

RTD Temperature Sensor *omnigrad S TR 88*

RTD assembly with extension neck

Replaceable insert

PCP (4...20 mA), HART® or PROFIBUS-PA® electronics



The TR 88 Omnigrad S range temperature sensors are resistance thermometers designed for use in the heavy chemical industry, in applications with high pressures, temperatures and high flows. They are equipped with a thermowell that must be purchased separately.

The TR 88 temperature sensors are made up of a measurement probe, an extension neck with thermowell connection, and a housing, which may contain the transmitter for the conversion of the variable measured.

Thanks to its modular configuration, the TR 88 is suitable for all industrial processes with severe thermal and mechanical stresses.

- PCP (4...20 mA, also with enhanced accuracy), HART® and PROFIBUS-PA® 2-wire transmitters
- Pt 100 sensing element with class A accuracy (DIN EN 60751) or 1/3 DIN B
- Pt 100 wire wound (-200...600°C) or thin film (-50...400°C)
- Double Pt 100, for redundancy purposes
- Single Pt 100 with 4 wires connection, double Pt 100 with 3 wires
- ATEX II 1 or 1/2 GD EEx ia certification
- EA calibration certificate

Features and benefits

- Customized immersion lengths
- Separate extension neck
- Stainless steel, aluminium or plastic housings, with protection grade from IP65 to IP67
- Replaceable mineral insulated insert, with a diameter of 3 or 6 mm

Endress + Hauser

The Power of Know How



Areas of application

- Chemical industry
- Energy industry

Function and system design

Measuring principle

In the RTD (Resistance Temperature Detector) thermometers, the sensing element consists of an electrical resistance with value of $100\ \Omega$ at 0°C (called Pt 100, in compliance with standard DIN EN 60751) which increases at higher temperatures according to a coefficient characteristic of the resistor material (platinum). In industrial thermometers that comply with the DIN EN 60751 standard, the value of this coefficient is $\alpha = 3.85 \cdot 10^{-3}\ ^\circ\text{C}^{-1}$, calculated between 0 and 100°C .

Equipment architecture

The Omnigrad S TR 88 temperature sensor is made up of a measurement probe, an extension neck with thermowell connection and a housing (head), which may contain a transmitter or the terminals on the ceramic block for electrical connection.

Construction of the sensor is based on the following standards: DIN 43729 (housing), 43772 (neck) and 43735 (probe), and can therefore guarantee, together with a suitable thermowell, a good level of resistance to the most typical and common industrial processes.

The measurement probe (insert) is tensioned by means of springs and therefore maintained in contact with the lower base of protection thermowell to enhance the heat transfer. The sensing element (Pt 100) is positioned close to the tip of the probe.

The TR 88 can be fitted on the plant (tube or tank) through the use of the connection to the thermowell, which can be purchased separately.

The electrical structure of the thermometer always complies with DIN EN 60751 standard rules. The sensing element is available in two versions with a thin film (TF) or wire wound (WW), the latter with a large measurement and accuracy range.

The housing can be of different types and materials (plastic, painted aluminium alloy, stainless steel). The way in which it fits to extension neck and the cable gland ensure a minimum grade of IP65 (Ingress Protection).

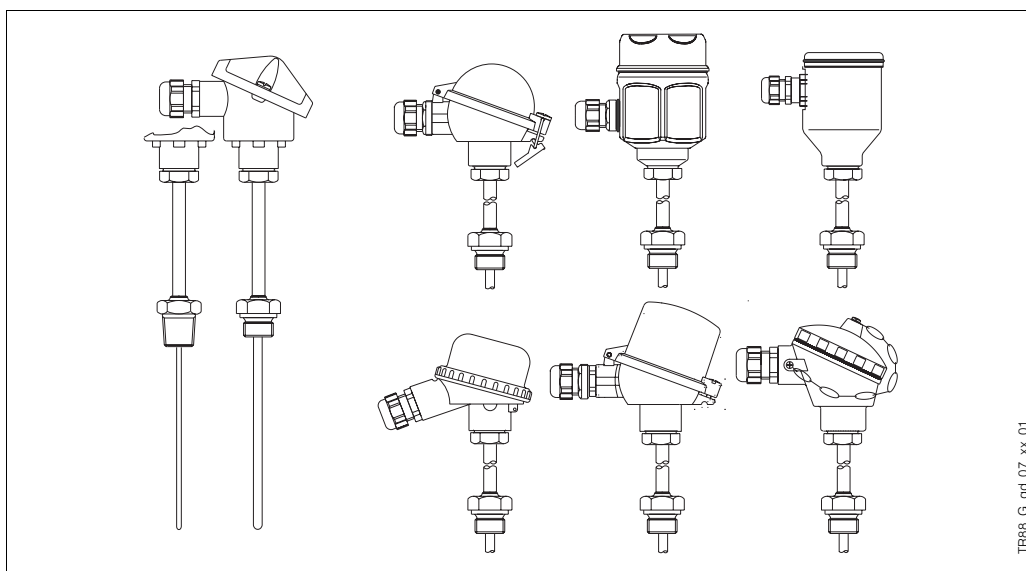


Fig. 1: TR 88 with various types of heads

Material

- Extension neck in
- Insert sheath in

SS 316Ti/1.4571

SS 316L/1.4404

Weight

From 1 to 2.0 kg for standard options.

Electronics

The required type of output signal can be obtained by choosing the correct head-mounted transmitter.

Endress+Hauser supplies "state-of-the-art" transmitters (the iTEMP® series) built in 2-wire technology and with 4...20 mA output signal, HART® or PROFIBUS-PA®. All of the transmitters can be easily programmed using a personal computer through the ReadWin® 2000 public domain software (for transmitters 4...20 mA and HART®) or the Commuwin II software (for PROFIBUS-PA® transmitters). The HART® transmitters can also be programmed with the hand-held operating module DXR 275 (Universal HART® Communicator).

A PCP (4...20 mA, TMT 180) model with enhanced accuracy is available.

In the case of PROFIBUS-PA® transmitters, E+H recommends the use of PROFIBUS® dedicated connectors. The Weidmüller type (Pg 13.5 - M12) is provided as a standard option.

For detailed information about transmitters, please refer to the relevant documentation (refer to the TI codes at the end of the document).

If a head-mounted transmitter is not employed, the sensor probe can be connected through the terminal block to a remote converter (i.e. DIN rail transmitter).

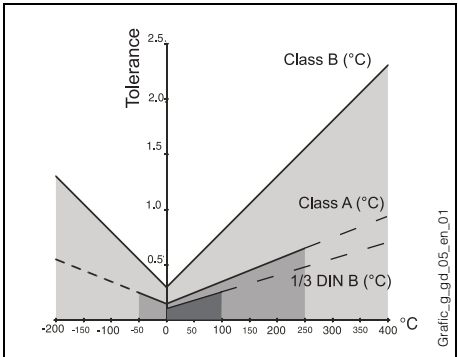
Performance

Operating conditions

<u>Ambient temperature</u> (housing without head-mounted transmitter)	
• metal housings	-40÷130°C
• plastic housings	-40÷85°C
<u>Ambient temperature</u> (housing with head-mounted transmitter)	-40÷85°C
<u>Ambient temperature</u> (housing with display)	-20÷70°C
<u>Process temperature</u>	
Same of measurement range (see below).	
<u>Maximum process pressure and maximum flow velocity</u>	
Depending on the type of thermowell used.	
<u>Shock and vibration resistance</u>	
According to DIN EN 60751	
	3 g peak / 10÷500 Hz

Accuracy

<u>Probe maximum error (type TF)</u>	
• cl. A	
3σ = 0.15+0.0020 t	50...250°C
3σ = 0.30+0.0050 t	250...400°C
• cl. 1/3 DIN B	
3σ = 0.10+0.0017 t	0...100°C
3σ = 0.15+0.0020 t	-50...0 / 100...250°C
3σ = 0.30+0.0050 t	250...400°C
(± 3σ = range including 99.7% of the readings, (t = absolute value of the temperature in °C)	



Installation

Omnigrad S TR 88 thermometers can be mounted on thermowells installed on pipes, tanks or other plant parts that may require them.

In the case of ATEX-certified components (transmitter, insert), please refer to the relevant documentation (refer to the code at the end of this document).

Immersion length may have an effect on the accuracy of the measurement. If the immersion is too low, an error may be generated in the temperature recorded due to the lower temperature of the process fluid near to the walls and heat transfer, which takes place through the sensor stem. The incidence of such an error can be not negligible if there is a big difference between the process temperature and the ambient temperature. In order to avoid this source of inaccuracy, the thermowell should have a small diameter and the immersion length (L) should be, if possible, at least 100 mm.

In pipes of a small section the axis line of the duct must be reached and if possible slightly exceeded by the tip of the probe (refer to fig. 2A-2B). Insulation of the outer part of the sensor reduces the effect produced by a low immersion. Another solution may be a tilted installation (see fig. 2C-2D).

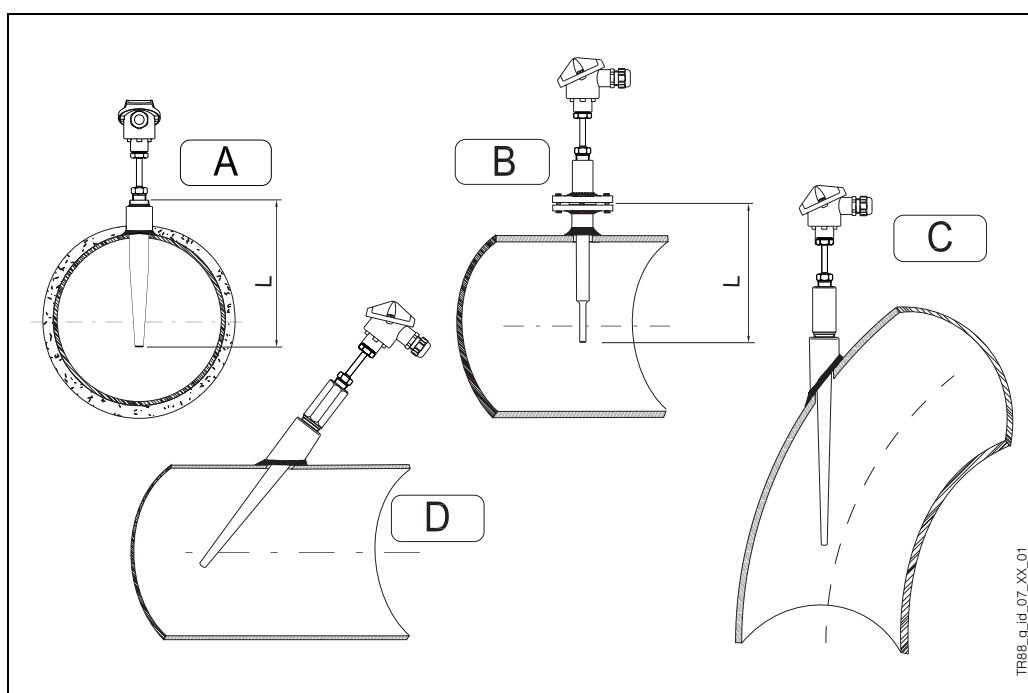


Fig. 2: Installation examples

With regard to corrosion, it is very important to choose the correct base material for the thermowell; Endress+Hauser offers a wide range of thermowells suitable for all kinds of applications. For further information on specific applications, please contact the E+H Customer Service Department.

In the case that the sensor components are disassembled, in the following reassembly procedure the definite torques must be employed. This will assure the housings with the IP grade protection defined.

When the surrounding environment has a high humidity rate and the process is at low temperature, a plastic housing is recommended (i.e. model TA20B) to avoid problems due to condensation.

In the case of vibrations the thin film sensing element (TF) may offer advantages, but the behaviour depends on the intensity, the direction and the dominating frequency in the vibration mode. The wire wound Pt 100 (WW), besides having a larger measurement and accuracy range, guarantees greater long term stability.

Upon request, the Customer Service of E+H can verify through calculation the resistance of thermowells at specific operating conditions (pressure, temperature, fluid velocity) taking into account also the forces and vibrations generated by the flow.

System components

Housing

The housing, which contains the electric terminals or the transmitter, is available in different types and materials, e.g. plastic, painted aluminium alloy and stainless steel. The coupling method with the rest of the probe and the gland for the cable entry ensures a minimum IP65 grade (refer also to fig. 3).

All available heads have internal geometry according to DIN 43729 standard (form B), and thermometer connection M24x1.5.

Head type TA20A is the basic E+H aluminium housing for temperature sensors. It is supplied in the E+H corporate colours, without any extra charge.

Head TA20B is a black polyamide housing, sometimes referred to as the BBK in the "Temperature" market.

A screw cap is employed in TA21E and is joined to the head body by a chain.

The TA20D head (aluminium), also referred to as BUZH, is able to contain a board and a transmitter or two transmitters at the same time. The order of the double transmitter must be carried out by choosing the option "flying wires" in the sales structure, and two transmitters in a separate position (THT1, see the table at the end of the document).

The TA20J head is a stainless steel housing used in other instruments made by E+H and can be provided with a LCD display (4 digits), which operates with 4...20 mA transmitters.

The TA20R is normally recommended by the Temperature division of E+H for hygienic applications.

The TA20W (BUS type) is a round blue/grey coloured head made of aluminium, with a clip for the cap closure.

The cable gland M20x1.5 provided with the housings, is compatible with cables of a diameter between 5 and 9 mm.

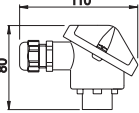
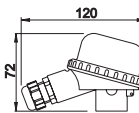
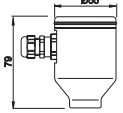
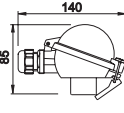
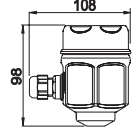
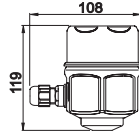
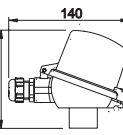
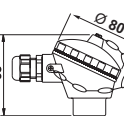
Housing type	IP	Housing type	IP	Housing type	IP	Housing type	IP
TA20A 	66 67	TA20B 	65	TA20R 	66 67	TA20W 	66
TA20J 	66 67	TA20J (display) 	66 67	TA20D 	66	TA21E 	65

Fig. 3: Housings and relative IP grade

Head transmitter

The head-mounted transmitters available are (also refer to the "Electronics" section):

- TMT 180
 - TMT 181
 - TMT 182
 - TMT 184
- PCP 4...20 mA
PCP 4...20 mA
Smart HART®
PROFIBUS-PA®.

The TMT 180 and the TMT 181 (see fig. 4) are PC programmable transmitters.

The TMT 180 is also available in a version with enhanced accuracy (0.1°C vs. 0.2°C) in the temperature range -50...250°C, and in a version with a fixed measurement range (specified by the customer in the order phase).

The TMT 182 output consists of 4...20 mA and HART® superimposed signals.

For the TMT 184 (see fig. 5), with PROFIBUS-PA® output signal, the communication address may be set via software or via mechanical dip-switch. The customer may specify the configuration desired during the order phase.

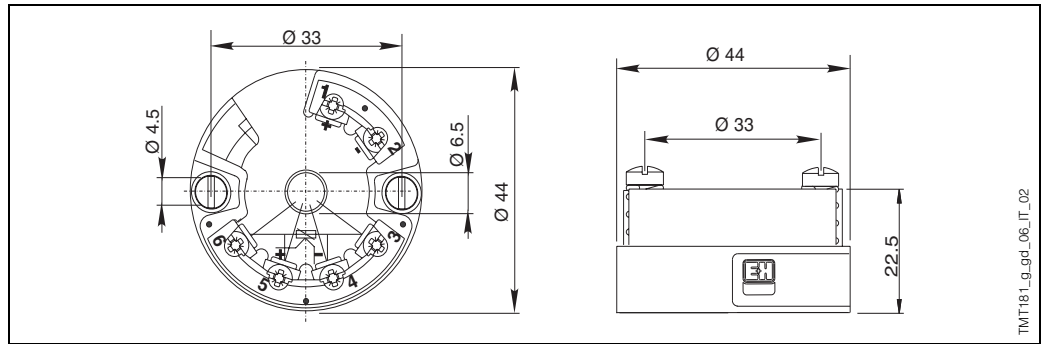


Fig. 4: TMT 180-181-182

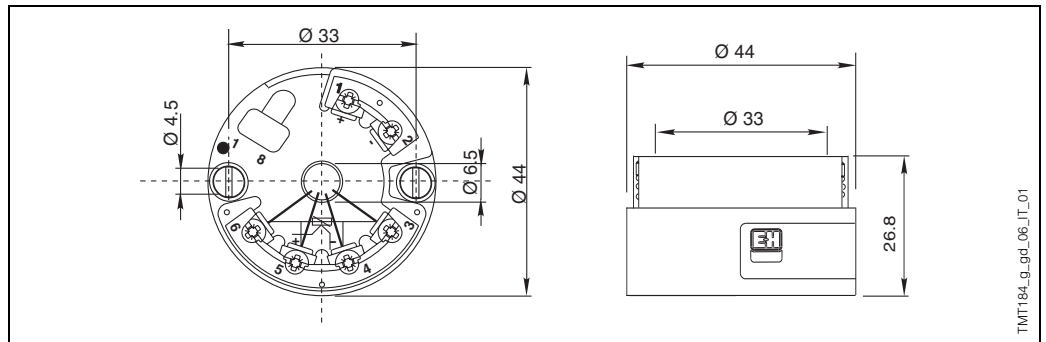


Fig. 5: TMT 184

Extension neck

The extension neck is the part between the thermowell and the head.

It is constituted by an 11 mm tube in SS 316L/1.4404 (fig. 6), whose standard length (E) can be chosen among the following values:

- 80 mm
- 100 mm
- 155 mm (normally used for a length L = 110 mm of thermowells DIN 43772 Form 4)
- 165 mm (normally used for other lengths of thermowells DIN 43772 Form 4/4F)
- 200 mm.

Other sizes are available on request.

The connection situated in the upper part of the neck allows for orientation of the sensor head. As illustrated by the chart in figure 7, the length of the extension neck may influence the temperature in the head. It is necessary that this temperature is kept within the limit values defined in the paragraph "Operating conditions".

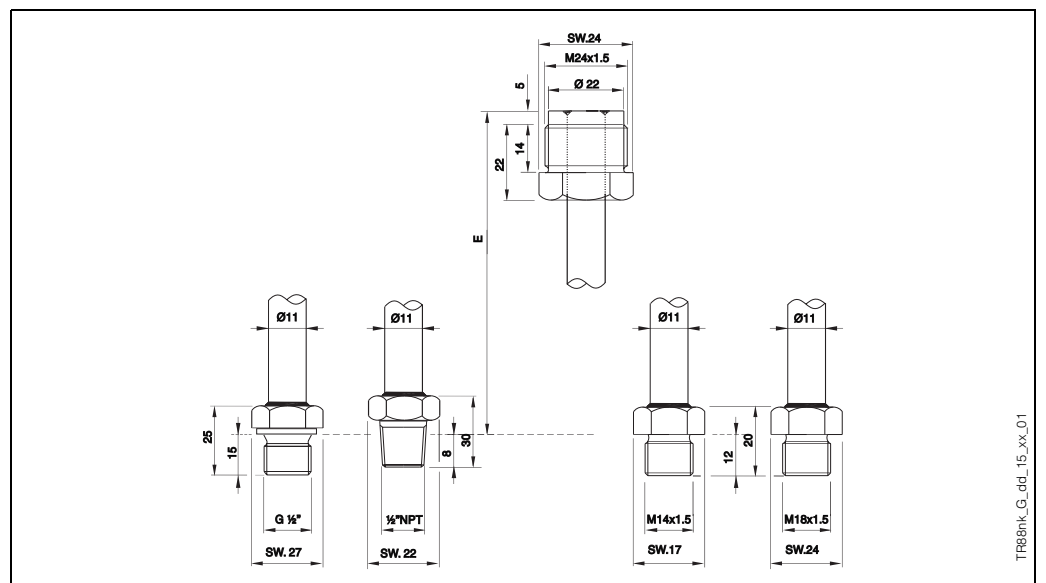


Fig. 6: Extension neck in different versions

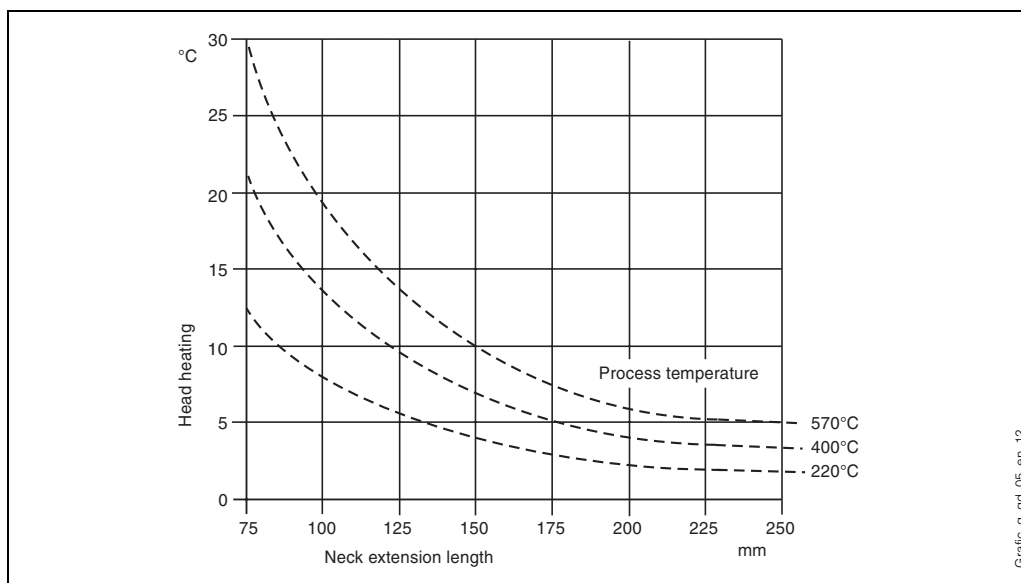


Fig. 7: Graph showing the heating of the head caused by the process temperature

Thermowell connection

Available in standard versions:

- M14 x 1.5 (normally used for thermowells DIN 43772 Form 4/4F with a diameter of 18 mm)
- M18 x 1.5 (normally used for thermowells DIN 43772 Form 4/4F with a diameter of 24 mm)
- G 1/2" B ISO 228-1
- 1/2" NPT ANSI B2.1.

Other versions may be supplied upon request.

Figure 6 shows the basic dimensions of the threaded connections available from the sales structure (see paragraph "Ordering information" at the end of this document).

Probe

In the TR 88 the measuring probe is made up of a mineral (MgO) insulated insert positioned inside the thermowell.

The insert length is available in the standard dimensions DIN 43772 and in the most commonly used ones, or it can be personalized by the customer within a range of values (refer to "Sales Structure" at the end of the document).

The immersion length (ML) must be chosen in compliance with the total length of thermowell (A) and of the type of thermowell used; see the following table (valid for thermowell base with a standard thickness):

Type of thermowell	ML	Type of thermowell	ML	Type of thermowell	ML
TA 535	ML = A	TW 15	ML = A (L)	TA 570	ML = A - 3
TA 540	ML = A - 2	TA 560	ML = A - 3	TA 571	ML = A - 3
TA 550	ML = A - 3	TA 562	ML = A - 3	TA 572	ML = A - 3
TA 555	ML = A - 2	TA 565	ML = A - 3	TA 575	ML = A - 3
TA 557	ML = A - 2	TA 566	ML = A - 3	TA 576	ML = A - 2

For thermowells with a non standard end thickness (D), use the following formula: $ML = A - D + 3$.
For replacement, the length of the insert (IL) must be chosen using the formula: $IL = ML + E + 10$.

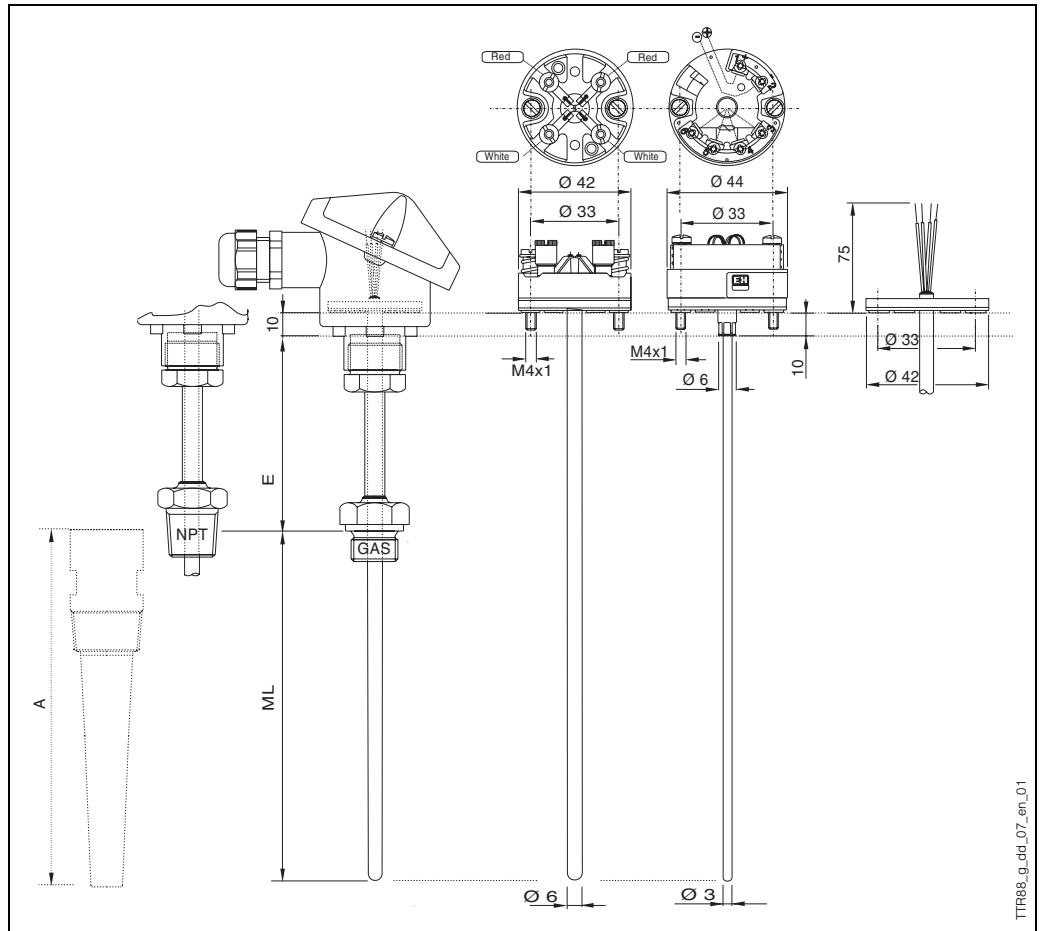


Fig. 8: Functional components

Although the wiring diagram of single Pt 100s is always supplied with 4 wires configuration, the connection of a transmitter can be executed with 3 wires as well, by avoiding to connect whichever of the terminals. The configuration Pt 100 double with 2 wires (class B) is only available for the ATEX certified inserts.

The use of standard dimensions (extension neck and length of immersion) allows for the use inserts on sensors of different kinds and guarantees rapid delivery times; this allows our customers to reduce the amount of spare parts to be kept on stock.

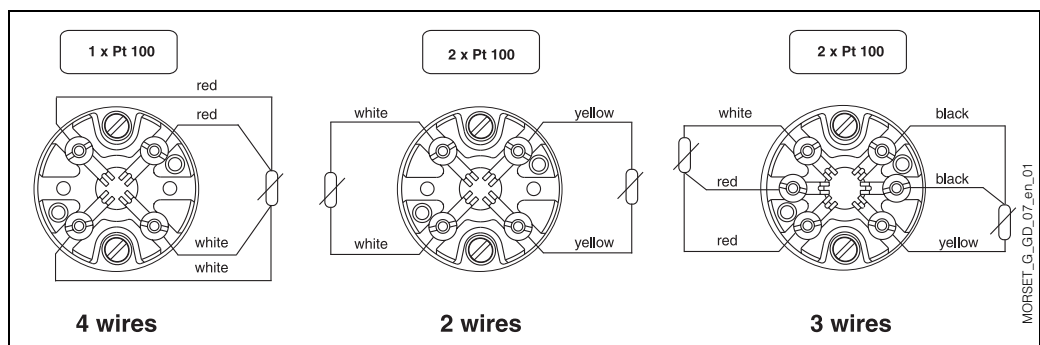


Fig. 9: Standard electrical diagrams (ceramic terminal block)

Certificates & approvals

<i>Ex approval</i>	ATEX Certificate KEMA 01 ATEX1169 X (1 GD or 1/2 GD IIC EEx ia T6...T1 T85...450°C).
<i>PED approval</i>	The Pressure Equipment Directive (97/23/CE) is respected. As paragraph 2.1 of article 1 is not applicable to these types of instruments, the CE mark is not requested for the TR 88 destined for general use.
<i>Material certification</i>	Material certifications can be requested separately.
<i>Test report and calibration</i>	With regards to the tests and calibration, the "Inspection Report" consists of a compliance declaration for the essential points of the standard DIN EN 60751. The "Factory calibration" is carried out in an authorised laboratory EA (European Accreditation) of E+H according to an internal procedure. A calibration may be requested separately according to an accredited procedure EA (SIT calibration). Calibration is carried out on the thermometer insert.

Further details

<i>Maintenance</i>	The Omnigrad S thermometers do not require any specific maintenance. In case of ATEX certified components (transmitter, insert), please refer to the relevant specific documentation (see the code at the end of this document).
<i>Delivery time</i>	For small quantities (approximately 10 units) and standard options, between 5 and 15 days depending on the configuration required.

Ordering information

Sales structure

TR88-		Safety (Ex) certification	
	A	Ex certification not required	
	B	ATEX II 1 GD EEx ia IIC certified	
	E	ATEX II 1/2 GD EEx ia IIC certified	
		Head material, conduit, IP grade	
	A	TA20A Aluminium, conduit M20x1.5, IP66/IP67	
	4	TA20A Aluminium, PROFIBUS® connector, IP66	
	2	TA20A Aluminium, conduit 1/2" NPT, IP66/IP67	
	7	TA20B Polyamide, black, conduit M20x1.5, IP65	
	E	TA21E Aluminium, screw cap, M20x1.5, IP65	
	6	TA20D Aluminium, high lid, conduit M20x1.5, IP66	
	5	TA20D Aluminium, high lid, PROFIBUS® connector, IP66	
	8	TA20D Aluminium, high lid, conduit 1/2" NPT, IP66	
	J	TA20J SS 316L, conduit M20x1.5, IP66/IP67	
	K	TA20J SS 316L, with display, conduit M20x1.5, IP66/IP67	
	M	TA20J SS 316L, PROFIBUS® connector, IP66	
	R	TA20R SS 316L, screw cap, conduit M20x1.5, IP66/IP67	
	S	TA20R SS 316L, screw cap, PROFIBUS® connector, IP66	
	W	TA20W Aluminium, round lid, clip, conduit M20x1.5, IP66	
	Y	Special version	
		Length of extension neck E (45-300 mm); material SS 316L/1.4404	
	1	80	mm, extension E
	2	100	mm, extension E
	3	155	mm, extension E (DIN43772 only ML=110)
	4	165	mm, extension E (DIN43772)
	5	200	mm, extension E
	8	...	mm, extension E to specify
	9	...	mm, special extension E
		Thermowell connection	
	A	M14x1.5 DIN 43772	
	B	M18x1.5 DIN 43772	
	C	G1/2" B ISO 228-1	
	E	1/2" NPT ANSI B2.1	
	Y	Special version	
		Diameter and material of extension neck E	
	1	D1=11 mm, SS 316Ti/1.4571	
	9	Special version	
		Insertion length ML (50-2000 mm)	
	A	110 mm	Insertion length ML
	B	140 mm	Insertion length ML
	C	170 mm	Insertion length ML
	D	200 mm	Insertion length ML
	E	260 mm	Insertion length ML
	F	410 mm	Insertion length ML
	X	... mm	Length ML to specify
	Y	... mm	Special ML length
		Insert diameter	
	1	Diameter 3 mm, SS 316L/1.4404	
	2	Diameter 6 mm, SS 316L/1.4404	
		Terminal type or built-in transmitter	
	F	Flying leads	
	C	Ceramic terminal block	
	2	TMT180-A22, fixed range, from...to...°C, accuracy 0.2 K, span -50...650°C	
	3	TMT180-A11, fixed range, from...to...°C, accuracy 0.1 K, span -50...250 °C	
	4	TMT180-A11 configurable range, from...to...°C, accuracy 0.2 K, span -200...650°C	
	5	TMT180-A12 configurable range, from...to...°C, accuracy 0.1 K, span -50...250°C	
	P	TMT181-A insulated, 2-wire PCP transmitter configured from ...to...°C	
	Q	TMT181-B isolated, 2-wire PCP ATEX transmitter, configured from ...to...°C	
	T	HART® ATEX transmitter 2-wire TMT182-B, isolated, configured from ...to...°C	
	S	PROFIBUS-PA® transmitter 2-wire TMT184-A, configured from ...to...°C	
	V	PROFIBUS-PA® ATEX transmitter 2-wire TMT184-B, configured from ...to...°C	

RTD type, temperature range, wiring diagram											
3	1 Pt 100, TF	Class A,	-50/400°C	4 wires							
7	1 Pt 100, TF	Class 1/3 DIN B	-50/400°C	4 wires							
B	2 Pt 100, WW	Class A,	-200/600°C	3 wires							
C	1 Pt 100, WW	Class A,	-200/600°C	4 wires							
D	2 Pt 100, WW	Class B,	-200/600°C	2 wires							
F	2 Pt 100, WW	Class 1/3 DIN B	-200/600°C	3 wires							
G	1 Pt 100, WW	Class 1/3 DIN B	-200/600°C	4 wires							
Y	Special version										
Material certification											
0	Material certification not requested										
9	Special version										
Test and calibration on the insert											
0	Test and calibration not requested										
1	Inspection report on sensor										
2	Inspection report on loop										
A	Factory calibration, single RTD , 0-100°C										
B	Factory calibration, single RTD , loop, 0-100°C										
C	Factory calibration, double RTD, 0-100°C										
E	Factory calibration, single RTD, 0-100-150°C										
F	Factory calibration, single RTD, loop, 0-100-150°C										
G	Factory calibration, double RTD, 0-100-150°C										
Additional options											
0	Additional options not required										
9	Special version										
Marking											
0	Tagging according to customer specifications										
TR88-											Complete order code

Sales structure

THT1		Model and version of the head transmitter
	A11	TMT180-A11 programmable from...to...°C, accuracy 0.2 K, span limit -200...650°C
	A12	TMT180-A12 programmable from...to...°C, accuracy 0.1 K, span limit -50...250°C
	A13	TMT180-A21AA fixed range, accuracy 0.2 K, span 0...50°C
	A14	TMT180-A21AB fixed range, accuracy 0.2 K, span 0...100°C
	A15	TMT180-A21AC fixed range, accuracy 0.2 K, span 0...150°C
	A16	TMT180-A21AD fixed range, accuracy 0.2 K, span 0...250°C
	A17	TMT180-A22AA fixed range, accuracy 0.1 K, span 0...50°C
	A18	TMT180-A22AB fixed range, accuracy 0.1 K, span 0...100°C
	A19	TMT180-A22AC fixed range, accuracy 0.1 K, span 0...150°C
	A20	TMT180-A22AD fixed range, accuracy 0.1 K, span 0...250°C
	F11	TMT181-A PCP, 2-wire, isolated, programmable from...to...°C
	F21	TMT181-B PCP ATEX, 2-wire, isolated, programmable from...to...°C
	F22	TMT181-C PCP FM IS, 2-wire, isolated, programmable from...to...°C
	F23	TMT181-D PCP CSA, 2-wire, isolated, programmable from...to...°C
	L11	TMT182-A HART®, 2-wire, isolated, programmable from...to...°C
	L21	TMT182-B HART® ATEX, 2-wire, isolated, programmable from...to...°C
	L22	TMT182-C HART® FM IS, 2-wire, isolated, programmable from...to...°C
	L23	TMT182-D HART® CSA, 2-wire, isolated, programmable from...to...°C
	K11	TMT184-A PROFIBUS-PA®, 2-wire, programmable from...to...°C
	K21	TMT184-B PROFIBUS-PA® ATEX, 2-wire, programmable from...to...°C
	K23	TMT184-C PROFIBUS-PA® FM IS, 2-wire, programmable from...to...°C
	K24	TMT184-D PROFIBUS-PA® CSA, 2-wire, programmable from...to...°C
	YYY	Special transmitter
		Application and services
	1	Assembled into position
	9	Special version
THT1-		Complete order code

Supplementary documentation

<input type="checkbox"/> RTD Thermometers Omnigrad TST - General information	TI 088T/02/en
<input type="checkbox"/> Industrial protecting tubes - Omnigrad TA series	TI138T/02/en
<input type="checkbox"/> Terminal housings - Omnigrad TA 20	TI 072T/02/en
<input type="checkbox"/> Temperature head transmitter iTEMP® Pt TMT 180	TI 088R/09/en
<input type="checkbox"/> Temperature head transmitter iTEMP® PCP TMT 181	TI 070R/09/en
<input type="checkbox"/> Temperature head transmitter iTEMP® HART® TMT 182	TI 078R/09/en
<input type="checkbox"/> Temperature head transmitter iTEMP® PA TMT 184	TI 079R/09/en
<input type="checkbox"/> Pt 100 insert - Omniset TPR 100	TI 268T/02/en
<input type="checkbox"/> Thermowell for temperature sensor - Omnigrad M TW 15	TI 265T/02/en
<input type="checkbox"/> Safety instructions for use in hazardous areas	XA 003T/02/z1
<input type="checkbox"/> E+H Thermolab - calibration certificates for industrial thermoelements and working standards. <i>RTD's and thermocouples</i>	TI 236T/02/en

Subject to modification

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