



General Information

In many industrial sectors and fields of research, temperature measurement is one of the most important parameters to determine 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. IST sensors exceed the industry standard of temperature measurement and have the 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, allow 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 result in thin-film sensors that combine the positive attributes of traditional wire-wound platinum sensors - accuracy, long-term stability, repeatability, interchangeability, and wide temperature range, with the advantages of mass-production, which ultimately creates an 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 a precisely defined basic value of 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 thermal contact resistance, and the enclosure medium.

Long-Term Stability

The change of ohmage after 1,000 hrs at maximum operating temperature until the 7W types (750°C) 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 k Ω , I = measuring current in mA

Applied 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 applied current with platinum thin-film. The current depends highly on the application in use. For sensors from 750°C - 1000°C (7W, 8W, 10W), the current must reach no higher than 1 mA.

We recommend at:

100 Ω : 1 mA 500 Ω : 0.5 mA 1000 Ω : 0.3 mA 2000 Ω : 0.2 mA 10000 Ω : 0.1 mA

The point of measurement is 5 mm behind of the end of the wire. At wire lengths longer than 10 mm, the wire resistor is compensated (measured at room temperature).



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 10⁶ is often entered: TCR = 10⁶ * $\frac{R_{100} - R_0}{100 \cdot R_0}$ [ppm/K].
In this case, the numerical value is 3850 ppm/K.

Temperature 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 to 0°C $R(t) = R_0 (1 + A \cdot t + B \cdot t^2 + C \cdot [t-100] \cdot t^3)$

0 to 850°C $R(t) = R_0 (1 + A \cdot t + B \cdot t^2)$

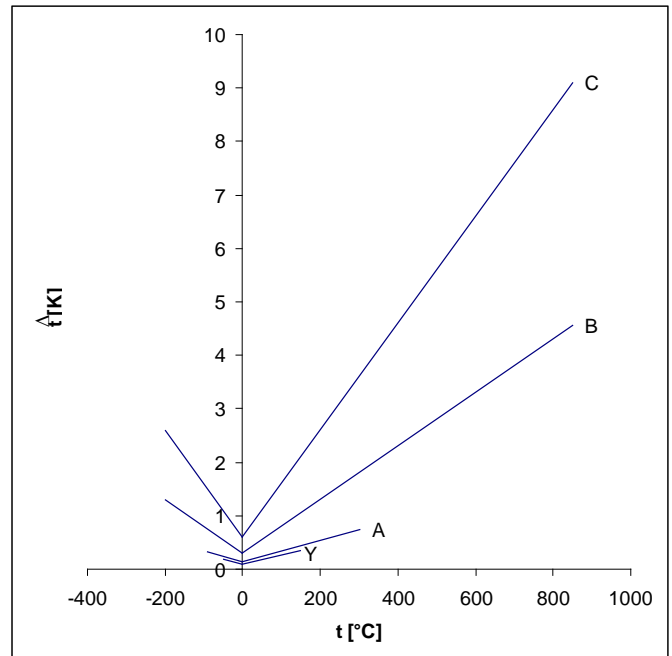
Platinum (3850 ppm/K):
 $A = 3.9083 \cdot 10^{-3}$ [°C⁻¹]; $B = -5.775 \cdot 10^{-7}$ [°C⁻²];
 $C = -4.183 \cdot 10^{-12}$ [°C⁻⁴]

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

Platinum (3770 ppm/K):
 $A = 3.8285 \cdot 10^{-3}$ [°C⁻¹]; $B = -5.85 \cdot 10^{-7}$ [°C⁻²];

Platinum (3911 ppm/K):
 $A = 3.9692 \cdot 10^{-3}$ [°C⁻¹]; $B = -5.829 \cdot 10^{-7}$ [°C⁻²];
 $C = -4.3303 \cdot 10^{-12}$ [°C⁻⁴]

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



Tolerance field

Tolerance Classes DIN EN 60751 Norm

Temperature sensors are divided into classes according to their limit deviations (DIN EN 60751, 2009-05):

Class	+/- limit deviations in °C (K)	IST AG designation	area of validity of temperature class
DIN EN 60751, F 0.1 (former class 1/3 DIN B)	0.10 + 0.0017 x t	Y	-50°C to 150°C
DIN EN 60751, F 0.15 (former class A)	0.15 + 0.002 x t	A	-90°C to 300°C
DIN EN 60751, F 0.3 (former class B)	0.30 + 0.005 x t	B	-200°C to 850°C
2 DIN EN 60751, F 0.6 (former class C)	0.60 + 0.01 x t	C	-200°C to 850°C
1/5 DIN EN 60751 F 0.3	0.06 + 0.001 x t	K	on request
1/10 DIN EN 60751 F 0.3	0.03 + 0.0005 x t	K	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)



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Platinum Temperature Sensors



Tolerance Classes DIN EN 60751 and GOST 8.625-2006 norm (only PW and PG product series)

Class	+/- limit deviations in °C (K)	IST AG designation	area of validity of temperature class
DIN/GOST, F 0.1 (former class 1/3 DIN B)	$0.10 + 0.0017 \times t $	Y	-200°C to 500°C
DIN/GOST, F 0.15 (former class A)	$0.15 + 0.002 \times t $	A	-200°C to 600°C
DIN/GOST, F 0.3 (former class B)	$0.30 + 0.005 \times t $	B	-200°C to 600°C
DIN/GOST, F 0.6 (former class C)	$0.60 + 0.01 \times t $	C	-200°C to 600°C

Response Times and Self-Heating

Dimension Number	Sensor Size L x W x T / H in mm	Response Time in seconds						Self-Heating			
		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]*
161	1.6 x 1.2 x 0.25/0.8	0.05	0.08	0.18	1	1.2	2.5	12	8.3	1.8	56
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 0.25/1.3	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	0.11	0.16	0.38	3.6	4.9	10.2	32	3.1	3.2	31
216	2.5 x 1.6 x 0.65/1.3	0.12	0.18	0.42	4	5.4	11	36	2.8	3.6	28
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 applied current at 0°C

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	Wire length ± 1.0 mm (5-100 mm)
Sensor length (L) ± 0.2 mm	Wire length longer than 100 mm, tolerances on request
Sensor height (H) ± 0.3 mm	Tube length (sensor elements in round housing) ± 0.2 mm
Sensor thickness (T) ± 0.1 mm	Tube diameter (sensor elements in round housing) ± 0.1 mm
Ni/Au flat wire (H) ± 0.02 mm	Ni/Au flat wire (B) ± 0.05 mm



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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 F 0.15 (former Class A)
- B Class F 0.3 (former Class B)
- C Class 2 x F 0.3 (former 2 x Class B)
- Y Class F 0.1 (former 1/3 Class B)
- P Pairs*
- G Groups*
- K Customer specific*

Extension type

- S SIL (Single in line)
- P SMD contact around the sides →
- FC Flip Chip →
- W Wire
- SW Perpendicular leads
- FW Flat wire
- I Insulated contacts
- E Enameled wires
- L Insulated stranded wires
- K Customer specific*

2P = Contact tin-coated, LMP lead free, RoHS-conform
 3P = Contact tin-coated, HMP, RoHS-conform
 4P = Gold coated contacts, solderable layer

1FC = contact tin-coated, LMP lead free
 2FC = contact tin-coated, HMP
 3FC = Au-Pads (bonding pads)
 4FC = Thin film Pt-pads
 5FC = increased thin film Pt-Pads (solderable pads)
 6FC = Thick film Pt-pads

Temperature range

- 1 -50°C to 150°C
- 2 -50°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)
- 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: 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 = -200°C to +400°C
 - 5: Extension = Wire connections (Ag, Ø 0.25 mm)
 - 6: Tolerance class = DIN EN 60751 F 0.3 (former Class B)
 - 7: Connection length = 10 mm
 - 8: Special = metalized backside

Specifications are subject to change without notice

All mechanical dimensions are valid at 25°C ambient temperature, if not differently indicated. ■ All data except the mechanical dimensions only have information purposes and are not to be understood as assured characteristics. ■ Technical changes without previous announcement as well as mistakes reserve. ■ The information on this data sheet was examined carefully and will be accepted as correct. No liability in case of mistakes. ■ Load with extreme values during a longer period can affect the reliability. All rights reserved. The material contained herein may not be reproduced, adapted, merged, translated, stored, or used without the prior written consent of the copyright owner. Typing errors and mistakes reserved. Product specifications are subject to change without notice.



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