



OPTITEMP TT 10 C/R **Technical Datasheet**

Analogue 2-wire temperature transmitter

- Temperature linear 4...20 mA output
- Rangeable with solder pads and potentiometers
- Easy wiring through large center hole



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

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1.1 The analogue, adjustable 2-wire temperature transmitter

The **OPTITEMP TT 10** is an analogue, multirange 2-wire temperature transmitter which works together with RTDs of the type Pt100. The main field of application is an industrial environment, therefore the device has a high reliability and an excellent industrial performance.

The **OPTITEMP TT 10** series consists of 2 different versions in terms of the mounting. The **TT 10 R** is the rail-mount version for DIN rails whereas the **TT 10 C** is primarily intended to be mounted in a "B connection head" or larger according to DIN 43729. As an alternative you can also mount the in-head version on a DIN rail according to DIN 50022 / EN 60715 with the help of an optionally available rail mounting kit.

The whole TT 10 transmitter series utilizes a modular design in hardware to ensure the quality and reliability of the transmitter signal output. In the standard delivery condition the transmitters are not preset. Therefore you have to make a complete solder pad configuration before using the devices for the first time. As an option the manufacturer offers preset transmitters according to the customer's order.



- ① In-head transmitter
- ② Rail-mount transmitter

Highlights

- Rangeable with solder pads and potentiometers
- Temperature linear output for Pt100
- Sensor break monitoring
- Short-circuit protected output
- Polarity protected power supply
- Easy wiring, in-head version with large center hole
- In-head version with moulded electronics for high protection
- In-head version optionally available in an intrinsically safe version for installation in hazardous areas (zone 0)

Industries

- Chemicals
- Oil & Gas
- Power industry
- Iron, Steel & Metal
- Pulp & Paper
- Food & Beverage
- Pharmaceuticals

1.2 Options and variants

In-head transmitter (TT 10 C)



The in-head version distinguishes itself by an easy wiring and the large centre hole. The "low profile" housing is extremely durable and facilitates easy connections and adjustments. The transmitter is optionally available in an intrinsically safe version for installation hazardous areas. The nameplate of these transmitters has an "Ex" symbol (TT 10 C Ex), they are approved for use in zone 0.

There are two different installation situations for the in-head version. Primarily it is intended to be mounted in a "B connection head" or larger according to DIN 43729. As an alternative you can also mount it on a DIN rail according to DIN 50022 / EN 60715 with the help of an optionally available rail mounting kit.

Rail-mount transmitter (TT 10 R)



The distinctive feature of the rail-mount version is the combination of a compact housing with an easy wiring and a very economic operation. The rail-mount transmitter is intended for installation on a DIN rail according to DIN 50022 / EN 60715. This allows to group several devices in limited space.

1.3 Resistance thermometer

The transmitter only 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 $3.85 \times 10^{-3} \text{ K}^{-1}$ in the range from 0...+100°C / +32...+212°F.

During operation, a constant current $I (\leq 1 \text{ mA})$ 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).

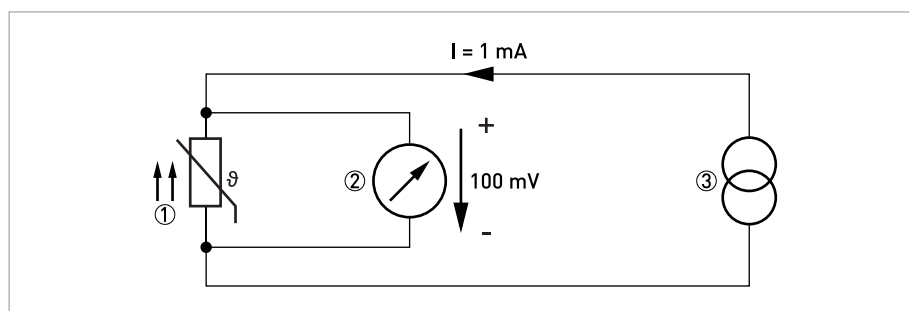


Figure 1-1: Pt100 resistance thermometer in 4-wire connection at 0°C / +32°F, schematic.

- ① Pt100 RTD
- ② Voltage meter
- ③ Current source

2.1 Technical data

- *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 representative.*
- *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.
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Design

Versions	
TT 10 C	In-head transmitter which is optionally available in an intrinsically safe version for installation in potentially explosive areas (zone 0).
TT 10 R	Rail-mount transmitter, not available as intrinsically safe version.
Special feature	
Sensor break monitoring	User-definable output: ≤ 3.6 mA or ≥ 21 mA

Measuring accuracy

Accuracy	Typically $\pm 0.15\%$ of temperature span
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Operating conditions

Temperature	
In-head transmitter	Operating and storage temperature:
	Non-Ex version: $-40\dots+85^{\circ}\text{C}$ / $-40\dots+185^{\circ}\text{F}$ Ex version: $-40\dots+85^{\circ}\text{C}$ / $-40\dots+185^{\circ}\text{F}$ (storage temperature), for detailed information about the ambient temperatures refer to <i>Temperature data for potentially explosive areas</i> on page 10.
Rail-mount transmitter	Operating and storage temperature: $-20\dots+70^{\circ}\text{C}$ / $-4\dots+158^{\circ}\text{F}$
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 DIN 50022 / EN 60715 (refer to <i>Rail mounting kit for in-head transmitters</i> on page 16).
	Rail-mount transmitter: rail according to DIN 50022 / EN 60715, 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 <i>Dimensions</i> on page 9.

Materials

Housing	In-head transmitter: PC (Non-Ex), Zinc alloy + PC (Ex version)
	Rail-mount transmitter: PC
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

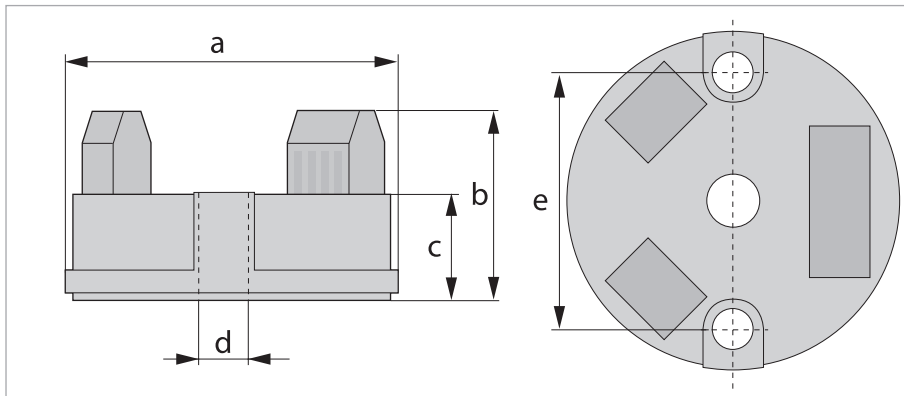
Input	
Pt100 (IEC 60751, $\alpha=0.00385$)	Type of connection: 3-wire
	Span: 50/100/150/200/300/400/500°C and 100/200/300/400/600/800/1000°F
	Zero point: -50...+50°C / -60...+120°F
	Fine adjustment: $\pm 10\%$
Output	
Output signal	4...20 mA, temperature linear, 2-wire connection
Update time	≤ 200 ms
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	Current limitations and failure currents acc. to 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)	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

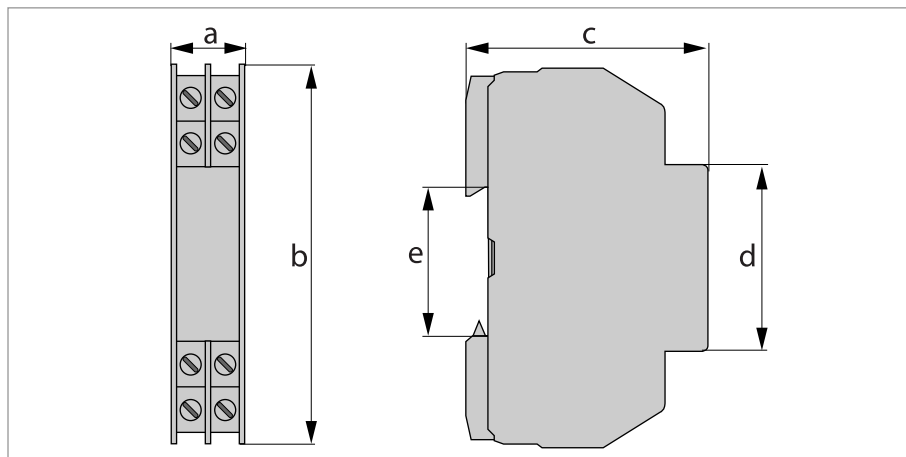
2.2 Dimensions

In-head transmitter (Ex and Non-Ex)



	Dimensions	
	[mm]	[inches]
a	44	1.73
b	26	1.02
c	16	0.63
d	7	0.28
e	33	1.30

Rail-mount transmitter (Ex and 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

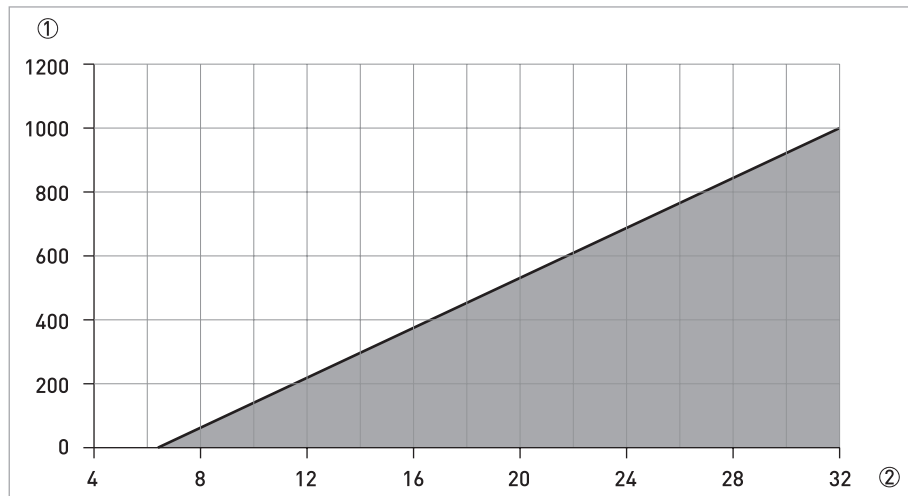
2.3 Temperature data for potentially explosive areas

In-head transmitter (Ex version)

Temperature class	Ambient temperature T_a
T6	$-40^{\circ}\text{C} \leq T_a \leq +50^{\circ}\text{C}$ / $-40^{\circ}\text{F} \leq T_a \leq +122^{\circ}\text{F}$
T5	$-40^{\circ}\text{C} \leq T_a \leq +65^{\circ}\text{C}$ / $-40^{\circ}\text{F} \leq T_a \leq +149^{\circ}\text{F}$
T4	$-40^{\circ}\text{C} \leq T_a \leq +85^{\circ}\text{C}$ / $-40^{\circ}\text{F} \leq T_a \leq +185^{\circ}\text{F}$

2.4 Output load diagrams

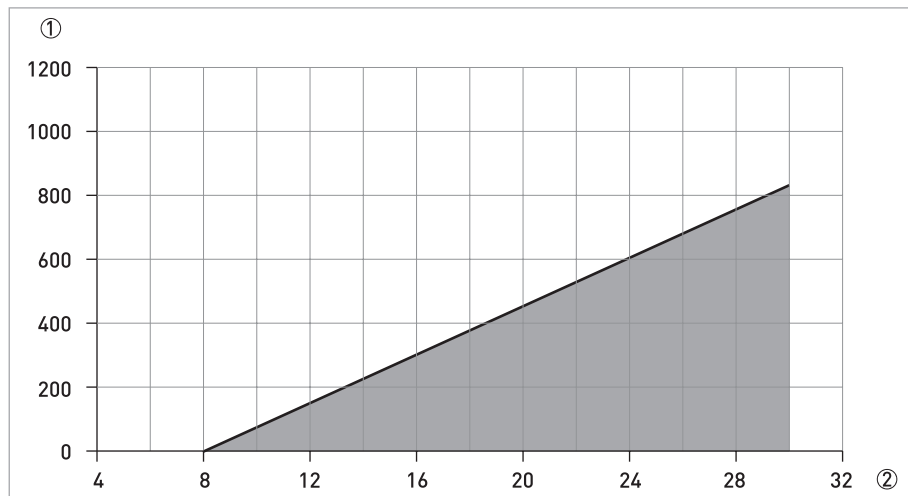
In-head transmitter (Non-Ex)



- 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] = $(U - 6.5) / 0.025$

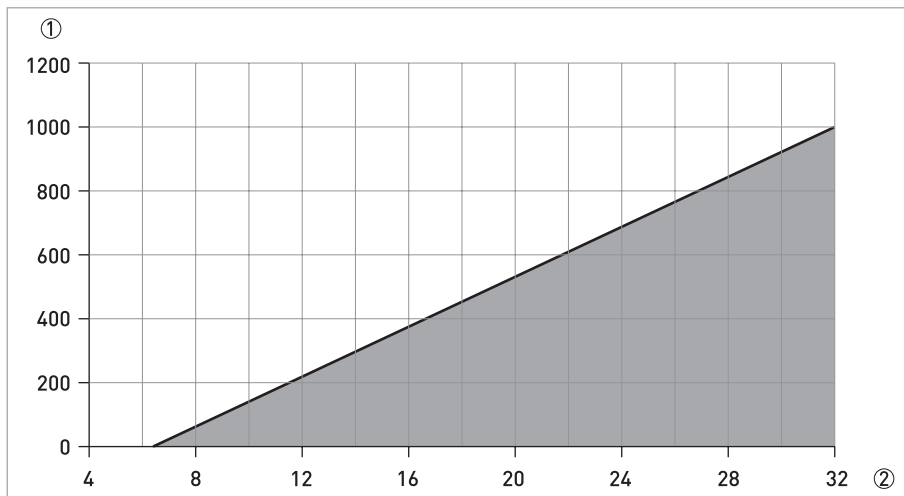
In-head transmitter (Ex)



- 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

2.5 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

3.1 Notes on installation

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

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

Look at the device nameplate to ensure that the device is delivered according to your order. Check for the correct supply voltage printed on the nameplate.

3.2 Intended use

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.

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".

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.

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. The main field of application is an industrial environment.

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

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 supplied by an intrinsically safe power supply unit or a Zener barrier placed outside of the potentially explosive area.*

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 category. For detailed information refer to the section about the temperature data for potentially explosive areas on page 10.*
- *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 $\varnothing 7$ mm / 0.28" 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:

The connection head installation kit does not belong to the standard scope of delivery of the transmitter. All devices which are necessary to mount the transmitter on a measuring insert of the manufacturer belong to the scope of delivery of the measuring insert.

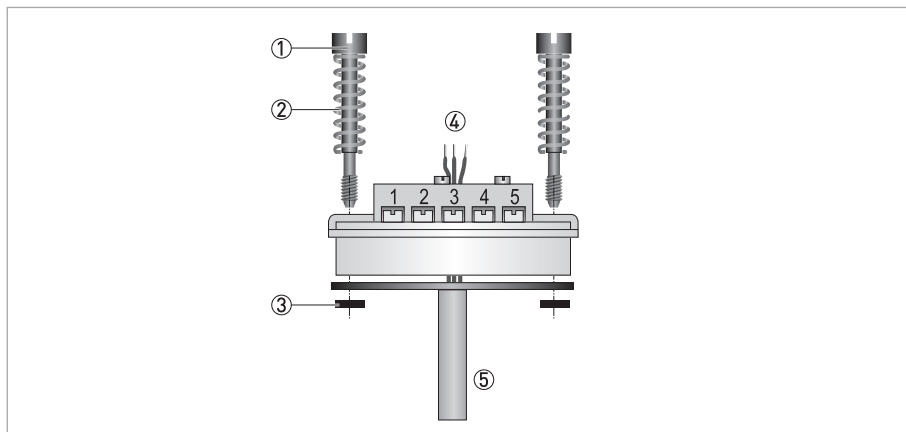


Figure 3-1: Connection head installation kit

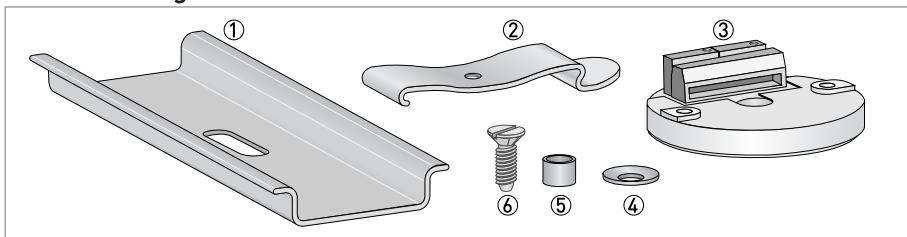
- ① M4 screw
- ② Spring
- ③ Lock washer
- ④ Wires of measuring insert
- ⑤ Sheath

3.4 Rail mounting kit for in-head transmitters

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!

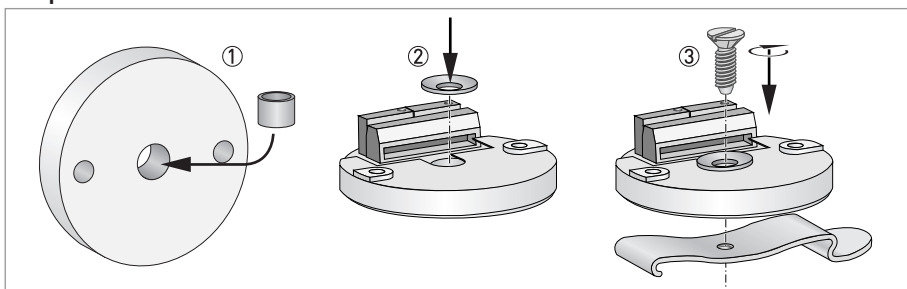
The rail mounting kit allows to install the in-head transmitter on a rail according to DIN 50022. The kit does not belong to the standard scope of delivery, you have to order it separately. For more information refer to the section about the accessory parts in the chapter "Service".

Rail mounting kit for in-head transmitters

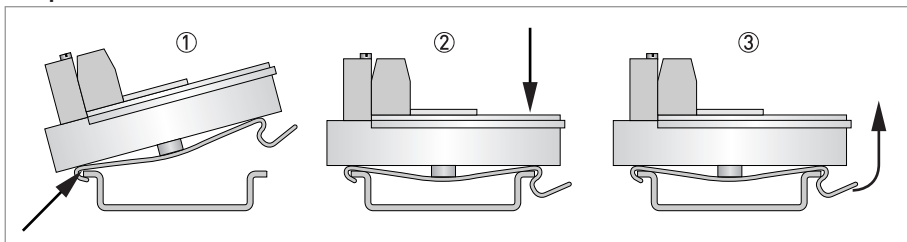


- ① Rail
- ② Clamp
- ③ Transmitter
- ④ Washer
- ⑤ Sleeve
- ⑥ Screw

Step 1



Step 2



3.5 Rail-mount transmitter

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!

The rail-mount transmitter is intended for installation on a rail according to DIN 50022.

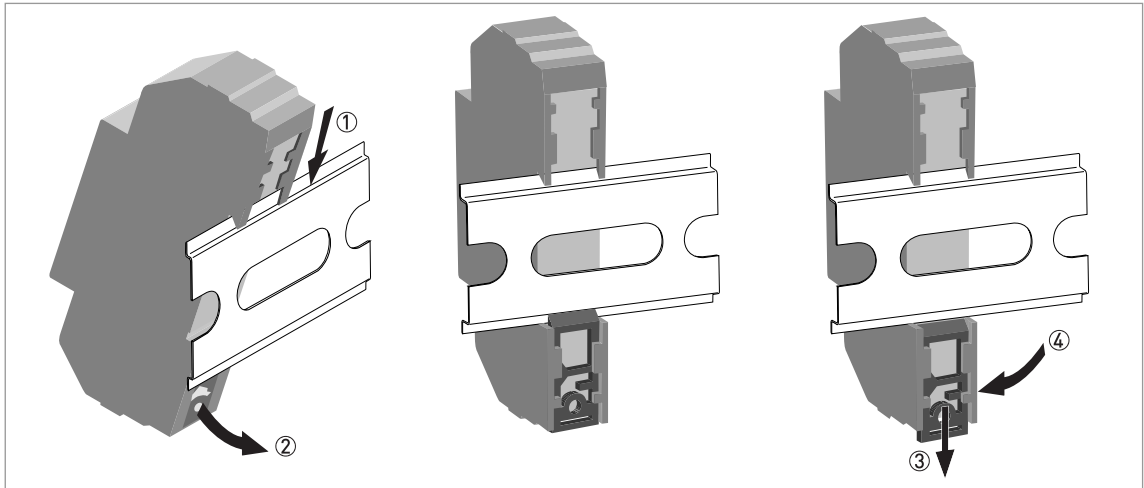


Figure 3-2: Installation of the rail-mount version

- 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

All work on the electrical connections may only be carried out with the power disconnected. Take note of the voltage data on the nameplate!

Observe the national regulations for electrical installations!

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.*

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 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 and the relevant instructions of this document.*

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.

Look at the device nameplate to ensure that the device is delivered according to your order. Check for the correct supply voltage printed on the nameplate.

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.

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

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

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)

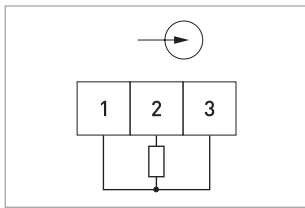


Figure 4-1: Pt100, 3-wire input connection (Ex and Non-Ex version)

4.2.2 Rail-mount transmitter

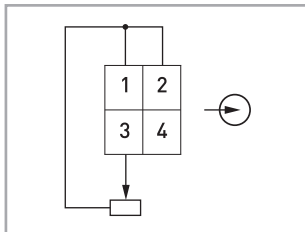


Figure 4-2: Pt100, 3-wire connection

4.3 Electrical connection diagrams

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

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)

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!

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".

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

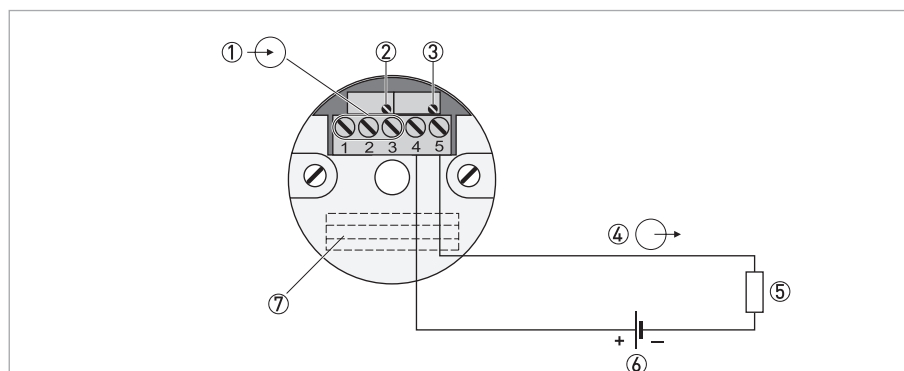


Figure 4-3: Connection diagram of the in-head transmitter (Non-Ex)

- 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)

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 supplied by an intrinsically safe power supply unit or Zener barrier placed outside of the potentially explosive 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).

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".

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

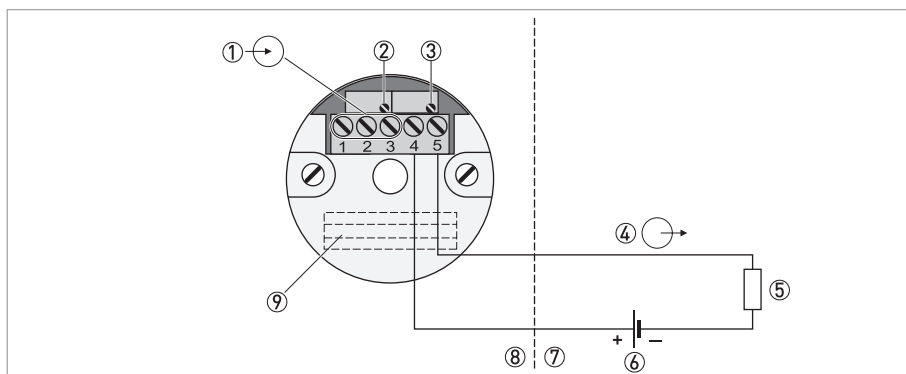


Figure 4-4: Connection diagram of the in-head transmitter (Ex)

- 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

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!

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".

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

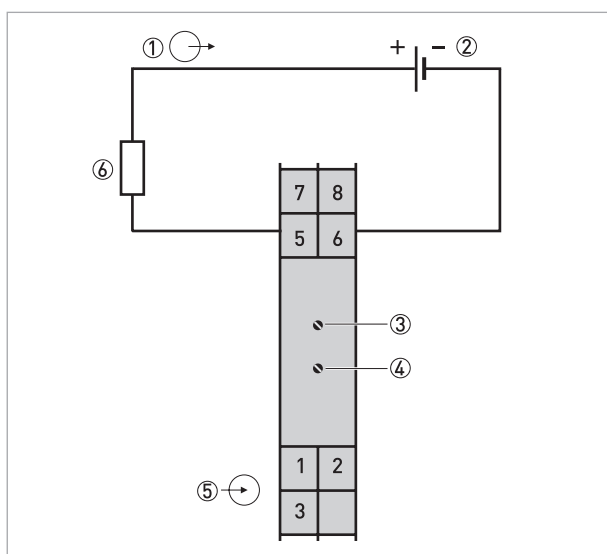


Figure 4-5: Connection diagram of the rail-mount transmitter (2-wire connection)

- 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 Order code

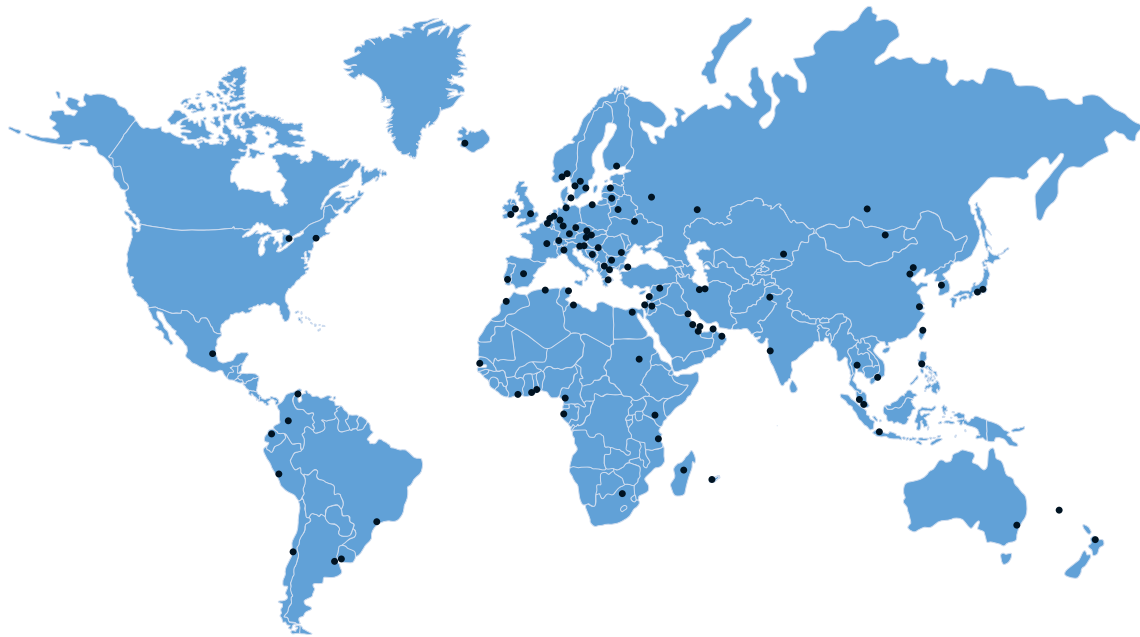
The characters of the order code highlighted in light grey describe the standard.

VTT1	4	Design
	1	Head mounting (type C)
	2	DIN-rail mounting, 35 mm / 1.38" (type R)
		Type
	0	TT 10, analogue, 4...20 mA, only Pt100
		Approvals
	0	Without
	1	ATEX: II 1G Ex ia (only type C)
		Sensor
	0	Without
	3	Pt100 ($\alpha = 0.00385$)
		Wiring
	0	Without
	3	3-wire (1 x sensor)
		Measuring range
	0	Without
	1	-50...+50°C / -58...+122°F
	2	-50...+100°C / -58...+212°F
	3	-50...+150°C / -58...+302°F
	4	0...+50°C / +32...+122°F
	5	0...+100°C / +32...+212°F
	6	0...+150°C / +32...+302°F
	7	0...+200°C / +32...+392°F
	8	0...+250°C / +32...+482°F
	A	0...+300°C / +32...+572°F
	B	0...+350°C / +32...+662°F
	C	0...+400°C / +32...+752°F
	D	0...+450°C / +32...+842°F
	E	0...+500°C / +32...+932°F
VTT1	4	Continued on next page









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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