# ctrlX I/O

## Temperature Measurement Module XI361002
## 2-channel, Thermocouples, Internal CJC

DOK-XIO***-XI361002*AI-DA02-EN-P

**R911421968**
**Edition 02**

# 1 Functional description

The XI361002 temperature measurement module reads in temperatures from thermocouples (TC) on two independent channels. The module supports common sensor types such as K, J, T as well as various others and has an internal cold junction compensation (CJC) that can be switched off.

Error states are shown at the status LED of the module and routed to the control via the local bus.

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

Fig. 1: Module XI361002

ℹ 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".

ℹ 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.

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".

# 2 Ordering data

| Type | Part number | Description |
|---|---|---|
| XI361002 | R911406108 | 2-channel analog input module for thermocouples (TC) |

ℹ For more ordering data (accessories), go to the product catalog under ➦ www.boschrexroth.com/electrics.

# 3 Technical data

## 3.1 General technical data

| | |
|---|---|
| Number of inputs | 2 |
| Connection method | Push-in terminal |
| Connection technique | 2-wire, shielded, twisted in pairs |
| Signal type | Differential |
| Supported sensor types | B, C, E, J, K, L, N, R, S, T, U |
| Value range | For the sensors, refer to the details |
| Resolution ADC | 24 Bits |
| Representation | 16 Bits incl. sign |
| Accuracy typ. | 0.3% of the measuring range; type K |
| Resolution | 0.1 °C, 0.1 °F |
| Unit | Switchable, °C or °F |
| Conversion time typ. | 240 ms for 1 channel<br>480 ms for 2 channels |
| Overload protection / Common Mode | DC 9.9 V max. |
| 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 $U_L$ | 42 mA |
| Current consumption $U_P$ | 12 mA |
| Max. power consumption of the module | 1.2 W |
| Bit width of the input data in the process data image, including fill byte, can be set channel-granularly | 10 Bytes |
| Parameterization | Via ctrlX Works (start parameter) |
| Configuration | No address or configuration setting required |
| Dimensions | 12 mm × 105 mm × 99 mm (width × height × depth) |
| Weight | 86 g (module including connector) |
| Electrical isolation | DC 1200 V $U_P$ to $U_L$, DC 707 V $U_P$/$U_L$ to FE, tested for 60 s each<br>(not evaluated by UL) |
| 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

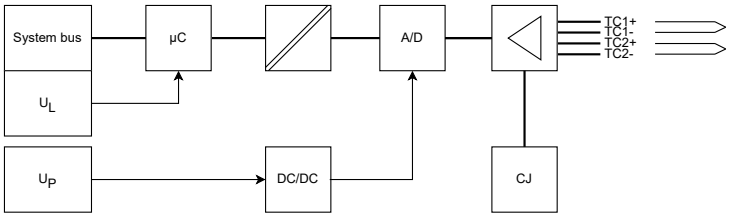



Fig. 2: Internal schematic diagram

## 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 Acc. to DIN 60204 | 5,000 m |
| 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 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 EN 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 ($SO_2$) and hydrogen sulphide ($H_2S$)). 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<br>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<br>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 |

ℹ 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 Signal processing

## 5.1 General information on signal processing

The signal processing of the module consists of several components shown in this section. The low-pass filter and the 50/60 Hz filter are implemented in hardware components while other components are implemented as firmware functions.

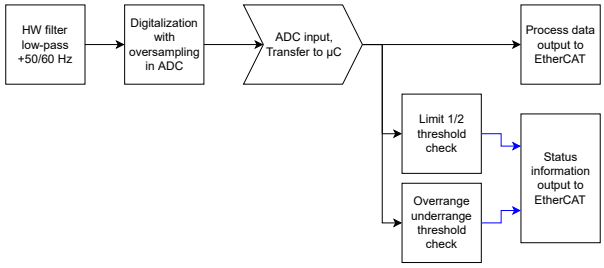



Fig. 3: Signal processing

## 5.2 Supported sensor types and measurement accuracy

| Sensor | Minimum Temperature | Maximum Temperature | Recommended minimum temperature | Recommended maximum temperature |
|---|---|---|---|---|
| B | +40 °C | 1820 °C | +600 °C | 1820 °C |
| C | 0 °C | 2315 °C | 0 °C | 2315 °C |
| E | -265 °C | 1000 °C | -100 °C | 1000 °C |
| J | -210 °C | 1200 °C | -100 °C | 1200 °C |
| K (standard) | -265 °C | 1372 °C | -100 °C | 1372 °C |
| L | -200 °C | 900 °C | -100 °C | 900 °C |
| N | -265 °C | 1300 °C | -100 °C | 1300 °C |
| R | -50 °C | 1768 °C | +250 °C | 1768 °C |
| S | -50 °C | 1768 °C | +250 °C | 1768 °C |
| T | -265 °C | 400 °C | -100 °C | 400 °C |
| U | -200 °C | 600 °C | -100 °C | 600 °C |

Table 1: Sensors and temperature ranges in degree Celsius

| Sensor | Minimum Temperature | Maximum Temperature | Recommended minimum temperature | Recommended maximum temperature |
|---|---|---|---|---|
| B | +104 °F | 3276.7 °F | 1112 °F | 3276.7 °F |
| E | -445 °F | 1832 °F | -148 °F | 1832 °F |
| J | -346 °F | 2192 °F | -148 °F | 2192 °F |
| K (standard) | -445 °F | 2501.6 °F | -148 °F | 2501.6 °F |
| L | -328 °F | 1652 °F | -148 °F | 1652 °F |
| N | -445 °F | 2372 °F | -148 °F | 2372 °F |
| R | -58 °F | 3214.4 °F | +482 °F | 3214.4 °F |
| S | -58 °F | 3214.4 °F | +482 °F | 3214.4 °F |
| T | -445 °F | 752 °F | -148 °F | 752 °F |
| U | -328 °F | 1112 °F | -148 °F | 1112 °F |

Table 2: Sensors and temperature ranges in degree Fahrenheit

Sensor type "C" is supported as of firmware version 1.2.0 and only in the "Celsius" setting.

**NOTICE**

**Falsified measured values**

Use galvanically isolated sensors to avoid falsified measured values.

### 5.2.1 Measurement accuracy

The measurement accuracy is specified over the entire recommended measuring range. Note that measurement errors increase strongly below the recommended range. The thermoelectric voltages are too low there to ensure accuracy and linearity in the specified range.

The measurements to determine the measurement accuracy were made at nominal operation with an ambient temperature of 23°C. The considered module was located between two similar modules at the end of a ctrlX I/O station. The specified accuracies apply to an active internal cold junction compensation. Other ambient and installation conditions can result in a higher inaccuracy.

| Sensor | Absolute accuracy over the recommended temperature range | Relative accuracy over the recommended temperature range |
|---|---|---|
| B | ±9.2 K | ±0.40% |
| C | ±4.8 K | ±0.21% |
| E | ±4.4 K | ±0.35% |
| J | ±4.1 K | ±0.29% |
| K (standard) | ±4.8 K | ±0.29% |
| L | ±4.1 K | ±0.37% |
| N | ±5.1 K | ±0.33% |
| R | ±5.9 K | ±0.32% |
| S | ±6.3 K | ±0.35% |
| T | ±5.4 K | ±0.81% |
| U | ±5.2 K | ±0.65% |

Table 3: Measurement accuracy XI361002

### 5.2.2 Switch-on behavior

The measurement accuracy when switching on with an active internal cold junction compensation depends on the heating of the cold junction. Thus, the general heating of the control cabinet and module results in a change of the measurement accuracy until the temperature level is stable.

The module has a warm-up time of about 30 minutes until the measured values are stable. The change immediately after switching on is higher and becomes lower over time until the value is stable.

For larger stations and other sources of heat in the control cabinet, the process may take longer with only a little change in measurement accuracy after 30 minutes.

## 5.3 Synchronizing the application

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

## 5.4 Signal filtering

In addition to a low-pass filter at the input of the analog-to-digital converter (ADC), this ADC contains a configurable digital notch filter to attenuate mains frequencies.

Possible values: 50 Hz, 55 Hz (Presetting), 60 Hz.

The filter is configured via the object xF800:02.

## 5.5 Limit value check of the upper and lower range limit

The input data from the analog-to-digital converter (ADC) is used to check whether the values are above or below the valid range.

Accordingly, the status bits "Overrange" and "Underrange" are set in the process data and the corresponding diagnostic messages are sent.

The limit values at which diagnostics are set and reset differ depending on the sensor type.

## 5.6 Limit value check of the process data

There are two individual and independent limit value checks per channel specifying whether the process data value is lower, equal to or higher than the limit value set.

The limit value to be checked is set in the parameter "Limit 1" or in the parameter "Limit 2" of the object "Channel x settings". The format of the limit value corresponds to that of the process data.

Each individual limit check is enabled using the parameter "Limit y enable" in the object "Channel x settings".

The result of the check is output in the process data "Ch. x Limit y". Alternatively, it can be retrieved either via the CoE object 60x0:04(hex) ("Channel x Limit 1") or the CoE object 60x0:06(hex) ("Channel x Limit 2"). Meaning of the bits:

| Bit | Meaning |
|---|---|
| 0 | 1 if the value is lower than or equal to the set date. |
| 1 | 1 if the value is higher than or equal to the set date. |

## 5.7 Error detection and response

The module is provided with different error detection mechanisms:

- Limit value check of the upper and lower range limit (refer to the respective chapter) ➥Chapter 5.5 “Limit value check of the upper and lower range limit” on page 3
- Detection of sensor and wiring errors
  Possible causes: Sensor not connected, sensor lines interrupted or short-circuited.
- Error detection during conversion
  Possible causes: Value beyond the value range of the ADC, only for the module XI361002 for thermocouples: Error in the cold junction compensation
- Undervoltage detection peripheral voltage supply

| Error | Process data | Status bit | Diagnostic message |
|---|---|---|---|
| Limit value check | Measured temperature | Channel: Underrange / Overrange | 8920(hex) Underrange 8910(hex) Overrange |
| Sensor/wiring error | -9990 (=-999.0°) | Channel: Error Bit | 8940(hex) Sensor fault |
| Error during conversion | -9990 (=-999.0°) | Channel: Error Bit | 1010(hex) Error at channel X |
| Peripheral voltage supply | -9990 (=-999.0°) | Device State: Error Bit + Periphery voltage OK | 3400(hex) Periphery supply voltage (UP) missing |

*For detailed diagnostic messages, see chapter "Status codes".*

# 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 |
| 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 |

| Index (hex) | Name |
|---|---|
| F100 | Device state |
| F800 | Device settings |

## 6.2 Module-specific CoE objects

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

| Index (hex) | Object name | Data type | Access | Description |
|---|---|---|---|---|
| **A000** | **ModuleIdentification** | | | |
| A000:0 | Material number | String(20) | RO | Part number of the module |
| A010:0 | Full serial number | String(20) | RO | Complete serial number of the module |
| **F100** | **Module diagnostics and information** | | | |
| F100:01 | Periphery voltage OK | BIT1 | RO | Indicates the peripheral voltage state, 1 = OK; 0 = Not OK |
| F100:02 | Error | BIT1 | RO | General module error |

## 6.3 COE objects for parameterization

The module can be parameterized using these objects. Each channel can be freely parameterized.

The module does not remanently store the parameter values. To automatically load the settings required upon each bus start, set the values in the start parameters of the Engineering application "ctrlX I/O Engineering".

| Index (hex) | Object name | Data type | Access | Description | Default (hex) |
|---|---|---|---|---|---|
| **8000 8010** | **Channel 1, 2 settings** | | | | |
| 80x0:01 | Limit 1 | Int16 | RW | Value for limit value check 1 of the channel, specified in 0.1 °C / °F / Ω | 0 |
| 80x0:02 | Limit 2 | Int16 | RW | Value for limit value check 2 of the channel, specified in 0.1 °C / °F / Ω | 0 |
| 80x0:03 | Limit 1 enable | Bit | RW | Enables the limit value check 1 of the channel<br>0: Disabled<br>1: Enabled | 0 |
| 80x0:04 | Limit 2 enable | Bit | RW | Enables the limit value check 2 of the channel<br>0: Disabled<br>1: Enabled | 0 |
| 80x0:05 | CJC active | Bit | RW | Enable cold junction compensation for the channel<br>0: Disabled<br>1: Enabled | 1 |
| 80x0:06 | - | Bit5 | - | Fill bits | |
| 80x0:07 | Sensor type | Bit8, ENUM | RW | Selection of the sensor type<br>0x00: Type B<br>0x01: Type C<br>0x02: Type E<br>0x03: Type J<br>0x04: Type K<br>0x05: Type L<br>0x06: Type N<br>0x07: Type R<br>0x08: Type S<br>0x09: Type T<br>0x0A: Type U | 4 (Type K) |
| **F800** | **Device Settings** | | | | |
| F800:01 | Temperature unit | 8 Bits (ENUM) | RW | Temperature unit for process data and all CoE objects<br>0x00: Celsius<br>0x01: Fahrenheit | 0: Celsius |
| F800:02 | Filter settings | 8 Bits (ENUM) | RW | Frequency selection for the mains frequency filter<br>0x00: 55 Hz<br>0x01: 60 Hz<br>0x02: 50 Hz | 0: 55 Hz |

# 7 Process data

## 7.1 Process data of the module

| Index (hex) | Object name | Data type | Access | Description | Default (hex) |
|---|---|---|---|---|---|
| **6000 6010** | **Channel 1, 2** | | | | |
| 60x0:01 | Value | Int16 | RO | Measured value in 0.1 °C / °F / Ω | 0 |
| 60x0:02 | Error | Bit | RO | Channel error (short circuit, cable break) | 0 |
| 60x0:03 | Underrange | Bit | RO | Measurement underrange | 0 |
| 60x0:04 | Overrange | Bit | RO | Measurement overrange | 0 |
| 60x0:05 | Limit 1 | Bit2 | RO | Result of limit value check 1<br>Bit0: Value ≤ Limit 1<br>Bit1: Value ≥ Limit 1 | 0 |
| 60x0:07 | Limit 2 | Bit2 | RO | Result of limit value check 2<br>Bit0: Value ≤ Limit 2<br>Bit1: Value ≥ Limit 2 | 0 |
| 60x0:08 | - | Bit9 | - | Fill bits | |

The representation of the measured values (both in the process data and in the CoE objects) is standardized to the set temperature unit (°C / °F / Ω). The value is specified with one decimal place.

| Temperature (°C / °F) | Data |
|---|---|
| 36.8 | 368 |
| 0.0 | 0 |
| -31.4 | -314 |

Table 4: Example representation of temperature values

## 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

| Text ID (hex) | Error, warning, information | Text |
|---|---|---|
| 1000 | Error | Module error <opt. info> - internal Error, Temperature, Error bit is set |
| 1010 | Error | Error at channel <Channel no.> |
| 1020 | Warning | Error during update, data corrupted, please update again |
| 3400 | Error | Periphery supply voltage ($U_P$) missing |
| 6820 | Warning | Complete Access of subindex <index>:<subindex> not allowed |
| 8910 | Warning | Overrange at channel <Channel no.> |
| 8920 | Warning | Underrange at channel <Channel no.> |
| 8940 | Warning | Sensor fault at channel <Channel no.> |

## 8.4 Module 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 -- -- -- -- -- ⮌ |
| Channel error | YE YE YE YE YE -- -- -- -- -- ⮌ |

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.

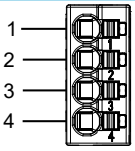
A new status is only displayed after the previous flashing cycle has elapsed. A change in status can thus be delayed up to two seconds.

## 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 |
|---|---|---|---|
|  | Channel 1+ | None | Grey |
| | Channel 1- | None | Grey |
| | Channel 2+ | None | Grey |
| | Channel 2- | None | Grey |



## 9.2 Connection instructions

### 9.2.1 Differential input and potential reference

For analog inputs, there are inputs without a reference to an external mass. Thus, note that the "Common Mode" – the average value of the signals at the plus pin and at the minus pin – is not higher than the value specified in the technical data compared to the internal mass $U_P$ GND.

### 9.2.2 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.

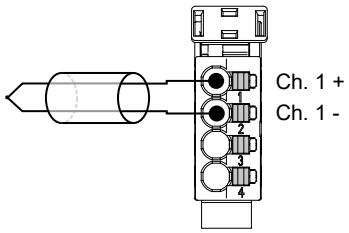
Connect the cable shielding to the functional earth immediately after entering the control cabinet. Route the cable with its shielding up to the module. The signal cables should be routed the shortest possible without shielding.

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

## 9.3 Connection examples

### 9.3.1 Temperature measurement with absolute value

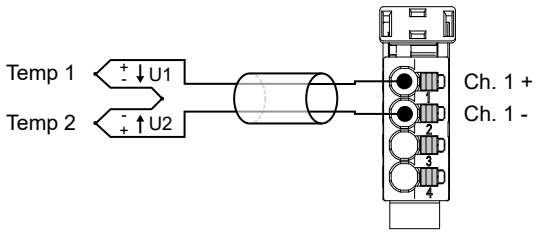
When measuring the temperature to determine an absolute value, the thermocouple is connected as shown. The internal cold junction compensation is switched on.




### 9.3.2 Differential temperature measurement

The differential temperature measurement allows to determine exact temperature differences between two measuring points (e.g. between flow and return).

Two thermocouples are connected in series in opposite directions while the cold junction compensation is disabled.




## 9.4 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/ctrx-i-o-anwendungsbeschreibung/latest/en/.

**NOTICE**

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

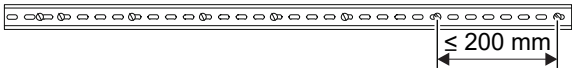
Follow the mounting instructions in the application manual to ensure a correct mounting and to prevent damage to the device.

**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 dismounting the module.




- Provide the following minimum distances for sufficient cooling:

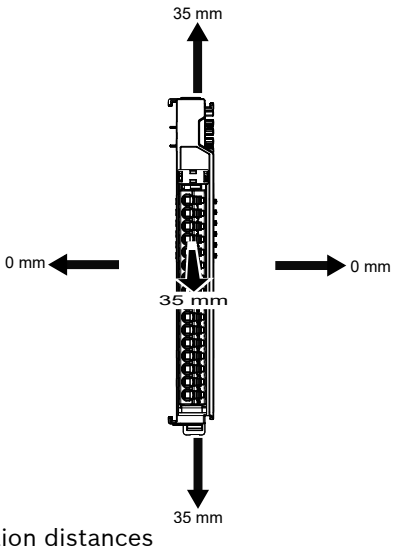



Fig. 4: Ventilation distances

- 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.

### 9.4.1 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 dismounting.

**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. 5.

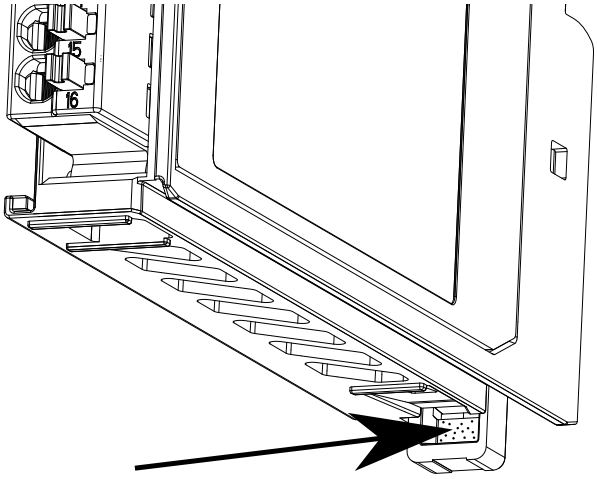



Fig. 5: Locking lever to release the clamping of the open position.

Each module has to be snapped separately.

### 9.4.2 Positioning plug

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

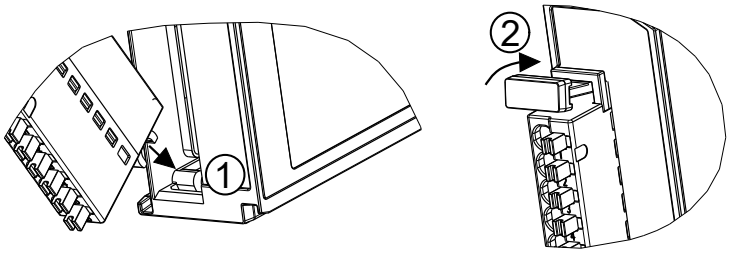



Fig. 6: Positioning plug

### 9.4.3 Removing plug

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

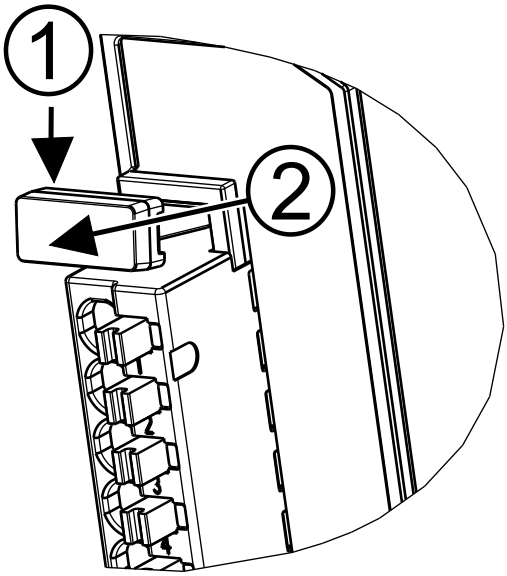



Fig. 7: Removing plug

### 9.4.4 Dismounting module

ℹ 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].

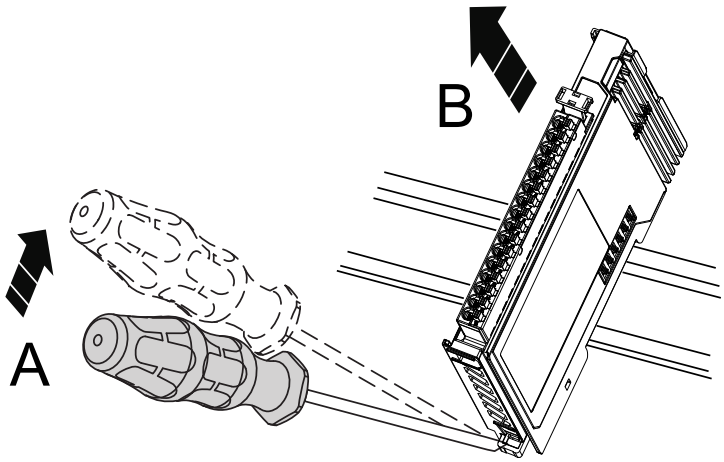



Fig. 8: Removing module from support rail

ℹ 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. 5.

### 9.4.5 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 ±.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 ±0.5 mm
- Flexible line with wire end ferrule
- Use a cable cross-section corresponding to the current (minimum 0.2 $mm^2$, maximum 1.5 $mm^2$) to avoid an excessive increase in temperature. A cable cross-section of 1.5 $mm^2$ 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 $mm^2$.
- 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.

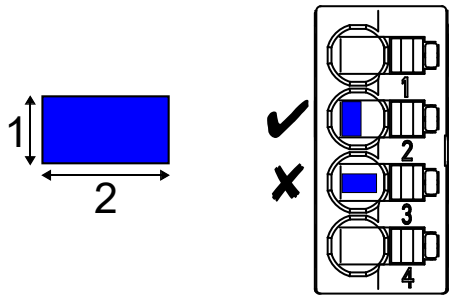



Fig. 9: Orientation of the wire end ferrules in the clamping point
1 Height of the crimped wire end ferrule
2 Width of the crimped wire end ferrule

### 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 mm² | Ordering numbers of the wire end ferrules (Weidmüller company) |
|---|---|---|
| 24 AWG | 0.2 mm² | 9025760000, 500 pieces |
| 22 AWG | 0.35 mm² | 9025770000, 500 pieces |
| 20 AWG | 0.5 mm² | 0690700000, 500 pieces |
| | | 1476230000, 100 pieces |
| 18 AWG | 0.75 mm² | 0462900000, 500 pieces |
| | | 1476240000, 100 pieces |
| - | 1 mm² | 0463000000, 500 pieces |
| | | 1476250000, 100 pieces |
| 16 AWG | 1.5 mm² | 0463100000, 500 pieces |
| | | 1476270000, 100 pieces |

#### Orientation of wire end ferrules

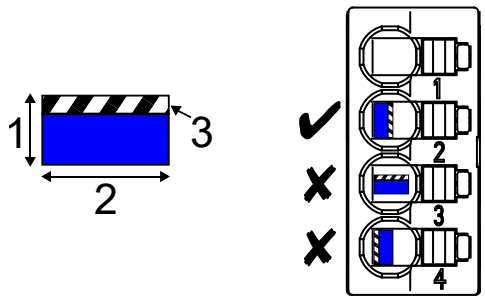



Fig. 10: Orientation of the wire end ferrules in the clamping point
1 Height of the crimped wire end ferrule
2 Width of the crimped wire end ferrule
3 Crimped side of the wire end ferrule

# 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.

ℹ 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.

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

ℹ 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

## 11.3 Ring-buffer



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