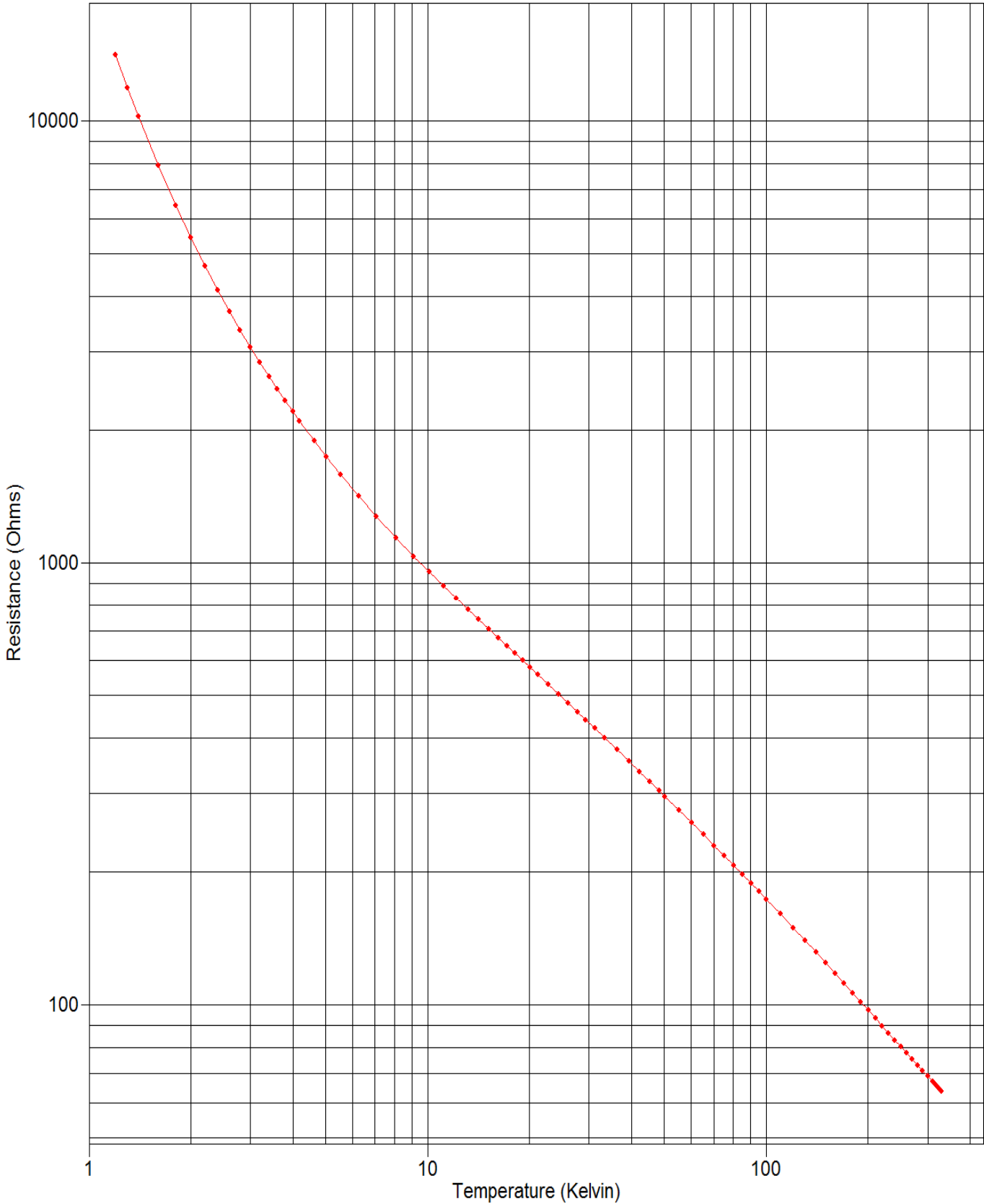


# DATA PLOT

Calibration Report: 637815  
Sensor Model: CX-1050-SD-1.4L  
Sensor Type: Cernox Resistor

Sales Order: 66130  
Serial Number: X71676  
Temperature Range: 1.40K to 325K



# TEST DATA

Calibration Report: 637815  
Sensor Model: CX-1050-SD-1.4L  
Sensor Type: Cernox Resistor

Sales Order: 66130  
Serial Number: X71676  
Temperature Range: 1.40K to 325K

Index	Temp. (K)	Resistance ( $\Omega$ )	Excitation	Index	Temp. (K)	Resistance ( $\Omega$ )	Excitation
1	1.19941	14123.8	2mV $\pm$ 25%	46	42.3450	336.487	2mV $\pm$ 25%
2	1.29972	11891.6	2mV $\pm$ 25%	47	45.3470	319.665	2mV $\pm$ 25%
3	1.39988	10218.7	2mV $\pm$ 25%	48	48.3318	304.751	2mV $\pm$ 25%
4	1.59999	7924.07	2mV $\pm$ 25%	49	50.3338	295.564	2mV $\pm$ 25%
5	1.80049	6445.75	2mV $\pm$ 25%	50	55.3250	275.144	2mV $\pm$ 25%
6	2.00003	5434.36	2mV $\pm$ 25%	51	60.3216	257.580	2mV $\pm$ 25%
7	2.19991	4696.46	2mV $\pm$ 25%	52	65.3113	242.325	2mV $\pm$ 25%
8	2.40039	4137.80	2mV $\pm$ 25%	53	70.3096	228.917	2mV $\pm$ 25%
9	2.59730	3709.30	2mV $\pm$ 25%	54	75.3020	217.031	2mV $\pm$ 25%
10	2.79672	3362.64	2mV $\pm$ 25%	55	80.2947	206.420	2mV $\pm$ 25%
11	2.99982	3074.56	2mV $\pm$ 25%	56	85.2868	196.865	2mV $\pm$ 25%
12	3.19995	2839.81	2mV $\pm$ 25%	57	90.2843	188.209	2mV $\pm$ 25%
13	3.40031	2641.76	2mV $\pm$ 25%	58	95.2740	180.316	2mV $\pm$ 25%
14	3.60013	2473.15	2mV $\pm$ 25%	59	100.277	173.065	2mV $\pm$ 25%
15	3.80032	2327.34	2mV $\pm$ 25%	60	110.261	160.315	2mV $\pm$ 25%
16	3.99971	2200.45	2mV $\pm$ 25%	61	120.255	149.359	2mV $\pm$ 25%
17	4.19481	2090.94	2mV $\pm$ 25%	62	130.242	139.859	2mV $\pm$ 25%
18	4.62771	1889.73	2mV $\pm$ 25%	63	140.237	131.496	2mV $\pm$ 25%
19	5.03372	1738.14	2mV $\pm$ 25%	64	150.231	124.138	2mV $\pm$ 25%
20	5.54290	1585.17	2mV $\pm$ 25%	65	160.230	117.563	2mV $\pm$ 25%
21	6.25599	1419.37	2mV $\pm$ 25%	66	170.228	111.681	2mV $\pm$ 25%
22	7.07153	1275.34	2mV $\pm$ 25%	67	180.224	106.372	2mV $\pm$ 25%
23	8.09354	1139.01	2mV $\pm$ 25%	68	190.210	101.581	2mV $\pm$ 25%
24	9.11255	1035.38	2mV $\pm$ 25%	69	200.213	97.2125	2mV $\pm$ 25%
25	10.1328	953.080	2mV $\pm$ 25%	70	210.213	93.2329	2mV $\pm$ 25%
26	11.1549	885.760	2mV $\pm$ 25%	71	220.208	89.5879	2mV $\pm$ 25%
27	12.1700	829.867	2mV $\pm$ 25%	72	230.204	86.2477	2mV $\pm$ 25%
28	13.1800	782.521	2mV $\pm$ 25%	73	240.210	83.1619	2mV $\pm$ 25%
29	14.1827	741.764	2mV $\pm$ 25%	74	250.202	80.3163	2mV $\pm$ 25%
30	15.1743	706.353	2mV $\pm$ 25%	75	260.204	77.6781	2mV $\pm$ 25%
31	16.1622	675.046	2mV $\pm$ 25%	76	270.198	75.2351	2mV $\pm$ 25%
32	17.1435	647.122	2mV $\pm$ 25%	77	280.197	72.9632	2mV $\pm$ 25%
33	18.1240	621.959	2mV $\pm$ 25%	78	290.202	70.8375	2mV $\pm$ 25%
34	19.1017	599.019	2mV $\pm$ 25%	79	300.204	68.8638	2mV $\pm$ 25%
35	20.0829	578.088	2mV $\pm$ 25%	80	310.209	67.0073	2mV $\pm$ 25%
36	21.1648	556.863	2mV $\pm$ 25%	81	315.212	66.1261	2mV $\pm$ 25%
37	22.7467	528.975	2mV $\pm$ 25%	82	320.216	65.2733	2mV $\pm$ 25%
38	24.3520	503.800	2mV $\pm$ 25%	83	326.205	64.2860	2mV $\pm$ 25%
39	26.0235	480.404	2mV $\pm$ 25%	84	330.210	63.6440	2mV $\pm$ 25%
40	27.6957	459.334	2mV $\pm$ 25%				
41	29.3463	440.527	2mV $\pm$ 25%				
42	31.1921	421.491	2mV $\pm$ 25%				
43	33.3251	401.586	2mV $\pm$ 25%				
44	36.3480	376.787	2mV $\pm$ 25%				
45	39.3585	355.267	2mV $\pm$ 25%				



# UNCERTAINTY ANALYSIS

Calibration Report: 637815  
 Sensor Model: CX-1050-SD-1.4L  
 Sensor Type: Cernox Resistor

Sales Order: 66130  
 Serial Number: X71676  
 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.

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



# POLYNOMIAL EQUATION

Calibration Report: 637815  
Sensor Model: CX-1050-SD-1.4L  
Sensor Type: Cernox Resistor

Sales Order: 66130  
Serial Number: X71676  
Temperature Range: 1.40K to 325K

Polynomial Type: Chebychev  
Useful Range of Fit:

1.40 K to 14.2 K  
1.021e+4 Ohms to 741.8 Ohms

Lower and Upper limits of Log(Resistance) used in computing Chebychev coefficients:  
ZL = 2.82933361418      ZU = 4.14995007988

Order	Coefficient	Std. Deviation of Coefficient	Ratio (Coeff./Std Dev.)
0	5.519949	1.6165E-04	34148.40
1	-6.366336	2.5948E-04	-24535.30
2	2.834456	2.2809E-04	12427.14
3	-1.040023	2.3447E-04	-4435.72
4	0.316998	2.2205E-04	1427.60
5	-0.075877	2.0480E-04	-370.49
6	0.011384	2.0253E-04	56.21
7	0.000353	2.0356E-04	1.74
8	-0.001713	2.0597E-04	-8.32

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

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

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: 637815  
Sensor Model: CX-1050-SD-1.4L  
Sensor Type: Cernox Resistor

Sales Order: 66130  
Serial Number: X71676  
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	14123.75	1.19941	1.19919	0.22
2	11891.57	1.29972	1.30061	-0.89
3	10218.72	1.39988	1.39909	0.79
4	7924.070	1.59999	1.59943	0.56
5	6445.755	1.80049	1.80130	-0.81
6	5434.357	2.00003	2.00057	-0.54
7	4696.460	2.19991	2.20002	-0.11
8	4137.800	2.40039	2.39998	0.41
9	3709.299	2.59730	2.59684	0.45
10	3362.643	2.79672	2.79611	0.62
11	3074.561	2.99982	2.99963	0.19
12	2839.807	3.19995	3.19988	0.07
13	2641.757	3.40031	3.40040	-0.09
14	2473.154	3.60013	3.60035	-0.21
15	2327.336	3.80032	3.80057	-0.25
16	2200.450	3.99971	4.00029	-0.58
17	2090.936	4.19481	4.19590	-1.09
18	1889.734	4.62771	4.62717	0.54
19	1738.144	5.03372	5.03368	0.04
20	1585.171	5.54290	5.54318	-0.28
21	1419.372	6.25599	6.25500	0.99
22	1275.335	7.07153	7.07014	1.38
23	1139.014	8.09354	8.09396	-0.42
24	1035.380	9.11255	9.11327	-0.72
25	953.0796	10.13283	10.13350	-0.68
26	885.7600	11.15486	11.15542	-0.56
27	829.8667	12.17003	12.17038	-0.35
28	782.5208	13.18001	13.17904	0.97
29	741.7636	14.18271	14.18169	1.02
30	706.3525	15.17428	15.17425	0.02
31	675.0464	16.16224	16.16296	-0.71

Order of Fit = 8                      RMS error of fit = 0.64 mK  
Largest absolute error = 1.38 mK at data point no. 22



# POLYNOMIAL EQUATION

Calibration Report: 637815  
Sensor Model: CX-1050-SD-1.4L  
Sensor Type: Cernox Resistor

Sales Order: 66130  
Serial Number: X71676  
Temperature Range: 1.40K to 325K

Polynomial Type: Chebychev  
Useful Range of Fit:

14.2 K to 80.3 K  
741.8 Ohms to 206.4 Ohms

Lower and Upper limits of Log(Resistance) used in computing Chebychev coefficients:  
ZL = 2.27464076326      ZU = 2.91900833386

Order	Coefficient	Std. Deviation of Coefficient	Ratio (Coeff./Std Dev.)
0	42.519146	4.0073E-04	106102.99
1	-37.904645	6.5205E-04	-58131.16
2	8.587330	5.9891E-04	14338.27
3	-1.146354	5.5627E-04	-2060.79
4	0.124695	5.3408E-04	233.48
5	-0.005386	5.1306E-04	-10.50
6	-0.004754	5.0906E-04	-9.34
7	-0.001090	4.9200E-04	-2.22
8	0.001188	4.9517E-04	2.40

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

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

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: 637815  
Sensor Model: CX-1050-SD-1.4L  
Sensor Type: Cernox Resistor

Sales Order: 66130  
Serial Number: X71676  
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	829.8667	12.17038	12.17013	0.25
28	782.5208	13.17904	13.17936	-0.32
29	741.7636	14.18169	14.18227	-0.59
30	706.3525	15.17428	15.17424	0.03
31	675.0464	16.16224	16.16140	0.85
32	647.1218	17.14352	17.14343	0.10
33	621.9587	18.12399	18.12256	1.43
34	599.0188	19.10171	19.10372	-2.01
35	578.0875	20.08291	20.08206	0.86
36	556.8630	21.16482	21.16509	-0.28
37	528.9752	22.74667	22.74681	-0.14
38	503.7995	24.35200	24.35334	-1.34
39	480.4035	26.02348	26.02349	0.00
40	459.3338	27.69568	27.69678	-1.10
41	440.5271	29.34633	29.34618	0.16
42	421.4908	31.19210	31.18742	4.68
43	401.5855	33.32514	33.32562	-0.47
44	376.7873	36.34800	36.34879	-0.79
45	355.2668	39.35852	39.36008	-1.56
46	336.4871	42.34503	42.34352	1.51
47	319.6649	45.34702	45.35150	-4.48
48	304.7513	48.33180	48.33057	1.23
49	295.5638	50.33379	50.33355	0.24
50	275.1441	55.32498	55.32214	2.84
51	257.5803	60.32157	60.32010	1.47
52	242.3253	65.31133	65.31389	-2.55
53	228.9170	70.30957	70.30946	0.11
54	217.0307	75.30201	75.30401	-2.00
55	206.4198	80.29465	80.29299	1.67
56	196.8654	85.28685	85.28590	0.95
57	188.2092	90.28433	90.28508	-0.75

Order of Fit = 8                      RMS error of fit = 1.66 mK  
Largest absolute error = 4.68 mK at data point no. 42



# POLYNOMIAL EQUATION

Calibration Report: 637815  
Sensor Model: CX-1050-SD-1.4L  
Sensor Type: Cernox Resistor

Sales Order: 66130  
Serial Number: X71676  
Temperature Range: 1.40K to 325K

Polynomial Type: Chebychev  
Useful Range of Fit:

80.3 K to 325. K  
206.4 Ohms to 64.48 Ohms

Lower and Upper limits of Log(Resistance) used in computing Chebychev coefficients:  
ZL = 1.80375777813      ZU = 2.359677971

Order	Coefficient	Std. Deviation of Coefficient	Ratio (Coeff./Std Dev.)
0	177.189046	1.6070E-03	110259.64
1	-126.677285	2.4811E-03	-51055.95
2	22.460193	2.3837E-03	9422.39
3	-3.159435	2.2634E-03	-1395.90
4	0.597144	2.1556E-03	277.02
5	-0.114282	2.1608E-03	-52.89
6	0.014900	2.1347E-03	6.98
7	-0.002117	2.0620E-03	-1.03

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

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

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: 637815  
Sensor Model: CX-1050-SD-1.4L  
Sensor Type: Cernox Resistor

Sales Order: 66130  
Serial Number: X71676  
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	228.9170	70.30946	70.30816	1.29
54	217.0307	75.30401	75.30601	-2.00
55	206.4198	80.29299	80.29583	-2.84
56	196.8654	85.28685	85.28602	0.83
57	188.2092	90.28433	90.27642	7.91
58	180.3163	95.27404	95.27177	2.28
59	173.0647	100.27665	100.28648	-9.84
60	160.3146	110.26064	110.26102	-0.39
61	149.3594	120.25465	120.25262	2.03
62	139.8593	130.24235	130.23263	9.73
63	131.4955	140.23673	140.25421	-17.48
64	124.1379	150.23071	150.22525	5.47
65	117.5634	160.22965	160.22924	0.41
66	111.6814	170.22825	170.21852	9.73
67	106.3721	180.22356	180.22816	-4.60
68	101.5815	190.20971	190.20658	3.14
69	97.21251	200.21279	200.21867	-5.87
70	93.23291	210.21280	210.21515	-2.35
71	89.58785	220.20834	220.21655	-8.21
72	86.24769	230.20385	230.19541	8.44
73	83.16191	240.20996	240.20458	5.38
74	80.31630	250.20217	250.19991	2.26
75	77.67810	260.20357	260.20999	-6.41
76	75.23514	270.19834	270.19916	-0.82
77	72.96322	280.19734	280.18776	9.58
78	70.83753	290.20180	290.21694	-15.14
79	68.86375	300.20388	300.19026	13.62
80	67.00730	310.20925	310.21749	-8.23
81	66.12608	315.21228	315.21670	-4.43
82	65.27328	320.21601	320.21185	4.16
83	64.28598	326.20543	326.19861	6.83
84	63.64405	330.20993	330.21440	-4.47

Order of Fit = 7      RMS error of fit = 7.23 mK  
Largest absolute error = -17.48 mK at data point no. 63



# INTERPOLATION TABLE

Calibration Report: 637815  
 Sensor Model: CX-1050-SD-1.4L  
 Sensor Type: Cernox Resistor

Sales Order: 66130  
 Serial Number: X71676  
 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	10205.3	-14732.	-2.0209	15.50	695.624	-32.306	-0.71986
1.500	8918.43	-11239.	-1.8904	16.00	679.927	-30.512	-0.71801
1.600	7919.02	-8907.0	-1.7996	16.50	665.085	-28.882	-0.71654
1.700	7114.43	-7261.2	-1.7351	17.00	651.021	-27.392	-0.71528
1.800	6453.56	-6013.4	-1.6772	17.50	637.672	-26.027	-0.71426
1.900	5902.31	-5049.9	-1.6256	18.00	624.977	-24.771	-0.71344
2.000	5436.79	-4290.3	-1.5783	18.50	612.884	-23.616	-0.71285
2.100	5039.20	-3682.5	-1.5346	19.00	601.346	-22.548	-0.71241
2.200	4696.52	-3188.0	-1.4934	19.50	590.323	-21.559	-0.71216
2.300	4398.65	-2782.2	-1.4548	20.00	579.775	-20.641	-0.71205
2.400	4137.76	-2446.1	-1.4188	21.00	559.978	-18.992	-0.71224
2.500	3907.58	-2165.4	-1.3854	22.00	541.720	-17.553	-0.71287
2.600	3703.20	-1929.0	-1.3543	23.00	524.813	-16.289	-0.71387
2.700	3520.60	-1728.3	-1.3255	24.00	509.094	-15.169	-0.71511
2.800	3356.57	-1556.8	-1.2986	25.00	494.433	-14.173	-0.71660
2.900	3208.45	-1409.1	-1.2736	26.00	480.715	-13.279	-0.71822
3.000	3074.09	-1281.2	-1.2503	27.00	467.845	-12.475	-0.71995
3.100	2951.66	-1169.8	-1.2286	28.00	455.740	-11.748	-0.72176
3.200	2839.67	-1072.1	-1.2082	29.00	444.328	-11.087	-0.72358
3.300	2736.85	-986.12	-1.1890	30.00	433.547	-10.484	-0.72545
3.400	2642.12	-909.97	-1.1710	31.00	423.343	-9.9319	-0.72728
3.500	2554.57	-842.28	-1.1540	32.00	413.668	-9.4254	-0.72912
3.600	2473.42	-781.81	-1.1379	33.00	404.479	-8.9586	-0.73090
3.700	2398.00	-727.62	-1.1227	34.00	395.739	-8.5280	-0.73269
3.800	2327.72	-678.85	-1.1082	35.00	387.413	-8.1286	-0.73436
3.900	2262.07	-634.81	-1.0945	36.00	379.472	-7.7581	-0.73600
4.000	2200.62	-594.91	-1.0813	37.00	371.888	-7.4141	-0.73765
4.200	2088.78	-525.70	-1.0570	38.00	364.636	-7.0931	-0.73919
4.400	1989.59	-467.84	-1.0346	39.00	357.694	-6.7933	-0.74069
4.600	1901.04	-419.06	-1.0140	40.00	351.043	-6.5133	-0.74217
4.800	1821.47	-377.68	-0.99528	42.00	338.536	-6.0044	-0.74492
5.000	1749.58	-342.15	-0.97780	44.00	326.985	-5.5553	-0.74754
5.200	1684.28	-311.50	-0.96170	46.00	316.281	-5.1568	-0.75001
5.400	1624.71	-284.79	-0.94656	48.00	306.329	-4.8012	-0.75233
5.600	1570.13	-261.55	-0.93284	50.00	297.051	-4.4830	-0.75459
5.800	1519.91	-241.04	-0.91981	52.00	288.376	-4.1967	-0.75676
6.000	1473.56	-222.86	-0.90743	54.00	280.246	-3.9379	-0.75879
6.500	1371.82	-185.87	-0.88070	56.00	272.608	-3.7040	-0.76088
7.000	1286.27	-157.58	-0.85755	58.00	265.416	-3.4910	-0.76287
7.500	1213.19	-135.57	-0.83808	60.00	258.631	-3.2969	-0.76484
8.000	1149.97	-117.99	-0.82085	65.00	243.226	-2.8800	-0.76966
8.500	1094.62	-103.86	-0.80652	70.00	229.700	-2.5413	-0.77446
9.000	1045.69	-92.210	-0.79363	75.00	217.716	-2.2606	-0.77873
9.500	1002.07	-82.558	-0.78269	77.35	212.541	-2.1447	-0.78052
10.00	962.883	-74.415	-0.77284	80.00	207.017	-2.0264	-0.78309
10.50	927.443	-67.522	-0.76444	85.00	197.387	-1.8304	-0.78822
11.00	895.202	-61.592	-0.75683	90.00	188.667	-1.6620	-0.79283
11.50	865.713	-56.482	-0.75029	95.00	180.728	-1.5173	-0.79759
12.00	838.612	-52.025	-0.74444	100.0	173.462	-1.3917	-0.80230
12.50	813.594	-48.126	-0.73941	105.0	166.785	-1.2817	-0.80692
13.00	790.414	-44.663	-0.73458	110.0	160.623	-1.1849	-0.81143
13.50	768.867	-41.589	-0.73023	115.0	154.918	-1.0991	-0.81587
14.00	748.766	-38.872	-0.72680	120.0	149.617	-1.0225	-0.82010
14.50	729.942	-36.464	-0.72435	125.0	144.679	-0.95393	-0.82418
15.00	712.264	-34.284	-0.72201	130.0	140.067	-0.89216	-0.82804



# INTERPOLATION TABLE

Calibration Report: 637815  
Sensor Model: CX-1050-SD-1.4L  
Sensor Type: Cernox Resistor

Sales Order: 66130  
Serial Number: X71676  
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	135.748	-0.83631	-0.83170	235.0	84.7352	-0.30868	-0.85607
140.0	131.695	-0.78558	-0.83512	240.0	83.2225	-0.29653	-0.85514
145.0	127.884	-0.73937	-0.83832	245.0	81.7689	-0.28504	-0.85406
150.0	124.295	-0.69710	-0.84127	250.0	80.3711	-0.27417	-0.85283
155.0	120.907	-0.65835	-0.84399	255.0	79.0262	-0.26388	-0.85147
160.0	117.706	-0.62270	-0.84645	260.0	77.7314	-0.25411	-0.84997
165.0	114.676	-0.58984	-0.84868	265.0	76.4842	-0.24485	-0.84835
170.0	111.803	-0.55945	-0.85065	270.0	75.2821	-0.23606	-0.84662
175.0	109.078	-0.53130	-0.85239	273.15	74.5470	-0.23074	-0.84547
180.0	106.487	-0.50515	-0.85389	275.0	74.1229	-0.22770	-0.84477
185.0	104.023	-0.48084	-0.85515	280.0	73.0044	-0.21975	-0.84283
190.0	101.676	-0.45817	-0.85618	285.0	71.9248	-0.21219	-0.84079
195.0	99.4387	-0.43701	-0.85698	290.0	70.8820	-0.20499	-0.83866
200.0	97.3037	-0.41722	-0.85757	295.0	69.8743	-0.19813	-0.83646
205.0	95.2644	-0.39869	-0.85794	300.0	68.9002	-0.19158	-0.83418
210.0	93.3149	-0.38130	-0.85810	305.0	67.9580	-0.18534	-0.83183
215.0	91.4496	-0.36498	-0.85807	310.0	67.0463	-0.17938	-0.82942
220.0	89.6635	-0.34962	-0.85783	315.0	66.1637	-0.17370	-0.82695
225.0	87.9519	-0.33516	-0.85742	320.0	65.3089	-0.16826	-0.82443
230.0	86.3105	-0.32154	-0.85683	325.0	64.4807	-0.16306	-0.82187



## THERMAL CYCLE TESTING

Sensor Model: CX-1050-SD-1.4L

Serial Number: X71676

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:	67.9 $\Omega$
Liquid Nitrogen:	213 $\Omega$
Liquid Helium:	2083 $\Omega$

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: 637815  
Sensor Model: CX-1050-SD-1.4L  
Sensor Type: Cernox Resistor

Sales Order: 66130  
Serial Number: X71676  
Temperature Range: 1.40K to 325K

Name: CX-1050-SD-1.4L  
Serial number: X71676  
Format: 4 ;Log Ohms/Kelvin  
Limit: 325.0  
Coefficient: 1 ;Negative

Point 1: 1.80941,325.000	Point 56: 2.32459, 78.000	Point 111: 3.00083, 9.500
Point 2: 1.81608,319.000	Point 57: 2.33340, 76.000	Point 112: 3.01555, 9.100
Point 3: 1.82232,313.500	Point 58: 2.34241, 74.000	Point 113: 3.03107, 8.700
Point 4: 1.82870,308.000	Point 59: 2.35166, 72.000	Point 114: 3.04756, 8.300
Point 5: 1.83521,302.500	Point 60: 2.36115, 70.000	Point 115: 3.06509, 7.900
Point 6: 1.84185,297.000	Point 61: 2.37088, 68.000	Point 116: 3.08145, 7.550
Point 7: 1.84865,291.500	Point 62: 2.38089, 66.000	Point 117: 3.09880, 7.200
Point 8: 1.85559,286.000	Point 63: 2.39117, 64.000	Point 118: 3.11734, 6.850
Point 9: 1.86268,280.500	Point 64: 2.40175, 62.000	Point 119: 3.13719, 6.500
Point 10: 1.86994,275.000	Point 65: 2.41266, 60.000	Point 120: 3.15856, 6.150
Point 11: 1.87736,269.500	Point 66: 2.42277, 58.200	Point 121: 3.18032, 5.820
Point 12: 1.88495,264.000	Point 67: 2.43316, 56.400	Point 122: 3.20312, 5.500
Point 13: 1.89272,258.500	Point 68: 2.44387, 54.600	Point 123: 3.22627, 5.200
Point 14: 1.90067,253.000	Point 69: 2.45491, 52.800	Point 124: 3.24966, 4.920
Point 15: 1.90881,247.500	Point 70: 2.46631, 51.000	Point 125: 3.27501, 4.640
Point 16: 1.91714,242.000	Point 71: 2.47808, 49.200	Point 126: 3.30267, 4.360
Point 17: 1.92490,237.000	Point 72: 2.49026, 47.400	Point 127: 3.33082, 4.100
Point 18: 1.93283,232.000	Point 73: 2.50288, 45.600	Point 128: 3.35440, 3.900
Point 19: 1.94094,227.000	Point 74: 2.51597, 43.800	Point 129: 3.37581, 3.730
Point 20: 1.94923,222.000	Point 75: 2.52804, 42.200	Point 130: 3.39870, 3.560
Point 21: 1.95772,217.000	Point 76: 2.54052, 40.600	Point 131: 3.42330, 3.390
Point 22: 1.96640,212.000	Point 77: 2.55347, 39.000	Point 132: 3.44824, 3.230
Point 23: 1.97530,207.000	Point 78: 2.56692, 37.400	Point 133: 3.47510, 3.070
Point 24: 1.98441,202.000	Point 79: 2.58003, 35.900	Point 134: 3.50234, 2.920
Point 25: 1.99374,197.000	Point 80: 2.59364, 34.400	Point 135: 3.53179, 2.770
Point 26: 2.00331,192.000	Point 81: 2.60781, 32.900	Point 136: 3.56167, 2.630
Point 27: 2.01312,187.000	Point 82: 2.62159, 31.500	Point 137: 3.59409, 2.490
Point 28: 2.02318,182.000	Point 83: 2.63594, 30.100	Point 138: 3.62956, 2.350
Point 29: 2.03351,177.000	Point 84: 2.65092, 28.700	Point 139: 3.66567, 2.220
Point 30: 2.04304,172.500	Point 85: 2.66545, 27.400	Point 140: 3.70524, 2.090
Point 31: 2.05281,168.000	Point 86: 2.68063, 26.100	Point 141: 3.74892, 1.960
Point 32: 2.06282,163.500	Point 87: 2.69655, 24.800	Point 142: 3.79355, 1.840
Point 33: 2.07308,159.000	Point 88: 2.71196, 23.600	Point 143: 3.84292, 1.720
Point 34: 2.08362,154.500	Point 89: 2.72813, 22.400	Point 144: 3.89342, 1.610
Point 35: 2.09443,150.000	Point 90: 2.74517, 21.200	Point 145: 3.94441, 1.510
Point 36: 2.10554,145.500	Point 91: 2.76165, 20.100	Point 146: 3.99600, 1.420
Point 37: 2.11696,141.000	Point 92: 2.76638, 19.800	Point 147: 4.00890, 1.400
Point 38: 2.12871,136.500	Point 93: 2.77425, 19.300	
Point 39: 2.14081,132.000	Point 94: 2.78485, 18.650	
Point 40: 2.15189,128.000	Point 95: 2.79583, 18.000	
Point 41: 2.16325,124.000	Point 96: 2.80723, 17.350	
Point 42: 2.17496,120.000	Point 97: 2.81817, 16.750	
Point 43: 2.18700,116.000	Point 98: 2.82952, 16.150	
Point 44: 2.19942,112.000	Point 99: 2.84133, 15.550	
Point 45: 2.21224,108.000	Point 100: 2.85365, 14.950	
Point 46: 2.22547,104.000	Point 101: 2.86543, 14.400	
Point 47: 2.23744,100.500	Point 102: 2.87771, 13.850	
Point 48: 2.24623, 98.000	Point 103: 2.89054, 13.300	
Point 49: 2.25519, 95.500	Point 104: 2.90277, 12.800	
Point 50: 2.26437, 93.000	Point 105: 2.91555, 12.300	
Point 51: 2.27377, 90.500	Point 106: 2.92895, 11.800	
Point 52: 2.28341, 88.000	Point 107: 2.94304, 11.300	
Point 53: 2.29329, 85.500	Point 108: 2.95640, 10.850	
Point 54: 2.30344, 83.000	Point 109: 2.97041, 10.400	
Point 55: 2.31387, 80.500	Point 110: 2.98520, 9.950	



# BREAKPOINTS 91C/93C/330 FORMAT

Calibration Report: 637815  
 Sensor Model: CX-1050-SD-1.4L  
 Sensor Type: Cernox Resistor

Sales Order: 66130  
 Serial Number: X71676  
 Temperature Range: 1.40K to 325K

Interpolation Method: Lagrangian  
 Limit: 325.0 (Kelvin)  
 Format: 4 (Log Ohms/Kelvin)  
 Number of Breakpoints: 52

No.	Units	Temperature (K)	No.	Units	Temperature (K)
1	1.80943	325.0	31	2.95192	11.0
2	1.81053	324.0	32	3.00450	9.4
3	1.82754	309.0	33	3.05626	8.1
4	1.84555	294.0	34	3.10933	7.0
5	1.86466	279.0	35	3.16188	6.1
6	1.88496	264.0	36	3.21078	5.4
7	1.90658	249.0	37	3.26042	4.8
8	1.92965	234.0	38	3.30915	4.3
9	1.95431	219.0	39	3.35451	3.9
10	1.98075	204.0	40	3.40732	3.5
11	2.00918	189.0	41	3.45327	3.2
12	2.03986	174.0	42	3.50630	2.9
13	2.07310	159.0	43	3.54662	2.7
14	2.10934	144.0	44	3.59191	2.5
15	2.14911	129.0	45	3.64332	2.3
16	2.19319	114.0	46	3.67178	2.2
17	2.24271	99.0	47	3.73534	2.0
18	2.29937	84.0	48	3.77102	1.9
19	2.36600	69.0	49	3.80980	1.8
20	2.41546	59.5	50	3.85214	1.7
21	2.47283	50.0	51	3.95029	1.5
22	2.50723	45.0	52	4.00883	1.4
23	2.54536	40.0			
24	2.58817	35.0			
25	2.63704	30.0			
26	2.69163	25.2			
27	2.74378	21.3			
28	2.79586	18.0			
29	2.84849	15.2			
30	2.90032	12.9			

## Temperature for Resistance Decades:

Res. (Ohms)	Temp. (K)
100	193.722
1000	9.525
10000	1.414



# BREAKPOINTS 234 FORMAT

Calibration Report: 637815  
 Sensor Model: CX-1050-SD-1.4L  
 Sensor Type: Cernox Resistor

Sales Order: 66130  
 Serial Number: X71676  
 Temperature Range: 1.40K to 325K

Maximum Temperature Error:

1.4 - 10K: 0.015K  
 10 - 20K: 0.006K  
 20 - 40K: 0.011K  
 40 - 100K: 0.023K  
 > 100K: 0.085K

<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	315.544	66.06934	1.820	46	23.000	524.8075	2.720
2	298.533	69.18310	1.840	47	21.562	549.5409	2.740
3	282.575	72.44360	1.860	48	20.212	575.4399	2.760
4	267.580	75.85776	1.880	49	18.946	602.5596	2.780
5	253.468	79.43282	1.900	50	17.762	630.9573	2.800
6	240.156	83.17638	1.920	51	16.653	660.6934	2.820
7	227.581	87.09636	1.940	52	15.618	691.8310	2.840
8	215.681	91.20108	1.960	53	14.652	724.4360	2.860
9	204.412	95.49926	1.980	54	13.752	758.5776	2.880
10	193.724	100.0000	2.000	55	12.913	794.3282	2.900
11	183.574	104.7129	2.020	56	12.133	831.7638	2.920
12	173.933	109.6478	2.040	57	11.408	870.9636	2.940
13	164.764	114.8154	2.060	58	10.734	912.0108	2.960
14	156.041	120.2264	2.080	59	10.107	954.9926	2.980
15	147.738	125.8925	2.100	60	9.525	1000.000	3.000
16	139.833	131.8257	2.120	61	8.482	1096.478	3.040
17	132.308	138.0384	2.140	62	7.582	1202.264	3.080
18	125.146	144.5440	2.160	63	6.804	1318.257	3.120
19	118.319	151.3561	2.180	64	6.129	1445.440	3.160
20	111.827	158.4893	2.200	65	5.544	1584.893	3.200
21	105.646	165.9587	2.220	66	5.035	1737.801	3.240
22	99.772	173.7801	2.240	67	4.590	1905.461	3.280
23	94.188	181.9701	2.260	68	4.199	2089.296	3.320
24	88.882	190.5461	2.280	69	3.855	2290.868	3.360
25	83.844	199.5262	2.300	70	3.552	2511.886	3.400
26	79.066	208.9296	2.320	71	3.283	2754.229	3.440
27	74.533	218.7762	2.340	72	3.043	3019.952	3.480
28	70.242	229.0868	2.360	73	2.830	3311.311	3.520
29	66.178	239.8833	2.380	74	2.638	3630.781	3.560
30	62.331	251.1886	2.400	75	2.467	3981.072	3.600
31	58.692	263.0268	2.420	76	2.312	4365.158	3.640
32	55.248	275.4229	2.440	77	2.172	4786.301	3.680
33	51.993	288.4032	2.460	78	2.046	5248.075	3.720
34	48.918	301.9952	2.480	79	1.930	5754.399	3.760
35	46.010	316.2278	2.500	80	1.824	6309.573	3.800
36	43.264	331.1311	2.520	81	1.728	6918.310	3.840
37	40.671	346.7369	2.540	82	1.639	7585.776	3.880
38	38.220	363.0781	2.560	83	1.558	8317.638	3.920
39	35.908	380.1894	2.580	84	1.483	9120.108	3.960
40	33.724	398.1072	2.600	85	1.414	10000.00	4.000
41	31.664	416.8694	2.620	86	1.266	12589.25	4.100
42	29.719	436.5158	2.640				
43	27.885	457.0882	2.660				
44	26.158	478.6301	2.680				
45	24.531	501.1872	2.700				

