

MODEL 107F
TEMPERATURE PROBE
INSTRUCTION MANUAL

SIXTH REVISION: 6/94-T

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MODEL 107F

TEMPERATURE PROBE

1. GENERAL

The Model 107F probe contains a YSI 44002A thermistor configured for use with CSC's CR7, 21X, and CR10 dataloggers. The probe is designed to be housed in the 41301-5 6 Plate Radiation Shield, or equivalent; a ten foot lead length is standard. Longer lead lengths are available up to 1000 feet. Do not extend lead lengths by adding wire to the Pigtail (connection) end or measurement errors will result.

2. ACCURACY - TEMPERATURE SENSOR

The overall sensor accuracy is a combination of YSI's interchangeability specification, the precision of the bridge resistors and the linearization error (Figure 1). In a "worst case" example, all of the errors add in one direction to yield a $\pm 0.4^{\circ}\text{C}$ accuracy over the range of -53°C to $+48^{\circ}\text{C}$.

NOTE: It is emphasized that this is "worst case" and is CSC's experience the overall accuracy is typically better than $\pm 0.2^{\circ}\text{C}$.

The major error component is the $\pm 0.2^{\circ}\text{C}$ thermistor specification. Although the thermistor interchangeability is typically better than this, any existing error is predominantly offset and can be determined with a single point calibration. The error can then be compensated for by entering an offset in the measurement instruction.

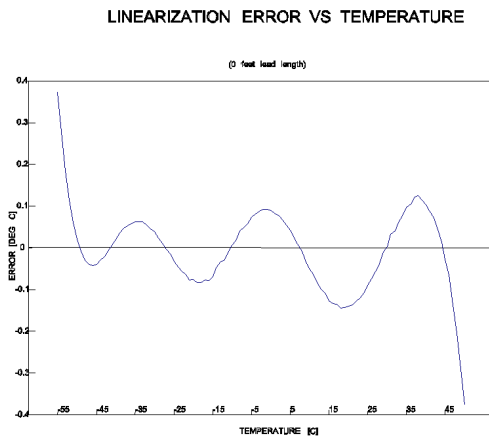


FIGURE 1. Temperature Probe Polynomial Error Curve (0 ft lead) Linearization Range from -55 to 50°C

The bridge resistors are 0.1% tolerance with a 10ppm temperature coefficient.

3. WIRING

Connections to the datalogger for the 107F are shown in Figure 2. The probe requires a single ended analog measurement, the red lead can be inserted into either HI or LO inputs.

The black thermistor excitation lead connects to any excitation channel. The number of 107F probes per excitation channel is physically limited by the number of lead wires that can be inserted into a single excitation terminal (approximately ten).

The purple lead connects to Analog Ground. Analog Ground, labelled "AG" on the CR10, is the same as Ground (G) for the 21X and CR7. The clear lead is the shield which connects to Ground (G) on the datalogger.

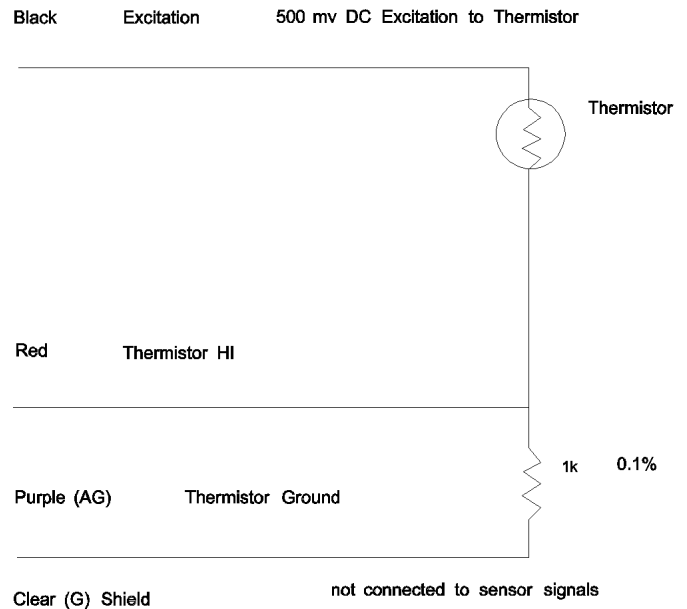


FIGURE 2. 107F Probe Datalogger Connection

EXAMPLE 1. Sample 21X Instructions for 107F Probe

4. PROGRAMMING

Program Instruction 4 provides an excitation voltage to the thermistor bridge, then makes a single ended voltage measurement. Program Instruction 55 converts the mV output into degrees Celsius and corrects for errors due to lead length.

Example 1 shows the use of Program Instructions 4 and 55.

The resistance of the YSI44002A thermistor used in the 107F probe decreases from 9.171K ohms at -50 degrees Celsius to 141.2 ohms at +48 degrees Celsius. Due to the very low resistance of the thermistor at higher temperatures, the cable resistance can introduce significant errors to the measurement. These errors can be eliminated by taking into account the cable resistance when calculating the linearization coefficients for the thermistor.

Figures 3 and 4 show the linearization error with and without lead length compensation.

Table 1 lists the polynomial coefficients and corresponding lead lengths for 22 AWG cable which are to be used for 107F probes with serial numbers C1233 and greater. Table 2 lists polynomial coefficients for 24 AWG cable and is used for 107F probes with serial numbers C1000 - C1232 and all 107FB probes. Table 3 lists the YSI44002A thermistor resistance without cable at various temperatures.

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01: P    4      Excite, Delay, Volt (SE)
01:     1      Rep
02:     4      ** mV slow Range
03:     1      *  IN Chan
04:     1      Excite all reps w/EXchan 1
05:     10     Delay (units .01 sec)
06:     500   ** mV Excitation
07:     1      Loc [:Air Temp.]
08:     0.001 **Mult
09:     0      Offset

02: P    55     Polynomial
01:     1      Rep
02:     1      *  X Loc Air Temp.
03:     1      *  F (X) Loc [Air Temp.]
04:     ????  *** C0
05:     ????  *** C1
06:     ????  *** C2
07:     ????  *** C3
08:     ????  *** C4
09:     ????  *** C5
    
```

- * Proper entries will vary depending on the program and datalogger channel usage.
- ** On CR10 the 250 mV input range and 250 mV excitation with a multiplier of 0.002 are used. On CR7 program like the 21X except for range code of 6 instead of 4 and specify card numbers.
- *** Refer to Table 1 or 2 for coefficients.

COMPENSATION FOR ERROR DUE TO LEAD LENGTH

COMPENSATED ERROR WITH 100 FT 22 AWG

UNCOMPENSATED ERROR WITH 100 FT 22 AWG

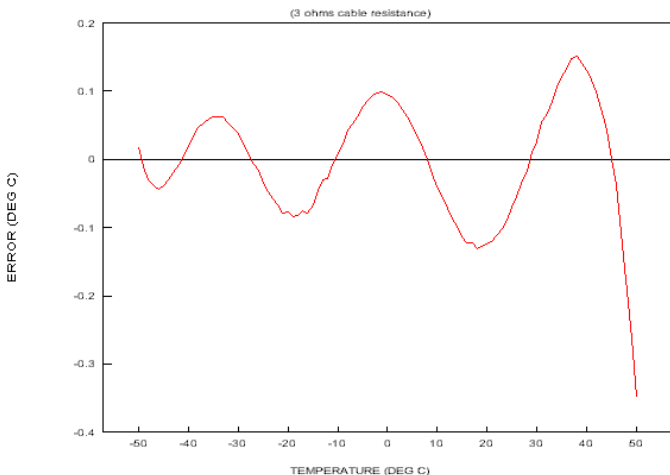


Figure 3: Compensated Error (100 ft 22 AWG)

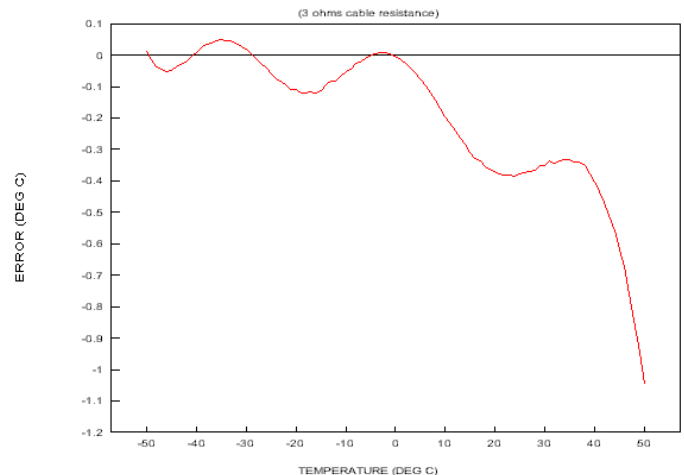


Figure 4: Uncompensated Error (100 ft 22 AWG)

TABLE 1: COEFFICIENTS FOR USE WITH 22 AWG CABLE
 (For use with 107F SN C1233 and greater, all HMP35CF and all 207F sensors)

LEAD LENGTH (feet) (ohms)	CABLE RESISTANCE	COEFFICIENTS					
		C0	C1	C2	C3	C4	C5
10	0.30	-74.146	645.35	-3837.9	16039	-34037	29809
25	0.75	-74.154	645.68	-3842.1	16065	-34108	29885
30	0.90	-74.157	645.78	-3843.4	16073	-34130	29909
35	1.05	-74.159	645.87	-3844.6	16081	-34152	29933
50	1.50	-74.168	646.22	-3848.9	16107	-34225	30009
75	2.25	-74.181	646.76	-3855.7	16149	-34341	30134
100	3.00	-74.194	647.28	-3862.4	16191	-34458	30258
125	3.75	-74.208	647.83	-3869.3	16233	-34574	30383
150	4.50	-74.221	648.34	-3875.8	16274	-34691	30508
175	5.25	-74.235	648.88	-3882.7	16317	-34810	30636
200	6.00	-74.248	649.41	-3889.5	16359	-34927	30762
225	6.75	-74.261	649.94	-3896.3	16401	-35045	30889
250	7.50	-74.276	650.51	-3903.4	16446	-35168	31020
275	8.25	-74.289	651.04	-3910.2	16488	-35287	31148
300	9.00	-74.301	651.55	-3916.8	16529	-35403	31274
325	9.75	-74.316	652.10	-3923.8	16573	-35525	31405
350	10.50	-74.329	652.64	-3930.7	16616	-35646	31535
375	11.25	-74.343	653.20	-3937.8	16660	-35768	31666
400	12.00	-74.356	653.73	-3944.6	16703	-35888	31796
425	12.75	-74.369	654.26	-3951.4	16745	-36009	31926
450	13.50	-74.384	654.83	-3958.8	16791	-36135	32061
475	14.25	-74.397	655.35	-3965.4	16833	-36254	32191
500	15.00	-74.410	655.89	-3972.3	16876	-36376	32323

TABLE 2: COEFFICIENTS FOR USE WITH 24 AWG CABLE
 (For use with 107F SN C1000 - C1232 and all 107FB sensors.)

LEAD LENGTH (feet) (ohms)	CABLE RESISTANCE	COEFFICIENTS					
		C0	C1	C2	C3	C4	C5
10	0.48	-74.150	645.51	-3839.8	16051	-34067	29841
25	1.20	-74.162	646.00	-3846.1	16090	-34177	29959
50	2.40	-74.183	646.83	-3856.8	16156	-34362	30157
75	3.60	-74.205	647.70	-3867.7	16224	-34550	30358
100	4.80	-74.227	648.56	-3878.7	16292	-34739	30560
125	6.00	-74.248	649.41	-3889.5	16359	-34927	30762
150	7.20	-74.269	650.25	-3900.2	16426	-35115	30965
165	7.92	-74.282	650.78	-3907.0	16468	-35232	31090
175	8.40	-74.291	651.13	-3911.5	16496	-35310	31173
200	9.60	-74.314	652.02	-3922.7	16566	-35504	31381
250	12.00	-74.356	653.73	-3944.6	16703	-35888	31796

TABLE 3: Temperature VS Thermistor Resistance for YSI44002A

° C	OHMS	-32.0	3400.0	-4.0	919.0	24.0	310.8
		-30.0	3069.0	-2.0	844.8	26.0	289.7
-56.0	13170.0	-28.0	2775.0	0.0	777.5	28.0	270.3
-54.0	11650.0	-26.0	2512.0	2.0	716.3	30.0	252.4
-52.0	10330.0	-24.0	2278.0	4.0	660.6	32.0	235.9
-50.0	9171.0	-22.0	2068.0	6.0	609.9	34.0	220.6
-48.0	8158.0	-20.0	1880.0	8.0	563.6	36.0	206.5
-46.0	7270.0	-18.0	1712.0	10.0	521.5	38.0	193.4
-44.0	6489.0	-16.0	1561.0	12.0	482.9	40.0	181.4
-42.0	5803.0	-14.0	1424.0	14.0	447.6	42.0	170.2
-40.0	5198.0	-12.0	1302.0	16.0	415.4	44.0	159.8
-38.0	4663.0	-10.0	1191.0	18.0	385.8	46.0	150.1
-36.0	4191.0	-8.0	1091.0	20.0	358.6	48.0	141.2
-34.0	3772.0	-6.0	1001.0	22.0	333.7	50.0	132.9