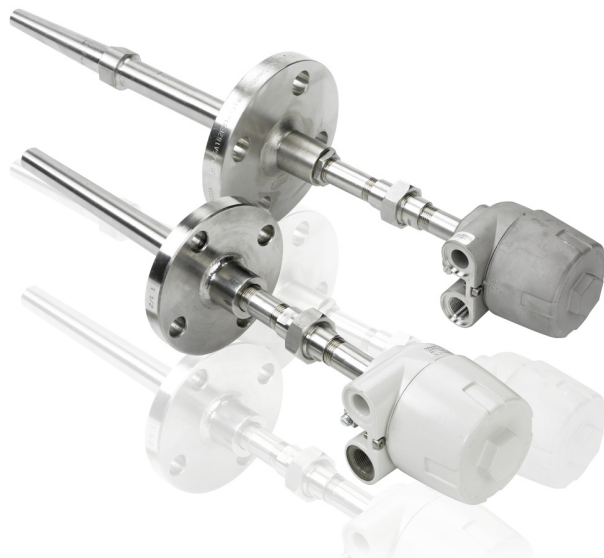# Measurement made easy
TSP411 SensyTemp
Temperature sensors

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

Power and productivity
for a better world™

ABB

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.
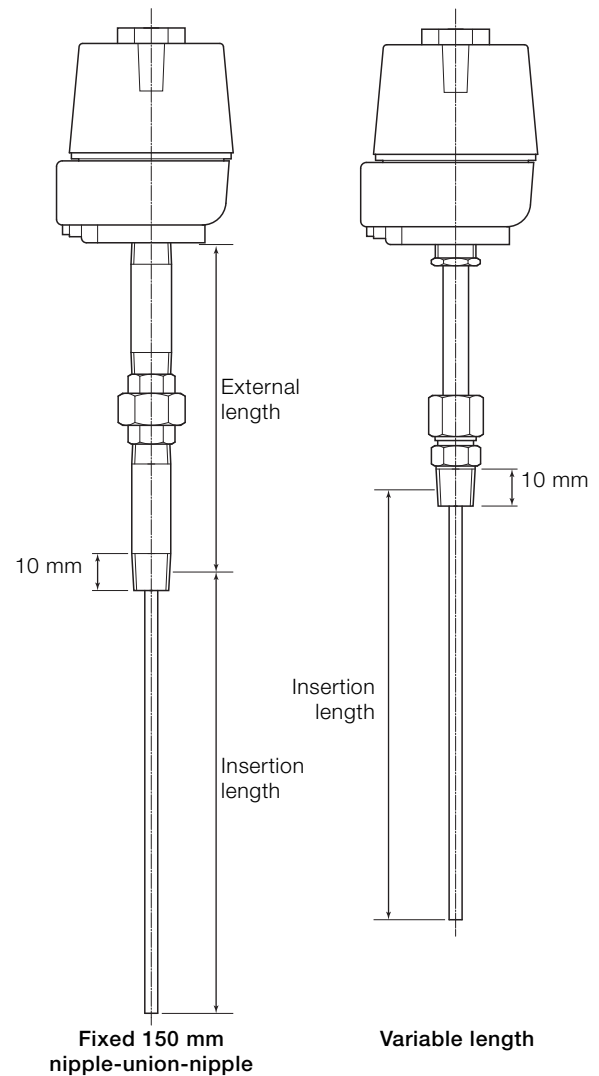

External length

10 mm

10 mm

Insertion length

Insertion length

Insertion length

Fixed 150 mm nipple-union-nipple

Variable length

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.
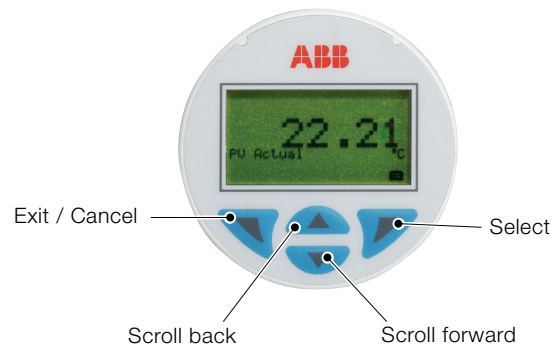

Fig. 7: Type A LCD display

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
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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.
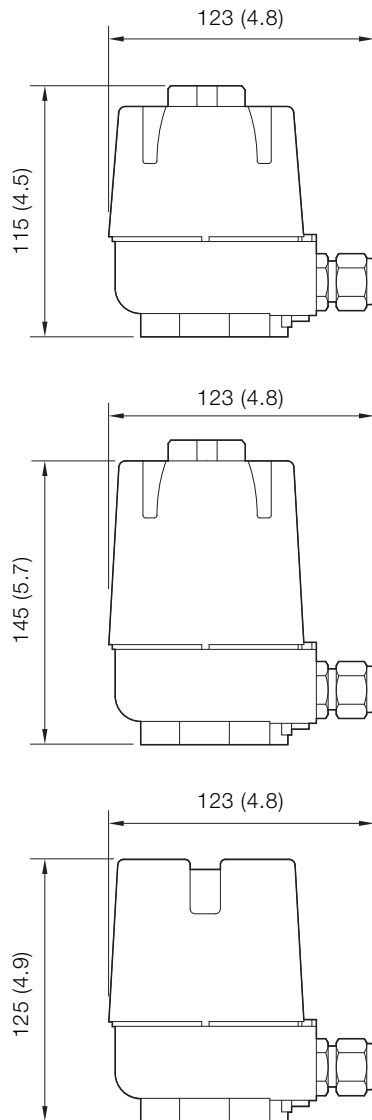
Dimensions in mm (in.)

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_{amb} –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)

			Maximum (°C)	
	T Rating	Minimum °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_{amb} –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

		Main code						Optional code				
TSP 411 European design	**TSP411**	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX
									See page 10			
Explosion protection / approvals												
Without (safe area)	Y0											
ATEX ia	A1											
ATEX d	A5											
ATEX n	A7											
FM Intrinsic safety	F1											
IECEx d, ia	M5											
Others	Z9											
Measuring inset type												
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										
Insertion length												
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									

	Main code	Optional code
TSP 411 European design	TSP411 XX XX XX XX XX XX	XX XX XX XX XX
	See page 8	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

	Main code	Optional code
TSP 411 European design	TSP411 XX XX XX XX XX XX	XX XX XX XX XX
	See pages 8 and 9	

Accessories		
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
Calibration certificates		
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
Display type		
None	L0
LCD indicator type AS	L1
Configurable LCD indicator type A	L2
Documentation language		
German	M1
Spanish	M3
French	M4
English	M5
Transmitter options		
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

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