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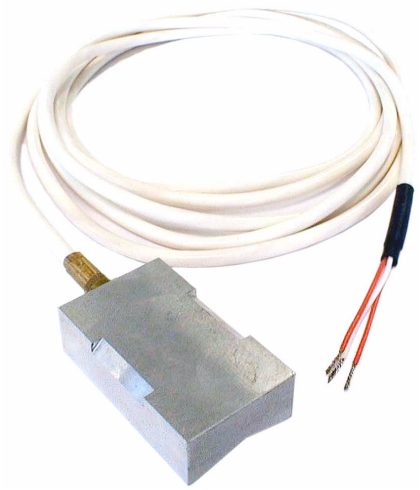
Technical Information
TST602

RTD assembly, surface sensor with connecting cable



Suitable for measuring the temperature of the surfaces of different pipe diameters or vessels

Application

The TST602 RTD assembly is used to measure the temperature of the surfaces of different pipes or vessels. It is usually attached to pipes with a hose clip.

- For universal use
- Measuring range: −20 to +200 °C (−4 to 392 °F)

Your benefits

- Easy installation without interrupting the process
- Easy retrofitting possible
- Suitable for pipes or even surfaces

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Function and system design

The thermometer consists of an aluminum block and the contact area is either flat or has a triangular recess to rest on pipes of various diameters. Single or double Pt100 sensors are embedded in the aluminum block; these sensor elements achieve accuracy class A or B in accordance with IEC 60751. 3- or 4-wires can be selected as the connection method. The connecting cable made from a variety of materials is available in different lengths.

The easy, quick and subsequent installation directly on a pipe or vessel wall, irrespective of the process connection, enables different applications, such as checks on existing devices or temporary temperature measurement without interrupting the process. It is particularly suitable for climate control and applications in production automation and heat exchangers.

Measuring principle

RTD assembly

These RTD assemblies 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 RTD assemblies:

- **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 RTD assemblies 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.

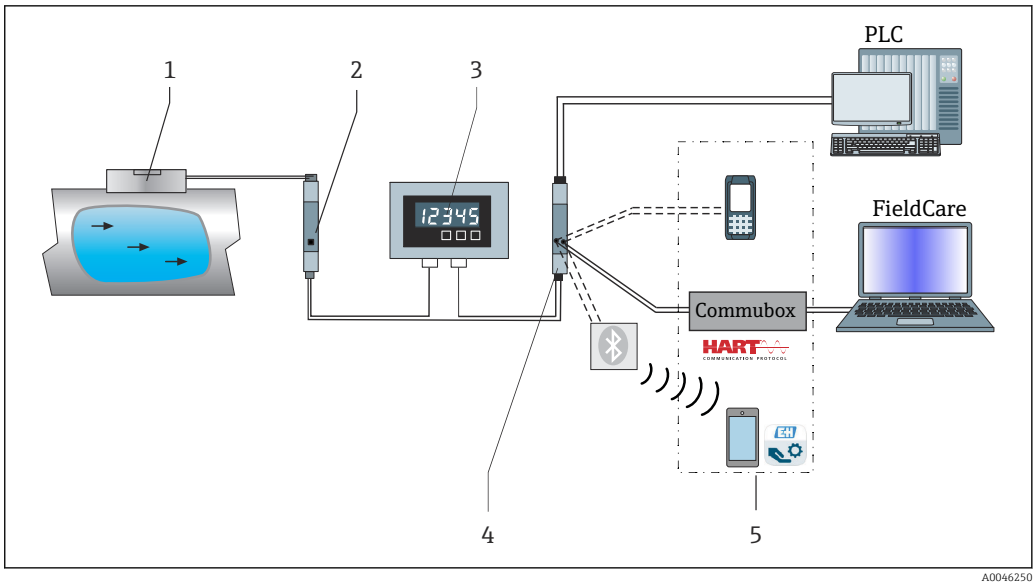
The primary advantages of thin film temperature sensors over wire wound versions are their smaller sizes and better vibration resistance. A relatively low principle-based deviation of the resistance/temperature characteristic from the standard characteristic of IEC 60751 can frequently be observed among TF sensors at high temperatures. As a result, the tight limit values of tolerance class A as per IEC 60751 can only be observed with TF sensors at temperatures up to approx. 300 °C (572 °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/barrier
- Display units
- Overvoltage protection

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



1 *Application example*

1 *RTD assembly for surface temperature measurement*
2 *iTEMP TMT7x temperature transmitter in DIN rail housing. The two-wire transmitter records the measuring signals of the thermometer and converts them to an analog 4 to 20 mA measuring signal. More information on this can be found in the Technical Information (see "Supplementary documentation").*
3 *RIA16 field indicator - The indicator records the analog measuring signal from the temperature transmitter and shows it 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 indicator is looped into the 4 to 20 mA circuit and gets the required energy from there. More information on this can be found in the Technical Information (see "Supplementary Documentation").*
4 *RN22 barrier - 1- or 2-channel barrier or signal doubler with transmission and galvanic isolation of analog 0/4 to 20 mA signals (optional intrinsically safe version [Ex-ia]), from the hazardous area. Supply of 2-wire transmitters, supply voltage > 16.5 V. More information on this can be found in the Technical Information (see "Supplementary documentation").*
5 *Communication examples: HART® Communicator (handheld terminal), FieldXpert, Commubox FXA195 for intrinsically safe HART® communication with FieldCare via the USB interface, Bluetooth® technology with SmartBlue App.*

Input

Measured variable

Temperature (temperature-linear transmission behavior)

Measuring range

Depends on the selected material of the connecting cable sheath, the wire insulation material and the application

Material (wire, sheath)	Maximum measuring range
PVC, PVC	−20 to +70 °C (−4 to +158 °F)
PTFE, silicone	−20 to +180 °C (−4 to +356 °F)
PTFE, PTFE	−20 to +200 °C (−4 to +392 °F)
Silicone, PTFE	−20 to +180 °C (−4 to +356 °F)

Output

Generally, the measured value can be transmitted in one of two ways:
- Sensors wired directly via flying leads - sensor measured values forwarded without a transmitter.
- Via all common protocols by selecting an appropriate Endress+Hauser iTEMP temperature transmitter.

Family of temperature transmitters

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

4 to 20 mA head transmitters
They offer a high degree of flexibility, thereby supporting universal application with low inventory storage. The iTEMP transmitters can be configured quickly and easily at a PC. Endress+Hauser offers free configuration software which can be downloaded from the Endress+Hauser Website. More information can be found in the Technical Information.

HART® head transmitters
The transmitter is a 2-wire device with one or two measuring inputs and one analog output. The device not only transfers converted signals from resistance thermometers and thermocouples, it also transfers resistance and voltage signals using HART® communication. Swift and easy operation, visualization and maintenance using universal device configuration tools like FieldCare, DeviceCare or FieldCommunicator 375/475. Integrated Bluetooth® interface for the wireless display of measured values and configuration via E+H SmartBlue (app), optional. 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.

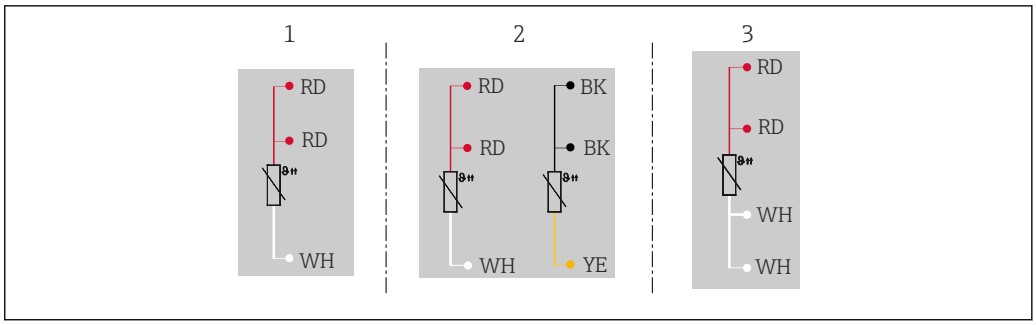
FOUNDATION Fieldbus™ head transmitters
Universally programmable head transmitter with FOUNDATION Fieldbus™ communication. Conversion of various input signals into digital output signals. High accuracy over the complete ambient temperature range. All transmitters are released for use in all important 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 connection

Type of sensor connection RTD



2 *Flying leads as connecting cables*

1 3-wire
2 2 x 3-wire
3 4-wire

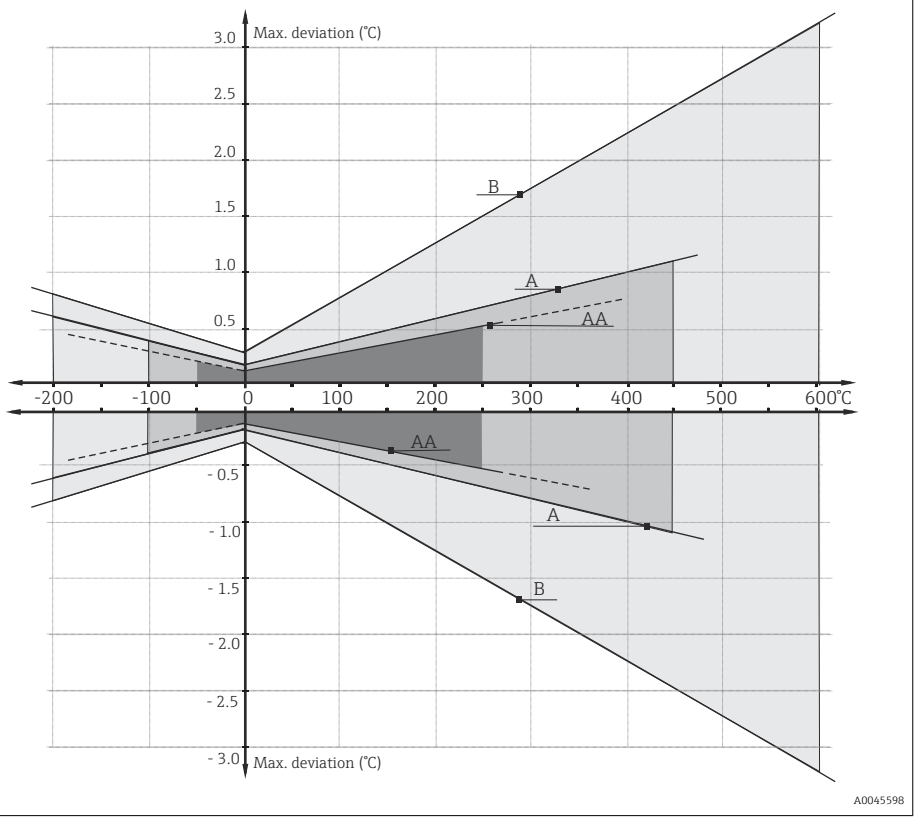
Cable specification

The sensor connection cables are fitted with ferrules. Different wire and cable sheath insulation can be selected depending on the application:

Wire insulation	Cable sheath insulation
PVC	PVC
PTFE	Silicone
PTFE	PTFE
Silicone	PTFE

Performance characteristics

RTD assembly as per IEC 60751

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

1) |t| = absolute temperature in °C

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

Temperature ranges

Sensor type	Operating temperature range	Class A	Class AA
Thin-film sensor (TF)	−50 to 400 °C (−58 to 752 °F)	−50 to 250 °C (−58 to 482 °F)	0 to 100 °C (32 to 212 °F)
Wire wound sensor (WW)	−200 to 600 °C (−328 to 1 112 °F)	−200 to 600 °C (−328 to 1 112 °F)	−50 to 250 °C (−58 to 482 °F)

The accuracy class is directly valid for the RTD sensor element and is of little relevance for the accuracy of the temperature measurement with the surface sensor. Surface sensors generally do not achieve the accuracy and response times expected from invasive sensors.

The accuracy of surface sensors depends greatly on the ambient conditions, e.g. temperature, humidity, wind, the thermal connection to the surface to be measured, and on the conditions in the pipe or tank (degree of filling, flow conditions, medium, etc.). Normally, insulating the measuring point to the environment is highly effective in improving the measurement result. Please contact the Endress+Hauser sales organization for any questions on the correct application of the surface sensor.

Self heating

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

Response time

The response time of surface sensors is greatly affected by the application conditions: e.g. temperature differences, wall thicknesses, process conditions, quality of thermal coupling. As no reference operating conditions are defined for this type of sensory mechanism, it is not possible to make a general statement on the response time.

Calibration

A calibration of the surface sensor is not recommended. The thermometer's immersion length to be calibrated in the calibration bath is only 55 mm (2.17 in). This does not suffice for a robust calibration. The temperature of the calibration bath is not stable enough in this range. The sensor is greatly affected by the ambient temperature via the connecting cables. The critical measured error comes from the application as a surface sensor. Calibrating by immersing the entire sensor is, however, of no significance in this regard.

Insulation resistance

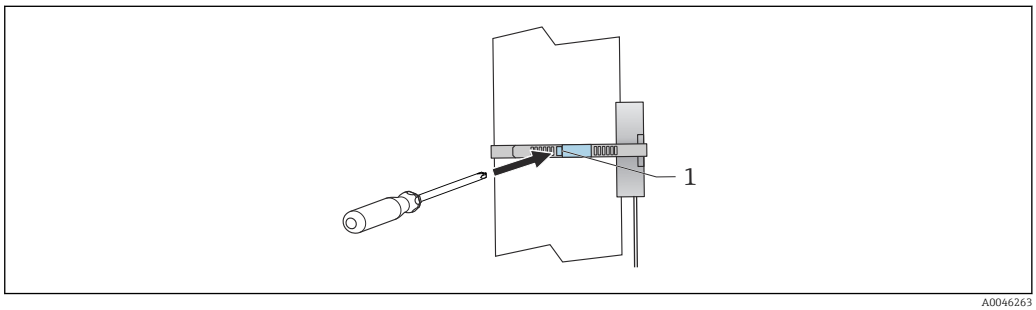
Insulation resistance between the terminals and the block, as per IEC 60751 > 100 MΩ at 25 °C, measured with a minimum testing voltage of 100 V DC

Installation

Orientation

No restrictions. If pipes are only partially filled, it can be useful to mount the sensor on the underside of the pipe.

Installation instructions



3 Installation of the surface sensor with a tightening band collar

1 Securely fasten the collar with a screwdriver

Environment

Ambient temperature range

Cable insulation material	Temperature range
PVC	−20 to +70 °C (−4 to +158 °F)
PTFE, silicone	−20 to +180 °C (−4 to +356 °F)
PTFE	−20 to +200 °C (−4 to +392 °F)

Storage temperature

For information, see the ambient temperature range.

Degree of protection

No degree of protection is defined due to the design.

Shock and vibration resistance

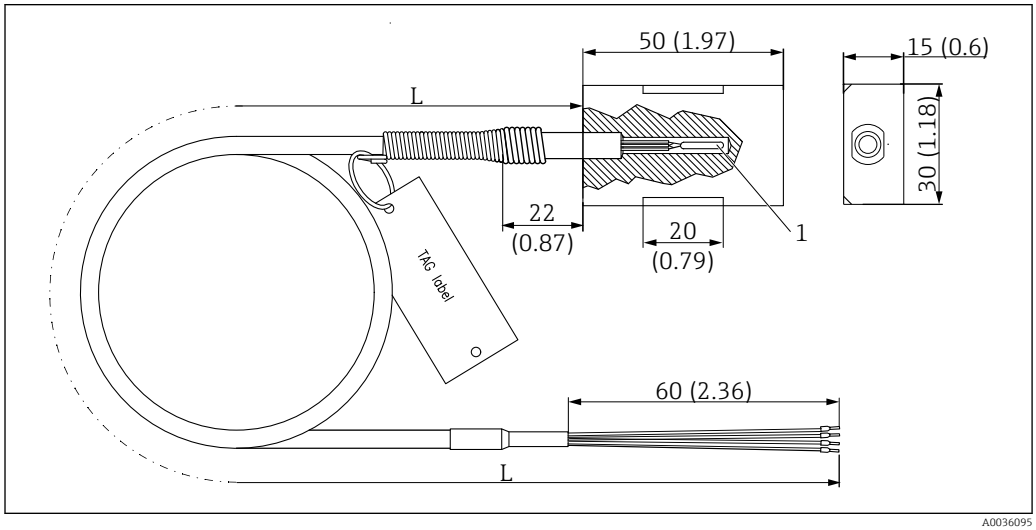
The Endress+Hauser temperature sensors exceed the requirements of IEC 60751 regarding shock and vibration resistance of 3g in the range from 10 to 500 Hz. The vibration resistance of the measuring point depends on the sensor type and design. See the following table:

Sensor type	Vibration resistance for the sensor tip
Pt100 (WW)	> 30 m/s² (3g)
Pt100 (TF), basic	

Mechanical construction

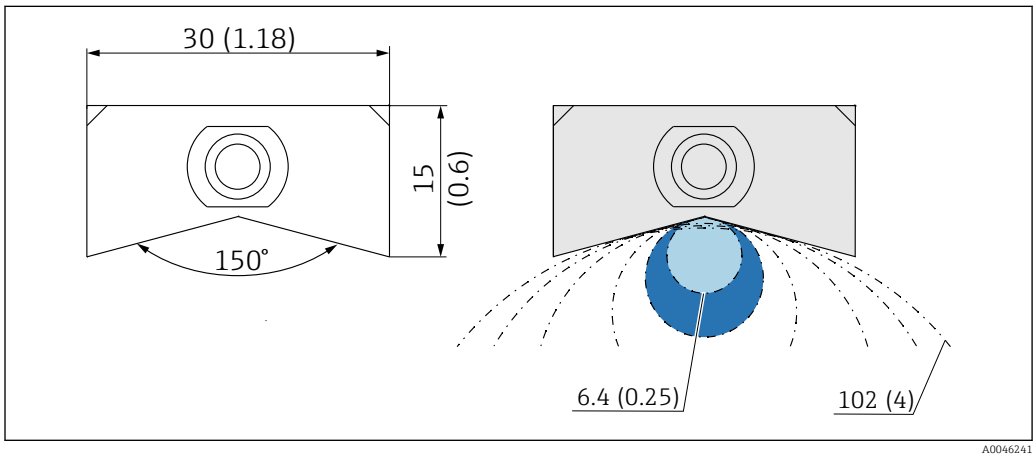
Design, dimensions

All dimensions in mm (in).



1 Installed RTD sensor in the measuring block
L Length of connecting cable - can be selected individually.

For installation on a pipe, the measuring block features a recess of 150° for better thermal coupling, suitable for pipe diameters of 6.4 to 102 mm (¼ to 4 in).



Weight

Depends on the version. Typical value: 150 g (0.33 lb) for version with 2 m (3.28 ft) cable length.

Material

Component	Material
Measuring block	Aluminum
Wire or cable sheath insulation	Can be combined depending on the application: ▪ PVC ▪ PTFE ▪ Silicone

Surface roughness

Standard surface of measuring block	$R_a \leq 1.6$ µm (63 µin)

Certificates and approvals

Current certificates and approvals for the product are available via the Product Configurator at www.endress.com.

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

The **Configuration** button opens the Product Configurator.

Ordering information

Detailed ordering information is available for your nearest sales organization www.addresses.endress.com or in the Product Configurator under www.endress.com :

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

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

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

Supplementary documentation

Technical Information for application example
- iTEMP TMT72 temperature transmitter; conversion of the sensor signal to a stable, standardized output signal in industrial temperature measurement (TI01392T)
- RN22; 1- or 2-channel active barrier for separation of 0/4 to 20 mA standard signal circuits, optionally available as a signal doubler, 24 V DC. HART-transparent (TI01515K)
- RIA16 process indicator; loop-powered indicator. Easy-to-read display of the 4 to 20 mA signal on site with a bar graph for a better process overview! (TI00144R)

www.addresses.endress.com

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