MACX MCR-RTD-I(-SP(-C))

Temperature signal conditioner



Data sheet
108680_en_06

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1 Description

The programmable temperature signal conditioner has been designed for electrically isolated operation of resistance thermometers and resistance-type sensors. The measured values are converted into a linear 0/4 ... 20 mA signal.

The temperature transducer is either configured with a standard configuration or with an order-specific configuration in accordance with an order key and is delivered calibrated ready for operation (...-C versions).

You can configure features such as sensor type, connection technology, measuring range, measuring unit, filter, alarm signal, and output range using the clipx ENGINEER or FDT/DTM software.

Use the IFS-USB-PROG-ADAPTER programming adapter (Item No. 2811271) to connect the device to the PC.

Alternatively, you can use the Bluetooth programming adapter (Item No. 2905872).

Installation in zone 2 in accordance with Ex ec type of protection is permitted.

Features

- Input for standard temperature sensors (RTDs), resistance-type sensors, and potentiometers
- Current output 0 mA ... 20 mA or 4 mA ... 20 mA
- High level of accuracy over the entire measuring range
- Configuration via software (clipx ENGINEER or DTM)
- Up to SIL 2/SC 2 in accordance with IEC/EN 61508 at output 4 mA ... 20 mA
- 3-way electrical isolation in accordance with EN 61010
- Installation in Ex zone 2 permitted
- High transmission accuracy
- Status and error indicator in accordance with NE 44
- Power supply possible via DIN rail connector
- Housing width of 12.5 mm
- Screw or push-in connection available

You can use the Signal Conditioner app to call-up comprehensive module information via the integrated QR code reader.

This document is valid for the products listed in the “Ordering data” chapter.

Make sure you always use the latest documentation.
It can be downloaded at: phoenixcontact.com/product/1050192

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3 Ordering data

Description	Type	Item no.	Pcs./Pkt.
Temperature transducer, converts signals from resistance temperature detectors and resistors into analog 0/4 - 20 mA signals. Freely programmable, screw connection, SIL, 3-way electrical isolation, standard configuration.	MACX MCR-RTD-I	1050192	1
Temperature transducer, converts signals from resistance temperature detectors and resistors into analog 0/4 - 20 mA signals. Freely programmable, Push-in connection, SIL, 3-way electrical isolation, standard configuration.	MACX MCR-RTD-I-SP	1050201	1
Temperature transducer, converts signals from resistance temperature detectors and resistors into analog 0/4 - 20 mA signals. Freely programmable, Push-in connection, SIL, 3-way electrical isolation, order configuration.	MACX MCR-RTD-I-SP-C	1052464	1

Accessories	Type	Item no.	Pcs./Pkt.
DIN rail connector (TBUS), 5-pos., for bridging the supply voltage, can be snapped onto NS 35/... DIN rail in accordance with EN 60715	ME 6,2 TBUS-2 1,5/5-ST-3,81 GY	2695439	10
Power rail adapter (ME 6,2 TBUS-PR-ADAPTER), 2-pos., enables MINI and MACX Analog modules to be adapted for supply via universal power rail UPR-03 and UPR-05.	ME 6,2 TBUS-PR-ADAPTER	1136500	10
The partition plate is used to maintain Ex i isolating distances when Ex i and non-Ex i devices are mounted side by side on a DIN rail.	MCR-DP	1430594	1
Cover for screw shafts of the MSTB connector ranges with a pitch of 5.0 mm and 5.08 mm. These can be aligned and shortened for use with different numbers of positions.	EA-MSTB 2,5/ 5	1831016	50
Universal termination carrier for connecting 16 MACX Analog Ex i signal conditioners to digital or analog I/O cards, via D-SUB connector, 37-pos. (1:1 connection), with HART multiplexer connection	TC-D37SUB-AIO16-EX-PS-UNI	2902932	1
Universal termination carrier for connecting 16 MACX Analog Ex i signal conditioners to digital or analog I/O cards, via D-SUB connector, 37-pos. (1:1 connection)	TC-D37SUB-ADIO16-EX-P-UNI	2924854	1
Programming adapter with USB interface, for programming with software. The USB driver is included in the software solutions for the products to be programmed, such as measuring transducers or motor managers.	IFS-USB-PROG-ADAPTER	2811271	1
Bluetooth adapter with micro USB and S-PORT interface for wireless communication with the MINI Analog, MINI Analog Pro, MACX Analog, Interface System Gateways, and PLC logic device series.	IFS-BT-PROG-ADAPTER	2905872	1

Accessories	Type	Item no.	Pcs./Pkt.
Insulating sleeve, color: white	MPS-IH WH	0201663	10
Insulating sleeve, color: red	MPS-IH RD	0201676	10
Insulating sleeve, color: blue	MPS-IH BU	0201689	10
Insulating sleeve, color: yellow	MPS-IH YE	0201692	10
Insulating sleeve, color: green	MPS-IH GN	0201702	10
Insulating sleeve, color: gray	MPS-IH GY	0201728	10
Insulating sleeve, color: black	MPS-IH BK	0201731	10
Test plug, with solder connection up to 1 mm² conductor cross section, number of positions: 1, color: gray	MPS-MT	0201744	10
Plastic label, Sheet, white, unlabeled, can be labeled with: BLUEMARK ID COLOR, BLUEMARK ID, BLUEMARK CLED, PLOTMARK, CMS-P1-PLOTTER, mounting type: adhesive, Number of individual labels: 10, text field height: 9 mm, text field width: 11 mm	UC-EMLP (11X9)	0819291	10
Plastic label, Sheet, yellow, unlabeled, can be labeled with: BLUEMARK ID COLOR, BLUEMARK ID, BLUEMARK CLED, PLOTMARK, CMS-P1-PLOTTER, mounting type: adhesive, Number of individual labels: 10, text field height: 9 mm, text field width: 11 mm	UC-EMLP (11X9) YE	0822602	10
Plastic label, can be ordered: by sheet, white, labeled according to customer specifications, mounting type: adhesive	UC-EMLP (11X9) CUS	0824547	1
Plastic label, can be ordered: by sheet, yellow, labeled according to customer specifications, mounting type: adhesive	UC-EMLP (11X9) YE CUS	0824548	1
Plastic label, Sheet, silver, unlabeled, can be labeled with: BLUEMARK ID COLOR, BLUEMARK ID, BLUEMARK CLED, PLOTMARK, CMS-P1-PLOTTER, mounting type: adhesive, Number of individual labels: 10, text field height: 9 mm, text field width: 11 mm	UC-EMLP (11X9) SR	0828094	10
Plastic label, can be ordered: by sheet, silver, labeled according to customer specifications, mounting type: adhesive, Number of individual labels: 10	UC-EMLP (11X9) SR CUS	0828098	1
Plastic label, Card, white, unlabeled, can be labeled with: BLUEMARK ID COLOR, BLUEMARK ID, THERMOMARK PRIME, THERMOMARK CARD 2.0, THERMOMARK CARD, mounting type: adhesive, Number of individual labels: 135, text field height: 9 mm, text field width: 11 mm	US-EMLP (11X9)	0828789	10
Plastic label, Card, yellow, unlabeled, can be labeled with: BLUEMARK ID COLOR, BLUEMARK ID, THERMOMARK PRIME, THERMOMARK CARD 2.0, THERMOMARK CARD, mounting type: adhesive, Number of individual labels: 135, text field height: 9 mm, text field width: 11 mm	US-EMLP (11X9) YE	0828871	10

Accessories	Type	Item no.	Pcs./Pkt.
Plastic label, Card, silver, unlabeled, can be labeled with: BLUEMARK ID COLOR, BLUEMARK ID, THERMOMARK PRIME, THERMOMARK CARD 2.0, THERMOMARK CARD, mounting type: adhesive, Number of individual labels: 135, text field height: 9 mm, text field width: 11 mm	US-EMLP (11X9) SR	0828872	10
Device marker, Sheet, white, unlabeled, can be labeled with: TOPMARK NEO, TOPMARK LASER, mounting type: adhesive, Number of individual labels: 255, text field height: 9 mm, text field width: 11 mm	LS-EMLP (11X9) WH	0831678	10
Device marker, Sheet, silver, unlabeled, can be labeled with: TOPMARK NEO, TOPMARK LASER, mounting type: adhesive, Number of individual labels: 255, text field height: 9 mm, text field width: 11 mm	LS-EMLP (11X9) SR	0831705	10
Device marker, Sheet, yellow, unlabeled, can be labeled with: TOPMARK NEO, TOPMARK LASER, mounting type: adhesive, Number of individual labels: 255, text field height: 9 mm, text field width: 11 mm	LS-EMLP (11X9) YE	0831732	10
Power and fault signaling module with screw connection, including corresponding ME 17,5 TBUS 1,5/ 5-ST-3,81 GY DIN rail connector	MACX MCR-PTB	2865625	1
Power and fault signaling module with Push-in connection, including corresponding ME 17,5 TBUS 1,5/ 5-ST-3,81 GY DIN rail connector	MACX MCR-PTB-SP	2924184	1
Primary-switched power supply, QUINT POWER, screw connection, DIN rail mounting, supply of devices possible via the TBUS DIN rail connector, protective coating, input: single-phase, output: 24 V DC/2.5 A	QUINT4-SYS-PS/1AC/24DC/2.5/SC	2904614	1
Actuation tool, for ST terminal blocks, insulated, also suitable for use as a bladed screwdriver, size: 0.6 x 3.5 x 100 mm, 2-component grip, with non-slip grip	SZS 0,6X3,5	1205053	10

4 Technical data

Hardware/firmware version	
Hardware/firmware version (1050192)	07 / 01
Hardware/firmware version (1050201)	06 / 01
Hardware/firmware version (1052464)	06 / 01
The technical data and safety characteristics are valid as of the specified HW/FW version.	

Input data Resistance thermometer	
Sensor types (RTD) that can be used	Pt, Ni, Cu sensors: 2, 3, 4-wire
Resistance thermometers	Pt 50 , Pt 100 , Pt 200 , Pt 500 , Pt 100S , Pt 500S , Ni 100 , Ni 500 , Cu 50 , Cu 53
Potentiometer	0 Ω ... 50 kΩ
Max. permissible overall conductor resistance	50 Ω (Per cable)
Linear resistance measuring range	0 Ω ... 50 kΩ
Temperature measuring range	-200 °C ... 850 °C (Range depending on the sensor type)
Temperature measuring range	≥ 50 K

Output data Current output	
Configurable/programmable	Yes
Current output signal	0 mA ... 20 mA 4 mA ... 20 mA (SIL)
Output signal maximum current	≥ 21 mA
Load/output load current output	≤ 600 Ω
Output ripple (current)	< 15 μA_{PP} < 10 μA_{rms}
Behavior in the event of a sensor error	Freely definable

General data	
Nominal supply voltage	24 V DC -20 % ... +25 %
Supply voltage range	19.2 V DC ... 30 V DC
Current consumption	≤ 40 mA (24 V DC)
Power dissipation	≤ 0.76 W
Power consumption	≤ 1 W
Transmission error, typical	0.1 % (e.g. for Pt 100, 300 K span, 4 ... 20 mA)
Temperature coefficient, typical	0.01 %/K
Step response (0–99%) with filter factor = 1	1 s ≤ 1.7 s
Degree of protection	IP20
Flammability rating according to UL 94	V0 (Housing)
Status display	Green LED (supply voltage) Red LED, flashing 2.4 Hz (cable error, sensor error on input or output, ERR) Red LED, flashing 1.2 Hz (service operation, ERR) Red LED, permanently on (module error, ERR)

General data	
Dimensions W/H/D	12.5 mm / 112.5 mm / 113.7 mm (MACX MCR-RTD-I) 12.5 mm / 107.9 mm / 113.7 mm (MACX MCR-RTD-I-SP)
Depth (Snapped onto DIN rail NS 35/7,5 in accordance with EN 60715)	114.5 mm
Type of housing	PA 6.6-FR

Ambient conditions	
Ambient temperature (operation)	-40 °C … 70 °C (Any mounting position)
Ambient temperature (storage/transport)	-40 °C … 80 °C
Permissible humidity (operation)	5 % … 95 % (non-condensing)
Altitude Ambient temperature (operation) Rated insulation voltage	≤ 2000 m -40 °C … 70 °C 300 V_{rms}
Height range Ambient temperature (operation) Rated insulation voltage	> 2000 m … 3000 m -40 °C … 63 °C 150 V_{rms}
Height range Ambient temperature (operation) Rated insulation voltage	> 3000 m … 4000 m -40 °C … 56 °C 150 V_{rms}
Height range Ambient temperature (operation) Rated insulation voltage	> 4000 m … 5000 m -40 °C … 49 °C 150 V_{rms}

Electrical isolation (≤ 2000 m above mean sea level)	
Electrical isolation	3-way isolation
Test voltage Overvoltage category Pollution degree	2.5 kV AC (50 Hz, 60 s) II 2
Input/output/power supply Standards/regulations Rated insulation voltage Insulation	 IEC/EN 61010-1 300 V_{rms} Safe isolation
Input/output Standards/regulations Rated insulation voltage	 IEC/EN 60079-11 375 V_{PP}
Input/power supply Standards/regulations Rated insulation voltage	 IEC/EN 60079-11 375 V_{PP}

Connection data	Screw connection	Push-in connection
Conductor cross section, rigid	0.2 mm² ... 2.5 mm²	0.2 mm² ... 2.5 mm²
Conductor cross section, flexible	0.2 mm² ... 2.5 mm²	0.2 mm² ... 2.5 mm²
Conductor cross section flexible (2 conductors with same cross section)		0.25 mm² ... 0.34 mm² (TWIN ferrule without plastic sleeve) 0.5 mm² ... 1.5 mm² (TWIN ferrule with plastic sleeve)
Conductor cross section AWG	24 ... 14	24 ... 14 24 ... 22 (TWIN ferrule without plastic sleeve) 20 ... 16 (TWIN ferrule with plastic sleeve)
Stripping length	7 mm	10 mm
Tightening torque	0.5 Nm ... 0.6 Nm	
Diameter Test socket in the connector	2 mm	

Conformance with EMC directive
Noise immunity according to EN 61000-6-2 When being exposed to interference, there may be minimal deviations.
Noise emission according to EN 61000-6-4

Conformance/Approvals	
CE CE-compliant and EN 61326	
ATEX IBExU19ATEX1006 X	Ⓔx II 3 G Ex ec ic IIC T4 Gc
IECEx IECEx IBE 19.0001 X	Ex ec ic IIC T4 Gc
UL, USA/Canada	UL 61010 Listed Class I, Div. 2, Groups A, B, C, D T4 Class I, Zone 2, Group IIC T4
Shipbuilding approval DNV GL TAA00000AG Temperature Humidity Vibration EMC Enclosure	 B B A B Required protection according to the Rules shall be provided upon installation on board
Safety Integrity Level (SIL, IEC 61508) SEBS-A.150520/17, V2.0	2
Systematic Capability	2
INMETRO DNV 21.0064 X	Ex ec ic IIC T4 Gc
EAC Ex BY/112 02.01 TP012 103.01 00082	EAC Ex 2Ex ec ic IIC T4 Gc

5 Safety regulations and installation notes

5.1 Installation notes

- The EPL Gc (ATEX category 3) device is designed for installation in zone 2 potentially explosive areas. It satisfies the requirements of the following standards. Comprehensive details are to be found in the EU Declaration of Conformity which is enclosed and also available on our website in the latest version:
  IEC/EN 60079-0, IEC/EN 60079-7, IEC/EN 60079-11
  ABNT NBR IEC 60079-0, ABNT NBR IEC 60079-7, ABNT NBR IEC 60079-11
  For detailed information, please refer to the declarations of conformity.
- Installation, operation, and maintenance may only be carried out by qualified electricians. Follow the installation instructions as described.
- When installing and operating the device, observe the applicable regulations and safety directives (including national safety directives), as well as the generally recognized technical regulations.
- Observe the safety information, conditions, and limits of use specified in the product documentation. Comply with them.
- The device must not be opened or modified. Do not repair the device yourself, replace it with an equivalent device. Repairs may only be carried out by the manufacturer. The manufacturer is not liable for damage resulting from violation.
- While the devices are in operation, contact-dangerous voltages may be present on the control elements. For this reason parameterization, conductor connection, and opening of the module lid are allowed only when devices are in a de-energized state unless the connected circuits are exclusively SELV or PELV circuits.
- The IP20 degree of protection (IEC/EN 60529) specifies that the device is intended for use in a clean and dry environment. Do not subject the device to mechanical and/or thermal stress that exceeds the specified limits.
- The device complies with the EMC regulations for industrial areas (EMC class A). When using the device in residential areas, it may cause radio interference.
- Only Phoenix Contact devices may be connected to the programming interface that have been specified for this – see respective data sheet.
- A SELV/PELV power supply unit with a nominal voltage of 24 V DC (max. 30 V DC) is needed for the external power supply of the device.
- Only use copper connecting cables.
- The USB programming adapter may not be connected, disconnected, or used in potentially explosive areas.

5.2 Installation in the Ex area (zone 2)

- Observe the specified conditions for use in potentially explosive areas. For installation, use a suitable approved housing with a minimum degree of protection of IP54 that meets the requirements of IEC/EN 60079-7 or another degree of protection in accordance with ABNT NBR IEC 60079-7, Section 1. Also observe the requirements of IEC/EN 60079-14.
- Only devices which are designed for operation in Ex zone 2 and are suitable for the conditions at the installation location may be connected to the circuits in the Ex zone.
- In potentially explosive areas, connecting and disconnecting cables and plugs in non-intrinsically safe circuits and the latching of devices onto and unlatching devices from the DIN rail connector is only permitted in a de-energized state or when the atmosphere is not potentially explosive.
- The device must be stopped and immediately removed from the Ex area if it is damaged, was subject to an impermissible load, stored incorrectly or if it malfunctions.

5.3 Installation in areas with a danger of dust explosions (zone 22)

- The device is not suitable for installation in zone 22.
- If, however, you wish to use the device in zone 22, you must install it in housing that complies with IEC/EN 60079-31. When doing so, observe the maximum surface temperatures. Observe the requirements of IEC/EN 60079-14.

5.4 Safety-related applications (SIL)

When using the device in safety-related applications, observe the instructions in “Safety-related applications”, as the requirements differ for safety-related functions.

5.5 UL notes

PROCESS CONTROL EQUIPMENT FOR HAZARDOUS LOCATIONS

1 WARNING EXPLOSION HAZARD - Do not disconnect equipment unless power has been removed or the area is known to be non-hazardous.

2 WARNING - EXPLOSION HAZARD - Substitution of components may impair suitability for Class I, Zone 2/Division 2.

6 Installation

6.1 Connection notes

WARNING: Electrical danger due to improper installation

Observe the connection notes for safe installation in accordance with EN/UL 61010-1:

- Disconnecting devices and branch circuit protection with suitable AC or DC rating shall be provided in the building installation.
- The device is intended for installation in a control cabinet or in a comparable enclosure. The device may only be operated when it has been installed. The control cabinet must meet the requirements of UL/IEC 61010-1 in terms of protection against spread of fire and protection against electric shock or burn.
- Provide for a switch/circuit-breaker in the vicinity of a device that is marked as disconnect device for this device.
- Provide for an overcurrent protection device (I ≤ 16 A) in the installation.
- For UL applications, install a UL-approved (JDYX2) overcurrent protection unit (I ≤ 16 A, U > 30 V DC, usable in DC circuits, slow-blow) in the installation.
- To protect the device against mechanical or electrical damage, install it in suitable housing with an appropriate degree of protection according to IEC/EN 60529.
- During maintenance work, disconnect the device from all effective power sources.
- If the device is not used as described in the documentation, the intended protection can be negatively affected.
- Thanks to its housing, the device has basic insulation to the neighboring devices, for 300 V_{eff}. If several devices are installed next to each other, this has to be taken into account, and additional insulation has to be installed if necessary! If the neighboring device is equipped with basic insulation, no additional insulation is necessary.

6.2 Electrostatic discharge

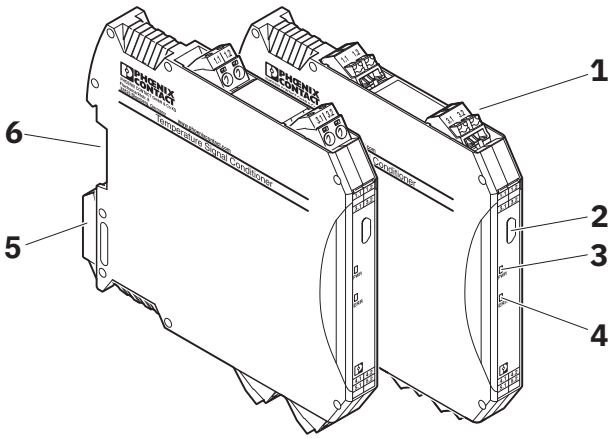
NOTE: Electrostatic discharge

The device contains components that can be damaged or destroyed by electrostatic discharge. When handling the device, observe the necessary safety precautions against electrostatic discharge (ESD) according to EN 61340-5-1 and EN 61340-5-2.

Take protective measures against electrostatic discharge before operating or installing the device.

6.3 Structure

Figure 1 Structure



1 COMBICON plug-in screw or push-in connection terminal

2 Programming socket for connection of the programming adapter

3 Green “PWR” LED, power supply

4 Error indicator "ERR" red LED

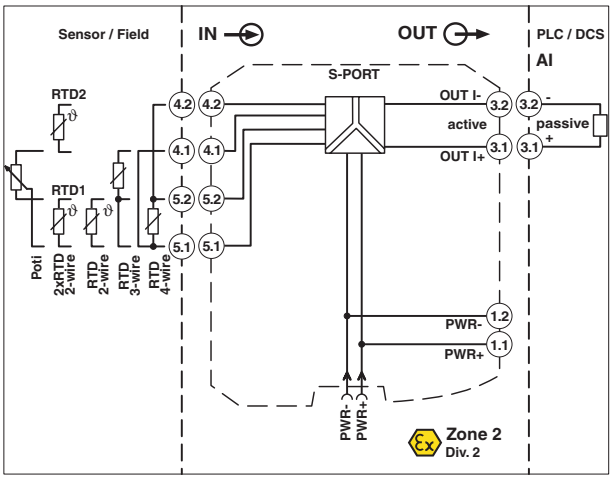
Flashing quickly (2.4 Hz): Sensor error or line fault at the input and output, simulation mode
Flashing slowly (1.2 Hz): service mode
Lights up: module error

5 Snap-on foot for DIN rail mounting

6 Connection for DIN rail connector

6.4 Basic circuit diagram with connection terminal blocks

Figure 2 Basic circuit diagram



6.5 Power supply

You must refer to the "MACX and MINI Analog power manual" for the design of the power supply; it is available to download at www.phoenixcontact.com/products under the item listing.

NOTE

Never connect the supply voltage directly to the DIN rail connector. It is not permitted to draw power from the DIN rail connector or from individual modules.

The supply voltage can be supplied via connection terminal blocks 1.1 (+) and 1.2 (-) or via the DIN rail connector.

Supply via the MACX Analog module

Where the total current consumption of the aligned modules does not exceed 400 mA, the power can be supplied directly at the connection terminal blocks of the module.

Up to 16 modules can be supplied depending on the current consumption of the modules.

We recommend connecting a 630 mA fuse (normal-blow or slow-blow) upstream.

Supply via power and error message module

The MACX MCR-PTB (Item No. 2865625) or the MACX MCR-PTB-SP (Item No. 2924184) supply and error message module is used to provide the supply voltage to the DIN rail connector.

Simple or redundant diode-decoupled power supply is possible.

Depending on the current consumption of the modules, up to 150 individual modules can be supplied by a supply that is protected by a fuse.

The module has integrated error evaluation. An auxiliary supply failure or fuse fault is indicated at a relay contact and displayed via a flashing LED.

Supply via a system power supply unit

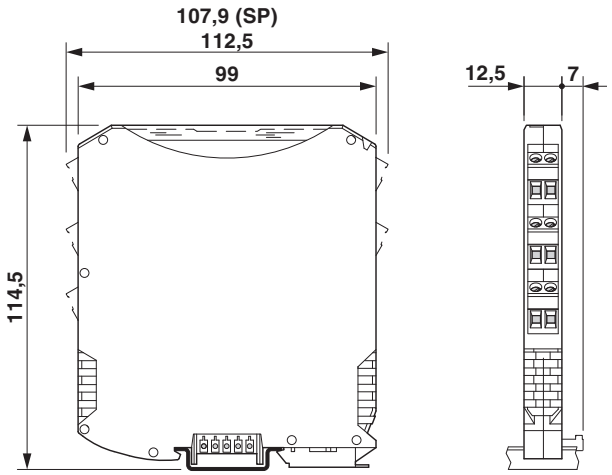
Use the QUINT4-SYS-PS/1AC/24DC/2.5/SC (Item No. 2904614) as the system power supply.

The power supply can be installed on all 35 mm DIN rails in accordance with EN 60715. The normal mounting position is horizontal (input terminals facing down). The minimum clearance to other devices is 30 mm above/below.

If you would like to supply adjacent items using the power supply, use a DIN rail bus distributor. To do so, insert the DIN rail bus adapter ME 22,5 TBUS ADAPTER KMGY (Item No.: 2201756) and the DIN rail connector ME 17,5 TBUS 1,5/ 5-ST-3,81 KMGY (Item No.: 2713645) plugged together in the DIN rail.

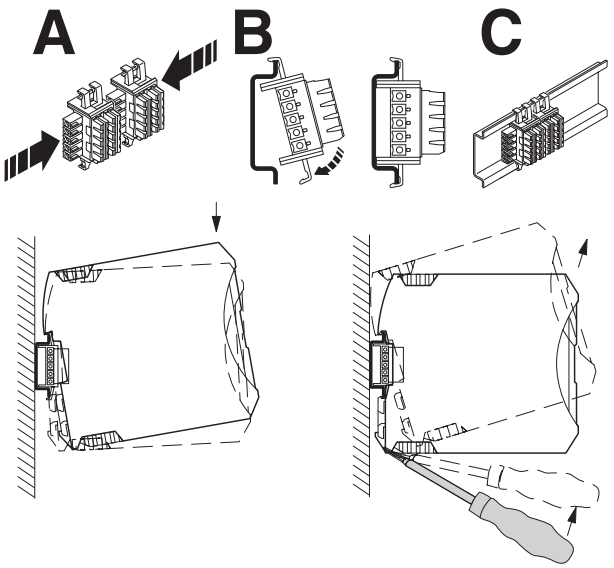
6.6 Dimensions

Figure 3 Dimensions



6.7 Mounting

Figure 4 Mounting and removing



- Mount the device on a 35 mm DIN rail in accordance with EN 60715.
- When using the DIN rail connector, first insert it in the 35 mm DIN rail in accordance with EN 60715 (A – C). DIN rails with a height of 7.5 mm or more can be used. The DIN rail connector is used to bridge the power supply and communication.
- The snap-in direction of device (D) and DIN rail connector (C) must be observed: snap-on foot on the bottom and connector on the left.
- Install the module in a suitable housing to meet the requirements for the protection class.
- Before startup, check that the device is operating and wired correctly.

6.8 Partition plate

If you want to mount Ex i and non-Ex i devices next to each other on a DIN rail, you will require the MCR-DP partition plate (item no. 1430594). The partition plate ensures that Ex i isolating distances are maintained.

The partition plate is tailored to the MINI Analog, MINI Analog Pro, and MACX Analog device series and the QUINT4 system power supply (item no. 2904614).

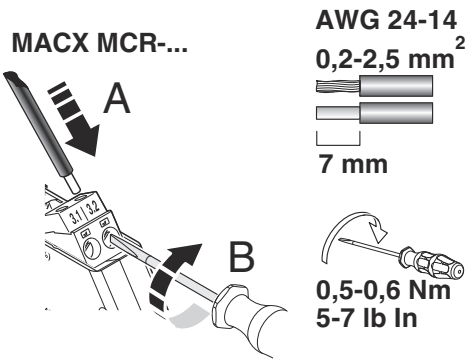
The partition plate is compatible with the ME … TBUS DIN rail connectors (e.g., item no. 1090049, 2695439).

6.9 Connecting the cables

- Screw terminal blocks: fit the litz wires with ferrules, permitted conductor cross section: 0.2 mm² to 2.5 mm²
- Push-in terminal blocks: fit the litz wires with ferrules, permitted conductor cross section: 0.2 mm² to 1.5 mm²
- Install intrinsically safe and non-intrinsically safe cables separately.

Screw connection

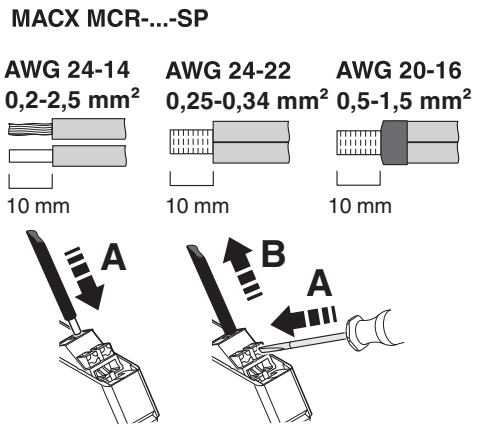
Figure 5 Screw connection



- Strip the wire by approximately 7 mm and crimp the ferrules.
- Insert the wire into the corresponding connection terminal block.
- Use a screwdriver to tighten the screw in the opening above the connection terminal block. Tightening torque: 0.6 Nm

Push-in connection (PSPT):

Figure 6 Push-in connection



If you want to use conductors with ferrule:

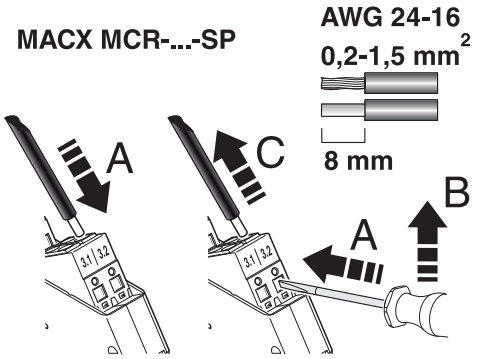
- Strip the wire by approximately 10 mm and crimp ferrules to the end of the wire.
- Insert the wire into the corresponding connection terminal block.
- Push in the pushbutton with a screwdriver to release.

If you want to use conductors without ferrule:

- Strip 10 mm off the wire.
- Push the pushbutton in with a screwdriver.
- Insert the wire into the corresponding connection terminal block.
- Push in the pushbutton with a screwdriver to release.

Push-in connection (TVFKC):

Figure 7 Push-in connection



If you want to use conductors with ferrule:

- Strip the wire by approximately 8 mm and crimp ferrules to the end of the wires.
- Insert the wire into the corresponding connection terminal block.
- Push in the pushbutton with a screwdriver to release.

If you want to use conductors without ferrule:

- Push the pushbutton in with a screwdriver.
- Insert the wire into the corresponding connection terminal block.
- Push in the pushbutton with a screwdriver to release.

6.10 LED status indicators

LED	Color/status	Description
PWR	Green	Supply voltage
	On	Ready to operate
		Configuration without device supply via IFS-USB-PROG-ADAPTER programming adapter
DAT	Green	Currently with no function
ERR	Red	Error
	On	Module error
	Flashing (1.2 Hz)	Service mode
	Flashing (2.4 Hz)	Line error

6.11 Sensor types

6.11.1 Resistance temperature detector (RTD)

Depending on the connection method, the following terminal points must be connected for temperature measurement with resistance thermometers:

RL ≤25 Ω per lead

2-conductor connection technology

Terminals 5.1, 5.2

You can compensate for the cable resistance using the clipx ENGINEER PC program.

3-conductor connection technology

Terminals 4.1, 5.1, 5.2

With 3-conductor connection technology, ensure that all three cables have the same resistance.

4-conductor connection technology

Terminals 4.1, 4.2, 5.1, 5.2

2 x 2-conductor connection technology

RTD 1 terminals: 5.1, 5.2

RTD 2 terminals: 4.1, 4.2

6.11.2 Potentiometer

Terminals 4.1, 5.1, 5.2

6.11.3 Resistance measurement

Terminal points 5.1 and 5.2 can be used for measuring variable resistances between 0 kΩ ... 50 kΩ.

Up to 75 Ω: RL ≤ 2.5 Ω for each lead

Up to 150 Ω: RL ≤ 5 Ω per lead

Up to 300 Ω: RL ≤ 10 Ω per lead

6.12 Current output

The current output can be freely configured within the limits of 0 mA ...20 mA.

The minimum span is 4 mA.

In safety-relevant applications (SIL = ON), the output is fixed at 4 mA ...20 mA.

Terminals 3.1 (+) and 3.2 (-)

6.13 Monitoring function

The device is equipped with monitoring functions for the input and output range.

Input monitoring function

The input monitoring function for line break and short circuit refers to the sensor connected to the input.

When an error is detected, the output signal is set to the configured error value.

With RTD sensors and resistance-type sensors, short-circuit failures are detected resistance values <1 Ω.

With RTD sensors, resistance-type sensors, and potentiometers, a line break is detected when the current flow through the sensor is faulty.

Once the fault has been eliminated, the device resumes performing its normal functions.

Output monitoring function

The current output can be monitored for line breaks and maximum load.

This is activated via the configuration.

In safety-relevant applications (SIL = ON), output monitoring is always active.

As soon as the fault has been eliminated, the device continues to perform its normal function.

6.14 Operating modes

If you change the configuration via PC-based software (e.g., clipx ENGINEER), you must always re-check and release the changes prior to transferring them to the device.

Once transferred, the new data in the device is adopted via activation and warm start.

6.14.1 SIL ON / SIL OFF

You can operate the device either in the normal SIL ON or SIL OFF operating modes.

The standard configuration is the SIL ON operating mode.

With the order configuration, you can select customer-specific configurations in the order key.

6.14.2 Service mode

You can configure the service mode at any time via the configuration software, e.g., clipx ENGINEER.

If you change the settings during service mode and then leave service mode, the device will then perform a warm start in order to apply the newly set values.

If you do not make any changes, the device starts up in normal measuring mode without a warm start.

In service mode, it is also possible to simulate the output signal independently of the input signal (force).

In this case, in safety-relevant applications, the safety function of the device is deactivated and the initial value for the analog output signal is 2 mA, which enables downstream devices to detect the deviation from normal mode as a result of the measured value being below the measurement range.

7 Minimum spans and measuring accuracy

7.1 Input for Pt RTDs and Ni RTDs

Minimum measuring span

10 Ω ≤ R_0 < 100 Ω	:	100 K
100 Ω ≤ R_0 ≤ 10 kΩ	:	20 K

R_0 is the resistance value of the sensor at 0°C.

Measuring accuracy

10 Ω ≤ R_0 < 100 Ω	:	0.2 K x 100 Ω / R_0	=	0.1% x (100 Ω / R0) x (200 K / measuring span)
100 Ω ≤ R_0 ≤ 1 kΩ	:	0.2 K	=	0.1% x (200 K / measuring span)
1 kΩ < R_0 ≤ 10 kΩ	:	0.4 K	=	0.1% x (400 K / measuring span)

7.2 Input for Cu RTDs

Minimum measuring span

10 Ω ≤ R_0 < 100 Ω	:	100 K
100 Ω ≤ R_0 ≤ 10 kΩ	:	20 K

Measuring accuracy

10 Ω ≤ R_0 < 100 Ω	:	0.5 K x 100 Ω / R0	=	0.1% x (100 Ω / R_0) x (500 K / measuring span)
100 Ω ≤ R_0 ≤ 1 kΩ	:	0.5 K	=	0.1% x (500 K / measuring span)
1 kΩ < R_0 ≤ 10 kΩ	:	1.0 K	=	0.1% x (1000 K / measuring span)

7.3 Input for Ni 1000 (Landis & Gyr), KTY 81-110, KTY 84-130 (Philips)

Minimum measuring span

20 K

Measuring accuracy

0.2 K

7.4 Resistance-type sensors and resistors

50% of the measuring range ≤ (nominal value of resistance-type sensor + lead resistance) ≤ measuring range

Minimum measuring span

10% of the selected measuring range

Measuring accuracy

0 Ω ... 75 Ω	:	0.10 %	(of the measuring range)
0 Ω ... 150 Ω	:	0.05 %	(of the measuring range)
0 Ω ... 300 Ω	:	0.02 %	(of the measuring range)
0 Ω ... 600 Ω	:	0.01 %	(of the measuring range)
0 Ω ... 1200 Ω	:	0.01 %	(of the measuring range)
0 Ω ... 2400 Ω	:	0.01 %	(of the measuring range)
0 Ω ... 4800 Ω	:	0.01 %	(of the measuring range)
0 Ω ... 6250 Ω	:	0.02 %	(of the measuring range)
0 Ω ... 12500 Ω	:	0.02 %	(of the measuring range)
0 Ω ... 25000 Ω	:	0.02 %	(of the measuring range)
0 Ω ... 50000 Ω	:	0.02 %	(of the measuring range)

Example

Resistance-type sensor with nominal value	:	1000 Ω
Measuring range to be selected	:	0 Ω ... 1200 Ω
Minimum measuring span	:	10% of the selected measuring range = 120 Ω
Measuring accuracy	:	0.01% of the selected measuring range = 120 mΩ

7.5 Potentiometer

50% of the measuring range ≤ (nominal value of potentiometer + lead resistance) ≤ measuring range

The line resistance must be ≤10 Ω per cable and the same in all three cables.

Minimum measuring span

10% of the selected measuring range

Measuring accuracy

0 Ω ... 75 Ω	:	0.10 %	(of the measuring range)
0 Ω ... 150 Ω	:	0.05 %	(of the measuring range)
0 Ω ... 300 Ω	:	0.02 %	(of the measuring range)
0 Ω ... 600 Ω	:	0.02 %	(of the measuring range)
0 Ω ... 1200 Ω	:	0.02 %	(of the measuring range)
0 Ω ... 2400 Ω	:	0.02 %	(of the measuring range)
0 Ω ... 4800 Ω	:	0.02 %	(of the measuring range)
0 Ω ... 6250 Ω	:	0.10 %	(of the measuring range)
0 Ω ... 12500 Ω	:	0.10 %	(of the measuring range)
0 Ω ... 25000 Ω	:	0.10 %	(of the measuring range)
0 Ω ... 50000 Ω	:	0.10 %	(of the measuring range)

Example

Potentiometer with nominal value	:	1000 Ω
Measuring range to be selected	:	0 Ω ... 1200 Ω
Minimum measuring span	:	10% of the selected measuring range = 120 Ω
Measuring accuracy	:	0.02% of the selected measuring range = 240 mΩ

7.6 Output signal

Error analog output

4 µA	:	0.02 %	for	0 mA ... 20 mA

8 Password

The device is protected by means of a four-digit password set in the factory in order to prevent impermissible changes to the configuration.

Default setting: 1111

For safety-relevant applications, you should change the password set in the factory.

If the password is lost, a reset is not possible.

In this case, please contact Phoenix Contact.

If you only want to display data from the device or install the device in non-safety-relevant applications, you can deactivate the password.

Setting: 0000

The device is accessed via a service PC with connected IFS-USBPROG-ADAPTER programming adapter (item no. 2811271) and the clipx ENGINEER configuration software.

Alternatively, you can use the Bluetooth programming adapter (Item No. 2905872).

Further information on configuration via the clipx ENGINEER configuration software can be found in the relevant manual.

WARNING

If you activate Functional Safety or make configuration changes with Functional Safety activated, you must observe the rules in the section “Safety-relevant applications, installation and startup”.

WARNING: Limitations for safety-relevant applications

Only 4 mA ... 20 mA, limited programming of output current in the event of line faults ($2\ mA \leq I_{Out} \leq 3.6\ mA$ or $I_{Out} \geq 21\ mA$)

WARNING

Once new configuration data has been written, the device performs a warm start that changes the properties of the device.

Adapt the downstream control device to these modifications.

NOTE

Transfer and activate the configuration after the password has been changed.

9 Configuration

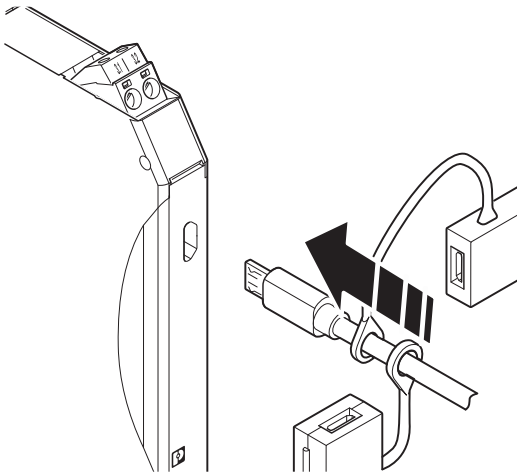
WARNING - Explosion Hazard

If configuring for zone 2, the PC must be approved for use in zone 2!

Changes to the configuration and parameterization data can be made during operation as well as in a disconnected state.

The configuration software can be downloaded as a DTM and as a standalone clipx ENGINEER version free of charge from: www.phoenixcontact.com/products. The online manual and the online help for the intuitive software explain the configuration, parameterization, and service options (e.g., online monitoring) and their use.

Figure 8 IFS-USB-PROG-ADAPTER



- Connect the device and PC using the IFS-USB-PROG-ADAPTER programming adapter (Item No. 2811271).

Alternatively, you can use the Bluetooth programming adapter (Item No. 2905872).

9.1 System requirements

For a complete list of system requirements, please refer to the clipx ENGINEER website at https://www.phoenixcontact.com/product/1272241.

Use the IFS-USB-PROG-ADAPTER (Item No.: 2811271) for connecting the device to the PC. The drivers for the USB programming adapter are installed automatically.

Alternatively, you can use the Bluetooth programming adapter (Item No. 2905872).

9.2 Configuring the user characteristic curve

Freely configurable user characteristic curve for individual adaptation of resistance temperature detectors (RTDs)

You can create the user characteristic curve with the PC-based clipx ENGINEER software and load it into the device.

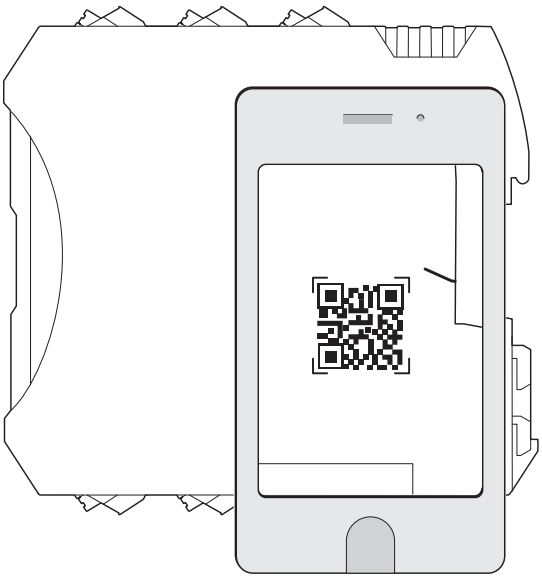
The user characteristic curve is selected via clipx ENGINEER.

10 Digital nameplate

The digital nameplate provides the option of obtaining product-specific data related to a specific serial number.

If you scan the QR code (digital nameplate) on the device, you can, for example, retrieve documents on the production status as well as clearly identify the hardware and firmware status of the device at hand.

Figure 9 Scan QR code



11 Safety-related applications

The following notes apply for the devices:

Designation	Item No.
Standard configuration	
MACX MCR-RTD-I	1050192
MACX MCR-RTD-I-SP	1050201
Order configuration	
MACX MCR-RTD-I-SP-C	1052464

The devices listed above are certified by TÜV Nord.

Certificate number: SEBS-A.150520/17, V 2.0

11.1 Safety function and safety requirements

The safety-relevant devices are used for the acquisition of a sensor signal (RTD sensor and resistance-type sensor), that is converted into a scaled signal and from which a standardized “live zero” current signal is generated.

The entire conversion is continuously monitored to a maximum transmission error of 5%.

In the event of greater deviations, the device switches to the safe state.

The safe state is an output signal of either <3.6 mA or >21 mA.

NOTE

The evaluation unit downstream of the device (e.g. safety-relevant PLC) must recognize these states and control the actuator as the final link in the safety chain accordingly.

If an internal fault is detected, the device also switches to the safe state (current output <3.6 mA or >21 mA).

The transition to the safe state always takes place within the internal fault detection time of 50 s.

The device is released (restarted) by switching off the supply voltage and switching it back on again, by resetting the device via the serial interface, or by activating the “Restart” option during configuration.

The integrated startup tests are then performed.

If the fault is still present, it will be detected during these tests.

If the fault is still present, the devices switches back to the safe state.

In addition to the safety functions, there are also monitoring functions for the input and the current output.

Evaluation

Faults which are detected in the device and to which the device responds by switching to the safe state are safe faults (λs).

Faults where the device does not follow a change of input signal or generates an output signal that deviates from the intended value by more than ±5% are evaluated as dangerous faults (λd).

Both safe (λs) and dangerous (λd) faults can be detected by diagnostic measures.

Detected dangerous faults (λdd) are handled in the same way as safe faults.

The monitoring functions refer to events whose cause is detected and reported outside of the device.

Summary

Function	Output signal	Safe state	Cause
Safety function	4 mA ... 20 mA	<3.6 mA or >21 mA relay is not actuated	Deviation >5%
Input monitoring	4 mA ... 20 mA	2 mA ... 3,6 mA, >21 mA	Line fault, input
Output monitoring	4 mA ... 20 mA	= 0 mA	Line fault, output

Together with the actual signal transmission, continuous checks and diagnostic functions are performed in the devices in order to detect faulty behavior.

The internal fault monitoring time (diagnostics test interval) is the time taken to carry out and repeat these tests in full.

Random hardware faults are detected during this time.

The internal fault monitoring time is 50 seconds.

11.2 Safety integrity requirements

Due to the multiple connection options, only two configurations, for “RTD 3-conductor” and “potentiometer input”, are considered in the following.

These are representative of all configurations at the input terminals and reflect the most conservative case.

FIT (Failure in Time)

1 FIT is 1 failure per 10^9 hours

11.2.1 Error rates

NOTE

The specified safety characteristics only relate to the device and do not include the connected sensors.

Input	RTD 3-conductor connection technology
Output	Analog output 4 mA ... 20 mA

- Type B device (in accordance with IEC/EN 61508-2)
- Safety Integrity Level (SIL) 2 / SC 2
- Architecture $1oo1_D$
- HFT 0
- MTTR 24 h
- Ambient temperature 40°C

The failure rates in FIT for the entire device are as follows:

λ_{SU}	λ_{SD}	λ_{DU}	λ_{DD}	SFF	DC_D
240	0.8	36.1	401.5	94.1 %	93.8 %

The total failure rate is 679.8 FIT.

The MTBF is 96 years.

The average probability of the specified function failing on demand for “low demand” mode and the probability of a dangerous failure per hour for “continuous demand” mode are calculated based on the failure rates.

PFD_{avg} values

T [PROOF]	1 year	2 years	5 years
PFD_{avg}	$1.58 * 10^{-4}$	$3.161 * 10^{-4}$	$7.902 * 10^{-4}$

PFH = $3.61 * 10^{-8}$/h

The calculation is performed assuming a checking interval (T_{PROOF}) of one year and a repair time (MTTR) of 24 hours, a test coverage (CPT) of 95%, and a lifetime (LT) of 30 years.

On the basis of the value determined for the average probability of failure PFD_{avg}, the checking interval can be increased to five years if the percentage of the device for the entire safety circuit is assumed to be 10%.

11.2.2 Error rates

Input	Potentiometer
Output	Analog output 4 mA ... 20 mA

- Type B device (in accordance with IEC/EN 61508-2)
- Safety integrity level (SIL) 2
- Architecture $1oo1_D$
- HFT 0
- MTTR 24 h
- Ambient temperature 40°C

The failure rates in FIT for the entire device are as follows:

λ_{SU}	λ_{SD}	λ_{DU}	λ_{DD}	SFF	DC_D
240	0.8	37.8	401.3	94 %	93.3 %

The total failure rate is 680.8 FIT.

The MTBF is 96 years.

The average probability of the specified function failing on demand for “low demand” mode and the probability of a dangerous failure per hour for “continuous demand” mode are calculated based on the failure rates.

PFD_{avg} values

T [PROOF]	1 year	2 years	5 years
PFD_{avg}	$1.652 * 10^{-4}$	$3.04 * 10^{-4}$	$8.259 * 10^{-4}$

PFH = $3.771 * 10^{-8}$/h

The calculation is performed assuming a checking interval (T_{PROOF}) of one year and a repair time (MTTR) of 24 hours, a test coverage (CPT) of 95%, and a lifetime (LT) of 30 years.

On the basis of the value determined for the average probability of failure PFD_{avg}, the checking interval can be increased to five years if the percentage of the device for the entire safety circuit is assumed to be 10%.

11.3 Conditions

– The failure rates of the components used remain constant throughout the period of use.
– The propagation of errors by the device in the system is not taken into consideration.
– The repair time (replacement) should be 24 hours.
– The failure rates of the external power supply are not taken into consideration.
– The average temperature at which the device is to be used is +40°C.
– The specified error rates are based on an ambient temperature of +40°C. For an ambient temperature of +60°C, the error rates must be multiplied by factor 2.5. Factor 2.5 is based on guide values.
– The supplying power supply unit must be able to absorb an interruption to the supply voltage of 20 ms.

11.4 Configuring a SIL device

The following configuration options are available:

– The devices are delivered with a standard configuration for safety-relevant applications with a 4 mA ... 20 mA output.
– Customer-specific preconfigured devices (-C) can be delivered for both safety-relevant applications and “normal” applications.
– The devices can also be configured by users for both safety-relevant applications and “normal” applications.

You can read out and change the configuration of all devices at any time.

For safety-relevant applications, you should change the password set in the factory.

If the password is lost, a reset is not possible.

In this case, please contact Phoenix Contact.

Configuring safety-relevant applications

- Connect the device and PC using the IFS-USB-PROG-ADAPTER programming adapter (Item No. 2811271).
- Alternatively, you can also use the Bluetooth programming adapter (Item No. 2905872).
- Call up the clipx ENGINEER configuration software.
- Read out the current configuration.
- Enter the password in clipx ENGINEER in the “PIN” hardware configuration (set to 1111 in the factory).
- Activate/deactivate SIL.

In “SIL ON”, you can deactivate the “Restart after failsafe” function.

This means that in the event of a fault, the device enters the failsafe state in accordance with the safety functions, but is not restarted.

- Write the changed configuration data to the device.
- Check that the new configuration data in the control window is correct and confirm with “OK”, or “Cancel” if not correct.

NOTE: Installation, operation, and maintenance may only be carried out by professionals.

WARNING

If you activate Functional Safety or make configuration changes with Functional Safety activated, you must observe the rules in the section “Safety-relevant applications, installation and startup”.

WARNING: Limitations for safety-relevant applications

Only 4 mA ... 20 mA, limited programming of output current in the event of line faults ($2\ mA \leq I_{Out} \leq 3.6\ mA$ or $I_{Out} \geq 21\ mA$)

WARNING

Once new configuration data has been written, the device performs a warm start that changes the properties of the device.

Adapt the downstream control device to these modifications.

WARNING

The device must be write-protected to prevent improper use.

To apply write protection, issue a password.

11.5 Installation and startup

NOTE: Installation, operation, and maintenance may only be carried out by professionals.

During installation, observe the instructions in the package slip:

Designation	MNR No.
PACKB.MACX MCR-RTD-I(-SP(-C))	1077321

The package slip is supplied with the device. It can also be downloaded at: www.phoenixcontact.com/products.

Lockable housing with IP54 protection is recommended for the installation of the devices.

- Check that the configuration of the device is correct for the intended application.
- Connect the device according to the installation notes.
- Ensure that the connected sensor corresponds to the intended configuration.
- Check that the device operates correctly with the measuring transducer and sensor connected.
- A calibrated sensor simulator and a calibrated digital multimeter may be required in order to check the device with the measuring transducer connected.
- Start up the safety circuit and check that it operates correctly.

11.6 Notes on operation

In normal operation, only the green LED (PWR) is on.

If a malfunction occurs during operation and the red LED (ERR) flashes, there is a line fault.

The output current of the device is then between 2 mA … 3.6 mA or is higher than 21.0 mA (in the case of faults in the sensor circuit) or is 0 mA (in the case of a line break in the output circuit).

Check all signal lines.

The device will automatically switch back to normal operation once the fault has been eliminated.

If a fault occurs during operation and the red LED (ERR) is permanently lit, the device has switched to the “safe state” (output current is less than 2 mA).

Restart the device in order to set it to normal operation again.

If no PC/laptop has been connected, you can also interrupt the power supply.

Or you can carry out a warm start via the configuration software (Service > Reset).

The device should then return to normal operation.

If not, you must replace the device.

11.7 Recurring checks

The function of the entire safety loop must be checked regularly according to IEC/EN 61508 and IEC/EN 61511.

The intervals for checking are specified by the intervals of each individual device within the safety loop.

The devices must be checked at least every five years (maximum proof test interval).

It is the operator's responsibility to select the type of checks and the checking intervals in the specified time period.

Checking must be carried out in such a way that the correct function of the safety equipment in conjunction with all components can be verified.

Possible procedure for recurring checks for discovering dangerous and undetected device failures

A calibrated sensor simulator and a calibrated digital multimeter are necessary for checking the devices.

1. Take appropriate steps to prevent incorrect use.
2. Disconnect the safety circuit from further processing.
3. Connect the sensor simulator to the input of the measuring transducer using the intended connection technology.
4. Connect the digital multimeter to the output in current measuring operating mode (20 mA range).
5. Restore the safety circuit to full functionality.
6. Resume normal operation.

11.8 Repair

The devices have a long service life, are protected against malfunctions, and are maintenance-free.

However, if a device should fail, send it back to Phoenix Contact immediately. The type of malfunction and possible cause must also be stated.

Please use the original packaging or other suitable safe packaging when sending devices back for repairs or recalibration.

Phoenix Contact GmbH & Co. KG
Abteilung Service und Reparatur
Flachsmarktstr. 8
32825 Blomberg
GERMANY

11.9 Standards

The devices are developed and tested according to the following standards:

IEC/EN 61508-1: 2011	Functional Safety of electrical/electronic/programmable electronic safety-related systems - Part 1: General requirements
IEC/EN 61508-2: 2011	Functional Safety of electrical/electronic/programmable electronic safety-related systems - Part 2: Requirements for electrical/electronic/programmable electronic safety-related systems
IEC/EN 61326-1: 2006	Electrical equipment for measurement, control and laboratory use - EMC requirements
IEC/EN 61326-3-2: 2006	Electrical equipment for measurement, control and laboratory use - EMC requirements - Part 3-2: Immunity requirements for safety-related systems and for equipment intended to perform safety-related functions (Functional Safety) - Industrial applications with specified electromagnetic environment

11.10 Abbreviations

Abbreviation		Meaning
DC_D	Diagnostic coverage of dangerous failures	Diagnostic coverage of dangerous failures: $DC_D = \lambda_{DD}/(\lambda_{DU} + \lambda_{DD})$
DC_S	Diagnostic coverage of safe failures	Diagnostic coverage of safe failures: $DC_S = \lambda_{SD}/(\lambda_{SU} + \lambda_{SD})$
FIT	Failure in time	1 FIT = 1 failure/10^9 h
HFT	Hardware fault tolerance	Hardware fault tolerance: ability of a function unit to continue with the execution of a demanded function despite existing faults or deviations
β	Common cause factor	Proportion of undetected failures as a result of a common cause
β_D	Common cause factor, diagnostic	Proportion of failures as a result of a common cause which are detected by the diagnostic test.
λ_D	Rate of dangerous failures	Proportion of dangerous failures per hour
λ_{DD}	Rate of dangerous detected failures	Proportion of detected dangerous failures per hour
λ_{DU}	Rate of dangerous undetected failures	Proportion of undetected dangerous failures per hour
λ_S	Rate of safe failures	Proportion of safe failures per hour
λ_{SD}	Rate of safe detectable failures	Proportion of detectable safe failures per hour
λ_{SU}	Rate of safe undetectable failures	Proportion of undetectable safe failures per hour
MTBF	Mean time between failures	Mean time between consecutive failures
PFD_{avg}	Average probability of failure on demand	Average probability of dangerous failure on demand of a safety function
PFH_D	Probability of a dangerous failure per hour	Probability of failure per hour for the safety function
SFF	Safe failure fraction	Proportion of safe failures: proportion of failures without the potential to set the safety-related system to a dangerous or impermissible function state
SIL	Safety integrity level	International standard IEC 61508 defines four discrete safety integrity levels (SIL 1 to 4). Each level corresponds to a probability range for the failure of a safety function. The higher the safety integrity level of safety-related systems, the lower the probability that the demanded safety functions will not be performed.

12 Revision history

Document revision	Hardware revision	Firmware revision	Date	Description
06	07 (1050192)	01 (1050192)	2024-08-12	Figure 2 adjusted due to new printing
	06 (1050201)	01 (1050201)		Description of new Push-in connection technology (PSPT) added
	06 (1052464)	01 (1052464)		Description of digital nameplate added
				New accessory MCR-DP (item no. 1430594) added
				NEPSI approval removed
				INMETRO approval added
				Phased-out device version removed (1052472 MACX MCR-RTD-I-C)
				Update to SIL certificate (SC 2 added)
				UKCA approval removed