

Certificate of Calibration

Report Number: 754503

Sensor Model: RX-202A-AA-0.05B	Serial Number: U04184
Sensor Type: Ruthenium Oxide Resistor	Sales Order: 89237-1
Sensor Excitation: see <i>Test Data</i> page of report	Date: February 12, 2014
Temperature Range: 0.05K to 40.0K	Due: February 12, 2015

Traceability and Calibration Method

This temperature sensor has been calibrated to the International Temperature Scale of 1990 (ITS-90) or the Provisional Low Temperature Scale (PLTS-2000) as appropriate. The calibrations are traceable to the National Institute of Standards and Technology (NIST, United States), the National Physical Laboratory (NPL, United Kingdom), the Physikalisch-Technische Bundesanstalt (PTB, Germany), or natural physical constants.

Lake Shore Cryotronics maintains ITS-90 and PLTS-2000 on standard platinum (PRT), rhodium-iron (RIRT), and germanium (GRT) resistance thermometers that have been calibrated directly by an internationally recognized national metrology institute (NIST, NPL, PTB) for $T < 330$ K or an ISO 17025 accredited metrology laboratory for $330 \text{ K} < T < 800 \text{ K}$. A nuclear orientation thermometer is also used for temperatures less than 50 mK. These standards are routinely intercompared to verify consistency and accuracy of the temperature scale.

The sensor calibrations are performed by comparison to laboratory standard resistance thermometers and tested in accordance with Lake Shore Cryotronics, Inc. Quality Assurance Manual (QP-4220). The quality system of Lake Shore Cryotronics is registered to ISO 9001:2008.

Procedures used: 021-97-02, 099-00-00, 121-96-02, 029-95-02

Notes

The calibration results in this report apply only to the specific sensor specified above.

This report shall not be reproduced, except in full, without written approval from Lake Shore Cryotronics, Inc.

Unless stated otherwise, the uncertainties in this report are based on an approximate 95% confidence level with a coverage factor $k=2$.

Reported by: Todd Rittershausen
Calibration Engineer/Technician

Approved by: John Krause
Metrology



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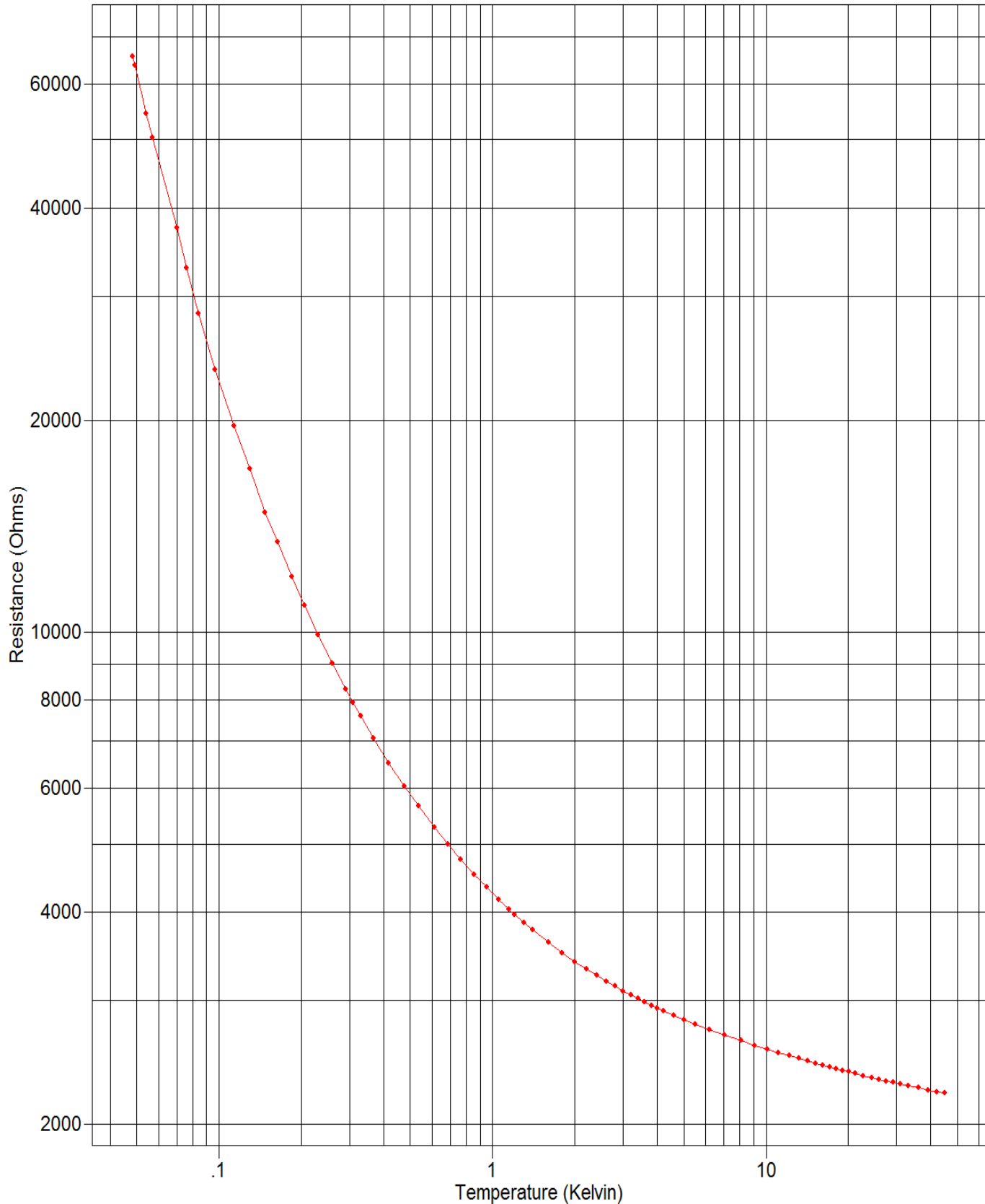
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F010-04-00_B 06/21/2011

DATA PLOT

Calibration Report: 754503
Sensor Model: RX-202A-AA-0.05B
Sensor Type: Rox Resistor

Sales Order: 89237-1
Serial Number: U04184
Temperature Range: 0.05K to 40.0K



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TEST DATA

Calibration Report: 754503

Sensor Model: RX-202A-AA-0.05B

Sensor Type: Rox Resistor

Sales Order: 89237-1

Serial Number: U04184

Temperature Range: 0.05K to 40.0K

Index	Temp. (K)	Resistance (Ω)	Excitation	Index	Temp. (K)	Resistance (Ω)	Excitation
1	4.81699e-2	65658.0	< 20 μ V	46	3.99974	2925.39	2mV \pm 25%
2	4.90762e-2	63713.0	< 20 μ V	47	4.20267	2899.83	2mV \pm 25%
3	5.40023e-2	54460.8	< 20 μ V	48	4.59856	2854.96	2mV \pm 25%
4	5.70864e-2	50369.1	< 20 μ V	49	5.00271	2815.68	2mV \pm 25%
5	6.99325e-2	37453.9	< 20 μ V	50	5.50467	2773.59	2mV \pm 25%
6	7.57975e-2	32844.3	< 20 μ V	51	6.20805	2724.81	2mV \pm 25%
7	8.40011e-2	28339.8	< 20 μ V	52	7.02143	2678.30	2mV \pm 25%
8	9.65981e-2	23568.1	< 20 μ V	53	8.08093	2628.65	2mV \pm 25%
9	0.113518	19637.8	< 63 μ V	54	9.08910	2589.82	2mV \pm 25%
10	0.129234	17058.5	< 63 μ V	55	10.1061	2556.72	2mV \pm 25%
11	0.147489	14808.5	< 63 μ V	56	11.1260	2527.94	2mV \pm 25%
12	0.163480	13442.4	< 63 μ V	57	12.1397	2502.67	2mV \pm 25%
13	0.183941	12020.7	< 63 μ V	58	13.1475	2480.43	2mV \pm 25%
14	0.205170	10899.8	< 63 μ V	59	14.1483	2460.62	2mV \pm 25%
15	0.230030	9908.70	< 63 μ V	60	15.1380	2442.84	2mV \pm 25%
16	0.259416	9012.90	< 63 μ V	61	16.1252	2426.71	2mV \pm 25%
17	0.289530	8305.40	< 63 μ V	62	17.1077	2411.86	2mV \pm 25%
18	0.308421	7941.20	< 63 μ V	63	18.0865	2398.29	2mV \pm 25%
19	0.328723	7599.40	< 63 μ V	64	19.0658	2385.75	2mV \pm 25%
20	0.367099	7062.80	< 63 μ V	65	20.0477	2374.05	2mV \pm 25%
21	0.417405	6515.80	< 63 μ V	66	21.1344	2361.97	2mV \pm 25%
22	0.475084	6037.40	< 63 μ V	67	22.7178	2345.98	2mV \pm 25%
23	0.534600	5656.40	< 63 μ V	68	24.3176	2330.97	2mV \pm 25%
24	0.611421	5278.60	< 63 μ V	69	25.9231	2317.66	2mV \pm 25%
25	0.686455	4991.57	< 63 μ V	70	27.5366	2305.45	2mV \pm 25%
26	0.765261	4750.77	< 63 μ V	71	29.1605	2293.89	2mV \pm 25%
27	0.855314	4528.69	< 63 μ V	72	30.9846	2282.07	2mV \pm 25%
28	0.949524	4340.53	< 63 μ V	73	33.0986	2269.35	2mV \pm 25%
29	1.04891	4176.34	< 63 μ V	74	36.1015	2253.26	2mV \pm 25%
30	1.14746	4039.65	< 63 μ V	75	39.1034	2239.06	2mV \pm 25%
31	1.20116	3972.98	2mV \pm 25%	76	42.0947	2226.41	2mV \pm 25%
32	1.30236	3866.09	2mV \pm 25%	77	45.0856	2214.76	2mV \pm 25%
33	1.40178	3774.23	2mV \pm 25%				
34	1.59883	3623.29	2mV \pm 25%				
35	1.80009	3501.61	2mV \pm 25%				
36	2.00023	3403.29	2mV \pm 25%				
37	2.19920	3322.05	2mV \pm 25%				
38	2.40039	3251.94	2mV \pm 25%				
39	2.60020	3191.95	2mV \pm 25%				
40	2.79923	3139.76	2mV \pm 25%				
41	3.00183	3093.09	2mV \pm 25%				
42	3.19912	3052.64	2mV \pm 25%				
43	3.40107	3015.75	2mV \pm 25%				
44	3.60074	2982.58	2mV \pm 25%				
45	3.80194	2952.35	2mV \pm 25%				



UNCERTAINTY ANALYSIS

Calibration Report: 754503
 Sensor Model: RX-202A-AA-0.05B
 Sensor Type: Rox Resistor

Sales Order: 89237-1
 Serial Number: U04184
 Temperature Range: 0.05K to 40.0K

Calibration Data Uncertainty

The uncertainties of the measured calibration data for Lake Shore's sensors are summarized in the table below. The values given are the combined uncertainty of the temperature measurement and the resistance or voltage measurement expressed as an equivalent temperature uncertainty in millikelvin (mK). Note that the values are the calibration uncertainty only and do not include the stability of the temperature sensor. The uncertainty analysis has followed the guidelines for determining measurement uncertainty as outlined in the ISO Guide to the Expression of Uncertainty in Measurement, NIST Technical Note 1297, and ANSI/NCSL Z540-2-1997. Since the uncertainty varies with temperature due to the variation of the sensor sensitivity and excitation, the table gives typical values at several different temperatures throughout the range of the calibration. The uncertainty is based on an approximate 95% confidence level with a coverage factor $k = 2$.

T (K)	Uncertainty (\pm mK)												
	GR	Cernox (CX)					RX			Platinum		RF-800	Diode
		1010	1030	1050	1070	1080	102A	103A	202A	100 Ω	25 Ω	27 Ω	
1.4	4	4	4	4			4	4	4			5	7
4.2	4	4	4	4	4		4	6	5			5	5
10	4	5	5	4	4		10	15	12			7	6
20	8	10	9	8	8	8	35	35	28	9	10	13	9
30	9	13	11	9	9	9	76	61	46	9	9	14	31
50	11	18	14	12	12	11				10	10	13	37
100	20	29	22	17	16	14				11	12	12	32
300		78	60	46	45	36				24	24	25	35
400		124	94	74	72	60				45	45	45	49
500										51	51		54

Polynomial Fit Uncertainty

When a sensor is used to measure temperature, a polynomial fit to the measured calibration data is often used to convert the sensor resistance (R) or voltage (V) to a temperature (T). How well the polynomial represents the sensor calibration data is another source of uncertainty when using the sensor. In the polynomials provided with this set of calibration data, the standard deviation of the fit can be used as an estimate of this additional temperature uncertainty. The standard deviation of fit is determined from the following equation:

$$\sigma_{fit}^2 = \frac{\sum_{i=1}^N (T_i - T_{i,calc})^2}{N - n} = \frac{N}{N - n} (\Delta T_{RMS})^2$$

where

- σ_{fit} = standard deviation of the fit
- T_i = measured temperature for point i
- $T_{i,calc}$ = the temperature calculated from the polynomial equation for point i
- N = number of data points in fit range
- n = number of fit coefficients
- ΔT_{RMS} = root mean square deviation of fit

A value of ΔT_{RMS} is given for each range of fit.

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F010-04-00_B 06/21/2011

POLYNOMIAL EQUATION

Calibration Report: 754503
Sensor Model: RX-202A-AA-0.05B
Sensor Type: Rox Resistor

Sales Order: 89237-1
Serial Number: U04184
Temperature Range: 0.05K to 40.0K

Polynomial Type: Chebychev
Useful Range of Fit:

5.00e-2 K to 0.856 K
6.155e+4 Ohms to 4529. Ohms

Lower and Upper limits of Log(Resistance) used in computing Chebychev coefficients:
ZL = 3.62079584778 ZU = 4.81728764961

Order	Coefficient	Std. Deviation of Coefficient	Ratio (Coeff./Std Dev.)
0	0.296224	3.7856E-05	7825.08
1	-0.382254	5.7377E-05	-6662.08
2	0.199639	5.4742E-05	3646.92
3	-0.095095	5.5788E-05	-1704.59
4	0.042764	5.6162E-05	761.44
5	-0.019139	5.1917E-05	-368.64
6	0.008222	4.8926E-05	168.05
7	-0.003247	5.8521E-05	-55.49
8	0.001658	6.2868E-05	26.37
9	-0.000563	5.5845E-05	-10.09

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

$k = ((Z - Z_L) - (Z_U - Z)) / (Z_U - Z_L)$

Temp. (K) = $\sum A_i \cdot \text{COS}(i \cdot \text{ARCCOS}(k))$, where $0 \leq i \leq 9$
and the A_i 's are the coefficients in the table above.



POLYNOMIAL EQUATION

Calibration Report: 754503

Sensor Model: RX-202A-AA-0.05B

Sensor Type: Rox Resistor

Sales Order: 89237-1

Serial Number: U04184

Temperature Range: 0.05K to 40.0K

Polynomial Type: Chebychev

Temp. (K) vs. Log(Resistance)

	R Meas. (Ω)	T Meas. (K)	T Eq. (K)	T diff. (mK)
1	65658.00	0.04817	0.04821	-0.04
2	63713.00	0.04908	0.04902	0.06
3	54460.80	0.05400	0.05405	-0.04
4	50369.10	0.05709	0.05708	0.00
5	37453.90	0.06993	0.06981	0.12
6	32844.30	0.07580	0.07595	-0.15
7	28339.80	0.08400	0.08395	0.05
8	23568.10	0.09660	0.09673	-0.13
9	19637.80	0.11352	0.11329	0.23
10	17058.50	0.12923	0.12908	0.15
11	14808.50	0.14749	0.14805	-0.56
12	13442.40	0.16348	0.16328	0.20
13	12020.70	0.18394	0.18383	0.11
14	10899.80	0.20517	0.20521	-0.04
15	9908.700	0.23003	0.22996	0.07
16	9012.900	0.25942	0.25939	0.03
17	8305.400	0.28953	0.28959	-0.06
18	7941.200	0.30842	0.30843	0.00
19	7599.400	0.32872	0.32871	0.01
20	7062.800	0.36710	0.36708	0.02
21	6515.800	0.41740	0.41744	-0.03
22	6037.400	0.47508	0.47517	-0.09
23	5656.400	0.53460	0.53468	-0.08
24	5278.600	0.61142	0.61125	0.17
25	4991.570	0.68645	0.68632	0.13
26	4750.770	0.76526	0.76522	0.04
27	4528.690	0.85531	0.85553	-0.22
28	4340.530	0.94952	0.94959	-0.07
29	4176.340	1.04891	1.04880	0.11

Order of Fit = 9

RMS error of fit = 0.15 mK

Largest absolute error = -0.56 mK at data point no. 11



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POLYNOMIAL EQUATION

Calibration Report: 754503
Sensor Model: RX-202A-AA-0.05B
Sensor Type: Rox Resistor

Sales Order: 89237-1
Serial Number: U04184
Temperature Range: 0.05K to 40.0K

Polynomial Type: Chebychev
Useful Range of Fit:

0.856 K to 6.21 K
4529. Ohms to 2725. Ohms

Lower and Upper limits of Log(Resistance) used in computing Chebychev coefficients:
ZL = 3.41973233024 ZU = 3.69823716588

Order	Coefficient	Std. Deviation of Coefficient	Ratio (Coeff./Std Dev.)
0	2.781978	4.2134E-04	6602.70
1	-3.062546	6.9341E-04	-4416.66
2	1.366584	6.3240E-04	2160.95
3	-0.553517	5.4518E-04	-1015.30
4	0.208109	5.1492E-04	404.15
5	-0.074351	4.9323E-04	-150.74
6	0.025240	5.1810E-04	48.72
7	-0.007465	5.1011E-04	-14.63
8	0.002348	5.0928E-04	4.61

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

$k = ((Z - Z_L) - (Z_U - Z)) / (Z_U - Z_L)$

Temp. (K) = $\sum A_i \cdot \text{COS}(i \cdot \text{ARCCOS}(k))$, where $0 \leq i \leq 8$
and the A_i 's are the coefficients in the table above.



POLYNOMIAL EQUATION

Calibration Report: 754503

Sensor Model: RX-202A-AA-0.05B

Sensor Type: Rox Resistor

Sales Order: 89237-1

Serial Number: U04184

Temperature Range: 0.05K to 40.0K

Polynomial Type: Chebychev

Temp. (K) vs. Log(Resistance)

	R Meas. (Ω)	T Meas. (K)	T Eq. (K)	T diff. (mK)
25	4991.570	0.68632	0.68638	-0.06
26	4750.770	0.76522	0.76486	0.35
27	4528.690	0.85553	0.85628	-0.75
28	4340.530	0.94952	0.94935	0.18
29	4176.340	1.04891	1.04803	0.88
30	4039.650	1.14746	1.14712	0.34
31	3972.982	1.20116	1.20237	-1.21
32	3866.093	1.30236	1.30234	0.02
33	3774.230	1.40178	1.40159	0.19
34	3623.285	1.59883	1.59916	-0.32
35	3501.606	1.80009	1.80018	-0.09
36	3403.289	2.00023	1.99995	0.28
37	3322.048	2.19920	2.19813	1.06
38	3251.941	2.40039	2.39978	0.61
39	3191.950	2.60020	2.60027	-0.07
40	3139.758	2.79923	2.80020	-0.96
41	3093.089	3.00183	3.00304	-1.21
42	3052.645	3.19912	3.20057	-1.45
43	3015.745	3.40107	3.40137	-0.30
44	2982.577	3.60074	3.60124	-0.50
45	2952.348	3.80194	3.80173	0.20
46	2925.391	3.99974	3.99728	2.46
47	2899.834	4.20267	4.19914	3.52
48	2854.962	4.59856	4.59848	0.08
49	2815.678	5.00271	5.00388	-1.17
50	2773.589	5.50467	5.50896	-4.28
51	2724.806	6.20805	6.20804	0.00
52	2678.303	7.02143	7.01804	3.39
53	2628.647	8.08093	8.08214	-1.21

Order of Fit = 8

RMS error of fit = 1.45 mK

Largest absolute error = -4.28 mK at data point no. 50



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POLYNOMIAL EQUATION

Calibration Report: 754503
Sensor Model: RX-202A-AA-0.05B
Sensor Type: Rox Resistor

Sales Order: 89237-1
Serial Number: U04184
Temperature Range: 0.05K to 40.0K

Polynomial Type: Chebychev
Useful Range of Fit:

6.21 K to 40.0 K
2725. Ohms to 2235. Ohms

Lower and Upper limits of Log(Resistance) used in computing Chebychev coefficients:
ZL = 3.34532592031 ZU = 3.44958295882

Order	Coefficient	Std. Deviation of Coefficient	Ratio (Coeff./Std Dev.)
0	18.216100	2.4075E-03	7566.26
1	-18.085502	3.8824E-03	-4658.30
2	6.307190	3.4633E-03	1821.14
3	-1.827232	3.2773E-03	-557.54
4	0.494402	3.1030E-03	159.33
5	-0.125533	3.0158E-03	-41.63
6	0.027743	3.0181E-03	9.19
7	-0.006698	2.9639E-03	-2.26
8	0.003679	2.8706E-03	1.28

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

$k = ((Z - Z_L) - (Z_U - Z)) / (Z_U - Z_L)$

Temp. (K) = $\sum A_i \cdot \text{COS}(i \cdot \text{ARCCOS}(k))$, where $0 \leq i \leq 8$
and the A_i 's are the coefficients in the table above.



POLYNOMIAL EQUATION

Calibration Report: 754503

Sensor Model: RX-202A-AA-0.05B

Sensor Type: Rox Resistor

Sales Order: 89237-1

Serial Number: U04184

Temperature Range: 0.05K to 40.0K

Polynomial Type: Chebychev

Temp. (K) vs. Log(Resistance)

	R Meas. (Ω)	T Meas. (K)	T Eq. (K)	T diff. (mK)
49	2815.678	5.00388	5.00415	-0.27
50	2773.589	5.50896	5.50766	1.30
51	2724.806	6.20804	6.21069	-2.65
52	2678.303	7.02143	7.01937	2.07
53	2628.647	8.08093	8.08033	0.61
54	2589.820	9.08910	9.09076	-1.66
55	2556.724	10.10606	10.10541	0.66
56	2527.937	11.12602	11.12451	1.51
57	2502.666	12.13966	12.14234	-2.68
58	2480.427	13.14753	13.14927	-1.74
59	2460.623	14.14834	14.14738	0.96
60	2442.842	15.13798	15.13678	1.20
61	2426.710	16.12519	16.12099	4.19
62	2411.856	17.10766	17.10918	-1.52
63	2398.290	18.08654	18.08825	-1.71
64	2385.752	19.06577	19.06527	0.50
65	2374.050	20.04765	20.04591	1.74
66	2361.967	21.13439	21.13497	-0.59
67	2345.981	22.71777	22.70879	8.98
68	2330.970	24.31763	24.34139	-23.76
69	2317.665	25.92307	25.93011	-7.03
70	2305.452	27.53661	27.52000	16.61
71	2293.888	29.16049	29.15461	5.88
72	2282.069	30.98458	30.97002	14.56
73	2269.350	33.09855	33.10644	-7.89
74	2253.256	36.10153	36.11908	-17.55
75	2239.058	39.10338	39.10777	-4.39
76	2226.407	42.09471	42.07358	21.13
77	2214.756	45.08563	45.09408	-8.45

Order of Fit = 8

RMS error of fit = 8.68 mK

Largest absolute error = -23.76 mK at data point no. 68



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INTERPOLATION TABLE

Calibration Report: 754503
Sensor Model: RX-202A-AA-0.05B
Sensor Type: Rox Resistor

Sales Order: 89237-1
Serial Number: U04184
Temperature Range: 0.05K to 40.0K

Temp (K)	Res. (Ω)	dR/dT (Ω/K)	dlogR/dlogT	Temp (K)	Res. (Ω)	dR/dT (Ω/K)	dlogR/dlogT
5.000e-2	61548.6	-2.0932e+6	-1.7005	1.300	3868.42	-994.83	-0.33432
5.500e-2	53097.3	-1.3844e+6	-1.4340	1.400	3775.61	-866.13	-0.32116
6.000e-2	46912.0	-1.1253e+6	-1.4392	1.500	3694.39	-761.39	-0.30914
6.500e-2	41730.9	-9.5489e+5	-1.4873	1.600	3622.71	-675.05	-0.29814
7.000e-2	37296.0	-8.2483e+5	-1.5481	1.700	3558.90	-603.19	-0.28813
7.500e-2	33488.4	-6.9364e+5	-1.5535	1.800	3501.70	-542.49	-0.27886
8.000e-2	30370.5	-5.5846e+5	-1.4711	1.900	3450.10	-490.96	-0.27038
8.500e-2	27853.8	-4.5264e+5	-1.3813	2.000	3403.27	-446.81	-0.26258
9.000e-2	25800.9	-3.7247e+5	-1.2993	2.100	3360.53	-408.78	-0.25544
9.500e-2	24094.6	-3.1312e+5	-1.2346	2.200	3321.35	-375.71	-0.24886
0.1000	22643.7	-2.6907e+5	-1.1883	2.300	3285.25	-346.80	-0.24279
0.1100	20290.7	-2.0635e+5	-1.1187	2.400	3251.87	-321.34	-0.23716
0.1200	18440.2	-1.6616e+5	-1.0813	2.500	3220.88	-298.82	-0.23194
0.1300	16931.5	-1.3709e+5	-1.0526	2.600	3192.03	-278.75	-0.22705
0.1400	15675.4	-1.1502e+5	-1.0273	2.700	3165.06	-260.80	-0.22248
0.1500	14615.2	-97702.	-1.0027	2.800	3139.81	-244.64	-0.21817
0.1600	13710.2	-83770.	-0.97761	2.900	3116.08	-230.06	-0.21411
0.1700	12931.3	-72381.	-0.95155	3.000	3093.75	-216.83	-0.21026
0.1800	12255.9	-63002.	-0.92529	3.100	3072.68	-204.79	-0.20661
0.1900	11665.8	-55260.	-0.90001	3.200	3052.76	-193.80	-0.20314
0.2000	11146.5	-48799.	-0.87560	3.300	3033.89	-183.72	-0.19984
0.2100	10686.3	-43403.	-0.85294	3.400	3015.98	-174.47	-0.19668
0.2200	10275.7	-38837.	-0.83149	3.500	2998.97	-165.94	-0.19367
0.2300	9907.17	-34974.	-0.81194	3.600	2982.77	-158.07	-0.19078
0.2400	9574.33	-31673.	-0.79395	3.700	2967.33	-150.79	-0.18802
0.2500	9272.23	-28818.	-0.77699	3.800	2952.60	-144.03	-0.18537
0.2600	8996.66	-26357.	-0.76172	3.900	2938.51	-137.75	-0.18283
0.2700	8744.04	-24211.	-0.74759	4.000	2925.03	-131.90	-0.18038
0.2800	8511.60	-22317.	-0.73415	4.200	2899.73	-121.37	-0.17580
0.2900	8296.94	-20651.	-0.72181	4.400	2876.40	-112.13	-0.17153
0.3000	8097.95	-19174.	-0.71031	4.600	2854.80	-103.99	-0.16756
0.3200	7740.45	-16667.	-0.68904	4.800	2834.74	-96.802	-0.16391
0.3400	7428.08	-14637.	-0.66997	5.000	2816.03	-90.439	-0.16058
0.3600	7152.66	-12957.	-0.65216	5.200	2798.52	-84.729	-0.15744
0.3800	6907.86	-11562.	-0.63604	5.400	2782.10	-79.495	-0.15430
0.4000	6688.80	-10375.	-0.62045	5.600	2766.69	-74.728	-0.15126
0.4200	6491.66	-9367.5	-0.60606	5.800	2752.18	-70.453	-0.14847
0.4400	6313.19	-8498.9	-0.59233	6.000	2738.48	-66.665	-0.14606
0.4600	6150.95	-7742.5	-0.57902	6.500	2707.15	-58.961	-0.14157
0.4800	6002.82	-7086.4	-0.56665	7.000	2679.32	-52.531	-0.13724
0.5000	5866.98	-6509.4	-0.55475	7.500	2654.45	-47.119	-0.13313
0.5500	5572.13	-5344.2	-0.52750	8.000	2632.05	-42.630	-0.12957
0.6000	5327.90	-4465.0	-0.50283	8.500	2611.68	-38.915	-0.12665
0.6500	5122.11	-3794.8	-0.48157	9.000	2593.04	-35.746	-0.12407
0.7000	4945.89	-3275.6	-0.46360	9.500	2575.86	-33.047	-0.12188
0.7500	4793.15	-2845.0	-0.44516	10.00	2559.94	-30.696	-0.11991
0.8000	4660.21	-2488.6	-0.42721	10.50	2545.11	-28.648	-0.11819
0.8500	4542.61	-2231.4	-0.41754	11.00	2531.25	-26.826	-0.11658
0.9000	4436.03	-2032.6	-0.41238	11.50	2518.25	-25.207	-0.11511
0.9500	4339.33	-1835.9	-0.40193	12.00	2506.02	-23.745	-0.11370
1.000	4252.18	-1654.9	-0.38919	12.50	2494.48	-22.428	-0.11239
1.050	4173.37	-1501.8	-0.37784	13.00	2483.57	-21.227	-0.11111
1.100	4101.64	-1370.6	-0.36758	13.50	2473.23	-20.134	-0.10990
1.150	4036.02	-1256.7	-0.35807	14.00	2463.42	-19.130	-0.10872
1.200	3975.72	-1157.9	-0.34949	14.50	2454.09	-18.209	-0.10759



INTERPOLATION TABLE

Calibration Report: 754503

Sensor Model: RX-202A-AA-0.05B

Sensor Type: Rox Resistor

Sales Order: 89237-1

Serial Number: U04184

Temperature Range: 0.05K to 40.0K

<u>Temp (K)</u>	<u>Res. (Ω)</u>	<u>dR/dT (Ω/K)</u>	<u>dlogR/dlogT</u>	<u>Temp (K)</u>	<u>Res. (Ω)</u>	<u>dR/dT (Ω/K)</u>	<u>dlogR/dlogT</u>
15.00	2445.20	-17.359	-0.10649	30.00	2288.26	-6.5262	-8.5561e-2
15.50	2436.72	-16.575	-0.10543	31.00	2281.88	-6.2320	-8.4664e-2
16.00	2428.62	-15.847	-0.10440	32.00	2275.79	-5.9598	-8.3801e-2
16.50	2420.86	-15.173	-0.10341	33.00	2269.96	-5.7074	-8.2972e-2
17.00	2413.44	-14.545	-0.10245	34.00	2264.37	-5.4727	-8.2174e-2
17.50	2406.31	-13.960	-0.10153	35.00	2259.01	-5.2533	-8.1392e-2
18.00	2399.47	-13.414	-0.10063	36.00	2253.86	-5.0488	-8.0642e-2
18.50	2392.89	-12.904	-9.9763e-2	37.00	2248.90	-4.8578	-7.9923e-2
19.00	2386.56	-12.426	-9.8923e-2	38.00	2244.14	-4.6783	-7.9217e-2
19.50	2380.46	-11.977	-9.8113e-2	39.00	2239.54	-4.5100	-7.8539e-2
20.00	2374.58	-11.556	-9.7328e-2	40.00	2235.11	-4.3519	-7.7883e-2
21.00	2363.42	-10.785	-9.5832e-2				
22.00	2352.98	-10.099	-9.4426e-2				
23.00	2343.19	-9.4856	-9.3107e-2				
24.00	2333.99	-8.9328	-9.1854e-2				
25.00	2325.31	-8.4340	-9.0676e-2				
26.00	2317.11	-7.9810	-8.9554e-2				
27.00	2309.33	-7.5682	-8.8485e-2				
28.00	2301.96	-7.1910	-8.7469e-2				
29.00	2294.94	-6.8447	-8.6493e-2				



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F010-04-00_B 06/21/2011

THERMAL CYCLE TESTING

Sensor Model: RX-202A-AA-0.05B

Serial Number: U04184

Sensor Type: Rox Resistor

This sensor was tested for repeatability through rapid thermal cycles from room temperature into liquid helium. During this test, the following four lead resistance values were recorded:

Approximately 305 K:	2008 Ω
Liquid Nitrogen:	2132 Ω
Liquid Helium:	2895 Ω

The nitrogen and helium values were recorded in OPEN dewars, so precision comparisons with calibration values or other thermal cycle test values should not be made.

Recommended Operating Parameters:

For sensors calibrated by LSCI, the current to the sensor is adjusted to maintain the sensor output voltage or power at the values listed on the Test Data page.



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F010-04-00_B 06/21/2011

BREAKPOINTS 340 FORMAT

Calibration Report: 754503

Sensor Model: RX-202A-AA-0.05B

Sensor Type: Rox Resistor

Sales Order: 89237-1

Serial Number: U04184

Temperature Range: 0.05K to 40.0K

Name: RX-202A-AA-0.05B

Serial number: U04184

Format: 4 ;Log Ohms/Kelvin

Limit: 40.0

Coefficient: 1 ;Negative

Point 1: 3.34929, 40.000	Point 56: 3.46710, 3.950	Point 111: 3.96707, 0.250
Point 2: 3.35051, 38.600	Point 57: 3.47061, 3.780	Point 112: 3.98678, 0.236
Point 3: 3.35169, 37.300	Point 58: 3.47437, 3.610	Point 113: 4.00839, 0.222
Point 4: 3.35292, 36.000	Point 59: 3.47841, 3.440	Point 114: 4.03044, 0.209
Point 5: 3.35422, 34.700	Point 60: 3.48250, 3.280	Point 115: 4.05275, 0.197
Point 6: 3.35547, 33.500	Point 61: 3.48691, 3.120	Point 116: 4.07722, 0.185
Point 7: 3.35679, 32.300	Point 62: 3.49138, 2.970	Point 117: 4.10423, 0.173
Point 8: 3.35817, 31.100	Point 63: 3.49620, 2.820	Point 118: 4.13415, 0.161
Point 9: 3.35962, 29.900	Point 64: 3.50143, 2.670	Point 119: 4.16744, 0.149
Point 10: 3.36116, 28.700	Point 65: 3.50674, 2.530	Point 120: 4.20139, 0.138
Point 11: 3.36264, 27.600	Point 66: 3.51252, 2.390	Point 121: 4.23907, 0.127
Point 12: 3.36420, 26.500	Point 67: 3.51839, 2.260	Point 122: 4.27740, 0.117
Point 13: 3.36585, 25.400	Point 68: 3.52479, 2.130	Point 123: 4.31592, 0.108
Point 14: 3.36760, 24.300	Point 69: 3.53184, 2.000	Point 124: 4.36226, 0.099
Point 15: 3.36928, 23.300	Point 70: 3.53902, 1.880	Point 125: 4.40793, 0.091
Point 16: 3.37106, 22.300	Point 71: 3.54695, 1.760	Point 126: 4.45504, 0.084
Point 17: 3.37294, 21.300	Point 72: 3.55502, 1.650	Point 127: 4.51083, 0.077
Point 18: 3.37495, 20.300	Point 73: 3.56396, 1.540	Point 128: 4.61455, 0.066
Point 19: 3.37644, 19.600	Point 74: 3.57395, 1.430	Point 129: 4.71856, 0.056
Point 20: 3.37777, 19.000	Point 75: 3.58416, 1.330	Point 130: 4.78059, 0.051
Point 21: 3.37915, 18.400	Point 76: 3.59558, 1.230	Point 131: 4.78922, 0.050
Point 22: 3.38048, 17.850	Point 77: 3.60327, 1.170	
Point 23: 3.38186, 17.300	Point 78: 3.60867, 1.130	
Point 24: 3.38329, 16.750	Point 79: 3.61439, 1.090	
Point 25: 3.38479, 16.200	Point 80: 3.62046, 1.050	
Point 26: 3.38636, 15.650	Point 81: 3.62690, 1.010	
Point 27: 3.38800, 15.100	Point 82: 3.63378, 0.970	
Point 28: 3.38956, 14.600	Point 83: 3.64112, 0.930	
Point 29: 3.39120, 14.100	Point 84: 3.64897, 0.890	
Point 30: 3.39291, 13.600	Point 85: 3.65727, 0.850	
Point 31: 3.39470, 13.100	Point 86: 3.66495, 0.815	
Point 32: 3.39658, 12.600	Point 87: 3.67309, 0.780	
Point 33: 3.39857, 12.100	Point 88: 3.68187, 0.745	
Point 34: 3.40045, 11.650	Point 89: 3.69135, 0.710	
Point 35: 3.40242, 11.200	Point 90: 3.70158, 0.675	
Point 36: 3.40449, 10.750	Point 91: 3.71103, 0.645	
Point 37: 3.40669, 10.300	Point 92: 3.72114, 0.615	
Point 38: 3.40901, 9.850	Point 93: 3.73206, 0.585	
Point 39: 3.41119, 9.450	Point 94: 3.74388, 0.555	
Point 40: 3.41350, 9.050	Point 95: 3.75673, 0.525	
Point 41: 3.41595, 8.650	Point 96: 3.76600, 0.505	
Point 42: 3.41856, 8.250	Point 97: 3.77526, 0.486	
Point 43: 3.42099, 7.900	Point 98: 3.78564, 0.466	
Point 44: 3.42358, 7.550	Point 99: 3.79559, 0.448	
Point 45: 3.42634, 7.200	Point 100: 3.80615, 0.430	
Point 46: 3.42931, 6.850	Point 101: 3.81739, 0.412	
Point 47: 3.43249, 6.500	Point 102: 3.82937, 0.394	
Point 48: 3.43593, 6.150	Point 103: 3.84221, 0.376	
Point 49: 3.43922, 5.840	Point 104: 3.85597, 0.358	
Point 50: 3.44265, 5.540	Point 105: 3.86911, 0.342	
Point 51: 3.44638, 5.240	Point 106: 3.88315, 0.326	
Point 52: 3.45017, 4.960	Point 107: 3.89825, 0.310	
Point 53: 3.45430, 4.680	Point 108: 3.91454, 0.294	
Point 54: 3.45848, 4.420	Point 109: 3.93105, 0.279	
Point 55: 3.46305, 4.160	Point 110: 3.94893, 0.264	



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F010-04-00_B 06/21/2011

BREAKPOINTS 234 FORMAT

Calibration Report: 754503

Sensor Model: RX-202A-AA-0.05B

Sensor Type: Rox Resistor

Sales Order: 89237-1

Serial Number: U04184

Temperature Range: 0.05K to 40.0K

Maximum Temperature Error:

1.4 - 10K: 0.197K
10 - 20K: 1.403K
20 - 40K: 1.787K
40 - 100K: -
> 100K: -

<u>BP #</u>	<u>Temp. (K)</u>	<u>Res. (Ω)</u>	<u>Log10 Res.</u>	<u>BP #</u>	<u>Temp. (K)</u>	<u>Res. (Ω)</u>	<u>Log10 Res.</u>
1	29.603	2290.868	3.360	16	0.255	9120.108	3.960
2	11.756	2511.886	3.400	17	0.227	10000.00	4.000
3	5.770	2754.229	3.440	18	0.175	12589.25	4.100
4	3.377	3019.952	3.480	19	0.138	15848.93	4.200
5	2.227	3311.311	3.520	20	0.112	19952.62	4.300
6	1.588	3630.781	3.560	21	0.092	25118.86	4.400
7	1.195	3981.072	3.600	22	0.078	31622.78	4.500
8	0.936	4365.158	3.640	23	0.067	39810.72	4.600
9	0.752	4786.301	3.680	24	0.057	50118.72	4.700
10	0.618	5248.075	3.720	25	0.049	63095.73	4.800
11	0.518	5754.399	3.760				
12	0.440	6309.573	3.800				
13	0.379	6918.310	3.840				
14	0.330	7585.776	3.880				
15	0.289	8317.638	3.920				



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