

## Overview



Temperature sensors of the SITRANS TS500 product family are used to measure temperatures in industrial equipment.

## Benefits

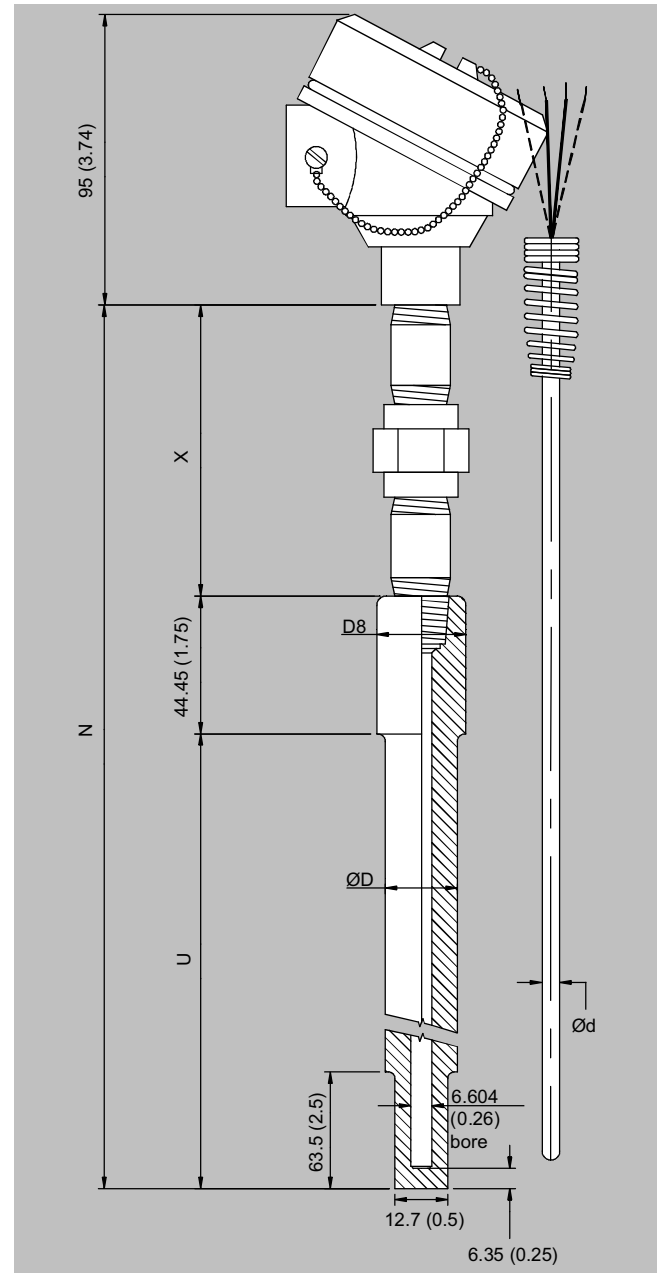
The modular design makes it possible to customize the temperature sensor for most applications, while still being able to use many standardized individual components.

### **SITRANS TS500 Temperature sensors as a modular system**

Due to their modular design, temperature sensors of the SITRANS TS500 series are well suited to a large number of applications. The replaceable measuring insert makes it possible to conduct maintenance work even during ongoing operations. These devices are used particularly frequently in vessels and pipelines of the following industries:

- Power plants
- Chemical industry
- Petrochemical industry
- General process engineering
- Water, waste water

## Design



SITRANS TS500, type SWR, socket reduced well, dimensions in mm (inch)

The temperature sensors of the SITRANS TS500 series are available in four different designs:

- General Purpose without Thermowell
- Threaded Thermowell
- Flanged Thermowell
- Socket Thermowell

# Temperature measurement

## Temperature sensors

### SITRANS TS500 / Technical description

#### Design (continued)

##### Configuration components

##### Process connections

##### Flanges

The different properties of the flanges are as follows:

- Standard series EN 1092, ASME 16.5,..
- Nominal pressure
- Nominal diameter
- Sealing face

This information is stamped into the flange, as well as the material code and batch number for "3.1 Material".

##### Thermowell

Thermowells fulfill two basic functions:

- They protect the measuring insert from aggressive media
- They make it possible to replace units during ongoing operations

This catalog is limited to the standard versions. Special versions are available on request.

- Barstock thermowells
  - Where process loads are too high, or where thermowells with welded seams are not allowed, deep hole drilled barstock thermowells are used.

##### Extension (neck tube)

The extension is the section from the lower edge of the connection head to the fixed point of the process connection or thermowell. There is a variety of terms for this components, e.g. neck tube. For this reason the term extension has been selected as a standardized term for the different designs. Function is the deciding factor:

- Thermal decoupling of connection head from process temperature
- Installation of connection head over existing insulation
- Simple standardization of measuring inserts: In general, the length of the extension may be freely selected. However, when using standardized insertion lengths ensures that measuring inserts are quickly available can be used.
- The extension takes the spring load of the sensor.
- Depending on the design, the extension can also be used to achieve an alignment of the connection head.

##### Connection head

The connection head protects the wiring connections. The connection head features sufficient room for mounting a terminal block or transmitter.

Different connection heads are used depending on the application and preference.

##### Measuring insert

Measuring inserts feature a large spring range. These measuring inserts are ideal for use with NPT threads with the typical loose tolerances. In this configuration, the extension function is partially or fully integrated (nipple-union-nipple). Moreover it is also possible to directly attach field devices, e.g. SITRANS TF.

##### Transmitters

SITRANS TH head transmitters process the weak non-linear sensor signals and transmit a stable and temperature-linear standard signal, thereby minimizing sensor signal disruptions.

The transmitters constantly monitor the temperature sensors and transmit diagnostic data to superordinate systems.

#### Design (continued)

Because of the low energy feed of the SITRANS TH head transmitters, self-heating of the temperature sensors can be maintained at minimal levels.

The electrical isolation and integrated cold junction ensure that temperature sensors with thermocouples provide reliable measurements at a low cost.

##### SITRANS TH product family

For detailed technical data on the SITRANS TH transmitters, please refer to the catalog FI 01.

- TH100 - the basic device
  - Output 4 to 20mA
  - for Pt100
  - can be configured using simple software
- TH320 - the universal device
  - Output 4 ... 20 mA or:
  - Output 4 ... 20 mA/HART
  - 1 x input resistance thermometer, thermocouples
  - Can be configured using simple software
- TH420 - Twice as safe
  - Output 4 ... 20 mA/HART
  - 2 x input resistance thermometer, thermocouples, hot backup, drift detection, etc. can be achieved as a result
  - Extended diagnostics functions

## Function

A complete measuring point consists of a measuring insert which contains the basic sensors, the protective fitting and an optional transmitter.

The basic sensors are:

- Resistance thermometers:
  - Temperature measurement is based on the temperature dependency of the installed measuring resistor.
- Thermocouples:
  - Temperature measurement is based on the Seebeck effect. A thermocouple which subjected to a temperature drop produces thermoelectric voltage that can be measured.

Transmitters:

The optional Siemens transmitters assume the following functions:

- Optimum measurement processing
- Strengthening of weak sensor signals directly on site
- Transmits standardized signals
- Protects against electromagnetic interferences
- Support enhanced diagnosis options

The resistance thermometer is intended for installation in containers and pipelines.

- Modular design consisting of thermowell, measuring insert, connection head and optional transmitter.
- Transmitter can be integrated (4 to 20 mA, PROFIBUS PA or FOUNDATION Fieldbus)

# Temperature measurement

## Temperature sensors

### SITRANS TS500 / Technical description

#### Selection and ordering data

SITRANS TS500 Threaded Sensor Assembly (no thermowell)	Article No.	Order code
Click on the Article No. for the online configuration in the PIA Life Cycle Portal.	7MC650	● - ● ● ● ● ● - 0 ● ● ● - ● ● ●
<b>Sheath material</b>		
316L Stainless Steel	2	
310 Stainless Steel	4	
Alloy 600	7	
<b>Form</b>		
Adjustable Compression Fitting	2	
Fixed Welded	3	
Spring-Loaded	4	
<b>Process connection size</b>		
½" NPT		J
<b>Insertion length (U-Length)</b>		
1"		P 0
1.5"		P 1
2"		P 2
2.5"		P 3
3"		P 4
3.5"		P 5
4"		P 6
4.5"		P 7
5"		P 8
5.5"		Q 0
6"		Q 1
6.5"		Q 2
7"		Q 3
7.5"		Q 4
8"		Q 5
8.5"		Q 6
9"		Q 7
9.5"		Q 8
10"		R 0
10.5"		R 1
11"		R 2
11.5"		R 3
12"		R 4
12.5"		R 5
13"		R 6
13.5"		R 7
14"		R 8
14.5"		S 0
15"		S 1
15.5"		S 2
16"		S 3
16.5"		S 4
17"		S 5
17.5"		S 6
18"		S 7
18.5"		S 8
19"		T 0
19.5"		T 1
20"		T 2
20.5"		T 3
21"		T 4
21.5"		T 5
22"		T 6
22.5"		T 7
23"		T 8
23.5"		U 0
24"		U 1

## Selection and ordering data (continued)

	Article No.	Order code
<b>SITRANS TS500 Threaded Sensor Assembly (no thermowell)</b>	7MC650	● - ● ● ● ● ● - 0 ● ● ● - ● ● ●
Other, specify U length		Z 0 K 1 Y
<b>Sensor diameter</b>		
1/4"		7
<b>Connection head</b>		
Cast Aluminum		J
Cast Stainless Steel		S
Flip-Top Aluminum		B
Explosion Proof Aluminum		G
Explosion Proof Aluminum with window and display		H
Explosion Proof SS		U
Without Head (for TF/display, use option A80-A86)		N
Other		Z P 1 Y
<b>Sensor type</b>		
<b>RTD</b>		
Standard RTDs are 3-wire, 100 Ohm Platinum, 500 F		
Class B		A 1
Class A		A 2
Class AA (4-wire)		A 3
Class B Dual		A 5
Class A Dual		A 6
High Vibration RTD (900 F) - Class B		B 1
RTD high temp (900 F) - Class B		C 1
<b>Thermocouple</b>		
Standard thermocouples are ungrounded		
Type J		J 1
Type J dual		J 5
Type K		K 1
Type K dual		K 5
Type T		T 1
Type T dual		T 5
Type E		E 1
Type E dual		E 5
Other		Z 0 Q 1 Y

	Order code
<b>Options</b>	
Please add "-Z" to Article No. and add options, separate extensions with "+"	
<b>Hazardous area classification</b>	
FM non-Ex, general purpose	E10
FM flameproof NPT-thr. (incl. flame-path fitting)	E13
FM non incandive	E16
<b>Transmitter mounted in head</b>	
Measuring range to be set must be specified with plain text data "Y01".	
SITRANS TH100, Input: 1 x Pt100, Output: 4-20 mA	T12
SITRANS TH320, Input: 1 x universal, Output: 4-20 mA	T24
SITRANS TH320, Input: 1 x universal, Output: 4-20 mA; HART	T34
SITRANS TH420, Input: 2 x universal, Output: 4-20 mA; HART	T35
<b>Transmitter with display</b>	
Dual chamber housing, Aluminum General purpose, with local operation and indicator (select internal transmitter via T**-option)	A85
Dual chamber housing, Aluminum XP, with local operation and indicator (select internal transmitter via T**-option)	A86

	Order code
<b>Other temperature transmitter (Metric housing, SST housing, etc)</b>	
Mounting of transmitter - ordered separately	A80
<b>Transmitter configuration</b>	
Specify measuring range in plain text	Y01
Specify HART-address (max. 8 characters) in plain text	Y17
Fail-safe value 3.6 mA (instead of 22.8 mA)	U36
<b>Certificates</b>	
Material certificate for wetted parts	C12
Cert SIL 2/3	C20
Factory cal - matched pair	C15
3-point factory calibration: sensor without transmitter. Default calibration = 32-212F (0-100C). Specify other range with option Y01	C60
3-point factory calibration: sensor with transmitter. Default calibration = 32-212F (0-100C). Specify other range with option Y01	C61
CRN-marking (Specify which province via text)	Y60
<b>Sensor options</b>	
Grounded T/C (std = ungrounded)	G31
4-wire RTD (std = 3-wire)	R04

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### SITRANS TS500 / Technical description

#### Selection and ordering data (continued)

	Order code
<b>Further options</b>	
SS tag plate - wired to sensor assembly (connection head only)	Y15
Special option (define in plain text: "Y99:...")	Y99

SITRANS TS500 Barstock Thermowell Assembly	Article No.	Order code															
	7MC652	●	-	●	●	●	●	●	-	●	●	●	●	-	●	●	●
Click on the Article No. for the online configuration in the PIA Life Cycle Portal.																	
<b>Well material</b>																	
316 SS																	
Special Version (Y99 required)																	
<b>Thermowell process connection type and size</b>																	
<b>Threaded thermowell</b>																	
½" NPT																	
½" NPT																	
1" NPT																	
<b>Flanged thermowell</b>																	
1.0" 150# RF																	
1.0" 300# RF																	
1.5" 150# RF																	
1.5" 300# RF																	
2.0" 150# RF																	
2.0" 300# RF																	
2.0" 300# RF																	
3.0" 300# RF																	
<b>Socket weld thermowell</b>																	
¾" Socket Weld																	
1" Socket Weld																	
<b>Other design</b>																	
Customer-specified connection (Specify in plain text)																	
<b>Thermowell form</b>																	
Straight																	
Tapered																	
Step-Down (Reduced)																	
Other, specify thermowell form, U-length and T-length																	
<b>Insertion length (U-Length), with standard T-length (1.75")</b>																	
2"																	
2.5"																	
3"																	
3.5"																	
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4.5"																	
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12.5"																	
13"																	



# Temperature measurement

## Temperature sensors

### SITRANS TS500 / Technical description

#### Selection and ordering data (continued)

SITRANS TS500 Barstock Thermowell Assembly	Article No. 7MC652	Order code
Type T dual		T 5
Type E		E 1
Type E dual		E 5
<b>Other sensor</b> Other, specify type (Q1Y = ...)		Z 0 Q 1 Y
<b>No sensor</b> For well-only configurations		N 0

	Order code
<b>Options</b> Please add "-Z" to Article No. and add options, separate extensions with "+"	
<b>Hazardous area classification</b>	
FM non-Ex, general purpose	E10
FM flameproof NPT-thr. (incl. flame-path fitting)	E13
FM non incandive	E16
<b>Transmitter mounted in head</b> Measuring range to be set must be specified with plain text data "Y01".	
SITRANS TH100, Input: 1 x Pt100, Output: 4-20 mA	T12
SITRANS TH320, Input: 1 x universal, Output: 4-20 mA	T24
SITRANS TH320, Input: 1 x universal, Output: 4-20 mA; HART	T34
SITRANS TH420, Input: 2 x universal, Output: 4-20 mA; HART	T35
<b>Transmitter with display</b>	
Dual chamber housing, Aluminum General purpose, with local operation and indicator (select internal transmitter via T**-option)	A85
Dual chamber housing, Aluminum XP, with local operation and indicator (select internal transmitter via T**-option)	A86
<b>Other temperature transmitter (Metric housing, SST housing, etc)</b>	
Mounting of transmitter - ordered separately	A80
<b>Transmitter configuration</b>	
Specify measuring range in plain text	Y01
Specify HART-address (max. 8 characters) in plain text	Y17
Fail-safe value 3.6 mA (instead of 22.8 mA)	U36
<b>Certificates</b>	
Material certificate for wetted parts	C12
Cert SIL 2/3	C20

	Order code
Hydrostatic pressure test	C31
Thermowell NACE cert.	C50
Oxygen-cleaned (ISO 9001 grease-free for oxygen service)	C51
Inspection certificate Thermowell calculation according ASME PTC 19.3 (Murdock)	C37
Factory cal - matched pair	C15
3-point factory calibration: sensor without transmitter. Default calibration = 32-212F (0-100C). Specify other range with option Y01	C60
3-point factory calibration: sensor with transmitter. Default calibration = 32-212F (0-100C). Specify other range with option Y01	C61
CRN-marking (Specify which province via text)	Y60
<b>Thermowell options</b>	
Thermowell lag-length (T-length): 2 .. 3.5 inch: please specify in 1/2" steps	Y40
Thermowell lag-length (T-length): 4 .. 6 inch: please specify in 1/2" steps	Y41
Thermowell lag-length (T-length): longer than 6 inch: please specify in 1/2" steps	Y42
<b>Full penetration welding for flanged process connections</b>	
Full penetration weld	G02
X-ray test certificate for full penetration weld	C41
Ultrasonic test certificate for full penetration weld	C44
<b>Sensor options</b>	
Grounded T/C (std = ungrounded)	G31
4-wire RTD (std = 3-wire)	R04
<b>Further options</b>	
SS tag plate - wired to sensor assembly (connection head only)	Y15
Special option (define in plain text: "Y99:...")	Y99

## Technical specifications

### Measuring technology: Sensor elements

The diverse application spectrum for industrial temperature measuring technology requires different sensor technologies.

#### Resistance thermometer

Sensor elements made of other basic materials with different nominal resistances or different underlying standards are available on request. Resistance thermometers can be classified as follows:

- Basic design:
  - The sensor element is built with thin layer technology. The resistance material is applied in the form of a thin layer on a ceramic carrier material.
- Versions featuring increased vibration-resistance:
  - In addition to the basic design, the vibration resistance is improved through extra measures.
- Versions with expanded measuring range:
  - Elements in wire-wound design. The wire winding is embedded in a ceramic body.

#### Thermocouples

Other thermocouples based on other thermo couples or underlying standards are available upon request.

The most common base metal thermocouples include:

- Type K (NiCr-Ni) more stable than type J, but drifts in upper range.
- Type J (Fe-CuNi) narrow application band

### Measuring technology: Measuring range

The measuring range describes the temperature limits within which the thermometer can be used in a way that is meaningful for measurement purposes. Depending on the loads present, the thermowell materials and the desired accuracy levels, the actual application range for the thermometer may be smaller.

Resistance thermometer [°C (°F)]	
Basic version and increased vibration resistance	-50 ... +400 (-58 ... +752)
Expanded measuring range	-196 ... +600 (-320.8 ... +1112)

Thermocouple [°C (°F)]	
Type K	-40 ... +1000 (-40 ... +1132)
Type J	-40 ... +750 (-40 ... +1382)

### Measuring technology: Measuring accuracy

#### Resistance thermometer

The tolerance classes of the resistance thermometers correspond with IEC 751/EN 60751:

Tolerance	$\Delta t$
Basic accuracy, Class B	$\pm(0.30\text{ °C} + 0.0050 t [\text{°C}])$ $\pm(0.54\text{ °F} + 0.0050 t [\text{°F}-32])$
Increased accuracy, Class A	$\pm(0.15\text{ °C} + 0.0020 t [\text{°C}])$ $\pm(0.27\text{ °F} + 0.0020 t [\text{°F}-32])$
High degree of accuracy, Class A+ (1/3 B)	$\pm(0.10\text{ °C} + 0.0017 t [\text{°C}])$ $\pm(0.18\text{ °F} + 0.0017 t [\text{°F}-32])$

The following tables provide an overview of the scope of these tolerances. If you exceed the specified limits with a resistance thermometer, the values of the next lower accuracy class apply:

Resistance thermometer Basic version [°C (°F)]	
Tolerance	Range
Basic accuracy, Class B	-50 ... +400 (-58 ... +752)
Increased accuracy, Class A	-30 ... +300 (-22 ... +572)
High degree of accuracy, Class A+ (1/3 B)	0 ... 150 (32 ... 302)

Resistance thermometer Increased vibration-resistance [°C (°F)]	
Tolerance	Range
Basic accuracy, Class B	-50 ... +400 (-58 ... +752)
Increased accuracy, Class A	-30 ... +300 (-22 ... +572)
High degree of accuracy, Class A+ (1/3 B)	0 ... 150 (32 ... 302)

Resistance thermometer Expanded measuring range [°C (°F)]	
Tolerance	Range
Basic accuracy, Class B	-196 ... +600 (-321 ... +1112)
Increased accuracy, Class A	-100 ... +450 (-148 ... +842)

#### Thermocouples

The tolerance classes of the thermocouples correspond with IEC 584/EN 60584.

#### Catalog versions

Type	Basic accuracy, Class 2	Increased accuracy, Class 1
K	-40 °C ... +333 °C $\pm 2.5\text{ °C}$ (-40 °F ... +631 °F $\pm 4.5\text{ °F}$ ) 333 °C ... 1000 °C $\pm 0.0075x t [\text{°C}]$ (631 °F ... 1832 °F $\pm 0.0075x t [\text{°F}-32]$ )	-40 °C ... +375 °C $\pm 1.5\text{ °C}$ (-40 °F ... +707 °F $\pm 2.7\text{ °F}$ ) 375 °C ... 1000 °C $\pm 0.004x t [\text{°C}]$ (707 °F ... 1832 °F $\pm 0.004x t [\text{°F}-32]$ )
J	-40 °C ... +333 °C $\pm 2.5\text{ °C}$ (-40 °F ... +631 °F $\pm 4.5\text{ °F}$ ) 333 °C ... 750 °C $\pm 0.0075x t [\text{°C}]$ (631 °F ... 1382 °F $\pm 0.0075x t [\text{°F}-32]$ )	-40 °C ... +375 °C $\pm 1.5\text{ °C}$ (-40 °F ... +707 °F $\pm 2.7\text{ °F}$ ) 375 °C ... 750 °C $\pm 0.004x t [\text{°C}]$ (707 °F ... 1382 °F $\pm 0.004x t [\text{°F}-32]$ )

#### Other thermocouples, ignoble

Type	Basic accuracy, Class 2	Increased accuracy, Class 1
T	-40 °C ... 133 °C $\pm 1\text{ °C}$ (-40 °F ... +271 °F $\pm 1.8\text{ °F}$ ) 133 °C ... 350 °C $\pm 0.0075x t [\text{°C}]$ (271 °F ... 662 °F $\pm 0.0075x t [\text{°F}-32]$ )	-40 °C ... +125 °C $\pm 0.5\text{ °C}$ (-40 °F ... +257 °F $\pm 0.9\text{ °F}$ ) 125 °C ... 350 °C $\pm 0.004x t [\text{°C}]$ (257 °F ... 662 °F $\pm 0.004x t [\text{°F}-32]$ )
E	-40 °C ... +333 °C $\pm 2.5\text{ °C}$ (-40 °F ... +631 °F $\pm 4.5\text{ °F}$ ) 333 °C ... 900 °C $\pm 0.0075x t [\text{°C}]$ (631 °F ... 1652 °F $\pm 0.0075x t [\text{°F}-32]$ )	-40 °C ... +375 °C $\pm 1.5\text{ °C}$ (-40 °F ... +707 °F $\pm 2.7\text{ °F}$ ) 375 °C ... 800 °C $\pm 0.004x t [\text{°C}]$ (707 °F ... 1472 °F $\pm 0.004x t [\text{°F}-32]$ )

#### Other thermocouples, noble

Type	Basic accuracy, Class 2	Increased accuracy, Class 1
R and S	0 °C ... 600 °C $\pm 1.5\text{ °C}$ (32 °F ... 1112 °F $\pm 2.7\text{ °F}$ ) 600 °C ... 1600 °C $\pm 0.0025\text{ x } t $ (1112 °F ... 2912 °F $\pm 0.0025\text{ x } t $ )	0 °C ... 1100 °C $\pm 1\text{ °C}$ (32 °F ... 2012 °F $\pm 1.8\text{ °F}$ ) 1100 °C ... 1600 °C $\pm [1 + 0.003\text{ (t - 1100)}]\text{ °C}$ (2112 °F ... 2912 °F $\pm [1.8 + 0.003\text{ (t - 212)}]\text{ °F}$ )
B	600 °C ... 1700 °C $\pm 0.0025\text{ x } t $ (1112 °F ... 3092 °F $\pm 0.0025\text{ x } t $ )	

### Measuring technology: Connection types

In the case of resistance thermometers, the type of sensor connection directly affects the level of accuracy:

#### Two-wire system

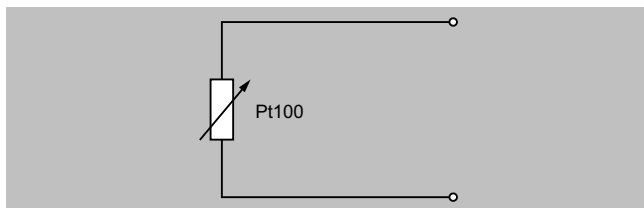
The resistance of sensor lines are included in the measurement result as an error. Adjustments are recommended in this case.

# Temperature measurement

## Temperature sensors

### SITRANS TS500 / Technical description

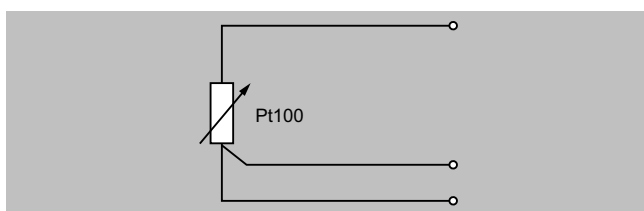
#### Technical specifications (continued)



Pt100 Two-wire system

#### Three-wire system

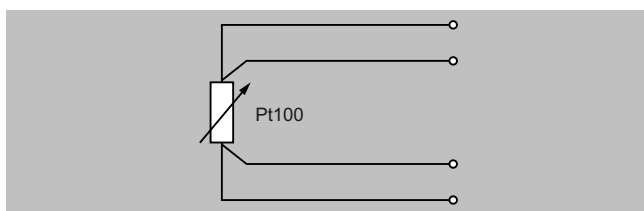
Line resistance is not included in the measurement result. Requirements: all terminal and line resistances (corrosion) are at the same level, and terminals are at the same temperature level.



Pt100 Three-wire system

#### Four-wire system

Line resistance is not included in the measurement result. This type of connection is the most secure and most accurate.



Pt100 Four-wire system

Siemens measuring inserts can be used to implement all types of connections for 1 x Pt100 devices. In the case of 2 x Pt100 versions, two- and three-wire systems are also possible. For measurement-related reasons, we always recommend a 1 x four-wire or 2 x 3-wire connection.

#### Thermowell calculation

Properly applied load diagrams will provide a sufficient degree of safety for the most common thermowell configurations.

However, there are cases in which operating conditions deviate too greatly from standard parameters. In this case, a customized thermowell calculation may be required.

Another reason for doing this calculation is the fact that flowing media can create turbulence at the tip of the thermowell under certain conditions. The thermowell will then vibrate and may even be destroyed if not configured correctly. This is the most frequent cause of thermowell failure.

SIEMENS offers the two recognized methods for calculating the thermowell:

- DIN/Dittrich method
- ASME/Murdock method
  - This method also takes into account turbulence formation on a mathematical level.

Both methods provide a high degree of safety with regard to thermowell configuration, however, they do not provide a guarantee against breakdowns.

#### Materials

Material descriptions/Standards comparison				Max. temperature [°C (°F)] (unloaded)	Properties	Applications
Mat. No.:	AISI/Trade name:	EN 10028-2:	Description			
1.4404 or 1.4435	AISI 316 L	X2CrNiMo17-12-2	Austenitic stainless steel	600 (1112)	Good acid resistance, resistant against grain boundary corrosion	Chemical industry, waste treatment, paper and cellulose industry, food industry
2.4816	Inconel 600	NiCr15Fe	Nickel-Chrome alloy	1150 (2102)	Resistant at high temperatures, resistant against chlorine-induced cold crack corrosion	Chemical industry, petrochemical industry, food industry

## Technical specifications (continued)

Material descriptions/Standards comparison				Max. temperature [°C (°F)] (unloaded)	Properties	Applications
1.4876	Incoloy 800	X10NiCrAlTi32-21	Austenitic heatresistant stainless steel	1100 (2012)	Excellent resistance against oxidation and carbonization at high temperatures, good corrosion resistance	O&G industry, waste gas treatment, power plants (steam boiler, heat exchanger), applications using aggressive fluids
2.4819	Hastelloy C 276	NiMo16Cr15W	Nickel-Chrome-Molybdenum alloy	1100 (2012)	Resistant at high temperatures, in oxidizing and reducing atmosphere, resistant against pitting and crevice corrosion, good corrosion resistance after welding	Chemicals industry, paper and cellulose industry, waste treatment, waste incinerators, emissions controls, shipbuilding and offshore industry
2.4360	Monel 400	NiCu30Fe	Nickel-Copper alloy	500 (932)	Excellent corrosion resistance, particularly against chlorineinduced cold crack corrosion	Chemical industry, offshore industry, nuclear technology, petrochemical industry

Where cost-intensive materials are used with flange thermowells, cost savings can be achieved by using a so-called flanged wheel. A thin disc of the material which comes into contact with media is applied prior to the flange (ordinary stainless steel).

Vibration resistance of measuring insert, cable sensor

Similar to the thermowell, inner (Karman vortices) and outer (plant) vibrations also affect the measuring insert. For this reason, a special assembly of measurement elements is required. Other than a few exceptions for cable and compact thermometers, Siemens only produces sensors based on a mineral-insulated cable. Together with precautions taken when installing the measuring element, the Siemens basic version already exceeds EN 60751 by more than a factor of 3. Pursuant to the measurement methods of this standard, the following values are obtained (tip-tip):

- 10 g: Basic version and expanded measuring range
- 60 g: Increased vibration-resistance and thermocouple

**Electrical stability**Insulation resistance

The insulation resistance between each measuring circuit and the fitting is tested at a voltage of 500 V DC at room temperature.

Riso ≥ 100 MΩ

Due to the property of the mineral-insulated cable, the insulation resistance decreases as temperature increases. Because of the special production method, it is, however, possible to achieve very good values even at high temperatures.

Line resistance

When connected to two-wire systems, the line resistance is included in the measurement result. The following rule of thumb can be used:

- Ø Measuring insert 6 mm (0.24 in) 2.8 Ω/m or 44.78 (44.78 )

For this reason a connection to three- or four-wire systems is highly recommended.

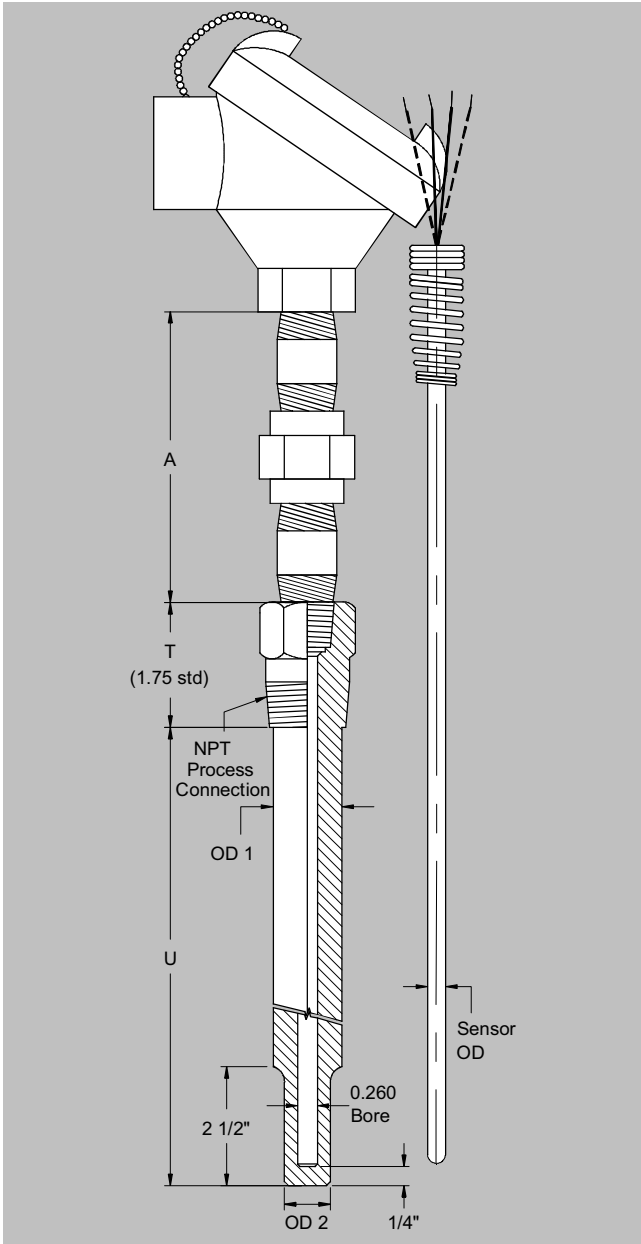
# Temperature measurement

## Temperature sensors

### SITRANS TS500 / Technical description

#### Dimensional drawings

##### Step down threaded well assemblies

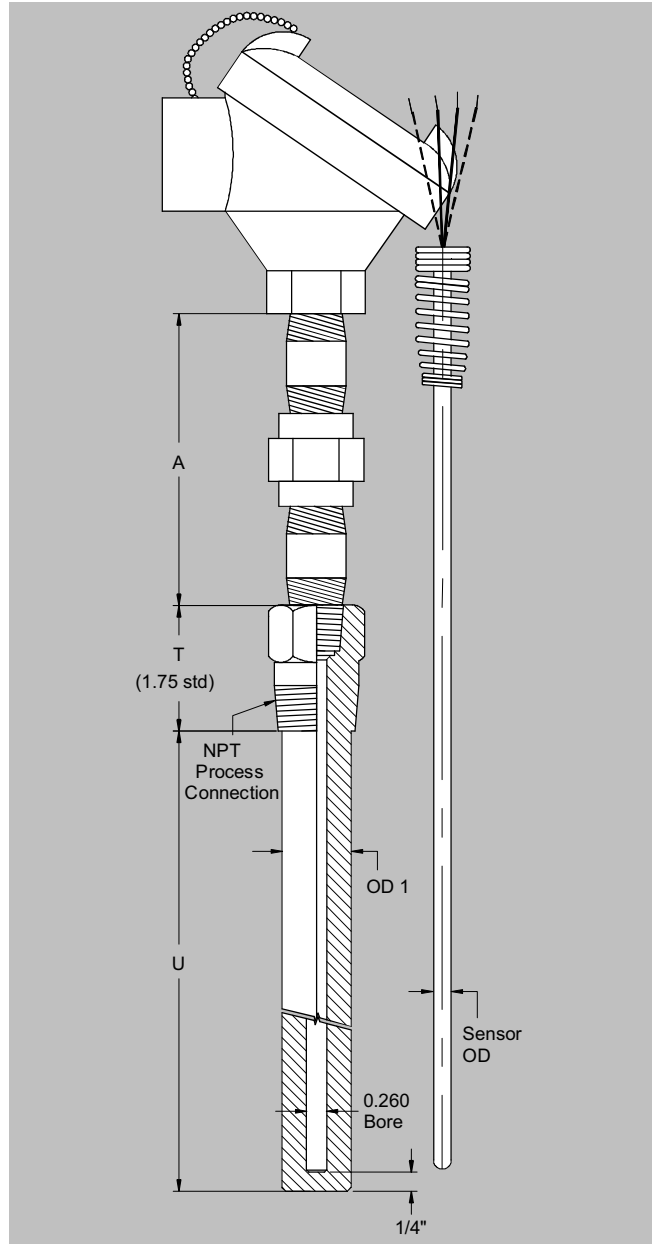


Dimensions in inch

Process NPT	OD1	OD2
1/2"	0.68"	5/8"
3/4"	7/8"	5/8"
1"	1 1/16"	5/8"
1 1/4"	1 1/8"	3/4"
1 1/2"	1 1/8"	3/4"

#### Dimensional drawings (continued)

##### Straight threaded well assemblies

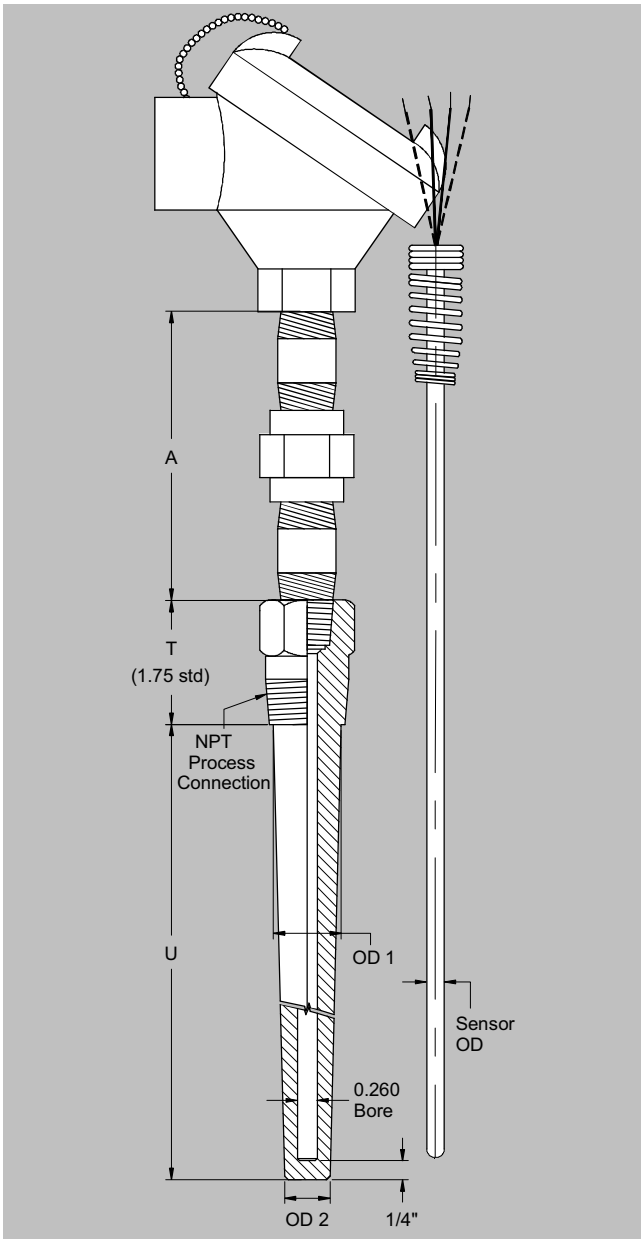


Dimensions in inch

Process NPT	OD1
1/2"	0.68"
3/4"	3/4"
1"	7/8"
1 1/4"	1 1/8"
1 1/2"	1 1/8"

Dimensional drawings (continued)

Tapered threaded well assemblies

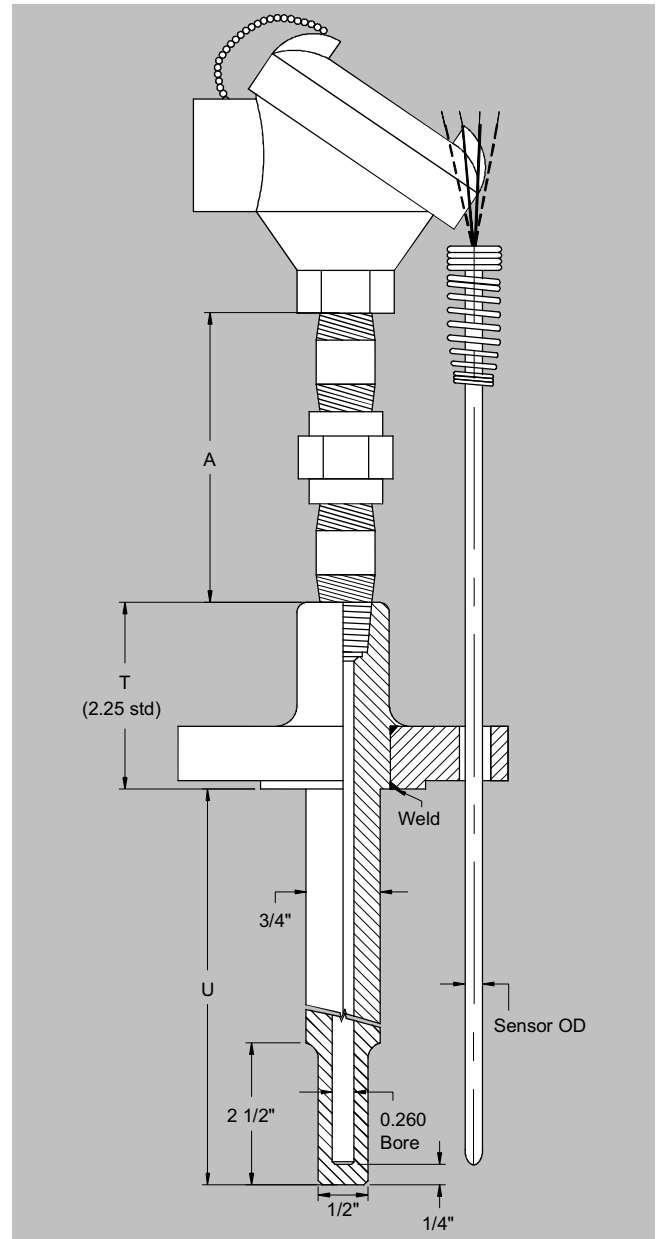


Dimensions in inch

Process NPT	OD1	OD2
1/2"	0.68"	5/8"
3/4"	7/8"	5/8"
1"	1 1/16"	5/8"
1 1/4"	1 1/8"	3/4"
1 1/2"	1 1/8"	3/4"

Dimensional drawings (continued)

Step down flanged well assemblies



Dimensions in inch

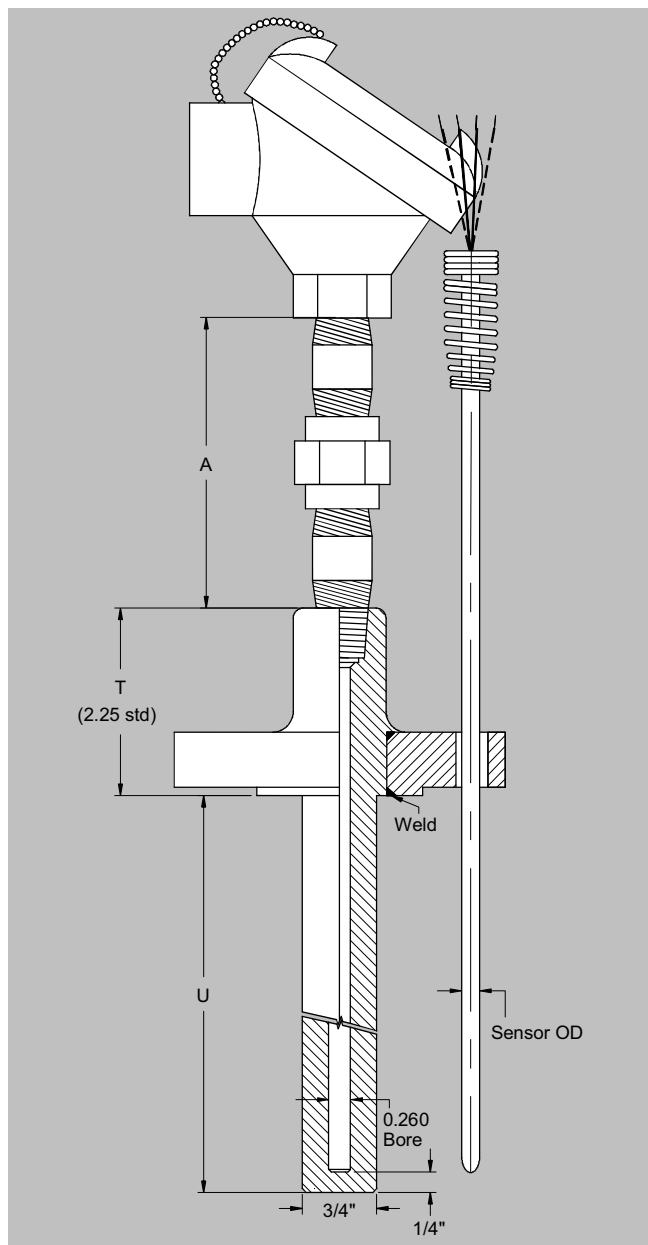
# Temperature measurement

## Temperature sensors

### SITRANS TS500 / Technical description

#### Dimensional drawings (continued)

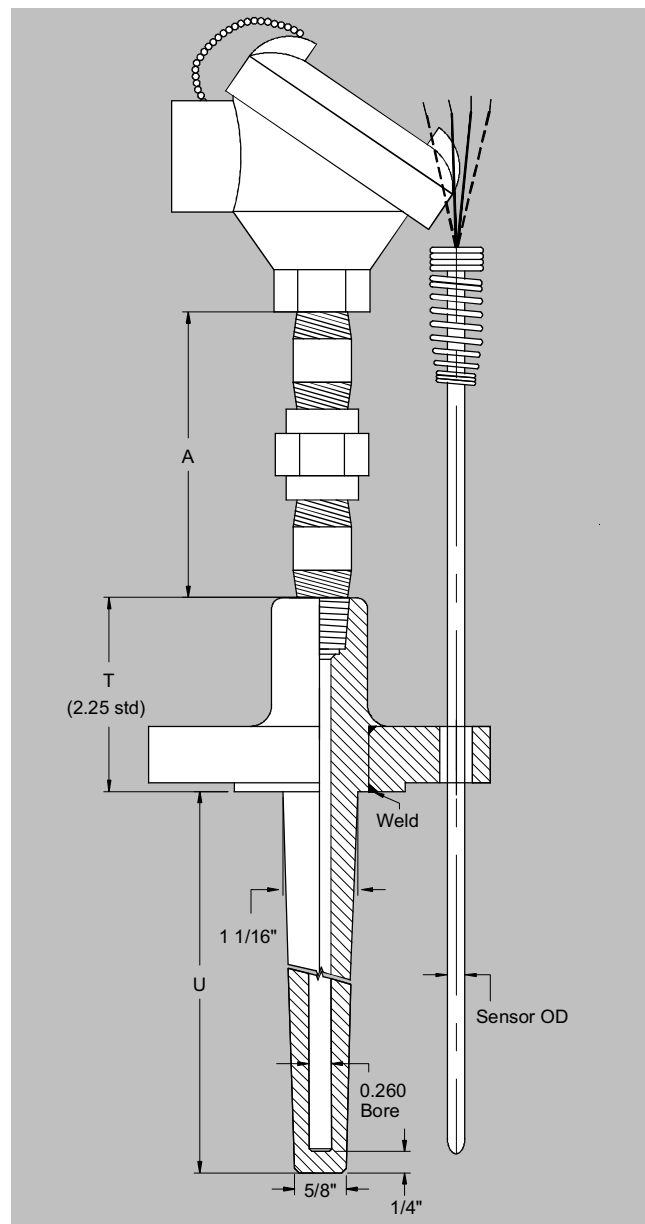
##### *Straight flanged well assemblies*



Dimensions in inch

#### Dimensional drawings (continued)

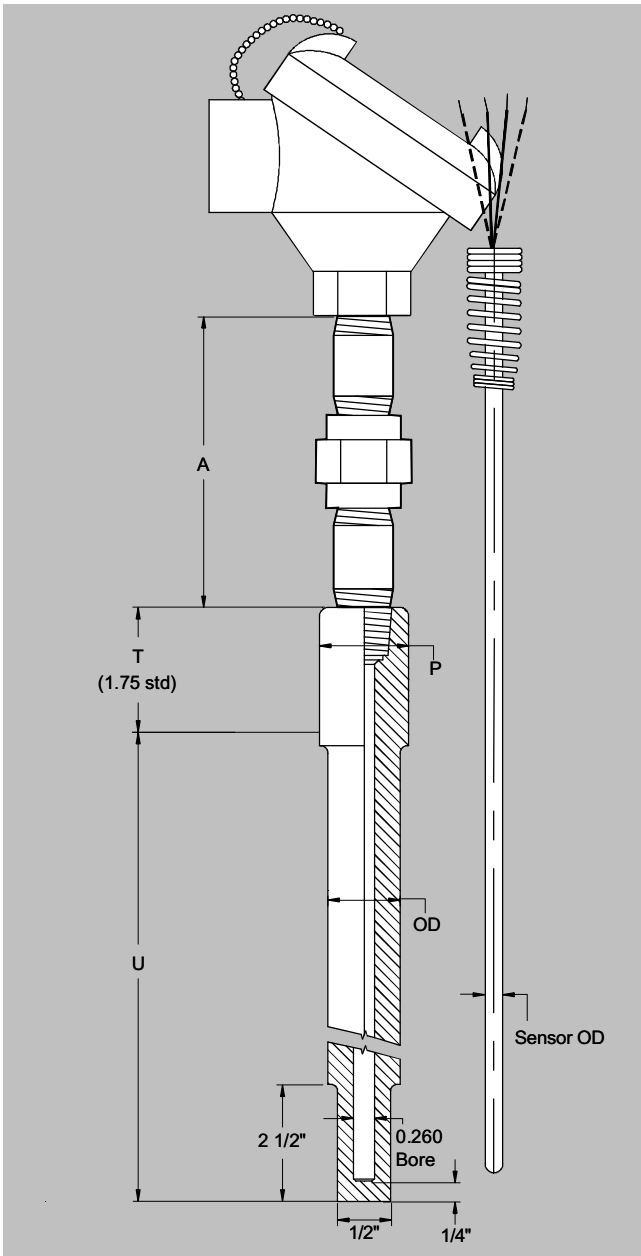
##### *Tapered flanged well assemblies*



Dimensions in inch

Dimensional drawings (continued)

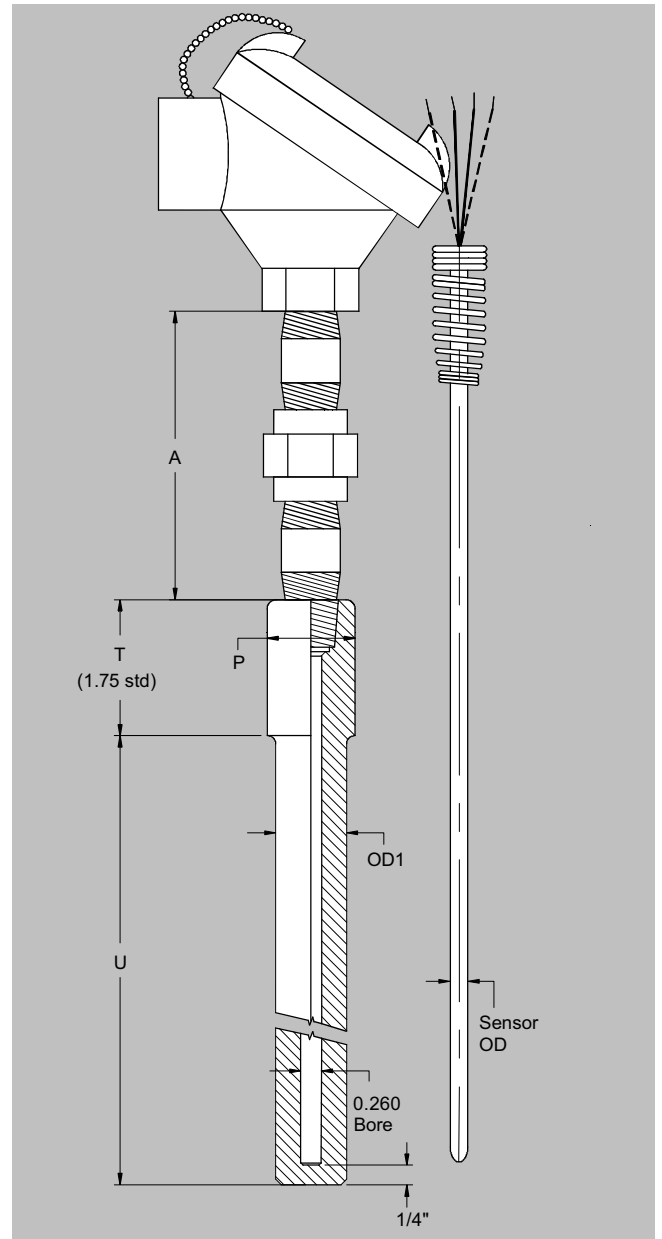
Step down socket well assemblies



Dimensions in inch

Dimensional drawings (continued)

Straight socket well assemblies



Dimensions in inch

Process NPT	OD1
1/2"	0.68"
3/4"	3/4"
1"	7/8"
1 1/4"	1 1/8"
1 1/2"	1 1/8"

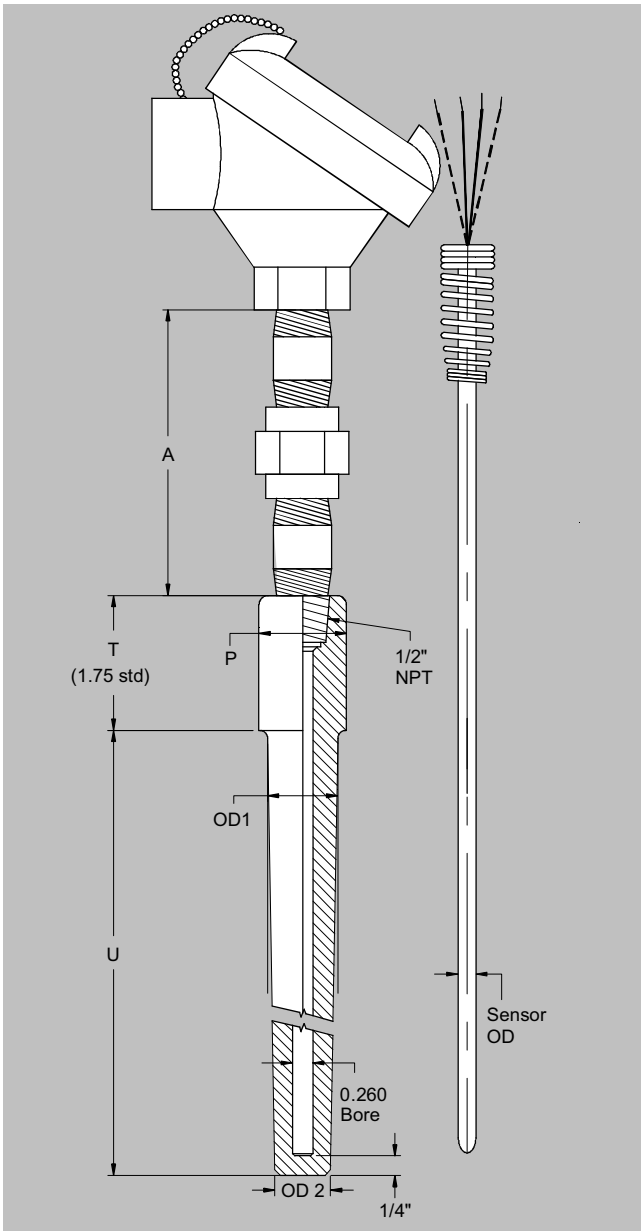
# Temperature measurement

## Temperature sensors

### SITRANS TS500 / Technical description

#### Dimensional drawings (continued)

##### Tapered socket well assemblies

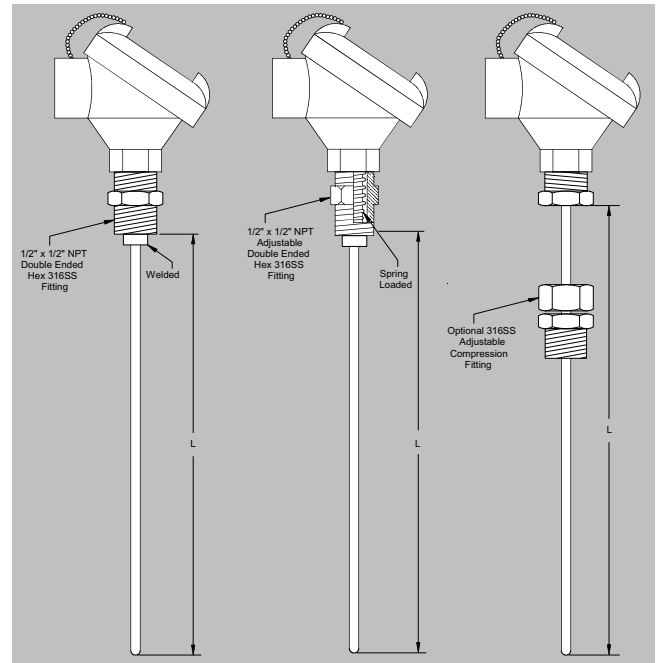


Dimensions in inch

Process NPT	OD1	OD2
1/2"	0.68"	5/8"
3/4"	7/8"	5/8"
1"	1 1/16"	5/8"
1 1/4"	1 1/8"	3/4"
1 1/2"	1 1/8"	3/4"

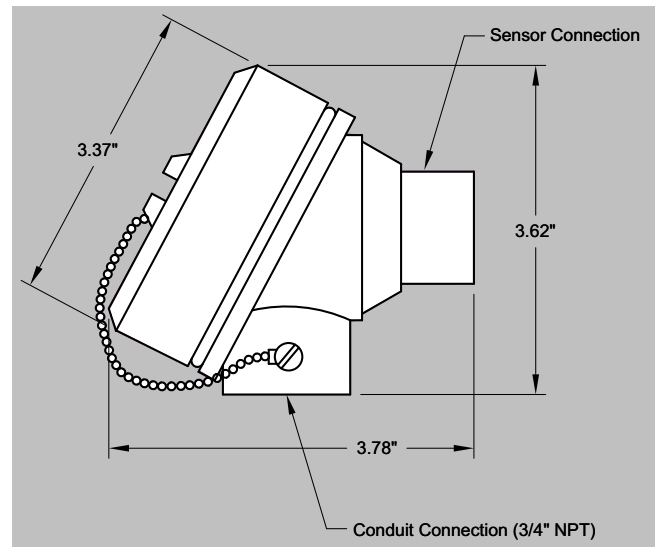
#### Dimensional drawings (continued)

##### General purpose sensors



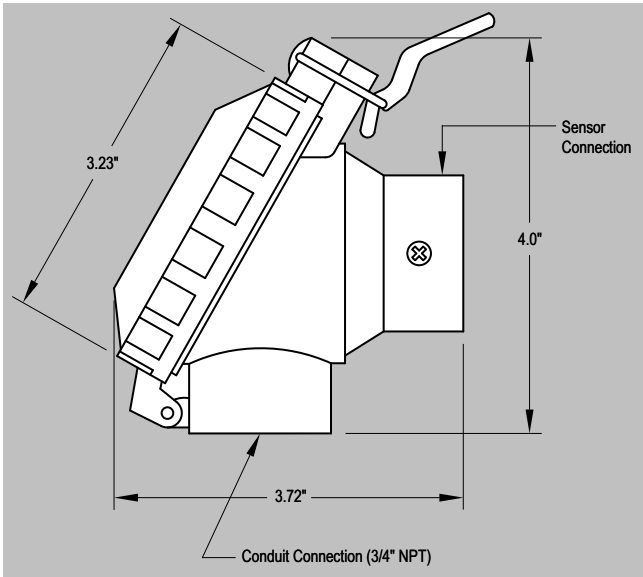
Dimensions in inch

##### Connection heads

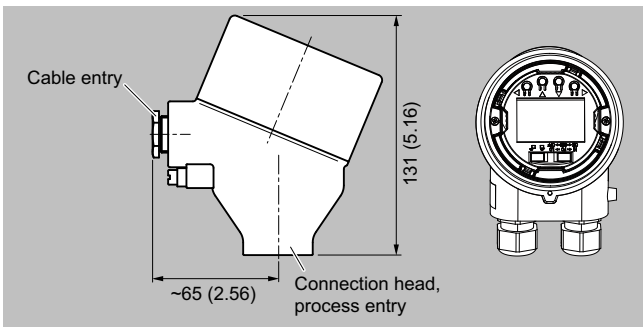


Connection head, aluminum (types G and J), stainless steel (types S and U)

Dimensional drawings (continued)



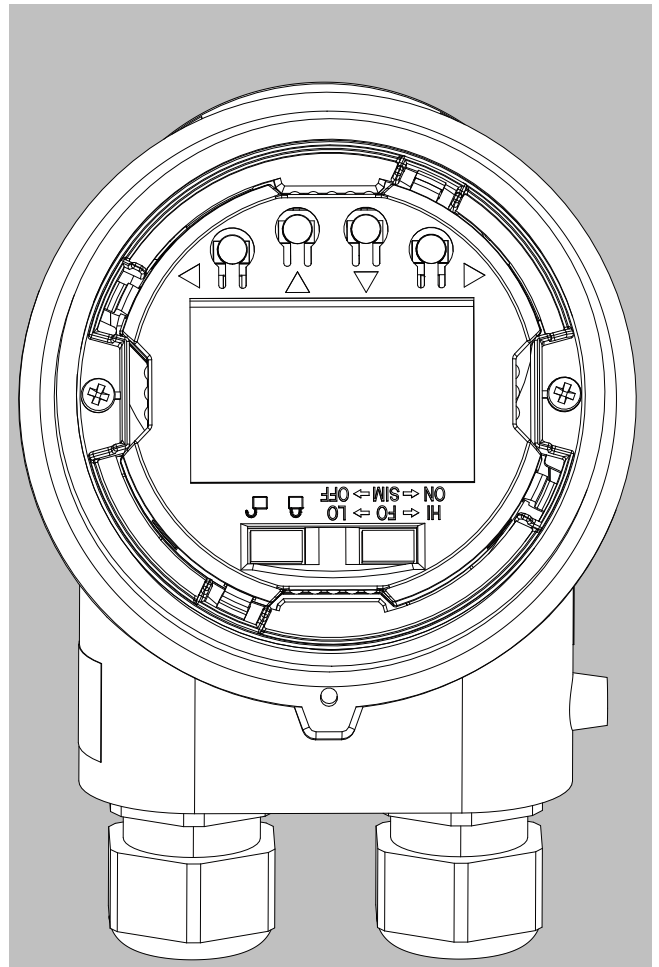
Connection head, flip-top aluminum (type B)



Connection head with 4-20 mA display, aluminum, type AH0, stainless steel, type AV0, dimensions in mm (inch)

Dimensional drawings (continued)

SITRANS TS500 – Connection head with display



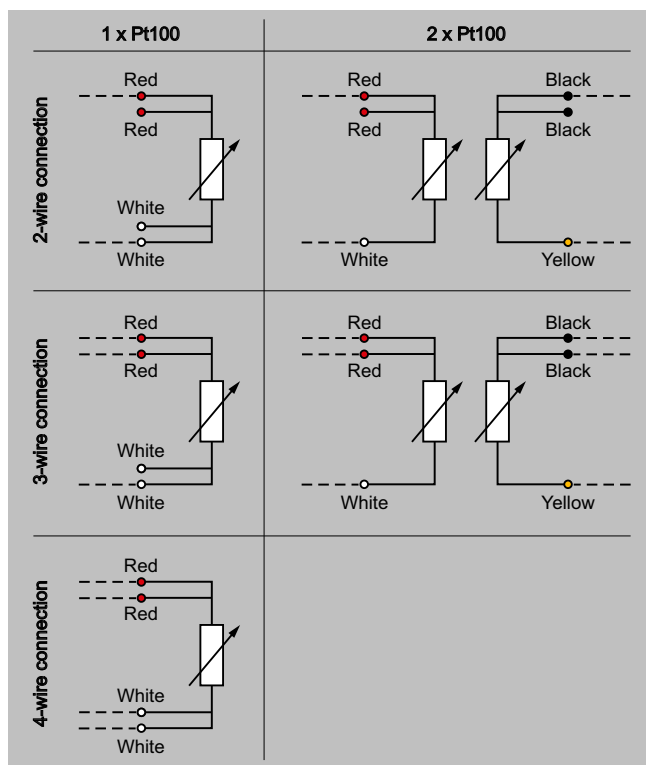
# Temperature measurement

## Temperature sensors

### SITRANS TS500 / Technical description

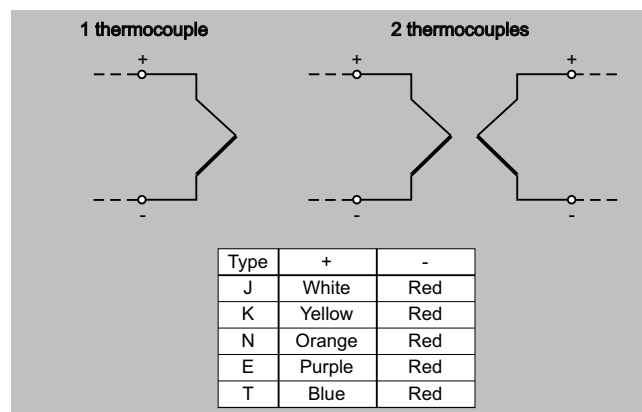
#### Circuit diagrams

##### Resistance thermometer



Schematics 1 x Pt100-2W up to 2 x Pt100-4W

##### Thermocouples



Circuit diagram for thermocouple

Where thermocouples are used, the use of head transmitters offers particular advantages: The cold junction is already integrated into the universal transmitter. There is no need for expensive thermo or extension cable. This also removes a number of possible error sources. The weak millivolt signal of the thermocouple is already converted into a stable and temperature-linear DC or bus signal on site. This drastically reduces the effects of electromagnetic factors on the measurement result.

If a head transmitter is not installed, the sensor feed line consists either of the appropriate thermo or extension leads. The thermo line is made from the thermo material of the relevant thermocouple, while the extension lead uses a cost-effective substitute material. The extension cable behaves similar to a thermo line at an electrical level, within a limited temperature range of up to 200°C. A wide spectrum of color coding is available for thermocouples on an international level. This must be taken into account during the electrical connecting.

Country	International/Germany			North America			UK/Czech Republic		
<b>Standard</b>	Not intrinsically safe <sup>1)</sup>			Extension lead <sup>2)</sup>			BS 1843		
	Jacket	+	-	Jacket	+	-	Jacket	+	-
N	PN	PN	WH	OG	OG	RD	OG	OG	BU
K	GN	GN	WH	YE	YE	RD	RD	BR	BU
J	BK	BK	WH	BK	WH	RD	BK	YE	BU
T	BR	BR	WH	BU	BU	RD	BU	WH	BU
E	VT	VT	WH	VT	VT	RD	BR	BR	BU
R+S	OG	OG	WH		BK	RD	GN	WH	BU
B	GY	GY	WH	GY	GY	RD	-	-	-

<sup>1)</sup> With an intrinsically safe line as per IEC 584-3, the sheath is always blue.

<sup>2)</sup> For thermo lines as per ANSI MC96, the sheath is always blue.

Country	Netherlands			Japan			France		
<b>Standard</b>	DIN 43714			ISC 1610-198			NF C42-323		
	Jacket	+	-	Jacket	+	-	Jacket	+	-
N	GN	RD	GN	BU	RD	WH	VT	VT	YE
K	BU	RD	BU	YE	RD	WH	BK	BK	YE
J	BR	RD	BR	BR	RD	WH	BU	BU	YE
T	BK	RD	BK	VT	RD	WH	OG	OG	YE
E	WH	RD	WH	BK	RD	WH	GN	GN	YE
R+S	GY	RD	GY	GY	RD	WH	-	-	-
B	GN	RD	GN	BU	RD	WH	VT	VT	YE

**Circuit diagrams** (continued)**Abbreviation for colors**

BK: black	BR: brown	BU: blue	GD: gold	GN: green
GY: gray	OG: orange	PN: pink	RD: red	SR: silver
TQ: turquoise	VT: violet	WH: white	YE: yellow	

**Transmitters**

In addition, our transmitters also allow for a large number of other possible connections (e.g. difference, average, two sensors). More

information can be obtained at: <http://www.usa.siemens.com/temperature>