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Technical Information
iTEMP TMT162

Temperature field transmitter with HART® protocol



Application

- Universal input for resistance thermometer (RTD), thermocouple (TC), resistance transmitter (Ω), voltage transmitter (mV)
- Output:
  Conversion of various signals to the HART® protocol and a scalable 4 to 20 mA analog output signal. Transmitter operation using FieldXpert SMT70 and Field Communicator 475 or via a PC.

Your benefits

- Extremely reliable in harsh industrial environments thanks to dual-compartment housing and compact, fully potted electronics
- Backlit display with large characters
- Diagnostics information according to NAMUR NE107
- Reliable operation thanks to sensor monitoring: failure information, sensor backup, drift alarm, corrosion detection and device hardware error detection
- International approvals such as FM, CSA (IS, NI, XP and DIP) and ATEX (Ex ia, Ex nA nL, Ex d and dust ignition-proof)
- SIL certification as per IEC 61508:2010
- Galvanic isolation 2 kV (sensor input/current output)

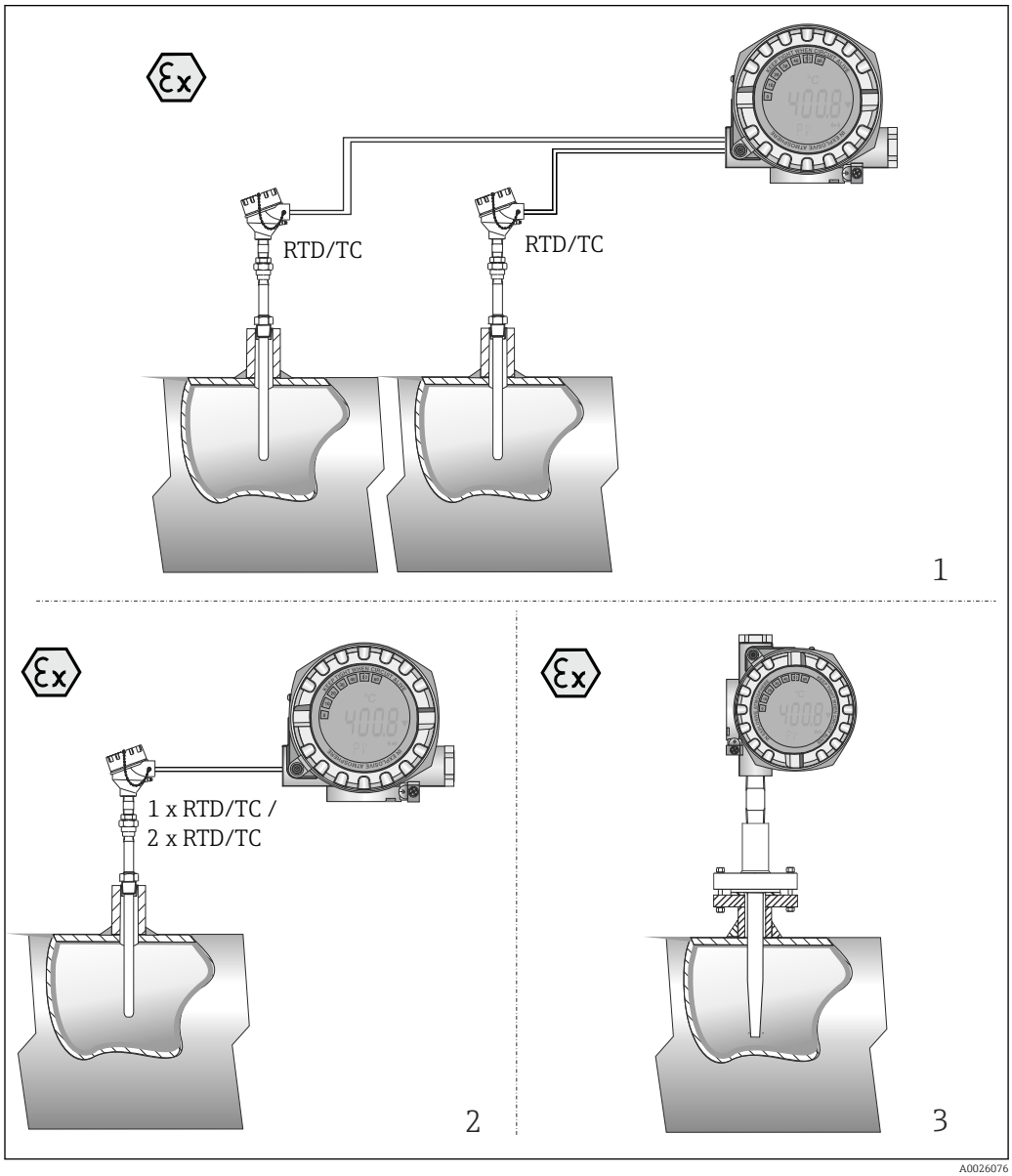
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Function and system design

Measuring principle

Electronic monitoring, conversion and display of input signals used in industrial temperature measurement.

Measuring system



1 Application examples

1 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
2 1 x RTD/TC or 2 x RTD/TC for redundancy
3 Temperature field transmitter in combination with a sensing element, insert and thermowell as compact thermometer

The iTEMP temperature field transmitter TMT162 is a two-wire transmitter with an analog output or fieldbus protocol, two (optional) measuring inputs for resistance thermometers and resistance transmitters in 2-, 3- or 4-wire connection (for a resistance measuring input), thermocouples and voltage transmitters. The LC display shows the current measured value digitally and as a bar graph and also indicates the current status of the device.

Standard diagnostic functions of the sensor cables
- Cable open circuit, short-circuit
- 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 field transmitter offers the possibility of detecting corrosion on thermocouples and resistance thermometers with a 4-wire connection before measured value corruption occurs. The transmitter prevents incorrect readings of measured values and can issue a warning on the display as well as through the HART® or fieldbus protocol if wire resistance values exceed plausible limits.

Low voltage detection
The low voltage detection function prevents the device from continuously outputting an incorrect analog output value (i.e. due to a damaged or incorrect power supply or due to a damaged signal cable). If the supply voltage drops below the required value, the analog output value drops to < 3.6 mA for > 4 s. An error message is displayed. The device then cyclically tries to restart and output the normal analog output value. If the supply voltage is still too low, the analog output value drops again to < 3.6 mA.

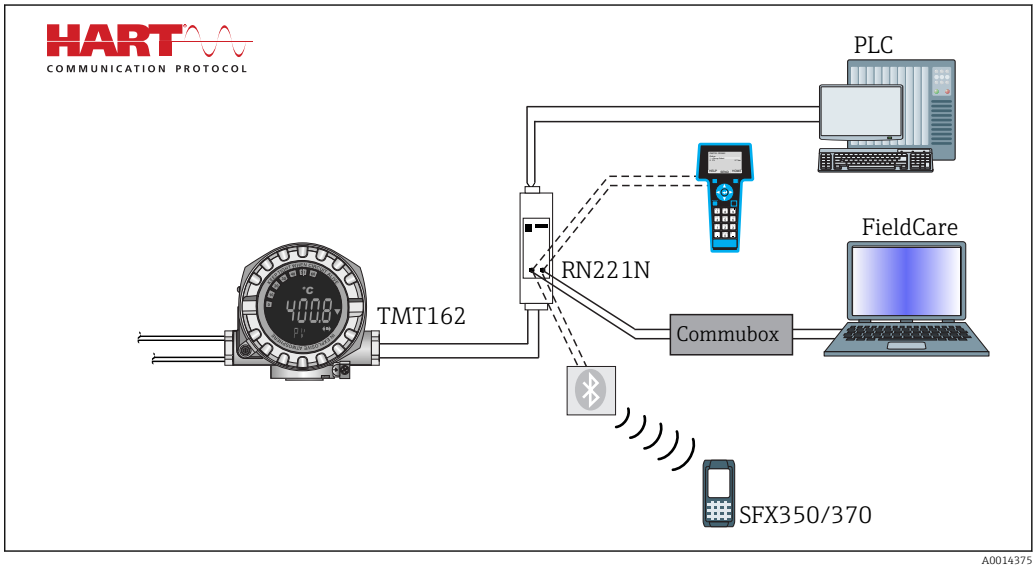
2-channel functions
These functions increase the reliability and availability of the process values:
- Sensor backup : If sensor 1 fails, the output signal is switched without interruption to the measured value of sensor 2.
- Temperature-dependent sensor switching: The measured value is recorded by sensor 1 or 2 depending on the process temperature.
- Sensor drift detection: Drift warning or alarm, if the measured values between sensor 1 and 2 deviate from a specified value.
- Mean value or differential measurement from two sensors
- Mean value measurement with sensor redundancy

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

Functional Safety Manual for temperature field transmitter TMT162: SD01632T/09

Equipment architecture

Analog current output 4 to 20 mA with HART® protocol



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Input

Measured variable

Temperature (temperature-linear transmission behavior), resistance and voltage.

Measuring range

It is possible to connect two sensors that are independent of one another [1]. The measuring inputs are not galvanically isolated from each other.

Resistance thermometer (RTD) as per standard	Description	α	Measuring range limits	Min. span
IEC 60751:2008	Pt100 (1) Pt200 (2) Pt500 (3) Pt1000 (4)	0.003851	−200 to +850 °C (−328 to +1 562 °F) −200 to +850 °C (−328 to +1 562 °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)
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)
	▪ Type of connection: 2-wire, 3-wire or 4-wire connection, sensor current: ≤ 0.3 mA ▪ With 2-wire circuit, compensation of wire resistance possible (0 to 30 Ω) ▪ With 3-wire and 4-wire connection, sensor wire resistance up to max. 50 Ω per wire			
Resistance transmitter	Resistance Ω		10 to 400 Ω 10 to 2 000 Ω	10 Ω 10 Ω

Thermocouples as per standard	Description	Measuring range limits		Min. span
			Recommended temperature range:	
IEC 60584, Part 1 ASTM E230-3	Type A (W5Re-W20Re) (30) Type B (PtRh30-PtRh6) (31) Type E (NiCr-CuNi) (34) Type J (Fe-CuNi) (35) Type K (NiCr-Ni) (36) Type N (NiCrSi-NiSi) (37) Type R (PtRh13-Pt) (38) Type S (PtRh10-Pt) (39) Type T (Cu-CuNi) (40)	0 to +2 500 °C (+32 to +4 532 °F) +40 to +1 820 °C (+104 to +3 308 °F) −250 to +1 000 °C (−418 to +1 832 °F) −210 to +1 200 °C (−346 to +2 192 °F) −270 to +1 372 °C (−454 to +2 501 °F) −270 to +1 300 °C (−454 to +2 372 °F) −50 to +1 768 °C (−58 to +3 214 °F) −50 to +1 768 °C (−58 to +3 214 °F) −200 to +400 °C (−328 to +752 °F)	0 to +2 500 °C (+32 to +4 532 °F) +500 to +1 820 °C (+932 to +3 308 °F) −150 to +1 000 °C (−238 to +1 832 °F) −150 to +1 200 °C (−238 to +2 192 °F) −150 to +1 200 °C (−238 to +2 192 °F) −150 to +1 300 °C (−238 to +2 372 °F) +50 to +1 768 °C (+122 to +3 214 °F) +50 to +1 768 °C (+122 to +3 214 °F) −150 to +400 °C (−238 to +752 °F)	50 K (90 °F) 50 K (90 °F) 50 K (90 °F) 50 K (90 °F) 50 K (90 °F) 50 K (90 °F) 50 K (90 °F) 50 K (90 °F) 50 K (90 °F)
IEC 60584, Part 1 ASTM E230-3 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) Type U (Cu-CuNi) (42)	−200 to +900 °C (−328 to +1 652 °F) −200 to +600 °C (−328 to +1 112 °F)	−150 to +900 °C (−238 to +1 652 °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)

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.

Thermocouples as per standard	Description	Measuring range limits	Min. span
	▪ Internal cold junction (Pt100) ▪ External cold junction: configurable value −40 to +85 °C (−40 to +185 °F) ▪ Maximum sensor wire resistance 10 kΩ (If the sensor wire resistance is greater than 10 kΩ, an error message is output in accordance with NAMUR NE89.)		
Voltage transmitter (mV)	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			
		RTD or resistance transmitter, 2-wire	**RTD or resistance transmitter, 3-wire**	**RTD or resistance transmitter, 4-wire**	**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	-	-	-	-
	Thermocouple (TC), voltage transmitter	☑	☑	☑	☑

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, 1 min. (input/output)

Failure information

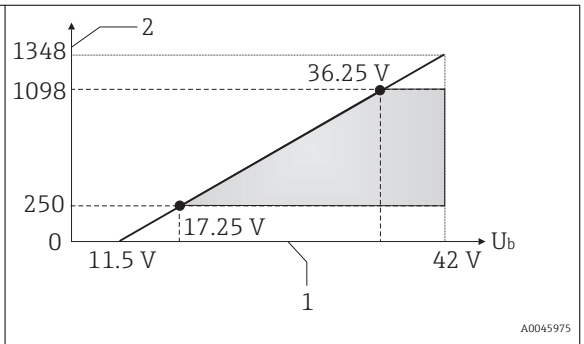
Failure information as per NAMUR NE43:

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 drop 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

$R_{b\ max.}$ = ($U_{b\ max.}$ - 11.5 V) / 0.023 A (current output)



1 Supply voltage U_b (V_{DC})
2 Load (Ω)

Linearization/transmission behavior

Temperature-linear, resistance-linear, voltage-linear

Mains filter

50/60 Hz

Filter

1st order digital filter: 0 to 120 s

Protocol-specific data

Manufacturer ID	17 (0x11)
Device type ID	0x11CE
HART® specification	7.6
Device address in the multi-drop mode [1]	Software setting addresses 0 to 63
Device description files (DTM, DD)	Information and files under: www.endress.com www.fieldcommgroup.org
HART load	Min. 250 Ω
HART device variables	The measured values can be freely assigned to the device variables. Measured values for PV, SV, TV and QV (first, second, third and fourth device variable) ▪ Sensor 1 (measured value) ▪ Sensor 2 (measured value) ▪ Device temperature ▪ Average of the two measured values: 0.5 x (SV1+SV2) ▪ Difference between sensor 1 and sensor 2: SV1-SV2 ▪ Sensor 1 (backup sensor 2): If sensor 1 fails, the value of sensor 2 automatically becomes the primary HART® value (PV): sensor 1 (OR sensor 2) ▪ Sensor switching: If the value exceeds the configured threshold value T for sensor 1, the measured value of sensor 2 becomes the primary HART® value (PV). The system switches back to sensor 1 if the measured value of sensor 1 is at least 2 K below T: sensor 1 (sensor 2, if sensor 1 > T) ▪ Average: 0.5 x (SV1+SV2) with backup (measured value of sensor 1 or sensor 2 in the event of a sensor error in the other sensor)
Supported functions	▪ Burst mode [1] ▪ Squawk ▪ Condensed status

1) Not possible in the SIL mode, see Functional Safety Manual SD01632T/09

Wireless HART data

Minimum starting voltage	11.5 V_{DC}
Start current	3.58 mA
Starting time	▪ Normal operation: 6 s ▪ SIL mode: 29 s
Minimum operating voltage	11.5 V_{AC}

Multidrop current	4.0 mA [1]
Time for connection setup	▪ Normal operation: 9 s ▪ SIL mode: 10 s

1) No Multidrop current in SIL mode

Write protection for device parameters

- Hardware: Write protection using DIP switch on electronics module in the device
- Software: Write protection using password

Switch-on delay

- Until the start of HART® communication, approx. 10 s, while switch-on delay = $I_a \leq 3.6$ mA
- Until the first valid measured value signal is present at the current output, approx. 28 s, while switch-on delay = $I_a \leq 3.6$ mA

Power supply

Supply voltage

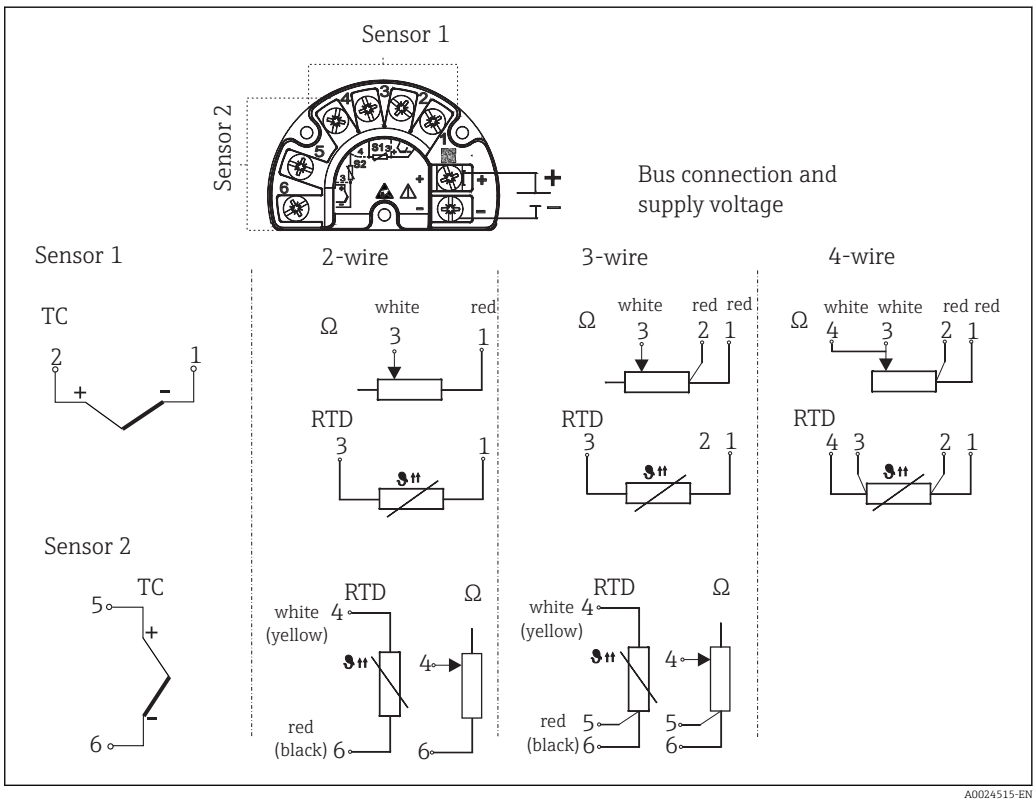
Values for non-hazardous areas, protected against polarity reversal:
- 11.5 V ≤ Vcc ≤ 42 V (standard)
- I ≤ 23 mA

Values for hazardous areas, see Ex documentation → 🖹 25

The transmitter must be powered by a power supply 11.5 to 42 V_{DC} in accordance with NEC Class 02 (low voltage/low current) with restricted power limited to 8 A/150 VA in the event of a short-circuit (in accordance with IEC 61010-1, CSA 1010.1-92).

The device may only be powered by a power unit with an energy-limited circuit in accordance with UL/EN/IEC 61010-1, Section 9.4 and the requirements of Table 18.

Terminal assignment



🖹 2 *Wiring the transmitter*

A shielded cable that is grounded on both sides must be used for sensor cable lengths of 30 m (98.4 ft) and more. The use of shielded sensor cables is generally recommended.

Connection of the functional grounding may be needed for functional purposes. Compliance with the electrical codes of individual countries is mandatory.

Current consumption

Current consumption	3.6 to 23 mA
Minimum current consumption	≤ 3.5 mA, Multidrop mode 4 mA (not possible in SIL mode)
Current limit	≤ 23 mA

Terminals

2.5 mm² (12 AWG) plus ferrule

Cable entries

Version	Type
Thread	2x thread ½" NPT
	2x thread M20
	2x thread G½"
Cable gland	2x coupling M20

Residual ripple

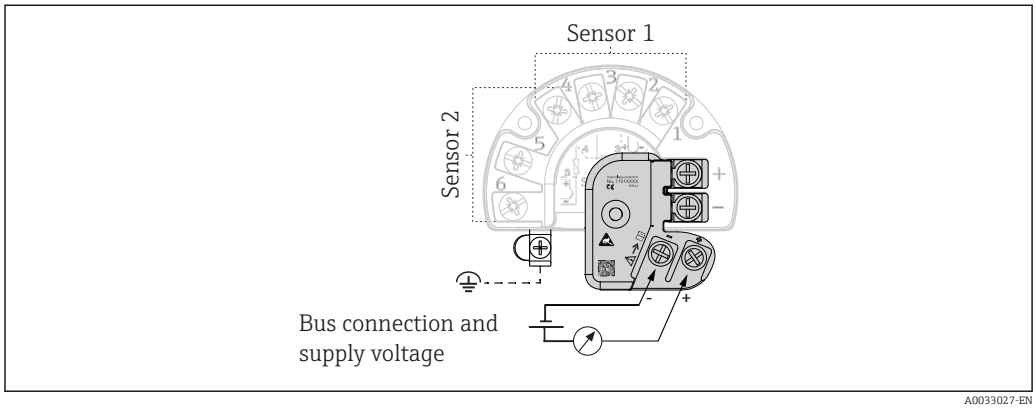
Permanent residual ripple $U_{SS} \leq 3$ V at $U_b \geq 13.5$ V, $f_{max.} = 1$ kHz

Surge arrester

The surge arrester can be ordered as an optional extra. The module protects the electronics from damage from overvoltage. Overvoltage occurring in signal cables (e.g. 4 to 20 mA, communication lines (fieldbus systems) and power supply is diverted to ground. The functionality of the transmitter is not affected as no problematic voltage drop occurs.

Connection data:

Maximum continuous voltage (rated voltage)	$U_C = 42\ V_{DC}$
Nominal current	I = 0.5 A at $T_{amb.}$ = 80 °C (176 °F)
Surge current resistance ▪ Lightning surge current D1 (10/350 µs) ▪ Nominal discharge current C1/C2 (8/20 µs)	 ▪ I_{imp} = 1 kA (per wire) ▪ I_n = 5 kA (per wire) I_n = 10 kA (total)
Series resistance per wire	1.8 Ω, tolerance ±5 %



3 Electrical connection of surge arrester

Grounding

The device must be connected to the potential equalization. The connection between the housing and the local ground must have a minimum cross-section of 4 mm² (13 AWG). All ground connections must be secured tightly.

Performance characteristics

Response time

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

Resistance temperature detector (RTD)	0.9 to 1.3 s (depends on the connection method 2/3/4-wire)
Thermocouples (TC)	0.8 s
Reference temperature	0.9 s

When recording step responses, it must be taken into account that the times for the measurement of the second channel and the internal reference measuring point are added to the specified times where applicable.

Reference operating conditions

- Calibration temperature: +25 °C ±3 K (77 °F ±5.4 °F)
- Supply voltage: 24 V DC
- 4-wire circuit for resistance adjustment

Maximum measured error

In accordance with DIN EN 60770 and the reference conditions specified above. The measured error data correspond to ±2 σ (Gaussian distribution), i.e. 95.45%. The data include non-linearities and repeatability.

Typical

Standard	Designation	Measuring range	Typical measured error (±)	
Resistance thermometer (RTD) as per standard			Digital value [1]	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)		0.06 °C (0.11 °F)	0.1 °C (0.18 °F)
GOST 6651-94	Pt100 (9)		0.07 °C (0.13 °F)	0.09 °C (0.16 °F)
Thermocouples (TC) as per standard			Digital value [1]	Value at current output
IEC 60584, Part 1	Type K (NiCr-Ni) (36)	0 to +800 °C (32 to +1 472 °F)	0.22 °C (0.4 °F)	0.24 °C (0.43 °F)
IEC 60584, Part 1	Type S (PtRh10-Pt) (39)		1.17 °C (2.1 °F)	1.33 °C (2.4 °F)
GOST R8.585-2001	Type L (NiCr-CuNi) (43)		2.0 °C (3.6 °F)	2.4 °C (4.32 °F)

1) Measured value transmitted via HART®.

Measured error for resistance thermometers (RTD) and resistance transmitters

Standard	Designation	Measuring range	Measured error (±)	
			Digital [1]	D/A [2]
			Based on measured value [3]	
IEC 60751:2008	Pt100 (1)	−200 to +850 °C (−328 to +1 562 °F)	ME = ± (0.06 °C (0.11 °F) + 0.005% * (MV - LRV))	0.03 % (≙ 4.8 µA)
	Pt200 (2)		ME = ± (0.05 °C (0.09 °F) + 0.012% * (MV - LRV))	
	Pt500 (3)	−200 to +500 °C (−328 to +932 °F)	ME = ± (0.03 °C (0.05 °F) + 0.012% * (MV - LRV))	
	Pt1000 (4)	−200 to +250 °C (−328 to +482 °F)	ME = ± (0.02 °C (0.04 °F) + 0.012% * (MV - LRV))	
JIS C1604:1984	Pt100 (5)	−200 to +510 °C (−328 to +950 °F)	ME = ± (0.05 °C (0.09 °F) + 0.006% * (MV - LRV))	
GOST 6651-94	Pt50 (8)	−185 to +1 100 °C (−301 to +2 012 °F)	ME = ± (0.1 °C (0.18 °F) + 0.008% * (MV - LRV))	
	Pt100 (9)	−200 to +850 °C (−328 to +1 562 °F)	ME = ± (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 = ± (0.05 °C (0.09 °F) - 0.006% * (MV - LRV))	

Standard	Designation	Measuring range	Measured error (±)	
	Ni120 (7)			
OIML R84: 2003 / GOST 6651-2009	Cu50 (10)	−180 to +200 °C (−292 to +392 °F)	ME = ± (0.10 °C (0.18 °F) + 0.006% * (MV - LRV))	
	Cu100 (11)	−180 to +200 °C (−292 to +392 °F)	ME = ± (0.05 °C (0.09 °F) + 0.003% * (MV - LRV))	
	Ni100 (12)	−60 to +180 °C (−76 to +356 °F)	ME = ± (0.06 °C (0.11 °F) - 0.005% * (MV - LRV))	
	Ni120 (13)		ME = ± (0.05 °C (0.09 °F) - 0.005% * (MV - LRV))	
OIML R84: 2003, GOST 6651-94	Cu50 (14)	−50 to +200 °C (−58 to +392 °F)	ME = ± (0.1 °C (0.18 °F) + 0.004% * (MV - LRV))	
Resistance transmitter	Resistance Ω	10 to 400 Ω	ME = ± (21 mΩ + 0.003% * (MV - LRV))	0.03 % (≙ 4.8 µA)
		10 to 2 000 Ω	ME = ± (35 mΩ + 0.010% * (MV - LRV))	

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

Measured error for thermocouples (TC) and voltage transmitters

Standard	Designation	Measuring range	Measured error (±)	
			Digital [1]	D/A [2]
			Based on measured value [3]	
IEC 60584-1 ASTM E230-3	Type A (30)	0 to +2 500 °C (+32 to +4 532 °F)	ME = ± (0.08 °C (0.14 °F) + 0.018% * (MV - LRV))	0.03 % (≙ 4.8 µA)
	Type B (31)	+500 to +1 820 °C (+932 to +3 308 °F)	ME = ± (1.23 °C (2.14 °F) - 0.05% * (MV - LRV))	
IEC 60584-1 ASTM E988-96 ASTM E230-3	Type C (32)	0 to +2 000 °C (+32 to +3 632 °F)	ME = ± (0.5 °C (0.9 °F) + 0.005% * (MV - LRV))	
ASTM E988-96	Type D (33)		ME = ± (0.63 °C (1.13 °F) - 0.007% * (MV - LRV))	
IEC 60584-1 ASTM E230-3	Type E (34)	−150 to +1 000 °C (−238 to +1 832 °F)	ME = ± (0.19 °C (0.3 °F) - 0.006% * (MV - LRV))	
	Type J (35)	−150 to +1 200 °C (−238 to +2 192 °F)	ME = ± (0.23 °C (0.4 °F) - 0.005% * (MV - LRV))	
	Type K (36)		ME = ± (0.3 °C (0.5 °F) - 0.002% * (MV - LRV))	
	Type N (37)	−150 to +1 300 °C (−238 to +2 372 °F)	ME = ± (0.4 °C (0.7 °F) - 0.01% * (MV - LRV))	
	Type R (38)	+50 to +1 768 °C (+122 to +3 214 °F)	ME = ± (0.95 °C (1.7 °F) - 0.025% * (MV - LRV))	
	Type S (39)		ME = ± (0.98 °C (1.8 °F) - 0.02% * (MV - LRV))	
	Type T (40)	−150 to +400 °C (−238 to +752 °F)	ME = ± (0.31 °C (0.56 °F) - 0.034% * (MV - LRV))	
DIN 43710	Type L (41)	−150 to +900 °C (−238 to +1 652 °F)	ME = ± (0.26 °C (0.47 °F) - 0.008% * (MV - LRV))	
	Type U (42)	−150 to +600 °C (−238 to +1 112 °F)	ME = ± (0.27 °C (0.49 °F) - 0.022% * (MV - LRV))	
GOST R8.585-2001	Type L (43)	−200 to +800 °C (−328 to +1 472 °F)	ME = ± (2.13 °C (3.83 °F) - 0.012% * (MV - LRV))	
Voltage transmitter (mV)		−20 to +100 mV	ME = ± (6.5 µV + 0.002% * (MV - LRV))	4.8 µA

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

MV = Measured value

LRV = Lower range value of relevant sensor

Total measured error of transmitter at current output = √(Measured error digital² + Measured error D/A²)

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

Measured error digital = 0.06 °C+ 0.006% * (200 °C - (-200 °C)):	0.08 °C (0.15 °F)
Measured error D/A = 0.03 % * 200 °C (360 °F)	0.06 °C (0.11 °F)
Measured error digital value (HART):	0.08 °C (0.15 °F)
Measured error analog value (current output): √(Measured error digital² + Measured error D/A²)	0.10 °C (0.19 °F)

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

Measured error digital = 0.06 °C+ 0.006% * (200 °C - (-200 °C)):	0.08 °C (0.15 °F)
Measured error D/A = 0.03 % * 200 °C (360 °F)	0.06 °C (0.11 °F)
Influence of ambient temperature (digital) = (35 - 25) * (0.002% * 200 °C - (-200 °C)), min. 0.005 °C	0.08 °C (0.14 °F)
Influence of ambient temperature (D/A) = (35 - 25) * (0.001% * 200 °C)	0.02 °C (0.04 °F)
Influence of ambient temperature (digital) = (30 - 24) * (0.002% * 200 °C - (-200 °C)), min. 0.005 °C	0.05 °C (0.09 °F)
Influence of supply voltage (D/A) = (30 - 24) * (0.001% * 200 °C)	0.01 °C (0.02 °F)
Measured error digital value (HART): √(Measured error digital² + Influence of ambient temperature (digital)² + Influence of supply voltage (digital)²	**0.13 °C (0.23 °F)**
Measured error analog value (current output): √(Measured error digital² + Measured error D/A² + Influence of ambient temperature (digital)² + Influence of ambient temperature (D/A)² + Influence of supply voltage (digital)² + Influence of supply voltage (D/A)²	**0.14 °C (0.25 °F)**

The measured error data correspond to 2 σ (Gaussian distribution)

MV = Measured value

LRV = Lower range value of relevant sensor

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 measured errors apply in SIL mode.

For more detailed information please refer to the Functional Safety Manual SD01632T/09.

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 explained 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 measured error data correspond to ±2 σ (Gaussian distribution), i.e. 95.45%.

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

Designation	Standard	Ambient temperature: Influence (±) per 1 °C (1.8 °F) change			Supply voltage: Influence (±) per V change		
		Digital [1]		D/A [2].	Digital [1]		D/A [2]
		Maximum	Based on measured value		Maximum	Based on measured value	
Pt100 (1)	IEC 60751:2008	≤ 0.02 °C (0.036 °F)	0.002% * (MV -LRV), at least 0.005 °C (0.009 °F)	0.001 %	≤ 0.02 °C (0.036 °F)	0.002% * (MV -LRV), at least 0.005 °C (0.009 °F)	0.001 %
Pt200 (2)		≤ 0.026 °C (0.047 °F)	-		≤ 0.026 °C (0.047 °F)	-	
Pt500 (3)		≤ 0.013 °C (0.023 °F)	0.002% * (MV -LRV), at least 0.009 °C (0.016 °F)		≤ 0.013 °C (0.023 °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)		≤ 0.008 °C (0.014 °F)	0.002% * (MV -LRV), at least 0.004 °C (0.007 °F)	
Pt100 (5)	JIS C1604:1984	≤ 0.013 °C (0.023 °F)	0.002% * (MV -LRV), at least 0.005 °C (0.009 °F)		≤ 0.013 °C (0.023 °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)		≤ 0.01 °C (0.018 °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 IPTS-68	≤ 0.004 °C (0.007 °F)	-		≤ 0.005 °C (0.009 °F)	-	
Ni120 (7)			-			-	
Cu50 (10)	OIML R84: 2003 / GOST 6651-2009	≤ 0.007 °C (0.013 °F)	-		≤ 0.008 °C (0.014 °F)	-	
Cu100 (11)			0.002% * (MV -LRV), at least 0.004 °C (0.007 °F)		≤ 0.004 °C (0.007 °F)	0.002% * (MV -LRV), at least 0.004 °C (0.007 °F)	

Designation	Standard	Ambient temperature: Influence (±) per 1 °C (1.8 °F) change			Supply voltage: Influence (±) per V change		
Ni100 (12)		≤ 0.004 °C (0.007 °F)	-			-	
Ni120 (13)			-			-	
Cu50 (14)	OIML R84: 2003 / GOST 6651-94	≤ 0.007 °C (0.013 °F)	-		≤ 0.008 °C (0.014 °F)	-	
Resistance transmitter (Ω)							
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

Designation	Standard	Ambient temperature: Influence (±) per 1 °C (1.8 °F) change			Supply voltage: Influence (±) per V change		
		Digital [1]		D/A [2]	Digital		D/A [2]
		Maximum	Based on measured value		Maximum	Based on measured value	
Type A (30)	IEC 60584-1	≤ 0.13 °C (0.23 °F)	0.0055% * (MV -LRV), at least 0.03 °C (0.054 °F)	0.001 %	≤ 0.07 °C (0.13 °F)	0.0054% * (MV -LRV), at least 0.02 °C (0.036 °F)	0.001 %
Type B (31)		≤ 0.06 °C (0.11 °F)	-		≤ 0.06 °C (0.11 °F)	-	
Type C (32)	IEC 60584-1 / ASTM E988-96	≤ 0.08 °C (0.14 °F)	0.0045% * (MV -LRV), at least 0.03 °C (0.054 °F)		≤ 0.04 °C (0.07 °F)	0.0045% * (MV -LRV), at least 0.03 °C (0.054 °F)	
Type D (33)	ASTM E988-96		0.004% * (MV -LRV), at least 0.035 °C (0.063 °F)			0.004% * (MV -LRV), at least 0.035 °C (0.063 °F)	
Type E (34)	IEC 60584-1	≤ 0.03 °C (0.05 °F)	0.003% * (MV -LRV), at least 0.016 °C (0.029 °F)		≤ 0.02 °C (0.04 °F)	0.003% * (MV -LRV), at least 0.016 °C (0.029 °F)	
Type J (35)		≤ 0.04 °C (0.07 °F)	0.0028% * (MV -LRV), at least 0.02 °C (0.036 °F)			0.0028% * (MV -LRV), at least 0.02 °C (0.036 °F)	
Type K (36)			0.003% * (MV -LRV), at least 0.013 °C (0.023 °F)			0.003% * (MV -LRV), at least 0.013 °C (0.023 °F)	
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)		≤ 0.05 °C (0.09 °F)	0.0035% * (MV -LRV), at least 0.047 °C (0.085 °F)		≤ 0.05 °C (0.09 °F)	0.0035% * (MV -LRV), at least 0.047 °C (0.085 °F)	
Type S (39)			-			-	
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)	-			-	
Type U (42)		≤ 0.01 °C (0.02 °F)	-			-	
Type L (43)	GOST R8.585-2001	≤ 0.02 °C (0.04 °F)	-			-	

Designation	Standard	Ambient temperature: Influence (±) per 1 °C (1.8 °F) change			Supply voltage: Influence (±) per V change		
Voltage transmitter (mV)				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 relevant sensor

Total measured error of transmitter at current output = √(Measured error digital² + Measured error D/A²)

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

Designation	Standard	Long-term drift (±) 1)		
		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)
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)
Resistance transmitter				
10 to 400 Ω		≤ 0.0122% * (MV - LRV) or 12 mΩ	≤ 0.02% * (MV - LRV) or 20 mΩ	≤ 0.022% * (MV - LRV) or 22 mΩ
10 to 2 000 Ω		≤ 0.015% * (MV - LRV) or 144 mΩ	≤ 0.024% * (MV - LRV) or 240 mΩ	≤ 0.03% * (MV - LRV) or 295 mΩ

1) The larger value is valid

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

Designation	Standard	Long-term drift (±) [1]		
		after 1 year	after 3 years	after 5 years
		Based on measured value		
Type A (30)	IEC 60584-1	≤ 0.048% * (MV - LRV) or 0.46 °C (0.83 °F)	≤ 0.072% * (MV - LRV) or 0.69 °C (1.24 °F)	≤ 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 E988-96	≤ 0.038% * (MV - LRV) or 0.41 °C (0.74 °F)	≤ 0.057% * (MV - LRV) or 0.62 °C (1.12 °F)	≤ 0.078% * (MV - LRV) or 0.85 °C (1.53 °F)
Type D (33)	ASTM E988-96	≤ 0.035% * (MV - LRV) or 0.57 °C (1.03 °F)	≤ 0.052% * (MV - LRV) or 0.86 °C (1.55 °F)	≤ 0.071% * (MV - LRV) or 1.17 °C (2.11 °F)
Type E (34)	IEC 60584-1	≤ 0.024% * (MV - LRV) or 0.15 °C (0.27 °F)	≤ 0.037% * (MV - LRV) or 0.23 °C (0.41 °F)	≤ 0.05% * (MV - LRV) or 0.31 °C (0.56 °F)
Type J (35)		≤ 0.025% * (MV - LRV) or 0.17 °C (0.31 °F)	≤ 0.037% * (MV - LRV) or 0.25 °C (0.45 °F)	≤ 0.051% * (MV - LRV) or 0.34 °C (0.61 °F)
Type K (36)		≤ 0.027% * (MV - LRV) or 0.23 °C (0.41 °F)	≤ 0.041% * (MV - LRV) or 0.35 °C (0.63 °F)	≤ 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)	2.23 °C (4.01 °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)	0.42 °C (0.76 °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)
Voltage transmitter (mV)				
–20 to 100 mV		≤ 0.027% * (MV - LRV) or 5.5µV	≤ 0.041% * (MV - LRV) or 8.2µV	≤ 0.056% * (MV - LRV) or 11.2µV

1) The larger value is valid

Long-term drift analog output

Long-term drift D/A [1] (±)		
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 reference junction

Pt100 DIN IEC 60751 Cl. B (internal reference junction with thermocouples TC)

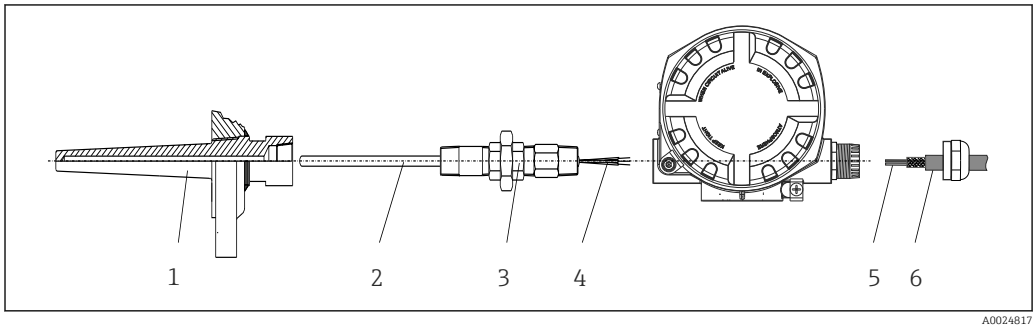
Installation

Mounting location

If stable sensors are used, the device can be fitted directly to the sensor. For remote mounting to a wall or stand pipe, two mounting brackets are available. The illuminated display can be mounted in four different positions.

Installation instructions

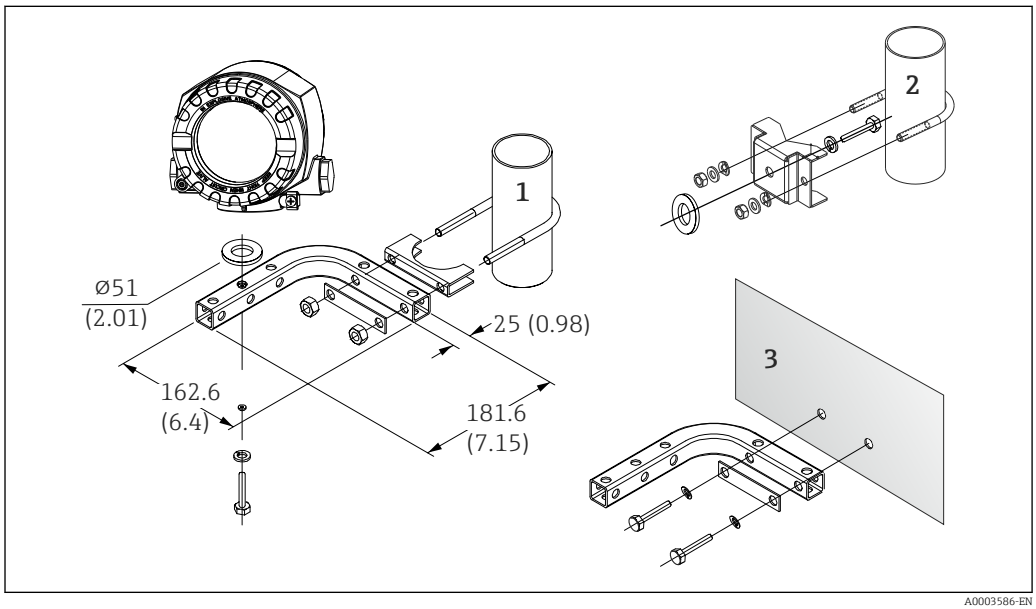
Direct sensor mounting



4 Direct field transmitter mounting on sensor

1 *Thermowell*
2 *Insert*
3 *Neck tube nipple and adapter*
4 *Sensor cables*
5 *Fieldbus cables*
6 *Fieldbus shielded cable*

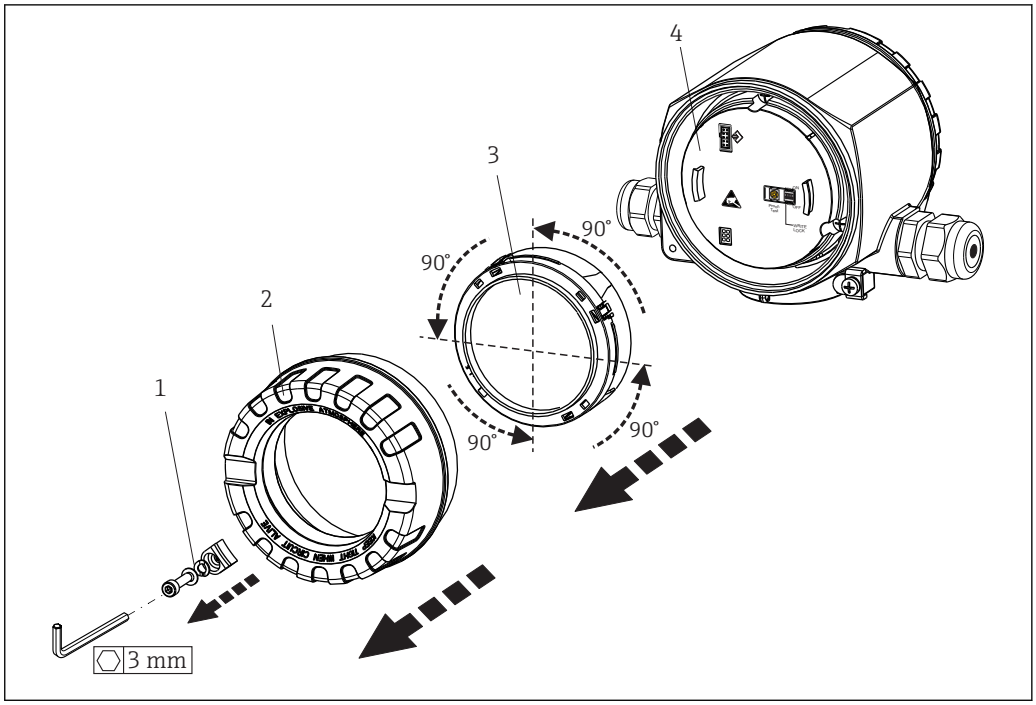
Remote mounting



5 Installing the field transmitter using the mounting bracket, see "Accessories" section. 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*

Display mounting



6 *4 display installation positions, attachable in 90° stages*

1 *Cover clamp*
2 *Housing cover with O-ring*
3 *Display with retainer and twist protection*
4 *Electronics module*

Environment

Ambient temperature

- −40 to +85 °C (−40 to +185 °F), for hazardous areas see Ex documentation → 25
- Without display: −40 to +85 °C (−40 to +185 °F)
- With display: −40 to +80 °C (−40 to +176 °F)
- With overvoltage protection module: −40 to +85 °C (−40 to +185 °F)
- SIL mode: −40 to +75 °C (−40 to +167 °F)

The display can react slowly at temperatures < −20 °C (−4 °F). The legibility of the display cannot be guaranteed at temperatures < −30 °C (−22 °F).

Storage temperature

- Without display: −40 to +100 °C (−40 to +212 °F) −50 to +100 °C (−58 to +212 °F)
- With display: −40 to +80 °C (−40 to +176 °F)
- With overvoltage protection module: −50 to +100 °C (−58 to +212 °F)

Humidity

Permitted: 0 to 95 %

Altitude

Up to 2 000 m (6 560 ft) above sea level

Climate class

As per IEC 60654-1, Class Dx

Degree of protection

- Die-cast aluminum or stainless steel housing: IP66/67, Type 4X
- Stainless steel housing for hygienic applications (T17 housing): IP66 / IP68 (1.83 m H2O for 24 h), NEMA 4X, NEMA 6P

Shock and vibration resistance

Shock resistance as per KTA 3505 (section 5.8.4 Shock test)

IEC 60068-2-6 test

Fc: Vibration (sinusoidal)

Vibration resistance according to DNV GL Guideline, Vibration: B

The use of L-shaped mounting brackets can cause resonance (see wall/pipe 2" mounting bracket in the 'Accessories' section). Caution: vibrations at the transmitter may not exceed specifications.

Electromagnetic compatibility (EMC)

CE compliance

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.

Maximum measured error <1% of measuring range.

Interference immunity as per IEC/EN 61326 series, industrial requirements

Interference emission as per IEC/EN 61326 series, Class B equipment

SIL conformity according to IEC 61326-3-1 or IEC 61326-3-2

A shielded cable that is grounded on both sides must be used for sensor cable lengths of 30 m (98.4 ft) and more. The use of shielded sensor cables is generally recommended.

Connection of the functional grounding may be needed for functional purposes. Compliance with the electrical codes of individual countries is mandatory.

Overvoltage category

II

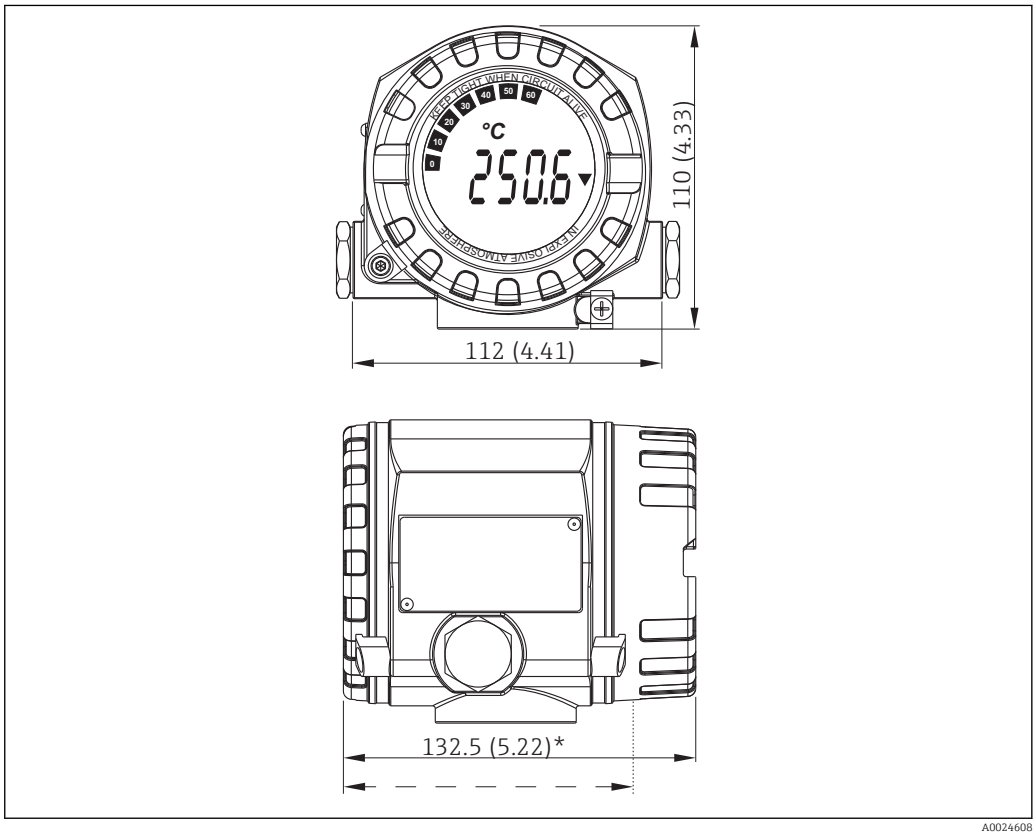
Degree of contamination

2

Mechanical construction

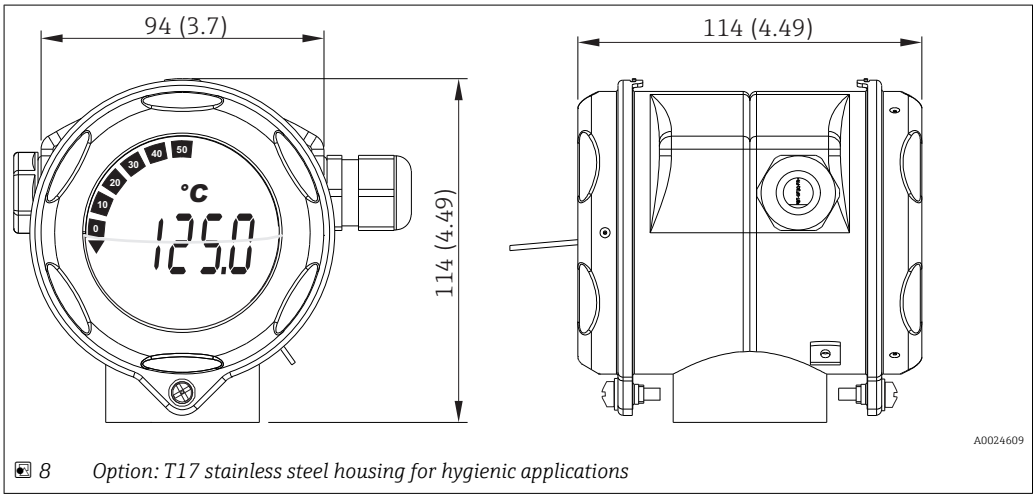
Design, dimensions

Dimensions in mm (in)



7 *Die-cast aluminum housing for general applications, or optional stainless steel housing (316L)*

* Dimensions without display = 112 mm (4.41")



8 *Option: T17 stainless steel housing for hygienic applications*

- Separate electronics module and connection compartment
- Display attachable in 90° stages

Weight

- Aluminum housing approx. 1.4 kg (3 lb), with display
- Stainless steel housing approx. 4.2 kg (9.3 lb), with display
- T17 housing approx. 1.25 kg (2.76 lb), with display

Materials

Housing	Sensor terminals	Nameplate
Die-cast aluminum housing AlSi10Mg/ AlSi12 with powder coating on polyester base	Nickel-plated brass 0.3 µm gold flashed / cpl., corrosion-free	Aluminum AlMgl, anodized in black
316L		1.4404 (AISI 316L)
Stainless steel 1.4435 (AISI 316L) for hygienic applications (T17 housing)		-
Display O-ring 88x3: HNBR 70° Shore PTFE coating	-	-

Cable entries

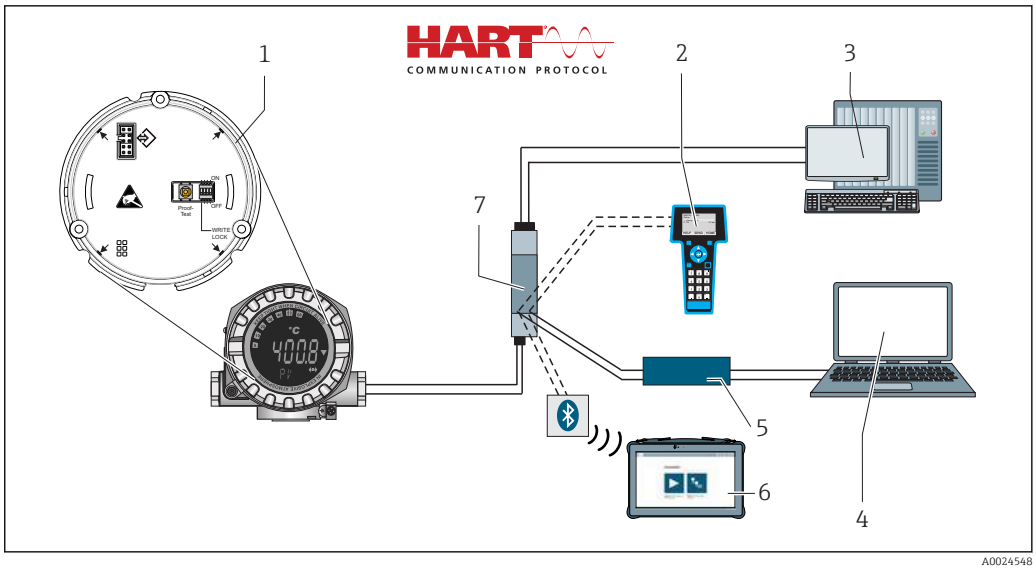
Version	Type
Thread	2x thread ½" NPT
	2x thread M20
	2x thread G½"
Cable gland	2x coupling M20

Operability

Operation concept

There are different options available for configuring and commissioning the device:

- **Configuration programs**
  The setup and the configuration of device-specific parameters is performed via the HART® protocol. You can obtain special configuration and operating programs from various manufacturers for these purposes.
- **Miniature switch (DIP switch) and proof-test button for various hardware settings**
  - Hardware write protection is activated and deactivated via a miniature switch (DIP switch) on the electronics module.
  - Proof-test button for testing in SIL mode without HART operation. Pressing the button triggers a device restart. The proof test checks the functional integrity of the transmitter in the SIL mode during commissioning, in the event of changes to safety-related parameters or generally at appropriate intervals.



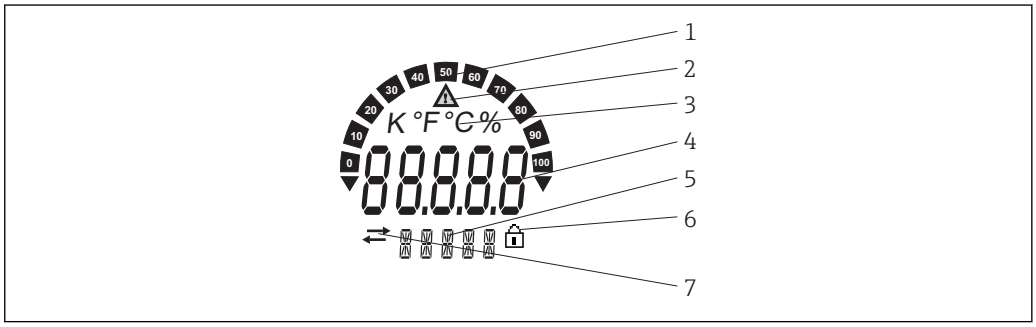
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9 *Operating options of device*

1 *Hardware settings via DIP switch and proof-test button*
2 *HART® handheld communicator*
3 *PLC/DCS*
4 *Configuration software, e.g. FieldCare*
5 *Commubox: Power supply and modem for field devices with HART® protocol*
6 *Configuration via Field Xpert SFX350/370*
7 *Power supply unit and active barrier, .e.g. RN221 from Endress+Hauser*

Local operation

Display elements



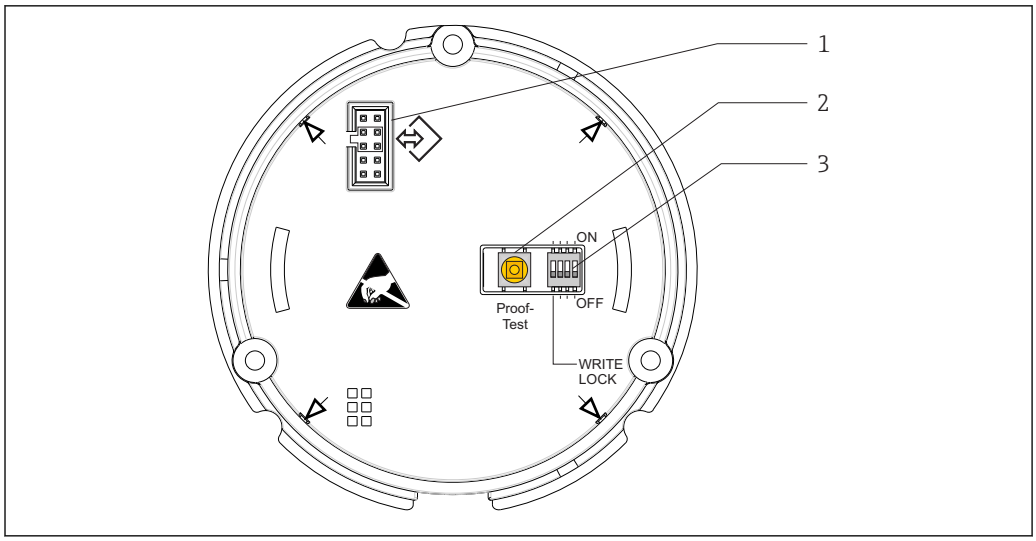
A0034101

10 *LC display of the field transmitter (backlit, attachable in 90° stages)*

1 *Bar graph display*
2 *'Caution' symbol*
3 *Unit display K, °F, °C or %*
4 *Measured value display, digit height 20.5 mm*
5 *Status and information display*
6 *'Configuration locked' symbol*
7 *'Communication' symbol*

Operating elements

To prevent device manipulation, no operating elements are present directly on the display. Various operating elements for configuring the device are located on the electronics module, which is located under the display.



1 Electrical connection for the display module
2 Proof-test button for testing in SIL mode without HART operation
3 DIP switch for activating or deactivating device write protection

Remote operation

All software parameters are accessible depending on the position of the write protection switch on the device.

Hardware and software for remote operation	Function
FieldCare, DeviceCare	FieldCare is an Endress+Hauser asset management tool based on FDT technology. With FieldCare, you can configure all Endress+Hauser devices as well as devices from other manufacturers that support the FDT standard. FieldCare supports the following functions: ▪ Configuration of transmitters in offline and online mode ▪ Loading and saving device data (upload/download) ▪ Documentation of the measuring point ▪ Connection options via Commubox FXA195 and the USB interface of a computer For further information, please contact your local Endress+Hauser Sales Center.
Commubox, e.g. FXA195	HART modem, for intrinsically safe HART communication with FieldCare via the USB interface.
Field Xpert SFX350, SFX370	Field Xpert is an industrial PDA with a high-resolution full VGA touchscreen (640x480 pixels) from Endress+Hauser based on Windows Embedded Handheld. It offers wireless communication via the optional VIATOR Bluetooth modem from Endress+Hauser. Field Xpert also works as a stand-alone device for asset management applications. For details, see BA01202S/04 (hardware) and BA01211S/04 (software).
Field Communicator 475	The 475 Field Communicator is designed to facilitate your work in the field. Featuring a large touchscreen, it supports HART Version 5, 6, and 7 devices (including WirelessHART™), and your 475 Field Communicator can be updated via the Internet. It offers new, innovative functions, such as a color display, Bluetooth communication and powerful advanced diagnostic functions. The device is designed for universal use, can be upgraded by the user, is Ex(i)-approved, robust and reliable. For further information, please contact your local Endress+Hauser Sales Center.

Certificates and approvals

CE mark	The product meets the requirements of the harmonized European standards. As such, it complies with the legal specifications of the EC directives. The manufacturer confirms successful testing of the product by affixing to it the CE-mark.
EAC mark	The product meets the legal requirements of the EEU guidelines. The manufacturer confirms the successful testing of the product by affixing the EAC mark.
Ex approval	Information about currently available Ex versions (ATEX, FM, CSA, etc.) can be supplied by your E+H Sales Center on request. All explosion protection data are given in separate documentation which is available upon request.
MTTF	According to Siemens SN-29500 at 40 °C (104 °F) The mean time to failure (MTTF) denotes the theoretically expected time until the device fails during normal operation. The term MTTF is used for non-repairable systems such as temperature transmitters.
UL approval	More information under UL Product iq™, search for keyword "E225237")
CSA	The product meets the requirements as per "CLASS 2252 05 - Process Control Equipment"
Maritime guidelines	For the type approval certificates (GL, BV etc.) currently available, please contact your Endress +Hauser Sales Center for information. All data relating to shipbuilding can be found in separate type approval certificates which can be requested as needed.
Functional safety	SIL 2/3 (hardware/software) certified to: ▪ IEC 61508-1:2010 (Management) ▪ IEC 61508-2:2010 (Hardware) ▪ IEC 61508-3:2010 (Software) For more detailed information please refer to the 'Functional Safety Manual'. → 25
HART® certification	The temperature transmitter is registered by the HART® FieldComm Group. The device meets the requirements of the FieldComm Group HART® Specifications, Revision 7.6.
Other standards and guidelines	▪ IEC 60529: Degrees of protection provided by enclosures (IP code) ▪ IEC/EN 61010-1: Safety requirements for electrical equipment for measurement, control, and laboratory use ▪ IEC/EN 61326 series: Electromagnetic compatibility (EMC requirements)

Ordering information

Detailed ordering information is available for your nearest sales organization www.addresses.endress.com or in the Product Configurator under www.endress.com :

1. Click Corporate
2. Select the country
3. Click Products
4. Select the product using the filters and search field
5. Open the product page

The Configuration button to the right of the product image opens the Product 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

Accessories

Various accessories, which can be ordered with the device or subsequently from Endress+Hauser, are available for the device. Detailed information on the order code in question is available from your local Endress+Hauser sales center or on the product page of the Endress+Hauser website: www.endress.com.

Always quote the serial number of the device when ordering accessories!

Device-specific accessories

Accessories	Description
Dummy plugs	▪ M20x1.5 EEx-d/XP ▪ G ½" EEx-d/XP ▪ NPT ½" ALU ▪ NPT ½" V4A
Cable glands	▪ M20x1.5 ▪ NPT ½" D4-8.5, IP68 ▪ NPT ½" cable gland 2 x D0.5 cable for 2 sensors ▪ M20x1.5 cable gland 2 x D0.5 cable for 2 sensors
Adapter for cable gland	M20x1.5 outside/M24x1.5 inside
Wall and pipe mounting bracket	Stainless steel wall/2" pipe Stainless steel 2" pipe V4A
Surge arrester	The module protects the electronics from overvoltage. Not available for T17 stainless steel housing.

Communication-specific accessories

Accessories	Description
Field Xpert SFX350	Field Xpert SFX350 is a mobile computer for commissioning and maintenance. It enables efficient device configuration and diagnostics for HART and FOUNDATION Fieldbus devices in the **non-Ex area**. For details, see Operating Instructions BA01202S
Field Xpert SFX370	Field Xpert SFX370 is a mobile computer for commissioning and maintenance. It enables efficient device configuration and diagnostics for HART and FOUNDATION Fieldbus devices in the **non-Ex area and the Ex area**. For details, see Operating Instructions BA01202S

Service-specific accessories

Accessories	Description
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: ▪ Via the Internet: https://wapps.endress.com/applicator ▪ On CD-ROM for local PC installation.

W@M	Life cycle management for your plant W@M supports you with a wide range of software applications over the entire process: from planning and procurement, to the installation, commissioning and operation of the measuring devices. All the relevant device information, such as the device status, spare parts and device-specific documentation, is available for every device over the entire life cycle. The application already contains the data of your Endress+Hauser device. Endress +Hauser also takes care of maintaining and updating the data records. W@M is available: ▪ Via the Internet: www.endress.com/lifecyclemanagement ▪ On CD-ROM for local PC installation.
FieldCare	FDT-based plant asset management tool from Endress+Hauser. 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. For details, see Operating Instructions BA00027S and BA00059S
DeviceCare	Configuration tool for devices via fieldbus protocols and Endress+Hauser service protocols. DeviceCare is the tool developed by Endress+Hauser for the configuration of Endress+Hauser devices. All smart devices in a plant can be configured via a point-to-point or point-to-bus connection. The user-friendly menus enable transparent and intuitive access to the field devices. For details, see Operating Instructions BA00027S

System products

Accessories	Description
Graphic Data Manager Memograph M	The Advanced Data Manager Memograph M is a flexible and powerful system for organizing process values. 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. For details, see Technical Information TI01180R/09
RN221N	Active barrier with power supply for safe separation of 4 to 20 mA standard signal circuits. Has bidirectional HART® transmission and optional HART® diagnostics if transmitters are connected with monitoring of 4 to 20 mA signal or HART® status byte analysis and an E+H-specific diagnostic command. For details, see Technical Information TI00073R/09
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 For details, see Technical Information TI01043K/09

Supplementary documentation

Supplementary ATEX documentation:
- 0 Ex ia IIC T6...T4 Ga X, 1Ex d IIC T6...T4 Gb X, Ex tb IIIC T85°C...T105°C X: XA01453T
- ATEX/IECEx II 1G Ex ia IIC Ga, II 2D Ex ia IIIC Db: XA01689T
- ATEX/IECEx II 2D Ex tb IIIC T110 °C Db: XA00032R
- ATEX/IECEx II 1G Ex ia IIC: XA01688T

iTEMP TMT162 HART® Operating Instructions (BA01801T) and associated printed Brief Operating Instructions iTEMP TMT162 HART® (KA00250R)
Functional Safety Manual (SD01632T)



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