



TEMPERATURE SENSORS GENERAL INFORMATION

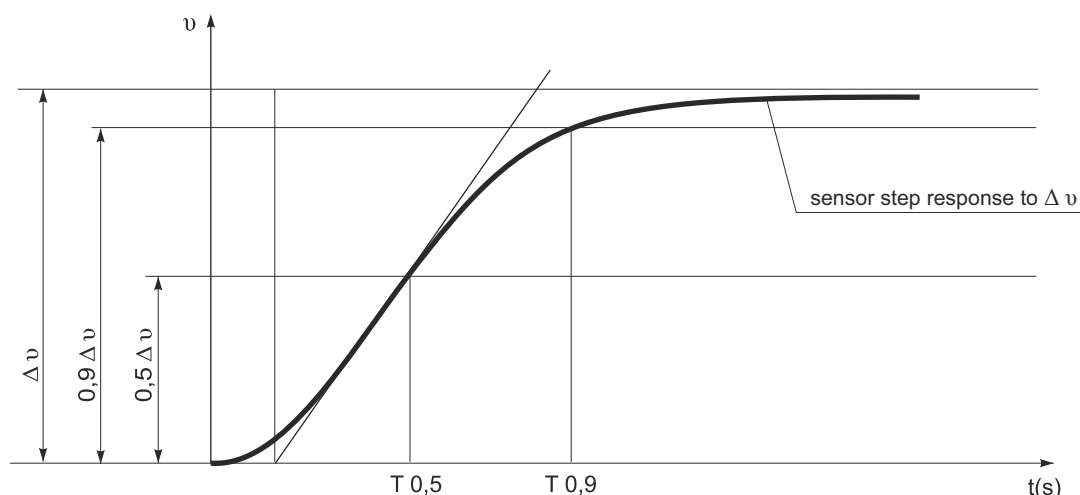
- time constants
- tolerances
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- sensor connection diagrams
- thermocouple types
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- thermowells and fittings codes
- terminal heads codes
- connectors codes



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TIME CONSTANTS



RTD SENSORS

SENSORS WITH COVER OF STAINLESS STEEL PIPE DIMENSION	RESPONSE TIME			
	water 0,4 m/s		air 1,0 m/s	
	T 0,5	T 0,9	T 0,5	T 0,9
∅ 3 x 0,25	7	19	35	95
∅ 4 x 0,35	12	32	45	125
∅ 5 x 0,35	17	45	70	190
∅ 6 x 0,35	22	61	80	235
∅ 8 x 0,60	27	72	105	310
∅ 10 x 1,60	35	96	140	375
∅ 12 x 2,00	51	138	165	420

THERMOCOUPLE SENSORS

SENSORS WITH COVER OF HIGH HEAT RESISTANT STEEL PIPE DIMENSION		RESPONSE TIME				
		water 0,4 m/s		air 1,0 m/s		
		T 0,5	T 0,9	T 0,5	T 0,9	
∅ 6 x 1	junction isolated	28	68	80	270	
∅ 8 x 1		35	79	130	390	
∅ 10 x 2		46	108	155	480	
∅ 13,5 x 2		72	163	185	610	
∅ 22 x 2		121	440	375	1120	
SENSORS WITH COVER OF CERAMIC DIMENSION		water 0,4 m/s		air 1,0 m/s		
		T 0,5	T 0,9	T 0,5	T 0,9	
∅ 10 x 2 KER 610		32	95	105	260	
∅ 15 x 2,5 KER 610		46	138	230	540	
∅ 6 x 1 KER 799		26	75	85	205	
∅ 10 x 2 KER 799		41	122	130	340	
∅ 15 x 2,5 KER 799		65	194	290	700	
SENSORS WITH SHEATHED THERMOCOUPLES MINERAL INSULATED CABLE DIMENSION		water 0,4 m/s		air 1,0 m/s		
		T 0,5	T 0,9	T 0,5	T 0,9	
∅ 1,0		junction grounded	0,11	0,26	2	12
∅ 1,5			0,15	0,40	3	26
∅ 3,0			0,20	0,70	7	73
∅ 4,5			0,45	1,50	21	104
∅ 6,0			0,60	2,50	35	168
∅ 1,0		junction isolated	0,19	0,52	6	15
∅ 1,5			0,30	0,60	7	20
∅ 3,0			1,35	3,00	21	75
∅ 4,5			2,55	6,00	35	125
∅ 6,0			4,50	9,80	58	210

The response time [T 0,5] is the time after which the sensor will show a 50% temperature jump.
The response time [T 0,9] is the time after which the sensor will show a 90% temperature jump



RTD TOLERANCES

Pt 100, Pt 500, Pt 1000, Ni 100, Ni 1000

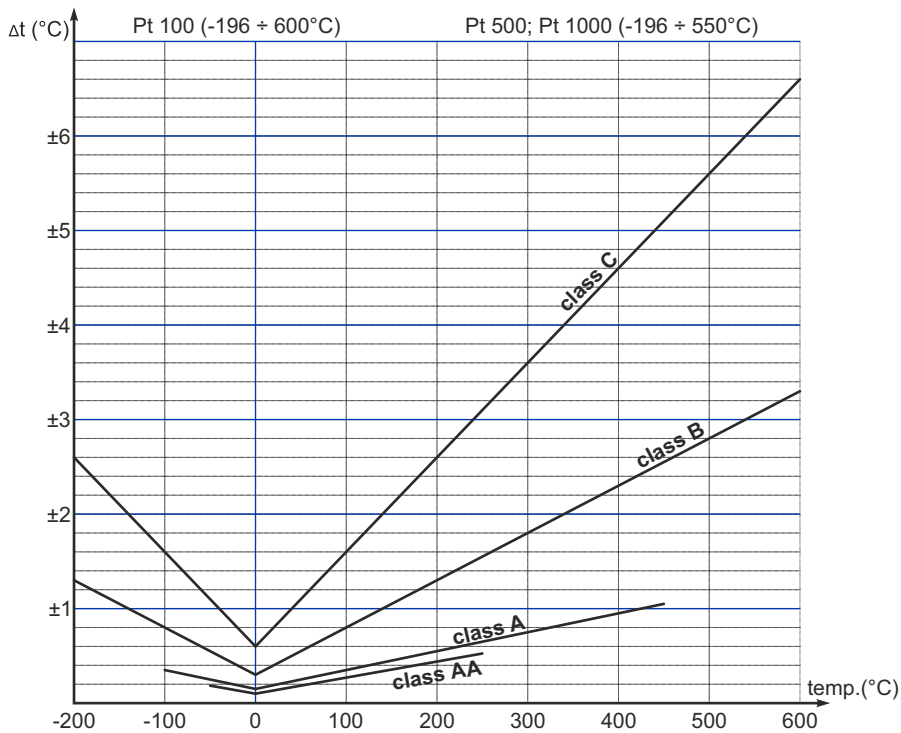


TABLE 1 as per PN-EN 60751:2009 (Pt 100, Pt 500, Pt 1000)

tolerance class	temperature range		tolerance (°C)
	wire-wound construction (°C)	thin-film construction (°C)	
AA	-50 do + 250	0 do + 150	$\pm (0,1 + 0,0017 t)$
A	-100 do + 450	-30 do + 300	$\pm (0,15 + 0,002 t)$
B	-196 do + 600	-50 do + 500	$\pm (0,3 + 0,005 t)$
C	-196 do + 600	-50 do + 600	$\pm (0,6 + 0,01 t)$

|t| = absolute temperature value

TABLE 2 as per PN-83/M-53852 (Ni 100, Ni 1000)

tolerance class	tolerance (°C)
C	$-60 \div 0^{\circ}\text{C} \pm (0,3 + 0,0165 t)$
	$0 \div 180^{\circ}\text{C} \pm (0,3 + 0,008 t)$

|t| = absolute temperature value

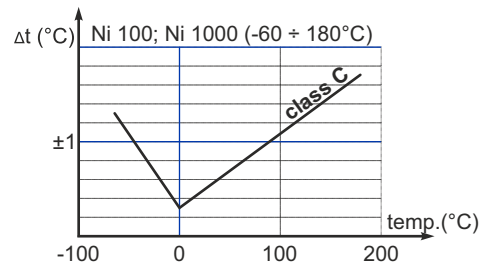


TABLE 3

resistor type	max. resistor current			
	thin-film construction		wire-wound construction	
	recommended current	max. current	recommended current	max. current
Pt100	1,0 mA	7 mA	5 mA	10 mA
Pt500	0,5 mA	3 mA	-	-
Pt1000	0,1 mA	1 mA	-	-
Ni100	1,0 mA	7 mA	-	-
Ni1000	0,1 mA	1 mA	-	-

THERMOCOUPLE TOLERANCES

K (NiCr - NiAl); N (NiCrSi - NiSi); J (Fe - CuNi); T (Cu- CuNi)

A

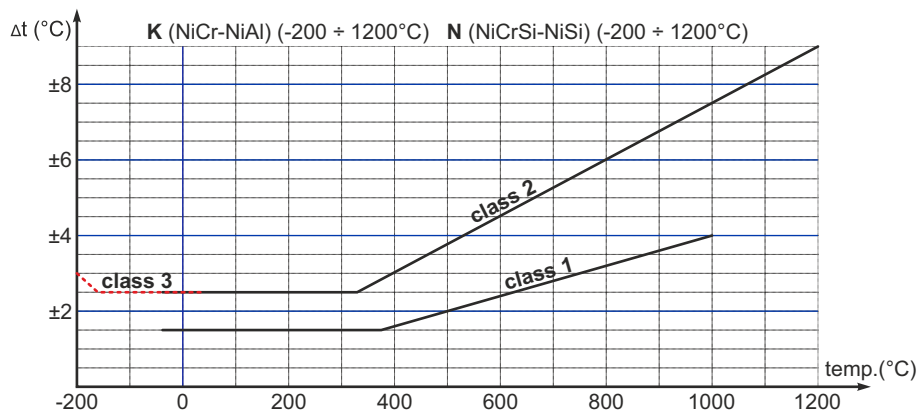


TABLE 1 as per PN-EN 60584

tolerance class	temperature range	tolerance (°C)
1	-40 ÷ 375°C	± 1,5
	375 ÷ 1000°C	± 0,004 (t)
2	-40 ÷ 333°C	± 2,5
	333 ÷ 1200°C	± 0,0075 (t)
3	-200 ÷ -167°C	± 0,015 (t)
	-167 ÷ 40°C	± 2,5

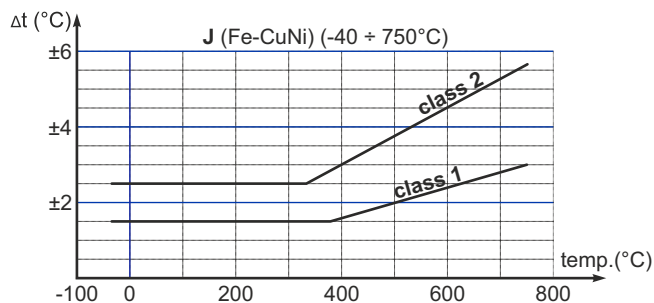


TABLE 2 as per PN-EN 60584

tolerance class	temperature range	tolerance (°C)
1	-40 ÷ 375°C	± 1,5
	375 ÷ 750°C	± 0,004 (t)
2	-40 ÷ 333°C	± 2,5
	333 ÷ 750°C	± 0,0075 (t)

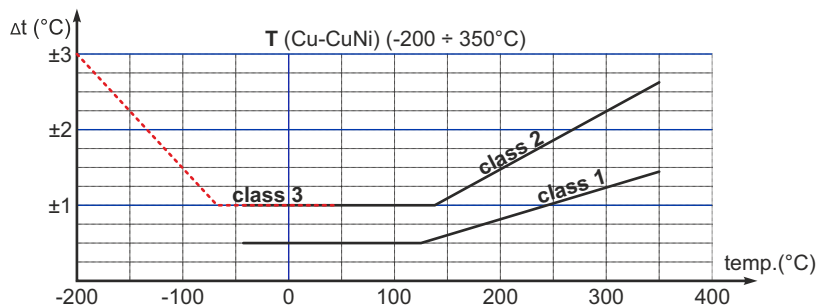


TABLE 3 as per PN-EN 60584

tolerance class	temperature range	tolerance (°C)
1	-40 ÷ 125°C	± 0,5
	125 ÷ 350°C	± 0,004 (t)
2	-40 ÷ 133°C	± 1
	133 ÷ 350°C	± 0,0075 (t)
3	-200 ÷ -67°C	± 0,015 (t)
	-67 ÷ 40°C	± 1



THERMOCOUPLE TOLERANCES

S (PtRh10 - Pt); R (PtRh13 - Pt); B (PtRh30 - PtRh6)

A

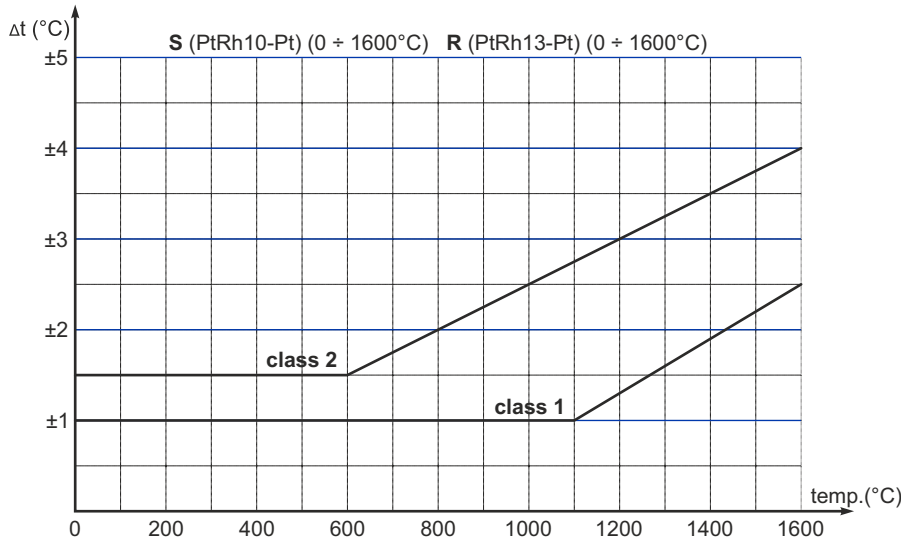


TABLE 4 as per PN-EN 60584

tolerance class	temperature range	tolerance (°C)
1	0 ÷ 1100°C	± 1
	1100 ÷ 1600°C	± (1+0,003(t-1100))
2	0 ÷ 600°C	± 1,5
	600 ÷ 1600°C	± 0,0025 (t)

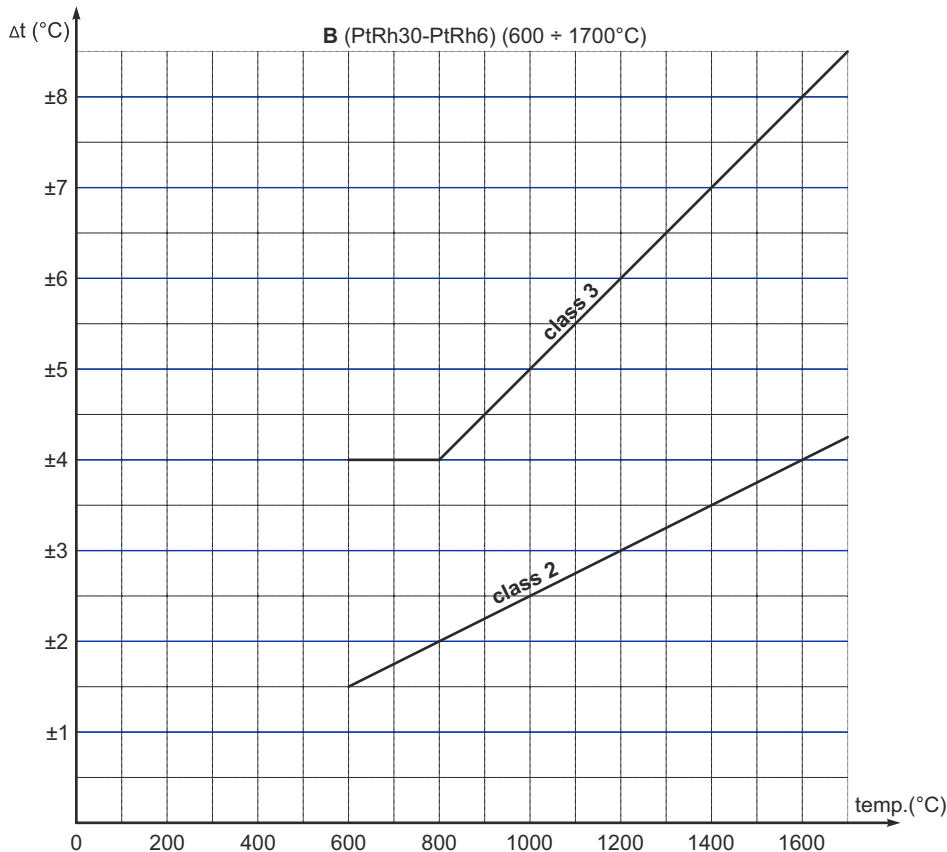


TABLE 4 as per PN-EN 60584

tolerance class	temperature range	tolerance (°C)
2	600 ÷ 1700°C	± 0,0025 (t)
3	600 ÷ 800°C	± 4
	800 ÷ 1700°C	± 0,005 (t)



THERMOELECTRIC CHARACTERISTICS

Resistor Pt 100					
T (°C)	RW	T (°C)	RW	T (°C)	RW
-200	18,52	160	161,05	520	287,62
-190	22,83	170	164,77	530	290,92
-180	27,10	180	168,48	540	294,21
-170	31,34	190	172,17	550	297,49
-160	35,54	200	175,86	560	300,75
-150	39,72	210	179,53	570	304,01
-140	43,88	220	183,19	580	307,25
-130	48,00	230	186,84	590	310,49
-120	52,11	240	190,47	600	313,71
-110	56,19	250	194,10	610	316,92
-100	60,26	260	197,71	620	320,12
-90	64,30	270	201,31	630	323,30
-80	68,33	280	204,90	640	326,48
-70	72,33	290	208,48	650	329,64
-60	76,33	300	212,05	660	332,79
-50	80,31	310	215,61	670	335,93
-40	84,27	320	219,15	680	339,06
-30	88,22	330	222,68	690	342,18
-20	92,16	340	226,21	700	345,28
-10	96,09	350	229,72	710	348,38
0	100,00	360	233,21	720	351,46
10	103,90	370	236,70	730	354,53
20	107,79	380	240,18	740	357,59
30	111,67	390	243,64	750	360,64
40	115,54	400	247,09	760	363,67
50	119,40	410	250,53	770	366,70
60	123,24	420	253,96	780	369,71
70	127,08	430	257,38	790	372,71
80	130,90	440	260,78	800	375,70
90	134,71	450	264,18	810	378,68
100	138,51	460	267,56	820	381,65
110	142,29	470	270,93	830	384,60
120	146,07	480	274,29	840	387,55
130	149,83	490	277,64	850	390,48
140	153,58	500	280,98		
150	157,33	510	284,30		

as per PN-EN 60751:2009

Resistor Ni 100	
T (°C)	RW
-60	69,51
-50	74,20
-40	79,06
-30	84,08
-20	89,26
-10	94,56
0	100,00
10	105,56
20	111,25
30	117,07
40	123,01
50	129,09
60	135,30
70	141,67
80	148,19
90	154,86
100	161,71
110	168,74
120	175,94
130	183,34
140	190,93
150	198,71
160	206,70
170	214,90
180	223,10

as per PN-83/M-53852



THERMOELECTRIC CHARACTERISTICS

Resistor		Pt 500	
T (°C)	RW	T (°C)	RW
-200	92,60	160	805,25
-190	114,15	170	823,85
-180	135,50	180	842,40
-170	156,70	190	860,65
-160	177,70	200	879,30
-150	196,60	210	897,65
-140	219,40	220	915,95
-130	240,00	230	934,20
-120	260,55	240	952,35
-110	280,95	250	970,50
-100	301,30	260	988,55
-90	321,50	270	1006,55
-80	341,65	280	1024,50
-70	361,65	290	1042,40
-60	381,65	300	1060,25
-50	401,55	310	1078,05
-40	421,35	320	1095,75
-30	441,10	330	1113,40
-20	460,80	340	1131,05
-10	480,45	350	1148,60
0	500,00	360	1166,05
10	519,50	370	1183,50
20	538,95	380	1200,90
30	558,35	390	1218,20
40	577,70	400	1235,45
50	597,00	410	1252,65
60	616,20	420	1269,80
70	635,40	430	1286,90
80	654,50	440	1303,90
90	673,55	450	1320,90
100	692,55	460	1337,80
110	711,45	470	1354,65
120	730,35	480	1371,45
130	749,15	490	1388,20
140	767,90	500	1404,90
150	786,65		

as per PN-EN 60751:2009

Resistor		Pt 1000	
T (°C)	RW	T (°C)	RW
-200	185,20	160	1610,50
-190	228,30	170	1647,70
-180	271,00	180	1684,80
-170	313,40	190	1721,70
-160	355,40	200	1758,60
-150	397,20	210	1795,30
-140	438,80	220	1831,90
-130	480,00	230	1868,40
-120	521,10	240	1904,70
-110	561,90	250	1941,00
-100	602,60	260	1977,10
-90	643,00	270	2013,10
-80	683,30	280	2049,00
-70	723,30	290	2084,80
-60	763,30	300	2120,50
-50	803,10	310	2156,10
-40	842,70	320	2191,50
-30	882,20	330	2226,80
-20	921,60	340	2262,10
-10	960,90	350	2297,20
0	1000,00	360	2332,10
10	1039,00	370	2367,00
20	1077,90	380	2401,80
30	1116,70	390	2436,40
40	1155,40	400	2470,90
50	1194,00	410	2505,30
60	1232,40	420	2539,60
70	1270,80	430	2573,80
80	1309,00	440	2607,80
90	1347,10	450	2641,80
100	1385,10	460	2675,60
110	1422,90	470	2709,30
120	1460,70	480	2742,90
130	1498,30	490	2776,40
140	1535,80	500	2809,80
150	1573,30		

as per PN-EN 60751:2009



THERMOELECTRIC CHARACTERISTICS

K NiCr - NiAl	
T (°C)	STE (mV)
-200	-5,891
-150	-4,913
-100	-3,554
-50	-1,889
0	0,000
20	0,798
50	2,023
100	4,096
150	6,138
200	8,138
250	10,135
300	12,209
350	14,293
400	16,397
450	18,516
500	20,644
550	22,776
600	24,905
650	27,025
700	29,125
750	31,213
800	33,275
850	35,313
900	37,326
950	39,314
1000	41,267
1050	43,211
1100	45,119
1150	46,995
1200	48,838
1250	50,644
1300	52,410

N NiCrSi - NiSi	
T (°C)	STE (mV)
-200	-3,990
-150	-3,336
-100	-2,407
-50	-1,269
0	0,000
20	0,525
50	1,340
100	2,774
150	4,302
200	5,913
250	7,597
300	9,341
350	11,136
400	12,974
450	14,846
500	16,748
550	18,672
600	20,613
650	22,566
700	24,527
750	26,491
800	28,455
850	30,416
900	32,371
950	34,319
1000	36,256
1050	38,179
1100	40,087
1150	41,976
1200	43,846
1250	45,694
1300	47,513

J Fe - CuNi	
T (°C)	STE (mV)
-100	-4,633
-50	-2,431
0	0,000
20	1,019
50	2,585
100	5,269
150	8,010
200	10,779
250	13,555
300	16,327
350	19,090
400	21,848
450	24,610
500	27,393
550	30,216
600	33,102
650	36,071
700	39,132
750	42,281
800	45,494

T Cu - CuNi	
T (°C)	STE (mV)
-250	-6,180
-200	-5,603
-150	-4,648
-100	-3,379
-50	-1,819
0	0,000
20	0,790
50	2,036
100	4,279
150	6,704
200	9,288
250	12,013
300	14,862
350	17,819
400	20,872

as per PN-EN 60584-1:2014-04



THERMOELECTRIC CHARACTERISTICS

S PtRh10 - Pt	
T (°C)	STE (mV)
0	0,000
20	0,113
50	0,299
100	0,646
150	1,029
200	1,441
250	1,874
300	2,323
350	2,786
400	3,259
450	3,742
500	4,233
550	4,732
600	5,239
650	5,753
700	6,275
750	6,806
800	7,345
850	7,893
900	8,449
950	9,014
1000	9,587
1050	10,168
1100	10,757
1150	11,351
1200	11,951
1250	12,554
1300	13,159
1350	13,766
1400	14,373
1450	14,978
1500	15,582
1550	16,182
1600	16,777
1650	17,366
1700	17,947

R PtRh13 - Pt	
T (°C)	STE (mV)
0	0,000
20	0,111
50	0,296
100	0,647
150	1,041
200	1,469
250	1,923
300	2,401
350	2,896
400	3,408
450	3,933
500	4,471
550	5,021
600	5,583
650	6,157
700	6,743
750	7,340
800	7,950
850	8,571
900	9,205
950	9,850
1000	10,506
1050	11,173
1100	11,850
1150	12,535
1200	13,228
1250	13,926
1300	14,629
1350	15,334
1400	16,040
1450	16,746
1500	17,451
1550	18,152
1600	18,849
1650	19,540
1700	20,222

B PtRh30 - PtRh6	
T (°C)	STE (mV)
0	0,000
50	0,002
100	0,033
150	0,092
200	0,178
250	0,291
300	0,431
350	0,596
400	0,787
450	1,002
500	1,242
550	1,505
600	1,792
650	2,101
700	2,431
750	2,782
800	3,154
850	3,546
900	3,957
950	4,387
1000	4,834
1050	5,299
1100	5,780
1150	6,276
1200	6,786
1250	7,311
1300	7,484
1350	8,397
1400	8,956
1450	9,524
1500	10,099
1550	10,679
1600	11,263
1650	11,848
1700	12,433
1750	13,014
1800	13,591

as per PN-EN 60584-1:2014-04

SENSOR CONNECTION DIAGRAMS

RTD CONNECTING WIRE CONFIGURATION

A

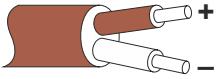
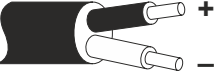
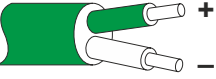
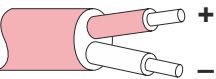
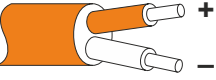
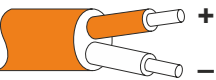
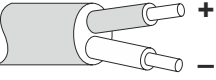
	2-wire-configuration	3-wire-configuration	4-wire-configuration
1 resistor			
2 resistors			

THERMOCOUPLES WIRE CONFIGURATION

SINGLE THERMOCOUPLE	DOUBLE THERMOCOUPLE

LIST PARAMETERS OF THERMOCOUPLE, THERMOCOUPLE EXTENSION AND COMPENSATING CABLES

A

THERMOCOUPLES				THERMOCOUPLE EXTENSION AND COMPENSATING CABLES			
Type	Alloy combination		Temperature range	Type	Alloy combination		Color codes IEC 584-3
	+	-			+	-	
T	Cu	CuNi	-200°C to 350°C	TX	Cu	CuNi (T)	BROWN 
J	Fe (magnetic)	CuNi	-40°C to 750°C	JX	Fe (magnetic)	CuNi (J)	BLACK 
K	NiCr	NiAl (magnetic)	-200°C to 1200°C	KX	NiCr	NiAl (magnetic)	GREEN 
				KCA	Fe (magnetic)	410Alloy	
				KCB	Cu	CuNi	
N	NiCrSi	NiSi (weakly magnetic)	-200°C to 1200°C	NX	NiCrSi	NiSi (weakly magnetic)	PINK 
				NC	Cu	CuNi (N)	
S	PtRh10	Pt	0°C to 1300°C	SC	Cu	CuNi (S)	ORANGE 
R	PtRh13	Pt	0°C to 1300°C	RC	Cu	CuNi (S)	ORANGE 
B	PtRh30	PtRh6	600°C to 1600°C	BC	Cu	Cu	GRAY 

CODE LIST

RTD CABLES					
Insulation	Temperature range	No. of cores x mm ²	Shield	Nominal O/D	Code
Silicon	-60 ÷ 180°C	2x0,75	-	6,4	S2
		3x0,50	-	5,9	S9
		3x0,75	-	6,8	S3
		4x0,75	-	7,6	S4
	-60 ÷ 200°C	2x0,25	-	4,2	S1
		3x0,25	-	4,5	S5
	-60 ÷ 280°C	4x0,25	-	4,7	S7
Silicon / cores Teflon	-60 ÷ 200°C	3x0,22	CuSn	4,3	S6
		4x0,22	-	4,4	S11
		8x0,22	-	4,9	S10
Teflon FEP	-200 ÷ 200°C	2x0,25	-	3,0	T1
		3x0,25	-	3,2	T2
		4x0,25	-	3,5	T3
Fibreglass	-50 ÷ 400°C	2x0,22	Inox	3,5	W1
		4x0,22	Inox	4,3	W2
PVC	-15 ÷ 80°C	2x0,50	-	4,9	P3
		2x0,75	-	5,3	P1
		3x0,75	-	5,6	P2
Curly polyurethane	-25 ÷ 105°C	4x0,14	-	4,2	Pz

Shield: CuSN - tinned copper; Inox - stainless steel.
Cable diameter tolerance ± 0,2mm

THERMOCOUPLE EXTENSION AND COMPENSATING CABLES


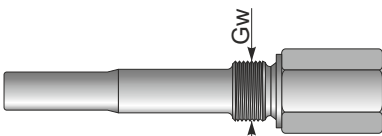

CODE 1 First part of the code - type of cable						CODE 1 Second part of the code - cable compensation type*		
Insulation	No. of cores x mm ²	Shield	Temperature range	Nominal O/D	Code	Thermocouple type	Cable type	Code
Silicon	2x0,22	-	-60 ÷ 200°C	3,8	KS	T	TX	T
		CuSn		4,4	KSek	J	JX	J
Teflon FEP	2x0,22	-	-200 ÷ 200°C	4,0	KT	K	KX	K
Fibreglass	2x0,22	-	-50 ÷ 400°C	3,5	KW		KCA	KCA
		FeZn		4	KWu		KCB	KCB
		Inox		4	KWn	N	NX	N
CuSn	4	KWek	NC	NC				
PVC	2x0,22	-	-25 ÷ 105°C	3,7	KP	R	SC	R/S
Curly polyurethane	2x0,22	-	-25 ÷ 105°C	4	KPz	S	RC	R/S
Shield: CuSN - tinned copper; FeZN - galvanized steel; Inox - stainless steel. Cable diameter tolerance ± 0,2mm						B	BC	B

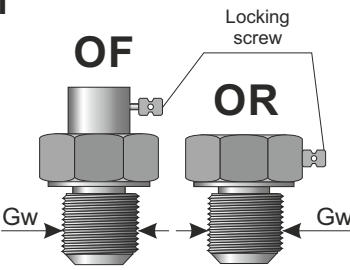
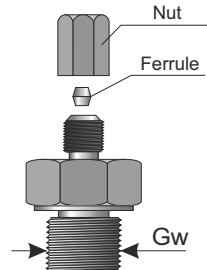
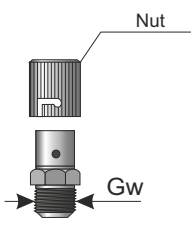
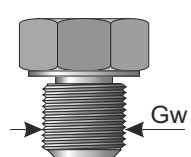
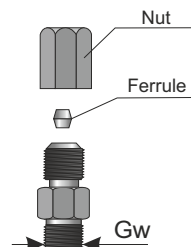
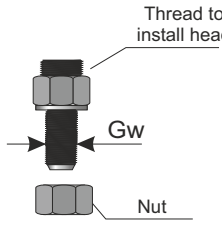
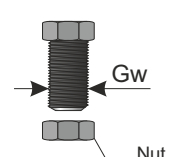
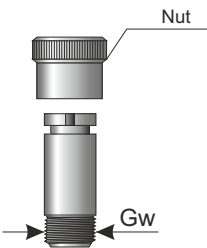

* only when ordering the cable itself

Przykłady:

- KSek-N-2x0,22** - "N" thermocouple extension cable, silicone insulation in tinned copper; 2x0,22mm² cores (on special order can be used other diameters of cores e.g. 2x1mm²);
- KSek** - thermocouple extension cable, silicone insulation in tinned copper; (as part of the sensor code, the cable type defines the thermocouple measuring insert)
- S2** - RTD cable, silicone insulation, 2x0,75mm² cores

CODE LIST

THERMOWELLS	
<p>OF INOX TWWS INOX</p>  <p>Threads: a, b, c, d, g, h, t, u</p>	 <p>HIGH PRESSURE THERMOWELLS MADE ONLY TO ORDER</p>
<p>OR INOX</p>  <p>Threads: a, b, c, d, g, h, t, u</p>	

FITTINGS		
<p>K1 INOX</p>  <p>Threads: a, b, c, d, g, h, t, u</p>	<p>K2 INOX</p>  <p>Threads: a, b, c, d, f, g, h, l, t, u, x</p>	<p>K3 BRASS</p>  <p>Threads: a, g, t, u, w, x, y</p>
<p>K4 INOX</p>  <p>Threads: b, c, d, e, q, u, y</p>	<p>K5 BRASS</p>  <p>Threads: q, u, v, w, x, y</p>	<p>K6 INOX</p>  <p>Threads: p, u</p>
<p>K7 INOX</p>  <p>Threads: u</p>	<p>K8 BRASS</p>  <p>Threads: t</p>	<p>K9 INOX</p>  <p>Threads: u, y, x</p>

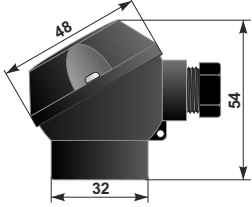
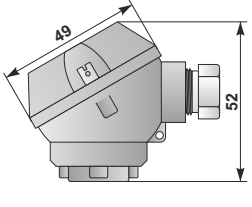
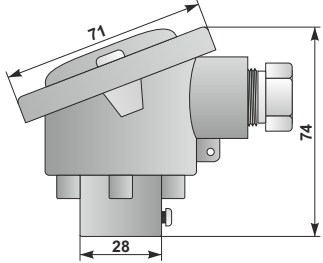
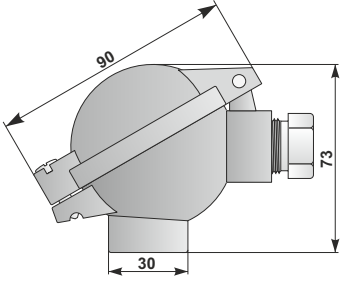
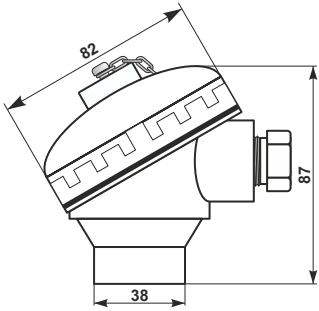
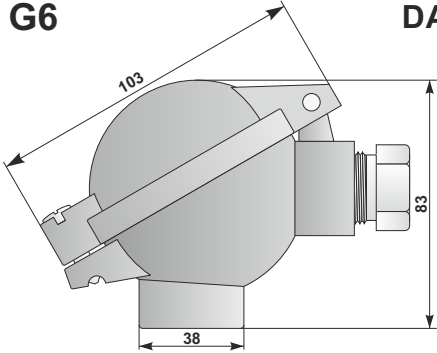
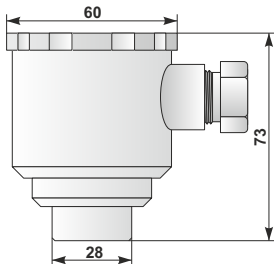
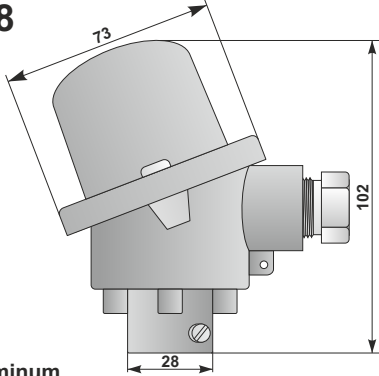
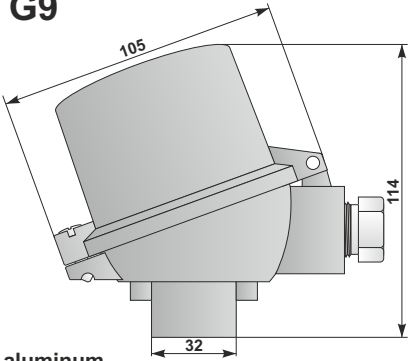
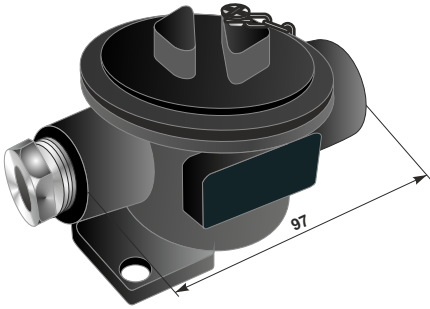
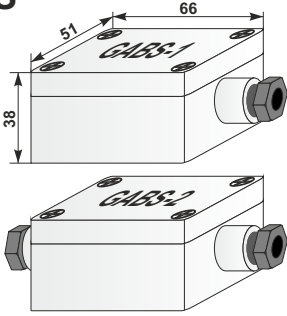
THREAD TYPES Gw

Metric threads		Imperial threads	
M 6	- z	G 1/4"	- g
M 8	- v	G 3/8"	- a
M 8x1	- q	G 1/2"	- b
M 10	- p	G 3/4"	- d
M 10x1	- u	G 1"	- h
M 12	- y	other	
M 12x1	- w		
M 12x1,5	- x		
M 14x1,5	- t		
M 16	- o		
M 16x1,5	- f		
M 18x1,5	- l		
M 20x1,5	- c		
M 27x2	- e		
other			

EXACT DESCRIPTION IN PART »G« OF THE CATALOG

CODE LIST

TERMINAL HEADS

<p>G1 MI</p>  <p>itamid (polyamide GF30) IP65; (-20...+100°C)</p>	<p>G2 MA</p>  <p>aluminum IP66; (-40...+100°C) option (-40...+150°C)</p>	<p>G3 B</p>  <p>aluminum IP66; (-40...+100°C) option (-40...+150°C)</p>
<p>G4 NA</p>  <p>aluminum IP66; (-40...+100°C) option (-40...+150°C)</p>	<p>G5</p>  <p>polypropylene IP68; (-40...+100°C)</p>	<p>G6 DA</p>  <p>aluminum IP63; (-40...+100°C) option (-40...+150°C)</p>
<p>G7</p>  <p>stainless steel IP68; (-40...+100°C) option (-40...+150°C)</p>	<p>G8</p>  <p>aluminum IP66; (-40...+100°C) option (-40...+150°C)</p>	<p>G9</p>  <p>aluminum IP66; (-40...+100°C)</p>
<p>G10</p>  <p>aluminum IP68; (-40...+100°C)</p>	<p>GABS</p>  <p>ABS IP65; (-40...+85°C)</p>	

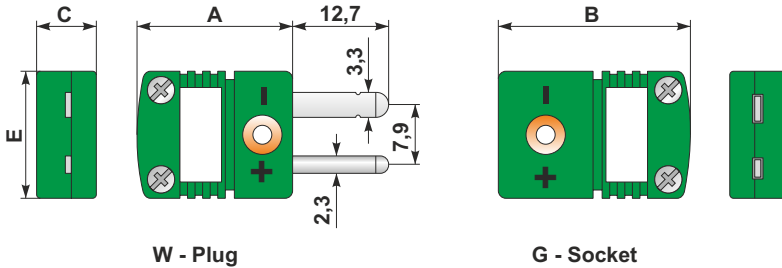
A

CODE LIST

CONNECTORS

Z1

MINI



W - Plug

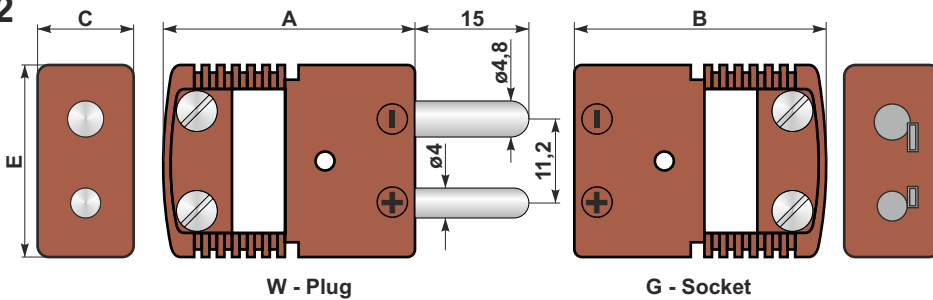
G - Socket

DIMENSION	POLYAMIDE	CERAMIC
A	20,6	22,4
B	25,4	26,9
C	7,9	9,7
E	16,8	19,1

temperature range: polyamide (-29 ÷ 220°C); ceramic (-29 ÷ 650°C)

Z2

STANDARD



W - Plug

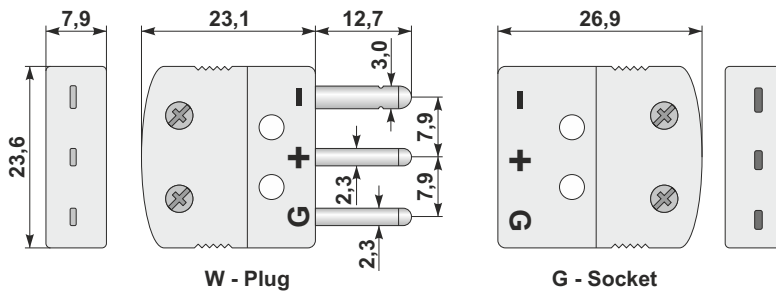
G - Socket

DIMENSION	POLYAMIDE	CERAMIC
A	33,3	38,1
B	33,3	38,1
C	12,7	16,0
E	25,4	25,4

temperature range: polyamide (-29 ÷ 220°C); ceramic (-29 ÷ 650°C)

Z3

MINI 3P

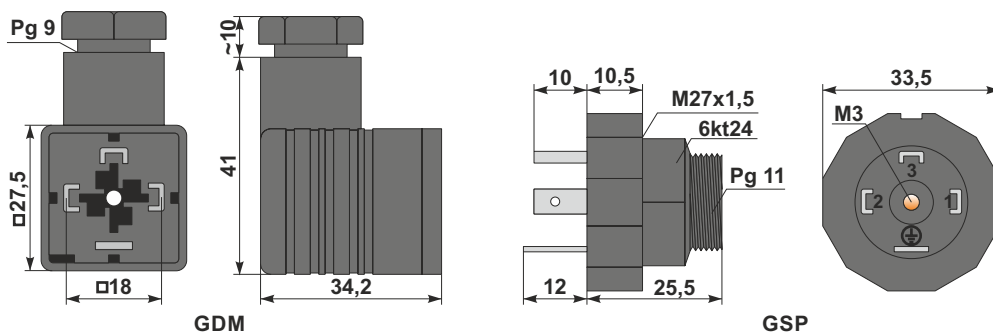


W - Plug

G - Socket

temperature range: polyamide (-29 ÷ 220°C)

GDM/GSP



GDM

GSP

temperature range: polyamide (-29 ÷ 125°C)

EXACT DESCRIPTION IN PART »H« OF THE CATALOG