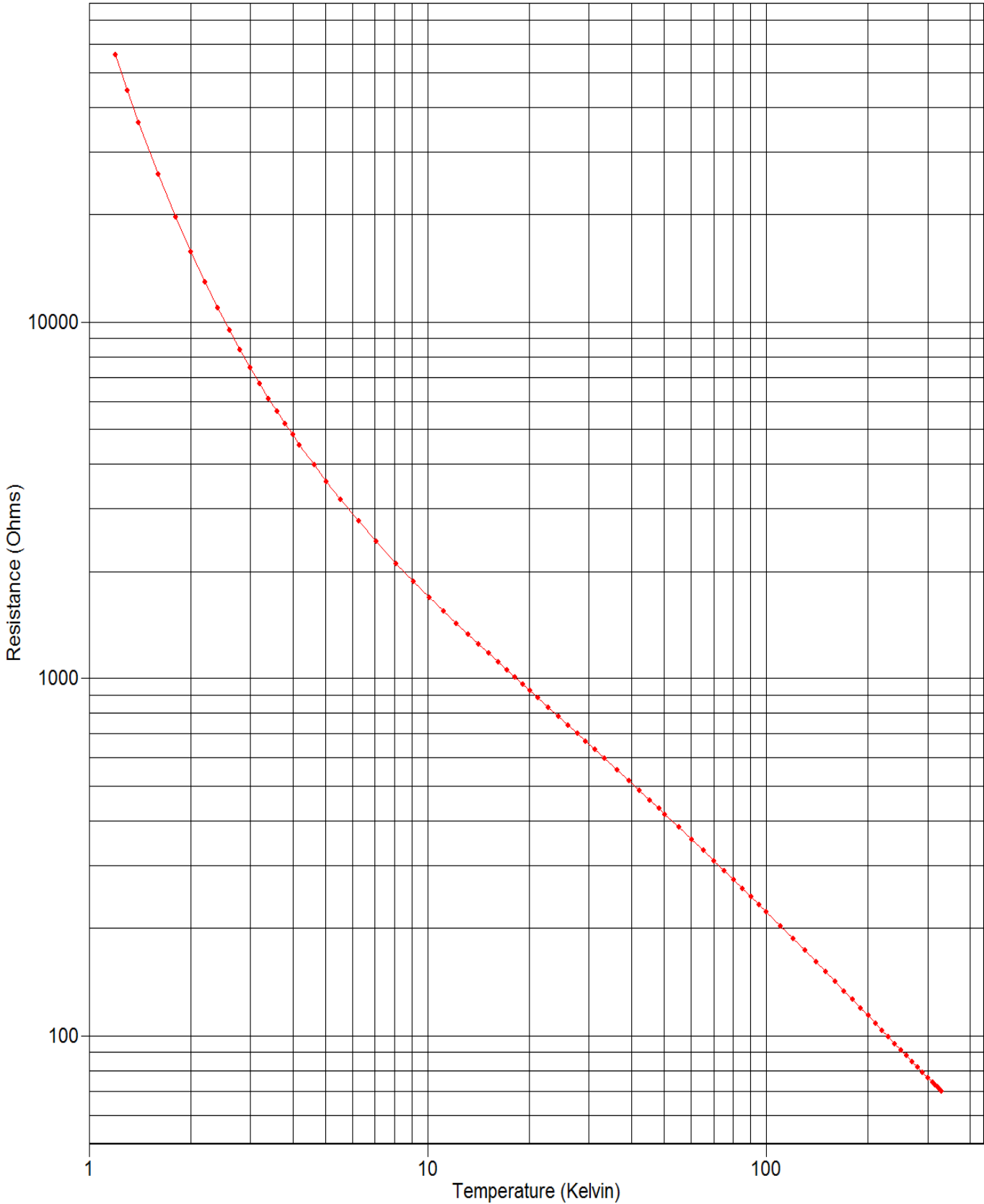


# DATA PLOT

Calibration Report: 637802  
Sensor Model: CX-1050-SD-1.4L  
Sensor Type: Cernox Resistor

Sales Order: 66130  
Serial Number: X70252  
Temperature Range: 1.40K to 325K



# TEST DATA

Calibration Report: 637802  
Sensor Model: CX-1050-SD-1.4L  
Sensor Type: Cernox Resistor

Sales Order: 66130  
Serial Number: X70252  
Temperature Range: 1.40K to 325K

Index	Temp. (K)	Resistance ( $\Omega$ )	Excitation	Index	Temp. (K)	Resistance ( $\Omega$ )	Excitation
1	1.19828	56165.9	2mV $\pm$ 25%	46	42.3458	484.945	2mV $\pm$ 25%
2	1.29968	44479.3	2mV $\pm$ 25%	47	45.3446	456.584	2mV $\pm$ 25%
3	1.40102	36222.4	2mV $\pm$ 25%	48	48.3331	431.482	2mV $\pm$ 25%
4	1.59922	25886.0	2mV $\pm$ 25%	49	50.3366	416.198	2mV $\pm$ 25%
5	1.79978	19675.5	2mV $\pm$ 25%	50	55.3245	382.551	2mV $\pm$ 25%
6	1.99932	15695.4	2mV $\pm$ 25%	51	60.3206	353.974	2mV $\pm$ 25%
7	2.19960	12941.0	2mV $\pm$ 25%	52	65.3122	329.473	2mV $\pm$ 25%
8	2.40104	10949.0	2mV $\pm$ 25%	53	70.3087	308.145	2mV $\pm$ 25%
9	2.59694	9496.39	2mV $\pm$ 25%	54	75.3012	289.482	2mV $\pm$ 25%
10	2.79669	8352.78	2mV $\pm$ 25%	55	80.2957	272.945	2mV $\pm$ 25%
11	2.99946	7434.82	2mV $\pm$ 25%	56	85.2897	258.185	2mV $\pm$ 25%
12	3.19910	6708.49	2mV $\pm$ 25%	57	90.2824	244.945	2mV $\pm$ 25%
13	3.39946	6109.40	2mV $\pm$ 25%	58	95.2753	232.968	2mV $\pm$ 25%
14	3.59966	5610.22	2mV $\pm$ 25%	59	100.276	222.109	2mV $\pm$ 25%
15	3.79953	5188.04	2mV $\pm$ 25%	60	110.260	203.101	2mV $\pm$ 25%
16	3.99966	4827.32	2mV $\pm$ 25%	61	120.253	187.024	2mV $\pm$ 25%
17	4.19481	4520.83	2mV $\pm$ 25%	62	130.242	173.246	2mV $\pm$ 25%
18	4.62785	3974.48	2mV $\pm$ 25%	63	140.234	161.296	2mV $\pm$ 25%
19	5.03304	3574.32	2mV $\pm$ 25%	64	150.228	150.843	2mV $\pm$ 25%
20	5.54137	3181.68	2mV $\pm$ 25%	65	160.228	141.640	2mV $\pm$ 25%
21	6.25330	2768.84	2mV $\pm$ 25%	66	170.226	133.460	2mV $\pm$ 25%
22	7.06897	2421.81	2mV $\pm$ 25%	67	180.221	126.154	2mV $\pm$ 25%
23	8.09161	2104.12	2mV $\pm$ 25%	68	190.208	119.611	2mV $\pm$ 25%
24	9.10982	1870.29	2mV $\pm$ 25%	69	200.211	113.696	2mV $\pm$ 25%
25	10.1313	1689.11	2mV $\pm$ 25%	70	210.213	108.333	2mV $\pm$ 25%
26	11.1550	1544.06	2mV $\pm$ 25%	71	220.208	103.466	2mV $\pm$ 25%
27	12.1705	1426.08	2mV $\pm$ 25%	72	230.201	99.0318	2mV $\pm$ 25%
28	13.1798	1327.84	2mV $\pm$ 25%	73	240.211	94.9628	2mV $\pm$ 25%
29	14.1831	1244.48	2mV $\pm$ 25%	74	250.199	91.2294	2mV $\pm$ 25%
30	15.1721	1173.37	2mV $\pm$ 25%	75	260.200	87.7892	2mV $\pm$ 25%
31	16.1614	1110.78	2mV $\pm$ 25%	76	270.196	84.6161	2mV $\pm$ 25%
32	17.1425	1055.80	2mV $\pm$ 25%	77	280.201	81.6777	2mV $\pm$ 25%
33	18.1246	1006.56	2mV $\pm$ 25%	78	290.200	78.9507	2mV $\pm$ 25%
34	19.1031	962.259	2mV $\pm$ 25%	79	300.203	76.4154	2mV $\pm$ 25%
35	20.0845	922.032	2mV $\pm$ 25%	80	310.206	74.0581	2mV $\pm$ 25%
36	21.1635	881.760	2mV $\pm$ 25%	81	315.214	72.9360	2mV $\pm$ 25%
37	22.7460	829.325	2mV $\pm$ 25%	82	320.212	71.8528	2mV $\pm$ 25%
38	24.3551	782.411	2mV $\pm$ 25%	83	326.203	70.6039	2mV $\pm$ 25%
39	26.0249	739.321	2mV $\pm$ 25%	84	330.208	69.7950	2mV $\pm$ 25%
40	27.6981	700.938	2mV $\pm$ 25%				
41	29.3472	667.034	2mV $\pm$ 25%				
42	31.1912	632.963	2mV $\pm$ 25%				
43	33.3289	597.666	2mV $\pm$ 25%				
44	36.3460	554.315	2mV $\pm$ 25%				
45	39.3586	517.142	2mV $\pm$ 25%				



# UNCERTAINTY ANALYSIS

Calibration Report: 637802  
 Sensor Model: CX-1050-SD-1.4L  
 Sensor Type: Cernox Resistor

Sales Order: 66130  
 Serial Number: X70252  
 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 $\Omega$	25 $\Omega$	27 $\Omega$	
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

- $\sigma_{fit}$  = 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
- $\Delta T_{RMS}$  = root mean square deviation of fit

A value of  $\Delta T_{RMS}$  is given for each range of fit.

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# POLYNOMIAL EQUATION

Calibration Report: 637802  
Sensor Model: CX-1050-SD-1.4L  
Sensor Type: Cernox Resistor

Sales Order: 66130  
Serial Number: X70252  
Temperature Range: 1.40K to 325K

Polynomial Type: Chebychev  
Useful Range of Fit:

1.40 K to 14.2 K  
3.622e+4 Ohms to 1244. Ohms

Lower and Upper limits of Log(Resistance) used in computing Chebychev coefficients:  
ZL = 3.04562923268      ZU = 4.74947302166

Order	Coefficient	Std. Deviation of Coefficient	Ratio (Coeff./Std Dev.)
0	5.420277	2.1648E-04	25038.31
1	-6.269000	3.4772E-04	-18028.80
2	2.875500	3.0618E-04	9391.43
3	-1.112564	3.1375E-04	-3546.00
4	0.367137	2.9611E-04	1239.88
5	-0.099358	2.7206E-04	-365.21
6	0.019389	2.7192E-04	71.30
7	-0.001518	2.7520E-04	-5.52
8	-0.001847	2.7686E-04	-6.67

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

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

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: 637802  
Sensor Model: CX-1050-SD-1.4L  
Sensor Type: Cernox Resistor

Sales Order: 66130  
Serial Number: X70252  
Temperature Range: 1.40K to 325K

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

	R Meas. ( $\Omega$ )	T Meas. (K)	T Eq. (K)	T diff. (mK)
1	56165.94	1.19828	1.19802	0.27
2	44479.30	1.29968	1.30080	-1.13
3	36222.41	1.40102	1.39992	1.10
4	25885.99	1.59922	1.59865	0.57
5	19675.51	1.79978	1.80081	-1.03
6	15695.43	1.99932	2.00001	-0.69
7	12941.03	2.19960	2.19972	-0.12
8	10949.02	2.40104	2.40045	0.59
9	9496.386	2.59694	2.59616	0.78
10	8352.784	2.79669	2.79584	0.86
11	7434.824	2.99946	2.99924	0.21
12	6708.492	3.19910	3.19909	0.01
13	6109.397	3.39946	3.39970	-0.24
14	5610.215	3.59966	3.60002	-0.36
15	5188.036	3.79953	3.80033	-0.80
16	4827.324	3.99966	4.00031	-0.65
17	4520.829	4.19481	4.19658	-1.77
18	3974.478	4.62785	4.62670	1.15
19	3574.317	5.03304	5.03256	0.48
20	3181.684	5.54137	5.54102	0.35
21	2768.839	6.25330	6.25235	0.95
22	2421.813	7.06897	7.06772	1.25
23	2104.116	8.09161	8.09229	-0.67
24	1870.286	9.10982	9.11104	-1.23
25	1689.105	10.13130	10.13195	-0.66
26	1544.063	11.15498	11.15531	-0.33
27	1426.079	12.17052	12.17055	-0.03
28	1327.843	13.17977	13.17912	0.65
29	1244.480	14.18307	14.18247	0.59
30	1173.372	15.17206	15.17069	1.37
31	1110.783	16.16141	16.16289	-1.49

Order of Fit = 8                      RMS error of fit = 0.84 mK  
Largest absolute error = -1.77 mK at data point no. 17



# POLYNOMIAL EQUATION

Calibration Report: 637802  
Sensor Model: CX-1050-SD-1.4L  
Sensor Type: Cernox Resistor

Sales Order: 66130  
Serial Number: X70252  
Temperature Range: 1.40K to 325K

Polynomial Type: Chebychev  
Useful Range of Fit:

14.2 K to 80.3 K  
1244. Ohms to 272.9 Ohms

Lower and Upper limits of Log(Resistance) used in computing Chebychev coefficients:  
ZL = 2.38906854683      ZU = 3.15414358935

Order	Coefficient	Std. Deviation of Coefficient	Ratio (Coeff./Std Dev.)
0	42.361653	3.3720E-04	125629.25
1	-37.853488	5.5128E-04	-68664.94
2	8.736561	5.0117E-04	17432.18
3	-1.194777	4.7012E-04	-2541.45
4	0.132662	4.5134E-04	293.93
5	-0.008457	4.3381E-04	-19.50
6	-0.004636	4.2311E-04	-10.96
7	0.000575	4.1679E-04	1.38

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

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

Temp. (K) =  $\sum A_i \cdot \text{COS}(i \cdot \text{ARCCOS}(k))$ , where  $0 \leq i \leq 7$   
and the  $A_i$ 's are the coefficients in the table above.

# POLYNOMIAL EQUATION

Calibration Report: 637802  
Sensor Model: CX-1050-SD-1.4L  
Sensor Type: Cernox Resistor

Sales Order: 66130  
Serial Number: X70252  
Temperature Range: 1.40K to 325K

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

	R Meas. ( $\Omega$ )	T Meas. (K)	T Eq. (K)	T diff. (mK)
27	1426.079	12.17055	12.17009	0.45
28	1327.843	13.17912	13.17995	-0.83
29	1244.480	14.18247	14.18339	-0.92
30	1173.372	15.17206	15.17077	1.29
31	1110.783	16.16141	16.16098	0.42
32	1055.798	17.14250	17.14203	0.47
33	1006.563	18.12461	18.12379	0.82
34	962.2588	19.10306	19.10387	-0.81
35	922.0323	20.08452	20.08469	-0.17
36	881.7602	21.16354	21.16573	-2.19
37	829.3254	22.74604	22.74577	0.27
38	782.4113	24.35507	24.35441	0.66
39	739.3214	26.02486	26.02539	-0.53
40	700.9382	27.69810	27.69837	-0.28
41	667.0341	29.34715	29.34575	1.41
42	632.9634	31.19118	31.18844	2.74
43	597.6658	33.32891	33.32973	-0.82
44	554.3145	36.34603	36.34900	-2.97
45	517.1415	39.35862	39.35694	1.69
46	484.9448	42.34580	42.34809	-2.30
47	456.5836	45.34462	45.34380	0.81
48	431.4820	48.33309	48.33372	-0.64
49	416.1985	50.33657	50.33584	0.73
50	382.5507	55.32447	55.32268	1.79
51	353.9740	60.32061	60.32096	-0.34
52	329.4733	65.31217	65.31125	0.93
53	308.1451	70.30865	70.31231	-3.66
54	289.4818	75.30116	75.30029	0.88
55	272.9449	80.29575	80.29359	2.16
56	258.1846	85.28974	85.29084	-1.10
57	244.9450	90.28243	90.28239	0.04

Order of Fit = 7      RMS error of fit = 1.43 mK  
Largest absolute error = -3.66 mK at data point no. 53



# POLYNOMIAL EQUATION

Calibration Report: 637802  
Sensor Model: CX-1050-SD-1.4L  
Sensor Type: Cernox Resistor

Sales Order: 66130  
Serial Number: X70252  
Temperature Range: 1.40K to 325K

Polynomial Type: Chebychev  
Useful Range of Fit:

80.3 K to 325. K  
272.9 Ohms to 70.85 Ohms

Lower and Upper limits of Log(Resistance) used in computing Chebychev coefficients:  
ZL = 1.84382455525      ZU = 2.48875529888

Order	Coefficient	Std. Deviation of Coefficient	Ratio (Coeff./Std Dev.)
0	176.847879	1.0541E-03	167773.90
1	-126.585654	1.6395E-03	-77209.67
2	22.798119	1.5562E-03	14649.83
3	-3.246258	1.4751E-03	-2200.66
4	0.597600	1.4038E-03	425.69
5	-0.113532	1.4111E-03	-80.46
6	0.016496	1.3930E-03	11.84
7	-0.003205	1.3569E-03	-2.36
8	0.001358	1.3471E-03	1.01

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

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

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: 637802  
Sensor Model: CX-1050-SD-1.4L  
Sensor Type: Cernox Resistor

Sales Order: 66130  
Serial Number: X70252  
Temperature Range: 1.40K to 325K

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

	R Meas. ( $\Omega$ )	T Meas. (K)	T Eq. (K)	T diff. (mK)
53	308.1451	70.31231	70.31280	-0.49
54	289.4818	75.30029	75.29927	1.02
55	272.9449	80.29359	80.29305	0.54
56	258.1846	85.28974	85.29060	-0.85
57	244.9450	90.28243	90.28224	0.19
58	232.9681	95.27530	95.28066	-5.36
59	222.1092	100.27649	100.27067	5.82
60	203.1006	110.26024	110.26141	-1.17
61	187.0245	120.25335	120.25127	2.08
62	173.2465	130.24208	130.24012	1.97
63	161.2960	140.23400	140.23778	-3.78
64	150.8429	150.22796	150.23672	-8.76
65	141.6405	160.22825	160.22145	6.80
66	133.4604	170.22631	170.22069	5.62
67	126.1537	180.22056	180.22444	-3.88
68	119.6107	190.20832	190.20391	4.41
69	113.6956	200.21053	200.20690	3.63
70	108.3334	210.21325	210.22028	-7.03
71	103.4657	220.20787	220.21824	-10.36
72	99.03178	230.20071	230.19830	2.41
73	94.96283	240.21136	240.20208	9.29
74	91.22935	250.19944	250.19871	0.73
75	87.78920	260.20045	260.20227	-1.82
76	84.61612	270.19604	270.19665	-0.61
77	81.67770	280.20101	280.19712	3.90
78	78.95073	290.19982	290.20278	-2.96
79	76.41540	300.20304	300.21060	-7.56
80	74.05805	310.20606	310.20057	5.49
81	72.93599	315.21366	315.21048	3.19
82	71.85280	320.21229	320.21478	-2.48
83	70.60392	326.20350	326.20162	1.88
84	69.79504	330.20828	330.21010	-1.82

Order of Fit = 8      RMS error of fit = 4.60 mK  
Largest absolute error = -10.36 mK at data point no. 71



# INTERPOLATION TABLE

Calibration Report: 637802  
 Sensor Model: CX-1050-SD-1.4L  
 Sensor Type: Cernox Resistor

Sales Order: 66130  
 Serial Number: X70252  
 Temperature Range: 1.40K to 325K

Temp (K)	Res. ( $\Omega$ )	dR/dT ( $\Omega/K$ )	dlogR/dlogT	Temp (K)	Res. ( $\Omega$ )	dR/dT ( $\Omega/K$ )	dlogR/dlogT
1.400	36217.0	-70231.	-2.7148	15.50	1151.68	-64.491	-0.86795
1.500	30247.3	-50702.	-2.5144	16.00	1120.44	-60.554	-0.86472
1.600	25834.0	-38518.	-2.3856	16.50	1091.06	-57.007	-0.86212
1.700	22412.8	-30333.	-2.3008	17.00	1063.37	-53.783	-0.85982
1.800	19695.1	-24324.	-2.2231	17.50	1037.23	-50.847	-0.85788
1.900	17498.0	-19822.	-2.1523	18.00	1012.49	-48.163	-0.85624
2.000	15695.6	-16378.	-2.0869	18.50	989.028	-45.705	-0.85493
2.100	14197.2	-13697.	-2.0260	19.00	966.748	-43.445	-0.85385
2.200	12937.8	-11572.	-1.9677	19.50	945.553	-41.363	-0.85302
2.300	11868.7	-9870.7	-1.9128	20.00	925.359	-39.438	-0.85237
2.400	10952.8	-8495.8	-1.8616	21.00	887.683	-36.000	-0.85165
2.500	10161.2	-7373.5	-1.8141	22.00	853.206	-33.023	-0.85150
2.600	9471.56	-6448.1	-1.7700	23.00	821.511	-30.425	-0.85182
2.700	8866.38	-5678.2	-1.7291	24.00	792.252	-28.140	-0.85247
2.800	8331.78	-5032.6	-1.6913	25.00	765.141	-26.120	-0.85344
2.900	7856.56	-4486.6	-1.6561	26.00	739.938	-24.321	-0.85459
3.000	7431.78	-4021.4	-1.6233	27.00	716.436	-22.711	-0.85592
3.100	7050.08	-3622.3	-1.5928	28.00	694.461	-21.265	-0.85737
3.200	6705.50	-3277.7	-1.5642	29.00	673.861	-19.957	-0.85888
3.300	6393.04	-2978.3	-1.5374	30.00	654.505	-18.773	-0.86048
3.400	6108.58	-2716.8	-1.5121	31.00	636.280	-17.694	-0.86209
3.500	5848.62	-2487.1	-1.4883	32.00	619.085	-16.710	-0.86374
3.600	5610.27	-2284.3	-1.4658	33.00	602.832	-15.808	-0.86537
3.700	5390.99	-2104.6	-1.4445	34.00	587.443	-14.981	-0.86705
3.800	5188.68	-1944.7	-1.4242	35.00	572.849	-14.217	-0.86863
3.900	5001.49	-1801.7	-1.4049	36.00	558.989	-13.512	-0.87021
4.000	4827.84	-1673.5	-1.3865	37.00	545.807	-12.861	-0.87183
4.200	4515.85	-1454.0	-1.3523	38.00	533.252	-12.256	-0.87336
4.400	4243.62	-1273.8	-1.3208	39.00	521.281	-11.694	-0.87486
4.600	4004.26	-1124.4	-1.2917	40.00	509.852	-11.170	-0.87637
4.800	3792.22	-999.56	-1.2652	42.00	488.478	-10.225	-0.87919
5.000	3603.16	-893.90	-1.2404	44.00	468.872	-9.3979	-0.88192
5.200	3433.60	-804.00	-1.2176	46.00	450.820	-8.6687	-0.88452
5.400	3280.73	-726.70	-1.1961	48.00	434.142	-8.0221	-0.88695
5.600	3142.20	-660.22	-1.1766	50.00	418.684	-7.4469	-0.88933
5.800	3016.08	-602.24	-1.1581	52.00	404.314	-6.9323	-0.89159
6.000	2900.83	-551.41	-1.1405	54.00	390.920	-6.4695	-0.89367
6.500	2651.84	-449.78	-1.1025	56.00	378.405	-6.0532	-0.89581
7.000	2446.83	-373.85	-1.0695	58.00	366.682	-5.6760	-0.89781
7.500	2274.96	-315.99	-1.0418	60.00	355.678	-5.3337	-0.89975
8.000	2128.76	-270.67	-1.0172	65.00	330.900	-4.6045	-0.90448
8.500	2002.70	-234.83	-0.99667	70.00	309.395	-4.0179	-0.90905
9.000	1892.81	-205.73	-0.97821	75.00	290.541	-3.5394	-0.91367
9.500	1796.07	-181.96	-0.96244	77.35	282.455	-3.3445	-0.91589
10.00	1710.19	-162.17	-0.94823	80.00	273.863	-3.1434	-0.91825
10.50	1633.37	-145.60	-0.93601	85.00	258.999	-2.8119	-0.92282
11.00	1564.18	-131.52	-0.92488	90.00	245.658	-2.5322	-0.92770
11.50	1501.50	-119.50	-0.91521	95.00	233.610	-2.2930	-0.93246
12.00	1444.41	-109.12	-0.90654	100.0	222.673	-2.0869	-0.93721
12.50	1392.15	-100.12	-0.89897	105.0	212.696	-1.9078	-0.94180
13.00	1344.12	-92.180	-0.89154	110.0	203.557	-1.7511	-0.94627
13.50	1299.82	-85.179	-0.88468	115.0	195.153	-1.6133	-0.95067
14.00	1258.79	-79.066	-0.87935	120.0	187.398	-1.4912	-0.95486
14.50	1220.62	-73.706	-0.87557	125.0	180.219	-1.3825	-0.95889
15.00	1185.00	-68.867	-0.87173	130.0	173.555	-1.2852	-0.96270



# INTERPOLATION TABLE

Calibration Report: 637802  
Sensor Model: CX-1050-SD-1.4L  
Sensor Type: Cernox Resistor

Sales Order: 66130  
Serial Number: X70252  
Temperature Range: 1.40K to 325K

<u>Temp (K)</u>	<u>Res. (<math>\Omega</math>)</u>	<u>dR/dT (<math>\Omega/K</math>)</u>	<u>dlogR/dlogT</u>	<u>Temp (K)</u>	<u>Res. (<math>\Omega</math>)</u>	<u>dR/dT (<math>\Omega/K</math>)</u>	<u>dlogR/dlogT</u>
135.0	167.350	-1.1979	-0.96631	235.0	97.0346	-0.40727	-0.98633
140.0	161.562	-1.1190	-0.96966	240.0	95.0416	-0.39011	-0.98511
145.0	156.148	-1.0476	-0.97278	245.0	93.1318	-0.37395	-0.98374
150.0	151.075	-0.98263	-0.97563	250.0	91.3006	-0.35871	-0.98222
155.0	146.312	-0.92340	-0.97823	255.0	89.5433	-0.34432	-0.98055
160.0	141.833	-0.86921	-0.98055	260.0	87.8560	-0.33073	-0.97875
165.0	137.613	-0.81951	-0.98261	265.0	86.2348	-0.31787	-0.97682
170.0	133.631	-0.77380	-0.98440	270.0	84.6762	-0.30570	-0.97476
175.0	129.869	-0.73167	-0.98593	273.15	83.7248	-0.29837	-0.97341
180.0	126.309	-0.69273	-0.98720	275.0	83.1768	-0.29417	-0.97259
185.0	122.936	-0.65670	-0.98822	280.0	81.7335	-0.28324	-0.97030
190.0	119.738	-0.62326	-0.98900	285.0	80.3435	-0.27286	-0.96791
195.0	116.700	-0.59220	-0.98954	290.0	79.0040	-0.26300	-0.96541
200.0	113.812	-0.56328	-0.98985	295.0	77.7126	-0.25364	-0.96281
205.0	111.064	-0.53632	-0.98994	300.0	76.4669	-0.24473	-0.96013
210.0	108.446	-0.51115	-0.98982	305.0	75.2646	-0.23624	-0.95735
215.0	105.950	-0.48761	-0.98949	310.0	74.1038	-0.22817	-0.95449
220.0	103.567	-0.46557	-0.98897	315.0	72.9824	-0.22047	-0.95155
225.0	101.292	-0.44490	-0.98827	320.0	71.8985	-0.21312	-0.94854
230.0	99.1161	-0.42550	-0.98739	325.0	70.8506	-0.20611	-0.94545



## THERMAL CYCLE TESTING

Sensor Model: CX-1050-SD-1.4L

Serial Number: X70252

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:	75.2 $\Omega$
Liquid Nitrogen:	283 $\Omega$
Liquid Helium:	4532 $\Omega$

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: 637802  
Sensor Model: CX-1050-SD-1.4L  
Sensor Type: Cernox Resistor

Sales Order: 66130  
Serial Number: X70252  
Temperature Range: 1.40K to 325K

Name: CX-1050-SD-1.4L  
Serial number: X70252  
Format: 4 ;Log Ohms/Kelvin  
Limit: 325.0  
Coefficient: 1 ;Negative

Point 1: 1.85033,325.000	Point 56: 2.44252, 79.000	Point 111: 3.25647, 9.450
Point 2: 1.85800,319.000	Point 57: 2.45532, 76.500	Point 112: 3.27468, 9.050
Point 3: 1.86518,313.500	Point 58: 2.46585, 74.500	Point 113: 3.29398, 8.650
Point 4: 1.87251,308.000	Point 59: 2.47662, 72.500	Point 114: 3.31450, 8.250
Point 5: 1.88000,302.500	Point 60: 2.48768, 70.500	Point 115: 3.33641, 7.850
Point 6: 1.88766,297.000	Point 61: 2.49904, 68.500	Point 116: 3.35689, 7.500
Point 7: 1.89547,291.500	Point 62: 2.51071, 66.500	Point 117: 3.37869, 7.150
Point 8: 1.90347,286.000	Point 63: 2.52271, 64.500	Point 118: 3.40203, 6.800
Point 9: 1.91163,280.500	Point 64: 2.53506, 62.500	Point 119: 3.42711, 6.450
Point 10: 1.91999,275.000	Point 65: 2.54779, 60.500	Point 120: 3.45421, 6.100
Point 11: 1.92853,269.500	Point 66: 2.56025, 58.600	Point 121: 3.48102, 5.780
Point 12: 1.93727,264.000	Point 67: 2.57241, 56.800	Point 122: 3.50819, 5.480
Point 13: 1.94622,258.500	Point 68: 2.58493, 55.000	Point 123: 3.53759, 5.180
Point 14: 1.95537,253.000	Point 69: 2.59785, 53.200	Point 124: 3.56744, 4.900
Point 15: 1.96475,247.500	Point 70: 2.61118, 51.400	Point 125: 3.59986, 4.620
Point 16: 1.97347,242.500	Point 71: 2.62495, 49.600	Point 126: 3.63277, 4.360
Point 17: 1.98238,237.500	Point 72: 2.63920, 47.800	Point 127: 3.66870, 4.100
Point 18: 1.99149,232.500	Point 73: 2.65396, 46.000	Point 128: 3.69896, 3.900
Point 19: 2.00082,227.500	Point 74: 2.66927, 44.200	Point 129: 3.72646, 3.730
Point 20: 2.01035,222.500	Point 75: 2.68339, 42.600	Point 130: 3.75595, 3.560
Point 21: 2.02011,217.500	Point 76: 2.69800, 41.000	Point 131: 3.78578, 3.400
Point 22: 2.03011,212.500	Point 77: 2.71411, 39.300	Point 132: 3.81782, 3.240
Point 23: 2.04034,207.500	Point 78: 2.72989, 37.700	Point 133: 3.85246, 3.080
Point 24: 2.05083,202.500	Point 79: 2.74527, 36.200	Point 134: 3.88764, 2.930
Point 25: 2.06158,197.500	Point 80: 2.76124, 34.700	Point 135: 3.92315, 2.790
Point 26: 2.07259,192.500	Point 81: 2.77787, 33.200	Point 136: 3.96160, 2.650
Point 27: 2.08390,187.500	Point 82: 2.79405, 31.800	Point 137: 4.00350, 2.510
Point 28: 2.09550,182.500	Point 83: 2.81090, 30.400	Point 138: 4.04603, 2.380
Point 29: 2.10740,177.500	Point 84: 2.82851, 29.000	Point 139: 4.09244, 2.250
Point 30: 2.11841,173.000	Point 85: 2.84560, 27.700	Point 140: 4.14349, 2.120
Point 31: 2.12967,168.500	Point 86: 2.86346, 26.400	Point 141: 4.19542, 2.000
Point 32: 2.14123,164.000	Point 87: 2.88219, 25.100	Point 142: 4.25245, 1.880
Point 33: 2.15309,159.500	Point 88: 2.90035, 23.900	Point 143: 4.31567, 1.760
Point 34: 2.16526,155.000	Point 89: 2.91939, 22.700	Point 144: 4.38010, 1.650
Point 35: 2.17776,150.500	Point 90: 2.93947, 21.500	Point 145: 4.45163, 1.540
Point 36: 2.19061,146.000	Point 91: 2.95891, 20.400	Point 146: 4.51781, 1.450
Point 37: 2.20382,141.500	Point 92: 2.97376, 19.600	Point 147: 4.55884, 1.400
Point 38: 2.21742,137.000	Point 93: 2.98626, 18.950	
Point 39: 2.22986,133.000	Point 94: 2.99921, 18.300	
Point 40: 2.24264,129.000	Point 95: 3.01266, 17.650	
Point 41: 2.25577,125.000	Point 96: 3.02555, 17.050	
Point 42: 2.26929,121.000	Point 97: 3.03894, 16.450	
Point 43: 2.28322,117.000	Point 98: 3.05288, 15.850	
Point 44: 2.29758,113.000	Point 99: 3.06619, 15.300	
Point 45: 2.31240,109.000	Point 100: 3.08004, 14.750	
Point 46: 2.32772,105.000	Point 101: 3.09449, 14.200	
Point 47: 2.34158,101.500	Point 102: 3.10959, 13.650	
Point 48: 2.35174, 99.000	Point 103: 3.12396, 13.150	
Point 49: 2.36212, 96.500	Point 104: 3.13898, 12.650	
Point 50: 2.37276, 94.000	Point 105: 3.15475, 12.150	
Point 51: 2.38365, 91.500	Point 106: 3.17132, 11.650	
Point 52: 2.39481, 89.000	Point 107: 3.18701, 11.200	
Point 53: 2.40626, 86.500	Point 108: 3.20348, 10.750	
Point 54: 2.41802, 84.000	Point 109: 3.22085, 10.300	
Point 55: 2.43010, 81.500	Point 110: 3.23920, 9.850	



# BREAKPOINTS 91C/93C/330 FORMAT

Calibration Report: 637802  
 Sensor Model: CX-1050-SD-1.4L  
 Sensor Type: Cernox Resistor

Sales Order: 66130  
 Serial Number: X70252  
 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	1.85034	325.0	31	3.20543	10.7
2	1.85161	324.0	32	3.26780	9.2
3	1.87118	309.0	33	3.33370	7.9
4	1.89191	294.0	34	3.39531	6.9
5	1.91391	279.0	35	3.45436	6.1
6	1.93729	264.0	36	3.51597	5.4
7	1.96218	249.0	37	3.57889	4.8
8	1.98875	234.0	38	3.64100	4.3
9	2.01718	219.0	39	3.69910	3.9
10	2.04767	204.0	40	3.76705	3.5
11	2.08050	189.0	41	3.82643	3.2
12	2.11596	174.0	42	3.89523	2.9
13	2.15445	159.0	43	3.94775	2.7
14	2.19646	144.0	44	4.00694	2.5
15	2.24266	129.0	45	4.07440	2.3
16	2.29398	114.0	46	4.11186	2.2
17	2.35176	99.0	47	4.15220	2.1
18	2.41804	84.0	48	4.19578	2.0
19	2.49619	69.0	49	4.24299	1.9
20	2.55433	59.5	50	4.29436	1.8
21	2.62189	50.0	51	4.35050	1.7
22	2.66244	45.0	52	4.48069	1.5
23	2.70744	40.0	53	4.55891	1.4
24	2.75804	35.0			
25	2.81591	30.0			
26	2.88374	25.0			
27	2.94826	21.0			
28	3.01375	17.6			
29	3.07880	14.8			
30	3.14369	12.5			

### Temperature for Resistance Decades:

Res. (Ohms)	Temp. (K)
100	227.940
1000	18.261
10000	2.522



# BREAKPOINTS 234 FORMAT

Calibration Report: 637802  
 Sensor Model: CX-1050-SD-1.4L  
 Sensor Type: Cernox Resistor

Sales Order: 66130  
 Serial Number: X70252  
 Temperature Range: 1.40K to 325K

Maximum Temperature Error:

1.4 - 10K: 0.009K  
 10 - 20K: 0.021K  
 20 - 40K: 0.008K  
 40 - 100K: 0.017K  
 > 100K: 0.064K

<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	317.464	72.44360	1.860	46	34.817	575.4399	2.760
2	302.511	75.85776	1.880	47	33.017	602.5596	2.780
3	288.380	79.43282	1.900	48	31.304	630.9573	2.800
4	275.002	83.17638	1.920	49	29.674	660.6934	2.820
5	262.318	87.09636	1.940	50	28.124	691.8310	2.840
6	250.278	91.20108	1.960	51	26.652	724.4360	2.860
7	238.834	95.49926	1.980	52	25.254	758.5776	2.880
8	227.941	100.0000	2.000	53	23.927	794.3282	2.900
9	217.565	104.7129	2.020	54	22.667	831.7638	2.920
10	207.675	109.6478	2.040	55	21.474	870.9636	2.940
11	198.236	114.8154	2.060	56	20.344	912.0108	2.960
12	189.219	120.2264	2.080	57	19.274	954.9926	2.980
13	180.603	125.8925	2.100	58	18.263	1000.000	3.000
14	172.364	131.8257	2.120	59	16.405	1096.478	3.040
15	164.485	138.0384	2.140	60	14.753	1202.264	3.080
16	156.938	144.5440	2.160	61	13.287	1318.257	3.120
17	149.714	151.3561	2.180	62	11.991	1445.440	3.160
18	142.796	158.4893	2.200	63	10.845	1584.893	3.200
19	136.172	165.9587	2.220	64	9.833	1737.801	3.240
20	129.825	173.7801	2.240	65	8.939	1905.461	3.280
21	123.746	181.9701	2.260	66	8.149	2089.296	3.320
22	117.922	190.5461	2.280	67	7.450	2290.868	3.360
23	112.346	199.5262	2.300	68	6.831	2511.886	3.400
24	107.011	208.9296	2.320	69	6.282	2754.229	3.440
25	101.902	218.7762	2.340	70	5.794	3019.952	3.480
26	97.010	229.0868	2.360	71	5.358	3311.311	3.520
27	92.334	239.8833	2.380	72	4.969	3630.781	3.560
28	87.864	251.1886	2.400	73	4.621	3981.072	3.600
29	83.589	263.0268	2.420	74	4.307	4365.158	3.640
30	79.507	275.4229	2.440	75	4.025	4786.301	3.680
31	75.609	288.4032	2.460	76	3.770	5248.075	3.720
32	71.886	301.9952	2.480	77	3.539	5754.399	3.760
33	68.336	316.2278	2.500	78	3.328	6309.573	3.800
34	64.950	331.1311	2.520	79	3.137	6918.310	3.840
35	61.721	346.7369	2.540	80	2.962	7585.776	3.880
36	58.641	363.0781	2.560	81	2.803	8317.638	3.920
37	55.707	380.1894	2.580	82	2.657	9120.108	3.960
38	52.911	398.1072	2.600	83	2.522	10000.00	4.000
39	50.245	416.8694	2.620	84	2.231	12589.25	4.100
40	47.706	436.5158	2.640	85	1.991	15848.93	4.200
41	45.287	457.0882	2.660	86	1.789	19952.62	4.300
42	42.983	478.6301	2.680	87	1.619	25118.86	4.400
43	40.790	501.1872	2.700	88	1.475	31622.78	4.500
44	38.701	524.8075	2.720	89	1.353	39810.72	4.600
45	36.712	549.5409	2.740	90	1.247	50118.72	4.700

