INSTRUCTION MANUAL

Model 083E Relative Humidity and Temperature Sensor

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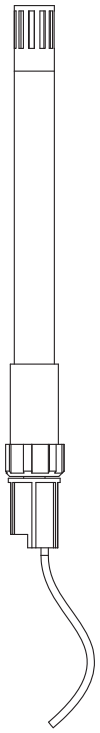

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Figures

Table

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°C to 50°C. It is commonly used in association with wind farm power performance measurements on permanent met towers.

Before using the 083E, please study

- Section 2, *Cautionary Statements*
- Section 3, *Initial Inspection*
- Section 4, *Quickstart*

More details are available in the remaining sections.

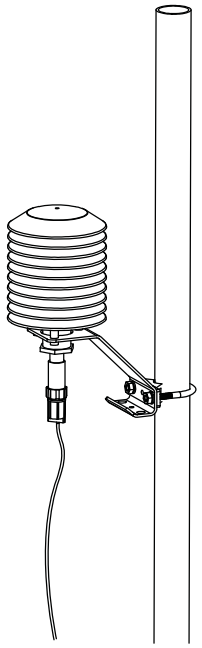


FIGURE 1-1. 083E mounted in a 41003-5 radiation shield

2. Cautionary Statements

- 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

Figure 1-1 shows the 083E installed in a 41003-5 radiation shield. Figures 4-1 and 4-2 show the radiation shield mounted on a crossarm and a mast, respectively.

4.1 Quick Installation

Review Section 7, *Installation* for complete instructions. To install the 083E, you will need:

- 41003-5 Radiation Shield
- 28415 Hex Plug (ships with 083E sensor)

1. Insert the 28415 hex plug that ships with the 083E sensor into the underside of the 41003-5 base.

2. Attach the radiation shield to the tripod mast, crossarm, or tower leg using the supplied U-bolt. See Figures 4-1 and 4-2 for examples of shield mounting.

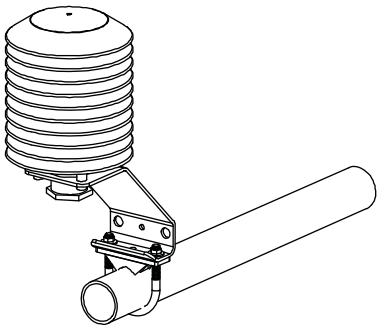


FIGURE 4-1. 41003-5 radiation shield mounted on a crossarm

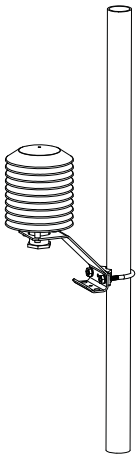


FIGURE 4-2. 41003-5 radiation shield mounted on a mast

3. Insert the sensor through the center of the hex plug at the bottom of the radiation shield.

4. Tighten the hex plug such that it compresses against the body of the 083E to hold it inside the radiation shield.

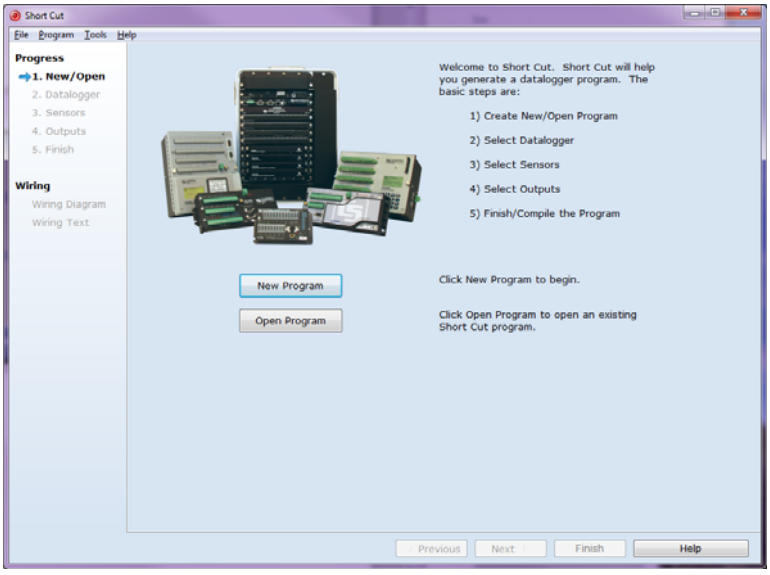
5. Attach the sensor cable to the connector on the bottom of the 083E.

6. Secure sensor cable to mast or crossarm with cable ties.

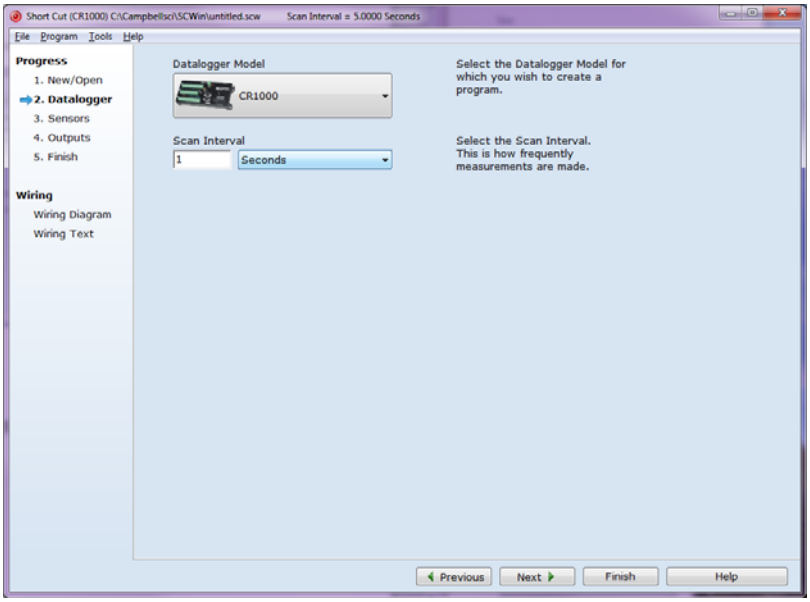
4.2 Programming with Short Cut

Short Cut Program Generator for Windows can be used to program the CR1000 datalogger to measure the 083E as outlined in the following procedure. Short Cut can also be used to program other 083E compatible Campbell Scientific dataloggers.

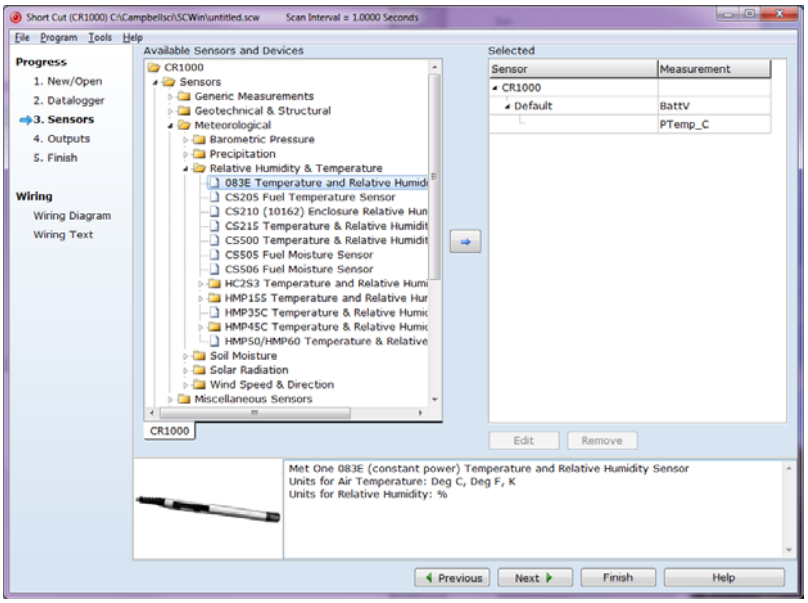
1. Open Short Cut and click on **New Program**.



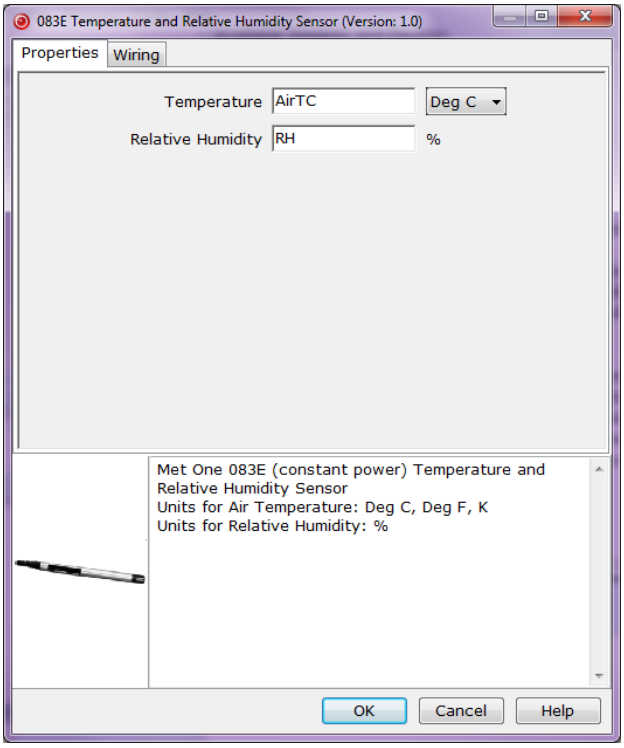
2. Select a scan interval.



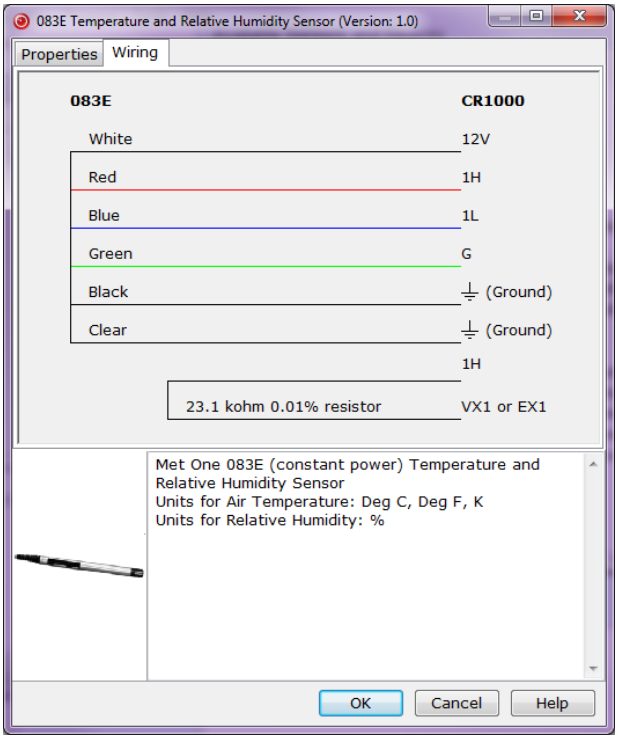
3. Select **083E Temperature and Relative Humidity Sensor** and click the **right arrow** to add it to the list of sensors to be measured.



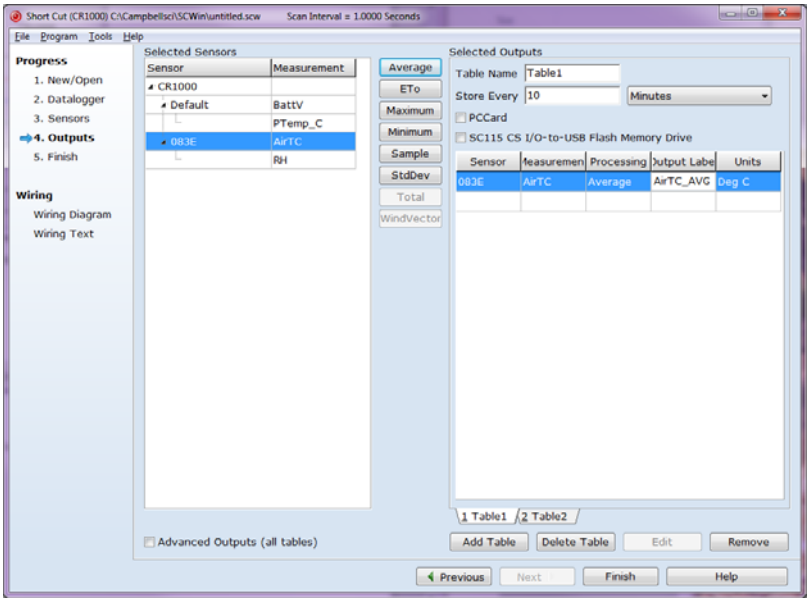
4. Define the name of the public variables. Variables default to **AirTC** and **RH** that hold the air temperature and relative humidity measurements. Select the desired units of measure. Units default to **Deg C**.



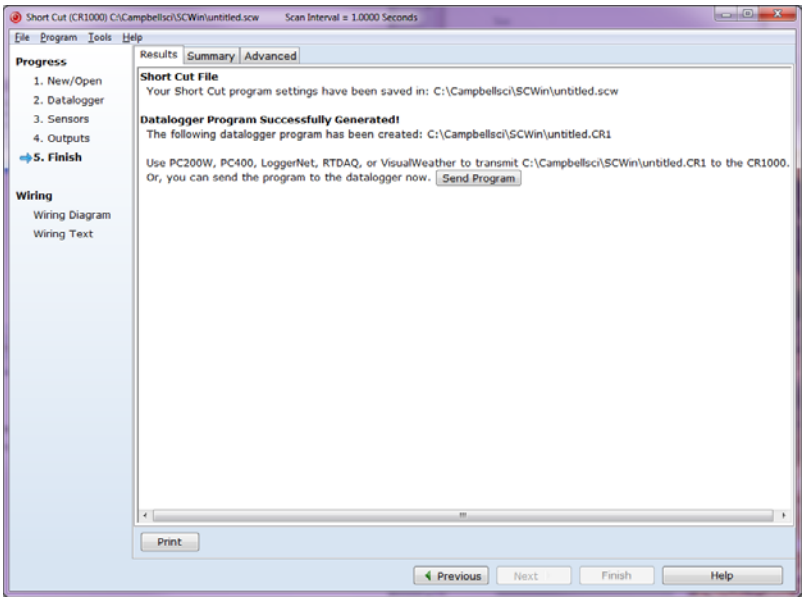
5. Sensor connections to the CR1000 datalogger are shown in the **Wiring** tab.



6. Select the desired output data for final storage and click **Finish**.



7. A full description of sensor wiring can be found by selecting **Wiring Diagram** at the left of the Short Cut window. Send the program from the PC to the CR1000 datalogger if telecommunications link is active.



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°C 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

Compatibility

Dataloggers: CR800 series
CR1000
CR3000

Measurement

Ranges

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

Accuracies

RH: ±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 Measurement at Below Freezing Temperatures*.
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 the sensor is to be mounted in a radiation shield, refer to the radiation shield manual section for mounting details. A typical installation is illustrated in the Section 7.2, *Mounting*.

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* for a list of sources that discuss temperature and relative humidity sensors and siting.

7.2 Mounting

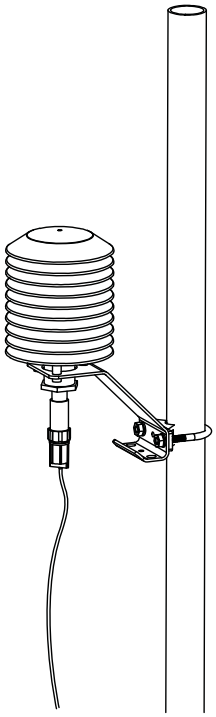


FIGURE 7-1. 092 mounted in 41003-5 radiation shield

7.3 Wiring Instructions

083E Pin Number (pin F not used)	Wire Color	Cable Label	Description	Datalogger Channel CR800 CR850 CR5000 CR3000 CR1000 CR23X	Datalogger Channel CR10(X) CR500 CR510	Jumped Resistor 28430
A	White	Power 12V	+10 to +18 Vdc	12V	12V	Jump resistor between SE and VX
B	Green	Ground	Signal Ground	G	G	
C	Blue	Signal ref	RH Analog Output	SE	SE	
D	Black	Signal reference temperature	Temperature Common	⏚	AG	
E	Red	Signal temp	Temperature Signal	SE	SE	
	Clear	Shield	Shield	⏚	G	23.1 kΩ ±0.1%
				EX or VX	EX or VX	

7.4 Programming

This section is for users who write their own CRBasic datalogger programs. To use the Short Cut program builder, see Section 4, *Quickstart*.

7.4.1 Programming Example

Table 7-1 describes the sensor wiring used with the following example CRBasic datalogger program.

TABLE 7-1. 083E Sensor Wiring for Example Program

Wire Color	Cable Label	Datalogger Channel CR1000	Jumped Resistor 28430
White	Power 12V	12V	Jump resistor between SE8 and VX1
Green	Ground	G	
Blue	Signal ref	SE1	
Black	Signal reference temperature	⏚	
Red	Signal temp	SE8	
Clear	Shield	⏚	23.1 kΩ ±0.1%
		VX1	

```
'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
```

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 Temperature Table

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

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*.

12 Month Interval:

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

10. References

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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.

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