

# Technical Information

## Omnigrad S TR61, TC61

Modular thermometer, explosion-protected, with thermowell and extension neck, variety of process connections

TR61 Resistance thermometer (RTD)  
TC61 Thermometer with thermocouple (TC)



### Applications

- Heavy duty applications
- Oil & Gas processing industry
- Measuring range:
  - Resistance insert (RTD): -200 to 600 °C (-328 to 1 112 °F)
  - Thermocouple (TC): -40 to 1 100 °C (-40 to 2 012 °F)
- Static pressure range up to 75 bar depending on the process connection used
- Degree of protection up to IP68

### Head transmitter

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
- Extension neck to protect the head transmitter from overheating
- Fast response time with reduced/tapered tip form
- Types of protection for use in hazardous locations:
  - Intrinsic Safety (Ex ia)
  - Flameproof (Ex d)
  - Non-sparking (Ex nA)

## 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  $\Omega$  at 0 °C (32 °F) and a temperature coefficient  $\alpha = 0.003851 \text{ } ^\circ\text{C}^{-1}$ .

**There are generally two different kinds of platinum resistance thermometers:**

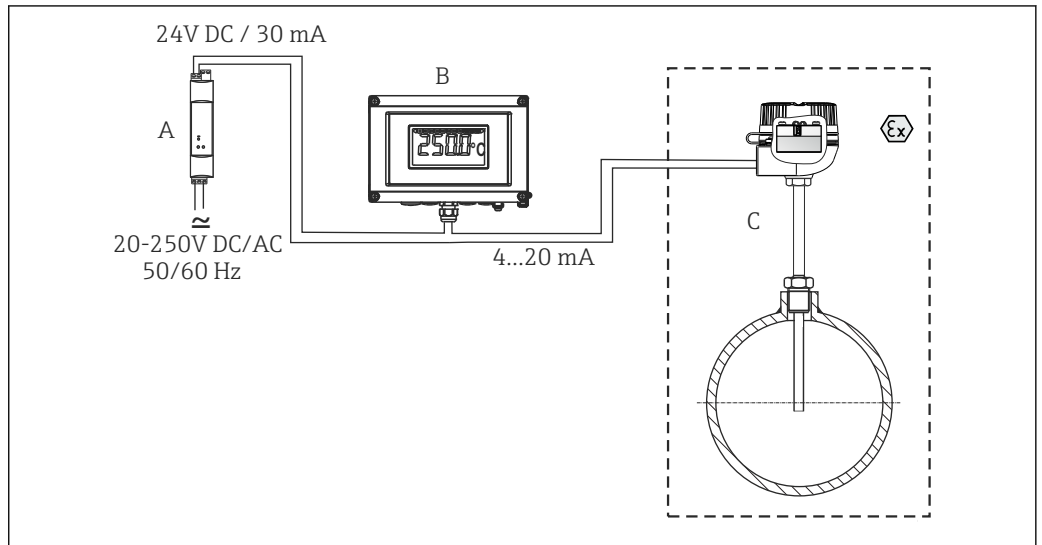
- **Wire wound (WW):** Here, a double coil of fine, high-purity platinum wire is located in a ceramic support. This is then sealed top and bottom with a ceramic protective layer. Such resistance thermometers not only facilitate very reproducible measurements but also offer good long-term stability of the resistance/temperature characteristic within temperature ranges up to 600 °C (1 112 °F). 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  $\mu\text{m}$  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 °C (572 °F).

#### Thermocouples (TC)

Thermocouples are comparatively simple, robust temperature sensors which use the Seebeck effect for temperature measurement: if two electrical conductors made of different materials are connected at a point, a weak electrical voltage can be measured between the two open conductor ends if the conductors are subjected to a thermal gradient. This voltage is called thermoelectric voltage or electromotive force (emf.). Its magnitude depends on the type of conducting materials and the temperature difference between the "measuring point" (the junction of the two conductors) and the "cold junction" (the open conductor ends). Accordingly, thermocouples primarily only measure differences in temperature. The absolute temperature at the measuring point can be determined from these if the associated temperature at the cold junction is known or is measured separately and compensated for. The material combinations and associated thermoelectric voltage/temperature characteristics of the most common types of thermocouple are standardized in the IEC 60584 and ASTM E230/ANSI MC96.1 standards.

Measuring system

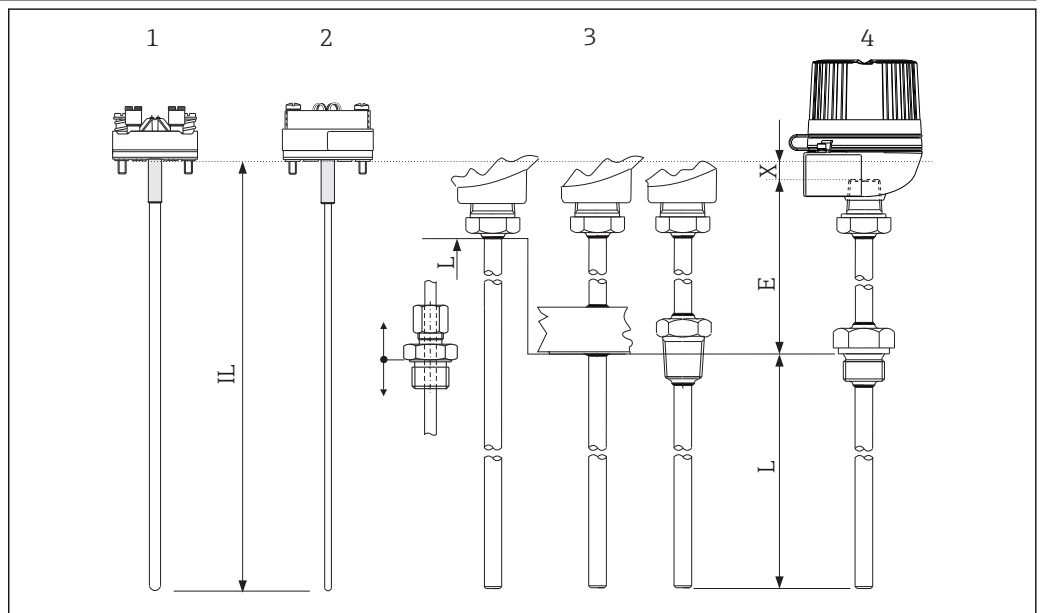


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1 Application example

- A 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").
- B RIA16 field display unit - 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 display unit is looped into the 4 to 20 mA circuit and gets the required energy from there. More information on this can be found in the Technical Information (see "Documentation").
- C Mounted thermometer with head transmitter installed.

Design



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2 Thermometer design

- 1 Insert with mounted ceramic terminal block (example)
- 2 Insert with mounted head transmitter (example)
- 3 Process connections
- 4 Complete thermometer with terminal head
- IL Installation length of insert
- E Extension neck length
- L Immersion length
- X Variable for calculating the length of the insert

Thermometers from the Omnigrad S TR61 and TC61 series 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 can be replaced or calibrated without interrupting the process. The insert has flying leads, a ceramic terminal block or mounted temperature transmitter.

**Measuring range**

- RTD: -200 to 600 °C (-328 to 1 112 °F)
- TC: -40 to 1 100 °C (-40 to 2 012 °F)

## Performance characteristics

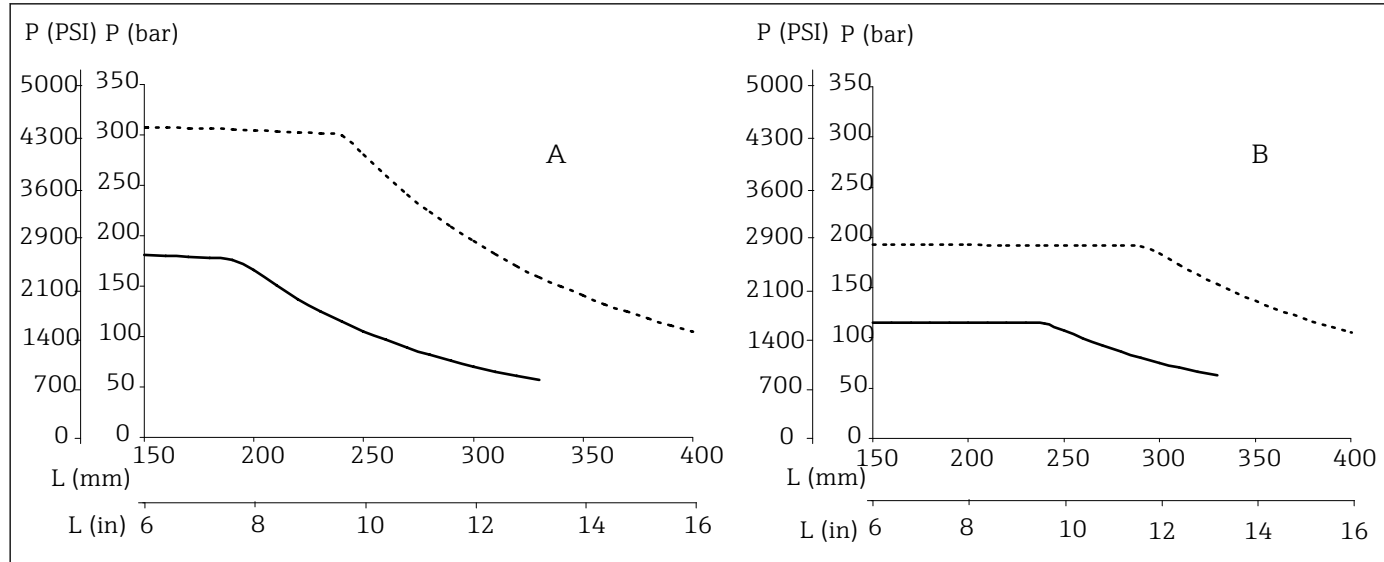
**Operating conditions**

**Ambient temperature range**

Terminal head	Temperature in °C (°F)
Without mounted head transmitter	Depends on the terminal head used and the cable gland or fieldbus connector, see 'Terminal heads' section → 10
With mounted head transmitter	-40 to 85 °C (-40 to 185 °F)
With mounted head transmitter and display	-20 to 70 °C (-4 to 158 °F)

**Process pressure**

The pressure values which the actual thermowell can be exposed to at the various temperatures and the maximum permitted flow velocity are illustrated in the figure below. The pressure loading capacity of the process connection can sometimes be considerably lower. The maximum permitted process pressure for a certain thermometer is derived from the lower pressure value of the thermowell and process connection!



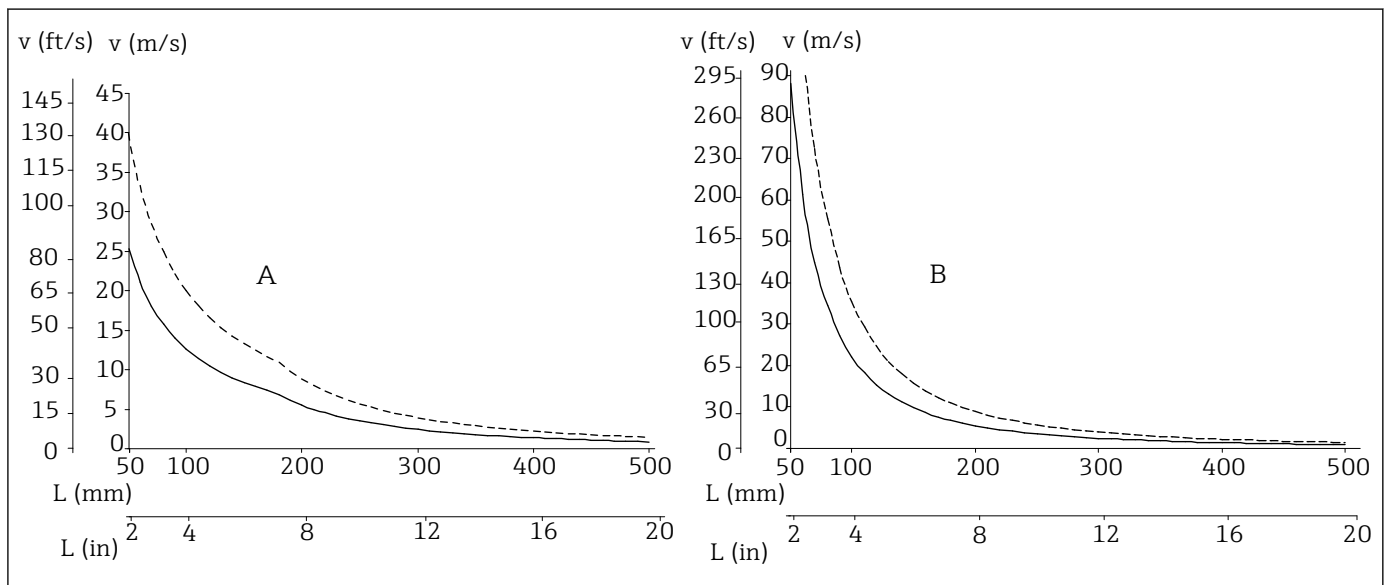
3 Maximum permitted process pressure for thermowell diameter

- A Medium water  $T = 50\text{ °C}$  (122 °F)
- B Medium superheated steam at  $T = 400\text{ °C}$  (752 °F)
- L Immersion length
- P Process pressure
- Thermowell diameter  $9 \times 1\text{ mm}$  (0.35 in)
- - - Thermowell diameter  $12 \times 2.5\text{ mm}$  (0.47 in)

Process connection	According to standard	Max. process pressure
M20x1.5	DIN 13-6	75 bar
Thread G1"	ISO 228	
Thread G½", G¾"	ISO 228	
Thread NPT ½", NPT ¾"	ANSI B1.20.1	
Flange	EN1092-1 or ISO 7005-1	Max. flange pressure rating PN40
Flange	ASME B16.5	Max. flange pressure rating 300 lb
Compression fitting		40 bar with metal clamping ring 5 bar with PTFE clamping ring

**Maximum flow velocity**

The maximum flow velocity tolerated by the thermowell diminishes with increasing immersion of the sensor in the liquid flow. See the figures below for more detailed information.



4 Flow velocity depending on the immersion depth

- A Medium water at T = 50 °C (122 °F)
- B Medium superheated steam at T = 400 °C (752 °F)
- L Immersion length
- v Flow velocity
- Thermowell diameter 9 x 1 mm (0.35 in)
- - - Thermowell diameter 12 x 2.5 mm (0.47 in)

**Shock and vibration resistance**

**RTD:**

The Endress+Hauser inserts exceed the requirements of IEC 60751 which specify shock and vibration resistance of 3 g in the range from 10 to 500 Hz.

The vibration resistance at the measuring point depends on the sensor type and design, see the following table:

Sensor type	Vibration resistance for the sensor tip <sup>1)</sup>
iTHERM StrongSens Pt100 (TF, vibration-resistant)	600 m/s <sup>2</sup> (60 g)
Thin-film sensor (TF)	>4 g
Wire wound sensor (WW)	>3 g

1) (measured according to IEC 60751 at varying frequencies in the 10 to 500 Hz range)

#### Thermocouple TC:

4G / 2 to 150 Hz as per IEC 60068-2-6

#### Accuracy

Permissible deviation limits of thermoelectric voltages from the standard characteristic for thermocouples as per IEC 60584 or ASTM E230/ANSI MC96.1:

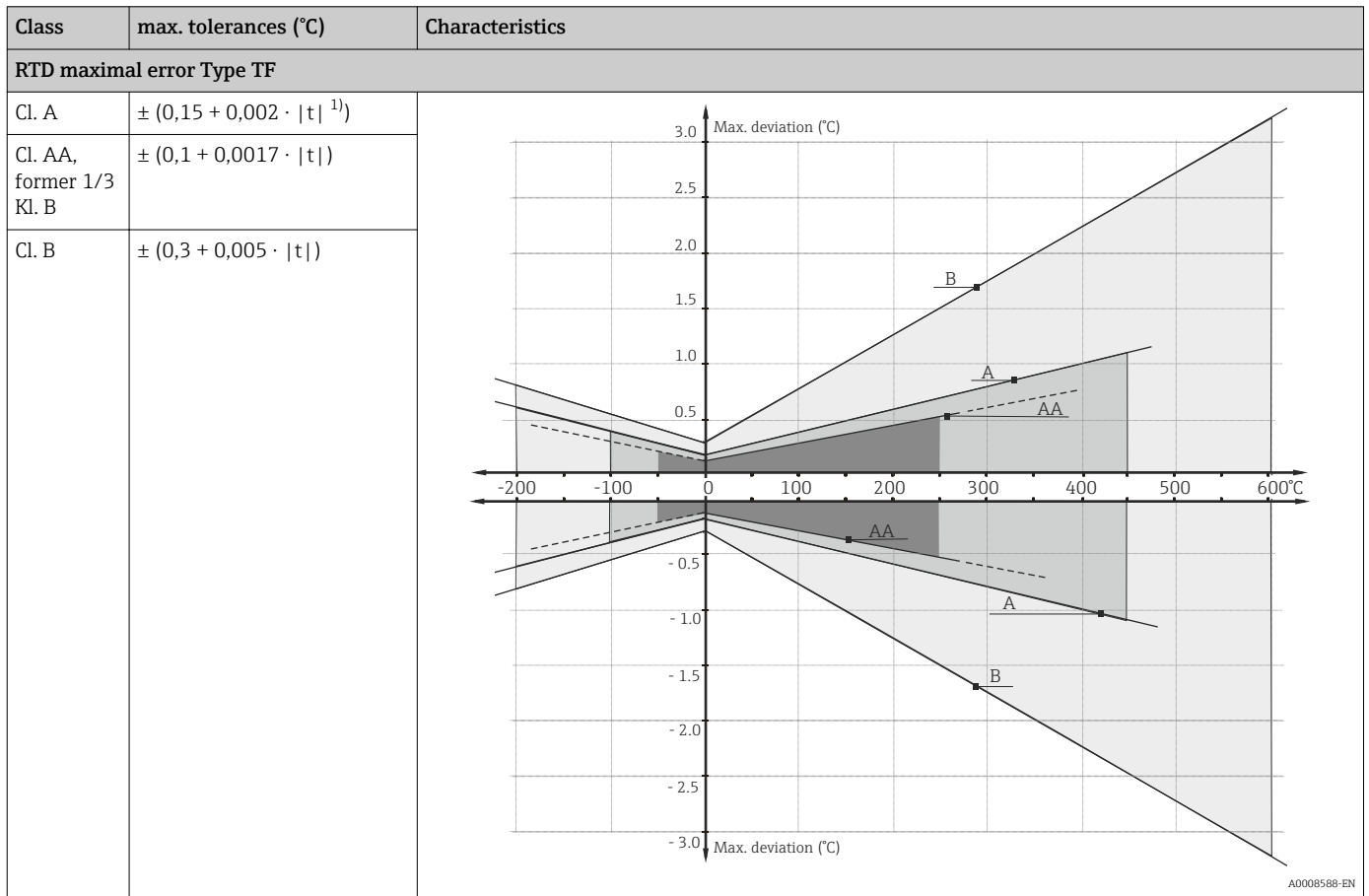
Standard	Type	Standard tolerance		Special tolerance	
		Class	Deviation	Class	Deviation
IEC 60584	J (Fe-CuNi)	2	$\pm 2,5 \text{ }^\circ\text{C}$ (-40 to 333 $^\circ\text{C}$ ) $\pm 0,0075  t $ <sup>1)</sup> (333 to 750 $^\circ\text{C}$ )	1	$\pm 1,5 \text{ }^\circ\text{C}$ (-40 to 375 $^\circ\text{C}$ ) $\pm 0,004  t $ <sup>1)</sup> (375 to 750 $^\circ\text{C}$ )
	K (NiCr-NiAl)	2	$\pm 2,5 \text{ }^\circ\text{C}$ (-40 to 333 $^\circ\text{C}$ ) $\pm 0,0075  t $ <sup>1)</sup> (333 to 1200 $^\circ\text{C}$ )	1	$\pm 1,5 \text{ }^\circ\text{C}$ (-40 to 375 $^\circ\text{C}$ ) $\pm 0,004  t $ <sup>1)</sup> (375 to 1000 $^\circ\text{C}$ )

1)  $|t|$  = absolute value in  $^\circ\text{C}$

Standard	Type	Standard tolerance	Special tolerance
ASTM E230/ANSI MC96.1		Deviation, the larger respective value applies	
	J (Fe-CuNi)	$\pm 2,2 \text{ K}$ or $\pm 0,0075  t $ <sup>1)</sup> (0 to 760 $^\circ\text{C}$ )	$\pm 1,1 \text{ K}$ or $\pm 0,004  t $ <sup>1)</sup> (0 to 760 $^\circ\text{C}$ )
	K (NiCr-NiAl)	$\pm 2,2 \text{ K}$ oder $\pm 0,02  t $ <sup>1)</sup> (-200 to 0 $^\circ\text{C}$ ) $\pm 2,2 \text{ K}$ or $\pm 0,0075  t $ <sup>1)</sup> (0 to 1260 $^\circ\text{C}$ )	$\pm 1,1 \text{ K}$ or $\pm 0,004  t $ <sup>1)</sup> (0 to 1260 $^\circ\text{C}$ )

1)  $|t|$  = absolute value in  $^\circ\text{C}$

RTD resistance thermometer as per IEC 60751



1) |t| = absolute value in °C


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):

Thermometer type	Diameter	t <sub>(x)</sub>	Reduced tip	Tapered tip	Straight tip
Resistance thermometer (measuring probe Pt100, TF/WW)	9 mm (0.35 in)	t <sub>50</sub>	7.5 s	11 s	18 s
		t <sub>90</sub>	21 s	37 s	55 s
	11 mm (0.43 in)	t <sub>50</sub>	7.5 s	not available	18 s
		t <sub>90</sub>	21 s	not available	55 s
	12 mm (0.47 in)	t <sub>50</sub>	not available	11 s	18 s
		t <sub>90</sub>	not available	37 s	55 s
Thermocouple	9 mm (0.35 in)	t <sub>50</sub>	5.5 s	9 s	15 s
		t <sub>90</sub>	13 s	31 s	46 s
	11 mm (0.43 in)	t <sub>50</sub>	5.5 s	not available	15 s
		t <sub>90</sub>	13 s	not available	46 s

Thermometer type	Diameter	t <sub>(x)</sub>	Reduced tip	Tapered tip	Straight tip
	12 mm (0.47 in)	t <sub>50</sub>	not available	8.5 s	32 s
		t <sub>90</sub>	not available	20 s	106 s

 Response time for insert without transmitter.

#### Insulation resistance

Insulation resistance  $\geq 100 \text{ M}\Omega$  at ambient temperature.

Insulation resistance between the terminals and the mineral insulated cable is measured with a 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.

#### Calibration

Endress+Hauser provides comparison temperature calibration from  $-80$  to  $+1\,400 \text{ }^\circ\text{C}$  ( $-110$  to  $+2\,552 \text{ }^\circ\text{F}$ ) based on the International Temperature Scale (ITS90). Calibrations are traceable to national and international standards. The calibration certificate is referenced to the serial number of the thermometer. Only the insert is calibrated.

Insert: $\varnothing 6 \text{ mm (0.24 in)}$ and $3 \text{ mm (0.12 in)}$	Minimum insertion length of insert in mm (in)	
	without head transmitter	with head transmitter
Temperature range		
$-80$ to $250 \text{ }^\circ\text{C}$ ( $-110$ to $480 \text{ }^\circ\text{F}$ )	No minimum immersion length required	
$250$ to $550 \text{ }^\circ\text{C}$ ( $480$ to $1020 \text{ }^\circ\text{F}$ )	300 (11.81)	
$550$ to $1\,400 \text{ }^\circ\text{C}$ ( $1020$ to $2\,552 \text{ }^\circ\text{F}$ )	450 (17.72)	



**Material**

Extension neck, thermowell, insert.

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. temperature for continuous use in air	Properties
AISI 316/1.4401	X5CrNiMo 17-12-2	650 °C (1 202 °F) <sup>1)</sup>	<ul style="list-style-type: none"> <li>▪ Austenitic, stainless steel</li> <li>▪ High corrosion resistance in general</li> <li>▪ Particularly high corrosion resistance in chlorine-based and acidic, non-oxidizing atmospheres through the addition of molybdenum (e.g. phosphoric and sulfuric acids, acetic and tartaric acids with a low concentration)</li> </ul>
AISI 316L/ 1.4404 1.4435	X2CrNiMo17-12-2 X2CrNiMo18-14-3	650 °C (1 202 °F) <sup>1)</sup>	<ul style="list-style-type: none"> <li>▪ Austenitic, stainless steel</li> <li>▪ High corrosion resistance in general</li> <li>▪ Particularly high corrosion resistance in chlorine-based and acidic, non-oxidizing atmospheres through the addition of molybdenum (e.g. phosphoric and sulfuric acids, acetic and tartaric acids with a low concentration)</li> <li>▪ Increased resistance to intergranular corrosion and pitting</li> <li>▪ Compared to 1.4404, 1.4435 has even higher corrosion resistance and a lower delta ferrite content</li> </ul>
AISI 316Ti/1.4571	X6CrNiMoTi17-12-2	700 °C (1 292 °F) <sup>1)</sup>	<ul style="list-style-type: none"> <li>▪ Properties comparable to AISI316L</li> <li>▪ Addition of titanium means increased resistance to intergranular corrosion even after welding</li> <li>▪ Broad range of uses in the chemical, petrochemical and oil industries as well as in coal chemistry</li> <li>▪ Can only be polished to a limited extent, titanium streaks can form</li> </ul>
Alloy600/ 2.4816	NiCr15Fe	1 100 °C (2 012 °F)	<ul style="list-style-type: none"> <li>▪ A nickel/chromium alloy with very good resistance to aggressive, oxidizing and reducing atmospheres, even at high temperatures</li> <li>▪ Resistance to corrosion caused by chlorine gases and chlorinated media as well as many oxidizing mineral and organic acids, sea water etc.</li> <li>▪ Corrosion from ultrapure water</li> <li>▪ Not to be used in sulfur-containing atmospheres</li> </ul>
AlloyC276/2.4819	NiMo16Cr15W	1 100 °C (2 012 °F)	<ul style="list-style-type: none"> <li>▪ A nickel-based alloy with good resistance to oxidizing and reducing atmospheres, even at high temperatures</li> <li>▪ Particularly resistant to chlorine gas and chloride as well as to many oxidizing mineral and organic acids</li> </ul>

1) Can be used to a limited extent up to 800 °C (1472 °F) 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

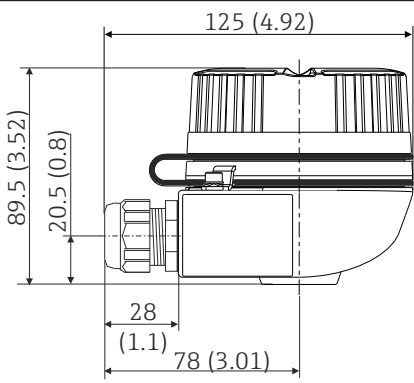
Universally programmable head transmitter with FOUNDATION Fieldbus™ communication. Conversion of various input signals into digital output signals. High accuracy over the complete ambient temperature range. Swift and easy operation, visualization and maintenance using a PC directly from the control panel, e.g. using operating software such as ControlCare from Endress +Hauser or NI Configurator from National Instruments. For more information, see the Technical Information.

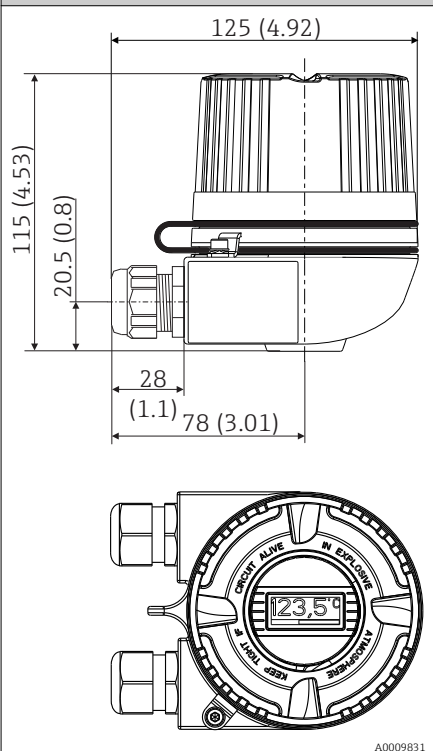
Advantages of the iTEMP transmitters:

- Dual or single sensor input (optionally for certain transmitters)
- Pluggable display (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

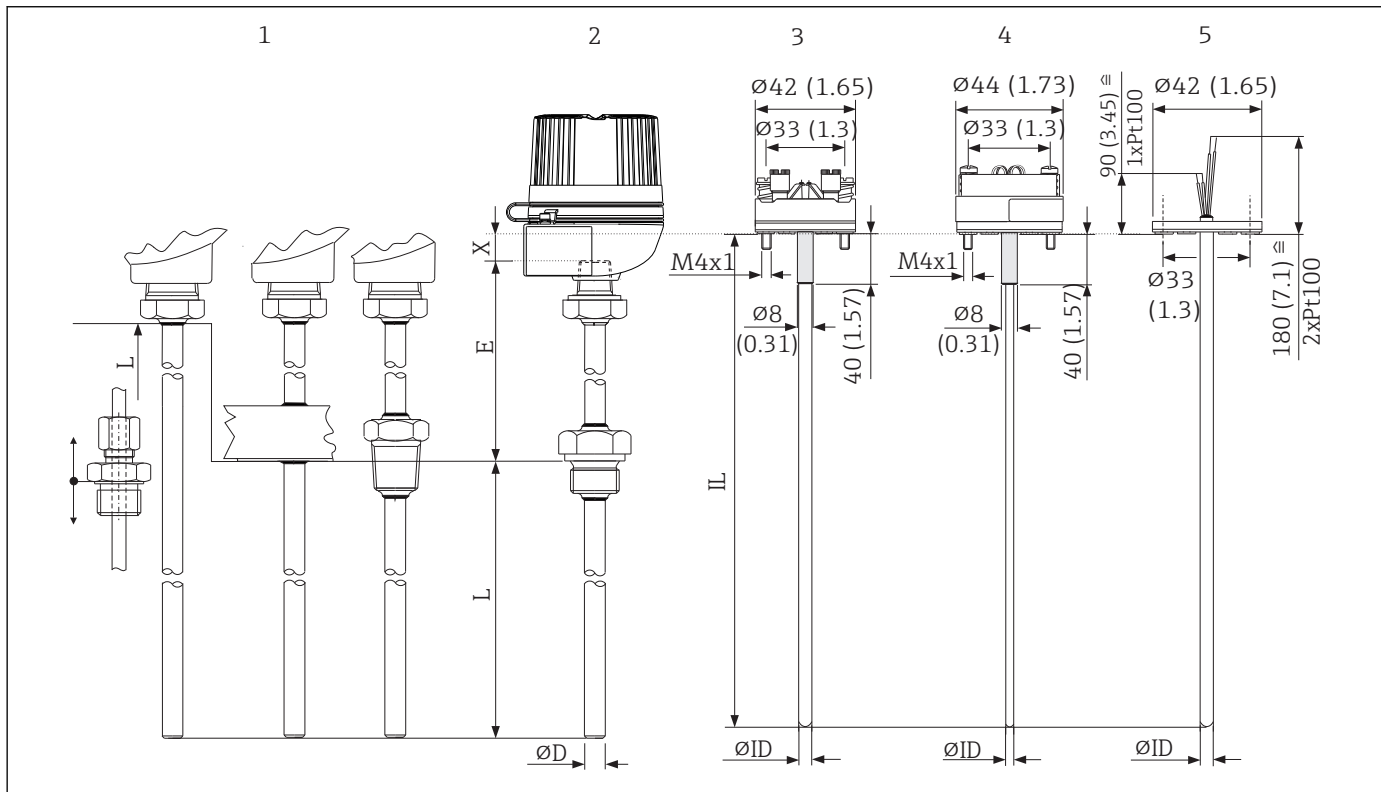
All terminal heads have an internal shape and size in accordance with DIN EN 50446, flat face and a thermometer connection with a M24x1.5, G½" or ½" NPT thread. All dimensions in mm (in). The cable glands in the diagrams correspond to M20x1.5 connections. Specifications without head transmitter installed. For ambient temperatures with head transmitter installed, see "Operating conditions" section.

TA30H	Specification
 <p style="text-align: right; font-size: small;">A0009832</p>	<ul style="list-style-type: none"> <li>■ Flameproof (XP) version, explosion-protected, captive screw cap, available with one or two cable entries</li> <li>■ Degree of protection: IP 66/68, NEMA Type 4x Encl. Ex-version: IP 66/67</li> <li>■ Temperature: -50 to +150 °C (-58 to +302 °F) for rubber seal without cable gland (observe max. permitted temperature of cable gland!)</li> <li>■ Material: aluminum; polyester powder coated</li> <li>■ Thread: ½" NPT, ¾" NPT, M20x1.5, G½"</li> <li>■ Extension neck/thermowell connection: ½" NPT</li> <li>■ Color of head: blue, RAL 5012</li> <li>■ Color of cap: gray, RAL 7035</li> <li>■ Weight: approx. 640 g (22.6 oz)</li> </ul>

TA30H with display window in cover	Specification
 <p>Technical drawing of the TA30H sensor. The side view shows a cylindrical head with a diameter of 125 (4.92) and a total height of 115 (4.53). The mounting neck has a diameter of 20.5 (0.8) and a length of 28 (1.1). The total length of the sensor body is 78 (3.01). The top view shows a circular cover with a central display window showing the number '123.5'. The cover has safety markings: 'KEEP HEAD TIGHT', 'OPEN ALIVE', and 'NO EXPLOSION'. The drawing is labeled A0009831.</p>	<ul style="list-style-type: none"> <li>▪ Flameproof (XP) version, explosion-protected, captive screw cap, available with one or two cable entries</li> <li>▪ Degree of protection: IP 66/68, NEMA Type 4x Encl. Ex-version: IP 66/67</li> <li>▪ Temperature: -50 to +150 °C (-58 to +302 °F) for rubber seal without cable gland (observe max. permitted temperature of cable gland!)</li> <li>▪ Material: aluminum; polyester powder coated</li> <li>▪ Thread: ½" NPT, ¾" NPT, M20x1.5, G½"</li> <li>▪ Extension neck/thermowell connection: ½" NPT</li> <li>▪ Color of head: blue, RAL 5012</li> <li>▪ Color of cap: gray, RAL 7035</li> <li>▪ Weight: approx. 860 g (30.33 oz)</li> <li>▪ Head transmitter optionally available with TID10 display</li> </ul>

## Design

All dimensions in mm (in).

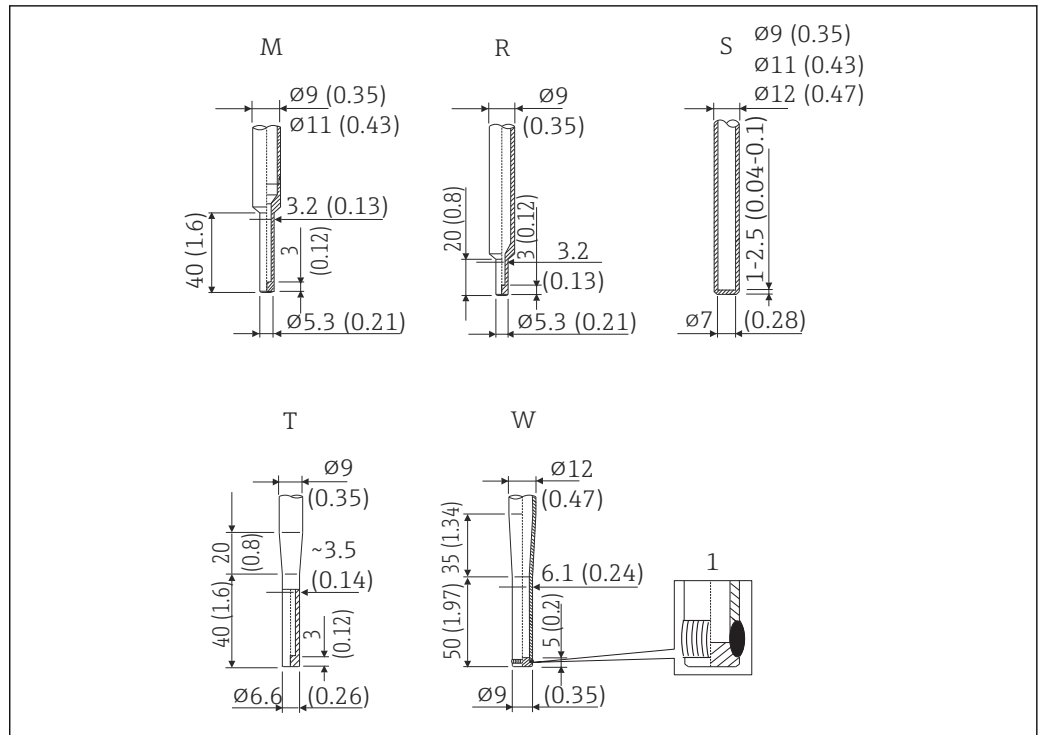


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5 Dimensions of Omnigrad S TR61 and TC61

- 1 Process connections
- 2 Complete thermometer with terminal head
- 3 Insert with terminal block mounted
- 4 Insert with head transmitter mounted
- 5 Insert with flying leads
- IL Installation length of insert
- L Immersion length
- E Extended neck length
- X Variable for calculating the length of the insert
- ID Insert diameter
- D Diameter

**Tip shape**



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6 Thermowell tips available (reduced, straight or tapered). Maximum surface roughness  $Ra \leq 0.8 \mu\text{m}$  (31.5  $\mu\text{in}$ )

1 Weld quality as per EN ISO 5817 - quality standard B

Item	Tip shape, L = immersion depth	Insert diameter
M	Reduced, $L \geq 70 \text{ mm}$ (2.76 in)	3 mm (0.12 in)
R	Reduced, $L \geq 50 \text{ mm}$ (1.97 in) <sup>1)</sup>	3 mm (0.12 in)
S	Straight	6 mm (0.24 in)
T	Tapered, $L \geq 90 \text{ mm}$ (3.54 in) <sup>1)</sup>	3 mm (0.12 in)
W	Tapered DIN43772-3G, $L \geq 115 \text{ mm}$ (4.53 in) <sup>1)</sup>	6 mm (0.24 in)

1) Not with AlloyC276/2.4819 and Alloy600

**Weight**

0.5 to 2.5 kg (1 to 5.5 lbs) for standard options.

**Process connection**

The process connection refers to the connection between the thermometer and the process. The following process connections are available:

Thread	Version	Thread length TL
Cylindrical	G	G½" DIN / BSP
	G	G1" DIN / BSP
Conical	G	G¾" BSP
	NPT	NPT ½"
NPT	NPT	NPT ¾"
	R	R ½"
R	R	R ¾"
	M	M20x1.5

Process connection
Threaded compression fitting (TA50)

Version	F in mm (in)	L in mm (in)	C in mm (in)	B in mm (in)	Clamping ring material	Max. process temperature	Max. process pressure	
TA50	G½"	SW/AF 27	45 mm (1.77 in) 47	-	15 mm (0.6 in) 15	SS316 <sup>1)</sup>	800 °C (1472 °F)	40 bar at 20 °C (580 psi at 68 °F)
						PTFE <sup>2)</sup>	200 °C (392 °F)	10 bar at 20 °C (145 psi at 68 °F)
	G1"	SW/AF 41	70 mm (2.75 in)	-	25 mm (0.98 in)	SS316 <sup>1)</sup>	800 °C (1472 °F)	40 bar at 20 °C (580 psi at 68 °F)
						PTFE <sup>2)</sup>	200 °C (392 °F)	10 bar at 20 °C (145 psi at 68 °F)
	M20x1.5	SW/AF 27	55 mm (2.16 in)	-	15 mm (0.59 in)	SS316 <sup>1)</sup>	800 °C (1472 °F)	40 bar at 20 °C (580 psi at 68 °F)
						PTFE <sup>2)</sup>	200 °C (392 °F)	10 bar at 20 °C (145 psi at 68 °F)
	R½"	SW/AF 27	50 mm (1.96 in)	-	8 mm (0.31 in)	PTFE <sup>2)</sup>	200 °C (392 °F)	10 bar at 20 °C (145 psi at 68 °F)

Version	F in mm (in)		L in mm (in)	C in mm (in)	B in mm (in)	Clamping ring material	Max. process temperature	Max. process pressure
	R3/4"	SW/AF 27	55 mm (2.16 in)	-	8 mm (0.31 in)	PTFE <sup>2)</sup>	200 °C (392 °F)	10 bar at 20 °C (145 psi at 68 °F)
	R1"	SW/AF 36	70 mm (2.75 in)	-	10 mm (0.39 in)	PTFE <sup>2)</sup>	200 °C (392 °F)	10 bar at 20 °C (145 psi at 68 °F)

- 1) SS316 clamping ring: can only be used once. Once released the compression fitting cannot be repositioned on the thermowell. Fully adjustable immersion length on initial installation
- 2) PTFE/Silopren<sup>®</sup> clamping ring: can be reused, once released the fitting can be moved up and down the thermowell. Fully adjustable immersion length

**i** When a compression fitting is used, the thermometer is pushed through a gland and fixed in place using a clamping ring (can be released) or a metal clamping ring (cannot be released).

Flange	
<p>All the flange connections available meet the relevant standards:</p> <ul style="list-style-type: none"> <li>▪ ANSI/ASME B16.5</li> <li>▪ ISO 7005-1</li> <li>▪ EN 1092-1</li> <li>▪ JIS B 2220 : 2004</li> </ul>	<p>Ideally the flange should be made from the same material as the thermowell. Alloy thermowells have flanges made from 316L/1.4404 and an alloy disc that is in contact with the process medium.</p>

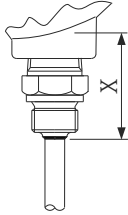
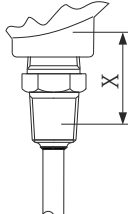
**Spare parts**

- The thermowells (TW10, TW11, TW12 and TW13) are available as spare parts → 21
- The RTD insert is available as spare part TPR100/TPR300 or TS111 → 21
- The TC insert is available as spare part TPC100/TPC300 → 21
- If the insert is required as a spare part, please note the following formulas:

Universal or EX certification			
Insert	Ømm	Thermowell	IL in mm (in)
TS111, TPx100 or TPx300	3 or 6	TW10	$IL = L + E + 28$ (1.10)
TS111, TPx100 or TPx300	3 or 6	TW11	$IL = L + X$ (see table below)
TS111, TPx100 or TPx300	3 or 6	TW12	$IL = L + 58$ (2.28)
TS111, TPx100 or TPx300	3 or 6	TW13	$IL = L + E + 28$ (1.10)

**i TW11**

If using the thermowell TW11, the variable for calculating the length of the insert depends on the process connection used.

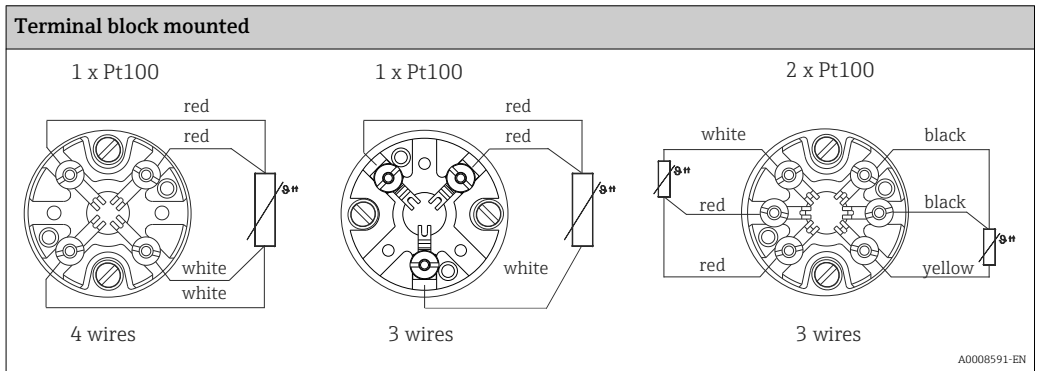
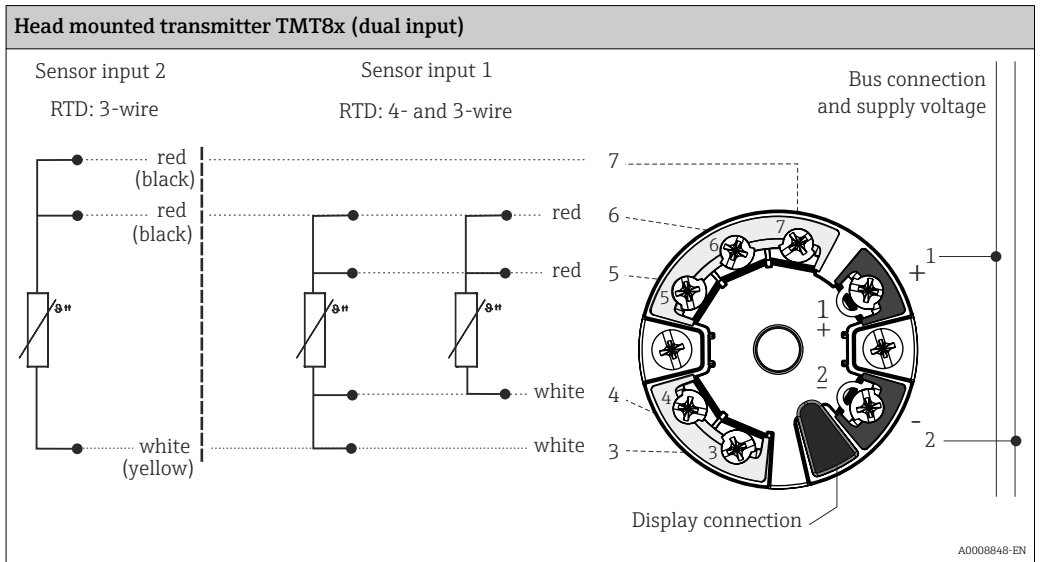
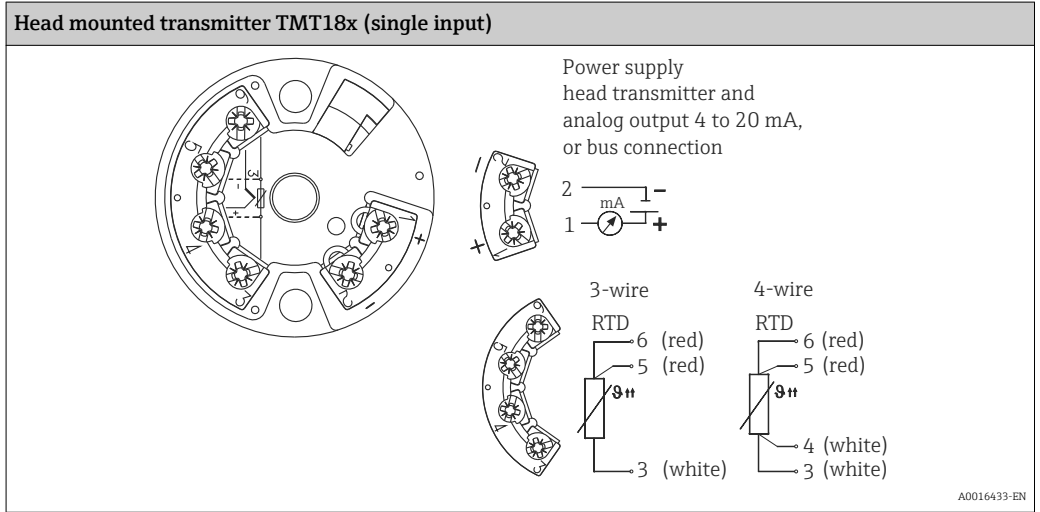
Process connection	Thread version	X = Variable for calculating the length of the insert
 <small>A0017874</small>	G	65 mm (2.56 in)
	M	
 <small>A0017875</small>	R	68 mm (2.68 in)
	NPT	70 mm (2.75 in)



# Wiring

## Wiring diagrams for RTD

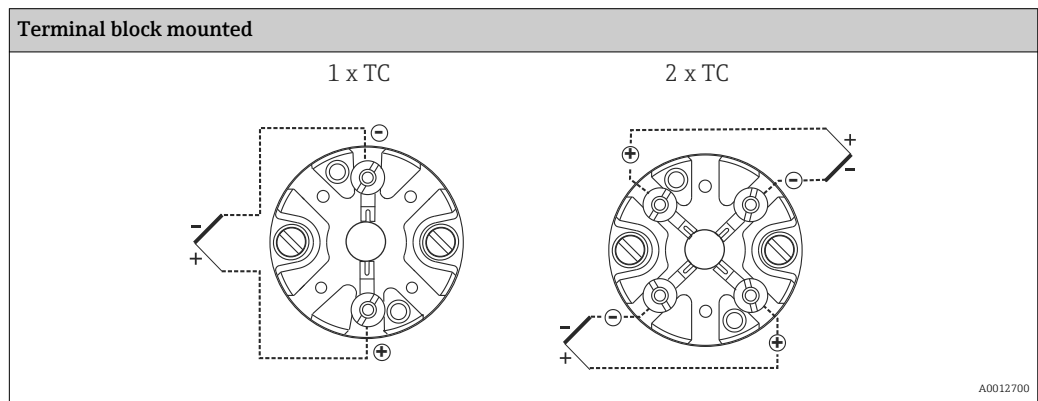
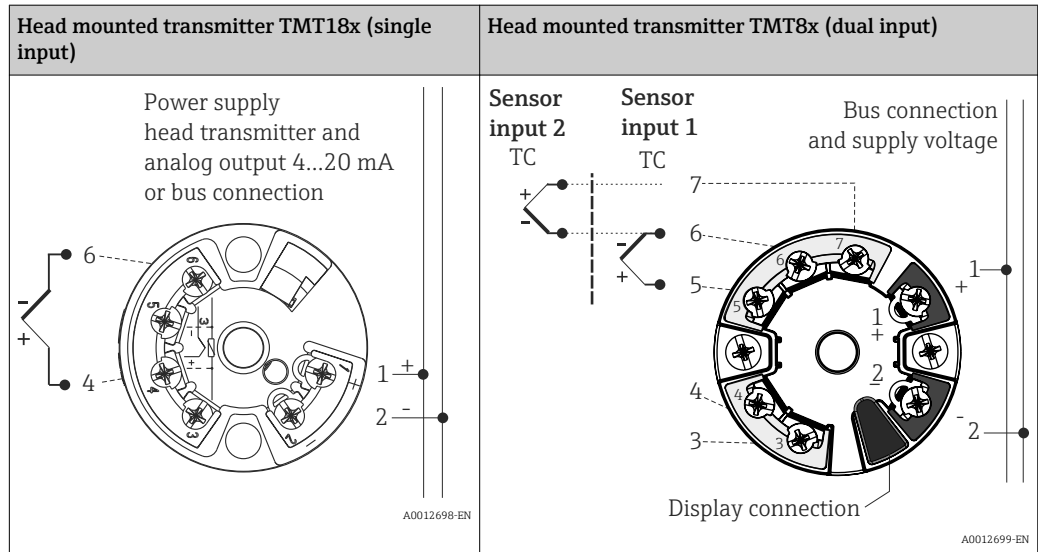
Type of sensor connection



## Wiring diagram for TC

Thermocouple wire colors

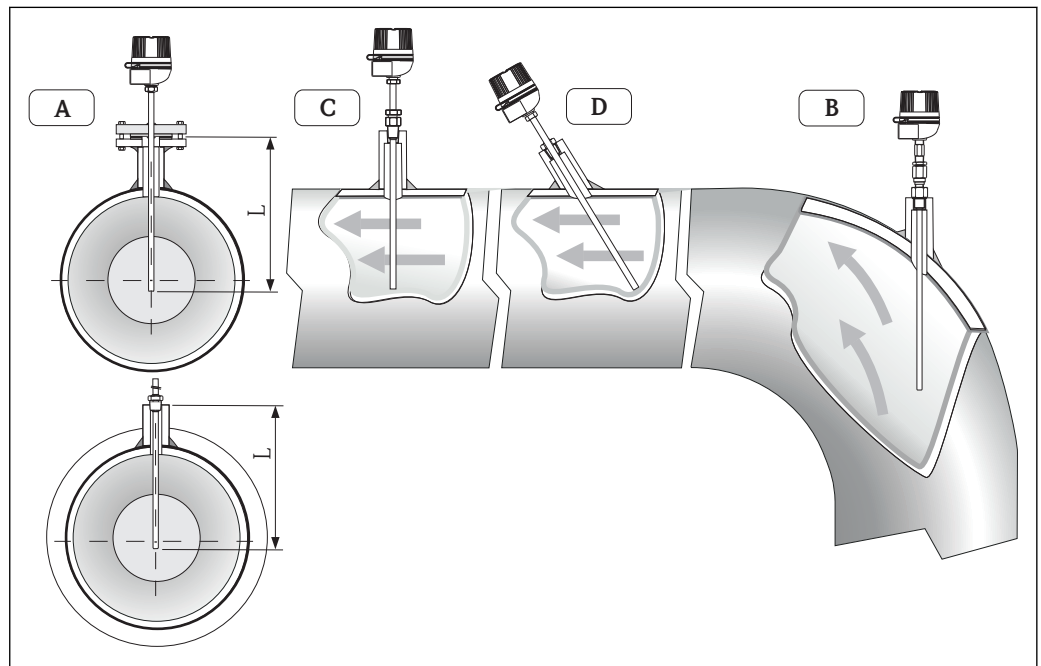
As per IEC 60584	As per ASTM E230
<ul style="list-style-type: none"> <li>Type J: black (+), white (-)</li> <li>Type K: green (+), white (-)</li> </ul>	<ul style="list-style-type: none"> <li>Type J: white (+), red (-)</li> <li>Type K: yellow (+), red (-)</li> </ul>



## Installation conditions

**Orientation** No restrictions.

### Installation instructions



**7** Installation examples

A - C In pipes with a small cross-section, the sensor tip should reach or extend slightly past the center axis of the pipe ( $= L$ ).

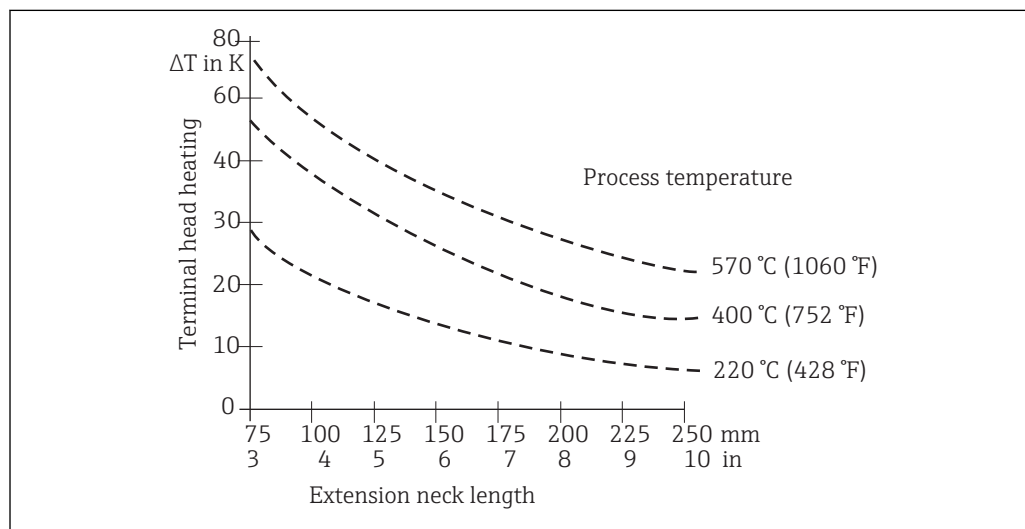
B, D Slanted orientation.

The immersion length of the thermometer influences the accuracy. If the immersion length is too small, errors in the measurement are caused by heat conduction via the process connection and the container wall. For installation in a pipe, therefore, the recommended installation depth ideally corresponds to half of the pipe diameter. Installation at an angle (see item B and D) could be another solution. When determining the immersion length or installation depth all the parameters of the thermometer and of 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 depth = 80 to 100 mm (3.15 to 3.94 in)  
The immersion depth should be at least 8 times the diameter of the thermowell. Example:  
Thermowell diameter 12 mm (0.47 in) x 8 = 96 mm (3.8 in). A standard immersion depth of 120 mm (4.72 in) is recommended.
- ATEX certification: Observe the installation instructions in the Ex documentation!

**Extended neck length**

The extended neck is the part between the process connection and the terminal head. As illustrated in the following diagram, the extended neck length influences the temperature in the terminal head. This temperature must remain within the limit values defined in the "Operating conditions" section.



8 Heating of the terminal head as a function of the process temperature. Temperature in terminal head = ambient temperature 20 °C (68 °F) +  $\Delta T$

## Certificates and approvals

**CE mark**

The product meets the requirements of the harmonized European standards. As such, it complies with the legal specifications of the EC directives. The manufacturer confirms successful testing of the product by affixing to it the CE-mark.

**Hazardous area approvals**

For further details on the available Ex versions (ATEX, CSA, FM etc.), please contact your nearest Endress+Hauser sales organization. All relevant data for hazardous areas can be found in separate Ex documentation.

**Other standards and guidelines**

- IEC 60529: Degrees of protection provided by enclosures (IP code)
- IEC/EN 61010-1: Safety requirements for electrical equipment for measurement, control and laboratory use
- IEC 60751: Industrial platinum resistance thermometers
- IEC 60584 and ASTM E230/ANSI MC96.1: Thermocouples
- DIN 43772: Thermowells
- DIN EN 50446: Terminal heads

**Test on thermowell**

Thermowell pressure tests are carried out in accordance with the specifications in DIN 43772. With regard to thermowells with tapered or reduced tips that do not comply with this standard, these are tested using the pressure of corresponding straight thermowells. Sensors for use in hazardous areas are also always subjected to a comparative pressure during the tests. Tests according to other specifications can be carried out on request. The liquid penetration test verifies that there are no cracks in the welded seams of the thermowell.

**Test report and calibration**

The "Factory calibration" is carried out according to an internal procedure in a laboratory of Endress+Hauser accredited by the European Accreditation Organization (EA) to ISO/IEC 17025. A calibration which is performed according to EA guidelines (SIT/Accredia) or (DKD/DAkkS) may be requested separately. The calibration is performed on the replaceable insert of the thermometer. In the case of thermometers without a replaceable insert, the entire thermometer - from the process connection to the tip of the thermometer - is calibrated.

## Ordering information

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

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

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



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

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

## Supplementary documentation

Technical Information:

- Temperature head transmitter iTEMP:
  - TMT180, PC-programmable, single-channel, Pt100 (TI00088R/09/en)
  - PCP 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)
- Inserts:
  - Resistance thermometer insert Omniset TPR100 (TI268T/02) or iTHERM TS111 (TI01014T/09)
  - Thermocouple insert Omniset TPC100 (TI278T/02/en)
- Application example:
  - RN221N Active barrier, for supplying loop-powered transmitters (TI073R/09/en)
  - RIA16 Field display unit, loop-powered (TI00144R/09/en)

Technical Information on thermowells:

Thermowell type	
TW10	TI261T/02/en
TW11	TI262T/02/en
TW12	TI263T/02/en
TW13	TI00264T/09/en

Supplementary ATEX documentation:

- RTD/TC Thermometer Omnigrad TRxx, TCxx, TxCxxx, ATEX II 1GD or II 1/2GD Ex ia IIC T6...T1 (XA00072R/09/a3)
- RTD/TC Thermometer Omnigrad S TR/TC6x, ATEX II1/2, 2GD or II2G (XA014T/02/a3)
- RTD/TC Thermometer Omnigrad S TR/TC6x, ATEX II 1/2 or 2G; II 1/2 or 2D; II 2G (XA00084R/09/a3)
- Inserts Omniset TPR100, TPC100, ATEX/IECEx Ex ia (XA00100R/09/a3)

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

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