BECKHOFF New Automation Technology

Manual | EN

CX8200

Embedded PC with Arm® Cortex®-A53 processor

2024-12-16 | Version: 1.0

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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.
For installation and commissioning of the components, it is absolutely necessary to comply with the documentation and the following notes and explanations.
The qualified personnel is always obliged to use the currently valid documentation.

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

Disclaimer

The documentation has been prepared with care. The products described are, however, constantly under development.
We reserve the right to revise and change the documentation at any time and without notice.
No claims to modify products that have already been supplied may be made on the basis of the data, diagrams, and descriptions in this documentation.

Trademarks

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Patents

The EtherCAT Technology is covered by the following patent applications and patents, without this constituting an exhaustive list:
EP1590927, EP1789857, EP1456722, EP2137893, DE102015105702
and similar applications and registrations in several other countries.

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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	Comment
1.0	First version.

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 CX8200 Embedded PC.

	CX8200
Dimensions (W x H x D)	71 mm x 100 mm x 73 mm
Weight	approx. 220 g

Storage

- Store the Embedded PC in the original packaging.

4 Product overview

The CX8200 Embedded PC series is a further development of the existing CX8100 series and combines higher computing power in a compact format. The CX8200 Embedded PC has an Arm® Cortex® A53 dual core processor with 1.2 GHz.

The CX8200 Embedded PC has the following basic configuration:

- a 1 Gbit Ethernet interface
- a USB 3.0 interface
- a 1 GB LPDDR4 RAM
- and a slot for a microSD card

The microSD card is not included in the scope of delivery and must be ordered according to the desired storage capacity.

Beckhoff RT Linux® is used as the operating system. As there is no monitor port, the operating system can only be accessed remotely via the network. The Beckhoff Device Manager is also available.

The embedded PC features an internal 1-second UPS as persistent data memory. The 1-second UPS enables persistent data to be saved to the microSD card in the event of a power failure.

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).

The use of EtherCAT Terminals (E-bus) enables further options, such as the implementation of different topologies, the integration of further bus systems such as CANopen, PROFIBUS and PROFINET and – with the EtherCAT Box modules – connection to the IP67 world.

Fieldbus interface

CX8200 devices are being prepared for further fieldbus systems such as EtherCAT (slave), PROFINET, EtherNet/IP, CANopen, PROFIBUS and other communication systems.

Programming

The CX8200 Embedded PC is programmable and is able to execute its own control program. The CX8200 Embedded PCs are programmed according to the powerful IEC 61131-3 standard. TwinCAT 3 automation software forms the basis for programming the embedded PC.

The CX8200 Embedded PC is commissioned via the Ethernet interface. The fieldbus interface and all connected devices such as EtherCAT Terminals or bus terminals are then read out via TwinCAT 3. The configuration is stored on the embedded PC after the parameterization. This created configuration can also be read out again.

4.1 Structure

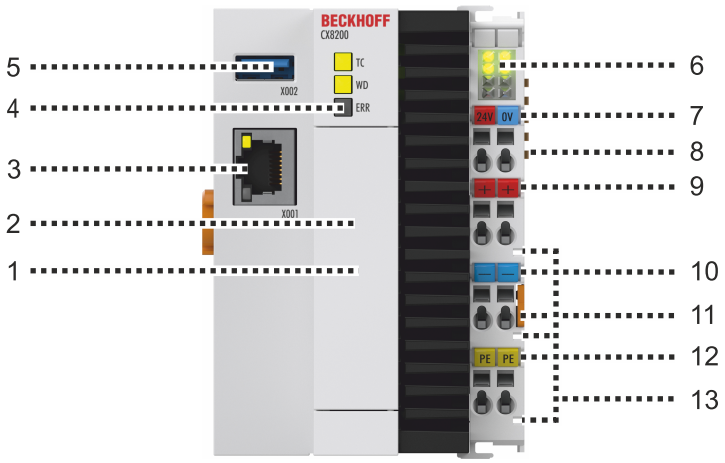


Fig. 1: Sample configuration of a CX Name Embedded PC.

Table 2: Legend for the configuration of the basic CPU module.

No.	Component	Description
1	Reset button (under the front flap)	This switches the embedded PC to Config mode.
2	MicroSD card slot (under the front flap)	Slot for industrial microSD cards.
3	Ethernet interface (X001)	For the connection to local networks. Serves as a programming interface.
4	USB 3.0 interface (X002)	Interface for additional USB data memory and for connecting wireless and mobile phone components.
5	I/O status LEDs	Diagnosis of the power supply for the embedded PC and the terminal bus. Status of the E-bus or K-bus communication and multi-function I/Os.
6	Diagnostic LEDs	1 x TC status, 1 x PN, 1 x DG.
7	Spring-loaded terminals, +24 V and 0 V	Power supply for embedded PC.
8	Terminal bus (K-bus or E-bus)	Interface for EtherCAT Terminals or bus terminals. Data exchange and supply.
9	Spring-loaded terminal, +24 V	Power supply for bus terminals via power contact.
10	Spring-loaded terminal, 0 V	Power supply for bus terminals via power contact.
11	Terminal release	Releases the power supply terminal and thus the embedded PC from the DIN rail.
12	Spring-loaded terminal, PE	Spring-loaded terminal for power contact PE.
13	Power contacts, +24 V, 0 V, PE	Power contacts for bus terminals.

4.2 Name plate

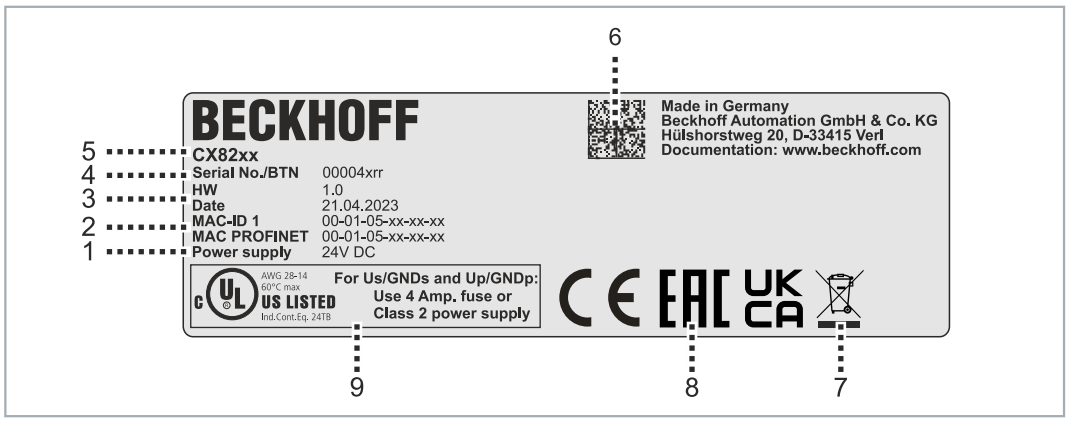


Fig. 2: Name plate example.

Table 3: Information on the name plate.

No.	Description
1	Power supply 24 V DC.
2	MAC addresses of the built-in Ethernet and PROFINET interface.
3	Hardware version and date of manufacture.
4	Serial number/Beckhoff Traceability Number (BTN) for the unambiguous identification of the product. The host name is formed based on BTN and the serial number/Beckhoff Traceability Number (BTN). Example: the BTN 00004xrr results in the host name **BTN-00004xrr**.
5	Product designation for identification of the embedded PC.
6	Machine-readable information in the form of a Data Matrix Code (DMC, code scheme ECC200) that can be used for better identification and management.
7	Marking for garbage disposal. Do not dispose of this product with household waste.
8	CE, EAC and UKCA marking.
9	UL marking with prescribed information on power supply, fuse, temperature, and cable cross-sections.

4.3 Ethernet interfaces

You can program and commission the CX8200 Embedded PC via the Ethernet interface X001. The Ethernet interface achieves speeds of 10/100/1000 Mbit/s.

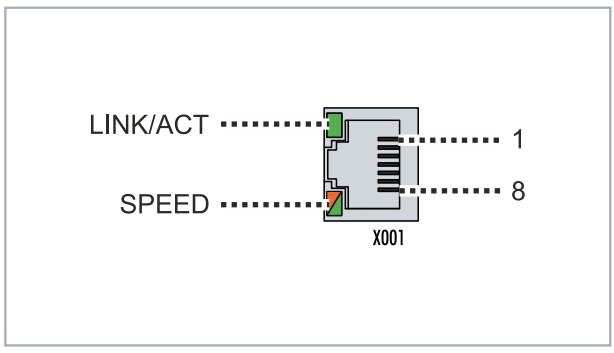


Fig. 3: Ethernet interface X001.

The LEDs on the left of the interface indicate the connection status. The upper 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 transfer is underway on the interface.

The lower LED (SPEED) indicates the connection speed. At a speed of 10 Mbit/s, the LED does not light up. At a speed of 100 Mbit/s, the LED lights up green. At 1000 Mbit/s (Gigabit), the LED lights up orange.

Table 4: Ethernet interface X001, 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		

Transmission standards

10Base5

The transmission medium for 10Base5 consists of a thick coaxial cable ("yellow cable") with a max. data transfer rate of 10 Mbaud arranged in a line topology with branches (drops) each of which is connected to one network device. Because all the devices are in this case connected to a common transmission medium, it is inevitable that collisions occur often in 10Base5.

10Base2

10Base2 (Cheaper net) is a further development of 10Base5, and has the advantage that the coaxial cable is cheaper and, being more flexible, is easier to lay. It is possible for several devices to be connected to one 10Base2 cable. It is frequent for branches from a 10Base5 backbone to be implemented in 10Base2.

10BaseT

Describes a twisted pair cable for 10 Mbaud. The network here is constructed as a star. It is no longer the case that every device is attached to the same medium. This means that a broken cable no longer results in failure of the entire network. The use of switches as star couplers enables collisions to be reduced. Using full-duplex connections they can even be entirely avoided.

100BaseT

Twisted pair cable for 100 Mbaud. It is necessary to use a higher cable quality and to employ appropriate hubs or switches in order to achieve the higher data rate.

10BaseF

The 10BaseF standard describes several optical fiber versions.

Short description of the 10BaseT and 100BaseT cable types

Twisted-pair copper cable for star topologies, where the distance between two devices may not exceed 100 meters.

UTP

Unshielded twisted-pair
This type of cable belongs to category 3, and is not recommended for use in an industrial environment.

S/UTP

Screened/unshielded twisted-pair (shielded with copper braid)
Has an overall shield of copper braid to reduce influence of external interference. This cable is recommended for use with Bus Couplers.

FTP

Foiled shielded twisted-pair (shielded with aluminum foil)
This cable has an outer shield of laminated aluminum and plastic foil.

S/FTP

Screened/foiled shielded twisted-pair (shielded with copper braid and aluminum foil)
Has a laminated aluminum shield with a copper braid on top. Such cables can provide up to 70 dB reduction in interference power.

STP

Shielded twisted-pair
Describes a cable with overall shielding without further specification of the type of shielding.

S/STP

Screened/shielded twisted-pair (wires are individually shielded)
This identification refers to a cable with a shield for each of the two wires as well as an outer shield.

ITP

Industrial Twisted-Pair
The structure is similar to that of S/STP, but, in contrast to S/STP, it has only two pairs of conductors.

4.4 USB 3.0 interface X002

The embedded PC has a USB 3.0 interface that can be used to connect wireless and mobile phone components or other USB storage media.

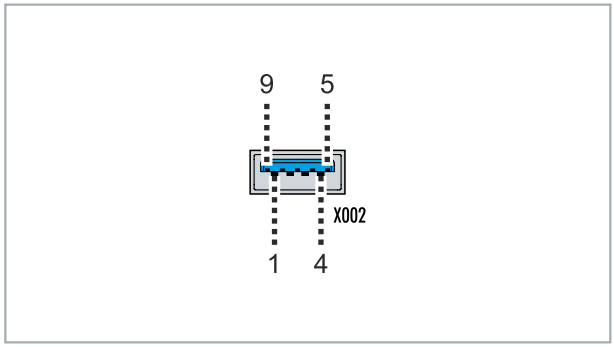


Fig. 4: USB interface X002.

The USB interface is of type A and complies with the USB 3.0 specification.

Table 5: USB interface X002, 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

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

4.5 MicroSD card

The basic version of the CX8200 does not include a microSD card. Only use microSD cards approved by Beckhoff for industrial applications.

Order identifier	Capacity	Description
CX1900-0132	16 GB	microSD card (SLC memory) with extended temperature range for industrial applications as spare part.

4.6 Reset button

Use the Reset button to activate Config mode. You can use this function if the PLC program unexpectedly causes an error. To do this, keep the Reset button pressed during the restart for an extended period.

Activate Config mode as follows:

1. Open the front flap.
2. Switch off the Embedded PC.
3. Start the Embedded PC and keep the Reset button pressed until the ERR LED turns red and then yellow.

⇨ The CX81xx Embedded PC is put into Config mode.

5 Commissioning

5.1 Mounting

All dimensions are in mm.

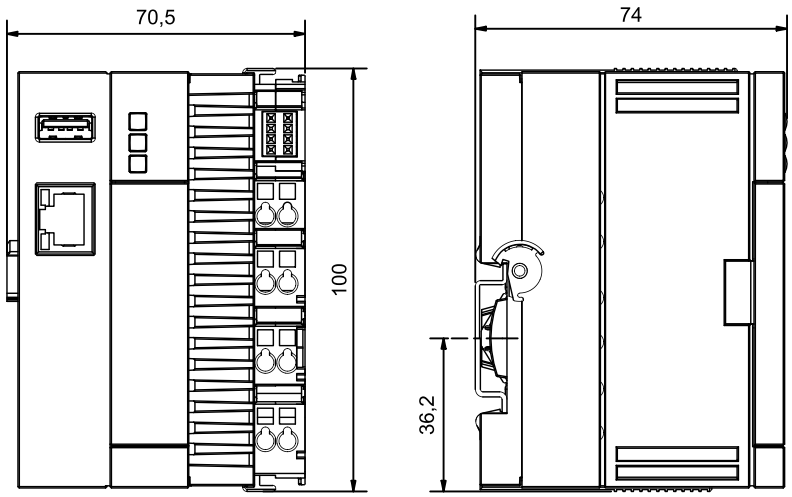


Fig. 5: CX82xx Embedded PC, dimensions.

5.1.1 Note the 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.

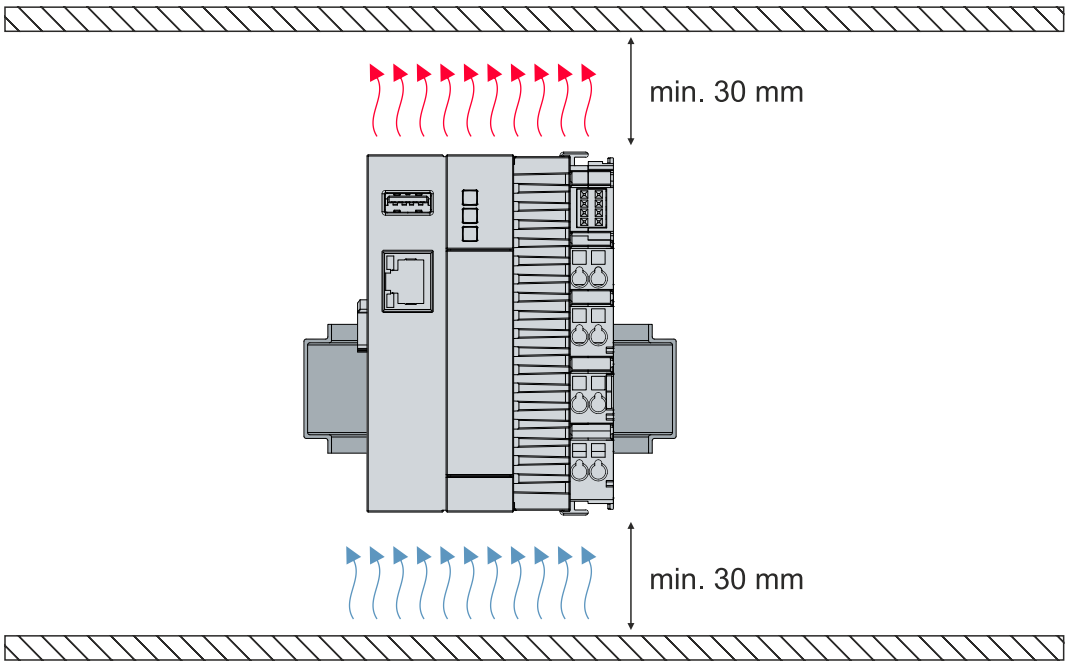


Fig. 6: CX82xx Embedded PC, permissible installation position.

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.

5.1.2 Fastening to the DIN rail

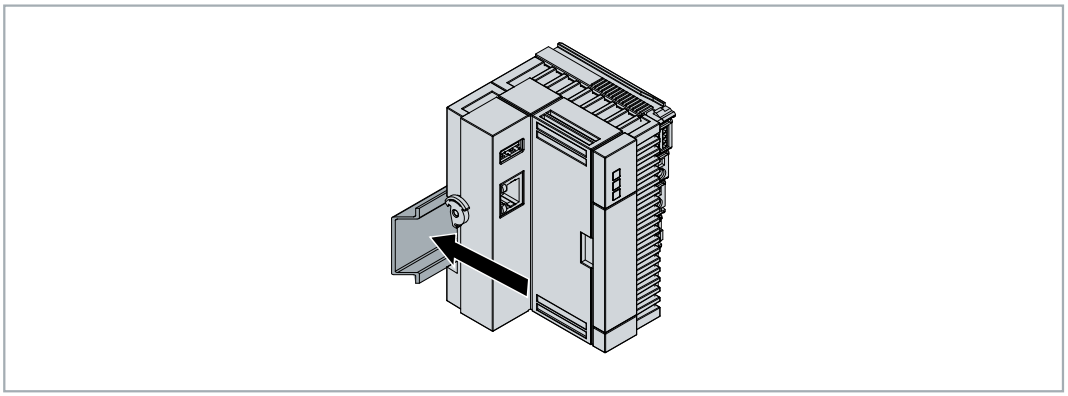
The housing is designed such that the embedded PC can be pushed against the DIN rail and latched onto it.

Requirements:

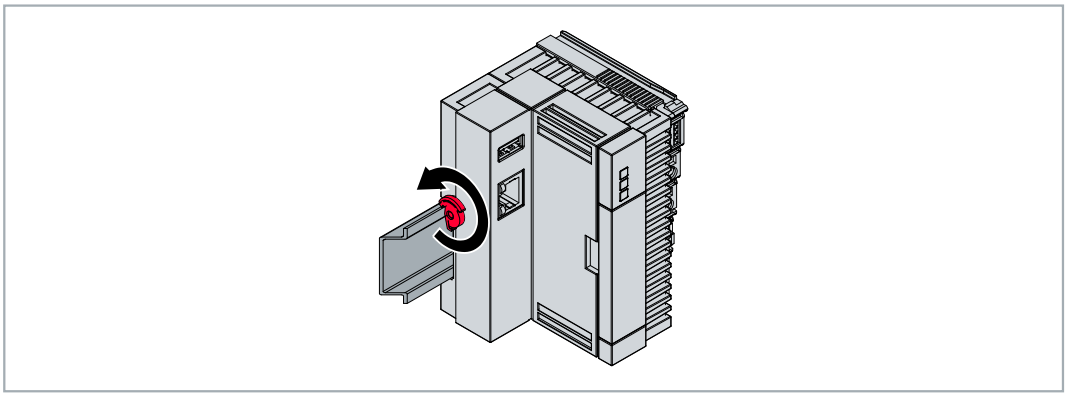
- DIN rail of the type TS35/7.5 or TS35/15 according to EN 60715.

Fasten the embedded PC to the DIN rail as follows:

1. 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.



2. Subsequently, lock the catch on the left side of the embedded PC.
3. Turn the latch counter clockwise until the latch quietly clicks and engages.



⇨ 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.

5.1.3 Changing the MicroSD card

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 an industrially compatible microSD card. The firmware of the embedded PC is stored on the microSD card. If necessary, the microSD card can be written to from TwinCAT 3, allowing user-defined data to be stored.

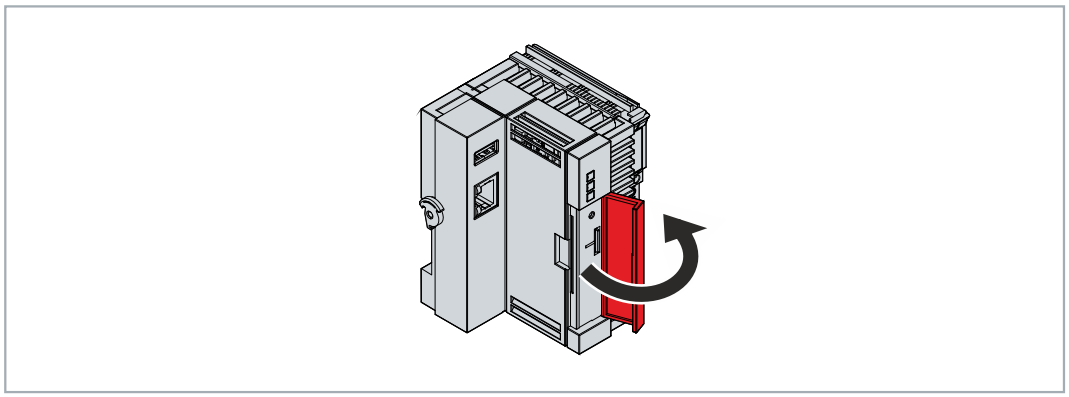
The eject mechanism is based on the push/push principle. Below, we show you how to change the microSD card.

Requirements:

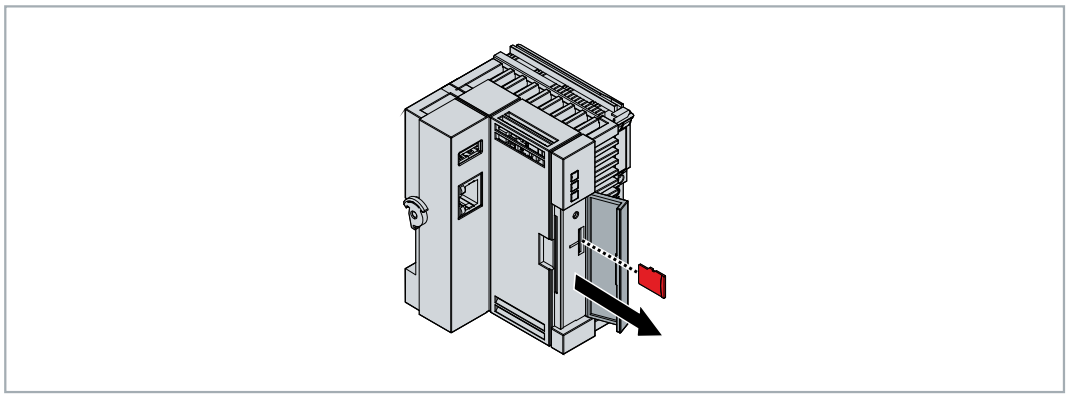
- The embedded PC must be switched off. The microSD card may only be installed or removed in switched-off state.

Changing the microSD card

1. Push the black cover upwards.



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. Push the new microSD card into the card slot with the contacts at the front. The contacts face to the right.
5. A soft click can be heard when the microSD card engages.

⇨ The card is seated correctly when it is about 1 mm deeper than the front side of the housing.

5.1.4 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.

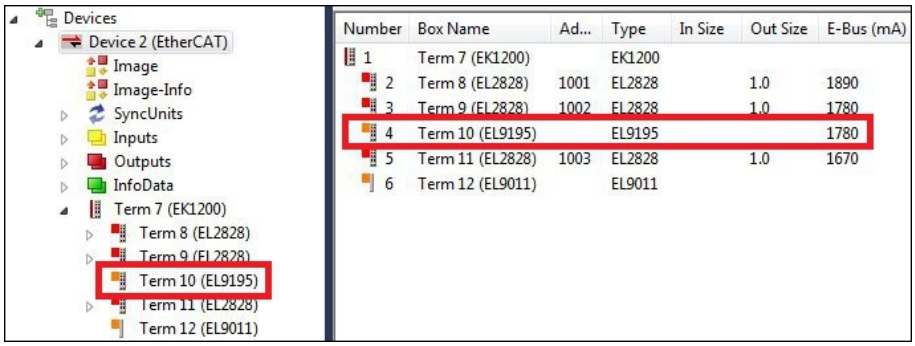


Fig. 7: Identifying a passive EtherCAT Terminal in TwinCAT.

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.

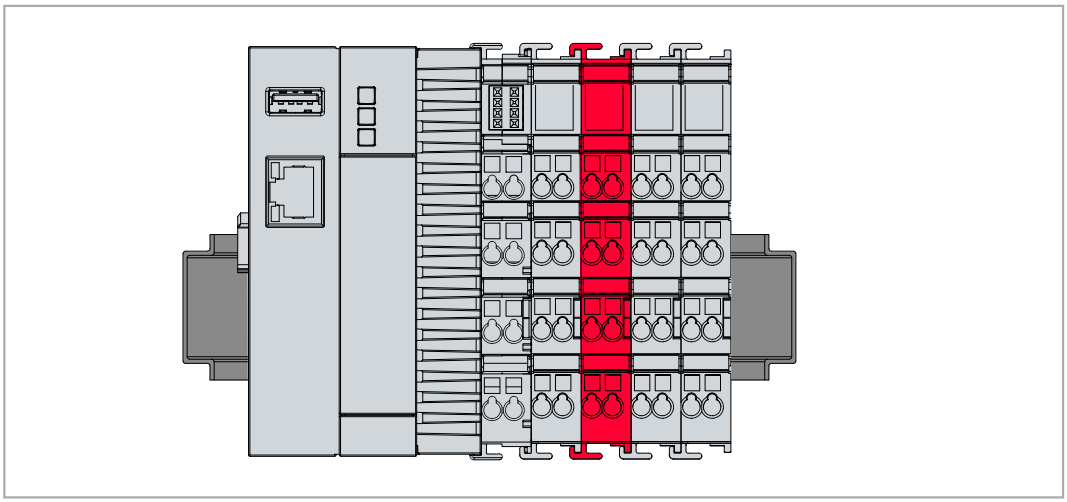


Fig. 8: Passive EtherCAT Terminals, permissible installation.

5.2 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 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 one point of the energy source for this circuit must be connected to the protective earth conductor system.

Connections

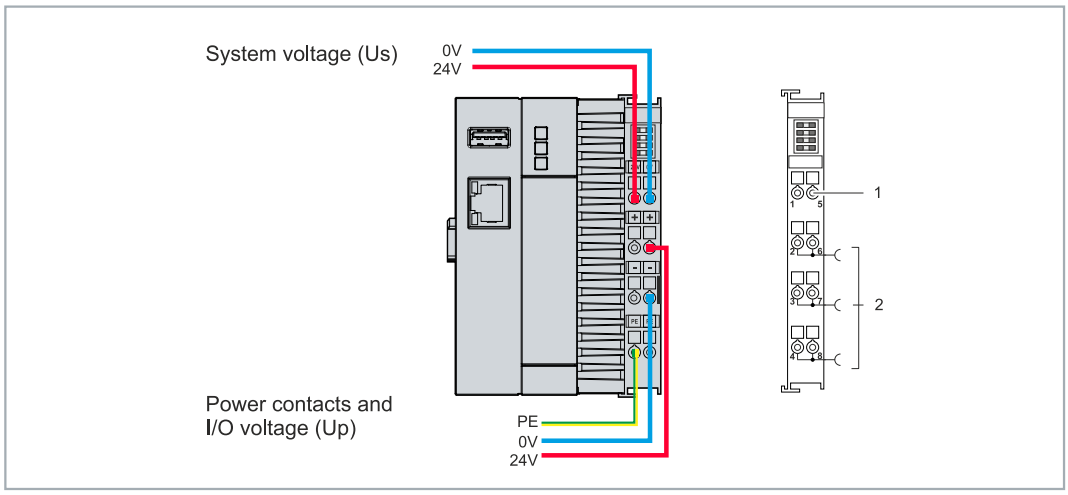


Fig. 9: Connections for system voltage (Us) and power contacts (Up).

Table 6: Legend for the connection example.

No.	Description
1	The upper spring-loaded terminals labeled "+24 V Us" and "0 V Us" supply the basic CPU module and the terminal bus (data transmission via K-bus or E-bus) with voltage.
2	The spring-loaded terminals labeled "+24 V Up" and "0 V Up" supply the multi-functional I/Os, the bus terminals, and EtherCAT Terminals with voltage via the power contacts.

Fuse

- When dimensioning the fuse for the system voltage (Us), take the maximum power consumption of the embedded PC into account (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 which have their own power supply (e.g. a panel) must have the same potential for "PE" and "0 V" as the embedded PC has (no potential difference).

5.2.1 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 7: Required conductor cross-sections and strip lengths.

Conductor cross-section	e*: 0.08 ... 1.5 mm²	e*: AWG 28 ... 16
	f*: 0.25 ... 1.5 mm²	f*: AWG 22 ... 16
	a*: 0.14 ... 0.75 mm²	a*: AWG 26 ... 19
Strip length	8 ... 9 mm	0.33-inch

*e: solid wire; f: stranded wire; a: with ferrule

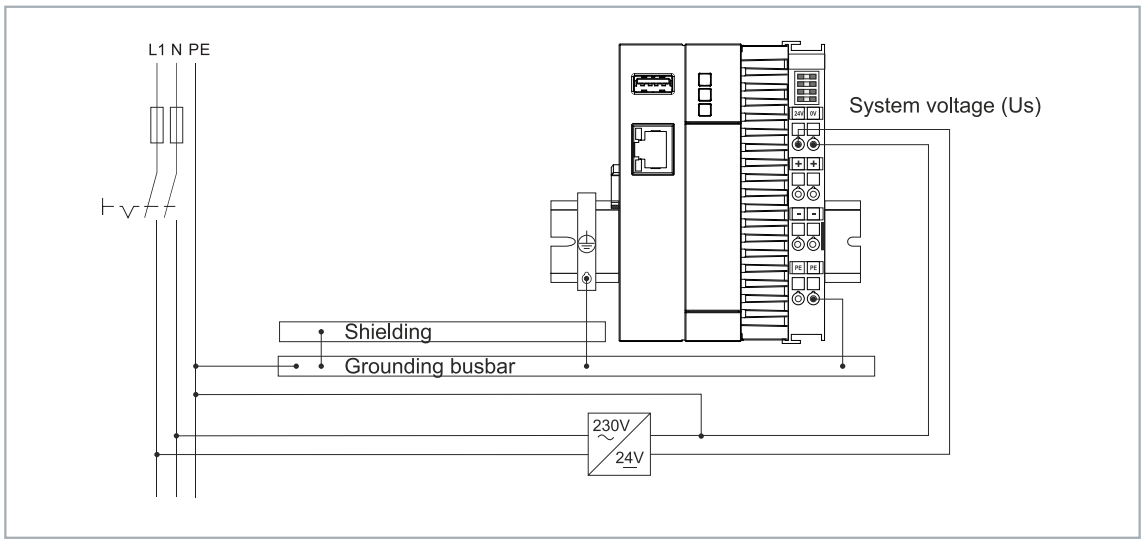
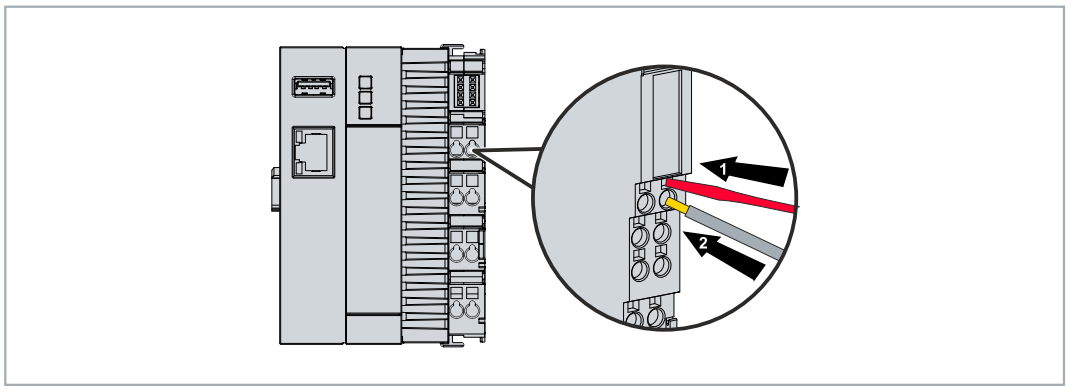


Fig. 10: Connection example with a CX8200.

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 24 V) 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.

5.2.2 UL requirements

The CX8200 Embedded PCs are UL-certified. The corresponding UL label can be found on the name plate.

Fig. 11: UL label for CX8200.

The CX8200 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.

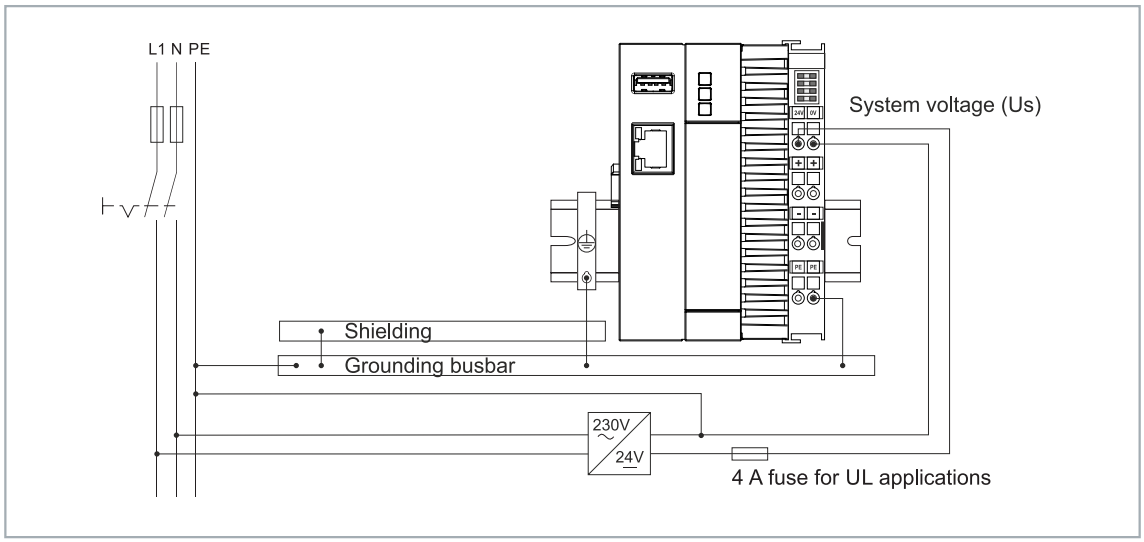


Fig. 12: Connection example for areas with special UL requirements.

6 1-second UPS (CX72x0)

Loss of data

Only use TwinCAT to control the 1-second UPS and save only persistent data with a maximum size of 1 MB. Any other use may result in data loss or data corruption.

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.

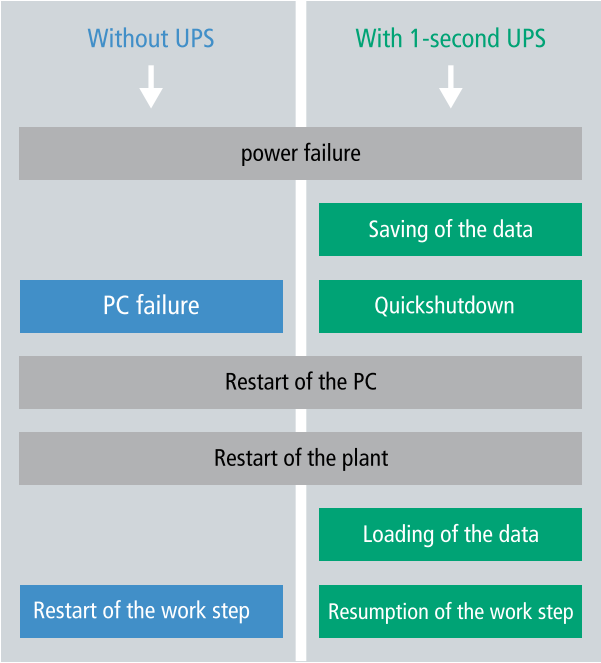


Fig. 13: Behavior of systems in the event of a power failure without and with a 1-second UPS.

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.

Configuration of the 1-second UPS

- 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 [▶ 28]).
- 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 [▶ 29]).

Sample project:
https://infosys.beckhoff.com/content/1033/CX8200/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

It is also possible in TwinCAT 3 to specify on the left in the tree view under **PLC** whether the backup file is to be used or not. The backup file is used by default:

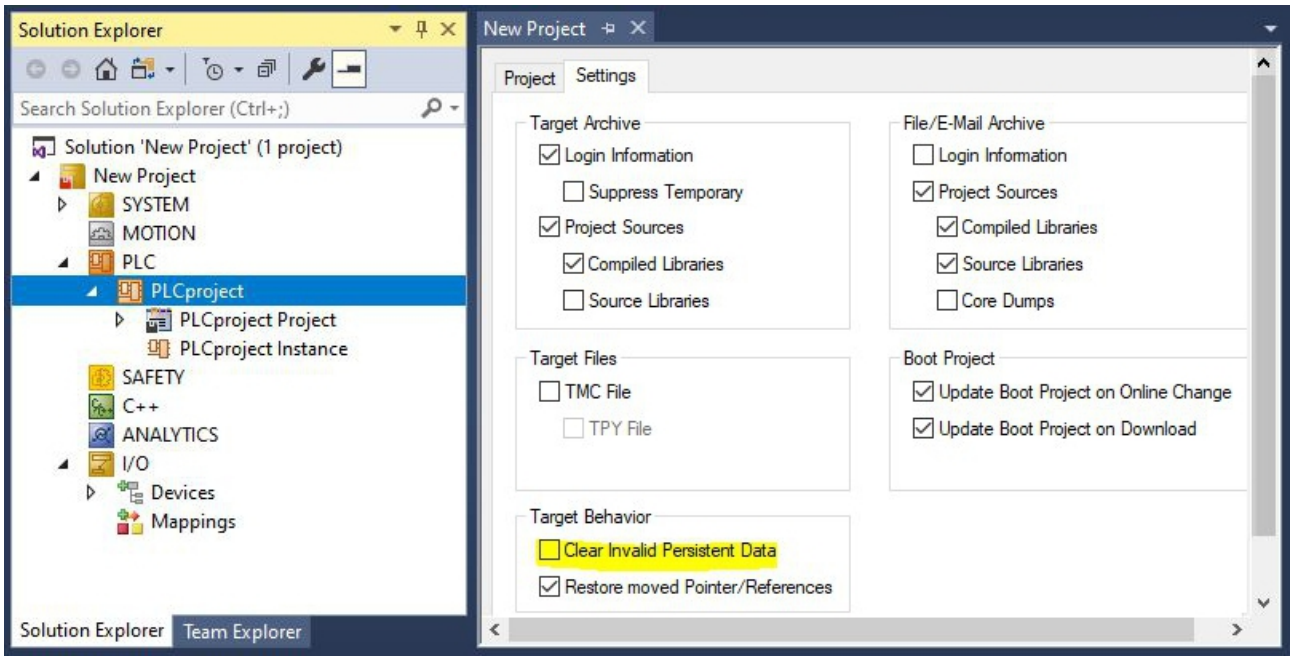


Fig. 14: Loading a backup of the persistent data. Settings in TwinCAT 3.

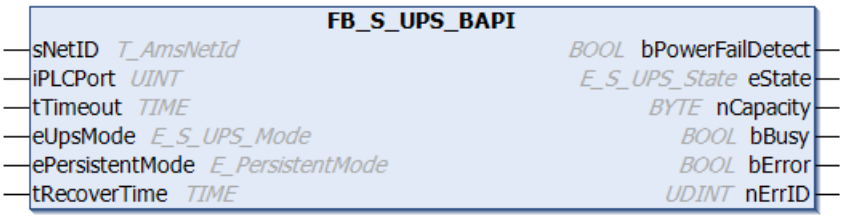
The backup files will be deleted if the option **Clear Invalid Persistent Data** is activated.

6.1 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.



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
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

6.2 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)
```

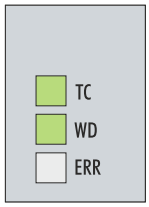
E_S_UPS_State

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
```

7 Error handling and diagnostics

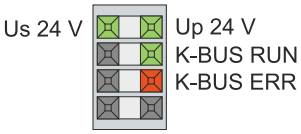
7.1 Diagnostic LEDs

Display	LED	Meaning
	TC	TwinCAT status LED: 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)
	WD	No function ex factory. The LED can be parameterized for user-specific diagnosis messages.
	ERR	Lights up red when switching on. Software is being loaded. Goes off if everything is OK. The LED can be parameterized for user-specific diagnosis messages.

7.1.1 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 8: 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 9: 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 10: 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.

Error code	Error code argument	Description	Remedy
			• 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.

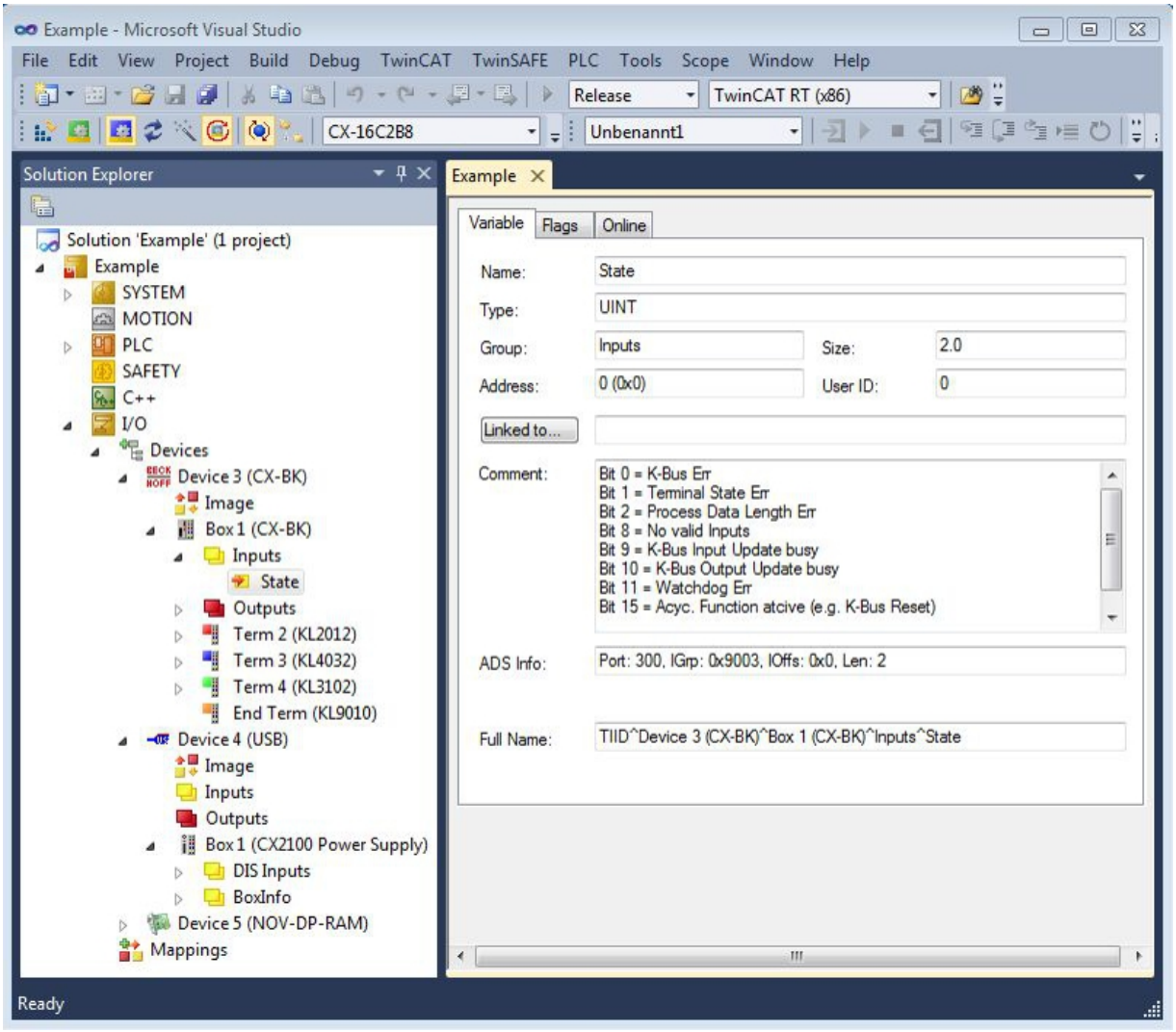


Fig. 15: Status variable for error handling and diagnostics under TwinCAT.

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 11: Description of the State variable values.

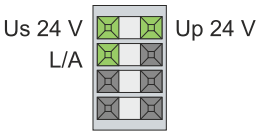
Bit	Description
Bit 0	K-bus error.
Bit 1	Terminal configuration has changed since the start.
Bit 2	Process image lengths do not match.
Bit 8	(still) no valid inputs.
Bit 9	K-bus input update not yet complete.
Bit 10	K-bus output update not yet complete.
Bit 11	Watchdog.
Bit 15	Acyclic K-bus function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

7.1.2 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 12: 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 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.

7.2 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.

8 Technical data

Table 13: Technical data, dimensions and weights.

	CX8200
Dimensions (W x H x D)	71 mm x 100 mm x 73 mm
Weight	220 g

Table 14: Technical data, general data.

Technical data	CX8200
Processor	Arm® Cortex® A53, 1.2 GHz
Number of cores	2
Flash memory	Slot for microSD card, card not included (requires at least a 16 GB microSD card)
Main memory	1 GB LPDDR4 RAM (not expandable)
1-second UPS	integrated (1 MB on microSD card)
Interfaces	1 x RJ45 10/100/1000 Mbit/s, 1 x USB 3.0
Cooling	passive
Bus interface	-
Data transfer rates	-
Diagnostic LED	1 x TC status, 1 x WD, 1 x Error
Clock	internal, capacitor-buffered real-time clock for time and date (memory > 21 days)
Operating system	Beckhoff RT Linux®
Control software	TwinCAT 3 Runtime (XAR) from TwinCAT 3.1 Build 4026
Power supply	24 V_{DC} (-15%/+20%)
Max. power consumption	4 W
Max. power consumption (with UPS charging)	7.5 W
Max. power consumption E-bus/K-bus	10 W (5 V/max. 2 A)
Approvals	CE, UL

Table 15: Technical data, I/O terminals.

Technical data	CX8200
I/O connection	E-bus or K-bus, automatic recognition
Power supply E-bus/K-bus	2 A
Power contacts current load	max. 10 A
Process data on the K-bus	max. 2 kB In and 2 kB Out
max. number of terminals (K-bus)	64 (255 with K-bus extension)
max. number of terminals (E-bus)	up to 65534 terminals.

Table 16: Technical data, environmental conditions.

Technical data	CX8200
Ambient temperature during operation	-25° C … +60 °C
Ambient temperature during storage	-40° C … +85 °C see notes under: Transport and storage
Relative humidity	95% no condensation
Vibration resistance	conforms to EN 60068-2-6
Shock resistance	conforms to EN 60068-2-27

Technical data	CX8200
EMC immunity	conforms to EN 61000-6-2
EMC emission	conforms to EN 61000-6-4
Protection rating	IP20

9 Appendix

9.1 Third-Party components

This device contains Beckhoff software and third-party software.
Please refer to the license file on the storage medium.

9.2 Accessories

Table 17: microSD cards.

Order number	Description
CX1900-0132	16 GB microSD card

9.3 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.

9.4 Support and Service

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

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