

# INSTRUCTION MANUAL



## **CMP6, CMP11, and CMP21 Pyranometers**

Revision: 5/17



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# Precautions

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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.ca](http://www.campbellsci.ca) or by telephoning (780) 454-2505 (Canada). 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 personnel (e.g. 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.
- 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.

## 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.

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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:

<b>Area:</b>	1 in <sup>2</sup> (square inch) = 645 mm <sup>2</sup>
<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>Mass:</b>	1 oz. (ounce) = 28.35 g
	1 lb (pound weight) = 0.454 kg
<b>Pressure:</b>	1 psi (lb/in <sup>2</sup> ) = 68.95 mb
<b>Volume:</b>	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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# ***CMP6, CMP11, and CMP21 Pyranometers***

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## **1. Introduction**

CMP-series pyranometers are designed for continuous outdoor monitoring of solar radiation intensity. A flat spectral sensitivity from 285 to 2800 nm enables accurate measurements in natural sunlight, under plant canopies, and in green houses or buildings. When inverted, these pyranometers can measure reflected solar radiation. Uses include monitoring global horizontal irradiance (GHI) and plane of array irradiance (POA). Diffuse sky radiation can also be measured with the use of a shade mechanism.

### **NOTE**

This manual provides information only for CRBasic dataloggers. It is also compatible with many of our retired Edlog dataloggers. For Edlog datalogger support, see an older manual at [www.campbellsci.com/old-manuals](http://www.campbellsci.com/old-manuals).

## **2. Precautions**

- READ AND UNDERSTAND the *Safety* section at the front of this manual.
- CMP-series pyranometers are rugged, but they should be handled as precision scientific instruments.
- Care should be taken when opening the shipping package to not damage or cut the cable jacket. If damage to the cable is suspected, consult with a Campbell Scientific applications engineer.

## **3. Initial Inspection**

Check the contents of the shipment. If there is a shortage (see Section 3.1, *Ships With (p. 1)*), contact Campbell Scientific. If any damage has occurred during transport, immediately file a claim with the carrier and contact Campbell Scientific to facilitate repair or replacement.

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 correct product and cable length are received.

### **3.1 Ships With**

- (2) Bolts for mounting from original manufacturer
- (1) Instruction Manual from original manufacturer
- (1) Sun Shield from original manufacturer
- (2) Nylon washers from original manufacturer

## 3.2 Calibration Certificate

Each pyranometer is shipped with an instruction manual provided by Kipp & Zonen that contains information concerning its construction, spectral sensitivity, cosine response, and a simple sensor check out procedure. Included with the sensor and manual is a calibration certificate with the sensor sensitivity value and serial number.

---

**NOTE**

Cross check this serial number against the serial number on your pyranometer to ensure that the given sensitivity value corresponds to your sensor.

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## 4. QuickStart

### 4.1 Siting

The pyranometer is usually installed horizontally for global horizontal measurements. However, the pyranometer can be installed at any angle for POA measurements and in the inverted position for reflected measurements. In all cases it will measure the solar flux incident on the sensor surface.

Site the pyranometer to allow easy access for maintenance while ideally avoiding any obstructions or reflections above the plane of the sensing element. It is important to mount the pyranometer such that a shadow or reflection will not be cast on it at any time.

If this is not possible, try to choose a site where any obstruction over the azimuth range between earliest sunrise and latest sunset has an elevation not exceeding 5°. Diffuse solar radiation is less influenced by obstructions near the horizon. For instance, an obstruction with an elevation of 5° over the whole azimuth range of 360° decreases the downward diffuse solar radiation by only 0.8%.

### 4.2 Mounting

The sensor should be mounted with the cable pointing towards the nearest magnetic pole (e.g., in the Northern Hemisphere point the cable toward the North Pole); see FIGURE 4-1 through FIGURE 4-4.

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**NOTE**

Appendix C, *CVF4 Ventilation Unit (p. C-1)*, provides the mounting information for the CVF4 ventilation unit.

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See Section 7.1, *Mounting to a Tripod or Tower (p. 10)*, for more information.

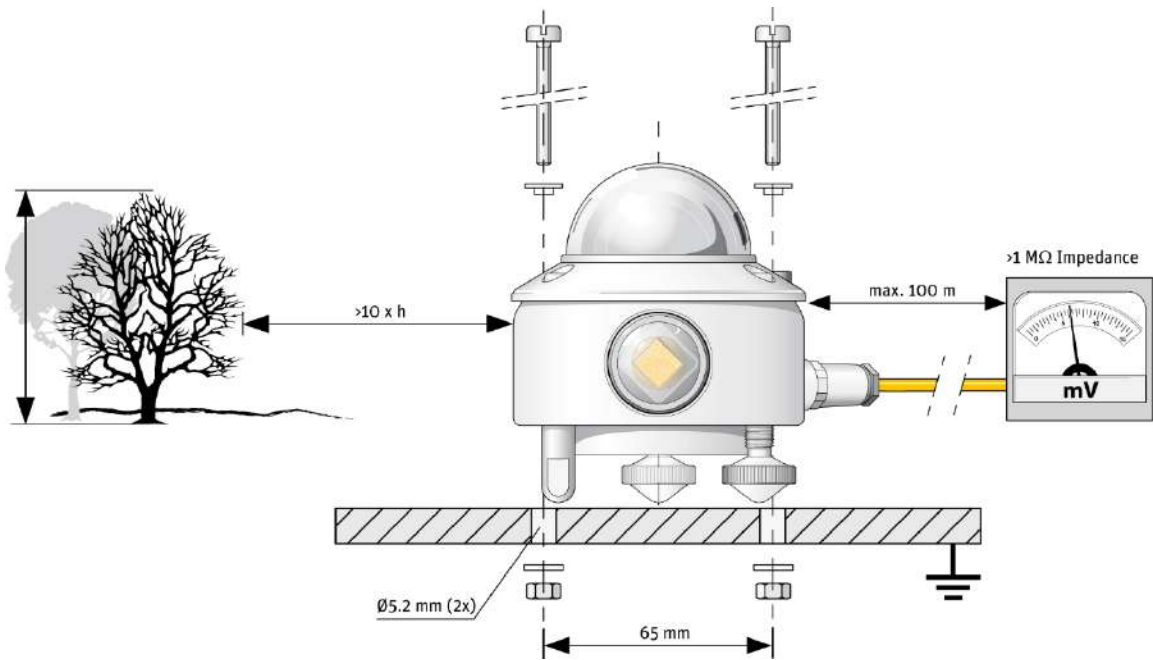


FIGURE 4-1. Pyranometer installation

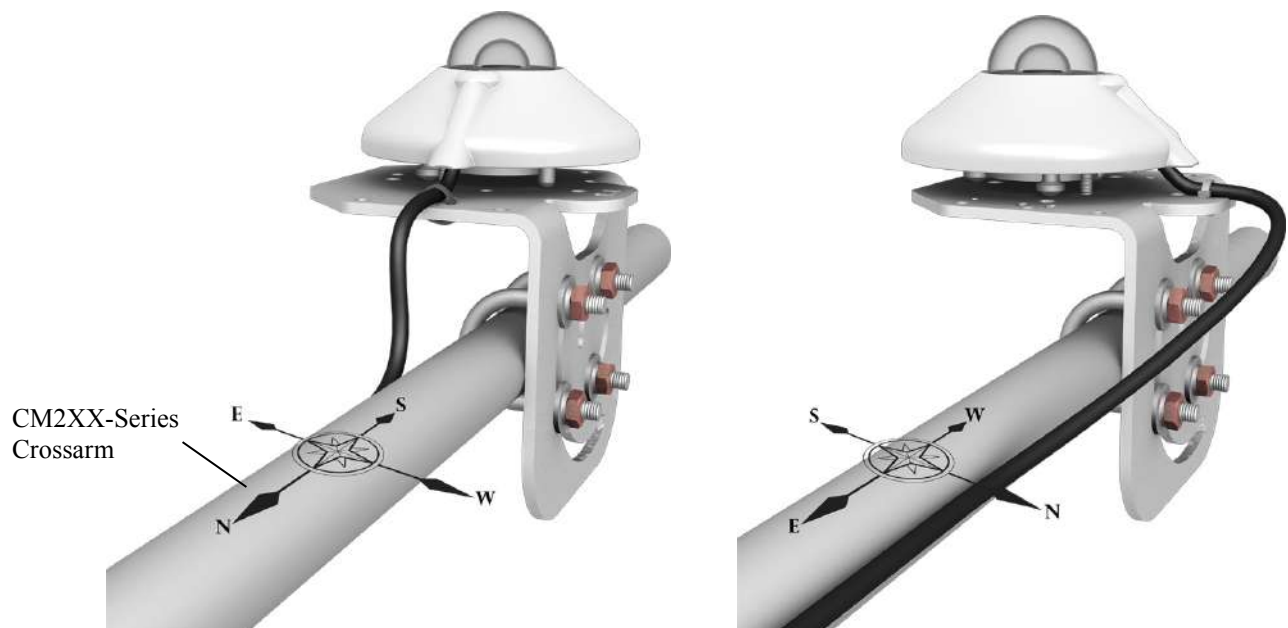


FIGURE 4-2. Pyranometer mounted horizontally for the Northern Hemisphere (left) and Southern Hemisphere (right)



FIGURE 4-3. Two views of a pyranometer mounted at an angle for the Northern Hemisphere



FIGURE 4-4. Pyranometer mounted at an angle for the Southern Hemisphere

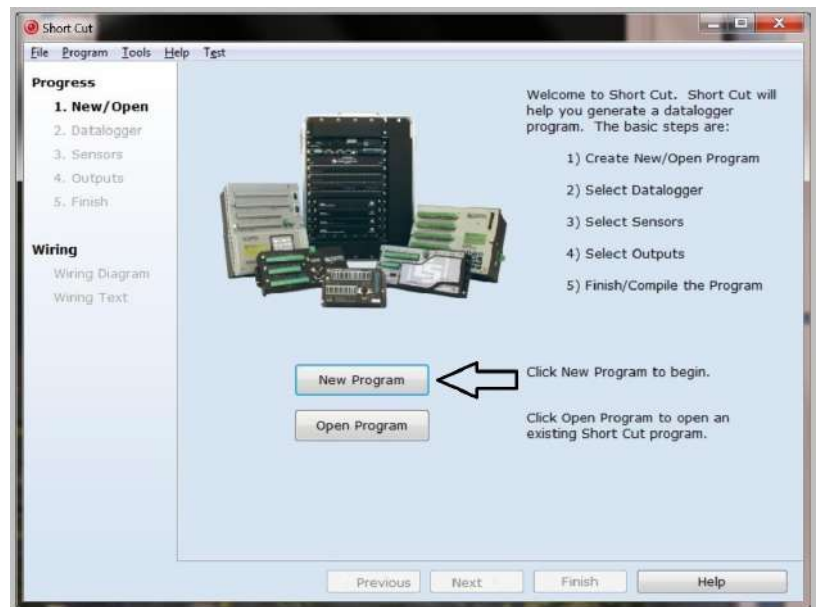
## 4.3 Short Cut Programming

**NOTE** The CMP21 is not included in *Short Cut*. Refer to Section 7, *Installation (p. 10)*, for wiring and programming information if not using *Short Cut*.

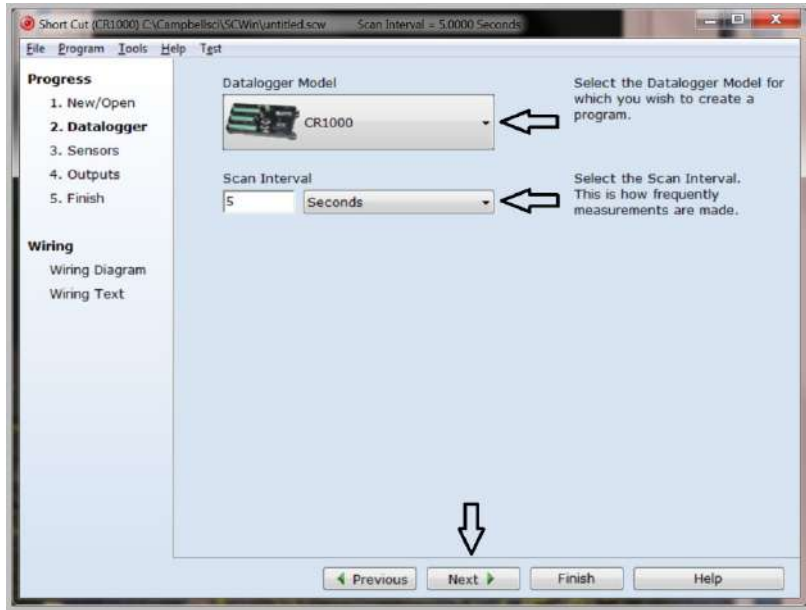
*Short Cut* is an easy way to program your datalogger to measure the pyranometer and assign datalogger wiring terminals. *Short Cut* is available as a download on [www.campbellsci.com](http://www.campbellsci.com) and the *ResourceDVD*. It is included in installations of *LoggerNet*, *PC200W*, *PC400*, or *RTDAQ*.


Use the following procedure to get started.

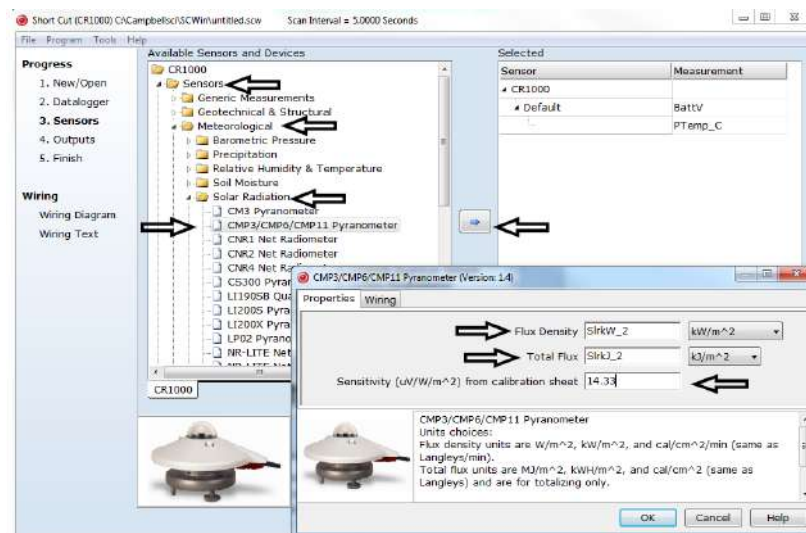
1. Open *Short Cut*. Click **New Program**.



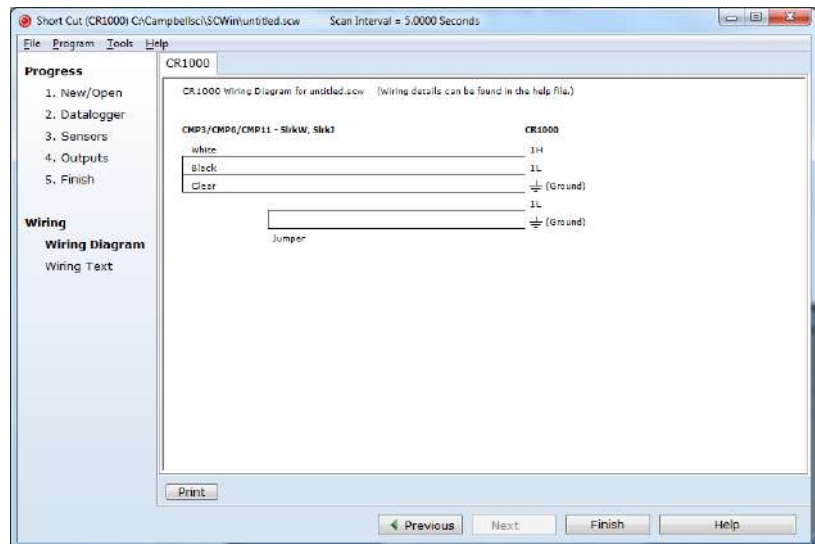
2. Select **Datalogger Model** and **Scan Interval** (default of 5 seconds is OK for most applications). Click **Next**.



3. Under the **Available Sensors and Devices** list, select **Sensors | Meteorological | Solar Radiation** folder. Select **CMP3/CMP6/CMP11 Pyranometer**. Click  to move the selection to the **Selected** device window. Default units are kW/m<sup>2</sup> for flux density units and kJ/m<sup>2</sup> for total flux. These can be changed by clicking the **Flux Density** and **Total Flux** boxes and selecting different values. A sensitivity value needs to be entered. This value is unique to each sensor and is listed on the calibration sheet that is included with the sensor.



- After selecting the sensor, click **Wiring Diagram** to see how the sensor is to be wired to the datalogger. The wiring diagram can be printed now or after more sensors are added.



- Select any other sensors you have, then finish the remaining *Short Cut* steps to complete the program. The remaining steps are outlined in *Short Cut Help*, which is accessed by clicking on **Help | Contents | Programming Steps**.
- If *LoggerNet*, *PC400*, *RTDAQ*, or *PC200W* is running on your PC, and the PC to datalogger connection is active, you can click **Finish** in *Short Cut* and you will be prompted to send the program just created to the datalogger.
- If the sensor is connected to the datalogger, as shown in the wiring diagram in step 4, check the output of the sensor in the datalogger support software data display to make sure it is making reasonable measurements.

## 5. Overview

### 5.1 Models

CMP-series models differ in accuracy and performance (see Section 6, *Specifications (p. 8)*). The CMP21 also includes an internal thermistor allowing individually optimized compensation of the measurements.

The -L portion of the model number indicates that the pyranometer has a user-specified cable length. The pyranometers have several cable termination options. Their cables can terminate in:

- Pigtails that connect directly to a Campbell Scientific datalogger (cable termination option -PT).
- Connector that attaches to a prewired enclosure (cable termination option -PW).
- Connector that attaches to a CWS900 Wireless Sensor Interface (cable termination option -CWS). The CWS900 enables the pyranometer to

be used in a wireless sensor network. Please note that this option is not available for the CMP21.

## 5.2 Construction

The pyranometers consist of a thermopile sensor, housing, two glass domes, and cable. The thermopile is coated with a black absorbent coating. The paint absorbs the radiation and converts it to heat. The resultant temperature difference is converted to a voltage by the copper-constantan thermopile. The thermopile is encapsulated in the housing in such a way that it has a field of view of 180 degrees and the angular characteristics needed to fulfill the cosine response requirements.

# 6. Specifications

### Features:

- Double glass dome
- Integrated bubble level is visible without removing sun shield
- Measures reflected solar radiation when inverted
- Desiccant-filled drying cartridge prevents dew from forming on the inner sides of the domes
- Provides measurements in direct sunlight, under plant canopies, when the sky is cloudy, and in artificial light
- Compatible with Campbell Scientific CRBasic dataloggers: CR300 series, CR6 series, CR800 series, CR1000, CR3000, CR5000, and CR9000(X).

## 6.1 Pyranometers

Dimensions are shown in FIGURE 6-1 and the other specifications are provided in TABLE 6-1.

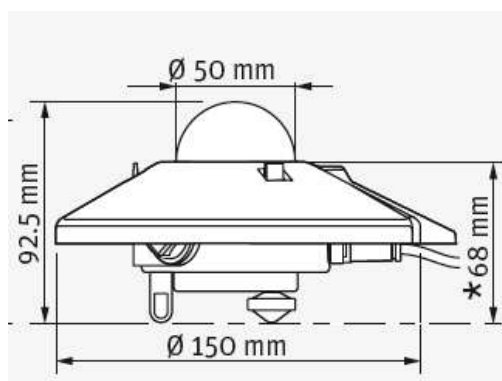


FIGURE 6-1. Dimensions of the CMP6, CMP11, and CMP21

TABLE 6-1. CMP-series Specifications

TABLE 6-1. CMP-series Specifications			
Specification	CMP6	CMP11	CMP21
ISO Classification	First Class	Secondary Standard	
Maximum irradiance	2000 W•m <sup>-2</sup>	4000 W•m <sup>-2</sup>	
Spectral range (50% points)	285 to 2800 nm		
Response time (95 %)	<18 s	<5 s	
Expected daily uncertainty	<5%	<2%	
Zero offset due to thermal radiation (200 W•m <sup>-2</sup> )	<15 W•m <sup>-2</sup>	<7 W•m <sup>-2</sup>	
Zero offset due to temperature change (5 K•hr <sup>-1</sup> )	<4 W • m <sup>-2</sup>	<2 W•m <sup>-2</sup>	
Non-stability (change/year)	<1 %	<0.5%	
Non-linearity (0 to 1000 W•m <sup>-2</sup> )	<1%	<0.2%	
Directional error (up to 80° with 1000 W•m <sup>-2</sup> beam)	<20 W•m <sup>-2</sup>	<10 W•m <sup>-2</sup>	
Tilt error (at 1000 W•m <sup>-2</sup> )	<1%	<0.2%	
Level accuracy	0.1°		
Operating temperature	-40 to 80 °C		
Temperature dependence of sensitivity	<4% (-10 to 40 °C)	<1% (-10 to 40 °C)	<1% (-20 to 50 °C)
Sensitivity	5 to 20 µV / W•m <sup>-2</sup>	7 to 14 µV / W•m <sup>-2</sup>	
Typical signal output for atmospheric applications	0 to 20 mV	0 to 15 mV	
Weight	0.6 kg (1.3 lb) without cable; 0.9 kg (2 lb) with 10 m (33 ft) cable		
Impedance <sup>1</sup>	20 to 200 Ω	10 to 100 Ω	
<sup>1</sup> Impedance is defined as the total electrical impedance at the radiometer output connector fitted to the housing. It arises from the electrical resistance in the thermal junctions, wires, and passive electronics within the radiometer.			

## 6.2 CVF4 Ventilation Unit

**Compatible pyranometers:** CMP6, CMP11, CMP21

**Power supply:** 12 Vdc, 0.9 A (with 5.5 W Heater)

**Operating temperature range:** -40 to 70 °C

**Ventilation power:** 5 W continuously

**Heating power:** 5.5 W

<b>Heater induced offset:</b>	<1 W•m <sup>-2</sup> (with CMP11 Pyranometer)
<b>Weight without cable:</b>	1.6 kg (3.5 lb)
<b>Height:</b>	12.95 cm (5.1 in)
<b>Length:</b>	35.5 cm (14.0 in)
<b>Width:</b>	23.0 cm (9.1 in)

## 7. Installation

If you are programming your datalogger with *Short Cut*, skip Section 7.2, *Wiring* (p. 11), and Section 7.3, *Programming* (p. 14). *Short Cut* does this work for you. See Section 4.3, *Short Cut Programming* (p. 5), for a tutorial.

### 7.1 Mounting to a Tripod or Tower

Tools required for installation on a tripod or tower:

Small and medium Phillips screwdrivers  
5/16-inch, 1/2-inch open end wrenches  
5/32-inch Allen wrench  
Tape measure  
UV-resistant wire ties  
Side-cut pliers  
Compass  
Step ladder

The pyranometers include a bubble level and two leveling screws, which allow them to be leveled horizontally without using a leveling base. They typically mount to a crossarm via the CM255 or CM255LS Mounting Stand.

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**NOTE**

The CM255 and CM255LS are not compatible with a pyranometer housed in a CVF4 Ventilation Unit. The CVF4 mounts to a tripod or tower using the 31153 mounting stand and either the CM220 Right-Angle Mount or the 17953 1 inch by 1 inch NU-RAIL. Refer to Appendix C, *CVF4 Ventilation Unit* (p. C-1), for more information.

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The CM255 and CM255LS can be adjusted to any angle from horizontal to vertical. If mounting the pyranometer at an angle, ensure that the crossarm is leveled horizontally before placing the bracket at its proper angle. Refer to the [015ARM, CM225, CM255, CM255LS Solar Radiation Sensor Mounts](#) manual for more information.

Do the following to level the pyranometer horizontally (see FIGURE 7-1):

1. Attach the mounting stand to the crossarm.
2. Loosely mount the pyranometer on the mounting stand. Do not fully tighten the two mounting screws.

3. Turn the leveling screws as required to bring the bubble of the level within the ring.
4. Tighten the mounting screws to secure the assembly in its final position. Check that the pyranometer is still correctly leveled and adjust as necessary.
5. Attach the white plastic sun screen to the pyranometer.
6. Route the sensor cable along the underside of the crossarm to the tower/tripod mast, and to the instrument enclosure.
7. Secure the sensor cable to the crossarm and mast using cable ties.

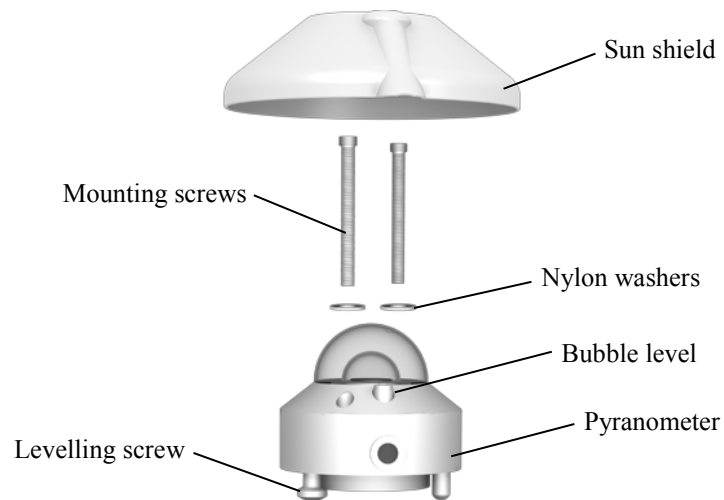


FIGURE 7-1. Exploded view of the pyranometer

## 7.2 Wiring

The cable of the CMP6 and CMP11 has two conductors and a shield. The cable of the CMP21 has five conductors and a shield. The additional conductors on the CMP21's cable are for connecting its internal thermistor. A schematic for the CMP6, CMP11, and the thermopile of the CMP21 is provided in Section [7.2.1, CMP6, CMP11, and CMP21 Thermopile Schematic \(p. 12\)](#). Wiring for the CMP6 and CMP11 is described in Section [7.2.2, CMP6 and CMP11 Wiring \(p. 12\)](#). Wiring for the CMP21 is described in Section [7.2.3, CMP21 Wiring \(p. 13\)](#).

### 7.2.1 CMP6, CMP11, and CMP21 Thermopile Schematic

A schematic diagram of a CMP6, CMP11, or CMP21 thermopile is shown in FIGURE 7-2.

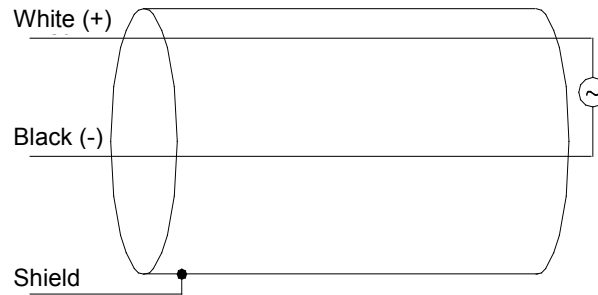


FIGURE 7-2. CMP6, CMP11, and CMP21 thermopile detector schematic

### 7.2.2 CMP6 and CMP11 Wiring

#### NOTE

A CMP6 or CMP11 purchased from Campbell Scientific has different wiring than a pyranometer purchased directly from Kipp & Zonen.

Connections to Campbell Scientific dataloggers are given in TABLE 7-1. The pyranometer can be measured using either differential or single-ended analog channels. The differential measurement has better noise rejection and is therefore recommended. For differential measurements, a user-supplied jumper wire needs to be connected between the low side of the differential input and ground to keep the signal in common mode range.

TABLE 7-1. CMP6 and CMP11 Wire Color, Function, and Datalogger Connection

Wire Color	Wire Function	Differential Datalogger Connection Terminal	Single-Ended Datalogger Connection Terminal
White	Signal High	U configured for differential input <sup>1</sup> , <b>DIFF H</b> (differential high, analog-voltage input)	U configured for single-ended analog input <sup>1</sup> , <b>SE</b> (single-ended, analog-voltage input)
Black	Signal Reference	U configured for differential input <sup>1, 2</sup> , <b>DIFF L</b> (differential low, analog-voltage input) <sup>2</sup>	AG or $\perp$ (analog ground)
Clear	Shield	AG or $\perp$ (analog ground)	AG or $\perp$ (analog ground)

<sup>1</sup>U channels are automatically configured by the measurement instruction.

<sup>2</sup>Jumper to AG or  $\perp$  with a user-supplied wire.

### 7.2.3 CMP21 Wiring

**NOTE**

A CMP21 purchased from Campbell Scientific has different wiring than a CMP21 purchased directly from Kipp & Zonen.

Connections to Campbell Scientific dataloggers are given in TABLE 7-2.

The CR21's pyranometer can be measured using either differential or single-ended analog channels. The differential measurement has better noise rejection and is therefore recommended. For differential measurements, a user-supplied jumper wire needs to be connected between the low side of the differential input and ground to keep the signal in common mode range. A single-ended channel and a voltage excitation channel are used to measure the CMP21's internal thermistor.

**TABLE 7-2. CMP21 Wire Color, Function, and Datalogger Connection**

Wire Color	Wire Function	Differential Datalogger Connection Terminal	Single-Ended Datalogger Connection Terminal
White	Pyranometer Signal High	U configured for differential input <sup>1</sup> , <b>DIFF H</b> (differential high, analog-voltage input)	U configured for single-ended analog input <sup>1</sup> , <b>SE</b> (single-ended, analog-voltage input)
Blue	Pyranometer Signal Reference	U configured for differential input <sup>1,2</sup> , <b>DIFF L</b> (differential low, analog-voltage input) <sup>2</sup>	AG or $\perp$ (analog ground)
Yellow	Thermistor Voltage Excitation	U configured for voltage excitation <sup>1</sup> , <b>EX, VX</b> (voltage excitation)	U configured for voltage excitation <sup>1</sup> , <b>EX, VX</b> (voltage excitation)
Black	Thermistor Signal	U configured for single-ended analog input <sup>1</sup> , <b>SE</b> (single-ended, analog-voltage input)	U configured for single-ended analog input <sup>1</sup> , <b>SE</b> (single-ended, analog-voltage input)
Brown	Thermistor Reference	AG or $\perp$ (analog ground)	AG or $\perp$ (analog ground)
Clear	Shield	AG or $\perp$ (analog ground)	AG or $\perp$ (analog ground)

<sup>1</sup>U channels are automatically configured by the measurement instruction.

<sup>2</sup>Jumper to AG or  $\perp$  with a user-supplied wire.

## 7.3 Programming

*Short Cut* is the best source for up-to-date datalogger programming code. Programming code is needed when:

- Creating a program for a new datalogger installation
- Adding sensors to an existing datalogger program

If your data acquisition requirements are simple, you can probably create and maintain a datalogger program exclusively with *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 Section 4, *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 Appendix A, *Importing Short Cut Code Into CRBasic Editor* (p. A-1). Programming basics for CRBasic dataloggers are provided below. Complete program examples for select dataloggers can be found in Appendix B, *Example Programs* (p. B-1).

### 7.3.1 Solar Radiation Measurements

Solar radiation can be reported as an average flux density ( $\text{W}\cdot\text{m}^{-2}$ ) or daily total flux density ( $\text{MJ}\cdot\text{m}^{-2}$ ). The appropriate multipliers are listed in TABLE 7-3. Programming examples are given for both average and daily total solar radiation.

The pyranometers output a low level voltage ranging from 0 to a maximum of up to 20 mV, in natural light, depending on the calibration factor and radiation level.

This voltage output is measured using either the **VoltDiff()** CRBasic instruction or **VoltSE()** CRBasic instruction.

---

**CAUTION**

Nearby AC power lines, electric pumps, or motors can be a source of electrical noise. If the sensor or datalogger is located in an electrically noisy environment, the measurement should be made with the 60 or 50 Hz rejection integration option as shown in the example programs.

---

#### 7.3.1.1 Input Range

The output voltage is usually between 5 and 20 mV per  $1000 \text{ W}\cdot\text{m}^{-2}$ . When estimating the maximum likely value of sensor output a maximum value of solar radiation of  $1100 \text{ W}\cdot\text{m}^{-2}$  can be used for field measurements on a horizontal surface. Plane of array irradiances can exceed  $1500 \text{ W}\cdot\text{m}^{-2}$ .

Select the input range as follows:

1. Estimate the maximum expected input voltage by multiplying the maximum expected irradiance (in  $\text{W}\cdot\text{m}^{-2}$ ) by the calibration factor (in  $\mu\text{V} / \text{W}\cdot\text{m}^{-2}$ ). Divide the answer by 1000 to give the maximum in millivolt units.
2. Select the smallest input range which is greater than the maximum expected input voltage. Normally the 50 mV range for the CR3000, CR5000, or CR9000(X), and the 25 mV range for the CR800, CR850, and CR1000, and the 200 mV range for the CR6. The exact range will depend on the sensitivity of your individual sensor and the maximum expected reading. With some dataloggers an autorange option can be used if measurement time is not critical.

The parameter code for the input range also specifies the measurement integration time. The slow or 60 Hz rejection integration gives a more noise-free reading. The 250  $\mu\text{s}$  integration takes less power and allows for faster throughput.

### 7.3.1.2 Multiplier

The multiplier converts the millivolt reading to engineering units. The sensitivity value supplied by the manufacturer gives the output of the sensor as  $\mu\text{V}$  (micro-volts) /  $\text{W}\cdot\text{m}^{-2}$ . As the datalogger voltage measurement instructions give a default output in mV, the following equation should be used to calculate the multiplier to give the readings in  $\text{W}\cdot\text{m}^{-2}$ :

$$M = 1000/c$$

Where,

M = multiplier

c = sensor output in  $\mu\text{V} / \text{W}\cdot\text{m}^{-2}$

Other units can be used by adjusting the multiplier as shown in TABLE 7-3.

TABLE 7-3. Multipliers Required for Flux Density and Total Fluxes		
Units	Multiplier	Output Processing
$\text{W}\cdot\text{m}^{-2}$	M	Average
$\text{MJ}\cdot\text{m}^{-2}$	$M \cdot t \cdot 0.000001$	Totalize
$\text{kJ}\cdot\text{m}^{-2}$	$M \cdot t \cdot 0.001$	Totalize
$\text{cal}\cdot\text{cm}^{-2}$	$M \cdot t \cdot 0.0239 \cdot 0.001$	Totalize
$\text{cal} \cdot \text{cm}^{-2} \cdot \text{min}^{-1}$	$M \cdot 1.434 \cdot 0.001$	Average
$\text{W} \cdot \text{hr} \cdot \text{m}^{-2}$	$M \cdot t / 3600$	Totalize
M = calibration factor with units of $\text{W}\cdot\text{m}^{-2} / \text{mV}$ t = datalogger program execution interval in seconds		

### 7.3.1.3 Offset

The offset will normally be fixed at zero as the sensor should output no significant signal in dark conditions. In practice, because of the nature of thermopile detector sensors, there will be some offset in dark conditions; sometimes this offset can give negative light readings. This offset varies with

several factors (e.g., rate of change of sensor temperature), so it cannot be removed with a fixed offset. Some users may wish to remove small negative readings by including code after the measurement instructions that sets negative readings to zero.

#### 7.3.1.4 Output Format Considerations

Over-ranging may be an issue if the measurement values are totalized. Over-ranging can be prevented when using CRBasic by storing the data in the IEEE4 format.

### 7.3.2 CMP21 Internal Thermistor Measurement

The thermistor is measured using the BrHalf CRBasic instruction. The value provided by the half bridge instruction needs to be converted to resistance and then converted to temperature.

The following equation is used to convert to resistance:

$$\text{Res.} = 1000 \left( \frac{V_x}{1 - V_x} \right)$$

Where,

V<sub>x</sub> = the value provided by the half bridge instruction

In CRBasic, the conversion to resistance is entered as a mathematical expression.

The Steinhart-Hart equation is used to convert resistance to temperature. The Steinhart-Hart equation for converting resistance to degree Celsius is as follows:

$$\text{Temperature} = 1/[A + B \cdot \text{LN}(\text{resistance}) + C \cdot (\text{LN}(\text{resistance}))^3] - 273.15$$

Where A, B, and C are coefficients for the Steinhart-Hart equation.

The coefficients for the Steinhart-Hart equation are specific to the thermistor contained in your CMP21. A calibration certificate that lists these coefficients is shipped with each CMP21 pyranometer.

In CRBasic, the Steinhart-Hart equation is entered as a mathematical expression.

## 8. Maintenance/Troubleshooting

### 8.1 Maintenance

At regular intervals, physically inspect the pyranometer to ensure that:

- Dome is free of dirt, condensation, and ice (see Section 8.1.1, *Cleaning Domes* (p. 17)).
- Desiccant granules are orange and opaque (see Section 8.1.2, *Changing the Desiccant* (p. 17)).

- Mounting is secure.
- Pyranometer is level (if mounted horizontally).
- Cables are in good condition.

### 8.1.1 Cleaning Domes

Clean the outer dome at regular intervals (e.g., every week or so). Remove any accumulated dust, condensation, or ice from the dome and pyranometer body using a soft cloth dampened with water or alcohol (see FIGURE 8-1).



FIGURE 8-1. Reading is reduced if dome is not dry or clean

### 8.1.2 Changing the Desiccant

A desiccant-filled drying cartridge prevents dew from forming on the inner sides of the domes; Campbell Scientific pn 27052 is the replacement desiccant for this cartridge. The optional CVF4 Heater/Ventilator Unit is also available to keep the pyranometer dome free from ice and dew (see Appendix C, *CVF4 Ventilation Unit (p. C-1)*). In some applications, the CVF4 may also reduce the deposition of dust on the pyranometer dome, and therefore reduce the cleaning interval frequency.

The silica gel desiccant granules in the drying cartridge should be orange and opaque. Replace the desiccant granules when they become translucent (normally after several months). Refill packs of desiccant are shipped with the pyranometer and can be purchased from Campbell Scientific. The drying cartridge uses the content of one refill pack. FIGURE 8-2 shows the replacement process.

When changing the desiccant, ensure that:

- The surfaces touching the rubber O-ring are clean. Dirt, in combination with water, can cause corrosion, harming it.
- The rubber O-ring is coated with silicon grease or petroleum jelly. The grease coating improves the O-ring's seal.
- The drying cartridge is tightly threaded into the pyranometer's body.

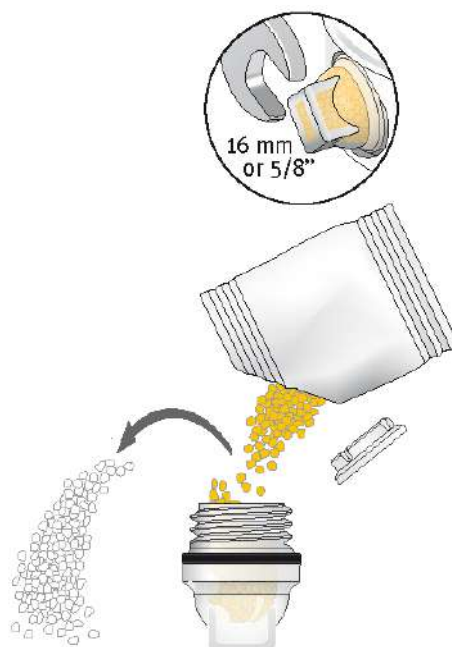


FIGURE 8-2. Changing the desiccant

### 8.1.3 Check Sensor Output

It is also important to check the data returned from the sensor as it will show the first indication of a fault. When doing this you should be aware of several expected phenomena that can cause strange measurements. In particular, on clear, windless nights the outer dome temperature of horizontally placed pyranometers can fall as low as the dew point temperature of the air, due to infrared radiation exchange with the cold sky. (The effective sky temperature can be 30 °C lower than the ground temperature, which results in an infrared emission of  $-150 \text{ W}\cdot\text{m}^{-2}$ ). If this happens, dew, glazed frost or hoar frost can be precipitated on the top of the outer dome and can stay there for several hours in the morning. An ice cap on the dome is a strong diffuser and can increase the pyranometer signal by up to 50% in the first hours after sunrise.

## 8.2 Recalibration

The calibration of the pyranometer may drift with time and exposure to radiation. Recalibration every two years is recommended. The sensor should be returned to Campbell Scientific for recalibration. A Returned Materials Authorization (RMA) is required (refer to the Assistance page for more information).

## 8.3 Troubleshooting

Symptom: NAN, -9999, or radiation values around 0

1. Check that the sensor is wired to the differential channel specified by the measurement instruction.
2. Verify that the range code is correct for the datalogger type.

3. Measure the impedance across the red and blue sensor wires. This should be around 100 ohms plus the cable resistance (typically  $0.1 \text{ ohm} \cdot \text{m}^{-1}$ ). If the resistance is very low, there may be a short circuit (check the wiring). Resistances somewhat lower than expected could be due to water ingress into the sensor or enclosure connectors. If the resistance is infinite, there is a broken connection (check the wiring).
4. Disconnect the sensor cable and check the voltage output from the sensor. With the sensor located 8 inches below a 60 W incandescent light bulb the voltage should be approximately 2.5 mV. No voltage indicates a problem with the sensor.

Symptom: sensor signal is unrealistically high or low

1. Check that the right calibration factor has been properly entered into the datalogger program. Please note that each sensor has its own individual calibration factor.
2. Check the condition of the sensor cable.

Symptom: sensor signal shows unexpected variations

1. Check for the presence of strong sources of electromagnetic radiation (radar, radio, etc.).
2. Check the condition and the connection of the sensor shield wire.
3. Check the condition of the sensor cable.



# Appendix A. Importing Short Cut Code Into CRBasic Editor

---

This tutorial shows:

- How to import a *Short Cut* program into a program editor for additional refinement
- How to import a wiring diagram from *Short Cut* into the comments of a custom program

*Short Cut* creates files, which can be imported into *CRBasic Editor*. Assuming defaults were used when *Short Cut* was installed, these files reside in the C:\campbellsci\SCWin folder:

- .DEF (wiring and memory usage information)
- .CR300 (CR300-series datalogger code)
- .CR6 (CR6-series datalogger code)
- .CR8 (CR800-series datalogger code)
- .CR1 (CR1000 datalogger code)
- .CR3 (CR3000 datalogger code)
- .CR5 (CR5000 datalogger code)
- .CR9 (CR9000(X) datalogger code)

Use the following procedure to import *Short Cut* code and wiring diagram into *CRBasic Editor*.

1. Create the *Short Cut* program following the procedure in Section 4, *QuickStart* (p. 2). Finish the program and exit *Short Cut*. Make note of the file name used when saving the *Short Cut* program.
2. Open *CRBasic Editor*.
3. Click **File | Open**. Assuming the default paths were used when *Short Cut* was installed, navigate to C:\CampbellSci\SCWin folder. The file of interest has the .CR300, .CR6, .CR8, .CR1, .CR3, .CR5, or .CR9 extension. Select the file and click **Open**.
4. Immediately save the file in a folder different from C:\Campbellsci\SCWin, or save the file with a different file name.

---

## NOTE

Once the file is edited with *CRBasic Editor*, *Short Cut* can no longer be used to edit the datalogger program. Change the name of the program file or move it, or *Short Cut* may overwrite it next time it is used.

---

5. The program can now be edited, saved, and sent to the datalogger.
6. Import wiring information to the program by opening the associated .DEF file. Copy and paste the section beginning with heading “-Wiring for CRXXX-” into the CRBasic program, usually at the head of the file. After pasting, edit the information such that an apostrophe (') begins each line. This character instructs the datalogger compiler to ignore the line when compiling.



# Appendix B. Example Programs


## NOTE

For an example program for using the CVF4 ventilator, see Appendix C, *CVF4 Ventilation Unit (p. C-1)*.

## B.1 CR1000 Example Program for Measuring a CMP6

Although this example is for the CR1000, other CRBasic dataloggers are programmed similarly. The following program measures the CMP6 every second and converts the millivolt output to  $W \cdot m^{-2}$ . A sensor calibration of  $14.33 \mu V / W \cdot m^{-2}$  is used for the example program. Every 10 minutes, the program outputs the average and standard deviation of the flux ( $W \cdot m^{-2}$ ) measurements.

Wiring for this example is given in TABLE B-1.

TABLE B-1. CR1000 Wiring for CMP6 Example Program			
Wire Color	Description	CR1000	Jumper <sup>1</sup>
White	Solar Signal (+)	1H	
Black	Solar Signal (–)	1L	
Clear	Shield	⏏	
<sup>1</sup> Jumper 1L to ⏏ with user-supplied 26 AWG or larger wire.			

CRBasic Example B-1. CR1000 Example Program for Measuring a CMP6

```
'CR1000 Series Datalogger

Public PTemp
Public Batt_Volt
Public CMP6_Irr

Units CMP6_Irr = W/m2

DataTable (TenMin,1,-1)
  DataInterval (0,1,Min,4)
  Minimum (1,Batt_Volt,FP2,0,False)
  Sample (1,PTemp,FP2)
  Average (1,CMP6_Irr,FP2,False)
  StdDev (1,CMP6_Irr,FP2,False)
EndTable

BeginProg
  Scan (1,Sec,0,0)

  'Measure the Battery Voltage and Panel Temperature
  PanelTemp (PTemp,250)
  Battery (Batt_Volt)

  'Measure the CMP6
  VoltDiff (CMP6_Irr,1,mV25C,1,True ,10000,_60Hz,1000/14.33,0)


  CallTable TenMin

NextScan
EndProg
```

## B.2 CR1000 Example Program for Measuring a CMP11

Although this example is for the CR1000, other CRBasic dataloggers are programmed similarly. The following program measures the CMP11 every second and converts the millivolt output to  $\text{W}\cdot\text{m}^{-2}$ . A sensor calibration of  $8.55 \mu\text{V} / \text{W}\cdot\text{m}^{-2}$  is used for the example program. Every 10 minutes, the program outputs the average and standard deviation of the flux ( $\text{W}\cdot\text{m}^{-2}$ ) measurements.

Wiring for this example is given in TABLE B-2.

TABLE B-2. CR1000 Wiring for CMP11 Example Program			
Wire Color	Description	CR1000	Jumper <sup>1</sup>
White	Solar Signal (+)	2H	
Black	Solar Signal (–)	2L	
Clear	Shield	⏏	
<sup>1</sup> Jumper 2L to ⏏ with user-supplied 26 AWG or larger wire.			

**CRBasic Example B-2. CR1000 Example Program for Measuring a CMP11**

```
'CR1000 Series Datalogger

Public PTemp
Public Batt_Volt
Public CMP11_Irr

Units CMP11_Irr = W/m2

DataTable (TenMin,1,-1)
  DataInterval (0,1,Min,4)
  Minimum (1,Batt_Volt,FP2,0,False)
  Sample (1,PTemp,FP2)
  Average (1,CMP11_Irr,FP2,False)
  StdDev (1,CMP11_Irr,FP2,False)
EndTable

BeginProg
  Scan (1,Sec,0,0)

    'Measure the Battery Voltage and Panel Temperature
    PanelTemp (PTemp,250)
    Battery (Batt_Volt)

    'Measure the CMP11
    VoltDiff (CMP11_Irr,1,mV25C,2,True ,10000,_60Hz,1000/8.55,0)


  CallTable TenMin

NextScan
EndProg
```

## B.3 CR1000 Example Program for Measuring a CMP21

Although this example is for the CR1000, other CRBasic dataloggers are programmed similarly. The following program measures the CMP21 every second. It converts the pyranometer's millivolt output to  $\text{W}\cdot\text{m}^{-2}$ . A pyranometer calibration of  $8.65 \mu\text{V} / \text{W}\cdot\text{m}^{-2}$  is used for the example program. The resistance of the internal thermistor is converted to degree Celsius and then to Kelvin. Every 10 minutes, the program outputs the average and standard deviation of the flux ( $\text{W}\cdot\text{m}^{-2}$ ) measurements and temperature measurements.

Wiring for this example is given in TABLE B-3.

TABLE B-3. CR1000 Wiring for CMP21 Example Program			
Wire Color	Description	CR1000	Jumper <sup>1</sup>
White	Solar Signal (+)	3H	
Blue	Solar Signal (-)	3L	
		$\perp$	
Yellow	Voltage Excitation	VX1	
Black	Temp Signal	15 SE	
Brown	Signal Reference	$\perp$	
Clear	Shield	$\perp$	

<sup>1</sup> Jumper 3L to  $\perp$  with user-supplied 26 AWG or larger wire.

**CRBasic Example B-3. CR1000 Example Program for Measuring a CMP21**

```
'CR1000 Series Datalogger

Public PTemp
Public Batt_Volt
Public CMP21_Irr
Public CMP21_T_C
Public CMP21_T_K
Dim Rs,Vs,Vx

Units CMP21_Irr = W/m2
Units CMP21_T_C = Degrees C
Units CMP21_T_K = Degrees K

DataTable (TenMin,1,-1)
  DataInterval (0,1,Min,8)
  Minimum (1,Batt_Volt,FP2,0,False)
  Sample (1,PTemp,FP2)
  Average (1,CMP21_Irr,FP2,False)
  StdDev (1,CMP21_Irr,FP2,False)
  Average (1,CMP21_T_C,FP2,False)
  StdDev (1,CMP21_T_C,FP2,False)
  Average (1,CMP21_T_K,FP2,False)
  StdDev (1,CMP21_T_K,FP2,False)
EndTable

BeginProg
```

```
Scan (1,Sec,0,0)

    'Measure the Battery Voltage and Panel Temperature
    PanelTemp (PTemp,250)
    Battery (Batt_Volt)

    'Measure the CMP21 pyranometer
    VoltDiff (CMP21_Irr,1,mV25C,3,True,10000,_60Hz,1000/8.65,0)

    'CMP21 Thermistor Measurement
    BrHalf (Vs_Vx,1,mV5000,15,Vx1,1,2500,True ,0,250,1.0,0)
    Rs = 1000*(Vs_Vx/(1-Vs_Vx))
    CMP21_T_C = 1/(1.0295e-3+2.391e-4*LN(Rs)+1.568e-7*(LN(Rs))^3)-273.15

    'Convert CMP21 temp to Kelvin.
    CMP21_T_K = CMP21_T_C+273.15

    CallTable TenMin

NextScan
EndProg
```

# Appendix C. CVF4 Ventilation Unit

---

## C.1 General Information

Ventilation of radiometers improves the reliability and accuracy of the measurement by reducing dust, raindrops and dew on the dome. With thermopile-based instruments ventilation stabilizes the temperature of the radiometer and suppresses thermal offsets. The integrated heater can be used to disperse precipitation and melt frost, or even melt snow and ice in cold climates.

CVF4 is a low power, low maintenance ventilation unit. The only part that needs maintenance is the removable air inlet filter, which should be checked at regular intervals and cleaned or replaced when necessary.

The flow that the CVF4 creates is unique. At the top of the pyranometer dome the flow is very high and it swirls to improve the air distribution over the dome. The position of the heaters and the new cover material ensures that only half the heating power is needed to melt frost and snow compared to older ventilation units.

CVF4 is designed to be used with Kipp & Zonen's:

- CMP / SMP pyranometers
- CGR 4 pyrgeometer
- CUV 5 total UV radiometer

CVF4 can be mounted on the 2AP and SOLYS 2 sun trackers.

CVF4 replaces the successful and widely used CVF3 ventilation unit.

The CVF4 is meant to run continuously. The heater can either be switched on permanently for cold regions or be switched by a Campbell Scientific datalogger to remove dew in the morning and be switched off afterwards. In that case, the heater could operate for a period of time before and after sunrise. This saves power in situations where power is limited, such as PV operated systems.

---

### NOTE

The CVF4 is manufactured by Kipp & Zonen and cabled by Campbell Scientific. The wiring of a CVF4 purchased from Campbell Scientific is different than the wiring of a CVF4 purchased directly from Kipp & Zonen.

---

## C.2 CVF4 Components

FIGURE C-1 and FIGURE C-2 show the components of the CVF4. It is shipped with a cover, power cable, eight washers, four screws, Allen wrench, and five spare filters (FIGURE C-3).

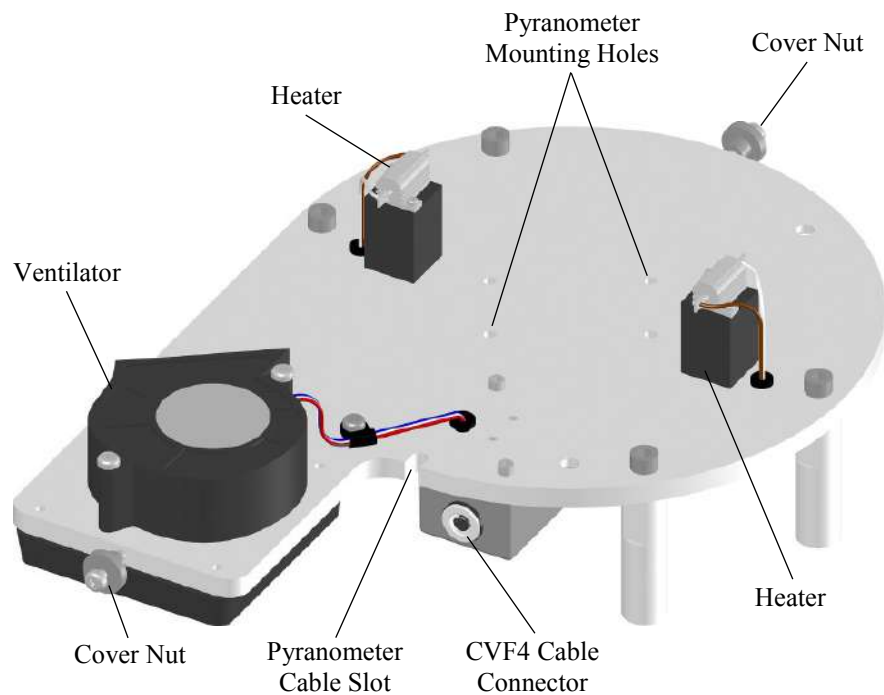


FIGURE C-1. CVF4 Components (top view, no cover)

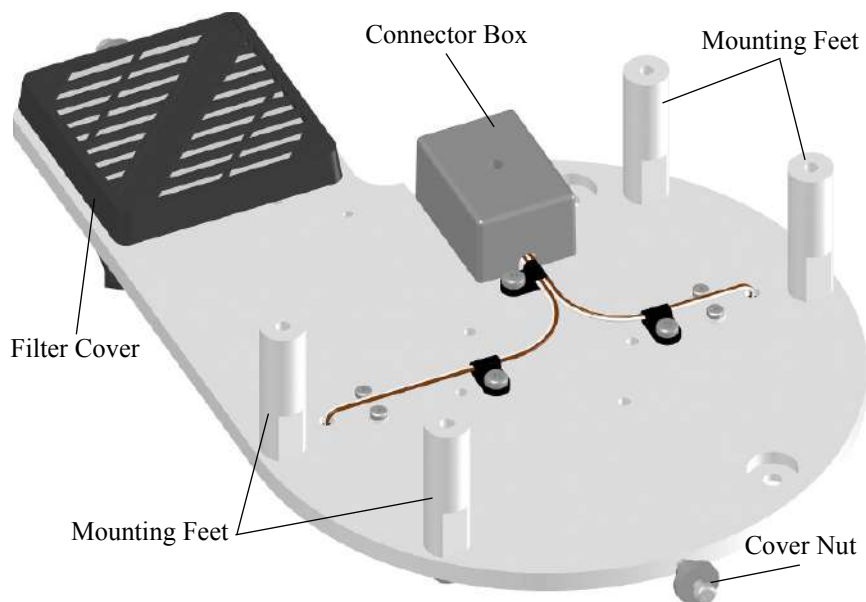


FIGURE C-2. CVF4 Components (bottom view)



FIGURE C-3. CVF4 Ventilation Unit and Ships With Kit

## C.3 CVF4 Installation

Siting information provided in Section 4.1, *Siting (p. 2)*, is pertinent when using the CVF4 heater/ventilation.

1. CVF4 heater/ventilator unit includes the heater/ventilator unit, white cover, cable, and mounting hardware. The CVF4 is mounted to a crossarm using the 31153 mount and either the CM220 Right-Angle Mounting Bracket or the 17953 1-inch by 1-inch NU-RAIL.

### NOTE

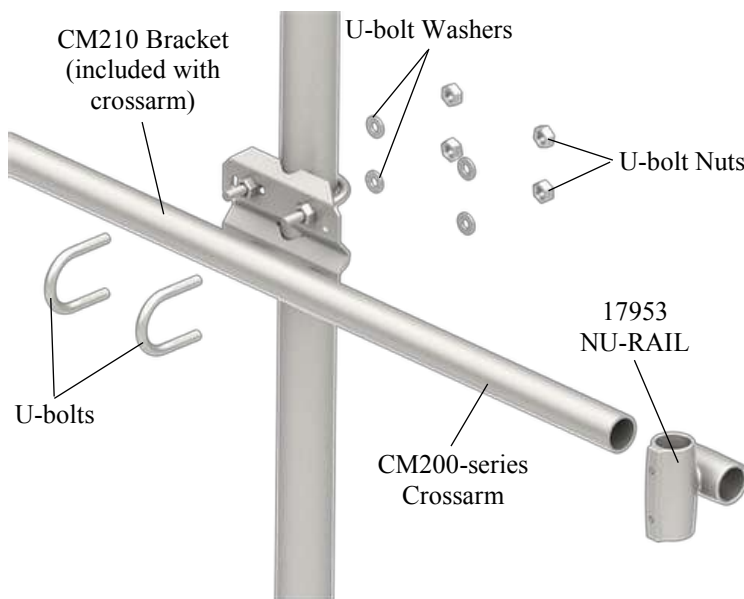
Refer to the Kipp & Zonen Instruction Manual if mounting the CVF4 to a SOLYS 2 Solar Tracker or to a CM 121C Shadow Ring.

Tools required for mounting to a tripod or tower are:

- Small and medium Phillips screwdrivers
- 5/16-inch, 1/2-inch open end wrenches
- 5/32-inch Allen wrench
- Tape measure
- UV-resistant wire ties
- Side-cut pliers
- Step ladder

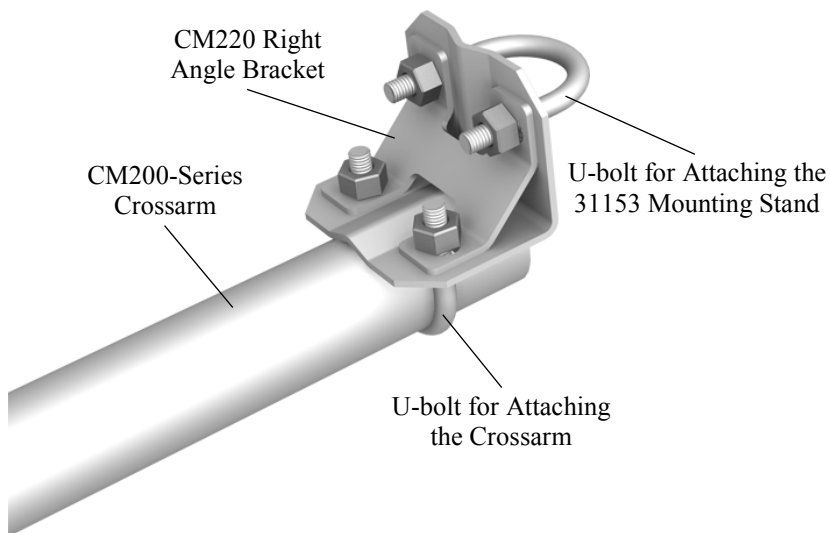
To install, do the following:

1. Mount the crossarm to the tripod or tower (FIGURE C-4).



**FIGURE C-4. Crossarm and 17953 NU-RAIL Mounted to Mast (exploded view)**

2. Attach the CM220 Right-Angle Mounting Bracket (FIGURE C-5) or a 17953 1 in. by 1 in. NU-RAIL (FIGURE C-4) to the crossarm.



**FIGURE C-5. CM220 Right-Angle Mounting Bracket attached to CM200-series crossarm**

3. Place the CVF4 (without the white plastic cover) on the 31153 with the fan hanging over the edge of the plate and with the mounting feet lined up with the mounting holes.
4. Fasten the CVF4's feet to the 31153 using the supplied washers and screws (FIGURE C-6).

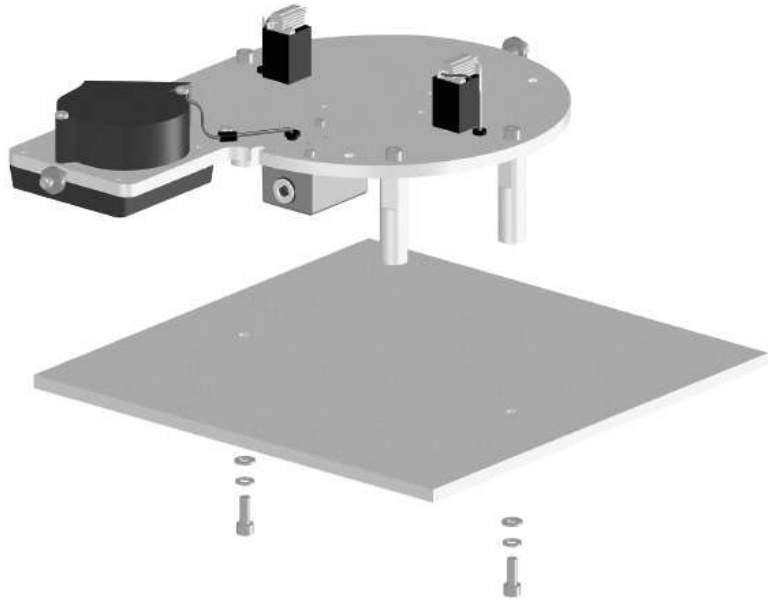


FIGURE C-6. Mounting CVF4 feet to a mounting stand

5. Loosely mount the pyranometer on the CVF4 using the mounting screws and washers. Do not fully tighten the pyranometer's two mounting screws (FIGURE C-7).

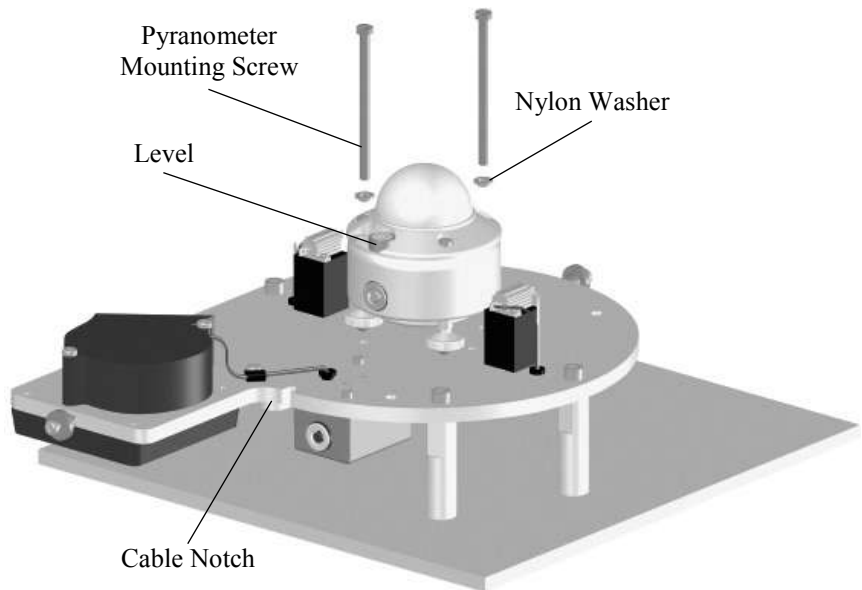


FIGURE C-7. Mounting the pyranometer to the CVF4

6. Turn the pyranometer's leveling screws as required to bring the bubble of the level within the ring.
7. Tighten the pyranometer's mounting screws to secure the assembly in its final position. Check that the pyranometer is still correctly leveled and adjust as necessary.
8. Route the pyranometer's cable through the cable notch.
9. Fit the white cover onto the CVF4 and secure it with the cover nuts (see FIGURE C-8).

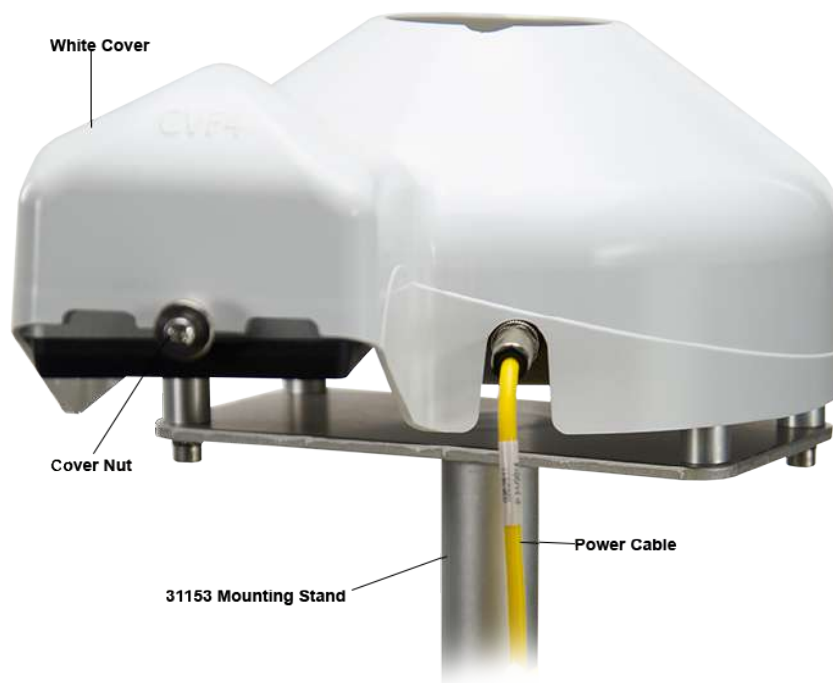


FIGURE C-8. CVF4 Mounted to 31153 Stand (pyranometer not shown)

10. Attach the power cable to the CVF4 connector.
11. Route the cables along the underside of the crossarm to the tower/tripod mast, and to the instrument enclosure.
12. Secure the cables to the crossarm and mast using cable ties.

## C.4 Wiring

Wiring of the CVF4 is shown in TABLE C-1 and TABLE C-2. Refer to Section 7.2, *Wiring (p. 11)*, for information about wiring the pyranometer.

**TABLE C-1. CVF4 8-Pin Wiring**

Wire Color	Description	Power Supply Connection	Datalogger Connection
Brown	Ventilator Power	+12V	--
Blue	Heater Power	+12V	--
Black	Power Ground	G	--
White	Tachometer Signal	--	U configured for pulse input <sup>1</sup> , P (pulse input), C (control port) or P_SW (pulse, switch closure input)
Clear	Shield	--	AG or $\frac{1}{2}$ (analog ground)
<sup>1</sup> U channels are automatically configured by the measurement instruction.			

**TABLE C-2. CVF4 4-Pin Wiring**

Wire Color	Description	Power Supply Connection	Datalogger Connection
Red	Ventilator Power	+12V	--
White	Heater Power	+12V	--
Black	Power Ground	G	--
Green	Tachometer Signal	--	U configured for pulse input <sup>1</sup> , P (pulse input), C (control port) or P_SW (pulse, switch closure input)
Clear	Shield	--	AG or $\frac{1}{2}$ (analog ground)
<sup>1</sup> U channels are automatically configured by the measurement instruction.			

C.4.1 Implementation Examples

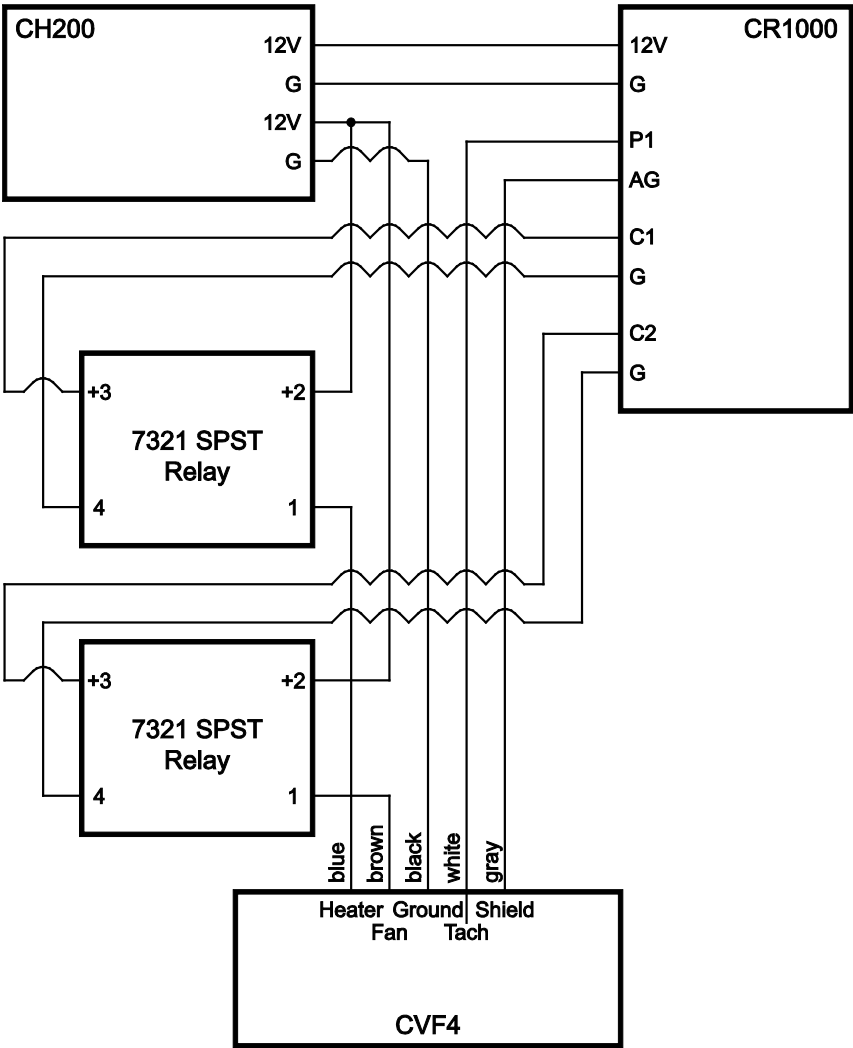


FIGURE C-9. 8-Pin Implementation Example

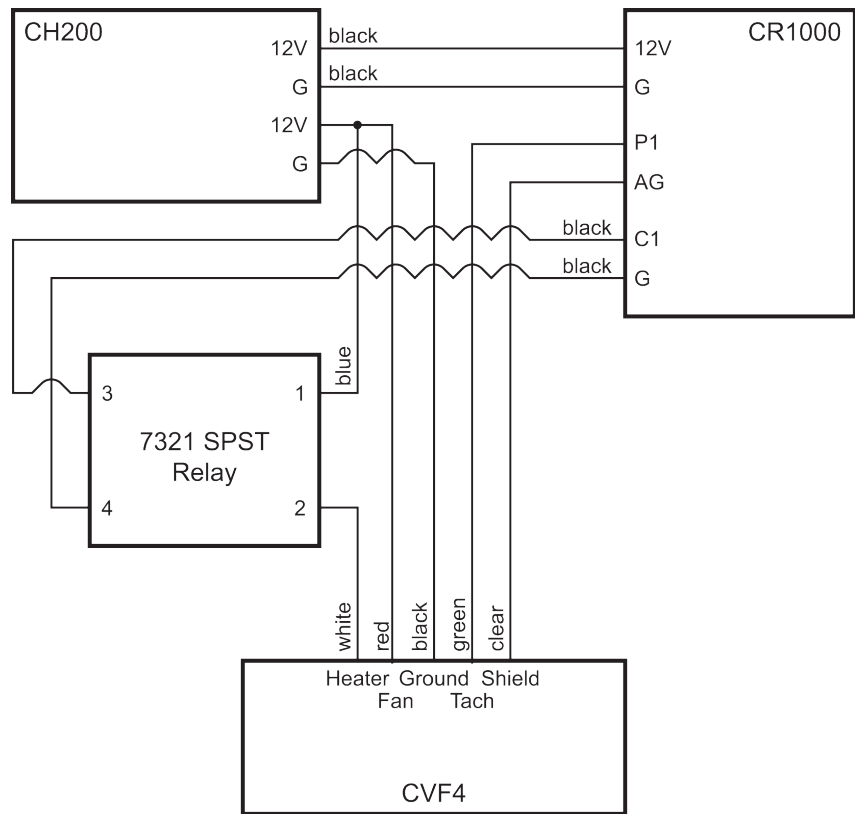


FIGURE C-10. 4-Pin Implementation Example

## C.5 CVF4 Example Program

### CRBasic Example C-1. CVF4 Example Program

```
'CR1000 Series Datalogger
'Example program for CVF4

'Declare Public Variables
Public PTemp, batt_volt
Public GH_Irradiance_CMP11
Public CVF4_Tach
Public SolarPos(5)
Public Airtemp
Public TimeArray(9)

'Declare Constants
Const CMP11_Sensitivity = 12.5
Const Latitude = 41.767561
Const Longitude = -111.85592
Const Altitude = 1358

'Define Aliases
Alias SolarPos(1) = SolarAzimuth
Alias SolarPos(2) = SunElevation
Alias SolarPos(3) = HourAngle
Alias SolarPos(4) = Declination
Alias SolarPos(5) = AirMass

'Define Data Tables
```

```

DataTable (Ten_Min,1,-1)
DataInterval (0,10,Min,10)
Minimum (1,batt_volt,FP2,0,False)
Sample (1,PTemp,FP2)
Average (1,GH_Irradiance_CMP11,FP2,False)
StdDev (1,GH_Irradiance_CMP11,FP2,False)
Average (1,CVF4_Tach,FP2,False)
EndTable

'Main Program
BeginProg
  Scan (1,Sec,0,0)
  PanelTemp (PTemp,250) 'Measure wire panel temperature
  Battery (batt_volt) 'Measure battery voltage

  'Retrieve the current time for use in the Solar Position Calculation
  '-----
  RealTime (TimeArray())
  '-----

  'Measure Air Temperature
  '-----
  Therm109 (Airtemp,1,3,Vx1,0,250,1.0,0)
  '-----

  'Calculate the Solar Position
  '-----
  SolarPosition (SolarPos(),TimeArray,0,Latitude,Longitude,Altitude,-1,Airtemp)
  '-----

  'Measure GH Irradiance with CMP11 Pyranometer
  '-----
  VoltDiff (GH_Irradiance_CMP11,1,mV25,1,True,0,_60Hz,1000/CMP11_Sensitivity,0)
  '-----

  'Measure CVF4 Tachometer Output
  '-----
  PulseCount (CVF4_Tach,1,1,0,1,1.0,0)
  CVF4_Tach = CVF4_Tach*(60/2) 'convert to RPM, CVF4 outputs two pulses per revolution
  '-----

  'Control the CVF4 Heater
  '-----
  If SunElevation > -10 AND SunElevation < 10 Then
    PortSet (1,1)
  Else
    PortSet (1,0)
  EndIf
  '-----

CallTable Ten_Min
NextScan
EndProg

```

## C.6 CVF4 Heater/Ventilator Maintenance

1. Refer to Section 8.1, *Maintenance (p. 16)*, for the pyranometer's maintenance.
2. Inspect the area directly under the fan to ensure that it is free from leaves, snow, or other obstructions that can inhibit air flow.
3. Regularly inspect the fan inlet by unclipping the cover. For optimal air flow, make sure the diagonal line on the filter cover is in line with the

diagonal line on the ventilator (FIGURE C-11). The filter cover clicks back on the ventilator.

4. Clean or replace filters typically every 6 months.

---

**NOTE**

The filters may need to be cleaned or replaced more frequently depending on the site and air pollution.

---

5. If desired, clean the plastic cover using water and a brush or cloth.

---

**NOTE**

Discoloration of the plastic cover does not affect the operation of the CVF4. The cover only needs to be cleaned for aesthetic reasons.

---

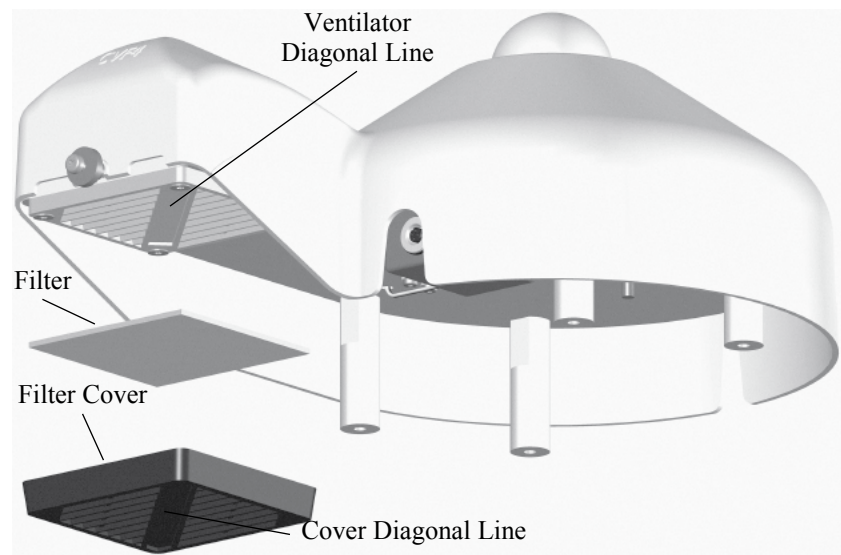


FIGURE C-11. CVF4 filter replacement, pn 31435





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