

## MS-80

### Secondary Standard Pyranometer





# Guarantee

---

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:

- Equipment which has been modified or altered in any way without the written permission of Campbell Scientific
- Batteries
- Any product which has been subjected to misuse, neglect, acts of God or damage in transit.

Campbell Scientific will return guaranteed equipment by surface carrier prepaid. Campbell Scientific will not reimburse the claimant for costs incurred in removing and/or reinstalling equipment. This guarantee and the Company's obligation thereunder is in lieu of all other guarantees, expressed or implied, including those of suitability and fitness for a particular purpose. Campbell Scientific is not liable for consequential damage.

Please inform us before returning equipment and obtain a Repair Reference Number whether the repair is under guarantee or not. Please state the faults as clearly as possible, and if the product is out of the guarantee period it should be accompanied by a purchase order. Quotations for repairs can be given on request. It is the policy of Campbell Scientific to protect the health of its employees and provide a safe working environment, in support of this policy a "Declaration of Hazardous Material and Decontamination" form will be issued for completion.

When returning equipment, the Repair Reference Number must be clearly marked on the outside of the package. Complete the "Declaration of Hazardous Material and Decontamination" form and ensure a completed copy is returned with your goods. Please note your Repair may not be processed if you do not include a copy of this form and Campbell Scientific Ltd reserves the right to return goods at the customers' expense.

Note that goods sent air freight are subject to Customs clearance fees which Campbell Scientific will charge to customers. In many cases, these charges are greater than the cost of the repair.



Campbell Scientific Ltd,  
80 Hathern Road,  
Shepshed, Loughborough, LE12 9GX, UK  
Tel: +44 (0) 1509 601141  
Fax: +44 (0) 1509 270924  
Email: [support@campbellsci.co.uk](mailto:support@campbellsci.co.uk)  
[www.campbellsci.co.uk](http://www.campbellsci.co.uk)



# About this manual

---

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:

**Area:** 1 in<sup>2</sup> (square inch) = 645 mm<sup>2</sup>

**Length:** 1 in. (inch) = 25.4 mm  
1 ft (foot) = 304.8 mm  
1 yard = 0.914 m  
1 mile = 1.609 km

**Mass:** 1 oz. (ounce) = 28.35 g  
1 lb (pound weight) = 0.454 kg

**Pressure:** 1 psi (lb/in<sup>2</sup>) = 68.95 mb

**Volume:** 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.



Campbell Scientific Ltd, 80 Hathern Road, Shepshed, Loughborough, LE12 9GX,  
UK Tel: +44 (0) 1509 601141 Fax: +44 (0) 1509 270924  
Email: [support@campbellsci.co.uk](mailto:support@campbellsci.co.uk)  
[www.campbellsci.co.uk](http://www.campbellsci.co.uk)



# 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.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.





# Table of contents

---

|   |           |
|---|-----------|
| <b>1. MS-80 introduction .....</b>                                    | <b>1</b>  |
| <b>2. QuickStart .....</b>  | <b>1</b>  |
| <b>3. MS-80 specifications .....</b>                                  | <b>5</b>  |
| <b>4. Siting .....</b>  | <b>5</b>  |
| <b>5. Mounting procedure .....</b>                                    | <b>6</b>  |
| <b>6. MS-80 wiring .....</b>  | <b>8</b>  |
| <b>7. Solar radiation programming .....</b>                           | <b>9</b>  |
| <b>8. Internal PT100 programming .....</b>                            | <b>10</b> |
| <b>9. Maintenance and troubleshooting .....</b>                       | <b>10</b> |
| <b>Appendix A. Importing Short Cut code into CRBasic Editor .....</b> | <b>12</b> |
| <b>Appendix B. MS-80 example program .....</b>                        | <b>13</b> |



# 1. MS-80 introduction

---

The MS-80, manufactured by EKO Instruments, is an innovative, next-generation secondary standard pyranometer inspired by the combination of latest technologies and state-of-the-art thermopile sensor with an unprecedented low zero-offset behaviour; fast sensor response; and a five-year warranty and recalibration interval.

The MS-80 features a compact design with internal desiccation, single dome, isolated thermopile detector, quartz diffusor, immunity to offsets, ultra-low temperature dependency, and exceptional non-linearity characteristics. EKO instruments is the only ISO 17025 accredited pyranometer manufacturer in the world, enabling highest-quality calibration, compliant to international standards (ISO/IEC 17025/9847).

For a similar pyranometer with RS-485 Modbus communications, refer to the MS-80M: [www.campbellsci.eu/ms-80m-l](http://www.campbellsci.eu/ms-80m-l).

## 2. QuickStart

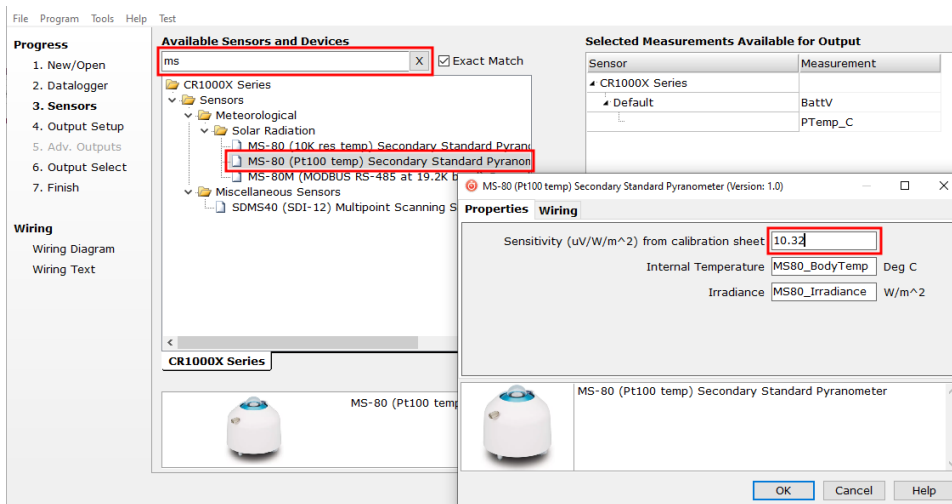
---

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 the 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*, *PC400*, or *PC200W*.

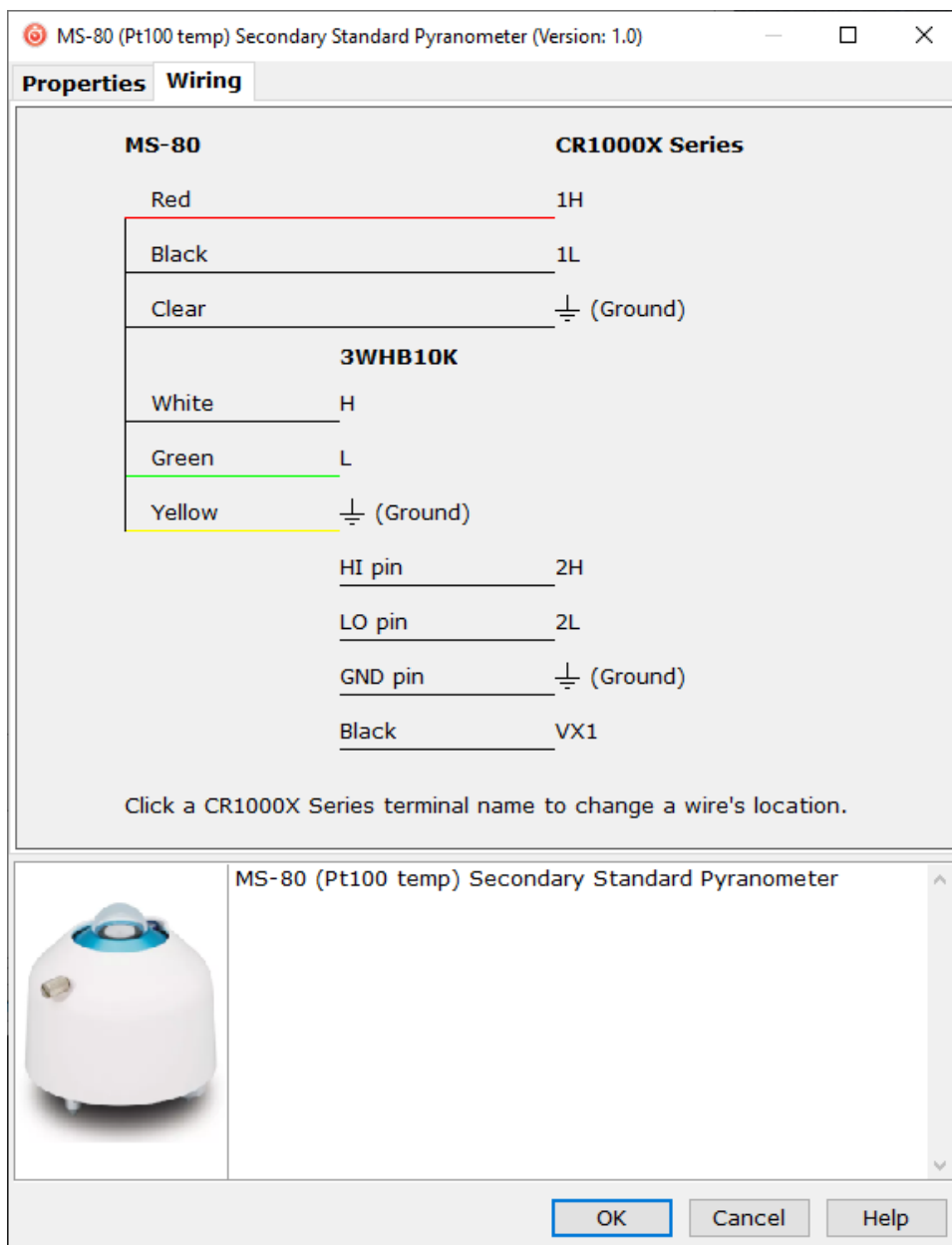
The following procedure also shows using *Short Cut* to program the sensor.

1. Open *Short Cut* and click **Create New Program**.
2. Double-click the data logger model.

3. In the **Available Sensors and Devices** box, type MS-80 or locate the sensor in the **Sensors > Meteorological > Solar Radiation** folder. Double-click the **MS-80 (Pt100 temp) Secondary Standard Pyranometer**. Type the **Sensitivity (uV/W/m^2)** from calibration sheet. This value is unique for each MS-80.



- Click the **Wiring** tab to see how the sensor is to be wired to the data logger and 3WHB10K; a completion resistor such as the 3WHB10K is required to connect the MS-80 to a data logger. Click **OK** after wiring the sensor.



- Repeat steps three and four for other sensors.

6. In **Output Setup**, type the scan rate, meaningful table names, and **Data Output Storage Interval**.

Short Cut (CR1000X Series) C:\Campbellsci\SCWin\untitled.scw

File Program Tools Help Test

**Progress**

1. New/Open
2. Datalogger
3. Sensors
4. Output Setup
5. Adv. Outputs
6. Output Select
7. Finish

**Wiring**

Wiring Diagram  
Wiring Text

How often should the CR1000X Series measure its sensor(s)?  Seconds

Data is processed by the datalogger and then stored in an output table. Two tables are defined by default; up to 10 tables can be added.

**1 Hourly 2 Daily**

Table Name

Data Output Storage Interval  
Makes 17280 measurements per output interval based upon the chosen measurement interval of 5 Seconds.

Minutes

☐ Advanced Outputs (all tables)

Specify how often measurements are to be made and how often outputs are to be stored. Note that multiple output intervals can be specified, one for each output table. By default, an output table is set up to send data to memory based on time. Select the Advanced Output option to send data to memory based on one or more of the following conditions: time, the state of a flag, or the value of a measurement.

7. Select the measurement and its associated output option.

Short Cut (CR1000X Series) C:\Campbellsci\SCWin\untitled.scw

File Program Tools Help Test

**Progress**

1. New/Open
2. Datalogger
3. Sensors
4. Output Setup
5. Adv. Outputs
6. Output Select
7. Finish

**Wiring**

Wiring Diagram  
Wiring Text

**Selected Measurements Available for Output**

| Sensor  | Measurement     |
|---------|-----------------|
| CR1000X |                 |
| Default | BattV           |
|         | PTemp_C         |
| MS-80   | MS80_BodyT...   |
|         | MS80_Irradia... |

**Selected Measurements for Output**

**1 Hourly 2 Daily**

| Average    | Sensor | Measurement | Processing | Output Label | Units |
|------------|--------|-------------|------------|--------------|-------|
| ETo        | MS-80  | MS80_Body   | Average    | MS80_Body    | Deg C |
| Maximum    | MS-80  | MS80_Irrad  | Average    | MS80_Irrad   | W/m^2 |
| Minimum    |        |             |            |              |       |
| Sample     |        |             |            |              |       |
| StdDev     |        |             |            |              |       |
| Total      |        |             |            |              |       |
| WindVector |        |             |            |              |       |

Select which measurements to store in which tables and how each measurement should be processed. For each value to be stored in the table, choose a measurement from "Selected Measurements Available for Output." Next, select one of the processing functions, such as Average, Sample, etc. Note that the output tables must be set up in order for data to be stored in the datalogger memory.

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 logger support software data display in **LoggerNet**, **PC400**, **RTDAQ**, or **PC200W** to make sure it is making reasonable measurements.

## 3. MS-80 specifications

---

|                              |   |
|------------------------------|---|
| ISO 9060 classification:     | Secondary standard  |
| Output:                      | Analogue (mV)   |
| Response time 95%:           | < 0.5 s   |
| Zero offset A:               | < 1 W/m <sup>2</sup> (response to 200 W/m <sup>2</sup> net thermal radiation)       |
| Zero offset B:               | ±1 W/m <sup>2</sup> (5 K/hr)  |
| Non-stability:               | ±0.5% change in 5 years   |
| Non-linearity:               | ±0.2% (1000 W/m <sup>2</sup> )  |
| Directional response:        | ±10 W/m <sup>2</sup> (1000 W/m <sup>2</sup> )                                       |
| Spectral selectivity:        | ±3% (0.35 to 1.5 µm)  |
| Spectral range:              | 285 to 3000 nm  |
| Operating temperature range: | −40 to 80 °C  |
| Temperature response:        | < 0.8% (−10 to 40 °C), < 1% (−20 to 50 °C)  |
| Tilt response:               | ±0.2% (1000 W/m <sup>2</sup> )  |
| Sensitivity:                 | ~10 µV/W/m <sup>2</sup>   |
| Impedance:                   | < 45000 Ω   |
| Irradiance range:            | 0 to 4000 W/m <sup>2</sup>  |
| Compliance documents:        | View at: <a href="http://www.campbellsci.eu/ms-80-l">www.campbellsci.eu/ms-80-l</a> |

## 4. Siting

---

The solar radiation sensor is usually installed horizontally, but can also be installed at any angle including an inverted position. Site the sensor 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 sensor such that a shadow or a 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. The sensor should be mounted with the cable

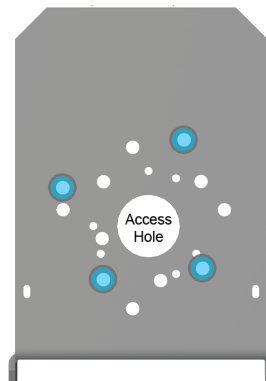
pointing towards the nearest magnetic pole. For example, in the northern hemisphere, point the cable toward the North Pole.

## 5. Mounting procedure

---

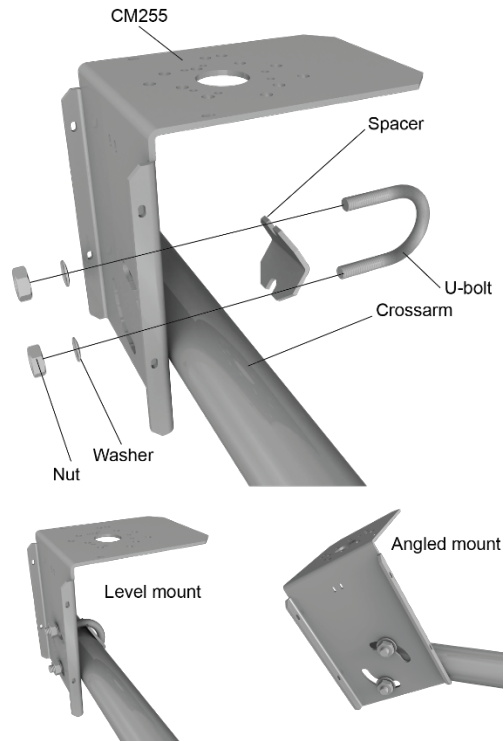
Required tools:

- Diopter
  - Solar compass
  - 8 mm (5/16-inch) open-end wrench for U-bolt nuts
1. On a level surface, level the solar radiation sensor using the levelling feet on the sensor. Alternatively, remove the sensor levelling feet to allow it to be mounted directly to the mounting bracket.
  2. Secure the solar radiation sensor to the mounting bracket. The blue dots in the following figure indicate the mounting holes used for this pyranometer.

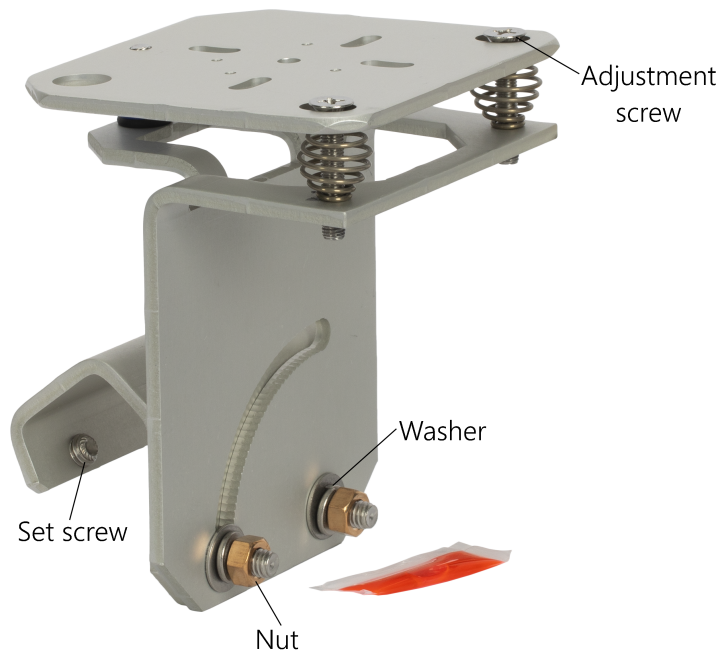


3. Using a diopter in combination with a solar compass, install and orient the crossarm on the tripod or the mast. If installing the mounting bracket on a vertical pole, ensure the pole is truly vertical.
4. Secure the mounting bracket to the crossarm or vertical pole using the hardware included with the mounting bracket. The CM255 uses one U-bolt, nuts, flat washers, and lock washers to mount the bracket, as shown in the following figure.





5. For the CM256 bracket, use the two set screws to secure the bracket to the crossarm or pole as shown in the following figure. For pyranometers mounted horizontally, ensure the mounting bracket is horizontal in two dimensions. For pyranometers mounted at an angle, set the mounting bracket angle to the desired angle prior to tightening the mounting hardware.



6. Verify mounting hardware is firmly tightened, and that the mounting bracket is at the desired angle.

## 6. MS-80 wiring

The MS-80 requires a completion resistor such as the 3WHB10K to measure the internal PT100 sensor. [Table 6-1](#) (p. 8) shows the wiring to the data logger and 3WHB10K.

| Table 6-1: Pin-out, wire colour, function, and connections of data logger and 3WHB10K |         |  |  |                    |
|---|---------|--|--|--------------------|
| Wire colour   | Pin-out | Function                                   | Data logger connection   | 3WHB10K connection |
| Red   | 1       | Pyranometer signal high                    | U configured for differential input <sup>1</sup> ,<br>DIFF H (differential high, analog-voltage input) |                    |
| Black   | 2       | Pyranometer signal reference               | U configured for differential input <sup>1</sup> ,<br>DIFF L (differential low, analog-voltage input)  |                    |
| Clear   | N/C     | Shield (tied to connector, body of sensor) | ⏏ (analogue ground)  |                    |
| White   | 3       | PT100 voltage excitation                   |  | H                  |
| Green   | 4       | PT100 signal                               |  | L                  |
| Yellow  | 5       | PT100 ground                               |  | ⏏                  |
|   |         |  | U configured for differential input <sup>1</sup> ,<br>DIFF H (differential high, analog-voltage input) | HI pin             |
|   |         |  | U configured for differential input <sup>1</sup> ,<br>DIFF L (differential low, analog-voltage input)  | LO pin             |

| Table 6-1: Pin-out, wire colour, function, and connections of data logger and 3WHB10K |         |          |   |                    |
|---|---------|----------|---|--------------------|
| Wire colour   | Pin-out | Function | Data logger connection  | 3WHB10K connection |
|   |         |          | $\perp$ (analogue ground)   | GND pin            |
|   |         |          | U configured for voltage excitation <sup>1</sup> ,<br>EX, VX (voltage excitation) | Black wire         |
| <sup>1</sup> U channels are automatically configured by the measurement instruction.  |         |          |   |                    |

## 7. Solar radiation programming

The pyranometer outputs a low level voltage that 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 data logger 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.

If measurement time is not critical, the autorange option can be used in the `Voltdiff()` or `VoltsE()` instruction; the autorange adds a few milliseconds to the measurement time. Otherwise, select the input range as follows:

1. Estimate the maximum expected input voltage by multiplying the maximum expected irradiance (in  $\text{W} \times \text{m}^{-2}$ ) by the calibration factor (in  $\mu\text{V} / \text{W} \times \text{m}^{-2}$ ). Divide the answer by 1000 to give the maximum in millivolt units.
2. Select the smallest input range that is greater than the maximum expected input voltage.

If electromagnetic radiation can be a problem, use an  $f_{N1}$  of 50 or 60 Hz. Select 60 Hz Noise Rejection for North America and areas using 60 Hz AC voltage. Select 50 Hz Noise Rejection for most of the Eastern Hemisphere and areas that operate at 50 Hz. The multiplier converts the millivolt reading to engineering units. [Table 7-1](#) (p. 10) provides the calculations required for the various units. The offset will normally be fixed at zero (see [MS-80 example program](#) (p. 13)).

| Table 7-1: Multipliers required for flux density and total fluxes  |   |                   |
|--|---|-------------------|
| Units  | Multiplier                              | Output processing |
| $W \times m^{-2}$  | M                                       | Average           |
| $MJ \times m^{-2}$   | $M \times t \times 0.000001$            | Totalize          |
| $kJ \times m^{-2}$   | $M \times t \times 0.001$               | Totalize          |
| $cal \times cm^{-2}$   | $M \times t \times 0.0239 \times 0.001$ | Totalize          |
| $cal \times cm^{-2} \times min^{-1}$   | $M \times 1.434 \times 0.001$           | Average           |
| $W \times hr \times m^{-2}$  | $M \times t / 3600$                     | Totalize          |
| M = 1000/c, where c is the sensor output in $\mu V / W \times m^{-2}$<br>t = data logger program execution interval in seconds |   |                   |

## 8. Internal PT100 programming

Measure the PT100 resistance using the `BrHa1f3W()` CRBasic instruction, then convert the resistance by using the `PRT()` instruction. A typical `BrHa1f3W()` instruction is:

```
BrHa1f3W (Rs,1,mV200,3,Vx1,1,2500,True,0,60,100,0)
```

This assumes the 3WHB10K is connected to the **SE3**, **SE4**, and **VX1** data logger terminals.

A typical `PRT()` instruction is:

```
PRT (Sensor_Temp,1,Rs,1.0,0)
```

## 9. Maintenance and troubleshooting

The MS-80 has no service items requiring scheduled replacement. There is no accessible desiccant cartridge to maintain. Use pure alcohol or distilled water and a lint-free cloth to clean the dome, removing smears and deposits. Local conditions and application dictate cleaning interval. Sophisticated research applications require daily cleaning. For typical PV applications, clean once per week, bi-monthly, or monthly. The MS-80 should be recalibrated following industry standard best practices such as ASTM G167, ISO 9846, ASTM E824 or ASTM G207 by an

accredited lab. The recommended recalibration interval is two years. Contact Campbell Scientific for more information.

Unexpected results typically occur because of improper wiring or programming, electromagnetic radiation, or damaged cables. Ensure that the data logger program includes the correct parameters for the measurement instructions. Check for the presence of strong sources of electromagnetic radiation and use the 50 or 60 Hz integration option in the data logger program if electromagnetic radiation can be a problem. Check the cable for damage and ensure that it is properly connected to the data logger.



# 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. MS-80 example program

Table B-1 (p. 13) provides wiring for the example program. The MS-80 requires a completion resistor such as the 3WHB10K to connect to the data logger. Although this program is for the CR1000X, other CRBasic data loggers are programmed similarly.

Programming tips are provided at: [www.campbellsci.eu/videos/datalogger-programming](http://www.campbellsci.eu/videos/datalogger-programming).

| Table B-1: Wiring for example program |                              |                     |                    |
|---------------------------------------|------------------------------|---------------------|--------------------|
| Wire colour                           | Function                     | CR1000X connection  | 3WHB10K connection |
| Red                                   | Pyranometer signal high      | 1H                  |                    |
| Black                                 | Pyranometer signal reference | 1L                  |                    |
| Clear                                 | Shield                       | ⏏ (analogue ground) |                    |
| White                                 | PT100 voltage excitation     |                     | H                  |
| Green                                 | PT100 signal                 |                     | L                  |
| Yellow                                | PT100 ground                 |                     | ⏏                  |
|                                       |                              | 2H                  | HI pin             |
|                                       |                              | 2L                  | LO pin             |
|                                       |                              | ⏏ (analogue ground) | GND pin            |
|                                       |                              | VX1                 | Black wire         |

## CRBasic Example 1: CR1000X program that measures the MS-80

```
'CR1000X Series
'MS-80-L with PT100

'SENS is sensitivity value from the calibration sheet.
'It is unique for each sensor.
Const SENS = 10.26 'uV/W/m^2

Public IRR
Public Rs
Public Sensor_Temp
Units IRR = W/m^2
Units Sensor_Temp = DegC

DataTable (MS80,1,-1 )
  DataInterval (0,1,Min,10)
  Average (1,IRR,IEEE4,False)
  Average (1,Sensor_Temp, FP2, False)

EndTable
BeginProg
  Scan (1,Sec,3,0)
    'Measure the irradiance
    VoltDiff (IRR,1,mV200,1,True,3000,60,1000/SENS,0)

    'Measure the PT100 PRT Temperature Sensor(3WHB10K)
    BrHalf3W (Rs,1,mV200,3,Vx1,1,2500,True,0,60,100,0)
    PRT (Sensor_Temp,1,Rs,1.0,0)

  CallTable MS80
  NextScan
EndProg
```





## Global Sales & Support Network

*A worldwide network to help meet your needs*



### Campbell Scientific regional offices

#### Australia

**Location:** Garbutt, QLD Australia  
**Phone:** 61.7.4401.7700  
**Email:** [info@campbellsci.com.au](mailto:info@campbellsci.com.au)  
**Website:** [www.campbellsci.com.au](http://www.campbellsci.com.au)

#### Brazil

**Location:** São Paulo, SP Brazil  
**Phone:** 11.3732.3399  
**Email:** [vendas@campbellsci.com.br](mailto:vendas@campbellsci.com.br)  
**Website:** [www.campbellsci.com.br](http://www.campbellsci.com.br)

#### Canada

**Location:** Edmonton, AB Canada  
**Phone:** 780.454.2505  
**Email:** [dataloggers@campbellsci.ca](mailto:dataloggers@campbellsci.ca)  
**Website:** [www.campbellsci.ca](http://www.campbellsci.ca)

#### China

**Location:** Beijing, P. R. China  
**Phone:** 86.10.6561.0080  
**Email:** [info@campbellsci.com.cn](mailto:info@campbellsci.com.cn)  
**Website:** [www.campbellsci.com.cn](http://www.campbellsci.com.cn)

#### Costa Rica

**Location:** San Pedro, Costa Rica  
**Phone:** 506.2280.1564  
**Email:** [info@campbellsci.cc](mailto:info@campbellsci.cc)  
**Website:** [www.campbellsci.cc](http://www.campbellsci.cc)

#### France

**Location:** Vincennes, France  
**Phone:** 0033.0.1.56.45.15.20  
**Email:** [info@campbellsci.fr](mailto:info@campbellsci.fr)  
**Website:** [www.campbellsci.fr](http://www.campbellsci.fr)

#### Germany

**Location:** Bremen, Germany  
**Phone:** 49.0.421.460974.0  
**Email:** [info@campbellsci.de](mailto:info@campbellsci.de)  
**Website:** [www.campbellsci.de](http://www.campbellsci.de)

#### India

**Location:** New Delhi, DL India  
**Phone:** 91.11.46500481.482  
**Email:** [info@campbellsci.in](mailto:info@campbellsci.in)  
**Website:** [www.campbellsci.in](http://www.campbellsci.in)

#### South Africa

**Location:** Stellenbosch, South Africa  
**Phone:** 27.21.8809960  
**Email:** [sales@campbellsci.co.za](mailto:sales@campbellsci.co.za)  
**Website:** [www.campbellsci.co.za](http://www.campbellsci.co.za)

#### Spain

**Location:** Barcelona, Spain  
**Phone:** 34.93.2323938  
**Email:** [info@campbellsci.es](mailto:info@campbellsci.es)  
**Website:** [www.campbellsci.es](http://www.campbellsci.es)

#### Thailand

**Location:** Bangkok, Thailand  
**Phone:** 66.2.719.3399  
**Email:** [info@campbellsci.asia](mailto:info@campbellsci.asia)  
**Website:** [www.campbellsci.asia](http://www.campbellsci.asia)

#### UK

**Location:** Shepshed, Loughborough, UK  
**Phone:** 44.0.1509.601141  
**Email:** [sales@campbellsci.co.uk](mailto:sales@campbellsci.co.uk)  
**Website:** [www.campbellsci.co.uk](http://www.campbellsci.co.uk)

#### USA

**Location:** Logan, UT USA  
**Phone:** 435.227.9120  
**Email:** [info@campbellsci.com](mailto:info@campbellsci.com)  
**Website:** [www.campbellsci.com](http://www.campbellsci.com)