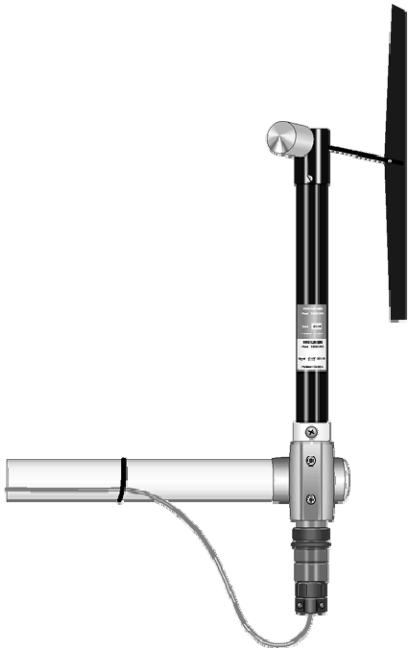
INSTRUCTION MANUAL

# Model 024A Met One Wind Direction Sensor

Revision: 10/12



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# *024A Met-One Wind Direction Sensor*

## 1. Introduction

The 024A is a wind vane manufactured by Met One. It measures wind direction only and is traditionally used in tandem with Met One's 014A Wind Speed Sensor.

Before installing the 024A, please study

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

## 2. Cautionary Statements

- The 024A is a precision instrument. Please handle it with care.
- If the 024A is to be installed at heights over 6 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 024A or before raising a tower.
- The black outer jacket of the cable is Santoprene® rubber. This compound was chosen for its resistance to temperature extremes, moisture, and UV degradation. However, this jacket will support combustion in air. It is rated as slow burning when tested according to U.L. 94 H.B. and will pass FMVSS302. Local fire codes may preclude its use inside buildings.

## 3. Initial Inspection

- Upon receipt of the 024A, inspect the packaging and contents for damage. File damage claims with the shipping company. Immediately check package contents against the shipping documentation. Contact Campbell Scientific about any discrepancies.
- 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 Step 1 — Mount the Sensor

Please review Section 7, *Installation*, for siting and other guidelines.

Install the 024A using:

- CM220 Right-Angle Mounting Kit, or
- 17953 1 x 1 inch NURAIL Crossover Fitting

1. Remove the Allen hex screw in the lower part of the sensor housing (see FIGURE 4-1).

2. Insert the 024A in the mounting bushing (see FIGURE 4-1).

3. Tighten the screw in the bushing onto the sensor housing (see FIGURE 4-1).

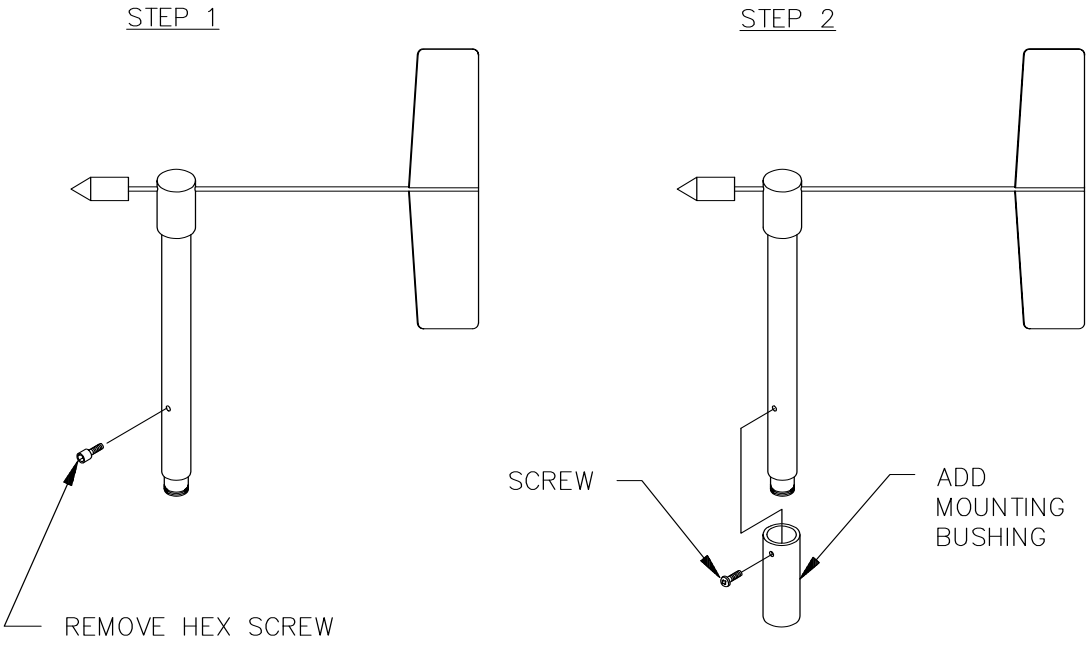



*FIGURE 4-1. Bushing installation on 024A sensor*

4. Mount a CM202, CM204, or CM206 crossarm to a tripod or tower.

5. Orient the crossarm north-south, with the CM220 or 17953 NU-RAIL on the north end. Appendix A contains detailed information on determining True North using a compass and the magnetic declination for the site.

6. Insert the sensor in the CM220 or NU-RAIL fitting (see FIGURE 4-2).

7. Align the sensor so that the counter weight points to True South and tighten the U-bolts on the CM220 or tighten the set screws on the NU-RAIL fitting.

8. Connect the cable assembly to the sensor receptacle.

9. Route the sensor cable along the underside of the crossarm to the tripod or tower, and to the instrument enclosure.

10. Secure the cable to the crossarm and tripod or tower using cable ties.

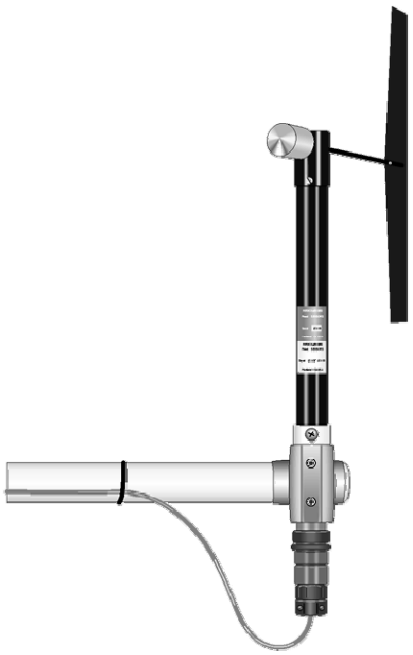
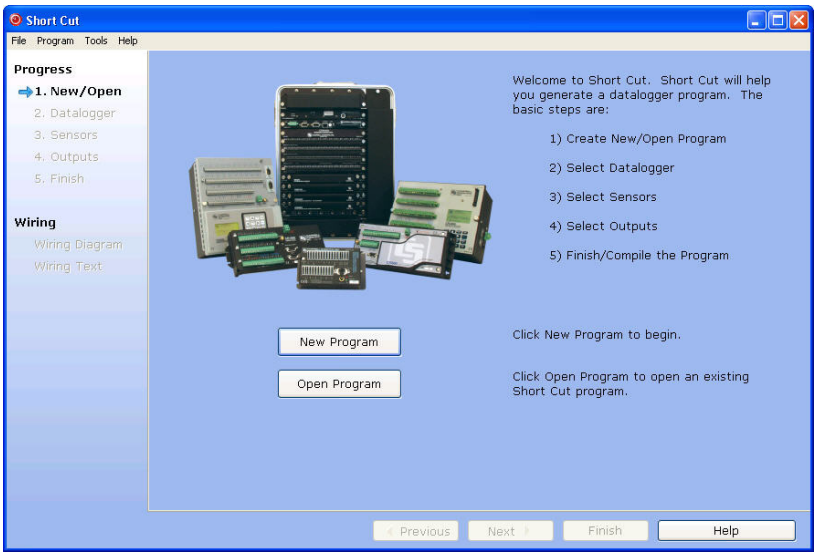


*FIGURE 4-2. The 024A mounted to a crossarm via the 17953 NU-RAIL*

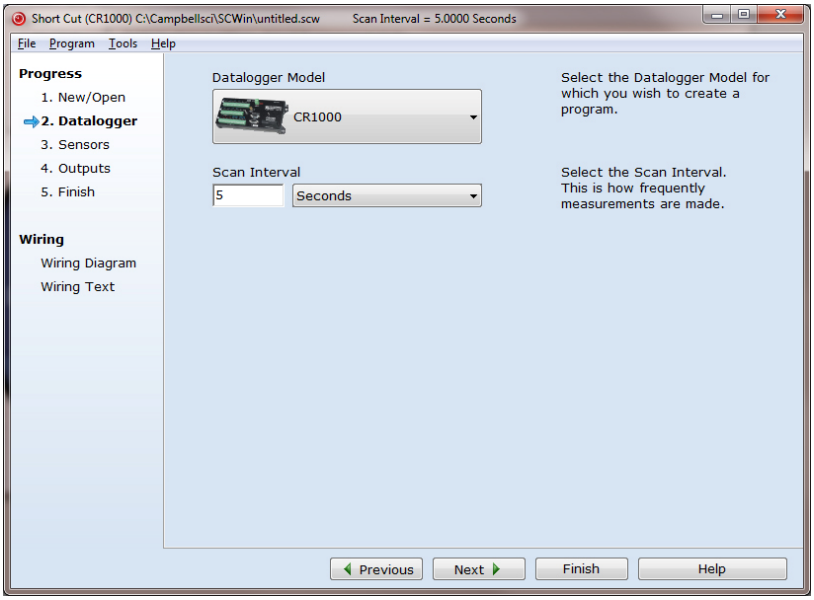
## 4.2 Step 2 — Use SCWin Short Cut to Program Datalogger and Generate Wiring Diagram

The simplest method for programming the datalogger to measure the 024A is to use Campbell Scientific's SCWin Short Cut Program Generator.

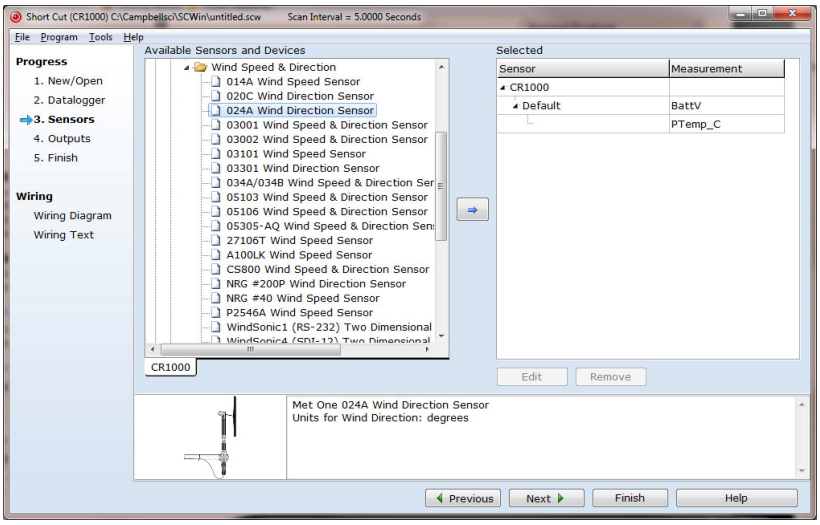
1. Open Short Cut and click on **New Program**.



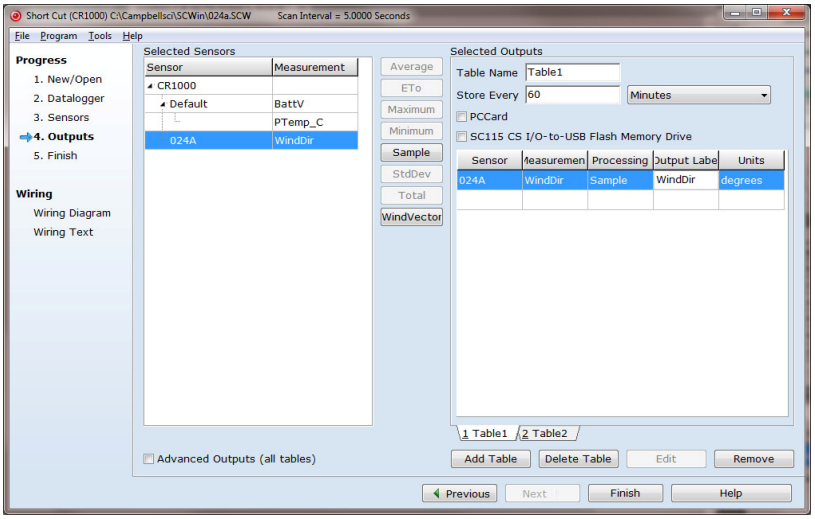

2. Select the datalogger and enter the scan interval.



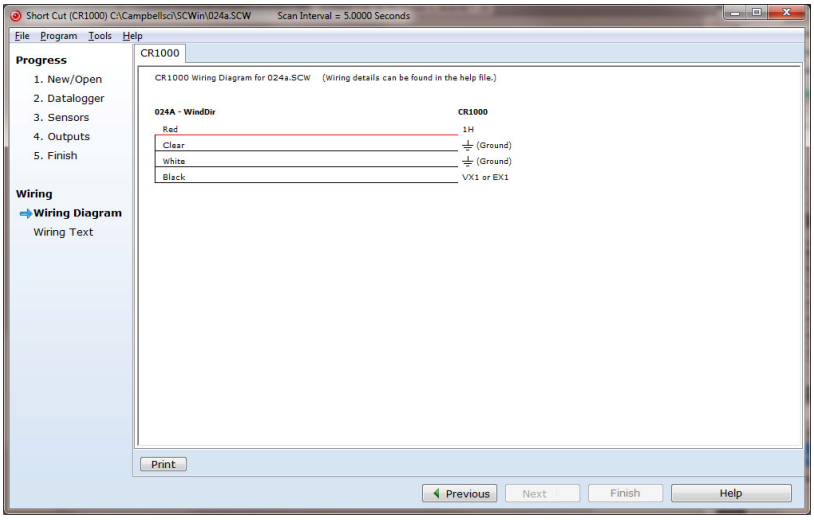
3. Select 024A Wind Direction Sensor and select the right arrow to add it to the list of sensors to be measured then select next.




4. Select Sample for the output and then select finish



5. Wire according to the wiring diagram generated by SCWin Short Cut.




# 5. Overview

Met One's 024A is a wind vane that measures wind direction from 0 to 360 degrees with a 5 degree accuracy. It uses a 10-kohm potentiometer to sense wind direction. A datalogger applies a precision excitation voltage to the potentiometer, resulting in an analog voltage output that is directly proportional to the wind direction's azimuth.

Cable length for the 024A is specified when the sensor is ordered. TABLE 5-1 gives the recommended cable length for mounting the sensor at the top of a tripod/tower via a CM202 crossarm.

**TABLE 5-1. Recommended Cable Lengths**

| CM106 | CM110 | CM115 | CM120 | UT10 | UT20 | UT30 |
|---|---|---|---|---|---|---|
| 11 ft | 14 ft | 19 ft | 24 ft | 14 ft | 24 ft | 37 ft |

The 024A's cable can terminate in:

- Pigtails that connect directly to a Campbell Scientific datalogger (option –PT).
- Connector that attaches to a prewired enclosure (option –PW). Refer to *www.campbellsci.com/prewired-enclosures* for more information.

# 6. Specifications

| | |
|---|---|
| **Compatible Dataloggers:** | CR200(X)<br>CR800 series<br>CR1000<br>CR3000<br>CR5000<br>CR9000(X)<br>CR510<br>CR10(X)<br>CR23X<br>CR7<br>21X |
| **Range:** | 0 to 360 degrees |
| **Threshold:** | 0.447 m $s^{-1}$ (1.0 mph) |
| **Accuracy:** | ±5 degrees |
| **Temperature Range:** | -50° to +70°C |
| **Delay Distance:** | Less than 1.5 m (5 ft.) |
| **Damping Ratio** | |
| **Standard:** | 0.25 |
| **Optional:** | 0.4 |
| **Potentiometer Specifications** | |
| **Sand, Dust, and Fungus:** | MIL-E-5272 |
| **Salt Spray:** | MIL-E-12934 |
| **Resistance:** | 0 to 10,000 ohms |
| **Weight:** | 450 g (1 lb) |
| **Dimensions** | |
| **Overall Height:** | 33.8 cm (13.3 in) |
| **Overall Length:** | 44.7 cm (17.6 in) |
| **Tail Height:** | 30.5 cm (12 in) |
| **Tail Width:** | 7.6 cm (3 in) |

# 7. Installation

## 7.1 Siting

Locate wind sensors away from obstructions (e.g. trees and building). As a general rule of thumb there should be a horizontal distance of at least ten times the height of the obstruction between the windset and the obstruction. If it is necessary to mount the sensors on the roof of a building, the height of the sensors, above the roof, should be at least 1.5 times the height of the building. See Section 9, *References*, for a list of references that discuss siting wind direction sensors.

## 7.2 Mounting Options

The 024A can be attached to a CM202, CM204, or CM206 crossarm via a 17953 NU-RAIL fitting (see FIGURE 4-2 in Quickstart) or a CM220 Right Angle Mounting Bracket (see FIGURE 7-1). Alternatively, the 024A can be attached to the top of our stainless-steel tripods via the CM216 Sensor Mounting Kit (see FIGURE 7-2). The CM216 extends 4 in. above the mast of a stainless-steel CM110, CM115, or CM120 tripod.

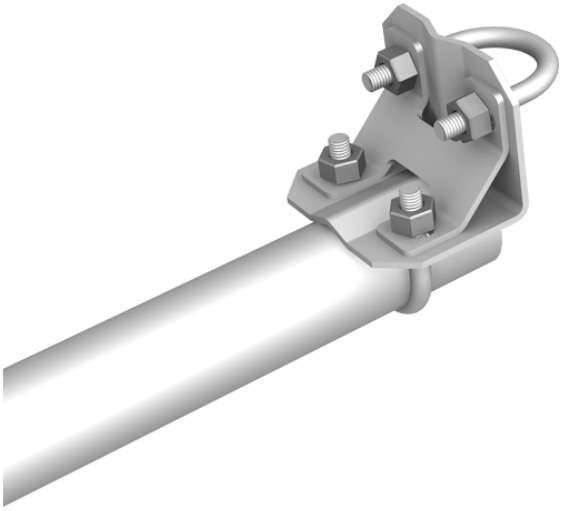


*FIGURE 7-1. CM220 mount attached to a crossarm*

*FIGURE 7-2. CM216 mount*

## 7.3 Wiring

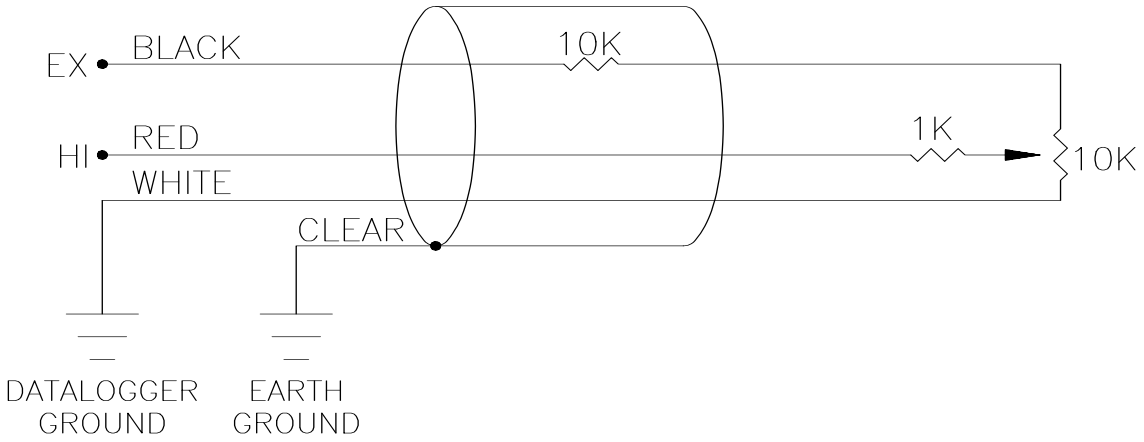



*FIGURE 7-3. Schematic of 024A Wind Direction Sensor*

FIGURE 7-3 and TABLE 7-1 shows wiring; a detailed cable diagram is provided in Section 8, *Maintenance* (FIGURE 8-1). When Short Cut is used to create the datalogger program, the sensor should be wired to the channels shown on the wiring diagram created by Short Cut.

**TABLE 7-1. Connections to Campbell Scientific Dataloggers**

| Color | Description | CR800 CR5000 CR3000 CR1000 | CR510 CR500 CR10(X) | 21X CR7 CR23X | CR200(X) |
|---|---|---|---|---|---|
| Red | Wind Dir. Signal | SE Analog | SE Analog | SE Analog | SE Analog |
| Black | Wind Dir. Excitation | Excitation | Excitation | Excitation | Excitation |
| White | Wind Dir. Reference | ⏚ | AG | ⏚ | ⏚ |
| Clear | Wind Dir. Shield | ⏚ | G | ⏚ | ⏚ |

## 7.4 Programming

**NOTE** This section is for users who write their own programs. A datalogger program to measure this sensor can be created using Campbell Scientifics' Short Cut Program Builder software. You do not need to read this section to use Short Cut.

### 7.4.1 Datalogger Instruction

The datalogger instruction that measures the 024A is datalogger dependent. The **BRHalf()** measurement instruction is used for our CR800, CR850, CR1000, CR3000, and CR5000 dataloggers. Our CR200(X)-series dataloggers use the **EX-DEL_SE()**. Our Edlog dataloggers (e.g., CR510, CR10(X), CR23X) use Instruction 4 – Excite, Delay, Measure. Excitation voltages, range

codes, and delays for CSI dataloggers are listed in TABLE 7-2. The process for determining the correct multiplier is provided in Section 7.4.2, *Calibration and Orientation*.

**TABLE 7-2. Parameters for Wind Direction**

| | **CR200(X)** | **CR10(X), CR510** | **CR7, 21X, CR23X** | **CR800, CR850, CR1000** | **CR5000, CR3000** |
|---|---|---|---|---|---|
| Measurement Range | 2500 mV | 250 mV, fast | 500 mV, fast | 2500 mV, 250 microsecond integration, reverse excitation | 5000 mV, 250 microsecond integration, reverse excitation |
| Excitation Voltage | 2500 mV | 500 mV | 1000 mV | 2500 mV | 5000 mV |
| Delay or Settling Time | 2 ms | 2 ms | 2 ms | 2 ms | 2 ms |
| Multiplier | See Section 7.4.2 | See Section 7.4.2 | See Section 7.4.2 | See Section 7.4.2 | See Section 7.4.2 |
| Offset | 0 | 0 | 0 | 0 | 0 |

### 7.4.2 Calibration and Orientation

Conversion of the voltage output into wind direction is done by entering the proper multiplier. The proper multiplier is calculated by dividing 360 by the full scale input voltage (i.e., 360/FSIV). The full scale input voltage (FSIV) is the maximum voltage output from the wind vane. This is found by creating a datalogger program with a multiplier of 1, the default excitation, and a fast scan interval. With a multiplier of 1, the value stored in the variable or input location is simply the voltage output. Slowly turn the wind vane; the shoulder screw must first be removed. The maximum value observed is the full scale input voltage (FSIV).

**NOTE** If the reading is -99999, exceeds 500 on the 21X or CR7, or exceeds 250 on the CR10, then reduce the millivolts of excitation by 5 mV.

Multiplier 360/FSIV*
Offset 0.0

*FSIV = Full scale input voltage

Enter the calculated multiplier in the program.

Orientation of the 024A Wind Direction Sensor should be complete if the 024A counter weight was aligned due south.

### 7.4.3 Example Programs

**NOTE** For these examples, the multiplier is listed as 1. The multiplier is unique to individual devices. Follow the procedure provided in Section 7.4.2, *Calibration and Orientation*, to acquire the correct multiplier for your sensor.

```
'CR200(X) Series
'Created by Short Cut (2.5)

'Declare Variables and Units
Public Batt_Volt
Public WindDir
Public NewMult

Units Batt_Volt=Volts
Units WindDir=degrees

'Define Data Tables
DataTable(Table2,True,-1)
  DataInterval(0,1440,Min)
  Minimum(1,Batt_Volt,False,False)
EndTable

'Main Program
BeginProg
  Scan(10,Sec)
    'Default Datalogger Battery Voltage measurement Batt_Volt:
    Battery(Batt_Volt)
    '024A Wind Direction Sensor measurement WindDir:
    ExDelSE(WindDir,1,1,1,2500,2000,1.0,0)
    NewMult=360/WindDir
    'Call Data Tables and Store Data
    CallTable(Table2)
  NextScan
EndProg
```

```
'CR1000
'Created by Short Cut (2.5 Beta)

'Declare Variables and Units
Public Batt_Volt
Public WindDir
Public NewMult

Units Batt_Volt=Volts
Units WindDir=degrees

'Define Data Tables
DataTable(Table1,True,-1)
  DataInterval(0,60,Min,10)
  Sample(1,WindDir,FP2)
EndTable

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

```
'Main Program
BeginProg
  Scan(5,Sec,1,0)
    'Default Datalogger Battery Voltage measurement Batt_Volt:
    Battery(Batt_Volt)
    '024A Wind Direction Sensor measurement WindDir:
    BrHalf(WindDir,1,mV2500,1,1,1,2500,True,2000,250,1.0,0)
    NewMult=360/WindDir
    'Call Data Tables and Store Data
    CallTable(Table1)
    CallTable(Table2)
  NextScan
EndProg
```

```
'CR3000
'Created by Short Cut (2.5)

'Declare Variables and Units
Public Batt_Volt
Public WindDir
Public NewMult

Units Batt_Volt=Volts
Units WindDir=degrees

'Define Data Tables
DataTable(Table1,True,-1)
  DataInterval(0,60,Min,10)
  Sample(1,WindDir,FP2)
EndTable

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

'Main Program
BeginProg
  Scan(5,Sec,1,0)
    'Default Datalogger Battery Voltage measurement Batt_Volt:
    Battery(Batt_Volt)
    '024A Wind Direction Sensor measurement WindDir:
    BrHalf(WindDir,1,mV5000,1,1,1,5000,True,2000,250,1.0,0)
    NewMult=360/WindDir
    'Call Data Tables and Store Data
    CallTable(Table1)
    CallTable(Table2)
  NextScan
EndProg
```

```
;{CR10X}
;
*Table 1 Program
  01:  10            Execution Interval (seconds)

;Measure sensor. Multiplier is unique to individual devices.
1:  Excite-Delay (SE) (P4)
   1:   1            Reps
   2:   14           250 mV Fast Range
   3:   1            SE Channel
   4:   1            Excite all reps w/Exchan 1
   5:   2            Delay (0.01 sec units)
   6:   500          mV Excitation
   7:   1            Loc [ wind_dir  ]
   8:   1.0          Multiplier
   9:   0.0          Offset

;Store measurements in final storage
2:  If time is (P92)
   1:   0000         Minutes (Seconds --) into a
   2:   60           Interval (same units as above)
   3:   10           Set Output Flag High (Flag 0)

3:  Set Active Storage Area (P80)
   1:   1            Final Storage Area 1
   2:   101          Array ID

4:  Real Time (P77)
   1:   1220         Year,Day,Hour/Minute (midnight = 2400)

5:  Sample (P70)
   1:   1            Reps
   2:   1            Loc [ wind_dir  ]
```

# 8. Maintenance

## 8.1 6 to 12 Month Periodic Service *

Inspect sensor for physical damage and verify that the vane assembly rotates freely. To verify parts and locations, refer to the parts diagram (FIGURE 8-2) and the parts list (TABLE 8-1).

## 8.2 24 to 36 Month Service *

A complete factory overhaul of the sensor, including the replacement of the potentiometer, is recommended. To send the 024A to Campbell Scientific, the customer must receive an RMA number and fill out a “Statement of Product Cleanliness”. For more information, refer to the Assistance section that is at the beginning of this document.

* Schedule is based on average to adverse environments.

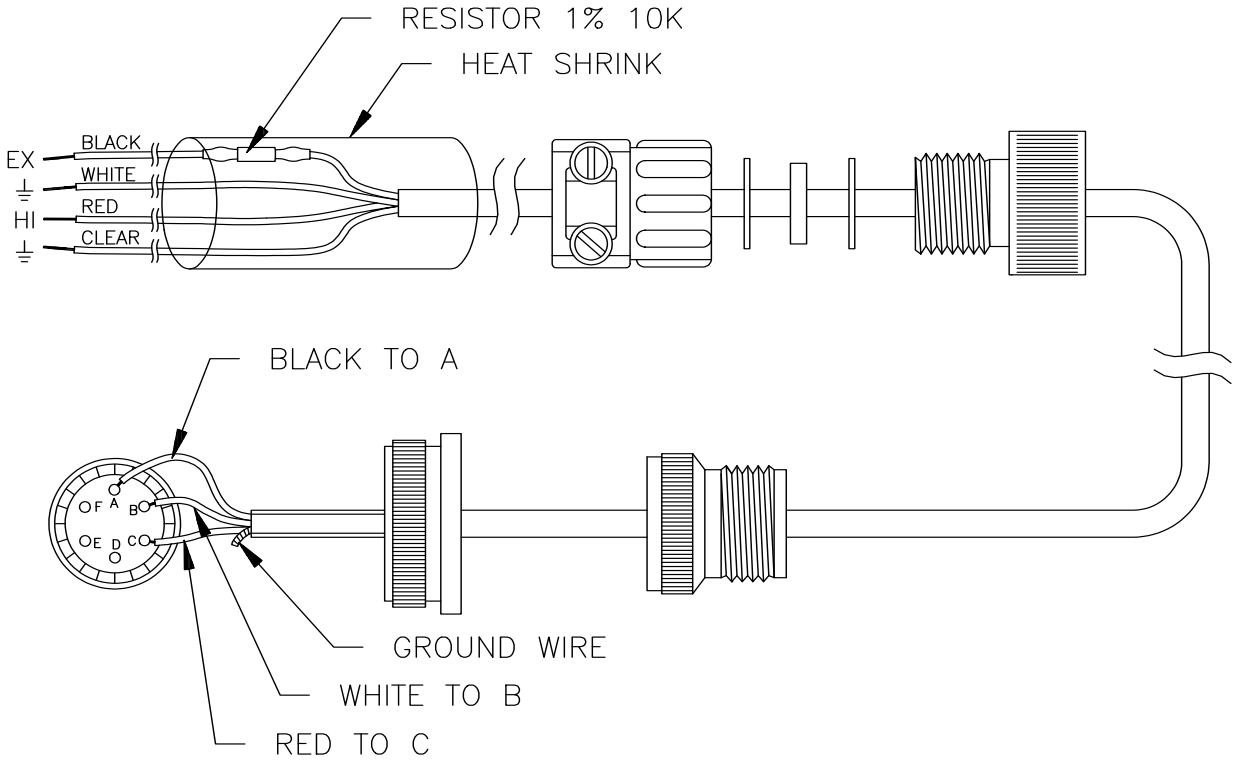



*FIGURE 8-1. Cable diagram*

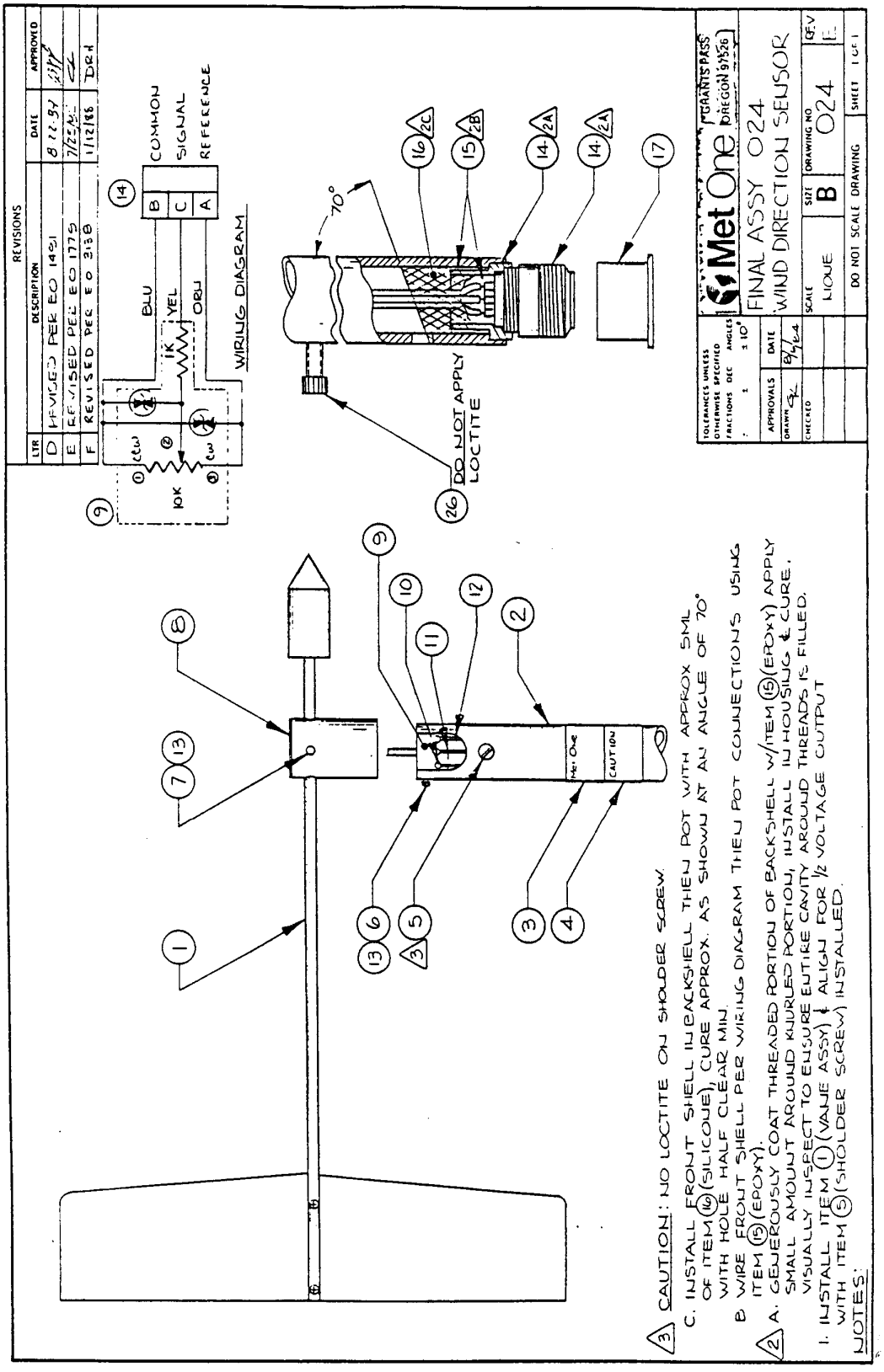



*FIGURE 8-2. Parts diagram*

| TABLE 8-1. Met-One Parts List Reproduced by Campbell Scientific, Inc. | | | |
|---|---|---|---|
| **Item** | **Part No.** | **Description.** | **Qty./Assy** |
| 1 | 102105 | Vane Assembly | 1 |
| 2 | 101685-1 | Wind Dir. Support | 1 |
| 3 | 101049-2 | Label, Wind Dir. | 1 |
| 4 | 101789 | Label, Caution | 1 |
| 5 | 860015 | Screw, Shoulder | 1 |
| 6 | 601100 | Screw, Pan Hd Ph, 2-56x3/16 | 3 |
| 7 | 601680 | Scrw, Set A/H, 8-32x3/8 | 2 |
| 8 | 101687 | Label, Met-One | 1 |
| 9 | 102017 | Assy, Potentiometer | 1 |
| 10 | 980495 | Wire, 22Ga, Yel | 1 |
| 11 | 980450 | Wire, 22Ga, Blu | 1 |
| 12 | 980475 | Wire, 22Ga, Orn | 1 |
| 13 | 995425 | Loctite 222 | A/R |
| 14 | 500280 | Connector, 6 Pin | 1 |
| 15 | 995100 | Adhesive, Epoxy | A/R |
| 16 | 995060 | Adhesive, Silicone | 5ml |
| 17 | 510020 | Cap | 1 |
| 18 | | | |
| 19 | | | |
| 20 | | | |
| 21 | 101806 | Assembly, Cable | Ref |
| 22 | 101699 | Assy Instructions | Ref |
| 23 | 101706 | 014 & 024 Installation | Ref |
| 24 | 101697 | Wir. Diagram | Ref |
| 25 | | | |
| 26 | 601850 | Scrw, Cap A/H SS 10-32x5/8 | 1 |

# 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 FIGURE A-2 (0° and 360° are the same point on the compass). For example, the declination for Logan, Utah is 14° East. True North is 360° - 14°, or 346° 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 the NU-RAIL 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 degrees. Tighten the set screws.

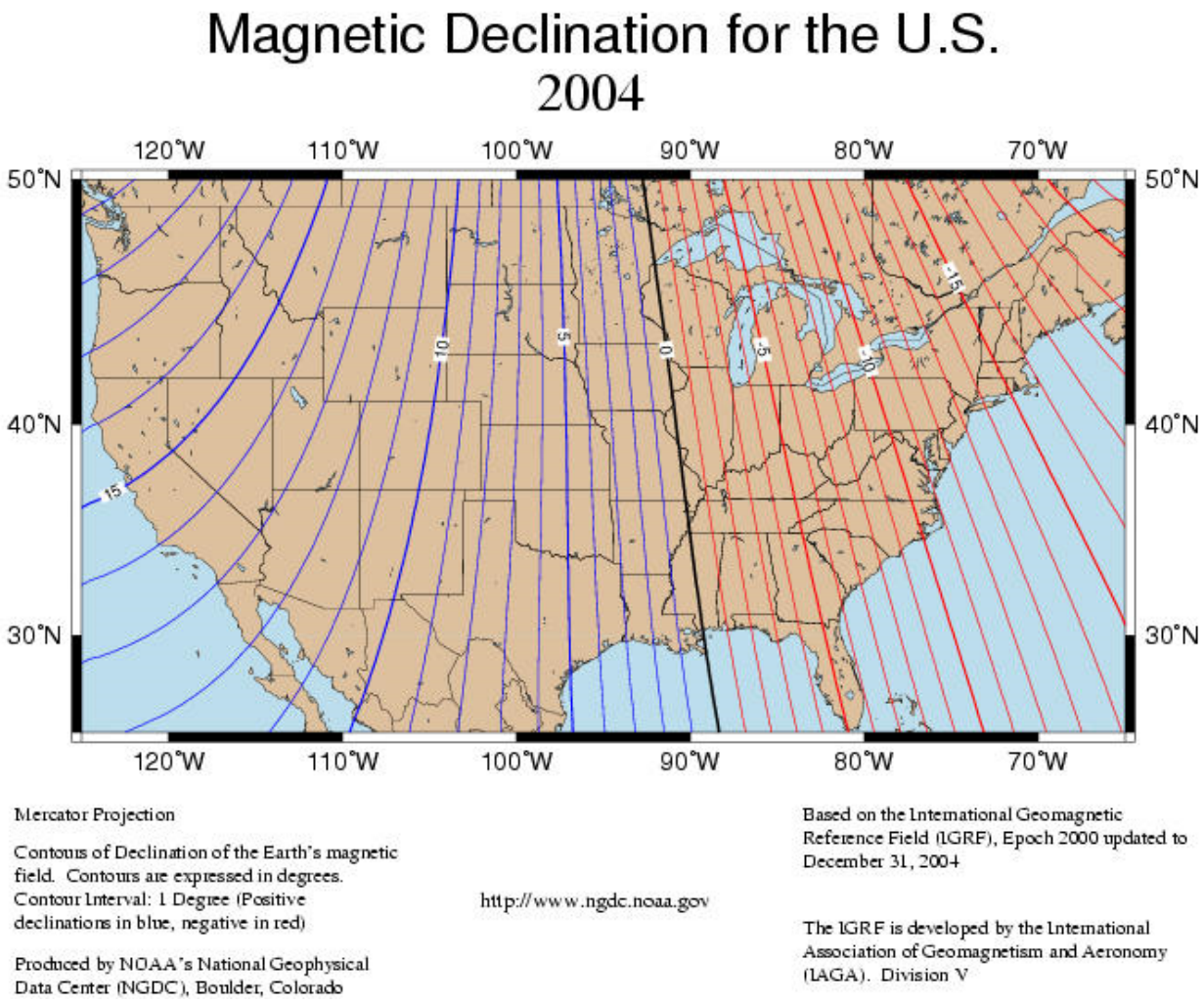



*FIGURE A-1. Magnetic declination for the contiguous United States (2004)*

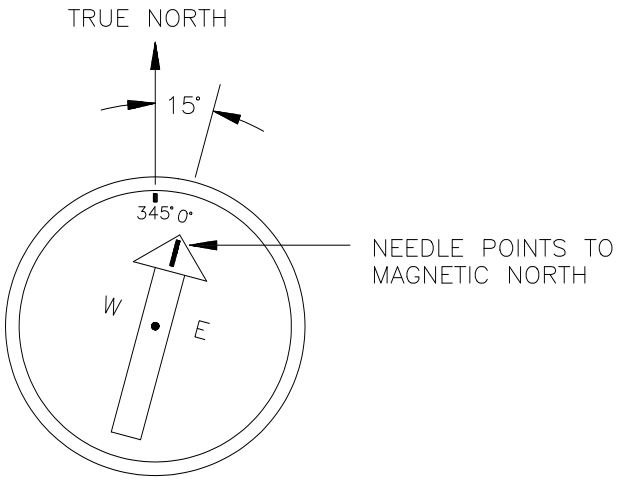



*FIGURE A-2. Declination angles east of True North are subtracted from 0 to get True North*

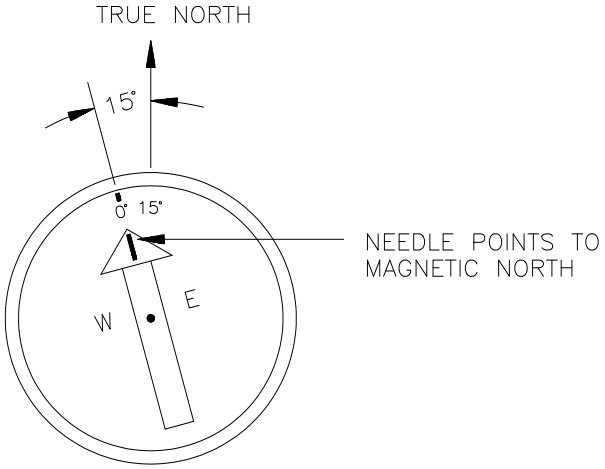



*FIGURE A-3. Declination angles west of True North are added to 0 to get True North*

## Campbell Scientific Companies


**Campbell Scientific, Inc. (CSI)**
815 West 1800 North
Logan, Utah 84321
UNITED STATES
www.campbellsci.com • info@campbellsci.com

**Campbell Scientific Africa Pty. Ltd. (CSAf)**
PO Box 2450
Somerset West 7129
SOUTH AFRICA
www.csafrica.co.za • cleroux@csafrica.co.za

**Campbell Scientific Australia Pty. Ltd. (CSA)**
PO Box 8108
Garbutt Post Shop QLD 4814
AUSTRALIA
www.campbellsci.com.au • info@campbellsci.com.au

**Campbell Scientific do Brazil Ltda. (CSB)**
Rua Luisa Crapsi Orsi, 15 Butantã
CEP: 005543-000 São Paulo SP BRAZIL
www.campbellsci.com.br • suporte@campbellsci.com.br

**Campbell Scientific Canada Corp. (CSC)**
11564 - 149th Street NW
Edmonton, Alberta T5M 1W7
CANADA
www.campbellsci.ca • dataloggers@campbellsci.ca

**Campbell Scientific Centro Caribe S.A. (CSCC)**
300 N Cementerio, Edificio Breller
Santo Domingo, Heredia 40305
COSTA RICA
www.campbellsci.cc • info@campbellsci.cc

**Campbell Scientific Ltd. (CSL)**
Campbell Park
80 Hathern Road
Shepshed, Loughborough LE12 9GX
UNITED KINGDOM
www.campbellsci.co.uk • sales@campbellsci.co.uk

**Campbell Scientific Ltd. (France)**
3 Avenue de la Division Leclerc
92160 ANTONY
FRANCE
www.campbellsci.fr • info@campbellsci.fr

**Campbell Scientific Spain, S. L.**
Avda. Pompeu Fabra 7-9, local 1
08024 Barcelona
SPAIN
www.campbellsci.es • info@campbellsci.es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