

Technical Information

iTHERM ModuLine TM111

Innovative, robust, and modular thermometer designed for direct installation (without a thermowell), suitable for a wide range of industrial applications

Easy-to-use metric version with outstanding RTD or TC sensor technology.
Direct installation without a thermowell



Application

- For universal use
- Measuring range: -200 to +1 100 °C (-328 to +2 012 °F)
- Pressure range: up to 75 bar (1 088 psi)

Head transmitter

Endress+Hauser transmitters are available with enhanced measurement accuracy and reliability compared to directly wired sensors. With a choice of the following outputs and communication protocols, they are easily customized to your measuring task:

- Analog output 4 to 20 mA, HART®
HART® SIL transmitter, optional
- PROFIBUS® PA, FOUNDATION Fieldbus™
- PROFINET® with Ethernet-APL
- IO-Link®

Your benefits

- User-friendly and reliable from product selection to maintenance
- iTHERM inserts: globally unique, automated production. Full traceability and consistently high product quality for reliable measured values
- iTHERM QuickSens: fastest response times of 1.5 s for optimum process control
- iTHERM StrongSens: unsurpassed vibration resistance ($\leq 60g$) for ultimate plant safety
- International certifications: explosion protection according to ATEX, IECEx, CSA and NEPSI
- Bluetooth® connectivity (optional)

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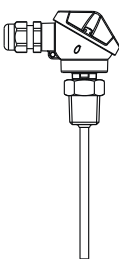
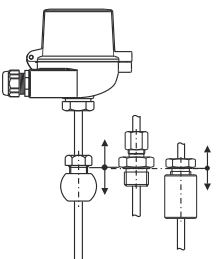
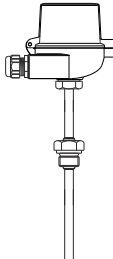
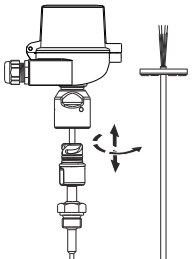
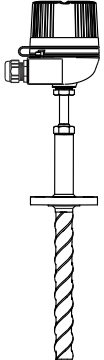
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Function and system design

iTHERM ModuLine

This thermometer is part of the product line of modular thermometers for industrial applications.

Differentiating factors when selecting a suitable thermometer:

Thermowell	Direct contact - without thermowell		Thermowell, welded		Thermowell from barstock material
Device type	Metric				
Thermometer	<p>TM101</p>  <p>A0039102</p>	<p>TM111</p>  <p>A0038281</p>	<p>TM121</p>  <p>A0038194</p>	<p>TM131</p>  <p>A0038195</p>	<p>TM151</p>  <p>A0052360</p>
FLEX segment	F	E	F	E	E
Properties	Excellent price-performance ratio	iTHERM StrongSens and QuickSens inserts	Excellent price-performance ratio with thermowell	<ul style="list-style-type: none"> ▪ iTHERM StrongSens and QuickSens inserts ▪ QuickNeck ▪ Fast response times ▪ Dual-seal technology ▪ Dual-compartment housing 	<ul style="list-style-type: none"> ▪ iTHERM StrongSens and QuickSens inserts ▪ QuickNeck ▪ TwistWell ▪ Fast response times ▪ Dual-seal technology ▪ Dual-compartment housing
Hazardous area	-	EX	-	EX	EX

Measuring principle**Resistance thermometers (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 °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):Wire Wound, WW** In these thermometers, a double coil of fine, high-purity platinum wire is accommodated in a ceramic support. This support 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 is comparatively sensitive to vibrations.
- **Thin-film platinum resistance thermometers (Thin Film, 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 class 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.

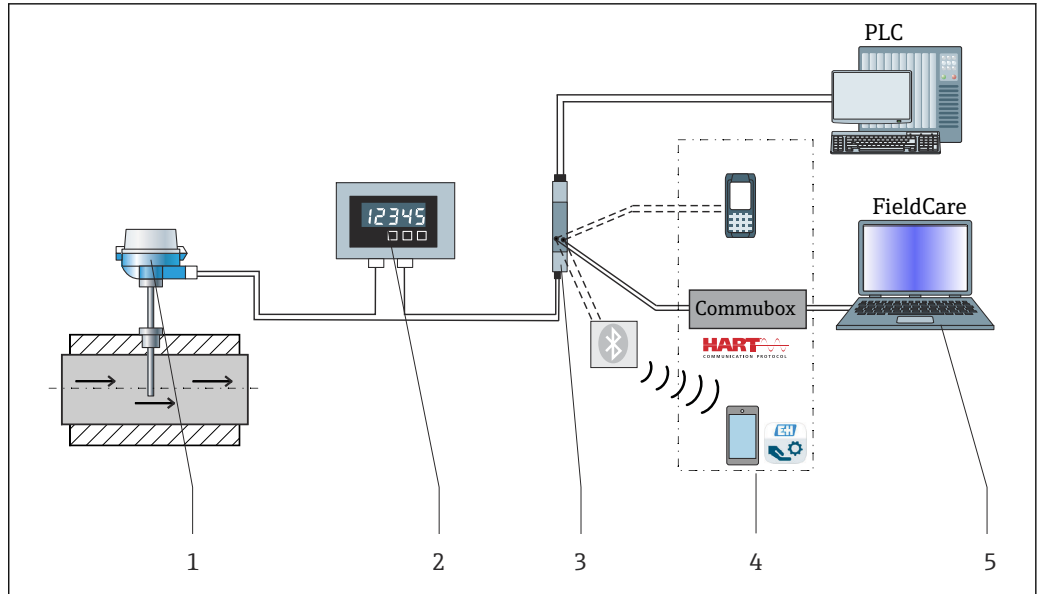
Measuring system

Endress+Hauser offers a complete portfolio of optimized components for the temperature measuring point – everything you need for the seamless integration of the measuring point into the overall facility. These include:

- Power supply unit/barrier
- Display units
- Surge arrester



For more information, see the brochure "System Components - Solutions for a Complete Measuring Point" (FA00016K)

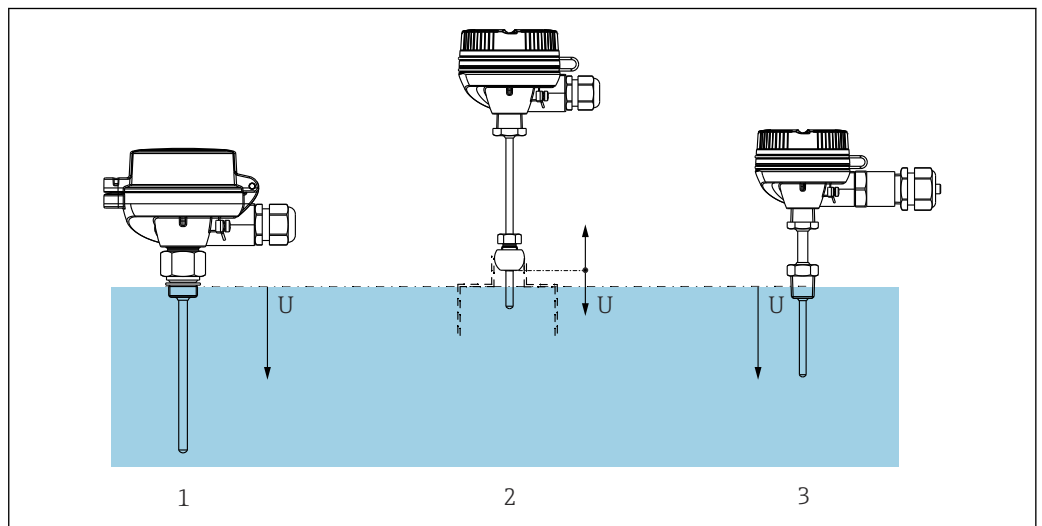


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1 Example of application, measuring point layout with additional Endress+Hauser components

- 1 Installed iTHERM thermometer with HART® communication protocol
- 2 RIA15 loop-powered process indicator - The process indicator is incorporated into the current loop and displays the measuring signal or the HART® process variables in digital form. The process display unit does not require an external power supply. It is powered directly from the current loop.
- 3 Active barrier RN42 - The RN42 (17.5 V_{DC}, 20 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 24 to 230 V AC/DC, 0/50/60 Hz, which means that it can be used in all international power grids.
- 4 Communication examples: HART® Communicator (handheld terminal), FieldXpert, Commubox FXA195 for intrinsically safe HART® communication with FieldCare via the USB interface, Bluetooth® technology with SmartBlue App.
- 5 FieldCare is a FDT-based plant asset management tool from Endress+Hauser, for details see section "accessories".

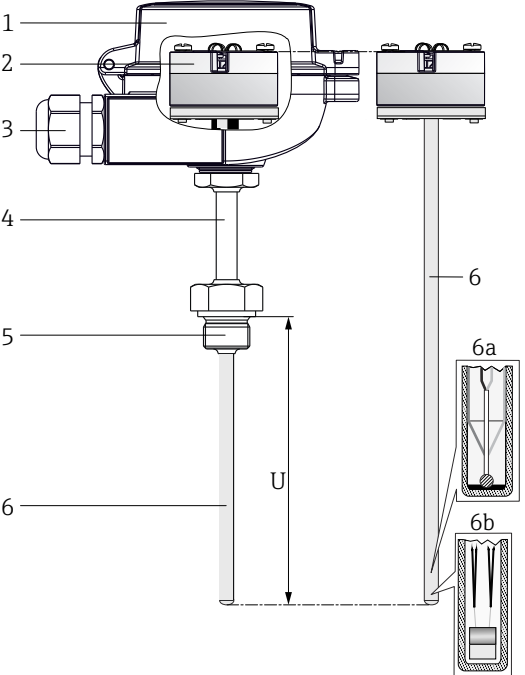
Modular design



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2 The thermometer is designed for direct process installation.

- 1 Threaded process connection without lagging
- 2 Weld-in adapter, spherical or cylindrical version
- 3 With extension neck and threaded process connection

Design	Options
 <p>1: Terminal head 2: Wiring, electrical connection, output signal 3: Plug or cable gland 4: Lagging 5: Process connection 6: Insert 6a: iTHERM QuickSens 6b: iTHERM StrongSens</p> <p>U</p> <p>A0038973</p>	<p>1: Terminal head</p> <p>Variety of terminal heads made of aluminum, polyamide or stainless steel</p> <p>i Your benefits:</p> <ul style="list-style-type: none"> ■ Optimum terminal access thanks to low housing edge of bottom section: <ul style="list-style-type: none"> ■ Easier to use ■ Lower installation and maintenance costs ■ Optional display: local process display for added reliability
	<p>2: Wiring, electrical connection, output signal</p> <ul style="list-style-type: none"> ■ Ceramic terminal block ■ Flying leads ■ Head transmitter: 4 to 20 mA, HART®, Ethernet-APL, PROFIBUS® PA, FOUNDATION™ Fieldbus, IO-Link® (single-channel or dual-channel) ■ Attachable display
	<p>3: Plug or cable gland</p> <ul style="list-style-type: none"> ■ Polyamide or brass cable glands ■ M12 plug, 4-pin/8-pin: PROFIBUS® PA, Ethernet-APL, IO-Link® ■ 7/8" plug: PROFIBUS® PA, FOUNDATION™ Fieldbus
	<p>4: Lagging</p> <p>Different options are available for the lagging</p> <ul style="list-style-type: none"> ■ Without extension (versions without fixed process connection) ■ Defined extension (minimum available extension for fixed process connections) ■ Extension welded in place (selectable lengths)
	<p>5: Process connection</p> <p>Variety of process connections including threads, cap nuts and compression fittings</p>
	<p>6: Insert</p> <p>6a: iTHERM QuickSens 6b: iTHERM StrongSens</p> <p>The sheath of the insert is in direct contact with the process medium and does not have to be inserted into a thermowell. The process connection is welded to the insert. The insert is not replaceable and not spring-loaded. However, if a compression fitting is used as the process connection, the insert can be replaced.</p> <p>Sensor models: RTD - wire wound (WW), thin-film sensor (TF) or thermocouples type K, J or N. Insert diameter $\varnothing 3$ mm (0.12 in) or $\varnothing 6$ mm (0.24 in), depending on thermowell tip or selected thermometer</p> <p>i Your benefits:</p> <ul style="list-style-type: none"> ■ iTHERM QuickSens - insert with the world's fastest response time: <ul style="list-style-type: none"> ■ Insert: $\varnothing 3$ mm (0.12 in) or $\varnothing 6$ mm (0.24 in) ■ Fast, highly accurate measurements, delivering maximum process safety and control ■ Quality and cost optimization ■ Minimization of necessary immersion length: better product protection thanks to improved process flow ■ iTHERM StrongSens - insert with unbeatable durability: <ul style="list-style-type: none"> ■ Vibration resistance $\leq 60g$: lower life cycle costs thanks to longer operating life and high plant availability ■ Automated, traceable production: top quality and maximum process safety ■ High long-term stability: reliable measured values and high level of system safety

Input

Measured variable Temperature (temperature linear transmission behavior)

Measuring range *Depends on the type of sensor used*

Sensor type	Measuring range
Pt100 thin-film (TF), basic iTHERM QuickSens, fast response	-50 to +200 °C (-58 to +392 °F)
Pt100 thin film (TF), standard	-50 to +400 °C (-58 to +752 °F)
Pt100 thin film (TF), iTHERM StrongSens, vibration-resistant ≤ 60g	-50 to +500 °C (-58 to +932 °F)
Pt100 wire wound (WW), extended measuring range	-200 to +600 °C (-328 to +1 112 °F)
Thermocouple TC, type J	-40 to +750 °C (-40 to +1 382 °F)
Thermocouple TC, type K	-40 to +1 100 °C (-40 to +2 012 °F)
Thermocouple TC, type N	

Output

Output signal Generally, the measured value can be transmitted in one of two ways:

- Directly-wired sensors - sensor measured values forwarded without a transmitter.
- Via all common protocols by selecting an appropriate Endress+Hauser iTEMP transmitter. All the transmitters listed below are mounted directly in the terminal head and wired with the sensory mechanism.

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.

4 to 20 mA 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.

HART® 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. Swift and easy operation, visualization and maintenance using universal configuration software like FieldCare, DeviceCare or FieldCommunicator 375/475. Integrated Bluetooth® interface for the wireless display of measured values and configuration via Endress +Hauser SmartBlue (app), optional.

PROFIBUS® PA head transmitters

Universally programmable head transmitter with PROFIBUS® PA communication. Conversion of various input signals into digital output signals. High measurement accuracy over the complete ambient temperature range. PROFIBUS PA functions and device-specific parameters are configured via fieldbus communication.

FOUNDATION Fieldbus™ head transmitters

Universally programmable head transmitter with FOUNDATION Fieldbus™ communication. Conversion of various input signals into digital output signals. High measurement accuracy over the complete ambient temperature range. All transmitters are approved for use in all the main process control systems. The integration tests are performed in Endress+Hauser's 'System World'.

Head transmitter with PROFINET® and Ethernet-APL

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-T1. 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.


Head transmitter with IO-Link®

The temperature transmitter is an IO-Link® device with a measurement input and an IO-Link® interface. It offers a configurable, simple and cost-effective solution thanks to digital communication via IO-Link®. The device is mounted in a terminal head form B (flat face) as per DIN EN 5044.

Advantages of the iTEMP transmitters:

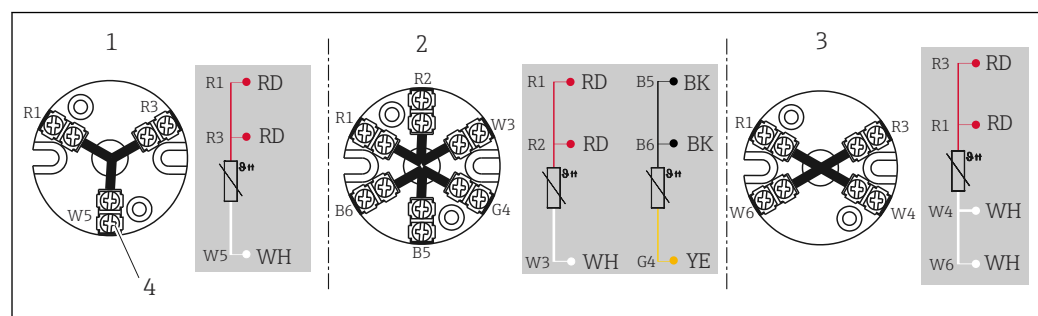
- Dual or single sensor input (optionally for certain transmitters)
- Attachable display (optionally for certain transmitters)
- Unsurpassed reliability, accuracy and long-term stability in critical processes
- Mathematical functions
- Monitoring of the thermometer drift, sensor backup functionality, sensor diagnostic functions
- Sensor-transmitter-matching based on the Callendar van Dusen coefficients (CvD).

Power supply

 The sensor connection wires are equipped with terminal lugs. The nominal diameter of the cable lug is 1.3 mm (0.05 in)

Terminal assignment

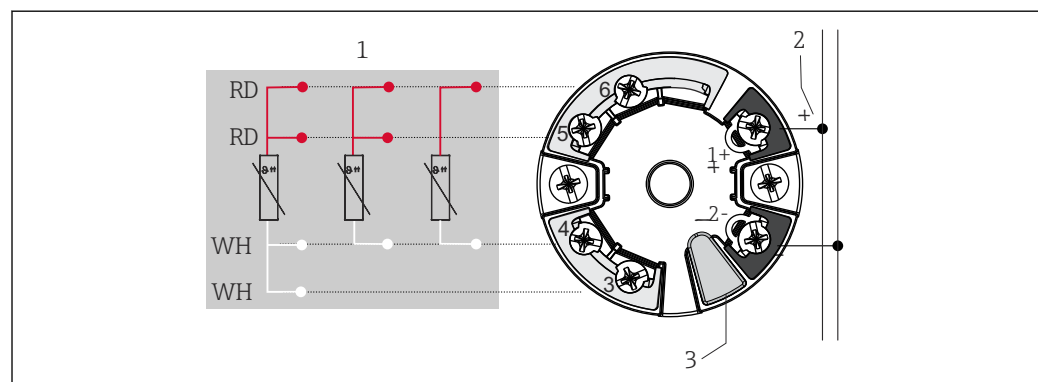
Type of sensor connection RTD



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3 Mounted ceramic terminal block

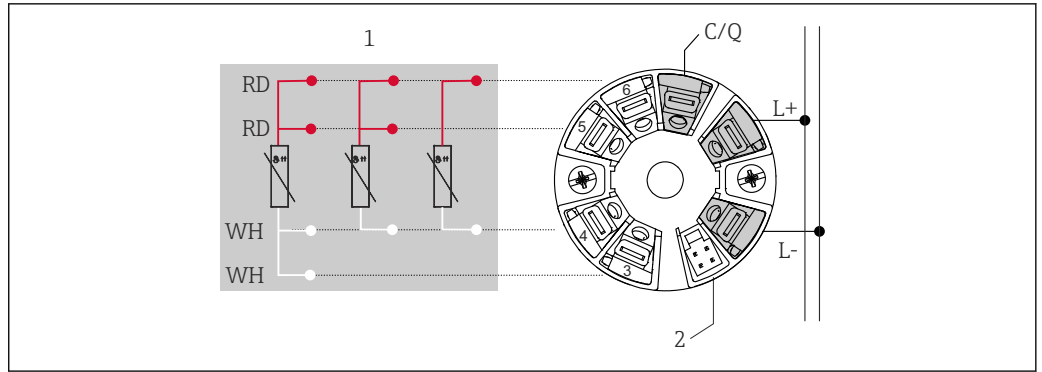
- 1 3-wire
- 2 2x3-wire
- 3 4-wire
- 4 Outside screw



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4 Head mounted transmitter TMT7x or TMT31 (single input)

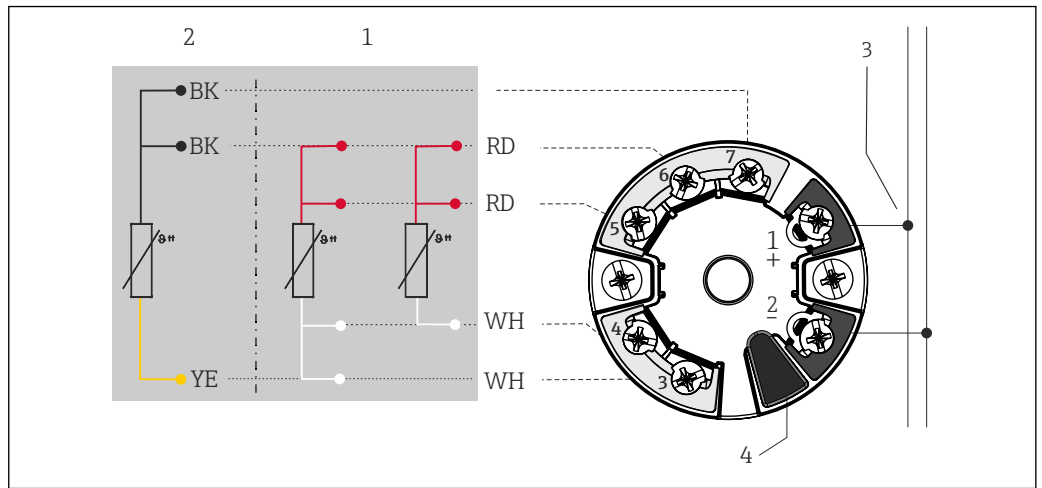
- 1 Sensor input, RTD, 4-, 3- and 2-wire
- 2 Power supply/bus connection
- 3 Display connection/CDI interface



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5 Head-mounted transmitter TMT36 (single input)

- 1 RTD sensor input: 4-, 3- and 2-wire
- 2 Display connection
- L+ 18 to 30 V_{DC} power supply
- L- 0 V_{DC} power supply
- C/Q IO-Link or switch output

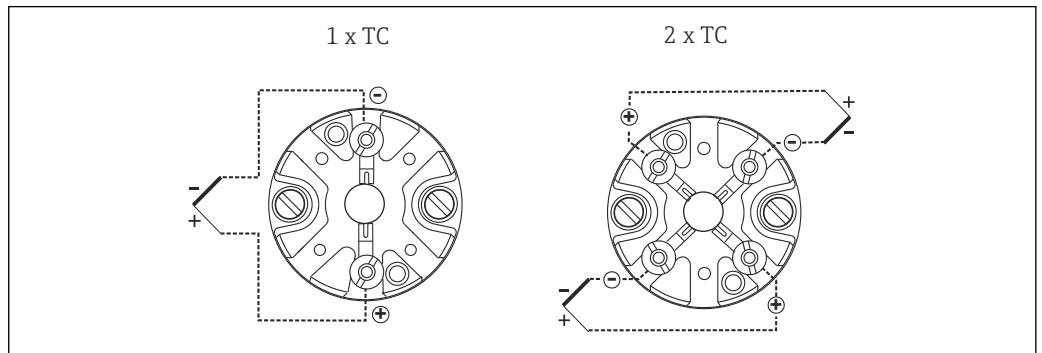


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6 Head-mounted transmitter TMT8x (dual sensor input)

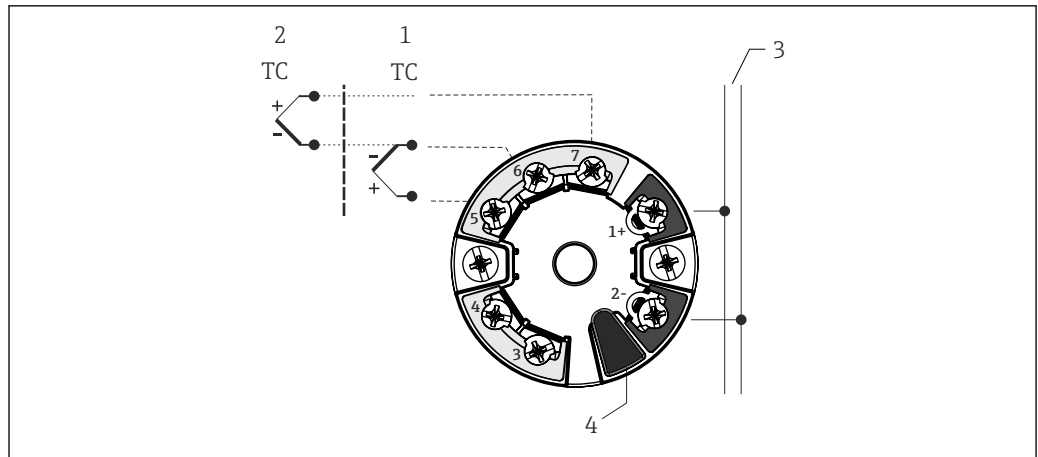
- 1 Sensor input 1, RTD, 4- and 3-wire
- 2 Sensor input 2, RTD, 3-wire
- 3 Fieldbus connection and power supply
- 4 Display connection

Type of sensor connection thermocouple (TC)



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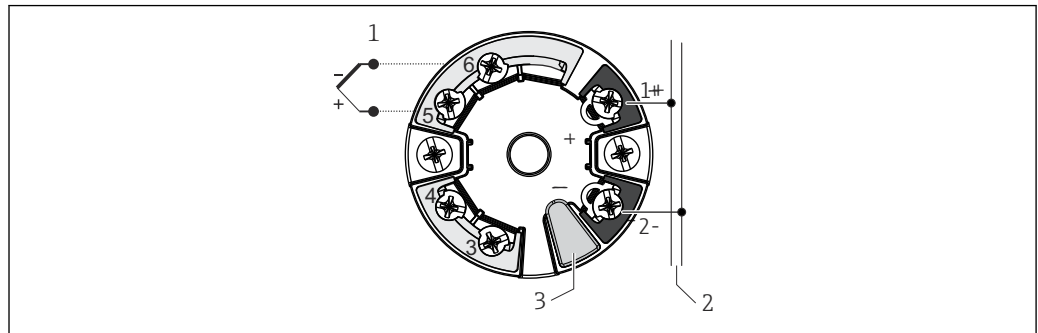
7 Mounted ceramic terminal block



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8 Head-mounted transmitter TMT8x (dual sensor input)

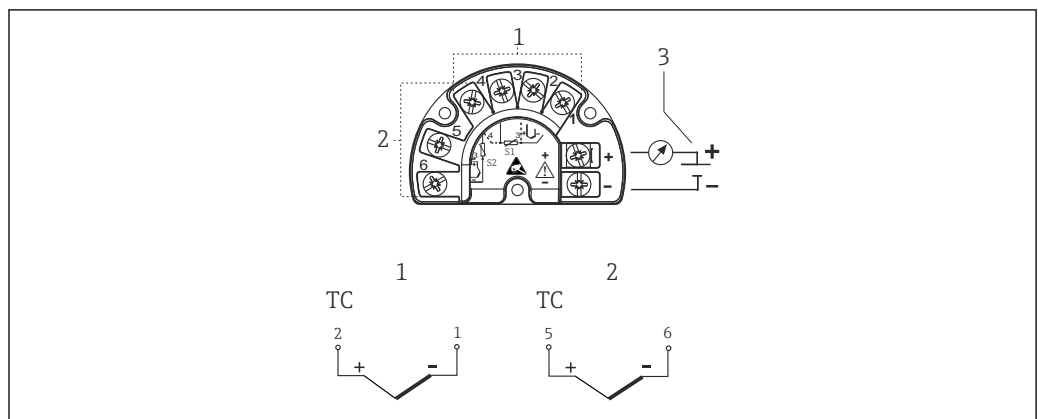
- 1 Sensor input 1
- 2 Sensor input 2
- 3 Fieldbus connection and power supply
- 4 Display connection



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9 Head-mounted transmitter TMT7x (single input)

- 1 Sensor input
- 2 Power supply and bus connection
- 3 Display connection and CDI interface



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10 Mounted field transmitter TMT162 or TMT142B

- 1 Sensor input 1
- 2 Sensor input 2 (not TMT142B)
- 3 Supply voltage for field transmitter and analog output 4 to 20 mA or fieldbus communication

Thermocouple wire colors

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

Terminals

iTEMP head transmitters fitted with push-in terminals unless screw terminals are explicitly selected, the second process seal is chosen or a double sensor is installed.


Cable entries

See "Terminal heads" section.

The cable entries must be selected during the configuration of the device. Different terminal heads offer different possibilities with regard to threads and the number of available cable entries.

Connectors

Endress+Hauser offers a wide variety of connectors for the simple and fast integration of the thermometer into a process control system. The following tables show the PIN assignments of the various plug connector combinations.

 We do not recommend connecting thermocouples directly to connectors. The direct connection to the pins of the plug might generate a new 'thermocouple' which influences the accuracy of the measurement. Therefore we do not connect thermocouples directly to connectors. The thermocouples are connected in combination with a transmitter.

Abbreviations

#1	Order: first transmitter/insert	#2	Order: second transmitter/insert
i	Insulated. Wires marked 'i' are not connected and are insulated with heat shrink tubes.	YE	Yellow
GND	Grounded. Wires marked 'GND' are connected to the internal grounding screw in the terminal head.	RD	Red
BN	Brown	WH	White
GNYE	Green-yellow	PK	Pink
BU	Blue	GN	Green
GY	Gray	BK	Black

Terminal head with one cable entry

Plug	1x PROFIBUS® PA								1x FOUNDATION™ Fieldbus (FF)				1x PROFINET® and Ethernet-APL			
	M12				7/8"				7/8"				M12			
PIN number	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Electrical connection (terminal head)																
Flying leads and TC	Not connected (not insulated)															
3-wire terminal block (1x Pt100)	RD	RD	WH		RD	RD	WH		RD	RD	WH		RD	RD	WH	
4-wire terminal block (1x Pt100)			WH	WH			WH	WH			WH	WH				
6-wire terminal block (2x Pt100)	RD (#1) ¹	RD (#1)	WH (#1)		RD (#1)	RD (#1)	WH (#1)		RD (#1)	RD (#1)	WH (#1)		RD	RD	WH (#1)	
1x TMT 4 to 20 mA or HART®	+	i	-	i	+	i	-	i	+	i	-	i	+	i	-	i

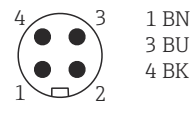
Plug	1x PROFIBUS® PA								1x FOUNDATION™ Fieldbus (FF)				1x PROFINET® and Ethernet-APL			
2x TMT 4 to 20 mA or HART® in the terminal head with a high cover	+(#1)	+(#2)	-(#1)	- (#2)	+(#1)	+(#2)	-(#1)	- (#2)	+(#1)	+(#2)	-(#1)	- (#2)	+(#1)	+(#2)	-(#1)	- (#2)
1x TMT PROFIBUS® PA	+	i	-	GND ₂₎	+	i	-	GND ₂₎	Cannot be combined							
2x TMT PROFIBUS® PA	+(#1)		- (#1)		+		-									
1x TMT FF	Cannot be combined				Cannot be combined				-	+	GND	i	Cannot be combined			
2x TMT FF									-(#1)	+(#1)						
1x TMT PROFINET®									Cannot be combined				Cannot be combined			
2x TMT PROFINET®	APL signal - (#1)	APL signal + (#1)														
PIN position and color code									1 BN 2 GNYE 3 BU 4 GY		1 BU 2 BN 3 GY 4 GNYE		1 RD 2 GN			

- 1) Second Pt100 is not connected
- 2) If using a head without a grounding screw, e.g. plastic housing TA30S or TA30P, insulated 'i' instead of grounded GND

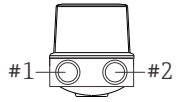
Terminal head with one cable entry



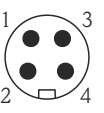
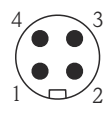
Plug	4-pin/8-pin							
Plug thread	M12							
PIN number	1	2	3	4	5	6	7	8
Electrical connection (terminal head)								
Flying leads and TC	Not connected (not insulated)							
3-wire terminal block (1x Pt100)	RD	RD	WH		i			
4-wire terminal block (1x Pt100)			WH	WH				
6-wire terminal block (2x Pt100)			WH		BK	BK	YE	
1x TMT 4 to 20 mA or HART®	+(#1)	i	-(#1)	i	i			
2x TMT 4 to 20 mA or HART® in the terminal head with a high cover					+(#2)	i	-(#2)	i
1x TMT PROFIBUS® PA	Cannot be combined							
2x TMT PROFIBUS® PA								
1x TMT FF	Cannot be combined							
2x TMT FF								
1x TMT PROFINET®	Cannot be combined							
2x TMT PROFINET®	Cannot be combined							
PIN position and color code								

Terminal head with one cable entry


Plug		1x IO-Link®, 4-pin			
Plug thread		M12			
PIN number		1	2	3	4
Electrical connection (terminal head)					
Flying leads		Not connected (not insulated)			
3-wire terminal block (1x Pt100)		RD	i	RD	WH
4-wire terminal block (1x Pt100)		Cannot be combined			
6-wire terminal block (2x Pt100)		Cannot be combined			
1x TMT 4 to 20 mA or HART®		Cannot be combined			
2x TMT 4 to 20 mA or HART® in the terminal head with a high cover		Cannot be combined			
1x TMT PROFIBUS® PA		Cannot be combined			
2x TMT PROFIBUS® PA		Cannot be combined			
1x TMT FF		Cannot be combined			
2x TMT FF		Cannot be combined			
1x TMT PROFINET®		Cannot be combined			
2x TMT PROFINET®		Cannot be combined			
1x TMT IO-Link®		L+	-	L-	C/Q
2x TMT IO-Link®		L+ (#1)	-	L- (#1)	C/Q
PIN position and color code					

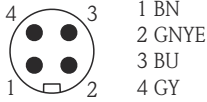
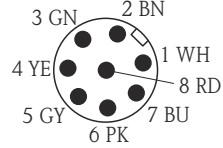
Terminal head with two cable entries

Plug	2x PROFIBUS® PA				2x FOUNDATION™ Fieldbus (FF)				2x PROFINET® and Ethernet-APL								
Plug thread  <small>A0021706</small>	M12(#1) / M12(#2)				7/8"(#1)/7/8"(#2)				7/8"(#1)/7/8"(#2)				M12 (#1)/M12 (#2)				
PIN number	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	
Electrical connection (terminal head)																	
Flying leads and TC		Not connected (not insulated)															
3-wire terminal block (1x Pt100)		RD/i	RD/i	WH/i		RD/i	RD/i	WH/i		RD/i	RD/i	WH/i		RD/i	RD/i	WH/i	
4-wire terminal block (1x Pt100)				WH/i	WH/i			WH/i	WH/i			WH/i	WH/i			WH/i	WH/i
6-wire terminal block (2x Pt100)		RD/B K	RD/B K	WH/YE		RD/B K	RD/B K	WH/YE		RD/B K	RD/B K	WH/YE		RD/B K	RD/B K	WH/YE	
1x TMT 4 to 20 mA or HART®		+/i		-/i		+/i		-/i		+/i		-/i		+/i		-/i	
2x TMT 4 to 20 mA or HART® in the terminal head with a high cover		+	i/i	-	i/i	+	i/i	-	i/i	+	i/i	-	i/i	+	i/i	-	i/i
		(#1)/		(#1)/		(#1)/		(#1)/		(#1)/		(#1)/		(#1)/		(#1)/	
		+		-		+		-		+		-		+		-	
		(#2)		(#2)		(#2)		(#2)		(#2)		(#2)		(#2)		(#2)	


Plug	2x PROFIBUS® PA						2x FOUNDATION™ Fieldbus (FF)				2x PROFINET® and Ethernet-APL			
1x TMT PROFIBUS® PA	+/i		-/i		+/i		-/i		Cannot be combined					
2x TMT PROFIBUS® PA	+ (#1)/ + (#2)		- (#1)/ - (#2)	GND/ GND	+ (#1)/ + (#2)		- (#1)/ - (#2)	GND/ GND						
1x TMT FF	Cannot be combined			Cannot be combined			-/i	+/i			Cannot be combined			
2x TMT FF							- (#1)/ - (#2)	+ (#1)/ + (#2)	i/i	GND/ GND				
1x TMT PROFINET®	Cannot be combined			Cannot be combined			Cannot be combined				APL signal -	APL signa 1 +		
2x TMT PROFINET®	Cannot be combined			Cannot be combined			Cannot be combined				APL signal - (#1) and (#2)	APL signa 1 + (#1) and (#2)	GND	i
PIN position and color code	 1 BN 2 GNYE 3 BU 4 GY		 1 BN 2 GNYE 3 BU 4 GY		 1 BU 2 BN 3 GY 4 GNYE		 1 RD 2 GN							

Terminal head with two cable entries

Plug	4-pin/8-pin							
Plug thread 	M12 (#1)/M12 (#2)							
PIN number	1	2	3	4	5	6	7	8
Electrical connection (terminal head)								
Flying leads and TC	Not connected (not insulated)							
3-wire terminal block (1x Pt100)	RD/i	RD/i	WH/i		i/i			
4-wire terminal block (1x Pt100)			WH/i	WH/i				
6-wire terminal block (2x Pt100)	RD/BK	RD/BK	WH/YE					
1x TMT 4 to 20 mA or HART®	+/i		-/i					
2x TMT 4 to 20 mA or HART® in the terminal head with a high cover	+ (#1)/ + (#2)		i/i	- (#1)/ - (#2)		i/i		
1x TMT PROFIBUS® PA	Cannot be combined							
2x TMT PROFIBUS® PA	Cannot be combined							
1x TMT FF	Cannot be combined							
2x TMT FF	Cannot be combined							
1x TMT PROFINET®	Cannot be combined							

Plug	4-pin/8-pin	
2x TMT PROFINET®	Cannot be combined	
PIN position and color code	 <p>1 BN 2 GNYE 3 BU 4 GY</p> <p>A0018929</p>	 <p>1 WH 2 BN 3 GN 4 YE 5 GY 6 PK 7 BU 8 RD</p> <p>A0018927</p>

Terminal head with two cable entries

Plug	2x IO-Link®, 4-pin			
Plug thread	M12(#1)/M12 (#2)			
PIN number	1	2	3	4
Electrical connection (terminal head)				
Flying leads	Not connected (not insulated)			
3-wire terminal block (1x Pt100)	RD	i	RD	WH
4-wire terminal block (1x Pt100)	Cannot be combined			
6-wire terminal block (2x Pt100)	RD/BK	i	RD/BK	WH/YE
1x TMT 4 to 20 mA or HART®	Cannot be combined			
2x TMT 4 to 20 mA or HART® in the terminal head with a high cover				
1x TMT PROFIBUS® PA	Cannot be combined			
2x TMT PROFIBUS® PA				
1x TMT FF	Cannot be combined			
2x TMT FF				
1x TMT PROFINET®	Cannot be combined			
2x TMT PROFINET®				
1x TMT IO-Link®	L+	-	L-	C/Q
2x TMT IO-Link®	L+ (#1) and (#2)	-	L- (#1) and (#2)	C/Q
PIN position and color code	 <p>1 BN 3 BU 4 BK</p> <p>A0055383</p>			

Connection combination: insert - transmitter

Insert	Transmitter connection ¹⁾			
	TMT31/TMT7x		TMT8x	
	1x 1-channel	2x 1-channel	1x 2-channel	2x 2-channel
1x sensor (Pt100 or TC), flying leads	Sensor (#1) : transmitter (#1)	Sensor (#1) : transmitter (#1) (Transmitter (#2) not connected)	Sensor (#1) : transmitter (#1)	Sensor (#1) : transmitter (#1) Transmitter (#2) not connected
2x sensor (2x Pt100 or 2x TC), flying leads	Sensor (#1) : transmitter (#1) Sensor (#2) insulated	Sensor (#1) : transmitter (#1) Sensor (#2) : transmitter (#2)	Sensor (#1) : transmitter (#1) Sensor (#2) : transmitter (#1)	Sensor (#1) : transmitter (#1) Sensor (#2) : transmitter (#1) (Transmitter (#2) not connected)
1x sensor (Pt100 or TC), with terminal block ²⁾	Sensor (#1) : transmitter in cover	Cannot be combined	Sensor (#1) : transmitter in cover	Cannot be combined

Insert	Transmitter connection ¹⁾			
	TMT31/TMT7x		TMT8x	
	1x 1-channel	2x 1-channel	1x 2-channel	2x 2-channel
2x sensor (2x Pt100 or 2x TC) with terminal block	Sensor (#1) : transmitter in cover Sensor (#2) not connected		Sensor (#1) : transmitter in cover Sensor (#2): transmitter in cover	
2x sensors (2x Pt100 or 2x TC) in conjunction with feature 600, option MG ³⁾	Cannot be combined	Sensor (#1) : transmitter (#1) Sensor (#2): transmitter (#2)	Cannot be combined	Sensor (#1): transmitter (#1) - channel 1 Sensor (#2): transmitter (#2) - channel 1

- 1) If 2 transmitters are selected in a terminal head, transmitter (#1) is installed directly on the insert. Transmitter (#2) is installed in the high cover. A TAG cannot be ordered for the second transmitter as standard. The bus address is set to the default value and, if necessary, must be changed manually before commissioning.
- 2) Only in the terminal head with a high cover, only 1 transmitter possible. A ceramic terminal block is automatically fitted on the insert.
- 3) Individual sensors each connected to channel 1 of a transmitter

Surge arrester

To protect against overvoltage in the power supply and signal/communication cables for the thermometer electronics, Endress+Hauser offers the HAW562 surge arrester for DIN rail mounting and the HAW569 for field housing installation.



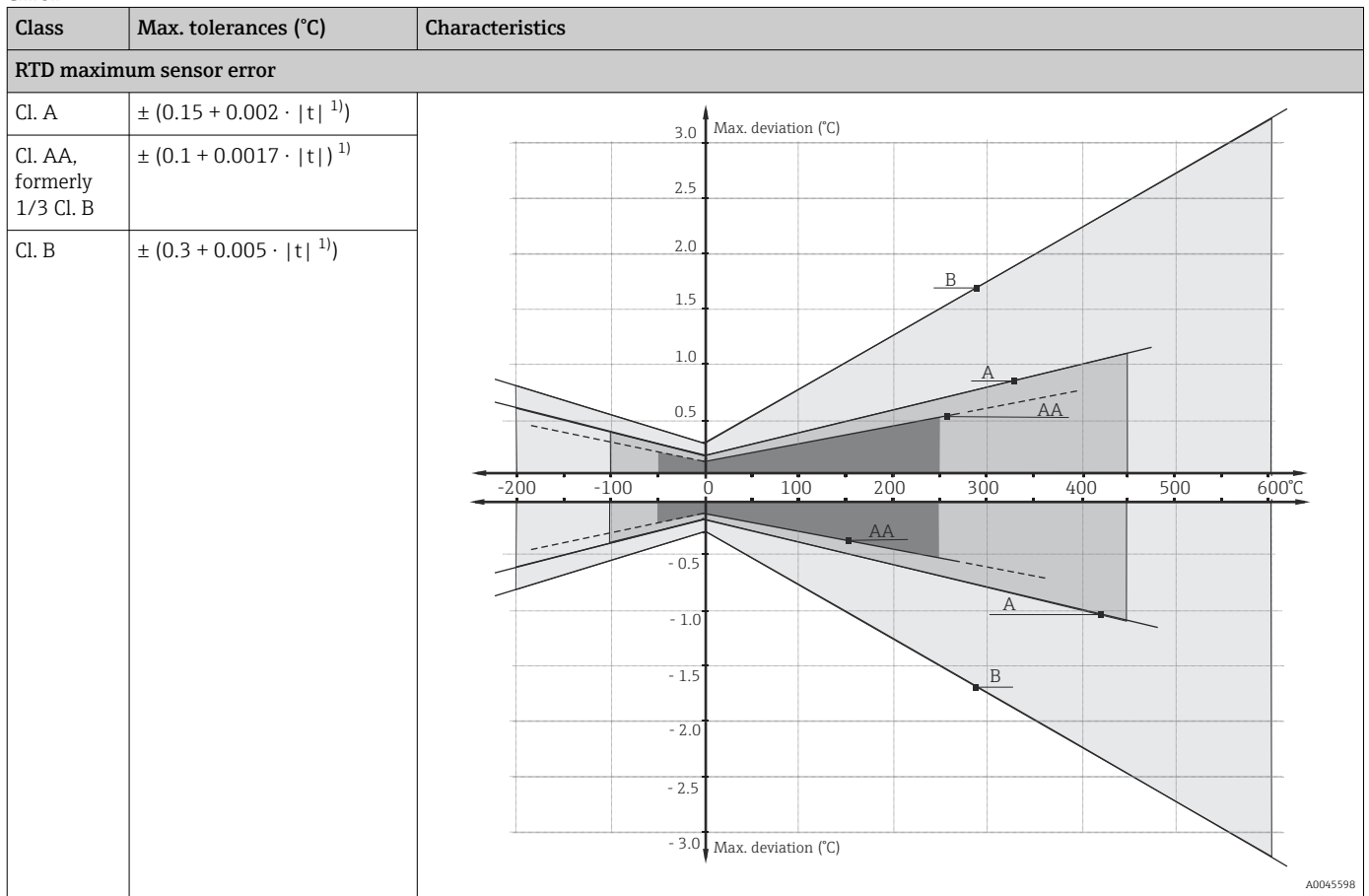
For more information, see the Technical Information "HAW562 Surge arrester" TI01012K and "HAW569 Surge arrester" TI01013K.

Performance characteristics

Reference conditions

These data are relevant for determining the measurement accuracy of the transmitters used. For details, see the relevant Technical Information.

Maximum measurement error RTD resistance thermometer or assembly as per IEC 60751



1) |t| = absolute temperature value in °C

To obtain the maximum tolerances in °F, multiply the results in °C by a factor of 1.8.

Temperature ranges

Sensor type ¹⁾	Operating temperature range	Class B	Class A	Class AA
Pt100 (TF) Basic	-50 to +200 °C (-58 to +392 °F)	-50 to +200 °C (-58 to +392 °F)	-30 to +200 °C (-22 to +392 °F)	-
Pt100 (TF) Standard	-50 to +400 °C (-58 to +752 °F)	-50 to +400 °C (-58 to +752 °F)	-30 to +250 °C (-22 to +482 °F)	0 to +150 °C (32 to 302 °F)
Pt100 (TF) iTHERM QuickSens	-50 to +200 °C (-58 to +392 °F)	-50 to +200 °C (-58 to +392 °F)	-30 to +200 °C (-22 to +392 °F)	0 to +150 °C (32 to 302 °F)
Pt100 (TF) iTHERM StrongSens	-50 to +500 °C (-58 to +932 °F)	-50 to +500 °C (-58 to +932 °F)	-30 to +300 °C (-22 to +572 °F)	0 to +150 °C (+32 to +302 °F)
Pt100 (WW)	-200 to +600 °C (-328 to +1112 °F)	-200 to +600 °C (-328 to +1112 °F)	-100 to +450 °C (-148 to +842 °F)	-50 to +250 °C (-58 to +482 °F)

1) Selection depending on product and configuration

Influence of ambient temperature

Depends on the head transmitter used. For details, see the relevant Technical Information.

Self-heating

RTD elements are passive resistors 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 transmitter (very small measurement current) is connected.

Response time

Tests have been performed in water at 0.4 m/s (according to IEC 60751) and with a 10 K temperature step change.

Standard Pt100, typical values	t ₅₀	t ₉₀
Direct contact: TF, WW 3 or 6 mm diameter	5 s	11 s
iTHERM QuickSens	0.5 s	1.5 s

Type J, K, N (TC), typical values	t ₅₀	t ₉₀
Direct contact 3 or 6 mm diameter	2.5 s	7 s

Calibration**Calibration of thermometers**

Calibration involves comparing the measured values of a unit under test (UUT) with those of a more precise calibration standard using a defined and reproducible measurement method. The aim is to determine the deviation of the UUT's measured values from the true value of the measured variable. Two different methods are used for thermometers:

- Calibration at fixed-point temperatures, e.g. at the freezing point of water at 0 °C,
- Calibration compared against a precise reference thermometer.

The thermometer to be calibrated must display the fixed point temperature or the temperature of the reference thermometer as accurately as possible. Temperature-controlled calibration baths with very homogeneous thermal values, or special calibration furnaces are typically used for thermometer calibrations. The measurement uncertainty may increase due to heat conduction errors and short immersion lengths. The existing measurement uncertainty is recorded on the individual calibration certificate. For accredited calibrations in accordance with ISO17025, a measurement uncertainty that is twice as high as the accredited measurement uncertainty is not permitted. If this limit is exceeded, only a factory calibration is possible.

Evaluation of thermometers

If a calibration with an acceptable measurement uncertainty and transferable measurement results is not possible, Endress+Hauser offers customers a thermometer evaluation measurement service, if technically feasible. This is the case when:

- The process connections/flanges are too big or the immersion length (IL) is too short to allow the UUT to be immersed sufficiently in the calibration bath or furnace (see the following table), or
- Due to heat conduction along the thermometer tube, the resulting sensor temperature generally deviates significantly from the actual bath/furnace temperature.

The measured value of the UUT is determined using the maximum possible immersion depth and the specific measuring conditions and measurement results are documented on an evaluation certificate.

Sensor-transmitter-matching

The resistance/temperature curve of platinum resistance thermometers is standardized but in practice it is rarely possible to keep to the values precisely over the entire operating temperature range. For this reason, platinum resistance sensors are divided into tolerance classes, such as Class A, AA or B as per IEC 60751. These tolerance classes describe the maximum permissible deviation of the specific sensor characteristic curve from the standard curve, i.e. the maximum temperature-dependent characteristic error that is permitted. The conversion of measured sensor resistance values to temperatures in temperature transmitters or other meter electronics is often susceptible to considerable errors as the conversion is generally based on the standard characteristic curve.


When Endress +Hauser temperature transmitters are used, this conversion error can be reduced significantly by sensor-transmitter matching:

- Calibration at three temperatures at least and determination of the actual temperature sensor characteristic curve,
- Adjustment of the sensor-specific polynomial function using Calendar-van Dusen (CvD) coefficients,
- Configuration of the temperature transmitter with the sensor-specific CvD coefficients for resistance/temperature conversion, and
- another calibration of the reconfigured temperature transmitter with connected resistance thermometer.

Endress+Hauser offers its customers this kind of sensor-transmitter matching as a separate service. Furthermore, the sensor-specific polynomial coefficients of platinum resistance thermometers are always provided on every Endress+Hauser calibration certificate where possible, e.g. at least three calibration points, so that users themselves can also appropriately configure suitable temperature transmitters.

For the device, Endress+Hauser offers standard calibrations at a reference temperature of -80 to +600 °C (-112 to +1 112 °F) based on the ITS90 (International Temperature Scale). Calibrations in other temperature ranges are available from your Endress+Hauser sales center on request. Calibrations are traceable to national and international standards. The calibration certificate is referenced to the serial number of the device. Only the insert is calibrated.

Minimum immersion length (IL) for inserts required to perform a correct calibration

 Due to the limitations of furnace geometries, the minimum insertion lengths must be observed at high temperatures to enable a calibration to be performed with an acceptable degree of measurement uncertainty. The same applies when using a head transmitter. Due to heat conduction, minimum lengths must be observed in order to guarantee the functionality of the transmitter -40 to +85 °C (-40 to +185 °F)

Calibration temperature	Minimum immersion length IL in mm without head transmitter
-196 °C (-320.8 °F)	120 mm (4.72 in) ¹⁾
-80 to +250 °C (-112 to +482 °F)	No minimum immersion length required ²⁾
251 to 550 °C (483.8 to 1022 °F)	300 mm (11.81 in)
551 to 600 °C (1023.8 to 1 112 °F)	400 mm (15.75 in)

- 1) with iTEMP head transmitter min. 150 mm (5.91 in) is required
- 2) at a temperature of 80 to 250 °C (176 to 482 °F), the iTEMP head transmitter requires min. 50 mm (1.97 in)

Insulation resistance

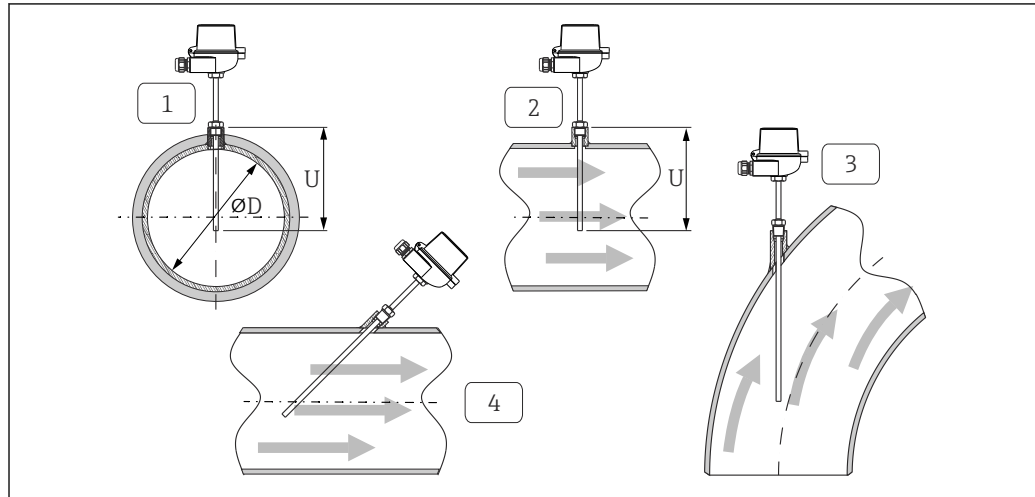
- RTD:
Insulation resistance according to IEC 60751 > 100 MΩ at 25 °C between terminals and sheath material measured with a minimum test voltage of 100 V DC
- TC:
Insulation resistance according to IEC 1515 between terminals and sheath material with a test voltage of 500 V DC:
 - > 1 GΩ at 20 °C
 - > 5 MΩ at 500 °C

Installation

Orientation

No restrictions. However, self-draining in the process should be guaranteed depending on the application.

Installation instructions



A0038768

11 Installation examples

1 - 2 In pipes with a small cross-section, the sensor tip should reach or extend slightly past the center axis of the pipe ($=U$).

3 - 4 Slanted orientation.

The immersion length of the thermometer influences the measurement 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. Therefore, if installing in a pipe the immersion length should be at least half the pipe diameter. Installation at an angle (see item 3 and 4) could be another solution. When determining the immersion length, all the parameters of the thermometer and of the process to be measured must be taken into account (e.g. flow velocity, process pressure).

The counterparts for process connections and seals are not supplied with the thermometer and must be ordered separately if needed.

Ambient 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.
	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)
Storage temperature	For information, see the ambient temperature above.	
Humidity	Depends on the transmitter used. If Endress+Hauser iTEMP head transmitters are used: <ul style="list-style-type: none"> ■ Condensation permitted as per IEC 60 068-2-33 ■ Max. rel. humidity: 95% as per IEC 60068-2-30 	
Climate class	As per EN 60654-1, Class C	
Degree of protection	Max. IP 66 (NEMA Type 4x encl.)	Depending on the design (terminal head, connector, etc.).
	Partly IP 68	Tested in 1.83 m (6 ft) over 24 h

Shock and vibration resistance

The Endress+Hauser inserts exceed the requirements of IEC 60751 with regard to shock and vibration resistance of 3g in a range of 10 to 500 Hz. The vibration resistance of the measuring point depends on the sensor type and design. Refer to the following table:

Sensor type	Vibration resistance for the sensor tip
Pt100 (WW)	≤ 30 m/s ² (3g)
Pt100 (TF), basic	
Pt100 (TF), standard	≤ 40 m/s ² (4g)
iTHERM StrongSens Pt100 (TF)	≤ 600 m/s ² (60g)
iTHERM QuickSens Pt100 (TF), version: Ø6 mm (0.24 in)	≤ 600 m/s ² (60g)
iTHERM QuickSens Pt100 (TF), version: Ø3 mm (0.12 in)	≤ 30 m/s ² (3g)
Thermocouple inserts	≤ 30 m/s ² (3g)

Electromagnetic compatibility (EMC)

Depends on the head transmitter used. For details, see the relevant Technical Information.

Process

Process temperature range


Depends on the sensor type and the material used,
max. -200 to +1 100 °C (-328 to +2 012 °F)

Process pressure range

Pressure range:

- Max. 75 bar (1 088 psi) to +200 °C (+392 °F) for standard thin-film and iTHERM QuickSens Pt100 sensors.
- Max. 50 bar (725 psi) to +400 °C (+752 °F) for all other sensor types.


The maximum possible process pressure depends on various influencing factors, such as the design, process connection and process temperature. For information on the maximum possible process pressures for the individual process connections, see the 'Process connection' section.

 It is possible to calculate the permitted flow rate according to DIN 43772 for thermometers with a thermowell. A calculation is not standardized and not usual for thermometers without a thermowell. If there are any concerns regarding the mechanical loading capacity of the device, the use of a thermometer with a thermowell is recommended.

Mechanical construction

Design, dimensions

All dimensions in mm (in). The design of the thermometer depends on the general design version used.

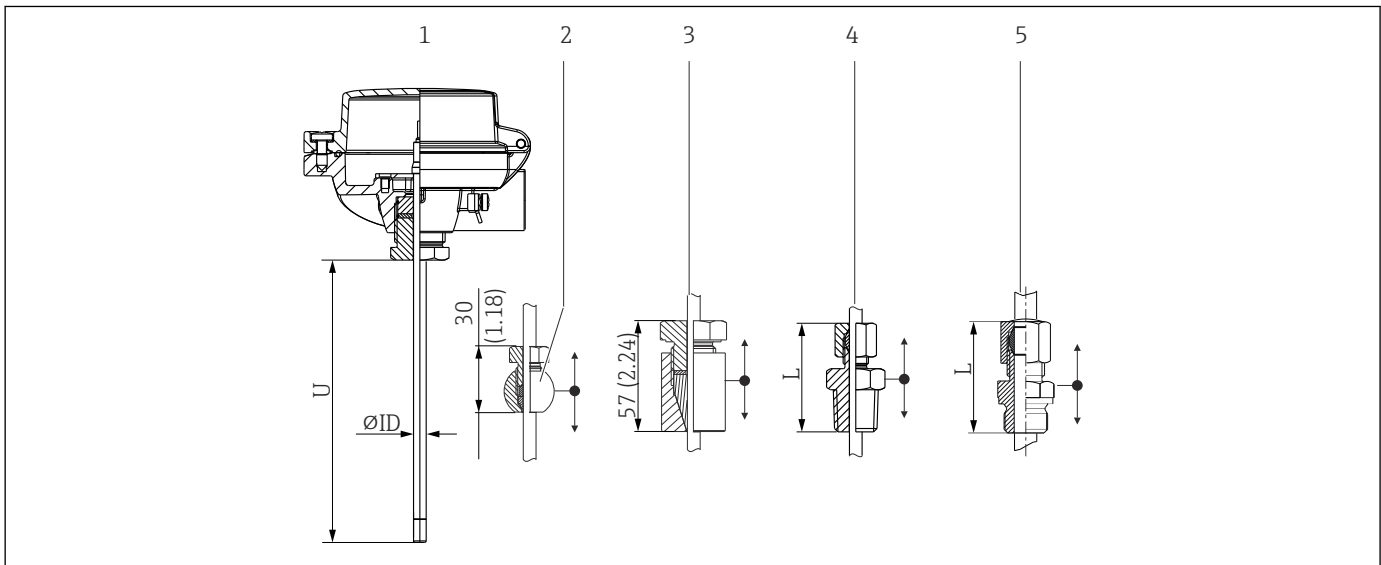
 Various dimensions, such as the immersion length U for example, are variable values and are therefore indicated as items in the following dimensional drawings.

Variable dimensions:

Item	Description
IL	Insertion length of insert
T	Length of lagging: variable or predefined, depends on thermowell version (see also the individual table data)
U	Immersion length: variable, depending on the configuration

Item	Description
Hd, SL	<p>Variable for calculating the insertion length of the insert, depending on different screw-in lengths in terminal head thread M24x1.5 or ½" NPT, see insert length calculation (IL).</p> <div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"> <p>1 M24x1.5</p> </div> <div style="text-align: center;"> <p>2 NPT ½"</p> </div> </div> <p>12 Different screw-in lengths in terminal head thread for M24x1.5 and ½" NPT</p> <p>1 Metric thread M24x1.5 2 Conical thread NPT ½" Hd Distance in terminal head SL Spring pre-load</p>
ØID	Insert diameter: 3 mm (0.12 in) or 6 mm (0.24 in)

Thermometer without fixed process connection



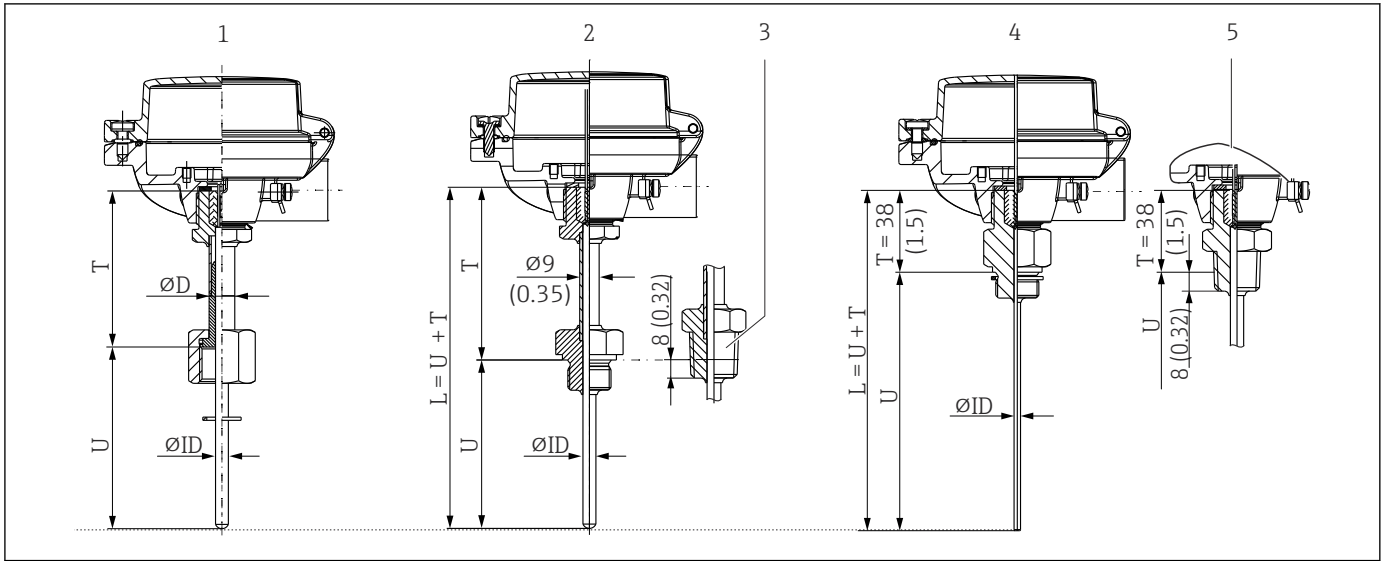
- 1 Without process connection
- 2 Thermometer with spherical, movable TK40 compression fitting for weld-in application
- 3 Thermometer with cylindrical, movable TK40 compression fitting for weld-in application
- 4 With compression fitting NPT thread, spring loaded version as option
- 5 With compression fitting G thread, spring loaded version as option

i Thermometers with Ø3 mm sheathed cable and compression fitting may incur damage depending on configuration (length, terminal head, etc.), orientation and ambient conditions (e.g. vibrations). In adverse scenarios, the sheathed cable is susceptible to kinking.

The versions with an M24 thread to the terminal head use a replaceable TS111 insert. All other versions do not have a replaceable insert.

Type of compression fitting	L	U _{min} (with use of compression fitting)
NPT thread, not spring loaded	51 mm (2.0 in)	≥ 70 mm (2.76 in)
G thread, not spring loaded	47 mm (1.85 in)	
G- or NPT-thread, spring loaded	60 mm (2.36 in)	

Thermometer with fixed process connection



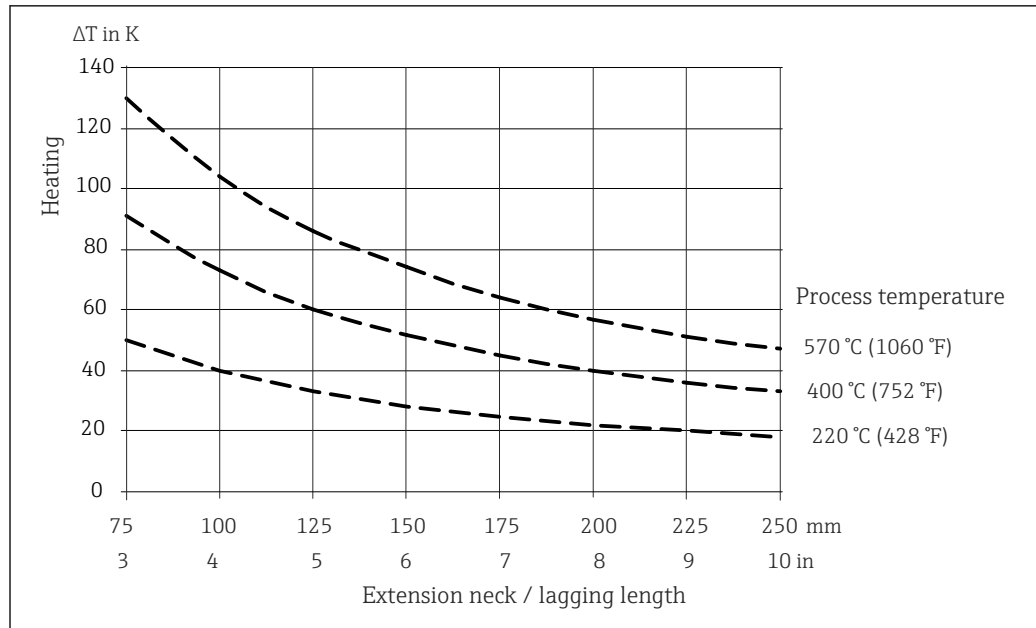
- 1 With lagging and cap nut, female thread, available in G½" and G¾", ØD = 9 mm (0.35 in) or 12 mm (0.47 in)
- 2 With lagging, G- or M-thread version
- 3 With lagging, NPT-thread version
- 4 Without lagging, terminal head process connection, M- or G-thread version
- 5 Without lagging, terminal head process connection, NPT-thread version

The versions do not have a replaceable insert. The insert is not spring-loaded even if the cap nut is used.

Minimum length definition

Thermometer version	U	T
1	<ul style="list-style-type: none"> ■ ≥ 50 mm (1.97 in) for sensor type iTHERM QuickSens ■ ≥ 40 mm (1.57 in) for all other sensor types 	≥ 85 mm (3.35 in)
2+3		
4+5		38 mm (1.5 in)

As illustrated in the following figure, the lagging length may influence the temperature in the terminal head. This temperature must remain within the limit values defined in the "Operating conditions" section.



13 Heating of the terminal head as a function of the process temperature. Temperature in terminal head = ambient temperature 20 °C (68 °F) + ΔT

The diagram can be used to calculate the transmitter temperature.

Example: At a process temperature of 220 °C (428 °F) and with a lagging length of 100 mm (3.94 in), the heat conduction is 40 K (72 °F). The transmitter temperature is therefore 40 K (72 °F) plus the ambient temperature, e.g. 25 °C (77 °F): 40 K (72 °F) + 25 °C (77 °F) = 65 °C (149 °F).

Result: The temperature of the transmitter is OK; the length of the lagging is sufficient.

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

Materials 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 operating temperatures can be reduced considerably in cases where abnormal conditions such as high mechanical load occur or in aggressive media.

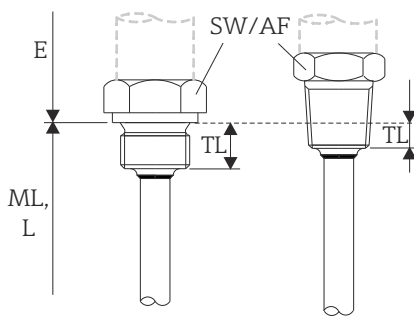
i Please note that the maximum temperature always also depends on the temperature sensor used.

Material name	Short form	Recommended max. temperature for continuous use in air	Properties
AISI 316/1.4401	X5CrNiMo 17-12-2	650 °C (1202 °F) ¹⁾	<ul style="list-style-type: none"> ■ Austenitic stainless steel ■ High corrosion resistance in general ■ Particularly high corrosion resistance in chlorinated and acidic, non-oxidizing atmospheres through the addition of molybdenum (e.g. phosphoric and sulfuric acids, acetic and tartaric acids with a low concentration)
AISI 316L/1.4404 1.4435	X2CrNiMo17-12-2 X2CrNiMo18-14-3	650 °C (1202 °F) ¹⁾	<ul style="list-style-type: none"> ■ Austenitic stainless steel ■ High corrosion resistance in general ■ Particularly high corrosion resistance in chlorinated and acidic, non-oxidizing 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
Alloy600/2.4816	NiCr15Fe	1100 °C (2012 °F)	<ul style="list-style-type: none"> ■ A nickel/chromium alloy with very good resistance to aggressive, oxidizing and reducing atmospheres, even at high temperatures ■ Resistance to corrosion caused by chlorine gases and chlorinated media as well as many oxidizing mineral and organic acids, sea water etc. ■ Corrosion from ultrapure water ■ Not to be used in sulfur-containing atmospheres

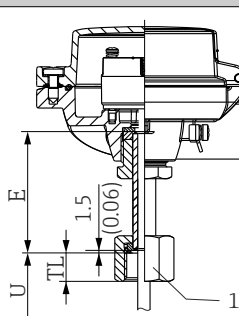
1) Can be used to a limited extent up to 800 °C (1472 °F) for low mechanical loads and in non-corrosive media. Please contact your Endress+Hauser sales team for further information.

Process connections

Threaded process connection

Type	Version		Dimensions		Technical properties
			Thread length TL in mm (in)	Width across flats AF	
 <p>A0008620</p> <p>14 Cylindrical (left side) and conical (right side) version</p>	M	M20x1.5	14 mm (0.55 in)	27	<ul style="list-style-type: none"> ■ P_{max.} = 75 bar (1088 psi) to +200 °C (+392 °F) for standard thin-film and iTHERM QuickSens Pt100 sensors. ■ P_{max.} = 50 bar (725 psi) to +400 °C (+752 °F) for all other sensor types. ¹⁾
		M18x1.5	12 mm (0.47 in)	24	
	G	G ½"	15 mm (0.6 in)	27	
		G ¼"	12 mm (0.47 in)	24	
	NPT	NPT ½"	8 mm (0.32 in)	22	
		NPT ¾"	8.5 mm (0.33 in)	27	

1) The insert type is the deciding factor here. The process connection thread is of secondary importance.

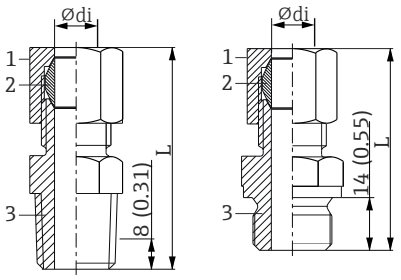
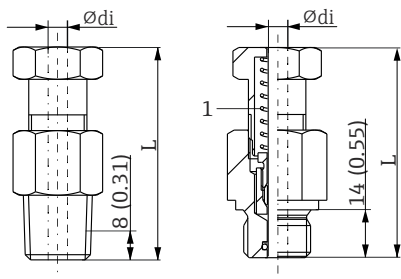
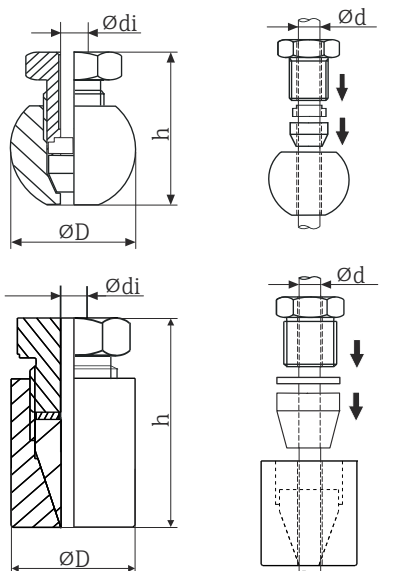
Connection thread Cap nut ¹⁾	Version	Thread length TL	Width across flats	
 <p>A0043608</p> <p>1 Cap nut thread</p>	G ½"	15.5 mm (0.61 in)	27 mm (1.06 in)	The cap nuts are not designed as process connections. This connection is only available for thermometers without a thermowell.
	G ¾"	19.5 mm (0.77 in)	32 mm (1.26 in)	

1) For selection without thermowell. Only available for installation in an existing thermowell. Special attention has to be paid to the length as the insert is not springload!

i The 316L compression fittings can only be used once due to deformation. This applies to all the components of the compression fittings! A replacement compression fitting must be secured at another point (grooves in thermowell). PEEK compression fittings must never be used at a temperature that is lower than the temperature present when the compression fitting is secured. This is because the fitting would no longer be leak-tight as a result of heat contraction of the PEEK material.

SWAGELOCK or similar fittings are strongly recommended for higher requirements.

Compression fitting

Type TK40	Version	Dimensions		Technical properties
		Ø di	Width across flats	
 <p>1 Nut 2 Ferrule 3 Process connection</p> <p>A0038320</p>	<p>NPT ½", L = approx. 52 mm (2.05 in) G ½", L = approx. 47 mm (1.85 in) Ferrule material PEEK or 316L</p> <p>Tightening torque:</p> <ul style="list-style-type: none"> 10 Nm (PEEK) 25 Nm (316L) 	<p>3 mm (0.12 in) or 6 mm (0.24 in)</p>	<p>G½": 27 mm (1.06 in) ½" NPT: 24 mm (0.95 in)</p>	<ul style="list-style-type: none"> P_{max.} = 5 bar (72.5 psi), at T = +180 °C (+356 °F) for PEEK P_{max.} = 40 bar (104 psi) at T = +200 °C (+392 °F) for 316L P_{max.} = 25 bar (77 psi) at T = +400 °C (+752 °F) for 316L
Spring loaded version as option				
 <p>1 Spring</p> <p>A0038944</p>	<p>G½" or NPT ½", spring-loaded, L = approx. 60 mm (2.36 in)</p>	<p>6 mm (0.24 in)</p>	<p>G½": 27 mm (1.06 in) ½" NPT: 24 mm (0.95 in)</p>	<p>It is not pressure tight. Only to be used in combination with thermowell or in medium air.</p> <p>Tightening torque:</p> <ul style="list-style-type: none"> G½": 40 Nm ½" NPT: 55 Nm
Weld-in design				
 <p>A0017582</p>	<p>Spherical Ferrule material 316L Thread G¼"</p> <p>Cylindrical Ferrule material Elastosil Thread G½"</p>	<p>3 mm (0.12 in) or 6 mm (0.24 in)</p>	<p>-</p>	<ul style="list-style-type: none"> P_{max.} = 50 bar (725 psi) T_{max.} = 200 °C (392 °F) Tightening torque: 25 Nm <ul style="list-style-type: none"> P_{max.} = 10 bar (145 psi) T_{max.} = 200 °C (392 °F) Tightening torque: 5 Nm

Inserts

Sensor	Standard thin-film	iTHERM StrongSens	iTHERM QuickSens ¹⁾	Wire wound	
Sensor design; connection method	1x Pt100, 3- or 4-wire, mineral insulated	1x Pt100, 3- or 4-wire, mineral insulated	1x Pt100, 3- or 4-wire <ul style="list-style-type: none"> ▪ Ø6 mm (0.24 in), mineral insulated ▪ Ø3 mm (0.12 in), Teflon insulated 	1x Pt100, 3- or 4-wire, mineral insulated	2x Pt100, 3-wire, mineral insulated
Vibration resistance of the insert tip	≤ 3g	Increased vibration resistance ≤ 60g	<ul style="list-style-type: none"> ▪ Ø3 mm (0.12 in) ≤ 3g ▪ Ø6 mm (0.24 in) ≤ 60g 	≤ 3g	
Measuring range; accuracy class	-50 to +400 °C (-58 to +752 °F), Class A or AA	-50 to +500 °C (-58 to +932 °F), Class A or AA	-50 to +200 °C (-58 to +392 °F), Class A or AA	-200 to +600 °C (-328 to +1 112 °F), Class A or AA	
Diameter	3 mm (0.12 in), 6 mm (0.24 in)	6 mm (0.24 in)	3 mm (0.12 in), 6 mm (0.24 in)		

1) Recommended for immersion lengths $U < 70$ mm (2.76 in)

TC thermocouples	Type K	Type J	Type N
Sensor design	Mineral insulated, Alloy600 sheathed cable	Mineral insulated, stainless steel sheathed cable	Mineral insulated, Alloy TD sheathed cable
Vibration resistance of the insert tip	≤ 3g		
Measuring range	-40 to +1 100 °C (-40 to +2 012 °F)	-40 to +750 °C (-40 to +1 382 °F)	-40 to +1 100 °C (-40 to +2 012 °F)
Connection type	Grounded or ungrounded		
Temperature-sensitive length	Insert length		
Diameter	3 mm (0.12 in), 6 mm (0.24 in)		

Surface roughness

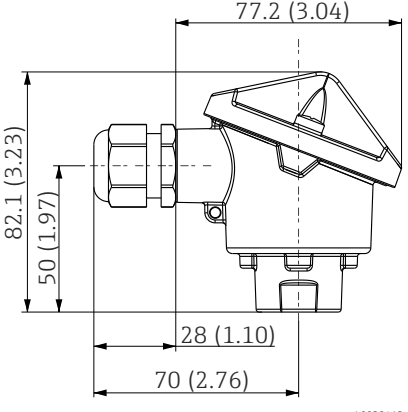
Values for wetted surfaces:

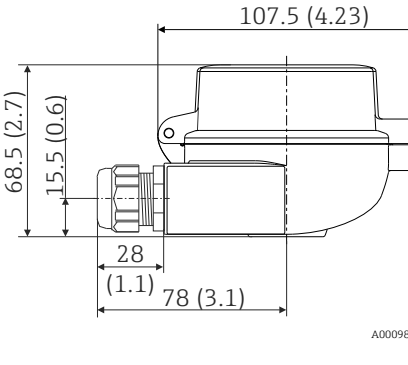
Standard surface	$R_a \leq 0.76 \mu\text{m}$ (0.03 μin)
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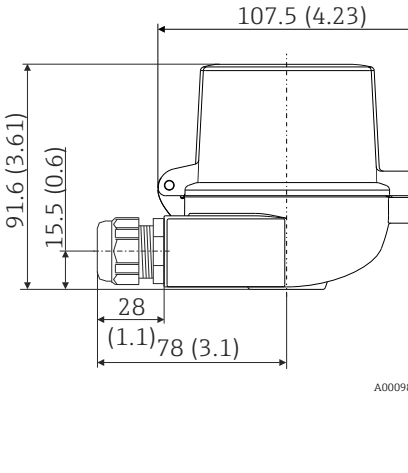
Terminal heads

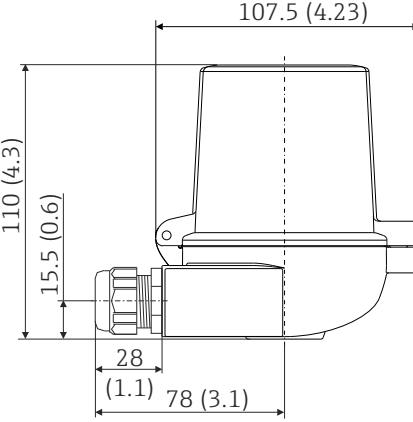
All terminal heads have an internal shape and size in accordance with DIN EN 50446, flat face and a thermometer connection with a M24x1.5 or ½" NPT thread. All dimensions in mm (in). The sample cable glands in the diagrams correspond to M20x1.5 connections with non-Ex polyamide cable glands. Specifications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

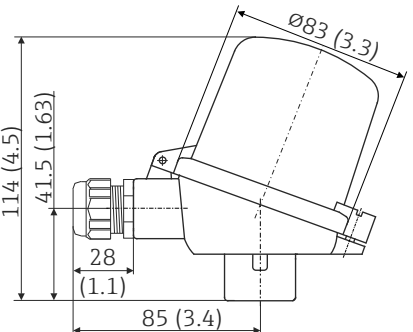
As a special feature, Endress+Hauser offers terminal heads with optimized terminal accessibility for easy installation and maintenance.

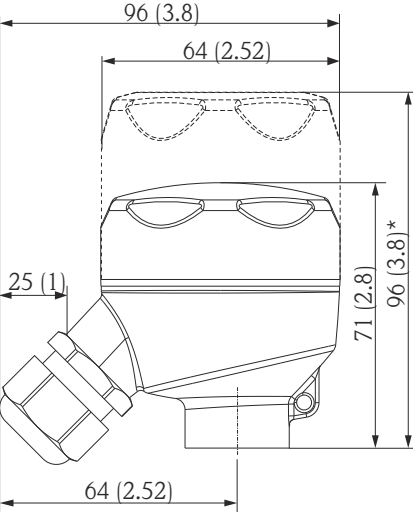
TA20AB	Specification
	<ul style="list-style-type: none"> ■ Protection class: IP 66/68, NEMA 4x ■ Temperature: -40 to +100 °C (-40 to +212 °F), polyamide cable gland ■ Material: aluminum; polyester powder coated ■ Seals: silicone ■ Threaded cable entry: NPT ½" and M20x1.5 ■ Color: blue, RAL 5012 ■ Weight: approx. 300 g (10.6 oz)

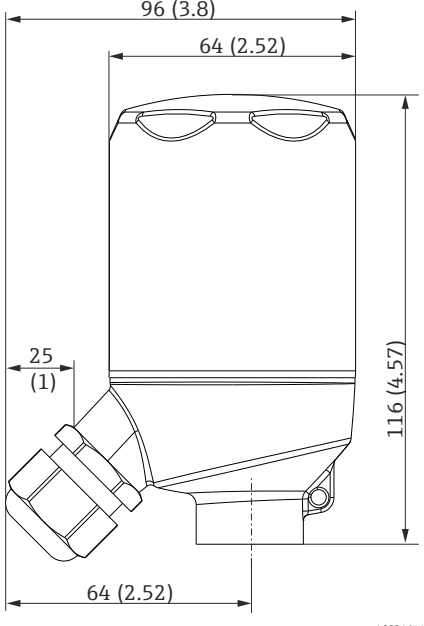
TA30A	Specification
	<ul style="list-style-type: none"> ■ Degree of protection: <ul style="list-style-type: none"> ■ IP66/68 (NEMA Type 4x incl.) ■ For ATEX: IP66/67 ■ Temperature: -50 to +150 °C (-58 to +302 °F) without cable gland ■ Material: aluminum, polyester powder coated ■ Seals: silicone ■ Cable entry thread: G ½", ½" NPT and M20x1.5; ■ Protective fitting connection: M24x1.5 ■ Head color: blue, RAL 5012 ■ Cap color: gray, RAL 7035 ■ Weight: 330 g (11.64 oz) ■ Ground terminal, internal and external ■ Available with sensors with 3-A® symbol

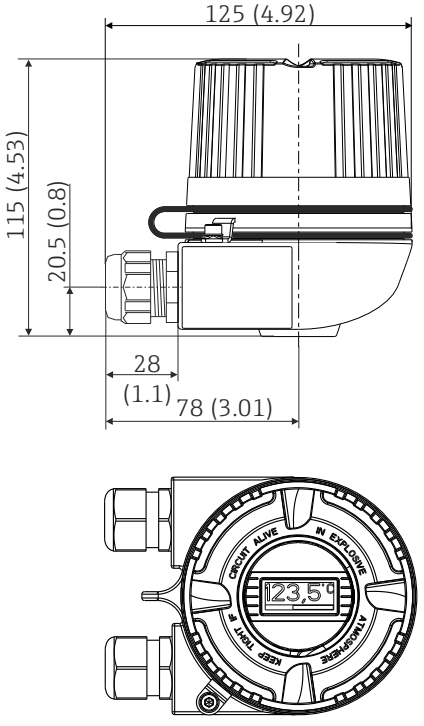
TA30A with display window in cover	Specification
	<ul style="list-style-type: none"> ■ Degree of protection: <ul style="list-style-type: none"> ■ IP66/68 (NEMA Type 4x incl.) ■ For ATEX: IP66/67 ■ Temperature: -50 to +150 °C (-58 to +302 °F) without cable gland ■ Material: aluminum, polyester powder coated ■ Seals: silicone ■ Cable entry thread: G ½", ½" NPT and M20x1.5 ■ Protective fitting connection: M24x1.5 ■ Color of head: blue, RAL 5012 ■ Color of cap: gray, RAL 7035 ■ Weight: 420 g (14.81 oz) ■ Display window: single-pane safety glass according to DIN 8902 ■ Display window in cover for head transmitter with TID10 display ■ Ground terminal, internal and external ■ Available with sensors with 3-A® symbol

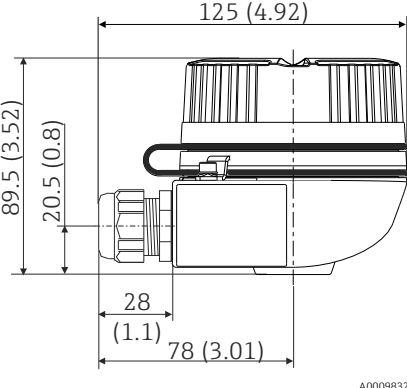
TA30D	Specification
 <p style="text-align: right; font-size: small;">A0009822</p>	<ul style="list-style-type: none"> ▪ Degree of protection: <ul style="list-style-type: none"> ▪ IP66/68 (NEMA Type 4x encl.) ▪ For ATEX: IP66/67 ▪ Temperature: -50 to +150 °C (-58 to +302 °F) without cable gland ▪ Material: aluminum, polyester powder coated Seals: silicone ▪ Cable entry thread: G ½", ½" NPT and M20x1.5 ▪ Protective fitting connection: M24x1.5 ▪ 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) ▪ Ground terminal, internal and external ▪ Available with sensors with 3-A® symbol

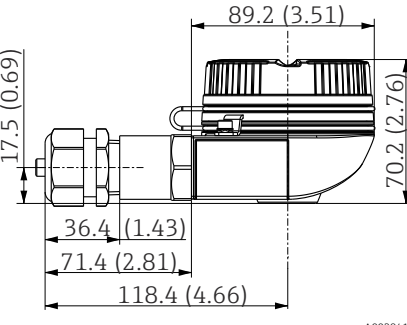
TA30P	Specification
 <p style="text-align: right; font-size: small;">A0023477</p>	<ul style="list-style-type: none"> ▪ Degree of protection: IP65 ▪ Max. temperature: -40 to +120 °C (-40 to +248 °F) ▪ Material: polyamide (PA12), antistatic Seals: silicone ▪ Threaded cable entry: M20x1.5 ▪ Protective fitting connection: M24x1.5 ▪ 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 and cap color: black ▪ Weight: 135 g (4.8 oz) ▪ Type of protection: intrinsic safety (G Ex ia) ▪ Ground terminal: only internal via auxiliary terminal ▪ Available with sensors with 3-A® symbol

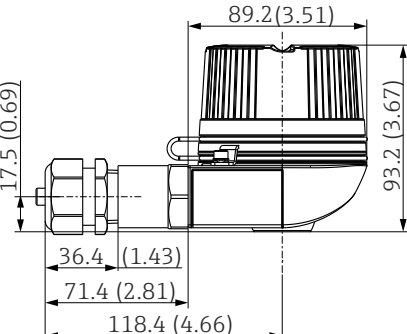
TA30R (optionally with display window in cover)	Specification
 <p style="text-align: right; font-size: small;">A0017145</p> <p>* Dimensions of version with display window in cover</p>	<ul style="list-style-type: none"> ▪ Degree of protection - standard version: IP69K (NEMA Type 4x encl.) Degree of protection - version with display window: IP66/68 (NEMA Type 4x encl.) ▪ Temperature: -50 to +130 °C (-58 to +266 °F) without cable gland ▪ Material: stainless steel 316L, abrasive-blasted or polished Seals: silicone, optional EPDM for applications free from paint-wetting impairment substances Display window: polycarbonate (PC) ▪ Cable entry thread ½" NPT and M20x1.5 ▪ Weight <ul style="list-style-type: none"> ▪ Standard version: 360 g (12.7 oz) ▪ Version with display window: 460 g (16.23 oz) ▪ Display window in cover optionally for head transmitter with display TID10 ▪ Protection armature connection: M24x1.5 or ½" NPT ▪ Ground terminal: internal as standard ▪ Available with 3-A marked sensors ▪ Not allowed for Class II and III applications

TA30R (high version for two transmitters)	Specification
 <p>A0034644</p>	<ul style="list-style-type: none"> ▪ Degree of protection: IP69K (NEMA Type 4x encl.) ▪ Temperature: -50 to +130 °C (-58 to +266 °F) without cable gland ▪ Material: stainless steel 316L, abrasive-blasted or polished ▪ Seals: EPDM ▪ Cable entry thread ½" NPT and M20x1.5 ▪ Weight: 460 g (16.23 oz) ▪ For two head transmitter ▪ Protection armature connection: M24x1.5 or ½" NPT ▪ Ground terminal: internal in standard version ▪ Not allowed for Class II and III applications ▪ Available with 3-A marked sensors

TA30H with display window in cover	Specification
 <p>A0009831</p>	<ul style="list-style-type: none"> ▪ Flameproof (XP) version, explosion-protected, captive screw cap, available with one or two cable entries ▪ Degree of protection: IP 66/68, NEMA Type 4x encl. Ex-version: IP 66/67 ▪ Temperature: -50 to +150 °C (-58 to +302 °F) for rubber seal without cable gland (observe max. permitted temperature of cable gland!) ▪ Material: <ul style="list-style-type: none"> ▪ Aluminum; polyester powder coated ▪ Stainless steel 316L without coating ▪ Klüber Syntheso Glep 1 dry-film lubricant ▪ Display window: single-pane safety glass according to DIN 8902 ▪ Thread: ½" NPT, ¾" NPT, M20x1.5, G½" ▪ Extension neck/thermowell connection: M20x1.5 or ½" NPT ▪ Color of aluminum head: blue, RAL 5012 ▪ Color of aluminum cap: gray, RAL 7035 ▪ Weight: <ul style="list-style-type: none"> ▪ Aluminum approx. 860 g (30.33 oz) ▪ Stainless steel approx. 2 900 g (102.3 oz) ▪ Head transmitter optionally available with TID10 display <p>i If the housing cover is unscrewed: Before tightening, clean the thread in the cover and housing base and lubricate if necessary (Recommended lubricant: Klüber Syntheso Glep 1)</p>

TA30H	Specification
 <p>A0009832</p>	<ul style="list-style-type: none"> ▪ Flameproof (XP) version, explosion-protected, captive screw cap, available with one or two cable entries ▪ Degree of protection: IP 66/68, NEMA Type 4x encl. Ex-version: IP 66/67 ▪ Temperature: -50 to +150 °C (-58 to +302 °F) for rubber seal without cable gland (observe max. permitted temperature of cable gland!) ▪ Material: <ul style="list-style-type: none"> ▪ Aluminum with polyester powder coating ▪ Stainless steel 316L without coating ▪ Klüber Syntheso Glep 1 dry-film lubricant ▪ Thread: ½" NPT, ¾" NPT, M20x1.5, G½" ▪ Extension neck/thermowell connection: M20x1.5 or ½" NPT ▪ Color of aluminum head: blue, RAL 5012 ▪ Color of aluminum cap: gray, RAL 7035 ▪ Weight: <ul style="list-style-type: none"> ▪ Aluminum: approx. 640 g (22.6 oz) ▪ Stainless steel: approx. 2 400 g (84.7 oz) <p>i If the housing cover is unscrewed: Before tightening, clean the thread in the cover and housing base and lubricate if necessary (Recommended lubricant: Klüber Syntheso Glep 1)</p>

TA30EB	Specification
 <p>A0038414</p>	<ul style="list-style-type: none"> ▪ Screw cap ▪ Degree of protection: IP 66/68, NEMA 4x ▪ Temperature: -50 to +150 °C (-58 to +302 °F) ▪ Material: aluminum; polyester powder coating; Klüber Syntheso Glep 1 dry-film lubricant ▪ Thread: M20x1.5 ▪ Extension neck/thermowell connection: NPT ½" ▪ Color of head: blue, RAL 5012 ▪ Color of cap: gray, RAL 7035 ▪ Weight: approx. 400 g (14.11 oz) ▪ Ground terminal: internal and external <p>i If the housing cover is unscrewed: Before tightening, clean the thread in the cover and housing base and lubricate if necessary (Recommended lubricant: Klüber Syntheso Glep 1)</p>

TA30EB with display window in cover	Specification
 <p>A0038428</p>	<ul style="list-style-type: none"> ▪ Screw cap ▪ Degree of protection: IP 66/68, NEMA 4x Ex-version: IP 66/68 ▪ Temperature: -50 to +150 °C (-58 to +302 °F) for rubber seal without cable gland (observe max. permitted temperature of cable gland!) ▪ Material: aluminum; polyester powder coating; Klüber Syntheso Glep 1 dry-film lubricant ▪ Display window: single-pane safety glass according to DIN 8902 ▪ Thread: ½" NPT, ¾" NPT, M20x1.5, G½" ▪ Extension neck/thermowell connection: ½" NPT ▪ Color of head: blue, RAL 5012 ▪ Color of cap: gray, RAL 7035 ▪ Weight: approx. 400 g (14.11 oz) <p>i If the housing cover is unscrewed: Before tightening, clean the thread in the cover and housing base and lubricate if necessary (Recommended lubricant: Klüber Syntheso Glep 1)</p>

Cable glands and connectors ¹⁾

Type	Suitable for cable entry	Degree of protection	Temperature range	Suitable cable diameter
Cable gland, polyamide blue (indication of Ex-i circuit)	½" NPT	IP68	-30 to +95 °C (-22 to +203 °F)	7 to 12 mm (0.27 to 0.47 in)
Cable gland, polyamide	½" NPT, ¾" NPT, M20x1.5 (optionally 2x cable entry)	IP68	-40 to +100 °C (-40 to +212 °F)	5 to 9 mm (0.19 to 0.35 in)
	½" NPT, M20x1.5 (optionally 2x cable entry)	IP69K	-20 to +95 °C (-4 to +203 °F)	
Cable gland for dust ignition-proof area, polyamide	½" NPT, M20x1.5	IP68	-20 to +95 °C (-4 to +203 °F)	
Cable gland for dust ignition-proof area, brass	M20x1.5	IP68 (NEMA Type 4x)	-20 to +130 °C (-4 to +266 °F)	
M12 plug, 4-pin, 316 (PROFIBUS® PA, Ethernet-APL, IO-Link®)	½" NPT, M20x1.5	IP67	-40 to +105 °C (-40 to +221 °F)	-
M12 plug, 8-pin, 316	M20x1.5	IP67	-30 to +90 °C (-22 to +194 °F)	-
7/8" plug, 4-pin, 316 (FOUNDATION™ Fieldbus, PROFIBUS® PA)	½" NPT, M20x1.5	IP67	-40 to +105 °C (-40 to +221 °F)	-

1) Depending on product and configuration



For explosion proof thermometers no cable glands are assembled.

Certificates and approvals

Current certificates and approvals for the product are available at www.endress.com on the relevant product page:

1. Select the product using the filters and search field.
2. Open the product page.
3. Select **Downloads**.

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.

MID

Test certificate (only in SIL mode). In compliance with:

- WELMEC 8.8, "Guide on the General and Administrative Aspects of the Voluntary System of Modular Evaluation of Measuring Instruments."
- OIML R117-1 Edition 2007 (E) "Dynamic measuring systems for liquids other than water"
- EN 12405-1/A2 Edition 2010 "Gas meters - Conversion devices - Part 1: Volume conversion"
- OIML R140-1 Edition 2007 (E) "Measuring systems for gaseous fuel"

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

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

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

Service-specific accessories

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:

<https://portal.endress.com/webapp/applicator>

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
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The Configurator is available on the Endress+Hauser website: www.endress.com -> Click "Corporate" -> Select your country -> Click "Products" -> Select the product using the filters and the search field -> Open the product page -> The "Configure" button to the right of the product image opens the Product Configurator.

DeviceCare SFE100

Configuration tool for HART, PROFIBUS and FOUNDATION Fieldbus field devices

DeviceCare is available for download at www.software-products.endress.com. You need to register in the Endress+Hauser software portal to download the application.



Technical Information TI01134S

FieldCare SFE500

FDT-based plant asset management tool

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.



Technical Information TI00028S

Netilion

IloT ecosystem: Unlock knowledge


With the Netilion IloT ecosystem, Endress+Hauser enables you to optimize plant performance, digitize workflows, share knowledge, and enhance collaboration. Drawing on decades of experience in process automation, Endress+Hauser provides the process industry with an IloT ecosystem that unlocks valuable insights from data. These insights allow process optimization, leading to increased plant availability, efficiency, and reliability - ultimately resulting in a more profitable plant.



www.netilion.endress.com

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.
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.



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www.addresses.endress.com
