MODEL 108 TEMPERATURE PROBE
INSTRUCTION MANUAL

REVISION: 4/03

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CAMPBELL SCIENTIFIC, INC.
RMA#_____
815 West 1800 North
Logan, Utah 84321-1784

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Model 108 Temperature Probe

1. General

The 108 temperature probe uses a thermistor to measure temperature. Lead lengths are available up to 1000 feet.

The probe is designed for measuring air/soil/water temperatures. For air temperature, a 41303 radiation shield is used to mount the 108 Probe and limit solar radiation loading. The 108 temperature probe is designed to be buried or submerged in water up to 50 feet.

1.1 Specifications

Temperature Measurement Range: -5° to +95°C

Survival Temperature Range: -50° to +100°C

Thermistor Interchangeability Error: Typically <±0.2°C over 0°C to 70°C ±0.3 @ 95°C.

Polynomial Linearization Error: <±0.5°C over -7°C to +90°C.

Time Constant in Air: 200 ± 10 seconds

NOTE The black outer jacket of the cable is Santoprene® rubber. This compound was chosen for its resistance to temperature extremes, moisture, and UV degradation. However, this jacket will support combustion in air. It is rated as slow burning when tested according to U.L. 94 H.B. and will pass FMVSS302. Local fire codes may preclude its use inside buildings.

2. Accuracy

The overall probe accuracy is a combination of the thermistor's interchangeability specification, the precision of the bridge resistors, and the polynomial error. In a "worst case" all errors add to an accuracy of ±0.3°C over the range of -3° to 90°C and ±0.7°C over the range of -7°C to 95°C. The major error component is the interchangeability specification of the thermistor, tabulated in Table 2-1. For the range of 0° to 50°C the interchangeability error is predominantly offset and can be determined with a single point calibration. Compensation can then be done with an offset entered in the measurement instruction. The bridge resistors are 0.1% tolerance with a 10 ppm temperature coefficient. Polynomial errors are tabulated in Table 2-2 and plotted in Figure 2-1.

TABLE 2-1. Thermistor Interchangeability Specification

Temperature (°C)	Temperature Tolerance (±°C)
−10	0.25
0 to +50	0.20
+70	0.20
+90	0.31

TABLE 2-2. Polynomial Error

-10 to +95	<±1.0°C
-7 to +95	<±0.5°C
-3 to +90	<±0.1°C

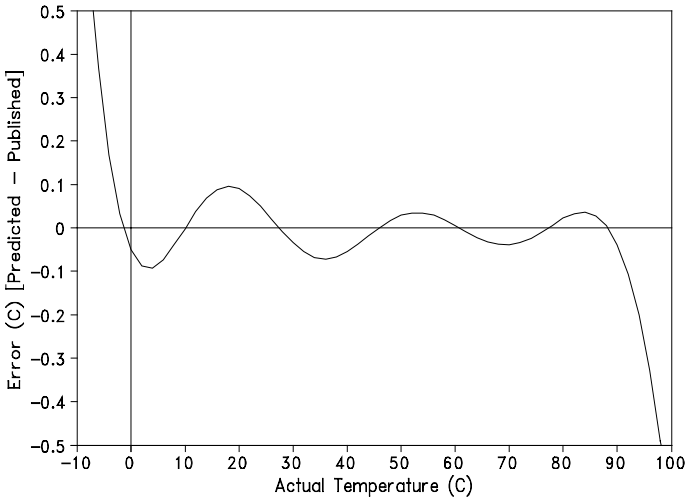

FIGURE 2-1. 108 Probe Polynomial Error Curve

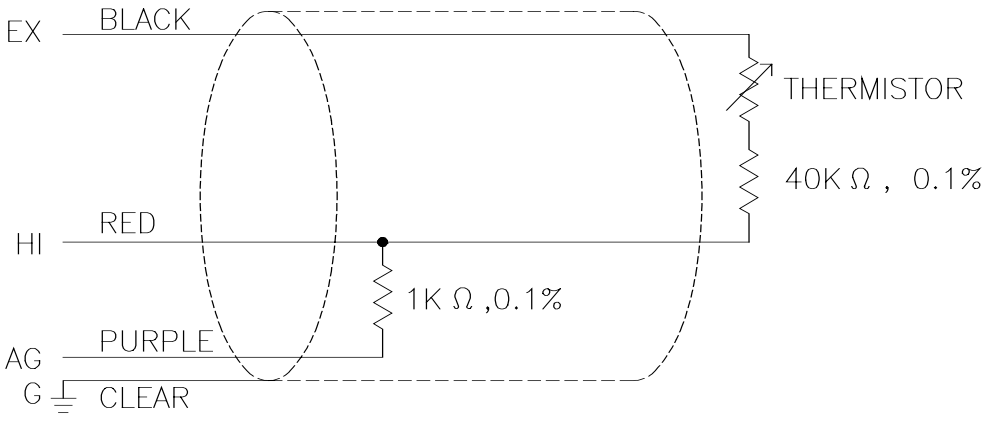

FIGURE 2-2. 108 Probe Schematic

3. Installation and Wiring

For air temperature measurement, the 108 must be housed inside a radiation shield when used outdoors. The 41303 Radiation Shield (see Figure 3-1) mounts to a CM6 or CM10 tripod. The UT018 mounting arm and UT6P Radiation Shield are used to mount the 108 to a UT30 tower.

The standard lead length of 6 feet and 9 feet allow the 108 to be mounted at a 2 meter height on the CM6/CM10 tripod or the UT30 tower respectively.

Connections to the datalogger for the 108 are shown in Figure 3-2. The probe is measured by a single-ended analog input channel. The red lead is connected to a single ended analog input. The black lead connects to an excitation channel.

The number of 108 probes per excitation channel is physically limited by the number of lead wires that can be inserted into a single excitation terminal (approximately 6).

The purple leads connect to Analog Ground (AG) on the CR500 and CR10(X), and Ground on the 21X and CR7. The clear lead is the shield which connects to Ground (G) on the datalogger.

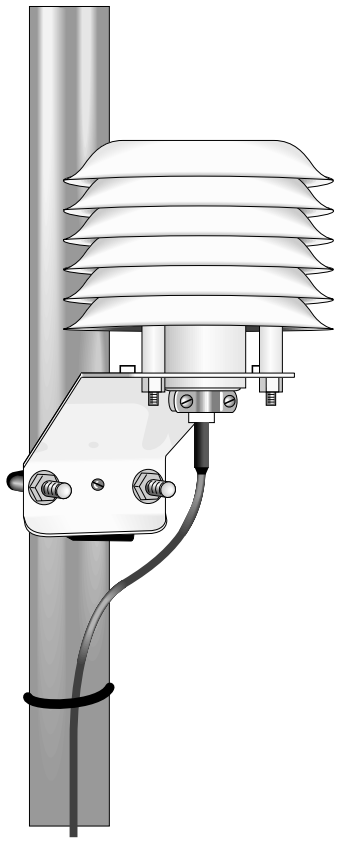

FIGURE 3-1. 108 and 41303 Radiation Shield on a CM6/CM10 Tripod Mast

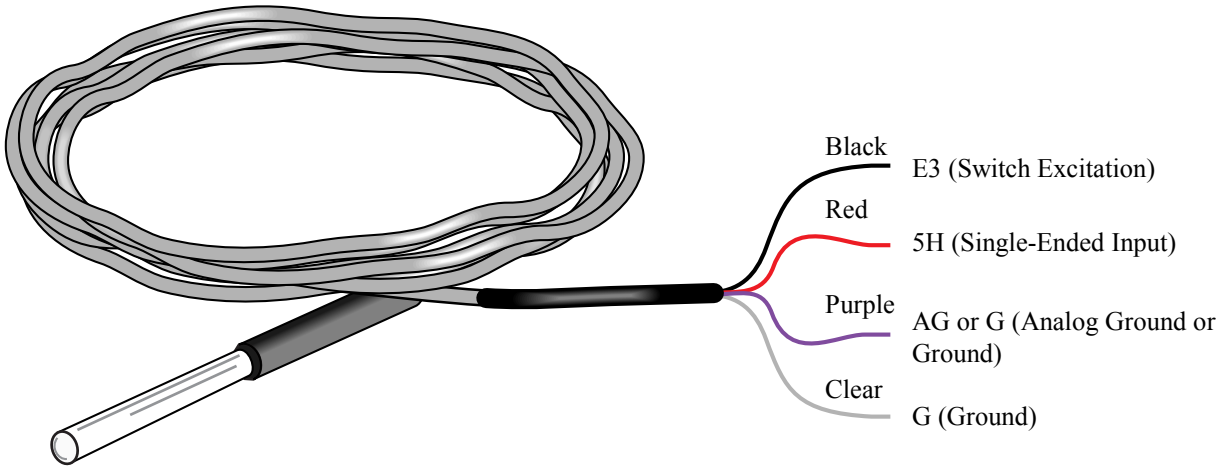

FIGURE 3-2. 108 Probe Datalogger Connections

4. Programming

Instruction 5 (AC Half Bridge) is used to measure the 108 temperature probe. Instruction 55 (polynomial) is used to find the temperature in degrees Celsius.

EXAMPLE 1. Sample CR500 and CR10(X) Instructions

```
01:  AC Half Bridge (P5)
   1:   1              Reps
   2:   3**            ± 25 mV Slow Range
   3:   9*             In Chan
   4:   3*             Ex Chan Option
   5:   1000           mV Excitation
   6:   11*            Loc [ Tmp108C   ]
   7:   200            Mult
   8:   0              Offset

02:  Polynomial (P55)
   1:   1              Reps
   2:   11*            X Loc [ Tmp108C   ]
   3:   11*            F(X) Loc [ Tmp108C   ]
   4:   -26.97         C0
   5:   69.635         C1
   6:   -40.66         C2
   7:   16.573         C3
   8:   -3.455         C4
   9:   .301           C5

*   Proper entries will vary with program and datalogger channel and input location assignments.
**  On the 21X and CR7 use the 50 mV input range and 2000 mV excitation.
```

TABLE 4-1. Polynomial Coefficients

Coefficient	Value
C_0	-26.97
C_1	69.635
C_2	-40.66
C_3	16.573
C_4	-3.455
C_5	0.301

TABLE 4-2. Actual Temperature, Sensor Resistance, and Computed Temperature

Temperature °C	Resistance OHMS	Output °C
-10.00	612366	-9.02
-8.00	546376	-7.36
-6.00	488178	-5.63
-4.00	436773	-3.83
-2.00	391294	-1.97
0.00	351017	-0.05
2.00	315288	1.91
4.00	283558	3.91
6.00	255337	5.93
8.00	230210	7.96
10.00	207807	10.00
12.00	187803	12.04
14.00	169924	14.07
16.00	153923	16.09
18.00	139588	18.10
20.00	126729	20.09
22.00	115179	22.07
24.00	104796	24.05
26.00	95449	26.02
28.00	87026	27.99
30.00	79428	29.97
32.00	72567	31.94
34.00	66365	33.93
36.00	60752	35.93
38.00	55668	37.93
40.00	51058	39.94
42.00	46873	41.96
44.00	43071	43.98
46.00	39613	46.00
48.00	36465	48.02
50.00	33598	50.03
52.00	30983	52.03
54.00	28595	54.03
56.00	26413	56.03
58.00	24419	58.02
60.00	22593	60.01
62.00	20921	61.99
64.00	19388	63.98
66.00	17981	65.97

68.00	16689	67.96
70.00	15502	69.96
72.00	14410	71.97
74.00	13405	73.98
76.00	12479	75.99
78.00	11625	78.01
80.00	10837	80.02
82.00	10110	82.03
84.00	9438.1	84.04
86.00	8816.9	86.03
88.00	8241.9	88.00
90.00	7709.7	89.96
92.00	7216.3	91.89
94.00	6758.9	93.80
96.00	6334.5	95.67
98.00	5940.5	97.51
100.00	5574.3	99.31

5. Maintenance and Calibration

The 108 Probe requires minimal maintenance. Check monthly to make sure the radiation shield is free from debris.

For most applications it is unnecessary to calibrate the 108 to eliminate the thermistor offset. However, for those users that are interested, the following briefly describes calibrating the 108 probes.

A single point calibration can be performed to determine the 108 temperature offset (thermistor interchangeability). This calibration will not remove the polynomial error. The value of the offset must be chosen so that the probe outputs the temperature calculated by the polynomial, not the actual calibration temperature. For example, a 108 is placed in a calibration chamber that is at 0°C and the probe outputs 0.1°C. The offset is -0.15, because at 0°C the polynomial calculates a temperature of -0.05°C (Table 4-2).

6. Long Lead Lengths

If the 108 has lead lengths of more than 300 feet, use the DC Half Bridge instruction (Instruction 4) with a 2 millisecond delay to measure temperature. The delay provides a longer settling time before the measurement is made. Do not use the 108 with long lead lengths in an electrically noisy environment.

Example 3. Sample Program CR10(X) Using DC Half Bridge with Delay

```
01:  Excite, Delay,Volt(SE) (P4)
   1:   1              Rep
   2:   3**            ±25 mV slow range
   3:   9*             IN Chan
   4:   3*             Excite all reps w/EXchan 3
   5:   2              Delay (units .01sec)
   6:   1000**         mV Excitation
   7:   11*            Loc [:Temp_C   ]
   8:   .2***          Mult
   9:   0              Offset

02:  Polynomial (P55)
   1:   1              Reps
   2:   11             X Loc [ Tmp108C   ]
   3:   11             F(X) Loc [ Tmp108C   ]
   4:   -26.97         C0
   5:   69.635         C1
   6:   -40.66         C2
   7:   16.573         C3
   8:   -3.455         C4
   9:   .301           C5

*    Proper entries will vary with program and datalogger channel and input location assignments.
**   On the 21X and CR7 use the 50 mV input range and 2000 mV excitation.
***  Use a multiplier of 0.1 with a 21X and CR7.
```