

DATA PLOT

Calibration Report: 80307

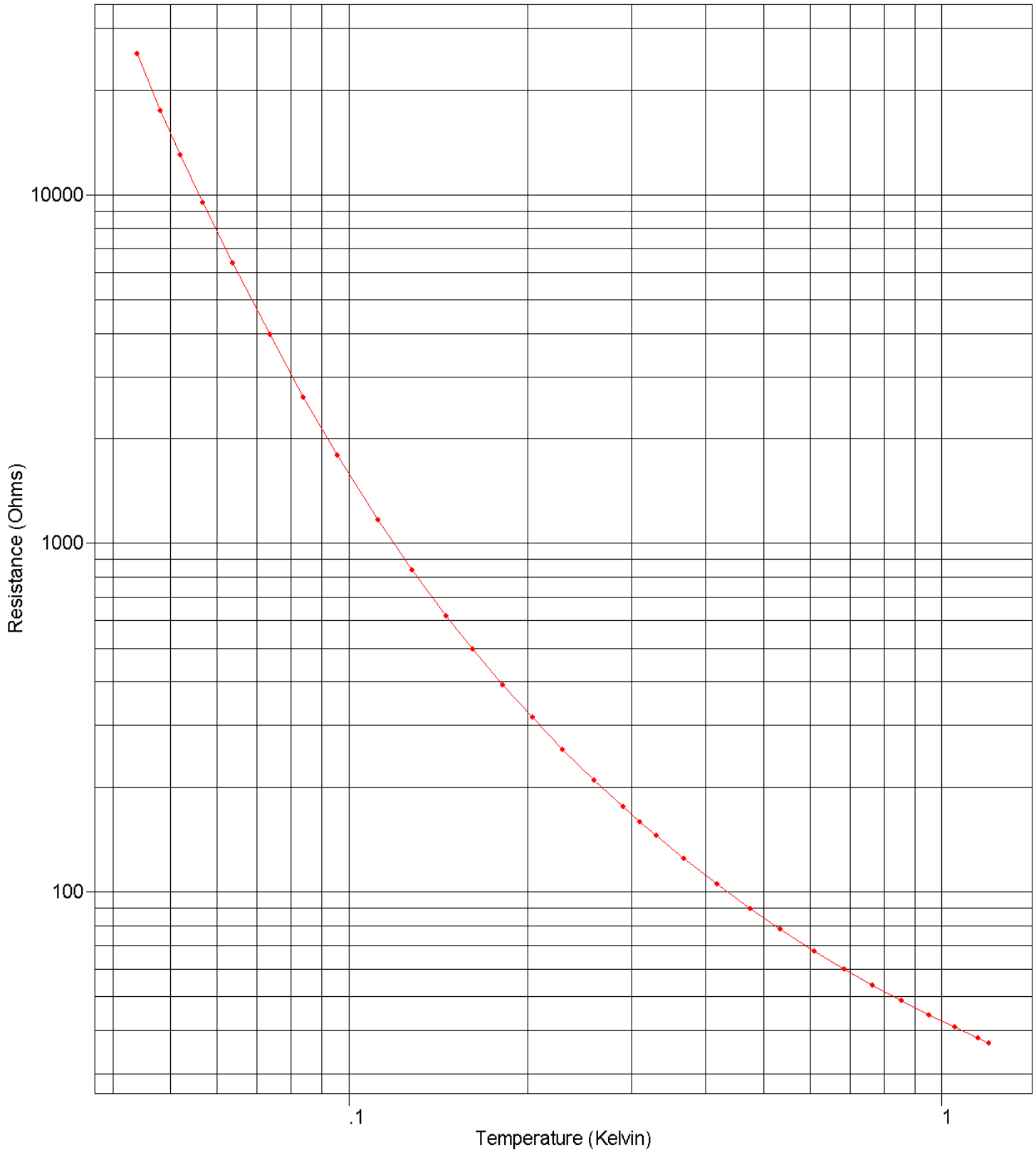
Sensor Model: GR-200A-30-CD-1.15

Sensor Type: Germanium Resistor

Sales Order: 35105

Serial Number: 29931

Temperature Range: 0.05K to 1.15K



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TEST DATA

Calibration Report: 80307

Sensor Model: GR-200A-30-CD-1.15

Sensor Type: Germanium Resistor

Sales Order: 35105

Serial Number: 29931

Temperature Range: 0.05K to 1.15K

Index	Temp. (K)	Resistance (Ω)	Excitation	Index	Temp. (K)	Resistance (Ω)	Excitation
1	4.39501e-2	25445.0	< 20 μ V	21	0.417609	104.974	< 63uV
2	4.81935e-2	17431.4	< 20 μ V	22	0.475087	89.3680	< 63uV
3	5.19374e-2	13043.7	< 20 μ V	23	0.534055	77.9470	< 63uV
4	5.67530e-2	9477.20	< 20 μ V	24	0.608979	67.5060	< 63uV
5	6.36961e-2	6384.30	< 20 μ V	25	0.685006	59.8600	< 63uV
6	7.36032e-2	3966.97	< 20 μ V	26	0.763277	53.8930	< 63uV
7	8.39627e-2	2619.74	< 20 μ V	27	0.854663	48.5931	< 63uV
8	9.55888e-2	1782.50	< 20 μ V	28	0.950306	44.3181	< 63uV
9	0.112021	1165.16	< 63 μ V	29	1.05031	40.7703	< 63uV
10	0.127963	836.810	< 63 μ V	30	1.14980	37.9172	< 63uV
11	0.145929	618.810	< 63 μ V	31	1.20104	36.6537	2mV \pm 25%
12	0.162040	496.168	< 63 μ V				
13	0.181987	392.156	< 63 μ V				
14	0.203955	315.939	< 63 μ V				
15	0.229740	255.810	< 63 μ V				
16	0.259666	208.493	< 63 μ V				
17	0.289966	175.314	< 63 μ V				
18	0.309990	158.420	< 63 μ V				
19	0.329970	144.728	< 63 μ V				
20	0.367658	124.271	< 63 μ V				



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POLYNOMIAL EQUATION

Calibration Report: 80307

Sales Order: 35105

Sensor Model: GR-200A-30-CD-1.15

Serial Number: 29931

Sensor Type: Germanium Resistor

Temperature Range: 0.05K to 1.15K

Polynomial Type: Chebychev

Useful Range of Fit:

5.00e-2K to 1.15K
1.508e+4 Ohms to 37.92 Ohms

Lower and Upper limits of Log(resistance) used in computing Chebychev coefficients:

ZL = 1.56411782095 ZU = 4.40560245521

Order	Coefficient	Std. Deviation of Coefficient	Ratio (Coeff./Std Dev.)
0	0.310035	2.3628E-05	13121.75
1	-0.421947	3.7875E-05	-11140.54
2	0.238000	3.5432E-05	6717.10
3	-0.122568	3.2248E-05	-3800.80
4	0.059277	2.9746E-05	1992.81
5	-0.027569	2.8074E-05	-982.03
6	0.012730	2.8106E-05	452.92
7	-0.005593	2.8824E-05	-194.05
8	0.002252	3.1190E-05	72.19
9	-0.000842	3.2364E-05	-26.01
10	0.000173	3.0447E-05	5.69

$Z = \text{Log}(\text{resistance})$

$X = ((Z-ZL)-(ZU-Z))/(ZU-ZL)$

Temp. (K) = $\sum A_i \cdot \text{COS}(i \cdot \text{ARCCOS}(X))$, where $0 \leq i \leq 10$
and the A_i 's are the coefficients in the table above.



POLYNOMIAL EQUATION

Calibration Report: 80307

Sales Order: 35105

Sensor Model: GR-200A-30-CD-1.15

Serial Number: 29931

Sensor Type: Germanium Resistor

Temperature Range: 0.05K to 1.15K

Polynomial Type: Chebychev

Temp. (K) vs. Log(resistance)

	R Meas. (Ω)	T Meas. (K)	T Eq. (K)	T diff. (mK)
1	25445.00	0.04395	0.04395	0.00
2	17431.40	0.04819	0.04821	-0.02
3	13043.70	0.05194	0.05192	0.02
4	9477.200	0.05675	0.05674	0.01
5	6384.300	0.06370	0.06373	-0.04
6	3966.970	0.07360	0.07360	0.00
7	2619.740	0.08396	0.08391	0.05
8	1782.500	0.09559	0.09563	-0.04
9	1165.160	0.11202	0.11198	0.05
10	836.8100	0.12796	0.12803	-0.06
11	618.8100	0.14593	0.14604	-0.11
12	496.1680	0.16204	0.16188	0.16
13	392.1560	0.18199	0.18192	0.06
14	315.9390	0.20395	0.20397	-0.02
15	255.8100	0.22974	0.22975	-0.01
16	208.4930	0.25967	0.25975	-0.08
17	175.3140	0.28997	0.28997	-0.01
18	158.4200	0.30999	0.31011	-0.13
19	144.7280	0.32997	0.32987	0.10
20	124.2710	0.36766	0.36764	0.01
21	104.9740	0.41761	0.41747	0.13
22	89.36800	0.47509	0.47509	0.00
23	77.94700	0.53405	0.53408	-0.03
24	67.50600	0.60898	0.60910	-0.12
25	59.86000	0.68501	0.68488	0.13
26	53.89300	0.76328	0.76341	-0.13
27	48.59310	0.85466	0.85473	-0.07
28	44.31810	0.95031	0.95010	0.20
29	40.77030	1.05031	1.05030	0.02
30	37.91720	1.14980	1.14993	-0.13
31	36.65370	1.20104	1.20099	0.05

Order of Fit = 10

RMS error of fit = 0.08 mK

Largest absolute error = 0.20 mK at data point no. 28



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INTERPOLATION TABLE

Calibration Report: 80307

Sensor Model: GR-200A-30-CD-1.15

Sensor Type: Germanium Resistor

Sales Order: 35105

Serial Number: 29931

Temperature Range: 0.05K to 1.15K

Temp (K)	Res. (Ω)	dR/dT (Ω/K)	dlogR/dlogT	Temp (K)	Res. (Ω)	dR/dT (Ω/K)	dlogR/dlogT
5.000e-2	15079.3	-1.1818e+6	-3.9188	0.3000	166.482	-837.22	-1.5087
5.500e-2	10570.3	-6.8151e+5	-3.5461	0.3200	151.259	-691.63	-1.4632
6.000e-2	7822.47	-4.4275e+5	-3.3960	0.3400	138.593	-579.60	-1.4219
6.500e-2	5977.24	-3.0696e+5	-3.3381	0.3600	127.917	-491.46	-1.3831
7.000e-2	4674.72	-2.1981e+5	-3.2914	0.3800	118.814	-421.42	-1.3478
7.500e-2	3732.84	-1.6064e+5	-3.2276	0.4000	110.974	-364.50	-1.3138
8.000e-2	3038.66	-1.1943e+5	-3.1443	0.4200	104.164	-318.07	-1.2825
8.500e-2	2518.77	-90161.	-3.0426	0.4400	98.1986	-279.59	-1.2528
9.000e-2	2123.05	-69297.	-2.9376	0.4600	92.9387	-247.33	-1.2242
9.500e-2	1816.08	-54296.	-2.8402	0.4800	88.2705	-220.27	-1.1978
0.1000	1573.45	-43290.	-2.7513	0.5000	84.1013	-197.24	-1.1726
0.1100	1219.91	-28753.	-2.5927	0.5500	75.4156	-152.96	-1.1155
0.1200	978.884	-20126.	-2.4672	0.6000	68.5921	-121.73	-1.0649
0.1300	807.042	-14641.	-2.3584	0.6500	63.0975	-99.156	-1.0215
0.1400	680.077	-10984.	-2.2611	0.7000	58.5814	-82.294	-0.98335
0.1500	583.593	-8463.0	-2.1752	0.7500	54.8033	-69.385	-0.94955
0.1600	508.447	-6663.4	-2.0969	0.8000	51.5947	-59.349	-0.92023
0.1700	448.714	-5347.7	-2.0260	0.8500	48.8346	-51.359	-0.89393
0.1800	400.397	-4362.3	-1.9611	0.9000	46.4327	-44.931	-0.87090
0.1900	360.679	-3613.1	-1.9033	0.9500	44.3222	-39.665	-0.85018
0.2000	327.583	-3030.0	-1.8499	1.000	42.4511	-35.307	-0.83172
0.2100	299.660	-2572.0	-1.8025	1.050	40.7797	-31.656	-0.81509
0.2200	275.845	-2204.3	-1.7580	1.100	39.2761	-28.569	-0.80012
0.2300	255.338	-1907.5	-1.7182	1.150	37.9154	-25.925	-0.78633
0.2400	237.517	-1664.3	-1.6817				
0.2500	221.916	-1462.1	-1.6471				
0.2600	208.163	-1293.7	-1.6158				
0.2700	195.955	-1151.6	-1.5868				
0.2800	185.062	-1030.3	-1.5589				
0.2900	175.291	-926.61	-1.5330				



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BREAKPOINTS 340 FORMAT

Calibration Report: 80307

Sensor Model: GR-200A-30-CD-1.15

Sensor Type: Germanium Resistor

Sales Order: 35105

Serial Number: 29931

Temperature Range: 0.05K to 1.15K

Name: GR-200A-30-CD-1.15

Serial number: 29931

Format: 4 ;Log Ohms/Kelvin

Limit: 1.15

Coefficient: 1 ;Negative

Point 1: 1.57872, 1.150

Point 2: 1.59407, 1.100

Point 3: 1.60870, 1.055

Point 4: 1.62248, 1.015

Point 5: 1.63702, 0.975

Point 6: 1.65245, 0.935

Point 7: 1.66885, 0.895

Point 8: 1.68637, 0.855

Point 9: 1.70273, 0.820

Point 10: 1.72012, 0.785

Point 11: 1.73872, 0.750

Point 12: 1.75865, 0.715

Point 13: 1.78011, 0.680

Point 14: 1.79993, 0.650

Point 15: 1.82112, 0.620

Point 16: 1.84396, 0.590

Point 17: 1.86863, 0.560

Point 18: 1.89542, 0.530

Point 19: 1.91964, 0.505

Point 20: 1.93929, 0.486

Point 21: 1.95899, 0.468

Point 22: 1.97985, 0.450

Point 23: 2.00203, 0.432

Point 24: 2.02565, 0.414

Point 25: 2.05084, 0.396

Point 26: 2.07782, 0.378

Point 27: 2.10677, 0.360

Point 28: 2.13441, 0.344

Point 29: 2.16396, 0.328

Point 30: 2.19573, 0.312

Point 31: 2.23221, 0.295

Point 32: 2.26711, 0.280

Point 33: 2.30484, 0.265

Point 34: 2.34590, 0.250

Point 35: 2.38774, 0.236

Point 36: 2.43008, 0.223

Point 37: 2.47628, 0.210

Point 38: 2.52712, 0.197

Point 39: 2.57895, 0.185

Point 40: 2.63616, 0.173

Point 41: 2.69453, 0.162

Point 42: 2.75926, 0.151

Point 43: 2.83188, 0.140

Point 44: 2.90626, 0.130

Point 45: 2.98988, 0.120

Point 46: 3.07542, 0.111

Point 47: 3.17225, 0.102

Point 48: 3.27765, 0.094

Point 49: 3.39211, 0.086

Point 50: 3.52472, 0.078

Point 51: 3.67827, 0.070

Point 52: 3.85499, 0.062

Point 53: 4.03549, 0.055

Point 54: 4.17681, 0.050



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BREAKPOINTS 91C/93C/330 FORMAT

Calibration Report: 80307

Sales Order: 35105

Sensor Model: GR-200A-30-CD-1.15

Serial Number: 29931

Sensor Type: Germanium Resistor

Temperature Range: 0.05K to 1.15K

Interpolation Method: Lagrangian

Limit: 1.15 (Kelvin)

Format: 4 (Log Ohms/Kelvin)

Number of Breakpoints: 11

No.	Units	Temperature (K)	No.	Units	Temperature (K)
1	1.57882	1.2	11	4.17838	0.1
2	1.61044	1.1			
3	1.68873	.9			
4	1.73881	.8			
5	1.80001	.7			
6	1.87746	.6			
7	1.97995	.5			
8	2.12397	.4			
9	2.34619	.3			
10	2.76611	.2			

Temperature for Resistance Decades:

Res. (Ohms)	Temp. (K)
100	0.434
1000	0.129
10000	0.085



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BREAKPOINTS 234 FORMAT

Calibration Report: 80307

Sales Order: 35105

Sensor Model: GR-200A-30-CD-1.15

Serial Number: 29931

Sensor Type: Germanium Resistor

Temperature Range: 0.05K to 1.15K

Maximum Temperature Error:

1.4 - 10K: 0.001K
 10 - 20K: -
 20 - 40K: -
 40 - 100K: -
 > 100K: -

BP #	Temp. (K)	Res. (Ω)	Log10 Res.	BP #	Temp. (K)	Res. (Ω)	Log10 Res.
1	1.146	38.01894	1.580	51	0.185	380.1894	2.580
2	1.082	39.81072	1.600	52	0.181	398.1072	2.600
3	1.022	41.68694	1.620	53	0.176	416.8694	2.620
4	0.967	43.65158	1.640	54	0.172	436.5158	2.640
5	0.916	45.70882	1.660	55	0.169	457.0882	2.660
6	0.869	47.86301	1.680	56	0.165	478.6301	2.680
7	0.826	50.11872	1.700	57	0.161	501.1872	2.700
8	0.785	52.48075	1.720	58	0.158	524.8075	2.720
9	0.748	54.95409	1.740	59	0.154	549.5409	2.740
10	0.713	57.54399	1.760	60	0.151	575.4399	2.760
11	0.680	60.25596	1.780	61	0.148	602.5596	2.780
12	0.650	63.09573	1.800	62	0.145	630.9573	2.800
13	0.622	66.06934	1.820	63	0.142	660.6934	2.820
14	0.595	69.18310	1.840	64	0.139	691.8310	2.840
15	0.570	72.44360	1.860	65	0.136	724.4360	2.860
16	0.547	75.85776	1.880	66	0.133	758.5776	2.880
17	0.525	79.43282	1.900	67	0.131	794.3282	2.900
18	0.505	83.17638	1.920	68	0.128	831.7638	2.920
19	0.485	87.09636	1.940	69	0.126	870.9636	2.940
20	0.467	91.20108	1.960	70	0.124	912.0108	2.960
21	0.450	95.49926	1.980	71	0.121	954.9926	2.980
22	0.434	100.0000	2.000	72	0.119	1000.000	3.000
23	0.418	104.7129	2.020	73	0.115	1096.478	3.040
24	0.404	109.6478	2.040	74	0.111	1202.264	3.080
25	0.390	114.8154	2.060	75	0.107	1318.257	3.120
26	0.377	120.2264	2.080	76	0.103	1445.440	3.160
27	0.364	125.8925	2.100	77	0.100	1584.893	3.200
28	0.352	131.8257	2.120	78	0.096	1737.801	3.240
29	0.341	138.0384	2.140	79	0.093	1905.461	3.280
30	0.330	144.5440	2.160	80	0.090	2089.296	3.320
31	0.320	151.3561	2.180	81	0.088	2290.868	3.360
32	0.310	158.4893	2.200	82	0.085	2511.886	3.400
33	0.301	165.9587	2.220	83	0.083	2754.229	3.440
34	0.292	173.7801	2.240	84	0.080	3019.952	3.480
35	0.283	181.9701	2.260	85	0.078	3311.311	3.520
36	0.275	190.5461	2.280	86	0.076	3630.781	3.560
37	0.267	199.5262	2.300	87	0.074	3981.072	3.600
38	0.259	208.9296	2.320	88	0.071	4365.158	3.640
39	0.252	218.7762	2.340	89	0.069	4786.301	3.680
40	0.245	229.0868	2.360	90	0.068	5248.075	3.720
41	0.239	239.8833	2.380	91	0.066	5754.399	3.760
42	0.232	251.1886	2.400	92	0.064	6309.573	3.800
43	0.226	263.0268	2.420	93	0.062	6918.310	3.840
44	0.220	275.4229	2.440	94	0.061	7585.776	3.880
45	0.215	288.4032	2.460	95	0.059	8317.638	3.920
46	0.209	301.9952	2.480	96	0.057	9120.108	3.960
47	0.204	316.2278	2.500	97	0.056	10000.00	4.000
48	0.199	331.1311	2.520	98	0.052	12589.25	4.100
49	0.194	346.7369	2.540	99	0.049	15848.93	4.200
50	0.189	363.0781	2.560	100	0.047	19952.62	4.300



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