

# Miniature resistance thermometer

## Threaded

### Model TR33

WIKA data sheet TE 60.33



for further approvals  
see page 6

### 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 per IEC 60751

### Description

Resistance thermometers of these series are used as universal thermometers for the measurement of liquid and gaseous media in the range  $-50 \dots +250 \text{ }^{\circ}\text{C}$  [ $-58 \dots +482 \text{ }^{\circ}\text{F}$ ].

They can be used for pressures up to 140 bar [2,030 psi] with 3 mm [0.12 in] protection tube diameters and up to 270 bar [3,916 psi] with 6 mm [0.24 in] protection tube diameters, depending on the instrument version. All electrical components are protected against humidity (IP67 or IP69K) 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 WIKAsoft-TT PC configuration software. Measuring range, dampening, error signalling per NAMUR NE 043 and tag no. can be adjusted.



**Fig. left: Resistance thermometer, model TR33**  
**Fig. right: M12 x 1 adapter to DIN EN 175301-803 angular connector**

Insertion length, process connection, sensor and connection method can each be selected for the respective application within the ordering information. The model TR33 resistance thermometer consists of a protection tube with a fixed process connection and is screwed directly into the process. The electrical connection is made via an M12 x 1 circular connector. An adapter for electrical connection with angular connector per DIN EN 175301-803 is optionally available (patent, industrial property right: 001370985).

# Specifications

Measuring element		
<b>Type of measuring element</b>		
Version 4 ... 20 mA (model TR33-Z-TT)	Pt1000 (measuring current < 0.3 mA; self-heating can be ignored)	
Version Pt100 (model TR33-Z-Px) / Pt1000 (model TR33-Z-Sx)	<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>	
	→ For detailed specifications for Pt sensors, see Technical information IN 00.17 at <a href="http://www.wika.com">www.wika.com</a> .	
<b>Connection method</b>		
Version 4 ... 20 mA (model TR33-Z-TT)	2-wire	The lead resistance is recorded as an error in the measurement
Version Pt100 (model TR33-Z-Px) / Pt1000 (model TR33-Z-Sx)	2-wire	The lead resistance is recorded as an error in the measurement
	3-wire	With a cable length of 30 m or longer, measuring deviations can occur
	4-wire	The lead resistance can be ignored
<b>Tolerance value of the measuring element <sup>1)</sup> per IEC 60751</b>		
Version 4 ... 20 mA (model TR33-Z-TT)	Class A	
Version Pt100 (model TR33-Z-Px) / Pt1000 (model TR33-Z-Sx)	<ul style="list-style-type: none"> <li>■ Class A</li> <li>■ Class B at 2-wire</li> </ul>	

Accuracy specifications (4 ... 20 mA version)	
<b>Tolerance value of the measuring element <sup>1)</sup> per IEC 60751</b>	Class A
<b>Measuring deviation of the transmitter per IEC 62828</b>	±0.25 K
<b>Total measuring deviation per IEC 62828</b>	Measuring deviation of the measuring element + transmitter
<b>Influence of the ambient temperature</b>	0.1 % of the set measuring span / 10 K T <sub>a</sub>
<b>Influence of supply voltage</b>	±0.025 % / V (depending on the supply voltage U <sub>B</sub> )
<b>Influence of the load</b>	±0.05 % / 100 Ω
<b>Linearisation</b>	Linear to temperature per IEC 60751
<b>Output error</b>	±0.1 % <sup>2)</sup>
<b>Reference conditions</b>	
Ambient temperature T <sub>a</sub> ref	23 °C
Supply voltage U <sub>B</sub> ref	DC 12 V

1) Depending on the process connection, the deviation can be bigger.

2) ±0.2 % for start of measuring range less than 0 °C [32 °F]

## Example calculation: Total measuring deviation

(measuring range 0 ... 150 °C, load 200 Ω, supply voltage 16 V, ambient temperature 33 °C, process temperature 100 °C)

Sensor element (class A per IEC 60751: 0.15 + (0.0020(t))):	±0.350 K
Measuring deviation of the transmitter ±0.25 K:	±0.250 K
Output error ±(0.1 % of 150 K):	±0.150 K
Influence of load ±(0.05 % / 100 Ω of 150 K):	±0.150 K
Influence of supply voltage ±(0.025 % / V of 150 K):	±0.150 K
Influence of the ambient temperature ±(0.1 % / 10 K T <sub>a</sub> of 150 K):	±0.150 K

## Measuring deviation (typical)

$$\text{sqrt}(0.35 \text{ K}^2 + 0.25 \text{ K}^2 + 0.15 \text{ K}^2 + 0.15 \text{ K}^2 + 0.15 \text{ K}^2)$$

$$\text{sqrt}(0.275 \text{ K}^2) = 0.524 \text{ K}$$

## Measuring deviation (maximum)

$$0.35 \text{ K} + 0.25 \text{ K} + 0.15 \text{ K} + 0.15 \text{ K} + 0.15 \text{ K} + 0.15 \text{ K} = 1.2 \text{ K}$$

Measuring range	
<b>Temperature range</b>	
Version 4 ... 20 mA (model TR33-Z-TT)	Without neck tube -30 ... +150 °C [-22 ... +302 °F] With neck tube -30 ... +250 °C [-22 ... +482 °F] <sup>1)</sup> Version with FKM O-ring: -20 ... +125 °C [-4 ... +257 °F]
Version Pt100 (model TR33-Z-Px) / Pt1000 (model TR33-Z-Sx)	Class A Without neck tube -30 ... +150 °C [-22 ... +302 °F] With neck tube -30 ... +250 °C [-22 ... +482 °F] Version with FKM O-ring: -20 ... +125 °C [-4 ... +257 °F]
	Class B Without neck tube -50 ... +150 °C [-58 ... +302 °F] With neck tube -50 ... +250 °C [-58 ... +482 °F]
<b>Unit (4 ... 20 mA version)</b>	Configurable °C, °F, K
<b>Temperature at the connector (Pt100, Pt1000 version)</b>	Max. 85 °C [185 °F]
<b>Measuring span (4 ... 20 mA version)</b>	Minimum 20 K, maximum 300 K

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

Process connection	
<b>Type of process connection</b>	<ul style="list-style-type: none"> <li>■ G ¼ B</li> <li>■ G ⅜ B</li> <li>■ G ½ B</li> <li>■ ¼ NPT</li> <li>■ ½ NPT</li> <li>■ M12 x 1.5</li> <li>■ M20 x 1.5</li> <li>■ 7/16-20 UNF-2A</li> </ul>
<b>Protection tube</b>	
Protection tube diameter	<ul style="list-style-type: none"> <li>■ 3 mm [0.12 in]</li> <li>■ 6 mm [0.24 in]</li> </ul>
Insertion length U <sub>1</sub>	<ul style="list-style-type: none"> <li>■ 50 mm [1.97 in]</li> <li>■ 75 mm [2.95 in] <sup>1)</sup></li> <li>■ 100 mm [3.94 in] <sup>1)</sup></li> <li>■ 120 mm [4.72 in] <sup>1)</sup></li> <li>■ 150 mm [5.91 in] <sup>1)</sup></li> <li>■ 200 mm [7.87 in] <sup>1)</sup></li> <li>■ 250 mm [9.84 in] <sup>1)</sup></li> <li>■ 300 mm [11.81 in] <sup>1)</sup></li> <li>■ 350 mm [13.78 in] <sup>1)</sup></li> <li>■ 400 mm [15.75 in] <sup>1)</sup></li> </ul> <p>Other insertion lengths on request</p>
Material (wetted)	Stainless steel 1.4571

1) Not for protection tube diameter 3 mm [0.12 in]

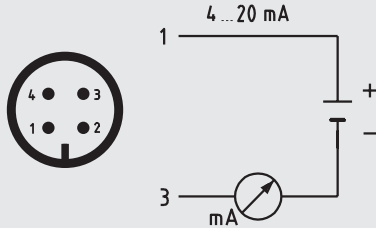
If the resistance thermometer is to be operated in an additional protection tube, a spring-loaded compression fitting must be used.

<b>Output signal (4 ... 20 mA version)</b>	
<b>Analogue output</b>	4 ... 20 mA, 2-wire
<b>Load <math>R_A</math></b>	$R_A \leq (U_B - 10 \text{ V}) / 23 \text{ mA}$ with $R_A$ in $\Omega$ and $U_B$ in V The permissible load depends on the loop supply voltage. For communication with the instrument with programming unit PU-548, a max. load of 350 $\Omega$ is admissible.
<b>Load diagram</b>	<p>The load diagram is a graph with 'Load <math>R_A</math> in <math>\Omega</math>' on the vertical axis and 'Voltage <math>U_B</math> in V' on the horizontal axis. The vertical axis has markings at 583, 833, and 1083. The horizontal axis has markings at 10, 24, 30, and 36. A solid line starts at (10, 0) and goes up to (36, 1083). The area under this line is shaded with diagonal lines. Dashed lines connect the points (24, 583), (30, 833), and (36, 1083) to their respective values on the axes.</p>
<b>Factory configuration</b>	
Measuring range	Measuring range 0 ... 150 °C [32 ... 302 °F] Other measuring ranges are adjustable
Current signals for error signalling	Configurable in accordance with NAMUR NE 043 downscale $\leq 3.6 \text{ mA}$ upscale $\geq 21.0 \text{ mA}$
Current value for sensor short-circuit	Not configurable in accordance with NAMUR NE 043 downscale $\leq 3.6 \text{ mA}$
<b>Communication</b>	
Info data	Tag no., description and user message can be stored in transmitter
Configuration and calibration data	Permanently stored
Configuration software	WIKAssoft-TT → Configuration software (multilingual) as a download from <a href="http://www.wika.com">www.wika.com</a>
<b>Voltage supply</b>	
Supply voltage $U_B$	DC 10 ... 30 V
Supply voltage input	Protected against reverse polarity
Permissible residual ripple of supply voltage	10 % generated by $U_B < 3 \%$ ripple of the output current
<b>Time response</b>	
Switch-on delay, electrical	Max. 4 s (time before the first measured value)
Warm-up time	After approx. 4 minutes, the instrument will function to the specifications (accuracy) given in the data sheet.

Electrical connection	
Connection type	M12 x 1 circular connector (4-pin)
Material	Stainless steel 1.4571

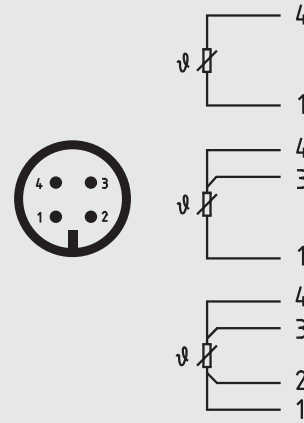
### Pin assignment

Output signal 4 ... 20 mA  
M12 x 1 circular connector (4-pin)



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

Output signal Pt100 or Pt1000 sensor  
M12 x 1 circular connector (4-pin)



### Operating conditions

#### Ambient temperature range

Version 4 ... 20 mA (model TR33-Z-TT) -40 ... +85 °C [-40 ... +185 °F]  
Version with FKM O-ring: -20 °C [-4 °F]

Version Pt100 (model TR33-Z-Px) / Pt1000 (model TR33-Z-Sx) -50 ... +85 °C [-58 ... +185 °F]  
Version with FKM O-ring: -20 °C [-4 °F]

#### Storage temperature range

-40 ... +85 °C [-40 ... +185 °F]  
Version with FKM O-ring: -20 °C [-4 °F]

#### Climate class per IEC 60654-1

Version 4 ... 20 mA (model TR33-Z-TT) Cx (-40 ... +85 °C [-40 ... +185 °F], 5 ... 95 % r. h.)  
Version with FKM O-ring: -20 °C [-4 °F]

Version Pt100 (model TR33-Z-Px) / Pt1000 (model TR33-Z-Sx) Cx (-50 ... +85 °C [-58 ... +185 °F], 5 ... 95 % r. h.)  
Version with FKM O-ring: -20 °C [-4 °F]

#### Maximum permissible humidity, condensation

100 % r. h., condensation allowed

#### Maximum operating pressure <sup>1) 2)</sup>

For protection tube diameter 3 mm [0.12 in] 140 bar [2,030 psi]

For protection tube diameter 6 mm [0.24 in] 270 bar [3,916 psi]

#### Salt fog

IEC 60068-2-11

#### Vibration resistance per IEC 60751

10 ... 2,000 Hz, 20 g <sup>1)</sup>

#### Shock resistance per IEC 60068-2-27

50 g, 6 ms, 3 axes, 3 directions, three times per direction

#### Maximum permissible autoclaving conditions

Max. 134 °C, 3 bar abs., 100 % r. h., duration 20 min., max. 50 cycles

Autoclavable with mounted protective cap at coupler connector

#### Conditions for outdoor use (only applies to UL approval)

- The instrument is suitable for applications with pollution degree 3.
- The power supply must be suitable for operation above 2,000 m should the temperature transmitter be used at this altitude.
- The instrument shall be installed in locations sheltered from the weather.
- The instrument shall be installed sun/UV irradiation protected.

Operating conditions	
<b>Ingress protection (IP code)</b>	
Case with connected connector <sup>3)</sup>	<ul style="list-style-type: none"> <li>■ IP67 per IEC/EN 60529</li> <li>■ IP69 per IEC/EN 60529</li> <li>■ IP69K per ISO 20653</li> </ul> <p>The stated ingress protection only applies when plugged in using line connectors that have the appropriate ingress protection.</p>
Coupler connector, not connected	IP67 per IEC/EN 60529
<b>Weight</b>	approx. 0.2 ... 0.7 kg [0.44 ... 1.54 lbs] - depending on version




1) Dependent on the instrument version

2) Reduced operating pressure when using a compression fitting: Stainless steel = max. 100 bar [1,450 psi] / PTFE = max. 8 bar [116 psi]







3) Not tested with UL

## Approvals

### Approvals included in the scope of delivery

Logo	Description	Country
	<b>EU declaration of conformity</b> EMC directive <sup>1) 2)</sup> EN 61326 emission (group 1, class B) and immunity (industrial application) Configuration at 20 % of the full measuring range RoHS directive	European Union
	<b>CSA</b> Safety (e.g. electr. safety, overpressure, ...)	USA and Canada
	<b>UL</b> Safety (e.g. electr. safety, overpressure, ...)	USA and Canada

### Optional approvals

Logo	Description	Country
	<b>EAC</b> EMC directive <sup>1)</sup>	Eurasian Economic Community
	<b>GOST</b> Metrology, measurement technology	Russia
	<b>KazInMetr</b> Metrology, measurement technology	Kazakhstan
-	<b>MTSCHS</b> Permission for commissioning	Kazakhstan
	<b>BelGIM</b> Metrology, measurement technology	Belarus
	<b>UkrSEPRO</b> Metrology, measurement technology	Ukraine
	<b>Uzstandard</b> Metrology, measurement technology	Uzbekistan

1) Only for built-in transmitter

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

## Certificates (option)

Certification type	Measurement 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.

For calibration, the measuring insert is removed from the thermometer. The minimum length (metal part of the probe) for carrying out a 3.1 measurement accuracy test or DKD/DAkkS is 100 mm [3.94 in].

Calibration of shorter lengths on request.

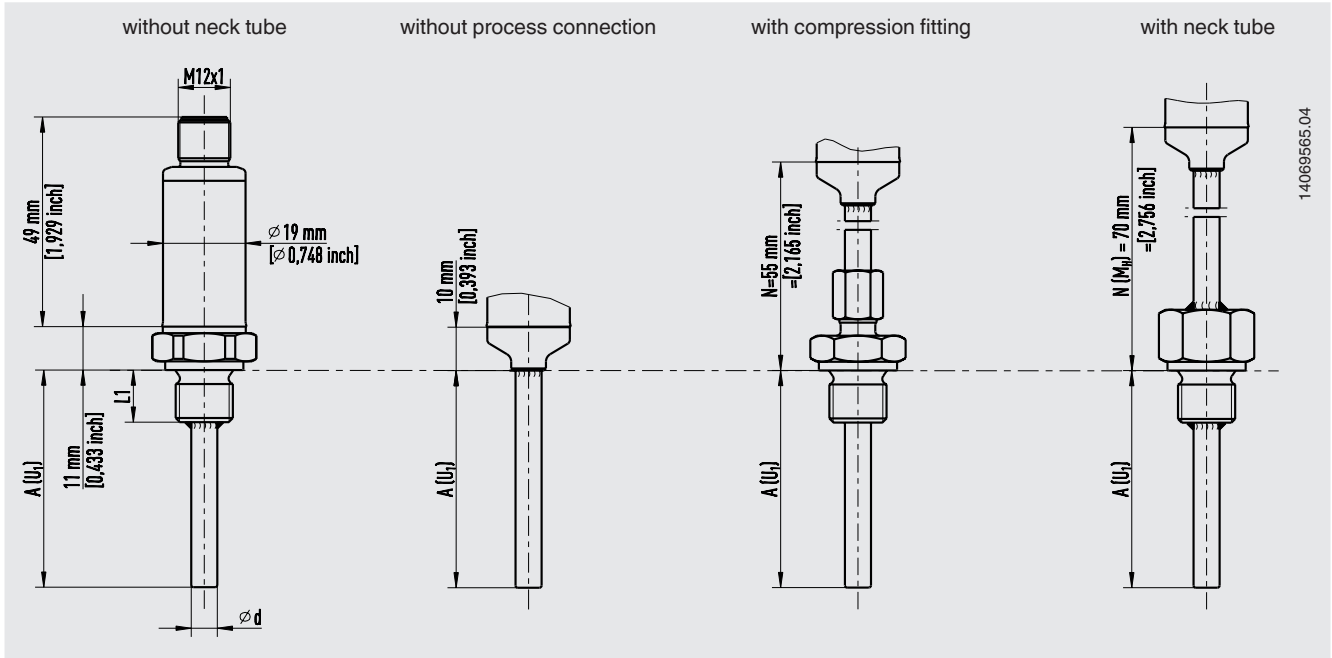
Approvals and certificates, see website

## Patents, property rights

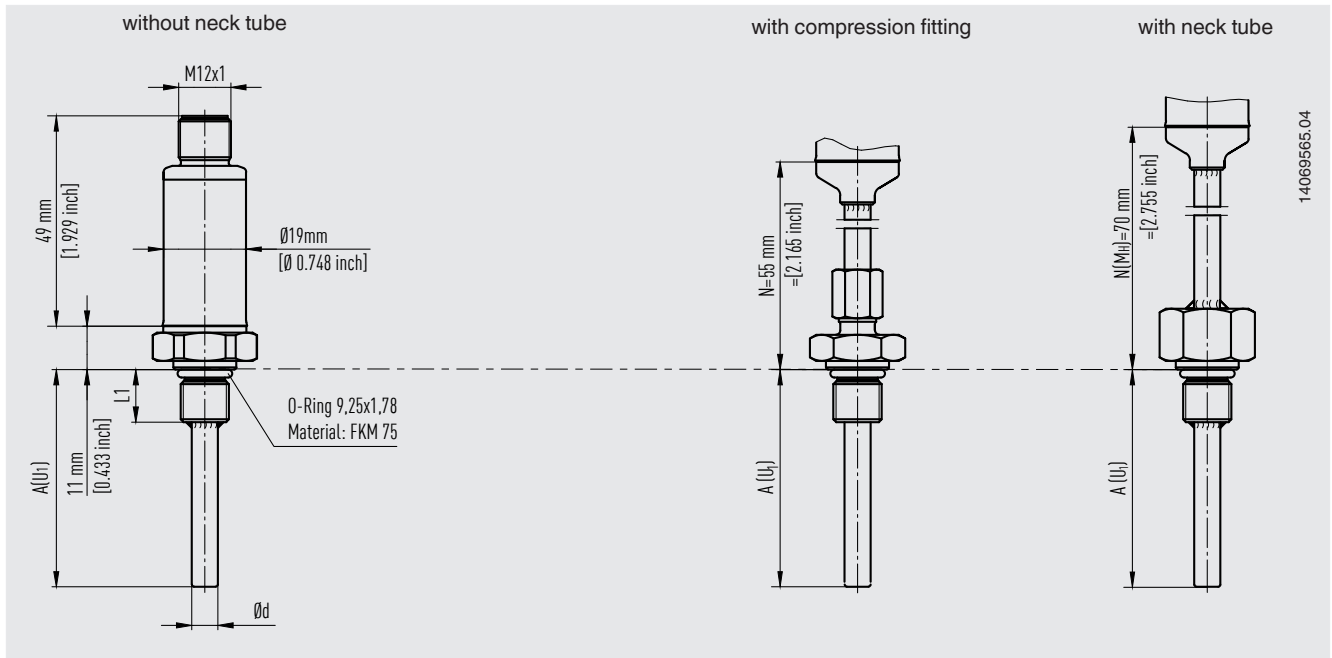
M12 x 1 adapter to DIN EN 175301-803 angular connector (001370985)

# Dimensions in mm [in]

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



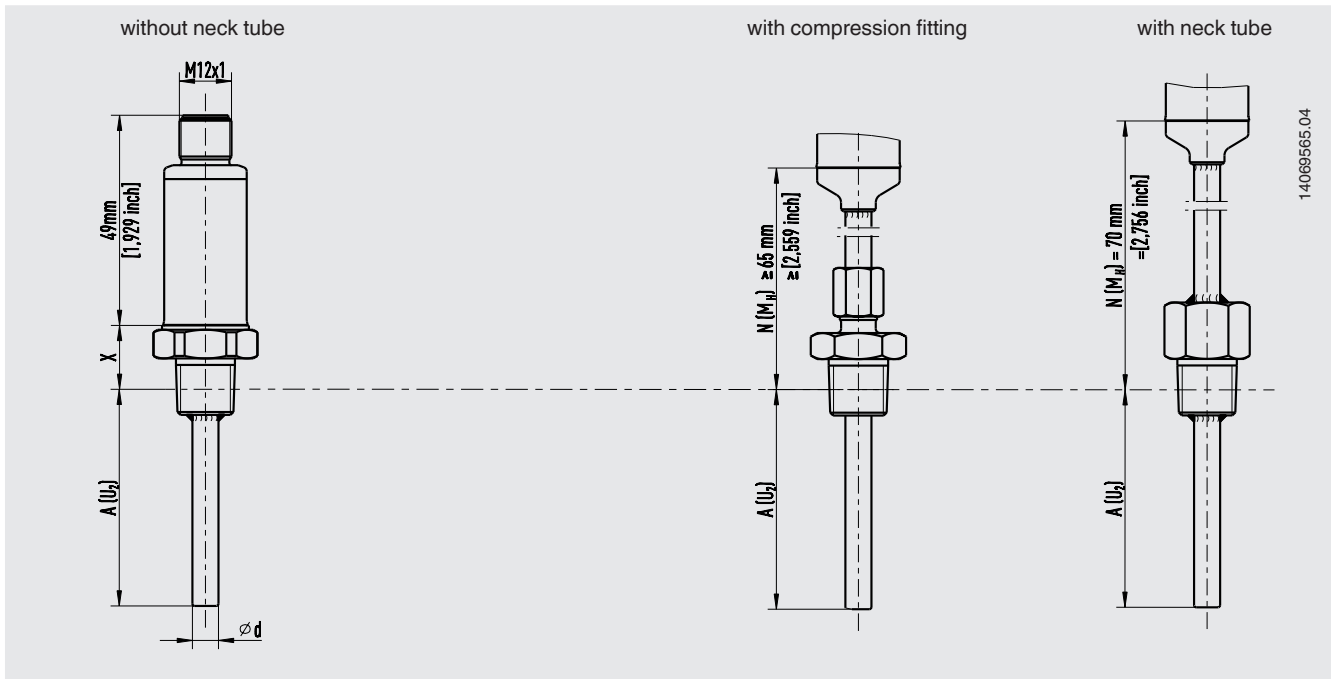
## Process connection with parallel thread (7/16-20 UNF-2A) and O-ring



The FKM O-ring must be protected from temperatures lower than -20 °C [-4 °F] and higher than 125 °C [257 °F].



## Process connection with tapered thread



14089565.04

At a process temperature of  $> 150\text{ }^{\circ}\text{C}$  [ $302\text{ }^{\circ}\text{F}$ ], a neck length  $N (M_H)$  of 70 mm [2.76 in] is necessary, otherwise  $N (M_H)$  selectable (55 mm [2.17 in], 65 mm [2.56 in] or 70 mm [2.76 in]).

Legend:

$A (U_1)$  Insertion length (parallel thread)

$A (U_2)$  Insertion length (tapered thread)

$N (M_H)$  Neck length

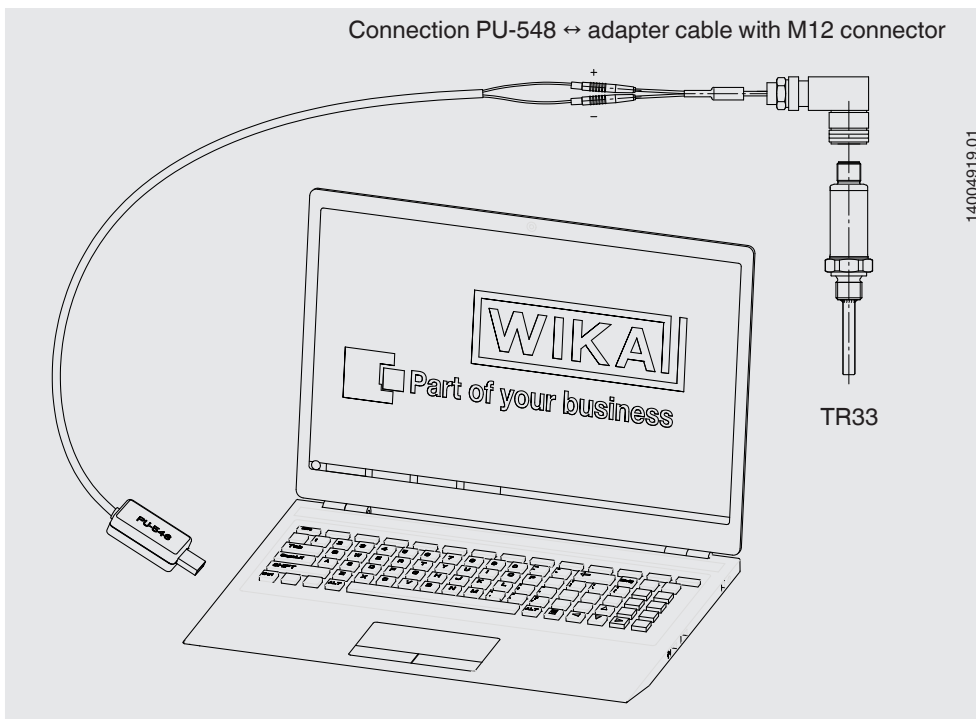
$\varnothing d$  Protection tube diameter

$X$  Height process connection

1/4 NPT = 15 mm [0.59 in]

1/2 NPT = 19 mm [0.75 in]

## Connecting the PU-548 programming unit



14004919.01

(predecessor, programming unit model PU-448, also compatible)

## Accessories

Model	Description	Order no.
 <p><b>Programming unit Model PU-548</b></p>	<ul style="list-style-type: none"> <li>■ Easy to use</li> <li>■ LED status display</li> <li>■ Compact design</li> <li>■ No further voltage supply needed, neither for the programming unit nor for the transmitter</li> </ul> <p>(replaces programming unit model PU-448)</p>	14231581
 <p><b>Adapter cable M12 to PU-548</b></p>	<p>Adapter cable for the connection of a model TR33 resistance thermometer to the model PU-548 programming unit</p>	14003193
 <p><b>M12 x 1 transmitter adapter to DIN EN 175301-803 angular connector</b> (yellow female connector element)</p>	<p>Adapter for the connection of a resistance thermometer with a DIN EN 175301-803 angular connector form A with a 4 ... 20 mA output signal → see data sheet AC 80.17</p> <p>Case: PA Ambient temperature: -40 ... +115 °C [-40 ... +239 °F] Union nut: Zinc die-cast Contacts: Copper-zinc alloy, tinned Dielectric strength: 500 V Ingress protection: IP65</p> <p style="text-align: center;">M12 x 1 connector                      Angular connector</p> 	14069503
 <p><b>M12 x 1 Pt adapter to DIN EN 175301-803 angular connector</b> (black female connector element)</p>	<p>Adapter for the connection of the resistance thermometer with a DIN EN 175301-803 form A angular connector with direct resistance output signal → see data sheet AC 80.17</p> <p>Case: PA Ambient temperature: -40 ... +115 °C [-40 ... +239 °F] Union nut: Zinc die-cast Contacts: Copper-zinc alloy, tinned Dielectric strength: 500 V Ingress protection: IP65</p> <p style="text-align: center;">M12 x 1 connector                      Angular connector</p> 	14061115
 <p><b>Angular connector</b></p>	<p>Per DIN EN 175301-803 form A</p>	11427567
 <p><b>Sealing for angular connector</b></p>	<p>For use with angular connector DIN EN 175301-803-A EPDM, brown</p>	11437902

Model	Description	Order no.	
- <b>M12 connection cable</b>	Cable socket straight, 4-pin, ingress protection IP67 Temperature range -20 ... +80 °C [-4 ... +176 °F]	Cable length 2 m [6.56 ft]	14086880
		Cable length 5 m [16.40 ft]	14086883
	Cable socket straight, 4-pin, ingress protection IP69K, hygienic design Union nut from stainless steel Temperature range -40 ... +80 °C [-40 ... +176 °F]	Cable length 3 m [9.84 ft]	14137167
		Cable length 5 m [16.40 ft]	14137168
	Angled socket, 4-pin, ingress protection IP67 Temperature range -20 ... +80 °C [-4 ... +176 °F]	Cable length 2 m [6.56 ft]	14086889
		Cable length 5 m [16.40 ft]	14086891
	Angled socket, 4-pin, ingress protection IP69K, hygienic design Union nut from stainless steel Temperature range -40 ... +80 °C [-40 ... +176 °F]	Cable length 3 m [9.84 ft]	14137169
		Cable length 5 m [16.40 ft]	14137170
	- <b>M12 connector</b>	Female angled, 4-pin, ingress protection IP67 Screw connection for conductor cross-section 0.25 ... 0.75 mm <sup>2</sup> [24 ... 18 AWG] Cable gland Pg7, outside diameter of cable 4 ... 6 mm [0.16 ... 0.24 in] Temperature range -40 ... +80 °C [-40 ... +176 °F]	14136815

### Ordering information

Model / Output signal / Transmitter temperature unit / Process temperature / Transmitter initial value / Transmitter end value / Process connection / Protection tube 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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