Temperature Sensors

TEMPERATURE-RESISTANCE CURVES

PRODUCT DATA

PT1000 CELSIUS TEMPERATURE CHARACTERISTIC

temp. (°C)	resist. (Ω)		temp. (°C)	resist. (Ω)		temp. (°C)	resist. (Ω)		temp. (°C)	resist. (Ω)		temp. (°C)	resist. (Ω)
-40.0	842.7		1.0	1003.9		41.0	1159.3		81.0	1312.8		121.0	1464.5
-39.0	846.7		2.0	1007.8		42.0	1163.1		82.0	1316.6		122.0	1468.2
-38.0	850.7		3.0	1011.7		43.0	1167.0		83.0	1320.4		123.0	1472.0
-37.0	854.6		4.0	1015.6		44.0	1170.9		84.0	1324.2		124.0	1475.8
-36.0	858.6		5.0	1019.5		45.0	1174.7		85.0	1328.0		125.0	1479.5
-35.0	862.5		6.0	1023.4		46.0	1178.6		86.0	1331.8		126.0	1483.3
-34.0	866.5		7.0	1027.3		47.0	1182.4		87.0	1335.7		127.0	1487.0
-33.0	870.4		8.0	1031.2		48.0	1186.3		88.0	1339.5		128.0	1490.8
-32.0	874.3		9.0	1035.1		49.0	1190.1		89.0	1343.3		129.0	1494.6
-31.0	878.3		10.0	1039.0		50.0	1194.0		90.0	1347.1		130.0	1498.3
-30.0	882.2		11.0	1042.9		51.0	1197.8		91.0	1350.9		131.0	1502.1
-29.0	886.2		12.0	1046.8		52.0	1201.7		92.0	1354.7		132.0	1505.6
-28.0	890.1		13.0	1050.7		53.0	1205.5		93.0	1358.4		133.0	1509.6
-27.0	894.1		14.0	1054.5		54.0	1209.4		94.0	1362.3		134.0	1513.3
-26.0	898.0		15.0	1058.5		55.0	1213.2		95.0	1366.1		135.0	1517.1
-25.0	901.9		16.0	1062.4		56.0	1217.1		96.0	1369.9		136.0	1520.9
-24.0	905.6		17.0	1066.3		57.0	1220.9		97.0	1373.7		137.0	1524.6
-23.0	909.8		18.0	1070.2		58.0	1224.7		98.0	1377.5		138.0	1528.4
-22.0	913.7		19.0	1074.1		59.0	1228.6		99.0	1381.3		139.0	1532.1
-21.0	917.7		20.0	1077.9		60.0	1232.4		100.0	1385.0		140.0	1535.8
-20.0	921.6		21.0	1081.8		61.0	1236.3		101.0	1388.9		141.0	1539.6
-19.0	925.5		22.0	1085.7		62.0	1240.1		102.0	1392.6		142.0	1543.3
-18.0	929.9		23.0	1089.6		63.0	1243.9		103.0	1396.4		143.0	1547.1
-17.0	933.4		24.0	1093.5		64.0	1247.8		104.0	1400.2		144.0	1550.8
-16.0	937.3		25.0	1097.4		65.0	1251.6		105.0	1404.0		145.0	1554.6
-15.0	941.3		26.0	1101.2		66.0	1255.4		106.0	1407.8		146.0	1558.3
-14.0	945.2		27.0	1105.1		67.0	1259.3		107.0	1411.6		147.0	1562.0
-13.0	949.1		28.0	1109.0		68.0	1263.1		108.0	1415.4		148.0	1565.8
-12.0	953.0		29.0	1112.9		69.0	1266.9		109.0	1419.1		149.0	1569.5
-11.0	956.9		30.0	1116.7		70.0	1270.8		110.0	1422.9		150.0	1573.1
-10.0	960.9		31.0	1120.6		71.0	1274.6		111.0	1426.7			
-9.0	964.8		32.0	1124.5		72.0	1278.4		112.0	1430.5			
-8.0	968.7		33.0	1128.4		73.0	1282.2		113.0	1434.3			
-7.0	972.6		34.0	1132.2		74.0	1286.0		114.0	1438.0			
-6.0	976.5		35.0	1136.1		75.0	1289.9		115.0	1441.8			
-5.0	980.4		36.0	1140.0		76.0	1293.7		116.0	1445.6			
-4.0	984.4		37.0	1143.8		77.0	1297.5		117.0	1449.4			
-3.0	988.3		38.0	1147.7		78.0	1301.3		118.0	1453.1			
-2.0	992.2		39.0	1151.6		79.0	1305.2		119.0	1456.9			
-1.0	996.1		40.0	1155.4		80.0	1309.0		120.0	1460.6			
0.0	1000.0												

BALCO 500 CELSIUS TEMPERATURE CHARACTERISTIC

temp. (°C)	resist. (Ω)		temp. (°C)	resist. (Ω)		temp. (°C)	resist. (Ω)		temp. (°C)	resist. (Ω)		temp. (°C)	resist. (Ω)
-40.0	379.35		1.0	455.13		41.0	537.29		81.0	627.58		121.0	726.00
-39.0	381.10		2.0	457.09		42.0	539.45		82.0	629.95		122.0	728.57
-38.0	382.85		3.0	459.05		43.0	541.62		83.0	632.31		123.0	731.14
-37.0	384.61		4.0	461.01		44.0	543.78		84.0	634.68		124.0	733.71
-36.0	386.37		5.0	462.98		45.0	545.96		85.0	637.06		125.0	736.28
-35.0	388.14		6.0	464.96		46.0	548.14		86.0	639.44		126.0	738.88
-34.0	389.91		7.0	466.94		47.0	550.32		87.0	641.83		127.0	741.47
-33.0	391.69		8.0	468.92		48.0	552.51		88.0	644.22		128.0	744.06
-32.0	393.47		9.0	470.91		49.0	554.70		89.0	646.62		129.0	746.66
-31.0	395.26		10.0	472.91		50.0	556.90		90.0	649.02		130.0	749.27
-30.0	397.05		11.0	474.91		51.0	559.10		91.0	651.43		131.0	751.88
-29.0	398.85		12.0	476.92		52.0	561.31		92.0	653.84		132.0	754.49
-28.0	400.65		13.0	478.93		53.0	563.53		93.0	656.26		133.0	757.11
-27.0	402.46		14.0	480.94		54.0	565.75		94.0	658.68		134.0	759.74
-26.0	404.27		15.0	482.96		55.0	567.97		95.0	661.11		135.0	762.37
-25.0	406.09		16.0	484.99		56.0	570.20		96.0	663.54		136.0	765.00
-24.0	407.91		17.0	487.02		57.0	572.43		97.0	665.98		137.0	767.64
-23.0	409.74		18.0	489.06		58.0	574.67		98.0	668.42		138.0	770.29
-22.0	411.57		19.0	491.10		59.0	576.92		99.0	670.87		139.0	772.94
-21.0	413.41		20.0	493.15		60.0	579.17		100.0	673.32		140.0	775.68
-20.0	415.25		21.0	495.20		61.0	581.42		101.0	675.78		141.0	778.26
-19.0	417.10		22.0	497.25		62.0	583.68		102.0	678.24		142.0	780.92
-18.0	418.95		23.0	499.32		63.0	585.95		103.0	680.71		143.0	783.60
-17.0	420.81		24.0	501.38		64.0	588.22		104.0	683.18		144.0	786.28
-16.0	422.68		25.0	503.45		65.0	590.49		105.0	685.66		145.0	788.96
-15.0	424.54		26.0	505.53		66.0	592.77		106.0	688.14		146.0	791.64
-14.0	426.42		27.0	507.61		67.0	595.06		107.0	690.63		147.0	794.32
-13.0	428.30		28.0	509.70		68.0	597.35		108.0	693.12		148.0	797.00
-12.0	430.18		29.0	511.79		69.0	599.64		109.0	695.62		149.0	799.68
-11.0	432.07		30.0	513.89		70.0	601.94		110.0	698.13		150.0	802.36
-10.0	433.96		31.0	515.99		71.0	604.25		111.0	700.64			
-9.0	435.96		32.0	518.10		72.0	606.56		112.0	703.25			
-8.0	437.77		33.0	520.21		73.0	608.88		113.0	705.67			
-7.0	439.68		34.0	522.33		74.0	611.20		114.0	708.19			
-6.0	441.59		35.0	524.45		75.0	613.52		115.0	710.72			
-5.0	443.51		36.0	526.58		76.0	615.85		116.0	713.25			
-4.0	445.43		37.0	528.71		77.0	618.19		117.0	715.79			
-3.0	447.36		38.0	530.85		78.0	620.53		118.0	718.34			
-2.0	449.30		39.0	532.99		79.0	622.88		119.0	720.89			
-1.0	451.24		40.0	535.14		80.0	625.23		120.0	723.44			
0.0	453.18												

NTC 10K CELSIUS TEMPERATURE CHARACTERISTIC

temperature (°C)	nominal resistance (Ω)
-40.0	327344
-35.0	237193
-30.0	173657
-25.0	128410
-20.0	95862
-15.0	72222
-10.0	54892
-5.0	42073
0.0	32510
5.0	25316
10.0	19862
15.0	15694
20.0	12486
25.0	10000
30.0	8060
35.0	6535
40.0	5330
45.0	4372
50.0	3605
55.0	2989
60.0	2490
65.0	2084
70.0	1753
75.0	1481
80.0	1256
85.0	1070
90.0	916
95.0	786
100.0	678
105.0	586
110.0	509

NTC 20K CELSIUS TEMPERATURE CHARACTERISTIC

temp. (°C)	resist. (Ω)		temp. (°C)	resist. (Ω)		temp. (°C)	resist. (Ω)		temp. (°C)	resist. (Ω)		temp. (°C)	resist. (Ω)
-50.0	1659706		-9.0	115575		31.0	15180		71.0	2989		111.0	793.7
-49.0	1541379		-8.0	109189		32.0	14511		72.0	2882		112.0	770.3
-48.0	1432919		-7.0	103194		33.0	13875		73.0	2779		113.0	747.7
-47.0	1332091		-6.0	97564		34.0	13270		74.0	2681		114.0	725.8
-46.0	1238358		-5.0	92274		35.0	12695		75.0	2587		115.0	704.7
-45.0	1153525		-4.0	87303		36.0	12148		76.0	2496		116.0	684.2
-44.0	1073429		-3.0	82628		37.0	11627		77.0	2409		117.0	664.5
-43.0	999894		-2.0	78232		38.0	11131		78.0	2325		118.0	645.3
-42.0	932327		-1.0	74094		39.0	10659		79.0	2245		119.0	626.9
-41.0	869327		0.0	70200		40.0	10210		80.0	2168		120.0	609.0
-40.0	814000		1.0	66515		41.0	9781		81.0	2094		121.0	591.7
-39.0	759391		2.0	63046		42.0	9373		82.0	2022		122.0	575.0
-38.0	708806		3.0	59777		43.0	8983		83.0	1954		123.0	558.8
-37.0	661924		4.0	56697		44.0	8612		84.0	1888		124.0	543.2
-36.0	618451		5.0	53793		45.0	8258		85.0	1824		125.0	528.0
-35.0	578119		6.0	51055		46.0	7920		86.0	1763		126.0	513
-34.0	540677		7.0	48472		47.0	7598		87.0	1705		127.0	499
-33.0	505902		8.0	46034		48.0	7291		88.0	1648		128.0	485
-32.0	473588		9.0	43733		49.0	6998		89.0	1594		129.0	472
-31.0	443546		10.0	41560		50.0	6718		90.0	1542		130.0	459
-30.0	415600		11.0	39500		51.0	6450		91.0	1491			
-29.0	389298		12.0	37553		52.0	6195		92.0	1443			
-28.0	364833		13.0	35714		53.0	5951		93.0	1396			
-27.0	342063		14.0	33975		54.0	5718		94.0	1351			
-26.0	320860		15.0	32331		55.0	5495		95.0	1308			
-25.0	301107		16.0	30775		56.0	5282		96.0	1266			
-24.0	282696		17.0	29303		57.0	5078		97.0	1226			
-23.0	265528		18.0	27909		58.0	4883		98.0	1187			
-22.0	249511		19.0	26590		59.0	4696		99.0	1150			
-21.0	234561		20.0	25340		60.0	4518		100.0	1114			
-20.0	220600		21.0	24155		61.0	4347		101.0	1079			
-19.0	207607		22.0	23032		62.0	4184		102.0	1046			
-18.0	195459		23.0	21967		63.0	4027		103.0	1014			
-17.0	184096		24.0	20958		64.0	3877		104.0	982.8			
-16.0	173463		25.0	20000		65.0	3734		105.0	952.8			
-15.0	163508		26.0	19089		66.0	3596		106.0	923.9			
-14.0	154185		27.0	18224		67.0	3464		107.0	896.0			
-13.0	145450		28.0	17404		68.0	3338		108.0	869.1			
-12.0	137262		29.0	16624		69.0	3216		109.0	843.1			
-11.0	129583		30.0	15884		70.0	3100		110.0	818.0			
-10.0	122380												

NI1000 TK6180 DIN B CELSIUS TEMPERATURE CHARACTERISTIC

Nominal Resistance: R_0 = 1000 Ω, Sensitivity: TC = 6180 ppm/K

°C	-0	-1	-2	-3	-4	-5	-6	-7	-8	-9
-50	742.55									
-40	791.31	786.37	781.45	776.54	771.64	766.76	761.89	757.03	752.19	747.36
-30	841.46	836.38	831.32	826.27	821.23	816.21	811.21	806.21	801.23	796.26
-20	892.96	887.75	882.56	877.37	872.20	867.04	861.90	856.77	851.65	846.55
-10	945.82	940.47	935.14	929.82	924.51	919.22	913.94	908.68	903.43	898.19
0	1000.00	994.52	989.06	983.60	978.17	972.74	967.33	961.93	956.55	951.17
°C	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
0	1000.00	1005.49	1011.00	1016.51	1022.05	1027.59	1033.15	1038.72	1044.31	1049.90
10	1055.52	1061.14	1066.78	1072.43	1078.09	1083.77	1089.46	1095.17	1100.89	1106.62
20	1112.36	1118.12	1123.90	1129.68	1135.48	1141.29	1147.12	1152.96	1158.81	1164.68
30	1170.56	1176.45	1182.36	1188.28	1194.21	1200.16	1206.13	1212.10	1218.09	1224.09
40	1230.11	1236.14	1242.19	1248.25	1254.32	1260.41	1266.51	1272.62	1278.75	1284.89
50	1291.05	1297.22	1303.41	1309.61	1315.82	1322.05	1328.29	1334.55	1340.82	1347.10
60	1353.40	1359.72	1366.05	1372.39	1378.75	1385.12	1391.51	1397.91	1404.33	1410.76
70	1417.21	1423.67	1430.14	1436.64	1443.14	1449.67	1456.20	1462.75	1469.32	1475.91
80	1482.50	1489.12	1495.75	1502.39	1509.05	1515.73	1522.42	1529.13	1535.85	1542.59
90	1549.34	1556.12	1562.90	1569.71	1576.53	1583.36	1590.21	1597.08	1603.97	1610.87
100	1617.79	1624.72	1631.67	1638.64	1645.62	1652.62	1659.64	1666.68	1673.73	1680.80
110	1687.89	1694.99	1702.11	1709.25	1716.41	1723.58	1730.77	1737.98	1745.21	1752.45
120	1759.72	1767.00	1774.30	1781.61	1788.95	1796.30	1803.68	1811.07	1818.48	1825.90
130	1833.35	1840.82	1848.30	1855.80	1863.33	1870.87	1878.43	1886.01	1893.61	1901.23
140	1908.87	1916.52	1924.20	1931.90	1939.62	1947.35	1955.11	1962.89	1970.69	1978.51
150	1986.35									

NI1000 TK5000 DIN B CELSIUS TEMPERATURE CHARACTERISTIC

Nominal Resistance: R_0 = 1000 Ω, Sensitivity: TC = 5000 ppm/K

°C	-0	-1	-2	-3	-4	-5	-6	-7	-8	-9
-50	790.88									
-40	830.84	826.80	822.78	818.76	814.75	810.75	806.76	802.78	798.80	794.84
-30	871.69	867.57	863.45	859.34	855.24	851.15	847.07	843.00	838.94	834.88
-20	913.48	909.26	905.05	900.85	896.65	892.47	888.30	884.13	879.98	875.83
-10	956.24	951.92	947.61	943.31	939.02	934.74	930.47	926.21	921.96	917.72
0	1000.00	995.58	991.17	986.77	982.37	977.99	973.62	969.26	964.91	960.57
°C	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
0	1000.00	1004.43	1008.87	1013.33	1017.79	1022.26	1026.75	1031.24	1035.75	1040.27
10	1044.79	1049.33	1053.88	1058.44	1063.01	1067.59	1072.18	1076.78	1081.39	1086.02
20	1090.65	1095.30	1099.96	1104.62	1109.30	1113.99	1118.70	1123.41	1128.13	1132.87
30	1137.62	1142.37	1147.14	1151.92	1156.72	1161.52	1166.34	1171.16	1176.00	1180.85
40	1185.71	1190.59	1195.47	1200.37	1205.28	1210.20	1215.13	1220.07	1225.03	1230.00
50	1234.98	1239.97	1244.97	1249.99	1255.02	1260.06	1265.11	1270.18	1275.25	1280.34
60	1285.45	1290.56	1295.69	1300.83	1305.98	1311.14	1316.32	1321.51	1326.71	1331.92
70	1337.15	1342.39	1347.64	1352.91	1358.18	1363.47	1368.78	1374.09	1379.42	1384.77
80	1390.12	1395.49	1400.87	1406.26	1411.67	1417.09	1422.53	1427.97	1433.43	1438.91
90	1444.39	1449.90	1455.41	1460.94	1466.48	1472.03	1477.60	1483.18	1488.77	1494.38
100	1500.00	1505.64	1511.29	1516.95	1522.63	1528.32	1534.03	1539.75	1545.48	1551.22
110	1556.98	1562.76	1568.55	1574.35	1580.17	1586.00	1591.84	1597.70	1603.58	1609.47
120	1615.37	1621.28	1627.22	1633.16	1639.12	1645.10	1651.08	1657.09	1663.11	1669.14
130	1675.19	1681.25	1687.33	1693.42	1699.52	1705.65	1711.78	1717.93	1724.10	1730.28
140	1736.48	1742.69	1748.91	1755.15	1761.41	1767.68	1773.97	1780.27	1786.59	1792.92
150	1799.27									

NOMINAL VALUES

	sensing element			
	Pt 1000	**BALCO 500**	**NTC 10K Thermistor**	**NTC 20K Thermistor**
resistance	1000 Ω at 0 °C	500 Ω at 23.3 °C	10 kΩ at 25 °C	20 kΩ at 25 °C
accuracy	DIN IEC 751 Class B 0.3 + 0.005 • |t|*	±1 Ω	±0.7 K at -40 °C ±0.3 K at +25 °C ±1.9 K at +110 °C	±0.6 K at -40 °C ±0.3 K at +25 °C ±1.2 K at +100 °C
sensitivity	≈ 3.85 Ω / K	≈ 2.2 Ω / K	---	---
characteristics	see page 1	see page 2	see page 3	see page 4
*|t| = absolute temperature "t" in °C				

THERMAL COUPLING QUALITY FOR STRAP-ON SENSORS

The following equation provides a measure of the thermal coupling quality ("C"), which indicates how well a strap-on type sensor is "coupled" to the pipe:

$$C = \frac{T_S - (T_{S(50)} - T_{0(50)}) - T_R}{T_{Pipe} - T_R}$$

with:

T_S	Sensor Temperature
T_{Pipe}	Pipe Temperature
T_R	Room Temperature
$(T_{S(50)}-T_{0(50)})$	Sensor accuracy ΔT @50°C

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