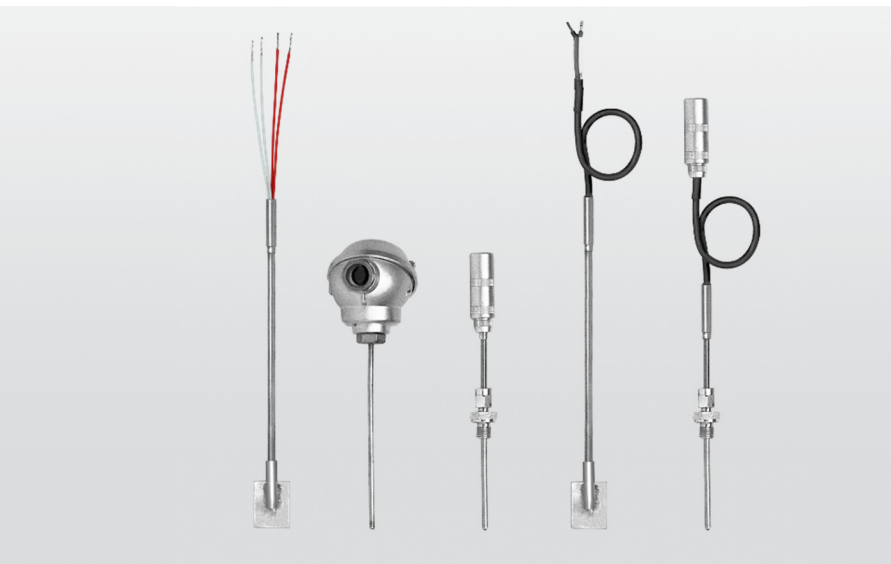


ABB MEASUREMENT & ANALYTICS | OPERATING INSTRUCTION | OI/TSC400-EN REV. B

# SensyTemp TSC400

## Industrial thermometer



**Measurement made easy**

### **Additional Information**

Additional documentation on SensyTemp TSC400 is available for download free of charge at [www.abb.com/temperature](http://www.abb.com/temperature). Alternatively simply scan this code:



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# 1 Safety

## General information and instructions

These instructions are an important part of the product and must be retained for future reference.

Installation, commissioning, and maintenance of the product may only be performed by trained specialist personnel who have been authorized by the plant operator accordingly. The specialist personnel must have read and understood the manual and must comply with its instructions.

For additional information or if specific problems occur that are not discussed in these instructions, contact the manufacturer.

The content of these instructions is neither part of nor an amendment to any previous or existing agreement, promise or legal relationship.

Modifications and repairs to the product may only be performed if expressly permitted by these instructions.

Information and symbols on the product must be observed.

These may not be removed and must be fully legible at all times.

The operating company must strictly observe the applicable national regulations relating to the installation, function testing, repair and maintenance of electrical products.

## Warnings

The warnings in these instructions are structured as follows:

### **DANGER**

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

### **WARNING**

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

### **CAUTION**

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

### **NOTICE**

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

### **Note**

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

## ... 1 Safety

### Intended use

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.

## Warranty provisions

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

## Manufacturer's address

### **ABB Automation Products GmbH Measurement & Analytics**

Schillerstr. 72

32425 Minden

Germany

Tel: +49 571 830-0

Fax: +49 571 830-1806

### **Customer service center**

Tel: +49 180 5 222 580

Email: [automation.service@de.abb.com](mailto:automation.service@de.abb.com)

## 2 Use in potentially explosive atmospheres

### 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.

### Intrinsic safety type of protection approvals (Ex i)

The SensyTemp TSC400 temperature sensors are equipped with the following approvals.

ATEX approvals are valid throughout the EU and in Switzerland, IECEx approvals are recognized internationally.

The device has the following approvals (examination certificates):

- ATEX Ex i, PTB 01 ATEX 2200 X
- IECEx Ex i, IECEx PTB 11.0111 X

A list of applied standards including the output data with which the device is in conformity can be found in the (EC type) examination certificate.

Industrial thermometers that conform to the requirements of both the type examination certificate for ATEX 'Ex i' and NAMUR-specification NE24, are available on request.

### Electrical data

All of the values listed below are valid assuming that an additional transmitter has been connected.

The following electric values must not be up-scaled:

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

$P_i$  (internal power) = max. 0.5 W

$L_i$  (internal inductance) = 15  $\mu$ H/m

$C_i$  (internal capacitance) = 280 pF/m

#### Note

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  $I_i \geq I_o$ .

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.

#### Output power $P_o$ with ABB transmitters

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

\* as of HW-Rev. 1.12, previously  $P_o \leq 38$  mW

\*\* as of HW-Rev. 2.00, previously  $P_o \leq 38$  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.).

#### Note

Temperature sensors for use in Zone 0 may only contain an intrinsically safe circuit and may only be connected to declared intrinsically safe circuits with type of protection "Ex ia".

## Temperature data

### Thermal resistance

The thermal resistances for mineral insulated cables are listed in the following table.

The values are specified under 'gas with a flow velocity of 0 m/s' conditions.

Thermal resistance $R_{th}$	Diameter of the mineral insulated cable	
	< 6 mm (0.24 in)	≥ 6 mm (0.24 in)
Resistance thermometer	200 K/W	84 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  $\Delta t$  as appropriate for the applied power. This temperature rise  $\Delta t$  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  $\Delta t$  can be calculated using the following formula:

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

$\Delta t$  Temperature rise

$R_{th}$  Thermal resistance

$P_o$  Output power of an additional connected transmitter

### Example:

Resistance thermometer diameter 3 mm (0.12 in):

$R_{th} = 200 \text{ K/W}$

Temperature transmitter TTxx00  $P_o = 38 \text{ mW}$ , see also **Output power  $P_o$  with ABB transmitters** on page 6.

$\Delta t = 200 \text{ K/W} \times 0.038 \text{ W} = 7.6 \text{ K}$

Therefore, at transmitter output power  $P_o = 38 \text{ mW}$ , the temperature rise in the event of a fault is approximately 8 K. This results in the following maximum possible process temperatures  $T_{medium}$ , as shown in Table **Maximum process temperature  $T_{medium}$  in Zone 0 and Zone 1** on page 7.

### Note

For a higher output power  $P_o$  as 38 mW in case of failure, but also for a generally higher output power of a connected transmitter as 38 mW, the temperature increase  $\Delta t$  must be recalculated.

### 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 **Temperature rise in the event of a fault** on page 7.

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)

... 2 Use in potentially explosive atmospheres

Mounting

Obligations of the owner

The installation, commissioning, maintenance and repair of devices in potentially explosive atmospheres must only be carried out by appropriately trained personnel. Works may be carried out only by persons, whose training has included instructions on different types of protection and installation techniques, concerned rules and regulations as well as general principles of zoning.

The person must possess the appropriate competences for the type of work to be conducted.

The safety instructions for electrical apparatus in potentially explosive areas must be in accordance with Directive 2014/34/EU (ATEX) and IEC 60079-14 (Installation of electrical equipment in potentially explosive areas).

Comply with the applicable regulations for the protection of employees to ensure safe operation.

General

When installing the temperature sensor, observe the following points:

- Avoid impermissible increases in the ambient temperature by making sure that equipment is at a sufficient distance from system components with excessively high temperatures.
- Heat dissipation by means of unrestricted air circulation must be guaranteed.
- You must avoid up-scaling the maximum permissible ambient temperature as per the approved temperature class.
- Compliance with the Ex temperature classes must be guaranteed through suited measures.

Note

- 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 included in the potential equalization.

Installation instructions

Type of protection intrinsic safety up to Zone 0

Ex marking	Model
Zone 0, 1, 2	TSC4x0-A1
ATEX II 1 G Ex ia IIC T6...T1 Ga	

When implementing in Zone 0, the use of aluminum connection heads is not permitted. Moreover, no additional specific information needs to be observed for mechanical installation.

Type of protection intrinsic safety up to Zone 1

Ex marking	Model
Zones 1, 2	TSC4x0-A2
ATEX II 2 G Ex ib IIC T6...T1 Gb	

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



## Electrical connections

### Grounding

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

For reinforced connection cables, the mineral insulated cable of the temperature sensor must be connected with the potential equalization of the installation

### 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)
	$U_i \geq U_o$
	$I_i \geq I_o$
	$P_i \geq P_o$
	$L_i + L_c \text{ (cable)} \leq L_o$
	$C_i + C_c \text{ (cable)} \leq C_o$

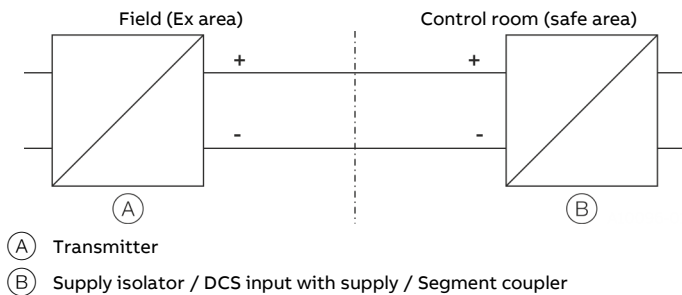


Figure 1: Intrinsic safety installation check

### Electrical connection notice

Only certified transmitters with the maximum values specified in the operating instruction may be connected to the temperature sensors.

Observe the following points when connecting to the temperature transmitter:

- If two transmitters are used for two intrinsically safe circuits, the sum of the values may not up-scale the maximum values specified in the operating instruction.
- The temperature sensor must feature appropriate input protection circuits 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.

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.

## ... 2 Use in potentially explosive atmospheres

### ... Electrical connections

Type of protection intrinsic safety up to Zone 0

Ex marking	Model
Zone 0, 1, 2	TSC4x0-A1
ATEX II 1 G Ex ia IIC T6...T1 Ga	

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 two sensor elements to be connected, as 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.

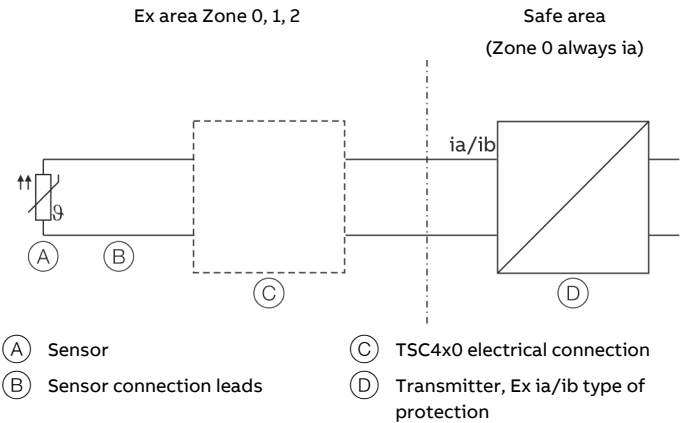


Figure 2: Interconnection

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

Type of protection intrinsic safety up to Zone 1

Ex marking	Model
Zones 1, 2	TSC4x0-A2
ATEX II 2 G Ex ib IIC T6...T1 Gb	

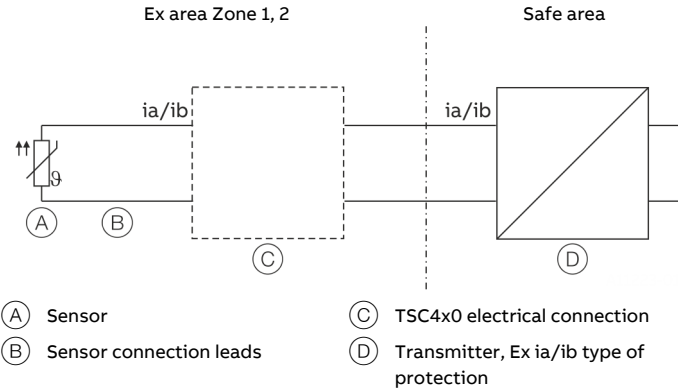


Figure 3: Interconnection

### 3 Functional safety (SIL)

The following notes should be observed to calculate the safety integrity level (SIL) of the combination of a temperature sensor SensyTemp TSC400 with an SIL-certified transmitter – e.g. The ABB TTFx00 temperature transmitter for field installation.

#### 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	high stress	low stress	high stress
		close coupled	close coupled	extension wire	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<sup>9</sup> hours.

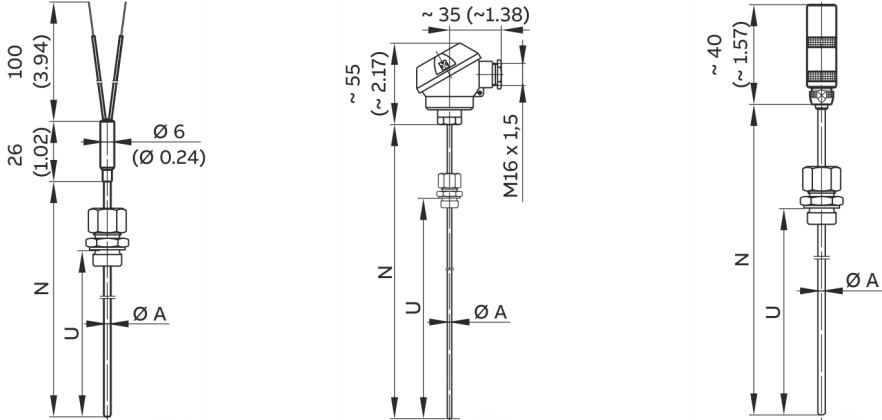
Information on the functional safety of the TTx300 and TTx200 temperature transmitters can be found in the corresponding SIL-Safety Manual.

4 General description

Type TSC420, with direct electrical connection

Dimensions in mm (in)

U = Installation length  
N = Nominal length  
ØA = Diameter of the mineral insulated cable

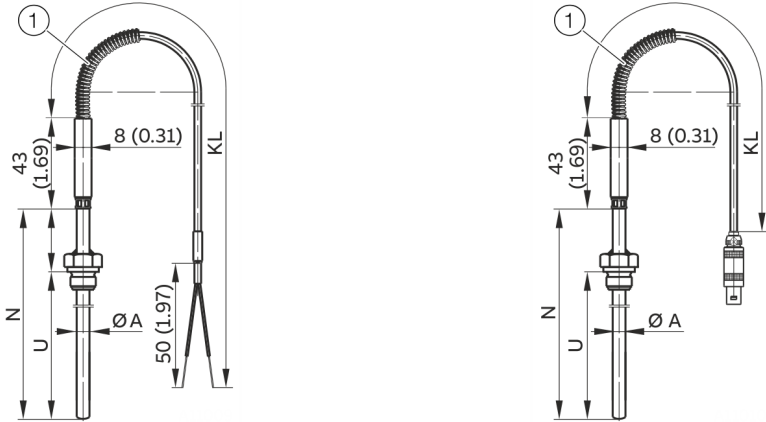


Electrical connection	Single and double thermocouples		
	Single Pt100 / 2-, 3-, or 4-wire		
Design	Double Pt100 / 2-, 3-, or 4-wire	Double Pt100 / 2-wire	Double Pt100 / 2- or 3-wire
	Bendable mineral insulated cable with sealing sleeve	Open cable ends, standard 100 mm (3.94 in) or customer-specific	Form F connecting head
			Plug, socket

Type TSC430, with connection cable

Dimensions in mm (in)

U = Installation length  
N = Nominal length  
KL = Cable length  
ØA = Diameter of the mineral insulated cable



Electrical connection	Single and double thermocouples	
	Single Pt100 / 2-, 3-, or 4-wire	
Design	Double Pt100 / 2-, 3-, or 4-wire	Double Pt100 / 2- or 3-wire
	Bendable mineral insulated cable with sealing sleeve and optional anti-kink spring (1)	Open cable ends
		Plug, socket

Selectable process connections

- Without process connection
- With fixed connection (please specify nominal length ‘N’ and installation length ‘U’)
- With movable connection (please specify nominal length ‘N’ only)
- With weld-on plate 25 x 25 x 3 mm (0.98 x 0.98 x 0.12 in) or 35 x 25 x 3 mm (1.38 x 0.98 x 0.12 in) for surface measurement
- With molded part for tension clip mounting
- Temperature sensor for use with or without thermowell

## 5 Product identification

### Name plate

#### Note

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

#### Note

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

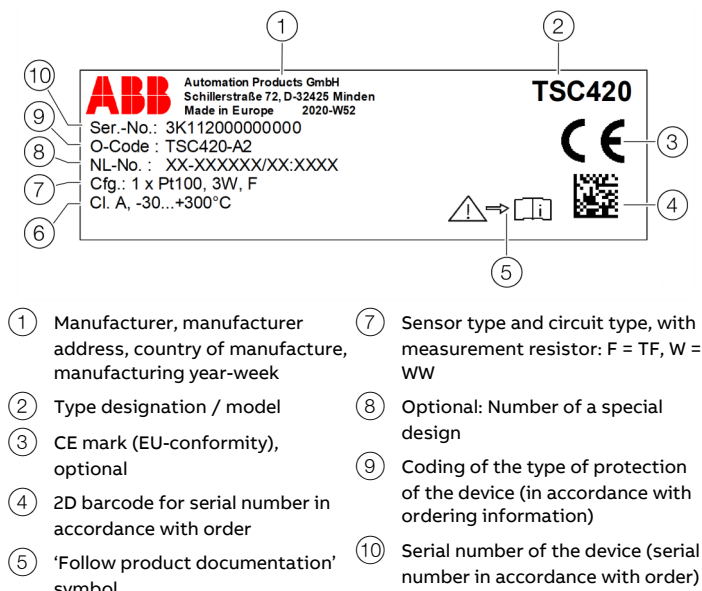


Figure 4: Name plate TSC420 (example)

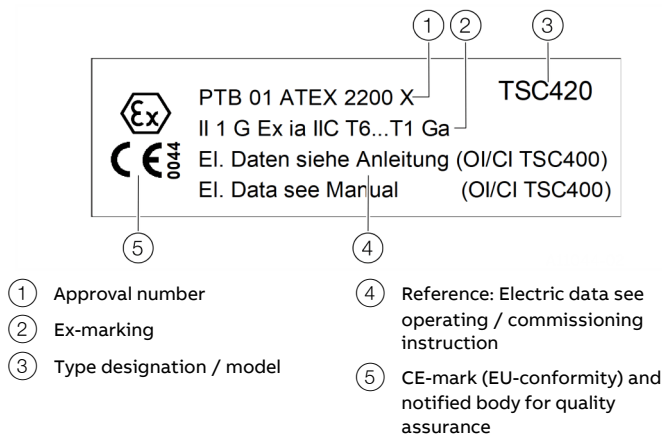


Figure 5: Additional plate TSC420 (example)

## 6 Transport and storage

### Inspection

Check the devices immediately after unpacking for possible damage that may have occurred from improper transport. Details of any damage that has occurred in transit must be recorded on the transport documents.

All claims for damages must be submitted to the shipper without delay and before installation.

### Transporting the device

Observe the following instructions:

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

### Storing the device

Bear the following points in mind when storing devices:

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

### Ambient conditions

The ambient conditions for the transport and storage of the device correspond to the ambient conditions for operation of the device.

Adhere to the device data sheet!

### Returning devices

For the return of devices, follow the instructions in **Maintenance / Repair** on page 23.

## 7 Installation

### General information

#### Note

When using the device in potentially explosive atmospheres, note the additional temperature data in **Use in potentially explosive atmospheres** on page 6!

- 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.

### Cable glands

SensyTemp TSC420 temperature sensors are supplied with a M16 x 1.5 cable gland.

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 54 for the SensyTemp TSC420.

Alternatively, the temperature sensors are available without a cable gland, but with a M16 x 1.5 thread. In this case, the user must take suited measures to make sure that the required IP rating is achieved.

With this option it is also necessary to ensure that the measures taken satisfy the Ex relevant specifications and standards, and approvals for the relevant temperature sensors (e.g. Ex-certificate PTB 01 ATEX 2200 X for Ex ia type of protection). 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 of the cable glands 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.

## Installation instructions

The usual way of ensuring that thermal measurements are accurate is to comply with the minimum installation length of the temperature sensor. Ideally, in the case of pipelines, the sensor on a thermometer should be located in the center of the pipe. If this is not possible, both in the case of pipes and containers, a minimum installation length of 10- to 15-times the temperature sensor diameter is assumed to be sufficient.

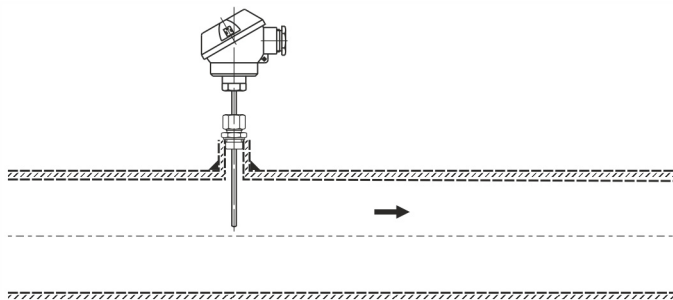


Figure 6: Recommended installation

## Insufficient nominal diameter

In the case of pipelines with very small nominal diameters, installation inside an elbow pipe is recommended. The temperature sensor tip is set in opposition to the flow direction of the measuring medium. Also installing the temperature sensor with an adapter at an acute angle against the flow direction can also distort measurement results.

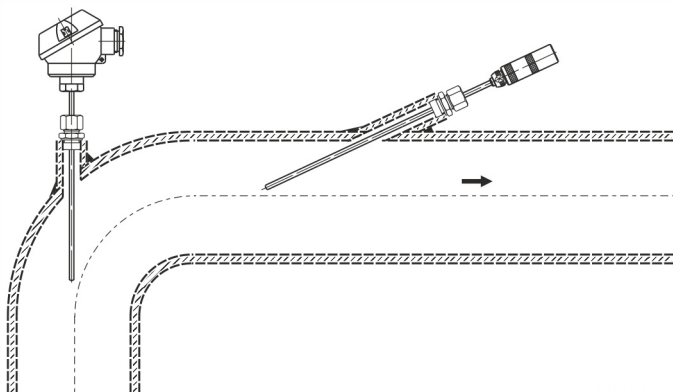


Figure 7: Installation with small nominal diameter

## Permissible ambient temperature at the closure of the mineral insulated cable

Design	Ambient temperature
Standard	-40 to 120 °C (-40 to 248 °F)
Optional	-56 to 200 °C (-68.8 to 392 °F)

In type TSC430, the temperature limits of the connection cables used should also be considered. See **Connection cable for the resistance thermometer** on page 19 and **Connection cables for thermocouples** on page 21.

## ... 7 Installation

### Process connections for surface thermometers

#### NOTICE

##### Damage to the temperature sensor by the welding process.

- To avoid damage to the temperature sensor, the permissible maximum operating temperature of the temperature sensor (see data sheet) must not be up-scaled throughout the welding process.  
For a Pt100 thin film resistor of accuracy class B, this is for example 400 °C (752 °F).

Apply the weld-on plate in such a way to guarantee good heat conductivity between the temperature sensor and the process.

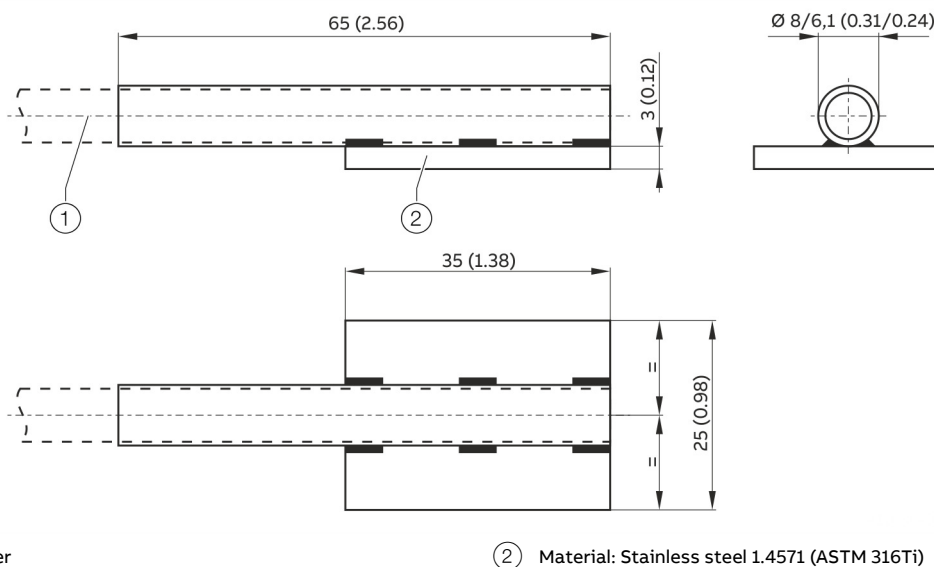


Figure 8: Weld-on plate for resistance thermometer, all dimensions in mm (in)

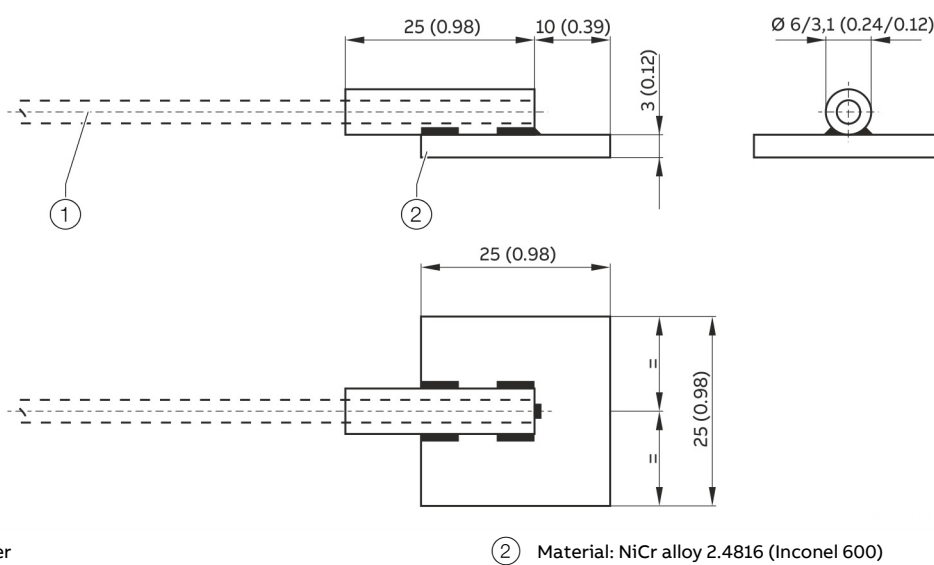


Figure 9: Weld-on plate for thermocouples, all dimensions in mm (in)



## Electrical connections

### Safety instructions for electrical installation

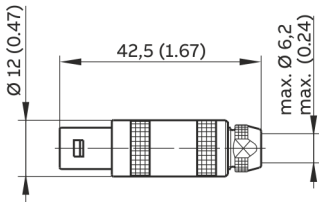
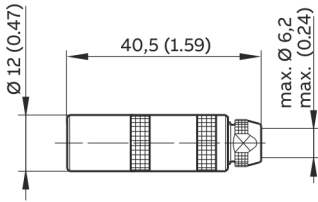
The electrical connection may only be established by authorized specialist personnel.

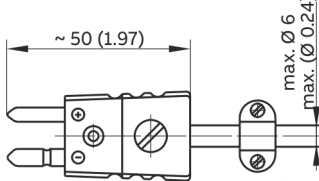
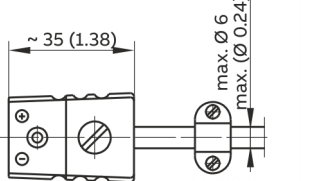
Notices on electrical connection in this instruction must be observed; otherwise, electric safety and the IP-rating may be adversely affected.

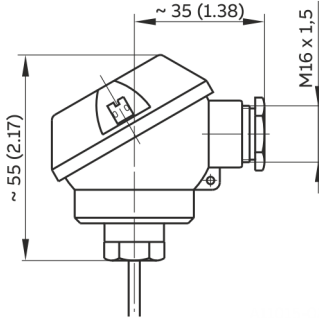
Safe isolation of electric circuits which are dangerous if touched is only guaranteed when the connected devices fulfill the requirements of EN 61140 (basic requirements for secure separation).

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.

### Plug connector and connection head

	Lemo plug size 1S	Lemo socket size 1S
Dimensions in mm (in)		
Type	FFA	PCA
Chassis	Nickel-plated brass, gold-plated brass contacts, PEEK isolator, maximum 6 contacts	
IP rating	IP 54	
Maximum ambient temperature	200 °C (392 °F)	

	Thermocouple – standard plug	Thermocouple – standard socket
Dimensions in mm (in)		
Type	Standard	
Material	Plastic	
Maximum ambient temperature	200 °C (392 °F)	

	Form F connecting head	Functions of the connection head
Dimensions in mm (in)		<ul style="list-style-type: none"> <li>Housing of a coupler connector</li> <li>Protection of the terminal compartment against environmental influence</li> </ul>
Chassis	Aluminum epoxide coating, loose cover,	
IP rating	IP 65	
Maximum ambient temperature	120 °C (248 °F)	
		<b>Ambient temperature</b> The ambient temperature on the Form F connection head can be between -40 and 120 °C (-40 to 248 °F). The most commonly used cable gland is suited for a temperature range of -20 to 100 °C (-4 to 212 °F). For temperatures outside this range, an appropriate cable gland can be installed.

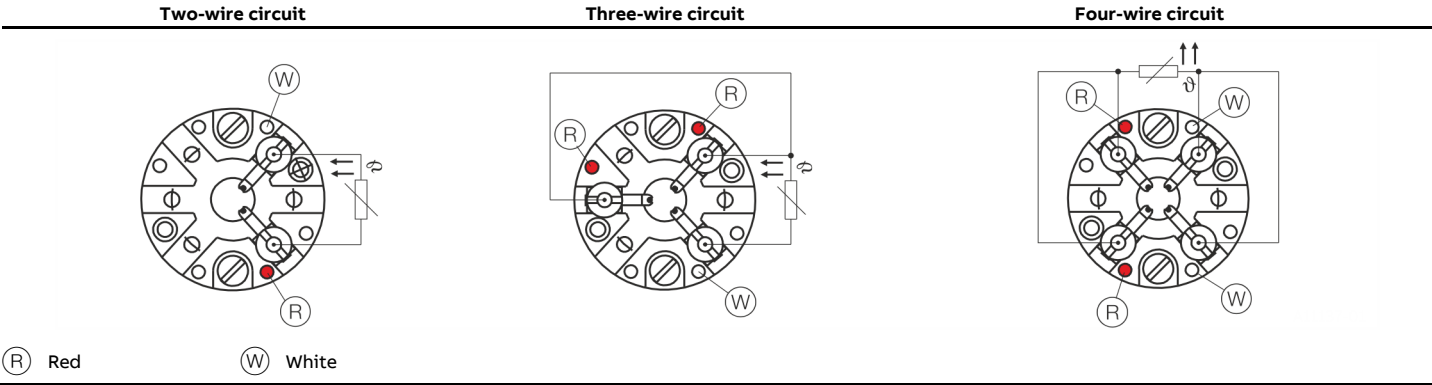
... 7 Installation

... Electrical connections

Electrical connections

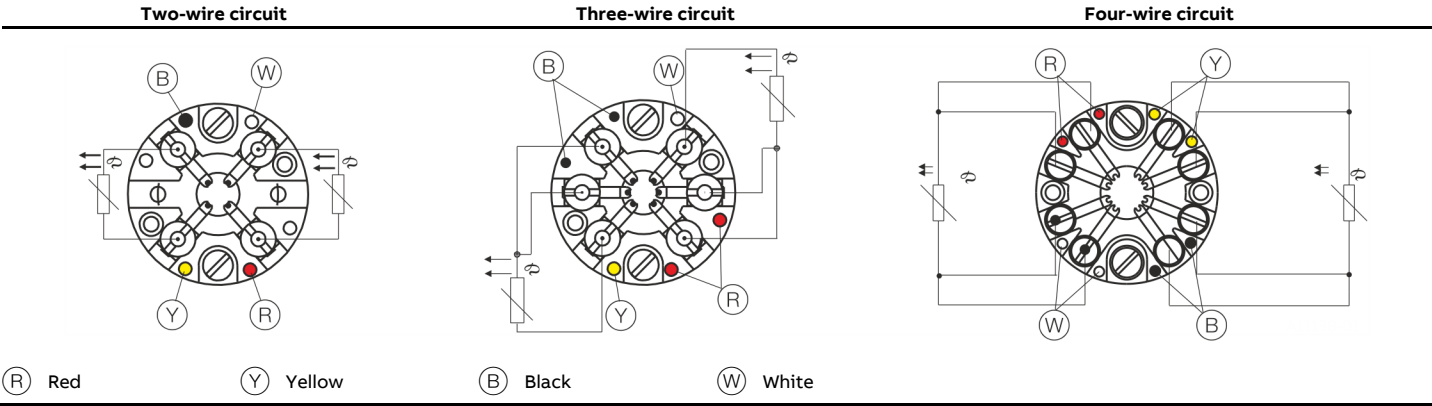
Electrical connections and color coding of resistance thermometers in accordance with IEC 60751

Single sensor

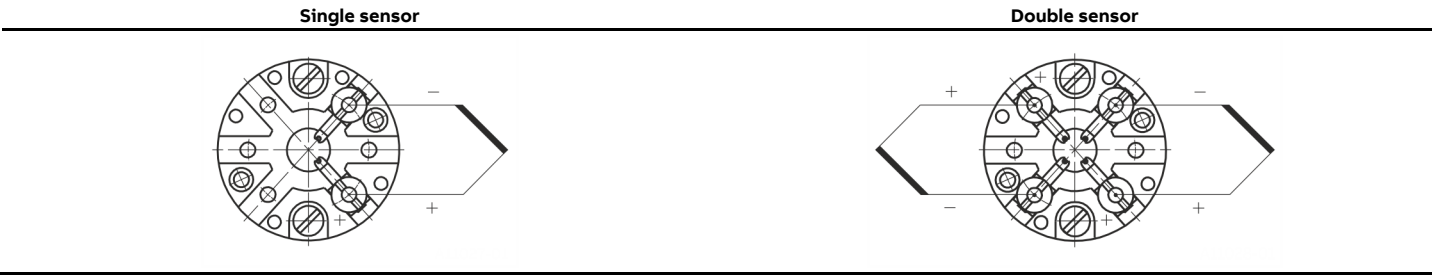


Electrical connections and color coding of resistance thermometers in accordance with IEC 60751

Double sensor



Electrical connections of thermocouples in accordance with IEC 60584



## Connection cable for the resistance thermometer

### Note

The specified outside diameters of the connection cable are batch-dependent and should be treated as guideline values.

### Note

The color coding of the wires for the resistance thermometer is in accordance with IEC 60751.

See **Electrical connections** on page 18.

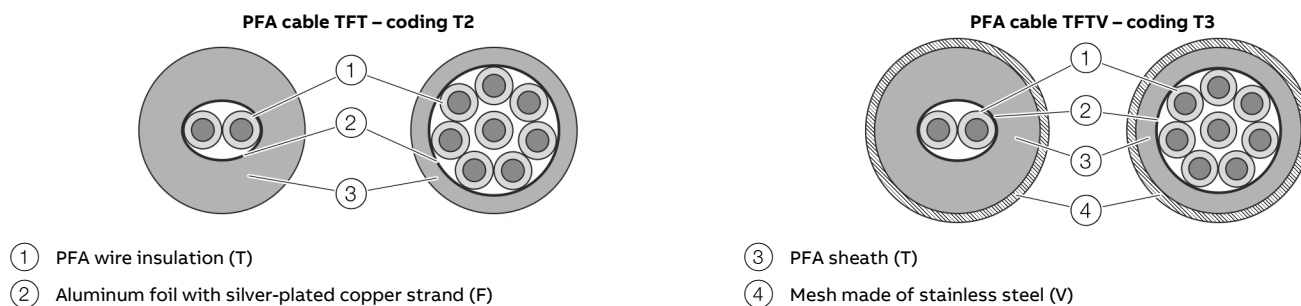


Figure 10: PFA cable

Design	Design	Sensor design
PFA cable TFT – coding T2	<b>General:</b> Stranded wire, wire material: solid copper Temperature resistance of the insulation: -200 to 200 °C (-328 to 392 °F) <b>Up to 4 wires:</b> Outside diameter: approx. 4.8 mm (0.19 in), conductor cross-section: 0.75 mm <sup>2</sup> <b>From 6 wires:</b> Outside diameter: approx. 4.5 mm (0.18 in), conductor cross-section: 0.22 mm <sup>2</sup>	1 x Pt100 / 2-w. – coding P1 1 x Pt100 / 3-w. – coding P2 1 x Pt100 / 4-w. – coding P3 2 x Pt100 / 2-w. – coding P4 2 x Pt100 / 3-w. – coding P5 2 x Pt100 / 4-w. – coding P6
PFA cable TFTV – coding T3	<b>General:</b> Stranded wire, wire material: solid copper Temperature resistance of the insulation: -200 to 200 °C (-328 to 392 °F) <b>Up to 4 wires:</b> Outside diameter: approx. 4.0 mm (0.16 in), conductor cross-section: 0.22 mm <sup>2</sup> <b>From 6 wires:</b> Outside diameter: approx. 5.5 mm (0.22 in), conductor cross-section: 0.22 mm <sup>2</sup>	

... 7 Installation

... Electrical connections

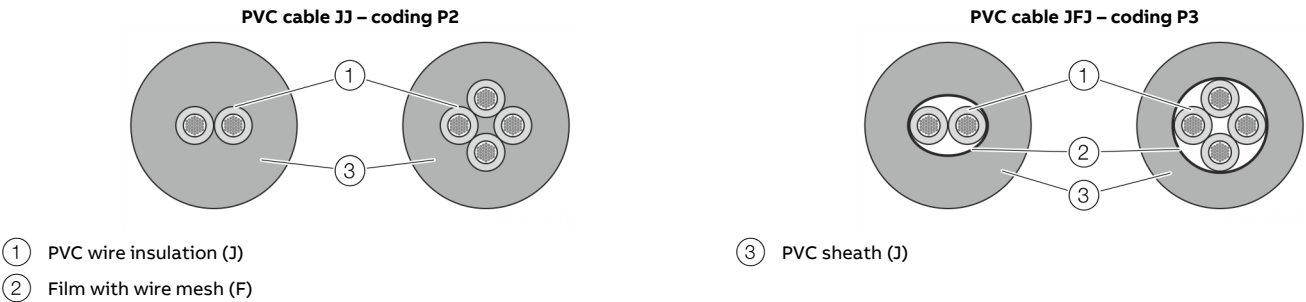


Figure 11: PVC cable

Design	Design	Sensor design
PVC cable JJ – coding P2	Outside diameter approx. 5.5 mm (0.22 in)	1 x Pt100 / 2-w. – coding P1
	Conductor cross-section: 0.22 mm <sup>2</sup> , Wire material: copper strand	1 x Pt100 / 3-w. – coding P2
	Temperature resistance of the insulation: –20 to 105 °C (–4 to 221 °F)	1 x Pt100 / 4-w. – coding P3
PVC cable JFJ – coding P3	Outside diameter approx. 5.5 mm (0.22 in)	2 x Pt100 / 2-w. – coding P4
	Conductor cross-section: 0.50 mm <sup>2</sup> , Wire material: copper strand	
	Temperature resistance of the insulation: –10 to 105 °C (14 to 221 °F)	

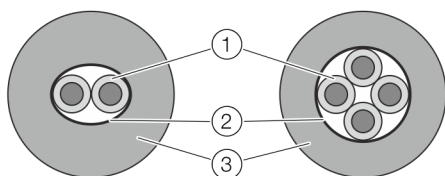
## Connection cables for thermocouples

### Note

The specified outside diameters of the connection cable are batch-dependent and should be treated as guideline values.

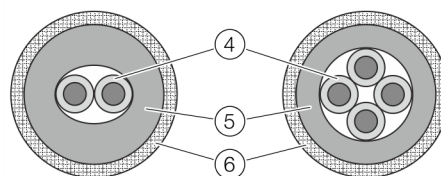
Type	Class of upper/lower deviation		Application temperature range
	Class 1	Class 2	
JX	$\pm 85 \mu\text{V}$ ( $\pm 1.5 \text{ }^{\circ}\text{C}$ (34.7 °F))	–	–25 to 200 °C (–13 to 392 °F)
EX	$\pm 120 \mu\text{V}$ ( $\pm 1.5 \text{ }^{\circ}\text{C}$ (34.7 °F))	–	–25 to 200 °C (–13 to 392 °F)
NX	$\pm 60 \mu\text{V}$ ( $\pm 1.5 \text{ }^{\circ}\text{C}$ (34.7 °F))	–	–25 to 200 °C (–13 to 392 °F)
KCA	–	$\pm 100 \mu\text{V}$ ( $\pm 2.5 \text{ }^{\circ}\text{C}$ (36.5 °F))	0 °C to 150 °C (32 to 302 °F):

PVC cable JFJ – coding P3



- ① PVC wire insulation, overmolded (J)
- ② Plastic-laminated aluminum foil shield (F)
- ③ PVC sheath (J)

Silicone cable SLSLGL – coding S3



- ④ Silicone rubber wire insulation, overmolded (SL)
- ⑤ Silicone rubber sheath (SL)
- ⑥ Glass filament mesh (GL)

Figure 12: PVC and silicone cable

Design	Design	Sensor design
PVC cable JFJ – coding P3	<b>General:</b>	1 x JX – coding J1
	Stranded wire, conductor cross-section: 0.22 mm <sup>2</sup> , Temperature resistance of the insulation: –10 to 105 °C (14 to 221 °F)	2 x JX – coding J2
	<b>Type JX:</b>	1 x KCA – coding K1
	Outside diameter up to 4 wires approx. 5.8 mm (0.23 in)	2 x KCA – coding K2
Silicone cable SLSLGL – coding S3	<b>Type KCA:</b>	
	Outside diameter up to 4 wires approx. 5.0 mm (0.20 in)	
	Stranded wire, conductor cross-section: 0.22 mm <sup>2</sup> , Temperature resistance of the insulation: –200 to 200 °C (–328 to 392 °F)	1 x KCA – coding K1
	Outside diameter up to 2 wires approx. 4.7 mm (0.19 in)	2 x KCA – coding K2
	Outside diameter up to 4 wires approx. 5.5 mm (0.22 in)	

... 7 Installation

... Electrical connections

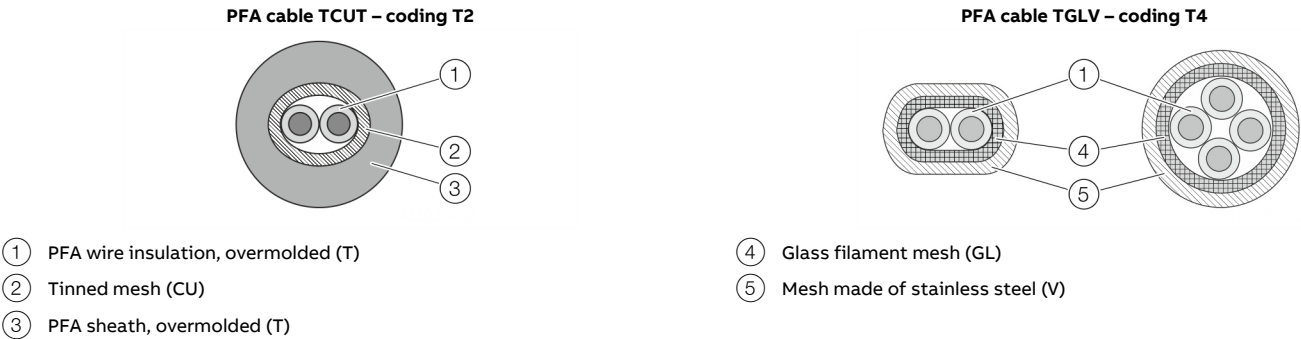


Figure 13: PFA cable

Design	Design	Sensor design
PFA cable TCUT – coding T2	Stranded wire, conductor cross-section: 0.22 mm <sup>2</sup> Temperature resistance of the insulation: -200 to 200 °C (-328 to 392 °F) Outside diameter approx. 3.0 mm (0.12 in)	1 x NX – coding N1
PFA cable TGLV – coding T4	<b>General:</b> With single thermocouple: parallel wire With double thermocouple: stranded wire Conductor cross-section: 0.22 mm <sup>2</sup> Temperature resistance of the insulation: -200 to 200 °C (-328 to 392 °F) <b>Type JX:</b> Outside diameter with 2 wires (oval conductor): approx. 3.3 mm x 2.0 mm (0.13 x 0.08 in) Outside diameter up to 4 wires approx. 3.7 mm (0.15 in) <b>Type KCA:</b> Outside diameter with 2 wires (oval conductor): approx. 3.3 mm x 2.0 mm (0.13 x 0.08 in) Outside diameter up to 4 wires approx. 3.7 mm (0.15 in) <b>Type NX:</b> Outside diameter up to 4 wires approx. 3.5 mm (0.14 in) <b>Type EX:</b> Outside diameter up to 4 wires approx. 3.4 mm (0.13 in)	1 x JX – coding J1 2 x JX – coding J2  1 x KCA – coding K1 2 x KCA – coding K2  1 x NX – coding N1 2 x NX – coding N2  1 x EX – coding E1 2 x EX – coding E2

## 8 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.

### 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 potential equalization line must be connected.
- The electric specifications must comply with the specified Ex relevant values.
- The electrical connection and mounting must be performed professionally in accordance with Installation and Electrical connections.

## 9 Maintenance / Repair

### **WARNING**

#### **Risk of explosion!**

Faulty temperature sensors may not be repaired by the operator.

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

The industrial thermometers do not require any maintenance if they are used as intended under normal operating conditions. No on-site repair or replacement of electronic parts by the user is required.

### Returning devices

Use the original packaging or a secure transport container of an appropriate type if you need to return the device for repair or recalibration purposes.

Fill out the return form (see **Return form** on page 25) and include this with the device.

In accordance with the EU Directive governing hazardous materials, the owner of hazardous waste is responsible for its disposal or must observe the following regulations for shipping purposes:

All devices delivered to ABB must be free from any hazardous materials (acids, alkalis, solvents, etc.).

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

## 10 Recycling and disposal

### Dismounting

#### WARNING

##### **Risk of injury due to process conditions.**

The process conditions, for example high pressures and temperatures, toxic and aggressive measuring media, can give rise to hazards when dismantling the device.

- If necessary, wear suited personal protective equipment during disassembly.
- Before disassembly, make sure that the process conditions do not pose any safety risks.
- Depressurize and empty the device / piping, allow to cool and purge if necessary.

Bear the following points in mind when dismantling the device:

- Switch off the power supply.
- Disconnect electrical connections.
- Allow the device / piping to cool and depressurize and empty. Collect any escaping medium and dispose of it in accordance with environmental guidelines.
- 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 notices in **Returning devices** on page 13.

### 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](http://www.abb.com/temperature).

## 12 Declaration of conformity

#### Note

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

## Trademarks

Inconel is a registered trademark of Special Metals Corporation



## 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

## Notes

## Notes

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## ABB Measurement & Analytics

For your local ABB contact, visit:  
**[www.abb.com/contacts](http://www.abb.com/contacts)**

For more product information, visit:  
**[www.abb.com/temperature](http://www.abb.com/temperature)**

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