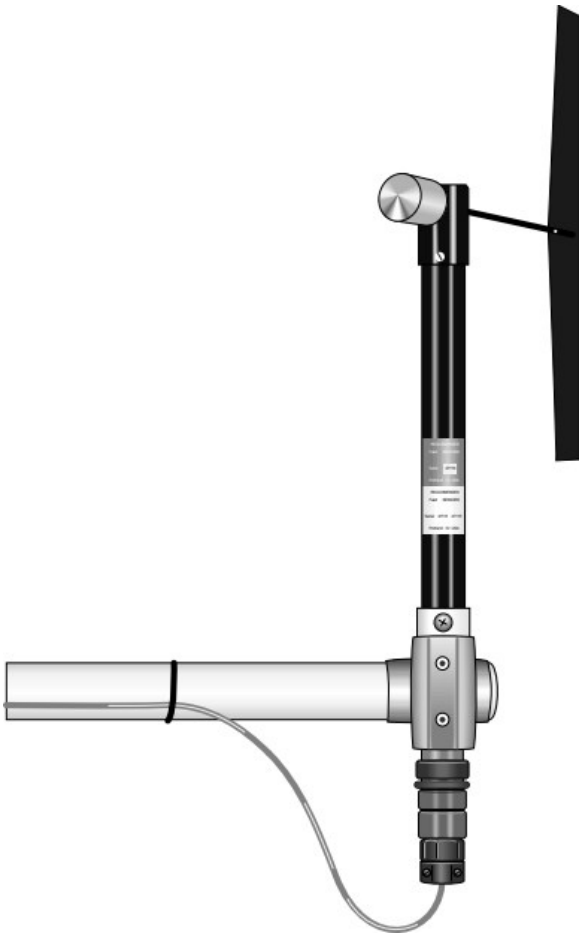
Product Manual

Sensor

024A

Met One Wind Direction Sensor



Revision: 12/2022

RELIABLE SINCE 1974 MONITORING

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1. Introduction

The 024A is a wind vane manufactured by Met One. It measures wind direction only and is traditionally used in tandem with the 014A wind speed sensor.

> NOTE:
> This manual provides information only for CRBasic data loggers. For retired Edlog data logger support, see an older manual at www.campbellsci.com/old-manuals.

2. Precautions

- READ AND UNDERSTAND the Safety section at the back of this manual.
- The 024A is a precision instrument. Please handle it with care.
- The black outer jacket of the cable is Santoprene® rubber. This compound was chosen for its resistance to temperature extremes, moisture, and ultraviolet (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

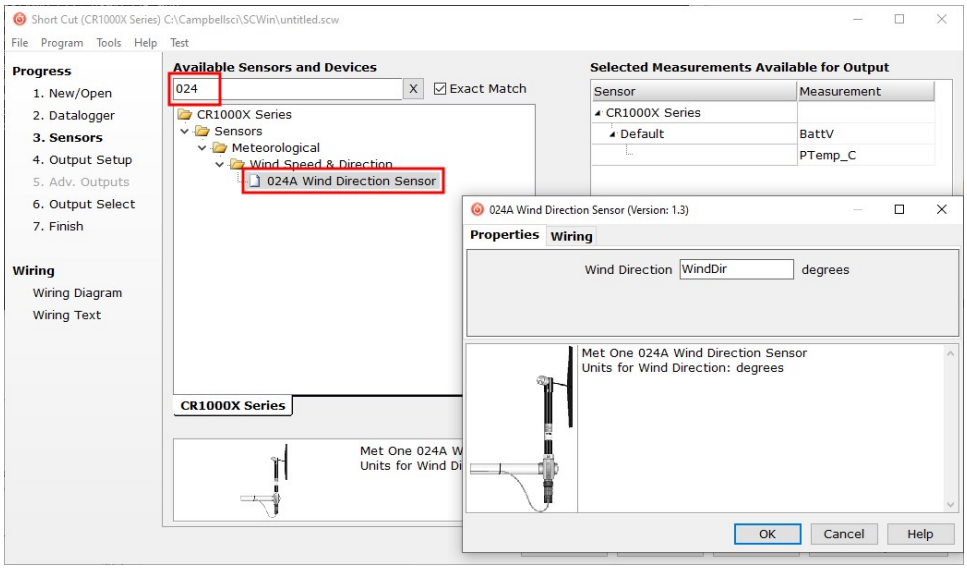
- Upon receipt of the 024A, inspect the packaging and contents for damage. File damage claims with the shipping company. Immediately check package contents against the shipping documentation. Contact Campbell Scientific about any discrepancies.
- The model number and cable length are printed on a label 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

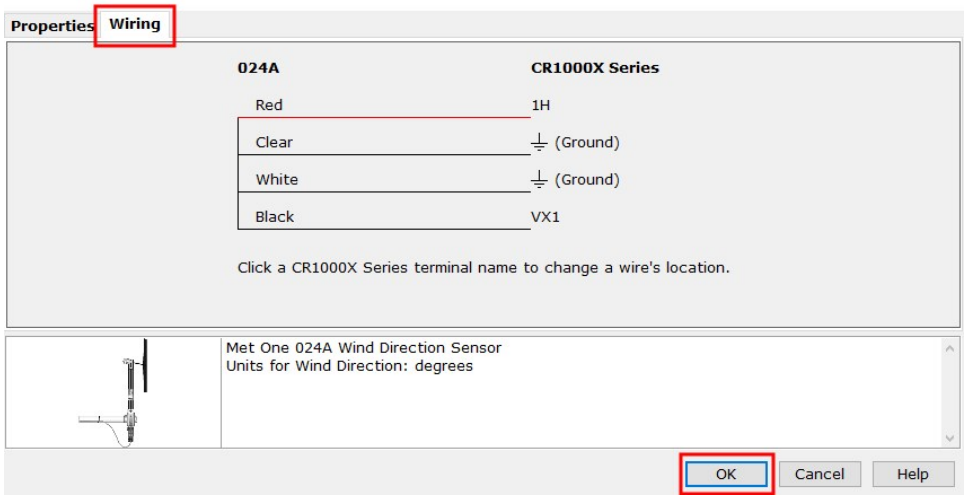
A video that describes data logger programming using ***Short Cut*** is available at: www.campbellsci.com/videos/cr1000x-datalogger-getting-started-program-part-3. ***Short Cut*** is an easy way to program your data logger to measure this sensor and assign data logger wiring terminals. ***Short Cut*** is available as a download on www.campbellsci.com. It is included in installations of ***LoggerNet***, ***RTDAQ***, or ***PC400***.

The following procedure shows using ***Short Cut*** to program the sensor.

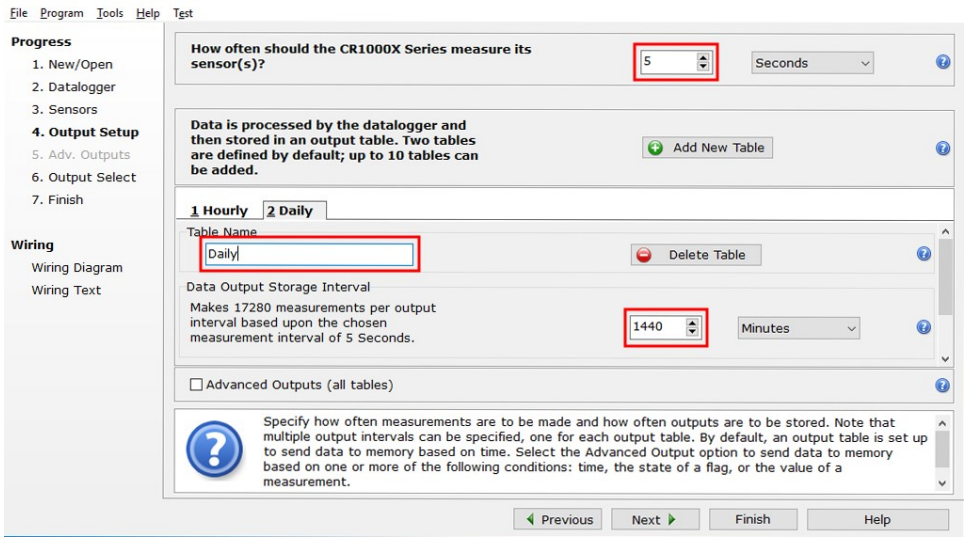
1. Open ***Short Cut*** and create a new program.
2. Double-click the data logger model.
3. In the **Available Sensors and Devices** box, type 024A or find the sensor in the **Sensors** > **Meteorological** > **Wind Speed & Direction** folder. Double-click **024A Wind Direction Sensor**.



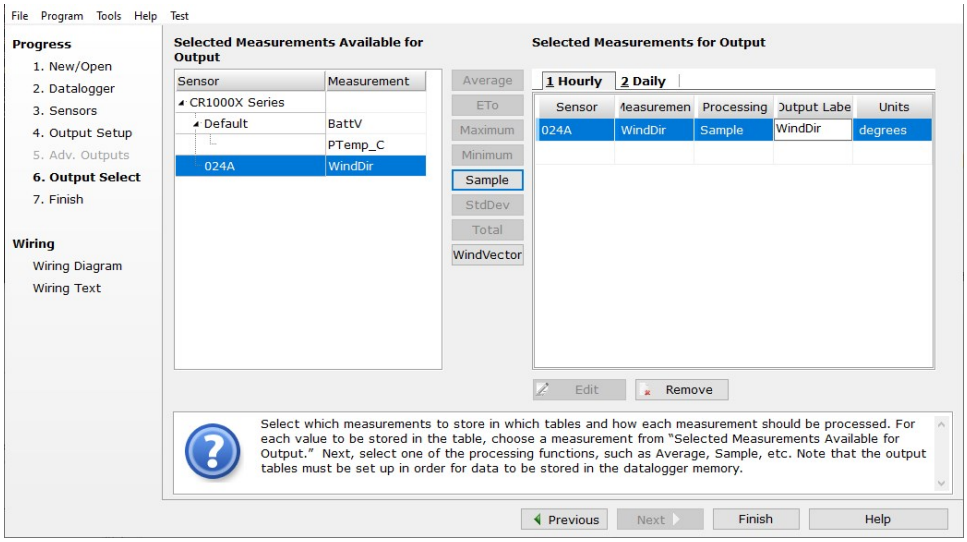
4. Click the **Wiring** tab to see how the sensor is to be wired to the data logger. Click **OK** after wiring the sensor.



5. Select any other sensors you have, then finish the remaining ***Short Cut*** steps to complete the program.
6. In **Output Setup**, enter the scan rate and **Data Output Storage Interval**.



7. Select the output options.



8. Click **Finish** and save the program. Send the program to the data logger if the data logger is connected to the computer.
9. If the sensor is connected to the data logger, check the output of the sensor in the data display in ***LoggerNet***, ***RTDAQ***, or ***PC400*** to make sure it is making reasonable measurements.

5. Overview

The 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 data logger 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 10 kOhm 1% resistor as shown in Figure 7-1 (p. 6). 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*** (Data logger instruction [p. 7]).

Cable length for the 024A is specified when the sensor is ordered. Table 5-1 (p. 5) gives the recommended cable length for mounting the sensor at the top of the tripod/tower with a CM200-series crossarm.

Table 5-1: Recommended cable lengths						
CM106B	CM110	CM115	CM120	UT10	UT20	UT30
4.2 m (14 ft)	4.2 m (14 ft)	5.8 m (19 ft)	7.3 m (24 ft)	4.2 m (14 ft)	7.3 m (24 ft)	11.3 m (37 ft)

Features:

- Compatible with Campbell Scientific CRBasic data loggers: CR6, CR1000X, CR800 series, CR350 series, CR300 series, CR3000, and CR1000

6. Specifications

Range:	0 to 360 degrees
Threshold:	0.447 m/s (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 10,000 Ω
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 data logger with ***Short Cut***, skip Wiring (p. 6) and Programming (p. 7). ***Short Cut*** does this work for you. See QuickStart (p. 2) for a ***Short Cut*** tutorial.

7.1 Wiring

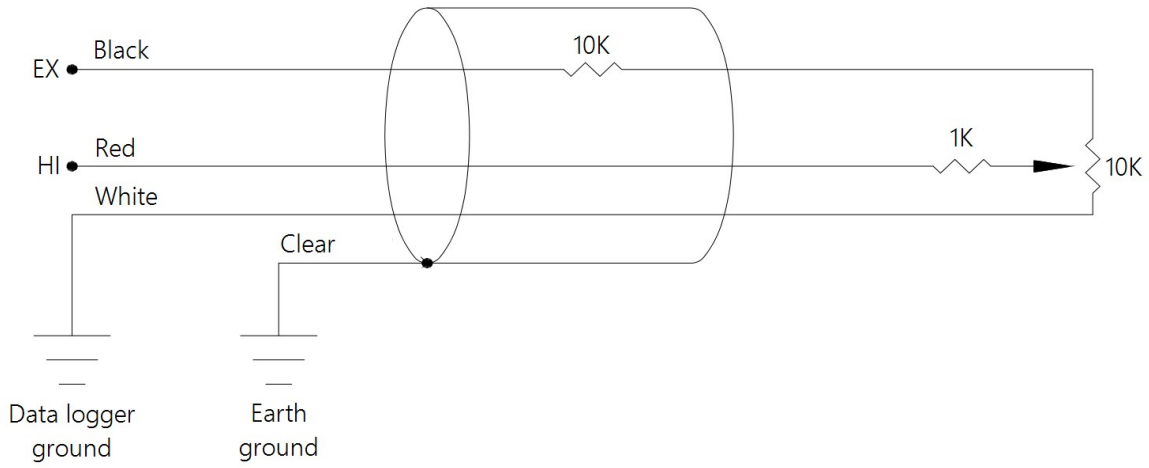


Figure 7-1. Schematic of 024A wind direction sensor

Figure 7-1 (p. 6) and Table 7-1 (p. 6) shows wiring.

Table 7-1: Wire color, function, and data logger connection

Wire color	Wire function	Data logger 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	⏚ (analog ground)
Clear	Shield	⏚ (analog ground)

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

7.2 Programming

Short Cut is the best source for up-to-date data logger programming code. If your data acquisition requirements are simple and you are connecting the sensor to a pulse terminal, you can probably create and maintain a data logger program exclusively by using ***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 QuickStart (p. 2). If you wish to import ***Short Cut*** code into ***CRBasic Editor*** to create or add to a customized program, follow the procedure in Importing Short Cut code into CRBasic Editor (p. 13). Programming basics for CRBasic data loggers are provided in the following sections. A complete program is provided in Example program (p. 14). Programming basics and programming examples for Edlog data loggers are provided at www.campbellsci.com\old-manuals.

7.2.1 Data logger instruction

Wind direction is measured by the `BRHalf()` instruction.

Some CRBasic measurement sequences can cause the measurement of the wind direction to return a negative wind direction (–30°). Overcome this problem by using a delay of 20 ms (20,000 µs) and setting negative wind direction values to 0.0:

```
If WindDir < 0, then WindDir = 0.0
```

The excitation voltage, range codes, and multipliers for the different data logger types are listed in Table 7-2 (p. 7).

Table 7-2: Parameters for wind direction

	CR300 series	CR800, CR850, CR1000	CR6, CR1000X	CR3000
Measurement range	mV2500	mV2500	mV5000	mV5000
Excitation voltage[1]	2500 mV	2500 mV	2500 mV	5000 mV
Reverse excitation	NA	True	True	True

Table 7-2: Parameters for wind direction

	CR300 series	CR800, CR850, CR1000	CR6, CR1000X	CR3000
Delay or settling time	20000 µs	20000 µs	20000 µs	20000 µs
Multiplier	720	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.

7.2.2 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 (p. 8) to calculate a multiplier that accounts for cable length and resistor tolerances:

$$\text{Calculated Multiplier} = 360/\text{FSX} \qquad \textbf{Eq. 1}$$

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.

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 (p. 7), 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 0.5 for the `BRHalf()` instruction. The calculated multiplier is 360/(FSX) and should be close to the multiplier listed in Table 7-2 (p. 7). Keep the offset at 0.

Enter the value calculated in Eq. 1 (p. 8) in the program using ***CRBasic Editor***.

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

7.3 Siting

Locate wind sensors away from obstructions such as trees or buildings. Generally, there should be a horizontal distance of at least ten times the height of the obstruction between the 024A and

the obstruction. If the sensors need to be mounted on a roof, the height of the sensors above the roof, should be at least 1.5 times the height of the building. See References (p. 12) for a list of references that discuss siting wind speed and direction sensors.

7.4 Assembly and mounting the sensor

Materials required:

- 5/64-inch hex key wrench
- 1/2-inch open end wrench
- Compass and declination angle for the site (see Wind direction sensor orientation [p. 16])
- Small screwdriver provided with data logger
- UV resistant cable ties
- 6-inch to 10-inch torpedo level
- 1-inch-by-1-inch Nu-Rail crossover fitting
- 024A vane
- Mounting bushing

The following procedure is for assembling the sensor and mounting it to a crossarm.

1. Remove the hex screw in the lower part of the sensor housing (Figure 7-2 [p. 9]).
2. Insert the 024A in the mounting bushing (Figure 7-2 [p. 9]).
3. Tighten the mounting bushing screw onto the sensor housing (Figure 7-2 [p. 9]).

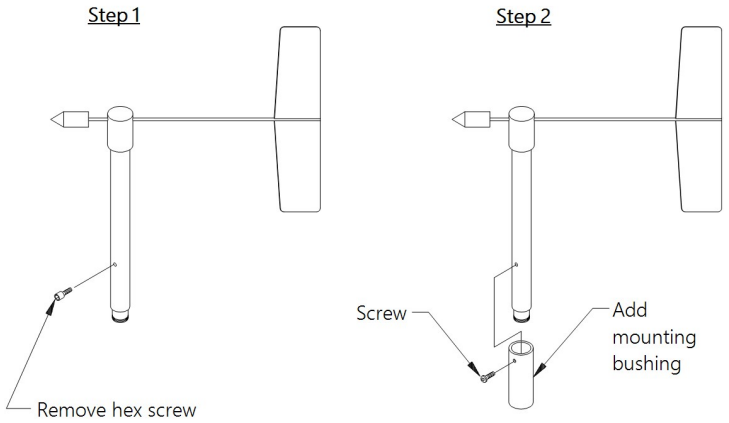


Figure 7-2. Bushing installation on 024A sensor

4. Mount a crossarm to a tripod or tower.
5. If a pyranometer is also being mounted on the crossarm, orient the crossarm north-south with the Nu-Rail on the end farthest from the equator. Otherwise, the crossarm may be oriented north-south, east west, or any other angle desired. Wind direction sensor orientation (p. 16) contains detailed information on determining true north by using a compass and the magnetic declination for the site.
6. Insert the sensor in the Nu-Rail fitting.

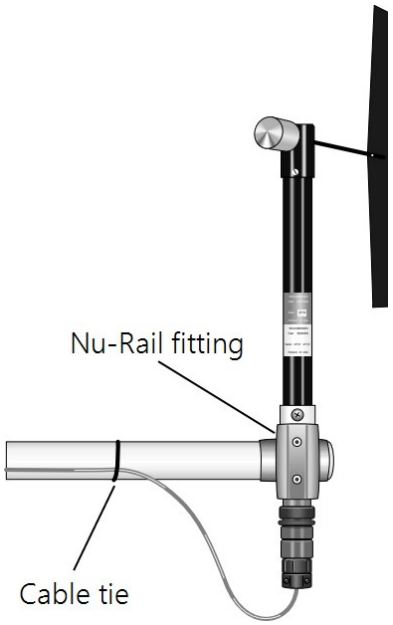


Figure 7-3. The 024A mounted to a crossarm

7. Align the sensor so that the counter weight points due south and tighten the set screws on the Nu-Rail fitting.
8. Use the torpedo level to ensure that the sensor is level.
9. Connect the cable assembly to the sensor receptacle.
10. Route the sensor cable along the underside of the crossarm to the tripod or tower, and to the instrument enclosure.
11. Secure the cable to the crossarm and tripod or tower by using cable ties.

The 024A can also use a CM221 Right-Angle Mounting Kit or CM216 Sensor Mounting Kit; see the following figures. The CM221 uses U-bolts to secure the sensor to a crossarm. The CM216 mounts the sensor on top of a CM106B, CM110, CM115, or CM120 tripod. The CM216 extends 10 cm (4 in) above the mast of the tripod.

Figure 7-4. CM221 Right-Angle Mounting Kit

Figure 7-5. The CM216 allows the 024A to mount atop a tripod mast

8. Troubleshooting and maintenance

NOTE:
All factory repairs and recalibrations require a returned material authorization (RMA) and completion of the "Declaration of Hazardous Material and Decontamination" form. Refer to the Assistance page near the end of this manual for more information.

8.1 Troubleshooting

Symptom: NAN, –9999, or no change in direction

1. Check that the sensor is wired to the excitation and single-ended terminal specified by the measurement instruction.
2. Verify that the excitation voltage and range code are correct for the data logger type.

8.2 Maintenance schedule

The maintenance schedules are for average to adverse environments.

8.2.1 6 to 12 month periodic service

Inspect sensor for physical damage and verify that the vane assembly rotates freely.

8.2.2 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 page near the end of this manual.

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*

Short Cut creates a .DEF file that contains wiring information and a program file that can be imported into ***CRBasic Editor***. By default, these files reside in the C:\campbellsci\SCWin folder.

Import ***Short Cut*** program file and wiring information into ***CRBasic Editor***:

1. Create the ***Short Cut*** program, then save it. Click the **Advanced** tab then the **CRBasic Editor** button. Your program file will open in CRBasic with a generic name. Provide a meaningful name and save the CRBasic program. This program can now be edited for additional refinement.

   > **NOTE:**
   > Once the file is edited with ***CRBasic Editor***, ***Short Cut*** can no longer be used to edit the program.

2. To add the ***Short Cut*** wiring information into the new CRBasic program, open the .DEF file located in the C:\campbellsci\SCWin folder. Copy the wiring information found at the beginning of the .DEF file.
3. Go into the CRBasic program and paste the wiring information at the beginning of the program.
4. In the CRBasic program, highlight the wiring information, right-click, and select **Comment Block**. This adds an apostrophe (') to the beginning of each of the highlighted lines, which instructs the data logger compiler to ignore those lines when compiling. The **Comment Block** feature is demonstrated at about 5:10 in the CRBasic | Features video.

Appendix B. Example program

The following program example measures 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.

CRBasic Example 1: CR1000X program

```
'CR1000X

'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(Hourly,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 Data logger Battery Voltage measurement 'BattV'
    Battery(BattV)
    'Default Wiring Panel Temperature measurement 'PTemp_C'
    PanelTemp(PTemp_C,60)
    '014A Wind Speed Sensor measurement 'WS_ms'
    PulseCount(WS_ms,1,P1,1,1,0.8,0.447)
    If WS_ms<0.457 Then WS_ms=0
    '024A Wind Direction Sensor measurement 'WindDir'
    BrHalf(WindDir,1,mV5000,1,Vx1,1,2500,True,20000,250,720,0)
    If WindDir>=360 Or WindDir<0 Then WindDir=0
    'Call Data Tables and Store Data
    CallTable Hourly
```

CRBasic Example 1: CR1000X program

```
  NextScan
EndProg
```

Appendix C. Wind direction sensor orientation

C.1 Determining true north and sensor orientation

Orientation of the wind direction sensor is done after the data logger 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 (p. 17).

Declination angles east of true north are considered negative, and are subtracted from 360 degrees to get true north as shown Figure C-2 (p. 17) (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 (p. 18).

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 data logger.

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 by using a laptop or keyboard display.
3. Loosen 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 data logger indicates 0 degrees. Tighten the set screws.

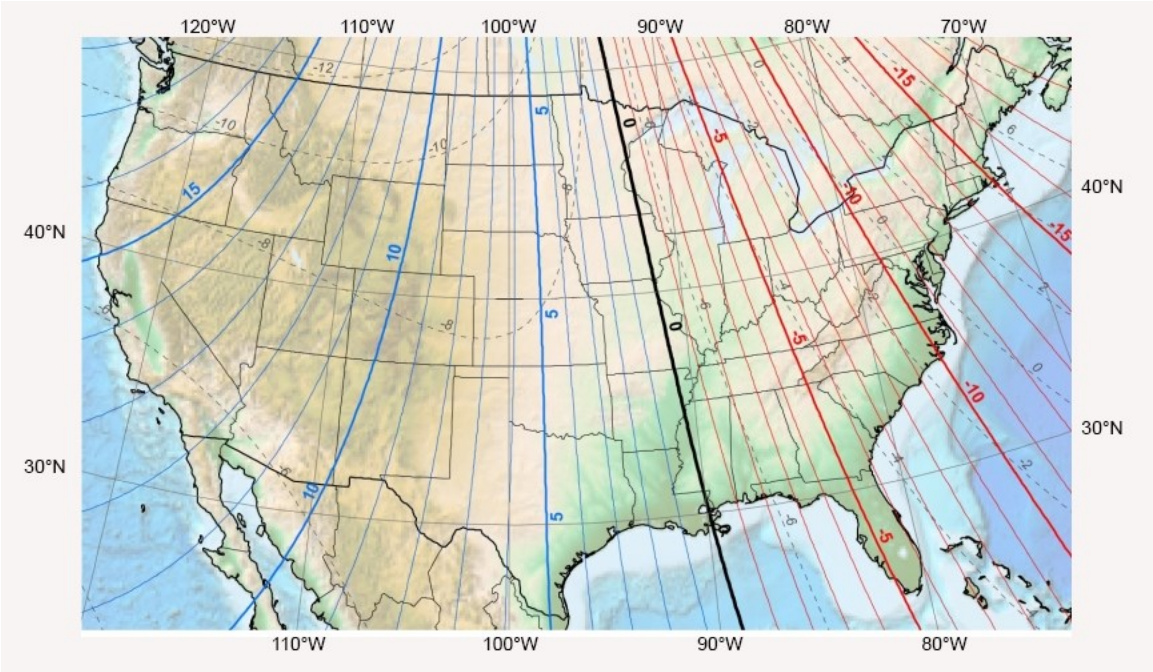


Figure C-1. Magnetic declination for the contiguous United States (2015)

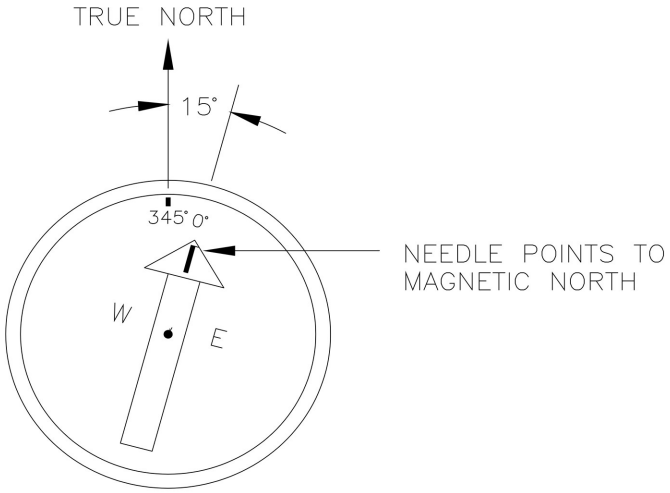


Figure C-2. Declination angles east of true north are subtracted from 0 to get true north

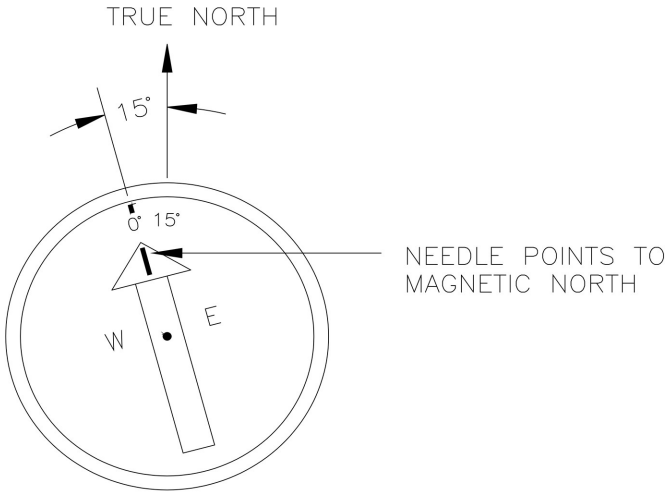


Figure C-3. Declination angles west of true north are added to 0 to get true north

Limited warranty

Products manufactured by Campbell Scientific are warranted by Campbell Scientific to be free from defects in materials and workmanship under normal use and service for twelve months from the date of shipment unless otherwise specified on the corresponding product webpage. See Product Details on the Ordering Information pages at www.campbellsci.com. Other manufacturer's products, that are resold by Campbell Scientific, are warranted only to the limits extended by the original manufacturer.

Refer to www.campbellsci.com/terms#warranty for more information.

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Assistance

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For all returns, the customer must provide a "Statement of Product Cleanliness and Decontamination" or "Declaration of Hazardous Material and Decontamination" form and comply with the requirements specified in it. The form is available from your CAMPBELL SCIENTIFIC regional office. Campbell Scientific is unable to process any returns until we receive this statement. If the statement 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. 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

- Protect from over-voltage.
- Protect electrical equipment from water.
- Protect from electrostatic discharge (ESD).
- Protect from lightning.
- Prior to performing site or installation work, obtain required approvals and permits. Comply with all governing structure-height regulations.
- 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, 6 meters (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.
- Only use power sources approved for use in the country of installation to power Campbell Scientific devices.

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.

Internal Battery

- Be aware of fire, explosion, and severe-burn hazards.
- Misuse or improper installation of the internal lithium battery can cause severe injury.
- Do not recharge, disassemble, heat above 100 °C (212 °F), solder directly to the cell, incinerate, or expose contents to water. Dispose of spent batteries properly.

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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