Certificate of Calibration
Report Number: 1323944

Sensor Model: DT-670-CU-1.4L	Serial Number: D6121829
Sensor Type: Silicon Diode	Calibration Date: May 18, 2022
Sensor Excitation: see *Test Data* page of report	Calibration Due:
Temperature Range: 1.40 K to 325 K	

Traceability and Calibration Method

This temperature sensor has been calibrated to the International Temperature Scale of 1990 (ITS-90) or the Provisional Low Temperature Scale (PLTS-2000) as appropriate. The calibrations are traceable to the National Institute of Standards and Technology (NIST, United States), the National Physical Laboratory (NPL, United Kingdom), the Physikalisch-Technische Bundesanstalt (PTB, Germany), or natural physical constants.

Lake Shore Cryotronics maintains ITS-90 and PLTS-2000 on standard platinum (PRT), rhodium-iron (RIRT), and germanium (GRT) resistance thermometers that have been calibrated directly by an internationally recognized national metrology institute (NIST, NPL, PTB) for T < 330 K or an ISO 17025 accredited metrology laboratory for 330 K < T < 800 K. A nuclear orientation thermometer is also used for temperatures less than 50 mK. These standards are routinely intercompared to verify consistency and accuracy of the temperature scale.

The sensor calibrations are performed by comparison to laboratory standard resistance thermometers and tested in accordance with Lake Shore Cryotronics, Inc. Quality Assurance Manual (QP-4220). The quality system of Lake Shore Cryotronics is registered to ISO 9001.

Procedures used: 021-97-02, 099-00-00, 121-96-02, 029-95-02

Notes
The calibration results in this report apply only to the specific sensor specified above.

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

Reported by: Matt Vance
Calibration Engineer/Technician

Approved by: Romerero Prince
Metrology

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DATA PLOT

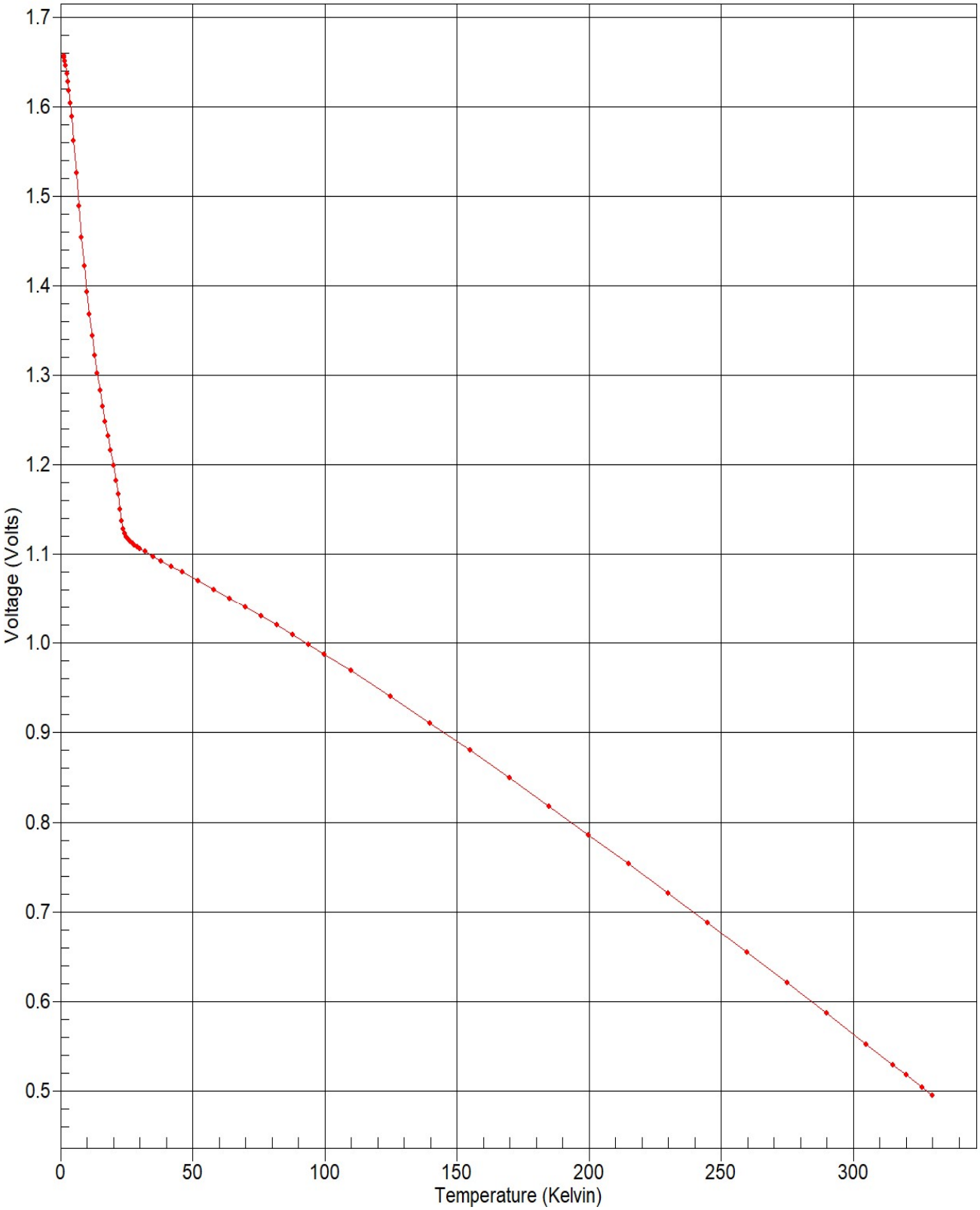
Calibration Report: 1323944

Sensor Model: DT-670-CU-1.4L

Serial Number: D6121829

Sensor Type: Silicon Diode

Temperature Range: 1.40 K to 325 K



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TEST DATA

Calibration Report: 1323944

Sensor Model: DT-670-CU-1.4L

Serial Number: D6121829

Sensor Type: Silicon Diode

Temperature Range: 1.40 K to 325 K

Index	Temp. (K)	Voltage (V)	Excitation	Index	Temp. (K)	Voltage (V)	Excitation
1	1.19651	1.65701	10µA±0.1%	41	34.9920	1.09763	10µA±0.1%
2	1.29735	1.65597	10µA±0.1%	42	37.9957	1.09270	10µA±0.1%
3	1.39884	1.65479	10µA±0.1%	43	41.9919	1.08632	10µA±0.1%
4	1.69722	1.65056	10µA±0.1%	44	45.9835	1.07996	10µA±0.1%
5	1.99949	1.64526	10µA±0.1%	45	51.9765	1.07030	10µA±0.1%
6	2.40043	1.63691	10µA±0.1%	46	57.9744	1.06051	10µA±0.1%
7	2.79954	1.62751	10µA±0.1%	47	63.9689	1.05058	10µA±0.1%
8	3.20149	1.61730	10µA±0.1%	48	69.9530	1.04051	10µA±0.1%
9	3.70333	1.60357	10µA±0.1%	49	75.9457	1.03025	10µA±0.1%
10	4.20190	1.58854	10µA±0.1%	50	81.9429	1.01982	10µA±0.1%
11	5.00148	1.56183	10µA±0.1%	51	87.9322	1.00922	10µA±0.1%
12	5.99974	1.52592	10µA±0.1%	52	93.9293	0.998433	10µA±0.1%
13	7.00494	1.48898	10µA±0.1%	53	99.9273	0.987469	10µA±0.1%
14	8.00176	1.45403	10µA±0.1%	54	109.905	0.968867	10µA±0.1%
15	9.00525	1.42204	10µA±0.1%	55	124.899	0.940117	10µA±0.1%
16	10.0029	1.39344	10µA±0.1%	56	139.888	0.910533	10µA±0.1%
17	11.0012	1.36752	10µA±0.1%	57	154.897	0.880192	10µA±0.1%
18	11.9995	1.34382	10µA±0.1%	58	169.894	0.849268	10µA±0.1%
19	12.9994	1.32198	10µA±0.1%	59	184.893	0.817814	10µA±0.1%
20	14.0008	1.30178	10µA±0.1%	60	199.881	0.785918	10µA±0.1%
21	14.9999	1.28301	10µA±0.1%	61	214.885	0.753552	10µA±0.1%
22	15.9992	1.26535	10µA±0.1%	62	229.889	0.720789	10µA±0.1%
23	17.0006	1.24846	10µA±0.1%	63	244.889	0.687662	10µA±0.1%
24	17.9987	1.23220	10µA±0.1%	64	259.892	0.654187	10µA±0.1%
25	19.0000	1.21616	10µA±0.1%	65	274.895	0.620396	10µA±0.1%
26	20.0857	1.19863	10µA±0.1%	66	289.906	0.586321	10µA±0.1%
27	21.0546	1.18222	10µA±0.1%	67	304.911	0.552046	10µA±0.1%
28	21.8320	1.16756	10µA±0.1%	68	314.957	0.529015	10µA±0.1%
29	22.6233	1.15039	10µA±0.1%	69	319.974	0.517500	10µA±0.1%
30	23.2181	1.13755	10µA±0.1%	70	325.970	0.503723	10µA±0.1%
31	23.8185	1.12838	10µA±0.1%	71	329.984	0.494489	10µA±0.1%
32	24.4166	1.12302	10µA±0.1%				
33	25.0137	1.11964	10µA±0.1%				
34	25.6143	1.11717	10µA±0.1%				
35	26.4059	1.11462	10µA±0.1%				
36	27.2024	1.11250	10µA±0.1%				
37	27.9981	1.11063	10µA±0.1%				
38	28.9949	1.10850	10µA±0.1%				
39	29.9939	1.10652	10µA±0.1%				
40	31.9958	1.10281	10µA±0.1%				

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Calibration Data Uncertainty

The uncertainties of the measured calibration data for Lake Shore's sensors are summarized in the table below. The values given are the combined uncertainty of the temperature measurement and the resistance or voltage measurement expressed as an equivalent temperature uncertainty in millikelvin (mK). Note that the values are the calibration uncertainty only and do not include the stability of the temperature sensor. The uncertainty analysis has followed the guidelines for determining measurement uncertainty as outlined in the ISO Guide to the Expression of Uncertainty in Measurement, NIST Technical Note 1297, and ANSI/NCSL Z540-2-1997. Since the uncertainty varies with temperature due to the variation of the sensor sensitivity and excitation, the table gives typical values at several different temperatures throughout the range of the calibration. The uncertainty is based on an approximate 95% confidence level with a coverage factor k = 2.

T (K)	Uncertainty (± mK)												
	GR	Cernox (CX)					RX			Platinum		RF-800	Diode
		1010	1030	1050	1070	1080	102A	103A	202A	100 Ω	25 Ω	27 Ω	
1.4	4	4	4	4			4	4	4			5	7
4.2	4	4	4	4	4		4	6	5			5	5
10	4	5	5	4	4		10	15	12			7	6
20	8	10	9	8	8	8	35	35	28	9	10	13	9
30	9	13	11	9	9	9	76	61	46	9	9	14	31
50	11	18	14	12	12	11				10	10	13	37
100	20	29	22	17	16	14				11	12	12	32
300		78	60	46	45	36				24	24	25	35
400		124	94	74	72	60				45	45	45	49
500										51	51		54

Polynomial Fit Uncertainty

When a sensor is used to measure temperature, a polynomial fit to the measured calibration data is often used to convert the sensor resistance (R) or voltage (V) to a temperature (T). How well the polynomial represents the sensor calibration data is another source of uncertainty when using the sensor. In the polynomials provided with this set of calibration data, the standard deviation of the fit can be used as an estimate of this additional temperature uncertainty. The standard deviation of fit is determined from the following equation:

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

where

σ_{fit} = standard deviation of the fit
T_i = measured temperature for point i
T_{icalc} = the temperature calculated from the polynomial equation for point i
N = number of data points in fit range
n = number of fit coefficients
ΔT_{RMS} = root mean square deviation of fit

A value of ΔT_{RMS} is given for each range of fit.

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POLYNOMIAL EQUATION

Calibration Report: 1323944

Sensor Model: DT-670-CU-1.4L | Serial Number: D6121829

Sensor Type: Silicon Diode | Temperature Range: 1.40 K to 325 K

Polynomial Type: Chebychev

Useful Range of Fit:

1.40 K	to	12.0 K
1.655 volts	to	1.344 volts

Lower and Upper limits of Voltage used in computing Chebychev coefficients:

ZL = 1.301775653 ZU = 1.657009029

Order	Coefficient	Std. Deviation of Coefficient	Ratio (Coeff./Std Dev.)
0	7.536505	2.5877E-03	2912.38
1	-5.972814	3.8129E-03	-1566.46
2	0.198324	3.8546E-03	51.45
3	-0.361908	3.5765E-03	-101.19
4	-0.082689	3.3916E-03	-24.38
5	-0.034168	3.3015E-03	-10.35
6	-0.022058	3.2559E-03	-6.77
7	-0.016963	3.2886E-03	-5.16
8	-0.012756	3.4027E-03	-3.75
9	-0.009145	3.6477E-03	-2.51
10	-0.011953	3.6204E-03	-3.30

Z = Voltage

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

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

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POLYNOMIAL EQUATION

Calibration Report: 1323944
Sensor Model: DT-670-CU-1.4L
Serial Number: D6121829
Sensor Type: Silicon Diode
Temperature Range: 1.40 K to 325 K

Polynomial Type: Chebychev
Temp. (K) vs. Voltage

	V Meas. (V)	T Meas. (K)	T Eq. (K)	T diff. (mK)
1	1.657009	1.19651	1.21037	-13.87
2	1.655969	1.29735	1.29611	1.25
3	1.654788	1.39884	1.38890	9.93
4	1.650560	1.69722	1.68634	10.88
5	1.645259	1.99949	2.00016	-0.67
6	1.636911	2.40043	2.40996	-9.53
7	1.627508	2.79954	2.80524	-5.70
8	1.617300	3.20149	3.19770	3.79
9	1.603572	3.70333	3.69442	8.91
10	1.588541	4.20190	4.20272	-0.82
11	1.561835	5.00148	5.01098	-9.50
12	1.525918	5.99974	5.99137	8.36
13	1.488979	7.00494	7.00701	-2.08
14	1.454034	8.00176	8.00643	-4.67
15	1.422037	9.00525	8.99927	5.98
16	1.393435	10.00294	10.00343	-0.49
17	1.367520	11.00122	11.00647	-5.25
18	1.343816	11.99947	11.99403	5.44
19	1.321982	12.99938	13.00177	-2.39
20	1.301776	14.00078	14.00037	0.41

Order of Fit = 10 RMS error of fit = 6.76 mK
Largest absolute error = -13.87 mK at data point no. 1

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POLYNOMIAL EQUATION

Calibration Report: 1323944

Sensor Model: DT-670-CU-1.4L | Serial Number: D6121829

Sensor Type: Silicon Diode | Temperature Range: 1.40 K to 325 K

Polynomial Type: Chebychev

Useful Range of Fit:

12.0 K	to	25.0 K
1.344 volts	to	1.120 volts

Lower and Upper limits of Voltage used in computing Chebychev coefficients:

ZL = 1.114623308 ZU = 1.393435328

Order	Coefficient	Std. Deviation of Coefficient	Ratio (Coeff./Std Dev.)
0	17.121899	9.2691E-03	1847.20
1	-7.758740	1.6808E-02	-461.60
2	0.508041	1.4265E-02	35.62
3	-0.030176	1.1290E-02	-2.67
4	0.192821	8.0149E-03	24.06
5	-0.255372	6.8137E-03	-37.48
6	0.215179	8.6831E-03	24.78
7	-0.120235	1.1853E-02	-10.14
8	0.109794	1.3052E-02	8.41
9	-0.029036	1.2877E-02	-2.25
10	0.048921	1.0297E-02	4.75

Z = Voltage

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

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

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POLYNOMIAL EQUATION

Calibration Report: 1323944

Sensor Model: DT-670-CU-1.4L Serial Number: D6121829

Sensor Type: Silicon Diode Temperature Range: 1.40 K to 325 K

Polynomial Type: Chebychev

Temp. (K) vs. Voltage

	V Meas. (V)	T Meas. (K)	T Eq. (K)	T diff. (mK)
16	1.393435	10.00343	10.00310	-0.16
17	1.367520	11.00647	10.99945	1.77
18	1.343816	11.99403	12.00721	-7.74
19	1.321982	12.99938	12.98380	15.58
20	1.301776	14.00078	14.01138	-10.59
21	1.283012	14.99990	15.00878	-8.88
22	1.265346	15.99921	15.98880	10.41
23	1.248459	17.00064	16.99010	10.54
24	1.232203	17.99869	18.00551	-6.82
25	1.216164	18.99996	19.01484	-14.89
26	1.198633	20.08565	20.08167	3.99
27	1.182221	21.05459	21.03501	19.58
28	1.167557	21.83197	21.83773	-5.76
29	1.150389	22.62328	22.64990	-26.61
30	1.137553	23.21809	23.19747	20.62
31	1.128378	23.81847	23.79627	22.20
32	1.123017	24.41664	24.43031	-13.67
33	1.119643	25.01365	25.03386	-20.20
34	1.117175	25.61430	25.61933	-5.03
35	1.114623	26.40588	26.39022	15.67

Order of Fit = 10 RMS error of fit = 13.98 mK

Largest absolute error = -26.61 mK at data point no. 29

POLYNOMIAL EQUATION

Calibration Report: 1323944
Sensor Model: DT-670-CU-1.4L
Serial Number: D6121829
Sensor Type: Silicon Diode
Temperature Range: 1.40 K to 325 K

Polynomial Type: Chebychev
Useful Range of Fit:

25.0 K	to	87.9 K
1.120 volts	to	1.009 volts

Lower and Upper limits of Voltage used in computing Chebychev coefficients:

ZL = 0.9874692421 ZU = 1.128377658

Order	Coefficient	Std. Deviation of Coefficient	Ratio (Coeff./Std Dev.)
0	59.903145	9.5303E-03	6285.55
1	-39.870845	1.6703E-02	-2386.99
2	1.119975	1.5974E-02	70.11
3	1.542874	1.1379E-02	135.59
4	0.880766	8.3754E-03	105.16
5	0.362607	3.8815E-03	93.42
6	0.071538	4.3265E-03	16.53
7	-0.044263	7.9989E-03	-5.53
8	-0.069001	1.1383E-02	-6.06
9	-0.038902	1.2274E-02	-3.17
10	-0.026271	1.2721E-02	-2.07
11	-0.006435	9.9136E-03	-0.65
12	-0.007765	7.1210E-03	-1.09

Z = Voltage

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

Temp. (K) = ΣA_i* COS(i * ARCCOS(k)), where 0 <= i <= 12
and the A_i's are the coefficients in the table above.

POLYNOMIAL EQUATION

Calibration Report: 1323944

Sensor Model: DT-670-CU-1.4L Serial Number: D6121829

Sensor Type: Silicon Diode Temperature Range: 1.40 K to 325 K

Polynomial Type: Chebychev

Temp. (K) vs. Voltage

	V Meas. (V)	T Meas. (K)	T Eq. (K)	T diff. (mK)
31	1.128378	23.79627	23.81742	1.05
32	1.123017	24.43031	24.42688	-10.24
33	1.119643	25.03386	24.99805	15.61
34	1.117175	25.61430	25.60675	7.55
35	1.114623	26.40588	26.41379	-7.90
36	1.112498	27.20235	27.21499	-12.64
37	1.110630	27.99807	28.00627	-8.20
38	1.108504	28.99493	28.99319	1.73
39	1.106523	29.99390	29.98317	10.73
40	1.102815	31.99578	31.98316	12.63
41	1.097635	34.99198	34.99780	-5.82
42	1.092703	37.99572	38.00702	-11.30
43	1.086323	41.99187	41.98758	4.29
44	1.079959	45.98349	45.97734	6.15
45	1.070300	51.97651	51.98077	-4.26
46	1.060506	57.97439	57.97526	-0.87
47	1.050579	63.96888	63.96601	2.87
48	1.040506	69.95298	69.95475	-1.77
49	1.030253	75.94565	75.94534	0.31
50	1.019818	81.94291	81.94272	0.19
51	1.009220	87.93218	87.93232	-0.14
52	0.9984328	93.92930	93.92926	0.03
53	0.9874692	99.92735	99.92735	0.00

Order of Fit = 12 RMS error of fit = 7.29 mK

Largest absolute error = 15.61 mK at data point no. 33

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POLYNOMIAL EQUATION

Calibration Report: 1323944
Sensor Model: DT-670-CU-1.4L
Serial Number: D6121829
Sensor Type: Silicon Diode
Temperature Range: 1.40 K to 325 K

Polynomial Type: Chebychev
Useful Range of Fit:

87.9 K	to	325 K
1.009 volts	to	0.5060 volts

Lower and Upper limits of Voltage used in computing Chebychev coefficients:
ZL = 0.4944888555 ZU = 1.030253241

Order	Coefficient	Std. Deviation of Coefficient	Ratio (Coeff./Std Dev.)
0	207.102283	1.4675E-04	1411244.70
1	-126.057665	2.1204E-04	-594499.07
2	-3.912104	2.0745E-04	-18857.99
3	-0.882415	2.1458E-04	-4112.26
4	-0.213815	2.1352E-04	-1001.37
5	-0.083158	2.0506E-04	-405.53
6	-0.012872	1.9738E-04	-65.21
7	0.002275	1.9717E-04	11.54
8	0.001817	1.9979E-04	9.09
9	0.001339	1.9956E-04	6.71

Z = Voltage

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

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

POLYNOMIAL EQUATION

Calibration Report: 1323944

Sensor Model: DT-670-CU-1.4L Serial Number: D6121829

Sensor Type: Silicon Diode Temperature Range: 1.40 K to 325 K

Polynomial Type: Chebychev

Temp. (K) vs. Voltage

	V Meas. (V)	T Meas. (K)	T Eq. (K)	T diff. (mK)
49	1.030253	75.94534	75.94569	-0.03
50	1.019818	81.94272	81.94304	-0.13
51	1.009220	87.93232	87.93210	0.08
52	0.9984328	93.92930	93.92869	0.61
53	0.9874692	99.92735	99.92770	-0.35
54	0.9688673	109.90510	109.90556	-0.46
55	0.9401173	124.89888	124.89887	0.01
56	0.9105335	139.88806	139.88754	0.52
57	0.8801920	154.89727	154.89707	0.19
58	0.8492681	169.89364	169.89421	-0.58
59	0.8178142	184.89277	184.89329	-0.53
60	0.7859181	199.88050	199.87970	0.81
61	0.7535520	214.88533	214.88506	0.27
62	0.7207889	229.88892	229.88927	-0.35
63	0.6876616	244.88927	244.88980	-0.52
64	0.6541868	259.89245	259.89164	0.81
65	0.6203959	274.89453	274.89526	-0.73
66	0.5863211	289.90607	289.90547	0.60
67	0.5520459	304.91143	304.91135	0.08
68	0.5290151	314.95730	314.95827	-0.97
69	0.5175001	319.97431	319.97398	0.33
70	0.5037233	325.97034	325.96951	0.83
71	0.4944889	329.98444	329.98493	-0.49

Order of Fit = 9 RMS error of fit = 0.52 mK

Largest absolute error = -0.97 mK at data point no. 68

INTERPOLATION TABLE

Calibration Report: 1323944

Sensor Model: DT-670-CU-1.4L Serial Number: D6121829

Sensor Type: Silicon Diode Temperature Range: 1.40 K to 325 K

Temp (K)	Volts (V)	dV/dT (mV/K)	Temp (K)	Volts (V)	dV/dT (mV/K)
1.400	1.65477	-12.324	15.50	1.27405	-17.665
1.500	1.65348	-13.605	16.00	1.26533	-17.228
1.600	1.65206	-14.817	16.50	1.25681	-16.855
1.700	1.65052	-15.960	17.00	1.24847	-16.532
1.800	1.64886	-17.046	17.50	1.24027	-16.275
1.900	1.64711	-18.085	18.00	1.23218	-16.096
2.000	1.64525	-19.078	18.50	1.22416	-16.003
2.100	1.64329	-20.011	19.00	1.21616	-16.001
2.200	1.64125	-20.871	19.50	1.20814	-16.108
2.300	1.63912	-21.659	20.00	1.20004	-16.340
2.400	1.63692	-22.374	21.00	1.18319	-17.611
2.500	1.63465	-23.021	22.00	1.16408	-21.028
2.600	1.63232	-23.603	23.00	1.14199	-21.390
2.700	1.62993	-24.120	24.00	1.12643	-9.8273
2.800	1.62750	-24.572	25.00	1.11971	-4.7309
2.900	1.62502	-24.989	26.00	1.11586	-3.2141
3.000	1.62250	-25.398	27.00	1.11301	-2.5644
3.100	1.61994	-25.799	28.00	1.11063	-2.2346
3.200	1.61734	-26.194	29.00	1.10849	-2.0450
3.300	1.61470	-26.605	30.00	1.10651	-1.9279
3.400	1.61202	-27.058	31.00	1.10463	-1.8489
3.500	1.60929	-27.553	32.00	1.10281	-1.7906
3.600	1.60651	-28.091	33.00	1.10104	-1.7459
3.700	1.60367	-28.671	34.00	1.09931	-1.7078
3.800	1.60077	-29.269	35.00	1.09762	-1.6765
3.900	1.59781	-29.856	36.00	1.09596	-1.6509
4.000	1.59480	-30.432	37.00	1.09432	-1.6300
4.200	1.58860	-31.551	38.00	1.09270	-1.6138
4.400	1.58218	-32.582	39.00	1.09109	-1.6019
4.600	1.57558	-33.481	40.00	1.08949	-1.5939
4.800	1.56880	-34.247	42.00	1.08631	-1.5896
5.000	1.56189	-34.880	44.00	1.08313	-1.5941
5.200	1.55486	-35.408	46.00	1.07993	-1.6007
5.400	1.54773	-35.860	48.00	1.07672	-1.6083
5.600	1.54052	-36.236	50.00	1.07350	-1.6155
5.800	1.53324	-36.535	52.00	1.07026	-1.6224
6.000	1.52591	-36.758	54.00	1.06701	-1.6293
6.500	1.50747	-36.867	56.00	1.06374	-1.6364
7.000	1.48916	-36.273	58.00	1.06046	-1.6439
7.500	1.47129	-35.130	60.00	1.05717	-1.6518
8.000	1.45409	-33.597	65.00	1.04886	-1.6742
8.500	1.43772	-31.890	70.00	1.04043	-1.6972
9.000	1.42220	-30.227	75.00	1.03188	-1.7206
9.500	1.40748	-28.657	77.35	1.02783	-1.7322
10.00	1.39352	-27.230	80.00	1.02322	-1.7453
10.50	1.38023	-25.943	85.00	1.01443	-1.7698
11.00	1.36755	-24.789	90.00	1.00552	-1.7941
11.50	1.35542	-23.736	95.00	0.996488	-1.8187
12.00	1.34380	-22.747	100.0	0.987335	-1.8423
12.50	1.33266	-21.824	105.0	0.978068	-1.8648
13.00	1.32197	-20.964	110.0	0.968688	-1.8868
13.50	1.31169	-20.168	115.0	0.959201	-1.9080
14.00	1.30179	-19.434	120.0	0.949610	-1.9282
14.50	1.29224	-18.768	125.0	0.939920	-1.9474
15.00	1.28301	-18.178	130.0	0.930137	-1.9656

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INTERPOLATION TABLE

Calibration Report: 1323944

Sensor Model: DT-670-CU-1.4L Serial Number: D6121829

Sensor Type: Silicon Diode Temperature Range: 1.40 K to 325 K

Temp (K)	Volts (V)	dV/dT (mV/K)	Temp (K)	Volts (V)	dV/dT (mV/K)
135.0	0.920266	-1.9829	235.0	0.709542	-2.2047
140.0	0.910310	-1.9993	240.0	0.698498	-2.2126
145.0	0.900274	-2.0147	245.0	0.687416	-2.2202
150.0	0.890164	-2.0294	250.0	0.676296	-2.2277
155.0	0.879982	-2.0432	255.0	0.665139	-2.2351
160.0	0.869733	-2.0563	260.0	0.653946	-2.2424
165.0	0.859420	-2.0687	265.0	0.642716	-2.2494
170.0	0.849047	-2.0806	270.0	0.631452	-2.2559
175.0	0.838615	-2.0919	273.15	0.624340	-2.2597
180.0	0.828128	-2.1028	275.0	0.620157	-2.2619
185.0	0.817588	-2.1133	280.0	0.608834	-2.2674
190.0	0.806996	-2.1234	285.0	0.597483	-2.2727
195.0	0.796353	-2.1334	290.0	0.586107	-2.2777
200.0	0.785662	-2.1432	295.0	0.574707	-2.2824
205.0	0.774922	-2.1527	300.0	0.563284	-2.2865
210.0	0.764135	-2.1620	305.0	0.551843	-2.2900
215.0	0.753303	-2.1709	310.0	0.540386	-2.2928
220.0	0.742427	-2.1796	315.0	0.528917	-2.2944
225.0	0.731507	-2.1882	320.0	0.517441	-2.2962
230.0	0.720545	-2.1966	325.0	0.505954	-2.2987

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THERMAL CYCLE TESTING

Calibration Report: 1323944
Sensor Model: DT-670-CU-1.4L Serial Number: D6121829
Sensor Type: Silicon Diode

This sensor was tested for repeatability through rapid thermal cycles from room temperature into liquid helium. During this test, the following four lead voltage values were recorded:

Approximately 305 K:	0.552 V
Liquid Nitrogen:	1.028 V
Liquid Helium:	1.589 V

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 diode sensors calibrated by Lake Shore, the current is maintained at the constant values listed on the Test Data page. In order to minimize calibration offsets due to the nonlinear voltage-current relationship in the diode sensor, these same guidelines should be followed in using the sensor.

BREAKPOINTS CUBIC SPLINE FORMAT

Calibration Report: 1323944

Sensor Model: DT-670-CU-1.4L Serial Number: D6121829

Sensor Type: Silicon Diode Temperature Range: 1.40 K to 325 K

Sensor Model: DT-670-CU-1.4L
Serial Number: D6121829
Data Format: 6 (Volts/Kelvin)
Setpoint Limit: 325

Measurement (V)	Temp (K)	Curvature	Measurement (V)	Temp (K)	Curvature
4.94489E-01	3.29984E+02	-5.36413E+01	1.39344E+00	1.00029E+01	1.35056E+02
5.03723E-01	3.25970E+02	-4.75597E+01	1.42204E+00	9.00525E+00	1.18930E+02
5.17500E-01	3.19974E+02	-3.84865E+01	1.45403E+00	8.00176E+00	8.88124E+01
5.29015E-01	3.14957E+02	-1.84455E+01	1.48898E+00	7.00494E+00	3.78762E+01
5.52046E-01	3.04911E+02	-5.52217E+01	1.52592E+00	5.99974E+00	-1.81840E+01
5.86321E-01	2.89906E+02	-8.26279E+01	1.56183E+00	5.00148E+00	-6.22570E+01
6.20396E-01	2.74895E+02	-9.82220E+01	1.58854E+00	4.20190E+00	-1.65857E+02
6.54187E-01	2.59892E+02	-1.29809E+02	1.60357E+00	3.70333E+00	-2.57076E+02
6.87662E-01	2.44889E+02	-1.36370E+02	1.61730E+00	3.20149E+00	-2.20860E+02
7.20789E-01	2.29889E+02	-1.56613E+02	1.62751E+00	2.79954E+00	-2.78227E+02
7.53552E-01	2.14885E+02	-1.72182E+02	1.63691E+00	2.40043E+00	-5.56974E+02
7.85918E-01	1.99881E+02	-1.96760E+02	1.64526E+00	1.99949E+00	-1.32838E+03
8.17814E-01	1.84893E+02	-2.16747E+02	1.65056E+00	1.69722E+00	-2.46862E+03
8.49268E-01	1.69894E+02	-2.56384E+02	1.65479E+00	1.39884E+00	-6.42998E+03
8.80192E-01	1.54897E+02	-3.13757E+02	1.65597E+00	1.29735E+00	-1.01495E+04
9.10533E-01	1.39888E+02	-3.96288E+02	1.65701E+00	1.19651E+00	-1.34225E+04
9.40117E-01	1.24899E+02	-5.04688E+02			
9.68867E-01	1.09905E+02	-6.44588E+02			
9.87469E-01	9.99273E+01	-7.30564E+02			
9.98433E-01	9.39293E+01	-8.27775E+02			
1.00922E+00	8.79322E+01	-8.51653E+02			
1.01982E+00	8.19429E+01	-9.11476E+02			
1.03025E+00	7.59457E+01	-9.63977E+02			
1.04051E+00	6.99530E+01	-9.15675E+02			
1.05058E+00	6.39689E+01	-1.02259E+03			
1.06051E+00	5.79744E+01	-8.54217E+02			
1.07030E+00	5.19765E+01	-7.88680E+02			
1.07996E+00	4.59835E+01	-9.41055E+02			
1.08632E+00	4.19919E+01	-4.13799E+02			
1.09270E+00	3.79957E+01	3.37031E+03			
1.09763E+00	3.49920E+01	6.06372E+03			
1.10281E+00	3.19958E+01	8.62999E+03			
1.10652E+00	2.99939E+01	1.27847E+04			
1.10850E+00	2.89949E+01	1.73524E+04			
1.11063E+00	2.79981E+01	2.15681E+04			
1.11250E+00	2.72024E+01	2.58157E+04			
1.11462E+00	2.64059E+01	2.82338E+04			
1.11717E+00	2.56143E+01	2.69279E+04			
1.11964E+00	2.50137E+01	2.38162E+04			
1.12302E+00	2.44166E+01	1.59593E+04			
1.12838E+00	2.38185E+01	6.15442E+03			
1.13755E+00	2.32181E+01	1.35372E+03			
1.15039E+00	2.26233E+01	-1.15204E+02			
1.16756E+00	2.18320E+01	-5.24419E+02			
1.18222E+00	2.10546E+01	-4.18628E+02			
1.19863E+00	2.00857E+01	-1.48846E+02			
1.21616E+00	1.90000E+01	-2.20844E+01			
1.23220E+00	1.79987E+01	6.83259E+01			
1.24846E+00	1.70006E+01	1.32592E+02			
1.26535E+00	1.59992E+01	1.57392E+02			
1.28301E+00	1.49999E+01	1.85721E+02			
1.30178E+00	1.40008E+01	1.92631E+02			
1.32198E+00	1.29994E+01	1.79962E+02			
1.34382E+00	1.19995E+01	1.62323E+02			
1.36752E+00	1.10012E+01	1.43102E+02			

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BREAKPOINTS 340 FORMAT

Calibration Report: 1323944

Sensor Model: DT-670-CU-1.4L Serial Number: D6121829

Sensor Type: Silicon Diode Temperature Range: 1.40 K to 325 K

Name: DT-670-CU-1.4L
Serial Number: D6121829
Format: 2 ;Volts/Kelvin
Limit: 325.0
Coefficient: 1 ;Negative

Point 1: 9.06000e-02,500.000	Point 51: 1.11407, 26.600	Point 101: 1.64127, 2.200
Point 2: .110239,491.000	Point 52: 1.11553, 26.100	Point 102: 1.64450, 2.040
Point 3: .136555,479.500	Point 53: 1.11686, 25.700	Point 103: 1.64731, 1.890
Point 4: .179181,461.500	Point 54: 1.11837, 25.300	Point 104: 1.64972, 1.750
Point 5: .265393,425.500	Point 55: 1.11970, 25.000	Point 105: 1.65177, 1.620
Point 6: .349522,390.000	Point 56: 1.12124, 24.700	Point 106: 1.65349, 1.500
Point 7: .452797,346.000	Point 57: 1.12311, 24.400	Point 107: 1.65478, 1.400
Point 8: .505975,325.000	Point 58: 1.12545, 24.100	
Point 9: .562163,300.500	Point 59: 1.12745, 23.900	
Point 10: .600913,283.500	Point 60: 1.12982, 23.700	
Point 11: .635984,268.000	Point 61: 1.13267, 23.500	
Point 12: .666277,254.500	Point 62: 1.13601, 23.300	
Point 13: .695197,241.500	Point 63: 1.14192, 23.000	
Point 14: .722761,229.000	Point 64: 1.16206, 22.100	
Point 15: .748977,217.000	Point 65: 1.17221, 21.600	
Point 16: .774944,205.000	Point 66: 1.18326, 21.000	
Point 17: .799571,193.500	Point 67: 1.19848, 20.100	
Point 18: .822884,182.500	Point 68: 1.20165, 19.900	
Point 19: .844900,172.000	Point 69: 1.21459, 19.100	
Point 20: .865635,162.000	Point 70: 1.23376, 17.900	
Point 21: .885100,152.500	Point 71: 1.24844, 17.000	
Point 22: .903312,143.500	Point 72: 1.26102, 16.250	
Point 23: .920284,135.000	Point 73: 1.27314, 15.550	
Point 24: .936036,127.000	Point 74: 1.28480, 14.900	
Point 25: .950590,119.500	Point 75: 1.29599, 14.300	
Point 26: .964925,112.000	Point 76: 1.30666, 13.750	
Point 27: .978083,105.000	Point 77: 1.31777, 13.200	
Point 28: .988264, 99.500	Point 78: 1.32937, 12.650	
Point 29: .996495, 95.000	Point 79: 1.34150, 12.100	
Point 30: 1.00463, 90.500	Point 80: 1.35419, 11.550	
Point 31: 1.01266, 86.000	Point 81: 1.36750, 11.000	
Point 32: 1.02060, 81.500	Point 82: 1.38019, 10.500	
Point 33: 1.02844, 77.000	Point 83: 1.39346, 10.000	
Point 34: 1.03618, 72.500	Point 84: 1.40743, 9.500	
Point 35: 1.04382, 68.000	Point 85: 1.42064, 9.050	
Point 36: 1.05137, 63.500	Point 86: 1.43450, 8.600	
Point 37: 1.05981, 58.400	Point 87: 1.44904, 8.150	
Point 38: 1.06832, 53.200	Point 88: 1.46599, 7.650	
Point 39: 1.07673, 48.000	Point 89: 1.48728, 7.050	
Point 40: 1.08536, 42.600	Point 90: 1.54131, 5.580	
Point 41: 1.09124, 38.900	Point 91: 1.56265, 4.980	
Point 42: 1.09529, 36.400	Point 92: 1.57830, 4.520	
Point 43: 1.09846, 34.500	Point 93: 1.59054, 4.140	
Point 44: 1.10121, 32.900	Point 94: 1.59903, 3.860	
Point 45: 1.10388, 31.400	Point 95: 1.60597, 3.620	
Point 46: 1.10612, 30.200	Point 96: 1.61285, 3.370	
Point 47: 1.10808, 29.200	Point 97: 1.61996, 3.100	
Point 48: 1.10974, 28.400	Point 98: 1.62678, 2.830	
Point 49: 1.11130, 27.700	Point 99: 1.63258, 2.590	
Point 50: 1.11275, 27.100	Point 100: 1.63739, 2.380	

Note: Breakpoints outside of the calibration range were added from the standard curve. These extra points conform to reduced accuracy specifications and are added as a convenience to the customer.

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BREAKPOINTS 91C/93C/330 FORMAT

Calibration Report: 1323944

Sensor Model: DT-670-CU-1.4L Serial Number: D6121829

Sensor Type: Silicon Diode Temperature Range: 1.40 K to 325 K

Interpolation Method: Straight Line
Limit: 325.0 (Kelvin)
Format: 2 (Volts/Kelvin)
Number of Breakpoints: 36

No.	Units	Temperature (K)	No.	Units	Temperature (K)
1	0.147030	475.0	21	1.11056	28.0
2	0.218700	445.0	22	1.11301	27.0
3	0.326000	400.0	23	1.11586	26.0
4	0.490260	330.0	24	1.11971	25.0
5	0.506050	325.0	25	1.12643	24.0
6	0.597550	285.0	26	1.14199	23.0
7	0.665220	255.0	27	1.16408	22.0
8	0.731610	225.0	28	1.18319	21.0
9	0.785730	200.0	29	1.27347	15.5
10	0.838710	175.0	30	1.33167	12.5
11	0.880030	155.0	31	1.39265	10.0
12	0.920350	135.0	32	1.46976	7.5
13	0.949640	120.0	33	1.57684	4.6
14	0.978130	105.0	34	1.62614	2.9
15	1.00558	90.0	35	1.65126	1.7
16	1.03194	75.0	36	1.65464	1.4
17	1.05723	60.0			
18	1.08320	44.0			
19	1.09589	36.0			
20	1.10456	31.0			

Note: Breakpoints outside of the calibration range were added from the standard curve. These extra points conform to reduced accuracy specifications and are added as a convenience to the customer.

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