EQX EXPANSION MODULE · EQXPTxx FAMILY

Dual-Channel RTD Sensor Expansion Module for EQSP32

1 Description

The **EQXPT02** is a **dual-channel RTD sensor** expansion module made for precise PT100 temperature sensor measurements in industrial applications. Designed to seamlessly integrate with the EQSP32 Micro-PLC Industrial IoT controller, it supports **PT100** sensors for 2-wire, 3-wire, and 4-wire configurations for maximum versatility.

With its compact, **DIN-rail mountable design**, the EQXPT02 integrates seamlessly into control cabinets, ensuring tidy and efficient wiring for automation systems. This streamlined approach makes it an excellent choice for professional installations in industrial environments.

Designed for effortless integration, the EQXPT02 is **automatically detected by the EQSP32** upon power-up, operating as a native peripheral. This plug-and-play functionality streamlines setup, enabling users to expand their system with minimal configuration.

The EQXPT02 features robust input **protection from over-voltage** conditions, making it ideal for demanding industrial environments. With its built-in shorted cable and open cable detection, the module ensures reliable operation by quickly identifying potential wiring issues.

Equipped with a front-facing USB-C port, the module **simplifies firmware updates** to ensure access to the latest features and performance enhancements, without removing it from the setup. This straightforward update mechanism **minimizes downtime** and ensures the module remains optimized for your system's requirements.

Supported by the **EQ-AI generative AI model**, the EQXPT02 enables users to effortlessly generate the required code by describing their setup and desired functionality. This innovative approach **accelerates the integration** of the module into both new and existing EQSP32-based automation systems, making advanced industrial solutions accessible even to users with limited programming expertise.

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2 Key Features

- Dual-channel support for PT100 RTD sensors
- 15-bit ADC resolution with a nominal temperature resolution of 0.032°C
- Supports 2-wire, 3-wire, and 4-wire configurations for maximum flexibility
- Compact DIN-rail cabinet design for neat and organized installations
- Automatic module detection by EQSP32
- LED indicator for power and module status
- Front-facing USB-C connector for firmware update
- Built-in shorted and open cable detection for quick wiring issue identification
- Protected inputs against overvoltage conditions
- Generative AI Coding Assistant trained with EQSP32 Library and EQXPT features
- Compact, 2SU-wide (36 mm), DIN-rail mount enclosure with 12 screw terminals
- IP20 Protection
- −20 °C to +55 °C operating ambient temperature

3 Applications

- Industrial Control
- Environmental Monitoring
- Process Automation
- Food and Beverage Industry
- Energy Management Systems
- Pharmaceutical Production
- HVAC Systems
- Temperature-Sensitive Manufacturing
- Educational Projects

4 Ordering Information

Part number	Description	Inputs	Enclosure
EQXPT02	Dual-Channel RTD Sensor Expansion Module for EQSP32	2 × PT100 RTD, 2-, 3- or 4-wire	2SU (36 mm) DIN-rail, IP20

Product page and ordering: erqos.com/product/eqxpt02

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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 EQXPT....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....9
10 Power Distribution....9
11 RTD Sensor Inputs....10
11.1 Equivalent RTD Measurement Circuit....10
11.2 4-Wire RTD....10
11.3 3-Wire RTD....10
11.4 2-Wire RTD....11
11.5 Readings and Fault Codes....11
12 Boot Button and Firmware Update....13
12.1 Boot Button....13
13 Mechanical Dimensions....14
14 Notices....15
15 Revision History....15

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5 Block Diagram

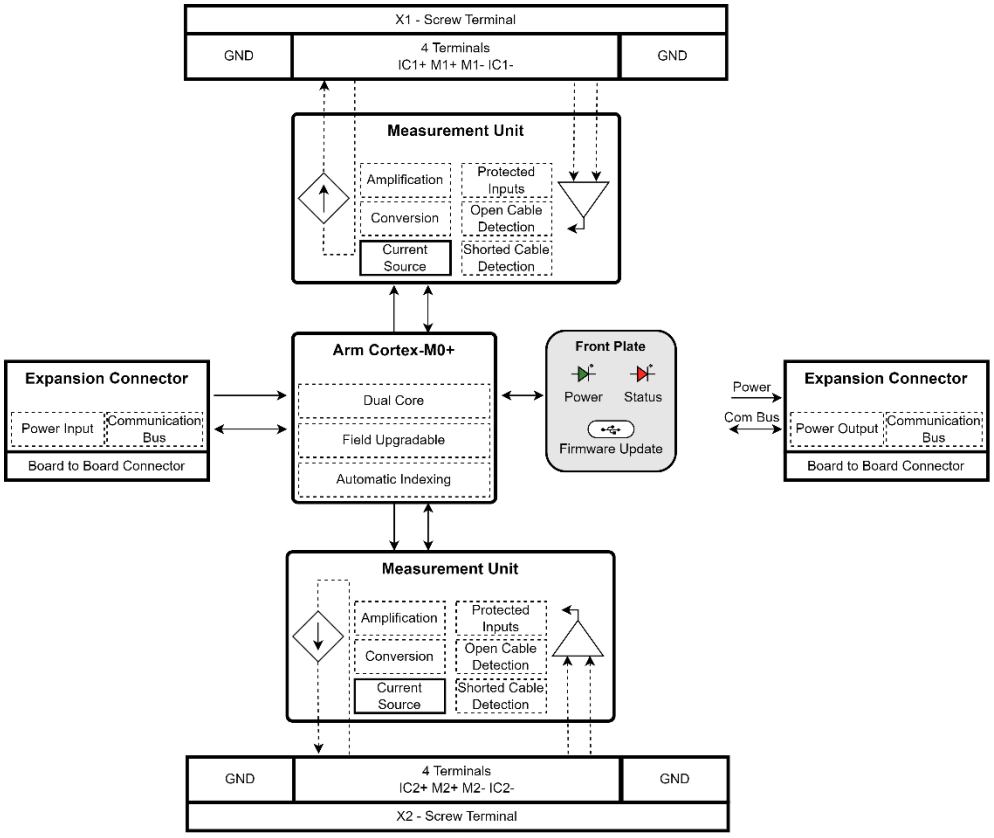

Figure 5-1. EQXPT02 block diagram

6 Specifications

6.1 System Specifications

Table 6-1. System Specifications

Section	Features
Power Management	Supplied by the board-to-board connector
RTD Inputs	2 x PT100 RTD Sensor Inputs Supports 2-wire, 3-wire, and 4-wire configurations 15-bit ADC resolution, with a nominal temperature resolution of 0.032°C Built-in shorted and open cable detection to identify wiring issues Overvoltage protection
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
I+, I- to GND	Current Output	-50		50	V
M+, M- to GND	Analog Input	-50		50	V

7 Connecting EQXPT

To use the EQXPT RTD 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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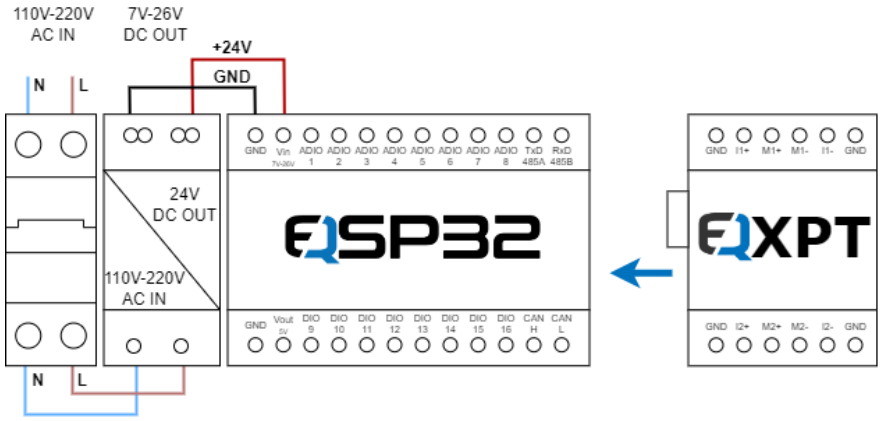

Figure 7-1. Slide EQXPT to connect on EQSP32

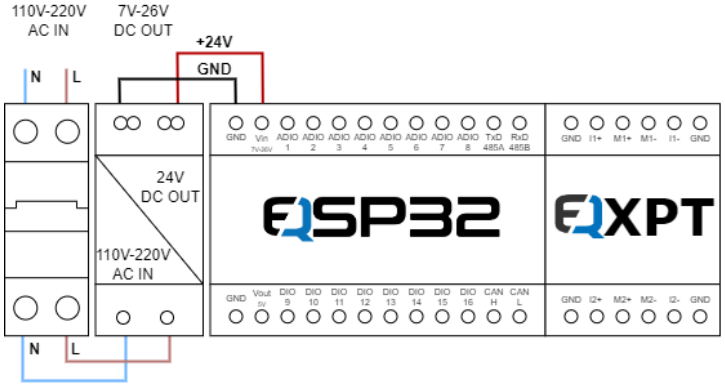

Figure 7-2. Connected EQXPT on EQSP32

> **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

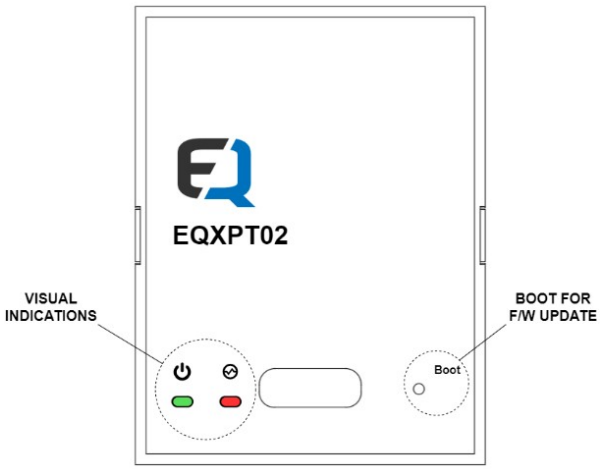

Figure 8-1. Front panel: LEDs and Boot button

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 EQXPT module is not communicating with the EQSP32.

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During data exchange between the main EQSP32 unit and the EQXPT 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

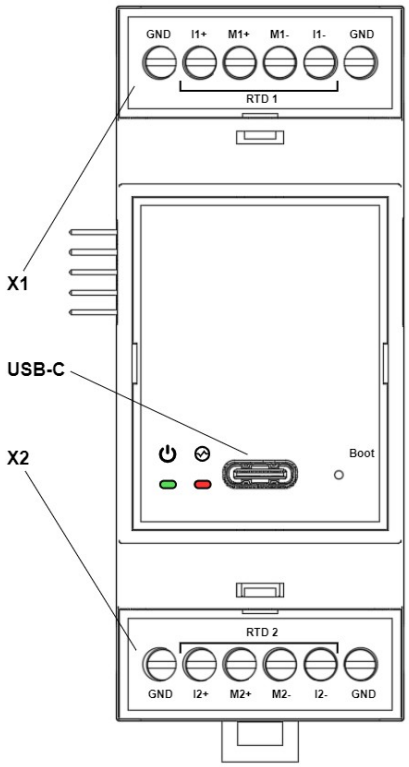

Figure 9-1. EQXPT02 terminals and front panel

X1 – Screw terminal connector 1

USB-C – Firmware update port

X2 – Screw terminal connector 2

9.1 X1 – Screw Terminal Connector 1

X1 connector accommodates the connections for the RTD sensor 1. It includes terminals for the sensor's wiring and GND terminals for connecting the sensor shielding if available.

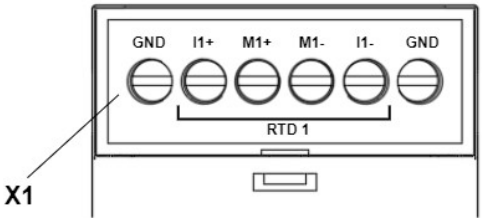

Figure 9-2. X1 terminals

Table 9-1. X1 – Screw Terminal Connector 1

Name	Pin	Function	Type
X1	GND	GND for sensor shielding (*)	SHIELDING
	I1+, I1-	Constant current source for generating voltage on the RTD	CURRENT OUT
	M1+, M1-	Analog voltage sensor for calculating the RTD resistance	ANALOG IN

NOTE
(*) The GND terminals are common with the system's GND.

9.2 X2 – Screw Terminal Connector 2

X2 connector accommodates the corresponding terminals for wiring the RTD sensor 2.

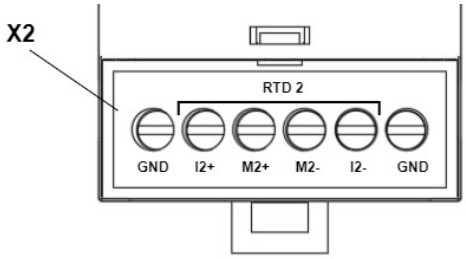

Figure 9-3. X2 terminals

Table 9-2. X2 – Screw Terminal Connector 2

Name	Pin	Function	Type
X2	GND	GND for sensor shielding (*)	SHIELDING
	I2+, I2-	Constant current source for generating voltage on the RTD	CURRENT OUT
	M2+, M2-	Analog voltage sensor for calculating the RTD resistance	ANALOG IN

> **NOTE**
> (*) The GND terminals are common with the system's GND.

10 Power Distribution

EQXPT's internal systems 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.

EQXPT's control unit may also be powered by the front-facing USB-C port. By connecting the RTD sensor expansion module via the USB port, the system's core will be powered on, allowing for easy firmware update without any external power supply.

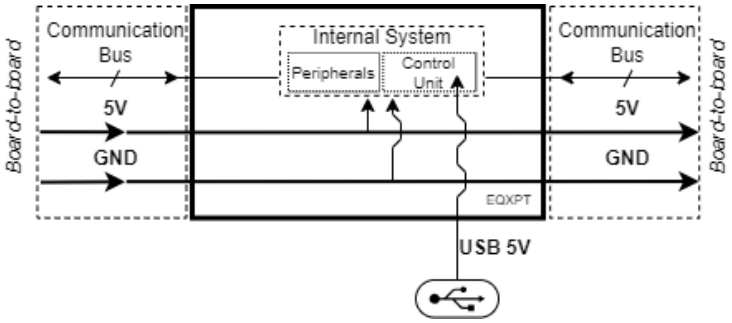

Figure 10-1. Power distribution

11 RTD Sensor Inputs

11.1 Equivalent RTD Measurement Circuit

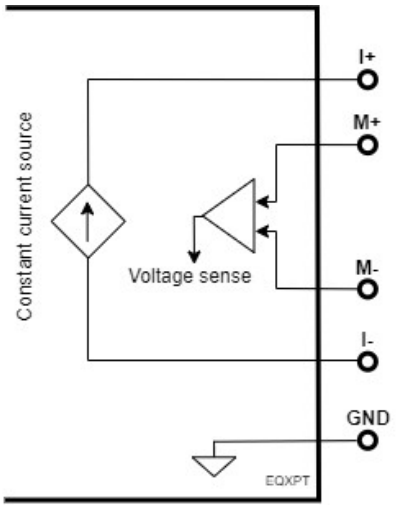

Figure 11-1. Equivalent RTD Measurement Circuit

11.2 4-Wire RTD

A 4-wire RTD offers highly accurate temperature measurement by eliminating lead wire resistance errors.

Two wires carry the excitation current to the RTD sensor (terminals I+ and I-), while the other two measure the voltage across the RTD element (terminals M+ and M-).
Since the voltage wires carry minimal current, their resistance has no impact on the measurement, ensuring precise detection of the RTD resistance.

If the RTD sensor is shielded, the shielding wire may be connected to the GND terminal.

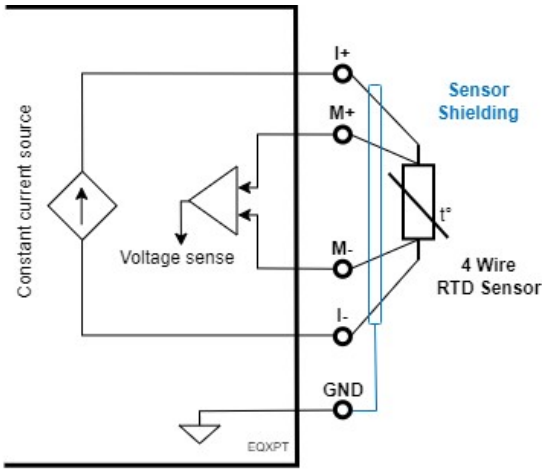

Figure 11-2. 4-Wire RTD wiring example

11.3 3-Wire RTD

A 3-wire RTD provides a balance between accuracy and simplicity by partially compensating for lead wire resistance.

Two wires carry the excitation current to the RTD sensor (terminals I+ and I-), while the third wire (terminal M-) measures the voltage across the RTD element, paired with one of the current-carrying wires (M+ terminal must be connected with I+).

This configuration reduces the effect of lead wire resistance, though it is not entirely eliminated.

For a 3-wire sensor, set the channel to the 3-wire mode with `eqsp32.pinMode( EQXPT(ii, nn), PT100_3W )`.

For shielded RTD sensors, the shielding wire can be connected to the GND terminal.

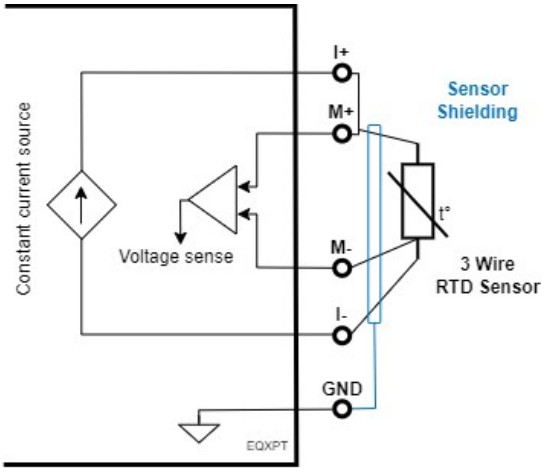

Figure 11-3. 3-Wire RTD wiring example

11.4 2-Wire RTD

A 2-wire RTD is the simplest configuration, suitable for applications where lead wire resistance has a minimal impact or accuracy is less critical.

Both excitation current and voltage measurement are carried by the same pair of wires (terminal I+ connected with M+ and terminal I- connected to M-), making the lead wire resistance a part of the total measured resistance.

This configuration is typically used for shorter lead lengths or less critical measurements.

If the RTD sensor is shielded, the shielding wire may be connected to the GND terminal.

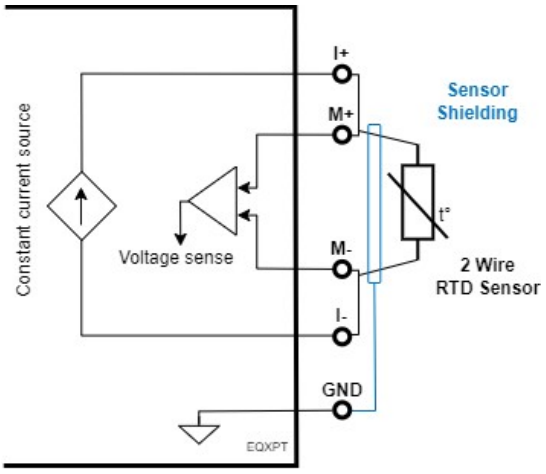

Figure 11-4. 2-Wire RTD wiring example

11.5 Readings and Fault Codes

`eqsp32.readPin( EQXPT(ii, nn) )` returns the temperature of channel nn in °C × 100; for example, 2534 corresponds to 25.34 °C.

If the module detects a sensor or wiring fault on a channel, `readPin()` returns a fault code instead of a temperature: a value of 0x800000 (8388608) or more. A single fault returns one of the constants `PT_FAULT_THR_HIGH`, `PT_FAULT_THR_LOW`, `PT_FAULT_REFIN_LOW`, `PT_FAULT_REFIN_HIGH`, `PT_FAULT_RTDIN_LOW` and `PT_FAULT_OVUV`; several faults at once give a combined code. Treat any fault code as an invalid reading.

The wiring mode of each channel is set with `eqsp32.pinMode()` (Table 11-1). The module does not store it: set it again after power-up, a module reset or a lost connection.

A module that is not connected reads 0 (0.00 °C) on both channels. Use `eqsp32.isModuleDetected( EQXPT(ii) )` to tell a disconnected module from a reading of 0.00 °C.

Table 11-1. Library reference: RTD Sensor Inputs

Configuration	
`eqsp32.pinMode( EQXPT(ii, nn), mode )`	ii: number (index) of EQXPT module on the chain (*) nn: EQXPT channel number (1 or 2) mode: `PT100_24W` for 2-wire and 4-wire sensors (default), `PT100_3W` for 3-wire sensors
Usage	
`eqsp32.readPin( EQXPT(ii, nn) )`	Returns the temperature in °C × 100 (2534 for 25.34 °C), or a fault code (0x800000 or more, see 11.5) ii: number (index) of EQXPT module on the chain ***(*)*** nn: EQXPT channel number (1 or 2)

NOTE

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

12 Boot Button and Firmware Update

12.1 Boot Button

The Boot button is only used for entering the EQXPT 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.

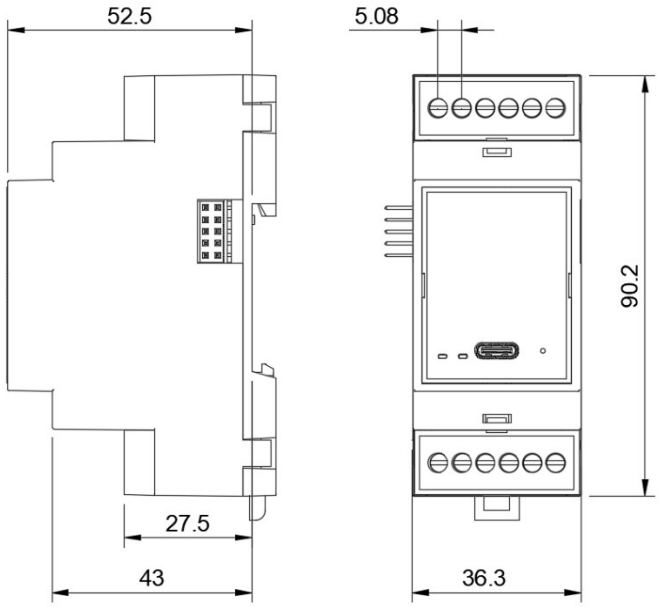

Figure 13-1. Mechanical dimensions: side and front views

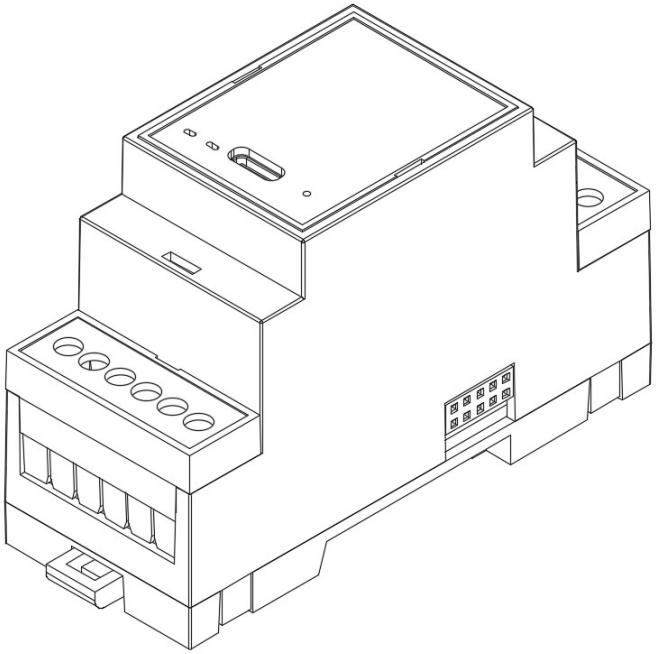

Figure 13-2. Mechanical dimensions: 3D view

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 wiring mode setting and fault codes.
v1.0	Rev101926	19 Oct 2026	Released	First released version.

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