

# OEM miniature resistance thermometer Models TR31-3 and TR31-K, thread-mounted

WIKA data sheet TE 60.31



## Applications

- Machine building, plant and vessel construction
- Propulsion technology, hydraulics

## Special features

- Very compact design, high vibration resistance and fast response time
- With direct sensor output (Pt100, Pt1000 in 2-, 3- or 4-wire connection) or integrated transmitter with 4 ... 20 mA output signal
- Integrated transmitter is individually parameterisable with free-of-charge WIKAsoft-TT PC configuration software
- Sensor element with accuracy class A in accordance with IEC 60751
- EMC conformity in accordance with NAMUR NE21

## Description

Resistance thermometers of this series are used as universal thermometers for the measurement of liquid and gaseous media in the range -50 ... +250 °C (-58 ... +482 °F). For application in hazardous areas, intrinsically safe versions are available.

They can be used for pressures up to 140 bar with 3 mm sensor diameters and up to 270 bar with 6 mm sensor diameters, depending on the instrument version. All electrical components are protected against humidity (IP 67 or IP 69K) and designed to withstand vibration (20 g, depending on instrument version).

The resistance thermometer is available with direct sensor output or integrated transmitter, which can be configured individually via the PC configuration software WIKAsoft-TT. Measuring range, damping, error signalling per NAMUR NE43 and TAG no. can be adjusted.

Insertion length, process connection, sensor and connection method can each be selected for the respective application



**Fig. left: Resistance thermometer with M12 x 1, model TR31-3**  
**Fig. centre: Resistance thermometer with directly connected cable, model TR31-K**  
**Fig. right: M12 x 1 adapter to DIN EN 175301-803 angular connector**

within the order information. The model TR31 resistance thermometer consists of a thermowell with a fixed process connection and is screwed directly into the process. The electrical connection depends on the design and is made with an M12 x 1 circular connector or via a directly connected cable. For the M12 x 1 circular connector, an adapter for electrical connection with angular connector per DIN EN 175301-803 form A (patent, property right registered under no. 001370985) is optionally available. As a special feature, the miniature OEM resistance thermometer is also available in customer-specific designs.

## Sensor

The sensor is located in the tip of the thermometer.

The resistance thermometers of the series TR31 are designed for direct installation into the process. Using it in an additional thermowell is not advisable.

| Sensor diameter<br>in mm | Process connection |       |       |       |       |           |           |
|--------------------------|--------------------|-------|-------|-------|-------|-----------|-----------|
|                          | G ¼ B              | G ⅜ B | G ½ B | ¼ NPT | ½ NPT | M12 x 1.5 | M20 x 1.5 |
| 3                        | x                  | x     | x     | x     | x     | x         | x         |
| 6                        | x                  | x     | x     | x     | x     | x         | x         |

other process connections on request

| Sensor diameter<br>in mm | Sensor tube length<br>Insertion length U <sub>1</sub> in mm |    |     |     |     |     |     |     |     |     |
|--------------------------|---|----|-----|-----|-----|-----|-----|-----|-----|-----|
|                          | 50  | 75 | 100 | 120 | 150 | 200 | 250 | 300 | 350 | 400 |
| 3                        | x   | -  | -   | -   | -   | -   | -   | -   | -   | -   |
| 6                        | x   | x  | x   | x   | x   | x   | x   | x   | x   | x   |

## Specifications

| Thermometer with transmitter and 4 ... 20 mA output signal (model TR31-x-x-TT) |  |
|--|--|
| Temperature range  | Without neck tube -50 ... +150 °C (-58 ... +302 °F)<br>With neck tube -50 ... +250 °C (-58 ... +482 °F) <sup>1)2)</sup>  |
| Measuring element  | Pt1000   |
| Connection method  | 2-wire   |
| Tolerance value of the measuring element per IEC 60751                         | Class A <sup>3)</sup>  |
| Measuring deviation of the transmitter per IEC 60770                           | ±0.25 K  |
| Total measuring deviation in accordance with IEC 60770                         | Measuring deviation of the measuring element + the transmitter   |
| Measuring span   | Minimum 20 K, maximum 300 K  |
| Basic configuration  | Measuring range 0 ... 150 °C (32 ... 302 °F), other measuring ranges are adjustable  |
| Analogue output  | 4 ... 20 mA, 2-wire  |
| Linearisation  | Linear to temperature per IEC 60751  |
| Linearisation error  | ±0.1 % <sup>4)</sup>   |
| Switch-on delay, electrical  | Max. 4 s (time before the first measured value)  |
| Warming-up period  | After approx. 4 minutes, the instrument will function to the specifications (accuracy) given in the data sheet.  |
| Current signals for error signalling   | Configurable in accordance with NAMUR NE43<br>downscale ≤ 3.6 mA                      upscale ≥ 21.0 mA  |
| Sensor short-circuit   | Not configurable, in accordance with NAMUR NE43 downscale ≤ 3.6 mA   |
| Sensor current   | < 0.3 mA (self-heating can be ignored)   |
| Load R <sub>A</sub>  | $R_A \leq (U_B - 10 \text{ V}) / 23 \text{ mA}$ with R <sub>A</sub> in Ω and U <sub>B</sub> in V   |
| Effect of load   | ±0.05 % / 100 Ω  |
| Power supply U <sub>B</sub>  | DC 10 ... 30 V   |
| Max. permissible residual ripple   | 10 % generated by U <sub>B</sub> < 3 % ripple of the output current  |
| Power supply input   | Protected against reverse polarity   |
| Power supply effect  | ±0.025 % / V (depending on the power supply U <sub>B</sub> )   |
| Influence of the ambient temperature   | 0.1 % of span / 10 K T <sub>a</sub>  |
| Electromagnetic compatibility (EMC) <sup>6)</sup>                              | 2004/108/EC, EN 61326 emission (group 1, class B) and interference immunity (industrial application) <sup>5)</sup> , configuration at 20 % of the full measuring range |
| Temperature units  | Configurable °C, °F, K   |
| Info data  | TAG no., description and user message can be stored in transmitter   |
| Configuration and calibration data   | Permanently stored   |
| Electrical connection  | <ul style="list-style-type: none"> <li>■ M12 x 1, 4-pin circular connector</li> <li>■ Directly connected cable</li> </ul>  |
| Explosion protection (option)  | Intrinsically safe to Ex i (ATEX) gas/dust, per directive 94/9/EC<br>(for further information see "Further specifications for explosion-protected version")            |

Readings in % refer to the measuring span

1) The temperature transmitter should therefore be protected from temperatures over 85 °C (185 °F).

2) Version with mineral-insulated sheathed cable can be used up to 300 °C (572 °F).

3) Class accuracy A only valid in the temperature range -30 ... +150 °C (-22 ... +302 °F) or -30 ... +250 °C (-22 ... +482 °F), otherwise class B

4) ±0.2 % for measuring ranges with a lower limit less than 0 °C (32 °F)

5) Use resistance thermometers with shielded cable, and ground the shield on at least one end of the lead, if the lines are longer than 30 m or leave the building. The instrument must be operated grounded.

6) During transient interferences (e.g. burst, surge, ESD) take into account an increased measuring deviation of up to 2 %.

**Thermometer with direct sensor output with Pt100 (model TR31-x-x-Px) or Pt1000 (model TR31-x-x-Sx)**

|   |   |
|---|---|
| Temperature range   | Without neck tube -50 ... +150 °C (-58 ... +302 °F)<br>With neck tube -50 ... +250 °C (-58 ... +482 °F) <sup>7)</sup>   |
| Temperature at connector or at the directly connected cable | Max. 85 °C (185 °F)   |
| Measuring element   | <ul style="list-style-type: none"> <li>■ Pt100 (measuring current: 0.1 ... 1.0 mA)</li> <li>■ Pt1000 (measuring current: 0.1 ... 0.3 mA)</li> </ul>   |
| Connection method   | <ul style="list-style-type: none"> <li>■ 2-wire The lead resistance is recorded as an error in the measurement.</li> <li>■ 3-wire With a cable length of 30 m or longer, measuring deviations can occur.</li> <li>■ 4-wire The lead resistance can be ignored.</li> </ul> |
| Tolerance value of the measuring element per IEC 60751      | <ul style="list-style-type: none"> <li>■ Class A <sup>8)</sup></li> <li>■ Class B at 2-wire</li> </ul>  |
| Electrical connection                                       | <ul style="list-style-type: none"> <li>■ M12 x 1, 4-pin circular connector</li> <li>■ Directly connected cable</li> </ul>   |
| Explosion protection (option)                               | Intrinsically safe to Ex i (ATEX) gas/dust, per directive 94/9/EC (for further information see "Further specifications for explosion-protected version")  |

For detailed specifications for Pt sensors, see Technical information IN 00.17 at [www.wika.com](http://www.wika.com).

**Case**

|   |  |
|---|--|
| Material  | Stainless steel  |
| Ingress protection  |  |
| <ul style="list-style-type: none"> <li>■ Case with connected connector or directly connected cable</li> </ul> | IP 67 and IP 69 per IEC 60529/EN 60529, IP 69K per ISO 20653<br>The stated ingress protection only applies when plugged in using mating connectors that have the appropriate ingress protection. |
| <ul style="list-style-type: none"> <li>■ Coupler connector, not connected</li> </ul>                          | IP 67 per IEC 60529/EN 60529   |
| Weight in kg  | Approx. 0.2 ... 0.7 (depending on version)   |
| Dimensions  | See "Dimensions in mm"   |

**Ambient conditions**

|   |  |
|---|--|
| Ambient temperature range   |  |
| <ul style="list-style-type: none"> <li>■ Standard version <ul style="list-style-type: none"> <li>- M12 x 1 circular connector, model TR31-3-x-xx -50 ... +85 °C (-58 ... +185 °F)</li> <li>- Directly connected cable, model TR31-K-x-xx -20 ... +80 °C (-4 ... +176 °F)</li> </ul> </li> <li>■ Explosion-protected version <ul style="list-style-type: none"> <li>- M12 x 1 circular connector <ul style="list-style-type: none"> <li>Model TR31-3-x-TT -40 ... +85 °C (-40 ... +185 °F)</li> <li>Models TR31-3-x-Px, TR31-3-x-Sx -50 ... +85 °C (-58 ... +185 °F)</li> </ul> </li> <li>- Directly connected cable, model TR31-K-x-xx -20 ... +80 °C (-4 ... +176 °F)</li> </ul> </li> </ul>   |  |
| Storage temperature range   |  |
| <ul style="list-style-type: none"> <li>■ M12 x 1 circular connector, model TR31-3-x-xx -40 ... +85 °C (-40 ... +185 °F)</li> <li>■ Directly connected cable, model TR31-K-x-xx -20 ... +80 °C (-4 ... +176 °F)</li> </ul>   |  |
| Climate class per IEC 60654-1   |  |
| <ul style="list-style-type: none"> <li>■ Standard version <ul style="list-style-type: none"> <li>- M12 x 1 circular connector, model TR31-3-x-xx Cx (-50 ... +85 °C or -58 ... +185 °F, 5 ... 95 % r. h.)</li> <li>- Directly connected cable, model TR31-K-x-xx Cx (-20 ... +80 °C or -4 ... +176 °F, 5 ... 95 % r. h.)</li> </ul> </li> <li>■ Explosion-protected version <ul style="list-style-type: none"> <li>- M12 x 1 circular connector <ul style="list-style-type: none"> <li>Model TR31-3-x-TT Cx (-40 ... +85 °C or -40 ... +185 °F, 5 ... 95 % r. h.)</li> <li>Models TR31-3-x-Px, TR31-3-x-Sx Cx (-50 ... +85 °C or -58 ... +185 °F, 5 ... 95 % r. h.)</li> </ul> </li> <li>- Directly connected cable, model TR31-K-x-xx Cx (-20 ... +80 °C or -4 ... +176 °F, 5 ... 95 % r. h.)</li> </ul> </li> </ul> |  |
| Maximum permissible humidity per IEC 60068-2-30 var. 2  | 100 % r. h., condensation allowed                                      |
| Maximum operating pressure <sup>9) 10)</sup>  | 140 bar with 3 mm sensor diameter<br>270 bar with 6 mm sensor diameter |
| Vibration per IEC 60751   | 10 ... 2,000 Hz, 20 g <sup>9)</sup>                                    |
| Shock   | IEC 60068-2-27   |
| Salt fog  | IEC 60068-2-11   |

7) Version with mineral-insulated sheathed cable can be used up to 300 °C (572 °F).

8) Class accuracy A only valid in the temperature range -30 ... +150 °C (-22 ... +302 °F) or -30 ... +250 °C (-22 ... +482 °F), otherwise class B

9) Dependent on the instrument version

10) Reduced operating pressure when using a compression fitting: Stainless steel: max. 100 bar  
PTFE: max. 8 bar

## Further specifications for explosion-protected version (optional)

### ■ Thermometer with transmitter and 4 ... 20 mA output signal (model TR31-x-x-TT)

#### Marking:

| Hazardous gas atmosphere        | Temperature class | Ambient temperature range ( $T_a$ ) | Maximum surface temperature ( $T_{max}$ ) at the sensor or thermowell tip                                  |
|---------------------------------|-------------------|-------------------------------------|--|
| II 1G Ex ia IIC T1 - T6 Ga      | T6                | -40 ... +45 °C                      | $T_M$ (medium temperature) + self-heating (15 K)<br>Pay attention to the specific conditions for safe use. |
| II 1/2G Ex ia IIC T1 - T6 Ga/Gb | T5                | -40 ... +60 °C                      |  |
| II 2G Ex ia IIC T1 - T6 Gb      | T4                | -40 ... +85 °C                      |  |
|                                 | T3                | -40 ... +85 °C                      |  |
|                                 | T2                | -40 ... +85 °C                      |  |
|                                 | T1                | -40 ... +85 °C                      |  |

| Hazardous dust atmosphere        | Power $P_i$ | Ambient temperature range ( $T_a$ ) | Maximum surface temperature ( $T_{max}$ ) at the sensor or thermowell tip                                  |
|----------------------------------|-------------|-------------------------------------|--|
| II 1D Ex ia IIIC T135 °C Da      | 750 mW      | -40 ... +40 °C                      | $T_M$ (medium temperature) + self-heating (15 K)<br>Pay attention to the specific conditions for safe use. |
| II 1/2D Ex ia IIIC T135 °C Da/Db | 650 mW      | -40 ... +70 °C                      |  |
| II 2D Ex ia IIIC T135 °C Db      | 550 mW      | -40 ... +85 °C                      |  |

#### Safety-related maximum values for the current loop circuit (+ and - connections):

| Parameters   | Hazardous gas atmosphere | Hazardous dust atmosphere |
|--|--------------------------|---------------------------|
| Terminals  | + / -                    | + / -                     |
| Voltage $U_i$  | DC 30 V                  | DC 30 V                   |
| Current $I_i$  | 120 mA                   | 120 mA                    |
| Power $P_i$  | 800 mW                   | 750/650/550 mW            |
| Effective internal capacitance $C_i$                 | 29.7 nF                  | 29.7 nF                   |
| Effective internal inductance $L_i$                  | negligible               | negligible                |
| Maximum self-heating at the sensor or thermowell tip | 15 K                     | 15 K                      |

### ■ Thermometer with direct sensor output with Pt100 (model TR31-x-x-Px) or Pt1000 (model TR31-x-x-Sx)

#### Marking:

| Marking                         | Temperature class | Ambient temperature range ( $T_a$ ) | Maximum surface temperature ( $T_{max}$ ) at the sensor or thermowell tip                                |
|---------------------------------|-------------------|-------------------------------------|--|
| II 1G Ex ia IIC T1 - T6 Ga      | T6                | -50 ... +80 °C                      | $T_M$ (medium temperature) + self-heating<br>Pay attention to the specific conditions for safe use (17). |
| II 1/2G Ex ia IIC T1 - T6 Ga/Gb | T5                | -50 ... +85 °C                      |  |
| II 2G Ex ia IIC T1 - T6 Gb      | T4                | -50 ... +85 °C                      |  |
|                                 | T3                | -50 ... +85 °C                      |  |
|                                 | T2                | -50 ... +85 °C                      |  |
|                                 | T1                | -50 ... +85 °C                      |  |

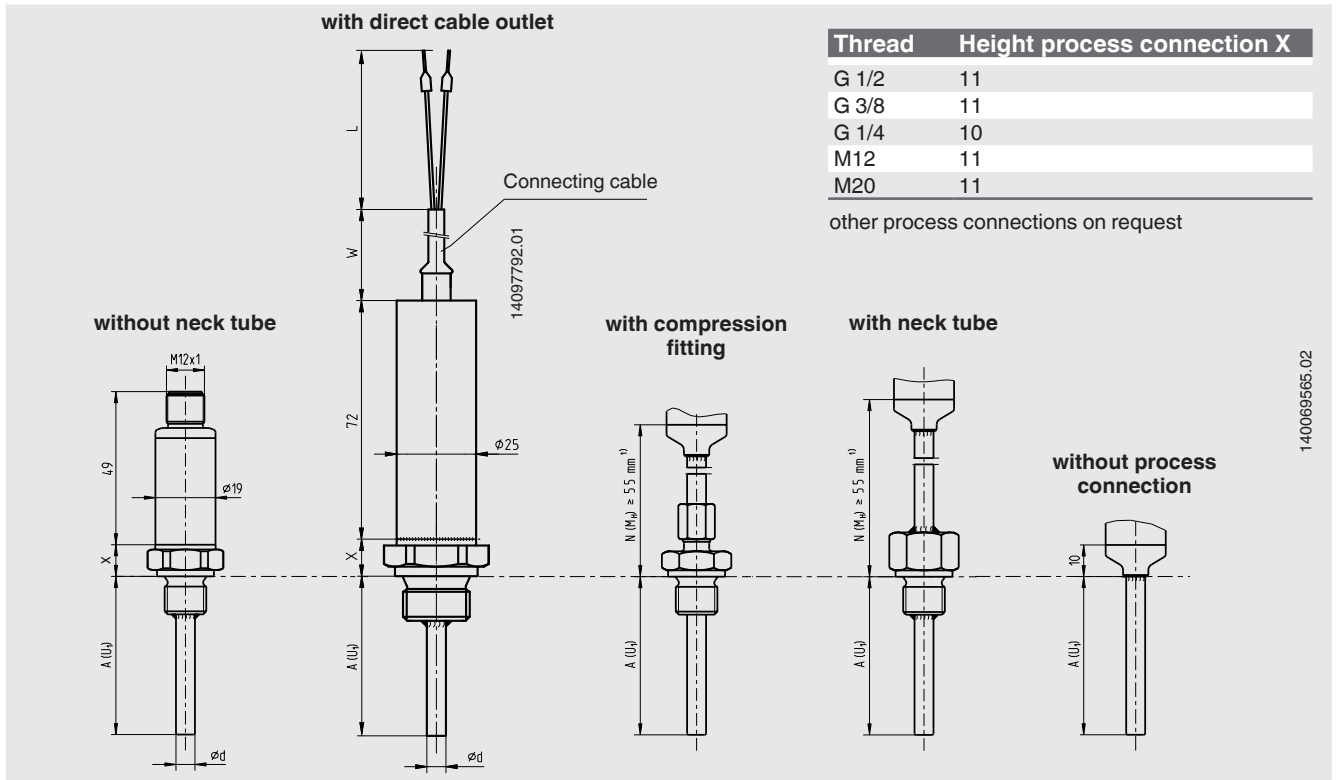
| Marking                          | Power $P_i$ | Ambient temperature range ( $T_a$ ) | Maximum surface temperature ( $T_{max}$ ) at the sensor or thermowell tip                                |
|----------------------------------|-------------|-------------------------------------|--|
| II 1D Ex ia IIIC T135 °C Da      | 750 mW      | -50 ... +40 °C                      | $T_M$ (medium temperature) + self-heating<br>Pay attention to the specific conditions for safe use (17). |
| II 1/2D Ex ia IIIC T135 °C Da/Db | 650 mW      | -50 ... +70 °C                      |  |
| II 2D Ex ia IIIC T135 °C Db      | 550 mW      | -50 ... +85 °C                      |  |

#### Safety-related maximum values for the current loop circuit (connections in accordance with pin assignment 1 - 4):

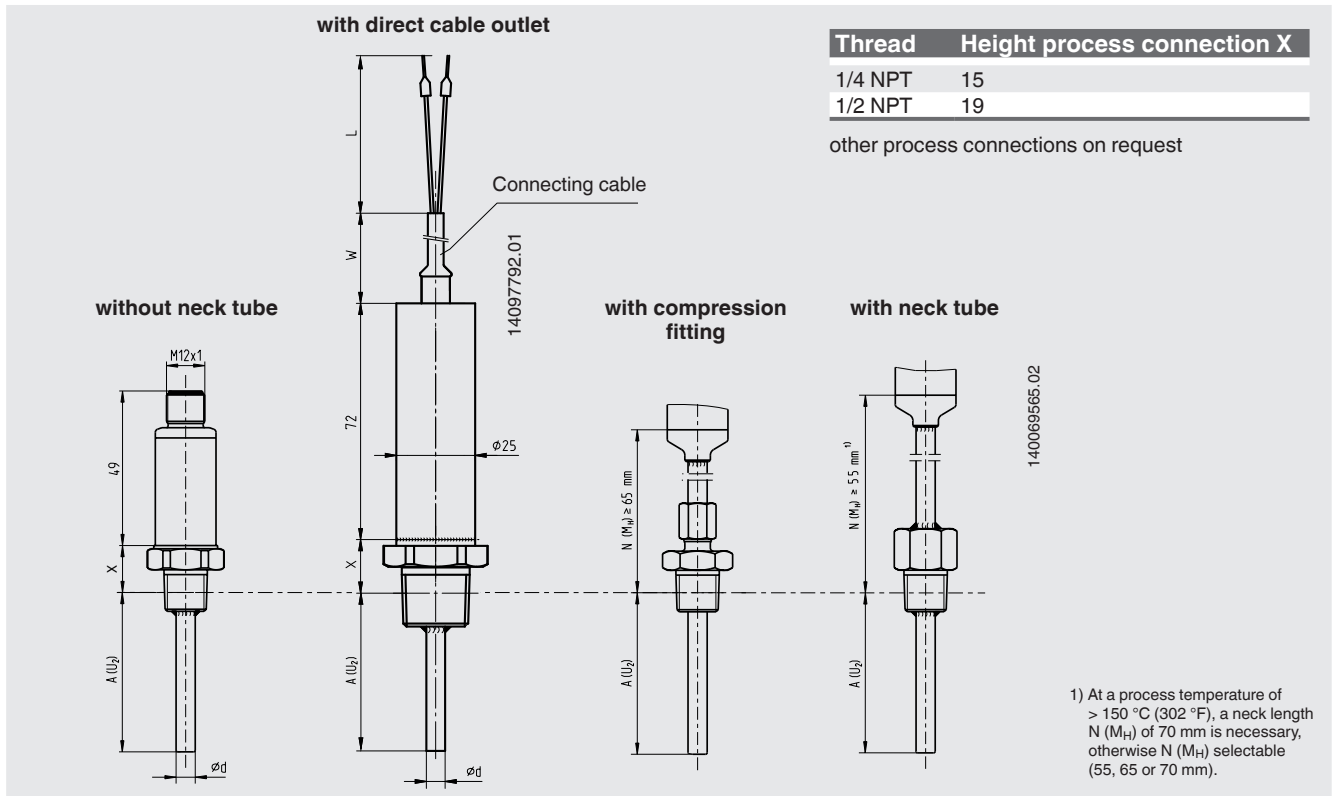
| Parameters   | Gas applications             | Dust applications            |
|--|------------------------------|------------------------------|
| Terminals  | 1 - 4                        | 1 - 4                        |
| Voltage $U_i$  | DC 30 V                      | DC 30 V                      |
| Current $I_i$  | 550 mA                       | 250 mA                       |
| Power $P_i$  | 1,500 mW                     | 750/650/550 mW               |
| Effective internal capacitance $C_i$                 | negligible                   | negligible                   |
| Effective internal inductance $L_i$                  | negligible                   | negligible                   |
| Maximum self-heating at the sensor or thermowell tip | $(R_{th}) = 335 \text{ K/W}$ | $(R_{th}) = 335 \text{ K/W}$ |

# Dimensions in mm

## Process connection with parallel threads (or without process connection)




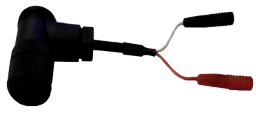

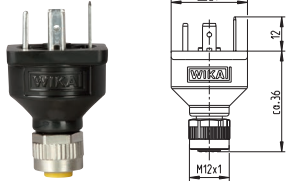
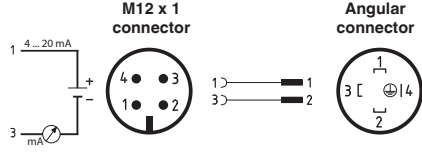
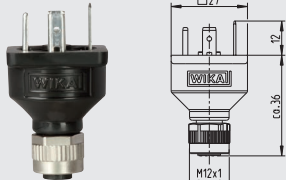
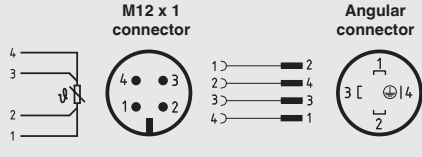


## Process connection with tapered thread



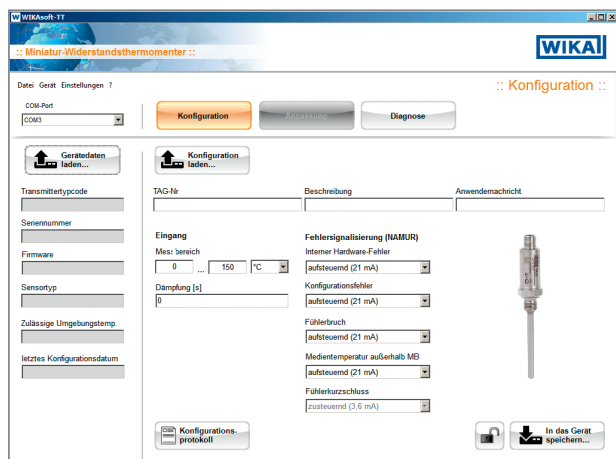
### Legend:

- A (U<sub>1</sub>) Insertion length (parallel thread)
- A (U<sub>2</sub>) Insertion length (tapered thread)
- N (M<sub>H</sub>) Neck length
- X Height process connection
- Ød Sensor diameter
- W Length of the directly connected cable
- L Length of the free wire ends

## Accessories

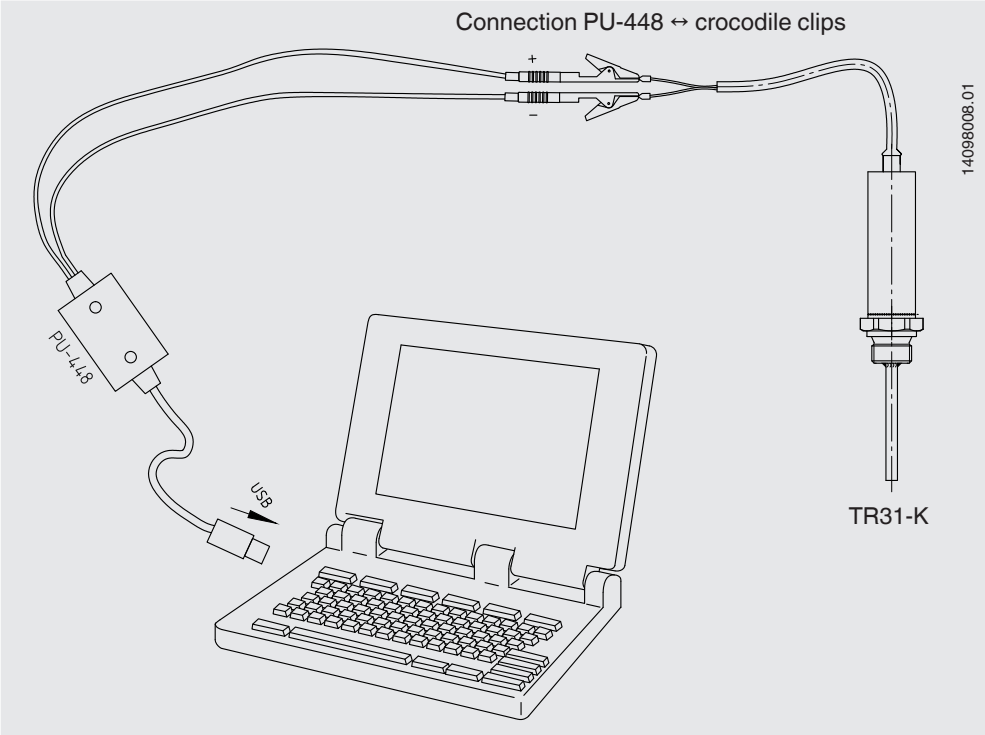
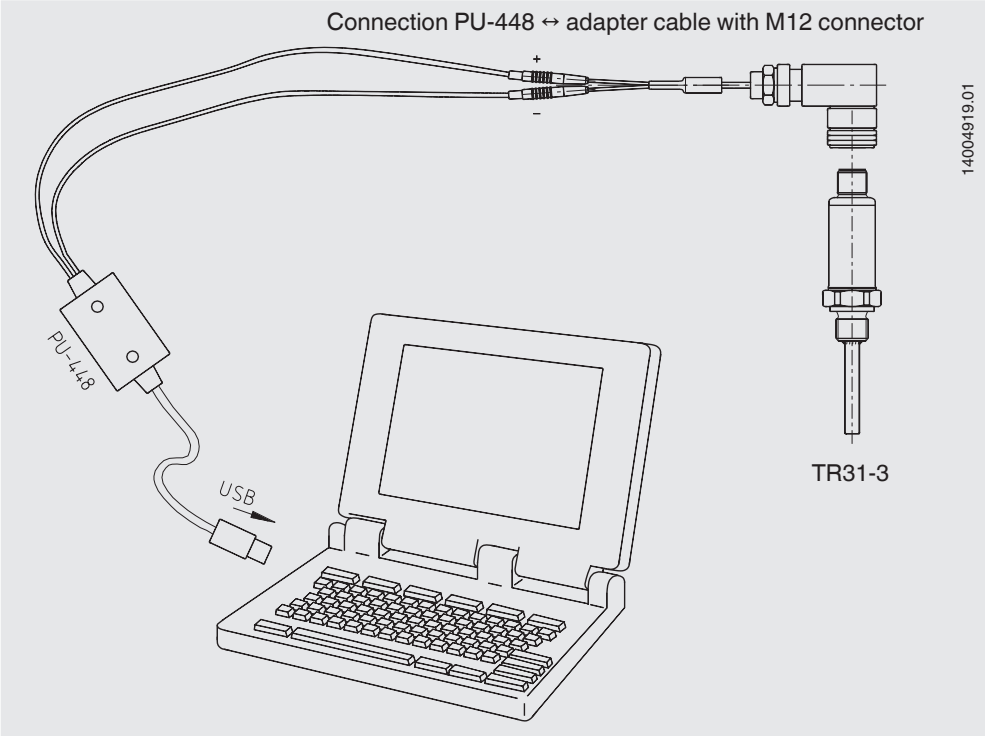
| Model   | Special features  | Order no. |
|---|---|-----------|
| Programming unit<br>Model PU-448<br>   | <ul style="list-style-type: none"> <li>Easy to use</li> <li>LED status/diagnostic displays</li> <li>Compact design</li> <li>No further voltage supply is needed for either the programming unit or for the transmitter</li> </ul>   | 11606304  |
| Adapter cable M12 to PU-448<br>  | Adapter cable for the connection of a model TR31 resistance thermometer to the model PU-448 programming unit  | 14003193  |
| Crocodile clip set<br>  | Crocodile clips for the connection of the model TR31-K resistance thermometer with directly connected cable with the model PU-448 programming unit  | 14097967  |
| M12 x 1 transmitter adapter to angular connector DIN EN 175301-803 (yellow female connector element)<br> | Adapter for the connection of a resistance thermometer with a DIN EN 175301-803 form A angular connector with a 4 ... 20 mA output signal (data sheet AC 80.17)<br> <p> <b>Case: PA</b><br/> <b>Ambient temperature:</b> -40 ... +115 °C<br/> <b>Union nut:</b> zinc diecast<br/> <b>Contacts:</b> copper-zinc alloy, tin-plated<br/> <b>Dielectric strength:</b> 500 V<br/> <b>Ingress protection:</b> IP 65         </p>         | 14069503  |
| M12 x 1 Pt adapter to angular connector DIN EN 175301-803 (black female connector element)<br>         | Adapter for the connection of the resistance thermometer with a DIN EN 175301-803 form A angular connector with direct resistance output signal (data sheet AC 80.17)<br> <p> <b>Case: PA</b><br/> <b>Ambient temperature:</b> -40 ... +115 °C<br/> <b>Union nut:</b> zinc diecast<br/> <b>Contacts:</b> copper-zinc alloy, tin-plated<br/> <b>Dielectric strength:</b> 500 V<br/> <b>Ingress protection:</b> IP 65         </p> | 14061115  |
| Angular connector<br>  | per DIN EN 175301-803 form A  | 11427567  |
| Sealing for angular connector<br>  | for use with angular connector DIN EN 175301-803-A<br>EPDM, brown   | 11437902  |

## Configuration software WIKAsoft-TT



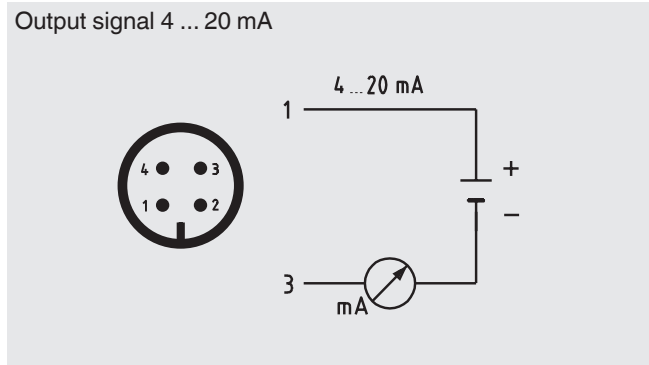
Configuration software (multilingual) as a download from [www.wika.com](http://www.wika.com)

# Connecting PU-448 programming unit

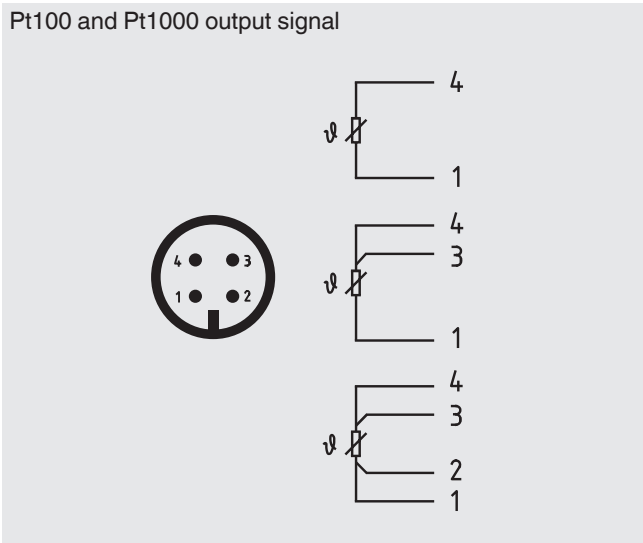


# Electrical connection

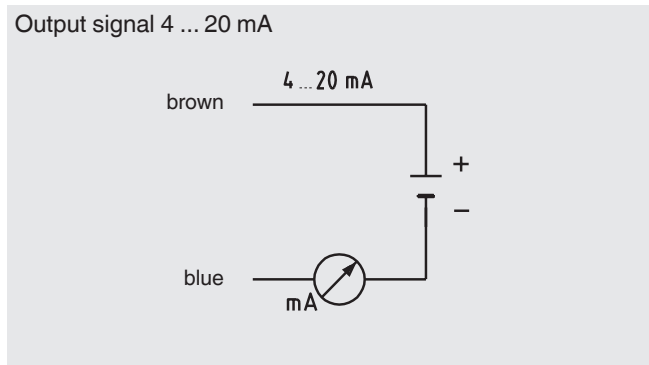
## M12 x 1, 4-pin circular connector



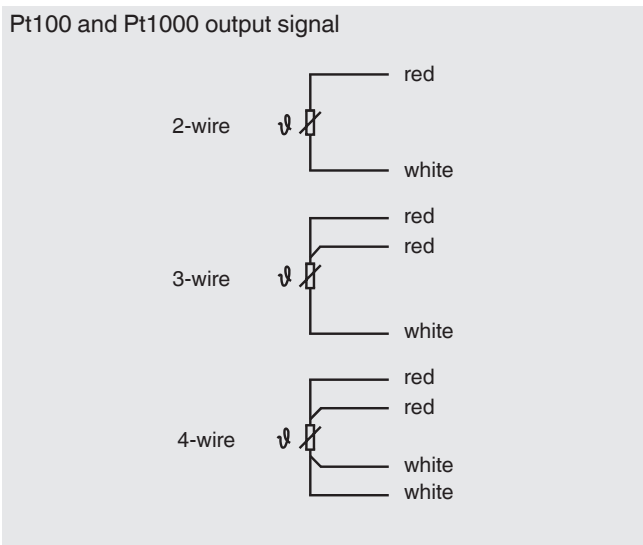
| Pin | Signal | Description   |
|-----|--------|---------------|
| 1   | L+     | 10 ... 30 V   |
| 2   | VQ     | not connected |
| 3   | L-     | 0 V           |
| 4   | C      | not connected |



## Directly connected cable

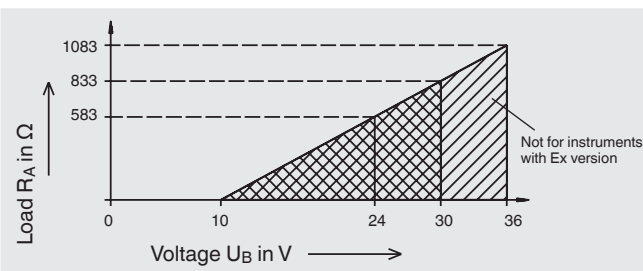


| Pin   | Signal | Description |
|-------|--------|-------------|
| Brown | L+     | 10 ... 30 V |
| Blue  | L-     | 0 V         |



## Load diagram

The permissible load depends on the loop supply voltage. For communication with the instrument with programming unit PU-448, a max. load of 350 Ω is admissible.





## CE conformity

### EMC directive <sup>1)</sup>

2004/108/EC, EN 61326 emission (group 1, class B) and interference immunity (industrial application)

### ATEX directive (option)

94/9/EC, II 1G Ex ia IIC T1 - T6 Ga  
II 1/2G Ex ia IIC T1 - T6 Ga/Gb  
II 2G Ex ia IIC T1 - T6 Gb  
II 1D Ex ia IIIC T135 °C Da  
II 1/2D Ex ia IIIC T135 °C Da/Db  
II 2D Ex ia IIIC T135 °C Db

1) Only for built-in transmitter

## Patents, property rights

M12 x 1 adapter to DIN EN 175301-803 angular connector, registered under no. 001370985

## Approvals (option)

IECEX, ignition protection type "i" - intrinsic safety, ignition protection type "iD" - dust protection through intrinsic safety, international certification for the Ex area

## Certificates (option)

| Certification type                | Measuring accuracy | Material certificate |
|-----------------------------------|--------------------|----------------------|
| 2.2 test report                   | x                  | x                    |
| 3.1 inspection certificate        | x                  | x                    |
| DKD/DAkkS calibration certificate | x                  | -                    |

The different certifications can be combined with each other.

Approvals and certificates, see website

## Ordering information

Model / Design / Output signal / Transmitter temperature unit / Process temperature / Transmitter initial value / Transmitter end value / Process connection / Sensor diameter / Insertion length A (U<sub>1</sub>) or A (U<sub>2</sub>) / Neck length N (M<sub>H</sub>) / Accessories / Certificates

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