Product Manual

Sensor

014A

Met One Wind Speed Sensor

Revision: 08/2022

RELIABLE SINCE 1974 MONITORING

CAMPBELL SCIENTIFIC

Table of contents

1. Introduction

The 014A is a three-cup anemometer that monitors horizontal wind speed for the range of 0 to 45 m/s with a threshold of 0.45 m/s. It connects directly to a Campbell Scientific data logger, which measures the 014A pulse signal and converts the signal to engineering units (mph, m/s, knots).

> 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 014A is a precision instrument. Please handle it with care.
- 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.

3. Initial inspection

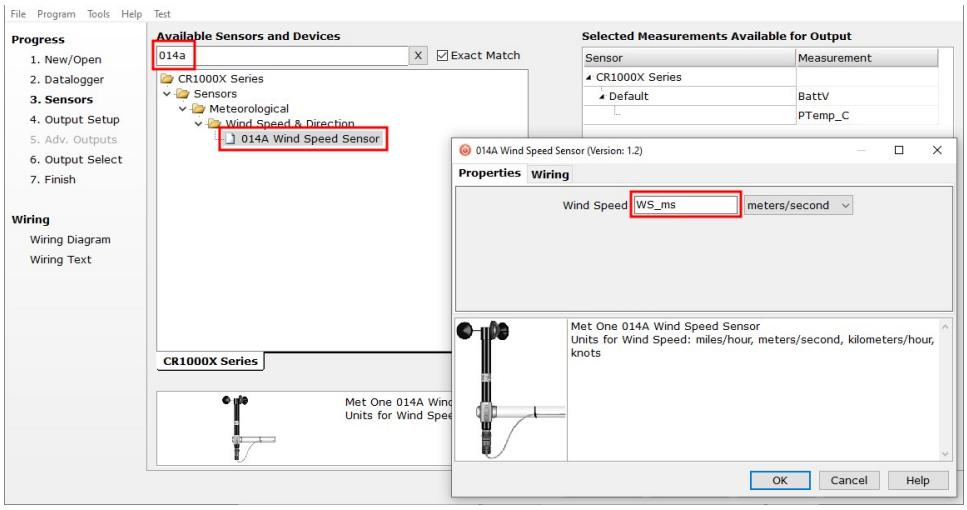
- Upon receipt of the 014A, inspect the packaging and contents for damage. File damage claims with the shipping company. Immediately check package contents against the shipping documentation. Contact Campbell Scientific about any discrepancies.
- The model number and cable length are printed on a label 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 Assemble and mount the sensor (p. 7) section.

4. QuickStart

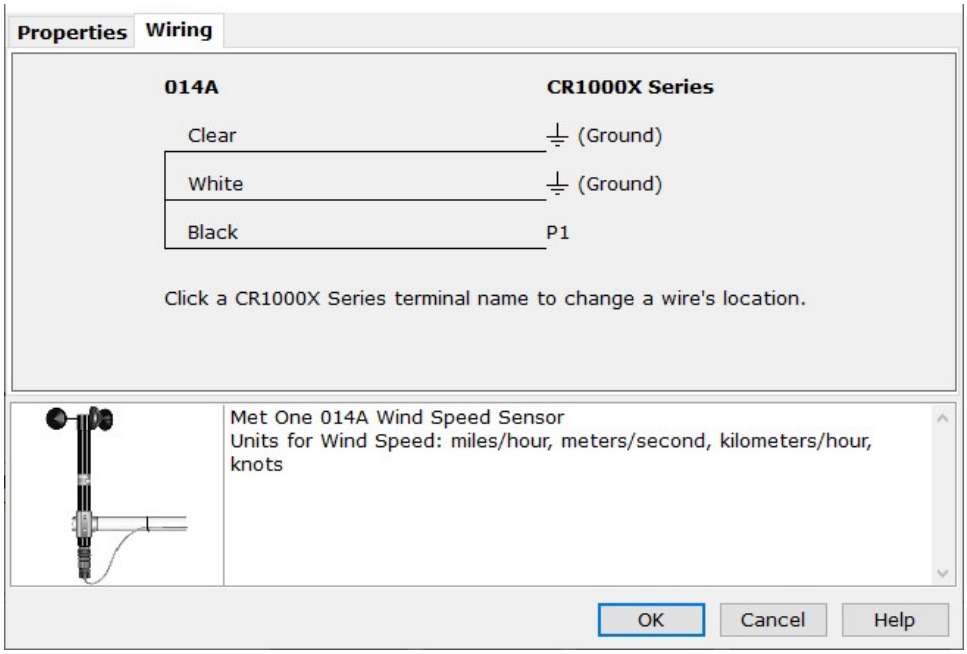
A video that describes data logger programming using ***Short Cut*** is available at: www.campbellsci.com/videos/cr1000x-datalogger-getting-started-program-part-3. ***Short Cut*** is an easy way to program your data logger to measure this sensor and assign data logger wiring terminals. ***Short Cut*** 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 014A.

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 014A or find the sensor in the **Sensors** > **Meteorological** > **Wind Speed & Direction** folder. Double-click **014A Wind Speed 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.

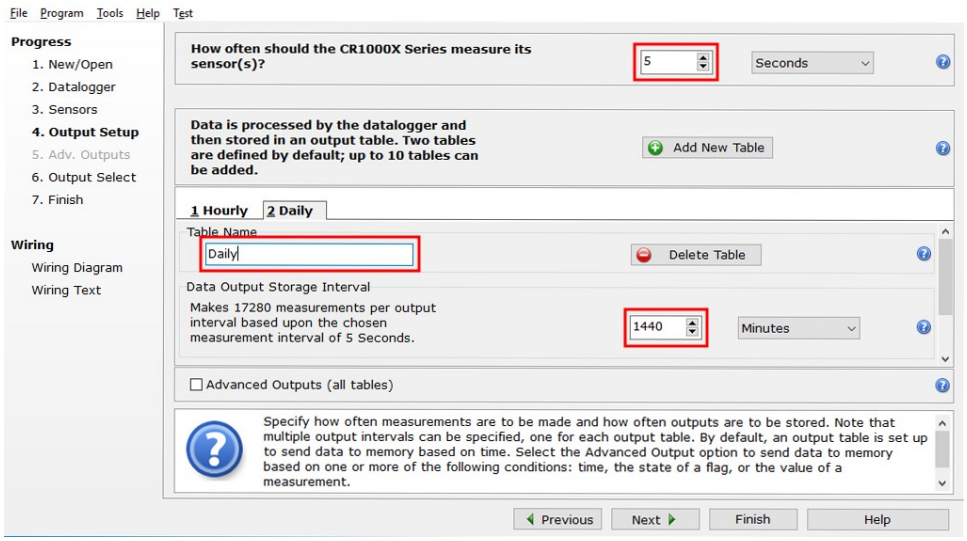


4. Click on the **Wiring** tab to see how the sensor is to be wired to the data logger. Click **OK** after wiring the sensor.

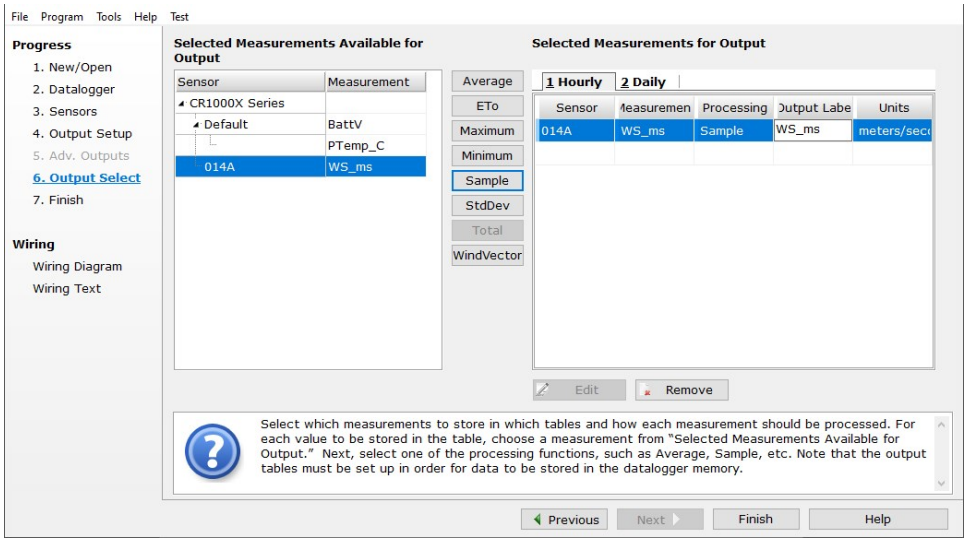


5. Select any other sensors you have, then finish the remaining ***Short Cut*** steps to complete the program.

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 014A is constructed of corrosion-resistant, stainless-steel and anodized aluminum. Its three-cup anemometer assembly contains a sealed magnetic reed switch. Rotation of the cup wheel produces a pulse that is directly proportional to wind speed.

Cable length for the 014A is specified when the sensor is ordered. Table 5-1 (p. 4) 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)

Features:

- Ideal for applications that do not require wind direction measurements
- Sealed magnetic reed switch
- Designed for continuous, long term, unattended operation in adverse conditions
- Compatible with Campbell Scientific CRBasic data loggers: CR6, CR1000X, CR800 series, CR350 series, CR300 series, CR3000, and CR1000

6. Specifications

Threshold:	0.45 m/s (1 mph)
Calibrated range:	0 to 45 m/s (0 to 100 mph)
Gust survival:	0 to 53 m/s (0 to 120 mph)
Accuracy:	1.5% or 0.11 m/s (0.25 mph)
Temperature range:	–50 to 70 °C
Output signal:	Contact closure, reed switch
Weight:	680 g (1.5 lb)
Distance constant[1]:	< 4.5 m (15 ft) standard; < 1.5 m (5 ft) optional fast response

[1] The distance traveled by the air after a sharp-edged gust has occurred for the anemometer to reach 63% of the new speed.

7. Installation

If you are programming your data logger with ***Short Cut***, skip Wiring (p. 5) and Programming (p. 6). ***Short Cut*** does this work for you. See QuickStart (p. 2) for a ***Short Cut*** tutorial.

7.1 Wiring

Connections to Campbell Scientific data loggers are given in Table 7-1 (p. 6). 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: Wire color, wire function, and data logger connection		
Wire color	Wire function	Data logger connection terminal
Black	Signal	**U** configured for pulse input[1], **P** (pulse input), or **P_SW** (pulse, switch closure input)
White	Signal reference	⏚
Clear	Shield	⏚ (analog ground)
[1] **U** terminals are automatically configured by the measurement instruction.		

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. 13). Programming basics for CRBasic data loggers are provided in the following section. A complete program example can be found in Example program (p. 14).

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 **Switch Closure** 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 7-2 (p. 7) lists the multipliers to obtain miles/hour or meters/second when the measurement instruction is configured to output Hz.

Table 7-2: Wind speed multiplier*

Model	Meters/Second	Miles/Hour
014A	M = 0.8000 Off = 0.447	M = 1.789 Off = 1.0

*When configured to output counts, the above multiplier is divided by the execution interval in seconds

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 014A 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. 12) for a list of references that discuss siting wind speed and direction sensors.

7.4 Assemble and mount the sensor

Tools required:

- 5/64-inch hex key wrench (shipped with the 014A)
- 1/2-inch open end wrench
- Small screwdriver provided with data logger
- UV resistant cable ties
- Small pair of diagonal-cutting pliers
- 6-inch to 10-inch torpedo level
- 3/4 x 1-inch Nu-Rail crossover fitting

The 014A ships with the cup assembly separate from the main housing. Assemble the sensor using the following procedure:

1. Take the cup assembly and main housing out of the shipping box (see Figure 7-1 [p. 8]).

Figure 7-1. 014A shipping box

2. Gently slide the cup assembly down over the shaft at the top of the sensor until it meets the top bearing.
3. Use the 5/64-inch hex key to tighten the screw on the side of the cup assembly; tighten until snug (see Figure 7-2 [p. 8]).

Figure 7-2. Hex key tightening bolt

4. Ensure that the cup assembly spins freely.

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

1. Mount a crossarm to a tripod or tower.

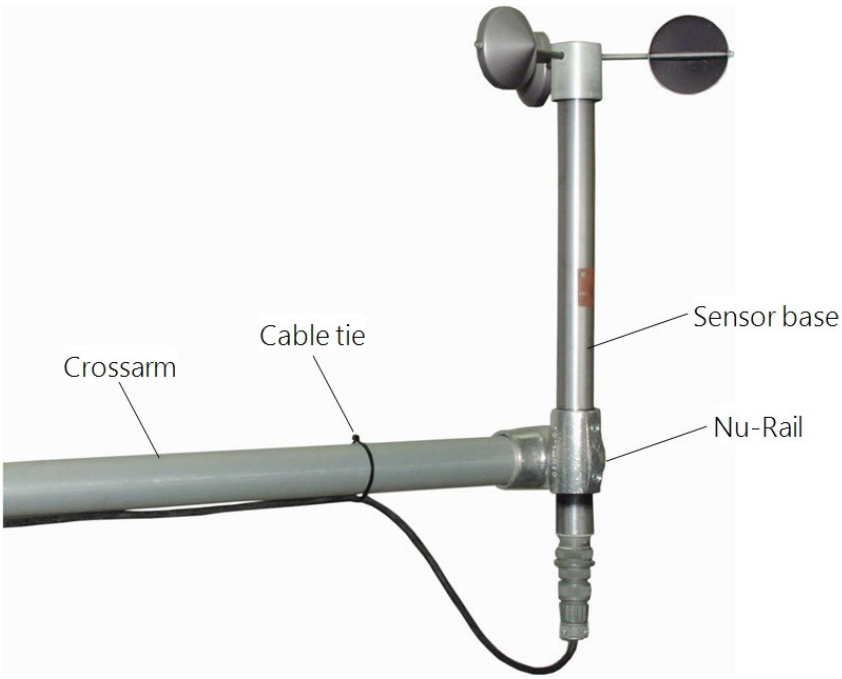


Figure 7-3. 014A mounted on a crossarm with the 3/4 x 1 inch Nu-Rail fitting

2. 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.
3. Insert the base of the 014A into the Nu-Rail and tighten the set screws on the Nu-Rail (do not over tighten).
4. Attach the sensor cable to the connector on the 014A. Make sure the connector is properly keyed, and finger-tighten the knurled ring.
5. Use the torpedo level to ensure that the sensor 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 crossarm and tripod or tower by using cable ties.

The 014A 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 7-4. CM221 Right-Angle Mounting Kit

Figure 7-5. The CM216 allows the 014A to mount atop a tripod mast

8. Troubleshooting and maintenance

NOTE:
All factory repairs and recalibrations require a returned material authorization (RMA) and completion of the "Declaration of Hazardous Material and Decontamination" form. Refer to the Assistance page at the back of this manual for more information.

8.1 Troubleshooting

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 ohm meter to check the reed switch. The resistance between the white and black wires should vary from infinite (switch open) to less than 1 ohm (switch closed) as the cup wheel is slowly turned.
3. Verify that the configuration code, and multiplier and offset parameters for the pulse count instruction are correct for the data logger type.

8.2 Suggested maintenance schedules

8.2.1 6 to 12 month periodic service

Visually inspect the anemometer cups for cracks and breaks, and make sure that each arm is securely attached to the cup assembly hub. Also check to see that the vent hole, located at the base of the sensor, is unobstructed.

Special caution is advised under adverse conditions of high winds, heat, and/or sandy areas. Look for abrupt stopping of the cup assembly with slow cup rotation. If this occurs, the bearings may need to be replaced. Factory replacement is recommended; see Assistance page.

8.2.2 12 to 24 month service

Replace sensor bearings. Factory replacement is recommended; see Assistance page.

8.2.3 24 to 36 month service

A complete factory overhaul of the sensor is recommended. Contact Met One directly for wind speed sensor repair and recalibration service. This repair and calibration service includes disassembly and detailed inspection of all moving mechanical parts and all electronic components. Service includes replacement of bearings, shaft, and set screws as well as a functional test of the sensor. Charges above the basic service charge may be added for replacement of additional materials.

Met One Instruments, Inc.
1600 Washington Blvd.
Grants Pass, OR 97526
(541) 471-7111
FAX (541) 471-7116

9. References

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

The following CR1000X program uses a pulse port to measure the 014A every 5 seconds. The program stores mean wind speed (in m/s) every 60 minutes. Wiring for the examples is given in Table B-1 (p. 14).

Table B-1: Wiring for pulse port example program

Color	Description	CR1000X
Black	Signal	P1
White	Signal reference	⏚
Clear	Shield	⏚

CRBasic Example 1: CR1000X program measuring 014A using pulse channel

```
'CR1000X

'Declare Variables and Units
Public Batt_Volt
Public WS_ms

Units Batt_Volt=Volts
Units WS_ms=meters/second

'Define Data Tables
DataTable(Hourly,True,-1)
  DataInterval(0,60,Min,10)
  Average(1,WS_ms,FP2,False)
EndTable

'Main Program
BeginProg
  Scan(5,Sec,1,0)
    'Default Data logger Battery Voltage measurement Batt_Volt:
    Battery(Batt_Volt)
    '014A Wind Speed Sensor measurement WS_ms:
      PulseCount(WS_ms,1,P1,1,1,0.8,0.447)
    If WS_ms<0.448 Then WS_ms=0
    'Call Data Tables and Store Data
    CallTable(Hourly)
  NextScan
EndProg
```

Appendix C. Reed switch and bearing replacement

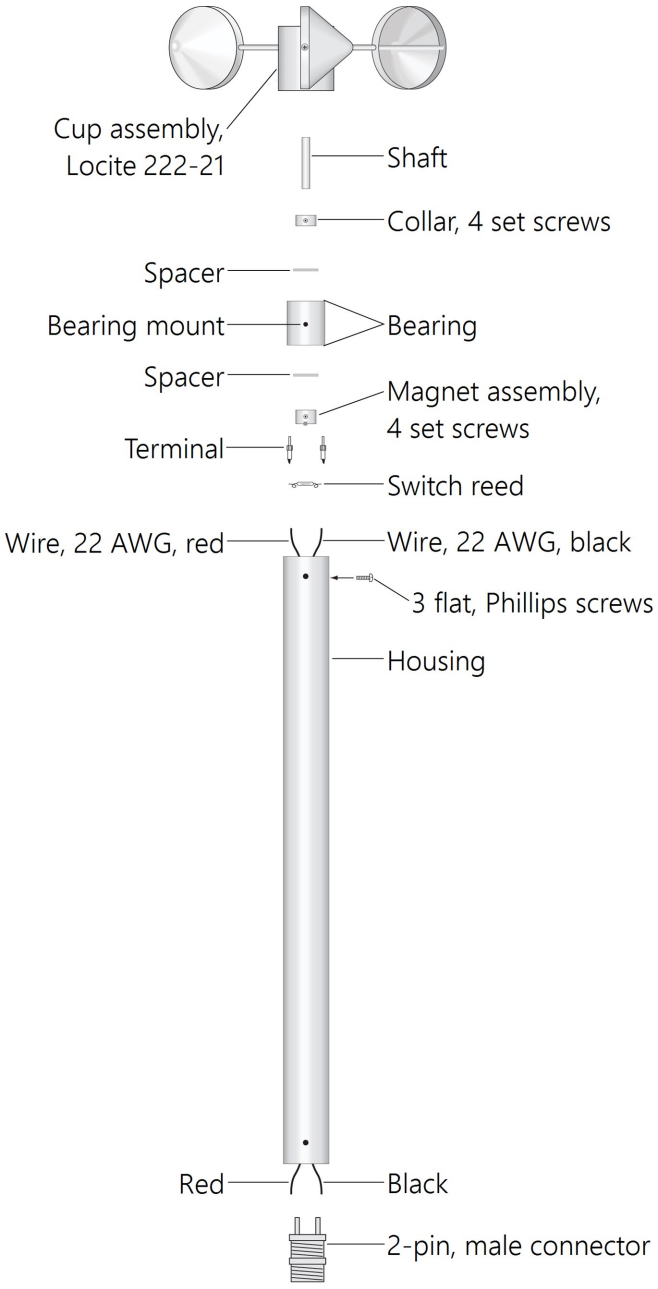


Figure C-1. Exploded view of the 014A

C.1 Reed switch replacement procedure

To verify parts and locations, refer to Figure C-1 (p. 15).

1. Remove sensor from mounting arm and disconnect cable.
2. Remove the cup assembly.
3. Remove the three Philips screws at the top of the sensor and lift out the bearing mount assembly.
4. Unsolder the wires of the reed switch and remove the switch from the two mounting terminals; see the parts diagram.
5. Solder the new switch onto the sides of the switch mount terminals (form a loop in the relay wires to obtain proper length).

   > **CAUTION:**
   > Do not cut the relay wires.

   Measure the distance between the bottom of the rotating magnet and the top of the switch envelope, as shown in Figure C-2 (p. 16). The spacing should measure between 0.01 and 0.02 inches.
6. Spin the shaft to verify switch operation by listening for a faint sound of the switch closure. If the switch cannot be heard, move the switch slightly closer to the magnet assembly.
7. Reassemble sensor.

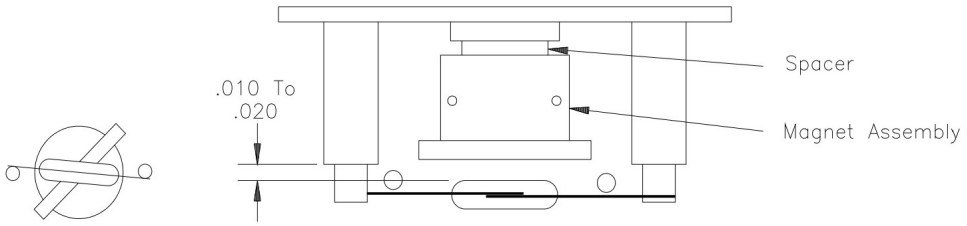


Figure C-2. Reed switch assembly

C.2 Bearing replacement procedure

The bearings used in the 014A sensor are special stainless steel ball bearings with a protective shield. Bearings are lubricated and sealed.

> **CAUTION:**
> Do not lubricate bearings as the lubrication will attract dust and inhibit bearing operation.

1. Follow steps 1, 2, and 3 in reed switch replacement procedure.
2. Loosen set screws in magnet assembly, lift shaft and collar up and out of bearing mount. Be sure to retain lower spacer.
3. Insert a right-angle type of tool, such as hex key, into bearing. Cock it slightly to one side and remove both bearings.
4. Install new bearings. Be careful not to introduce dirt particles into bearings.

   > CAUTION:
   > Clean hands only! Do not add lubrication of any kind.

5. Reassemble the sensor in reverse order. Be sure to include spacers over the bearings when replacing the shaft in the bearing mount. After the magnet assembly has been tightened, a barely perceptible amount of endplay should be felt when the shaft is moved up and down.

Appendix D. Theory of operation

D.1 Mechanical

The sensor cup assembly consists of three aluminum cups mounted on a cup assembly hub. A stainless steel shaft, which rotates on precision-sealed ball bearings, connects the cup assembly to a magnet assembly. When the shaft is rotated, the turning magnet assembly causes a reed switch to close. There are two contacts (reed switch closures) per revolution. The frequency of closures is linear from threshold to 45 m/s.

D.2 Calibration

The 014A sensor has a threshold speed of 0.447 m/s and follows the equation:

$V = 0.447 + f/1.250$

where

V = wind speed (m/s)

f = output frequency (hz)

or, $V = 1.0 + f/0.5589$

where

V = wind speed (mph)

f = output frequency (hz)

Limited warranty

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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.

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Phone: 34.93.2323938
Email: info@campbellsci.es
Website: www.campbellsci.es

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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
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