TI01605T/09/EN/01.22-00
71588784
2022-04-30

Technical Information
iTEMP TMT86

Dual-input temperature transmitter PROFINET with Ethernet-APL



Applications

- Ethernet-APL: 2-wire Ethernet IEEE 802.3cg 10BASE-T1L
- Temperature measurement with two independent universal inputs (RTD, Ω, TC, mV)
- System integration with PROFINET®
- Installation in terminal head form B (flat face) as per DIN EN 50446
- Optional: installation in field housing for Ex d applications
- Reliability, long-term stability, high precision and advanced diagnostic function in critical processes

Your benefits

- Digital communication down to the field level, even in explosive atmospheres
- Easy and standardized system integration via PROFINET® Profile 4
- Integrated web server offers simplicity during engineering, commissioning and maintenance
- High accuracy of measuring point through sensor-transmitter matching
- Reliable operation with sensor monitoring and device hardware fault recognition
- Fast and tool-free wiring thanks to push-in terminal technology, optional
- Attachable measured value display, optional

Endress+Hauser
People for Process Automation

Table of contents

Function and system design 3
Measuring principle 3
Measuring system 3
Equipment architecture 4
Dependability 4

Input 5
Measured variable 5
Measuring range 5
Type of input 6

Output 6
Output signal 6
Signal on alarm 6
Linearization 6
Galvanic isolation 6
Protocol-specific data 7

Power supply 7
Supply voltage 7
Electrical connection 8
Terminals 8

Performance characteristics 8
Response time 8
Reference operating conditions 8
Maximum measured error 8
Sensor adjustment 10
Operating influences 11
Influence of the cold junction 13

Mounting 14
Installation instructions 14

Environment 14
Ambient temperature range 14
Storage temperature 15
Operating altitude 15
Relative humidity 15
Climate class 15
Degree of protection 15
Shock and vibration resistance 15
Electromagnetic compatibility (EMC) 15
Overvoltage category 15
Pollution degree 15
Insulation class 15

Mechanical construction 16
Design, dimensions 16
Weight 18
Materials 18

Operability 19
Operating concept 19
Local operation 19
Remote operation 19
System integration 19
Supported operating tools 19

Certificates and approvals 20
Certification PROFINET®-APL 20
MTTF 20

Ordering information 20

Accessories 20
Device-specific accessories 21
Communication-specific accessories 21
Service-specific accessories 21

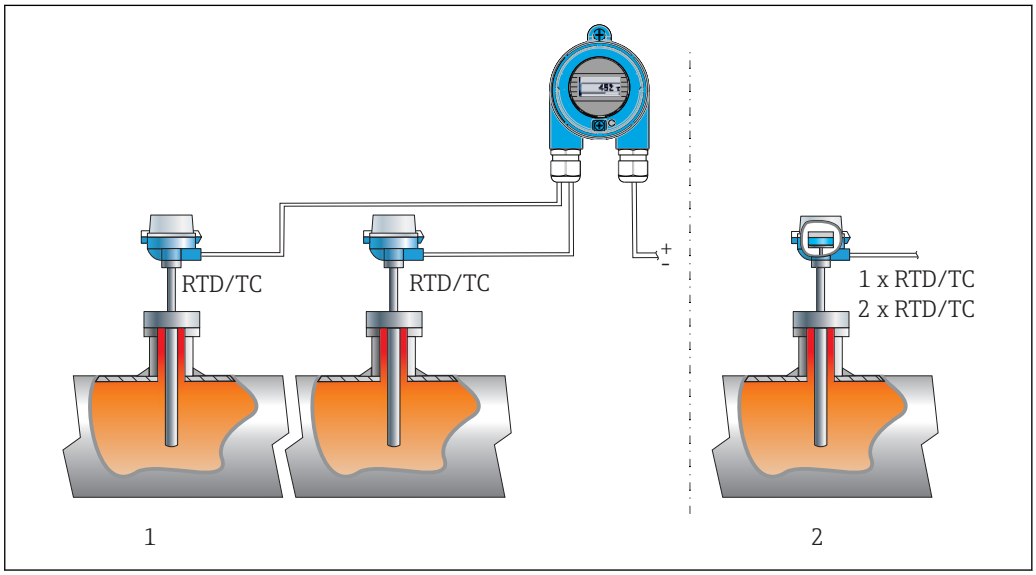
Supplementary documentation 21

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*
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.

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 the PROFINET® protocol. Power is supplied via the 2-wire Ethernet connection according to IEEE 802.3cg 10BASE-T1L. The transmitter can be installed as an intrinsically safe electrical apparatus in Zone 1 hazardous areas. The device can be used for instrumentation purposes in the terminal head form B (flat face) according to DIN EN 50446.

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

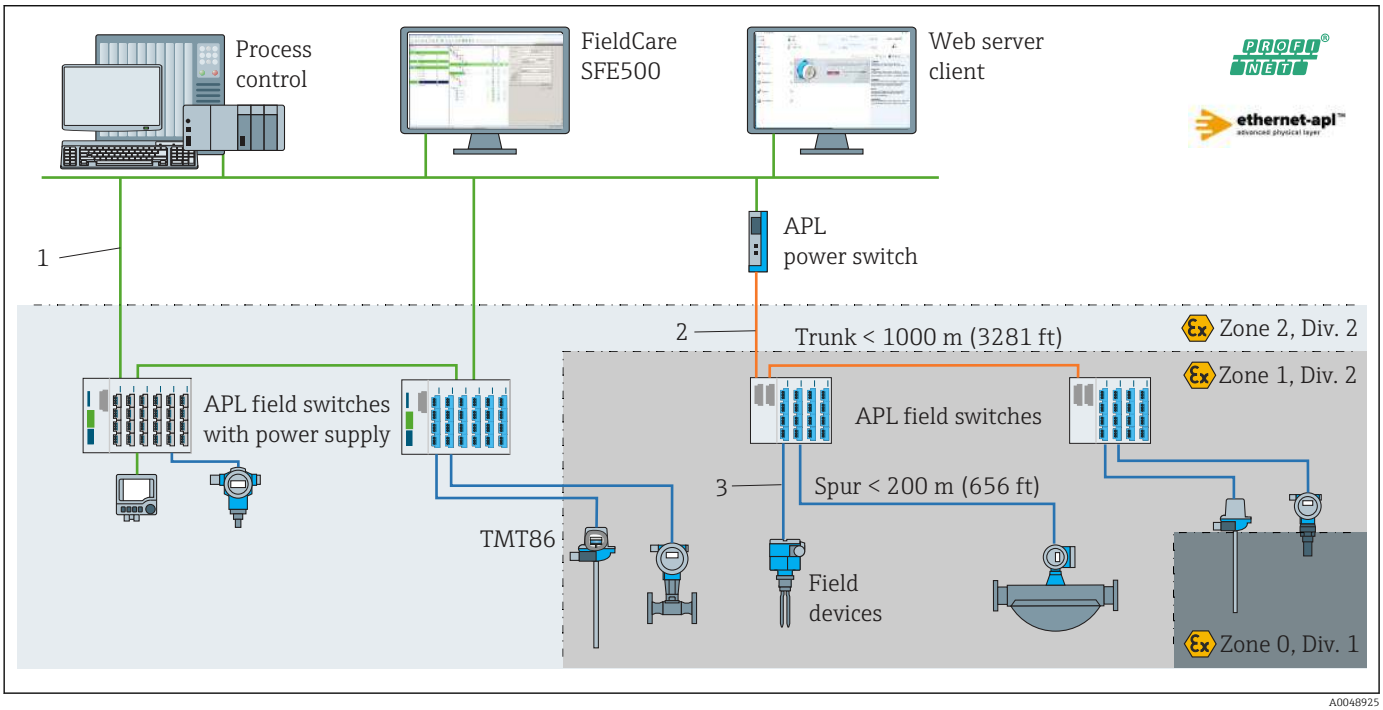
Corrosion detection as per NAMUR NE89

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

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
- Mean value or differential measurement from two sensors

Equipment architecture



2 *Equipment architecture of the transmitter with PROFINET with Ethernet-APL communication*

1 Facility Ethernet
2 Ethernet-APL with advanced safety
3 Ethernet-APL with intrinsic safety

Dependability

IT security

Endress+Hauser can only provide a warranty if the device is installed and used as described in the Operating Instructions. The device is equipped with security mechanisms to protect it against any inadvertent changes to the device settings. IT security measures in line with operators' security standards and designed to provide additional protection for the device and device data transfer must be implemented by the operators themselves.

Device-specific IT security

The device offers specific functions to support protective measures by the operator. These functions can be configured by the user and guarantee greater in-operation safety if used correctly. An overview of the most important functions is provided in the following section:

Password to change the user role [1)]

Function/interface	Factory setting	Recommendation
Password (also applies for web server login or FieldCare connection)	Not enabled (0000)	Assign an individual password when commissioning.
Web server	Enabled	On an individual basis following risk assessment.
Service interface (CDI)	Enabled	On an individual basis following risk assessment.
Write protection via hardware write protection switch (optional via display)	Not enabled	On an individual basis following risk assessment.

Protecting access via a password

Different passwords are available to protect write access to the parameters of the device.

1) FDI driver package

Protect write access to the parameters of the device via the web browser or operating tool (e.g. FieldCare, DeviceCare). Access authorization is clearly regulated through the use of a user-specific password.

Access via web server

The device can be operated and configured via a web browser with the integrated web server. For device versions with the PROFINET® communication protocol, the connection can be established via the terminal connection for signal transmission with PROFINET®.

For detailed information on device parameters, see:
"Description of Device Parameters" document

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 60751:2022	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 +500 °C (−328 to +932 °F)
JIS C1604:1984	Pt100 (5)	0.003916	−200 to +510 °C (−328 to +950 °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)
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)
OIML R84: 2003, GOST 6651-94	Cu50 (14)	0.004260	−50 to +200 °C (−58 to +392 °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.
	▪ Connection type: 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 2 850 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) 0 to +1 820 °C (+32 to +3 308 °F) [1)] −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)	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) +200 to +1 768 °C (+392 to +3 214 °F) +200 to +1 768 °C (+392 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)

Thermocouples as per standard	Description	Measuring range limits	
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)
	▪ Internal cold 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	

1) In the undefined range between 0 °C (+32 °F) and +45 °C (+113 °F), the device will constantly output +20 °C (+68 °F) without a diagnostic message. This is intended for installation start-ups at room temperature.

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**	**TC, voltage transmitter, internal CJ**	**TC, voltage transmitter, external CJ**
Sensor input 2	**RTD or resistance transmitter, 2-wire**	✔	✔	-	✔	-
	RTD or resistance transmitter, 3-wire	✔	✔	-	✔	-
	RTD or resistance transmitter, 4-wire	-	-	-	-	-
	TC, voltage transmitter, internal CJ	✔	✔	✔	✔	-
	TC, voltage transmitter, external CJ	✔	✔	-	-	✔

Internal and external cold junctions (CJ) are selectable reference junction measurements for the connection of thermocouple sensors (TC).
- Internal CJ: the internal cold junction temperature is used.
- External CJ: an RTD resistance sensor Pt1000 must also be connected. → 🖹 8

Output

Output signal

PROFINET® according to IEEE 802.3cg 10BASE-T1L, 2-wire 10 Mbps

Signal on alarm

PROFINET®: according to "Application Layer protocol for decentralized periphery", Version 2.4

Linearization

Temperature-linear, resistance-linear, voltage-linear

Galvanic isolation

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

Protocol-specific data

Protocol	Application layer protocol for decentral device periphery and distributed automation, Version 2.4
Communication type	10 Mbps
Conformance Class	Conformance Class B
Netload Class	Netload Class 10BASE-T1L
Baud rates	Automatic 10 Mbps with full-duplex detection
Cycle times	128 ms
Polarity	Auto-polarity for automatic correction of crossed TxD and RxD pairs
Real Time Class	Class 1
Media Redundancy Protocol (MRP)	No
System redundancy support	System redundancy S2 (4 AR with 1 NAP)
Neighborhood detection (LLDP)	Yes
Device profile	Profile DeviceID 0xB300 Generic device
Manufacturer ID	0x11
Device type ID	0xA3FF
Device description files (GSD, FDI, EDD)	Information and files at: ▪ www.endress.com. On the product page for the device: Documents/Software → Device drivers ▪ www.profibus.com
Supported connections	2 x AR (IO Controller AR) 2 x AR (device access, acyclic communication)
Configuration options	▪ Manufacturer-specific software (FieldCare, DeviceCare) ▪ Web browser ▪ Device master file (GSD): can be read out via the integrated web server of the measuring device.
Configuration of the device label	▪ DCP protocol ▪ Field Device Integration (FDI) ▪ Process Device Manager (PDM) ▪ Integrated web server

Power supply

Supply voltage

The device may only be operated according to the following APL port classifications:
- If used in hazardous areas: SLAA or SLAC
- If used in non-hazardous areas: SLAX

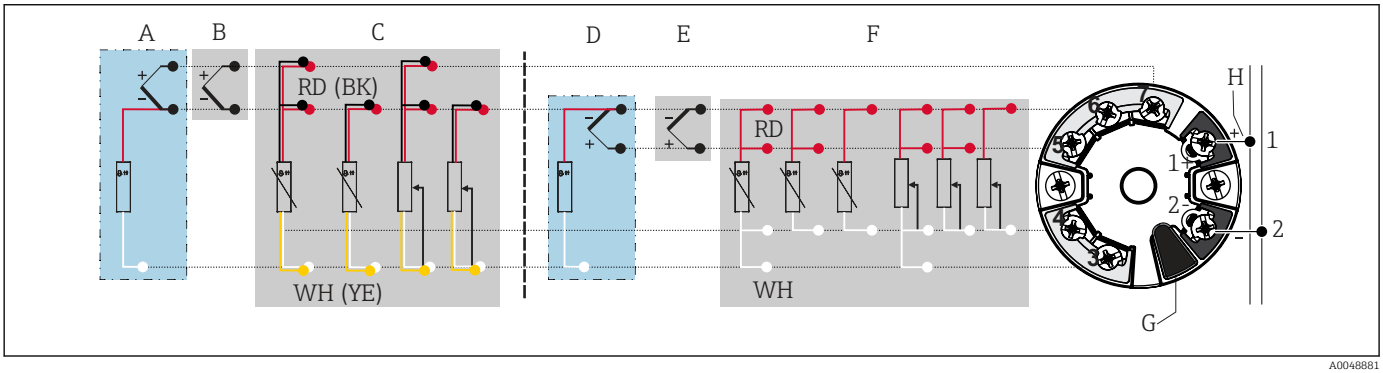
Connection values of APL field switch (corresponds to APL port classification SPCC or SPAA, for instance):
- Maximum input voltage: 15 V_{DC} for APL
- Minimum output values: 0.54 W

Device connection to an SPE switch

If used in non-hazardous areas: suitable SPE switch. Prerequisite:
- Support of standard 10BASE-T1L
- Support of PoDL power class 10, 11 or 12
- Detection of SPE field devices without integrated PoDL module
- Polarity-independent

Connection values of SPE switch:
- Maximum input voltage: 30 V_{DC}
- Minimum output values: 1.85 W

Electrical connection



3 *Assignment of terminal connections for head transmitter*

A Sensor input 2, TC and mV, external cold junction (CJ) Pt1000
B Sensor input 2, TC and mV, internal cold junction (CJ)
C Sensor input 2, RTD and Ω, 2- and 3-wire
D Sensor input 1, TC and mV, external cold junction (CJ) Pt1000
E Sensor input 1, TC and mV, internal cold junction (CJ)
F Sensor input 1, RTD and Ω, 2-, 3- and 4-wire
G Display connection, service interface
H Bus terminator and power supply

Terminals

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

Terminal design	Cable design	Cable cross-section
Screw terminals	Rigid or flexible	≤ 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

- ≤ 0.5 s per channel RTD
- ≤ 0.5 s per channel TC
- ≤ 1.6 s per channel CJ

In the two-channel mode, the response times double due to sequential measured value acquisition.

Reference operating conditions

- Calibration temperature: +25 °C ±3 K (77 °F ±5.4 °F)
- Supply voltage: 15 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 corresponds to ±2 σ (Gaussian distribution). The data include non-linearities and repeatability.

Typical

Standard	Description	Measuring range	Typical measured error (±)
Resistance thermometer (RTD) as per standard			Digital value
IEC 60751:2022	Pt100 (1)	0 to +200 °C (32 to +392 °F)	0.08 °C (0.14 °F)

Standard	Description	Measuring range	Typical measured error (±)
IEC 60751:2022	Pt1000 (4)		0.06 °C (0.11 °F)
GOST 6651-94	Pt100 (9)		0.07 °C (0.13 °F)
Thermocouples (TC) as per standard			Digital value
IEC 60584, Part 1	Type K (NiCr-Ni) (36)	0 to +800 °C (32 to +1 472 °F)	0.36 °C (0.65 °F)
IEC 60584, Part 1	Type S (PtRh10-Pt) (39)		1.01 °C (1.82 °F)
GOST R8.585-2001	Type L (NiCr-CuNi) (43)		2.35 °C (4.23 °F)

Measured error for resistance thermometers (RTD) and resistance transmitters

Standard	Description	Measuring range	Measured error (±)
			Based on measured value
IEC 60751:2022	Pt100 (1)	−200 to +850 °C (−328 to +1 562 °F)	0.06 °C (0.11 °F) + 0.006% * (MV - LRV)
	Pt200 (2)		0.11 °C (0.2 °F) + 0.018% * (MV - LRV)
	Pt500 (3)	−200 to +500 °C (−328 to +932 °F)	0.05 °C (0.09 °F) + 0.015% * (MV - LRV)
	Pt1000 (4)	−200 to +500 °C (−328 to +932 °F)	0.03 °C (0.05 °F) + 0.013% * (MV - LRV)
JIS C1604:1984	Pt100 (5)	−200 to +510 °C (−328 to +950 °F)	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)	0.10 °C (0.18 °F) + 0.008% * (MV - LRV)
	Pt100 (9)	−200 to +850 °C (−328 to +1 562 °F)	0.05 °C (0.09 °F) + 0.006% * (MV - LRV)
OIML R84: 2003 / GOST 6651-2009	Cu50 (10)	−180 to +200 °C (−292 to +1 562 °F)	0.09 °C (0.16 °F) + 0.006% * (MV - LRV)
	Cu100 (11)		0.05 °C (0.09 °F) + 0.003% * (MV - LRV)
OIML R84: 2003, GOST 6651-94	Cu50 (14)	−50 to +200 °C (−58 to +392 °F)	0.09 °C (0.16 °F) + 0.004% * (MV - LRV)
Resistance transmitter	Resistance Ω	10 to 400 Ω	20 mΩ + 0.003% * (MV - LRV)
		10 to 2 850 Ω	100 mΩ + 0.006% * (MV - LRV)

Measured error for thermocouples (TC) and voltage transmitters

Standard	Description	Measuring range	Measured error (±)
			Based on measured value
IEC 60584-1	Type A (30)	0 to +2 500 °C (+32 to +4 532 °F)	0.9 °C (1.62 °F) + 0.025% * (MV - LRV)
	Type B (31)	+500 to +1 820 °C (+932 to +3 308 °F)	1.6 °C (2.88 °F) - 0.065% * (MV - LRV)
IEC 60584-1 / ASTM E988-96	Type C (32)	0 to +2 000 °C (+32 to +3 632 °F)	0.6 °C (1.08 °F) + 0.0055% * MV
ASTM E988-96	Type D (33)		0.8 °C (1.44 °F) - 0.008% * MV
IEC 60584-1	Type E (34)	−150 to +1 000 °C (−238 to +2 192 °F)	0.25 °C (0.45 °F) - 0.008% * (MV - LRV)
	Type J (35)	−150 to +1 200 °C (−238 to +2 192 °F)	0.3 °C (0.54 °F) - 0.007% * (MV - LRV)
	Type K (36)	−150 to +1 200 °C (−238 to +2 192 °F)	0.4 °C (0.72 °F) - 0.004% * (MV - LRV)
	Type N (37)	−150 to +1 300 °C (−238 to +2 372 °F)	0.5 °C (0.9 °F) - 0.015% * (MV - LRV)
	Type R (38)	+200 to +1 768 °C (+392 to +3 214 °F)	0.9 °C (1.62 °F) - 0.015% * MV
	Type S (39)		0.95 °C (1.71 °F) - 0.01% * MV
	Type T (40)	−150 to +400 °C (−238 to +752 °F)	0.4 °C (0.72 °F) - 0.04% * (MV - LRV)
DIN 43710	Type L (41)	−150 to +900 °C (−238 to +1 652 °F)	0.31 °C (0.56 °F) - 0.01% * (MV - LRV)
	Type U (42)	−150 to +600 °C (−238 to +1 112 °F)	0.35 °C (0.63 °F) - 0.03% * (MV - LRV)
GOST R8.585-2001	Type L (43)	−200 to +800 °C (−328 to +1 472 °F)	2.2 °C (3.96 °F) - 0.015% * (MV - LRV)

Standard	Description	Measuring range	Measured error (±)
Voltage transmitter (mV)		−20 to +100 mV	10 µV

MV = measured value

LRV = lower range value of the sensor in question

Sample calculation with Pt100, measuring range 0 to +200 °C (+32 to +392 °F), ambient temperature +25 °C (+77 °F), supply voltage 15 V:

Measured 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 9 V

Measured error = 0.06 °C + 0.006% x (200 °C - (-200 °C)):	0.084 °C (0.151 °F)
Influence of ambient temperature = (35 - 25) x (0.0013% x 200 °C - (-200 °C)), min. 0.003 °C	0.05 °C (0.09 °F)
Influence of supply voltage = (15 - 9) x (0.0007% x 200 °C - (-200 °C)), min. 0.005 °C	0.02 °C (0.03 °F)
Measured error: √(Measured error² + Influence of ambient temperature² + Influence of supply voltage²)	**0.10 °C (0.18 °F)**

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 measured error data corresponds to ±2 σ (Gaussian distribution).

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

Description	Standard	Ambient temperature: Influence (±) per 1 °C (1.8 °F) change		Supply voltage: Influence (±) per 1 V change	
		Digital		Digital	
		Maximum	Based on measured value	Maximum	Based on measured value
Pt100 (1)	IEC 60751:2022	≤ 0.013 °C (0.023 °F)	0.0013% * (MV - LRV), at least 0.002 °C (0.004 °F)	≤ 0.007 °C (0.013 °F)	0.0007% * (MV - LRV), at least 0.002 °C (0.004 °F)
Pt200 (2)		≤ 0.017 °C (0.031 °F)	0.002% * (MV - LRV), at least 0.012 °C (0.022 °F)	≤ 0.009 °C (0.016 °F)	0.001% * (MV - LRV), at least 0.008 °C (0.014 °F)
Pt500 (3)		≤ 0.008 °C (0.014 °F)	0.0013% * (MV - LRV), at least 0.005 °C (0.009 °F)	≤ 0.004 °C (0.007 °F)	0.0007% * (MV - LRV), at least 0.003 °C (0.005 °F)
Pt1000 (4)		≤ 0.008 °C (0.014 °F)	0.0013% * (MV - LRV), at least 0.002 °C (0.004 °F)		0.0007% * (MV - LRV), at least 0.002 °C (0.004 °F)
Pt100 (5)	JIS C1604:1984	≤ 0.009 °C (0.016 °F)	0.0015% * (MV - LRV), at least 0.002 °C (0.004 °F)		0.0007% * (MV - LRV), at least 0.002 °C (0.004 °F)
Pt50 (8)	GOST 6651-94	≤ 0.017 °C (0.031 °F)	0.0015% * (MV - LRV), at least 0.005 °C (0.009 °F)	≤ 0.009 °C (0.016 °F)	0.0007% * (MV - LRV), at least 0.003 °C (0.005 °F)
Pt100 (9)		≤ 0.013 °C (0.023 °F)	0.0015% * (MV - LRV), at least 0.002 °C (0.004 °F)	≤ 0.007 °C (0.013 °F)	0.0007% * (MV - LRV), at least 0.002 °C (0.004 °F)
Cu50 (10)	OIML R84: 2003 / GOST 6651-2009	≤ 0.005 °C (0.009 °F)	0.001% * (MV - LRV), at least 0.004 °C (0.007 °F)	≤ 0.002 °C (0.004 °F)	0.0007% * (MV - LRV), at least 0.003 °C (0.005 °F)
Cu100 (11)		≤ 0.004 °C (0.007 °F)	0.0015% * (MV - LRV), at least 0.002 °C (0.004 °F)		0.0007% * (MV - LRV), at least 0.002 °C (0.004 °F)
Cu50 (14)	OIML R84: 2003 / GOST 6651-94	≤ 0.005 °C (0.009 °F)	0.002% * (MV - LRV), at least 0.005 °C (0.009 °F)	≤ 0.002 °C (0.004 °F)	0.0007% * (MV - LRV), at least 0.003 °C (0.005 °F)
Resistance transmitter (Ω)					
10 to 400 Ω		≤ 4 mΩ	0.001% * MV, at least 1 mΩ	≤ 2 mΩ	0.0005% * MV, at least 1 mΩ
10 to 2 850 Ω		≤ 29 mΩ	0.001% * MV, at least 10 mΩ	≤ 14 mΩ	0.0005% * MV, at least 5 mΩ

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

Description	Standard	Ambient temperature: Influence (±) per 1 °C (1.8 °F) change		Supply voltage: Influence (±) per 1 V change	
		Digital		Digital	
		Maximum	Based on measured value	Maximum	Based on measured value
Type A (30)	IEC 60584-1/ ASTM E230-3	≤ 0.07 °C (0.13 °F)	0.003% * (MV - LRV), at least 0.01 °C (0.018 °F)	≤ 0.03 °C (0.054 °F)	0.0014% * (MV - LRV), at least 0.01 °C (0.018 °F)
Type B (31)		≤ 0.04 °C (0.07 °F)	-	≤ 0.02 °C (0.036 °F)	-
Type C (32)	IEC 60584-1 / ASTM E230-3 ASTM E988-96	≤ 0.04 °C (0.07 °F)	0.0021% * (MV - LRV), at least 0.01 °C (0.018 °F)	≤ 0.02 °C (0.036 °F)	0.0012% * (MV - LRV), at least 0.01 °C (0.018 °F)
Type D (33)	ASTM E988-96	≤ 0.04 °C (0.07 °F)	0.002% * (MV - LRV), at least 0.01 °C (0.018 °F)	≤ 0.02 °C (0.036 °F)	0.0011% * (MV - LRV), at least 0.0 °C (0.0 °F)
Type E (34)	IEC 60584-1 / ASTM E230-3	≤ 0.02 °C (0.036 °F)	0.0014% * (MV - LRV), at least 0.0 °C (0.0 °F)	≤ 0.01 °C (0.018 °F)	0.0008% * (MV - LRV), at least 0.0 °C (0.0 °F)
Type J (35)			0.0014% * (MV - LRV), at least 0.0 °C (0.0 °F)		0.0008% * MV, at least 0.0 °C (0.0 °F)

Description	Standard	Ambient temperature: Influence (±) per 1 °C (1.8 °F) change		Supply voltage: Influence (±) per 1 V change	
		Digital		Digital	
Type K (36)		≤ 0.02 °C (0.036 °F)	0.0015% * (MV - LRV), at least 0.0 °C (0.0 °F)	≤ 0.01 °C (0.018 °F)	0.0009% * (MV - LRV), at least 0.0 °C (0.0 °F)
Type N (37)			0.0014% * (MV - LRV), at least 0.010 °C (0.018 °F)		0.0008% * MV, at least 0.0 °C (0.0 °F)
Type R (38)		≤ 0.03 °C (0.054 °F)	-	≤ 0.02 °C (0.036 °F)	-
Type S (39)			-		-
Type T (40)		≤ 0.01 °C (0.018 °F)	-	0.01 °C (0.018 °F)	-
Type L (41)	DIN 43710		-		-
Type U (42)			-		-
Type L (43)	GOST R8.585-2001		-		-
Voltage transmitter (mV)					
–20 to 100 mV	-	≤ 1.5 µV	0.0015% * MV, at least 0.2µV	≤ 0.8 µV	0.0008% * MV, at least 0.1 µV

MV = measured value

LRV = lower range value of the sensor in question

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

Description	Standard	Long-term drift (±) [1]		
		after 1 year	after 3 years	after 5 years
		Based on measured value		
Pt100 (1)	IEC 60751:2022	≤ 0.007% * (MV - LRV) or 0.02 °C (0.04 °F)	≤ 0.0095% * (MV - LRV) or 0.03 °C (0.05 °F)	≤ 0.0105% * (MV - LRV) or 0.03 °C (0.05 °F)
Pt200 (2)		≤ 0.008% * (MV - LRV) or 0.08 °C (0.14 °F)	≤ 0.0105% * (MV - LRV) or 0.10 °C (0.18 °F)	≤ 0.0115% * (MV - LRV) or 0.04 °C (0.07 °F)
Pt500 (3)		≤ 0.006% * (MV - LRV) or 0.02 °C (0.04 °F)	≤ 0.008% * (MV - LRV) or 0.04 °C (0.07 °F)	≤ 0.009% * (MV - LRV) or 0.04 °C (0.07 °F)
Pt1000 (4)		≤ 0.006% * (MV - LRV) or 0.02 °C (0.04 °F)	≤ 0.008% * (MV - LRV) or 0.02 °C (0.04 °F)	≤ 0.009% * (MV - LRV) or 0.02 °C (0.04 °F)
Pt100 (5)	JIS C1604:1984	≤ 0.007% * (MV - LRV) or 0.02 °C (0.04 °F)	≤ 0.0095% * (MV - LRV) or 0.03 °C (0.05 °F)	≤ 0.0105% * (MV - LRV) or 0.03 °C (0.05 °F)
Pt50 (8)	GOST 6651-94	≤ 0.0075% * (MV - LRV) or 0.04 °C (0.08 °F)	≤ 0.01% * (MV - LRV) or 0.06 °C (0.11 °F)	≤ 0.011% * (MV - LRV) or 0.07 °C (0.12 °F)
Pt100 (9)		≤ 0.007% * (MV - LRV) or 0.02 °C (0.04 °F)	≤ 0.0095% * (MV - LRV) or 0.03 °C (0.05 °F)	≤ 0.0105% * (MV - LRV) or 0.03 °C (0.05 °F)
Cu50 (10)	OIML R84: 2003 / GOST 6651-2009	0.04 °C (0.07 °F)	0.05 °C (0.09 °F)	0.05 °C (0.09 °F)
Cu100 (11)		≤ 0.007% * (MV - LRV) or 0.02 °C (0.04 °F)	≤ 0.0095% * (MV - LRV) or 0.03 °C (0.05 °F)	≤ 0.0105% * (MV - LRV) or 0.03 °C (0.05 °F)
Cu50 (14)	OIML R84: 2003 / GOST 6651-94	0.04 °C (0.07 °F)	0.05 °C (0.09 °F)	0.05 °C (0.09 °F)
Resistance transmitter				
10 to 400 Ω		≤ 0.0055% * MV or 7 mΩ	≤ 0.0075% * MV or 10 mΩ	≤ 0.008% * (MV - LRV) or 11 mΩ
10 to 2 850 Ω		≤ 0.0055% * (MV - LRV) or 50 mΩ	≤ 0.0065% * (MV - LRV) or 60 mΩ	≤ 0.007% * (MV - LRV) or 70 mΩ

1) The larger value is valid

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

Description	Standard	Long-term drift (±) [1]		
		after 1 year	after 3 years	after 5 years
		Based on measured value		
Type A (30)	IEC 60584-1 / ASTM E230-3	≤ 0.044% * (MV - LRV) or 0.70 °C (1.26 °F)	≤ 0.058% * (MV - LRV) or 0.95 °C (1.71 °F)	≤ 0.063% * (MV - LRV) or 1.05 °C (1.89 °F)
Type B (31)		1.70 °C (3.06 °F)	2.20 °C (3.96 °F)	2.40 °C (4.32 °F)
Type C (32)	IEC 60584-1 / ASTM E230-3 ASTM E988-96	0.70 °C (1.26 °F)	0.95 °C (1.71 °F)	1.00 °C (1.80 °F)
Type D (33)	ASTM E988-96	0.90 °C (1.62 °F)	1.15 °C (2.07 °F)	1.30 °C (2.34 °F)
Type E (34)	IEC 60584-1 / ASTM E230-3	0.30 °C (0.54 °F)	0.35 °C (0.63 °F)	0.45 °C (0.81 °F)
Type J (35)			0.40 °C (0.72 °F)	0.44 °C (0.79 °F)
Type K (36)		0.40 °C (0.72 °F)	0.50 °C (0.90 °F)	0.50 °C (0.90 °F)
Type N (37)		0.55 °C (0.99 °F)	0.70 °C (1.26 °F)	0.75 °C (1.35 °F)
Type R (38)		1.30 °C (2.34 °F)	1.70 °C (3.06 °F)	1.85 °C (3.33 °F)
Type S (39)				
Type T (40)		0.40 °C (0.72 °F)	0.50 °C (0.90 °F)	0.55 °C (0.99 °F)
Type L (41)	DIN 43710	0.25 °C (0.45 °F)	0.35 °C (0.63 °F)	0.40 °C (0.72 °F)
Type U (42)		0.40 °C (0.72 °F)	0.50 °C (0.90 °F)	0.55 °C (0.99 °F)
Type L (43)	GOST R8.585-2001	0.30 °C (0.54 °F)	0.40 °C (0.72 °F)	0.45 °C (0.81 °F)
Voltage transmitter (mV)				
−20 to 100 mV		≤ 0.025% * MV or 8 µV	≤ 0.033% * MV or 11 µV	≤ 0.036% * MV or 12 µV

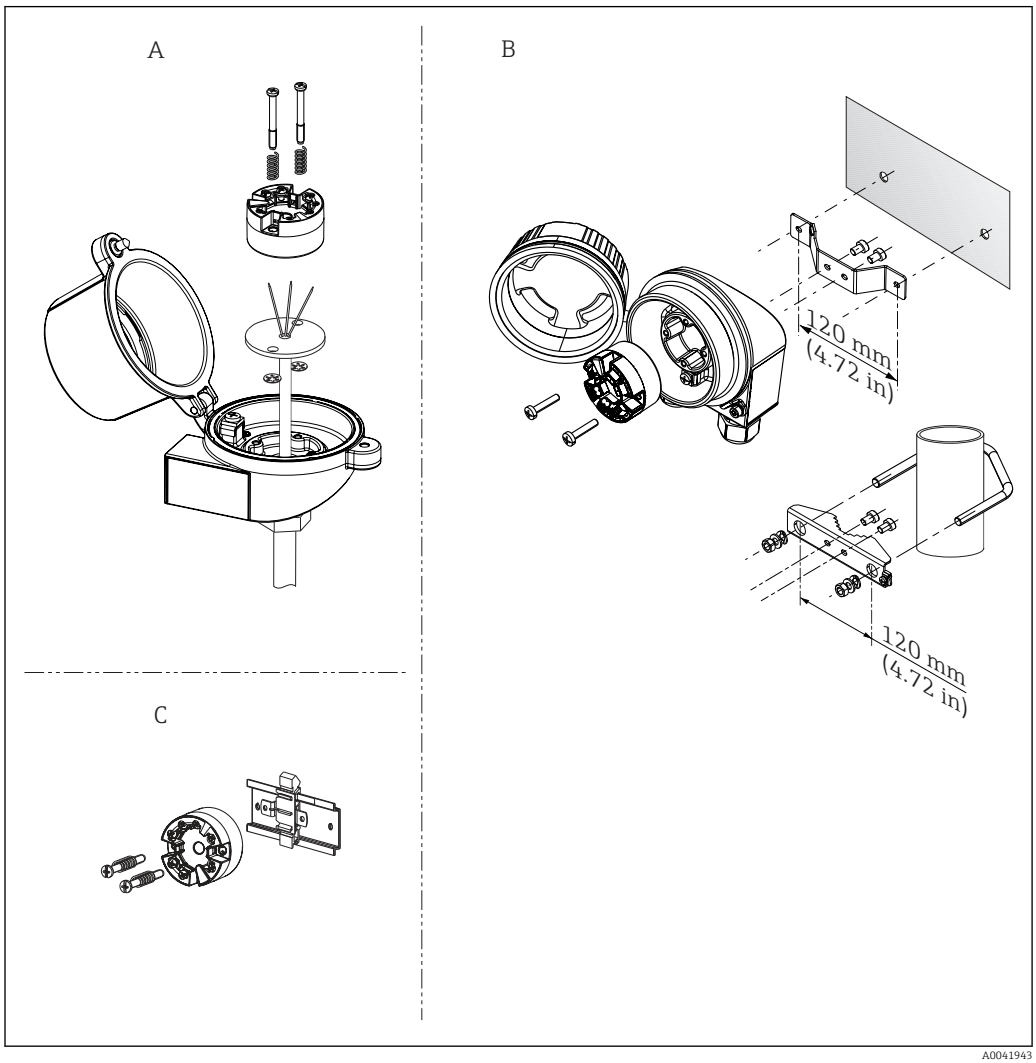
1) The larger value is valid

Influence of the cold junction Pt100 DIN IEC 60751 Cl. B (internal cold junction with thermocouples TC)

A 2-wire Pt1000 resistor must be used for external cold junction measurement. The Pt1000 must be positioned directly at the sensor terminals of the device, as the temperature difference between the Pt1000 and the terminal must be added to the measured error of the sensor element and sensor input Pt1000.

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
- −50 to +85 °C (−58 to +185 °F), for hazardous areas see Ex documentation, Product Configurator order code for "Test, certificate, declaration", option "JM" [2)]
- −52 to +85 °C (−62 to +185 °F), for hazardous areas see Ex documentation, Product Configurator order code for "Test, certificate, declaration", option "JN" [2)]

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

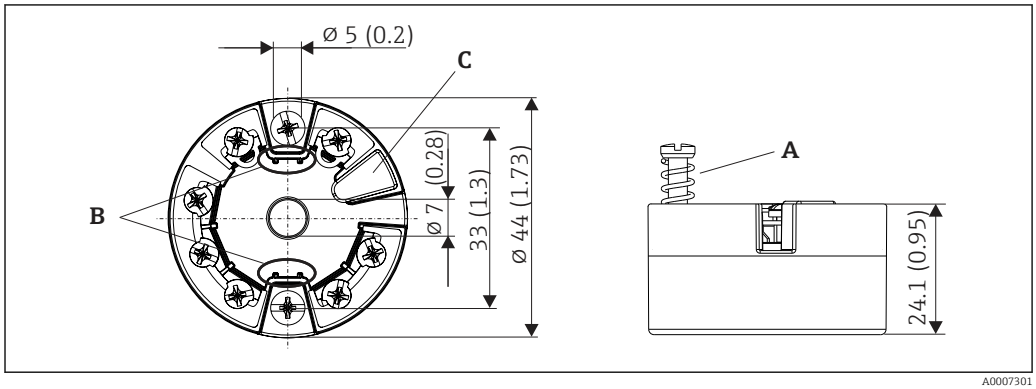
Storage temperature	−52 to +100 °C (−62 to +212 °F)
Operating altitude	Up to 4000 m (4374.5 yards) above mean sea level as per IEC 61010-1, CAN/CSA C22.2 No. 61010-1
Relative humidity	▪ Condensation permitted as per IEC 60 068-2-33 ▪ Max. rel. humidity: 95% as per IEC 60068-2-30
Climate class	C1 as per EN 60654-1 ▪ Temperature: −5 to +45 °C (+23 to +113 °F) ▪ Relative humidity: 5 to 95 %
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	Shock as per DIN EN 60068-2-27 Vibration resistance as per DNVGL-CG-0339 : 2015 and DIN EN 60068-2-6: 2 to 100 Hz at 4g
Electromagnetic compatibility (EMC)	**CE conformity** 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
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 degree	Pollution degree 2 as per IEC 61010-1.
Insulation class	Class III

Mechanical construction

Design, dimensions

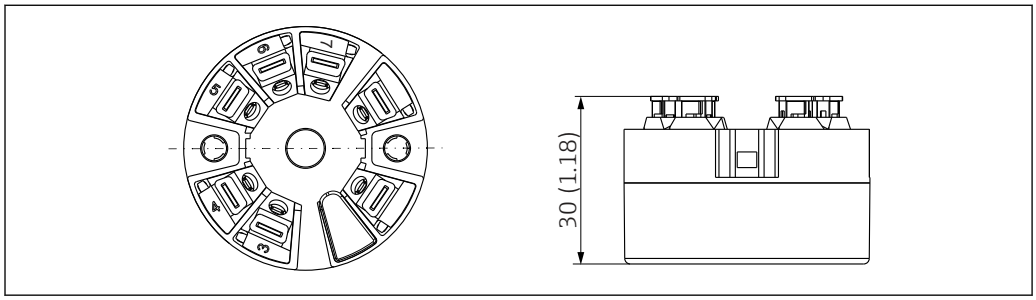
Dimensions in mm (in)

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

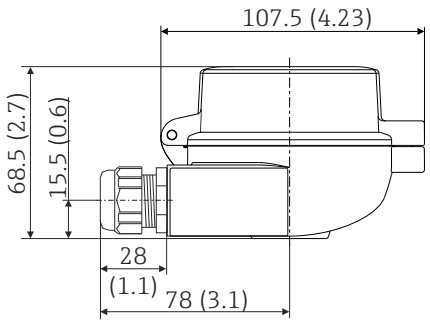


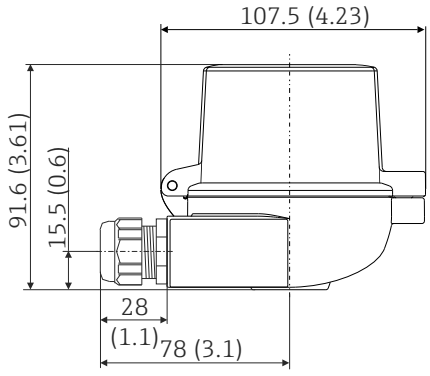
6 Version with push-in terminals. Dimensions are identical to the version with screw terminals, apart from housing height.

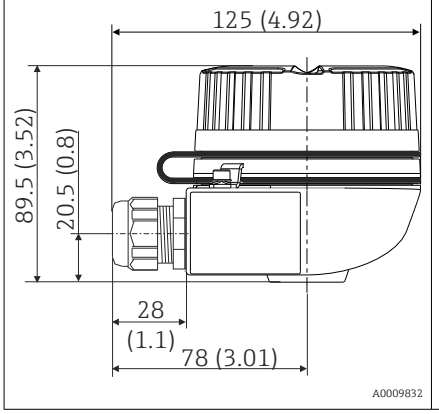
Field housing

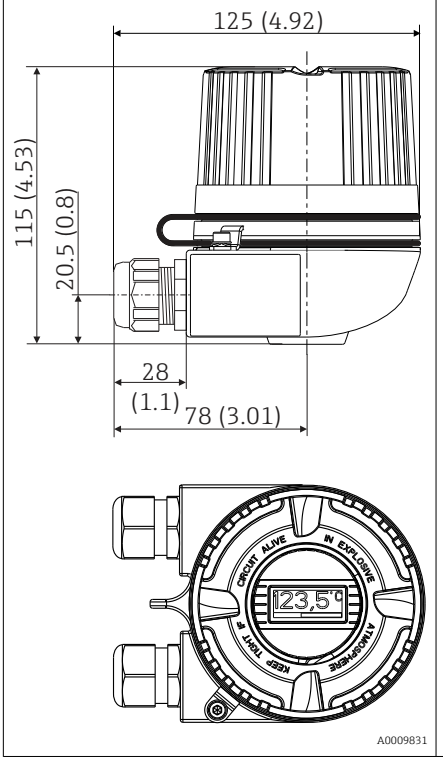
All field housings have an internal geometry in accordance with DIN EN 50446, form B (flat face).
Cable glands in the diagrams: M20x1.5

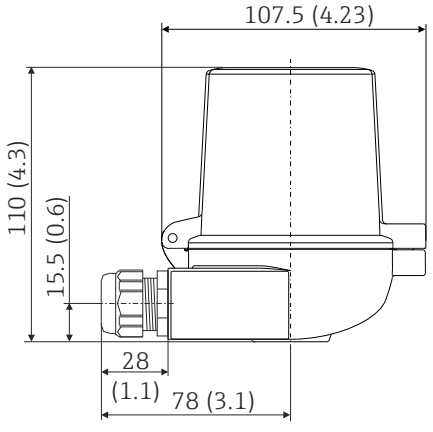
Maximum ambient temperatures for cable glands	
Type	**Temperature range**
Polyamide cable gland ½" NPT, M20x1.5 (non-Ex)	–40 to +100 °C (–40 to 212 °F)
Polyamide cable gland M20x1.5 (for dust ignition-proof area)	–20 to +95 °C (–4 to 203 °F)
Brass cable gland ½" NPT, M20x1.5 (for dust ignition-proof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

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: ½" NPT 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 ▪ Degree of protection: ▪ IP66/68 (NEMA Type 4x encl.) ▪ For ATEX: IP66/67 ▪ Cable entry glands: ½" NPT 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 ▪ For 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 ▪ Cable entry glands: ½" NPT, 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)

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 ▪ Display window: single-pane safety glass according to DIN 8902 ▪ Cable entry glands: ½" NPT, 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 TID10 display

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: ½" NPT 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: QSIL 553

Field housing: see specifications

Operability

Operating concept

Operator-oriented menu structure for user-specific tasks
- Commissioning
- Operation
- Maintenance

Fast and safe commissioning
- Guided operation: commissioning wizards for applications
- Menu guidance with short explanations of the individual parameter functions
- Access to the device via web server

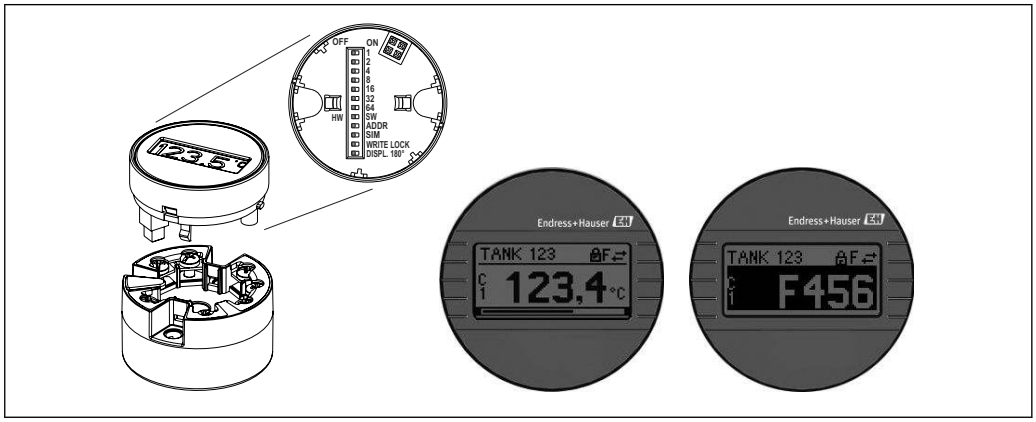
Reliable operation
Uniform operating concept in all operating tools

Efficient diagnostic possibilities increase measurement availability
- Troubleshooting measures can be called up in the operating tools
- Variety of simulation options and logbook of events that have occurred

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. In the event of a fault in the measurement chain, this will be displayed in inverse color showing the channel ident and error number. DIP switches can be found on the rear of the display. These enable hardware settings to be made e.g. write protection.



A0020347

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
- PROFINET with Ethernet-APL
- Web server
- Service interface

System integration

PROFINET® Profile 4.0

Supported operating tools

Different operating tools can be used for local or remote access to the measuring device. Depending on the operating tool used, access is possible with different operating units and interfaces.

Configuration software
Endress+Hauser FieldCare, DeviceCare, Field Xpert (FDI/iDTM)
SIMATIC PDM (FDI)
Field Information Manager / FIM (FDI)
Honeywell Field Device Manager (FDI)

Where to obtain GSD files and device drivers:

- GSD file: www.endress.com (→ Download → Device drivers)
- GSD file: download from the web server
- Profile GSD file: www.profibus.com
- FDI, FDI/iDTM: www.endress.com (→ Download → Device drivers)

Certificates and approvals

Current certificates and approvals that are available for the product can be selected via 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**.

Certification PROFINET®-APL

The temperature transmitter is certified and registered by the PNO (PROFIBUS Nutzerorganisation e.V. /PROFIBUS User Organization). The device meets the requirements of the following specifications.

- Certified according to:
  - Test specification for PROFINET® devices
  - PROFINET® Security Level – Netload Class
- The device can also be operated with certified devices of other manufacturers (interoperability). The device supports PROFINET® S2 system redundancy.

MTTF

95 years

The mean time to failure (MTTF) denotes the theoretically expected time until the device fails during normal operation. The term MTTF is used for systems that cannot be repaired, e.g. temperature transmitters.

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 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.

Device-specific accessories

Accessories
TID10 display unit for Endress+Hauser head transmitter iTEMP TMT8x [1], attachable
TID10 service cable; connecting cable for service interface, 40 cm (15.75 in)
Field housing TA30x for DIN flat face (form B) 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 mounting screws (2 M4 screws and 1 display connector cover)
Stainless steel wall mounting bracket Stainless steel pipe mounting bracket

1) Without TMT80

Communication-specific accessories

Accessories	Description
Commubox FXA291	Connects Endress+Hauser field devices with a CDI interface (= Common Data Interface) and the USB port of a computer or laptop. For details, see Technical Information TI405C
Field Xpert SMT70, SMT77	Universal, high-performance tablet PC for device configuration The tablet PC enables mobile plant asset management in hazardous (Ex-Zone-1) and non-hazardous areas. It is suitable for commissioning and maintenance staff to manage field instruments with a digital communication interface and to record progress. This tablet PC is designed as a comprehensive, all-in-one solution. With a pre-installed driver library, it is an easy-to-use, touch-sensitive tool which can be used to manage field instruments throughout their entire life cycle. For details: ▪ SMT70 - Technical Information TI01342S ▪ SMT77 - Technical Information TI01418S

Service-specific accessories

Device Viewer

The Device Viewer is an online tool for the device-specific selection of device information, technical documentation including device-specific documents. Using the serial number of a device, the Device Viewer displays information about the product life cycle, documents, spare parts, etc.

The Device Viewer is available: https://portal.endress.com/webapp/DeviceViewer/

Supplementary documentation

The following types of documentation are available on the product pages and in the Download Area of the Endress+Hauser website (www.endress.com/downloads) (depending on the selected device version):

Document	Purpose and content of the document
Technical Information (TI)	**Planning aid for your device** The document contains all the technical data on the device and provides an overview of the accessories and other products that can be ordered for the device.
Brief Operating Instructions (KA)	**Guide that takes you quickly to the 1st measured value** The Brief Operating Instructions contain all the essential information from incoming acceptance to initial commissioning.
Operating Instructions (BA)	**Your reference document** The Operating Instructions contain all the information that is required in various phases of the life cycle of the device: from product identification, incoming acceptance and storage, to mounting, connection, operation and commissioning through to troubleshooting, maintenance and disposal.

Document	Purpose and content of the document
Description of Device Parameters (GP)	**Reference for your parameters** The document provides a detailed explanation of each individual parameter. The description is aimed at those who work with the device over the entire life cycle and perform specific configurations.
Safety Instructions (XA)	Depending on the approval, Safety Instructions (XA) are supplied with the device. The Safety Instructions are an integral part of the Operating Instructions. Information on the Safety Instructions (XA) that are relevant for the device is provided on the nameplate.
Supplementary device-dependent documentation (SD/FY)	Always comply strictly with the instructions in the relevant supplementary documentation. The supplementary documentation is an integral part of the device documentation.



www.addresses.endress.com

Endress+Hauser

People for Process Automation