P0K1.232.6W.Y.010

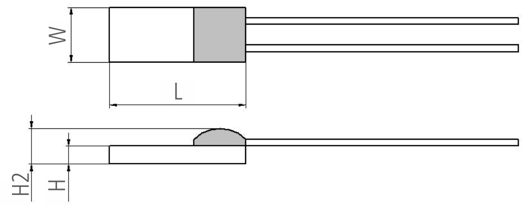
Platinum sensor with wires

For high temperatures

Benefits & Characteristics

- Excellent long-term stability
- Low self-heating
- Fast response time
- Vibration and temperature shock resistant

Illustration[1)]



Technical Data

Operating temperature range:	-200 °C to +600 °C
Nominal resistance:	100 Ω at 0 °C
Characteristics curve:	3850 ppm/K
Long-term stability:	< 0.04 % at 1000 h at maximal operating temperature
Tolerance class (dependent on temperature range):	IEC 60751 F0.1 Y (IST AG reference)
Connection:	Pt-cladded Ni-wire, Ø 0.2 mm (solderable, weldable, crimpable, brazeable), 10 mm long
Dimensions:	2.2 x 2.0 x 0.65 / 1.1
Tolerance (chip):	L ±0.2 mm, W ±0.2 mm,H ±0.1 mm, H2 ±0.3 mm

Product Photo

Order Information

Description:	Item number:	Former main reference:
P0K1.232.6W.Y.010	100118	010.00032

Application Note
RTD Platinum Sensor

1. General Information

In many sectors, temperature is one of the most important physically defined parameters to determine product quality, security and reliability. Temperature sensors are produced with different technologies to fit specific application requirements. IST AG has concentrated on the development and manufacturing of high-quality thin-film temperature sensors. This know-how, partially derived from the semiconductor industry, allows IST AG to manufacture sensors in very small dimensions. Thin-film temperature sensors exhibit a very short response time due to their low thermal mass. The technologies and processes of IST AG thin-film sensors combine the positive attributes of traditional sensors - accuracy, long-term stability, repeatability and interchangeability within a wide temperature range. The advantages of thin-film mass-production create an optimal price/performance-ratio.

2. Construction

The temperature sensor consists of a high-purity platinum meander, structured on a ceramic substrate by the use of photolithography. The resistivity is laser-trimmed and precisely adjusted to the final value. The resistive structure is covered with a glass passivation layer protecting the sensor against mechanical and chemical damages. The welded lead wires are covered with an additional fixation layer.

3. Nominal Value and Temperature Coefficent

The nominal value of the sensor is the defined value of the sensor resistance at 0 °C. The temperature coefficient α (TCR) is defined as:

$$\alpha = \frac{R_{100} - R_0}{100 \times R_0} \quad [K^{-1}]$$ according to the IEC60751, 2008-07 numerical value of 0.00385 K^{-1}.

Generally, the value is defined in ppm/K.

This example defines 3850 ppm/K 1).

R_0 = resistance value in Ω at 0 °C
R_{100} = resistance value in Ω at +100 °C

1) Other TCRs available upon request

4. Long-term Stability

For all sensor types up to 7W (+750 °C), the change in ohmic value after 1000 hrs is less than 0.04 % at maximum operating temperatures.

5. Temperature Characteristic Curve

The curve determines the relationship between the electrical resistance and the temperature.

$R(T) = R_0\,(1 + A \times T + B \times T^2)$ 0 °C to +850 °C
$R(T) = R_0\,(1 + A \times T + B \times T^2 + C \times [T-100] \times T^3)$ -200 °C to 0 °C

Platinum (3850 ppm/K)	Platinum (3911 ppm/K)	Platinum (3750 ppm/K)	Platinum (3770 ppm/K)
$A = 3.9083 \times 10^{-3}$ [°C^{-1}]	$A = 3.9692 \times 10^{-3}$ [°C^{-1}]	$A = 3.8102 \times 10^{-3}$ [°C^{-1}]	$A = 3.8285 \times 10^{-3}$ [°C^{-1}]
$B = -5.775 \times 10^{-7}$ [°C^{-2}]	$B = -5.829 \times 10^{-7}$ [°C^{-2}]	$B = -6.01888 \times 10^{-7}$ [°C^{-2}]	$B = -5.85 \times 10^{-7}$ [°C^{-2}]
$C = -4.183 \times 10^{-12}$ [°C^{-4}]	$C = -4.3303 \times 10^{-12}$ [°C^{-4}]	$C = -6 \times 10^{-12}$ [°C^{-4}]	

R_0 = resistance value in Ω at 0 °C
T = temperature in accordance with ITS 90

6. Tolerance Classes IEC60751 Norm

Temperature sensors are classified according to IEC60751, 2008-07.

Class	± deviations in °C	Temperature range of validity in °C*	IST AG reference
IEC60751 F 0.1	0.10 + 0.0017 x |T|	0 to +150	Y
IEC60751 F 0.15	0.15 + 0.002 x |T|	-30 to +300	A
IEC60751 F 0.3	0.30 + 0.005 x |T|	-50 to +500	B
IEC60751 F 0.6	0.60 + 0.01 x |T|	-50 to +600	C
1/5 IEC60751 F 0.3	0.06 + 0.001 x |T|	upon request	K
1/10 IEC60751 F 0.3	0.03 + 0.0005 x |T|	upon request	K

* Customer-specific temperature range available on request

|T| is the numerical value of the temperature in °C without taking leading signs into account.

The temperature curves refer to IEC60751 standards. The values in the table are for informative purposes only. Based on the assembly method and the different measurement conditions, accuracy, self-heating and response time may vary.

The measurement point is 5 mm from the wire end. For long wires (> 20 mm) the resistance is compensated (measured at room temperature) to ensure the correct resistance at the chip edge.

The resistance compensation of long wires (direct soldered or extended wires) has always to be taken into consideration for the end application. Exceptions are 3 or 4 wire solutions.

For 1/3 IEC60751, 1/5 IEC60751, 1/10 IEC60751 and 3- or 4-wire sensors please contact us.

7. Applied Current

The influence of the applied current is highly dependent on how the sensor is used in the application and can lead to significant self-heating effects. In general, the applied current should be as low as possible in order to reduce self-heating effects. The following values are typically used as measurement current:

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

Higher measurement currents can be applied as long as self-heating does not change the measurement value more than the needed measurement accuracy. The maximum current for sensors between 750°C and 1000°C should not exceed 1mA.

8. Self-heating

The electric current generates self-heating resulting in errors of measurement. To minimize the error, the testing current should be kept as low as possible. The measurement error caused by self-heating is dependent on temperature error $\Delta T = R \times I^2 / E$.

E = self-heating coefficient in mW/K, R = resistance in kΩ, I = measuring current in mA

9. Response Time

The response time is defined as the time in seconds the sensor needs to detect the change in temperature. $t_{0.63}$ describes the time in seconds the sensor needs to measure 63 % of the temperature change. The response time depends on the sensor dimensions, the thermal contact resistance and the surrounding medium.

Dimensions number	Response time in seconds						Self-heating			
	Water (v = 0.4 m/s)			Air (v = 1 m/s)			Water (v = 0 m/s)		Air (v = 0 m/s)	
	$t_{0.5}$	$t_{0.63}$	$t_{0.9}$	$t_{0.5}$	$t_{0.63}$	$t_{0.9}$	E in mW/K	ΔT in [mK]1)	E in mW/K	ΔT in [mK]1)
161	0.05	0.08	0.18	1	1.2	2.5	12	8.3	1.8	56
308	0.08	0.1	0.25	1.2	1.5	3.5	15	6.7	2.2	46
232 (thin substrate)	0.09	0.12	0.33	2.7	3.6	7.5	40	2.5	4	25
202	0.11	0.16	0.38	3.6	4.9	10.2	32	3.1	3.2	31
216	0.12	0.18	0.42	4	5.4	11	36	2.8	3.6	28
232	0.15	0.2	0.55	4.5	6	12	40	2.5	4	25
325	0.25	0.3	0.7	5.5	7.5	16	90	1.1	8	13
516	0.25	0.3	0.7	5.5	7.5	16	80	1.3	7	14
520	0.25	0.3	0.75	6	8.5	18	80	1.3	7	14
525	0.33	0.4	0.85	6.5	9	19	90	1.1	8	13
538	0.35	0.4	0.90	7.5	10	20	140	0.7	10	10
505	0.4	0.5	1.1	8	11	21	150	0.7	11	9
102	0.33	0.4	0.85	7.5	10.5	20	140	0.7	10	10
281	2.5	4.5	8	10	15	28	60	1.7	5.5	18
281*	2	2.5	5.5	10	12	22	45	2.2	4	25
451	8	10	22	12	22	40	85	1.2	8	13
451*	5	6	14	16	18	37	60	1.7	6.5	15
SMD 1206	0.15	0.25	0.45	3.5	4.2	10	55	1.8	7	14
SMD 0805	0.1	0.12	0.33	2.5	3	8	38	2.6	4	25
FC 0603	0.08	0.1	0.25	1.8	2.2	5.5	25	4	2.5	40

1) Self-heating ΔT[mK] measured with Pt100 at 1 mA applied current at 0 °C

* Two sensing elements in the same round ceramic housing

L: Sensor length (without connections)

W: Sensor width

H: Sensor height (without connections)

H2: Sensor height (incl. connections and strain relief)

10. Dimensions Tolerances

Sensor width (W) ±0.2 mm
Sensor length (L) ±0.2 mm
Sensor height (H2) ±0.3 mm
Sensor height (H) ±0.1 mm

Wire length ±1 mm (up to 30 mm)
Wire length > 30 mm, tolerances according ISO 2768-1, tolerance class V (very coarse): see table below

Wire length in mm	31-120	121-400	401-1000	1001-2000	2001-4000
ISO 2768-1, tolerance class V (very coarse):	±1.5 mm	±2.5 mm	±4 mm	±6 mm	±8 mm

11. Operating Conditions

Platinum temperature sensors are built on the basis of very robust materials: a high temperature glass protects the meander, the substrate is mainly based on densely sintered high-purity alumina and the wire fixations enable a reliable strain relief of the welding points.

Unfortunately it is not possible to test the sensor behavior in all application and installation conditions. Therefore the customer needs to test the compatibility of the sensor element with the application and/or the installation conditions. With certain ceramic casting compounds for instance there can occur chemical reactions between the passivation glass and the fixation glass. Potential problems can also arise due to strong creeping polymers (e.g. uncured

silicones) or because of the reaction between plastic-based casting compounds with the plastic-based wire fixations, used for directly welded wires. The use of bare sensors in long-term humid environment as well as in aggressive atmospheres has to be avoided; the same applies to the direct dipping of the sensor into liquids. Furthermore mechanical pressure on the sensors, e.g. caused by hard or strong post-curing casting compounds should be avoided. Some epoxy-based casting compounds might become conductive above Tg and therefore cause a bypass via the sensor wires, which can lead to a lower resistance reading.

For sensors at higher temperatures (> +600 °C) oxygen access should be guaranteed in order to counter post-oxidation-effects in stainless steel housings. Alternatively the construction should be chosen in a way that no significant decrease of the oxygen partial pressure might occur in the installation. In principle, stainless steel parts should be carefully cleaned and pre-oxidized.

IST AG also offers special (customer-specific) sensors for various applications. Please don’t hesitate to contact us and ask for your suitable sensor solution.

12. Storage

Platinum thin-film sensors must not be exposed to etching, corrosive or damp environments.
Humidity above 70% rH and direct exposure to sunlight should be avoided.
Additional storage precautions apply to specific sensors.

In ideal circumstances, the following parameters apply:

Temp. range:	10 °C to 30 °C
Humidity:	50 +/- 10 % rH
Storage:	Neutral environment, no direct exposure to sunlight

Additional storage precautions:

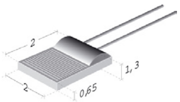
Silver plated and silver wire should be packaged in an airtight wrapping to avoid tarnishing.

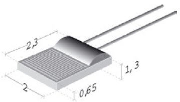
13. Voltage Sensitivity (e.g. ESD)

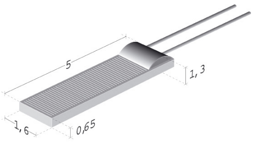
Platinum temperature sensors are passive components which cannot actively be protected against excess voltage events, such as ESD. In terms of ESD-sensitivity, they react similar to thin-film resistors. This means, that the ESD sensitivity is inherent to sensor design and is typically a function of size. But also, base resistance, meander design and special coating might have impact on ESD-sensitivity of platinum temperature sensors. ESD-induced damages of platinum RTDs a rarely observed in customer returns and are typically related to a specific assembly or application. In case ESD-damages are observed on the customer side, we recommend taking normal ESD precautions when handling the sensors. IST AG can also support critical applications with special design and help with the selection of sensor type.

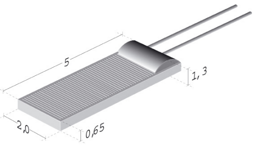
14. Sensor Construction Examples

Wire

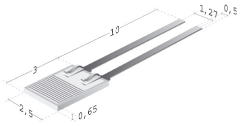


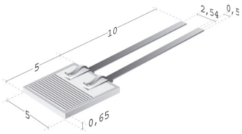


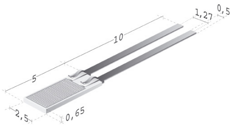


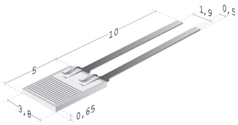


SIL

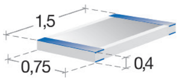


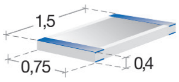


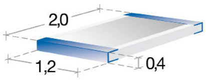


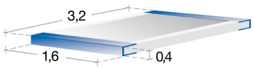


FlipChip and SMD

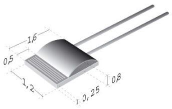


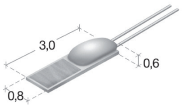




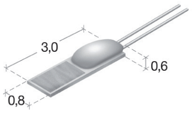


Minisens and Slimsens

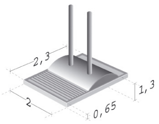




Long wire, insulated wire and insulated stranded wire



Inverted wire and perpendicular wire



Round ceramic housing