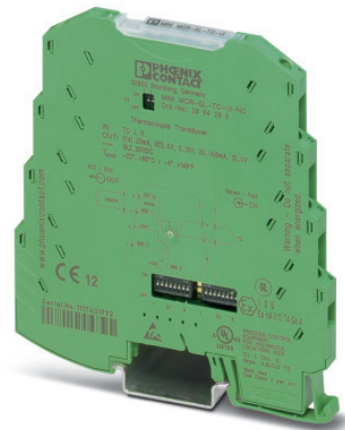


# MINI MCR-SL-TC-UI(-NC)



## Configurable temperature transducer for thermocouple types J and K

Data sheet  
101950\_en\_07

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## 1 Description

The MINI MCR-SL-TC-UI(-NC) is a configurable 3-way isolated temperature transducer. It is suitable for the connection of thermocouple types J and K in acc. with IEC 60584-1.

The standard analog signals 0...20 mA, 4...20 mA, 0...10 V, 0...5 V, 1...5 V, 10...0 V, 20...0 mA, 20...4 mA are available electrically isolated on the output side.

The DIP switches are accessible on the side of the housing and allow the following parameters to be configured:

- Sensor type
- Temperature range to be measured
- Cold junction compensation ON/OFF
- Output signal
- Type of fault evaluation

The power supply (19.2...30 V DC) can be supplied either via connection terminal blocks "7"/"8" on the modules or in conjunction with the DIN rail connector. Please refer to the section titled "Power supply" for more information.

## Features

- Configurable 3-way temperature transducer
- Connection of thermocouple types J and K
- Measuring range -150°C to 1200°C (type J) or -150°C to 1350°C (type K)
- Output signal range 0...20 mA, 4...20 mA, 0...10 V, 0...5 V, 1...5 V, 10...0 V, 20...0 mA or 20...4 mA
- Approval for Ex-zone 2 (nA)
- Can be supplied configured or unconfigured



### NOTE: Correct usage in potentially explosive areas

The module is a category 3 item of electrical equipment. It is absolutely vital to follow the instructions provided here during installation and observe the information in the "Safety regulations and installation notes".



Make sure you always use the latest documentation. It can be downloaded from the product at [phoenixcontact.net/products](http://phoenixcontact.net/products).



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

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### 3 Ordering data

Description	Type	Order No.	Pcs./Pkt.
MCR temperature transducer for thermocouples, can be configured via DIP switches, with screw connection, order configuration	MINI MCR-SL-TC-UI	2864448	1
MCR temperature transducer for thermocouples, can be configured via DIP switches, with screw connection, standard configuration	MINI MCR-SL-TC-UI-NC	2864299	1
Accessories	Type	Order No.	Pcs./Pkt.
DIN rail connector for DIN rail mounting. Universal for TBUS housing. Gold-plated contacts, 5-pos. Plug component, Number of positions: 5, Pitch: 3.81 mm	ME 6,2 TBUS-2 1,5/5-ST-3,81 GN	2869728	10
MCR power terminal block for supplying several MINI Analog modules via the DIN rail connector, with screw connection, maximum current consumption of up to 2 A	MINI MCR-SL-PTB	2864134	1
MCR power terminal block for supplying several MINI Analog modules via the DIN rail connector, with spring-cage connection, maximum current consumption of up to 2 A	MINI MCR-SL-PTB-SP	2864147	1
Primary-switched MINI POWER supply for DIN rail mounting, input: 1-phase, output: 24 V DC/1.5 A	MINI-SYS-PS-100-240AC/24DC/1.5	2866983	1
Primary-switched power supply MINI POWER for DIN rail mounting, input: 1-phase, output: 24 V DC/1,5 A, for the potentially explosive area	MINI-PS-100-240AC/24DC/1.5/EX	2866653	1
Eight MINI analog signal converters with screw connection method can be connected to a control system using a system adapter and system cabling with a minimum of wiring and very low error risk.	MINI MCR-SL-V8-FLK 16-A	2811268	1
Fold up transparent cover for MINI MCR modules with additional labeling option using insert strips and flat Zack marker strip 6.2 mm	MINI MCR DKL	2308111	10
Label for extended marking of MINI MCR modules in connection with the MINI MCR-DKL Marking label, white	MINI MCR-DKL-LABEL	2810272	10

### 3.1 Order key

(standard configuration entered as example)

Order No.	Sensor type	Measuring range [°C]		Output	Failure information	Factory calibration certificate
		Start	End			
2864448	3	0	1000	OUT01	A	NONE
	J ≙ Type J	0	<b>Range</b>	OUT01 ≙ 0 ... 20 mA	A	NONE ≙ Without factory
		-10	(increment)	OUT02 ≙ 4 ... 20 mA	B	YES ≙ With factory
	K ≙ Type K	-20		OUT03 ≙ 0 ... 10 V	C	calibration certificate
		-30		OUT05 ≙ 0 ... 5 V	D	(a fee is charged)
		-40	0 ... 300 (10 K)	OUT06 ≙ 1 ... 5 V		YESPLUS ≙ Factory calibration
		-50	320 ... 700 (20 K)	OUT07 ≙ 20 ... 0 mA		certificate with
		-100	750...1350 (50 K)	OUT08 ≙ 20 ... 4 mA		5 measuring points
		-150		OUT09 ≙ 10 ... 0 V		(a fee is charged)

<sup>1)</sup> See below for explanation

Failure information (depends on the output signal range):

	Measuring range overrange			Open circuit		
	0 ... 20 mA	4 ... 20 mA	0 ... 10 V	0 ... 20	4 ... 20	0 ... 10 V
A	20.5 mA	20.5 mA	10.25 V	21 mA	21 mA	10.5 V
B	20.5 mA	20.5 mA	10.25 V	21 mA	21 mA	10.5 V
C	20 mA	20 mA	10 V	21 mA	21 mA	10.5 V
D	20 mA	20 mA	10 V	0 mA	4 mA	0 V

	Measuring range underrange		
	0 ... 20 mA	4 ... 20 mA	0 ... 10 V
A	0 mA	4 mA	0 V
B	0 mA	3,5 mA	0 V
C	0 mA	4 mA	0 V
D	0 mA	4 mA	0 V

## 4 Technical data

Input	
Sensor type	Thermocouples type J, K (IEC 584-1)
Measuring range span	min. 50 K
Number of inputs	1
Output	
Number of outputs	1
Voltage output signal	0 V ... 10 V 10 V ... 0 V 0 V ... 5 V 1 V ... 5 V
Max. voltage output signal	approx. 12.5 V
Short-circuit current	approx. 10 mA
Current output signal	0 mA ... 20 mA (please indicate if different setting when ordering) 4 mA ... 20 mA 20 mA ... 0 mA 20 mA ... 4 mA
Max. current output signal	23 mA
Non-load voltage	approx. 12.5 V
Load/output load voltage output	$\geq 10 \text{ k}\Omega$
Ripple	$< 20 \text{ mV}_{\text{PP}}$ (at $500 \Omega$ )
Load/output load current output	$< 500 \Omega$ (at 20 mA)
Supply	
Nominal supply voltage	24 V DC
Supply voltage range	19.2 V DC ... 30 V DC (The DIN rail bus connector (ME 6,2 TBUS-2 1,5/5-ST-3,81 GN, Order No. 2869728) can be used to bridge the supply voltage. It can be snapped onto a 35 mm DIN rail according to EN 60715))
Max. current consumption	$< 25 \text{ mA}$ (at 24 V DC)
Power consumption	$< 500 \text{ mW}$

**General data**

Transmission error in the set measuring range	((150 K / set measurement range [K]) + 0.1)%
Transmission error in the full measuring range	≤ 0,2 %
Maximum temperature coefficient	< 0.02 %/K
Step response (0–99%)	< 30 ms
Typical cold point errors	< 2 K
Cold point error, max.	< 3 K
Electrical isolation	Basic insulation according to EN 61010
Overvoltage category	II
Mounting position	any
Degree of protection	IP20
Degree of pollution	2
Rated insulation voltage	50 V AC/DC
Test voltage, input/output/supply	1.5 kV (50 Hz, 1 min.)
Dimensions W/H/D	6.2 mm / 93.1 mm / 102.5 mm
Type of housing	PBT green

**Connection data**

Connection method	Screw connection
Conductor cross section, solid	0.2 mm <sup>2</sup> ... 2.5 mm <sup>2</sup>
Conductor cross section, flexible	0.2 mm <sup>2</sup> ... 2.5 mm <sup>2</sup>
Conductor cross section AWG/kcmil	26 ... 12
Stripping length	12 mm

**Ambient conditions**

Ambient temperature (operation)	-20 °C ... 65 °C
Ambient temperature (storage/transport)	-40 °C ... 85 °C

**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
ATEX	Ⓔ II 3 G Ex nA IIC T4 Gc X
UL, USA/Canada	UL 508 Recognized
UL, USA/Canada	Class I, Div. 2, Groups A, B, C, D T5
Shipbuilding	GL EMC 2 D

## 5 Safety regulations and installation notes

### 5.1 Installation notes

- The category 3 device is suitable for installation in the zone 2 potentially explosive area. It fulfills the requirements of EN 60079-0:2012+A11:2013 and EN 60079-15:2010.
- Installation, operation, and maintenance may only be carried out by qualified electricians. Follow the installation instructions 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. The technical data is provided in this package slip and on the certificates (conformity assessment, additional approvals where applicable).
- It is not permissible to open or modify the device. Do not repair the device yourself but 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 degree of protection (IEC 60529/EN 60529) of the device is intended for use in a clean and dry environment. Do not subject the device to any load that exceeds the described limits.
- The device is not designed for use in atmospheres with a danger of dust explosions.

### 5.2 Installation in the Ex area (zone 2)

- Observe the specified conditions for use in potentially explosive areas.
- The device must be installed in a housing (control or distributor box) which meets the requirements of EN 60079-15 and provides at least IP54 (EN 60529) degree of protection.
- During installation and when connecting the supply and signal circuits, observe the requirements of EN 60079-14. Devices may only be connected to circuits in zone 2 if they are suitable for operation in Ex zone 2 and for the prevailing conditions at the place of use.
- 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, has been subjected to an impermissible load, has been stored incorrectly, or if it malfunctions.
- You can download the latest documents for these devices from [phoenixcontact.net/products](http://phoenixcontact.net/products).

## 6 Installation

### 6.1 Connection notes



**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 61340-5-1.

### 6.2 Structure

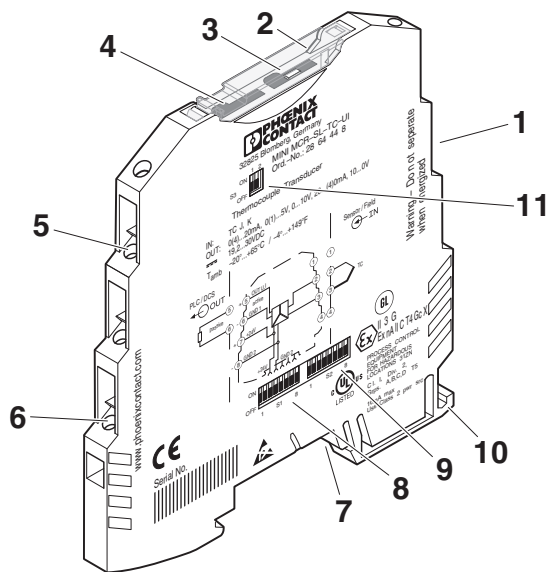


Figure 1 Structure

1. Input: Thermocouple
2. Cover
3. Diagnostics LED
4. Groove for ZBF 6 zack marker strip
5. Output: Standard signals
6. Supply voltage
7. Connection option for DIN rail bus connector
8. DIP switch S1
9. DIP switch S2
10. Universal snap-on foot for EN DIN rails
11. DIP switch S3

### 6.3 Block diagram

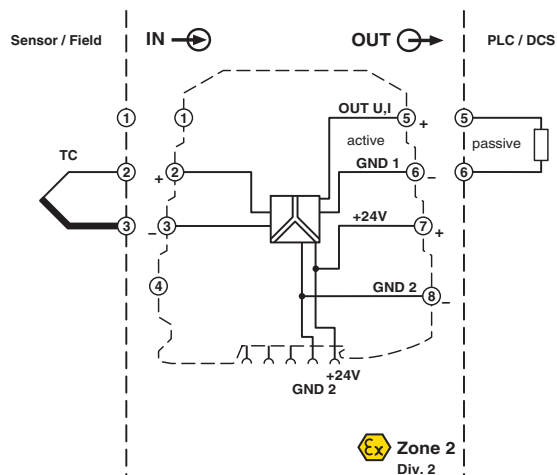


Figure 2 Block diagram

### 6.4 Power supply



**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 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.

A 400 mA fuse should be connected upstream.

#### Supply via a power terminal block

The MINI MCR-SL-PTB power terminal block (Order No. 2864134) or the MINI MCR-SL-PTB-SP power terminal block (Order No. 2864147), which are the same shape, are used to feed the supply voltage to the DIN rail connector.

A 2 A fuse should be connected upstream.

#### Supply via a system power supply unit

The system power supply unit with 1.5 A output current connects the DIN rail connector to the supply voltage and can therefore be used to supply several modules from the mains.

- MINI-SYS-PS-100-240AC/24DC/1.5 (Order No. 2866983)
- Potentially explosive areas:  
MINI-PS-100-240AC/24DC/1.5/EX (Order No. 2866653)

### 6.5 Assembly

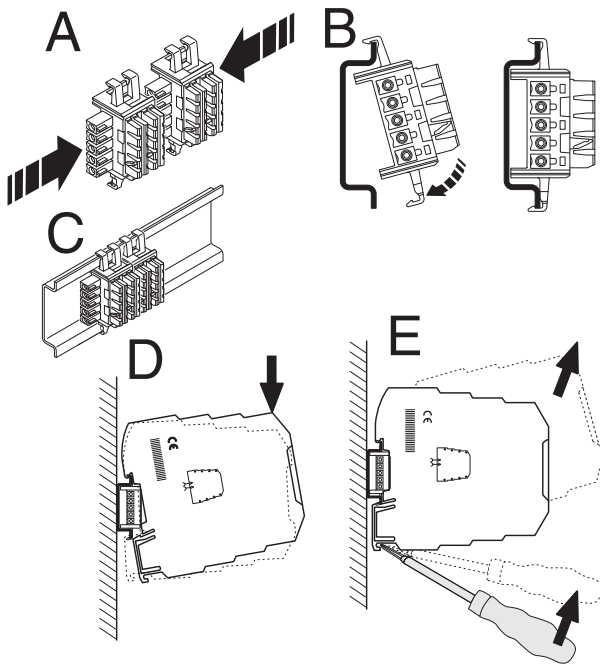


Figure 3 Mounting and removing

- Mount the module on a 35 mm DIN rail according to EN 60715.
- When using the DIN rail connector, first place it into the DIN rail (see A – C). It is used to bridge the power supply. It is also absolutely vital that you snap the module and the DIN rail connector into position in the correct direction: the snap-on foot should be at the bottom and the connector on the left.

### 6.6 Connection of the cables

The MINI MCR-SL-TC-UI... is available with the following type of connection:

- Screw terminal blocks (MINI MCR-SL-TC-UI)

#### Screw connection:

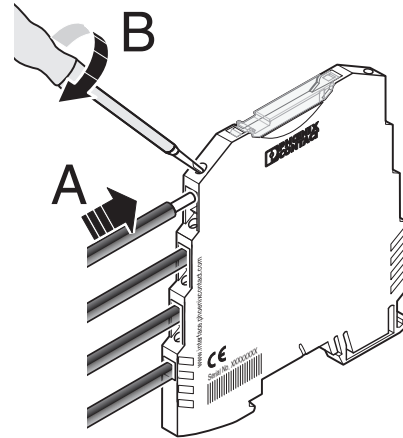


Figure 4 Screw connection

- Insert the wire into the corresponding connection terminal block.
- Use a screwdriver to tighten the screw in the opening above the connection terminal block.

## 7 Notes on using thermocouples

Thermocouples consist of two conductors made from different metals with different thermoelectric properties which are connected together on one side and are exposed to a temperature gradient and, therefore, convert heat flow to electrical voltage. Electrical voltage is measured at both thermocouple connections.

### 7.1 Cold junction compensation

In a thermocouple, however, voltage will not only be generated at the contact point of the connected conductors, but also at both connection points of the measuring transducer, as each of these points together with the connected thermocouple cable will form another thermocouple.

In order to be able to calculate the absolute measurement point temperature value from this voltage difference, and thus also the temperature difference, the temperature of the connection points must be the same and known.

To this end, the connection points are artificially maintained at a known temperature: for laboratory measurements, for example, at 0°C using ice water, in industrial applications with thermostatically controlled heating and cooling.

When considering the connection point temperature, this is referred to as cold junction compensation.

Cold junction compensation can also be implemented with a separate temperature measurement at the connection points.

Interface modules are available for the connection of thermocouples, in which cold junction compensation is already integrated. Interface modules of this type are also signal transformers with cable connections to the evaluation unit.

Thermocouples are often referred to with the abbreviation TC.



Thermocouples are suitable for high temperatures or large temperature ranges. Resistance thermometers are more suitable for temperatures up to a maximum of 800°C.

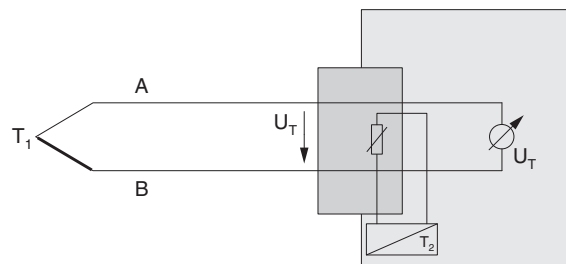


Figure 5 Thermocouple and interface module at the sensor including cold junction compensation

- $T_1$  Temperature at the measurement point
- $T_2$  Temperature at the connection point
- $U_T$  Voltage generated between the measurement point and the connection point. Indicates the absolute temperature  $T_1$  at the measurement point by considering the connection point temperature  $T_2$ .

### 7.2 Thermocouple types

Type	Standard	Temperature range [°C]	IEC color code
B	IEC 584	+500 ... +1820	Not defined
E	IEC 584	-230 ... +1000	Purple
J	IEC 584	-210 ... +1200	Black
K	IEC 584	-250 ... +1372	Green
N	IEC 584	-200 ... +1300	Pink
R	IEC 584	-50 ... +1768	Orange
S	IEC 584	-50 ... +1768	Not defined
T	IEC 584	-200 ... +400	Brown
L	DIN 43710	-200 ... +900	-
U	DIN 43710	-200 ... +600	-
A-1	GOST 8.585	0 ... +2500	-
A-2	GOST 8.585	0 ... +1800	-
A-3	GOST 8.585	0 ... +1800	-
M	GOST 8.585	-200 ... +100	-
L	GOST 8.585	-200 ... +800	-

## 8 Configuration

### NC version

If a device has not been configured (MINI MCR-SL-TC-UI-NC), all DIP switches will be in position 0. The device only has a defined function once the DIP switches have been set.

### DIP switch S1

DIP switch S1 is used to define the sensor type, the cold point compensation, the output signal range, and the start of the measuring range.

### DIP switch S2

DIP switch S2 is used to specify the measuring range final value and fault evaluation.

### DIP switch S3

DIP switch S2 can be used to select the voltage and current output.

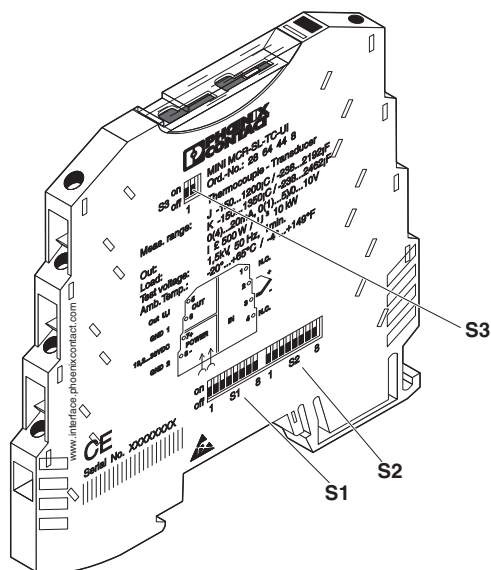


Figure 6 DIP switches

**MINI MCR-SL-TC-UI(-NC)**

**8.1 Configuration table**

DIP S1		Output signal range OUT			Start temperature						
1	Sensor type	2	Cold Junction Compensation	3	4	5	6	7	8	[°C]	[°F]
	J	•	ON							0	32
•	K		OFF	•			•			-10	14
				•	•		•			-20	-4
				•	•	•	•			-30	-22
						•	•			-40	-40
				•	•		•			-50	-58
				•	•	•	•			-100	-148
				•	•	•	•	•		-150	-238

DIP S2								Final temperature				Final temperature				Final temperature									
1	2	3	4	5	6	[°C]	[°F]	1	2	3	4	5	6	[°C]	[°F]	1	2	3	4	5	6	[°C]	[°F]		
						0	32	•	•	•	•			220	428			•	•	•	•			580	1076
•						10	50	•	•	•	•	•		230	446	•		•	•	•	•			600	1112
	•					20	68			•	•			240	464	•	•	•	•					620	1148
		•				30	86	•		•	•			250	482	•	•	•	•					640	1184
			•			40	104	•	•	•	•			260	500	•		•	•	•				660	1220
•	•					50	122	•	•	•	•			270	518	•		•	•	•				680	1256
		•				60	140			•	•			280	536	•		•	•					700	1292
			•			70	158	•		•	•			290	554	•		•	•					750	1382
				•		80	176	•	•	•	•			300	572	•		•	•					800	1472
•		•				90	194	•	•	•	•			320	608	•		•	•					850	1562
	•					100	212				•			340	644	•		•	•					900	1652
		•				110	230	•			•			360	680	•		•	•					950	1742
			•			120	248			•				380	716	•		•	•					1000	1832
•		•				130	266	•		•				400	752	•		•	•					1050	1922
			•			140	284			•	•			420	788	•		•	•					1100	2012
		•				150	302	•		•	•			440	824	•		•	•					1150	2102
				•		160	320			•	•			460	860	•		•	•					1200	2192
•				•		170	338	•		•	•			480	896	•		•	•					1250 <sup>1</sup>	2282
	•					180	356			•	•			500	932	•		•	•					1300 <sup>1</sup>	2372
		•				190	374	•		•	•			520	968	•		•	•					1350 <sup>1</sup>	2462
			•			200	392			•	•			540	1004	•		•	•						
•				•		210	410			•	•			560	1040	•		•	•						

1. Type J up to 1200°C/type K up to 1350°C

DIP S2	7	8	Cable break	Measuring range overrange	Measuring range underrange
A			Measuring range final value +5%	Measuring range final value +2.5%	Measuring range start value
B	•		Measuring range final value +5%	Measuring range final value +2.5%	Measuring range start value -12.5%
C		•	Measuring range final value +5%	Measuring range final value	Measuring range start value
D	•	•	Measuring range start value	Measuring range final value	Measuring range start value

DIP S3	1	2	OUT
•			0...20 mA, 4...20 mA, 20...0 mA, 20...4 mA
			0...10 V, 10...0 V, 0...5 V, 1...5 V

• ≙ ON  
 ≙ OFF

## **9    Diagnostics LED**

The LED which is visible on the front displays the following faults:

- LED flashing: Measuring range span less than 50 K
- LED flashing: Measuring range final value on type J configured > 1200°C
- LED ON: Open circuit on the sensor side
- LED ON: Short-circuit on the sensor side
- LED ON: Measuring range overrange
- LED ON: Measuring range underrange



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