

INSTRUCTIONS MANUAL

OMM

Thermoelectric sensors
with ceramic sheath



Thermoelectric sensors with ceramic sheath

Sensor type	Sheath material*	Thermoelectrode diameter (type)	Maximum measurement range	Fastening method	Ceramic sheath diameter	Ingress protection rating
TTKCU.. TTSCU..	1.4841 + C799	Ø2 (K) Ø0.35 (S)	0..+1150°C	sliding clamp UG, UZ	Ø15 + steel Ø22	DAN – IP53 DANW – IP53
TTKCU.. TTSCU..	1.4762 + C799	Ø2 (K) Ø0.35 (S)	0..+1200°C			
TT438..	C610	Ø2 (K) Ø0.35 (S) Ø0.50 (S)	0..+1200°C 0..+1300°C 0..+1400°C		Ø24 + internal Ø15	
TT438..	C799	Ø2 (K) Ø0.35 (S) Ø0.50 (S) Ø0.50 (B)	0..+1200°C 0..+1300°C 0..+1600°C 0..+1800°C			
TT440..	C610	Ø2 (K) Ø0.35 (S) Ø0.50 (S)	0..+1200°C 0..+1300°C 0..+1400°C		Ø15	
TT440..	C799	Ø2 (K) Ø0.35 (S) Ø0.50 (S) Ø0.50 (B)	0..+1200°C 0..+1300°C 0..+1600°C 0..+1800°C			
TT441..	C610	Ø0.35 (S) Ø0.50 (S)	0..+1300°C 0..+1400°C		Ø15 + internal Ø8	
TT441..	C799	Ø0.35 (S) Ø0.50 (S) Ø0.50 (B)	0..+1300°C 0..+1600°C 0..+1800°C			
TT442..	C610	Ø0.35 (S) Ø0.50 (S)	0..+1300°C 0..+1400°C		Ø10	
TT442..	C799	Ø0.35 (S) Ø0.50 (S) Ø0.50 (B)	0..+1300°C 0..+1600°C 0..+1800°C			
TT443..	C610	Ø0.35 (S) Ø0.50 (S)	0..+1300°C 0..+1400°C		Ø8	
TT443..	C799	Ø0.35 (S) Ø0.50 (S) Ø0.50 (B)	0..+1300°C 0..+1600°C 0..+1800°C			
TT444..	C610	Ø0.35 (S) Ø0.50 (S)	0..+1300°C 0..+1400°C		Ø6	
TT444..	C799	Ø0.35 (S) Ø0.50 (S) Ø0.50 (B)	0..+1300°C 0..+1600°C 0..+1800°C			

* other parameters available upon customer's request

1. Safety

Information about our products and equipment as well as our installations and technological processes result from extensive research and user experience. We pass these results, however, we do not assume any responsibility which falls outside the scope of the content of each individual contract, in the oral or written form in accordance with our best knowledge. Nevertheless, we reserve the right to introduce technical amendments resulting from the development of our products.

In addition, our Consumer Technology Department remains at your disposal to provide further advice, as well as to participate in the search for solutions in the field of production issues and technology of use.

This fact, however, does not relieve the user from the obligation to verify our information and instructions before each application in terms of their usefulness.

It applies in particular to the foreign supplies within the scope of protective rights of third parties, as well as the use and practices that have not been overtly presented by us in writing.

In the case of any damage, our liability is limited to the compensation benefits for quality defects and presented in our General Conditions of Sale and Delivery.

1.1 General safety information

The chapter entitled "Safety" shall entail all the safety aspects that are to be taken into account during the operation of the device.

This device has been designed with regard to the temporary technology principles, and therefore it is reliable in its operation. The device has been tested and left the factory as safe in technical terms. To ensure safety during operation, follow the instructions of this manual.

Ensure the compliance with the general provisions concerning the safety of operating the equipment. In addition to these general information, the individual chapters of this manual also include descriptions and operating instructions along with specific indications regarding safety.

Compliance with all indications and instructions concerning safety allows for protection of the staff and the natural environment against threats and ensures safe and smooth operation of the device.

1.2 Intended use

Temperature sensors are used to measure the temperature in all sorts of process applications. Resistance thermometers or thermocouples can be used with or without a protective tube.

1.3 Technical limits

The device is intended solely for use within the technical limit values specified on the identification plates and technical sheets.

Please observe the following limit values:

- Do not exceed the maximum operating temperature.
- Do not exceed the maximum environment temperature.
- The rules concerning the type of the body protection measures must be observed.

1.4 Warranty provisions

Misuse, not abiding by the instructions of this manual, applying operating staff having no sufficient qualifications as well as arbitrary tampering exclude the manufacturer's liability for the caused damage. Warranty of the manufacturer expires.

1.5 Obligations of the user

- Before using corrosive and abrasive measuring materials, ensure that the relevant structural elements, which are to be in contact with these materials, are sufficiently resistant. TERMOAPARATURA may provide assistance in the matter of selection. It cannot, however, assume any liability whatsoever.
- Above all observe the national laws pertaining to the control of operation, repair, and maintenance of electrical equipment.

1.6 Staff qualifications

Installation, commissioning, and maintenance can be done only by trained personnel, authorised for this purpose by the installation user. The personnel must read and understand this instructions manual and follow its guidelines.

1.7 Guidance on safety in transport

The following points must be observed:

- Do not expose the device to moisture during transport. The device should be properly packaged.
- Package the device in such a way that during the transport it is protected against shocks, for example by means of a package with bubble wrap.

Before installing the device, examine it for possible damages which may have been caused due to unprofessional transport. Damages resulting from transport must be noted in the freight documents. All claims for damages must be immediately asserted against the freight forwarder – even before installation.

1.8 Guidance on safety of electrical installations

Electrical installation of the device can only be made by authorised electricians and in accordance with the electrical plans.

Follow the instructions regarding electrical installation. Otherwise, the type of electrical protection may be affected.

Safe separation of electrical circuits which are dangerous to touch can only be ensured if the connected devices comply with the requirements of VDE 0106 T 101 (basic requirements for safe separation).


In terms of safe separation, lay the power lines separately from the electrical circuits which are dangerous to touch or additionally insulate them.


2. The design and operating method


2.1 General information

The supplied thermometers are ready for operation or possible enclosing.

These thermocouples are very accurate, they contain ceramic elements. They should be handled with appropriate care.

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 During the delivery of the thermometer, pay attention if all the loosely packed elements have been unpacked.

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 Long thermometers must be supported in several points, lifted and transported in a proper manner. During the assembly, also apply proper care.

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 Before the assembly, examine the thermometers (see 5.1) in order to exclude damages that may have occurred during shipping.

The main element of thermoelectric sensors is a measuring insert in a ceramic sheath, the clamps of which are covered with a head made of aluminium alloy. The insert includes thermocouple wires connected with external clamps of the terminal block or of the 4..20 mA transmitter.

The measuring device responds to changes in temperature of the medium with a change in electromotive force EMF. These changes are consistent with the thermometric characteristics specified in the PN-EN 60584 standard.

Basic technical data:	
Thermocouple type	1x or 2xNiCr-Ni (K) 1x or 2xNiCrSi-NiSi (N) 1x or 2xPtRh10-Pt (S) 1x or 2xPtRh13-Pt (R) 1x or 2xPtRh30-PtRh6 (B) A or B class in accordance with PN-EN 60584-2
Maximum measurement range	-40..+1200°C for K, N 0..+1600°C for S, R 0..+1800°C for B
Measuring junction type	isolated
Sheath material	Mullite C610 Corundum C799
Holding tube material	heat-resistant steel 1.4841
Acceptable temperature for head	+100°C (rubber seal)
Ingress protection rating	IP53 DAN, DANW heads
Size of the gland	M20x1.5

2.2 Thermocouples

Thermocouples can consist of 1 or 2 elements. The thermocouple measuring junction is isolated. The thermocouple and the measuring device are connected by a compensating cable. Be sure to connect the compensating cables suited to the thermocouple of correct polarity. These wires should be placed at a distance of at least 0.5 m from power lines, preferably in their own cable ducts. Twisted and shielded cables reduce the electric and magnetic interference. The positive pole on the terminal block is marked with a red dot. Twisted and shielded cables reduce the electric and magnetic interference. The principle of connections and insulation colour are shown in the table below.

Standard	Type of item			Wire material			Colour marking		
	Type	Pole+	Pole-	Code	Pole+	Pole-	Core insulation		Sheath
							Pole+	Pole-	
IEC 584-3 DIN 43722 JIS C1610	T	Cu	CuNi	TX	Cu	CuNi	brown	white	brown
	E	NiCr	CuNi	EX	NiCr	CuNi	violet	white	violet
	J	Fe	CuNi	JX	Fe	CuNi	black	white	black
	K	NiCr	Ni	KX	NiCr	Ni	green	white	green
	K	NiCr	Ni	KC A	Fe	CuNi	green	white	green
	K	NiCr	Ni	KC B	Cu	CuNi	green	white	green
	N	NiCrSi	NiSi	NX	NiCrSi	NiSi	pink	white	pink
	N	NiCrSi	NiSi	NC	E-Cu	CuNiMn	pink	white	pink
	R/S	Pt13/10Rh	Pt	RCA/SCA	E-Cu	CuNiMn	orange	white	orange
	R/S	Pt13/10Rh	Pt	RCB/SCB	E-Cu	CuNiMn	orange	white	orange
ANSI MC 96.1	B	Pt30Rh	Pt6Rh	BC	CuMn	E-Cu	grey	white	grey
	T	Cu	CuNi	TX	Cu	CuNi	blue	red	blue
	E	NiCr	CuNi	EX	NiCr	CuNi	purple	red	purple
	J	Fe	CuNi	JX	Fe	CuNi	white	red	black
	K	NiCr	Ni	KX	NiCr	Ni	yellow	red	yellow
	R/S	Pt13/10Rh	Pt	RX/SX	E-Cu	CuNiMn	black	red	green
NF C42-324 - 1985	B	Pt30Rh	Pt6Rh	BX	CuMn	E-Cu	grey	red	grey
	T	Cu	CuNi	TX/C	Cu	CuNi	yellow	blue	blue
	E	NiCr	CuNi	EX/C	NiCr	CuNi	yellow	orange	orange
	J	Fe	CuNi	JX/C	Fe	CuNi	yellow	black	black
	K	NiCr	Ni	KX/C	NiCr	Ni	yellow	violet	violet
	K	NiCr	Ni	VC	Cu	CuNi	yellow	brown	brown
	K	NiCr	Ni	WC	Fe	CuNi	yellow	white	white
	R/S	Pt13/10Rh	Pt	SC	E-Cu	CuNiMn	yellow	green	green
DIN 43714 - 1979	B	Pt30Rh	Pt6Rh	BC	CuMn	E-Cu	yellow	grey	grey
	U	Cu	CuNi		Cu	CuNi	red	brown	brown
	L	Fe	CuNi		Fe	CuNi	red	blue	blue
	K	NiCr	Ni		Fe	CuNiMn	red	green	green
BS 4937	R/S	PtRh	Pt		E-Cu	CuNiMn	red	white	white
	T	Cu	CuNi		Cu	CuNi	white	blue	blue
	J	Fe	CuNi		Fe	CuNi	yellow	blue	black
	E	NiCr	CuNi		NiCr	CuNi	brown	blue	brown
	K	NiCr	Ni		NiCr	Ni	brown	blue	red
	K	NiCr	Ni		E-Cu	CuNiMn	white	blue	red
R/S	PtRh	Pt		E-Cu	CuNiMn	white	blue	green	

2.3 Thermometers with transducers

You can avoid potential problems arising from the transitional resistance of the wires and electromagnetic compatibility by installing 2-conductor transducers (output 4 ... 20 mA) on the connection head. Only the twisted-pair copper cable is necessary. Then there is no need to use compensation cables.

In the case of using the transducers, consider:

- The instruction manual of the transducer;
- The relevant provisions concerning the performance and operation of electrical systems, as well as regulations and guidelines for explosion protection.

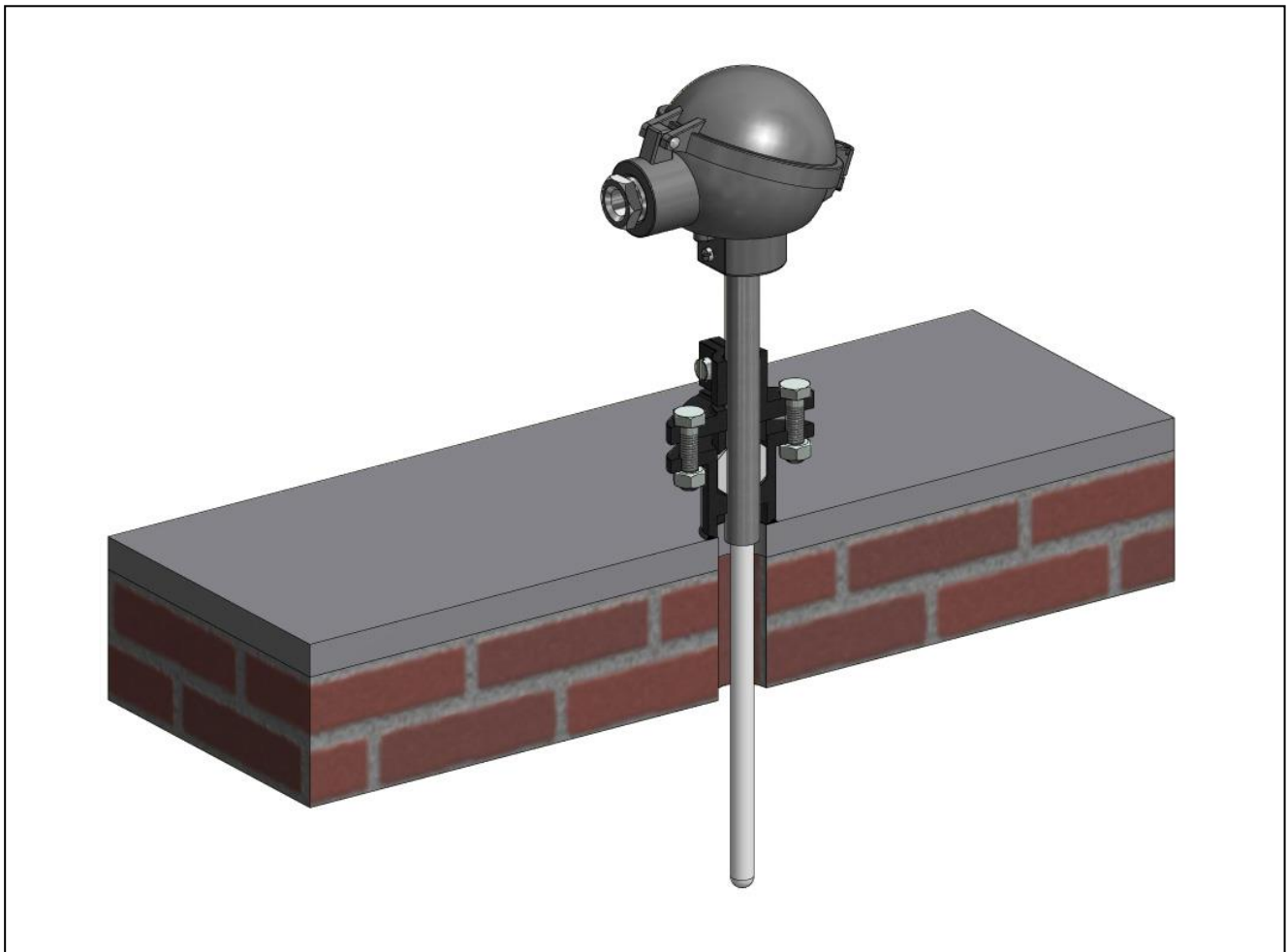
3. Installation

3.1 Enclosure

Installation of sensors with a ceramic protective sheath is possible with the use of flanged or threaded sliding clamps. In both cases, the depth of the sensor immersion can be regulated by sliding the clamp through the metal holding tube. Immersion adjustment limits are set by the length of the holding tube used to clamp the thermocouple onto it, in order to make it gas-proof.

It is required to use a complete clamp with the body (UZ11 type) in flanged clamps in order to make a gas-tight connection.

Example of installing a sensor with a UZ clamp holder.



3.2 Ceramic sheaths installation instructions

High alumina ceramics C799 is characterised by low resistance to rapid temperature changes. Thus, special attention needs to be paid during mounting or dismantling the sensor.

Temperature shock adversely affects the structure of sheath material, which can damage the sheath. Therefore, thermocouples with ceramic sheaths need to be carefully immersed in the process. Moreover, ceramic tubes need to be protected against mechanical load. The sensor can be exposed to such load e.g. during the mounting of the sensor in the horizontal position. Depending on the sheath diameter and shape, and immersion length, additional protection against unwanted bending should be provided.

This instruction also extends to temperature sensors with metal sheaths.

3.3 Installation of a ceramic sheath during furnace operation



Installation temperature:

1600°C immersion speed: 1-2 cm/min

1200°C immersion speed: 10-20 cm/min

4. Maintenance / repair

Thermometers and temperature measuring circuits should be regularly checked in terms of:

- wear of the protective tube or influence of chemicals,
- a change in the output rate of measuring devices over time due to the ageing process,
- insulation resistance drop due to moisture or soiling,
- a wrong contact of wire connections,
- mechanical and chemical damage to thermometers and wires.

Thermocouple measuring circuits are checked by replacing the thermocouples through connecting voltage on a known level of MV series to the measuring circuit. That way, you can check if there are large deviations from the setpoints and if the thermometer or instruments are the reason for functional errors.

The insulation resistance of the entire measuring circuit without earthing (power lines and thermometer) in relation to the ground should be $> 1 \text{ M}\Omega$ (as measured with a voltage of 100 VDC).

5. Error messages

5.1 Quick supervision method

Instant supervision of thermocouples and its measuring circuits while disassembled.

Required instruments:

- millivoltmeter
- insulation resistance meter with voltage 60 ... 500 V (all measurements in room temperature)

You can perform the following tests:

- Check penetration and insulation at room temperature.

Thermocouple must be classified as correct if $R < 20 \Omega$ (wire $> 0.5 \text{ mm } \varnothing$). This value is dependent on the length and section of a wire. Risol (insulation resistance) = 100 M Ω (insulated thermocouple).

Tip!

The accuracy of the temperature sensors can be checked in accordance with the requirements of ISO 9001 only by using comparable reference elements. In this respect, disassembly and supervision in the fire-chamber is necessary.

5.2 Error table

You should regularly check the entire temperature measuring circuit. The following table shows the most common errors and their possible causes, as well as suggested solutions.

Error	Cause of the error	Solution
Distortion of the measuring signal	<ul style="list-style-type: none"> • Electric/magnetic influence 	<ul style="list-style-type: none"> • The distance between the measuring cables of at least 0.5 m in the case of parallel arrangement. • Electrostatic shielding with foil/coil grounded at one point. • Twisting pairs as a protection against magnetic influences. • Crossing measurement leads with confounding power cords at right angle. • Using transducers.
	<ul style="list-style-type: none"> • Ground fault 	<ul style="list-style-type: none"> • Only one earthing point in the circuit or measuring system in a “suspended state” (without earthing)
	<ul style="list-style-type: none"> • Insulation resistance drop 	<ul style="list-style-type: none"> • The thermometer or the measuring insert is moist or wet; if necessary, dry up and seal it tightly. • Replace the measuring insert. • Check to make sure if the thermometer is not thermally overloaded.
Response times are too long, Wrong measurement results	<ul style="list-style-type: none"> • Wrong enclosure place: <ul style="list-style-type: none"> – In a shadowed place – Within the scope of operation 	<ul style="list-style-type: none"> • Select the mounting location in such a way that the agent can transmit temperature to the thermometer without interference.
	<ul style="list-style-type: none"> • Wrong enclosure method: <ul style="list-style-type: none"> – Immersion too shallow. – Heat dissipation too large. 	<ul style="list-style-type: none"> • Ensure thermal contacts, especially in the case of surface measurements, through appropriate contact surfaces and/or heat transmitting substances.
	<ul style="list-style-type: none"> • Protective tube too thick. • The opening of the protective tube too large. 	<ul style="list-style-type: none"> • Use a protective tube that is as small as possible, depending on the process technology. • The response time during the first approach proportional to the section or volume of the thermometer, depending on the coefficient of heat absorption and air gaps in the body.
	<ul style="list-style-type: none"> • Deposits on the protective tube. 	<ul style="list-style-type: none"> • Remove during inspections. • If possible, use another protective tube or select a different installation location.
Interruptions in the thermometer	<ul style="list-style-type: none"> • Vibration. 	<ul style="list-style-type: none"> • Shortening the housing. • Displacement of thermocouple measurement junction (if possible) • Special design of the protective tube measuring insert.

Error	Cause of the error	Solution
The protective tube heavily covered with corrosion.	<ul style="list-style-type: none"> • The composition of the environment different from assumptions or changed. • You have selected incorrect material of the sheath. 	<ul style="list-style-type: none"> • Check the environment. • Possibly analyse the damaged protective tube and then apply better suited material. • Provide extra surface protection. • Protective tube should be replaced on a regular basis as a wearing part.

5.3 Characteristic errors in thermocouples

Error	Cause of the error	Solution
The temperature display is deviating, while the remaining structure of the thermocouple measuring circuit is faultless.	<ul style="list-style-type: none"> • Reference junction temperature not constant. 	<ul style="list-style-type: none"> • Reference junction temperature has to be maintained at a constant level. – (<0.1%) (check instruments).
Temperature display with strong deviations in relation to the thermocouples tables.	<ul style="list-style-type: none"> • Incorrect material combinations. • Wrong sockets. <ul style="list-style-type: none"> – Interference voltages (thermovoltages, galvanic voltages). • Incorrect compensating cable. 	<ul style="list-style-type: none"> • Check thermocouples and wires in terms of: <ul style="list-style-type: none"> – the right selection. – unbroken compensating cable. – correct polarity. • Permissible environment temperature at the connection head.

6. Electrical connections

Diagram of thermocouples connections on the terminal block diagram in the sensor head.

