

# Compact Thermocouple Thermometer *omnigrad S TMT 162C*

*Compact TC assembly based on HART® transmitter  
Explosion area certified executions according to  
ATEX, FM, CSA (Explosion proof and Intrinsic safety)*



The temperature assembly TMT 162C from the family Omnigrad S is a compact thermocouple (TC) thermometer specifically designed to fulfill the requirements of different process industries such as the chemical, petrochemical, oil & gas and energy but even suitable to other general purpose applications.

The thermometer assembly TMT 162C consists of a temperature thermocouple sensor insert (TC type J or K) and an electronic 2-wire Temperature transmitter providing a 4...20 mA output, configurable via HART® protocol.

Thanks to the versatility of its product structure, the TMT 162C is easily adaptable to various applications in many different industrial processes.

### **Features and benefits**

- HART® protocol 2-wire transmitter
- Dual compartment housing
- Galvanically isolated electronics
- Universally programmable with HART® protocol by means of the DXR 275 handheld
- Dual input transmitter for redundancy, average or differential measurements

- Most common mechanical process connections to thermowells available
- Most used standard threads available in the product catalog, other on request
- Customised immersion lengths
- TC inserts type J or K made by mineral oxide cables (MgO); hot junction grounded or insulated, replaceable inserts
- Material of the sensors SS 316L/1.4404 or INCONEL® 600
- Thermocouple sensing element type J or K, accuracy class 1 or 2 (DIN EN 60584)
- Single or double TC element
- Explosion proof construction, flame path inside the sensor insert
- Aluminium or Stainless steel (optional) housing with ingress protection degree IP67 or NEMA 4x
- Explosion certifications according to ATEX (EEx d and EEx ia), FM and CSA (Ex d and Ex i)
- Calibration certificate can be ordered together with the assembly

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The Power of Know How



## Areas of application

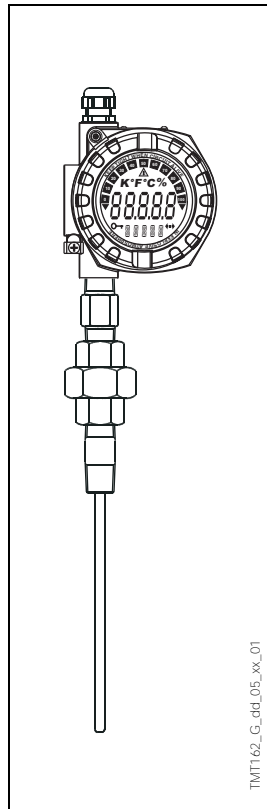
- Chemical and pharma/chemical industries
- Petrochemical industry
- Oil & Gas industry
- Energy industry
- Waste burning treatment

## Function and system design

### Measuring principle

In the thermocouple thermometer the sensing element is created by the physical junction of two homogeneous but different alloys (wires) isolated for the entire length, except in the junction point. The two wires are welded on one side, named 'measuring or hot junction', while the other free wires side, named 'reference or cold junction' is connected to an electrical circuit measuring the electromotive force (mVolts) generated by the different thermoelectric characteristics of the two thermocouple wires when a temperature difference between the hot junction (T1) and the cold junction (T0) occurs. This thermoelectric effect is named Seebeck effect and the T0 temperature must be referred to the 0°C as reference point. The function linking the electromotive force to the temperatures T1 and T0 depends on the materials utilised in the alloys (Ni, Cr, Fe, Cu, ...). These functions are standardised curves, for different alloys couples, by the following international norms DIN EN 60584 (Europe) and ANSI MC96.1 (North America).

### Equipment architecture



The compact temperature assembly TMT 162C consists of a thermocouple sensor (TC type J or K) mounted on a fully programmable HART® protocol transmitter which belongs to the iTEMP® family.

The sensor construction is based on the DIN EN 60584 standard, giving high reliability and performance in all the typical industrial environment conditions.

The TC sensing elements are created by two types of alloy couples: the type J (Iron-Constantan or Fe-CuNi) or the type K (Chromel®-Alumel® or NiCr-NiAl). The measuring ranges of this temperature sensing elements have different values depending on the couple types.

The sensing element (hot junction) is located on the tip of the sensor.

The measuring probe (TC replaceable insert) must be installed in a suitable thermowell.

Thanks to the spring load construction method, the thermometer insert stays always in contact with the inner tip of the thermowell in order to guarantee the best heating transfer from the process to the sensing element.

The transmitter housing is available either in aluminium (double color painted) or in Stainless steel (optional), with or without LC display. The way in which it fits to the thermowell and the cable gland ensures a minimum IP65 (Ingress Protection) grade.

The thermowell (to be ordered separately) can be either bar-stock or welded tube fabricated, depending on the specific application. The thermowells are available in different forms and with many process connections threads, flanges or weld-in types (see the paragraph "Thermowell").

Endress+Hauser has a full range of thermowells for the TMT 162C assembly, according to the various specific application.

Fig. 1: TMT 162C

### Material

Transmitter housing is in painted aluminium or stainless steel.  
Sensor stem: SS 316L/1.4404.

### Weight

From 1.5 to 5 kg for standard options (aluminium housing).

## Electronics

The TMT 162C output signal is a 4...20 mA (or 20...4 mA), in 2-wires technology. In case of sensor breakage, the transmitter can set the output signal value above the maximum (21 mA) or below the minimum (3.6 mA).

A dual input functionality is also available: two input signals coming from two different TC elements can be managed as difference, average or redundancy.

The TMT 162C transmitter can be configured through the HART® protocol by means of the operative "hand-held" DXR 275 (Universal HART® Communicator).

For the two wire powering of the TMT 162C in the hazardous areas, Endress+Hauser produces suitable electronic supply modules, galvanically isolated and specifically designed for the intrinsic safety interfacing.

For any further details or information on the iTEMP transmitter please refer to the relevant documentation (see TI codes at the end of this document).

The electronic module compact thermometers such as the TMT 162C, should not be exposed at very high ambient temperature exceeding the maximum working temperature specified (see fig. 4).

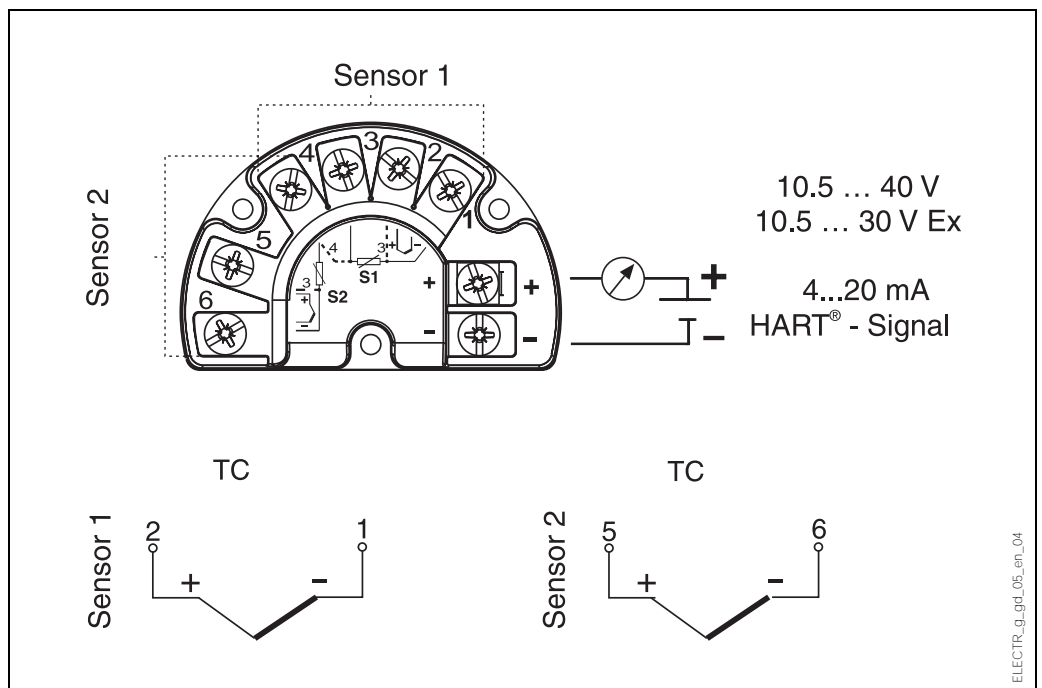


Fig. 2: Wiring diagram

## Performance

### Operating conditions

#### Ambient temperature

- transmitter without display -40÷85°C (-40÷185°F)
- transmitter with display -30÷70°C (-22÷158°F)

For use in hazardous area see the relevant documentation

#### Storage temperature

- transmitter without display -40÷100°C (-40÷212°F)
- transmitter with display -40÷85°C (-40÷185°F)

#### Process temperature

Could be limited by the thermowell.

#### Maximum process pressure

Maximum pressure values at various temperature are indicated in the Technical Information of the different thermowells (see TI documentation codes at the end of this document).

Maximum flow velocity

The maximum flow velocity to which the TMT 162C can be exposed reduces with the increasing of the immersion length of the sensor inside the flow. The maximum flow velocity depends on the mechanical and construction characteristics of the thermowell itself, on the fluid characteristics and on the working conditions (pressure, temperature). For the choice of the proper thermowell according to the process conditions, flow velocity, etc. you are kindly requested to contact the Sales office of Endress+Hauser in your country.

**Accuracy**

The accuracy values of thermocouples type J and K are defined by the DIN EN 60584 standard, as follow.

Type	Standard tolerance (DIN EN 60584)		Reduced tolerance (DIN EN 60584)	
	Class	Deviation	Class	Deviation
J (Fe-CuNi)	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)
K (NiCr-Ni)	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)

(|t|=absolute temperature value in °C)

Transmitter and display maximum error

See relevant documentation (docu code at the end of this document).

**Measurement range**

- Thermocouple sensor type J -40...750°C
- Thermocouple sensor type K -40...1100°C

**Response time**

Tests in water at 0.4 m/s (according to DIN EN 60584; 23 to 33°C step changes), only on the TC insert:

- T<sub>50</sub> 2.5 s
- T<sub>90</sub> 7 s

**Insulation**

Insulation resistance between terminals and probe sheath (according to DIN EN 60584, test voltage 500 Vdc) above 1 GΩ a 25°C  
above 5MΩ a 500°C

**Self heating**

Negligible

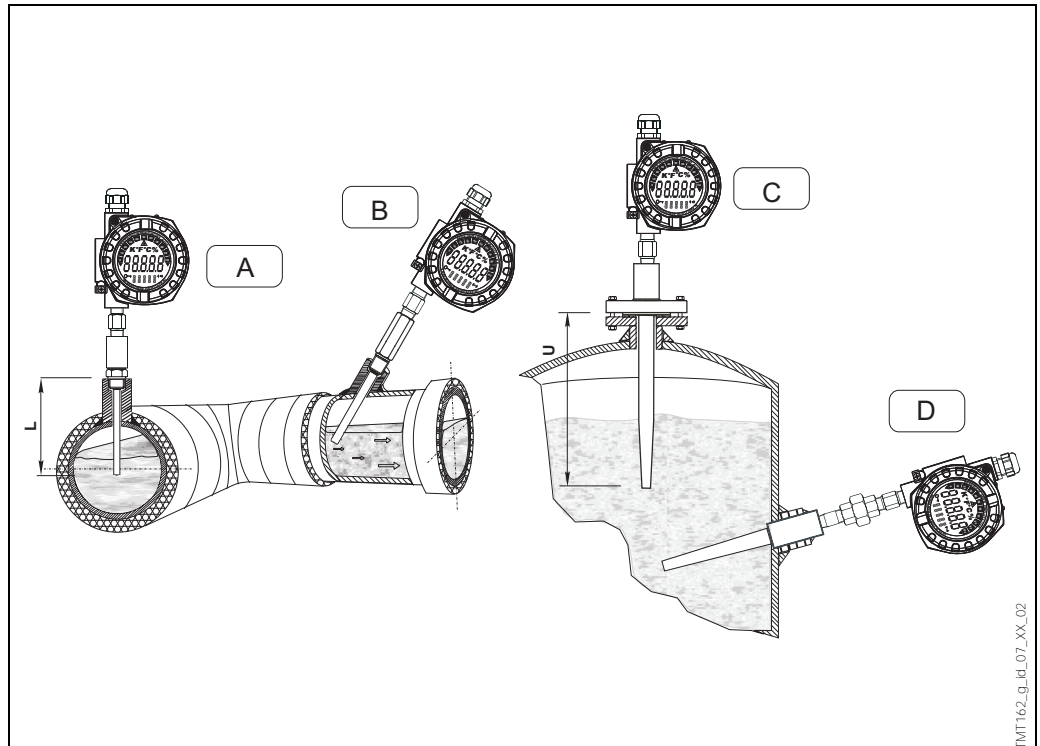
## Installation

The Omnigrad S thermocouple thermometer model TMT 162C can be mounted on the wall of pipes or vessels or other plant parts that may be necessary.

In the case of ATEX/FM/CSA certified components (transmitter + insert), please refer to the relevant documentation (TI code at the end of this document).

The 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 detected due to the lower temperature of the process fluid near to the walls and the 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÷150 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. 3A-3C). 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. 3B-3D).



**Fig. 3:** Examples of installation

In the case of two-phase flows, please pay special attention to the choice of the measurement point, as there may be fluctuations in the value of the detected temperature.

With regard to corrosion, it's important to choose the right base material of the thermowells; Endress+Hauser offers a wide range of thermowells suitable for each kind of application, please contact the E+H Sales Office in your country.

In case that the sensor components are disassembled and then re-mounted the proper assembling torque must be applied in order to guarantee the original tightness and ingress protection in the coupling sensor-housing.

## System components

### Housing

The housing of the TMT 162C is a dual compartment container.

One compartment includes the electronics of the transmitter and the LC digital display (optional) while the second compartment, mechanically separated but electrically cabled to the first, contains the terminals for the electrical interface (for the TC sensor and output current 4...20 mA with HART® protocol) and the cable entries. When necessary, the display can easily be rotated with 90 degrees angle rotation thus adapting the display to the different local visualization needs. The housing is available either in painted aluminium (blue-grey E+H corporate colours) and, optionally, in stainless steel.

The ingress protection of the TMT 162C housing is IP67-Nema 4x; the electrical cable connection for the signal output 4...20 mA is available in different versions (1/2" NPT, M20x1.5, ...). The standard coupling sensor-housing is realised through 1/2" NPT thread, thus granting an IP65 ingress protection.

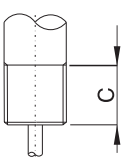
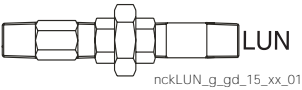
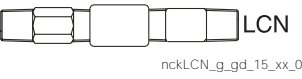
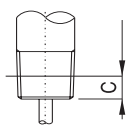
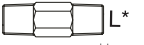
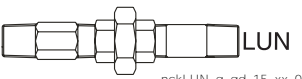
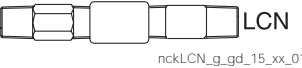
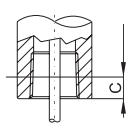
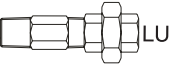
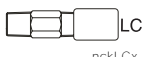
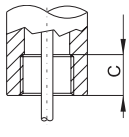
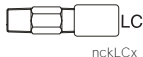
### Extension neck

The extension neck is the mechanical interface between the process connection of the sensor and the housing. The function of the extension neck is to separate the electronics from the high temperature of the process. It is normally made of a tube assembled to various fittings (nipples, union) suitable to adapt the temperature sensor to the different thermowells existing in the plant or available from the E+H catalog.

The neck material is usually SS 316L/1.4404.

The standard lengths (N) and the extension neck versions are selectable amongst the following options:

- 52 mm (only 1/2" NPT, type L)
- 102 mm (nipple+union, type LU)
- 96 mm (nipple+coupling, type LC)
- 144 mm (nipple+union+nipple, type LUN)
- 138 mm (nipple+coupling+nipple, type LCN)

Process connection to thermowell: threads					
Type	Threads	Option	C (mm)	Details	Neck type
Male	G 1/2"	D	15	 ConGAS_G_dd_09_XX_01	 LUN nckLUN_g_gd_15_xx_01  LCN nckLCN_g_gd_15_xx_01
	1/2" NPT	N	8	 ConNPT_G_dd_09_XX_01	 L* nckLxx_g_gd_15_xx_01  LUN nckLUN_g_gd_15_xx_01
	3/4" NPT	P	8.5		 LCN nckLCN_g_gd_15_xx_01
Female	1/2" NPT	U	8	 ConNPT_G_dd_09_XX_02	 LU nckLUX_g_gd_15_xx_01  LC nckLCx_g_gd_15_xx_01
	M24x1.5	5	16	 ConM24_G_dd_09_XX_01	 LC nckLCx_g_gd_15_xx_01



Warning !

\* Extension necks available only with 1/2" NPT threads

Besides the standard neck options indicated it's possible to order a specific neck by typing the lengths in the order code.

The mechanical coupling situated in the upper part of the neck allows for orientation of the sensor head. As illustrated by the drawing in figure 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".

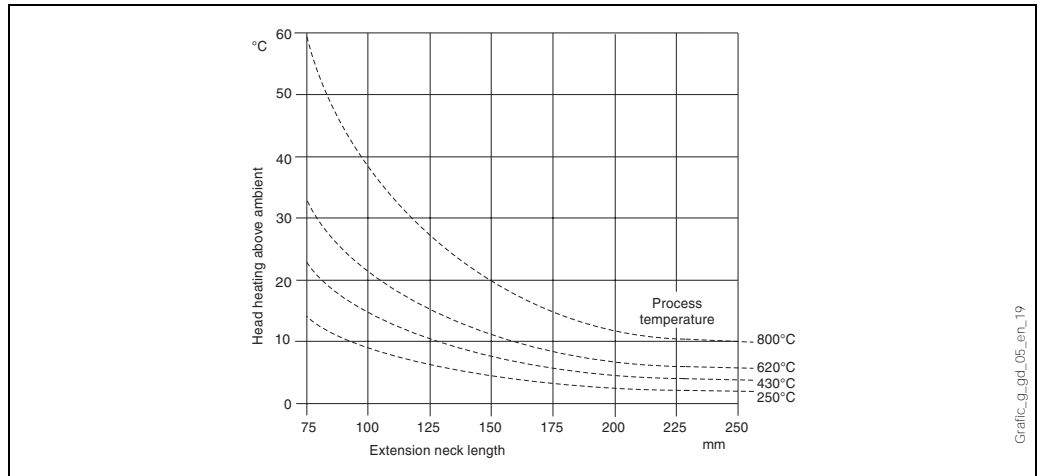


Fig. 4: Heating of the head consequent to the process temperature

**Thermowell**

The compact thermoter TMT 162C can be assembled to a thermowell separately ordered or already existing in the plant. To this scope the extension neck is available with different forms and executions. In order to easily select the right mechanical fitting for the thermowell you are kindly requested to use the table list and the ML values described at the chapter "Probe".

**Probe**

In the TMT 162C compact thermometer the probe is made by a mineral oxyde insert (MgO) which shall be assembled to a temperature thermowell (thermowell to be ordered separately). The length of the sensor is freely selectable inside the predefined lengths range (50...990 mm). Sensors exceeding the 990 mm length can be ordered separately after technical analysis of the application. The immersion length (ML) must be defined as a function of the type and length of the relevant thermowell. In case of spare inserts to be ordered please read carefully the following table (table valid for standard thickness tip):

Thermowell type	ML	Thermowell type	ML	Thermowell type	ML
TW 10*	ML = A - 8	TA 535	ML = A - 8	TA 560	ML = A - 11
TW 11*	ML = A - 8			TA 562	ML = A - 11
TW 12*	ML = A - 8	TA 540	ML = A - 10	TA 565	ML = A - 11
TW 13*	ML = A - 8	TA 541*	ML = A - 10	TA 566	ML = A - 11
TW 10**	ML = A - 15			TA 570	ML = A - 11
TW 11**	ML = A - 15	TA 550	ML = A - 11	TA 571	ML = A - 11
TW 12**	ML = A - 15	TA 555	ML = A - 10	TA 572	ML = A - 11
TW 13**	ML = A - 15	TA 556	ML = A - 10	TA 575	ML = A - 11
TW 15**	ML = A - 12	TA 557	ML = A - 10	TA 576	ML = A - 10



**Warning !**

- \* TMT 162C with connection to thermowell NPT female
- \*\* TMT 162C with connection to thermowell metric female (M24x1.5)

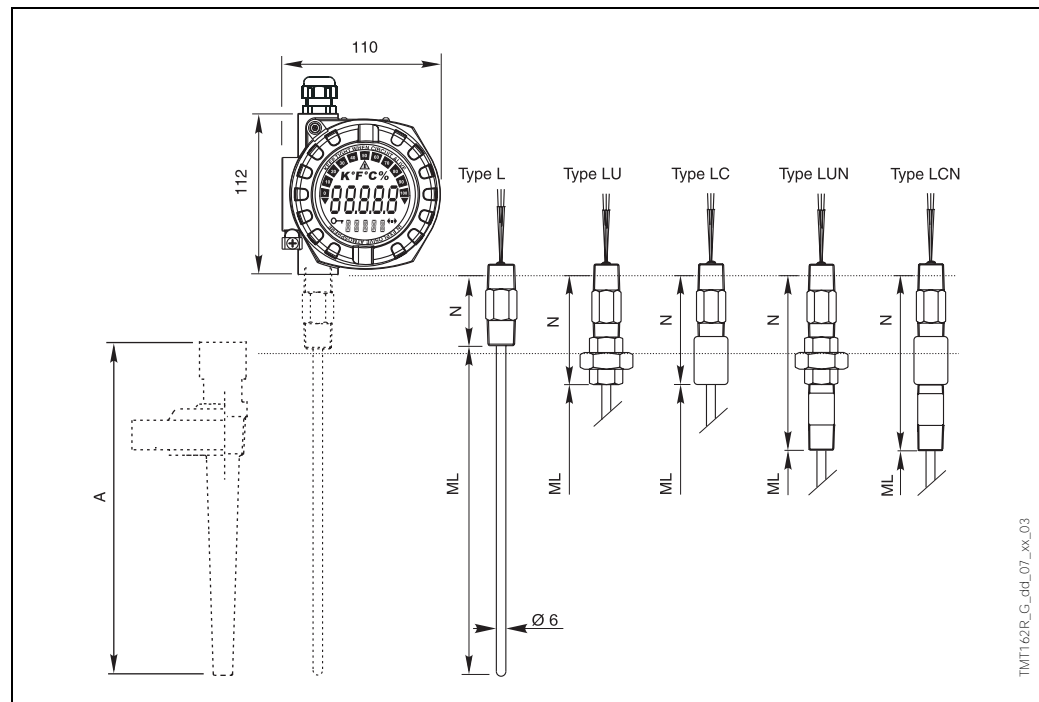


Fig. 5: System components

## Certification

### Ex approvals

Refer to the specific documentation (see codes at the end of the document).

### PED

The Pressure Equipment Directive (97/23/CE) is respected, (paragraph 2.1 of article 1 is not applicable to these types of instruments).

### Test report and calibration

With regards to the tests and calibration, the "Inspection Report" consists of a compliance declaration for the essential points of the standard DIN EN 60584.

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

### Maintenance

The Omnigrad S thermometers do not require any specific maintenance.

In the case of ATEX/FM/CSA certified components (transmitter, insert) please refer to the corresponding specific relevant documentation (refer to the code at the end of the document).

### Delivery time

For small quantities (approximately 10 units) and standard options, between 5 and 20 days depending on the configuration required.



## Ordering Information

*Sales structure*

<b>TMT162C</b>	<b>Housing material, certification</b>	
	A	Aluminium housing, general purpose
	B	Aluminium housing, ATEX II1G EEx ia IIC T4/T5/T6
	C	Aluminium housing, FM IS, NI I/1+2/A-D
	D	Aluminium housing, CSA IS, NI I/1+2/A-D
	E	Aluminium housing, ATEX II 2G EEx d IIC T6
	F	Aluminium housing, FM XP, DIP I, II, III/1+2/A-D
	G	Aluminium housing, CSA XP, DIP I, II, III/1+2/A-D
	H	Aluminium housing, ATEX EEx d, EEx ia
	J	Aluminium housing, FM XP, DIP, IS, NI I, II, III/1+2/A-D
	K	Aluminium housing, CSA XP, DIP, IS, NI I, II, III/1+2/A-D
	L	Aluminium housing, ATEX II 3G EEx nA IIC T4/T5/T6
	<b>Electrical connection, display</b>	
	1	Cable entry M20x1.5, without display
	2	Cable entry M20x1.5, with display
	3	Cable entry 1/2" NPT, without display
	4	Cable entry 1/2" NPT, with display
	<b>Configuration</b>	
	Y	Customized configuration (Tmin, Tmax, °C/°F, minimum span 10°C/18°F)
	<b>Neck length stainless steel (N) SS 316L/1.4404</b>	
	1	52 mm, N nipple (only 1/2" NPT), type L
	2	102 mm, N nipple + union, type LU
	3	96 mm, N nipple + coupling, type LC
	4	144 mm, N nipple + union + nipple, type LUN
	5	138 mm, N nipple + coupling + nipple, type LCN
	9	... mm, N to specify type LUN o LCN
	<b>Thermowell</b>	
	0	Thermowell not required
	1	E+H thermowell from bar stock (separate position)
	2	E+H thermowell from pipe (separate position)
	<b>Connection thread to thermowell</b>	
	N	1/2" NPT male (L, LUN, LCN)
	U	M24x1.5 female (LC)
	5	1/2" NPT female LU, LC)
	P	3/4" NPT male (LUN, LCN)
	D	G 1/2" B male (LUN, LCN)
	Y	Special version
	<b>TC type, sheath mat., price per 100 mm ML</b>	
	A	1xTC IEC584 type K D=6 mm, INCONEL®600
	C	1xTC IEC584 type J D=6 mm, SS 316L
	G	1xTC ANSI Type K D=6 mm, INCONEL®600
	J	1xTC ANSI Type J D=6 mm, SS 316L
	9	Special version
	<b>MgO Type, tolerance, hot measur.junction, Class of tolerance: ANSI MC 96.1 (IEC 584)</b>	
	1	Std. purity, Class 2, hot junction grounded
	2	Std. purity, Class 1, hot junction grounded
	5	Std. purity, Class 2, hot junction insulated
	6	Std. purity, Class 1, hot junction insulated
	9	Special version
	<b>Insertion length ML (50-990 mm)</b>	
	X	... mm insertion length ML to specify
	Y	... mm special insertion length ML
	<b>Test and calibration on inset</b>	
	0	Test and calibration not required
	1	Inspection test report on sensor
	2	Insp. test report on loop TC + transm.
	A	Factory calibration, single RTD, 0-100°C
	B	Factory calibration, loop single RTD, 0-100°C
	E	Factory calibration, single RTD, 0-150°C
	F	
	Y	
TMT162C-		Complete Order Code

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## Supplementary Documentation

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<input type="checkbox"/> TCThermometer Omnigrad TSC - General Information	TI 090T/02/en
<input type="checkbox"/> Temperature Field Transmitter iTEMP HART TMT162	TI 086R/09/en
<input type="checkbox"/> Thermocouple insert (J, K) - TEC300	TI 226T/02/en
<input type="checkbox"/> Pipe thermowell - Omnigrad M TW 10	TI 261T/02/it
<input type="checkbox"/> Pipe thermowell - Omnigrad M TW 11	TI 262T/02/it
<input type="checkbox"/> Pipe thermowell - Omnigrad M TW 12	TI 263T/02/it
<input type="checkbox"/> Pipe thermowell - Omnigrad M TW 13	TI 264T/02/it
<input type="checkbox"/> Bar stock thermowell - Omnigrad M TW 15	TI 265T/02/it
<input type="checkbox"/> Industrial protecting tube - Omnigrad TA540	TI 166T/02/en
<input type="checkbox"/> Industrial protecting tube - Omnigrad TA550	TI 153T/02/en
<input type="checkbox"/> Industrial protecting tube - Omnigrad TA555	TI 154T/02/en
<input type="checkbox"/> Industrial protecting tube - Omnigrad TA557	TI 156T/02/it
<input type="checkbox"/> Industrial thermowell - Omnigrad TA560	TI 159T/02/en
<input type="checkbox"/> Industrial thermowell - Omnigrad TA565	TI 160T/02/en
<input type="checkbox"/> Industrial protecting tube -Omnigrad TA576	TI 163T/02/en
<input type="checkbox"/> E+H Thermolab - Calibration certificate for industrial thermometers	XA005T/02/z1
<b><i>RTD e thermocouples</i></b>	TI 236T/02/en

**Subject to modification**

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