Temperature Sensor Ni1000SOT

Rev 4: 21st June 2007

INTRODUCTION

The Ni1000SOT is a nickel thin film resistance temperature detector (RTD) that is suitable for use in contact temperature sensing. The characteristics of the temperature sensor comply with the former DIN 43760 standard.

The Ni1000SOT 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.

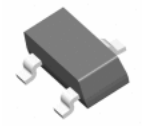
The Ni1000SOT sensor is qualified for the most demanding automotive applications (including exposure to hot oil) and is suitable for many more applications in harsh environments.

FEATURES

- Resistance: 1000 ohms at 0°C
- Min/ Max Temp -55°C to +160°C
- Package type SOT23
- Tape and reel (8mm format)
- Good Linearity between resistance and temperature (R V's T)
- Large Temperature Coefficient of Resistance (TCR): 6178 ppm/K (measured at 0°C, 100°C)
- Low power consumption
- Good Thermal contact via Pin 3 of SOT23

APPLICATIONS

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



SOT23 Nickel Sensor

1000 Ω at 0°C

Parameter	Typical	Condition
Package	SOT23	
Lead frame material	Alloy 42 Ag-Coating: 2 µm Pin Coating (Sn > 99.5%): 8-10 µm	
Soldering	96Sn4Ag	Reflow to + 260°C
Packing units	Reel Size: 7" (180 mm) 3000 sensors or 13" (330 mm) 10000 sensors	
Basic resistance	1000 Ω	0°C
Temperature coefficient of resistance (according to DIN 43760, see below)	6178 ppm/K	0°C to +100°C
Measurement current	1.2 mA, max: 5 mA	
Self heating coefficient	EK = (1.7 ± 0.3) mW/K	+23 °C Still air
Operation temperature	-55°C … +160°C	
Storage temperature	-55°C… +160°C	
ESD Resistant	Exceeds requirements	MIL 883E3015.7

Note: 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 $P = I^2 X R$ is the power generated by the measurement current and EK is the self heating coefficient.

The self heating coefficient for the Ni1000SOT is EK = (1.7 ± 0.3) mW/K (23 °C Still Air).

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:

Type DIN 43760 TCR = 6178 ppm/K between 0 ... 100 °C

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

Coefficients:
a = 5.485×10^{-3}
b = 6.650×10^{-6}
c = 2.805×10^{-11}
d = -2.000×10^{-17}

$$T(R) = a'+b'(1+c'R)^{1/2}+d'R^5+e'R^7$$

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

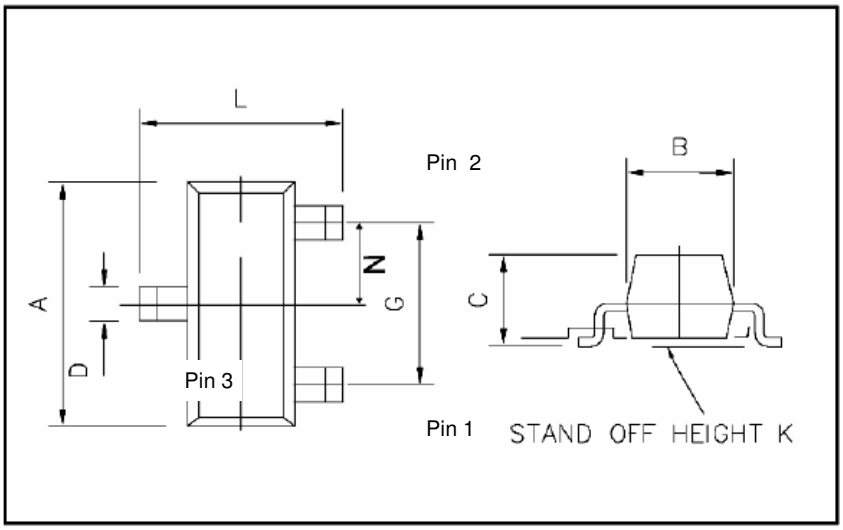
Tolerances: Class B ± (0.4+0.007 x |T|) in range from 0°C to +160 °C
± (0.4+0.028 x |T|) in range from -55°C to 0 °C

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

Table 1: Ni1000 DIN 43760 Temperature (°C) versus Resistance (Ohms - Ω)

MECHANICAL DIMENSIONS

SOT23



DIM	Millimeters		Inches	
	Min	Max	Min	Max
A	2.67	3.05	0.105	0.120
B	1.20	1.40	0.047	0.055
C	-	1.10	-	0.043
D	0.37	0.53	0.0145	0.021
G	NOM 1.9		NOM 0.075	
K	0.01	0.10	0.0004	0.004
L	2.10	2.50	0.0825	0.0985
N	NOM 0.95		NOM 0.37	

PIN DIMENSIONS

Dimension	Millimeters		Inches	
	Min	Max	Min	Max
Pin Thickness	0.085	0.15	0.033	0.0059

CONNECTIONS

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

RELIABILITY DATA

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

APPLICATION NOTE: Interface Circuit

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

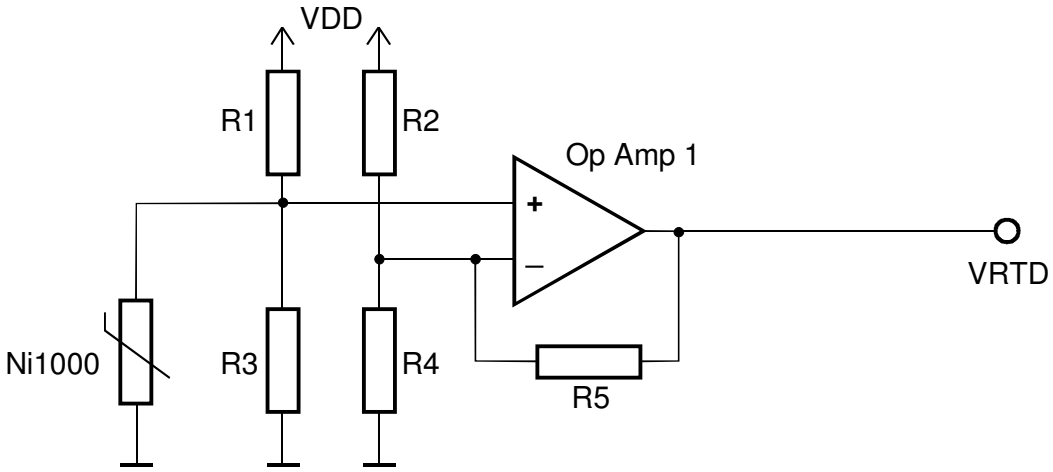
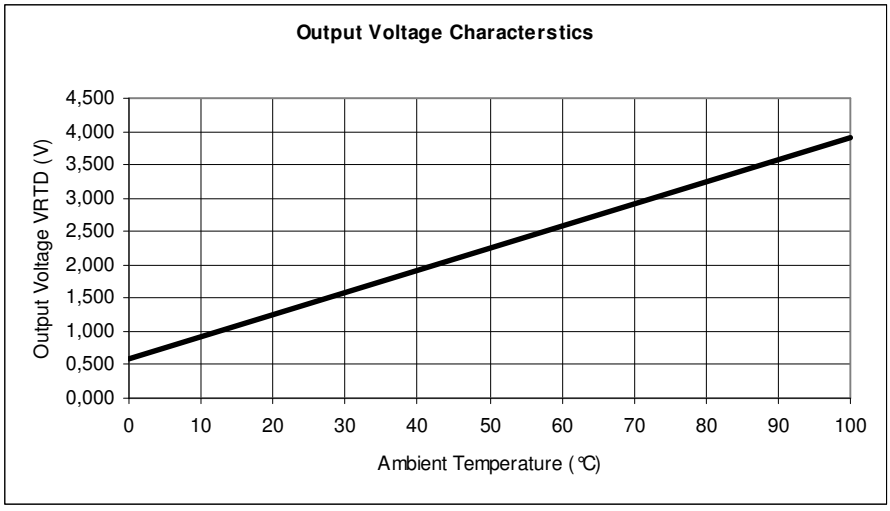


Fig. 1: Example of analog interface circuit using the Ni1000SOT sensor

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



Application note is subject to change without notice

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