

# INSTRUCTION MANUAL



## **Model 092** **Barometric Pressure Sensor**

Revision: 10/16



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RMA# \_\_\_\_\_  
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Logan, Utah 84321-1784

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# Safety

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**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](http://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 092 Barometric Pressure Sensor***

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## **1. Introduction**

The 092 Barometric Pressure Sensor measures ambient atmospheric pressure and is configured at Campbell Scientific for analog output. It is recommended for wind-farm power-performance research.

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### **NOTE**

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

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## **2. Precautions**

- READ AND UNDERSTAND the *Safety* section at the front of this manual.
- Install the sensor such that it faces north in the northern hemisphere, or south in the southern hemisphere. This orientation will shield the polycarbonate sensor housing from most direct sunlight.
- The pressure sensor element is light sensitive. Only operate the 092 when the polycarbonate case is closed.
- Pressure conditions in the range of 10 to 10,000 millibars will not harm the sensor, but the measurement accuracy is not guaranteed beyond the range of 600 to 1100 millibars.

## **3. Initial Inspection**

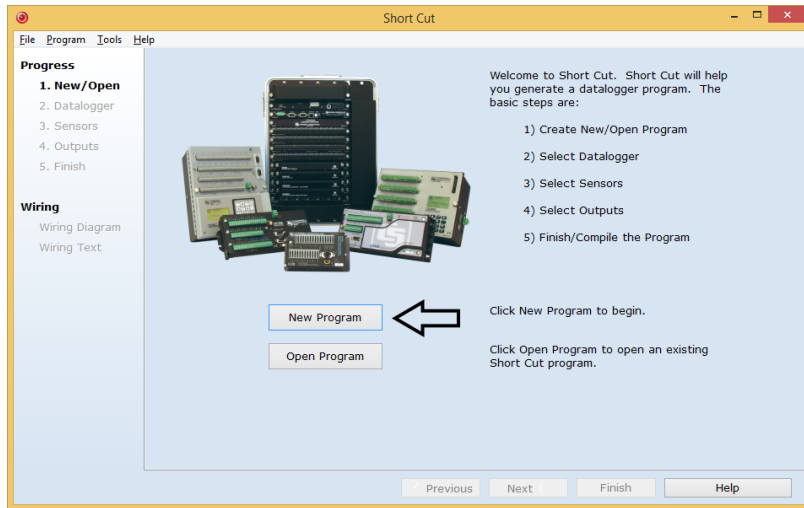
- Upon receipt of the 092, inspect the packaging and contents for damage. File damage claims with the shipping company, but contact Campbell Scientific to arrange for repair or replacement.
- The model number and cable length are printed on a label at the connection end of the cable. Check this information against the shipping documents to ensure the expected product and cable length are received.

## **4. QuickStart**

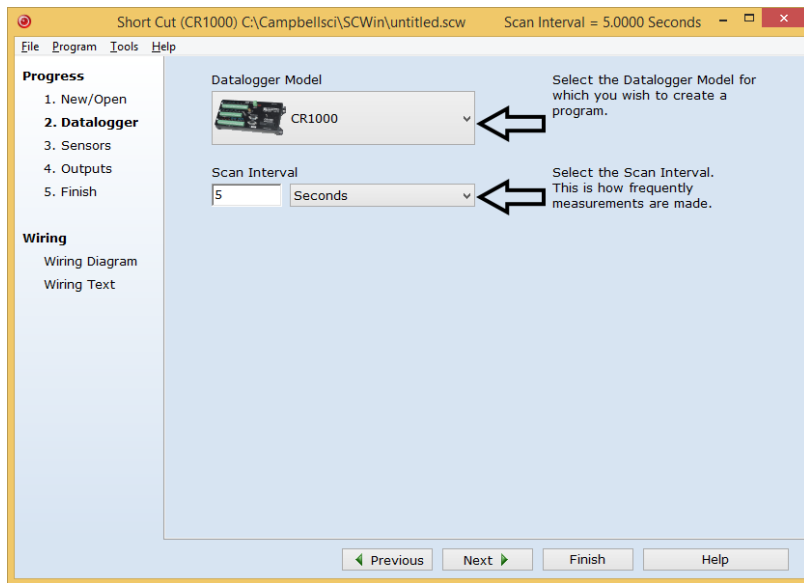
*Short Cut* is an easy way to program your datalogger to measure the 092 and assign datalogger wiring terminals. *Short Cut* is available as a download on [www.campbellsci.com](http://www.campbellsci.com) and the *ResourceDVD*. It is included in installations of *LoggerNet*, *PC200W*, *PC400*, or *RTDAQ*.


Use the following procedure to get started.

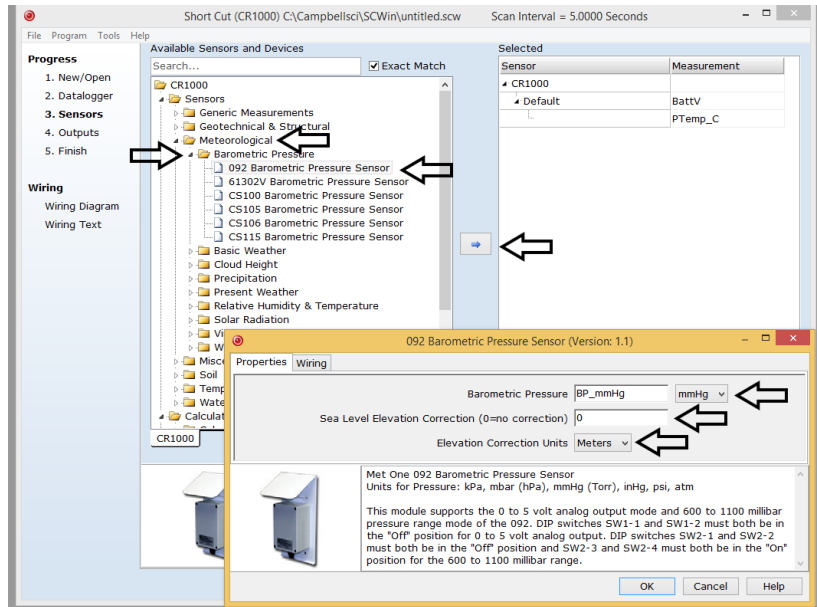
1. Open *Short Cut*. Click **New Program**.



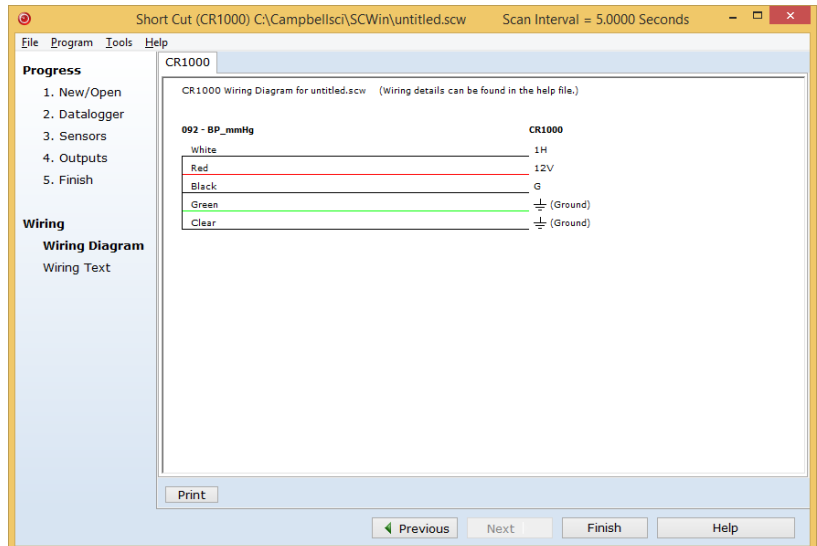
2. Select **Datalogger Model** and **Scan Interval** (default of 5 seconds is OK for most applications). Click **Next**.



- Under the **Available Sensors and Devices** list, select **Sensors | Meteorological | Barometric Pressure** folder. Select **092 Barometric Pressure Sensor**. Click  to move the selection to the **Selected** device window. Enter the **Sea Level Elevation Correction**. The default units for the sea level elevation correction is meters; this can be changed by clicking on the **Elevation Correction Units** box and selecting **Feet**. Defaults for the barometric pressure measurement is **mmHg**. This can be changed by clicking the **Barometric Pressure** box and selecting different units.



- 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.



5. 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 092 ships from Campbell Scientific pre-wired for analog output with the following settings:

- Analog Output Voltage: 0 to 5 Vdc
- Range: 600 to 1100 mbar

Refer to Appendix C, *Analog Output Configurations (p. C-1)*, for available analog output options.

The 092 uses an on-board microcontroller and piezoresistive pressure sensor module. This module contains an analog-to-digital converter, a temperature sensor, and non-volatile memory for storage of factory-determined calibration coefficients. The microcontroller polls the sensor module once per second. Measurements are temperature corrected, the calibration coefficients applied, and the processed pressure measurement stored for output.

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### NOTE

The pressure sensor element is light sensitive. Do not operate the 092 without the top cover of the polycarbonate case securely in place.

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All wiring terminals on the 092 are protected from static-surge damage by transzorb and current-limiting resistors.

Although the 092 is configured at Campbell Scientific for analog output, digital output options including RS-232 and SDI-12 are available. Contact Campbell Scientific for more information.

## 6. Specifications

### Features:

- Configured by Campbell Scientific
- Configurable settings:
  - measurement range
  - data output option / communication option
  - analog output range
- Compatible with Campbell Scientific CRBasic dataloggers: CR200(X) series, CR300 series, CR6 series, CR800 series, CR1000, CR3000, CR5000, and CR9000(X)

### Measurement

<b>Range:</b>	600 to 1100 mbar
<b>Resolution:</b>	0.1 mbar (.003 Hg)
<b>Accuracy:</b>	±0.35 mbar at 25 °C ±0.75 mbar at 0 to 55 °C ±1.5 mbar at -40 °C
<b>Long-term stability:</b>	±1 mbar in 12 months

### Temperature

<b>Operating range:</b>	-40 to 55 °C
<b>Compensated range:</b>	-40 to 55 °C

### Power requirement

<b>Source:</b>	6 to 16 Vdc
<b>Load:</b>	10 mA at 12 Vdc

**Output:** Analog, 0 to 5 Vdc

**Enclosure:** Polycarbonate

**Size:** 120 x 80 x 55 mm (4.7 x 3.1 x 2.2 in)

**CE certification:** See Appendix E, *CE Certification (p. E-1)*

**Calibration:** Factory-calibrated against a NIST traceable anemometer

## 7. Installation

If you are programming your datalogger with *Short Cut*, skip Section 7.2, *Datalogger Wiring (p. 6)*, and Section 7.3, *Programming (p. 7)*. *Short Cut* does this work for you. See Section 4, *QuickStart (p. 1)*, for a *Short Cut* tutorial.

### 7.1 Mounting

The 092 is factory-mounted to a solar shield. The solar shield mounts to a vertical pipe with a diameter of up to 2-inch IPS. Install the sensor such that it

faces north in the northern hemisphere, or south in the southern hemisphere. This orientation will shield the polycarbonate sensor housing from most direct sunlight.

To install the 092:

1. The 092 enclosure is pre-supplied with desiccant and does not need to be opened.
2. Attach the 092 to the tripod or tower leg using the supplied U-bolts. FIGURE 7-1 shows the 092 installed on a vertical mast.

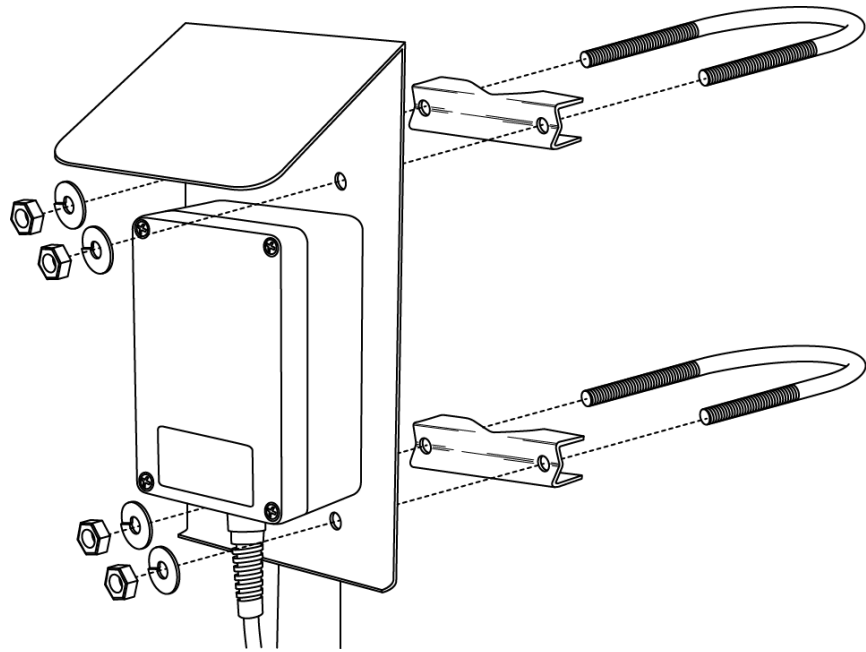


FIGURE 7-1. 092 installed on a vertical mast

## 7.2 Datalogger Wiring

Datalogger wiring is provided in TABLE 7-1 and a wiring schematic is provided in Appendix D, *Internal Cable Connections* (p. D-1).

<b>Wire Color</b>	<b>Wire Function</b>	<b>Datalogger Connection Terminal</b>
White	Signal	U configured for single-ended analog input <sup>1</sup> , SE (single-ended, analog input)
Green	Signal Reference	AG or $\perp$ (analog ground)
Red	Power	12V
Black	Ground	G
Clear	Shield	AG or $\perp$ (analog ground)

<sup>1</sup>U channels are automatically configured by the measurement instruction.

## 7.3 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).

### 7.3.1 CRBasic Instruction

The **VoltSE()** measurement instruction typically programs the datalogger to measure the 092.

```
VoltSE( Dest, Repts, Range, SEChan, MeasOff, SettlingTime,
Integration, Multiplier, Offset )
```

For the *multiplier*, enter 0.1. For the *offset*, enter 600. The *offset* will need to be adjusted if the barometer is not at sea level (see Section 8.2, *Correcting Pressure to Sea Level* (p. 8)). If barometric pressure units other than mbar or hPA are desired, see Section 8.1, *Conversion Factors* (p. 8).

Atmospheric pressure changes little with time. In most weather station applications, measuring the barometer pressure once an hour is adequate. See Appendix B, *Example Program (p. B-1)*, for more information.

## 8. Operations

### 8.1 Conversion Factors

To report pressure in different units, multiply the measured pressure by the appropriate conversion factor. This is done by including an expression in the CRBasic program. See TABLE 8-1 below for conversion factors.

To Find	Multiply By
hPa	1.0
kPa	0.1
mm of Hg	0.75006
in of Hg	0.02953
Psi	0.0145
Atm	0.00099
Torr	0.75006

### 8.2 Correcting Pressure to Sea Level

The weather service, most airports, radio stations, and television stations adjust the atmospheric pressure to a common reference (sea level). Equation 1 can be used to find the difference in pressure between the sea level and the site. That value ( $dP$ ) is then added to the offset in the measurement instruction. U. S. Standard Atmosphere and dry air were assumed when Equation 1 was derived (Wallace, J. M. and P. V. Hobbes, 1977: *Atmospheric Science: An Introductory Survey*, Academic Press, pp. 59-61).

$$dP = 1013.25 \left\{ 1 - \left( 1 - \frac{E}{44307.69231} \right)^{5.25328} \right\} \quad (1)$$

The value  $dP$  is in millibars and the site elevation,  $E$ , is in meters. Add  $dP$  value to the offset in the measurement instruction.

Use Equation 2 to convert feet to meters.

$$E(m) = \frac{E(ft)}{3.281ft/m} \quad (2)$$

The corrections involved can be significant. For example, at 1000 mb and 20 °C, barometric pressure will decrease by 1.1 mb for every 10 m increase in altitude.



## **9. Maintenance**

### **9.1 Cleaning**

Periodic cleaning of the sintered filter at the base of the unit may be required in dusty conditions. Remove the filter and clean with distilled water.

### **9.2 Calibration**

Calibration is performed against a NIST traceable standard. Calibration coefficients are stored in non-volatile memory at the factory. No user calibration procedure is available. The sensor must be returned to Met One Instruments when calibration is desired. Yearly calibrations are recommended.

For calibration, contact:

Met One Instruments  
1600 Washington Blvd.  
Grants Pass, OR 97526  
Phone: (541) 471-7111  
Fax: (541) 471-7116

Met One Instruments  
3206 Main Street  
Suite 106  
Rowlett, TX 75088  
Phone: (972) 412-4747  
Fax: (972) 412-4716



# Appendix A. Importing Short Cut Code Into CRBasic Editor

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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(X) 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.

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## 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.

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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

The following CR1000 programming example can be used, in whole or in part, if the datalogger is being programmed with CRBasic Editor. Programming is similar with the CR800 and CR3000.

## CRBasic Example B-1. CR1000 Program Measuring the 092

```
'CR1000 with 092 Barometric Pressure Sensor

'-Wiring-
'1H: White
'Ground: Green
'Ground: Clear
'G: Black
'12V: Red

'Declare Variables and Units
Public BattV
Public PTemp_C
Public BP_mmHg

Units BattV=Volts
Units PTemp_C=Deg C
Units BP_mmHg=mmHg

'Define Data Tables
DataTable(Table1,True,-1)
  DataInterval(0,60,Min,10)
  Average(1,BP_mmHg,FP2,False)
EndTable

DataTable(Table2,True,-1)
  DataInterval(0,1440,Min,10)
  Minimum(1,BattV,FP2,False,False)
EndTable

'Main Program
BeginProg
  'Main Scan
  Scan(5,Sec,1,0)
  'Default Datalogger Battery Voltage measurement 'BattV'
  Battery(BattV)
  'Default Wiring Panel Temperature measurement 'PTemp_C'
  PanelTemp(PTemp_C,_60Hz)
  '092 Barometric Pressure Sensor measurement 'BP_mmHg'
  VoltSE(BP_mmHg,1,mV5000,1,1,0,_60Hz,0.1,600)
  BP_mmHg=BP_mmHg*0.75006
  'Call Data Tables and Store Data
  CallTable(Table1)
  CallTable(Table2)
NextScan
EndProg
```



# Appendix C. Analog Output Configurations

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The 092 ships from Campbell Scientific pre-wired and pre-configured for analog output with the following settings:

- Analog Output Voltage: 0 to 5 Vdc
- Range: 600 to 1100 mbar

Output voltage and measurement ranges are set by switches. Dip switch settings are listed in TABLE C-1 and TABLE C-2. Highlighted settings are those set at the factory by Campbell Scientific.

<b>TABLE C-1. Dip Switches SW1: Analog Output Voltage Settings</b>		
<b>Range</b>	<b>SW1-1</b>	<b>SW1-2</b>
0 to 1 Vdc	On	On
0 to 2 Vdc	On	Off
0 to 2.5 Vdc	Off	On
<b>0 to 5 Vdc*</b>	<b>Off*</b>	<b>Off*</b>
<b>*Factory configuration at Campbell Scientific.</b>		

**TABLE C-2. Dip Switches SW2: Analog Output Pressure Range Settings**

RANGE SELECTION						SWITCH SETTINGS			
mbar		mm Hg		in. Hg					
LOWER	UPPER	LOWER	UPPER	LOWER	UPPER	SW2-1	SW2-2	SW2-3	SW2-4
600	800	450	600	17.72	23.62	ON	ON	ON	ON
600	900	450	675	17.72	26.58	OFF	ON	ON	ON
600	1000	450	750	17.72	29.53	ON	OFF	ON	ON
600 <sup>1</sup>	1100 <sup>1</sup>	450 <sup>1</sup>	825 <sup>1</sup>	17.72 <sup>1</sup>	32.48 <sup>1</sup>	OFF <sup>1</sup>	OFF <sup>1</sup>	ON <sup>1</sup>	ON <sup>1</sup>
700	800	525	600	20.67	23.62	ON	ON	OFF	ON
700	900	525	675	20.67	26.58	OFF	ON	OFF	ON
700	1000	525	750	20.67	29.53	ON	OFF	OFF	ON
700	1100	525	825	20.67	32.48	OFF	OFF	OFF	ON
677.1	1083.6	508.0	812.8	20.00	32.00	ON	ON	ON	OFF
800	900	600	675	23.62	26.58	OFF	ON	ON	OFF
800	1000	600	750	23.62	29.53	ON	OFF	ON	OFF
800	1100	600	825	23.62	32.48	OFF	OFF	ON	OFF
2	2	2	2	2	2	ON <sup>2</sup>	ON <sup>2</sup>	OFF <sup>2</sup>	OFF <sup>2</sup>
2	2	2	2	2	2	OFF <sup>2</sup>	ON <sup>2</sup>	OFF <sup>2</sup>	OFF <sup>2</sup>
900	1000	675	750	26.58	29.53	ON	OFF	OFF	OFF
900	1100	675	825	26.58	32.48	OFF	OFF	OFF	OFF

<sup>1</sup>Factory configuration at Campbell Scientific

<sup>2</sup>Settings with no pressure values are invalid settings. If the switches are set to either of these combinations, the analog output will default to the full range of 600 to 1100 mbar.



# Appendix D. Internal Cable Connections

The 092 ships from Campbell Scientific pre-wired for analog output. Internal cable connections are shown in FIGURE D-1.

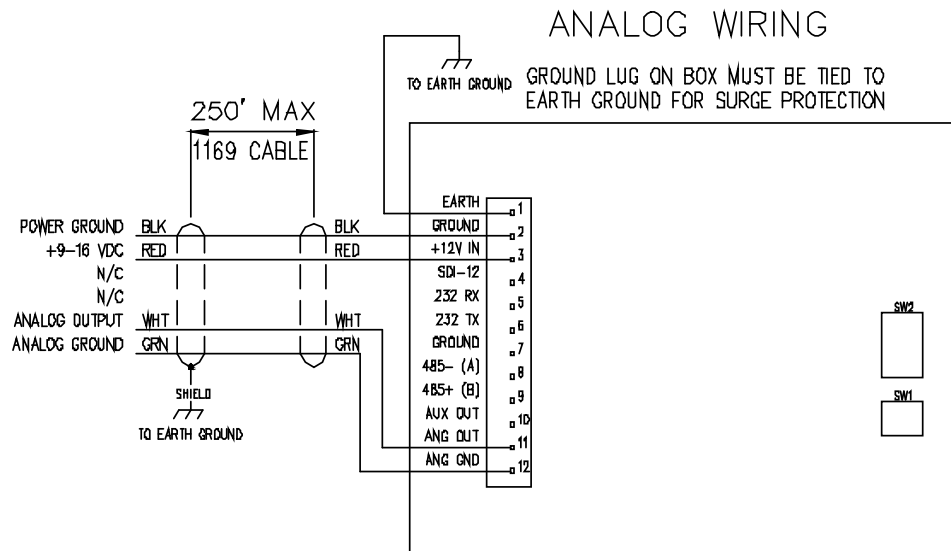


FIGURE D-1. Analog wiring schematic



# Appendix E. CE Certification

## Certificate of Conformance European Community Council Directive 2004/108/EC

Date of Issue: November, 2008  
Issued By: Retlif Testing Laboratories  
795 Marconi Avenue  
Ronkonkoma, NY 11779  
Issued To: Climatronics Corp.  
140 Wilbur Place  
Bohemia, NY 11716

Reference: Retlif Report Number R-12669

Retlif Testing Laboratories hereby acknowledges that compliance testing in accordance with the below listed standards was performed on a representative sample of the equipment listed below. Retlif Testing Laboratories further acknowledges that the test sample listed below was found to be in compliance with these standards.

This certificate is hereby issued to the above named grantee and is valid only for the equipment identified below.

**Manufacturer:** Climatronics Corp.  
140 Wilbur Place  
Bohemia, NY 11716

**Equipment Tested:** Barometric Pressure Sensor

**Part Number:** 102663/092

**Serial Number:** 42288

**Brand Name:** Climatronics Corp./Met One Instruments

**Product Type:** Measurement, Control Equipment and Laboratory Use

Note(s): 1) See attached report R-12669 for details and/or conditions pertaining to this certificate.  
2) Conforms to the emissions requirements of EN 61326-1:2006; Clause 7.2  
CISPR 11:1Edition 4 2003 Class A, Radiated Emissions, 30 MHz to 1 GHz  
3) Conforms to the immunity requirements of EN 61326:2006-1:2006; Table 2  
IEC 61000-4-2:2001 Electrostatic Discharge  
IEC 61000-4-3:2002 Radiated Immunity  
IEC 61000-4-4:2004 EFT/Burst, Power and I/O Leads  
IEC 61000-4-5:2001 Surge Immunity, Power Leads  
IEC 61000-4-6:2003 Conducted Immunity, Power and I/O Leads





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