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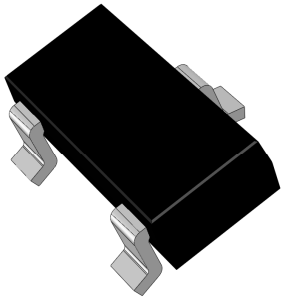
Ni1000SOT Temperature Sensor



- **Contact temperature sensing**
- **Comply with former DIN 43760 standard**
- **Small SMD package SOT 23**
- **Automotive qualified**

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.

FEATURES

- Resistance: 1000 ohms at 0°C
- Min/ Max temp -55°C to +160°C
- Good linearity between resistance and temperature (R V's T)
- Large temperature coefficient of resistance: 6178 ppm/K (0°C, 100°C)
- Low power consumption
- Good thermal contact via Pin 3
- Tape and reel (8mm format)

APPLICATIONS

- Temperature sensing, control and compensation
- General instrumentation
- Automotive (VW standard 801-01 vibration)
- Remote sensing

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PERFORMANCE SPECS

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
Basic resistance	R_0	0°C	997,81	1000	1002,20	Ω
Temperature coefficient of resistance (according to DIN 43760, see below)	TCR	0°C to +100°C	6100	6178	6240	ppm/K
Measurement current	I			0.2	5	mA
Self heating coefficient	EK	+23 °C, still air	1.4	1.7	2	mW/K
Operation temperature	T_{Op}		-55		+160	°C
Storage temperature	T_{St}		-55		+160	°C
ESD resistant		MIL 883E3015.7		Exceeds requirements		

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.

HANDLING INFORMATION

Parameter	Condition	Typ.	Max.	Unit
Package		SOT23		
Lead frame material and thickness		Alloy-42, Ag-Coating: 2 Pin Coating (Sn > 99.5%): 8-10		µm
Soldering	Reflow to + 260°C	96Sn4Ag		
Packing units		7” (180 mm) / 3000	13” (330 mm) / 10000	Reel Size / # of sensors

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TYPICAL PERFORMANCE CURVES

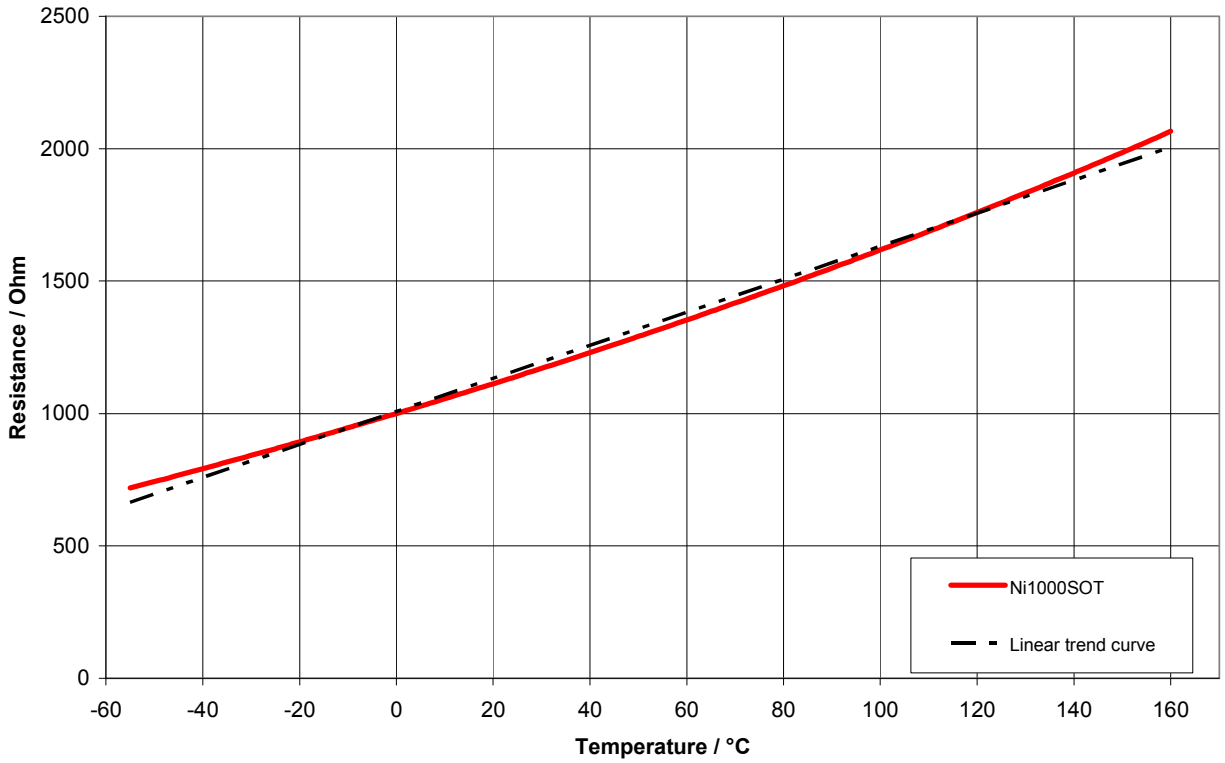

Figure 1: Resistance characteristics

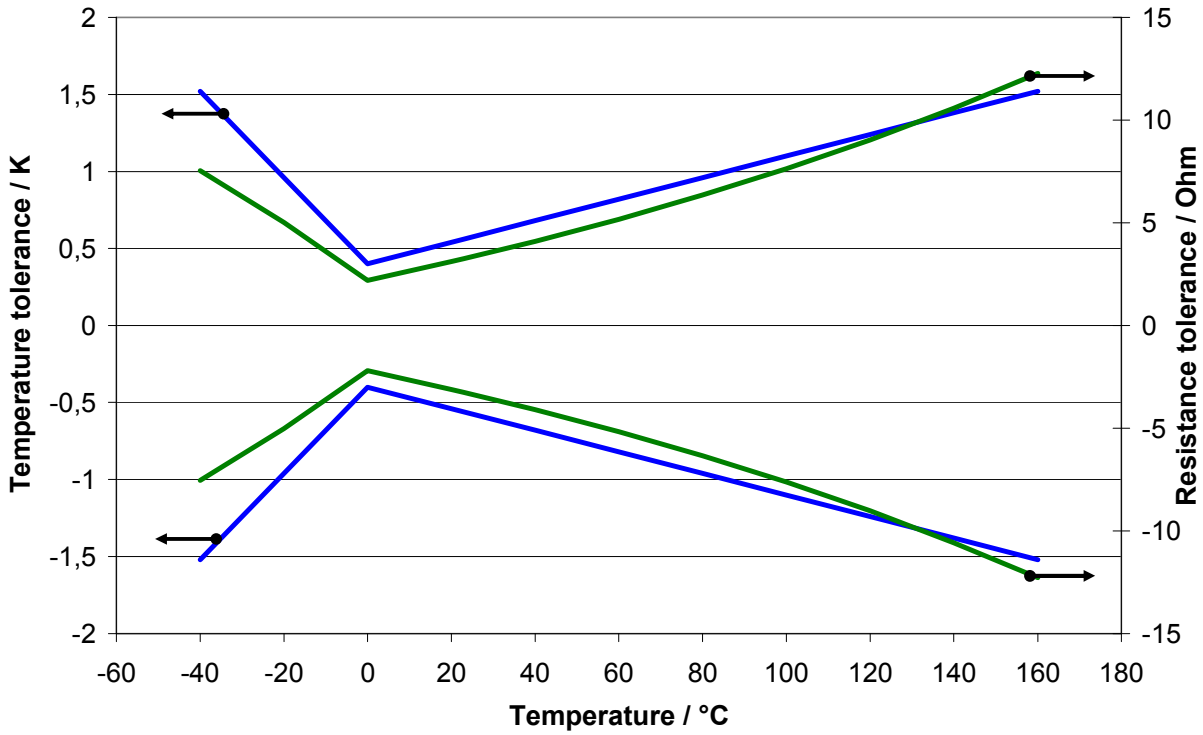

Figure 2: Tolerance chart

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ELECTRICAL CHARACTERISTIC

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:

$a = 5.485 \times 10^{-3}$
$b = 6.650 \times 10^{-6}$
$c = 2.805 \times 10^{-11}$
$d = -2.000 \times 10^{-17}$

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

Coefficients:

$a' = -412.6$
$b' = 140.41$
$c' = 0.00764$
$d' = -6.25 \times 10^{-17}$
$e' = -1.25 \times 10^{-24}$

Tolerances: Class B $\pm$ (0.4+0.007 x |T|) in range from 0°C to +160 °C
$\pm$ (0.4+0.028 x |T|) in range from -55°C to 0 °C

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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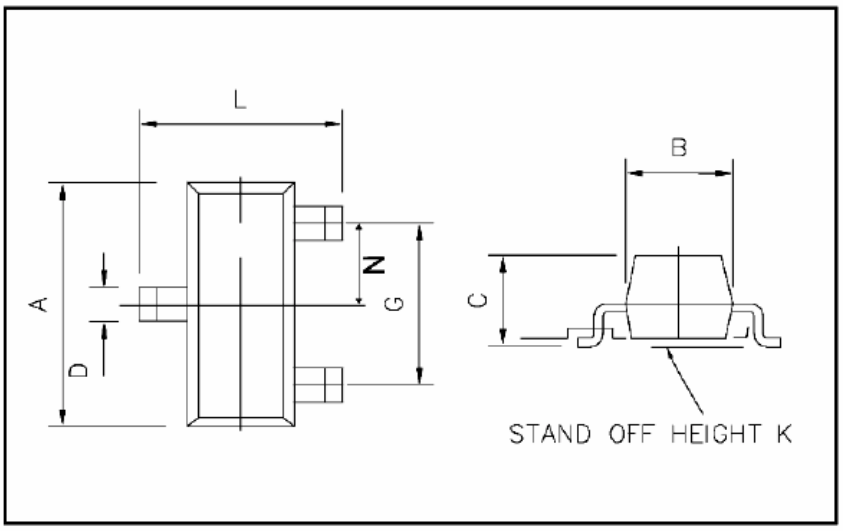
MECHANICAL DIMENSIONS

PACKAGE DIMENSIONS SOT23



DIM	Millimeters		Inches	
	Min	Max	Min	Max
A	2.67	3.05	0.1051	0.1201
B	1.20	1.40	0.0472	0.0551
C	-	1.10	-	0.0433
D	0.37	0.53	0.0146	0.0209
G	NOM 1.9		NOM 0.0748	
K	0.01	0.10	0.0004	0.0039
L	2.10	2.50	0.0827	0.0984
N	NOM 0.95		NOM 0.0374	

PIN DIMENSIONS

Dimension	Millimeters		Inches	
	Min	Max	Min	Max
Pin Thickness	0.085	0.15	0.0033	0.0059

CONNECTIONS

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

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RELIABILITY DATA

Test	Standard	Test conditions	Test Criteria	50 / 0	Remarks
High temperature life time test	CECC 50000	+160°C, I_F=1.5 mA, in air Duration: 1008 h	Electrical specification (Class B)	50 / 0	No failure
Rapid temperature change	IEC 68-2-14, Test N	-55°C / +160°C; hold time: 15 min; transfer time: <10 s # Cycles: 1000	Electrical specification (Class B)	50 / 0	No failure
Temperature and humidity during operation	CECC 50000	+85°C / 85% R.H.; I_F=1.5 mA Duration: 1008 h	Electrical specification (Class B)	50 / 0	No failure
Low temperature life time test		-55°C, I_F=5 mA, alternating operation 1 h on / 1 h off Duration: 1008 h	Electrical specification (Class B)	100 / 0	No failure
Life time test in oil		T= +135°C, I_F=1.2 mA Duration: 1008 h	Electrical specification (Class B)	50 / 0	No failure
High temperature exposure		+150°C , Duration 1000 h	<0.1% Delta (Δ) Resistance	50 / 0	No failure
Soldering temperature resistance		Soldering temperature: 260°C+/-5°C Duration: 10 s	Electrical specification (Class B)	50 / 0	No failure
Solderability		Soldering temperature: +260°C+/-5°C duration: 2 +/-0.5 s. drop speed: 25 +/-5 mm/s. Contact wetting: 90%		50 / 0	No visible damage

APPLICATION NOTE

Analogue Interface Circuit

The following circuit has been evaluated and is designed to provide a voltage output signal that is a linear function of temperature.

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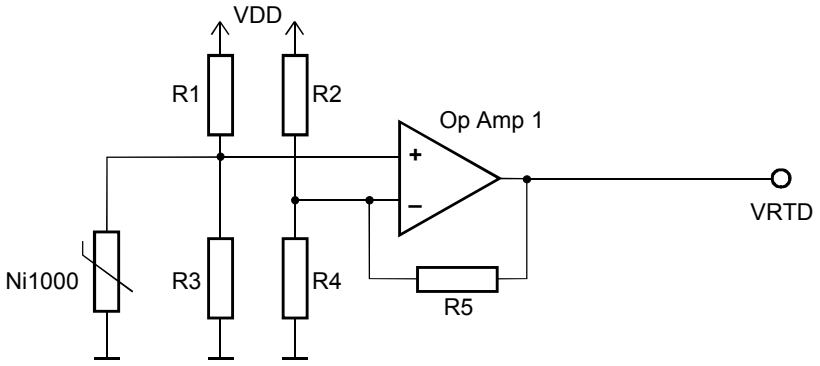

Figure 3: Example of analog interface circuit using Ni1000SOT sensor

VDD = 4.1 V
R1 = 56 kΩ
R2 = 56 kΩ
R3 = 3.65 kΩ
R4 = 732 Ω
R5 = 100 kΩ

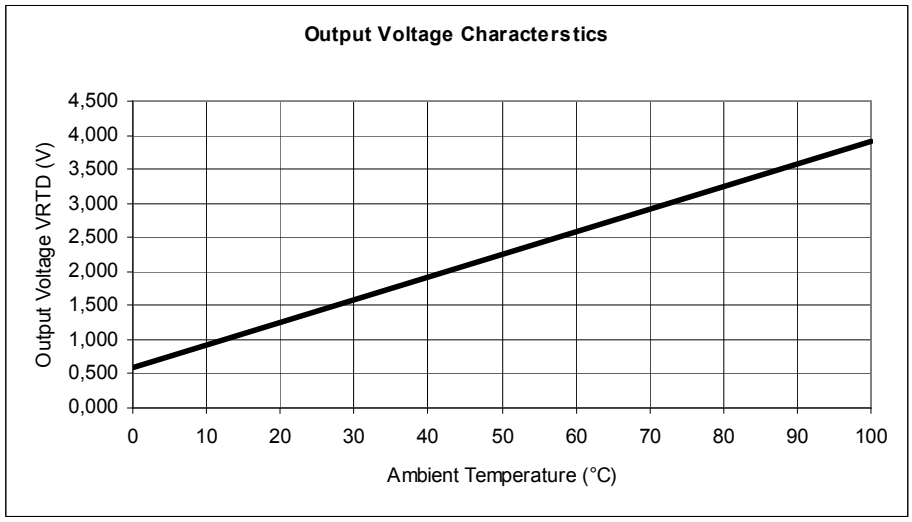

Figure 4: Output voltage characteristics of example circuit

ORDERING INFORMATION

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