TI01256T/09/EN/04.22-00
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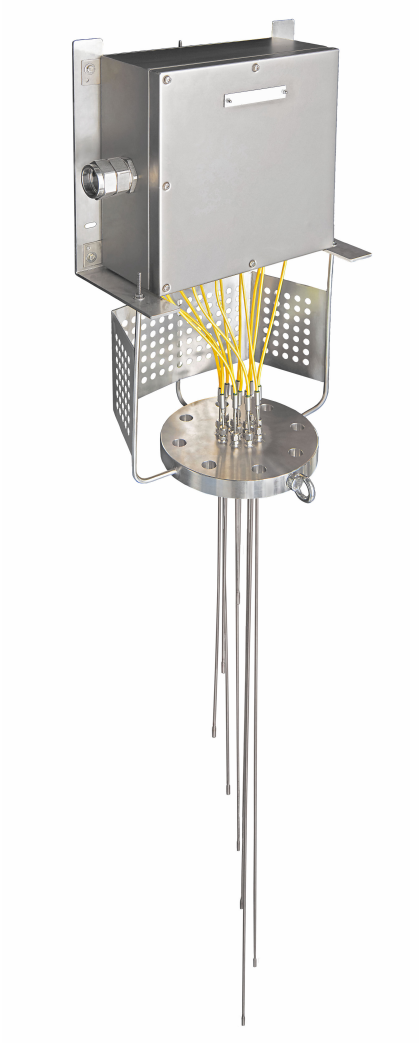
2022-06-15

Technical Information
iTHERM
MultiSens Flex TMS01

Modular direct contact TC and RTD multipoint thermometer for Oil & Gas and Petrochemical applications



Application

- Easy-to-use device with modular and flexible design, ready to be installed either for direct contact measurements, or in an existing thermowell
- Specifically designed for Oil & Gas and Petrochemical processing industries
- Measuring range:
  - Resistance insert (RTD): −200 to 600 °C (−328 to 1 112 °F)
  - Thermocouple (TC): −270 to 1 150 °C (−454 to 2 102 °F)
- Static pressure range: Up to 100 bar (1 450 psi). Specific maximum process pressure achievable depending on the thermometer design and process temperature
- Degree of protection: IP66/67

Head transmitter

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

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

Your benefits

- Infinite 3D sensors distribution layouts for any process monitoring configuration
- High density of measuring points thanks to the possibility to mount the ProfileSens sensor technology
- High degree of customization thanks to a modular product design for easy installation, process integration and maintenance
- Easy integration due to inserts according standard IEC 60584, ASTM E230 and IEC 60751
- Thanks to a proper junction box support frame design, overheating of electronic is avoided resulting in a longer product lifetime
- Compliance to different types of protection for use in hazardous locations for a wide and easy process integration
- Possibility of sensing elements replacement

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Table of contents

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.

Resistance thermometer (RTD)

These resistance thermometers use a Pt100 temperature sensor according to IEC 60751. The temperature sensor is a temperature-sensitive platinum resistor with a resistance of 100 Ω at 0 °C (32 °F) and a temperature coefficient α = 0.003851 °C-1.

There are generally two different kinds of platinum resistance thermometers:

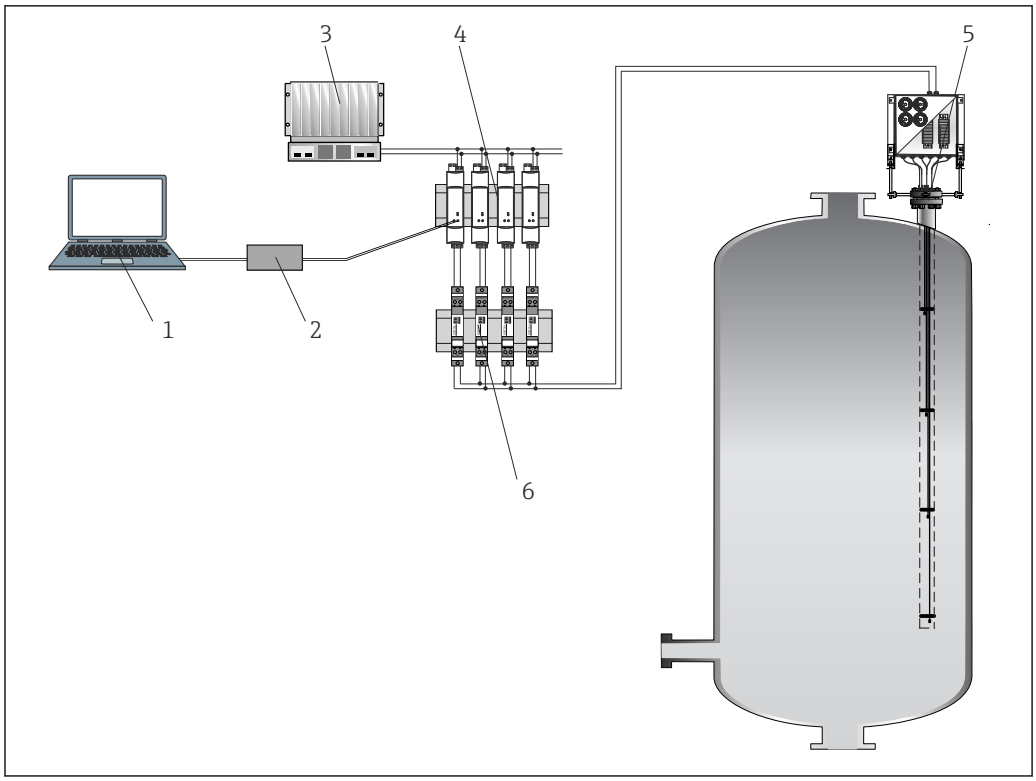
- **Wire wound (WW):** Here, a double coil of fine, high-purity platinum wire is located in a ceramic support. This is then sealed top and bottom with a ceramic protective layer. Such resistance thermometers not only facilitate very reproducible measurements but also offer good long-term stability of the resistance/temperature characteristic within temperature ranges up to 600 °C (1 112 °F). This type of sensor is relatively large in size and it is comparatively sensitive to vibrations.
- **Thin film platinum resistance thermometers (TF):** A very thin, ultrapure platinum layer, approx. 1 µm thick, is vaporized in a vacuum on a ceramic substrate and then structured photolithographically. The platinum conductor paths formed in this way create the measuring resistance. Additional covering and passivation layers are applied and reliably protect the thin platinum layer from contamination and oxidation, even at high temperatures. The primary advantages of thin film temperature sensors over wire wound versions are their smaller sizes and better vibration resistance. A relatively low principle-based deviation of the resistance/temperature characteristic from the standard characteristic of IEC 60751 can frequently be observed among TF sensors at high temperatures. As a result, the tight limit values of tolerance category A as per IEC 60751 can only be observed with TF sensors at temperatures up to approx. 300 °C (572 °F). For this reason, thin-film sensors are generally only used for temperature measurements in ranges below 400 °C (752 °F).

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.

This includes:
- Power supply unit/active barrier
- Configuration units
- Overvoltage protection

For more information, see the brochure 'System Components - Solutions for a Complete Measuring Point' (FA00016K/09)



1 *Application example in a reactor, mounted multipoint thermometer in a locally existing thermowell with four measurement points and four built-in transmitters or terminal blocks.*

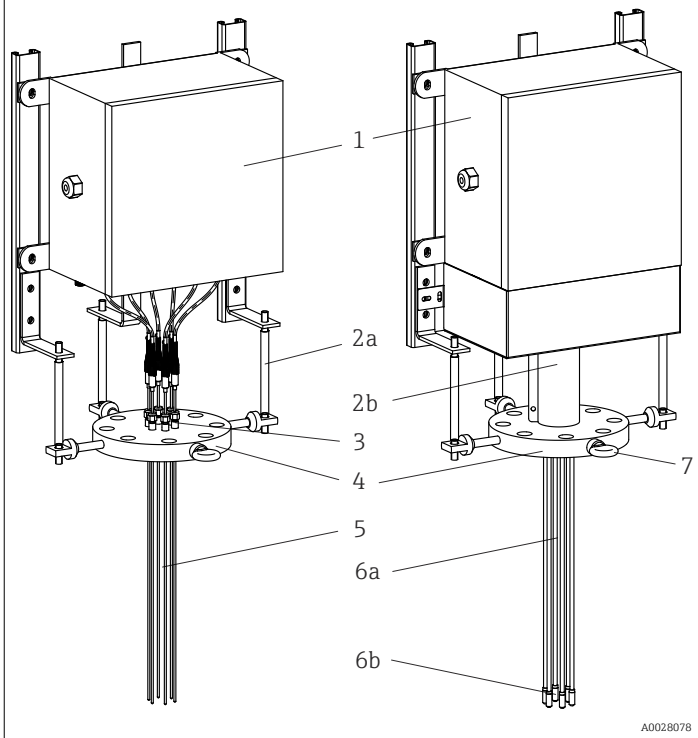
1 *Device configuration with application software FieldCare*
2 *Commubox*
3 *PLC*
4 *Active barrier RN221N (24 V_{DC}, 30 mA) that has a galvanically isolated output for supplying voltage to loop-powered transmitters. The universal power supply works with an input supply voltage of 20 to 250 V DC/AC; 50/60 Hz, which means that it can be used in all international power grids.*
5 *Mounted multipoint thermometer in a locally existing thermowell, optionally with built-in transmitters in the junction box for 4 to 20 mA-, HART-, PROFIBUS® PA-, FOUNDATION Fieldbus™ communication or terminal blocks for remote wiring.*
6 *Surge arrester modules HAW562 for protection of signal lines and components in hazardous areas, e.g. 4 to 20 mA- , PROFIBUS® PA, FOUNDATION Fieldbus™ signal lines. More information on this can be found in the Technical Information → 29*

Equipment architecture

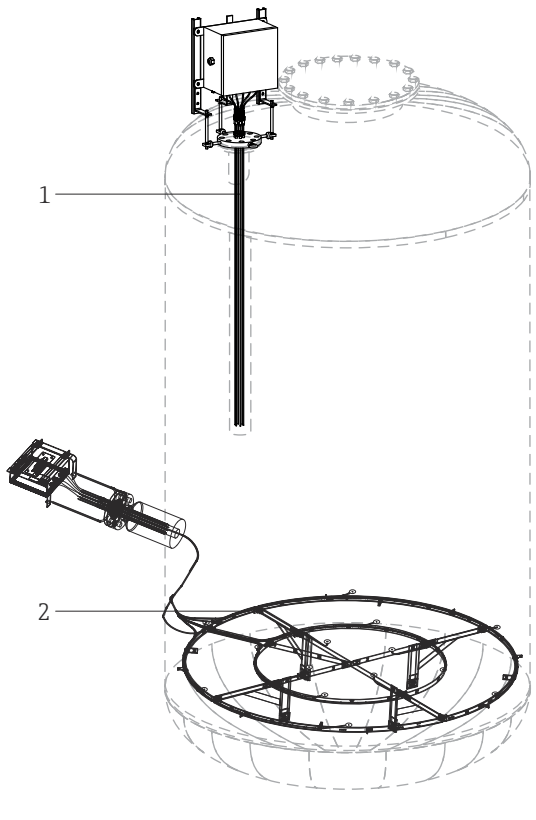
The multipoint thermometer belongs to a range of modular product configuration for multipoint temperature detection with a design where subassemblies and components can be managed individually for easy maintenance and spare part ordering.

It consists of the following main sub-assemblies:
- **Single point insert:** Done by a metal sheathed sensing measuring element (thermocouple or resistance), extension cables and transition bushing. When applicable, each insert can be handled as an individual spare part that may be replaceable by untightening its compression fitting installed onto the process connection. They can be ordered via specific standard product order codes (e.g. TSC310, TST310) or special codes. For the specific order code please contact the Endress+Hauser service department.
- **Multiple insert:** Composed of a plurality of independent metal sheated thermocouple cables in one probe, each of them provided with its seal pot and extension cables resulting in a dual seal insert design (Endress+Hauser ProfileSens).
- **Process connection:** Represented by an ASME or EN flange, it might be provided with eyebolts for lifting the device.
- **Head:** It is composed of a junction box provided with its components such as cable glands, draining valves, earth screws, terminals, head transmitters, etc.
- **Neck:** It is designed to support the junction box by components such as supporting rods and plates or tube extension.
- **Additional accessories:** Components that can be ordered independently from the selected product configuration, such as clips, pads, tips, spacers and plates for tag sensors.
- **Thermowells:** They are directly welded on the process connection, designed to guarantee higher degree of mechanical protection and corrosion resistance for each sensor.

In general, the system measures the temperature profile inside the process environment by means of many sensors, jointed to a suitable process connection which ensures the right tightness levels. Externally, the extension cables are wired into the junction box, which can be directly mounted or remote as option.

Design		Description, available options and materials
	1: Head	Hinged cover junction box for electrical connections. It includes components such as electrical terminals, transmitters and cable glands. ▪ 316/316L ▪ Other materials on request
	2a: Frame neck	Modular frame support that is adjustable for all available junction boxes. 316/316L
	2b: Tube neck	Modular tube support that is adjustable for all available junction boxes and ensures extension cable inspection. 316/316L
	3: Compression fitting	High performance compression fitting for a proper tightness between process and external environment, for a wide range of process fluids concentration and severe combination between temperature and pressure. ▪ 316L ▪ 316H
	4: Process connection	Represented by a flange according to international standards, or engineered to satisfy specific process requirements. → 🖹 21 ▪ 304/304L ▪ 316/316L ▪ 316Ti ▪ 321 ▪ 347 ▪ Other materials on request
	5: Insert	▪ Mineral insulated grounded and ungrounded thermocouples or RTD (Pt100 wire wound) ▪ Mineral insulated ungrounded multipoint cable insert with thermocouples (ProfileSens) For details refer to the ordering information table
	6a: Protecting thermowells 6b: Thermowells closure tip	The thermometer can be equipped: ▪ either with protecting thermowells for increased mechanical strength and corrosion resistance ▪ or open guiding tubes for installation in an existing thermowell. ▪ 316/316L ▪ 321 ▪ 347 ▪ Alloy 600 ▪ Other materials on request
	7: Eyebolt	Lifting device for easy handling during installation phase. 316

The modular multipoint thermometer is characterized by the following possible main configurations:



2 Main configuration possibilities

1 Linear configuration
2 3D configuration

- **Linear configuration**
  The different sensors are aligned along the straight direction coinciding with the longitudinal axis of the multipoint assembly itself (linear multipoint measurement). This configuration can be used to install the multipoint either in an existing thermowell as part of the reactor or in direct contact with the process.
- **3D distribution configuration**
  For a high number of measuring points, each multipoint cable sensor can be bent and arranged in a three dimensional configuration by fixing them through clips or other equivalent accessories. This configuration is commonly used to reach several measurement points distributed at different cross sections and levels. Specific support frames can be provided and installed on request if they are not already available on site.

Input

Measured variable

Temperature (temperature linear transmission behavior)

Measuring range

RTD:

Input	Designation	Measuring range limits
RTD as per IEC 60751	Pt100	−200 to +600 °C (−328 to +1 112 °F)

Thermocouple:

Input	Designation	Measuring range limits
Thermocouples (TC) as per IEC 60584, part 1 - using an Endress+Hauser - iTEMP temperature head transmitter	Type J (Fe-CuNi) Type K (NiCr-Ni) Type N (NiCrSi-NiSi) Type T (Cu-CuNi)	−210 to +720 °C (−346 to +1 328 °F) −270 to +1 150 °C (−454 to +2 102 °F) −270 to +1 100 °C (−454 to +2 012 °F) −270 to +370 °C (−454 to +698 °F)
	Internal cold junction (Pt100) Cold junction accuracy: ± 1 K Max. sensor resistance: 10 kΩ	

Input	Designation	Measuring range limits
Thermocouples (TC) - flying leads - as per IEC 60584 and ASTM E230	Type J (Fe-CuNi)	−270 to +720 °C (−454 to +1 328 °F), typical sensitivity above 0 °C ≈ 55 µV/K
	Type K (NiCr-Ni)	−270 to +1 150 °C (−454 to +2 102 °F) [1], typical sensitivity above 0 °C ≈ 40 µV/K
	Type N (NiCrSi-NiSi)	−270 to +1 100 °C (−454 to +2 012 °F), typical sensitivity above 0 °C ≈ 40 µV/K
	Type T (Cu-CuNi)	−270 to +370 °C (−454 to +698 °F), typical sensitivity above 0 °C ≈ 43 µV/K

1) Limited by jacket material of insert

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 junction box 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 using universal device configuration tools like FieldCare, DeviceCare or FieldCommunicator 375/475. 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. The configuration of PROFIBUS PA functions and of device-specific parameters is performed via fieldbus communication. 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. All transmitters are released for use in all important process control systems. The integration tests are performed in Endress+Hauser's "System World". For more information, see the Technical Information.

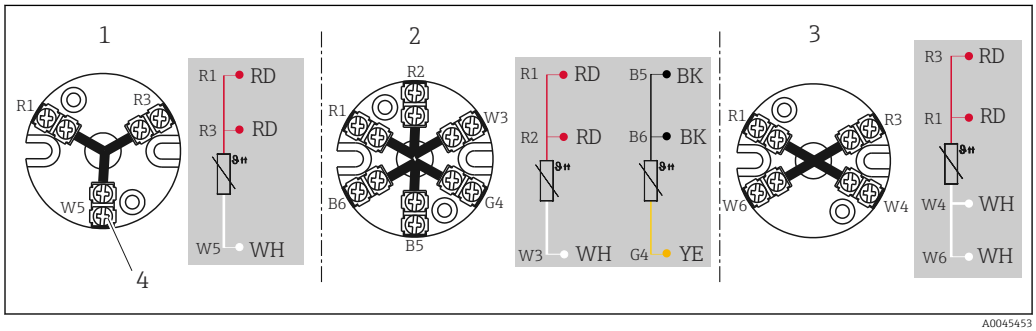
Advantages of the iTEMP transmitters:
- Dual or single sensor input (optionally for certain transmitters)
- Pluggable display (optionally for certain transmitters)
- Unsurpassed reliability, accuracy and long-term stability in critical processes
- Mathematical functions
- Monitoring of the thermometer drift, sensor backup functionality, sensor diagnostic functions
- Sensor-transmitter matching for dual sensor input transmitters, based on Callendar/Van Dusen coefficients

Power supply

- Electrical connecting cables must be smooth, corrosion resistant, easy to be cleaned and inspected, robust against mechanical stresses, no-humidity sensitivity.
- Grounding or shielding connections are possible via ground terminals on the junction box.

Wiring diagrams

Type of sensor connection RTD



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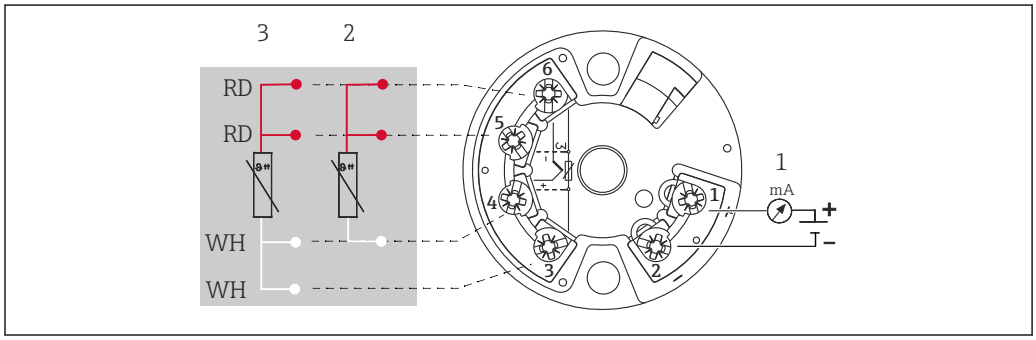
3 *Terminal block mounted*

1 *3-wire, single*
2 *2 x 3-wire, single*
3 *4-wire, single*
4 *Outside screw*



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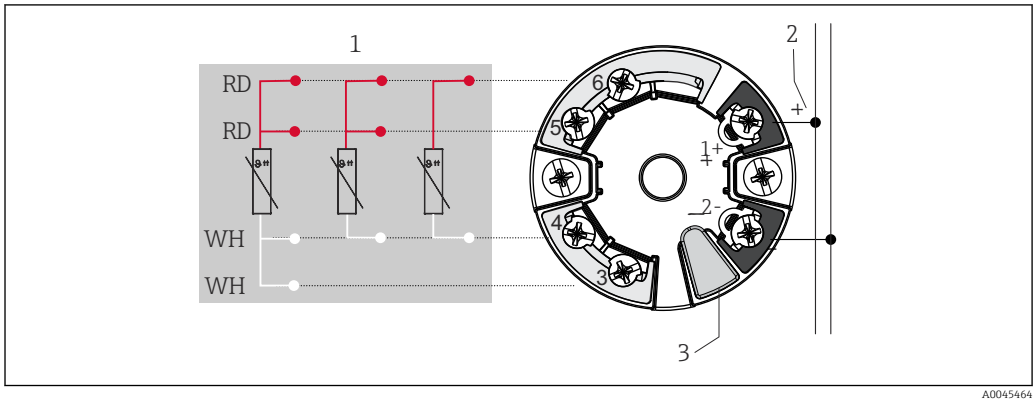
4 *Head mounted transmitter TMT18x (single sensor input)*

1 *Power supply, head transmitter and analog output 4 to 20 mA or fieldbus connection*
2 *RTD, 3-wire*
3 *RTD, 4-wire*

Only available with screw terminals



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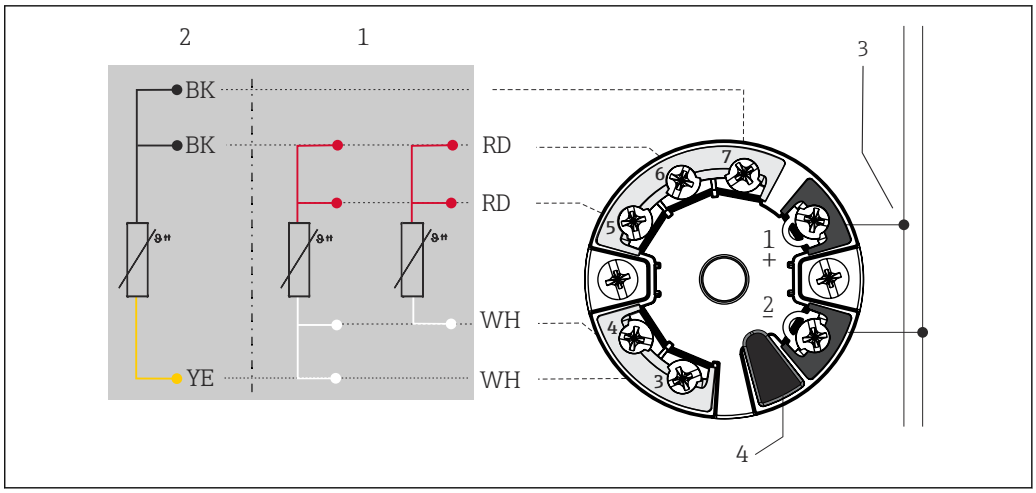
5 *Head mounted transmitter TMT7x or TMT31 (single sensor input)*

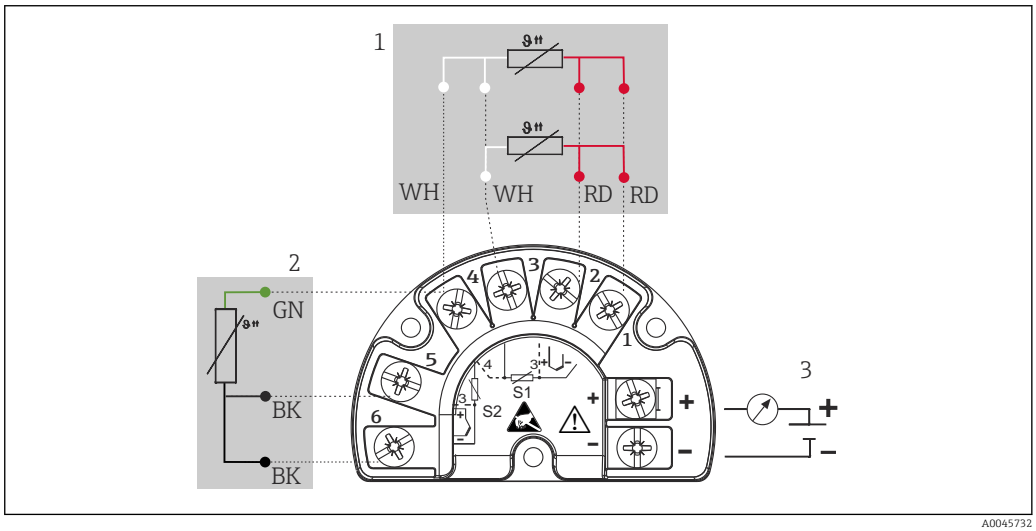
1 *Sensor input, RTD and Ω: 4-, 3- and 2-wire*
2 *Power supply or fieldbus connection*
3 *Display connection/CDI interface*



6 *Head mounted transmitter TMT8x (dual sensor input)*

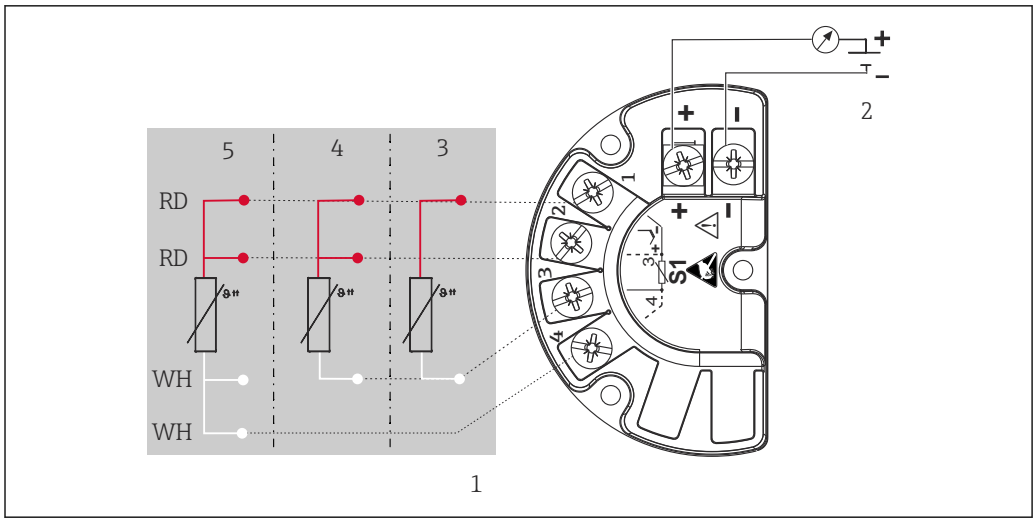
1 *Sensor input 1, RTD: 4- and 3-wire*
2 *Sensor input 2, RTD: 3-wire*
3 *Power supply or fieldbus connection*
4 *Display connection*

Mounted field transmitter: Fitted with screw terminals



7 *TMT162 (dual sensor input)*

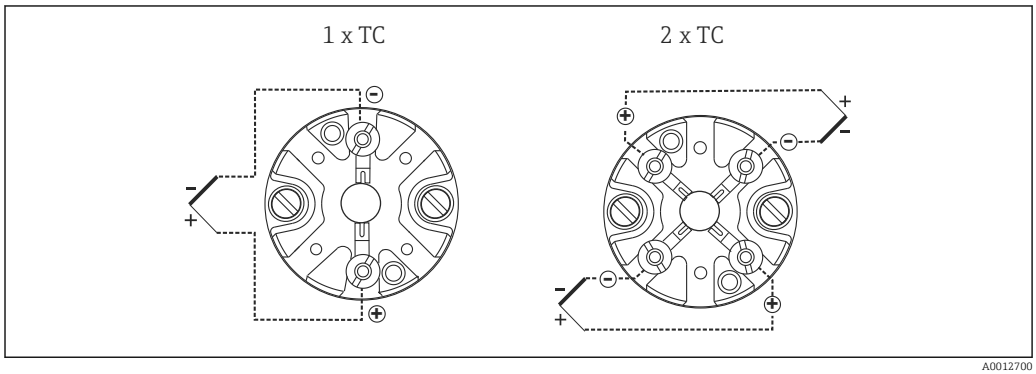
1 *Sensor input 1, RTD: 3- and 4-wire*
2 *Sensor input 2, RTD: 3-wire*
3 *Power supply, field transmitter and analog output 4 to 20 mA or fieldbus connection*



8 *TMT142B (single sensor input)*

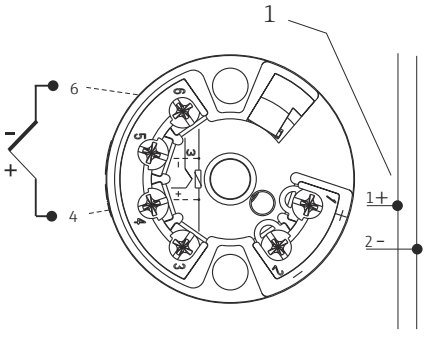
1 *Sensor input RTD*
2 *Power supply, field transmitter and analog output 4 to 20 mA, HART® signal*
3 *2-wire*
4 *3-wire*
5 *4-wire*

Type of sensor connection thermocouple (TC)



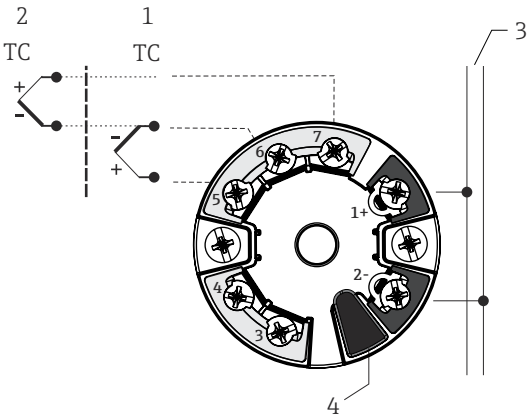
9 *Terminal block mounted*

Head mounted transmitter TMT18x (single sensor input) [1]



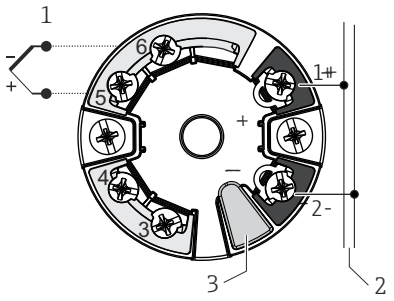
1 Power supply, head transmitter and analog output 4 to 20 mA or fieldbus communication

Head mounted transmitter TMT8x (dual sensor input) [2]



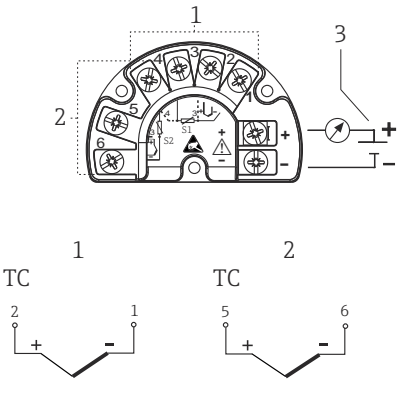
1 Sensor input 1
2 Sensor input 2
3 Fieldbus communication and power supply
4 Display connection

Head mounted transmitter TMT7x (single sensor input) [2]



1 Sensor input TC, mV
2 Power supply, bus connection
3 Display connection/CDI interface

Mounted field transmitter TMT162 or TMT142B [1]



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

1) Fitted with screw terminals
2) Fitted with spring terminals if screw terminals are not explicitly selected or a dual sensor is installed.

Thermocouple wire colors

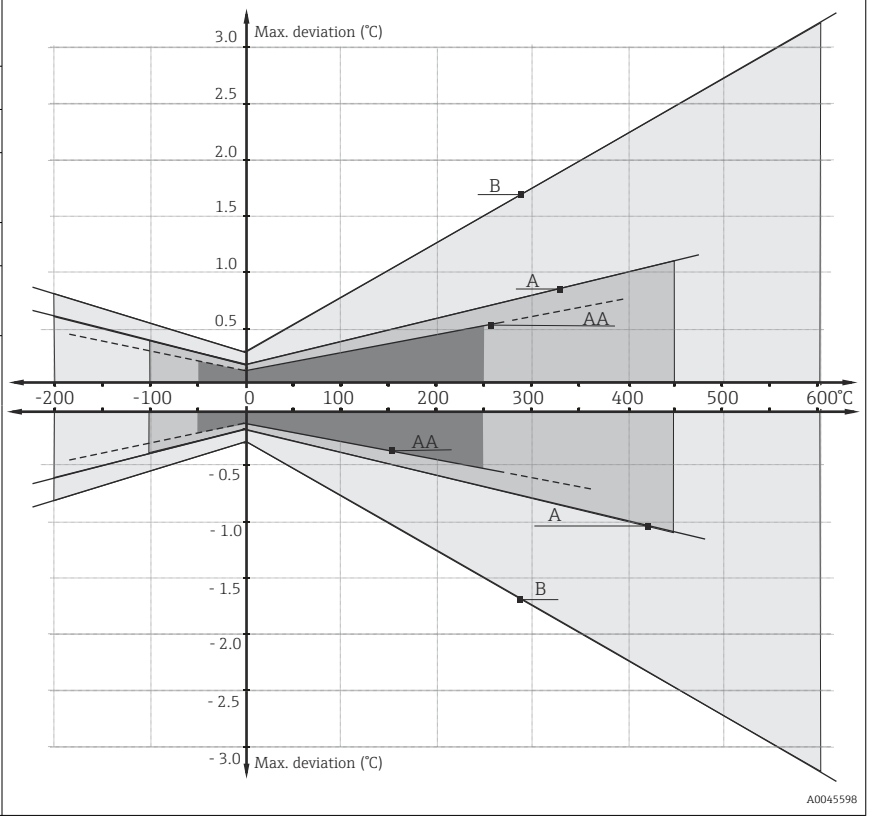
As per IEC 60584	As per ASTM E230
▪ Type J: black (+), white (-) ▪ Type K: green (+), white (-) ▪ Type N: pink (+), white (-) ▪ Type T: Brown (+), white (-)	▪ Type J: white (+), red (-) ▪ Type K: yellow (+), red (-) ▪ Type N: orange (+), red (-) ▪ Type T: Blue (+), red (-)

Performance characteristics

Accuracy RTD resistance thermometer as per IEC 60751

Class	Max. tolerances (°C)	
Cl. AA, former 1/3 Cl. B	± (0.1 + 0.0017 · |t| [1])	
Cl. A	± (0.15 + 0.002 · |t| [1])	
Cl. B	± (0.3 + 0.005 · |t| [1])	
Temperature ranges for compliance with the tolerance classes		
Wire wound sensor (WW):	Cl. A	Cl. AA
	– 100 to +450 °C	−50 to +250 °C
Thin-film version (TF):	Cl. A	Cl. AA
Standard	−30 to +300 °C	0 to +150 °C

Characteristics



1) |t| = absolute value °C

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

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

Standard	Type	Standard tolerance		Special tolerance	
IEC 60584		Class	Deviation	Class	Deviation
	J (Fe-CuNi)	2	±2.5 °C (−40 to 333 °C) ±0.0075 |t| [1] (333 to 750 °C)	1	±1.5 °C (−40 to 375 °C) ±0.004 |t| [1] (375 to 750 °C)
	K (NiCr-NiAl)	2	±2.5 °C (−40 to 333 °C) ±0.0075 |t| [1] (333 to 1200 °C)	1	±1.5 °C (−40 to 375 °C) ±0.004 |t| [1] (375 to 1000 °C)

1) |t| = absolute value °C

Standard	Type	Standard tolerance	Special tolerance
ASTM E230/ANSI MC96.1		Deviation, the larger respective value applies	
	J (Fe-CuNi)	±2.2 K or ±0.0075 |t| [1] (0 to 760 °C)	±1.1 K or ±0.004 |t| [1] (0 to 760 °C)
	K (NiCr-NiAl)	±2.2 K or ±0.02 |t| [1] (−200 to 0 °C) ±2.2 K or ±0.0075 |t| [1] (0 to 1260 °C)	±1.1 K or ±0.004 |t| [1] (0 to 1260 °C)

1) |t| = absolute value °C

Response time

Response time for the sensor assembly without transmitter. It refers to inserts in direct contact with process. When thermowells are selected specific evaluation should be done.

RTD

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

Insert diameter	Response time	
Mineral-insulated cable, 3 mm (0.12 in)	t_{50}	2 s
	t_{90}	5 s
RTD insert StrongSens, 6 mm (¼ in)	t_{50}	< 3.5 s
	t_{90}	< 10 s

Thermocouple (TC)

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

Insert diameter	Response time	
Grounded thermocouple: 3 mm (0.12 in), 2 mm (0.08 in)	t_{50}	0.8 s
	t_{90}	2 s
Ungrounded thermocouple: 3 mm (0.12 in), 2 mm (0.08 in)	t_{50}	1 s
	t_{90}	2.5 s
Grounded thermocouple 6 mm (¼ in)	t_{50}	2 s
	t_{90}	5 s
Ungrounded thermocouple 6 mm (¼ in)	t_{50}	2.5 s
	t_{90}	7 s

Cable probe diameter (ProfileSens)	Response time	
8 mm (0.31 in)	t_{50}	2.4 s
	t_{90}	6.2 s
9.5 mm (0.37 in)	t_{50}	2.8 s
	t_{90}	7.5 s
12.7 mm (½ in)	t_{50}	3.8 s
	t_{90}	10.6 s

Shock and vibration resistance

- RTD: 3G / 10 to 500 Hz according to IEC 60751
- RTD iTHERM StrongSens Pt100 (TF, vibration resistant): Up to 60G
- TC: 4G / 2 to 150 Hz according to IEC 60068-2-6

Calibration

Calibration is a service that can be performed on each individual insert, either in order phase, or after multipoint installation.

When calibration shall be performed once the multipoint is installed, please contact the Endress+Hauser service to get full support. Together with the Endress +Hauser service any further activity can be organised to achieve the calibration of the target sensor. In any case it is forbidden to unscrew any threaded component on the process connection under operating conditions = running process.

Calibration involves comparing the measured values of the sensing elements of the multipoint inserts (DUT device under test) with those of a more precise calibration standard using a defined and

reproducible measurement method. The aim is to determine the deviation of the DUT measured values from the true value of the measured variable.

In case of multipoint cable sensor, temperature controlled calibration baths from −80 to 550 °C (−112 to 1022 °F) can be used only for the last measuring point (when NL-L_{MPx} < 100 mm (3.94 in)) for either factory calibration or accredited calibration. Special bore through calibration furnaces with homogeneous distribution of temperature are used for thermometer factory calibration along the length: 200 to 550 °C (392 to 1022 °F)

Two different methods are used for the inserts:
- Calibration at fixed-point temperatures, e.g. at the freezing point of water at 0 °C (32 °F).
- Calibration compared against a precise reference thermometer.

Evaluation of inserts

If a calibration with an acceptable uncertainty of measurement and transferable measurement results is not possible, Endress+Hauser offers an insert evaluation measurement service, if technically feasible.

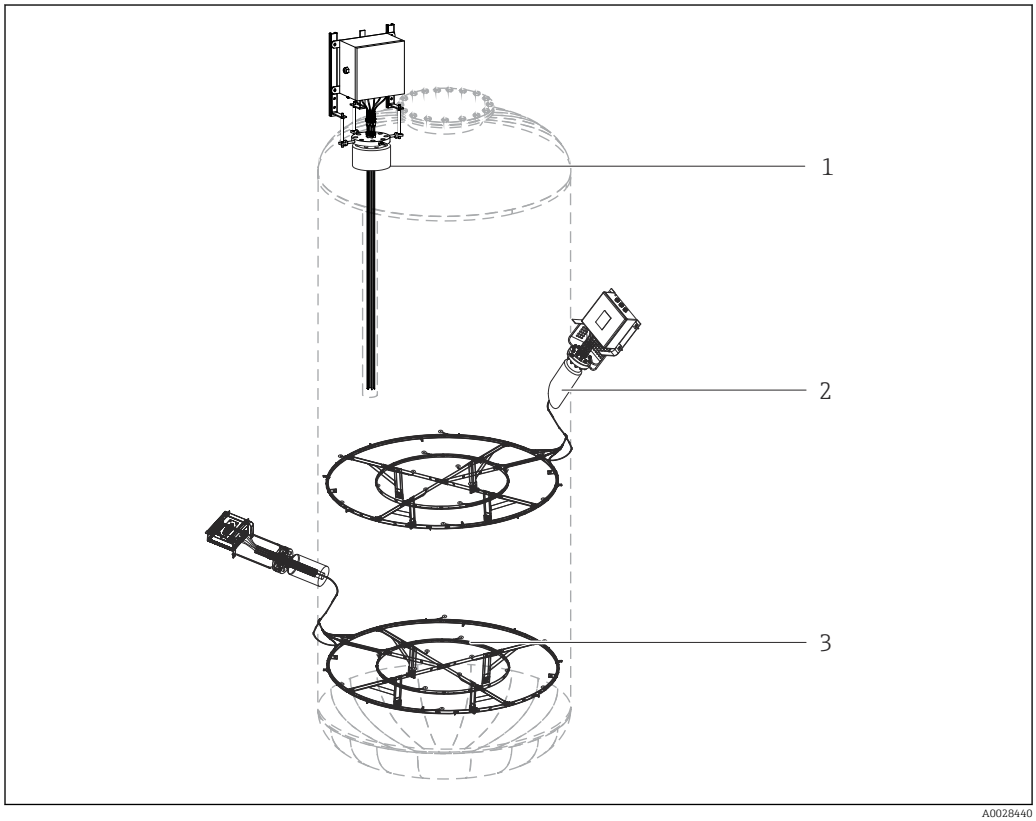
Installation

Mounting location

The installation location must meet the requirements listed in this documentation, such as ambient temperature, protection classification, climatic class, etc.. Care should be taken when checking the sizes of possible existing support frames or brackets welded on the reactor's wall (usually not included in the scope of delivery) or of any other existing frame in the installation area.

Orientation

No restrictions. The multipoint thermometer can be installed either in horizontal, oblique or in vertical configuration, related to the reactor or vessel vertical axis.



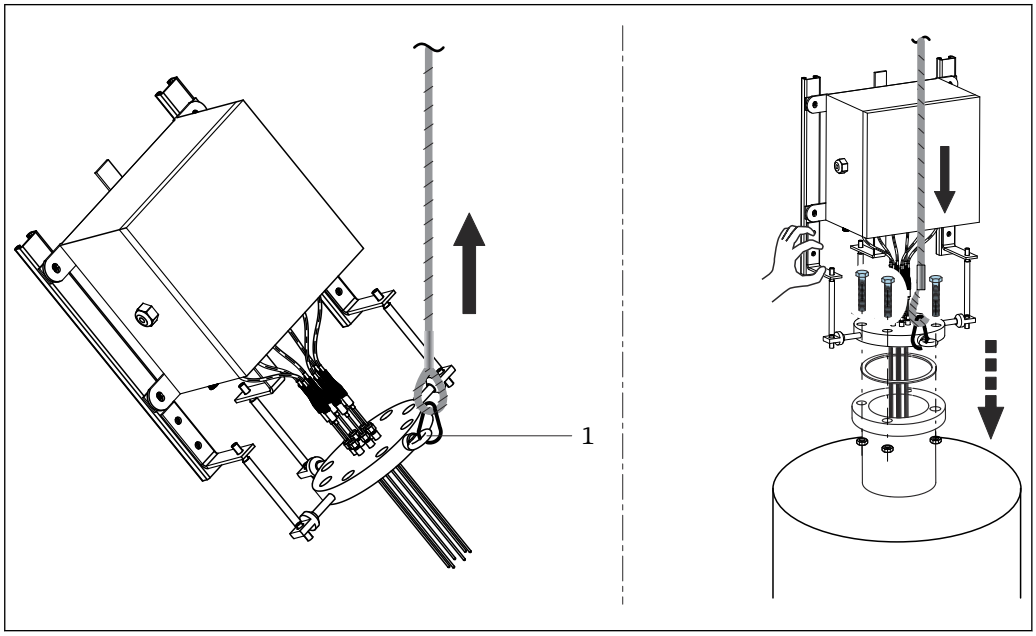
10 Installation examples - no restrictions to the installation orientation

1 Vertical installation with linear configuration
2 Oblique installation with 3D distribution configuration
3 Horizontal installation with 3D distriburtion configuration

Installation instructions

The modular multipoint thermometer is designed to be installed with a flanged process connection into a vessel, reactor, tank or similar environment. All parts and components have to be handled with care. During the installation phase, lifting and introduction of the equipment through the preset nozzle, the following must be avoided:

- Misalignment with the nozzle axis.
- Any load on the welded or threaded parts due to the action of the weight of the device.
- Deformation or crushing of the threaded components, bolts, nuts, cable glands and compression fittings.
- Bending radius of the thermowells smaller than 20 times the diameter of the thermowell.
- Friction between the temperature probes and the internals of the reactor.
- Fixing the temperature probes to the reactor's infrastructures without allowing axial displacements or movements.
- A bending radius of the sheathed cable (inserts) smaller than 5 times the outer diameter of the sheathed cable.



11 Multipoint thermometer installation in a reactor nozzle via flange process connection.

During installation the whole thermometer must only be lifted and moved by using ropes properly mounted on the eyebolt of the flange (1).

Environment

Ambient temperature range

Junction box	Non-hazardous area	Hazardous area
Without mounted transmitter	−40 to +85 °C (−40 to +185 °F)	−40 to +60 °C (−40 to +140 °F)
With mounted head transmitter	−40 to +85 °C (−40 to +185 °F)	Depends on the respective hazardous area approval. Details see Ex documentation.

Storage temperature

Junction box	
With head transmitter	−40 to +95 °C (−40 to +203 °F)
With DIN rail transmitter	−40 to +95 °C (−40 to +203 °F)

Humidity

Condensation according to IEC 60068-2-14:
- Head transmitter: Permitted
- DIN rail transmitter: Not permitted

Maximum relative humidity: 95% according to IEC 60068-2-30

Climate class

Determined when the following components are installed into the junction box:
- Head transmitter: Class C1 according to EN 60654-1
- Multi-channel transmitter: Tested as per IEC 60068-2-30, meets the requirements regarding class C1-C3 in accordance with IEC 60721-4-3
- Terminal blocks: Class B2 according to EN 60654-1

Degree of protection

- Specification for conduit: IP68
- Specification for the junction box: IP66/67

Electromagnetic compatibility (EMC)

Depending on the transmitter used. For detailed information see the related Technical Information, listed at the end of this document.

Process

The process temperature and process pressure are the minimum input parameters for the selection of the right product configuration. If special product features are requested, additional data such as process fluid type, phases, concentration, viscosity, stream and turbulences, corrosion rate have to be considered as mandatory for the whole product definition.

Process temperature range

Up to +1 150 °C (+2 102 °F).

Process pressure range

0 to 100 bar (0 to 1 450 psi)

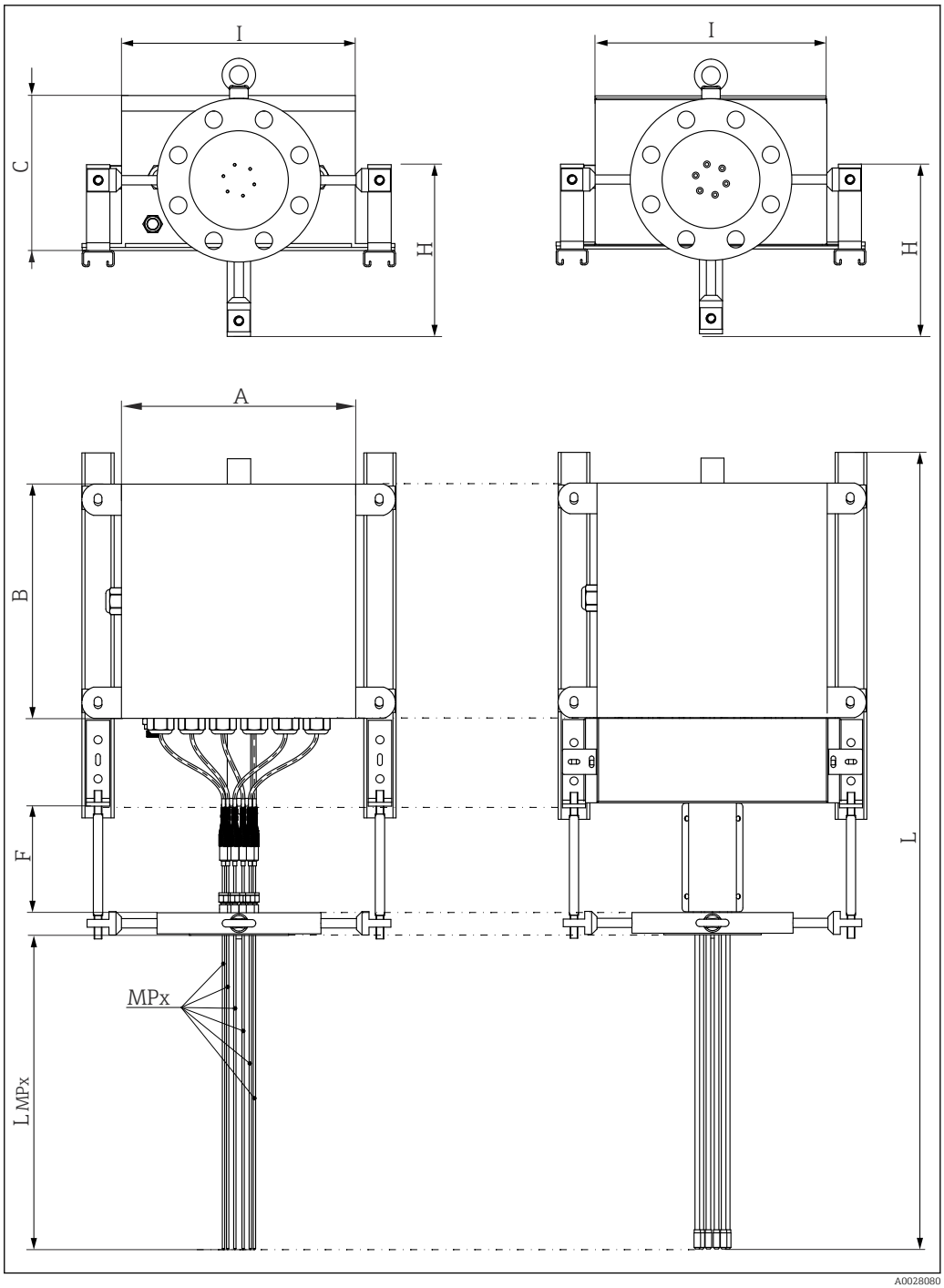
Anyhow, the maximum required process pressure has to be combined with the maximum design process temperature. Process connections like compression fittings, flanges with their specific ratings, thermowells, selected according to the plant requirements, define the maximum process conditions at which the device has to operate. Endress+Hauser experts can support the customer on any related questions.

Process applications:
- Olefins
- Ethylene
- Propylene
- Aromatics
- Benzene
- N-based inorganics
- Ammonia
- Urea
- NGTL
- Distillation units and hydrogenation

Mechanical construction

Design, dimensions

The overall multipoint assembly is composed of different sub-assemblies. Both linear and 3D configurations have the same features, dimensions and materials. Different inserts are available, based upon specific process conditions, in order to have the highest accuracy and an extended lifetime. In addition, protecting thermowells can be selected to further increase mechanical performances and corrosion resistance, and to allow insert replacement. Associated shielded extension cables are provided with high resistance sheath materials to withstand different environmental conditions and to ensure steady and noiseless signals. The transition between the inserts and the extension cable is obtained by the usage of specially sealed bushings, ensuring the declared IP degree protection.



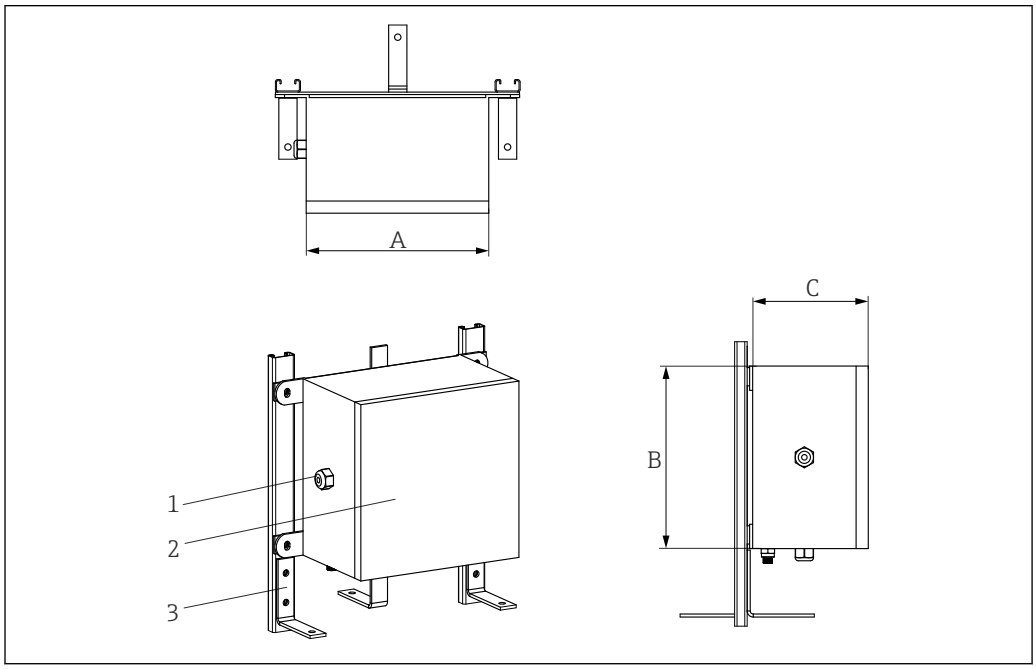
12 *Design of the modular multipoint thermometer, with frame neck on the left side or with frame neck and covers on the right side. All dimensions in mm (in)*

A, B, Dimensions of the junction box, see following figure
C
MPx Numbers and distribution of measuring points: MP1, MP2, MP3 etc.
L_{MPx} Different immersion length of sensing elements or thermowells
I, H Encumbrance of the junction box and support system
F Extension neck length
L Overall device length

Extension neck F in mm (in)
Standard 250 (9.84) Specifically customized extension necks are available on request.

Immersion lengths MPx of sensing elements/thermowells:
Based on customer requirements

Junction box



1 Cable gland
2 Junction box
3 Frame

The junction box is suited for chemical agents environments. Sea water corrosion resistance and extreme temperature variation stability is guaranteed. Ex e/Ex i terminals can be installed.

The multipoint thermometer can be provided of both ground terminals or shield terminals. Please follow your plant guidelines for a proper cables connection.

Possible junction box dimensions (A x B x C) in mm (in):

		A	B	C
Stainless Steel	Min.	170 (6.7)	170 (6.7)	130 (5.1)
	Max.	500 (19.7)	500 (19.7)	240 (9.5)
Aluminium	Min.	100 (3.9)	150 (5.9)	80 (3.2)
	Max.	330 (13)	500 (19.7)	180 (7.1)

Type of specification	Junction box	Cable glands
Material	AISI 316	NiCr Plated brass AISI 316 / 316L
Ingress protection (IP)	IP66/67	IP66
Ambient temperature range (ATEX)	−55 to +110 °C (−67 to +230 °F)	
Approvals	ATEX, IECEx, UL, CSA, EAC approval for use in hazardous area	

Type of specification	Junction box	Cable glands
Marking	▪ ATEX II 2GD Ex e IIC T6/T5/T4 Gb Ex ia IIC T6/T5/T4 Ga Ex tb IIIC T85°C/T100°C/ T135°C Db IP66 ▪ IECEx Ex e IIC T6/T5/T4 Gb/ Ex ia IIC T6/T5/T4 Ga Ex tb IIIC T85°C/T100°C/ T135°C Db IP66 ▪ UL913 Class I, Zone 1, AEx e IIC; Zone 21, AEx tb IIIC IP66 ▪ CSA C22.2 No.157 Class I, Zone 1 Ex e IIC; Class II, Groups E, F and G	According to the junction box approval
Cover	Hinged	-
Maximum sealing diameter	-	6 to 12 mm (0.24 to 0.47 in)

Neck extension

The neck extension ensures the connection between the flange and the junction box. The design has been developed to ensure several mounting layouts to deal with possible obstacles and constraints that can be met in any plant such as the reactor's infrastructure (step ways, loading structures, supporting skirts, stairs, etc.) and reactor thermal insulation. The neck extension design ensures easy access for monitoring and maintaining inserts and extension cables. It guarantees a high stiffness connection for the junction box and vibration loads. No closed volumes are present in the neck extension. This avoids the accumulation of waste and potentially dangerous fluids coming from the environment that can damage the instrumentation allowing continuous ventilation.

Insert and thermowells

Different insert and thermowell types are available. For any different requirement that is not described here, please contact the Endress+Hauser sales department.

In case of multipoint cable insert (ProfileSens), see Technical Information TI01346T

Thermocouple

Diameter in mm (in)	Type	Standard	Hot junction type	Sheath material
6 (0.24) 4.5 (0.18) 3 (0.12) 2 (0.08) 1.5 (0.06)	1x type K 2x type K 1x type J 2x type J 1x type N 2x type N 1x type T 2x type T	IEC 60584 /ASTM E230	Grounded/Ungrounded	Alloy600 / AISI 316L / Pyrosil

RTD

Diameter in mm (in)	Type	Standard	Sheath material
3 (0.12) 6 (¼)	1x Pt100 WW 2x Pt100 WW 1x Pt100 TF 2x Pt100 TF	IEC 60751	AISI 316L

Thermowells

External diameter in mm (in)	Sheath material	Type	Thickness in mm (in)
6 (0.24)	AISI 316/316L AISI 316Ti AISI 321 AISI 347 Alloy 600	closed or open	1 (0.04) or 1.5 (0.06)
8 (0.32)	AISI 316/316L AISI 316Ti AISI 321 AISI 347 Alloy 600	closed or open	1 (0.04) or 1.5 (0.06) or 2 (0.08)
10.2 (⅛)	AISI 316/316L AISI 316Ti AISI 321 AISI 347 Alloy 600	closed or open	1.73 (0.068)

Weight

The weight can vary depending on the configuration: Dimension and content of the junction box, neck length, dimensions of process connection and the number of inserts. The approximate weight of a typically configured multipoint thermometer (number of inserts = 12, flange size = 3", medium size junction box) = 40 kg (88 lb)

Materials

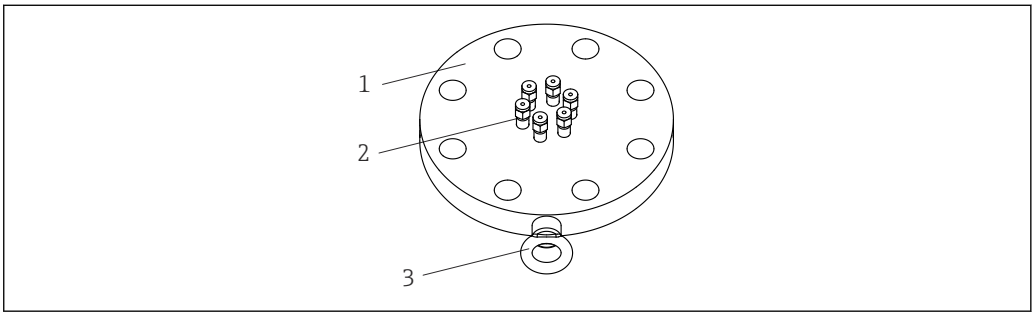
It refers to insert sheath, neck extension, junction box and all wetted parts.

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

Material name	Short form	Recommended max. temperature for continuous use in air	Properties
AISI 316/1.4401	X5CrNiMo 17-12-2	650 °C (1202 °F)	▪ 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)	▪ 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	1 100 °C (2 012 °F)	▪ 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

Material name	Short form	Recommended max. temperature for continuous use in air	Properties
AISI 304/1.4301	X5CrNi18-10	850 °C (1562 °F)	▪ Austenitic, stainless steel ▪ Well usable in water and lowly pollute waste water ▪ Only at relatively low temperatures resistant to organic acids, saline solutions, sulphates, alkaline solutions, etc.
AISI 304L/ 1.4307	X2CrNi18-9	850 °C (1562 °F)	▪ Good welding properties ▪ Impervious to intergranular corrosion ▪ High ductility, excellent drawing, forming, and spinning properties
AISI 316Ti/ 1.4571	X6CrNiMoTi17-12-2	700 °C (1292 °F)	▪ Addition of titanium means increased resistance to intergranular corrosion even after welding ▪ Broad range of uses in the chemical, petrochemical and oil industries as well as in coal chemistry ▪ Can only be polished to a limited extent, titanium streaks can form
AISI 321/1.4541	X6CrNiTi18-10	815 °C (1499 °F)	▪ Austenitic stainless steel ▪ High resistance to intergranular corrosion even after welding ▪ Good welding characteristics, suitable to all standard welding methods ▪ It is used in many sectors of the chemical industry, petrochemical, and pressurized vessels
AISI 347/1.4550	X6CrNiNb10-10	800 °C (1472 °F)	▪ Austenitic stainless steel ▪ Good resistance to a wide variety of environments in the chemical, textile, oil-refining, dairy and food industries ▪ Added niobium makes this steel impervious to intergranular corrosion ▪ Good weldability ▪ Main applications are furnace fire walls, pressure vessels, welded structures, turbine blades

Process connection



13 Flange as process connection

1 Flange
2 Compression fittings
3 Eyebolt

Standard process connection flanges are designed according to the following standards:

Standard [1]	Size	Rating	Material
ASME	1½", 2", 3", 4", 6", 8"	150#, 300#, 400#, 600#	AISI 316, 316L, 304, 304L, 316Ti, 321, 347
EN	DN40, DN50, DN80, DN100, DN150, DN200	PN10,PN16, PN25, PN40, PN63, PN100	

1) Flanges according to GOST standard are available on request.

Compression fittings

The compression fittings are welded or threaded into the flange to ensure tightness to the process connection. Dimensions are coherent with the insert dimensions. Compression fittings comply with the highest standards of reliability in terms of materials and performances required.

Material	AISI 316/316H

Operability

For details of operability, see the Technical Information of the Endress+Hauser temperature transmitters or the manuals of the related operating software. → 🖹 29

Certificates and approvals

CE Mark	The complete assembly is provided with individual components CE marked, to ensure safe use in hazardous areas and pressurized environments.
Hazardous area approvals	The Ex approval applies to individual components like junction box, cable glands, terminals. For further details on the available Ex versions (ATEX, UL, CSA, IECEx, NEPSI, EAC Ex), please contact your nearest Endress+Hauser sales organization. All relevant data for hazardous areas can be found in separate Ex documentation. ATEX Ex ia inserts are available only for diameters ≥ 1.5 mm (0.6 in). For further details contact an Endress+Hauser technician.
Certification HART	The HART® temperature transmitter is registered by the FieldComm Group. The device meets the requirements of the HART® Communication Protocol Specifications.
Certification FOUNDATION Fieldbus	The FOUNDATION Fieldbus™ temperature transmitter has successfully passed all test procedures and is certified and registered by the Fieldbus Foundation. The device thus meets all the requirements of the following specification: ▪ Certified according to FOUNDATION Fieldbus™ specification ▪ FOUNDATION Fieldbus™ H1 ▪ Interoperability Test Kit (ITK), up to date revision status (device certification no. available on request): the device can also be operated with certified devices of other manufacturers ▪ Physical layer conformance test of the FOUNDATION Fieldbus™
Certification PROFIBUS® PA	The PROFIBUS® PA temperature transmitter is certified and registered by the PNO (PROFIBUS® Nutzerorganisation e. V.), PROFIBUS user organization. The device meets all the requirements of the following specifications: ▪ Certified according to FOUNDATION Fieldbus™ specification ▪ Certified in accordance with PROFIBUS® PA Profile (the up to date profile version is available on request) ▪ The device can also be operated with certified devices of other manufacturers (interoperability)
Other standards and guidelines	▪ EN 60079: ATEX certification for hazardous areas ▪ IEC 60079: IECEx certification for hazardous areas ▪ IEC 60529: Degree of protection of housing (IP code) ▪ IEC 60584 and ASTM E230/ANSI MC96.1: Thermocouples
Material certification	The material certificate 3.1 (according to EN 10204) can be requested separately. The certificate includes a declaration related to the materials used to produce the thermometer. It guarantees the traceability of the materials through the identification number of the multipoint thermometer.
Test report and calibration	The "Factory calibration" is carried out according to an internal procedure in a laboratory of Endress +Hauser accredited by the European Accreditation Organization (EA) to ISO/IEC 17025. A calibration which is performed according to EA guidelines (LAT/Accredia) or (DKD/DAkkS) may be requested separately. The calibration is performed on the inserts of the multipoint.
Material requirements	Endress+Hauser can supply components according to AD 2000 W2 And W10 standards.
Welding requirements	Endress+Hauser has been audited according to DIN EN ISO 3834-2:2005.
Pressure equipment requirements	Endress+Hauser can supply devices according to 2014/68/EU.

Ordering information

Overview of the scope of delivery see the configuration table below.

Detailed ordering information is available from your Endress+Hauser Sales Center:
www.addresses.endress.com

Process connection: Flange		
Standard	▪ ASME B16.5 ▪ EN 1092-1 Others on request	☐ ☐
Material	316 + 316L, 316Ti, 304, 304L, 321, 347 Others on request	_____
Face	▪ RF ▪ RTJ Others on request	☐ ☐
Size	▪ 1½", 2", 3", 4", 6", 8" ▪ DN40, DN50, DN80, DN100, DN150, DN200 Others on request	_____ _____

The values reported in the table below are indicative, based on calculations for nozzles with standard dimensions. So the maximum number of measurement points can differ from the maximum number of the configuration table. It depends on the dimensions of the nozzle used on location.

Flange size (considering a schedule 40 nozzle)	**Maximum number of thermowells with insert-Ø:1.5 mm (0.06 in) or 2 mm (0.08 in)**			**Maximum number of inserts**				
	Thermowell diameter			**Inserts diameter**				
	10.24 mm (⅛ in)	**6 mm (0.24 in)**	**8 mm (0.32 in)**	**3 mm (0.12 in)**	**4.5 mm (0.18 in)**	**4.8 mm (0.19 in)**	**6 mm (0.24 in)**	**ProfileSens 8 mm (0.31 in), 9.5 mm (0.37 in) or 12.7 mm (½ in)**
1½"	3			3				1
2"	5			5				1
3"	8			8				2
4"	16			16				4
6"	30			30				11
8"	48			48				20

Insert, sensor		
Measuring principle	▪ Thermocouple (TC) ▪ Resistance Temperature Detection (RTD) ▪ Multipoint cable sensor ProfileSens (TC)	☐ ☐ ☐
Type	TC: J, K, N, T RTD: Pt100	_____
Design	▪ TC: Single, duplex ▪ RTD: 3-wire, 4-wire, 2x3-wire	☐ ☐
Execution	▪ TC: Grounded, Ungrounded ▪ RTD: Wire wound (WW); Thin film (TF)	☐ ☐
Sheath material	316L, Alloy 600, Pyrosil®	_____
Approvals	▪ Intrinsic safety ▪ Non hazardous	_____

Insert, sensor		
Insert diameter	▪ 1.5 mm (0.06 in) ▪ 2 mm (0.08 in) ▪ 3 mm (0.12 in) ▪ 4.5 mm (0.18 in) ▪ 4.8 mm (0.19 in) ▪ 6 mm (0.24 in) ▪ ProfileSens 8 mm (0.31 in) ▪ ProfileSens 9.5 mm (0.37 in) ▪ ProfileSens 12.7 mm (½ in) Others on request	☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐
Standard/Class	IEC/Class 1 for TC ASTM/Class special for TC IEC/Class A for RTD IEC/Class AA for RTD Others on request	_____

Measurement point distribution		
Positioning	▪ Equi spaced ▪ Customized	☐ ☐
Number	2, 4, 6, 8, 10, 12 ... 48 [1]	_____

Insertion length [2]	TAG (description)	(L_{MPx}) in mm (in)
MP_1	_____	_____
MP_2	_____	_____
MP_3	_____	_____
MP_4	_____	_____
MP_5	_____	_____
MP_6	_____	_____
MP_x	_____	_____

1) Different numbers/configurations are available on request
2) If the multipoint cable insert (ProfileSens) will be used, refer to TI01346T

Junction box (head)		
Material	▪ Stainless steel (standard) ▪ Aluminum (to be specified) Others on request	☐ ☐
Electrical connection	Terminal block wiring: ▪ Terminal block - standard/number ▪ Terminal block - compensated/number ▪ Terminal block - spare/number Transmitter wiring: ▪ HART protocol, e. g.: TMT182, TMT82 ▪ PROFIBUS PA protocol, e. g.: TMT84 ▪ FOUNDATION Fieldbus protocol, e. g.: TMT85, TMT125 (multi-channel transmitter) ▪ Quantity	 ☐ / _____ ☐ / _____ ☐ / _____ ☐ ☐ ☐ _____
Approvals	Ex e / Ex ia / Ex d Others on request	_____
Cable entries (process side)	Single or multiple, type: M20, NPT ½", Quantity Others on request	_____ / _____ _____ / _____
Cable entries (user side)	Single or multiple, type: M20, M25, NPT ½", NPT 1" / Quantity Others on request	_____ / _____ _____ / _____

Extension neck		
Length F in mm (in)	250 mm (9.84 in) Or as specified	☐ _____

TAG		
Device information	Refer to customer specification As specified	☐ ☐ (table)
Measuring point information If the multipoint cable sensor (ProfileSens) will be used, multiple tagging along the probe will be provided.	Refer to customer specification Location, as specified: ▪ Tagging (TAG), on extension wires insert ▪ Tagging (TAG), RFID ▪ Tagging (TAG), on tip ▪ Tagging (TAG), on insert bushing ▪ Tagging (TAG), on device ▪ Tagging (TAG), by customer ▪ Tagging (TAG), on transmitter Special version, to be specified	☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

Additional requests		
Extension wire length, only for remote head	Specification in mm:	_____
Extension wires sheath material	▪ PVC ▪ HYFLON Others on request	☐ ☐
On-site existing thermowell	Yes No	☐ ☐

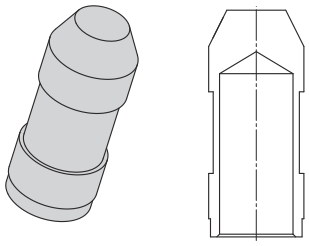
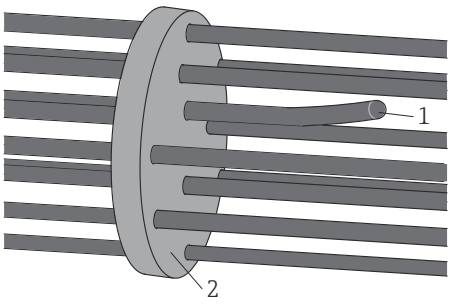
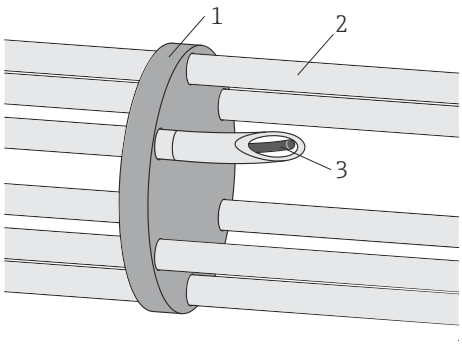
Test, Certificate, Declaration	
Inspection certificate 3.1, EN10204 (material certificate wetted parts) [1]	☐
Inspection certificate 3.1, short form, EN10204, (material certificate wetted parts)	☐
Internal pressure test according to Endress+Hauser procedure, test report (in case of thermowells)	☐
Internal helium leak test according to Endress+Hauser procedure, test report (in case of thermowells) [1]	☐
PMI test, Endress+Hauser procedure, (wetted parts), test report	☐
Final assembly functional test, test report [1]	☐
Final inspection report [1]	☐
External pressure test according to Endress+Hauser procedure, test report (max length 10 m)	☐
Routing design including 3D drawing [1]	☐
2D dimensional drawing	☐
Welding book (including welding map)	☐
Radiographic inspection certificate for thermowell welds	☐
Radiographic inspection certificate on hot junctions/tips for sensors [1]	☐
Manufacturer declaration	☐
Dye penetrant test, thermowell welding, test report	☐
Inspection test report (Sensor/TMT), inspection certificate [1]	☐
Quality control plan	☐

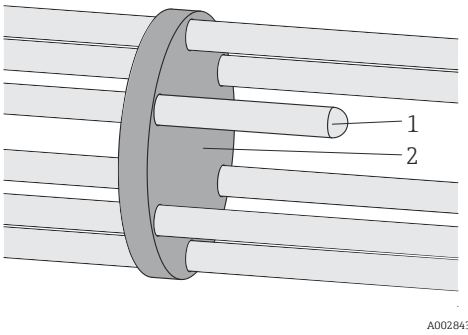
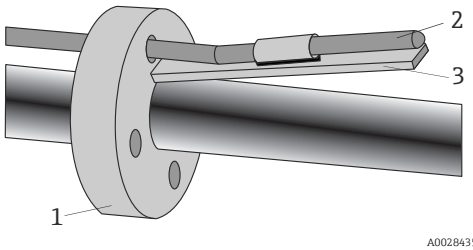
1) (recommended)

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 is available from your local Endress +Hauser sales center.

Device-specific accessories

Accessories	Description
Tip end  A0028427	Terminal closure welded at the tip end of the probe in order to protect the insert (or the thermowell) from aggressive process conditions and to facilitate its fixing by means of metallic tie wraps.
Thermal contact system	
Insert and spacers  A0033485 *1 Insert* *2 Spacer*	▪ Used on straight configurations and in case of an existing thermowell for axial centering of the insert bundle ▪ Prevent the twisting of the inserts ▪ Give flexural stiffness to the sensor bundle
Guiding tubes and spacers  A0028783 *1 Spacer* *2 Guiding tube* *3 Insert*	▪ Used on straight configurations and in case of an existing thermowell for axial centering of the insert bundle ▪ Give flexural stiffness to the sensor bundle ▪ Allow sensor replacement ▪ Guarantee thermal contact between the sensor tip and the existing thermowell ▪ Modular design [1)]

Accessories	Description
Thermowells and spacers  *1 Thermowell* *2 Spacer*	Used on straight configurations and existing thermowells Avoid twisting of sensor cables Give flexural stiffness to the sensor bundle Allows sensor replacement
Bimetallic stripes  *14 Bimetal strips with or without guiding tubes* *1 Spacer* *2 Guiding tube* *3 Bimetallic stripe*	▪ Used on straight configurations and inside existing thermowells ▪ Guarantee thermal contact between the sensor tip and the thermowell due to bimetallic stripes activated by temperature difference ▪ No friction during installation even with already installed sensors

1) Can be mounted in-house or on-site

Service-specific accessories

Accessories	Description
Applicator	Software for selecting and sizing Endress+Hauser measuring devices: ▪ Calculation of all the necessary data for identifying the optimum measuring device: e.g. pressure loss, accuracy or process connections. ▪ Graphic illustration of the calculation results Administration, documentation and access to all project-related data and parameters over the entire life cycle of a project. Applicator is available: Via the Internet: https://portal.endress.com/webapp/applicator

Accessories	Description
Configurator	Product Configurator - the tool for individual product configuration ▪ Up-to-the-minute configuration data ▪ Depending on the device: Direct input of measuring point-specific information such as measuring range or operating language ▪ Automatic verification of exclusion criteria ▪ Automatic creation of the order code and its breakdown in PDF or Excel output format ▪ Ability to order directly in the Endress+Hauser Online Shop The Configurator is available on the Endress+Hauser website at: www.endress.com -> Click "Corporate" -> Select your country -> Click "Products" -> Select the product using the filters and search field -> Open product page -> The "Configure" button to the right of the product image opens the Product Configurator.

FieldCare SFE500	FDT-based plant asset management tool from Endress+Hauser. It can configure all smart field units in your system and helps you manage them. By using the status information, it is also a simple but effective way of checking their status and condition. For details, see Operating Instructions BA00027S and BA00065S

DeviceCare SFE100	Configuration tool for devices via fieldbus protocols and Endress+Hauser service protocols. DeviceCare is the tool developed by Endress+Hauser for the configuration of Endress+Hauser devices. All smart devices in a plant can be configured via a point-to-point or point-to-bus connection. The user-friendly menus enable transparent and intuitive access to the field devices. For details, see Operating Instructions BA00027S

Accessories	Description
W@M	Life cycle management for your plant W@M offers assistance 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 information is available for every measuring device over the entire life cycle, such as the device status, device-specific documentation, spare parts etc. The application already contains the data of your Endress+Hauser device. Endress+Hauser also takes care of maintaining and updating the data records. W@M is available: Via the Internet: www.endress.com/lifecyclemanagement

Documentation

- Operating manuals iTEMP temperature transmitters:
  - TMT180, PC-programmable, single-channel, Pt100 (KA00118R)
  - HART® TMT82, two-channel, RTD, TC, Ω, mV (BA01028T)
  - PROFIBUS® PA TMT84, two-channel, RTD, TC, Ω, mV (BA00257R)
  - FOUNDATION Fieldbus™ TMT85, two-channel, RTD, TC, Ω, mV (BA00251R)
- Supplementary ATEX documentation:
  ATEX/IECEx (Ex ia IIC): XA01647T
- Technical Information of inserts:
  - Resistance thermometer insert Omnigrad T TST310 (TI00085T)
  - Thermocouple insert Omnigrad T TSC310 (TI00255T)
  - Multipoint temperature cable probe iTHERM ProfileSens TS901 (TI01346T)
- Technical Information application example:
  HAW562 surge arresters, (TI01012K)

www.addresses.endress.com

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