



Level



Pressure



Flow



Temperature

Liquid  
Analysis

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Systems  
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Solutions

## Technical Information

# Thermocouple TH53, TH54 and TH55

Thermocouple assemblies in Thermowells with spring loaded insert and enclosure for process industry



### Areas of application

The TH53, TH54 and TH55 temperature sensors are Thermocouple assemblies installed in Thermowells and designed for use in all types of process industries, including harsh environments, due to their rugged design. The sensor is made up of a Magnesium Oxide insulated thermocouple as a measurement probe and a thermowell made of bar-stock material.

The sensor assemblies can be used in process industries such as:

- Chemicals
- Petrochemicals
- Power plants
- Refineries
- Offshore Platforms

### Head transmitters

Instead of directly wiring your temperature sensors to your control system, use transmitters to reduce wiring and maintenance costs while increasing measurement accuracy.

### Field transmitters

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

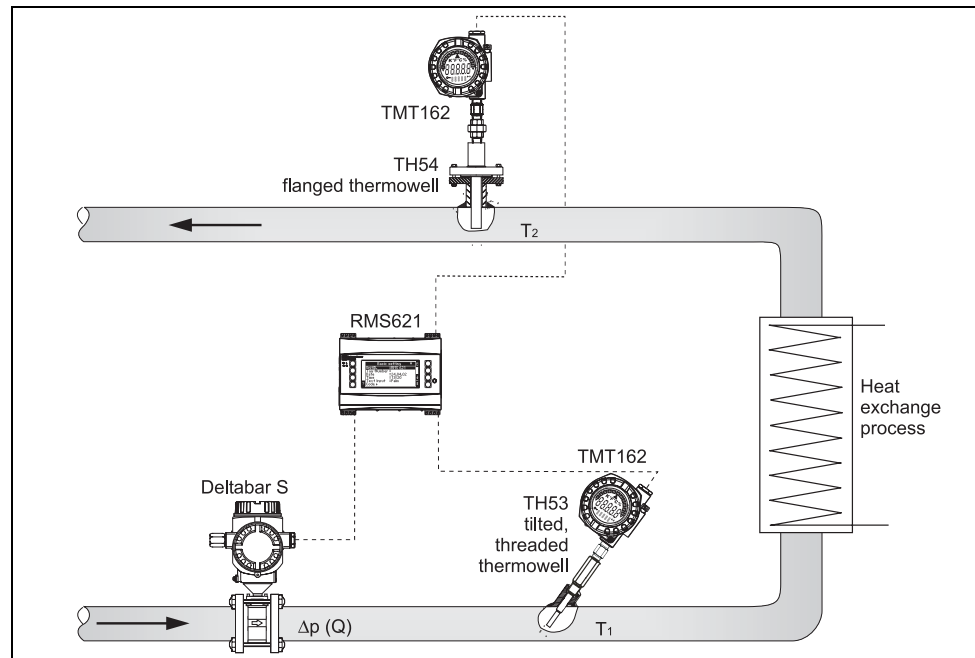
- One source shopping for temperature measurement solutions. World class transmitter with integrated sensor offering for heavy process industry applications.
- Remove and install straight out of the box!
- Improved galvanic isolation on most devices (2 kV)
- Simplified model structure: Competitively priced, offers great value. Easy to order and reorder. A single model number includes sensor, thermowell 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

The thermocouple sensing element consists of two metal wires that are homogeneous but different from each other and insulated along their entire length. The two wires are welded together at one end, known as the "hot junction". The other end, where the wires are free, is known as the "cold junction" and is connected to an electromotive force measurement circuit where the force is generated by the different thermoelectric power of each of the thermocouple wires if there is a temperature difference between the hot junction and the cold junction (Seebeck effect). The function that links the electromotive force to the temperature differences is a curve whose characteristics depend on the materials used in the construction of the thermocouple. The thermocouples comply with the temperature-electromotive force (EMF) tables of ASTM E-230 and IEC60584 standards.

### Measuring system



Example of an application of the temperature assemblies

Water - heat Differential

Calculation of heat quantity which is emitted or absorbed by a water flow in a heating or cooling system. The quantity of heat is calculated from the process variable for  $\Delta p$  flow ( $Q$ ) and the differential from the feed and return temperature ( $T_2 - T_1$ ). Bidirectional energy calculations, such as the calculating systems with changing flow direction (charging/ discharging the heat accumulator) are also possible.

### Energy manager RMS621

Energy conservation and cost expenditures are significant issues in today's industry. Accurate flow monitoring and calculation is the basis for thorough analysis and billing of energy. This data can serve as a basis to maximize savings potential and help in controlling operational costs on a daily basis. Endress+Hauser's energy managers provide accurate and reliable calculations for the monitoring and control of energy consumption (both produced and consumed) according to international standards, e.g. IAPWS-IF 97, AGA8, ISO 5167 etc. For RMS621 details, see Technical Information.

### iTEMP® TMT162 Temperature Field Transmitter

Aluminum or stainless steel dual compartment explosion - proof enclosure and compact, fully potted electronics provide the ultimate protection in harshest environments. TMT162 prevents costly plant shutdowns by detecting corrosion on RTDs or thermocouples before it corrupts the measured value. Endress+Hauser's Field Temperature Transmitters with backlit display and sensor backup functionality are designed with safety in mind to keep your plant, equipment and personnel safe. For TMT162 details, see Technical Information.

**Deltabar S/Cerabar S**

The evolution series of Cerabar S/Deltabar S represents a decisive step ahead in making pressure instrumentation better and safer for the process industry. The development of new products thrives especially on the knowledge, commitment and experience of staff members. Permanent high performance can only be achieved if dedicated and enthusiastic people provide their ideas. Endress+Hauser's instruments are not only supposed to distinguish themselves for customers and users by technological novelties but also by the presence of people supporting this progress, be it in service, sales or production. For Deltabar S & Cerabar S details see Technical Information.

**Equipment architecture**

MgO thermocouple assemblies consists of a thermocouple element swaged in hard-packed standard purity (96%) Magnesium Oxide mineral insulation and encased in a metal sheath. Thermocouple sheaths have been fully annealed; the hot junction of the thermocouple types according to ASTM E-230 specification are welded to form a pure joint to ensure highest accuracy and long term stability. The thermocouple assemblies with 1/4" sheaths and 0.26" ID drilled bar stock thermowells are an installation ready solution providing reliable temperature measurement for all applications in the process industry. Thermowells are used to provide an isolation between a temperature sensor and the environment, either liquid, gas or slurry. A thermowell allows the temperature sensor to be removed and replaced without compromising either the ambient region or the process.

**Measurement range**

Upper Temperature limits for various thermocouple types in °F (°C)					
Sheath OD	Type T	Type J	Type E	Type K	Type N
Ø 1/4"	700 °F (370 °C)	1330 °F (720 °C)	1510 °F (820 °C)	2100 °F (1150 °C)	
Maximum Element Temperature Range Limits	-454 to 752 °F (-270 to +400 °C)	-346 to 2192 °F (-210 to +1200 °C)	-454 to 1832 °F (-270 to +1000 °C)	-454 to 2500 °F (-270 to +1372 °C)	-454 to 2372 °F (-270 to +1300 °C)



Note!

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 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.



Note!

Thermocouples with 316 SS sheath and assemblies with 316 SS thermowells are rated for a maximum temperature of 1700 °F (927 °C).

**Calibration specifications**

3 point sensor calibration		
-40 to 0 °C	0 to 100 °C	+40 to 215 °C
-40 to 32 °F	32 to 212 °F	104 to 420 °F
Minimum length requirements for calibrated sensors = 6"		



Note!

Use option code 'B' (Block: Test; calibration) for calibration, the three temperature points need to be specified in 5 °C (9 °F) increments.

The manufacturer provides comparison temperature calibrations from -40 to +215 °C (-40 to +420 °F) on the international temperature scale of 1990. Calibrations are traceable to standards maintained by the National Institute of Standards and Technology (NIST). Calibration services are in conformance with ASTM E220, IEC 17025 and ANSI/NCSL Z540-1-1994. The report of calibration is referenced to the serial number of the assembly.

Three point calibrations are provided, given that the specified temperatures are within the recommended range and the minimum length requirements are met as specified. The minimum length is based on overall length 'x' of the spring loaded insert.

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## Electronics

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<b>Family of temperature transmitters</b>	Measurement assemblies with iTEMP® transmitters are an installation ready solution to improve the functionality of temperature measurement by increasing accuracy and reliability when compared to direct wired sensors. Overall installation costs are lower than with direct wired sensors, since an inexpensive pair of signal (4 to 20 mA) wires can be run over long distances.
<b>PC programmable device TMT181</b>	PC programmable head transmitter offers you extreme flexibility and help control costs with the ability to stock one device and program it for your needs. Regardless of your choice of output, all iTEMP® transmitters can be configured quickly and easily with a PC. To help you with this task, Endress+Hauser offers free software ReadWin® 2000 which can be downloaded from our website. Go to <a href="http://www.readwin2000.com">www.readwin2000.com</a> to download ReadWin® 2000 today. For details see Technical Information.
<b>HART® TMT182 head transmitter</b>	HART® communication is all about easy, reliable data access and getting better information more inexpensively. iTEMP® transmitters integrate seamlessly into your existing control system and provide painless access to preventative diagnostic information. Configuration with a DXR275 or 375 hand-held or a PC with configuration program (FieldCare, ReadWin® 2000) or configure with AMS or PDM. For details, see Technical Information.
<b>Field transmitter TMT162 - Dual compartment housing</b>	Field transmitter with HART® communication, FOUNDATION Fieldbus™ protocol and blue backlit display. Can be read easily from a distance, in sunlight and at night. Large measurement value, bargraph and fault indication display. Benefits are: dual sensor input, highest reliability in harsh industrial environments, mathematic functions, thermometer drift monitoring, sensor back-up functionality, corrosion detection and sensor transmitter matching by accepting Callendar Van Dusen constants. For details, see Technical Information.
<b>Field transmitter TMT142 - Single compartment housing</b>	Field transmitter with HART® communication. The one channel TMT142 allows for cost effective replacement of smaller transmitters with tiny display and old style analog transmitters. Large and brilliant blue backlit display. Regardless of whether you install the transmitter in a dark location or in direct sunlight, you still get a clear temperature reading. Reliable temperature measurement through advanced diagnostics. For details, see Technical Information.
<b>PROFIBUS® PA TMT184 head transmitter</b>	Universally programmable head transmitter with PROFIBUS®-PA fieldbus communication. Converting various input signals into a digital output signal. High accuracy in the total ambient temperature range. Swift and easy operation, visualization and maintenance using a PC direct from the control panel, e. g. using operating software such as FieldCare, Simatic PDM or AMS. DIP switch for address setting, makes start up and maintenance safe and reliable. For details, see Technical Information.
<b>FOUNDATION Fieldbus™ TMT85 head transmitter</b>	Universally programmable head transmitter with FOUNDATION Fieldbus™ communication. Converting various input signals into a digital output signal. High accuracy in the total ambient temperature range. Swift and easy operation, visualization and maintenance using a PC direct from the control panel, e. g. using operating software such as ControlCare from Endress+Hauser or the NI Configurator from National Instruments. Benefits are: dual sensor input, highest reliability in harsh industrial environments, mathematic functions, thermometer drift monitoring, sensor back-up functionality, sensor diagnosis functions and sensor-transmitter matching by accepting Callendar Van Dusen constants. For details, see Technical Information.

## Performance characteristics

### Response time

63% response time per ASTM E839

Thermocouple assembly TH55 without thermowell

Construction	Thermocouple insert $\varnothing$ 1/4"
Grounded thermocouples	1.3 s
Ungrounded thermocouples	2.9 s



Note!

Response time for the sensor assembly without transmitter.

Response time examples for thermocouples assemblies with thermowell TH53 and TH54

Construction	Stepped thermowell	Tapered thermowell	3/4" straight thermowell
Time	15 s	20 s	25 s



Note!

Response times for thermocouples assemblies with thermowell are provided for general design guidance without transmitter.

When the temperature of a process media changes, the output signal of a Thermocouple assembly follows this change after a certain time delay. The physical cause is the time related to heat transfer from the process media through the thermowell and the insert to the sensor element (thermocouple). The manner in which the reading follows the change in temperature of the assembly over time is referred to as the response time. Variables that influence or impact the response time are:

- Wall thickness of thermowell
- Spacing between thermocouple insert and thermowell
- Sensor packaging
- Process parameters such as media, flow velocity, etc.

### Maximum measured error

Thermocouples corresponding to ASTM E-230.

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



Note!

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

### Measurement accuracy transmitter

Thermocouple type	TMT181 multifunctional PCP	TMT182 HART®	TMT184 PROFIBUS® PA	TMT162 FF Field transmitter	TMT162 and TMT142 HART® Field transmitter	
					Accuracy	
					Digital	D/A <sup>1</sup>

Thermocouple type	TMT181 multifunctional PCP	TMT182 HART®	TMT184 PROFIBUS® PA	TMT162 FF Field transmitter	TMT162 and TMT142 HART® Field transmitter	
K, J, T, E	typ. 0.9 °F (0.5 °C) or 0.08% <sup>2</sup>	typ. 0.9 °F (0.5 °C) or 0.08% <sup>2</sup>	typ. 0.9 °F (0.5 °C)	typ. 0.45 °F (0.25 °C)	0.45 °F (0.25 °C) <sup>3</sup>	0.02%
N	typ. 1.8 °F (1.0 °C) or 0.08% <sup>2</sup>	typ. 1.8 °F (1.0 °C) or 0.08% <sup>2</sup>	typ. 1.8 °F (0.9 °C)	typ. 0.9 °F (0.5 °C)	0.9 °F (0.5 °C) <sup>3</sup>	0.02%

- 1) % relates to the set span. Accuracy = digital + D/A accuracy
- 2) % is related to the adjusted measurement range. The value to be applied is the greater.
- 3) for TMT142 only with the option 'advanced electronics'

#### Transmitter long-term stability

≤ 0.18 °F / year (≤ 0.1 °C/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.

- 1,000 MΩ at 77 °F (25 °C)

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

#### Galvanic isolation

Galvanic isolation of Endress+Hauser iTEMP® transmitters (input/output)

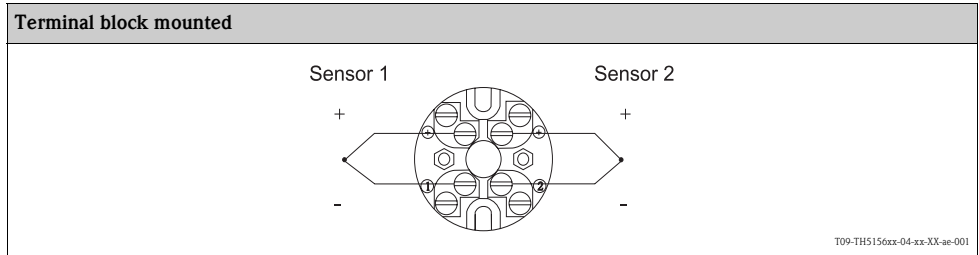
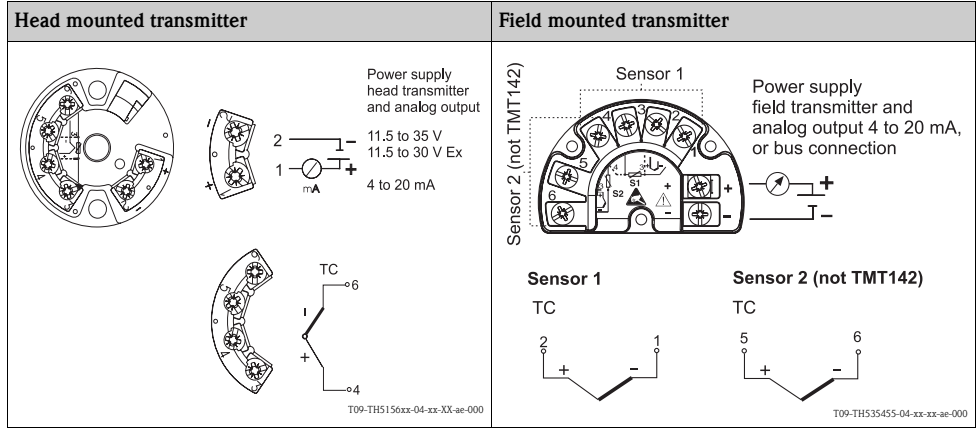
Transmitter type	Galvanic isolation
TMT181 PCP	Ū = 3.75 kV AC
TMT182 HART®	U = 2 kV AC
TMT184 PROFIBUS®-PA	
TMT162 HART®, FF Field transmitter	
TMT142 HART® Field transmitter	

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



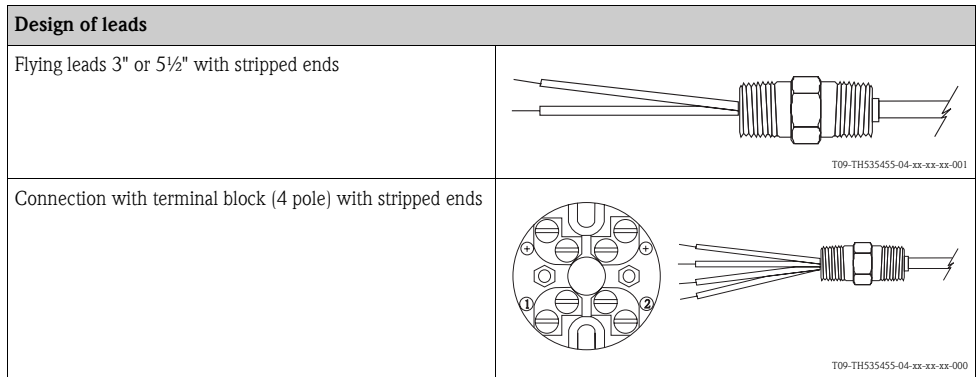
Note!

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

## Wire specifications

Thermocouple grade, TFE insulated 20AWG, 7 strands with stripped ends

Electrical connection
Flying leads, standard 3" for wiring in connection head, head mounted transmitter or terminal block mounted
Flying leads, 5½" for wiring with TMT162 or TMT142 assemblies



**Thermocouple color codes per ASTM E-230**

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

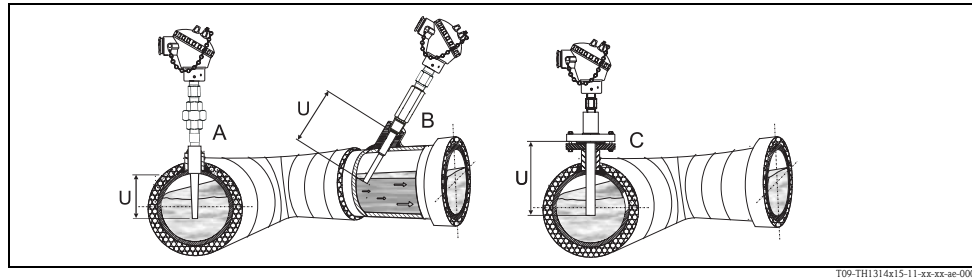
1) Silicon, or aluminum and silicon, may be present in combination with other elements.

**Installation conditions**

**Orientation**

No restrictions for installation orientation.

**Installation instructions**



Examples for pipe installation - In pipes with a small cross section the sensor tip should reach or extend slightly past the center line of the pipe (=U).

- A: TH53 assembly socket weld installation
- B: Threaded, tilted installation of TH53 assembly
- C: Flange installation of TH54 assembly

**Immersion**

Minimum immersion length TH55 without thermowell should be 2.5 inches for the 1/4" OD thermocouple sheath, nominal.

For temperature assemblies with thermowell (TH53 and TH54) the minimum immersion is the depth to which the thermowell is immersed in the medium, measured from the tip. To minimize errors from ambient temperature the following minimum immersion lengths are recommended:

Construction	Minimum Immersion (Inch)
Stepped thermowell	2½"
Tapered thermowell	4½"
¾" straight thermowell	4"
Weld in thermowell	4½"

## Environmental conditions

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### Ambient temperature

Housing without head-mounted transmitter

- Aluminum pressure die-cast housing -40 to 300 °F (-40 to 150 °C)
- Plastic housing -40 to 185 °F (-40 to 85 °C)
- Deep drawn SS housing without display -40 to 300 °F (-40 to 150 °C)

Housing with head-mounted transmitter

- -40 to 185 °F (-40 to 85 °C)

Field transmitter without display

- -40 to 185 °F (-40 to 85 °C)
- 

**Shock and vibration resistance** 4g / 2 to 150 Hz as per IEC 60 068-2-6

## Process conditions

Thermowells are used in measuring the temperature of a moving fluid in a conduit, where the stream exerts an appreciable force. The limiting value for the thermowells is governed by the temperature, the pressure and the speed of the medium, the immersion length, the materials of the thermowells and the medium, etc.

Calculations for stress and vibration of thermowells can be done according to ASME PTC 19.3-1974 standard, please consult Endress+Hauser.



All thermowells are marked with:

- Material I.D.
- CRN# (Canadian Registration Number)
- Heat No.

Dimensions of TH53					
U	E	T	Process connection	Shape of Thermowell	ø Q
2½", 4½", 7½", 10½" specified length 2" to 18" in ½" increments	Hex nipple = 1" or Nipple Union Nipple (NUN) = 4" or 7" Material: Steel or 316SS	3" or specified length 1" to 6" in ½" increments	½" NPT	Stepped (Standard duty) Tapered (Heavy duty)	5/8" 1 1/16"
			¾" NPT	Stepped (Standard duty) Tapered (Heavy duty)	¾" 7/8"
			1" NPT	Stepped (Standard duty) Tapered (Heavy duty)	7/8" 1 1/16"
			¾" Socket weld	Stepped (Standard duty) Tapered (Heavy duty)	¾" ¾"
			1" Socket weld	Stepped (Standard duty) Tapered (Heavy duty)	7/8" 1"
			¾" weld in	Tapered (Heavy duty)	1.050"
			1" weld in	Tapered (Heavy duty)	1.315"
Immersion length thermocouple sensor = Thermowell drilled length $X_A = A = U + 1\frac{1}{2}" + T$ Insert overall length $X = A + E$					
P = Pipe size Nom. ¾"; Dia. = 1.050" Nom. 1"; Dia. = 1.315"					

Dimensions of TH54 Flange rating: ASME B16.5				
U	E	T	Flange size	ø Q, Tapered version
2", 4", 7", 10" specified length 2" to 18" in ½" increments	Hex nipple = 1" or Nipple Union Nipple (NUN) = 4" or 7" Material: Steel or 316SS	specified length 1" to 10" in ½" increments	1"	7/8"
			1½"	1 1/16"
			2"	1 1/16"
Immersion length thermocouple sensor - Thermowell drilled length $X_A = A = U + 2" + T$ Insert overall length $X = A + E$				

Dimensions of TH55 (without Thermowell)	
Immersion length thermocouple sensor $X_A$	E
4", 6", 9", 12", 14" specified length 4" to 30" in ½" increments	Hex nipple = 1" or Nipple Union Nipple (NUN) = 4" or 7"

**Hot or measuring junction****Grounded junction****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. 2kV (from the sensor input to the output and the housing).

**Ungrounded junction****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 IEC61326 for use in noisy environments.

**Note!**

Dual ungrounded elements are supplied with individually isolated junctions.

**Weight**

From 1 to 10 lbs

**Material**

Sheath materials		
Material	Max. temp. rating	Application notice
316SS	1700 °F (927 °C)	Superior corrosion resistance
Inconel 600 <sup>1 2 3</sup>	2100 °F (1149 °C)	Excellent oxidation and corrosion resistance at high temperature. Not to be used in sulphur atmosphere <sup>3</sup> .

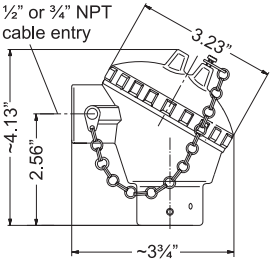
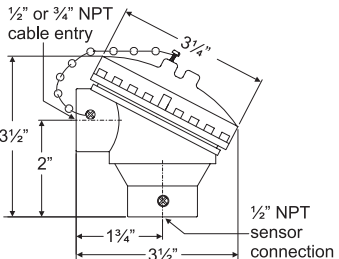
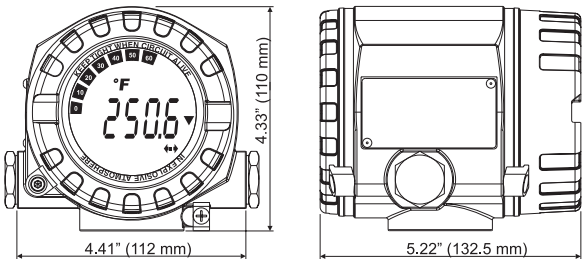
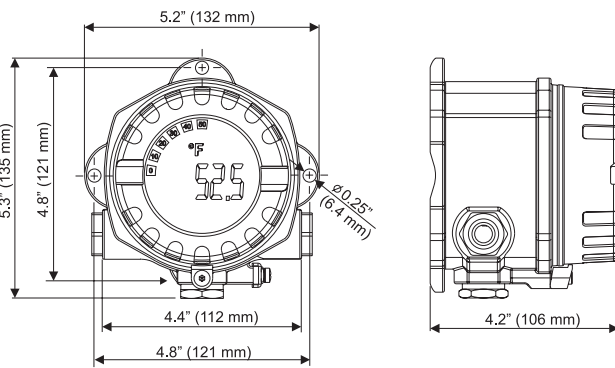
- 1) Type T & J thermocouples are not available with Inconel 600 sheaths.
- 2) Type N thermocouples are not available with 316SS sheaths.
- 3) Inconel 600 maximum working temperature is 2100 °F (1149 °C) under oxidizing conditions: Reducing conditions reduce maximum temperature to 1900 °F (1038 °C). Must not be placed in sulfurous atmospheres over 1000 °F (538 °C).

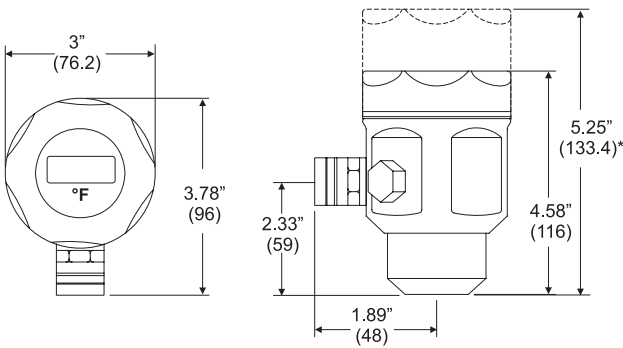
**Thermowell material**

Wetted parts 316SS for usage up to 1700 °F (927 °C). 316SS has good oxidation and corrosion resistance in a wide range of industrial environments with improved resistance to mild acid and pitting corrosion. Exposure to carbide precipitation, reduces corrosion resistance in the 800 to 1000 °F (427 to 538 °C) temperature range. Good mechanical properties for -300 to 1450 °F (-184 to 788 °C) temperature range. Generally regarded as standard protection tube material, other materials are available upon request.

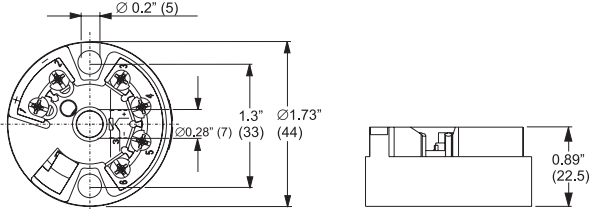
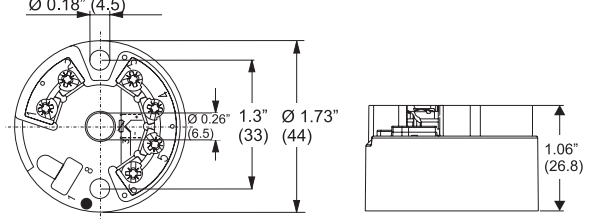
## System components

### Housing

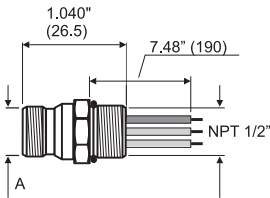
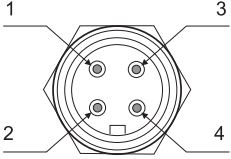
Type of housing	Specification
<p>Connection head Aluminum</p>  <p style="text-align: right; font-size: small;">T09-TH11xxxx-06-xx-xx-ae-001</p>	<ul style="list-style-type: none"> <li>■ Material: Die-cast Aluminum head</li> <li>■ Sensor connection: 1/2" NPT Female</li> <li>■ Cable entry: 1/2" NPT or 3/4" NPT Female. 1/2" NPT has a Al reducer bushing</li> <li>■ Body paint: Spray SPU, RAL5012</li> <li>■ Cover paint: Spray SPU, RAL7035</li> <li>■ Coating thread (body-cover), lubricant acc. E+H standard, MgO coating; benefits include ease of opening/closing cover and improved thread engagement. Improves lifetime of the connection head.</li> <li>■ Degree of protection NEMA 4X (IP 66)</li> </ul>
<p>Connection head plastic</p>  <p style="text-align: right; font-size: small;">T09-TH11xxxx-06-xx-xx-ae-000</p>	<ul style="list-style-type: none"> <li>■ Polypropylene, FDA compliant</li> <li>■ Sensor connection: 1/2" NPT Female</li> <li>■ Cable entry: 1/2" NPT or 3/4" NPT Female. 1/2" NPT with nylon reducer bushing (FDA compliant)</li> <li>■ Degree of protection NEMA 4X</li> </ul>
<p>Temperature field transmitter iTEMP® TMT162</p>  <p style="text-align: right; font-size: small;">T09-TMT16ZZ-06-00-xx-ae-001</p>	<ul style="list-style-type: none"> <li>■ Material: Die-cast aluminum housing AlSi10Mg with powder coating on polyester base</li> <li>■ Separate electronics compartment and connection compartment</li> <li>■ Display rotatable in 90° increments</li> <li>■ Cable entry: 2 x 1/2" NPT</li> <li>■ Degree of protection NEMA 4X (IP 67)</li> <li>■ Brilliant blue backlit display with ease of visibility in bright sunshine or pitch darkness</li> <li>■ Gold plated terminals to avoid corrosion and additional measurement errors</li> </ul> <p>Details see Technical Information (see 'Documentation')</p>
<p>Temperature field transmitter iTEMP® HART® TMT142</p>  <p style="text-align: right; font-size: small;">T09-TMT14ZZ-06-00-xx-ae-001</p>	<ul style="list-style-type: none"> <li>■ Material: Die-cast aluminum housing AlSi10Mg with powder coating on polyester base</li> <li>■ Display rotatable in 90° increments</li> <li>■ Cable entry: 3 x 1/2" NPT</li> <li>■ Degree of protection NEMA 4X (IP 67)</li> <li>■ Brilliant blue backlit display with ease of visibility in bright sunshine or pitch darkness</li> <li>■ Gold plated terminals to avoid corrosion and additional measurement errors</li> </ul> <p>Details see Technical Information (see 'Documentation')</p>

Type of housing	Specification
<p>Connection head deep drawn stainless steel, TA20J style</p>  <p>* dimensions with optional display</p> <p style="text-align: right;">#0005938</p>	<ul style="list-style-type: none"> <li>■ Material: Deep drawn stainless steel AISI 316L SS (hygienic design)</li> <li>■ Optional with display and/or head transmitter</li> <li>■ Sensor connection: ½" NPT female</li> <li>■ Cable entry: ½" NPT female</li> <li>■ Degree of protection NEMA 4X (IP 66)</li> </ul> <p>Display:</p> <ul style="list-style-type: none"> <li>■ 4 digits 7-segments LC display (loop powered)</li> <li>■ Maximum error: 0.1% of programmed range</li> <li>■ Loop drop: 2.5 V at 22 mA</li> <li>■ Max. ambient temperature: -4 to 160 °F (-20 to 70 °C)</li> </ul> <p>The programming is executed through 3 keys mounted on the bottom of the display.</p>

**Head transmitter**

Type of transmitter)	Specification
<p>iTEMP® TMT18x</p>  <p style="text-align: right;">R09-TMT18ZZ-06-06-xx-ae-001</p>	<ul style="list-style-type: none"> <li>■ Material</li> <li>■ Housing: PC</li> <li>■ Potting: PUR</li> <li>■ Terminals: Cable up to max. 16 AWG (secure screws) or with wire end ferrules</li> <li>■ Eyelets for easy connection of a HART®-handheld terminal with alligator clips</li> <li>■ Degree of protection NEMA 4 (see also type of connection head)</li> </ul> <p>Details see Technical Information (see 'Documentation')</p>
<p>iTEMP® PA TMT184</p>  <p style="text-align: right;">T09-TMT184ZZ-06-06-xx-ae-001</p>	

**Fieldbus connector**

Type (dimensions in inches [mm])	Specification	
<p>Fieldbus connector to PROFIBUS® -PA or FOUNDATION Fieldbus™</p>  <p>Pos. A: M12 on PROFIBUS® -PA connector 7/8-16 UNC on FOUNDATION Fieldbus™ connector</p> <p style="text-align: right; font-size: small;">T09-FFCONNEC-06-xx-xx-ae-000 <span style="float: right;">a0006023</span></p>	<ul style="list-style-type: none"> <li>■ Ambient temperature: -40 to 300 °F (-40 to 150 °C)</li> <li>■ Degree of protection IP 67</li> </ul> <p>Wiring diagram:</p> 	
	<p>PROFIBUS® -PA Pos 1: grey (shield) Pos 2: brown (+) Pos 3: blue (-) Pos 4: not connected</p>	<p>FOUNDATION Fieldbus™ Pos 1: blue (-) Pos 2: brown (+) Pos 3: not connected Pos 4: ground (green/yellow)</p>

## Certificates and approvals

**CE Mark**

The iTEMP® Series of temperature transmitters complies with the legal requirements laid out within the EU regulations.

**Other standards and guidelines**

- IEC 60529:  
Degrees of protection by housing (IP-Code)
- IEC 61010:  
Safety requirements for electrical measurement, control and laboratory instrumentation
- IEC60584  
Thermocouples - Reference tables
- ASTM E-230:  
Standard Specification and Temperature-Electromotive Force (EMF) Tables for Standardized Thermocouples
- ASTM E839:  
American society for testing and materials, Standard test methods for sheathed thermocouples and sheathed thermocouple material
- NEMA - ANSI / NEMA 250  
Standardization association for the electrical industry
- ASME PTC 19.3 - 1974  
Performance test codes, Temperature Measurement

**UL**

Temperature transmitters are recognized components to UL 3111-1 (iTEMP® Series) except for TMT184 PROFIBUS®-PA.

**CSA GP**

The installed and assembled transmitters (iTEMP® Series) are CSA GP approved, except TMT184 PROFIBUS® PA

## Ordering information

### Product structure, thermocouple assembly in thermowell TH53

TH53-	Thermocouple assembly in thermowell		
	<b>TW Immersion length U:</b>		
	<b>1</b>	2½ inch	
	<b>2</b>	4½ inch	
	<b>3</b>	7½ inch	
	<b>4</b>	10½ inch	
	<b>8</b>	.... inch to spec.	
	<b>Y</b>	Special	
	<b>Process connection, TW:</b>		
	<b>A1</b>	½" NPT 316SS	
	<b>A2</b>	¾" NPT 316SS	
	<b>A3</b>	1" NPT 316SS	
	<b>B1</b>	Socket weld ¾" 316SS	
	<b>B2</b>	Socket weld 1" inch 316SS	
	<b>C1</b>	Weld in ¾" 316SS	
	<b>C2</b>	Weld in 1" inch 316SS	
	<b>YY</b>	Special	
	<b>Shape of TW:</b>		
	<b>2</b>	Stepped, Standard Duty	
	<b>3</b>	Tapered, Heavy Duty	
	<b>9</b>	Special	
	<b>Lag of TW, T:</b>		
	<b>A</b>	None	
	<b>E</b>	3 inch	
	<b>X</b>	.... inch (0.5" increment)	
	<b>Y</b>	Special	
	<b>Extension:</b>		
	<b>1</b>	Hex nipple 316SS	
	<b>2</b>	Nipple Union Nipple 316SS	
	<b>3</b>	Hex nipple steel E=1"	
	<b>4</b>	Nipple Union Nipple steel E=1"	
	<b>5</b>	Nipple Union Nipple steel E=7"	
	<b>6</b>	Nipple Union Nipple 316SS E=7"	
	<b>9</b>	Special	
	<b>Type Sensor; IEC Class:</b>		
	<b>A</b>	1 x J; 2, Insert 316SS	
	<b>B</b>	2 x J; 2, Insert 316SS	
	<b>C</b>	1 x J; 1, Insert 316SS	
	<b>D</b>	2 x J; 1, Insert 316SS	
	<b>E</b>	1 x K; 2, Insert Inconel 600	
	<b>F</b>	2 x K; 2, Insert Inconel 600	
	<b>G</b>	1 x K; 2, Insert Inconel 600	
	<b>H</b>	2 x K; 1, Insert Inconel 600	
	<b>J</b>	1 x E; 2, Insert Inconel 600	
	<b>K</b>	2 x E; 2, Insert Inconel 600	
	<b>L</b>	1 x E; 1, Insert Inconel 600	
	<b>M</b>	2 x E; 1, Insert Inconel 600	
	<b>N</b>	1 x N; 2, Insert Inconel 600	
	<b>O</b>	2 x N; 2, Insert Inconel 600	
	<b>P</b>	1 x N; 1, Insert Inconel 600	
	<b>Q</b>	2 x N; 1, Insert Inconel 600	
	<b>R</b>	1 x T; 2, Insert 316SS	
	<b>S</b>	2 x T; 2, Insert 316SS	
	<b>T</b>	1 x T; 1, Insert 316SS	
	<b>U</b>	2 x T; 1, Insert 316SS	
	<b>Y</b>	Special	
TH53-			← Order code (Part 1)



**Product structure,  
thermocouple assembly in  
flanged thermowell TH54**

TH54-	Thermocouple assembly in flanged thermowell				
	<b>TW Immersion length U:</b>				
	<b>1</b>	2 inch			
	<b>2</b>	4 inch			
	<b>3</b>	7 inch			
	<b>4</b>	10 inch			
	<b>8</b>	.... inch to spec. (0.5" increment)			
	<b>Y</b>	Special			
	<b>Flange size; TW Material</b>				
	<b>A</b>	1 inch 316SS			
	<b>B</b>	1½ inch 316SS			
	<b>C</b>	2 inch 316SS			
	<b>Y</b>	Special			
	<b>Rating; Type:</b>				
	<b>1</b>	150 psi; RF			
	<b>2</b>	300 psi; RF			
	<b>3</b>	600 psi; RF			
	<b>9</b>	Special			
	<b>Shape of TW; Welding:</b>				
	<b>1</b>	Straight; standard			
	<b>2</b>	Tapered; standard			
	<b>3</b>	Straight; full penetration			
	<b>4</b>	Tapered; full penetration			
	<b>9</b>	Special			
	<b>Lag of TW, T:</b>				
	<b>A</b>	None			
	<b>X</b>	inch (0.5" increment)			
	<b>Y</b>	Special			
	<b>Extension:</b>				
	<b>1</b>	Hex nipple 316SS, E=1"			
	<b>2</b>	Nipple Union Nipple 316SS, E=4"			
	<b>3</b>	Hex nipple steel, E=1"			
	<b>4</b>	Nipple Union Nipple, steel, E=4"			
	<b>5</b>	Nipple Union Nipple, steel, E=7"			
	<b>6</b>	Nipple Union Nipple, 316SS, E=7"			
	<b>9</b>	Special			
	<b>Type Sensor; Class:</b>				
	<b>A</b>	1 x J; 2, Insert 316SS			
	<b>B</b>	2 x J; 2, Insert 316SS			
	<b>C</b>	1 x J; 1, Insert 316SS			
	<b>D</b>	2 x J; 1, Insert 316SS			
	<b>E</b>	1 x K; 2, Insert Inconel 600			
	<b>F</b>	2 x K; 2, Insert Inconel 600			
	<b>G</b>	1 x K; 1, Insert Inconel 600			
	<b>H</b>	2 x K; 1, Insert Inconel 600			
	<b>J</b>	1 x E; 2, Insert Inconel 600			
	<b>K</b>	2 x E; 2, Insert Inconel 600			
	<b>L</b>	1 x E; 1, Insert Inconel 600			
	<b>M</b>	2 x E; 1, Insert Inconel 600			
	<b>N</b>	1 x N; 2, Insert Inconel 600			
	<b>O</b>	2 x N; 2, Insert Inconel 600			
	<b>P</b>	1 x N; 1, Insert Inconel 600			
	<b>Q</b>	2 x N; 1, Insert Inconel 600			
	<b>R</b>	1 x T; 2, Insert 316SS			
	<b>S</b>	2 x T; 2, Insert 316SS			
	<b>T</b>	1 x T; 1, Insert 316SS			
	<b>U</b>	2 x T; 1, Insert 316SS			
	<b>Y</b>	Special			
TH54-					← Order code (Part 1)



**Product structure,  
Thermocouple assembly  
TH55**

TH55-	Thermocouple assembly		
	<b>Immersion length <math>X_A</math>:</b>		
	<b>1</b>	4 inch	
	<b>2</b>	6 inch	
	<b>3</b>	9 inch	
	<b>4</b>	12 inch	
	<b>5</b>	14 inch	
	<b>8</b>	.... inch to spec. (0.5" increment)	
	<b>Y</b>	Special	
	<b>Sheath diameter:</b>		
	<b>A</b>	¼ inch 316SS	
	<b>B</b>	¼ inch Inconel 600	
	<b>Y</b>	Special	
	<b>Extension:</b>		
	<b>1</b>	Hex nipple 316SS, E=1"	
	<b>2</b>	Nipple Union Nipple 316SS, E=4"	
	<b>3</b>	Hex nipple steel, E=1"	
	<b>4</b>	Nipple Union Nipple, steel, E=4"	
	<b>5</b>	Nipple Union Nipple, steel, E=7"	
	<b>6</b>	Nipple Union Nipple, 316SS, E=7"	
	<b>9</b>	Special	
	<b>Type Sensor; Class:</b>		
	<b>A</b>	1 x J; 2	
	<b>B</b>	2 x J; 2	
	<b>C</b>	1 x J; 1	
	<b>D</b>	2 x J; 1	
	<b>E</b>	1 x K; 2	
	<b>F</b>	2 x K; 2	
	<b>G</b>	1 x K; 1	
	<b>H</b>	2 x K; 1	
	<b>J</b>	1 x E; 2	
	<b>K</b>	2 x E; 2	
	<b>L</b>	1 x E; 1	
	<b>M</b>	2 x E; 1	
	<b>N</b>	1 x N; 2	
	<b>O</b>	2 x N; 2	
	<b>P</b>	1 x N; 1	
	<b>Q</b>	2 x K; 1	
	<b>R</b>	1 x T; 2	
	<b>S</b>	2 x T; 2	
	<b>T</b>	1 x T; 1	
	<b>U</b>	2 x T; 1	
	<b>Y</b>	Special	
	<b>Junction style + purity:</b>		
	<b>1</b>	grounded	
	<b>2</b>	ungrounded	
	<b>9</b>	special	
TH55-			← Order code (part 1)



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## Documentation

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- Compact instructions TH53 TC assembly in thermowell (KA196r/24/ae)
- Compact instructions TH54 TC assembly in flanged thermowell (KA197r/24/ae)
- Compact instructions TH55 TC assembly - spring loaded (KA198r/24/ae)
- Technical information Temperature field transmitter iTEMP® TMT162 (TI086r/24/ae)
- Technical information Temperature field transmitter iTEMP® HART® TMT142 (TI107r/24/ae)
- Technical information Temperature head transmitter iTEMP® PCP TMT181 (TI070r/24/ae)
- Technical information Temperature head transmitter iTEMP® HART® TMT182 (TI078r/24/ae)
- Technical information Temperature head transmitter iTEMP® PA® TMT184 (RI079r/24/ae)

### Application example:

- Technical information Energy manager RMS621 (TI092r/24/ae)
- Technical information Cerabar S (TI383r/24/ae)
- Technical information Deltabar S (TI384r/24/ae)



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