Measuring inserts: TR 100 resistance sensors and TC 100 thermocouples

Category II 1G
CONTENTS

1 Safety instructions 3
   1.1 General notes ................................................................. 3
   1.2 EC conformity ............................................................... 3
   1.3 Safety instructions ......................................................... 3

2 Device description 4
   2.1 Device description ........................................................ 4
   2.2 Description code .......................................................... 4
   2.3 Marking ........................................................................... 4
   2.4 Flammable products ...................................................... 5
   2.5 Equipment category ....................................................... 5
   2.6 Protection types ............................................................. 5
   2.7 Temperature classes ..................................................... 6
   2.8 Electrical data ............................................................... 8

3 Installation 9
   3.1 Special Conditions ......................................................... 9
   3.2 Installation ..................................................................... 9

4 Electrical connections 10
   4.1 General notes ............................................................... 10
   4.2 Power supply ............................................................... 11
   4.3 Inputs / Outputs ............................................................ 11
      4.3.1 Pt100 measuring inserts ........................................... 11
      4.3.2 Thermocouple measuring inserts ............................. 12
   4.4 Earthing and equipotential bonding ............................... 12

5 Operation 13
   5.1 Start-up ....................................................................... 13
   5.2 Operation .................................................................... 13

6 Service 14
   6.1 Maintenance ............................................................... 14
   6.2 Dismantling ................................................................. 14

7 Notes 15
1.1 General notes

These additional Ex instructions apply to explosion-protected versions of measuring inserts with the marking II 1 G. They complement the standard documentation for non-explosion protected versions.

The information given in these Instructions contains only the data relevant to Category 1 explosion protection. The technical details given in the standard documentation for the non-explosion protected versions apply unchanged unless excluded or superseded by these Instructions.

1.2 EC conformity

The manufacturer declares with the EC Declaration of Conformity on his own responsibility conformity with the protection goals of Directive 2014/34/EU for use in hazardous areas with gas.

The EC Type Test Certificate of the National Metrology Institute (PTB) forms the basis of the EC Declaration of Conformity:

PTB 13 ATEX 2002X

IECEx PTB 14.0007X

The “X” after the certificate number refers to special conditions for safe use of the device as described in these Instructions.

You may download the EC Type Test Certificate from the manufacturer’s website as needed.

1.3 Safety instructions

Assembly, installation, start-up and maintenance may only be performed by personnel trained in explosion protection!

CAUTION!

Should operating conditions and locations require the observance of further standards, guidelines and laws, this is the responsibility of the operator and/or those commissioned by him.
2 DEVICE DESCRIPTION

2.1 Device description

Electric measuring inserts measure the temperature of combustible and non-combustible gases and liquids. The measuring inserts contains a Pt100 RTD or a thermocouple.

2.2 Description code

The safety description code of the measuring inserts is made up of the following elements (spaces in the code may be omitted):

- Sensor type (TR = resistance sensor, TC = thermocouple)
- Version (Ex = ATEX approved)
- Diameter of measuring insert (6 = 6 mm / 0.24”)
- Space for information not relevant for ex purposes

The length of the measuring insert is displayed on the nameplate in plain text.

2.3 Marking

The marking contains the following information:

- Description code
- Identification number of the notified body as per Directive 2014/34/EU, Appendix IV
- Ex-marking
- Number of the EC Type Test Certificate
- Number of the IECEx approval
- Equipment group and category
- Unique serial number
- Production order number
- Sensor name (e.g. 1xPt100-A-WW), single version 1x Pt100 respectively 1 x TC J/K or double version 2 x Pt100 respectively 2 x TC J/K (here: simple, thus 1x), tolerance class (here: tolerance class A), type of RTD: WW for wire wound version and TF for thin film version (here: wire-wound version, thus WW)
- Temperature range of use
2.4 Flammable products

Atmospheric conditions
An explosive atmosphere is a mixture of air and flammable gases, vapours, mists or dusts under atmospheric conditions. The following values define it:

\[ T_{\text{atm}} = -20 \ldots +60^\circ\text{C} / -4 \ldots +140^\circ\text{F} \quad \text{and} \quad P_{\text{atm}} = 0.8 \ldots 1.1 \text{ bar} / 11.6 \ldots 15.9 \text{ psi} \]

Outside of this range, no key data are available as to ignition behaviour for most mixtures.

Operating conditions
Outside of atmospheric conditions you cannot apply explosion protection according to Directive 2014/34/EU (ATEX) – regardless of the zone assignment - due to the lack of key safety data.

\[ \text{CAUTION!} \]

The operator is responsible for ensuring that the measuring inserts are operated safely as regards the temperature and pressure of the products used.

Include the temperature assembly in the periodic pressure tests of the system when operating with flammable products.

2.5 Equipment category

The measuring inserts are designed in category II 1 G for use in Zone 0.

\[ \text{INFORMATION!} \]

Definition of Zone 0 according to EN 1127-1:
An area with a constant or long-term or frequent explosive atmosphere made up of a mixture of flammable substances in the form of gas, vapours or mist.

For detailed information refer to Flammable products on page 5.

2.6 Protection types

The marking according to ATEX is: II 1 G Ex ia IIC T6 Ga

The following types of protection are used:
- The measuring insert is designed in protection type intrinsically safe "i".
- Operation on intrinsically safe circuits with protection level "ia".
2.7 Temperature classes

The permissible ambient temperature range of the measuring inserts at the terminal block is:

\[ T_{\text{amb}} = -40^\circ\text{C} \ldots +100^\circ\text{C} \; / \; -40^\circ\text{F} \ldots +212^\circ\text{F}. \]

Due to the influence of the product temperature, no fixed temperature class is assigned to measuring inserts. The temperature class of the devices is much more a function of the existing product temperature and the maximum value of the sensor output \( P_i \). Please consult the following tables for the assignment of the respective version.

**CAUTION!**

The maximum permissible product temperatures listed in the tables are valid under the following conditions:

- The measuring insert is installed and operated in accordance with the installation instructions in the standard documentation.
- Ensure that the measuring insert is not heated by the effects of additional heat radiation (sunshine, neighbouring system components) and thus operated above the permissible ambient temperature range.

### Maximum permissible medium temperature in °C

<table>
<thead>
<tr>
<th>Temperature class</th>
<th>( T_0 )</th>
<th>( P_i \leq 50\text{mW} )</th>
<th>( P_i \leq 100\text{mW} )</th>
<th>( P_i \leq 200\text{mW} )</th>
<th>( P_i \leq 500\text{mW} )</th>
<th>( P_i \leq 650\text{mW} )</th>
<th>( P_i \leq 750\text{mW} )</th>
<th>( P_i \leq 800\text{mW} )</th>
<th>( P_i \leq 1000\text{mW} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>T1</td>
<td>450</td>
<td>436</td>
<td>432</td>
<td>425</td>
<td>402</td>
<td>391</td>
<td>383</td>
<td>380</td>
<td>365</td>
</tr>
<tr>
<td>T2</td>
<td>300</td>
<td>286</td>
<td>282</td>
<td>275</td>
<td>252</td>
<td>241</td>
<td>233</td>
<td>230</td>
<td>215</td>
</tr>
<tr>
<td>T3</td>
<td>200</td>
<td>191</td>
<td>187</td>
<td>180</td>
<td>157</td>
<td>144</td>
<td>138</td>
<td>135</td>
<td>120</td>
</tr>
<tr>
<td>T4</td>
<td>135</td>
<td>126</td>
<td>122</td>
<td>115</td>
<td>92</td>
<td>81</td>
<td>73</td>
<td>70</td>
<td>55</td>
</tr>
<tr>
<td>T5</td>
<td>100</td>
<td>91</td>
<td>87</td>
<td>80</td>
<td>57</td>
<td>46</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>T6</td>
<td>85</td>
<td>76</td>
<td>72</td>
<td>65</td>
<td>42</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

For 2xPt100 \( P_0 \) is the sum of the two individual powers.
### OPTITEMP TR/TC100

#### DEVICE DESCRIPTION

**Maximum permissible medium temperature in °F**

<table>
<thead>
<tr>
<th>Temperature class</th>
<th>T₀ in °F</th>
<th>P₀ ≤ 50 mW</th>
<th>P₀ ≤ 100 mW</th>
<th>P₀ ≤ 200 mW</th>
<th>P₀ ≤ 500 mW</th>
<th>P₀ ≤ 650 mW</th>
<th>P₀ ≤ 750 mW</th>
<th>P₀ ≤ 800 mW</th>
<th>P₀ ≤ 1000 mW</th>
</tr>
</thead>
<tbody>
<tr>
<td>T1</td>
<td>842</td>
<td>816</td>
<td>809</td>
<td>797</td>
<td>755</td>
<td>721</td>
<td>716</td>
<td>716</td>
<td>689</td>
</tr>
<tr>
<td>T2</td>
<td>572</td>
<td>546</td>
<td>539</td>
<td>527</td>
<td>485</td>
<td>465</td>
<td>451</td>
<td>446</td>
<td>419</td>
</tr>
<tr>
<td>T3</td>
<td>392</td>
<td>375</td>
<td>368</td>
<td>356</td>
<td>314</td>
<td>294</td>
<td>280</td>
<td>275</td>
<td>248</td>
</tr>
<tr>
<td>T4</td>
<td>275</td>
<td>258</td>
<td>251</td>
<td>238</td>
<td>197</td>
<td>177</td>
<td>163</td>
<td>158</td>
<td>131</td>
</tr>
<tr>
<td>T5</td>
<td>212</td>
<td>195</td>
<td>188</td>
<td>176</td>
<td>134</td>
<td>114</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>T6</td>
<td>185</td>
<td>168</td>
<td>161</td>
<td>149</td>
<td>107</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

For 2xPt100 Po is the sum of the two individual powers.

**Maximum permissible medium temperature in °C**

For thin film RTD 1xPt1100 TF and 1xPt1100 TF shock resistant as well as for RTDs 2xPt1100 TF and 2xPt1100 TF shock resistant

<table>
<thead>
<tr>
<th>Temperature class</th>
<th>T₀ in °C</th>
<th>P₀ ≤ 50 mW</th>
<th>P₀ ≤ 100 mW</th>
<th>P₀ ≤ 200 mW</th>
<th>P₀ ≤ 500 mW</th>
<th>P₀ ≤ 650 mW</th>
<th>P₀ ≤ 750 mW</th>
<th>P₀ ≤ 800 mW</th>
<th>P₀ ≤ 1000 mW</th>
</tr>
</thead>
<tbody>
<tr>
<td>T1</td>
<td>450</td>
<td>438</td>
<td>432</td>
<td>423</td>
<td>398</td>
<td>386</td>
<td>377</td>
<td>373</td>
<td>356</td>
</tr>
<tr>
<td>T2</td>
<td>300</td>
<td>286</td>
<td>282</td>
<td>273</td>
<td>248</td>
<td>236</td>
<td>227</td>
<td>223</td>
<td>206</td>
</tr>
<tr>
<td>T3</td>
<td>200</td>
<td>191</td>
<td>187</td>
<td>176</td>
<td>153</td>
<td>141</td>
<td>132</td>
<td>128</td>
<td>111</td>
</tr>
<tr>
<td>T4</td>
<td>135</td>
<td>126</td>
<td>122</td>
<td>113</td>
<td>88</td>
<td>76</td>
<td>67</td>
<td>63</td>
<td>44</td>
</tr>
<tr>
<td>T5</td>
<td>100</td>
<td>91</td>
<td>87</td>
<td>78</td>
<td>53</td>
<td>41</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>T6</td>
<td>85</td>
<td>76</td>
<td>72</td>
<td>63</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

For 2xPt100 Po is the sum of the two individual powers.
Maximum permissible medium temperature in °F

For thin film RTD 1xPt100 TF and 1xPt100 TF shock resistant as well as for RTDs 2xPt100 TF and 2xPt100 TF shock resistant

<table>
<thead>
<tr>
<th>Temperature class</th>
<th>$T_m$ in [°F]</th>
<th>$P_0$ ≤ 50 mW</th>
<th>$P_0$ ≤ 100 mW</th>
<th>$P_0$ ≤ 200 mW</th>
<th>$P_0$ ≤ 500 mW</th>
<th>$P_0$ ≤ 650 mW</th>
<th>$P_0$ ≤ 750 mW</th>
<th>$P_0$ ≤ 800 mW</th>
<th>$P_0$ ≤ 1000 mW</th>
</tr>
</thead>
<tbody>
<tr>
<td>T1</td>
<td>842</td>
<td>816</td>
<td>809</td>
<td>794</td>
<td>749</td>
<td>726</td>
<td>711</td>
<td>703</td>
<td>673</td>
</tr>
<tr>
<td>T2</td>
<td>572</td>
<td>546</td>
<td>539</td>
<td>539</td>
<td>479</td>
<td>456</td>
<td>441</td>
<td>433</td>
<td>403</td>
</tr>
<tr>
<td>T3</td>
<td>392</td>
<td>375</td>
<td>368</td>
<td>368</td>
<td>308</td>
<td>285</td>
<td>270</td>
<td>262</td>
<td>232</td>
</tr>
<tr>
<td>T4</td>
<td>275</td>
<td>258</td>
<td>251</td>
<td>251</td>
<td>191</td>
<td>168</td>
<td>153</td>
<td>145</td>
<td>115</td>
</tr>
<tr>
<td>T5</td>
<td>212</td>
<td>195</td>
<td>188</td>
<td>188</td>
<td>128</td>
<td>105</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>T6</td>
<td>165</td>
<td>161</td>
<td>141</td>
<td>161</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

For 2xPt100 $P_0$ is the sum of the two individual powers.

Regardless of the temperature class, the lower limit value for the product temperature for all versions is:

- TC 100: $T_m = -40°C / -40°F$
- TR 100: $T_m = -200°C / -328°F$

2.8 Electrical data

Connect the sensor circuit of a measuring insert only to intrinsically safe circuits as well as separate transmitters certified as intrinsically safe or zener barriers. Observe the following maximum values:

- $U_i = 30 V$
- $I_i = 140 mA$
- $P_i = 1.0 W$

Keep in mind the following maximum values for effective capacities and inductances when interconnecting:

<table>
<thead>
<tr>
<th>Sensor length</th>
<th>up to 5 m / 16.4 ft</th>
<th>up to 30 m / 98.4 ft</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$C_r$ [nF]</td>
<td>$L_r$ [µH]</td>
</tr>
<tr>
<td>TR100 with 1xPt100 in 2-, 3- or 4-wire connection</td>
<td>3.5</td>
<td>65</td>
</tr>
<tr>
<td>TC100 with 1x TC (Typ K)</td>
<td>2.5</td>
<td>25</td>
</tr>
<tr>
<td>TC100 with 1x TCJ (Typ J)</td>
<td>2</td>
<td>48.5</td>
</tr>
<tr>
<td>TR100 with 2xPt100 3-wire connection</td>
<td>4.7</td>
<td>77.3</td>
</tr>
<tr>
<td>TR100 with 2xPt100 4-wire connection</td>
<td>1.7</td>
<td>22.5</td>
</tr>
<tr>
<td>TC100 with 2x TC (Typ K)</td>
<td>1.21</td>
<td>25</td>
</tr>
<tr>
<td>TC100 with 2x TCJ (Typ J)</td>
<td>1.45</td>
<td>36</td>
</tr>
</tbody>
</table>

Keep in mind the following maximum values for effective capacities and inductances when interconnecting:
3.1 Special Conditions

Operate the measuring insert only if it is installed in a connection head.

3.2 Installation

**DANGER!**

The manufacturer is not liable for any damage or injuries resulting from improper use or use other than the intended purpose. This applies in particular to hazards due to insufficient corrosion resistance and suitability of the materials in contact with product.

Installation and setup must be carried out according to the applicable installation standards (e.g. EN 60079-14) by qualified personnel trained in explosion protection. Observe the information contained in the manuals and the supplementary instructions.

Install the measuring inserts such that

- the terminal base is protected by a connection head,
- no external forces are acting on the measuring insert,
- the device is accessible for any necessary visual inspections and can be viewed from all sides.
4. Electrical connections

4.1 General notes

The actual temperature sensor, either a Pt100 RTD or a thermocouple, is located in the replaceable measuring insert. It is inserted through the open head into the temperature assembly fitting and attached with two spring loaded M4 screws.

**Basic measuring insert versions**

1. Measuring insert with terminal block
2. Measuring insert with flying wires for transmitter mounting
3. Measuring insert with Ex transmitter (separately approved)

**DANGER!**
The Ex manual for the transmitter also applies to the variant with the Ex transmitter!
4.2 Power supply

As required for further information about the power supply to the measuring inserts refer to Electrical data on page 8.

DANGER!
If you are operating the measuring insert together with a transmitter, pay attention to the details about the power supply in the Ex documentation of the transmitter used. Also observe the maximum values of the sensor circuit.

4.3 Inputs / Outputs

4.3.1 Pt100 measuring inserts

A measuring insert with a Pt RTD is connected according to DIN EN 60751 in three different wiring variants (from left to right: 2, 3 and 4 wire switch).
4.3.2 Thermocouple measuring inserts

Wiring of a thermocouple measuring insert is done in accordance with DIN EN 60584:

TC 100: Wiring (single and double design)

4.4 Earthing and equipotential bonding

The measuring insert connections withstand a test voltage of 500 VAC to earth.

DANGER!
Equipotential bonding
Always include the measuring inserts in the equipotential bonding of the installation site (when installed correctly, the fixing screws guarantee this).
Operation

5.1 Start-up

**DANGER!**
To avoid injury and material damage, only operate the measuring inserts under the following conditions:

- The equipment was installed and connected in accordance with the manufacturer’s instructions.
- At the operator’s request, a test was conducted prior to start-up to ensure the correct installation and connection.
- The check prior to start-up was in compliance with the national regulations for checks before start-up.

5.2 Operation

**DANGER!**
To avoid injury and material damage, only operate the measuring inserts under the following conditions:

- Temperatures, pressures and electrical limit values are in the manufacturer’s specified range.
- The equipment parts necessary for safety are effective in the long run, never disable them during operation!
## 6.1 Maintenance

**DANGER!**
Maintenance measures of a safety-relevant nature within the meaning of explosion protection may only be carried out by the manufacturer, his authorised representative or under the supervision of authorised inspectors.

For systems in hazardous areas, regular tests are required in order to maintain the proper condition. The manufacturer recommends checking the following components regularly for corrosion and damage:

- Housing
- Cable entry(ies)
- Feed lines

## 6.2 Dismantling

**DANGER!**
To avoid injury and material damage caused by electric shock, only remove the measuring insert in a de-energised state!

**CAUTION!**
So as not to damage the cover of the connection head, only open it using a suitable tool (e.g. a screwdriver).

**INFORMATION!**
You can replace the measuring insert with a measuring insert identical in construction.
KROHNE – Process instrumentation and measurement solutions

- Flow
- Level
- Temperature
- Pressure
- Process Analysis
- 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.com

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