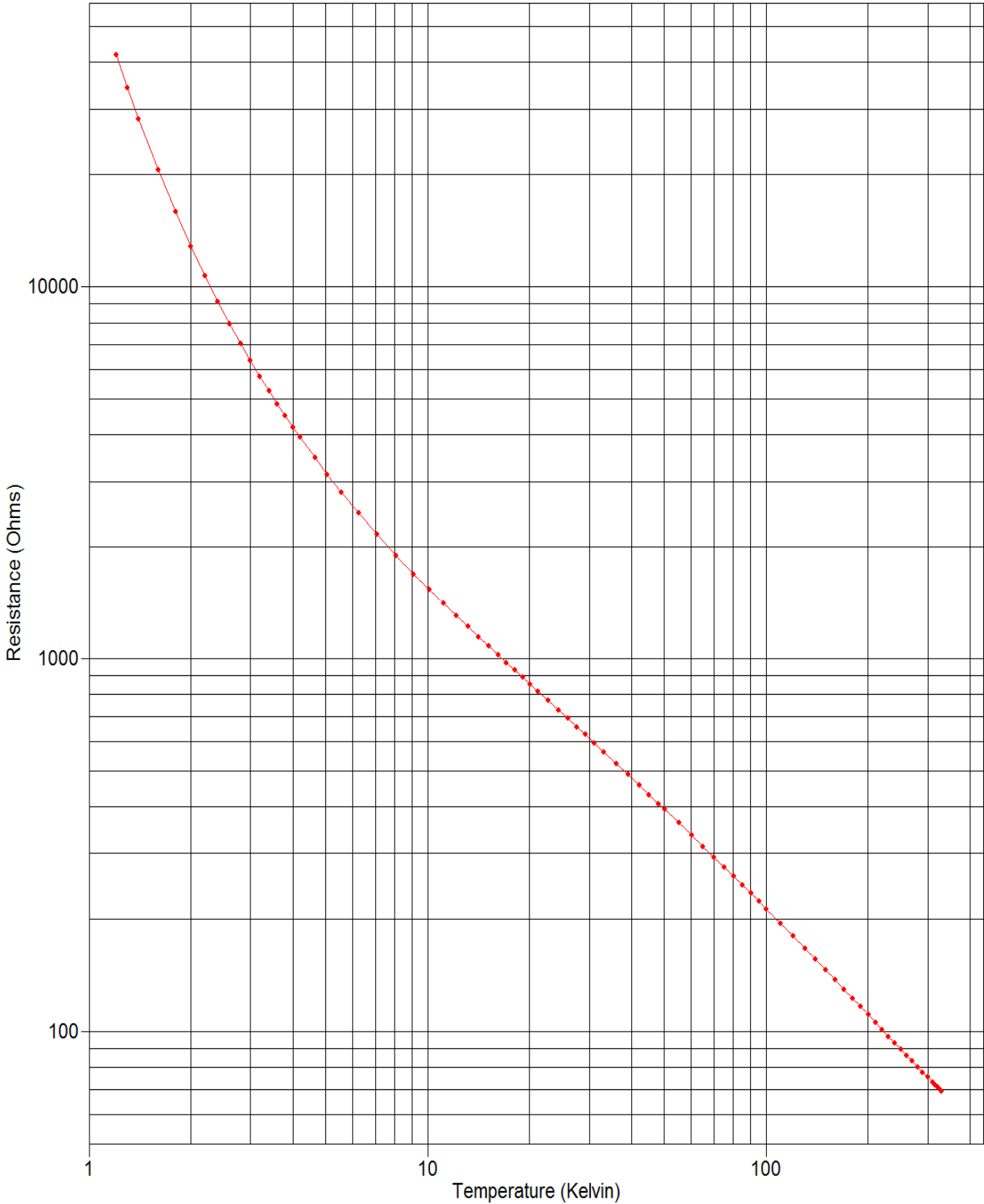


DATA PLOT

Calibration Report: 648021
Sensor Model: CX-1050-SD-1.4L
Sensor Type: Cernox Resistor

Sales Order: 68653
Serial Number: X73612
Temperature Range: 1.40K to 325K



TEST DATA

Calibration Report: 648021
Sensor Model: CX-1050-SD-1.4L
Sensor Type: Cernox Resistor

Sales Order: 68653
Serial Number: X73612
Temperature Range: 1.40K to 325K

Index	Temp. (K)	Resistance (Ω)	Excitation	Index	Temp. (K)	Resistance (Ω)	Excitation
1	1.20413	41980.8	2mV \pm 25%	46	42.1801	457.150	2mV \pm 25%
2	1.29996	34161.9	2mV \pm 25%	47	45.1751	430.956	2mV \pm 25%
3	1.39993	28242.6	2mV \pm 25%	48	48.1738	407.640	2mV \pm 25%
4	1.59850	20580.7	2mV \pm 25%	49	50.1630	393.573	2mV \pm 25%
5	1.80064	15866.5	2mV \pm 25%	50	55.1617	362.321	2mV \pm 25%
6	2.00006	12818.3	2mV \pm 25%	51	60.1601	335.787	2mV \pm 25%
7	2.20092	10677.6	2mV \pm 25%	52	65.1508	313.009	2mV \pm 25%
8	2.40027	9130.50	2mV \pm 25%	53	70.1443	293.195	2mV \pm 25%
9	2.60051	7954.25	2mV \pm 25%	54	75.1394	275.777	2mV \pm 25%
10	2.79988	7047.14	2mV \pm 25%	55	80.1295	260.362	2mV \pm 25%
11	2.99992	6322.19	2mV \pm 25%	56	85.1265	246.582	2mV \pm 25%
12	3.20010	5732.88	2mV \pm 25%	57	90.1184	234.204	2mV \pm 25%
13	3.39969	5246.94	2mV \pm 25%	58	95.1140	223.016	2mV \pm 25%
14	3.59872	4840.91	2mV \pm 25%	59	100.120	212.810	2mV \pm 25%
15	3.79721	4496.28	2mV \pm 25%	60	110.106	195.009	2mV \pm 25%
16	4.00384	4188.76	2mV \pm 25%	61	120.103	179.921	2mV \pm 25%
17	4.19537	3939.84	2mV \pm 25%	62	130.096	166.963	2mV \pm 25%
18	4.65010	3463.53	2mV \pm 25%	63	140.094	155.720	2mV \pm 25%
19	5.05239	3134.16	2mV \pm 25%	64	150.090	145.884	2mV \pm 25%
20	5.55754	2807.46	2mV \pm 25%	65	160.089	137.180	2mV \pm 25%
21	6.26370	2461.61	2mV \pm 25%	66	170.090	129.449	2mV \pm 25%
22	7.07532	2165.85	2mV \pm 25%	67	180.086	122.546	2mV \pm 25%
23	8.09224	1893.97	2mV \pm 25%	68	190.076	116.351	2mV \pm 25%
24	9.10618	1691.66	2mV \pm 25%	69	200.081	110.737	2mV \pm 25%
25	10.1231	1533.75	2mV \pm 25%	70	210.082	105.660	2mV \pm 25%
26	11.1411	1406.93	2mV \pm 25%	71	220.076	101.043	2mV \pm 25%
27	12.1557	1302.69	2mV \pm 25%	72	230.071	96.8211	2mV \pm 25%
28	13.1644	1215.76	2mV \pm 25%	73	240.079	92.9505	2mV \pm 25%
29	14.1662	1141.79	2mV \pm 25%	74	250.070	89.3990	2mV \pm 25%
30	15.1559	1078.34	2mV \pm 25%	75	260.070	86.1184	2mV \pm 25%
31	16.1442	1022.61	2mV \pm 25%	76	270.071	83.0935	2mV \pm 25%
32	17.1220	973.434	2mV \pm 25%	77	280.072	80.2914	2mV \pm 25%
33	18.1014	929.360	2mV \pm 25%	78	290.076	77.6854	2mV \pm 25%
34	19.0804	889.658	2mV \pm 25%	79	300.083	75.2673	2mV \pm 25%
35	20.0592	853.391	2mV \pm 25%	80	310.086	73.0117	2mV \pm 25%
36	21.1435	816.951	2mV \pm 25%	81	315.090	71.9445	2mV \pm 25%
37	22.7231	769.628	2mV \pm 25%	82	320.088	70.9035	2mV \pm 25%
38	24.3325	727.145	2mV \pm 25%	83	326.079	69.7093	2mV \pm 25%
39	25.9516	689.225	2mV \pm 25%	84	330.080	68.9366	2mV \pm 25%
40	27.5859	655.001	2mV \pm 25%				
41	29.2167	624.312	2mV \pm 25%				
42	31.0481	593.214	2mV \pm 25%				
43	33.1692	561.053	2mV \pm 25%				
44	36.1788	521.219	2mV \pm 25%				
45	39.1767	487.037	2mV \pm 25%				



UNCERTAINTY ANALYSIS

Calibration Report: 648021
 Sensor Model: CX-1050-SD-1.4L
 Sensor Type: Cernox Resistor

Sales Order: 68653
 Serial Number: X73612
 Temperature Range: 1.40K to 325K

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.

F008-04-00_B (01/17/11)



POLYNOMIAL EQUATION

Calibration Report: 648021
Sensor Model: CX-1050-SD-1.4L
Sensor Type: Cernox Resistor

Sales Order: 68653
Serial Number: X73612
Temperature Range: 1.40K to 325K

Polynomial Type: Chebychev
Useful Range of Fit:

1.40 K to 14.2 K
2.820e+4 Ohms to 1142. Ohms

Lower and Upper limits of Log(Resistance) used in computing Chebychev coefficients:
ZL = 3.00970904694 ZU = 4.62305095745

Order	Coefficient	Std. Deviation of Coefficient	Ratio (Coeff./Std Dev.)
0	5.455438	1.5453E-04	35303.04
1	-6.293238	2.4726E-04	-25452.07
2	2.854727	2.1755E-04	13122.46
3	-1.085315	2.2423E-04	-4840.12
4	0.349158	2.1329E-04	1637.00
5	-0.091148	1.9663E-04	-463.56
6	0.016829	1.9406E-04	86.72
7	-0.000803	1.9519E-04	-4.11
8	-0.001729	1.9674E-04	-8.79

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

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

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

POLYNOMIAL EQUATION

Calibration Report: 648021
Sensor Model: CX-1050-SD-1.4L
Sensor Type: Cernox Resistor

Sales Order: 68653
Serial Number: X73612
Temperature Range: 1.40K to 325K

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

	R Meas. (Ω)	T Meas. (K)	T Eq. (K)	T diff. (mK)
1	41980.82	1.20413	1.20392	0.22
2	34161.85	1.29996	1.30082	-0.86
3	28242.58	1.39993	1.39912	0.82
4	20580.68	1.59850	1.59811	0.39
5	15866.50	1.80064	1.80135	-0.71
6	12818.33	2.00006	2.00062	-0.56
7	10677.65	2.20092	2.20091	0.01
8	9130.503	2.40027	2.39969	0.58
9	7954.250	2.60051	2.60018	0.33
10	7047.141	2.79988	2.79944	0.44
11	6322.187	2.99992	2.99961	0.32
12	5732.878	3.20010	3.20002	0.08
13	5246.935	3.39969	3.40000	-0.31
14	4840.908	3.59872	3.59904	-0.32
15	4496.280	3.79721	3.79761	-0.40
16	4188.755	4.00384	4.00412	-0.28
17	3939.837	4.19537	4.19664	-1.26
18	3463.532	4.65010	4.64940	0.70
19	3134.164	5.05239	5.05211	0.28
20	2807.462	5.55754	5.55751	0.02
21	2461.608	6.26370	6.26208	1.62
22	2165.848	7.07532	7.07558	-0.26
23	1893.974	8.09224	8.09267	-0.43
24	1691.655	9.10618	9.10659	-0.41
25	1533.751	10.12310	10.12359	-0.49
26	1406.935	11.14112	11.14087	0.25
27	1302.688	12.15569	12.15649	-0.80
28	1215.761	13.16441	13.16374	0.67
29	1141.793	14.16622	14.16553	0.69
30	1078.339	15.15588	15.15544	0.43
31	1022.608	16.14416	16.14493	-0.77

Order of Fit = 8 RMS error of fit = 0.61 mK
Largest absolute error = 1.62 mK at data point no. 21



POLYNOMIAL EQUATION

Calibration Report: 648021
Sensor Model: CX-1050-SD-1.4L
Sensor Type: Cernox Resistor

Sales Order: 68653
Serial Number: X73612
Temperature Range: 1.40K to 325K

Polynomial Type: Chebychev
Useful Range of Fit:

14.2 K to 80.1 K
1142. Ohms to 260.4 Ohms

Lower and Upper limits of Log(Resistance) used in computing Chebychev coefficients:
ZL = 2.36959427507 ZU = 3.11484034215

Order	Coefficient	Std. Deviation of Coefficient	Ratio (Coeff./Std Dev.)
0	42.328104	2.4734E-04	171136.54
1	-37.786151	4.0274E-04	-93822.78
2	8.679853	3.6954E-04	23487.96
3	-1.187809	3.4301E-04	-3462.88
4	0.134091	3.2941E-04	407.06
5	-0.007755	3.1636E-04	-24.51
6	-0.005090	3.1384E-04	-16.22
7	0.000317	3.0364E-04	1.04
8	0.000668	3.0543E-04	2.19

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

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

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: 648021
Sensor Model: CX-1050-SD-1.4L
Sensor Type: Cernox Resistor

Sales Order: 68653
Serial Number: X73612
Temperature Range: 1.40K to 325K

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

	R Meas. (Ω)	T Meas. (K)	T Eq. (K)	T diff. (mK)
27	1302.688	12.15649	12.15623	0.26
28	1215.761	13.16374	13.16409	-0.35
29	1141.793	14.16553	14.16632	-0.79
30	1078.339	15.15588	15.15552	0.36
31	1022.608	16.14416	16.14271	1.45
32	973.4337	17.12199	17.12250	-0.51
33	929.3598	18.10135	18.10181	-0.46
34	889.6581	19.08039	19.07848	1.91
35	853.3911	20.05916	20.06024	-1.08
36	816.9514	21.14349	21.14485	-1.36
37	769.6275	22.72311	22.72349	-0.38
38	727.1449	24.33255	24.33287	-0.32
39	689.2253	25.95159	25.95156	0.03
40	655.0010	27.58592	27.58589	0.03
41	624.3124	29.21668	29.21438	2.30
42	593.2144	31.04809	31.04742	0.67
43	561.0532	33.16920	33.16938	-0.18
44	521.2191	36.17885	36.18043	-1.59
45	487.0367	39.17668	39.17692	-0.24
46	457.1500	42.18015	42.18159	-1.44
47	430.9556	45.17507	45.17341	1.67
48	407.6397	48.17379	48.17415	-0.36
49	393.5729	50.16299	50.16373	-0.74
50	362.3211	55.16169	55.15963	2.06
51	335.7871	60.16006	60.15986	0.21
52	313.0090	65.15080	65.15209	-1.29
53	293.1955	70.14433	70.14422	0.10
54	275.7772	75.13941	75.13997	-0.56
55	260.3621	80.12948	80.12951	-0.03
56	246.5824	85.12647	85.12526	1.21
57	234.2040	90.11842	90.11902	-0.60

Order of Fit = 8 RMS error of fit = 1.02 mK
Largest absolute error = 2.30 mK at data point no. 41



POLYNOMIAL EQUATION

Calibration Report: 648021
Sensor Model: CX-1050-SD-1.4L
Sensor Type: Cernox Resistor

Sales Order: 68653
Serial Number: X73612
Temperature Range: 1.40K to 325K

Polynomial Type: Chebychev
Useful Range of Fit:

80.1 K to 325. K
260.4 Ohms to 69.92 Ohms

Lower and Upper limits of Log(Resistance) used in computing Chebychev coefficients:
ZL = 1.83844958651 ZU = 2.46715726855

Order	Coefficient	Std. Deviation of Coefficient	Ratio (Coeff./Std Dev.)
0	176.540072	1.3488E-03	130888.45
1	-126.538213	2.0921E-03	-60482.96
2	22.936740	1.9890E-03	11531.90
3	-3.307858	1.8664E-03	-1772.28
4	0.617497	1.7757E-03	347.75
5	-0.120049	1.7813E-03	-67.39
6	0.016727	1.7594E-03	9.51
7	-0.003666	1.7180E-03	-2.13
8	0.001075	1.7394E-03	0.62
9	0.002716	1.7323E-03	1.57

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

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

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

POLYNOMIAL EQUATION

Calibration Report: 648021
Sensor Model: CX-1050-SD-1.4L
Sensor Type: Cernox Resistor

Sales Order: 68653
Serial Number: X73612
Temperature Range: 1.40K to 325K

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

	R Meas. (Ω)	T Meas. (K)	T Eq. (K)	T diff. (mK)
53	293.1955	70.14422	70.14504	-0.82
54	275.7772	75.13997	75.13714	2.83
55	260.3621	80.12951	80.13105	-1.54
56	246.5824	85.12647	85.12831	-1.83
57	234.2040	90.11842	90.12030	-1.88
58	223.0156	95.11398	95.11003	3.96
59	212.8096	100.11957	100.11938	0.19
60	195.0091	110.10596	110.10592	0.04
61	179.9205	120.10349	120.10151	1.98
62	166.9630	130.09628	130.10145	-5.17
63	155.7196	140.09356	140.09828	-4.72
64	145.8843	150.09012	150.08066	9.46
65	137.1800	160.08904	160.08866	0.38
66	129.4495	170.09039	170.09253	-2.14
67	122.5463	180.08630	180.08729	-0.99
68	116.3513	190.07580	190.06896	6.84
69	110.7374	200.08053	200.08882	-8.29
70	105.6597	210.08225	210.08632	-4.07
71	101.0431	220.07599	220.07271	3.28
72	96.82108	230.07062	230.07138	-0.76
73	92.95051	240.07911	240.07533	3.78
74	89.39905	250.06980	250.06347	6.33
75	86.11837	260.06955	260.07633	-6.78
76	83.09352	270.07119	270.07021	0.98
77	80.29137	280.07243	280.06798	4.46
78	77.68544	290.07592	290.08680	-10.88
79	75.26727	300.08306	300.08309	-0.03
80	73.01170	310.08556	310.08697	-1.41
81	71.94450	315.08954	315.07078	18.76
82	70.90349	320.08831	320.09876	-10.45
83	69.70926	326.07864	326.08062	-1.98
84	68.93656	330.07968	330.07918	0.50

Order of Fit = 9 RMS error of fit = 5.68 mK
Largest absolute error = 18.76 mK at data point no. 81



INTERPOLATION TABLE

Calibration Report: 648021
 Sensor Model: CX-1050-SD-1.4L
 Sensor Type: Cernox Resistor

Sales Order: 68653
 Serial Number: X73612
 Temperature Range: 1.40K to 325K

Temp (K)	Res. (Ω)	dR/dT (Ω/K)	dlogR/dlogT	Temp (K)	Res. (Ω)	dR/dT (Ω/K)	dlogR/dlogT
1.400	28197.3	-51122.	-2.5382	15.50	1058.11	-57.457	-0.84167
1.500	23814.2	-37549.	-2.3651	16.00	1030.25	-54.024	-0.83900
1.600	20525.9	-28861.	-2.2497	16.50	1004.03	-50.921	-0.83682
1.700	17952.2	-22916.	-2.1700	17.00	979.285	-48.095	-0.83491
1.800	15891.4	-18519.	-2.0976	17.50	955.891	-45.518	-0.83333
1.900	14212.7	-15200.	-2.0320	18.00	933.731	-43.159	-0.83199
2.000	12826.2	-12640.	-1.9710	18.50	912.700	-40.995	-0.83094
2.100	11666.3	-10634.	-1.9142	19.00	892.707	-39.002	-0.83009
2.200	10685.9	-9034.6	-1.8600	19.50	873.672	-37.163	-0.82947
2.300	9849.03	-7747.2	-1.8092	20.00	855.521	-35.462	-0.82901
2.400	9128.43	-6700.7	-1.7617	21.00	821.618	-32.419	-0.82861
2.500	8502.65	-5841.9	-1.7177	22.00	790.548	-29.780	-0.82874
2.600	7955.15	-5130.3	-1.6767	23.00	761.947	-27.474	-0.82932
2.700	7472.70	-4535.8	-1.6388	24.00	735.510	-25.443	-0.83021
2.800	7044.88	-4034.8	-1.6037	25.00	710.984	-23.645	-0.83141
2.900	6663.21	-3609.6	-1.5710	26.00	688.156	-22.042	-0.83278
3.000	6320.91	-3245.9	-1.5406	27.00	666.845	-20.606	-0.83431
3.100	6012.34	-2932.9	-1.5122	28.00	646.896	-19.313	-0.83596
3.200	5732.94	-2661.6	-1.4856	29.00	628.177	-18.145	-0.83765
3.300	5478.86	-2425.2	-1.4607	30.00	610.571	-17.084	-0.83941
3.400	5246.93	-2218.0	-1.4373	31.00	593.978	-16.117	-0.84118
3.500	5034.43	-2035.6	-1.4152	32.00	578.308	-15.234	-0.84296
3.600	4839.10	-1874.2	-1.3943	33.00	563.485	-14.424	-0.84472
3.700	4659.00	-1730.7	-1.3745	34.00	549.439	-13.679	-0.84648
3.800	4492.45	-1602.7	-1.3557	35.00	536.108	-12.991	-0.84814
3.900	4338.01	-1488.0	-1.3378	36.00	523.439	-12.356	-0.84980
4.000	4194.46	-1384.9	-1.3207	37.00	511.380	-11.768	-0.85146
4.200	3935.77	-1207.9	-1.2890	38.00	499.889	-11.221	-0.85302
4.400	3709.21	-1062.0	-1.2598	39.00	488.924	-10.713	-0.85455
4.600	3509.33	-940.49	-1.2328	40.00	478.451	-10.240	-0.85606
4.800	3331.69	-838.72	-1.2084	42.00	458.847	-9.3832	-0.85888
5.000	3172.83	-752.24	-1.1854	44.00	440.848	-8.6321	-0.86155
5.200	3029.94	-678.45	-1.1644	46.00	424.260	-7.9694	-0.86407
5.400	2900.77	-614.79	-1.1445	48.00	408.921	-7.3811	-0.86641
5.600	2783.44	-559.88	-1.1264	50.00	394.692	-6.8574	-0.86870
5.800	2676.37	-511.90	-1.1093	52.00	381.455	-6.3883	-0.87085
6.000	2578.30	-469.72	-1.0931	54.00	369.108	-5.9662	-0.87285
6.500	2365.69	-385.01	-1.0579	56.00	357.562	-5.5863	-0.87490
7.000	2189.83	-321.39	-1.0274	58.00	346.739	-5.2419	-0.87683
7.500	2041.79	-272.70	-1.0017	60.00	336.573	-4.9292	-0.87872
8.000	1915.41	-234.39	-0.97895	65.00	313.656	-4.2625	-0.88334
8.500	1806.08	-203.97	-0.95993	70.00	293.732	-3.7258	-0.88789
9.000	1710.51	-179.19	-0.94284	75.00	276.236	-3.2863	-0.89224
9.500	1626.14	-158.89	-0.92824	77.35	268.728	-3.1065	-0.89418
10.00	1551.06	-141.94	-0.91509	80.00	260.744	-2.9218	-0.89644
10.50	1483.74	-127.71	-0.90379	85.00	246.918	-2.6179	-0.90120
11.00	1423.00	-115.59	-0.89351	90.00	234.488	-2.3607	-0.90608
11.50	1367.86	-105.22	-0.88460	95.00	223.251	-2.1395	-0.91044
12.00	1317.55	-96.247	-0.87660	100.0	213.042	-1.9486	-0.91464
12.50	1271.42	-88.453	-0.86963	105.0	203.724	-1.7825	-0.91869
13.00	1228.95	-81.568	-0.86284	110.0	195.182	-1.6373	-0.92272
13.50	1189.71	-75.492	-0.85663	115.0	187.322	-1.5096	-0.92676
14.00	1153.33	-70.167	-0.85174	120.0	180.062	-1.3965	-0.93070
14.50	1119.44	-65.481	-0.84817	125.0	173.336	-1.2959	-0.93456
15.00	1087.77	-61.262	-0.84478	130.0	167.085	-1.2059	-0.93824



INTERPOLATION TABLE

Calibration Report: 648021
Sensor Model: CX-1050-SD-1.4L
Sensor Type: Cernox Resistor

Sales Order: 68653
Serial Number: X73612
Temperature Range: 1.40K to 325K

<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>
135.0	161.262	-1.1249	-0.94173	235.0	94.8726	-0.38698	-0.95856
140.0	155.823	-1.0518	-0.94496	240.0	92.9784	-0.37085	-0.95724
145.0	150.733	-0.98541	-0.94794	245.0	91.1626	-0.35563	-0.95576
150.0	145.959	-0.92501	-0.95062	250.0	89.4207	-0.34127	-0.95412
155.0	141.474	-0.86985	-0.95302	255.0	87.7486	-0.32771	-0.95233
160.0	137.253	-0.81933	-0.95512	260.0	86.1424	-0.31488	-0.95039
165.0	133.274	-0.77295	-0.95695	265.0	84.5986	-0.30274	-0.94830
170.0	129.517	-0.73025	-0.95851	270.0	83.1140	-0.29123	-0.94609
175.0	125.966	-0.69087	-0.95980	273.15	82.2076	-0.28430	-0.94464
180.0	122.603	-0.65446	-0.96085	275.0	81.6853	-0.28033	-0.94376
185.0	119.416	-0.62074	-0.96166	280.0	80.3097	-0.26999	-0.94131
190.0	116.392	-0.58946	-0.96224	285.0	78.9845	-0.26017	-0.93877
195.0	113.518	-0.56038	-0.96261	290.0	77.7072	-0.25084	-0.93614
200.0	110.785	-0.53330	-0.96277	295.0	76.4753	-0.24198	-0.93343
205.0	108.182	-0.50805	-0.96273	300.0	75.2867	-0.23355	-0.93066
210.0	105.702	-0.48446	-0.96249	305.0	74.1391	-0.22554	-0.92784
215.0	103.335	-0.46240	-0.96207	310.0	73.0306	-0.21791	-0.92498
220.0	101.075	-0.44173	-0.96146	315.0	71.9594	-0.21065	-0.92210
225.0	98.9156	-0.42233	-0.96067	320.0	70.9236	-0.20373	-0.91921
230.0	96.8499	-0.40412	-0.95970	325.0	69.9216	-0.19714	-0.91633



THERMAL CYCLE TESTING

Sensor Model: CX-1050-SD-1.4L

Serial Number: X73612

Sensor Type: Cernox 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:	74.2 Ω
Liquid Nitrogen:	269 Ω
Liquid Helium:	3941 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.



BREAKPOINTS 340 FORMAT

Calibration Report: 648021

Sensor Model: CX-1050-SD-1.4L

Sensor Type: Cernox Resistor

Sales Order: 68653

Serial Number: X73612

Temperature Range: 1.40K to 325K

Name: CX-1050-SD-1.4L

Serial number: X73612

Format: 4 ;Log Ohms/Kelvin

Limit: 325.0

Coefficient: 1 ;Negative

Point 1: 1.84459,325.000	Point 56: 2.41863, 79.500	Point 111: 3.21537, 9.400
Point 2: 1.85203,319.000	Point 57: 2.43105, 77.000	Point 112: 3.23305, 9.000
Point 3: 1.85899,313.500	Point 58: 2.44127, 75.000	Point 113: 3.25179, 8.600
Point 4: 1.86610,308.000	Point 59: 2.45173, 73.000	Point 114: 3.27171, 8.200
Point 5: 1.87335,302.500	Point 60: 2.46246, 71.000	Point 115: 3.29296, 7.800
Point 6: 1.88077,297.000	Point 61: 2.47348, 69.000	Point 116: 3.31284, 7.450
Point 7: 1.88835,291.500	Point 62: 2.48480, 67.000	Point 117: 3.33399, 7.100
Point 8: 1.89610,286.000	Point 63: 2.49643, 65.000	Point 118: 3.35663, 6.750
Point 9: 1.90403,280.500	Point 64: 2.50841, 63.000	Point 119: 3.38097, 6.400
Point 10: 1.91213,275.000	Point 65: 2.52074, 61.000	Point 120: 3.40725, 6.050
Point 11: 1.92042,269.500	Point 66: 2.53346, 59.000	Point 121: 3.43242, 5.740
Point 12: 1.92891,264.000	Point 67: 2.54659, 57.000	Point 122: 3.45869, 5.440
Point 13: 1.93759,258.500	Point 68: 2.56016, 55.000	Point 123: 3.48713, 5.140
Point 14: 1.94648,253.000	Point 69: 2.57278, 53.200	Point 124: 3.51599, 4.860
Point 15: 1.95559,247.500	Point 70: 2.58580, 51.400	Point 125: 3.54733, 4.580
Point 16: 1.96406,242.500	Point 71: 2.59925, 49.600	Point 126: 3.57916, 4.320
Point 17: 1.97272,237.500	Point 72: 2.61317, 47.800	Point 127: 3.61390, 4.060
Point 18: 1.98158,232.500	Point 73: 2.62759, 46.000	Point 128: 3.64316, 3.860
Point 19: 1.99064,227.500	Point 74: 2.64255, 44.200	Point 129: 3.66977, 3.690
Point 20: 1.99991,222.500	Point 75: 2.65634, 42.600	Point 130: 3.69828, 3.520
Point 21: 2.00940,217.500	Point 76: 2.67061, 41.000	Point 131: 3.72716, 3.360
Point 22: 2.01912,212.500	Point 77: 2.68635, 39.300	Point 132: 3.75818, 3.200
Point 23: 2.02907,207.500	Point 78: 2.70176, 37.700	Point 133: 3.79173, 3.040
Point 24: 2.03927,202.500	Point 79: 2.71678, 36.200	Point 134: 3.82583, 2.890
Point 25: 2.04972,197.500	Point 80: 2.73237, 34.700	Point 135: 3.86028, 2.750
Point 26: 2.06044,192.500	Point 81: 2.74861, 33.200	Point 136: 3.89760, 2.610
Point 27: 2.07144,187.500	Point 82: 2.76441, 31.800	Point 137: 3.93830, 2.470
Point 28: 2.08272,182.500	Point 83: 2.78085, 30.400	Point 138: 3.97965, 2.340
Point 29: 2.09315,178.000	Point 84: 2.79802, 29.000	Point 139: 4.02481, 2.210
Point 30: 2.10382,173.500	Point 85: 2.81469, 27.700	Point 140: 4.07452, 2.080
Point 31: 2.11476,169.000	Point 86: 2.83210, 26.400	Point 141: 4.12514, 1.960
Point 32: 2.12598,164.500	Point 87: 2.85035, 25.100	Point 142: 4.18080, 1.840
Point 33: 2.13750,160.000	Point 88: 2.86803, 23.900	Point 143: 4.24261, 1.720
Point 34: 2.14932,155.500	Point 89: 2.88658, 22.700	Point 144: 4.30573, 1.610
Point 35: 2.16146,151.000	Point 90: 2.90612, 21.500	Point 145: 4.36947, 1.510
Point 36: 2.17394,146.500	Point 91: 2.92503, 20.400	Point 146: 4.43408, 1.420
Point 37: 2.18678,142.000	Point 92: 2.93947, 19.600	Point 147: 4.45031, 1.400
Point 38: 2.19999,137.500	Point 93: 2.95163, 18.950	
Point 39: 2.21208,133.500	Point 94: 2.96421, 18.300	
Point 40: 2.22448,129.500	Point 95: 2.97728, 17.650	
Point 41: 2.23724,125.500	Point 96: 2.98981, 17.050	
Point 42: 2.25037,121.500	Point 97: 3.00281, 16.450	
Point 43: 2.26389,117.500	Point 98: 3.01633, 15.850	
Point 44: 2.27784,113.500	Point 99: 3.03043, 15.250	
Point 45: 2.29223,109.500	Point 100: 3.04392, 14.700	
Point 46: 2.30711,105.500	Point 101: 3.05797, 14.150	
Point 47: 2.32057,102.000	Point 102: 3.07265, 13.600	
Point 48: 2.33045, 99.500	Point 103: 3.08662, 13.100	
Point 49: 2.34053, 97.000	Point 104: 3.10123, 12.600	
Point 50: 2.35086, 94.500	Point 105: 3.11655, 12.100	
Point 51: 2.36144, 92.000	Point 106: 3.13265, 11.600	
Point 52: 2.37229, 89.500	Point 107: 3.14791, 11.150	
Point 53: 2.38342, 87.000	Point 108: 3.16391, 10.700	
Point 54: 2.39484, 84.500	Point 109: 3.18078, 10.250	
Point 55: 2.40657, 82.000	Point 110: 3.19860, 9.800	



BREAKPOINTS 91C/93C/330 FORMAT

Calibration Report: 648021
 Sensor Model: CX-1050-SD-1.4L
 Sensor Type: Cernox Resistor

Sales Order: 68653
 Serial Number: X73612
 Temperature Range: 1.40K to 325K

Interpolation Method: Lagrangian
 Limit: 325.0 (Kelvin)
 Format: 4 (Log Ohms/Kelvin)
 Number of Breakpoints: 53

No.	Units	Temperature (K)	No.	Units	Temperature (K)
1	1.84461	325.0	31	3.16034	10.8
2	1.84584	324.0	32	3.21976	9.3
3	1.86480	309.0	33	3.28226	8.0
4	1.88490	294.0	34	3.34041	7.0
5	1.90623	279.0	35	3.40351	6.1
6	1.92892	264.0	36	3.46251	5.4
7	1.95310	249.0	37	3.52266	4.8
8	1.97892	234.0	38	3.58193	4.3
9	2.00655	219.0	39	3.63729	3.9
10	2.03620	204.0	40	3.70195	3.5
11	2.06813	189.0	41	3.75838	3.2
12	2.10264	174.0	42	3.82368	2.9
13	2.14012	159.0	43	3.87348	2.7
14	2.18106	144.0	44	3.92955	2.5
15	2.22608	129.0	45	3.99339	2.3
16	2.27610	114.0	46	4.02881	2.2
17	2.33246	99.0	47	4.06693	2.1
18	2.39718	84.0	48	4.10810	2.0
19	2.47350	69.0	49	4.15268	1.9
20	2.53027	59.5	50	4.20116	1.8
21	2.59626	50.0	51	4.25412	1.7
22	2.63587	45.0	52	4.37684	1.5
23	2.67984	40.0	53	4.45021	1.4
24	2.72925	35.0			
25	2.78574	30.0			
26	2.85186	25.0			
27	2.91296	21.1			
28	2.97630	17.7			
29	3.03654	15.0			
30	3.09830	12.7			

Temperature for Resistance Decades:

Res. (Ohms)	Temp. (K)
100	222.463
1000	16.577
10000	2.281



BREAKPOINTS 234 FORMAT

Calibration Report: 648021
 Sensor Model: CX-1050-SD-1.4L
 Sensor Type: Cernox Resistor

Sales Order: 68653
 Serial Number: X73612
 Temperature Range: 1.40K to 325K

Maximum Temperature Error:

1.4 - 10K: 0.010K
 10 - 20K: 0.020K
 20 - 40K: 0.008K
 40 - 100K: 0.017K
 > 100K: 0.074K

<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	312.723	72.44360	1.860	46	32.189	575.4399	2.760
2	297.578	75.85776	1.880	47	30.476	602.5596	2.780
3	283.287	79.43282	1.900	48	28.848	630.9573	2.800
4	269.786	83.17638	1.920	49	27.301	660.6934	2.820
5	257.005	87.09636	1.940	50	25.834	691.8310	2.840
6	244.894	91.20108	1.960	51	24.442	724.4360	2.860
7	233.391	95.49926	1.980	52	23.123	758.5776	2.880
8	222.462	100.0000	2.000	53	21.874	794.3282	2.900
9	212.061	104.7129	2.020	54	20.691	831.7638	2.920
10	202.152	109.6478	2.040	55	19.573	870.9636	2.940
11	192.713	114.8154	2.060	56	18.517	912.0108	2.960
12	183.705	120.2264	2.080	57	17.519	954.9926	2.980
13	175.104	125.8925	2.100	58	16.580	1000.000	3.000
14	166.893	131.8257	2.120	59	14.859	1096.478	3.040
15	159.046	138.0384	2.140	60	13.336	1202.264	3.080
16	151.546	144.5440	2.160	61	11.992	1318.257	3.120
17	144.371	151.3561	2.180	62	10.810	1445.440	3.160
18	137.505	158.4893	2.200	63	9.768	1584.893	3.200
19	130.940	165.9587	2.220	64	8.851	1737.801	3.240
20	124.659	173.7801	2.240	65	8.043	1905.461	3.280
21	118.649	181.9701	2.260	66	7.330	2089.296	3.320
22	112.900	190.5461	2.280	67	6.702	2290.868	3.360
23	107.403	199.5262	2.300	68	6.146	2511.886	3.400
24	102.151	208.9296	2.320	69	5.653	2754.229	3.440
25	97.135	218.7762	2.340	70	5.215	3019.952	3.480
26	92.342	229.0868	2.360	71	4.825	3311.311	3.520
27	87.765	239.8833	2.380	72	4.475	3630.781	3.560
28	83.397	251.1886	2.400	73	4.163	3981.072	3.600
29	79.226	263.0268	2.420	74	3.882	4365.158	3.640
30	75.248	275.4229	2.440	75	3.628	4786.301	3.680
31	71.457	288.4032	2.460	76	3.399	5248.075	3.720
32	67.844	301.9952	2.480	77	3.192	5754.399	3.760
33	64.401	316.2278	2.500	78	3.003	6309.573	3.800
34	61.123	331.1311	2.520	79	2.832	6918.310	3.840
35	58.001	346.7369	2.540	80	2.675	7585.776	3.880
36	55.028	363.0781	2.560	81	2.532	8317.638	3.920
37	52.199	380.1894	2.580	82	2.401	9120.108	3.960
38	49.506	398.1072	2.600	83	2.281	10000.00	4.000
39	46.945	416.8694	2.620	84	2.019	12589.25	4.100
40	44.507	436.5158	2.640	85	1.802	15848.93	4.200
41	42.188	457.0882	2.660	86	1.620	19952.62	4.300
42	39.982	478.6301	2.680	87	1.468	25118.86	4.400
43	37.885	501.1872	2.700	88	1.339	31622.78	4.500
44	35.889	524.8075	2.720	89	1.228	39810.72	4.600
45	33.992	549.5409	2.740				

