INSTRUCTION MANUAL

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

Revision: 11/05

Warranty and Assistance

The **05103, 05106, and 05305 R.M. YOUNG WIND MONITORS** are warranted by CAMPBELL SCIENTIFIC, INC. 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 have no warranty. CAMPBELL SCIENTIFIC, INC.'s obligation under this warranty is limited to repairing or replacing (at CAMPBELL SCIENTIFIC, INC.'s option) defective products. The customer shall assume all costs of removing, reinstalling, and shipping defective products to CAMPBELL SCIENTIFIC, INC. CAMPBELL SCIENTIFIC, INC. will return such products by surface carrier prepaid. This warranty shall not apply to any CAMPBELL SCIENTIFIC, INC. 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. CAMPBELL SCIENTIFIC, INC. is not liable for special, indirect, incidental, or consequential damages.

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RMA#_____
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Logan, Utah 84321-1784

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

1. General Description

The 05103, 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 05106 is recommended for marine applications.

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 1-1 gives the recommended lead length for mounting the sensor at the top of the tripod/tower with a 019ALU or CM202 crossarm (CM220 or PN 17953 required with CM202).

TABLE 1-1. 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 is also shipped with the sensor, which includes operating principles, installation and alignment guide, and calibration information.

2. Specifications

	05103 and 05106	05305
Wind Speed		
Range:	0-134 mph (0-60 m s^{-1})	0-90 mph (0-40 m s^{-1})
Accuracy:	±0.6 mph (±0.3 m s^{-1})	±0.4 mph (±0.2 m s^{-1})
Starting threshold:	2.2 mph (1.0 m s^{-1}) 05103; 2.4 mph (1.1 m s^{-1}) 05106	0.9 mph (0.4 m s^{-1})
Gust survival:	220 mph (100 m s^{-1})	100 mph (45 m s^{-1})
Distance constant (63% recovery):	8.9 ft (2.7 m)	6.9 ft (2.1 m)
Output:	ac voltage (3 pulses per revolution). 1800 rpm (90 Hz) = 19.7 mph (8.8 m s^{-1})	ac voltage (3 pulses per revolution) 1800 rpm (90 Hz) = 20.6 mph (9.2 m s^{-1})

	05103 and 05106	**05305**
Wind Direction		
Range:	0-360° mechanical, 355° electrical (5° open)	Same
Accuracy:	±3°	±3°
Starting threshold at 10° displacement:	2.2 mph (1.1 m s^{-1})	1.0 mph (0.5 m s^{-1})
Delay distance (50% recovery):	4.3 ft (1.3 m)	3.9 ft (1.2 m)
Damping ratio:	0.25	0.45
Damped natural wavelength:	24.3 ft (7.4 m)	16.1 ft (4.9 m)
Undamped natural wavelength:	23.6 ft (7.2 m)	14.4 ft (4.4 m)
Output:	Analog dc voltage from potentiometer – resistance 10 kΩ, linearity 0.25%, life expectancy 50 million revolutions.	Same
Power	Switched excitation voltage supplied by the datalogger.	Same
Physical		
Operating Temperature	-50° to +50°C, assuming non-riming conditions	-50° to +50°C, assuming non-riming conditions
Dimensions		
Overall:	14.6” H x 21.7” L (37 cm x 55 cm)	15.0” H x 25.6“ L (38 cm x 65 cm)
Main housing Diameter:	2.0“ (5 cm)	Same
Propeller Diameter:	7.1” (18 cm)	7.9” (20 cm)
Mounting Pipe:	1.34” (34 mm) OD; standard 1.0” IPS schedule 40	Same
Weight (shipping approx.)	3.2 lbs (5.5 lbs); 1.5 kg (2.3 kg)	2.5 lbs (5.5 lbs); 1.1 kg (2.3 kg)

Manufactured by RM Young (Traverse City, MI) and cabled by Campbell Scientific for use with our dataloggers.

NOTE 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. Installation

The Wind Monitor mounts to a standard 1" IPS schedule 40 pipe (1.32" 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 12" length of unthreaded pipe is shipped with the Wind Monitor for mounting the sensor to the 019ALU crossarm (Figure 3-1), or to a CM200 series crossarm using the PN 17953 Nu-Rail Connector (Figure 3-2) or CM220 Right Angle Mounting Kit (Figure 3-3).

Install the Wind Monitor and orientation ring as follows:

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

Sensor Alignment to True North:

Alignment of the sensor to True North is most easily done with two people after the datalogger has been programmed to measure wind direction. Sighting down the centerline of instrument, point the nose cone to a reference point for True North. While 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.

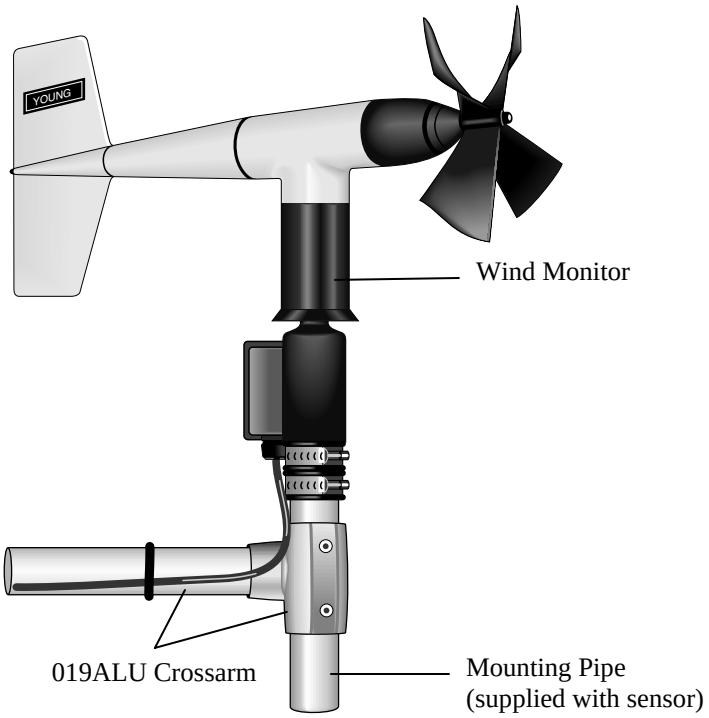

FIGURE 3-1. Wind Monitor Mounted to the 019ALU Crossarm

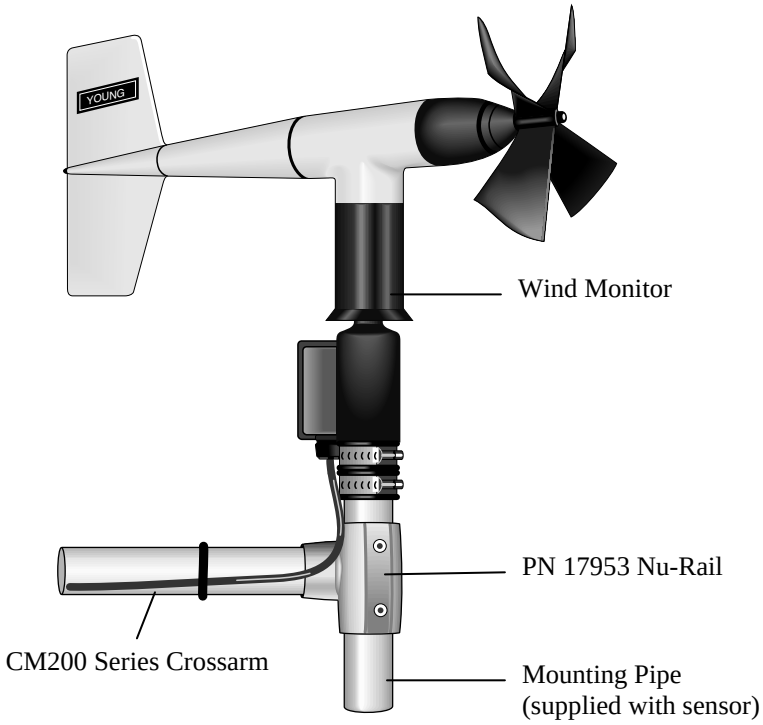

FIGURE 3-2. Wind Monitor Mounted to a CM200 Series Crossarm with PN 17953 Nu-Rail

FIGURE 3-3. Wind Monitor Mounted to a CM200 Series Crossarm with CM220 Right Angle Mounting Kit

4. Wiring

Connections to Campbell Scientific dataloggers are given in Table 4-1. 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 4-1. Connections to Campbell Scientific Dataloggers

Color	Description	CR9000(X) CR5000 CR3000 CR1000	CR510 CR500 CR10(X)	21X, CR7 CR23X	CR200
Red	Wind Spd. Signal	Pulse	Pulse	Pulse	P_LL
Black	Wind Spd. Reference	⏚	G	⏚	⏚
Green	Wind Dir. Signal	SE Analog	SE Analog	SE Analog	SE Analog
Blue	Wind Dir. Excitation	Excitation	Excitation	Excitation	Excitation
White	Wind Dir. Reference	⏚	AG	⏚	⏚
Clear	Shield wire	⏚	G	⏚	⏚

5. Example Programs

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.

5.1 Wind Speed

Wind speed is measured with the pulse count instruction. With the pulse count instruction, specify the low level AC configuration code. For dataloggers programmed with Edlog, specify configuration code 21 to output frequency in Hertz.

The expression for wind speed (U) is:

$$U = MX + B$$

where

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

Table 5-1 lists the multipliers to obtain miles/hour or meters/second 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 5-1. Wind Speed Multiplier (With Configuration Code 21*)

Model	Miles/Hour Output	Meters/Second Output
05103 or 05106	0.2192	0.0980
05305	0.2290	0.1024

*When configuration code 11 is used, the multiplier above is divided by the execution interval in seconds.

5.2 Wind Direction

The wind vane is coupled to a 10K potentiometer. The potentiometer has a 5 degree dead band between 355 and 360 degrees, therefore the maximum signal is 355 degrees. The potentiometer is measured with a half bridge measurement instruction, which applies an excitation voltage and makes a Single-Ended voltage measurement. The multiplier converts the measurement result to degrees.

The EX-DEL_SE measurement instruction is used for dataloggers that are programmed with Edlog (e.g. CR10X, CR23X) and the CR200. The measurement result is mV; the multiplier to convert mV to degrees is 355deg/excitation mV.

The BRHalf measurement instruction is used for dataloggers that are programmed with CRBasic (e.g. CR100, CR3000). The measurement result is the measured mV/excitation mV; the multiplier to convert mV/excitation mV to degrees is 355.

The excitation voltage, range codes, and multipliers for the different datalogger types are listed in Table 5-2.

TABLE 5-2. Parameters for Wind Direction

	CR10(X), CR510, CR200	**CR7, 21X, CR23X**	**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

5.3 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.

5.4 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 5-3.

TABLE 5-3. Wiring for Example Programs

Color	**Description**	**CR1000**	**CR10X**
Red	Wind Spd. Signal	P1	P1
Black	Wind Spd. Reference	⏚	G
Green	Wind Dir. Signal	SE 1	SE 1
Blue	Wind Dir. Excitation	EX 1	E1
White	Wind Dir. Reference	⏚	AG
Clear	Shield wire	⏚	G

5.4.1 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   ]
```

5.4.2 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
        'Call Data Tables and Store Data
        CallTable(Table1)
    NextScan
EndProg
```

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 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 ohm 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 about 1K to 11K depending on vane position. Resistance when the vane is in the 5 degree dead band should be about 1M 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.

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