

Platinum - Temperature Sensors



INNOVATIVE SENSOR TECHNOLOGY

Data Sheet for Platinum Temperature Sensors

General Information:

In many industrial sectors and fields of research, temperature is one of the most important parameters which decides about product quality, security, and reliability. Temperature sensors are manufactured by variable technologies, according to the field of application. In sense of a specified product policy, IST has concentrated its development and manufacturing on high-end thin film temperature sensors. These processes derived from the semiconductor industry allow to manufacture sensors in very small dimensions. Because of their low thermic mass thin film temperature sensors exhibit a very short response time. Furthermore, thin film sensors 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
- simple interchangeability
- small dimensions
- resistant against vibration and temperature shocks
- high reliability

Response Time:

The response time $T_{0,63}$ is the time the sensors need to respond to 63% of the change in temperature. The response time depends on the sensor dimensions.

Long-Term Stability:

The change of ohmage after 1,000 hrs at maximum operating temperature 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 $k\Omega$, I = measuring current in 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} .

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.

Temperature Dependence of Resistivity:

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:

$$-200 \text{ at } 0^\circ\text{C} \quad R(t) = R_0 (1 + At + Bt^2 + C [t-100] \cdot t^3)$$

$$0 \text{ at } 850^\circ\text{C} \quad R(t) = R_0 (1 + At + Bt^2)$$

$$A = 3 \cdot 9083 \times 10^{-3} \cdot ^\circ\text{C}^{-1}; B = -5.775 \cdot 10^{-7} \cdot ^\circ\text{C}^{-2}; C = -4 \cdot 183 \cdot 10^{-12} \cdot ^\circ\text{C}^{-4}$$

R_0 = resistance value in ohm at 0°C

t = temperature in accordance with ITS90

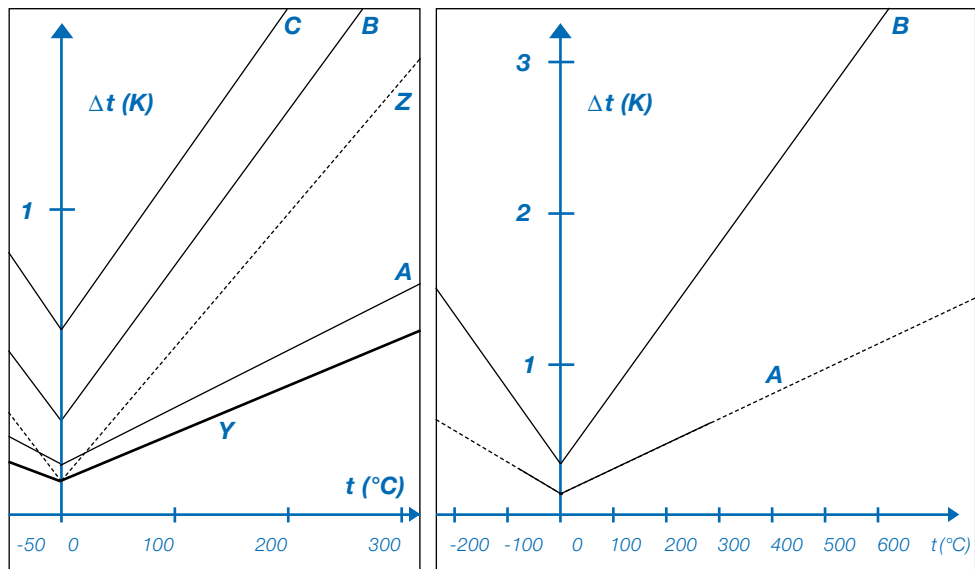
Tolerance Classes:

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

Class	± limit deviations in °C (K)	IST AG designation
DIN class A	0.15 + 0.002 · t	A
DIN class B	0.3 + 0.005 · t	B
2 x class B	0.6 + 0.005 · t	C
1/3 class B +	0.1 + 0.0017 · t	Y
1/3 class B -	0.1 + 0.005 · t	Z

|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)

Tolerance fields:



IST AG

EN60751
IST AG ———

Response Times and Self-Heating:

Sensor size	Response Time						Self-Heating	
	water 0.4m/s			air 1m/s			water	air
	$T_{0.5}$	$T_{0.63}$	$T_{0.9}$	$T_{0.5}$	$T_{0.63}$	$T_{0.9}$	mW/°C	mW/°C
2.3 x 2.0 x 0.25	0.09	0.12	0.33	2.7	3.6	7.5	40	4
2.3 x 2.0 x 0.63	0.15	0.2	0.55	4.5	6	12	40	4
3.0 x 2.5 x 0.63	0.25	0.3	0.7	5.5	7.5	16	90	8
5.0 x 1.6 x 0.63	0.25	0.3	0.7	5.5	7.5	16	80	7
5.0 x 2.0 x 0.63	0.25	0.3	0.75	6	8.5	18	80	7
5.0 x 2.5 x 0.63	0.33	0.4	0.85	6.5	9	19	90	8
10. x 2.0 x 0.63	0.33	0.4	0.85	7.5	10.5	20	140	10
5.0 x 3.8 x 0.63	0.35	0.4	0.9	7.5	10	20	140	10
5.0 x 5.0 x 0.63	0.4	0.5	1.1	8	11	21	150	11
1 x 13 x Ø 2.8	2.5	4.5	8	10	15	28	60	5.5
2 x 13 x Ø 2.8	2	2.5	5.5	10	12	22	45	4
1 x 13 x Ø 4.5	8	10	22	12	22	40	85	8
2 x 13 x Ø 4.5	5	6	14	16	18	37	60	6.5

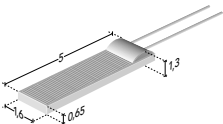
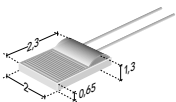
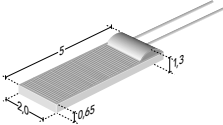
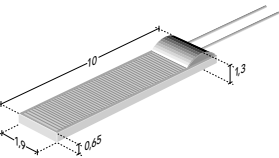
Tolerances of dimensions:

Sensor width	± 0.2 mm	Wire length	± 1.0 mm
Sensor length	± 0.2 mm	Tube length	± 0.2 mm
Sensor thickness	± 0.1 mm	Tube diameter	± 0.1 mm

Standard Versions

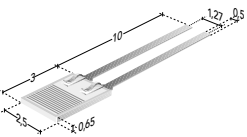
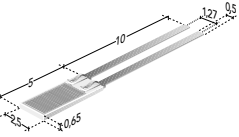
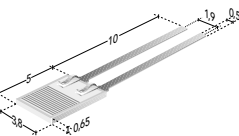
Temperature sensors with Wire Terminations:

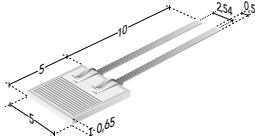
Product series Pxxx.xxx.4W.x.010 -200°C .. 400°C (silver-wire 0.25 x 10 mm)
 Product series Pxxx.xxx.6W.x.010 -200°C .. 600°C (platinum-clad-Nickel wire 0.2 x 10 mm)

Dimensions	Nominal resistance at 0°C (Ohm)	Part number
	100	P0k1.516.xW.x.010
	500	P0k5.516.xW.x.010
	1 000	P1k0.516.xW.x.010
	2 000	P2k0.516.xW.x.010
	100	P0k1.232.xW.x.010
	500	P0k5.232.xW.x.010
	1 000	P1k0.232.xW.x.010
	2 000	P2k0.232.xW.x.010
	100	P0k1.520.xW.x.010
	500	P0k5.520.xW.x.010
	1 000	P1k0.520.xW.x.010
	2 000	P2k0.520.xW.x.010
	100	P0k1.102.xW.x.010
	500	P0k5.102.xW.x.010
	1 000	P1k0.102.xW.x.010
	2 000	P2k0.102.xW.x.010

Temperature sensors with SIL lead frames:

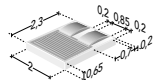
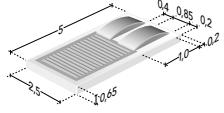
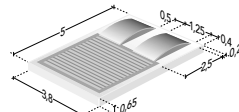
Product series Pxxx.xxx.2S.x -50 .. 200°C

Dimensions	Nominal resistance at 0°C (Ohm)	Part number
	100	P0k1.325.2S.x
	500	P0k5.325.2S.x
	1 000	P1k0.325.2S.x
	100	P0k1.525.2S.x
	500	P0k5.525.2S.x
	1 000	P1k0.525.2S.x
	2 000	P2k0.525.2S.x
	5 000	P5k0.525.2S.x
	100	P0k1.538.2S.x
	500	P0k5.538.2S.x
	1 000	P1k0.538.2S.x

Dimensions	Nominal resistance at 0°C (Ohm)	Part number
	100	P0k1.505.2S.x
	500	P0k5.505.2S.x
	1 000	P1k0.505.2S.x

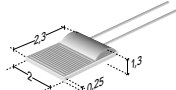
**Leadless Chip
Temperatur sensors:**

- Product series Pxxx.xxx.1P.x -50 .. 150°C (with low melting point solder bumps)
- Product series Pxxx.xxx.2P.x -50 .. 200°C (with high melting point solder bumps)
- Product series Pxxx.xxx.4P.x -50 .. 400°C (without solder bumps)

Dimensions	Nominal resistance at 0°C (Ohm)	Part number
	100	P0k1.232.xP.x
	500	P0k5.232.xP.x
	1 000	P1k0.232.xP.x
	100	P0k1.525.xP.x
	500	P0k5.525.xP.x
	1 000	P1k0.525.xP.x
	100	P0k1.538.xP.x
	500	P0k5.538.xP.x
	1 000	P1k0.538.xP.x

**Temperature sensors
on a Thin Substrate:**

Product series Pxxx.232.xT.x.010

Dimensions	Nominal resistance at 0°C (Ohm)	Part number
	100	P0k1.232.xT.x.010
	500	P0k5.232.xT.x.010
	1 000	P1k0.232.xT.x.010

**Temperature sensors
with perpendicular leads:**

Product series Pxxx.232.4SW.x.010

	100	P0k1.232.4SW.x.010
	500	P0k5.232.4SW.x.010
	1 000	P1k0.232.4SW.x.010

Standard Versions

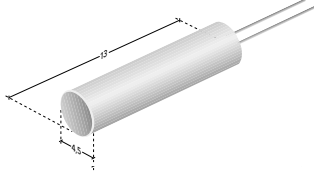
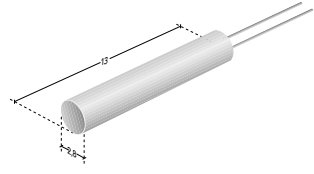

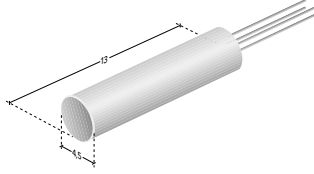
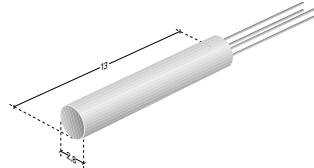
Temperature sensors in ceramic tubes:

Product series Pxxx.xxx.4R.x.013 -50°C .. 400°C (silver-wire 0.25 x 13 mm)

Product series Pxxx.xxx.6R.x.007 -50°C .. 600°C (platinum-clad-nickel-wire 0.2 x 7 mm)

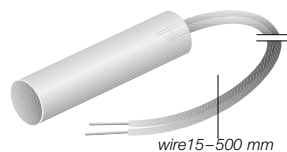
Product series Pxxx.204.4R.x.007 -50°C .. 400°C (silver-wire 0.2 x 7 mm)

Product series Pxxx.204.6R.x.007 -50°C .. 600°C (platinum-clad-nickel-wire 0.2 x 7 mm)

Dimensions	Nominal resistance at 0°C (Ohm)	Part number
	100	P0k1.451.xR.x
	500	P0k5.451.xR.x
	1 000	P1k0.451.xR.x
	100	P0k1.281.xR.x
	500	P0k5.281.xR.x
	1 000	P1k0.281.xR.x
	100	P0k1.204.xR.x
	500	P0k5.204.xR.x
	1 000	P1k0.204.xR.x
	100	2x P0k1.451.xR.x
	500	2x P0k5.451.xR.x
	1 000	2x P1k0.451.xR.x
	100	2x P0k1.281.xR.x
	500	2x P0k5.281.xR.x
	1 000	2x P1k0.281.xR.x

Special Versions

With long and insulated wire terminations: for dimensions nos. 281 and 451



100	P0k1.xxx.xRI.x
500	P0k5.xxx.xRI.x
1 000	P1k0.xxx.xRI.x

Special Versions:

Special Versions: IST AG offers many special versions. We shall be pleased to inform you about the various available solutions such as e.g.:

- special chip dimensions
- special nominal values
- substrate thickness: 0.25 mm, 0.38 mm
- wire material: Pt, Pd, Ni, AgPd, AuPd, insulated wire materials
- wire diameters: 0.1 - 0.4 mm
- wire length may be freely selected,
- metal-coated backside: either - Pt, or -NiCr/Ni/Au

**Resistor Table:
relative values
of resistivity
in steps of 1°C**

°C	-0	-1	-2	-3	-4	-5	-6	-7	-8	-9
-200	0.185	0.190	0.194	0.198	0.202	0.207	0.211	0.215	0.220	0.224
-190	0.228	0.233	0.237	0.241	0.245	0.250	0.254	0.258	0.262	0.267
-180	0.271	0.275	0.279	0.284	0.288	0.292	0.296	0.301	0.305	0.309
-170	0.313	0.318	0.322	0.326	0.330	0.334	0.339	0.343	0.347	0.351
-160	0.355	0.360	0.364	0.368	0.372	0.376	0.381	0.385	0.389	0.393
-150	0.397	0.401	0.406	0.410	0.414	0.418	0.422	0.426	0.430	0.435
-140	0.439	0.443	0.447	0.451	0.455	0.459	0.464	0.468	0.472	0.476
-130	0.480	0.484	0.488	0.492	0.496	0.501	0.505	0.509	0.513	0.517
-120	0.521	0.525	0.529	0.533	0.537	0.542	0.546	0.550	0.554	0.558
-110	0.562	0.566	0.570	0.574	0.578	0.582	0.586	0.590	0.594	0.599
-100	0.603	0.607	0.611	0.615	0.619	0.623	0.627	0.631	0.635	0.639
-90	0.643	0.647	0.651	0.655	0.659	0.663	0.667	0.671	0.675	0.679
-80	0.683	0.687	0.691	0.695	0.699	0.703	0.707	0.711	0.715	0.719
-70	0.723	0.727	0.731	0.735	0.739	0.743	0.747	0.751	0.755	0.759
-60	0.763	0.767	0.771	0.775	0.779	0.783	0.787	0.791	0.795	0.799
-50	0.803	0.807	0.811	0.815	0.819	0.823	0.827	0.831	0.835	0.839
-40	0.843	0.847	0.851	0.855	0.859	0.862	0.866	0.870	0.874	0.878
-30	0.882	0.886	0.890	0.894	0.898	0.902	0.906	0.910	0.914	0.918
-20	0.922	0.926	0.929	0.933	0.937	0.941	0.945	0.949	0.953	0.957
-10	0.961	0.965	0.969	0.973	0.977	0.980	0.984	0.988	0.992	0.996
°C	0	1	2	3	4	5	6	7	8	9
0	1.000	1.004	1.008	1.012	1.016	1.020	1.023	1.027	1.031	1.035
10	1.039	1.043	1.047	1.051	1.055	1.058	1.062	1.066	1.070	1.074
20	1.078	1.082	1.086	1.090	1.093	1.097	1.101	1.105	1.109	1.113
30	1.117	1.121	1.124	1.128	1.132	1.136	1.140	1.144	1.148	1.152
40	1.155	1.159	1.163	1.167	1.171	1.175	1.179	1.182	1.186	1.190
50	1.194	1.198	1.202	1.206	1.209	1.213	1.217	1.221	1.225	1.229
60	1.232	1.236	1.240	1.244	1.248	1.252	1.255	1.259	1.263	1.267
70	1.271	1.275	1.278	1.282	1.286	1.290	1.294	1.298	1.301	1.305
80	1.309	1.313	1.317	1.320	1.324	1.328	1.332	1.336	1.339	1.343
90	1.347	1.351	1.355	1.358	1.362	1.366	1.370	1.374	1.377	1.381
100	1.385	1.389	1.393	1.396	1.400	1.404	1.408	1.412	1.415	1.419
110	1.423	1.427	1.430	1.434	1.438	1.442	1.446	1.449	1.453	1.457
120	1.461	1.464	1.468	1.472	1.476	1.480	1.483	1.487	1.491	1.495
130	1.498	1.502	1.506	1.510	1.513	1.517	1.521	1.525	1.528	1.532
140	1.536	1.540	1.543	1.547	1.551	1.555	1.558	1.562	1.566	1.570
150	1.573	1.577	1.581	1.584	1.588	1.592	1.596	1.599	1.603	1.607
160	1.611	1.614	1.618	1.622	1.625	1.629	1.633	1.637	1.640	1.644
170	1.648	1.651	1.655	1.659	1.663	1.666	1.670	1.674	1.677	1.681
180	1.685	1.688	1.692	1.696	1.700	1.703	1.707	1.711	1.714	1.718
190	1.722	1.725	1.729	1.733	1.736	1.740	1.744	1.748	1.751	1.755
200	1.759	1.762	1.766	1.770	1.773	1.777	1.781	1.784	1.788	1.792
210	1.795	1.799	1.803	1.806	1.810	1.814	1.817	1.821	1.825	1.828
220	1.832	1.836	1.839	1.843	1.846	1.850	1.854	1.857	1.861	1.865
230	1.868	1.872	1.876	1.879	1.883	1.887	1.890	1.894	1.897	1.901
240	1.905	1.908	1.912	1.916	1.919	1.923	1.926	1.930	1.934	1.937
250	1.941	1.945	1.948	1.952	1.955	1.959	1.963	1.966	1.970	1.974
260	1.977	1.981	1.984	1.988	1.992	1.995	1.999	2.002	2.006	2.010
270	2.013	2.017	2.020	2.024	2.028	2.031	2.035	2.038	2.042	2.045
280	2.049	2.053	2.056	2.060	2.063	2.067	2.071	2.074	2.078	2.081
290	2.085	2.088	2.092	2.096	2.099	2.103	2.106	2.110	2.113	2.117
300	2.121	2.124	2.128	2.131	2.135	2.138	2.142	2.145	2.149	2.153
310	2.156	2.160	2.163	2.167	2.170	2.174	2.177	2.181	2.184	2.188
320	2.192	2.195	2.199	2.202	2.206	2.209	2.213	2.216	2.220	2.223
330	2.227	2.230	2.234	2.237	2.241	2.244	2.248	2.252	2.255	2.259
340	2.262	2.266	2.269	2.273	2.276	2.280	2.283	2.287	2.290	2.294
350	2.297	2.301	2.304	2.308	2.311	2.315	2.318	2.322	2.325	2.329
360	2.332	2.336	2.339	2.343	2.346	2.350	2.353	2.357	2.360	2.364
370	2.367	2.370	2.374	2.377	2.381	2.384	2.388	2.391	2.395	2.398
380	2.402	2.405	2.409	2.412	2.416	2.419	2.423	2.426	2.429	2.433
390	2.436	2.440	2.443	2.447	2.450	2.454	2.457	2.461	2.464	2.467
400	2.471	2.474	2.478	2.481	2.485	2.488	2.492	2.495	2.498	2.502
410	2.505	2.509	2.512	2.516	2.519	2.522	2.526	2.529	2.533	2.536
420	2.540	2.543	2.546	2.550	2.553	2.557	2.560	2.564	2.567	2.570
430	2.574	2.577	2.580	2.584	2.587	2.591	2.594	2.598	2.601	2.604
440	2.608	2.611	2.615	2.618	2.621	2.625	2.628	2.632	2.635	2.638
450	2.642	2.645	2.649	2.652	2.655	2.659	2.662	2.665	2.669	2.672
460	2.676	2.679	2.682	2.686	2.689	2.692	2.696	2.699	2.703	2.706
470	2.709	2.713	2.716	2.719	2.723	2.726	2.730	2.733	2.736	2.740
480	2.743	2.746	2.750	2.753	2.756	2.760	2.763	2.766	2.770	2.773
490	2.776	2.780	2.783	2.786	2.790	2.793	2.796	2.800	2.803	2.806
500	2.810	2.813	2.816	2.820	2.823	2.826	2.830	2.833	2.836	2.840
510	2.843	2.846	2.850	2.853	2.856	2.860	2.863	2.866	2.870	2.873
520	2.876	2.879	2.883	2.886	2.889	2.893	2.896	2.899	2.903	2.906
530	2.909	2.912	2.916	2.919	2.922	2.926	2.929	2.932	2.936	2.939
540	2.942	2.945	2.949	2.952	2.955	2.958	2.962	2.965	2.968	2.972
550	2.975	2.978	2.981	2.985	2.988	2.991	2.994	2.998	3.001	3.004
560	3.008	3.011	3.014	3.017	3.021	3.024	3.027	3.030	3.034	3.037
570	3.040	3.043	3.047	3.050	3.053	3.056	3.060	3.063	3.066	3.069
580	3.073	3.076	3.079	3.082	3.085	3.089	3.092	3.095	3.098	3.102
590	3.105	3.108	3.111	3.115	3.118	3.121	3.124	3.127	3.131	3.134
600	3.137	3.140	3.144	3.147	3.150	3.153	3.156	3.160	3.163	3.166

Part numbering

P	x	x	x	x	x	x	x	x	x	x	x	x	x	x	
										wire length					
Class															
										A	Class A				
										B	Class B				
										C	Class 2 DIN B				
										Z	Class 1/3 DIN B-				
										Y	Class 1/3 DIN B+				
										K	custom specified				
Contact version															
										S	SIL (Comatel)				
										P	pad				
										W	wire				
										I	insulated termination				
										R	round case				
										RI	round case + insulated terminations				
										T	thin substrate				
										K	customized				
										SW	perpendicular wire terminations				
Temperature range															
										1	.. 150°C				
										2	.. 200°C				
										4	.. 400°C				
										6	.. 600°C				
										Dimension number (see possible dimensions)					
Resistor (Ohm)															
Sensor-material identification															

Order example:

P 1 k 0 . 5 2 0 . 4 W . B . 0 1 0

1 | 2 | 3 | 4 | 5 | 6 | 7

- 1:** Identification of material = Platin temperature sensor
- 2:** Resistance value in ohm = 1 000 Ω / 0°C
- 3:** Chip size = 5 x 2 mm
- 4:** Temperature range = + 400°C
- 5:** Termination = Wire terminations (Ag, Ø 0,25 x 10 mm)
- 6:** Tolerance class = DIN EN 60 751 class B
- 7:** Length of termination = 10 mm

Subject to technical changes.



INNOVATIVE SENSOR TECHNOLOGY

