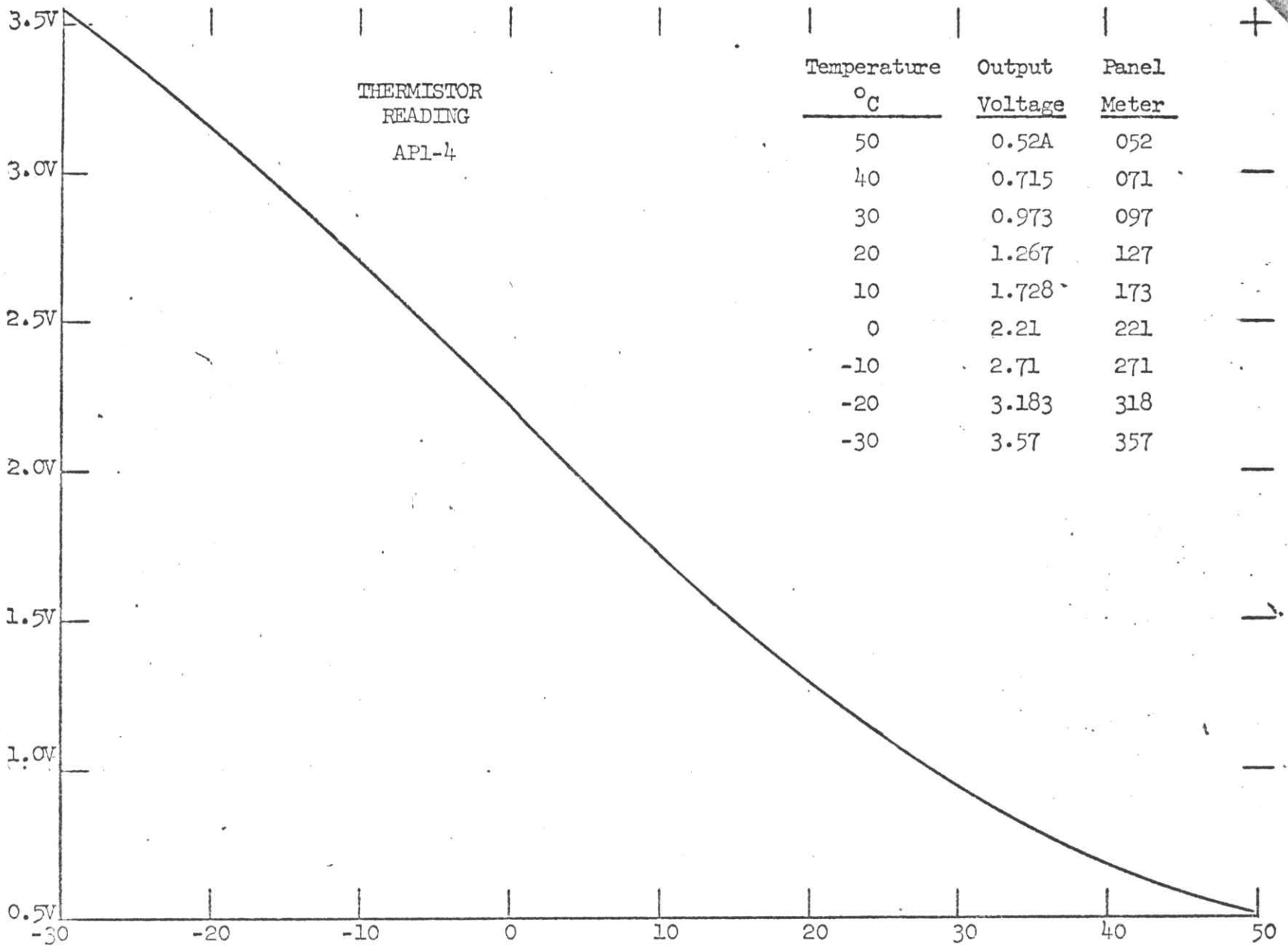


Temperature °C	Output Voltage	Panel Meter
50	0.52A	052
40	0.715	071
30	0.973	097
20	1.267	127
10	1.728	173
0	2.21	221
-10	2.71	271
-20	3.183	318
-30	3.57	357

FIGURE IX-1

IX-8

Approved _____

Date _____

$$T = \frac{10 \log\left(\frac{V+1.0}{3.21}\right)}{\log\left(\frac{2.728}{3.21}\right)} = \frac{10 \log\left(\frac{V+1.0}{3.21}\right)}{\log(0.850)}$$

$$\log 0.850 = 0.9294 - 1.0 = 0.0706$$
$$= \cancel{-0.706}$$

$$T = \frac{10}{(-0.706)} \log\left(\frac{V+1.0}{3.21}\right)$$

$$\boxed{T = -14.16 \log\left(\frac{V+1.0}{3.21}\right)^{\circ}C}$$

sample point $T = 30$ $V = 0.973$

$$T = -14.16 \log\left(\frac{1.973}{3.21}\right) = 29.9^{\circ}$$

$$.6146$$

$$-.2111$$

$T = 40$ $V = .715$

$$T = -14.16 \log\left(\frac{1.715}{3.21}\right) = 38.6^{\circ}$$

$$.2725$$

$T = 50^\circ \quad V = 1.52$

$T = -141.6 \log \frac{1.52}{3.21} = 45.9^\circ$

$-.3242.$

$T = -10^\circ \quad V = 2.71 = -8.86^\circ$

$T = -141.6 \log \frac{3.71}{3.21}$

1.156

$.0626.$

$T = -20^\circ \quad V = 3.183 = -16.28$

$T = -141.6 \log \frac{4.183}{3.21}$

1.303

$T = -30^\circ \quad T = -141.6 \log \frac{4.57}{3.21} = -21.7$

$T = +20 \quad T = -141.6 \log \frac{2.267}{3.21} = 21.5$

$T = +10 \quad T = -141.6 \log \frac{2.728}{3.21} = 10.0$

Temp	Tcalc.	Δ Tcalc − Temp	V.	$-0.656(V-1.728)^3$
-30	-21.7	+8.3	.52	+11.56
-20	-16.3	+3.7	.715	
-10	-8.9	+1.1	.973	
0	0	0	1.267	
10	10.0	0	1.728	
20	21.5	1.5	2.21	
30	29.9	0	2.71	
40	38.6	-1.4	3.183	
50	43.9	-4.1	3.57	

corr = $A(V-1.728)^3 =$

$A(3.57-1.728)^3 = -4.1$

$A = \frac{-4.1}{(3.57-1.728)^3} = \frac{-4.1}{6.251} = -0.656$

$$\log(V+1.0) = AT + B$$

50	.72		
		.195	
40	.715		0.063
		.258	
30	.973		0.036
		.294	
20	1.267		0.167
		.461	
10	1.728		0.021
		.482	
0	2.21		0.018
		.508	
-10	2.71		-0.027
		.473	
-20	3.183		-0.086
		.387	
-30	3.57		

$T = 0 \qquad B = \log 3.21$

$AT = \log(V+1.0) - \log 3.21$

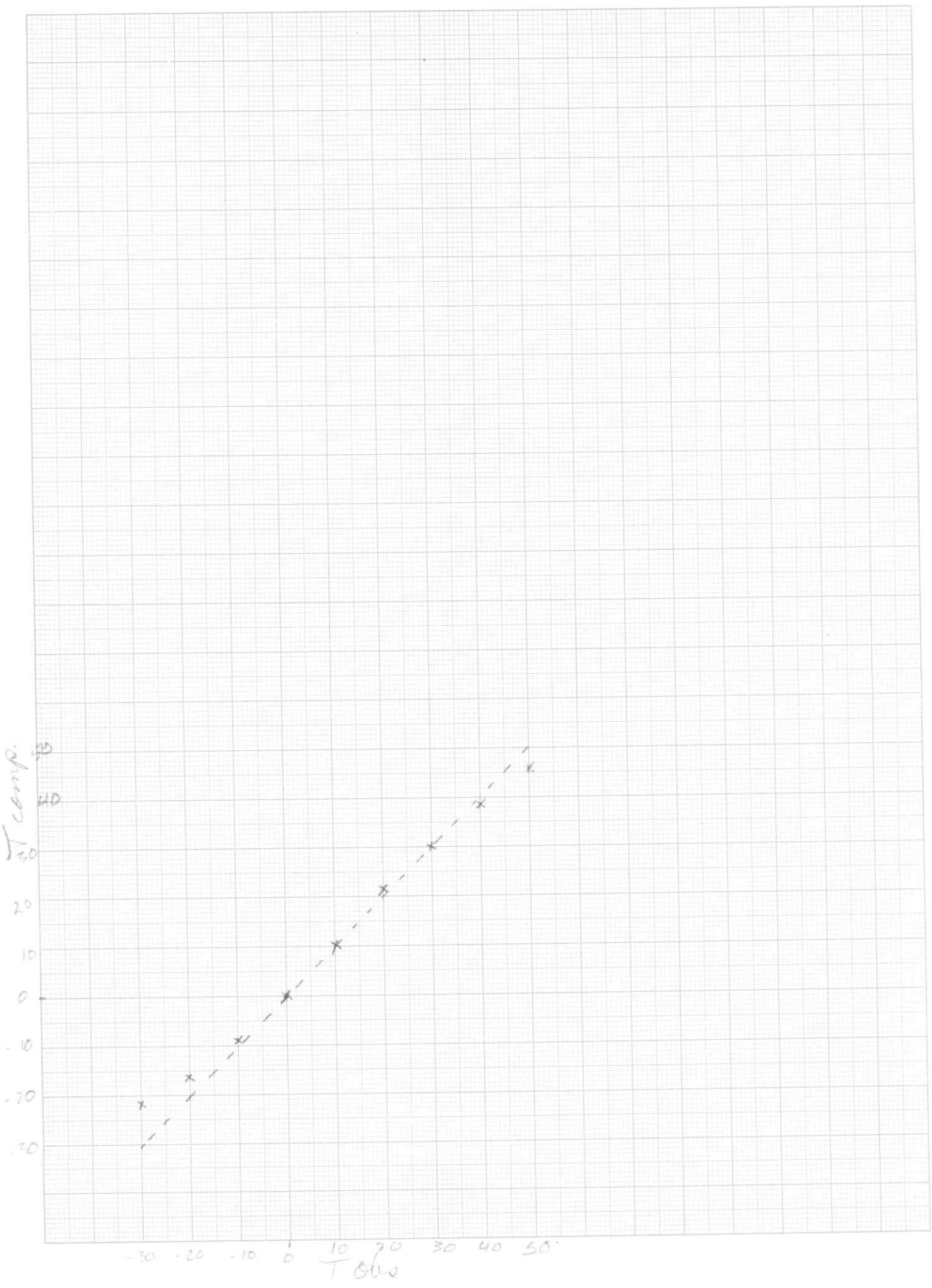
$T = \frac{1}{A} \log\left(\frac{V+1.0}{3.21}\right)$

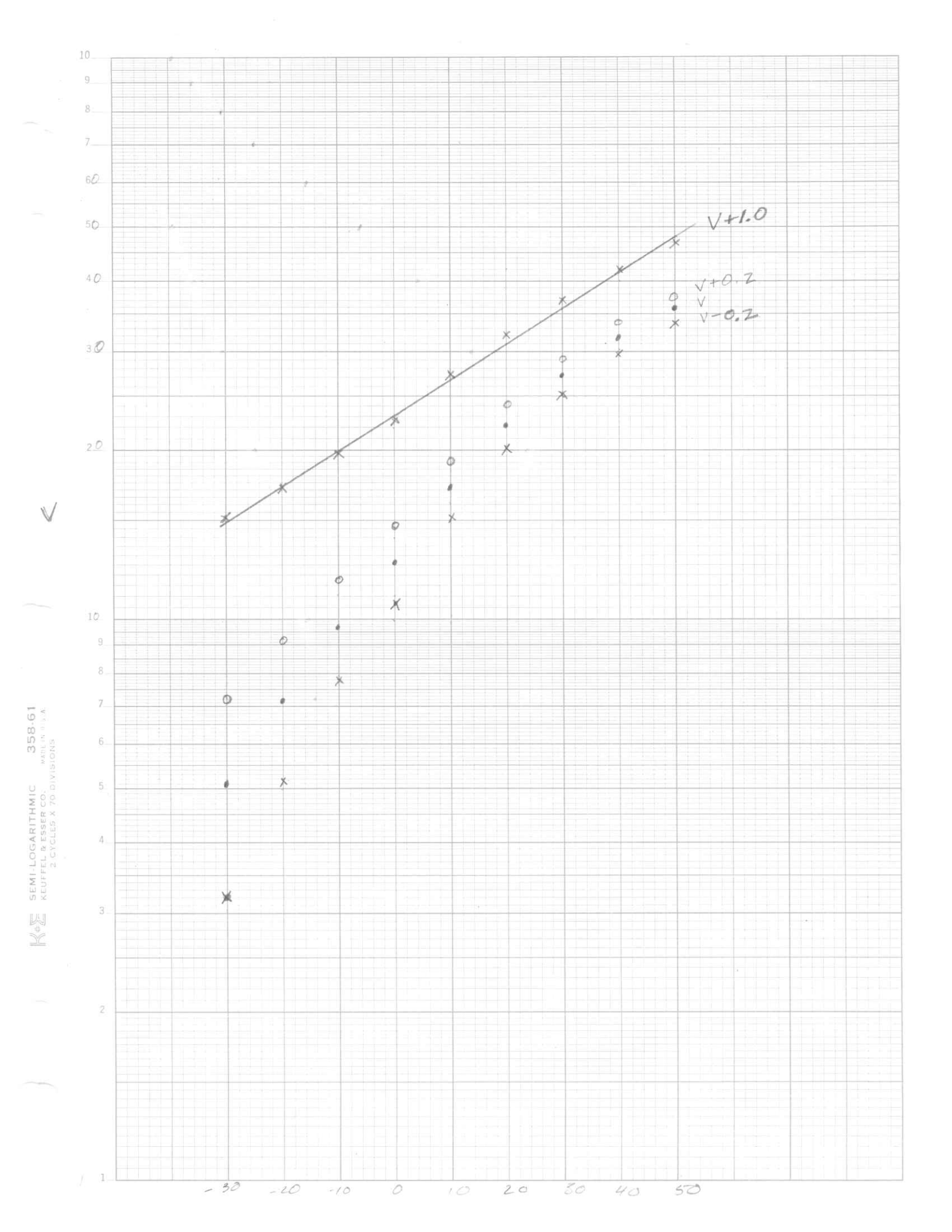
$$T = \frac{1}{A} \log\left(\frac{V+1.0}{3.21}\right)$$

~~$A^{-1} = T / \log\left(\frac{V+1.0}{3.21}\right)$~~

~~$A = 10 / \log\left(\frac{2.728}{3.21}\right)$~~

$$A = \frac{1}{10} \log\left(\frac{2.728}{3.21}\right)$$

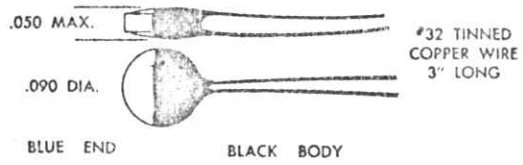



V+1.0
V+0.2
V
V-0.2
V
10
9
8
7
6
5
4
3
2
1
-30
-20
-10
0
10
20
30
40
50
SEMI-LOGARITHMIC 358-61
KEUFFEL & ESSER CO. MADE IN U.S.A.
2 CYCLES X 70 DIVISIONS

YSI PRECISE THERMISTOR

10,000 OHMS AT 25°C

PART No. 44006



TIME CONSTANT:*

1 second maximum. This value was determined with the thermistor suspended by its leads in a "well stirred" oil bath.

10 seconds maximum. This value was determined with the thermistor suspended by its leads in still air.

*Time constant is the time required for the thermistor to indicate 63% of a new impressed temperature.

DISSIPATION CONSTANT:**

8 mw/°C. This value was determined with the thermistor suspended by its leads in a "well stirred" oil bath.

1 mw/°C. This value was determined with the thermistor suspended by its leads in still air.

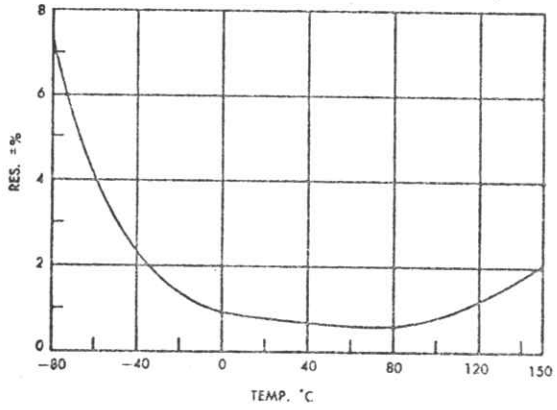
**The dissipation constant is the amount of power in milliwatts required to raise the thermistor 1°C above the surrounding temperature.

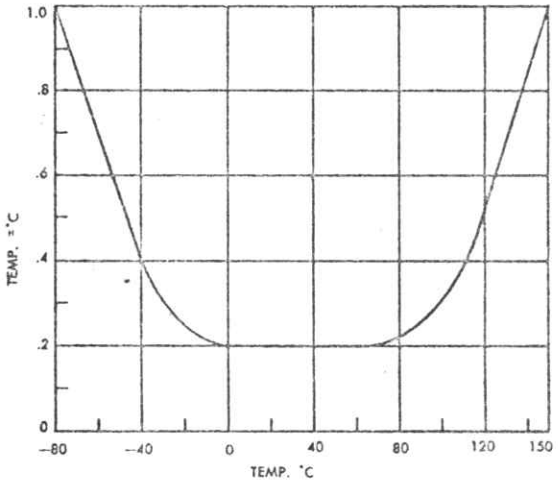
COLOR CODE:

Black epoxy on the body of the thermistor with blue end. Maximum operating temperature 150°C.

TOLERANCES

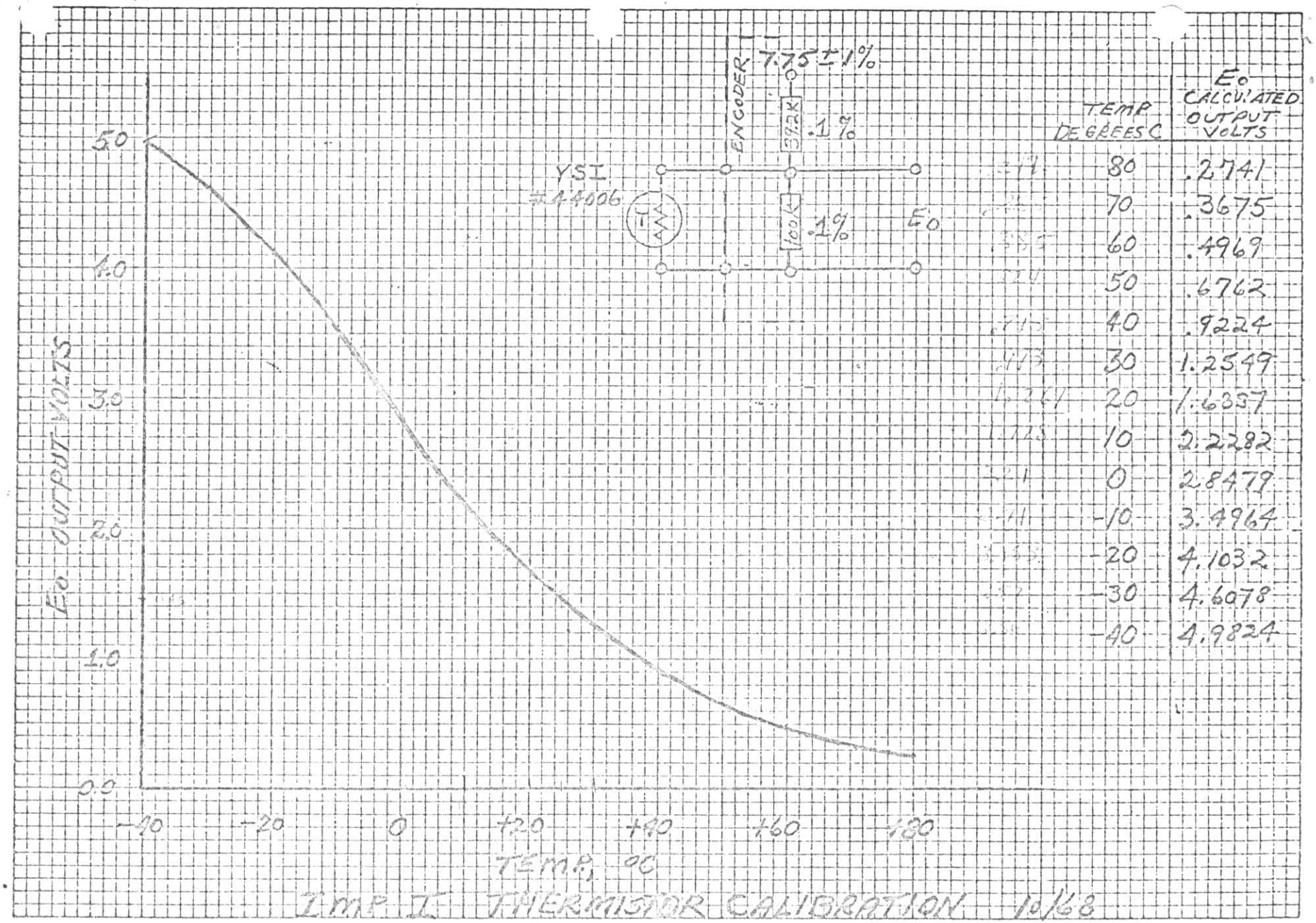
Preliminary Data, Sept. 15, 1961





RESISTANCE VERSUS TEMPERATURE −80°C to +150°C

TEMP.°C	RES.Ω	TEMP.°C	RES.Ω	TEMP.°C	RES.Ω	TEMP.°C	RES.Ω	TEMP.°C	RES.Ω	TEMP.°C	RES.Ω	TEMP.°C	RES.Ω
-80	355.8K	-44	304.6K	-8	43.31K	28	8667	64	2417	100	816.8	136	326.3
79	329.6K	43	286.7K	7	41.07K	29	8523	65	2339	101	794.6	137	318.7
78	305.5K	42	270.0K	6	39.11K	30	8194	66	2264	102	773.1	138	311.3
77	283.3K	41	254.4K	5	37.31K	31	7880	67	2191	103	752.3	139	304.2
76	262.9K	40	239.8K	4	35.57K	32	7579	68	2122	104	732.1	140	297.2
75	244.0K	39	226.0K	3	33.93K	33	7291	69	2055	105	712.6	141	290.6
74	226.6K	38	213.2K	2	32.37K	34	7016	70	1990	106	693.6	142	283.8
73	210.6K	37	201.1K	-1	30.89K	35	6752	71	1928	107	675.3	143	277.4
72	195.7K	36	189.8K	0	29.46K	36	6500	72	1868	108	657.5	144	271.2
71	182.1K	35	179.2K	1	28.15K	37	6258	73	1810	109	640.3	145	265.1
70	169.4K	34	169.3K	2	26.89K	38	6026	74	1754	110	623.5	146	259.2
69	157.7K	33	160.0K	3	25.69K	39	5805	75	1700	111	607.3	147	253.4
68	146.9K	32	151.2K	4	24.54K	40	5592	76	1648	112	591.6	148	247.8
67	136.9K	31	143.0K	5	23.46K	41	5389	77	1598	113	576.4	149	242.3
66	127.6K	30	135.2K	6	22.43K	42	5193	78	1549	114	561.6	150	237.0
65	119.0K	29	127.9K	7	21.45K	43	5006	79	1503	115	547.3		
64	111.1K	28	121.1K	8	20.52K	44	4827	80	1458	116	533.4		
63	103.7K	27	114.6K	9	19.63K	45	4655	81	1414	117	519.9		
62	96.8.4K	26	108.6K	10	18.79K	46	4489	82	1372	118	506.8		
61	90.4.9K	25	102.9K	11	17.98K	47	4331	83	1332	119	494.1		
60	84.5.9K	24	97.49K	12	17.22K	48	4179	84	1293	120	481.8		
59	791.1K	23	92.43K	13	16.49K	49	4033	85	1255	121	469.8		
58	760.2K	22	87.66K	14	15.79K	50	3893	86	1218	122	458.2		
57	692.8K	21	83.16K	15	15.13K	51	3758	87	1183	123	446.9		
56	648.8K	20	78.91K	16	14.50K	52	3629	88	1149	124	435.9		
55	607.8K	19	74.91K	17	13.90K	53	3504	89	1116	125	425.3		
54	569.6K	18	71.13K	18	13.33K	54	3385	90	1084	126	414.9		
53	534.1K	17	67.57K	19	12.78K	55	3270	91	1053	127	404.9		
52	501.0K	16	64.20K	20	12.26K	56	3160	92	1023	128	395.1		
51	470.1K	15	61.02K	21	11.77K	57	3054	93	994.2	129	385.6		
50	441.3K	14	58.01K	22	11.29K	58	2952	94	966.3	130	376.4		
49	414.5K	13	55.17K	23	10.84K	59	2854	95	939.3	131	367.4		
48	389.4K	12	52.48K	24	10.41K	60	2760	96	913.2	132	358.7		
47	366.0K	11	49.96K	25	10000	61	2669	97	887.9	133	350.3		
46	344.1K	10	47.51K	26	9605	62	2582	98	863.4	134	342.0		
-45	323.7K	-9	45.27K	27	9227	63	2497	99	839.7	135	334.0		



TEMP DEGREES C	E₀ CALCULATED OUTPUT VOLTS
80	.2741
70	.3675
60	.4969
50	.6762
40	.9224
30	1.2549
20	1.6837
10	2.2282
0	2.8479
-10	3.4964
-20	4.1032
-30	4.6078
-40	4.9824

THE JOHNS HOPKINS UNIVERSITY
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8621 GEORGIA AVENUE
SILVER SPRING, MARYLAND 20910

TELEPHONE
776-7100
589-7700
AREA CODE 301

MAR 19 1970

Please refer to:
TSSD-1847

Director
National Aeronautics and Space Administration
Goddard Space Flight Center
Greenbelt, Maryland 20771

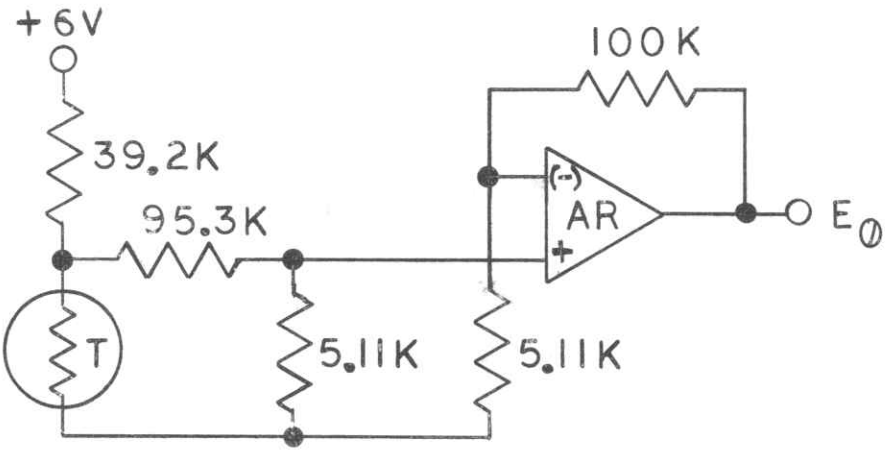
Attention: Mr. William R. Limberis, Code 724

Subject: Temperature Monitor on APP Experiment, IMP H and J
(APL, Dr. S. M. Krimigis).

Dear Sir:

This letter is in response to your request for information on the APL method of measuring the APP package temperature. One such measurement will be made by a thermistor mounted on the Proton Electron Telescope. This output is sub-commutated onto the analog performance parameter as one of eight (8) measurements. The thermistor to be used is a YSI 44006 furnished by the project office. We will require a total of four (4) units, three (3) to be used in the flight units plus one spare. We require at least one such thermistor by May 1, 1970 in order to meet our production schedule for the protoflight package.

APL will use the same network used by GSFC for making temperature measurements. However, the supply voltage is different from that used by GSFC (6.0V vs. 7.75V) and there are gain changes in the sub-commutation process. The circuit is shown below in a simplified form.



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This schematic shows that the thermistor voltage is attenuated by a factor of 20 and then multiplied by a factor of 20 in an operational amplifier. The net effect is that the calibration curve is the same as that given by the project office multiplied by a factor of 0.775 (6.0V/7.75V).

If any additional information is desired about the temperature monitor, please contact R. E. Cashion at telephone number 776-7100, extension 2068.

Very truly yours,

R. B. Kershner
Space Development
Department Head

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