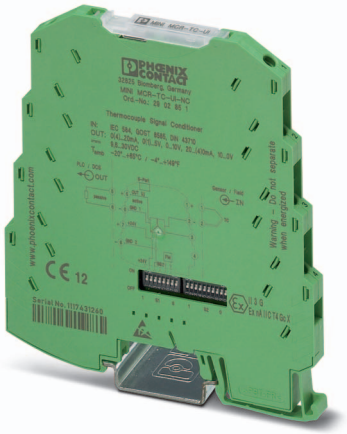
MINI MCR-TC-UI-NC

Temperature transducers for thermocouples



Data sheet
105447_en_02

1 Description

Configurable 3-way isolated temperature transducer. The device is suitable for the connection of thermocouples.

The measured values are converted into a linear current or voltage signal.

The device can either be configured via DIP switches or, with extended functionality, via the S-PORT using the software (FDT/DTM).

The device supports fault monitoring.

Features

- Configurable 3-way temperature transducer
- Configurable via DIP switch
- Screw connection available

Make sure you always use the latest documentation.
It can be downloaded from the product at phoenixcontact.net/products.

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

2 Table of contents

3 Ordering data

Description	Type	Order No.	Pcs./Pkt.
Configurable temperature transducer for the connection of thermocouples. Can be configured via DIP switches or, with extended functionality, using the software. Screw connection, standard configuration.	MINI MCR-TC-UI-NC	2902851	1

Accessories	Type	Order No.	Pcs./Pkt.
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
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
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
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
The MINI MCR-SL-PTB-FM(-SP) power terminal block is used to supply the supply voltage to the DIN rail connector. The FM power terminal block offers the additional function of monitoring in combination with the fault monitoring module. Screw connection.	MINI MCR-SL-PTB-FM	2902958	1
The fault monitoring module is used to evaluate and report group errors from the fault monitoring system and to monitor the supply voltages. The error is reported via an N/O contact. Screw connection, standard configuration.	MINI MCR-SL-FM-RC-NC	2902961	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
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	MINI MCR-DKL-LABEL	2810272	10

4 Technical data

Input	
Configurable/programmable	Yes
Sensor type	B, E, J, K, N, R, S, T, L, U, A-1, A-2, A-3, M, L
Temperature measuring range	-250 °C ... 2500 °C (Range depends on sensor type, range can be set freely via software or in increments from -150°C to 1350°C via DIP switches)
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. 12.3 V
Short-circuit current	< 31.5 mA
Current output signal	0 mA ... 20 mA 4 mA ... 20 mA 20 mA ... 0 mA 20 mA ... 4 mA
Max. current output signal	24.6 mA
Non-load voltage	< 17.5 V
Configurable/programmable	Yes
Load/output load voltage output	≥ 10 kΩ
Ripple	< 20 mV_{PP}
Load/output load current output	< 500 Ω (at 20 mA)
Supply	
Supply voltage range	9.6 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))
Typical current consumption	< 27 mA (at 24 V DC)
Max. current consumption	72 mA
Power consumption	≤ 700 mW (at I_{OUT} = 20 mA, 9.6 V DC, load 500 Ω)

General data	
Transmission error thermocouples	0.1 % * 600 K / set measuring range; 0.1 % > 600 K (E, J, K, N, T, L, U, M Gost, L Gost) 0.2 % * 600 K / set measuring range; 0.2 % > 600 K (B, R, S, A1, A2, A3) 0.2% * 600 K / set measuring range; 0.2% > 600 K (E, J, K, N, T, L, U, M Gost, L Gost); Highspeed Mode 0.4% * 600 K / set measuring range; 0.4% > 600 K (B, R, S, A1, A2, A3); Highspeed Mode
Maximum temperature coefficient	≤ 0.01 %/K
Step response (0–99%)	typ. 400 ms (Highspeed Mode: typ. 150 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 / 101.2 mm
Type of housing	PBT green

Connection data	
Connection method	Screw connection
Conductor cross section solid	0.2 mm² ... 2.5 mm²
Conductor cross section flexible	0.2 mm² ... 2.5 mm²
Conductor cross section AWG	26 ... 12
Stripping length	12 mm

Ambient conditions	
Ambient temperature (operation)	-20 °C ... 65 °C
Ambient temperature (storage/transport)	-40 °C ... 85 °C
Permissible humidity (operation)	5 % ... 95 % (non-condensing)
Maximum altitude for use above sea level	≤ 2000 m

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
UL, USA/Canada	UL 508 Listed Class I, Div. 2, Groups A, B, C, D T4 Class I, Zone 2, Group IIC
Shipbuilding approval DNV GL TAA00002R0	
Temperature	B
Humidity	B
Vibration	B
EMC	A
Enclosure	Required protection according to the Rules shall be provided upon installation on board

5 Safety regulations and installation notes

5.1 Installation notes

– 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 UL notes

PROCESS CONTROL EQUIPMENT FOR HAZARDOUS LOCATIONS 31ZN

1 Suitable for use in class 1, division 2, groups A, B, C and D hazardous locations, or nonhazardous locations only.

2 WARNING - EXPLOSION HAZARD: Do not disconnect equipment while the circuit is live or unless the area is known to be free of ignitable concentrations.

3 WARNING - EXPLOSION HAZARD: Substitution of any components may impair suitability for Class I, Division 2.

4 CAUTION: Use copper supply wires that are approved up to 60 °C.

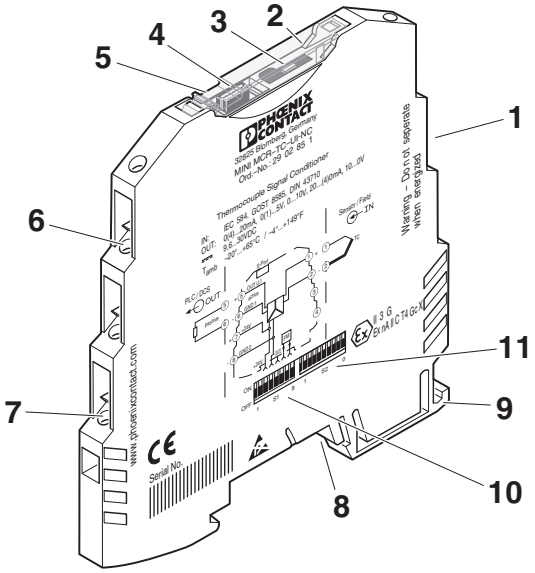
6 Installation

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 IEC 61340-5-1.

6.2 Structure

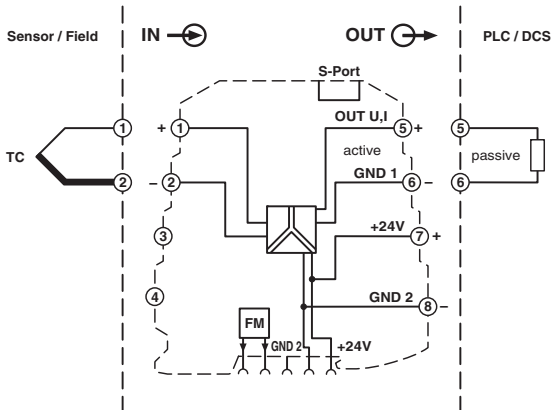
Figure 1 Structure



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

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 MINI Analog Module

Where the total current consumption of the aligned MINI Analog modules does not exceed 400 mA, the power can be supplied directly at the connection terminal blocks of one MINI Analog 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) of the same shape is used to feed in the supply voltage to the DIN rail connector.

We recommend connecting a 2.5 A slow-blow fuse (e.g., SIBA 179 120.2,5 20x5).

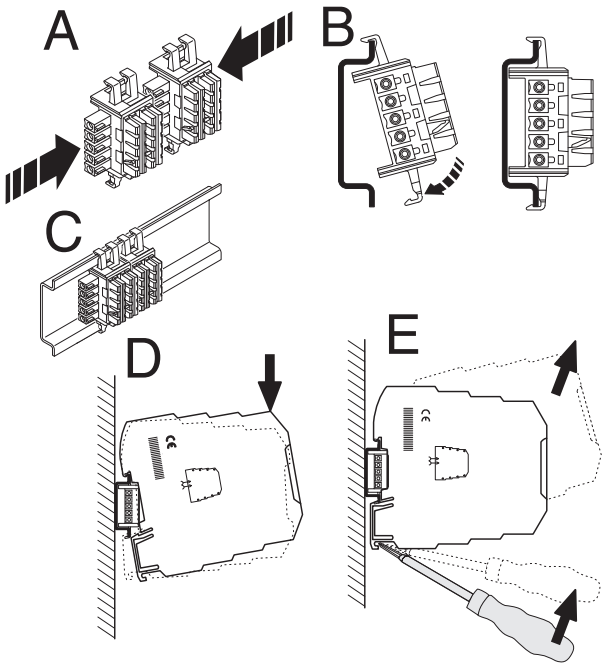
Supply via a system power supply unit

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)

6.5 Mounting

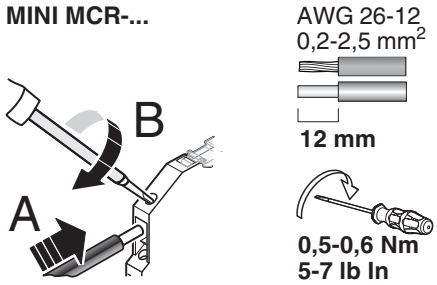
Figure 3 Mounting and removing



– 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

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.

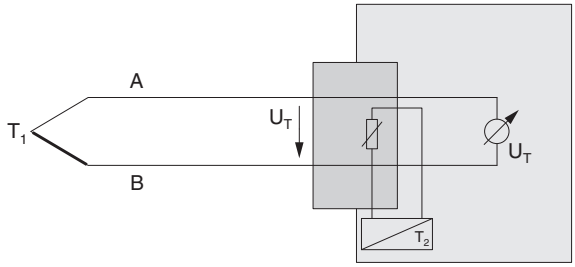
Interface modules are available for the connection of thermocouples, in which cold junction compensation is already integrated. Interface modules of this type are also signal transformers with cable connections to the evaluation unit.

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 °C... +1000 °C	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 Fault monitoring FM

Detected errors on the signal input or in the device are reported via the DIN rail connector to the MINI MCR-SL-FM-RC-NC (Order No. 2902961) or MINI MCR-SL-FM-RC-SP-NC (Order No. 2902962), which are the same shape. The module reports the error centrally via an N/C contact.

In one group, a fault monitoring module is only required once. Individual evaluation of the up to 80 Phoenix Contact isolation amplifiers can be omitted.

The fault monitoring module can also be used to monitor the supply voltage.

- For the behavior of the fault monitoring contact for the different DIP switch configurations, please refer to the table.

Error response		**Fault monitoring: N/C contact**		
		Measuring range overrange	Measuring range underrange	Cable break
A		activated	deactivated	activated
B		activated	activated	activated
C		deactivated	deactivated	activated
D		deactivated	deactivated	deactivated
NE43	Upscale	activated	activated	activated
	Downscale			
	0 mA			
	Upscale/downscale			
Module error		activated (error is always reported)		
Invalid DIP switch configuration		activated (error is always reported)		

9 Configuration

The modules have the standard configuration:

- TC sensor type J IEC 584
- Cold junction compensation “ON”
- -200...1200°C
- Output 4 ... 20 mA
- Error evaluation according to NE43 (downscale)
- Fault monitoring contact reacts to all errors

The module can also be configured with the supply voltage not connected.

9.1 Configuration via DIP switches

At delivery, all DIP switches are in the "OFF" position.

Configure the DIP switches according to the planned application using the configuration tables.

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 is used to specify the measuring range final value, configuration method, and error contact behavior.

Configuration tables

			• ≙ ON DIP S1							
			1	2	3	4	5	6	7	8
Sensor type	J (IEC 584)									
	K (IEC 584)		•							
Cold junction compensation	OFF									
	ON			•						
Analog output signal	0...20 mA									
	20...0 mA				•					
	4...20 mA					•				
	20...4 mA				•	•				
	0...10 V						•			
	10...0 V				•		•			
	0...5 V					•	•			
	1...5 V				•	•	•			
Start temperature	0°C	≙ 32°F								
	-10°C	≙ 14°F						•		
	-20°C	≙ -4°F							•	
	-30°C	≙ -22°F						•	•	
	-40°C	≙ -40°F								•
	-50°C	≙ -58°F						•		•
	-100 °C	≙ -148°F							•	•
	-150 °C	≙ -238°F						•	•	•

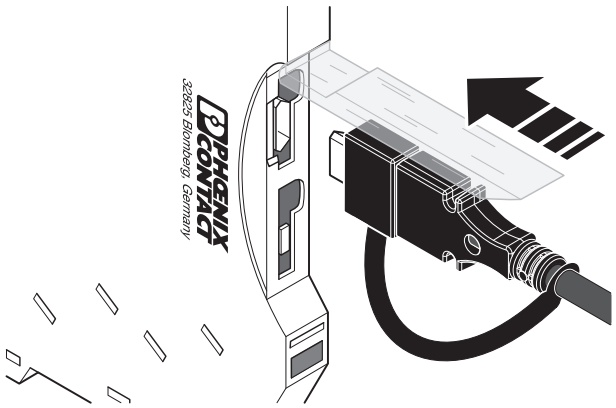
Measuring range final value	DIP S2						• ≙ ON	DIP S2									
	1	2	3	4	5	6		1	2	3	4	5	6	7	8	9	0
0°C ≙ 32°F							340°C ≙ 644°F						•				
10°C ≙ 50°F	•						360°C ≙ 680°F	•					•				
20°C ≙ 68°F		•					380°C ≙ 716°F		•				•				
30°C ≙ 86°F	•	•					400°C ≙ 752°F	•	•				•				
40°C ≙ 104°F			•				420°C ≙ 788°F			•			•				
50°C ≙ 122°F	•		•				440°C ≙ 824°F	•		•			•				
60°C ≙ 140°F		•	•				460°C ≙ 860°F		•	•			•				
70°C ≙ 158°F	•	•	•				480°C ≙ 896°F	•	•	•			•				
80°C ≙ 176°F				•			500°C ≙ 932°F				•		•				
90°C ≙ 194°F	•			•			520°C ≙ 968°F	•			•		•				
100°C ≙ 212°F		•		•			540°C ≙ 1004°F		•		•		•				
110°C ≙ 230°F	•	•		•			560°C ≙ 1040°F	•	•		•		•				
120°C ≙ 248°F			•	•			580°C ≙ 1076°F			•	•		•				
130°C ≙ 266°F	•		•	•			600°C ≙ 1112°F	•		•	•		•				
140°C ≙ 284°F		•	•	•			620°C ≙ 1148°F		•	•	•		•				
150°C ≙ 302°F	•	•	•	•			640°C ≙ 1184°F	•	•	•	•		•				
160°C ≙ 320°F					•		660°C ≙ 1220°F					•	•				
170°C ≙ 338°F	•				•		680°C ≙ 1256°F	•				•	•				
180°C ≙ 356°F		•			•		700°C ≙ 1292°F		•			•	•				
190°C ≙ 374°F	•	•			•		750°C ≙ 1382°F	•	•			•	•				
200°C ≙ 392°F			•		•		800°C ≙ 1472°F			•		•	•				
210°C ≙ 410°F	•		•		•		850°C ≙ 1562°F	•		•		•	•				
220°C ≙ 428°F		•	•		•		900°C ≙ 1652°F		•	•		•	•				
230°C ≙ 446°F	•	•	•		•		950°C ≙ 1742°F	•	•	•		•	•				
240°C ≙ 464°F				•	•		1000°C ≙ 1832°F				•	•	•				
250°C ≙ 482°F	•			•	•		1050°C ≙ 1922°F	•			•	•	•				
260°C ≙ 500°F		•		•	•		1100°C ≙ 2012°F		•		•	•	•				
270°C ≙ 518°F	•	•		•	•		1150°C ≙ 2102°F	•	•		•	•	•				
280°C ≙ 536°F			•	•	•		1200°C ≙ 2192°F			•	•	•	•				
290°C ≙ 554°F	•		•	•	•		1250°C ≙ 2282°F	•		•	•	•	•				
300°C ≙ 572°F		•	•	•	•		1300°C ≙ 2372°F		•	•	•	•	•				
320°C ≙ 608°F	•	•	•	•	•		1350°C ≙ 2462°F	•	•	•	•	•	•				

Fault evaluation		Analog OUT								• ≙ ON DIP S2			
		0...20 mA	20...0 mA	4...20 mA	20...4 mA	0...10 V	10...0 V	0...5 V	1...5 V	7	8	9	0
A	Cable break	21 mA	21 mA	21 mA	21 mA	10.5 V	10.5 V	5.25 V	5.25 V				
	Overrange	20.5 mA	20.5 mA	20.5 mA	20.5 mA	10.25 V	10.25 V	5.125 V	5.125 V				
	Underrange	0 mA	0 mA	4 mA	4 mA	0 V	0 V	0 V	1 V				
B	Cable break	21 mA	21 mA	21 mA	21 mA	10.5 V	10.5 V	5.25 V	5.25 V				
	Overrange	20.5 mA	20.5 mA	20.5 mA	20.5 mA	10.25 V	10.25 V	5.125 V	5.125 V	•			
	Underrange	0 mA	0 mA	3.5 mA	3.5 mA	0 V	0 V	0 V	0.875 V				
C	Cable break	21 mA	21 mA	21 mA	21 mA	10.5 V	10.5 V	5.25 V	5.25 V				
	Overrange	20 mA	20 mA	20 mA	20 mA	10 V	10 V	5 V	5 V		•		
	Underrange	0 mA	0 mA	4 mA	4 mA	0 V	0 V	0 V	1 V				
D	Cable break	0 mA	0 mA	4 mA	4 mA	0 V	0 V	0 V	1 V				
	Overrange	20 mA	20 mA	20 mA	20 mA	10 V	10 V	5 V	5 V	•	•		
	Underrange	0 mA	0 mA	4 mA	4 mA	0 V	0 V	0 V	1 V				
NE43	(Only OUT = 4...20 mA or 20...4 mA)												
	Upscale	Cable break, overrange, underrange							= 21.5 mA			•	
	Downscale	Cable break, overrange, underrange							= 3.5 mA	•		•	
	0 mA	Cable break, overrange, underrange							= 0 mA		•	•	
	Up/downscale	Cable break					= 3.5 mA			•	•	•	
		Overrange, underrange					= 21.5 mA						
Configuration		Via software											
		Via DIP switch											•

9.2 Configuration via software (FDT/DTM)

Use the IFS-USB-PROG-ADAPTER (Order No.: 2811271) for connecting the device to the PC.

Figure 6 Connection for programming adapter



Software configuration provides advantages such as 15 different sensor types, customer-specific characteristic curves, free adjustment of signal output, temperature ranges, and error indication.

The software consists of the FDT framework application and a driver (DTM) for every device. The software is available free of charge on the Internet at phoenixcontact.com.

- Enter the order number of your measuring transducer in the search field. The installation packages can be found under Downloads.
- If you are already using an FDT framework application, only download the DTMs.
- In any other case, download the IFS-CONF software package. It contains both the framework application and the pre-installed DTMs.

ANALOG-CONF standard software

- If you do not require an FDT/DTM-based software solution, you can use the ANALOG-CONF standard software. This software also allows for performing all the settings on the device. The software is available free of charge on the Internet at phoenixcontact.com.

The USB driver for the programming adapter is part of the IFS-CONF, ANALOG-CONF, and of the DTM installation package.

10 Diagnostic indicator

The red LED indicates the following error states:

– LED flashes at 2.8 Hz: sensor error or invalid DIP switch configuration
– LED flashes at 1.4 Hz: simulation mode
– LED is permanently on: internal device error