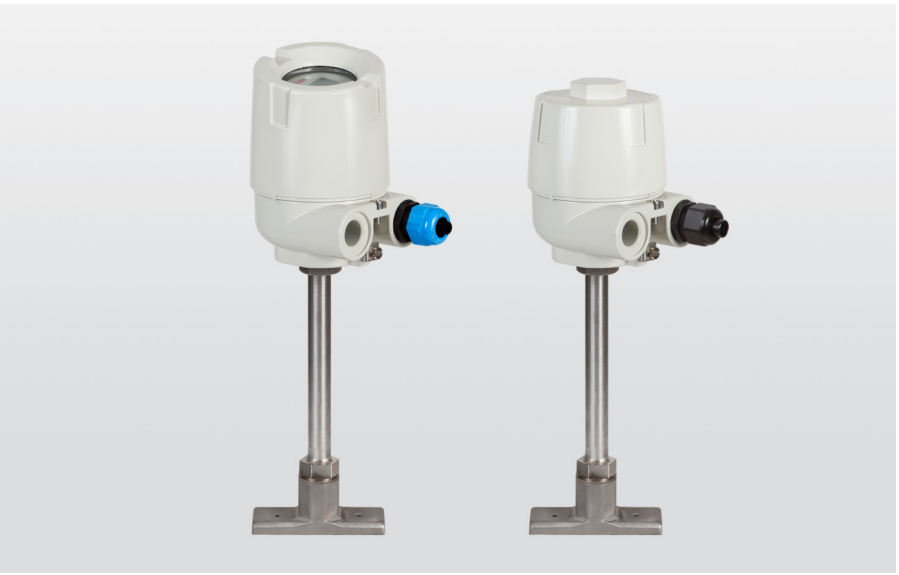
NINVA™ TSP341-N

Sensor for non-invasive temperature measurement



Measurement made easy

TSP341-N

Introduction

The temperature sensor TSP341-N allows for reliable temperature measurement without intervention in the process.
Plant safety is clearly increased as a result.
Thanks to the quick and easy surface mounting and by eliminating the thermowell and the need to open the process, substantial cost reductions are achieved.

* 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.

Additional Information

Additional documentation on TSP341-N is available for download free of charge at www.abb.com/**temperature**.
Alternatively simply scan this code:

Table of contents

1 Safety

General information and instructions

These instructions are an important part of the product and must be retained for future reference.
Installation, commissioning, and maintenance of the product may only be performed by trained specialist personnel who have been authorized by the plant operator accordingly. The specialist personnel must have read and understood the manual and must comply with its instructions.
For additional information or if specific problems occur that are not discussed in these instructions, contact the manufacturer.
The content of these instructions is neither part of nor an amendment to any previous or existing agreement, promise or legal relationship.
Modifications and repairs to the product may only be performed if expressly permitted by these instructions.
Information and symbols on the product must be observed. These may not be removed and must be fully legible at all times.
The operating company must strictly observe the applicable national regulations relating to the installation, function testing, repair and maintenance of electrical products.

Warnings

The warnings in these instructions are structured as follows:

⚠ DANGER

The signal word '**DANGER**' indicates an imminent danger. Failure to observe this information will result in death or severe injury.

⚠ WARNING

The signal word '**WARNING**' indicates an imminent danger. Failure to observe this information may result in death or severe injury.

⚠ CAUTION

The signal word '**CAUTION**' indicates an imminent danger. Failure to observe this information may result in minor or moderate injury.

NOTICE

The signal word ***'NOTICE'*** indicates possible material damage.

Note

'**Note**' indicates useful or important information about the product.

Intended use

Temperature sensor to enable non-invasive measurement of temperature of a flowing fluid in a pipe by accurately measuring the surface temperature.
The device is designed for use exclusively within the values stated on the name plate and in the specifications (see **Specifications** in the operating instruction or data sheet).

- The permissible ambient temperature range may not be up-scaled or down-scaled.
- The IP rating must be observed during operation.
- For use in potentially explosive atmospheres, follow the respective guidelines.
- When using as a SIL-device in safety-relevant applications, the corresponding SIL-Safety Manual should be observed.

Improper use

The following are considered to be instances of especially improper use of the device:

- For use as a climbing aid, for example for mounting purposes.
- For use as a bracket for external loads, for example as a support for piping, etc.
- Material application, for example by painting over the housing, name plate or welding/soldering on parts.
- Material removal, for example by spot drilling the housing.

Warranty provisions

Using the device in a manner that does not fall within the scope of its intended use, disregarding this manual, using underqualified personnel, or making unauthorized alterations releases the manufacturer from liability for any resulting damage. This renders the manufacturer's warranty null and void.

Cyber security disclaimer

This product is designed to be connected to and to communicate information and data via a network interface.
It is operator's sole responsibility to provide and continuously ensure a secure connection between the product and your network or any other network (as the case may be).
Operator shall establish and maintain any appropriate measures (such as but not limited to the installation of firewalls, application of authentication measures, encryption of data, installation of anti-virus programs, etc.) to protect the product, the network, its system and the interface against any kind of security breaches, unauthorized access, interference, intrusion, leakage and/or theft of data or information.
ABB and its affiliates are not liable for damages and/or losses related to such security breaches, any unauthorized access, interference, intrusion, leakage and/or theft of data or information.

On www.abb.com/cybersecurity under 'Additional resources', 'Alerts and notifications' you will find notifications about newly discovered software vulnerabilities. It is recommended that you visit this website regularly and activate 'Subscribe to email alerts' to receive email notifications about 'ABB cyber security alerts and notifications'.

Software downloads

By visiting the web page indicated below, you will find options to download the latest software. It is recommended that you visit this web page regularly:

ABB-Library – NINVA TSP341-N – Software Downloads

Manufacturer's address

ABB AG
Measurement & Analytics
Schillerstr. 72
32425 Minden
Germany
Tel: +49 571 830-0
Fax: +49 571 830-1806

Service address

Customer service center
Tel: +49 180 5 222 580
Email: automation.service@de.abb.com

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

General

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.

Special regulations must be observed in potentially explosive atmospheres as regards the power supply, signal inputs / outputs and ground connections. The information relating specifically to explosion protection that appears within the individual chapters must be observed.

All parts must be installed in accordance with the manufacturer's specifications, as well as relevant standards and regulations. For commissioning and operation, the respectively applicable regulations, especially for the protection of employees, should be complied with.

IP rating

The connection parts of the temperature sensor must be installed so that at least the IP rating of the type of protection used can be achieved.

Temperature classes

If the temperature sensor is identified with temperature class T6 only, the following will apply:

- If the existing explosive gas atmosphere is to be assigned a temperature class of T5, T4, T3, T2, or T1, the temperature sensors can be used at correspondingly higher process temperatures, according to the specifications of the temperature class.

LCD Indicator A/AS/B/BS

For detailed information on the display connections please refer to the datasheet and operating instructions for TTX300.

Notice on the ‘Ex i – Intrinsic safety’ type of protection declaration

Type examination certificates for the ‘**Ex i – Intrinsic safety**’ type of protection of the TSP341-N cover the complete device, including the integrated transmitter and an optional LCD indicator.

Therefore, the transmitter and the indicator in the TSP341-N **do not require a separate** type examination certificate.
The PTB 01 ATEX 2200 X and IECEx PTB 11.0111 X type examination certificates of the TSP300 do not apply to the TSP341-N.

The certificates PTB 18 ATEX 2002 X and IECEx PTB 18.0041 X contain details of the explosion protection standards used with their issue dates.

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

Table 1: 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

Table 2: 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 3: 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

Table 4: IECEx Ex marking, ‘Ex ec, EX na – non-sparking and increased safety’ type of protection

‘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 5: 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 6: 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 8.

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’.

… 2 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 10.

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:

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

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 7** on page 8 .

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 8.

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			
	Aluminum connection head*		Stainless steel connection head	
	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 7: Maximum permissible ambient temperatures for TSP341-N with integrated TTH300-N transmitter for intrinsic safe applications.

Connection data of the TSP341-N with integrated transmitter
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 TTH300are not applicable.

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

Max. input voltage U_i	30 V
Short-circuit current I_i	130 mA
Max. power P_i	0.8 W
Internal inductance L_i	160 µH
Internal capacitance C_i	0,57 nF

The HMI connector is only for installation of an ABB HMI Type A or AS (certified according PTB 05 ATEX 2079 X resp. IECEx PTB 12-0028X, issue 1).

Note
The standard supplied M20 × 1.5 plastic cable gland has a limited temperature range of −40 to 70 °C (−40 to 158 °F).
When using the supplied cable gland, make sure that the ambient temperature is within this range.

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 (**Figure 9** on page 22) 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 8 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 (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	70 °C	69 °C	72 °C
T4 / 122 °C	111 °C	116 °C	109 °C	115 °C
T3 / 187 °C	105 °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	60 °C	85 °C

Table 8: 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 the TSP341-N without integrated transmitter to certified intrinsically safe circuits, the following maximum input values must be observed.

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)	50 µH/m
C_i (inner capacitance of the sensor)	1 nF

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

… Type of protection Ex i, intrinsic safety

Special conditions for Intrinsic Safety

1. For the application as EPL "Ga" equipment the temperature measuring transducers of type TSP341-N shall be installed as such, that they are protected against strong impact or friction.
2. The device must be integrated into the local grounding concept.
3. When operating the temperature sensor without integrated temperature transmitter as intrinsically safe equipment, the sum of the respective output values of the individual measuring circuits must not exceed the specified input values.
4. Inadmissible electrostatic charge of the plastic housing of the temperature measuring transducers LCD indicator shall be avoided and a warning label shall be provided on the equipment.
5. Heat-resistant connection cables shall be used if the temperature at the cable entries or inside the enclosure of the TSP341-N temperature measuring sensor is higher than 70 °c.

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 (158 °F).

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

The standard supplied M20 × 1.5 plastic cable gland has a limited temperature range of −40 to 70 °C (−40 to 158 °F). When using the supplied cable gland, make sure that the ambient temperature is within this range.

Type of protection increase safety ‘ec’ and non-sparking ‘nA’

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 8.

Note

The ambient temperatures specified in the following table must be processed in accordance with EN 60079-14 for device protection level Gc (zone 2).

Surface temperature $T_{surf.}$	Ambient temperature with integrated TTH300-N transmitter Intrinsically safety Ex ia and increased safety Ex ec (nA)			
	Aluminum connection head		Stainless steel connection head	
	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 Gc (zone 2)

* Table applies for AGL and BUZ housing.

The increased 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.

Connection data

The integrated transmitter is based on the TTH300-N HART from ABB. When connecting the TSP341-N to increased safety or non-sparking circuit, the following maximum input values must be observed.

Max. input voltage U_i	30 V (Transients limited to max +40%)
Short-circuit current I_i	Protected by external fuse with 32mA

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 operation as a category 3 equipment, the following conditions apply:

- The cables shall be firmly laid and secured against tensile loads.
- The power supply circuit of the transmitter must be limited by an upstream IEC fuse with a rated fuse current of 32 mA. The rated fuse voltage must be equal to or higher than 30V and the breaking capacity of the fuse link shall be higher than the maximum assumed short circuit current at the installation location.
- The maxim voltage represents the maximum supply from the source.

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 (**Figure 9** on page 22) or without a transmitter. The latter is termed a TSP341-N remote sensing apparatus and the sensor connections are terminated on a ceramic terminal block in the head. The increased safety or non-sparking TSP341-N without integrated transmitter is only for connection with a Temperature Transmitter certified according PTB 20 ATEX 2008 X resp. IECEx PTB 20.0035X. All other usage is prohibited.

For this configuration, the ambient temperatures specified in the following table must be processed in accordance with EN 60079-14 for device protection level Gc (zone 2).

Surface temperature $T_{surf.}$	**Ambient temperature with ceramic socket increased safety 'ec' and non-sparking applications 'nA' (IP requirements according to EN60079-0)**			
	Aluminum connection head		**Stainless steel connection head**	
	Without insulation	**With insulation**	**Without insulation**	**With insulation**
T6 / 72 °C (T5 / 87 °C)	68 °C	70 °C	69 °C	72 °C
T4 / 122 °C	101 °C	106 °C	99 °C	105 °C
T3 / 187 °C	95 °C	103 °C	89 °C	99 °C
T2 / 282 °C	87 °C	99 °C	74 °C	90 °C
T1 / 432 °C	73 °C	92 °C	50 °C	75 °C

Table 10 :Maximum permissible ambient temperatures for TSP341-N remote sensor apparatus with ceramic terminal block for increase safety 'ec' and non-sparking 'nA' applications.

* Table applies for AGL, AGS and BUZ housing.

The permissible ambient temperature range for the external transmitter is independent from the values above.

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

… Type of protection increase safety ‘ec’ and non-sparking ‘nA’

Special Conditions increased safety and non-sparking

1. The device must be integrated into the local grounding concept.
2. For operation as a category 3 equipment in the type of protection Increased Safety "ec" or Non-sparking Device "nA", the connecting cables must be firmly laid and secured against tensile loads.
3. Heat-resistant connection cables shall be used if the temperature at the cable entries or inside the enclosure of the TSP341-N temperature measuring sensor is higher than 70 °c.
4. For TSP341-N with integrated transmitter the operation as category-3 equipment in type of protection Increased Safety "ec" or Non-sparking Device "nA", a fuse acc. to IEC 60127 having a rated fuse current of 32 mA shall be connected in series to the temperature measuring transducer. The fuse may be accommodated in the associated supply unit or shall be connected in series separately. The rated fuse voltage shall be equal to or higher than 30 V. The breaking capacity of the fuse link shall be equal to or higher than the maximum short-circuit current to be assumed at the place of installation (usually 1500 A).
5. The specified operating voltage Us = 30 V represents the maximum permissible value of the supplying source acc. to EN IEC 60079-0:2017, clause 3.93. This voltage shall not be exceeded for the operation as category-3 equipment in type of protection "Increased Safety ec". An overvoltage protection (Us +40 %) shall be installed to meet the requirements to type of protection "Non-sparking device nA" or "Increased Safety ec".
6. Inadmissible electrostatic charge of the plastic housing of the temperature measuring transducers LCD indicator shall be avoided and a warning label shall be provided on the equipment.
7. Heat-resistant connection cables shall be used if the temperature at the cable entries or inside the enclosure of the TSP341-N temperature measuring sensor is higher than 70 °c

Type of protection Ex d - flameproof (enclosure)

The TSP341-N with an integrated transmitter 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 7.
- 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 85 °C
	(−40 to 212 °F)	(−40 to 185°F)
T6	−40 to 75 °C	−40 to 67 °C
	(−40 to 167 °F)	(−40 to 152 °F)

Table 11: 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 12: 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)

Installation instructions

Avoid increases in the ambient temperature by ensuring equipment is at a sufficient distance from system components with excessively high temperatures. It must be ensured that heat dissipation can take place by means of unrestricted air circulation . The maximum permissible ambient temperature must not exceed the approved temperature class.

The assembly and disassembly may only be performed by specialist personnel who have knowledge of the concept of the corresponding types of Ex protection. Compliance with the Ex temperature classes must be ensured through suitable measures.

It is essential to ensure compliance with the EC-type-examination certificates for the equipment, including the documents associated with these.
The temperature sensors must be integrated in the potential equalization of the installation location.

The installation, commissioning, maintenance and repair of devices in potentially explosive atmospheres must only be carried out by appropriately trained personnel. Works may be carried out only by persons, whose training has included instructions on different types of protection and installation techniques, concerned rules and regulations as well as general principles of zoning.
The person must possess the appropriate competences for the type of work to be conducted.
The safety instructions for electrical apparatus in potentially explosive areas must be in accordance with Directive 2014/34/EU (ATEX) and IEC 60079-14 (Installation of electrical equipment in potentially explosive areas).
Comply with the applicable regulations for the protection of employees to ensure safe operation.

Type of protection Ex i, intrinsic safety

⚠ WARNING

Explosion hazard
Explosion hazard due to improper installation of devices with aluminum housing.
When using the device in areas that require the device safety level EPL "Ga" (Zone 0), the devices must be installed with aluminum housings, protected against strong mechanical impacts or friction.

Note
When operating the complete device in zone 0 (EPL ‘Ga’), the compatibility of the device materials with the surrounding atmosphere must be ensured.
Encapsulation material used for the integrated transmitter:
Polyurethane (PUR)

Apart from that, no additional specific information needs to be observed for mechanical installation.

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

If the temperature on the cable entries or the interior of the connection head is over 70° C (158 °F), connection leads with sufficient temperature resistance must be used.

Cable glands for type of protection ‘Ex d’

Devices with type of protection ‘Ex d’ supplied without cable glands
For devices with ‘Ex d - flameproof (enclosure)’ type of protection supplied without cable glands, refer to the notes in **Devices in ‘Ex d’ type of protection with cable gland** on page 14.
When installing cable glands provided by the operator, observe the data sheet, instruction and approval notes of the cable gland.

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

… Installation instructions

Devices in 'Ex d' type of protection with cable gland
If devices in 'Ex d – flameproof (enclosure)' type of protection with cable gland are ordered, an Ex d certified cable gland is factory-installed.
This case occurs if the cable gland is not deselected in the order by entering the 'Cable input options – U1 or U2' order code.

Data on the factory-installed Ex d cable gland
- Thread: M20 × 1.5
- Temperature range: −40 to 85 °C (−40 to 185 °F)
- Cable outside diameter: 3.2 to 8.7 mm (0.13 to 0.34 in)
- Material: nickel-plated brass

Note
In such cases, the value 'U1' (thread M20 × 1.5) is provided on the additional plate for explosion-protected apparatus in the type designation in accordance with the approval.

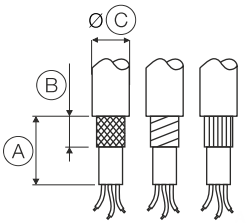
The cable gland is only suited for fixed installations and non-reinforced cables with round and smooth plastic sleeves and suitable outside diameter. The cables must be attached appropriately in order to prevent them being pulled out or twisted.

The operating instruction and approvals supplied with the cable glands, as well as any applicable requirements in accordance with EN 60079-14 must be taken into account accordingly.

Installation instructions
The sealing rings of the cable glands harden at low temperatures.
- Before installation, bring the sealing rings to a temperature of at least 20 °C (68 °F) for at least 24 hours.
- Before inserting the sealing rings and fixing them onto the cable gland, knead the rings to make sure they are soft and flexible.

IP rating IP66 / 67 is only achieved by installing the black neoprene sealing ring between the cable gland and the housing and by observing the tightening torque of 3.6 Nm (Figure 2, item (2)).

Cables must be protected against extreme mechanical loads (caused by tension, torsion, crushing, and so on). Even under operating conditions, it must be ensured that the cable entry remains hermetically sealed. The customer must provide a strain relief device for the cable.



(A) 40 mm (1.57 in)
(B) 12 mm (0.47 in)
(C) Ø 8.5 / 12 mm (0.33 / 0.47 in)

Figure 1: Stripping the connection cable

1. Check that cable used is suitable (i.e., check the mechanical resilience, temperature range, creep resistance, resistance to chemicals, outside diameter, and so on).
2. Strip the cable in accordance with Figure 1.
3. Check the outer sleeve for damage and soiling.
4. Insert the cable in the cable gland.

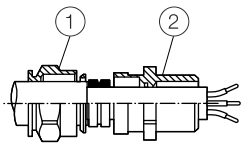


Figure 2: Tighten cable gland

5. Tighten the cable gland until the cable is firmly enclosed by the sealing ring (Figure 2, item (1)). Do not tighten more than 1.5--times of the specified torque on the cases (see assembly instructions)!

Maintenance
Check the cable glands during each scheduled maintenance. If the cable is slack, retighten the cap(s) of the cable glands.
If it is not possible to retighten them, the cable gland will need to be replaced.

Plastic cable gland M20 × 1.5 for 'Ex i' type of protection
When ordered, the standard supplied M20 × 1.5 plastic cable gland has a limited temperature range.

Type examination certificate
IMQ 13 ATEX 010 X and IECEx IMQ 13.0003X,
Manufacturer code HIBM-MX2DSC.

Permissible ambient temperature range
The permissible ambient temperature range of the cable gland is −40 to 70 °C (−40 to 158 °F).
When using the cable gland, make sure that the ambient temperature is within this range.

Notes on installation
The cable gland has two gaskets to support a clamping area of 4 to 7 mm (0.16 to 0.28 in) and 7 to 13 mm (0.28 to 0.51 in).
Depending on the cable outside diameter, observe the following points:

- For a clamping area of 7 to 13 mm (0.28 to 0.51 in), the inner gasket should be carefully removed.
- For a clamping area of 4 to 7 mm (0.16 to 0.28 in) (both gaskets required), installation should be made with a tightening torque of 3.5 Nm.
- For a clamping area of 7 to 13 mm (0.28 to 0.51 in) (outer gasket only), installation should be made with a tightening torque of 4.5 Nm.

On the cable side, when installing the connection of the cable gland and cable, check for tightness to make sure that the required IP rating is correct.
The cable gland is not suited for use as a blind plug. Use suited blind plugs only!
The cable glands are suited for fixed installations only.
The cables must be attached appropriately in order to prevent them being pulled out or twisted.
The information in the instruction of the cable gland (Safety, Maintenance and Mounting Instructions) should be observed!

Electrical connections

Grounding

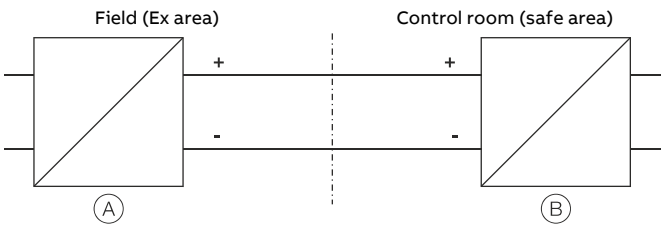
Note
The device shall be included in the equipotential bonding system using the grounding terminal intended for this purpose.

If, for functional reasons, the intrinsically safe circuit needs to be grounded by means of a connection to the potential equalization, it may only be grounded at one point.

Intrinsic safety proof

If the temperature sensors are operated in an intrinsically safe circuit, proof that the interconnection is intrinsically safe must be provided in accordance with DIN VDE 0165/Part 1 (EN 60079-25 and IEC 60079-25).
The supply isolators / distributed control system (DCS) inputs must feature intrinsically safe input protection circuits to eliminate hazards (spark formation).
In order to provide proof of intrinsic safety, the electrical limit value must be used as the basis for the EC-type examination certificates for the equipment (devices); this includes the capacitance and inductance values of the cables.
Proof of intrinsic safety is said to have been provided if the following conditions are fulfilled when a comparison is carried out in relation to the limit values of the equipment:

Transmitter (intrinsically safe equipment)	Supply isolator / DCS input (related equipment)
$U_i \geq U_o$	
$I_i \geq I_o$	
$P_i \geq P_o$	
$L_i + L_c$ (cable) $\leq L_o$	
$C_i + C_c$ (cable) $\leq C_o$	



(A) Transmitter
(B) Supply isolator / DCS input with supply / Segment coupler

Figure 3: Intrinsic safety installation check

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

… Electrical connections

Type of protection Ex i, intrinsic safety

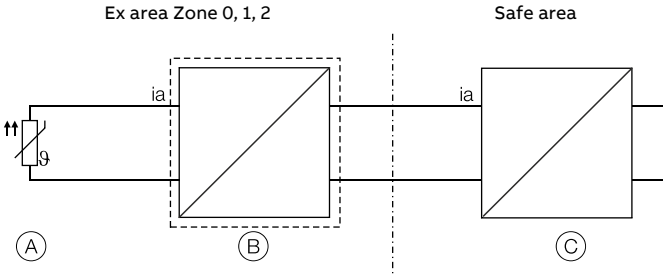
Ex marking

Model TSP341-N-D2

ATEX II 1 G Ex ia IIC T6…T1 Ga (zone 0, 1, 2)

Model TSP341-N-J2

IECEx ia IIC T6…T1 Ga (zone 0, 1, 2)



Ⓐ Sensors for contact and ambient temperature

Ⓑ Transmitter in connection head, intrinsically safe to zone 0

Ⓒ Ex ia supply isolator

Figure 4: Interconnection 'Ex i – intrinsic safety' type of protection

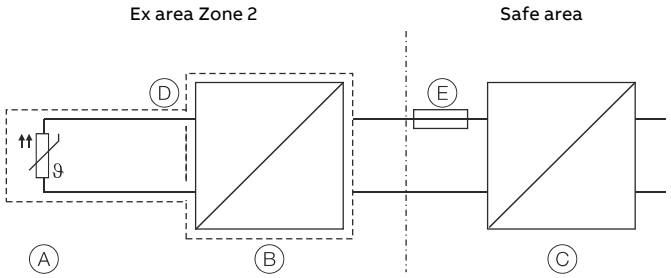
The TSP341-N is approved for use in zone 0 in 'Ex i – intrinsic safety' type of protection.
With this instrumentation, it must be ensured that the power feed only comes from an approved intrinsically safe electrical circuit of the appropriate category.
A supply isolator with 'Ex ia' type of protection is required for use in zone 0.

Electric and limit values must not be exceeded, see **Type of protection Ex i, intrinsic safety** on page 16 and **Temperature data** on page 27.

Type of protection Ex ec, EX nA – non-sparking and increased safety'

Ex marking

Model TSP341-N-B7:
ATEX II 3 G Ex ec IIC T6…T1 Gc
Model TSP341-N-H8:
IECEx nA IIC T6…T1 Gc
IECEx ec IIC T6…T1 Gc



Ⓐ Sensors for contact and ambient temperature

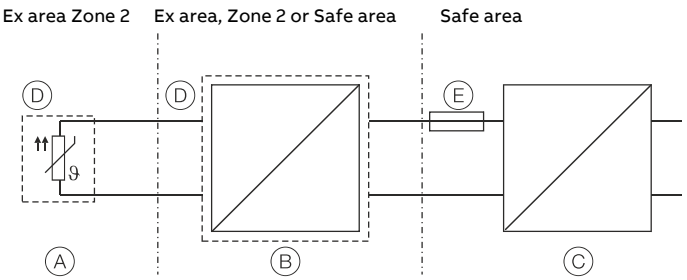
Ⓑ Transmitter in connection head

Ⓒ Supply isolator with voltage limit

Ⓓ IP housing with cable gland

Ⓔ Fuse 32 mA

Figure 5: Interconnection with integrated transmitter in 'Ex ec, EXna – non sparking and increased safety' type of protection*



Ⓐ Sensors for contact and ambient temperature

Ⓑ Transmitter in connection head

Ⓒ Supply isolator with voltage limit

Ⓓ IP housing with cable gland

Ⓔ Fuse 32 mA

Figure 6: Interconnection for remote sensor apparatus with ceramic terminal blocks in 'Ex ec, EXna – non sparking and increased safety' type of protection*

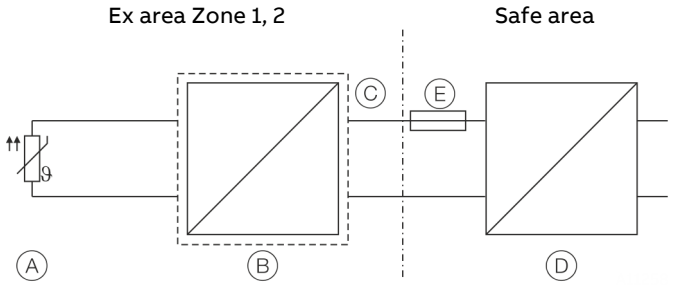
Connection notes

- The power supply of the transmitter must be limited by an upstream fuse with a fuse current rating of 32 mA.
- Maximum input terminal voltage of the transmitter: 30 V DC
- The 'Ex ec – increased safety' type of protection can only be achieved by correctly installing a specially certified cable gland with Ex ec type of protection and a corresponding marking.
- As far as the installation and mounting of components is concerned (cable entries, connection parts), only those components are approved which at the least technically comply with the current version of the type examination certificate and for which a separate examination certificate exists. At the same time, it is imperative that the operating conditions listed in the respective component certificates are complied with.
- For the connection, suited cable entries or piping systems must be used that satisfy the requirements of IEC/EN 60079-0 and for which separate examination certificates exist. If the transmitter is connected to pipeline systems, the relevant sealing device must be affixed directly to the housing.
- Cable entries (PG glands) and sealing plugs of simple design must not be used.
- Close off unused openings in accordance with IEC/EN 60079- 0.
- The connection lead must be routed securely and in such a way to guarantee adequate protection against damage.
- The terminal clamps must be tightened securely with a torque of 0.5 to 0.6 Nm.

Type of protection Ex d - flameproof (enclosure)

Ex marking

Model TSP341-N-D7:
ATEX II 2 G Ex db IIC T6/T4 Gb (Zone 1 und 2)
Model TSP341-N-J7:
IECEx db IIC T6/T4 Gb (Zone 1 and 2)



(A) Sensors for contact and ambient temperature
(B) Transmitter in connection head
(C) Ex d housing (IP 6X) with Ex d cable gland
(D) Supply isolator with voltage limit (30 V)
(E) Fuse 32 mA

Figure 7: Interconnection in 'Ex d – flameproof (enclosure)' type of protection*

The TSP341-N in Ex d – flameproof (enclosure) type of protection is supplied with a non-intrinsically safe transmitter.

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

… Electrical connections

Connection notes

- The power supply of the transmitter must be limited by an upstream fuse with a fuse current rating of 32 mA.
- Maximum input terminal voltage of the transmitter: 30 V DC
- The 'Ex d – flameproof (enclosure)' type of protection can only be achieved by correctly installing a specially certified cable gland with Ex d type of protection and a corresponding marking.
- As far as the installation and mounting of components is concerned (explosion-proof cable entries, connection parts), only those components are approved which at the least technically comply with the current version of the PTB 99 ATEX 1144 X type examination certificate and for which a separate examination certificate exists. At the same time, it is imperative that the operating conditions listed in the respective component certificates are complied with.
- For the connection, suited cable entries or piping systems must be used that satisfy the requirements of EN 60079-1 and for which separate examination certificates exist. If the transmitter is connected to pipeline systems, the relevant sealing device must be affixed directly to the housing.
- Cable entries (PG glands) and sealing plugs of simple design must not be used.
- Close off unused openings in accordance with EN 60079-1.
- The connection lead must be routed securely and in such a way to guarantee adequate protection against damage.

Commissioning

The commissioning and parameterization of the device may also be carried out in potentially explosive atmospheres using a handheld terminal that has been approved accordingly under consideration of an intrinsic safety installation check. Alternatively, an Ex modem can be connected to the circuit outside the potentially explosive atmosphere.

Operating instructions

⚠ DANGER

Risk of explosion due to hot parts

Hot parts inside the device pose an explosion hazard.

- Never open the device immediately after switch-off.
- A waiting time of at least four minutes should be observed before opening the device.

⚠ DANGER

Explosion hazard when opening the device

Explosion hazard when opening the device with activated power supply.

- Before opening the device, switch off the power supply.

Damage to the 'Flameproof (enclosure)– Ex d' type of protection

The cover thread is used as a flameproof joint for the 'Flameproof (enclosure) – Ex d' type of protection.

- During assembly / disassembly of the device, make sure that the cover thread does not get damaged.
- Devices with damaged threads must no longer be used in potentially explosive atmospheres.

Protection against electrostatic discharges

The painted surface of the housing and the plastic parts inside the device can store electrostatic charges.

⚠ WARNING

Risk of explosion!

The device must not be used in areas in which process-related electrostatic charging of the housing may occur.

- The device must be installed, maintained and cleaned such that any dangerous electrostatic charge is avoided.

Repair

⚠ DANGER

Explosion hazard

Explosion hazard due to improper repair of the device. Faulty devices must not be repaired by the operator.

- The device may only be repaired by the ABB Service Department.
- Repairs on flameproof joints are not permitted.

3 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	

Installation instructions

The installation, commissioning, maintenance and repair of devices in areas with explosion hazard must only be carried out by appropriately trained personnel.
The operator must strictly observe the applicable national regulations with regard to installation, function tests, repairs, and maintenance of electrical devices. (e. g. NEC, CEC).

Warnings and instructions should be followed as per notes on the associated control drawing for installation in the associated hazardous area.

The control drawings are available for download under the following link. Just scan or click on the QR code:

ABB Library – NINVA TSP341-N – control drawings

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

Electrical connections

Grounding

Transmitters can be installed in all kinds of industrial sectors. Potentially explosive systems are divided into zones, meaning that a wide range of different instruments are also required. For this, pay attention to the country-specific guidelines and certificates!

Note

When operating the transmitter in Zone 0, the compatibility of the device materials with the surrounding atmosphere must be guaranteed.

Encapsulation material used for the transmitter:

Polyurethane (PUR)

Installation in a potentially explosive atmosphere

Transmitters can be installed in all kinds of industrial sectors. Potentially explosive systems are divided into zones, meaning that a wide range of different instruments are also required. For this, pay attention to the country-specific guidelines and certificates!

Commissioning

The commissioning and parameterization of the device may also be carried out in potentially explosive atmospheres using a handheld terminal that has been approved accordingly under consideration of an intrinsic safety installation check. Alternatively, an Ex modem can be connected to the circuit outside the potentially explosive atmosphere.

Operating instructions

⚠ DANGER

Risk of explosion due to hot parts

Hot parts inside the device pose an explosion hazard.

- Never open the device immediately after switch-off.
- A waiting time of at least four minutes should be observed before opening the device.

⚠ DANGER

Explosion hazard when opening the device

Explosion hazard when opening the device with activated power supply.

- Before opening the device, switch off the power supply.

Protection against electrostatic discharges

The plastic parts inside the device can store electrostatic charges.

Make sure that no electrostatic charges can accumulate when handling the device.

⚠ WARNING

Risk of explosion!

The device must not be used in areas in which process-related electrostatic charging of the housing may occur.

- The device must be installed, maintained and cleaned such that any dangerous electrostatic charge is avoided.

Repair

⚠ DANGER

Explosion hazard

Explosion hazard due to improper repair of the device. Faulty devices must not be repaired by the operator.

- The device may only be repaired by the ABB Service Department.
- Repairs on flameproof joints are not permitted.

4 Design and function

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.

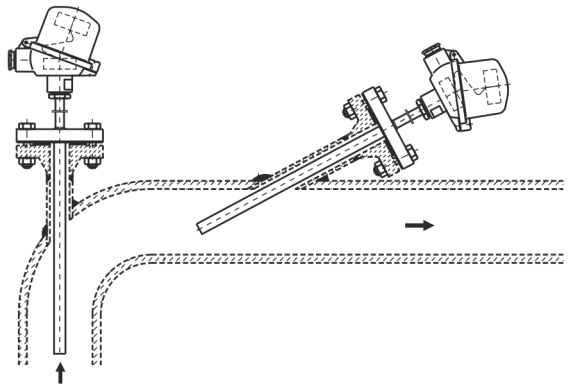


Figure 8: Classic installation of temperature sensors in piping

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. However, the sensor can be effectively used in the vast majority of process and piping conditions without any need for the input of process or piping specification. Please see more details in the section **How to effectively use a non-invasive measurement** on page 25.

* 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.

... 4 Design and function

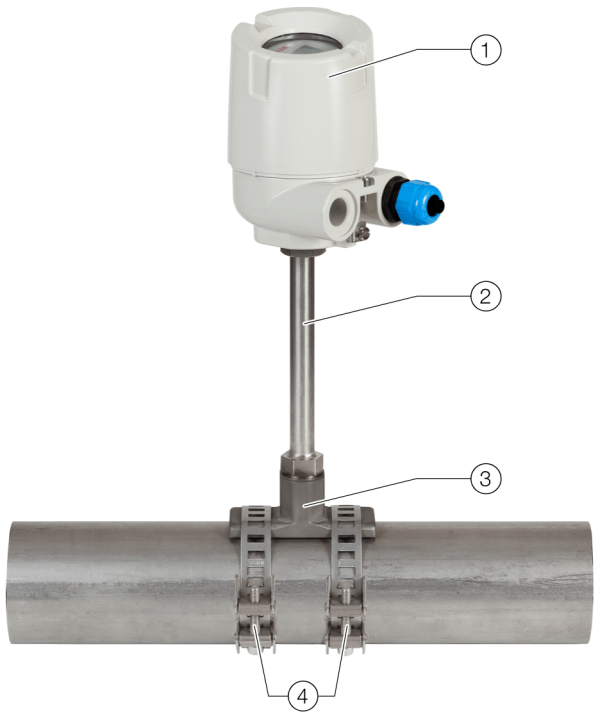
System structure

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 A and AS LCD indicator can be integrated.

The transmitter is connected to two temperature sensors. The first - sensor 1 - measures the contact temperature at the measuring point, while the second - 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 temperature options up to 550 °C (1022 °F) can be realized as special designs with remote sensor apparatus being able to withstand ambient temperatures up to 100 °C (212 °F).

The transmitter can be configured using the software provided by ABB with TSP341-N-support (DTM and EDD) and tools such as Field Information Manager (FIM) in accordance with the current conditions of use.



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

Figure 9: 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 foot of the sensor.

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** on page 25.
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.

5 Product identification

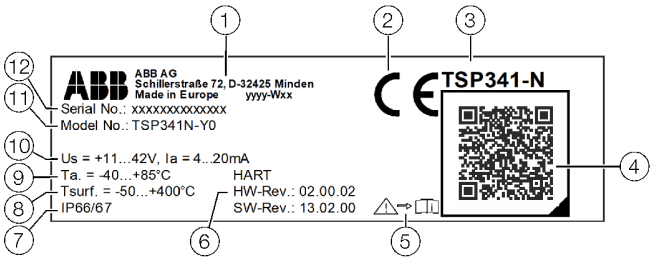
Name plate

Note

The name plates displayed are examples. The device identification plates affixed to the device can differ from this representation.

Note

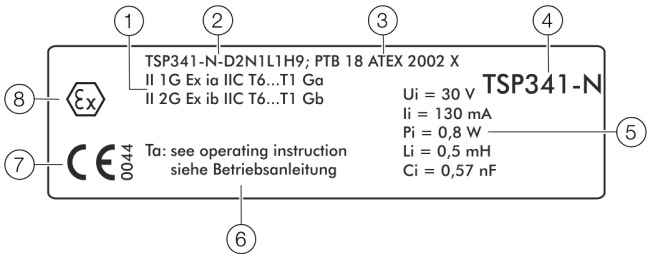
The values specified on the name plate are maximum values and do not take process-related stress into consideration. This should be taken into consideration when working with the instruments.



1. Manufacturer address, year / week of manufacture
2. CE mark (EU conformity), if not on additional plate
3. Type designation / model
4. AutoID according to IEC 61406
5. Note: Observe product documentation
6. With integrated transmitter: Hardware / software revision
7. IP rating of housing
8. Surface temperature range $T_{amb.}$, for Ex versions on additional plate
9. Ambient temperature range T_{amb}. (temperature on connection head), for Ex versions on additional plate
10. Transmitter specification
11. Model number
12. Serial number

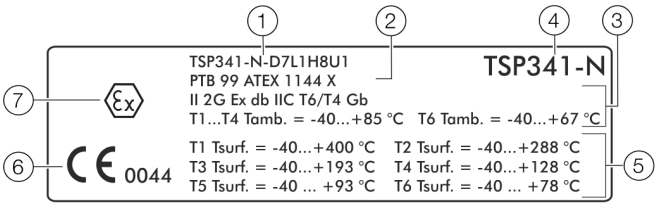
Figure 10: TSP341-N name plate (example for 'Ex i – intrinsic safety' type of protection)

Additional certification plate for explosion-proof devices



1. Ex marking
2. Type designation in accordance with approval
3. Approval number
4. Type designation
5. Device connection data
6. Note on instruction for ambient temperature
7. CE mark (EU conformity) and notified body for quality assurance
8. Ex Mark

Figure 11: Additional certification plate for devices with type of protection "Ex i - intrinsic safety" (example)



1. Type designation in accordance with approval
2. Approval number
3. Ex marking
4. Type designation
5. Temperature range
6. CE mark (EU conformity) and notified body for quality assurance
7. Ex Mark

Figure 12: Additional certification plate for devices with type of protection "Ex d - flameproof enclosure" (example)

6 Transport and storage

Inspection

Check the devices immediately after unpacking for possible damage that may have occurred from improper transport. Details of any damage that has occurred in transit must be recorded on the transport documents.
All claims for damages must be submitted to the shipper without delay and before installation.

Transporting the device

Observe the following instructions:

- Do not expose the device to humidity during transport. Pack the device accordingly.
- Pack the device so that it is protected against vibrations during transport, for example, by using air-cushioned packing.

Storing the device

Bear the following points in mind when storing devices:

- Store the device in its original packaging in a dry and dust-free location.
- Observe the permitted ambient conditions for transport and storage.
- Avoid storing the device in direct sunlight.
- In principle, the devices may be stored for an unlimited period. However, the warranty conditions stipulated in the order confirmation of the supplier apply.

Ambient conditions

The ambient conditions for the transport and storage of the device correspond to the ambient conditions for operation of the device.
Adhere to the device data sheet!

Returning devices

For the return of devices, follow the instructions in **Repair** on page 53.

7 Installation

Safety instructions

⚠ DANGER

Explosion hazard
Improper installation and commissioning of the device carries a risk of explosion.

- For use in potentially explosive atmospheres, observe the information in **Use in potentially explosive atmospheres in accordance with ATEX and IECEx** on page 6!

⚠ CAUTION

Risk of burns due to hot measuring media
The device surface temperature may exceed 70 °C (158 °F), depending on the measuring medium temperature!

- Before starting work on the device, make sure that it has cooled sufficiently.

Achieving IP rating IP 66 / IP 67

The user must take appropriate measures to ensure that the required IP rating according to the IEC 60529 standard is achieved.

The IP rating IP 66 / 67 is only achieved after the device has been correctly and fully installed, as described in this chapter.

- Suited cable glands should be used.
- Unused device inputs must be closed off using suited plugs.

See also **Cable gland** on page 27 and **Cable glands** on page 31.

How to effectively use a non-invasive measurement

A NINVA™ TSP341-N can be mounted on any process pipe or container to provide an accurate measurement of the surface temperature of the structure. Uniquely, by contacting the surface perpendicular to the primary axis of the pipe, a NINVA™ measurement can be handled and managed in a similar manner to any thermowell measurement.

However, the NINVA™ TSP341-N approach provides unprecedented abilities to estimate the complete performance of a temperature measurement point before installation. When considering a NINVA measurement, the following three steps should be followed:

Step 1: 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.

NINVA performance predictor

Step 2: Mount in location
Follow the mounting instructions carefully ensuring to loosen the nut on the head before mounting the device (see **Figure 14** on page 28). This ensures that the contact sensor tip will not get damaged or bent and that a good and repeatable contact of the sensor is made once the final tightening of the head is completed.

If the default or ordered preset measurement range does not match the requirement for the location, the lower (4 mA) and upper (20 mA) temperature range should be adjusted to the desired measurement range using a handheld terminal.

Step 3: Insulate if used on an outdoor location
NINVA™ turns the pipe into a sensor and measures the surface temperature of the pipe. If it rains or the wind is blowing strongly at the location, the true surface temperature of the pipe can be affected. The correlation with the process temperature will therefore deviate. Insulation will allow the pipe surface temperature to better correlate with the process temperature. However, in all cases, the NINVA™ will compensate the contact sensor measurement for ambient effects delivering the true surface temperature of the pipe under the sensor under all conditions.

Detailed background information on non-invasive temperature measurement can be found at:

… 7 Installation

General Notes

The sensor assembly is designed to ensure long term mechanical stability in mounting and performance. The sensor is mounted on to the pipe or vessel by means of at least 2 clamp collars. The collars are tensioned with a screw lock assembly where a torque of 10 Nm is specified in order to ensure that the mounting is stable in service.

When installing the temperature sensor using clamp collars, observe the following points:

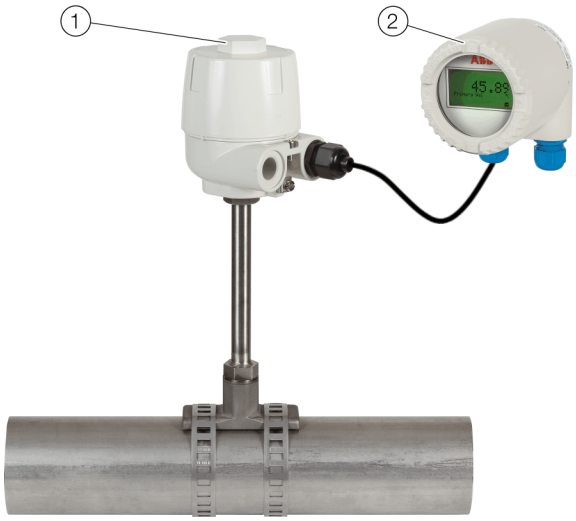
- The temperature sensor must be firmly and securely installed in a way that conforms to the application.
- The temperature sensor must be installed at angle of 90° to the piping.
- The retaining plate of the temperature sensor must lie flat on the measuring point, with the sides of the plate parallel to the centerline of the pipe. Ensure that the contact surface is free of dirt or loose materials.
- The retaining plate of the temperature sensor must be installed on the piping using suited clamp collars. Select the length of the clamp collars and the material according to the installation position.
- The IP rating will no longer apply in the event of damage to the connection head or the threads, gaskets or cable glands on the connection head.
- The connection leads must be firmly connected to the terminals.
- After connecting the connection lines with a suited tool (screwdriver, wrench), securely close and seal the connection head. Be sure to observe here that the sealing rings of the connection heads are clean and undamaged.
- Insulation of the piping around the measuring point is recommended for any installation to ensure that the pipe surface temperature correlates to the process temperature without convective losses to the environment. Ambient conditions like rain will affect the pipe surface temperature and the corresponding relation to the true process temperature.

Variants

The TSP341-N is available as an integral version with a head mounted TTH300-N transmitter (**Figure 9** on page 22) or without a transmitter. The latter is termed a TSP341-N remote sensing apparatus and the sensor connections are terminated on a ceramic terminal block in the connection head.

The unique advantage of the ABB NINVA approach is that the sensor assembly can be mounted remotely to the transmitter without affecting the performance of the measurement (Figure 13). This approach has advantages in allowing the sensor to be used in situations where the ambient temperature exceeds the capabilities of the transmitter electronics.

Additionally, the remote sensor apparatus is advantageous when the sensor is mounted in locations where the visibility of the display and access to the transmitter is difficult. When a remote installation is required, the TSP341-N Remote sensor apparatus, is to be used in conjunction with a TTF300-N field-mount transmitter (Figure 13).



① Remote sensor apparatus ② TTF300-N transmitter

Figure 13: Example of installing TTF300-N with TSP341-N remote sensor apparatus

The TTF300-N differs from a TTF300 in the following manner:

1. The TTF300-N is capable of non-invasive temperature measurements, which is set up as the factory default.
2. When connected to a TSP341-N for non-invasive temperature measurement, care must be taken to wire the sensors to the transmitter according to this manual to ensure a correct measurement. See **Electrical connections** on page 15.
3. The TTF300-N can be used in conventional mode wherein it functions as a TTx300 for use with both RTDs and thermocouples. Details can be found in the corresponding **Operating Instruction OI/TTF300**.

Temperature data

Ambient temperature at connection head

Note

During use in potentially explosive atmospheres, restrictions in permissible ambient temperature are possible which comply with additional data included in **Use in potentially explosive atmospheres in accordance with ATEX and IECEx** on page 6 as well in declarations of conformity and type examination certificates!

Permissible ambient temperature range $T_{amb.}$ on the connection head	
Connection head without LCD indicator	−40 to 85 °C (−40 to 185 °F)
Connection head with LCD indicator	−20 to 70 °C (−4 to 158 °F)

Table 13: Ambient temperature on the connection head

When using a contact 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 14: 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.

For detailed information on insulating the measuring point, see **Insulation of the measuring point** on page 30.

Cable gland

The plastic cable gland for cable outer diameters of 4 to 13 mm (0.16 to 0.51 in.) used as a standard is suited for a temperature range of −40 to 70 °C (−40 to 158 °F). For temperatures outside this range, an appropriate cable gland can be installed.

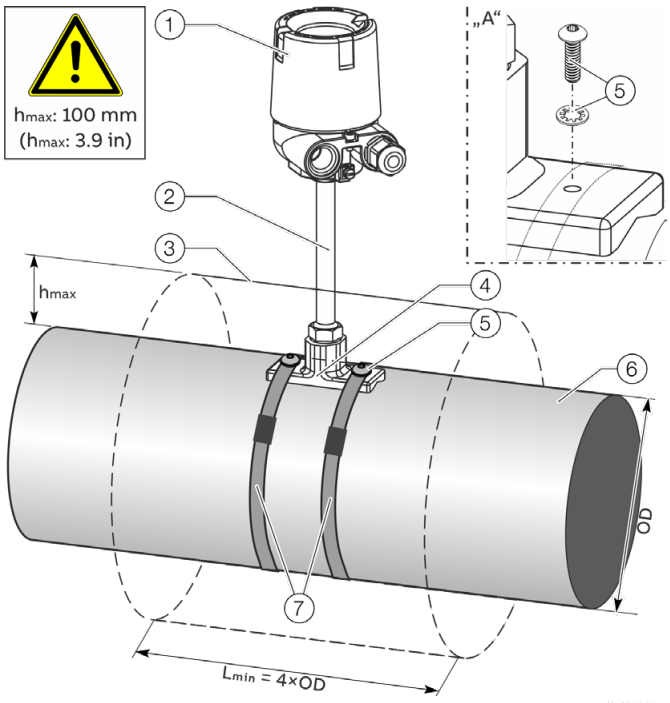
The metal cable gland for Ex d (flameproof enclosure) used as a standard for cable outer diameters of 3.2 to 8.7 mm (0.13 to 0.34 inch) covers a permissible temperature range of −40 to 85 °C (−40 to 185 °F).

Conductor material

If the temperature on the cable entries of the device is over 70° C (158 °F), connection leads with sufficient temperature resistance must be used.

… 7 Installation

Mounting



① Connection head
② Extension tube
③ Insulation of the measuring point
④ Retaining plate
⑤ M5 screws with safety washers (Detail 'A')
⑥ Piping
⑦ Clamp collars
L_{min} minimum insulation length
OD Pipe outer diameter

Figure 14: Assembly on piping (example)

Selecting clamp collars

The minimum selectable pipe diameter for installation of the TSP341-N is DN 40 (1.5 in). Special designs for smaller piping are available upon request. Clamp collars consist of universal bands that are cut to the required length and associated clamp locks based on the selected diameter. Typically, the length of the bands is approximately 150 mm (6 in) longer than the required circumference.

The clamps sets are designed with a low thermal mass and with as much continuous contact to the pipe as possible. This ensures a fast thermal response of that keeps the sensor in strong mechanical mounting contact with the pipe even through dramatic temperature changes. To ensure good thermal expansion matching, two types of clamp materials are offered that depend on the expansion coefficients of the piping as follows:

The following materials are available:

- Chrome-steel 1.4016 (ASTM 430),
  $\alpha = 10$ to $10.5 \times 10^{-6}/K$
- Stainless steel 1.4301 (ASTM 304),
  $\alpha = 16$ to $17.5 \times 10^{-6}/K$

Clamp sets

- **Nominal diameter DN 40 to DN 80:**
  Universal clamps type PG 174, width 10 mm (0.4 in)
- **Nominal diameter > DN 80:**
  Universal clamps type PG 174, width 18 mm (0.7 in)

The selection of the pipe diameter for the clamp dictates the maximum pipe size that the clamp set can be used on. For example, a DN 600 Clamp set can be used for any piping from DN 80 to DN 600.

More information on the universal clamps is available at www.oetiker.com.

For installation on piping smaller than DN 40 in diameter, please contact ABB.

Assembly of the temperature sensor

NOTICE

Impairment of the device function

For trouble-free operation of the temperature sensor, the following points should be observed:

- If fluid accumulation in the extension tube can be expected at the installation location, install the temperature sensor with connection head above the horizontal line.
- The extension tube and retaining plate are tightened at the plant with a torque of 70 Nm, do not loosen this connection!
- Make sure that both sensor elements of the TSP341-N do not come into contact with each other at the ends.
- Make sure that no lateral forces (e.g. due to shifting of the retaining plate) are exerted on the protruding contact sensor during assembly.
- Make sure that both contact areas of the retaining plate are set level on the measuring point over their entire length.

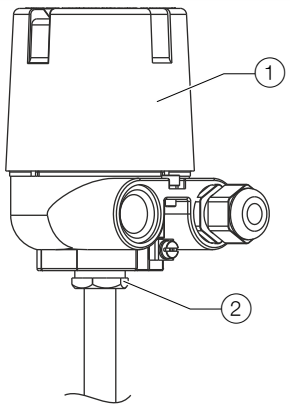
1. Remove the plastic transport protection on the retaining plate before assembly.
2. The measuring point must be flat and free of impurities and foreign substances. Clean the measuring point as needed.
3. Cut the clamp collar to the appropriate length, circumference + 150 mm (6 in).

⚠ CAUTION

Risk of injury

Risk of injury due to sharp edges of the clamp collar band.

- To avoid injuries, deburr the sharp edges of the clamp collar band with a file and chamfer the corners of the clamp collar band.



① Connection head ② Mounting nut

Figure 15: Align connection head

4. Loosen the mounting nut of the screwed connection from the extension tube and connection head by 3.5 to 4 turns maximum.
5. Gently pull the connection head away from the extension tube (see Figure 15).
6. Place the clamp collars around the piping to the left and right of the measuring point and loosely tighten.
7. Place the temperature sensor with the retaining plate on the measuring point and slide the clamp collars laterally over the retaining plate.
8. **18 mm clamp collar:**
   Secure the clamp collars in the threaded holes of the retaining plate using the supplied M5 screws and safety washers (alternatively also after tightening the collars).
   10 mm clamp collar:
   Push the clamp collars are far in as possible during assembly on the retaining plate.
   Then, place the supplied screws (M5) and safety washers in the threaded holes of the retaining plate to the left and right respectively to secure against slipping (alternatively also after tightening the collars).
9. Align the retaining plate level at the measuring point and tighten the clamp collars on the turnbuckle.
   Tightening torque:
   18 mm clamp collar: 10 Nm
   10 mm clamp collar: 3 Nm
   For clamp collar band lengths > 1 m (3.3 ft), for piping larger than DN 300, one or more clamp collar sets are provided. These sets have to be combined with each other to encircle the circumference of the pipe.
10. Turn the connection head to the desired position.
11. To fix the connection head in the desired position, tighten the mounting nut with a torque of 35 Nm.

… 7 Installation

… Mounting

Insulation of the measuring point

Insulation of the piping around the measuring point is recommended for any installation to ensure that the pipe surface temperature correlates to the process temperature without convective losses to the environment. Ambient conditions like rain will affect the pipe surface temperature and the corresponding relation to the true process temperature. Typical insulation should be at least 2 × outer diameter (OD) of the piping on either side of the sensor mounting position with a thickness of at least 3 cm (see **Figure 14**). Mineral wool or particle foam (PET) based insulations are typical forms of insulating material that can be used.

For high temperature applications, the insulation also protects the connection head from excessive temperatures due to heat radiation from the piping.

In all cases, the insulating material used must be suited for the process and ambient conditions that apply to the process and are the responsibility of the user.

NOTICE

Impact on measuring accuracy

Impairment of measuring accuracy due to improper insulation of the measuring point.

- Insulate measuring point to the height 'h_{max}' as presented in **Figure 14** only.
- The extension tube should not be insulated above the measuring point.

Electrical connections

Safety instructions

⚠ WARNING

Risk of injury due to live parts.

Improper work on the electrical connections can result in electric shock.

- Connect the device only with the power supply switched off.
- Observe the applicable standards and regulations for the electrical connection.

The electrical connection may only be established by authorized specialist personnel.

Notices on electrical connection in this instruction must be observed; otherwise, electric safety and the IP-rating may be adversely affected.

Safe isolation of electric circuits which are dangerous if touched is only guaranteed when the connected devices fulfill the requirements of EN 61140 (basic requirements for secure separation).

To ensure safe isolation, install supply lines so that they are separate from electrical circuits which are dangerous if touched, or implement additional isolation measures for them.

Cable glands

The temperature sensor TSP341-N is supplied with a M20 × 1.5 cable gland. The supplied cable gland is suited for use under the following conditions.

Data of the supplied plastic cable gland

- Thread: M20 × 1.5
- Temperature range: −40 to 70 °C (−40 to 158 °F)
- Cable outside diameter: 5.5 to 13 mm (0.22 to 0.51 in)
- Material: polyamid

For differing temperatures, an appropriately specified cable gland must be installed.

Note

In devices for use in potentially explosive atmospheres, observe the information in **Devices in 'Ex d' type of protection with cable gland** on page 14 and **Plastic cable gland M20 × 1.5 for 'Ex i' type of protection** on page 15!

Alternatively, the temperature sensor can be supplied without cable glands, but with an M20 × 1.5 or ½ in NPT thread. In this case, the user must take appropriate measures to ensure that the necessary IP-rating is achieved, the temperature range maintained and that the cable gland used is approved in accordance with the standard on which our certificate is based.

To achieve the IP rating, the cable gland used must be approved for the cable diameter. The IP rating IP 66 / IP 67 or NEMA 4X of the used cable gland used must be checked. The operating temperature range of the cable gland used must not be up-scaled.
Observe tightening torque in accordance with information in the data sheet / operating instruction for cable gland used.

In practice, you may find the specified IP rating can no longer be achieved if certain cables and lines are used in conjunction with the cable gland. Deviations from the test conditions as set out in the IEC 60529 standard must be checked. Check the cables' concentricity, transposition, external hardness, sheath, and surface roughness.

Requirements for achieving the IP rating

- Only use cable glands in the specified clamping area.
- When using very soft cable types, do not use them in the lower clamping area.
- Only use round cables or cables with a slightly oval-shaped cross section.
- Frequent opening / closing is possible but may have a negative effect on the IP rating.
- If cables are demonstrating pronounced cold flow behavior, the cable glands will need to be retightened.
- Cables with VA wire mesh require special cable glands.

Conductor material

NOTICE

Danger of wire breakage

The use of conductive material with solid wires can lead to wire breakage.

- For the electrical connection of the temperature sensor, only use cable material with flexible conductors.

Power supply

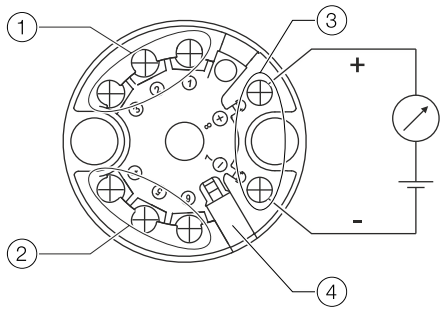
- Cable type: flexible standard cable material
- Maximum wire cross-section: 1.5 mm^2 (AWG 16)

… 7 Installation

… Electrical connections

Terminal layout

The transmitter used in the TSP341-N temperature sensor is based on the TTH300-N.



(1) terminals 1 to 3 for sensor 1 (Contact Sensor)

(1) terminals 4 to 6 for sensor 2 (Reference Sensor)

(3) terminals 8/+ and 7/– for current output of 4 to 20 mA and HART communication

(4) LCD indicator interface

Figure 16: Pin assignment of the integrated transmitter

Terminals 1 to 6 are internally connected to the TSP341-N sensors.
The power supply and signal are routed in the same line and must be implemented as a SELV or PELV circuit in accordance with the relevant standard (standard version).

- For the explosion-proof design, the guidelines in accordance with the Ex standard must be adhered to.
- The cable wires must be provided with end sleeves.
- The user is responsible for ensuring EMC-compliant cabling.

The power supply and signal are routed in the same line and must be implemented as a SELV or PELV circuit in accordance with the relevant standard (standard version).
For the explosion-proof design, the guidelines in accordance with the Ex standard must be adhered to.

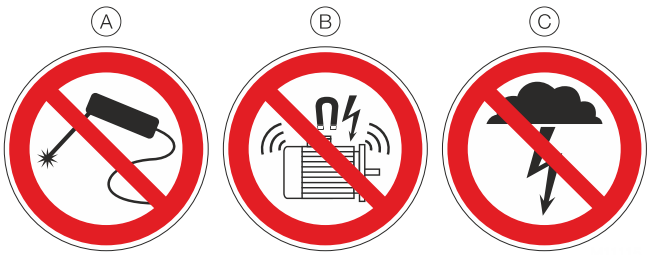
- The cable wires must be provided with end sleeves.
- The user is responsible for ensuring EMC-compliant cabling.

Protection of the transmitter from damage caused by highly energetic electrical interferences

The transmitter has no switch-off elements. Therefore, overcurrent protective devices, lightning protection, or voltage disconnection options must be provided at the plant.

NOTICE

Temperature transmitter damage!
Overvoltage, overcurrent and high-frequency interference signals on the supply connection as well as sensor connection side of the device can damage the temperature transmitter.



(A) Do not weld

(B) No high-frequency interference signals / switching operations of large consumers

(C) No overvoltage due to lightning

Figure 17: Warning signs

Overcurrent and overvoltage can occur through for example welding operations, switching operations of large electric consumers, or lightning in the vicinity of the transmitter, sensor, as well as connector cables.
Temperature transmitters are sensitive devices on the sensor side as well. Long connector cables to the sensor can encourage damaging interference. This can already happen if temperature sensors are connected to the transmitter during installation, but are not yet integrated into the system (no connection to the supply isolator / DCS)!

Suited protective measures

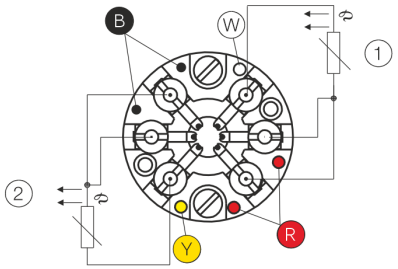
The following items should be observed to protect the transmitter from sensor-side damage:

- In the vicinity of the transmitter, sensor and sensor connector cable in case of a connected sensor, high-energy overvoltage, overcurrent and high-frequency interference signals due to welding operations, lightning, circuit breakers or large consumers of electricity among others should be absolutely avoided.
- The connection cable of the sensor on the transmitter should be disconnected when performing welding work in the vicinity of the installed transmitter, sensor, as well as supply lines from the sensor to the transmitter.
- This correspondingly also applies to the supply side, if there is a connection there.

Connections for the TSP341-N Remote sensor apparatus

In the TSP341-N Remote sensor apparatus, the two sensors (sensor 1 and 2) are connected to a ceramic terminal board and marked with a color coding as shown in Figure 18.

The non-invasive device has two resistance sensors, each in three-wire circuit internally. Sensor 1 (contact sensor) is assigned to colors RED and WHITE, sensor 2 (reference sensor) to colors BLACK and YELLOW.



(R) Red (Y) Yellow (B) Black (W) White

(1) Sensor 1 (contact sensor)

(2) Sensor 2 (reference sensor)

Figure 18: Pin assignment for ceramic terminal block in the remote transmitter (view from above)

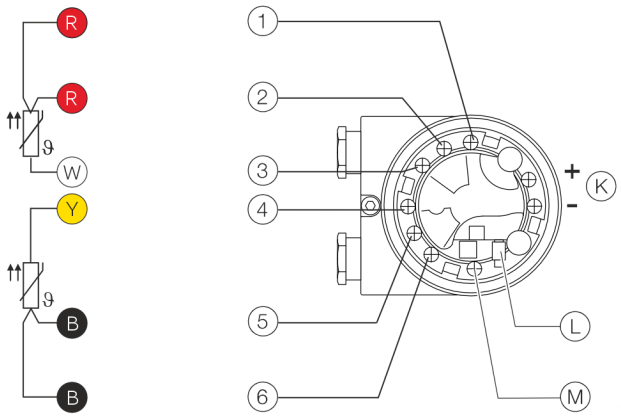
Note

For the correct connection to the ceramic terminal block, the color markings described are decisive, rather than any numbers that may be on the base.

The TSP341-N Remote sensor apparatus can then be connected to a TTF300-N with six wire cables to obtain a NINVA™ measurement. The wiring in the TTF300-N transmitter follows the pin assignments shown in brief in Figure 19. More details on the pin assignment can be found in the **Operating Instructions 'OI/TTF300'** or the **Commissioning Instructions 'CI/TTF300'** for the TTF300-N.

NOTICE

If the sensor is connected to any 2-channel temperature transmitter other than the TTF300-N with non-invasive model, the temperature measurements from the sensors will still function as two independent, 3-wire, Pt100s. However, the design of the TSP341-N remote sensor apparatus is not suitable for any other measurement application other than to measure the surface temperature of piping and vessels. In such a case, the red and white contacts would provide the surface sensor temperature and the yellow and black would provide reference sensor temperature in the vicinity of the surface sensor.



From sensor:

(R) Red
(W) White
(Y) Yellow
(B) Black

To transmitter:

(1) to (3) Connection sensor 1 (contact sensor)
(4) to (6) Connection sensor 2 (reference sensor)

(K) 4 to 20 mA HART®
(L) Interface for LCD indicator
(M) Ground terminals for shield support for sensors and supply / signal lines

When connected to the TSP341-N Remote sensor apparatus, sensor 1 is the contact sensor and sensor 2 is the reference sensor.

Figure 19: Pin assignment for processing and displaying component.

NOTICE

For an accurate non-invasive temperature measurement using a TSP341-N remote sensor apparatus, the appropriate sensor pair value indicated on the device has to be input into the TTF300-N (**SPV**). This can be done when following the steps for the 'Easy Set-up' configuration of the TTF300-N transmitter. The following section details the operation of the display interface to the device. The relation to the process temperature can be found in the section **How to effectively use a non-invasive measurement** on page 25.

8 Commissioning and operation

Safety instructions

⚠ CAUTION

Risk of burns due to hot measuring media

The device surface temperature may exceed 70 °C (158 °F), depending on the measuring medium temperature!

- Before starting work on the device, make sure that it has cooled sufficiently.

If there is a chance that safe operation is no longer possible, take the device out of operation and secure it against unintended startup.

General

When so ordered, the temperature sensor is ready for operation after assembly and installation of the connections.

The parameters of the integrated transmitter are preset at the factory based on factory defaults and the customer specific order. The settings can be changed at any time through HART communication (DTM, EDD, FIM) or through a display.

The operation of the display is valid for TTx300-N transmitters and applies to both the integral version of the TSP341-N with a built-in transmitter as well as for the TTF300-N. The menu, display and parameters outlined here are specific to the non-invasive measurement functionality.

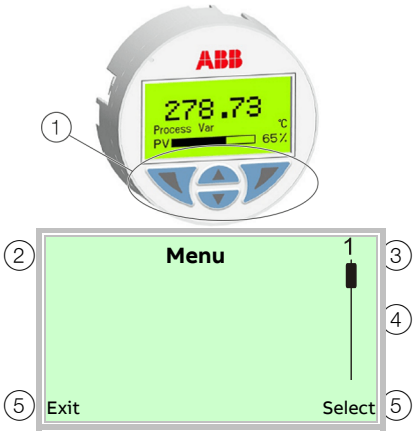
Checks prior to commissioning

The following points must be checked before commissioning the device:

- Check the installation of the sensor for optimal contact with the measuring point and correct insulation.
- Correct wiring in accordance with **Electrical connections** on page 30.
- Potential equalization must be connected.
- The connected lines must be checked for firm seating. Only firmly seated lines ensure full functionality.
- The ambient conditions must correspond to the information given on the name plate and in the data sheet.
- If devices are to be used in potentially explosive atmospheres, the temperature and electric data in accordance with **Use in potentially explosive atmospheres in accordance with ATEX and IECEx** on page 6 must be maintained.

Operation / control

Menu navigation



1. Operating buttons for menu navigation
2. Indication of menu designation
3. Indication of menu number
4. Marking to indicate relative position within the menu
5. Indication of the current function assigned to the operating buttons and

Figure 20: LCD display (example)

You can use the or operating buttons to browse through the menu or select a number or character within a parameter value.
Different functions can be assigned to the and operating buttons. The function (5) that is currently assigned to them is shown on the LCD display.

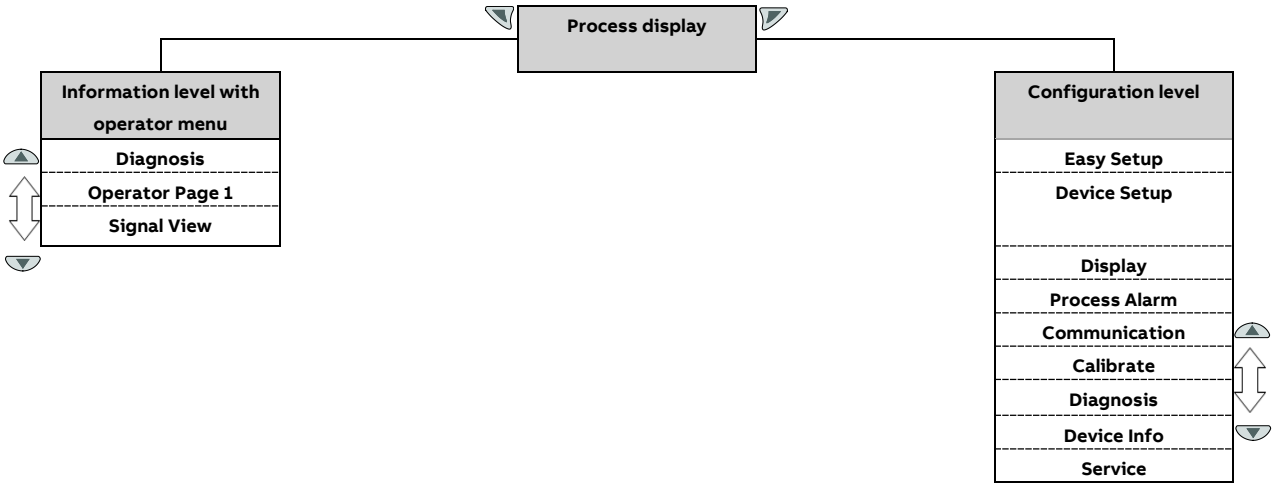
Control button functions

	Meaning
Exit	Exit menu
Back	Go back one submenu
Cancel	Cancel a parameter entry
Next	Select the next position for entering numerical and alphanumeric values

	Meaning
Select	Select submenu / parameter
Edit	Edit parameter
OK	Save parameter entered

… 8 Commissioning and operation

HART® menu levels



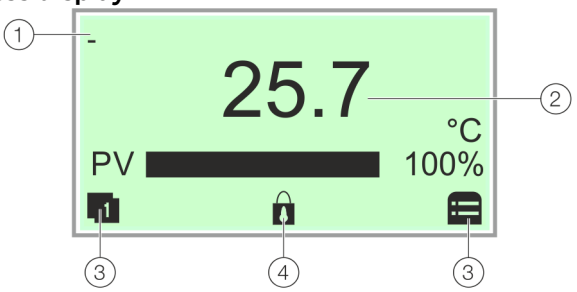
Process display
The process display shows the current process values.

Operator menu
On the information level, the operator menu can be used to display diagnostic information and choose which operator pages to display.

Configuration level
The configuration level contains all the parameters required for device commissioning and configuration. The device configuration can be changed on this level.

Commissioning
The menu item “Easy Setup” from SW-Rev.: 03.00 enables a simplified configuration of the device.

Process display



1. Measuring point tagging (Device TAG)
2. Current process values
3. 'Button function' symbol
4. 'Parameterization protected' symbol

Figure 21: Process display (example)

The process display appears on the LCD display when the device is powered on.It shows information about the device and current process values.
The way in which the current process values are shown can be adjusted on the configuration level.
The symbols at the bottom of the process display are used to indicate the functions of the operating buttons and , in addition to other information.

From SW-Rev.: 03.00, two process variables can also be optionally displayed: one is displayed above the other.

Symbol	Description
	Call up information level.
	Call up configuration level.
	The device is protected against changes in the parametrization.

Error messages in the HART® LCD display

In the event of an error, the relevant device status symbol and the associated diagnosis group will appear:

The diagnostic messages are divided into the following groups in accordance with the NAMUR classification scheme:

Status symbols according to NAMUR NE 107**	Description	
not applicable	OK or Information	Device is functioning or information is available
	Check Function	Device is undergoing maintenance (for example simulation)
	Off Specification	Device or measuring point is being operated outside of the specifications
	Maintenance Required	Request service to prevent the measuring point from failing
	Failure	Error; measuring point has failed

The error can then be read in plain text via the "Diagnosis" information level (from SW-Rev.: 03.00).

Additionally, the diagnostic messages are divided into the following areas:

Range	Description
Electronics	Diagnosis for device hardware.
Sensor	Diagnosis for sensor elements and connection lines.
Configuration	Diagnosis of the communication interface and parameterization / configuration.
Operating conditions	Diagnosis for ambient and process conditions.
Process (from SW-Rev.: 03.00)	Notes and warnings when leaving the sensor or process temperature range.

Note

For a detailed description of the errors and notices on troubleshooting, see **Diagnosis / error messages** on page 52.

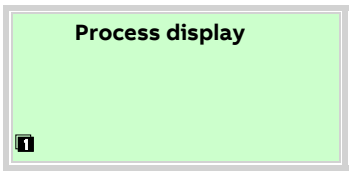
Diagnosis / error messages on page 52

… 8 Commissioning and operation

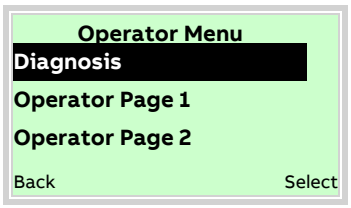
… HART® menu levels

Switching to the information level (operator menu)

On the information level, the operator menu can be used to display diagnostic information and choose which operator pages to display.



1. Open the using Operator Menu.



2. Select the desired submenu using / .
3. Confirm the selection with .

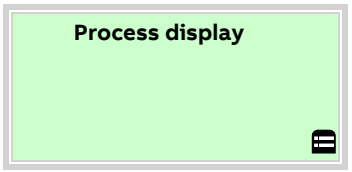
Menu	Description
… / Operator Menu	
Diagnosis	Selection of the “Diagnosis” submenu, see also **Error messages in the HART® LCD display** on page 37
Operator Page 1	Selection of operator page to be displayed.
Operator Page 2*	
Autoscroll*	When ‘Multiplex mode‘ is activated, automatic switching of the operator pages is initiated on the process screen.
Signal View	Selects the ‘Signal View’ submenu, in which all dynamic measured values are displayed.

* Only for PROFIBUS PA® and FOUNDATION Fieldbus®

Error messages in the HART® LCD display on page 37

Switching to the configuration level (parameterization)

The device parameters can be displayed and changed on the configuration level.



1. Switch to the configuration level using .

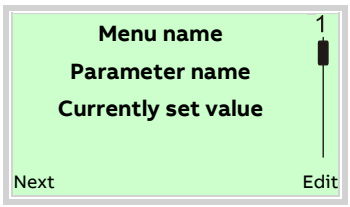
The LCD display now indicates the first menu item on the configuration level.

2. Select a menu using / .
3. Confirm the selection with .

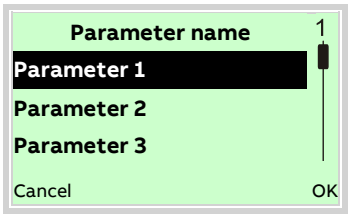
Selecting and changing parameters

Entry from table

When an entry is made from a table, a value is selected from a list of parameter values.



1. Select the parameters you want to set in the menu.
2. Use to call up the list of available parameter values. The parameter value that is currently set is highlighted.

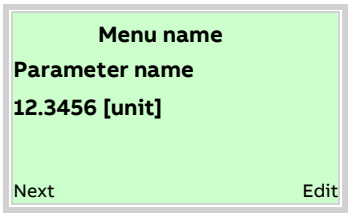


3. Select the desired value using / .
4. Confirm the selection with .

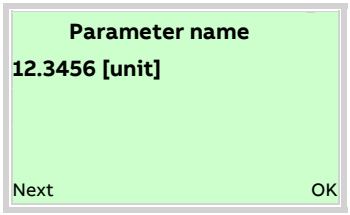
This concludes the procedure for selecting a parameter value.

Numerical entry

When a numerical entry is made, a value is set by entering the individual decimal positions.



1. Select the parameters you want to set in the menu.
2. Use to call up the parameter for editing. The decimal place that is currently selected is highlighted.

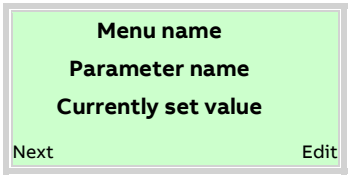


3. Use to select the decimal place to change.
4. Use / to set the desired value.
5. Use to select the next decimal place.
6. If necessary select and set additional decimal places in accordance with steps 3 to 4.
7. Use to confirm your setting.

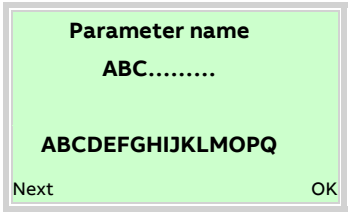
This concludes the procedure for changing a parameter value.

Alphanumeric entry

When an alphanumeric entry is made, a value is set by entering the individual decimal positions.



1. Select the parameters you want to set in the menu.
2. Use to call up the parameter for editing. The decimal place that is currently selected is highlighted.



3. Use to select the decimal place to change.
4. Use / to set the desired value.
5. Use to select the next decimal place.
6. If necessary select and set additional decimal places in accordance with steps 3 to 4.
7. Use to confirm your setting.

This concludes the procedure for changing a parameter value.

… 8 Commissioning and operation

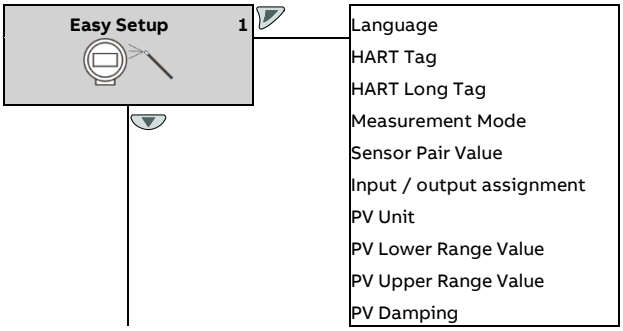
Parameter overview HART® (for TTx300-N and TSP341-N)

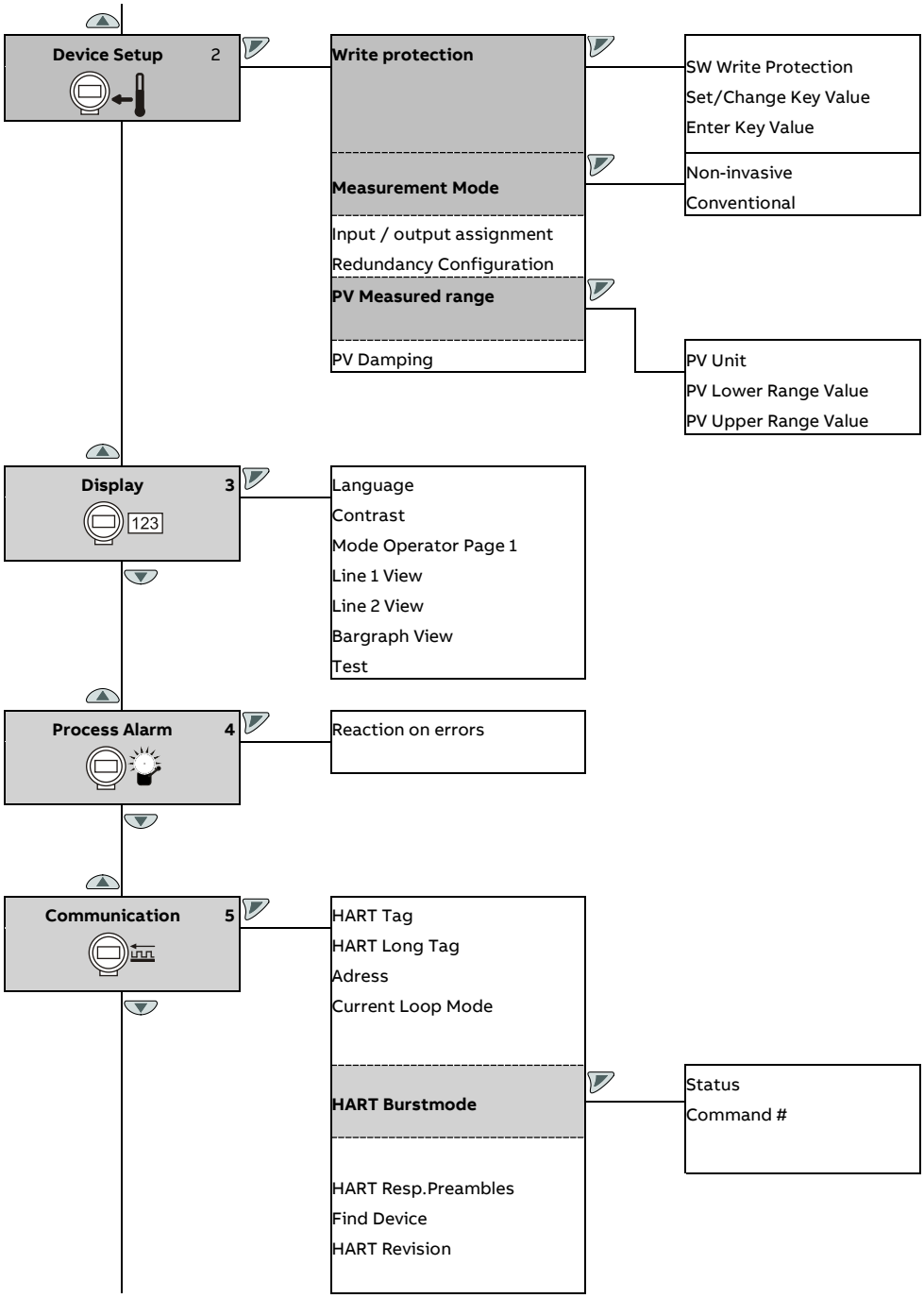
Note

This overview of parameters shows the menus and parameters available on the device by default. The TTx300-N differs from the standard TTx300 in that a measurement mode is selectable through the easy setup. There are two measurement modes: non-invasive and conventional. Every TSP341-N with a transmitter and TTF300-N uses a TTx300-N transmitter unit. The factory default setting is non-invasive mode. The non-invasive mode has a set configuration of the type of sensors (2 × 3 -wire PT100), and the associated outputs for current as well as the mapping of the HART variables (non-invasive temperature being the default 4 to 20 mA current output and the Primary Output variable for HART). This configuration cannot be changed in the non-invasive mode.

However, the transmitter can be switched to conventional measuring mode, at which point the full range of capabilities of the TTx300 is available. This flexibility has been implemented for advanced users to use the same transmitter for standard measurement tasks and to allow for the use of the transmitter in non-standard or novel non-invasive applications. When conventional mode is selected, the device will show an application warning and is diagnosed per default as 'Check function notification'.

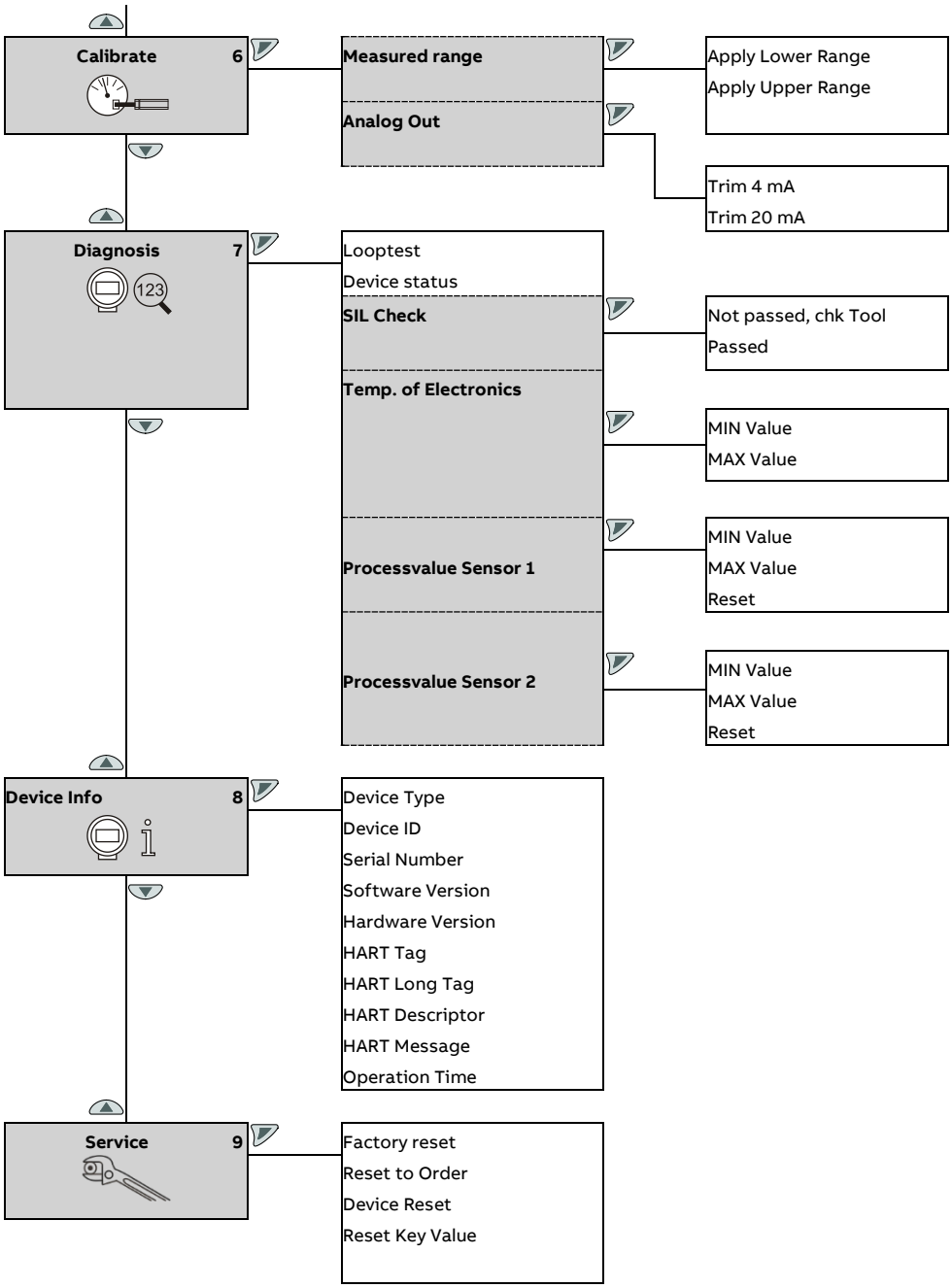
In addition, for devices from SW-Rev.: 03.00, additional information (event and configuration monitor, see HART interface description, COM/TTX300/HART) and detailed diagnostics can be displayed and configured in Tools / Drivers, such as FIM and DTM.




Device Setup 2
Write protection
SW Write Protection
Set/Change Key Value
Enter Key Value
Measurement Mode
Non-invasive
Conventional
Input / output assignment
Redundancy Configuration
PV Measured range
PV Unit
PV Lower Range Value
PV Upper Range Value
PV Damping
Display 3
123
Language
Contrast
Mode Operator Page 1
Line 1 View
Line 2 View
Bargraph View
Test
Process Alarm 4
Reaction on errors
Communication 5
HART Tag
HART Long Tag
Adress
Current Loop Mode
HART Burstmode
Status
Command #
HART Resp.Preambles
Find Device
HART Revision

… 8 Commissioning and operation

… Parameter overview HART® (for TTx300-N and TSP341-N)



Parameter description HART® (for TTx300-N and TSP341-N)

This section only describes the additional parameters unique to the TTx300-N in non-invasive measuring mode. The standard list of parameters available on the TTH300 can be obtained when selecting the conventional mode. For a detailed description of the parameters in the TTH300 please refer to the manual associated with the SW-Rev.:03.00 and higher.

Menu: Easy Setup

Menu / parameter	Description
... /Easy Setup	
Language	Language selects the menu language. • German • English
HART Tag	Measuring point tagging • 8 characters
HART Long Tag	Long tag:Unique device label in the plant (from HART 7) • 32 characters
Measurement Mode	Selects the measurement mode of the transmitter • Non-invasive (default) • Conventional
Sensor Pair Value	Input only when used with TTF300-N • Input value from TSP341-N remote sensor apparatus
In-output Assignment	Input / output assignment selects the inputs that are mapped to the current output • Sensor 1 (contact temperature) • Electr. Meas. S1 • Temp. of Electronics • Difference (S2-S1) • Meanvalue • Sensor 2 • Electr. Meas. S2 • Redundancy (S1, S2) • Difference (S1-S2) • Non-invasive temp. (default) • Surface temp.
PV Unit	Selects the physical unit for the sensor measuring signal Units: °C, °F, °R, K, mV, Ω, V, kΩ
PV Lower Range Value	Defines the value for 4 mA (adjustable)
PV Upper Range Value	Defines the value for 20 mA (adjustable)
PV Damping	Configurable τ 63% output signal damping value Value range:0 to 100 s

… 8 Commissioning and operation

… Parameter description HART® (for TTx300-N and TSP341-N)

Menu: Device Setup

Menu / parameter	Description
… / Device Setup	
Write protection	Select the '**Write protection**' submenu.
Measurement Mode	Select 'Non-invasive' or 'Conventional'
Input / output assignment	Input / output assignment Selects the inputs that are mapped to the current. see table of input / output assignment … / Easy Setup / In-output assignment
PV Measured range	Select the '**PV Measured range**' submenu.
PV Damping	Configurable τ 63% output signal damping value Value range:0 to 100 s

… / Device Setup / Measurement Mode	
Non-invasive	Default – 2 × 3 -wire PT100; with following variable mapping • 4-20 mA Signal – Non-invasive temp. (default) • PV – Non-invasive temp. (default) • SV – Surface temp. • TV – Sensor 1 (contact temperature) • SV – Sensor 2 (reference temperature)
Conventional	Standard TTx300 settings

… / Device Setup / PV Measured range	
PV Unit	Selects the physical unit for the sensor measuring signal Units: °C, °F, °R, K, mV, Ω, V, kΩ
PV Lower Range Value	Defines the value for 4 mA (adjustable)
PV Upper Range Value	Defines the value for 20 mA (can be configured)

Menu: Display

Menu / parameter	Description
... /Display	
Language	Language selects the menu language. • German • English
Contrast	Sets the display contrast Value range: 0 to 100%
Mode Operator Page 1	Selects the mode for the operator page (main view) of the display • One Line: Show one measured value (default PV = process variable) • One Line + Bargraph: In addition to line 1, display bar graph (default:output current %) • Two Lines: Second line for an additional measured value (such as Sensor 2) • Two Lines + Bargraph: Display 2 lines and a bar graph
Line 1 View	Selects the process value shown in Bargraph view of process display • Process Variable: Calculated process variable (PV) - default is non-invasive temperature • Sensor 1: Reading from sensor 1 (contact temperature) • Sensor 2: Reading from sensor 2 (reference temperature) • Difference (S1-S2): Calculate difference Sensor 1 – Sensor 2 • Electr. Meas. S1: Reading from sensor 1 (in Ω or mV) • Electr. Meas. S2: Reading from sensor 2 (in Ω or mV) • Difference (S2-S1): Calculate difference Sensor 2 – Sensor 1 • Average S1 S2: Calculate average Sensor 1 / Sensor 2 • Redundancy S1 S2: Redundancy Sensor 1 and Sensor 2 • Electr. Meas. S1: Reading from sensor 1 (in Ω or mV) • Electr. Meas. S2: Reading from sensor 2 (in Ω or mV) • Temp. Electronics: Temperature of transmitter • Output Current: Output current of 4 to 20 mA signal • Output %: Output value as % of measurement range • Non-invasive temp. (default): Non-invasive temperature • Surface temp. :Surface temperature
Line 2 View	Selects the process value shown in line 2 of process display (only 2 lines) Table of selectable measured values: see “… / Display /Line 1 View”
Bargraph View	Selects the process value shown in bar graph view of process display Table of selectable measured values: see “… / Display /Line 1 View”
Test	Display test - different patterns and letter sets are shown

Menu: Process Alarm

Menu / parameter	Description
... /Process Alarm	
Reaction on errors	• Low Alarm:In the event of an error, the current (e.g. 3.5 mA) is output. • High Alarm:In the event of an error, the current (e.g. 22 mA) is output.

… 8 Commissioning and operation

… Parameter description HART® (for TTx300-N and TSP341-N)

Menu: Communication

Menu / parameter	Description
… /Communication	
HART Tag	Measuring point tagging • 8 characters
HART Long Tag	Long tag:Unique device label in the plant (from HART 7) • 32 characters
Address	Address range Value range:0 to 63 (independent of Current Loop Mode)
Current Loop Mode	• Independent of the address • Enabled = normal operation (output current depends on process variable (PV)) • Disabled = Constant output current (like Multidrop HART 5 address 0>)
HART Burstmode	Select the '**HART Burstmode**' submenu.
HART Resp.Preambles	Number of preambles to be used for sending Value range:5 to 20
Find Device	This option helps with finding a device The HART master sends HART command #73 to search for the device. Device answeres with HART initialize Command #0 (long address) - if found Options: • Disabled: no reaction HART command #0 • Once:One-time reaction to HART command #0 • Continuous:Always switch to HART command #0

… / Communication / HART Burstmode	
Status	• Off:HART burst operating mode inactive • On:HART burst operating mode active
Command #	Sets the HART command to be sent cyclically • 1 Process value: Process value PV • 2 current+%: Output current and percentage range • 3 Current+Dyn.Vars: Current output and dynamic variables PV, SV, QV, TV • 9 Dev.Variables : Device variables • 48 Add.Dev.Status: Additional device status

Note
This menu / parameter structure is the same as for TTx300.

Menu: Calibrate

Menu / parameter	Description
... /Calibrate	
Measured range	Select the '**Measured range**' submenu.
Analog Out	Select the '**Analog Out**' submenu.

... / Calibrate / Measured range	
Apply Lower Range	The current reading (PV) is used as the lower range limit (4 mA).
Apply Upper Range	The current reading (PV) is used as the upper range limit (20 mA).

... / Calibrate / Analog Out	
Trim 4 mA	Adjusts the current output with a 4 mA setpoint Value range:3.500 to 4.500 mA
Trim 20 mA	Adjusts the current output with a 20 mA setpoint Value range:19.500 to 20.500 mA

Note
This menu / parameter structure is the same as for TTx300.

Menu: Diagnosis

Menu / parameter	Description
... /Diagnosis	
Looptest	Simulates the current output signal Value range:3.500 to 23.600 mA 0.000 mA:Ends loop test
Device status	Diagnostic notice (maintenance required, failure, etc.)
SIL Check	Select the '**SIL Check**' submenu. • Not passed, chk Tool:Use tool for a detailed check of the current device configuration. • Passed:SIL Configuration Check successful.The device configuration is valid for SIL Safety applications.
Temp. of Electronics	Select the '**Temp. of Electronics**' submenu. Drag indicator: maximum or minimum device temperature
Processvalue Sensor 1	Select the '**Sensor 1 process data**' submenu. Drag indicator: maximum or minimum sensor temperature for sensor 1 • Reset: Resets the values
Processvalue Sensor 2	Select the '**Sensor 2 process data**' submenu. Drag indicator: maximum or minimum sensor temperature for sensor 2 • Reset: Resets the values

Note
This menu / parameter structure is the same as for TTx300.

… 8 Commissioning and operation

… Parameter description HART® (for TTx300-N and TSP341-N)

Menu: Device Info

Menu / parameter	Description
… /Device Info	
Device Type	Displays device type.
Device ID	7 or 8-digit serial number of the device electronic unit.
Serial Number	Serial number of the device (serial number in accordance with order)
Software Version	Displays device software version.
Hardware Version	Displays device hardware version.
HART Tag	Displays the HART Tag.
HART Long Tag	Display the HART long tag.
HART Descriptor	Displays the HART Descriptor.
HART Message	Display the HART message.
Operation Time	Displays device operating hours.

Note
This menu / parameter structure is the same as for TTx300.

Menu: Service

Menu / parameter	Description
… /Service	
Factory reset	Device restarts with factory settings applied.
Reset to Order	Device restarts with settings according to the customer order.
Device Reset	Device restarts without configuration changes.
Reset Key Value	Key value of the advanced write protection is reset to factory setting.
Sensor Pair Value	Input Sensor Pair Value. For use only in TTF300-N when used with TSP341-N remote sensor apparatus

Software write protection

In addition to regular software write protection, the device features advanced software write protection. It can be configured on the device both via the LCD indicator and via the device drivers (FDIX/DTM/EDD).

If write protection has been activated, a padlock symbol will appear in the LCD indicator or the device drivers.

If the configured key value for the advanced software write protection is entered incorrectly more than five times, the device will be permanently locked.This locking function can only be deactivated on the device via the "„Reset Key Value" function.

Enable or disable regular write protection

1. "Device Setup" can be confirmed via , then select the "Write protection" submenu.
   - The "Write protection" submenu will be displayed.
2. Select the "SW Write Protection" entry and confirm with .
   - The current write protection configuration will be displayed.
3. Use "Edit" to edit the current write protection configuration (enabled/disabled), and confirm with .
   - If the "Edit" menu item is not available, the advanced write protection has been activated.
4. The current write protection setting is displayed.

Enable advanced software write protection

1. "Device Setup" can be confirmed via , then select the "Write protection" submenu.
   - The "Write protection" submenu will be displayed.
2. Select the "Set/Change Key Value" entry and confirm with .
3. Use "Edit" to edit the current key value configuration.
4. Using / , select four alphanumeric characters, and confirm with .The key value must differ from "0000".
5. The advanced write protection has been activated, the device is write-protected.

Temporarily disable software write protection

1. "Device Setup" can be confirmed via , then select the "Write protection" submenu.
   - The "Write protection" submenu will be displayed.
2. Select the "Enter Key Value" entry and confirm with .
3. Use "Edit" to edit the current key value configuration.If the "Edit" menu item is not available, the device will be locked permanently.
4. Using / , select four alphanumeric characters, and confirm with .
5. When the correct key value has been entered, write protection will be temporarily disabled, the "Write protection" subitem shows "Disabled".
6. By activating the write protection or entering a new key value, the advanced write protection will be reactivated and the device will be write-protected.

Disable advanced software write protection

1. "Device Setup" can be confirmed via , then select the "Write protection" submenu.
   - The "Write protection" submenu will be displayed.
2. Select the "Enter Key Value" entry and confirm with .
3. Use "Edit" to edit the current key value configuration.If the "Edit" menu item is not available, the device will be locked permanently.
4. Using / , select four alphanumeric characters, and confirm with .
5. Using / , select the "„Set/Change Key Value" menu item, and confirm with .
6. Using / , select the "0000" input combination, and confirm with .
7. The advanced write protection has been disabled, the device is no longer write-protected.

Reset key value

1. Confirm "Service" with and select the "Reset Key Value" item.The submenu will be displayed.
2. Confirm reset of the key value using "OK".
3. The advanced write protection has been disabled, the device is no longer write-protected.

… 8 Commissioning and operation

Factory settings

Firmware settings

The transmitter is configured ex works.

These devices can be reset to the factory setting as well as to the setting according to the customer order.

- With the menu item “Factory reset” in the service menu, the settings are reset to the factory settings in accordance with the following table (corresponds to default configuration BS).
- The menu item “Reset to Order” in the service menu is used to reset the settings to the configuration ordered by the customer (default configuration BS, customer-specific configuration without special user characteristic BF.

Devices with HART® (all SW revisions)

The following table with the corresponding parameter values applies:

Menu	Designation	Parameter	Factory setting
Device Setup	Write protection	–	No
	Input Sensor 1	Sensor Type	Pt100 (IEC60751)
	Sensor Pair Value = 306	R-Connection	Three-wire
		Measured Range Begin	0
		Measured Range End[1)]	100
		Engeneering Unit	Degrees °C
		Damping	Off
Process Alarm		Fault signaling	Underrange / low alarm 3.5 mA
	Input Sensor 2	Sensor Type	Pt100 (IEC60751)
		R-Connection	Three-wire
	Input / output assignment	Measurement type	Non-invasive
	TAG	–	–
	HART Descriptor	–	–
Display	Display Value	–	Process Variable
	Bargraph	–	Yes, output %
	Language	–	English
	Contrast	–	50 %
Communication	HART Burstmode	Status	Off
	Simulation mode	–	Off

Commissioning the TSP341-N Remote sensor apparatus with TTF300-N

After connecting and powering up a TTF300-N transmitter, the non-invasive model parameters of the TSP341-N Remote sensing apparatus must be entered to ensure an accurate measurement. This model parameter is termed as a sensor pair value and needs to be entered during commissioning.

For an integral TSP341-N Sensor with an inbuilt transmitter, the sensor pair value is derived and entered at the factory and does not need to be changed. However, for a TTF300-N, the factory default is the same for every transmitter (Default = 306) and the sensor pair value from the remote sensor apparatus must be entered. The sensor pair value (SPV) can be found on the ceramic mount and is indicated as 'SPV' (see figure 22).

Note
Failure to enter the SPV will result in a non-invasive temperature measurement error of up to + 10% of the difference in temperature between the process and the surrounding ambient temperature. In addition, the speed of response will also be affected.

① Exemplary location of SPV: 332

Figure 22: Positioning of sensor pair value (SPV) on remote sensor apparatus (example)

9 Diagnosis / error messages

Error messages

Note
For a detailed description of the errors and notices on troubleshooting, see transmitter operating instruction.

Malfunctions

The entire temperature measurement circuit should be tested routinely. The table below contains the most important errors together with their possible causes and suggestions for how to remedy them.

Failure	Cause	Repair
Measuring signal fault	• Electrical/magnetic interspersion	• Electrostatic shielding via on one point grounded foil/netting. • Twist wires (pairs) against magnetic interspersion.
	• Earth Fault	• Create only one grounding point in measuring loop or 'floating' measuring system (not grounded).
	• Decrease of insulation resistance	• Humidity has possibly penetrated into the temperature sensor or the measuring inset; dry if necessary and seal again. • Replace measuring inset. • Check whether the temperature sensor is thermally overloaded.
Response times too long, incorrect measuring signals	Incorrect position of the measuring point. • In the area of influence of a heat source	• Select the position of the measuring point in such a way to make sure that the measurement of the surface temperature is not distorted by external influence. • Minimize environmental influence on the measuring point by using suited insulating materials
	Incorrect installation method: • Error due to poor contact	• Guarantee thermal contact, by following the installation procedure. Ensure that the contact surface is clean and free of dirt or objects that would prevent the contact sensor from making good contact. – Mounting procedure • Ensure that the sensor is mounted firmly – Follow a sensor mount check Mount check video • When using a TSP341-N Remote Sensor Apparatus, ensure that the sensor pair value has been correctly entered.
Interruptions in temperature sensor output	Loose wiring or loosely mounted sensor	• Check all connections (sensor and power) • Ensure that the device is mounted firmly by trying to move the neck. Any large movements indicate a poor installation. • Relocation of the measuring point (if possible).

10 Maintenance

Safety instructions

⚠ CAUTION

Risk of burns due to hot measuring media

The device surface temperature may exceed 70 °C (158 °F), depending on the measuring medium temperature!

- Before starting work on the device, make sure that it has cooled sufficiently.

The temperature sensor does not require any maintenance if it is used as intended under normal operating conditions. If wetted parts of the temperature sensor are exposed to the influence of abrasive or corrosive measuring media, periodic inspection by the operator must be performed.
No on-site repair or replacement of electronic parts by the user is required.

Cleaning

When cleaning the exterior of meters, make sure that the cleaning agent used does not corrode the housing surface and the seals.
To avoid static charge, a damp cloth must be used for cleaning.

11 Repair

Safety instructions

⚠ DANGER

Explosion hazard

Explosion hazard due to improper repair of the device. Faulty devices must not be repaired by the operator.

- The device may only be repaired by the ABB Service Department.
- Repairs on flameproof joints are not permitted.

Exchange of measurement insets

Please see latest service manual for exchange aspects that are permitted on the device.

Returning devices

Use the original packaging or a secure transport container of an appropriate type if you need to return the device for repair or recalibration purposes.
Fill out the return form (see **Return form** on page 55) and include this with the device.
In accordance with the EU Directive governing hazardous materials, the owner of hazardous waste is responsible for its disposal or must observe the following regulations for shipping purposes:
All devices delivered to ABB must be free from any hazardous materials (acids, alkalis, solvents, etc.).

Please contact Customer Center Service acc. to page 5 for nearest service location.

12 Dismounting and disposal

Dismounting

⚠ CAUTION

Risk of burns due to hot measuring media

The device surface temperature may exceed 70 °C (158 °F), depending on the measuring medium temperature!

- Before starting work on the device, make sure that it has cooled sufficiently.

Bear the following points in mind when dismantling the device:

- Switch off the power supply.
- Disconnect electrical connections.
- Allow device / piping to cool.
- Use suited tools to disassemble the device, taking the weight of the device into consideration.
- If the device is to be used at another location, the device should preferably be packaged in its original packing so that it cannot be damaged.
- Observe the notes in **Returning devices** on page 53.

Disposal

Note

Products that are marked with the adjacent symbol may **not** be disposed of as unsorted municipal waste (domestic waste).
They should be disposed of through separate collection of electric and electronic devices.

This product and its packaging are manufactured from materials that can be recycled by specialist recycling companies.

Bear the following points in mind when disposing of them:

- As of 8/15/2018, this product will be under the open scope of the WEEE Directive 2012/19/EU and relevant national laws (for example, ElektroG - Electrical Equipment Act - in Germany).
- The product must be supplied to a specialist recycling company. Do not use municipal waste collection points. These may be used for privately used products only in accordance with WEEE Directive 2012/19/EU.
- If there is no possibility to dispose of the old equipment properly, our Service can take care of its pick-up and disposal for a fee.

13 Specification

Note

The device data sheet is available in the ABB download area at www.abb.com/temperature.

14 Additional documents

Note

Declarations of conformity of the device are available in the download area of ABB at www.abb.com/temperature. In addition, these are also included with the device in case of ATEX-certified devices.

15 Appendix

Return form

Statement on the contamination of devices and components

Repair and/or maintenance work will only be performed on devices and components if a statement form has been completed and submitted.
Otherwise, the device/component returned may be rejected. This statement form may only be completed and signed by authorized specialist personnel employed by the operator.

Customer details:

Company:	
Address:	
Contact person:	Telephone:
Fax:	Email:

Device details:

Type:	Serial no.:
Reason for the return/description of the defect:	

Was this device used in conjunction with substances which pose a threat or risk to health?

☐ Yes ☐ No

If yes, which type of contamination (please place an X next to the applicable items):

☐ biological	☐ corrosive / irritating	☐ combustible (highly / extremely combustible)
☐ toxic	☐ explosive	☐ other toxic substances
☐ radioactive		

Which substances have come into contact with the device?

1.
2.
3.

We hereby state that the devices/components shipped have been cleaned and are free from any dangerous or poisonous substances.

Town/city, date	Signature and company stamp

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

3KXT161302R4201

OI/TSP341-N-EN Rev. G 09.2024