# Platinum and Nickel Thin Film Temperature Sensors

## Summary of Standard Products

TEMPERATURE

HUMIDITY

FLOW

At IST AG Switzerland, the only manufacturer of Platinum and Nickel thin film temperatur sensors, you get an unequaled range of various sensors. Our range includes more then 1000 sensor versions and offers the appropriate sensor for every application.
Based on this variety, this brochure is limited to our standard products. Which are available in small and high quantities.
Additional information will be obtained in the product data sheets MiniSens, SlimSens, CustomSens, HighSens Pt, HighSens Ni, mySens™, FW Line, Pt-1000℃, Pt-850℃ and SMD 0805/1206.
As a matter of course, we offer you specially designed products for your individual applications. The application engineers of IST are looking forward to consult you.

### 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.

IST product-code

*Combination only possible within the column!*

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Material (1)** | ● | Platinum (3850ppm/K) | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | P |
| | ○ | Platinum PU (3750ppm/K) | | | | | ○ | | | | | | PU |
| | ■ | Nickel NL (5000ppm/K) | | ■ | ■ | ■ | | | | | | | NL |
| | □ | Nickel ND (6180ppm/K) | | □ | □ | □ | | | | | □ | | ND |
| | | 25 further characteristics on request | | | | | | | | | | | → 1 |
| **Nominal resistance (2)** | | 100 Ohms | ● | ● | ● | ●■□ | ● | ● | ● | ● | ●□ | ● | 0k1 |
| | | 200 Ohms | | | | | | | | | | | 0k2 |
| | | 500 Ohms | ● | ■□ | ● | ●■□ | ● | ● | ● | ● | ● | ● | 0k5 |
| | | 1000 Ohms | ● | ●■□ | ●■□ | ●■□ | ●○ | ● | ● | ● | ●□ | ● | 1k0 |
| | | 5000 Ohms | | | ■□ | ● | | | | | | | 5k0 |
| | | 10'000 Ohms | | | ■□ | ● | | | | | | | 10k |
| | | further nominal resistance on request | | | | | | | | | | | → 2 |
| **Chip size (3)** | | 10.0 x 2.0 mm (Length x Width [mm]) | ● | | | | | | | | | | 102 |
| | | 5.0 x 3.8 mm | | ●■□ | | | | | | | | | 538 |
| | | 5.0 x 2.5 mm | | ●■□ | | | | | | | | | 525 |
| | | 5.0 x 2.0 mm | | | ●■□ | | | | | | | | 520 |
| | | 2.3 x 2.0 mm | | | | | ●○ | | | | | | 232 |
| | | 5.0 x 1.6 mm | | | | | | ● | | | | | 516 |
| | | 1.6 x 1.2 mm | | | | | | | | | | | 161 |
| | | 3.0 x 0.8 mm | | | | | | | | ● | | | 308 |
| | | 3.0 x 1.5 mm (SMD) | | | | | | | | | ●□ | | 1206 |
| | | 2.0 x 1.2 mm (SMD) | | | | | | | | | | ● | 0805 |
| | | | | | | | | | | | | | → 3 |
| **Temperature range (4)** | | up to 150 ℃ (wire only Cu/Ag or Cu Lack) | | | | ● | ● | | | | | | 1 |
| | | up to 200 ℃ (wire only Cu/Ag or silver) | | ●■□ | ●■□ | ●■□ | ● | | | | ●□ | ● | 2 |
| | | up to 300 ℃ (wire only Nickel) | | | ●■□ | ● | | | | ● | | | 3 |
| | | up to 400 ℃ | ● | | | ● | ●○ | ● | ● | | | | 4 |
| | | up to 600 ℃ | ● | | | ● | ●○ | ● | ● | | | | 6 |
| | | up to 750 ℃ | | | | ● | ● | | | ●* | | | 7 |
| | | up to 850 ℃ | ● | | | | | | | | | | 8 |
| | | up to 1000 ℃ on request | | | | | | | | | | | → 4 |
| **Wire bonding (5)** | | insulated wires: | | | | | | | | | | | |
| | | Cu enameled 0.2mm, < 150 ℃ | | | | | ● | | | ● | | | E |
| | | Cu/Ag-W. AWG 30, PTFE, 200 ℃ | | ●■□ | | ●■□ | ● | | | | | | I |
| | | Cu/Ag-str. W. AWG 28/7, PTFE, < 200 ℃ | | | | | ● | | | | | | L |
| | | bare wire: | | | | | | | | | | | |
| | | Silver, Ø 0.25mm, 200 ℃ or 400 ℃ | ● | ● | | ●■□ | ●○ | ● | ● | | | | W |
| | | Nickel, Ø 0.2mm, 300 ℃ | | | | ●■□ | ● | | | | | | W |
| | | Nickel, flatwire Gold coated, 300 ℃ | | | | ●■□ | ● | | | | | | FW |
| | | Nickel / Platinum, Ø 0.2mm, ≤ 600 ℃ | ● | | | ● | ●○ | ● | ● | | | | W |
| | | Platinum Ø 0.2mm, > 600 ℃ | ● | | | ● | ● | | | ●* | | | W |
| | | SIL (Comatel), 1.27 and 1.9mm, < 150 ℃ | | ●■□ | ●□ | | | | | | | | S |
| | | SMD (tin plated contacts), RoHS conform | | | | | | | | | ●□ | ● | P |
| | | | | | | | | | | * wire diameter 0.15mm | | | → 5 |
| **Tolerance (6)** | | class B Platinum (DIN EN 60751) | ● | ● | ● | ● | ●○ | ● | ● | ● | ● | ● | B |
| | | class A Platinum (DIN EN 60751) | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | A |
| | | class Y Platinum (⅓ DIN 60751 class B) | ● | ● | ● | ● | ● | ● | ● | ● | | | Y |
| | | class B Nickel (DIN 43760) | | ■□ | ■□ | ■□ | | | | | □ | | B |
| | | class A Nickel (⅓ DIN 43760) | | ■□ | | | | | | | | | A |
| | | other tolerances on request | | | | | | | | | | | → 6 |
| **Wire length (7)** | | 10mm (2-wires) | ● | ●■□ | ●■□ | ●■□ | ●○ | ● | ● | ● | | | 010 |
| | | | | | | | | | | | | | → 7 |

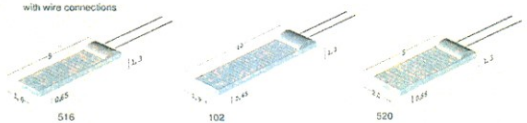
- Sensors with silver wires has a standard length of 10 or 15mm
- special wire length (typically 35 up to 1000mm) with 2-, 3- or 4-wires or insulated wires on request.

*IST AG offers a variety of special applications, we will be glad to inform you about the options.*

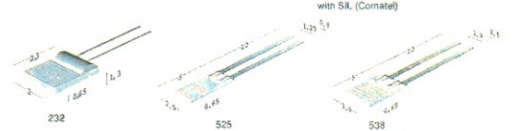


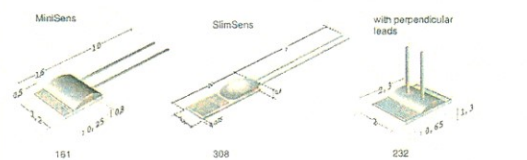
**Dimensions**

with wire connections




with SIL (Comatel)




**Configuration IST product-code**

| | Product-code | |
|---|---|---|
| 1 | | Material: |
| 2 | | Nominal resistance: |
| 3 | | Chip size: |
| 4 | | Temperature range: |
| 5 | | Wire bonding: |
| 6 | | Tolerance: |
| 7 | | Wire length: |

**Legend**

| | |
|---|---|
| ● | Platinum P (3850 ppm/K) |
| ○ | Platinum PU (3750ppm/K) |
| ■ | Nickel NL (5000ppm/K) |
| □ | Nickel ND (6180ppm /K) |
| | on request |
| | production not possible |

*Example:*

*Article No.: P1k0.520.6W.B.010*

| P | resp. | Platinum temperature sensor | |
|---|---|---|---|
| 1k0 | | 1000 Ω / 0 ℃ | Material |
| 520 | | 5 x 2 mm | Nominal resistance |
| 6 | | + 600 ℃ | Chip size |
| W | | Nickel / Platinum-wire 0.2mm | Temperature range |
| B | | DIN EN 60 751 class B | Wire bonding |
| 10 | | 10mm | Tolerance |
| | | | Wire length |

# Platinum and Nickel Thin Film Temperature Sensors
## Sensor Characteristics

## Platinum

### Characteristic Temperature Curve

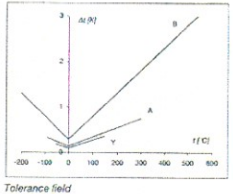
*The following definition of the temperature curve according to the DIN EN 60751 standard applies:*

*-200 to 0 °C* $R(t) = R_0 (1 + At + Bt^2 + C [t-100] \cdot t^3)$

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

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

$R_0$ = *resistance value in ohms at 0 °C*
*t = temperature in accordance with ITS90*



*Tolerance field*

### Tolerance Classes

| *Class* | *+/- limit deviations in °C (K)* | *IST AG designation* | *Temperature range** |
|---|---|---|---|
| *DIN 60751, class B* | *0.30 + 0.005 x \|t\|* | *B* | *-200 °C to 850 °C* |
| *DIN 60751, class A* | *0.15 + 0.002 x \|t\|* | *A* | *-90 °C to 300 °C* |
| *1/3 DIN 60751, class B* | *0.10 + 0.0017 x \|t\|* | *Y* | *-50 °C to 150 °C* |

**Temperature range referring to tolerance classes*

## Nickel

### Characteristic Temperature Curve

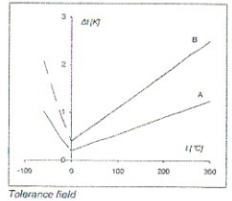
*The characteristic temperature curve determines the dependence of the electrical resistivity on the temperature:*

$R(t) = R_0 (1 + A \cdot t + B \cdot t^2 + C \cdot t^3 + D \cdot t^4 + E \cdot t^5 + F \cdot t^6)$

*Coefficients for:*
*Nickel NL (5000 ppm/K):*
$A = 4.427 \cdot 10^{-3} \cdot °C^{-1}$; $B = 5.127 \cdot 10^{-6} \cdot °C^{-2}$;
$C = 5.585 \cdot 10^{-9} \cdot °C^{-3}$; $D = E = F = 0$

*Nickel ND (6180 ppm/K):*
$A = 5.485 \cdot 10^{-3} \cdot °C^{-1}$; $B = 6.65 \cdot 10^{-6} \cdot °C^{-2}$; $C = 0$;
$D = 2.805 \cdot 10^{-11} \cdot °C^{-4}$; $E = 0$; $F = -2 \cdot 10^{-17} \cdot °C^{6}$

$R_0$ = *resistance value in ohms at 0 °C*
*t = temperature in accordance with ITS90*



*Tolerance field*

### Tolerance Classes

| *Class* | *+/- limit deviations in °C (K)* | | *IST AG designation* |
|---|---|---|---|
| | *t<0 °C* | *t>0 °C* | |
| *DIN 43760* | *0.4 + 0.028 x \|t\|* | *0.4 + 0.007 x \|t\|* | *B* |
| *⅓ DIN 43760* | *0.2 + 0.014 x \|t\|* | *0.2 + 0.0035 x \|t\|* | *A* |

# Platinum and Nickel Thin Film Temperature Sensors
## General Information

### Typical Features

- *brief response time*
- *excellent long-term stability*
- *low self-heating rate*
- *simple interchange ability*
- *small dimensions*
- *resistant against vibration and temperature shocks*
- *high reliability*

### Response Time

*The response time To.63 is the time the sensors need to respond to 63% of the change in temperature. The response time depends on the sensor dimensions.*

### 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 Pt100).*
*Temperature errorst = R/E; with E = self-heating coefficient in mW/K*
*R = resistance in kOhm, I = measuring current in mA*

### Response Times and Self Heating

| | *Response Times* | | | | | | *Self Heating* | |
|---|---|---|---|---|---|---|---|---|
| | *water 0.4 m/s* | | | *air 1 m/s* | | | *water* | *air* |
| *Sensor size* | $T_{0.5}$ | $T_{0.63}$ | $T_{0.9}$ | $T_{0.5}$ | $T_{0.63}$ | $T_{0.9}$ | *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* |
| *10.0 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* | *50* | *6.5* |

### Long-Term Stability

*Platinum: The change of ohmage after 1,000 hrs at maximum operating temperature amounts to less than 0.03%.*
*Nickel: The change of ohmage after 1,000 hrs at maximum operating temperature amounts to less than 0.1%.*



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