

## OPTITEMP TT 50 C/R Technical Datasheet

HART<sup>®</sup>-compatible, intelligent two-wire transmitter

- Fully universal and isolated
- 50 point linearisation
- Sensor isolation monitoring (SmartSense)



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## 1.1 The universal, 2-wire temperature transmitter

The TT 50 is a universal, HART® 5 compatible 2-wire transmitter for temperature, resistance or voltage measurements in an industrial environment.

The TT 50 series consists of 2 different versions. The TT 50 R is the rail-mount version whereas TT 50 C is primarily intended to be mounted in a "B connection head" or larger according to DIN 43729. Both versions are compatible with the HART® 5 protocol.

The whole TT 50 transmitter series utilizes a modular design in hardware as well as in software to ensure the quality and reliability of the transmitter signal output.



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

**Highlights**

- Fully universal and isolated
- Accepts RTD, TC, mV and  $\Omega$
- SmartSense feature allows low sensor isolation detection
- Sensor break detection
- Sensor error correction
- 50 point linearisation, matches any sensor
- Easy configuration, installation and maintenance via a HART-modem and a PC with the software "HartSoft" (HART<sup>®</sup> 5 protocol), a hand held communicator or EDD enabled device management systems
- In-head version optionally available in an intrinsically safe version for installation in hazardous areas (zone 0, 1 and 2)

**Industries**

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



## 1.3 Measuring principles

The kind of the measuring principle depends on the measuring insert that you combine with the transmitter. In matters of the thermometer type the manufacturer offers two different measuring inserts, either with a resistance thermometer or with a thermocouple. For more information refer to the handbook of the measuring inserts or the handbook of the industrial thermometers.

### 1.3.1 Resistance thermometer

The measuring insert with a resistance thermometer 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).

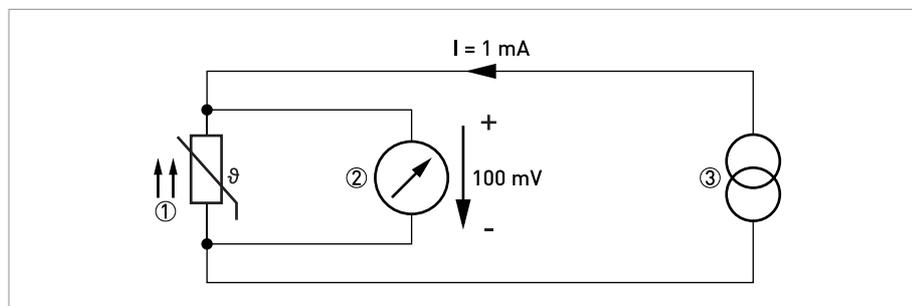


Figure 1-1: Pt100 resistance thermometer in 4-wire connection at 0°C / +32°F, schematic.

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

### 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.*

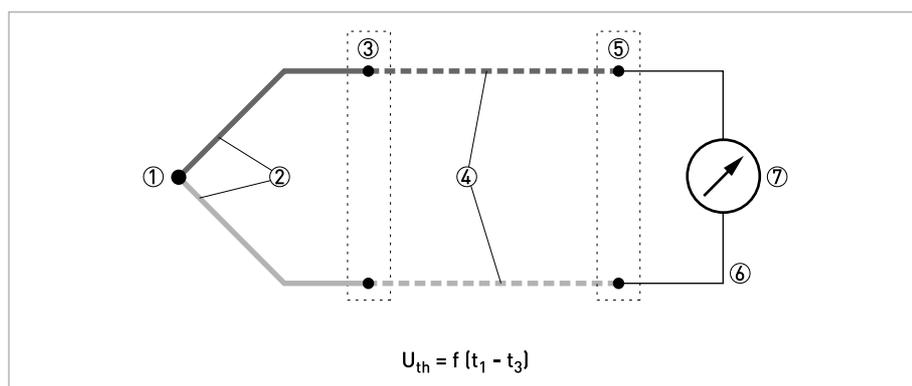


Figure 1-2: Thermocouple measuring circuit, schematic.

- 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 (Download Center).*

### Measuring system

Application range	Temperature, resistance or voltage measurements of solids, liquids and gases in industrial environment.
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### Design

Versions	
TT 50 C	In-head transmitter which is intended for installation in a "B connection head" or larger according to DIN 43729. This transmitter is optionally available in an intrinsically safe version for installation in potentially explosive areas (TT 50 C Ex).
TT 50 R	Rail-mount transmitter which is intended for installation on a top-hat rail according to DIN 50022 / EN 60715.
Features	
HART® 5 compliance	The transmitter are fully compliant with the HART® 5 protocol. HART® 5 offers the possibility to receive diagnostic information such as sensor errors or sensor conditions.
Sensor isolation monitoring	The isolation resistance of thermocouples and RTD's as well as the cabling between sensor and transmitter is being monitored. If the isolation is below a user-defined level, this will be indicated in HartSoft and with a diagnostic HART® message, and the output signal can be forced upscale or downscale. This feature requires an extra lead inside the thermocouple or RTD.
Customized linearization	For resistance and mV inputs, the 50-point customized linearization can provide a correct process value, in a choice of engineering units, for a sensor with non-linear input/output relation.
Sensor break monitoring	User-definable output: 3.6...22.8 mA.

### Measuring accuracy

Accuracy	RTD and thermocouple: for detailed information refer to <i>RTD and TC accuracy table</i> on page 16.
	Resistance: $\pm 0.1 \Omega$ or $\pm 0.1\%$ of span
	Voltage: $\pm 20 \mu\text{V}$ or $\pm 0.1\%$ of span
Temperature influence	RTD and thermocouple: for detailed information refer to <i>RTD and TC accuracy table</i> on page 16.
	Resistance: $\pm 0.01\%$ of span per °C or °F
	Voltage: $\pm 0.01\%$ of span per °C or °F

Cold Junction Compensation (CJC)	<b>In-head transmitter:</b>
	Celsius: $\pm 0.5^{\circ}\text{C}$ within ambient temperature $-40\dots+85^{\circ}\text{C}$
	Fahrenheit: $\pm 0.9^{\circ}\text{F}$ within ambient temperature $-40\dots+185^{\circ}\text{F}$
	<b>Rail-mount transmitter:</b>
	Celsius: $\pm 0.5^{\circ}\text{C}$ within ambient temperature $-20\dots+70^{\circ}\text{C}$
	Fahrenheit: $\pm 0.9^{\circ}\text{F}$ within ambient temperature $-4\dots+158^{\circ}\text{F}$
Temperature influence CJC	$\pm 0.02^{\circ}\text{C}$ per $^{\circ}\text{C}$ / $\pm 0.02^{\circ}\text{F}$ per $^{\circ}\text{F}$
Sensor wire influence	RTD and resistance, 2-wire: adjustable wire resistance compensation.
	RTD and resistance, 3-wire: negligible, with equal wire resistance.
	RTD and resistance, 4-wire: negligible.
	Thermocouple and voltage: negligible.
Supply voltage influence	Negligible
Long-term drift	$\pm 0.1\%$ of span per year

### Operating conditions

<b>Temperature</b>	
In-head transmitter	<b>Operating and storage temperature:</b>
	Standard version: $-40\dots+85^{\circ}\text{C}$ / $-40\dots+185^{\circ}\text{F}$
	Intrinsically safe version: for detailed information refer to <i>Temperature data for potentially explosive areas</i> on page 15.
Rail-mount transmitter	<b>Storage temperature:</b>
	$-40\dots+85^{\circ}\text{C}$ / $-40\dots+185^{\circ}\text{F}$
	<b>Operating temperature:</b>
	$-20\dots+70^{\circ}\text{C}$ / $-4\dots+158^{\circ}\text{F}$
Humidity	5...95% RH (non-condensing)
<b>Protection category</b>	
In-head transmitter	Housing: IP50
	Terminals: IP10
Rail-mount transmitter	Housing: IP20
	Terminals: IP00

### Installation conditions

Mounting	In-head transmitter: DIN B-head or larger, DIN-rail (with adapter).
	Rail-mount transmitter: rail acc. to DIN 50022 / EN 60715, 35 mm / 1.38".
	For detailed information refer to chapter "Installation".
Weight	In-head transmitter: 50 g / 0.11 lb
	Rail-mount transmitter: 70 g / 0.15 lb
Dimensions	For detailed information refer to <i>Dimensions</i> on page 12.

## Materials

Housing and flammability acc. to UL	In-head transmitter: PC + ABS (V0), polyamide (V2)
	Rail-mount transmitter: PC + glassfibre (V0)

## Electrical connections

Power supply	In-head transmitter: 10...42 VDC
	Rail-mount transmitter: 11...42 VDC
	Intrinsically safe version: 12...30 VDC at maximum of 100 mA and 0.9 W.
Isolation	1500 VAC, 1 min
Connection	Single/stranded wires: max. 1.5 mm <sup>2</sup> / AWG 16

## Inputs / Outputs

<b>Input - RTD</b>	
Pt100 (IEC 60751, $\alpha=0.00385$ )	-200...+1000°C / -328...+1832°F
Pt100 (JIS C 1604-8, $\alpha=0.003916$ )	
PT X ( $10 \leq X \leq 1000$ ) (IEC 60751, $\alpha=0.00385$ )	Corresponding to max. 2000 $\Omega$
Ni100 (DIN 43760, $\alpha=0.006180$ )	-60...+250°C / -76...+482°F
Ni1000 (DIN 43760, $\alpha=0.006180$ )	-60...+150°C / -76...302°F
Sensor current	Circa 400 $\mu$ A
Maximum sensor wire resistance	25 $\Omega$ /wire
<b>Input - resistance / potentiometer</b>	
Range, resistance	0...2000 $\Omega$
Range, potentiometer	0...2000 $\Omega$
Minimum span	10 $\Omega$
Customized linearization	Up to 50 points
Sensor current	Circa 400 $\mu$ A
Maximum sensor wire resistance	25 $\Omega$ /wire
<b>Input - thermocouples</b>	
T/C type B - Pt30Rh-Pt6Rh (IEC 60584)	+400...+1800°C / +752...+3272°F
T/C type E - NiCr-CuNi (IEC 60584)	-200...+1000°C / -328...+1832°F
T/C type J - Fe-CuNi (IEC 60584)	
T/C type K - NiCr-Ni (IEC 60584)	-200...+1350°C / -328...+2442°F
T/C type L - Fe-CuNi (DIN 43710)	-200...+900°C / -328...+1652°F
T/C type U - Cu-CuNi (DIN 43710)	-200...+600°C / -328...+1112°F
T/C type N - NiCrSi-NiSi (IEC 60584)	-100...+1300°C / -148...+2372°F
T/C type R - Pt13Rh-Pt (IEC 60584)	-50...+1750°C / -58...+3182°F
T/C type S - Pt10Rh-Pt (IEC 60584)	
T/C type T - Cu-CuNi (IEC 60584)	-200...+400°C / -328...+752°F
Input impedance	>10 M $\Omega$
Cold Junction Compensation (CJC)	Internal, external (Pt100) or fixed

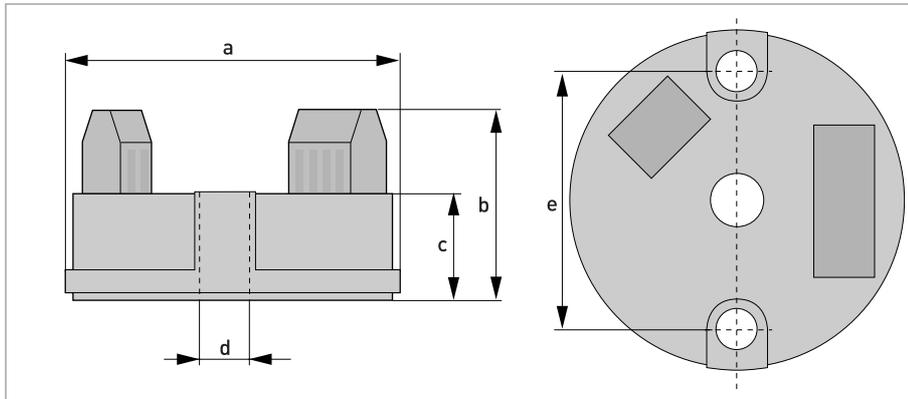
<b>Input - voltage</b>	
Range	-10...+500 mV
Minimum span	2 mV
Customized linearization	Up to 50 points
Input impedance	>10 M $\Omega$
Maximum wire loop resistance	500 $\Omega$
<b>Output</b>	
Output signal	4...20 mA, 20...4 mA or customized
	Temperature linear for RTD & T/C
HART <sup>®</sup> protocol	HART <sup>®</sup> 5
Adjustable output filtering	0...10 s (time constant)
Permissible load	Note: Communication according to HART <sup>®</sup> always requires a resistance greater than 250 $\Omega$ ! For TT 50 C Ex and TT 50 R a greater load than the below-mentioned is allowed with a higher supply voltage, see output load diagram.
	TT 50 C: 610 $\Omega$ at 24 VDC and 23 mA
	TT 50 C Ex: 520 $\Omega$ at 24 VDC and 23 mA
	TT 50 R: 565 $\Omega$ at 24 VDC and 23 mA.
<b>Configuration</b>	
HartSoft	The PC configuration software "HartSoft" is a versatile and user-friendly tool for transmitter configuration, loop check-up and sensor diagnostics. It runs on Windows 2000, XP and Vista.
Alternatives	Hand held communicator, e.g. FC375/FC475 (Emerson)
	Management systems, e.g. AMS (Emerson) and PDM (Siemens)
	EDD enabled systems

### 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.
Intrinsically safe version	ATEX: II 1 G Ex ia IIC T4/T5/T6
Electromagnetic compatibility	Directive: 2004/108/EC.
	Harmonized standards: EN 61326-1:2006.

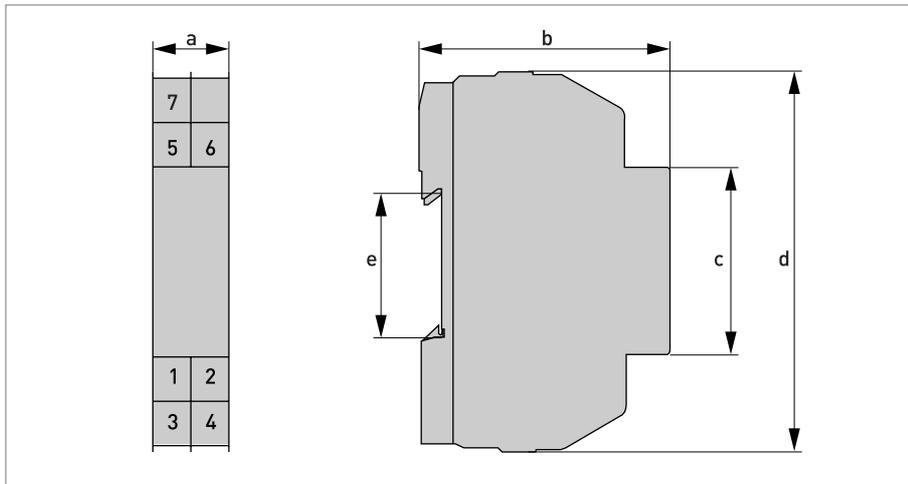
## 2.2 Dimensions

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



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

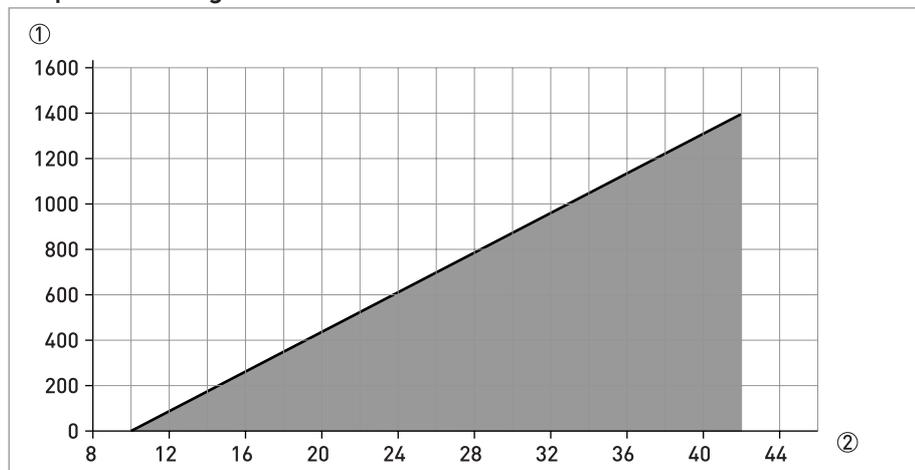
### Rail-mount transmitter



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

## 2.3 Output load diagrams

Output load diagram TT 50 C

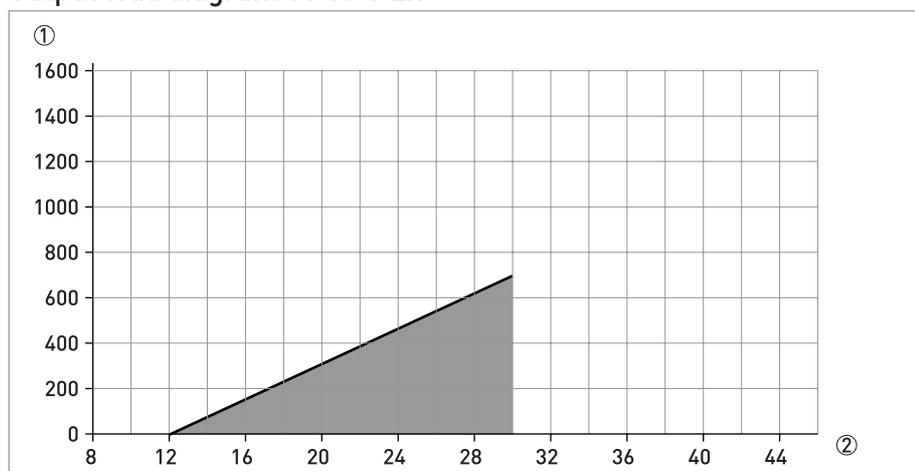


① R: total output load in  $\Omega$

② U: supply voltage in VDC

Formula for the maximum permissible output load of the TT 50 C:  
 permissible  $R_{Load} [\Omega] = (U-10)/0.023$

Output load diagram TT 50 C Ex



① R: total output load in  $\Omega$

② U: supply voltage in VDC

Formula for the maximum permissible output load of the TT 50 C Ex:  
 permissible  $R_{Load} [\Omega] = (U-12)/0.023$

Output load diagram TT 50 R



- ① R: total output load in  $\Omega$   
 ② U: supply voltage in VDC

Formula for the maximum permissible output load of the TT 50 R:  
 permissible  $R_{Load} [\Omega] = (U-11)/0.023$

## 2.4 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	$-40^{\circ}\text{C} \leq T_a \leq +85^{\circ}\text{C}$ / $-40^{\circ}\text{F} \leq T_a \leq +185^{\circ}\text{F}$

## 2.5 Electrical data for outputs and inputs

### In-head transmitter (Ex-version)

Output (supply)		Input (sensor)	
Max. voltage to transmitter	$U_i = 30 \text{ VDC}$	Max. voltage from transmitter	$U_o = 30 \text{ VDC}$
Max. current to transmitter	$I_i = 100 \text{ mA}$	Max. current from transmitter	$I_o = 25 \text{ mA}$
Max. power to transmitter	$P_i = 900 \text{ mW}$	Max. power from transmitter	$P_o = 190 \text{ mW}$
Internal inductance	$L_i = 1 \text{ mH}$	Max. inductance (input loop)	$L_o = 19 \text{ mH}$
Internal capacitance	$C_i = 1 \text{ nF}$	Max. capacitance (input loop)	$C_o = 31 \text{ nF}$

## 2.6 RTD and TC accuracy table

- *Conformance level 95% (2 $\sigma$ )*
- *CJC = Cold Junction Compensation*

### Accuracies in °C

Input type	Temp. range	Min. span	Accuracy	Temp. influence (Dev. from ref. temp. 20°C)
	[°C]		[°C]	
RTD Pt100	-200...+1000	10	$\pm 0.2^\circ\text{C}$ or $\pm 0.1\%$ of span	$\pm 0.01\%$ of span per °C
RTD Ni100	-60...+250	10	$\pm 0.2^\circ\text{C}$ or $\pm 0.1\%$ of span	$\pm 0.01\%$ of span per °C
TC type J	-200...+1000	50	$\pm 0.3^\circ\text{C}$ or $\pm 0.1\%$ of span ①	$\pm 0.01\%$ of span per °C
TC type K	-200...+1350	50	$\pm 0.5^\circ\text{C}$ or $\pm 0.1\%$ of span ①	$\pm 0.01\%$ of span per °C
TC type S	-50...+1750	300	$\pm 2.0^\circ\text{C}$ or $\pm 0.1\%$ of span ①	$\pm 0.01\%$ of span per °C
TC type B	+400...+1800	700	$\pm 2.0^\circ\text{C}$ or $\pm 0.1\%$ of span ①	$\pm 0.01\%$ of span per °C

① CJC error is not included

### Accuracies in °F

Input type	Temp. range	Min. span	Accuracy	Temp. influence (Dev. from ref. temp. 68°F)
	[°F]		[°F]	
RTD Pt100	-328...+1832	50	$\pm 0.4^\circ\text{F}$ or $\pm 0.1\%$ of span	$\pm 0.006\%$ of span per °F
RTD Ni100	-76...+482	50	$\pm 0.4^\circ\text{F}$ or $\pm 0.1\%$ of span	$\pm 0.006\%$ of span per °F
TC type J	-328...+1832	122	$\pm 0.5^\circ\text{F}$ or $\pm 0.1\%$ of span ①	$\pm 0.006\%$ of span per °F
TC type K	-328...+2462	122	$\pm 0.9^\circ\text{F}$ or $\pm 0.1\%$ of span ①	$\pm 0.006\%$ of span per °F
TC type S	-58...+3182	572	$\pm 3.6^\circ\text{F}$ or $\pm 0.1\%$ of span ①	$\pm 0.006\%$ of span per °F
TC type B	+752...+3272	1292	$\pm 3.6^\circ\text{F}$ or $\pm 0.1\%$ of span ①	$\pm 0.006\%$ of span per °F

① CJC error is not included

### 3.1 Intended use

#### TT 50 C

The TT 50 C is an intelligent, universal HART®-compatible 2-wire in-head transmitter for temperature, resistance or voltage measurements in an industrial environment.

The transmitter is optionally available in an intrinsically safe version for installation in potentially explosive areas. These devices are labeled with the "Ex" symbol (TT 50 C Ex) and are approved for use in zone 0, 1 and 2 and division 1 and 2.

All versions are intended for installation in a "B connection head" or larger according to DIN 43729.

#### TT 50 R

The TT 50 R is an intelligent, universal HART®-compatible 2-wire rail-mount transmitter for temperature, resistance or voltage measurements in an industrial environment.

All versions are intended for installation on a top-hat rail according to DIN 50022.

### 3.2 General notes on installation

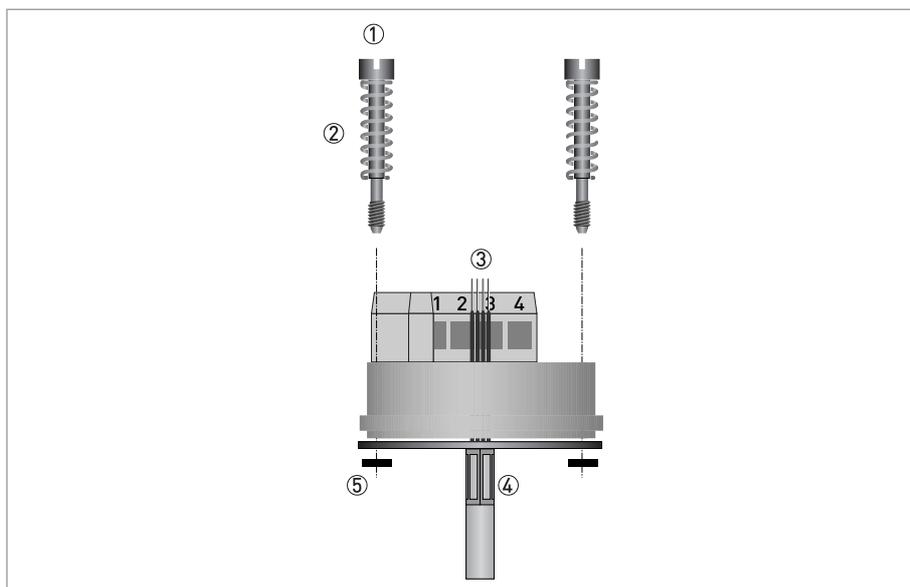
*Inspect the cartons carefully for damages or signs of rough handling. Report damage to the carrier and to the local office of the manufacturer.*

*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.*

### 3.3 In-head transmitter

These transmitters are intended for installation in DIN B connection heads or larger. The large Ø7 mm / 0.28" center hole facilitates the electrical connection of the sensor and the installation. For detailed information refer to the chapter "Dimensions and weights".



- ① Screw M4
- ② Spring
- ③ Sensor connection cables
- ④ Thermowell
- ⑤ Lock washer

*Never install or operate the TT 50 C in potentially explosive areas, it might cause an explosion that can result in fatal injuries! Only use the TT 50 C Ex in potentially explosive areas! The Ex transmitter can be installed in potentially hazardous areas zone 0, 1 and 2. It must be supplied by an intrinsically safe power supply unit or Zener barrier placed outside of the potentially explosive zone.*

*The Ex transmitter must be installed in a housing with the protection rating IP20 or better according to EN 60529 / IEC 60529.*

*The TT 50 C / TT 50 C Ex temperature transmitter has been developed for an ambient temperature of  $-40...+85^{\circ}\text{C}$  /  $-40...+185^{\circ}\text{F}$ . Please also note that the ambient temperature is also dependent on the temperature category. For detailed information refer to Ex data of the ambient temperature.*

*The process temperature is also transferred to the transmitter housing via the thermowell. If the process temperature is close to or exceeds the maximum specified ambient temperature of the transmitter, then the temperature in the transmitter housing can rise above the maximum permissible ambient temperature. Always check that the ambient temperature does not exceed the permissible range!*

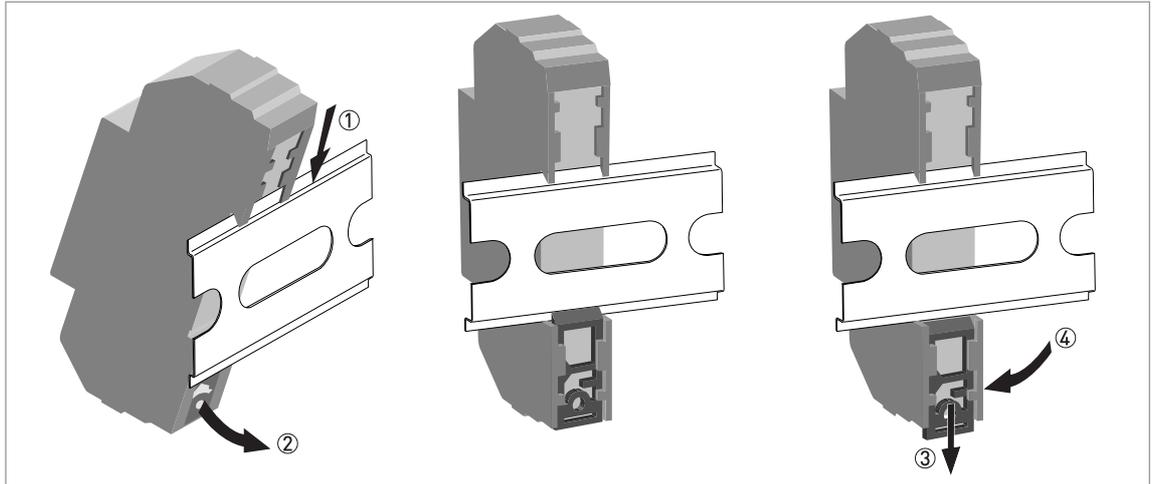
*One way to decrease heat transfer via the protective tube is to make the protective tube longer or in general to install the transmitter farther away from the heat source. The same safety measures can be taken if the temperature is below the specified minimum temperature.*

*The TT 50 C Ex may only be installed in a light metal housing, whose magnesium component does not exceed 6%.*

### 3.4 Rail-mount transmitter

*Never install or operate the TT 50 C in potentially explosive areas, it 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.



- 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!*

*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.*

*Always observe the corresponding chapters and the instructions in this manual when connecting devices with an Ex certificate!*

*Never install or operate the TT 50 C in potentially explosive areas, it might cause an explosion that can result in fatal injuries!*

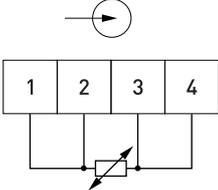
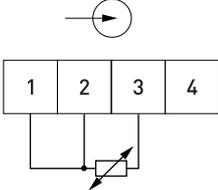
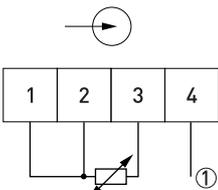
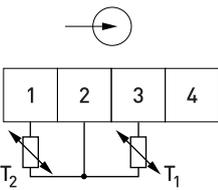
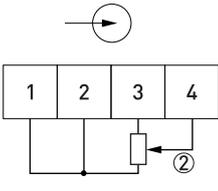
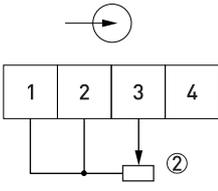
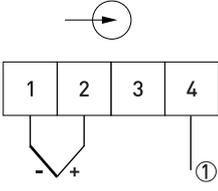
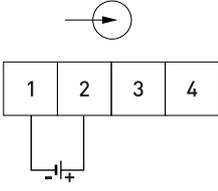
*For the operation in potentially explosive areas the manufacturer offers the TT 50 C Ex. You may only connect this transmitter to sensors that meet the requirements for "simple equipment" in EN 60079-11:2007, section 5.7.*

*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.*

## 4.2 Electrical input connections (in-head and rail-mount)

The input and output signals and the power supply must be connected in accordance with the following illustrations. The in-head 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.

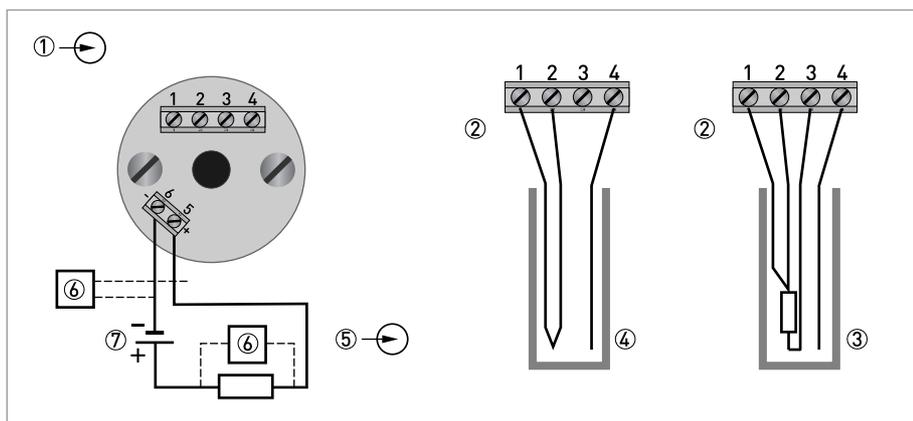
<p><b>Pt10...1000, Ni100, Ni1000, 4-wire connection</b></p> 	<p><b>Pt10...1000, Ni100, Ni1000, 3-wire connection</b></p> 
<p><b>Pt100 "SmartSense", 3-wire connection</b></p> 	<p><b>Pt100, temperature difference, <math>T_1 &gt; T_2</math></b></p> 
<p><b>Potentiometer, 4-wire connection</b></p> 	<p><b>Potentiometer, 3-wire connection</b></p> 
<p><b>Thermocouple</b></p> 	<p><b>Voltage</b></p> 

- ① SmartSense wire  
② Maximum input

### 4.3 Connection diagram of in-head transmitter

*Never install or operate this transmitter in potentially explosive areas, it might cause an explosion that can result in fatal injuries!*

*To enable HART<sup>®</sup> communication, the output circuit must have an output load of at least 250  $\Omega$ .*



- ① Input
- ② SmartSense temperature sensor
- ③ Pt100 3-wire connection
- ④ Thermocouple
- ⑤ Output
- ⑥ Modem
- ⑦ Voltage supply 10...42 VDC

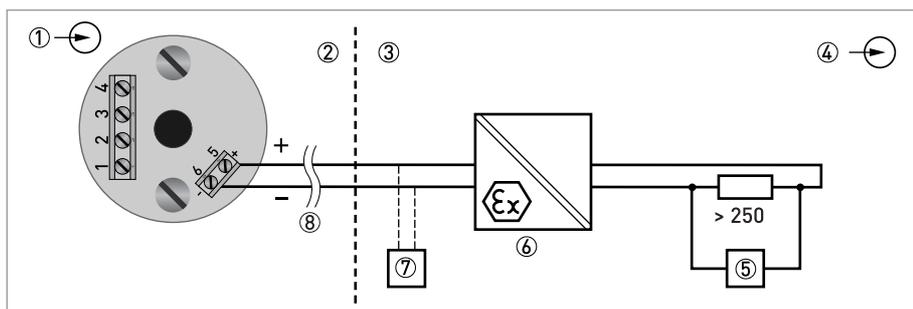
*The HART<sup>®</sup> modem is connected parallel to the output load or parallel to the output of the transmitter.*

#### 4.4 Connection diagram of in-head transmitter (Ex)

The Ex transmitter can be installed in potentially explosive areas of zone 0, 1 and 2. It may only be connected to sensors that meet the requirements for "simple equipment" in EN 60079-11:2007, section 5.7. During operations in potentially explosive areas always regard 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 and the output parameters of the Ex approved HART unit or modem have to be less or equal than the input parameters of the transmitter (i.e.  $U_i$ ,  $I_i$ ,  $P_i$ ,  $L_i$ ,  $C_i$ ).
- Only use an Ex approved HART<sup>®</sup> modem.
- Observe the maximum cable length of the output circuit to ensure reliable HART<sup>®</sup> communication with this transmitter ( on page 24).

To enable HART<sup>®</sup> communication, the output circuit must have an output load of at least 250  $\Omega$ .



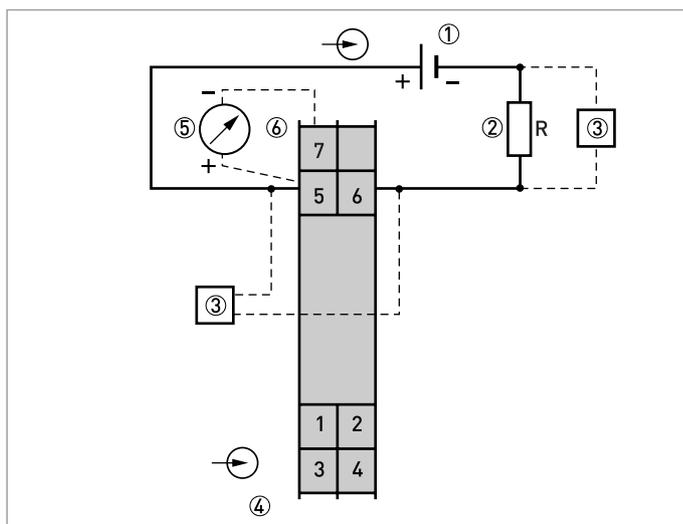
- ① Input
- ② Potentially explosive area
- ③ Safe area
- ④ Output
- ⑤ Modem
- ⑥ Zener barrier or voltage supply 12...30 VDC (intrinsically safe)
- ⑦ Modem, Ex-approved
- ⑧ See section "Cable length"

The HART<sup>®</sup> modem is connected parallel to the output load or parallel to the output of the transmitter.

## 4.5 Connection diagram of 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!*

*To enable HART<sup>®</sup> communication, the output circuit must have an output load of at least 250  $\Omega$ .*



- ① Voltage supply 11...42 VDC
- ②  $R_{Load}$
- ③ Modem
- ④ Input
- ⑤ Measuring device
- ⑥ Test circuit

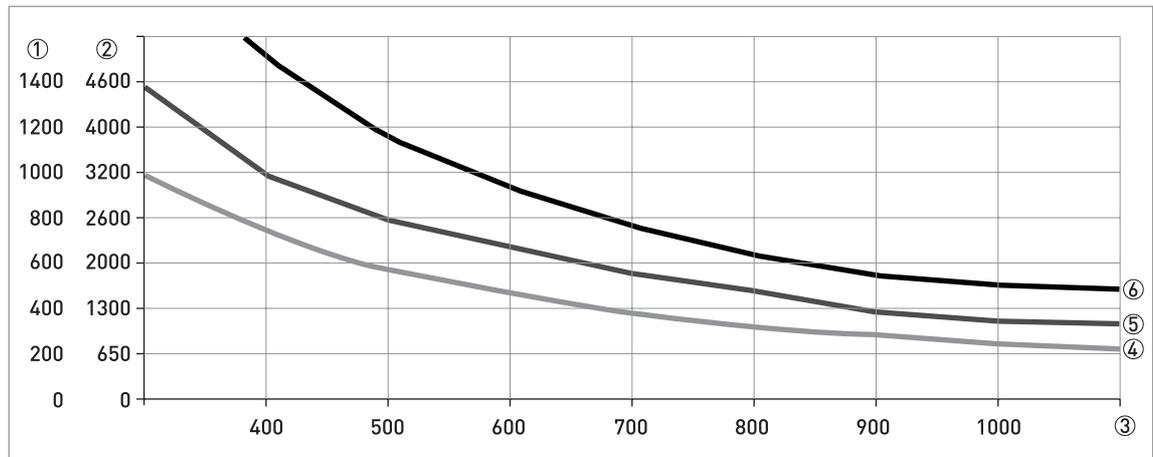
*The HART<sup>®</sup> modem is connected parallel to the output load or parallel to the output of the transmitter.*

## 4.6 Cable length

In order to ensure reliable HART<sup>®</sup> communication, the maximum cable length of the output circuit must be observed.

*In the Ex version, please note that the maximum cable length is determined by a resistance, an inductance and a capacitance of the cable. The total capacitance and inductance of the cable must be within the limits for the transmitter described in the Ex certificate.*

To calculate the maximum cable length for the output circuit, determine the total resistance of the output loop (load resistance + approximate cable resistance). Find out the capacitance of the cable being used. In the following tables you can find the maximum cable length based on the typical values for 1 mm<sup>2</sup> cables. CN is the abbreviation for "Capacitance Number" which is multiple of 5000 pF present in the device.



- ① Cable length [m]
- ② Cable length [ft]
- ③ Load resistance and cable resistance
- ④ 200 pF per m/ft
- ⑤ 150 pF per m/ft
- ⑥ 100 pF per m/ft

For multiple connections (multidrop mode), the following formula shall be used:

$$L = [(65 \times 10^6) / (R \times C)] \times (C_n \times 5000 + 10000) / C$$

with

L: cable length [m or ft]

R: load resistance (incl. the resistance of any Zener barrier) + cable resistance [Ω]

C: cable capacitance [pF/m or pF/ft]

C<sub>n</sub>: number of transmitters in the loop

## 5.1 Order code

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

VTT1	4	<b>Design</b>
	1	Head mounting (type C)
	2	DIN-rail mounting, 35 mm / 1.38" (type R)
		<b>Type</b>
	T	TT 50, digital, HART®, 4...20 mA
		<b>Approvals</b>
	0	Without
	1	ATEX: II 1 G Ex ia (only type C)
		<b>Sensor</b>
	0	Without
	3	Pt 100 ( $\alpha = 0.00385$ )
	5	Pt 100 ( $\alpha = 0.003916$ )
	8	Pt 1000
	A	Potentiometer
	B	Thermocouple (type "B")
	C	Thermocouple (type "C")
	E	Thermocouple (type "E")
	H	Thermocouple (type "J")
	K	Thermocouple (type "K")
	L	Thermocouple (type "L")
	N	Thermocouple (type "N")
	R	Thermocouple (type "R")
	S	Thermocouple (type "S")
	T	Thermocouple (type "T")
	W	Ni 100
	X	Ni 120
	Y	Ni 1000
	Z	Customised
		<b>Wiring</b>
	0	Without
	2	2-wire (1 x sensor)
	3	3-wire (1 x sensor)
	4	4-wire (1 x sensor)
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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[www.krohne.com](http://www.krohne.com)

**KROHNE**