



## Features

- Automotive qualified according to AEC-Q-101
- Package MLS1 certified
- Small SMD package SOT 23 for short step response
- Comply with former DIN 43760 standard Class B
- Resistance: 1000 ohms at 0°C
- Temperature range: -55°C to +160°C
- Good linearity between resistance and temperature
- Large temperature coefficient of resistance: 6178 ppm/K (0°C, 100°C)
- Good thermal contact via Pin 3

## Applications

- Contact temperature sensing, control and compensation
- General instrumentation
- Remote sensing

# NI1000SOT

## Temperature Sensor

### General description

Ni1000SOT is a nickel thin film resistance temperature detector (RTD) that is suitable for use in contact temperature sensing.

The devices are manufactured by PVD-deposition on a silicon substrate. The thin film structure is covered by a passivation layer for environmental protection and enhanced stability. The nickel elements are mounted on lead frames and encapsulated in SOT23 packages. This technology allows the production of miniature, low cost, high precision temperature sensors.

The characteristics of the temperature sensor comply with the former DIN 43760 standard. It is qualified for the most demanding automotive applications (incl. exposure to hot oil) and is suitable for many more applications in harsh environments.

The lead frame of the used package consists of Alloy 42 with a thin silver surface. The leads are tin coated for reflow soldering assembly process.

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Temperature Sensor

## Ordering Information

Description	Part Number
NI 1000 DIN 43760 KL.B SOT23	G-NICO-001

## Specifications

### Absolute Maximum Ratings

Parameter	Symbol	Unit	Min	Typ.	Max	Condition
Storage Temperature	T <sub>st</sub>	°C	-55	---	165	---
Current	I	mA	---	---	5	Sensor temperature shall not exceed 165°C
ESD Rating (HBM)	Class	---	---	1B (500V)	---	MIL 883E3015.7
ESD Rating (CDM)	Class	---	---	C2a (500V)	---	

Note:

Stress above one or more of the limiting values may cause permanent damage to the device. Exposure to limiting values for extended periods may affect device reliability.

### Performance specs

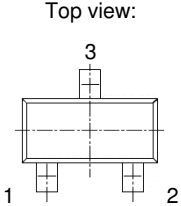
Parameter	Symbol	Min.	Typ.	Max.	Unit	Condition
Basic resistance	R <sub>0</sub>	997.81	1000	1002.2	Ω	0°C
Temperature coefficient of resistance	TCR		6178		ppm/K	0°C to +100°C
Resistance at 100°C	R <sub>100</sub>	1610.2	1617.8	1625.4	Ω	100°C
Measurement current	I	---	1.2	---	mA	---
Self-heating coefficient	EK	1.4	1.7	2	mW/K	+23 °C, still air
Operation temperature	T <sub>Op</sub>	-55	---	+165	°C	---
Maximum resistance drift	ΔR	---	0.1	---	%	1000h@150°C
Time constant	t <sub>63</sub>	---	0.5	---	s	Measured in non-conductive liquid, step: 20°C ... 100°C
Moisture sensitivity level	MSL	---	1	---	---	

### Self-heating effect

For accurate temperature measurement it is recommended to choose a small current to avoid self-heating of the nickel sensing element. The temperature error caused by excessive measurement current can be calculated using:  $\Delta T = P/EK$

where  $P = I^2 \cdot R$  is the power generated by the measurement current and EK is the self heating coefficient.

### Terminal connection

	Pin # 1	Nickel RTD electrical contact
	Pin # 2	Nickel RTD electrical contact
	Pin # 3	Electrically isolated thermal contact

**Characteristic curve and tolerances**

The characteristic of the nickel temperature sensor is specified as per DIN 43760. The large Temperature Coefficient of Resistance (TCR) of the Ni-RTD, 6178 ppm/K, offers greater sensitivity than other types of RTD's. The electrical characteristic can be described by the following equation:

$$R(T) = R_0 (1+aT+bT^2+cT^4+dT^6)$$

**Coefficients:**

a =	5.485 x 10 <sup>-3</sup>
b =	6.650 x 10 <sup>-6</sup>
c =	2.805 x 10 <sup>-11</sup>
d =	-2.000 x 10 <sup>-17</sup>

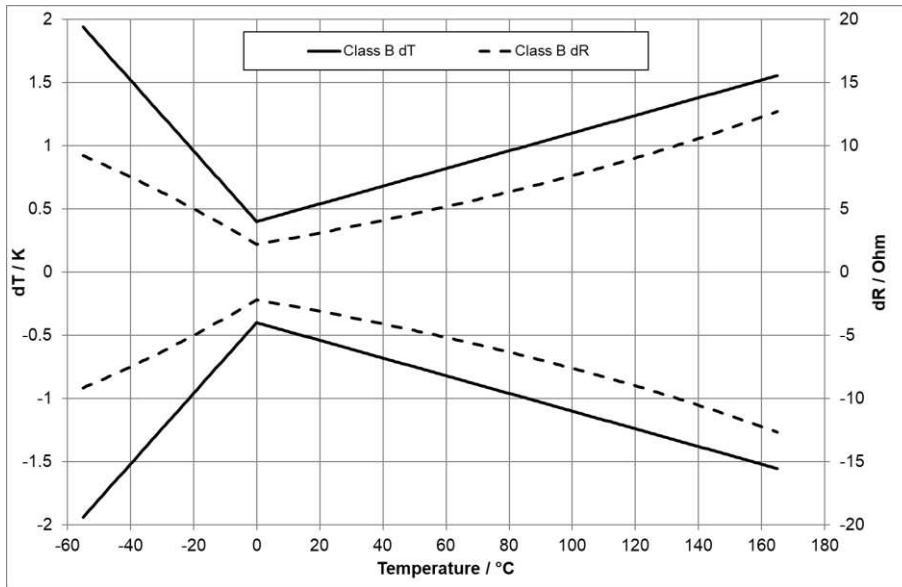
$$T(R) = a' + b'(1+c'R)^{1/2} + d'R^5 + e'R^7 \quad dT < 0.12 \text{ K (higher order equations on request)}$$

**Coefficients:**

a' =	-412.6
b' =	140.41
c' =	0.00764
d' =	-6.25 x 10 <sup>-17</sup>
e' =	-1.25 x 10 <sup>-24</sup>

**Tolerances according Class B:** ± (0.4+0.007 x |T|) in range from 0°C to +165°C  
 ± (0.4+0.028 x |T|) in range from -55°C to 0°C

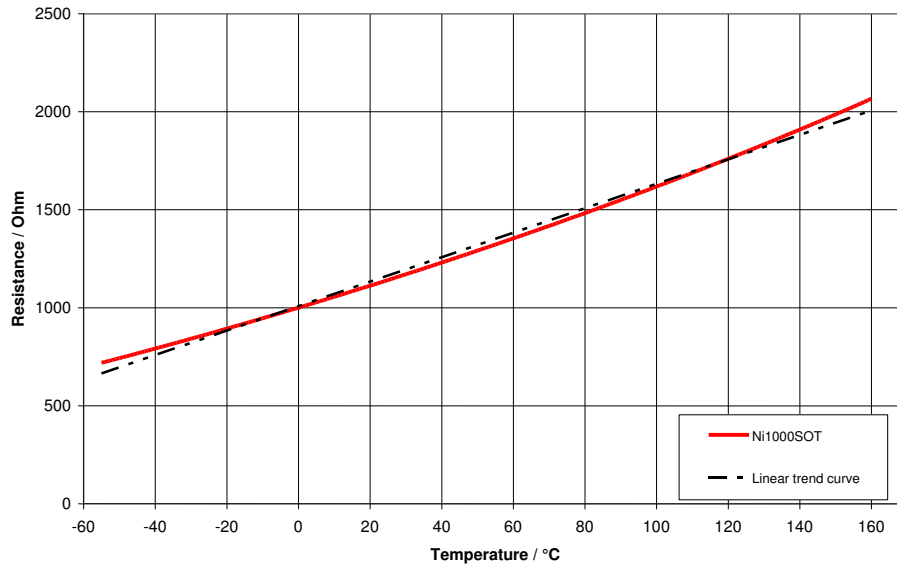
The figure below shows the tolerance chart.



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The following diagram shows the nominal resistance versus temperature diagram.



## Resistance Table

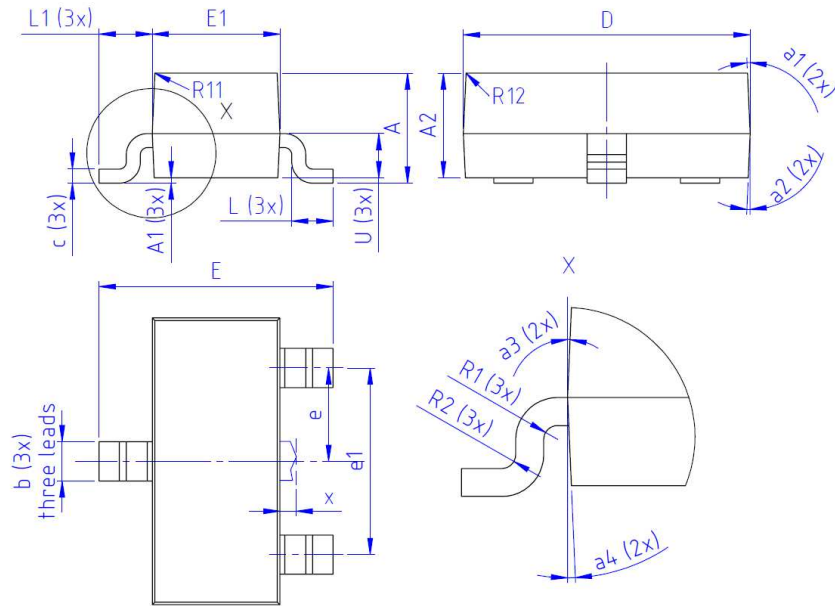
Temperature (°C) against Resistance (Ohm).

T/°C	0	1	2	3	4	5	6	7	8	9
-60	695.2	699.9	704.6	709.3	714.0	718.7	723.4	728.2	733.0	737.8
-50	742.6	747.4	752.2	757.0	761.9	766.8	771.6	776.5	781.4	786.4
-40	791.3	796.3	801.2	806.2	811.2	816.2	821.2	826.3	831.3	836.4
-30	841.5	846.5	851.7	856.8	861.9	867.0	872.2	877.4	882.6	887.8
-20	893.0	898.2	903.4	908.7	913.9	919.2	924.5	929.8	935.1	940.5
-10	945.8	951.2	956.5	961.9	967.3	972.7	978.2	983.6	989.1	994.5
0	1000.0	1005.5	1011.0	1016.5	1022.0	1027.6	1033.1	1038.7	1044.3	1049.9
10	1055.5	1061.1	1066.8	1072.4	1078.1	1083.8	1089.5	1095.2	1100.9	1106.6
20	1112.4	1118.1	1123.9	1129.7	1135.5	1141.3	1147.1	1153.0	1158.8	1164.7
30	1170.6	1176.5	1182.4	1188.3	1194.2	1200.2	1206.1	1212.1	1218.1	1224.1
40	1230.1	1236.1	1242.2	1248.2	1254.3	1260.4	1266.5	1272.6	1278.8	1284.9
50	1291.1	1297.2	1303.4	1309.6	1315.8	1322.0	1328.3	1334.5	1340.8	1347.1
60	1353.4	1359.7	1366.0	1372.4	1378.7	1385.1	1391.5	1397.9	1404.3	1410.8
70	1417.2	1423.7	1430.1	1436.6	1443.1	1449.7	1456.2	1462.8	1469.3	1475.9
80	1482.5	1489.1	1495.7	1502.4	1509.1	1515.7	1522.4	1529.1	1535.9	1542.6
90	1549.3	1556.1	1562.9	1569.7	1576.5	1583.4	1590.2	1597.1	1604.0	1610.9
100	1617.8	1624.7	1631.7	1638.6	1645.6	1652.6	1659.6	1666.7	1673.7	1680.8
110	1687.9	1695.0	1702.1	1709.3	1716.4	1723.6	1730.8	1738.0	1745.2	1752.5
120	1759.7	1767.0	1774.3	1781.6	1788.9	1796.3	1803.7	1811.1	1818.5	1825.9
130	1833.3	1840.8	1848.3	1855.8	1863.3	1870.9	1878.4	1886.0	1893.6	1901.2
140	1908.9	1916.5	1924.2	1931.9	1939.6	1947.4	1955.1	1962.9	1970.7	1978.5
150	1986.3	1994.2	2002.1	2010.0	2017.9	2025.9	2033.8	2041.8	2049.8	2057.8
160	2065.9	2074.0	2082.1	2090.2	2098.3	2106.5	2114.6	2122.8	2131.1	2139.3

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## Mechanical dimensions



Dimension	Min	Typ	Max	Unit
A	0.91	1.00	1.10	mm
A1	0.01	0.05	0.10	mm
A2	0.90	0.95	1.00	mm
b	0.35	0.40	0.45	mm
c	0.08	0.10	0.12	mm
D	2.94	3.00	3.06	mm
e	0.90	0.95	1.00	mm
E	2.23	2.42	2.64	mm
E1	1.33	1.38	1.43	mm
e1	1.85	1.90	1.95	mm
L	0.32	0.40	0.48	mm
L1	0.45	0.52	0.62	mm
R1	0.03	0.10	0.30	mm
R2	0.05	0.15	0.50	mm
R11	0.00	0.00	0.05	mm
R12	0.00	0.01	0.05	mm
U	0.34	0.39	0.44	mm
X	0.00	0.10	0.25	mm
a1	0	7	14	°
a2	0	7	14	°
a3	0	7	14	°
a4	0	7	14	°

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### Marking on sensor housing

Three digit marking on package:

First digit:	internal code (1)
Second and third digit:	Revision of sensor: (e.g. 06)

Resulting marking: **106**

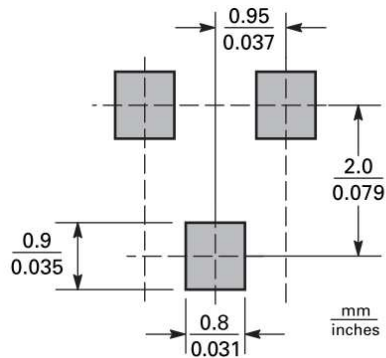
### Nominal weight

8mg per sensor

### Materials

IMDS ID:	539752560
Die:	Silicon wafer with structured thin film layer of Nickel, Titanium, Tungsten and Gold
Leadframe base material:	Alloy 42, thickness 1000µm (nominal)
Leadframe coating (from top to bottom):	<ul style="list-style-type: none"><li>• 8 – 10 µm Tin coating (&gt; 99.5%) – only at pin area!</li><li>• 0.2 µm (nominal) Ag coating</li><li>• 0.3 µm (nominal)</li></ul>
Bond wires:	Gold, 22 µm diameter, two wires per pad
Mold:	GE1030M, Manufacturer: Nitto (Hitachi)

### Footprint



### Recommended assembly method

Reflow soldering at 260°C – Soldering paste: 96Sn4Ag

## NI1000SOT

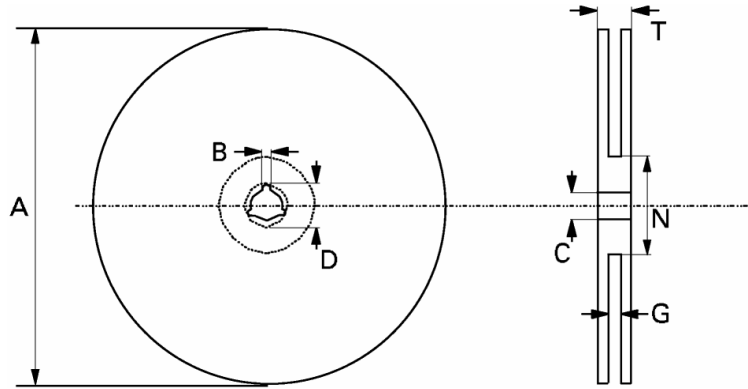
Temperature Sensor

### Packaging Information

The sensor will be delivered in tape and reel package. Each reel is packed in a karton box, called pizza box.

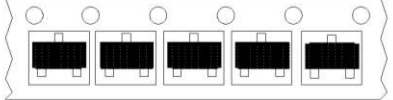
Reel diameter: 13 inches (330mm): 10000 pieces per reel

#### Dimensions of Reel



Dimension	Min	Typ	Max	Unit
A	---	---	330 (13")	mm
B	1.5	---	---	mm
C	12.8	13	13.2	mm
D	20.2	---	---	mm
N	60.5	62	63.5	mm
G	6.9	8.4 ± 1.5	9.9	mm
T	---	---	14.4	mm

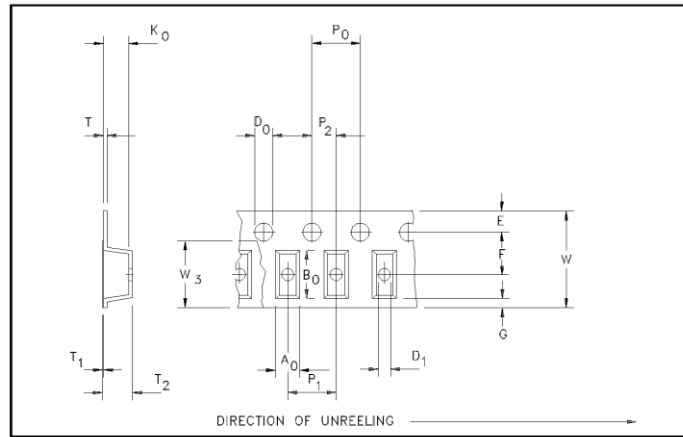
#### Orientation of Sensors inside Tape

Package	Orientation diagrams	Reel size supplied	No. of components	Tape option indicator
SOT 23		13" (330 mm)	10,000	TC

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## Dimension of Tape



Dimension	Min	Typ	Max	Unit
Tape Size	---	8	---	mm
A0	---	3.2	---	mm
B0	---	4	---	mm
K0	---	---	2.4	mm
D0	1.45	1.5	1.55	mm
D1	---	1.5	---	mm
E	1.65	1.75	1.85	mm
F	3.495	3.5	3.505	mm
G	---	0.75	---	mm
P0	3.9	4	4.1	mm
P1	---	4	---	mm
P2	1.95	2	2.05	mm
T	---	0.3	0.3	mm
T1	---	0.1	0.1	mm
T2	---	2.5	2.5	mm
W	7.7	8	8.3	mm
W3	---	5.5	---	mm

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