

1 Functional description

The Ethernet switchport junction XB-ET-31 is used to decentrally connect any Ethernet devices within a modular ctrlX I/O station. The Ethernet communication of the connected devices is routed completely transparently and without collisions via the EtherCAT local bus. The switchport junction can be used at any position within the ctrlX I/O station. A configuration is not required.

The logic and peripheral voltage supply as well as the EtherCAT-based module communication are routed through the module.



Fig. 1: Module XB-ET-31

For an application manual of the ctrlX I/O modules, refer to the media directory www.boschrexroth.com/mediadirectory and enter the search term "R911423458".

Ensure that the current documentation is consulted. For the current documentations, go to www.boschrexroth.com/mediadirectory and enter the module type as search term.

For the integration into the parent system, the respective ESI files are available. For the ESI files, go to <http://www.boschrexroth.com/electrics>, search term "ESI-Files".

2 Ordering data

Type	Part number	Description
XB-ET-31	R911419351	1 × Ethernet switch port interface

3 Technical data

3.1 General technical data

	XB-ET-31
Connection technique	RJ45
Number of outputs	1
Electrical isolation	DC 707 V U_L to FE
Nominal voltage U_L	DC 24 V (19.2 V to 30 V, including tolerance and residual ripple) PELV/SELV (safety extra-low voltage)

XB-ET-31	
Current consumption U_L	45 mA max.
Max. power consumption of the module	1.1 W
Dimensions	20 mm × 105 mm × 85 mm (width × height × depth)
Weight	100 g
EMC resistance	Acc. to EN 61000-6-2 and EN 61000-6-4
Mounting position	Vertical, on a horizontal mounting rail
Labeling, approvals	CE, UKCA, UL

3.2 Internal schematic diagram

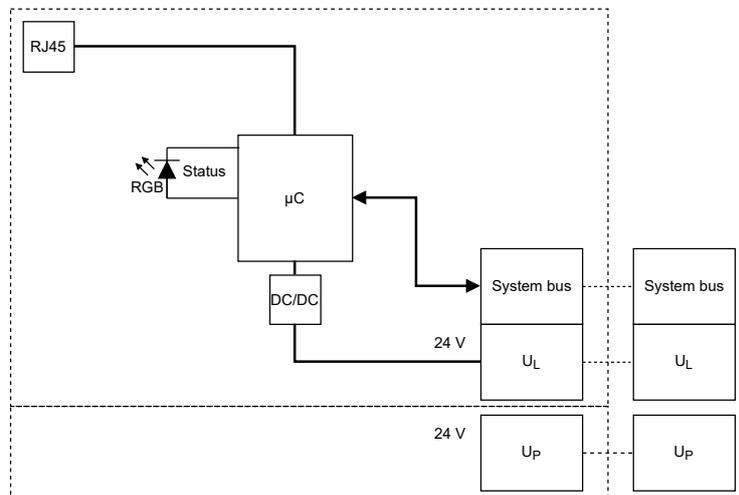


Fig. 2: Internal schematic diagram

3.3 Ambient conditions

Ambient temperature	
≤ 2,000 m	-25 to +55 °C
2,000 m to 3,000 m:	-25 to +50 °C
3,000 m to 4,000 m:	-25 to +45 °C
4,000 m to 5,000 m:	-25 to +40 °C
Maximum operating altitude	5,000 m
Acc. to DIN 60204	
Ambient temperature (storage and transport)	-40 to +70 °C
Permitted air humidity according to DIN EN 61131-2 (Operation, storage, transport)	10 to 95 %
Degree of protection	IP20
Acc. to DIN EN 60 529	(not evaluated by UL)
Protection class	III
Acc. to DIN EN 61010-2-201	
Overvoltage category	2
Acc. to IEC 60664-1	
Contamination level	2, no condensation
Acc. to EN 61010-1	

NOTICE**Defective device due to contaminated air!**

- The ambient air must not contain acids, alkaline solutions, corrosive agents, salts, metal vapors and other electrically conductive contaminants in high concentrations.
- The devices to be installed into the housings and installation compartments must at least comply with the degree of protection IP 54 according to DIN EN 60529.
- The device shall be provided in a suitable fire enclosure in the end-use application.

NOTICE**Defective device due to gases jeopardizing functions**

Due to the risk of corrosion, avoid sulphureous gases (e.g. sulphur dioxide (SO₂) and hydrogen sulphide (H₂S)). The device is not resistant against these gases.

NOTICE**Defective device due to overheating**

To avoid overheating and to ensure a trouble-free operation of the device, the ambient air has to circulate. Also refer to the section "Installation notes".

3.4 Mechanical tests

Vibration resistance Acc. to DIN EN 60068-2-6	Oscillations, sinusoidal in all three axes, 5 Hz - 8,4 Hz with 3.5 mm amplitude 8.4 Hz -150 Hz with 1 g peak acceleration
Shock test Acc. to DIN EN 60068-2-27	Shock stress: Shock resistance in all three axes 11 ms semi-sinusoidal 15 g
Broadband noise Acc. to DIN EN 60068-2-64	20-500 Hz with 1.22 g RMS (Root Mean Square), 30 min in all three axes

🔗 For the current approvals, go to
➔ www.boschrexroth.com/electrics.

4 For your safety

4.1 Intended use

Use the module only as specified in the data sheet.

4.2 User qualification

The product use described in this data sheet is only intended for qualified electricians and staff trained by these qualified electricians. The user has to be familiar with the known safety concepts on automation technology, applicable standards and other guidelines.

4.3 Electrical safety

NOTICE**Loss of electric safety**

Unintended handling can affect the device safety! Observe the notes in the present data sheet during installation, commissioning and operation.

5 IT security

Operating systems and machines requires the implementation of a comprehensive concept for state-of-the-art IT security. Bosch Rexroth products are part of this comprehensive concept. The properties of the Bosch Rexroth products have to be considered for a comprehensive IT Security concept. For the required properties, refer to the IT Security Guideline (➔ R911342562).

6 Signal processing

6.1 General information on signal processing

6.1.1 Configuring the mailbox

In the presetting, the mailbox has been set to 768 bytes at the input and 768 bytes at the output. The size of the mailbox may be increased to up to 1024 bytes. To configure the size in "ctrlX I/O Engineering", proceed as follows:

1. Open the device editor, select the module XB-ET-31 in the "ctrlX I/O Engineering" device tree. Select the "General" tab and there activate the "Expert" setting.
2. Click on the "SyncManager" tab, select "Mailbox In" or "Mailbox Out" and double-click on the column.
3. Change the size (1024 bytes max.) in the opened dialog.
4. Save the change and download the change to the EtherCAT master to activate this configuration.

6.1.2 Activating the EoE function in ctrlX I/O Engineering

For more information, see EtherCAT master documentation:

➔ <https://docs.automation.boschrexroth.com/doc/2451554957/acyclic-communication-mailbox/latest/en>.

6.1.3 Cycle time and data rate

The maximum attainable data rate of the XB-ET-31 module depends on the following values:

- EtherCAT cycle time on the field bus: The shorter the EtherCAT cycle the higher the EtherCAT data processing capacity which also increases the data processing capacity of the XB-ET-31 module.
- Mailbox size: The bigger the mailbox size the more Ethernet frames the XB-ET-31 module can simultaneously send to the EtherCAT master or receive from it.

When using an EtherCAT master with an EtherCAT cycle time of 2 ms and a mailbox size of 768 bytes, the data processing capacity of the XB-ET-31 module can reach 1 Mbit/s. Different EtherCAT masters may cause deviations in the data processing capacity.

7 Object directory

7.1 CoE standard objects

The object directory of the module contains objects that can be triggered via SDO services. These are defined in the ETG standards:

Index (hex)	Name
1000	Device type
1001	Error register
1008	Device name
1009	Hardware version
100A	Software version
1018	Identity
10F1	Error settings
10F3	Diagnosis history
10F8	Timestamp object
1C00	Sync manager type
1C12	Sync manager 2 assignment
1C13	Sync manager 3 assignment
F000	Modular device profile

7.2 Module-specific CoE objects

Objects with a module-specific design are described in the following table.

Index (hex)	Object name	Data type	Access	Description
8000	System info		s	

Index (hex)	Object name	Data type	Access	Description
8000:01	Link Status	UINT16	RO	XF15 port status: 00(hex): No link 01(hex): 10 MBit/s 02(hex): 100 MBit/s
8000:02	Frame Error Cnt	UINT16	RO	Number of faulty frames
8000:03	Frame Receive Cnt	UINT32	RO	Number of received frames
8000:04	Frame Send Cnt	UINT32	RO	Number of sent frames
8000:05	Frame Receive Drop Cnt	UINT32	RO	Number of dropped frames on the receiving side
8000:06	Frame Send Drop Cnt	UINT32	RO	Number of dropped frames on the sending side
A000	Module identification			
A000:00	Material number	String(20)	RO	Part number of the module
A010:00	Full serial number	String(20)	RO	Complete serial number of the module

8 Diagnostic strategy

8.1 Mechanisms

Mechanism	Diagnostics
EtherCAT state machine EtherCAT hardware watchdog	EtherCAT system diagnostics
Module status LED	Shows the general module status
NET-ST LED	Shows the EtherCAT status and error states

8.2 Module status LED

Device state	LED flashing pattern
Booting	
Initialization	
It is currently configured. Module not yet ready.	
Process data transmission, outputs inactive.	
Module in "Run" state	
Error and warning states	
Logic or peripheral voltage error	
Communication or configuration error	

 One square corresponds to a period of 200 ms. The arrow represents the end of a cycle.

 LED is not on.

 LED is blue.

 LED is green.

 LED is red.

 A new status is only displayed after the previous flashing cycle has elapsed. A change in status can thus be delayed up to two seconds.

8.3 NET status LED

The NET status LED according to the EtherCAT specification (ETG.1300) displays the EtherCAT bus state at the module.

The operating state is displayed in green .

LED color green	Description
Off	Status INIT
Flickers	Status BOOT
Flashes	Status PRE-OP
Single flash	Status SAFE-OP
Lit	Status OP

The error state is displayed in red .

LED color red	Description
Off	No error
Flickers	Boot error
Flashes	Invalid configuration
Single flash	Local error (e.g. synchronization)
Double flash	Watchdog error
Lit	Communication error

9 Installation

9.1 Connection instructions

9.1.1 Connecting the Ethernet network

Connect the Ethernet to the bus coupler via an 8-pin RJ45 plug.

Name	Remark
XF15	Line connection to Ethernet network or device.

 Autocrossover: The Ethernet interface is provided with the "Autocrossover" function.

 Shielding: The shield of the connectable twisted-pair wires is electroconductive and connected to the socket. When connecting net segments, avoid ground loops, accidental energization and potential equalization currents via the shielding braid.

 Observe bending radii: The housing dimensions under "Dimensions" refer to the bus coupler with peripheral plugs without Ethernet connection. When installing the bus coupler into a control box, observe the bending radii of the Ethernet cables and the plug connectors used.

To observe the bending radii, use angled RJ45 plugs.

 Installing the Ethernet cable: The Ethernet cable must not be installed or routed outside the building.

Connection method	RJ45 socket (Autonegotiation and Autocrossing)
Transmission rate	100 MBit/s (full duplex)
Cycle time	125 us min., 10 ms max.
Transmission physics	Ethernet in RJ45-Twisted-Pair
Transmission length	100 m max.

Table 1: Ethernet interface

9.2 Mounting and installation

The application manual for the ctrlX I/O modules contains notes on installation, mounting and dismounting. For the application description, go to:

- www.boschrexroth.com/MediaDirectory, Search term: "R911423458" or
- <https://docs.automation.boschrexroth.com/doc/4126711705/ctrlx-i-o-anwendungsbeschreibung/latest/en/>.

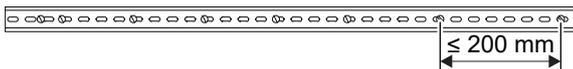
NOTICE**Destruction of the device due to non-compliance with the application manual**

Follow the mounting instructions in the application manual to ensure a correct mounting and to prevent damage to the device.

NOTICE**Device destruction due to electrostatic discharge**

The device contains components that can be damaged or destroyed by electrostatic discharge. Comply with the required safety measures against electrostatic discharge (ESD) acc. to EN 61340-5-1 when operating the module.

- Mounting location
The module has the degree of protection IP 20 and is thus intended for use in a closed control cabinet or control box (terminal box) with the degree of protection IP 54 or higher. The control cabinet fulfills the function of the final safety enclosure. The modules must be installed in the final safety enclosure. They have to be provided with sufficient rigidity according to UL 61010-1, 61010-2-201 and have to meet the requirements with regard to fire propagation.
- End clamps
Fasten end clamps of the type SUP-M01-ENDHALTER (R911170685) on both sides of the station. End clamps ensure the correct fastening on the support rail and are used as lateral end elements. Always fasten one end clamp of the station before mounting the station. This ensures the following:
 - It impedes the shifting of the modules
 - The installation place for the end clamp is secured.
- Endcover
At the end of each ctrlX I/O station, slide an endcover of type XACC-2-END-COVR onto the last module. The endcover is included in the scope of delivery of the bus coupler. Sliding on the endcover ensures protection against accidental contact.
- Mounting rail
Mount the module on a 35 mm standard support rail. Use only a TH 35-7.5 support rail acc. to EN 60715. The fastening distance of the support rails may not exceed 200 mm. This distance is required to ensure stability while mounting and dismantling the module.



- Provide the following minimum distances for sufficient cooling:

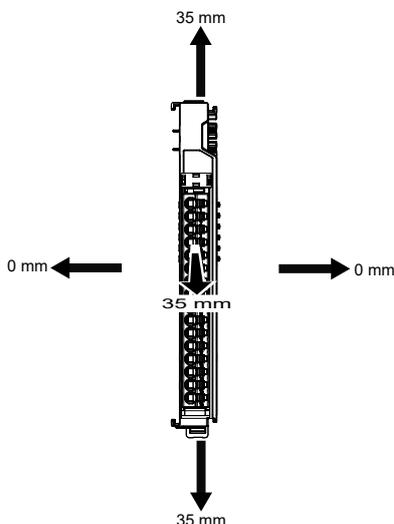


Fig. 3: Ventilation distances

- Additionally, provide sufficient distance for mounting, dismounting, plugs and cables.
- If more devices are connected in series to the station on the left or right, the surface temperature may not exceed 60° C
- In case of a several line design, the supply air has to be measured under each line and its limit value may not be exceeded. For permitted values, refer to the chapter "Ambient conditions" of the respective module data sheet.

9.2.1 Mounting the ctrlX I/O module

NOTICE**Damage of the device by plug mounting under voltage!**

Disconnect the module and all connected module components from voltage before mounting or dismantling.

NOTICE**Damage of the device by short circuit of patch connectors**

There is an endcover on the right upon delivery of the bus coupler. Remove this endcover to connect the modules at the bus coupler in series. Position the endcover on the last module of the station to protect it against short circuit and contamination.

NOTICE**Possible damage to property due to unintended mounting of the support rail**

- Connect the support rail to a functional earth.
- Mount the module on a support rail.
- Install the module in a control cabinet or in an appropriate housing.

NOTICE**Module is not fixed correctly due to open support arm mounting!**

Before mounting, ensure that the support arm mounting of the control is not in open position. If required, release the clamping of the open position using the locking lever, refer to the following figure Fig. 4.

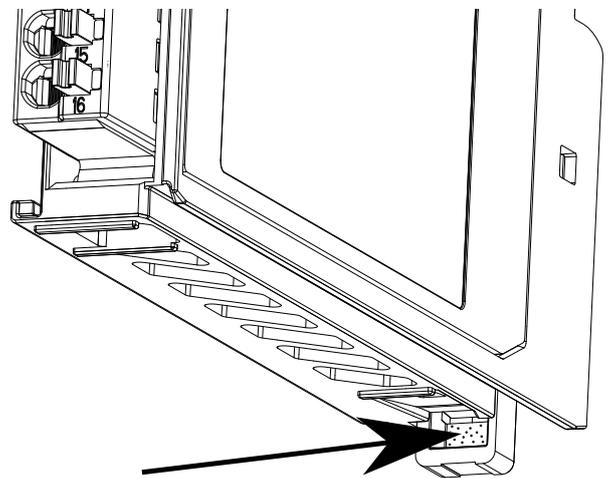


Fig. 4: Locking lever to release the clamping of the open position.

Each module has to be snapped separately.

9.2.2 Positioning plug

1. Position the plug on the connector holder, see ①.
2. The plug engages at the locking lever, see ②

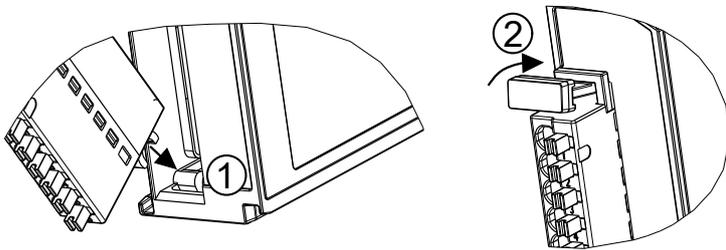


Fig. 5: Positioning plug

9.2.3 Removing plug

1. Press the locking lever of the plug at the top, see ①
2. Remove the plug, see ②.

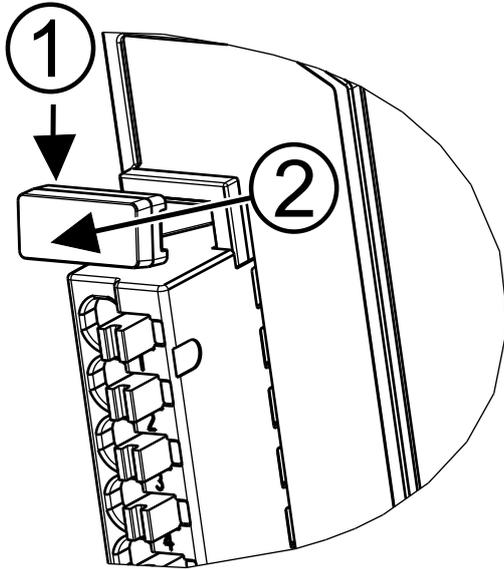


Fig. 6: Removing plug

9.2.4 Dismounting module

⚠ For dismounting, use a common tool such as a slotted screwdriver with a 2.5 mm blade.

NOTICE

Destruction of components and devices due to mounting and dismounting under voltage!

Disconnect the module and all connected module components from voltage before mounting or dismounting.

Removing module from support rail

1. Use a suitable tool (e.g. slotted screwdriver) and put it into the lower disengaging mechanism (base latch) of the module and disengage the module (see (A) in the following figure). The base latch is locked in the open position.
2. Remove the module vertically to the support rail [see (B) in the following figure].

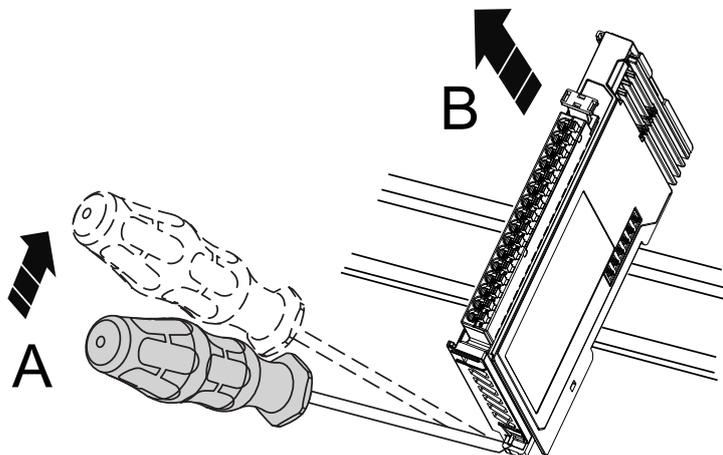


Fig. 7: Removing module from support rail

⚠ Before mounting the module on the support rail again, release the clamping of the open position again. Press the locking lever, refer to the figure Fig. 4.

9.2.5 Electric installation

Notes on the electrical connection

- To avoid EMC interferences due to loop formation, 24 V voltage potential and ground (GND) have to be connected in star shape from the 24 V power supply unit to the connections for logic voltage (U_L) and peripheral voltage (U_P).
- Use only insulated copper wires suitable for at least 75 °C.

Tools

- Use the "Phoenix Crimpfox 6" crimping plier to crimp wire end ferrules. The ordering number is: "1212034 Crimpfox 6" at Phoenix Contact.
- Use a slotted screwdriver with a 2.5 mm blade.

Permitted lines

- Rigid lines
Stripping length: 8.5 mm \pm 0.5 mm, burr-free
- Flexible line without wire end ferrule
Stripping length: The length of the stripped and 360° twisted braids has to be 8.5 mm \pm 0.5 mm
- Flexible line with wire end ferrule
- Use a cable cross-section corresponding to the current (minimum 0.2 mm², maximum 1.5 mm²) to avoid an excessive increase in temperature. A cable cross-section of 1.5 mm² is specified for the power supply (U_P) of 8 A. The minimum cable cross-section for the power supply (U_L) is 0.75 mm².
- The insulation of the cables used has to correspond to the rated voltage.

Wire end ferrules

- Wire end ferrules with and without insulating collar are permitted with a contact length of 8 mm according to DIN 46228.
- Maximum dimensions of the crimped wire end ferrule:
Height 1.45 mm
Width 2.34 mm
- Twin wire end ferrules are not permitted.

Orientation of the wire end ferrules

- The orientation of the wire end ferrule in the clamping point has to be vertical.

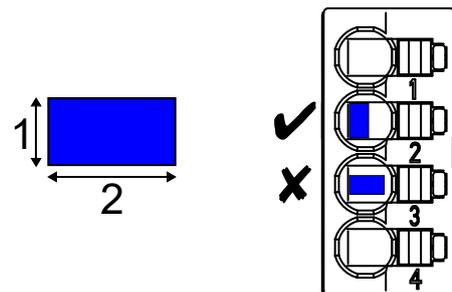


Fig. 8: Orientation of the wire end ferrules in the clamping point

- 1 Height of the crimped wire end ferrule
- 2 Width of the crimped wire end ferrule

Installing lines

- Press the pusher with a suitable slotted screwdriver.
- Insert the line into the clamping point as far as possible.
- Release the pusher.

Uninstalling lines

- Press the pusher with a suitable slotted screwdriver.
- Remove line.
- Release the pusher.

Mounting notes for UL certification

Permitted lines

- Use flexible lines with wire end ferrules for UL devices.
- The following wire end ferrules are permitted:
 - Wire end ferrules with insulating collar as per the table:

Cable cross-section in AWG	Cable cross-section mm ²	Ordering numbers of the wire end ferrules (Weidmüller company)
24 AWG	0.2 mm ²	9025760000, 500 pieces
22 AWG	0.35 mm ²	9025770000, 500 pieces
20 AWG	0.5 mm ²	0690700000, 500 pieces 1476230000, 100 pieces
18 AWG	0.75 mm ²	0462900000, 500 pieces 1476240000, 100 pieces
-	1 mm ²	0463000000, 500 pieces 1476250000, 100 pieces
16 AWG	1.5 mm ²	0463100000, 500 pieces 1476270000, 100 pieces

Orientation of wire end ferrules

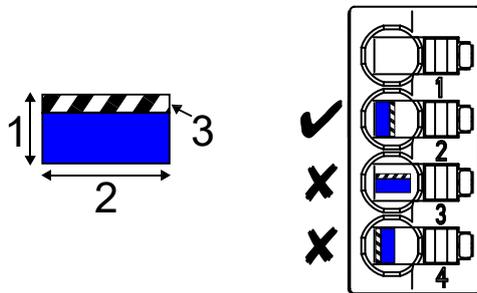


Fig. 9: Orientation of the wire end ferrules in the clamping point

- 1 Height of the crimped wire end ferrule
- 2 Width of the crimped wire end ferrule
- 3 Crimped side of the wire end ferrule

10 Firmware update via FoE

⚠ WARNING

Risk of injury due to unsafe machine states

The machine has to be in a safe state before updating.

The firmware of the module can be updated via FoE. For new firmware files, go to www.boschrexroth.com/mediadirectory and search for the type code of the module.

A firmware module can be updated with all EtherCAT masters supporting the file download via FoE. The module has to be in the BOOTSTRAP state. Entering a password or a file name is not required.

If the update has been completed successfully, the module is restarted as soon as the module state changes from BOOTSTRAP to another state. The reloaded firmware is started.

⚠ Do not disconnect the voltage supply of the module during the file transfer.

Please note that the logic voltage supply is temporarily interrupted for the following modules when completing the firmware update of the bus coupler and a subsequent restart.

⚠ If switching to INIT is not possible, disconnect the ctrlX I/O from the power supply and connect it again.

⚠ The new firmware version might require an updated description file in the Engineering to use new functions. For details, refer to the release notes.

Check whether the latest version of the description file is installed.

10.1 ctrlX I/O Engineering

Within the ctrlX I/O Engineering, the required user interface is only displayed for modules supporting a firmware update.

1. Switch the EtherCAT master of the ctrlX CORE to the "INIT" state.

2. First change to the active state in the ctrlX I/O Engineering by enabling "Show online data".
 - ➔ This is the requirement to update the firmware. The corresponding user interface tab is only displayed if the requirement is met.
3. To open the device editor, double-click on the module in the ctrlX I/O Engineering device tree and select the "FoE" tab.
4. In the "Download" section, select the firmware file (*.EFW) under "Local file name". Ensure that this is the correct file for the module to be updated.
5. Check that the option "Required state" is active under "Details" and that "BOOTSTRAP" is selected.
6. Use the "Download" button to start the firmware update.

11 License information

11.1 EtherCAT®



The ctrlX I/O modules use EtherCAT® technology. "EtherCAT®" is a registered trademark and patented technology licensed by the Beckhoff Automation GmbH, Germany. EtherCAT is an open, internationally standardized standard and developed further by the "EtherCAT Technology Group" (ETG).

11.2 Libhydrogen

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11.3 Ring-buffer

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Bosch Rexroth AG
Bgm.-Dr.-Nebel-Str. 2
97816 Lohr a.Main
Germany
Tel. +49 9352 18 0
Fax +49 9352 18 8400
www.boschrexroth.com/electrics



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