

DATA PLOT

Calibration Report: 531611
Sensor Model: CX-1050-SD-4L
Sensor Type: Cernox Resistor

Sales Order: 42383
Serial Number: X49553
Temperature Range: 4.00K to 325K



TEST DATA

Calibration Report: 531611
Sensor Model: CX-1050-SD-4L
Sensor Type: Cernox Resistor

Sales Order: 42383
Serial Number: X49553
Temperature Range: 4.00K to 325K

Index	Temp. (K)	Resistance (Ω)	Excitation	Index	Temp. (K)	Resistance (Ω)	Excitation
1	3.59275	2907.52	2mV \pm 25%	41	75.0263	221.244	2mV \pm 25%
2	3.80010	2717.50	2mV \pm 25%	42	80.0248	209.490	2mV \pm 25%
3	3.99820	2560.58	2mV \pm 25%	43	85.0222	198.967	2mV \pm 25%
4	4.20696	2415.39	2mV \pm 25%	44	90.0208	189.484	2mV \pm 25%
5	4.59864	2190.09	2mV \pm 25%	45	95.0191	180.866	2mV \pm 25%
6	5.00346	2002.12	2mV \pm 25%	46	100.022	172.998	2mV \pm 25%
7	5.51150	1813.65	2mV \pm 25%	47	110.010	159.194	2mV \pm 25%
8	6.21740	1612.14	2mV \pm 25%	48	120.009	147.418	2mV \pm 25%
9	7.02879	1438.34	2mV \pm 25%	49	130.003	137.265	2mV \pm 25%
10	8.04403	1275.93	2mV \pm 25%	50	140.004	128.422	2mV \pm 25%
11	9.05380	1153.86	2mV \pm 25%	51	149.999	120.645	2mV \pm 25%
12	10.0667	1057.62	2mV \pm 25%	52	160.006	113.766	2mV \pm 25%
13	11.0819	979.095	2mV \pm 25%	53	170.008	107.632	2mV \pm 25%
14	12.0923	914.300	2mV \pm 25%	54	180.011	102.138	2mV \pm 25%
15	13.1006	859.454	2mV \pm 25%	55	190.009	97.1939	2mV \pm 25%
16	14.1039	812.483	2mV \pm 25%	56	200.020	92.7189	2mV \pm 25%
17	15.0945	771.864	2mV \pm 25%	57	210.030	88.6548	2mV \pm 25%
18	16.0859	735.909	2mV \pm 25%	58	220.030	84.9609	2mV \pm 25%
19	17.0734	703.904	2mV \pm 25%	59	230.030	81.5810	2mV \pm 25%
20	18.0583	675.118	2mV \pm 25%	60	240.039	78.4798	2mV \pm 25%
21	19.0462	648.952	2mV \pm 25%	61	250.033	75.6283	2mV \pm 25%
22	20.0316	625.082	2mV \pm 25%	62	260.035	72.9990	2mV \pm 25%
23	21.1228	600.925	2mV \pm 25%	63	270.033	70.5673	2mV \pm 25%
24	22.7176	569.252	2mV \pm 25%	64	280.037	68.3188	2mV \pm 25%
25	24.3024	541.272	2mV \pm 25%	65	290.047	66.2312	2mV \pm 25%
26	25.8963	516.087	2mV \pm 25%	66	300.057	64.2848	2mV \pm 25%
27	27.5098	493.086	2mV \pm 25%	67	310.073	62.4716	2mV \pm 25%
28	29.1233	472.185	2mV \pm 25%	68	315.083	61.6101	2mV \pm 25%
29	30.9352	450.933	2mV \pm 25%	69	320.083	60.7801	2mV \pm 25%
30	33.0462	428.628	2mV \pm 25%	70	326.080	59.8198	2mV \pm 25%
31	36.0519	400.645	2mV \pm 25%	71	330.081	59.1991	2mV \pm 25%
32	39.0510	376.386	2mV \pm 25%				
33	42.0293	355.185	2mV \pm 25%				
34	45.0333	336.203	2mV \pm 25%				
35	48.0195	319.351	2mV \pm 25%				
36	50.0259	308.982	2mV \pm 25%				
37	55.0251	286.005	2mV \pm 25%				
38	60.0278	266.329	2mV \pm 25%				
39	65.0249	249.316	2mV \pm 25%				
40	70.0294	234.389	2mV \pm 25%				



UNCERTAINTY ANALYSIS

Calibration Report: 531611
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 Temperature Range: 4.00K 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 (+/- mK)											
	Ge (GR-200-X)		Cernox (CX-Y)		CGR	RX		Pt		RhFe		Diode
	X ≤ 100	X ≥ 250	Y ≤ 1030	Y ≥ 1050		-102	-103	100 Ω	25 Ω	27 Ω	100 Ω	
1.4	4	4	4	4	4	4	4			4	4	7
4.2	4	4	4	4	4	4	6			4	4	5
10	4	4	5	4	4	10	15			4	5	6
20	8	7	9	8	8	34	34	8	10	8	9	9
30	9	8	11	9	9	72	60	8	8	9	9	28
50	12	11	16	12	13			10	10	10	10	34
100	32	18	24	16	27			11	11	11	11	30
300			72	40	100			22	22	22	22	33
400			120	67				43	43	42		47
500								48	48			52

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 (08/06/04)



POLYNOMIAL EQUATION

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Sensor Type: Cernox Resistor

Sales Order: 42383
Serial Number: X49553
Temperature Range: 4.00K to 325K

Polynomial Type: Chebychev
Useful Range of Fit:

4.00K to 24.3K
2559. Ohms to 541.3 Ohms

Lower and Upper limits of Log(resistance) used in computing Chebychev coefficients:
ZL = 2.69292293916 ZU = 3.46352293897

Order	Coefficient	Std. Deviation of Coefficient	Ratio (Coeff./Std Dev.)
0	12.035615	1.4067E-04	85559.87
1	-11.257478	2.1695E-04	-51889.34
2	3.447266	2.1123E-04	16320.31
3	-0.710174	1.9821E-04	-3582.90
4	0.071517	1.9199E-04	372.50
5	0.009369	1.8690E-04	50.13
6	-0.003796	1.7994E-04	-21.09
7	-0.000059	1.7884E-04	-0.33
8	0.000772	1.7915E-04	4.31

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

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

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



POLYNOMIAL EQUATION

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Sales Order: 42383
Serial Number: X49553
Temperature Range: 4.00K to 325K

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

	R Meas. (Ω)	T Meas. (K)	T Eq. (K)	T diff. (mK)
1	2907.522	3.59275	3.59303	-0.28
2	2717.503	3.80010	3.79943	0.67
3	2560.581	3.99820	3.99789	0.31
4	2415.392	4.20696	4.20816	-1.20
5	2190.095	4.59864	4.59840	0.25
6	2002.122	5.00346	5.00324	0.23
7	1813.646	5.51150	5.51116	0.34
8	1612.140	6.21740	6.21757	-0.17
9	1438.341	7.02879	7.02872	0.07
10	1275.927	8.04403	8.04484	-0.81
11	1153.864	9.05380	9.05414	-0.34
12	1057.617	10.06672	10.06497	1.75
13	979.0953	11.08191	11.08207	-0.16
14	914.2996	12.09231	12.09248	-0.17
15	859.4539	13.10062	13.10135	-0.73
16	812.4826	14.10392	14.10370	0.22
17	771.8636	15.09447	15.09475	-0.27
18	735.9091	16.08590	16.08592	-0.02
19	703.9041	17.07344	17.07323	0.21
20	675.1181	18.05826	18.05862	-0.35
21	648.9520	19.04617	19.04555	0.62
22	625.0819	20.03157	20.03152	0.05
23	600.9251	21.12284	21.12302	-0.18
24	569.2515	22.71756	22.71714	0.43
25	541.2716	24.30239	24.30302	-0.62
26	516.0875	25.89631	25.89625	0.06
27	493.0863	27.50983	27.50972	0.11

Order of Fit = 8 RMS error of fit = 0.55 mK
Largest absolute error = 1.75 mK at data point no. 12



POLYNOMIAL EQUATION

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Sales Order: 42383
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Temperature Range: 4.00K to 325K

Polynomial Type: Chebychev
Useful Range of Fit:

24.3K to 110.K
541.3 Ohms to 159.2 Ohms

Lower and Upper limits of Log(resistance) used in computing Chebychev coefficients:
ZL = 2.13755956242 ZU = 2.77882034074

Order	Coefficient	Std. Deviation of Coefficient	Ratio (Coeff./Std Dev.)
0	65.068105	5.4296E-04	119839.95
1	-53.237611	8.9118E-04	-59738.53
2	10.407966	7.9939E-04	13019.90
3	-1.204939	7.3094E-04	-1648.48
4	0.085708	7.0228E-04	122.04
5	0.003399	6.9219E-04	4.91
6	0.001126	6.7741E-04	1.66
7	-0.000788	6.5315E-04	-1.21

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

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

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

POLYNOMIAL EQUATION

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Sales Order: 42383
Serial Number: X49553
Temperature Range: 4.00K to 325K

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

	R Meas. (Ω)	T Meas. (K)	T Eq. (K)	T diff. (mK)
23	600.9251	21.12302	21.12297	0.06
24	569.2515	22.71714	22.71747	-0.33
25	541.2716	24.30302	24.30311	-0.09
26	516.0875	25.89631	25.89578	0.54
27	493.0863	27.50983	27.50861	1.22
28	472.1854	29.12335	29.12442	-1.08
29	450.9330	30.93516	30.93549	-0.33
30	428.6276	33.04621	33.04631	-0.10
31	400.6450	36.05191	36.05380	-1.89
32	376.3864	39.05096	39.05014	0.81
33	355.1849	42.02931	42.02743	1.87
34	336.2028	45.03328	45.03257	0.71
35	319.3514	48.01949	48.01832	1.18
36	308.9815	50.02585	50.02704	-1.19
37	286.0052	55.02506	55.02630	-1.24
38	266.3286	60.02779	60.03030	-2.51
39	249.3160	65.02491	65.02465	0.26
40	234.3885	70.02937	70.03013	-0.77
41	221.2443	75.02626	75.01838	7.88
42	209.4895	80.02482	80.02711	-2.29
43	198.9667	85.02219	85.02690	-4.71
44	189.4840	90.02078	90.01909	1.69
45	180.8659	95.01907	95.01828	0.79
46	172.9981	100.02175	100.02296	-1.21
47	159.1939	110.00977	110.00899	0.79
48	147.4179	120.00906	120.00899	0.07
49	137.2649	130.00270	130.00284	-0.15

Order of Fit = 7 RMS error of fit = 2.09 mK
Largest absolute error = 7.88 mK at data point no. 41



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Sales Order: 42383
Serial Number: X49553
Temperature Range: 4.00K to 325K

Polynomial Type: Chebychev
Useful Range of Fit:

110.K to 325.K
159.2 Ohms to 59.99 Ohms

Lower and Upper limits of Log(resistance) used in computing Chebychev coefficients:

ZL = 1.77231512747 ZU = 2.25735660311

Order	Coefficient	Std. Deviation of Coefficient	Ratio (Coeff./Std Dev.)
0	194.586313	1.2653E-03	153787.77
1	-115.030649	1.9619E-03	-58631.46
2	17.525422	1.7749E-03	9874.04
3	-2.426519	1.7203E-03	-1410.52
4	0.426457	1.7181E-03	248.22
5	-0.073985	1.7174E-03	-43.08
6	0.012090	1.6854E-03	7.17
7	-0.001894	1.6358E-03	-1.16
8	-0.000953	1.5946E-03	-0.60
9	0.002163	1.5569E-03	1.39

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

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

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

POLYNOMIAL EQUATION

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Sensor Type: Cernox Resistor

Sales Order: 42383
Serial Number: X49553
Temperature Range: 4.00K to 325K

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

	R Meas. (Ω)	T Meas. (K)	T Eq. (K)	T diff. (mK)
45	180.8659	95.01828	95.01844	-0.16
46	172.9981	100.02296	100.02240	0.56
47	159.1939	110.00899	110.01032	-1.33
48	147.4179	120.00906	120.00728	1.78
49	137.2649	130.00270	130.00409	-1.39
50	128.4222	140.00381	140.00038	3.44
51	120.6449	149.99873	150.00582	-7.08
52	113.7658	160.00584	160.00211	3.73
53	107.6321	170.00761	170.00610	1.50
54	102.1376	180.01078	180.00988	0.90
55	97.19387	190.00939	190.00920	0.19
56	92.71886	200.01988	200.02038	-0.50
57	88.65477	210.02950	210.03686	-7.36
58	84.96088	220.03033	220.02864	1.69
59	81.58097	230.03029	230.02773	2.56
60	78.47977	240.03883	240.03152	7.31
61	75.62827	250.03295	250.03328	-0.33
62	72.99905	260.03463	260.03527	-0.64
63	70.56727	270.03254	270.04540	-12.85
64	68.31883	280.03688	280.03820	-1.32
65	66.23118	290.04731	290.03431	13.00
66	64.28475	300.05750	300.05598	1.52
67	62.47156	310.07280	310.07490	-2.11
68	61.61011	315.08306	315.08810	-5.04
69	60.78014	320.08305	320.08361	-0.56
70	59.81980	326.07954	326.07777	1.77
71	59.19910	330.08095	330.08021	0.73

Order of Fit = 9 RMS error of fit = 4.62 mK
Largest absolute error = 13.00 mK at data point no. 65



INTERPOLATION TABLE

Calibration Report: 531611
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 Sensor Type: Cernox Resistor

Sales Order: 42383
 Serial Number: X49553
 Temperature Range: 4.00K to 325K

Temp (K)	Res. (Ω)	dR/dT (Ω/K)	dlogR/dlogT	Temp (K)	Res. (Ω)	dR/dT (Ω/K)	dlogR/dlogT
4.000	2559.02	-736.94	-1.1519	37.00	392.631	-8.2893	-0.78115
4.200	2420.68	-649.37	-1.1267	38.00	384.524	-7.9279	-0.78346
4.400	2298.29	-576.61	-1.1039	39.00	376.767	-7.5908	-0.78574
4.600	2189.27	-515.35	-1.0828	40.00	369.335	-7.2756	-0.78797
4.800	2091.54	-463.26	-1.0632	42.00	355.369	-6.7031	-0.79221
5.000	2003.48	-418.51	-1.0445	44.00	342.478	-6.1977	-0.79625
5.200	1923.73	-379.86	-1.0268	46.00	330.540	-5.7492	-0.80010
5.400	1851.20	-346.27	-1.0101	48.00	319.449	-5.3489	-0.80372
5.600	1784.93	-317.08	-0.99480	50.00	309.116	-4.9905	-0.80722
5.800	1724.14	-291.36	-0.98014	52.00	299.464	-4.6678	-0.81053
6.000	1668.18	-268.65	-0.96627	54.00	290.425	-4.3761	-0.81366
6.500	1545.91	-222.66	-0.93621	56.00	281.941	-4.1122	-0.81677
7.000	1443.71	-187.72	-0.91017	58.00	273.960	-3.8718	-0.81970
7.500	1356.88	-160.65	-0.88796	60.00	266.439	-3.6527	-0.82256
8.000	1282.13	-139.17	-0.86838	65.00	249.394	-3.1820	-0.82933
8.500	1216.99	-121.95	-0.85175	70.00	234.473	-2.7993	-0.83570
9.000	1159.67	-107.83	-0.83683	75.00	221.290	-2.4837	-0.84176
9.500	1108.75	-96.162	-0.82393	77.35	215.608	-2.3541	-0.84453
10.00	1063.19	-86.372	-0.81239	80.00	209.550	-2.2201	-0.84758
10.50	1022.12	-78.111	-0.80241	85.00	199.020	-1.9977	-0.85318
11.00	984.882	-71.043	-0.79346	90.00	189.518	-1.8080	-0.85861
11.50	950.914	-64.971	-0.78574	95.00	180.896	-1.6450	-0.86389
12.00	919.779	-59.696	-0.77883	100.0	173.033	-1.5035	-0.86894
12.50	891.105	-55.098	-0.77289	105.0	165.831	-1.3800	-0.87377
13.00	864.589	-51.051	-0.76760	110.0	159.207	-1.2719	-0.87881
13.50	839.974	-47.479	-0.76308	115.0	153.091	-1.1764	-0.88373
14.00	817.045	-44.301	-0.75910	120.0	147.426	-1.0910	-0.88803
14.50	795.615	-41.467	-0.75573	125.0	142.166	-1.0144	-0.89192
15.00	775.530	-38.921	-0.75280	130.0	137.269	-0.94564	-0.89556
15.50	756.651	-36.630	-0.75037	135.0	132.698	-0.88365	-0.89898
16.00	738.864	-34.556	-0.74830	140.0	128.422	-0.82754	-0.90215
16.50	722.063	-32.673	-0.74663	145.0	124.414	-0.77658	-0.90508
17.00	706.162	-30.957	-0.74526	150.0	120.649	-0.73012	-0.90774
17.50	691.081	-29.389	-0.74421	155.0	117.106	-0.68762	-0.91012
18.00	676.752	-27.950	-0.74342	160.0	113.767	-0.64860	-0.91218
18.50	663.112	-26.628	-0.74289	165.0	110.615	-0.61269	-0.91393
19.00	650.107	-25.408	-0.74257	170.0	107.636	-0.57956	-0.91535
19.50	637.688	-24.280	-0.74246	175.0	104.815	-0.54891	-0.91646
20.00	625.813	-23.234	-0.74252	180.0	102.143	-0.52051	-0.91727
21.00	603.540	-21.358	-0.74316	185.0	99.6069	-0.49415	-0.91779
22.00	583.016	-19.725	-0.74432	190.0	97.1982	-0.46964	-0.91803
23.00	564.023	-18.290	-0.74585	195.0	94.9077	-0.44681	-0.91803
24.00	546.378	-17.026	-0.74788	200.0	92.7275	-0.42552	-0.91778
25.00	529.923	-15.906	-0.75038	205.0	90.6502	-0.40564	-0.91732
26.00	514.529	-14.899	-0.75285	210.0	88.6690	-0.38704	-0.91665
27.00	500.093	-13.991	-0.75536	215.0	86.7778	-0.36962	-0.91578
28.00	486.518	-13.171	-0.75801	220.0	84.9710	-0.35329	-0.91471
29.00	473.726	-12.426	-0.76067	225.0	83.2433	-0.33795	-0.91346
30.00	461.645	-11.746	-0.76334	230.0	81.5899	-0.32353	-0.91202
31.00	450.214	-11.125	-0.76600	235.0	80.0066	-0.30995	-0.91041
32.00	439.379	-10.554	-0.76863	240.0	78.4891	-0.29715	-0.90861
33.00	429.091	-10.028	-0.77124	245.0	77.0339	-0.28507	-0.90663
34.00	419.309	-9.5431	-0.77381	250.0	75.6374	-0.27365	-0.90447
35.00	409.994	-9.0933	-0.77627	255.0	74.2964	-0.26285	-0.90214
36.00	401.111	-8.6766	-0.77873	260.0	73.0080	-0.25262	-0.89964



INTERPOLATION TABLE

Calibration Report: 531611
Sensor Model: CX-1050-SD-4L
Sensor Type: Cernox Resistor

Sales Order: 42383
Serial Number: X49553
Temperature Range: 4.00K 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>
265.0	71.7693	-0.24292	-0.89697	285.0	67.2634	-0.20884	-0.88486
270.0	70.5779	-0.23373	-0.89415	290.0	66.2381	-0.20135	-0.88153
273.15	69.8504	-0.22818	-0.89230	295.0	65.2493	-0.19423	-0.87812
275.0	69.4312	-0.22500	-0.89118	300.0	64.2952	-0.18745	-0.87465
280.0	68.3271	-0.21671	-0.88808	305.0	63.3742	-0.18101	-0.87113
				310.0	62.4847	-0.17487	-0.86759
				315.0	61.6250	-0.16904	-0.86405
				320.0	60.7938	-0.16348	-0.86053
				325.0	59.9897	-0.15820	-0.85706



THERMAL CYCLE TESTING

Sensor Model: CX-1050-SD-4L

Serial Number: X49553

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:

Room Temperature:	63.3 Ω
Liquid Nitrogen:	216 Ω
Liquid Helium:	2420 Ω

The nitrogen and helium values were recorded in OPEN dewars, so precision comparisons with calibration values or other dip 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: 531611

Sensor Model: CX-1050-SD-4L

Sensor Type: Cernox Resistor

Sales Order: 42383

Serial Number: X49553

Temperature Range: 4.00K to 325K

Name: CX-1050-SD-4L
Serial number: X49553
Format: 4 ;Log Ohms/Kelvin
Limit: 325.0
Coefficient: 1 ;Negative

Point 1: 1.77806,325.000	Point 56: 2.32357, 79.500	Point 111: 3.06225, 9.050
Point 2: 1.78502,319.000	Point 57: 2.33530, 77.000	Point 112: 3.07876, 8.650
Point 3: 1.79154,313.500	Point 58: 2.34738, 74.500	Point 113: 3.09630, 8.250
Point 4: 1.79820,308.000	Point 59: 2.35732, 72.500	Point 114: 3.11500, 7.850
Point 5: 1.80502,302.500	Point 60: 2.36749, 70.500	Point 115: 3.13247, 7.500
Point 6: 1.81199,297.000	Point 61: 2.37793, 68.500	Point 116: 3.15104, 7.150
Point 7: 1.81912,291.500	Point 62: 2.38864, 66.500	Point 117: 3.17090, 6.800
Point 8: 1.82642,286.000	Point 63: 2.39965, 64.500	Point 118: 3.19221, 6.450
Point 9: 1.83389,280.500	Point 64: 2.41096, 62.500	Point 119: 3.21520, 6.100
Point 10: 1.84154,275.000	Point 65: 2.42261, 60.500	Point 120: 3.23791, 5.780
Point 11: 1.84937,269.500	Point 66: 2.43400, 58.600	Point 121: 3.26089, 5.480
Point 12: 1.85740,264.000	Point 67: 2.44634, 56.600	Point 122: 3.28570, 5.180
Point 13: 1.86486,259.000	Point 68: 2.45910, 54.600	Point 123: 3.31268, 4.880
Point 14: 1.87249,254.000	Point 69: 2.47094, 52.800	Point 124: 3.34012, 4.600
Point 15: 1.88030,249.000	Point 70: 2.48314, 51.000	Point 125: 3.37001, 4.320
Point 16: 1.88828,244.000	Point 71: 2.49574, 49.200	Point 126: 3.40045, 4.060
Point 17: 1.89644,239.000	Point 72: 2.50876, 47.400	Point 127: 3.40812, 4.000
Point 18: 1.90480,234.000	Point 73: 2.52222, 45.600	
Point 19: 1.91335,229.000	Point 74: 2.53617, 43.800	
Point 20: 1.92210,224.000	Point 75: 2.55064, 42.000	
Point 21: 1.93106,219.000	Point 76: 2.56398, 40.400	
Point 22: 1.94025,214.000	Point 77: 2.57778, 38.800	
Point 23: 1.94965,209.000	Point 78: 2.59211, 37.200	
Point 24: 1.95930,204.000	Point 79: 2.60699, 35.600	
Point 25: 1.96919,199.000	Point 80: 2.62151, 34.100	
Point 26: 1.97933,194.000	Point 81: 2.63658, 32.600	
Point 27: 1.98974,189.000	Point 82: 2.65230, 31.100	
Point 28: 2.00043,184.000	Point 83: 2.66759, 29.700	
Point 29: 2.01030,179.500	Point 84: 2.68353, 28.300	
Point 30: 2.02041,175.000	Point 85: 2.70021, 26.900	
Point 31: 2.03077,170.500	Point 86: 2.71642, 25.600	
Point 32: 2.04140,166.000	Point 87: 2.73339, 24.300	
Point 33: 2.05230,161.500	Point 88: 2.74984, 23.100	
Point 34: 2.06349,157.000	Point 89: 2.76708, 21.900	
Point 35: 2.07498,152.500	Point 90: 2.78527, 20.700	
Point 36: 2.08679,148.000	Point 91: 2.79965, 19.800	
Point 37: 2.09893,143.500	Point 92: 2.81126, 19.100	
Point 38: 2.11142,139.000	Point 93: 2.82243, 18.450	
Point 39: 2.12428,134.500	Point 94: 2.83400, 17.800	
Point 40: 2.13606,130.500	Point 95: 2.84603, 17.150	
Point 41: 2.14815,126.500	Point 96: 2.85756, 16.550	
Point 42: 2.16059,122.500	Point 97: 2.86954, 15.950	
Point 43: 2.17339,118.500	Point 98: 2.88203, 15.350	
Point 44: 2.18659,114.500	Point 99: 2.89396, 14.800	
Point 45: 2.20020,110.500	Point 100: 2.90638, 14.250	
Point 46: 2.21424,106.500	Point 101: 2.91935, 13.700	
Point 47: 2.22876,102.500	Point 102: 2.93294, 13.150	
Point 48: 2.24000, 99.500	Point 103: 2.94589, 12.650	
Point 49: 2.24959, 97.000	Point 104: 2.95943, 12.150	
Point 50: 2.25939, 94.500	Point 105: 2.97367, 11.650	
Point 51: 2.26943, 92.000	Point 106: 2.98714, 11.200	
Point 52: 2.27971, 89.500	Point 107: 3.00127, 10.750	
Point 53: 2.29025, 87.000	Point 108: 3.01616, 10.300	
Point 54: 2.30106, 84.500	Point 109: 3.03189, 9.850	
Point 55: 2.31217, 82.000	Point 110: 3.04667, 9.450	



BREAKPOINTS 91C/93C/330 FORMAT

Calibration Report: 531611
 Sensor Model: CX-1050-SD-4L
 Sensor Type: Cernox Resistor

Sales Order: 42383
 Serial Number: X49553
 Temperature Range: 4.00K to 325K

Interpolation Method: Lagrangian
 Limit: 325.0 (Kelvin)
 Format: 4 (Log Ohms/Kelvin)
 Number of Breakpoints: 46

No.	Units	Temperature (K)	No.	Units	Temperature (K)
1	1.77808	325.0	26	2.64598	31.7
2	1.77922	324.0	27	2.68476	28.2
3	1.78976	315.0	28	2.72421	25.0
4	1.80818	300.0	29	2.76275	22.2
5	1.82778	285.0	30	2.80132	19.7
6	1.84867	270.0	31	2.83953	17.5
7	1.87097	255.0	32	2.87890	15.5
8	1.89481	240.0	33	2.91699	13.8
9	1.92035	225.0	34	2.95535	12.3
10	1.94777	210.0	35	2.99338	11.0
11	1.97730	195.0	36	3.03016	9.9
12	2.00921	180.0	37	3.06840	8.9
13	2.04381	165.0	38	3.10793	8.0
14	2.08152	150.0	39	3.14301	7.3
15	2.12286	135.0	40	3.18299	6.6
16	2.16857	120.0	41	3.21533	6.1
17	2.21966	105.0	42	3.25162	5.6
18	2.27765	90.0	43	3.28414	5.2
19	2.34496	75.0	44	3.32047	4.8
20	2.41098	62.5	45	3.36140	4.4
21	2.44700	56.5	46	3.40807	4.0
22	2.49012	50.0			
23	2.52685	45.0			
24	2.56742	40.0			
25	2.60609	35.7			

Temperature for Resistance Decades:

Res. (Ohms)	Temp. (K)
100	184.208
1000	10.791



BREAKPOINTS 234 FORMAT

Calibration Report: 531611
 Sensor Model: CX-1050-SD-4L
 Sensor Type: Cernox Resistor

Sales Order: 42383
 Serial Number: X49553
 Temperature Range: 4.00K to 325K

Maximum Temperature Error:

1.4 - 10K: 0.016K
 10 - 20K: 0.011K
 20 - 40K: 0.009K
 40 - 100K: 0.019K
 > 100K: 0.084K

<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	323.327	60.25596	1.780	41	38.553	380.1894	2.580
2	306.547	63.09573	1.800	42	36.349	398.1072	2.600
3	290.841	66.06934	1.820	43	34.257	416.8694	2.620
4	276.105	69.18310	1.840	44	32.274	436.5158	2.640
5	262.254	72.44360	1.860	45	30.392	457.0882	2.660
6	249.197	75.85776	1.880	46	28.610	478.6301	2.680
7	236.867	79.43282	1.900	47	26.922	501.1872	2.700
8	225.198	83.17638	1.920	48	25.325	524.8075	2.720
9	214.141	87.09636	1.940	49	23.815	549.5409	2.740
10	203.650	91.20108	1.960	50	22.390	575.4399	2.760
11	193.685	95.49926	1.980	51	21.046	602.5596	2.780
12	184.208	100.0000	2.000	52	19.781	630.9573	2.800
13	175.187	104.7129	2.020	53	18.591	660.6934	2.820
14	166.594	109.6478	2.040	54	17.474	691.8310	2.840
15	158.399	114.8154	2.060	55	16.428	724.4360	2.860
16	150.581	120.2264	2.080	56	15.447	758.5776	2.880
17	143.119	125.8925	2.100	57	14.531	794.3282	2.900
18	135.995	131.8257	2.120	58	13.675	831.7638	2.920
19	129.190	138.0384	2.140	59	12.876	870.9636	2.940
20	122.694	144.5440	2.160	60	12.132	912.0108	2.960
21	116.492	151.3561	2.180	61	11.437	954.9926	2.980
22	110.567	158.4893	2.200	62	10.791	1000.000	3.000
23	104.907	165.9587	2.220	63	9.630	1096.478	3.040
24	99.505	173.7801	2.240	64	8.622	1202.264	3.080
25	94.351	181.9701	2.260	65	7.749	1318.257	3.120
26	89.435	190.5461	2.280	66	6.991	1445.440	3.160
27	84.747	199.5262	2.300	67	6.330	1584.893	3.200
28	80.280	208.9296	2.320	68	5.754	1737.801	3.240
29	76.025	218.7762	2.340	69	5.249	1905.461	3.280
30	71.972	229.0868	2.360	70	4.805	2089.296	3.320
31	68.111	239.8833	2.380	71	4.413	2290.868	3.360
32	64.441	251.1886	2.400	72	4.065	2511.886	3.400
33	60.947	263.0268	2.420	73	3.757	2754.229	3.440
34	57.624	275.4229	2.440				
35	54.465	288.4032	2.460				
36	51.462	301.9952	2.480				
37	48.609	316.2278	2.500				
38	45.898	331.1311	2.520				
39	43.322	346.7369	2.540				
40	40.876	363.0781	2.560				

