

MACX MCR-SL-RPSS-2I-2I(-SP)



Repeater power supply, 2-channel

Data sheet
108271_en_01

© PHOENIX CONTACT 2019-04-25

1 Description

The 2-channel repeater power supply is designed for electrically isolated operation of 2-wire measuring transducers.

2-wire measuring transducers are supplied with energy.

The analog 0/4 ... 20 mA measured value from the field level is transmitted to the control level via two electrically isolated outputs.

The outputs of the module are active.

The analog measured value on the Ex or non-Ex side can be overlaid with digital (HART) communication signals and transmitted bidirectionally.

Sockets are integrated into the COMBICON connectors for connecting HART (HHT) communicators.

Installation in zone 2 is permitted.

The module is suitable for safety-related applications up to SIL 3 according to IEC/EN 61508 and PL d according to EN ISO 13849-1.

Features

- 2-channel
- Inputs 4 mA ... 20 mA
- Outputs 4 mA ... 20 mA, active
- HART-compatible
- Error indication according to NAMUR NE 43
- Up to SIL 3 according to IEC/EN 61508
- PL d according to EN ISO 13849-1
- 5-way electrical isolation
- Safe electrical isolation between inputs and outputs, supply
- Power supply possible via DIN rail connector
- Installation in Ex zone 2 permitted
- Plug-in connection terminal blocks, either screw or spring-cage connection technology (Push-in technology)
- Housing width of 12.5 mm
- Low power dissipation
- High transmission accuracy



WARNING: Explosion hazard

The 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:

EN/IEC 60079-0, EN/IEC 60079-15

When installing and operating the device, the applicable safety directives (including national safety directives), accident prevention regulations, as well as general technical regulations must be observed.



Make sure you always use the latest documentation.

It can be downloaded from the product at [phoenixcontact.net/products](https://www.phoenixcontact.net/products).

This document is valid for the products listed in the "Ordering data".

2	Table of contents	
1	Description	1
2	Table of contents	2
3	Ordering data	3
4	Technical data	5
5	Safety regulations and installation notes.....	7
5.1	Content of the EU Declaration of Conformity.....	7
5.2	Safety notes	7
5.3	Installation notes	7
5.4	Installation in Zone 2.....	7
5.5	Installation in zone 22	8
5.6	Safety-related applications (SIL, PL).....	8
5.7	UL note	8
6	Installation	9
6.1	Connection notes	9
6.2	Electrostatic discharge	9
6.3	Structure	9
6.4	Basic circuit diagram with connection terminal blocks	10
6.5	Input.....	10
6.6	Output	10
6.7	Power supply.....	10
6.8	Dimensions	11
6.9	Mounting	11
6.10	Connecting the cables	12
6.11	Startup.....	12
7	Safety-related applications	13
7.1	Safety function	13
7.2	Safety integrity requirements	13
7.3	2-channel version	14
7.4	Conditions	14
7.5	Installation and startup	14
7.6	Notes on operation.....	14
7.7	Recurring checks.....	15
7.8	Repair.....	15
7.9	Standards.....	16
7.10	Abbreviations	16

3 Ordering data

Description	Type	Order No.	Pcs./Pkt.
2-channel repeater power supply for operating 2-wire measuring transducers, input: 4...20 mA (powered), output: 4...20 mA (active), bidirectional transmission of digital HART communication signals, screw connection, SIL, PL.	MACX MCR-SL-RPSS-2I-2I	2904089	1
2-channel repeater power supply for the operation of 2-conductor measuring transducers, input: 4... 20 mA (powered), output: 4...20 mA (active), bidirectional transmission of digital HART communication signals, Push-in connection, SIL, PL.	MACX MCR-SL-RPSS-2I-2I-SP	2904090	1
Accessories	Type	Order No.	Pcs./Pkt.
DIN rail connector for DIN rail mounting. Universal for TBUS housing. Gold-plated contacts, 5-pos.	ME 6,2 TBUS-2 1,5/5-ST-3,81 GN	2869728	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
Universal Termination Carrier for connecting 16 two-channel MACX Analog Ex i signal conditioners to digital or analog I/O cards, via two D-SUB connectors, 37-pos. (1:1 connection)	TC-2D37SUB-ADIO32-2EX-P-UNI	2904684	1
USB HART modem cable for communication between a PC and HART devices, cable length: 1m.	GW HART USB MODEM	1003824	1
Plastic label, Sheet, white, unlabeled, can be labeled with: BLUEMARK ID COLOR, BLUEMARK ID, BLUEMARK CLED, PLOTMARK, CMS-P1-PLOTTER, mounting type: adhesive, lettering field size: 11 x 9 mm	UC-EMLP (11X9)	0819291	10
Plastic label, can be ordered: by sheet, white, labeled according to customer specifications, mounting type: adhesive, lettering field size: 11 x 9 mm	UC-EMLP (11X9) CUS	0824547	1
Plastic label, Sheet, yellow, unlabeled, can be labeled with: BLUEMARK ID COLOR, BLUEMARK ID, BLUEMARK CLED, PLOTMARK, CMS-P1-PLOTTER, mounting type: adhesive, lettering field size: 11 x 9 mm	UC-EMLP (11X9) YE	0822602	10
Plastic label, can be ordered: by sheet, yellow, labeled according to customer specifications, mounting type: adhesive, lettering field size: 11 x 9 mm	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, lettering field size: 11 x 9 mm	UC-EMLP (11X9) SR	0828094	10

Accessories	Type	Order No.	Pcs./Pkt.
Plastic label, can be ordered: by sheet, silver, labeled according to customer specifications, mounting type: adhesive, lettering field size: 11 x 9 mm	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, lettering field size: 11 x 9 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, lettering field size: 11 x 9 mm	US-EMLP (11X9) YE	0828871	10
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, lettering field size: 11 x 9 mm	US-EMLP (11X9) SR	0828872	10
Device marker, Sheet, white, unlabeled, can be labeled with: TOPMARK NEO, TOPMARK LASER, mounting type: adhesive, lettering field size: 11 x 9 mm	LS-EMLP (11X9) WH	0831678	10
Device marker, Sheet, yellow, unlabeled, can be labeled with: TOPMARK NEO, TOPMARK LASER, mounting type: adhesive, lettering field size: 11 x 9 mm	LS-EMLP (11X9) YE	0831732	10
Device marker, Sheet, silver, unlabeled, can be labeled with: TOPMARK NEO, TOPMARK LASER, mounting type: adhesive, lettering field size: 11 x 9 mm	LS-EMLP (11X9) SR	0831705	10
Test plugs, with solder connection up to 1 mm ² conductor cross section, color: gray	MPS-MT	0201744	10
Insulating sleeve, color: black	MPS-IH BK	0201731	10
Insulating sleeve, color: gray	MPS-IH GY	0201728	10
Insulating sleeve, color: green	MPS-IH GN	0201702	10
Insulating sleeve, color: yellow	MPS-IH YE	0201692	10
Insulating sleeve, color: blue	MPS-IH BU	0201689	10
Insulating sleeve, color: red	MPS-IH RD	0201676	10
Insulating sleeve, color: white	MPS-IH WH	0201663	10

4 Technical data

Input data	
Current input signal	4 mA ... 20 mA
Transmitter supply voltage	> 16 V (at 20 mA)
Underload/overload signal range	0 mA ... 24 mA
Output	
Output description	Current output
Current output signal	4 mA ... 20 mA (active)
Underload/overload signal range	0 mA ... 24 mA
Transmission Behavior	1:1 to input signal
Load/output load current output	≤ 450 Ω (20 mA) ≤ 375 Ω (24 mA)
Output behavior in the event of an error	< 3.6 mA (In the event of cable break at the input (as per NE 43)) > 22.5 mA (In the event of cable short circuit at the input (as per NE 43))
General data	
Nominal supply voltage	24 V DC
Supply voltage range	19.2 V DC ... 30 V DC (24 V DC -20%...+25%)
Max. current consumption	< 100 mA (24 V / 20 mA)
Power dissipation	< 1.4 W (at 24 V DC / 20 mA)
Transmission error, typical	< 0.05 % (of final value)
Maximum transmission error	< 0.1 % (of final value)
Maximum temperature coefficient	< 0.01 %/K
Step response (10-90%)	< 1.3 ms (for 4 mA ... 20 mA step)
HART function	Yes
Protocols supported	HART
Signal bandwidth	as per HART specifications
Degree of protection	IP20
Flammability rating according to UL 94	V0
Overvoltage category	II
Degree of pollution	2
Status display	Green LED (supply voltage)
Dimensions W/H/D	12.5 mm / 112.5 mm / 114.5 mm (MACX MCR-SL-RPSS-2I-2I) 12.5 mm / 116 mm / 114.5 mm (MACX MCR-SL-RPSS-2I-2I-SP)
Type of housing	PA 6.6-FR gray
Ambient conditions	
Ambient temperature (operation)	-20 °C ... 60 °C (Any mounting position)

Ambient conditions	
Ambient temperature (storage/transport)	-40 °C ... 80 °C
Permissible humidity (operation)	10 % ... 95 % (non-condensing)
Maximum altitude for use above sea level	≤ 2000 m

Electrical isolation	
Input/output, power supply	
Rated insulation voltage (overvoltage category II; degree of pollution 2, safe isolation as per EN 61010-1)	300 V _{rms}
50 Hz, 1 min., test voltage	2.5 kV AC
Output 1/output 2/ power supply	
50 Hz, 1 min., test voltage	1.5 kV

Connection data	Screw connection	Push-in connection
Conductor cross section, solid	0.2 mm ² ... 2.5 mm ²	0.2 mm ² ... 1.5 mm ²
Conductor cross section, flexible	0.2 mm ² ... 2.5 mm ²	0.2 mm ² ... 1.5 mm ²
Conductor cross section AWG	24 ... 14	24 ... 16
Stripping length	7 mm	8 mm
Tightening torque	0.5 Nm ... 0.6 Nm	

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	
Conformance	CE-compliant, additionally EN 61326
ATEX	⊕ II 3 G Ex nA IIC T4 Gc X
UL, USA/Canada	UL 508 Listed UL 61010 Listed Class I, Div. 2, Groups A, B, C, D T4 Class I, Zone 2, Groups IIC, IIB, IIA T4
Shipbuilding (DNV GL TAA000020C)	
Temperature	B
Humidity	B
Vibration	A
EMC	A
Enclosure	Required protection according to the Rules shall be provided upon installation on board
Safety Integrity Level (SIL) IEC 61508	to 2/3
Performance level according to ISO 13849	PLd
Systematic Capability	SC 3

5 Safety regulations and installation notes

5.1 Content of the EU Declaration of Conformity

Manufacturer: PHOENIX CONTACT GmbH & Co.KG,
Flachmarktstr.8, 32825 Blomberg, Germany

Product designation:	Order No.:
MACX MCR-SL-RPSS-2I-2I	2904089
MACX MCR-SL-RPSS-2I-2I-SP	2904090

The above mentioned product conforms with the most important requirements of the following directive(s) and their modification directives:

2006/42/EC	Machinery Directive
2011/65/EU	RoHS directive
2014/30/EU	Electromagnetic Compatibility Directive (EMC)
2014/34/EU	ATEX Directive

5.2 Safety notes

- Observe the safety regulations of electrical engineering and industrial safety and liability associations.
- Disregarding these safety regulations may result in death, serious personal injury or damage to equipment.
- The device must be operated in a closed control cabinet!
- Before working on the device, disconnect the power.
- During operation, parts of electrical switching devices carry hazardous voltages.
- In the event of an error, replace the device.
- Keep the product documentation in a safe place.

5.3 Installation notes

- The 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: EN 60079-0, EN 60079-15
- Installation, operation, and maintenance may only be carried out by qualified electricians. Follow the installation instructions as described. When installing and operating the device, the applicable regulations and safety directives (including national safety directives), as well as general technical regulations, must be observed. For the safety data, refer to this document and the certificates (EU examination certificate and other approvals if appropriate).

- 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.
- The IP20 protection (IEC 60529/EN 60529) of the device is intended for use in a clean and dry environment. The device must not be subject to mechanical strain and/or thermal loads, which exceed the limits described.
- The device is not designed for use in potentially dust-explosive atmospheres. If dust is present, installation must take place in a suitable and approved housing (at least IP54) that meets the requirements of EN 60079-31. The specified surface temperature of the housing must be observed.
- 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.
- The device must be stopped if it is damaged, has been subjected to an impermissible load, stored incorrectly, or if it malfunctions.

5.4 Installation in Zone 2

- Observe the specified conditions for use in potentially explosive areas! Install the device in a suitable, approved housing that meets the requirements of IEC/EN 60079-15 and has at least IP54 protection. 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, terminals may only be snapped onto or off the DIN rail connector and wires may only be connected or disconnected when the power is switched off.
- 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.

5.5 Installation in zone 22

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

5.6 Safety-related applications (SIL, PL)

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

5.7 UL note

The safety specifications, which are based on UL approval, can be found in the “Control Drawing”. The “Control Drawing” is part of the package slip.

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:

- Provide a switch/circuit breaker close to the device that is labeled as the disconnect device for this device (or the entire control cabinet).
- Provide for an overcurrent protection device ($I \leq 16 \text{ A}$) in the installation.
- To protect the device against mechanical or electrical damage, install it in a suitable housing with appropriate degree of protection as per IEC 60529.
- During installation, servicing, and maintenance work and during configuration, disconnect the device from all effective power sources, provided you are not dealing with SELV or PELV circuits.
- 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 Veff. 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.
- The voltages applied to the input, output, and power supply are extra-low voltages (ELV). Depending on the application, hazardous contact voltage ($>30 \text{ V AC}/>60 \text{ V DC}$) to ground may occur. Safe electrical isolation from the other connections exists for this case.

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 IEC 61340-5-1.

6.3 Structure

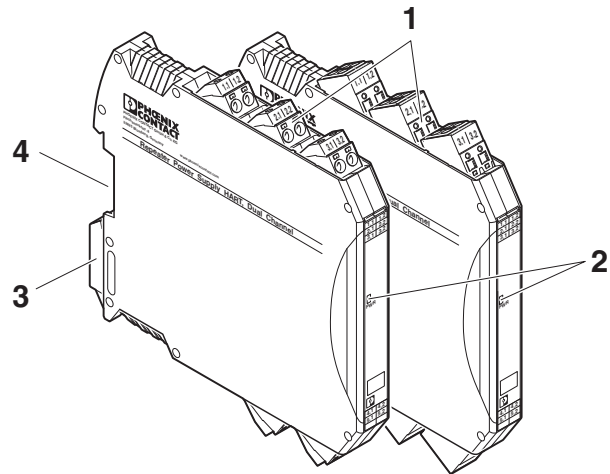


Figure 1 Structure

- 1 COMBICON plug-in, screw, or push-in connection terminal with integrated test socket
- 2 Green "PWR" LED, power supply
- 3 Snap-on foot for DIN rail mounting
- 4 Connection option for DIN rail connector

6.4 Basic circuit diagram with connection terminal blocks

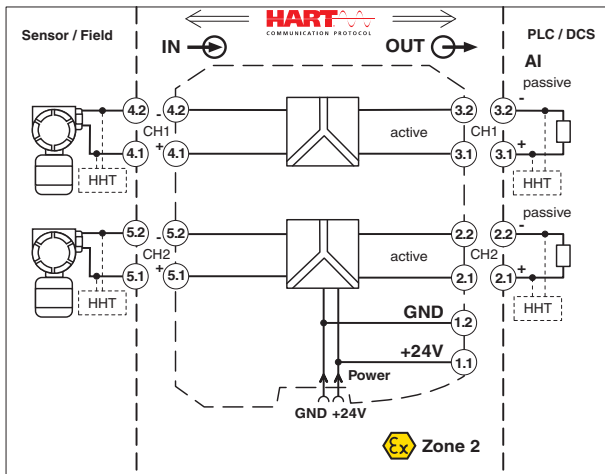


Figure 2 Basic circuit diagram

6.5 Input

- Channel 1: connection of 2-wire transmitters or 2-wire measuring transducers at terminals 4.1 (+) and 4.2 (-)
- Channel 2: connection of 2-wire transmitters or 2-wire measuring transducers at terminals 5.1 (+) and 5.2 (-)

HART communication

HART communicators (HHT) can be connected as shown in the basic circuit diagram. Test sockets (diameter 2.3 mm) have been integrated for this purpose.

6.6 Output

- Channel 1: active output (terminals 3.1 (+) and 3.2 (-)) for connecting passive analog input cards
- Channel 2: active output (terminals 2.1 (+) and 2.2 (-)) for connecting passive analog input cards

HART communication

HART communicators (HHT) can be connected as shown in the basic circuit diagram. Test sockets (diameter 2.3 mm) have been integrated for this purpose.

6.7 Power supply

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



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.

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 (Order No. 2865625) or the MACX MCR-PTB-SP (Order 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.

6.8 Dimensions

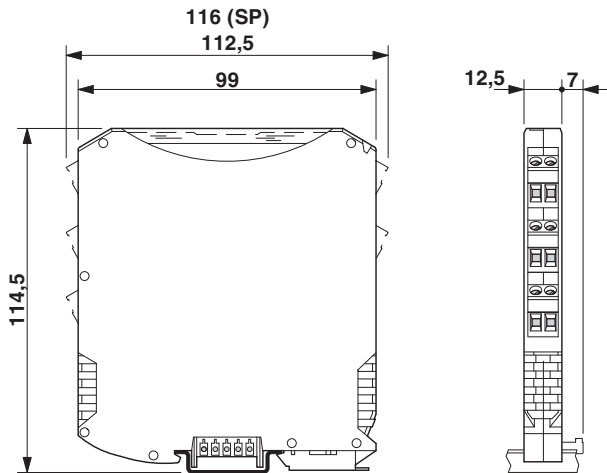


Figure 3 Dimensions

6.9 Mounting

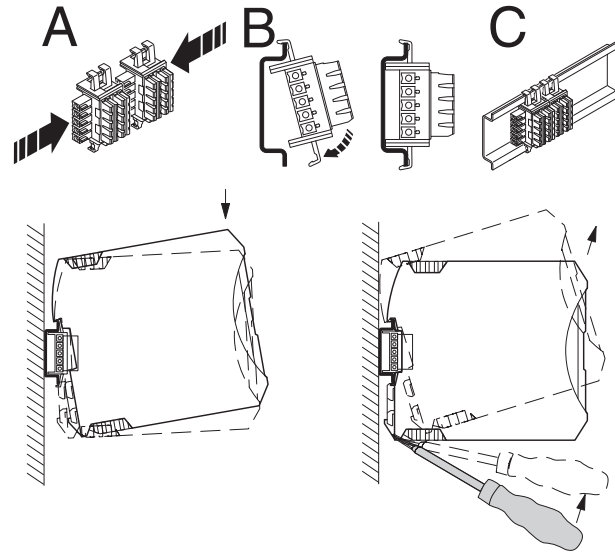


Figure 4 Mounting and removing

- Mount the device on a 35 mm DIN rail according to EN 60715.
- When using the DIN rail connector, first insert it in the 35 mm DIN rail according to 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 the device and DIN rail connector must be observed: snap-on foot on the bottom and plug on the left.
- Install the module in a suitable housing to meet the requirements for the protection class.

6.10 Connecting the cables

Screw Connection

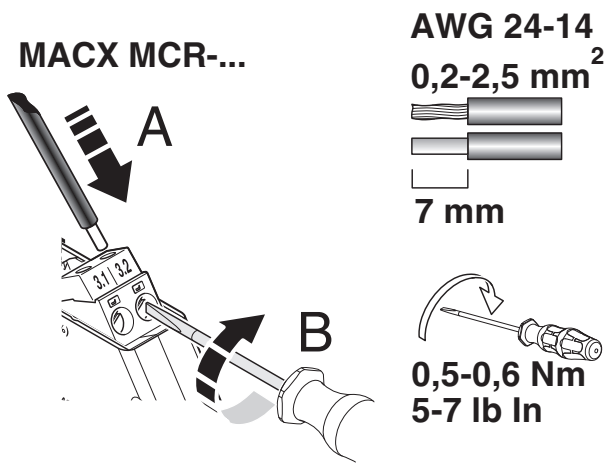


Figure 5 Screw connection

- Strip the wire by approximately 7 mm and crimp ferrules to the end of the wires.
- 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

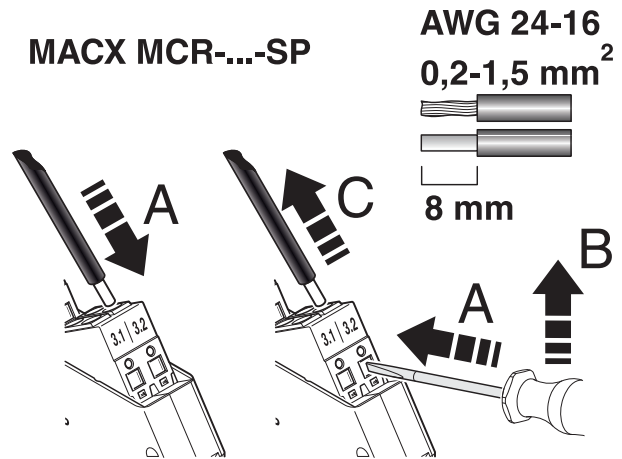


Figure 6 Push-in connection

- 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.

6.11 Startup

- Before startup, check that the device is operating and wired correctly.

7 Safety-related applications

The following notes apply for the devices:

Designation	Order No.
MACX MCR-SL-RPSS-2I-2I	2904089
MACX MCR-SL-RPSS-2I-2I-SP	2904090

The safety-related repeater power supplies and signal conditioners listed above are certified as conforming to DIN EN 61508-1:2011 and DIN EN 61508-2:2011. Test certificate: BVS Pb 04/13-01.

7.1 Safety function

The safety function of the device involves the electrically isolated forwarding of a 4 mA ... 20 mA standard signal with a maximum deviation of 2 %.

Safe state and error definition

The range from 3.6 ... 21 mA is considered the valid signal range.

Output values outside the range of 3.6 mA ... 21 mA are considered the safe state, which is detected by the subsequent controller.

Safe failures in the device are therefore those errors where the device sends an output signal that deviates from the input signal by no more than 2 %.

Dangerous undetectable failures are errors where the device does not follow a change in the input signal or deviates from the input signal by more than 2 % and is not outside the range.

Dangerous, detectable failures are those that send a signal outside the range (< 3.6 mA and > 21 mA).

7.2 Safety integrity requirements

7.2.1 Single-channel version

In the case of the single-channel version, each of the two channels can be used for a safety function.

The following then applies for the safety function:

- Type A device (according to IEC/EN 61508-2)
- Performance Level (EN ISO 13849) d
- Safety integrity level (SIL) 2 and 3
- HFT 0
- MTTR 24 h
- Ambient temperature 40°C

The failure rates in FIT for one channel each are as follows:

λ_{SD}	λ_{SU}	λ_{DD}	λ_{DU}	SFF _{avg}	DC _D
0	195	198	55	87.64 %	78.1 %

The total failure rate is 450 FIT.

The MTBF is 254 years.

PFD_{avg} values

T [PROOF] =	1 year	2 years	3 years	4 years	5 years
PFD _{avg} =	2.48 * 10 ⁻⁴	4.91 * 10 ⁻⁴	7.33 * 10 ⁻⁴	9.75 * 10 ⁻⁴	12.2 * 10 ⁻⁴

$$PFH = 5.53 * 10^{-8}/h$$

Failure limit

In SIL 2 applications, if the percentage of the device for the entire safety chain is assumed to be a maximum of 10%, a maintenance/test interval of 4 years can be achieved.

Safety circuit according to IEC / EN 61508-1			
Sensor	Device	Processing	Actuator
25 %	< 10 %	15 %	50 %

The maintenance/test interval depends on the characteristic data of all devices involved in the safety chain. The intervals may be shorter or longer depending on this characteristic data.

7.3 2-channel version

With the two-channel version, both channels of the repeater power supply are used for safety-related applications, which means that two different sensors are present at the measurement location and signal conditioning for the standard signal is 2-channel. For this, you must connect suitable measuring transducers and sensors to the inputs of the 2-channel repeater power supply. The subsequent safety-related controller then compares both signals to check that they match.

The following then applies for the safety function:

- Type A device (according to IEC/EN 61508-2)
- Performance Level (EN ISO 13849) d
- Safety integrity level (SIL) 3
- Architecture 1oo1_D + 1oo2
- HFT 0
- MTTR 24 h
- Ambient temperature 40°C

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

λ_{SD}	λ_{SU}	λ_{DD}	λ_{DU}	SFF _{avg}	DC _D
0	307	273	92	86.26 %	74.7 %

The total failure rate is 674 FIT.

PFD_{avg} values

T [PROOF]=	1 year	5 years	10 years
PFD _{avg} =	0.91 10 ⁻⁴	4.15 10 ⁻⁴	8.27 10 ⁻⁴

PFH = 1.99 * 10⁻⁸/h

When calculating the average probability of a dangerous failure on demand, errors with the same cause were taken into consideration and a β or β_D factor of 2% was determined.

The device is therefore suitable for SIL 3 applications.

Failure limit

In SIL 2 applications, if the percentage of the device for the entire safety chain is assumed to be a maximum of 10%, a maintenance/test interval of 10 years can be achieved.

Safety circuit according to IEC / EN 61508-1			
Sensor	Device	Processing	Actuator
25 %	< 10 %	15 %	50 %

The maintenance/test interval depends on the characteristic data of all devices involved in the safety chain. The intervals may be shorter or longer depending on this characteristic data.

In SIL 3 applications, it is recommended that the maximum possible test interval is determined together with data from the other devices involved in the safety chain.

7.4 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 failure rates of the external power supply are not taken into consideration.
- 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.

7.5 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-SL-RPSS-2I-2I(-SP)	9067481

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

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

- Connect the device according to the installation notes.
- Make sure that the connected sensor and measuring transducer correspond 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.

7.6 Notes on operation

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

If a failure occurs during operation, the output signal is usually set to a value outside the "normal" signal range of 3.6 ... 21 mA. The connected SIS should therefore check the validity of the read signal values and initiate appropriate measures in the event of deviations from the normal values.

You should also check whether the connected measuring transducer responds to line faults at the sensors. After being switched off and on again, the required voltages are

established in the device. Signal transmission is then performed without further action.

7.7 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.

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

In SIL 2 applications, the repeater power supplies/signal conditioners must be checked at least every 4 (10) years (maximum proof test interval, if they represent 10% of the entire safety chain).

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 simulator (0/4 ... 20 mA current) or a sensor simulator and one or ideally two calibrated digital multimeters are required in order to check the devices.

1. Take appropriate steps to prevent incorrect use.
2. Disconnect the safety circuit from further processing.
3. Connect the current simulator to the input of the repeater power supply/signal conditioner, or the sensor simulator to the input of the measuring transducer.
4. Connect the digital multimeters to the input and output of the repeater power supply/signal conditioner.
5. At the input of the device, set a signal in the range from 4 ... 20 mA or at the input of the connected measuring transducer, set a suitable signal with the sensor simulator.
6. Measure the current in the repeater power supply/signal conditioner. The output must be set to the same value.
7. Setting ≤ 3.6 mA or > 21 mA verifies that the subsequent processing can detect signals that are out of range and evaluate them accordingly. If the output value deviates from the input value by more than 3 times the specified class accuracy rating, the device should be checked. In the event of an error, the device should be replaced with an equivalent device.
8. Restore the safety circuit to full functionality.
9. Resume normal operation.

7.8 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
Flachmarktstr. 8
32825 Blomberg
GERMANY

7.9 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

7.10 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 _{avg}	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.