

**10TCRTF, CR10TCRF, AND CR10XTCRF
THERMOCOUPLE REFERENCE – THERMISTOR
INSTRUCTION MANUAL**

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10TCRTF, CR10TCRF and CR10XTCRF Thermocouple Reference

1. General

The 10TCRTF, CR10TCRF and CR10XTCRF (“Thermocouple Reference”) is designed as a temperature reference for thermocouples measured with the CR10/CR10X Measurement and Control Module. The Thermocouple Reference has an extended temperature range from -53 to 48°C . When installed, the Thermocouple Reference lies between the two analog input terminal strips of the CR10/CR10X. The Thermocouple Reference circuitry, measurement, and specifications are equivalent to the 107F Temperature Probe.

2. Accuracy

The overall sensor accuracy is a combination of YSI’s interchangeability specification, the precision of the bridge resistors, and the linearization error. 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°C . NOTE: It is emphasized that this is “worst case” and it is Campbell Scientific’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.

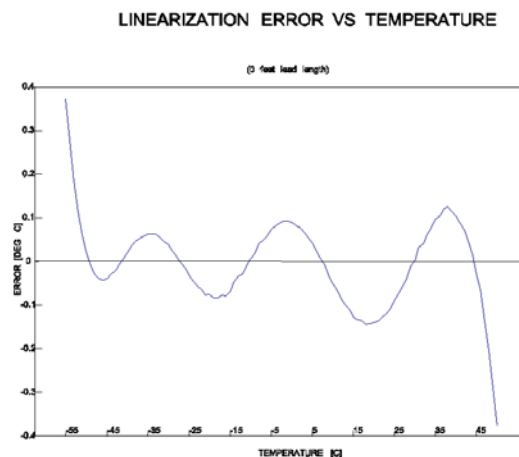


FIGURE 1. Thermocouple Reference Polynomial Error Curve Linearization Range from -55 to 50°C .

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

3. Wiring

Connections to the CR10/CR10X Measurement and Control Module for the Thermocouple Reference are shown in Figure 2.

Channel assignment for the Thermocouple Reference is predefined and cannot be changed. The Thermocouple Reference has been designed to have its red lead connected to Single Ended Input Channel 1 (labelled 1H), its black excitation lead to E3 and its clear lead to the Analog Ground (AG) next to E3.

Do not connect a thermocouple to Differential Analog Channel 1 when using the Thermocouple Reference. The electro magnetic noise picked up by a thermocouple connected to the same channel may generate an erroneous Reference Temperature Reading.

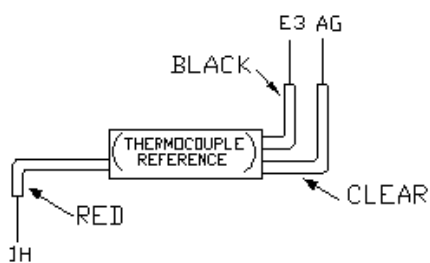
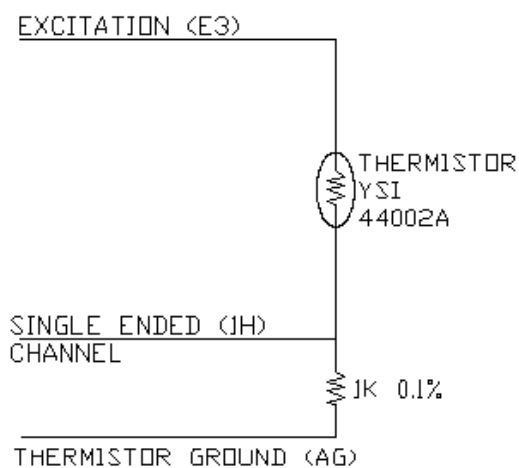


FIGURE 2. 10TCRTF, CR10TCRF, CR10XTCRF Thermocouple Datalogger Reference

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.

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

EXAMPLE 1. Instructions for Thermocouple Reference

01:	P 4	Excite, Delay, Volt (SE)
01:	1	Rep
02:	4	mV slow Range
03:	1	IN Chan
04:	3	Excite all reps w/EXchan 1
05:	0	Delay (units .01 sec)
06:	250	mV Excitation
07:	1	Loc [:Ref Temp]
08:	0.002	Mult
09:	0	Offset
02:	P 55	Polynomial
01:	1	Rep
02:	1	X Loc [:Ref Temp.]
03:	1	F(X) Loc [:Ref Temp]
04:	-74.143	C0
05:	645.21	C1
06:	-3835.8	C2
07:	16025	C3
08:	-33996	C4
09:	29763	C5

Table 1 lists the polynomial coefficients and their values.

TABLE 1. Polynomial Coefficients	
Coefficient	Value
C0	-74.143
C1	645.21
C2	-3835.8
C3	16025
C4	-33996
C5	29763

Table 2 displays resistance and datalogger output at several temperatures.

TABLE 2. Temperature, Resistance, and Datalogger Output for YSI44002A		
Temperature °C	Resistance OHMS	Output °C
-60.00	16930	-58.804
-58.00	14920	-57.197
-56.00	13170	-55.497
-54.00	11650	-53.722
-52.00	10330	-51.887
-50.00	9171	-49.981
-48.00	8158	-48.029
-46.00	7270	-46.044
-44.00	6489	-44.032
-42.00	5803	-42.007
-40.00	5198	-39.981
-38.00	4663	-37.955
-36.00	4191	-35.942
-34.00	3772	-33.938
-32.00	3400	-31.945
-30.00	3069	-29.962
-28.00	2775	-27.99
-26.00	2512	-26.015
-24.00	2278	-24.047
-22.00	2068	-22.066
-20.00	1880	-20.077
-18.00	1712	-18.083
-16.00	1561	-16.079
-14.00	1424	-14.048
-12.00	1302	-12.032
-10.00	1191	-9.9931
-8.00	1091	-7.961
-6.00	1001	-5.9415
-4.00	919	-3.9193
-2.00	844.8	-1.9093
0.00	777.5	0.08754
2.00	716.3	2.0748
4.00	660.6	4.0546
6.00	609.9	6.0233
8.00	563.6	7.9896
10.00	521.5	9.9489
12.00	482.9	11.918
14.00	447.6	13.891
16.00	415.4	15.866
18.00	385.8	17.854
20.00	358.6	19.861
22.00	333.7	21.871
24.00	310.8	23.893
26.00	289.7	25.926
28.00	270.3	27.962
30.00	252.4	30.001
32.00	235.9	32.038
34.00	220.6	34.078
36.00	206.5	36.104
38.00	193.4	38.124
40.00	181.4	40.104
42.00	170.2	42.072
44.00	159.8	44.014
46.00	150.1	45.932
48.00	141.2	47.798
50.00	132.9	49.626