ABB MEASUREMENT & ANALYTICS | DATA SHEET

NINVA™ TSP341-N

Sensor for non-invasive temperature measurement

HERMES AWARD 2019

Measurement made easy

A simpler and safer approach to temperature measurement

Safer – no process penetration

- Global approvals for explosion protection up to Zone 0
- Consideration of the NAMUR recommendation NE 24
- Sensor monitoring and self-monitoring (NE 89, NE 107)
- Functional safety SIL2 in accordance with IEC61508

Lower cost of ownership – faster and more cost-effective measurements

- Quick installation for lower installation costs
- No thermowell testing, calculations or exotic materials
- No shutdown required for verification of the measurement

Simpler – straightforward from ordering to maintenance

- Eliminates stocking thermowells and inset length variants
- Single variant for piping from DN 40 to DN 2500 (1.5 to 88 in)*
- Plug and play – no need to input pipe size and material

High performance – keep your measurement quality

- Accuracy and response times matching invasive measurements
- Repeatability proven under long term industrial testing
- Based on TTH300 (HART) transmitter with NINVA™ non-invasive temperature model

* Mounting for smaller piping down to DN 15 (0.5 in) available through special designs.

Introduction

Non-invasive temperature measurement

Classic temperature measurement in process technology is made by directly introducing the temperature sensor into the measuring medium.
The measuring medium (gaseous, liquid or paste-like) is usually in a vessel or piping and highly influences the selection of traditional invasive measurements.

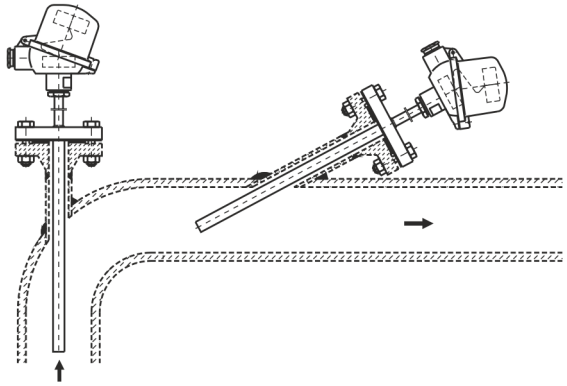


Figure 1: Classic installation of temperature sensors in piping

Depending on the process properties, the temperature sensor needs special protection to protect it from chemical and mechanical loads. For example, abrasive dust or sands, which move through the piping at high speeds, present a special challenge.

To protect the temperature sensor, the thermowells used must be inspected regularly and replaced as needed. Chemically aggressive or abrasive media can lead to the erosion of thermowell material.
A thermowell placed in flowing media can also begin to vibrate due to vortex formation and in extreme cases it can break.
Therefore, guidelines and standards for the stability of thermowells have become more restrictive over time, and so the costs of maintenance and exchange have increased as well. In addition, to prevent potential catastrophic failure, thermowells used must be inspected regularly and replaced as needed in known critical conditions.

These life cycle costs are in addition to capital expenditure costs incurred during planning and designing temperature measurement points. Engineering costs for stability calculations, structural flanges to support and seal the thermowells, and welding and fabrications costs all add up to the total capital expenditure.

The costs mentioned above can be eliminated if the process temperature could be measured non-invasively. Using ABB's non-invasive approach, it is possible to get an accurate measurement of the process temperature without the need for a thermowell.

The NINVA™ TSP341-N* temperature sensor now combines non-invasive temperature measurement with the established HART® communications protocol in two-wire technology. Therefore, the device can be integrated seamlessly in existing and future process facilities.

The 'N' in TSP341-N stands for non-invasive temperature measurement and can turn a metal pipe carrying a process media into a temperature sensor. Using model based algorithms in the transmitter electronics to compensate for ambient and surface contact conditions, a NINVA delivers an accurate measurement of the true surface temperature of the pipe. When coupled with process conditions, the sensor provides a non-invasive approach to measure the process temperature without the need for a thermowell for the process conditions.

A non-invasive approach to temperature measurement is well suited for turbulent, liquid like flows in metal pipes where the surface temperature is well correlated with the bulk temperature of the process media. The sensor can be effectively used in the wide range of possible process and piping conditions without any need for the input of process or piping specification into the device. Please see more details in the 'how to effectively use a non-invasive measurement' section in the **operating instructions**.

* The temperature sensor TSP341-N belongs to ABB's product family SensyTemp TSP. It is listed in the related type examination certificates for explosion protection as SensyTemp TSP341-N.

… Introduction

System structure

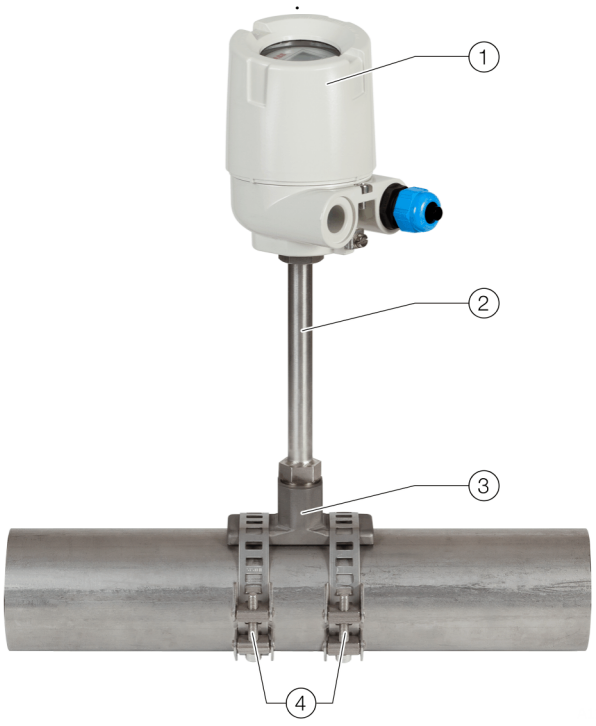
The TSP341-N temperature sensor contains a TTH300-N temperature transmitter with integrated calculation algorithms for non-invasive temperature measurement. The transmitter has an analog 4 to 20 mA current output and supports communication through the HART 7® protocol. As an option, the type AS LCD indicator can be integrated.

The transmitter is connected to two connected temperature sensors. One sensor (sensor 1) measures the contact temperature at the measuring point, while a second sensor (sensor 2) measures the ambient temperature at a reference test point near the measuring point.

By using the algorithms for accurate non-invasive temperature calculation, a process temperature range of −40 to 400 °C (−40 to 752 °F) with an ambient temperature of −40 to 85 °C (−40 to 177 °F) is covered. In a remote configuration, process temperatures up to 550 °C (1022 °F) are possible. The remote sensor apparatus can be operated with ambient temperatures up to 100 °C (212 °F).

The transmitter can be configured using the LCD indicator with configuration function* or the device driver provided by ABB for TSP341-N / TTx300-N (FDIX, EDD, DTM) in accordance with the current conditions of use.

* From HW-Rev. 02.00.



1 Connection head
2 Extension tube
3 Retaining plate
4 Clamp collars

Figure 2: TSP341-N

For non-invasive temperature measurement, the temperature sensor is fastened to a piping or vessel surface. Installation is made using two clamp collars, which fix the retaining plate to the pipe.

Clamps with different expansion coefficients are available to adapt to the piping or vessel material. For a good measurement, the surface under the retaining plate should be straight, and cleaned to remove any particles or dust. The presence of standard paint coatings (up to 300 µm) on a surface have a minimal effect on the absolute accuracy. For larger organic or non-thermally conductive coatings, please see more details in the section 'How to effectively use a non-invasive measurement' in the **operating instructions**.

During installation, make sure that the measuring tip with the integrated sensor element has optimal contact with the measuring point.

In addition, insulation to minimize the effect of humidity (rain and ice) and wind on the pipe surface temperature is recommended.

Note
Verify the expected measurement performance:
Input nominal process parameters and pipe dimensions into the **ABB performance predictor** to obtain an expected steady state result of a NINVA™ measurement. If the outcome is satisfactory for the application, proceed with the installation.

ABB performance predictor

Overview of temperature sensors

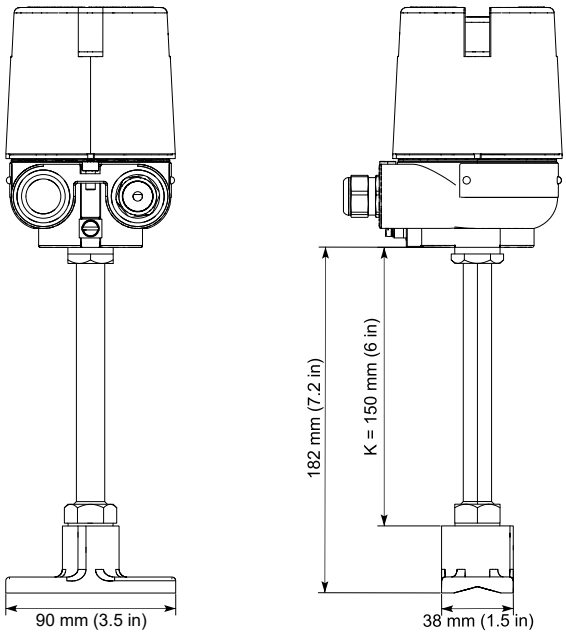
Type	**TSP341-N**
	
Design	Temperature sensor with or without integrated transmitter for surface mounting
Components	Retaining plate, measuring inset with measuring tip, extension tube, connection head, transmitter, optional LCD indicator
Materials	Retaining plate: stainless steel 1.4408 (J92900) Measuring inset: stainless steel 1.4571 (ASTM 316Ti) Measuring tip: pure nickel 2.4068 (LC-Ni99) Extension tube: stainless steel 1.4571 (ASTM 316Ti) Gasket for connection head: EPDM (ethylene propylene diene-monomer rubber)
Casting compound used for the device electronics	Polyurethane (PUR)
Process connection	Surface mounting to piping
Transport temperature / storage temperature	−20 to 70 °C (−4 to 158 °F)
Ambient temperature range at connection head	Without integrated transmitter: −40 to 100 °C (−40 to 212 °F)*** With integrated transmitter: −40 to 85 °C (−40 to 185 °F)
Measuring range (surface temperature)	−40 to 400 °C (−40 to 752 °F)*
Sensor	Thin film resistor Pt100 in three-wire circuit, accuracy class A in accordance with IEC 60751, measuring range −40 to 400 °C (−40 to 752 °F)
Extension tube	Extension tube diameter: 15 mm (0.59 in) Extension tube length: K = 150 mm (6 in) **Note** For the distance from connection head to piping include additional ≈32 mm (≈1.3 in) for the retaining plate
Clamp collars	Clamp collars for a variety of thermal expansion coefficients are available. Clamp collars are available for pipe diameters of 40 to 2500 mm (DN 40 to 2500, 1.5″ to 88″)** **Recommendation for pipes and vessels made of chrome steel or carbon steel** Clamp collar material: chrome steel 1.4016 (ASTM 430), α = 10 to 10.5×10^{-6}/K **Recommendation for pipes and vessels made of chrome-nickel steel** Clamp collar material: stainless steel 1.4301 (ASTM 304), α = 16 to 17.5×10^{-6}/K

Table 1: Overview

* Special designs for higher temperatures are available. Please contact your ABB sales representative

** Special designs for piping diameters below 40mm (1.5″) are available. Please contact your ABB sales representative.

*** Without cable gland. When used with a cable gland, the temperature range of cable gland must be considered.

Specification

Measuring accuracy

The temperature sensors used correspond to accuracy class A in accordance with the IEC 60751 standard, measuring range −40 to 400 °C (−40 to 752 °F).

For digital and sensor accuracy calculations please refer to the **TTH300 datasheet**.

Both temperature sensors of the TSP341-N temperature sensor are connected in a three-wire circuit.

Vibration resistance

Unlike invasive thermowell measurements, the sensor is not subject to the vibration loads of the process flow but those of the piping. The piping vibrations are orders of magnitude less than those experienced by devices in the flow.

The temperature sensor with the AGL or AGLD connection head in accordance with IEC 60068-2-6:

10 to 58 Hz: 0.075 mm (0.003 in)
> 58 to 2000 Hz: 10 m/s^2 (1 g)

Shock resistance:

500 ms^{-1} (50 g)

The temperature sensor with BUZ connection head without transmitter in accordance with IEC 60068-2-6:

10 to 58 Hz: 0.15 mm (0.003 in)
> 58 to 2000 Hz: 20 m/s^2 (2 g)

Shock resistance:

500 ms^{-1} (50 g)

Electromagnetic compatibility

Emitted interference and interference immunity in accordance with

- IEC EN 61326-1
- IEC EN 61326-3-2*
- NAMUR NE 21

* For HART communication from HW-Rev. 02.00.

SIL functional safety

The following two variants of the non-invasive temperature measurement devices meet the SIL safety requirements for the integration in Safety Instrumented Systems in compliance to IEC 61508:2010 within the process industry sector according to IEC 61511:2016:

- 'TSP341-N with integrated head-mount transmitter TTH300-N'
- 'TSP341-N remote sensor apparatus with connected field mount transmitter TTF300-N'

The area of SIL safety applications is limited to:

- up to SIL 2 as single (HFT=0) transmitter installation
- for the 'Low Demand Mode' safety operation

Detailed information can be found in the SIL-Safety Manual.

Insulation resistance of measuring inset

The insulation resistance is measured between the outer sheath and both measuring loops. In addition, the insulation resistance between both measuring loops is also measured. Thanks to a special process used during manufacturing, ABB measuring insets can boast outstanding insulation values even at high temperatures.

Insulation resistance R_{iso}

≥ 500 MΩ with a ambient temperature range from 15 to 35 °C (59 to 95 °F)

Air humidity

< 80 %

Extension tube

The extension tube as a module between the retaining plate and connection head allows for the use of insulation material at the measuring point.
Without insulation, the extension tube serves as a cooling line between the temperature-sensitive electronics of the transmitter in the connection head and the hot piping surface. The protection of the electronics from excessive temperatures should be ensured through suited measures.

Extension tube length TSP341-N

K = 150 mm (6 in), plus the height of the retaining plate of approximately 32 mm (approximately 1.3 in)

Extension tube outer diameter

15 mm (0.59 in)

Extension tube material

Stainless steel 1.4571 (ASTM 316Ti)

Connection heads

Functions of the connection head

- Housing of a transmitter and the optional LCD indicator or a terminal block
- Protection of the connection area against adverse environmental influences

When the connection cable is fed into the connection head, a special cable guide cable automatically positions it inside the connection area. The flat base of the housing ensures optimum access to the connection area.

Ambient temperature at connection head

Connection head without transmitter and without cable gland	−40 to 100 °C (−40 to 212 °F)
Connection head with transmitter*	−40 to 85 °C (−40 to 185 °F)

* Restricted display function (contrast, reaction time) in the temperature ranges: −50 to -20 °C (−58 to −4 °F) or 70 to 85 °C (158 to 185 °F)

Note
When using the device in potentially explosive atmospheres, restrictions of the ambient temperature range are possible. The notes in the corresponding declarations of conformity and type examination certificate should be complied with.

When using a surface sensor, temperature measurement is performed in direct contact with the hot surface.
Without suited insulation of the measuring point, the permissible ambient temperature must be reduced to prevent an up-scale of limit values.
The following table shows as an example the maximum ambient temperature $T_{amb.}$ for the TSP341-N at different surface temperatures $T_{surf.}$ for the TSP341-N with integrated LCD indicator.

Surface temperature $T_{surf.}$	Maximum permissible ambient temperature $T_{amb.}$:
100 °C (212 °F)	66 °C (150.8 °F)
200 °C (392 °F)	61 °C (141.8 °F)
300 °C (572 °F)	58 °C (136.4 °F)
400 °C (752 °F)	55 °C (131.0 °F)

Table 2: Ambient temperature as a function of surface temperature

Note
The operator must make sure, with the help of measurements if needed, that the maximum permissible temperature **in the connection head** is not up-scaled in intrinsically safe devices.

Use in potentially explosive atmospheres in accordance with ATEX and IECEx on page 11

… Connection heads

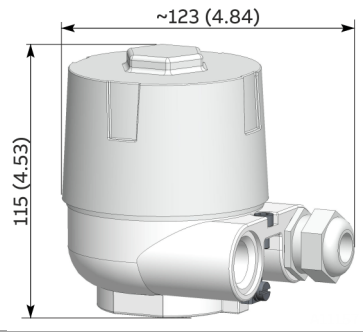
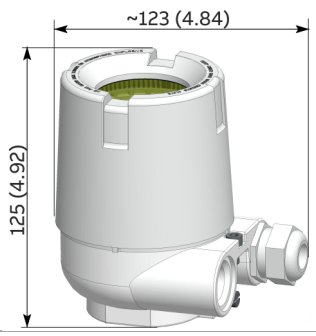
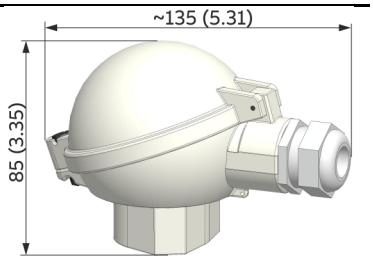
Head form	**AGL / AGS**	**AGLD / AGSD**	**BUZ head**
			
Material	AGL: Aluminum, epoxy-coated AGS: Stainless steel (1.4404/316L)	AGLD: Aluminum, epoxy-coated AGSD: Stainless steel (1.4404/316L)	Aluminum, epoxy-coated
Cover locking system	Screw-on cap		Hinged cover with screw plug
Cable gland	M20 × 1.5, optional cable entry ½ in NPT, without screwed connection		
IP rating	IP 66 / IP 67		IP 66
Transmitter mounting	On the measuring inset for AGL and AGLD heads		No transmitter

Table 3: Overview of connection heads

Dimensions in mm (in)

Transmitter

The TSP341-N temperature sensor contains a TTH300-N temperature transmitter with integrated calculation algorithms for non-invasive temperature measurement. The transmitter has a current output of 4 to 20 mA and communication through the HART 7 protocol

Installing a transmitter has the following advantages:

- Cost savings due to reduced wiring costs
- Amplification of the sensor signal at the measuring point and conversion to a standard signal (thereby increasing the signal's interference immunity).
- Option to install an LCD display in the connection head

The transmitter built into the TSP341-N has algorithms enabling accurate temperature calculation for the defined process temperature range.
For this purpose, the current ambient temperature is considered in addition to the measured surface temperature. Self-heating of the transmitter should be neglected.

The transmitter has continuous sensor and self-monitoring (supply voltage monitoring, wire break / corrosion monitoring in accordance with NE 89) and supplies diagnostic information in accordance with NE 107.

HART Device Type ID

TSP341-N: 0x1A4E

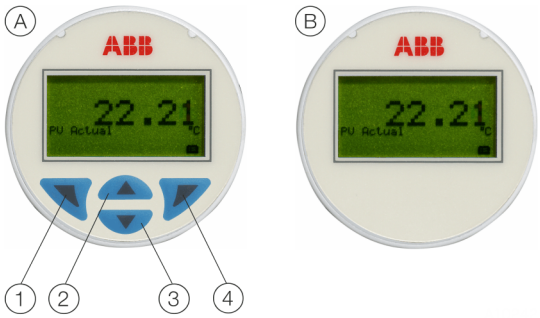
Write protection

Software write protection through the HART protocol

Note

For additional information on the transmitter please refer to the **TTH300 datasheet**.

Type A, B and type AS LCD indicators



1 Quit / Cancel
2 Scroll back
3 Scroll forward
4 Select

Figure 3: (A) LCD indicator Type A and B (B) LCD indicator Type AS

The LCD indicator type AS has a display function; the LCD indicator types A and B allows additional configuration functions to be carried out.
All LCD indicators can only be ordered in conjunction with temperature transmitter.

CE-Marking

The LCD indicator types A, B and type AS fulfill all requirements for CE marking in accordance with all applicable guidelines.

Properties

Transmitter-controlled graphic (alphanumeric) LCD indicator

- Character height, mode-dependent
- Sign, 4 digits, 2 decimal places
- Bargraph display
- Turnable in 12 increments of 30° each

Display options

Process information and display diagnostic information related to transmitter and sensor status.

- Display of either one or two process values
- Advanced diagnostics: Error display in plain text with possible shutdown measures. Display of multiple simultaneous diagnoses.

… Transmitter

… Type A, B and type AS LCD indicators

Specification

Temperature range

-40 to 85 °C (-40 to 185 °F)

Restricted display function (contrast, reaction time) in the temperature ranges:

- −50 to -20 °C (−58 to −4 °F) or
- 70 to 85 °C (158 to 185 °F)

Air humidity

0 to 100 %, condensation permitted

Configuration function

- Sensor configuration for standard sensors
- Measuring range
- Behavior in the event of a fault (HART)
- Software write protection for configuration data
- Device address for HART

Use in potentially explosive atmospheres in accordance with ATEX and IECEx

The temperature sensor TSP341-N belongs to ABB's product family SensyTemp TSP. It is listed in the related type examination certificates for explosion protection as SensyTemp TSP341-N.

Ex marking

‘Ex i – Intrinsic safety’ type of protection

Model TSP341-N-D2 in zone 0, 1, 2	
ATEX	
Type examination certificate:	PTB 18 ATEX 2002 X
Ex marking	ATEX II 1 G Ex ia IIC T6...T1 Ga
	ATEX II 2 G Ex ib IIC T6...T1 Gb

Table 4: ATEX Ex marking, ‘Ex i – intrinsic safety’ type of protection

Model TSP341-N-J2 in zone 0, 1, 2	
IECEx	
Type examination certificate:	IECEx PTB 18.0041 X
Ex marking	Ex ia IIC T6...T1 Ga
	Ex ib IIC T6...T1 Gb

Table 5: IECEx Ex marking, ‘Ex i – intrinsic safety’ type of protection

‘Ex ec, EX na –increased safety and non-sparking’ type of protection (non-Sparking only available with IECEx)

Model TSP341-N-B6 in zone 2	
ATEX	
Type examination certificate:	PTB 18 ATEX 2002 X
Ex marking	ATEX II 3 G Ex ec IIC T6…T1 Gc

Table 6: ATEX Ex marking, ‘Ex ec, EX na – non-sparking and increased safety’ type of protection

Model TSP341-N-H8 in zone 2	
IECEx	
Type examination certificate:	IECEx PTB 18.0041 X
Ex marking	Ex ec IIC T6…T1 Gc
	Ex na IIC T6…T1 Gc

‘Ex d - flameproof (enclosure)’ type of protection

Model TSP341-N-D7 in zone 1, 2	
ATEX	
Type examination certificate:	PTB 99 ATEX 1144 X
Ex marking	ATEX II 2 G Ex db IIC T6/T4 Gb

Table 7: ATEX Ex marking, ‘Ex d – flameproof (enclosure)’ type of protection

Model TSP341-N-J7 in zone 1, 2	
IECEx	
Type examination certificate:	IECEx PTB 12.0039 X
Ex marking	Ex db IIC T6/T4 Gb

Table 8: IECEx Ex marking, ‘Ex d – flameproof (enclosure)’ type of protection

General information

Thermal resistance

In addition to measurement of the contact temperature, a temperature measurement at a reference test point at small physical distance is made to improve measuring accuracy. For this, the measuring inset has two temperature sensors in two separate mineral insulated cables.

The following data applies for both temperature sensors, see also **Temperature rise in the event of a fault** on page 12.

Heat resistance R_{th} for mineral insulated cable Ø 3 mm (0.12 in)	
$\Delta t = 200\ K/W \times 0.038\ W = 7.6\ K$	
Resistance thermometer without thermowell	200 K/W

K/W = kelvin per watt

Note

The specified thermal resistance R_{th} should be indicated under the conditions ‘stationary gas (environment)’ and ‘mineral insulated cable without thermowell’.

… Use in potentially explosive atmospheres in accordance with ATEX and IECEx

… General information

Temperature rise in the event of a fault
In the event of a fault, the temperature sensors will exhibit a temperature rise Δt as appropriate for the applied power. This temperature rise Δt must be considered when determining permissible temperature classes, see **TSP341-N with integrated transmitter** on page 12.

Note
A dynamic short-circuit current that occurs in the measurement circuit for a matter of milliseconds in the event of a fault is irrelevant with regard to heating.
The temperature rise Δt can be calculated using the following formula:

$$\Delta t = R_{th} \times P_o \quad [K/W \times W]$$

Δt Temperature rise

R_{th} Thermal resistance

P_o Output power of the integrated transmitter

Example:
Resistance thermometer diameter approximately 3 mm (0.12 in) without thermowell:
R_{th} = 200 K/W,
P_o= 38 mW
Δt = 200 K/W × 0.038 W = 7.6 K

For a transmitter output power P_o = 38 mW, a temperature rise of approx. 8 K results in the event of a fault.
In consideration of this temperature rise, the maximum possible surface temperatures $T_{surf.}$ arise for temperature classes T1 to T6, as presented in **Table 9** on page 12 .

Type of protection Ex i, intrinsic safety

TSP341-N with integrated transmitter
Permissible ambient temperature
The following table shows the permissible ambient temperature $T_{amb.}$ for the corresponding equipment protection levels Ga (zone 0) and Gb (zone 1) as a function of the material of the connection head (aluminum or stainless steel), the thermal insulation at the measuring point and the surface temperature $T_{surf.}$ at the measuring point.

The surface temperatures ($T_{surf.}$) are determined as follows:
$T_{surf.}$ = T6 to T3 − 5°C − 8°C (Δt in the event of an error)
$T_{surf.}$ = T2 to T1 − 10°C − 8°C (Δt in the event of an error)

For Δt = 8 °C, see **Temperature rise in the event of a fault** on page 12.

Note
The ambient temperatures specified in the following table must be processed in accordance with EN 60079-14 for device protection level Ga (zone 0).

Surface temperature $T_{surf.}$	Ambient temperature with integrated TTH300-N transmitter Intrinsically safety Ex ia and increased safety Ex ec (nA)			
	ALU- housing (AGL*)		Stainless steel - housing (AGS)	
	Without insulation	With insulation	Without insulation	With insulation
T6 / 72 °C (T5 / 87 °C)	52 °C	55 °C	54 °C	57 °C
T4 / 122 °C	77 °C	81 °C	75 °C	81 °C
T3 / 187 °C	71 °C	78 °C	64 °C	74 °C
T2 / 282 °C	62 °C	74 °C	49 °C	65 °C
T1 / 432 °C	48 °C	67 °C	26 °C	50 °C

Table 9: Ambient temperature for equipment protection levels Ga (zone 0) and Gb (zone 1)

* Table applies for AGL and BUZ housing.

TSP341-N remote sensor apparatus with ceramic terminal block

Permissible ambient temperature

The TSP341-N is available as an integral version with a head mounted TTH300-N transmitter (**System structure** on page 4) and without a transmitter. The latter is termed a TSP341-N Remote sensor apparatus and the sensor connections are terminated on a ceramic terminal block in the head.
When used in this configuration the ambient temperatures specified in Table 10 must be processed in accordance with EN 60079-14 for device protection level Ga (zone 0).

Surface temperature $T_{surf.}$	Ambient temperature with ceramic terminal block Intrinsically safety Ex ia C (IP requirements only according to EN60529)			
	Aluminum connection head		Stainless steel connection head	
	Without insulation	With insulation	Without insulation	With insulation
T6 / 72 °C (T5 / 87 °C)	68°C	71°C	70°C	73°C
T4 / 122 °C	112°C	116°C	110°C	116°C
T3 / 187 °C	106°C	113°C	99°C	109°C
T2 / 282 °C	97°C	109°C	84°C	100°C
T1 / 432 °C	83°C	102°C	61°C	85°C

Table 10: Maximum permissible ambient temperatures for TSP341-N remote sensor apparatus with ceramic terminal block for intrinsic safe applications for AGL, AGS and BUZ housing

* Table applies for AGL, AGS and BUZ housing.

The TSP341-N remote sensor apparatus is intended for use with the TTF300-N field transmitter. When connecting to a field transmitter, the following maximum input values must be adhered to.

Max. input voltage U_i	6,5 V
Short-circuit current I_i	(Intrinsic safe supply) 25 mA
Max. power P_i	38 mW
L_i (inner inductance of the sensor)	15 µH/m
C_i (inner capacitance of the sensor)	280 pF/m

Note

Heat resistant connection cables shall be used if the temperature at the cable entries or inside the enclosure of the connection head is higher than 70 °C.

For the protection level “Ga” the temperature sensors must be installed such that they are protected against strong impact or friction.

TSP341-N connection data

The integrated transmitter is based on the TTH300 HART from ABB.

The intrinsic safety type examination certificates PTB 18 ATEX 2002 X and IECEx PTB 18.0041 X apply to the complete temperature sensor TSP341-N with integrated transmitter, so the type examination certificates for the TTH300 are **not** applicable.

When connecting the TSP341-N to certified intrinsically safe circuits, the following maximum input values must be observed.

Max. voltage U_i	30 V
Short-circuit current I_i	130 mA
Max. power P_i	0.8 W
Internal inductance L_i	0.5 mH
Internal capacitance C_i	0.57 nF

Table 11: Electrical data

… Use in potentially explosive atmospheres in accordance with ATEX and IECEx

Type of protection Ex d - flameproof (enclosure)

With connection head, the TSP341-N can be used in ‘Ex d – flameproof (enclosure)’ type of protection in zone 1.

- The connection conditions listed in the type examination certificate PTB 99 ATEX 1144 X or IECEx PTB 12.0039 X must be observed.
- For the TSP341-N with ‘Ex d – flameproof (enclosure)’ type of protection, the self-heating of the sensor in the event of a fault should be considered, see **Thermal resistance** on page 11.
- The temperature class and maximum permissible surface temperature or the temperature at the reference test point should be determined accordingly.

Temperature Data

Maximum permissible ambient temperature $T_{amb.}$ on the connection head*		
Temperature class	**Without transmitter**	**With transmitter**
T4 to T1	−40 to 100 °C (−40 to 212 °F)	−40 to 85 °C (−40 to 185°F)
T6	−40 to 75 °C (−40 to 167 °F)	−40 to 67 °C (−40 to 152 °F)

Table 12: Ambient temperature on the connection head

Temperature class	Maximum surface temperature $T_{surf.}$ in Zone 1**
T1	438 °C*** (820 °F)***
T2	288 °C (550 °F)
T3	193 °C (379 °F)
T4	128 °C (262 °F)
T5	93 °C (199 °F)
T6	78 °C (172 °F)

Table 13: Permissible surface temperature

* Ambient temperatures can be limited depending on the temperature resistance of the cable entry used

** Also applies for the temperature at the reference test point

*** Maximum measuring range of the device: 400 °C (752 °F)

Use in potentially explosive atmospheres in accordance with cFMus, FM and CSA

Note

- Further information on the approval of devices for use in potentially explosive atmospheres can be found in the explosion protection test certificates (at www.abb.com/temperature).
- Depending on the design, a specific marking in accordance with FM, CSA or cFMus applies.

Ex marking cFMus

cFMus Intrinsically Safe

Model TSP341-N-L1H for USA **Model TSP341-N- R1H for Canada**	
Control Drawing	TSP341-N-L1H
IS Class I,II,III, Div. 1,2 Group ABCDEFG T6, T4	
Zone 0 AEx/Ex ia IIC T6, T4 Ga	
Zone 1 AEx/Ex ia IIC T6, T4 Gb	
Ta= -40°C up to +81°C	

Model TSP341-N-L1Y, for USA and Canada **(without Transmitter, AGL head)**	
Control Drawing	TSP341-N-L1Y
IS Class I,II,III, Div. 1,2 Group ABCDEFG T6,T4	
Zone 0 AEx/Ex ia IIC T6, T4 Ga	
Zone 1 AEx/Ex ia IIC T6,T4 Gb	
Ta= -40°C up to +100°C	

Model TSP341-N-L1YB, for USA and Canada **(without Transmitter, BUZ head)**	
Control Drawing	TSP341-N-L1YB
IS Class I, Div. 1,2 Group ABCD T6,T4	
Zone 0 AEx/Ex ia IIC T6, T4 Ga	
Zone 1 AEx/Ex ia IIC T6,T4 Gb	
Ta= -40°C up to +100°C	

cFMus Non-Incendive

Model TSP341-N-L2H for USA **Model TSP341-N-R2H for Canada**	
Control Drawing	TSP341-N-L2H
NI Class I,II,III, Div. 2 Group ABCDEFG T6, T4,	
Zone 2 AEx/Ex nA IIC T6, T4 Gc	
Zone 2 AEx/Ex ec IIC T6, T4 Gc	
Ta= -40°C up to +81°C	

Model TSP341-N-L2Y, for USA and Canada **(without Transmitter, AGL head)**	
Control Drawing	TSP341-N-L2Y
NI Class I,II,III, Div. 2 Group ABCDEFG T6,T4,	
Zone 2 AEx/Ex nA IIC T6,T4 Gc	
Zone 2 AEx/Ex ec IIC T6,T4 Gc	
Ta= -40°C up to +96°C	

Model TSP341-N-L2YB, for USA and Canada **(without Transmitter, AGL head)**	
Control Drawing	TSP341-N-L2Y
NI Class I, Div. 2 Group ABCD T6,T4,	
Zone 2 AEx/Ex nA IIC T6,T4 Gc	
Zone 2 AEx/Ex ec IIC T6,T4 Gc	
Ta= -40°C up to +96°C	

Tests and certificates

In order to increase the safety and accuracy of the process, ABB offers various mechanical and electrical tests. The results are confirmed with certificates in accordance with EN 10204.

The following certificates are issued:

- Declaration of compliance 2.1 for order conformity
- Inspection certificate 3.1 for visual, dimensional and function checks of the temperature sensor
- Inspection certificate 3.1 acc. EN 10204for sensor calibration, double RTD and TSP341-N
- DAkkS sensor calibration, double RTD and TSP341N, calibration certificate per thermometer

Ordering Information

TSP341-N

Basic model												
Sensor for non-invasive temperature measurement	**TSP341-N**	**XX**	**XXX**	**XX**	**XX**	**XX**	**XX**	**XX**	**XX**	**XX**	**XX**	**XX**
Explosion Protection / Approvals												
Without explosion protection		Y0										
Intrinsic Safety ATEX,Zone 0: II 1 G Ex ia IIC T6#T1 Ga		D2										
Flameproof enclosure ATEX II 2 G Ex db IIC T6/T4 Gb		D7										
Intrinsic Safety IECEx,Zone 0: Ex ia IIC T6#T1 Ga, Zone 1: Ex ib IIC T6#T1 Gb		J2										
Flameproof enclosure IECEx db IIC T6/T4 Gb		J7										
Flameproof enclosure INMETRO Ex d		C5										
FM Approvals (USA & Canada) Intrinsic Safety (IS) HMI only with FMus Approval (USA)		L1										
FM Approvals (USA & Canada) Nonincendive (NI) HMI only with FMus Approval (USA)		L2										
FM Approvals (USA & Canada) Intrinsic Safety (IS) HMI only with cCSA Approval (Canada)		R1										
FM Approvals (USA & Canada) Nonincendive (NI) HMI only with cCSA Approval (Canada)		R2										
Sensor Mounting												
Clamp-on, sensor in 90° angle to pipe, pipe clamp material chromium steel 1.4016 (ASTM 430)			Y14									
Clamp-on, sensor in 90° angle to pipe, pipe clamp material stainless steel 1.4301 (ASTM 304)			Y15									
Pipe Clamp for Pipe Diameter*												
Without mounting material / clamp collars				C0								
DN 40 to DN 80 (1.5 to 3 in)				C8								
DN 80 to DN 300 (3 to 12 in)				C3								
DN 80 to DN 600 (3 to 24 in)				C6								
Others				Z9								
Extension Tube Length												
K = 150 mm (6 in), additionally ~32 mm (~1.3 in) for retaining plate					N1							
Measuring inset type												
RTD, TF, measuring range −40 to 400 °C (−40 to 752 °F)						S5						
Measuring Inset Diameter												
2 × 3 mm							N3					
Sensor Type and Wiring												
1 × Pt100, 3-wire								P2				
Sensor Accuracy												
Thin Film, Accuracy Class A, IEC 60751, Range −40 to 400 °C (−40 to 752 °F)									N2			
Connection Head Type / Material												
AGL / Aluminum, screwed cover										L1		
AGLD / Aluminum, screwed cover with display										L4		
AGS / Stainless steel, screwed cover										S1		
AGSD / Stainless steel, screwed cover with display										S4		
Transmitter												
Transmitter for non-invasive temperature measurement, HART®, output 4 to 20 mA											H8	
Transmitter for non-invasive temperature measurement, HART®, output 4 to 20 mA Ex i											H9	
Measuring Range												
0 to 400 °C												AH
32 to 752 °F												AT
Acc. customer specification												AZ

* Larger diameters than those indicated here can be achieved by combining clamp collar sets available in accessories.

… Ordering Information

… TSP341-N

Additional ordering information

TSP341-N Sensor for non-invasive temperature measurement	**XX**	**XXX**	**XXX**	**XX**	**XX**
Declarations and Certificates					
Declaration of compliance with the order 2.1 acc. EN 10204	C4				
Inspection certificate 3.1 acc. EN 10204for visual, dimensional and functional test	C6				
Inspection certificate 3.1 acc. EN 10204for sensor calibration, double RTD and TSP341-N	CE				
DAkkS sensor calibration, double RTD and TSP341N, calibration certificate per thermometer	CJ				
SIL 2 - Certificate acc. to IEC 61508 for sensor with integrated transmitter* **	CS				
Other certificates	CZ				
Handling of Certificates					
Send via e-mail			GHE		
Send with Instrument			GHA		
Send via e-mail and with instrument			GHC		
Number of Test Points					
1 point				P1	
2 points				P2	
3 points				P3	
4 points				P4	
5 points				P5	
Temperatures for Sensor Calibration					
Standard calibration: 0 °C (32 °F)					V1
Standard calibration: 100 °C (212 °F)					V2
Standard calibration: 0 °C and 100 °C (32 °F and 212 °F)					V4
Standard calibration: 0 °C, 100 °C and 200 °C (32 °F, 212 °F and 392 °F)					V7
Standard calibration: Customer specific temperatures					V6
DAkkS calibration: 0 °C (32 °F)					D1
DAkkS calibration: 100 °C (212 °F)					D2
DAkkS calibration: 400 °C (752 °F)					D3
DAkkS calibration: 100 °C (212 °F)					D4
DAkkS calibration: 0 °C and 400 °C (32 °F and 752 °F)					D5
DAkkS calibration: 0 °C, 100 °C and 200 °C (32 °F, 212 °F and 392 °F)					D7
DAkkS calibration: 0 °C, 200 °C and 400 °C (32 °F, 392 °F and 752 °F)					D8
DAkkS calibration: Customer specific temperatures					D6

TSP341-N	**XX**	**XX**	**XX**	**XX**	**XX**	**XX**	**XX**
Sensor for non-invasive temperature measurement							
Cable Entry Options							
1 × M20 × 1.5, without cable gland	U1						
1 × ½ in NPT, without cable gland	U2						
Display Type							
LCD Indicator type AS		L1					
Configurable LCD Indicator type A		L2					
Other Options							
Name plate stainless steel, standard plate for TSP300			PV				
Others			PZ				
Documentation Language							
German				M1			
English				M5			
Language package Western Europe / Scandinavia (Languages: DA, ES, FR, IT, NL, PT, FI, SV)				MW			
Language package Eastern Europe (Languages: EL, CS, ET, LV, LT, HU, HR, PL, SK, SL, RO, BG)				ME			
Hardware Version							
Hardware 01.07					Z7		
Hardware 02.00					Z2		
TAG Plate							
On stainless steel plate						T1	
Additional Identification Plate							
Stainless steel plate with customer specific text							T2
Adhesive label							T3

Accessories

Description	**Order number**
Clamp collar set for pipe diameters DN40 to DN80 (1,5" to 3") Chrome steel 1.4016 (ASTM 430)	3KXT091100L0002
Clamp collar set for pipe diameters DN80 to DN300 (3" to 12") Chrome steel 1.4016 (ASTM 430)	3KXT091100L0005
Clamp collar set for pipe diameters DN80 to DN600 (3" to 24") Chrome steel 1.4016 (ASTM 430)	3KXT091100L0007
Clamp collar set for pipe diameters DN40 to DN80 (1,5" to 3") Stainless steel 1.4301 (ASTM 304)	3KXT091100L0008
Clamp collar set for pipe diameters DN80 to DN300 (3" to 12") Stainless steel 1.4301 (ASTM 304)	3KXT091100L0011
Clamp collar set for pipe diameters DN80 to DN600 (3" to 24") Stainless steel 1.4301 (ASTM 304)	3KXT091100L0013

Trademarks

HART is a registered trademark of FieldComm Group, Austin, Texas, USA

ABB Measurement & Analytics

For your local ABB contact, visit:
www.abb.com/contacts

For more product information, visit:
www.abb.com/temperature

3KXT161302R1001

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