OPTITEMP TT 12 C/R

Technical Datasheet

2-wire transmitter with NFC™ technology

NFC

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

© KROHNE 01/2022 - 4008246602 – TD OPTITEMP TT12CR R02 en

KROHNE

1.1 2-wire universal temperature transmitter with NFC™ technology

The OPTITEMP TT 12 signal conditioner is a two-wire transmitter intended to be used in industrial environments and designed for:

- OPTITEMP TT 12 C RTD / OPTITEMP TT 12 R RTD
  Temperature measurements with resistance thermometers
- OPTITEMP TT 12 C TC / OPTITEMP TT 12 R TC
  Temperature measurements with thermocouples

OPTITEMP TT 12 C RTD / OPTITEMP TT 12 C TC
is intended for installation in a DIN B-head or larger according to EN 50446.
OPTITEMP TT 12 R RTD / OPTITEMP TT 12 R TC
is intended for installation on a 35 mm / 1.38 inch DIN-rail according to EN 60715

NFC™ features enables wireless communication and configuration between transmitter and a portable device such a smartphone. Typical characteristics are the high accuracy, stability and reliability.

Highlights

Compact design

- TT 12 C is 10.5 mm high / TT 12 R is 6.3 mm wide.

Long term stability

- Max. of ±0.05 °C or ±0.05% of span per year.

Easy to configure

- Wireless configuration with your smartphone via NFC™.

Highest quality

- Built on our latest transmitter platform to leverage efficiencies.

Designed for harsh conditions

- Designed for up to 10 g vibrations for in-head mounted / 5 g vibrations for rail mounted, 98 % RH (non-condensing).

Application range

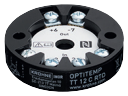
Typical industrial applications are in:

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

1.2 Options and variants

TT 12 C RTD / TT 12 C TC: in-head transmitter

TT 12 C RTD



TT 12 C TC

The TT 12 C RTD and TT 12 C TC is a non-isolated, 2-wire in-head transmitter for temperature measurements in an industrial environment.
The TT 12 C RTD and TT 12 C TC is intended for installation in a DIN B head or larger according to DIN EN 50446.

TT 12 R RTD / TT 12 R TC: rail-mount transmitter

TT 12 R RTD

TT 12 R TC

The TT 12 R RTD and TT 12 R TC is a non-isolated, 2-wire rail-mount transmitter for temperature measurements in an industrial environment.
The TT 12 R RTD and TT 12 R TC is intended for installation on a DIN rail according to EN 60715, 35 mm / 1.38 inch.

1.3 Measuring principles

The kind of measuring principle depends on the measuring insert that you combine with the transmitter. In matters of the sensor assembly type the manufacturer offers two different measuring inserts, either with a resistance sensor assembly or with a thermocouple.

1.3.1 Resistance temperature sensor

The measuring insert with a temperature-sensitive sensor made from a platinum(Pt) 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 temperature sensors to measure temperature. The "Pt100" temperature sensors 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 temperature assembly is 100 Ω (100 mV / 1 mA = 100 Ω).

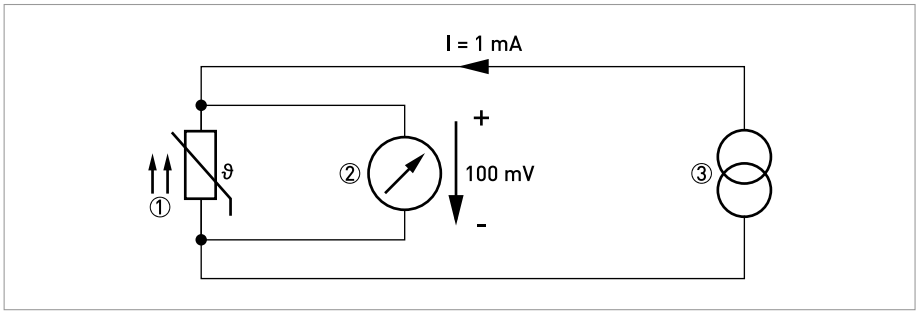


Figure 1-1: Pt100 resistance temperature sensor at 0°C / +32 °F, schematic

① Pt100 RTD
② Voltage meter
③ Current source

1.3.2 Thermocouples

The thermocouple features two electric conductors made from different metals, connected at one end. Each free end is connected to a compensation cable which is then 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 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.

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

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

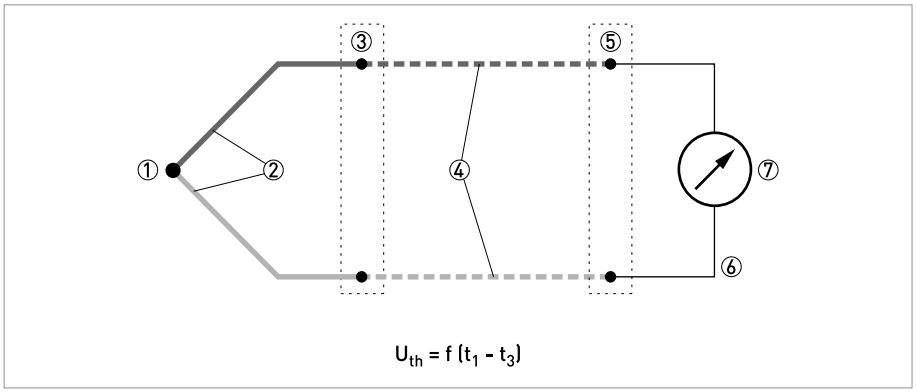


Figure 1-2: Thermocouple measuring circuit, schematic

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}

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 sales office.*
- *Additional information (certificates, special tools, software,...) and complete product documentation can be downloaded free of charge from the website (Downloadcenter).*

Measuring system

Application range	Temperature measurements of solids, liquids and gases in industrial environment.

Design

Versions	
TT 12 C, RTD and TC	In-head transmitters which are intended for installation in a DIN B-head or larger according to DIN EN 50446.
TT 12 R, RTD and TC	Rail-mount transmitters which are intended for installation on a DIN-rail according to EN 60715, 35 mm / 1.38 in.
NFC™	NFC™ enables wireless communication and configuration between transmitter and a portable device such a smartphone.
Configuration counter	Configuration counter stores the revision and date for the configuration downloaded into the transmitter.
Digital filtering	Digital filter to minimize any electronic noise on the line can be set from 0.4.... 26 s.
Error signaling	Error signal either upscale ≥21.0 mA or downscale ≤3.6 mA on the 4...20 mA loop, if the sensor is shortcircuit or broken.
2-wire compensation	Possibility to enter the cable resistance in a two wire RTD circuit to compensate for the wire resistance.

Measuring accuracy

Accuracy & stability	Typical accuracy is max. of ±0.15 °C or ±0.15% of span (Pt100, Pt1000, 3- or 4-wire connection); ±1 °C or ±0.2% of span (TC type E, J, K, N). For detailed information refer to *RTD and TC accuracy table* on page 13
Ambient temperature influence	For detailed information refer to *RTD and TC accuracy table* on page 13.
Supply voltage influence	<±0.005% of span per V.
Long-term drift	Max. of ±0.05 °C or ±0.05% of span per year.

Operating conditions

Temperature	
In-head transmitter	**Operating and storage temperature:** Standard version: -40...+85 °C / -40...+185 °F
Rail-mount transmitter	**Operating and storage temperature:** Standard version: -40...+85 °C / -40...+185 °F
Humidity	0...98% RH (non-condensing)
Protection category	
In-head transmitter	Housing: IP65
	Terminals: IP00
Rail-mount transmitter	Housing: IP20
	Terminals: IP20

Installation conditions

Mounting	In-head transmitter: DIN B-head or larger, DIN-rail (with adapter)
	Rail-mount transmitter: DIN-rail according to EN 60715, 35 mm / 1.38 in
	For detailed information refer to *Installation* on page 14.
Weight	In-head transmitter: 25 g / 0.0551 lb
	Rail-mount transmitter: 40 g / 0.0882 lb
Dimensions	For detailed information refer to *Dimensions* on page 11.

Materials

Housing	In-head transmitter: PC/ABS + PA
	Rail-mount transmitter: PBT
Flammability according to UL	V0

Electrical connections

Power supply	Standard version: 6.0...32 VDC
Connection	In-head transmitter: Single/stranded wires: max. 1.5 mm^2 / AWG 16
	Rail-mount transmitter: Spring cage connection, Single/stranded wires, Max. 2 .5 mm^2 / AWG 24...12
Reverse Polarity Protection	Yes

Inputs / Outputs

Input - RTD	
Pt100 (IEC 60751, α = 0.00385)	-200...+850 °C / -328...+1562 °F
Pt1000 (IEC 60751, α = 0.00385)	-200...+850 °C / -328...+1562 °F
Sensor current	≤100 µA
Maximum sensor wire resistance	**3-wire and 4-wire connection** 50 Ω/wire **2-wire connection** Compensation for 0 to 100 Ω loop resistance
Adjustment	Minimum span 20 °C / 36 °F
Input TC	
TC type B - Pt30Rh-Pt6Rh (IEC 60584)	0...+1820 °C / +32...+3308 °F
TC type E - NiCr-CuNi (IEC 60584)	-270...+1000 °C / -454...+1832 °F
TC type J - Fe-CuNi (IEC 60584)	-210...+1200 °C / -346...+2192 °F
TC type K - NiCr-NiAl (IEC 60584)	-270...+1300 °C / -454...+2372 °F
TC type N - NiCrSi-NiSi (IEC 60584)	-270...+1300 °C / -454...+2372 °F
TC type R - Pt13Rh-Pt (IEC 60584)	-50...+1750 °C / -58...+3182 °F
TC type S - Pt10Rh-Pt (IEC 60584)	-50...+1750 °C / -58...+3182 °F
TC type T - Cu-CuNi (IEC 60584)	-270...+400 °C / -454...+752 °F
Input impedance	>10 MΩ
Wire loop resistance	In-head transmitter (including TC sensor): ≤ 5 kΩ
	Field transmitter (including TC sensor): ≤ 10 kΩ
Cold Junction Compensation (CJC)	Internal or fixed.

Output	
Output signal	4...20 mA, linear temperature.
Permissible load	(Supply voltage U-6.0)/0.022 [Ω]
NAMUR compliance	Output limits and failure currents according to NAMUR NE 43.
Adjustable filtering level	0.4...26 s
Monitoring	Sensor break and short circuit monitoring, selectable, upscale ≥21.0 mA or downscale ≤3.6 mA action, individually configurable.
Configuration	
OPTICHECK Temperature Mobile	The app OPTICHECK Temperature Mobile for portable devices (smartphones) is a versatile and user-friendly tool for wireless configuration through NFC™ technology.

Approvals and certifications

Conformity	This device fulfils the statutory requirements of the relevant directives and regulations. The manufacturer certifies successful testing of the product by applying the conformity marking.
Ex approvals	
Standard version	Without.
Other standards and approvals	
Directive / Regulations	For more information on the directives, regulations, standards, and the approved certifications, please refer to the declaration of conformity which can be downloaded from the manufacturer's website.
Vibration resistance	According to IEC 60068-2-6, test Fc, 10...2000 Hz, 10 g for in-head mounted / 5 g for rail mounted transmitter.

Time response

Switch-on time (time to get the first measured value)	Max. 4 s
Warm-up time, TC	After a max. 20 minutes the accuracy specifications are reached (due to the internal cold junction).
Step response time	Equals filter time.
Filtering	Configurable between 0.4 s and 26 s.
Typical measuring rate	Measured value update approx. 8 measuring / seconds.

2.2 Dimensions

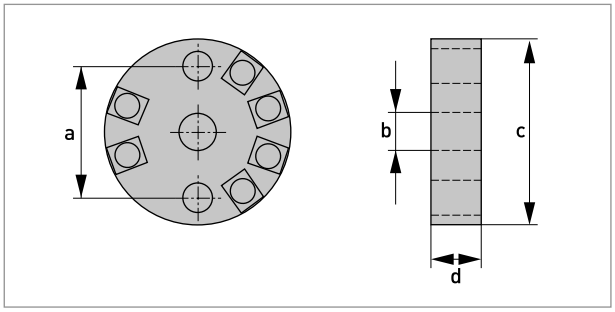


Figure 2-1: In-head transmitter

	Dimensions	
	[mm]	[inch]
a	33.0	1.30
b	7.0	0.28
c	44	1.73
d	10.5	0.41

Table 2-1: Dimensions in mm and inch

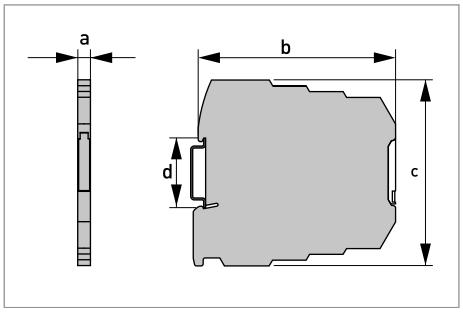


Figure 2-2: Rail-mount transmitter

	Dimensions	
	[mm]	[inch]
a	6.3	0.25
b	101.2	3.98
c	93.1	3.67
d	35	1.38

Table 2-2: Dimensions in mm and inch

2.3 Output load diagram

Formula for the maximum permissible output load for TT 12 C/R:
permissible R_{Load} [Ω] = (U-6.0)/0.022

Standard transmitter

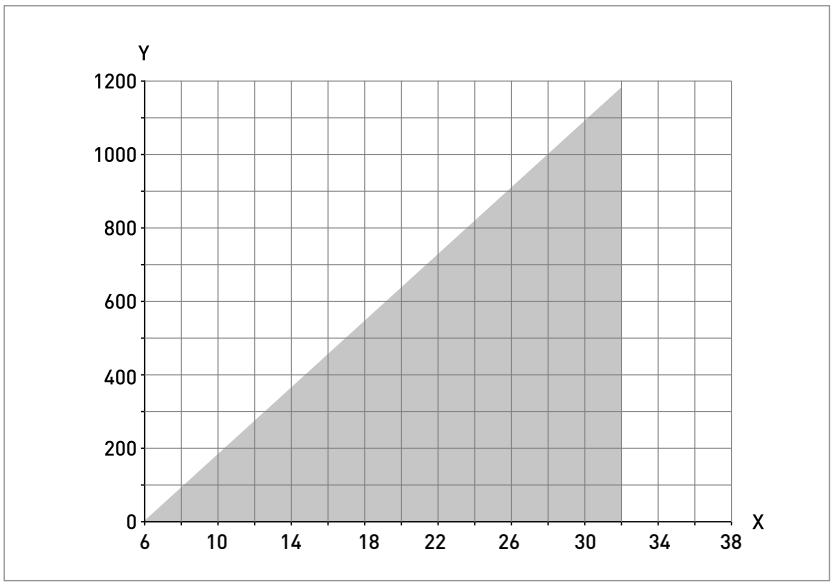


Figure 2-3: Output load diagram

X: Power supply U [VDC]
Y: Total output load R [Ω]

2.4 RTD and TC accuracy table

Typical accuracy ±0.15% of span, max. of ±0.15 K or ±0.15% of span
(Pt100, 3- or 4-wire connection)

CJC error not included

Conformance level 95% (2σ)

Input type	Temp. range	Min. span	Accuracy (maximum of)	Temp. influence (Dev. from ref. temp. 20 °C)
	[°C]	[°C]	[°C]	
RTD Pt100, Pt1000	-200...+850	20	±0.15 °C or ±0.15% of span	±0.015% of span per °C
TC type B	0...+100	700	Not specified	±0.02% of span per °C
TC type B	+100...+400	700	±10 °C ①	±0.02% of span per °C
TC type B	+400...+1820	700	±2 °C or ±0.2% of span ①	±0.02% of span per °C
TC type E	-270...+1000	50	±1 °C or ±0.2% of span ①	±0.02% of span per °C
TC type J	-210...+1200	50	±1 °C or ±0.2% of span ①	±0.02% of span per °C
TC type K	-270...+1300	50	±1 °C or ±0.2% of span ①	±0.02% of span per °C
TC type N	-100...+1300	100	±1 °C or ±0.2% of span ①	±0.02% of span per °C
TC type N	-270...-100	100	±2 °C ①	±0.2% of span per °C
TC type R	-50...+1750	300	±2 °C or ±0.2% of span ①	±0.02% of span per °C
TC type S	-50...+1750	300	±2 °C or ±0.2% of span ①	±0.02% of span per °C
TC type T	-270...+400	50	±2 °C or ±0.2% of span ①	±0.02% of span per °C

Table 2-3: Accuracies in °C
① CJC error not included. CJC typical accuracy ±1 °C, (max ±3 °C), within ambient temperature range

Input type	Temp. range	Min. span	Accuracy (maximum of)	Temp. influence (Dev. from ref. temp. 68 °F)
	[°F]	[°F]	[°F]	
RTD Pt100, Pt1000	-328...+1562	36	±0.27 °F or ±0.15% of span	±0.008% of span per °F
TC type B	+32...+212	1260	Not specified	±0.012% of span per °F
TC type B	+212...+752	1260	±18 °F ①	±0.012% of span per °F
TC type B	+752...+3308	1260	±3.6 °F or ±0.2% of span ①	±0.012% of span per °F
TC type E	-454...+1832	90	±1.8 °F or ±0.2% of span ①	±0.012% of span per °F
TC type J	-346...+2192	90	±1.8 °F or ±0.2% of span ①	±0.012% of span per °F
TC type K	-454...+2372	90	±1.8 °F or ±0.2% of span ①	±0.012% of span per °F
TC type N	-148...+2372	180	±1.8 °F or ±0.2% of span ①	±0.012% of span per °F
TC type N	-454...-148	180	±3.6 °F ①	±0.12% of span per °F
TC type R	-58...+3182	540	±3.6 °F or ±0.2% of span ①	±0.012% of span per °F
TC type S	-58...+3182	540	±3.6 °F or ±0.2% of span ①	±0.012% of span per °F
TC type T	-454...+752	90	±3.6 °F or ±0.2% of span ①	±0.012% of span per °F

Table 2-4: Accuracies in °F
① CJC error not included. CJC typical accuracy ±1.8 °F, (max ±5.4 °F), within ambient temperature range

3.1 In-head transmitter

The transmitter is intended for installation in DIN B connection head or larger.

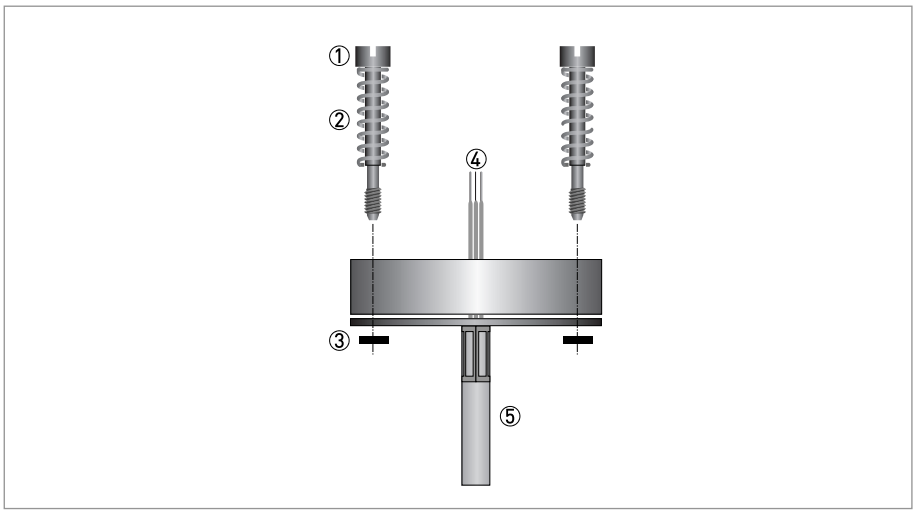


Figure 3-1: Connection head installation kit

① M4 screw
② Spring (Use 20 mm long spring.)
③ Lock washer
④ Wires from the measuring insert
⑤ MI cable

The connection head installation kit does not belong to the standard scope of delivery of the transmitter, you have to order it separately. Order code is 70ADA00017.

The transmitter has been developed for an operating temperature of -40...+85 °C / -40...+185 °F. To avoid destruction or damage of the device, always assure that the operating temperature or ambient temperature does not exceed the permissible range and never fasten the transmitter against a solid back without using a resilient attachment. The thermowell also transfer 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 head transfer via thermowell is to install the transmitter further away from the heat source. Inversely similar measurements can be done if the temperature gets below specified minimum temperature.

3.2 Rail mounting kit for in-head transmitters

The rail mounting kit allows to install the in-head transmitter on a rail according to EN 60715. The kit does not belong to the standard scope of delivery. You have to order it separately. Order code 70ADA00027.

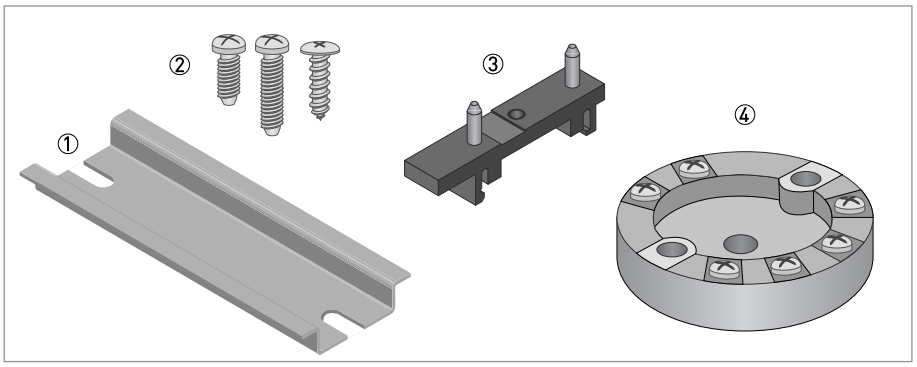


Figure 3-2: Rail mounting kit for in-head transmitters

① Rail (not include in the kit)
② Screws (Use self-tapping 13 mm screw)
③ Clip
④ Transmitter

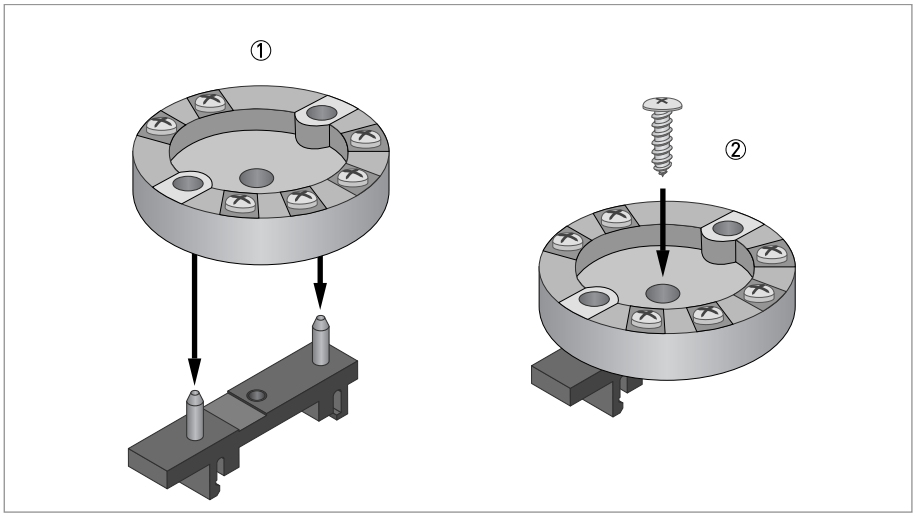


Figure 3-3: Installation procedure: Step 1

① Place the transmitter on the clip.
② Press down the transmitter until it is attached to the clip.
③ Screw the transmitter on to the clip, use max 0.5 Nm moment when tighten the screw.

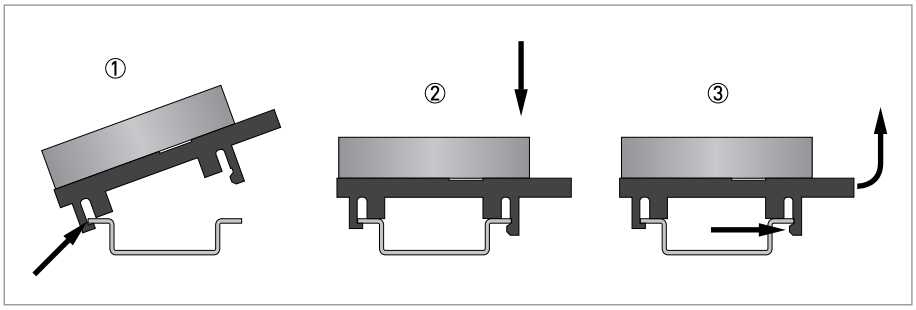


Figure 3-4: Installation procedure: Step 2

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

3.3 Rail-mount transmitter

These transmitters are intended for installation on a 35 mm / 1.38 inch rail according to EN 60715.

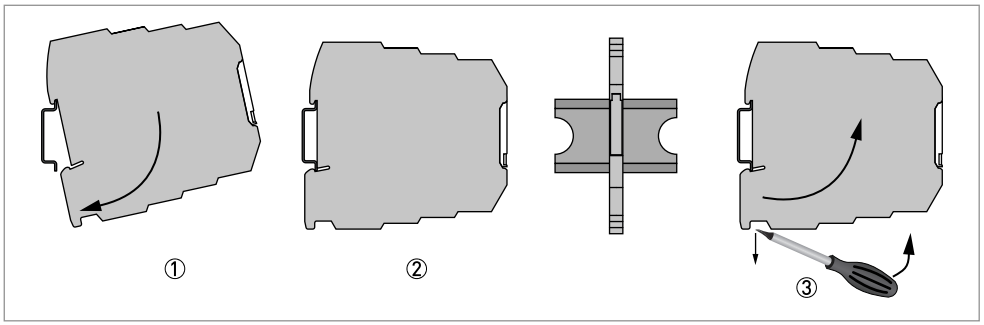


Figure 3-5: Rail installation

① Fix the upper part of the transmitter onto the rail.
② Press the lower part of the transmitter against the rail.
③ To remove the transmitter, bend the locking device using a small screwdriver. Carefully pull the transmitter in the forward direction.

The manufacturer has developed the TT 12 R for an operating temperature range of -40...+85 °C / -40...+185 °F.
To avoid destruction or damage of the device, always note the following items:

- *Assure that the operating temperature or the ambient temperature does not exceed the permissible range.*

4.1 Safety instructions

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

Observe the corresponding regulations, declarations 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.

4.2 Electrical connections of in-head transmitter

The input and output signals and the power supply must be connected in accordance with the following illustrations. The transmitter is easy to install with the connection head installation kit. To avoid measuring errors, all cables must be connected properly and the screws tightened correctly.

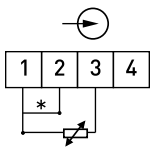
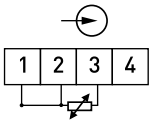
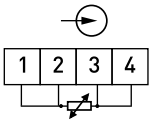
Pt100 and Pt1000 2-wire connection	Pt100 and Pt1000 3-wire connection	Pt100 and Pt1000 4-wire connection
		

Table 4-1: RTD measurement
*Connect terminals 1 and 2 on the transmitter, make the connection as short as possible.

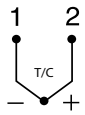
TC connection


Table 4-2: TC measurement

4.3 Connection diagram of in-head transmitter

Always establish the electrical connections according to the following diagrams. Otherwise it can come to destruction or damage of the transmitter. 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 Technical data on page 8.

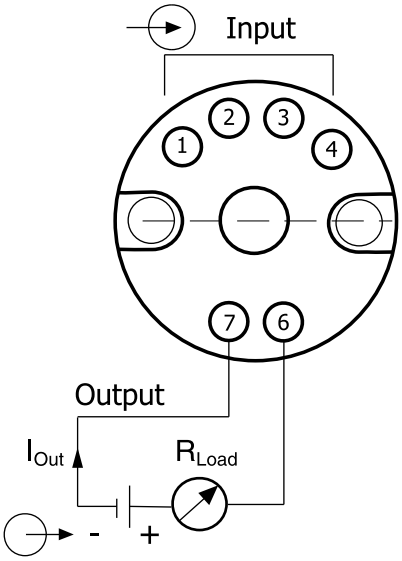


Figure 4-1: Connection diagram for RTD

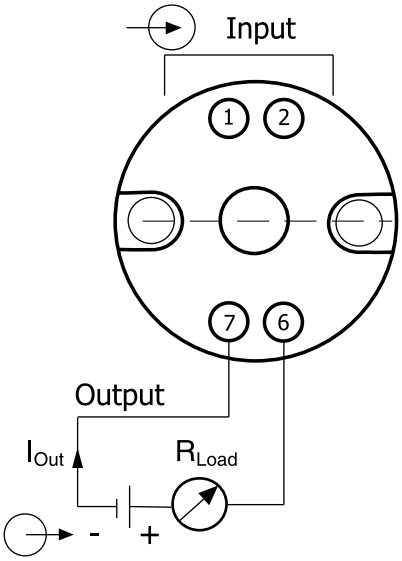


Figure 4-2: Connection diagram for TC

4.4 Electrical connections of rail-mount transmitter

The input and output signals and the power supply must be connected in accordance with the following illustrations. To avoid measuring errors, all cables must be connected properly.

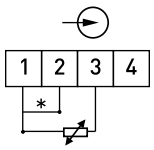
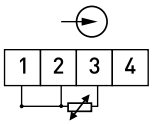
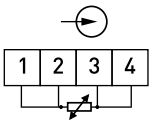
Pt100 and Pt1000 2-wire connection	Pt100 and Pt1000 3-wire connection	Pt100 and Pt1000 4-wire connection
		

Table 4-3: RTD measurement
* Connect terminals 1 and 2 on the transmitter, make the connection as short as possible.

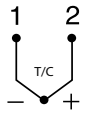
TC connection


Table 4-4: TC measurement

4.5 Connection diagram of rail-mount transmitter

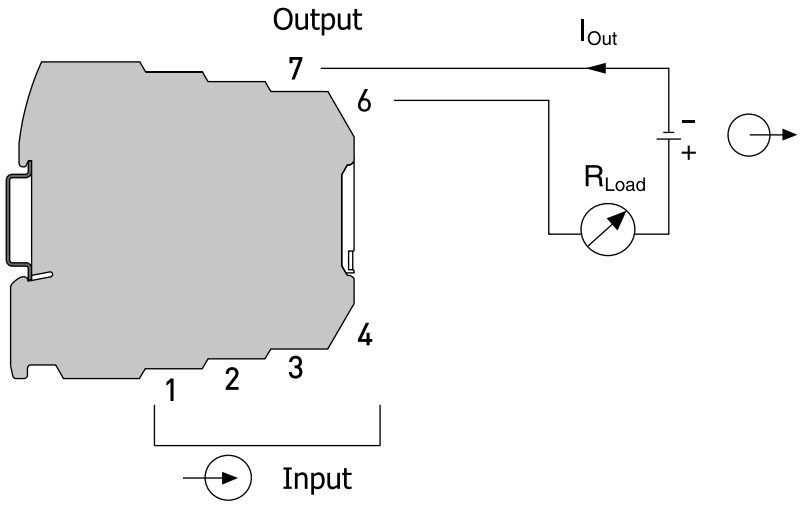


Figure 4-3: Connection diagram for RTD

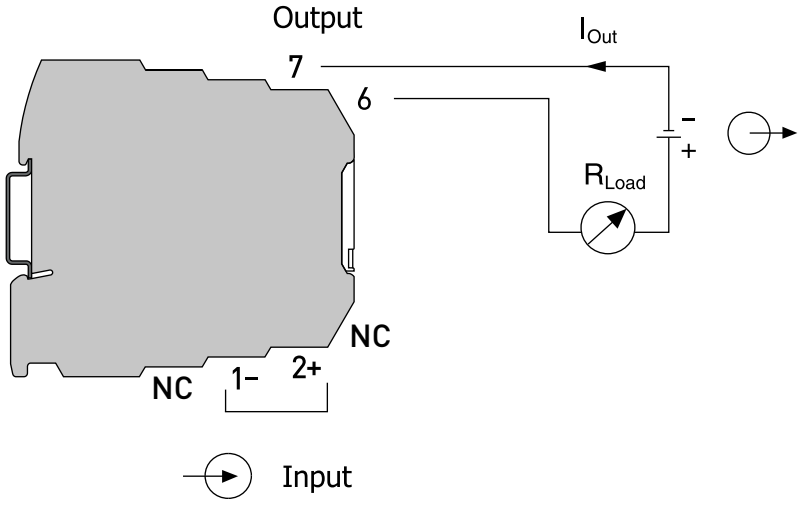


Figure 4-4: Connection diagram for TC

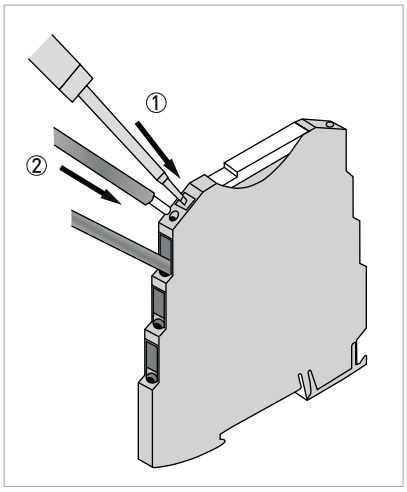


Figure 4-5: Spring-cage connection

To install

① Insert a screwdriver into the opening above the connection terminal block (Use a 2.5 x 50 mm slotted screwdriver.)
② Insert the wire into the corresponding connection terminal block

To remove

① Insert a screwdriver into the opening above the connection terminal block (Use a 2.5 x 50 mm slotted screwdriver.)
② Remove the wire

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					
			4	TT 12 digital, RTD transmitter				
			5	TT 12 digital, TC transmitter				
				Approvals				
				0	Without			
					Sensor type			
					0	Without		
					3	Pt100 (α = 0.00385)		
					8	Pt1000 (α = 0.00385)		
					B	Thermoelement type-B		
					E	Thermoelement type-E		
					H	Thermoelement type-J		
					K	Thermoelement type-K		
					N	Thermoelement type-N		
					R	Thermoelement type-R		
					S	Thermoelement type-S		
					T	Thermoelement type-T		
						Sensor Wiring		
						0	Without	
						2	2-wire (1 x sensor)	
						3	3-wire (1 x sensor)	
						4	4-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					
							F	0...+600°C / +32...+1112°F					
							G	0...+800°C / +32...+1472°F					
							H	0...+1000°C / +32...+1832°F					
							K	0...+1200°C / +32...+2192°F					
							Z	Customized					
								Certificates					
								0	Without				
									Accessories / phys. characteristics				
									0	Without			
									1	Head-mounted transmitter assembled to DIN-rail clip, 35mm			
									2	Assembly kit for in-head mounting (spring-load)			
										Calibration certificate			
										0	Without		
										2	2 points (0 and 100%)		
										3	3 points (0, 50 and 100%)		
										4	5 points (0, 25, 50, 75 and 100%)		
										5	11 points (0, 10, ..., 100%)		
										Z	Customized		
											Manuals		
											0	Without	
											1	German	
											3	English	
											4	French	
											5	Spanish	
											G	German / English	
												Private label	
												0	KROHNE Standard Version
VTT1	4												**Complete order code**

KROHNE – Products, Solutions and Services

- Process instrumentation for flow, level, temperature, pressure measurement and process analytics
- Flow metering, monitoring, wireless and remote metering solutions
- Engineering, commissioning, calibration, maintenance and training services

Head Office KROHNE Messtechnik GmbH
Ludwig-Krohne-Str. 5
47058 Duisburg (Germany)
Tel.: +49 203 301 0
Fax: +49 203 301 10389
info@krohne.de

The current list of all KROHNE contacts and addresses can be found at:
www.krohne.com

© KROHNE 01/2022 - 4008246602 – TD OPTITEMP TT12CR R02 en - Subject to change without notice.