# INSTRUCTION MANUAL

## 03002 R.M. Young Wind Sentry Set
## 03101 R.M. Young Wind Sentry Anemometer
## 03301 R.M. Young Wind Sentry Vane

Revision: 2/18

# WARRANTY AND ASSISTANCE

This equipment is warranted by CAMPBELL SCIENTIFIC (CANADA) CORP. ("CSC") to be free from defects in materials and workmanship under normal use and service for **twelve (12) months** from date of shipment unless specified otherwise. **\*\*\*\*\* Batteries are not warranted. \*\*\*\*\*** CSC's obligation under this warranty is limited to repairing or replacing (at CSC's option) defective products. The customer shall assume all costs of removing, reinstalling, and shipping defective products to CSC. CSC will return such products by surface carrier prepaid. This warranty shall not apply to any CSC products which have been subjected to modification, misuse, neglect, accidents of nature, or shipping damage. This warranty is in lieu of all other warranties, expressed or implied, including warranties of merchantability or fitness for a particular purpose. CSC is not liable for special, indirect, incidental, or consequential damages.

Products may not be returned without prior authorization. To obtain a Return Merchandise Authorization (RMA), contact CAMPBELL SCIENTIFIC (CANADA) CORP., at (780) 454-2505. An RMA number will be issued in order to facilitate Repair Personnel in identifying an instrument upon arrival. Please write this number clearly on the outside of the shipping container. Include description of symptoms and all pertinent details.

CAMPBELL SCIENTIFIC (CANADA) CORP. does not accept collect calls.

Non-warranty products returned for repair should be accompanied by a purchase order to cover repair costs.

# *Assistance*

Products may not be returned without prior authorization. The following contact information is for Canadian and international clients residing in countries served by Campbell Scientific (Canada) Corp. directly. Affiliate companies handle repairs for clients within their territories. Please visit *www.campbellsci.ca* to determine which Campbell Scientific company serves your country.

To obtain a Returned Materials Authorization (RMA), contact CAMPBELL SCIENTIFIC (CANADA) CORP., phone (780) 454-2505.  After a measurement consultant 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 (CANADA) CORP.**
RMA#_____
14532 131 Avenue NW
Edmonton, Alberta  T5L 4X4
Canada

For all returns, the client 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.ca/repair*. A completed form must be either emailed to *repair@campbellsci.ca* or faxed to (780) 454-2655. Campbell Scientific (Canada) Corp. 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 client at the client's expense. Campbell Scientific (Canada) Corp.f reserves the right to refuse service on products that were exposed to contaminants that may cause health or safety concerns for our employees.

# *Precautions*

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.ca or by telephoning (780) 454-2505 (Canada). 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 personnel (e.g. 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.
- 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.

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 CLIENT 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.

# PLEASE READ FIRST

## About this manual

Please note that this manual was originally produced by Campbell Scientific Inc. (CSI) primarily for the US market. Some spellings, weights and measures may reflect this origin.

Some useful conversion factors:

| | |
|---|---|
| **Area:** | 1 in$^2$ (square inch) = 645 mm$^2$ |
| **Length:** | 1 in. (inch) = 25.4 mm |
| | 1 ft (foot) = 304.8 mm |
| | 1 yard = 0.914 m |
| | 1 mile = 1.609 km |
| **Mass:** | 1 oz. (ounce) = 28.35 g |
| | 1 lb (pound weight) = 0.454 kg |
| **Pressure:** | 1 psi (lb/in2) = 68.95 mb |
| **Volume:** | 1 US gallon = 3.785 litres |

In addition, part ordering numbers may vary. For example, the CABLE5CBL is a CSI part number and known as a FIN5COND at Campbell Scientific Canada (CSC). CSC Technical Support will be pleased to assist with any questions.

## About sensor wiring

Please note that certain sensor configurations may require a user supplied jumper wire. It is recommended to review the sensor configuration requirements for your application and supply the jumper wire is necessary.

# Table of Contents

*PDF viewers: These page numbers refer to the printed version of this document. Use the PDF reader bookmarks tab for links to specific sections.*

## *Figures*

## *Tables*

## *CRBasic Examples*

# R.M. Young Wind Sentry

## 1.    Introduction

The 03002 Wind Sentry Set measures both wind speed and direction. It consists of a 3-cup anemometer and a wind vane mounted on a small crossarm. The anemometer (pn 03101) and vane (pn 03301) may be purchased separately.

| | |
|---|---|
| **NOTE** | This manual provides information only for CRBasic dataloggers. It is also compatible with the most of our retired Edlog dataloggers. For Edlog datalogger support, see an older manual at *www.campbellsci.com/old-manuals*. |

## 2.    Precautions

- READ AND UNDERSTAND the *Safety* section at the front of this manual.

- The 03002 is a precision instrument. Please handle it with care.

- If the 03002 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 03002 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 03002, inspect the packaging and contents for damage. File damage claims with the shipping company. Immediately check package contents against the shipping documentation (see Section 3.1, *Ships With List (p. 2)*). 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.

## 3.1    Ships With List

The 03002 Wind Sentry ships with:

(1)  03002 Wind Sentry including
    03102 anemometer
    03302 vane
    crossarm
    band clamp
(1)  1-inch IPS, 12-inch-long, unthreaded aluminum pipe
(1)  Allen wrench

The 03101 anemometer ships with:

(1)  03101 anemometer
(1)  3/4-inch IPS, 10-inch-long, threaded aluminum pipe
(1)  Allen wrench

The 03301 vane ships with:

(1)  03301 vane
(1)  3/4-inch IPS, 10-inch-long threaded aluminum pipe; this assumes
    mounting option –P.
(1)  Allen wrench

# 4.    QuickStart

*Short Cut* is an easy way to program your datalogger to measure the 03002 and assign datalogger wiring terminals. *Short Cut* is available as a download on *www.campbellsci.com*. It is included in installations of *LoggerNet*, *PC200W*, *PC400*, or *RTDAQ*.

The following procedure shows using *Short Cut* to program the 03002.

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

2.    Double-click the datalogger model.

3. In the search box under the **Available Sensors and Devices** heading, type in 03002 or find the sensor in the **Sensors** | **Meteorological** | **Wind Speed & Direction**. Double-click **03002 Wind Speed & Direction Sensor**. The wind speed defaults to meters/second. This can be changed by clicking the **Wind Speed** box and selecting one of the other options. After entering the **Properties**, click on the **Wiring** tab to see how the sensor is to be wired to the datalogger.
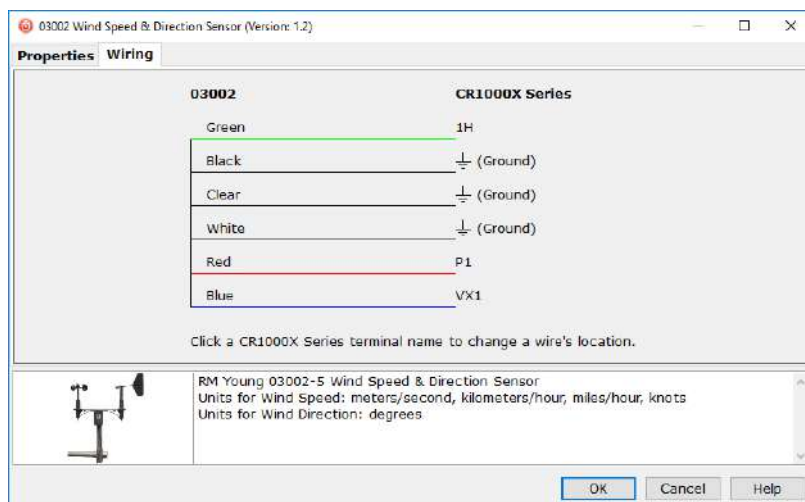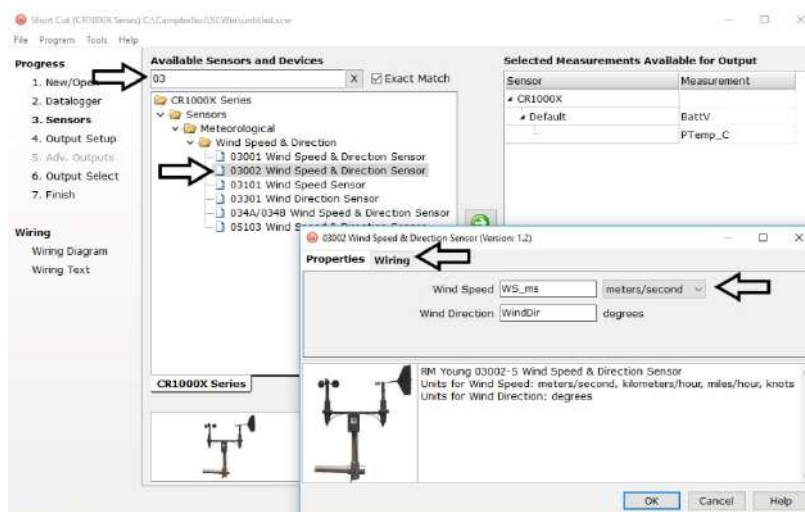




4. Select any other sensors you have, then finish the remaining *Short Cut* steps to complete the program.

5.  In **Output Setup**, enter the scan rate and **Data Output Storage Interval**.
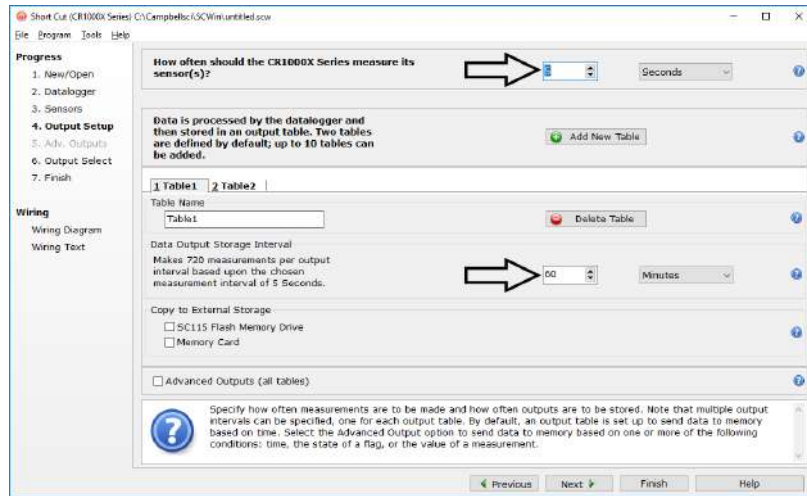


6.  Select the output options.
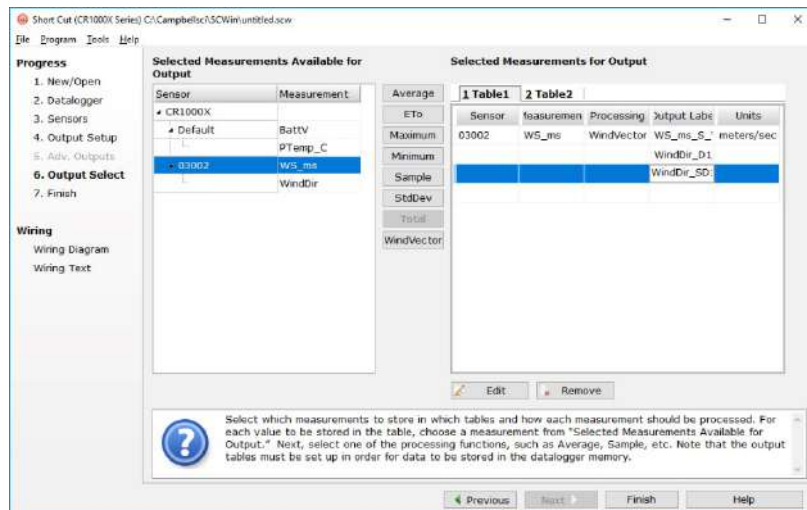


7.  If *LoggerNet*, *PC400*, *RTDAQ*, or *PC200W* is running on your computer, and the computer to datalogger connection is active, you can click **Finish** in *Short Cut* and you will be prompted to send the program just created to the datalogger.

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

# 5.    Overview

The 03002 Wind Sentry Set is used to measure horizontal wind speed and direction.

Wind speed is measured with a three-cup anemometer. Rotation of the cup wheel produces an ac sine wave voltage with frequency proportional to wind speed. This is a special version of the 03102 built for Campbell Scientific by

R.M. Young that has shielded bearings rather than sealed bearings. The shielded bearings provide a lower starting threshold than sealed bearings.

Vane position is transmitted by a 10 kΩ potentiometer. With a precision excitation voltage applied, the output voltage is proportional to wind direction.

The 03101 Anemometer and 03301 Vane can be ordered as separate sensors, which are also covered in this manual. These two sensors combined differ from the 03002 only by the absence of a junction box. The R.M. Young 03002 manual (see Section 10, *References (p. 16)*) includes additional information on the operating principles, installation, and maintenance of the sensor.

Cable length for the Wind Sentry is specified when the sensor is ordered. TABLE 5-1 gives the recommended lead 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 |
| 12 ft | 15 ft | 20 ft | 25 ft | 15 ft | 25 ft | 38 ft |

**NOTE**

Do not exceed 1,000 feet of cable.

**CAUTION**

Do not use long lead lengths in electrically noisy environments.

The 03002'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.

- Connector that attaches to a CWS900 Wireless Sensor Interface (option –CWS). The CWS900 allows the 03002 to be used in a wireless sensor network. Refer to *www.campbellsci.com/cws900* for more information.

# 6.   Specifications

**Features:**
- Designed for continuous, long term, unattended operation in adverse conditions
- Small size, simplicity, and rugged construction provide a quality instrument for a modest price
- Ideal for wind profile studies
- Compatible with the LLAC4 4-channel Low Level AC Conversion Module, which increases the number of anemometers one datalogger can measure

- Campbell Scientific version uses shielded bearings, which lowers the anemometer's starting threshold
- Compatible with Campbell Scientific CRBasic dataloggers: CR200(X) series, CR300 series, CR6 series, CR800 series, CR1000, CR1000X series, CR3000, CR5000, and CR9000X

## 6.1   Wind Speed (Anemometer)

| | |
|---|---|
| **Range:** | 0 to 50 m s$^{-1}$ (112 mph), gust survival 60 m s$^{-1}$ (134 mph) |
| **Sensor:** | 12 cm diameter cup wheel assembly, 40 mm diameter hemispherical cups |
| **Accuracy:** | ±0.5 m s$^{-1}$ (1.1 mph) |
| **Turning Factor:** | 75 cm (2.5 ft) |
| **Distance Constant (63% recovery):** | 2.3 m (7.5 ft) |
| **Threshold:** | 0.5 m s$^{-1}$ (1.1 mph) |
| **Transducer:** | Stationary coil, 1300-ohm nominal resistance |
| **Output:** | AC sine wave signal induced by rotating magnet on cup wheel shaft |
| | 100 mV peak-to-peak at 60 rpm; 6 V peak-to-peak at 3600 rpm |
| **Output Frequency:** | 1 cycle per cup wheel revolution; 0.75 m s$^{-1}$ per Hz |
| **Cup Wheel Diameter:** | 12 cm (4.7 in) |
| **Weight:** | 113 g (4 oz) |

## 6.2   Wind Direction (Vane)

| | |
|---|---|
| **Range:** | 360° mechanical, 352° electrical (8° open) |
| **Sensor:** | Balanced vane, 16 cm turning radius |
| **Settling Time:** | 20 ms |
| **Damping Ratio:** | 0.2 |
| **Delay Distance (50% recovery):** | 0.5 m (1.6 ft) |
| **Threshold:** | 0.8 m s$^{-1}$ (1.8 mph) at 10° displacement (1.8 m s$^{-1}$ (4 mph) at 5° displacement) |
| **Transducer:** | Precision conductive plastic potentiometer; 10 kΩ resistance; 1.0% linearity; life expectancy 50 million revolutions |
| | Rated 1 W at 40 °C, 0 W at 125 °C |

| | |
|---|---|
| **Transducer Excitation Requirement:** | Regulated dc voltage, 15 Vdc max |
| **Output:** | Analog dc voltage proportional to wind direction angle with regulated excitation voltage supplied by the datalogger |
| **Vane Length:** | 22 cm (8.7 in) |
| **Vane Weight:** | 170 g (6 oz) |

## 6.3   Wind Sentry Assembly

| | |
|---|---|
| **Operating Temperature:** | –50 to 50 °C assuming non-riming conditions |
| **Overall Height:** | 32 cm (12.6 in) |
| **Crossarm Length:** | 40 cm (15.7 in) between instruments (center-to-center) |
| **Mounting Diameter:** | 34 mm (1.34 in), mounts on standard 1 inch IPS pipe |

# 7.   Installation

If you are programming your datalogger with *Short Cut*, skip Section 7.3, *Wiring (p. 11)*, and Section 7.4, *Programming (p. 13)*. *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 (e.g., trees and buildings). As a general rule of thumb, there should be a horizontal distance of at least ten times the height of the obstruction between the wind set 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 10, *References (p. 16)*, for a list of references that discuss siting wind speed and direction sensors.

## 7.2   Assembly and Mounting

Tools required:

- 5/64-inch Allen wrench
- Allen wrench provided with sensor
- 1/2-inch open end wrench
- compass and declination angle for the site (see Appendix C, *Wind Direction Sensor Orientation (p. C-1)*)
- small screw driver provided with datalogger
- UV resistant cable ties
- small pair of diagonal-cutting pliers
- 6- to 10-inch torpedo level

### 7.2.1  Mounting the 03002 to a Crossarm

Install the 03002 using:

- Standard 1.0-inch IPS schedule 40 pipe
- CM220 Right-Angle Mounting Kit (FIGURE 7-1 and FIGURE 7-2), or
- 1 x 1 inch Nu-Rail Crossover Fitting (FIGURE 7-3)

1. Install the cup wheel to the anemometer shaft using the Allen wrench provided with the sensor.

2. Mount the crossarm to the tripod or tower.

3. Orient the crossarm North-South, with the CM220 mount or Nu-Rail on the north end. Appendix C, *Wind Direction Sensor Orientation (p. C-1)*, contains detailed information on determining True North using a compass and the magnetic declination for the site.

4. Secure the 12-inch aluminum pipe to the CM220 mount or Nu-Rail. The aluminum pipe is shipped with the 03002.

5. Place the 03002 on the pipe, and orient the sensor crossarm North-South with the vane to the North.

6. Tighten the mounting post band clamp. Final sensor orientation is done after the datalogger has been programmed to measure wind direction as described in Appendix C, *Wind Direction Sensor Orientation (p. C-1)*.

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

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



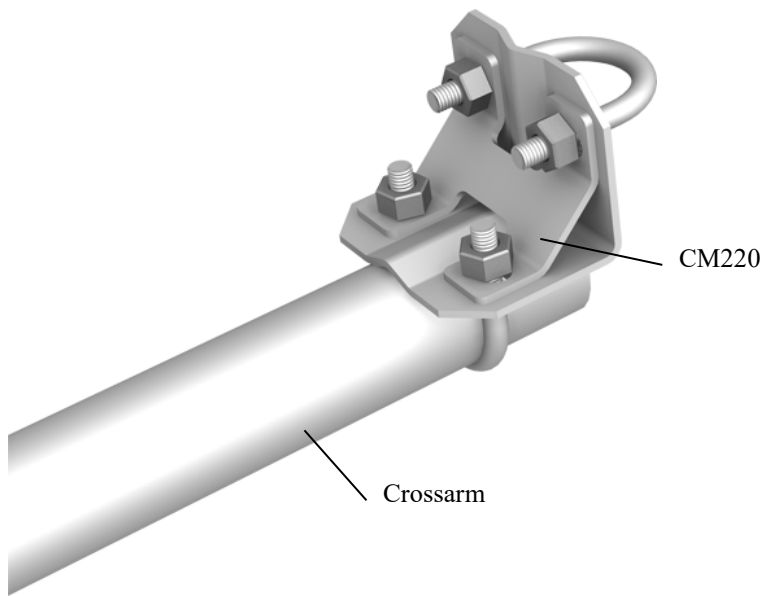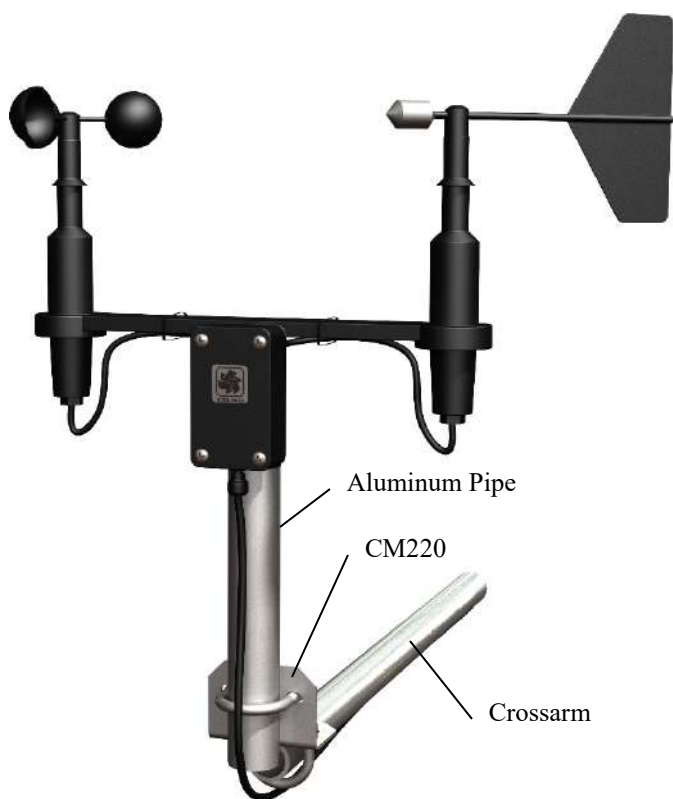*FIGURE 7-1.  Crossarm with CM220 Right Angle Mounting Bracket*

Aluminum Pipe

CM220

Crossarm

*FIGURE 7-2.  03002 mounted to a crossarm with the CM220*



Aluminum Pipe

Nu-Rail

Cable Tie
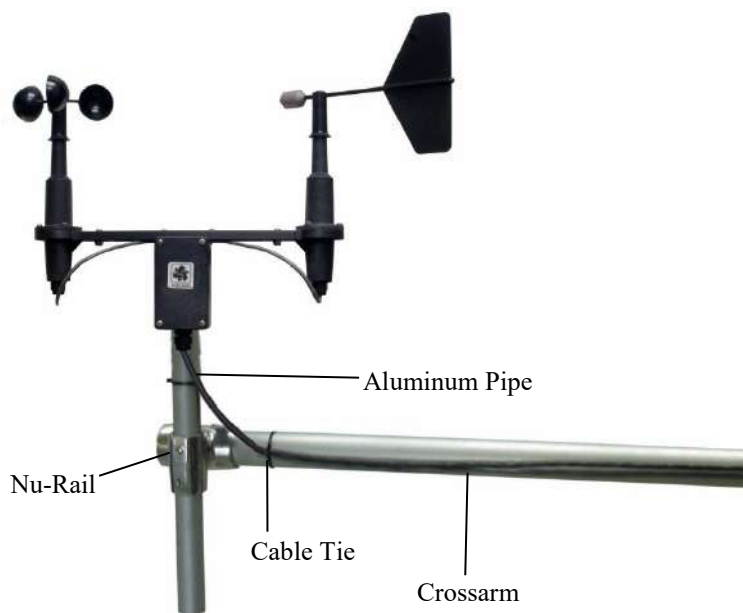
Crossarm

*FIGURE 7-3.  03002 mounted to a crossarm with 1 x 1 inch Nu-Rail fitting*

### 7.2.2  Mounting the 03101 Anemometer to a Crossarm

1.  Install the cup wheel to the anemometer shaft using the Allen wrench provided with the sensor.

2.  Mount the crossarm to the tripod or tower.

3.  Secure the 3/4-inch IPS, 10-inch-long, threaded aluminum pipe to the CM220 mount (FIGURE 7-1) or 3/4 x 1 inch Nu-Rail fitting (FIGURE 7-4).

4.  Place the 03101 on the pipe.

5.  Route the sensor cable to the instrument enclosure. If using a crossarm the cable should be routed along the underside of the crossarm.

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



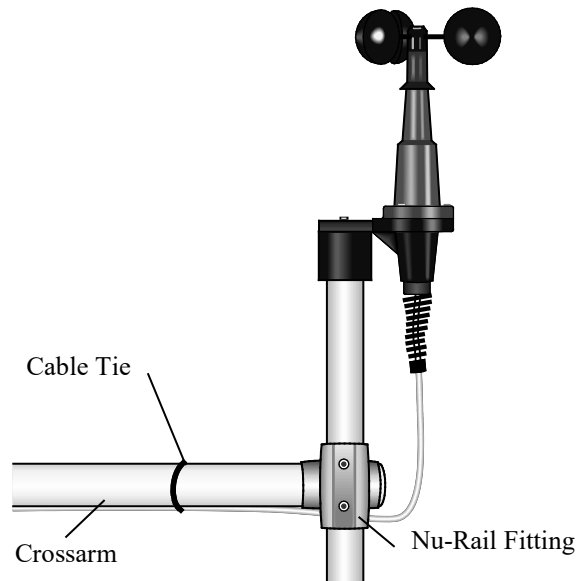*FIGURE 7-4.  03101 mounted to a crossarm via a 3/4 x 1 inch Nu-Rail fitting*

### 7.2.3  Mounting the 03002 or 03101 Atop a Tripod Mast

The 03002 and 03101 mount at the top of a CM106B, CM110, CM115, or CM120 tripod with the CM216 (see FIGURE 7-5). The CM216 extends 10 cm (4 in) above the mast of the tripod.

Fits in Mast
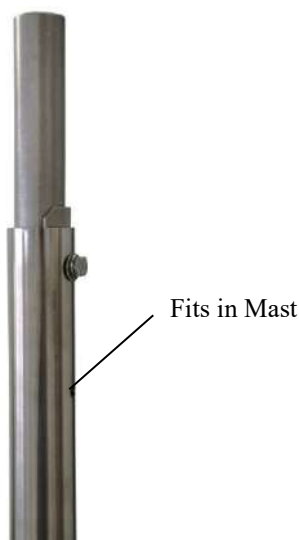
*FIGURE 7-5.  The CM216 allows an 03002 or 03101 to mount atop the mast of a CM106B, CM110, CM115, or CM120 tripod*

### 7.2.4  Mounting the 03301 Vane

The 03301 wind vane has three mounting options

- No Mounting (option –NM) is used when the 03301 will be replacing an existing 03301 within a Wind Sentry Set.
- Pipe Offset Mount (option –P) is used when the 03301 will be deployed on its own next to an anemometer that already has its own mount. With this option, the 03301 mounts to a crossarm using the CM220 mount or 3/4 x 1 inch Nu-Rail fitting.
- 03101 Conversion Kit (option –SM) is used when the 03301 will be mounted next to a previously purchased 03101 Anemometer (Wind Sentry Anemometer). This conversion kit includes the crossarm and other hardware to mount both sensors to a common crossarm as if they had been purchased originally as a complete Wind Sentry Set.

## 7.3   Wiring

Connections to CRBasic dataloggers are given in TABLE 7-1 and TABLE 7-2. To wire an Edlog datalogger, see an older manual at *www.campbellsci.com/old-manuals*.

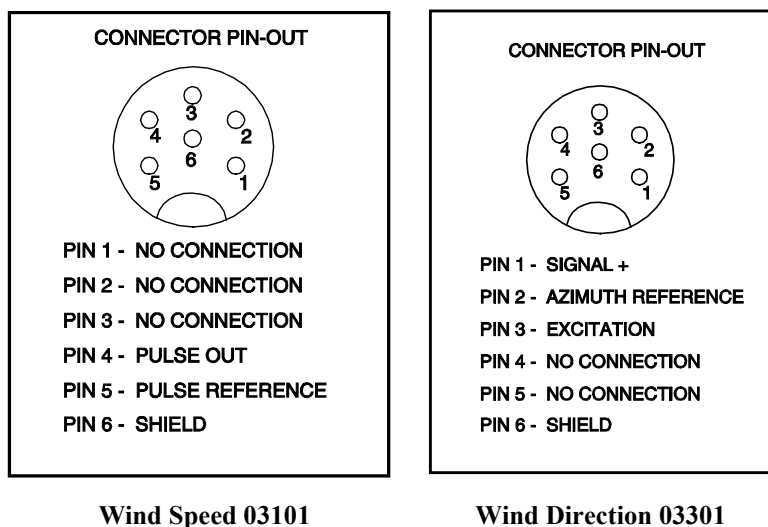| TABLE 7-1. 03002 Wire Color, Wire Function, and Datalogger Connection | | |
|---|---|---|
| **Wire Color** | **Wire Function** | **Datalogger Connection Terminal** |
| Red | WS Signal | **U** configured for pulse input[1], **P** (pulse input), or **P_LL** (pulse, low-level ac) |
| Black | WS Signal Reference | ⏚ |
| Green | WD Signal | **U** configured for single-ended analog input[1], **SE** (single-ended, analog input) |
| Blue | WD Voltage Excitation | **U** configured for voltage excitation[1], **EX**, or **VX** (voltage excitation) |
| White | WD Signal Reference | ⏚ (analog ground) |
| Clear | Shield | ⏚ (analog ground) |
| [1]**U** channels are automatically configured by the measurement instruction. | | |

| TABLE 7-2. 03101 or 03301 Wire Color, Wire Function, and Datalogger Connection | | |
|---|---|---|
| **Wire Color** | **Wire Function** | **Datalogger Connection Terminal** |
| Black | WS Signal | **U** configured for pulse input[1], **P** (pulse input), or **P_LL** (pulse, low-level ac) |
| White | WS Signal Reference | ⏚ |
| Clear | Shield | ⏚ (analog ground) |
|  |  |  |
| Red | WD Signal | **U** configured for single-ended analog input[1], **SE** (single-ended, analog input) |
| Black | WD Voltage Excitation | **U** configured for voltage excitation[1], **EX**, or **VX** (voltage excitation) |
| White | WD Signal Reference | ⏚ (analog ground) |
| Clear | Shield | ⏚ (analog ground) |
| [1]**U** channels are automatically configured by the measurement instruction. | | |

CONNECTOR PIN-OUT

**3**
**4** **6** **2**
**5** **1**

PIN 1 - NO CONNECTION
PIN 2 - NO CONNECTION
PIN 3 - NO CONNECTION
PIN 4 - PULSE OUT
PIN 5 - PULSE REFERENCE
PIN 6 - SHIELD

CONNECTOR PIN-OUT

**3**
**4** **6** **2**
**5** **1**

PIN 1 - SIGNAL +
PIN 2 - AZIMUTH REFERENCE
PIN 3 - EXCITATION
PIN 4 - NO CONNECTION
PIN 5 - NO CONNECTION
PIN 6 - SHIELD

**Wind Speed 03101**          **Wind Direction 03301**

## 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
- 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, *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 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  Wind Speed

Wind speed is measured with the Pulse Count instruction (**PulseCount()** in CRBasic. Use the low level AC configuration.

The expression for wind speed (U) is:

$$U = MX + B$$

where

M = multiplier
X = number of pulses per second (Hertz)
B = offset

**13**

TABLE 7-3 lists the multipliers (M) and offsets (Off) to obtain meters/second or miles/hour when the **Pulse Count** instruction is configured to output the result in hertz.

| **TABLE 7-3. Wind Speed Multiplier** (With Pulse Channel Configuration Set to Low Level AC, Output "Hz") | | |
|---|---|---|
| **Model** | **Meters/Second** | **Miles/Hour** |
| 03002 / 03101 | M = 0.750 Off = 0.2 | M = 1.677 Off = 0.4 |
| *When the pulse channel configuration is set to Low Level AC, output "counts", the multiplier above is divided by the execution interval in seconds. | | |

## 7.4.2  Wind Direction

The wind vane is coupled to a 10 kΩ potentiometer, which has an 8-degree electrical dead band between 352 and 360 degrees.

The CR200(X) dataloggers use the **ExDelSE()** instruction to measure wind direction. All other CRBasic dataloggers use the **BRHalf()** instruction.

Some CRBasic measurement sequences can cause the measurement of the wind direction to return a negative wind direction (–30°) while in the dead band. To overcome this problem, all program examples use a delay of 20 ms (20,000 μs) and set any negative wind direction values to 0.0: If WindDir < 0, then WindDir = 0.0.

Excitation voltages, range codes, and multipliers for Campbell Scientific dataloggers are listed in TABLE 7-4. Appendix D, *Wind Direction Measurement Theory (p. D-1)*, has additional information on the **BRHalf()** measurement instructions.

| **TABLE 7-4. Parameters for Wind Direction** | | | | | | |
|---|---|---|---|---|---|---|
| | **CR200(X)** | **CR300 Series** | **CR800, CR850, CR1000** | **CR1000X** | **CR6** | **CR5000, CR3000** |
| Measurement Range | NA | mV2500 | mV2500 | mV5000 | mV1000 | mV5000 |
| Excitation Voltage | 2500 mV | 2500 mV | 2500 mV | 2500 mV | 1000 mV | 5000 mV |
| Reverse Excitation | NA | NA | True | True | True | True |
| Delay or Settling Time | 20000 μs | 20000 μs | 20000 μs | 20000 μs | 20000 μs | 20000 μs |
| Multiplier | 0.1408 | 352 | 352 | 352 | 352 | 352 |
| Offset | 0 | 0 | 0 | 0 | 0 | 0 |

## 7.4.3  Wind Vector Processing Instruction

The **Wind Vector** output instruction is used to process and store mean wind speed, unit vector mean wind direction, and standard deviation of the wind direction (optional) from the measured wind speed and direction values.

# 8.    Sensor Maintenance

Every month do a visual/audio inspection of the anemometer at low wind speeds. Verify that the cup assembly and wind vane rotate freely. Inspect the sensor for physical damage.

Replace the anemometer bearings when they become noisy, or the wind speed threshold increases above an acceptable level. The condition of the bearings can be checked with a paper clip as described in the R.M. Young 03002 manual (see Section 10, *References (p. 16)*).

The potentiometer has a life expectancy of fifty million revolutions. As it becomes worn, the element can produce noisy signals or become nonlinear. Replace the potentiometer when the noise or nonlinearity becomes unacceptable.

Refer to the *Assistance* page at the beginning of this document for the procedure of returning the sensor to Campbell Scientific for wind vane and bearing replacement.

# 9.    Troubleshooting

## 9.1    Wind Direction

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

1.    Check that the sensor is wired to the excitation and single-ended channel specified by the measurement instruction.

2.    Verify that the excitation voltage and range code are correct for the datalogger type.

3.    Disconnect the sensor from the datalogger and use an ohm meter to check the potentiometer. Resistance should be about 10 kΩ between the black and white wires. The resistance between either the black/red or white/red wires for the 03301 and blue/red or white/red for the 03002 should vary from 1 kΩ to 11 kΩ depending on vane position. Resistance when the vane is in the 8-degree dead band should be about 1 MΩ.

Symptom: Incorrect wind direction

1.    Verify that the excitation voltage, range code, multiplier, and offset parameters are correct for the datalogger type.

2.    Check orientation of sensor as described in Section 7.2, *Assembly and Mounting (p. 7)*.

## 9.2    Wind Speed

Symptom:  No wind speed

1.    Check that the sensor is wired to the pulse channel specified by the pulse count instruction.

2.  Disconnect the sensor from the datalogger and use an ohm meter to check the coil. The resistance between the white and black wires for the 03101 and black and red wires for the 03002 should be a nominal 1300 ohms. Infinite resistance indicates an open coil; low resistance indicates a shorted coil.

3.  Verify that the configuration code, and multiplier and offset parameters for the pulse count instruction are correct for the datalogger type.

# 10.  References

Component part numbers and other information is available in the R.M. Young 03002 manual available at *www.campbellsci.com/03002-wind-sentry*. Because Campbell Scientific cables the sensor, the wiring in the R.M. Young manual will be different than the wiring listed in this manual.

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 files, which can be imported into *CRBasic Editor*. Assuming defaults were used when *Short Cut* was installed, these files reside in the C:\campbellsci\SCWin folder:

- .DEF (wiring and memory usage information)
- .CR2 (CR200(X)-series datalogger code)
- .CR300 (CR300-series datalogger code)
- .CR6 (CR6-series datalogger code)
- .CR8 (CR800-series datalogger code)
- .CR1 (CR1000 datalogger code)
- .CR1X (CR1000X-series 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. On the **Advanced** tab, click the **CRBasic Editor** button. The program opens in CRBasic with the name **noname.CR_**. Now save the program with your desired name in any folder.

**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.

2. The program can now be edited, saved, and sent to the datalogger.

3. Import wiring information to the program by opening the associated .DEF file. By default, it will be in the c:\campbellsci\SCWin folder. 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. You can highlight several lines of CRBasic code then right-click and select **Comment Block**. (This feature is demonstrated at about 5:10 in the *CRBasic | Features* video.)

# *Appendix B. Example Programs*

These example programs measure the 03002 every 5 seconds, and store mean wind speed, unit vector mean direction, and standard deviation of the direction every 60 minutes. Wiring for the examples is given in TABLE B-1.

| TABLE B-1. Wiring for Example Programs | | | | |
|---|---|---|---|---|
| **Color** | **Wire Label** | **CR1000X** | **CR6** | **CR200X** |
| Red | WS Signal | P1 | U4 | P_LL |
| Black | WS Reference | ⏚ | ⏚ | ⏚ |
| Clear | Shield | ⏚ | ⏚ | ⏚ |
| | | | | |
| Green | WD Signal | SE 1 | U2 | SE 1 |
| Blue | WD Volt Excit | VX 1 | U1 | VX1 |
| White | WD Reference | ⏚ | ⏚ | ⏚ |

---

**CRBasic Example B-1. CR1000X Program Measuring the 03002**

```
'CR1000X
'Declare Variables and Units
Public Batt_Volt
Public WS_ms
Public WindDir
Units Batt_Volt=Volts
Units WS_ms=meters/second
Units WindDir=Degrees

'Define Data Tables
DataTable(Hour,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
  Scan(5,Sec,1,0)
    'Default Datalogger Battery Voltage measurement Batt_Volt:
    Battery(Batt_Volt)

    '03002 or 03101 RM Young Wind Sentry Wind Speed Sensor measurement
    'WS_ms:
    PulseCount(WS_ms,1,P1,5,1,0.75,0.2)
    If WS_ms<0.21 Then WS_ms=0

    '03002 or 03301 RM Young Wind Sentry Wind Direction Sensor
    'measurement - WindDir:
    BrHalf(WindDir,1,mV1000,1,Vx1,1,1000,True,20000,_60Hz,352,0)
    'Use mV5000 range and 5000 mV excitation for CR3000 and CR5000
    'dataloggers.
    If WindDir>=360 OR WindDir<0 Then WindDir=0
    'Call Data Tables and Store Data
    CallTable(Hour)
  NextScan
EndProg
```

**CRBasic Example B-2.  CR6 Program Measuring the 03002**

```
'CR6 Series

'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(Hour,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(5,Sec,1,0)
    'Default Datalogger Battery Voltage measurement 'BattV'
    Battery(BattV)

    'Default Wiring Panel Temperature measurement 'PTemp_C'
    PanelTemp(PTemp_C,60)

    '03002 Wind Speed & Direction Sensor measurements 'WS_ms' and 'WindDir'
    'WS_ms
    PulseCount(WS_ms,1,U4,5,1,0.75,0.2)
    If WS_ms<0.21 Then WS_ms=0

    'WindDir
    BrHalf(WindDir,1,mV1000,U2,U1,1,1000,True,20000,60,352,0)
    If WindDir>=360 OR WindDir<0 Then WindDir=0

    'Call Data Tables and Store Data
    CallTable Hour
  NextScan
EndProg
```

**CRBasic Example B-3.  CR200(X) Program Measuring the 03002**

```
'CR200/CR200X Series

'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(Hour,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(5,Sec)
    'Default Datalogger Battery Voltage measurement 'BattV'
    Battery(BattV)

    '03002 Wind Speed & Direction Sensor measurements 'WS_ms' and 'WindDir'
    'WS_ms
    PulseCount(WS_ms,P_LL,1,1,0.75,0.2)
    If WS_ms<0.21 Then WS_ms=0

    'WindDir
    ExDelSE(WindDir,1,1,1,mV2500,20000,0.1408,0)
    If WindDir>=360 OR WindDir<0 Then WindDir=0

    'Call Data Tables and Store Data
    CallTable Hour
  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 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 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). 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. For example, the declination for Logan, Utah is 14° East. True North is 360° – 14°, or 346° as read on a compass.

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 or computer.

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.

# Magnetic Declination for the U.S. 2004
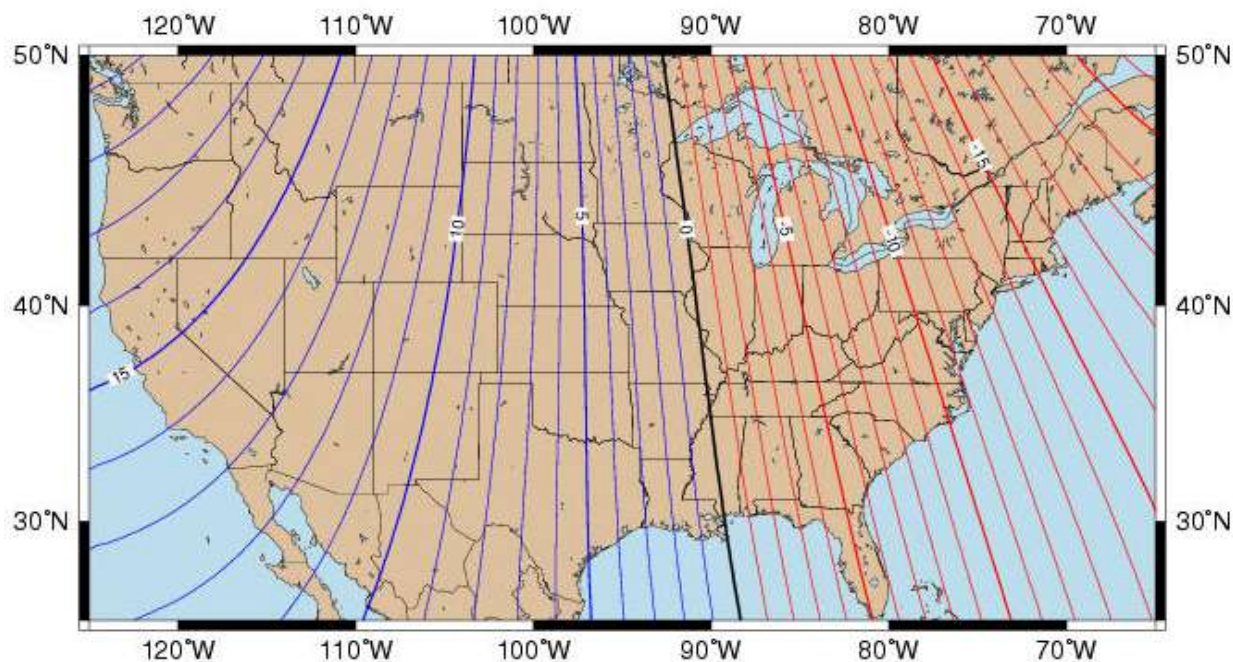
Mercator Projection

Contours of Declination of the Earth's magnetic field. Contours are expressed in degrees.
Contour Interval: 1 Degree (Positive declinations in blue, negative in red)

Produced by NOAA's National Geophysical Data Center (NGDC), Boulder, Colorado

http://www.ngdc.noaa.gov

Based on the International Geomagnetic Reference Field (IGRF), Epoch 2000 updated to December 31, 2004

The IGRF is developed by the International Association of Geomagnetism and Aeronomy (IAGA). Division V

FIGURE C-1. *Magnetic declination for the contiguous United States (2004)*
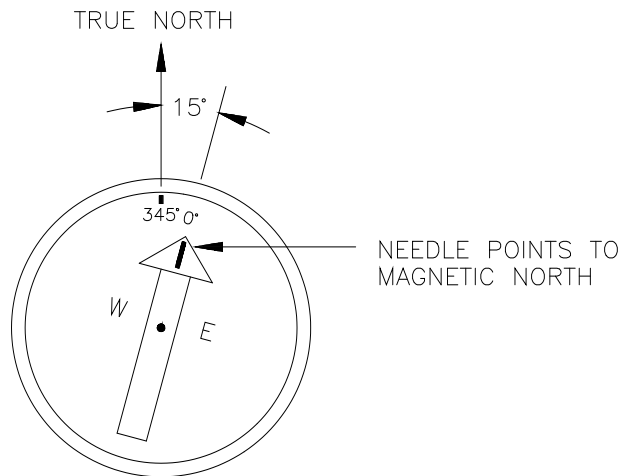
*FIGURE C-2.  Declination angles east of True North are subtracted from 0 to get True North*
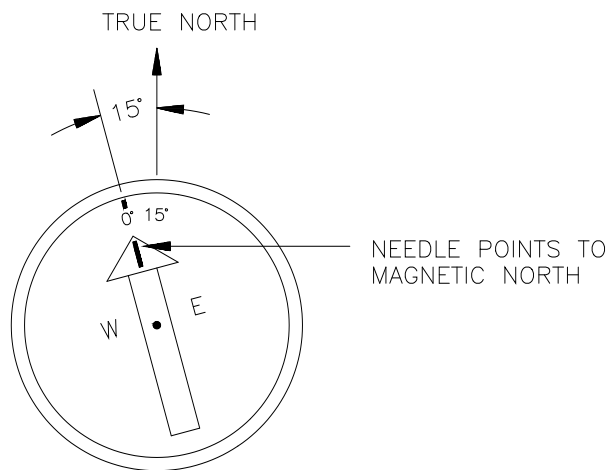


*FIGURE C-3.  Declination angles west of True North are added to 0 to get True North*

# *Appendix D. Wind Direction Measurement Theory*

It is not necessary to understand the concepts in this section for the general operation of the 03002 with Campbell Scientific's datalogger.
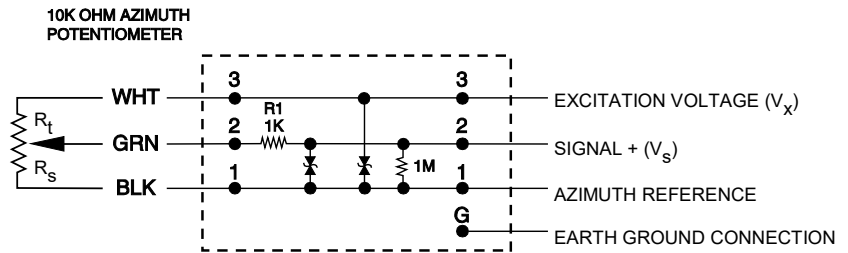


FIGURE D-1.  *03002 and 03301 potentiometer in a half bridge circuit*

## D.1  BRHalf Instruction

The **BRHalf()** instruction outputs a precise excitation voltage ($V_x$), and measures the voltage between the wiper and ground ($V_s$). The resistance between the wiper and ground, $R_s$, and $V_s$ varies with wind direction. The measurement result is the ratio of the measured voltage to the excitation voltage ($V_s/V_x$). This ratio is related to the resistance as shown below:

$$V_s / V_x = R_s / \left( R_t + R_s \right)$$

The maximum value that $R_s$ will reach is $R_f$, just before it crosses over from the west side of north to the east side of north (at this point $R_t = 0$). $V_s / V_x$ reaches its maximum value of 1.0 mV/mV at 352 degrees. The multiplier to convert $V_s/V_x$ to degrees is 352 degrees / 1.0 $V_s/V_x$ = 352. See datalogger manual for more information on the bridge measurements.

# Campbell Scientific Companies

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

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

**Campbell Scientific Southeast Asia Co., Ltd.**
877/22 Nirvana@Work, Rama 9 Road
Suan Luang Subdistrict, Suan Luang District
Bangkok 10250
THAILAND
*www.campbellsci.asia* • info@campbellsci.asia

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

**Campbell Scientific (Beijing) Co., Ltd.**
8B16, Floor 8 Tower B, Hanwei Plaza
7 Guanghua Road
Chaoyang, Beijing 100004
P.R. CHINA
*www.campbellsci.com* • info@campbellsci.com.cn

**Campbell Scientific do Brasil Ltda.**
Rua Apinagés, nbr. 2018 ─ Perdizes
CEP: 01258-00 ─ São Paulo ─ SP
BRASIL
*www.campbellsci.com.br* • vendas@campbellsci.com.br

**Campbell Scientific Canada Corp.**
14532 – 131 Avenue NW
Edmonton AB T5L 4X4
CANADA
*www.campbellsci.ca* • dataloggers@campbellsci.ca

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

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

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

**Campbell Scientific Ltd.**
Fahrenheitstraße 13
28359 Bremen
GERMANY
*www.campbellsci.de* • info@campbellsci.de

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

*Please visit www.campbellsci.com to obtain contact information for your local US or international representative.*