Platinum Temperature Sensors

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General Information

In many industrial sectors and fields of research, temperature measurement is one of the most important parameters which determines product quality, security, and reliability. Temperature sensors are available in several types all of which have a unique performance characteristic. The performance capability of the various sensors are a result of the manufacturing process and component materials associated with their technologies and intended application. It is IST Charter to produce sensors that exceed the industry standard of temperature measurement with additional capability to directly replace older traditional methods and provide the maximum performance. To this end IST has concentrated its development and manufacturing on the process and materials of high-end thin-film temperature sensors. Additionally these processes, partially derived from the semiconductor industry allows IST to manufacture sensors in very small dimensions. Because of their low thermic mass thin-film temperature sensors exhibit a very short response time. IST core technology and processes results in thin-film sensors that combine the good features of traditional wire wound platinum sensors such as accuracy, long-term stability, repeatability, interchangeability and wide temperature range, with the advantages of mass-production, which contributes to their optimal price/performance ratio.

Sensor Construction

The temperature sensor consists of a photo-lithographically structured, high-purity platinum coating arranged in the shape of a meander. The platinum thin-film structures are laser trimmed to form resistive paths with very precisely defined basic value of the resistivity. The sensors are covered with a glass passivation layer; to protect the sensor against mechanical and chemical damage. The bonded leadwires which are additionally covered with a drop of glass make electrical contacts to the resistive structure.

Typical Features

– brief response time
– excellent long-term stability
– low self-heating rate
– excellent price/performance ratio
– small dimensions
– resistant against vibration and temperature shocks
– simple interchangeability

Response Time

The response time $T_{0.63}$ is the time in seconds the sensors need to respond to 63% of the change in temperature. The response time depends on the sensor dimensions, the termal contact resistance and the encloser medium.

Long-Term Stability

The change of ohmage after 1,000 hrs at maximum operating temperature until the 7W types amounts to less than 0.03%.

Self Heating

To measure the resistance an electric current has to flow through the element, which will generate heat energy resulting in errors of measurement. To minimize the error, the testing current should be kept low (approximately 1 mA for pt-100). Temperature error $\Delta T = RI^2 / E$; with E = self-heating coefficient in mW/K R = resistance in kΩ, I = measuring current in mA

Measurement current

The amount of thermal transfer from the sensor in application determines how much measuring current can be applied. There is no bottom limit of the measurement current with platinum thin-film. The measurement current depend highly on the application in use. For sensors from 750°C - 1000°C (7W, 8W, 10W) the measurement current must limited at max. 1 mA.

We recommend at:

100 Ω:	typ. 1 mA	max. 5 mA
500 Ω:	typ. 0.5 mA	max. 3 mA
1000 Ω:	typ. 0.3 mA	max. 2 mA
2000 Ω:	typ. 0.2 mA	max. 1 mA
10000 Ω:	typ. 0.1 mA	max. 0.3 mA

Nominal values

The nominal or rated value of the sensor is the target value of the sensor resistance at 0° C. The temperature coefficient α is defined as $\alpha = \frac{R_{100} - R_0}{100 \cdot R_0}$ $[K^{-1}]$ and has the numerical value of 0.00385 K^{-1} according to DIN IEC 751.

In practice, a value multiplied by 10^6 is often entered: $TCR = 10^6 * \frac{R_{100} - R_0}{100 \cdot R_0}$ [ppm/K].
In this case, the numerical value is 3850 ppm/K.

Temperatur Characteristic Curve

The characteristic temperature curve determines the dependence of the electrical resistivity on the temperature.
The following definition of the temperature curve according to the DIN EN 60751 standard applies:

-200 bis 0°C $R(t) = R_0 (1 + A * t + B * t^2 + C * [t-100] * t^3)$

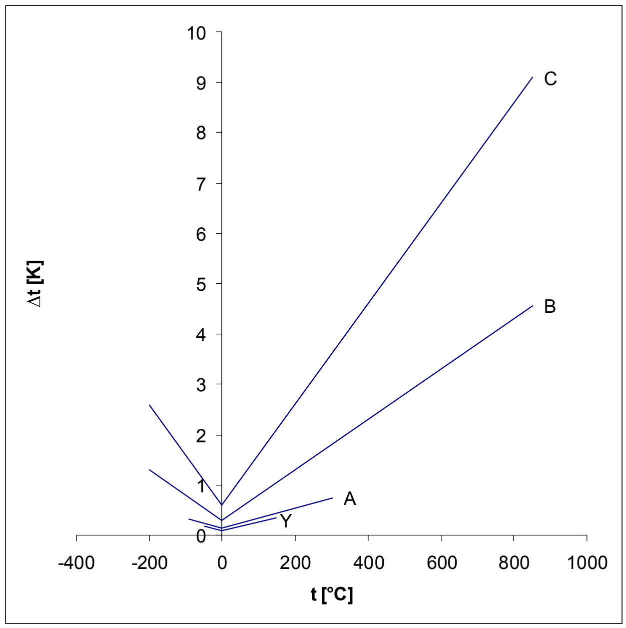
0 bis 850°C $R(t) = R_0 (1 + A * t + B * t^2)$

Platinum (3850 ppm/K):
$A = 3.9083 * 10^{-3}$ [°C^{-1}]; $B = -5.775 * 10^{-7}$ [°C^{-2}];
$C = -4.183 * 10^{-12}$ [°C^{-4}]

Platinum (3750 ppm/K):
$A = 3.8102 * 10^{-3}$ [°C^{-1}]; $B = -6.01888 * 10^{-7}$ [°C^{-2}];
$C = -6 * 10^{-12}$ [°C^{-4}]

Platinum (3770 ppm/K):
$A = 3.92 * 10^{-3}$ [°C^{-1}]; $B = -6.03 * 10^{-7}$ [°C^{-2}];

R_0 = Resistance value in ohm at 0°C;
t = temperature in accordance with ITS 90



Tolerance field

Tolerance Classes

temperature sensors are divided into classes according to their limit deviations:

Class	+/- limit deviations in °C (K)	IST AG designation	area of validity of temperature class
DIN 60751, class B	0.30 + 0.005 x | t |	B	-200°C bis 850°C
DIN 60751, class A	0.15 + 0.002 x | t |	A	-90°C bis 300°C
⅓ DIN 60751, class B	0.10 + 0.0017 x | t |	Y	-50°C bis 150°C
2DIN 60751, class B	0.60 + 0.01 x | t |	C	-200°C bis 850°C
1/5 DIN 60751, class B	0.06 + 0.001 x | t |	1/5	on request
1/10 DIN 60751, class B	0.03 + 0.0005 x | t |	1/10	on request

| t | is the numerical value of the temperature in °C without taking into account either negative or positive signs.
Special selection of sensors upon request (e.g. pairings, grouping, special tolerances)

IST AG, Industriestrasse 2, CH-9630 Wattwil, Switzerland, Phone (+)41 71 987 73 73, Fax (+)41 71 987 73 77
e-mail info@ist-ag.com, www.ist-ag.com

Response Times and Self-Heating

Dimension Number	Sensor Size	Response Time in seconds						Self-Heating			
	L x W x T / H in mm	Water 0.4 m/s			Air 1m/s			Water v = 0 m/s		Air v = 0 m/s	
		$T_{0.5}$	$T_{0.63}$	$T_{0.9}$	$T_{0.5}$	$T_{0.63}$	$T_{0.9}$	mW/K	ΔT[mK]*	mW/K	ΔT[mK]*
MiniSens 161	1.6 x 1.2 x 0.25 / 0.9	0.05	0.08	0.18	1	1.2	2.5	12	8.3	1.8	56
SlimSens 308	3.0 x 0.8 x 0.25 / 0.6	0.08	0.10	0.25	1.2	1.5	3.5	15	6.7	2.2	46
232	2.3 x 2.0 x 0.25 / 0.9	0.09	0.12	0.33	2.7	3.6	7.5	40	2.5	4	25
202	2.0 x 2.0 x 0.65 / 1.3	0.12	0.18	0.42	4	5.4	11	36	2.8	3.6	28
216	2.0 x 1.6 x 0.65 / 1.3	0.11	0.16	0.38	3.6	4.9	10.2	32	3.1	3.2	31
232	2.3 x 2.0 x 0.65 / 1.3	0.15	0.2	0.55	4.5	6	12	40	2.5	4	25
325	3.0 x 2.5 x 0.65 / 1.3	0.25	0.3	0.7	5.5	7.5	16	90	1.1	8	13
516	5.0 x 1.6 x 0.65 / 1.3	0.25	0.3	0.7	5.5	7.5	16	80	1.3	7	14
520	5.0 x 2.0 x 0.65 / 1.3	0.25	0.3	0.75	6	8.5	18	80	1.3	7	14
525	5.0 x 2.5 x 0.65 / 1.3	0.33	0.4	0.85	6.5	9	19	90	1.1	8	13
538	5.0 x 3.8 x 0.65 / 1.3	0.35	0.4	0.9	7.5	10	20	140	0.7	10	10
505	5.0 x 5.0 x 0.65 / 1.3	0.4	0.5	1.1	8	11	21	150	0.7	11	9
102	10.0 x 2.0 x 0.65 / 1.3	0.33	0.4	0.85	7.5	10.5	20	140	0.7	10	10
281	1 x 13 x Ø 2.8	2.5	4.5	8	10	15	28	60	1.7	5.5	18
281	2 x 13 x Ø 2.8	2	2.5	5.5	10	12	22	45	2.2	4	25
451	1 x 13 x Ø 4.5	8	10	22	12	22	40	85	1.2	8	13
451	2 x 13 x Ø 4.5	5	6	14	16	18	37	60	1.7	6.5	15
SMD 1206	3.2 x 1.6 x 0.4	0.15	0.25	0.45	3.5	4.2	10	55	1.8	7	14
SMD 0805	2.0 x 1.2 x 0.4	0.10	0.12	0.33	2.5	3	8	38	2.6	4	25
FC 0603	1.5 x 0.75 x 0.4	0.08	0.10	0.25	1.8	2.2	5.5	25	4	2.5	40

*self heating ΔT[mK] measured for Pt100 at 1mA measurement current at 0ºC

L: Chip length (sensor length without connections)
W: Sensor width
T: Chip thickness (sensor thickness without connections)
H: Sensor height (incl. connections and strain relief)

Notification: The values in the table are of informative nature only. Due to different measurement conditions you might assess deviant self heating and response time values of your application.

Tolerances of dimensions

Sensor width (W) ± 0.2 mm
Sensor length (L) ± 0.2 mm
Sensor height (H) ± 0.3 mm
Sensor thickness (T) ± 0.1 mm

Wire length ± 1.0 mm
Tube length ± 0.2 mm
Tube diameter ± 0.1 mm

Platinum Temperature Sensors

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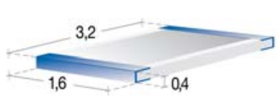
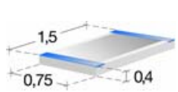
1P - Product Series   Temperature Range: -60°C... +150°C

Temperature sensors in SMD construction
Soldering depot, RoHs conform (reflow soderable) *only Flip Chip assembly

Technical Data

Temperature range:	-50°C to +150°C (1P, 2P) ; -50°C to +250°C (3P, 4P)
Classes:	Pt: DIN class A; DIN class B; 2x DIN class B
Soldering connection:	Contacts: 1P = Contacts tin coated (62Sn/36Pb/2Ag), LMP lead contained 2P = Contacts tin coated (96.5Sn/3Ag/0.5Cu), LMP lead free, RoHS conform 3P = Contacts tin coated (5Sn/93.5Pb/1.5Ag), HMP, RoHS conform 4P = Contacts gold plated, solderable film - The precision class is depending of the soldering process. - Bondable contacts without bumps available on request. Pads: 1FC = Contacts tin coated, LMP lead contained 2FC = Contacts tin coated HMP 3FC = Au-Pads (bondable Pads) 4FC = Without Pads 6FC = Screen printed Pads (Platinum)
Solderability:	235°C ≤ 8s (DIN IEC 68 2-20, Ta Meth 1)
Resistance to soldering heat:	260°C 10x (DIN IEC 68 2-20, Ta Meth. 1A)
Long-term stability:	Pt: max. Drift = 0.04% after 1000h at 130°C





Dimensions in mm	Nominal Resistance at 0°C in Ohm	Chip-Dimensions in mm	Description
see image 1	100	LxW 2.0 x 1.2	P0K1.0805.xP.x
	500	LxW 2.0 x 1.2	P0K5.0805.xP.x
	1000	LxW 2.0 x 1.2	P1K0.0805.xP.x
see image 2	100	LxW 3.2 x 1.6	P0K1.1206.xP.x
	500	LxW 3.2 x 1.6	P0K5.1206.xP.x
	1000	LxW 3.2 x 1.6	P1K0.1206.xP.x
see image 3	100	LxW 1.5 x 0.75	P0K1.0603.xFC.x*
	500	LxW 1.5 x 0.75	P0K5.0603.xFC.x*
	1000	LxW 1.5 x 0.75	P1K0.0603.xFC.x*

TEMPERATURE
HUMIDITY
FLOW

Platinum Temperature Sensors Order Information

P 1 K 0. 5 2 0. 4 W. B. 0 1 0. M — **Example**

Specials

T	Substrate thickness 0.25 mm
D	Substrate thickness 0.38 mm
R	Round housing
W	Sintered powder
M	Metallised backside
U	Inverted welding
S	Special*

Connection length in mm

Tolerance classes

A	Class DIN A
B	Class DIN B
C	2 Class DIN B
Y	1/3 Class DIN B
P	Pairs*
G	Groups*
K	Customer specific*

Extension type

S	SIL (single in line)
P	tin solder Overall (SMD)
FC	Tin-plated contacts
W	Wire
SW	Perpendicular leads
FW	Flat wire
I	Insulated contacts
E	Enameled wires
L	Insulated stranded wires
K	Customer specific*

1P = Contacts tin coated, LMP lead contained
2P = Contacts tin coated, LMP lead free, RoHS conform
3P = Contacts tin coated, HMP, RoHS conform
4P = Contacts gold plated, solderable film

Temperature range

1	-60°C to 150°C
2	-200°C to 200°C
3	-200°C to 300°C
4	-200°C to 400°C
6	-200°C to 600°C
7	-200°C to 750°C
8	-200°C to 850°C
10	-70°C to 1000°C

Mechanical dimensions (see various dimensions) in mm

Resistance value in ohm at 0°C

Characteristic curve

	Pt 3850 ppm/K
W	Pt 3850 ppm/K (extended temperature range in class A)
U	Pt 3750 ppm/K
G	Pt 3911 ppm/K

Material identification

P	Platinum

*** Additional details, specifications required from the customer.**

Order example:

P 1K0. 520. 4 W. B. 010. M
1 | 2 | 3 | 4 | 5 | 6 | 7 | 8

1:	Material identification	= Platinum Temperature Sensor
2:	Resistance value in ohm	= 1'000 Ω / 0°C
3:	Chip dimension	= 5 mm x 2 mm
4:	Temperature range	= + 400°C
5:	Extension	= Wire connections (Ag, Ø 0.25 mm)
6:	Tolerance class	= DIN EN 60751 class B
7:	Connection length	= 10 mm
8:	Special	= metallised backside

Specifications are subject to change without notice

INNOVATIVE SENSOR TECHNOLOGY

ISO 9001

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