Certificate of Calibration
Report Number: 1043106

Sensor Model: RX-102A-AA-0.05B	Serial Number: U05566
Sensor Type: Ruthenium Oxide Resistor	Calibration Date: June 09, 2018
Sensor Excitation: see *Test Data* page of report	Calibration Due:
Temperature Range: 0.05 K to 40.0 K	

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 K < T < 800 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.

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.

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

Reported by: Matt Vance
Calibration Engineer/Technician

Approved by: John Krause
Metrology

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DATA PLOT

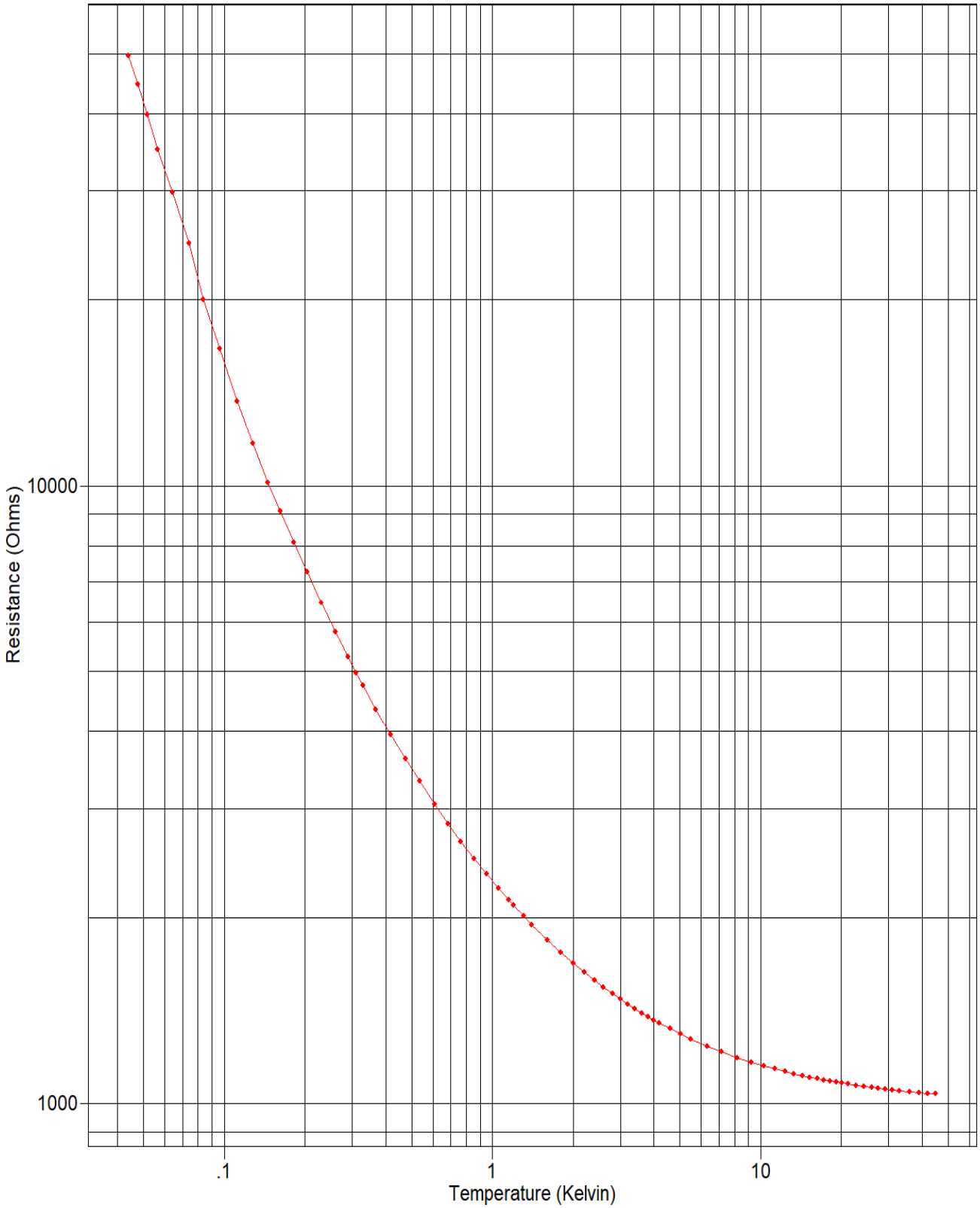
Calibration Report: 1043106

Sensor Model: RX-102A-AA-0.05B

Serial Number: U05566

Sensor Type: Ruthenium Oxide Resistor

Temperature Range: 0.05 K to 40.0 K



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TEST DATA

Calibration Report: 1043106

Sensor Model: RX-102A-AA-0.05B Serial Number: U05566

Sensor Type: Ruthenium Oxide Resistor Temperature Range: 0.05 K to 40.0 K

Index	Temp. (K)	Resistance (Ω)	Excitation	Index	Temp. (K)	Resistance (Ω)	Excitation
1	4.39203e-2	49708.0	< 20µV	46	4.00043	1364.49	2mV±25%
2	4.77490e-2	44578.7	< 20µV	47	4.19529	1348.83	2mV±25%
3	5.16631e-2	39850.0	< 20µV	48	4.60052	1320.27	2mV±25%
4	5.66573e-2	34968.8	< 20µV	49	5.00841	1295.92	2mV±25%
5	6.41050e-2	29844.8	< 20µV	50	5.50034	1271.12	2mV±25%
6	7.39586e-2	24688.4	< 20µV	51	6.32192	1237.99	2mV±25%
7	8.36550e-2	20012.7	< 20µV	52	7.15036	1211.88	2mV±25%
8	9.60554e-2	16670.4	< 20µV	53	8.19540	1186.20	2mV±25%
9	0.111993	13717.6	< 63µV	54	9.24015	1166.07	2mV±25%
10	0.127951	11717.9	< 63µV	55	10.2783	1149.98	2mV±25%
11	0.145993	10134.8	< 63µV	56	11.3068	1136.90	2mV±25%
12	0.161951	9109.70	< 63µV	57	12.3152	1126.03	2mV±25%
13	0.181976	8095.20	< 63µV	58	13.3107	1116.97	2mV±25%
14	0.203971	7265.20	< 63µV	59	14.2892	1109.25	2mV±25%
15	0.230190	6467.80	< 63µV	60	15.2626	1102.56	2mV±25%
16	0.260073	5790.05	< 63µV	61	16.2257	1096.64	2mV±25%
17	0.289974	5271.66	< 63µV	62	17.1815	1091.41	2mV±25%
18	0.309872	4974.67	< 63µV	63	18.1377	1086.76	2mV±25%
19	0.329723	4738.08	< 63µV	64	19.0976	1082.52	2mV±25%
20	0.368167	4342.22	< 63µV	65	20.0610	1078.69	2mV±25%
21	0.417864	3950.71	< 63µV	66	21.1317	1074.80	2mV±25%
22	0.474689	3608.99	< 63µV	67	22.7129	1069.75	2mV±25%
23	0.535817	3317.65	< 63µV	68	24.3009	1065.43	2mV±25%
24	0.609649	3046.33	< 63µV	69	25.8737	1061.50	2mV±25%
25	0.683573	2835.50	< 63µV	70	27.4577	1058.11	2mV±25%
26	0.764449	2653.65	< 63µV	71	29.0515	1055.03	2mV±25%
27	0.855076	2489.90	< 63µV	72	30.8582	1051.93	2mV±25%
28	0.949549	2352.70	< 63µV	73	32.9508	1048.73	2mV±25%
29	1.05069	2230.70	< 63µV	74	35.9460	1044.85	2mV±25%
30	1.15004	2133.46	< 63µV	75	38.9403	1041.44	2mV±25%
31	1.20051	2089.79	2mV±25%	76	41.9400	1038.60	2mV±25%
32	1.30429	2011.11	2mV±25%	77	44.9386	1036.15	2mV±25%
33	1.40021	1947.97	2mV±25%				
34	1.60182	1838.71	2mV±25%				
35	1.80125	1753.95	2mV±25%				
36	1.99746	1686.62	2mV±25%				
37	2.20169	1628.82	2mV±25%				
38	2.40063	1581.37	2mV±25%				
39	2.59809	1541.04	2mV±25%				
40	2.80496	1504.58	2mV±25%				
41	3.00327	1474.03	2mV±25%				
42	3.19851	1447.61	2mV±25%				
43	3.40075	1423.10	2mV±25%				
44	3.59979	1401.54	2mV±25%				
45	3.80138	1381.99	2mV±25%				

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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 (± 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:

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

where

σ_{fit} = standard deviation of the fit
T_i = measured temperature for point i
T_{icalc} = 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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POLYNOMIAL EQUATION

Calibration Report: 1043106
Sensor Model: RX-102A-AA-0.05B Serial Number: U05566
Sensor Type: Ruthenium Oxide Resistor Temperature Range: 0.05 K to 40.0 K

Polynomial Type: Chebychev
Useful Range of Fit:

5.00e-2 K	to	0.855 K
4.167e+4 ohms	to	2490 ohms

Lower and Upper limits of Log(Resistance) used in computing Chebychev coefficients:
ZL = 3.34844116728 ZU = 4.69642628966

Order	Coefficient	Std. Deviation of Coefficient	Ratio (Coeff./Std Dev.)
0	0.309853	9.7725E-05	3170.65
1	-0.401934	1.5105E-04	-2660.87
2	0.197861	1.4295E-04	1384.13
3	-0.086139	1.4063E-04	-612.52
4	0.033744	1.3532E-04	249.37
5	-0.013389	1.3179E-04	-101.59
6	0.005304	1.2814E-04	41.39
7	-0.001543	1.2798E-04	-12.06
8	0.000746	1.2649E-04	5.90
9	-0.000571	1.2490E-04	-4.57

Z = Log(Resistance)

k = ((Z-ZL)-(ZU-Z))/(ZU-ZL)

Temp. (K) = ΣA_i* COS(i * ARCCOS(k)), where 0 <= i <= 9
and the A_i's are the coefficients in the table above.

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POLYNOMIAL EQUATION

Calibration Report: 1043106
Sensor Model: RX-102A-AA-0.05B Serial Number: U05566
Sensor Type: Ruthenium Oxide Resistor Temperature Range: 0.05 K to 40.0 K

Polynomial Type: Chebychev
Temp. (K) vs. Log(Resistance)

	R Meas. (W)	T Meas. (K)	T Eq. (K)	T diff. (mK)
1	49708.00	0.04392	0.04393	-0.01
2	44578.70	0.04775	0.04774	0.01
3	39850.00	0.05166	0.05156	0.10
4	34968.80	0.05666	0.05684	-0.18
5	29844.80	0.06410	0.06418	-0.07
6	24688.40	0.07396	0.07344	0.52
7	20012.70	0.08366	0.08438	-0.72
8	16670.40	0.09606	0.09581	0.25
9	13717.60	0.11199	0.11162	0.38
10	11717.90	0.12795	0.12798	-0.03
11	10134.80	0.14599	0.14635	-0.36
12	9109.700	0.16195	0.16211	-0.16
13	8095.200	0.18198	0.18216	-0.18
14	7265.200	0.20397	0.20339	0.58
15	6467.800	0.23019	0.23001	0.18
16	5790.050	0.26007	0.25997	0.10
17	5271.660	0.28997	0.28978	0.20
18	4974.670	0.30987	0.31064	-0.76
19	4738.080	0.32972	0.32982	-0.10
20	4342.220	0.36817	0.36849	-0.32
21	3950.710	0.41786	0.41777	0.09
22	3608.990	0.47469	0.47380	0.89
23	3317.650	0.53582	0.53555	0.27
24	3046.330	0.60965	0.61001	-0.36
25	2835.500	0.68357	0.68419	-0.62
26	2653.650	0.76445	0.76454	-0.09
27	2489.900	0.85508	0.85497	0.10
28	2352.700	0.94955	0.94886	0.69
29	2230.700	1.05069	1.05108	-0.39

Order of Fit = 9 RMS error of fit = 0.39 mK
Largest absolute error = 0.89 mK at data point no. 22

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POLYNOMIAL EQUATION

Calibration Report: 1043106
Sensor Model: RX-102A-AA-0.05B Serial Number: U05566
Sensor Type: Ruthenium Oxide Resistor Temperature Range: 0.05 K to 40.0 K

Polynomial Type: Chebychev
Useful Range of Fit:

0.855 K	to	6.32 K
2490 ohms	to	1238 ohms

Lower and Upper limits of Log(Resistance) used in computing Chebychev coefficients:
ZL = 3.0741594975 ZU = 3.45262965162

Order	Coefficient	Std. Deviation of Coefficient	Ratio (Coeff./Std Dev.)
0	2.770433	1.6623E-04	16666.01
1	-3.042455	3.0655E-04	-9924.85
2	1.368559	2.5551E-04	5356.18
3	-0.584737	2.2028E-04	-2654.52
4	0.247566	1.6891E-04	1465.65
5	-0.104598	1.3448E-04	-777.79
6	0.044252	1.3876E-04	318.91
7	-0.019057	1.7781E-04	-107.17
8	0.007852	2.1679E-04	36.22
9	-0.003681	2.4317E-04	-15.14
10	0.001110	2.2059E-04	5.03
11	-0.001052	1.7923E-04	-5.87

Z = Log(Resistance)

k = ((Z-ZL)-(ZU-Z))/(ZU-ZL)

Temp. (K) = ΣA_i* COS(i * ARCCOS(k)), where 0 <= i <= 11
and the A_i's are the coefficients in the table above.

POLYNOMIAL EQUATION

Calibration Report: 1043106
Sensor Model: RX-102A-AA-0.05B Serial Number: U05566
Sensor Type: Ruthenium Oxide Resistor Temperature Range: 0.05 K to 40.0 K

Polynomial Type: Chebychev
Temp. (K) vs. Log(Resistance)

	R Meas. (W)	T Meas. (K)	T Eq. (K)	T diff. (mK)
25	2835.500	0.68419	0.68419	0.00
26	2653.650	0.76454	0.76450	0.03
27	2489.900	0.85497	0.85513	-0.15
28	2352.700	0.94955	0.94920	0.35
29	2230.700	1.05069	1.05104	-0.35
30	2133.461	1.15004	1.14990	0.14
31	2089.788	1.20051	1.20070	-0.18
32	2011.110	1.30429	1.30409	0.20
33	1947.965	1.40021	1.40009	0.12
34	1838.706	1.60182	1.60194	-0.12
35	1753.953	1.80125	1.80143	-0.18
36	1686.617	1.99746	1.99754	-0.08
37	1628.819	2.20169	2.20140	0.29
38	1581.367	2.40063	2.40047	0.16
39	1541.039	2.59809	2.59815	-0.06
40	1504.580	2.80496	2.80500	-0.04
41	1474.035	3.00327	3.00363	-0.36
42	1447.613	3.19851	3.19807	0.44
43	1423.100	3.40075	3.40091	-0.16
44	1401.538	3.59979	3.60044	-0.65
45	1381.990	3.80138	3.80134	0.04
46	1364.490	4.00043	3.99992	0.50
47	1348.830	4.19529	4.19487	0.42
48	1320.269	4.60052	4.60036	0.16
49	1295.918	5.00841	5.00877	-0.36
50	1271.120	5.50034	5.50104	-0.70
51	1237.990	6.32192	6.32103	0.89
52	1211.879	7.15036	7.15074	-0.38
53	1186.204	8.19540	8.19535	0.05

Order of Fit = 11 RMS error of fit = 0.34 mK
Largest absolute error = 0.89 mK at data point no. 51

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POLYNOMIAL EQUATION

Calibration Report: 1043106
Sensor Model: RX-102A-AA-0.05B Serial Number: U05566
Sensor Type: Ruthenium Oxide Resistor Temperature Range: 0.05 K to 40.0 K

Polynomial Type: Chebychev
Useful Range of Fit:

6.32 K	to	40.0 K
1238 ohms	to	1040 ohms

Lower and Upper limits of Log(Resistance) used in computing Chebychev coefficients:
ZL = 3.01542215821 ZU = 3.11257763365

Order	Coefficient	Std. Deviation of Coefficient	Ratio (Coeff./Std Dev.)
0	15.656155	7.9313E-03	1973.96
1	-15.658689	1.4508E-02	-1079.29
2	7.258157	1.3843E-02	524.31
3	-3.412116	1.2247E-02	-278.62
4	1.564714	9.4906E-03	164.87
5	-0.736992	6.3685E-03	-115.73
6	0.347844	7.1249E-03	48.82
7	-0.137769	1.1505E-02	-11.97
8	0.097021	1.5375E-02	6.31
9	-0.006431	1.4413E-02	-0.45
10	0.036943	9.6876E-03	3.81

Z = Log(Resistance)

k = ((Z-ZL)-(ZU-Z))/(ZU-ZL)

Temp. (K) = ΣA_i* COS(i * ARCCOS(k)), where 0 <= i <= 10
and the A_i's are the coefficients in the table above.

POLYNOMIAL EQUATION

Calibration Report: 1043106
Sensor Model: RX-102A-AA-0.05B Serial Number: U05566
Sensor Type: Ruthenium Oxide Resistor Temperature Range: 0.05 K to 40.0 K

Polynomial Type: Chebychev
Temp. (K) vs. Log(Resistance)

	R Meas. (W)	T Meas. (K)	T Eq. (K)	T diff. (mK)
49	1295.918	5.00877	5.00884	-0.07
50	1271.120	5.50104	5.50055	0.49
51	1237.990	6.32103	6.32389	-2.85
52	1211.879	7.15036	7.14212	8.24
53	1186.204	8.19540	8.20845	-13.05
54	1166.065	9.24015	9.23619	3.96
55	1149.982	10.27834	10.26780	10.54
56	1136.900	11.30678	11.30225	4.53
57	1126.027	12.31522	12.32730	-12.08
58	1116.971	13.31074	13.32131	-10.57
59	1109.254	14.28917	14.29403	-4.86
60	1102.563	15.26259	15.25479	7.81
61	1096.639	16.22573	16.21844	7.29
62	1091.406	17.18154	17.17691	4.63
63	1086.756	18.13773	18.12957	8.15
64	1082.521	19.09757	19.09405	3.52
65	1078.692	20.06102	20.05825	2.78
66	1074.799	21.13165	21.14238	-10.72
67	1069.746	22.71289	22.73262	-19.73
68	1065.433	24.30095	24.28621	14.74
69	1061.500	25.87367	25.89431	-20.64
70	1058.106	27.45774	27.45937	-1.63
71	1055.030	29.05146	29.04793	3.53
72	1051.932	30.85824	30.84278	15.46
73	1048.729	32.95079	32.94584	4.94
74	1044.847	35.94601	35.91083	35.18
75	1041.445	38.94030	38.97909	-38.79
76	1038.599	41.93997	41.96659	-26.62
77	1036.149	44.93865	44.91283	25.82

Order of Fit = 10 RMS error of fit = 14.90 mK
Largest absolute error = -38.79 mK at data point no. 75

INTERPOLATION TABLE

Calibration Report: 1043106

Sensor Model: RX-102A-AA-0.05B Serial Number: U05566

Sensor Type: Ruthenium Oxide Resistor Temperature Range: 0.05 K to 40.0 K

Temp (K)	Res. (Ω)	dR/dT (Ω/K)	dlogR/dlogT	Temp (K)	Res. (Ω)	dR/dT (Ω/K)	dlogR/dlogT
5.000e-2	41667.3	-1.2247e+6	-1.4696	1.300	2014.00	-707.42	-0.45663
5.500e-2	36492.5	-8.7037e+5	-1.3118	1.400	1948.02	-615.39	-0.44226
6.000e-2	32602.7	-7.0469e+5	-1.2969	1.500	1890.37	-539.85	-0.42837
6.500e-2	29336.6	-6.1001e+5	-1.3516	1.600	1839.63	-476.94	-0.41482
7.000e-2	26466.8	-5.3951e+5	-1.4269	1.700	1794.64	-424.31	-0.40193
7.500e-2	23927.2	-4.7717e+5	-1.4957	1.800	1754.49	-379.88	-0.38974
8.000e-2	21699.1	-4.1357e+5	-1.5248	1.900	1718.44	-342.28	-0.37844
8.500e-2	19794.1	-3.4848e+5	-1.4965	2.000	1685.85	-310.25	-0.36806
9.000e-2	18200.0	-2.9112e+5	-1.4396	2.100	1656.24	-282.75	-0.35851
9.500e-2	16865.2	-2.4440e+5	-1.3767	2.200	1629.18	-258.92	-0.34964
0.1000	15741.3	-2.0664e+5	-1.3127	2.300	1604.35	-238.14	-0.34140
0.1100	13961.1	-1.5373e+5	-1.2113	2.400	1581.47	-219.83	-0.33361
0.1200	12600.8	-1.2047e+5	-1.1472	2.500	1560.31	-203.62	-0.32625
0.1300	11516.8	-97776	-1.1037	2.600	1540.69	-189.17	-0.31923
0.1400	10624.9	-81392	-1.0725	2.700	1522.43	-176.22	-0.31253
0.1500	9875.09	-69142	-1.0502	2.800	1505.40	-164.57	-0.30609
0.1600	9233.49	-59546	-1.0318	2.900	1489.48	-154.05	-0.29993
0.1700	8677.82	-51843	-1.0156	3.000	1474.56	-144.51	-0.29400
0.1800	8192.10	-45507	-0.99990	3.100	1460.55	-135.84	-0.28831
0.1900	7764.05	-40252	-0.98504	3.200	1447.37	-127.93	-0.28285
0.2000	7384.36	-35809	-0.96987	3.300	1434.94	-120.71	-0.27761
0.2100	7045.61	-32038	-0.95492	3.400	1423.20	-114.10	-0.27257
0.2200	6741.84	-28798	-0.93974	3.500	1412.10	-108.02	-0.26774
0.2300	6468.14	-26013	-0.92498	3.600	1401.58	-102.43	-0.26310
0.2400	6220.34	-23601	-0.91059	3.700	1391.60	-97.278	-0.25864
0.2500	5995.10	-21495	-0.89636	3.800	1382.11	-92.513	-0.25436
0.2600	5789.55	-19659	-0.88284	3.900	1373.09	-88.099	-0.25023
0.2700	5601.19	-18046	-0.86990	4.000	1364.48	-84.000	-0.24625
0.2800	5428.00	-16619	-0.85730	4.200	1348.44	-76.650	-0.23874
0.2900	5268.24	-15359	-0.84545	4.400	1333.76	-70.230	-0.23168
0.3000	5120.36	-14238	-0.83422	4.600	1320.29	-64.590	-0.22504
0.3200	4855.28	-12339	-0.81326	4.800	1307.88	-59.629	-0.21884
0.3400	4624.35	-10806	-0.79448	5.000	1296.40	-55.251	-0.21309
0.3600	4421.26	-9544.1	-0.77712	5.200	1285.75	-51.324	-0.20757
0.3800	4241.10	-8502.2	-0.76179	5.400	1275.85	-47.702	-0.20190
0.4000	4080.11	-7621.9	-0.74722	5.600	1266.65	-44.388	-0.19625
0.4200	3935.32	-6878.4	-0.73411	5.800	1258.07	-41.463	-0.19115
0.4400	3804.27	-6241.0	-0.72183	6.000	1250.04	-38.929	-0.18685
0.4600	3685.11	-5688.3	-0.71005	6.500	1231.85	-34.071	-0.17978
0.4800	3576.24	-5210.3	-0.69933	7.000	1215.96	-29.428	-0.16941
0.5000	3476.32	-4790.0	-0.68895	7.500	1202.42	-24.967	-0.15573
0.5500	3259.12	-3941.3	-0.66513	8.000	1190.72	-22.077	-0.14833
0.6000	3078.80	-3300.2	-0.64315	8.500	1180.11	-20.440	-0.14722
0.6500	2926.62	-2806.8	-0.62338	9.000	1170.34	-18.585	-0.14292
0.7000	2796.39	-2417.6	-0.60518	9.500	1161.58	-16.465	-0.13466
0.7500	2683.64	-2103.2	-0.58779	10.00	1153.81	-14.686	-0.12728
0.8000	2585.09	-1846.7	-0.57150	10.50	1146.82	-13.301	-0.12178
0.8500	2498.23	-1634.6	-0.55616	11.00	1140.47	-12.134	-0.11703
0.9000	2421.00	-1460.4	-0.54289	11.50	1134.66	-11.142	-0.11292
0.9500	2351.65	-1318.9	-0.53282	12.00	1129.31	-10.282	-0.10926
1.000	2288.79	-1196.8	-0.52291	12.50	1124.36	-9.5395	-0.10605
1.050	2231.82	-1083.1	-0.50955	13.00	1119.76	-8.8736	-0.10302
1.100	2180.28	-981.77	-0.49533	13.50	1115.47	-8.2708	-0.10010
1.150	2133.37	-897.00	-0.48353	14.00	1111.48	-7.7199	-9.7238e-2
1.200	2090.36	-825.11	-0.47367	14.50	1107.75	-7.2164	-9.4460e-2

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INTERPOLATION TABLE

Calibration Report: 1043106

Sensor Model: RX-102A-AA-0.05B Serial Number: U05566

Sensor Type: Ruthenium Oxide Resistor Temperature Range: 0.05 K to 40.0 K

Temp (K)	Res. (Ω)	dR/dT (Ω/K)	dlogR/dlogT	Temp (K)	Res. (Ω)	dR/dT (Ω/K)	dlogR/dlogT
15.00	1104.26	-6.7542	-9.1748e-2	30.00	1053.34	-1.7184	-4.8942e-2
15.50	1100.99	-6.3307	-8.9125e-2	31.00	1051.68	-1.6101	-4.7459e-2
16.00	1097.92	-5.9422	-8.6596e-2	32.00	1050.12	-1.5114	-4.6057e-2
16.50	1095.04	-5.5870	-8.4184e-2	33.00	1048.65	-1.4218	-4.4741e-2
17.00	1092.33	-5.2614	-8.1884e-2	34.00	1047.27	-1.3398	-4.3497e-2
17.50	1089.77	-4.9638	-7.9711e-2	35.00	1045.97	-1.2646	-4.2316e-2
18.00	1087.36	-4.6908	-7.7651e-2	36.00	1044.74	-1.1961	-4.1216e-2
18.50	1085.08	-4.4408	-7.5713e-2	37.00	1043.58	-1.1332	-4.0179e-2
19.00	1082.92	-4.2108	-7.3879e-2	38.00	1042.47	-1.0753	-3.9196e-2
19.50	1080.86	-3.9993	-7.2152e-2	39.00	1041.42	-1.0222	-3.8280e-2
20.00	1078.91	-3.8040	-7.0515e-2	40.00	1040.43	-0.97320	-3.7416e-2
21.00	1075.29	-3.4561	-6.7497e-2				
22.00	1071.98	-3.1557	-6.4764e-2				
23.00	1068.96	-2.8942	-6.2271e-2				
24.00	1066.19	-2.6639	-5.9964e-2				
25.00	1063.63	-2.4603	-5.7828e-2				
26.00	1061.26	-2.2788	-5.5828e-2				
27.00	1059.06	-2.1161	-5.3949e-2				
28.00	1057.02	-1.9699	-5.2183e-2				
29.00	1055.12	-1.8379	-5.0515e-2				

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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:	1001 Ω
Liquid Nitrogen:	1021 Ω
Liquid Helium:	1347 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 Lake Shore, 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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BREAKPOINTS CUBIC SPLINE FORMAT

Calibration Report: 1043106

Sensor Model: RX-102A-AA-0.05B Serial Number: U05566

Sensor Type: Ruthenium Oxide Resistor Temperature Range: 0.05 K to 40.0 K

Sensor Model: RX-102A-AA-0.05B
Serial Number: U05566
Data Format: 7 (Ohms/Kelvin)
Setpoint Limit: 40

Measurement (ohms)	Temp (K)	Curvature	Measurement (ohms)	Temp (K)	Curvature
1.03615E+03	4.49128E+01	6.71607E-02	3.60899E+03	4.73798E-01	1.49966E-07
1.03860E+03	4.19666E+01	5.80709E-02	3.95071E+03	4.17774E-01	1.02223E-07
1.04144E+03	3.89791E+01	4.75153E-02	4.34222E+03	3.68491E-01	6.95721E-08
1.04485E+03	3.59108E+01	3.79146E-02	4.73808E+03	3.29819E-01	4.93755E-08
1.04873E+03	3.29458E+01	2.95288E-02	4.97467E+03	3.10637E-01	4.10032E-08
1.05193E+03	3.08428E+01	2.42943E-02	5.27166E+03	2.89778E-01	3.23509E-08
1.05503E+03	2.90479E+01	2.02420E-02	5.79005E+03	2.59974E-01	2.22301E-08
1.05811E+03	2.74594E+01	1.70537E-02	6.46780E+03	2.30013E-01	1.43989E-08
1.06150E+03	2.58943E+01	1.42648E-02	7.26520E+03	2.03392E-01	9.26319E-09
1.06543E+03	2.42862E+01	1.17835E-02	8.09520E+03	1.82158E-01	6.24018E-09
1.06975E+03	2.27326E+01	9.72107E-03	9.10970E+03	1.62110E-01	4.16013E-09
1.07480E+03	2.11424E+01	7.92601E-03	1.01348E+04	1.46350E-01	2.94882E-09
1.07869E+03	2.00582E+01	6.85992E-03	1.17179E+04	1.27983E-01	1.88673E-09
1.08252E+03	1.90941E+01	5.97399E-03	1.37176E+04	1.11618E-01	1.15992E-09
1.08676E+03	1.81296E+01	5.15418E-03	1.66704E+04	9.58082E-02	5.81791E-10
1.09141E+03	1.71769E+01	4.39645E-03	2.00127E+04	8.43797E-02	2.56801E-10
1.09664E+03	1.62184E+01	3.68345E-03	2.46884E+04	7.34362E-02	8.78198E-11
1.10256E+03	1.52548E+01	3.02242E-03	2.98448E+04	6.41754E-02	6.58258E-11
1.10925E+03	1.42940E+01	2.43452E-03	3.49688E+04	5.68351E-02	7.30795E-11
1.11697E+03	1.33213E+01	1.93544E-03	3.98500E+04	5.15582E-02	6.33226E-11
1.12603E+03	1.23273E+01	1.54576E-03	4.45787E+04	4.77408E-02	1.45784E-11
1.13690E+03	1.13023E+01	1.26782E-03	4.97080E+04	4.39337E-02	-3.82952E-11
1.14998E+03	1.02678E+01	1.04136E-03			
1.16607E+03	9.23619E+00	7.63680E-04			
1.18620E+03	8.20845E+00	3.26678E-04			
1.21188E+03	7.14212E+00	4.55411E-04			
1.23799E+03	6.32103E+00	1.90056E-04			
1.27112E+03	5.50104E+00	1.73802E-04			
1.29592E+03	5.00877E+00	1.19780E-04			
1.32027E+03	4.60036E+00	9.81192E-05			
1.34883E+03	4.19487E+00	7.51429E-05			
1.36449E+03	3.99992E+00	6.66335E-05			
1.38199E+03	3.80134E+00	5.77742E-05			
1.40154E+03	3.60044E+00	4.98178E-05			
1.42310E+03	3.40091E+00	4.25529E-05			
1.44761E+03	3.19807E+00	3.58761E-05			
1.47403E+03	3.00363E+00	3.01051E-05			
1.50458E+03	2.80500E+00	2.48278E-05			
1.54104E+03	2.59815E+00	2.00334E-05			
1.58137E+03	2.40047E+00	1.61004E-05			
1.62882E+03	2.20140E+00	1.27239E-05			
1.68662E+03	1.99754E+00	9.80655E-06			
1.75395E+03	1.80143E+00	7.39323E-06			
1.83871E+03	1.60194E+00	5.22831E-06			
1.94797E+03	1.40009E+00	3.50182E-06			
2.01111E+03	1.30409E+00	2.91951E-06			
2.08979E+03	1.20070E+00	2.38161E-06			
2.13346E+03	1.14990E+00	2.15517E-06			
2.23070E+03	1.05104E+00	1.71629E-06			
2.35270E+03	9.49202E-01	1.06203E-06			
2.48990E+03	8.54973E-01	9.30707E-07			
2.65365E+03	7.64536E-01	6.17760E-07			
2.83550E+03	6.84189E-01	4.58249E-07			
3.04633E+03	6.10005E-01	3.20557E-07			
3.31765E+03	5.35547E-01	2.17014E-07			

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BREAKPOINTS 340 FORMAT

Calibration Report: 1043106

Sensor Model: RX-102A-AA-0.05B Serial Number: U05566

Sensor Type: Ruthenium Oxide Resistor Temperature Range: 0.05 K to 40.0 K

Name: RX-102A-AA-0.05B
Serial Number: U05566
Format: 4 ;Log Ohms/Kelvin
Limit: 40.0
Coefficient: 1 ;Negative

Point 1: 3.01721, 40.000	Point 51: 3.07702, 7.850	Point 101: 3.47698, 0.625
Point 2: 3.01771, 38.800	Point 52: 3.07960, 7.550	Point 102: 3.49300, 0.590
Point 3: 3.01820, 37.700	Point 53: 3.08237, 7.250	Point 103: 3.50785, 0.560
Point 4: 3.01871, 36.600	Point 54: 3.08543, 6.950	Point 104: 3.52378, 0.530
Point 5: 3.01926, 35.500	Point 55: 3.08877, 6.650	Point 105: 3.53809, 0.505
Point 6: 3.01978, 34.500	Point 56: 3.09237, 6.350	Point 106: 3.55085, 0.484
Point 7: 3.02034, 33.500	Point 57: 3.09623, 6.050	Point 107: 3.56373, 0.464
Point 8: 3.02093, 32.500	Point 58: 3.10025, 5.760	Point 108: 3.57737, 0.444
Point 9: 3.02155, 31.500	Point 59: 3.10449, 5.480	Point 109: 3.59189, 0.424
Point 10: 3.02222, 30.500	Point 60: 3.10912, 5.200	Point 110: 3.60737, 0.404
Point 11: 3.02293, 29.500	Point 61: 3.11420, 4.920	Point 111: 3.62225, 0.386
Point 12: 3.02368, 28.500	Point 62: 3.11937, 4.660	Point 112: 3.63808, 0.368
Point 13: 3.02441, 27.600	Point 63: 3.12503, 4.400	Point 113: 3.65502, 0.350
Point 14: 3.02518, 26.700	Point 64: 3.13128, 4.140	Point 114: 3.67320, 0.332
Point 15: 3.02601, 25.800	Point 65: 3.13657, 3.940	Point 115: 3.69059, 0.316
Point 16: 3.02689, 24.900	Point 66: 3.14139, 3.770	Point 116: 3.71040, 0.299
Point 17: 3.02783, 24.000	Point 67: 3.14659, 3.600	Point 117: 3.73056, 0.283
Point 18: 3.02884, 23.100	Point 68: 3.15186, 3.440	Point 118: 3.75097, 0.268
Point 19: 3.02993, 22.200	Point 69: 3.15753, 3.280	Point 119: 3.77302, 0.253
Point 20: 3.03097, 21.400	Point 70: 3.16367, 3.120	Point 120: 3.79696, 0.238
Point 21: 3.03209, 20.600	Point 71: 3.16991, 2.970	Point 121: 3.82130, 0.224
Point 22: 3.03306, 19.950	Point 72: 3.17666, 2.820	Point 122: 3.84773, 0.210
Point 23: 3.03385, 19.450	Point 73: 3.18401, 2.670	Point 123: 3.87664, 0.196
Point 24: 3.03468, 18.950	Point 74: 3.19148, 2.530	Point 124: 3.90604, 0.183
Point 25: 3.03555, 18.450	Point 75: 3.19961, 2.390	Point 125: 3.93816, 0.170
Point 26: 3.03646, 17.950	Point 76: 3.20851, 2.250	Point 126: 3.97358, 0.157
Point 27: 3.03733, 17.500	Point 77: 3.21759, 2.120	Point 127: 4.00980, 0.145
Point 28: 3.03824, 17.050	Point 78: 3.22754, 1.990	Point 128: 4.04659, 0.134
Point 29: 3.03921, 16.600	Point 79: 3.23769, 1.870	Point 129: 4.08390, 0.124
Point 30: 3.04022, 16.150	Point 80: 3.24886, 1.750	Point 130: 4.12153, 0.115
Point 31: 3.04128, 15.700	Point 81: 3.26129, 1.630	Point 131: 4.16420, 0.106
Point 32: 3.04241, 15.250	Point 82: 3.27399, 1.520	Point 132: 4.21112, 0.098
Point 33: 3.04360, 14.800	Point 83: 3.28810, 1.410	Point 133: 4.26287, 0.090
Point 34: 3.04486, 14.350	Point 84: 3.30391, 1.300	Point 134: 4.32345, 0.082
Point 35: 3.04620, 13.900	Point 85: 3.31842, 1.210	Point 135: 4.44408, 0.068
Point 36: 3.04761, 13.450	Point 86: 3.32196, 1.190	Point 136: 4.54611, 0.057
Point 37: 3.04912, 13.000	Point 87: 3.32812, 1.155	Point 137: 4.60612, 0.051
Point 38: 3.05053, 12.600	Point 88: 3.33558, 1.115	Point 138: 4.61999, 0.050
Point 39: 3.05203, 12.200	Point 89: 3.34345, 1.075	
Point 40: 3.05361, 11.800	Point 90: 3.35182, 1.035	
Point 41: 3.05529, 11.400	Point 91: 3.36071, 0.995	
Point 42: 3.05708, 11.000	Point 92: 3.37012, 0.955	
Point 43: 3.05874, 10.650	Point 93: 3.38007, 0.915	
Point 44: 3.06051, 10.300	Point 94: 3.39062, 0.875	
Point 45: 3.06240, 9.950	Point 95: 3.40189, 0.835	
Point 46: 3.06443, 9.600	Point 96: 3.41243, 0.800	
Point 47: 3.06630, 9.300	Point 97: 3.42363, 0.765	
Point 48: 3.06830, 9.000	Point 98: 3.43561, 0.730	
Point 49: 3.07079, 8.650	Point 99: 3.44842, 0.695	
Point 50: 3.07382, 8.250	Point 100: 3.46217, 0.660	

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BREAKPOINTS 234 FORMAT

Calibration Report: 1043106

Sensor Model: RX-102A-AA-0.05B Serial Number: U05566

Sensor Type: Ruthenium Oxide Resistor Temperature Range: 0.05 K to 40.0 K

Maximum Temperature Error:	
1.4 - 10 K:	0.749 K
10 - 20 K:	1.046 K
20 - 40 K:	-
40 - 100 K:	-
> 100 K:	-

BP #	Temp. (K)	Res. (W)	Log10 Res.	BP #	Temp. (K)	Res. (W)	Log10 Res.
1	16.246	1096.478	3.040	21	0.214	6918.310	3.840
2	7.510	1202.264	3.080	22	0.195	7585.776	3.880
3	4.632	1318.257	3.120	23	0.177	8317.638	3.920
4	3.215	1445.440	3.160	24	0.162	9120.108	3.960
5	2.385	1584.893	3.200	25	0.148	10000.00	4.000
6	1.845	1737.801	3.240	26	0.120	12589.25	4.100
7	1.473	1905.461	3.280	27	0.099	15848.93	4.200
8	1.201	2089.296	3.320	28	0.085	19952.62	4.300
9	0.998	2290.868	3.360	29	0.073	25118.86	4.400
10	0.842	2511.886	3.400	30	0.061	31622.78	4.500
11	0.718	2754.229	3.440	31	0.052	39810.72	4.600
12	0.618	3019.952	3.480				
13	0.537	3311.311	3.520				
14	0.470	3630.781	3.560				
15	0.413	3981.072	3.600				
16	0.366	4365.158	3.640				
17	0.326	4786.301	3.680				
18	0.291	5248.075	3.720				
19	0.262	5754.399	3.760				
20	0.236	6309.573	3.800				

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