INSTRUCTION MANUAL

HMP45C212 Temperature & Relative Humidity Probe

October 2010

WARRANTY AND ASSISTANCE

The **HMP45C212 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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Non-warranty products returned for repair should be accompanied by a purchase order to cover repair costs.

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MODEL HMP45C212

TEMPERATURE AND RELATIVE HUMIDITY PROBE

1. GENERAL

The Model HMP45C212 probe contains a Vaisala capacitive relative humidity sensor and a YSI 44212 thermistor as per attached documentation in Appendix A. 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. TEMPERATURE SENSOR SPECIFICATIONS

Air temperature Measurement Range: -50 to +50°C

Thermistor Absoulte Accuracy and interchangability:	± 0.1°C
Linearity:	± 0.09°C
Maximum Uncertainty due to ±0.1% fixed resistors:	±0.15°C @ -50°C ±0.09°C @ 0°C ±0.03°C @ 50°C
Response Time:	10 sec in still air

3. RH SENSOR – SPECIFICATIONS

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 17 VDC

Settling Time: 0.15 seconds

Sensor: HUMICAP® 180

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

RH Output Signal Range: 0.008 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: ±0.05% RH/°C

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

Response Time (at 20°C, 90% response):
15 seconds with membrane filter

4. INSTALLATION

The HMP45C212 must be housed inside a radiation shield when used in the field. The 41002 Radiation Shield (Figure 1) mounts to a CM6/CM10 tripod or UT10 tower. The UT018 mounting arm and UT12VA Radiation Shield mount to a UT30 tower (Figure 2).

A lead length of 6 feet allows the HMP45C212 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.

> **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.

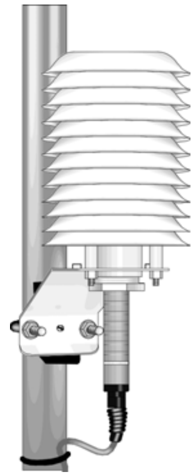

FIGURE 1. HMP45C212 and 41003-2 Radiation Shield on a CM6/CM10 Tripod Mast or UT10 Tower leg

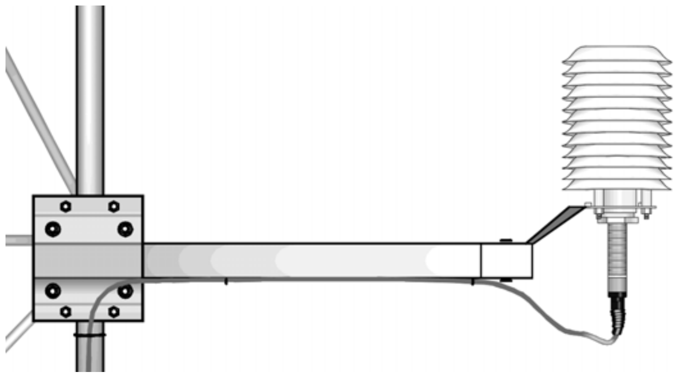

FIGURE 2. HMP45C212 with UT018 Mounting Bracket and Crossarm and UT12VA Radiation Shield Mounted on a UT30 Tower

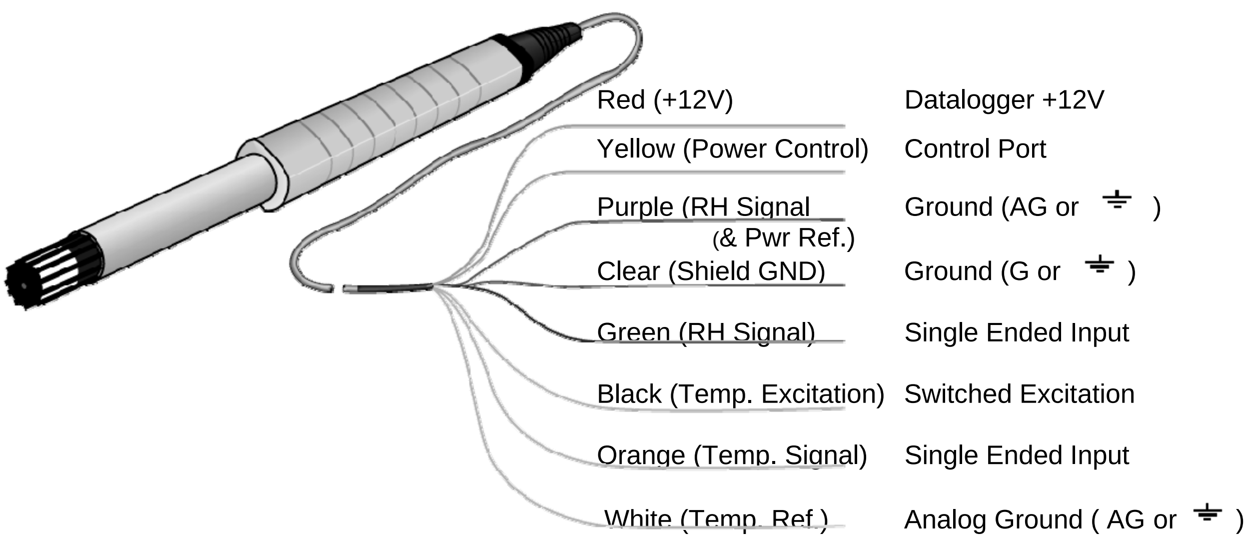

FIGURE 3. HMP45C212 Probe Datalogger Connection

TABLE 1. Datalogger Connections for Single-Ended Measurements

Description	Colour	CR10(X), CR510	CR23X, 21X, CR7	CR1000, CR3000, CR5000, CR800, CR850
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	⏚	⏚
Power Control	Yellow	Control Port	Control Port	Control Port
Power	Red	12V	12V	12V
RH Signal & Power Reference	Purple	AG	⏚	⏚
Shield	Clear	G	⏚	⏚
Temperature Excitation	Black	Switched Excitation	Switched Excitation	Switched Excitation

5. WIRING

Connections to the datalogger for the HMP45C212 are shown in Figure 3 and Table 1. 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 connected to a control port. The number of HMP45C212 probes per excitation channel is physically limited by the number of lead wires that can be inserted into a single excitation terminal (approximately 10).

The white lead connects to Analog ground. The purple lead connects to Analog ground as a reference for both the RH signal and power. Analog ground, labelled “AG” on the CR10X, 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.

6. PROGRAMMING

Program Instruction 4 is used to measure the temperature in example 1. In program example 2, for the CR1000 a Half Bridge measurement is used. Since a different instruction is used to determine temperature a different multiplier is required. However, the instruction offset is unaltered as the start point of the measurement range is the same (i.e. -50 Celsius).

Program Instruction 4 sets an excitation voltage to the thermistor bridge then makes a single ended voltage measurement. The thermistor portion of the probe has a linear millivolt output over the –50 to +50 Celsius range. A multiplier of 0.07154 and an offset of –72.789 provides output of temperature in Celsius.

The HMP45C212 output scale is 0 to 1000 millivolts for the relative humidity range of 0 to 100%. On the RH measurement, use a multiplier of 0.1 for percent and a multiplier of 0.001 for fraction output. The RH measurement does not require an offset.

Example 1. Sample CR10(X) Program Using Single-Ended Measurement Instructions (Includes optional instructions to calculate Vapour Pressure)

```
;Measure the HMP45C212 temperature.
;
01:   P      4      Excite, Delay, Volt (SE)
      1:     1      Rep
      2:     5      2500 mV Slow Range     ; CR510 (2500mV); CR23X, 21X, CR7 (5000mV)
      3:     3      IN Chan                ; Orange Wire (SE3)
      4:     1      EX Chan
```

```
        5:        0           Delay
        6:     2500           mV Excitation
        7:        1           Loc [Air Temp.]
        8:          .07154    Mult                      ; Degrees Celsius
        9:      -72.789       Offset                    ; Degrees Celsius

;Turn the HMP45C212 RH circuitry on.
;
02:     Do (P86)
        1:       41           Set Port 1 High           ; Yellow wire (C1)

;Pause 150 mSec, before making measurements, so the
;probe can stabilize on true readings.
;
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 HMP45C212 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)
        4:        2           Loc [ RH_pct   ]
        5:          .1        Mult                      ; mult 0.1 for percent RH, mult 0.001 for fraction
        6:        0           Offset

;Turn the HMP45C212 off.
;
05:     Do (P86)
        1:       51           Set Port 1 Low            ; Yellow wire (C1)

;Compute Saturation Vapour Pressure.
;The temperature must be in degrees Celsius

6:  Saturation Vapor Pressure (P56)
 1: 1        Temperature Loc [ Air_Temp  ]
 2: 3        Loc [ e_sat     ]

;Compute the Vapor Pressure.
;Relative humidity must be a fraction

7:  Z=X*F (P37)
 1: 2        X Loc [ RH_pct    ]
 2: 0.00001  F
 3: 4        Z Loc [ RH_frac   ]

8:  Z=X*Y (P36)
 1: 3        X Loc [ e_sat     ]
 2: 4        Y Loc [ RH_frac   ]
 3: 5        Z Loc [ e         ]
```

Example 2. Sample CR1000 Program using Single-Ended Measurement instructions (Includes optional instructions to calculate Vapour Pressure)

```
'Declare Variables
Public AirTemp, RH_pct
Public Sat_VP, Vapour_Pressure

'Define Data Tables
DataTable (Test,1,-1)
  DataInterval (0,1,Min,10)
  Average (1,AirTemp,FP2,False)
  Sample (1,RH_pct,FP2)
EndTable

'Main Program
BeginProg
  Scan (5,Sec,0,0)

    'Measure the HMP45C212 Temperature
    'Use 5000 mV voltage range with CR3000 and CR5000 dataloggers
    BrHalf (AirTemp,1,mV2500,1,Vx1,1,2500,True,0,_60Hz,178.85,-72.789)

    'Turn the HMP45C212 RH circuitry on
    PortSet (1,1)

    'Pause 150 mSec, before making measurements, so the
    'probe can stabilize on true readings
    Delay (0,150,mSec)

    'Measure the HMP45C212 relative humidity
    'Use 1000 mV voltage range with CR3000 and CR5000 dataloggers
    VoltSe (RH_pct,1,mV2500,2,1,0,_60Hz,0.1,0)

    'Turn the HMP45C212 RH circuitry off
    PortSet (1,0)

    'Compute Saturation Vapour Pressure
    SatVP (Sat_VP,AirTemp)
     'Compute Vapour Pressure
    VaporPressure (Vapour_Pressure,AirTemp,RH_pct)

    'Call Output Tables
    CallTable Test

  NextScan
EndProg
```

7. MAINTENANCE

The HMP45C212 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.

Long term exposure of the HUMICAP® relative humidity sensor to certain chemicals and gases may affect the characteristics of the sensor and shorten its life. Table 2 lists the maximum ambient concentrations, of some chemicals, that the HUMICAP® can be exposed to. Detailed information on allowed concentrations can be requested from Campbell Scientific representatives.

Table 2. Chemical Tolerances of HMP45C212

Chemical	Concentration (PPM)
Organic solvents	1,000 to 10,000
Aggressive Chemicals (e.g. SO_2, H_2SO_4, H_2S, HCL, CL_2, etc.)	1 to 10
Weak Acids	100 to 1,000
Bases	10,000 to 100,000

Recalibrate the HMP45C212 annually. Obtain an RMA number before returning the HMP45C212 to Campbell Scientific for recalibration.

8. REFERENCES

Goff, J.A. and S. Gratch, 1946: Low-pressure properties of water from -160° to 212°F, *Trans. Amer. Soc. Heat. Vent. Eng.*, **51**, 126-164.

Lowe, P.R., 1977: An approximating polynomial for the computation of saturation vapour pressure, *J. Appl. Meteor.*, **16**, 100-103.

Weiss, A., 1977: Algorithms for the calculation of moist air properties on a hand calculator, *Amer. Soc. Ag. Eng.*, **20**, 1133-1136