

1 XB-EC-12

The bus coupler XB-EC-12 connects the EtherCAT network and the ctrlX I/O system. The bus coupler supplies the connected I/O modules with the logic voltage U_L and the peripheral voltage U_P . For the integration into the parent system, the respective ESI files are available. For the ESI files, go to <http://www.boschrexroth.com/electrics>.

Ensure that the current documentation is consulted. For the current documentations, go to www.boschrexroth.com/mediadirectory.



Fig. 1: XB-EC-12 module

2 Ordering data

Bus coupler

Type	Part number	Description
XB-EC-12	R911406090	Bus coupler for EtherCAT including power connector and endcover

Power connector, 24 V

Ordering code	Part number	Description
XACC-1-CSPWRM	R911416670	24 V power connector

End clamp


Ordering code	Part number	Description
SUP-M01-END-HALTER	R911170685	2 pieces of snap-on end brackets for 35 mm NS 35/7.5 support rail; width: 9.5 mm


Endcover

Ordering code	Part number	Description
XACC-2-END-COVR	R911412178	Endcover

Documentation

Title	Part number
Project Planning Manual, Security Manual	➔ R911342562

 For more ordering data (accessories), go to the product catalog. The address is www.boschrexroth.com/electrics.

 The type plate of the bus coupler is under the endcover, positioned at the right of the module.

3 Technical data

	XB-EC-12
Connection method	Push-in
Nominal voltage (U_L , U_P)	DC 24 V (19.2 V to 30 V) PELV/SELV (safety extra-low voltage)
Current consumption U_L at a nominal voltage of 24 V	70 mA max. (without I/O modules), 3 A max. (complete system with I/O modules)
Power consumption U_L at a nominal voltage of 24 V	1.64 mA max. (without I/O modules), 72 W max. (complete system with I/O modules)
Current consumption U_P at a nominal voltage of 24 V	Typ. 5 mA (without I/O modules, 8 A max. (complete system with I/O modules)
Power consumption U_P at a nominal voltage of 24 V	Typ. 0.12 mA (without I/O modules), 192 W max. (complete system with I/O modules)
Reverse polarity protection (U_L , U_P)	Present
Fuse protection (U_L)	Internal with a protective fuse
Fuse protection (U_P)	No internal fuse protection. The operator has to provide protection against overload by an external fuse.
Overvoltage protection U_L and U_P	Present, fuses can trigger in case of overvoltage.
Transient protection U_L and U_P	Present, suppressor diodes, pulse load up to 1,500 W
Voltage dips at current supply interfaces	PS1 < 1 ms, evaluation criterion A
Electrical isolation	DC 1200 V U_P to U_L , DC 707 V U_P/U_L to FE
Configuration	No address or configuration setting required
Dimensions	23.3 mm × 105 mm × 99 mm (width × height × depth)
Weight	115 g (module including connector)
EMC resistance	Acc. to EN 61000-6-2 and EN 61000-6-4
Mounting position	Vertical, on a horizontal support rail
Labeling, approvals	CE
Supply voltage LEDs	At the connection point to signal the applied voltage

XB-EC-12	
	0 = Voltage missing or incorrectly wired --
	1 = Voltage applied GN
EtherCAT IN	XF25
EtherCAT OUT	XF26
Local bus interface	EtherCAT-based
Maximum number of modules per station	30

Table 1: Technical data of the module

Clamping point assignment

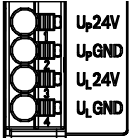


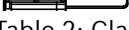
Clamping point	Assignment	Color	Maximum current
 U _P 24V	U _P 24 V	Red	8 A
 U _P GND	U _P GND	Blue	8 A
 U _L 24V	U _L 24 V	Red	3 A
 U _L GND	U _L GND	Blue	3 A

Table 2: Clamping point assignment

Internal schematic diagram

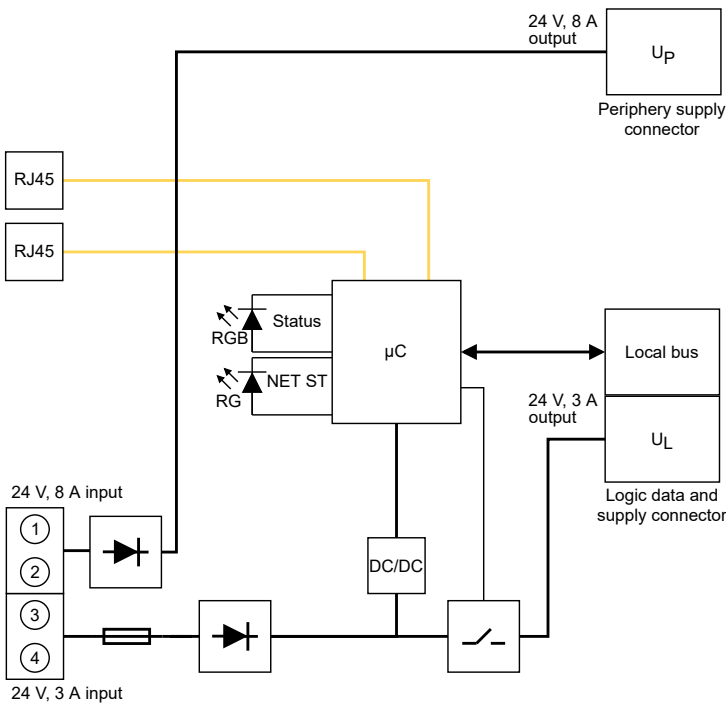


Fig. 2: Internal schematic diagram

Device status LED (diagnostic and device status)

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

Table 3: Device status LED (diagnostic and device status)

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

- : LED is not on.
- BU: LED is blue.
- GN: LED is green.
- RD: LED is red.

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

Ambient conditions

XB-EC-12	
Ambient temperature	
Up to 2000 m	-25 ... 55 °C
From 2000 m	-25 ... 50 °C
From 3000 m	-25 ... 45 °C
From 4000 m	-25 ... 40 °C
Maximum operating altitude	5000 m
Acc. to 60204	
Ambient temperature (Storage and transport)	-40 ... 70 °C
Permitted air humidity according to DIN EN 61131-2	
Operation	5-85 %
Storage	10-100 %
Transport	45-95 %
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 IEC 61010-1	

Table 4: Ambient conditions

NOTICE

Failure of the product 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 housing 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 product due to gases jeopardizing functions

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

NOTICE

Failure of the product due to overheating

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

Mechanical tests

Vibration resistance	Oscillations, sinusoidal in all three axes, 5 Hz - 8.4 Hz with 3.5 mm amplitude
Acc. to DIN EN 60068-2-6	8.4 Hz -150 Hz with 1 g peak acceleration
Shock test	Shock stress: Shock resistance in all three axes
Acc. to DIN EN 60068-2-27	

11 ms semi-sinusoidal 15 g

Broadband noise
Acc. to DIN EN 60068-2-64 5-20-150 Hz with 0.572 g, 5 h per axis

Table 5: Mechanical tests

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

4 For your safety

Intended use

Use only the bus head as specified in the present data sheet.

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.

Electric 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

NOTICE

Unauthorized network access possible

Devices connected to a network via Ethernet are at risk of unauthorized network access. To impede unauthorized network access, observe the following notes.

If possible, disable unused communication channels.

When assigning passwords, ensure that third parties cannot access the bus coupler without authorization and cannot make changes.

Due to its communication interfaces, do not use the bus coupler in safety-critical applications without using an additional security appliance.

Thus, take further protective measures (e.g., virtual networks (VPN) for remote maintenance access, firewalls, etc.) against unauthorized network access that meet the IT security requirements and applicable standards for your area of operation.

Operating systems and machines require the implementation of a comprehensive concept for state-of-the-art IT security. Bosch Rexroth products are part of an overall 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, see R911342562.

6 EtherCAT connection and supply

Connecting EtherCAT

Connect the EtherCAT to the bus coupler via an 8-pin plug. The EtherCAT connections are direction-dependent.

Name	Direction	Note
XF25	IN	Line connection from the direction of the master.
XF26	OUT	Line connection in the direction of further slaves.

Autocrossover: Both Ethernet interfaces are 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.

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 6: EtherCAT interface

7 Pin example

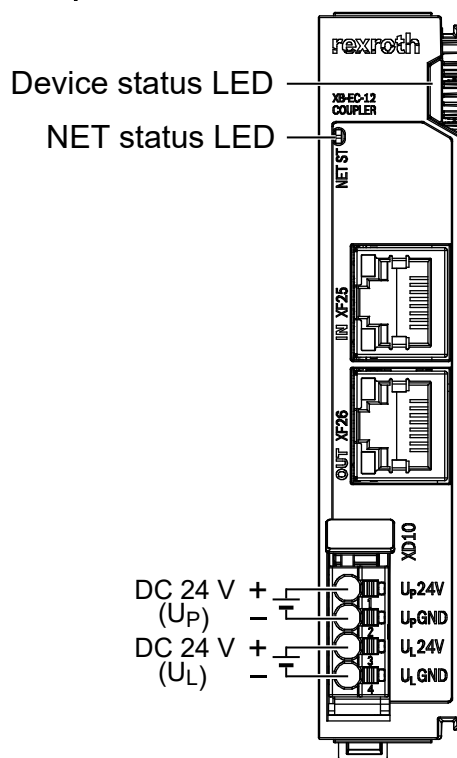


Fig. 3: Pin example

NOTICE

Electronic damages

Protect the bus coupler at U_L using an external 8 A fuse. A load above 8 A is not permitted.

The power supply unit has to be able to deliver the quadruple nominal current of the fuse to ensure that the fuse reliably triggers in case of error.

In case of overvoltage or undervoltage of U_L , all modules connected to the segment circuit are switched off.

8 NET status LED

The NET status LED is specified by the ETG (EtherCAT Technology Group) and indicates the EtherCAT bus state at the bus coupler.

The operating state is displayed in green **GN**:

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 **RD**:

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 Synchronizing the application

The application is synchronized in the "SM synchronous" mode.

10 Object directory

The object directory of the bus coupler 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	Identify
10F1	Error settings
10F3	Diagnosis history
10F8	Timestamp object
1Ann	PDO Mapping TxPDO
1C00	Sync manager type
1C12	Sync manager 2 assignment
1C13	Sync manager 3 assignment
1C33	SM input parameter
F000	Modular device profile

Table 7: CoE standard objects

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

Index (hex)	Object name	Data type	Error, warning	Diagnostic number	Unit
6000	U_P Supply periphery				
6000:01	U _P Voltage	Uint16	–	–	mV
6000:02	U _P Current	Uint16	–	–	mA
6010	U_P Supply logic				
6010:01	U _L Voltage	Uint16	–	–	mV
6010:02	U _L Current	Uint16	–	–	mA
6020	State				
6020:01	U _P Under-voltage	Bit	W	0x3420	–
6020:02	U _P Over-voltage	Bit	W	0x3410	–
6020:03	U _P Over-current	Bit	E	0x2316	–
6020:04	U _L Under-voltage	Bit	W	0x3421	–
6020:05	U _L Over-voltage	Bit	W	0x3411	–
6020:06	U _L Over-current	Bit	E	0x2315	–
8000	System info				
8000:01	Temperature	Int16	W	0x4210 0x4220	0.1 °C
8000:02	Power logic used	Uint16	–	–	mW
8000:03	Power logic available	Uint16	–	–	mW
A000:0	Material number	String(20)	–	–	–
A010:0	Full serial number	String(20)	–	–	–

Table 8: Module-specific CoE objects

11 Process data of the bus coupler

The bus coupler has data that is inserted into the cyclic process image. This data length is 5 words in total. According to the EtherCAT standard, this data is shown before the input process data is shown in the process image.

The process data words 0...4 contain the voltage and current values of U_P and U_L as well as their bits for the supply voltage diagnostics of the bus coupler. This information can also be retrieved via acyclic services using CoE. These are shown as the indices 6000, 6010 and 6020 hex.

Word 0	U _P Voltage
Word 1	U _P Current
Word 2	U _L Voltage
Word 3	U _L Current
Word 4	
0	U _P Undervoltage
1	U _P Overvoltage
2	U _P Overcurrent
3	U _L Undervoltage
4	U _L Overvoltage
5	U _L Overcurrent
6-15	Reserved

12 Diagnostic strategy

Mechanisms

Different mechanisms are used for the diagnostics of the bus coupler.

Mechanism	Diagnostics
EtherCAT state machine	EtherCAT system diagnostics
EtherCAT hardware watchdog	
Diagnostic objects in the CoE object directory	Extended diagnostics, e.g. peripheral errors
10F1	Error settings
Diagnosis history object	20 diagnostic messages can be stored
10F3	Diagnosis history

Diagnosis history 10F3_{hex}

The object 10F3_{hex} is implemented as ring memory into the "Overwrite mode". The latest 20 diagnostic messages are stored. Older messages are deleted.

The following table shows the structure of a diagnostic message of the bus coupler for EtherCAT.

Index (hex)	Sub-index	Object name	Data type	Length	Rights	Meaning
10F3		Diagnosis history				Diagnostic statistics
	01	Maximum messages	UINT8	1	R	Maximum number of messages
	02	Newest message	UINT8	1	R	Latest message
	03	Newest acknowledged message	UINT8	1	R/W	Latest confirmed message. Writing "0" deletes the messages in the ring memory.
	04	New messages available	Boolean	0.1	R	New message available
	05	Flags	UINT8	2	R/W	Setting of the object response. Refer to ETG.1020

13 Status codes

Error, warning	Text ID (hex)	Text
	0x2xxx	Current
E	0x2315	Current at supply voltage U _L too high
E	0x2316	Current at supply voltage U _P too high
	0x3xxx	Voltage
W	0x3410	Peripheral supply voltage (U _P) too high
W	0x3411	Logic supply voltage (U _L) too high
W	0x3420	Peripheral supply voltage (U _P) too low
W	0x3421	Logic supply voltage (U _L) too low
	0x4xxx	Temperature
W	0x4210	Module temperature too high
W	0x4220	Module temperature too low

14 Installation notes

NOTICE

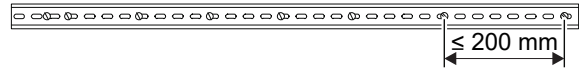
Device destruction due to electrostatic discharge

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 has to be provided with sufficient stability and rigidity (acc. to UL 61010-1, 61010-2-201).
- End clamps

Fasten end clamps of the type SUP-M01-ENDHALTER 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 clamps is secured.
- Support 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:

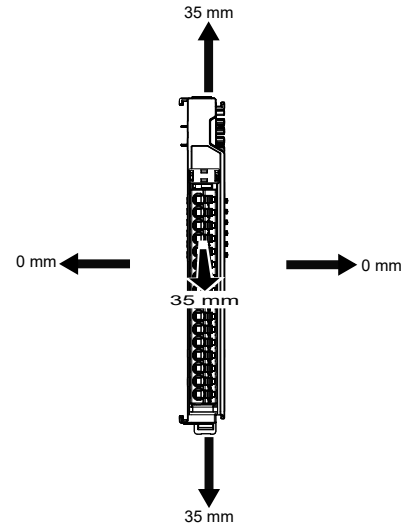


Fig. 4: Ventilation distance

- Additionally, provide sufficient distance for mounting, dismantling, 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 the permitted ambient temperatures, refer to the chapter "Ambient conditions".

15 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

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

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

NOTICE

Module is not fixed correctly due to engaged 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 5.

NOTICE

Damage of the device by short circuit of patch connectors

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

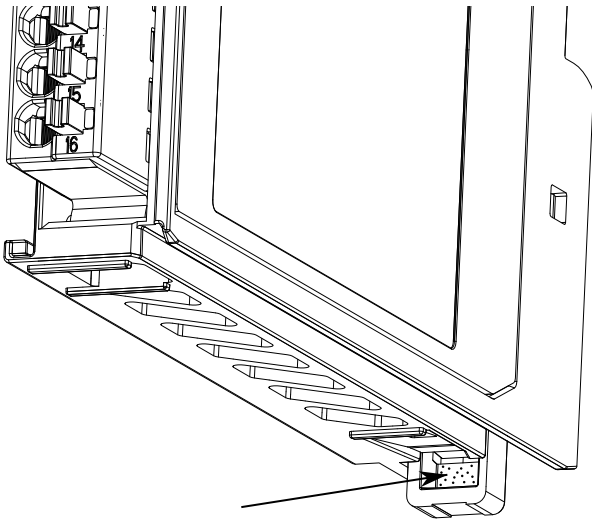


Fig. 5: Locking lever to release the clamping of the open position

Each module has to be snapped separately.

16 Positioning connector

1. Position the connector on the connector holder, see ①.
2. Engage the connector, see ②.

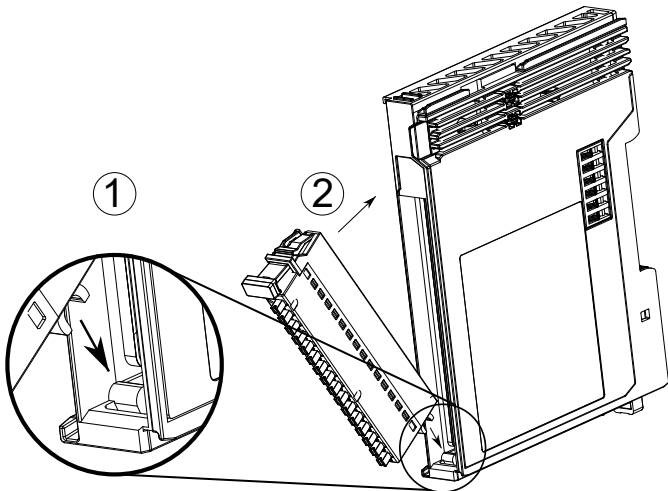


Fig. 6: Positioning connector

17 Notes on the electrical connection

- For the front connector, one-wire cables and stranded cables can be used with or without wire end ferrule (acc. to DIN 46228). These wire end ferrules can be with or without plastic collar. The contact surface has to be 8 mm.
- The wire ends may not have any burrs.
- The cable cross-section allowed is between 0.25 mm² and 1.5 mm² (AWG 24 to 16).
- The stripping length is 8 mm.
- To use stranded cables without wire end ferrules, twist the strand between 180° and 360°. The stripped area has to be 8 mm after twisting. If stranded cables are introduced, keep the pushbutton of the push-in terminal pressed.
- To remove the cables, press the pushbutton of the push-in terminal.
- To guarantee an UL/CSA-compliant operation, the following conditions have to be met:

- Use only insulated copper wires suitable for at least 60 °C

18 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].

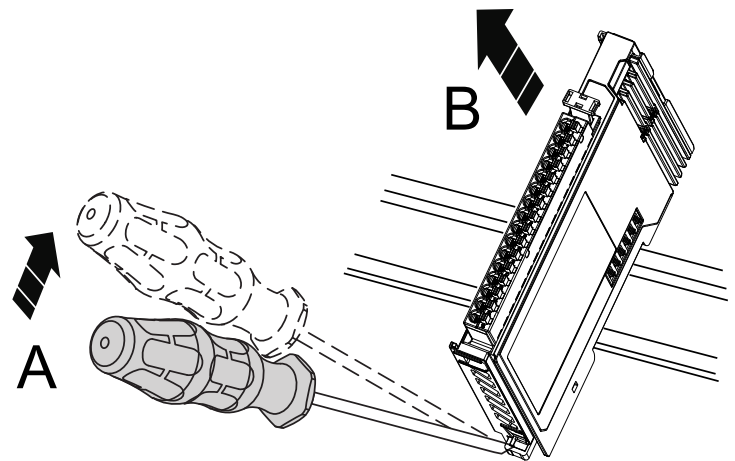


Fig. 7: Removing module from support rail

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 5.

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