OPTITEMP TT 10 C/R Handbook

Analogue 2-wire temperature transmitter, Pt100 or thermocouple input

The documentation is only complete when used in combination with the relevant documentation for the sensor.

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1.1 Intended use

DANGER!
You may only use transmitters labelled with the "Ex" symbol in potentially explosive areas or connect them to a sensor located in those areas. Additionally always note the zone(s) for which the devices have an approval. Otherwise the transmitters might cause an explosion that can result in fatal injuries.

DANGER!
Responsibility for the correct use of the devices with special regard to suitability, intended use and the field of application lies solely with the operator. To avoid any kind of incorrect use, also note the information in the chapter "Device description".

DANGER!
The transmitters do not contain any serviceable parts inside. Any substitution of components may impair the intrinsic safety of the versions with an Ex approval. Always send defective devices to the manufacturer or the local distributor for repair or exchange. If this is the case, attach a clear description of the malfunction for warranty claims.

INFORMATION!
The manufacturer is not liable for any damage resulting from improper use or use for other than the intended purpose. To avoid any kind of incorrect use, also note the information in the chapter "Device description"!

The manufacturer has constructed these transmitters only for temperature measurements with single resistance thermometers of the type Pt100 or with thermocouples type J, L, T, K, N. The main field of application is industrial environment.

1.2 Certifications

1.2.1 EC directive compliance

CE marking

The device fulfils all applicable statutory requirements of the following EC directives:

- EMC Directive 2004/108/EC, harmonized standard EN 61326-1:2006
- Devices for use in hazardous areas: ATEX Directive 94/9/EC, harmonized standards EN 60079-0:2006, EN 60079-11:2007 and EN 60079-26:2007
- CE Directive 93/68/EEC

The manufacturer certifies successful testing of the product by applying the CE marking.

1.2.2 Ex approvals (TT 10 C Ex)

ATEX	II 1 G Ex ia IIB T4/T5/T6 T4: +85°C / +185°F, T5: +55°C / +131°F, T6: +40°C / +104°F	DEMKO 06 ATEX 141331X

INFORMATION!
See also "Certificates" in the download area of the manufacturer's website.

1.3 Safety instructions from the manufacturer

1.3.1 Copyright and data protection

The contents of this document have been created with great care. Nevertheless, we provide no guarantee that the contents are correct, complete or up-to-date.

The contents and works in this document are subject to copyright. Contributions from third parties are identified as such. Reproduction, processing, dissemination and any type of use beyond what is permitted under copyright requires written authorisation from the respective author and/or the manufacturer.

The manufacturer tries always to observe the copyrights of others, and to draw on works created in-house or works in the public domain.

The collection of personal data (such as names, street addresses or e-mail addresses) in the manufacturer's documents is always on a voluntary basis whenever possible. Whenever feasible, it is always possible to make use of the offerings and services without providing any personal data.

We draw your attention to the fact that data transmission over the Internet (e.g. when communicating by e-mail) may involve gaps in security. It is not possible to protect such data completely against access by third parties.

We hereby expressly prohibit the use of the contact data published as part of our duty to publish an imprint for the purpose of sending us any advertising or informational materials that we have not expressly requested.

1.3.2 Disclaimer

The manufacturer will not be liable for any damage of any kind by using its product, including, but not limited to direct, indirect or incidental and consequential damages.

This disclaimer does not apply in case the manufacturer has acted on purpose or with gross negligence. In the event any applicable law does not allow such limitations on implied warranties or the exclusion of limitation of certain damages, you may, if such law applies to you, not be subject to some or all of the above disclaimer, exclusions or limitations.

Any product purchased from the manufacturer is warranted in accordance with the relevant product documentation and our Terms and Conditions of Sale.

The manufacturer reserves the right to alter the content of its documents, including this disclaimer in any way, at any time, for any reason, without prior notification, and will not be liable in any way for possible consequences of such changes.

1.3.3 Product liability and warranty

The operator shall bear responsibility for the suitability of the device for the specific purpose. The manufacturer accepts no liability for the consequences of misuse by the operator. Improper installation and operation of the devices (systems) will cause the warranty to be void. The respective "Standard Terms and Conditions" which form the basis for the sales contract shall also apply.

1.3.4 Information concerning the documentation

To prevent any injury to the user or damage to the device it is essential that you read the information in this document and observe applicable national standards, safety requirements and accident prevention regulations.

If this document is not in your native language and if you have any problems understanding the text, we advise you to contact your local office for assistance. The manufacturer can not accept responsibility for any damage or injury caused by misunderstanding of the information in this document.

This document is provided to help you establish operating conditions, which will permit safe and efficient use of this device. Special considerations and precautions are also described in the document, which appear in the form of underneath icons.

1.3.5 Warnings and symbols used

Safety warnings are indicated by the following symbols.

DANGER!
This information refers to the immediate danger when working with electricity.

DANGER!
This warning refers to the immediate danger of burns caused by heat or hot surfaces.

DANGER!
This warning refers to the immediate danger when using this device in a hazardous atmosphere.

DANGER!
These warnings must be observed without fail. Even partial disregard of this warning can lead to serious health problems and even death. There is also the risk of seriously damaging the device or parts of the operator's plant.

WARNING!
Disregarding this safety warning, even if only in part, poses the risk of serious health problems. There is also the risk of damaging the device or parts of the operator's plant.

CAUTION!
Disregarding these instructions can result in damage to the device or to parts of the operator's plant.

INFORMATION!
These instructions contain important information for the handling of the device.

LEGAL NOTICE!
This note contains information on statutory directives and standards.

- HANDLING
  This symbol designates all instructions for actions to be carried out by the operator in the specified sequence.

➲ RESULT
This symbol refers to all important consequences of the previous actions.

1.4 Safety instructions for the operator

WARNING!
In general, devices from the manufacturer may only be installed, commissioned, operated and maintained by properly trained and authorized personnel.
This document is provided to help you establish operating conditions, which will permit safe and efficient use of this device.

2.1 Scope of delivery

The scope of delivery always consists of the transmitter and its documentation.

2.2 General description

TT 10 C

RTD

The TT 10 C is an analogue 2-wire in-head transmitter for temperature measurements with single resistance thermometers of the type Pt100. The TT 10 C provides a temperature linear 4-20 mA output. The main field of application is industrial environments.

The transmitter is optionally available in an intrinsically safe version for installation in potentially explosive areas. These devices are labelled with the "Ex" symbol and are approved for use in zone 0.

Thermocouple

The TT 10 C T/C is an analogue 2-wire in-head transmitter for temperature measurements with single thermocouple input of type J, L, T, K and N. It provides a mV linear 4-20 mA output. The main field of application is industrial environments.

The TT10 C T/C is not available in an intrinsically safe version.

Installation on rail

All in-head versions are intended for installation in a "B connection head" or larger according to DIN 43729. As an alternative you can also mount the in-head version on a rail according to EN 60715 TH35 with the help of the rail installation kit (further information on page 18). In this way you may operate an in-head transmitter with an Ex approval with sensors in potentially explosive areas, if the transmitter is installed in the safe area (though this case is very uncommon).

TT 10 R

RTD

The TT 10 R is an analogue 2-wire rail-mount transmitter for temperature measurements. It has the same features like the in-head version, except that a version with an Ex-approval does not exist.

Thermocouple

The TT 10 R T/C is an analogue 2-wire rail-mount transmitter for temperature measurements. It has the same features like the in-head version.

The rail-mount transmitter is intended for installation on a rail according to EN 60715 TH35.

The TT10 R T/C is not available in an intrinsically safe version.

INFORMATION!
In the standard delivery condition the transmitters are not preset. Therefore you have to make a complete solder pad configuration and adjust the potentiometers before using the transmitter for the first time (refer to chapter "Operation"). As an option the manufacturer offers preset transmitters according to the customer's order.

2.3 Nameplate

INFORMATION!
Look at the device nameplate to ensure that the device is delivered according to your order.

The transmitter can be identified by the information on the nameplates.

2.3.1 In-head transmitter (Non-Ex version)

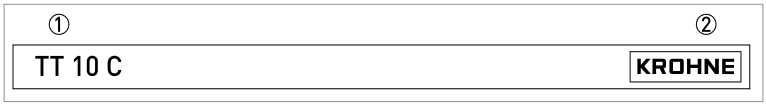


Figure 2-1: Nameplate of the in-head transmitter, RTD (Non-Ex,side)

① Product name
② Manufacturer

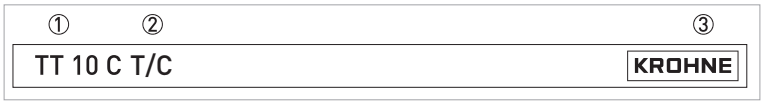


Figure 2-2: Nameplate of the in-head transmitter, thermocouples (Non-Ex,side)

① Product name
② Sensor type
③ Manufacturer

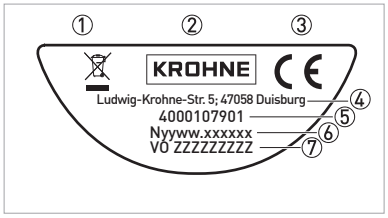


Figure 2-3: Nameplate for the in-head transmitter, RTD (Non-Ex, bottom)

① WEEE dustbin symbol
② Manufacturer
③ CE marking (EC conformity)
④ Address of manufacturer
⑤ Part number
⑥ Serial number
⑦ Batch number

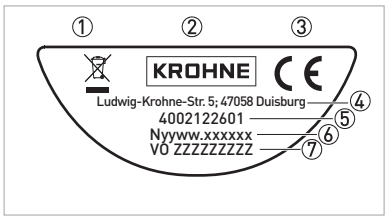


Figure 2-4: Nameplate for the in-head transmitter, thermocouples (Non-Ex, bottom)

① WEEE dustbin symbol
② Manufacturer
③ CE marking (EC conformity)
④ Address of manufacturer
⑤ Part number
⑥ Serial number
⑦ Batch number

2.3.2 In-head transmitter (Ex version)

Figure 2-5: Nameplate for the in-head transmitter (Ex, side)

① Product name
② Symbol for Ex-approval
③ CE marking (EC conformity)
④ Identification code of PQAN notified body
⑤ Supplementary Ex-data
⑥ Manufacturer

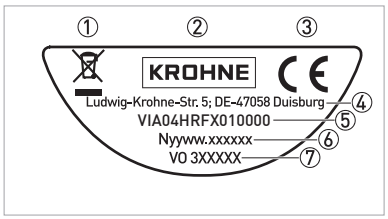


Figure 2-6: Nameplate of the in-head transmitter (Ex, bottom)

① WEEE dustbin symbol
② Manufacturer
③ CE marking (EC conformity)
④ Address of manufacturer
⑤ Part number
⑥ Serial number
⑦ Batch number

2.3.3 Rail-mount transmitter

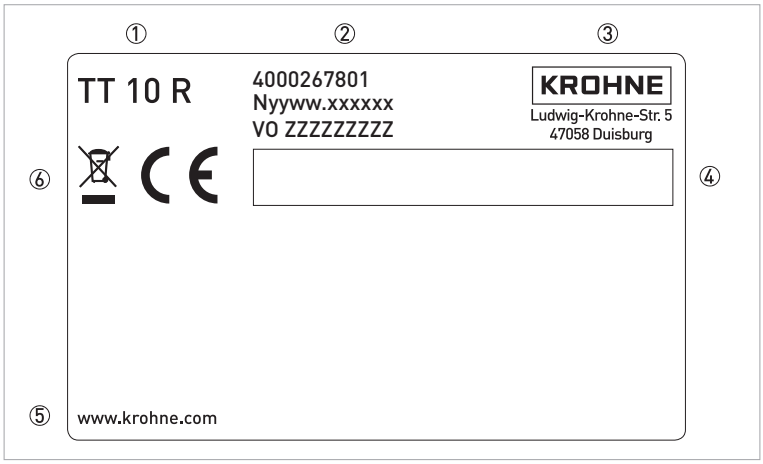


Figure 2-7: Nameplate of the rail-mount transmitter, RTD

① Product name
② Top down: part number, serial number and batch number
③ Manufacturer and address
④ Printable field, sensor configuration
⑤ Website of the manufacturer
⑥ WEEE dustbin symbol and CE marking (EC conformity)

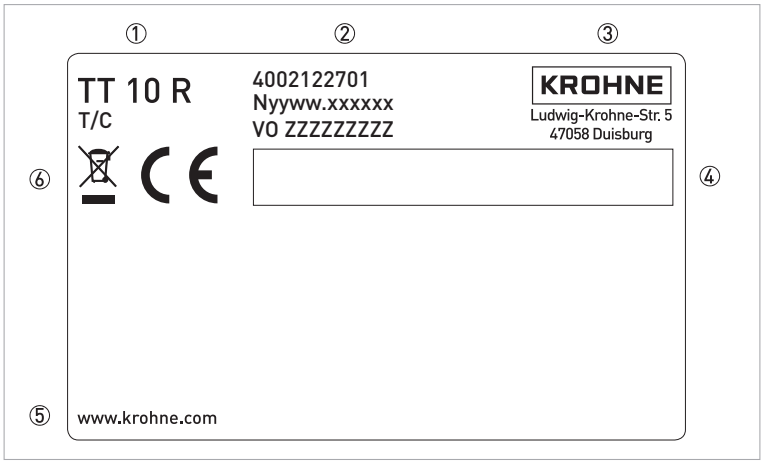


Figure 2-8: Nameplate of the rail-mount transmitter, thermocouple

① Product name
② Top down: part number, serial number and batch number
③ Manufacturer and address
④ Printable field, sensor configuration
⑤ Website of the manufacturer
⑥ WEEE dustbin symbol and CE marking (EC conformity)

3.1 Notes on installation

INFORMATION!
Inspect the cartons carefully for damages or signs of rough handling. Report damage to the carrier and to the local office of the manufacturer.

INFORMATION!
Do a check of the packing list to make sure that you have all the elements given in the order.

INFORMATION!
Look at the device nameplate to ensure that the device is delivered according to your order.

3.2 In-head transmitter (Ex and Non-Ex)

DANGER!
Never install or operate the Non-Ex version in potentially explosive areas, it might cause an explosion that can result in fatal injuries! Only use the Ex version in potentially explosive areas! Also note the following items which concern the Ex version:

- *It must be installed in a housing that has the protection category IP20 or better according to DIN IEC 60529 (an exception are in-head transmitters mounted on a rail as described in the next section). Additionally the magnesium component of the housing must not exceed 6% as a higher magnesium component may increase the flammability and the Ex capability.*
- *If it is mounted in a housing which is isolated from the ground and can be charged to an ignition capable level, then the housing must be electrostatically grounded when installed in hazardous areas.*
- *It is approved for potentially explosive areas (zone 0).*
- *It must be electrically connected (terminal 4 and 5) via a certified isolating interface/zener barrier having double or reinforced insulation which shall be placed outside the hazardous area.*

CAUTION!
The manufacturer has developed the Non-Ex version for an operating temperature range of -40...+85°C / -40...+185°F (the Ex version has the same ambient temperature range). To avoid destruction or damage of the device, always assure that the operating temperature or the ambient temperature does not exceed the permissible range and note the following items:

- *If you operate the Ex version in potentially explosive areas, the ambient temperature also depends on the temperature classification. For detailed information refer to the section about the temperature data for potentially explosive areas on page 46.*
- *The thermowell also transfers the process temperature to the transmitter housing. If the process temperature is close to or exceeds the maximum temperature of the transmitter, then the temperature in the transmitter housing can rise above the maximum permissible temperature!*

One way to decrease the heat transfer via the thermowell is to install the transmitter farther away from the heat source. An alternative is to make the thermowell longer. Inversely you can take similar measures if the temperature is below the specified minimum temperature.

The in-head transmitters (Ex and Non-Ex version) are intended for installation in DIN B connection heads or larger. The large Ø7.5 mm / 0.29" center hole facilitates the electrical connection of the measurement sensor and the installation (for detailed information refer to the chapter "Dimensions and weights"). The following drawing shows the installation of the in-head transmitter with the help of the connection head installation kit:

INFORMATION!
The connection head installation kit does not belong to the standard scope of delivery of the transmitter, you have to order it separately. For more information refer to Accessory parts on page 39.

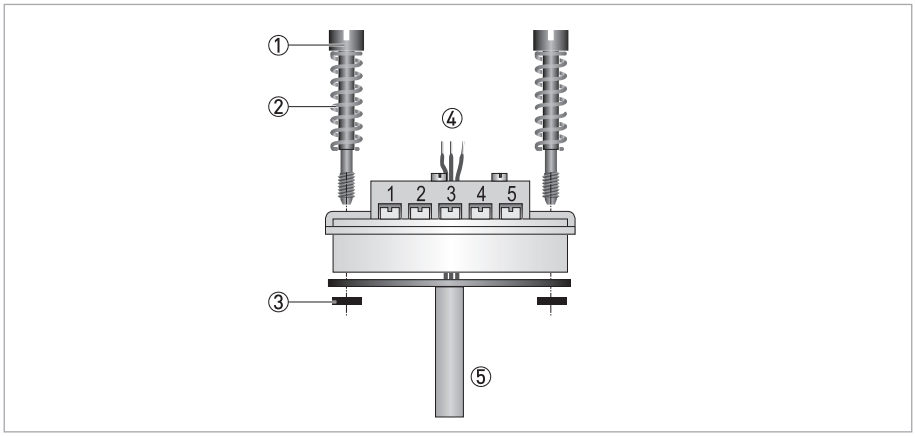


Figure 3-1: Connection head installation kit

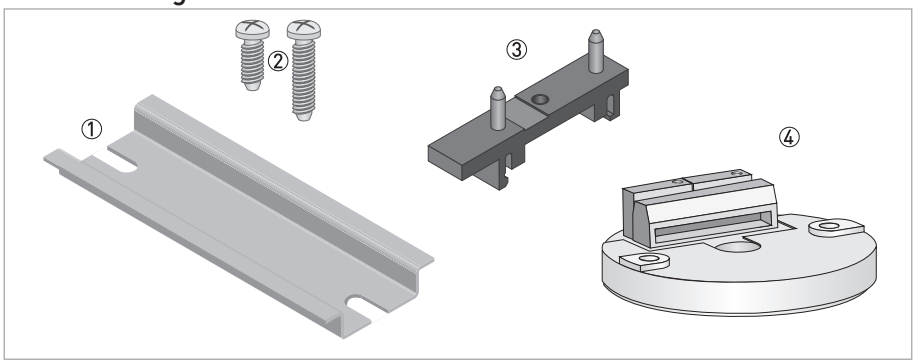
① M4 screw
② Spring
③ Lock washer
④ Wires of measuring insert
⑤ Sheath

3.3 Rail mounting kit for in-head transmitters

DANGER!
To avoid fatal injuries, destruction or damage of the transmitter, always note the relevant admonitions in the previous section if you install the in-head-transmitter on a rail!

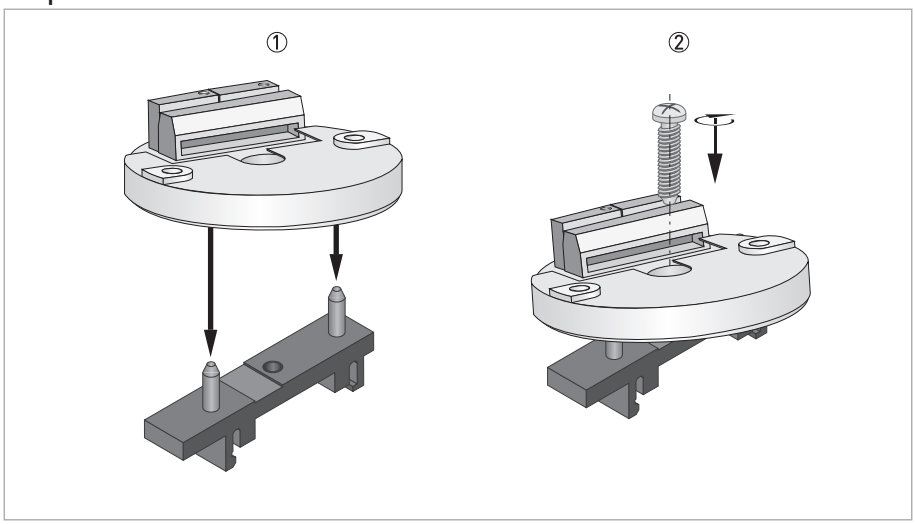
INFORMATION!
The rail mounting kit allows to install the in-head transmitter on a rail according to EN 60715 TH35. The kit does not belong to the standard scope of delivery, you have to order it separately. For more information refer to the section about the accessory parts in the chapter "Service".

Rail mounting kit for in-head transmitters



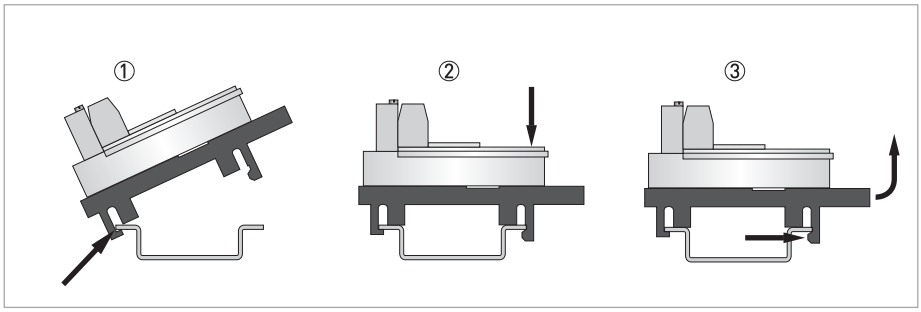
① Rail (not included in the kit)
② Screws
③ Clamp
④ Transmitter (not included in the kit)

Step 1



① Place the transmitter on the clamp as shown above.
② Push the transmitter down until it reaches the plate and secure with a screw.

Step 2



① Hook one end of the clamp into the rail as shown above.
② Push the other end of the the kit down until it snaps onto the rail.
③ Release by pushing the hook, shown in the picture, and at the same time lift the clip out of the rail.

3.4 Rail-mount transmitter

DANGER!
Neither operate this transmitter in potentially explosive areas, nor connect it to a sensor located in a potentially explosive area! Otherwise the transmitter might cause an explosion that can result in fatal injuries!

INFORMATION!
The rail-mount transmitter is intended for installation on a rail according to EN 60715 TH35.

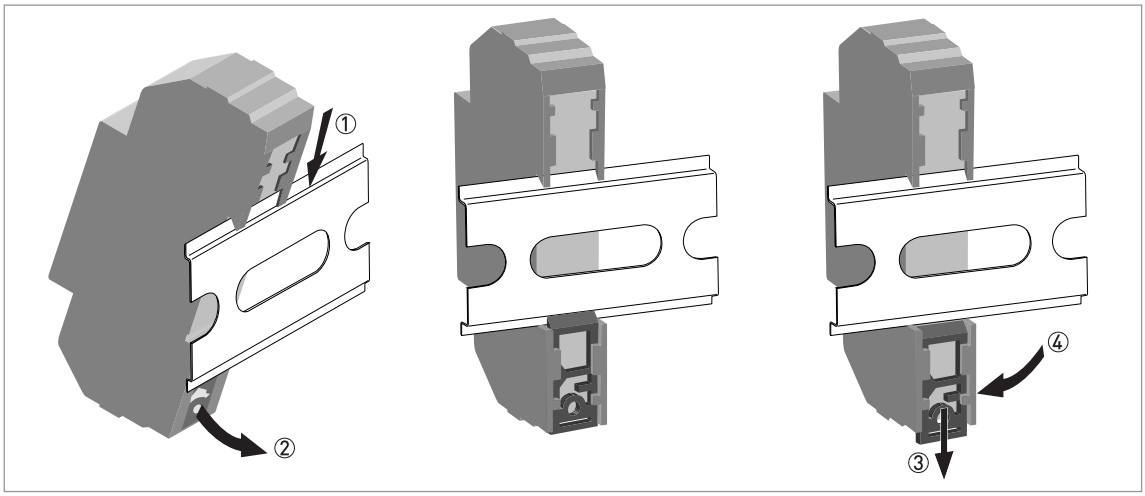


Figure 3-2: Installation of the rail-mount version

① Hook the upper groove of the transmitter onto the rail.
② Press the lower part of the transmitter against the rail.
➲ When you hear a "click" from the snap fastener, the transmitter is fixed onto the rail (drawing in the centre).
③ To remove the transmitter, use a small screwdriver to push the snap fastener downwards.
④ Carefully move the lower part of the transmitter in the forward direction and then upwards.

4.1 Safety instructions

DANGER!
All work on the electrical connections may only be carried out with the power disconnected.

DANGER!
Observe the national regulations for electrical installations!

CAUTION!
Before you connect and operate a transmitter, always note the following items to avoid an electric shock:

- *For all work on the electrical connections use an electrostatic safe (i.e. grounded) workplace! In this way you minimize the risk of electrostatic discharge (ESD).*
- *Assure that the cover was closed after any work on the device. The cover prevents electrostatic discharge if the solder pads are touched inadvertently; furthermore it protects the solder pads against dirt.*

DANGER!
Never connect or operate a non-Ex version of a transmitter in potentially explosive areas, otherwise it might cause an explosion that can result in fatal injuries! Before you connect and operate a transmitter version with an Ex approval, always note the following items to avoid an explosion which may result in fatal injuries:

- *Never do any soldering work in potentially explosive areas!*
- *Connect the Ex version only to Ex approved sensors or sensors that meet the requirements for "simple apparatus" in EN 60079-11:2007, section 5.7.*
- *Observe the corresponding regulations, the declaration of conformity, the type test certificate of the device, the ATEX certificate "Special conditions for safe use" for Ex versions and the relevant instructions of this document.*

WARNING!
Observe without fail the local occupational health and safety regulations. Any work done on the electrical components of the measuring device may only be carried out by properly trained specialists.

INFORMATION!
Look at the device nameplate to ensure that the device is delivered according to your order.

INFORMATION!
The transmitter is protected against polarity reversal. No damage will occur to the device if the polarity of the supply voltage is switched. The output will then indicate 0 mA.

INFORMATION!
The calibration of this transmitter works with potentiometers. Therefore assure that the transmitter is protected against heavy impacts or strong vibrations. Otherwise the calibration data could change.

4.2 Electrical input connections

CAUTION!
Always establish the electrical connections according to the following diagrams. Otherwise it can come to destruction or damage of the transmitter.

INFORMATION!
To avoid measuring errors, assure that all cables are connected properly and that the screws are tightened correctly.

4.2.1 In-head transmitter (Ex and Non-Ex)

RTD

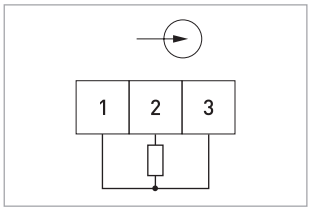


Figure 4-1: Pt100, 3-wire input connection (Ex and Non-Ex version)

Thermocouple

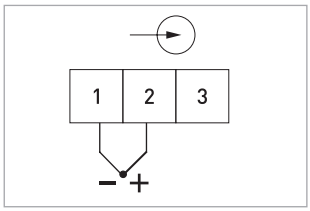


Figure 4-2: Thermocouple, 2-wire input connection

4.2.2 Rail-mount transmitter

RTD

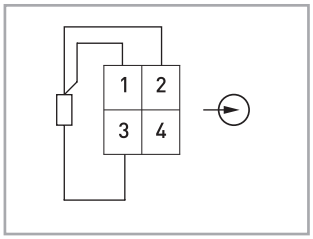


Figure 4-3: Pt100, 3-wire connection

Thermocouple

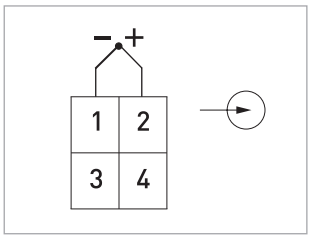


Figure 4-4: Thermocouple, 2-wire input connection

4.3 Electrical connection diagrams

CAUTION!
Always establish the electrical connections according to the following diagrams. Otherwise it can come to destruction or damage of the transmitter.

INFORMATION!
To avoid measuring errors, assure that all cables are connected properly and that the screws are tightened correctly.

4.3.1 In-head transmitter (Non-Ex)

DANGER!
Neither operate this transmitter in potentially explosive areas, nor connect it to a sensor located in a potentially explosive area! Otherwise the transmitter might cause an explosion that can result in fatal injuries!

CAUTION!
Note that the maximum output load always depends on the power supply. If the maximum output load is exceeded, then the measured value will become incorrect. For further information refer to the output load diagrams in the chapter "Technical data".

INFORMATION!
The transmitter has a polarity protection. Connecting the power supply with a wrong polarity will not damage the transmitter.

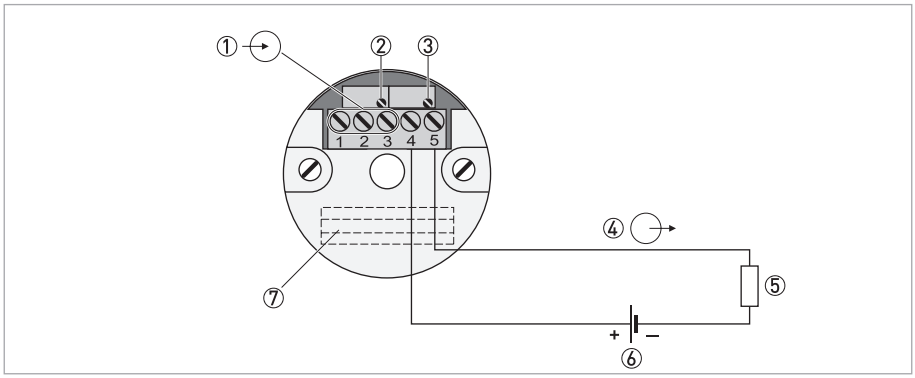


Figure 4-5: Connection diagram of the in-head transmitter (Non-Ex)

① Terminals for input signal (1, 2 and 3)
② Potentiometer for zero point setting
③ Potentiometer for measuring span setting
④ Output signal, terminals 4 and 5 (4...20 mA)
⑤ Load resistance
⑥ Power supply (6.5...32 VDC)
⑦ Solder pads

4.3.2 In-head transmitter (Ex)

DANGER!
The Ex transmitter can be installed in potentially explosive areas of zone 0. It may only be connected to sensors that meet the requirements for "simple apparatus" in EN 60079-11:2007, section 5.7. During operations in potentially explosive areas always note the relevant safety instructions and especially the following items:

- *The transmitter must be electrically connected (terminal 4 and 5) via a certified isolating interface/zener barrier having double or reinforced insulation which shall be placed outside the hazardous area.*
- *The output parameters of the Ex approved Zener barrier or voltage supply have to be less or equal than the input parameters of the transmitter (i.e. U_i, I_i, P_i, L_i, C_i).*

CAUTION!
Note that the maximum output load always depends on the power supply. If the maximum output load is exceeded, then the measured value will become incorrect. For further information refer to the output load diagrams in the chapter "Technical data".

INFORMATION!
The transmitter has a polarity protection. Connecting the power supply with a wrong polarity will not damage the transmitter.

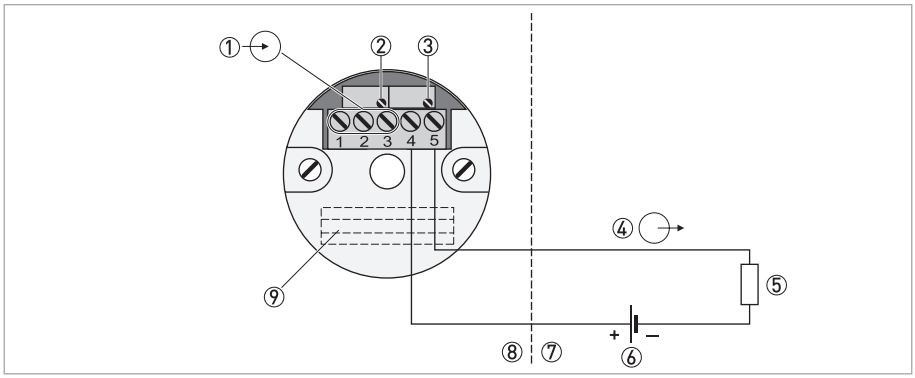


Figure 4-6: Connection diagram of the in-head transmitter (Ex)

① Input signal (terminals 1, 2 and 3)
② Potentiometer for zero point setting
③ Potentiometer for measuring span setting
④ Output signal, terminals 4 and 5 (4...20 mA)
⑤ Load resistance
⑥ Power supply
⑦ Safe area
⑧ Potentially explosive area
⑨ Solder pads

4.3.3 Rail-mount transmitter

DANGER!
Neither operate this transmitter in potentially explosive areas, nor connect it to a sensor located in a potentially explosive area! Otherwise the transmitter might cause an explosion that can result in fatal injuries!

CAUTION!
Note that the maximum output load always depends on the power supply. If the maximum output load is exceeded, then the measured value will become incorrect. For further information refer to the output load diagrams in the chapter "Technical data".

INFORMATION!
The transmitter has a polarity protection. Connecting the power supply with a wrong polarity will not damage the transmitter.

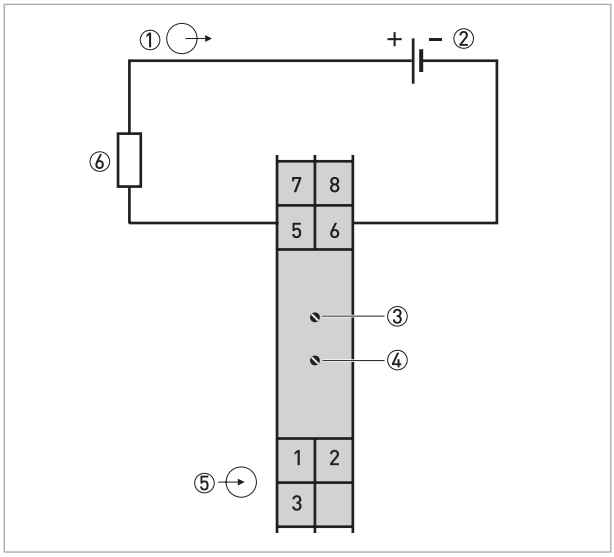


Figure 4-7: Connection diagram of the rail-mount transmitter (2-wire connection)

① Output signal (4...20 mA)
② Power supply
③ Potentiometer for zero point setting (Z)
④ Potentiometer for measuring span setting (S)
⑤ Terminals for input signal
⑥ Load resistance

5.1 Configuring the in-head version

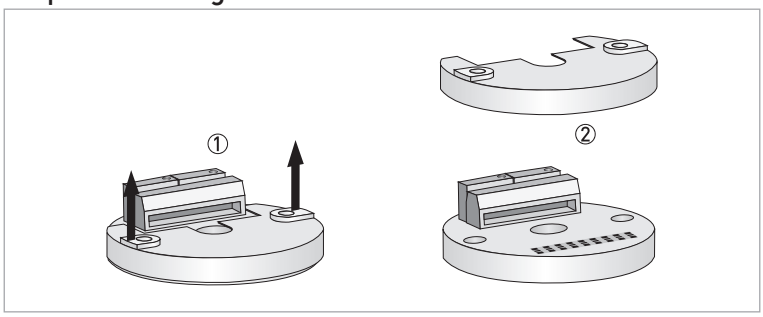
DANGER!
To avoid electric shocks and destructions or damages of the device, assure that all electrical connections comply with the instructions within the chapter "Electrical connections".

DANGER!
Only perform the configuration described in this section if no sensor is connected to the transmitter. Otherwise you could damage the cable insulation during soldering, furthermore the cables could handicap during soldering.

INFORMATION!
In the standard delivery condition the transmitters are not preset. Therefore you have to make a complete solder pad configuration and adjust the potentiometers before using the transmitter for the first time. Also note the following items:

- *The steps in this section show the complete configuration procedure in the correct order for new transmitters. The manufacturer strongly recommends to follow this procedure, otherwise the calibration may not be proper.*
- *As an option the manufacturer offers preset transmitters according to the customer's order. Only in this case the solder pad configuration and potentiometer adjustment is not necessary.*
- *In some cases you have to change the solder pad configuration and perform a new potentiometer adjustment of a transmitter that has already been in use. This may be the case e.g. if you must define a new zero point or measuring span for a new application.*

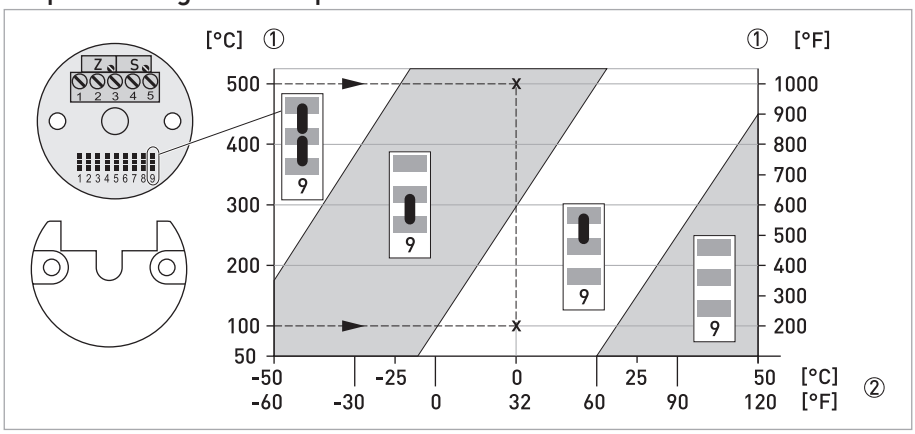
Step 1: removing the cover



- Take the transmitter with thumb and forefinger (bottom part lies on the forefinger while the thumb grips the terminals).
- Grip the cover with the thumb and the forefinger of the other hand beside the holes for the screws (the cover is not fixed with screws, but it is plugged on the bottom part).
- Pull the cover upwards (refer to previous drawing).

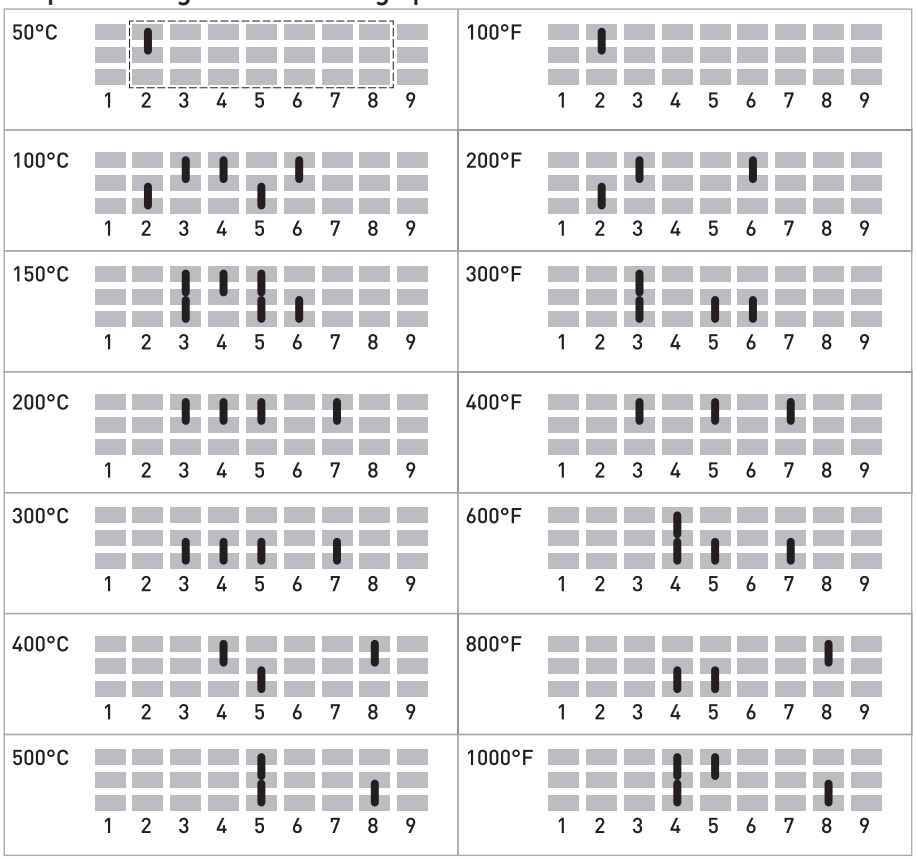
Step 2-3 for TT10 C RTD version

Step 2: setting the zero point



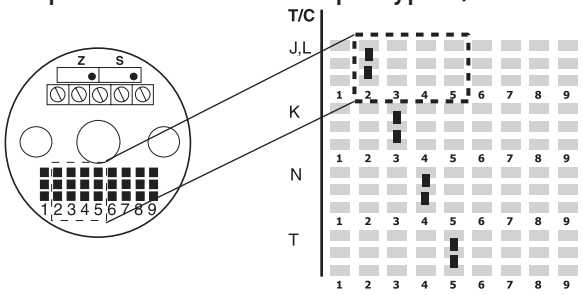
① Measuring span
② Zero point

Step 3: setting the measuring span

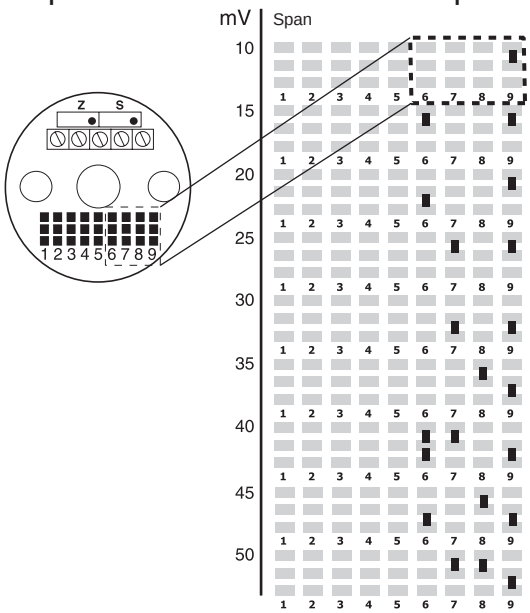


Step 2-3 for TT10 C thermocouple version

Step 2: Select thermocouple type T/C



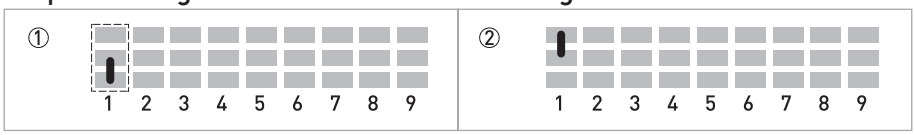
Step 3: Select recommended mV span according to table



mV Span	T Span									
	T/C J		T/C L		T/C K		T/C N		T/C T	
	°C	°F	°C	°F	°C	°F	°C	°F	°C	°F
10 mV	170-220	305-400	165-220	300-400	220-295	400-530	290-370	520-670	200-250	360-450
15 mV	220-320	400-575	220-320	400-575	295-430	530-770	370-520	670-940	250-340	450-610
20 mV	320-410	575-740	320-410	575-740	430-540	770-970	520-650	940-1170	340-400	610-720
25 mV	410-500	740-900	410-500	740-900	540-660	970-1190	650-770	1170-1390		
30 mV	500-580	900-1040	500-580	900-1040	660-775	1190-1395	770-890	1390-1600		
35 mV	580-670	1040-1200	580-660	1040-1190	775-900	1395-1620	890-1020	1600-1840		
40 mV	670-740	1200-1330	660-730	1190-1310	900-1010	1620-1820	1020-1140	1840-2050		
45 mV	740-830	1330-1490	730-820	1310-1480	1010-1220	1820-2200	1140-1300	2050-2340		
50 mV	830-950	1490-1710	820-900	1480-1620	1220-1370	2200-2470				

CAUTION!
You have to choose one sensor break configuration, i.e. you may only set one of the two solder jumper! If you establish both solder jumper connections, this could lead to damage or destruction of the transmitter.

Step 4: setting the sensor break monitoring

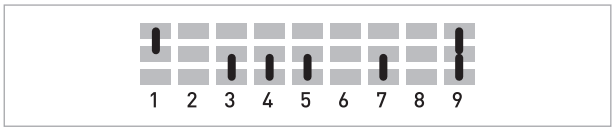


① Lower solder jumper: the output signal for sensor break is in this case ≤ 3.6 mA
② Upper solder jumper: the output signal for sensor break is in this case ≥ 23 mA

CAUTION!
After the solder pad configuration of the sensor break monitoring is complete, assure that the cover is on its original place again! The cover prevents electrostatic discharge if the solder pads are touched inadvertently; furthermore it protects the solder pads against dirt.

The setting of the sensor break monitoring is the last step in the configuration procedure. After the configuration is complete, a calibration and an adjustment of the potentiometers is necessary to achieve correct measuring results.

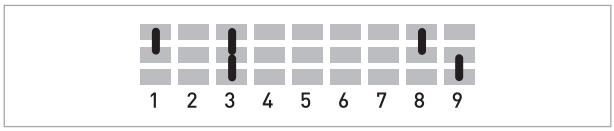
5.2 Configuration example (in-head version, RTD)



The previous drawing shows an example of a configuration with the following parameters:

- Measuring range: -50...+250°C / -58...+482°F
- Measuring span: 300°C / 540°F
- Sensor break: ≥23 mA
- Zero point: -50°C / -58°F

5.3 Configuration example (in-head version, thermocouple)



The previous drawing shows an example of a configuration with the following parameters:

- Measuring range: 0...+800°C / 32...+1472°F
- Measuring span: 775-900°C / 1395-1620°F
- Sensor break: ≥23 mA
- Zero point: 0°C / 32°F

5.4 Configuring the rail-mount version

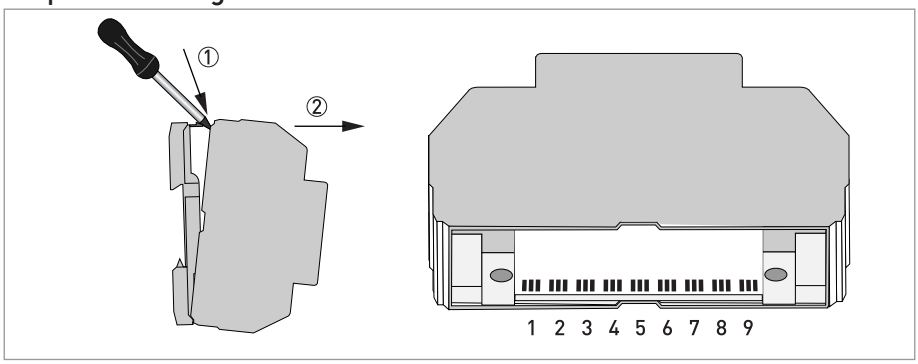
DANGER!
To avoid electric shocks and destructions or damages of the device, assure that all electrical connections comply with the instructions within the chapter "Electrical connections".

DANGER!
Only perform the configuration described in this section if no sensor is connected to the transmitter. Otherwise you could damage the cable insulation during soldering, furthermore the cables could handicap during soldering.

INFORMATION!
In the standard delivery condition the transmitters are not preset. Therefore you have to make a complete solder pad configuration and adjust the potentiometers before using the transmitter for the first time. Also note the following items:

- *The steps in this section show the complete configuration procedure in the correct order for new transmitters. The manufacturer strongly recommends to follow this procedure, otherwise the calibration may not be proper.*
- *As an option the manufacturer offers preset transmitters according to the customer's order. Only in this case the solder pad configuration and potentiometer adjustment is not necessary.*
- *In some cases you have to change the solder pad configuration and perform a new potentiometer adjustment of a transmitter that has already been in use. This may be the case e.g. if you must define a new zero point or measuring span for a new application.*

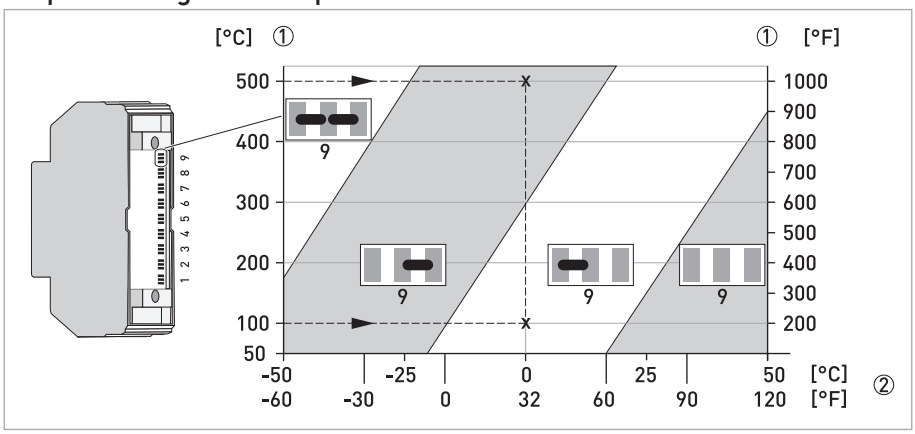
Step 1: removing the cover



- Take a screwdriver and press the tip between the housing and the cover as shown in the previous drawing.
- Remove the cover.

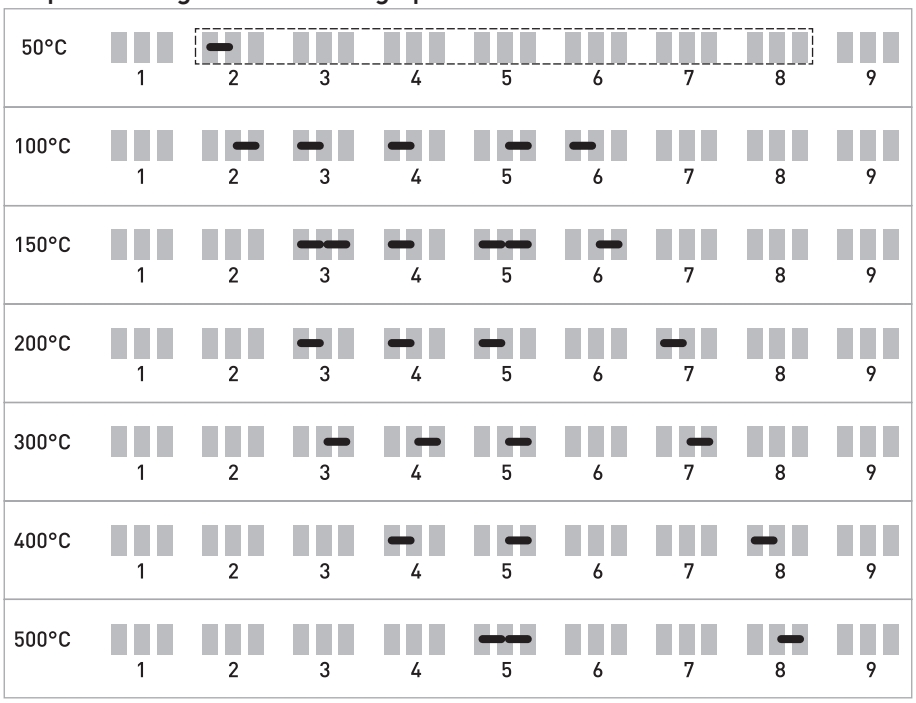
Step 2-3 for TT10 R RTD version

Step 2: setting the zero point

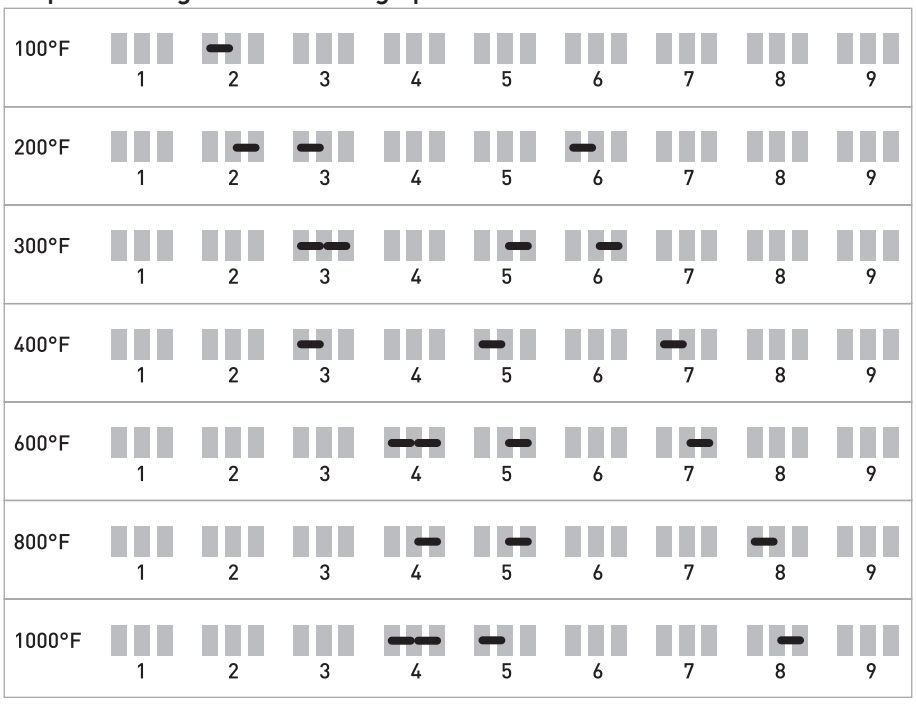


① Measuring span
② Zero point

Step 3: setting the measuring span

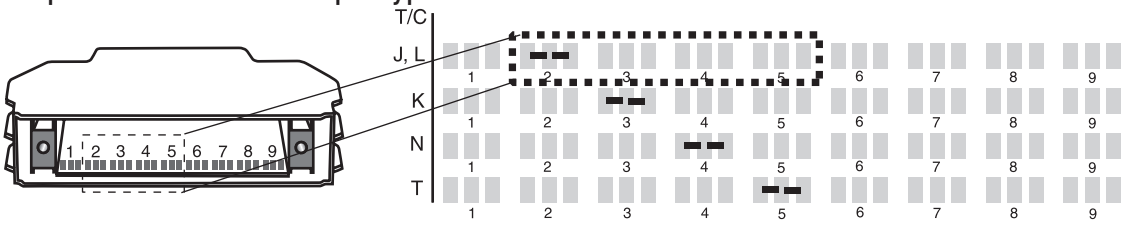


Step 3: setting the measuring span

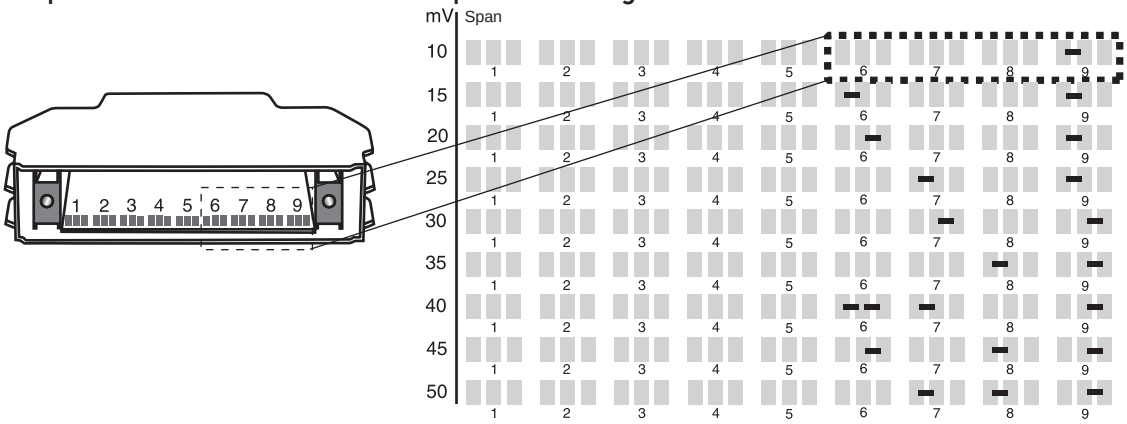


Step 2-3 for TT10 R thermocouple version

Step 2: Select thermocouple type



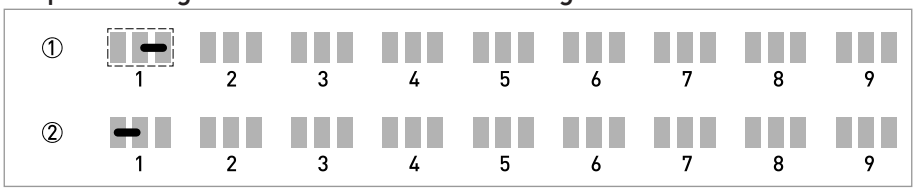
Step 3: Select recommended mV span according to table



mV Span	T Span									
	T/C J		T/C L		T/C K		T/C N		T/C T	
	°C	°F	°C	°F	°C	°F	°C	°F	°C	°F
10 mV	170-220	305-400	165-220	300-400	220-295	400-530	290-370	520-670	200-250	360-450
15 mV	220-320	400-575	220-320	400-575	295-430	530-770	370-520	670-940	250-340	450-610
20 mV	320-410	575-740	320-410	575-740	430-540	770-970	520-650	940-1170	340-400	610-720
25 mV	410-500	740-900	410-500	740-900	540-660	970-1190	650-770	1170-1390		
30 mV	500-580	900-1040	500-580	900-1040	660-775	1190-1395	770-890	1390-1600		
35 mV	580-670	1040-1200	580-660	1040-1190	775-900	1395-1620	890-1020	1600-1840		
40 mV	670-740	1200-1330	660-730	1190-1310	900-1010	1620-1820	1020-1140	1840-2050		
45 mV	740-830	1330-1490	730-820	1310-1480	1010-1220	1820-2200	1140-1300	2050-2340		
50 mV	830-950	1490-1710	820-900	1480-1620	1220-1370	2200-2470				

CAUTION!
You have to choose one sensor break configuration, i.e. you may only set one of the two solder jumper! If you establish both solder jumper connections, this could lead to damage or destruction of the transmitter.

Step 4: setting the sensor break monitoring

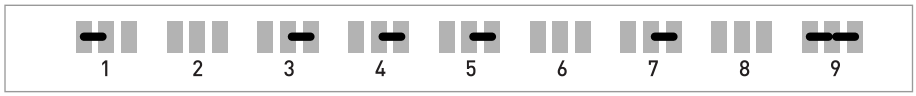


① Right solder jumper: the output signal for sensor break is in this case ≤ 3.6 mA
② Left solder jumper: the output signal for sensor break is in this case ≥ 23 mA

CAUTION!
After the solder pad configuration of the sensor break monitoring is complete, assure that the cover is on its original place again! The cover prevents electrostatic discharge if the solder pads are touched inadvertently; furthermore it protects the solder pads against dirt.

The setting of the sensor break monitoring is the last step in the configuration procedure. After the configuration is complete, a calibration and an adjustment of the potentiometers is necessary to achieve correct measuring results.

5.5 Configuration example (rail-mount version, RTD)



- Measuring range: -50...+250°C / -58...+482°F
- Measuring span: 300°C / 540°F
- Sensor break: ≥ 23 mA
- Zero point: -50°C / -58°F

5.6 Configuration example (rail-mount version, thermocouple)

- Measuring range: 0...+800°C / 32...+1472°F
- Measuring span: 775-900°C / 1395-1620°F
- Sensor break: ≥ 23 mA
- Zero point: 0°C / 32°F

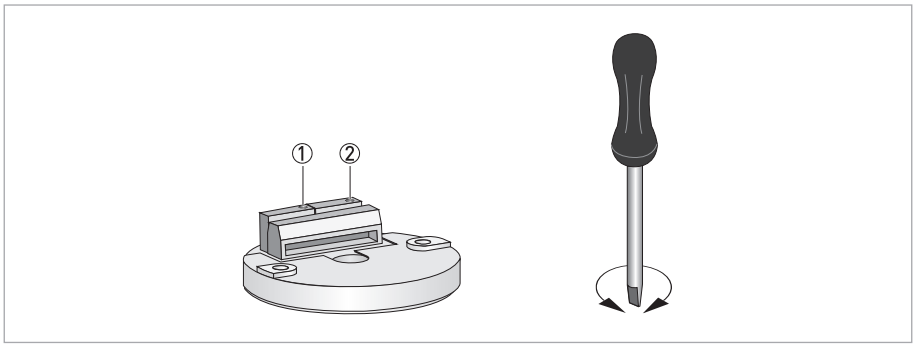
5.7 Calibration

DANGER!
To avoid electric shocks and destructions or damages of the device, assure that all electrical connections comply with the instructions within the chapter "Electrical connections".

INFORMATION!
The manufacturer recommends checking the calibration annually. To achieve the best possible accuracy, note the following items:

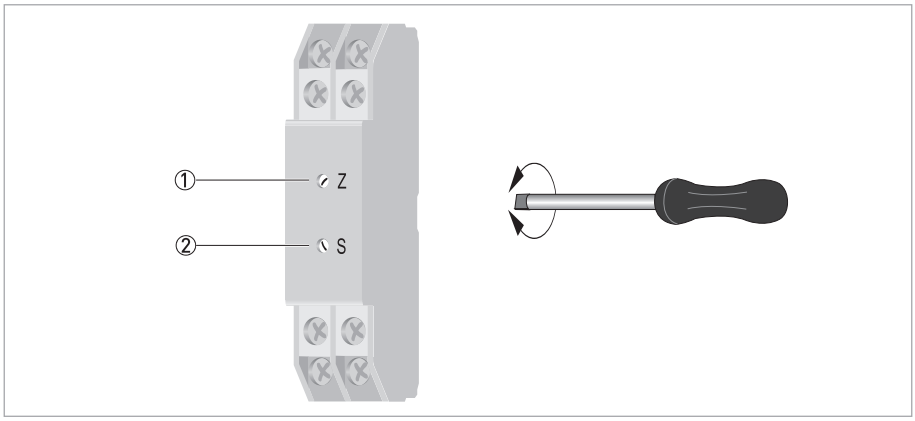
- *All calibration instruments (i.e. resistance decade and amperemeter) must have an accuracy of at least 0.02%.*
- *Assure that the complete solder pad configuration has taken place before the calibration.*
- *The calibration has to take place according to the temperature scales ITS 90 (IEC 60751 for Pt100, IEC 60584 for thermocouple type J, K, N and T and DIN 43710 for thermocouple type L). The simulation source for RTD input on the transmitter must have a temperature coefficient setting for platinum (= 0.00385). The simulation source for thermocouple input on the transmitter must have the selected thermocouple type and used with correct thermocouple wire that is connected with the correct polarity.*
- *If you set an input signal that delivers an outputs signal of 12 mA as described in the following actionsequence, wait about 15 minutes and check the stability of the output signal afterwards. Only if the output signal is stable then, the transmitter is ready for calibration.*

Potentiometers of the in-head version



① Potentiometer for zero point setting
② Potentiometer for measuring span setting

Potentiometers of the rail-mount version



① Potentiometer for zero point setting
② Potentiometer for measuring span setting

INFORMATION!
The following calibration procedure is valid not only for the rail-mount transmitter, but also for the Ex and the Non-Ex version of the in-head transmitter.

- Connect the power supply and the precision measuring device for current measurement according to the connection diagram in the chapter "Electrical connections" (the typical power supply is 24 VDC and depends on the overall output load (also refer to *Output load diagrams* on page 47).
- Connect the input signal (Pt100 or thermocouple simulator) according to the connection diagram in the chapter "Electrical connections".
- Set an input signal that delivers an output signal of approximately 12 mA.
- Wait circa 15 minutes and check the stability of the output signal afterwards. Only if the output signal is stable then, the transmitter is ready for calibration and you can go to the next step!
- Use the input simulation source to set an input signal T_{in} that corresponds to the selected lower measuring range value (e.g. 100 Ω for a measuring span from 0...+100°C / +32...212°F).
- Use the potentiometer for zero point setting to set exactly a current of I_{out} = 4.00 mA (refer to the drawing above).
- Use the input simulation source to set an input signal T_{in} that corresponds to the selected upper measuring range value (e.g. 138.5 Ω for a measuring span from 0...+100°C / +32...212°F).
- Use the potentiometer for the measuring span setting to set exactly a current of I_{out} = 20.00 mA
- Repeat the steps 5 till 8 until all of the signals are set exactly.
- Secure the potentiometers with varnish.

➲ The calibration is complete now.

6.1 Accessory parts

Accessory part	Order code
Connection head installation kit	70ADA00011
Rail mounting kit for in-head version (10 units)	70ADA00027

6.2 Spare parts availability

The manufacturer adheres to the basic principle that functionally adequate spare parts for each device or each important accessory part will be kept available for a period of 3 years after delivery of the last production run for the device.

This regulation only applies to spare parts which are subject to wear and tear under normal operating conditions.

6.3 Availability of services

The manufacturer offers a range of services to support the customer after expiration of the warranty. These include repair, maintenance, technical support and training.

INFORMATION!
For more precise information, please contact your local sales office.

6.4 Returning the device to the manufacturer

6.4.1 General information

This device has been carefully manufactured and tested. If installed and operated in accordance with these operating instructions, it will rarely present any problems.

CAUTION!
Should you nevertheless need to return a device for inspection or repair, please pay strict attention to the following points:

- *Due to statutory regulations on environmental protection and safeguarding the health and safety of our personnel, manufacturer may only handle, test and repair returned devices that have been in contact with products without risk to personnel and environment.*
- *This means that the manufacturer can only service this device if it is accompanied by the following certificate (see next section) confirming that the device is safe to handle.*

CAUTION!
If the device has been operated with toxic, caustic, flammable or water-endangering products, you are kindly requested:

- *to check and ensure, if necessary by rinsing or neutralising, that all cavities are free from such dangerous substances,*
- *to enclose a certificate with the device confirming that is safe to handle and stating the product used.*

6.4.2 Form (for copying) to accompany a returned device

Company:		Address:
Department:		Name:
Tel. no.:		Fax no.:
Manufacturer's order no. or serial no.:		
The device has been operated with the following medium:		
This medium is:	☐	water-hazardous
	☐	toxic
	☐	caustic
	☐	flammable
	☐	We checked that all cavities in the device are free from such substances.
	☐	We have flushed out and neutralized all cavities in the device.
We hereby confirm that there is no risk to persons or the environment through any residual media contained in the device when it is returned.		
Date:		Signature:
Stamp:		

6.5 Disposal

CAUTION!
Disposal must be carried out in accordance with legislation applicable in your country.

7.1 Measuring principle

7.1.1 Resistance thermometer

The transmitter works together with a measuring insert that has a Pt100 RTD. This kind of measuring inserts features a temperature-sensitive sensor made from a platinum RTD, whose value at 0°C / +32°F is 100 Ω. That is where the name "Pt100" comes from.

It is generally valid that the electric resistance of metals increases according to a mathematical function as the temperature rises. This effect is taken advantage of by resistance thermometers to measure temperature. The "Pt100" thermometer features a measuring resistance with defined characteristics, standardised in IEC 60751. The same is true for the tolerances. The average temperature coefficient of a Pt100 is 3.85 x 10^{-3} K^{-1} in the range from 0...+100°C / +32...+212°F.

During operation, a constant current I (≤ 1 mA) flows through the Pt100 RTD, which brings about a voltage drop U. The resistance R is calculated using Ohm's Law (R=U/I). As the voltage drop U at 0°C / +32°F is 100 mV, the resulting resistance of the Pt100 thermometer is 100 Ω (100 mV / 1 mA = 100 Ω).

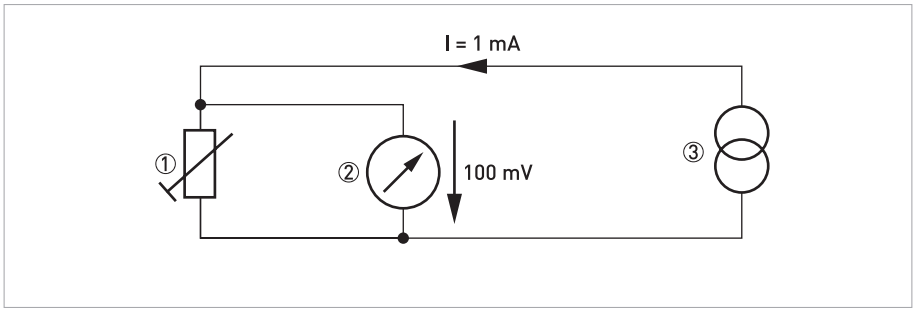


Figure 7-1: Pt100 resistance thermometer in 3-wire connection at 0°C / +32°F, schematic.

① Pt100 RTD
② Voltage meter
③ Current source

7.1.2 Thermocouples

The thermocouple features two electric conductors made from different metals, connected at one end. Each free end is connected to a compensation cable extension or direct connected to a millivolt meter. This circuitry forms a "thermal circuit". The point at which the two electric conductors connect is called the measuring point or hot junction and the point at which the compensation cables connect to the conductors of the millivolt meter is called the cold junction.

If the measuring point of this thermal circuit is heated up, a small electrical voltage (thermal voltage) can be measured. If, however, the measuring point and the cold junction are at the same temperature, no thermoelectric voltage is generated. The degree of thermoelectric voltage, also known as electromotive force (EMF), depends on the thermocouple material and the extent of the temperature difference between the measuring point and the cold junction. It can be measured using the millivolt meter with no auxiliary power.

Compensation cable has the same thermoelectric behavior as the thermocouple in a limited temperature range.

Extension cable is a thermocouple but designed as an installation cable.

Simply put, the thermocouple behaves like a battery, the voltage of which also increases as the temperature rises.

INFORMATION!
The characteristic curves and tolerances of commercially available thermocouples are standardised in IEC 60584.

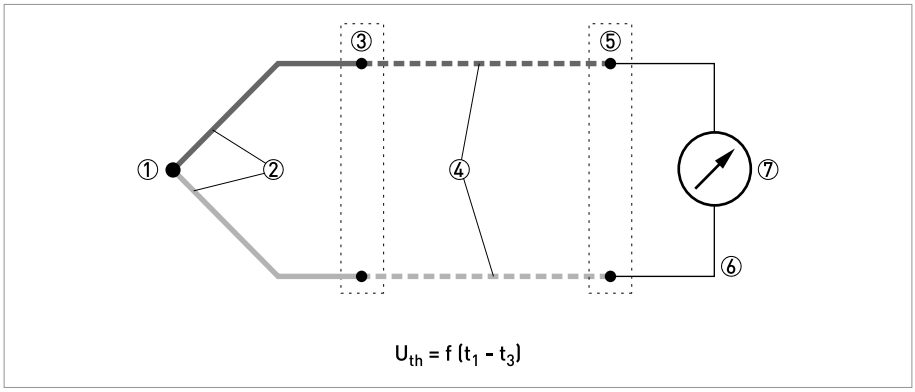


Figure 7-2: Thermocouple measuring circuit, schematic.

① Measuring point t_1 (hot junction)
② Thermocouple
③ Transition junction t_2
④ Compensation cable / extension cable
⑤ Reference junction t_3 (cold junction)
⑥ Copper conductor
⑦ Voltage meter U_{th}

7.2 Technical data

INFORMATION!

- *The following data is provided for general applications. If you require data that is more relevant to your specific application, please contact us or your local sales office.*
- *Additional information (certificates, special tools, software,...) and complete product documentation can be downloaded free of charge from the website (Download Center).*

Measuring system

Application range	Temperature measurements in an industrial environment.

Design

Versions	
TT 10 C	In-head transmitter for RTD input, optionally available in an intrinsically safe version for installation in potentially explosive areas (zone 0).
TT 10 C T/C	In-head transmitter for thermocouple input, not available as intrinsically safe version.
TT 10 R	Rail-mount transmitter for RTD input, not available as intrinsically safe version.
TT 10 R T/C	Rail-mount transmitter for thermocouple input, not available as intrinsically safe version.
Special feature	
Sensor break monitoring	User-definable output: ≤ 3.6 mA or ≥ 23 mA

Measuring accuracy

Accuracy	Calibration: ± 0.1% of span Linearity: ± 0.1% of span
Cold Junction Compensation (CJC) for TT 10 T/C	±1.0 °C / ±1.8 °F
Temperature influence	Pt100: ± 0,024% of span per °C
	Thermocouple: ± 0,024% of span per °C plus temperature influence CJC ± 0,05°C per °C

Operating conditions

Temperature	
In-head transmitter	**Operating and storage temperature:**
	Non-Ex version: -40...+85°C / -40...+185°F
	Ex version: -40...+85°C / -40...+185°F (storage temperature), for detailed information about the ambient temperatures refer to *Temperature data for potentially explosive areas* on page 46.
Rail-mount transmitter	**Operating and storage temperature:**
	-20...+70°C / -4...+158°F
Humidity	5...95% RH (non-condensing)
Protection category	
In-head transmitter	IP20 (with cover), IP10 (without cover)
Rail-mount transmitter	IP20

Installation conditions

Mounting	In-head transmitter: "B connection head" or larger according to DIN 43729; with the help of the rail mounting kit you can also fix this transmitters on a DIN rail according to EN 60715 TH35 (formerly EN 50022) (refer to *Rail mounting kit for in-head transmitters* on page 18).
	Rail-mount transmitter: rail according to EN 60715 TH35 (formerly EN 50022), 35 mm / 1.38".
	For detailed information refer to chapter "Installation".
Weight	In-head transmitter (Non-Ex and Ex version): 40 g / 0.09 lb
	Rail-mount transmitter: 55 g / 0.12 lb
Dimensions	For detailed information refer to *Dimensions* on page 45.

Materials

Housing	In-head transmitter: PC (Non-Ex), Zinc alloy + PC (Ex version)
	Rail-mount transmitter: PC + Glassfibre
Flammability acc. to UL	V0 (all versions)

Electrical connections

Power supply	In-head transmitter: 6.5...32 VDC (Non-Ex version), 8.5...30 VDC (Ex version)
	Rail-mount transmitter: 6.5...32 VDC
Galvanic isolation	No
Connection	Single/stranded wires: max. 1.5 mm^2 / AWG 16
Polarity protection	Standard for all versions

Inputs / Outputs

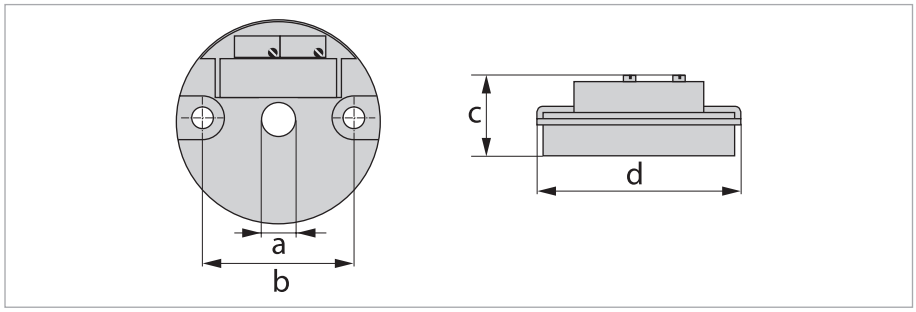
Input	
Pt100 (IEC 60751, α=0.00385)	Type of connection: 3-wire
	Span: 50/100/150/200/300/400/500°C and 100/200/300/400/600/800/1000°F
	Zero point: -50...+50°C / -60...+120°F
	Fine adjustment of span: ±10% of span (±5% for 600, 800 and 1000°F)
Thermocouple	Configuration span: 9 mV to 55 mV continuous Corresponding to: T/C J: 170-950 °C / 305-1710 °F T/C L: 165-900 °C / 300-1620 °F T/C K: 220-1370 °C / 400-2470 °F T/C N: 290-1300 °C / 520-2340 °F T/C T: 200-400 °C / 360-720 °F
	Zero point: ±10% of span
Output	
Output signal	4...20 mA, temperature linear, 2-wire connection 4...20 mA, mV linear, 2-wire connection
Update time	≤ 200 ms
Permissible load	In-head (Non-Ex) and rail-mount transmitter: 700 Ω at 24 VDC and 25 mA
	In-head transmitter (Ex): 620 Ω at 24 VDC and 25 mA
NAMUR compliance	NAMUR NE 21 (for frequencies ≥ 150 kHz)

Approvals and certifications

CE	The device fulfils the statutory requirements of the EC directives. The manufacturer certifies that these requirements have been met by applying the CE marking.
Ex approvals	
Non-Ex version	Without
Ex version (only TT 10 C Ex, RTD version)	Intrinsically safe according to II 1 G Ex ia IIB T4/T5/T6
	ATEX Directive 94/9/EC, harmonized standards EN 60079-0:2006, EN 60079-11:2007 and EN 60079-26:2007
Other standards and approvals	
Electromagnetic compatibility	Directive: 2004/108/EC
	Harmonized standard EN 61326-1:2006

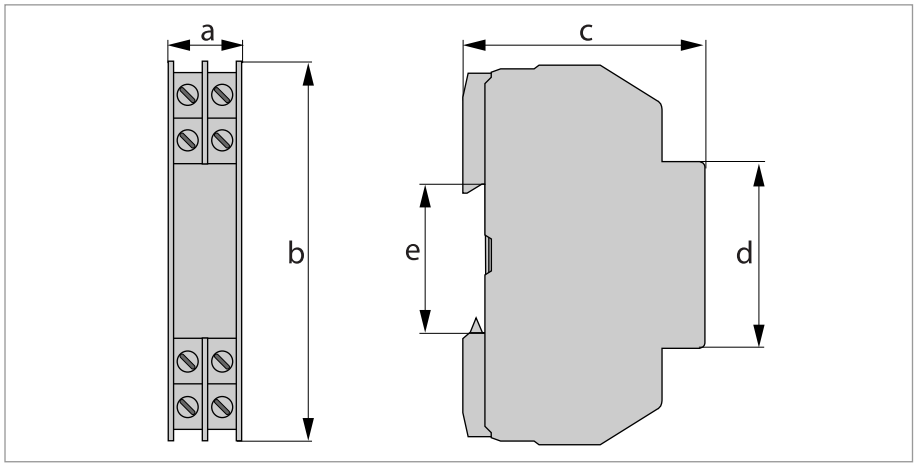
7.3 Dimensions

In-head transmitter (Ex and Non-Ex)



	Dimensions	
	[mm]	[inches]
a	7,5	0.29
b	33	1.30
c	18,5	0.73
d	44	1.73

Rail-mount transmitter (Non-Ex)



	Dimensions	
	[mm]	[inches]
a	17.5	0.69
b	90	3.54
c	58	2.28
d	45	1.77
e	35	1.38

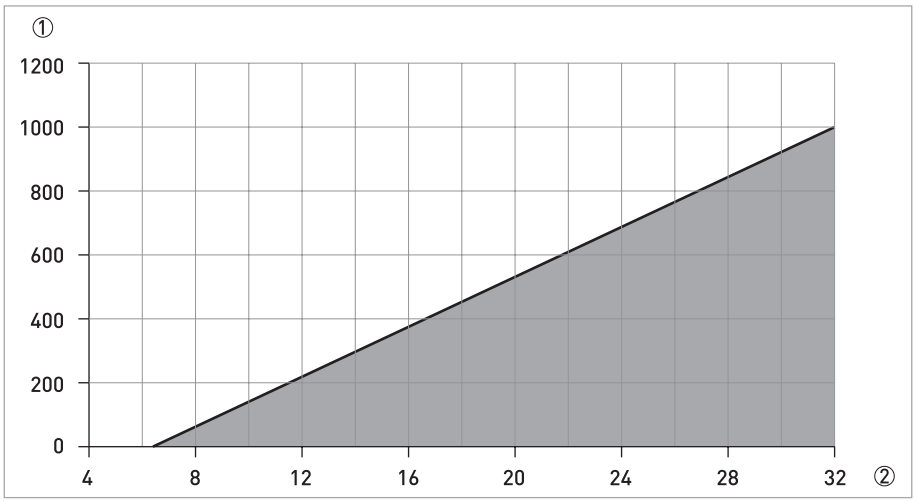
7.4 Temperature data for potentially explosive areas

In-head transmitter (Ex version)

Temperature class	Ambient temperature T_a
T6	$-40°C \leq T_a \leq +40°C$ / $-40°F \leq T_a \leq +104°F$
T5	$-40°C \leq T_a \leq +55°C$ / $-40°F \leq T_a \leq +131°F$
T4	$-40°C \leq T_a \leq +85°C$ / $-40°F \leq T_a \leq +185°F$

7.5 Output load diagrams

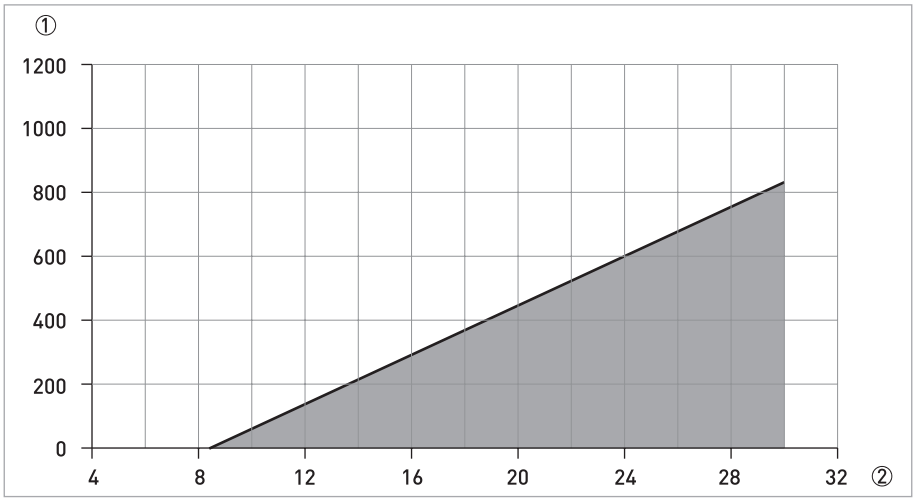
In-head transmitter (Non-Ex)



① Total output load R_{Load} [Ω]
② Supply voltage U [VDC]

Formula for the maximum permissible output load of the in-head version (Non-Ex):
permissible R_{Load} [Ω] = (U-6.5)/0.025

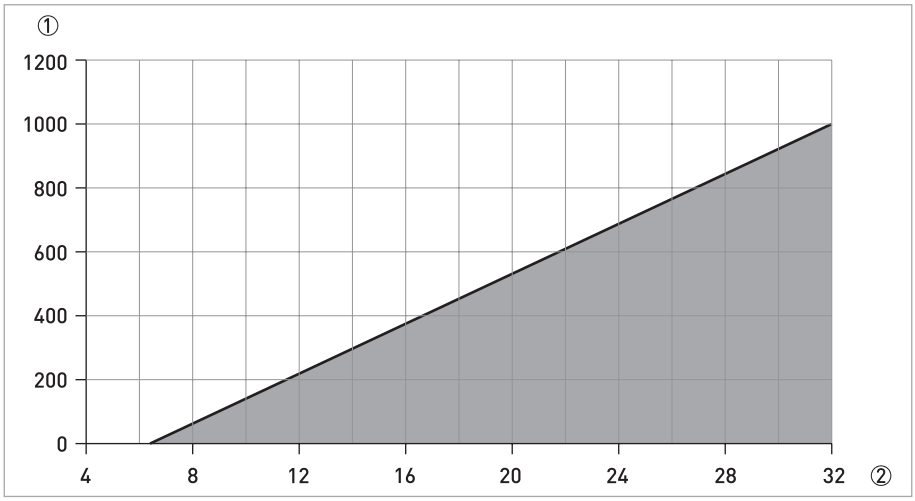
In-head transmitter (Ex)



① Total output load R_{Load} [Ω]
② Supply voltage U [VDC]

Formula for the maximum permissible output load of the in-head version (Ex):
permissible R_{Load} [Ω] = (U-8.5)/0.025

Rail-mount transmitter



① Total output load R_{Load} [Ω]
② Supply voltage U [VDC]

Formula for the maximum permissible output load of the rail-mount version:
permissible R_{Load} [Ω] = (U-6.5)/0.025

7.6 Electrical data for outputs and inputs

In-head transmitter (Ex version)

Output terminals 4, 5			Input terminals 1, 2, 3	
Max. voltage to transmitter	U_i = 30 VDC		Max. voltage from transmitter	U_o = 30 VDC
Max. current to transmitter	I_i = 100 mA		Max. current from transmitter	I_o = 100 mA
Max. power to transmitter	P_i = 700 mW		Max. power from transmitter	P_o = 700 mW
Internal inductance	L_i ~ 10 µH		Max. inductance (input loop)	L_o ~ 12 mH
Internal capacitance	C_i ~ 30 nF		Max. capacitance (input loop)	C_o ~ 220 nF

KROHNE product overview

- Electromagnetic flowmeters
- Variable area flowmeters
- Ultrasonic flowmeters
- Mass flowmeters
- Vortex flowmeters
- Flow controllers
- Level meters
- Temperature meters
- Pressure meters
- Analysis products
- Products and systems for the oil & gas industry
- Measuring systems for the marine industry

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