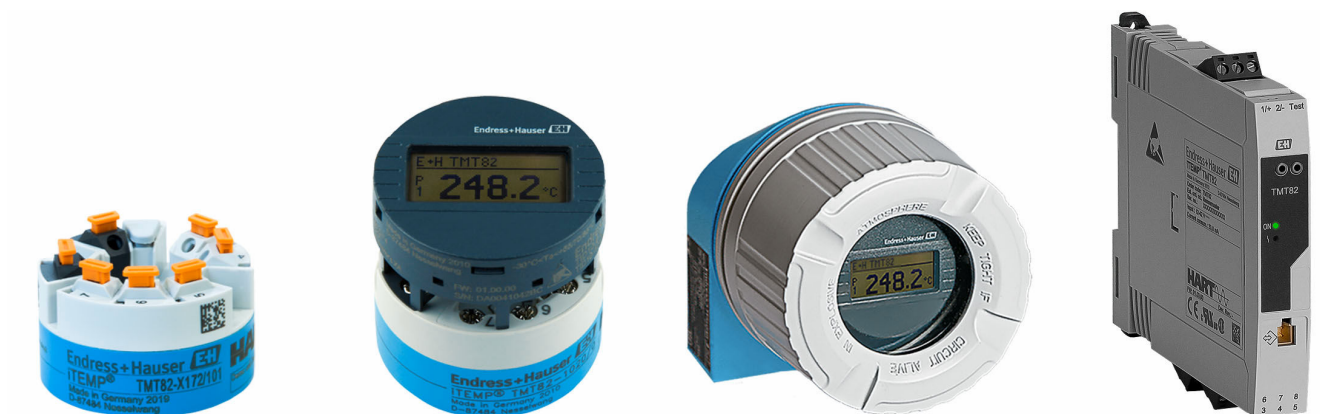


# Technical Information

## iTEMP TMT82

Temperature transmitter



HART<sup>®</sup> Temperature transmitter as head, field- or DIN rail device with two universal sensor inputs for explosive atmospheres and SIL2

### Application

- The iTEMP TMT82 stands out due to its reliability, longterm stability, high precision and advanced diagnostics (important in critical processes)
- Universal input for resistance thermometers (RTD), thermocouples (TC), resistance transmitters ( $\Omega$ ) and voltage transmitters (mV)
- Conversion into a scalable analog 4 to 20 mA output signal
- Installation in a flat-face terminal head as per DIN EN 50446
- Optional: installation in field housing for use in Ex d applications
- Optional: device design for DIN rail mounting

- Optional: installation in field mount housing with separate terminal compartment and plug-on display

*[Continued from front page]*

**Your benefits**

- Safe operation in hazardous areas due to international approvals
  - SIL certification as per IEC 61508:2010
  - High accuracy of measuring point through sensor-transmitter matching
  - Reliable operation with sensor monitoring and device hardware fault recognition
  - Diagnostics information according to NAMUR NE107
  - Several mounting versions and sensor connection combinations
- Fast connection thanks to push-in terminal technology, optional
  - Write protection for device parameters

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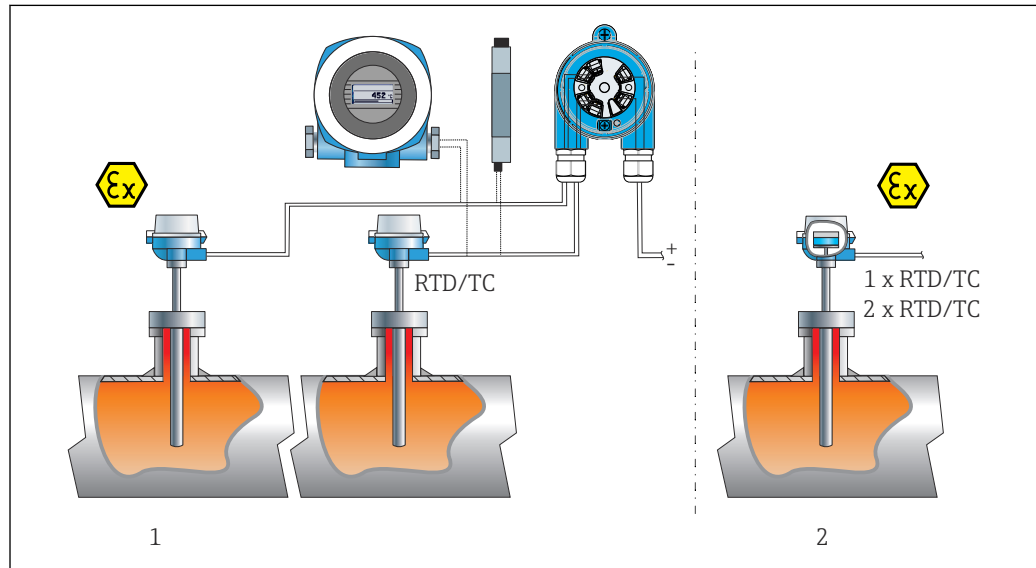
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## Function and system design

### Measuring principle

Electronic recording and conversion of various input signals in industrial temperature measurement.

### Measuring system



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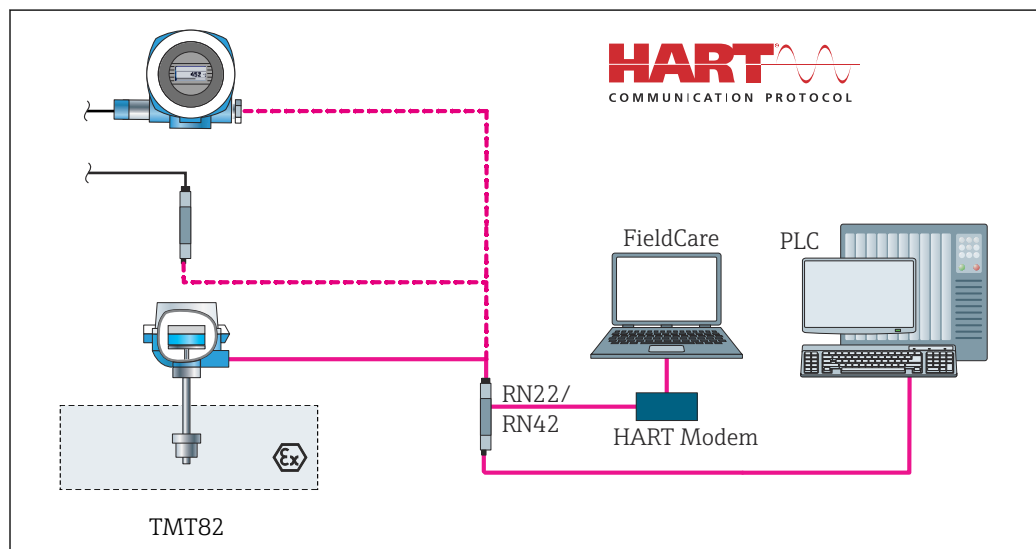
#### 1 Application examples

- Two sensors with measuring input (RTD or TC) in remote installation with the following advantages: drift warning, sensor backup function and temperature-dependent sensor switching
- Integrated transmitter - 1 x RTD/TC or 2 x RTD/TC for redundancy

Endress+Hauser offers a comprehensive range of industrial thermometers with resistance sensors or thermocouples.

When combined with the temperature transmitter, these components form a complete measuring point for a wide range of applications in the industrial sector.

The temperature transmitter is a 2-wire device with two measuring inputs and one analog output. The device not only transfers converted signals from resistance thermometers and thermocouples, it also transfers resistance and voltage signals using HART communication and as a 4 to 20 mA current signal. It can be installed as an intrinsically safe apparatus in hazardous areas. It is used for instrumentation in the terminal head (flat face) as per DIN EN 50446, for installation in the cabinet on a TH35 mounting rail as per EN 60715 or mounted in a 2-compartment field mount housing with glass window and included plug-on display.



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#### 2 Device architecture for HART communication

### Standard diagnostic functions

- Cable open-circuit, short-circuit of sensor wires
- Incorrect wiring
- Internal device errors
- Overrange/underrange detection
- Ambient temperature out-of-range detection

### Corrosion detection as per NAMUR NE89

Corrosion of the sensor connection cables can cause incorrect measured value readings. The transmitter offers the possibility of detecting any corrosion of the thermocouples, voltage transmitters (mV) and resistance thermometers, resistance transmitters (Ohm) with 4-wire connection before a measured value is corrupted. The transmitter prevents incorrect measured values from being exported and can issue a warning via the HART protocol if conductor resistance values exceed plausible limits.

### Low voltage detection

The low voltage detection function prevents the device from continuously transmitting an incorrect analog output value (caused by an incorrect or damaged power supply system or a damaged signal cable). If the supply voltage drops below the required value, the analog output value drops to < 3.6 mA for 5 s. The device then tries to output the normal analog output value again. If the supply voltage is still too low, this process is repeated cyclically.

### 2-channel functions

These functions increase the reliability and availability of the process values:

- Sensor backup switches to the second sensor if the primary sensor fails
- Drift warning or alarm if the deviation between sensor 1 and sensor 2 is less than or greater than a predefined limit value
- Temperature-dependent switching between sensors which are used in different measuring ranges
- Mean value or differential measurement from two sensors
- Mean value measurement with sensor redundancy



Not all modes are available in the SIL mode, see the 'Functional Safety Manual'.



Functional Safety Manual for temperature field transmitter TMT82: FY01105T

## Input

<b>Measured variable</b>	Temperature (temperature-linear transmission behavior), resistance and voltage.
<b>Measuring range</b>	It is possible to connect two sensors that are independent of one another <sup>1)</sup> . The measuring inputs are not galvanically isolated from each other.

Resistance thermometer (RTD) as per standard	Description	$\alpha$	Measuring range limits	Min. measuring span
IEC 60751:2008	Pt100 (1) Pt200 (2) Pt500 (3) Pt1000 (4)	0.003851	-200 to +850 °C (-328 to +1562 °F) -200 to +850 °C (-328 to +1562 °F) -200 to +500 °C (-328 to +932 °F) -200 to +250 °C (-328 to +482 °F)	10 K (18 °F)
JIS C1604:1984	Pt100 (5)	0.003916	-200 to +510 °C (-328 to +950 °F)	10 K (18 °F)
DIN 43760 IPTS-68	Ni100 (6) Ni120 (7)	0.006180	-60 to +250 °C (-76 to +482 °F) -60 to +250 °C (-76 to +482 °F)	10 K (18 °F)

1) In the case of 2-channel measurement the same measuring unit must be configured for the two channels (e.g. both °C or F or K). Independent 2-channel measurement of a resistance transmitter (Ohm) and voltage transmitter (mV) is not possible.

Resistance thermometer (RTD) as per standard	Description	$\alpha$	Measuring range limits	Min. measuring span
GOST 6651-94	Pt50 (8) Pt100 (9)	0.003910	-185 to +1 100 °C (-301 to +2 012 °F) -200 to +850 °C (-328 to +1 562 °F)	10 K (18 °F)
OIML R84: 2003, GOST 6651-2009	Cu50 (10) Cu100 (11)	0.004280	-180 to +200 °C (-292 to +392 °F) -180 to +200 °C (-292 to +392 °F)	10 K (18 °F)
	Ni100 (12) Ni120 (13)	0.006170	-60 to +180 °C (-76 to +356 °F) -60 to +180 °C (-76 to +356 °F)	10 K (18 °F)
OIML R84: 2003, GOST 6651-94	Cu50 (14)	0.004260	-50 to +200 °C (-58 to +392 °F)	10 K (18 °F)
-	Pt100 (Callendar van Dusen) Nickel polynomial Copper polynomial	-	The measuring range limits are specified by entering the limit values that depend on the coefficients A to C and R0.	10 K (18 °F)
	<ul style="list-style-type: none"> <li>▪ Connection type: 2-wire, 3-wire or 4-wire connection, sensor current: <math>\leq 0.3</math> mA</li> <li>▪ With 2-wire circuit, compensation of the wire resistance possible (0 to 30 <math>\Omega</math>)</li> <li>▪ With 3-wire and 4-wire connection, sensor wire resistance up to max. 50 <math>\Omega</math> per wire</li> </ul>			
<b>Resistance transmitter</b>	Resistance $\Omega$		10 to 400 $\Omega$ 10 to 2 000 $\Omega$	10 $\Omega$ 10 $\Omega$

Thermocouples as per standard	Description	Measuring range limits		Min. measuring span
IEC 60584, Part 1 ASTM E230-3	Type A (W5Re-W20Re) (30)	0 to +2 500 °C (+32 to +4 532 °F)	Recommended temperature range: 0 to +2 500 °C (+32 to +4 532 °F)	50 K (90 °F)
	Type B (PtRh30-PtRh6) (31)	+40 to +1 820 °C (+104 to +3 308 °F)	+500 to +1 820 °C (+932 to +3 308 °F)	50 K (90 °F)
	Type E (NiCr-CuNi) (34)	-250 to +1 000 °C (-418 to +1 832 °F)	-150 to +1 000 °C (-238 to +1 832 °F)	50 K (90 °F)
	Type J (Fe-CuNi) (35)	-210 to +1 200 °C (-346 to +2 192 °F)	-150 to +1 200 °C (-238 to +2 192 °F)	50 K (90 °F)
	Type K (NiCr-Ni) (36)	-270 to +1 372 °C (-454 to +2 501 °F)	-150 to +1 200 °C (-238 to +2 192 °F)	50 K (90 °F)
	Type N (NiCrSi-NiSi) (37)	-270 to +1 300 °C (-454 to +2 372 °F)	-150 to +1 300 °C (-238 to +2 372 °F)	50 K (90 °F)
	Type R (PtRh13-Pt) (38)	-50 to +1 768 °C (-58 to +3 214 °F)	+200 to +1 768 °C (+392 to +3 214 °F)	50 K (90 °F)
IEC 60584, Part 1 ASTM E230-3 ASTM E988-96	Type S (PtRh10-Pt) (39)	-50 to +1 768 °C (-58 to +3 214 °F)	+200 to +1 768 °C (+392 to +3 214 °F)	50 K (90 °F)
	Type T (Cu-CuNi) (40)	-200 to +400 °C (-328 to +752 °F)	-150 to +400 °C (-238 to +752 °F)	50 K (90 °F)
ASTM E988-96	Type C (W5Re-W26Re) (32)	0 to +2 315 °C (+32 to +4 199 °F)	0 to +2 000 °C (+32 to +3 632 °F)	50 K (90 °F)
ASTM E988-96	Type D (W3Re-W25Re) (33)	0 to +2 315 °C (+32 to +4 199 °F)	0 to +2 000 °C (+32 to +3 632 °F)	50 K (90 °F)
DIN 43710	Type L (Fe-CuNi) (41)	-200 to +900 °C (-328 to +1 652 °F)	-150 to +900 °C (-238 to +1 652 °F)	50 K (90 °F)
	Type U (Cu-CuNi) (42)	-200 to +600 °C (-328 to +1 112 °F)	-150 to +600 °C (-238 to +1 112 °F)	50 K (90 °F)
GOST R8.585-2001	Type L (NiCr-CuNi) (43)	-200 to +800 °C (-328 to +1 472 °F)	-200 to +800 °C (+328 to +1 472 °F)	50 K (90 °F)
	<ul style="list-style-type: none"> <li>▪ Internal reference junction (Pt100)</li> <li>▪ External reference junction: configurable value -40 to +85 °C (-40 to +185 °F)</li> <li>▪ Maximum sensor wire resistance 10 k<math>\Omega</math> (If the sensor wire resistance is greater than 10 k<math>\Omega</math>, an error message is output in accordance with NAMUR NE89.)</li> </ul>			
<b>Voltage transmitter (mV)</b>	Millivolt transmitter (mV)	-20 to 100 mV		5 mV

**Type of input**

The following connection combinations are possible when both sensor inputs are assigned:

		Sensor input 1			Thermocouple (TC), voltage transmitter	
Sensor input 2		RTD or resistance transmitter, 2-wire	RTD or resistance transmitter, 3-wire	RTD or resistance transmitter, 4-wire		
		RTD or resistance transmitter, 2-wire	☑	☑	-	☑
		RTD or resistance transmitter, 3-wire	☑	☑	-	☑

Sensor input 1				
RTD or resistance transmitter, 4-wire	-	-	-	-
Thermocouple (TC), voltage transmitter	☑	☑	☑	☑
<b>For field mount housing with a thermocouple on sensor input 1:</b> It is not possible to connect a second thermocouple (TC), resistance thermometer, resistance transmitter or voltage transmitter on sensor input 2 as this input is needed for the external reference junction.				

## Output

Output signal	
Analog output	4 to 20 mA, 20 to 4 mA (can be inverted)
Signal encoding	FSK ±0.5 mA via current signal
Data transmission rate	1200 baud
Galvanic isolation	U = 2 kV AC for 1 minute (input/output)

### Failure information

#### Failure information as per NAMUR NE43:

Failure information is created if the measuring information is missing or not valid. A complete list of all the errors occurring in the measuring system is created.

Underranging	Linear decrease from 4.0 to 3.8 mA
Overranging	Linear increase from 20.0 to 20.5 mA
Failure e.g. sensor failure; sensor short-circuit	≤ 3.6 mA ("low") or ≥ 21 mA ("high"), can be selected The "high" alarm setting can be set between 21.5 mA and 23 mA, thus providing the flexibility needed to meet the requirements of various control systems.

### Load

Head transmitter: $R_{b \max.} = (U_{b \max.} - 11 \text{ V}) / 0.023 \text{ A}$ (current output)	
Din rail transmitter: $R_{b \max.} = (U_{b \max.} - 12 \text{ V}) / 0.023 \text{ A}$ (current output)	

Load in Ω.  $U_b$  = supply voltage in V DC

**Linearization/transmission behavior** Temperature-linear, resistance-linear, voltage-linear

**Mains frequency filter** 50/60 Hz

**Filter** 1st order digital filter: 0 to 120 s

<b>Protocol-specific data</b>	HART version	7
	Device address in multi-drop mode <sup>1)</sup>	Software setting addresses 0 to 63
	Device description files (DD)	Information and files are available free of charge at: www.endress.com www.fieldcommgroup.org
	Load (communication resistor)	Min. 250 $\Omega$

1) Not possible in SIL mode; see Functional Safety Manual FY01105T.

**Write protection for device parameters**

- Hardware: Write protection for head transmitter on optional display using DIP switch
- Software: Write protection using password

**Switch-on delay**

- Until the start of HART communication, approx. 6 s <sup>2)</sup>, while switch-on delay =  $I_a \leq 3.8$  mA
- Until the first valid measured value signal is present for HART communication and at the current output, approx. 15 s, while switch-on delay =  $I_a \leq 3.8$  mA

## Power supply

**Supply voltage** Values for non-hazardous areas, protected against polarity reversal:

- Head transmitter
  - 11 V  $\leq V_{cc} \leq 42$  V (standard)
  - 11 V  $\leq V_{cc} \leq 32$  V (SIL mode)
  - $I: \leq 23$  mA
- DIN rail transmitter
  - 12 V  $\leq V_{cc} \leq 42$  V (standard)
  - 12 V  $\leq V_{cc} \leq 32$  V (SIL mode)
  - $I: \leq 23$  mA

Values for hazardous area, see Ex documentation.

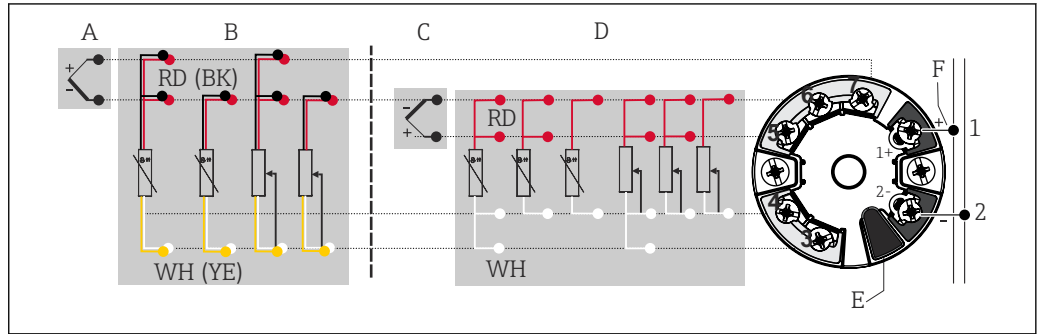
**Current consumption**

- 3.6 to 23 mA
- Minimum current consumption 3.5 mA, Multidrop mode 4 mA (not possible in the SIL mode)
- Current limit  $\leq 23$  mA

2) Does not apply to the SIL mode



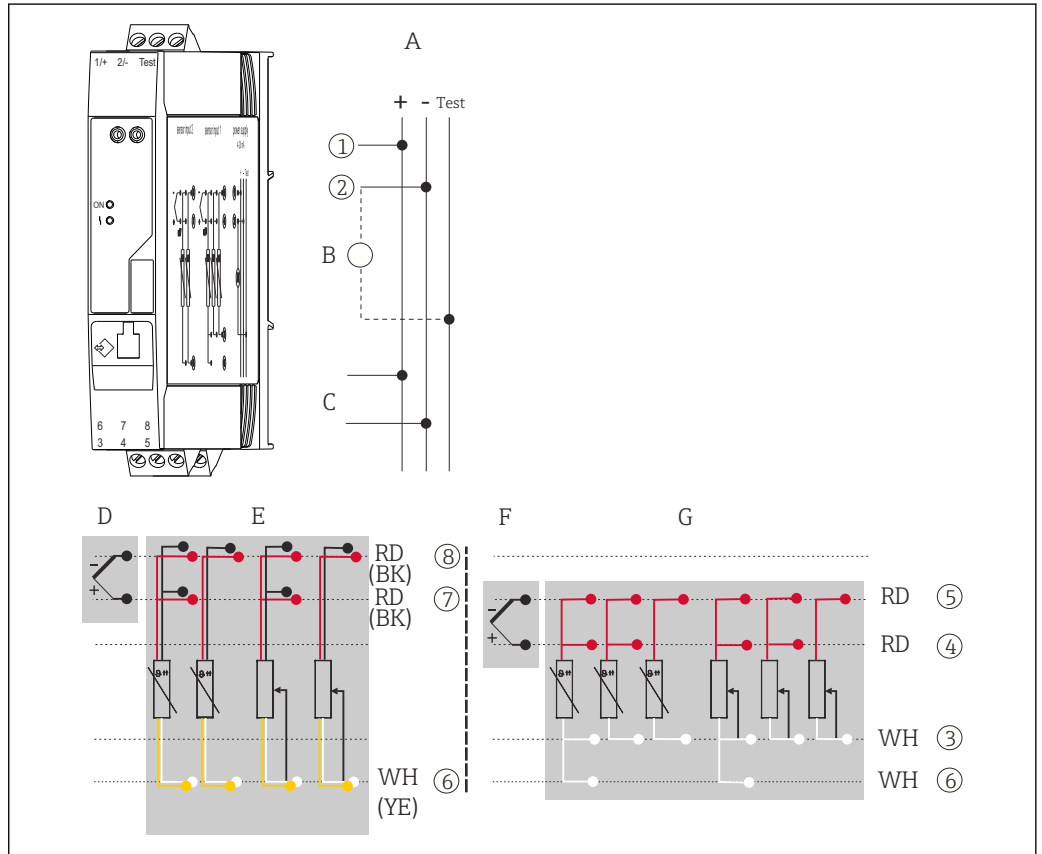
Electrical connection



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3 Assignment of terminal connections for head transmitter

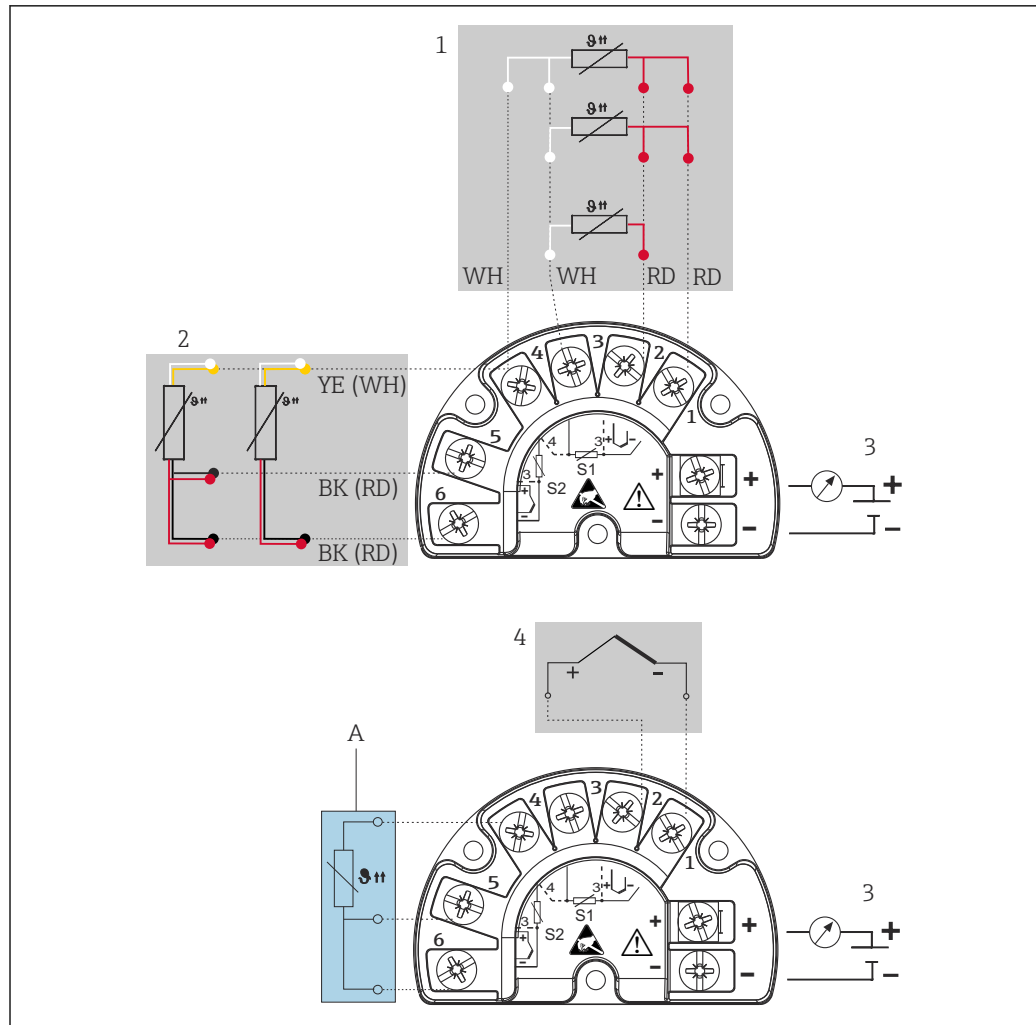
- A Sensor input 2, TC and mV
- B Sensor input 2, RTD and  $\Omega$ , 3- and 2-wire
- C Sensor input 1, TC and mV
- D Sensor input 1, RTD and  $\Omega$ , 4-, 3- and 2-wire
- E Display connection, service interface
- F Bus connection and power supply



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4 Assignment of terminal connections for DIN rail transmitter

- A Bus connection and power supply
- B To check the output current, an ammeter (DC measurement) can be connected between the "Test" and "-" terminals.
- C HART connection
- D Sensor input 2, TC and mV
- E Sensor input 2, RTD and  $\Omega$ , 3- and 2-wire
- F Sensor input 1, TC and mV
- G Sensor input 1, RTD and  $\Omega$ , 4-, 3- and 2-wire



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5 Terminal assignment of the field mount housing with separate terminal compartment

- 1 Sensor input 1, RTD, : 2-, 3- and 4-wire
- 2 Sensor input 2, RTD: 2-, 3-wire
- 3 Bus connection and power supply
- 4 Sensor input 1, thermocouple (TC)
- A If sensor input thermocouple (TC) is selected: permanent connection of the external reference junction, terminals 4, 5 and 6 (Pt100, IEC 60751, class B, 3-wire). It is not possible to connect a second thermocouple (TC) on sensor 2.

An unshielded installation cable suffices if only the analog signal is used. The use of shielded cables is recommended for increased EMC interference. As of a sensor cable length of 30 m (98.4 ft) 30 m (98.4 ft), a shielded cable must be used for a head transmitter in the field mount housing with a separate terminal compartment and for the DIN rail transmitter.


A shielded cable is recommended for HART communication. Observe grounding concept of the plant. A minimum load of 250  $\Omega$  is required in the signal circuit in order to operate the HART transmitter via the HART protocol (terminals 1 and 2).

## Terminals

Choice of screw terminals or push-in terminals for sensor and power supply cables:

Terminal design	Cable design	Cable cross-section
Screw terminals	Rigid or flexible	$\leq 2.5 \text{ mm}^2$ (14 AWG)
		Field mount housing: 2.5 mm <sup>2</sup> (12 AWG) plus ferrule


Terminal design	Cable design	Cable cross-section
Push-in terminals (cable version, stripping length = min. 10 mm (0.39 in))	Rigid or flexible	0.2 to 1.5 mm <sup>2</sup> (24 to 16 AWG)
	Flexible with ferrules (with or without plastic ferrule)	0.25 to 1.5 mm <sup>2</sup> (24 to 16 AWG)

 Ferrules must be used with push-in terminals and when using flexible cables with a cable cross-section of  $\leq 0.3 \text{ mm}^2$ . Otherwise, the use of ferrules when connecting flexible cables to push-in terminals is not recommended.

## Performance characteristics

**Response time** The measured value update depends on the type of sensor and connection method and moves within the following ranges:

Resistance thermometers (RTD)	0.9 to 1.5 s (depends on the connection method 2/3/4-wire)
Thermocouples (TC)	1.1 s
Reference junction	1.1 s

 When recording step responses, it must be taken into account that the times for measuring the second channel and the internal reference junction may be added to the specified times.

**Update time**  $\leq 100 \text{ ms}$

**Reference conditions**

- Calibration temperature:  $+25 \text{ °C} \pm 3 \text{ K}$  ( $77 \text{ °F} \pm 5.4 \text{ °F}$ )
- Supply voltage: 24 V DC
- 4-wire circuit for resistance adjustment

**Maximum measurement error** In accordance with DIN EN 60770 and the reference conditions specified above. The measurement error data correspond to  $\pm 2 \sigma$  (Gaussian distribution). The data include non-linearities and repeatability.

Typically

Standard	Name	Measuring range	Typical measurement error ( $\pm$ )	
<b>Resistance thermometer (RTD) as per standard</b>			Digital value <sup>1)</sup>	Value at current output
IEC 60751:2008	Pt100 (1)	0 to +200 °C (32 to +392 °F)	0.08 °C (0.14 °F)	0.1 °C (0.18 °F)
IEC 60751:2008	Pt1000 (4)		0.08 K (0.14 °F)	0.1 °C (0.18 °F)
GOST 6651-94	Pt100 (9)		0.07 °C (0.13 °F)	0.09 °C (0.16 °F)
<b>Thermocouples (TC) as per standard</b>			Digital value	Value at current output
IEC 60584, Part 1 ASTM E230-3	Type K (NiCr-Ni) (36)	0 to +800 °C (32 to +1472 °F)	0.25 °C (0.45 °F)	0.35 °C (0.63 °F)
	Type R (PtRh13-Pt) (38)		0.59 °C (1.06 °F)	0.64 °C (1.15 °F)
	Type S (PtRh10-Pt) (39)		0.67 °C (1.21 °F)	0.71 °C (1.28 °F)

1) Measured value transmitted via HART.

## Measurement error for resistance thermometers (RTD) and resistance transmitters

Standard	Name	Measuring range	Measurement error ( $\pm$ )	
			Digital <sup>1)</sup>	
			Based on measured value <sup>3)</sup>	
				D/A <sup>2)</sup>
IEC 60751:2008	Pt100 (1)	-200 to +850 °C (-328 to +1562 °F)	ME = $\pm$ (0.06 °C (0.11 °F) + 0.006% * (MV - LRV))	
	Pt200 (2)		ME = $\pm$ (0.12 °C (0.22 °F) + 0.015% * (MV - LRV))	
	Pt500 (3)	-200 to +500 °C (-328 to +932 °F)	ME = $\pm$ (0.05 °C (0.09 °F) + 0.014% * (MV - LRV))	
	Pt1000 (4)	-200 to +250 °C (-328 to +482 °F)	ME = $\pm$ (0.03 °C (0.05 °F) + 0.013% * (MV - LRV))	
JIS C1604:1984	Pt100 (5)	-200 to +510 °C (-328 to +950 °F)	ME = $\pm$ (0.05 °C (0.09 °F) + 0.006% * (MV - LRV))	
GOST 6651-94	Pt50 (8)	-185 to +1100 °C (-301 to +2012 °F)	ME = $\pm$ (0.10 °C (0.18 °F) + 0.008% * (MV - LRV))	
	Pt100 (9)	-200 to +850 °C (-328 to +1562 °F)	ME = $\pm$ (0.05 °C (0.09 °F) + 0.006% * (MV - LRV))	
DIN 43760 IPTS-68	Ni100 (6)	-60 to +250 °C (-76 to +482 °F)	ME = $\pm$ (0.05 °C (0.09 °F) - 0.006% * (MV - LRV))	
	Ni120 (7)			
OIML R84: 2003 / GOST 6651-2009	Cu50 (10)	-180 to +200 °C (-292 to +392 °F)	ME = $\pm$ (0.10 °C (0.18 °F) + 0.006% * (MV - LRV))	
	Cu100 (11)	-180 to +200 °C (-292 to +392 °F)	ME = $\pm$ (0.05 °C (0.09 °F) + 0.003% * (MV - LRV))	
	Ni100 (12)	-60 to +180 °C (-76 to +356 °F)	ME = $\pm$ (0.06 °C (0.11 °F) - 0.006% * (MV - LRV))	
	Ni120 (13)		ME = $\pm$ (0.05 °C (0.09 °F) - 0.006% * (MV - LRV))	
OIML R84: 2003, GOST 6651-94	Cu50 (14)	-50 to +200 °C (-58 to +392 °F)	ME = $\pm$ (0.10 °C (0.18 °F) + 0.004% * (MV - LRV))	
<b>Resistance transmitter</b>	Resistance $\Omega$	10 to 400 $\Omega$	ME = $\pm$ 21 m $\Omega$ + 0.003% * MV	
		10 to 2000 $\Omega$	ME = $\pm$ 90 m $\Omega$ + 0.011% * MV	
				0.03 % ( $\cong$ 4.8 $\mu$ A)

- 1) Measured value transmitted via HART.  
2) Percentages based on the configured span of the analog output signal.  
3) Deviations from maximum measurement error due to rounding is possible.

## Measurement error for thermocouples (TC) and voltage transmitters

Standard	Name	Measuring range	Measurement error ( $\pm$ )	
			Digital <sup>1)</sup>	
			Based on measured value <sup>3)</sup>	
				D/A <sup>2)</sup>
IEC 60584-1 ASTM E230-3	Type A (30)	0 to +2500 °C (+32 to +4532 °F)	ME = $\pm$ (0.7 °C (1.26 °F) + 0.019% * (MV - LRV))	
	Type B (31)	+500 to +1820 °C (+932 to +3308 °F)	ME = $\pm$ (1.15 °C (2.07 °F) - 0.04% * (MV - LRV))	
IEC 60584-1 ASTM E230-3 ASTM E988-96	Type C (32)	0 to +2000 °C (+32 to +3632 °F)	ME = $\pm$ (0.4 °C (0.72 °F) + 0.0065% * (MV - LRV))	
ASTM E988-96	Type D (33)	0 to +2000 °C (+32 to +3632 °F)	ME = $\pm$ (0.55 °C (0.99 °F) - 0.005% * (MV - LRV))	
IEC 60584-1 ASTM E230-3	Type E (34)	-150 to +1200 °C (-238 to +2192 °F)	ME = $\pm$ (0.17 °C (0.31 °F) - 0.005% * (MV - LRV))	
	Type J (35)	-150 to +1200 °C (-238 to +2192 °F)	ME = $\pm$ (0.22 °C (0.4 °F) - 0.0045% * (MV - LRV))	
	Type K (36)		ME = $\pm$ (0.28 °C (0.5 °F) - 0.003% * (MV - LRV))	
	Type N (37)	-150 to +1300 °C (-238 to +2372 °F)	ME = $\pm$ (0.37 °C (0.67 °F) - 0.01% * (MV - LRV))	
	Type R (38)	+200 to +1768 °C (+392 to +3214 °F)	ME = $\pm$ (0.65 °C (1.17 °F) - 0.01% * (MV - LRV))	
	Type S (39)		ME = $\pm$ (0.7 °C (1.26 °F) - 0.005% * (MV - LRV))	
Type T (40)	-150 to +400 °C (-238 to +752 °F)	ME = $\pm$ (0.3 °C (0.54 °F) - 0.027% * (MV - LRV))		
				0.03 % ( $\cong$ 4.8 $\mu$ A)

Standard	Name	Measuring range	Measurement error ( $\pm$ )	
DIN 43710	Type L (41)	-150 to +900 °C (-238 to +1 652 °F)	ME = $\pm$ (0.24 °C (0.43 °F) - 0.0055% * (MV - LRV))	
	Type U (42)	-150 to +600 °C (-238 to +1 112 °F)	ME = $\pm$ (0.33 °C (0.59 °F) - 0.028% * (MV - LRV))	
GOST R8.585-2001	Type L (43)	-200 to +800 °C (-328 to +1 472 °F)	ME = $\pm$ (2.2 °C (3.96 °F) - 0.015% * (MV - LRV))	
<b>Voltage transmitter (mV)</b>		-20 to +100 mV	ME = $\pm$ 10 $\mu$ V	4.8 $\mu$ A

- 1) Measured value transmitted via HART.
- 2) Percentages based on the configured span of the analog output signal.
- 3) Deviations from maximum measurement error due to rounding is possible.

MV = measured value

LRV = lower range value of the sensor in question

Total measurement error of transmitter at current output =  $\sqrt{(\text{Measurement error digital}^2 + \text{Measurement error D/A}^2)}$

Sample calculation with Pt100, measuring range 0 to +200 °C (+32 to +392 °F), ambient temperature +25 °C (+77 °F), supply voltage 24 V:

Measurement error digital = 0.06 °C + 0.006% x (200 °C - (-200 °C)):	0.08 °C (0.15 °F)
Measurement error D/A = 0.03 % x 200 °C (360 °F)	0.06 °C (0.11 °F)
<b>Measurement error digital value (HART):</b>	0.08 °C (0.15 °F)
<b>Measurement error analog value (current output):</b> $\sqrt{(\text{measurement error digital}^2 + \text{measurement error D/A}^2)}$	0.10 °C (0.19 °F)

Sample calculation with Pt100, measuring range 0 to +200 °C (+32 to +392 °F), ambient temperature +35 °C (+95 °F), supply voltage 30 V:


Measurement error digital = 0.06 °C + 0.006% x (200 °C - (-200 °C)):	0.08 °C (0.15 °F)
Measurement error D/A = 0.03 % x 200 °C (360 °F)	0.06 °C (0.11 °F)
Influence of ambient temperature (digital) = (35 - 25) x (0.002% x 200 °C - (-200 °C)), min. 0.005 °C	0.08 °C (0.14 °F)
Influence of ambient temperature (D/A) = (35 - 25) x (0.001% x 200 °C)	0.02 °C (0.04 °F)
Influence of supply voltage (digital) = (30 - 24) x (0.002% x 200 °C - (-200 °C)), min. 0.005 °C	0.05 °C (0.09 °F)
Influence of supply voltage (D/A) = (30 - 24) x (0.001% x 200 °C)	0.01 °C (0.02 °F)
<b>Measurement error digital value (HART):</b> $\sqrt{(\text{Measurement error digital}^2 + \text{Influence of ambient temperature (digital)}^2 + \text{Influence of supply voltage (digital)}^2)}$	<b>0.13 °C (0.23 °F)</b>
<b>Measurement error analog value (current output):</b> $\sqrt{(\text{Measurement error digital}^2 + \text{Measurement error D/A}^2 + \text{Influence of ambient temperature (digital)}^2 + \text{Influence of ambient temperature (D/A)}^2 + \text{Influence of supply voltage (digital)}^2 + \text{Influence of supply voltage (D/A)}^2)}$	<b>0.14 °C (0.25 °F)</b>

The measurement error data correspond to  $\pm 2 \sigma$  (Gaussian distribution).

MV = measured value

LRV = lower range value of the sensor in question

Physical input measuring range of sensors	
10 to 400 Ω	Cu50, Cu100, polynomial RTD, Pt50, Pt100, Ni100, Ni120
10 to 2 000 Ω	Pt200, Pt500, Pt1000
-20 to 100 mV	Thermocouples type: A, B, C, D, E, J, K, L, N, R, S, T, U

 Other measurement errors apply in the SIL mode.

 For more information, please refer to Functional Safety Manual FY01105T.

## Sensor adjustment

### Sensor-transmitter-matching

RTD sensors are one of the most linear temperature measuring elements. Nevertheless, the output must be linearized. To significantly improve temperature measurement accuracy, the device allows the use of two methods:

- Callendar van Dusen coefficients (Pt100 resistance thermometer)

The Callendar van Dusen equation is described as:

$$R_T = R_0[1 + AT + BT^2 + C(T - 100)T^3]$$

The coefficients A, B and C are used to match the sensor (platinum) and transmitter in order to improve the accuracy of the measuring system. The coefficients for a standard sensor are specified in IEC 751. If no standard sensor is available or if greater accuracy is required, the coefficients for each sensor can be determined specifically with the aid of sensor calibration.

- Linearization for copper/nickel resistance thermometers (RTD)

The polynomial equation for copper/nickel is as follows:

$$R_T = R_0(1 + AT + BT^2)$$

The coefficients A and B are used for the linearization of nickel or copper resistance thermometers (RTD). The exact values of the coefficients derive from the calibration data and are specific to each sensor. The sensor-specific coefficients are then sent to the transmitter.

Sensor-transmitter matching using one of the methods mentioned above significantly improves the temperature measurement accuracy of the entire system. This is because the transmitter uses the specific data pertaining to the connected sensor to calculate the measured temperature, instead of using the standardized sensor curve data.

#### 1-point adjustment (offset)

Shifts the sensor value

#### 2-point adjustment (sensor trimming)

Correction (slope and offset) of the measured sensor value at transmitter input

**Current output adjustment** Correction of 4 or 20 mA current output value (not possible in SIL mode)

**Operating influences** The measurement error data correspond to  $\pm 2 \sigma$  (Gaussian distribution).

*Influence of ambient temperature and supply voltage on operation for resistance thermometers (RTD) and resistance transmitters*

Name	Standard	Ambient temperature: Influence ( $\pm$ ) per 1 °C (1.8 °F) change		Supply voltage: Influence ( $\pm$ ) per V change		
		Digital <sup>1)</sup>	D/A <sup>2)</sup>	Digital	D/A	D/A
		Maximum	Based on measured value	Maximum	Based on measured value	
Pt100 (1)	IEC 60751:2008	$\leq 0.02$ °C (0.036 °F)	0.002% * (MV - LRV), at least 0.005 °C (0.009 °F)	$\leq 0.02$ °C (0.036 °F)	0.002% * (MV - LRV), at least 0.005 °C (0.009 °F)	0.001 %
Pt200 (2)		$\leq 0.026$ °C (0.047 °F)	-	$\leq 0.026$ °C (0.047 °F)	-	

Name	Standard	Ambient temperature: Influence (±) per 1 °C (1.8 °F) change		Supply voltage: Influence (±) per V change			
Pt500 (3)	JIS C1604:1984	≤ 0.014 °C (0.025 °F)	0.002% * (MV - LRV), at least 0.009 °C (0.016 °F)	0.001 %	≤ 0.014 °C (0.025 °F)	0.002% * (MV - LRV), at least 0.009 °C (0.016 °F)	
Pt1000 (4)		≤ 0.01 °C (0.018 °F)	0.002% * (MV - LRV), at least 0.004 °C (0.007 °F)		≤ 0.01 °C (0.018 °F)	0.002% * (MV - LRV), at least 0.004 °C (0.007 °F)	
Pt100 (5)			0.002% * (MV - LRV), at least 0.005 °C (0.009 °F)		0.002% * (MV - LRV), at least 0.005 °C (0.009 °F)		
Pt50 (8)	GOST 6651-94	≤ 0.03 °C (0.054 °F)	0.002% * (MV - LRV), at least 0.01 °C (0.018 °F)	0.001 %	≤ 0.03 °C (0.054 °F)	0.002% * (MV - LRV), at least 0.01 °C (0.018 °F)	
Pt100 (9)		≤ 0.02 °C (0.036 °F)	0.002% * (MV - LRV), at least 0.005 °C (0.009 °F)		≤ 0.02 °C (0.036 °F)	0.002% * (MV - LRV), at least 0.005 °C (0.009 °F)	
Ni100 (6)	DIN 43760	≤ 0.005 °C (0.009 °F)	-	0.001 %	≤ 0.005 °C (0.009 °F)	-	
Ni120 (7)	IPTS-68		-			-	
Cu50 (10)	OIML R84: 2003 / GOST 6651-2009	≤ 0.008 °C (0.014 °F)	-	0.001 %	≤ 0.008 °C (0.014 °F)	-	
Cu100 (11)			0.002% * (MV - LRV), at least 0.004 °C (0.007 °F)			0.002% * (MV - LRV), at least 0.004 °C (0.007 °F)	
Ni100 (12)		≤ 0.004 °C (0.007 °F)	-		≤ 0.004 °C (0.007 °F)	-	
Ni120 (13)			-			-	
Cu50 (14)	OIML R84: 2003 / GOST 6651-94	≤ 0.008 °C (0.014 °F)	-	0.001 %	≤ 0.008 °C (0.014 °F)	-	
<b>Resistance transmitter (Ω)</b>							
10 to 400 Ω		≤ 6 mΩ	0.0015% * (MV - LRV), at least 1.5 mΩ	0.001 %	≤ 6 mΩ	0.0015% * (MV - LRV), at least 1.5 mΩ	0.001 %
10 to 2 000 Ω		≤ 30 mΩ	0.0015% * (MV - LRV), at least 15 mΩ		≤ 30 mΩ	0.0015% * (MV - LRV), at least 15 mΩ	

- 1) Measured value transmitted via HART.
- 2) Percentages based on the configured span of the analog output signal

*Influence of ambient temperature and supply voltage on operation for thermocouples (TC) and voltage transmitters*

Name	Standard	Ambient temperature: Influence (±) per 1 °C (1.8 °F) change		Supply voltage: Influence (±) per V change		
		Digital <sup>1)</sup>		Digital		
		Maximum	Based on measured value	Maximum	Based on measured value	
Type A (30)	IEC 60584-1 ASTM E230-3	≤ 0.14 °C (0.25 °F)	0.0055% * (MV - LRV), at least 0.03 °C (0.054 °F)	0.001 %	≤ 0.14 °C (0.25 °F)	0.0055% * (MV - LRV), at least 0.03 °C (0.054 °F)
Type B (31)		≤ 0.06 °C (0.11 °F)	-		≤ 0.06 °C (0.11 °F)	-
Type C (32)	IEC 60584-1 ASTM E230-3 ASTM E988-96	≤ 0.09 °C (0.16 °F)	0.0045% * (MV - LRV), at least 0.03 °C (0.054 °F)	0.001 %	≤ 0.09 °C (0.16 °F)	0.0045% * (MV - LRV), at least 0.03 °C (0.054 °F)
Type D (33)	ASTM E988-96	≤ 0.08 °C (0.14 °F)	0.004% * (MV - LRV), at least 0.035 °C (0.063 °F)		≤ 0.08 °C (0.14 °F)	0.004% * (MV - LRV), at least 0.035 °C (0.063 °F)
Type E (34)	IEC 60584-1 ASTM E230-3	≤ 0.03 °C (0.05 °F)	0.003% * (MV - LRV), at least 0.016 °C (0.029 °F)	0.001 %	≤ 0.03 °C (0.05 °F)	0.003% * (MV - LRV), at least 0.016 °C (0.029 °F)
Type J (35)		≤ 0.02 °C (0.04 °F)	0.0028% * (MV - LRV), at least 0.02 °C (0.036 °F)		≤ 0.02 °C (0.04 °F)	0.0028% * (MV - LRV), at least 0.02 °C (0.036 °F)
Type K (36)		≤ 0.04 °C (0.07 °F)	0.003% * (MV - LRV), at least 0.013 °C (0.023 °F)		≤ 0.04 °C (0.07 °F)	0.003% * (MV - LRV), at least 0.013 °C (0.023 °F)

Name	Standard	Ambient temperature: Influence (±) per 1 °C (1.8 °F) change		Supply voltage: Influence (±) per V change			
		Type N (37)		0.0028% * (MV -LRV), at least 0.020 °C (0.036 °F)		0.0028% * (MV -LRV), at least 0.020 °C (0.036 °F)	
Type R (38)		≤ 0.06 °C (0.11 °F)	0.0035% * (MV -LRV), at least 0.047 °C (0.085 °F)	≤ 0.06 °C (0.11 °F)	0.0035% * (MV -LRV), at least 0.047 °C (0.085 °F)		
Type S (39)		≤ 0.05 °C (0.09 °F)	-	≤ 0.05 °C (0.09 °F)	-		
Type T (40)		≤ 0.01 °C (0.02 °F)	-	≤ 0.01 °C (0.02 °F)	-		
Type L (41)	DIN 43710	≤ 0.02 °C (0.04 °F)	-	≤ 0.02 °C (0.04 °F)	-		
Type U (42)		≤ 0.01 °C (0.02 °F)	-	≤ 0.01 °C (0.02 °F)	-		
Type L (43)	GOST R8.585-2001	≤ 0.01 °C (0.02 °F)	-	≤ 0.01 °C (0.02 °F)	-		
<b>Voltage transmitter (mV)</b>				0.001 %			0.001 %
-20 to 100 mV	-	≤ 3 µV	-		≤ 3 µV	-	

- 1) Measured value transmitted via HART.
- 2) Percentages based on the configured span of the analog output signal

MV = measured value

LRV = lower range value of the sensor in question

Total measurement error of transmitter at current output =  $\sqrt{(\text{Measurement error digital}^2 + \text{Measurement error D/A}^2)}$

#### Long-term drift, resistance thermometers (RTD) and resistance transmitters

Name	Standard	Long-term drift (±) <sup>1)</sup>		
		after 1 year	after 3 years	after 5 years
		Based on measured value		
Pt100 (1)	IEC 60751:2008	≤ 0.016% * (MV - LRV) or 0.04 °C (0.07 °F)	≤ 0.025% * (MV - LRV) or 0.05 °C (0.09 °F)	≤ 0.028% * (MV - LRV) or 0.06 °C (0.10 °F)
Pt200 (2)		0.25 °C (0.44 °F)	0.41 °C (0.73 °F)	0.50 °C (0.91 °F)
Pt500 (3)		≤ 0.018% * (MV - LRV) or 0.08 °C (0.14 °F)	≤ 0.03% * (MV - LRV) or 0.14 °C (0.25 °F)	≤ 0.036% * (MV - LRV) or 0.17 °C (0.31 °F)
Pt1000 (4)		≤ 0.0185% * (MV - LRV) or 0.04 °C (0.07 °F)	≤ 0.031% * (MV - LRV) or 0.07 °C (0.12 °F)	≤ 0.038% * (MV - LRV) or 0.08 °C (0.14 °F)
Pt100 (5)	JIS C1604:1984	≤ 0.015% * (MV - LRV) or 0.04 °C (0.07 °F)	≤ 0.024% * (MV - LRV) or 0.07 °C (0.12 °F)	≤ 0.027% * (MV - LRV) or 0.08 °C (0.14 °F)
Pt50 (8)	GOST 6651-94	≤ 0.017% * (MV - LRV) or 0.07 °C (0.13 °F)	≤ 0.027% * (MV - LRV) or 0.12 °C (0.22 °F)	≤ 0.03% * (MV - LRV) or 0.14 °C (0.25 °F)
Pt100 (9)		≤ 0.016% * (MV - LRV) or 0.04 °C (0.07 °F)	≤ 0.025% * (MV - LRV) or 0.07 °C (0.12 °F)	≤ 0.028% * (MV - LRV) or 0.07 °C (0.13 °F)
Ni100 (6)	DIN 43760 IPTS-68	0.04 °C (0.06 °F)	0.05 °C (0.10 °F)	0.06 °C (0.11 °F)
Ni120 (7)				
Cu50 (10)	OIML R84: 2003 / GOST 6651-2009	0.06 °C (0.10 °F)	0.09 °C (0.16 °F)	0.11 °C (0.20 °F)
Cu100 (11)		≤ 0.015% * (MV - LRV) or 0.04 °C (0.06 °F)	≤ 0.024% * (MV - LRV) or 0.06 °C (0.10 °F)	≤ 0.027% * (MV - LRV) or 0.06 °C (0.11 °F)
Ni100 (12)		0.03 °C (0.06 °F)	0.05 °C (0.09 °F)	0.06 °C (0.10 °F)
Ni120 (13)		0.03 °C (0.06 °F)	0.05 °C (0.09 °F)	0.06 °C (0.10 °F)



Name	Standard	Long-term drift ( $\pm$ ) <sup>1)</sup>		
Cu50 (14)	OIML R84: 2003 / GOST 6651-94	0.06 °C (0.10 °F)	0.09 °C (0.16 °F)	0.10 °C (0.18 °F)
<b>Resistance transmitter</b>				
10 to 400 $\Omega$		$\leq 0.0122\%$ * (MV - LRV) or 12 m $\Omega$	$\leq 0.02\%$ * (MV - LRV) or 20 m $\Omega$	$\leq 0.022\%$ * (MV - LRV) or 22 m $\Omega$
10 to 2 000 $\Omega$		$\leq 0.015\%$ * (MV - LRV) or 144 m $\Omega$	$\leq 0.024\%$ * (MV - LRV) or 240 m $\Omega$	$\leq 0.03\%$ * (MV - LRV) or 295 m $\Omega$

1) The larger value is valid

*Long-term drift, thermocouples (TC) and voltage transmitters*

Name	Standard	Long-term drift ( $\pm$ ) <sup>1)</sup>		
		after 1 year	after 3 years	after 5 years
Based on measured value				
Type A (30)	IEC 60584-1 ASTM E230-3	$\leq 0.048\%$ * (MV - LRV) or 0.46 °C (0.83 °F)	$\leq 0.072\%$ * (MV - LRV) or 0.69 °C (1.24 °F)	$\leq 0.1\%$ * (MV - LRV) or 0.94 °C (1.69 °F)
Type B (31)		1.08 °C (1.94 °F)	1.63 °C (2.93 °F)	2.23 °C (4.01 °F)
Type C (32)	IEC 60584-1 ASTM E230-3 ASTM E988-96	$\leq 0.038\%$ * (MV - LRV) or 0.41 °C (0.74 °F)	$\leq 0.057\%$ * (MV - LRV) or 0.62 °C (1.12 °F)	$\leq 0.078\%$ * (MV - LRV) or 0.85 °C (1.53 °F)
Type D (33)	ASTM E988-96	$\leq 0.035\%$ * (MV - LRV) or 0.57 °C (1.03 °F)	$\leq 0.052\%$ * (MV - LRV) or 0.86 °C (1.55 °F)	$\leq 0.071\%$ * (MV - LRV) or 1.17 °C (2.11 °F)
Type E (34)	IEC 60584-1 ASTM E230-3	$\leq 0.024\%$ * (MV - LRV) or 0.15 °C (0.27 °F)	$\leq 0.037\%$ * (MV - LRV) or 0.23 °C (0.41 °F)	$\leq 0.05\%$ * (MV - LRV) or 0.31 °C (0.56 °F)
Type J (35)		$\leq 0.025\%$ * (MV - LRV) or 0.17 °C (0.31 °F)	$\leq 0.037\%$ * (MV - LRV) or 0.25 °C (0.45 °F)	$\leq 0.051\%$ * (MV - LRV) or 0.34 °C (0.61 °F)
Type K (36)		$\leq 0.027\%$ * (MV - LRV) or 0.23 °C (0.41 °F)	$\leq 0.041\%$ * (MV - LRV) or 0.35 °C (0.63 °F)	$\leq 0.056\%$ * (MV - LRV) or 0.48 °C (0.86 °F)
Type N (37)		0.36 °C (0.65 °F)	0.55 °C (0.99 °F)	0.75 °C (1.35 °F)
Type R (38)		0.83 °C (1.49 °F)	1.26 °C (2.27 °F)	1.72 °C (3.10 °F)
Type S (39)		0.84 °C (1.51 °F)	1.27 °C (2.29 °F)	1.73 °C (3.11 °F)
Type T (40)		0.25 °C (0.45 °F)	0.37 °C (0.67 °F)	0.51 °C (0.92 °F)
Type L (41)		DIN 43710	0.20 °C (0.36 °F)	0.31 °C (0.56 °F)
Type U (42)	0.24 °C (0.43 °F)		0.37 °C (0.67 °F)	0.50 °C (0.90 °F)
Type L (43)	GOST R8.585-2001	0.22 °C (0.40 °F)	0.33 °C (0.59 °F)	0.45 °C (0.81 °F)
<b>Voltage transmitter (mV)</b>				
-20 to 100 mV		$\leq 0.027\%$ * (MV - LRV) or 5.5 $\mu$ V	$\leq 0.041\%$ * (MV - LRV) or 8.2 $\mu$ V	$\leq 0.056\%$ * (MV - LRV) or 11.2 $\mu$ V

1) Whichever is greater

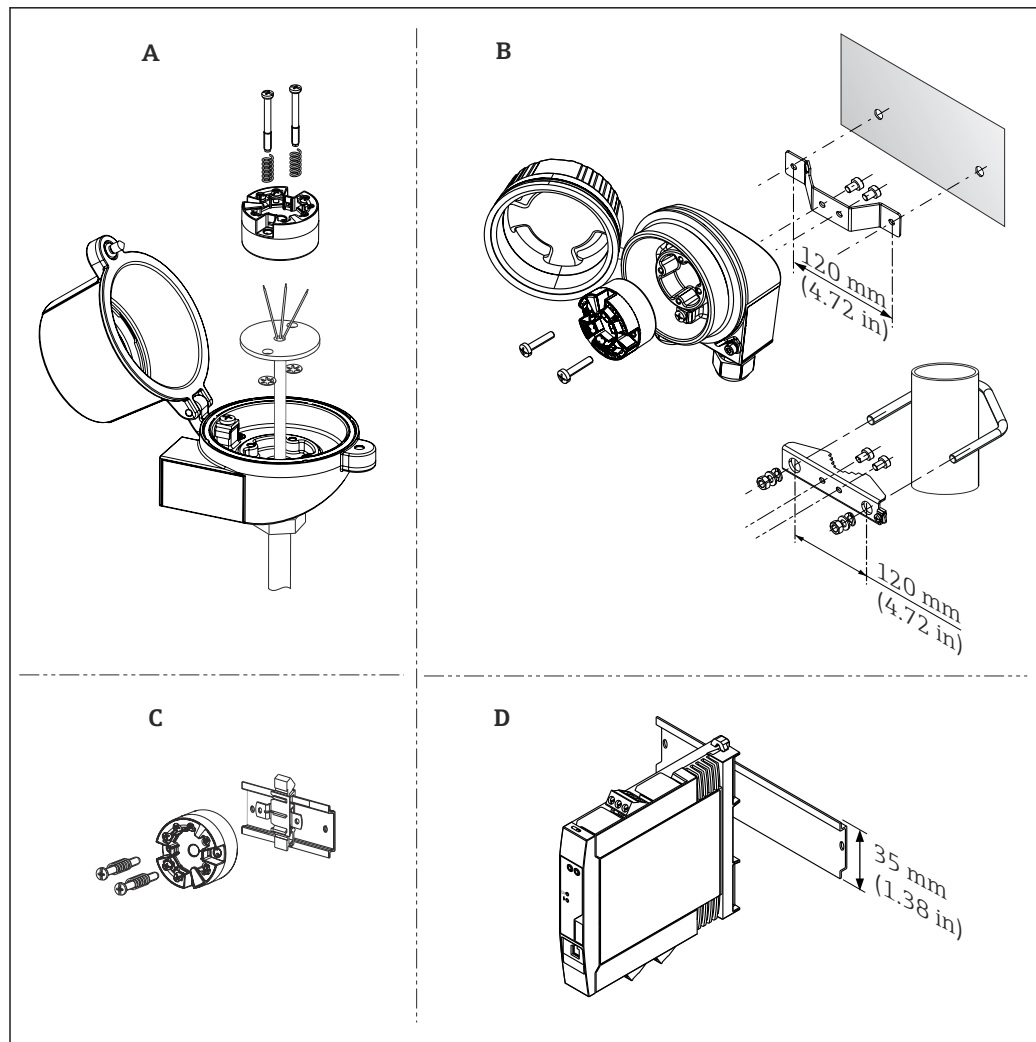
*Long-term drift analog output*

Long term drift D/A <sup>1)</sup> ( $\pm$ )		
after 1 year	after 3 years	after 5 years
0.021%	0.029%	0.031%

1) Percentages based on the configured span of the analog output signal.

**Influence of the reference junction**

- Pt100 DIN IEC 60751 Cl. B (internal reference junction with thermocouples TC)
- Field mount housing with separate terminal compartment: Pt100 DIN IEC 60751 Cl. B (external cold junction with thermocouples TC)

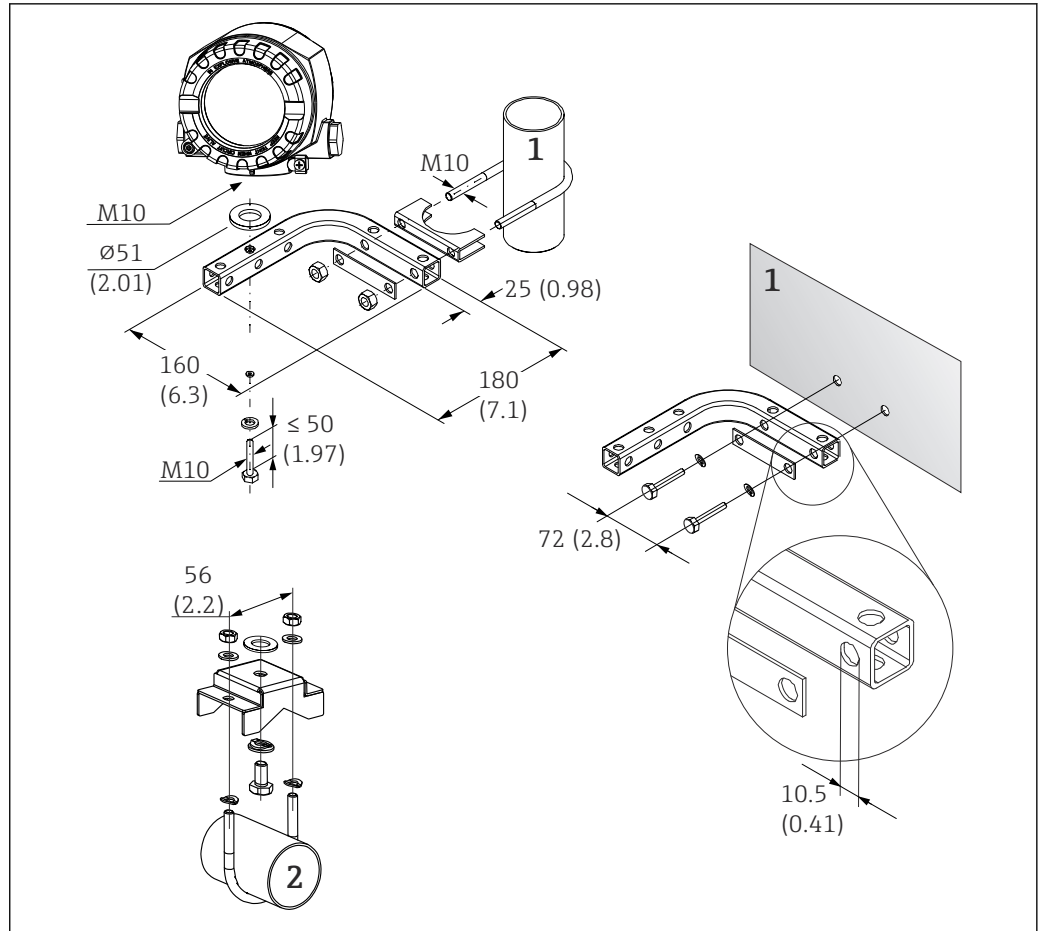
**Installation****Mounting location**

A0017817

6 Mounting location options for the transmitter

- A Terminal head form B (flat face) as per DIN EN 50446, direct installation on insert with cable entry (middle hole 7 mm (0.28 in))
- B Separated from process in field housing, wall or pipe mounting
- C With DIN rail clip on DIN rail as per IEC 60715 (TH35)
- D DIN rail transmitter for mounting on TH35 mounting rail as per EN 60715

- i** In SIL mode: The head transmitter must not be operated using the DIN rail clip and remote sensors as a substitute for a DIN rail transmitter in a cabinet.
- When installing the head transmitter in a terminal head form B (flat face), make sure there is sufficient space in the terminal head!



A0027188

7 Mounting the field mount housing using special mounting bracket. Dimensions in mm (in)

- 1 Mounting with combined wall/pipe mounting bracket
- 2 Mounting with pipe mounting bracket 2"/V4A
- 3 Mounting with wall mounting bracket

## Orientation

- Head transmitter: no restrictions.
- DIN rail transmitter: When DIN rail transmitters are used with a thermocouple/mV measurement, increased measurement deviation may occur depending on the installation situation and ambient conditions. If the transmitter is mounted in series in between other DIN rail devices (reference condition: 24 V, 12 mA), deviations of max.  $\pm 1.5\text{ }^{\circ}\text{C}$  may occur.

**i** To avoid additional higher measurement deviation, mount the DIN rail transmitter vertically and ensure that it is correctly aligned (sensor connection at bottom / power supply at top).

## Ambient conditions

### Ambient temperature

Head transmitter/DIN rail transmitter	-40 to +85 °C (-40 to +185 °F); for hazardous areas, see Ex documentation.
Optional	-50 to +85 °C (-58 to +185 °F), for hazardous areas, see Ex documentation, Product Configurator order code for "Test, certificate, declaration", option "JM". <sup>1)</sup>
Optional	-52 to +85 °C (-62 to +185 °F), for hazardous areas, see Ex documentation, Product Configurator order code for "Test, certificate, declaration", option "JN". <sup>1)</sup>

<b>Head transmitter, field mount housing with separate terminal compartment incl. display</b>	-30 to +85 °C (-22 to +185 °F). At temperatures < -20 °C (-4 °F) the display may react slowly, Product Configurator order code: "Field housing", option "R" and "S".
<b>SIL mode</b>	-40 to +70 °C (-40 to +158 °F)

1) If the temperature is below -40 °C (-40 °F), increased failure rates are likely.

<b>Storage temperature</b>	<b>Head transmitter</b>	-50 to +100 °C (-58 to +212 °F)
	<b>Optional</b>	-52 to 85 °C (-62 to 185 °F) Product Configurator order code for "Test, certificate, declaration", option "JN" <sup>1)</sup>
	<b>Head transmitter, field mount housing with separate terminal compartment incl. display</b>	-35 to +85 °C (-31 to +185 °F). At temperatures < -20 °C (-4 °F) the display may react slowly, Product Configurator order code: "Field housing", option "R" and "S".
	<b>DIN rail transmitter</b>	-40 to +100 °C (-40 to +212 °F)

1) If the temperature is below -50 °C (-58 °F), increased failure rates are likely.

<b>Operating altitude</b>	Up to 4,000 m (4,374.5 yards) above sea level.
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<b>Humidity</b>	<ul style="list-style-type: none"> <li>■ Condensation: <ul style="list-style-type: none"> <li>■ Head transmitter permitted</li> <li>■ DIN rail transmitter not permitted</li> </ul> </li> <li>■ Max. rel. humidity: 95% as per IEC 60068-2-30</li> </ul>
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<b>Climate class</b>	<ul style="list-style-type: none"> <li>■ Head transmitter: climate class C1 as per EN 60654-1</li> <li>■ DIN rail transmitter: climate class B2 as per IEC 60654-1</li> <li>■ Head transmitter, field mount housing with separate terminal compartment including display: climate Class Dx as per IEC 60654-1</li> </ul>
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<b>Degree of protection</b>	<ul style="list-style-type: none"> <li>■ Head transmitter with screw terminals: IP 20, with push-in terminals: IP 30. When the device is installed, the degree of protection depends on the terminal head or field housing used.</li> <li>■ When installed in field mount housing with separate terminal compartment: IP 67, NEMA Type 4x</li> <li>■ DIN rail transmitter: IP 20</li> </ul>
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<b>Shock and vibration resistance</b>	<p>Vibration resistance as per DNVGL-CG-0339:2015 and DIN EN 60068-2-27</p> <ul style="list-style-type: none"> <li>■ Head transmitter: 2 to 100 Hz at 4g (increased vibration stress)</li> <li>■ DIN rail transmitter: 2 to 100 Hz at 0.7 g (general vibration stress)</li> </ul> <p>Shock resistance as per KTA 3505 (section 5.8.4 Shock test)</p>
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<b>Electromagnetic compatibility (EMC)</b>	<p><b>CE conformity</b></p> <p>Electromagnetic compatibility in accordance with all the relevant requirements of the IEC/EN 61326 series and NAMUR Recommendation EMC (NE21). For details, refer to the Declaration of Conformity. All tests were passed both with and without ongoing digital HARTcommunication.</p> <p>Maximum measurement error &lt;1% of measuring range.</p> <p>Interference immunity as per IEC/EN 61326 series, industrial requirements</p> <p>Interference emission as per IEC/EN 61326 series, Class B equipment</p>
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<b>Overvoltage category</b>	Overvoltage category II
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<b>Pollution degree</b>	Pollution degree 2
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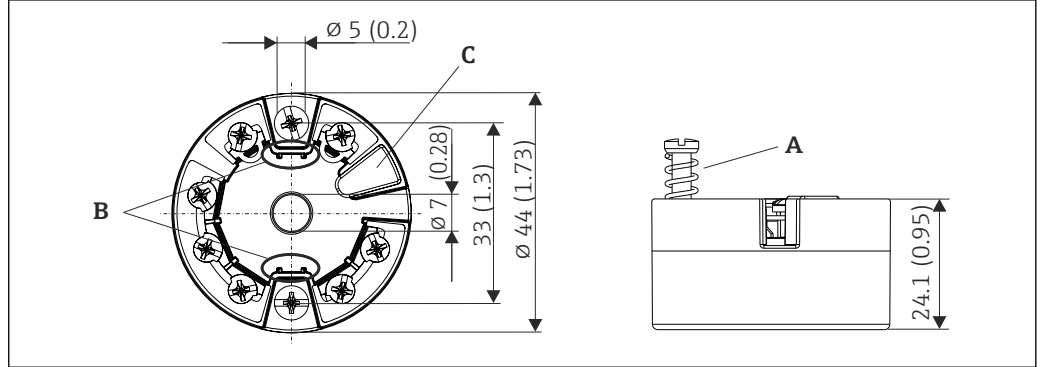
<b>Protection class</b>	Protection class III
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## Mechanical construction

**Design, dimensions**

Dimensions in mm (in)

*Head transmitter*



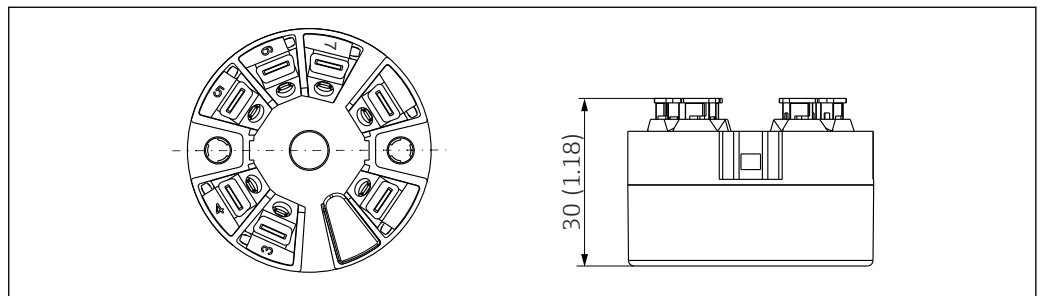
A0007301

8 Version with screw terminals

A Spring travel  $L \geq 5$  mm (not for US - M4 securing screws)

B Mounting elements for attachable measured value display TID10

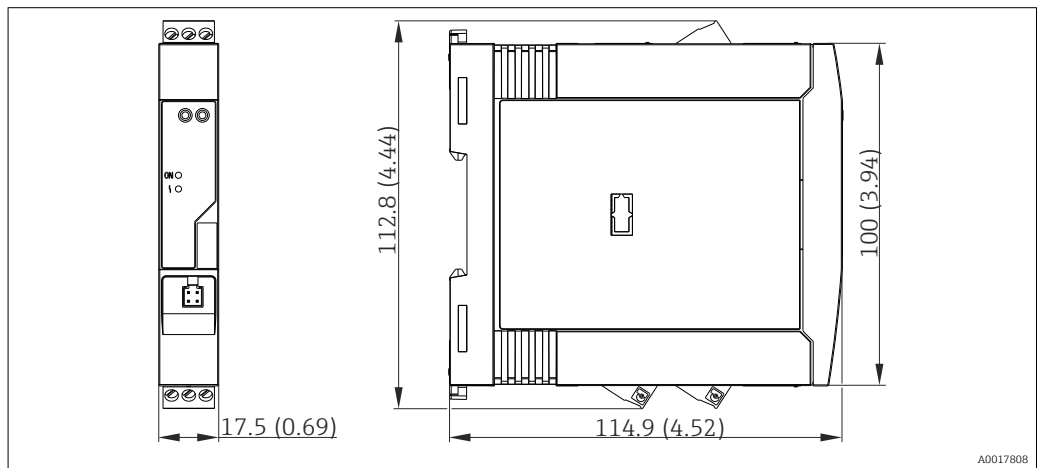
C Service interface for connecting measured value display or configuration tool



A0007672

9 Version with push-in terminals. Dimensions are identical to the version with screw terminals, apart from housing height.

*DIN rail transmitter*



A0017808

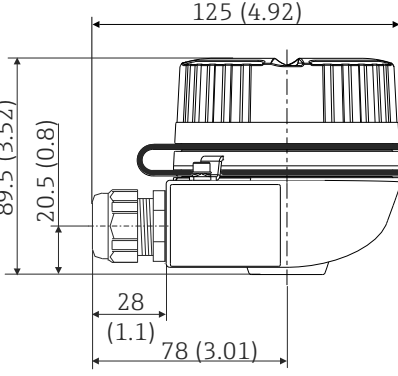
### Field housing

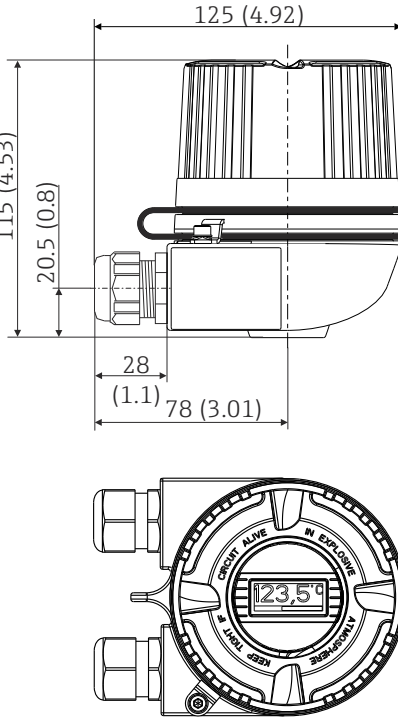
All field housings have an internal geometry in accordance with DIN EN 50446, Form B (flat face).  
Cable glands in the diagrams: M20x1.5

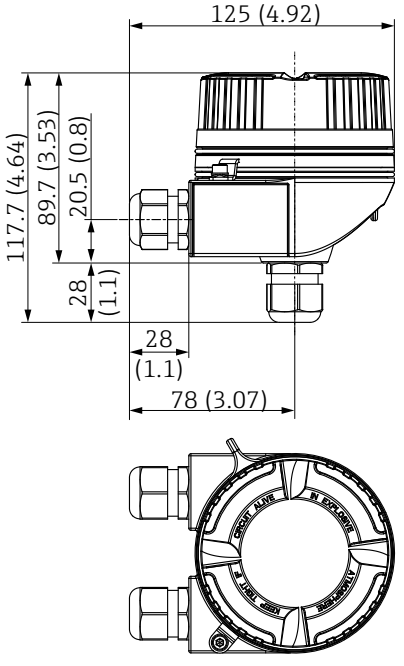
Maximum ambient temperatures for cable glands	
Type	Temperature range
Polyamide cable gland ½" NPT, M20x1.5 (non-Ex)	-40 to +100 °C (-40 to 212 °F)
Polyamide cable gland M20x1.5 (for dust ignition-proof area)	-20 to +95 °C (-4 to 203 °F)
Brass cable gland ½" NPT, M20x1.5 (for dust ignition-proof area)	-20 to +130 °C (-4 to +266 °F)

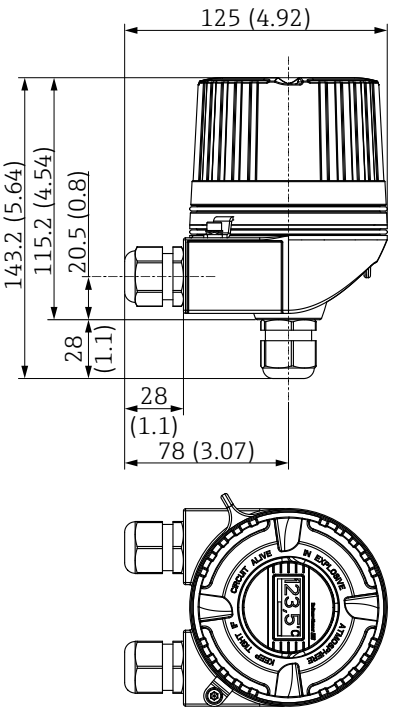
TA30A	Specification
	<ul style="list-style-type: none"> <li>■ Two cable entries</li> <li>■ Material: aluminum, polyester powder coated</li> <li>Seals: silicone</li> <li>■ Degree of protection: <ul style="list-style-type: none"> <li>■ IP66/68 (NEMA Type 4x encl.)</li> <li>■ For ATEX: IP66/67</li> </ul> </li> <li>■ Cable entry glands: NPT ½" and M20x1.5</li> <li>■ Color of head: blue, RAL 5012</li> <li>■ Color of cap: gray, RAL 7035</li> <li>■ Weight: 330 g (11.64 oz)</li> </ul>

TA30A with display window in cover	Specification
	<ul style="list-style-type: none"> <li>■ Two cable entries</li> <li>■ Material: aluminum, polyester powder coated</li> <li>Seals: silicone</li> <li>■ Degree of protection: <ul style="list-style-type: none"> <li>■ IP66/68 (NEMA Type 4x Encl.)</li> <li>■ For ATEX: IP66/67</li> </ul> </li> <li>■ Cable entry glands: ½" NPT and M20x1.5</li> <li>■ Head color: blue, RAL 5012</li> <li>■ Cap color: gray, RAL 7035</li> <li>■ Weight: 420 g (14.81 oz)</li> <li>■ Display window: single-pane safety glass according to DIN 8902</li> <li>■ For TID10 display</li> </ul>

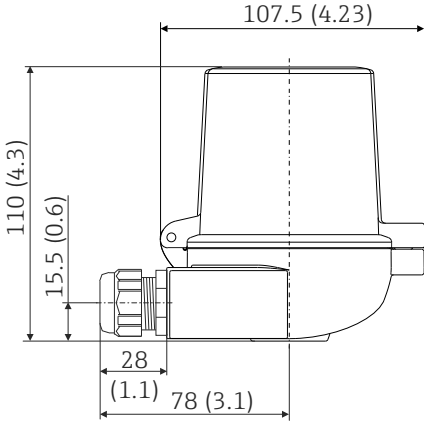
TA30H	Specification
 <p style="text-align: right; font-size: small;">A0009832</p>	<ul style="list-style-type: none"> <li>▪ Flameproof (XP) version, explosion-protected, captive screw cap, with two cable entries</li> <li>▪ Degree of protection: IP 66/68, NEMA Type 4x Encl. Ex-Version: IP 66/67</li> <li>▪ Material: <ul style="list-style-type: none"> <li>▪ Aluminum, with polyester powder coating</li> <li>▪ Stainless steel 316L without coating</li> <li>▪ Dry lubricant Klüber Syntheso Glep 1</li> </ul> </li> <li>▪ Cable entry glands: NPT ½", M20x1.5</li> <li>▪ Color of aluminum head: blue, RAL 5012</li> <li>▪ Color of aluminum cap: gray, RAL 7035</li> <li>▪ Weight: <ul style="list-style-type: none"> <li>▪ Aluminum approx. 640 g (22.6 oz)</li> <li>▪ Stainless steel approx. 2 400 g (84.7 oz)</li> </ul> </li> </ul> <p><b>i</b> When the housing cover is unscrewed: Before fastening, clean the threads in the cover and on the lower part of the housing and lubricate if necessary (recommended lubricant: Klüber Syntheso Glep 1).</p>

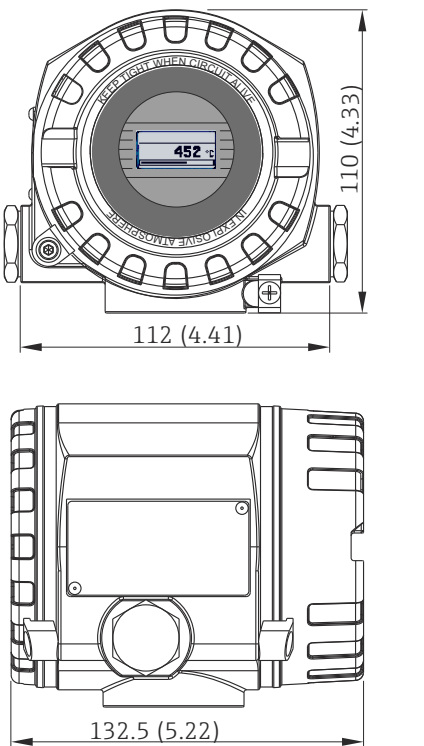
TA30H with display window in cover	Specification
 <p style="text-align: right; font-size: small;">A0009831</p>	<ul style="list-style-type: none"> <li>▪ Flameproof (XP) version, explosion-protected, captive screw cap, with two cable entries</li> <li>▪ Degree of protection: IP 66/68, NEMA Type 4x Encl. Ex-version: IP 66/67</li> <li>▪ Material: <ul style="list-style-type: none"> <li>▪ Aluminum with polyester powder coating</li> <li>▪ Stainless steel 316L without coating</li> <li>▪ Dry lubricant Klüber Syntheso Glep 1</li> </ul> </li> <li>▪ Display window: single-pane safety glass according to DIN 8902</li> <li>▪ Cable entry glands: NPT ½", M20x1.5</li> <li>▪ Color of aluminum head: blue, RAL 5012</li> <li>▪ Color of aluminum cap: gray, RAL 7035</li> <li>▪ Weight: <ul style="list-style-type: none"> <li>▪ Aluminum approx. 860 g (30.33 oz)</li> <li>▪ Stainless steel approx. 2 900 g (102.3 oz)</li> </ul> </li> <li>▪ For display TID10</li> </ul> <p><b>i</b> When the housing cover is unscrewed: Before fastening, clean the threads in the cover and on the lower part of the housing and lubricate if necessary (recommended lubricant: Klüber Syntheso Glep 1).</p>

TA30H with three cable entries	Specification
	<ul style="list-style-type: none"> <li>■ Flameproof (XP) version, explosion-protected, captive screw cap, with three cable entries (two at the front, one at the bottom) with grounding screw</li> <li>■ Protection class: NEMA Type 4x Encl.</li> <li>■ Material: <ul style="list-style-type: none"> <li>■ Aluminum, with polyester powder coating</li> <li>■ Dry lubricant Klüber Syntheso Glep 1</li> </ul> </li> <li>■ Cable entry glands: ½" NPT</li> <li>■ Color of head: blue, RAL 5012</li> <li>■ Color of cap: gray, RAL 7035</li> <li>■ Weight: approx. 640 g (22.6 oz)</li> </ul> <p><b>i</b> When the housing cover is unscrewed: Before screwing it on, clean the threads in the cover and on the lower part of the housing and lubricate if necessary (recommended lubricant: Klüber Syntheso Glep 1).</p>

TA30H with three cable entries and display window in cover	Specification
	<ul style="list-style-type: none"> <li>■ Flameproof (XP) version, explosion-protected, captive screw cap, with three cable entries (two at the front, one at the bottom), with grounding screw</li> <li>■ Protection class: NEMA Type 4x Encl.</li> <li>■ Material: <ul style="list-style-type: none"> <li>■ Aluminum with polyester powder coating</li> <li>■ Stainless steel 316L without coating</li> <li>■ Dry lubricant Klüber Syntheso Glep 1</li> </ul> </li> <li>■ Display window: single-pane safety glass according to DIN 8902</li> <li>■ Cable entry glands: ½" NPT</li> <li>■ Color of aluminum head: blue, RAL 5012</li> <li>■ Color of aluminum cap: gray, RAL 7035</li> <li>■ Weight: <ul style="list-style-type: none"> <li>■ Aluminum approx. 860 g (30.33 oz)</li> <li>■ Stainless steel approx. 2 900 g (102.3 oz)</li> </ul> </li> <li>■ For display TID10</li> </ul> <p><b>i</b> When the housing cover is unscrewed: Before screwing it on, clean the threads in the cover and on the lower part of the housing and lubricate if necessary (recommended lubricant: Klüber Syntheso Glep 1).</p>



TA30D	Specification
 <p style="text-align: right; font-size: small;">A0009822</p>	<ul style="list-style-type: none"> <li>■ 2 cable entries</li> <li>■ Material: aluminum, polyester powder coated</li> <li>Seals: silicone</li> <li>■ Degree of protection: <ul style="list-style-type: none"> <li>■ IP66/68 (NEMA Type 4x Encl.)</li> <li>■ For ATEX: IP66/67</li> </ul> </li> <li>■ Cable entry glands: NPT ½" and M20x1.5</li> <li>■ Two head transmitters can be mounted. In the standard configuration one transmitter is mounted in the terminal head cover and an additional terminal block is installed directly on the insert.</li> <li>■ Color of head: blue, RAL 5012</li> <li>■ Color of cap: gray, RAL 7035</li> <li>■ Weight: 390 g (13.75 oz)</li> </ul>

Field mount housing with separate terminal compartment	Specification
 <p style="text-align: right; font-size: small;">A0042357</p>	<ul style="list-style-type: none"> <li>■ Separate electronics compartment and terminal compartment</li> <li>■ Display rotatable in 90° increments</li> <li>■ Material: Die-cast aluminum housing AlSi10Mg with powder coating on polyester base</li> <li>■ Cable entry: 2x ½" NPT, 2x M20x1.5</li> <li>■ Protection class: IP67, NEMA type 4x</li> <li>■ Color: blue, RAL 5012</li> <li>■ Weight: approx. 1.4 kg (3 lb)</li> </ul>

<b>Weight</b>	<ul style="list-style-type: none"> <li>■ Head transmitter: approx. 40 to 50 g (1.4 to 1.8 oz)</li> <li>■ Field housing: see specifications</li> <li>■ DIN rail transmitter: approx. 100 g (3.53 oz)</li> </ul>
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<b>Materials</b>	<p>All the materials used are RoHS-compliant.</p> <ul style="list-style-type: none"> <li>■ Housing: polycarbonate (PC)</li> <li>■ Terminals: <ul style="list-style-type: none"> <li>■ Screw terminals: nickel-plated brass and gold-plated or tin-plated contacts</li> <li>■ Push-in terminals: tin-plated brass, contact springs 1.4310, 301 (AISI)</li> </ul> </li> <li>■ Potting compound: <ul style="list-style-type: none"> <li>■ Head transmitter: QSIL 553</li> <li>■ DIN rail housing: Silgel612EH</li> </ul> </li> </ul>
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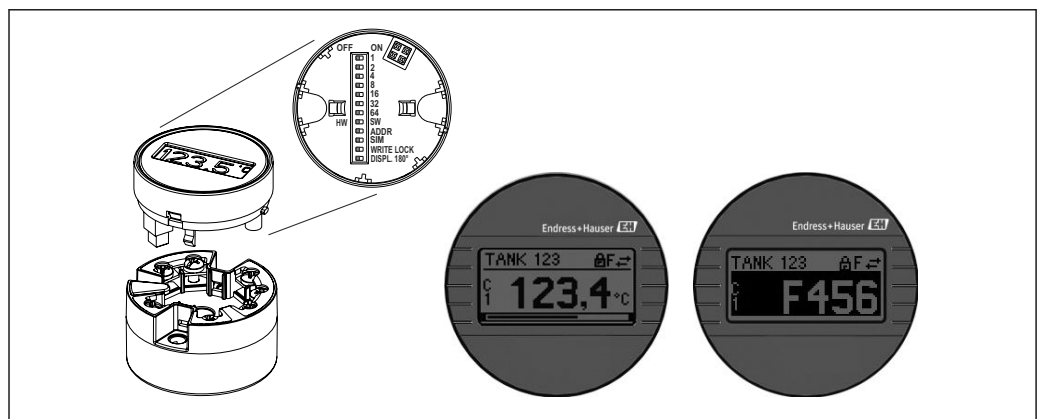
Field housing: see specifications

## Operability

### Onsite operation

#### Head transmitter

The head transmitter has no display or operating elements. There is the option of using the attachable measured value display TID10 together with the head transmitter. When the head transmitter will be ordered with the field mount housing with separate terminal compartment, the display is already included. The display provides plain-text information on the current measured value and the measuring point identification. An optional bar graph is also used. In the event of a fault in the measuring chain, this will be displayed in inverse color showing the channel ident and error number. DIP switches can be found on the rear of the display. These enable hardware settings to be made e.g. write protection.



A0020347

10 Attachable measured value display TID10 with bar graph indicator (optional)

**i** If the head transmitter is installed in a field housing and used with a display, an enclosure with a glass window in the cover must be used.

#### DIN rail transmitter

	1:	HART communication jacks (2 mm) for commissioning and configuration	
	2:	Power LED	A green LED indicates that the voltage supply is correct
	3:	Status LED	Off: no diagnostic message Red: Category F diagnostic message Red flashing: Category C, S or M diagnostic message
	4:	Service interface	For connecting a configuration tool (not in SIL mode)

A0017950

### Connecting a configuration tool

HART functions and device-specific parameters are configured via HART Communication or the CDI interface (service interface) of the device. There are special configuration tools from different manufacturers available for this purpose. For more information, contact your Endress+Hauser sales representative.

## Certificates and approvals

Current certificates and approvals for the product are available at [www.endress.com](http://www.endress.com) on the relevant product page:

1. Select the product using the filters and search field.
2. Open the product page.
3. Select **Downloads**.

<b>Functional safety</b>	<p><b>SIL 2/3 (hardware/software) certified to:</b></p> <ul style="list-style-type: none"> <li>■ IEC 61508-1:2010 (Management)</li> <li>■ IEC 61508-2:2010 (Hardware)</li> <li>■ IEC 61508-3:2010 (Software)</li> </ul>
<b>HART certification</b>	The temperature transmitter is registered by the FieldComm Group. The device meets the requirements of the FieldComm Group HART Specifications, Revision 7.
<b>Test certificate</b>	<p>Complies with:</p> <ul style="list-style-type: none"> <li>■ WELMEC 8.8, only in the SIL mode: "Guide on the General and Administrative Aspects of the Voluntary System of Modular Evaluation of Measuring Instruments".</li> <li>■ OIML R117-1 Edition 2007 (E) "Dynamic measuring systems for liquids other than water".</li> <li>■ EN 12405-1/A2 Edition 2010 "Gas meters – Conversion devices – Part 1: Volume conversion".</li> <li>■ OIML R140-1 Edition 2007 (E) "Measuring systems for gaseous fuel"</li> </ul>

## Ordering information

Detailed ordering information is available from your nearest sales organization [www.addresses.endress.com](http://www.addresses.endress.com) or in the Product Configurator at [www.endress.com](http://www.endress.com):

1. Select the product using the filters and search field.
2. Open the product page.
3. Select **Configuration**.



### Product Configurator - the tool for individual product configuration

- Up-to-the-minute configuration data
- Depending on the device: direct input of information specific to the measuring point, such as the measuring range or operating language
- Automatic verification of exclusion criteria
- Automatic creation of the order code and its breakdown in PDF or Excel output format
- Ability to order directly in the Endress+Hauser Online Shop

## Accessories

The accessories currently available for the product can be selected at [www.endress.com](http://www.endress.com):

1. Select the product using the filters and search field.
2. Open the product page.
3. Select **Spare parts & Accessories**.




<b>Device-specific accessories</b>	<p><b>Accessories for the head transmitter</b></p> <p>TID10 display unit for Endress+Hauser head transmitter iTEMP TMT8x<sup>1)</sup> or TMT7x, attachable</p> <p>Field housing TA30x for Endress+Hauser head transmitter</p> <p>Adapter for DIN rail mounting, clip as per IEC 60715 (TH35) without securing screws</p> <p>Standard - DIN mounting set (2 screws and springs, 4 securing disks and 1 display connector cover)</p>
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Accessories for the head transmitter
US - M4 mounting screws (2 M4 screws and 1 display connector cover)
Stainless steel wall mounting bracket Stainless steel pipe mounting bracket

1) Without TMT80

Accessories for field mount housing with separate terminal compartment
Cover locking
Stainless steel wall mounting bracket Stainless steel pipe mounting bracket
Cable glands M20x1.5 and NPT ½"
Adapter M20x1.5 outside/M24x1.5 inside
Dummy plugs M20x1.5 and NPT ½"

### Communication-specific accessories

Accessories	Description
Commubox FXA195 HART	For intrinsically safe HART communication with FieldCare via the USB interface.  For details, see Technical Information TI404F.
WirelessHART adapter SWA70	Is used for the wireless connection of field devices. The WirelessHART adapter can be easily integrated into field devices and existing infrastructures, offers data protection and transmission safety and can be operated in parallel with other wireless networks.  For details, see Technical Information TI00026S.
Field Xpert SMT70	Universal, high-performance tablet PC for device configuration The tablet PC enables mobile plant asset management in hazardous and non-hazardous areas. It is suitable for commissioning and maintenance staff to manage field instruments with a digital communication interface and to record progress. This tablet PC is designed as a comprehensive, all-in-one solution. With a pre-installed driver library, it is an easy-to-use, touch-sensitive tool which can be used to manage field instruments throughout their entire life cycle.  For details, see Technical Information TI01342S/04

### Service-specific accessories

#### Applicator

Software for selecting and sizing Endress+Hauser measuring devices:

- Calculation of all the necessary data for identifying the optimum measuring device: e.g. pressure loss, accuracy or process connections.
- Graphic illustration of the calculation results

Administration, documentation and access to all project-related data and parameters over the entire life cycle of a project.

Applicator is available:

<https://portal.endress.com/webapp/applicator>

#### Configurator

Product Configurator - the tool for individual product configuration

- Up-to-the-minute configuration data
- Depending on the device: Direct input of measuring point-specific information such as measuring range or operating language
- Automatic verification of exclusion criteria
- Automatic creation of the order code and its breakdown in PDF or Excel output format
- Ability to order directly in the Endress+Hauser Online Shop

The Configurator is available on the Endress+Hauser website: [www.endress.com](http://www.endress.com) -> Click "Corporate" -> Select your country -> Click "Products" -> Select the product using the filters and the search field -> Open the product page -> The "Configure" button to the right of the product image opens the Product Configurator.

**DeviceCare SFE100**

Configuration tool for HART, PROFIBUS and FOUNDATION Fieldbus field devices

DeviceCare is available for download at [www.software-products.endress.com](http://www.software-products.endress.com). You need to register in the Endress+Hauser software portal to download the application.



Technical Information TI01134S

**FieldCare SFE500**

FDT-based plant asset management tool

It can configure all smart field units in your system and helps you manage them. By using the status information, it is also a simple but effective way of checking their status and condition.



Technical Information TI00028S

**Netilion**

IIoT ecosystem: Unlock knowledge

With the Netilion IIoT ecosystem, Endress+Hauser enables you to optimize plant performance, digitize workflows, share knowledge, and enhance collaboration. Drawing on decades of experience in process automation, Endress+Hauser provides the process industry with an IIoT ecosystem that unlocks valuable insights from data. These insights allow process optimization, leading to increased plant availability, efficiency, and reliability - ultimately resulting in a more profitable plant.



[www.netilion.endress.com](http://www.netilion.endress.com)

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**System components****RN22**

Single- or two-channel active barrier for safe separation of 0/4 to 20 mA standard signal circuits with bidirectional HART transmission. In the signal duplicator option, the input signal is transmitted to two galvanically isolated outputs. The device has one active and one passive current input; the outputs can be operated actively or passively. The RN22 requires a supply voltage of 24 V<sub>DC</sub>.



Technical Information TI01515K

**RN42**

Single-channel active barrier for safe separation of 0/4 to 20 mA standard signal circuits with bidirectional HART transmission. The device has one active and one passive current input; the outputs can be operated actively or passively. The RN42 can be powered with a wide range voltage of 24 to 230 V<sub>AC/DC</sub>.



Technical Information TI01584K

**RIA15**

Process display, digital loop-powered display for 4 to 20 mA circuit, panel mounting, with optional HART communication. Displays 4 to 20 mA or up to 4 HART process variables



Technical Information TI01043K


**Advanced Data Manager Memograph M**

The Advanced Data Manager Memograph M is a flexible and powerful system for organizing process values. Optional HART input cards are available, each having 4 inputs (4/8/12/16/20), with highly accurate process values from the HART devices directly connected for the purpose of calculation and data logging. The measured process values are clearly presented on the display and logged safely, monitored for limit values and analyzed. Via common communication protocols, the measured and calculated values can be easily communicated to higher-level systems or individual plant modules can be interconnected.




Technical information: TI01180R

## Documentation

-  For an overview of the scope of the associated Technical Documentation, refer to the following:
- *Device Viewer* ([www.endress.com/deviceviewer](http://www.endress.com/deviceviewer)): Enter the serial number from the nameplate
  - *Endress+Hauser Operations app*: Enter serial number from nameplate or scan matrix code on nameplate.

The following documentation may be available depending on the device version ordered:

Document type	Purpose and content of the document
Technical Information (TI)	<b>Planning aid for your device</b> The document contains all the technical data on the device and provides an overview of the accessories and other products that can be ordered for the device.
Brief Operating Instructions (KA)	<b>Guide that takes you quickly to the 1st measured value</b> The Brief Operating Instructions contain all the essential information from incoming acceptance to initial commissioning.
Operating Instructions (BA)	<b>Your reference document</b> These Operating Instructions contain all the information that is required in the various life cycle phases of the device: from product identification, incoming acceptance and storage, to mounting, connection, operation and commissioning, through to troubleshooting, maintenance and disposal.
Description of Device Parameters (GP)	<b>Reference for your parameters</b> The document provides a detailed explanation of each individual parameter. The description is aimed at those who work with the device over the entire life cycle and perform specific configurations.
Safety Instructions (XA)	Depending on the approval, safety instructions for electrical equipment in hazardous areas are also supplied with the device. The Safety Instructions are a constituent part of the Operating Instructions.   Information on the Safety Instructions (XA) that are relevant for the device is provided on the nameplate.
Supplementary device-dependent documentation (SD/FY)	Always comply strictly with the instructions in the relevant supplementary documentation. The supplementary documentation is a constituent part of the device documentation.

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[www.addresses.endress.com](http://www.addresses.endress.com)

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