Technical Information

Omnigrad TST40N, TST41N

Modular resistance thermometer with threaded process connection

TST40N – with extension neck
TST41N – without extension neck

Application

- The RTD thermometer is a general purpose assembly suitable for liquids and gases.
- Measuring range: −200 to +600 °C (−328 to +1 112 °F)
- Pressure range up to 75 bar (1 088 psi)
- Degree of protection: up to IP68

Head transmitters

All Endress+Hauser transmitters are available with enhanced accuracy and reliability compared to directly wired sensors. Easy customizing by choosing one of the following outputs and communication protocols:

- Analog output 4 to 20 mA
- HART®
- PROFIBUS® PA
- FOUNDATION Fieldbus™

Your benefits

- High degree of flexibility thanks to modular design with standard terminal heads as per DIN EN 50446 and customer-specific immersion lengths
- High degree of insert compatibility and design as per DIN 43772
- Fast response time with reduced/tapered tip form
- Extension neck for protecting the head transmitter from heat (TST40N)

Endress+Hauser [EH]

People for Process Automation

Function and system design

| Measuring principle | **Resistance thermometer (RTD)**

These resistance thermometers use a Pt100 temperature sensor according to IEC 60751. The temperature sensor is a temperature-sensitive platinum resistor with a resistance of 100 Ω at 0 ℃ (32 ℉) and a temperature coefficient α = 0.003851 ℃$^{-1}$.

There are generally two different kinds of platinum resistance thermometers:
- **Wire wound (WW):** Here, a double coil of fine, high-purity platinum wire is located in a ceramic support. This is then sealed top and bottom with a ceramic protective layer. Such resistance thermometers not only facilitate very reproducible measurements but also offer good long-term stability of the resistance/temperature characteristic within temperature ranges up to 600 ℃ (1 112 ℉). This type of sensor is relatively large in size and it is comparatively sensitive to vibrations.
- **Thin film platinum resistance thermometers (TF):** A very thin, ultrapure platinum layer, approx. 1 μm thick, is vaporized in a vacuum on a ceramic substrate and then structured photolithographically. The platinum conductor paths formed in this way create the measuring resistance. Additional covering and passivation layers are applied and reliably protect the thin platinum layer from contamination and oxidation, even at high temperatures.

The primary advantages of thin film temperature sensors over wire wound versions are their smaller sizes and better vibration resistance. A relatively low principle-based deviation of the resistance/temperature characteristic from the standard characteristic of IEC 60751 can frequently be observed among TF sensors at high temperatures. As a result, the tight limit values of tolerance category A as per IEC 60751 can only be observed with TF sensors at temperatures up to approx. 300 ℃ (572 ℉). For this reason, thin-film sensors are generally only used for temperature measurements in ranges below 400 ℃ (752 ℉). |

Measuring system	
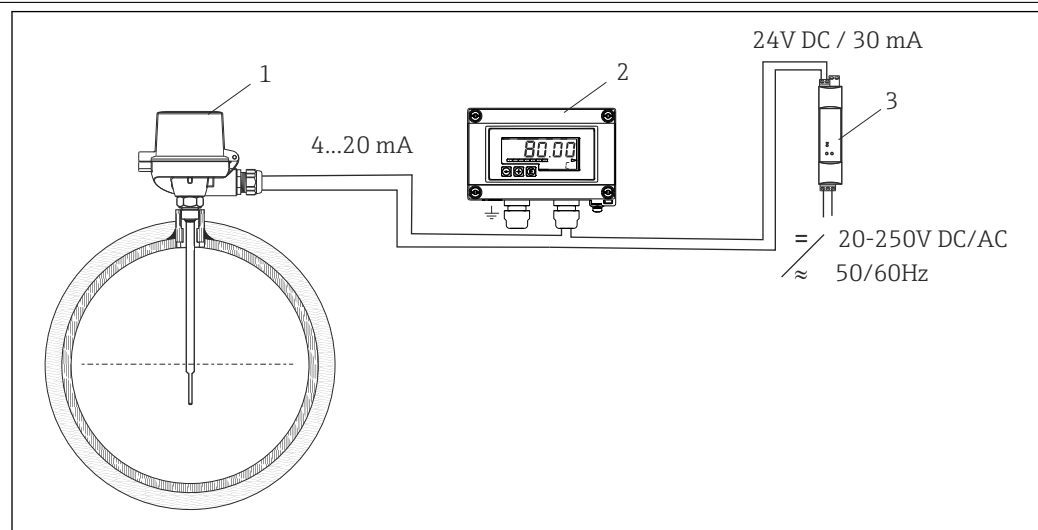
☒ *1 Application example*

1 Mounted thermometer with head transmitter installed.
2 RIA15 process display - The display unit records the analog measuring signal from the head transmitter and shows this on the display. The LC display shows the current measured value in digital form and as a bar graph indicating a limit value violation. The process display unit is integrated in the 4 to 20 mA or HART® loop and is powered directly from the current loop. Optionally up to four of a sensor's HART® process variables can be displayed. More information on this can be found in the Technical Information, see "Documentation".
3 Active barrier RN221N - The RN221N (24 V DC, 30 mA) active barrier has a galvanically isolated output for supplying voltage to loop-powered transmitters. The universal power supply works with an input supply voltage of 20 to 250 V DC/AC, 50/60 Hz, which means that it can be used in all international power grids. More information on this can be found in the Technical Information, see "Documentation".

Measuring range	−200 to +600 ℃ (−328 to +1 112 ℉)

Performance characteristics

Operating conditions

Ambient temperature

Terminal head	Temperature in ℃ (℉)
Without mounted head transmitter	Depends on the terminal head used and the cable gland or fieldbus connector, see 'Terminal heads' section
With mounted head transmitter	−40 to 85 ℃ (−40 to 185 ℉)
With mounted head transmitter and display	−20 to 70 ℃ (−4 to 158 ℉)

Process pressure

The maximum allowable process pressure depends on the process connection used. See the "Process connection" section for an overview of the process connections that can be used.

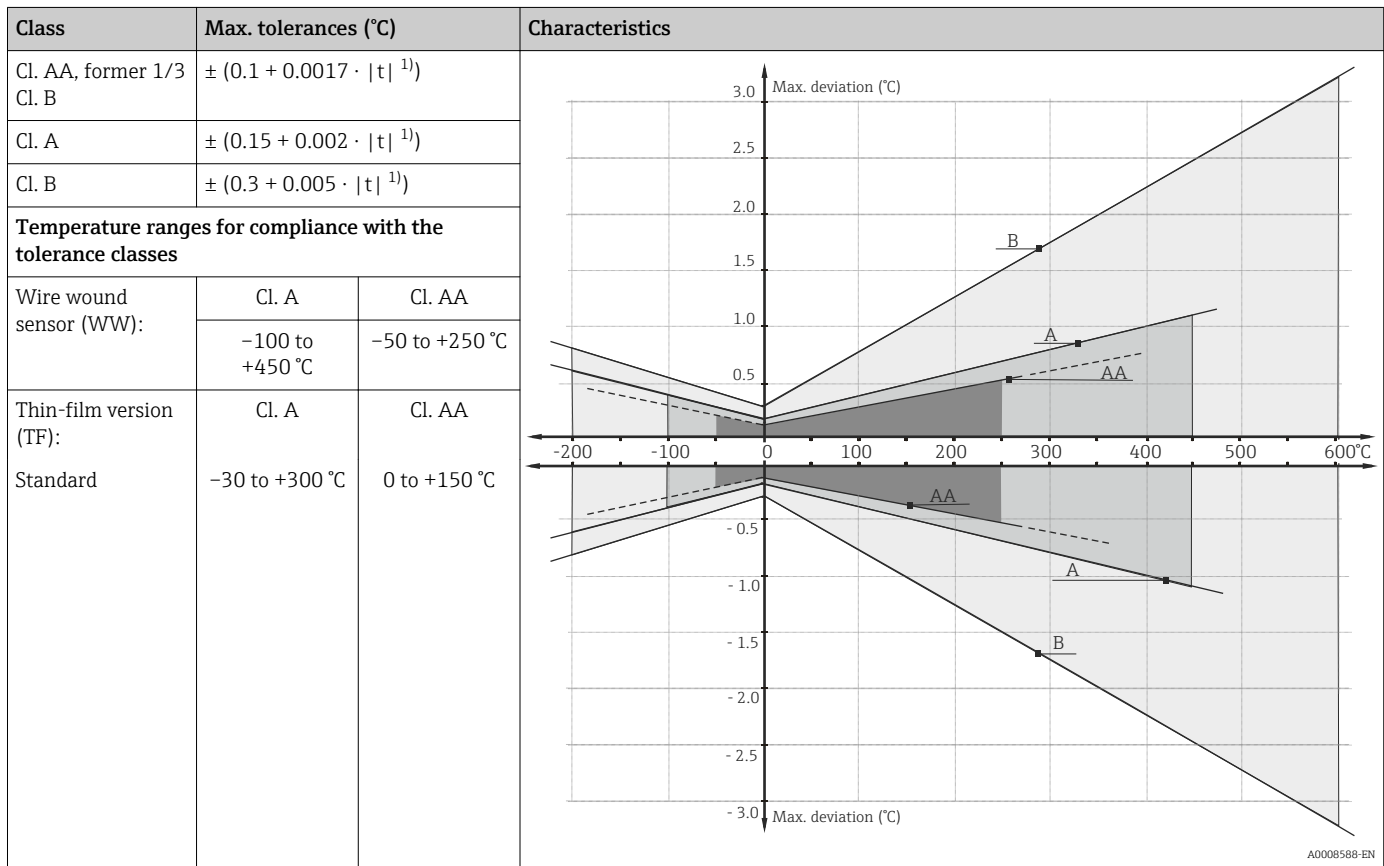| Process connection	According to standard	Max. process pressure
Thread G½"	ISO 228	75 bar
Thread G¾"		
Thread G1"		
Thread NPT½"	ANSI B1.20.1	
Thread NPT¾"		
Thread NPT1"		
Thread M20x1.5	DIN13	

Permitted flow velocity depending on the immersion length

The highest flow velocity tolerated by the thermometer diminishes with increasing immersion length exposed to the stream of the fluid. In addition it is dependent on the diameter of the thermometer tip, on the kind of measuring medium, on the process temperature and on the process pressure.

Shock and vibration resistance

3G / 10 to 500 Hz according to IEC 60751

Accuracy

RTD resistance thermometer as per IEC 60751

Class	Max. tolerances (°C)	Characteristics
Cl. AA, former 1/3 Cl. B	± (0.1 + 0.0017 · |t| [1])	
Cl. A	± (0.15 + 0.002 · |t| [1])	
Cl. B	± (0.3 + 0.005 · |t| [1])	

Temperature ranges for compliance with the tolerance classes		
Wire wound sensor (WW):	Cl. A	Cl. AA
	−100 to +450 °C	−50 to +250 °C
Thin-film version (TF):	Cl. A	Cl. AA
Standard	−30 to +300 °C	0 to +150 °C

A0008588-EN

1) |t| = absolute value °C

ℹ️ In order to obtain the maximum tolerances in °F, the results in °C must be multiplied by a factor of 1.8.

Response time

Calculated at an ambient temperature of approx. 23 °C by immersing in running water (0.4 m/s flow rate, 10 K excess temperature):

Insert diameter	Response time	
3 mm (0.12 in)	t_{50}	3 s
	t_{90}	6 s
6 mm (0.24 in)	t_{50}	3.5 s
	t_{90}	8 s

ℹ️ Response time for the sensor assembly without transmitter.

Insulation resistance

Insulation resistance ≥ 100 MΩ at ambient temperature.

Insulation resistance between the terminals and the outer jacket is measured with a minimum voltage of 100 V DC.

Self heating

RTD elements are passive resistances that are measured using an external current. This measurement current causes a self-heating effect in the RTD element itself which in turn creates an additional measurement error. In addition to the measurement current, the size of the measurement error is also affected by the temperature conductivity and flow velocity of the process. This self-heating error is negligible when an Endress+Hauser iTEMP temperature transmitter (very small measurement current) is connected.

Material	Insert and process connection

The temperatures for continuous operation specified in the following table are only intended as reference values for use of the various materials in air and without any significant compressive load. The maximum operation temperatures are reduced considerably in some cases where abnormal conditions such as high mechanical load occur or in aggressive media.

Material name	Short form	Recommended max. temp. for continuous use in air	Properties
AISI 316L/ 1.4404 1.4435	X2CrNiMo17-12-2 X2CrNiMo18-14-3	650 ℃ (1 202 ℉) [1]	• Austenitic, stainless steel • High corrosion resistance in general • Particularly high corrosion resistance in chlorine-based and acidic, nonoxidizing atmospheres through the addition of molybdenum (e.g. phosphoric and sulfuric acids, acetic and tartaric acids with a low concentration) • Increased resistance to intergranular corrosion and pitting • Compared to 1.4404, 1.4435 has even higher corrosion resistance and a lower delta ferrite content

[1] Can be used to a limited extent up to 800 ℃ (1472 ℉) for low compressive loads and in non-corrosive media. Please contact your Endress+Hauser sales team for further information.

Components

Family of temperature transmitters	Thermometers fitted with iTEMP transmitters are an installation-ready complete solution to improve temperature measurement by significantly increasing accuracy and reliability, when compared to direct wired sensors, as well as reducing both wiring and maintenance costs.

PC programmable head transmitters
They offer a high degree of flexibility, thereby supporting universal application with low inventory storage. The iTEMP transmitters can be configured quickly and easily at a PC. Endress+Hauser offers free configuration software which can be downloaded from the Endress+Hauser Website. More information can be found in the Technical Information.

HART® programmable head transmitters
The transmitter is a 2-wire device with one or two measuring inputs and one analog output. The device not only transfers converted signals from resistance thermometers and thermocouples, it also transfers resistance and voltage signals using HART® communication. It can be installed as an intrinsically safe apparatus in Zone 1 hazardous areas and is used for instrumentation in the terminal head (flat face) as per DIN EN 50446. Swift and easy operation, visualization and maintenance by PC using operating software, Simatic PDM or AMS. For more information, see the Technical Information.

PROFIBUS® PA head transmitters
Universally programmable head transmitter with PROFIBUS® PA communication. Conversion of various input signals into digital output signals. High accuracy over the complete ambient temperature range. Swift and easy operation, visualization and maintenance using a PC directly from the control panel, e. g. using operating software, Simatic PDM or AMS. For more information, see the Technical Information.
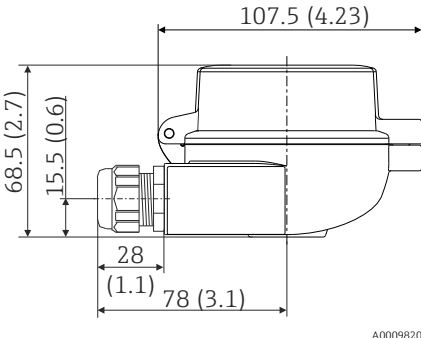
FOUNDATION Fieldbus™ head transmitters
Universally programmable head transmitter with FOUNDATION Fieldbus™ communication. Conversion of various input signals into digital output signals. High accuracy over the complete ambient temperature range. Swift and easy operation, visualization and maintenance using a PC directly from the control panel, e.g. using operating software such as ControlCare from Endress +Hauser or NI Configurator from National Instruments. For more information, see the Technical Information.
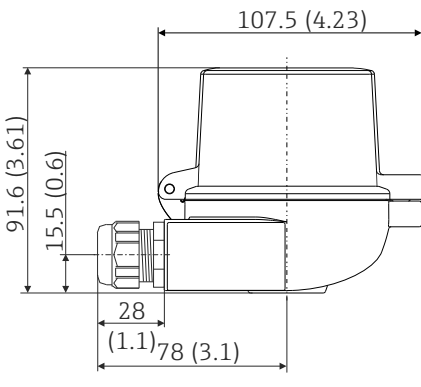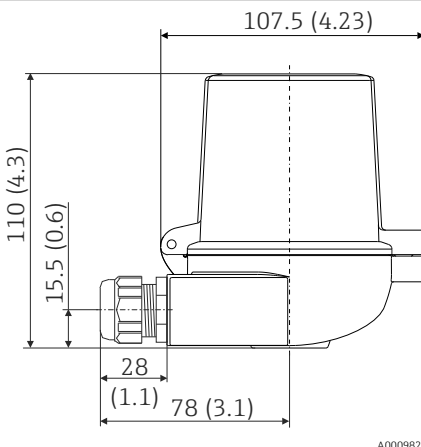
Advantages of the iTEMP transmitters:
• Dual or single sensor input (optionally for certain transmitters)
• Unsurpassed reliability, accuracy and long-term stability in critical processes
• Mathematical functions
• Monitoring of the thermometer drift, sensor backup functionality, sensor diagnostic functions
• Sensor-transmitter matching for dual sensor input transmitters, based on Callendar/Van Dusen coefficients
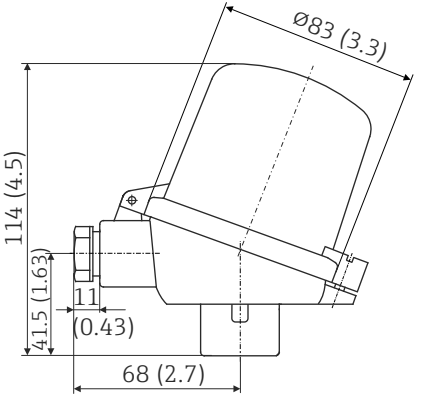
Terminal heads

All terminal heads have an internal shape and size in accordance with DIN EN 50446 flat face and a thermometer connection of M24x1.5, G1/2" or 1/2" NPT thread. All dimensions in mm (in). The cable glands in the diagrams correspond to M20x1.5 connections. Specifications without head transmitter installed. For ambient temperatures with head transmitter installed, see "Operating conditions" section.

| TA30A	Specification
107.5 (4.23) 68.5 (2.7) 15.5 (0.6) 28 (1.1) 78 (3.1) A0009820	• Available with one or two cable entries • Protection class: IP66/68 (NEMA Type 4x encl.) • Temperature: −50 to +150 °C (−58 to +302 °F) without cable gland • Material: aluminum, polyester powder coated Seals: silicone • Threaded cable entry: G ½", ½" NPT and M20x1.5; • Protection armature connection: M24x1.5 • Head color: blue, RAL 5012 • Cap color: gray, RAL 7035 • Weight: 330 g (11.64 oz) • Ground terminal, internal and external • With 3-A® symbol

TA30A with display window	Specification

107.5 (4.23)
91.6 (3.61)
15.5 (0.6)
28 (1.1)
78 (3.1)
A0009821
	• Available with one or two cable entries
	• Protection class: IP66/68 (NEMA Type 4x encl.)
	• Temperature: −50 to +150 °C (−58 to +302 °F) without cable gland
	• Material: aluminum, polyester powder coated
	  Seals: silicone
	• Threaded cable entry: G ½", ½" NPT and M20x1.5
	• Protection armature connection: M24x1.5
	• Head color: blue, RAL 5012
	  Cap color: gray, RAL 7035
	• Weight: 420 g (14.81 oz)
	• with TID10 display
	• Ground terminal, internal and external
	• 3-A® marked

TA30D	Specification
107.5 (4.23) 110 (4.3) 15.5 (0.6) 28 (1.1) 78 (3.1) A0009822	• Available with one or two cable entries • Protection class: IP66/68 (NEMA Type 4x encl.) • Temperature: −50 to +150 °C (−58 to +302 °F) without cable gland • Material: aluminum, polyester powder coated Seals: silicone • Threaded cable entry: G ½", ½" NPT and M20x1.5 • Protection armature connection: M24x1.5 • Two head transmitters can be mounted. In the standard version, 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) • Ground terminal, internal and external • With 3-A® symbol

TA30P	Specification

Ø83 (3.3)
114 (4.5)
41.5 (1.63)
11 (0.43)
68 (2.7)
A0012930
	• Protection class: IP65
	• Max. temperature: –40 to +120 °C (–40 to +248 °F)
	• Material: polyamide (PA), antistatic
	  Seals: silicone
	• Threaded cable entry: M20x1.5
	• Protection armature connection: M24x1.5
	• Head and cap color: black
	• Weight: 135 g (4.8 oz)
	• Types of protection for use in hazardous locations: Intrinsic
	  Safety (G Ex ia)
	• Ground terminal: only internal via auxiliary clamp

Design

All dimensions in mm (in).
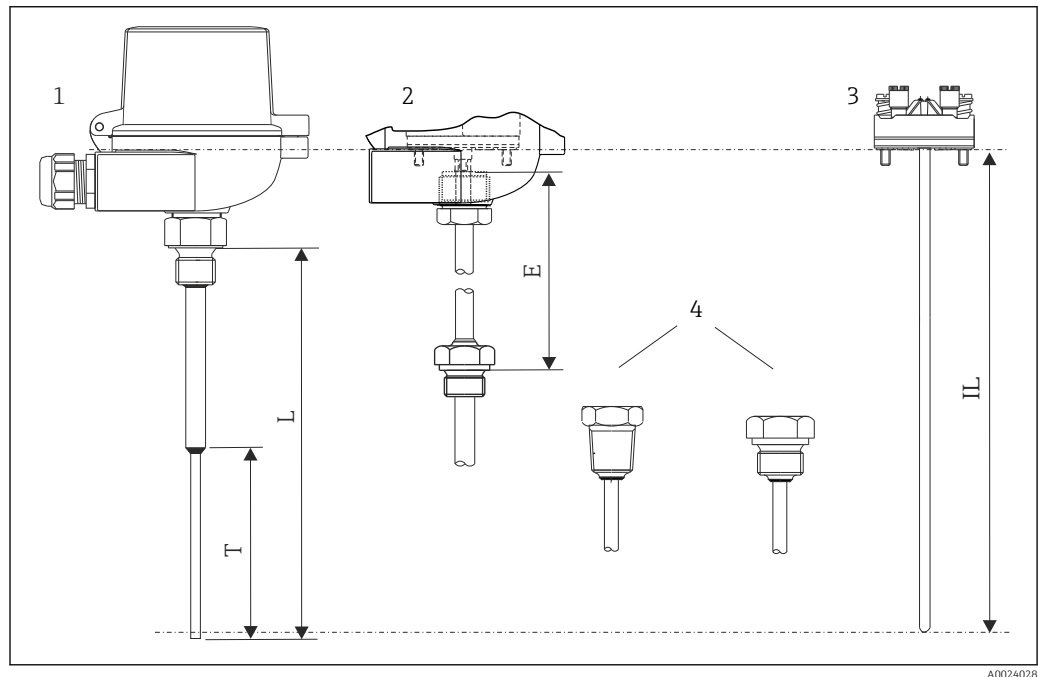
A0024028

🔲 *2   Dimensions of the Omnigrad TST40N, TST41N*

1   Complete thermometer without extension neck (TST41N)
2   Thermometer with extension neck (TST40N)
3   Insert with terminal block mounted
4   Process connection: Thread
E   Extension neck
IL   Total length of insert
L   Immersion length
T   Insertion length

The resistance thermometers from the series Omnigrad TST40N and TST41N have a modular design. The terminal head is used as a connection module for the mechanical and electrical connection of the insert. The position of the actual thermometer sensor in the insert ensures that it is mechanically protected. The insert has flying leads or a ceramic connection socket.

ℹ️ The standard insertion length is 30 mm (1.18 in). When selecting a customer-specific insertion length the following formula is to be observed: Insertion length $T \leq L - 25$ mm (0.98 in)

Weight

0.5 to 2.5 kg for standard options
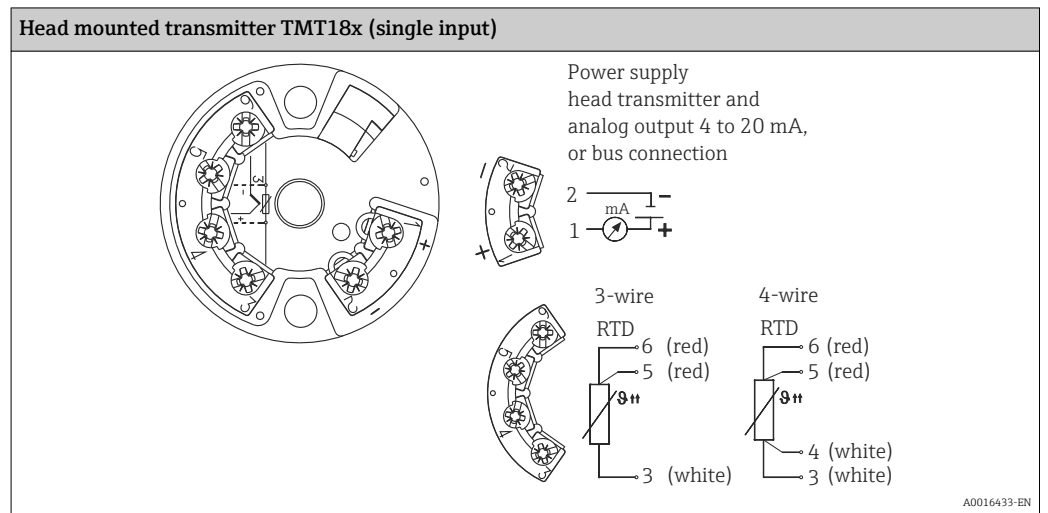
Process connection   The process connection is the connection between the process and the thermometer. The following process connections are available:
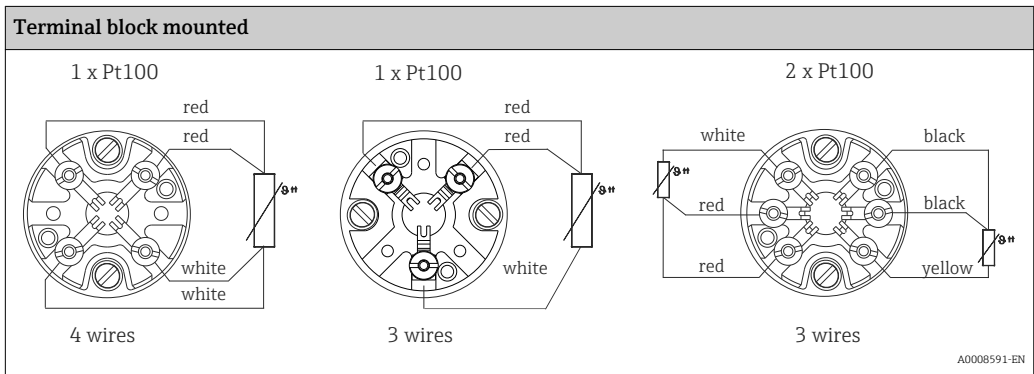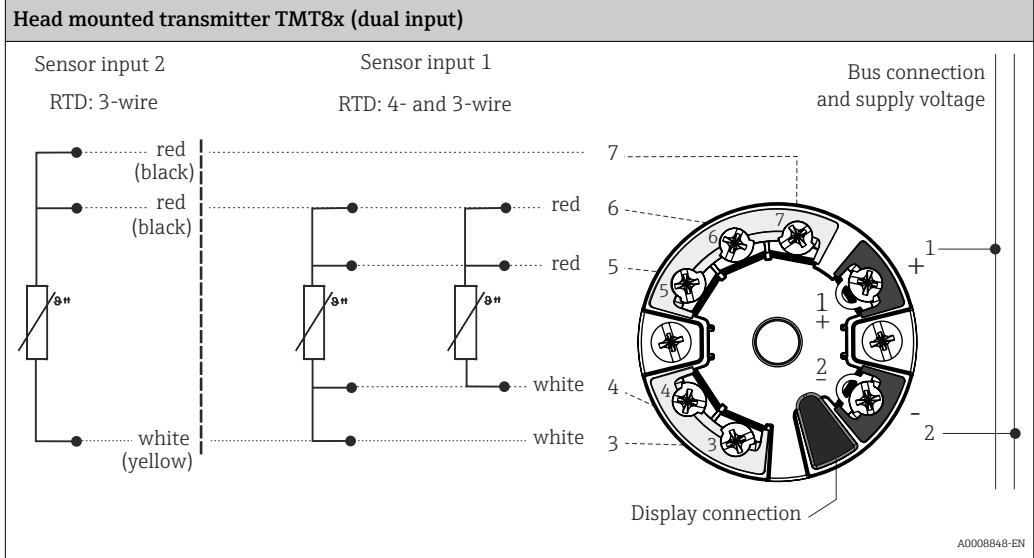
Thermometer	Thread		Version		Thread length (TL)	Width across flats SW/AF
TST40N	Cylindrical	Conical	G	G½"	15 mm (0.6 in)	27
				G¾"		32
				G1"	18 mm (0.71 in)	41
			NPT	NPT½"	8 mm (0.32 in)	22
				NPT¾"	8.5 mm (0.33 in)	27
				NPT1"	10 mm (0.39 in)	36
			M	M20x1,5	15 mm (0.6 in)	24
TST41N	Cylindrical	Conical	G	G½"	15 mm (0.6 in)	27
				G¾"		32
				G1"	18 mm (0.71 in)	41
			NPT	NPT½"	8 mm (0.32 in)	27
				NPT¾"	8.5 mm (0.33 in)	
				NPT1"	10 mm (0.39 in)	36
			M	M20x1,5	15 mm (0.6 in)	24

Wiring

Wiring diagrams for RTD   Type of sensor connection

Head mounted transmitter TMT18x (single input)

Head mounted transmitter TMT8x (dual input)

Sensor input 2

RTD: 3-wire

Sensor input 1

RTD: 4- and 3-wire

Bus connection
and supply voltage

red
(black)

red
(black)

red

red

white

white

white
(yellow)

7

6

5

4

3

1
+

2
−

1

2

+

−

Display connection

A0008848-EN

Terminal block mounted

1 x Pt100

red
red

white
white

4 wires

1 x Pt100

red
red

white

3 wires

2 x Pt100

white

red

red

black

black

yellow

3 wires

A0008591-EN

Installation conditions

Orientation   No restrictions.

Installation instructions

A0024010
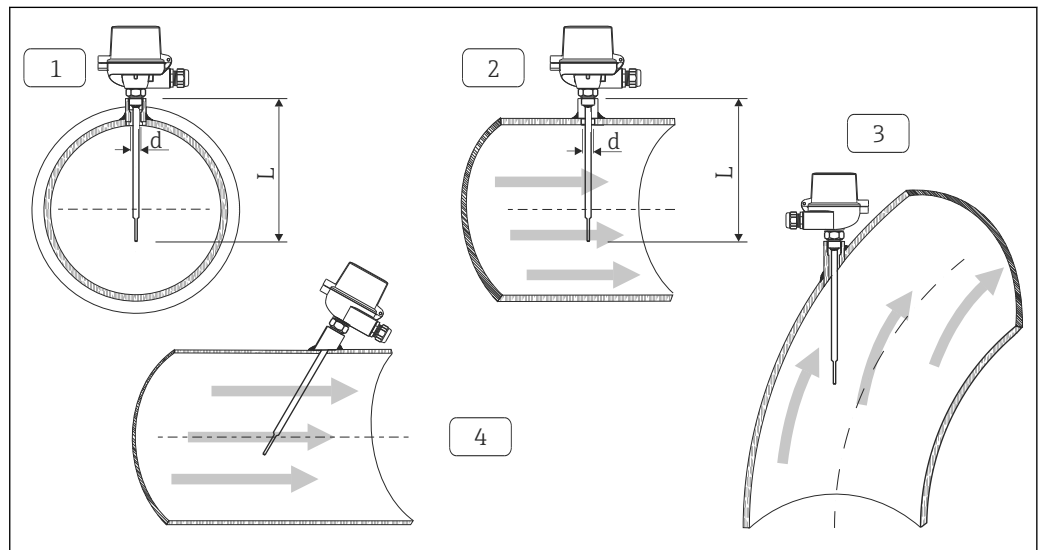
⊠ 3   Installation examples

1-2   In pipes with a small cross section the thermowell tip should reach or extend slightly past the center line of the pipe.

3-4   Angled installation.

The immersion length of the thermometer influences the accuracy. If the immersion length is too small then errors in the measurement are caused by heat conduction via the process connection and the container wall. If installing into a pipe then the immersion length should be at least half of the pipe diameter (see 1 and 2). A further solution could be an angled (tilted) installation (see 3 and 4). When determining the immersion length all thermometer parameters and the process to be measured must be taken into account (e.g. flow velocity, process pressure).

- Installation possibilities: Pipes, tanks or other plant components
- Recommended minimum immersion length: 80 to 100 mm (3.15 to 3.94 in)
  The immersion length should correspond to at least 8 times of the thermowell diameter. Example: Thermowell diameter 12 mm (0.47 in) x 8 = 96 mm (3.8 in). A standard immersion length of 120 mm (4.72 in) is recommended

Certificates and approvals

CE Mark   The device meets the legal requirements of the EC directives if applicable. Endress+Hauser confirms that the device has been successfully tested by applying the CE mark.

Other standards and guidelines
- EN 60079: ATEX certification for hazardous areas
- IEC 60529: Degree of protection of housing (IP code)
- IEC 61010-1: Protection Measures for Electrical Equipment for Measurement, Control, Regulation and Laboratory Procedures
- IEC 60751: Industrial platinum resistance thermometers
- DIN EN 50446: Terminal heads
- IEC 61326-1: Electromagnetic compatibility (EMC requirements)

Ordering information

Detailed ordering information is available from the following sources:
- In the Product Configurator on the Endress+Hauser website: www.endress.com → Select country → Instruments → Select device → Product page function: Configure this product
- From your Endress+Hauser Sales Center: www.endress.com/worldwide

ℹ️ **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.

Communication-specific accessories	Configuration kit TXU10	Configuration kit for PC-programmable transmitter with setup software and interface cable for PC with USB port Order code: TXU10-xx
	Commubox FXA195 HART	For intrinsically safe HART communication with FieldCare via the USB interface. 📖 For details, see "Technical Information" TI00404F
	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 details, see "Technical Information" TI00405C
	HART Loop Converter HMX50	Is used to evaluate and convert dynamic HART process variables to analog current signals or limit values. 📖 For details, see "Technical Information" TI00429F and Operating Instructions BA00371F
	Wireless HART adapter SWA70	Is used for the wireless connection of field devices. The WirelessHART adapter can be easily integrated into field devices and existing infrastructures, offers data protection and transmission safety and can be operated in parallel with other wireless networks with minimum cabling complexity. 📖 For details, see Operating Instructions BA061S
	Fieldgate FXA320	Gateway for the remote monitoring of connected 4-20 mA measuring devices via a Web browser. 📖 For details, see "Technical Information" TI00025S and Operating Instructions BA00053S
	Fieldgate FXA520	Gateway for the remote diagnostics and remote configuration of connected HART measuring devices via a Web browser. 📖 For details, see "Technical Information" TI00025S and Operating Instructions BA00051S
	Field Xpert SFX100	Compact, flexible and robust industry handheld terminal for remote configuration and for obtaining measured values via the HART current output (4-20 mA). 📖 For details, see Operating Instructions BA00060S

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.
Konfigurator+temperature	Software for selecting and configuring the product depending on the measuring task, supported by graphics. Includes a comprehensive knowledge database and calculation tools: • For temperature competence • Quick and easy design and sizing of temperature measuring points • Ideal measuring point design and sizing to suit the processes and needs of a wide range of industries The Konfigurator is available: On request from your Endress+Hauser sales office on a 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

Documentation

Technical Information
- iTEMP Temperature head transmitter
  - TMT180, PC-programmable, single-channel, Pt100 (TI088R/09/en)
  - TMT181, PC-programmable, single-channel, RTD, TC, Ω, mV (TI00070R/09/en)
  - HART® TMT182, single-channel, RTD, TC, Ω, mV (TI078R/09/en)
  - HART® TMT82, two-channel, RTD, TC, Ω, mV (TI01010T/09/en)
  - PROFIBUS® PA TMT84, two-channel, RTD, TC, Ω, mV (TI00138R/09/en)
  - FOUNDATION Fieldbus™ TMT85, two-channel, RTD, TC, Ω, mV (TI00134R/09/en)
- Application example:
  - RN221N Active barrier, for supplying loop-powered transmitters (TI073R/09/en)
  - RIA15 process display, loop-powered, with optional HART® communication (TI01043K/09/en)

www.addresses.endress.com

Endress+Hauser [EH]

People for Process Automation