MODEL HMP35CF TEMPERATURE

AND RELATIVE HUMIDITY PROBE

INSTRUCTION MANUAL

FOURTH REVISION: 5/97

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The **HMP35CF TEMPERATURE AND RELATIVE HUMIDITY PROBE** is warranted by CAMPBELL SCIENTIFIC (CANADA) CORP. ("CSC") to be free from defects in materials and workmanship under normal use and service for **twelve (12) months** from date of shipment unless specified otherwise. CSC's obligation under this warranty is limited to repairing or replacing (at CSC's option) defective products. The customer shall assume all costs of removing, reinstalling, and shipping defective products to CSC. CSC will return such products by surface carrier prepaid. This warranty shall not apply to any CSC products which have been subjected to modification, misuse, neglect, accidents of nature, or shipping damage. This warranty is in lieu of all other warranties, expressed or implied, including warranties of merchantability or fitness for a particular purpose. CSC is not liable for special, indirect, incidental, or consequential damages.

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MODEL HMP35CF
TEMPERATURE AND RELATIVE HUMIDITY PROBE

1. GENERAL

The Model HMP35CF probe contains a Vaisala capacity relative humidity sensor and the YSI 44002A thermistor. The probe is designed to be housed in the 41002-2 12 Plate Gill Radiation Shield, or equivalent; a ten foot lead length is standard. Longer lead lengths are available up to 1000 feet. Voltage drop in the longer lead lengths will lower the RH reading by approximately 0.6% RH per 100 feet of cable. 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 ± 0.4°C accuracy over the range of -53°C to +48°C. NOTE: It is emphasized that this is "worst case" and is CSC's experience the overall accuracy is typically better than ±0.2°C.

The major error component is the ± 0.2°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.

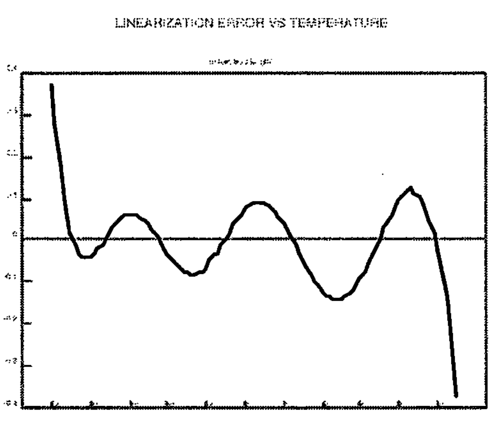

FIGURE 1. Temperature Probe Polynomial Error Curve (0 ft lead) Linearization Range from -55 to 50°C

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

> **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.

3. RH SENSOR - SPECIFICATIONS

The following relative humidity sensor specifications are provided by Vaisala, Inc.

TABLE 1. RH Sensor Specifications

Measurement Range	0 to 100% RH
Output Signal Range	0.002 to 1VDC
Accuracy (at 20°C, including nonlinearity and hysteresis	
against factory references	± 1% RH
against field references	± 2% RH, 0 to 90% ± 3% RH, 90 to 100%
Temperature dependence	± 0.04% RH/°C
Typical long term stability	better than 1% RH per year
Response time (at 20°C, 90% response)	15 s with membrane filter
Settling time	0.15 s
Supply voltage (via CSI switching circuit)	12 VDC
Current consumption	≤ 4 mA
Operating temperature	-20 to +60°C

4. WIRING

Connections to the datalogger for the HMP35CF are shown in Figure 2. The probe requires two single ended analog measurements, the green (RH) and the orange (temp.) leads can be inserted into either HI or LO inputs.

The black thermistor excitation lead connects to any excitation channel. The yellow lead is used to control switching 12 volts to the relative humidity sensor and is normally connected to an excitation channel, although a control port could be used with a different program in the datalogger. The number

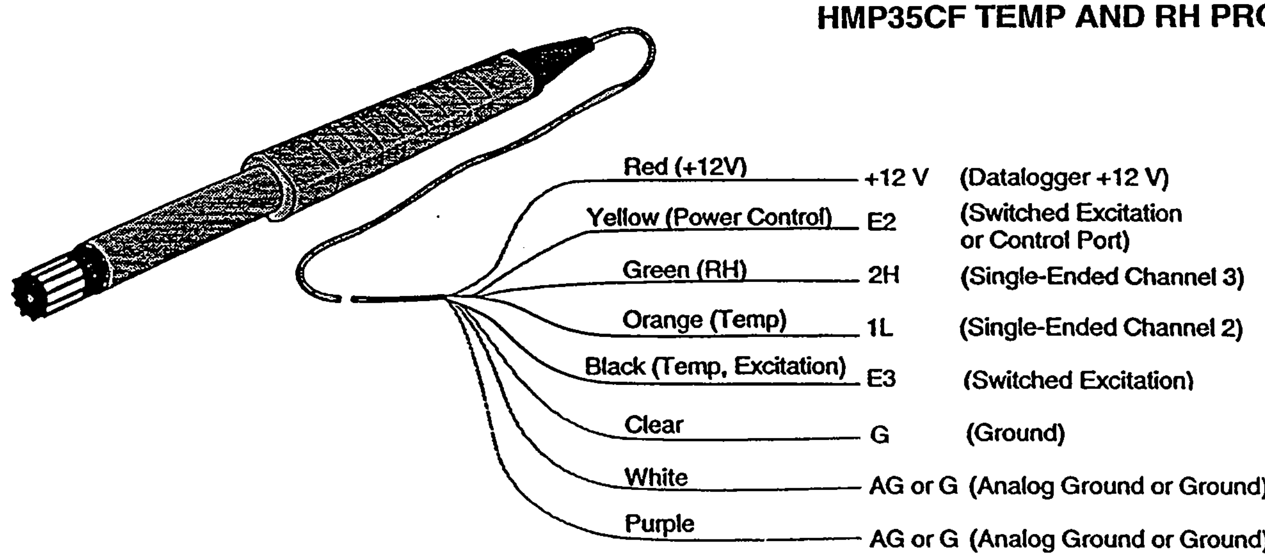

FIGURE 2. HMP35CF Probe Datalogger Connection

of HMP35CF probes per excitation channel is physically limited by the number of lead wires that can be inserted into a single excitation terminal (approximately ten).

> **NOTE:** Do not connect the power control lead and the temperature excitation to the same excitation channel. The power control will slow the response of the excitation and result in temperature errors.

The white and purple leads connect 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.

5. PROGRAMMING

Program Instruction 4 is used twice to measure temperature and relative humidity.

The first 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 of the temperature portion of the probe into degrees Celsius and corrects for errors due to lead length.

The second Program Instruction 4 provides an excitation voltage which switches 12 volts to the humidity circuitry, waits a specified time, then makes a single ended voltage measurement. The humidity portion of the probe is calibrated to have an output of 0 to 1000 millivolts for the 0 to 100% RH range. A multiplier of 0.1 and an offset of 0.0 provides output of relative humidity in percent.

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

The resistance of the YSI44002A thermistor used in the HMP35CF 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 2 lists the polynomial coefficients and corresc-ponding lead lengths for 22 AWG cable which are to be used for HMP35CF probes. Table 3 lists the YSI44002A thermistor resistance without cable at various tempera-tures.

EXAMPLE 1. Sample 21X Instructions for HMP35CF Probe

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:	0		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

03: P       4          Excite, Delay Volt(SE)
 01:        1          Rep
 02:        5   ***    5000 mV slow Range
 03:        2   *      IN Chan
 04:        2   *      Excite all reps w/EXchan 2
 05:       15          Delay (units .01 sec)
 06:     5000   ***    mV Excitation
 07:        2   *      Loc [RH   ]
 08:       .1          Mult
 09:        0          Offset
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* 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.

*** On CR10 the 2500 mV input range and 2500 mV excitation are used.

**** Refer to Table 2 for coefficients.

6. MAINTENANCE

The HMP35CF Probe requires minimal maintenance. Monthly, check to make sure the radiation shield is free from debris. The screen on the sensor should also be checked as often. Annually, check the calibration of the probe. (It should be sent to Campbell Scientific Canada Corp. when recalibration is required and facilities to do so are unavailable.)

COMPENSATION FOR ERROR DUE TO LEAD LENGTH

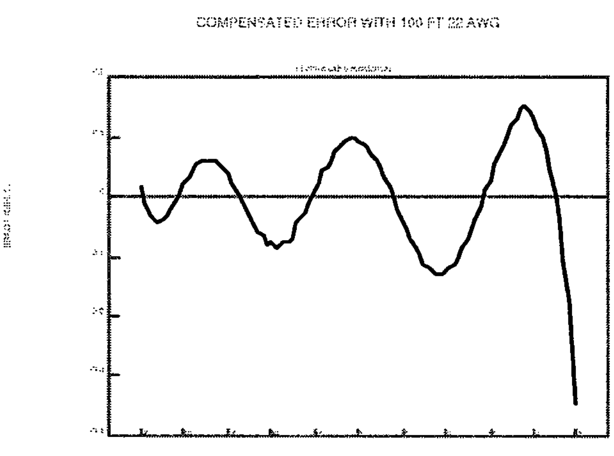

Figure 3: Compensated Error (100 ft 22 AWG)

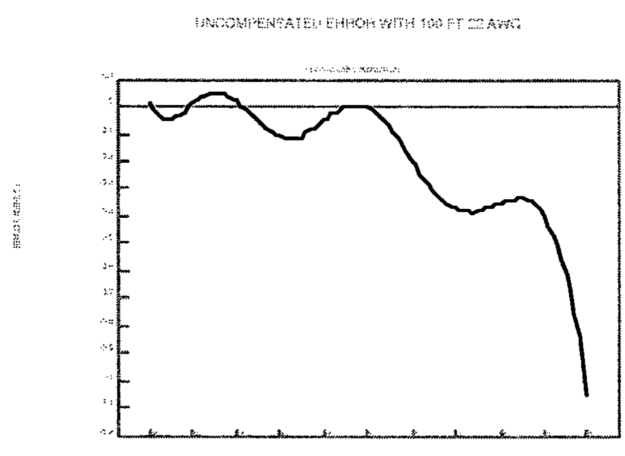

Figure 4: Uncompensated Error (100 ft 22 AWG)

TABLE 2: COEFFICIENTS FOR USE WITH 22 AWG CABLE

(For use with 107F SN C1233 and greater, all HMP35CF and all 207F sensors)

LEAD LENGTH (feet)	CABLE RESISTANCE (ohms)	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 3: Temperature VS Thermistor Resistance for YSI44002A

° C	OHMS	° C	OHMS	° C	OHMS	° 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