

# ABB TSP411 Temperature sensors datasheet

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# Measurement made easy

## TSP411 SensyTemp

### Temperature sensors

Temperature sensors for  
the Oil & Gas industry



#### Modular design

- Extremely robust connection head
- Optional LCD indicator
- Display with configuration function
- Transmitters available to SIL 2

#### Engineered with the Oil & Gas industry in mind

- Full compliance to ISO19001:2000

#### Hazardous area approvals

- IECEx ia and d
- ATEX Ex d
- ATEX Ex ia
- ATEX Ex n
- Others on application

#### Applications

- Off-shore
- On-shore refining and distribution

# TSP411 SensyTemp Temperature sensors

## General information

ABB manufacture the full range of temperature sensors required by the Oil & Gas industry, including multipoints, surface-mounted temperature solutions and boiler tube assemblies.

Most temperature measurement requirements in the Oil & Gas industry can be fulfilled from ABB's standardized product offering but if an application's exact requirements cannot be met from this product line, ABB also provide an engineered solution service.

## TSP411 sensor assembly components

### Connection head and lid

The connection head and lid form the protective housing for the sensor element and are available in either epoxy-coated aluminium (AGL series) or uncoated 316 stainless steel (AGS series). The head is provided with two connection ports, both drilled and threaded to M20 x 1.5 mm. One connection port is closed by an EX d rated plug.

A range of lids are available:

- a low lid for use with or without a transmitter \*
- a high blind lid for use with a transmitter without a display \*\*
- a high lid with window for use with transmitter with a display

### Extension pieces

Extension pieces are available that enable the connection head to be positioned clear of the process pipeline. The sensor is mounted inside the connection head and passes through the extension piece.

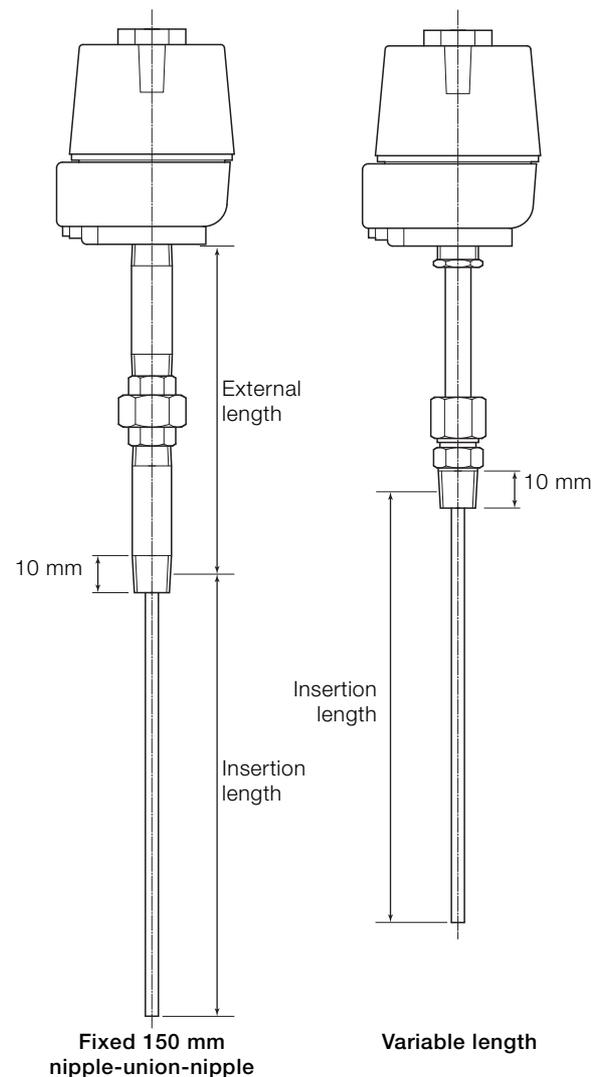


Fig. 1: Extension pieces

\* If a transmitter is required, it is mounted directly onto the sensor using a plate. If a transmitter is not required, a connection block is used.

\*\* The transmitter is mounted on pillars above a connection block.

## Sensors

All TSP411 sensors are manufactured from stainless steel sheathed \*, mineral insulated (magnesium oxide) cable. A variety of sensing elements are available in either simplex (single) or duplex (double) forms. The standard offering is either a 3-wire PT100 sensor or a 2-wire type K thermocouple. 4-wire PT100 sensors are available for applications where the sensor signal is to be converted to a robust field signal some distance away from the sensor mounting – ABB's TTF300 Series of field-mounting transmitters provide appropriate transmitter options for remote signal conditioning and transmission.

Type K thermocouples are provided with an Inconel 600 sheath.

## Transmitters

ABB strongly recommends that the weak primary signals from temperature sensors are converted to robust process communications protocols as close to the sensing element as possible. To achieve this, ABB manufacture two, best-in-class, head-mounted transmitter options – the TTH200 and the TTH300.

If a head-mounting transmitter cannot be used, ABB also manufacture a range of sophisticated and simple-to-install field-mounting transmitters. The single-compartment TTF300 and the dual-compartment TTF350 offer all the advantages of the TTH300 in a remote-mounting, ergonomically designed transmitter – see data sheets [DS/TTF300-EN](#) and [DS/TTF350-EN](#) for further details.



Fig. 2: TTH200 HART – 4 to 20 mA HART® transmitter



Fig. 3: TTH300 HART – 4 to 20 mA HART® transmitter



Fig. 4: TTH300 PA – PROFIBUS® PA transmitter



Fig. 5: TTH300 FF – FOUNDATION® Fieldbus H1 transmitter

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## TTH200

ABB's midrange transmitter is available with 4 to 20 mA and HART process protocol and offers industry-beating performance for a single-channel HART communication transmitter. A single sensor input for a wide range of resistance thermometers and thermocouples is also available.

The TTH200 features sophisticated fault detection to warn plant operators that the sensing element has either failed or is about to fail.

See data sheet [DS/TTH200-EN](#) for further details.

## TTH300

ABB's flagship transmitter offers unparalleled performance and a dual-channel input in HART and 4 to 20 mA or Profibus PA or Foundation Fieldbus communication protocols. Sensor inputs for a wide range of resistance thermometers and thermocouples are enhanced by inputs that accept simple voltage inputs.

Like the TTH200, the TTH300 also features sophisticated fault detection to warn plant operators that the sensing element has either failed or is about to fail.

Two sensors can be connected to the TTH300 providing some unique diagnostic opportunities:

**Drift detection** – where both sensors are continuously monitored and any drift between them detected to give early warning of sensor failure.

**Automatic redundancy** – where both sensors are monitored and failure of the primary sensor results in the automatic switching to the secondary sensor. This again provides warning of imminent sensor failure to enable replacement before the critical plant measurement is lost.

The TTH300 can also be programmed with a curve variable to match exactly the sensor supplied; this option is available to the Oil & Gas industry but has the disadvantage that new parameters must be loaded if a sensor is replaced.

See data sheet [DS/TTH300-EN](#) for further details.

## LCD Display

The TTH200 can be supplied fitted with a type AS LCD display module to provide visual indication of the process temperature.



Fig. 6: Type AS LCD display

The TTH300 can be supplied fitted with either a type AS or a type A LCD display module:

**type AS** – displays the process temperature only

**type A** – displays the process temperature and is also equipped with a tactile-button interface to enable local programming.

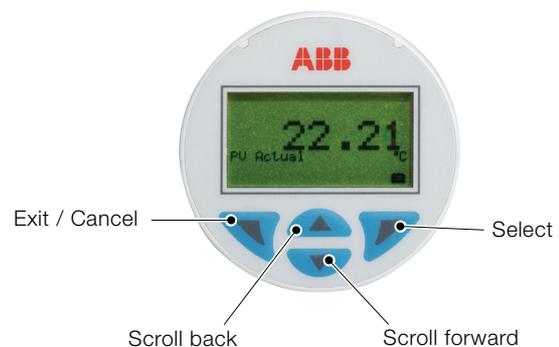


Fig. 7: Type A LCD display

## Thermowells

The TSW400 series of thermowells can be added as a configurable option to the TSP411 to provide a complete sensor system. Selecting option code Y1 'To suit thermowell attached' in the Ordering information coding table under 'Insertion length' (see page 8) implies that a TSW400 thermowell is required.

See data sheet [DS/TSW400-EN](#) for details of thermowells.

## Installation

The TSP411 is designed to be fitted to an existing thermowell or is supplied with a solid drilled thermowell. The TSP411 is equipped with 10 mm of spring-loaded adjustment that ensures that the sensor tip is pushed firmly into the end of the thermowell – good mechanical contact with the thermowell improves the sensor's speed of response to process temperature changes.

When ordering a TSP411 for fitment to an existing thermowell, the insertion depth (U) must be determined. Insert a 6 mm diameter (or less) rod into the thermowell and mark the point at which the rod exits the thermowell. Remove the rod and measure to the mark. Calculate the 'U' length required by subtracting the fixing length of the screw thread from the length measured. For example, in the case of a 1/2 in. NPT thread this is 10 mm (1/2 in.) (a 'screw-thread' connection type thermowell is normally equipped with a 1/2 in. NPT tapered thread).

## Measuring sensor specifications

All ABB TSP411 sensors for the Oil & Gas industry are manufactured using either class A PT100 sensors or Class 1 thermocouple cable to either IEC 60751 or IEC 60584. Verification of the accuracy of the sensor element can be obtained by requesting either a 3-point calibration at 0 to 50 to 100 °C or a custom calibration. Measuring sensors are manufactured using stainless steel sheathed \*, mineral-insulated cable 6 mm in diameter. ABB can supply other diameters on request of an engineered solution.

Type K thermocouples are provided with an Inconel 600 sheath.

## Sensor insulation resistance

IEC60751 regulations require that the resistance between the fitting and the sensor wires is a minimum of 100 MΩ at 100 volts DC. However, ABB tests TSP411 sensors at 500 volts DC and demand a resistance of at least 500 MΩ – far in excess of IEC60751 requirements.

# TSP411 SensyTemp Temperature sensors

## Head and lid specifications

AGL series heads and lids are manufactured from epoxy-coated aluminium.

AGS series heads and lids are manufactured from 316 stainless steel.

Both head and lid options are compliant with ingress protection standards IP66 and IP67.

Dimensions in mm (in.)

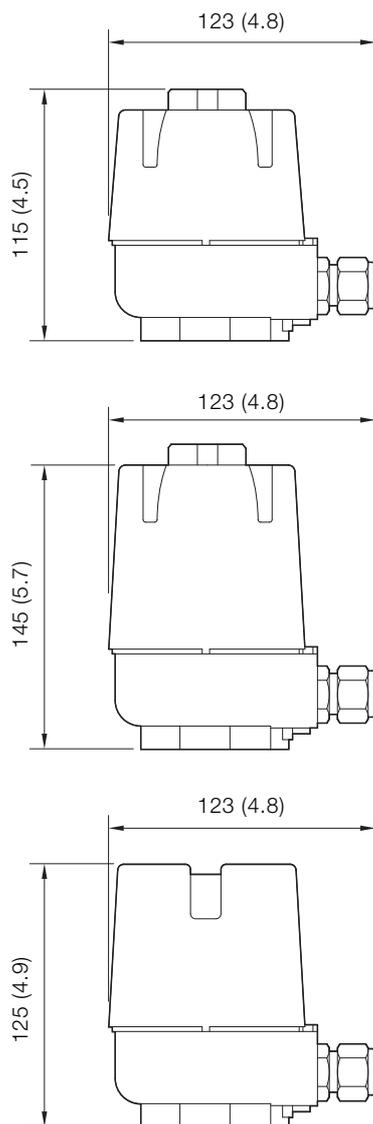


Fig. 8: Head and lid dimensions

## Functional safety (SIL)

Both TTH200 and TTH300 transmitters can be supplied with a certificate of conformity for use in safety-relevant applications up to and including SIL level 2.

## Tag numbers

Tag numbers (when requested) are engraved on a stainless steel plate that is attached to the sensor with stainless steel wire.

## EX specifications

### ATEX ia

#### Intrinsic safety ATEX

Explosion protection

– Approved for use in Zone 1

Designation

– II 1G Ex ia IIC T6

EC type-examination

– EC type-examination certificate PTB 05 ATEX 2079 X

### Safety specifications for intrinsic safety ATEX / IECEx

Temperature class	Permissible ambient temperature range	
	Device category 1 use	Device category 2 use
T6	–40 to 44° C (–40 to 112.2° F)	–40 to 56° C (–40 to 132.8° F)
T5	–40 to 56° C (–40 to 132.8° F)	–40 to 71° C (–40 to 159.8° F)
T4	–40 to 60° C (–40 to 140° F)	–40 to 85° C (–40 to 185° F)

### ATEX Ex d

Explosion Protection

– Approved for use in Zone 1

Designation

– EX II 2G Ex de IIC T6 (T<sub>amb</sub> –35° to 60° C) Gb

EC type-examination

– EC Type-examination certificate BASEEFA04ATEX0033X

### ATEX n

Explosion Protection

– Approved for use in Zone 2

Designation

– EX II 3G Ex nA II T6

(see the following table for T rating and allowable temperature)

Maximum permissible operating temperatures of assemblies (including extension tubes, thermowells, protection tubes, assembling sets etc. with direct thermal contact)

	T Rating	Minimum °C	Maximum (°C)	
			0 TX	1 TX
Inset only, no transmitter	T6	–20	85	N/A
TTH200	T6	–20	N/A	56
TTH300	T6	–20	N/A	56

EC type-examination

– EC Type-examination certificate: BASEEFA03ATEX0126X

### IECEx d

Explosion Protection

– Approved for use in Zone 1

Designation

– EX II 2G Ex de IIC T6 (T<sub>amb</sub> –35° to 60° C)

EC type-examination

– EC type-examination certificate: IECEx BAS 11.0063X

### 1.5 IECEx ia

#### Intrinsic safety IECEx

Explosion protection

– Approved for use in Zone 0

Designation

– Ex ia IIC T6

For further information, see certificate

### Safety specifications for intrinsic safety ATEX / IECEx

Temperature class	Permissible ambient temperature range	
	Device category 1 use	Device category 2 use
T6	–40 to 44° C (–40 to 112.2° F)	–40 to 56° C (–40 to 132.8° F)
T5	–40 to 56° C (–40 to 132.8° F)	–40 to 71° C (–40 to 159.8° F)
T4	–40 to 60° C (–40 to 140° F)	–40 to 85° C (–40 to 185° F)

# TSP411 SensyTemp

## Temperature sensors

### Ordering information

TSP 411 European design	TSP411	Main code						Optional code				
		XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	
<b>Explosion protection / approvals</b>												
Without (safe area)		Y0										
ATEX ia		A1										
ATEX d		A5										
ATEX n		A7										
FM Intrinsic safety		F1										
IECEX d, ia		M5										
Others		Z9										
<b>Measuring inset type</b>												
1 x Pt100, class A, 3-wire thin film resistor, measuring range -50 to 400 °C, vibration resistance 10 g		P2										
2 x Pt100, class A, 3-wire thin film resistor, measuring range -50 to 400 °C, vibration resistance 10 g		P5										
1 x Pt100, class A, 3-wire thin film resistor, measuring range -50 to 400 °C, vibration resistance 60 g		R2										
2 x Pt100, class A, 3-wire thin film resistor, measuring range -50 to 400 °C, vibration resistance 60 g		R5										
1 x Pt100, class A, 3-wire wire-wound resistor, measuring range -196 to 600 °C, vibration resistance 10 g		R6										
2 x Pt100, class A, 3-wire wire-wound resistor, measuring range -196 to 600 °C, vibration resistance 10 g		R7										
1 x Pt100, class A, 4-wire extended range wire-wound resistor, measuring range -196 to 600 °C, vibration resistance 10 g		P3										
1 x Type K thermocouple (NiCr-NiAl), class 1		K1										
2 x Type K thermocouple (NiCr-NiAl), class 1		K2										
Others		Z9										
<b>Insertion length</b>												
100 to 200 mm		H1										
201 to 300 mm		H2										
301 to 400 mm		H3										
401 to 500 mm		H4										
501 to 600 mm		H5										
601 to 700 mm		H6										
701 to 800 mm		H7										
801 to 900 mm		H8										
901 to 1000 mm		H9										
1001 to 1100 mm		T0										
To suit thermowell attached		Y1										

Optional code  
XX XX XX XX XX  
See page 10

Continued on next page ...

**TSP 411 European design**

**Main code**  
**TSP411** **XX** **XX** **XX** **XX** **XX** **XX**  
 See page 8

**Optional code**  
**XX** **XX** **XX** **XX** **XX**  
 See page 10

**Extension type**

ABB standard 45 to 175 mm adjustable, 1/2 in. BSP	B1
ABB standard 45 to 175 mm adjustable, 1/2 in. NPT	N1
ABB standard 150 mm fixed length, nipple-union-nipple, 1/2 in. NPT	N4
Nipple-union-nipple, variable length (minimum 85 mm), 1/2 in. NPT	N5
150 mm fixed length nipple only 1/2 in. NPT	N3
Variable length nipple only (minimum length 35 mm) 1/2 in. NPT	N2
Oil seal nipple only (length 34 mm) 1/2 in. NPT	W1
Oil seal nipple-union-nipple variable length (minimum length 115 mm) 1/2 in. NPT	W2
Others	Z9

**Connection head type / material**

AGL / Aluminium, screwed cover (transmitter mounted on plate or terminal block without transmitter)	L1
AGLH / Aluminium, high cover, screwed (terminal block with transmitter mounted on pillars)	L2
AGLD / Aluminium, screwed cover with display	L4
AGS / Stainless steel, screwed cover (transmitter mounted on plate or terminal block without transmitter)	S1
AGSH / Stainless steel, high cover, screwed (terminal block with transmitter mounted on pillars)	S2
AGSD / Stainless steel, screwed cover with display	S4
Others	Z9

**Transmitter type**

TTH300-HART, programmable, output signal 4 to 20 mA, dual input	H4
TTH300-HART, Ex version, programmable, output signal 4 to 20 mA, dual input	H5
TTH300-PA, programmable, output PROFIBUS PA, dual input	P6
TTH300-PA, Ex version, programmable, output PROFIBUS PA, dual input	P7
TTH300-FF, programmable, output FOUNDATION Fieldbus H1, dual input	F6
TTH300-FF, Ex version, programmable, output FOUNDATION Fieldbus H1, dual input	F7
TTH200-HART, programmable, output signal 4 to 20 mA	H6
TTH200-HART, Ex version, programmable, output signal 4 to 20 mA	H7
Others (price does not include transmitter)	Z9
Without	Y1

# TSP411 SensyTemp

## Temperature sensors

TSP 411 European design	Main code						Optional code					
	TSP411	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	
	See pages 8 and 9											
<b>Accessories</b>												
20 mm to 1/2 in. adapter											AN	
Additional stainless steel blind plug for cable entry Exd											AP	
2 blind brass plugs Exd											AR	
FieldKey wireless adaptor											AW	
<b>Calibration certificates</b>												
Three-point calibration 0 to 50 to 100 °C											VA	
Three-point calibration custom points (min. -20 °C, max. 600 °C)											VB	
Custom calibration											V6	
<b>Display type</b>												
None											L0	
LCD indicator type AS											L1	
Configurable LCD indicator type A											L2	
<b>Documentation language</b>												
German											M1	
Spanish											M3	
French											M4	
English											M5	
<b>Transmitter options</b>												
Transmitter set for redundancy											WR	
Transmitter set for drift detection											WT	
SIL2 – Declaration of conformity											WS	

### Added characteristics

- Actual Insertion length (mm)
- Actual extension length (mm)
- Transmitter temperature range (min.)
- Transmitter temperature range (max.)
- Custom calibration range
- Tag No.

## Acknowledgements

HART is a registered trademark of the HART Communication Foundation

PROFIBUS is a registered trademark of the PROFIBUS organization

FOUNDATION is a registered trademark of the Fieldbus Foundation

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