ABB MEASUREMENT & ANALYTICS | COMMISSIONING INSTRUCTION | CI/TSP-EN REV. E

Temperature sensors SensyTemp TSP

Measuring insets TSA

Measurement made easy

SensyTemp TSP temperature sensor

TSA measuring insets

Introduction

The SensyTemp TSP series temperature sensors are available for low and medium (TSP100) as well as high process requirements (TSP300). With their short response time and high vibration resistance along with their modular design, these devices are an outstanding solution for the most demanding process requirements.

The measuring insets for the SensyTemp TSA101 series are intended for installation in these temperature sensors. They can be hot-swapped, therefore allowing for long-time efficient use of the sensor.

Additional Information

Additional documentation on Temperature sensors SensyTemp TSP 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.

Intended use

The temperature sensors are used for measuring temperatures in a vast range of process applications.
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.

Before using the devices with corrosive or abrasive measuring media, the owner must check the level of resistance of all wetted parts. ABB Automation Products GmbH will gladly support you in selecting the appropriate device, but cannot accept any liability in doing so.

The device has been designed for use exclusively within the technical limit values indicated on the identification plate and in the data sheets.

When using measuring media, please note the following items:

- Measuring media may only be used if, based on the state of the art or the operating experience of the user, it can be assured that the chemical and physical properties necessary for operational security of the materials of the wetted parts of the temperature sensor will not be adversely affected during the operating time.
- Media containing chloride in particular can cause corrosion damage to stainless steels which, although not visible externally, can damage wetted parts beyond repair and lead to the measuring medium escaping. It is the operator's responsibility to check the suitability of these materials for the respective application.
- Measuring media with unknown properties or abrasive measuring media may only be used if the operator is able to perform regular and suitable tests to ensure the safe condition of the device

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.

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.

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2 Use in potentially explosive atmospheres in accordance with 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

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.

Ex relevant specification

Approvals

TSP temperature sensors are equipped with a wide range of approvals.
These range from metrological approvals to Ex-approvals for individual countries, ATEX certificates applicable throughout the EU and in Switzerland up to internationally recognized IECEx documents.
Specifically, these are:

Approval (examination certificate)	**standards applied**
— ATEX Ex i, PTB 01 ATEX 2200 X — ATEX Ex d (TSP3X1 only), PTB 99 ATEX 1144 X — Dust ignition protection (TSP3X1 only), BVS 06 ATEX E 029 — Ex na / Ex ec (Zone 2), Dust-ignition protection tc (Zone 22), manufacturer’s declarations — IECEx Ex i, IECEx PTB 11.0111 X — IECEx Ex d (TSP3X1 only), IECEx PTB 12.0039 X — Dust ignition protection (TSP3X1 only), IECEx BVS 17.0065 X	A list of standards including the dates of their issue with which the device is in conformity can be found in the (EC-type) examination certificate or manufacturer’s declaration.

The TSP3X1 temperature sensors are also available with several types of protection, such as Ex i and dust ignition protection (model TSP3X1-A4).
In devices with several types of protection, observe the information under **Product identification** in the operating or commissioning instruction before commissioning.

Conditions for use in potentially explosive atmospheres

The operator assumes responsibility for the proper installation when replacing the measuring inset in a thermometer in accordance with the valid approval conditions. You need to provide ABB the data provided on the old sensor so that ABB can check the conformity of the ordered design with the initial delivery and the valid approvals.

Thermal resistance

The following table lists thermal resistances for measuring insets with diameters of < 6.0 mm (0.24 in) and ≥ 6.0 mm (0.24 in) The values have been specified subject to the conditions 'Gas with a flow velocity of 0 m/s' and 'Measuring inset without or with an additional thermowell'.

Thermal resistance R_{th} Δt = 200 K/W x 0.038 W = 7.6 K	**Measuring inset Ø < 6 mm (0.24 in)**	**Measuring inset Ø ≥ 6 mm (0.24 in)**
Without thermowell		
Resistance thermometer	200 K/W	84 K/W
Thermocouple	30 K/W	30 K/W
With thermowell		
Resistance thermometer	70 K/W	40 K/W
Thermocouple	30 K/W	30 K/W

K/W = kelvin per watt

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 taken into account when determining the maximum process temperature for each temperature class.

Note

In the event of a fault (short-circuit), the dynamic short-circuit current that occurs in the measurement circuit for a matter of milliseconds is not relevant with regard to temperature rise.

The temperature rise Δt can be calculated using the following formula: $\Delta t = R_{th} \times P_o$ [K/W x W]

- 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} = 200 K/W

Temperature transmitter TTxx00 P_o= 38 mW, see also **Output power Po with ABB transmitters** on page 10.

Δt = 200 K/W x 0.038 W = 7.6 K

Therefore, at transmitter output power P_o = 38 mW the temperature rise in the event of a fault is approximately 8 K. This results in maximum feasible process temperatures T_{medium}, as presented in Table **Maximum process temperature Tmedium in Zone 0 and Zone 1** on page 10 .

Note

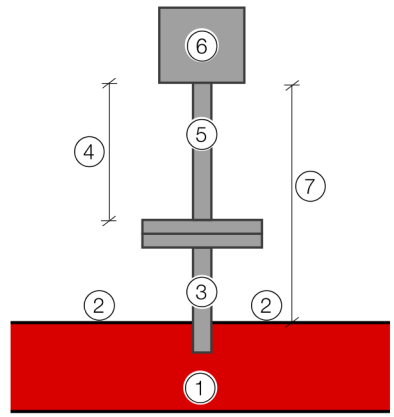
For a higher output power P_o in case of a malfunction of more than 38 mW, but also for a generally higher output power of a connected transmitter of more than 38 mW, the temperature rise Δt must be recalculated.

Impact of process and ambient temperature on the connection head

In addition to the ambient temperature, the impact of process temperature on the connection head and an optional integrated transmitter should generally be observed, and this especially in potentially explosive atmospheres.

At high process temperatures, excessive heat transfer to the connection head must be prevented by adjusting the length of the neck and using a suitably long extension tube. Additional improvement can be achieved by using suited insulation.

The neck length is defined as the distance between the surface of the process-media carrying system parts and the lower edge of the connection head in accordance with the following figure. It is greater or equal to the extension tube length. The neck length therefore represents the cooling section between the connection head and the process.



1. Process
2. Surface of process media-carrying system parts
3. Thermowell
4. Extension tube length
5. Extension tube
6. Connection head
7. Neck length

Figure 1: Definition of the neck length

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… Ex relevant specification

Affect of neck length on the temperature in the connection head

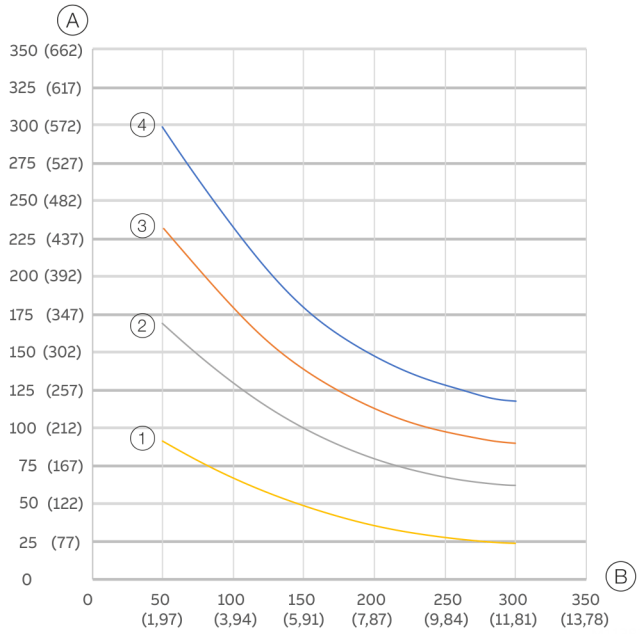
The temperature increase in the connection head as a function of the neck length for **operation without insulation** is shown below.

With regard to the heating behavior, there are three different groups of connection heads in different versions:

- Group 1: BEG, BBK head shape and similar head shapes
- Group 2: BUZ, BUS, AGS head shape and similar head shapes
- Group 3: AGL head and similar versions made from aluminum

The minimal neck length is a result of the maximum permissible temperature on or in the connection head. Depending on the selected version of the temperature sensor, this results in a minimum extension tube length.

Group 1: BEG, BBK head shape and similar head shapes



Ⓐ Temperature rise in connection head °C (°F)

Ⓑ Neck length mm (in)

Surface temperature of process media-carrying system parts °C (°F), see Figure 1 on page 7

① 250 (482)

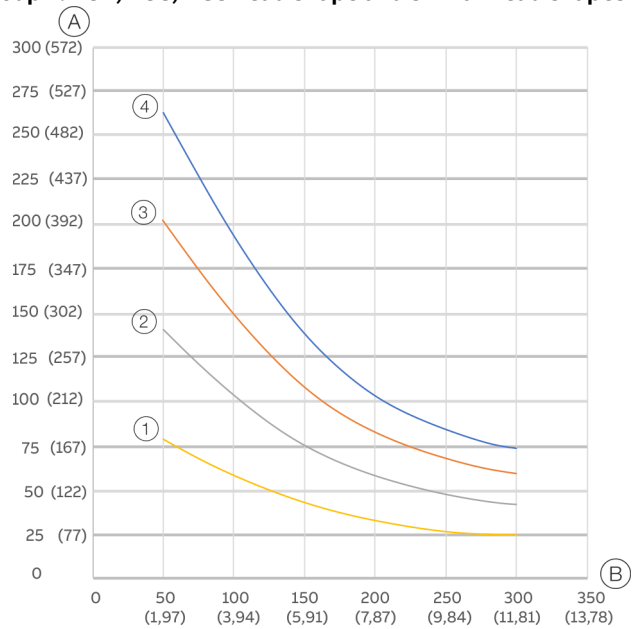
② 450 (842)

③ 620 (1148)

④ 800 (1472)

Figure 2: BEG, BBK head shape and similar head shapes

Group 2: BUZ, BUS, AGS head shape and similar head shapes



Ⓐ Temperature rise in connection head °C (°F)

Ⓑ Neck length mm (in)

Surface temperature of process media-carrying system parts °C (°F), see Figure 1 on page 7

① 250 (482)

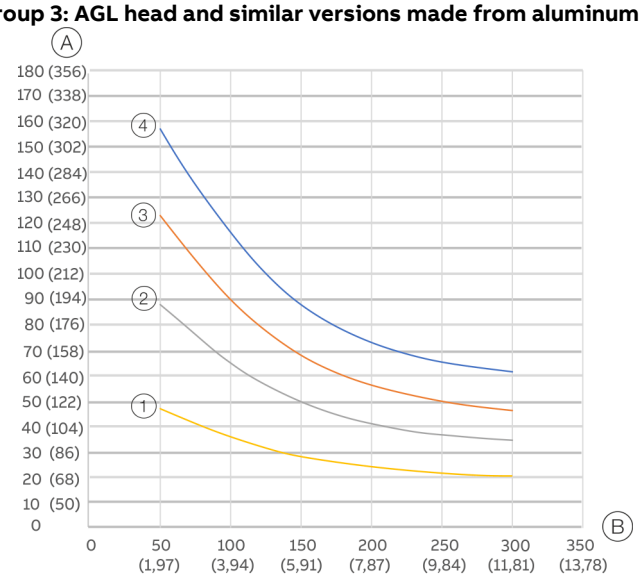
② 450 (842)

③ 620 (1148)

④ 800 (1472)

Figure 3: BUZ, BUS, AGS head shape and similar head shapes

Group 3: AGL head and similar versions made from aluminum



Ⓐ Temperature rise in connection head °C (°F)

Ⓑ Neck length mm (in)

Surface temperature of process media-carrying system parts °C (°F), see Figure 1 on page 7

① 250 (482)

② 450 (842)

③ 620 (1148)

④ 800 (1472)

Figure 4: AGL head and similar versions made from aluminum

Note

- When determining the required extension tube length, you also need to guarantee that the maximum permissible ambient temperature for the device is considered correctly and is not up-scaled. The temperature range of −40 to 80° C (−40 to 176 °F) permissible in the area of electrical connections must be maintained for temperature classes T6...T1.
- The operator must make sure that the maximum permissible temperature of the transmitter electronics in the connection head is not up-scaled in intrinsically safe devices.

ATEX and IECEx 'Ex i' intrinsic safety

Note

For compliance with the maximum permissible temperature of the transmitter in the connection head for devices in intrinsically safe design, see section **Impact of process and ambient temperature on the connection head** on page 7.

In the zone of the electrical connections, the permissible ambient temperature range is −40 to 80° C (−40 to 176 °F). Suited thermowells in accordance with PTB 01 ATEX 2200 X or IECEx PTB 11.0111 X should be used.

Electrical power limit Ex i

The TSP temperature sensors may only be operated in certified intrinsically safe category 'ia' or 'ib' circuits in the intrinsically safe Ex i type of protection.

The following electric values must not be up-scaled in the measurement current circuit of the temperature sensor:

U_i (input voltage)	I_i (input current)
30 V	101 mA
25 V	158 mA
20 V	309 mA

P_i (inner power) = max. 0.5 W

Notice: for the internal power P_i of the sensor and the output power P_o of the connected transmitter, the following must apply: $P_i \geq P_o$.

Likewise the following must apply: $U_i \geq U_o$ and $I_i \geq I_o$.

L_i (inner inductance of the sensor): negligible

C_i (inner capacitance of the sensor): negligible

The output values of a connected transmitter, both when mounting in the connection head and when mounting in the field, must not up-scale these electric values. The output values of ABB temperature transmitters (TTx300 and TTx200) are below these maximum values.

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Output power P_o with ABB transmitters

Transmitter type	P_o
TTH200, TTF200, TTR200 HART	≤ 29 mW*
TTH300, TTF300 HART	≤ 29 mW**
TTH300, TTF300 PA	≤ 38 mW
TTH300, TTF300 FF	≤ 38 mW

* as of HW-Rev. 1.12, previously Po ≤ 38 mW

** as of HW-Rev. 2.00, previously Po ≤ 38 mW

The type examination certificates for the corresponding transmitter types contain all further information necessary to verify intrinsic safety (U_o, I_o, P_o, L_o, C_o, etc.).

Maximum process temperature T_{medium} in Zone 0 and Zone 1
To calculate the temperature classes for T3, T4, T5 and T6, deduct 5 K in each instance from the maximum surface temperature; for T1 and T2, deduct 10 K in each instance from this surface temperature.
For temperature T_{medium}, the temperature rise in the event of a fault of 8 K as calculated as an example in **Conditions for use in potentially explosive atmospheres** on page 6.

Temperature class	−5 K	-10 K	T_{medium}
T1 (450 °C (842 °F))	—	440 °C (824 °F)	432 °C (809.6 °F)
T2 (300 °C (572 °F))	—	290 °C (554 °F)	282 °C (539.6 °F)
T3 (200 °C (392 °F))	195 °C (383 °F)	—	187 °C (368.6 °F)
T4 (135 °C (275 °F))	130 °C (266 °F)	—	122 °C (251.6 °F)
T5 (100 °C (212 °F))	95 °C (203 °F)	—	87 °C (188.6 °F)
T6 (85 °C (185 °F))	80 °C (176 °F)	—	72 °C (161.6 °F)

Type of protection Ex d - flameproof (enclosure) (only TSP3X1)
SensyTemp temperature sensors TSP300 can be used with the 'Ex d - flameproof (enclosure)' type of protection in the following zones:
– With suited thermowell and connection head in Zone 1 / 0 (zone separation, thus measuring inset in Zone 0).
– With connection head but without thermowell, in Zone 1

Observe the connection conditions listed in the PTB 99 ATEX 1144 X or IECEx PTB 12.0039 X type examination certificate, in this regard also see the connection instructions at page 21.

For the TSP300 with 'Ex d – flameproof (enclosure)' type of protection, the self-heating of the sensor in the event of a fault and if needed also during operation should be considered, see **Thermal resistance** on page 7.
The temperature class and the maximum permissible temperature of the measuring medium must be determined accordingly.

Temperature data
Maximum permissible ambient temperature T_{amb} on the connection head*:

Temperature class	Without transmitter	With transmitter
T1 … T4	−40 to 120 °C (−40 to 248 °F)	−40 to 85 °C (−40 to 185 °F)
T6	−40 to 75 °C (−40 to 167 °F)	−40 to 67 °C (−40 to 152 °F)

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

Note
With an ambient temperature T_{amb} lower than −20 °C (−4 °F) and higher than 70 °C (158 °F), the readability of a display can longer be guaranteed.

Maximum permissible process temperature T_{medium}:

Temperature class	Use in Zone 0	Use in Zone 1
T1	358 °C (676.4 °F)	438 °C (820.4 °F)
T2	238 °C (460.4 °F)	288 °C (550.4 °F)
T3	158 °C (316.4 °F)	193 °C (379.4 °F)
T4	106 °C (222.8 °F)	128 °C (262.4 °F)
T5	78 °C (172.4 °F)	93 °C (199.4 °F)
T6	66 °C (150.8 °F)	78 °C (172.4 °F)

Electric Data
The SensyTemp TSP300 (and TSP100) temperature sensors are available without integrated transmitters (e.g. for operation with ABB TTF200 or TTF300 transmitters) and with ABB TTH200 or TTH300 integrated transmitters.

In the 'Ex d – flameproof (enclosure)' type of protection, the following electric data for the power supply circuit and the measurement current circuit must be observed.

Supply circuit	
Maximum voltage	U_S = 30 V
Maximum current	I_s = 32 mA, limited by the upstream fuse (rated fuse current 32 mA)

Measurement current circuit	
Maximum voltage	U_O = 6.5 V
Maximum current	I_O = 17.8 mA
Maximum output power	P_O = 29 mW (TTF200, TTH200)* P_O = 38 mW (TTF300, TTH300)**

* as of HW-Rev. 1.12, previously 38 mW

** TTF300 HART, TTH300 HART as of HW-Rev. 2.00: 29 mW

The maximum output power P_O leads to a maximum temperature rise of 8 K, see **Thermal resistance** on page 7. For a higher output power P_O, the temperature rise must be recalculated.

Dust explosion protection – enclosure 't' (only TSP3X1)
SensyTemp TSP300 temperature sensors can be used with the dust explosion protection type of protection in the following zones:
– Without transmitter or with TTH200 transmitter and without LCD indicator in Zone 20.
– With TTH300 transmitter or with integrated LCD indicator in Zone 21.

The connection conditions listed in the type examination certificate BVS 06 ATEX E 029 or IECEx BVS 17.0065 X should be observed.

The power feed can come from a power supply unit with an intrinsically-safe output current circuit of type of protection 'Ex ia' or 'Ex ib', or can also be non-intrinsically safe.
In the case of non-intrinsically safe power feed, the maximum voltage in the supply circuit is U_s = 30 V and the maximum current I_s = 32 mA, limited by an upstream fuse (rated fuse current 32 mA).

The output circuit of the transmitter (sensor circuit) should be limited to a maximum permissible power loss in the measuring inset (sensor) of P_i = 0.5 W.
The maximum power loss P_i = 38 mW leads to a maximum temperature rise of 8 K, see **Thermal resistance** on page 7. For a higher power P_i, the temperature rise must be recalculated.

If in the dust explosion protection type of protection, the transmitter is supplied with power from a power supply unit which is designed as intrinsically safe in the 'Ex ia' or 'Ex ib' type of protection, a limitation of the power supply circuit by an upstream fuse is not required. In this case, the electric data of the transmitter used should be observed for the intrinsic safety type of protection. For ABB transmitters (TTH200, TTH300, TTF200, TTF300 and TTR200), see the 'Electric Data – Transmitter' section and the 'Type of protection intrinsic safety Ex ia IIC (Part 1)', '(… Part 2)' and '(… Part 3)' tables in the instructions of the respective devices.

For the highest value of thermal data for connection to an intrinsically-safe power supply unit of type of protection 'Ex ia / Ex ib'; refer to the "Thermal Data" table.

NOTICE
When using two transmitters and / or measuring insets, the sum of the voltages, currents and outputs must not up-scale the values specified in the type examination certificate.

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… Ex relevant specification

Thermal data

	Approved ambient temperature at connection head	Approved process temperature at thermowell	Maximum temperature at the process connection on the connection head side	Maximum surface temperature at the connection head	Maximum surface temperature at the thermowell
Category 1D or Category 1/2D with		−40 to 85 °C (−40 to 185 °F)	85 °C (185 °F)		133 °C (271.4 °F)
intrinsically-safe transmitter with Ex ia		−40 to 200 °C (−40 to 392 °F)*	164 °C (327.2 °F)		200 °C (392 °F)
type of protection installed	−40 to 85 °C	−40 to 300 °C (−40 to 572 °F)*	251 °C (483.8 °F)		300 °C (572 °F)
	(−40 to 185 °F)	−40 to 400 °C (−40 to 752 °F)*	346 °C (654.8 °F)	120 °C (248 °F)	400 °C (752 °F)
Category 1D or Category 1/2D with		−40 to 85 °C (−40 to 185 °F)	85 °C (185 °F)		133 °C (271.4 °F)
installed transmitter with fuse		−40 to 200 °C (−40 to 392 °F)*	164 °C (327.2 °F)	133 °C (271.4 °F)**	200 °C (392 °F)
protection by means of external fuse	−40 to 85 °C	−40 to 300 °C (−40 to 572 °F)*	251 °C (483.8 °F)	150 °C (302 °F)***	300 °C (572 °F)
	(−40 to 185 °F)	−40 to 400 °C (−40 to 752 °F)*	346 °C (654.8 °F)		400 °C (752 °F)
Category 1D or category 1/2D Ex ia intrinsically-safe measuring loop,					
remote or non-intrinsically-safe	−40 to 85 °C (−40 to 185 °F)	−40 to 85 °C (−40 to 185 °F)	85 °C (185 °F)	85 °C (185 °F)	133 °C (271.4 °F)
transmitter by means of external fuse	−40 to 120 °C (−40 to 248 °F)	−40 to 200 °C (−40 to 392 °F)	200 °C (392 °F)	120 °C (248 °F)	200 °C (392 °F)
in the power feed circuit of the remote	−40 to 120 °C (−40 to 248 °F)	−40 to 300 °C (−40 to 572 °F)	251 °C (483.8 °F)	120 °C (248 °F)	300 °C (572 °F)
transmitter	−40 to 120 °C (−40 to 248 °F)	−40 to 400 °C (−40 to 752 °F)	346 °C (654.8 °F)	120 °C (248 °F)	400 °C (752 °F)

* The user must take suited measures to make sure that the maximum permissible ambient temperature of 85 °C (185 °F) at the connection head is not up-scaled. In addition, the **Impact of process and ambient temperature on the connection head** on page 7 should be complied with.

** Fitted with a transmitter with and without display.

*** Fitted with two transmitters.

Non-sparking and increased safety as well as dust explosion protection
External measures must be made for the power supply circuit in order to prevent the rated voltage from being up-scaled by more than 40 % in the event of transient disturbances.

For the relation between ambient temperature and process temperature, see **Impact of process and ambient temperature on the connection head** on page 7. The lower limit of the ambient temperature is −40 °C (−40 °F).

With the integrated TTH200 or TTH300 transmitter and temperature class T6, the maximum permissible ambient temperature is 56 °C (132.8 °F).

Process temperature:	max. 400 °C (752 °F) for II 3G max. 300 °C (572 °F) for II 3D

Installation instructions

Prevent increases in the ambient temperature by making sure that 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 **Impact of process and ambient temperature on the connection head** on page 7 should be considered as well.

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.

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 that you guarantee compliance with the 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.
When operating with combustible dusts, comply with EN 60079-31.
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.

Installation notes for ‘Ex i – intrinsic safety’ type of protection

⚠ 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 and protected against mechanical impacts or friction.

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… Installation instructions

Note
When operating the complete device in Zone 0 (EPL 'Ga'), the compatibility of the device materials with the surrounding atmosphere must be guaranteed.
Encapsulation material used in a optionally integrated TTH200 or TTH300 transmitter:
Polyurethane (PUR), WEVO PU-417

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 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 10.

In addition, observe the instructions at **Flameproof enclosure (models TSA101-A5, TSP3X1-A5)** on page 17.

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
By accordingly selecting an order code for 'cable entry options', a suited and certified Ex d cable gland can be ordered. If you select order codes U1, U2, U4 or U5, the cable gland that would be supplied is deselected and only the cable entry is defined.

If you do not select an order code for 'cable gland options', a standard cable gland will be installed at the factory.

Standard cable gland data
- M20 × 1.5
- Temperature range: −40 to 120 °C (−40 to 248 °F)
- Cable outside diameter: 3.2 to 8.7 mm (0.13 to 0.34 in)
- Material: nickel-plated brass

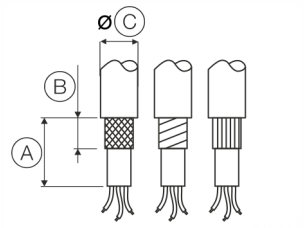
Note
In such cases, the value 'UA' (1 × M20 × 1.5, with Ex-d cable gland) is provided on the additional plate for explosion-protected apparatus in the type designation in accordance with the approval.

The cable entry is only suitable 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 ensure 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 6, 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.



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

Figure 5: 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 5.
3. Check the outer sleeve for damage and soiling.
4. Insert the cable in the cable gland.

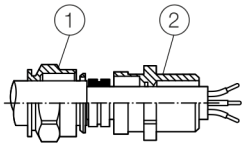


Figure 6: Tighten the cable gland

5. Tighten the cable gland until the cable is firmly enclosed by the sealing ring (Figure 6, 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 glands M20 × 1.5 for 'Ex i' (blue) and 'dust ignition protection' (black) types of protection.

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

⚠ WARNING

Explosion hazard

- The supplied cable gland is **not** approved for use in dust explosion protection **Zone 20**.
- When using in explosive dust areas, there is an explosion hazard due to static discharge. Clean using anti-static cloths only. The information in the instructions of the cable gland (Safety, Maintenance and Mounting Instructions) should be observed!

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).

- 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!

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

Mechanical mounting of explosion-proof devices

Intrinsic safety up to Zone 0 (model TSA101-A1, TSPXX1-A1)
ATEX II 1 G Ex ia IIC T6...T1 Ga (Zone 0, 1, 2) or
ATEX II 2 G Ex ib IIC T6...T1 Gb (Zone 1, 2) or
ATEX II 1/2 G Ex ib IIC T6...T1 Ga/Gb (Zone 0 through zone separation using thermowell, Zone 1, 2)

ATEX II 1 G Ex ia IIC T6...T1 Ga, Zone 0, 1, 2:
When used in Zone 0, the use of aluminum connection heads is only permitted if the devices are installed protected against mechanical shock loads or friction.

ATEX II 2 G Ex ib IIC T6...T1 Gb, Zone 1, 2:
No additional specific information needs to be observed for mechanical installation.

ATEX II 1/2 G Ex ib IIC T6...T1 Ga/Gb, Zone 0 through zone separation using thermowell, Zone 1, 2:
If the temperature sensors are installed in thermowells or separating elements are used, temperature sensors on certified intrinsically safe 'ib' circuits can also be assigned to category 1. The minimum wall thickness is ≥ 1 mm for stainless steels or ≥ 3 mm for other types of steel.
Thermowell materials and information on vibration resistance can be found in the data sheet for the SensyTemp TSP100 (DS/TSP1X1) or SensyTemp TSP300 (DS/TSP3X1) temperature sensors. The exact configuration of the temperature sensor can be determined through the serial number of the device (serial number in accordance with order).
This applies for all SensyTemp TSP1X1 and TSP3X1 temperature sensors and should be especially observed when installing the SensyTemp TSP111 and TSP311 temperature sensor in existing thermowells. Moreover, no additional specific information needs to be observed for mechanical installation.

Intrinsic safety up to Zone 0 in accordance with NAMUR recommendation (model TSA101-N1, TSPXX1-N1)
NE 24 and ATEX II 1 G Ex ia IIC T6...T1 Ga, Zone 0, 1, 2
When used in Zone 0, the use of aluminum connection heads is only permitted if the devices are installed protected against mechanical shock loads or friction.

Dust explosion protection (model TSA101-A3, TSP3X1-A3)
ATEX II 1 D Ex ta IIIC T133°C ... T400°C Da, Zone 20, 21, 22
ATEX II 1/2 D Ex ta/tb IIIC T133°C ... T400°C Da/Db, Zone 20 through zone separation using thermowell, Zone 21, 22
The use of the device in zone 20 is not permitted with integrated TTH300 transmitter or LCD indicator!
Devices for use in Zone 20 are always delivered without cable glands. Operation without cable gland is not permitted! The system operator is responsible for the correct selection of a cable gland suited for the application. For information on the cable gland used, refer to the relevant data sheet and operating instructions.

The assembly and disassembly may only be carried out by specialist personnel that have knowledge of the concept of the corresponding type of protection "Electrical apparatuses with protection through housing with isolation of the surface temperature for use in areas in which combustible dust is present in sufficient quantities that it could lead to fire or explosion (dust explosion protection)".
The temperature sensors are to be attached, according to their mounting type (thermowell with flange, with threaded connector, with sliding connector or as welded thermowell), securely, sealed and firmly with the respective container. Choose connection elements that are suitable for the application in question (Screws, seals etc.)
Only connection cables may be used which satisfy the requirements of the DIN EN 60079 standards series.
The SensyTemp TSP3X1 temperature sensors must be installed in an existing thermowell.

Dust explosion protection (model TSA101-D5, TSP3X1-D5)
ATEX II 2 D Ex tb IIIC T133°C ... T400°C Db, Zone 21, 22
The use of the device in zone 20 is not permitted with integrated TTH300 transmitter or LCD indicator!
For assembly and disassembly see **Dust explosion protection (model TSA101-A3, TSP3X1-A3)** on page 16

Dust explosion protection | intrinsic safety (model TSA101-A4, TSP3X1-A4)

ATEX II 1 D Ex ta IIIC T133°C ... T400°C Da or ATEX II 1/2 D Ex ta/tb IIIC T133°C ... T400°C Da/Db
and
ATEX II 1 G Ex ia IIC T6...T1 Ga or II 2 G Ex ib IIC T6...T1 Gb or II 1/2 G Ex ib IIC T6...T1 Ga/Gb, Zone 20, 21, 22 and 0, 1, 2

The 'A4' coding combines 'Dust explosion protection' (TSA101-A3, TSP3X1-A3) and 'Intrinsic safety' (TSA101-A1, TSP3X1-A1). Chapters **Dust explosion protection (model TSA101-A3, TSP3X1-A3)** on page 16 and **Intrinsic safety up to Zone 0 (model TSA101-A1, TSPXX1-A1)** on page 16 must be applied in respect of this.

Devices with several types of protection may only be operated in one of the possible types of protection. For this purpose, observe the 'Product Identification' chapter in the operating or commissioning instruction before commissioning.

Dust explosion protection | intrinsic safety (model TSA101-D6, TSP3X1-D6)

ATEX II 2 D Ex tb IIIC T133°C ... T400°C Db
and
ATEX II 1 G Ex ia IIC T6...T1 Ga or II 2 G Ex ib IIC T6...T1 Gb or II 1/2 G Ex ib IIC T6...T1 Ga/Gb, Zone 21, 22 and 0, 1, 2

The 'D6' coding combines the 'Dust explosion protection' (TSA101-D5, TSP3X1-D5) and 'Intrinsic safety' (TSA101-A1, TSP3X1-A1) types of protection. Chapters **Dust explosion protection (model TSA101-D5, TSP3X1-D5)** on page 16 and **Intrinsic safety up to Zone 0 (model TSA101-A1, TSPXX1-A1)** on page 16 must be applied in respect of this.

Devices with several types of protection may only be operated in one of the possible types of protection. For this purpose, observe the 'Product Identification' chapter in the operating or commissioning instruction before commissioning.

Note

Use in explosive hybrid mixtures, where explosive dusts and gases are present simultaneously, is not currently permitted in accordance with EN 60079-0 and EN 60079-31.

Flameproof enclosure (models TSA101-A5, TSP3X1-A5)

ATEX II 1/2 G Ex db IIC T6/T4 Ga/Gb, Zone 1 and 2

For use in Zone 0, thermowells which satisfy the following requirements must be used:

- Install suitable thermowells for zone separation. For operation in Zone 0, use thermowells that are suited for zone separation in accordance with EN 60079-26. SensyTemp TSP321 and TSP331 temperature sensors are supplied with an appropriate thermowell.
  Thermowell materials and information on vibration resistance can be found in the data sheet for the SensyTemp TSP100 (DS/TSP1X1) or SensyTemp TSP300 (DS/TSP3X1) temperature sensors. The exact configuration of the temperature sensor can be determined through the serial number of the device (serial number in accordance with order).
  SensyTemp TSP311 temperature sensors must be installed in an existing thermowell. The notes regarding thermowell material and vibration resistance should also be observed here.
- Suitable temperature-, pressure- and corrosion-resistant sealing elements must be used.

Use only prototype-certified ABB measuring insets whose diameter matches the corresponding hole of the connection head (ignition penetration-proof seam).

If there is surface damage in the area of the ignition penetration-proof seam of the measuring inset or the connection head base, the defective components may no longer be used.

- Observe the approval and installation information for the cable gland. For information on the cable gland used, refer to the relevant data sheet and operating instructions. When using as a surface sensor with exposed mineral insulated cable (custom-made), this cable must be permanently installed and mechanically protected.

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

… Mechanical mounting of explosion-proof devices

Dust explosion protection | flameproof enclosure (model TSA101-B5, TSP3X1-B5)
ATEX II 1 D Ex ta IIIC T133°C … T400°C Da or ATEX II 1/2 D Ex ta/tb IIIC T133°C … T400°C Da/Db
and
ATEX II 1/2 G Ex db IIC T6/T4 Ga/Gb, Zone 20, 21, 22 and 1, 2
The 'B5' coding combines 'Dust explosion protection' (TSA101-A3, TSP3X1-A3) and 'Flameproof enclosure' (TSA101-A5, TSP3X1-A5) types of protection.
Chapters **Dust explosion protection (model TSA101-A3, TSP3X1-A3)** on page 16 and **Flameproof enclosure (models TSA101-A5, TSP3X1-A5)** on page 17 must be applied in respect of this.

Devices with several types of protection may only be operated in one of the possible types of protection. For this purpose, observe the 'Product Identification' chapter in the operating or commissioning instruction before commissioning.

Dust explosion protection | flameproof enclosure (model TSA101-D8, TSP3X1-D8)
ATEX II 2 D Ex tb IIIC T133°C … T400°C Db
and
ATEX II 1/2 G Ex db IIC T6/T4 Ga/Gb, Zone 21, 22 and 1, 2
The 'D8' coding combines the 'Dust explosion protection' (TSA101-D5, TSP3X1-D5) and 'Flameproof enclosure' (TSA101-A5, TSP3X1-A5) types of protection.
Chapters **Dust explosion protection (model TSA101-D5, TSP3X1-D5)** on page 16 and **Flameproof enclosure (models TSA101-A5, TSP3X1-A5)** on page 17 must be applied in respect of this.

Devices with several types of protection may only be operated in one of the possible types of protection. For this purpose, observe the 'Product Identification' chapter in the operating or commissioning instruction before commissioning.

Note
Use in explosive hybrid mixtures, where explosive dusts and gases are present simultaneously, is not currently permitted in accordance with EN 60079-0 and EN 60079-31.

Non-sparking and increased safety as well as dust explosion protection (model TSA101-B1, TSPXX1-B1), Zone 2 and Zone 22
ATEX II 3 G Ex nA IIC T6…T1 Gc
ATEX II 3 G Ex ec IIC T6…T1 Gc
ATEX II 3 D Ex tc IIIB T133°C Dc

No additional specific information needs to be observed for mechanical installation.

Note
Use in explosive hybrid mixtures, where explosive dusts and gases are present simultaneously, is not currently permitted in accordance with EN 60079-0 and EN 60079-31.

Electrical connections

Grounding

Note

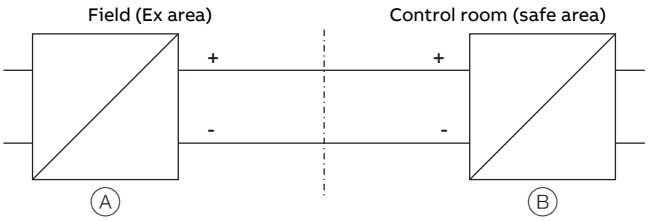
The device shall be included in the equipotential bonding system using the grounding terminal intended for this purpose.

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 7: Intrinsic safety installation check

Installation in potentially explosive atmospheres without integrated transmitter

The temperature sensor can be installed in a huge variety of industrial locations. Plants with explosion protection (Ex plants) are divided into zones, meaning that they also require a wide range of instruments. Different certificates are required for these depending on the region. The temperature sensor must be instrumented by the user in accordance with the valid Ex standards.

Note

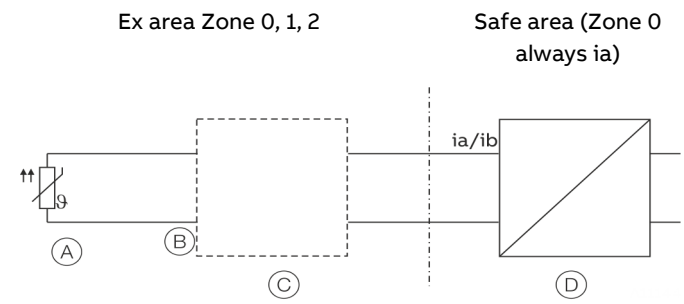
Ex relevant specifications must be taken from the applicable type examination certificates and other relevant certificates that apply in each case.

Intrinsic safety up to Zone 0 (model TSA101-A1, TSPXX1-A1)
ATEX II 1 G Ex ia IIC T6...T1 Ga (Zone 0, 1, 2) or
ATEX II 2 G Ex ib IIC T6...T1 Gb (Zone 1, 2) or
ATEX II 1/2 G Ex ib IIC T6...T1 Ga/Gb (Zone 0 through zone separation using thermowell, Zone 1, 2)
Only certified transmitters with the maximum values specified in the operating instructions may be connected to the temperature sensors. If two transmitters are used for two intrinsically safe circuits, the sum of the values may not exceed the maximum values specified in the operating instructions.
The temperature sensor must feature appropriate input protection circuits in order to eliminate hazards (spark formation). An intrinsic safety installation check must be performed. For this purpose, the electric limit values must be used as the basis for the type examination certificates for the equipment (devices); this includes the capacitance and inductance values of the connection leads.

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

… Electrical connections

ATEX II 1 G Ex ia IIC T6…T1 Ga, Zone 0, 1, 2:
In the case of the intrinsic safety type of protection, only one measuring element may be connected in Zone 0 if two measuring elements are being used (e.g. 2 x Pt100).
The internal wiring in TTF300 transmitters enables 2 measuring elements to be connected since both elements are integrated into the same intrinsically safe sensor circuit.
For the Zone 0 version, only one intrinsically safe sensor measurement circuit may be used.

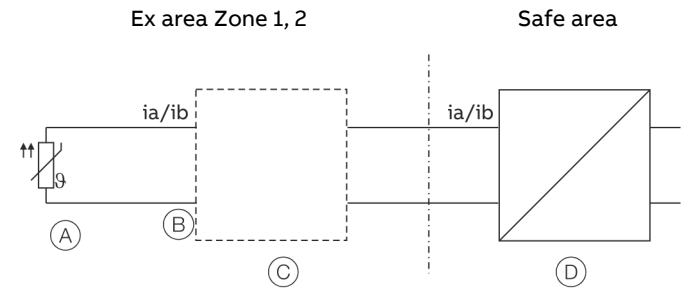


A Sensor
B Sensor connection leads
C Housing
D Ex ia/ib transmitter (Zone 0 always ia)

Figure 8: Interconnection

The transmitter must have an Ex ia (Category 1G) design to enable it to be used in Zone 0.

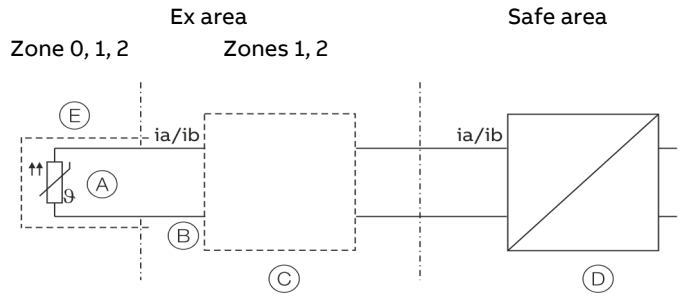
ATEX II 2 G Ex ib IIC T6…T1 Gb, Zone 1, 2:



A Sensor
B Sensor connection leads
C Housing
D Ex ia/ib transmitter

Figure 9: Interconnection

ATEX II 1/2 G Ex ib IIC T6…T1 Ga/Gb, Zone 0 through zone separation using thermowell, Zone 1, 2:



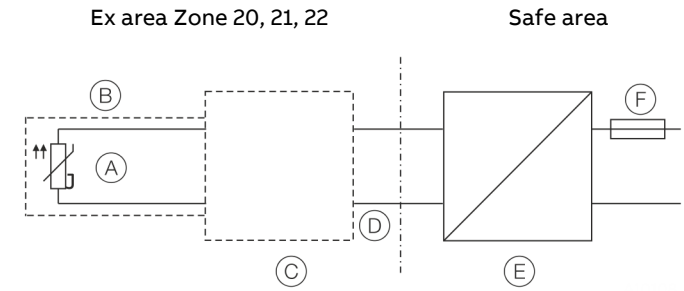
A Sensor
B Sensor connection leads
C Housing
D Ex ia/ib transmitter
E Thermowell, suitable for zone separation

Figure 10: Interconnection

Intrinsic safety up to Zone 0 in accordance with NAMUR recommendation (model TSA101-N1, TSPXX1-N1)
NE 24 and ATEX II 1 G Ex ia IIC T6…T1 Ga, Zone 0, 1, 2
Refer to **Intrinsic safety up to Zone 0 (model TSA101-A1, TSPXX1-A1)** on page 19.

Note
Due to the geometric dimensions within the mineral insulated cable, double sensors may not satisfy the requirements of Point 2 of Namur recommendation NE 24.

Dust explosion protection (model TSA101-A3, TSP3X1-A3)
ATEX II 1 D Ex ta IIIC T133°C ... T400°C Da, Zone 20, 21, 22
ATEX II 1/2 D Ex ta/tb IIIC T133°C ... T400°C Da/Db, Zone 20 through zone separation using thermowell, Zone 21, 22



A Sensor
B Thermowell
C Ex t approved housing with Ex t cable gland
D Sensor connection leads
E Transmitter with max. input terminal voltage 30 V DC
F Fuse 32 mA

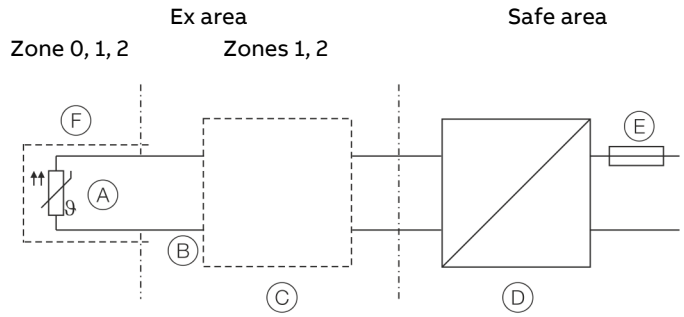
Figure 11: Interconnection

The power supply circuit of the transmitter must be limited by an upstream fuse with a fuse current rating of 32 mA.
This is not required if the transmitter has an intrinsically safe design in accordance with **Intrinsic safety up to Zone 0 (model TSA101-A1, TSPXX1-A1)** on page 19.
Maximum input terminal voltage of the transmitter: 30 V DC
The maximum permissible power dissipation in the measuring inset (sensor) is P_i = 0.5 W.

Dust explosion protection | intrinsic safety (model TSA101-A4, TSP3X1-A4)
ATEX II 1 D Ex ta IIIC T133°C ... T400°C Da or ATEX II 1/2 D Ex ta/tb IIIC T133°C ... T400°C Da/Db
and
ATEX II 1 G Ex ia IIC T6...T1 Ga or II 2 G Ex ib IIC T6...T1 Gb or II 1/2 G Ex ib IIC T6...T1 Ga/Gb, Zone 20, 21, 22 and 0, 1, 2
The 'A4' coding combines 'Dust explosion protection' (TSA101-A3, TSP3X1-A3) and 'Intrinsic safety' (TSA101-A1, TSP3X1-A1). Chapters **Dust explosion protection (model TSA101-A3, TSP3X1-A3)** on page 21 and **Intrinsic safety up to Zone 0 (model TSA101-A1, TSPXX1-A1)** on page 19 must be applied in respect of this.

Devices with several types of protection may only be operated in one of the possible types of protection. For this purpose, observe the 'Product Identification' chapter in the operating or commissioning instruction before commissioning.

Flameproof enclosure (models TSA101-A5, TSP3X1-A5)
ATEX II 1/2 G Ex db IIC T6/T4 Ga/Gb, Zone 1 and 2



A Sensor
B Sensor connection leads
C Ex d housing (IP 6X) with Ex d cable gland
D Transmitter with max. input terminal voltage 30 V DC
E Fuse 32 mA
F Thermowell, suitable for zone separation

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.

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

… Electrical connections

⚠ WARNING

Explosion hazard

- When used without a thermowell, particularly surface sensors with exposed mineral insulated cable, operation in Zone 0 is not permitted.

The maximum values for electric data for the measurement current circuit may not be up-scaled. Refer to **Type of protection Ex d - flameproof (enclosure)** on page 10.

The maximum output power of the transmitter P_o is based on a maximum temperature rise of 8 K, as described in **Thermal resistance** on page 7. If transmitters with an output power P_o higher than in ABB transmitters ($P_o \leq 38$ mW) are used, the temperature rise must be recalculated.

Dust explosion protection | flameproof enclosure (model TSA101-B5, TSP3X1-B5)
ATEX II 1 D Ex ta IIIC T133°C … T400°C Da or ATEX II 1/2 D Ex ta/tb IIIC T133°C … T400°C Da/Db
and
ATEX II 1/2 G Ex db IIC T6/T4 Ga/Gb, Zone 20, 21, 22 and 1, 2
The 'B5' coding combines 'Dust explosion protection' (TSA101-A3, TSP3X1-A3) and 'Flameproof enclosure' (TSA101-A5, TSP3X1-A5) types of protection. Chapters **Dust explosion protection (model TSA101-A3, TSP3X1-A3)** on page 21 and **Flameproof enclosure (models TSA101-A5, TSP3X1-A5)** on page 21 must be applied in respect of this.

Devices with several types of protection may only be operated in one of the possible types of protection. For this purpose, observe the 'Product Identification' chapter in the operating or commissioning instruction before commissioning.

Non-sparking and increased safety as well as dust explosion protection (model TSA101-B1, TSPXX1-B1), Zone 2 and Zone 22
ATEX II 3 G Ex nA IIC T6…T1 Gc
ATEX II 3 G Ex ec IIC T6…T1 Gc
ATEX II 3 D Ex tc IIIB T133°C Dc

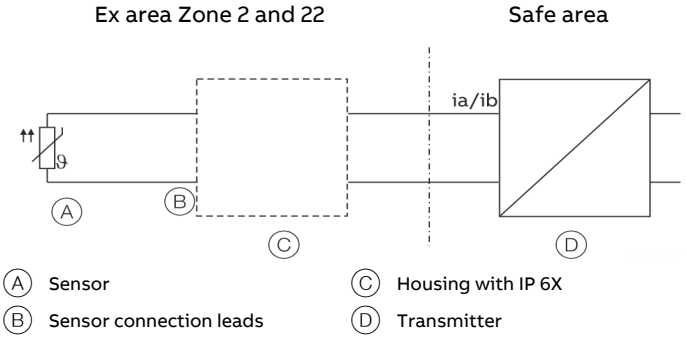


Figure 12: Interconnection

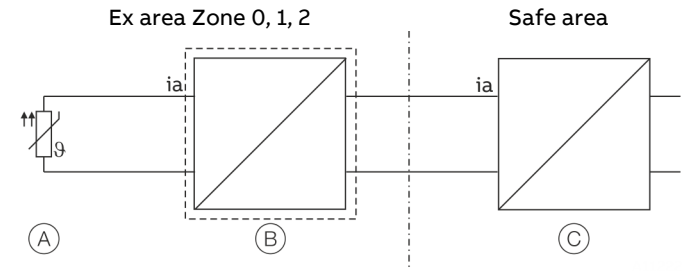
External measures must be made for the power supply circuit in order to prevent the rated voltage from being up-scaled by more than 40 % in the event of transient disturbances.

Use in explosive hybrid mixtures, where explosive dusts and gases are present simultaneously, is not currently permitted in accordance with EN 60079-0 and EN 60079-31.

Installation in potentially explosive areas with integrated transmitter

Intrinsic safety up to Zone 0 (model TSA101-A1, TSPXX1-A1)
ATEX II 1 G Ex ia IIC T6...T1 Ga (Zone 0, 1, 2) or
ATEX II 2 G Ex ib IIC T6...T1 Gb (Zone 1, 2) or
ATEX II 1/2 G Ex ib IIC T6...T1 Ga/Gb (Zone 0 through zone separation using thermowell, Zone 1, 2)
With this instrumentation, it must be ensured that the power feed only comes from an approved intrinsically safe electrical circuit of the appropriate category.
The electric and thermal parameters may not be up-scaled.
The respective information in the type examination certificates for the transmitter used (PTB 05 ATEX 2017 X or PTB 09 ATEX 2016 X) must be complied with.

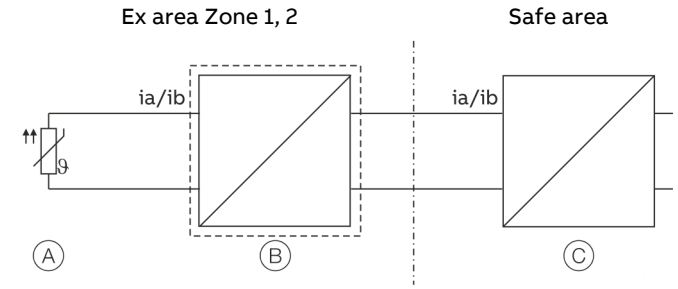
ATEX II 1 G Ex ia IIC T6...T1 Ga, Zone 0, 1, 2:



(A) Measuring inset
(B) Sensor head transmitter Ex ia, e.g. TTH200 or TTH300
(C) Supply isolator [Ex ia]

Figure 13: Interconnection

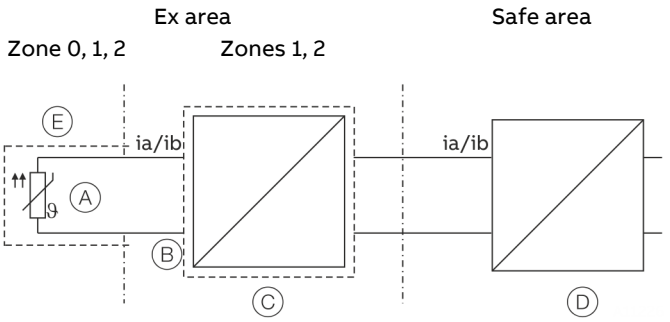
ATEX II 2 G Ex ib IIC T6...T1 Gb, Zone 1, 2:



(A) Sensor
(B) Ex ia/ib sensor head transmitter
(C) Supply isolator [Ex ia/ib]

Figure 14: Interconnection

ATEX II 1/2 G Ex ib IIC T6...T1 Ga/Gb, Zone 0 through zone separation using thermowell, Zone 1, 2:



(A) Sensor
(B) Sensor connection lead
(C) Housing
(D) Sensor head transmitter Ex ia/ib, e.g. TTH200 or TTH300
(E) Thermowell, suitable for zone separation

Figure 15: Interconnection

Intrinsic safety up to Zone 0 in accordance with NAMUR recommendation (model TSA101-N1, TSPXX1-N1)
NE 24 and ATEX II 1 G Ex ia IIC T6...T1 Ga, Zone 0, 1, 2
Refer to **Intrinsic safety up to Zone 0 (model TSA101-A1, TSPXX1-A1)** on page 23.

Note
Due to the geometric dimensions within the mineral insulated cable, double sensors may not satisfy the requirements of Point 2 of Namur recommendation NE 24.

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

… Electrical connections

Dust explosion protection (model TSA101-A3, TSP3X1-A3)
ATEX II 1 D Ex ta IIIC T133°C … T400°C Da, Zone 20, 21, 22
ATEX II 1/2 D Ex ta/tb IIIC T133°C … T400°C Da/Db,
Zone 20 through zone separation using thermowell, Zone 21, 22
Only for versions with TTH200 without LCD indicator!

Dust explosion protection (models TSA101-D5, TSP3X1-D5)
ATEX II 2 D Ex tb IIIC T133°C … T400°C Db, Zone 21, 22
The use of the device in zone 20 is not permitted with integrated TTH300 transmitter or LCD indicator!

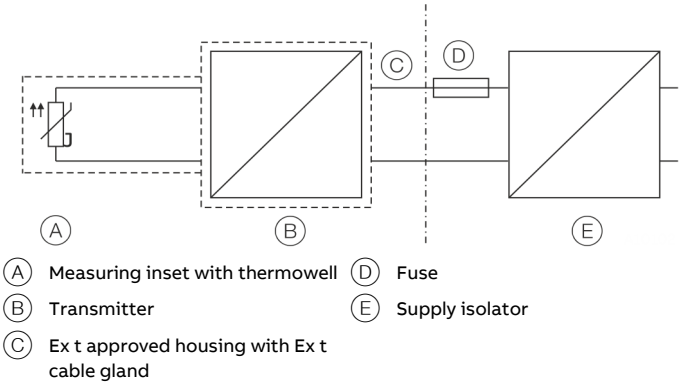


Figure 16: Interconnection

The power supply circuit of the transmitter must be limited by an upstream fuse with a fuse current rating of 32 mA.
This is not required if the transmitter has an intrinsically safe design in accordance with **Intrinsic safety up to Zone 0 (model TSA101-A1, TSPXX1-A1)** on page 23.
Maximum input terminal voltage of the transmitter: 30 V DC
The maximum permissible power dissipation in the measuring inset (sensor) is P_i = 0.5 W.

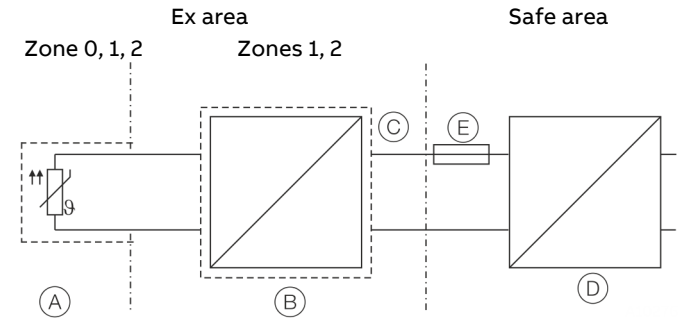
Dust explosion protection | intrinsic safety (model TSA101-A4, TSP3X1-A4)
ATEX II 1 D Ex ta IIIC T133°C … T400°C Da or ATEX II 1/2 D Ex ta/tb IIIC T133°C … T400°C Da/Db
and
ATEX II 1 G Ex ia IIC T6…T1 Ga or II 2 G Ex ib IIC T6…T1 Gb or II 1/2 G Ex ib IIC T6…T1 Ga/Gb, Zone 20, 21, 22 and 0, 1, 2
The 'A4' coding combines 'Dust explosion protection' (TSA101-A3, TSP3X1-A3) and 'Intrinsic safety' (TSA101-A1, TSP3X1-A1).
Chapters **Dust explosion protection (model TSA101-A3, TSP3X1-A3)** on page 24 and **Intrinsic safety up to Zone 0 (model TSA101-A1, TSPXX1-A1)** on page 23 must be applied in respect of this.

Devices with several types of protection may only be operated in one of the possible types of protection. For this purpose, observe the 'Product Identification' chapter in the operating or commissioning instruction before commissioning.

Dust explosion protection | intrinsic safety (model TSA101-D6, TSP3X1-D6)
ATEX II 2 D Ex tb IIIC T133°C … T400°C Db
and
ATEX II 1 G Ex ia IIC T6…T1 Ga or II 2 G Ex ib IIC T6…T1 Gb or II 1/2 G Ex ib IIC T6…T1 Ga/Gb, Zone 21, 22 and 0, 1, 2

The 'D6' coding combines the 'Dust explosion protection' (TSA101-D5, TSP3X1-D5) and 'Intrinsic safety' (TSA101-A1, TSP3X1-A1) types of protection.
Chapters **Dust explosion protection (models TSA101-D5, TSP3X1-D5)** on page 24 and **Intrinsic safety up to Zone 0 (model TSA101-A1, TSPXX1-A1)** on page 23 must be applied in respect of this.
Devices with several types of protection may only be operated in one of the possible types of protection. For this purpose, observe the 'Product Identification' chapter in the operating or commissioning instruction before commissioning.

Flameproof enclosure (models TSA101-A5, TSP3X1-A5)
ATEX II 1/2 G Ex db IIC T6/T4 Ga/Gb, Zone 1 and 2



(A) Measuring inset with a thermowell suited for zone separation
(B) Sensor head transmitter
(C) Ex d housing (IP 6X) with Ex d cable gland
(D) Supply isolator with voltage limit (30 V)
(E) Fuse 32 mA

Figure 17: Interconnection

The TSA101-A5, TSP3X1-A5 models (Ex d – flameproof enclosure type of protection) are available only with non-intrinsically safe transmitters (non-Ex variants of TTH200 and TTH300).

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.

⚠ WARNING

Explosion hazard

- When used without a thermowell, particularly surface sensors with exposed mineral insulated cable, operation in Zone 0 is not permitted.

The maximum values for electric data for the measurement current circuit may not be up-scaled. See **Ex - d flameproof enclosure type of protection** at **Type of protection Ex d - flameproof (enclosure)** on page 10.

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

… Electrical connections

Dust explosion protection | flameproof enclosure (model TSA101-B5, TSP3X1-B5)
ATEX II 1 D Ex ta IIIC T133°C … T400°C Da or ATEX II 1/2 D Ex ta/tb IIIC T133°C … T400°C Da/Db
and
ATEX II 1/2 G Ex db IIC T6/T4 Ga/Gb, Zone 20, 21, 22 and 1, 2

The 'B5' coding combines 'Dust explosion protection' (TSA101-A3, TSP3X1-A3) and 'Flameproof enclosure' (TSA101-A5, TSP3X1-A5) types of protection.
Chapters **Dust explosion protection (model TSA101-A3, TSP3X1-A3)** on page 24 and **Flameproof enclosure (models TSA101-A5, TSP3X1-A5)** on page 25 must be applied in respect of this.

Devices with several types of protection may only be operated in one of the possible types of protection. For this purpose, observe the 'Product Identification' chapter in the operating or commissioning instruction before commissioning.

Dust explosion protection | flameproof enclosure (model TSA101-D8, TSP3X1-D8)
ATEX II 2 D Ex tb IIIC T133°C … T400°C Db
and
ATEX II 1/2 G Ex db IIC T6/T4 Ga/Gb, Zone 21, 22 and 1, 2

The 'D8' coding combines the 'Dust explosion protection' (TSA101-D5, TSP3X1-D5) and 'Flameproof enclosure' (TSA101-A5, TSP3X1-A5) types of protection.
Chapters **Dust explosion protection (models TSA101-D5, TSP3X1-D5)** on page 24 and **Flameproof enclosure (models TSA101-A5, TSP3X1-A5)** on page 25 must be applied in respect of this.

Devices with several types of protection may only be operated in one of the possible types of protection. For this purpose, observe the 'Product Identification' chapter in the operating or commissioning instruction before commissioning.

Non-sparking and increased safety as well as dust explosion protection (model TSA101-B1, TSPXX1-B1), Zone 2 and Zone 22
ATEX II 3 G Ex nA IIC T6…T1 Gc
ATEX II 3 G Ex ec IIC T6…T1 Gc
ATEX II 3 D Ex tc IIIB T133°C Dc

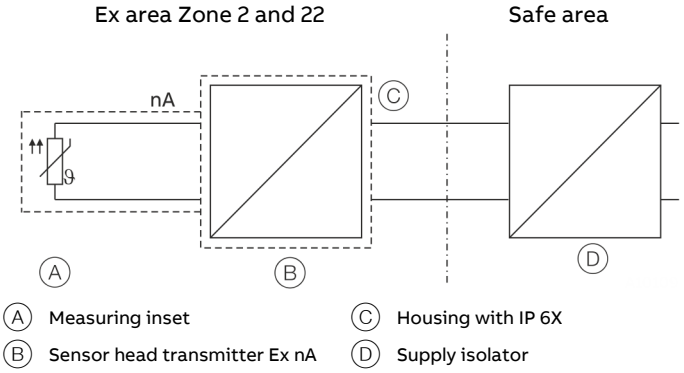


Figure 18: Interconnection

External measures must be made for the power supply circuit in order to prevent the rated voltage from being up-scaled by more than 40 % in the event of transient disturbances.

Use in explosive hybrid mixtures, where explosive dusts and gases are present simultaneously, is not currently permitted in accordance with EN 60079-0 and EN 60079-31.

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.

⚠ WARNING

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 Product identification

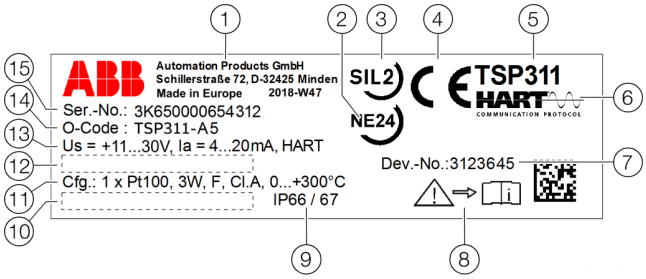
Name plate

Note

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

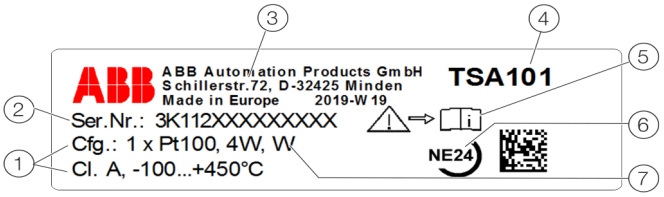
Note

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. NE24 conformity (optional)
3. SIL 2, Logo only for combination with an integarted TTHx00 HART transmitter.
4. CE mark (EU conformity), if not on additional plate
5. Type designation / model
6. With integrated transmitter: communications protocol of the transmitter (HART®, FF, PA)
7. 7-digit serial number of the transmitter device electronic unit
8. Note: Observe product documentation
9. IP rating of housing
10. Medium temperature range (process temperature) T_{med}, for Ex versions on additional plate
11. Sensor type and circuit type, accuracy class, set measuring range of the transmitter
12. Ambient temperature range $T_{amb.}$ (temperature on connection head), for Ex versions on additional plate
13. Transmitter specification
14. Coding of the type of protection of the device (in accordance with ordering information)
15. Serial number of the device (serial number in accordance with order)

Figure 19: TSP1x1, TSP3x1 name plate (example)



1. Sensor configuration
2. Serial number of the device (serial number in accordance with order)
3. Manufacturer address, year / week of manufacture
4. Type designation / model
5. Note: Observe the information in the product documentation
6. NE 24 conformity (optional)
7. Type of measurement resistor: F = SMW, W = DMW

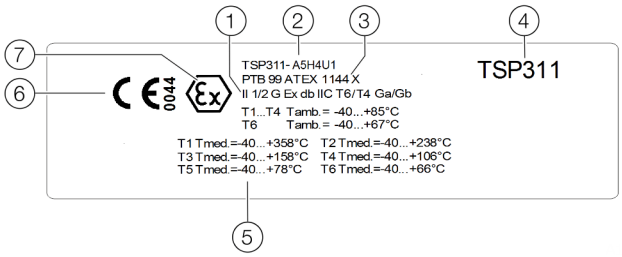
Figure 20: TSA101 name plate (example)

Explosion protection marking for devices with one type of protection

Devices with an explosion-proof design are marked with the following additional plates.

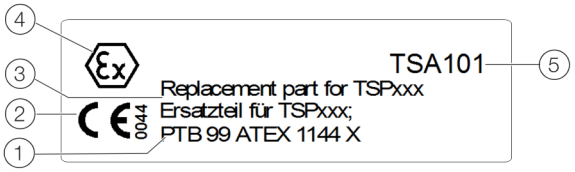
Note

- 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 ATEX or IECEx applies.



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

Figure 21: Additional plate TSP1x1, TSP3x1 (example)



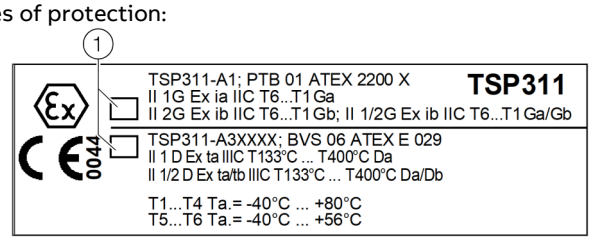
1. Approval number
2. CE-mark (EU-conformity) and notified body for quality assurance
3. Note: Measuring inset only for installation in SensyTemp TSP1x1, TSP3x1 temperature sensors
4. Ex-marking
5. Type designation

Figure 22: TSA101 additional plate (example)

Explosion protection marking for devices with several types of protection

Coding of the type of protection of the device in accordance with ordering information can also refer to different explosion approvals for various types of protection.
The 'intrinsic safety', 'flameproof (enclosure)' and 'dust explosion protection' types of protection can be possible for one device.

The following figure shows an example of explosion protection marking for the 'dust explosion protection' and 'intrinsic safety' types of protection:



1. Checkboxes for marking type of protection

Figure 23: Example for several types of protection: 'dust explosion protection' and 'intrinsic safety', type of protection coding: A4

Measures required before the use of devices with several types of protection

NOTE

Note for temperature sensors with several types of protection

Before the temperature sensor is installed, the selected type of protection must be indelibly marked on the explosion protection certification plate.
The temperature sensor can then only be operated with this type of protection throughout its entire service life.

- If two protection types are indelibly marked on the explosion protection certification plate, the transmitter must not be used in areas categorized as hazardous.

Devices with several types of protection may only be operated in one of the possible types of protection.
Before commissioning, users must decide on one of these types of protection and their corresponding approval.

- The 'A4' coding enables the 'Dust explosion protection' (up to Zone 20), type 'TSP3X1-A3' and 'intrinsic safety', type 'TSP3X1-A1' types of protection.
- The 'B5' coding enables the 'Dust explosion protection' (up to Zone 20), type 'TSP3X1-A3' and 'flameproof (enclosure)', type 'TSP3X1-A5' types of protection.
- The 'D6' coding enables the 'Dust explosion protection' (up to Zone 21), type 'TSP3X1-D5' and 'intrinsic safety', type 'TSP3X1-A1' types of protection.
- The 'D8' coding enables the 'Dust explosion protection' (up to Zone 21), type 'TSP3X1-D5' and 'flameproof (enclosure)', type 'TSP3X1-A5' types of protection.

Use in explosive hybrid mixtures (where explosive dusts and gases are present simultaneously) is not currently permitted in accordance with EN 60079-0 and EN 60079-31.

The additional plate has two checkboxes (see Figure 23) for marking.
It is absolutely necessary to mark one of the checkboxes on the left side indelibly in accordance with the selected type of protection of the application. This has to be done before the TSP3X1 is commissioned in the application.

The marking must be applied in a permanent and indelible manner, for example by using a caustic or acidic pencil or by stamping the marking on a metallic plate.

Unmarked devices must **NOT** be commissioned.

The TSA101 measuring insets as well can then only be operated with the once selected type of protection throughout their entire service life

4 Functional safety (SIL)

General

The Temperature sensors SensyTemp TSP with factory installed SIL-certified transmitters are available with conformity in accordance with IEC 61508 for use in safety relevant applications up to SIL 3 (redundant).
While using the transmitter, the device fulfills the requirements in accordance with SIL 2.
In the use of redundant handled transmitters, the requirements can be fulfilled in accordance with SIL 3.

When calculating the safety integrity level (SIL) of a combination of Temperature sensors SensyTemp TSP with a transmitter that is not factory-installed, the following instructions must be observed:

Failure rates of temperature sensors

The failure rates of the temperature sensor are included in the calculation of the safety integrity level (SIL) of a thermometer with temperature transmitter and sensor in a safety-related application in accordance with IEC 61508.
The typical failure rates of the temperature sensors listed below have been taken from referenced literature.
They are distinguished by fault type (break, short-circuit, drift), vibration requirements at the installation location (low stress / high stress) and type of connection between the measuring point and temperature transmitter (close coupled / extension wire).

Typical failure rates

Temperature sensor	Fault type	low stress close coupled	high stress close coupled	low stress extension wire	high stress extension wire
Thermocouple	Wire break	95 FIT	1900 FIT	900 FIT	18000 FIT
	Short circuit	4 FIT	80 FIT	50 FIT	1000 FIT
	Drift	1 FIT	20 FIT	50 FIT	1000 FIT
Four-wire resistance thermometer	Wire break	41.5 FIT	830 FIT	410 FIT	8200 FIT
	Short circuit	2.5 FIT	50 FIT	20 FIT	400 FIT
	Drift	6 FIT	120 FIT	70 FIT	1400 FIT
Two-wire / three-wire resistance thermometer	Wire break	37.92 FIT	758.5 FIT	370.5 FIT	7410 FIT
	Short circuit	1.44 FIT	28.8 FIT	9.5 FIT	190 FIT
	Drift	8.64 FIT	172.8 FIT	95 FIT	1900 FIT

Source: Exida: Safety Equipment Reliability Handbook - 3rd Edition, 2012, exida.com L.L.C.

Note: 1 FIT is 1 failure per 10^9 hours.

Information on the functional safety of the TTx300 and TTx200 temperature transmitters can be found in the corresponding SIL-Safety Manual.

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.

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

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

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 Fehler! Kein gültiges Resultat für Tabelle. 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.

General information

- The temperature sensors (thermocouple, resistance thermometer) must be brought into maximum contact with the medium to be measured.
- 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.
- The correct polarity must be ensured in the case of thermocouples.
- In the case of resistance thermometers, take note of whether a two-, three-, or four-wire circuit type is being used.
- When installing temperature sensors in existing thermowells, make sure that the measuring inset can be inserted easily. If this is not the case, the inside of the thermowell will need to be cleaned.
- The temperature sensor must be firmly and securely installed in a way that conforms to the requirements of the application process.
- Please take note of the sensor and circuit type specified.
- After clamping the connection leads using a suited tool (screwdriver, wrench), you must make sure that the connection heads are securely closed and sealed again. When doing this, make sure that the sealing rings of the connection heads are clean and undamaged.

… 6 Installation

Cable glands

SensyTemp TSP1X1 and TSP3X1 temperature sensors are supplied with a M20 × 1.5 cable gland.
The standard supplied plastic (polyamide) cable gland for cable outer diameters of 4 to 13 mm (0.16 to 0.51 in.) covers a temperature range of −40 to 70 °C (−40 to 158 °F). For differing temperatures, an appropriately specified cable gland must be installed.
The metal cable gland (nickel-plated brass) used for Ex d (flameproof enclosure, only for TSP3X1) as standard for cable outer diameters of 3.2 to 8.7 mm (0.13 to 0.34 inch) covers a temperature range of −40 to 120 °C (−40 to 248 °F).

Approved cable glands are used as appropriate for temperature sensors with Ex certification. If used correctly, these cable glands can help achieve an IP rating of at least IP 66 in the case of TSP1X1 or IP 66 / 67 in the case of SensyTemp TSP3X1.

Note
In the case of devices for use in potentially explosive atmospheres, observe the information in **Devices in ‘Ex d’ type of protection with cable gland** on page 14and **Plastic cable glands M20 × 1.5 for ‘Ex i’ (blue) and ‘dust ignition protection’ (black) types 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 suited measures to make sure 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 the 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 guaranteed. The operating temperature range of the cable gland used must not be up-scaled.
The Ex relevant specification of the cable gland used must be checked using the manufacturer data sheet or Ex declaration. Also observe the tightening torque in accordance with information in the data sheet / operating instruction for the cable gland used.

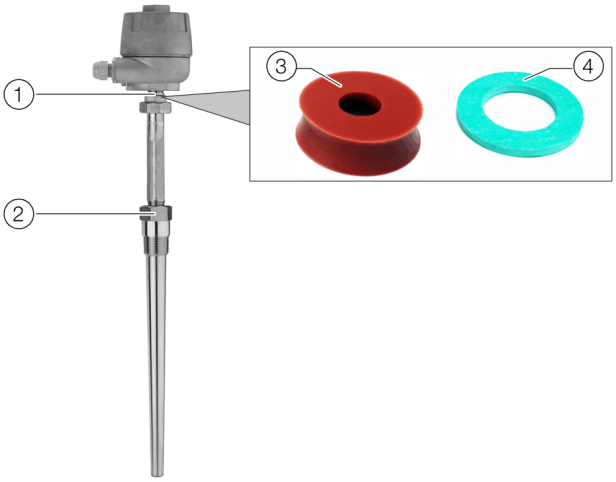
With this option it is also necessary to make sure that the measures taken satisfy the ex relevant requirements and standards as well as the approvals for the relevant temperature sensors (e.g. PTB 99 ATEX 1144 X for Ex d).
In practice, you may find the specified IP rating can no longer be achieved if 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
If the ambient temperature at the cable entries of the unit is more than 70 °C (158 °F), temperature resistant leads must be used accordingly.

Tightening torque during mounting

To simplify final mounting, the SensyTemp TSP100 and TSP300 temperature sensors are delivered with thermowells, extension tubes and connection heads which are only tightened by hand. For trouble-free operation of the temperature sensor, these components need to be screwed to each other before the first commissioning by applying the tightening torque recommended below.



1. Screwed connection on the connection head
2. Screwed connection between the thermowell and the extension tube (only with drilled thermowells)
3. Silicon profile gasket
4. Flat gasket

Figure 24: Screwed connections and gasket types in temperature sensors

Note

The maximum temperature at the joint of the extension tube and thermowell must not up-scale 300 °C (572 °F) when using a copper gasket.

Screwed connection on the connection head

		Recommended tightening torque	
Connection thread	**Seal**	**Metal connection head**	**Plastic connection head**
½ in NPT	—	35 Nm	10 Nm
M24 x 1.5	Flat gasket	35 Nm	10 Nm
	Silicon profile gasket	10 Nm	10 Nm

Table 1: Tightening torque for the screwed connection on the connection head

Screwed connection between the thermowell and the extension tube

- In extension tubes with thermowell connection M14 × 1.5 and G⅜ A (G⅜ in), the recommended tightening torque is 50 Nm.
- For all other extension tube types, the recommended tightening torque is 70 Nm.

⚠ WARNING

Loss of Ex protection!

Loss of Ex protection due to incorrect tightening torques at the screwed connections on the connection head and between the thermowell and extension tube.

- Observe the specified tightening torques!

… 6 Installation

Maintaining the IP rating with TSP111 / TSP311

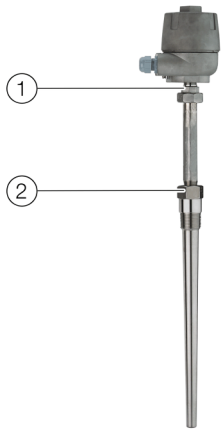
The SensyTemp TSP111, TSP311 and TSP311-W temperature sensors are designed for installation in an existing thermowell. Functional safety and preservation of the IP rating is only possible with an additional thermowell!

⚠ CAUTION

Achievement of the IP 66 IP rating with TSP111 or IP 66 / IP 67 with TSP311 is only guaranteed if suited measures are taken, including the use of a thermowell.

When using the temperature sensors without thermowell, the user must take appropriate measures to make sure that the specified IP rating at the connection point has not been affected:

- at the connection point on the connection head (1),
- or in the case of sensors with an extension tube at the connection point between the extension tube and the provided thermowell (2).



(1) Connection point on the connection head
(2) Connection point on the extension tube

Figure 25: TSP331 temperature sensor (example)

Installation instructions

The usual way of ensuring that thermal measurements are accurate is to comply with the minimum insertion depth of the temperature sensor. Ideally, the sensor on a thermometer should be located in the center of the pipe.

Recommended installation length
To avoid heat dissipation errors.

Medium	Installation length
Fluids	8 to 10 × Ø thermowell tip
Gases	10 to 15 × Ø thermowell tip

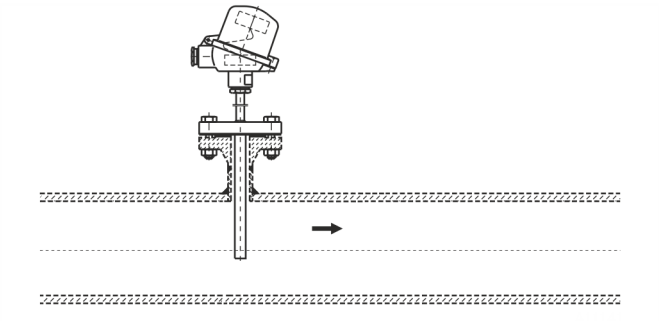


Figure 26: Recommended installation length

Insufficient nominal diameter

In the case of pipelines with very small nominal diameters, insertion inside an elbow pipe is recommended. The temperature sensor is set in opposition to the flow direction of the medium. Inserting the temperature sensor with an adapter at an angle of < 45°against the flow direction can also distort measurement results.

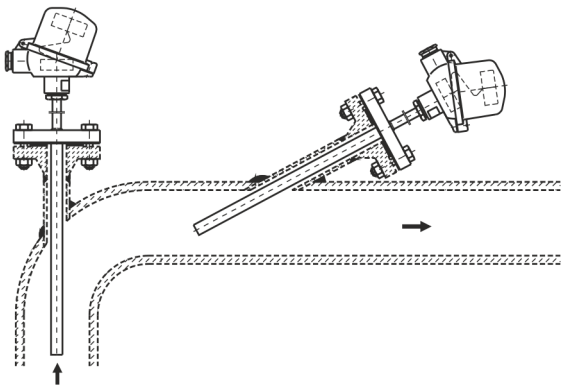


Figure 27: Insufficient nominal diameter

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.

General

The following applies to devices with a transmitter:
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.
- When using PROFIBUS PA®, the design must be in accordance with EN 50170 for PROFIBUS PA®.
- When using FOUNDATION Fieldbus® H1, the design must be in accordance with IEC 61158.
- The user is responsible for ensuring EMC-compliant cabling.

… 6 Installation

… Electrical connections

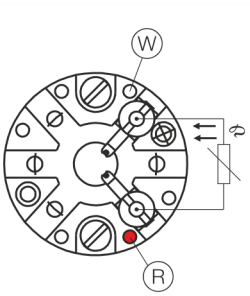
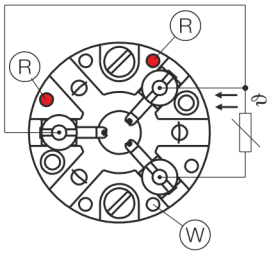
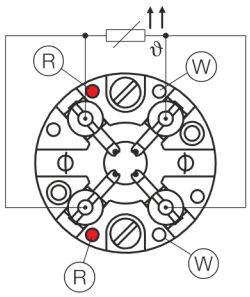
Electrical connections

Note

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

Electrical connections and color coding of resistance thermometers in accordance with IEC 60751

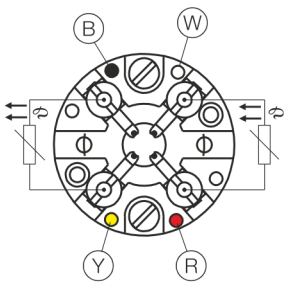
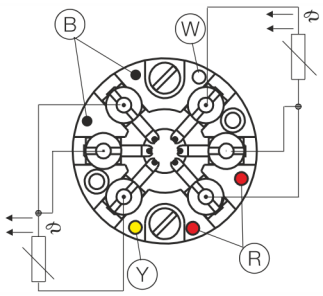
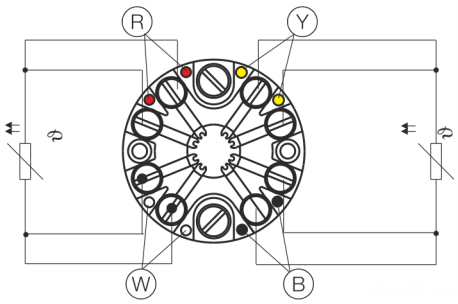
Single sensor

Two-wire circuit	Three-wire circuit	Four-wire circuit
		

(R) Red (W) White

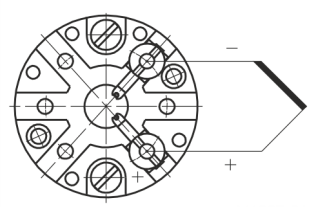
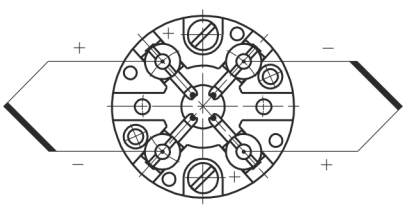
Electrical connections and color coding of resistance thermometers in accordance with IEC 60751

Double sensor

Two-wire circuit	Three-wire circuit	Four-wire circuit
		

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

Electrical connections of thermocouples in accordance with IEC 60584

Single sensor	Double sensor
	

Harting plug connection in connection head

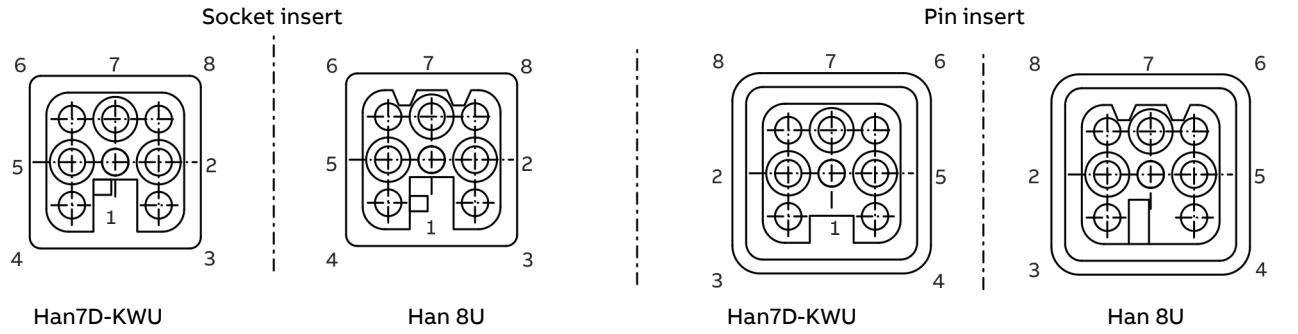


Figure 28: External view in each case

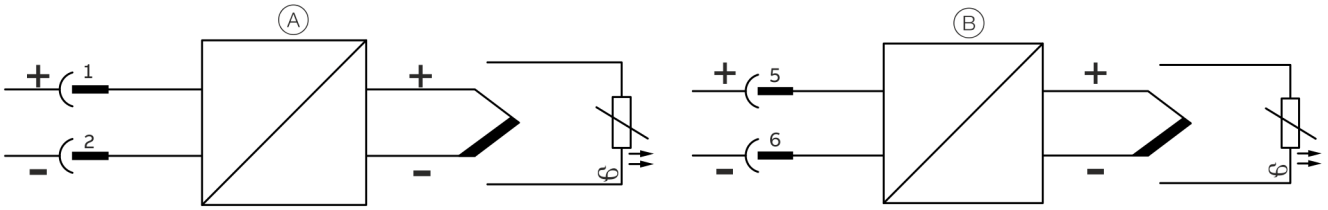


Figure 29: With one or two transmitters in connection head

Ⓐ One transmitter

Ⓑ Second transmitter

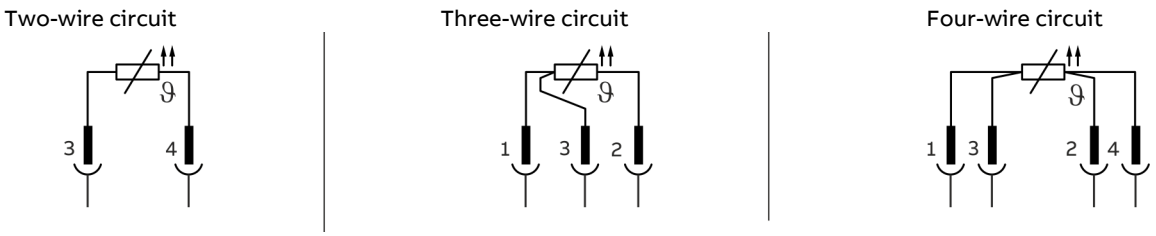


Figure 30: Resistance thermometer as single sensor

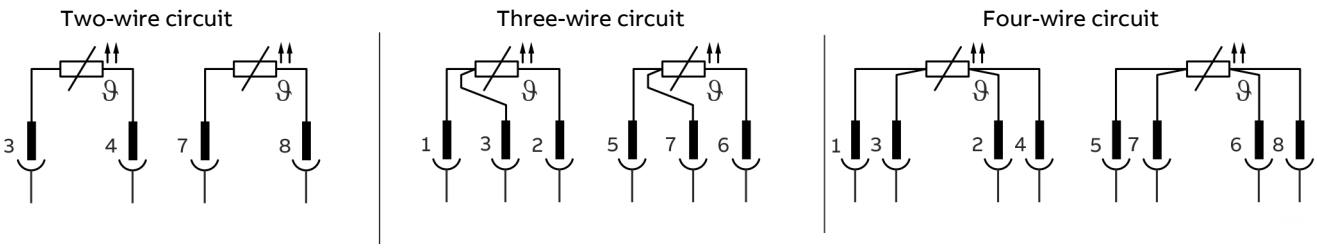


Figure 31: Resistance thermometer as double sensor

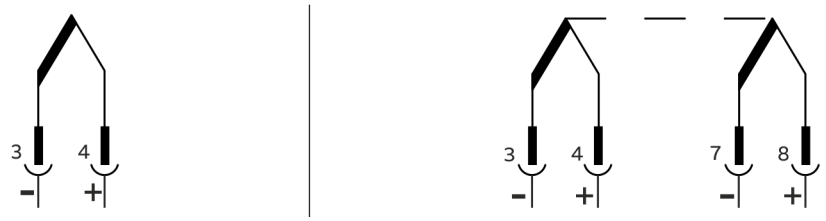


Figure 32: Thermocouple as single sensor or double sensor

… 6 Installation

… Electrical connections

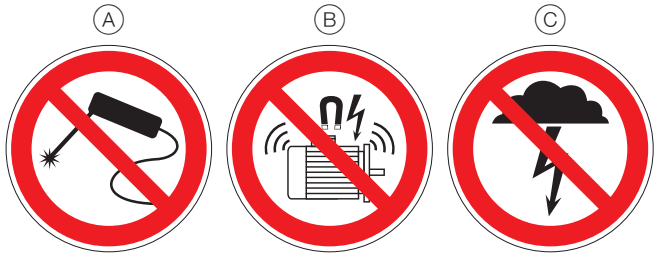
Protection of the optional transmitter from damage caused by highly energetic electric interferences

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 33: 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

Safety instructions for operation

Before switching on the device, make sure that your installation complies with the environmental conditions listed in the chapter “Technical Data” or on the data sheet.
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

In the case of a corresponding order, the device is ready for operation after mounting and installing the connections.
The parameters of the optional integrated transmitter are preset at the factory. These default settings can be changed at any time through HART, FF or PA communication (DTM, EDD, FIM, optional display with operating buttons).

For additional information on the TTH300 (TTH200) transmitter, refer to the CI/TTH300 (CI/TTH200) commissioning instruction, OI/TTH300 (OI/TTH200) operating instruction, as well as the DS/TTH300 (DS/TTH200) data sheet.

Checks prior to commissioning

The following points must be checked before commissioning the device:

- The proper mounting and sealing of thermowells or protective sleeves. This especially applies when used as a separating element for Zone 0.
- The electrical connection and mounting must be performed in accordance with **Installation** on page 31 and **Electrical connections** on page 35.
- The connected lines must be checked for firm seating. Only firmly seated lines ensure full functionality.
- Potential equalization must be connected.
- 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 must be maintained.

8 Operation

Safety instructions

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

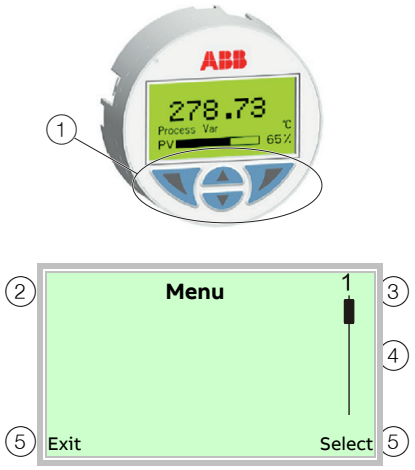
⚠ CAUTION

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.

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 34: LCD indicator (example)

Operating button functions

You can use the ▲ or ▼ operating buttons to browse through the menu or select a number or character within a parameter value.

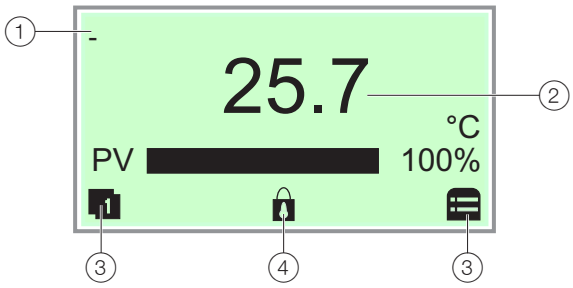
Different functions can be assigned to the ◥ and ◢ operating buttons. The function (5) that is currently assigned to them is shown on the LCD display.

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

Process display



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

Figure 35: 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. 3.00, two process variables can also be optionally displayed: one is displayed on top of the other.

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

Menu structure and diagnostic messages

The parameters are structured in the form of a menu. The menu consists of a maximum of three levels.
For detailed information on the menu structure, a description of the parameters and a list of possible diagnostic messages, please consult the operating instructions for the transmitter.

Setting the language

The language is set to German by default in the equipment's as-delivered state. To change it to English, proceed as follows:

1. Press the operating button to call up the configuration menu.
2. Use either the or operating button to scroll to the ‘Display’ submenu.
3. Press the operating button to call up the ‘Display’ submenu.
4. Use either the or operating button to scroll to the ‘Language’ submenu.
5. Press the operating button to call up the ‘Language’ submenu.
6. Press the operating button to switch to Edit mode and use either the or operating button to navigate to ‘English’.
7. Press the operating button to switch to the language setting for English.
8. Press the operating button three times to navigate back to the display.

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.

Note
For detailed information on the maintenance of the device, consult the associated operating instructions (OI)!

10 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 31.

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.

11 Specification

Note

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

12 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.

Trademarks

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

PROFIBUS and PROFIBUS PA are registered trademarks of PROFIBUS & PROFINET International (PI)

FOUNDATION Fieldbus is a registered trademark of FieldComm Group, Austin, Texas, USA.

13 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

ABB Measurement & Analytics

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

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

3KXT161001R4401

CI/TSP-EN Rev. E 03.2021