

# 27106T

## Vertical Propeller Anemometer



# Guarantee

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This equipment is guaranteed against defects in materials and workmanship. We will repair or replace products which prove to be defective during the guarantee period as detailed on your invoice, provided they are returned to us prepaid. The guarantee will not apply to:

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# About this manual

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Please note that this manual was originally produced by Campbell Scientific Inc. primarily for the North American market. Some spellings, weights and measures may reflect this origin.

Some useful conversion factors:

<b>Area:</b> 1 in <sup>2</sup> (square inch) = 645 mm <sup>2</sup>	<b>Mass:</b> 1 oz. (ounce) = 28.35 g 1 lb (pound weight) = 0.454 kg
<b>Length:</b> 1 in. (inch) = 25.4 mm 1 ft (foot) = 304.8 mm 1 yard = 0.914 m 1 mile = 1.609 km	<b>Pressure:</b> 1 psi (lb/in <sup>2</sup> ) = 68.95 mb <b>Volume:</b> 1 UK pint = 568.3 ml 1 UK gallon = 4.546 litres 1 US gallon = 3.785 litres

In addition, while most of the information in the manual is correct for all countries, certain information is specific to the North American market and so may not be applicable to European users.

Differences include the U.S standard external power supply details where some information (for example the AC transformer input voltage) will not be applicable for British/European use. *Please note, however, that when a power supply adapter is ordered it will be suitable for use in your country.*

Reference to some radio transmitters, digital cell phones and aerials may also not be applicable according to your locality.

Some brackets, shields and enclosure options, including wiring, are not sold as standard items in the European market; in some cases alternatives are offered. Details of the alternatives will be covered in separate manuals.

Part numbers prefixed with a “#” symbol are special order parts for use with non-EU variants or for special installations. Please quote the full part number with the # when ordering.

## Recycling information



At the end of this product's life it should not be put in commercial or domestic refuse but sent for recycling. Any batteries contained within the product or used during the products life should be removed from the product and also be sent to an appropriate recycling facility.

Campbell Scientific Ltd can advise on the recycling of the equipment and in some cases arrange collection and the correct disposal of it, although charges may apply for some items or territories.

For further advice or support, please contact Campbell Scientific Ltd, or your local agent.



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# Safety

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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.eu](http://www.campbellsci.eu) or by telephoning +44(0) 1509 828 888 (UK). 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

- Prior to performing site or installation work, obtain required approvals and permits. Comply with all governing structure-height regulations, such as those of the FAA in the USA.
- 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, or 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.

## 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.

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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# 1. Introduction

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The 27106T vertical propeller anemometer is a low threshold precision air velocity sensor that is especially suited for monitoring the vertical wind component. It connects directly to a Campbell Scientific data logger, which measures the 27106T 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](http://www.campbellsci.com/old-manuals) .

## 2. Precautions

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- READ AND UNDERSTAND the [Safety](#) section at the front of this manual.
- The 27106T 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

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Upon receipt of your shipment, immediately open the shipping carton and ensure that you have all of the 27106T components. If an item is not initially visible, remove the foam from the shipping carton and thoroughly inspect both sides of the foam for the item. Immediately contact Campbell Scientific if any item is missing.

Make sure you have removed and accounted for all items from the shipping carton before discarding the shipping foam and shipping carton. The foam can hide some of the items.

The shipping carton should include:

- 16-inch-by-2-inch-by-2-inch box labelled Propeller Anemometer, which contains the propeller shaft
- 9-inch-by-9-inch-by-2-inch box labelled Carbon Fibre Propeller
- Cable (routed through the mounting pipe to mating connector)
- 3/4-inch IPS threaded pipe

## 4. QuickStart

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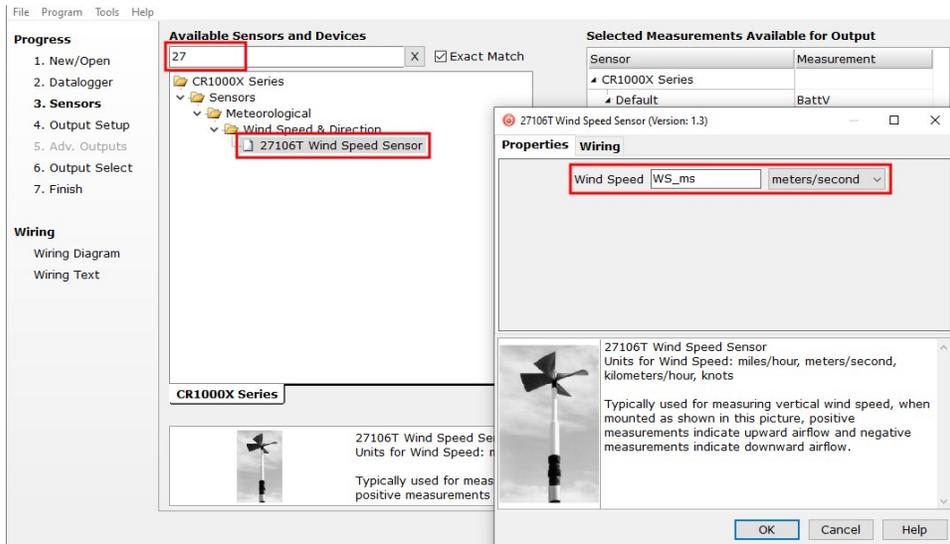
A video that describes data logger programming using *Short Cut* is available at:

[www.campbellsci.eu/videos/cr1000x-datalogger-getting-started-program-part-3](http://www.campbellsci.eu/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.eu](http://www.campbellsci.eu).  It is included in installations of *LoggerNet*, *RTDAQ*, or *PC400*.

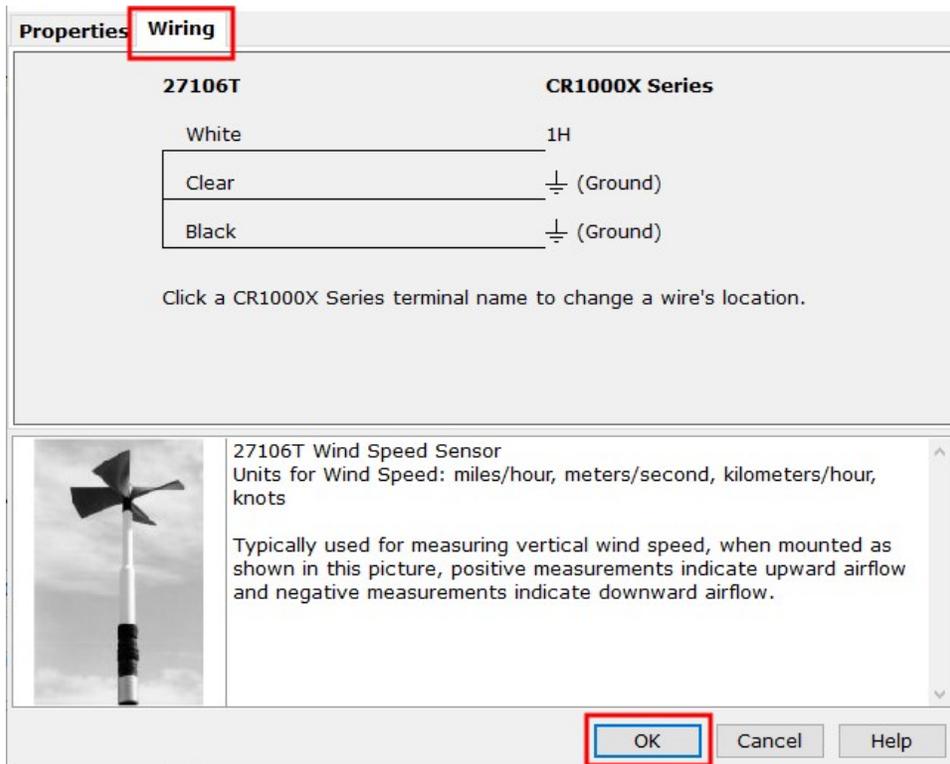
Use the following procedure to get started.

1. Open *Short Cut* and create a new program.
2. Double-click the data logger model.

- In the **Available Sensors and Devices** box, type 27106T. You can also locate the sensor in the **Sensors > Meteorological > Wind Speed & Direction** folder. Double-click **27106T Wind Speed Sensor**. The units default to **metres/second**, which can be changed by clicking the **Wind Speed** box and selecting one of the other options.

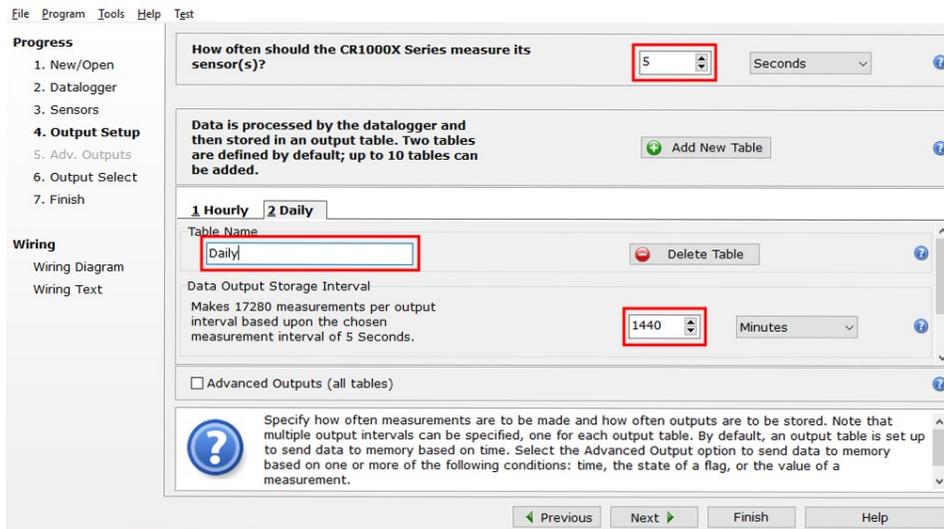


- Click on the **Wiring** tab, wire the sensor, then click **OK**.

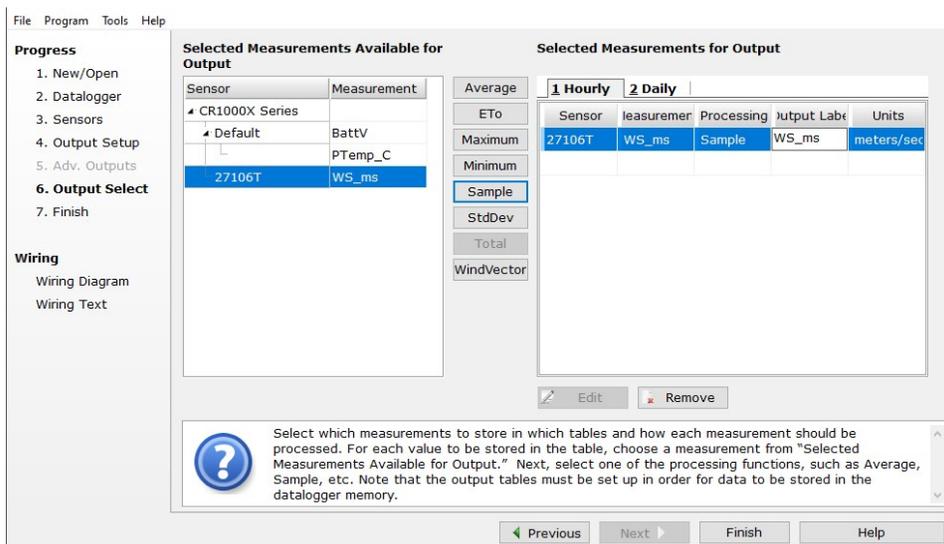


- Repeat steps three and four for other sensors you want to measure. Click **Next**.

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

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The 27106T measures air velocity using a fast-response, four-blade helicoid propeller that drives a high quality tech-generator transducer. The transducer converts the propeller rotation to a DC voltage that is linearly proportional to air velocity. The 27106T connects directly to a Campbell Scientific data logger, which measures the 27106T signal and converts the signal to engineering units (mph, m/s, knots).

The 27106T is manufactured by R.M. Young (Traverse City, MI) and cabled by Campbell Scientific for use with our data loggers. The R.M. Young instruction manual includes additional information on the operating principles, installation, and maintenance of the sensor.

## Features:

- Especially suited for monitoring vertical wind, but can be mounted to monitor the wind in whatever direction is desired
- Carbon-fibre thermoplastic (CFT) propeller provides greater range and durability than other propeller anemometers offered by R.M. Young.
- Compatible with Campbell Scientific CRBasic data loggers: CR6, CR1000X, CR800 series, CR350 series, CR300 series, CR3000, CR1000

# 6. Specifications

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## Range

**Axial flow:** 0 to 40 m/s (0 to 90 mph)

**All angles:** 0 to 35 m/s (0 to 80 mph)

**Threshold sensitivity:**<sup>1</sup> 0.4 m/s (0.8 mph)

**Distance constant:**<sup>1</sup> <2.1 m (6.9 ft)

**Pitch:** 30.0 cm (11.8 in) air passage per revolution

**Signal output:** Analogue DC voltage proportional to axial wind component.

Polarity reverses with reverse rotation.

1800 rpm (500 mV) = 9.0 m/s (20.1 mph)

**Operating temperature:** -50 to 50 °C

**Propeller description:** 4-blade helicoids propeller moulded of carbon fibre thermoplastic

**Dimensions**

**Overall length:** 43 cm (17 in)

**Propeller diameter:** 20 cm (8 in)

**Housing diameter:** 2.5 cm (1 in)

**Mounting pipe description:** 12-in. long, 3/4-in. IPS schedule 40 pipe (1.05 in. OD)

**Weight:** 0.5 kg (1.2 lb)

<sup>1</sup>Threshold and distant constant values are for axial flows.

## 7. Installation

If you are programming your data logger with *Short Cut*, skip [Wiring](#) (p. 6) 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).

Wire colour	Wire function	Data logger connection terminal
White	Signal	U configured for single-ended analogue input <sup>1</sup> , SE (single-ended, analogue-voltage input)
Black	Signal reference	⊥ (analogue ground)
Clear	Shield	⊥ (analogue ground)

<sup>1</sup>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. 14). Programming basics for CRBasic data loggers are provided in the following sections. A complete program is provided in [Example program](#) (p. 15). Programming basics and programming examples for Edlog data loggers are provided at [www.campbellsci.com/old-manuals](http://www.campbellsci.com/old-manuals) .

## 7.2.1 VoltSE() instruction

The **VoltSE()** measurement instruction programs the data logger to measure the 27106T.

**VoltSE**(Dest, Reps, Range, SEChan, MeasOff, SettlingTime, Integ/fnotch, Mult, Offset)

For **Range**, use **mV2500** (CR300, CR1000) or **mV5000** (CR6, CR1000X, CR3000). If the anemometer will be in electrically noisy environments, use 50 Hz or 60 Hz rejection for **Integ/f<sub>notch</sub>**.

## 7.2.2 Multiplier and offset

The expression for wind speed (U) is:

$$U = MX + B$$

Where,

M = multiplier

X = voltage measured by the data logger

B = offset

[Table 7-2](#) (p. 8) lists the multipliers to obtain miles/hour, metres/second, km/hr, and knots. The helicoid propeller has a calibration that passes through zero, so the offset is zero.

Table 7-2: Wind speed multiplier<sup>1</sup>

Unit	Multiplier
Miles per hour	0.04025
Metres/Second	0.01800
Kilometres/Hour	0.06480
Knots	0.03496

<sup>1</sup>When the propeller is used for measuring the vertical wind component, users may want to apply an additional multiplier of 1.25 to the output signal. This may be done numerically in the data processing operations or electronically in the signal conditioning. Using the additional multiplier brings the anemometer output signal within  $\pm 3\%$  of the cosine response for elevation angles between  $-30^\circ$  and  $30^\circ$ . Since the standard deviation of wind elevation angle in open terrain rarely exceeds  $12^\circ$ , 98% (2.5 standard deviations) of observations will be within  $\pm 30^\circ$ . Using the multiplier is not necessary when the anemometer is used in a UVW configuration with R.M. Young model 26601UVW Translator.

## 7.3 Siting

The 27106T should be oriented with the propeller facing the predominant flow of air being measured. No obstacle should interfere with the vertical air flow from either the up or down direction.

The propeller responds only to the component of the air flow, which is parallel to the axis of its rotation. Off-axis response closely approximates a cosine curve with appropriate polarity. With perpendicular air flow, the propeller does not rotate.

## 7.4 Assembly and mounting

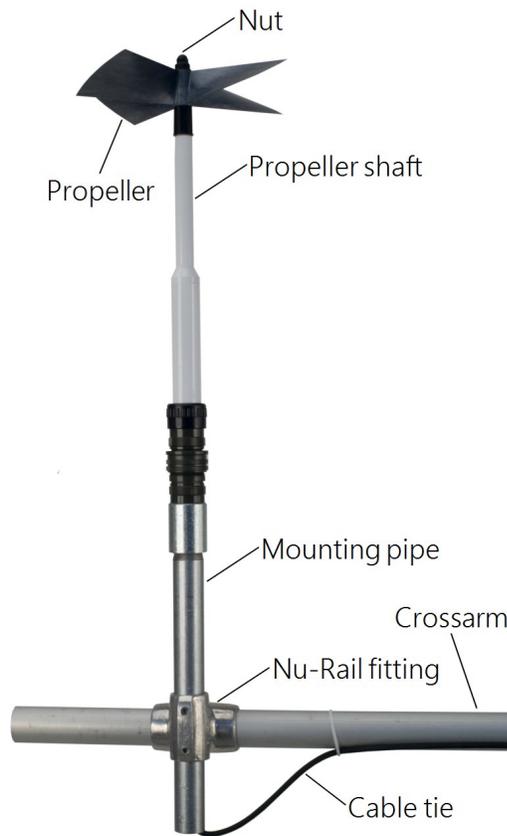
Materials required:

- 5/32-inch hex key wrench
- UV resistant cable ties
- Small pair of diagonal-cutting pliers
- 6-inch to 10-inch torpedo level
- Cable (shipped routed through the mounting pipe to mating connector)
- 3/4-inch IPS threaded mounting pipe (shipped with the sensor)
- 3/4 x 1-inch Nu-Rail crossover fitting

- Propeller
- Propeller shaft

The following is the assembly and mounting procedure.

1. Mount a crossarm to a tripod or tower.
2. Remove the nut that is on the top of the propeller shaft (Figure 7-1 [p. 9]).
3. Place the propeller on top of the propeller shaft. Replace the nut and tighten to secure the propeller to the shaft (Figure 7-1 [p. 9]).



*Figure 7-1. 27106T mounted to a crossarm via a Nu-Rail fitting*

4. Remove the dust cap from the mating connector and attach it with the sensor connector. The cable comes routed through the 3/4-inch IPS pipe to the mating connector.
5. Secure the pipe to the Nu-Rail (Figure 7-1 [p. 9]).
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 27106T can also use a CM221 Right-Angle Mounting Kit; see the following figure. The CM221 uses U-bolts to secure the sensor to a crossarm.



Figure 7-2. CM221 Right-Angle Mounting Kit

## 8. Maintenance and troubleshooting

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### NOTE:

All factory repairs and replacements require a returned material authorization (RMA) and completion of the “Declaration of Hazardous Material and Decontamination” form. Refer to the [About this manual](#) page at the front of this manual for more information.

### 8.1 Maintenance

Given proper care, the 27106T should provide years of service. Components are conservatively rated and require little maintenance. The only parts likely to need replacement due to normal wear are the precision ball bearings and the tach-generator.

### CAUTION:

Campbell Scientific recommends returning the sensor to the factory and having our qualified technicians replace the bearings and tach-generator. When available, a qualified technician can replace the bearings and/or generator by following the procedures included in this document. These replacement procedures are from *R.M. Young 27106T Operational Manual*.

#### 8.1.1 Flange bearing replacement

If anemometer bearings become noisy or wind speed threshold increases above an acceptable level, bearings may need replacement. You can check bearing condition using a Model 18310

Anemometer Bearing Torque Disk (available from R.M. Young). If, after replacing bearings, the torque is still too high, check the tach-generator.

If the bearings need to be replaced, have either Campbell Scientific or a qualified technician replace them by using the following procedure:

1. Remove old bearings:
  - a. Remove propeller from anemometer.
  - b. Unthread and separate shaft housing assembly from generator housing.
  - c. Loosen set screw on shaft collar/coupling disk and remove from propeller shaft.
  - d. Slide propeller shaft through both bearings and out of housing.
  - e. Pull front bearing dust shield off housing.
  - f. Using the edge of a pocket knife, gently pry front and rear bearings out of housing.
2. Install new bearings:
  - a. Gently insert front bearing into housing.
  - b. Push front bearing dust shield back onto housing.
  - c. Carefully slide propeller shaft through front bearing and into housing.
  - d. Slide rear bearing over propeller shaft and gently push it into housing.
  - e. Place shaft collar/coupling disk on propeller shaft.
  - f. Allow 0.010 inch (0.25 mm) end play gap between shaft collar/coupling disk and bearing. Tighten set screw (80 oz in, 5600 gm-cm max torque).
  - g. Thread shaft housing assembly into generator housing. Tighten firmly.
  - h. Check bearing torque to confirm it is within specifications.

## 8.1.2 Tach-generator replacement

When the tach-generator output becomes erratic (usually due to brush failure) or begins to show signs of bearing failure (high torque), the entire generator assembly should be removed and replaced. Before replacing the tach-generator due to excessive torque, ensure it is caused by a worn tach-generator, and not the anemometer flange bearings.

If the tach-generator needs to be replaced, have either Campbell Scientific or a qualified technician replace it by using the following procedure:

1. Remove old generator assembly:
  - a. Remove propeller from anemometer.
  - b. Unthread generator housing collar. Pull generator housing away from sensor connector and generator assembly.
  - c. Note position of generator wires on sensor connector pins. Unsolder wires from pins and remove old generator assembly.
2. Install new generator assembly:
  - a. Solder wires from new generator assembly onto proper sensor connector pins. Verify correct polarity; CCW rotation produces negative output voltage.
  - b. Slide generator housing over generator assembly. Firmly tighten housing collar onto connector threads.
  - c. Check bearing torque to confirm it is within specification.

## 8.2 Troubleshooting

Symptom: No wind speed

1. Check that the sensor is wired to the single-ended terminal specified by the [Vo1tSE\(\)](#) instruction.
2. Disconnect the sensor from the data logger and use an ohm meter to check the tach-generator. The resistance between the white and black wires should be about 32  $\Omega$ . Infinite resistance indicates an open coil; low resistance indicates a shorted coil.
3. Verify that the **Range** parameter for the [Vo1tSE\(\)](#) instruction is correct for the data logger type.

## 9. References

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References containing additional information about the 207106T are listed below in chronological order.

Holmes, R.M., Gill, G.C., and Carson, H.W., "A Propeller Type Vertical Anemometer", *Journal of Applied Meteorology*, Vol 3, 1964, pp. 802-804

Drinkow, R., "A Solution to the Paired Gill-Anemometer Response Function", *Journal of Applied Meteorology*, Vol 11, 1972, pp. 7-80.

Hicks, B. B., "Propeller Anemometers as Sensors of Atmospheric Turbulence", *Boundary-Layer Meteorology*, Vol 3, 1972, pp. 214-228

Fichtl, G. H., and Kumar, P., "The Response of Propeller Anemometer to Turbulent Flow with the Mean Wind Vector Perpendicular to the Axis of Rotation", *Boundary-Layer Meteorology*, Vol 6, 1974, pp. 363-379.

McMichael, J.M., and Klebanoff, P. S., "The Dynamic Response of Helicoid Anemometers", NBSIR 75-772, National Bureau of Standards, 1975.

R.M Young Model 27106 Gill Propeller Anemometer Manual PN: 27106-90, Rev: D030106

# Appendix A. Importing *Short Cut* code into *CRBasic Editor*

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*Short Cut* creates a .DEF file that contains wiring information and a program file that can be imported into *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, then save it. Click the **Advanced** tab then the **CRBasic Editor** button. Your program file will open in CRBasic with a generic name. 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.

2. To add the *Short Cut* wiring information into the new CRBasic program, open the .DEF file located in the C:\campbellsci\SCWin folder. Copy the wiring information found at the beginning of the .DEF file.
3. Go into the CRBasic program and paste the wiring information at the beginning of the program.
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 program measures the 27106T every second, and stores the maximum, minimum, and average wind speed every 10 minutes. Wiring for the example is given in [Table B-1](#) (p. 15).

Colour	Wire label	CR1000X
White	Signal	SE1
Black	Signal reference	⏏
Clear	Shield	⏏

## CRBasic Example 1: CR1000X example program

```
'CR1000X Series Data Logger
'Declare Public Variables
Public Batt_Volt
Public WS_ms

Units Batt_Volt=Volts
Units WS_ms=metres/second

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

'Main Program
BeginProg
  Scan (1,Sec,1,0)
  Battery (Batt_Volt)
  '27106T Wind Speed Sensor measurement
  VoltSe (WS_ms,1,mV5000,1,1,0,60,0.01800,0)

  'Call Output Tables
  CallTable TenMinute
NextScan
EndProg
```



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