INSTRUCTION MANUAL

R.M. Young Wind Monitors
05103, 05103-10
05106, 05106-10
05108, 05108-10
05305, 05305-10

November 2015

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.

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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.

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Tables

R.M. Young Wind Monitors

1. Introduction

Table 1-1. R.M. Young Wind Monitors Variations	
Model	**Description**
05103	Standard Wind Monitor, RMY Configuration
05103-10	Standard Wind Monitor, CSC Configuration
05106	Marine Wind Monitor, RMY Configuration
05106-10	Marine Wind Monitor, CSC Configuration
05108	Heavy Duty Wind Monitor, RMY Configuration
05108-10	Heavy Duty Wind Monitor, CSC Configuration
05305	Air Quality Wind Monitor, RMY Configuration
05305-10	Air Quality Wind Monitor, CSC Configuration

The R.M. Young Wind Monitor sensors are used to measure horizontal wind speed and direction. There are several variations of the wind monitor; see Table 1-1. Some models are configured for use with R.M. Young displays such as the Wind Tracker or Translator. Others are configured for use with Campbell Scientific dataloggers.

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 10K ohm potentiometer. With a precision excitation voltage applied, the output voltage is proportional to wind direction.

Lead length for the Wind Monitor is specified when the sensor is ordered. Table 1-2 gives the recommended lead length for mounting the sensor at the top of the tripod/tower with a crossarm

Table 1-2. Recommended Lead Lengths

CM6	CM10	CM110	CM115	CM120	UT10	UT20	UT30
10’	13’	13’	19’	24’	13’	24’	34’

The R.M. Young Instruction Manual for each model are available upon request. Each manual includes operating principles, installation and alignment guide, and calibration information.

Before installing the Wind Monitor, please study

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

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 is 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

4. Specifications

Wind Speed

	05103 Wind Monitor	05108 Wind Monitor	05106 Wind Monitor	05305 Wind Monitor
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)		1.1 m s^{-1} (2.4 mph)	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	05108 Wind Monitor	05106 Wind Monitor	05305 Wind Monitor
Range	0° to 360° mechanical, 355° electrical (5° open)			
Accuracy	±3°			
Starting Threshold	1.1 m s^{-1} (2.4 mph)	1.0 m s^{-1} (2.2 mph)	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 (15 Vdc max)

Physical

	05103 Wind Monitor	05108 Wind Monitor	05106 Wind Monitor	05305 Wind Monitor
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)			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)

Note The wind monitor is manufactured by R.M. Young (Traverse City, Michigan) and cabled by CSC. 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.

5. Installation

5.1 Siting

Locate wind sensors away from obstructions (for example, trees and buildings). Generally, there should be a horizontal distance of at least ten times the height of 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 Section 8, *References*, for a list of references that discuss siting wind speed and direction sensors.

5.2 Assembly and Mounting

Tools required:

- 5/64 inch Allen wrench
- ½ 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

The Wind Monitor mounts to a standard 1" IPS schedule 40 pipe (1.34" O.D). An orientation ring is provided so that the instrument can be removed for maintenance, and reinstalled without loss of the wind direction reference.

A Campbell Scientific crossarm can be purchased to mount the Wind Monitor at a distance from the tower or tripod, so as to minimize the shadowing effect of the structure.

Install the Wind Monitor and orientation ring as follows:

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

Place the orientation ring followed by the Wind Monitor on the vertical mounting pipe; do not tighten the band clamps yet. Orient the junction box so that it faces south.

Using a compass, orient the sensor to True North or Magnetic North, depending on your requirements. For a discussion on determining True North and correcting magnetic declination see Appendix A.

Alignment of the sensor is most easily done with two people after the datalogger has been programmed to measure wind direction. Sighting down the centerline of the instrument, point the nose cone to a reference point for North or True North. With holding this position, rotate the base of the sensor until the datalogger reads 0. Make sure that the indexing pin on the orientation ring is engaged with the notch in the sensor, and tighten both band clamps.

When removing the sensor for maintenance, leave the orientation ring in place to ensure proper orientation upon re-installation of the sensor.

Figure 5-1. Wind Monitor Mounted to a CSC Crossarm

5.3 Wiring

Connections to Campbell Scientific dataloggers are given in Tables 5-1 and 5-2. 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. Colours may vary when using some versions of Short Cut.

Table 5-1. 05103-10 and 05305-10 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	⏚	⏚

Table 5-2. 05106-10 and 05108-10 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	WD Reference	⏚	G	⏚	⏚
Green	WD Signal	SE Analog	SE Analog	SE Analog	SE Analog
Blue	WS Reference	⏚	AG	⏚	⏚
White	WD Volt Excit	Excitation	Excitation	Excitation	Excitation
Clear	Shield	⏚	G	⏚	⏚

Table 5-3. Connections to R.M. Young Displays (05103, 05305, 05106, 05108)

Board Connections	Connection Description	Sensors		
		05103	05305	05106 & 05108
WS SIG / F	Wind Speed Signal	Red	Red	Red
WS REF / E	Wind Speed Reference	No Connection	No Connection	Blue
WD SIG / B	Wind Direction Signal	Green	Green	Green
WD EXC / C	Wind Direction Excitation	White	White	White
WD REF / A	Wind Direction / Signal Reference	Black	Black	Black
EARTH GND / D	Shield	Clear	Clear	Clear

5.4 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 Short Cut Program Builder software. You do not need to read this section to use Short Cut.

5.4.1 Wind Speed

For CRBasic dataloggers, wind speed is measured using the **PulseCount()** instruction. Syntax of 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 5-4 lists the multipliers to obtain different units when the pulse count instruction is configured to output Hz (configuration code 21). The helicoid propeller has a calibration that passes through zero, so the offset is zero (Gill, 1973; Baynton, 1976).

Table 5-4. Wind Speed Multipliers (With Configuration Code 21*)

Model	m/s	kmph	mph	knots
05103-10	0.0980	0.3528	0.2192	0.1904
05106-10	0.0980	0.3528	0.2192	0.1904
05108-10	0.1666	0.5998	0.3726	0.3238
05305-10	0.1024	0.3686	0.2290	0.1989

* If Configuration Code 11 is used, the multiplier above is divided by the execution interval in seconds.

5.4.2 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 5-5. Appendix B has additional information on the P4 and **BRHalf()** measurement instructions.

Table 5-5. Parameters for Wind Direction

	CR10(X), CR510, CR200	**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 deg/mV	0.071 deg/mV	355 deg excitation (mV/mV)	355 deg excitation (mV/mV)
Offset	0	0	0	0

5.4.3 Wind Vector Processing Instruction (Output)

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.

5.4.4 Example Programs

The following programs measure the Wind Monitor 05103-10 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 5-6.

Table 5-6. 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

5.4.4.1 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)
		'05103-10 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)
		'5000 mV excitation and mV 5000 range for CR3000 and CR5000 dataloggers,
		2500mV excitation and mV 2500 range for CR800 and CR1000 dataloggers

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

5.4.4.2 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   ]
```

5.4.4.3 Wind Gust Program Example

Along with the standard data suite, this program example includes data outputs for wind gust. The output interval for all data in the example is 10 minutes. For each 10 minute interval, average wind spped, direction and standard deviation are output. Minimum, maximum and wind gust speed values are also output with their related wind direction values.

In order for a wind gust to be generated for the interval, the wind speed must be greater than 7.78 m/s and exceed a running 2 minute average by at least 2.5 m/s. If these requirements are not met, the zero value is output for both the wind gust speed and the related wind direction.

```
'CR1000 Series Datalogger

'Wind gust programming example using the RM Young 05013-10 wind monitor
'Date: August 2014
'Program author: Campbell Scientific Canada

'Declare Public Variables for 05103-10-L Wind Speed / Direction sensor
Public WindSpd
Public WindDir
Public WS2minrunavg
Public WS_10_max
Public WS_Gust
Public WS_Gust_dir
Public maxavgdif

'Declare Variable Units
Units WindSpd = m/s
Units WindDir = degrees
Units WS_Gust = m/s
Units WS_Gust_dir = degrees


'Define Output Data Tables
DataTable (TenMinute,1,1000)
  DataInterval (0,10,Min,10)
  WindVector (1,WindSpd,WindDir,FP2,False,0,0,0)
  FieldNames ("WindSpd_AVG:Deg,WindDir_AVG:Deg,WindDir_STDEV:Deg")
  Minimum (1,WindSpd,FP2,False,False)
  Maximum (1,WindSpd,FP2,False,False)
  SampleMaxMin (1,WindDir,FP2,False)
  Maximum (1,WS_Gust,FP2,False,False)
  SampleMaxMin (1,WS_Gust_dir,FP2,False)
EndTable
```

```
'Main Program
BeginProg
  Scan (5,Sec,0,0)

    '----------- Measure 05103-10 Wind Speed & Direction Sensor ----------
    PulseCount (WindSpd,1,1,1,1,0.098,0)
    BrHalf (WindDir,1,mV2500,10,Vx2,1,2500,True,0,_60Hz,355,0)
    If WindDir>=360 Then WindDir=0


    'Program code for outputting wind gust data as per EC MSC guidelines
    AvgRun (WS2minrunavg,1,WindSpd,24)

    'Resest 10 Minute Max every 10 minutes.
    If  TimeIntoInterval(0,10,Min) Then
      WS_10_max = 0
      WS_Gust = 0
      WS_Gust_dir = 0
    EndIf

    'Record Gust only if wind speed is greater than 7.78 m/s (15 knots).
    'Record the 10 Minute Max as the current gust if it exceeds the
    '2 minute average by 2.5 m/s (5 knots), otherwise record it as zero.
    If WindSpd >= 7.78 Then
      If WindSpd >= WS_10_max Then
        WS_10_max = WindSpd
        maxavgdif = WS_10_max - WS2minrunavg
        If maxavgdif >= 2.5 Then
          WS_Gust = WS_10_max
          WS_Gust_dir = WindDir
        Else
          WS_Gust = 0
          WS_Gust_dir = 0

        EndIf
      EndIf
    EndIf

    'Call Output Data Table
    CallTable TenMinute
  NextScan
EndProg
```

5.4.5 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 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.

Note Do not use long lead lengths in electronically noisy environments.

6. Maintenance

R.M. Young suggests that the anemometer bearings and the potentiometer be inspected at least every 24 months. Only a qualified technician should perform the replacement.

Obtain an RMA number before returning the sensor to Campbell Scientific (Canada) for service.

7. Troubleshooting

7.1 Wind Direction

Symptom: -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 ohn meter to check the potentiometer. Resistance should be about 10K ohms between the Blue and White wires. The resistance between either the Blue/Green or White/Green wires should vary between 1K to 11K depending on the vane position. Resistance when the vane is in the 5 degree dead band should be about 1 M ohm.

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 3.

7.2 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 red and black wires should be about 2075 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.

Symptom: Wind speed does not change

1. For the dataloggers that are 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.

8. 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.

WMO, 1983: *Guide to Meteorological Instruments and Methods of Observation,* World Meterological 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. Magnetic declination for a specific site can be obtained from a map, local airport, or through the Natural Resources Canada website at:

http://geomag.nrcan.gc.ca/calc/mdcal-eng.php

A general map showing magnetic declination for Canada is shown in Figure A-1.

Declination angles east of True North are considered negative, and are subtracted from 0 degrees to get True North as shown in Figure A-2. 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 for wind direction using the *6 mode of the datalogger, or the Monitor Mode of LoggerNet with an online PC.

3. Loosen the band clamps or set screws that secure the base of the sensor to the mast or crossarm. While holding the vane position, slowly rotate the sensor base until the datalogger indicates 0 degrees. Tighten the band clamps or set screws loosened previously.

4. Engage the orientation ring indexing pin in the notch at the instrument base (05103, 05106, and 05305 sensors only), and tighten the band clamp on the orientation ring.

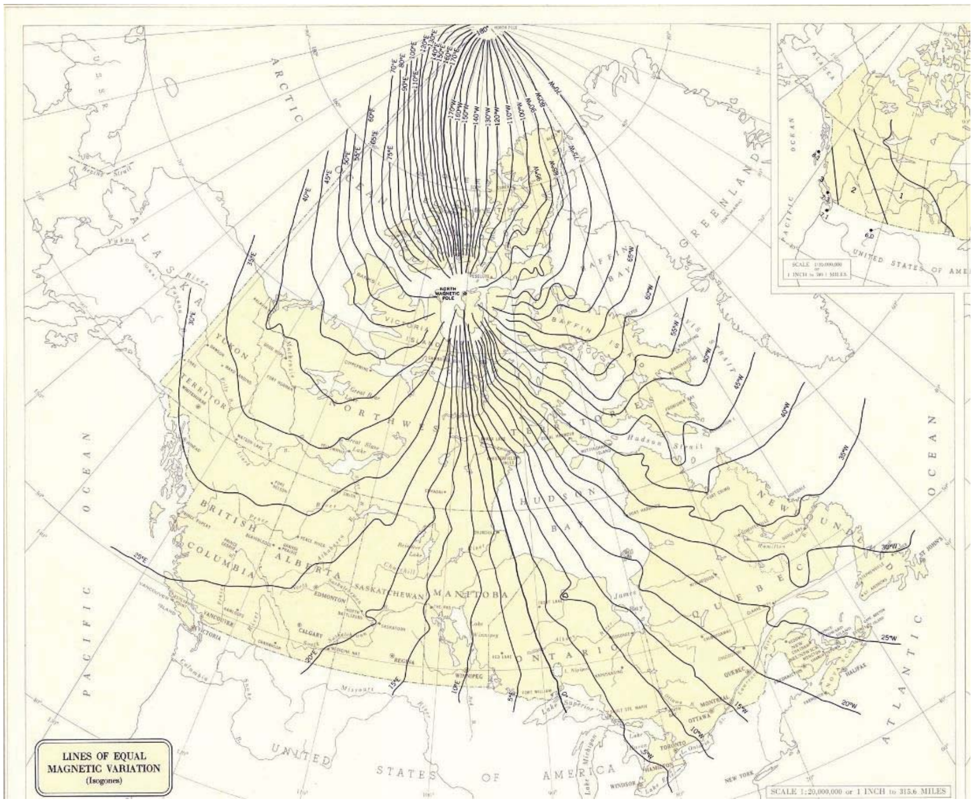


Figure A-1. Magnetic Declination for Canada

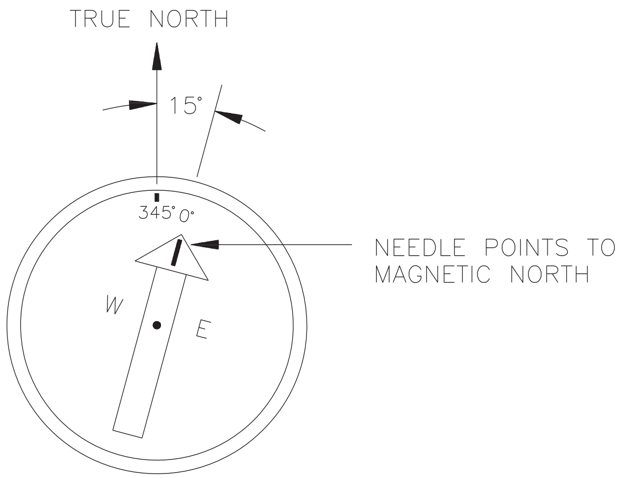


Figure A-2. Declination Angles East of True North Are Subtracted from 0 to get True North

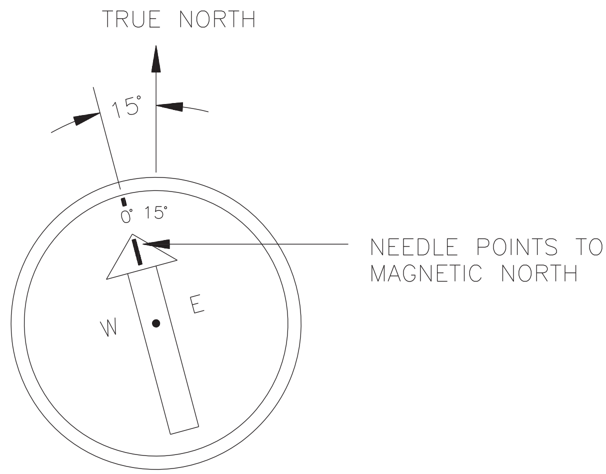
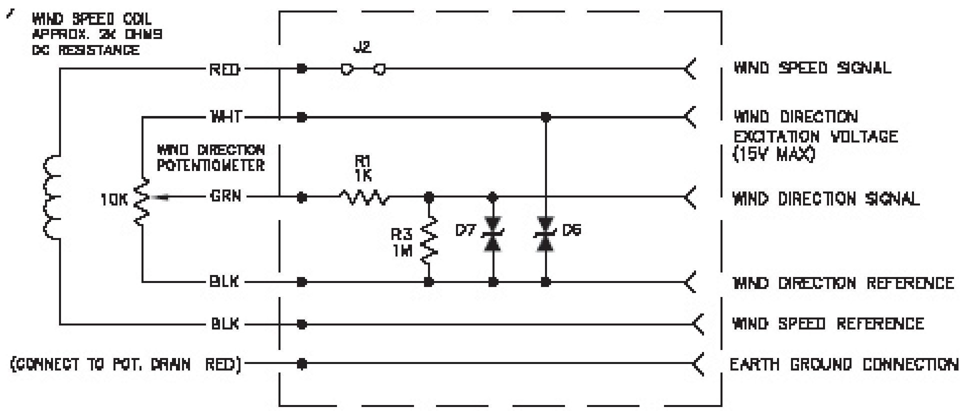


Figure A-3. Declination Angles West of True North are Added to 0 to get True North

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.



D6 AND D7 ARE TRANSZORB TRANSIENT PROTECTION DEVICES.

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 for more information on the bridge measurements.

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

Instuction 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 coltage, V_s. This measured voltage is related to resistance as shown below:

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

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 reaches its maximum value of V_x. The 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 for more information on the bridge measurements.