



Level



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omnigrad M TR46

Hygienic in-line RTD thermometer

PCP (4...20 mA), HART[®] or PROFIBUS-PA[®] electronic



The TR 46 is a temperature sensor specifically designed for hygienic applications (mainly in the pharmaceutical field). It is designed to avoid any intrusion of the measurement probe into the process duct.

It consists of a pipe segment, which can be inserted into the pipeline through the side connections (clamps or threads), and a housing, which may contain the transmitter for the conversion of the measured variable.

The sensing element is applied onto the outer wall of the tube. The thermometer is designed to measure the temperature of the process fluid as accurately as possible.

Features and benefits

- 3-A[®] certification
- SS 316L/1.4435 for "wetted" parts (BN 2 compliance on request)
- Threaded or clamped process connections supplied as standard, other types on request
- Surface finishing down to Ra < 0.4 mm, with or without electro-polishing
- Stainless steel, aluminum or plastic housing, all of which are easily cleanable and IP65 as a minimum (IP68 also available)
- PCP (4...20 mA, also with enhanced accuracy), HART[®] and PROFIBUS-PA[®] 2-wire transmitters
- Pt100 sensing elements with class A accuracy (DIN EN 60751)
- Double Pt100 as standard, for redundancy or validation purposes
- Material certification (3.1.B, ...)
- Ferrite content determination
- EA calibration certificate
- Sensor matching calibration



Areas of application

- Food industry: milk, beer, fruit juice, syrup, chocolate, oils/fats
- Biotechnology industry: fermenters
- Pharmaceutical industry: fluids, acids, purified water
- Fine chemicals industry: cosmetics

Function and system design

Measuring principle

In the Platinum 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 $\alpha = 3.85 \cdot 10^{-3}\ \text{C}^{-1}$, calculated between 0 and 100°C .

Equipment architecture

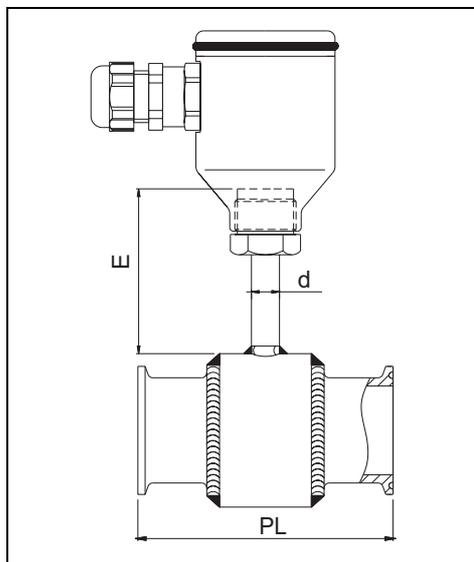


Fig. 1: TR 46

TR 46 is an in-line sensor, which can be inserted into the pipeline through the side connections.

The housing (head) may contain a transmitter or the terminals for the electrical connection.

The sensing element is fixed on the external surface of the process pipe. Its construction, executed according to 3-A[®] design criteria, allows the sensor to withstand any stress caused by CIP (Cleaning In Place) and SIP (Sterilization In Place) processes.

The internal shape of the duct has not undergone any change in diameter and no welding points are in contact with the process medium.

The electrical structure complies with the rules of DIN EN 60751 standard.

The housing can be made of various types and materials (plastic, painted aluminium, stainless steel). The way in which it fits to the rest of the probe and the gland for cable entry ensures a minimum of IP65 (Ingress Protection) grade.

Material

Wetted parts in SS 316L/1.4435.

Weight

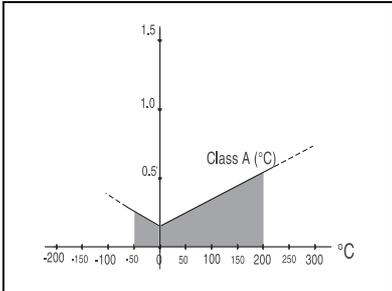
From 1.0 to 2.5 kg for standard options.

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):	-40 ÷ 130 °C
	■ metal housings	-40 ÷ 85 °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>	
	The measurement range (see below) can be limited due to the the gasket employed in the process connection.	
	<u>Maximum process pressure:</u>	2 MPa (20 bar) up to 140 °C
	In clamped connections, the maximum operating pressure depends heavily on the type of gaskets and clamps utilised.	
	<u>Maximum flow velocity</u>	No limitations
Accuracy	<u>Sensing element maximum error (cl. A)</u>	
	$3\sigma = 0.15 + 0.0020 t $ -40...200 °C (t =absolute value of temperature in °C)	
	<u>Transmitter maximum error</u>	See relevant documentation (codes at the end of this document).
	<u>Display maximum error</u>	0.1% of the set span + 1 digit
		
Measurement range	-40...200 °C	
Response time	This instrument's response time depends strongly on the heat transfer coefficient between the process fluid and the pipe wall. For example, the higher the flow velocity, the faster the response time. Until now no standards have been established for this type of instrument.	
Insulation	Insulation resistance between terminals and pipe (according to DIN EN 60751, test voltage 250 V)	more than 100 MOhm at 25 °C more than 10 MOhm at 200 °C
Self heating	Negligible when E+H iTEMP [®] transmitters are employed.	

Installation

The pipe segment, which makes up the TR 46, must be inserted into the pipeline through the side connections. The counterparts for the pipe connections and the respective gaskets or sealing rings are not supplied with the sensors. Consequently, they are the customer's responsibility (3-A[®] requirements must be fulfilled). With clamp connections, the customer must choose the correct gasket and clamping ring in accordance with the temperature and pressure operating conditions. With regard to ATEX-certified components (transmitter), please refer to the relevant documentation (see the code at the end of this document).

As in all such types of instruments and due to the unavoidable heat transfer between the pipe wall and the external environment, the recorded value may differ with the temperature of the process fluid. That deviation decreases if the difference between the process and the room temperature is low and if the convection coefficient consequent to the internal flow is high.

Attention should be paid to the choice of measurement point in the case of two-phase flows, which may cause fluctuations or errors in the temperature value.

With regard to corrosion, the base material of the wetted parts (SS 316L/1.4435) is capable of tolerating common corrosive media up to high temperatures. For information regarding particular applications, please contact the E+H Service Department.

When disassembling the sensors, new gaskets equivalent to the originals and specific torques must be utilised for the re-assembling procedure in order to ensure the stated IP (Ingress Protection) grade of the enclosure. When the ambient has a high humidity rate and the process is at low temperature, a plastic housing (i.e. model TA20B) is recommended in order to avoid problems due to condensation.

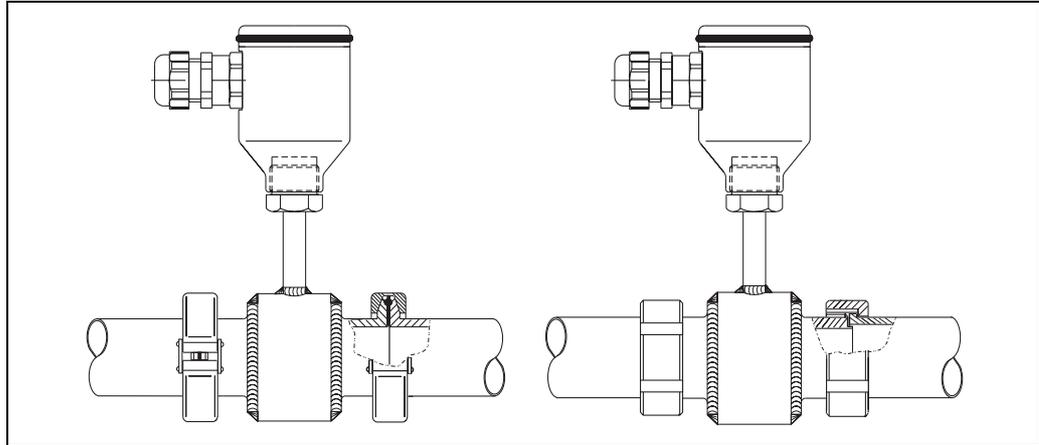


Fig. 2: TR 46 with clamp pipe connections (left) or with threaded (DIN 11851 or 11864) connections (right)

System components

Housing

The housing which contains the electric terminals or the transmitter can be of different types and materials (plastic, painted aluminium, stainless steel). The way in which it fits to the rest of the probe and the gland for the cable entry ensures a minimum of IP65 grade (also refer to figure 3). All the supplied heads have internal geometry according to DIN 43729 standard (form B), and a M24x1.5 thermometer connection.

Head type TA20A is the basic E+H aluminium housing for temperature sensors. It is provided in the E+H corporate colours and without any extra charge for the IP66/IP67 version.

The TA20B head is a black or white polyamide housing, sometimes referred to with the code BBK in the Temperature market.

A screw cap is featured in the TA21E and it is attached to the head body by a chain.

Head type TA20D (aluminium), also referred to as BUZH, is able to contain a terminal block and a transmitter or two transmitters at the same time.

The TA20J head is the stainless steel housing in E+H corporate design, which can also be supplied with a LCD display (4 digits), operating with 4...20 mA transmitters.

The TA20R is the head recommended by the E+H Temperature Division for hygienic applications because it comes in stainless steel and because of its "clean" design.

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

The cable glands M20x1.5 and Pg16 supplied with the housings, accept cable diameters from 7 to 12 mm.

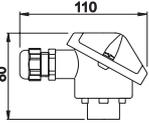
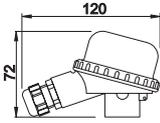
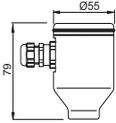
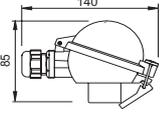
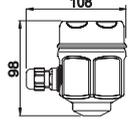
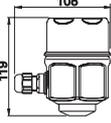
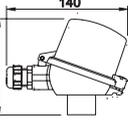
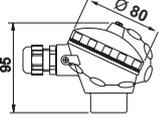
Housing type	IP	Housing type	IP	Housing type	IP	Housing type	IP
TA20A 	66 67 68	TA20B 	65	TA20R 	66 67	TA20W 	66
TA20J-(without display) 	66 67	TA20J-(with display) 	66 67	TA20D 	66	TA21E 	65

Fig. 3: Housing protection grade (IP)

Head transmitter

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

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

TMT 180 and TMT 181 are PC Programmable transmitters. TMT 180 can be supplied in a version with enhanced accuracy (0.1°C vs. 0.2°C) in the bandwidth -50...250°C. A model with a fixed measurement range (specified by the customer in the order phase) is also available.

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

The communication address for the TMT 184, with PROFIBUS-PA® output signal, can be set via software or by means of a mechanical dip-switch. The customer may specify the desired configuration during the order phase.

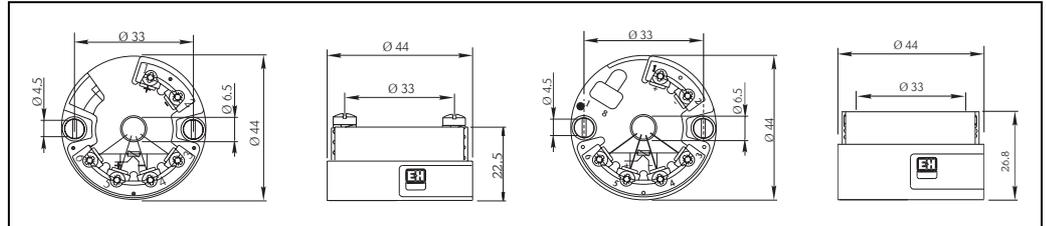


Fig. 4: TMT180 - TMT181 - TMT182 (left), TMT184 (right)

Extension neck

The extension neck (the part between the process connection and the housing), is built in stainless steel and consists of a 15 mm standard diameter tube, which is 65 mm long.

The upper connection of the neck permits adjustments to the orientation of the sensor head.

Pipe

The side connections can be selected from the following types:

- ISO 2852 clamp
- Tri-Clamp®
- DIN 11851
- DIN 11864-1-A

Others (e.g. Neumo, ...) are available on request.

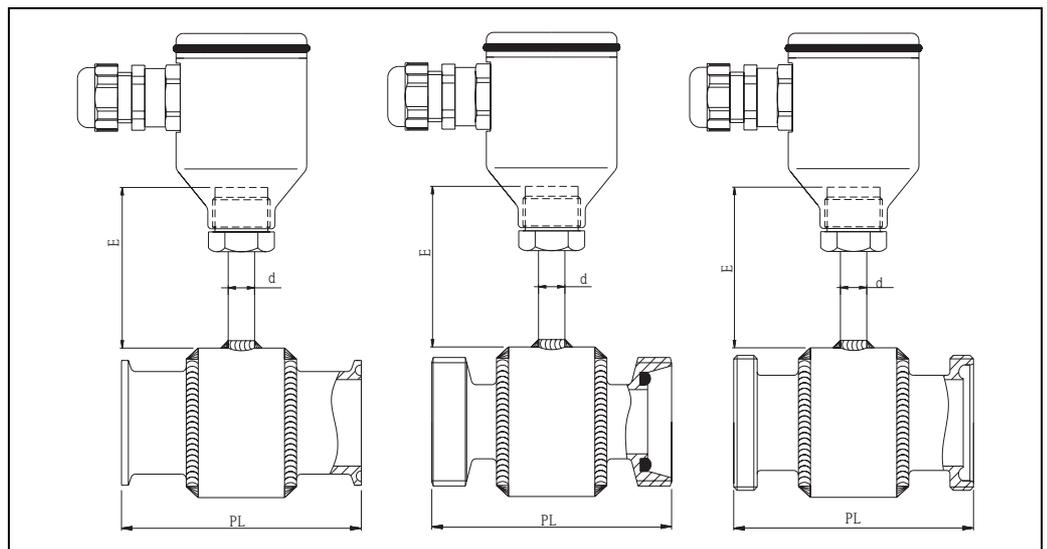


Fig. 5: ISO 2852 clamp or Tri-Clamp® pipe connections (left), DIN 11851 connections (middle), DIN 11864-1-A connections (right)

The standard length of the pipe segment, which constitutes the sensor, is 100 mm. A non-standard (special) length may be requested through the use of the "9" digit in the order code.

The internal dimensions of the pipes are listed in the following table:

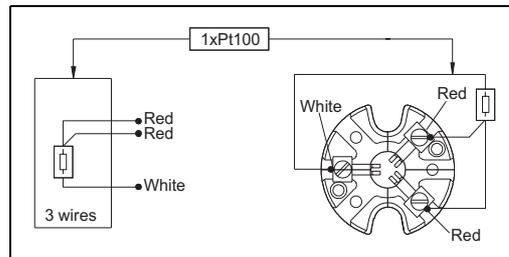
DN	I.D. (mm)			
	ISO 2852	Tri-Clamp®	DIN 11851	DIN 11864-1-A
25 (1")	25	22.3	26	26
40 (1 1/2")	40	35	38	38
50 (2")	51	47.8	50	50

The starting material for the wetted parts can be supplied in compliance with Basler Norm 2 (BN2), which imposes a limited ferrite content and a consequently enhanced corrosion resistance, on request.

The surface roughness (Ra) of the wetted parts is supplied down to 0.4 mm. Surface roughness below 0.4÷0.5 mm has not been proven to be advantageous sanitary applications.

Electro-polishing is an electrolytic treatment of metal surfaces, which results in cleaning, levelling and passivity.

Probe



The thermometer has two Pt 100 (cl. A) sensors close to each other. One can be connected to the transmitter or to the terminal block and the other can be used for redundancy, to get a second signal or for validation purposes.

The sensing elements are glued onto the external surface of the pipe, and protected by a cylindrical metal casing.

The standard wiring diagram is 3-wires.

Fig. 6: Standard wiring (3-wires)

Certificates & Approvals

Sanitary compatibility

- 3-A[®] Authorization no. 1144 for the declaration of compliance with standard 74-03.
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Material certification

The 3.1.B material certificate according to standard EN 10204 can be requested directly during the purchase of the product. Other types of material certifications may be requested separately.
The "standard" certificate is a simplified and cost-effective version in which the documentation about the origin of the materials employed refers to each individual sensor. The "labelled" certificate has also a specific marking relating to the wetted parts of the sensor and ensures that the relevant of the thermometer is placed in the archives.

Test report & calibration

Regarding tests and calibration, the "inspection test report" consists of a declaration of conformity with the essential points in standard DIN EN 60751.
Due to the characteristics of the sensor, a calibration procedure can be carried out only with prior agreement with the customer.

Further details

Maintenance

Omnigrad M thermometers do not require a specific maintenance. With regard to the models supplied with process connections including seals, the integrity of the sealing ring should be checked regularly and it must be substituted when necessary.

Delivery time

For small quantities (about 10 units) and standard options, generally 20 days.

Ordering information

Product structure

TR46-	In-line thermometer with sanitary process connection. Installation without dead space, for food and pharma industry. Pipe wall temperature measurement. Double not replaceable sensing element. DN40/50, 1,5"/2" PED cat. 1(max. 20bar). Temperature range: from -50 to 200°C.		
Process connections and pipe nominal diameter			
RB	ISO 2852 clamp,	pipe DN25	
RG	ISO 2852 clamp,	pipe DN40	
RL	ISO 2852 clamp,	pipe DN50	
SB	Tri-Clamp® ,	pipe 1"	
SG	Tri-Clamp® ,	pipe 1 1/2"	
SL	Tri-Clamp® ,	pipe 2"	
PB	Dairy	DIN11851, pipe DN25	
PH	Dairy	DIN11851, pipe DN40	
PL	Dairy	DIN11851, pipe DN50	
QB	Aseptic	DIN11864-1-A, pipe DN25	
QH	Aseptic	DIN11864-1-A, pipe DN40	
QL	Aseptic	DIN11864-1-A, pipe DN50	
YY	Special version		
Pipe length PL			
1	100 mm pipe length PL		
9mm pipe length PL to specify		
Neck dimensions: E			
	<i>E (65-145 mm) and d</i>		
A	65 mm neck length E,	15 mm diameter d	
X mm neck length E to specify,	15 mm diameter d	
Y mm special neck length E	and diameter d	
Material and finishing of wetted parts			
1	SS 316L/1.4435,	Ra<=0.8 µm	
2	SS 316L/1.4435,	Ra<=0.6 µm	
3	SS 316L/1.4435,	Ra<=0.4 µm,	
4	SS 316L/1.4435,	Ra<=0.4 µm,	electropolishing
9	Special version		
Terminal type			
2	Flying leads		
3	Ceramic terminal block		
4	HR fiber terminal block		
RTD type and wiring diagram			
L	2 Pt100 class A, 3-wire		
Y	Special version		
Housing material, cable entry, IP grade			
A	TA20A	Alu., M20x1.5 conduit	IP66/IP67
3	TA20A	Alu., Pg16,	IP66/IP68
4	TA20A	Aluminium, PROFIBUS® connector,	IP66
B	TA20B	Polyamide white, Pg16,	IP65
C	TA20B	Polyamide black, Pg16,	IP65
E	TA21E	Aluminium, screw cap., M20x1.5	IP65
D	TA20D	Aluminium, high lid, Pg16,	IP66
5	TA20D	Aluminium, high lid, PROFIBUS® connector	IP66
J	TA20J	SS316L, M20x1.5,	IP66/IP67
K	TA20J	SS316L, M20x1.5, + display	IP66/IP67
M	TA20J	SS316L, PROFIBUS® connector	IP66/IP67
R	TA20R	SS316L, screw cap , M20x1.5,	IP66/IP67
S	TA20R	SS316L, screw cap , PROFIBUS® connector	IP66/IP67
W	TA20W	Aluminium, round lid, clip, Pg16	IP66
Y	Special	version	
Built-in head transmitter			
See the subsequent table			

										Certificates		
										0	Certificates not required	
										B	3.1.B EN10204, standard for wetted parts	
										G	3.1.B EN10204, labelled for wetted parts	
										D	3.1.B EN10204, standard + roughness	
										H	3.1.B EN10204, labelled + roughness	
										Tests and calibration		
										0	Tests and calibration not required	
										1	Inspection test report (TZC135-A), sensor	
										2	Inspection test report (TZC135-D), loop	
										Additional options		
										0	Additional options not required	
TR46-												← Order code

Built-in head transmitter

Structure

THT1-	Model and version of the head transmitter												
	A11	TMT180-A11	accuracy 0.2 K,	span limit: -200...650°C, programmable		from...to...°C							
	A12	TMT180-A12	accuracy 0.1 K,	span limit: -50...250°C, programmable		from...to...°C							
	A21	TMT180-A21	accuracy 0.2 K,	span limit: -200...650°C, fixed range		from...to...°C							
	A22	TMT180-A22	accuracy 0.1 K,	span limit: -50...250°C, fixed range		from...to...°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						
	F24	TMT181-E	PCP	ATEX II3G EEx-nA	2-wire, isolated	programmable	from...to...°C						
	F25	TMT181-F	PCP	ATEX II3D	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						
	L24	TMT182-E	HART®	ATEX II3G EEx-nA	2-wire, isolated	programmable	from...to...°C						
	L25	TMT182-F	HART®	ATEX II3D	2-wire, isolated	programmable	from...to...°C						
	K11	TMT184-A	PROFIBUS-PA®	2-wire, isolated	programmable	from...to...°C							
	K21	TMT184-B	PROFIBUS-PA®	ATEX	2-wire, isolated	programmable	from...to...°C						
	K22	TMT184-C	PROFIBUS-PA®	FM IS	2-wire, isolated	programmable	from...to...°C						
	K23	TMT184-D	PROFIBUS-PA®	CSA	2-wire, isolated	programmable	from...to...°C						
	K24	TMT184-E	PROFIBUS-PA®	ATEX II3G EEx-nA	2-wire, isolated	programmable	from...to...°C						
	K25	TMT184-F	PROFIBUS-PA®	ATEX II3D	2-wire, isolated	programmable	from...to...°C						
	YYY	Special transmitter											
												Application and services	
												1	Assembled into position
												9	Special version
THT1-												← Order code	

Supplementary documentation

<input type="checkbox"/> RTD thermometers Omnigrad TST - General information	TI 088T/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

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