EQX EXPANSION MODULE · EQXTCxx FAMILY

6 Channel K-Thermocouple Sensor Expansion Module for EQSP32 Micro PLC

1 Description

The **EQXTC06** is a **six-channel thermocouple** expansion module for the EQSP32 Micro-PLC IoT controller, designed for precise temperature measurements in industrial applications.

Supporting **K-type thermocouples**, each module sequentially processes and updates all of its six channels. With up to 15 cascaded modules, a single EQSP32 may be equipped with **up to 90 thermocouple sensors** without adding to the system's processing time.

The processed temperature data is automatically requested by the EQSP32 controller and made available locally, as if it were a native EQSP32 peripheral.

It incorporates **ESD protection**, integrated **cold-junction compensation**, and a **high-resolution 14-bit** signed conversion, delivering a nominal temperature resolution of 0.25°C.

With its **integrated fault detection** capabilities, reliable operation is ensured by quickly highlighting and addressing potential wiring issues. The fault detection includes identifying thermocouple shorts to GND or VCC as well as open sensor connections.

It is housed in a space-efficient **DIN-rail mountable enclosure**, tailored for easy installation and organized wiring within control cabinets. Its design includes high-quality **screw terminals**, ensuring secure and reliable connections for thermocouple sensors, minimizing the risk of disconnections in industrial settings.

Designed for industrial environments, the module operates reliably in temperatures ranging from **−20 °C to +55 °C** and features IP20 protection.

The EQXTC06 is **automatically detected by the EQSP32** upon power-up, functioning seamlessly as a native peripheral. Powered directly through the EQSP32's board-to-board connector, it eliminates the need for additional power supplies. This plug-and-play capability simplifies setup, enabling users to expand their systems with minimal effort or configuration.

Firmware updates are easily applied through its front-facing USB-C port, ensuring quick access to the latest features and improvements. This update mechanism **minimizes downtime** and maintains optimal functionality without removing the module from the system. The front-facing LEDs provide **visual indicators** for power and operational status, for easy assessment of the module's state.

The EQXTC06 is supported by the **EQ-AI generative AI** model, simplifying programming and integration by assisting in code generation. This innovative approach **reduces complexity and accelerates deployment**, making advanced industrial solutions accessible to users with varying technical expertise.

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2 Key Features

- Six-channel support for K-type thermocouples
- High-resolution 14-bit signed conversion with 0.25°C nominal temperature resolution
- Integrated cold-junction compensation for precise ambient temperature adjustment
- Fault detection for shorts to GND, VCC, and open thermocouple connections
- ESD protection up to ±2kV (Human Body Model)
- Compact DIN-rail mountable design for organized installation
- Automatic detection by EQSP32
- LED indicators for power and status monitoring
- Front-facing USB-C port for convenient firmware updates
- Powered directly by EQSP32, no external power supply required
- Simplified integration with EQ-AI generative AI for easy code generation
- Compact, 2SU-wide (36 mm), DIN-rail mount enclosure with 12 screw terminals
- −20 °C to +55 °C operating ambient temperature
- IP20-rated enclosure

3 Applications

- Industrial temperature monitoring.
- Process control systems.
- HVAC system management.
- Furnace and oven control.
- Food and beverage processing.
- Plastic and rubber manufacturing.
- Pharmaceutical production.
- Energy and utility monitoring.
- Oil and gas operations.
- Environmental monitoring.
- Textile industry processes.
- Cold chain logistics.
- Building automation systems.
- Aerospace testing.
- Brewing and distillation.
- Waste management systems.

4 Ordering Information

Part number	Description	Inputs	Enclosure
EQXTC06	6 Channel K-Thermocouple Sensor Expansion Module for EQSP32	6 × K-type thermocouple	2SU (36 mm) DIN-rail, IP20

Product page and ordering: erqos.com/product/eqxtc06

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Contents

1 Description....1
2 Key Features....2
3 Applications....2
4 Ordering Information....2
5 Block Diagram....4
6 Specifications....5
6.1 System Specifications....5
6.2 Absolute Maximum Ratings....5
7 Connecting EQXTC....5
8 Visual Indications....6
8.1 LED Indications....7
9 Pinout....8
9.1 X1 – Screw Terminal Connector 1....8
9.2 X2 – Screw Terminal Connector 2....8
10 Power Distribution....9
11 Thermocouple Sensor Inputs....10
11.1 Equivalent Thermocouple Conditioning and Measurement Circuit....10
11.2 Thermocouple Wiring....10
11.3 Readings and Fault Codes....10
12 Boot Button and Firmware Update....12
12.1 Boot Button....12
13 Mechanical Dimensions....13
14 Notices....14
15 Revision History....14

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5 Block Diagram

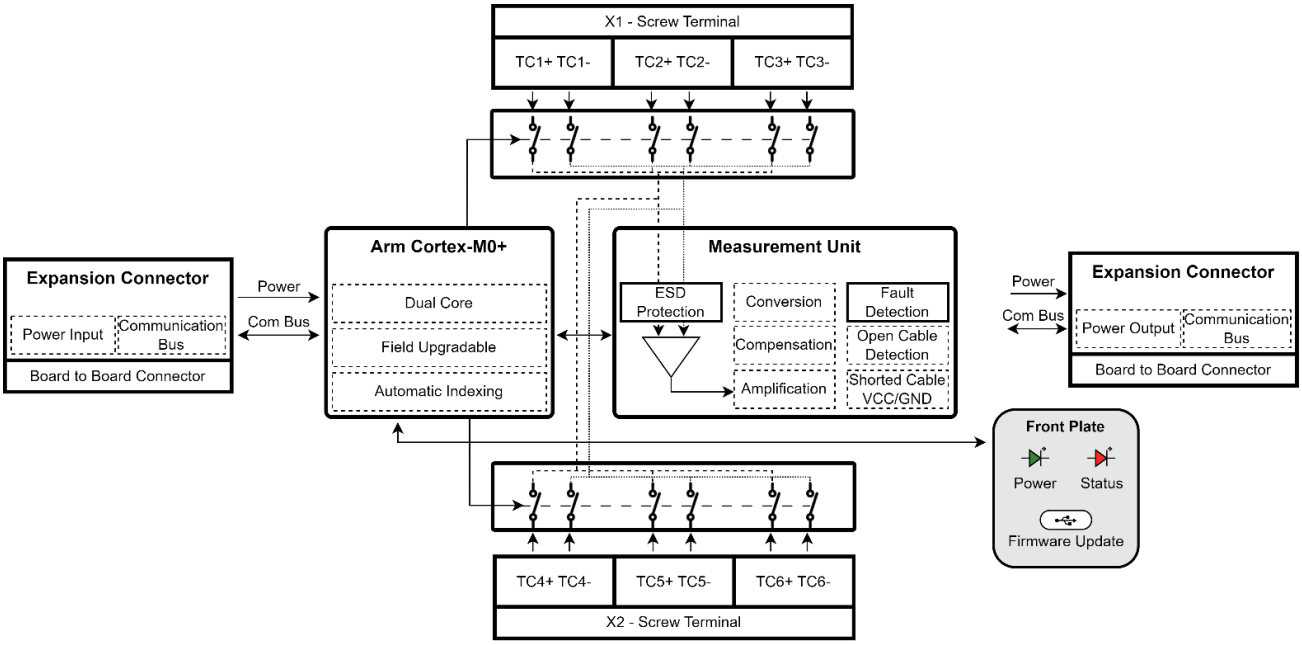

Figure 5-1. EQXTC06 block diagram

6 Specifications

6.1 System Specifications

Table 6-1. System Specifications

Section	Features
Power Management	Supplied by the board-to-board connector
Thermocouple Inputs	6 x K-type thermocouple sensor inputs Measuring range −200 °C to +1350 °C 14-bit signed temperature readings with 0.25°C nominal temperature resolution Integrated cold-junction compensation ESD protection up to ±2kV (Human Body Model) Shorted sensor to GND or VCC, and open sensor
Indications	Green LED for power indication Red LED for device status
Enclosure	Easy standard DIN rail push-fit mounting with spring mechanism IP20
Expandability	Push-fit expansion module mounting Automatic module detection and characterization
Firmware Update	Front-facing USB-C for easy firmware upgrades
Environment	−20 °C to +55 °C

6.2 Absolute Maximum Ratings

Table 6-2. Absolute Maximum Ratings

Pin	Type	Min.	Typ.	Max.	Unit
T+, T- to GND	Analog Input	-0.3		3.6	V
T+, T- ESD (Human Body Model)	Analog Input	-2000		2000	V

7 Connecting EQXTC

To use the EQXTC thermocouple sensor expansion module, mount it next to the EQSP32 controller on the DIN rail and simply slide it until the board-to-board connector is fully inserted into EQSP32.

The expansion module is powered by the board-to-board connector and does not require an external power supply.

When adding additional modules, it is recommended that the power is disconnected from the system. After adding the expansion modules and powering up the system, EQSP32 will start the automatic detection and indexing process.

For safety and ease of use, it is strongly recommended that a main circuit breaker is used to completely isolate the AC/DC from the grid.

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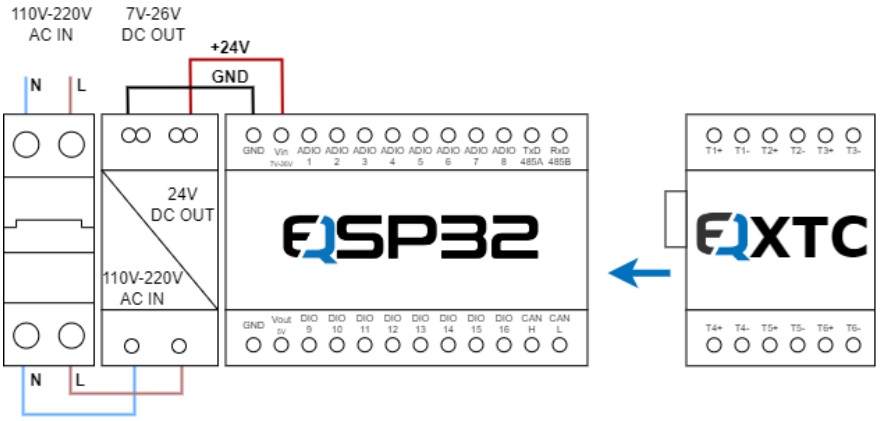

Figure 7-1. Slide EQXTC to connect on EQSP32

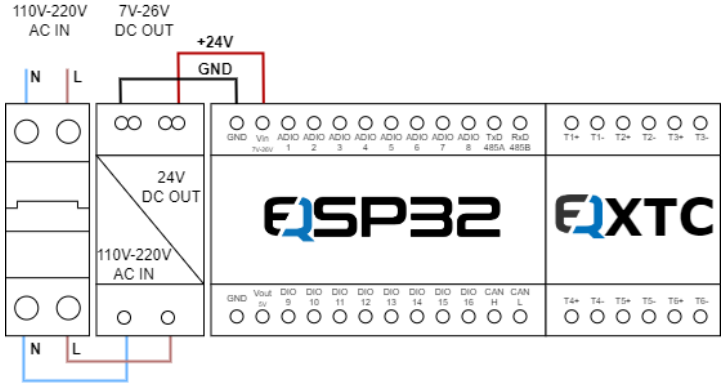

Figure 7-2. Connected EQXTC on EQSP32

> **WARNING**
> Make sure that the appropriate ground fault circuit breaker, fuses or circuit breakers and any other necessary protective components are used if there is any risk of user electrocution.

8 Visual Indications

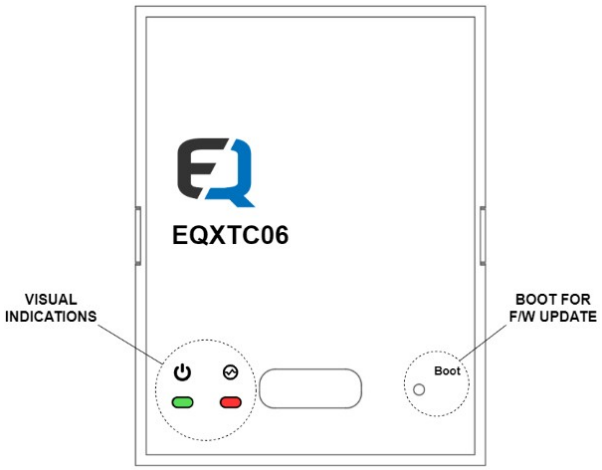

Figure 8-1. Front panel: LEDs and Boot button

When the module is connected and the system is powered on, the POWER LED should light up solid green.

If the STATUS LED is solid red after the automatic detection, it means that the EQXTC module has encountered a communication issue.

During data exchange between the main EQSP32 unit and the EQXTC module, the STATUS LED will be flashing for each transaction.

8.1 LED Indications

Table 8-1. LED indications

State	Meaning	Pattern
Power LED		
On	Powered on	
Off	No power	
Status LED		
Off	No errors, no communication	
Fast Flashing	Data exchange	
On	Communication error	

9 Pinout

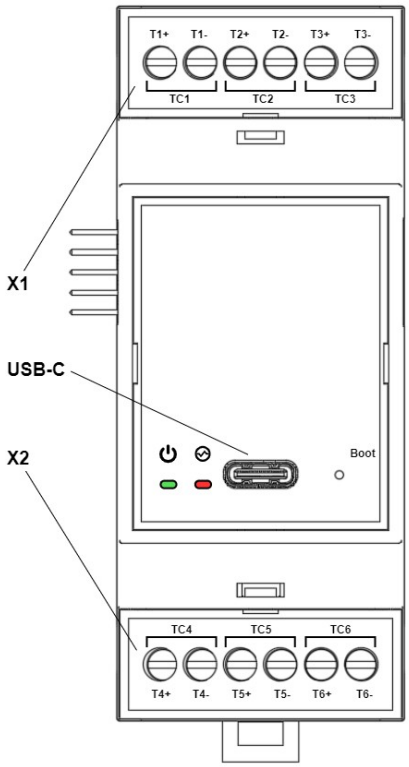

Figure 9-1. EQXTC06 terminals and front panel

X1 – Screw terminal connector 1

USB-C – Firmware update port

X2 – Screw terminal connector 2

9.1 X1 – Screw Terminal Connector 1

The X1 connector provides wiring connections for thermocouple sensors' channels 1, 2, and 3, marked as TC1, TC2 and TC3 respectively.

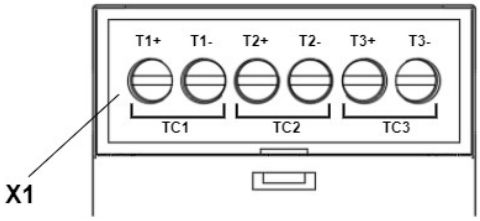

Figure 9-2. X1 terminals

Table 9-1. X1 – Screw Terminal Connector 1

Name	Pin	Function	Type
X1	T1+, T2+, T3+	Positive thermocouple terminal (+)	ANALOG IN
	T1-, T2-, T3-	Negative thermocouple terminal (-)	ANALOG IN

9.2 X2 – Screw Terminal Connector 2

The X2 connector provides wiring connections for thermocouple sensors' channels 4, 5, and 6, marked as TC4, TC5 and TC6 respectively.

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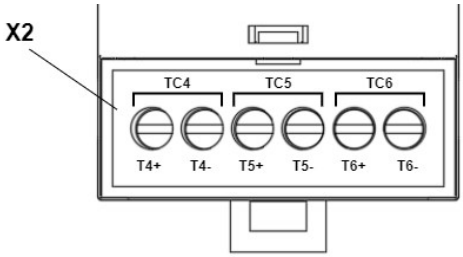

Figure 9-3. X2 terminals

Table 9-2. X2 – Screw Terminal Connector 2

Name	Pin	Function	Type
X2	T4+, T5+, T6+	Positive thermocouple terminal (+)	ANALOG IN
	T4-, T5-, T6-	Negative thermocouple terminal (-)	ANALOG IN

10 Power Distribution

EQXTC's core and peripherals are powered by EQSP32's power management unit via the board-to-board connector. The board-to-board connector carries the power lines for system operation and the communication bus for allowing the expansion modules to interact with the main EQSP32 unit.

EQXTC's control unit may also be powered by the front-facing USB-C port. By connecting the thermocouple sensor expansion module via the USB-C port, the system's core will be powered on. This allows for easy firmware update without being connected to the EQSP32 or any external power supply.

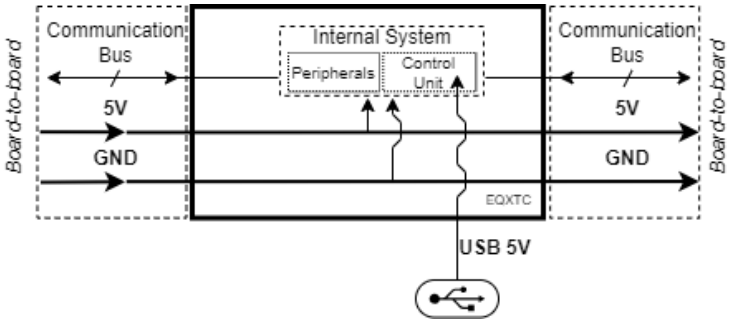

Figure 10-1. Power distribution

11 Thermocouple Sensor Inputs

11.1 Equivalent Thermocouple Conditioning and Measurement Circuit

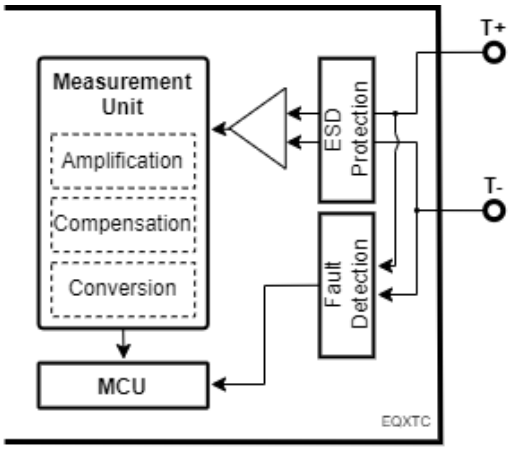

Figure 11-1. Equivalent Thermocouple Input Circuit

11.2 Thermocouple Wiring

The thermocouple sensor provides precise temperature measurement by utilizing the voltage generated at the thermocouple junction.

Each thermocouple channel includes two terminals (T+ and T-) for connecting the thermocouple wires. The EQXTC amplifies and measures the voltage generated at the junction to determine the temperature.

Additionally, the module measures the ambient temperature to apply cold-junction compensation, ensuring accurate readings regardless of external temperature variations.

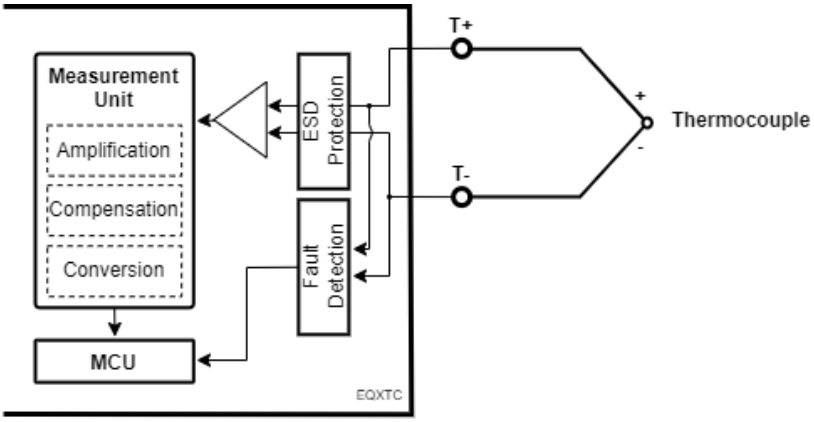

Figure 11-2. Thermocouple wiring example

11.3 Readings and Fault Codes

`eqsp32.readPin( EQXTC(ii, nn) )` returns the temperature of channel nn in °C × 10; for example, 253 corresponds to 25.3 °C. Channel 7 returns the internal (cold-junction) temperature of the module in the same unit.

If the module detects a thermocouple fault on a channel, `readPin()` returns a fault code instead of a temperature: `TC_FAULT_OPEN` (open thermocouple), `TC_FAULT_SHORT_GND` (thermocouple shorted to GND) or `TC_FAULT_SHORT_VCC` (thermocouple shorted to VCC). Several faults at once give a combined code; any value of 0x8000 (32768) or more is a fault code. The channel returns to the temperature as soon as the fault is gone.

A module that is not connected reads 0 (0.0 °C) on all channels. Use `eqsp32.isModuleDetected( EQXTC(ii) )` to tell a disconnected module from a reading of 0.0 °C.

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Table 11-1. Library reference: Thermocouple Sensor Inputs

Usage	
`eqsp32.readPin( EQXTC(ii, nn) )`	Returns the temperature in °C × 10 (253 for 25.3 °C), or a fault code (0x8000 or more, see 11.3) ii: number (index) of EQXTC module on the chain ***(*)*** nn: EQXTC channel number (1 to 6 for thermocouple channels, 7 for the module's internal temperature)

NOTE

(*) For 2 EQXTC modules connected on the main unit, the first one (closer to the main unit) will have an index of 1, the second EQXTC index of 2 etc.

The index refers only to the same type of modules. Different types of modules will be indexed with their own type.

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12 Boot Button and Firmware Update

12.1 Boot Button

The Boot button is only used for entering the EQXTC module into firmware update mode (or maintenance mode). To enter maintenance mode, keep the Boot button pressed while powering up the module.

Another option is to keep the Boot button pressed while sending a reset command to the module via the serial terminal (`!RST=1`, 115200 baud).

Once the module is in maintenance mode, it will be shown as a storage device. Drag and drop the desired .uf2 firmware file into the RPI-RP2 storage device and the update will be performed automatically.

Once the update is done, the unit will be automatically rebooted.

Power cycle the system to trigger the automatic detection procedure and the system will be ready for normal operation.

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13 Mechanical Dimensions

All dimensions are measured in mm with a +/-0.1 tolerance.

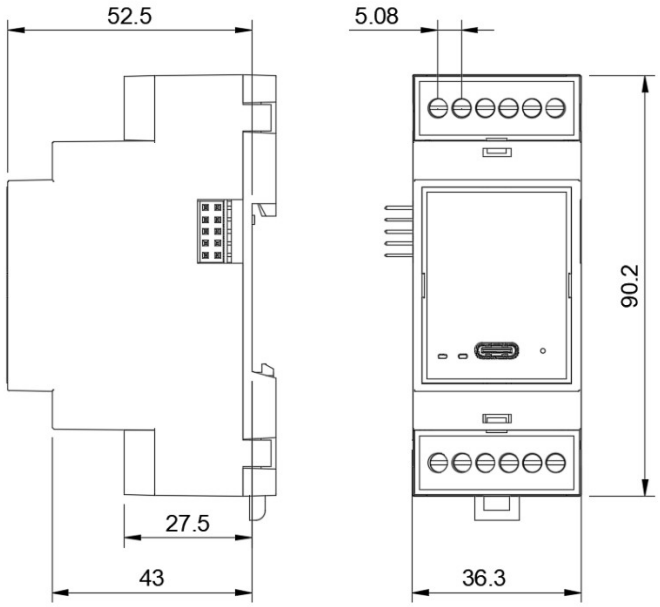

Figure 13-1. Mechanical dimensions: side and front views

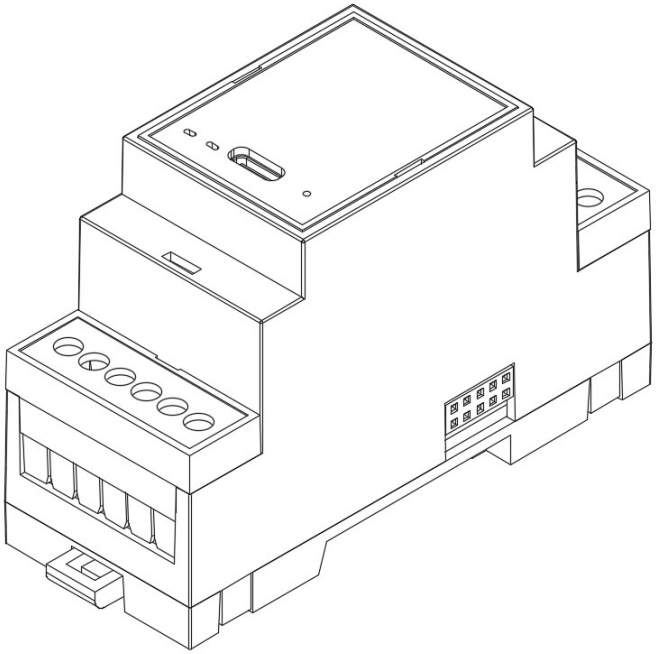

Figure 13-2. Mechanical dimensions: 3D view

14 Notices

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15 Revision History

VERSION	REVISION	STATUS
v1.1	**Rev102026**	**Released**

Table 15-1. Revision history

Version	Revision	Date	Status	Changes
v1.1	Rev102026	20 Oct 2026	Released	Updated the temperature format; added the measuring range and fault codes.
v1.0	Rev101926	19 Oct 2026	Released	First released version.

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