INSTRUCTION MANUAL

05103, 05103-45, 05106, and 05305 R.M. Young Wind Monitors

Revision: 10/13

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05103, 05103-45, 05106, and 05305 R.M. Young Wind Monitors

1. Introduction

The 05103, 05103-45, 05106, and 05305 Wind Monitor sensors are used to measure horizontal wind speed and direction. The 05305 is a high performance version of the 05103 designed to meet PSD specifications for air quality applications. The 05103-45 is an alpine version that discourages ice buildup. The 05106 is recommended for marine applications.

Before installing the Wind Monitor, please study

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

2. Cautionary Statements

- The Wind Monitor is a precision instrument. Please handle it with care.
- If the Wind Monitor 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 Wind Monitor 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 Wind Monitor, 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*). 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

The Wind Monitors ship with:

(1) Allen wrench from manufacturer
(1) Bearing spacer from manufacturer
(1) Calibration sheet
(1) Instruction manual
(1) 3659 mounting pipe

4. Quickstart

4.1 Step 1 — Mount the Sensor

FIGURE 4-1 shows a 05103 installed with a 17953 Nurail®*. Please review Section 7, *Installation*, for siting and other guidelines.

Install the 05103 using:

- 3659 12 inch aluminum pipe
- CM220 Right-Angle Mounting Kit, or
- 17953 1 x 1 inch Nurail® Crossover Fitting

1. Secure the propeller to its shaft using the nut provided with the sensor.

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

3. Orient the crossarm North-South, with the 17953 Nurail® on the north end. Appendix A contains detailed information on determining true north using a compass and the magnetic declination for the site.

4. Secure the 3659 12 inch aluminum pipe to the 17953 Nurail®. The 3659 aluminum pipe is shipped with the Wind Monitor.

5. Place the orientation ring, followed by the Wind Monitor on the aluminum pipe.

6. Orient the junction box to the south, and tighten the band clamps on the orientation ring and aluminum pipe. Final sensor orientation is done after the datalogger has been programmed to measure wind direction as described in Appendix A.

7. Use the torpedo level to ensure that the Wind Monitor 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 using cable ties.

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* Nurail® is a registered trademark of the Hollaender Manufacturing Company.

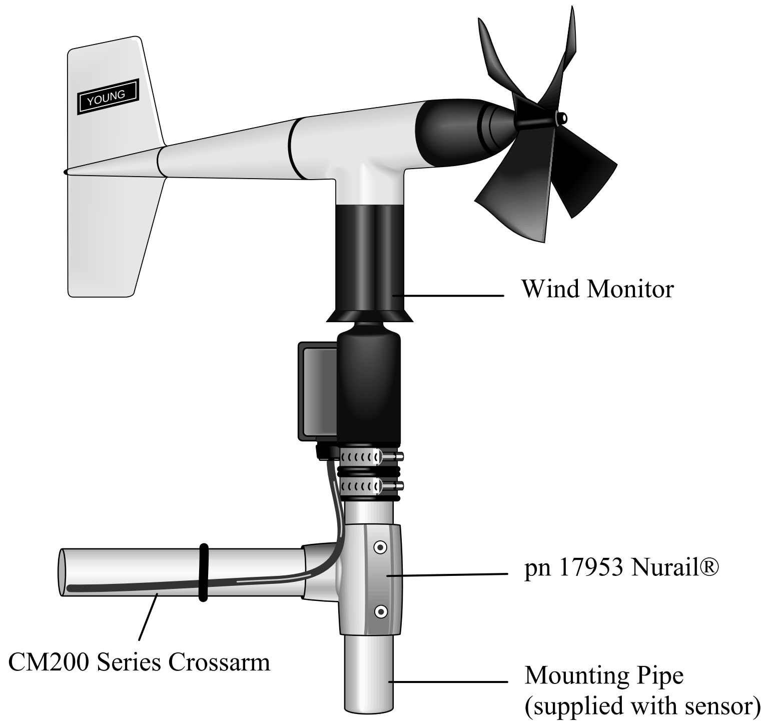
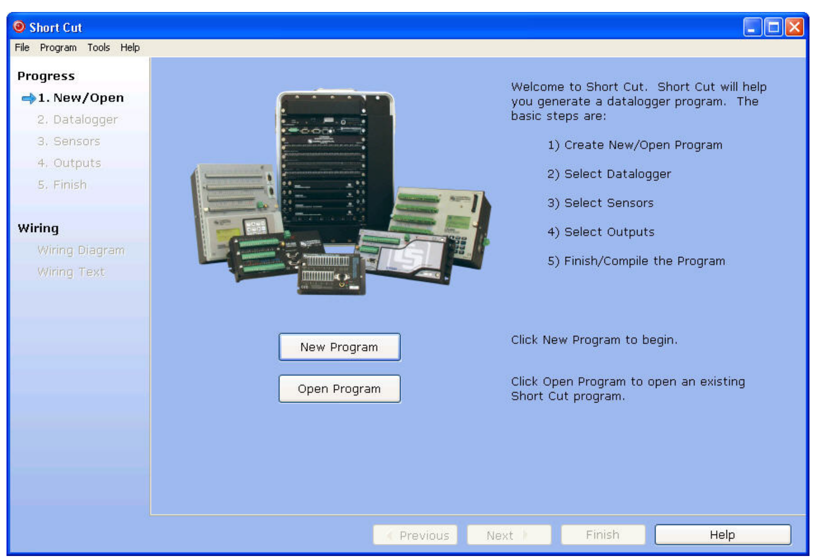


FIGURE 4-1. Wind monitor mounted to a CM200 Series Crossarm with pn 17953 Nurail®

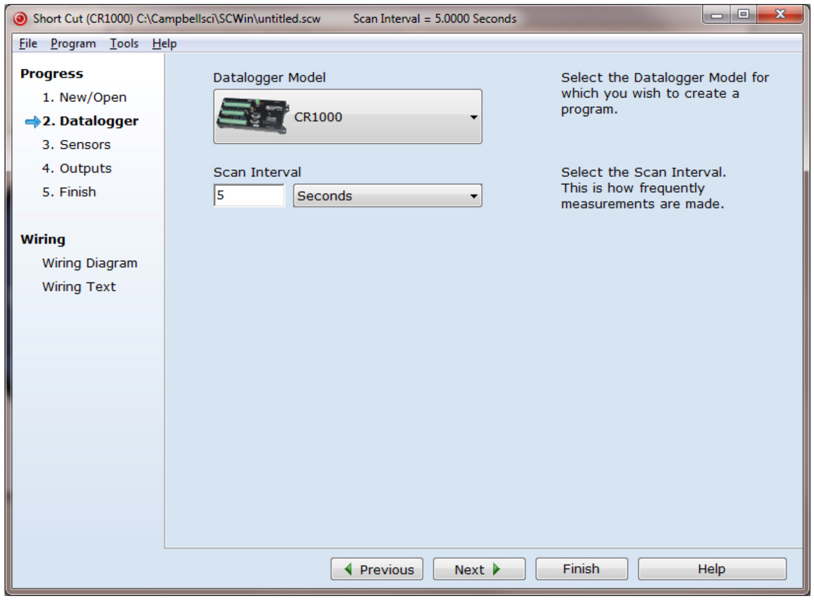
4.2 Step 2 — Use SCWin Short Cut to Program Datalogger and Generate Wiring Diagram

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

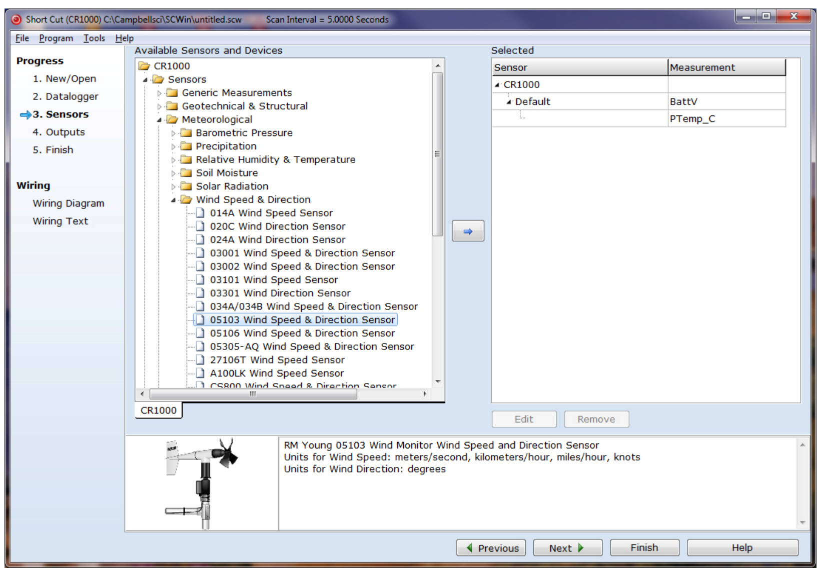
1. Open Short Cut and click on **New Program**.



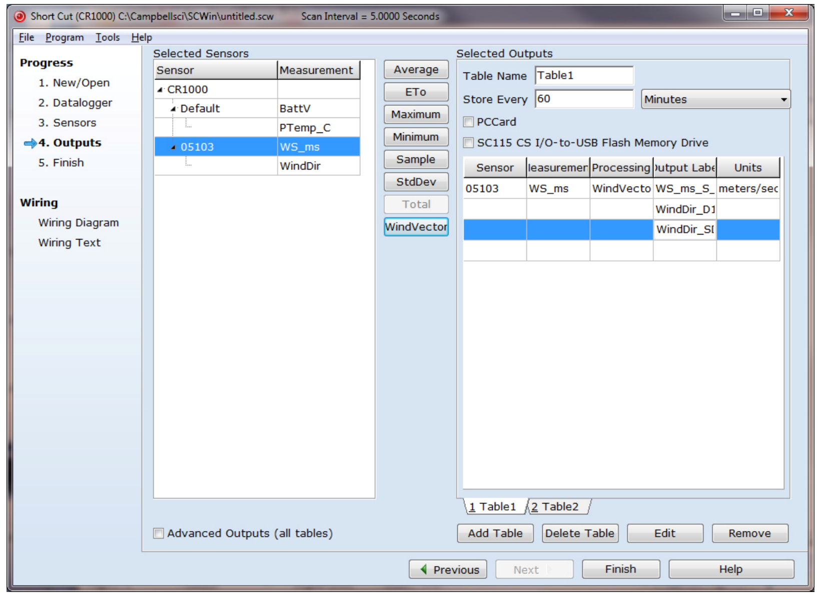
2. Select the **Datalogger Model** and enter the **Scan Interval**.



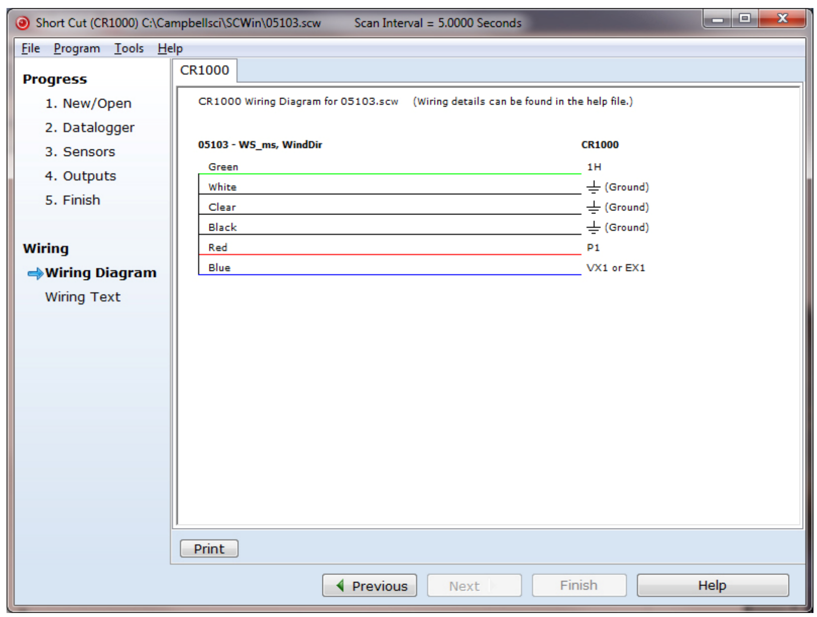
3. Under **Available Sensors and Devices**, select your sensor, and select the **right arrow** to add it to the list of sensors to be measured then select next.



4. Select **WindVector** for the output and then select **Finish**.



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



5. Overview

Wind speed is measured with a helicoid-shaped, four-blade propeller. Rotation of the propeller produces an AC sine wave signal with frequency proportional to wind speed.

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

The R.M. Young Instruction Manual includes additional information on the operating principles, installation, and maintenance of the sensor.

The Wind Monitors are manufacturered by R.M. Young and cabled by Campbell Scientific for use with our dataloggers. Lead lengths for the Wind Monitors are specified when the sensors are 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 Lead Lengths

CM106	CM110	CM115	CM120	UT10	UT20	UT30
13 ft	13 ft	19 ft	24 ft	13 ft	24 ft	34 ft

The Wind Monitor'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 Wind Monitor to be used in a wireless sensor network. Refer to *www.campbellsci.com/cws900* for more information.

6. Specifications

Wind Speed

	05103 Wind Monitor	05103-45 Wind Monitor-Alpine	05106 Wind Monitor-MA	05305 Wind Monitor-AQ
Range	0 to 100 m s^{-1} (0 to 224 mph)			0 to 50 m s^{-1} (0 to 112 mph)
Accuracy	±0.3 m s^{-1} (±0.6 mph) or 1% of reading			±0.2 m s^{-1} (±0.4 mph) or 1% of reading
Starting Threshold	1.0 m s^{-1} (2.2 mph)		2.4 mph (1.1 m s^{-1})	0.4 m s^{-1} (0.9 mph)
Distance Constant (63% recovery)	2.7 m (8.9 ft)			2.1 m (6.9 ft)
Output	ac voltage (3 pulses per revolution); 1800 rpm (90 hz) = 8.8 m s^{-1} (19.7 mph)			ac voltage (3 pulses per revolution); 1800 rpm (90 hz) = 9.2 m s^{-1} (20.6 mph)
Resolution	(0.0980 m s^{-1})/(scan rate in seconds) or (0.2192 mph)/(scan rate in (seconds)			(0.1024 m s^{-1})/(scan rate in sec.) or (0.2290 mph)/(scan rate in sec.)

Wind Direction

	05103 Wind Monitor	**05103-45 Wind Monitor-Alpine**	**05106 Wind Monitor-MA**	**05305 Wind Monitor-AQ**
Range	0° to 360° mechanical, 355° electrical (5° open)			
Accuracy	±3°	±5°	±3°	
Starting Threshold	1.1 m s^{-1} (2.4 mph)			0.5 m s^{-1} (1.0 mph)
Distance Constant (50% recovery)	1.3 m (4.3 ft)			1.2 m (3.9 ft)
Damping Ratio	0.3			0.45
Damped Natural Wavelength	7.4 m (24.3 ft)			4.9 m (16.1 ft)
Undamped Natural Wavelength	7.2 m (23.6 ft)			4.4 m (14.4 ft)
Output	analog dc voltage from potentiometer—resistance 10 kΩ; linearity 0.25%; life expectancy 50 million revolutions			
Power	switched excitation voltage supplied by datalogger			

Physical

	05103 Wind Monitor	**05103-45 Wind Monitor-Alpine**	**05106 Wind Monitor-MA**	**05305 Wind Monitor-AQ**
Operating Temperature Range	–50° to +50°C, assuming non-riming conditions			
Overall Height	37 cm (14.6 in)			38 cm (15 in)
Overall Length	55 cm (21.7 in)			65 cm (25.6 in)
Main Housing Diameter	5 cm (2 in)			
Propeller Diameter	18 cm (7.1 in)	14 cm (5.5 in)	18 cm (7.1 in)	20 cm (7.9 in)
Mounting Pipe Description	34 mm (1.34 in) outer diameter; standard 1.0 in IPS schedule 40			
Weight	1.5 kg (3.2 lb)	1 kg (2.2 lb)	1.5 kg (3.2 lb)	1.1 kg (2.5 lb)

CAUTION

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.

7. Installation

7.1 Siting

Locate wind sensors away from obstructions (for example, trees and building). Generally, there should be a horizontal distance of at least ten times the height of the obstruction between the windset 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 Section 10, *References*, 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
- 1/2 inch open end wrench
- compass and declination angle for the site (see Appendix A)
- small screw driver provided with datalogger
- UV resistant cable ties
- small pair of diagonal-cutting pliers
- 6 – 10 inch torpedo level

Install the propeller to its shaft using the nut provided with the sensor.

The Wind Monitor mounts to a standard 1 inch IPS schedule 40 pipe (1.31 inch O.D.). A 12 inch long mounting pipe ships with the Wind Monitor for attaching the sensor to a CM200-series crossarm with the CM220 (FIGURE 7-1) or 1049 Nurail® fitting (FIGURE 4-1 in Quickstart section). The 05103 can also be mounted to a CM110 series tripod mast with the CM216 Mast Mounting Kit (see FIGURE 7-2).

Mount the CM200-series crossarm to the tripod or tower. Orient the crossarm North-South, with the 1 inch Nurail® or CM220 on the North end. Appendix A contains detailed information on determining true north using a compass and the magnetic declination for the site.

Secure the mounting pipe to the Nurail® or CM220. Place the orientation ring, followed by the Wind Monitor on the mounting pipe. Orient the junction box to the south, and tighten the band clamps on the orientation ring and mounting post. Final sensor orientation is done after the datalogger has been programmed to measure wind direction as described in Appendix A.

Route the sensor cable along the underside of the crossarm to the tower/tripod mast, and to the instrument enclosure. Secure the sensor cable to the crossarm and mast using cable ties.

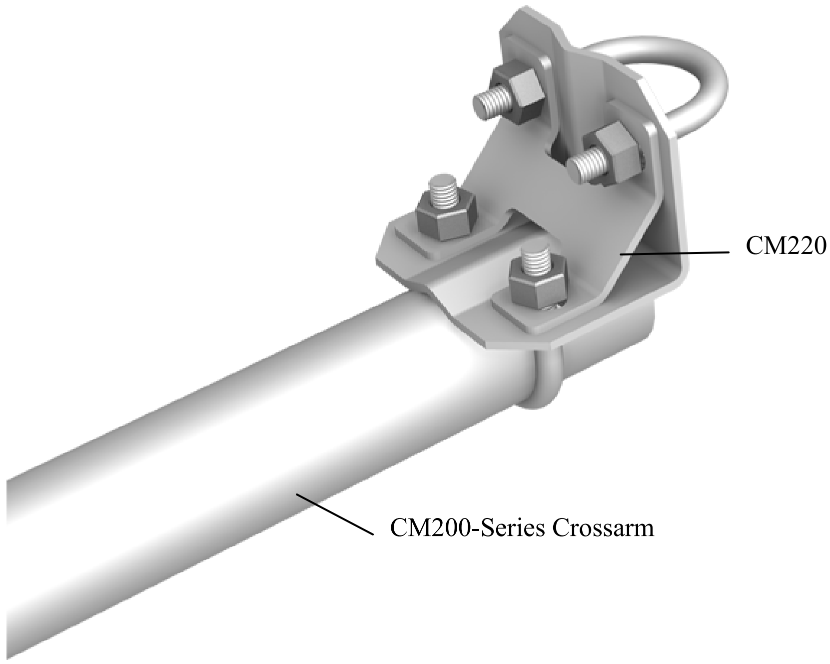


FIGURE 7-1. CM220 Right Angle Mounting Kit mounted to a crossarm

FIGURE 7-2. The CM216 allows the wind monitor to mount atop a tripod

7.3 Wiring

Connections to Campbell Scientific dataloggers are given in TABLE 7-1. When Short Cut for Windows software is used to create the datalogger program, the sensor should be wired to the channels shown in the wiring diagram created by Short Cut.

TABLE 7-1. Connections to Campbell Scientific Dataloggers

Color	**Wire Label**	**CR800 CR5000 CR3000 CR1000**	**CR510 CR500 CR10(X)**	**21X, CR7 CR23X**	**CR200(X)**
Red	WS Signal	Pulse	Pulse	Pulse	P_LL
Black	WS Reference	⏚	G	⏚	⏚
Green	WD Signal	SE Analog	SE Analog	SE Analog	SE Analog
Blue	WD Volt Excit	Excitation	Excitation	Excitation	Excitation
White	WD Reference	⏚	AG	⏚	⏚
Clear	Shield	⏚	G	⏚	⏚

7.4 Programming

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

7.4.1 Wind Speed

For CRBasic dataloggers, wind speed is measured using the **PulseCount()** instruction. Syntax of the the **PulseCount()** instruction is:

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

The *PConfig* parameter should be set to *1 (Low Level AC)* and the *POption* parameter should be set to *1 (Frequency)*.

For Edlog dataloggers, wind speed is measured using Edlog instruction **Pulse (P3)**. The configuration parameter should be set to *code* 21 *(Low Level AC, Output Hz configuration).*

The expression for wind speed (U) is:

$$U = Mx + B$$

where

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

TABLE 7-2 lists the multipliers to obtain miles/hour or meters/second when the measurement instruction is configured to output Hz.

The helicoid propeller has a calibration that passes through zero, so the offset is zero (Gill, 1973; Baynton, 1976).

TABLE 7-2. Wind Speed Multiplier

Model	**Miles/ Hour Output**	**Meters/ Second Output**
05103, 05103-45, or 05106	0.2192	0.0980
05305	0.2290	0.1024

7.4.2 Wind Direction

The wind vane is coupled to a 10 kΩ potentiometer, which has a 5 degree electrical dead band between 355 and 360 degrees. A 1 MΩ resistor between the signal and ground pulls the signal to 0 mV (0 degrees) when wind direction is between 355 and 360 degrees.

The CR200(X) datalogger uses the **ExDelSE()** instruction to measure wind direction. All other CRBasic dataloggers use the **BRHalf()** instruction. Edlog dataloggers (CR510, CR10X, CR23X) use Edlog Instruction 4—Excite, Delay (P4).

Some CRBasic measurement sequences cause the measurement of the wind direction to return a negative wind direction (–30º) while in the dead band. This can be overcome by using a delay of 40 ms (40,000µs) or by 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 datalogger types are listed in TABLE 7-3. Appendix B has additional information on the P4 and **BRHalf()** measurement instructions.

TABLE 7-3. Parameters for Wind Direction

	CR10(X), CR510, CR200(X)	CR7, 21X, CR23X	CR800 CR1000	CR5000, CR3000
Measurement Range	2500 mV, slow	5000 mV, slow/60 Hz	2500 mV, 60 Hz, reverse excitation	5000 mV, 60 Hz, reverse excitation
Excitation Voltage	2500 mV	5000 mV	2500 mV	5000 mV
Multiplier	0.142	0.071	355	355
Offset	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) using the measured wind speed and direction samples.

7.4.4 Example Programs

The following programs measure the Wind Monitor 05103 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 7-4.

TABLE 7-4. Wiring for Example Programs

Color	Wire Label	CR1000	CR10X
Red	WS Signal	P1	P1
Black	WS Reference	⏚	G
Green	WD Signal	SE 1	SE 1
Blue	WD Volt Excit	EX 1	E1
White	WD Reference	⏚	AG
Clear	Shield	⏚	G

7.4.4.1 CR1000 Example Program

```
'CR1000
'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(Table1,True,-1)
  DataInterval(0,60,Min,10)
  WindVector (1,WS_ms,WindDir,FP2,False,0,0,0)
  FieldNames("WS_ms_S_WVT,WindDir_D1_WVT,WindDir_SD1_WVT")
EndTable

'Main Program
BeginProg
  Scan(5,Sec,1,0)
    'Default Datalogger Battery Voltage measurement Batt_Volt:
    Battery(Batt_Volt)
    '05103 Wind Speed & Direction Sensor measurements WS_ms and WindDir:
    PulseCount(WS_ms,1,1,1,1,0.098,0)
    BrHalf(WindDir,1,mV2500,1,1,1,2500,True,0,_60Hz,355,0) 'mV5000
    'range, 5000 mV excitation for CR3000 and CR5000 dataloggers

    If WindDir>=360 Then WindDir=0
    If WindDir<0 Then WindDir=0
    'Call Data Tables and Store Data
    CallTable(Table1)
  NextScan
EndProg
```

7.4.4.2 CR10X Example Program

```
;{CR10X}
*Table 1 Program
  01: 5.0000       Execution Interval (seconds)

1: Pulse (P3)
  1: 1             Reps
  2: 1             Pulse Channel 1
  3: 21            Low Level AC, Output Hz
  4: 3             Loc [ WS_ms    ]
  5: 0.098         Multiplier
  6: 0             Offset

2: Excite-Delay (SE) (P4)
  1: 1             Reps
  2: 5             2500 mV Slow Range        ; 5000 mV(slow/60 hz) Range for CR23X, 21X, CR7
  3: 1             SE Channel
  4: 1             Excite all reps w/Exchan 1
  5: 2             Delay (0.01 sec units)
  6: 2500          mV Excitation             ; 5000 mV for CR23X, 21X, CR7
  7: 4             Loc [ WindDir  ]
  8: 0.142         Multiplier                ; 0.071 for CR23X, 21X, CR7
  9: 0             Offset

3: If (X<=>F) (P89)
  1: 4             X Loc [ WindDir  ]
  2: 3             >=
  3: 360           F
  4: 30            Then Do

4: Z=F x 10^n (P30)
  1: 0             F
  2: 0             n, Exponent of 10
  3: 4             Z Loc [ WindDir  ]
```

```
5:  End (P95)

6:  If time is (P92)
  1:   0            Minutes (Seconds --) into a
  2:   60           Interval (same units as above)
  3:   10           Set Output Flag High (Flag 0)

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

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

9:  Wind Vector (P69)
  1:   1            Reps
  2:   0            Samples per Sub-Interval
  3:   0            S, theta(1), sigma(theta(1)) with polar sensor
  4:   3            Wind Speed/East Loc [ WS_ms     ]
  5:   4            Wind Direction/North Loc [ WindDir   ]
```

7.4.5 Long Lead Lengths

When sensor lead length exceeds 100 feet, the settling time allowed for the measurement of the vane should be increased to 20 milliseconds. Theoretical calculations indicate that 20 milliseconds is conservative.

For the CR200(X) datalogger, enter 20 ms for the *Delay* parameter of the **ExDelaySE()** instruction. For other CRBasic dataloggers, increase the *Settling Time* parameter of the **BRHalf()** instruction to 20 milliseconds (20,000 microseconds). For Edlog dataloggers, use **Instruction 4—Excite, Delay (P4)** and enter a 2 in the *Delay* parameter. Edlog dataloggers cannot use a delay when the 60 Hz rejection option is used.

CAUTION Do not use long lead lengths in electrically noisy environments.

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 with R.M. Young's Propeller Torque Disc (pn 18310) as described in the R.M. Young manual (see *www.youngusa.com/products/7/*).

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. The condition of the vertical shaft (vane) bearings can be checked with R.M. Young's Vane Torque Gauge (pn 18331).

NOTE Often 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's manuals (*www.youngusa.com/products/7/*).

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 ohmmeter to check the potentiometer. Resistance should be about 10 kΩ between the blue and white wires. The resistance between either the blue/green or white/green wires should vary between about 1 kΩ to 11 kΩ depending on vane position. Resistance when the vane is in the 5 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, *Installation*.

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 ohmmeter to check the coil. The resistance between the red and black wires should be about 2075 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 datalogger type.

Symptom: Wind speed does not change

1. For the dataloggers programmed with Edlog, the input location for wind speed is not updated if the datalogger is getting "Program Table Overruns". Increase the execution interval (scan rate) to prevent overruns.

10. References

Gill, G.C., 1973: The Helicoid Anemometer Atmosphere, II, 145–155.

Baynton, H.W., 1976: Errors in Wind Run Estimates from Rotational Anemometers Bul. Am. Met. Soc., vol. 57, No. 9, 1127–1130.

The following references give detailed information on siting wind speed and wind direction sensors.

EPA, 1989: *Quality Assurance Handbook for Air Pollution Measurements System*, Office of Research and Development, Research Triangle Park, NC, 27711.

EPA, 1987: *On-Site Meteorological Program Guidance for Regulatory Modeling Applications,* EPA-450/4-87-013, Office of Air Quality Planning and Standards, Research Triangle Park, NC 27711.

The State Climatologist, 1985: *Publication of the American Association of State Climatologists: Height and Exposure Standards*, for Sensors on Automated Weather Stations, vol. 9, No. 4.

WMO, 1983: *Guide to Meteorological Instruments and Methods of Observation,* World Meteorological Organization, No. 8, 5th edition, Geneva, Switzerland.

Appendix A. Wind Direction Sensor Orientation

A.1 Determining True North and Sensor Orientation

Orientation of the wind direction sensor is done after the datalogger has been programmed, and the location of True North has been determined. True North is usually found by reading a magnetic compass and applying the correction for magnetic declination; where magnetic declination is the number of degrees between True North and Magnetic North. The preferred method to obtain the magnetic declination for a specific site is to use a computer service offered by NOAA at *www.ngdc.noaa.gov/geomag*. 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 A-1.

Declination angles east of True North are considered negative, and are subtracted from 360 degrees to get True North as shown FIGURE A-2 (0° and 360° are the same point on a compass). For example, the declination for Logan, Utah is 13.5° East. True North is 360° – 13.5°, or 346.5° as read on a compass. Declination angles west of True North are considered positive, and are added to 0 degrees to get True North as shown in FIGURE A-3.

Orientation is most easily done with two people, one to aim and adjust the sensor, while the other observes the wind direction displayed by the datalogger.

1. Establish a reference point on the horizon for True North.
2. Sighting down the instrument center line, aim the nose cone, or counterweight at True North. Display the input location or variable for wind direction using a a laptop or keyboard display.
3. Loosen the U-bolt on the CM220 or the set screws on the Nurail® that secure the base of the sensor to the crossarm. While holding the vane position, slowly rotate the sensor base until the datalogger indicates 0 degrees. Tighten the set screws.

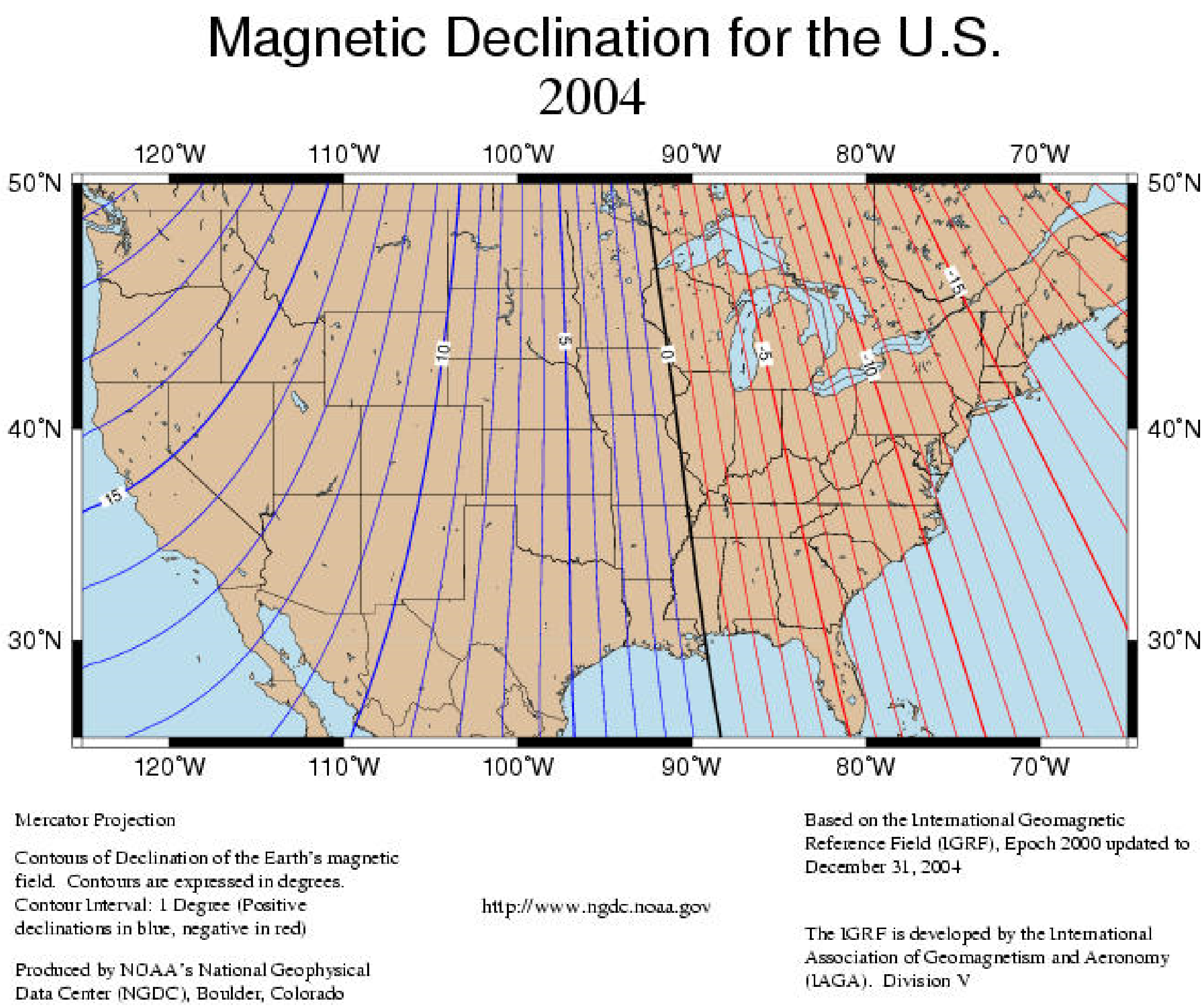


FIGURE A-1. Magnetic declination for the contiguous United States (2004)

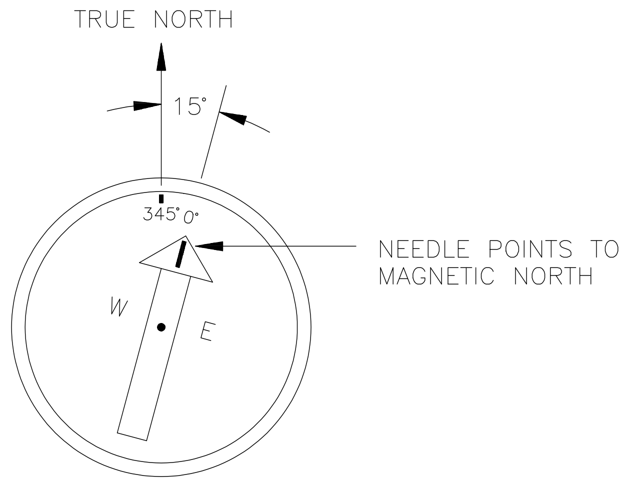


FIGURE A-2. Declination angles east of True North are subtracted from 0 to get True North

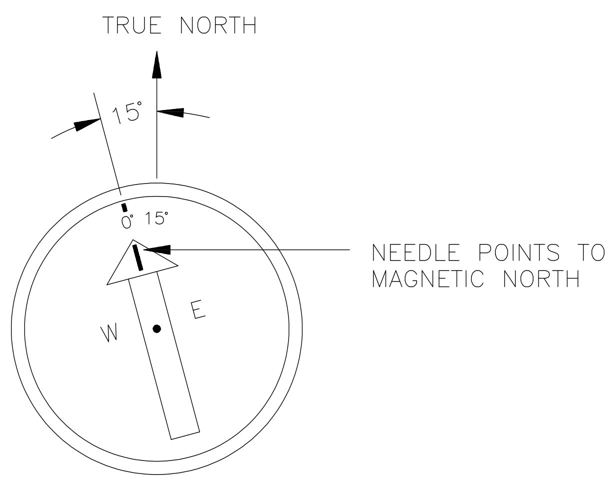


FIGURE A-3. Declination angles west of True North are added to 0 to get True North

Appendix B. Wind Direction Measurement Theory

It is not necessary to understand the concepts in this section for the general operation of the 05103 with Campbell Scientific's datalogger.

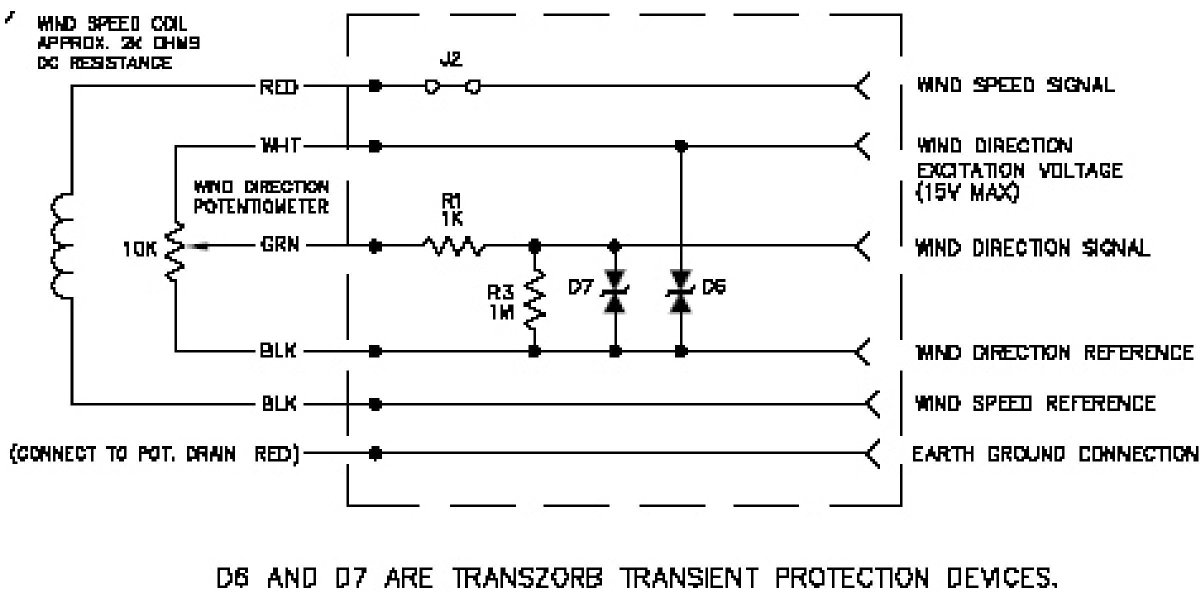


FIGURE B-1. 05103 potentiometer in a half bridge circuit

B.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:

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

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. Since the datalogger outputs the ratio V_s / V_x, the multiplier is the same for both the CR10(X) and CR3000, even though they use a different excitation voltage. See Section 13.5 in the datalogger manual from more information on the bridge measurements.

B.2 EX-DEL-SE (P4) Instruction

Instruction 4 outputs a precise excitation voltage (V_x) and measures the voltage between the wiper and analog ground, V_s. The resistance between the wiper and analog ground, R_s, and V_s varies with wind direction. Instruction 4 outputs the measured voltage, V_s. This measured voltage is related to resistance as shown below:

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

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 reaches its maximum value of V_x. This maximum voltage equals 2500 mV for an excitation voltage of 2500 mV recommended for the CR10(X) and 5000 mV for an excitation voltage of 5000 mV recommended for the CR23X at 355 degrees. The multiplier to convert V_s to degrees is 355 degrees / 2500 mV = 0.142 for the CR10X, or, 355 degrees / 5000 mV = 0.071 for the CR23X. See Section 13.5 in the datalogger manual from more information on the bridge measurements

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