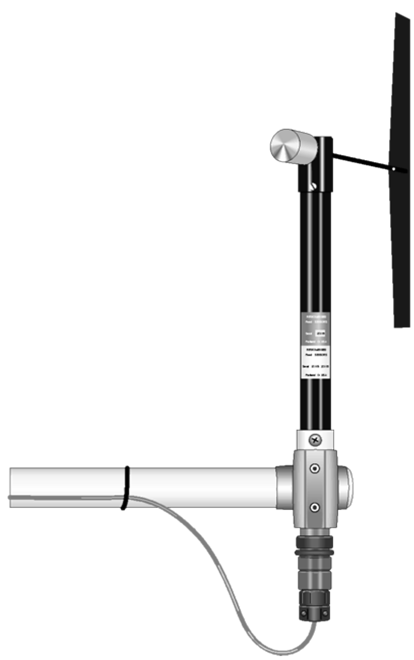
INSTRUCTION MANUAL

024A Met One Wind Direction Sensor

Revision: 12/15



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To obtain a Returned Materials Authorization (RMA), contact CAMPBELL SCIENTIFIC, INC., phone (435) 227-9000. After an application 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 website 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.

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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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.

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* or contact a Campbell Scientific application engineer for assistance.

2. Precautions

- READ AND UNDERSTAND the *Safety* section at the front of this manual.
- The 024A is a precision instrument. Please handle it with care.
- If the 024A is to be installed at heights over 6 ft, 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 Mount the Sensor

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

Install the 024A using:

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

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

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

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

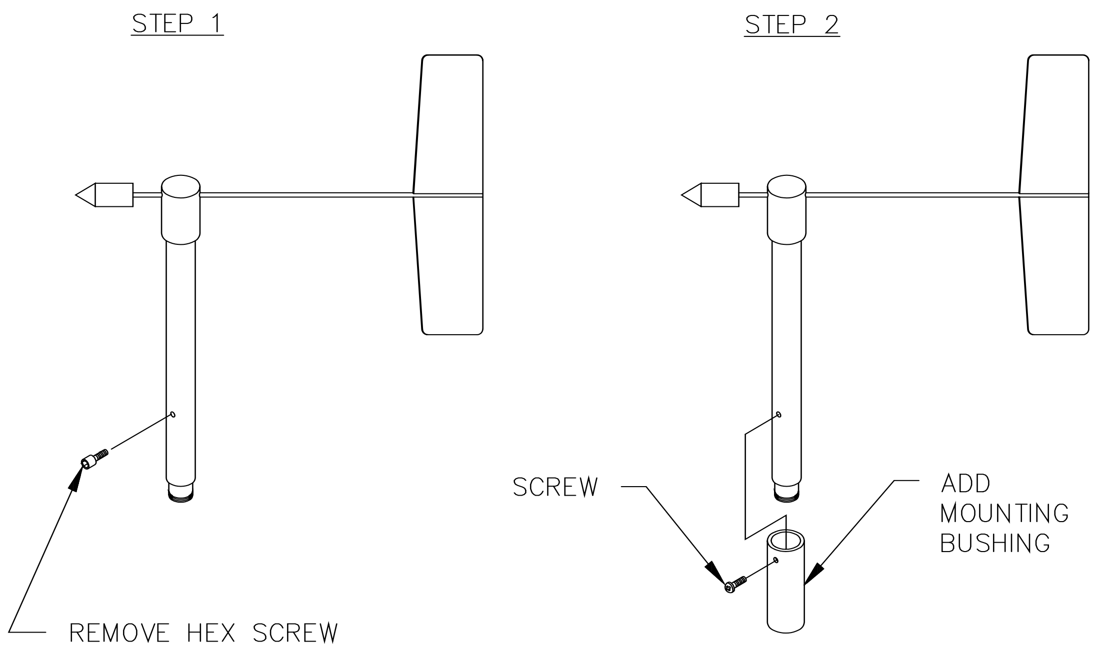


FIGURE 4-1. Bushing installation on 024A sensor

4. Mount the crossarm to a tripod or tower.

5. Orient the crossarm north-south, with the CM220 or 17953 NU-RAIL on the north end. Appendix C, *Determining True North and Sensor Orientation* (p. C-1), 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 due 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/tower, and to the instrument enclosure.

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

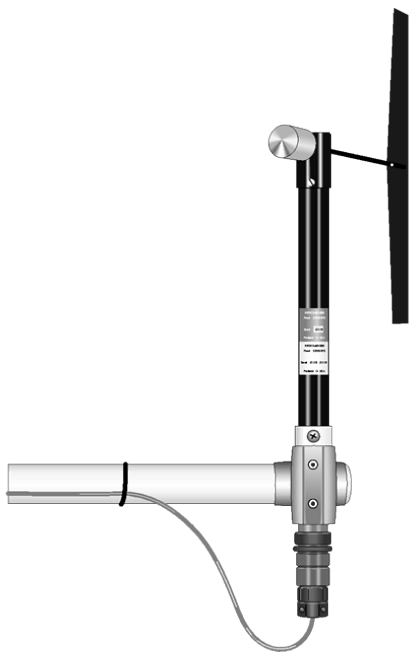


FIGURE 4-2. The 024A mounted to a crossarm via the 17953 NU-RAIL

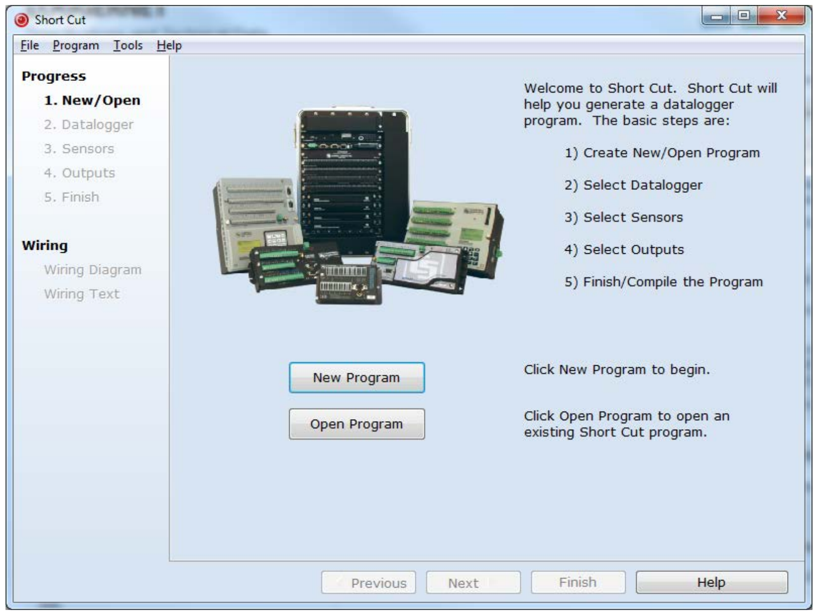
4.2 Short Cut

Short Cut is an easy way to program your datalogger to measure this sensor and assign datalogger wiring terminals. The following procedure shows using *Short Cut* to program the sensor.

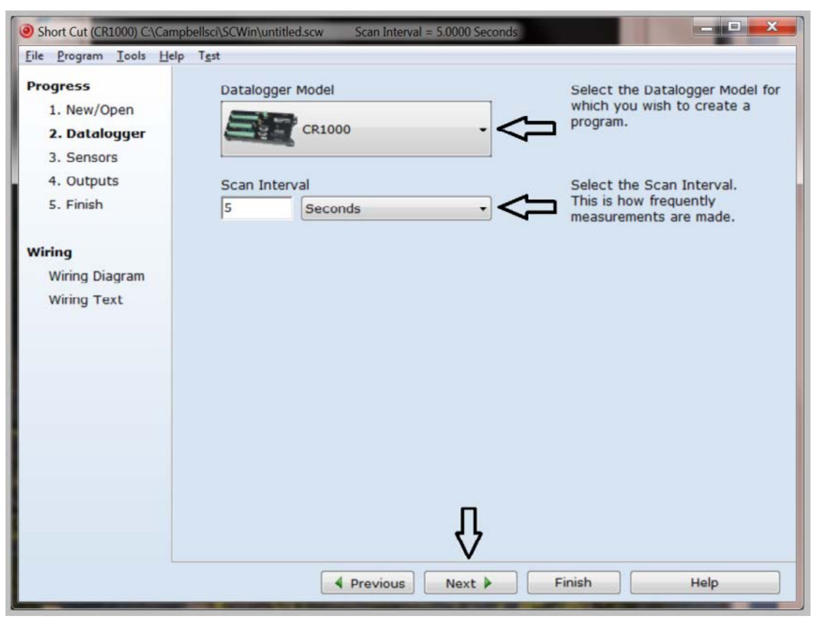
1. Install *Short Cut* by clicking on the install file icon. Get the install file from either www.campbellsci.com, the ResourceDVD, or find it in installations of *LoggerNet*, *PC200W*, *PC400*, or *RTDAQ* software.

2. The *Short Cut* installation should place a shortcut icon on the desktop of your computer. To open *Short Cut*, click on this icon.

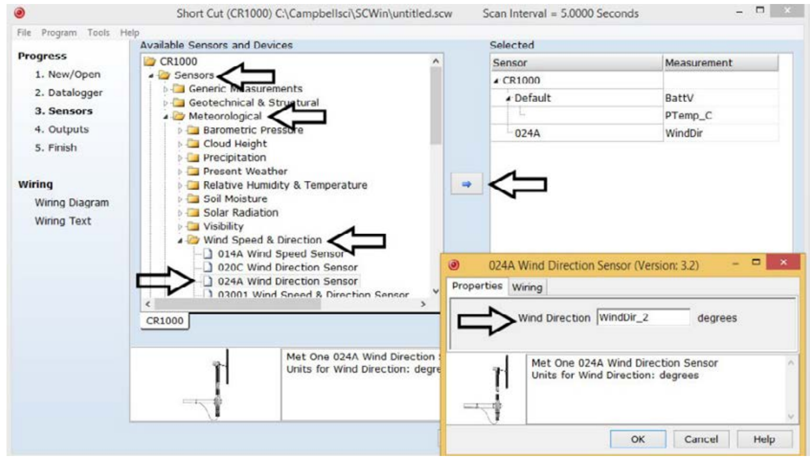
3. When *Short Cut* opens, select **New Program**.



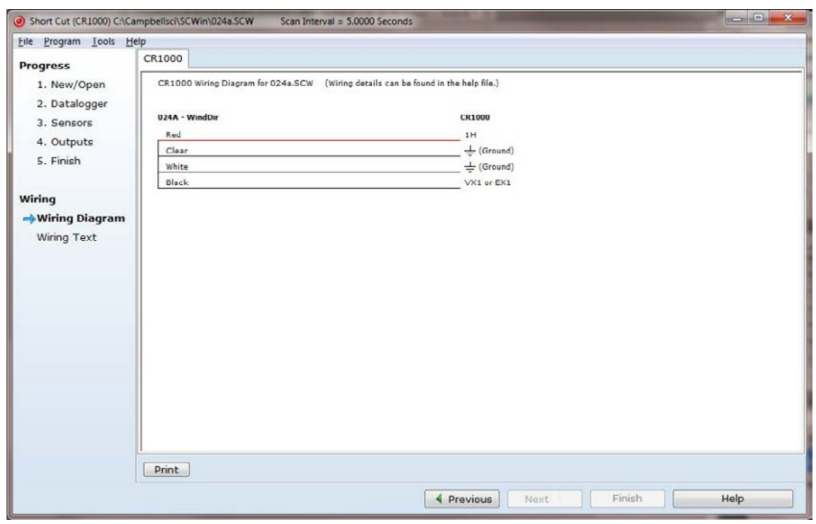
4. Select the **Datalogger Model** and enter the **Scan Interval** (default of **5** seconds is OK for most applications). Click **Next**.



5. Under **Available Sensors and Devices**, select your sensor, and select the **Sensors | Meteorological | Wind Speed & Direction** folder. Select **024A Wind Direction Sensor**. Click [→] to move the selection to the **Selected** device window.



6. After selecting the sensor, click at the left of the screen on **Wiring Diagram** to see how the sensor is to be wired to the datalogger. The wiring diagram can be printed out now or after more sensors are added.



7. 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**.

8. 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.

9. If the sensor is connected to the datalogger, as shown in the wiring diagram in step 6, check the output of the sensor in the datalogger support software data display to make sure it is making reasonable measurements.

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-kΩ 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.

The cable includes a 10k 1% resistor as shown in FIGURE 7-3. If the cable was purchased from Met One Instruments, the 10k resistor is not included. The cable can be used without the resistor, but this requires program changes not supported by *Short Cut* (see Section 7.4.1, *Datalogger Instruction* (p. 9)).

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

CM106B	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

Features:

- Compatible with Campbell Scientific CRBasic dataloggers: CR6, CR200(X) series, CR800, CR850, CR1000, CR3000, CR5000, and CR9000(X).

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: < 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 10,000Ω

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

If you are programming your datalogger with *Short Cut*, skip Section 7.3, *Wiring* ***(p. 8)***, and Section 7.4, *Programming* ***(p. 9)***. *Short Cut* does this work for you. See Section 4, *QuickStart* ***(p. 2)***, for a *Short Cut* tutorial.

7.1 Siting

Locate wind sensors away from obstructions such as trees or buildings. The recommended horizontal distance is 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* ***(p. 13)***, for a list of references that discuss siting wind direction sensors.

7.2 Mounting Options

The 024A can be attached to a 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 CM110, CM115, or CM120 tripods via the CM216 Sensor Mounting Kit (see FIGURE 7-2). The CM216 extends 4 inches above the tripod mast.

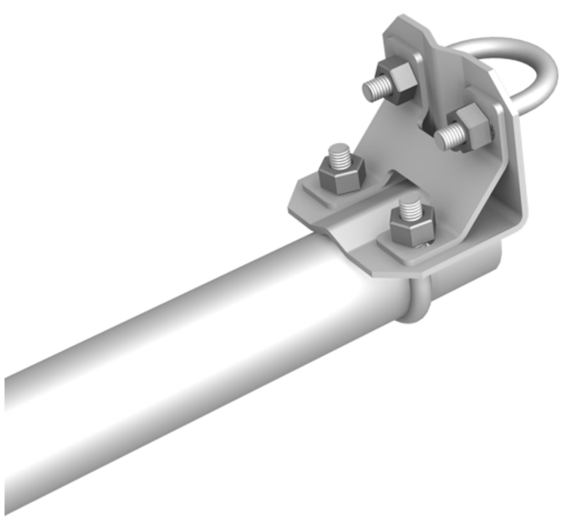


FIGURE 7-1. CM220 mount attached to a crossarm

FIGURE 7-2. CM216 mount

7.3 Wiring

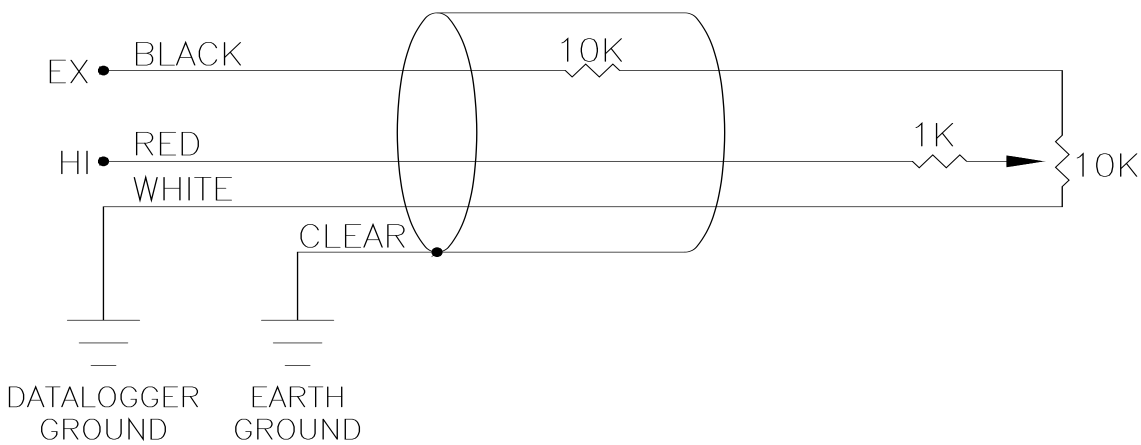


FIGURE 7-3. Schematic of 024A Wind Direction Sensor

FIGURE 7-3 and TABLE 7-1 shows wiring; a detailed cable diagram is provided in Section 8, *Maintenance* *(p. 11)* (FIGURE 8-1).

TABLE 7-1. Wire Color, Function, and Datalogger Connection

Wire Color	Wire Function	Datalogger Connection Terminal
Red	Signal	**U** configured for single-ended analog input[1], **SE** (single-ended, analog-voltage input)
Black	Voltage excitation input	**U** configured for voltage excitation[1], **EX**, **VX** (voltage excitation)
White	Wind Direction Reference	AG or ⏚ (analog ground)
Clear	Shield	AG or ⏚ (analog ground)

[1]**U** channels are automatically configured by the measurement instruction.

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
- when adding sensors to an existing datalogger program

If your data acquisition requirements are simple and you are connecting the sensor to a pulse port, 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 4.2, *Short Cut* ***(p. 3)***. 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 provided in the following sections. Complete program examples for select CRBasic dataloggers can be found in Appendix B, *Example Programs* ***(p. B-1)***. Programming basics and programming examples for Edlog dataloggers are provided at *www.campbellsci.com\old-manuals.*

7.4.1 Datalogger Instruction

The datalogger instruction that measures the 024A is datalogger dependent. The **BRHalf()** measurement instruction is used for our CR6, CR800, CR850, CR1000, CR3000, and CR5000 dataloggers. Our CR200(X)-series dataloggers use the **EX-DEL_SE()**. Excitation voltages, range codes, delays, and multipliers are listed in TABLE 7-2. The multipliers listed in TABLE 7-2 do not account for cable length or resistor tolerances. A more accurate multiplier can be determined as described in Section 7.4.2, *Calibration* ***(p. 10)***.

TABLE 7-2. Parameters for Wind Direction				
	CR200(X)	**CR800, CR850, CR1000**	**CR6**	**CR5000, CR3000**
Measurement Range, Integration	2500 mV	2500 mV, 250 µs integration, reverse excitation	5000 mV, 250 µs f_{N1}, reverse excitation	5000 mV, 250 µs integration, reverse excitation
Excitation Voltage[1]	2500 mV	2500 mV	2500 mV	5000 mV
Delay or Settling Time	20 ms	20 ms	20 ms	20 ms
Multiplier	0.288	720	720	720
Offset	0	0	0	0
[1]For cables purchased from Met One that do not include the 10k-series resistor, reduce the excitation voltages listed in this table by half.				

7.4.2 Calibration

Conversion of the measurement result (X) to wind direction is done by the multiplier parameter of the measurement instruction. For a more accurate measurement, use Eq. 1 to calculate a multiplier that accounts for cable length and resistor tolerances:

Calculated Multiplier = 360/FSX   Eq. 1

Where,

FSX = full scale measurement result

With a multiplier of 1, the measurement result (X) for the **BRHalf()** instruction is the ratio V_1/V_X, where V_1 is the voltage measured on the SE channel, and V_X is the excitation voltage. For the **EX-DEL-SE()** instruction used with the CR200(X), the measurement result is the mV value.

The full scale measurement result (FSX) is the maximum, X, output from the 024A. To determine the FSX, create a program with the parameters listed in TABLE 7-2, and a multiplier of 1. The value displayed in the input variable is (X). With the shoulder screw removed, slowly rotate the wind vane to get the maximum value, which is the FSX. With the 10k series resistor, the FSX is approximately half the excitation voltage for the **EX-DEL-SE()** instruction and approximately 0.5 for the **BRHalf()** instruction. The calculated multiplier is 360/(FSX) should be close to the multiplier listed in TABLE 7-2. Keep the offset at 0.

Enter the value calculated in Eq. 1 in the program using the CRBasic program editor.

NOTE	If the FSX is *NAN* or *–99999*, reduce the excitation voltage by 5 mV and determine the new FSX.

8. Maintenance

8.1 6 to 12 Month Periodic Service[1]

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[1]

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.

[1]Schedule is based on average to adverse environments.

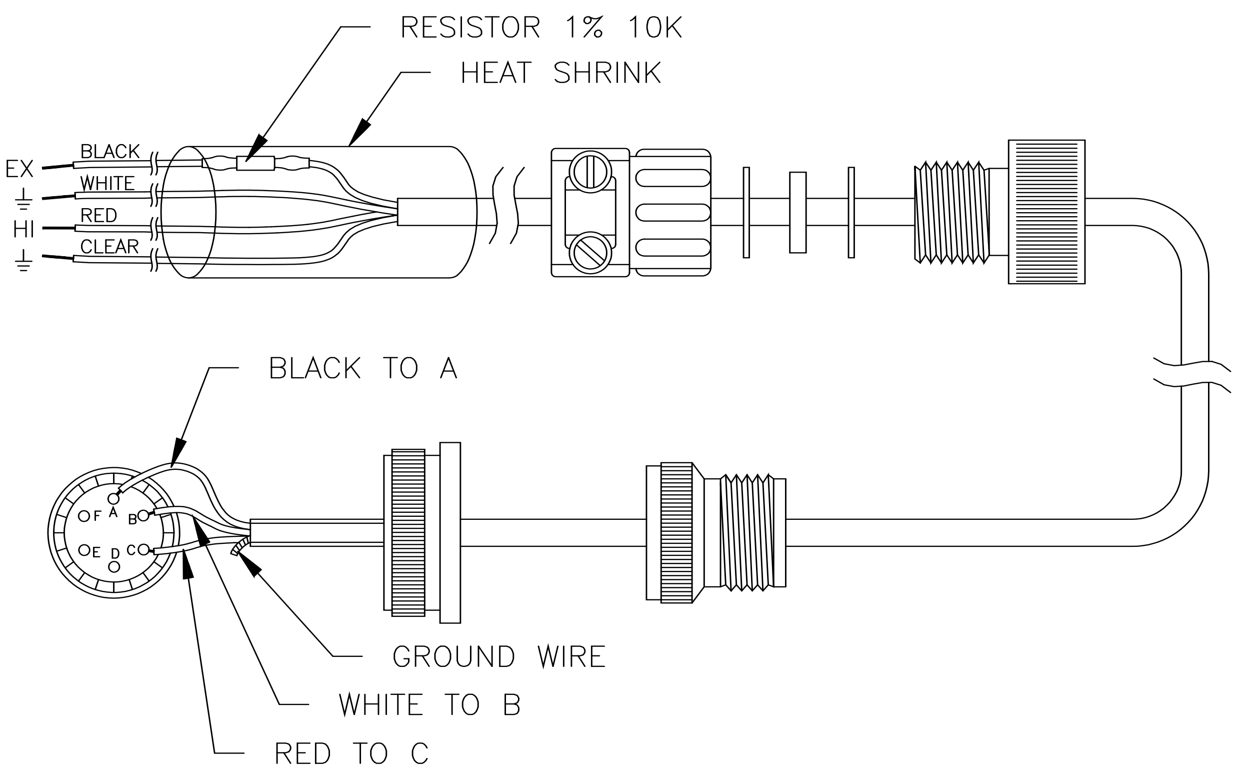


FIGURE 8-1. Cable diagram

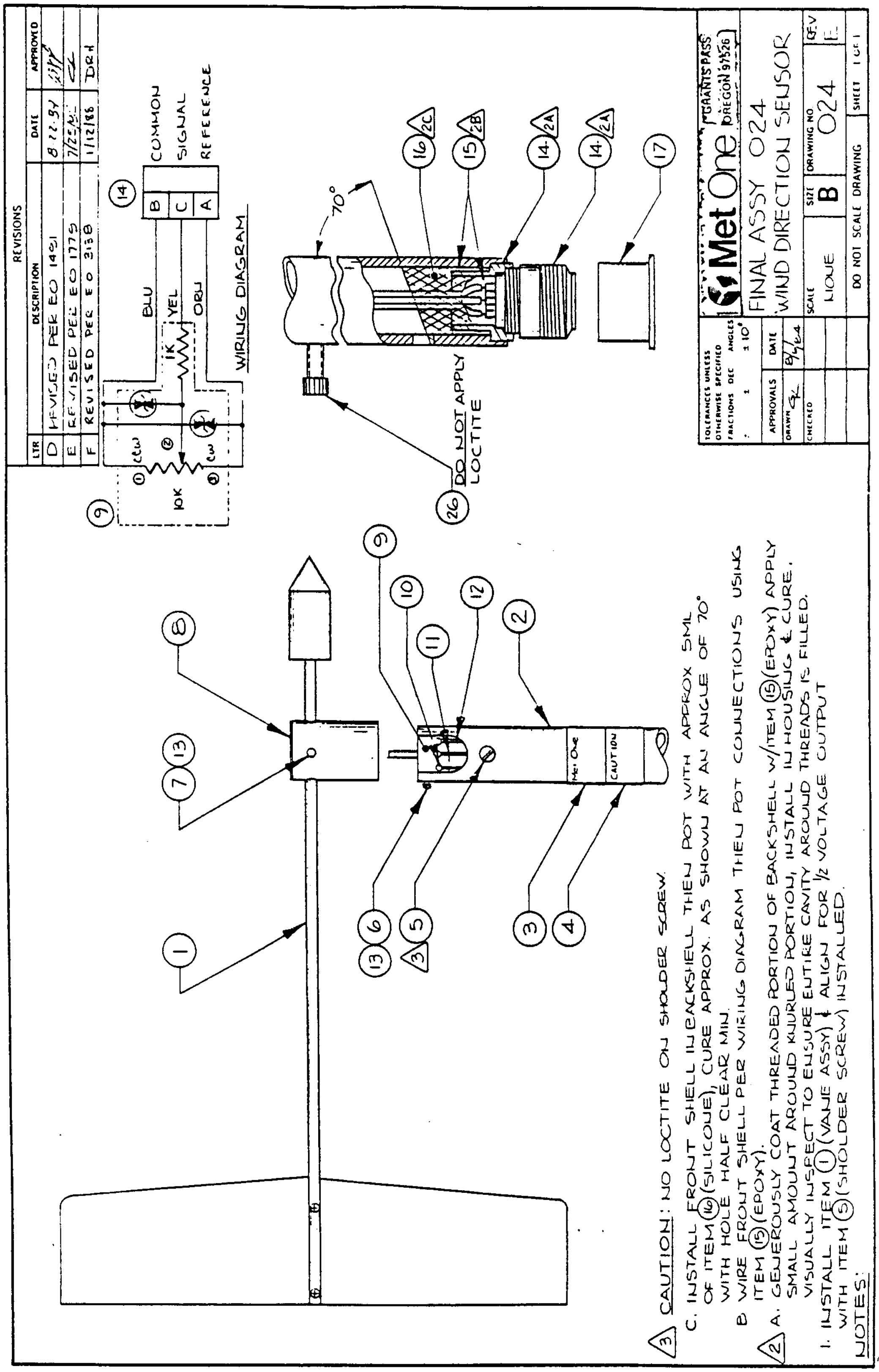


FIGURE 8-2. Parts diagram

TABLE 8-1. Met One Parts List Reproduced by Campbell Scientific

Item	Part No.	Description	Qty./Assy
1	102105	Vane Assembly	1
2	101685-1	Wind Direction Support	1
3	101049-2	Label, Wind Direction	1
4	101789	Label, Caution	1
5	860015	Screw, Shoulder	1
6	601100	Screw, Pan Head Ph, 2-56x3/16	3
7	601680	Screw, Set A/H, 8-32x3/8	2
8	101687	Label, Met One	1
9	102017	Assembly, Potentiometer	1
10	980495	Wire, 22 Gage, Yellow	1
11	980450	Wire, 22 Gage, Blue	1
12	980475	Wire, 22 Gage, Orange	1
13	995425	Loctite 222	A/R
14	500280	Connector, 6 Pin	1
15	995100	Adhesive, Epoxy	A/R
16	995060	Adhesive, Silicone	5 ml
17	510020	Cap	1
18			
19			
20			
21	101806	Assembly, Cable	Ref
22	101699	Assembly Instructions	Ref
23	101706	014 and 024 Installation	Ref
24	101697	Wiring Diagram	Ref
25			
26	601850	Screw, 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. 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 the following 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) datalogger code)
- .CR6 (CR6 datalogger code)
- .CR1 (CR1000 datalogger code)
- .CR8 (CR800 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. 2)*. 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, .CR6, .CR1, .CR8, .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 Programs

The following program examples measure the 014A wind speed sensor and the 024A wind direction sensor. Wind speed and direction measurements are processed by the **WindVector()** instruction, which outputs mean wind speed, mean wind vector direction, and standard deviation of wind direction for the output interval.

B.1 CR1000 Program

CRBasic Example B-1. CR1000 Program

```
'CR1000

'Declare Variables and Units
Public BattV
Public PTemp_C
Public WS_ms
Public WindDir

Units BattV=Volts
Units PTemp_C=Deg C
Units WS_ms=meters/second
Units WindDir=degrees

'Define Data Tables
DataTable(Table1,True,-1)
  DataInterval(0,60,Min,10)
  WindVector(1,WS_ms,WindDir,FP2,False,0,0,0)
  FieldNames("WS_ms_S_WVT,WindDir_D1_WVT,WindDir_SD1_WVT")
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)
    '014A Wind Speed Sensor measurement 'WS_ms'
    PulseCount(WS_ms,1,1,2,1,0.8,0.447)
    If WS_ms<0.457 Then WS_ms=0
    '024A Wind Direction Sensor measurement 'WindDir'
    BrHalf(WindDir,1,mV2500,1,1,1,2500,True,20000,250,720,0)
    If WindDir>=360 Or WindDir<0 Then WindDir=0
    'Call Data Tables and Store Data
    CallTable Table1
  NextScan
EndProg
```

B.2 CR200(X) Program

CRBasic Example B-2. CR200(X) Program

```
'CR200/CR200X

'Declare Variables and Units
Public BattV
Public WS_ms
Public WindDir

Units BattV=Volts
Units WS_ms=meters/second
Units WindDir=degrees

'Define Data Tables
DataTable(Table1,True,-1)
  DataInterval(0,60,Min)
  WindVector(WS_ms,WindDir,False,0,0)
  FieldNames("WS_ms_S_WVT,WindDir_D1_WVT,WindDir_SD1_WVT")
EndTable

'Main Program
BeginProg
  'Main Scan
  Scan(1,Sec)
    'Default Datalogger Battery Voltage measurement 'BattV'
    Battery(BattV)
    '014A Wind Speed Sensor measurement 'WS_ms'
    PulseCount(WS_ms,P_SW,2,1,0.8,0.447)
    If WS_ms<0.457 Then WS_ms=0
    '024A Wind Direction Sensor measurement 'WindDir'
    ExDelSE(WindDir,1,1,1,2500,20000,0.288,0)
    If WindDir>=360 Or WindDir<0 Then WindDir=0
    'Call Data Tables and Store Data
    CallTable Table1
  NextScan
EndProg
```

B.3 CR3000 Program

CRBasic Example B-3. CR3000 Program

```
'CR3000

'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
```

Appendix C. 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*. The 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 C-1.

Declination angles east of True North are considered negative, and are subtracted from 360 degrees to get True North as shown FIGURE C-2 (0° and 360° are the same point on a compass). For example, the declination for Logan, Utah is 11.78° East (11 August 2015). True North is 360° – 11.78°, or 348.22° 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 C-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 South. Display the input location or variable for wind direction and verify the value is close to 180 degrees.

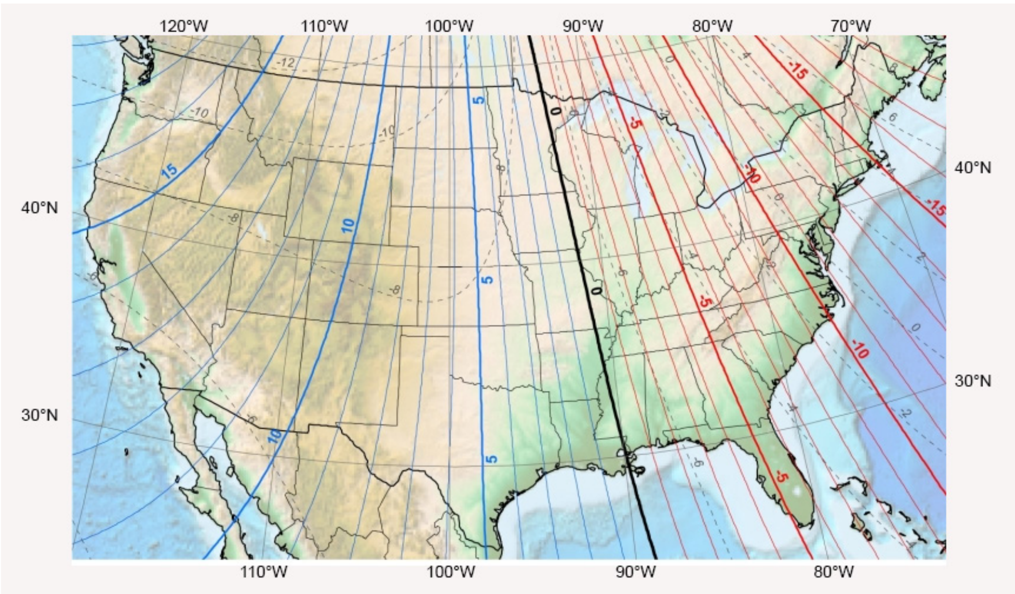


FIGURE C-1. Magnetic declination for the contiguous United States (2015)

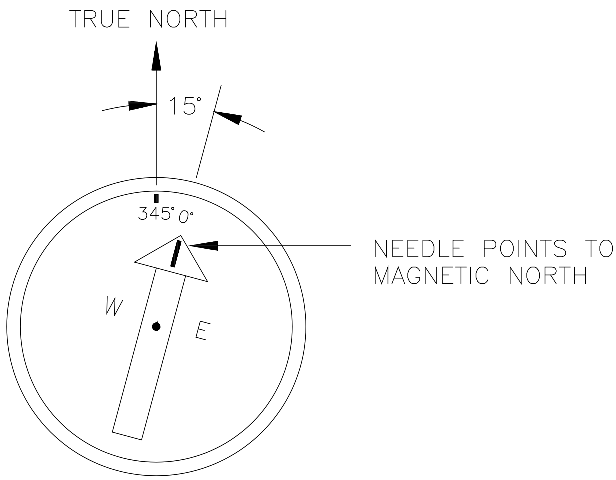


FIGURE C-2. Declination angles east of True North are subtracted from 0 to get True North

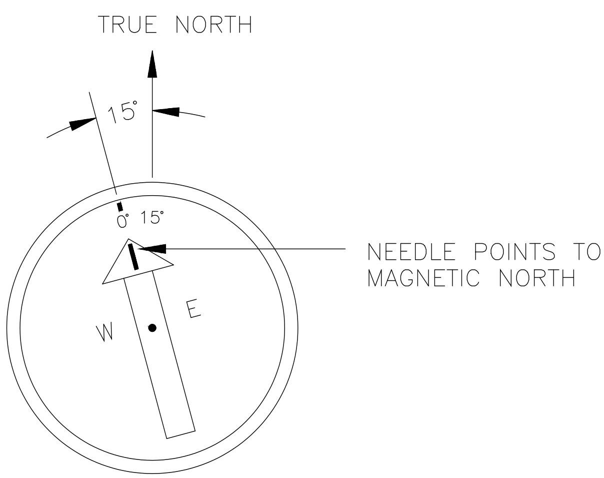


FIGURE C-3. Declination angles west of True North are added to 0 to get True North

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