

Technical Information

TH51, TH52 and TH56

General purpose MgO insulated thermocouples with connection head, extension lead wires or connectors for process and laboratory applications



Application

Magnesium Oxide insulated thermocouples, commonly referred to as MgO thermocouples, are used in many process and laboratory applications. They have many desirable characteristics making thermocouples a good choice for general and special purpose applications.

The sensors can be used on:

- Heat exchangers
- Power and recovery areas
- Furnaces, dryers, flue gas
- Compressor stations
- Process reactors
- Metallurgical and glass manufacturing

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™

Field transmitter

Temperature field transmitters with HART® or FOUNDATION Fieldbus™ protocol for highest reliability in harsh industrial environments. Blue backlit display with large measured value, bargraph and fault condition indication for ease of reading.

Your benefits

- One source shopping for temperature measurement solutions. World class transmitter with integrated sensor offering. Remove and install straight out of the box!
- Improved galvanic isolation on most devices (2 kV)
- Simplified model structure: Competitively priced, offers great value. Easy to order and reorder. A single model number includes sensor and transmitter assembly for a complete point solution.
- All iTEMP transmitters provide long-term stability $\leq 0.05\%$ per year

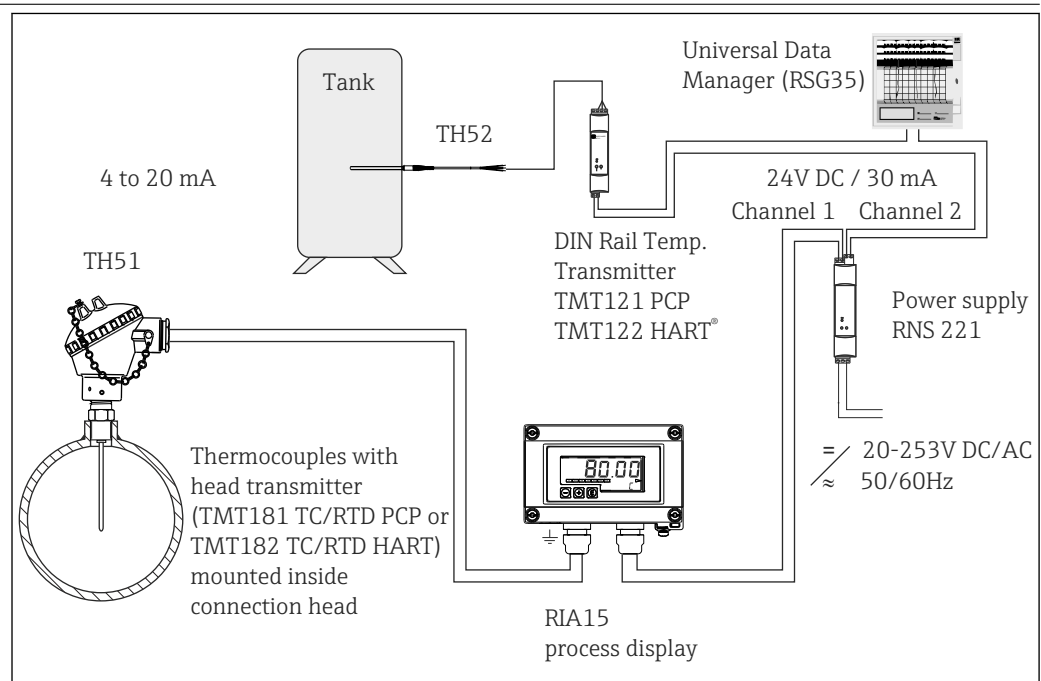
Function and system design

Measuring principle

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

RIA15 process display

The display unit records the analog measuring signal from the head transmitter and shows this on the display. The LC display shows the current measured value in digital form and as a bar graph indicating a limit value violation. The process display unit is integrated in the 4 to 20 mA or HART® loop and is powered directly from the current loop. Optionally up to four of a sensor's HART® process variables can be displayed. More information on this can be found in the Technical Information, see "Documentation".

RNS221

The RNS221 (24 V DC, 30 mA) power supply has two galvanically isolated outputs for supplying voltage to loop-powered transmitters. The two-channel 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". RNS221 is an UL recognized component according to UL-3111-1.

Ecograph T, RSG35

Universal graphic display recorder with up to 12 universal inputs, 5.7" TFT screen for displaying measured values in a maximum of four groups, with digital, bar graph and curve display. More information on this can be found in the Technical Information, see "Documentation".

Input

Measured variable Temperature (temperature-linear transmission behavior)

Measurement range

Measuring range by type and size

Upper temperature limits for various sheath diameters °C (°F)							
Nominal diameter			Thermocouple type				
Sheath O.D.	Element wire Ø (in)	Element wire gauge	T	J	E	K	N
Ø 1/16 in	0.010	30	260 °C (500 °F)	440 °C (825 °F)	510 °C (950 °F)	920 °C (1 690 °F)	
Ø 1/8 in	0.020	24	315 °C (600 °F)	520 °C (970 °F)	650 °C (1 200 °F)	1 070 °C (1 960 °F)	
Ø 3/16 in	0.029	21	370 °C (700 °F)	620 °C (1 150 °F)	730 °C (1 350 °F)	1 150 °C (2 100 °F)	
Ø 1/4 in	0.039	19		720 °C (1 330 °F)	820 °C (1 510 °F)		
Ø 3/8 in	0.060	15					
Maximum element temperature range limits			-270 to +400 °C (-454 to +752 °F)	-210 to +1 200 °C (-346 to +2 192 °F)	-270 to +1 000 °C (-454 to +1 832 °F)	-270 to +1 372 °C (-454 to +2 500 °F)	-270 to +1 300 °C (-454 to +2 372 °F)



These values are valid for single and duplex thermocouples. The temperature limits given are intended only as a guide to the user and should not be taken as absolute values or as guarantees of satisfactory life or performance. These types and sizes are sometimes used at temperatures above the given limits, but usually at the expense of stability or life or both. In other instances, it may be necessary to reduce the above limits in order to achieve adequate service.

Duplex versions (2 elements) of type N with 1/16 in, 3/16 in and 3/8 in sheath diameter are not available. Thermocouples with 316 SS sheath are rated for a maximum temperature of 927 °C (1 700 °F).

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 temperature transmitter. All the transmitters listed below are mounted directly in the terminal head or as field transmitter 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.

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


HART® Field transmitter

Field transmitter with HART® communication and blue backlit display. Can be read easily from a distance, in sunlight and at night. Large measurement value, bargraph and fault indication displayed. Benefits are: dual sensor input, highest reliability in harsh industrial environments, mathematic functions, thermometer drift monitoring and sensor back-up functionality, corrosion detection.

Galvanic isolation

Galvanic isolation of Endress+Hauser iTEMP transmitters

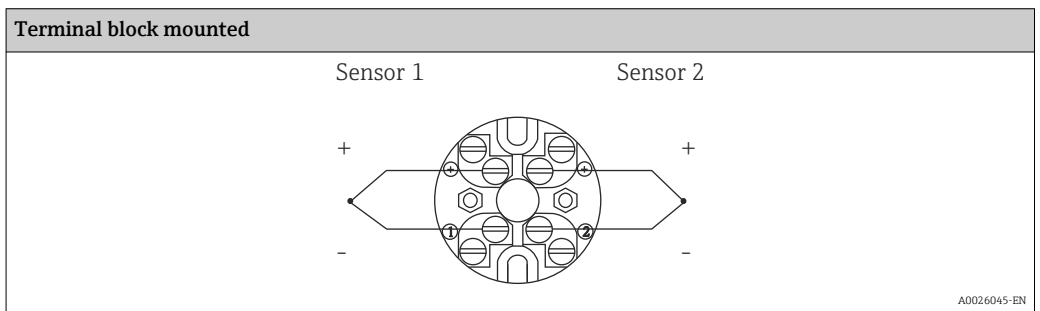
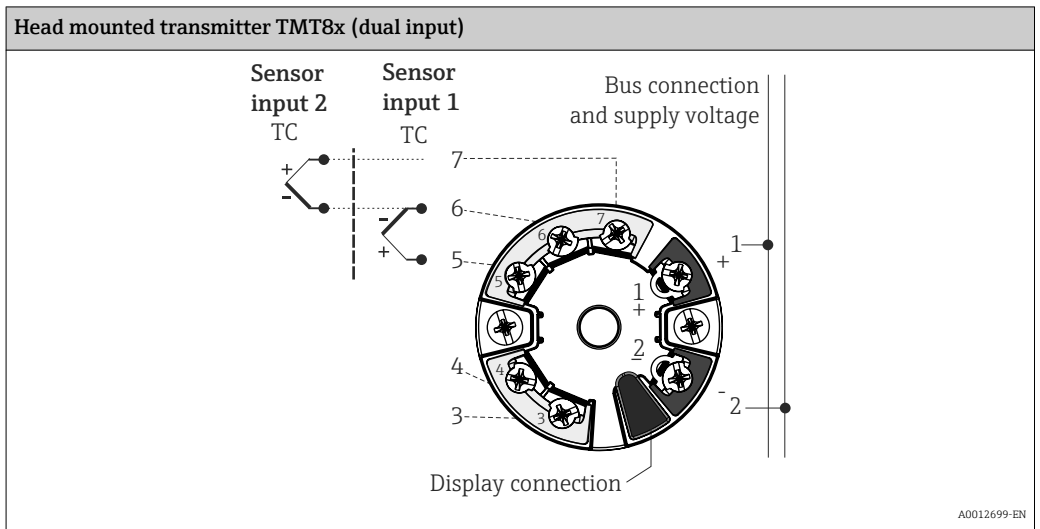
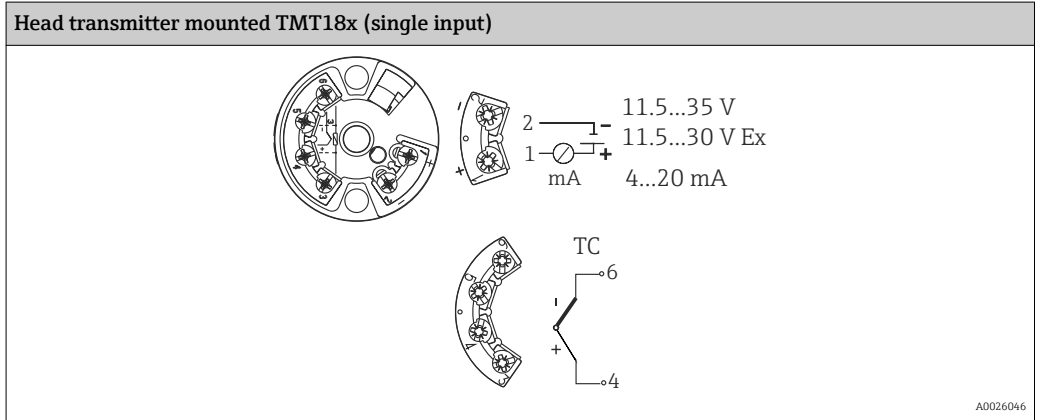
Transmitter type	Sensor
TMT181 PCP	$\hat{U} = 3.75 \text{ kV AC}$
TMT182 HART®	$U = 2 \text{ kV AC}$
TMT162 HART® Field transmitter	$U = 2 \text{ kV AC}$
TMT82 HART®	$U = 2 \text{ kV AC}$
TMT84 PA	
TMT85 FF	

 In applications where fast response time is needed, grounded thermocouples are recommended. This thermocouple design may cause a ground loop. This can be avoided by using iTEMP transmitters with high galvanic isolation.

Wiring

Wiring diagrams

Type of sensor connection TH51



i DIN rail transmitters (TMT121 PCP/TMT122 HART®) can be purchased separately when using a TH52.

The blocks and transmitters are shown as they sit inside the heads in reference to the conduit opening.

Wire specifications

TH51

Thermocouple grade, TFE insulated 20 AWG, 7 strands with wire termination

TH52

All thermocouple extension wires are thermocouple grade.

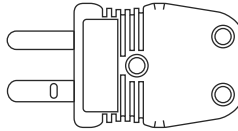
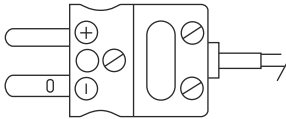
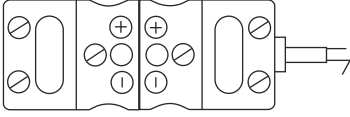
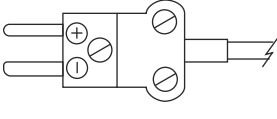
Sheath OD	Number of elements	Extension wire (gauge)
Ø ¹ / ₁₆ "	1	24
	2	24
Ø ¹ / ₈ "	1	20
	2	24
Ø ³ / ₁₆ "	1	20
	2	24
Ø ¹ / ₄ "	1	20
	2	20
Ø ³ / ₈ "	1	20
	2	20

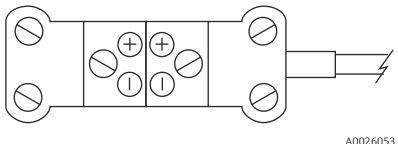
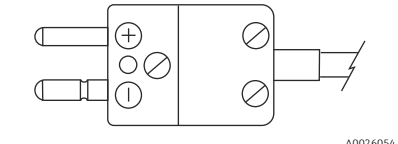
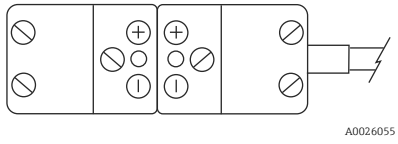
Thermocouple wire types Construction and characteristics

Type	Single conductor		Duplex conductor		Max. continuous temperature	Notes
	Insulation	Impregnation	Insulation	Impregnation		
Fiberglass	Glass braid 0.006"	Silicone modified resin	Glass braid 0.006"	Impregnation	482 °C (900 °F)	Impregnation retained to 204 °C (400 °F)
Teflon	FEP extruded 0.008"	/	Impregnation 0.010"	/	204 °C (400 °F)	

 Flex armor is 0.272" nominal OD, 304SS 0.010" thick, square lock style.
TH52 is also available with connector, see section "Connector style",

Connector style Type of connectors TH52 and TH56, standard and miniature plugs

A = STANDARD		max. 176.7 °C (350 °F) TH52, all types J and K TH56, types J and K ³ / ₁₆ " and ¹ / ₄ " only
		max. 176.7 °C (350 °F) All Others!
B = STANDARD W/FEMALE		max. 176.7 °C (350 °F)
C = MINI		max. 176.7 °C (350 °F)

D = MINI W/FEMALE		max. 176.7 °C (350 °F)
E = STANDARD (high temp.)		max. 426.7 °C (800 °F)
G = STANDARD W/FEMALE (high temp.)		max. 426.7 °C (800 °F)
Y = SPECIAL		

Thermocouple color codes according to ASTM E-230

T.C. Type	POS NEG	Material	MAGNETIC		Insulation		Plug & Jack ¹⁾
			YES	NO	Single conductor	Overall T.C. wire	
E	EP (+)	Nickel - 10% chromium		X	Purple	Brown	Purple
	EN (-)	Copper - 45% nickel (constantan)		X	Red		
J	JP (+)	Iron	X		White	Brown	Black
	JN (-)	Copper - 45% nickel (constantan)		X	Red		
K	KP (+)	Nickel - 10% chromium		X	Yellow	Brown	Yellow
	KN (-)	Nickel - 5% (aluminum, silicon) ²⁾	X		Red		
T	TP (+)	Copper		X	Blue	Brown	Blue
	TN (-)	Copper - 45% nickel (constantan)		X	Red		
N	NP (+)	Nickel - 14% chromium - 1.5% silicon		X	Orange	Brown	Orange
	NN (-)	Nickel - 4.5% silicon - 0.1% magnesium		X	Red		

- 1) References for Plug & Jack Color Codes are based on ASTM E-1129/E 1129M-98, Standard Specification of Thermocouple connectors and ASTM E-1684, Standard Specification for Miniature Thermocouple Connectors.
- 2) Silicon, or aluminum and silicon may be present in combination with other elements.

Performance characteristics

Reference conditions

These data are relevant for determining the accuracy of the temperature transmitters used. More information on this can be found in the Technical Information of the iTEMP temperature transmitters.

Response time

63% response time per ASTM E839

Junction style	Ø $\frac{1}{16}$ "	Ø $\frac{1}{8}$ "	Ø $\frac{3}{16}$ "	Ø $\frac{1}{4}$ "	Ø $\frac{3}{8}$ "
Grounded	0.3 s	0.6 s	0.9 s	1.3 s	3.5 s
Ungrounded	0.4 s	1.6 s	2.4 s	2.9 s	7.2 s



Response time for the sensor assembly without transmitter.

Maximum measured error

Thermocouples corresponding to ASTM E839

Type	Temperature range	Standard tolerance (IEC class 2)	Special tolerance (IEC class 1)
		[°C] whichever is greater	[°C] whichever is greater
E	0 to 870 °C (32 to 1600 °F)	±1.7 or ±0.5%	±1 or ±0.4%
J	0 to 760 °C (32 to 1400 °F)	±2.2 or ±0.75%	±1.1 or ±0.4%
K	0 to 1260 °C (32 to 2300 °F)	±2.2 or ±0.75%	±1.1 or ±0.4%
T	0 to 370 °C (32 to 700 °F)	±1 or 0.75%	±0.5 or ±0.4%
N	0 to 1260 °C (32 to 2300 °F)	±2.2 or ±0.75%	±1.1 or ±0.4%



For measurement errors in °F, calculate using equation above in °C, then multiply the outcome by 1.8.

Transmitter long-term stability

≤ 0.1 °C (0.18 °F) / year or ≤ 0.05 % / year

Data under reference conditions; % relates to the set span. The larger value applies.

Insulation resistance

Insulation resistance for MgO insulated thermocouples with ungrounded hot junction between terminals and probe sheath, test voltage 500 V_{DC}.

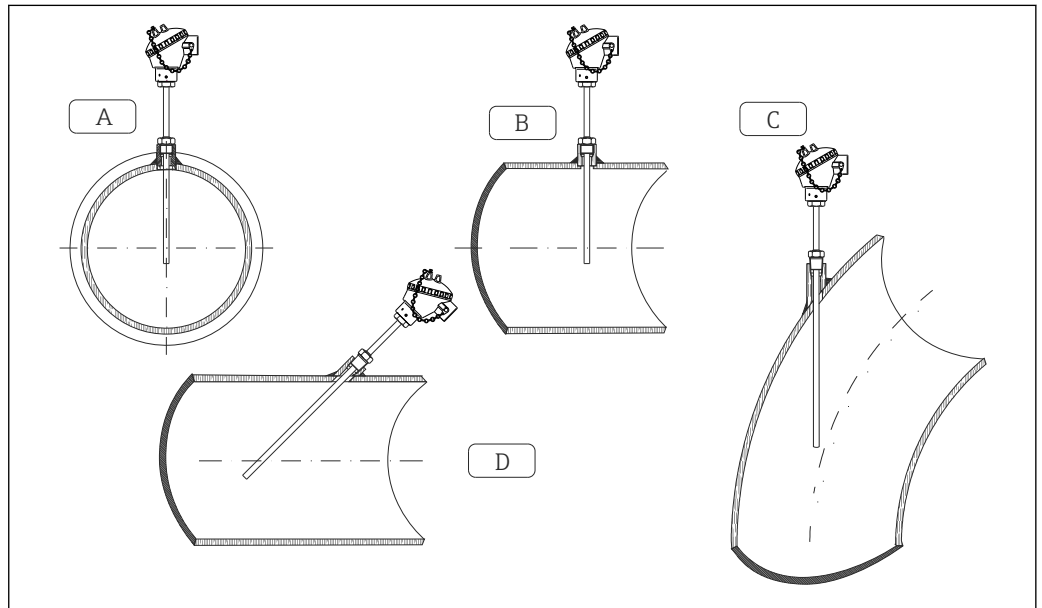
1000 MΩ at 25 °C (77 °F)

These values for insulation resistance also apply between each thermocouple wire at single and duplex constructions with ungrounded hot junction.

Installation conditions

Orientation No restrictions.

Installation instructions



2 Installation examples

A-B In pipes with a small cross section the thermowell tip should reach or extend slightly past the center line of the pipe (= U)
 C-D Tilted installation

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

- Installation possibilities: Pipes, tanks or other plant components
- Minimum immersion length should be 10 times the OD of the sheath, nominal.

Environment

Ambient temperature

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)

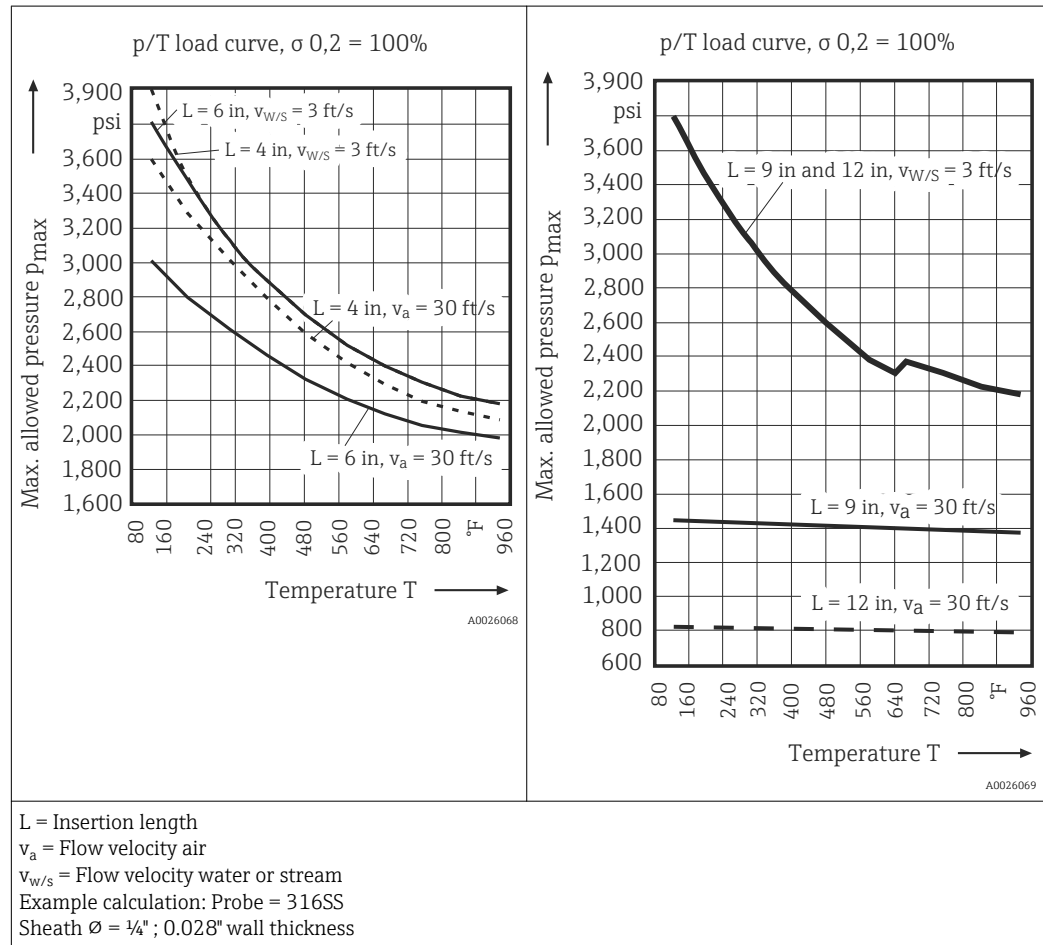
Shock and vibration resistance

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

Process

Process pressure limits

p/T load curve example according to Dittrich



i Avoid resonance frequency as this will cause damage to the probe!

- L = 4 and 6 in:
Resonance frequency occurs when permanent flow velocity is at 18.1, 22.6 or 27.1 ft/s (air) for 6 in and/or 40.5, 50.6 or 60.8 ft/s (air) for 4 inch probe (T = 482 °F, p = 2700/2600 psi).
- L = 9 and 12 in:
Resonance frequency occurs when permanent flow velocity is at 8.1, 10.1 or 12.1 ft/s (air) for 9 inch and/or 4.6, 5.7 or 6.8 ft/s (air) for 12 inch probe (T = 482 °F, p = 2600 psi).

i The calculation was done for pipes only, for MgO insulated thermocouples the values might be higher. In any case for different lengths, other materials, variation in sheath diameter or wall thicknesses, stress analysis is recommended. Failures are caused by forces imposed by static pressure, steady state flow, and vibration.

Max. allowable process pressure (PSIG) for instrumentation with one time adjustable compression fittings.

Temperature	1/8" NPT and 1/4" NPT compression fitting				
°C (°F)	Sheath $\varnothing = 1/16"$	Sheath $\varnothing = 1/8"$	Sheath $\varnothing = 3/16"$	Sheath $\varnothing = 1/4"$	Sheath $\varnothing = 3/8"$ 1)
-28 to 204 °C (-20 to 300 °F)	3300	2850	3150	3350	3900
204 °C (400 °F)	3200	2750	3050	3250	3800
260 °C (500 °F)	3000	2550	2850	3000	3500
316 °C (600 °F)	2800	2400	2700	2850	3300

Temperature	$\frac{1}{8}$ " NPT and $\frac{1}{4}$ " NPT compression fitting				
	Sheath $\varnothing = \frac{1}{16}$ "	Sheath $\varnothing = \frac{1}{8}$ "	Sheath $\varnothing = \frac{3}{16}$ "	Sheath $\varnothing = \frac{1}{4}$ "	Sheath $\varnothing = \frac{3}{8}$ " ¹⁾
371 °C (700 °F)	2 700	2 350	2 600	2 750	3 200
427 °C (800 °F)	2 650	2 300	2 550	2 650	3 100
482 °C (900 °F)	2 600	2 200	2 450	2 600	3 050
538 °C (1 000 °F)	2 400	2 100	2 300	2 450	2 850

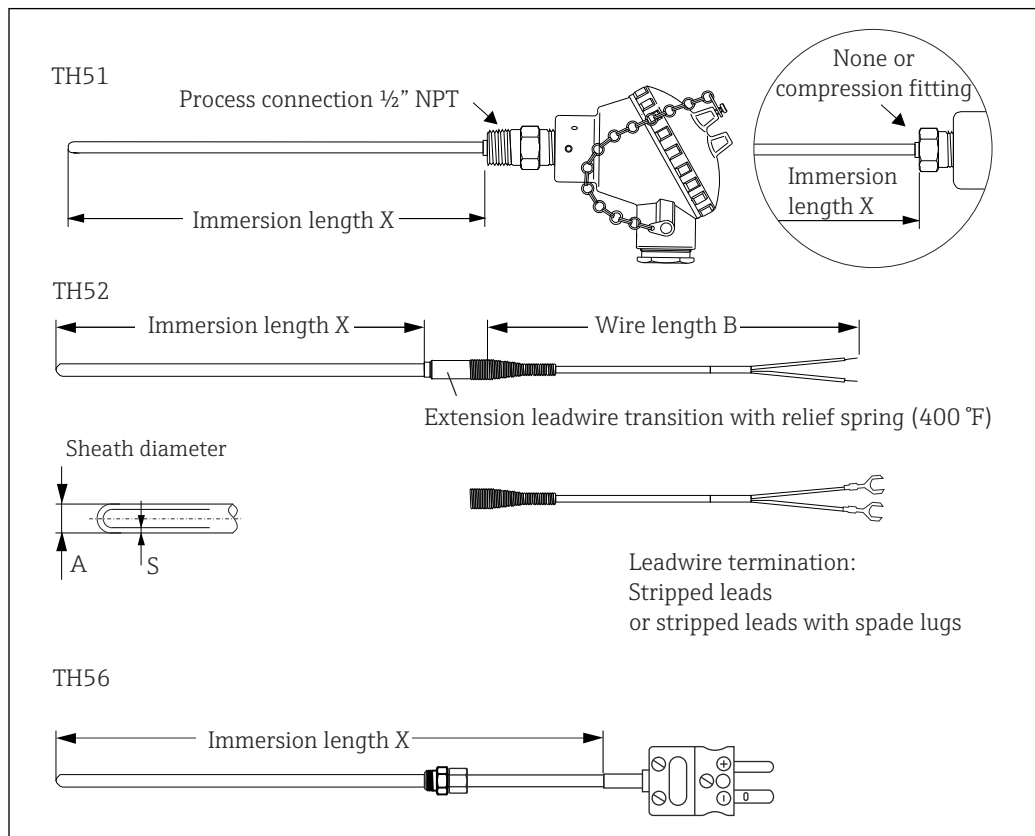
1) not available with compression fittings $\frac{1}{8}$ " NPT



Re-adjustable compression fittings are not intended to be used for pressure retaining applications and should only be used for the mechanical holding of sensors.

Mechanical construction

Design, dimensions



3 For values related to this graphic please refer to the table below.

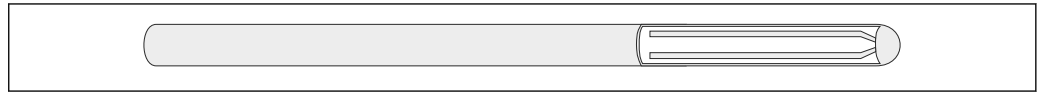
Duplex version (2 elements) of TH56 is not available.

Dimensions in inches


Immersion length X			Wire length B	Sheath diameter A	Wall thickness S
TH51	TH52	TH56			
4", 6", 9", 12"	6", 12", 18", 24"	12", 18", 24", 48", 72", 96"	48", 72", 120" specified length 12" to 300" in 12" increments	∅1/16"	0.007"
				∅1/8"	0.014"
				∅3/16"	0.022"
				∅1/4"	0.029"
specified length 2" to 96" in 1/2" increments				∅3/8"	0.045"

Hot or measuring junction

Grounded junction



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 4 *Grounded junction*

The thermocouple junction is welded securely into the closure end of the sheath, becoming an integral part of the weld. This is a good general purpose, low cost junction providing faster response times than an ungrounded junction of similar sheath diameter. Grounded junctions should not be used with Type T thermocouples, due to the copper wire. For a reliable temperature reading of grounded thermocouples transmitters with galvanic isolation are strongly recommended. iTEMP transmitters have galvanic isolation of min. 2 kV (from the sensor input to the output and the housing).


Ungrounded junction



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 5 *Ungrounded junction*

The welded thermocouple junction is fully isolated from the welded closed end sheath. This junction provides electrical isolation to reduce problems associated with electrical interference. Ungrounded junctions are also recommended for use in extreme positive or negative temperatures, rapid thermal cycling and for ultimate corrosion resistance of the sheath alloy. iTEMP transmitters have an excellent noise immunity (EMC) meeting all requirements listed under IEC 61326 for use in noisy environments.

 Dual ungrounded elements supplied with individually isolated junctions, except $\varnothing 1/16"$ which are supplied with common junctions.

Weight

0.5 to 2.5 kg (1 to 5.5 lb)

Material

Process connection, terminal head and sheath

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	X5CrNiMo17-12-2	650 °C (1202 °F) ¹⁾	<ul style="list-style-type: none"> ▪ Austenitic, stainless steel ▪ High corrosion resistance in general ▪ Particularly high corrosion resistance in 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)
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 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) ▪ 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 ▪ Resistant to corrosion caused by chlorine gas and chlorinated media as well as many oxidizing mineral and organic acids, sea water etc. ▪ Corrosion from ultrapure water ▪ Not to be used in a sulfur-containing atmosphere

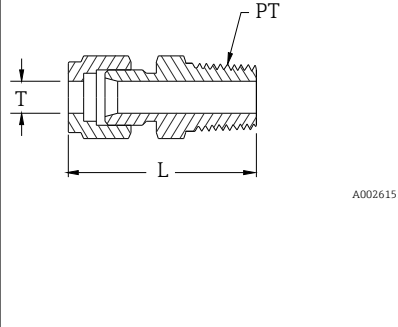
- 1) Can be used to a limited extent up to 800 °C (1472 °F) for low compressive loads and in non-corrosive media. Please contact your Endress+Hauser sales team for further information.

Process connection

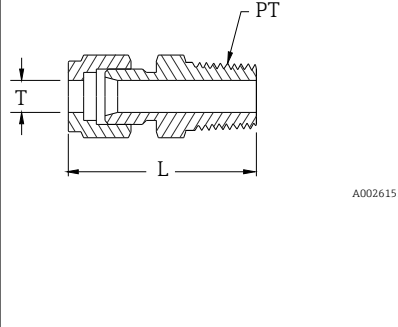
Compression fitting

All dimensions in inch

Re-adjustable compression fittings in stainless steel with FEP ferrule

Type of fitting	Tube size - Outer diameter (T) in inch	Process thread (PT) in inch	Length (L) in inch
	1/16	1/8 NPT	1 1/4
	1/8	1/8 NPT	1 1/4
	3/16	1/8 NPT	1 1/4
	1/4	1/4 NPT	2 1/2
	3/8	1/4 NPT	2 1/2
	1/4	1/8 NPT	1 1/4
	1/8	1/4 NPT	1 9/16
	3/16	1/4 NPT	1 9/16

One-time adjustable compression fittings in stainless steel with SS ferrule


Type of fitting	Tube size - Outer diameter (T) in inch	Process thread (PT) in inch	Length (L) in inch
	1/16	1/8 NPT	1 1/4
	1/8	1/8 NPT	1 1/4
	3/16	1/8 NPT	1 1/4
	1/4	1/8 NPT	1 1/4
	1/8	1/4 NPT	1 7/16
	3/16	1/4 NPT	1 1/2
	1/4	1/4 NPT	1 9/16
	3/8	1/4 NPT	1 5/8

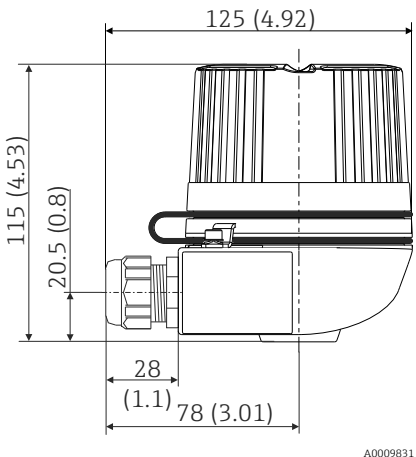
Housing

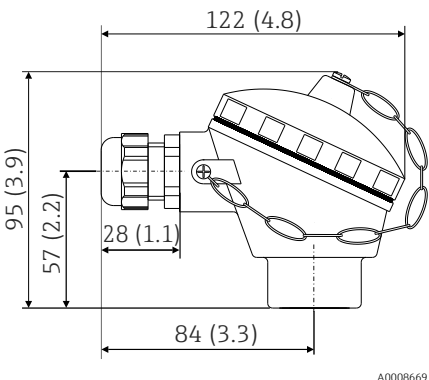
Terminal heads

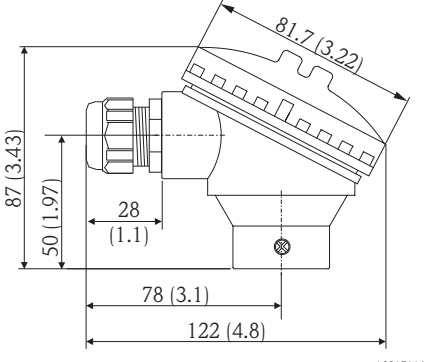
All terminal heads have an internal shape and size in accordance with DIN EN 50446, flat face and a thermometer connection with a 1/2" NPT thread. All dimensions in mm (in). Specifications without head transmitter installed. For ambient temperatures with head transmitter installed, see the 'Environment' section. → 9

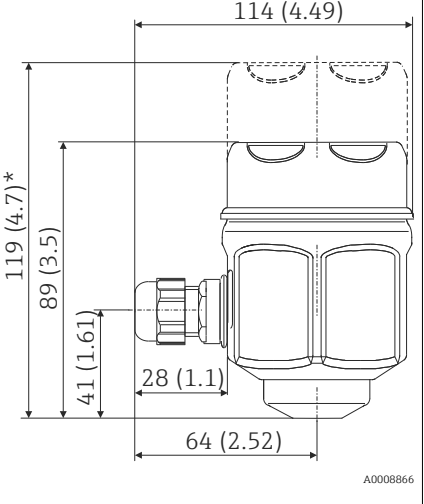
As a special feature, Endress+Hauser offers terminal heads with optimized terminal accessibility for easy installation and maintenance.

 Some of the specifications listed below may not be available on this product line.

TA30H with display window in cover	Specification
 <p style="text-align: right; font-size: small;">A0009831</p>	<ul style="list-style-type: none"> ▪ Flameproof (XP) version, explosion-protected, captive screw cap, available with one or two cable entries ▪ Protection class: IP 66/68 ▪ Temperature: -50 to +150 °C (-58 to +302 °F) or rubber seal without cable gland (observe max. permitted temperature of cable gland!) ▪ Material: aluminum; polyester powder coated ▪ Thread: 1/2" NPT, 3/4" NPT, M20x1.5, G1/2" ▪ Extension neck/thermowell connection: 1/2" NPT ▪ Color of head: blue, RAL 5012 ▪ Color of cap: gray, RAL 7035 ▪ Weight: approx. 860 g (30.33 oz) ▪ Head transmitter optionally available with TID10 display

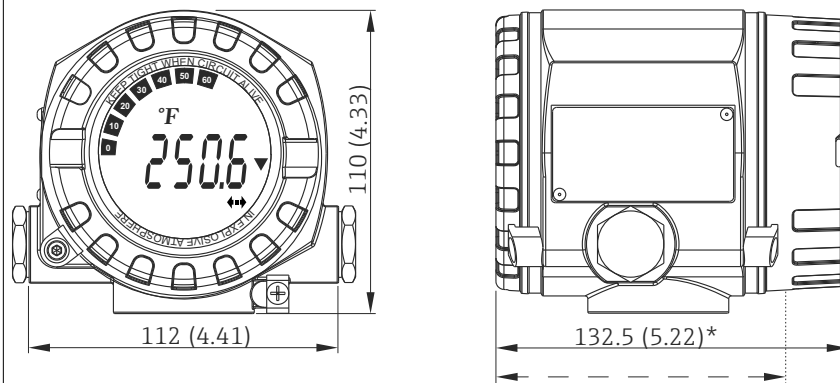
TU401	Specification
 <p style="text-align: right; font-size: small;">A0008669</p>	<ul style="list-style-type: none"> ▪ Protection class: IP65 (NEMA Type 4x encl.) ▪ Temperature: -40 to 130 °C (-40 to 266 °F) silicone, up to 100 °C (212 °F) rubber seal without cable gland (observe max. permitted temperature of the cable gland!) ▪ Material: aluminum alloy with polyester or epoxy coating, rubber or silicone seal under the cover ▪ Cable entry: M20x1.5 or plug M12x1 PA ▪ Protection armature connection: M24x1.5, G 1/2" or NPT 1/2" ▪ Head color: blue, RAL 5012 ▪ Cap color: gray, RAL 7035 ▪ Weight: 300 g (10.58 oz)

TU401 (TA30S style)	Specification
 <p>A0017146</p>	<ul style="list-style-type: none"> ▪ Degree of protection: IP65 (NEMA Type 4x encl.) ▪ Temperature: -40 to +85 °C (-40 to +185 °F) without cable gland ▪ Material: polypropylene (PP), FDA-compliant, seals: O-ring EPDM ▪ Cable entry thread: 3/4" NPT (with adapter for 1/2" NPT), M20x1.5 ▪ Protective assembly connection: 1/2" NPT ▪ Color: white ▪ Weight: approx. 100 g (3.5 oz) ▪ Ground terminal: only internal via auxiliary terminal

TU401 (TA20J style)	Specification
 <p>A0008866</p> <p>* dimensions with optional display</p>	<ul style="list-style-type: none"> ▪ Protection class: IP66/IP67 (NEMA Type 4x encl.) ▪ Temperature: -40 to 70 °C (-40 to 158 °F) without cable gland ▪ Material: 316L (1.4404) stainless steel, rubber seal under the cover (hygienic design) ▪ 4 digits 7-segments LC display (loop powered with optional 4 to 20 mA transmitter) ▪ Cable entry: 1/2" NPT, M20x1.5 o plug M12x1 PA ▪ Protection armature connection: M24x1.5 or 1/2" NPT ▪ Head and cap color: stainless steel, polished ▪ Weight: 650 g (22.93 oz) with display ▪ Humidity: 25 to 95 %, no condensation ▪ 3-A® marked <p>The programming is executed through 3 keys at the bottom of the display.</p>

Field housings

Temperature field transmitter iTEMP TMT162

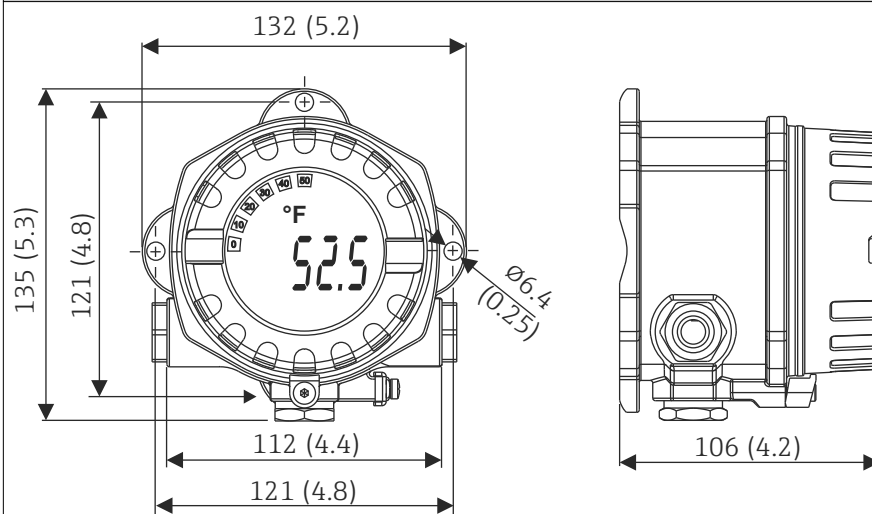


A0024608

* Dimensions without display = 112 mm (4.41 in)

- Separate electronics compartment and connection compartment
- Protection class: IP67, NEMA type 4x
- Material: Die-cast aluminum housing AlSi10Mg with powder coating on polyester base, 316L
- Display rotatable in 90° increments
- Cable entry: 2x ½" NPT
- Brilliant blue backlit display with ease of visibility in bright sunshine or pitch darkness
- Gold plated terminals to avoid corrosion and additional measurement errors

Temperature field transmitter iTEMP HART® TMT142



A0025824

- Protection class: IP67, NEMA type 4x
- Material: Die-cast aluminum housing AlSi10Mg with powder coating on polyester base
- Display rotatable in 90° increments
- Cable entry: 3x ½" NPT
- Brilliant blue backlit display with ease of visibility in bright sunshine or pitch darkness
- Gold plated terminals to avoid corrosion and additional measurement errors

Certificates and approvals

CE Mark	The device meets the legal requirements of the EC directives if applicable. Endress+Hauser confirms that the device has been successfully tested by applying the CE mark.
Other standards and guidelines	<ul style="list-style-type: none"> ▪ IEC 60529: Degree of protection of housing (IP code) ▪ IEC 61010-1: Safety requirements for electrical equipment for measurement, control, and laboratory use – Part 1: General requirements ▪ IEC 60584 and ASTM E230/ANSI MC96.1: Thermocouples ▪ ASTM E839: American society for testing and materials, standard test methods for sheathed thermocouples and sheathed thermocouple material ▪ ASTM E1129/E1129M-98: Standard specification of thermocouple connectors ▪ ASTM E1684: Standard specification for miniature thermocouple connectors ▪ NEMA - ANSI/NEMA 250: Enclosures for Electrical Equipment
UL	Temperature transmitters UL recognized components under Category Code.file number QUYX8.E225237 and QUYX2.E225237

Ordering information

Product Configurator










Product Configurator - the tool for individual product configuration


Detailed ordering information is available from the following sources:

- In the Product Configurator on the Endress+Hauser website: www.endress.com → Select country → Instruments → Select device → Product page function: Configure this product
- From your Endress+Hauser Sales Center: www.endress.com/worldwide
- Up-to-the-minute configuration data
- Depending on the device: Direct input of measuring point-specific information such as measuring range or operating language
- Automatic verification of exclusion criteria
- Automatic creation of the order code and its breakdown in PDF or Excel output format
- Ability to order directly in the Endress+Hauser Online Shop




Accessories

Various accessories, which can be ordered with the device or subsequently from Endress+Hauser, are available for the device. Detailed information on the order code in question is available from your local Endress+Hauser sales center or on the product page of the Endress+Hauser website: www.endress.com.

Device-specific accessories	TU301	Threaded compression fitting Order code: TU301
	TU201	Sensor extension cable Order code: TU201
Communication-specific accessories	Configuration kit TXU10	Configuration kit for PC-programmable transmitter with setup software and interface cable for PC with USB port Order code: TXU10-xx
	Commubox FXA195 HART	For intrinsically safe HART communication with FieldCare via the USB interface.  For details, see "Technical Information" TI00404F
	Commubox FXA291	Connects Endress+Hauser field devices with a CDI interface (= Endress+Hauser Common Data Interface) and the USB port of a computer or laptop.  For details, see "Technical Information" TI00405C
	HART Loop Converter HMX50	Is used to evaluate and convert dynamic HART process variables to analog current signals or limit values.  For details, see "Technical Information" TI00429F and Operating Instructions BA00371F
	Wireless HART adapter SWA70	Is used for the wireless connection of field devices. The WirelessHART adapter can be easily integrated into field devices and existing infrastructures, offers data protection and transmission safety and can be operated in parallel with other wireless networks with minimum cabling complexity.  For details, see Operating Instructions BA061S
	Fieldgate FXA320	Gateway for the remote monitoring of connected 4-20 mA measuring devices via a Web browser.  For details, see "Technical Information" TI00025S and Operating Instructions BA00053S
	Fieldgate FXA520	Gateway for the remote diagnostics and remote configuration of connected HART measuring devices via a Web browser.  For details, see "Technical Information" TI00025S and Operating Instructions BA00051S
	Field Xpert SFX100	Compact, flexible and robust industry handheld terminal for remote configuration and for obtaining measured values via the HART current output (4-20 mA).  For details, see Operating Instructions BA00060S
Service-specific accessories	Accessories	Description
Applicator	Software for selecting and sizing Endress+Hauser measuring devices: <ul style="list-style-type: none"> 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: <ul style="list-style-type: none"> Via the Internet: https://wapps.endress.com/applicator On CD-ROM for local PC installation. 	

Configurator ^{+temperature}	<p>Software for selecting and configuring the product depending on the measuring task, supported by graphics. Includes a comprehensive knowledge database and calculation tools:</p> <ul style="list-style-type: none"> ▪ For temperature competence ▪ Quick and easy design and sizing of temperature measuring points ▪ Ideal measuring point design and sizing to suit the processes and needs of a wide range of industries <p>The "Configurator" is available: On request from your Endress+Hauser sales office on a CD-ROM for local PC installation.</p>
W@M	<p>Life cycle management for your plant W@M supports you with a wide range of software applications over the entire process: from planning and procurement, to the installation, commissioning and operation of the measuring devices. All the relevant device information, such as the device status, spare parts and device-specific documentation, is available for every device over the entire life cycle. The application already contains the data of your Endress+Hauser device. Endress+Hauser also takes care of maintaining and updating the data records. W@M is available:</p> <ul style="list-style-type: none"> ▪ Via the Internet: www.endress.com/lifecyclemanagement ▪ On CD-ROM for local PC installation.
FieldCare	<p>FDT-based plant asset management tool from Endress+Hauser. It can configure all smart field units in your system and helps you manage them. By using the status information, it is also a simple but effective way of checking their status and condition.</p> <p> For details, see Operating Instructions BA00027S and BA00059S</p>

System components

Accessories	Description
Process display unit RIA15	<p>The display unit records the analog measuring signal from the head transmitter and shows this on the display. The LC display shows the current measured value in digital form and as a bar graph indicating a limit value violation. The process display unit is integrated in the 4 to 20 mA or HART® loop and is powered directly from the current loop. Optionally up to four of a sensor's HART® process variables can be displayed.</p> <p> For details, see the "Technical Information" document TI01043K/09/EN</p>
Ecograph T, RSG35	<p>Universal graphic display recorder with up to 12 universal inputs, 5.7" TFT screen for displaying measured values in a maximum of four groups, with digital, bar graph and curve display.</p> <p> For details, see "Technical Information" TI01079R/09/EN</p>
RNS221	<p>Supply unit for powering two 2-wire measuring devices solely in the non-Ex area. Bidirectional communication is possible via the HART communication jacks.</p> <p> For details, see "Technical Information" TI00081R and Brief Operating Instructions KA00110R</p>

Documentation

Brief operating instructions

- TH51 Thermocouple assembly, KA00184R/24/EN
- TH52 Thermocouple assembly, KA185R/24/AE
- TH56 Thermocouple assembly, KA186R/24/AE

Technical Information

- Temperature transmitter iTEMP HART® TMT82, TI01010T/09/EN
- Temperature field transmitter iTEMP TMT162, TI00086R/09/EN
- Temperature field transmitter iTEMP HART® TMT142, TI00107R/09/EN
- Temperature head transmitter iTEMP PCP TMT181, TI00070R/09/EN
- Temperature head transmitter iTEMP HART® TMT182, TI00078R/09/EN

Application example

- Temperature transmitter iTEMP PCP DIN rail TMT121, TI00087R/09/EN
- Temperature transmitter iTEMP HART® DIN rail TMT122, TI090R/09/EN
- Loop-powered process display unit RIA15, TI01043K/09/EN
- Power supply RNS221, TI081R/24/AE
- Universal Data Manager Ecograph T, RSG35, TI01079R/09/EN



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