INSTRUCTION MANUAL

P2546A-L Anemometer

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Products may not be returned without prior authorization. The following contact information is for US and international customers residing in countries served by Campbell Scientific, Inc. directly. Affiliate companies handle repairs for customers within their territories. Please visit *www.campbellsci.com* to determine which Campbell Scientific company serves your country.

To obtain a Returned Materials Authorization (RMA), contact CAMPBELL SCIENTIFIC, INC., phone (435) 227-9000. After an applications engineer determines the nature of the problem, an RMA number will be issued. Please write this number clearly on the outside of the shipping container. Campbell Scientific's shipping address is:

CAMPBELL SCIENTIFIC, INC.
RMA#_____
815 West 1800 North
Logan, Utah 84321-1784

For all returns, the customer must fill out a "Statement of Product Cleanliness and Decontamination" form and comply with the requirements specified in it. The form is available from our web site at *www.campbellsci.com/repair*. A completed form must be either emailed to *repair@campbellsci.com* or faxed to (435) 227-9106. Campbell Scientific is unable to process any returns until we receive this form. If the form is not received within three days of product receipt or is incomplete, the product will be returned to the 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.

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P2546A-L Anemometer

1. Introduction

The P2546A is a Class 1 anemometer used in wind energy applications. It primarily provides wind speed resource assessment, and wind turbine power performance monitoring. Wind speed is sensed by a three-cup rotor assembly. Magnets mounted on the shaft cause a switch to close and open two times per revolution. Our dataloggers measure the switch closure and convert the signal to engineering units (mph, m/s, knots).

Before using the P2546A-L Anemometer, please study

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

More details are available in the remaining sections.

2. Cautionary Statements

- The P2546A is a precision instrument. Please handle it with care.
- If the P2546A 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 P2546A or before raising a tower.

3. Initial Inspection

- Upon receipt of the P2546A, 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.
- Each P2546A anemometer is shipped with a MEASNET calibration certificate that contains information concerning where the anemometer was calibrated, the calibration procedure used, the calibration equation obtained, and the serial number of the anemometer. Cross check the serial number in the calibration certificate against the serial number on the anemometer to ensure that the given sensitivity value corresponds to your sensor.

4. Quickstart

4.1 Step 1 — Mount the Sensor

To mount the sensor, do the following.

1. Mount a CM202, CM204, or CM206 crossarm to a tripod or tower.
2. Orient the crossarm north-south, with the CM220 Mount on the north end.
3. Place the 27739 30 inch pole in the bottom of the P2546A.
4. Place the bottom of the 27739 pole in the CM220's u-bolt and tighten the nuts (see FIGURE 4-1).
5. Use a bubble level to ensure that the anemometer is level.
6. Route the sensor cable along the underside of the crossarm to the tripod or tower, and to the instrument enclosure.
7. Secure the cable to the 27739 pole, crossarm, and tripod or tower using cable ties.

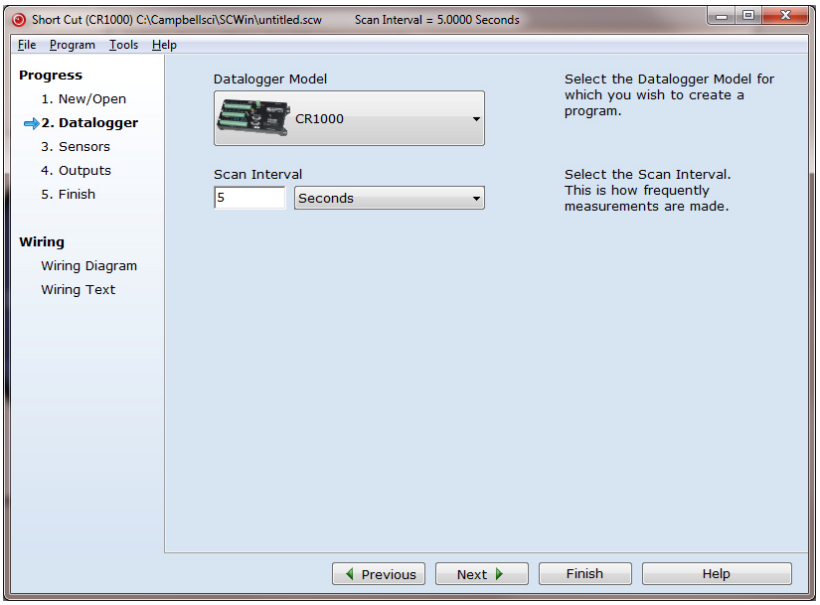
FIGURE 4-1. 27739 pole mounted to a crossarm via the CM220

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

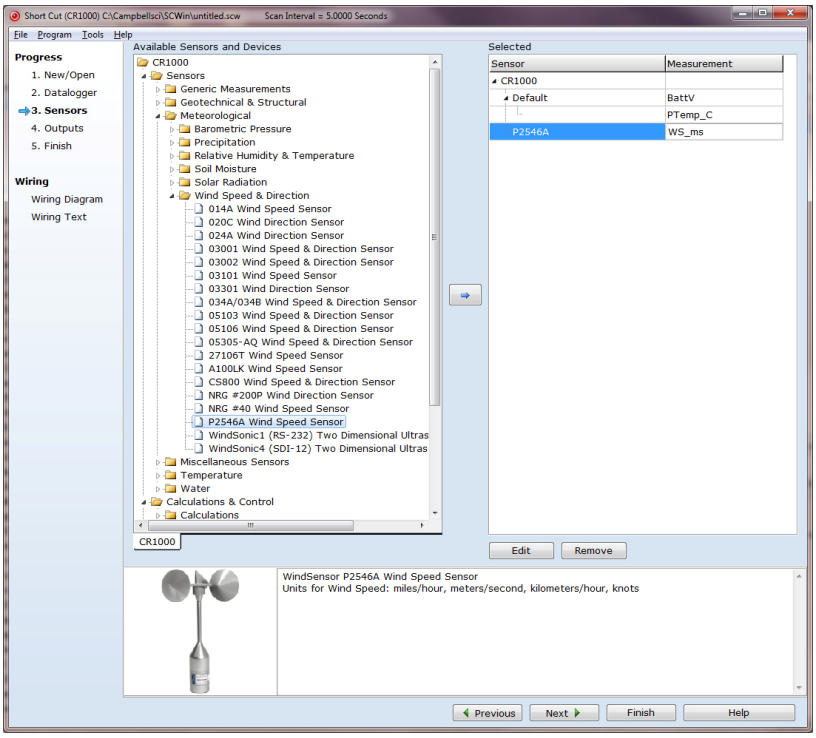
The simplest method for programming the datalogger to measure an P2546A is to use Campbell Scientific's SCWin Short Cut Program Generator.

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

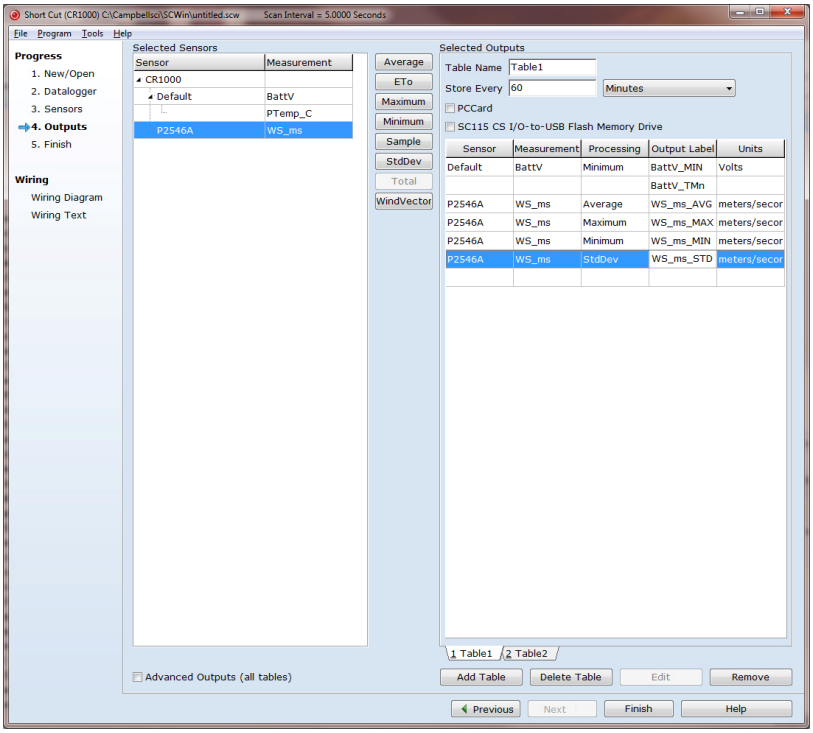
2. Select datalogger and enter scan interval.



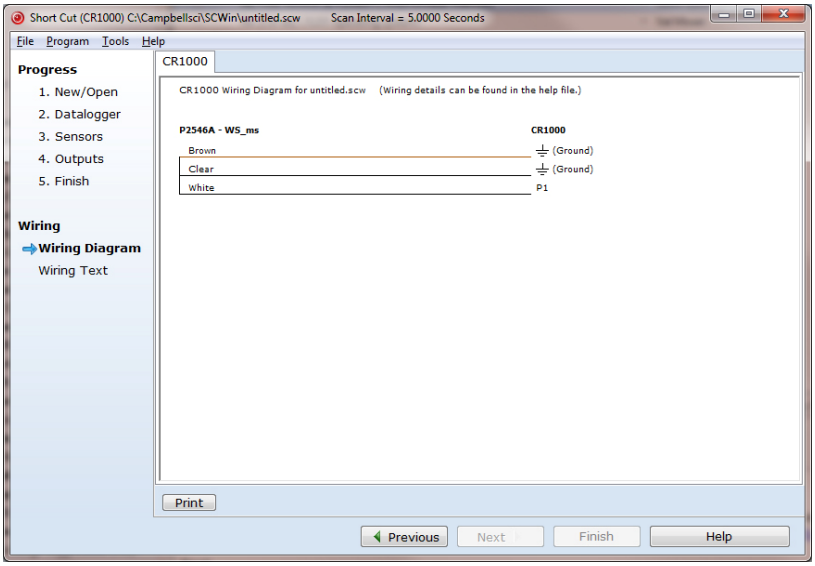
3. Select P2546A and select the right arrow to add it to the list of sensors to be measured then select next.



4. Select the outputs then select finish.



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



5. Overview

The P2546A-L cup anemometer is a sturdy device that senses wind speed with a three-cup rotor assembly (see FIGURE 5-1). Permanent magnets mounted on the shaft cause a switch to close and open two times per revolution. The switch has no bounce, and is equipped with a special mechanism that reduces the variation in operating time over the frequency range. This feature facilitates obtaining instantaneous wind speed by measuring the time interval of each revolution.

FIGURE 5-1. P2546A Anemometer

The P2546A anemometer is manufactured by Windsensor and cabled by Campbell Scientific. Lead length for the P2546A is specified when the sensor is ordered.

The P2546A'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.

6. Specifications

Features:

- Calibration — The P2546A-L is shipped with a MEASNET certificate containing information about where the anemometer was calibrated, the calibration procedure used, the calibration equation obtained, and the serial number of the anemometer.

- Quality — Constructed only of durable materials such as anodized aluminum and stainless steel.

Compatibility

Dataloggers: CR800 / 850, CR1000, CR3000, CR5000, CR10(X), CR510, CR23X, 21X, CR7

NOTE The specifications are based on 80 wind tunnel calibrations performed according to the Measnet Cup Anemometer Calibration Procedure. The specified offset and gain figures represent the mean values of these calibrations. Variation among units designates the maximum deviation of any unit from the straight line representing these mean values. All units are run-in for 225 hours at 9 m/s, in order to reduce the initial bearing friction to a level close to the steady state value. After run-in, bearing friction is tested at –15 °C and at room temperature. The allowed limits for this test assures that the temperature influence on the calibration is within the specified limit.

Starting Threshold: < 0.4 m/s

Starting Speed: 0.27 m/s

Gain: 0.6201 m

Distance Constant: $\lambda_0 = 1.81 \pm 0.04$ m

Standard Deviation of Offset: 0.014 m/s

Standard Deviation of Gain: 0.027 m

Variation Among Units: ±1%

Nonlinearity: < 0.04 m/s

Temperature Influence (-15° to 60°C): < 0.05 m/s

6.1 Calibration

Standard: $U=A_0+B_0\times f$,

Where:

U=Wind speed in m/s

f = Output frequency in Hz

A_0 = 0.27 m/s

B_0 = 0.620 m

6.2 Switching Characteristics

Signal Type: potential free contact closure

Duty Cycle: 40% to 60%

Maximum Switching Voltage: 30 V

Maximum Recommended Switching Current: 10 mA

Series Resistance: 330 Ω, 1 W

Operating Temperature: –35° to 60°C

7. Installation

Locate wind sensors away from obstructions (e.g., trees and building). As a general rule, there should be a horizontal distance of at least ten times the height of the obstruction between the wind set and the obstruction. If mounting the sensors on the roof of a building, the height of the sensors above the roof should be at least 1.5 times the height of the building. See Section 10 for a list of references that discuss siting wind speed and direction sensors. For power performance applications, refer to IEC 61400-12-1 which specifies the mounting and location of anemometers.

7.1 Wiring

Connections to Campbell Scientific dataloggers are given in TABLE 7-1 and TABLE 7-2. When Short Cut program generator software is used to create the datalogger program, wire the sensor to the datalogger as directed by the wiring diagram created by Short Cut.

TABLE 7-1. Connections to Campbell Scientific Dataloggers Pulse Channels				
Color	**Wire Label**	**CR800 CR850 CR5000 CR3000 CR1000**	**CR510 CR500 CR10X**	**21X CR7 CR23X**
White	Signal	Pulse	Pulse	Pulse
Brown	Signal Reference	⏚	G	⏚
Clear	Shield	⏚	G	⏚

TABLE 7-2. Connections to Campbell Scientific Dataloggers Control Ports			
Color	**Wire Label**	**CR800 CR850 CR5000 CR3000 CR1000**	**CR10X**
White	Signal	C1-C8	C6-C8
Brown	Signal Reference	5V	5V
Clear	Shield	⏚	G

7.2 Programming

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

Wind speed is typically measured an a datalogger pulse channel. The P2546A uses the CRBasic **PulseCount()** instruction configuring the pulse channel for switch closure with frequency counting. For dataloggers programmed with EDLOG, specify configuration code 22 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

The following table lists the multiplier and offset to obtain meters per second (m/s) when the pulse count instruction is configured to output the result in Hz.

TABLE 7-3. Wind Speed Multiplier and Offset

Standard Calibration is listed below. Using the MEASNET calibration will give measurements in m/s. MEASNET calibration multiplier and offset will be listed on the MEASNET calibration sheet included with each sensor.

Model	**m/s**
P2546A	Multiplier = 0.6207 Offset = 0.27

7.2.1 Example Program

The following CR1000 example program uses a pulse port to measure the P2546A once a second. The program stores the mean, maximum, minimum, and standard deviation of the measured wind speed over a 10 minute interval. Wiring for the example is given in the following table.

```
'Pulse Port Example

'CR1000 Series Datalogger
'Program to measure P2546A and store ten minute averages

'Wiring
'                                       Datalogger
'Color            Description           Channel
'-----            -----------           -------
'Brown            Signal Reference      P1
'White            Signal
'Clear            Shield

Const P2546A_mult = .6201
Const p2546a_offset = .27

Public PTemp, batt_volt
Public P2546A

'Define Data Tables
DataTable (Test,1,1000)
  DataInterval (0,10,Min,10)
  Minimum (1,batt_volt,FP2,0,False)
  Sample (1,PTemp,FP2)
  Average (1,P2546A,FP2,False)
  Maximum (1,P2546A,FP2,False,False)
  Minimum (1,P2546A,FP2,False,False)
  StdDev (1,P2546A,FP2,False)
EndTable

'Main Program

BeginProg
  Scan (1,Sec,0,0)
    PanelTemp (PTemp,250)
    Battery (batt_volt)

    'Measure P2546A and correct measurement if wind speed is zero
    PulseCount (P2546A,1,1,2,1,P2546A_mult,p2546a_offset)
    If P2546A <= p2546a_offset Then P2546A = 0
```

```
    'Call data tables
    CallTable Test

  NextScan
EndProg
```

8. Troubleshooting

Symptom: No wind speed

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

2. 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.

9. Maintenance

Every month do a visual/audio inspection of the anemometer at low wind speeds. Verify that the anemometer 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.

CAUTION Disassembling an anemometer to change the bearings will invalidate the MEASNET calibration.

MEASNET calibrations are normally valid for 12 months in the field (assuming the anemometer is installed within 6 months of the calibration test). In high-accuracy applications, Campbell Scientific recommends that the anemometer be returned to us for maintenance/overhaul between deployments; we can arrange for a new MEASNET calibration after maintenance/overhaul where required.

Before the anemometer is sent to Campbell Scientific, the customer must get an RMA (returned material authorization) and fill out the Declaration of Hazardous Material and Decontamination form.

10. References

IEC 61400 Part 12-1, "Wind turbine generator systems Part 12: Wind Turbine Power Performance Testing".

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.

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