Level | Pressure | Flow | Temperature | Liquid Analysis | Registration | Systems Components | Services | Solutions

Technical Information

Omnigrad S TC65

Thermocouple thermometer EEx-d certified, no replaceable insert, no thermowell, process connection threaded fixed or compression fitting PCP (4...20 mA), HART® or PROFIBUS-PA® electronics

Range of uses

The Omnigrad S TC65 is an industrial thermometer (thermocouple TC: K or J), developed for use in the fine chemicals and petrochemical industry but also suitable for generic industrial applications.
In compliance to EN 50014/18/20 (ATEX certification) it is therefore particularly suitable also for hazardous areas.
When required, it's also available with a transmitter (PCP, HART® or PROFIBUS-PA®) into the housing.
The TC65 is available in different configurations and characteristics depending on process requirements.
The installation on the plants normally needed a special process connection as a spring compression fitting.

Application areas

- Fine chemicals industry
- Petrochemical industry
- Light energy industry
- General industrial services
- Environmental engineering

Features and benefits

- Customized immersion length
- Aluminium housing, with protection grade from IP66 to IP68
- Thermocouple with hot junction grounded or ungrounded in mineral oxide cable (MgO cable) diameter: 3 or 6 mm
- Process connection welded or sliding/spring compression fitting or std compression fitting
- PCP, HART® and PROFIBUS-PA®, (4...20 mA 2-wire transmitters)
- The accuracy of the thermocouple TC (K (NiCr-Ni) and J (Fe-CuNi)) are: Cl. 1 - 2 (EN 60584) or Cl. Special - Standard (ANSI MC96.1)
- The thermocouple TC (K or J) are available in single or double element
- ATEX II 2 GD EEx-d IIC certification
- ATEX II 1/2 GD EEx d IIC certification

CE Ex

TI288T/02/en

Endress+Hauser

People for Process Automation

Function and system design

Measuring principle

The thermocouple (TC) thermometer's sensing element consists of two metal wires that are homogeneous but different one from the other and insulated along their entire length. The two wires are welded together at one end, known as the "measurement or hot junction". The other end, where the wires are free, is known as the "cold or reference junction" and is connected to a electromotive force measurement circuit where the force is generated by the different thermoelectric power of each of the thermocouple's wires if there is a temperature difference between the hot joint (T1) and the cold joint (Seebeck effect). The cold junction has to be "compensated" with reference to the temperature of 0°C (T0). The function that links the electromotive force to the temperatures T1 and T0 is a curve whose characteristics depend on the materials used in the construction of the thermocouple. Some thermocouples curves, and particularly those most reliable for the purposes of industrial readings, are those compliant with standards EN 60584 and ANSI MC96.1.

Equipment architecture

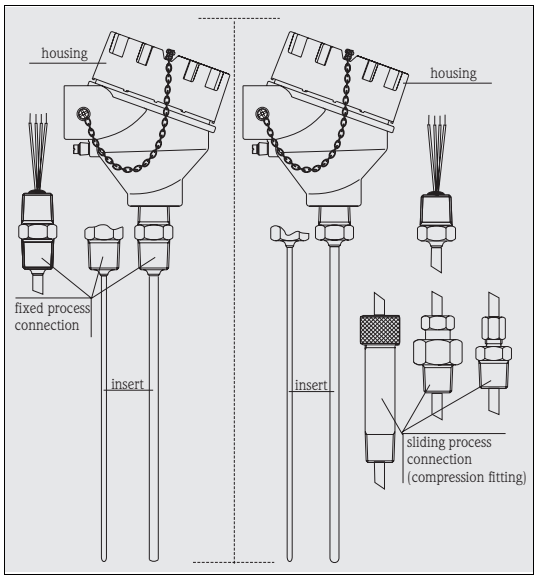


Fig. 1: TC65 with the various types of process connections (fixed or fitting) and parts of the insert.

The construction of the TC65 temperature sensor is based on the following standards:
- EN 50014/18 (housing)
- Neck (Fixed or sliding process connection)
- EN 60584 (insert and sensing element).

The housing is in painted aluminium alloy; it is suitable to contain a transmitter and/or the ceramic block of the insert; the "Ingress Protection" is from IP66 to IP68.
The process connections of the TC65 are: compression fitting (sliding or spring loaded), fixed process connection threaded (M, GAS or NPT, see the section "System components").
The hot junction of the thermocouple (type K or J) are positioned close to the tip of the probe. The thermocouple is available in two versions: grounded or ungrounded hot junction. The electrical structure of the thermocouple always complies with EN 60584/61515 or ANSI MC96.1/ASTM E585 standard rules.

Material & Weight

Housing	Insert	Process connection	Weight
aluminium epoxy coated	sheath in: SS 316L/1.4404 Inconel® 600/2.4816	fixed or sliding or sping loaded in SS 316/1.4401	from 0,5 to 1.0 kg for standard options

Performance

Operating conditions

Operating condition or test	Product type or rules		Value or data of test	
Ambient temperature	housing (without head-mounted transmitter		-40÷130°C	
	housing (with head-mounted transmitter)		-40÷85°C	
Process temperature	It is restricted by the material sheath: insert or thermowell	< 600°C	SS 316L/1.4404	
		< 800°C	SS 316Ti/1.4571	
		< 1100°C	Hast.® C276/2.4819 - Inc.600®/2.4816	
Process pressure (Maximum)	The pressure values can be subjected at the various temperatures. Example: for 9 mm diameter pipes, with a limited flow velocity, the maximum tolerated pressures are the following:			50 bar to 20°C 33 bar to 250°C 24 bar to 400°C
Maximum flow velocity	The highest flow velocity, (of the stream or of the fluid), tolerated, diminishes with increasing lengths of the thermowell/probe exposed.			
Shock and vibration resistance test	Insert in according to the rule IEC 60751:	Acceleration	3 g of peak	
		Frequency	from 10Hz to 500Hz and back	
		Time of the test	10 hours	

Accuracy

Thermocouple and range °C	EN 60584				
	Class	Max deviation	Class	Max deviation	Cable colours
J (Fe-CuNi) -40° ... 750°C	2	+/-2.5°C (-40...333°C) +/-0.0075 |t| (333...750°C)	1	+/-1.5°C (-40...375°C) +/-0.004 |t| (375...750°C)	+ black - white
K (NiCr-Ni) -40 ... 1200°C	2	+/-2.5°C (-40...333°C) +/-0.0075 |t| (333...1200°C)	1	+/-1.5°C (-40...375°C) +/-0.004 |t| (375...1000°C)	+ green - white
ItI = absolute temperature value in °C					

Thermocouple and range °C	ANSI MC96.1				
	Class	Max deviation	Class	Max deviation	Cable colours
J (Fe-CuNi) 0 ...750°C	Stand-ard	+/-2.2°C (0...293°C) +/-0.75% (293...750°C)	Special	+/-1.1°C (0...275°C) +/-0.4% (275...750°C)	+ black - red
K (NiCr-Ni) 0...1250°C	Stand-ard	+/-2.2°C (0...293°C) +/-0.75% (293...1250°C)	Special	+/-1.1°C (0...275°C) +/-0.4% (275...1250°C)	+ yellow - red
ItI = absolute temperature value in °C					

Others errors	
Transmitter maximum error	See the corresponding documentation (codes at the end of the document)
Display maximum error	0.1% FSR + 1 digit (FSR = Full Scale Range)

Response time

Tests, with the TC insert, in water at 0.4 m/s (according to IEC 60751) from 23 to 33°C:

Stem diameter of the insert	Sensing element type	Temperature of test	Response time
SS 316 - d. 6 mm	K (NiCr-Ni) or J (Fe-CuNi)	t_{50}	2,5 s
		t_{90}	7,0 s

Insulation

Measurement Insulation type	Result
Insulation resistance between terminals and probe sheath according to EN 60584, test voltage 500 V	> 1GΩ at 25°C
	> 5 MΩ at 500°C

Self heating

Negligible when the E+H iTEMP® transmitters are employed.

Installation

The Omnigrad S TC65 thermometer can be mounted on pipes, vessels or other plant parts that may be necessary, by means of compression junctions or thermowells.
The absence of the extension neck (situated between the process connection and the head) may expose the housing to overheating. To ensure that, the head temperature has not to exceed the limit values defined in paragraph "System components" (refer to fig. 3).
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 depth 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. To avoid measurement errors of this kind, it is advisable to set an immersion length (**L**) of at least 50÷70 mm (without thermowell).
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 pipe reduces the effect produced by a low immersion of the sensor. Another solution may be a tilted installation (see fig. 2C-2D). For a best installation, in the industries, it's better to follow the rule: $h \simeq d$, $L > D/2 + h$.

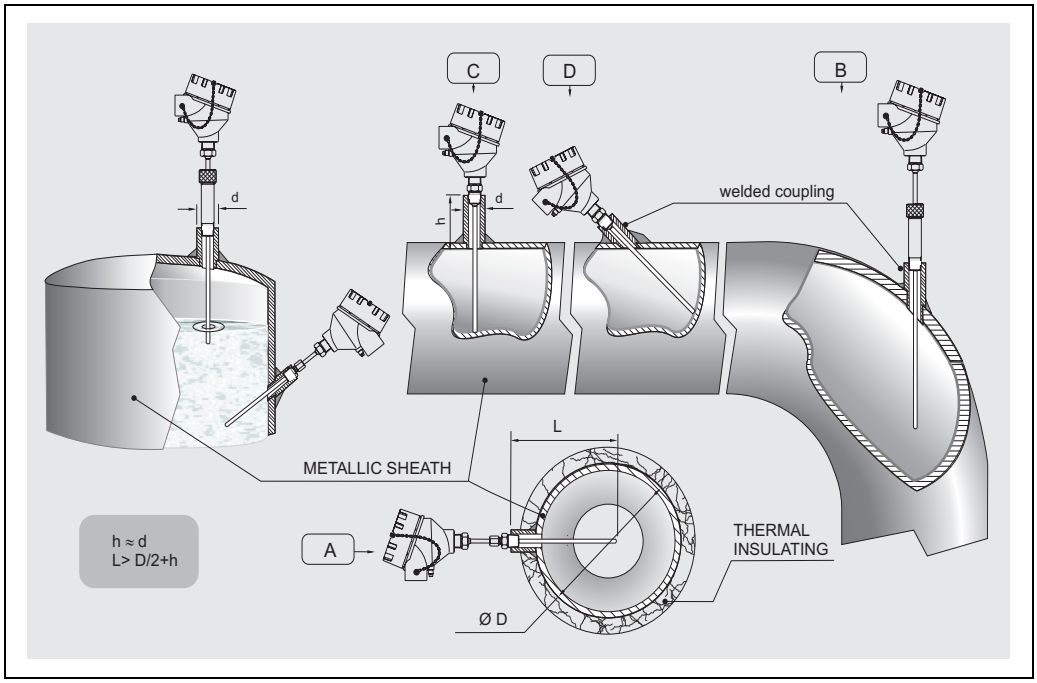


Fig. 2: Installation examples

In the case of two-phase flows, pay special attention to the choice of measurement point, as there may be fluctuations in the value of the detected temperature.
With regard to corrosion, the base material of the wetted parts in contact with the fluid (SS 316L/1.4404 or , compression fitting in SS 316/1.4401or Inconel® 600/2.4816 and several types of sleeves) can tollerate the common corrosive media up to even the highest temperatures. 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.

System components

Housing

The protection housing, our "TA21H", commonly referred to the “connection head”, is used to contain and protect the terminal block or the transmitter and to join the electric connections to the mechanical component.

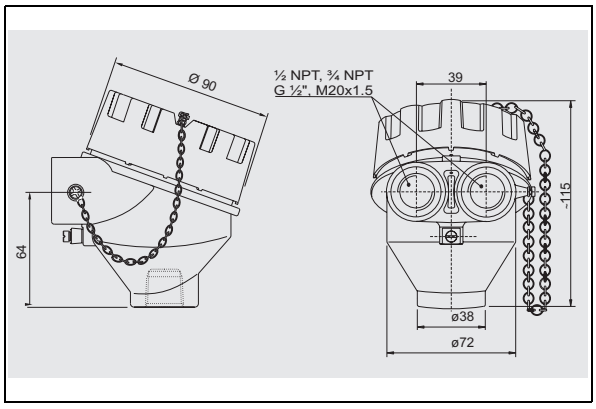


Fig. 3: Housing TA21H

The TA21H used for the TC65 is compliant with EN 50014/18 and EN 50281-1-1, EN 50281-1-2 standards (EEx-d certification for explosion proof type of protection).
The matching of the head with the extension below the head and the cover (threaded) ensures a degree of protection from IP66 to IP68.
The head also has a chain to connect the body to the cover, which facilitates the use of the instrument during the maintenance on systems. The single or double threaded electrical cable entry can be: M20x1.5, 1/2” NPT or 3/4” NPT, G1/2".

Extension neck

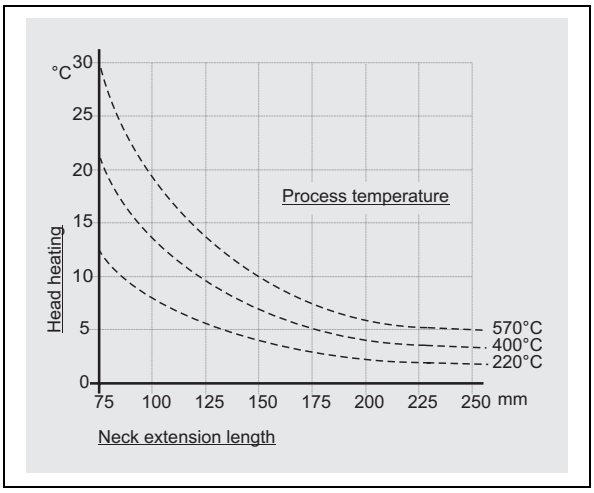


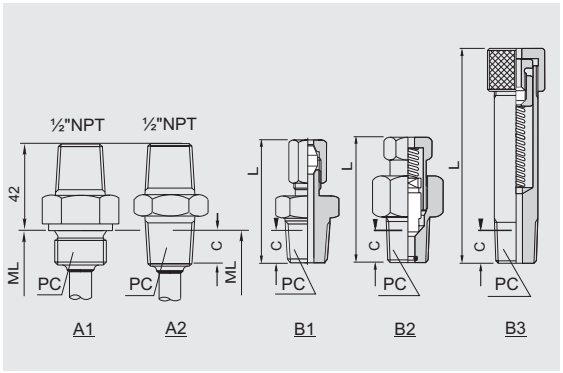
Fig. 4: Heating of the head caused by the process temperature

The extension length, inserted between the housing and the thermowell or the plant connection, is called: neck.
In the TC65 the extension length of the neck, is defined by the process connection: fixed, sliding or spring loaded compression fitting.
As illustrated by the drawing (fig. 4), 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”.
Before choosing the connection, it is better to verify this graphic and therefore to choose a suitable extension to avoid the heating of the head.

Process connection

Standard process connection available in the following types:

Type	Model	Threaded PC	L mm	C mm
A1	Fixed	3/4" NPT	42	15
A2	Fixed	1/2” NPT	42	8
B1	Comp. fitting	1/2” NPT 3/4" NPT	55 55	8 8
B2	Spring loaded	1/2” NPT	55	8
B3	Spring loaded	1/2” NPT 3/4" NPT	105 120	8 8

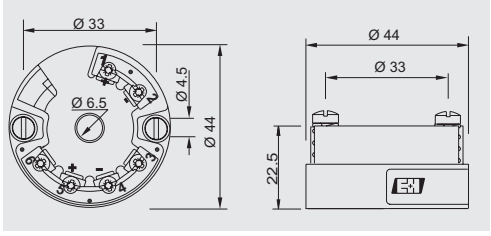


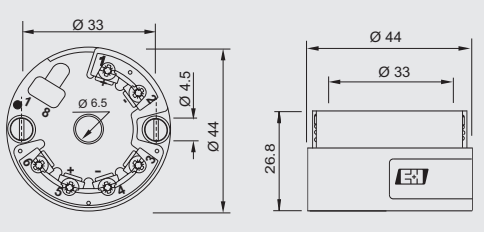
Electronic head transmitter

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 PC:

Head transmitter	Communication software
PCP TMT181	ReadWin® 2000
HART® TMT182	ReadWin® 2000, FieldCare, Hand held module DXR275, DXR375
PROFIBUS PA® TMT184	FieldCare

In the case of PROFIBUS-PA® transmitters, E+H recommends the use of PROFIBUS® dedicated connectors. The Weidmüller type is provided as a standard option. For detailed information about transmitters, please refer to the relevant documentation (refer to TI codes at the end of the document). If a head-mounted transmitter is not employed, the sensor probe may be connected through the terminal block to a remote converter (i.e. DIN rail transmitter). The customer may specify the configuration desired during the order phase. The head-mounted transmitters available are:

Description	Dwg
TMT181: PCP 4…20 mA. The TMT181 is a PC programmable transmitters TMT182: Smart HART®. The TMT182 output consists of 4…20 mA and HART® superimposed signals.	

Description	Dwg
TMT184: PROFIBUS-PA®. For the TMT184, with PROFIBUS-PA® output signal, the communication address may be set via software or via mechanical dip-switch.	

Probe

On TC65 the measurement probe is constituted by a not replaceable mineral insulated insert (MgO) with a sheath in AISI316L.
The immersion length (ML) is available in the most commonly used dimensions and customized special dimensions. They can be personalized by the client within a range of values (refer to “Sales Structure” at the end of the document).
The length of the sensor can be chosen within a standard range from 50 to 5000 mm.
Sensors with a length above 5000 mm can also be ordered and supplied after a technical analysis of the application (max length 30.000 mm).
The electrical connection for ever thermocouple it is to 2 wires. (see the following fig. 5)

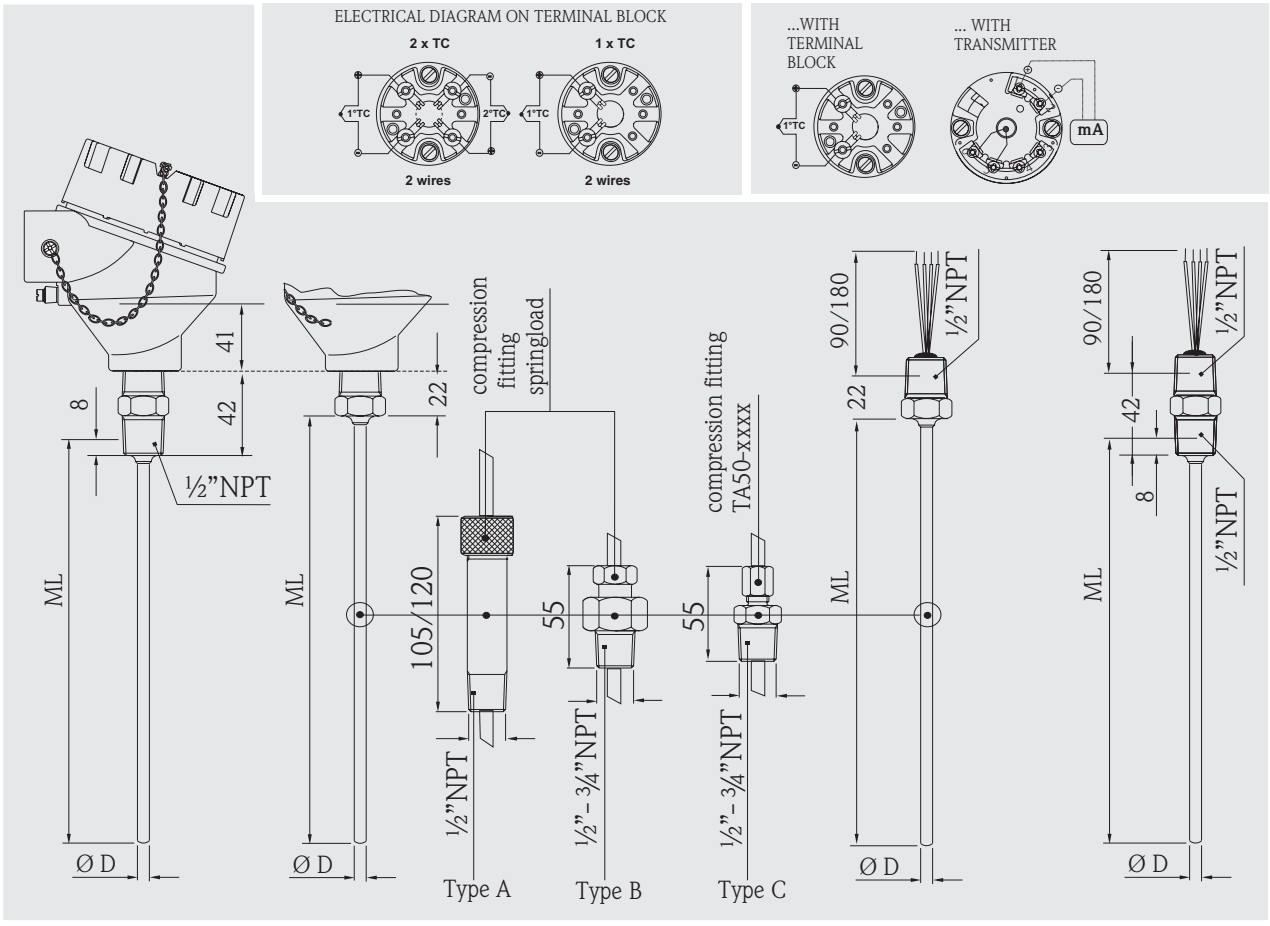


Fig. 5: Functional components and stand ard electrical diagrams with ceramic terminal block and transmitter.

The use of a TC65 with standard lengths ensures fast delivery times; this allows our customers to reduce the amount of spare parts to be kept on stock.

Certificates & approvals

Ex approval

- ATEX Certificate CESI 05ATEX038 for explosion proof type of protection: ATEX II 2 GD EEx-d IIC T6..T5 T85°...T100°C, and ATEX II 1/2 GD EEx-d IIC T6..T5 T85°...T100°C. The TC65 is CE marked.

With regards to the NAMUR NE 24 certificate and the Manufacturer's Declaration according to the standard EN 50018, EN 50020, EN 50281-1-1, EN 50281-1-2, E+H Customer Service will be able to provide further detailed information.

PED approval

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 according to PED Directive is not requested.

Material certification

The material certificate EN 10204 3.1 can be directly selected from the sale structure of the product and refers to the parts of the sensor in contact with the process fluid.
Other types of certificates related to materials can be requested separately.
The "short form" certificate includes a semplified declaration with no enclosures of documents related to the materials used in the construction of the single sensor and guarantees the traceability of the materials through the identification number of the thermometer.
The data related to the origin of the materials can subsequently be requested by the client if necessary.

Further details

Maintenance

The Omnigrad S TC65 thermometers do not require any specific maintenance.
In the case of ATEX certified components (transmitter, insert) please refer to the corresponding specific relevant documentation (at the end of the document).

Ordering information

Sales structure

TC65-	**Omnigrad S TC65 thermocouple thermometer** Thermocouple thermometer complete EE-d certified, without replaceabble insert. Housing: IP66 / IP68, material: aluminium epoxy coating. Execution for direct contact with a process connection welded at the insert or sliding on the insert sheath. Two operating and measurement ranges: from -40 to 750°C (with TC J); -40 to 1200°C (with TC K)

Approval

A	Non-hazardous area
M	*ATEX II 1/2 GD EEx d IIC
E	*ATEX II 2 GD EEx d IIC

Head, material, IP grade

A	TA21H, Aluminium epoxy coating, , IP66 / IP68
Y	Special version, to be specified

Cable entry

A	1 x 1/2 NPT
B	2 x 1/2 NPT
C	1 x 3/4 NPT
D	2 x 3/4 NPT
E	1 x M20 x1,5
F	2 x M20 x1,5
Y	Special version, to be specified

Process connection

AA	Not needed
11	Thread 1/2" NPT - M, SS 316
12	Thread 3/4" NPT - M, SS 316
21	Compression fitting, 1/2" NPT - M, 55 mm, springloaded
31	Compression fitting, 1/2" NPT - M, 105 mm, springloaded
32	Compression fitting, 3/4" NPT - M, 120 mm, springloaded
41	Compression fitting TA50, 1/2" NPT - M, sliding
42	Compression fitting TA50, 3/4" NPT - M, sliding
99	Special version, to be specified

Insertion length ML

X	... mm
Y	Special version, to be specified

Insert diameter

1	3.0 mm
3	6.0 mm
9	Special version, to be specified

Tip Shape

1	Standard
2	Conical to 120°
9	Special version, to be specified

Head transmitter; Range

F	Flying leads
C	Terminal block
P	TMT181-A, PCP, from...to...°C, 2-wire, isolated
Q	TMT181-B, PCP ATEX, from...to...°C, 2-wire, isolated
R	TMT182-A, HART®, from...to...°C, 2-wire, isolated
T	TMT182-B, HART® ATEX, from...to...°C, 2-wire, isolated
S	TMT184-A, Profibus PA®, from...to...°C, 2-wire, isolated
V	TMT184-B, Profibus PA® ATEX, from...to...°C, 2-wire, isolated
1	THT1 separate item

TC Accuracy; Material;

A	1x type K Cl. 1 special; Inconel®600
B	2x type K Cl. 1 special; Inconel®600
E	1x type J Cl. 1 special; SS 316L
F	2x type J Cl. 1 special; SS 316L
Y	Special version, to be specified

											TC standard; Hot junction;		
											1		EN 60584; ungrounded
											2		EN 60584; grounded
											3		ANSI MC96.1; ungrounded
											4		ANSI MC96.1; grounded
											9		Special version, to be specified
												Additional options	
												A	Not needed
												Y	Special version, to be specified
TC65-													**⇐ Order code (complete)**

Sales structure

THT1	**Model and version of the head transmitter**		
	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 II3D, 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 II3D, 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, programmable from...to...°C	
	K21	TMT184-B PROFIBUS-PA® ATEX, 2-wire, programmable from...to...°C	
	K22	TMT184-C PROFIBUS-PA® FM IS, 2-wire, programmable from...to...°C	
	K23	TMT184-D PROFIBUS-PA® CSA, 2-wire, programmable from...to...°C	
	K24	TMT184-E PROFIBUS-PA® CSA, 2-wire, 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 (complete)**

Supplementary documentation

❑ Brochure Field of activities – Temperature measurement	FA006T/09/en
❑ Temperature head transmitter iTEMP® PCP TMT181	TI070R/09/en
❑ Temperature head transmitter iTEMP® HART® TMT182	TI078R/09/en
❑ Temperature head transmitter iTEMP® PA TMT184	TI079R/09/en
❑ TC insert for temperature sensors – Omniset TPC100	TI278T/02/en
❑ TC insert for temperature sensors – Omniset TPC300 (to be released)	TI291T/02/en
❑ Safety instructions for use in hazardous areas (TPC300, to be released)	XA017T/02/en
❑ TA fittings & sockets Omnigrad TA50, TA55, TA60, TA70, TA75	TI091T/02/en
❑ TC thermometers Omnigrad TSC – General information	TI090T/02/en
❑ Industrial thermometers, RTD and thermocouples	TI236T/02/en

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