INSTRUCTION MANUAL

Model HMP35C Temperature and Relative Humidity Probe

Revision: 1/99

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MODEL HMP35C
TEMPERATURE AND RELATIVE HUMIDITY PROBE

1. GENERAL DESCRIPTION

The HMP35C Temperature and Relative Humidity probe contains a thermistor for measuring temperature and a Vaisala capacitive polymer H chip for measuring relative humidity.

The -L option on the model HMP35C Temperature and Relative Humidity probe (HMP35C-L) indicates that the cable length is user specified. This manual refers to the sensor as the HMP35C.

2. SPECIFICATIONS

Operating Temperature: -35° to +60°C

Storage Temperature: -40° to +80°C

Probe Length: 25.4 cm (10 in.)

Probe Body Diameter: 2.5 cm (1 in.)

Filter: 0.2 µm Teflon membrane

Filter Diameter: 1.9 cm (0.75 in.)

Power Consumption: < 4 mA

Supply Voltage (via CSI switching circuit):
7 to 35 VDC

Settling Time after power is switched on:
0.15 seconds

2.1 TEMPERATURE SENSOR

Sensor: thermistor (100 kΩ @ 25°C)

Temperature Measurement Range:
-35° to +55°C

Thermistor Interchangeability Error:
Typically < ±0.2°C over 0° to +60°C, ±0.4°C @ -35°C

Polynomial Linearization Error:
< ±0.5°C over -35° to +50°C

2.1.1 Temperature Sensor 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 ±0.4°C over the range of -24°C to 48°C and ±0.9°C over the range of -38° to 53°C. The major error component is the interchangeability specification of the thermistor, tabulated in Table 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 and plotted in Figure 1.

TABLE 1. Thermistor Interchangeability

Temperature (°C)	Temperature Tolerance (±°C)
–40	0.40
–30	0.40
–20	0.32
–10	0.25
0 to +50	0.20

TABLE 2. Polynomial Error

Temperature Range(°C)	Error (°C)
–40 to +56	<±1.0°C
–38 to +53	<±0.5°C
–24 to +48	<±0.1°C

2.2 RELATIVE HUMIDITY SENSOR

Sensor: Vaisala capacitive polymer H chip

Relative Humidity Measurement Range:
0 to 100% non-condensing

RH Output Signal Range:
0.002 to 1 VDC

Accuracy at 20°C
±2% RH (0 to 90% Relative Humidity)
±3% RH (90 to 100% Relative Humidity)

Temperature Dependence of Relative Humidity Measurement: ±0.04% RH/°C

Typical Long Term Stability:
Better than 1% RH per year

Response Time (at 20°C, 90% response to steep change in humidity):
15 seconds with membrane filter

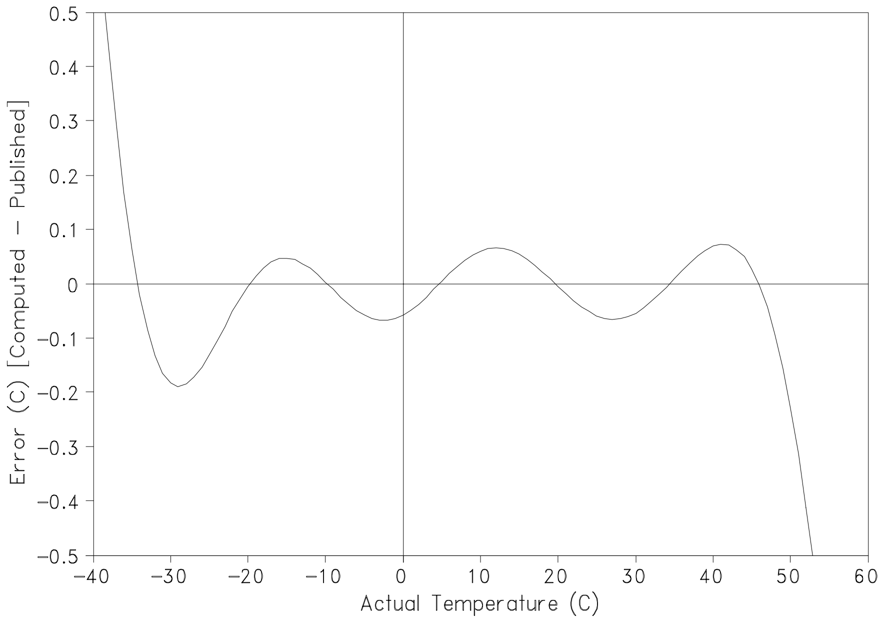

FIGURE 1. Error Produced by Polynomial Fit to Published Values

3. INSTALLATION

The HMP35C must be housed inside a radiation shield when used in the field. The 41002 Radiation Shield (Figure 2) mounts to a CM6/CM10 tripod or UT10 tower. The UT018 mounting arm and UT12VA Radiation Shield mount to a UT30 tower (Figure 3).

A lead length of 6 feet allows the HMP35C to be mounted at a 2 meter height on a CM6/CM10 tripod. Use a lead length of 9 feet for the UT10 tower or a UT30 tower respectively.

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.

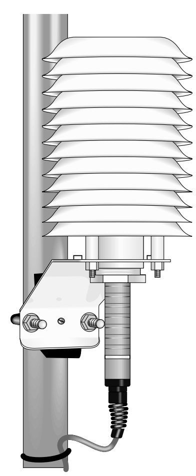

FIGURE 2. HMP35C and 41002 Radiation Shield on a CM6/CM10 Tripod Mast or UT10 Tower Leg

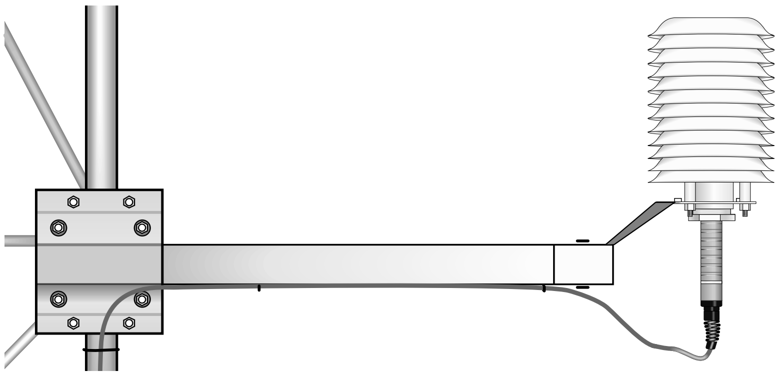

FIGURE 3. HMP35C with UT018 Mounting Bracket and Crossarm and UT12VA Radiation Shield Mounted on a UT30 Tower

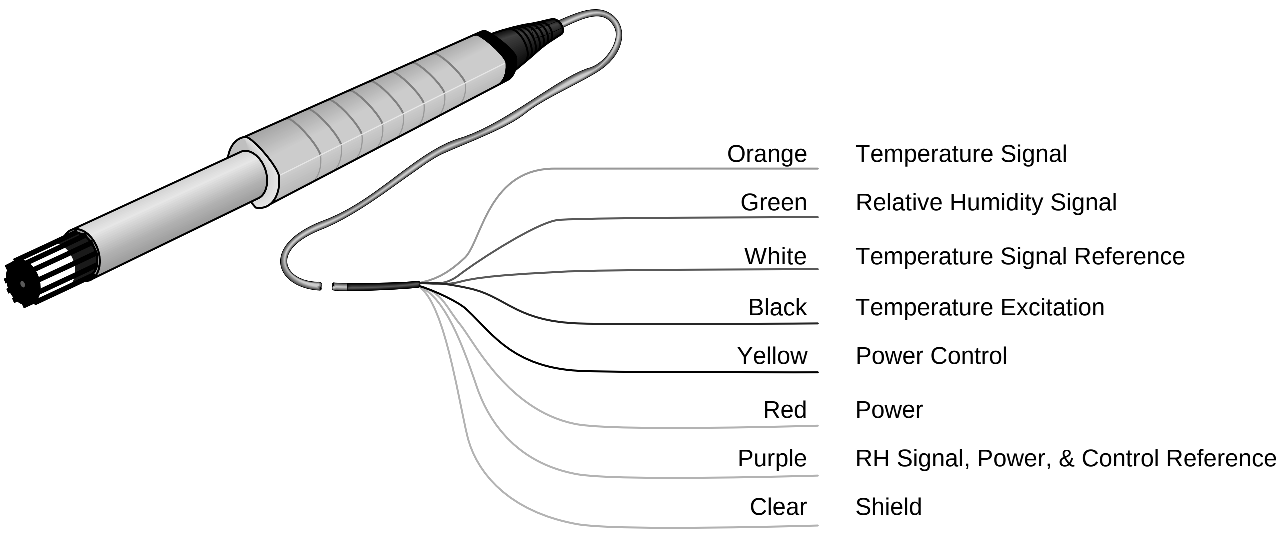

FIGURE 4. HMP35C Probe to Datalogger Connections

TABLE 3. Datalogger Connections

Description	Color	CR10(X), CR500	CR23X	21X, CR7
Temperature	Orange	Single-Ended Input	Single-Ended Input	Single-Ended Input
Relative Humidity	Green	Single-Ended Input	Single-Ended Input	Single-Ended Input
Temperature Signal Reference	White	AG	⏚	⏚
Temperature Excitation	Black	Excitation Channel	Excitation Channel	Excitation Channel
Power Control	Yellow	Control Port	Control Port	Control Port
Power	Red	12 V	12 V	12 V
RH Signal, Power, & Control Reference	Purple	AG	⏚	⏚
Shield	Clear	G	⏚	⏚

4. WIRING

Connections to Campbell Scientific dataloggers are given in Table 3. The probe is measured by two single-ended input channels, one for temperature and one for relative humidity. A single excitation channel is used for the temperature measurement.

The number of HMP35C probes that can be excited by one excitation channel is physically limited by the number of lead wires that can be inserted into a single excitation terminal (approximately 6).

5. EXAMPLE PROGRAMS

This section is for users who write their own datalogger programs. A datalogger program to measure this sensor can be created using Campbell Scientific's Short Cut Program Builder software. You do not need to read this section to use Short Cut.

The temperature is measured using a single-ended analog measurement and an excitation channel (Instruction 11). The relative humidity is measured using a single-ended analog measurement (Instruction 1). Tables 4 and 5 provide calibration information for temperature and relative humidity.

> **CAUTION:** Do no turn the HMP35C on before measuring the thermistor. Doing so will induce a transient signal spike on the thermistor leads that will result in an erroneous temperature measurement. Always measure the HMP35C temperature first.

TABLE 4. Calibration for Temperature

Units	Multiplier (degrees mV^{-1})	Offset (degrees)
Celsius	1	0
Fahrenheit	1.8	32

TABLE 5. Calibration for Relative Humidity

Units	Multiplier (% mV^{-1})	Offset (%)
Percent	0.1	0
Fraction	0.001	0

TABLE 6. Wiring for Example 1

Description	Color	CR10(X)
Temperature	Orange	SE 3 (2H)
Relative Humidity	Green	SE 4 (2L)
Temperature Signal Reference	White	AG
Temperature Excitation	Black	E1
Power Control	Yellow	C1
Power	Red	12 V
RH Signal, Power, & Control Reference	Purple	AG
Shield	Clear	G

Example 1. Sample CR10(X) Program measuring HMP35C Temperature and Relative Humidity

```
;Measure the HMP35C temperature.
;
01:  Temp (107) (P11)
     1:  1    Reps
     2:  3    SE Channel             ;Orange wire (SE 3), White wire (AG)
     3:  1    Excite all reps w/E1   ;Black wire (EX 1)
     4:  1    Loc [ T_C     ]
     5:  1    Mult                   ;See Table 4 for alternate multipliers
     6:  0    Offset                 ;See Table 4 for alternate offsets

;Turn the HMP35C on.
;
02:  Do (P86)
     1: 41    Set Port 1 High        ;Yellow wire (C1)
```

```
;Pause 150 milliseconds, before making the measurement, so the
;probe can stabilize on the true relative humidity.
;
03:  Excitation with Delay (P22)
     1:   1     Ex Channel
     2:   0     Delay W/Ex (units = 0.01 sec)
     3:  15     Delay After Ex (units = 0.01 sec)
     4:   0     mV Excitation

;Measure the HMP35C relative humidity.
;
04:  Volt (SE) (P1)
     1:   1     Reps
     2:   5     2500 mV Slow Range    ;CR500 (2500 mV); CR23X (1000 mV); 21X, CR7 (5000 mV)
     3:   4     SE Channel            ;Green wire (SE 4), Purple wire (AG)
     4:   2     Loc [ RH_pct    ]
     5:   0.1   Mult                  ;See Table 5 for alternate multipliers
     6:   0     Offset

;Turn the HMP35C off.
;
05:  Do (P86)
     1:  51     Set Port 1 Low        ;Yellow wire (C1)
```

6. LONG LEAD LENGTHS

When long lead lengths are required, the measurement settling time for the temperature measurement must be increased. For HMP35Cs with lead lengths greater than 300 feet, use the DC Half Bridge instruction (Instruction 4) with a 20 millisecond delay to measure the thermistor (Example 2).

Long lead lengths cause errors in the measured relative humidity. The approximate error in relative humidity is 0.6% RH per 100 feet of cable length. When long lead lengths are required and the above errors in relative humidity are unacceptable, use the HMP45C temperature and humidity probe.

TABLE 7. Wiring for Example 2

Description	Color	CR10(X)
Temperature	Orange	SE 3 (2H)
Relative Humidity	Green	SE 4 (2L)
Temperature Signal Reference	White	AG
Temperature Excitation	Black	E1
Power Control	Yellow	C1
Power	Red	12 V
RH Signal, Power, & Control Reference	Purple	AG
Shield	Clear	G

Example 2. Sample CR10(X) Program measuring HMP35C Temperature using DC Half Bridge with Delay

```
;Measure the HMP35C thermistor.
;
01:    Excite-Delay (SE) (P4)
       1:     1       Reps
       2:     2       7.5 mV Slow Range    ;CR500 (7.5 mV); CR23X (10 mV); 21X, CR7 (15 mV)
       3:     3       SE Channel           ;Orange wire (SE 3), White wire (AG)
       4:     1       Excite all reps w/Ex 1 ;Black wire (EX 1)
       5:     2       Delay (units 0.01 sec)
       6:  2000       mV Excitation        ;CR500, CR23X (2000 mV); 21X, CR7 (4000 mV)
       7:     1       Loc [ T_C      ]
       8:     0.4     Mult                 ;CR500, CR23X (0.4); 21X, CR7 (0.2)
       9:     0       Offset

;Compute the temperature in degrees Celsius.
;
02:    Polynomial (P55)
       1:     1       Reps
       2:     1       X Loc [ T_C      ]
       3:     1       F(X) Loc [ T_C      ]
       4:   -53.46    C0
       5:    90.807   C1
       6:   -83.257   C2
       7:    52.283   C3
       8:   -16.723   C4
       9:     2.211   C5

;Apply the temperature multiplier.
;
03:    Z=X*F (P37)
       1:     1       X Loc [ T_C      ]
       2:     1       F                    ;See Table 4 for alternate multipliers
       3:     1       Z Loc [ T_C      ]

;Apply the temperature offset.
;
04:    Z=X+F (P34)
       1:     1       X Loc [ T_C      ]
       2:     0       F                    ;See Table 4 for alternate offsets
       3:     1       Z Loc [ T_C      ]

;Turn the HMP35C on.
;
05:    Do (P86)
       1:    41       Set Port 1 High      ;Yellow wire (C1)

;Pause 150 milliseconds, before making the measurement, so the
;probe can stabilize on the true relative humidity.
;
06:    Excitation with Delay (P22)
       1:     1       Ex Channel
       2:     0       Delay W/Ex (units = 0.01 sec)
       3:    15       Delay After Ex (units = 0.01 sec)
       4:     0       mV Excitation
```

```
;Measure the HMP35C relative humidity.
;
07:   Volt (SE) (P1)
      1:   1     Reps
      2:   5     2500 mV Slow Range ;CR500 (2500 mV); CR23X (1000 mV); 21X, CR7 (5000 mV)
      3:   4     SE Channel         ;Green wire (SE 4), Purple wire (AG)
      4:   2     Loc [ RH_pct    ]
      5:   0.1   Mult               ;See Table 5 for alternate multipliers
      6:   0     Offset

;Turn the HMP35C off.
;
08:   Do (P86)
      1:  51     Set Port 1 Low     ;Yellow wire (C1)
```

6.1 TEMPERATURE

Understanding the following details are not required for the general operation of the HMP35C with Campbell Scientific's dataloggers.

Whenever an analog input is switched into the datalogger measurement circuitry prior to making a measurement, a finite amount of time is required for the signal to stabilize to its correct value. The rate at which the signal settles is determined by the input settling time constant which is a function of both the source resistance and input capacitance. Campbell Scientific dataloggers allow a 450 µs settling time before initiating the measurement. In most applications, this settling time is adequate, but additional wire capacitance associated with long sensor leads can increase the settling time constant so that measurement errors occur. See Section 13 in the datalogger manuals for more information.

6.2 RELATIVE HUMIDITY

Understanding the following details are not required for the general operation of the HMP35C with Campbell Scientific's dataloggers.

The relative humidity signal reference and the power reference (black) are the same lead in the HMP35C. When the measuring relative humidity, both the signal and power references are connected to ground at the datalogger. The signal/power reference lead serves as the return path for 12 V. There will be a voltage drop along this lead because the wire itself has resistance. The HMP35C draws approximately 4 mA when it is powered. The wire used in the HMP35C (P/N 9721) has a resistance of 13.9 Ω/1000 feet. Using Ohm's law, the voltage drop (V_d), along the signal reference/power ground lead, is given by Eq. (1).

$$\begin{aligned} V_d &= I * R \\ &= 4 \text{ mA} * 13.9\ \Omega / 1000 \text{ ft} \\ &= 55.6 \text{ mV} / 1000 \text{ ft} \end{aligned} \quad (1)$$

This voltage drop will raise the apparent temperature and relative humidity because the difference between the signal and signal reference, at the datalogger, has increased by V_d. The approximate error in relative humidity is 0.6% RH per 100 feet of cable length.

7. ELECTRICALLY NOISY ENVIRONMENTS

AC power lines can be the source of electrical noise. If the datalogger is in an electronically noisy environment, the HMP35C temperature measurement should be made with the AC half bridge instruction (Instruction 5) with the 60 Hz rejection integration option on the CR10(X), CR500, and CR23X. Use the slow integration on the 21X and CR7.

Use the 60 Hz rejection integration option when measuring the relative humidity with the single-ended analog measurement on the CR10(X), CR500, and CR23X. Use the slow integration on the 21X and CR7.

TABLE 8. Wiring for Example 3

Description	Color	CR10(X)
Temperature	Orange	SE 3 (2H)
Relative Humidity	Green	SE 4 (2L)
Temperature Signal Reference	White	AG
Temperature Excitation	Black	E1
Power Control	Yellow	C1
Power	Red	12 V
RH Signal, Power, & Control Reference	Purple	AG
Shield	Clear	G

Example 3. CR10(X) Program that Measures the HMP35C in an Electrically Noisy Environment

```
;Measure the HMP35C thermistor.
;
01:    AC Half Bridge (P5)
       1:     1       Reps
       2:    22       7.5 mV 60 Hz Rejection Range   ;CR500 (7.5 mV); CR23X (10 mV)
                                                     ;21X, CR7 (15 mV)
       3:     3       SE Channel             ;Orange wire (SE 3), White wire (AG)
       4:     1       Excite all reps w/Ex 1 ;Black wire (EX 1)
       5:  2000       mV Excitation          ;CR500, CR23X (2000 mV); 21X, CR7 (4000 mV)
       6:     1       Loc [ T_C      ]
       7:   800       Mult
       8:     0       Offset

;Compute the temperature in degrees Celsius.
;
02:    Polynomial (P55)
       1:     1       Reps
       2:     1       X Loc [ T_C      ]
       3:     1       F(X) Loc [ T_C      ]
       4:   -53.46    C0
       5:    90.807   C1
       6:   -83.257   C2
       7:    52.283   C3
       8:   -16.723   C4
       9:     2.211   C5

;Apply the temperature multiplier.
;
03:    Z=X*F (P37)
       1:     1       X Loc [ T_C      ]
       2:     1       F                      ;See Table 4 for alternate multipliers
       3:     1       Z Loc [ T_C      ]

;Apply the temperature offset.
;
04:    Z=X+F (P34)
       1:     1       X Loc [ T_C      ]
       2:     0       F                      ;See Table 4 for alternate offsets
       3:     1       Z Loc [ T_C      ]
```

```
;Turn the HMP35C on.
;
05:   Do (P86)
      1:   41     Set Port 1 High        ;Yellow wire (C1)

;Pause 150 milliseconds, before making the measurement, so the
;probe can stabilize on the true relative humidity.
;
06:   Excitation with Delay (P22)
      1:    1     Ex Channel
      2:    0     Delay W/Ex (units = 0.01 sec)
      3:   15     Delay After Ex (units = 0.01 sec)
      4:    0     mV Excitation

;Measure the HMP35C relative humidity.
;
07:   Volt (SE) (P1)
      1:    1     Reps
      2:   25     2500 mV 60 Hz Rejection Range   ;CR500 (2500 mV); CR23X (1000 mV)
                                                  ;21X, CR7 (5000 mV)
      3:    4     SE Channel             ;Green wire (SE 4), Purple wire (AG)
      4:    2     Loc [ RH_pct    ]
      5:    0.1   Mult                   ;See Table 5 for alternate multipliers
      6:    0     Offset

;Turn the HMP35C off.
;
08:   Do (P86)
      1:   51     Set Port 1 Low         ;Yellow wire (C1)
```

8. ABSOLUTE HUMIDITY

The HMP35C measures the relative humidity. Relative humidity is defined by the equation below:

$$RH = \frac{e}{e_s} * 100 \qquad (2)$$

where RH is the relative humidity, e is the vapor pressure in kPa , and e_s is the saturation vapor pressure in kPa. The vapor pressure, e, is an absolute measure of the amount of water vapor in the air and is related to the dew point temperature. The saturation vapor pressure is the maximum amount of water vapor that air can hold at a given air temperature. The relationship between dew point and vapor pressure, and air temperature and saturation vapor pressure are given by Goff and Gratch (1946), Lowe (1977), and Weiss (1977).

When the air temperature increases, so does the saturation vapor pressure. Conversely, a decrease in air temperature causes a corresponding decrease in saturation vapor pressure. It follows then from Eq. (2) that a change in air temperature will change the relative humidity, without causing a change in absolute humidity.

For example, for an air temperature of 20°C and a vapor pressure of 1.17 kPa, the saturation vapor pressure is 2.34 kPa and the relative humidity is 50%. If the air temperature is increased by 5°C and no moisture is added or removed from the air, the saturation vapor pressure increases to 3.17 kPa and the relative humidity decreases to 36.9%. After the increase in air temperature, the air can hold more water vapor. However, the actual amount of water vapor in the air has not changed. Thus, the amount of water vapor in the air, relative to saturation, has decreased.

Because of the inverse relationship between relative humidity and air temperature, finding the mean relative humidity is meaningless. A more useful quantity is the mean vapor pressure. The mean vapor pressure can be computed on-line by the datalogger (Example 4).

TABLE 9. Wiring for Example 4

Description	Color	CR10(X)
Temperature	Orange	SE 3 (2H)
Relative Humidity	Green	SE 4 (2L)
Temperature Signal Reference	White	AG
Temperature Excitation	Black	E1
Power Control	Yellow	C1
Power	Red	12 V
RH Signal, Power, & Control Reference	Purple	AG
Shield	Clear	G

Example 4. Sample CR10(X) Program that Computes Vapor Pressure and Saturation Vapor Pressure

```
;Measure the HMP35C temperature.
;
01:     Temp (107) (P11)
        1:  1     Reps
        2:  3     SE Channel              ;Orange wire (SE 3), White wire (AG)
        3:  1     Excite all reps w/E1    ;Black wire (EX 1)
        4:  1     Loc [ T_C      ]
        5:  1     Mult                    ;See Table 4 for alternate multipliers
        6:  0     Offset                  ;See Table 4 for alternate offsets

;Turn the HMP35C on.
;
02:     Do (P86)
        1: 41     Set Port 1 High         ;Yellow wire (C1)

;Pause 150 milliseconds, before making the measurement, so the
;probe can stabilize on the true relative humidity.
;
03:     Excitation with Delay (P22)
        1:  1     Ex Channel
        2:  0     Delay W/Ex (units = 0.01 sec)
        3: 15     Delay After Ex (units = 0.01 sec)
        4:  0     mV Excitation

;Measure the HMP35C relative humidity.
;
04:     Volt (SE) (P1)
        1:  1     Reps
        2:  5     2500 mV Slow Range      ;CR500 (2500 mV); CR23X (1000 mV); 21X, CR7 (5000 mV)
        3:  4     SE Channel              ;Green wire (SE 4), Purple wire (AG)
        4:  2     Loc [ RH_frac   ]
        5:  0.001 Mult                    ;See Table 5 for alternate multipliers
        6:  0     Offset

;Turn the HMP35C off.
;
05:     Do (P86)
        1: 51     Set Port 1 Low          ;Yellow wire (C1)
```

```
;Compute the saturation vapor pressure in kPa.  The temperature must be in degrees Celsius.
;
06:    Saturation Vapor Pressure (P56)
       1:  1       Temperature Loc [ T_C      ]
       2:  3       Loc [ e_sat    ]

;Compute the vapor pressure in kPa.  Relative humidity must be a fraction.
;
07:    Z=X*Y (P36)
       1:  3       X Loc [ e_sat    ]
       2:  2       Y Loc [ RH_frac  ]
       3:  4       Z Loc [ e_kPa    ]
```

9. INSTRUCTION 11 DETAILS

Understanding the details in this section are not necessary for using the HMP35C Probe with Campbell Scientific's dataloggers.

Instruction 11 outputs a precise 2 VAC excitation (4 V with the 21X) and measures the voltage drop due to the sensor resistance (Figure 5). The thermistor resistance changes with temperature. Instruction 11 calculates the ratio of voltage measured to excitation voltage (Vs/Vx) which relates to resistance as shown below:

$$\frac{V_s}{V_x} = \frac{1000}{R_s + 249000 + 1000} \qquad (2)$$

where Rs is the resistance of the thermistor.

See the measurement section of the datalogger manual for more information on bridge measurements.

Instruction 11 then calculates temperature using a fifth order polynomial equation correlating Vs/Vx with temperature. The polynomial coefficients are given in Table 10. The polynomial input is (Vs/Vx)∗800. Resistance and datalogger output at several temperatures are shown in Table 11.

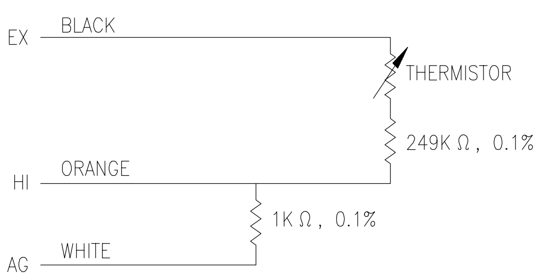

FIGURE 5. Thermistor Probe Schematic

TABLE 10. Polynomial Coefficients

Coefficient	Value
C0	-53.4601
C1	90.807
C2	-83.257
C3	52.283
C4	-16.723
C5	2.211

10. MAINTENANCE

The HMP35C Probe requires minimal maintenance. Check monthly to make sure the radiation shield is free from debris. The black screen on the sensor's end should also be checked.

When installed in close proximity to the ocean or other bodies of salt water (e.g., Great Salt Lake), a coating of salt (mostly NaCl) may build up on the radiation shield, sensor, filter and even the chip. NaCl has an affinity for water. The humidity over a saturated NaCl solution is 75%. A buildup of salt on the filter or chip will delay or destroy the response to atmospheric humidity.

The filter can be rinsed gently in distilled water. If necessary, the chip can be removed and rinsed as well. Do not scratch the chip while cleaning.

Recalibrate the HMP35C annually. Obtain an RMA number before returning the HMP35C to Campbell Scientific for recalibration.

TABLE 11. Temperature, Resistance, and Datalogger Output

Temperature (°C)	Resistance (Ω)	Output (°C)
-40.00	4067212	-39.18
-38.00	3543286	-37.55
-36.00	3092416	-35.83
-34.00	2703671	-34.02
-32.00	2367900	-32.13
-30.00	2077394	-30.18
-28.00	1825568	-28.19
-26.00	1606911	-26.15
-24.00	1416745	-24.11
-22.00	1251079	-22.05
-20.00	1106485	-20.00
-18.00	980100	-17.97
-16.00	869458	-15.95
-14.00	772463	-13.96
-12.00	687276	-11.97
-10.00	612366	-10.00
-8.00	546376	-8.02
-6.00	488178	-6.05
-4.00	436773	-4.06
-2.00	391294	-2.07
0.00	351017	-0.06
2.00	315288	1.96
4.00	283558	3.99
6.00	255337	6.02
8.00	230210	8.04
10.00	207807	10.06
12.00	187803	12.07
14.00	169924	14.06
16.00	153923	16.05
18.00	139588	18.02
20.00	126729	19.99
22.00	115179	21.97
24.00	104796	23.95
26.00	95449	25.94
28.00	87026	27.93
30.00	79428	29.95
32.00	72567	31.97
34.00	66365	33.99
36.00	60752	36.02
38.00	55668	38.05
40.00	51058	40.07
42.00	46873	42.07
44.00	43071	44.05
46.00	39613	46.00
48.00	36465	47.91
50.00	33598	49.77
52.00	30983	51.59
54.00	28595	53.35
56.00	26413	55.05
58.00	24419	56.70
60.00	22593	58.28

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