

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								

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:

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

with:

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

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