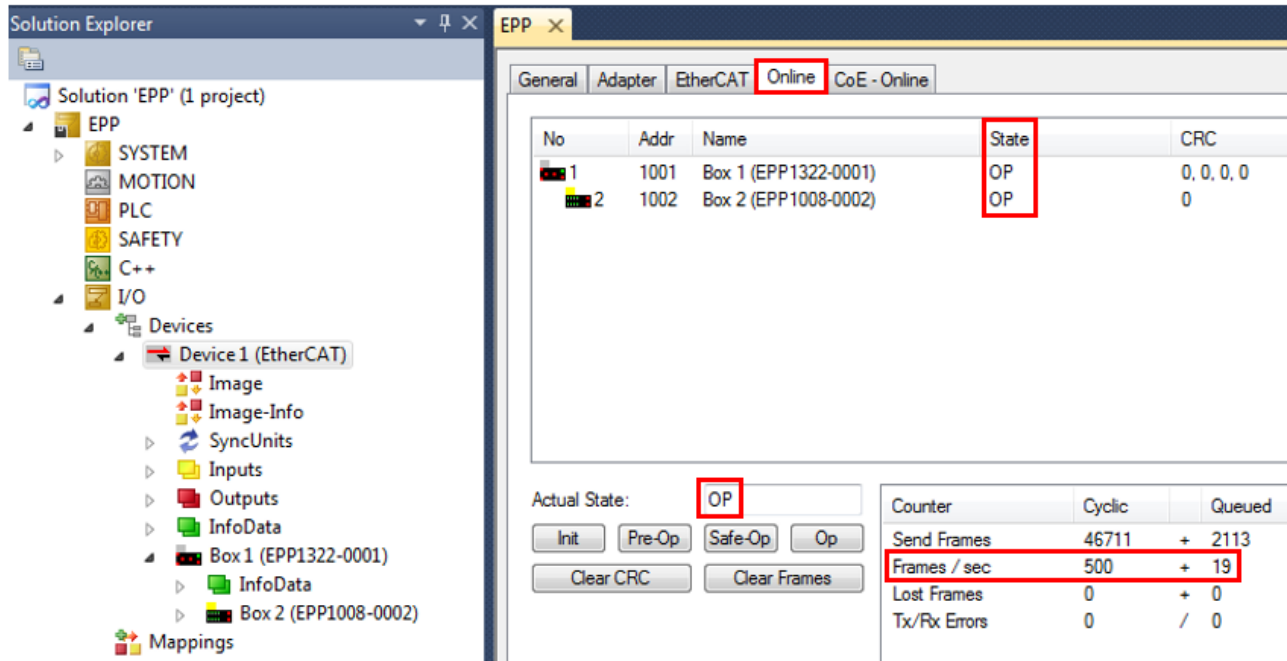


Fig. 6: online display example

Please note:

- All Boxes should be in OP state
- "frames/sec" should match the cycle time taking into account the sent number of frames
- no excessive "LostFrames" or CRC errors should occur

The configuration is now complete. It can be modified as described under manual procedure.

As can be seen in the illustration below, the connected EtherCAT/EtherCAT P Box (in this case: EPP1322-0001 and EPP1008-0002) is shown in the TwinCAT tree.

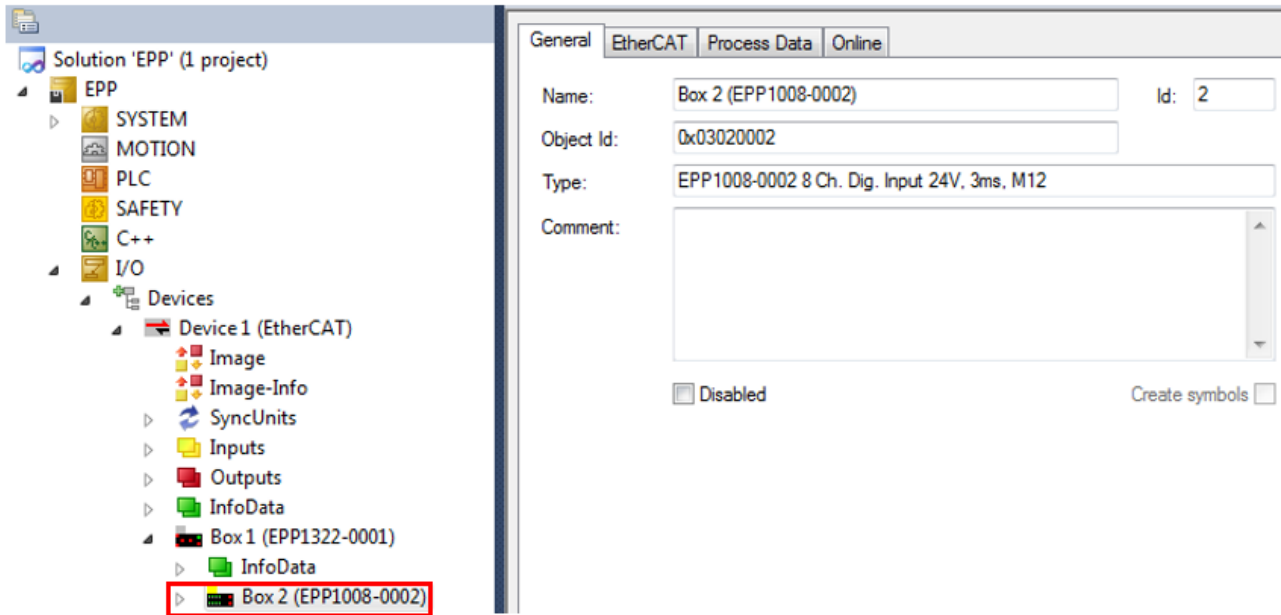


Fig. 7: Box display after "Scan for boxes"

Troubleshooting

Various effects may occur during scanning.

- An **unknown device** is detected, i.e. an EtherCAT/EtherCAT P device for which no ESI XML description is available. In this case the System Manager offers to read any ESI that may be stored in the device.
- **Device are not detected properly**
Possible reasons include
 - faulty data links, resulting in data loss during the scan
 - the device has an invalid device description
 The connections and devices should be checked in a targeted manner, e.g. via the emergency scan. Then re-run the scan.

Scan over existing Configuration

If a scan is initiated for an existing configuration, the actual I/O environment may match the configuration exactly or it may differ. This enables the configuration to be compared.

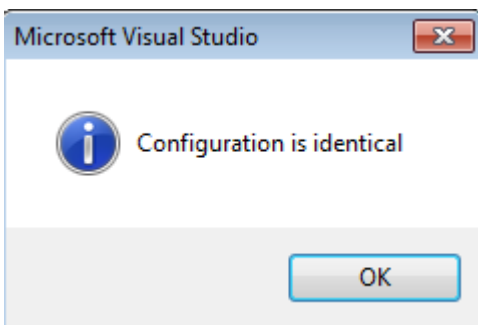


Fig. 8: Identical configuration

If differences are detected, they are shown in the correction dialog, so that the user can modify the configuration as required.

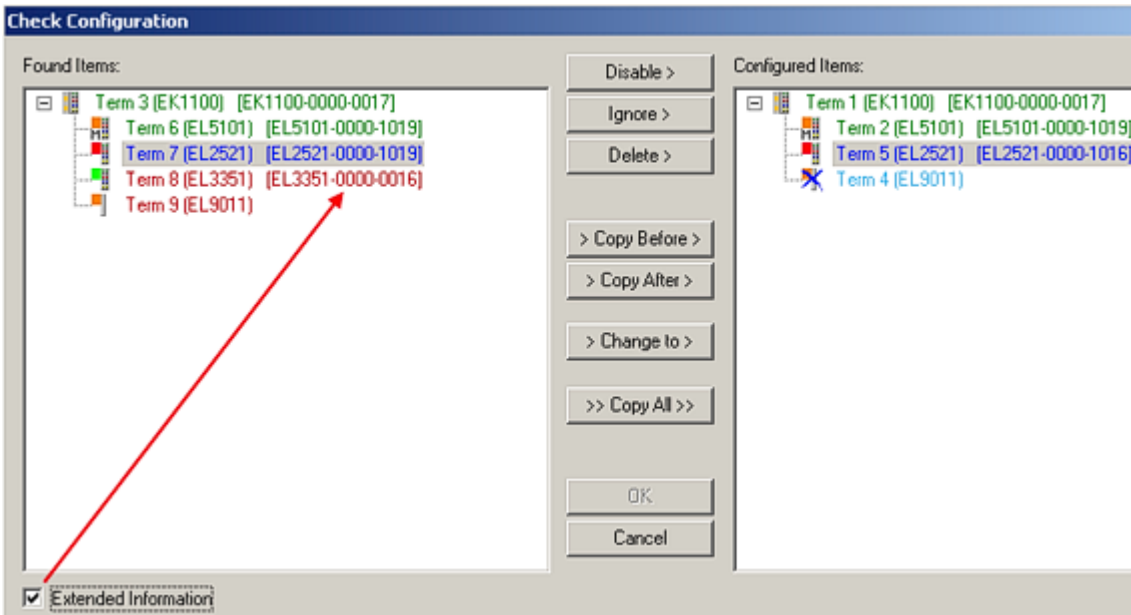


Fig. 9: Example correction dialog

It is recommended to check the "Extended Information" box, in order to show differences in the revision.

Color	Explanation
green	this EtherCAT/EtherCAT P device has a counterpart on the other side. Both type and revision match.
blue	this EtherCAT/EtherCAT P device is present on the other side, but in a different revision. If the found revision is higher than the configured revision, the use is possible provided compatibility issues are taken into account. If the found revision is lower than the configured revision, it is likely that the use is not possible. The found devices may not support all functions that the master expects based on the higher revision number.
light blue	this EtherCAT/EtherCAT P device is ignored ("Ignore" button)
red	this EtherCAT/EtherCAT P device is not present on the other side.

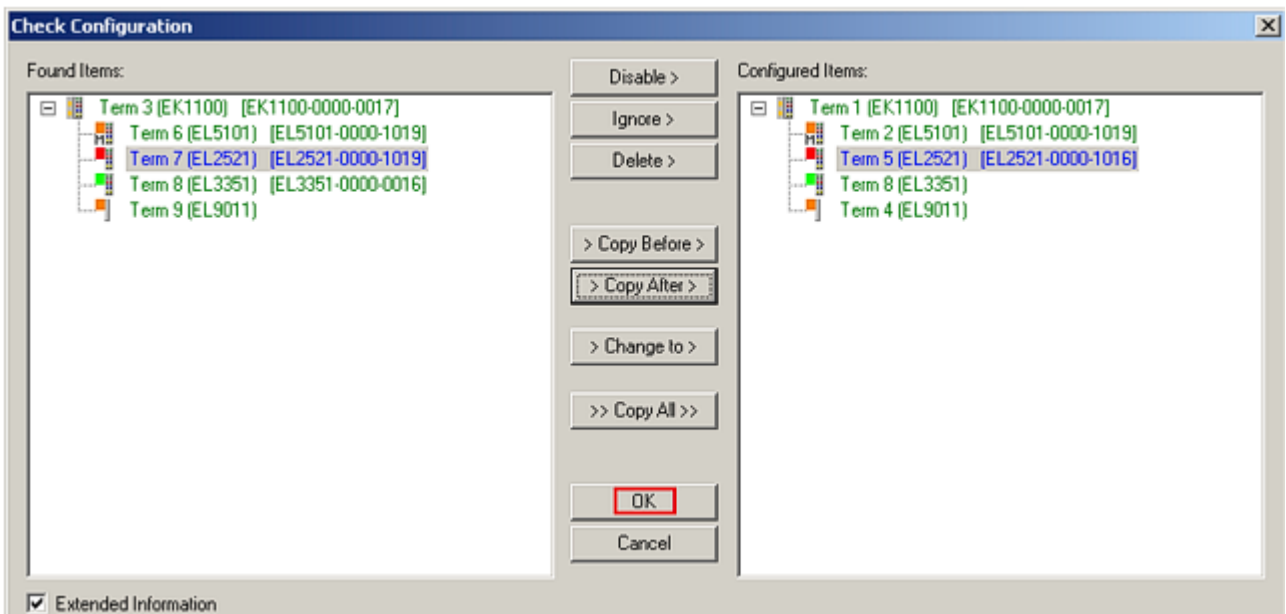


Fig. 10: Example correction dialog with modifications

Once all modifications have been saved or accepted, click "OK" to transfer them to the real *.tsm configuration.

6 Configuration of EtherCAT P via TwinCAT

EtherCAT P tab

From TwinCAT 3 Build 4020 TwinCAT has the tab “EtherCAT P”. This tab contains a planning tool to calculate voltages, currents and cable lengths of EtherCAT P system. The figure below shows the tab EtherCAT P when no device is connected to the junction device (A).

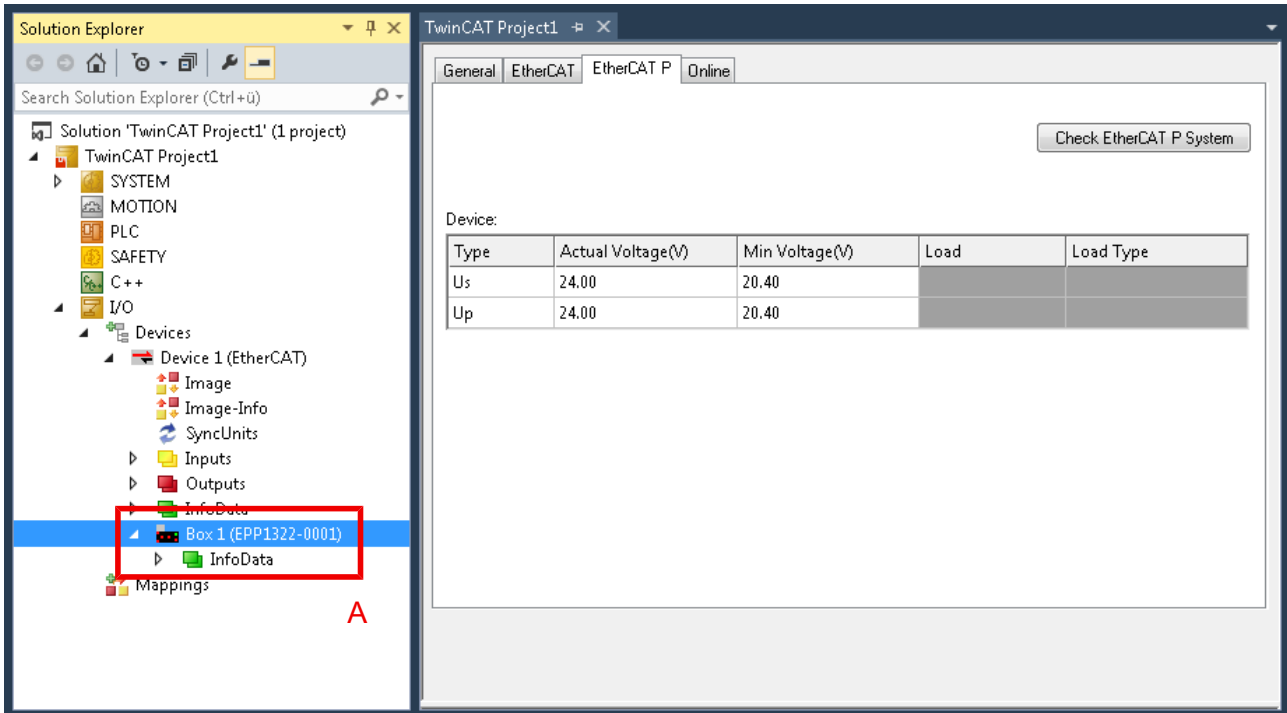


Fig. 11: Tab EtherCAT P: No device connected to junction device

If a device is connected to the junction device (A), you can set the cross-section and the length of the EtherCAT P cable in the Tab „EtherCAT P“ of the device. See figure below, B).

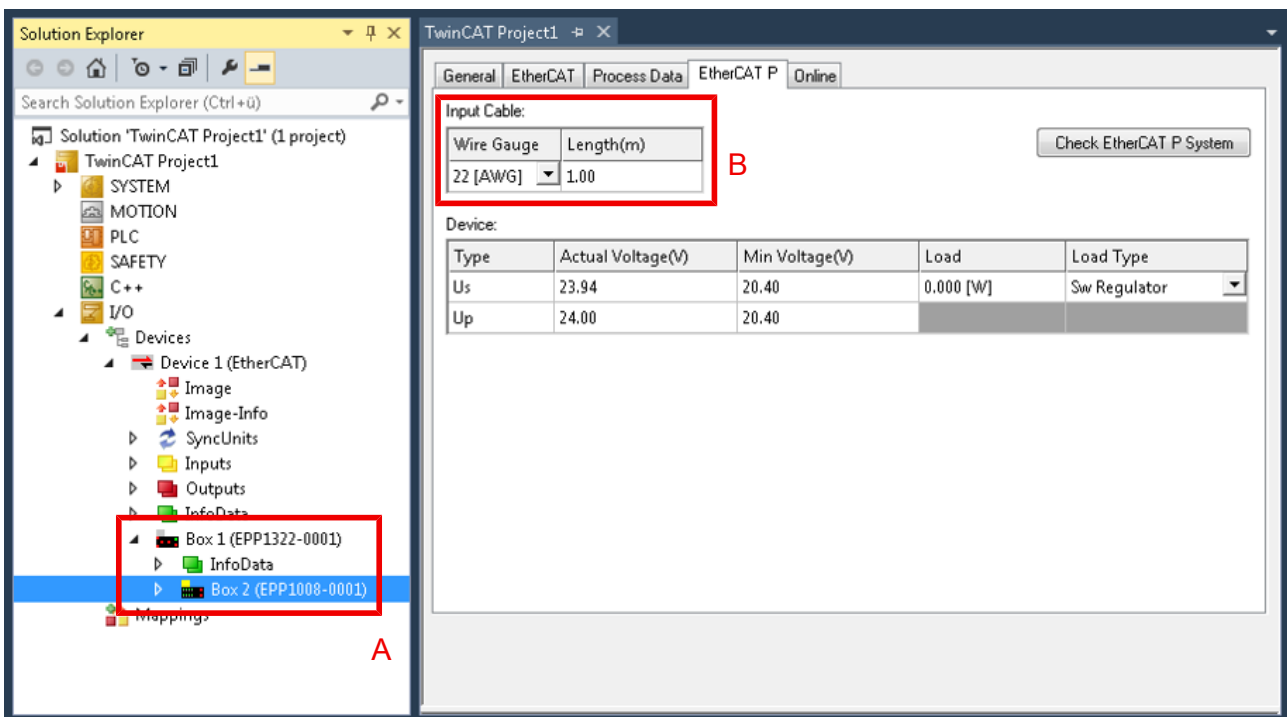


Fig. 12: Tab EtherCAT P: One device connected to junction device

Are three devices connected to the three ports of the junction device (A), they are displayed as shown in the figure below.

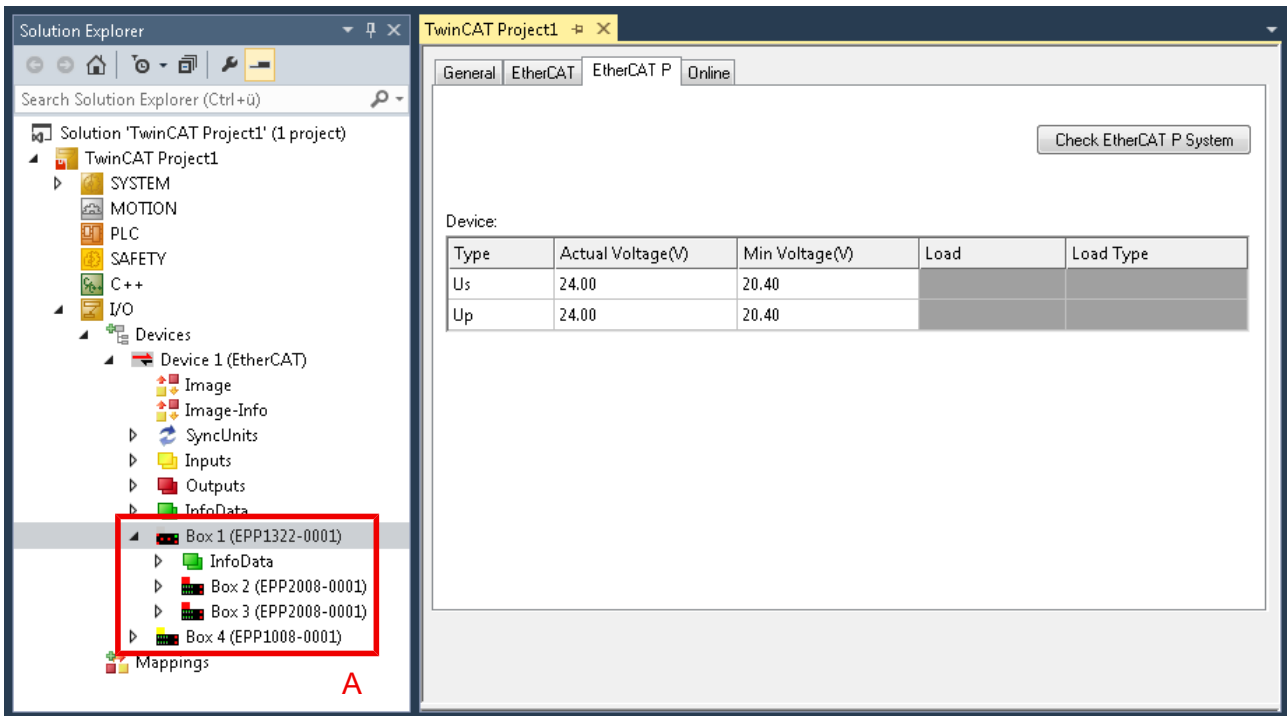
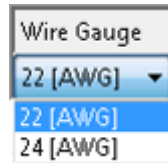


Fig. 13: Tab EtherCAT P: Three devices connected to junction device

You can display [the topology of your EtherCAT P system](#) [▶ 22].

Wire Gauge Selection of the wire cross-sectional area of the cable which is to be used
 AWG 22 = 0.34 mm²
 AWG 24 = 0.22 mm²



Length (m) Indication of the cable length which is to be used
Check EtherCAT P System At least one device is connected to the controller, the connected EtherCAT P system can be checked

Type Listing of two voltages: Box supply U_s, Auxiliary voltage U_p

Actual Voltage (V) The respective voltage at which the system is powered, can be entered manually. The default setting is 24.00 V.

Min Voltage (V) The minimum voltage is preset by the device and described in the ESI file. The EtherCAT P system is to be interpreted after this voltage. It is valid not to fall short this voltage.

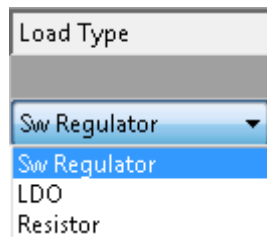
Load (A) The total consumption of the connected sensors / actuators at the device can be specified here, e.g. 100 mA.

Load Type The characteristic of the load which is connected to the devices can be selected here. Which of the three options is right for the connected load (Sw regulator, LDO, Resistor), must be taken from the datasheet. In case of doubt please select the default value "Sw Regulator".

Sw Regulator: Switching regulators, consume more energy and therefore require an efficient power supply.

LDO: Low drop voltage regulator, the energy demand is often small and the heat dissipation is not a problem, e.g. proximity sensor.

Resistor: electronic, passive components e.g. relay, coil



If you click on the button “Check EtherCAT P System”, all devices that are attached to your TwinCAT tree are listed as shown in the following figure.

No.	Name	Previous	Us(V)	Up(V)	Sum Is(A)	Sum Ip(A)	Us Load	Up Load	Us Load Type	Up Load Type	Cable Length(m)	Wire Gauge
1	Box 1 (EPP1322-0001)		24,00	24,00	0,518	0,254					0,00	0 [mm ²]
2	Box 2 (EPP1008-0002)	1-B	23,00	23,39	0,418	0,254	0,125 [A]		LDO		20,00	22 [AWG]
3	Box 3 (EPP3174-0002)	2-B	22,94	23,33	0,230	0,254		0,100 [W]		Sw Regulator	0,20	22 [AWG]
4	Box 4 (EPP2334-0061)	3-B	22,91	23,26	0,126	0,250		0,000 [W]		Sw Regulator	0,20	22 [AWG]
5	Box 5 (EPP2334-0061)	4-B	22,89	23,16	0,063	0,250		0,250 [A]		LDO	1,00	22 [AWG]

Fig. 14: Check EtherCAT P System

- No.** The automatically assigned number of the device according to its position in the EtherCAT P strand.
- Name** Designation of the device in TwinCAT.
- Previous** Number of the previous device in the EtherCAT P strand and the output port used (A/B/C/D).
- Us (V), Up (V)** Supply voltage which is present at the input of the device. For device No. 1 You can enter the voltages manually.
- Sum Is(A), Sum Ip(A)** Sum currents of the supply voltages at the input of the device.
- Us Load, Up Load** Enter here the total load at the IO ports of the device here. The unit of this value is set by the choice of "Us Load Type" and "Up Load Type".
- Us Load Type, Up Load Type** Choose here the characteristic of the load [▶ 19], which is connected to the IO ports of the device.
- Cable Length (m)** Enter here the length of the EtherCAT P cable, which is connected to the input of the device.
- Wire Gauge** Choose here the wire cross-section of the EtherCAT P cable, which is connected to the input of the device.
 - AWG 22 = 0,34 mm²
 - AWG 24 = 0,22 mm²

Example with problem case and troubleshooting

The following figure shows the planning of the EtherCAT P system without a problem. All voltages in the column “Supply Voltage (V)” are highlighted in green.

No.	Name	Previous	Us(V)	Up(V)	Sum Is(A)	Sum Ip(A)	Us Load	Up Load	Us Load Type	Up Load Type	Cable Length(m)	Wire Gauge
1	Box 1 (EPP1322-0001)		24,00	24,00	0,538	0,504					0,00	0 [mm ²]
2	Box 2 (EPP1008-0002)	1-B	23,43	23,34	0,438	0,504	0,150 [A]		LDO		10,00	22 [AWG]
3	Box 3 (EPP3174-0002)	2-B	23,35	23,18	0,227	0,504		0,100 [W]		Sw Regulator	1,00	22 [AWG]
4	Box 4 (EPP2334-0061)	3-B	23,31	22,99	0,124	0,500		0,000 [W]		Sw Regulator	1,00	22 [AWG]
5	Box 5 (EPP2334-0061)	4-B	23,19	22,02	0,062	0,500		0,500 [A]		LDO	15,00	22 [AWG]

Fig. 15: Check EtherCAT P system without problem

The following figure shows the planning of the EtherCAT P system with a problem. The “Supply Voltage (V)” of Box 5 drops below the “Min. voltage (V)”. The corresponding field is highlighted in red. The error occurs because longer cables (adjustable in Cable Length (m)) and also AWG 24 instead of AWG 22 cables (adjustable in Wire Gauge) be used.

No.	Name	Previous	Us(V)	Up(V)	Sum Is(A)	Sum Ip(A)	Us Load	Up Load	Us Load Type	Up Load Type	Cable Length(m)	Wire Gauge
1	Box 1 (EPP1322-0001)		24.00	24.00	0.541	0.504					0.00	0 [mm ²]
2	Box 2 (EPP1008-0002)	1-B	23.42	23.34	0.441	0.504	0.150 [A]		LDO		10.00	22 [AWG]
3	Box 3 (EPP3174-0002)	2-B	23.17	22.79	0.229	0.504		0.100 [W]		Sw Regulator	5.00	24 [AWG]
4	Box 4 (EPP2334-0061)	3-B	23.08	22.40	0.126	0.500		0.000 [W]		Sw Regulator	3.00	24 [AWG]
5	Box 5 (EPP2334-0061)	4-B	22.72	19.52	0.063	0.500		0.500 [A]		LDO	50.00	22 [AWG]

Fig. 16: Check EtherCAT P System with problem

This area offers the following three options to adjust the system so that there is no error:

- Provide a higher voltage: There are max. 28.8 V possible.
- Use an EtherCAT P cable with a larger wire cross sectional area (AWG 22 instead of AWG 24).
- New voltage feed.

Topology of the EtherCAT P system

You can view the topology of your EtherCAT P system, as described in the figure below:

1. In the Click on "Device 1 (EtherCAT)" in the "Solution Explorer"
 2. Click on the "EtherCAT" tab
 3. Click on the "Topology" button
- ⇒ The topology of your EtherCAT P system is displayed.

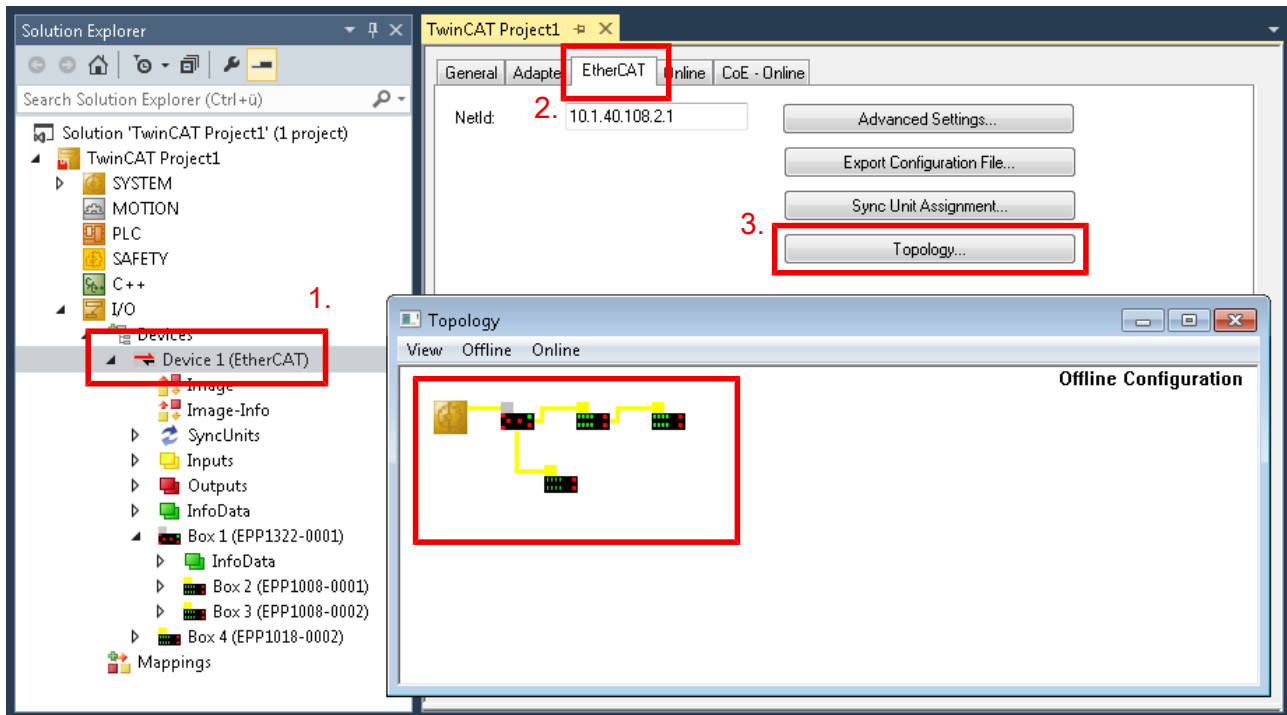


Fig. 17: Example: Three devices are connected to the three ports of the distributor device.

7 Appendix

7.1 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

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