BECKHOFF New Automation Technology

Manual | EN

CX56x0

Embedded PC

Table of contents

1 Notes on the documentation

This description is intended exclusively for trained specialists in control and automation technology who are familiar with the applicable national standards.
The documentation and the following notes and explanations must be complied with when installing and commissioning the components.
The trained specialists must always use the current valid documentation.

The trained specialists must ensure that the application and use of the products described is in line with all safety requirements, including all relevant laws, regulations, guidelines, and standards.

Disclaimer

The documentation has been compiled 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 notice.
Claims to modify products that have already been supplied may not be made on the basis of the data, diagrams, and descriptions in this documentation.

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1.1 Representation and structure of warnings

The following warnings are used in the documentation. Read and follow the warnings.

Warnings relating to personal injury:

⚠ DANGER
Hazard with high risk of death or serious injury.

⚠ WARNING
Hazard with medium risk of death or serious injury.

⚠ CAUTION
There is a low-risk hazard that can result in minor injury.

Warnings relating to damage to property or the environment:

NOTICE
There is a potential hazard to the environment and equipment.

Notes showing further information or tips:

This notice provides important information that will be of assistance in dealing with the product or software. There is no immediate danger to product, people or environment.

1.2 Documentation issue status

Version	Changes
1.0	First release
1.1	Chapters "Care and maintenance" and "Accessories" adapted.

2   For your safety

Read the chapter on safety and follow the instructions in order to protect from personal injury and damage to equipment.

Limitation of liability

All the components are supplied in particular hardware and software configurations appropriate for the application. Unauthorized modifications and changes to the hardware or software configuration, which go beyond the documented options, are prohibited and nullify the liability of Beckhoff Automation GmbH & Co. KG.
In addition, the following actions are excluded from the liability of Beckhoff Automation GmbH & Co. KG:

- Failure to comply with this documentation.
- Improper use.
- Use of untrained personnel.
- Use of unauthorized replacement parts.

2.1   Intended use

The embedded PC is a control system for use in machine and system engineering for automation, visualization and communication. The embedded PC is designed for installation in a control cabinet or terminal box and is used together with Bus or EtherCAT Terminals to receive digital and analog signals from sensors and output them to actuators or forward them to higher-level controllers.

The Embedded PC is designed for a working environment that meets the requirements of protection class IP20. This involves finger protection and protection against solid foreign objects up to 12.5 mm, but not protection against water. Operation of the devices in wet and dusty environments is not permitted, unless specified otherwise. The specified limits for electrical and technical data must be adhered to.

Improper use

The Embedded PC is not suitable for operation in the following areas:

- Potentially explosive atmospheres.
- Areas with an aggressive environment, e.g. aggressive gases or chemicals.
- Living areas. If the devices are to be used in living areas, the relevant standards and guidelines for interference emissions must be adhered to, and the devices must be installed in housings or control boxes with suitable shielding.

2.2   Staff qualification

All operations involving Beckhoff software and hardware may only be carried out by qualified personnel with knowledge of control and automation engineering. The qualified personnel must have knowledge of the administration of the Industrial PC and the associated network.

All interventions must be carried out with knowledge of control programming, and the qualified personnel must be familiar with the current standards and guidelines for the automation environment.

2.3   Safety instructions

The following safety instructions must be followed during installation and working with networks and the software.

Mounting

- Never work on live equipment. Always switch off the power supply for the device before installation, troubleshooting or maintenance. Protect the device against unintentional switching on.

- Observe the relevant accident prevention regulations for your machine (e.g. the BGV A 3, electrical systems and equipment).
- Ensure standard-compliant connection and avoid risks to personnel. Ensure that data and supply cables are laid in a standard-compliant manner and ensure correct connection.
- Observe the relevant EMC guidelines for your application.
- Avoid polarity reversal of the data and supply cables, as this may cause damage to the equipment.
- The devices contain electronic components, which may be destroyed by electrostatic discharge when touched. Observe the safety precautions against electrostatic discharge according to DIN EN 61340-5-1/-3.

Working with networks

- Restrict access to all devices to an authorized circle of persons.
- Change the default passwords to reduce the risk of unauthorized access.
- Protect the devices with a firewall.
- Apply the IT security precautions according to IEC 62443, in order to limit access to and control of devices and networks.

Working with the software

- The sensitivity of a PC against malicious software increases with the number of installed and active software.
- Uninstall or disable unnecessary software.

Further information on the safe handling of networks and software can be found in the Beckhoff Information System:
http://infosys.beckhoff.com

Document name
IPC Security Guideline

2.4   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.

3 Transport and storage

Transport

NOTICE
Short circuit due to moisture
Moisture can form during transport in cold weather or in the event of large temperature fluctuations.
Avoid moisture formation (condensation) in the embedded PC, and leave it to adjust to room temperature slowly. If condensation has occurred, wait at least 12 hours before switching on the embedded PC.

Despite the robust design of the unit, the components are sensitive to strong vibrations and impacts. Transporting a control cabinet with a built-in embedded PC can result in excessive impact on the embedded PC.

- During transport, the device must therefore be protected from excessive mechanical stress.
- Appropriate packaging of the industrial PC, in particular the original packaging, can improve vibration resistance during transport.
- Send the embedded PC in the original packaging and additional outer packaging.

Table 1: Dimensions and weight of the individual modules.

	CX5620	CX5630
Dimensions (W x H x D)	124 mm x 100 mm x 92 mm	142 mm x 100 mm x 92 mm
Weight	approx. 860 g	approx. 960 g

Storage

- Remove the battery from the Embedded PC if storage temperatures exceed 60 °C. The battery should be stored separate from the Embedded PC in a dry environment at a temperature between 0 °C and 30 °C.
  The preset date and time are lost if the battery is removed.

4   Product overview

The CX5600 product family includes two different embedded PCs, which differ by their processor type and RAM. The CX56x0 Embedded PC is a full-fledged PC with the following basic configuration:

- an M.2 SSD slot,
- a microSD card slot,
- two independent Gbit Ethernet interfaces,
- four USB 3.0 interfaces,
- and a DVI-D interface

The embedded PC features an internal 1-second UPS as persistent data memory. In the event of a power failure the 1-second UPS can store up to 1 MB of persistent data on the M.2 SSD card or microSD card. Windows 10 IoT Enterprise 2019 LTSC, Windows 10 IoT Enterprise 2021 LTSC or TwinCAT/BSD can be used as the operating system.

Extension modules

The basic CPU module can be extended if required and thus equipped with additional interfaces. To do this, a system module or fieldbus module from the CX2500-xxxx series can be plugged in via the multi-pin connection on the left-hand side of the device. In total, no more than one module can be plugged in.

Table 2: Available extension modules for the CX56x0.

Module	Description
CX2500-0030	RS232 serial interface, 2 x D-sub connector, 9-pin
CX2500-0031	RS422/RS485 serial interface, 2 x D-sub socket, 9-pin
CX2500-0060	Ethernet module, 2 x Ethernet, 10/100/1000 Mbit/s
CX2500-0061	Power-over-Ethernet module (PoE), 1 x RJ45, 10/100/1000 Mbit/s
CX2500-0070	USB 3.0 module, 4 x USB 3.0, type A
CX2500-M310	PROFIBUS fieldbus master module, 1 x D-sub socket, 9-pin
CX2500-B310	PROFIBUS fieldbus slave module, 1 x D-sub socket, 9-pin
CX2500-M510	CANopen fieldbus master module, 1 x D-sub connector, 9-pin
CX2500-B510	CANopen fieldbus slave module, 1 x D-sub connector, 9-pin

Optional interface

The embedded PC can be ordered ex factory with an optional interface. The optional interface cannot be retrofitted.

Table 3: Available optional interfaces for the CX56x0.

CX56x0-xxxx	Optional interfaces
CX56x0-N010	DVI-D, additional DVI-D socket for clone and extended display mode.[1]
CX56x0-N011	DisplayPort, additional DisplayPort for clone and extended display mode.[1]
CX56x0-N020	Audio interface, 3 x 3.5 mm jack plug, Line-In, Mic-In, Line-Out
CX56x0-N030	RS232, D-sub connector, 9-pin.
CX56x0-N031	RS422/RS485, D-sub socket, 9-pin.
CX56x0-M112	2 x EtherCAT master, RJ45.
CX56x0-B110	EtherCAT slave, EtherCAT IN and OUT (2 x RJ45).
CX56x0-M310	PROFIBUS master, D-sub socket, 9-pin.
CX56x0-B310	PROFIBUS slave, D-sub socket, 9-pin.
CX56x0-M510	CANopen master, D-sub connector, 9-pin.
CX56x0-B510	CANopen slave, D-sub connector, 9-pin.
CX56x0-M930	PROFINET RT, controller, Ethernet (2 x RJ-45).
CX56x0-B930	PROFINET RT, device, Ethernet (2 x RJ-45 switch).

Power supply terminal

The power supply terminal for the embedded PC is located on the right-hand side. Bus terminals (K-bus) or EtherCAT Terminals (E-bus) can be attached on the right-hand side of the power supply terminal. The power supply terminal automatically recognizes the respective bus system (K-bus or E-bus).

Software

In combination with the TwinCAT automation software, the CX56x0 Embedded PC becomes a powerful IEC 61131-3 PLC with up to four user tasks.

Additionally, Motion Control tasks can also be executed. It may be possible to control several servo axes, depending on the required sampling time. In addition to simple point-to-point movements, it is possible to execute more complex multi-axis functions such as electronic gearing, cam plate and flying saw.

In addition to real-time execution of control tasks, the TwinCAT real-time kernel ensures that enough time remains for the user interface (HMI), to communicate with the real-time components via software interfaces such as ADS or OPC.
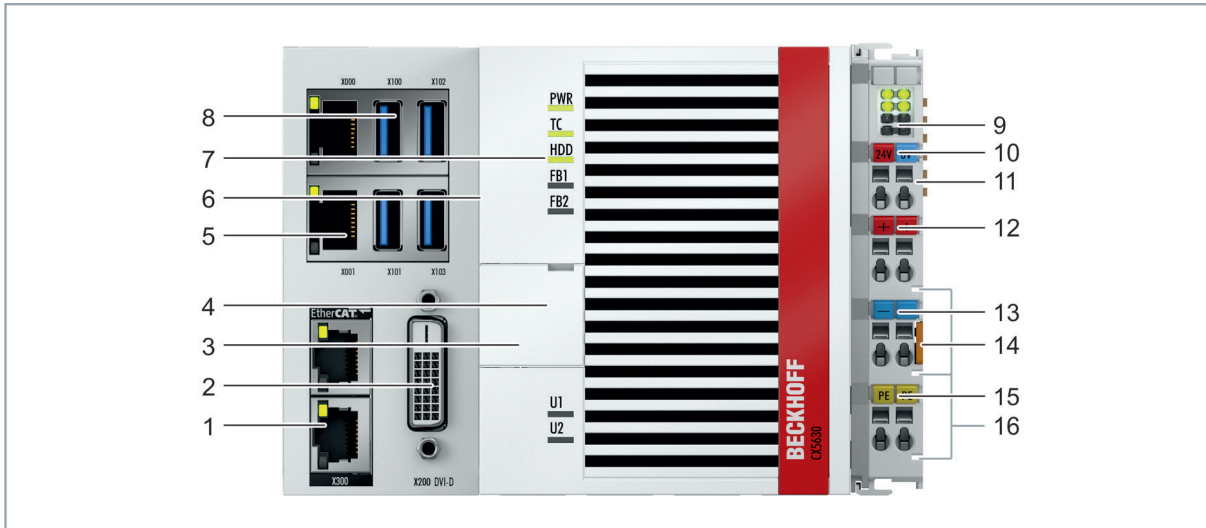
4.1   Structure

Fig. 1: Example configuration of a CX5630 Embedded PC.

Table 4: Legend for the configuration.

| No.	Component	Description
1	Optional interface [▶ 20] (X300).	Space for interfaces such as RS232, EtherCAT, CANopen or others. The optional interface must be ordered ex factory and cannot be retrofitted retrospectively.
2	DVI-D interface [▶ 19] (X200).	Interface for a monitor or panel.
3	Battery compartment (under the front flap).	Power supply for the battery-backed clock for time and date.
4	MicroSD card slot [▶ 33] (under the front flap).	Slot for industrial microSD cards.
5	Ethernet interfaces RJ45 [▶ 17] (X000, X001).	For connecting to local networks or the internet.
6	M.2 SSD slot [▶ 34] (under the side flap).	Slot for industrial M.2 SSDs.
7	Diagnostic LEDs [▶ 62].	Diagnostic LEDs for power supply, TwinCAT and the optional interface.
8	USB interfaces [▶ 17] (X100, X101, X102, X103).	Interfaces for peripheral devices such as mouse, keyboard or USB memory.
9	Diagnostic LEDs, power supply terminal.	Diagnosis of the power supply for the embedded PC and the terminal bus. Status of the E-bus and K-bus communication.
10	Spring-loaded terminals, +24 V and 0 V	Power supply for embedded PC.
11	Terminal bus (K-bus or E-bus)	Interface for EtherCAT Terminals or bus terminals. Data exchange and supply.
12	Spring-loaded terminal, +24 V	Power supply for bus terminals via power contact.
13	Spring-loaded terminal, 0 V	Power supply for bus terminals via power contact.
14	Terminal release	Releases the power supply terminal and thus the embedded PC from the DIN rail.
15	Spring-loaded terminal, PE	Spring-loaded terminal for power contact PE.
16	Power contacts, +24 V, 0 V, PE	Power contacts for bus terminals.

4.2 Name plate
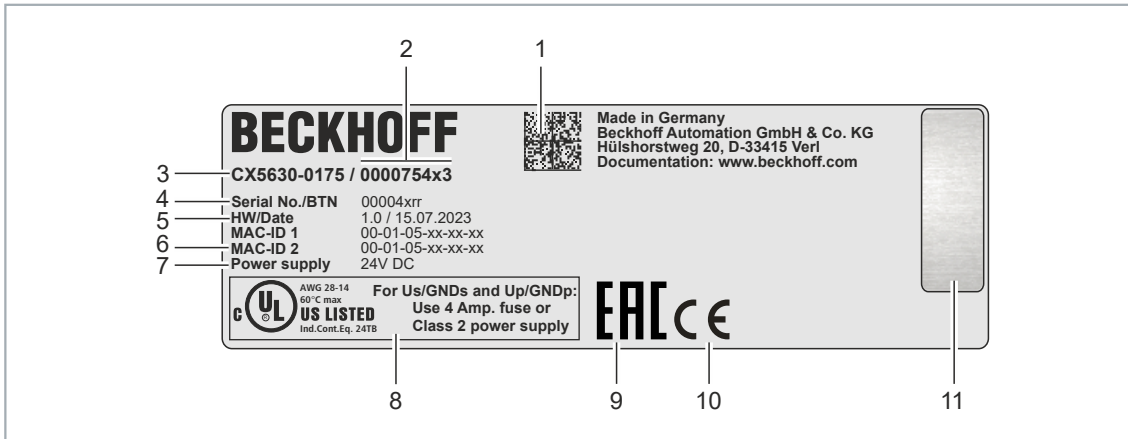
Fig. 2: Name plate example.

Table 5: Information on the name plate.

No.	Description
1	Machine-readable information in the form of a Data Matrix Code (DMC, code scheme ECC200) that you can use for better identification and management.
2	Variant number for identification of the Embedded PC configuration. With this number, the exact configuration of Embedded PC, operating system, options and TwinCAT can be reordered.
3	Product designation for identification of the Embedded PC.
4	Serial number/ Beckhoff Traceability Number (BTN) for the unambiguous identification of the product.
5	Hardware version and date of manufacture.
6	MAC addresses of the built-in Ethernet interfaces. The host name is made up of CX and the last three bytes of the MAC address. Example: the MAC address: 00-01-05-aa-bb-cc results in the host name **CX-aabbcc**.
7	Power supply 24 V DC
8	UL marking with prescribed information on power supply, fuse, temperature and cable cross-sections.
9	EAC marking
10	CE marking
11	License sticker for operating system (optional).

4.3   Types

The CX56x0 Embedded PC can be ordered with different software options. Use this overview in conjunction with the information on the name plate to ascertain the operating system and the TwinCAT version of the embedded PC.
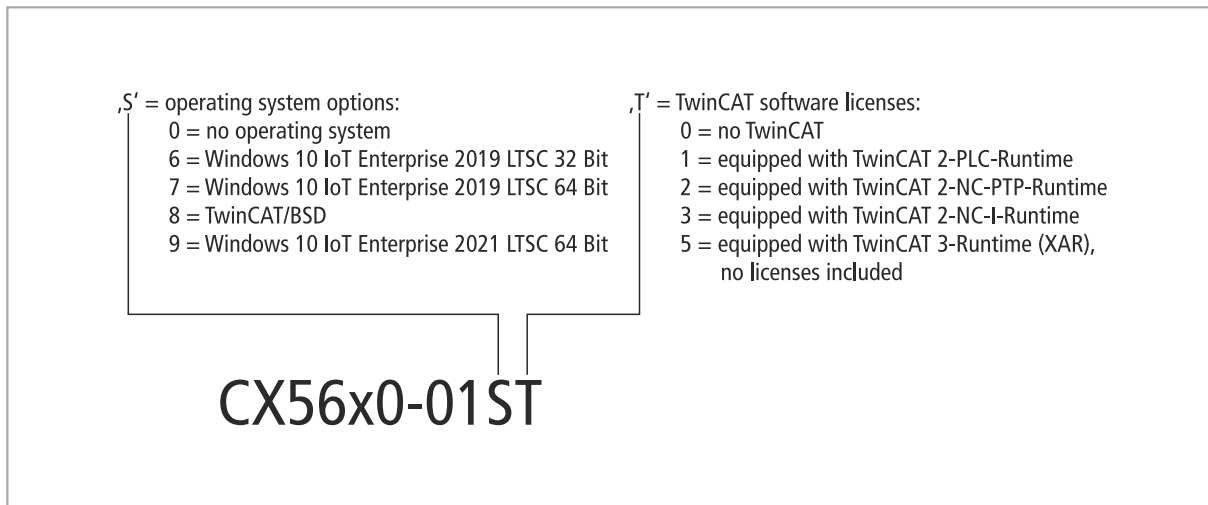
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‚S' = operating system options:              ‚T' = TwinCAT software licenses:
    0 = no operating system                      0 = no TwinCAT
    6 = Windows 10 IoT Enterprise 2019 LTSC 32 Bit   1 = equipped with TwinCAT 2-PLC-Runtime
    7 = Windows 10 IoT Enterprise 2019 LTSC 64 Bit   2 = equipped with TwinCAT 2-NC-PTP-Runtime
    8 = TwinCAT/BSD                              3 = equipped with TwinCAT 2-NC-I-Runtime
    9 = Windows 10 IoT Enterprise 2021 LTSC 64 Bit   5 = equipped with TwinCAT 3-Runtime (XAR),
                                                     no licenses included


                      CX56x0-01ST
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Fig. 3: Nomenclature for the CX56x0 Embedded PC.

The CX5620 and CX5630 Embedded PCs are available with the following software options:

Table 6: CX56x0, ordering information for software.

Ordering information	Description
CX56x0-0100	no operating system, no TwinCAT
CX56x0-0160	Windows 10 IoT Enterprise 2019 LTSC 32-bit, no TwinCAT
CX56x0-0161	Windows 10 IoT Enterprise 2019 LTSC 32-bit, TwinCAT 2 PLC runtime
CX56x0-0162	Windows 10 IoT Enterprise 2019 LTSC 32-bit, TwinCAT 2 NC PTP runtime
CX56x0-0163	Windows 10 IoT Enterprise 2019 LTSC 32-bit, TwinCAT 2 NC I runtime
CX56x0-0170	Windows 10 IoT Enterprise 2019 LTSC 64-bit, no TwinCAT
CX56x0-0175	Windows 10 IoT Enterprise 2019 LTSC 64-bit, TwinCAT 3 runtime (XAR)
CX56x0-0185	TwinCAT/BSD, TwinCAT 3 runtime (XAR)
CX56x0-0190	Windows 10 IoT Enterprise 2021 LTSC 64-bit, no TwinCAT
CX56x0-0195	Windows 10 IoT Enterprise 2021 LTSC 64-bit, TwinCAT 3 runtime (XAR)

TwinCAT/BSD and Windows 10 IoT Enterprise require an M.2 SSD (SATA).

4.4   Architecture overview

The Embedded PCs of the CX56x0 family all have the same architecture. This is described below.
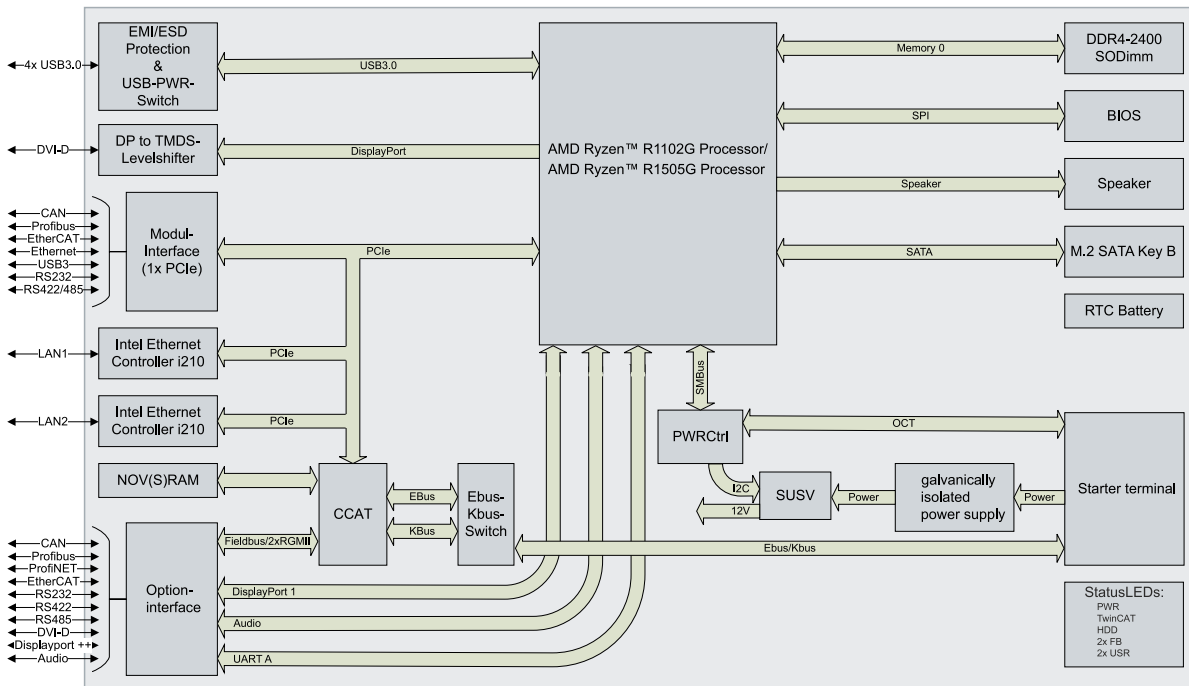

Fig. 4: Architecture overview of a CX56x0 embedded PC.

The CX56x0 Embedded PCs are based on the AMD Zen microarchitecture. The following CPUs are used:

- AMD Ryzen™ R1102G, 1.2 GHz (dual core)
- AMD Ryzen™ R1505G, 2.0 GHz (quad core)

In addition to the arithmetic unit, the CPU also contains the memory controller and the graphics controller. For details on the CPUs please refer to AMD. The memory is connected directly to the CPU. The embedded PCs are available in two memory configurations: 4GB or 8GB DDR4 RAM. The memory is not extendable.

The CPU provides all required interfaces:

- 1 PCIe lane for each of the two Intel® i210 Gigabit Ethernet controllers
- 4x USB 3.0 (interfaces)
- DVI-D interface (second interface optional with CX56x0-N010)
- 1 PCIe for FPGA for K-/E-bus
- 1 SATA to M.2 SSD interface
- 1 IDE for microSD card interface

The interfaces (USB, DVI, and LAN) are standard interfaces. Devices that meet the corresponding standard can be connected to and operated at these interfaces.

5 Interface description

5.1 USB 3.0 (X100, X101, X102, X103)

The embedded PC has four independent USB interfaces. for connecting keyboards, mice, touch screens and other input or data storage devices.
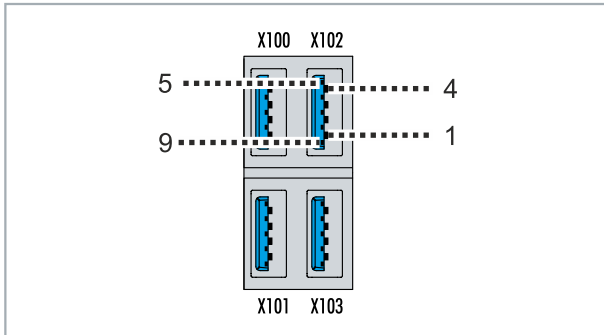

Fig. 5: USB interfaces X100, X101, X102, X103.

The USB interfaces are type A and comply with the USB 3.0 specification.

Table 7: USB interfaces (X100, X101, X102, X103), pin assignment.

Pin	Connection	Typical assignment
1	VBUS	Red
2	D-	White
3	D+	Green
4	GND	Black
5	StdA_SSRX−	Blue
6	StdA_SSRX+	Yellow
7	GND_DRAIN	N/A
8	StdA_SSTX−	Purple
9	StdA_SSTX+	Orange
Shell	Shield	Drain Wire

Pay attention to the power consumption of the connected devices. No more than 900 mA and 4.5 W of power can be output per interface. The USB interfaces support data rates of up to 5 Gbit/s.

5.2 Ethernet RJ45 (X000, X001)

The two Ethernet interfaces are independent; no switch is integrated. The independent Ethernet interfaces can be configured in different ways. In their delivered state, the Ethernet interfaces (X000, X001) are configured for EtherCAT communication.

Note that an additional switch is required for a line topology.
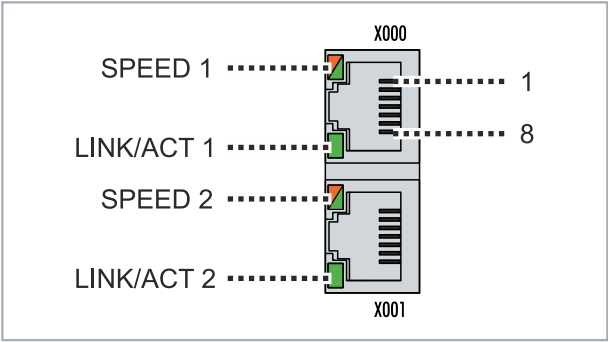
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Fig. 6: Ethernet interfaces X000, X001.

Both Ethernet interfaces reach speeds of 10/100/1000 Mbits. The LEDs on the left of the interfaces show the connection status. The lower LED (LINK/ACT) indicates whether the interface is connected to a network. If this is the case, the LED lights up green. The LED flashes when data is being transferred on the interface.

The upper LED (SPEED) indicates the connection speed. At a speed of 10 Mbits, the LED does not light up. If the speed is 100 Mbits, the LED lights up green. If the speed is 1000 Mbits (gigabit) the LED lights up red.

Table 8: Ethernet interface X000 and X001, pin assignment.

PIN	Signal	Description
1	T2 +	Pair 2
2	T2 -	
3	T3 +	Pair 3
4	T1 +	Pair 1
5	T1 -	
6	T3 -	Pair 3
7	T4 +	Pair 4
8	T4 -	

5.3 DVI-D (X200)

The DVI-D interface (X200) transfers digital data and is suitable for connection to digital displays. The resolution on the display or the Beckhoff Control Panel depends on the distance from the display device. The maximum distance is 5 m. Beckhoff offers various panels with an integrated DVI extension. A cable length of up to 50 meters is therefore possible.
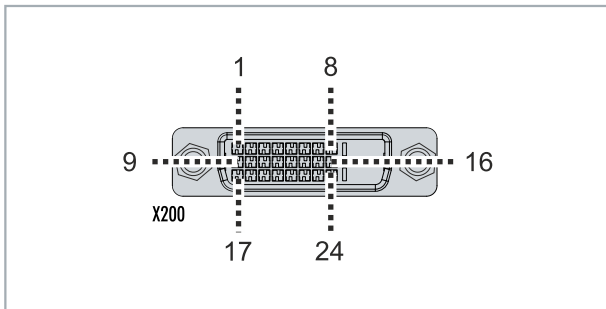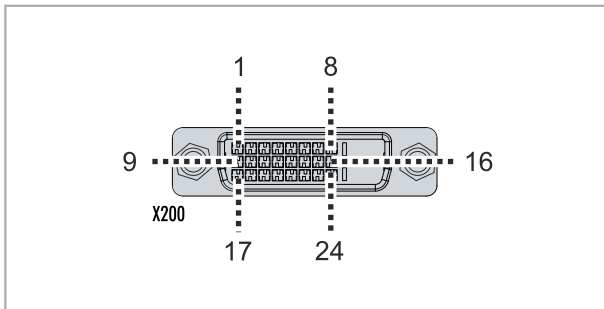
Fig. 7: DVI-D interface X200.

Table 9: DVI-D interface X200, pin assignment.

Pin	Connection	Pin	Connection	Pin	Connection
1	TMDS Data 2-	9	TMDS Data 1-	17	TMDS Data 0-
2	TMDS Data 2+	10	TMDS Data 1+	18	TMDS Data 0+
3	TMDS Data 2/4 Shield	11	TMDS Data 1/3 Shield	19	TMDS Data 0/5 Shield
4	not connected	12	not connected	20	not connected
5	not connected	13	not connected	21	not connected
6	DDC Clock	14	+ 5V Power	22	TMDS Clock Shield
7	DDC Data	15	Ground (+5V, Analog H/ V Sync)	23	TMDS Clock +
8	Analog Vertical Sync	16	Hot Plug Detect	24	TMDA Clock -

Table 10: DVI-D interface X200, resolution at the monitor.

Resolution in pixels	Distance of the interface from the monitor
1920 x 1200	5 m
1920 x 1080	5 m
1600 x 1200	5 m
1280 x 1024	5 m
1024 x 768	5 m
800 x 600	5 m
640 x 480	5 m

The embedded PC also supports higher resolutions, based on the DVI standard. A maximum resolution of 1920 x 1200 pixels can be set on the embedded PC. Whether this resolution is achieved depends on the monitor, the cable quality, and the cable length.

5.4   Optional interfaces

An optional interface is an additional interface that can be equipped with a wide range of signal types ex factory and extends the Embedded PC beyond the basic equipment. The optional interface must be ordered in advance and cannot be retrofitted to the device.

5.4.1   DVI-D (N010)

The DVI-D interface (X300) transfers digital data and is suitable for connection to digital displays. The resolution at the display or the Beckhoff Control Panel depends on the distance from the display device. The maximum distance is 5 m. Beckhoff offers various Panels with an integrated "DVI extension". These make a cable length of up to 50 meters possible.

Fig. 8: DVI-D interface X300.

Table 11: DVI-D interface X300, pin assignment.

Pin	Connection	Pin	Connection	Pin	Connection
1	TMDS Data 2-	9	TMDS Data 1-	17	TMDS Data 0-
2	TMDS Data 2+	10	TMDS Data 1+	18	TMDS Data 0+
3	TMDS Data 2/4 Shield	11	TMDS Data 1/3 Shield	19	TMDS Data 0/5 Shield
4	not connected	12	not connected	20	not connected
5	not connected	13	not connected	21	not connected
6	DDC Clock	14	+ 5V Power	22	TMDS Clock Shield
7	DDC Data	15	Ground (+5V, Analog H/ V Sync)	23	TMDS Clock +
8	Analog Vertical Sync	16	Hot Plug Detect	24	TMDA Clock -

Table 12: DVI-D interface X300, resolution at the monitor.

Resolution in pixels	Distance of the interface from the monitor
1920 x 1200	5 m
1920 x 1080	5 m
1600 x 1200	5 m
1280 x 1024	5 m
1024 x 768	5 m
800 x 600	5 m
640 x 480	5 m

The Embedded PC also supports higher resolutions, based on the DVI standard. A maximum resolution of 1920 x 1200 pixels can be set on the Embedded PC. Whether this resolution is achieved depends on the monitor, the cable quality and the cable length.

5.4.2   DisplayPort (N011)

The DisplayPort transfers image and audio signal at the same time and is therefore suitable for connecting panels or monitors to the Embedded PC.
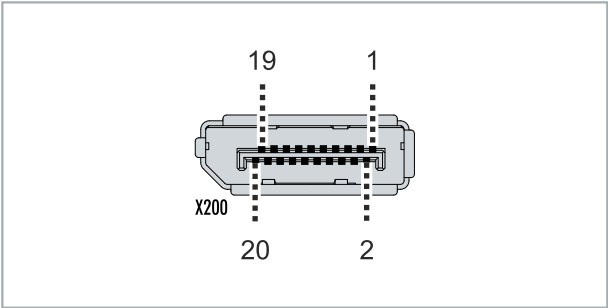
Fig. 9: DisplayPort X300.

Version 1.1a of the DisplayPort (DisplayPort++) is installed on the Embedded PC. Adapters from DisplayPort to DVI-D or DisplayPort to HDMI can be used to connect monitors without DisplayPort to the Embedded PC.

Table 13: DisplayPort, pin assignment.

Pin	Connection	Pin	Connection
1	LVDS lane 0+	2	Ground
3	LVDS lane 0-	4	LVDS lane 1+
5	Ground	6	LVDS lane 1-
7	LVDS lane 2+	8	Ground
9	LVDS lane 2-	10	LVDS lane 3+
11	Ground	12	LVDS lane 3-
13	Config 1	14	Config 2
15	AUX channel+	16	Ground
17	AUX channel-	18	Hot-plug detection
19	Power supply: Ground	20	Power supply: 3.3 V / 500 mA

Table 14: DisplayPort X300, resolution at the monitor.

Interface	Resolution in pixels
DisplayPort	max. 2560x1600@60Hz
DisplayPort with adapter, DisplayPort to DVI-D	max. 1600x1200@60Hz

5.4.3   Audio interface (N020)

Two inputs are available: "LINE IN" (X300) and "MIC IN" (X301). The "LINE OUT" interface (X302) is intended for audio signal output. The 3.5 mm sockets are designed for jack plugs. It can also be used for connecting headphones with a maximum output of 200 mW.
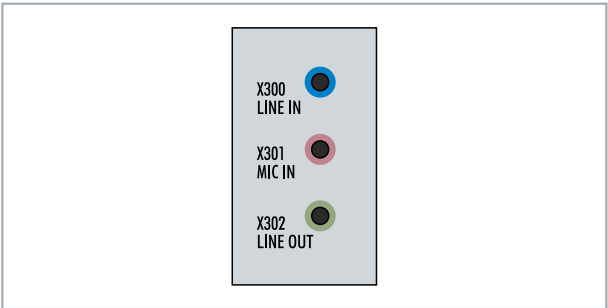
Fig. 10: Audio interface X300, X301, X302.

The audio interfaces are accessed via the operating system. The audio interface operates in stereo mode as standard, using stereo outputs/inputs and a single-channel input for the microphone. The inputs should be connected as indicated.

The left channel is transferred via the tip of the jack plug, the right channel via the first ring. The remainder of the sleeve is used for earthing.
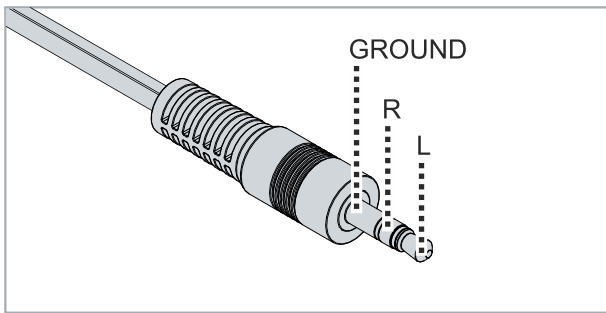
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Fig. 11: Line In / Line Out X300, X302 jack plugs.

Table 15: Line In /Line Out jack plugs, pin assignment.

Signal	Description
L	Left channel
R	Right channel
Ground	Ground

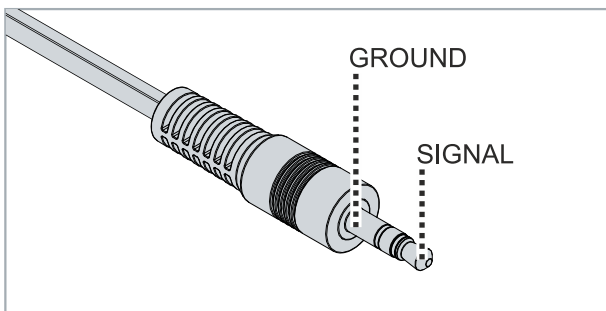The only existing channel is transferred via the tip, the remainder of the sleeve is used for earthing.

Fig. 12: Mic In X301 jack plug.

5.4.4 RS232 (N030)

The optional N030 interface provides an RS232 interface (X300). The RS232 interface is implemented on a 9-pin D-sub connector.
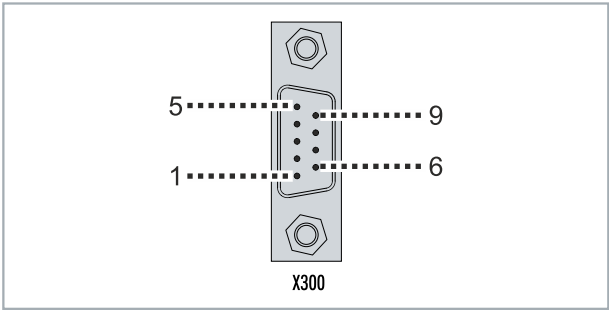
Fig. 13: RS232 interface X300.

The maximum baud rate on both channels is 115 kbit. The interface parameters are set via the operating system or from the PLC program.

Table 16: RS232 interface X300, pin assignment.

PIN	Signal	Type	Description
1	-	-	-
2	RxD	Signal in	Receive Data
3	TxD	Signal out	Transmit Data
4	-	-	-
5	GND	Ground	Ground
6	DSR	Signal in	Dataset Ready
7	RTS	Signal out	Request to Send
8	CTS	Signal in	Clear to Send
9	-	-	-

5.4.5 RS422/RS485 (N031)

The optional N031 interface provides an RS422 or RS485 interface (X300). The interface is executed on a 9-pin D-sub socket.
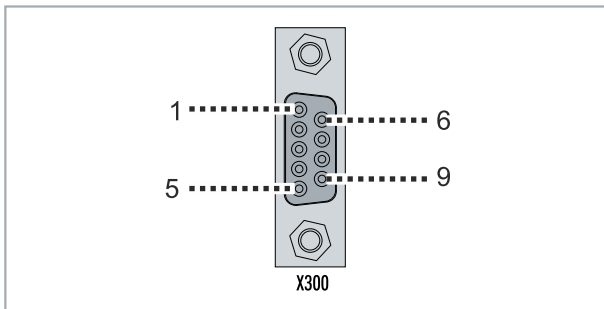
Fig. 14: RS485 interface X300.

The maximum baud rate on both channels is 115 kbit. The interface parameters are set via the operating system or from the PLC program.

Table 17: RS422/485 interface, pin assignment.

PIN	Signal	Type	Description
2	TxD+	Data-Out +	Transmit 422
3	RxD+	Data-In +	Receive 422
5	GND	Ground	Ground
6	VCC	VCC	+5 V
7	TxD-	Data-Out -	Transmit 422
8	RxD-	Data-In -	Receive 422

For RS 485 pins 2 and 3 (data +) must be connected, and pins 7 and 8 (data -).

By default the interface is parameterized as follows on delivery:

Table 18: Default setting, RS485 without echo with end point (terminated).

Function	Status
Echo on	off
Echo off	on
Auto send on	on
Always send on	off
Auto receive on	on
Always receive on	off
Term on	on
Term on	On

Other configurations for the RS485 interface

Other configurations for the RS485 interface can be ordered ex factory. The following options are available:

- N031-0001 RS485 with echo, end point (terminated).
- N031-0002 RS485 without echo, stub (without termination).
- N031-0003 RS485 with echo, stub (without termination).
- N031-0004 RS422 full duplex end point (terminated).

An RS485 interface cannot be configured retrospectively and must always be ordered ex factory as required.

5.4.6 EtherCAT master (M112)

The latest generation of embedded PCs can be ordered ex factory with an EtherCAT master interface (M112). On the devices, the optional M112 interface is referred to as X300. With this option, a total of three EtherCAT masters are available, whereby two EtherCAT masters can be run from the front of the device and one EtherCAT master can be run from the right side of the terminal segment.

The EtherCAT masters are fully DC-synchronous due to the direct FPGA connection. External synchronization is not necessary in order to synchronize the EtherCAT masters or EtherCAT rings with one another. This function is particularly interesting for smaller XTS systems that require synchronously running EtherCAT masters. The optional interface can also be used for EtherCAT redundancy, while the two upper Ethernet interfaces are available for other applications.
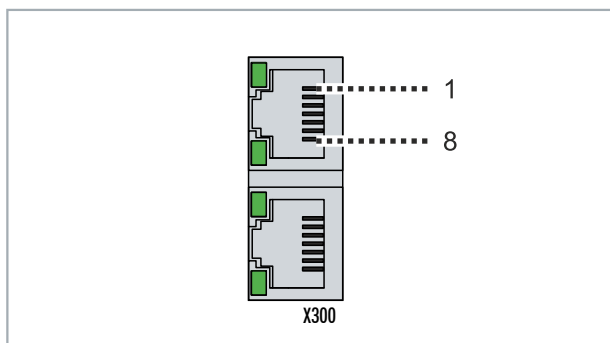
Fig. 15: EtherCAT master interface X300.

The incoming EtherCAT signal is connected to the upper LAN interface. The lower LAN interface relays the signal to other EtherCAT master devices.

Table 19: EtherCAT master interface X300, pin assignment.

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

5.4.7 EtherCAT slave (B110)

The latest generation of embedded PCs can be ordered ex factory with an EtherCAT slave interface (B110). On the devices, the optional B110 interface is referred to as X300.
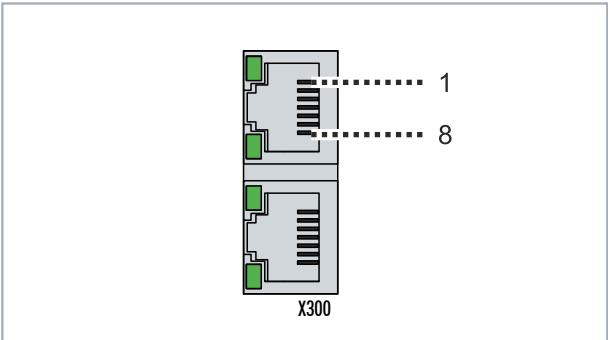
Fig. 16: EtherCAT slave interface X300.

The incoming EtherCAT signal is connected to the upper LAN interface. The lower LAN interface relays the signal to other EtherCAT slave devices.

Table 20: EtherCAT slave interface X300, pin assignment.

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

For the EtherCAT slave optional interface (B110), documentation with further information is available: https://infosys.beckhoff.com/content/1033/b110_ethercat_optioninterface/index.html?id=2623834056269338700

Document name
CXxxxx-B110 | EtherCAT Slave Optional Interface.

5.4.8   PROFIBUS (x310)

Pin 6 transfers 5 V_{DC}, pin 5 transfers GND for the active termination resistor. These must never be used for other functions, as this can lead to destruction of the device.

Pins 3 and 8 transfer the PROFIBUS signals. These must never be swapped over, as this will prevent communication.
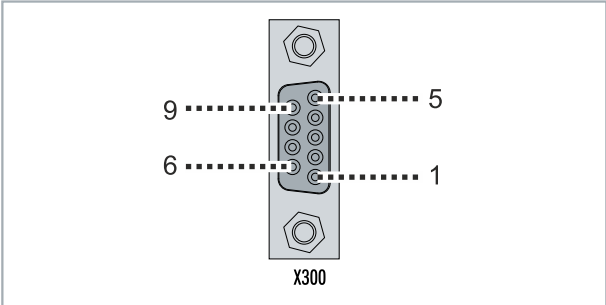
Fig. 17: PROFIBUS interface X310.

The Profibus bus line is connected via a 9-pin D-sub with the following pin assignment:

Table 21: PROFIBUS interface X310, pin assignment.

Pin	Connection
1	Shielding
2	not used
3	RxD/TxD-P
4	not used
5	GND
6	+5 V_{DC}
7	not used
8	RxD/TxD-N
9	not used

Table 22: Wire colors of the PROFIBUS line.

PROFIBUS line	D-sub
B red	Pin 3
A green	Pin 8

For the PROFIBUS optional interface (x310), documentation with further information is available:
https://infosys.beckhoff.com/content/1033/m310_b310_profibus_optioninterface/index.html?id=2233561431434830097

Document name
CXxxxx-M310/B310	Profibus Optional Interface

5.4.9   CANopen (x510)
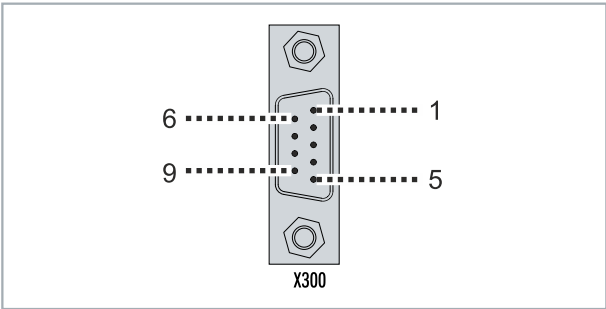
Fig. 18: CANopen interface X510.

The CAN bus line is connected via a 9-pin D-sub connector with the following pin assignment:

Table 23: CANopen interface X510, pin assignment.

Pin	Connection
1	not used
2	CAN low (CAN-)
3	CAN Ground (internally connected to pin 6)
4	not used
5	Shield
6	CAN Ground (internally connected to pin 3)
7	CAN high (CAN+)
8	not used
9	not used

For the CANopen optional interface (x510), documentation with further information is available:
https://infosys.beckhoff.com/content/1033/m510_b510_canopen_optioninterface/index.html?id=1404127979601372947

Document name
CXxxxx-M510/B510	CANopen Optional Interface

5.4.10   PROFINET RT (x930)
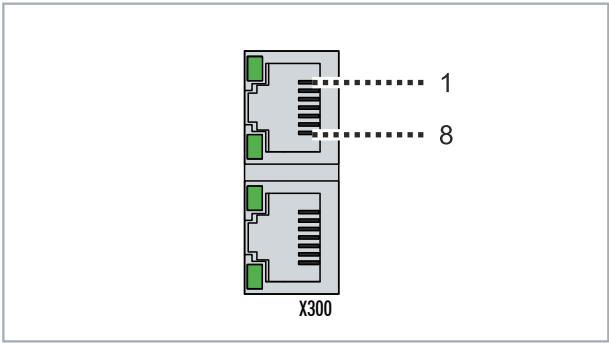
Fig. 19: PROFINET RT interface X300.

Table 24: PROFINET RT interface, pin assignment.

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

For the PROFINET RT optional interface (x930), documentation with further information is available:
https://infosys.beckhoff.com/content/1033/m930_b930_profinet_optioninterface/index.html?id=3617310193267164961

Document name
CXxxxx-M930/B930 | Profinet Optional Interface

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6 Commissioning

6.1 Assembly
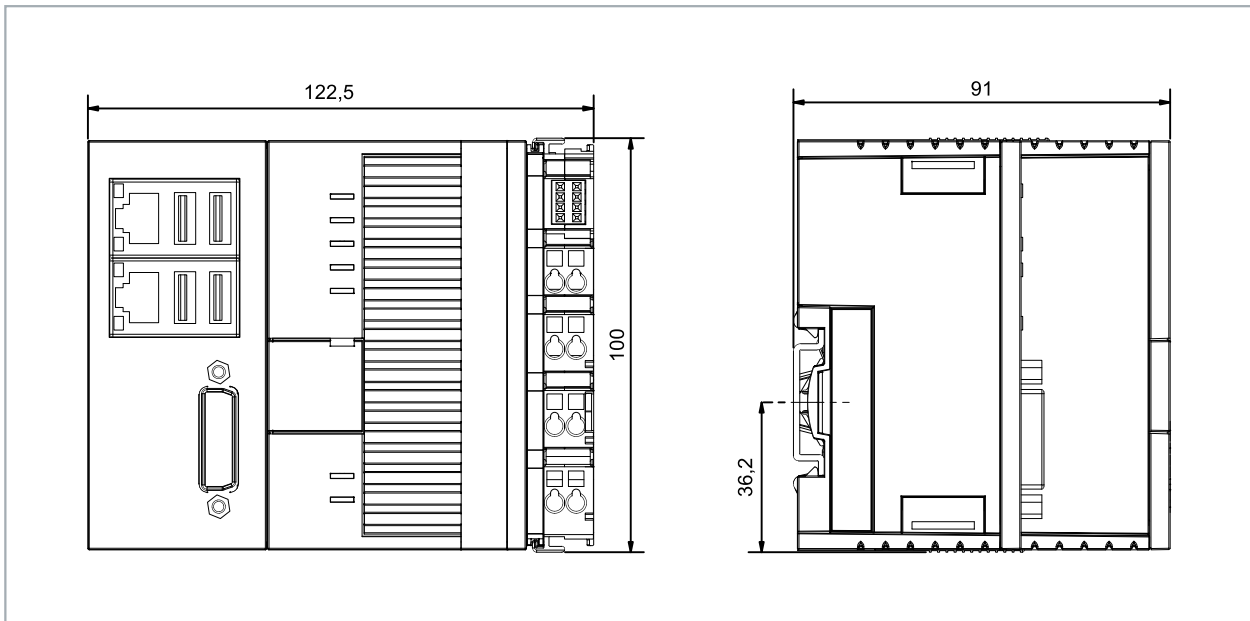
Fig. 20: CX5620 Embedded PC, dimensions.
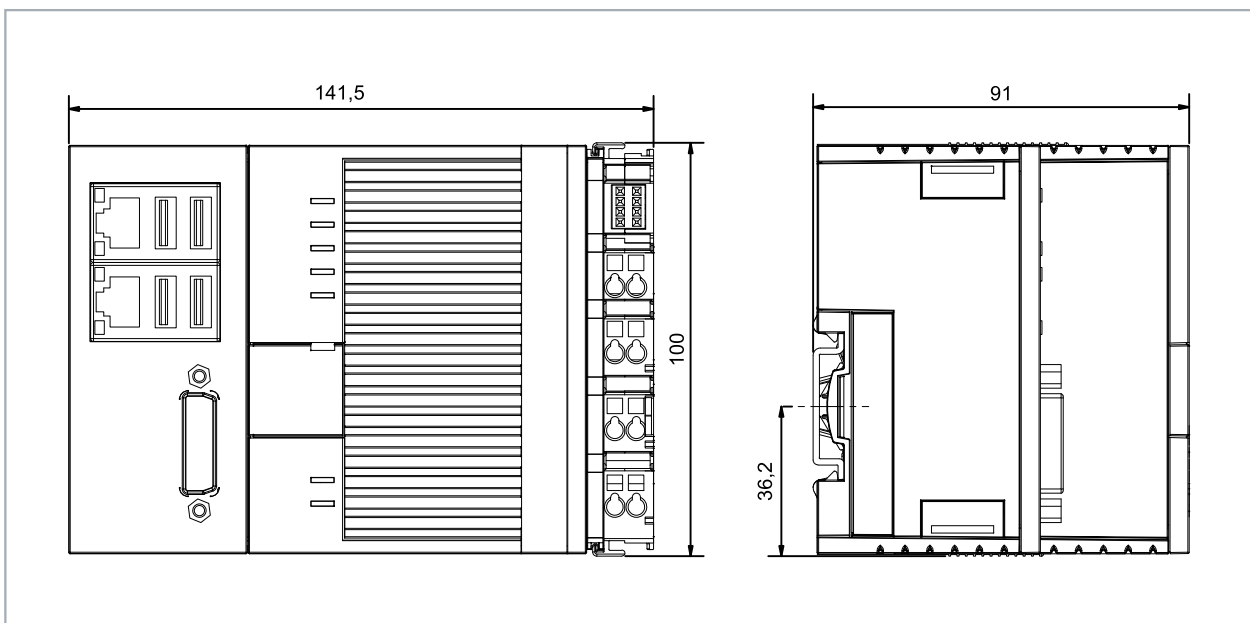
Fig. 21: CX5630 Embedded PC, dimensions.

6.1.1   Permissible installation positions

NOTICE
Overheating
The embedded PC may overheat if the installation position is incorrect or the minimum distances are not adhered to. Adhere to the maximum ambient temperature of 60°C and the mounting instructions.

Install the embedded PC horizontally in the control cabinet on a DIN rail, in order to ensure optimum heat dissipation.

Note the following specifications for the control cabinet:

- The embedded PC should only be operated at ambient temperatures between -25 °C and 60 °C. Measure the temperature below the embedded PC at a distance of 30 mm to the cooling fins, in order to determine the ambient temperature correctly.

- Adhere to the minimum distances of 30 mm above and below the embedded PC.

- Additional electrical equipment affects the heat generation in the control cabinet. Select a suitable control cabinet enclosure depending on the application, or ensure that excess heat is dissipated from the control cabinet.

The embedded PC must be mounted horizontally on the DIN rail. Ventilation openings are located at the top and bottom of the housing. This ensures an optimum airflow through the embedded PC in vertical direction. In addition, a minimum clearance of 30 mm above and below the embedded PC is required, in order to ensure adequate ventilation.
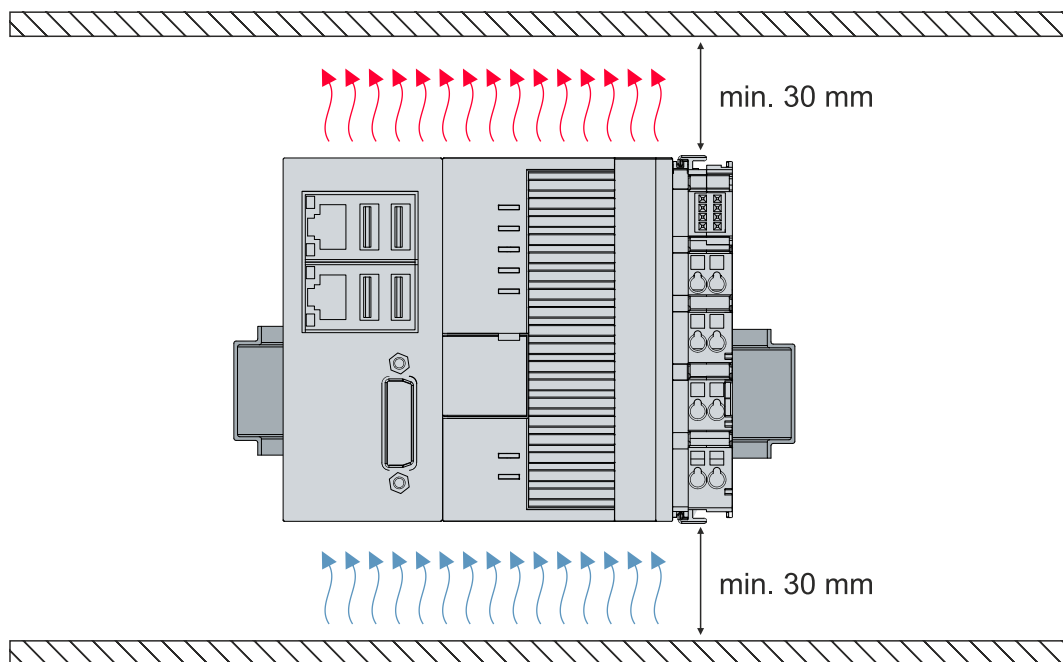
Fig. 22: CX56x0 Embedded PC, permitted installation position.

If vibrations and impact occur in the same direction as the DIN rail, the embedded PC must be secured with an additional bracket, in order to prevent it slipping.

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6.1.2   Fastening to the DIN rail

The housing is designed such that the Embedded PC can be pushed against the DIN rail and latched onto it.
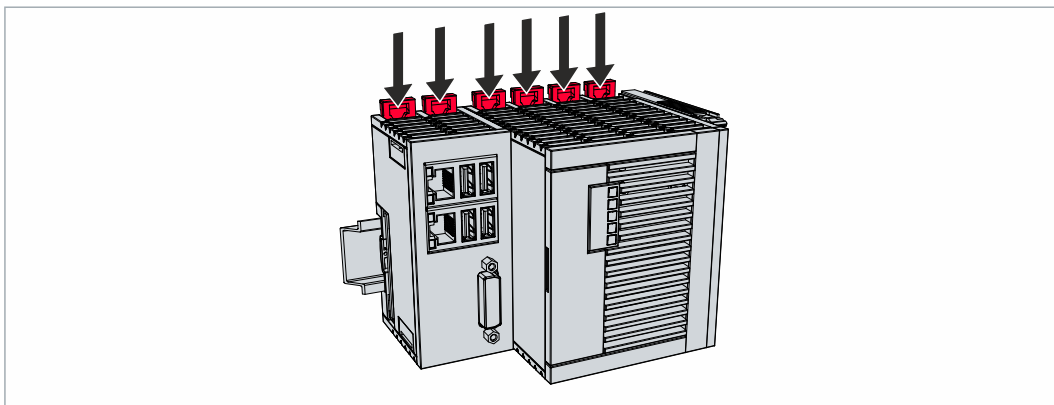
Requirements:

- DIN rail of the type TS35/7.5 or TS35/15 according to EN 60715.

Fasten the Embedded PC to the DIN rail as follows:

1. Unlock the latches at the top and bottom.
2. Place the Embedded PC on the DIN rail. Slightly press the Embedded PC onto the DIN rail until a soft click can be heard and the Embedded PC has latched.
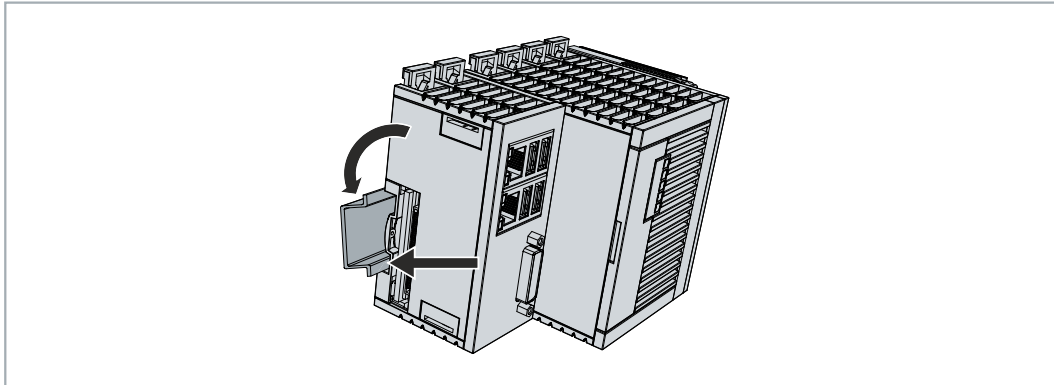
3. Then lock the latches again.

⇨ You have installed the Embedded PC successfully. Check again that the mounting is correct and that the Embedded PC is engaged on the DIN rail.

6.1.3   Changing the MicroSD card

ℹ **Loss of data**

MicroSD cards are subjected to heavy load during operation and have to withstand many write cycles and extreme ambient conditions. MicroSD cards from other manufacturer may fail, resulting in data loss.

Only use industrial microSD cards provided by Beckhoff.

The microSD card slot is intended for a microSD card. Data or additional programs can be stored here. The eject mechanism is based on the push/push principle. Below, we show you how to change the microSD card.

Requirements:

- The embedded PC must be switched off. The microSD card may only be installed or removed in switched-off state.

Changing the microSD card

1. Open the front flap with a spatula or screwdriver.
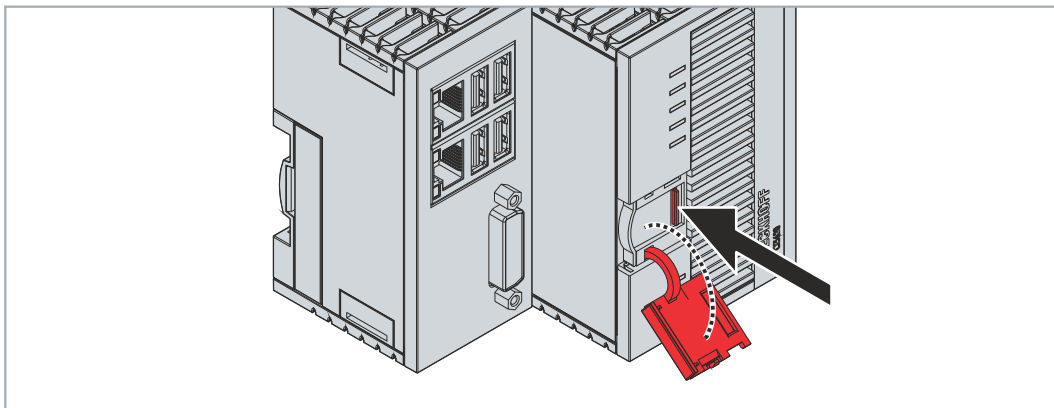
2. Gently push the microSD card.
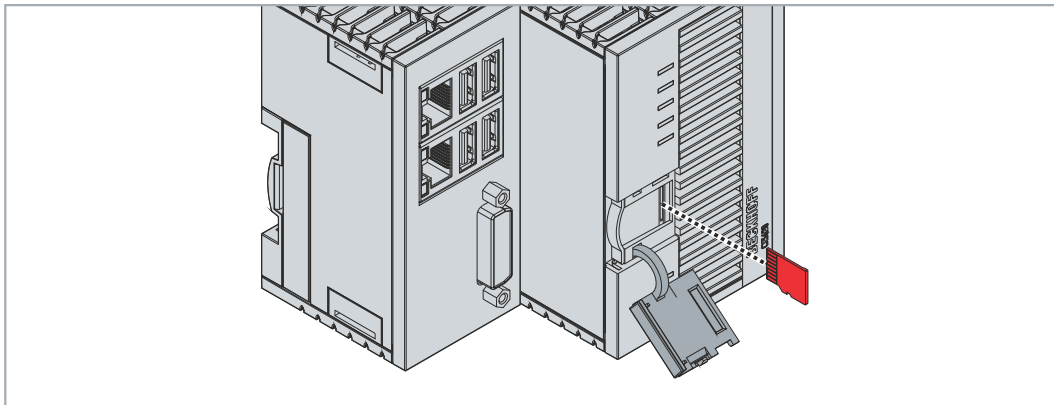
3. The card is unlatched with a quiet click and raised about 2 – 3 mm out of the housing.
4. Insert the new microSD card into the card slot with the contacts first.
   The contacts point to the left.
5. A soft click can be heard when the microSD card engages.
⇨ The microSD card is seated correctly when it is about 1 mm deeper than the front side of the housing.

6.1.4 Change M.2 SSD hard disk

ⓘ Loss of data

M.2 SSD hard disks are subjected to heavy load during operation and have to withstand many write cycles and extreme ambient conditions. M.2 SSD hard disks from other manufacturer may fail, resulting in data loss.

Only use industrial M.2 SSD hard disks provided by Beckhoff.

An M.2 SSD hard disk is a non-volatile memory. Data to be retained in the event of a power failure should be saved on the M.2 SSD hard disk. The supplied M.2 SSD hard disks from Beckhoff are industrial M.2 SSD hard disks with an increased number of write cycles.

If you want to exchange a storage medium according to Beckhoff's recommendation, you must copy the data from the old to the new storage medium. You can use the Beckhoff Service Tool (BST) for this purpose. The BST is a graphical backup and restore program for industrial PCs with a Windows operating system. You can create an image of your operating system and use it to back up the operating system. Then you can restore the created image to a new data carrier. The BST is available on a bootable BST USB flash drive.

You can then keep the flash drive as a backup copy. For this purpose, the BST USB flash drives are designed for particularly long data preservation by means of special flash. For more information on the function of the BST, please refer to the corresponding documentation.
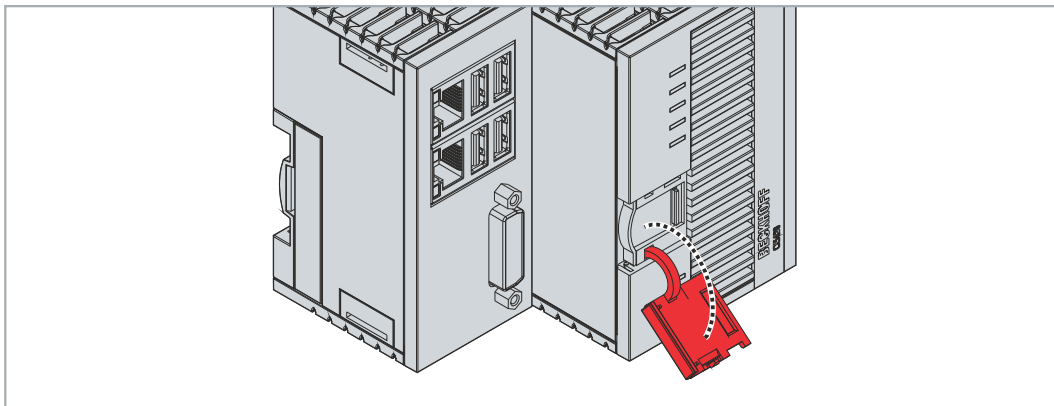
If your storage medium is defective and there is no backup, Beckhoff Service can provide you with a fresh Windows image.
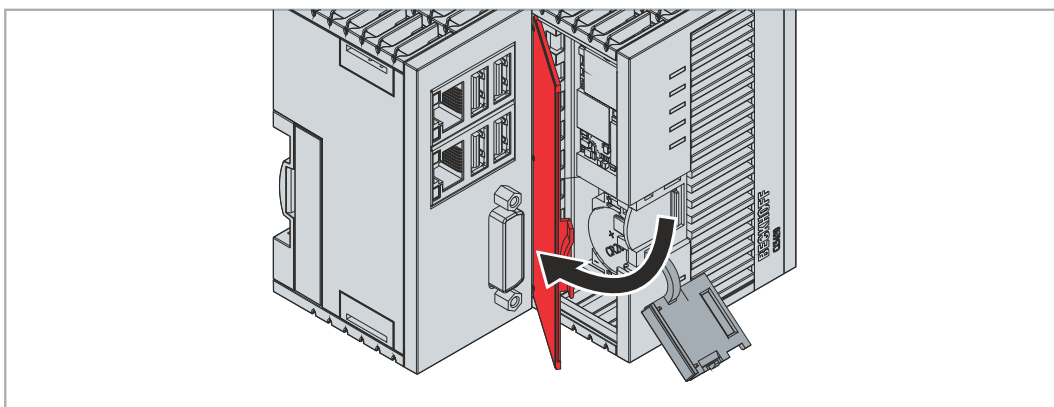
Requirements:

- The M.2 SSD hard disks may only be installed or removed when the PC is switched off.
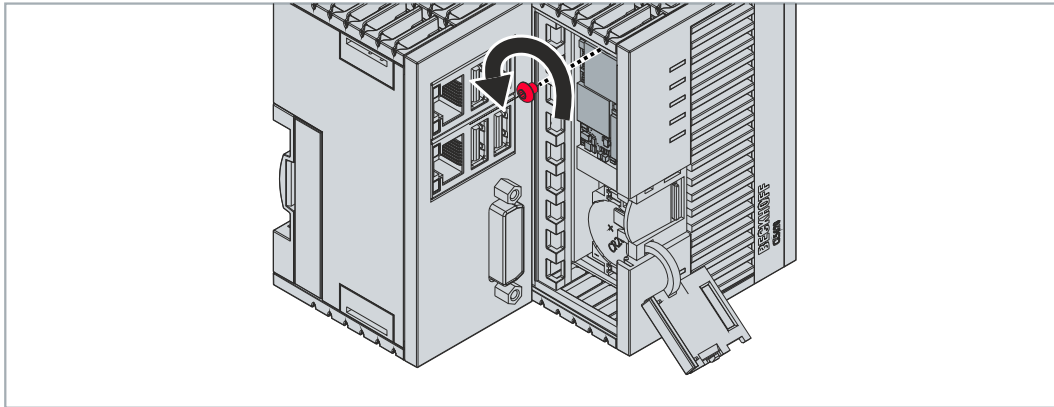
Change M.2 SSD hard disk

1. Open the front flap with a spatula or screwdriver.
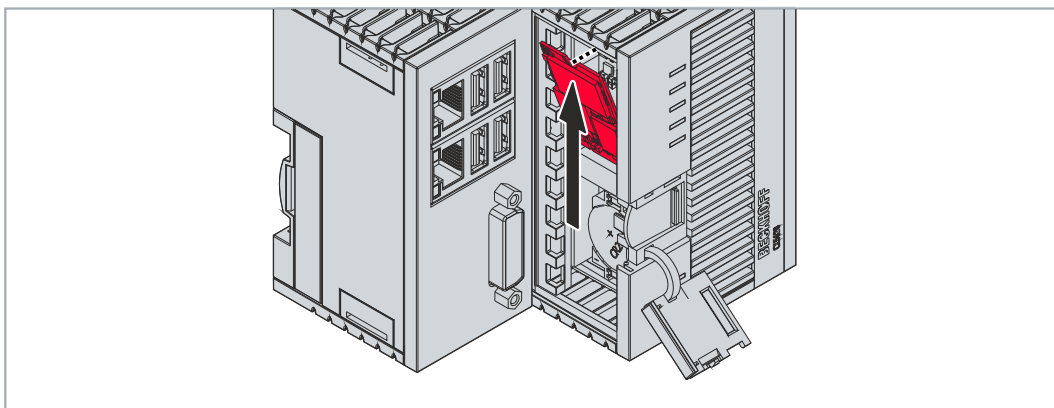

2. Push the side flap away to the left.

3. Use a screwdriver to loosen the screw for the M.2 SSD.

4. Slightly tilt the M.2 SSD out of the housing at the top and pull the M.2 SSD upwards out of the M.2 SSD slot in this inclined position.

5. Insert the new M.2 SSD into the M.2 SSD slot in the same inclined position.

6. Push the protruding side of the M.2 SSD in the housing.

7. Replace the fixing screw and tighten it to a tightening torque of approx. 0.3 Nm.

⇨ The old M.2 SSD must be disposed of in accordance with the national electronic waste regulations.

6.1.5   Installing passive EtherCAT Terminals
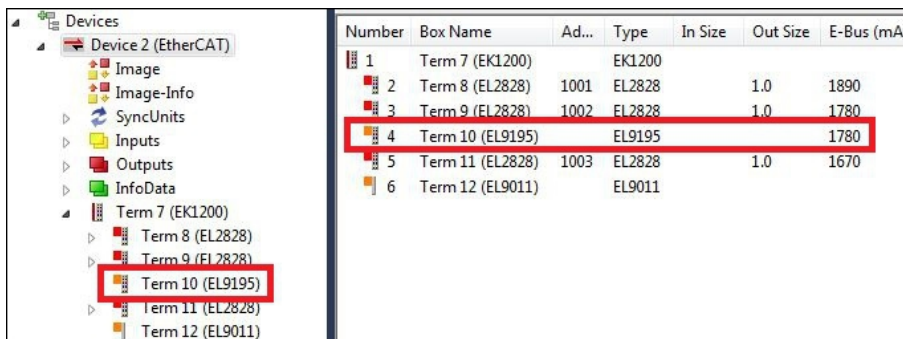
ⓘ   **Incorrectly installed passive EtherCAT Terminals**

The E-bus signal between an embedded PC and the EtherCAT Terminals can be impaired due to incorrectly installed passive EtherCAT Terminals.

Passive EtherCAT Terminals should not be installed directly on the power supply unit.

EtherCAT Terminals that do not take part in active data exchange are referred to as passive terminals. Passive EtherCAT Terminals have no process image and do not require current from the terminal bus (E-bus).

Passive EtherCAT Terminals (e.g. EL9195) can be detected in TwinCAT. The EtherCAT Terminal is displayed without process image in the structure tree, and the value in column "E-bus (mA)" does not change, compared to the preceding EtherCAT Terminal.

Fig. 23: Identifying a passive EtherCAT Terminal in TwinCAT.

The entry "Current consumption via E-Bus" in the technical data of an EtherCAT Terminal indicates whether a particular EtherCAT Terminal requires power from the terminal bus (E-bus).

The following diagram shows the permissible installation of a passive EtherCAT Terminal. The passive EtherCAT Terminal was not directly attached to the power supply unit.
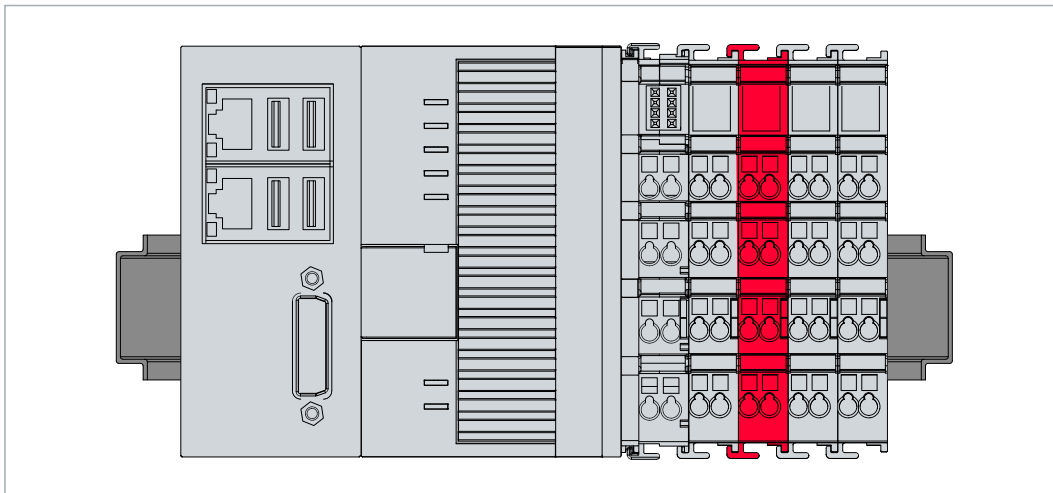

Fig. 24: Passive EtherCAT Terminals, permissible installation.

6.2   Power supply

NOTICE
Damage to the Embedded PCs
The Embedded PCs may be damaged during wiring.
• The cables for the power supply should only be connected in de-energized state.

The power supply terminal requires an external voltage source, which provides 24 V DC (-15 % / +20 %). The power supply terminal must provide 4 A at 24 V, in order to ensure the operation of the embedded PC in all situations.

The cabling of the Embedded PC in the control cabinet must be done in accordance with the standard EN 60204-1:2006 PELV = Protective Extra Low Voltage:

- The "PE" and "0 V" conductors of the voltage source for a basic CPU module must be on the same potential (connected in the control cabinet).
- Standard EN 60204-1:2006, section 6.4.1:b stipulates that one side of the circuit, or a point of the energy source for this circuit must be connected to the protective earth conductor system.
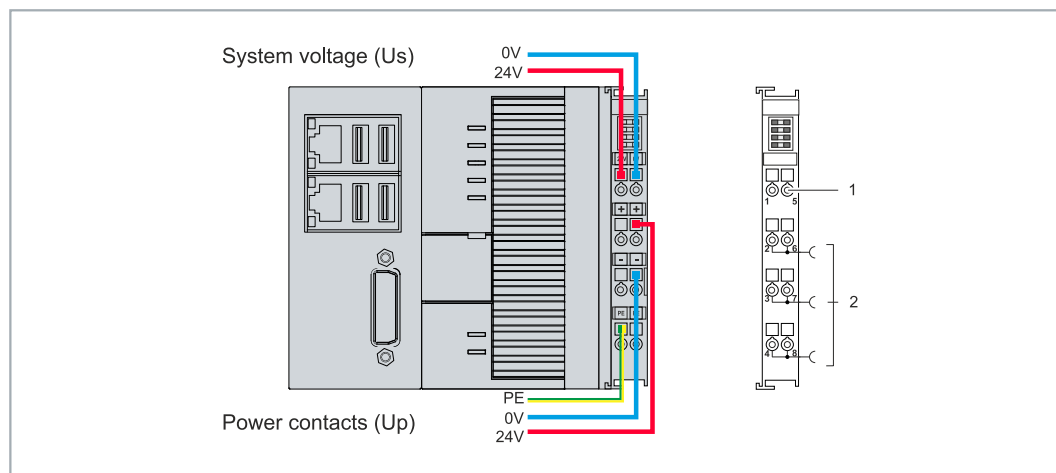
Connections

Fig. 25: Connections for system voltage (Us) and power contacts (Up)

No.	Description
1	The upper spring-loaded terminals (Us) identified with "24 V" and "0 V" supply the embedded PC and the terminal bus (data transmission via K-bus or E-bus).
2	The spring-loaded terminals (Up) identified as "+", "-" and "PE" supply the bus terminals via the power contacts and the sensors or actuators connected to the bus terminals.

Fuse

- When dimensioning the fuse for the system voltage (Us), observe the maximum power consumption of the embedded PC (see: Technical data)
- Protect the power contacts (Up) with a fuse with a max. rating of 10 A (slow-blow).

Interrupting/switching off the power supply

To switch off the embedded PC, do not disconnect the ground (0 V), because otherwise current may continue to flow via the shielding, depending on the device, and damage the embedded PC or peripheral devices.

Always disconnect the 24 V line. Devices connected to the embedded PC with their own power supply (e.g. a panel) must have the same potential for "PE" and "0 V" as the embedded PC (no potential difference).

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6.2.1 Connect Embedded PC

The cables of an external voltage source are connected to spring-loaded terminals on the power supply terminal. Observe the required conductor cross-sections and strip lengths.

Table 25: Required conductor cross-sections and strip lengths.

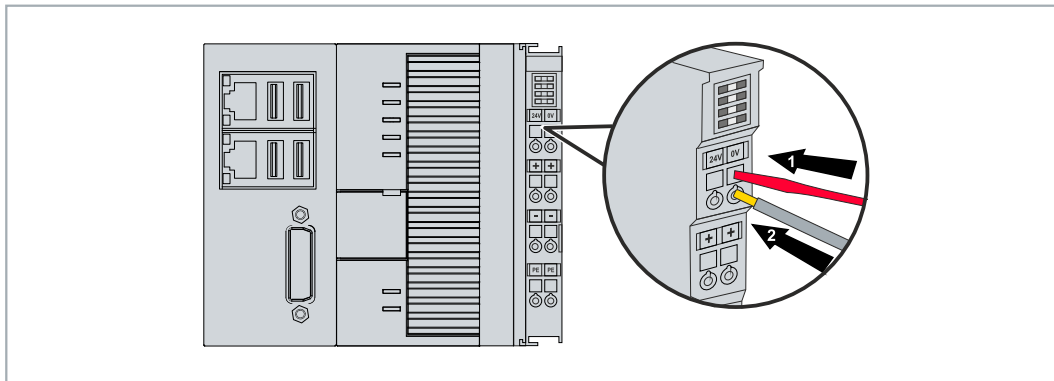| Conductor cross-section	0.5 ... 2.5 mm^2	AWG 20 ... AWG 14
Strip length	8 ... 9 mm	0.33 inch
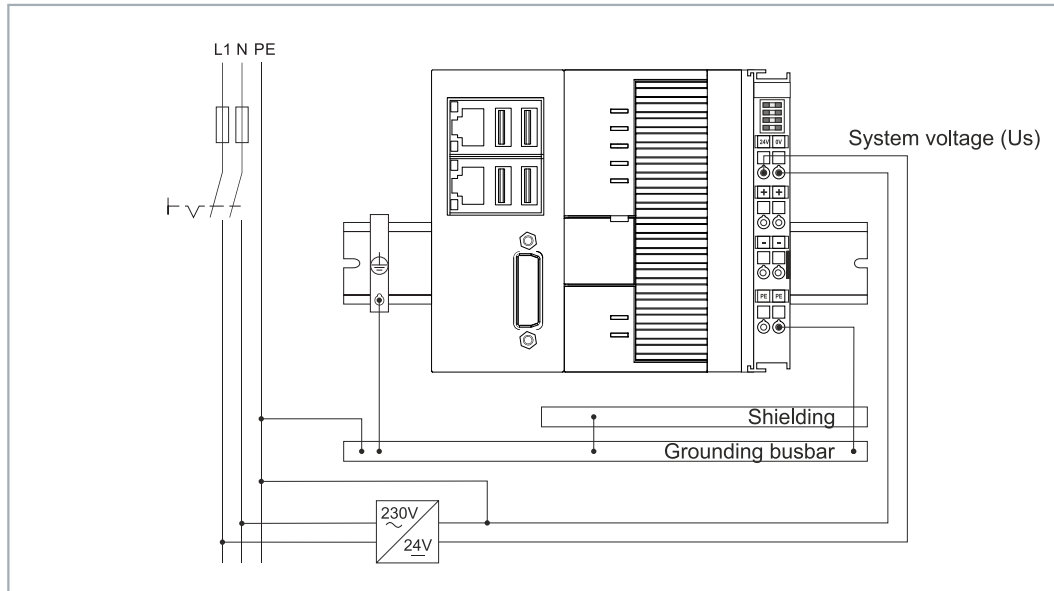
Fig. 26: Connection example with a CX5620.

Connect the embedded PC as follows:

1. Open a spring-loaded terminal by slightly pushing with a screwdriver or a rod into the square opening above the terminal.

2. The wire can now be inserted into the round terminal opening without any force.

3. The terminal closes automatically when the pressure is released, holding the wire safely and permanently.

⇨ You have successfully connected the voltage source to the power supply terminal when the two upper LEDs of the power supply terminal light up green.

The left LED (Us 24V) indicates the supply of the basic CPU module and the terminal bus. The right LED (Up 24 V) indicates the bus terminal supply via the power contacts.

6.2.2 UL requirements

The CX56x0 Embedded PCs are UL-certified. The corresponding UL label can be found on the name plate.

For Us/GNDs and Up/GNDp:
Use 4 Amp. fuse or
Class 2 power supply

AWG 28-14
60°C max
US LISTED
Ind.Cont.Eq. 24TB

Fig. 27: UL label for CX56x0.

The CX56x0 Embedded PCs can thus be used in areas in which special UL requirements have to be met. These requirements apply to the system voltage (Us) and the power contacts (Up). Applications without special UL requirements are not affected by UL regulations.

UL requirements:

- The embedded PCs must not be connected to unlimited voltage sources.
- Embedded PCs may only be supplied from a 24 V DC voltage source. The voltage source must be insulated and protected with a fuse of maximum 4 A (corresponding to UL248).
- Or the power supply must originate from a voltage source that corresponds to NEC class 2. An NEC class 2 voltage source must not be connected in series or parallel with another NEC class 2 voltage source.
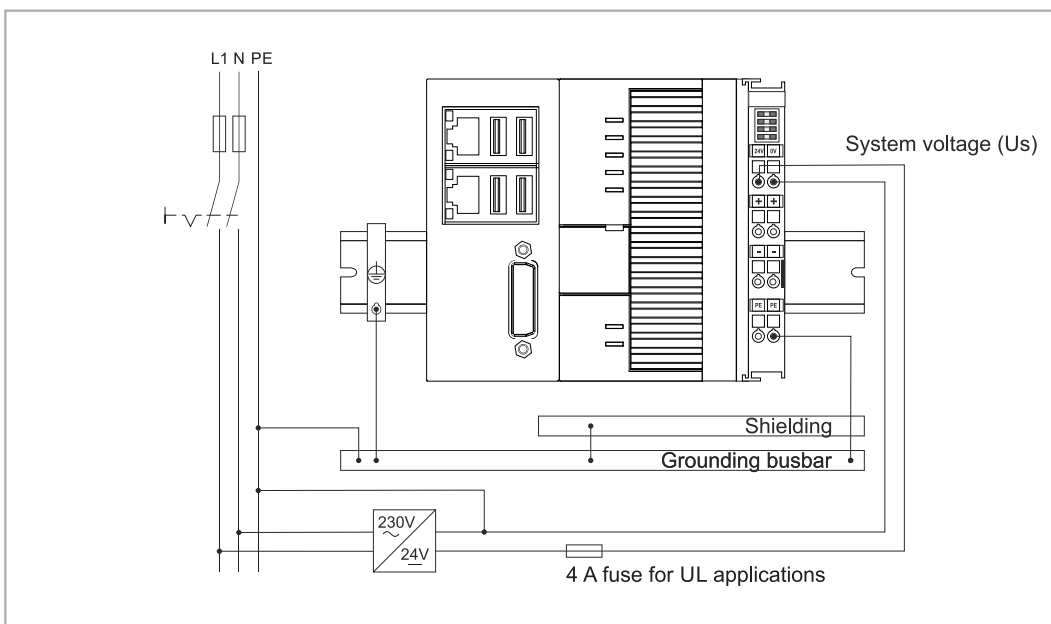

Fig. 28: Connection example for areas with special UL requirements.

6.3   Switching on

Please ensure that the embedded PC is fully configured before switching on the embedded PC.

Switch on the embedded PC as follows:

1. Check that you have chosen the correct installation position.
2. Check whether the embedded PC is mounted securely on the DIN rail and all required bus terminals are connected.
3. Only then switch on the power supply for the power supply unit.
⇨ The embedded PC starts automatically when the external power supply is switched on. The pre-installed operating system is started and all connected extension, system and fieldbus modules are configured.

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6.4 Switching off

ℹ **Loss of data**

If the embedded PC is switched off during operation, data on the CFast card or other hard disks may be lost.

Do not disconnect the embedded PC during operation.

To switch off the embedded PC, do not disconnect the ground (0 V), because otherwise current may continue to flow via the shielding, depending on the device, and damage the embedded PC or peripheral devices.

Always switch off the power supply unit first and then disconnect the 24 V line.

Switch off the embedded PC as follows:

1. Stop all running programs properly, e.g. the control software on the embedded PC.
2. Shut down the operating system.
3. Do not switch off the external power supply until all other tasks have been completed, in order to switch off the embedded PC.

7 Configuration

7.1 Starting the Beckhoff Device Manager

Using the Beckhoff Device Manager, an industrial PC can be configured by remote access with the aid of a web browser. Depending on the image version, access takes place via different protocols and requires different open ports. For older image versions access takes place via the HTTP protocol and Port 80 (TCP). More up-to-date image versions use HTTPS and Port 443 (TCP).

Requirements:

- Host PC and embedded PC must be located in the same network. Depending on the operating system version, the network firewall must allow access via port 80 (HTTP) or port 443 (HTTPS).
- IP address or host name of the embedded PC.

Table 26: Access data for the Beckhoff Device Manager on delivery.

User name	Password
Administrator	1

Start the Beckhoff Device Manager as follows:

1. Open a web browser on the host PC.
2. Enter the IP address or the host name of the industrial PC in the web browser to start the Beckhoff Device Manager.
   - Example with IP address: https://169.254.136.237/config
   - Example with host name: https://CX-16C2B8/config
3. Enter the user name and password. The start page appears:
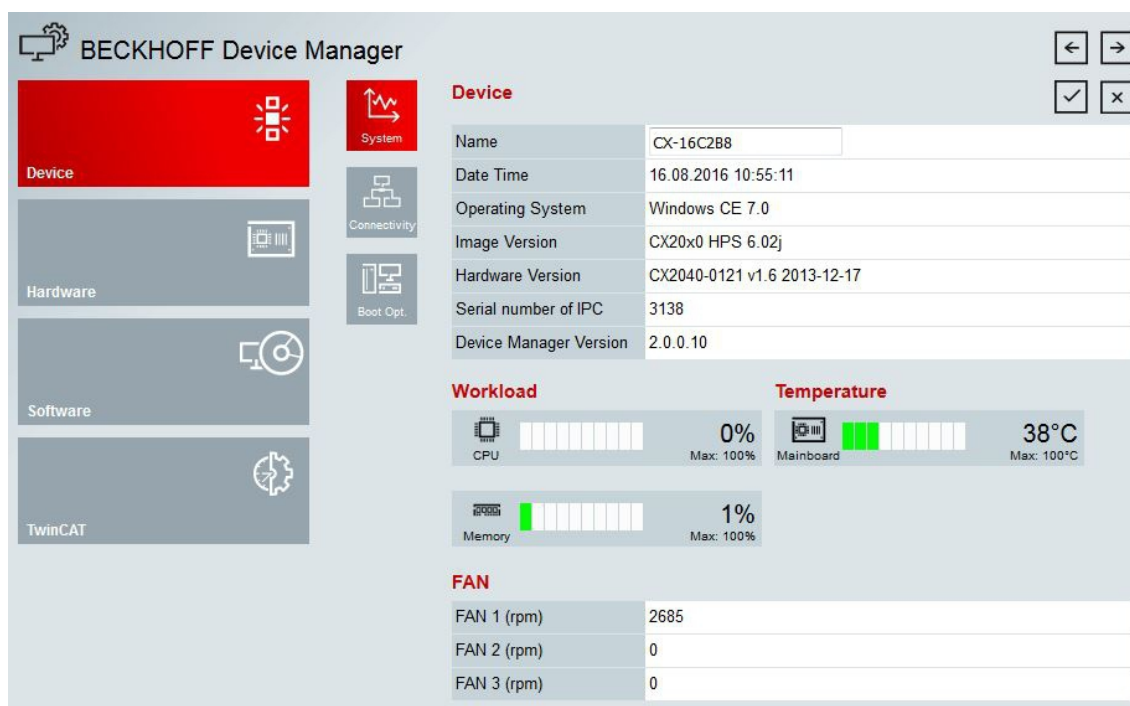
⇨ Navigate forward in the menu and configure the industrial PC. Note that modifications only become active once they have been confirmed. It may be necessary to restart the industrial PC.

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7.2 Enable TPM

The CX56x0 is extended with a TPM (Trusted Platform Module) for basic safety functions. Among other features, this enables encryption of the user data and thus prevents unauthorized read access when the device is switched off. Unauthorized manipulation of the software is also prevented. On the CX56x0 the firmware TPM solution (fTPM) is implemented, where the main CPU has a microcode to represent the function of a TPM (see: Technical data).
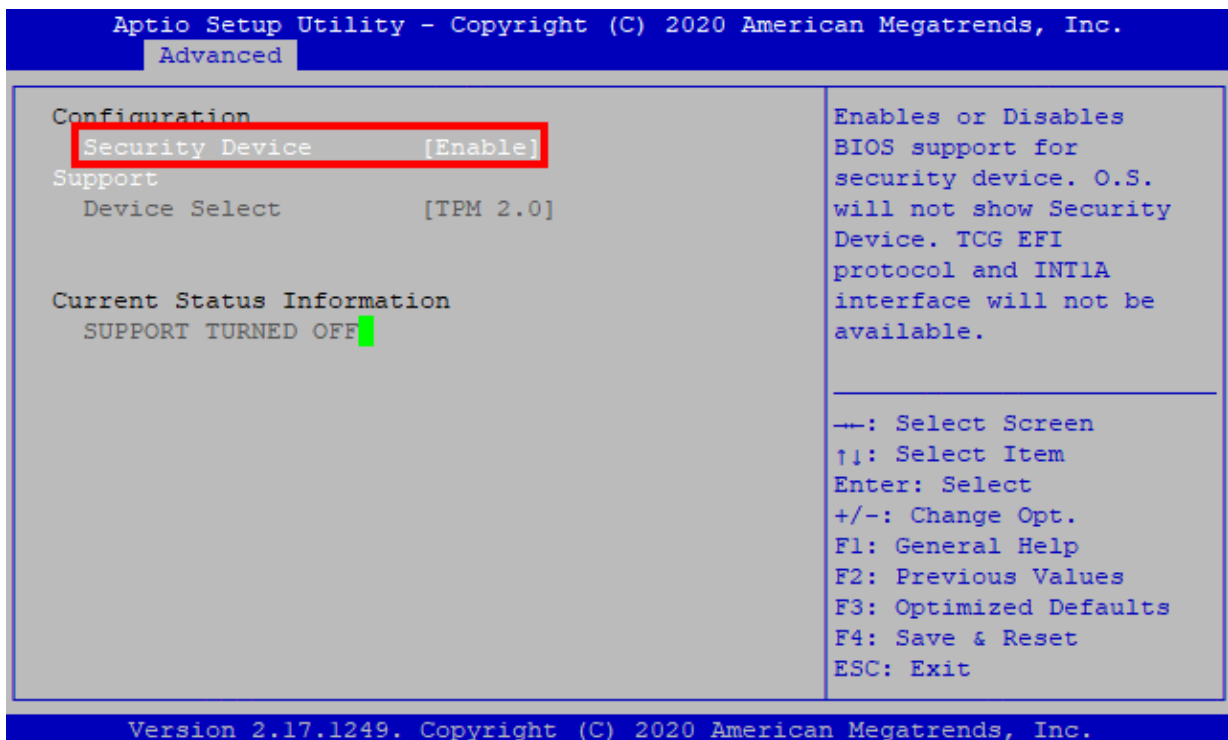
The TPM is disabled by default and has to be enabled in the BIOS before it can be used. Further information about the use of a TPM on a Beckhoff Industrial PC can be found at: TPM on Beckhoff IPC

Requirements:

- UEFI BIOS.
- 64-bit Windows 10 version 1809 or higher required.

Proceed as follows:

1. Restart your Industrial PC and press **[Del]** to start the BIOS setup.
   The BIOS setup window appears.
2. Under **Boot > Boot mode select**, select the option **UEFI**.
3. Under **Advanced > Trusted Computing** set the option **Security Device Support** to **Enable**.

```
Aptio Setup Utility - Copyright (C) 2020 American Megatrends, Inc.
  Advanced

 Configuration                            Enables or Disables
   Security Device        [Enable]        BIOS support for
 Support                                  security device. O.S.
   Device Select          [TPM 2.0]       will not show Security
                                          Device. TCG EFI
                                          protocol and INT1A
 Current Status Information               interface will not be
   SUPPORT TURNED OFF                     available.


                                          →←: Select Screen
                                          ↑↓: Select Item
                                          Enter: Select
                                          +/-: Change Opt.
                                          F1: General Help
                                          F2: Previous Values
                                          F3: Optimized Defaults
                                          F4: Save & Reset
                                          ESC: Exit

       Version 2.17.1249. Copyright (C) 2020 American Megatrends, Inc.
```

4. Press **[F4]** to save the settings and exit the BIOS setup.
   The device is restarted.

⇨ If you have previously stored keys in the TPM, we recommend resetting the TPM to factory defaults, which will delete any existing keys. The required options are available in the BIOS once the TPM has been enabled and the PC has been rebooted.

7.3 Windows 10 IoT Enterprise

7.3.1 Identification of the Ethernet interfaces (X000, X001)

Network and Sharing Center

In the Network and Sharing Center the Ethernet interfaces (X000, X001) of the embedded PC are identified as follows:
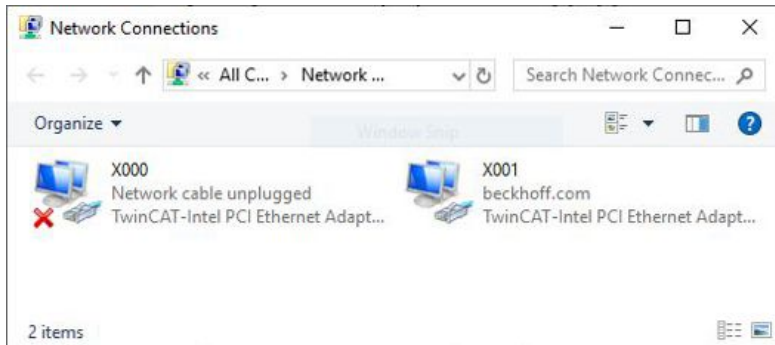

Fig. 29: Windows 10, Identification of the Ethernet interfaces (X000, X001) in the Network and Sharing Center.

Device Manager

By default, the Device Manager identifies the embedded PC's Ethernet interfaces (X000, X001) as follows:

- TwinCAT Intel PCI Ethernet adapter (gigabit) corresponds to the Ethernet interface X000.
- TwinCAT Intel PCI Ethernet adapter (gigabit) #2 corresponds to the Ethernet interface X001.

Fig. 30: Windows 10, identification of the Ethernet interfaces (X000, X001) in the device manager.

7.3.2 Enabling jumbo frames

Standardized Ethernet frames have a size of 1518 bytes. Ethernet frames that are larger than 1518 bytes are referred to as jumbo frames. Jumbo frames are used for transferring large data quantities. Jumbo frames are useful for certain applications, e.g. video cameras.

The Ethernet interfaces (X000, X001) support jumbo frames only if the original Intel® driver is installed.

Requirements:

- The original Intel® driver can be downloaded from https://downloadcenter.intel.com.
- Install the original Intel® driver. Note that this will delete the real-time capable driver from Beckhoff.
- Check whether the peripheral devices support jumbo frames.

Jumbo frames are activated as follows:

1. Under **Start > Control Panel > Hardware and Sound** click on **Device Manager**.

2. Double-click on the interface and then on the **Advanced** tab.
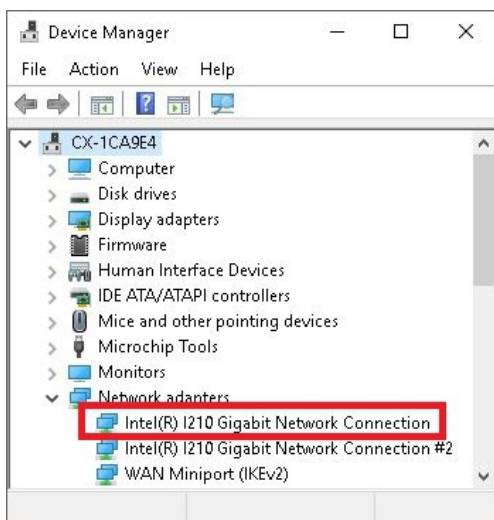
3. Under **Settings** click on Jumbo Packet, under **Value** select the option 4088 bytes or 9014 bytes.
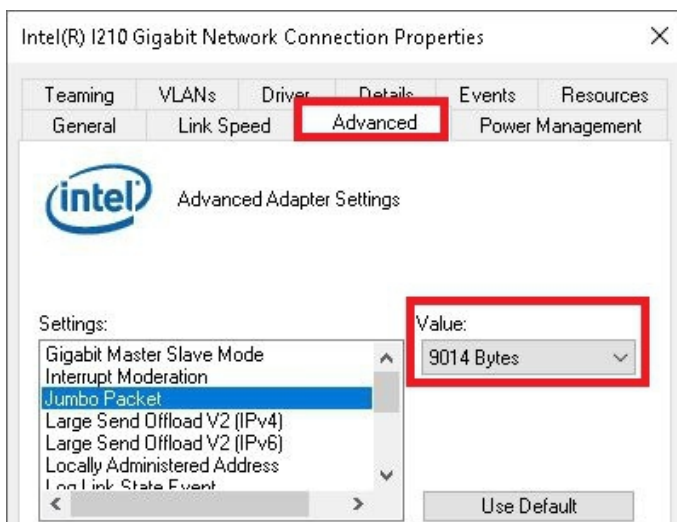
⇨ You have successfully activated jumbo frames, and you can now transfer larger data quantities.

7.3.3   Restoring the Beckhoff real-time driver

The Beckhoff real-time driver can be restored if the real-time driver was uninstalled or the original Intel® driver for jumbo frames or NIC Teaming was installed, for example. This chapter shows you how to use *TcRteInstall.exe* to restore the Beckhoff real-time driver. The file is in the TwinCAT directory by default.

Requirements:

- You can find the *TcRteInstall.exe* in a TwinCAT 2 standard installation under: *C:\TwinCAT\Io\TcRteInstall.exe*
- And in a TwinCAT 3 standard installation under: *C:\TwinCAT\3.1\System\TcRteInstall.exe*

Proceed as follows:

1. Double-click the *TcRteInstall.exe* file.
   The installation dialog appears and shows the compatible Ethernet interfaces under **Compatible devices**.
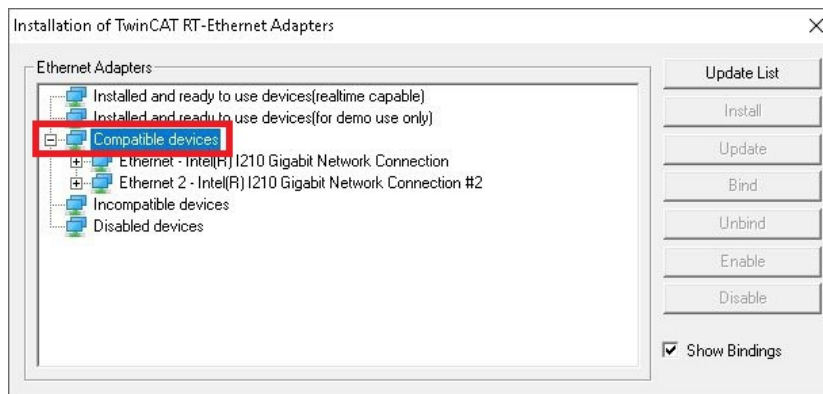
2. Select the Ethernet interfaces for which you wish to restore the Beckhoff real-time driver and click on **Install**.

⇨ The Beckhoff real-time driver is installed. The Ethernet interfaces with installed Beckhoff real-time driver are shown under **Installed and ready to use devices (real-time capable)**.
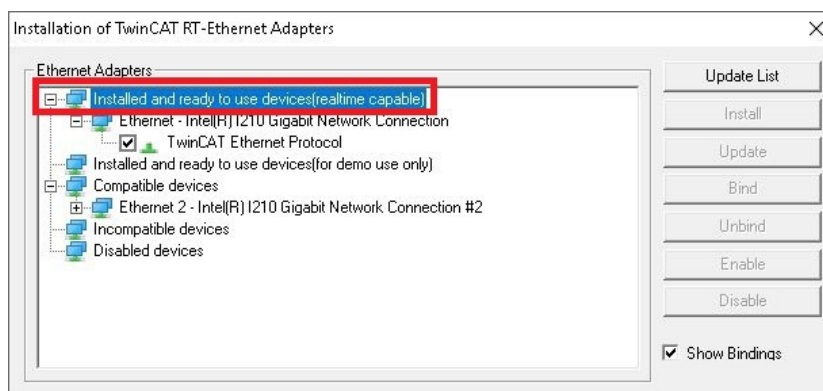
7.4 TwinCAT

7.4.1 Tree view

The Tree View chapter can be used as an example for creating a project without actual hardware. All devices and components of an embedded PC must be added manually in TwinCAT 3.

The smallest possible configuration of the CX56x0 Embedded PC is created as follows in the tree view under TwinCAT 3:
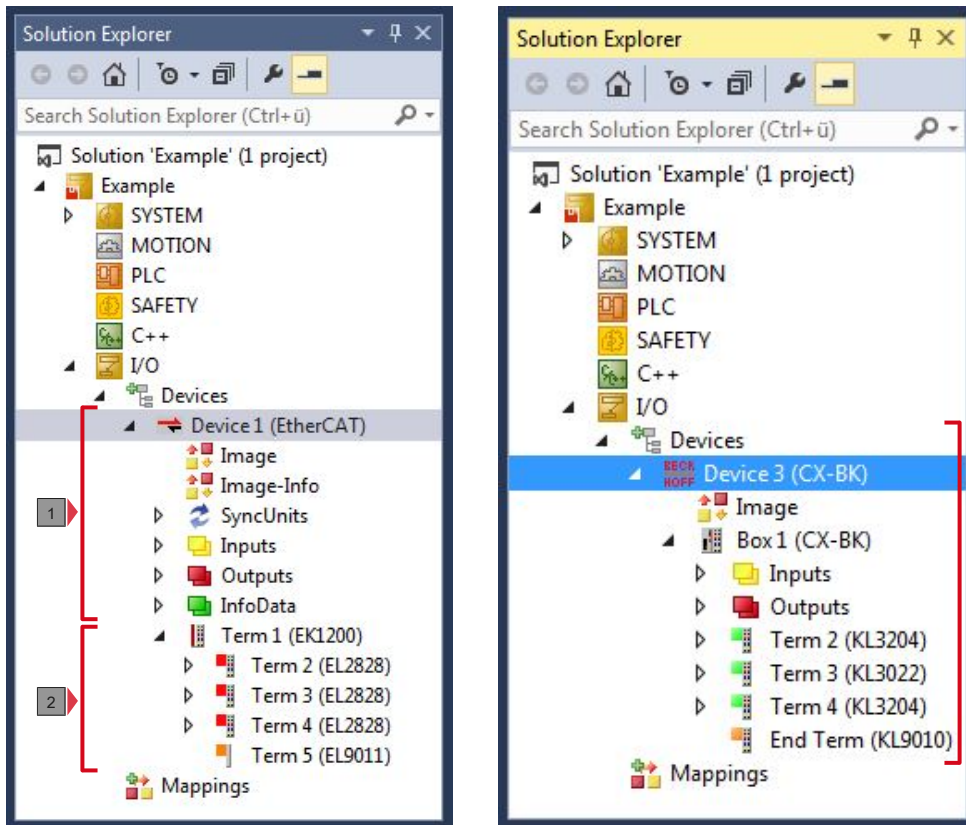
Fig. 31: CX56x0 Embedded PC in the tree view of TwinCAT 3, with attached EtherCAT Terminals (left) or Bus Terminals (right).

The configuration in the tree view differs depending on whether EtherCAT Terminals or Bus Terminals are connected to the Embedded PC.

Table 27: Key for the tree view.

No.	Description
1	The CX56x0 Embedded PC with EtherCAT Terminals is added as EtherCAT master. Variables for diagnostic purposes are listed under inputs or outputs.
2	EtherCAT Terminals (E-bus) are displayed under the EK1200 Bus Coupler in the tree view.
3	If Bus Terminals (K-bus) are used together with a CX56x0 Embedded PC, the Bus Coupler (CX-BK) is added together with the Bus Terminals.

7.4.2 Searching for target systems

Before you can work with the devices, you must connect your local computer to the target device. Then you can search for devices with the help of the IP address or the host name.

The local PC and the target devices must be connected to the same network or directly to each other via an Ethernet cable. In TwinCAT a search can be performed for all devices in this way and project planning subsequently carried out.

Prerequisites for this step:

- TwinCAT 3 must be in Config mode.
- IP address or host name of the device.

Search for the devices as follows:

1. In the menu at the top click on **File > New > Project** and create a new TwinCAT XAE project.
2. In the tree view on the left click on **SYSTEM**, and then **Choose Target**.

3. Click on **Search (Ethernet)**.
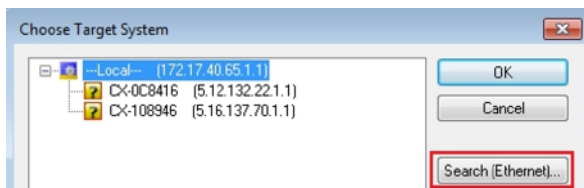
4. Type the host name or the IP address of the device into the **Enter Host Name / IP** box and press **[Enter]**.
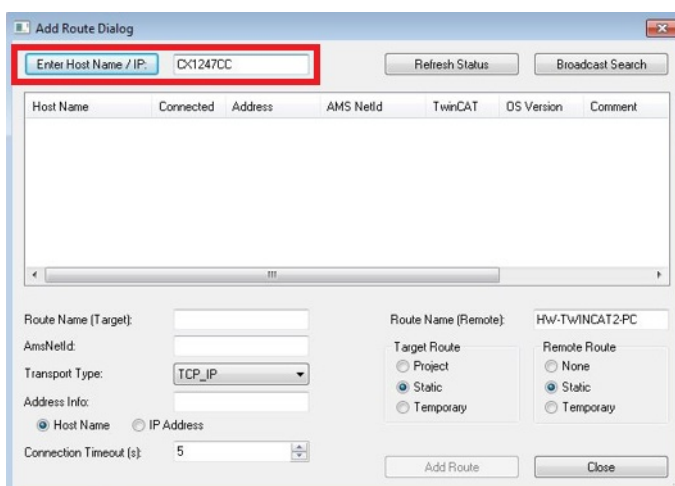
5. Mark the device found and click on **Add Route**.
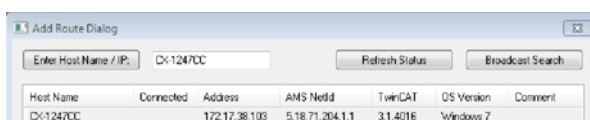
The Logon Information window appears.

BECKHOFF

Enter the user name and password for the CX in the **User Name** and **Password** fields and click **OK**.
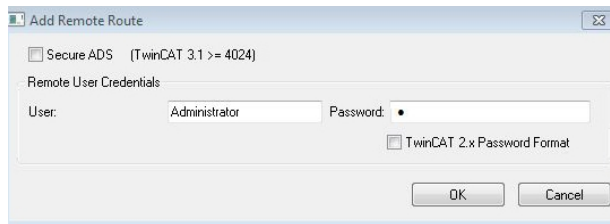
The following information is set as standard in CX devices:
User name: Administrator **Password:** 1

6. If you do not wish to search for any further devices, click on **Close** to close the Add Route Dialog.
The new device is displayed in the Choose Target System window.

7. Select the device you want to specify as target system and click **OK**.
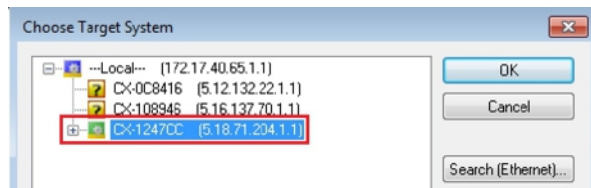
⇨ You have successfully searched for a device in TwinCAT and inserted the device as the target system.
The new target system and the host name are displayed in the menu bar.

Using this procedure you can search for all available devices and also switch between the target systems at any time. Next, you can append the device to the tree view in TwinCAT.

7.4.3 Scanning an Embedded PC

This step shows how to scan an Embedded PC in TwinCAT and then further configure it.
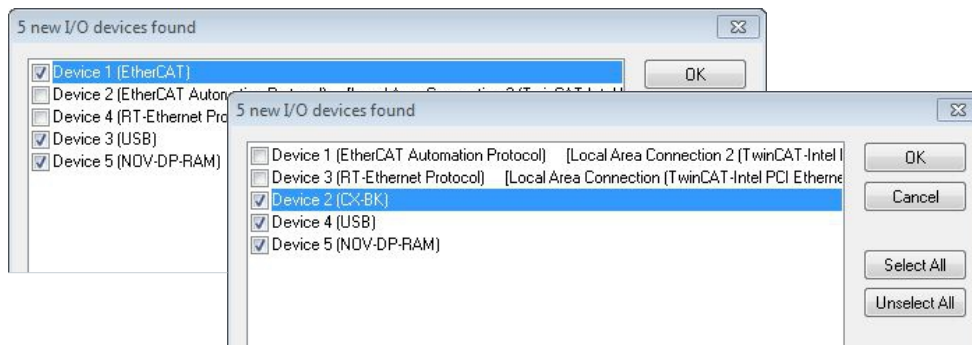
Prerequisites for this step:

- Selected target device.

Add the Embedded PC as follows:

1. Start TwinCAT and open an empty project.
2. In the tree view on the left, right-click on **I/O Devices**.
3. In the context menu click on **Scan**.
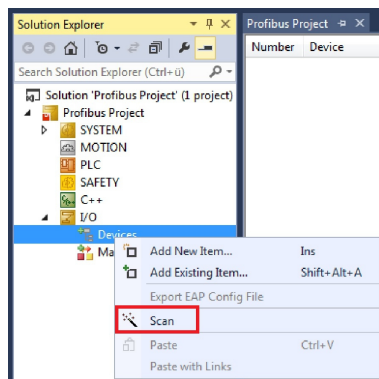
4. Select the devices you want to use and confirm the selection with **OK**.
   Only devices that are actual available are offered for selection.

For Embedded PCs with connected Bus Terminals (K-bus) a Bus Coupler device (CX-BK) is displayed. For EtherCAT Terminals (E-bus) the EtherCAT coupler is added automatically.

5. Confirm the request with **Yes**, in order to look for boxes.

6. Confirm the request whether to enable FreeRun with **Yes**.

⇨ The Embedded PC was successfully scanned in TwinCAT and is displayed in the tree view with the inputs and outputs.
The Tree view chapter illustrates how Embedded PCs with connected Bus or EtherCAT Terminals are displayed.

7.4.4   Configuring EtherCAT cable redundancy.

The embedded PC has two independent Ethernet interfaces, which can be used for EtherCAT cable redundancy. Cable redundancy offers resilience for the cabling. Interruptions of the EtherCAT communication due to wire break or unplugged LAN cables are avoided.
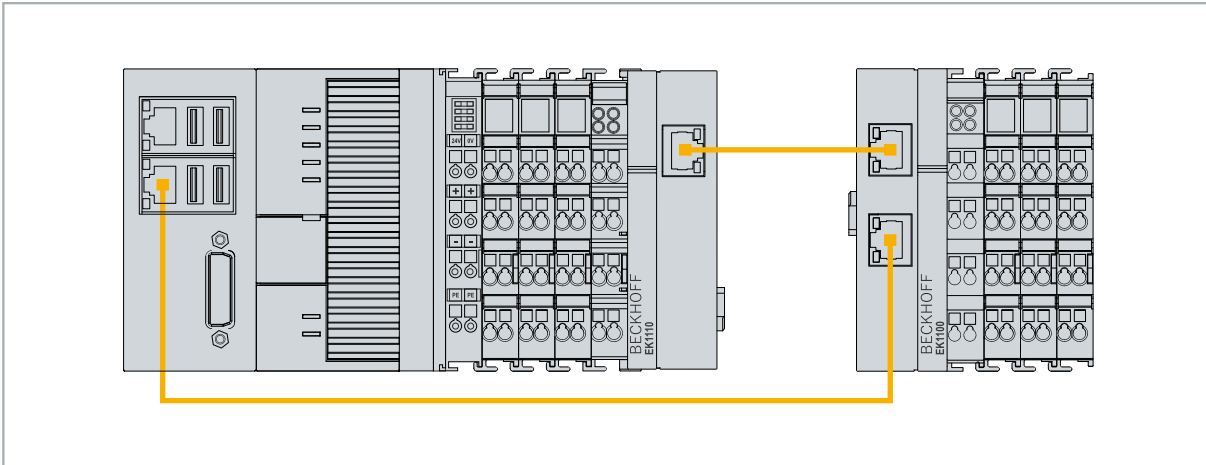

Fig. 32: Example configuration of a CX56x0 with EtherCAT cable redundancy.

Interference at the individual terminals is not intercepted by the cable redundancy.

Table 28: Cable redundancy, hardware for sample configuration.

| Type	Description
Embedded PC	Is the EtherCAT master in the example.
EK1110 Bus Coupler	EtherCAT extension can be used to extend an EtherCAT segment by up to 100 m.
EK1100 Bus Coupler	The Bus Coupler relays the EtherCAT signal to connected EtherCAT Terminals.
EtherCAT Terminals	Any number of EtherCAT Terminals can be connected to the Embedded PC and the Bus Coupler.

Requirements:

- In TwinCAT 3 the supplement is already included and only has to be licensed.
- Hardware wired as EtherCAT ring (see Fig.: Smallest possible configuration for EtherCAT cable redundancy) and added in TwinCAT.

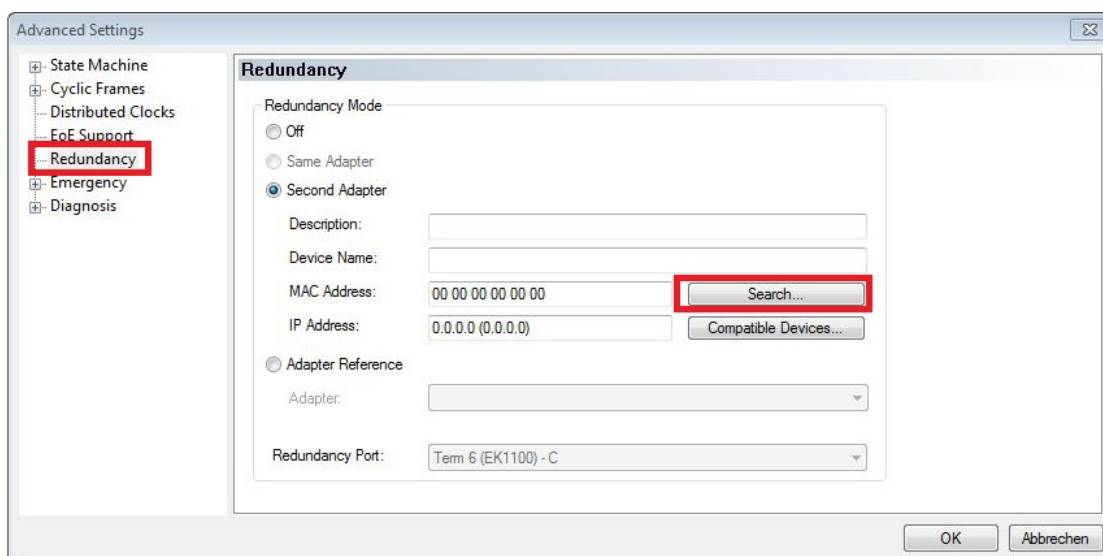**Configure EtherCAT cable redundancy as follows:**

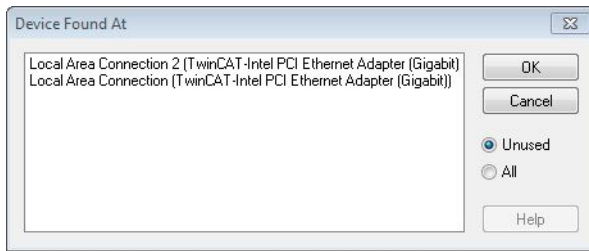1. In the tree view click on the EtherCAT master.
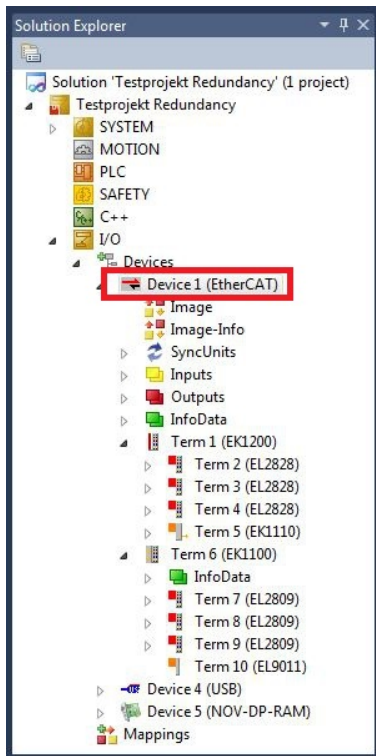
2. Click on the **EtherCAT** tab, then **Advanced Settings**.
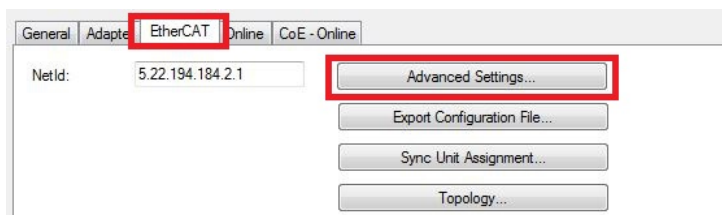
3. Click on **Redundancy** in the structure tree on the left.

4. Click the **Second Adapter** option and then the **Search** button.

5. Select the appropriate LAN connection according to your cabling at the embedded PC.

6. Confirm your settings with **Ok**.

⇨ You have successfully configured cable redundancy. The EtherCAT slaves configured for cable redundancy are displayed in the **Online** tab.

The state of the individual EtherCAT slaves can be found in the **State** column. If, for example, the cable connection between the EK1100 and EK1110 Bus Couplers is interrupted, the status of the Bus Coupler changes. The message "LINK_MIS B" and "LINK_MIS A" then appears in the State column.

Although the connection between the Bus Couplers is interrupted, the EtherCAT Terminals connected to the EK1100 Bus Coupler do not have a fault.

If the cable connection is interrupted at the same point without cable redundancy, a fault is displayed for the terminals in the State column.

7.4.5 Using a hardware watchdog

The function block **FB_PcWatchdog_BAPI** enables a hardware watchdog on the embedded PC. The watchdog can be used to automatically restart systems that have entered an infinite loop or where the PLC has stopped.

The watchdog is enabled with **bExecute** = TRUE and **nWatchdogTimeS** >= 1s.

Once the watchdog has been enabled, the function block must be called cyclically and at shorter intervals than nWatchdogTimeS, because the embedded PC automatically restarts if the set time is less than nWatchdogTimeS.

| *NOTICE* |
|---|
| **Unwanted restart** |
| The watchdog restarts the embedded PC as soon as the time set for nWatchdogTimeS elapses. |
| Be aware of this behavior and disable the watchdog if you use breakpoints, carry out a PLC reset or an overall reset, stop TwinCAT, switch to config mode or activate the configuration. |

Requirements:

- Tc2_System library.
- TwinCAT v3.1.0
- A previously created PLC project in TwinCAT.

Locating the function block in TwinCAT:

1. Double-click on **Tc2_System** in the tree view under **PLC > PLC project > References**. The Library Manager appears.
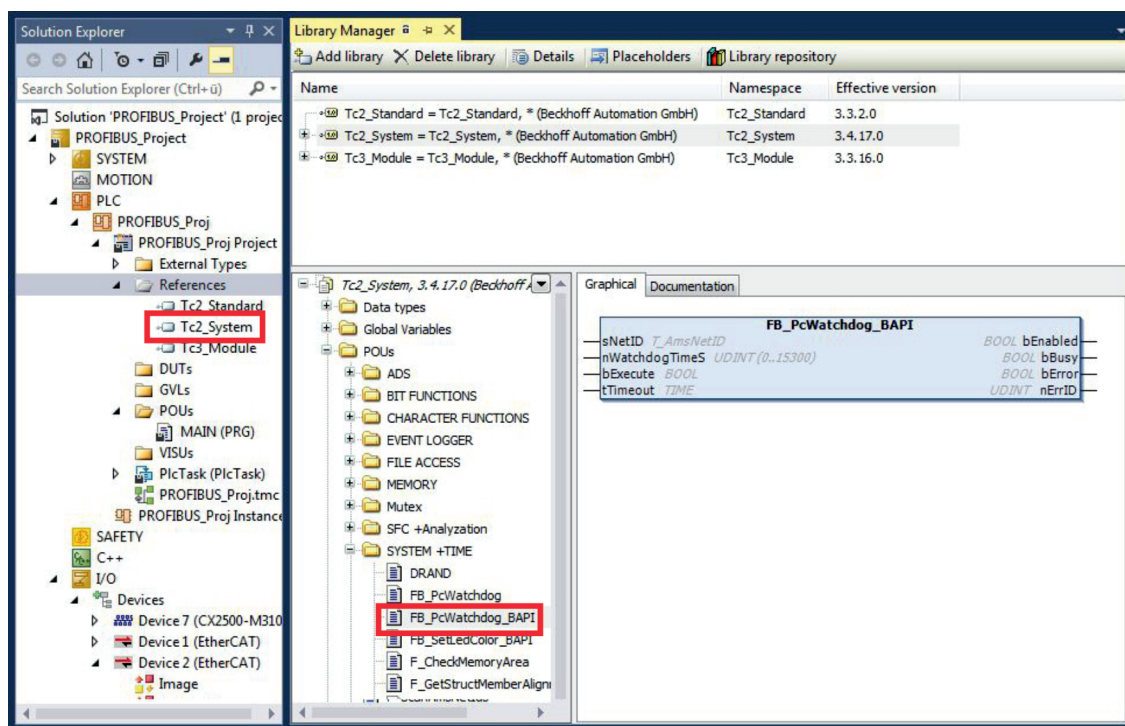
2. Under **Tc2_System > POUs > SYSTEM +TIME** click on the function block **FB_PcWatchdog_BAPI**.

⇨ The description of the function block can then be found under the **Documentation** tab or in the library description under: FB_PcWatchDog_BAPI. If necessary, you can install the **Tc2_System** library at a later stage via the **Add Library** button in the Library Manager.

7.4.6   Configure user LEDs U1 and U2

```
                    FB_SetLedColorEx_BAPI
──sNetID    T_AmsNetID              BOOL bBusy──
──nLedID    USINT                   BOOL bError──
──eNewColor E_UsrLED_Color         UDINT nErrID──
──bExecute  BOOL
──tTimeout  TIME
```

The function block FB_SetLedColorEx_BAPI can be used to switch the user LEDs on industrial PCs and embedded PCs with BIOS API support. The LED color is switched via a rising edge at bExecute and the eNewColor parameter. For devices with a user LED, this is selected via nLedID = 0 (default value is 0). For devices with several user LEDs, the U1 LED is selected via nLedID = 1 or the U2 LED via nLedID = 2.

The LED can be switched off (eNewColor = eUsrLED_Off) or set to red (eNewColor = eUsrLED_Red), blue (eNewColor = eUsrLED_Blue) or green (eNewColor = eUsrLED_Green).

📥 Inputs

```
VAR_INPUT
    sNetID          : T_AmsNetID;
    nLedID          : USINT;
    eNewColor       : E_UsrLED_Color;
    bExecute        : BOOL;
    tTimeout        : TIME;
END_VAR
```

Name	Type	Description
sNetID	T_AmsNetID	AMS network ID of the device (empty string or local network ID) (type T_AmsNetId)
nLedID	USINT	For devices with several user LEDs, the U1 LED is selected via nLedID = 1 or the U2 LED via nLedID = 2. (Default value is 0)
eNewColor	E_UsrLED_Color	New LED color (type E_UsrLED_Color)
bExecute	BOOL	The command is executed with a rising edge. The input must be reset as soon as the function block is no longer active (bBusy=FALSE).
tTimeout	TIME	Time until the internal ADS communication is aborted.

📤 Outputs

```
VAR_OUTPUT
    bBusy     : BOOL;
    bError    : BOOL;
    nErrID    : UDINT;
END_VAR
```

Name	Type	Description
bBusy	BOOL	TRUE, as long as the function block is active.
bError	BOOL	TRUE if an error occurs during command execution.
nErrID	UDINT	Contains the ADS error code or the command-specific error code of the last executed command. Is reset to 0 by the execution of a command at the inputs.

Prerequisites

Development environment	Target platform	PLC libraries to be integrated (category group)
TwinCAT v3.1.0	PC or CX (x86, x64, Arm®)	Tc2_System (system) v3.6.1.0

8 1-second UPS (persistent variables)

> **ⓘ** **Loss of data**
>
> Use only TwinCAT to control the 1-second UPS and save only persistent data with a maximum size of 1 MB. Use beyond this may result in data loss or corrupt data.

The 1-second UPS is an UltraCap capacitor that continues to supply the processor with power in the event of a power failure. During this period persistent data can be saved, which are available on switching on again.
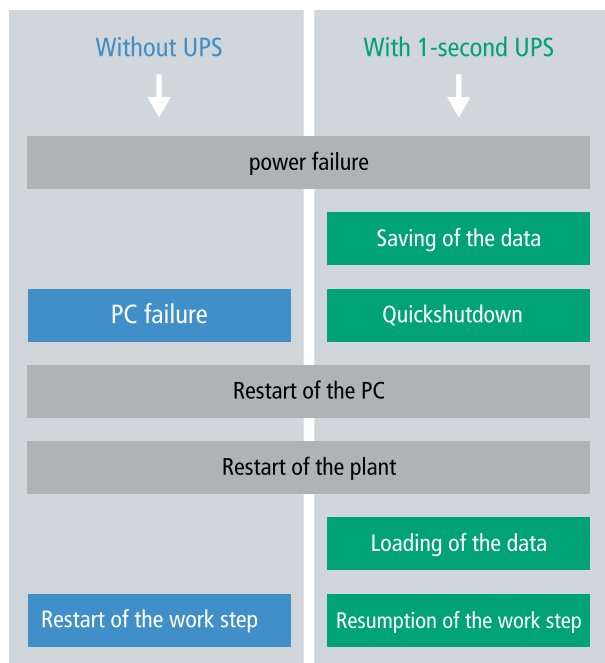

Fig. 33: Behavior of systems in the event of a power failure without and with a 1-second UPS.

Since the 1-second UPS is designed for the entire service life, the holding time is considerably longer with new devices. The capacitors age over the course of time and the holding time decreases. Therefore a maximum of 1 MB persistent data can be reliably saved over the entire service life. Do not save any other data and do not use any other applications to control the 1-second UPS.

Please note that the 1-second UPS does not supply power to the K-bus or the E-bus and that their data may already be invalid when the 1-second UPS is activated. Also, the fieldbus system (or Ethernet) may not work or not work properly once the 1-second UPS was activated.

Table 29: Storage location and names of the files depending on the TwinCAT version.

Development environment	File path	File name
TwinCAT 2	\\TwinCat\Boot\	TCPLC_T_x.wbp TCPLC_T_x.wb~ (backup) The x in the file name stands for the number of the runtime system.
TwinCAT 3	\\TwinCat\3.1\Boot\Plc	Port_85x.bootdata Port_85x.bootdata-old (backup) The x in the file name stands for the number of the runtime system.

Configuration of the 1-second UPS

- In the case of the CX56x0 , check whether the 1-second UPS is activated or deactivated in the BIOS (see: BIOS settings [▶ 57]).
- Configure the Windows Write Filter and issue the corresponding write permissions in order to be able to save persistent data (see: Windows write filter [▶ 58]).
- Declare important data such as counter values in the PLC as VAR PERSISTENT. Then call the function block FB_S_UPS_BAPI cyclically in TwinCAT in order to control the 1-second UPS (see: FB_S_UPS_BAPI [▶ 58]).
- Select the mode in the function block in order to specify what should happen in the case of a power failure. Specify, for example, whether persistent data are saved and a quick shutdown is executed (see: Data types [▶ 60]).
- You can then check the validity of the variables and monitor whether the persistent variables are loaded without error (see: PlcAppSystemInfo).

Sample project:

https://infosys.beckhoff.com/content/1033/CX56x0/Resources/1937303563.pro.

Saving and loading persistent data

The persistent data are saved in the Port_85x.bootdata file on the memory card. On starting the PLC the Port_85x.bootdata file is loaded from the memory card, backed up there as Port_85x.bootdata_old (backup) and then deleted.

Another current Port_85x.bootdata file is not written until the system is shut down or the 1-second UPS is activated.

If no Port_85x.bootdata file exists when starting the embedded PC, the persistent data are invalid and will be deleted (standard setting). The reason for this is that the 1-second UPS was activated before the TwinCAT PLC was started during startup of the embedded PC. In this case no persistent data were saved, since the system was unable to ensure sufficient buffer time for saving the data.

Always call the function block from the PLC and always use the fastest task to do so. In the case of a power failure Beckhoff recommends not calling the rest of the application in order to ensure that sufficient time remains for writing the data.

```
IF NOT FB_S_UPS_BAPI.bPowerFailDetect THEN
    ;//Call programs and function blocks
END_IF
```

The rest of the application influences the CPU load and the CPU load in turn affects the period during which the persistent data are written.

Loading a backup of the persistent data

A registry setting can be used to determine whether the backup file is deleted or used. The backup file is used by default (setting 0):

```
[HKEY_LOCAL_MACHINE\SOFTWARE\Beckhoff\TwinCAT\Plc]"ClearInvalidPersistentData"= 0
```

If the backup file is to be deleted, the value of "ClearInvalidPersistentData" in the registry must be set to 1.

It is also possible in TwinCAT to specify on the left in the tree view under **PLC** whether the backup file is to be used or not.
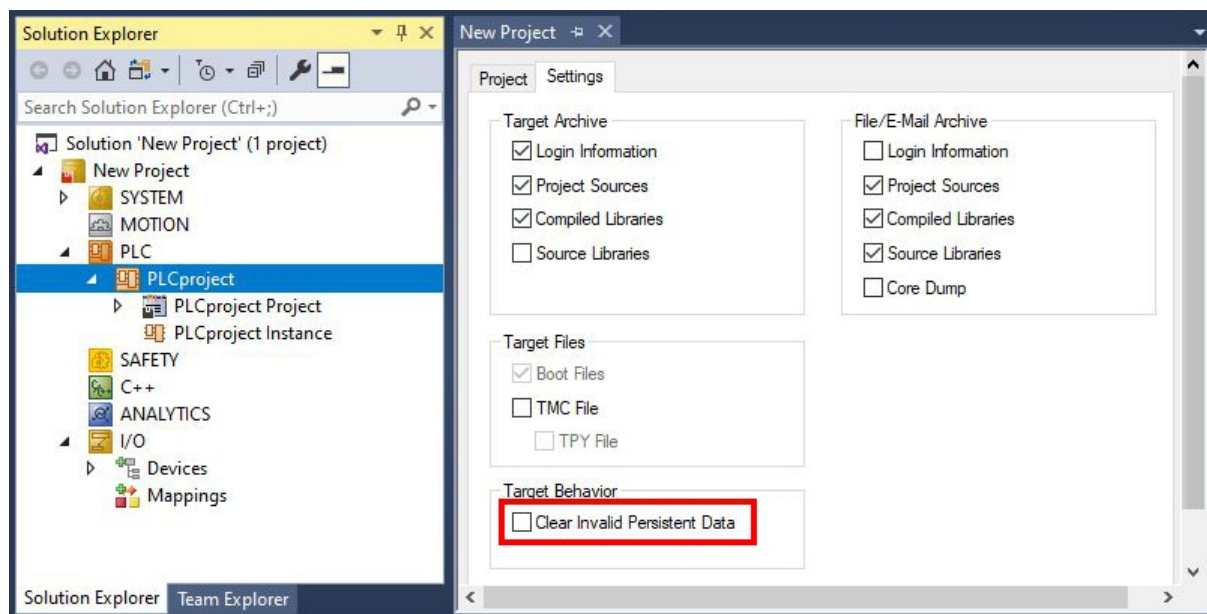
Fig. 34: Loading a backup of the persistent data. Settings in TwinCAT 3.

The backup files will be deleted if the option **Clear Invalid Persistent Data** is activated. Corresponds to registry entry 1.

8.1   BIOS settings

The 1-second UPS can be switched on or off via the BIOS. The parameters of the 1-second UPS are displayed in the following menu and can be adjusted if necessary:

Advanced > **Power Controller Options**

Advanced		
Bootloader version	1.00-23	Enables/disables the UPS
Firmware version	1.00-77	
Mainboard serial no	120003414250178	
Mainboard Prod. Date (Week.Year)	44.14	
Mainboard BootCount	4711	
Mainboard operation time	1224 min (20 h)	
Voltage (Min/Max)	5.00 V / 5.20 V	
Temperature (Min/Max)	15 °C / 63 °C	
USB-Port voltage	[Off in S3-5]	
Watchdog timer mode	[Compatibility mode]	
1-second Uninterruptable Power Supply (SUPS)		→ ←: Select Screen
SUPS Enable	**[Enable]**	↑ ↓: Select Item
Hold Usb	[Enable]	Enter: Select
Delay	0	+/-: Change Options
		F1: General Help
SUPS Firmware version	1.09	F2: Previous Values
Current Power source	On Line	F3: Optimized Defaults
Battery load level	100%	F4: Save & Exit
Powerfail counter	42	ESC: Quit

SUPS Enable
Options: Enable / Disable
Switches the 1-second UPS on or off.

Hold USB
Options: Enable / Disable
Switches off the power supply for the USB ports in UPS mode.

Delay
Options: 0…255 seconds
Start delay with which the 1-second UPS is charged.

SUPS Firmware version
Firmware version

Current Power source
Status of the power supply: On Line / Battery

Battery load level
Charge state in percent (n% cap. (n={0...100}) describes the capacity of the 1-second UPS)

Powerfail counter
Number of voltage failures

8.2   Windows write filter

Since the persistent data are stored on a storage medium, the file and the path must be writeable. If you use the Windows write filter, the Windows partition is protected against write access operations, and the persistent data are not saved.

UWF exception list

By default an exception list is automatically created when the UWF is switched on. The \Boot directory is already entered in this list. Check the configuration of the UWF if you have made changes to the exception list.
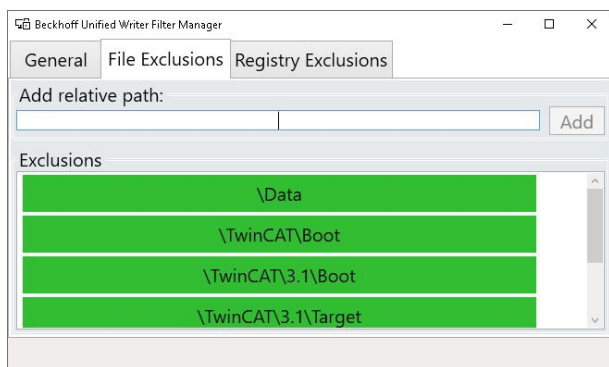
Fig. 35: UWF exception list under TwinCAT 3

By default, the persistent data are stored under \TwinCAT\3.1\Boot in TwinCAT 3.

The UWF can be configured via the Beckhoff Unified Write Filter Manager.

8.3   FB_S_UPS_BAPI

NOTICE
Loss of data
If other applications or the PLC keep further files open or write to them, file errors may occur if the 1-second UPS switches off the controller.

```
                           FB_S_UPS_BAPI
—sNetID    T_AmsNetId                        BOOL  bPowerFailDetect—
—iPLCPort  UINT                        E_S_UPS_State  eState—
—tTimeout  TIME                               BYTE  nCapacity—
—eUpsMode  E_S_UPS_Mode                        BOOL  bBusy—
—ePersistentMode  E_PersistentMode             BOOL  bError—
—tRecoverTime  TIME                           UDINT  nErrID—
```
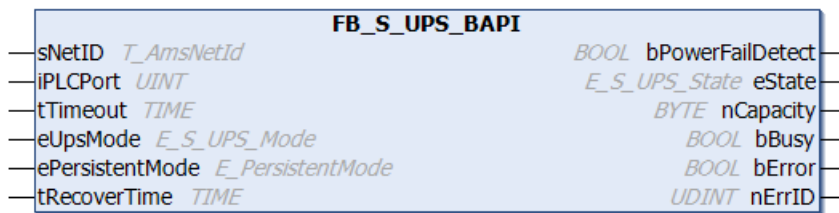
The function block FB_S_UPS_BAPI can be used on devices with 1-second UPS and with BIOS-API from version v1.15, in order to control the 1-second UPS from the PLC.

When the function block is first called, the data for accessing the 1-second UPS are determined via BIOS-API. This process takes several cycles. This is followed by cyclic testing for power failure. When the persistent data are written next, the access data for the PLC are saved persistently, so that during subsequent boot operations the check for power failures can take place immediately after the PLC start.

In the event of a power failure the charge state of the 1-second UPS is checked every 50 ms, every 200 ms if voltage is present and the capacity is less than 90%, and every second if voltage is present and the capacity is more than 90%. This also takes place via BIOS-API access.

In the event of a power failure the function block FB_S_UPS_BAPI can be used to save the persistent data and/or execute a quick shutdown, depending on the selected mode. The default input values of the FB_S_UPS_BAPI should be retained.

The 1-second UPS can be used only for a few seconds in the event of a power failure in order, to save persistent data. The data must be saved in the fast "persistent mode" "SPDM_2PASS", even though this can lead to real-time violations. Make sure you configure adequate router memory for saving the persistent data.

Irrespective of the mode and irrespective of whether data were saved or the quick shutdown was executed, the 1-second UPS switches off the mainboard after the discharging of the capacitors.

Function block modes

A QuickShutdown is performed automatically in the eSUPS_WrPersistData_Shutdown mode (standard setting) after the storage of the persistent data.

In the eSUPS_WrPersistData_NoShutdown mode only the persistent data are saved, no QuickShutdown is performed.

In eSUPS_ImmediateShutdown mode a quick shutdown is executed immediately, without saving data.

In the eSUPS_CheckPowerStatus mode only a check is performed as to whether a power failure has occurred. If this is the case, the function block only switches back to the PowerOK state after the expiry of tRecoverTime (10s).

Inputs

```
VAR_INPUT
    sNetID          : T_AmsNetId:= ''; (* '' = local netid *)
    iPLCPort        : UINT; (* PLC Runtime System for writing persistent data *)
    tTimeout        : TIME := DEFAULT_ADS_TIMEOUT; (* ADS Timeout *)
    eUpsMode        : E_S_UPS_Mode := eSUPS_WrPersistData_Shutdown; (* UPS mode (w/
wo writing persistent data, w/wo shutdown) *)
    ePersistentMode : E_PersistentMode := SPDM_2PASS; (* mode for writing persistent data *)
    tRecoverTime    : TIME := T#10s; (* ON time to recover from short power failure in mode eSUPS_Wr
PersistData_NoShutdown/eSUPS_CheckPowerStatus *)
END_VAR
```

Name	Type	Description
sNetID	T_AmsNetId	AmsNetID of the controller
iPLCPort	UINT	Port number of the PLC runtime system (851 for the first PLC runtime system, 852 for the second PLC runtime system, etc.). If you do not specify a port number, the function block then automatically determines the port of the PLC runtime system.
tTimeout	TIME	Timeout for writing the persistent data or the quick shutdown

Name	Type	Description
eUpsMode	E_S_UPS_Mode	Defines whether persistent data are to be written and whether a quick shutdown is to be executed. The default value is eSUPS_WrPersistData_Shutdown, i.e. a quick shutdown is executed automatically once the persistent data have been saved.
ePersistentMode	E_PersistentMode	Mode for writing the persistent data. Default value is SPDM_2PASS.
tRecoverTime	TIME	Time after which the UPS reverts to the PowerOK status in the event of UPS modes without shutdown. tRecoverTime must be somewhat longer than the maximum holding time of the UPS in order to ensure that the capacitors are fully charged.

Outputs

```
VAR_OUTPUT
    bPowerFailDetect  : BOOL; (* TRUE while powerfailure is detected *)
    eState            : E_S_UPS_State; (* current ups state *)
    nCapacity         : BYTE; (* actual capacity of UPS *)
    bBusy             : BOOL; (* TRUE: function block is busy *)
    bError            : BOOL; (* FALSE: function block has error *)
    nErrID            : UDINT; (* FB error ID *)
END_VAR
```

Name	Type	Description
bPowerFailDetect	BOOL	TRUE during power failure. FALSE if the supply voltage is present.
eState	E_S_UPS_State	Internal state of the function block
nCapacity	BYTE	Current charge state of the capacitors in percent (0..100%)
bBusy	BOOL	TRUE, as long as the function block is active.
bError	BOOL	FALSE if an error has occurred.
nErrID	UDINT	Error number

Requirements

Development environment	Target platform	PLC libraries to include
TwinCAT v3.1 B4020.32	Platforms that support the BIOS API from v1.15	Tc2_SUPS

8.4   Data types

E_S_UPS_Mode

With the mode selected in the function block you can specify what should happen in the case of a power failure.

```
eSUPS_WrPersistData_Shutdown: Writing of persistent data and then a QuickShutdown

eSUPS_WrPersistData_NoShutdown: Only writing of the persistent data (no QuickShutdown)

eSUPS_ImmediateShutdown: Only QuickShutdown (no writing of persistent data)

eSUPS_CheckPowerStatus: Only check status (neither writing of persistent data nor a QuickShutdown)
```

E_S_UPS_State

The internal state of the function block can be read with E_S_UPS_State.

```
eSUPS_PowerOK:
in all modes: Power supply is OK

eSUPS_PowerFailure:
```

```
in all modes: Power supply is faulty (only shown for one PLC cycle)

eSUPS_WritePersistentData:
in mode eSUPS_WrPersistData_Shutdown: Writing of persistent data is active
in mode eSUPS_WrPersistData_NoShutdown: Writing of persistent data is active

eSUPS_QuickShutdown:
in mode eSUPS_WrPersistData_Shutdown: QuickShutdown ist active
in Mode eSUPS_ImmediateShutdown: QuickShutdown is active

eSUPS_WaitForRecover:
in mode eSUPS_WrPersistData_NoShutdown: Wait for the reestablishment of the power supply
in mode eSUPS_CheckPowerStatus: Wait for the reestablishment of the power supply

eSUPS_WaitForPowerOFF:
in mode eSUPS_WrPersistData_Shutdown: Wait for switching off of the PC by the UPS
in mode eSUPS_ImmediateShutdown: Wait for switching off of the PC by the UPS
```
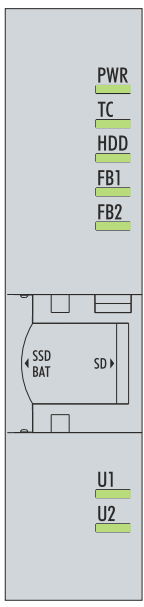
8.5   Checking the validity of the variables

For TwinCAT 2 the implicit structure Systeminfotype.bootDataFlags can be read in order to determine the validity of the persistent data (see: SYSTEMINFOTYPE).

For TwinCAT 3 the implicit variables PlcAppSystemInfo.BootDataLoaded and PlcAppSystemInfo.OldBootData are available for determining the validity of the persistent data (see: PlcAppSystemInfo).

9 Error handling and diagnostics

9.1 Diagnostic LEDs

Display	LED	Meaning
	PWR	Power supply The power LED lights green if the device is connected to a power supply unit and the unit is switched on. Die SUPS is active (violet). Bootloader is started and runs without errors (the colors red and yellow light up for one second).
	TC	TwinCAT status LEDs TwinCAT is in Run Mode (green) TwinCAT is in Stop Mode (red) TwinCAT is in Config Mode (blue) Error or crash of the PLC (yellow). Applies only to TwinCAT 3
	HDD	Read/Write storage medium (red) Indicates an access to the storage medium.
	FB1	Status LED1 for fieldbus (function is described in the fieldbus interface)
	FB2	Status LED2 for fieldbus (function is described in the fieldbus interface)
	U1	2 x user LED for free use. The RGB LEDs are switched by the function block FB_SetLedColorEx_BAPI. Use the user LEDs, for example, to make the states of the PLC program, communication or other indications externally visible.
	U2	

9.1.1 K-bus

The power supply unit checks the connected Bus Terminals for errors. The red LED "K-bus ERR" is off if no error is present. The red LED "K-bus ERR" flashes if Bus Terminal errors are present.

Table 30: Diagnostic LEDs in K-Bus mode.

Display	LED	Meaning
	Us 24 V	Power supply for basic CPU module. The LED lights green if the power supply is correct.
	Up 24V	Power supply for terminal bus. The LED lights green if the power supply is correct.
	K-BUS RUN	Diagnostic K-bus. The green LED lights up in order to indicate fault-free operation. "Error-free" means that the communication with the fieldbus system is also running.
	K-BUS ERR	Diagnostic K-bus. The red LED flashes to indicate an error. The red LED blinks with two different frequencies.

The frequency and number of the flashes can be used to determine the error code and the error argument. An error is indicated by the "K-bus ERR" LED in a particular order.

Table 31: K-bus ERR LED, fault indication sequence through the LED.

Order	Meaning
Fast blinking	Starting the sequence
First slow sequence	**Error code**
No display	Pause, the LED is off
Second slow sequence	**Error code argument**

Count how often the red LED K-bus ERR flashes, in order to determine the error code and the error argument. In the error argument the number of pulses shows the position of the last Bus Terminal before the error. Passive Bus Terminals, such as a power feed terminal, are not included in the count.

Table 32: K-BUS ERR LED, fault description and troubleshooting.

Error code	Error code argument	Description	Remedy
Persistent, continuous flashing		EMC problems.	• Check power supply for undervoltage or overvoltage peaks. • Implement EMC measures. • If a K-bus error is present, it can be localized by a restart of the power supply (by switching it off and then on again)
3 pulses	0	K-bus command error.	• No Bus Terminal inserted. • One of the Bus Terminals is defective; halve the number of Bus Terminals attached and check whether the error is still present with the remaining Bus Terminals. Repeat this procedure until the faulty Bus Terminal has been found.
4 pulses	0	K-bus data error, break behind the power supply unit.	Check whether the Bus End Terminal 9010 is connected.
	n	Break behind Bus Terminal n	Check whether Bus Terminal n+1 after the power supply unit is connected correctly; replace if necessary.
5 pulses	n	K-bus error in register communication with Bus Terminal n.	Replace Bus Terminal at location n.
6 pulses	0	Error at initialization.	Replace Embedded PC.
	1	Internal data error.	Hardware reset of the Embedded PC (switch off and back on again).
	8	Internal data error.	Hardware reset of the Embedded PC (switch off and back on again).
7 pulses	0	Process data lengths of the set and actual configurations do not correspond.	Check the configuration and the Bus Terminals for consistency.

For some error the LED "K-BUS ERR" does not go out, even if the error was rectified. Switch the power supply for the power supply unit off and back on again to switch off the LED after the error has been rectified.

State variable

In TwinCAT there is a State variable under the Bus Coupler for K-bus diagnostics.
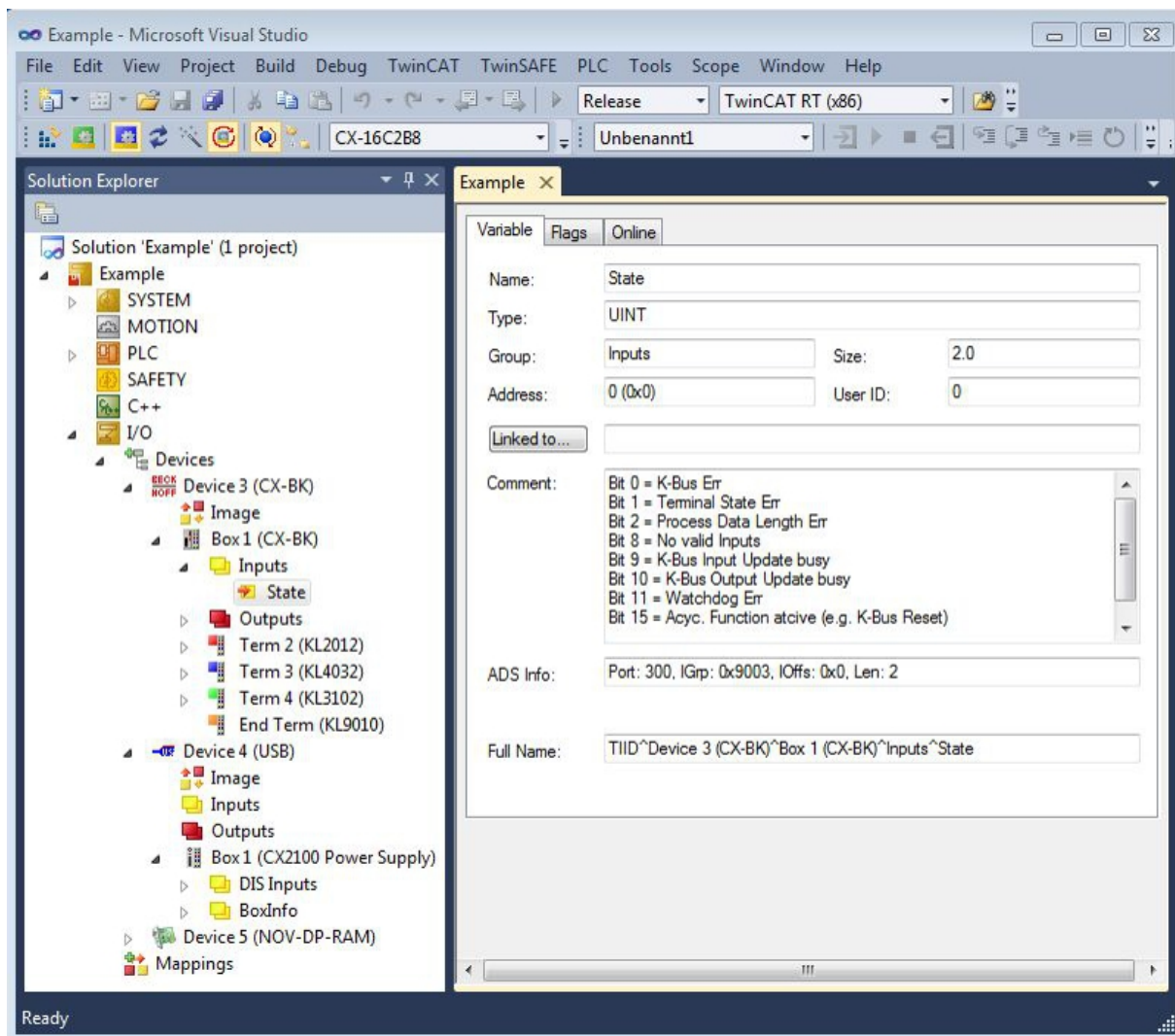
Fig. 36: Status variable for error handling and diagnostics under TwinCAT.

If the value is "0", the K-bus operates synchronous and without error. If the value is <> "0" there may be a fault, or it may only be an indication that the K-bus cycle is longer than the task. In which case it would no longer be synchronous with the task. The task time should be faster than 100 ms. We recommend a task time of less than 50 ms. The K-bus update time typically lies between one and five ms.

Table 33: Description of the State variable values.

Bit	Description
Bit 0	K-bus error.
Bit 1	Terminal configuration has changed since the start.
Bit 2	Process image lengths do not match.
Bit 8	(still) no valid inputs.
Bit 9	K-bus input update not yet complete.
Bit 10	K-bus output update not yet complete.
Bit 11	Watchdog.
Bit 15	Acyclic K-bus function active (e.g. K-bus reset).

If there is a K-bus error, this can be reset via the IOF_DeviceReset function block (in the TcIoFunctions.lib).

9.1.2   E-bus

The power supply unit checks the connected EtherCAT Terminals. The "L/A" LED is lit in E-bus mode. The "L/A" LED flashes during data transfer.

Table 34: Diagnostic LEDs in K-Bus mode.

Display	LED		Meaning
Us 24 V [display] Up 24 V L/A	Us 24 V		Power supply for basic CPU module. The LED lights green if the power supply is correct.
	Up 24 V		Power supply for terminal bus. The LED lights green if the power supply is correct.
	L / A	off	E-bus not connected.
		on	E-bus connected / no data traffic.
		flashes	E-bus connected / data traffic on the E-bus.

9.2 Faults

Possible faults and their correction

Fault	Cause	Measures
no function after the embedded PC has been switched on	No power supply to the embedded PC Other cause	Check fuse Check the supply voltage and the pin assignment Call Beckhoff Service
Embedded PC does not boot fully	Data carrier ejected from card slot File system damaged (e.g. by switching off while software is running) BIOS setup settings incorrect (does not apply to every model) Other cause	Check the position of the data carrier in the card slot Restart system, import backup Check BIOS setup settings (load defaults) Call Beckhoff Service
Embedded PC boots, software starts, but controller does not work properly	Cause of the fault is either in the software or in parts of the plant outside the embedded PC	Call the machine and software manufacturer

Please make a note of the following information **before** contacting Beckhoff service or support:

1. Precise device ID: CXxxxx-xxxx
2. Serial number/BTN
3. Hardware version
4. any interfaces (N030, N031, B110, ...)
5. TwinCAT version used
6. Any components / software used

The quickest response will come from support / service in your country. Therefore please contact your regional contact. For details please refer to our website at https://www.beckhoff.com or ask your distribution partner.

10 Care and maintenance

NOTICE
Use of incorrect spare parts
The use of spare parts not ordered from Beckhoff Service can lead to unsafe and faulty operation.
• Only use spare parts that you have ordered from Beckhoff Service.

Beckhoff industrial PCs are manufactured from components of the highest quality and robustness. They are selected and tested for best interoperability, long-term availability and reliable function under the specified environmental conditions.

Nevertheless, some components of the industrial PC may be subject to a limited service life if they are operated under certain conditions, such as more demanding ambient conditions during operation or during storage, or if they are out of service for long periods of storage.

Beckhoff therefore recommends replacing some of the industrial PC components after the time after which predictions of the remaining service life of such components can no longer be reliably calculated.

Depending on the device used, the following components are involved:

- Battery
- Storage medium
- Fan cartridge

The following table provides recommendations for the regular, precautionary replacement of the PC components:

Table 35: Replacement recommendations for PC components

Component	Recommendation for replacement intervals (years)
UPS, battery pack	5 years
2.5-inch hard disk	5 years or after 20,000 operating hours at more than 40 °C or after 30,000 operating hours at less than 40 °C
Fan	5 years
CFast, SSD, MicroSD, CompactFlash®	10 years
Motherboard battery	5 years

Beckhoff is excluded from liability in the event of possible damage occurring during maintenance work. Before working on the device, you should have established ESD protection to prevent damage to the device through electrostatic discharge.

ESD protection

NOTICE
Electrostatic discharge
The replacement of device components without ESD protection can lead to functional impairment and destruction of the device.
• If possible, apply ESD protection measures during maintenance work.

When working on electronic devices, there is a risk of damage due to ESD (electrostatic discharge), which can impair the function or destroy the device.

Protect the industrial PC and create an ESD-protected environment in which any electrostatic charges are discharged to the ground in a controlled manner and charging is prevented.

An ESD-protected environment can best be created by setting up ESD protection zones. The following measures serve this purpose:

- ESD-compliant floors with sufficient conductivity to the reference potential PE;

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- ESD-compatible work surfaces such as tables and shelves;

- Wrist grounding strap, especially for sedentary activities;

- grounded and electrostatically dissipating equipment and operating materials (e.g. tools) within the ESD protection zone.

If it is not possible to create an ESD protection zone, you can still protect the device against ESD damage. For example, the following measures can be used:

- Use conductive mats connected to the ground potential as underlays.

- Dissipate possible charges from your own body by touching grounded metal (e.g. control cabinet door).

- Wear a wrist grounding strap.

- Only remove new electronic components from the ESD packaging (tinted plastic bag) after putting on the wrist grounding strap.

- Do not walk around with electronic components in your hand if they are not in ESD packaging.

10.1   Replace the battery

NOTICE
Fire and explosion hazard
There is a risk of fire and explosion if the battery is short-circuited.
• Use insulated, non-conductive tools if you cannot grip the battery with your fingers and ensure correct polarity when changing the battery.

The battery must be replaced every 5 years. Replace the battery with a CR2032 battery (3 V, 225 mAh). The battery compartment is below the front flap.

The battery powers the built-in clock and thus buffers the time and date. The time and date are displayed incorrectly if the battery is empty or the battery is removed. Be aware of this behavior for your hardware and software configuration and reset the time and date in the BIOS after a battery change. If the operating system receives the time from an NTP server, the time and date can be set via the operating system.

Requirements:

- The embedded PC is switched off.

Replace the battery as follows:

1. Open the front flap with a spatula or screwdriver.
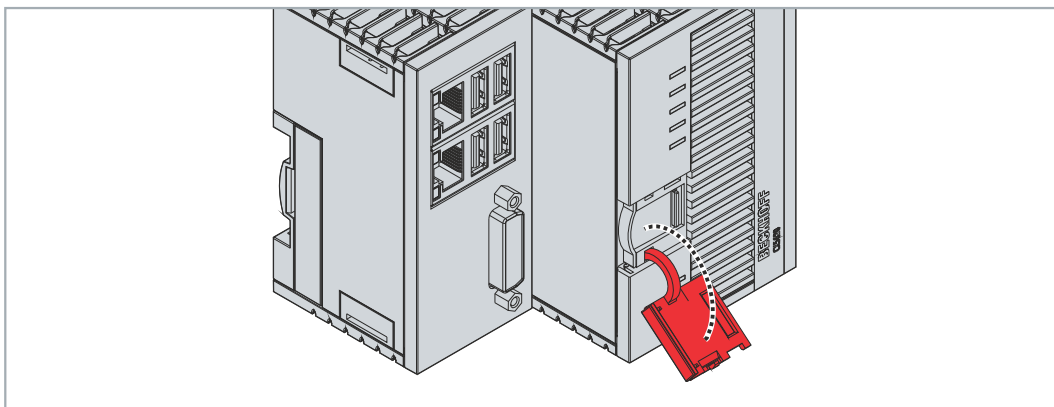
2. Push the side flap to the left.
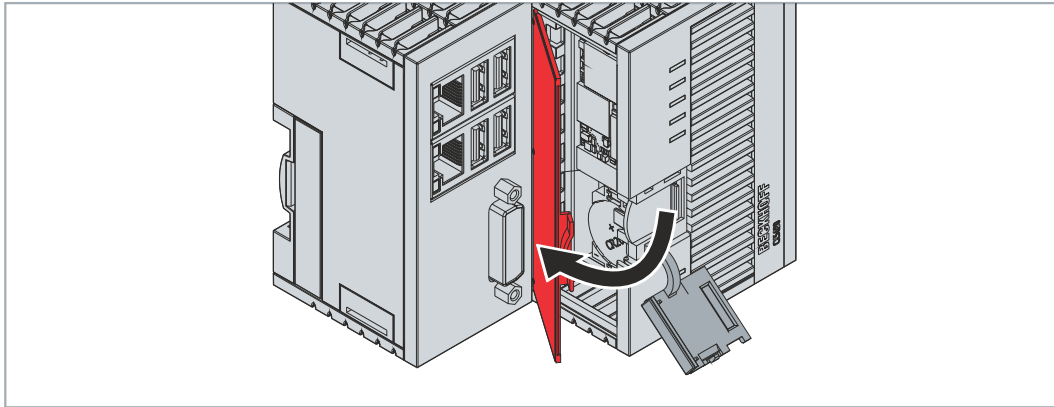
3. Carefully lever the battery out of the bracket with a plastic spatula.
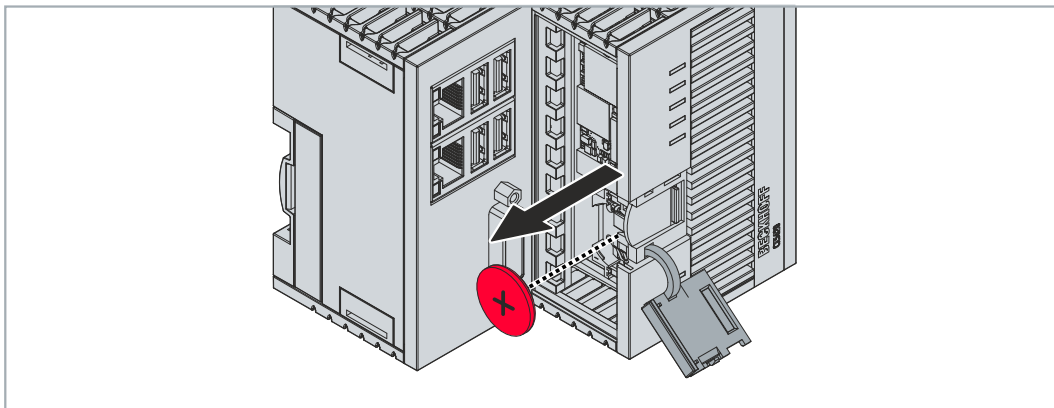
4. Push the new battery into the battery compartment. The positive pole points to the left towards the DVI interface.

⇨ The battery change is complete. Close the side and front flaps and reset the date and time in the BIOS. To dispose of the battery, remove it, stick insulating tape over the poles and take it to the local battery recycling.

10.2 Cleaning the Embedded PC

⚠ **CAUTION**

Risk of electric shock

Live devices or parts can cause electric shocks. Disconnect the embedded PC from the power supply before cleaning.

Clean only the housing of the embedded PC. Use a soft, moist cleaning cloth for this. Make sure that the ventilation slots of the device are always free and do not clog up. Only use a vacuum cleaner to clean the device. Never use compressed air to clean the embedded PC.

The following cleaning agents and materials are unsuitable and may cause damage:

- corrosive cleaning agents
- solvents
- scouring agents
- hard objects

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11 Decommissioning

11.1 Removing cables

NOTICE
Electrical voltage
If the power supply is switched on during dismounting, this can lead to damage to the Embedded PCs. Switch off the power supply for the Embedded PCs during dismounting.

Before dismantling the Embedded PC, shut down the Embedded PC and switch off the power supply. Only then can you remove all the cables. Also remove all cables from the first terminal after the power supply terminal.

Requirements:

- Terminate your software and shut down the Embedded PC.
- Switch off the power supply.

Remove the cables as follows:

1. Remove the cabling from the Embedded PC.
2. Remove the wiring from the first terminal next to the power supply terminal.
3. Pull the orange strap to remove the first terminal after the power supply terminal by pulling it forward.
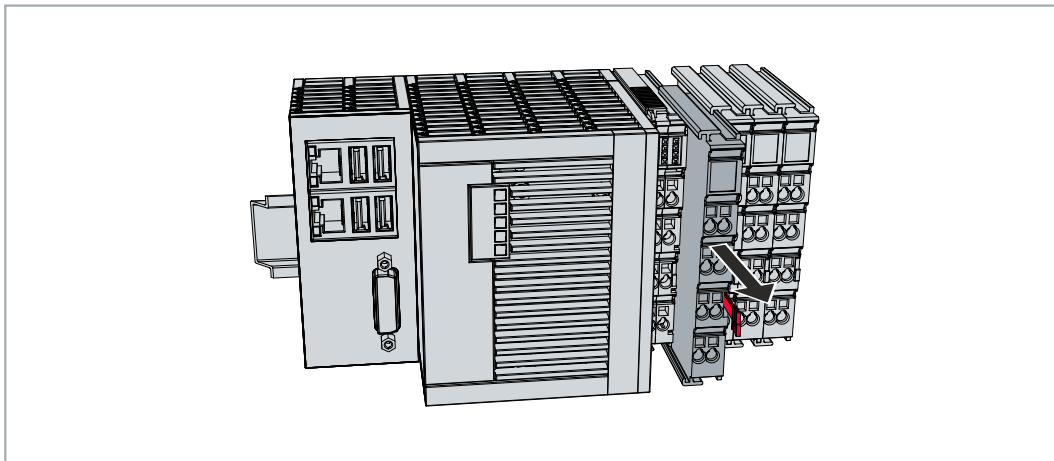
⇨ In the next step the Embedded PC can be removed from the DIN rail and dismantled.
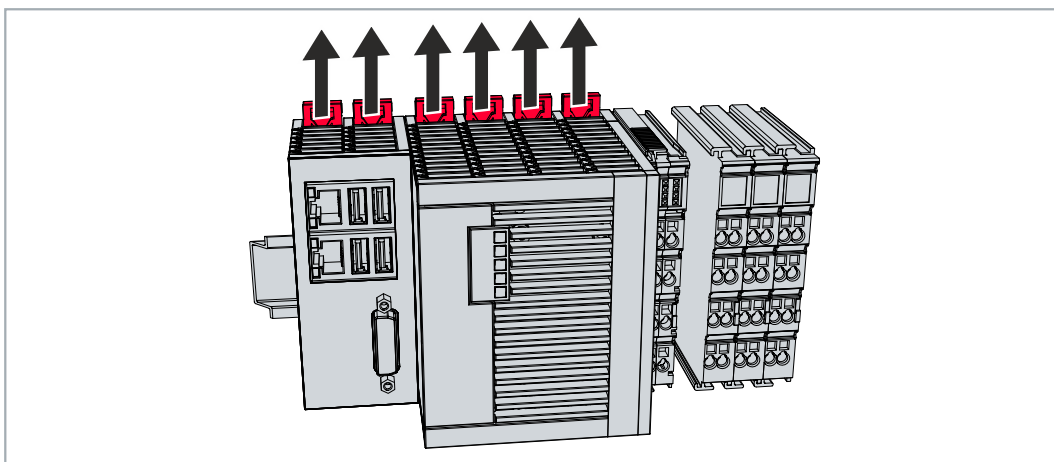
11.2 Dismantling the Embedded PC

This chapter explains how to dismantle the Embedded PC and remove it from the DIN rail.

Requirements:

- All cables were removed from the Embedded PC.

Dismantle the Embedded PC as follows:

1. Release the DIN rail mounting by pushing the latches outwards with a screwdriver.
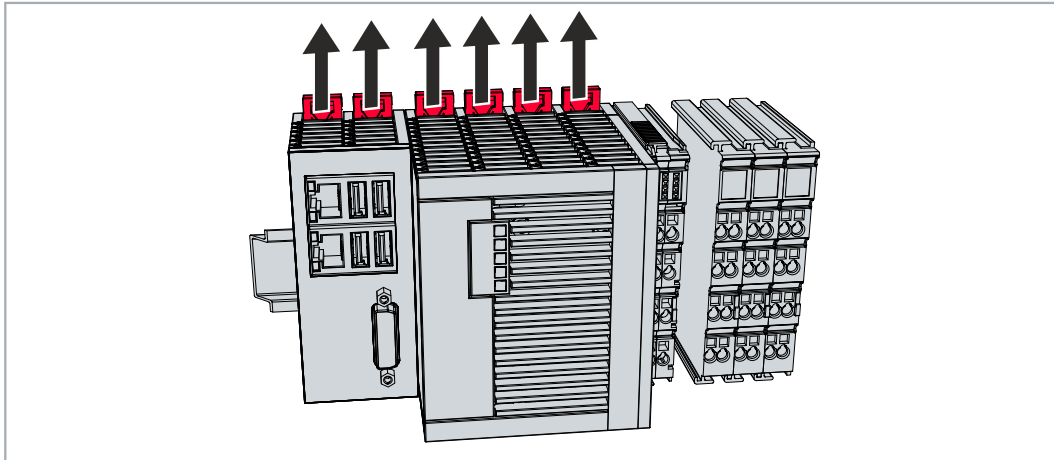
2. Pull the orange strap on the power supply terminal and gently remove the device from the DIN rail.
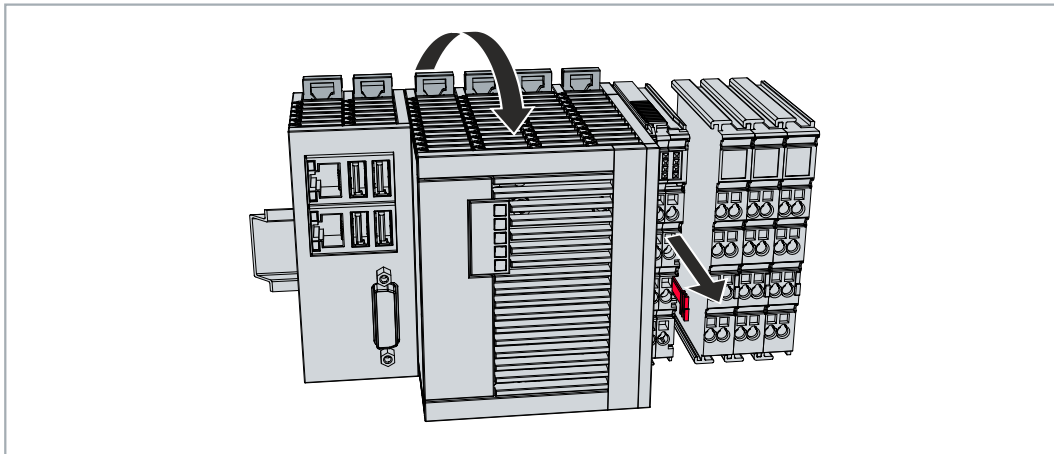
⇨ You have removed the Embedded PC successfully.

Disposal

The device must be fully dismantled in order to dispose of it. Electronic components must be disposed of according to national electronic waste regulations.

12 Technical data

Table 36: Technical data, dimensions and weights.

	CX5620	CX5630
Dimensions (W x H x D)	124 mm x 100 mm x 92 mm	142 mm x 100 mm x 92 mm
Weight	approx. 860 g	approx. 960 g

Table 37: Technical data, general data.

Technical data	CX5620	CX5630
Processor	AMD Ryzen™ R1102G, 1.2 GHz	AMD Ryzen™ R1505G, 2.0 GHz
Number of cores	2	2
Main memory	4 GB DDR4-RAM	8 GB DDR4-RAM
Flash memory	M.2 SSD (SATA) and microSD card (storage media not included)	
1-second UPS	integrated (1 MB on M.2 SSD)	
Power supply	24 V DC (-15 %/+20 %)	
Max. power consumption	10 W	20 W
Max. power consumption (with UPS charging)	17 W	27 W
Max. power consumption E-bus/K-bus	10 W (5 V/max. 2 A)	
Dielectric strength	500 V (supply / internal electronics)	
Operating system	Windows 10 IoT Enterprise 2019 LTSC, Windows 10 IoT Enterprise 2021 LTSC, TwinCAT/BSD	
Control software	TwinCAT-2-Runtime, TwinCAT-3-Runtime (XAR	
Secure element	fTPM 2.0 (UEFI BIOS and 64-bit Windows 10 version 1809 or higher required)	
Diagnostic LED	1 x power, 1 x TC status, 1 x flash access, 2 x bus status, 2 x user LED	
Clock	Internal battery-backed clock for time and date (battery replaceable)	
Approvals	CE, UL	

Table 38: Technical data, I/O terminals.

Technical data	Description
I/O connection	via power supply terminal (E-bus or K-bus, automatic recognition)
Power supply for I/O terminals	max. 2 A
Power contacts current load	max. 10 A
Process data on the K-bus	max. 2048 bytes input and 2048 bytes output
max. number of terminals (K-bus)	64 (255 with K-bus extension)
max. number of terminals (E-bus)	up to 65534 terminals.

Table 39: Technical data, environmental conditions.

Technical data	Description
Ambient temperature during operation	-25° C ... +60 °C
Ambient temperature during storage	-40° C ... +85° C see notes under: Transport and storage [▶ 10]
Relative humidity	95 % no condensation

Technical data	Description
Vibration resistance	10 frequency sweeps, in 3-axis 10 Hz < f < 58.1 Hz displacement 0.15 mm, constant amplitude 58.1 Hz < f < 500 Hz acceleration 2 g (~ 20 m/s^2), constant amplitude conforms to EN 60068-2-6
Shock resistance	1000 shocks in each direction, in 3 axes 15 g, 11 ms conforms to EN 60068-2-27
EMC immunity	conforms to EN 61000-6-2
EMC emission	conforms to EN 61000-6-4
Protection rating	IP20

Table 40: Technical data, graphic specifications.

Technical data	CX5620	CX5630
Processor graphics	AMD Radeon Vega 3 Graphics	
Shader model	6.7	
DirectX	12	
OpenGL	4.6	

Table 41: Technical data, interfaces.

Technical data	Description
LAN	2 x RJ 45, 10/100/1000 Mbit/s
USB	4 x USB 3.0 each rated at 900 mA, type A
DVI-D	Resolution on the monitor in pixels: 640 x 480 to 1920 x 1200

Table 42: Technical data, optional interfaces.

Technical data	Description
DVI-D	Resolution on the monitor in pixels: 640 x 480 to 1920 x 1200
DisplayPort	Resolution on the monitor in pixels: max. 2560x1600
Audio interface	3 x 3.5 mm jack sockets, Line In, Mic In, Line Out or 5.1 Surround
RS232	D-sub connector, 9-pin Electrical isolation 500 V
RS422/RS485	D-sub connector, 9-pin Electrical isolation 500 V
EtherCAT slave	2 x RJ 45, EtherCAT IN and OUT 100 Mbaud
PROFIBUS	D-sub connector, 9-pin 9.6 kbaud to 12 Mbaud
CANopen	D-sub connector, 9-pin 10 kbaud to 1,000 kbaud
PROFINET RT	2 x RJ-45 switches

13 Appendix

13.1 Accessories

Table 43: microSD cards.

Order number	Description
CX1900-0122	512 MB microSD card
CX1900-0132	16 GB microSD card

Table 44: M.2-2242-SSD.

Order number	Description
CX2900-0506	40 GB M.2-2242-SSD, 3D Flash, extended temperature range
CX2900-0507	80 GB M.2-2242-SSD, 3D Flash, extended temperature range
CX2900-0508	160 GB M.2-2242-SSD, 3D Flash, extended temperature range
CX2900-0509	320 GB M.2-2242-SSD, 3D Flash, extended temperature range

Table 45: Further spare parts.

Order number	Description
CX2900-0101	Housing locking clips (black) for CX52x0, CX53x0, CX56x0, and CX20xx. 10 locking sets of two clips each.
CX2900-0102	Cover for left-side bus connector, 5 pieces
CX2900-0108	Logo strips for CX5xxx, transparent for individual labeling, package contents: 20 pieces

13.2 Certifications

FCC Approvals for the United States of America

FCC: Federal Communications Commission Radio Frequency Interference Statement

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

FCC Approval for Canada

FCC: Canadian Notice

This equipment does not exceed the Class A limits for radiated emissions as described in the Radio Interference Regulations of the Canadian Department of Communications.

13.3 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.

Download finder

Our download finder contains all the files that we offer you for downloading. You will find application reports, technical documentation, technical drawings, configuration files and much more.

The downloads are available in various formats.

Beckhoff's branch offices and representatives

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

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

You will also find further documentation for Beckhoff components there.

Beckhoff Support

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

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

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e-mail: support@beckhoff.com

Beckhoff Service

The Beckhoff Service Center supports you in all matters of after-sales service:

- on-site service
- repair service
- spare parts service
- hotline service

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List of tables

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List of figures

More Information:
www.beckhoff.en/CX5600