ABB MEASUREMENT & ANALYTICS | OPERATING INSTRUCTION

SensyTemp TSP341-N

Sensor for non-invasive temperature measurement

Measurement made easy

Introduction

The SensyTemp 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.

Additional Information

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

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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.

… 1 Safety

Intended use

Temperature sensor for non-invasive measurement of the temperature of liquid and gaseous measuring media in piping and in vessels.
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 operating temperature range may not be up-scaled or down-scaled.
- The permissible ambient temperature range may not be up-scaled or down-scaled.
- The IP rating must be observed during operation.

Improper use

The following are considered to be instances of 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.

Notes on data safety

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 Automation Products GmbH 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.

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.

Manufacturer's address

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2 Use in potentially explosive atmospheres according to ATEX and IECEx

General

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
By default, the temperature sensors are marked with the T6 temperature class. 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.

Ex marking

The TSP341-N temperature sensor is available with ATEX approvals valid throughout the EU and in Switzerland, and internationally recognized IECEx approvals .

‘Ex i – Intrinsic safety’ type of protection

Model TSP341-N-D2 in zone 1, 2	
ATEX	
Type examination certificate:	PTB 01 ATEX 2200 X
Ex marking	ATEX II 2 G Ex ib IIC T6 Gb

Table 1: ATEX Ex marking, ‘Ex i – intrinsic safety’ type of protection

Model TSP341-N-J2 in zone 1, 2	
IECEx	
Type examination certificate:	IECEx PTB 11.0111X
Ex marking	Ex ib IIC T6 Gb

Table 2: IECEx Ex marking, ‘Ex i – intrinsic safety’ type of protection

‘Ex i – intrinsic safety’ type of protection in accordance with the NAMUR recommendation

Model TSP341-N-N3 in zone 1, 2	
ATEX	
Type examination certificate:	PTB 01 ATEX 2200 X
Ex marking	NE 24 and ATEX II 2 G Ex ib IIC T6 Gb

Table 3: ATEX Ex marking, ‘Ex i – intrinsic 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 4: 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 5: IECEx Ex marking, ‘Ex d – flameproof (enclosure)’ type of protection

… 2 Use in potentially explosive atmospheres according to ATEX and IECEx

General information

Conditions for use in potentially explosive atmospheres

Thermal resistance
In addition to measurement of the surface 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 6.

Heat resistance R_{th} for mineral insulated cable Ø 3 mm (0.12 in.)	
Δt = 130 K/W x 0.038 W = 4.9 K	
Resistance thermometer without thermowell	130 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’.

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 **Maximum surface temperature Tsurf. at the measuring point in Zone 1** on page 7.

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:

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

Δt Temperature rise

R_{th} Thermal resistance

P_o Output power of an additional connected transmitter

Example:
Resistance thermometer diameter approximately 3 mm (0.12 in.) without thermowell:

R_{th} = 130 K/W,
Output power of the temperature transmitter P_o= 38 mW, see also **Connection data of mounted transmitter** on page 7.

Δt = 130 K/W x 0.038 W = 4.9 K

For a transmitter output power P_o = 38 mW, a temperature rise of approximately 5 K results in the event of a fault.
In consideration of this temperature rise, the maximum possible surface temperatures $T_{surf.}$ and the temperatures at the reference test point arise for temperature classes T1 to T6, as presented in **Maximum surface temperature Tsurf. at the measuring point in Zone 1** on page 7 .

Type of protection Ex i, intrinsic safety

Permissible ambient temperature

In the zone of the electrical connections, the permissible ambient temperature range is −40 to 80° C (−40 to 176 °F).
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.

Note

The standard supplied M20 x 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.

Connection data of mounted transmitter

The output power of the transmitter used in the TSP341-N is P_o = 38 mW.
The transmitter is based on the TTH300 HART from ABB. The type examination certificates of the transmitter apply.
The corresponding type examination certificate for the TTH300 HART, PTB 05 ATEX 2017 X or IECEx PTB 11.0111X contains all further information necessary to verify intrinsic safety.

Maximum surface temperature $T_{surf.}$ at the measuring point in Zone 1

The temperature sensor has two separate temperature sensors, see **Thermal resistance** on page 6.
When determining the permissible temperature classes, the temperature at the reference test point should also be observed in addition to the surface temperature $T_{surf.}$ at the measuring point, especially for temperature classes T6 and T5.
The values indicated in the table for $T_{surf.}$ then also analogously apply for the temperature at the reference test point.

Note

To determine the permissible temperature classes, in addition to the temperature rise Δt, 5 K needs to be deducted for T3, T4, T5 and T6 respectively, and 10 K for T1 and T2 respectively.

Temperature class	-5 K	-10 K	$T_{surf.}$*
T1 – 450 °C (842 °F)	– –	440 °C (824 °F)	400 °C** (752 °F)**
T2 – 300 °C (572 °F)	– –	290 °C (554 °F)	285 °C (545 °F)
T3 – 200 °C (392 °F)	195 °C (383 °F)	– –	190 °C (374 °F)
T4 – 135 °C (275 °F)	130 °C (266 °F)	– –	125 °C (257 °F)
T5 – 100 °C (212 °F)	95 °C (203 °F)	– –	90 °C (194 °F)
T6 – 85 °C (185 °F)	80 °C (176 °F)	– –	75 °C (167 °F)

* Also applies for the temperature at the reference test point

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

… 2 Use in potentially explosive atmospheres according to ATEX and IECEx

Type of protection Ex d - flameproof (enclosure)

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

- The connection conditions listed in the type examination certificate PTB 99 ATEX 1144 or IECEx PTB 12.0039 X should 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 6.
- 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	**$T_{amb.}$ with LCD indicator**	**$T_{amb.}$ without LCD indicator**
T1 to T4	-20 to 70 °C (-4 to 158 °F)	−40 to 85 °C (−40 to 185°F)
T6	-20 to 67 °C (-4 to 152 °F)	−40 to 67 °C (−40 to 152 °F)

Temperature class	Maximum surface temperature $T_{surf.}$ in Zone 1*
T1	400 °C** (752 °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)

* 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. You must avoid exceeding the maximum permissible ambient temperature as per 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.

Consider the following points when installing the TP341_n in potentially explosive atmospheres:

- To comply with the 'Ex i – intrinsic safety' type of protection, the housing must meet IP rating IP 20 as a minimum after installation.
- Operation in areas with flammable dust (dust explosion protection) is **not permissible**.

Installation notes for 'Ex i – intrinsic safety' type of protection

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 of the device 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 **Type of protection Ex d - flameproof (enclosure)** on page 8. When installing cable glands provided by the operator, observe the data sheet, instruction and approval notes of the cable gland.

Devices in 'Ex d' type of protection with cable gland

If devices in 'Ex d – flameproof (enclosure)' type of protection with cable glands are ordered, an Ex d certified cable gland will be installed ex works. 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 x 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 x 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.

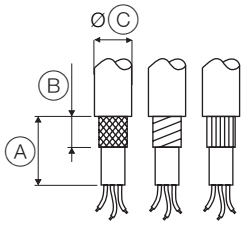
- Before installation, bring the sealing rings to a temperature of at least 20 °C (68 °F) for at least 24 hours.
- Before inserting the sealing rings and fixing them onto the cable gland, knead the rings to make sure they are soft and flexible.

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.

… 2 Use in potentially explosive atmospheres according to ATEX and IECEx

… Installation instructions



(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.

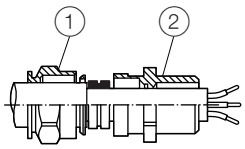


Figure 2: Tighten cable gland

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 x 1.5 for type of protection 'Ex i'
The standard supplied M20 x 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

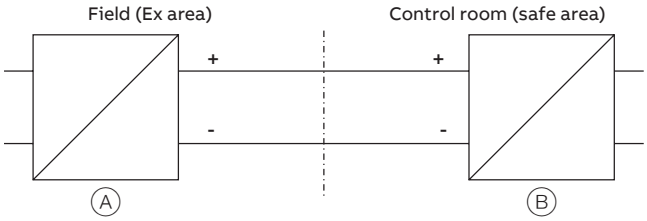
Grounding

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) $\leq C_o$	



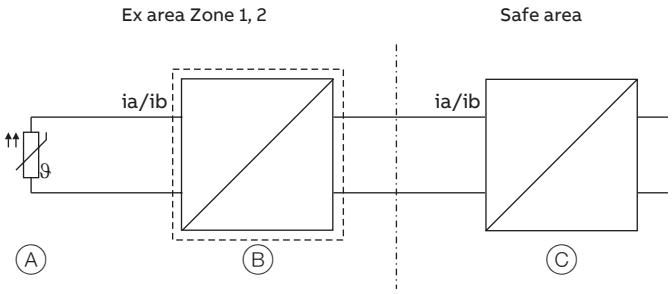
(A) Transmitter
(B) Supply isolator / DCS input with supply / Segment coupler

Figure 3: Intrinsic safety installation check

Type of protection Ex i, intrinsic safety

Ex marking

Model TSP341-N-D2:
ATEX II 2 G Ex ib IIC T6 Gb (Zone 1, 2)
Model TSP341-N-N3:
NE 24 and ATEX II 2 G Ex ib IIC T6 Gb (Zone 1, 2)
Model TSP341-N-J2:
IECEx ib IIC T6 Gb (Zone 1, 2)



(A) Sensors for surface and ambient temperature
(B) Ex ia/ib transmitter in connection head
(C) Ex ia/ib supply isolator

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

Power supply to the temperature sensor may be made only through an intrinsically safe circuit of the corresponding category.
Electric and limit values may not be up-scaled, see **Conditions for use in potentially explosive atmospheres** on page 6 and **Type of protection Ex i, intrinsic safety** on page 11.

… 2 Use in potentially explosive atmospheres according to ATEX and IECEx

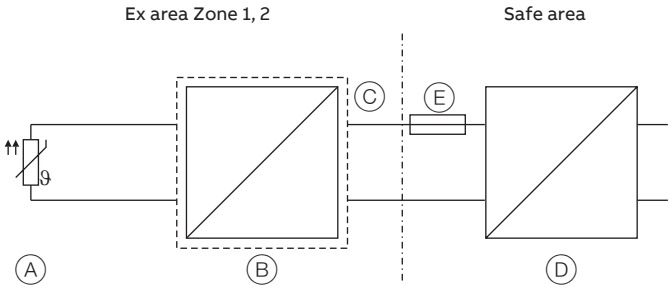
… Electrical connections

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 and 2)

Model TSP341-N-J7:
IECEx db IIC T6/T4 Gb (Zone 1 and 2)



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

Figure 5: 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-intrinsic transmitter.

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

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 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 maintained and cleaned so that any dangerous electrostatic charge is avoided.

3 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.
The measuring medium can stand idle or flow at high speed. Then especially abrasive measuring media are critical.

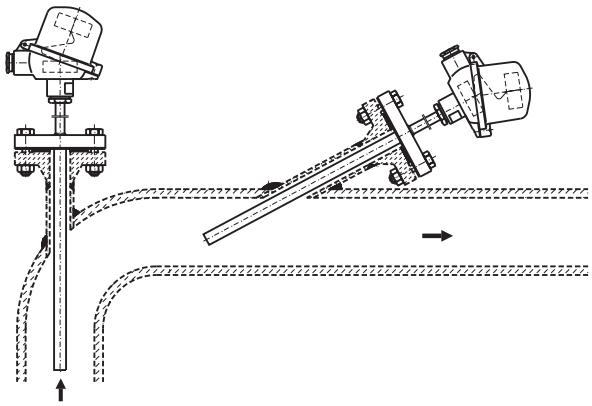


Figure 6: Classic installation of temperature sensors in piping

Depending on the material 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 current costs, other costs are already incurred during planning and design of an installation for openings in vessels and piping, through which the temperature sensor is introduced into the measuring medium. Here, for example, flanges or structural reinforcements are required.

The costs mentioned above can be eliminated if the process temperature could be measured indirectly and outside of the process. Using non-invasive temperature measurement, it is often possible to record process temperatures with an accuracy which is sufficient for the application.

ABB's first new-generation sensor from the line of sensors for non-invasive temperature measurement in process technology is the TSP341-W ('W' stands for 'wireless') introduced in 2014.
Thanks to its WirelessHART wireless communications protocol, the sensor is especially suited for later expansions in industrial installations.

The TSP341-N surface temperature sensor now combines non-invasive temperature measurement with the established HART communications protocol in two-wire technology.
Therefore, the device can also be integrated into existing structures without any issues whatsoever.

The 'N' in TSP341-N stands for 'NiTemp' here. The NiTemp calculation algorithms developed by ABB for non-invasive temperature measurement take ambient conditions, among other factors, into account during the measurement and therefore increase the accuracy of the surface measurement significantly.

Surface temperature measurement is especially suited in low-viscosity measuring media, in measuring media with high thermal conductivity and in processes with high medium velocity or turbulent flow. Examples: water, watery solutions and water-based liquids as well as fast flowing oil or saturated steam.

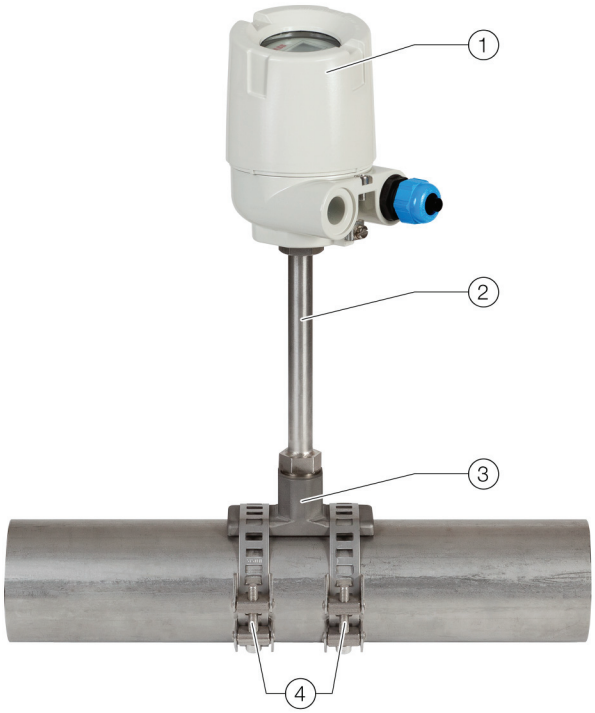
… 3 Design and function

System structure

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

The transmitter supports two connected temperature sensors. One sensor measures the surface temperature at the measuring point, while a second sensor measures the temperature at the reference test point near the measuring point.

By using the NiTemp algorithms for accurate 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 185 °F) is covered.
The transmitter can be configured using the software provided by ABB with NiTemp support (DTM and EDD) in accordance with current conditions of use.



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

Figure 7: 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.
Clips with different expansion coefficients are available to adapt to the piping or vessel material. Metallic materials are required for surface measurement. The surface under the measurement sensor must be straight, without foreign matter and without any coating.
To shorten the response time of the sensor, there is a hole in the retaining plate, through which the sensor element is guided directly to the surface of the measuring point.
During installation, make sure that the measuring needle with the integrated sensor element has optimal contact with the measuring point.
In addition, insulation to protect against the influence of ambient temperature is recommended by applying suited insulation materials.

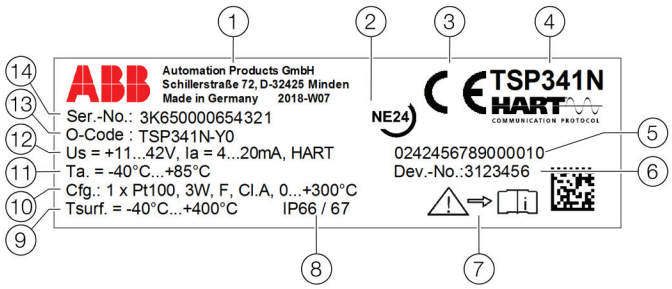
Pure surface measurement is often less accurate than temperature measurement directly in the process.
However, thanks to the ambient temperature effect taken into account by the TSP341-N, accuracy is significantly improved.
Accuracy can be increased even more with suited insulation at the measuring point.
Through the device configuration option (DTM, EDD) provided for the TSP341-N, the insulation of the measuring point is taken into consideration during temperature calculation (preset upon delivery of the device).
As a result, measuring accuracy achieves a range which makes surface measurement a reasonable and cost-saving alternative to measurement in the process.

4 Product identification

Name plate

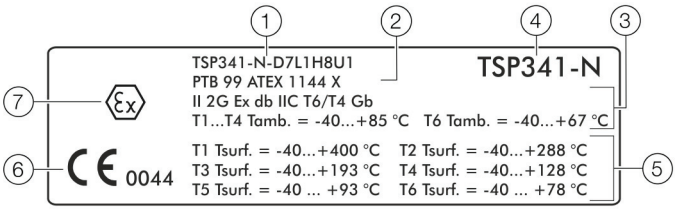
Notice
The name plates displayed are examples. The device identification plates affixed to the device can differ from this representation.

Notice
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. NE24 conformity (optional)
3. CE mark (EU conformity), if not on additional plate
4. Type designation / model
5. Order number and position
6. 7-digit serial number of the transmitter device electronic unit
7. Note: Observe product documentation
8. IP rating of housing
9. Surface temperature range $T_{surf.}$
10. Sensor type and circuit type, accuracy class, set measuring range of the transmitter
11. Ambient temperature range $T_{amb.}$ (temperature on connection head), for Ex versions on additional plate
12. Specification of the transmitter
10. Coding of the type of protection of the device (in accordance with ordering information)
11. Serial number of the device (serial number in accordance with order)

Figure 8: TSP341-N name plate (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 9: Additional plate for explosion-protected apparatus (example)

5 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.

6 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 according to ATEX and IECEx** on page 5!

⚠ 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.

General Notes

When installing the temperature sensor, 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 / vessel.
- The retaining plate of the temperature sensor must lie flat on the measuring point, if necessary remove existing coatings and impurities beforehand.
- The retaining plate of the temperature sensor must be installed on the piping / vessel 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 measuring point is recommended to increase measuring accuracy, but is not an absolute requirement. When operating without insulation, the transmitter can be appropriately configured through the DTM / EDD.

Temperature data

Note

When using the device in potentially explosive atmospheres, note the additional data in **Use in potentially explosive atmospheres according to ATEX and IECEx** on page 5, as well as in the declarations of conformity and type examination certificates!

Ambient temperature at connection head

When using the device in potentially explosive atmospheres, restrictions of the ambient temperature range are possible!

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)

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

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

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 19.

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.

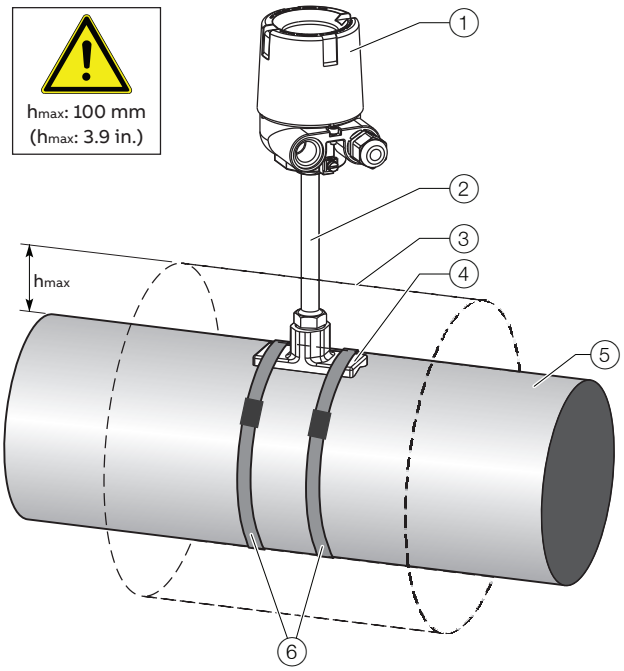
The metal cable gland for Ex d (flameproof enclosure) used as a standard for cable outer diameters of 3.2 to 8.7 mm (0.13 to 0.34 inch) covers a permissible temperature range of −40 to 85 °C (−40 to 185 °F).

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.

… 6 Installation

Mounting



1	Connection head with transmitter	4	Retaining plate
2	Extension tube	5	Piping
3	Insulation of the measuring point	6	Clamp collars

Figure 10: Assembly on piping (example))

Selecting clamp collars

Select the length of clamp collars according to the installation situation. The length of the clamp collars should be approximately 150 mm (6 in.) longer than the required circumference.

Depending on the expansion coefficients of the piping, clamp collars made of different materials are used.
Clamp collars from chrome steel 1.4016 (ASTM 430), α = 10 to 10.5*10^{-6}/K and stainless steel 1.4301 (ASTM 304), α = 16 to 17.5*10^{-6}/K are available.
More information on the PG 174 type universal clamp collars width 18 mm (0.7 in.) used is available at www.oetiker.com.

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, in the area of the retaining plate.
- Make sure that no lateral forces (e.g. due to shifting of the retaining plate) are exerted on the protruding surface sensor during assembly.
- Make sure that both contact areas of the retaining plate are set level on the measuring point over their entire length.
- To avoid measurement errors, make sure that the measuring needle of the surface sensor has optimal contact with the surface.

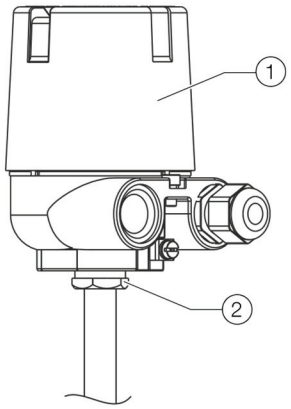
1. Remove the plastic transport protection on the retaining plate before assembly.
2. The measuring point must be flat, metallic bright and free of coatings, impurities and foreign substances. Clean the measuring point as needed.
3. Cut the clamp collar to the appropriate length, circumference + 150 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 11: 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.
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. Secure the clamp collars to the retaining plate using the supplied screws (M5) and safety washers (alternatively also after tightening the collars).
9. Align the retaining plate level at the measuring point and tighten the clamp collars on the turnbuckle (max. torque 10 Nm). For clamp collar band lengths > 1 m (3.3 ft), use another turnbuckle per meter of clamp collar band length if necessary.
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.

Insulation of the measuring point

Insulation of the measuring point is recommended to increase measuring accuracy, but is not an absolute requirement. When operating without insulation, the transmitter can be appropriately configured through the DTM / EDD.

The insulation also protects the connection head from excessive temperatures due to heat radiation from the piping.
Pressure-resistant, elastic mineral wool mats with higher raw density have proven to be especially suited.
The material must be suited for the measuring medium temperature range which can appear and for current ambient conditions.

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 10 only.
- The extension tube should not be insulated above the measuring point.

… 6 Installation

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 SensyTemp TSP341-N is supplied with a M20 x 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 x 1.5
- Temperature range: −40 to 70 °C (−40 to 158 °F)
- Cable outside diameter: 5.5 to 13 mm (0.22 bis 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 9 and **Plastic cable gland M20 x 1.5 for type of protection ‘Ex i’** on page 10!

Alternatively, the temperature sensor can be supplied without cable glands but with an M20 x 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.

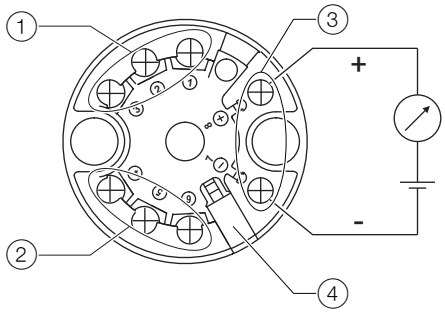
- For the electrical connection of the temperature sensor, only use cable material with flexible conductors.

Power supply

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

Terminal layout

The transmitter used in the TSP341-N temperature sensor is based on the TTH300 from ABB. Therefore, only the information differing from the TTH300 is described here.
For further information and electric data, especially for use in potentially explosive atmospheres, refer to the operating instruction OI/TTH300 and the data sheet DS/TTH300.



1. terminals 1 to 3 for sensor 1
2. terminals 4 to 6 for sensor 2
3. terminals 8/+ and 7/– for current output of 4 to 20 mA and HART communication
4. LCD indicator interface

Figure 12: 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.

… 6 Installation

… Electrical connections

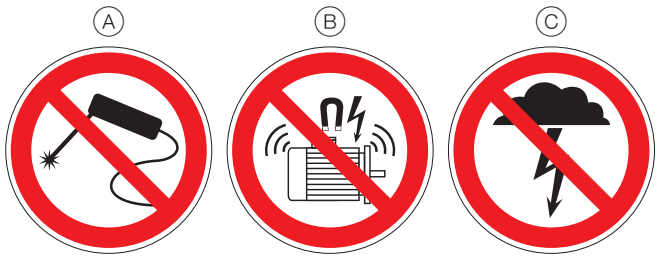
Protection of the transmitter from damage caused by highly energetic electrical interferences

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.



Ⓐ Do not weld

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

Ⓒ No overvoltage due to lightning

Figure 13: 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.

7 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. This default setting can be changed at any time through HART communication (DTM, EDD).

For more information about the transmitter, refer to the commissioning instruction CI/TTH300, the operating instruction OI/TTH300, as well as the data sheet DS/TTH300.

Checks prior to commissioning

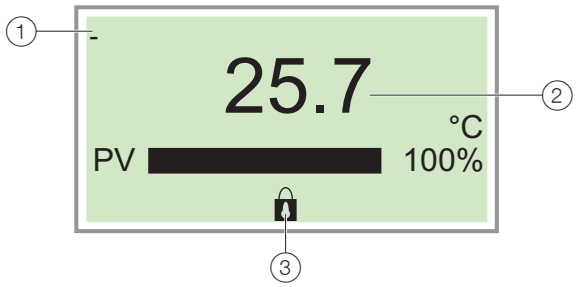
The following points must be checked before commissioning the device:

- 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 20.
- 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 according to ATEX and IECEx** on page 5 must be maintained.

Operation / control

Process display

Only for devices with optional LCD indicator.



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

Figure 14: 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.

HART Device Type ID

TSP341-N: 0x1A0E

Parameterization

The device does not have operating elements for parameterization on site.
Parameterization takes place via the HART interface.

The following parameters are preset upon delivery:

Parameter	Factory setting
Insulation around the measuring point	provided
Characteristic behavior	Increasing 4 to 20 mA
Output behavior for error	Override / 22 mA
Damping output (T63)	Off

Note

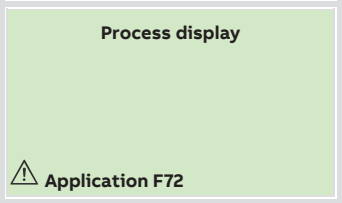
- The measuring range of the device will be specified when the order is placed. The measuring range can also be adjusted, just like the parameters described above.
- Write protection is implemented through standard HART communication write protection or with the use of hardware write protection (local write protection, via DIP switch on the device).

… 7 Commissioning and operation

… Operation / control

Error messages on the LCD display
Only for devices with optional LCD indicator.

If the event of an error, a message consisting of a symbol or letter (device status) and a number (DIAG NO.) will appear at the bottom of the process display.



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

ID code	Description
I	**OK or Information** Device is functioning or information is available
C	**Check Function** Device is undergoing maintenance (for example simulation)
S	**Off Specification** Device or measuring point is being operated outside of the specifications
M	**Maintenance Required** Request service to prevent the measuring point from failing
F	**Failure** Error; measuring point has failed

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.
Installation / Configuration	Diagnosis for communication interface and parameterization / configuration
Operating conditions	Diagnosis for ambient and process conditions.

Note
For a detailed description of errors and troubleshooting instructions, please see **Diagnosis / error messages** on page 25.

8 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).
	• Approval 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 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: • Too much heat dissipation	• Guarantee thermal contact, above all during surface measurements through suited contact surfaces and/or thermal conducting material.
Interruptions in temperature sensor	Vibration	• Reinforced springs on the measuring inset. • Relocation of the measuring point (if possible).

9 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.
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.

10 Repair

Safety instructions

⚠ DANGER

Explosion hazard

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

- Any repair may only be performed in the production plant or by workshops authorized by ABB.

Repair work on the flameproof joint may be conducted only in accordance with the manufacturer's design specifications.
Repair work in accordance with the values in Tables 1 and 2 of EN 60079-1 is not permissible.

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 28) 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 4 for nearest service location.

11 Recycling 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 26.

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 garbage 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.

12 Specification

Note

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

13 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.

14 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

Notes

Notes

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