INSTRUCTION MANUAL

Model 020C
Wind Direction Sensor

Revision: 5/12

Warranty

"PRODUCTS MANUFACTURED BY CAMPBELL SCIENTIFIC, INC. are warranted by Campbell Scientific, Inc. ("Campbell") to be free from defects in materials and workmanship under normal use and service for twelve (12) months from date of shipment unless otherwise specified in the corresponding Campbell pricelist or product manual. Products not manufactured, but that are re-sold by Campbell, are warranted only to the limits extended by the original manufacturer. Batteries, fine-wire thermocouples, desiccant, and other consumables have no warranty. Campbell's obligation under this warranty is limited to repairing or replacing (at Campbell's option) defective products, which shall be the sole and exclusive remedy under this warranty. The customer shall assume all costs of removing, reinstalling, and shipping defective products to Campbell. Campbell will return such products by surface carrier prepaid within the continental United States of America. To all other locations, Campbell will return such products best way CIP (Port of Entry) INCOTERM® 2010, prepaid. This warranty shall not apply to any products which have been subjected to modification, misuse, neglect, improper service, accidents of nature, or shipping damage. This warranty is in lieu of all other warranties, expressed or implied. The warranty for installation services performed by Campbell such as programming to customer specifications, electrical connections to products manufactured by Campbell, and product specific training, is part of Campbell's product warranty. CAMPBELL EXPRESSLY DISCLAIMS AND EXCLUDES ANY IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. Campbell is not liable for any special, indirect, incidental, and/or consequential damages."

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Products may not be returned without prior authorization. The following contact information is for US and international customers residing in countries served by Campbell Scientific, Inc. directly. Affiliate companies handle repairs for customers within their territories. Please visit *www.campbellsci.com* to determine which Campbell Scientific company serves your country.

To obtain a Returned Materials Authorization (RMA), contact CAMPBELL SCIENTIFIC, INC., phone (435) 227-9000. After an applications engineer determines the nature of the problem, an RMA number will be issued. Please write this number clearly on the outside of the shipping container. Campbell Scientific's shipping address is:

CAMPBELL SCIENTIFIC, INC.
RMA#_____
815 West 1800 North
Logan, Utah 84321-1784

For all returns, the customer must fill out a "Statement of Product Cleanliness and Decontamination" form and comply with the requirements specified in it. The form is available from our web site at *www.campbellsci.com/repair*. A completed form must be either emailed to *repair@campbellsci.com* or faxed to (435) 227-9106. Campbell Scientific is unable to process any returns until we receive this form. If the form 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.

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Figures

Tables

Model 020C Wind Direction Sensor

1. Introduction

The Model 020C Wind Direction Sensor measures azimuth with research-grade accuracy and precision. Campbell Scientific recommends the 020C for wind farm power performance research, such as on eighty- and ninety-meter met towers. The 020C is especially suited to applications requiring a low starting threshold, a high damping ratio, or a short delay distance.

Before installing the 020C, please study

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

2. Cautionary Statements

- The 020C is a precision instrument. Please handle it with care.
- If the 020C is to be installed at heights over six feet, be familiar with tower safety and follow safe tower-climbing procedures.
- **Danger** — Use extreme care when working near overhead electrical wires. Check for overhead wires before mounting the 020C or before raising a tower.

3. Initial Inspection

- Upon receipt of the 020C, inspect 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

4.1 Installation

Figure 4-1 shows the 020C installed with a CM220 Right Angle Mounting Kit. Please review Section 7, *Installation*, for complete guidelines. Install the 020C using:

- 28798 020C Mounting Bushing
- CM220 Right-Angle Mounting Kit, or
- 1049 ¾ x 1 inch NURAIL Crossover Fitting

1. Remove the orientation screw from the base of the sensor column. Place the sensor column in the bushing such that the hole in the bushing aligns with the hole just vacated by the orientation screw. Replace the screw and tighten until snug. Do not over-tighten.

2. Place the sensor and bushing in the right-angle mounting bracket or Nurail® fitting.

3. Rotate the sensor and bushing such that the vane and orientation screw point true south, ensuring that the notches on the sensor hub and column align.

4. Tighten the u-bolt (CM220) or set screws (pn 1049).

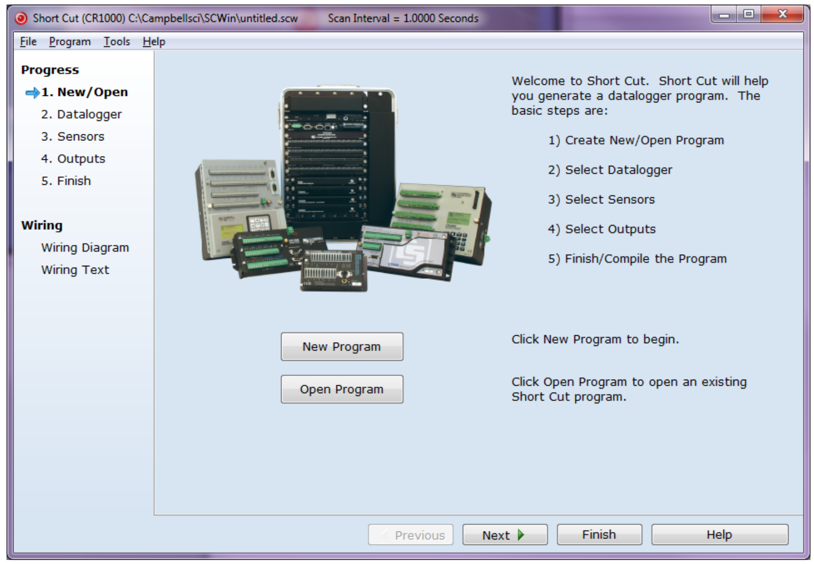
5. Attach the sensor cable to the six-pin male connector on the 020C.

FIGURE 4-1. Installation of 020C Wind Vane

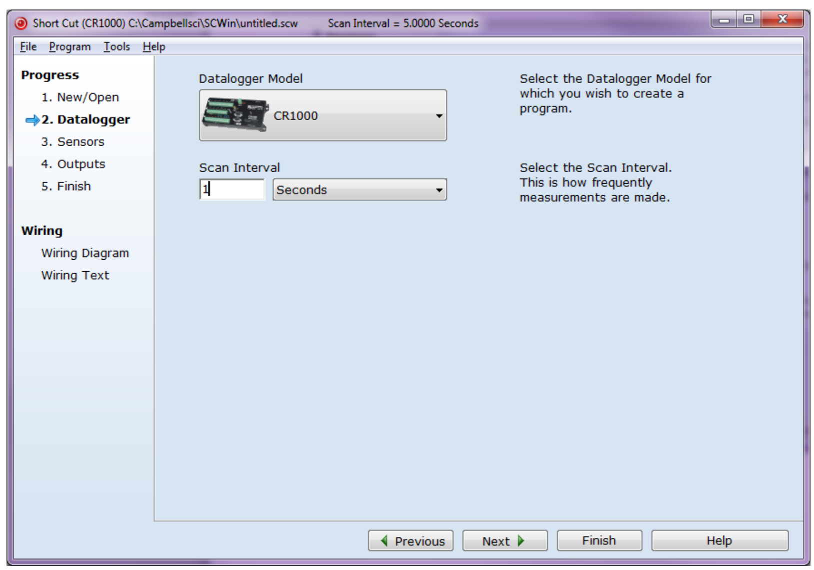
4.2 Programming with Short Cut

Short Cut Program Generator for Windows can be used to program the CR1000 datalogger to measure the 020C as outlined in the following procedure. Short Cut can also be used to program other 020C-compatible Campbell Scientific dataloggers.

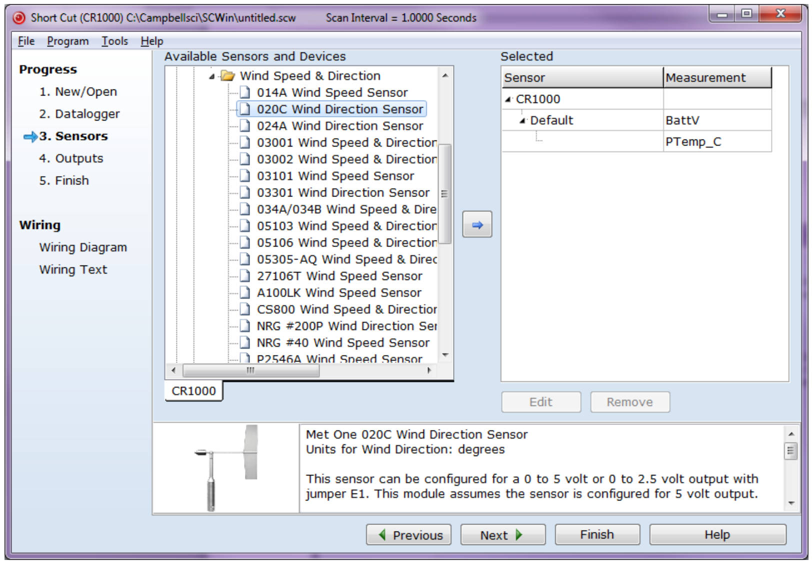
1. Open Short Cut and click on **New Program**.



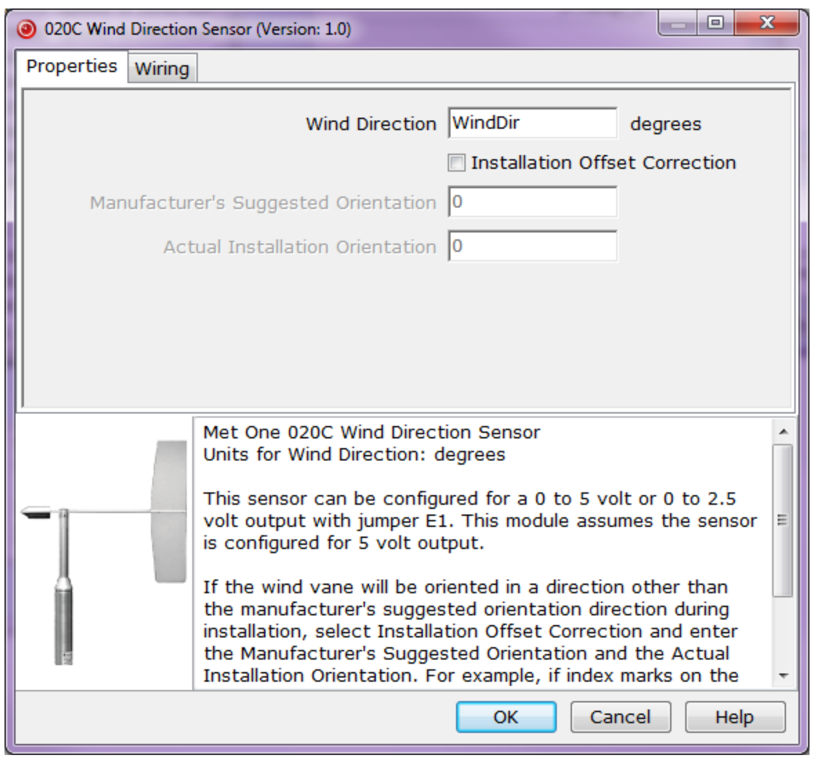
2. Select a scan interval.



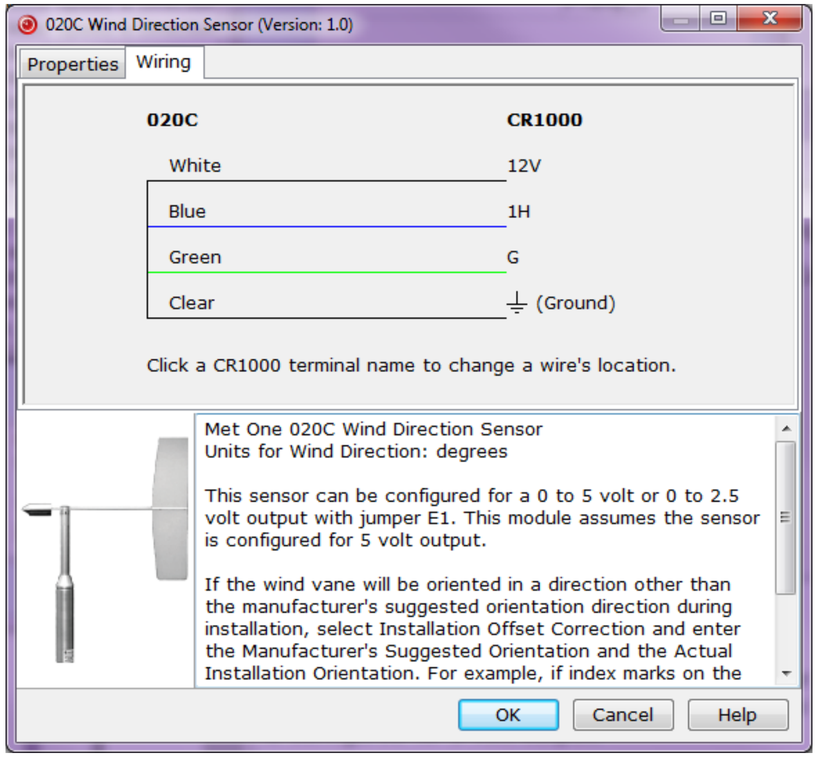
3. Select **020C Wind Direction Sensor** and select the right arrow to add it to the list of sensors to be measured.



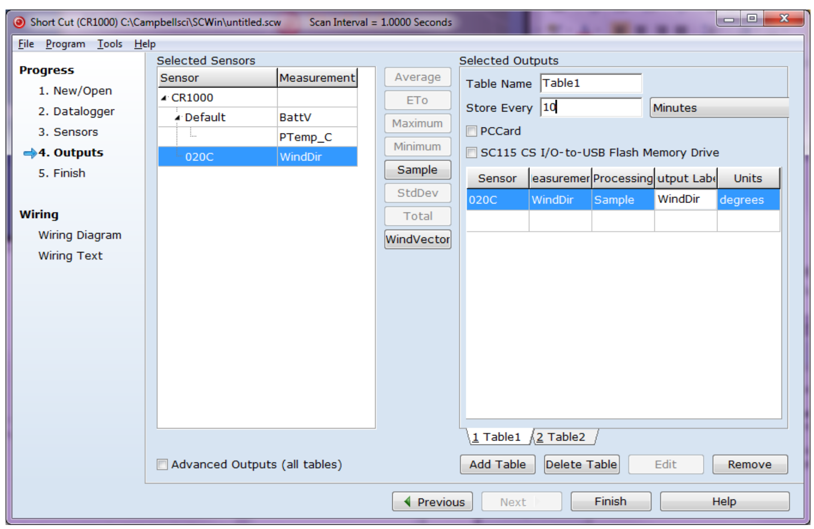
4. Define the name of the public variable (**WindDir**) that holds the wind direction measurement. When the sensor points south with the hub and column notches aligned, no installation-offset correction is required.



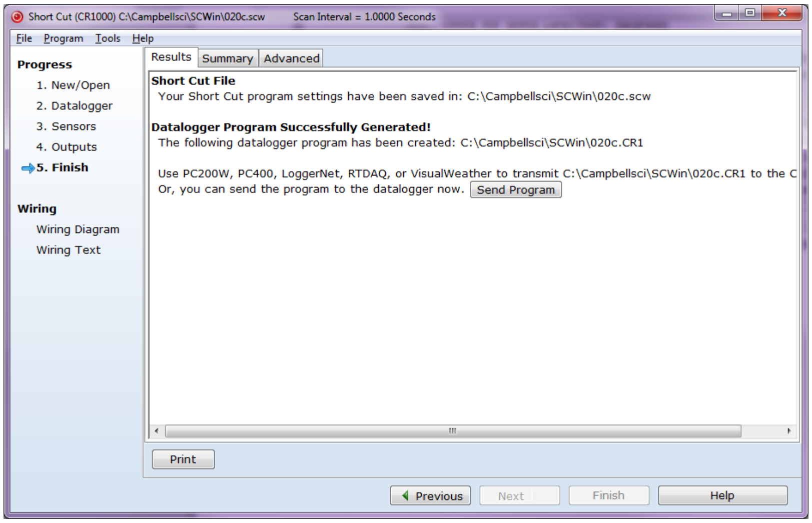
5. Sensor connections to the CR1000 datalogger are shown in the **Wiring** tab. In applications with tight power budgets, the power connection can be connected to a controlled 12-Vdc terminal or device. See Section 7, *Installation*.



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 the telecommunications link is active.



5. Overview

5.1 Operation

The lightweight, airfoil vane is directly coupled to a single precision micro-torque potentiometer. The built-in electronics provide a voltage source for the potentiometer and amplifies the output signal for transmission over long cable lengths. The following features increase the reliability of the 020C:

- Inclusion of internal heater, which provides positive clean aspiration through the bearings, thereby greatly increasing bearing life.
- Built-in electrical field surge protection reduces problems associated with static fields, near-miss lightning hits, and poor grounding systems.

5.2 Construction

The vane assembly is easily installed or replaced without requiring recalibration. All sensor components are constructed with stainless steel and anodized aluminum.

6. Specifications

Features

- Low starting threshold
- Internal heater for long bearing life
- Low profile to minimize turbulence
- High damping ratio
- Short delay distance
- Quick-disconnect connector

Compatibility

Dataloggers:	CR10(X) CR23X CR800 series CR1000 CR3000

Measurement

Range:	Electrical 0° to 357° Mechanical 0° to 360°
Threshold:	0.5 mph
Linearity:	± 0.5% of full scale
Accuracy:	±3°
Damping Ratio:	0.4
Delay Distance:	Less than 91 cm (3 ft)

Temperature Range: -50° to 85°C (-58° to 185°F)

Power requirement

Sensor	
Source:	12 Vdc
Load:	10 mA
Heater	
Source:	12 Vdc
Load:	350 mA

Output: 0 to 5 Vdc for 0 to 360°
(0 to 2.5 Vdc optional)

Output Impedance: 100 Ω maximum

Maximum Cable Length: 300 feet

Weight: 1.5 pounds

Finish: Anodized aluminum

7. Installation

Before installation:

- Check to see that the vane assembly rotates freely.
- Ensure that the vane assembly is balanced and the counterweight is tight by holding the sensor horizontal to verify balance.

7.1 Select Output Range

The output voltage range of the 020C is pre-set at 0 to 5 Vdc at a jumper under the outer cover of the main body of the probe. The cover is held in place by friction fit against two O-rings. To change the range to 0 to 2.5 Vdc, carefully slide the outer cover down to expose the circuit board. A set of three jumper pins is mounted at the top of the board. Set the jumper block over pins **E1** and **2.5**. Replace the cover by completely sliding it back over the top O-ring.

7.2 Siting

Locate wind sensors away from obstructions such as trees and buildings. A general rule is that a horizontal distance of at least ten times the height of the obstruction should be between the wind set and the obstruction. If mounting the sensor on the roof of a building is necessary, the height of the sensor above the roof should be at least 1.5 times the height of the building. See Section 9, *References*, for resources that discuss siting wind sensors.

7.3 Assembly and Mounting

Tools required:

- 1/2” open-end wrench (for CM220)
- 5/64” and 1/16” Allen wrenches
- compass and declination angle for the site (see Appendix A, *Wind Direction Sensor Orientation*)
- small screwdriver provided with datalogger
- UV-resistant cable ties
- small pair of diagonal-cutting pliers
- 6- to 10-inch torpedo or spirit level

Mount the CM200-series crossarm to the tripod or tower. Orient the crossarm North to South with PN 1049 or CM220 at the North end of the crossarm.

Remove the alignment screw at the base of the 020C (previous Figure 4-1). Insert the 020C into the aluminum bushing provided with the sensor. Align the hole in the bushing with that in the 020C base and replace the screw. Insert the 020C with bushing into the Nurail® or the CM220 u-bolt (Figure 7-2). Align the sensor such that alignment notches, alignment screw, and counterweight point true South. Tighten the set screws (PN 1049) or U-bolts (CM220).

Appendix A, *Wind Direction Sensor Orientation*, contains detailed information on determining true North using a compass and the magnetic declination for the site.

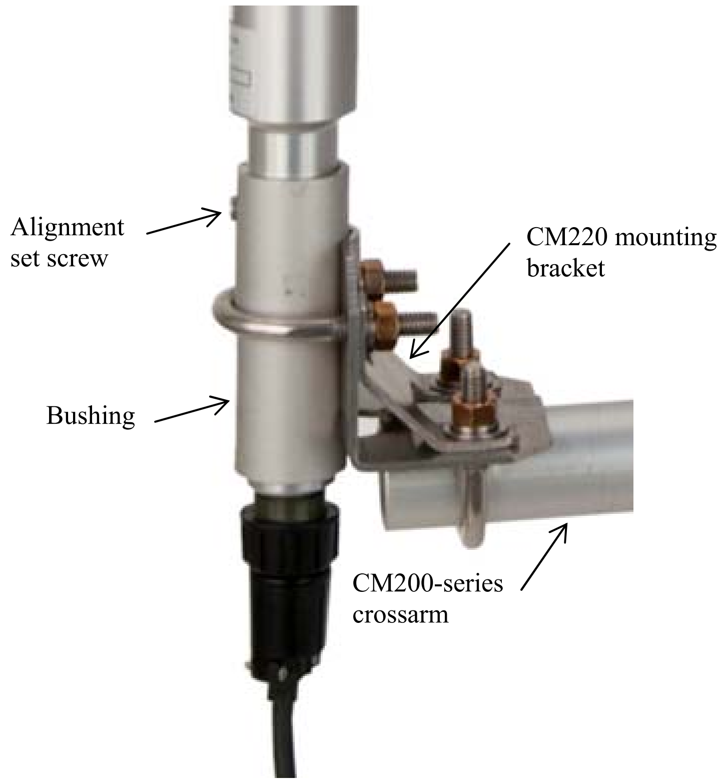


FIGURE 7-1. 020C mounted with CM200-series crossarm and CM220 right-angle mounting bracket

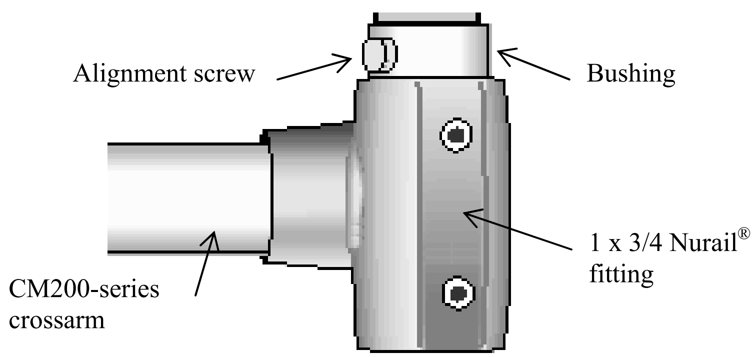


FIGURE 7-2. 020C mounted with CM200-series crossarm and 1049 Nurail® fitting

7.4 Wiring

Attach the sensor cable to the six-pin male connector on the 020C. Make sure the connector is properly keyed. Finger-tighten the knurled ring. Route the sensor cable along the underside of the crossarm to the tower, down the tower, and to the instrument enclosure. Secure the cable to the crossarm and tower using cable ties.

The cable consists of five wires. Wiring for specific Campbell Scientific dataloggers is shown in Table 7-1.

TABLE 7-1. 020C Wiring

Wire Color	**Wire Description**	**CR23X CR800-series CR1000 CR3000 CR5000**	**CR10(X) CR500 CR510**
White	**Power 12V**	12V	12V
Green	**Ground**	G	G
Blue	**Signal**	SE input	SE input
Red* **(Optional)**	**Heater +**	Supply 12V	Supply 12V
Black* **(Optional)**	**Heater -**	Supply ground	Supply ground
Clear	**Shield**	⏚	G

*Bearing heat only. Use of heater will prolong the life of the bearings, but using it is practical only when the datalogger primary power is AC mains power or very high capacity solar power. Make this connection directly to the power supply rather than on the datalogger wiring panel.

7.5 Programming with CRBasic

If Short Cut is not used to program the datalogger (see Section 4, *Quickstart*) the following example code can be used as a guide when programming with CRBasic Editor to measure the 020C. CRBasic Editor is included with Campbell Scientific software LoggerNet, PC400, and RTDAQ.

```
'CR1000

'Declare Variables and Units
Public BattV
Public PTemp_C
Public WindDir

Units BattV=Volts
Units PTemp_C=Deg C
Units WindDir=degrees

'Define Data Tables
DataTable(Table1,True,-1)
  DataInterval(0,10,Min,10)
  Sample(1,WindDir,FP2)
EndTable

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

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

    'Default Datalogger Battery Voltage measurement 'BattV'
    Battery(BattV)

    'Default Wiring Panel Temperature measurement 'PTemp_C'
    PanelTemp(PTemp_C,_60Hz)

    '020C Wind Direction Sensor measurement 'WindDir'
    VoltSe(WindDir,1,mV5000,1,1,0,_60Hz,0.072,0)

    'Offset correction for vane installed with 270 degree
    'installation orientation
    WindDir = (WindDir + 90 + 360)MOD 360

    'Call Data Tables and Store Data
    CallTable(Table1)
    CallTable(Table2)

  NextScan
```

7.6 Sensor Check-Out

With the datalogger measuring the sensor, 020C output moves up-scale as the vane rotates clockwise (as seen from above the sensor). Output will progress up-scale until the 360° (full scale) mark has been reached. Output then drops to near 0°. When the notches on the rotating hub and the column of the sensor are exactly aligned, the output will be 180°.

8. Troubleshooting and Maintenance

8.1 Troubleshooting

Consult Table 8-1 for recommended actions to resolve various fault conditions.

TABLE 8-1. 020C Wind Direction Sensor Troubleshooting

Symptom	Probable Cause	Solution	Refer to
No wind direction output	Loss of supply voltage	Check datalogger 12Vdc supply and connecting cables	Table 7-1, *020C Wiring*
No wind direction output	Faulty integrated circuit amplifier (output often will be steady 5.0V)	Replace IC amplifier (Plug-in)	Contact Campbell Scientific for repair authorization
No wind direction output	Faulty potentiometer	Replace potentiometer	Contact Campbell Scientific for repair authorization
No change in wind direction output below 2-5 mph	Bad bearings	Replace bearings	Contact Campbell Scientific for repair authorization

8.2 Maintenance Schedule

6-12 Month Intervals:

1. Inspect sensor for proper operation per Section 7.6, *Sensor Check-Out*.

2. Return to Campbell Scientific for calibration.

12-24 Month Intervals:

1. Return to Campbell Scientific for replacement of sensor bearings.

2. Return to Campbell Scientific for replacement of sensor potentiometer.

9. References

The following references give detailed information on siting wind-speed and wind-direction sensors.

EPA, 1989: *Quality Assurance Handbook for Air Pollution Measurements System*, Office of Research and Development, Research Triangle Park, NC, 27711.

EPA, 1987: *On-Site Meteorological Program Guidance for Regulatory Modeling Applications,* EPA-450/4-87-013, Office of Air Quality Planning and Standards, Research Triangle Park, NC 27711.

The State Climatologist, 1985: *Publication of the American Association of State Climatologists: Height and Exposure Standards*, for Sensors on Automated Weather Stations, vol. 9, No. 4.

WMO, 1983: *Guide to Meteorological Instruments and Methods of Observation,* World Meteorological Organization, No. 8, 5th edition, Geneva, Switzerland.

Appendix A. Wind Direction Sensor Orientation

A.1 Determining True North and Sensor Orientation

Orientation of the wind direction sensor is done after the datalogger has been programmed, and the location of true North has been determined. True North is usually found by reading a magnetic compass and applying the correction for magnetic declination; where magnetic declination is the number of degrees between true North and Magnetic North. The preferred method to obtain the magnetic declination for a specific site is to use a computer service offered by NOAA at www.ngdc.noaa.gov/geomag. Magnetic declination can also be obtained from a map or local airport. A general map showing magnetic declination for the contiguous United States is shown in Figure A-1.

Declination angles east of true North are considered negative, and are subtracted from 360 degrees to get true North as shown in Figure A-2 (0° and 360° are the same point on a compass). For example, the declination for Logan, Utah is 13.5° East, so true North is 360° - 13.5°, or 346.5° as read on a compass. Declination angles west of true North are considered positive, and are added to 0 degrees to get true North as shown in Figure A-3.

Orientation is most easily done with two people, one to aim and adjust the sensor, while the other observes the wind direction displayed by the datalogger.

1. Establish a reference point on the horizon for true North.
2. Sighting down the instrument center line, aim the nose cone or counterweight at true North. Display the input location or variable for wind direction using a hand-held keyboard display, PC, or palm.
3. Loosen the u-bolt on the CM220 (or the set screws on pn 1049) that secure the base of the sensor to the crossarm. While holding the vane position, slowly rotate the sensor base until the datalogger indicates 0°. Tighten the set screws.

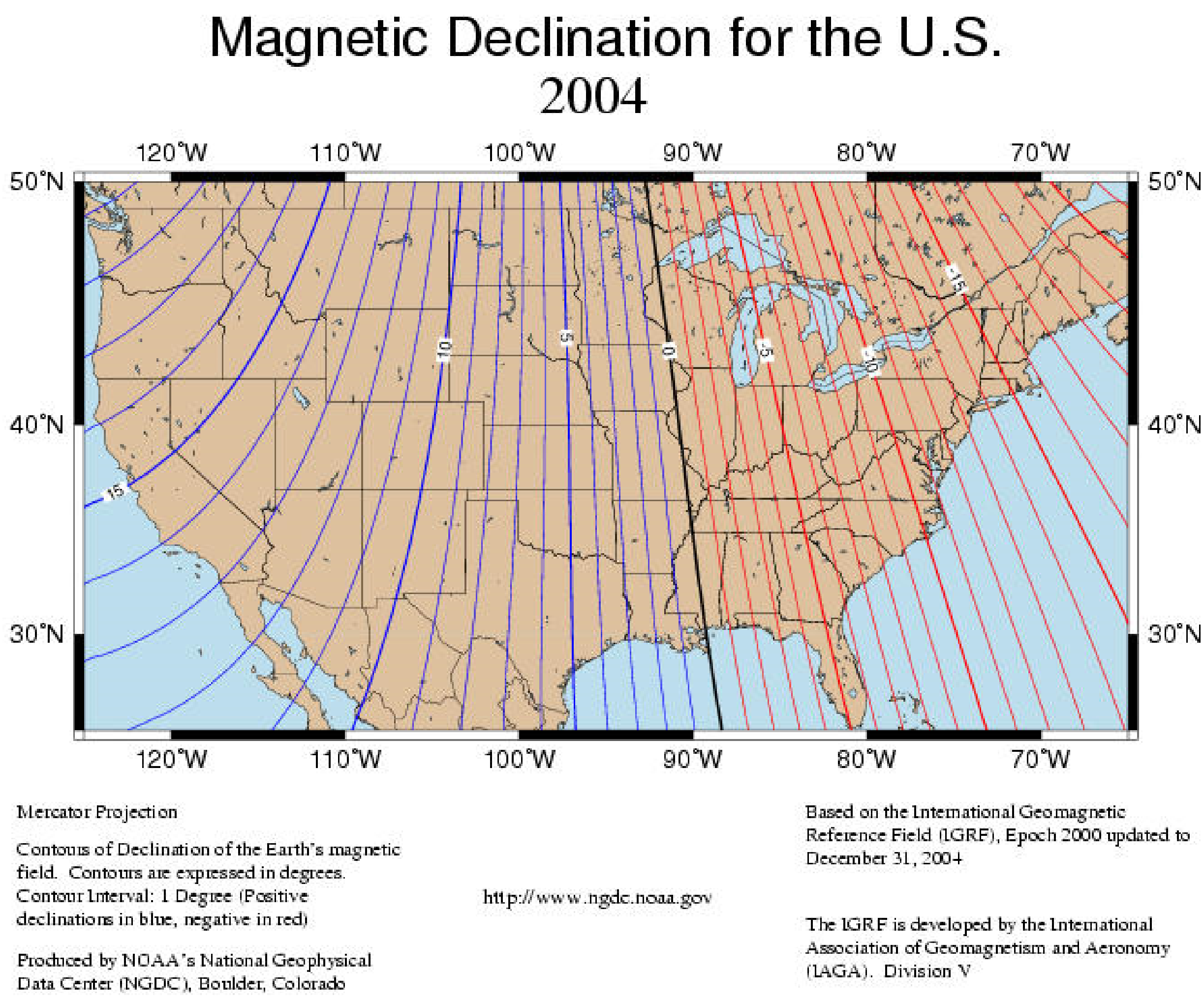


FIGURE A-1. Magnetic declination for the contiguous United States (2004)

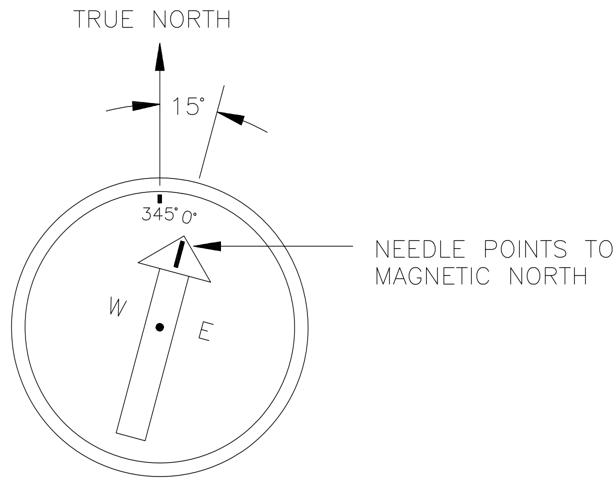


FIGURE A-2. Declination angles east of true North are subtracted from 360° to get true North

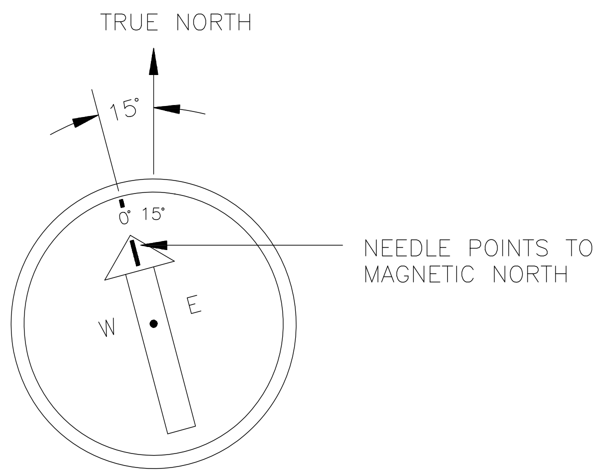


FIGURE A-3. Declination angles west of true North are added to 0° to get true North

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