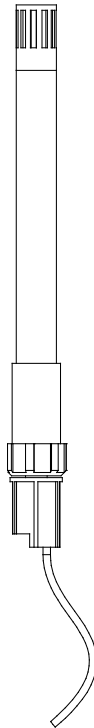


INSTRUCTION MANUAL



Model 083E Relative Humidity and Temperature Sensor

Revision: 9/16



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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 or by telephoning (435) 227-9000 (USA). 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

- Prior to performing site or installation work, obtain required approvals and permits. Comply with all governing structure-height regulations, such as those of the FAA in the USA.
- 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, 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.

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.

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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Model 083E Relative Humidity and Temperature Sensor

1. Introduction

The 083E is a microprocessor controlled relative humidity and temperature sensor. Measurement ranges are 0 to 100% relative humidity and -50 to 50 °C. It is commonly used in association with wind farm power performance measurements on permanent met towers.

NOTE

This manual provides information only for CRBasic dataloggers. It is also compatible with most of our retired Edlog dataloggers. For Edlog datalogger support, see an older manual at www.campbellsci.com/old-manuals.

2. Precautions

- READ AND UNDERSTAND the *Safety* section at the front of this manual.
- The 083E is a sensitive instrument. It is particularly susceptible to damage and miss-calibration. Repair and re-calibration should only be attempted by trained repair technicians. If repair or calibration is required, refer to the customer assistance statement at the head of this manual and contact Campbell Scientific.
- Do not touch the sensor element.

3. Initial Inspection

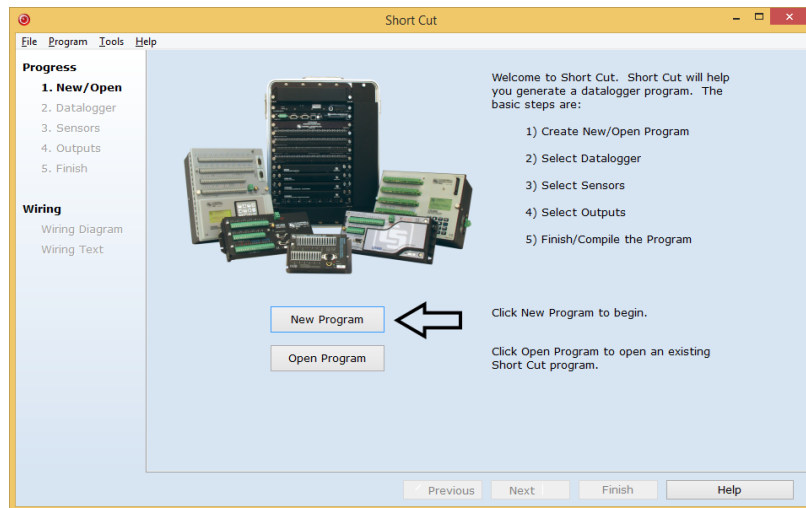
- Upon receipt of the 083E, inspect the packaging and contents for damage. File damage claims with the shipping company.
- The model number and cable length are printed on a label at the connection end of the cable. Check this information against the shipping documents to ensure the expected product and cable length are received.

4. QuickStart

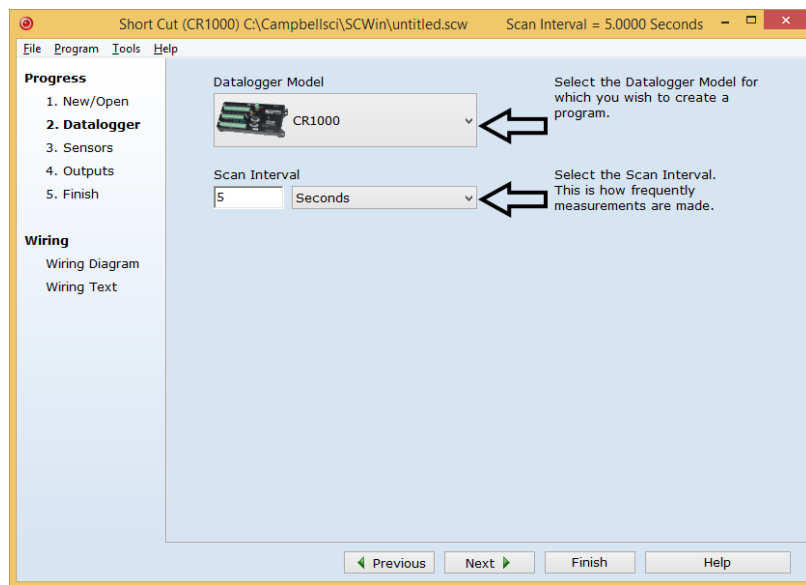
Short Cut is an easy way to program your datalogger to measure the 083E and assign datalogger wiring terminals. *Short Cut* is available as a download on www.campbellsci.com and the *ResourceDVD*. It is included in installations of *LoggerNet*, *PC200W*, *PC400*, or *RTDAQ*.


Use the following procedure to get started.

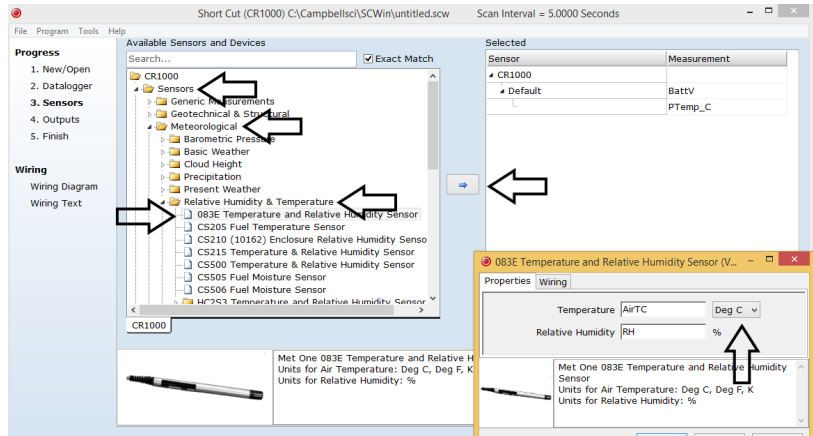
1. Open *Short Cut*. Click **New Program**.



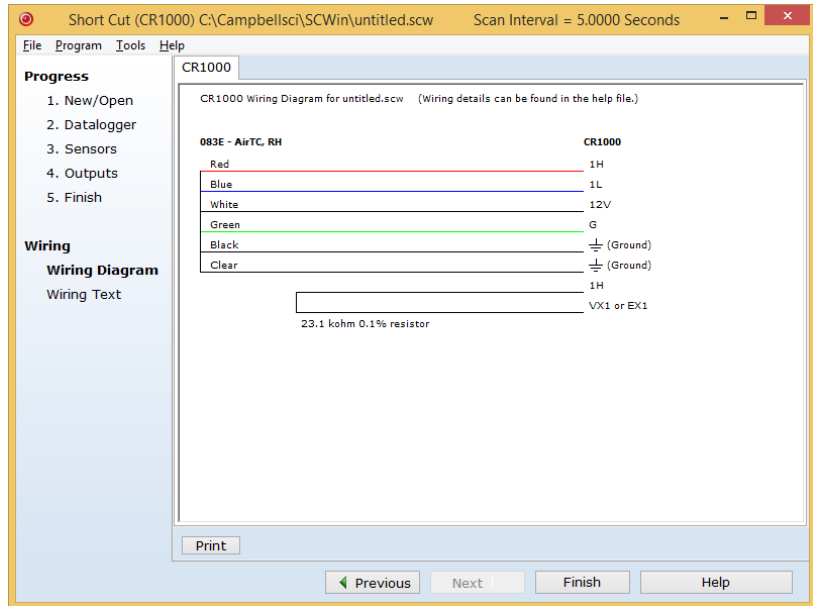
2. Select **Datalogger Model** and **Scan Interval** (default of 5 seconds is OK for most applications). Click **Next**.



- Under the **Available Sensors and Devices** list, select the **Sensors | Meteorological | Relative Humidity & Temperature** folder. Select **083E Temperature and Relative Humidity Sensor** and click  to move the selection to the selected device window. Temperature defaults to **Deg C**, which can be changed by clicking the **Temperature** box and selecting one of the other options.



- After selecting the sensor, click **Wiring Diagram** to see how the sensor is to be wired to the datalogger. The wiring diagram can be printed now or after more sensors are added.



- Select any other sensors you have, then finish the remaining *Short Cut* steps to complete the program. The remaining steps are outlined in *Short Cut Help*, which is accessed by clicking on **Help | Contents | Programming Steps**.

6. If *LoggerNet*, *PC400*, *RTDAQ*, or *PC200W* is running on your PC, and the PC to datalogger connection is active, you can click **Finish** in *Short Cut* and you will be prompted to send the program just created to the datalogger.
7. If the sensor is connected to the datalogger, as shown in the wiring diagram in step 4, check the output of the sensor in the datalogger support software data display to make sure it is making reasonable measurements.

5. Overview

The 083E is a microprocessor-controlled relative humidity and temperature sensor. Relative humidity response is linear with negligible hysteresis or temperature dependence. The temperature sensor is a three-element composite thermistor type with linear response over the range of -50 to 50 °C. The sensor is designed to be mounted in a radiation shield when used outdoors.

6. Specifications

Features:

- Relative humidity sensing element: thin film polymer capacitor
- Temperature sensing element: thermistor
- Compatible with Campbell Scientific CRBasic dataloggers: CR200(X) series, CR300 series, CR6 series, CR800 series, CR1000, CR3000, CR5000, and CR9000(X)

Measurement

Ranges

RH: 0 to 100% relative humidity
Temperature: -50 to 50 °C (-58 to 122 °F)

Accuracies

RH: $\pm 2.0\%$ from 0 to 100% RH
Temperature: ± 0.10 °C (0.18 °F)

Response

RH: 10 s with 2 m/s wind aspiration

Temperature

Operating: -50 to 50 °C (-58 to 122 °F)
 See Section 8.2, *Limitations of RH Measurements at Below Freezing Temperatures* (p. 8).

Compensation: RH is temperature compensated internally

Power requirement

Source: 10 to 18 Vdc
Load: < 5 mA

Outputs

RH: 0 to 1 Vdc
Temperature: Resistive bridge

Dimensions

Length: 216 mm (8.5 in)
Diameter: 19 mm (0.75 in)

7. Installation

If you are programming your datalogger with *Short Cut*, skip Section 7.3, *Wiring* (p. 7), and Section 7.4, *Programming* (p. 7). *Short Cut* does this work for you. See Section 4, *QuickStart* (p. 1), for a *Short Cut* tutorial.

If the sensor is to be mounted in a radiation shield, refer to Section 7.2, *Mounting* (p. 5). Sensors not installed in a radiation shield should be mounted in a representative location having good airflow and shaded from sunlight or other radiant heat source.

7.1 Siting

Locate sensors over an open level area at least 9 m (EPA) in diameter. The surface should be covered by short grass, or where grass does not grow, the natural earth surface. Locate sensors away from objects at least a distance equal to four times the height of the objects, and at least 30 m (EPA) from large paved areas. Protect sensors from thermal radiation and ensure adequate ventilation.

Standard measurement heights:

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

See Section 10, *References* (p. 10), for a list of sources that discuss temperature and relative humidity sensors and siting.

7.2 Mounting

When used in the field, the 083E must be housed in a radiation shield such as the 41003-5 or RAD14 naturally aspirated shields.

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 RAD14 uses a double-louvered design that offers improved sensor protection from insect intrusion and driving rain and snow. In addition, the RAD14 shield has 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.

The 41003-5 and RAD14 Radiation Shields attach to a crossarm, mast, or user-supplied pipe with a 2.5 to 5.3 cm (1.0 to 2.1 in) outer diameter. See FIGURE 7-1 for examples of shield mounting.

Tools required for installing a 083E sensor in a radiation shield to a tripod or tower include:

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

Attach the sensor cable to the connector on the bottom of the 083E.

7.2.1 Installation in a 41003-5 10-Plate Shield

1. The 083E is shipped with a hex plug to work with the 41003-5 10-plate shield. Loosely thread the hex plug into the base of the 10-plate shield.
2. Insert the 083E sensor through the center of the hex plug. See FIGURE 7-1.
3. Hold the hex plug and sensor, and finish threading the hex plug into the shield by hand. Tighten the hex plug around the probe until it firmly grips the body of the probe.

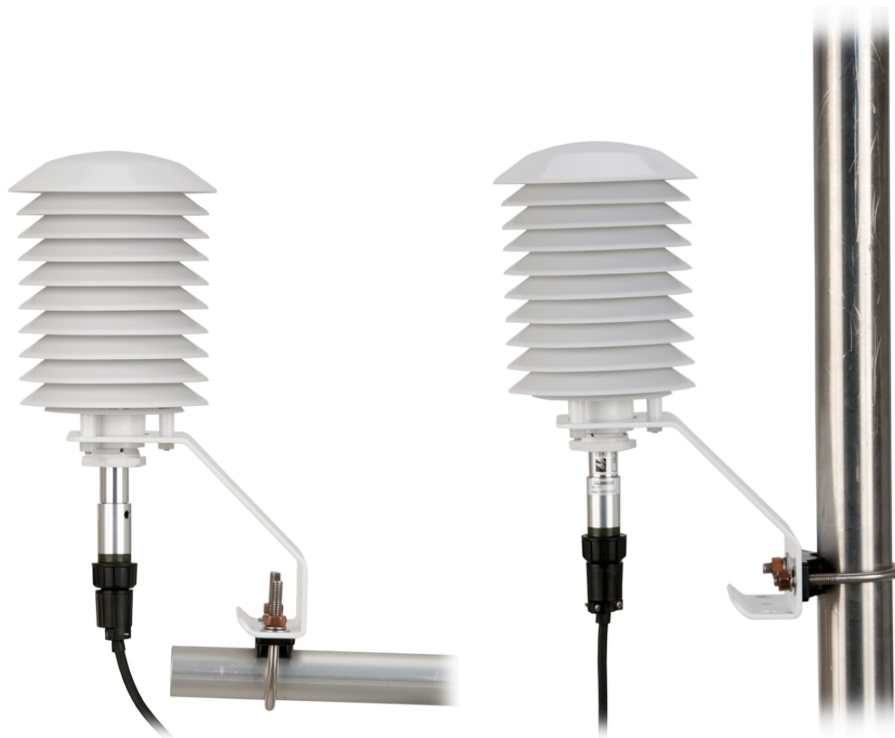


FIGURE 7-1. 083E and 41003-5 Radiation Shield on a CM200 Series Crossarm (left) and on a tripod mast (right)

7.2.2 Installation in a RAD14 14-Plate Shield

1. Loosen the nut on the entry gland at the bottom of the shield.
2. Insert the sensor up into the gland.
3. Using an adjustable wrench, tighten the nut on the gland until the sensor is held firmly in place. Do not over tighten.

7.2.3 Mount the Shield

1. Attach the radiation shield to the tripod mast, crossarm, or tower leg using the supplied U-bolt. See FIGURE 7-1 for examples of shield mounting.
2. Route the cable to the datalogger, and secure the cable to the mounting structure using cable ties.

7.3 Wiring

Datalogger wiring is provided in TABLE 7-1, and details about the connector pins are provided in Appendix C, *Pin Descriptions* (p. C-1).

Wire Color	Wire Function	Datalogger Connection Terminal
Red	Temperature Signal	U configured for single-ended analog input ¹ , SE (single-ended, analog input)
		U configured for voltage excitation ¹ , EX, or VX (voltage excitation) ²
Blue	RH Signal	U configured for single-ended analog input ¹ , SE (single-ended, analog input)
Black	Signal Reference	AG or \perp (analog ground)
White	Power	12V
Green	Ground	G
Clear	Shield	AG or \perp (analog ground)

23.1 kΩ
±0.1%

¹U channels are automatically configured by the measurement instruction.
²Use a jump resistor (pn 28430) between the single-ended analog input and the voltage excitation channel.

7.4 Programming

Short Cut is the best source for up-to-date datalogger programming code. Programming code is needed when:

- Creating a program for a new datalogger installation
- Adding sensors to an existing datalogger program

If your data acquisition requirements are simple, you can probably create and maintain a datalogger 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 Section 4, *QuickStart* (p. 1). If you wish to import *Short Cut* code into *CRBasic Editor* to create or add to a customized program, follow the procedure in Appendix A, *Importing Short Cut Code Into CRBasic Editor* (p. A-1). Programming basics for *CRBasic* dataloggers are in the following section. A complete program example for a select *CRBasic* datalogger can be found in Appendix B, *Example Program* (p. B-1).

7.4.1 Relative Humidity Program Instruction

For *CRBasic* dataloggers, relative humidity is measured using the **VoltSE()** instruction. Syntax of the **VoltSE()** instruction is:

`VolTSE(Dest, Reps, Range, SEChan, MeasOff, SettlingTime, Integ/FNotch, Mult, Offset)`

7.4.2 Temperature Program Instruction

For most CRBasic dataloggers, temperature is measured using the **BRHalf()** instruction. Syntax of the **BRHalf()** instruction is:

`BrHalf(Dest, Reps, Range, SEChan, ExChan, MeasPEX, ExmV, RevEx, SettlingTime, Integ, Mult, Offset)`

The CR200(X)-series dataloggers use the **EXDelSe()** instruction, which has the following syntax:

`ExDelSE(Dest, Reps, SEChan, ExChan, ExmV, Delay, Mult, Offset)`

The **BRHalf** and **EXDelSe** instructions provide a resistance value (see Section 8.3, *Converting Resistance Measurement to Temperature (p. 9)*).

8. Operation

8.1 Sensor Verification

To verify correct wiring and test the basic sensor operation, blow on the sensor. The moisture in your breath should cause the relative humidity reading to rise.

To ensure proper operation, check the output data against a relative humidity and temperature measuring device such as a psychrometer. Local weather service data should be used only as a guideline since relative humidity and temperature can vary significantly over short distances and over brief periods of time.

8.2 Limitations of RH Measurements at Below Freezing Temperatures

The relative humidity measurement is referenced to saturated water vapor pressure above liquid water. When air temperature is below freezing, the maximum theoretical measurement range is limited as follows:

Air Temperature (Deg C)	Maximum RH (%)
0	100
-5	96
-10	92
-15	88
-20	84
-25	80
-30	76
-35	72
-40	68
-45	64
-50	60

8.3 Converting Resistance Measurement to Temperature

The temperature sensor is a resistive device. A resistance measurement across the red and black leads of the 083E should equal the resistances listed in TABLE 8-1 at the stated temperatures.

TABLE 8-1. Model 083E-1-X Temperature vs. Sensor Resistance					
YSI thermistor bead 44212					
Temp (°C)	RCAL (Ω Ohms)	Temp (°C)	RCAL (Ω Ohms)	Temp (°C)	RCAL (Ω Ohms)
-50	158181	-16	49648	18	22404
-49	150561	-15	48389	19	21908
-48	143555	-14	47173	20	21423
-47	137093	-13	45997	21	20949
-46	131114	-12	44861	22	20484
-45	125564	-11	43761	23	20029
-44	120400	-10	42696	24	19583
-43	115583	-9	41665	25	19147
-42	111079	-8	40665	26	18719
-41	106858	-7	39696	27	18300
-40	102895	-6	38755	28	17889
-39	99166	-5	37843	29	17487
-38	95651	-4	36957	30	17092
-37	92333	-3	36097	31	16705
-36	89196	-2	35260	32	16325
-35	86224	-1	34447	33	15952
-34	83406	0	33657	34	15586
-33	80729	1	32888	35	15227
-32	78183	2	32139	36	14875
-31	75760	3	31410	37	14529
-30	73449	4	30700	38	14190
-29	71245	5	30009	39	13856
-28	69138	6	29335	40	13528
-27	67124	7	28677	41	13206
-26	65195	8	28037	42	12890
-25	63348	9	27411	43	12579
-24	61576	10	26801	44	12274
-23	59875	11	26206	45	11974
-22	58242	12	25624	46	11678
-21	56671	13	25056	47	11388
-20	55160	14	24501	48	11102
-19	53705	15	23959	49	10822
-18	52303	16	23429	50	10545
-17	50952	17	22911		

Following are polynomial expressions derived from TABLE 8-1.

$$T_c = (((R_t^{-1}) + (23100^{-1}))^{-1}) - 13698.3) / -129.163$$

$$R_t = (((-129.163 T_c) + 13698.3)^{-1}) - 23100^{-1})^{-1}$$

Where: T_c = temperature in °C and R_t = sensor resistance in ohms (Ω)

9. Maintenance and Troubleshooting

NOTE All factory repairs, replacements, and calibrations require a returned material authorization (RMA) and completion of the “Declaration of Hazardous Material and Decontamination” form. Refer to the [Assistance](#) page at the beginning of this manual for more information.

9.1 Maintenance Schedule

The 083E is designed to operate for an extended period with minimum maintenance. However, it can be damaged by untrained personnel attempting disassembly or calibration.

6 – 12 Month Intervals:

- Inspect the sensor for proper operation per Section 8.1, *Sensor Verification* (p. 8).

12 Month Interval:

- Return the sensor to Campbell Scientific for calibration and replacement of the O-rings and the filter membrane.

10. References

- 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/sites/default/files/upload/pdf/state-climatologist/00000029.pdf)
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Appendix A. Importing Short Cut Code Into CRBasic Editor

This tutorial shows:

- How to import a *Short Cut* program into a program editor for additional refinement
- How to import a wiring diagram from *Short Cut* into the comments of a custom program

Short Cut creates files, which can be imported into *CRBasic Editor*. Assuming defaults were used when *Short Cut* was installed, these files reside in the C:\campbellsci\SCWin folder:

- .DEF (wiring and memory usage information)
- .CR2 (CR200(X)-series datalogger code)
- .CR300 (CR300-series datalogger code)
- .CR6 (CR6-series datalogger code)
- .CR8 (CR800-series datalogger code)
- .CR1 (CR1000 datalogger code)
- .CR3 (CR3000 datalogger code)
- .CR5 (CR5000 datalogger code)
- .CR9 (CR9000 datalogger code)

Use the following procedure to import *Short Cut* code and wiring diagram into *CRBasic Editor*.

1. Create the *Short Cut* program following the procedure in Section 4, *QuickStart* (p. 1). Finish the program and exit *Short Cut*. Make note of the file name used when saving the *Short Cut* program.
2. Open *CRBasic Editor*.
3. Click **File | Open**. Assuming the default paths were used when *Short Cut* was installed, navigate to C:\CampbellSci\SCWin folder. The file of interest has the .CR2, .CR300, .CR6, .CR8, .CR1, .CR3, .CR5, or .CR9 extension. Select the file and click **Open**.
4. Immediately save the file in a folder different from C:\Campbellsci\SCWin, or save the file with a different file name.

NOTE

Once the file is edited with *CRBasic Editor*, *Short Cut* can no longer be used to edit the datalogger program. Change the name of the program file or move it, or *Short Cut* may overwrite it next time it is used.

5. The program can now be edited, saved, and sent to the datalogger.
6. Import wiring information to the program by opening the associated .DEF file. Copy and paste the section beginning with heading “-Wiring for CRXXX-” into the CRBasic program, usually at the head of the file. After pasting, edit the information such that an apostrophe (') begins each line. This character instructs the datalogger compiler to ignore the line when compiling.

Appendix B. Example Program

TABLE B-1 describes the sensor wiring used with the following example CRBasic datalogger program.

TABLE B-1. 083E Sensor Wiring for Example Program			
Wire Color	Cable Label	Datalogger Channel CR1000	Jumped Resistor 28430
White	Power 12V	12V	<p>Jump resistor between SE8 and VX1</p> <p>23.1 kΩ ±0.1%</p>
Green	Ground	G	
Blue	Signal ref	SE1	
Black	Signal reference temperature	⊥	
Red	Signal temp	SE8	
Clear	Shield	⊥	
		VX1	

```

CRBasic Example B-1. CR1000 Program Measuring 083E

'CR1000 program to measure 083E-L
Public MetOne_083E_Temp
Public MetOne_083E_RH

DataTable(Table1,True,-1)
  DataInterval(0,10,Min,10)
  Average(1,MetOne_083E_Temp,FP2,False)
  Sample(1,MetOne_083E_RH,FP2)
EndTable

'Main Program
BeginProg
  Scan (5,Sec,1,0)

  'MetOne 083E Temperature in Degrees C
  BrHalf (MetOne_083E_Temp,1,mV2500,8,Vx1,1,2000,True ,0,_60Hz,-178.89,105.99)

  'MetOne 083E Relative Humidity
  VoltSe (MetOne_083E_RH,1,mV2500C,2,1,0,_60Hz,0.1,0)

  CallTable(Table1)

NextScan
EndProg

```


Appendix C. Pin Descriptions

TABLE C-1 provides the pin label and pin function.

Pin	Pin Function
A	+10 to +18 Vdc
B	Signal Ground
C	RH Analog Output
D	Temperature Signal
E	Not Used

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