Product Manual

Sensor

Wind Sentry Series

03002, 03101, and 03301

Revision: 07/2022

RELIABLE SINCE 1974 MONITORING

CAMPBELL SCIENTIFIC

Table of contents

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 and vane may be purchased separately.

> 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 03002 is a precision instrument. Please handle it with care.
- Do not use cable lengths greater than 30 m (9 ft) in electrically noisy environments.
- 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.
- Wire color and functions of sensors purchased through Campbell Scientific may not correspond with the wire colors and functions given in the manufacturer's manual. To ensure proper function, follow the wiring provided in ***Short Cut*** or in the Campbell Scientific manual.

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. Contact Campbell Scientific about any discrepancies.

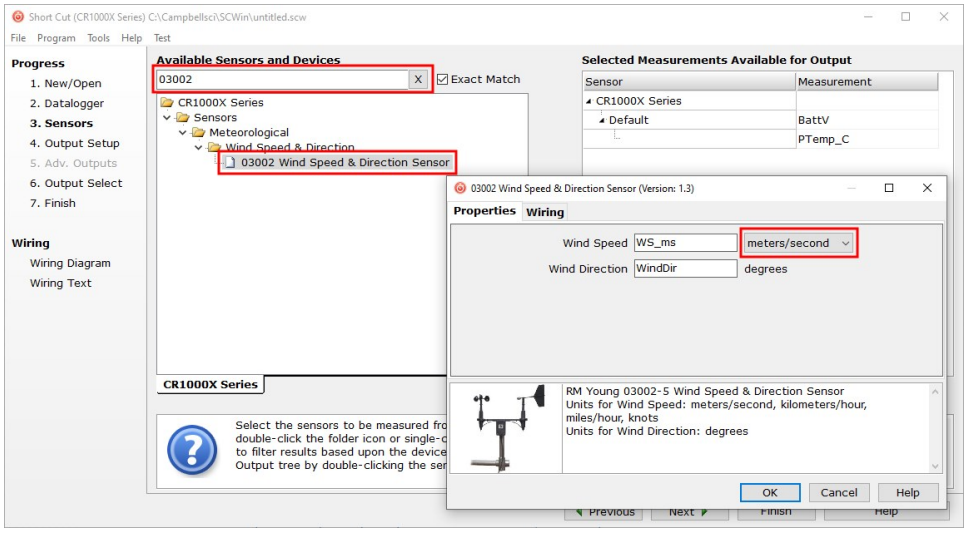
- The model number and cable length are printed on a label at the connection end of the cable. Check this information against the shipping documents to ensure the expected product and cable length are received.
- The sensor is shipped with the cup wheel unattached to the anemometer shaft. Refer to the Assembly and mounting the 03002 (p. 11) section.

4. QuickStart

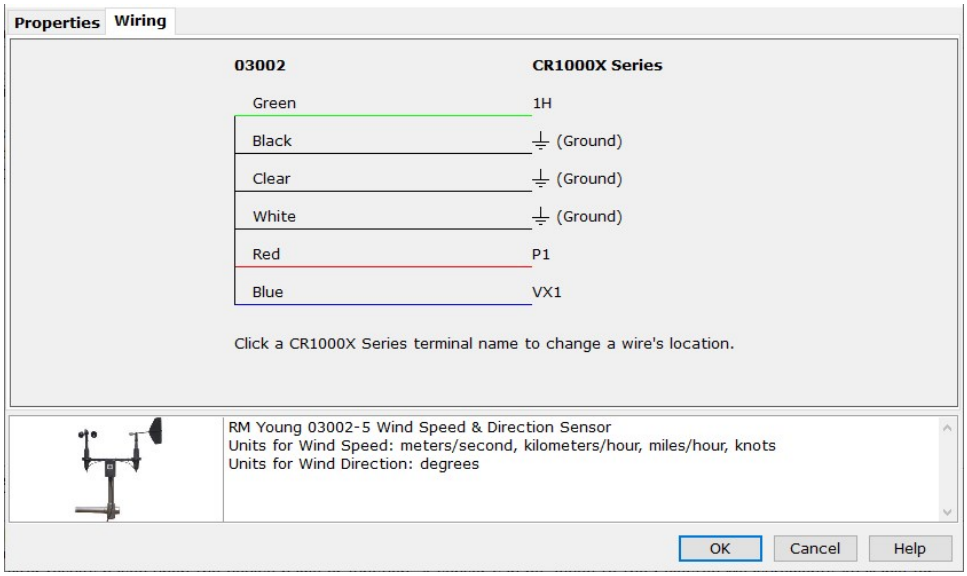
A video that describes data logger programming using ***Short Cut*** is available at: www.campbellsci.com/videos/cr1000x-datalogger-getting-started-program-part-3. ***Short Cut*** is an easy way to program your data logger to measure this sensor and assign data logger wiring terminals. ***Short Cut*** 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 03002.

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 03002 or find the sensor in the **Sensors** > **Meteorological** > **Wind Speed & Direction** folder. 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.

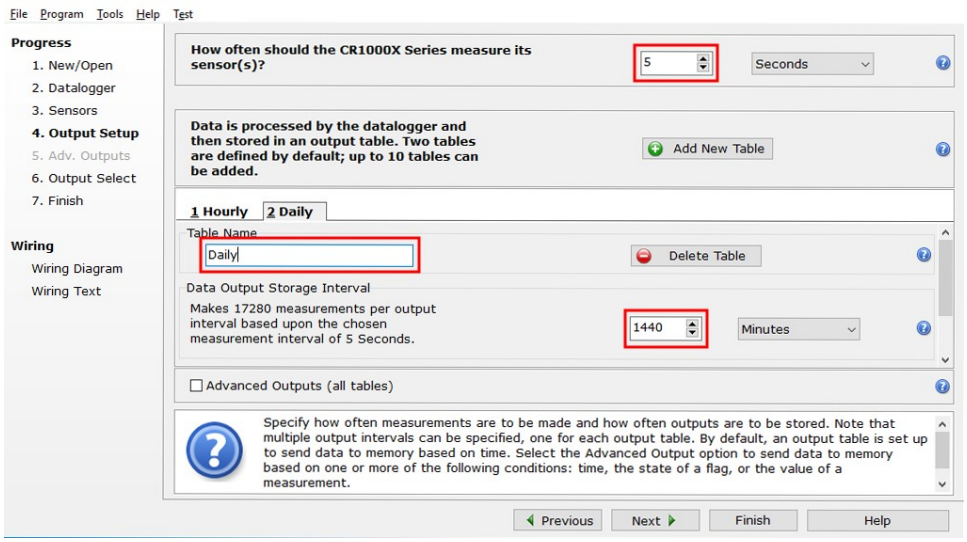


4. Click on the **Wiring** tab to see how the sensor is to be wired to the data logger. Click **OK** after wiring the sensor.

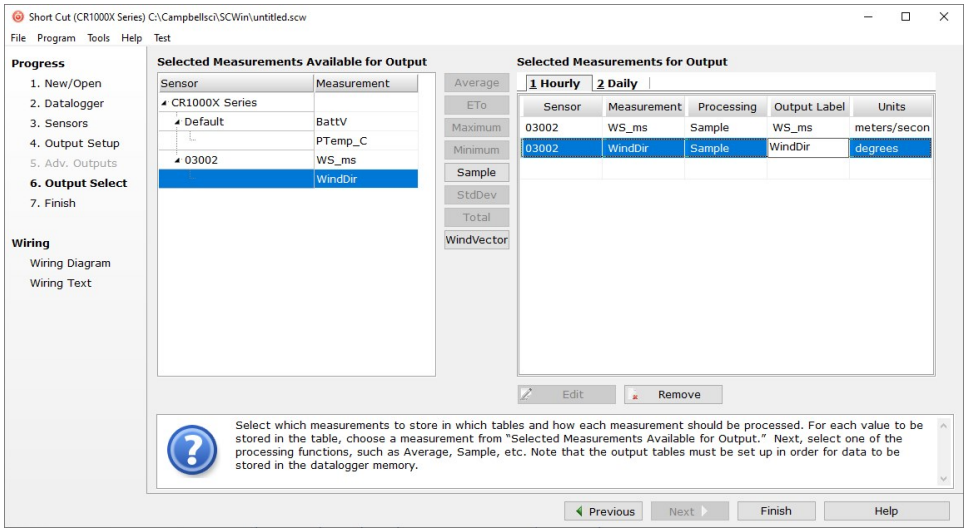


5. Select any other sensors you have, then finish the remaining ***Short Cut*** steps to complete the program.

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 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 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 (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)

NOTE:
Maximum cable length is 304.8 m (1000 ft).

CAUTION:
Do not use cable lengths greater than 30 m (9 ft) in electrically noisy environments.

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
- Campbell Scientific version uses shielded bearings, which lowers the anemometer starting threshold
- Compatible with the LLAC4 4-channel Low Level AC Conversion Module, which increases the number of anemometers one data logger can measure
- Compatible with Campbell Scientific CRBasic data loggers: CR6, CR1000X, CR800 series, CR350 series, CR300 series, CR3000, and CR1000

6. Specifications

6.1 Wind speed (anemometer)

Range:	0 to 50 m/s (112 mph), gust survival 60 m/s (134 mph)
Sensor:	12 cm diameter cup wheel assembly, 40 mm diameter hemispherical cups

Accuracy:	±0.5 m/s (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 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 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 (1.8 mph) at 10° displacement (1.8 m/s (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 data logger
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 data logger with ***Short Cut***, skip Wiring (p. 7) and Programming (p. 9). ***Short Cut*** does this work for you. See QuickStart (p. 2) for a ***Short Cut*** tutorial.

7.1 Wiring

Connections to CRBasic data loggers are given in Table 7-1 (p. 7), Table 7-2 (p. 8), and Table 7-3 (p. 8). When ***Short Cut*** software is used to create the data logger program, the sensor is wired to the terminals shown in the wiring diagram created by ***Short Cut***.

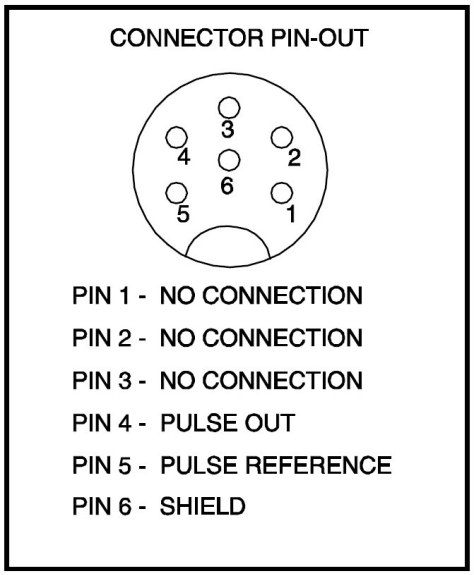
Table 7-1: 03002 Wind Sentry Set wire color, wire function, and data logger connection

Wire color	Wire function	Data logger 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)

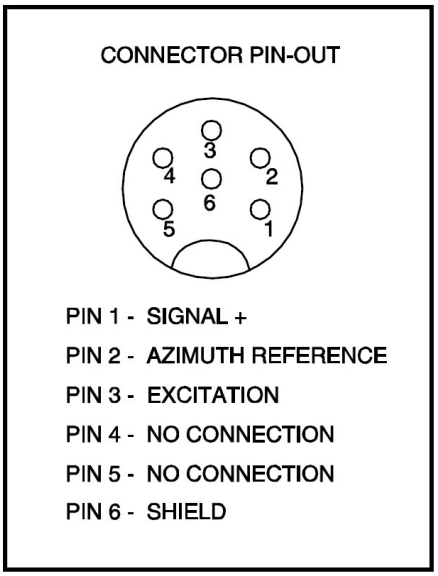
[1]**U** terminals are automatically configured by the measurement instruction.

Table 7-2: 03101 anemometer wire color, wire function, and data logger connection		
Wire color	**Wire function**	**Data logger 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)
[1]**U** terminals are automatically configured by the measurement instruction.		

Table 7-3: 03301 vane wire color, wire function, and data logger connection		
Wire color	**Wire function**	**Data logger connection terminal**
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** terminals are automatically configured by the measurement instruction.		



Wind Speed 03101



Wind Direction 03301

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. 17). Programming basics for CRBasic data loggers are provided in the following sections. A complete program is provided in Example program (p. 18). Programming basics and programming examples for Edlog data loggers are provided at www.campbellsci.com\old-manuals.

7.2.1 Wind speed

Wind speed is measured by using the `PulseCount()` instruction. Syntax of the the `PulseCount()` instruction is:

```
PulseCount(Dest, Reps, PChan, PConfig, POption, Mult, Offset)
```

Set the **PConfig** parameter to **Low Level AC** and the **POption** parameter to **Frequency**.

The expression for wind speed (U) is:

U = Mx + B

where

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

Table 7-4 (p. 10) lists the multipliers to obtain miles/hour or meters/second when the measurement instruction is configured to output Hz.

Table 7-4: Wind speed multiplier
(with pulse terminal 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 terminal configuration is set to Low Level AC, output "counts", the multiplier above is divided by the execution interval in seconds.

7.2.2 Wind direction

The wind vane is coupled to a 10 kΩ potentiometer, which has a 8-degree electrical dead band between 352 and 360 degrees. A 1 MΩ resistor between the signal and ground pulls the signal to 0 mV (0 degrees) when wind direction is in the dead band (between 352 and 360 degrees).

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°) 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.

The excitation voltage, range codes, and multipliers for the different data logger types are listed in Table 7-5 (p. 10). Wind direction measurement theory (p. 23) has additional information on the `BRHalf()` measurement instruction.

Table 7-5: Parameters for wind direction

	CR300 Series	CR800, CR850, CR1000	CR1000X	CR6	CR3000
Measurement range	mV2500	mV2500	mV5000	mV5000	mV5000
Excitation voltage	2500 mV	2500 mV	2500 mV	2500 mV	5000 mV
Reverse excitation	NA	True	True	True	True
Delay or settling time	20000 µs	20000 µs	20000 µs	20000 µs	20000 µs
Multiplier	352	352	352	352	352
Offset	0	0	0	0	0

7.2.3 WindVector processing instruction

The `WindVector` output is used to process and store mean wind speed, unit vector mean wind direction, and standard deviation of the wind direction (optional) by using the measured wind speed and direction samples.

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 wind monitor 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. 16) for a list of references that discuss siting wind speed and direction sensors.

7.4 Assembly and mounting the 03002

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. 20])
- Small screw driver provided with data logger
- UV resistant cable ties
- 6 to 10 inch torpedo level
- Unthreaded aluminum pipe, 1-inch IPS, 12-inch length (shipped with the sensor)
- 1-inch-by-1-inch Nu-Rail crossover fitting
- Cup wheel
- 03002 assembly

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

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

2. Mount a crossarm to a tripod or tower.

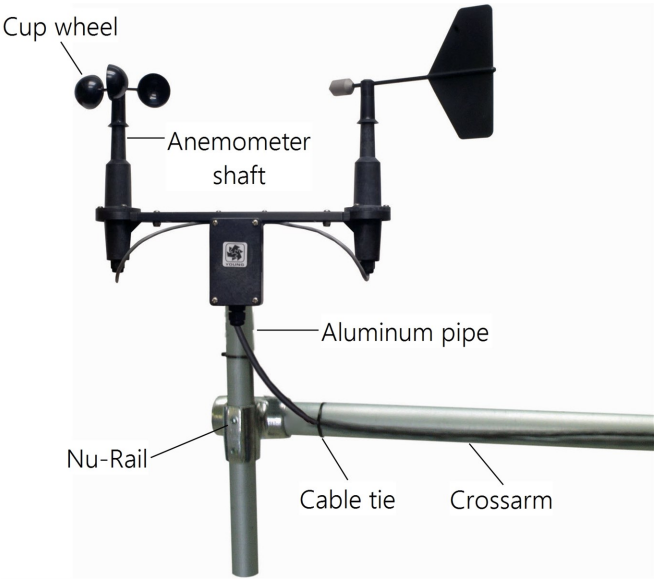


Figure 7-1. 03002 mounted to a crossarm with 1 x 1 inch Nu-Rail fitting

3. 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. 20) contains detailed information on determining true north by using a compass and the magnetic declination for the site.
4. Secure the 12-inch aluminum pipe to the Nu-Rail fitting.
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 data logger has been programmed to measure wind direction as described in Wind direction sensor orientation (p. 20).
7. Use the torpedo level to ensure that the sensor is level.
8. Route the sensor cable along the underside of the crossarm to the tripod or tower, and to the instrument enclosure.
9. Secure the cable to the crossarm and tripod or tower by using cable ties.

The 03002 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 7-2. CM221 Right-Angle Mounting Kit

Figure 7-3. The CM216 allows an 03002 or 03101 to mount atop a tripod mast

7.5 Mounting the 03101 anemometer to a crossarm

1. Install the cup wheel to the anemometer shaft using the hex key wrench provided with the sensor.
2. Mount a crossarm to a tripod or tower.
3. Secure the 3/4-inch IPS, 10-inch-long, threaded aluminum pipe to the CM220 mount or 3/4 x 1 inch Nu-Rail fitting (Figure 7-4 [p. 14]).
4. Place the 03101 on the pipe.
5. Route the sensor cable along the underside of the crossarm to the tripod or tower, and to the instrument enclosure.
6. Secure the cable to the crossarm and tripod or tower by using cable ties.

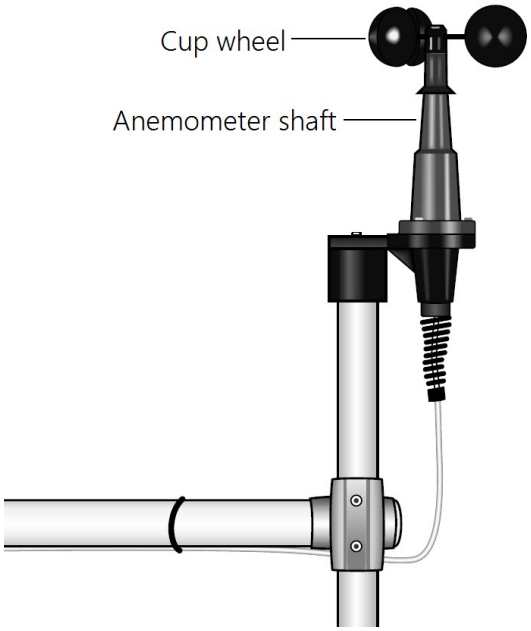


Figure 7-4. 03101 mounted to a crossarm via a 3/4 x 1 inch Nu-Rail fitting

7.6 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.

8. Sensor maintenance

Every month do a visual/audio inspection of the anemometer at low wind speeds. Verify that the propeller and wind vane bearing 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 by using the Propeller Torque Disc as described in the R. M. Young manual (see www.youngusa.com/product-category/wind-sensors-accessories).

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

> **NOTE:**
> Campbell Scientific recommends factory replacement of the bearings and potentiometer. Refer to the Assistance page of this document for the procedure of acquiring a Returned Materials Authorization (RMA). Mechanically-adept users may choose to replace the bearings or potentiometer themselves. Instructions for replacing the bearings and potentiometer are given in R. M. Young manuals (www.youngusa.com).

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 terminal specified by the measurement instruction.
2. Verify that the excitation voltage and range code are correct for the data logger type.
3. Disconnect the sensor from the data logger and use an ohmmeter to check the potentiometer. Resistance should be about 10 kΩ between the wind direction signal and reference wires. The resistance between either the black/red or white/red wires for the 03301 and blue/green or white/green wires 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 data logger type.
2. Check orientation of sensor as described in Assembly and mounting the 03002 (p. 11).

9.2 Wind speed

Symptom: No wind speed

1. Check that the sensor is wired to the pulse terminal specified by the pulse count instruction.
2. Disconnect the sensor from the data logger and use an ohmmeter 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 Ω. 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 data logger 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*

Short Cut creates a .DEF file that contains wiring information and a program file that can be imported into the *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. After saving the *Short Cut* program, click the **Advanced** tab then the **CRBasic Editor** button. A program file with a generic name will open in CRBasic. 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 it created.

2. To add the *Short Cut* wiring information into the new CRBasic program, open the .DEF file located in the C:\campbellsci\SCWin folder, and copy the wiring information, which is at the beginning of the .DEF file.
3. Go into the CRBasic program and paste the wiring information into it.
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

This example program measures the 03002 every 5 seconds, and stores mean wind speed, unit vector mean direction, and standard deviation of the direction every 60 minutes. Wiring for the example is given in Table B-1 (p. 18).

Table B-1: Wiring for example program

Color	Wire label	CR1000X
Red	WS Signal	P1
Black	WS Reference	⏚
Clear	Shield	⏚
Green	WD Signal	SE 1
Blue	WD Volt Excit	VX 1
White	WD Reference	⏚

CRBasic Example 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 Data Logger 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
    'data loggers.
    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 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. 21).

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. 21) (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. 22).

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 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.

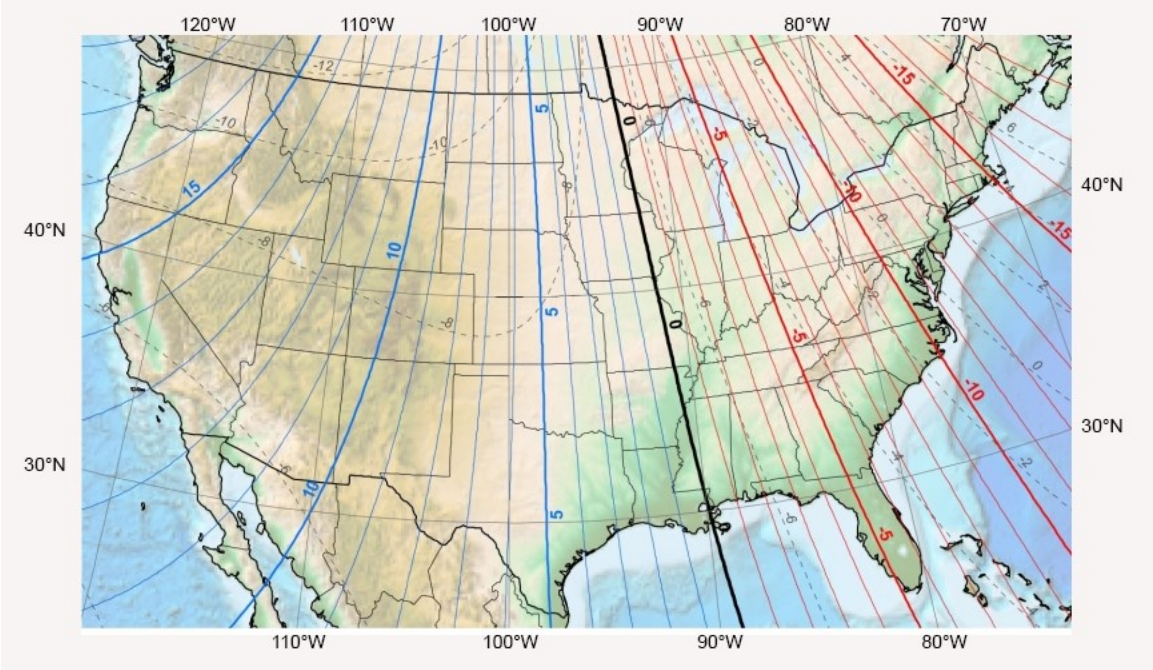


Figure C-1. Magnetic declination for the contiguous United States (2015)

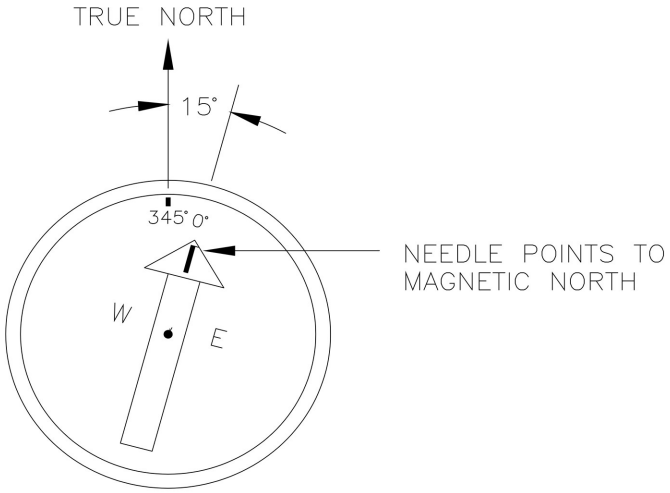


Figure C-2. Declination angles east of true north are subtracted from 0 to get true north

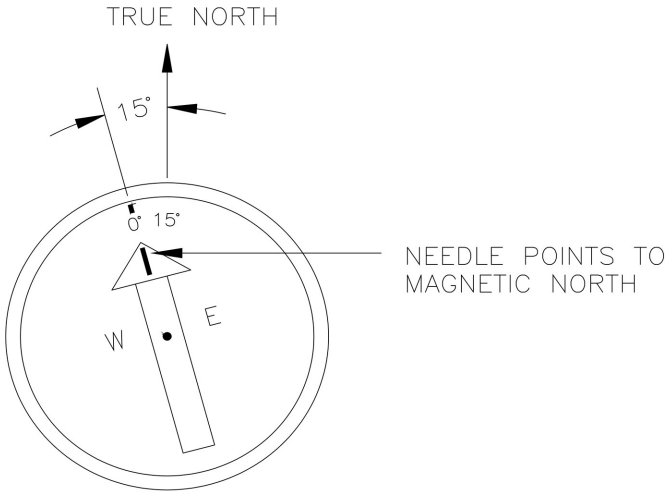


Figure C-3. Declination angles west of true north are added to 0 to get true north

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 a Campbell Scientific data logger.

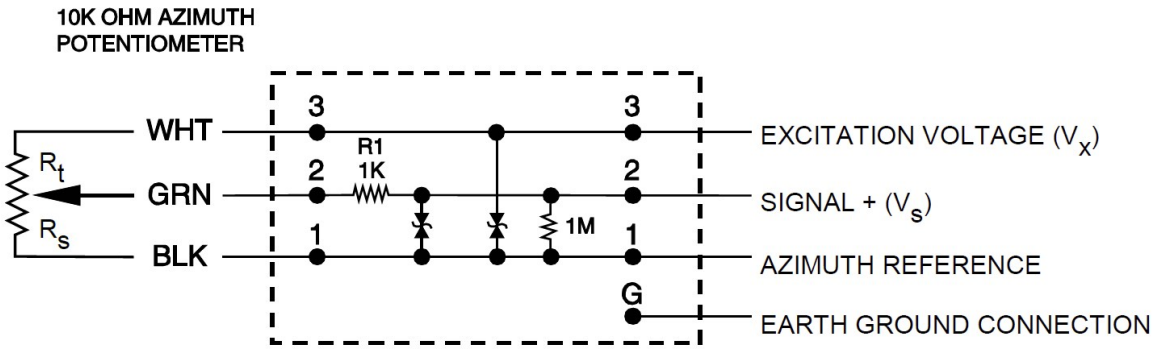


Figure D-1. 03002 and 03301 potentiometer in a half bridge circuit

The BRHalf CRBasic 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 vary 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 in this equation:

$$V_s/V_x = R_s/(R_t + R_s)$$

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 355 degrees. The multiplier to convert V_s/V_x to degrees is 355 degrees / 1.0 V_s/V_x = 355. Refer to the data logger manual for more information on the bridge measurements.

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.

CAMPBELL SCIENTIFIC EXPRESSLY DISCLAIMS AND EXCLUDES ANY IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. Campbell Scientific hereby disclaims, to the fullest extent allowed by applicable law, any and all warranties and conditions with respect to the Products, whether express, implied or statutory, other than those expressly provided herein.

Assistance

Products may not be returned without prior authorization.

Products shipped to Campbell Scientific require a Returned Materials Authorization (RMA) or Repair Reference number and must be clean and uncontaminated by harmful substances, such as hazardous materials, chemicals, insects, and pests. Please complete the required forms prior to shipping equipment.

Campbell Scientific regional offices handle repairs for customers within their territories. Please see the back page for the Global Sales and Support Network or visit www.campbellsci.com/contact to determine which Campbell Scientific office serves your country.

To obtain a Returned Materials Authorization or Repair Reference number, contact your CAMPBELL SCIENTIFIC regional office. Please write the issued number clearly on the outside of the shipping container and ship as directed.

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.

CAMPBELL SCIENTIFIC
WHEN MEASUREMENTS MATTER

Global Sales & Support Network

A worldwide network to help meet your needs

Campbell Scientific Regional Offices

Australia

Location: Garbutt, QLD Australia
Phone: 61.7.4401.7700
Email: info@campbellsci.com.au
Website: www.campbellsci.com.au

Brazil

Location: São Paulo, SP Brazil
Phone: 11.3732.3399
Email: vendas@campbellsci.com.br
Website: www.campbellsci.com.br

Canada

Location: Edmonton, AB Canada
Phone: 780.454.2505
Email: dataloggers@campbellsci.ca
Website: www.campbellsci.ca

China

Location: Beijing, P. R. China
Phone: 86.10.6561.0080
Email: info@campbellsci.com.cn
Website: www.campbellsci.com.cn

Costa Rica

Location: San Pedro, Costa Rica
Phone: 506.2280.1564
Email: info@campbellsci.cc
Website: www.campbellsci.cc

France

Location: Vincennes, France
Phone: 0033.0.1.56.45.15.20
Email: info@campbellsci.fr
Website: www.campbellsci.fr

Germany

Location: Bremen, Germany
Phone: 49.0.421.460974.0
Email: info@campbellsci.de
Website: www.campbellsci.de

India

Location: New Delhi, DL India
Phone: 91.11.46500481.482
Email: info@campbellsci.in
Website: www.campbellsci.in

South Africa

Location: Stellenbosch, South Africa
Phone: 27.21.8809960
Email: sales@campbellsci.co.za
Website: www.campbellsci.co.za

Spain

Location: Barcelona, Spain
Phone: 34.93.2323938
Email: info@campbellsci.es
Website: www.campbellsci.es

Thailand

Location: Bangkok, Thailand
Phone: 66.2.719.3399
Email: info@campbellsci.asia
Website: www.campbellsci.asia

UK

Location: Shepshed, Loughborough, UK
Phone: 44.0.1509.601141
Email: sales@campbellsci.co.uk
Website: www.campbellsci.co.uk

USA

Location: Logan, UT USA
Phone: 435.227.9120
Email: info@campbellsci.com
Website: www.campbellsci.com