

Head sensors with exchangeable measuring insert



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Head sensors with exchangeable measuring insert

In this Operation Manual, the following series of sensors with exchangeable measuring inserts are described:

T...GB-11, T...GN-11, T...GN-54, T..P-11, T...T-11, TT..U-45, TT..UO-15, T...SW-..., T...SWT-11, T...SWG-11, T...GI-11, T...G-31/M

The sensors presented are equipped with a terminal block or a 4-20 mA transmitter instead of a terminal block (designated as AP). Some of them are with local display (APW...)

All the sensors specified comply with the two followings standards:

- PN-EN 60751
- PN-EN 60584

1. Construction and principle of operation.

A resistance or thermoelectric measuring insert represents the basic element in each sensor. It is placed in an outer sheath; the clamps of the insert are shielded by a head made of aluminium alloy. The outer sheaths in this group of sensors are characterized by different types of process connections: there are threaded, slidable, clamps or flanged sheaths, etc. Inside the inserts, there is a thermometer resistor or a thermocouple connected with external clamps of the terminal block or of the 4-20 mA transmitter.

The measuring element of the insert responds to a change in temperature of a medium by changing its resistance /thermometric resistor/ or electromotive force EMF-thermocouple. The changes correspond to their thermometric characteristics as defined in the following standards:

- PN-EN 60751 – as for the thermometric resistors Pt100
- PN-EN 60584 – as for the thermocouples

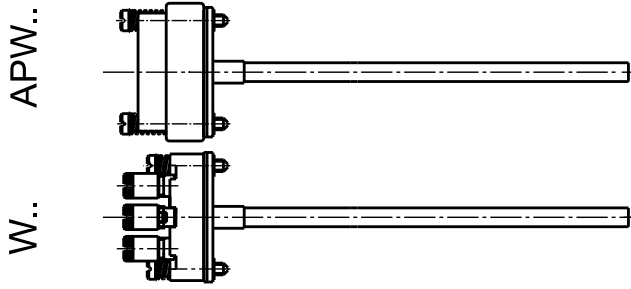
Sensors with DANAWwin head can be equipped at local display.

Specification:

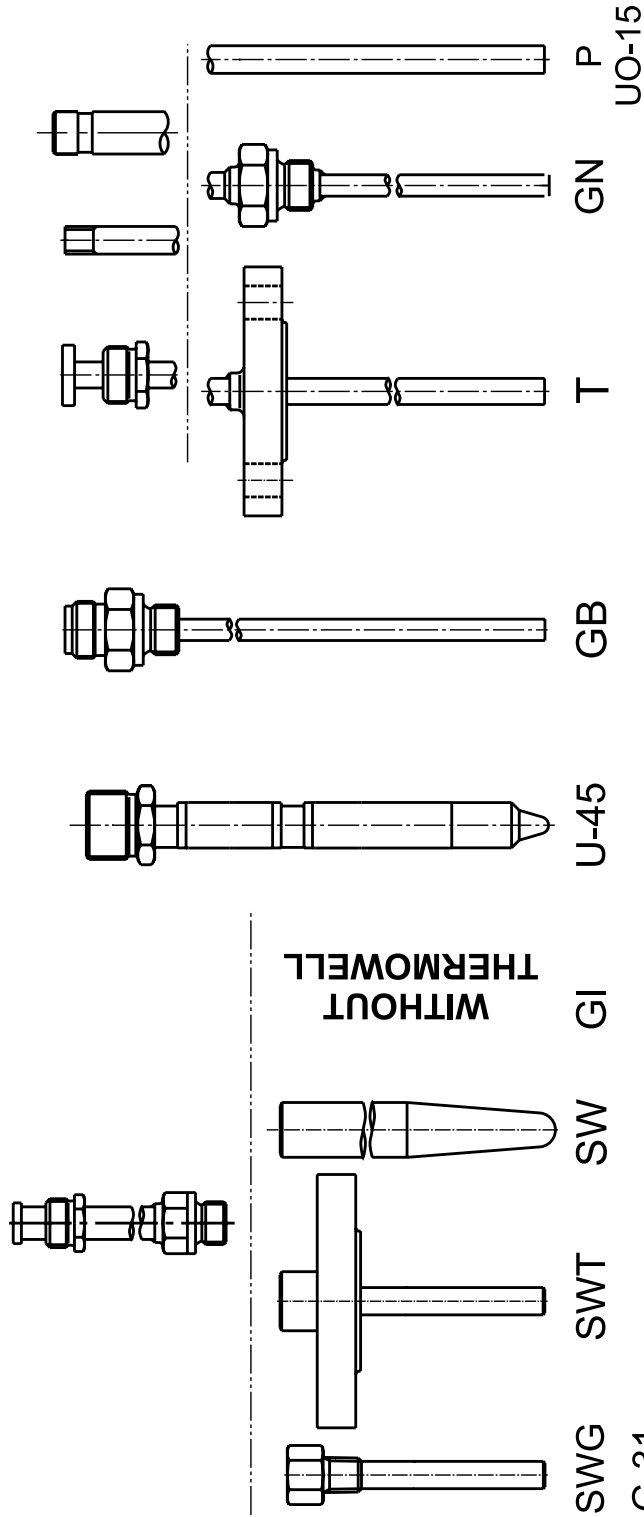
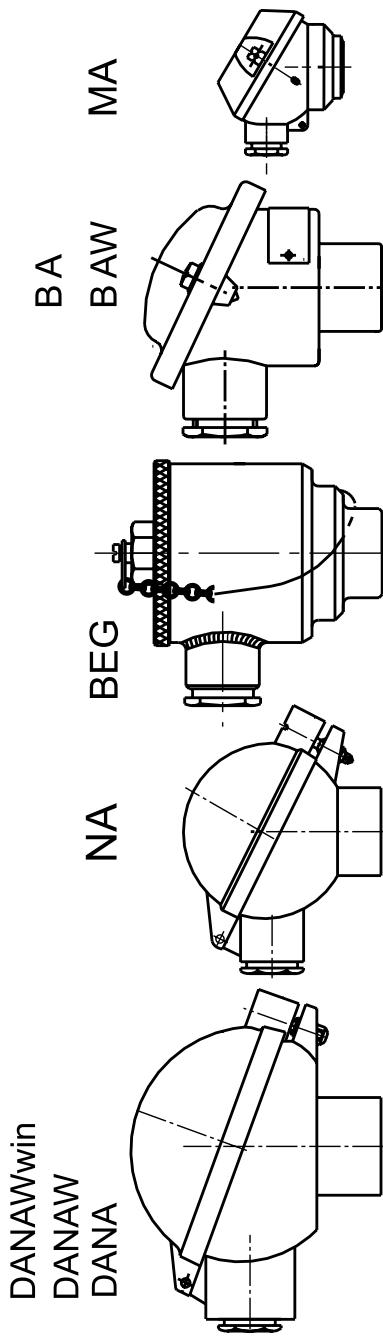
Resistor.....	1 or 2x Pt 100 ,500,1000; class A, B according to PN-EN 60751
Connection Line.....	2, 3, 4-wire as for Pt100
Thermocouple.....	1 or 2x Fe-CuNi /J/, NiCr-Ni/K/, class 1, 2 according to PN-EN 60584
Max temperature measurement range.....	-200 to +550°C as for Pt - 40 to +700°C as for J - 40 to +1200°C as for K
Measurement junction.....	isolated (SO, SOA, SOB) or earthed (SP)
Allowable working temperature of the head with a rubber seal.....	100°C
	with a silicone seal.....150°C
Protection degree provided by the housing.....	IP- 53 AA, DAA IP- 54 head MAA IP- 55 head BA, IP- 65 head NAA, DANA, DANAW, BEG, DANAWwin,
Cable gland.....	M16x1,5 as for MA head M20x 1,5 as for BA, NAA, DANA, DANAW, AA, DA
Transmitters.....	RT-01, TxBlock, APAQ, LTT, FLEX TOP, 248HA

2. Assembly diagram of sensor's units: exchangeable measuring inserts; MA/DAN/ heads; outer sheaths of the sensors.

Measuring inserts



Connection Heads



Outer sensors thermowells

Sensor Type	Sheath Material	Measurement range	Connection Type	Sheath Diameter	IP Protection Degree provided by the Housing
TOPGB-11 TT..GB-11	1.4541	-200÷150°C -40÷150 °C	welded, threaded fitting	ø9	BA- IP55 NAA - IP 65 DANA - IP65
TOPGN-11		-200÷550°C			
TTJGN-11, TTKGN-11		-40÷550°C			
TOPGN-11		-200÷550°C			
TTJGN-11, TTKGN-11		-40÷550°C	flange	ø11	
TOPT-11		-200÷550°C			
TTJT-11, TTKT-11		-40÷550°C			
TOPP-11	1.4541	-200÷550°C	UG-1, UG-8	ø9, 11, 12, 14, 15	
TTJP-11	1.4541	-40÷700°C	UG-1, UG-8	ø9, 11,12, 14, 15	
	1.4841	-40÷700°C	UG-1, UG-8,	ø15	
	1.4762	-40÷700°C	UZ-11, UZ-21		
TTKP-11	1.4541	-40÷700°C	UG-1, UG-8,	ø9, 11, 12, 14, 15	
	1.4841, 1.4762	-40÷900°C	UG-1, UG-8, UZ-11, UZ-21	ø 15	
TOPGN-54	1.4541	-200÷550°C	welded, threaded fitting	ø6, 8, 9, 10	IP 54
TTJGN-54, TTKGN-54		-40÷550°C			
TTJU-45		-40÷300°C	special construction can be mounted in door of a rubber mixer	ø16	
TTKU-45		-40÷300°C			
TOPSW-.. TT..SW-..	1.7335	0÷540°C	drilled thermowell for welding	ø18, 24	
TOPSWT-11	negotiated	-200÷600°C	drilled thermowell with flange	negotiated	BA- IP55 NAA - IP 65 DANA - IP65
TTJSWT-11		-40÷700°C			
TTKSWT-11		-40÷700°C			
TOPSWG-11	negotiated	-200÷600°C	drilled thermowell with threaded fitting	negotiated	BA- IP55 NAA - IP 65 DANA - IP65
TTJSWG-11		-40÷700°C			
TTKSWG-11		-40÷700°C			
TOPGI-11	distance 1.4541, outstanding measuring insert	-200÷600°C	distance with threaded fitting		
TTJGI-11, TTKGI-11		-40÷600°C	screwing in additional pocket	insert diameter	
PTTJUO-15	1.4841, H25T 1.4762	-40÷700°C	UG-8, UZ-11, UZ-21	ø 22	IP-53
PTTKUO-15		-40÷1200°C			
TOPG-31/M	1.4541	-50÷550°C	thermowell with threaded fitting	ø12	IP 54
TONG-31/M		-50÷150°C			
W1P	1.4541	-200÷550°C	springing fixed to the connection head by M4 screws	ø6, ø8	
W1J, W1K		-40÷700°C		ø4, ø5, ø6	
WM1P		-200÷550°C			
WM1J, WM1K		-40÷600°C			
W2P	1.4571	-200(-50)÷550°C		(ø3), ø6	
W2J	1.4541	-40÷700(450)°C		(ø3); ø4,5; ø6	
W2K	Inconel 600	-40÷1200(900)°C		(ø3); ø4,5; ø6; ø8	
WM2P	1.4571	-200(-50)÷600°C		(ø3), ø6	
WM2J	1.4541	-40÷700(450)°C			
WM2K	Inconel 600	-40÷1200(900)°C			

3. Minimum immersion depth of the sensor /thermometer/ - I_{min}

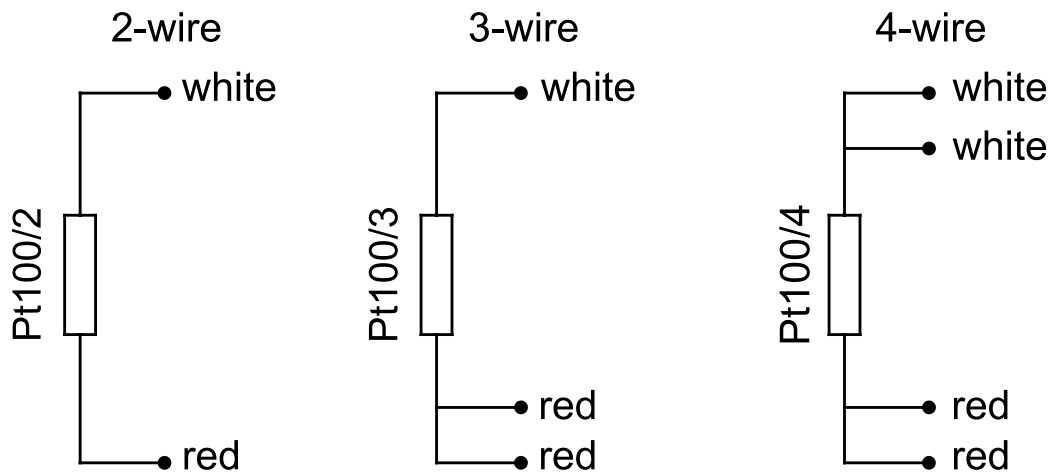
The temperature sensing part of the thermometer $C > 30$ mm

Outer diameter of the sheath: D

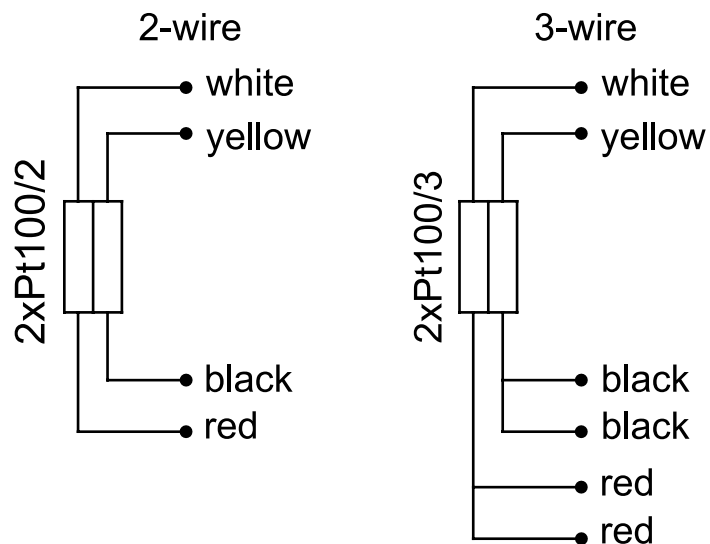
- in flowing water: $I_{min} = C + 5 D$
- in flowing air: $I_{min} = C + 15 D$

4. Resistance sensors – designation of connection clamps.

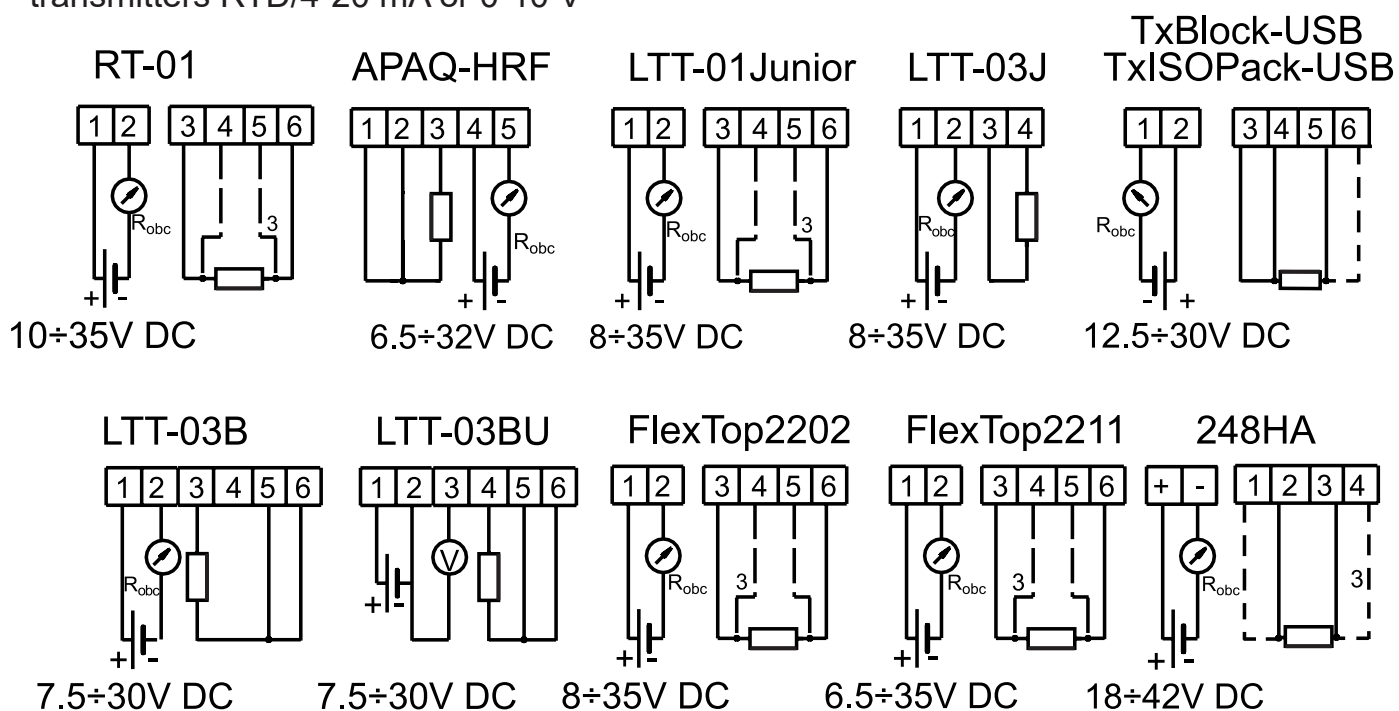
- terminal block – one measuring circuit



- terminal block - two measuring circuit



- transmitters RTD/4-20 mA or 0-10 V



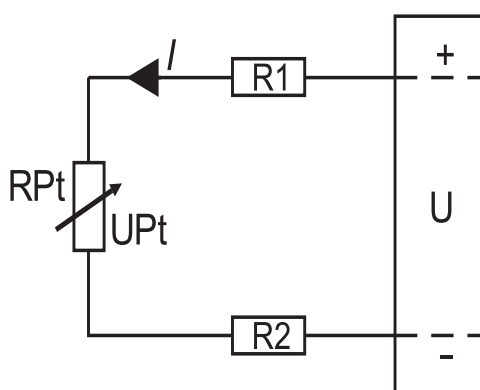
Resistance Sensors - 2-wire connection line

Diameter of the wire / Resistance of the wire

2x0,22 mm ² -0,175 Ω/m		2x0,25 mm ² -0,165 Ω/m
2x0,35 mm ² -0,105 Ω/m		2x0,50 mm ² -0,036 Ω/m

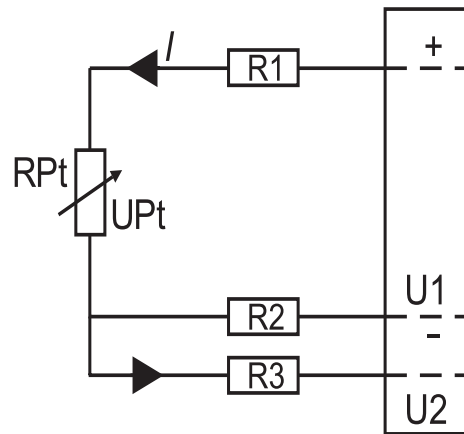
- resistance sensors: 2-wire connection line

A 2-wire connection line between the sensor and a particular device is used when it is sufficient to obtain temperature measurements with an average (not high) accuracy. The resistance of R1 + R2 connection line causes the following error in the temperature measurement: as for Pt 100, the error is about 2.6°C per one Ω of the wire resistance, and as for Pt 1000: 0.26°C per one Ω of the wire resistance.



- resistance sensors: 3-wire connection line

A 3-wire connection line between the resistor and devices is the most commonly used connection line in industrial applications since temperature-dependent changes in the resistance are automatically compensated, and the resistance of the connection line is also compensated.

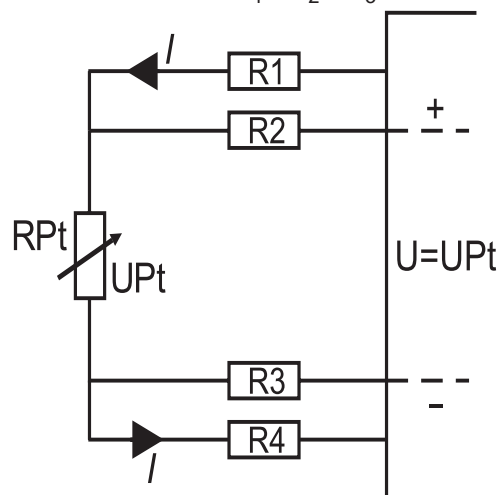


The resistance of all the connection wires must be identical, i.e. $R_1=R_2=R_3$. In the Table below, there are shown examples of errors caused by the resistance difference of $0.1\ \Omega$ and of $1.0\ \Omega$ between the wires of a 3-wire connection line for Pt 100 and Pt 1000.

	Difference in the resistance of wires	
	$0.1\ \Omega$	$1\ \Omega$
Pt100	0.26°C	2.6°C
Pt1000	0.03°C	0.26°C

For practical reasons, the resistance of a single wire input circuit of RTD should not be higher than $11\ \Omega$.

- resistance sensors: 4-wire connection line $R_1=R_2=R_3=R_4=R$



This connection line is used when a vary high accuracy of temperature measurements is required. In the case of a 4-wire connection line, the impact of resistor's wires resistance is totally eliminated. For practical reasons, the resistance of a single wire input circuit of RTD should not be higher than $11\ \Omega$.

5. Thermoelectric Sensors - designation of connection clamps.

Terminal Block

In the case of thermoelectric sensor is connected with external devices, then, the corresponding pole on the terminal block must be connected with the corresponding pole of the wire (which has a polarity-specific colour). In the Table below, there are shown: thermoelectric sensor types, the respective rule to connect a specific sensor type, and corresponding colour codes.

Type of thermoelectric sensor	Type of wire		Metal Composition		Colour Code „+”		Tolerances		Temperature range
	Compensation	Thermoelectric	Wire +	Wire -	IEC 584 „-”white	ANSI „-”red.	Class 1	Class 2	
J	-	JX	Fe	CuNi	black	white	±1.5	±2.5	-25÷200°C
K	-	KX	NiCr	NiAl	green	yellow	±1.5	±2.5	-25÷200°C
K	KCA	-	Fe	410 Alloy	green	-	-	±2.5	0÷150°C
K	KCB	-	Cu	CuNi	green	-	-	±2.5	0÷100°C
T	-	TX	Cu	CuNi	khaki	blue	±0.5	±1.0	-25÷200°C
E	-	EX	NiCr	CuNi	violet	violet	±1.5	±2.5	-25÷200°C
N	-	NX	Nicrosil	Nisil	pink	orange	±1.5	±2.5	-25÷200°C
N	NC	-	Cu	278 Alloy	pink	-	-	±2.5	0÷150°C

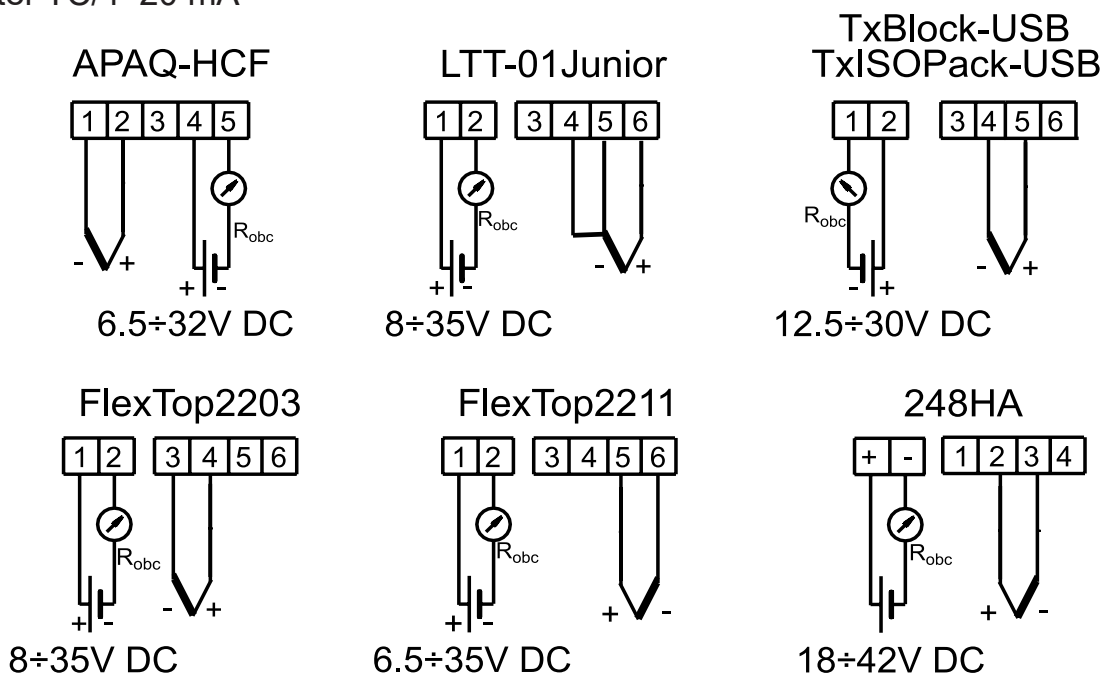
- cross-section areas of compensation and extension wires

0.22 mm²; 0.5 mm²; 0.75 mm²; 1.0 mm²; 1.5 mm² and the recommended cross-section areas of compensation and extension wires to be applied to connect sensors with external instruments are: 1.0 mm² or 1.5 mm² according to PN-EN 60584-3

General rules on applying respective colours for compensation wires:

- according to the standard PN-EN60584-3, the colour of an outer insulating sheath, an outer insulation, and a positive wire assigned to the positive thermoelectrode in the sensor is the same, and the colour of negative thermoelectrode is white;
- according to the Polish Standard PN-89/M-53859, the colours of an outer insulating sheath, and an outer insulation are different, the colour of insulation of the wire assigned to the positive thermoelectrode is red, whereas the insulation of the wire assigned to the negative thermoelectrode may be of any other colour except for red, purple, and pink.

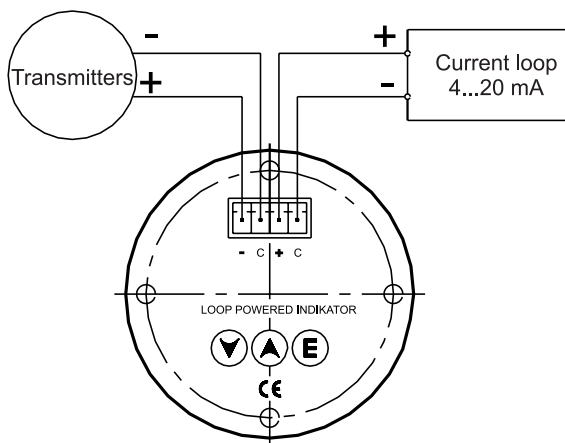
- transmitter TC/4÷20 mA



Sensors with local display

Technical displays:

- display range..... -1999 to +9999
- max display measurement error.....0,1% of range ±1 digit
- cross-section of connecting cables.....< 1 mm²



6. Recommended outer diameters of cables for cable glands in the temperature sensors' connection heads manufactured by the company "Limatherm Sensor" in Limanowa, Poland.

For Seals without Cuts:

- Cable Gland Pg9 cable diameter /ø4 - 6 mm/
- Cable Gland M16x1,5 cable diameter /ø4 - 6 mm/
- Cable Gland: Pg16 cable diameter /ø5.5 - 7.5 mm/
- Cable gland: M20x1.5 cable diameter /ø5.5 - 7.5 mm/

For Seals with Cuts

- Cable Gland Pg9 cable diameter / \varnothing 4 - 6 mm/
- Cable Gland M16x1,5 cable diameter / \varnothing 4 - 6 mm/
- Cable Gland: Pg16 cable diameter / \varnothing 4 - 12.5 mm/
- Cable Gland: M20x1.5 cable diameter / \varnothing 4 - 12.5 mm/

7. Packing and storing instructions, transportation.

The sensors to be transported must always be properly packed in order to avoid any damage during the transportation. It is recommended to place the sensors to be transported either in one general, shared package or in individual unit packages. The sensors should be stored in their packages in indoor storage spaces: the indoor air must contain **no traces of vapours and/or aggressive substances, the indoor air temperatures must range from +5°C to 50°C and the relative humidity must not exceed 85%**. Whilst being transported, the sensors must be protected against shifting inside the packagings. The sensors manufactured by 'Limatherm Sensor' can be transported using maritime, rail, road, or air modes of transport, in all cases provided that the direct impact of atmospheric factors on the sensors during the transportation is totally eliminated. The detailed transportation conditions are specified in the Polish Standard PN-81/M-42009.

8. Warranty.

- The Manufacturer provides the original purchaser of the sensor (sensors) with a twelve (12) month warranty and necessary service; for this period, the Manufacturer guarantees the uninterrupted and error free functioning of sensors;
- The twelve (12) month warranty begins on the day of purchase;
- Also, the Manufacturer provides the original purchaser of the sensors with a post-warranty service;
- The warranty voids in the case of any changes in and repairs of the instrument performed by the user;
- This warranty does not cover damages resulting from improper transportation, nor defects and errors caused by bad handling or misuse which does not comply with the provisions as set forth in this Operation Manual.

9. Recommended examples of assembling the sensors

