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Safety instructions

1.1 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.

1.2 Certifications

1.2.1 EC directive compliance

CE marking

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

• EMC Directive 2004/108/EC
• Devices for use in potentially explosive areas: ATEX Directive 94/9/EC

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

1.2.2 Ex approvals (TT 50 C Ex)

<table>
<thead>
<tr>
<th>ATEX</th>
<th>II 1 G Ex ia IIC T4/T5/T6</th>
</tr>
</thead>
<tbody>
<tr>
<td>T4:</td>
<td>+85°C / +185°F</td>
</tr>
<tr>
<td>T5:</td>
<td>+65°C / +149°F</td>
</tr>
<tr>
<td>T6:</td>
<td>+50°C / +122°F</td>
</tr>
</tbody>
</table>

DEMKO 06 ATEX 141335X

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.

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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, incidental, punitive 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 SAFETY INSTRUCTIONS

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

The TT 50 transmitters are intelligent 2-wire universal transmitters with one channel.

The transmitters are intended for:
- Temperature measurements with resistance thermometers
- Temperature measurements with thermocouples
- Temperature difference measurements with resistance thermometers
- Measurements with potentiometers
- Voltage measurements in a range -10…+500 mV

The TT 50 C / TT 50 C Ex are designed for installation in a "B connection head" according to DIN 43729 or larger.

The TT 50 R is designed for installation on a rail according to DIN 50022.

The 2-wire universal transmitters are HART® 5-compatible. Configuration of the transmitter is possible with:
- HART® 5 protocol via 4…20 mA output circuit
- HART® 5 hand held terminal
- The third part PC software with a FSK modem for HART® 5 communication
- PC configuration software (HartSoft) with HART® modem

To configure the transmitter using an IBM-compatible PC, the "HartSoft" software is required. The Windows-based "HartSoft" software can be used to access all functions of the transmitter. It is also used for configuration, calibration, display and documentation.
2 DEVICE DESCRIPTION

2.3 Nameplate

**INFORMATION!** 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 can be identified by the information on the nameplates.

2.3.1 Example of a nameplate for an in-head transmitter (Non-Ex)

![Nameplate Image]

1. Product name
2. Part number
3. Year and week of manufacturing / batch number
4. Manufacturer and address
5. Website of manufacturer
6. Space for configuration data sticker
7. CE marking (EC conformity)
8. WEEE dustbin symbol

2.3.2 Example of a nameplate for an in-head transmitter (Ex)

![Nameplate Image]

1. Product name
2. Symbol for Ex-approval
3. Part number
4. Year and week of manufacturing / batch number
5. Manufacturer and address
6. Website of manufacturer
7. Space for configuration data sticker
8. CE marking (EC conformity)
9. WEEE dustbin symbol
2.3.3 Nameplate for rail-mount transmitter

- Product name
- Symbol for Ex-approval
- ATEX approval
- Temperature classes
- Manufacturer and address
- Ex-relevant electrical data
- Supplementary Ex-data

---

- Product name
- Top down: part number, year and week of manufacturing, batch number
- Space for configuration data sticker
- Website of manufacturer
- CE marking (EC conformity)
- WEEE dustbin symbol
3 INSTALLATION

3.1 Notes on installation

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

**INFORMATION!**
Check the packing list to check if you received completely all that you ordered.

**INFORMATION!**
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 In-head transmitter

These transmitters are intended for installation in DIN B connection heads or larger. The large \( \Phi 7 \text{ mm} / 0.28'' \) center hole facilitates the electrical connection of the measurement sensor and the installation. For detailed information refer to the chapter “Dimensions and weights”.

![Diagram of in-head transmitter with labeled parts]

1. Screw M4
2. Spring
3. Sensor connection cables
4. Protection tube
5. Lock washer
DANGER!
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.

CAUTION!
The TT 50 C / TT 50 C Ex temperature transmitter has been developed for an ambient temperature of -40...-85°C / -40...-185°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 protective tube. 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.

CAUTION!
The TT 50 C Ex may only be installed in a light metal housing, whose magnesium component does not exceed 6%.
3.3 Rail-mount transmitter

**DANGER!**

*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

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

**DANGER!**
Observe the national regulations for electrical installations!

**DANGER!**
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.

**DANGER!**
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.

**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. Check for the correct supply voltage printed on the nameplate.

4.2 Electrical 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.
### ELECTRICAL CONNECTIONS

<table>
<thead>
<tr>
<th>Pt10...1000, Ni100, Ni1000, 4-wire connection</th>
<th>Pt10...1000, Ni100, Ni1000, 3-wire connection</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1.png" alt="4-wire connection diagram" /></td>
<td><img src="image2.png" alt="3-wire connection diagram" /></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Pt100 &quot;SmartSense&quot;, 3-wire connection</th>
<th>Pt100, temperature difference, $T_1 - T_2$</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image3.png" alt="3-wire connection diagram" /></td>
<td><img src="image4.png" alt="Temperature difference diagram" /></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Potentiometer, 4-wire connection</th>
<th>Potentiometer, 3-wire connection</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image5.png" alt="4-wire connection diagram" /></td>
<td><img src="image6.png" alt="3-wire connection diagram" /></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Thermocouple</th>
<th>Voltage</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image7.png" alt="Thermocouple diagram" /></td>
<td><img src="image8.png" alt="Voltage diagram" /></td>
</tr>
</tbody>
</table>

1. SmartSense wire
2. Maximum input
4.3 Connection diagram of in-head transmitter

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

**DANGER!**
To enable HART® communication, the output circuit must have an output load of at least 250 Ω.

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

**INFORMATION!**
The HART® modem is connected parallel to the output load or parallel to the output of the transmitter.
**4 ELECTRICAL CONNECTIONS**

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

**DANGER!**

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® modem.
- Observe the maximum cable length of the output circuit to ensure reliable HART® communication with this transmitter (on page 19).

**DANGER!**

To enable HART® communication, the output circuit must have an output load of at least 250 \( \Omega \).

![Connection diagram of in-head transmitter (Ex)](image)

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

**INFORMATION!**

The HART® modem is connected parallel to the output load or parallel to the output of the transmitter.
4.5 Connection diagram of 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!

**DANGER!**
To enable HART® communication, the output circuit must have an output load of at least 250 Ω.

![Connection diagram](image)

1. Voltage supply 11...42 VDC
2. R_load
3. Modem
4. Input
5. Measuring device
6. Test circuit

**INFORMATION!**
The HART® 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® communication, the maximum cable length of the output circuit must be observed.

**DANGER!**
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 mm² cables. CN is the abbreviation for “Capacitance Number” which is multiple of 5000 pF present in the device.

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

\[ L = \frac{(65 \times 10^6)}{(R \times C)} \times \left( C_n \times 5000 + 10000 \right) / C \]

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]
- \( C_n \): number of transmitters in the loop
5.1 HART® networks

**DANGER!**

Only connect an Ex approved HART® modem located in a safe area to a transmitter in a potentially explosive area.

**CAUTION!**

In order to ensure reliable HART® communication with this transmitter, the loop resistance must be at least 250 Ω.

5.1.1 Point-to-point connection analog / digital mode

Point-to-point connection between the transmitter and the HART® master.

The current output of the device may be active or passive.

---

1. Primary Master
2. HART® modem
3. HART® signal
4. Analog indicator
5. Terminal 5
6. Terminal 6
7. Device with address = 0 and passive or active current output
8. Secondary Master
9. Power supply for devices (slaves) with passive current output
10. Load ≥ 250 Ω (Ohm)
5.1.2 Multi-drop connection (2-wire connection)

As a multipoint connection (Multidrop) with up to 15 devices in parallel (this transmitter or other HART® devices).

The current outputs of the devices must be passive!

Burst mode is not supported.

---

1. Primary master
2. HART® modem
3. HART® signal
4. Other HART® devices or this transmitter (refer also to 7)
5. Terminal 5
6. Terminal 6
7. Device with address > 0 and passive current output, connection of max. 15 devices (slaves)
8. Secondary Master
9. Power supply for devices (slaves) with passive current output
10. Load ≥ 250 Ω (Ohm)
5.2 Factory settings for configuration

DANGER!

Only connect an Ex approved HART® modem located in a safe area to a transmitter in a potentially explosive area.

The transmitter are delivered with either a factory settings or configured according to customers’ specifications.

<table>
<thead>
<tr>
<th>Menu</th>
<th>Parameter</th>
<th>Factory settings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Device Root</td>
<td></td>
<td></td>
</tr>
<tr>
<td>menu</td>
<td>-&gt; Sensor</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Type of sensor 1</td>
<td>RTD Pt100 α=0.003850</td>
</tr>
<tr>
<td></td>
<td>Number of wires</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>PV Lower range value</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>PV Upper range value</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td>Digital units</td>
<td>°C</td>
</tr>
<tr>
<td></td>
<td>Lock code</td>
<td>Unlocked</td>
</tr>
<tr>
<td></td>
<td>Isolation resistance monitoring</td>
<td>Off</td>
</tr>
<tr>
<td></td>
<td>Sensor break (Off/Down scale/Up scale)</td>
<td>Up scale</td>
</tr>
<tr>
<td></td>
<td>Sensor short circuit</td>
<td>Off</td>
</tr>
<tr>
<td></td>
<td>Span</td>
<td>0...+100°C / +32...+212°F</td>
</tr>
</tbody>
</table>
5.3 Configuration of transmitter

The transmitters can be configured by means of:

1. The PC with the help of a HART-modem ("VIATOR") and the software "HartSoft".
2. A hand held communicator (secondary master) such as the field communicators FC 375 or FC 475 (Emerson)
3. EDD enabled device management softwares/systems (primary master) such as:
   • PDM - Process Device Manager (Siemens)
   • AMS - Asset Management Solutions (Emerson)

5.3.1 Configuration with PC and HART®-modem

Configuration with the PC requires a HART®-modem for connection to a USB-interface and the software "HartSoft". Therefore all models of the TT 50 series are HART®-compatible.

INFORMATION!
If you need "HartSoft", contact the manufacturer (the software is for free). The manual is available in the download area of the manufacturer’s website.

5.3.2 Configuration with a hand held communicator FC375/FC475

The Field communicators FC375/FC475 are hand held communicators from Emerson Process Management for configuring HART® and Foundation Fieldbus devices. To be able to configure the transmitter with the FC375/FC475 you need a Device Description (DD) file.

The transmitter DD has to be installed on the FC375/FC475, otherwise the user will work with the transmitter as generic device loosing opportunity to control all features of the transmitter. For installing DD on the FC375/FC475 the “Easy Upgrade Programming Utility” is needed and the FC375/FC475 must have a system card with “Easy Upgrade” option [see details in the “375/475 Field Communicator User’s Manual”].

The transmitter DD for FC375/FC475 can also be downloaded from our website. For information about installing, follow the instructions in the attached “readme.txt” file.

For proper connection of the transmitter with the hand held communicator refer to Connection diagram of in-head transmitter on page 17 and refer to Connection diagram of rail-mount transmitter on page 19.

To configure the transmitter for potentially explosive areas refer to Connection diagram of in-head transmitter (Ex) on page 18.
5.3.3 Device management software

The transmitter can be configured via the PC software as AMS (Asset Management System) and Simatic PDM.

**Asset Management Solutions Device Manager (AMS)**

The AMS is a PC application from Emerson Process Management for configuring and managing HART® and Foundation Fieldbus devices. For adaptation to different devices AMS uses Device Descriptions (DD).

The transmitter DD has to be installed on the AMS system and a so called “Installation Kit HART AMS” is needed (available as download on the internet). For installing the DD with the installation kit refer to the “AMS Intelligent Device Manager Books Online” section “Basic AMS Functionality /Device Configurations / Installing Device Types / Procedures /Install device types from media”. Please read also the “readme.txt”, which is also contained in the installation kit.

The transmitter DD for AMS can also be downloaded from our website. For information about installing, follow the instructions in the attached “readme.txt” file.

AMS supports the “EDDL Process Variables Root Menu”, the “Diagnostic Root Menu” and the “Device Root Menu” for online access to the device.

**Process Device Manager (PDM)**

The Simatic PDM is a PC application from Siemens for configuring HART® and PROFIBUS devices. For adaptation to different devices Simatic PDM uses Device Descriptions (DD).

The transmitter DD has to be installed on the PDM System and a so called “Device Install HART PDM” is needed (available as download on the internet).

For installing the DD on PDM refer to the “PDM Manual” section 13: “Integrating Devices”. Please read also the “readme.txt”, which is also contained in the “Device Install”.

The transmitter DD for PDM can also be downloaded from our website. For information about installing, follow the instructions in the attached “readme.txt” file.

PDM supports the “EDDL Process Variables Root Menu”, the “Diagnostic Root Menu” and the “Device Root Menu” for offline configuration.

5.4 Factory calibration of transmitter

The transmitters are delivered with a factory configuration Pt100 (α=0.00385), 3-wire connection 0...+100°C / +32...+212°F or configured according to customer’s requirements. For detailed information refer to Factory settings for configuration on page 23.

**INFORMATION!**

Should you for any reason require the re-calibration, send the transmitter back to the factory!
6.1 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.

6.2 Availability of services

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

6.3 Returning the device to the manufacturer

6.3.1 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 neutralizing, 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.
6.3.2 Form (for copying) to accompany a returned device

<table>
<thead>
<tr>
<th>Company:</th>
<th>Address:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Department:</th>
<th>Name:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Tel. no.:</th>
<th>Fax no.:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Manufacturer’s order no. or serial no.:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
</tbody>
</table>

The device has been operated with the following medium:

<table>
<thead>
<tr>
<th>This medium is:</th>
<th>water-hazardous</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>toxic</td>
</tr>
<tr>
<td></td>
<td>caustic</td>
</tr>
<tr>
<td></td>
<td>flammable</td>
</tr>
</tbody>
</table>

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.

<table>
<thead>
<tr>
<th>Date:</th>
<th>Signature:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Stamp:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
</tbody>
</table>

6.4 Disposal

**CAUTION!**

Disposal must be carried out in accordance with legislation applicable in your country.
7.1 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.

7.1.1 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 7-1: Pt100 resistance thermometer in 4 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 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 (hot junction) and the point at which the compensation cables connect to the conductors of the millivolt meter is called the reference junction (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 reference 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 reference 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.

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 representative.
- Additional information (certificates, special tools, software,...) and complete product documentation can be downloaded free of charge from the website (Download Center).

### Measuring system

<table>
<thead>
<tr>
<th>Application range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature, resistance or voltage measurements of solids, liquids and gases in industrial environment.</td>
</tr>
</tbody>
</table>

### Design

#### Versions

<table>
<thead>
<tr>
<th>Version</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>TT 50 C</td>
<td>In-head transmitter which is intended for installation in a &quot;B connection head&quot; 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).</td>
</tr>
<tr>
<td>TT 50 R</td>
<td>Rail-mount transmitter which is intended for installation on a top-hat rail according to DIN 50022 / EN 60715.</td>
</tr>
</tbody>
</table>

#### 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 ConSoft 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

<table>
<thead>
<tr>
<th>Accuracy</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>RTD and thermocouple</strong>: for detailed information refer to RTD and T/C accuracy table on page 38.</td>
<td></td>
</tr>
<tr>
<td>Resistance: ±0.1 Ω or ±0.1% of span</td>
<td></td>
</tr>
<tr>
<td>Voltage: ±20 µV or ±0.1% of span</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Temperature influence</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>RTD and thermocouple</strong>: for detailed information refer to RTD and T/C accuracy table on page 38.</td>
<td></td>
</tr>
<tr>
<td>Resistance: ±0.01% of span per °C or °F</td>
<td></td>
</tr>
<tr>
<td>Voltage: ±0.01% of span per °C or °F</td>
<td></td>
</tr>
</tbody>
</table>
### Cold Junction Compensation (CJC)

<table>
<thead>
<tr>
<th>In-head transmitter:</th>
<th>Celsius: ±0.5°C within ambient temperature -40...+85°C</th>
<th>Fahrenheit: ±0.9°F within ambient temperature -40...+185°F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rail-mount transmitter:</td>
<td>Celsius: ±0.5°C within ambient temperature -20...+70°C</td>
<td>Fahrenheit: ±0.9°F within ambient temperature -4...+158°F</td>
</tr>
</tbody>
</table>

Temperature influence CJC ±0.02°C per °C / ±0.02°F per °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 ±0.1% of span per year

### Operating conditions

#### Temperature

<table>
<thead>
<tr>
<th>In-head transmitter</th>
<th>Operating and storage temperature:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard version:</td>
<td>-40...+85°C / -40...+185°F</td>
</tr>
<tr>
<td>Intrinsically safe version:</td>
<td>for detailed information refer to Temperature data for potentially explosive areas on page 37.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Rail-mount transmitter</th>
<th>Storage temperature:</th>
</tr>
</thead>
<tbody>
<tr>
<td>-40...+85°C / -40...+185°F</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Intrinsically safe version:</th>
<th>Operating temperature:</th>
</tr>
</thead>
<tbody>
<tr>
<td>-20...+70°C / -4...+158°F</td>
<td></td>
</tr>
</tbody>
</table>

#### Humidity

5...95% RH (non-condensing)

### Protection category

<table>
<thead>
<tr>
<th>In-head transmitter</th>
<th>Housing: IP50</th>
</tr>
</thead>
<tbody>
<tr>
<td>Terminals: IP10</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Rail-mount transmitter</th>
<th>Housing: IP20</th>
</tr>
</thead>
<tbody>
<tr>
<td>Terminals: IP00</td>
<td></td>
</tr>
</tbody>
</table>

### Installation conditions

#### Mounting

<table>
<thead>
<tr>
<th>In-head transmitter:</th>
<th>DIN B-head or larger, DIN-rail (with adapter).</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rail-mount transmitter:</td>
<td>rail acc. to DIN 50022 / EN 60715, 35 mm / 1.38&quot;</td>
</tr>
<tr>
<td>For detailed information refer to chapter &quot;Installation&quot;.</td>
<td></td>
</tr>
</tbody>
</table>

#### Weight

<table>
<thead>
<tr>
<th>In-head transmitter:</th>
<th>50 g / 0.11 lb</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rail-mount transmitter:</td>
<td>70 g / 0.15 lb</td>
</tr>
</tbody>
</table>

#### Dimensions

For detailed information refer to Dimensions on page 34.
**Materials**

<table>
<thead>
<tr>
<th>Housing and flammability acc. to UL</th>
</tr>
</thead>
<tbody>
<tr>
<td>In-head transmitter: PC + ABS [V0], polyamide [V2]</td>
</tr>
<tr>
<td>Rail-mount transmitter: PC + glassfibre [V0]</td>
</tr>
</tbody>
</table>

**Electrical connections**

<table>
<thead>
<tr>
<th>Power supply</th>
</tr>
</thead>
<tbody>
<tr>
<td>In-head transmitter: 10...42 VDC</td>
</tr>
<tr>
<td>Rail-mount transmitter: 11...42 VDC</td>
</tr>
</tbody>
</table>

| 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 mm² / AWG 16 |

**Inputs / Outputs**

**Input - RTD**

| Pt100 (IEC 60751, α=0.00385) | -200...+1000°C / -328...+1832°F |
| Pt100 (JIS C 1604-2, α=0.003916) |
| Pt X (10 ≤ X ≤ 1000) (IEC 60751, α=0.00385) |
| Corresponding to max. 2000 Ω |
| Ni100 (DIN 43760, α=0.006180) |
| Ni1000 (DIN 43760, α=0.006180) |

| Sensor current |
| Circa 400 μA |

| Maximum sensor wire resistance |
| 25 Ω/wire |

**Input - resistance / potentiometer**

| Range, resistance |
| 0...2000 Ω |

| Range, potentiometer |
| 0...2000 Ω |

| Minimum span |
| 10 Ω |

| Customized linearization |
| Up to 50 points |

| Sensor current |
| Circa 400 μA |

| Maximum sensor wire resistance |
| 25 Ω/wire |

**Input - thermocouples**

| T/C type B - Pt30Rh-PtRh (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) |
| -200...+1350°C / -328...+2462°F |
| T/C type K - NiCr-Ni (IEC 60584) |
| -200...+900°C / -328...+1652°F |
| T/C type L - Fe-CuNi (DIN 43710) |
| -200...+600°C / -328...+1112°F |
| T/C type N - NiCr-Si-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) |

| Input impedance |
| >10 MΩ |

| Cold Junction Compensation (CJC) |
| Internal, external (Pt100) or fixed |
### Input - voltage

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Range</td>
<td>-10...+500 mV</td>
</tr>
<tr>
<td>Minimum span</td>
<td>2 mV</td>
</tr>
<tr>
<td>Customized linearization</td>
<td>Up to 50 points</td>
</tr>
<tr>
<td>Input impedance</td>
<td>&gt;10 MΩ</td>
</tr>
<tr>
<td>Maximum wire loop resistance</td>
<td>500 Ω</td>
</tr>
</tbody>
</table>

### Output

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output signal</td>
<td>4...20 mA, 20...4 mA or customized</td>
</tr>
<tr>
<td>HART® protocol</td>
<td>HART® 5</td>
</tr>
<tr>
<td>Adjustable output filtering</td>
<td>0...10 s (time constant)</td>
</tr>
<tr>
<td>Permissible load</td>
<td>Note: Communication according to HART® always requires a resistance greater than 250 Ω. 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 Ω at 24 VDC and 23 mA. TT 50 C Ex: 520 Ω at 24 VDC and 23 mA. TT 50 R: 565 Ω at 24 VDC and 23 mA.</td>
</tr>
</tbody>
</table>

### Configuration

- **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 fulfills 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**
7.3 Dimensions

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

<table>
<thead>
<tr>
<th>Dimensions</th>
<th>[mm]</th>
<th>[&quot;]</th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td>44</td>
<td>1.73</td>
</tr>
<tr>
<td>b</td>
<td>26</td>
<td>1.02</td>
</tr>
<tr>
<td>c</td>
<td>16</td>
<td>0.63</td>
</tr>
<tr>
<td>d</td>
<td>7</td>
<td>0.20</td>
</tr>
<tr>
<td>e</td>
<td>33</td>
<td>1.30</td>
</tr>
</tbody>
</table>
**Rail-mount transmitter**

<table>
<thead>
<tr>
<th>Dimensions</th>
<th>[mm]</th>
<th>[°]</th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td>17.5</td>
<td>0.69</td>
</tr>
<tr>
<td>b</td>
<td>58</td>
<td>2.28</td>
</tr>
<tr>
<td>c</td>
<td>45</td>
<td>1.77</td>
</tr>
<tr>
<td>d</td>
<td>90</td>
<td>3.54</td>
</tr>
<tr>
<td>e</td>
<td>35</td>
<td>1.38</td>
</tr>
</tbody>
</table>
7.4 Output load diagrams

Output load diagram TT 50 C:

Formula for the maximum permissible output load of the TT 50 C:

\[
\text{permissible } R_{\text{Load}} [\Omega] = \frac{U-10}{0.023}
\]

Output load diagram TT 50 C Ex:

Formula for the maximum permissible output load of the TT 50 C Ex:

\[
\text{permissible } R_{\text{Load}} [\Omega] = \frac{U-12}{0.023}
\]
7.5 Temperature data for potentially explosive areas

In-head transmitter (Ex-version)

<table>
<thead>
<tr>
<th>Temperature class</th>
<th>Ambient temperature $T_a$</th>
</tr>
</thead>
<tbody>
<tr>
<td>T6</td>
<td>$-40,^\circ C \leq T_a \leq +122,^\circ F$</td>
</tr>
<tr>
<td>T5</td>
<td>$-40,^\circ C \leq T_a \leq +149,^\circ F$</td>
</tr>
<tr>
<td>T4</td>
<td>$-40,^\circ C \leq T_a \leq +185,^\circ F$</td>
</tr>
</tbody>
</table>

7.6 Electrical data for outputs and inputs

In-head transmitter (Ex-version)

<table>
<thead>
<tr>
<th>Output (supply)</th>
<th>Input (sensor)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max. voltage to transmitter</td>
<td>$U_i = 30, VDC$</td>
</tr>
<tr>
<td>Max. current to transmitter</td>
<td>$I_i = 100, mA$</td>
</tr>
<tr>
<td>Max. power to transmitter</td>
<td>$P_i = 900, mW$</td>
</tr>
<tr>
<td>Internal inductance</td>
<td>$L_i = 1, mH$</td>
</tr>
<tr>
<td>Internal capacitance</td>
<td>$C_i = 1, nF$</td>
</tr>
<tr>
<td>Max. voltage from transmitter</td>
<td>$U_o = 30, VDC$</td>
</tr>
<tr>
<td>Max. current from transmitter</td>
<td>$I_o = 25, mA$</td>
</tr>
<tr>
<td>Max. power from transmitter</td>
<td>$P_o = 190, mW$</td>
</tr>
<tr>
<td>Max. inductance (input loop)</td>
<td>$L_o = 19, mH$</td>
</tr>
<tr>
<td>Max. capacitance (input loop)</td>
<td>$C_o = 31, nF$</td>
</tr>
</tbody>
</table>
### 7.7 RTD and T/C accuracy table

#### INFORMATION!
- Conformance level 95% (2σ)
- CJC = Cold Junction Compensation

**Accuracies in °C**

<table>
<thead>
<tr>
<th>Input type</th>
<th>Temp. range</th>
<th>Min. span</th>
<th>Accuracy</th>
<th>Temp. influence (Dev. from ref. temp. 20°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>RTD Pt100</td>
<td>-200...+1000</td>
<td>10</td>
<td>±0.2°C or ±0.1% of span</td>
<td>±0.01% of span per °C</td>
</tr>
<tr>
<td>RTD Ni100</td>
<td>-60...+250</td>
<td>10</td>
<td>±0.2°C or ±0.1% of span</td>
<td>±0.01% of span per °C</td>
</tr>
<tr>
<td>T/C type J</td>
<td>-200...+1000</td>
<td>50</td>
<td>±0.3°C or ±0.1% of span</td>
<td>±0.01% of span per °C</td>
</tr>
<tr>
<td>T/C type K</td>
<td>-200...+1350</td>
<td>50</td>
<td>±0.5°C or ±0.1% of span</td>
<td>±0.01% of span per °C</td>
</tr>
<tr>
<td>T/C type S</td>
<td>-50...+1750</td>
<td>300</td>
<td>±2.0°C or ±0.1% of span</td>
<td>±0.01% of span per °C</td>
</tr>
<tr>
<td>T/C type B</td>
<td>+400...+1800</td>
<td>700</td>
<td>±2.0°C or ±0.1% of span</td>
<td>±0.01% of span per °C</td>
</tr>
</tbody>
</table>

1. CJC error is not included

**Accuracies in °F**

<table>
<thead>
<tr>
<th>Input type</th>
<th>Temp. range</th>
<th>Min. span</th>
<th>Accuracy</th>
<th>Temp. influence (Dev. from ref. temp. 68°F)</th>
</tr>
</thead>
<tbody>
<tr>
<td>RTD Pt100</td>
<td>-328...+1832</td>
<td>50</td>
<td>±0.4°F or ±0.1% of span</td>
<td>±0.006% of span per °C</td>
</tr>
<tr>
<td>RTD Ni100</td>
<td>-76...+482</td>
<td>50</td>
<td>±0.4°F or ±0.1% of span</td>
<td>±0.006% of span per °C</td>
</tr>
<tr>
<td>T/C type J</td>
<td>-328...+1832</td>
<td>122</td>
<td>±0.5°F or ±0.1% of span</td>
<td>±0.006% of span per °C</td>
</tr>
<tr>
<td>T/C type K</td>
<td>-328...+2442</td>
<td>122</td>
<td>±0.9°F or ±0.1% of span</td>
<td>±0.006% of span per °C</td>
</tr>
<tr>
<td>T/C type S</td>
<td>-58...+3182</td>
<td>572</td>
<td>±3.6°F or ±0.1% of span</td>
<td>±0.006% of span per °C</td>
</tr>
<tr>
<td>T/C type B</td>
<td>+752...+3272</td>
<td>1292</td>
<td>±3.6°F or ±0.1% of span</td>
<td>±0.006% of span per °C</td>
</tr>
</tbody>
</table>

1. CJC error is not included
KROHNE product overview

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

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Ludwig-Krohne-Str. 5
D-47058 Duisburg (Germany)
Tel.: +49 (0)203 301 0
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