

## 1 Functional description

The analog output terminal XI442204 creates output signals in the range from 4 to 20 mA in a ctrlX I/O station. The output signal is output galvanically isolated from the system level with a resolution of 16 bits. The four output channels have a common mass potential. The peripheral supply voltage  $U_P$  supplies the output stages. The logic and peripheral voltage supply as well as the EtherCAT-based module communication are routed through the module.



Fig. 1: Module XI442204

**i** For a system description of the ctrlX I/O modules, refer to the media directory [www.boschrexroth.com/mediadirectory](http://www.boschrexroth.com/mediadirectory) and enter the search term ["R911423458"](http://www.boschrexroth.com/mediadirectory).

**i** Ensure that the current documentation is consulted. For the current documentations, go to [www.boschrexroth.com/mediadirectory](http://www.boschrexroth.com/mediadirectory) and enter the module type as search term.

**i** 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"](http://www.boschrexroth.com/electrics).

## 2 Ordering data

Type	Part number	Description
XI442204	R911406114	Analog output module, current between 4 and 20 mA

**i** For more ordering data (accessories), go to the product catalog under [www.boschrexroth.com/electrics](http://www.boschrexroth.com/electrics).

## 3 Technical data

### 3.1 General technical data

	XI442204	
Number of outputs	4	
Connection method	Push-in terminal	

	XI442204	
Connection technique	2-wire bipolar, shielded, twisted in pairs	
Output signal	4 mA to 20 mA	
Output load	$\leq 500 \Omega$	
Resolution D/A	16 bits	
Accuracy	Typ. $\pm 0.1 \%$ of the end value of the measured range (MBE) Max. $\pm 0.25\%$ of MBE (depending on load, aging and temperature drift)	
Process data update	250 $\mu$ s	
Overload protection	Yes	
Voltage supply	$U_P$ via jumper contacts	
Nominal voltage ( $U_L / U_P$ )	DC 24 V (19.2 V to 30 V, including tolerance and residual ripple) PELV/SELV (safety extra-low voltage)	
Current consumption $U_L$	Max. 40 mA	
Current consumption $U_P$	Max. 80 mA	
Max. power consumption of the module	2.25 W	
Bit width, output data in the process data image	8 bytes (can be set channel-granularly)	
Bit width, input data in the process data image (including filling bits)	10 bytes in the "standard" representation 2 bytes in the "compact" representation (can be set channel-granularly)	
Parameterization	Via ctrlX Works (startup parameter)	
Configuration	No address or configuration setting required	
Dimensions	12 mm $\times$ 105 mm $\times$ 99 mm (width $\times$ height $\times$ depth)	
Weight	100 g (module including connector)	
Electrical isolation	DC 1211 V $U_P$ to $U_L$ , DC 707 V $U_P/U_L$ to FE (not evaluated by UL)	
EMC resistance	Acc. to EN 61000-6-2 and EN 61000-6-4	
Mounting position	Vertical, on a horizontal support rail	
Labeling, approvals	CE, UKCA UL ( <a href="http://www.boschrexroth.com/electrics">File No. E210730</a> )	

### 3.2 Internal schematic diagram

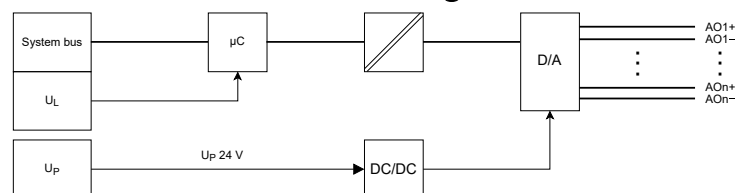


Fig. 2: Internal schematic diagram

### 3.3 Ambient conditions

Ambient temperature		
Up to 2000 m	-25 to +45 $^{\circ}$ C	
From 2000 m	-25 to +40 $^{\circ}$ C	

Maximum operating altitude Acc. to 60204	3000 m
Ambient temperature (storage and transport)	-40 to +70 °C
Permitted air humidity according to DIN EN 61131-2	
Operation	5 to 95 %
Storage	10 to 95 %
Transport	45 to 95 %
Degree of protection Acc. to DIN EN 60 529	IP20 (not evaluated by UL)
Protection class Acc. to DIN EN 61010-2-201	III
Overvoltage category Acc. to IEC 60664-1	2
Contamination level Acc. to IEC 61010-1	2, no condensation

**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 (SO<sub>2</sub>) and hydrogen sulphide (H<sub>2</sub>S)). 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](http://www.boschrexroth.com/electrics).

## 4 For your safety

### 4.1 Intended use

Only use the module 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 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 Signal processing

### 5.1 General information on signal processing

The signal processing of the module consists of several steps shown in this section.

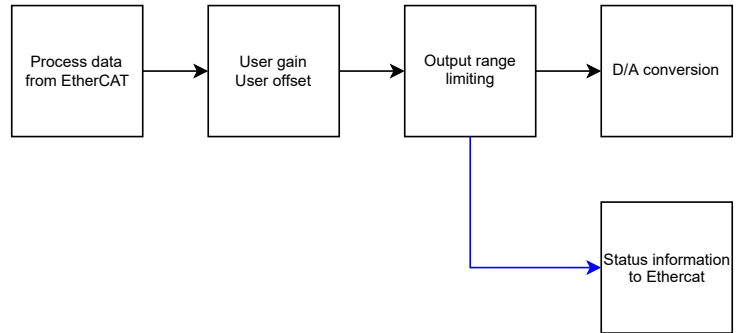


Fig. 3: Overview on signal processing

Diagnostic information is generated from firmware and hardware functions (e.g. overcurrent, wire break). This is displayed in the process data and in the CoE objects. No diagnostic information is generated for disabled channels.

🔗 To disable channels, see ↪ Chapter 7.2 "Disabling channels" on page 4.

### 5.2 Distinctive values and data format

Process data Value	Percent Equivalent current in $\mu$ A	Percent	Edition Value limited	Notes
>21600			21.6 mA	Output limited to 21.6 mA
21600	21.6 mA	108%	21.6 mA	Message on the upper range limit
20000	20 mA	100%	20 mA	–
4000	4 mA	20.0%	4 mA	–
3999	3.999 mA		4 mA	Message, lower range limit, output limited to 4.0 mA
0	0 mA	0%	4 mA	Output limited to 4.0 mA

The process data (output signals) is transmitted as normalized  $\mu$ A values in the format "signed int 16". The process data corresponds to the current value of the value provided at the output. Depending on the setting, gain and offset calculation are to be added. Thus, the conversion to an abstract value range is omitted.

Values smaller than 4 mA are not output. One bit at the DAC (digital-analog converter) corresponds to the value 0.366  $\mu$ A.

### 5.3 Synchronizing the application

The application is synchronized in the mode "SM synchronous". New values are output with each EtherCAT cycle.

### 5.4 User Scale: Gain and offset adjustment

The "User Scale" functionality allows an individual correction of the gain (User Gain) and the offset (User Offset) for each channel.

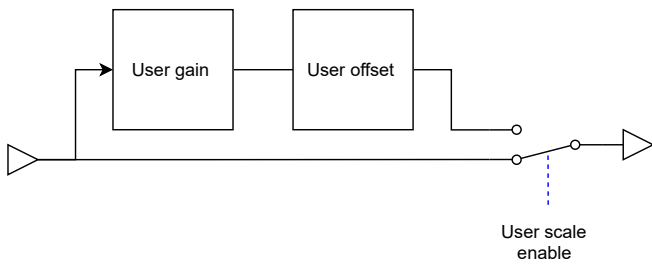


Fig. 4: User Gain and Offset

Enable the functionality "User Scale" to apply the correction. Therefore, set the parameter 80x0:05(hex) "User scale enable" to 1.

Output values to calculate gain and offset:

Value_Range:	The value range at the input of the "User Scale" calculation
Scaled_Value_Range:	The desired value range at the output of the User Scale calculation
Lower_Range_End_Value:	The value at the lower end of the input value range
Scaled_Lower_Range_End_Value:	The desired value at the lower end of the output value range

The values for gain and offset are calculated as follows:

Gain_Factor	= Scaled_Value_Range ÷ Value_Range
User_gain	= (Gain_Factor × 10000) – 10000

Enter the value "User\_gain" into the parameter 80x0:01(hex) "User gain".

Offset	= (Scaled_Lower_Range_End_Value) – (Lower_Range_End_Value × Gain_Factor)
User_offset	= Offset × 1000

Enter the value "User\_offset" into the parameter 80x0:02(hex) "User offset".

**Note** that possible limitations of the value range also remain after the "User Scale" calculation. For more detailed information, refer to the chapter "Distinctive values and data format".

**Note** Offset and gain settings can only be made in the "Pre-OP" state. Set the settings via "Start parameters" to ensure that the start parameters are automatically written to the module each time the EtherCAT bus starts.

### Example 1:

Module is XI422204, analog output with ±10 V. The target is to reduce the value range to values between -3V and +8V while the values of the application still use the value range from -10 V to +10 V.

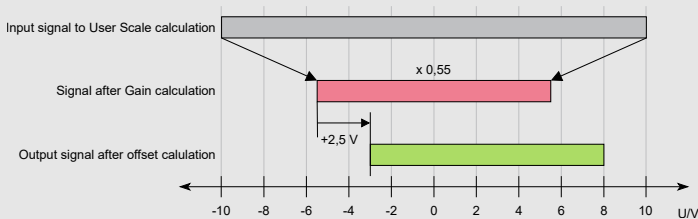


Fig. 5: Value range offset from -10 V .. +10 V to -3 V .. +8 V

Value_Range	= 10 V – (-10 V) = 20 V
Scaled_Value_Range	= 8 V – (-3 V) = 11 V
Lower_Range_End_Value	= -10 V
Scaled_Lower_Range_End_Value	= -3 V
Gain_Factor	= 11 V ÷ 20 V = 0.55
User_gain	= (0.55 × 10000) – 10000 = -4500
Offset	= (-3 V) – (-10 V × 0.55) = 2.5 V
User_offset	= 2.5 × 1000 = 2500

### Example 2

Module is XI342204, analog input from 4 to 20 mA. The connected system specifies 4.5 mA as minimum value and 18.5 mA as maximum value. The values should be mapped to a value range from 4 to 20 mA.



Fig. 6: Value range offset from the range 4.5 mA to 18.5 mA to the range 4 mA to 20 mA

Value_Range	= 18.5 mA – 4.5 mA = 14 mA
Scaled_Value_Range	= 20 mA – 4 mA = 16 mA
Lower_Range_End_Value	= 4.5 mA
Scaled_Lower_Range_End_Value	= 4 mA
Gain_Factor	= 16 mA ÷ 14 mA = 1.1429
User_gain	= (1.1429 × 10000) – 10000 = 1429
Offset	= 4 mA – (4.5 mA × 1.1429) = -1.143
User_offset	= -1.143 × 1000 = -1143

## 5.5 Limiting the value range at the output

Output values on the digital analog converter are limited to the module-specific limits. No values greater or smaller values than the limit values specified under "Distinctive values and data format" are output, see chapter "Distinctive values and data format".

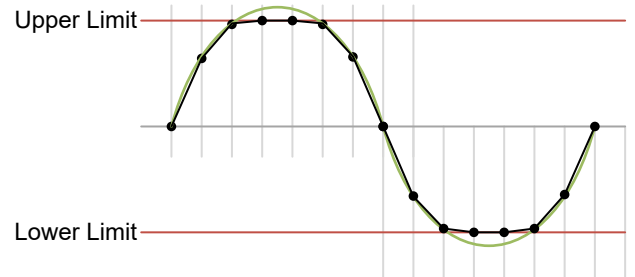


Fig. 7: Limiting the value range at the output

If a value is detected beyond the limits, the value is set to the limit value, the respective bit is set in the process data and in the respective CoE object and a diagnostic message is created.

## 5.6 Substitute Value

When the module starts up initially, 0 V and 0 mA is output as start value (for 4...20 mA modules, 4 mA) is output as start value. Only from the first change after the "SAFE-OP" phase, the substitute value set via the object 80x0:03(hex) is applied. This substitute value is then also output when the module is switched back to the "INIT", "PRE-OP" and "BOOTSTRAP" states. Deactivated channels remain at 0 V and 0 mA.

# 6 Object directory

## 6.1 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

Index (hex)	Name
1018	Identify
10F1	Error settings
10F3	Diagnosis history
10F8	Timestamp object
16nn	PDO mapping RxPDO
1Ann	PDO mapping TxPDO
1C00	Sync manager type
1C12	Sync manager 2 assignment
1C13	Sync manager 3 assignment
1C32	SM output parameter
1C33	SM input parameter
F000	Modular device profile
F100	Device state

## 6.2 Module-specific CoE objects

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

Index (hex)	Object name	Data type	Direction	Error, warning, information	Diagnostic number	Unit
<b>6000</b>	<b>Channel 1, 2, 3, 4</b>					
<b>6010</b>						
<b>6020</b>						
<b>6030</b>						
60x0:01	Wire break	Bit	IN	W	2360(hex)	–
60x0:02	Range limit active	Bit	IN	W	8910(hex) 8920(hex)	–
<b>7000</b>	<b>Channel 1, 2, 3, 4</b>					
<b>7010</b>						
<b>7020</b>						
<b>7030</b>						
70x0:01	Value	Int16	OUT	–	–	µA
A000:0	Material number	String(20)	IN	–	–	–
A010:0	Full serial number	String(20)	IN	–	–	–
F100:01	Periphery voltage ok	Bit	IN	I	2316(hex)	–
F100:02	Error	Bit	IN	E	3421(hex)	–

## 6.3 COE objects for parameterization

The module can be parameterized using these objects. Each channel can be freely parameterized. To do so, use the start parameters. The Engineering provides user-friendly support. The initial value for the objects is either "0" or "false".

⚠ The module does not permanently save the parameter values. To automatically load the settings required upon each bus start, set the values in the start parameters of the Engineering.

Index (hex)	Object name	Data type	Access	Description
<b>8000</b>	<b>Channel 1, 2, 3, 4 settings</b>			
<b>8010</b>				
<b>8020</b>				
<b>8030</b>				
80x0:01	User gain	Int32	RW	Maximum value range -32768 .. +32767
80x0:02	User offset	Int16	RW	–
80x0:03	Substitute value	Int16	RW	–
80x0:04	User scale enable	Bit	RW	–

# 7 Process data

## 7.1 Process data of the module

The module is provided with data that is implemented into the cyclic process data image. Depending on the setting "Standard" or "Compact", the module is represented as shown in the following tables.

Diagnostic information can also be retrieved via acyclic services using CoE. They are shown there as index 80x0(hex) (see Chapter 6.3 "COE objects for parameterization" on page 4).

The current values as well as the diagnostic data can be shown and hidden in the Engineering. This allows the reduction of the amount of data in the application.

Word 1	INT	OUT	Channel 1 Value
Word 2	INT	OUT	Channel 2 Value
Word 3	INT	OUT	Channel 3 Value
Word 4	INT	OUT	Channel 4 Value

Table 1: Output data

Word 1	Byte 1	IN	Channel 1 state
		Bit 0	Channel 1 Wire break
		Bit 1	Channel 1 Range limit active
Word 2	Byte 1	IN	Channel 2 state
		Bit 0	Channel 2 Wire break
		Bit 1	Channel 2 Range limit active
Word 3	Byte 1	IN	Channel 3 state
		Bit 0	Channel 3 Wire break
		Bit 1	Channel 3 Range limit active
Word 4	Byte 1	IN	Channel 4 state
		Bit 0	Channel 4 Wire break
		Bit 1	Channel 4 Range limit active
Word 5	Byte 1	IN	Device state
		Bit 0	Periphery voltage ok
		Bit 1	Error

Table 2: Input data in mapping "Standard"

Word 1	Byte 1	IN	Device state compact
		IN	
		Bit 0	Periphery voltage ok
		Bit 1	Error
		Bit 2	Channel 1 Wire break
		Bit 3	Channel 1 Range limit active
		Bit 4	Channel 2 Wire break
		Bit 5	Channel 2 Range limit active
		Bit 6	Channel 3 Wire break
Bit 7	Channel 3 Range limit active		
Byte 2	IN		
	Bit 0	Channel 4 Wire break	
	Bit 1	Channel 4 Range limit active	

Table 3: Input data in the mapping "Compact"

## 7.2 Disabling channels

Do not disable unused channels in the process data image. This reduces the data width in the process data image. Disabled channels are also disabled in the signal processing. No diagnostic messages are generated for these channels and the error bits in the respective CoE object no longer contain any valid information.

To disable a channel, edit the process data mapping (PDO assignment) of the module in the I/O Engineering Tool. The mapping can be set separately for input and output data. Disable process data of the channel. If the channel has its own Control/Status object in the input/output data, disable it as well.

## 8 Diagnostic strategy

### 8.1 Mechanisms

Different mechanisms are used for the diagnostics of the module.

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(hex)	Error settings
Diagnosis history object	20 diagnostic messages can be stored
10F3(hex)	Diagnosis history
Module status LED	Shows the general module status

### 8.2 Diagnosis history

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 the Diagnosis History object.

Index (hex)	Sub-index	Object name	Data type	Rights	Meaning
10F3		Diagnosis history			Diagnostic statistics
	01	Maximum messages	UINT8	R	Maximum number of messages
	02	Newest message	UINT8	R	Latest message
	03	Newest acknowledged message	UINT8	R/W	Latest confirmed message. Writing "0" deletes the messages in the ring memory.
	04	New messages available	Boolean	R	New message available
	05	Flags	UINT16	R/W	Setting of the object response. Refer to ETG.1020
	06 - 26	Diagnosis message	String	R	Diagnostic message according to ETG.1020

### 8.3 Status codes


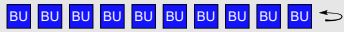
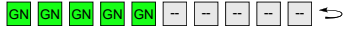



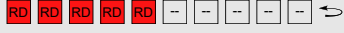
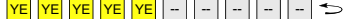
Error, warning, information	Text ID (hex)	Text
E	1000	Module error (internal error, temperature, sum error bit is set)
W	2310	Continuous overcurrent at channel x
W	2360	Open circuit (wire break) at channel x
E	3400	Peripheral supply voltage (U <sub>p</sub> ) missing
W	8910	Overrange at channel x
W	8920	Underrange at channel x

The diagnostics "Wire break" is run channel-granularly. Individual channels can be switched off. Then, no diagnostics is run.

The wire break detection for current outputs requires a minimum output value to work. Minimum output value for detection: Typical 1 mA.

🔧 To disable channels, see ➔ Chapter 7.2 "Disabling channels" on page 4.

### 8.4 Module status LED (diagnostic and device status)

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

🔧 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.
- YE: LED is yellow.

🔧 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.

🔧 To disable channels, see ➔ Chapter 7.2 "Disabling channels" on page 4.

### 8.5 Channel status LED

The modules have no channel status LED. Apart from the diagnostics via EtherCAT at the module, channel errors are only displayed via the state of the module status LED.

## 9 Installation

### 9.1 Clamping point assignment

Clamping point	Signal	LED	Pusher
1	AO channel 1	None	Grey
2	AO channel 1 GND	None	Dark blue
3	AO channel 2	None	Grey
4	AO channel 2 GND	None	Dark blue
5	AO channel 3	None	Grey
6	AO channel 3 GND	None	Dark blue
7	AO channel 4	None	Grey
8	AO channel 4 GND	None	Dark blue

🔧 Connection notes:

- The channel GND outputs are only to be used as reference potential for the respective output.
- These outputs may not be used as peripheral supply GND.
- To supply the connected actuators, use the potential distribution terminals, e.g. XI821116.

### 9.2 Connection instructions

#### 9.2.1 Cable and shielding

##### NOTICE

##### Electronic damages and measuring errors

Unshielded cables can cause that tolerance limits are easily exceeded in an environment prone to interferences.

Always connect the components with shielded cables twisted in pairs.

Connect the cable shielding to the functional earth immediately after entering the control cabinet. Route the cable with its shielding up to the module. The signal cables should be routed the shortest possible without shielding.

For the best connection directly in front of the module, the shield connection set (R911173030) is provided together with the busbar (R911173283).

### 9.3 Pin example

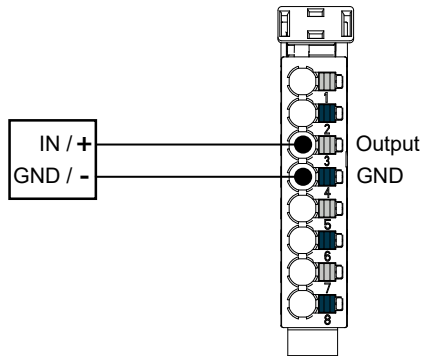
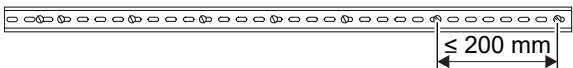


Fig. 8: Pin example

### 9.4 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 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 clamps is secured.
- Support rail  
 Mount the module on a 35 mm standard support rail. Only use a support rail TH 35-7.5 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:

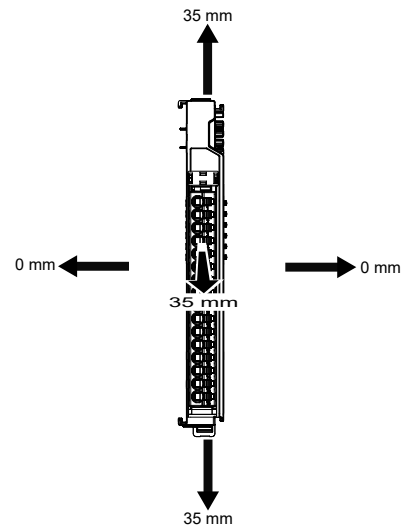


Fig. 9: Ventilation distance

- 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".

### 9.5 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 10.

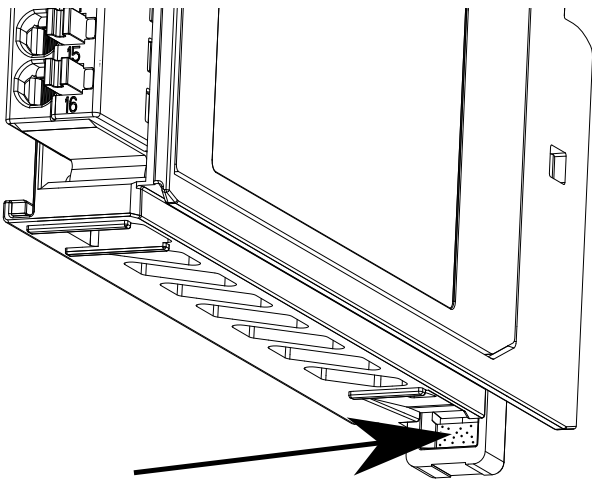


Fig. 10: Locking lever to release the clamping of the open position.

Each module has to be snapped separately.

## 9.6 Positioning plugs

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

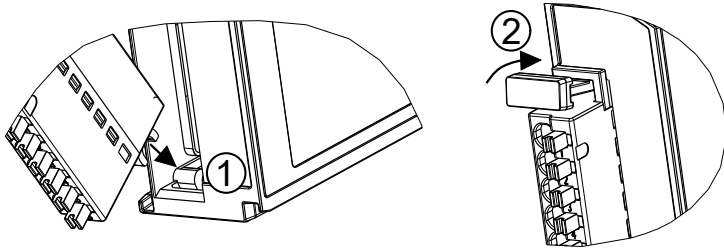


Fig. 11: Positioning plug

## 9.7 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 ( $U_P$ ). Twin wire end ferrules to loop the potentials are thus not required.
- Use only insulated copper wires suitable for at least 75 °C.

### 9.7.1 The plug and its functions

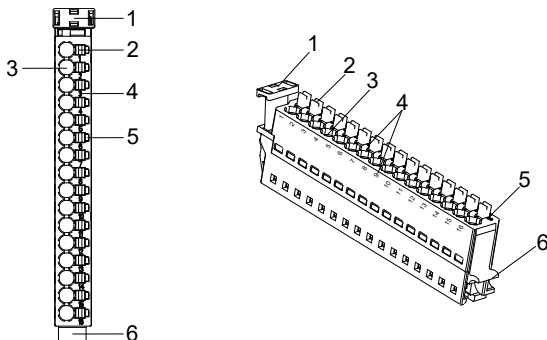


Fig. 12: Plug overview

- ① Locking lever
- ② Pusher
- ③ Clamping point
- ④ Clamping point labeling
- ⑤ Status display
- ⑥ Rotation axis

### 9.7.2 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.

### 9.7.3 Permitted strands

- Solid core  
Stripping length: 8.5 mm  $\pm$  0.5 mm, burr-free
- Braid without wire end ferrule  
Stripping length: The length of the stripped and 360° twisted braid has to be 8.5 mm  $\pm$  0.5 mm
- Braid with wire end ferrule
- Use a cable cross-section corresponding to the current (minimum 0.2 mm<sup>2</sup>, maximum 1.5 mm<sup>2</sup>) to avoid an excessive increase in temperature. A cable cross-section of 1.5 mm<sup>2</sup> 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 mm<sup>2</sup>.
- The insulation of the cables used has to correspond to the rated voltage.

### 9.7.4 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 in the ctrlX I/O system.

### 9.7.5 Orientation of the wire end ferrules

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

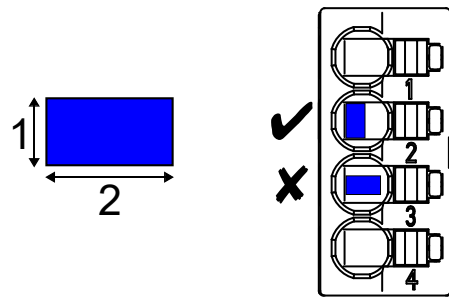


Fig. 13: Orientation of the wire end ferrules in the clamping point

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

### 9.7.6 Mounting strands

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

### 9.7.7 Unmounting strands

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

### 9.7.8 Mounting notes for UL certification

#### Permitted strands

- Use a braid 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 <sup>2</sup>	Ordering numbers of the wire end ferrules (Weidmüller company)
24 AWG	0.2 mm <sup>2</sup>	9025760000, 500 pieces
22 AWG	0.35 mm <sup>2</sup>	9025770000, 500 pieces
20 AWG	0.5 mm <sup>2</sup>	0690700000, 500 pieces 1476230000, 100 pieces
18 AWG	0.75 mm <sup>2</sup>	0462900000, 500 pieces

		1476240000, 100 pieces
-	1 mm <sup>2</sup>	0463000000, 500 pieces
		1476250000, 100 pieces
16 AWG	1.5 mm <sup>2</sup>	0463100000, 500 pieces
		1476270000, 100 pieces

### Strand orientation

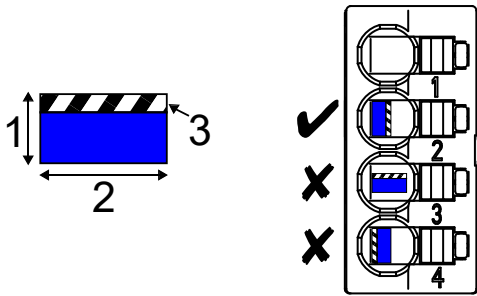


Fig. 14: Orientation of the wire end ferrules in the clamping point

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

### 9.8 Removing plug

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

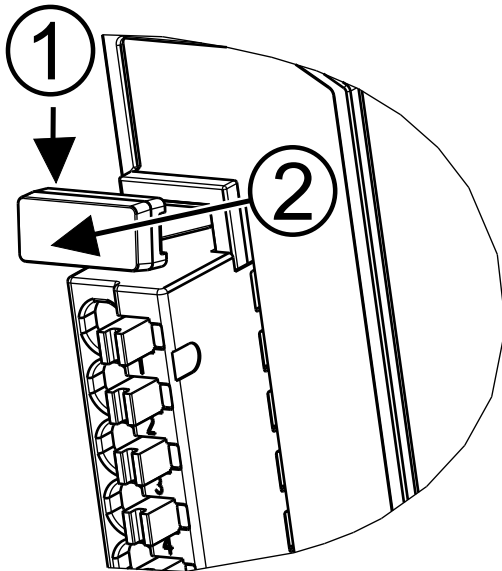


Fig. 15: Removing plug

### 9.9 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].

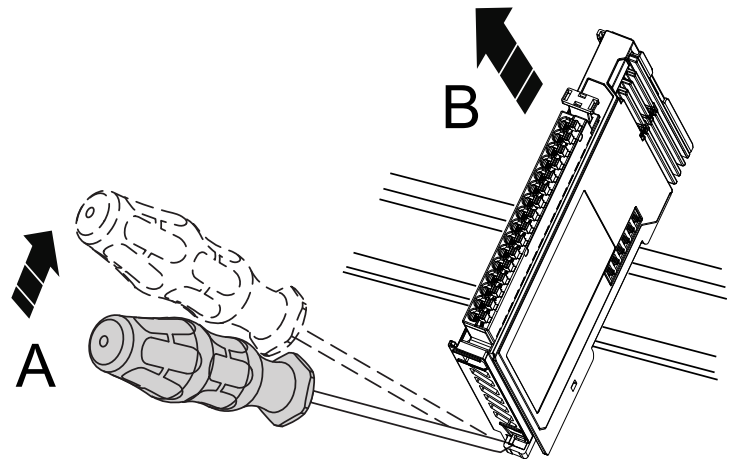


Fig. 16: Removing module from support rail

ⓘ 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 10.

## 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](http://www.boschrexroth.com/mediadirectory) and search for the type code of the module.

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

1. First change to the active state in 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.
2. To open the device editor, double-click on the module in the ctrlX I/O Engineering device tree and select the "FoE" tab.
3. 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.
4. Check that the option "Required state" is active under "Details" and that BOOTSTRAP is selected.
5. 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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