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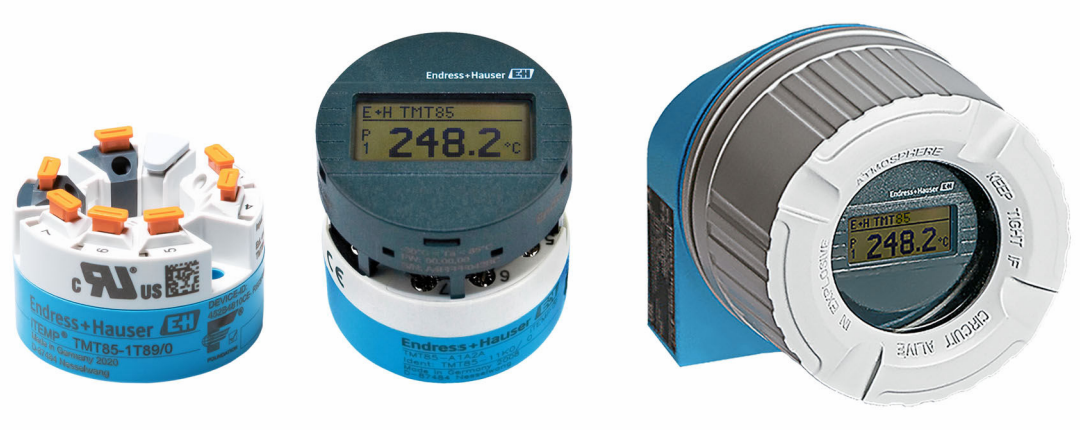
Technical Information
iTEMP TMT85

Temperature transmitter



FOUNDATION Fieldbus™ temperature transmitter as a head or field device with two universal sensor inputs for potentially explosive atmospheres

Application

- Two universal input channels and FOUNDATION Fieldbus™ protocol for the conversion of input signals into digital output signals
- The device stands out due to signal reliability, long-term stability, high precision and advanced diagnostics (important in critical processes)
- For the highest level of safety, reliability and risk reduction
- Installation in terminal head form B (flat face) as per DIN EN 50446
- Optional: Installation in field housing for Ex d applications
- Accessory: Wall or pipe mounting bracket for the field housing

Advantages

- Easy and standardized communication via FOUNDATION Fieldbus™ H1
- Straightforward design of measuring points in Ex-areas through FISCO/FNICO conformity in accordance with IEC 600079-27
- Safe operation in hazardous areas thanks to international approvals
- High accuracy of measuring point through sensor-transmitter matching
- Reliable operation with sensor monitoring and device hardware fault recognition
- Push-in terminals for fast, tool-free wiring during installation or maintenance

Endress+Hauser
People for Process Automation

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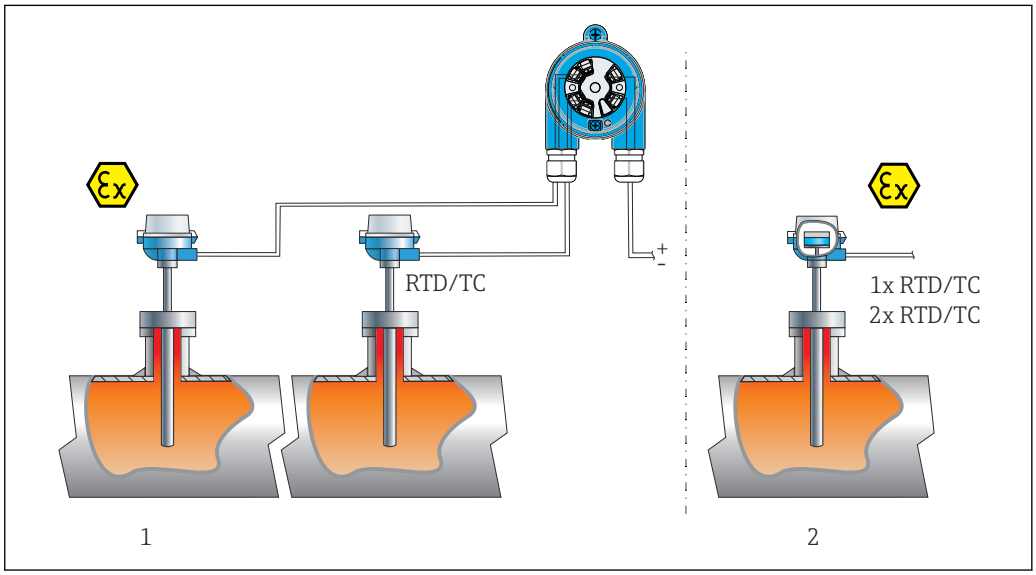
Function and system design

Measuring principle

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

Measuring system

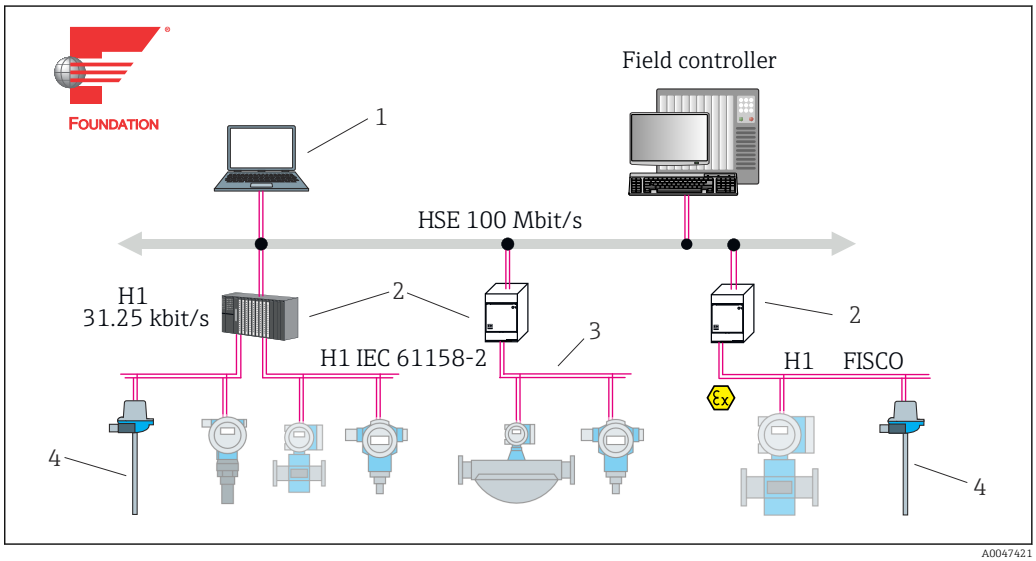


1 *Application examples*

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 *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.



2 *System integration via FOUNDATION Fieldbus™*

1 *Visualization and monitoring e.g. P View, FieldCare and diagnostic software*
2 *Linking device*
3 *32 devices per segment*
4 *Measuring point with installed transmitter*

The temperature transmitter is a 2-wire device with two measuring inputs. The device not only transfers converted signals from resistance thermometers and thermocouples, it also transfers

resistance and voltage signals using FOUNDATION Fieldbus™ communication. The device is powered via the FOUNDATION Fieldbus™ H1 bus and can be installed as an intrinsically safe apparatus in Zone 1 hazardous areas. The device is used for instrumentation purposes in the terminal head form B according to DIN EN 50446. Data transfer takes place via the following function blocks:

- 2 x 3 Analog Input (AI)
- 1 x Standard PID controller (PID)
- 1 x Input Selector (ISEL)

Standard diagnostic functions

- Open circuit, short-circuit, corrosion of sensor cables
- Incorrect wiring
- Internal device errors
- Overrange/underrange detection
- Ambient temperature out-of-range detection

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

Input

Measured variable

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

Measuring range

Two independent sensors can be connected. The measuring inputs are not galvanically isolated from each other.

Resistance thermometer (RTD) as per standard	Description	α	Measuring range limits
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 +250 °C (−328 to +482 °F) −200 to +250 °C (−328 to +482 °F)
JIS C1604:1984	Pt100 (5)	0.003916	−200 to +649 °C (−328 to +1 200 °F)
DIN 43760 IPTS-68	Ni100 (6) Ni1000	0.006180	−60 to +250 °C (−76 to +482 °F) −60 to +150 °C (−76 to +302 °F)
Edison Copper Winding No. 15	Cu10	0.004274	−100 to +260 °C (−148 to +500 °F)
Edison Curve	Ni120	0.006720	−70 to +270 °C (−94 to +518 °F)
GOST 6651-94	Pt50 (8) Pt100 (9)	0.003910	−200 to +1 100 °C (−328 to +2 012 °F) −200 to +850 °C (−328 to +1 562 °F)
OIML R84: 2003 GOST 6651-2009	Cu50 (10) Cu100 (11)	0.004280	−200 to +200 °C (−328 to +392 °F)
-	Pt100 (Callendar van Dusen) Nickel polynomial Copper polynomial	-	10 to 400 Ω, 10 to 2 000 Ω 10 to 400 Ω, 10 to 2 000 Ω 10 to 400 Ω, 10 to 2 000 Ω
	▪ Connection type: 2-wire, 3-wire or 4-wire connection, sensor current: ≤ 0.3 mA ▪ with 2-wire circuit, compensation of the wire resistance is 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

Thermocouples as per standard	Description	Measuring range limits	
IEC 60584, Part 1	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) −270 to +1 000 °C (−454 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) −260 to +400 °C (−436 to +752 °F)	Recommended temperature range: 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) +150 to +1 768 °C (+302 to +3 214 °F) +150 to +1 768 °C (+302 to +3 214 °F) −150 to +400 °C (−238 to +752 °F)
IEC 60584, Part 1; 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)
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)
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)
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)
	▪ 2-wire connection ▪ Internal reference junction (Pt100) ▪ External preset value: 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	

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

- FOUNDATION Fieldbus™ H1, IEC 61158-2
- Error current FDE (Fault Disconnection Electronic) = 0 mA
- Data transmission rate, supported baudrate: 31.25 kBit/s
- Signal encoding = Manchester II
- Output data:
  Available values via AI blocks: Temperature (PV), temp. sensor 1 + 2, terminal temperature
- LAS (Link Active Scheduler), LM (Link Master) function is supported: Therefore, the indicator can assume the head transmitter of a Link Active Scheduler (LAS) if the current Link Master (LM) is no longer available. The device is supplied as a BASIC device. To use the device as an LAS, this must be defined in the distributed control system and activated by downloading the configuration to the device.
- According to IEC 60079-27, FISCO/FNICO

Failure information

Status message in accordance with FOUNDATION Fieldbus™ specification.

Transmission behavior

Temperature-linear, resistance-linear, voltage-linear

Mains frequency filter

50/60 Hz

Galvanic isolation

U = 2 kV AC for 1 minute (input/output)

Switch-on delay

8 s

FOUNDATION Fieldbus™ basic data

Basic data

Device type	10CE (hex)
Device revision	02
Node address	Default: 247
ITK Version	6.0.1
ITK Certification Driver No.	IT085900
Link Master capability (LAS)	Yes
Choice of Link Master / Basic Device	Yes; factory setting: Basic Device
Number of VCRs	44
Number of link objects in VFD	50

Virtual communication references (VCRs)

Permanent entries	1
Completely configurable entries	43

Link settings

Slot time	8
Min. Inter PDU delay	10
Max. response delay slot time	24

Blocks

Block description	The Block Index [1].	Execution time (macro cycle ≤ 500 ms)	Block category
Resource block	400	-	Extended
Transducer Block Sensor 1	500	-	Manufacturer-specific
Transducer Block Sensor 2	600	-	Manufacturer-specific
Transducer Block Display	700	-	Manufacturer-specific
Transducer Block Adv. Diag.	800	-	Manufacturer-specific
Function Block AI1	900	30 ms	Extended
Function Block AI2	1000	30 ms	Extended
Function Block AI3	1100	30 ms	Extended
Function Block AI4	(1200)	30 ms (not instantiated)	Extended
Function Block AI5	(1300)	30 ms (not instantiated)	Extended
Function Block AI6	(1400	30 ms (not instantiated)	Extended

Block description	The Block Index [1].	Execution time (macro cycle ≤ 500 ms)	Block category
Function Block PID	1200 (1500)	25 ms	Standard
Function Block ISEL	1300 (1600)	20 ms	Standard

1) values in brackets are valid if all the AI blocks (AI1-AI6) are instantiated

Brief block description

Resource block

The Resource Block contains all the data that clearly identifies and characterizes the device. It is an electronic version of a nameplate on the device. In addition to parameters required to operate the device on the fieldbus, the Resource Block makes information available such as the order code, device ID, hardware version, firmware version, etc.

Transducer Block "Sensor 1" and "Sensor 2"

The Transducer Blocks of the head transmitter contain all the measurement-specific and device-specific parameters which are relevant for the measurement of the input variables.

Display Transducer

The parameters of the "Display" Transducer Block allow the configuration of the optional display.

Advanced Diagnostic

All the parameters for self-monitoring and diagnostics are grouped in this Transducer Block.

Analog Input (AI)

In the AI Function Block, the process variables from the Transducer Blocks are prepared for subsequent automation functions in the control system (e.g. scaling, limit value processing).

PID

This function block contains input channel processing, proportional integral-differential control (PID) and analog output channel processing. The following can be realized: Basic controls, feedforward control, cascade control and cascade control with limiting.

Input Selector (ISEL)

The Input Selector Block enables the selection of up to four inputs and generates an output based on the configured action.

Power supply

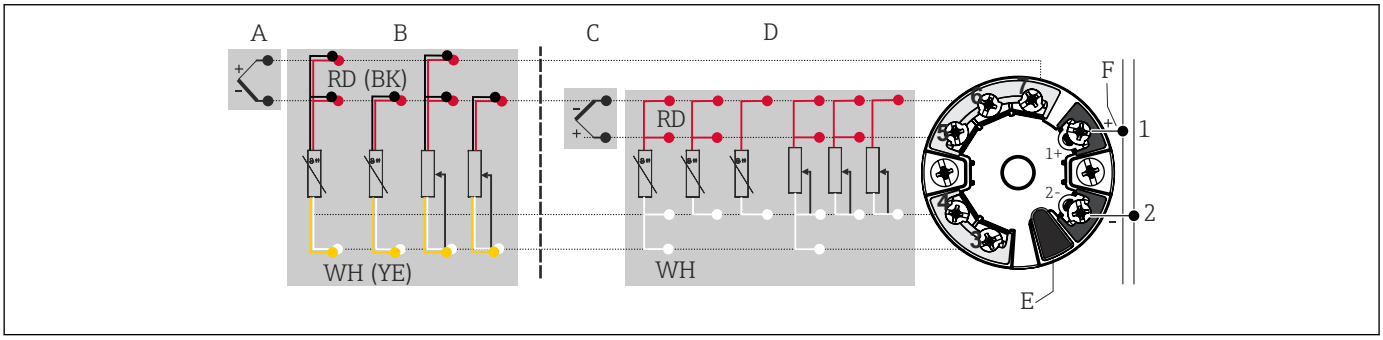
Supply voltage

U = 9 to 32 V DC, polarity-independent (max. voltage U_b = 35 V)

Current consumption

≤ 11 mA

Electrical connection



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3 *Assignment of terminal connections*

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

Terminals

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

Terminal version	Cable version	Cable cross-section
Screw terminals (with tabs on the fieldbus terminals for easy connection of a handheld terminal, e.g. FieldXpert, FC475, Trex)	Rigid or flexible	≤ 2.5 mm² (14 AWG)
Push-in terminals (cable design, stripping length = min. 10 mm (0.39 in)	Rigid or flexible	0.2 to 1.5 mm² (24 to 16 AWG)
	Flexible with wire end ferrules with/without plastic ferrule	0.25 to 1.5 mm² (24 to 16 AWG)

Ferrules must be used with push-in terminals and when using flexible cables with a cable cross-section of ≤ 0.3 mm². Otherwise, the use of ferrules when connecting flexible cables to push-in terminals is not recommended.

Performance characteristics

Response time

1s per channel

Reference operating conditions

- Calibration temperature: 25 °C ±5 K (77 °F ±9 °F)
- Supply voltage: 24 V DC
- 4-wire circuit for resistance adjustment

Maximum measurement error

In accordance with EN IEC 62828 and the reference operating conditions specified above. The measurement error data corresponds to ±2σ (Gaussian distribution). The data includes non-linearities and repeatability.

Typically

Standard	Designation	Measuring range	Typical measurement error (±)
Resistance thermometer (RTD) as per standard			Digital value [1]
IEC 60751:2008	Pt100 (1)	0 to 200 °C (32 to 392 °F)	0.08 °C (0.14 °F)
IEC 60751:2008	Pt1000 (4)		0.08 K (0.14 °F)

Standard	Designation	Measuring range	Typical measurement error (±)
GOST 6651-94	Pt100 (9)		0.07 °C (0.13 °F)
Thermocouples (TC) as per standard			Digital value [1]
IEC 60584, Part 1	Type K (NiCr-Ni) (36)	0 to 800 °C (32 to 1 472 °F)	0.31 °C (0.56 °F)
IEC 60584, Part 1	Type S (PtRh10-Pt) (39)		0.84 °C (1.51 °F)
GOST R8.585-2001	Type L (NiCr-CuNi) (43)		2.18 °C (3.92 °F)

1) Measured value transmitted via FIELDBUS®.

Measurement error for resistance thermometers (RTD) and resistance transmitters

Standard	Designation	Measuring range	Measurement error (±)	Non-repeatability: ±
			Digital [1]	
			Based on measured value [2]	
IEC 60751:2008	Pt100 (1)	−200 to 850 °C (−328 to 1 562 °F)	0.06 °C (0.11 °F) + 0.006% * (MV - LRV)	≤ 0.05 °C (0.09 °F)
	Pt200 (2)		0.11 °C (0.2 °F) + 0.018% * (MV - LRV)	≤ 0.13 °C (0.23 °F)
	Pt500 (3)	−200 to 250 °C (−328 to 482 °F)	0.05 °C (0.09 °F) + 0.015% * (MV - LRV)	≤ 0.08 °C (0.14 °F)
	Pt1000 (4)	−200 to 250 °C (−328 to 482 °F)	0.03 °C (0.05 °F) + 0.013% * (MV - LRV)	≤ 0.05 °C (0.09 °F)
JIS C1604:1984	Pt100 (5)	−200 to 649 °C (−328 to 1 200 °F)	0.05 °C (0.09 °F) + 0.006% * (MV - LRV)	≤ 0.04 °C (0.07 °F)
GOST 6651-94	Pt50 (8)	−200 to 1 100 °C (−328 to 2 012 °F)	0.10 °C (0.18 °F) + 0.008% * (MV - LRV)	≤ 0.11 °C (0.2 °F)
	Pt100 (9)	−200 to 850 °C (−328 to 1 562 °F)	0.05 °C (0.09 °F) + 0.006% * (MV - LRV)	≤ 0.05 °C (0.09 °F)
DIN 43760 IPTS-68	Ni100 (6)	−60 to 250 °C (−76 to 482 °F)	0.05 °C (0.09 °F) - 0.006% * (MV - LRV)	≤ 0.03 °C (0.05 °F)
	Ni1000	−60 to 150 °C (−76 to 302 °F)		
OIML R84: 2003 / GOST 6651-2009	Cu50 (10)	−200 to 200 °C (−328 to 1 562 °F)	0.09 °C (0.16 °F) + 0.006% * (MV - LRV)	≤ 0.05 °C (0.09 °F)
	Cu100 (11)		0.05 °C (0.09 °F) + 0.003% * (MV - LRV)	≤ 0.04 °C (0.07 °F)
Resistance transmitter	Resistance Ω	10 to 400 Ω	max. 32 mΩ	15mΩ
		10 to 2 000 Ω	max. 300 mΩ	≤ 200mΩ

1) Measured value transmitted via FIELDBUS®.
2) Deviations from maximum measurement error possible due to rounding.

Measurement error for thermocouples (TC) and voltage transmitters

Standard	Designation	Measuring range	Measurement error (±)	Non-repeatability: ±
			Digital [1]	
			Based on measured value [2]	
IEC 60584-1	Type A (30)	0 to 2 500 °C (32 to 4 532 °F)	0.8 °C (1.44 °F) + 0.021% * MV	≤ 0.52 °C (0.94 °F)
	Type B (31)	500 to 1 820 °C (932 to 3 308 °F)	1.5 °C (2.7 °F) - 0.06% * (MV - LRV)	≤ 0.67 °C (1.21 °F)
IEC 60584-1 / ASTM E988-96	Type C (32)	0 to 2 000 °C (32 to 3 632 °F)	0.55 °C (1 °F) + 0.0055% * MV	≤ 0.33 °C (0.59 °F)
ASTM E988-96	Type D (33)		0.75 °C (1.44 °F) - 0.008% * MV	≤ 0.41 °C (0.74 °F)

Standard	Designation	Measuring range	Measurement error (±)	Non-repeatability: ±
IEC 60584-1	Type E (34)	−150 to 1 000 °C (−238 to 2 192 °F)	0.22 °C (0.40 °F) - 0.006% * (MV - LRV)	≤ 0.07 °C (0.13 °F)
	Type J (35)	−150 to 1 200 °C (−238 to 2 192 °F)	0.27 °C (0.49 °F) - 0.005% * (MV - LRV)	≤ 0.08 °C (0.14 °F)
	Type K (36)		0.35 °C (0.63 °F) - 0.005% * (MV - LRV)	≤ 0.11 °C (0.20 °F)
	Type N (37)	−150 to 1 300 °C (−238 to 2 372 °F)	0.48 °C (0.86 °F) - 0.014% * (MV - LRV)	≤ 0.16 °C (0.29 °F)
	Type R (38)	150 to 1 768 °C (302 to 3 214 °F)	0.9 °C (1.62 °F) - 0.015% * MV	≤ 0.76 °C (1.37 °F)
	Type S (39)		0.95 °C (1.71 °F) - 0.013% * MV	≤ 0.74 °C (1.33 °F)
	Type T (40)	−150 to 400 °C (−238 to 752 °F)	0.36 °C (0.47 °F) - 0.04% * (MV - LRV)	≤ 0.11 °C (0.20 °F)
DIN 43710	Type L (41)	−150 to 900 °C (−238 to 1 652 °F)	0.29 °C (0.52 °F) - 0.009% * (MV - LRV)	≤ 0.07 °C (0.13 °F)
	Type U (42)	−150 to 600 °C (−238 to 1 112 °F)	0.33 °C (0.6 °F) - 0.028% * (MV - LRV)	≤ 0.10 °C (0.18 °F)
GOST R8.585-2001	Type L (43)	−200 to 800 °C (−328 to 1 472 °F)	2.2 °C (4.00 °F) - 0.015% * (MV - LRV)	≤ 0.15 °C (0.27 °F)
Voltage transmitter (mV)		−20 to 100 mV	≤ 10 µV	4 µV

1) Measured value transmitted via fieldbus.
2) Deviations from maximum measurement error possible due to rounding.

MV = measured value

LRV = lower range value of the sensor in question

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

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 = 0.06 °C+ 0.006% x (200 °C - (-200 °C)):	0.084 °C (0.151 °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 = 0.06 °C+ 0.006% x (200 °C - (-200 °C)):	0.084 °C (0.151 °F)
Influence of ambient temperature = (35 - 25) x (0.002% x 200 °C - (-200 °C)), at least 0.005 °C	0.08 °C (0.144 °F)
Influence of supply voltage = (30 - 24) x (0.002% x 200 °C - (-200 °C)), at least 0.005 °C	0.048 °C (0.086 °F)
Measurement error: √(Measurement error² + Influence of ambient temperature² + Influence of supply voltage²)	**0.126 °C (0.227 °F)**

Resolution Resolution of A/D converter = 18 bit

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.

Operating influences

The measurement error data correspond to ±2 σ (Gaussian distribution).

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]	Digital [1]
		Based on measured value	Based on measured value
Pt100 (1)	IEC 60751:2008	0.002% * (MV -LRV), at least 0.005 °C (0.009 °F)	0.002% * (MV -LRV), at least 0.005 °C (0.009 °F)
Pt200 (2)		≤ 0.026 °C (0.047 °F)	≤ 0.026 °C (0.047 °F)
Pt500 (3)		0.002% * (MV -LRV), at least 0.009 °C (0.016 °F)	0.002% * (MV -LRV), at least 0.009 °C (0.016 °F)
Pt1000 (4)		0.002% * (MV -LRV), at least 0.004 °C (0.007 °F)	0.002% * (MV -LRV), at least 0.004 °C (0.007 °F)
Pt100 (5)	JIS C1604:1984	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	0.002% * (MV -LRV), at least 0.01 °C (0.018 °F)	0.002% * (MV -LRV), at least 0.01 °C (0.018 °F)
Pt100 (9)		0.002% * (MV -LRV), at least 0.005 °C (0.009 °F)	0.002% * (MV -LRV), at least 0.005 °C (0.009 °F)
Ni100 (6)	DIN 43760 IPTS-68	≤ 0.005 °C (0.009 °F)	≤ 0.005 °C (0.009 °F)
Ni1000		≤ 0.005 °C (0.009 °F)	≤ 0.005 °C (0.009 °F)
Cu50 (10)	OIML R84: 2003 / GOST 6651-2009	≤ 0.008 °C (0.014 °F)	≤ 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)
Resistance transmitter (Ω)			

Designation	Standard	Ambient temperature: Influence (±) per 1 °C (1.8 °F) change	Supply voltage: Influence (±) per V change
10 to 400 Ω		0.0015% * (MV -LRV), at least 1.5 mΩ	0.0015% * (MV -LRV), at least 1.5 mΩ
10 to 2 000 Ω		0.0015% * (MV -LRV), at least 15 mΩ	0.0015% * (MV -LRV), at least 15 mΩ

1) Measured value transmitted via fieldbus.

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]	Digital
		Based on measured value	Based on measured value
Type A (30)	IEC 60584-1	0.0055% * MV, at least 0.03 °C (0.005 °F)	0.0055% * MV, at least 0.03 °C (0.005 °F)
Type B (31)		≤ 0.06 °C (0.11 °F)	≤ 0.06 °C (0.11 °F)
Type C (32)	IEC 60584-1 / ASTM E988-96	0.0045% * MV, at least 0.03 °C (0.005 °F)	0.0045% * MV, at least 0.03 °C (0.005 °F)
Type D (33)	ASTM E988-96	0.004% * MV, at least 0.035 °C (0.063 °F)	0.004% * MV, at least 0.035 °C (0.063 °F)
Type E (34)	IEC 60584-1	0.003% * (MV -LRV), at least 0.016 °C (0.029 °F)	0.003% * (MV -LRV), at least 0.016 °C (0.029 °F)
Type J (35)		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)		0.0035% * MV, at least 0.047 °C (0.085 °F)	0.0035% * MV, 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	≤ 0.02 °C (0.04 °F)	≤ 0.02 °C (0.04 °F)
Voltage transmitter (mV)			
−20 to 100 mV	-	≤ 3 µV	≤ 3 µV

1) Measured value transmitted via fieldbus.

MV = measured value

LRV = lower range value of the sensor in question

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

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

Designation	Standard	Long-term drift (±)		
		after 1 year	after 3 years	after 5 years
		Maximum		
Pt100 (1)	IEC 60751:2008	≤ 0.03 °C (0.05 °F) + 0.024% * span	≤ 0.042 °C (0.076 °F) + 0.035% * span	≤ 0.051 °C (0.092 °F) + 0.037% * span
Pt200 (2)		≤ 0.17 °C (0.31 °F) + 0.016% * span	≤ 0.28 °C (0.5 °F) + 0.022% * span	≤ 0.343 °C (0.617 °F) + 0.025% * span
Pt500 (3)		≤ 0.067 °C (0.121 °F) + 0.018% * span	≤ 0.111 °C (0.2 °F) + 0.025% * span	≤ 0.137 °C (0.246 °F) + 0.028% * span
Pt1000 (4)		≤ 0.034 °C (0.06 °F) + 0.02% * span	≤ 0.056 °C (0.1 °F) + 0.029% * span	≤ 0.069 °C (0.124 °F) + 0.032% * span
Pt100 (5)	JIS C1604:1984	≤ 0.03 °C (0.054 °F) + 0.022% * span	≤ 0.042 °C (0.076 °F) + 0.032% * span	≤ 0.051 °C (0.092 °F) + 0.034% * span
Pt50 (8)	GOST 6651-94	≤ 0.055 °C (0.01 °F) + 0.023% * span	≤ 0.089 °C (0.16 °F) + 0.032% * span	≤ 0.1 °C (0.18 °F) + 0.035% * span
Pt100 (9)	GOST 6651-94	≤ 0.03 °C (0.054 °F) + 0.024% * span	≤ 0.042 °C (0.076 °F) + 0.034% * span	≤ 0.051 °C (0.092 °F) + 0.037% * span
Ni100 (6)	DIN 43760 IPTS-68	≤ 0.025 °C (0.045 °F) + 0.016% * span	≤ 0.042 °C (0.076 °F) + 0.02% * span	≤ 0.047 °C (0.085 °F) + 0.021% * span
Ni1000	DIN 43760 IPTS-68	≤ 0.02 °C (0.036 °F) + 0.018% * span	≤ 0.032 °C (0.058 °F) + 0.024% * span	≤ 0.036 °C (0.065 °F) + 0.025% * span
Cu50 (10)	OIML R84:2003 / GOST 6651-2009	≤ 0.053 °C (0.095 °F) + 0.013% * span	≤ 0.084 °C (0.151 °F) + 0.016% * span	≤ 0.094 °C (0.169 °F) + 0.016% * span
Cu100 (11)		≤ 0.027 °C (0.049 °F) + 0.019% * span	≤ 0.042 °C (0.076 °F) + 0.026% * span	≤ 0.047 °C (0.085 °F) + 0.027% * span
Resistance transmitter				
10 to 400 Ω	-	≤ 10 mΩ + 0.022% * span	≤ 14 mΩ + 0.031% * span	≤ 16 mΩ + 0.033% * span
10 to 2 000 Ω	-	≤ 144 mΩ + 0.019% * span	≤ 238 mΩ + 0.026% * span	≤ 294 mΩ + 0.028% * span

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

Designation	Standard	Long-term drift (±)		
		after 1 year	after 3 years	after 5 years
		Maximum		
Type A (30)	IEC 60584-1	≤ 0.17 °C (0.306 °F) + 0.021% * span	≤ 0.27 °C (0.486 °F) + 0.03% * span	≤ 0.38 °C (0.683 °F) + 0.035% * span
Type B (31)		≤ 0.5 °C (0.9 °F)	≤ 0.75 °C (1.35 °F)	≤ 1.0 °C (1.8 °F)
Type C (32)	IEC 60584-1 / ASTM E988-96	≤ 0.15 °C (0.27 °F) + 0.018% * span	≤ 0.24 °C (0.43 °F) + 0.026% * span	≤ 0.34 °C (0.61 °F) + 0.027% * span
Type D (33)	ASTM E988-96	≤ 0.21 °C (0.38 °F) + 0.015% * span	≤ 0.34 °C (0.61 °F) + 0.02% * span	≤ 0.47 °C (0.85 °F) + 0.02% * span
Type E (34)	IEC 60584-1	≤ 0.06 °C (0.11 °F) + 0.018% * span	≤ 0.09 °C (0.162 °F) + 0.025% * span	≤ 0.13 °C (0.234 °F) + 0.026% * span
Type J (35)	IEC 60584-1	≤ 0.06 °C (0.11 °F) + 0.019% * span	≤ 0.1 °C (0.18 °F) + 0.025% * span	≤ 0.14 °C (0.252 °F) + 0.027% * span
Type K (36)		≤ 0.09 °C (0.162 °F) + 0.017% * (MV+ 150 °C (270 °F))	≤ 0.14 °C (0.252 °F) + 0.023% * span	≤ 0.19 °C (0.342 °F) + 0.024% * span

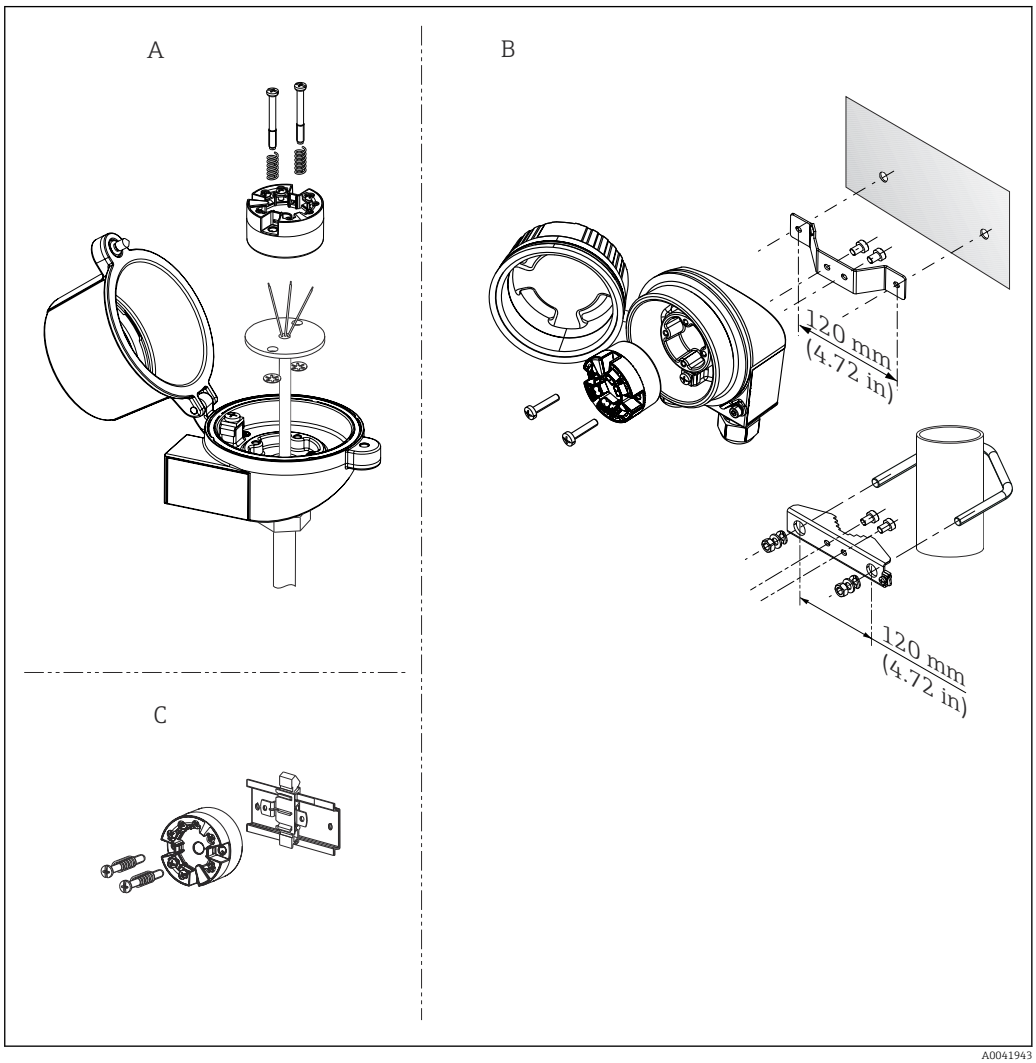
Designation	Standard	Long-term drift (±)		
Type N (37)	IEC 60584-1	≤ 0.13 °C (0.234 °F) + 0.015% * (MV + 150 °C (270 °F))	≤ 0.2 °C (0.36 °F) + 0.02% * span	≤ 0.28 °C (0.5 °F) + 0.02% * span
Type R (38)		≤ 0.31 °C (0.558 °F) + 0.011% * (MV- 50 °C (90 °F))	≤ 0.5 °C (0.9 °F) + 0.013% * span	≤ 0.69 °C (1.241 °F) + 0.011% * span
Type S (39)	IEC 60584-1	≤ 0.31 °C (0.558 °F) + 0.011% * span	≤ 0.5 °C (0.9 °F) + 0.013% * span	≤ 0.7 °C (1.259 °F) + 0.011% * span
Type T (40)		≤ 0.09 °C (0.162 °F) + 0.011% * span	≤ 0.15 °C (0.27 °F) + 0.013% * span	≤ 0.2 °C (0.36 °F) + 0.012% * span
Type L (41)		≤ 0.06 °C (0.108 °F) + 0.017% * span	≤ 0.1 °C (0.18 °F) + 0.022% * span	≤ 0.14 °C (0.252 °F) + 0.022% * span
Type U (42)		≤ 0.09 °C (0.162 °F) + 0.013% * span	≤ 0.14 °C (0.252 °F) + 0.017% * span	≤ 0.2 °C (0.360 °F) + 0.015% * span
Type L (43)	GOST R8.585-2001	≤ 0.08 °C (0.144 °F) + 0.015% * span	≤ 0.12 °C (0.216 °F) + 0.02% * span	≤ 0.17 °C (0.306 °F) + 0.02% * span
Voltage transmitter (mV)				
−20 to 100 mV	-	≤ 2 µV + 0.022% * span	≤ 3.5 µV + 0.03% * span	≤ 4.7 µV + 0.033% * span

Influence of reference junction

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

Mounting

Installation instructions



4 *Installation options for 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 clip on DIN rail as per IEC 60715 (TH35)

Orientation: No restrictions

When installing the head transmitter in a terminal head form B (flat face), make sure there is sufficient space in the terminal head!

Environment

Ambient temperature range	−40 to 85 °C (−40 to 185 °F), for hazardous areas, see Ex documentation
Storage temperature	−40 to 100 °C (−40 to 212 °F)
Relative humidity	▪ Condensation permitted as per IEC 60 068-2-33 ▪ Max. rel. humidity: 95% as per IEC 60068-2-30

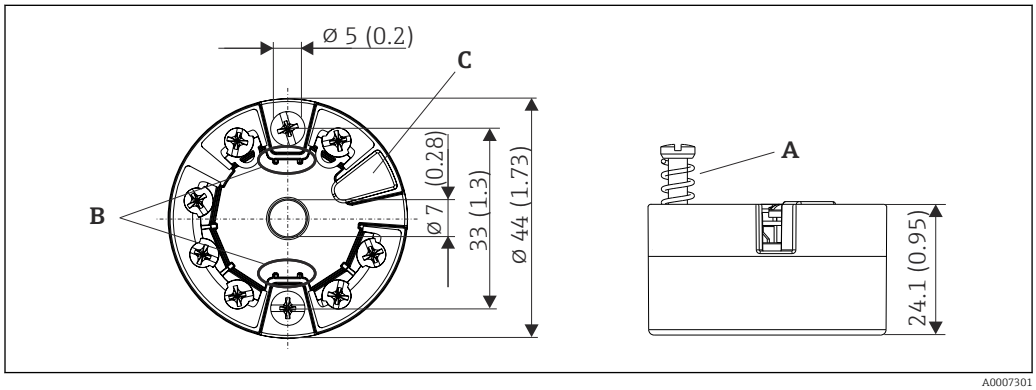
Altitude	Up to 4 000 m (13 123 ft) above mean sea level in accordance with IEC 61010-1, CAN/CSA C22.2 No. 61010-1
Climate class	C as per EN 60654-1
Degree of protection	▪ Head transmitter with screw or push-in terminals: IP 20. In the installed state, it depends on the terminal head or field housing used. ▪ When installing in field housing TA30A, TA30D or TA30H: IP 66/67 (NEMA Type 4x encl.)
Shock and vibration resistance	Vibration resistance as per IEC 60068-2-6: 10 to 2 000 Hz at 5g (increased vibration stress)
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 measurement 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
Overvoltage category	Measuring category II as per IEC 61010-1. The measuring category is provided for measuring on power circuits that are directly connected electrically with the low-voltage network.
Pollution level	Pollution degree 2 as per IEC 61010-1.

Mechanical construction

Design and dimensions

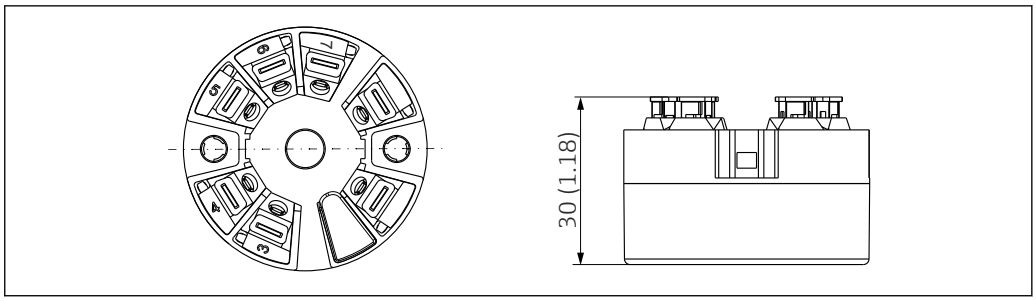
Dimensions in mm (in)

Head transmitter



5 Version with screw terminals

A Spring travel L ≥ 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



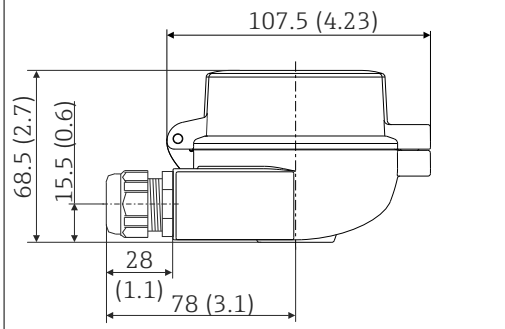
6 Version with push-in terminals. Dimensions are identical to the version with screw terminals, apart from housing height.

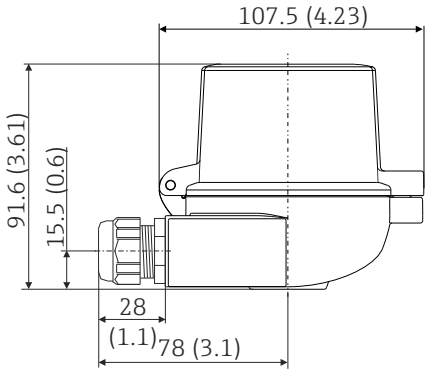
Field housing

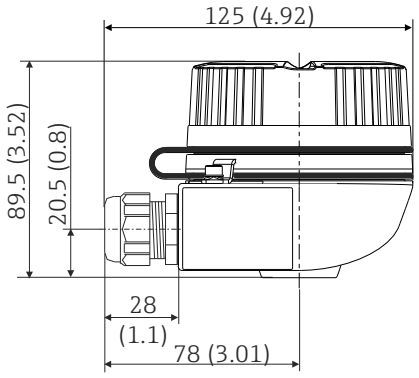
All field housings have an internal geometry in accordance with DIN EN 50446, Form B (flat face).
Cable glands in the diagrams: M20x1.5

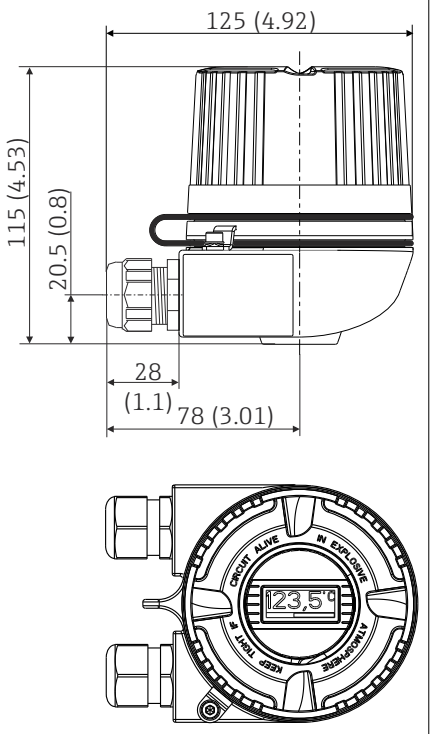
Maximum ambient temperatures for cable glands	
Type	**Temperature range**
Polyamide cable gland ½" NPT, M20x1.5 (non-Ex)	−40 to 100 °C (−40 to 212 °F)
Polyamide cable gland M20x1.5 (for dust ignition-proof area)	−20 to 95 °C (−4 to 203 °F)
Brass cable gland ½" NPT, M20x1.5 (for dust ignition-proof area)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

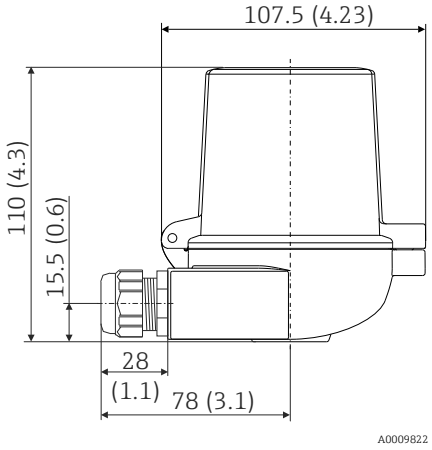
Maximum ambient temperatures for fieldbus connectors	
Type	**Temperature range**
Fieldbus connector (M12x1 PA, 7/8" PA, 7/8" FF)	−40 to 105 °C (−40 to 221 °F)

TA30A	Specification
	▪ Two cable entries ▪ Material: aluminum, polyester powder coated Seals: silicone ▪ Degree of protection: ▪ IP66/68 (NEMA Type 4x encl.) ▪ For ATEX: IP66/67 ▪ Cable entry glands: NPT ½" and M20x1.5 ▪ Head color: blue, RAL 5012 ▪ Cap color: gray, RAL 7035 ▪ Weight: 330 g (11.64 oz)

TA30A with display window in cover	Specification
	▪ Two cable entries ▪ Material: aluminum, polyester powder coated Seals: silicone ▪ Protection degree: ▪ IP66/68 (NEMA Type 4x encl.) ▪ For ATEX: IP66/67 ▪ Cable entry glands: NPT ½" and M20x1.5 ▪ Head color: blue, RAL 5012 ▪ Cap color: gray, RAL 7035 ▪ Weight: 420 g (14.81 oz) ▪ Display window: single-pane safety glass according to DIN 8902 ▪ Display window in cover for head transmitter with TID10 display

TA30H	Specification
	▪ Flameproof (XP) version, explosion-protected, captive screw cap, with two cable entries ▪ Degree of protection: IP 66/68, NEMA Type 4x Encl. Ex-version: IP 66/67 ▪ Material: ▪ Aluminum, with polyester powder coating ▪ Stainless steel 316L without coating ▪ Dry lubricant Klüber Syntheso Glep 1 ▪ Cable entry glands: NPT ½", M20x1.5 ▪ Color of aluminum head: blue, RAL 5012 ▪ Color of aluminum cap: gray, RAL 7035 ▪ Weight: ▪ Aluminum approx. 640 g (22.6 oz) ▪ Stainless steel approx. 2 400 g (84.7 oz) 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).

TA30H with display window in cover	Specification
	▪ Flameproof (XP) version, explosion-protected, captive screw cap, with two cable entries ▪ Degree of protection: IP 66/68, NEMA Type 4x Encl. Ex-version: IP 66/67 ▪ Material: ▪ Aluminum with polyester powder coating ▪ Stainless steel 316L without coating ▪ Dry lubricant Klüber Syntheso Glep 1 ▪ Display window: single-pane safety glass according to DIN 8902 ▪ Cable entry glands: NPT ½", M20x1.5 ▪ Color of aluminum head: blue, RAL 5012 ▪ Color of aluminum cap: gray, RAL 7035 ▪ Weight: ▪ Aluminum approx. 860 g (30.33 oz) ▪ Stainless steel approx. 2 900 g (102.3 oz) ▪ For display TID10 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).

TA30D	Specification
	▪ 2 cable entries ▪ Material: aluminum, polyester powder coated Seals: silicone ▪ Degree of protection: ▪ IP66/68 (NEMA Type 4x encl.) ▪ For ATEX: IP66/67 ▪ Cable entry glands: NPT ½" and M20x1.5 ▪ 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. ▪ Head color: blue, RAL 5012 ▪ Cap color: gray, RAL 7035 ▪ Weight: 390 g (13.75 oz)

Weight

- Head transmitter: approx. 40 to 50 g (1.4 to 1.8 oz)
- Field housing: see specifications

Materials

All the materials used are RoHS-compliant.

- Housing: Polycarbonate (PC), complies with UL94 HB (fire resistance properties)
- Terminals:
  - Screw terminals: nickel-plated brass and gold-plated or tin-plated contacts
  - Push-in terminals: tin-plated brass, contact springs 1.4310, 301 (AISI)
- Potting: PU, corresponds to UL94 V0 WEVO PU 403 FP / FL (fire resistance properties)

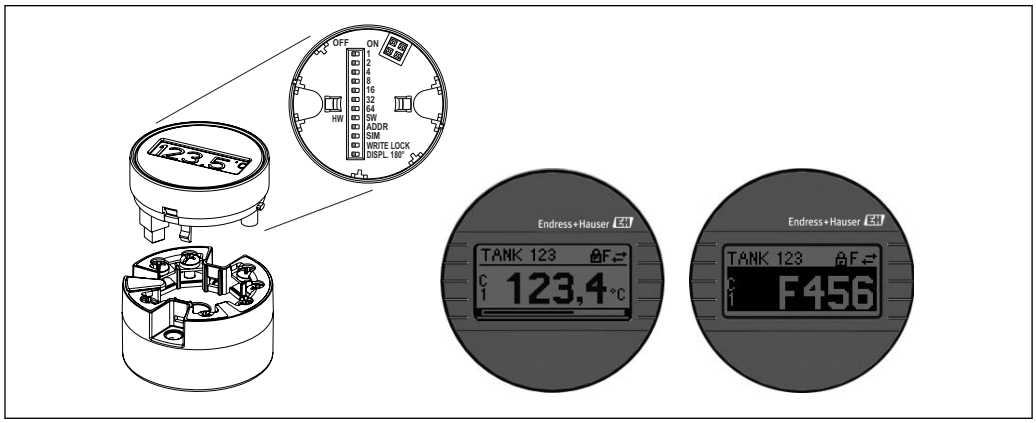
Field housing: see specifications

Display and user interface

Local 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. 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, such as write protection.



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

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.

Remote operation

FOUNDATION Fieldbus™ and device-specific parameters are configured via fieldbus communication. There are special configuration tools from different manufacturers available for this purpose. Please contact the manufacturer for further information.

Certificates and approvals

Current certificates and approvals for the product are available at 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**.

FOUNDATION Fieldbus™ certification

The temperature transmitter is certified and registered by the Fieldbus FOUNDATION. The measuring system meets all the requirements of the following specifications:

- Certified in accordance with FOUNDATION Fieldbus™ specification
- FOUNDATION Fieldbus™ H1
- Interoperability Test Kit (ITK), revision status 6.0.1 (device certification number available on request): The device can also be operated with certified devices of other manufacturers
- Physical Layer Conformance Test of the Fieldbus FOUNDATION™ (FF-830 FS 2.0)

Ordering information

Detailed ordering information is available from your nearest sales organization www.addresses.endress.com or in the Product Configurator at 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

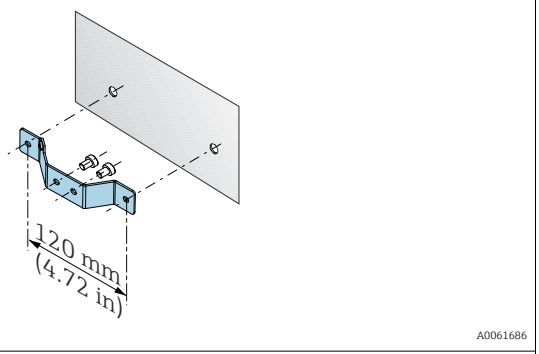
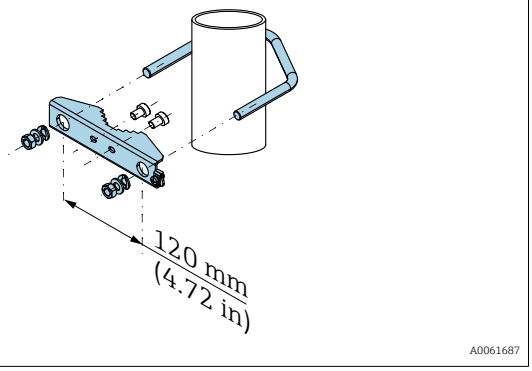
Accessories

The accessories currently available for the product can be selected at www.endress.com:

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

Device-specific accessories

Accessories	
Measured value display TID10 for iTEMP head transmitter, attachable	
TID10 service cable to remotely operate the display for service work; length 40 cm	
Field housing TA30x for iTEMP head transmitter	
Adapter for DIN rail mounting, clip as per IEC 60715 (TH35) without securing screws	
Standard - DIN mounting set (2 screws + springs, 4 securing disks and 1 display connector cover)	
US – M4 securing screws (2 M4 screws and 1 display connector cover)	
Fieldbus connector (FF):	▪ NPT ½" → 7/8" ▪ M20 → 7/8"

Accessories enclosed	
Wall mounting bracket, 316 L	 A0061686
Pipe mounting bracket, 316 L	 A0061687

Communication-specific accessories

Commubox FXA291

Connects Endress+Hauser field devices with a CDI interface (= Endress+Hauser Common Data Interface) and the USB port of a computer or laptop.

For more information, please refer to: www.endress.com

Field Xpert SMT70B
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.

Technical Information TI01814S

www.endress.com/smt70b

Service-specific accessories

DeviceCare SFE100
DeviceCare is an Endress+Hauser configuration tool for field devices using the following communication protocols: HART, PROFIBUS DP/PA, FOUNDATION Fieldbus, IO/Link, Modbus, CDI and Endress+Hauser Common Data Interfaces.

Technical Information TI01134S

www.endress.com/sfe100

FieldCare SFE500
FieldCare is a configuration tool for Endress+Hauser and third-party field devices based on DTM technology.
The following communication protocols are supported: HART, WirelessHART, PROFIBUS, FOUNDATION Fieldbus, Modbus, IO-Link, EtherNet/IP, PROFINET and PROFINET APL.

Technical Information TI00028S

www.endress.com/sfe500

Netilion
With the Netilion IIoT ecosystem, Endress+Hauser enables the optimization of plant performance, digitization of workflows, sharing of knowledge and improved collaboration. Drawing upon decades of experience in process automation, Endress+Hauser offers the process industry an IIoT ecosystem designed to effortlessly extract insights from data. These insights allow process optimization, leading to increased plant availability, efficiency, reliability and ultimately a more profitable plant.

www.netilion.endress.com

Online tools

Product information about the entire life cycle of the device is available at:
www.endress.com/onlinetools

Documentation

The following document types are available in the Downloads area of the Endress+Hauser website (www.endress.com/downloads), depending on the product configuration:

Document type	Purpose and content of the document
Technical Information (TI)	**Planning aid** This document contains all the technical data on the product and provides an overview of everything that can be ordered with the product.
Brief Operating Instructions (KA)	**Quick guide to obtaining the first measured value** The Operating Instructions contain all the essential information about the product from incoming acceptance to initial commissioning.

Document type	Purpose and content of the document
Operating Instructions (BA)	**Reference** The Operating Instructions contain the information that is required in the various phases of the life cycle of the product: From product identification, incoming acceptance and storage, to mounting, connection, operation and commissioning through to troubleshooting, maintenance and disposal.
Description of Device Parameters (GP)	**Reference for parameters** The document contains detailed explanations of readable or configurable parameters in the product. The description is aimed at those who work with the product over its entire life cycle and perform specific configurations.
Safety Instructions (XA)	Safety Instructions for electrical equipment in hazardous areas are supplied with the product depending on the approval. These are an integral part of the Operating Instructions. The nameplate indicates the Safety Instructions (XA) that are relevant to the product.
Supplementary device-dependent documentation (SD/FY)	Always comply strictly with the instructions in the relevant supplementary documentation. The supplementary documentation is an integral part of the product documentation.

www.addresses.endress.com

Endress+Hauser

People for Process Automation