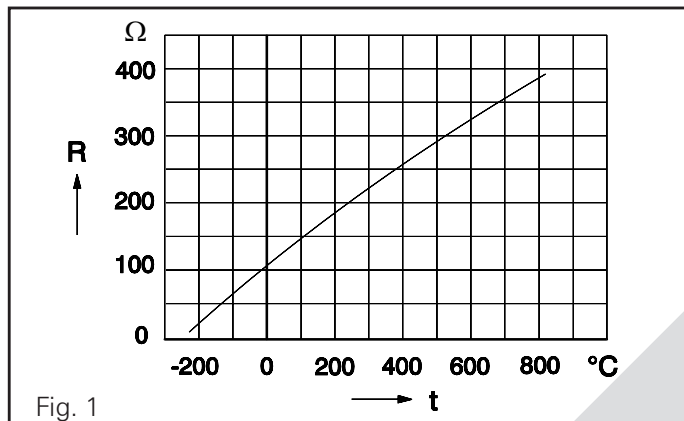


Measuring principle

The measuring principle of the resistance thermometers is based on the temperature dependent resistance change of metal wires.

The development of this measuring principle led to the technical platinum resistance thermometers which have found furthest application.

Fig. 1 shows the change of the resistance of a Pt 100 resistance thermometer, depending on the temperature. Resistance thermometers stand out due to this, that they obtain a very high measuring accuracy in a temperature range of -220 °C up to +850 °C.



Standard value: 5 times diameter of the protecting tube plus sensor length.

Technical parameters

Besides the special versions of resistance thermometers whose technical parameters will have to be fixed according to the customer's wishes. the following data are valid for the standard assortment:

Reference values Pt 100: acc. to EN 60751

Tolerances: tolerance class A or B acc. to EN 60751

Insulation resistance: ≥100 MΩ at room temperature and 500 VDC test voltage

Operating voltage: ≤ 30 V DC

Protection classification: IP 54 acc. to EN 60 529 (in case of silicone seals in the heads of higher protection).

If the Pt-nominal values are n-times higher than the basic values, tolerances and other values have to be also multiplied by n!

Max. operating temperature of the components

All types of resistance thermometers must be protected from inadmissible overheating in any case!

Depending on the materials chosen and under normal operating conditions, the following recommended standard values are valid for the single components in neutral medium:

Note!

The basic values of technical resistance thermometers are fixed in EN 60751. They can be calculated with the equations. On the last page of this operating instruction you find the calibration table acc. to EN 60751.

Accuracy classes

Resistance thermometers can be delivered in accuracy classes A or B, in which A is the exacter class.

- Class A

Limit deviation in °C = +/- (0.15 + 0.002 |t|)

- Class B

Limit deviation in °C = +/- (0.3 + 0.005 |t|)

Construction of a resistance thermometer

Basic element of the platinum resistance thermometer is the platinum measuring resistor. It is protected and embedded in measuring inserts, which are installed exchangeably into complete fittings.

The temperature sensitive part of the platinum measuring resistance is depending on construction embedded as a platinum wire inside of a ceramics- or solid glass-body, or is placed as a thin layer into the surface of a ceramic chip. The wires are connected vibration proof with the active part of the resistance.

The wires which belong together of a multiple resistance are indicated by identically lengths.

Depending on customers request, resistance thermometers can be manufactured with or without exchangeable measuring inserts.

Also on request they can be manufactured with or without neck tube.

Note!

Choose the immersion depth so errors by thermal leakage remain within the permissible error limits.

component	maximum temperature
connecting head (B-types only)	
- aluminum casting with rubber gasket	100 °C
- aluminum casting with silicon gasket	150 °C
- "VA"-part with TEFLON gasket	200 °C
connecting head with built-in transmitter	
- standard type	70 °C
- special type	85 °C
connecting cable	
- PVC, normal (PVC, heat-stabilized)	70 °C (105 °C)
- silicone	180 °C
- PTFE	200 °C
- glass-silk insulation	400 °C
If combining different insulation materials: The max. temperature load of that material with the lowest permissible max. temperature has to been taken into consideration. Other ranges are possible with special cables, these have to be obtained from the manufacturer.	
protecting tube	
see load characteristic diagrams acc. to DIN 43763	
1.4841 X15CrNiSi25 20	1150 °C
1.4571 X6CrNiMoTi17 12 2	800 °C
1.4571 coated with Cr ₂ O ₃ and TiN	400 °C
sensor type (in the front part of the protecting tube)	
- SA, SN, SY	550 °C
- SE, SH	700 °C
- SR, SO, SQ, SX	400 °C

Mounting and installation

-Notice to the mechanical installation

a) The installation has to be carried out in accordance with the relevant regulations and standards being in force for the respective place of measurement (welding regulations, etc.).

In particular, the following guidelines have to be taken into account :

- VDE/VDI 3511
"Temperature measurements in industry"
- VDE/VDI 3512. page 2
"Measuring setups for temperature measurements"

Special tmg recommendations are valid further-more beside these notes:

- for rod resistance thermometer (type WB 2)
- for tmg resistance thermometer in explosion-proof construction.

b) The installation has to be carried out in consideration of the correspondence between the respective technical parameters of the thermometers and the real field conditions, taking into account in particular:

- measuring range
- permissible max. pressure, flow rate
- immersion length, pipe dimensions
- mechanical stresses, vibrations

Attention!

Take care of the mechanical and thermal stress limits of the protecting tubes according to DIN 43763 in any case!

c) Notice to the process connection

Try to select the material of the protecting tube in that way that it is identically with the material of the pipe or the tank wall into which the thermometer shall be installed.

•Integral thread:

When mounting the resistance thermometer pay attention to a proper support of the seal! For integral threads the following permissible recommended values for starting torque are valid:

M 18 x 1.5; M 20 x 1.5 G1/2": 50 Nm
M 27 x 2.0 G3/4": 100 Nm

According to DIN 43763, a maximum permissible pressure of 10 MPa is generally fixed.

•Flange mounting:

As laid down by DIN 2527, the flanges have to be selected in consideration of the respective pressure and of the dimensions of the tube.

The flange fastening screws have to be tightened evenly crosswise.

Pay attention to a proper fit of the gasket.

•Welding version:

If the resistance thermometer comes into direct contact with any kind of food, particular welding instructions have to be observed. Basically, no uneven patches or similar things are allowed to occur on the welding seams. because these might affect the CIP-capability of the equipment.

In case of high-pressure lines, the relevant acceptance tests and inspection will have to be carried out.

•Cap nut fastening:

The permissible starting torques are the same as in case of integral threads!

•Adjustable screw joints:

In this case, attention has to be paid to the choice of the same material as used for the protecting tube with view to a possible contact corrosion. In addition, the "clamping element" has to be chosen in consideration of the tightness, e.g.: cutting ring, sealing ring, teflon locking ring.

d) Adjustment of the PG direction of rotation of the head
In case of resistance thermometers having measuring insert and standard DIN heads, it is possible to correct the PG direction of rotation whenever a problem is arising, even after the head has been screwed in. For this, loosen the adjusting screw again slightly, rotate the whole connecting head in the desired direction, and tighten the adjusting screw again properly.

Note! *If non-standard heads are used, please consult the manufacturer!*

-Electric Connection

When using thermometers with built-in transmitter, the parameters and hints for connection contained in the operating instructions for the transmitter have to be observed! Both the type of circuiting and the connecting head show in the next view.

If the resistance thermometer is connected in two wire circuit, the inside resistance must be taken into account and, if necessary, adjusted in the secondary electrical instrument. Generally used materials for inner wires are: Cu, Ag or Ni. For higher temperatures NiSi (diameter 0.5 mm) is used.

Note!

Because of self heating, the measuring current influences the measuring accuracy of the thermometer and should therefore in no circumstances be higher than 10 mA.

Standard values for measuring current (for class B):

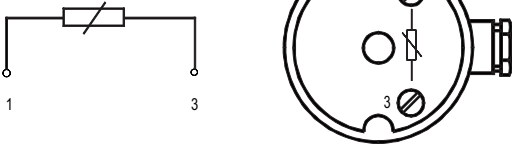
Resistance thermometer with measuring resistor	max. measuring current
wire-wound measuring resistor-inner winding	< 8 mA
wire-wound measuring resistor-outer winding	< 10 mA
glass measuring resistor	< 6...10 mA (depending on the sensor-size)
ceramics-thin film measuring resistor	< 2 mA

The resistance thermometer can be connected after removing the cap of the connecting head. For this, the connecting wire which is to be led through the PG-screw joint into the interior space of the connecting head is connected with the ends of the conductors by means of the wiring terminal.

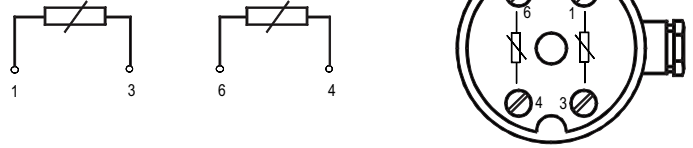
Circuiting of resistance thermometers

- Resistance thermometers with B-head

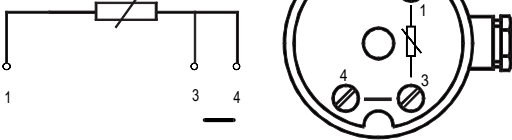
1 x two-wire circuit



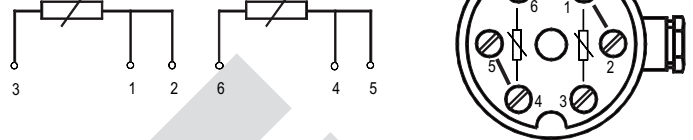
2 x two-wire circuit



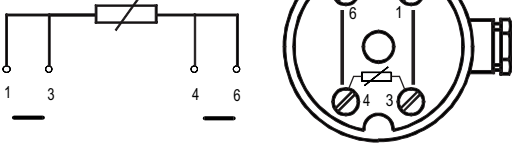
1 x three-wire circuit



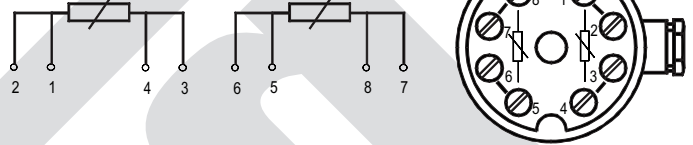
2 x three-wire circuit



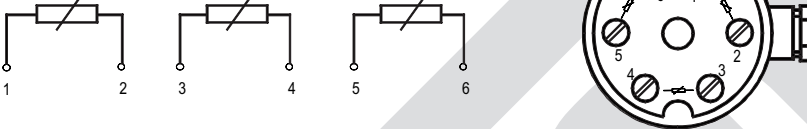
1 x four-wire circuit



2 x four-wire circuit



3 x two-wire circuit

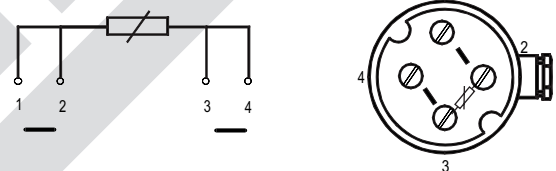


- Resistance thermometers with J-head

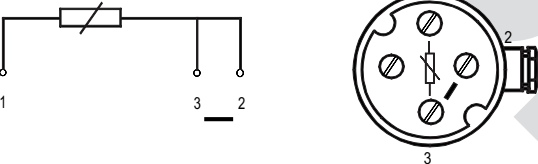
1 x two-wire circuit



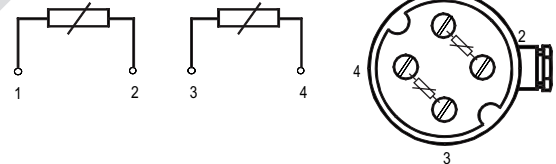
1 x four-wire circuit



1 x three-wire circuit



2 x two-wire circuit



- Resistance thermometers with plug connection

The circuit configuration acc. to the product data sheets.

- Resistance thermometers with free ends at the cable exit

In case of multiple circuit the wire ends marked in pairs with insulating tube.

Calibration table acc. to EN 60751

°C	0	-1	-2	-3	-4	-5	-6	-7	-8	-9
-50	80.31	79.91	79.51	79.11	78.72	78.32	77.92	77.52	77.12	76.73
-40	84.27	83.87	83.48	83.08	82.69	82.29	81.89	81.50	81.10	80.70
-30	88.22	87.83	87.43	87.04	86.64	86.25	85.85	85.46	85.06	84.67
-20	92.16	91.77	91.37	90.98	90.59	90.19	89.80	89.40	89.01	88.62
-10	96.09	95.69	95.30	94.91	94.52	94.12	93.73	93.34	92.95	92.55
0	100.00	99.61	99.22	98.83	98.44	98.04	97.65	97.26	96.87	96.48
°C	0	1	2	3	4	5	6	7	8	9
0	100.00	100.39	100.78	101.17	101.56	101.95	102.34	102.73	103.12	103.51
10	103.90	104.29	104.68	105.07	105.46	105.85	106.24	106.63	107.02	107.40
20	107.79	108.18	108.57	108.96	109.35	109.73	110.12	110.51	110.90	111.29
30	111.67	112.06	112.45	112.83	113.22	113.61	114.00	114.38	114.77	115.15
40	115.54	115.93	116.31	116.70	117.08	117.47	117.86	118.24	118.63	119.01
50	119.40	119.78	120.17	120.55	120.94	121.32	121.71	122.09	122.47	122.86
60	123.24	123.63	124.01	124.39	124.78	125.16	125.54	125.93	126.31	126.69
70	127.08	127.46	127.84	128.22	128.61	128.99	129.37	129.75	130.13	130.52
80	130.90	131.28	131.66	132.04	132.42	132.80	133.18	133.57	133.95	134.33
90	134.71	135.09	135.47	135.85	136.23	136.61	136.99	137.37	137.75	138.13
100	138.51	138.88	139.26	139.64	140.02	140.40	140.78	141.16	141.54	141.91
110	142.29	142.67	143.05	143.43	143.80	144.18	144.56	144.94	145.31	145.69
120	146.07	146.44	146.82	147.20	147.57	147.95	148.33	148.70	149.08	149.46
130	149.83	150.21	150.58	150.96	151.33	151.71	152.08	152.46	152.83	153.21
140	153.58	153.96	154.33	154.71	155.08	155.46	155.83	156.20	156.58	156.95
150	157.33	157.70	158.07	158.45	158.82	159.19	159.56	159.94	160.31	160.68
160	161.05	161.43	161.80	162.17	162.54	162.91	163.29	163.66	164.03	164.40
170	164.77	165.14	165.51	165.89	166.26	166.63	167.00	167.37	167.74	168.11
180	168.48	168.85	169.22	169.59	169.96	170.33	170.70	171.07	171.43	171.80
190	172.17	172.54	172.91	173.28	173.65	174.02	174.38	174.75	175.12	175.49
200	175.86	176.22	176.59	176.96	177.33	177.69	178.06	178.43	178.79	179.16
210	179.53	179.89	180.26	180.63	180.99	181.36	181.72	182.09	182.46	182.82
220	183.19	183.55	183.92	184.28	184.65	185.01	185.38	185.74	186.11	186.47
230	186.84	187.20	187.56	187.93	188.29	188.66	189.02	189.38	189.75	190.11
240	190.47	190.84	191.20	191.56	191.92	192.29	192.65	193.01	193.37	193.74
250	194.10	194.46	194.82	195.18	195.55	195.91	196.27	196.63	196.99	197.35
260	197.71	198.07	198.43	198.79	199.15	199.51	199.87	200.23	200.59	200.95
270	201.31	201.67	202.03	202.39	202.75	203.11	203.47	203.83	204.19	204.55
280	204.90	205.26	205.62	205.98	206.34	206.70	207.05	207.41	207.77	208.13
290	208.48	208.84	209.20	209.56	209.91	210.27	210.63	210.98	211.34	211.70
300	212.05	212.41	212.76	213.12	213.48	213.83	214.19	214.54	214.90	215.25
310	215.61	215.96	216.32	216.67	217.03	217.38	217.74	218.09	218.44	218.80
320	219.15	219.51	219.86	220.21	220.57	220.92	221.27	221.63	221.98	222.33
330	222.68	223.04	223.39	223.74	224.09	224.45	224.80	225.15	225.50	225.85
340	226.21	226.56	226.91	227.26	227.61	227.96	228.31	228.66	229.02	229.37
350	229.72	230.07	230.42	230.77	231.12	231.47	231.82	232.17	232.52	232.87
360	233.21	233.56	233.91	234.26	234.61	234.96	235.31	235.66	236.00	236.35
370	236.70	237.05	237.40	237.74	238.09	238.44	238.79	239.13	239.48	239.83
380	240.18	240.52	240.87	241.22	241.56	241.91	242.26	242.60	242.95	243.29
390	243.64	243.99	244.33	244.68	245.02	245.37	245.71	246.06	246.40	246.75
400	247.09	247.44	247.78	248.13	248.47	248.81	249.16	249.50	249.85	250.19
410	250.53	250.88	251.22	251.56	251.91	252.25	252.59	252.93	253.28	253.62
420	253.96	254.30	254.65	254.99	255.33	255.67	256.01	256.35	256.70	257.04
430	257.38	257.72	258.06	258.40	258.74	259.08	259.42	259.76	260.10	260.44
440	260.78	261.12	261.46	261.80	262.14	262.48	262.82	263.16	263.50	263.84
450	264.18	264.52	264.86	265.20	265.53	265.87	266.21	266.55	266.89	267.22
460	267.56	267.90	268.24	268.57	268.91	269.25	269.59	269.92	270.26	270.60
470	270.93	271.27	271.61	271.94	272.28	272.61	272.95	273.29	273.62	273.96
480	274.29	274.63	274.96	275.30	275.63	275.97	276.30	276.64	276.97	277.31
490	277.64	277.98	278.31	278.64	278.98	279.31	279.64	279.98	280.31	280.64
500	280.98	281.31	281.64	281.98	282.31	282.64	282.97	283.31	283.64	283.97
510	284.30	284.63	284.97	285.30	285.63	285.96	286.29	286.62	286.95	287.29
520	287.62	287.95	288.28	288.61	288.94	289.27	289.60	289.93	290.26	290.59
530	290.92	291.25	291.58	291.91	292.24	292.56	292.89	293.22	293.55	293.88
540	294.21	294.54	294.86	295.19	295.52	295.85	296.18	296.50	296.83	297.16
550	297.49	297.81	298.14	298.47	298.80	299.12	299.45	299.78	300.10	300.43
560	300.75	301.08	301.41	301.73	302.06	302.38	302.71	303.03	303.36	303.69
570	304.01	304.34	304.66	304.98	305.31	305.63	305.96	306.28	306.61	306.93
580	307.25	307.58	307.90	308.23	308.55	308.87	309.20	309.52	309.84	310.16
590	310.49	310.81	311.13	311.45	311.78	312.10	312.42	312.74	313.06	313.39
600	313.71	314.03	314.35	314.67	314.99	315.31	315.64	315.96	316.28	316.60

Inadmissible operations

- exceeding the permissible maximum temperature or also falling below the permissible minimum temperature,
- exceeding the permissible pressure values (acc. to DIN 43763 temperature-pressure-load diagrams),
- high mechanical stresses, particularly such, which lead to deformations of the protecting-tube zones in which

- the measuring resistor is built-in,
- exceeding the electrical connected loads,
- exceeding the degree of moistening and termical stress of the connecting head according to the respective protecting system.

The instructions are guide lines without obligations!