

HMP60

Temperature and Relative Humidity Probe




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1. Introduction

The HMP60 probe measures temperature for the range of -40 to 60 °C, and relative humidity for the range of 0 to 100% RH. It is suitable for long-term, unattended monitoring, and is compatible with all Campbell Scientific data loggers.

For Edlog data logger support, check the availability of an older manual at www.campbellsci.com/old-manuals .

2. Precautions



- READ AND UNDERSTAND the [Safety](#) section at the back of this manual.
- Care should be taken when opening the shipping package to not damage or cut the cable jacket. If damage to the cable is suspected, contact Campbell Scientific.
- Although the HMP60 is rugged, it should be handled as a precision scientific instrument.
- Do not touch the sensor element.
- Remove the yellow cap prior to installation.
- Santoprene® rubber, which composes the black outer jacket of the cable, will support combustion in air. It is used because of its resistance to temperature extremes, moisture, and UV degradation. It is rated as slow burning when tested according to U.L. 94 H.B. and passes FMVSS302. However, local fire codes may preclude its use inside buildings.

3. Initial inspection

- Upon receipt of the HMP60, inspect the packaging and contents for damage. File damage claims with the shipping company.
- The model number and cable length are printed on a label at the connection end of the cable. Check this information against the shipping documents to ensure the expected product and cable length were received.

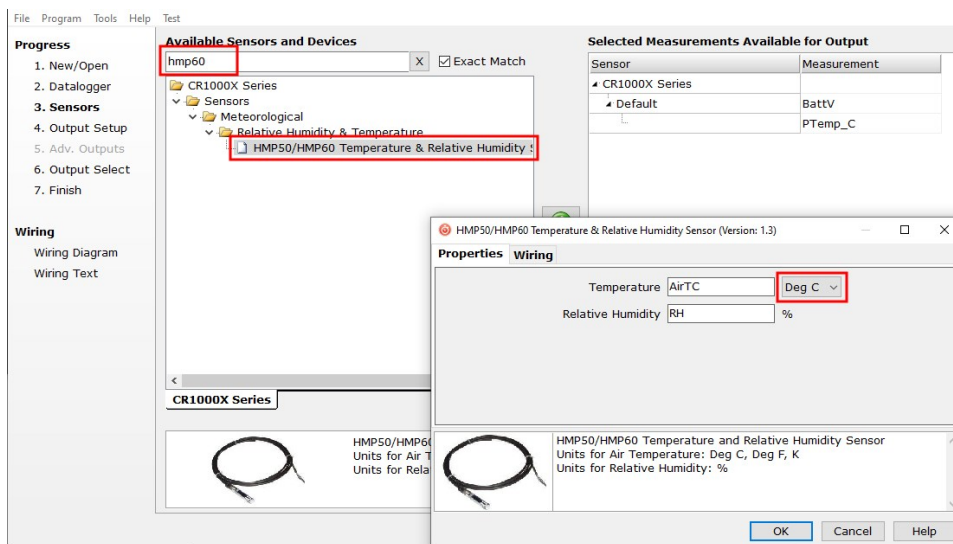
4. QuickStart

A video that describes data logger programming using *Short Cut* is available at:

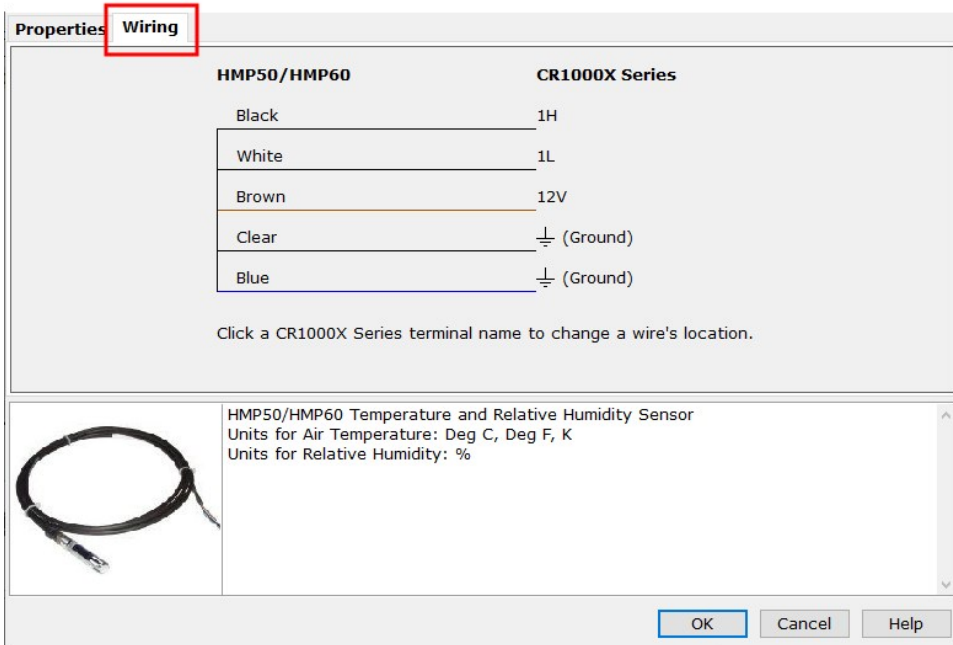
www.campbellsci.com/videos/cr1000x-data-logger-getting-started-program-part-3 . *Short Cut* is an easy way to program your data logger to measure the sensor and assign data logger wiring terminals. *Short Cut* is available as a download on www.campbellsci.com . It is included in installations of *LoggerNet*, *RTDAQ*, and *PC400*.

Use the following procedure to get started.

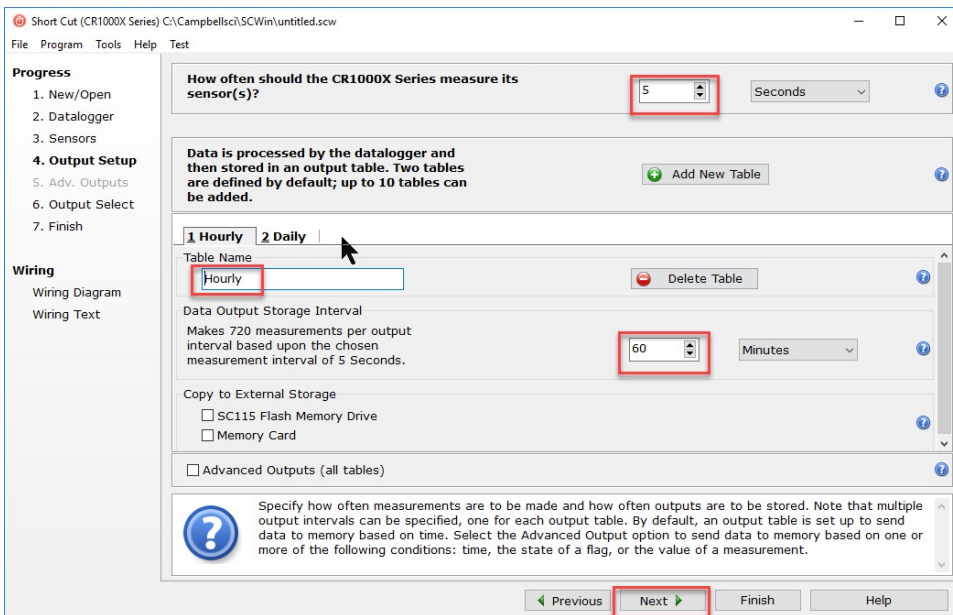
1. Open *Short Cut* and click **Create New Program**.
2. Double-click the data logger model.
3. In the **Available Sensors and Devices** box, type HMP60 or locate the sensor in the **Sensors > Meteorological > Relative Humidity & Temperature > HMP50/HMP60 Temperature & Relative Humidity** folder. Double-click **HMP50/HMP60 Temperature & Relative Humidity Sensor**. Data defaults to degree Celsius. This can be changed by clicking the **Deg C** box and selecting **Deg F**, for degrees Fahrenheit, or **K** for Kelvin.



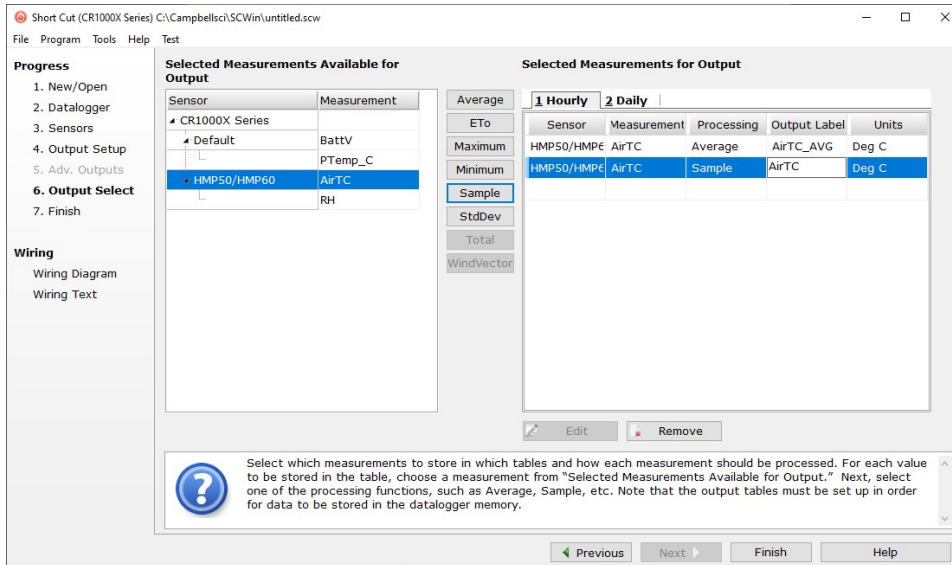
- Click the **Wiring** tab to see how the sensor is to be wired to the data logger. Click **OK** after wiring the sensor.



- Repeat steps three and four for other sensors.
- In **Output Setup**, type the scan rate, meaningful table names, and **Data Output Storage Interval**.



7. Select the measurement and its associated output option.



8. Click **Finish** and save the program. Send the program to the data logger if the data logger is connected to the computer.
9. If the sensor is connected to the data logger, check the output of the sensor in the data display in *LoggerNet*, *RTDAQ*, or *PC400* to make sure it is making reasonable measurements.

5. Overview

The HMP60 Temperature and Relative Humidity probe contains a Platinum Resistance Temperature detector (PRT) and a Vaisala INTERCAP® capacitive relative humidity sensor. It is suitable for long-term, unattended monitoring. The humidity chip is field-replaceable, eliminating recalibration downtime.

Features:

- Field-replaceable humidity chip eliminates recalibration down time
- Compatible with the following data loggers: CR6, CR1000X, CR800 series, CR350 series, CR300 series, CR3000, CR1000

6. Specifications

Operating temperature:	−40 to 60 °C
Probe length:	7.1 cm (2.8 in)
Probe body diameter:	1.2 cm (0.47 in)
Filter:	0.2 µm Teflon membrane
Filter diameter:	1.2 cm (0.47 in)
Housing	
Body material:	AISI 316 stainless steel
Filter cap material:	Chrome-coated ABS plastic
Classification:	IP65
Power consumption:	1 mA typical; 5 mA maximum
Supply voltage:	5 to 28 VDC
Settling time after power is switched on:	1 s
Output signal range:	0 to 1 VDC

6.1 Temperature sensor

Sensor:	1000 Ω PRT, DIN 43760B
Temperature measurement range:	−40 to 60 °C
Temperature accuracy:	±0.6 °C (−40 to 60 °C)

6.2 Relative humidity sensor

Sensor:	INTERCAP®
Relative humidity measurement range:	0 to 100% non-condensing

Typical accuracy
from 0 to 40 °C: ±3% RH over 0 to 90%
 ±5% RH over 90 to 100%

Typical Accuracy
from –40 to 0 °C
and 40 to 60 °C: ±5% RH over 0 to 90%
 ±7% RH over 90 to 100%

7. Installation

If you are programming your data logger with *Short Cut*, skip [Wiring to data logger](#) (p. 6) and [Data logger programming](#) (p. 7). *Short Cut* does this work for you. See [QuickStart](#) (p. 2) for a *Short Cut* tutorial.

7.1 Wiring to data logger

CAUTION:

Always connect the blue wire to the data logger first, followed by the black, white, and clear wires. Connect the brown (power) wire last.

Table 7-1: Wire color, function, and data logger connection

Wire color	Wire function	Data logger connection terminal
Black	Temperature signal	U configured for single-ended analog input ¹ , SE (single-ended, analog-voltage input)
White	Relative humidity signal	U configured for single-ended analog input, SE
Blue	Power ground and signal reference	G
Brown	Power	12V or SW12
Clear	EMF Shield	⏏ (analog ground)

¹U terminals are automatically configured by the measurement instruction.

7.2 Data logger programming

Short Cut is the best source for up-to-date programming code for Campbell Scientific data loggers. If your data acquisition requirements are simple, you can probably create and maintain a data logger program exclusively with *Short Cut*. If your data acquisition needs are more complex, the files that *Short Cut* creates are a great source for programming code to start a new program or add to an existing custom program.

NOTE:

Short Cut cannot edit programs after they are imported and edited in *CRBasic Editor*.

A *Short Cut* tutorial is available in [QuickStart](#) (p. 2). If you wish to import *Short Cut* code into *CRBasic Editor* to create or add to a customized program, follow the procedure in [Importing Short Cut code into CRBasic Editor](#) (p. 16). Programming basics for CRBasic data loggers are provided in the following sections. Complete program examples for select data loggers can be found in [Example programs](#) (p. 17).

Measure the HMP60 with either the [Vo1tSE\(\)](#) or [Vo1tDiff\(\)](#) measurement instruction as described in the following sections.

For a discussion on errors caused by long cable lengths, see [Long cable lengths](#) (p. 11).

7.2.1 Vo1tSE() instruction

When cable lengths are shorter than 6.1 meters or when power is switched, use the [Vo1tSE\(\)](#) measurement instruction to measure the temperature and relative humidity. The HMP60 output scale is 0 to 1000 millivolts for the temperature range of -40 to 60 °C and for the relative humidity range of 0 to 100%.

[Vo1tSE](#)(Dest, Repts, Range, SEChan, MeasOff, SettlingTime, Integ/FNotch, Mu1t, Offset)

Variations:

- Temperature reported as °C – set **Mu1t** to **0.1** and **Offset** to **-40**
- Temperature reported as °F – set **Mu1t** to **.18** and **Offset** to **-40**
- Humidity reported as a percent – set **Mu1t** to **0.1** and **Offset** to **0**
- Humidity reported as a fraction – set **Mu1t** to **0.001** and **Offset** to **0**

NOTE:

When the probe is connected to a CS110 Electric Field Meter, the probe is measured by the CS110 internal CR1000 data logger module using [Vo1tSEC\(\)](#) instructions. Relative humidity and temperature signals are measured on single-ended terminals 1 and 2, respectively. 250 μ s integration should be used in the [Vo1tSEC\(\)](#) instructions.

7.3 Mounting

Sensors should be located over an open level area at least 9 m (EPA) in diameter. The surface should be covered by short grass or the natural earth surface where grass does not grow. Sensors should be located at a distance of at least four times the height of any nearby obstruction, and at least 30 m (EPA) from large, paved areas. Sensors should be protected from thermal radiation, and adequately ventilated.

Standard measurement heights:

- 1.5 m (AASC)
- 1.25 to 2.0 m (WMO)
- 2.0 m (EPA)

See [Attributions and References](#) (p. 15) for a list of references that discuss temperature and relative humidity sensors.

When used in the field, the HMP60 must be housed inside a solar radiation shield. Typically, the 41303-5A or RAD06 6-plate solar radiation shield is used. The HMP60 is held within the 41303-5A by a mounting clamp ([FIGURE 7-2](#) (p. 9)).

This probe may also be housed in a 41003-5 or RAD10 10-plate shield. Additional hardware must be used with the 41003-5. No additional hardware is required with the RAD10. A 10-plate shield adapter allows the HMP60 to be mounted in the lower part of the 41003-5 shield.

The white color of these shields reflects solar radiation, and the louvered construction allows air to pass freely through, thereby keeping the probe at or near ambient temperature. The RAD06 and RAD10 use a double-louvered design that offers improved sensor protection from insect intrusion and driving rain and snow. In addition, the RAD06 and RAD10 shields have lower self-heating in bright sunlight combined with higher temperatures ($> 24\text{ }^{\circ}\text{C}$ ($75\text{ }^{\circ}\text{F}$)) and low wind speeds ($< 2\text{ m/s}$ (4.5 mph)), giving a better measurement.

Each of these solar radiation shields attaches to a crossarm, mast, or user-supplied pipe with a 2.5 to 5.3 cm (1.0 to 2.1 in) outer diameter.

Tools required:

- 1/2 inch open-end wrench
- small screwdriver provided with data logger
- UV-resistant cable ties
- small pair of diagonal-cutting pliers
- Adjustable wrench with a minimum 1-7/8 inch jaw size

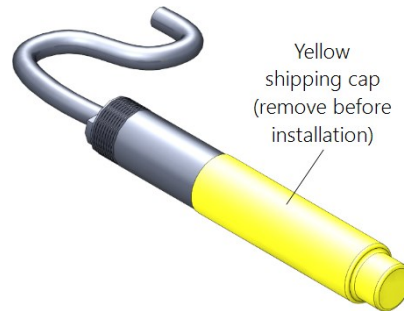


FIGURE 7-1. HMP60 as shipped

7.3.1 Installation in a 41303-5A or 41303-5B 6-plate shield

1. Pull off the yellow shipping cap (see [FIGURE 7-1](#) (p. 9)).
2. With a small Phillips screwdriver, loosen the plastic split collar at the base of the shield (reversing the removable portion if necessary) and gently insert the probe.
3. Tighten the screws on the collar until it firmly grips the probe body (see [FIGURE 7-2](#) (p. 9)).

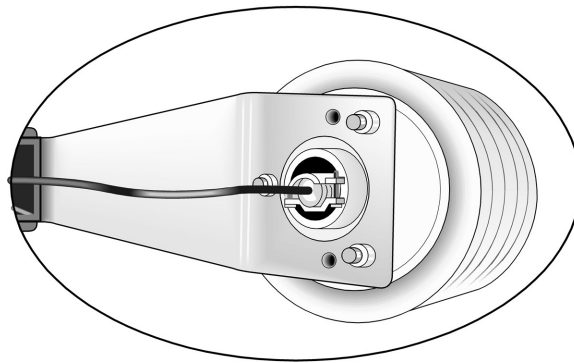


FIGURE 7-2. HMP60 and 41303-5A Radiation Shield

7.3.2 Installation in a RAD06 6-plate shield or RAD10 10-plate shield

1. Pull off the yellow shipping cap (see [FIGURE 7-1](#) (p. 9)).
2. Loosen the nut on the entry gland at the bottom of the shield.
3. Insert the sensor up into the gland as far as it will go (see [FIGURE 7-4](#) (p. 11)).
4. Using an adjustable wrench, tighten down the nut on the gland until the sensor is held firmly in place. Do not overtighten.

7.3.3 Mount the shield

1. Attach the radiation shield to the tripod mast, crossarm, or tower leg using the supplied U-bolt. See [FIGURE 7-3](#) (p. 10) and [FIGURE 7-4](#) (p. 11) for examples of shield mounting.
2. Route the cable to the data logger, and secure the cable to the mounting structure using cable ties.

CAUTION:

Failure to secure the cable can lead to breakage of the wires due to fatigue caused by blowing back and forth in the wind.



FIGURE 7-3. HMP60 and 41303-5A Radiation Shield on a tripod mast (left) and on a CM202 Crossarm (right)



FIGURE 7-4. HMP60 and RAD06 Radiation Shield on a tripod mast

8. Operation

8.1 Measurement

The HMP60 Temperature and Relative Humidity Probe uses a Platinum Resistance Temperature detector (PRT) and a Vaisala INTERCAP® capacitive relative humidity sensor.

8.2 Long cable lengths

Long cable lengths cause errors in the measured temperature and relative humidity. The approximate error in temperature and relative humidity is 0.52 °C and 0.52% per 100 feet of cable length, respectively.

When long cable lengths are required and the above errors in temperature and relative humidity are unacceptable, use the EE181 or HMP155A temperature and relative humidity probe instead.

Understanding the following details are not required for the general operation of the HMP60 with Campbell Scientific data loggers. The signal reference and the power ground (black) are the same wire in the HMP60. When the HMP60 temperature and relative humidity are measured, both the signal reference and power ground are connected to ground at the data logger. The signal reference/power ground wire serves as the return path for 12 V. There will be a voltage drop along this wire because the wire has resistance. The HMP60 draws approximately 2 mA (worst case) when it is powered. The wire used in the HMP60 has resistance of 26.2 Ω /1000 feet.

Using Ohm's law, the voltage drop (V_d), along the signal reference/power ground wire, is given by Eq. 1 (p. 12).

$$\begin{aligned} V_d &= I \times R \\ &= 2 \text{ mA} \times 26.2\Omega/1000 \text{ ft} \\ &= 52.4 \text{ mV}/1000 \text{ ft} \end{aligned} \tag{Eq. 1}$$

This voltage drop will raise the apparent temperature and relative humidity because the difference between the signal and signal reference at the data logger has increased by V_d .

8.3 Absolute humidity

The HMP60 measures relative humidity. Relative humidity is defined by the following equation:

$$\text{RH} = \frac{e}{e_s} \times 100 \tag{Eq. 2}$$

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 dewpoint temperature. The saturation vapor pressure is the maximum amount of water vapor that air can hold at a given air temperature. The relationship between dewpoint 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 (p. 12) that a change in air temperature will change the relative humidity, without causing a change 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 online by the data logger. CRBasic data loggers use the [VaporPressure\(\)](#) instruction to calculate vapor pressure from temperature and relative humidity measurements (see [CRBasic Example 2](#) (p. 18)).

9. Troubleshooting and maintenance

NOTE:

All factory repairs and recalibrations require a returned materials authorization (RMA) and completion of the “Declaration of Hazardous Material and Decontamination” form. Refer to the [Assistance](#) page at the end of this manual for more information.

9.1 Troubleshooting

Symptom: Relative Humidity is reported as –9999, NAN, or 0%

1. Check that the sensor is wired to the correct analog input terminals as specified by the measurement instructions.
2. Verify the range code for the single-ended measurement instruction is correct for the data logger type.

Symptom: Incorrect temperature or relative humidity

1. Verify the multiplier and offset parameters are correct for the desired units ([VoltSE\(\) instruction](#) (p. 7)).

9.2 Maintenance

Check the radiation shield monthly to make sure it is free from dust and debris. To clean the shield, first remove the sensor. Dismount the shield. Brush all loose dirt off. If more effort is needed, use warm, soapy water and a soft cloth or brush to thoroughly clean the shield. Allow the shield to dry before remounting.

The white screen at the tip of the HMP60 should also be checked for contaminants.

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 (see [FIGURE 9-1](#) (p. 14) and [Procedure for removing RH chip](#) (p. 14)). Do not scratch the silver chip while cleaning. It might be necessary to repeat rinsing.

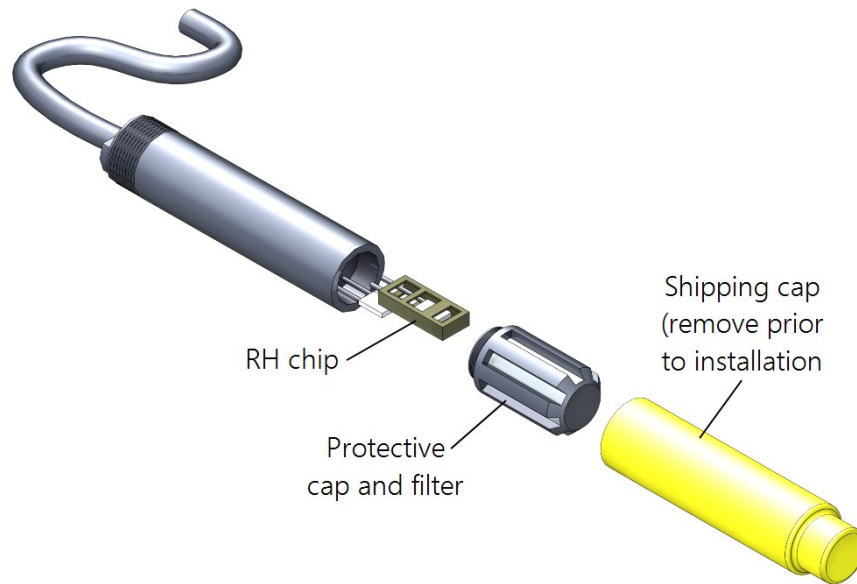


FIGURE 9-1. Exploded view of HMP60 (as shipped)

The offset and gain on the HMP60 electronics cannot be adjusted as part of a recalibration. Generally, the RH chip should be replaced every two years. To determine if the chip needs to be replaced, compare the RH reading with a reference, and replace the RH chip when the relative humidity measurement is out of tolerance.

9.2.1 Procedure for removing RH chip

1. Unscrew the protective cap.
2. Hold the plastic sides of the RH chip and unplug it.

CAUTION:

To prevent scratching, avoid touching the silver RH chip, and handle the RH chip with care.

3. Rinse the RH chip or dispose of the old RH chip.
4. Hold the sides of the rinsed or new chip and plug it in.
5. Screw on the protective cap.

10. Attributions and References

Santoprene[®] is a registered trademark of Exxon Mobile Corporation.

AASC, 1985: The State Climatologist (1985) Publication of the American Association of State Climatologists: *Heights and Exposure Standards for Sensors on Automated Weather Stations*, v. 9, No. 4 October, 1985. (www.stateclimate.org/publications/state-climatologist/NOAA-NCY-SCBOOKS-SC77097/00000029.pdf)

EPA, 2008: *Quality Assurance Handbook for Air Pollution Measurement Systems*, Vol. IV, Meteorological Measurements, Ver. 2.0, EPA-454/B-08-002 (revised 2008). Office of Air Quality Planning and Standards, Research Triangle Park, NC 27711.

Goff, J. A. and S. Gratch, 1946: Low-pressure properties of water from -160° to 212°F, *Trans. Amer. Soc. Heat. Vent. Eng.*, **51**, 125-164.

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

Meyer, S. J. and K. G. Hubbard, 1992: Nonfederal Automated Weather Stations and Networks in the United States and Canada: A Preliminary Survey, *Bulletin Am. Meteor. Soc.*, **73**, No. 4, 449-457.

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

WMO, 2008. *Guide to Meteorological Instruments and Methods of Observation*. World Meteorological Organization No. 8, 7th edition, Geneva, Switzerland.

Appendix A. Importing *Short Cut* code into *CRBasic Editor*


Short Cut creates a .DEF file that contains wiring information and a program file that can be imported into the *CRBasic Editor*. By default, these files reside in the C:\campbellsci\SCWin folder.

Import *Short Cut* program file and wiring information into *CRBasic Editor*:

1. Create the *Short Cut* program. After saving the *Short Cut* program, click the **Advanced** tab then the **CRBasic Editor** button. A program file with a generic name will open in CRBasic. Provide a meaningful name and save the CRBasic program. This program can now be edited for additional refinement.

NOTE:

Once the file is edited with *CRBasic Editor*, *Short Cut* can no longer be used to edit the program it created.

2. To add the *Short Cut* wiring information into the new CRBasic program, open the .DEF file located in the C:\campbellsci\SCWin folder, and copy the wiring information, which is at the beginning of the .DEF file.
3. Go into the CRBasic program and paste the wiring information into it.
4. In the CRBasic program, highlight the wiring information, right-click, and select **Comment Block**. This adds an apostrophe (') to the beginning of each of the highlighted lines, which instructs the data logger compiler to ignore those lines when compiling. The **Comment Block** feature is demonstrated at about 5:10 in the [CRBasic | Features](#) video .

Appendix B. Example programs

The following CR1000X program uses the switched 12 V terminal to switch power on only during measurement, reducing power consumption. Other data loggers are programmed similarly.

CRBasic Example 1: Temperature and RH program

'Program measures the HMP60 probe once every 5 seconds and stores the average temperature and a sample of the relative humidity every 60 minutes.

'Wiring Diagram

'=====

'HMP60

'Wire

<i>'Color</i>	<i>Function</i>	<i>Terminal</i>
<i>'Black</i>	<i>Temperature signal</i>	<i>SE1</i>
<i>'White</i>	<i>Relative Humidity signal</i>	<i>SE2</i>
<i>'Brown</i>	<i>Power</i>	<i>SW12_1</i>
<i>'Blue</i>	<i>Signal & Power Reference</i>	<i>G</i>
<i>'Clear</i>	<i>Shield</i>	<i>Ground Symbol</i>

Public AirTC

Public RH

DataTable(Temp_RH,True,-1)
 DataInterval(0,60,Min,0)
 Average(1,AirTC,FP2,False)
 Sample(1,RH,FP2)
EndTable

BeginProg

 Scan(5,Sec,1,0)

 SW12 (SW12_1,1) *'Turn on switched 12V*

 Delay(0,3,Sec) *'3-second delay*

'HMP50/HMP60 Temperature & Relative Humidity Sensor measurements AirTC and RH

 VoltSe(AirTC,1,mV1000,1,0,0,60,0.1,-40)

 VoltSe(RH,1,mV1000,2,0,0,60,0.1,0)

 If RH>100 AND RH<108 Then RH=100

 SW12 (SW12_1,0)

 CallTable(Temp_RH)

 NextScan

EndProg

The `VaporPressure()` instruction has the following syntax:

```
VaporPressure(Dest,Temp,RH)
```

Where:

Dest is the variable in which the results of the instruction will be stored.

Temp is the program variable that contains the value for the temperature sensor. The temperature measurement must be in degrees Celsius.

RH is the program variable that contains the value for the relative humidity sensor. The relative humidity measurement must be in percent of RH.

CRBasic Example 2: Vapor pressure program

```
'Wiring Diagram
'=====
'HMP60
'Wire
'Color   Function                               Terminal
'-----
'Black   Temperature signal                   SE1
'White   Relative Humidity signal           SE2
'Brown   Power                               12V
'Blue    Signal & Power Reference           G
'Clear   Shield                               Ground Symbol

Public AirTC
Public RH
Public VP

DataTable(Temp_RH,True,-1)
  DataInterval(0,60,Min,0)
  Average(1,AirTC,FP2,0)
  Sample(1,RH,FP2)
  Average(1,VP,FP2,0)
EndTable

BeginProg
  Scan(5,Sec,1,0)
  'HMP60 Temperature & Relative Humidity Sensor measurements AirTC and RH:
  VoltSe(AirTC,1,mV1000,1,0,0,60,0.1,-40.0)
  VoltSe(RH,1,mV1000,2,0,0,60,0.1,0)
  If (RH>100) AND (RH<108) Then RH=100
  VaporPressure(VP,AirTC,RH)
  CallTable(Temp_RH)
  NextScan
EndProg
```

Limited warranty

Products manufactured by Campbell Scientific are warranted by Campbell Scientific to be free from defects in materials and workmanship under normal use and service for twelve months from the date of shipment unless otherwise specified on the corresponding product webpage. See Product Details on the Ordering Information pages at www.campbellsci.com[↗]. Other manufacturer's products, that are resold by Campbell Scientific, are warranted only to the limits extended by the original manufacturer.


Refer to www.campbellsci.com/terms#warranty[↗] for more information.

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Assistance

Products may not be returned without prior authorization.

Products shipped to Campbell Scientific require a Returned Materials Authorization (RMA) or Repair Reference number and must be clean and uncontaminated by harmful substances, such as hazardous materials, chemicals, insects, and pests. Please complete the required forms prior to shipping equipment.

Campbell Scientific regional offices handle repairs for customers within their territories. Please see the back page for the Global Sales and Support Network or visit www.campbellsci.com/contact  to determine which Campbell Scientific office serves your country.

To obtain a Returned Materials Authorization or Repair Reference number, contact your CAMPBELL SCIENTIFIC regional office. Please write the issued number clearly on the outside of the shipping container and ship as directed.

For all returns, the customer must provide a "Statement of Product Cleanliness and Decontamination" or "Declaration of Hazardous Material and Decontamination" form and comply with the requirements specified in it. The form is available from your CAMPBELL SCIENTIFIC regional office. Campbell Scientific is unable to process any returns until we receive this statement. If the statement is not received within three days of product receipt or is incomplete, the product will be returned to the customer at the customer's expense. Campbell Scientific reserves the right to refuse service on products that were exposed to contaminants that may cause health or safety concerns for our employees.

Safety

DANGER — MANY HAZARDS ARE ASSOCIATED WITH INSTALLING, USING, MAINTAINING, AND WORKING ON OR AROUND TRIPODS, TOWERS, AND ANY ATTACHMENTS TO TRIPODS AND TOWERS SUCH AS SENSORS, CROSSARMS, ENCLOSURES, ANTENNAS, ETC. FAILURE TO PROPERLY AND COMPLETELY ASSEMBLE, INSTALL, OPERATE, USE, AND MAINTAIN TRIPODS, TOWERS, AND ATTACHMENTS, AND FAILURE TO HEED WARNINGS, INCREASES THE RISK OF DEATH, ACCIDENT, SERIOUS INJURY, PROPERTY DAMAGE, AND PRODUCT FAILURE. TAKE ALL REASONABLE PRECAUTIONS TO AVOID THESE HAZARDS. CHECK WITH YOUR ORGANIZATION'S SAFETY COORDINATOR (OR POLICY) FOR PROCEDURES AND REQUIRED PROTECTIVE EQUIPMENT PRIOR TO PERFORMING ANY WORK.

Use tripods, towers, and attachments to tripods and towers only for purposes for which they are designed. Do not exceed design limits. Be familiar and comply with all instructions provided in product manuals. Manuals are available at www.campbellsci.com. You are responsible for conformance with governing codes and regulations, including safety regulations, and the integrity and location of structures or land to which towers, tripods, and any attachments are attached. Installation sites should be evaluated and approved by a qualified engineer. If questions or concerns arise regarding installation, use, or maintenance of tripods, towers, attachments, or electrical connections, consult with a licensed and qualified engineer or electrician.

General

- Protect from over-voltage.
- Protect electrical equipment from water.
- Protect from electrostatic discharge (ESD).
- Protect from lightning.
- Prior to performing site or installation work, obtain required approvals and permits. Comply with all governing structure-height regulations.
- Use only qualified personnel for installation, use, and maintenance of tripods and towers, and any attachments to tripods and towers. The use of licensed and qualified contractors is highly recommended.
- Read all applicable instructions carefully and understand procedures thoroughly before beginning work.
- Wear a **hardhat** and **eye protection**, and take **other appropriate safety precautions** while working on or around tripods and towers.
- **Do not climb** tripods or towers at any time, and prohibit climbing by other persons. Take reasonable precautions to secure tripod and tower sites from trespassers.
- Use only manufacturer recommended parts, materials, and tools.

Utility and Electrical

- **You can be killed** or sustain serious bodily injury if the tripod, tower, or attachments you are installing, constructing, using, or maintaining, or a tool, stake, or anchor, come in **contact with overhead or underground utility lines**.
- Maintain a distance of at least one-and-one-half times structure height, 6 meters (20 feet), or the distance required by applicable law, **whichever is greater**, between overhead utility lines and the structure (tripod, tower, attachments, or tools).
- Prior to performing site or installation work, inform all utility companies and have all underground utilities marked.
- Comply with all electrical codes. Electrical equipment and related grounding devices should be installed by a licensed and qualified electrician.
- Only use power sources approved for use in the country of installation to power Campbell Scientific devices.

Elevated Work and Weather

- Exercise extreme caution when performing elevated work.
- Use appropriate equipment and safety practices.
- During installation and maintenance, keep tower and tripod sites clear of un-trained or non-essential personnel. Take precautions to prevent elevated tools and objects from dropping.
- Do not perform any work in inclement weather, including wind, rain, snow, lightning, etc.

Maintenance

- Periodically (at least yearly) check for wear and damage, including corrosion, stress cracks, frayed cables, loose cable clamps, cable tightness, etc. and take necessary corrective actions.
- Periodically (at least yearly) check electrical ground connections.

Internal Battery

- Be aware of fire, explosion, and severe-burn hazards.
- Misuse or improper installation of the internal lithium battery can cause severe injury.
- Do not recharge, disassemble, heat above 100 °C (212 °F), solder directly to the cell, incinerate, or expose contents to water. Dispose of spent batteries properly.

WHILE EVERY ATTEMPT IS MADE TO EMBODY THE HIGHEST DEGREE OF SAFETY IN ALL CAMPBELL SCIENTIFIC PRODUCTS, THE CUSTOMER ASSUMES ALL RISK FROM ANY INJURY RESULTING FROM IMPROPER INSTALLATION, USE, OR MAINTENANCE OF TRIPODS, TOWERS, OR ATTACHMENTS TO TRIPODS AND TOWERS SUCH AS SENSORS, CROSSARMS, ENCLOSURES, ANTENNAS, ETC.



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