Product Manual

Sensor

SR20-T2

ISO Spectrally Flat Class A (Secondary Standard) Pyranometer

Revision: 05/2020

RELIABLE SINCE 1974 MONITORING

CAMPBELL SCIENTIFIC

Table of contents

1. Introduction

The SR20-T2, manufactured by Hukseflux Thermal Sensors, is an ISO 9060 spectrally flat Class A (secondary standard) pyranometer that measures solar short-wave radiation in a full hemisphere of the sky. It has a built-in case temperature sensor and embedded heater for removing dew and light rain. It connects directly to a Campbell Scientific data logger and is designed for applications that require high measurement accuracy in demanding applications such as scientific meteorological observation networks and utility scale solar-energy-power production sites.

2. QuickStart

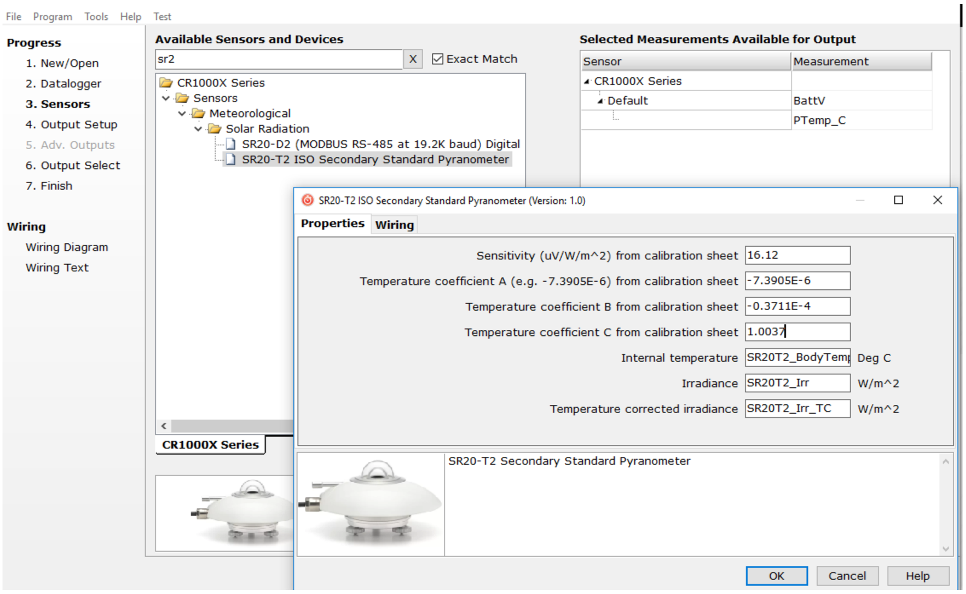
A video that describes data logger programming using Short Cut is available at: www.campbellsci.com/videos/cr1000x-datalogger-getting-started-program-part-3. Short Cut is an easy way to program your data logger to measure the sensor and assign data logger wiring terminals. Short Cut is available as a download on www.campbellsci.com. It is included in installations of LoggerNet, PC200W, PC400, or RTDAQ.

> **NOTE:**
> Short Cut uses the two-wire configuration to measure the integrated thermocouple.

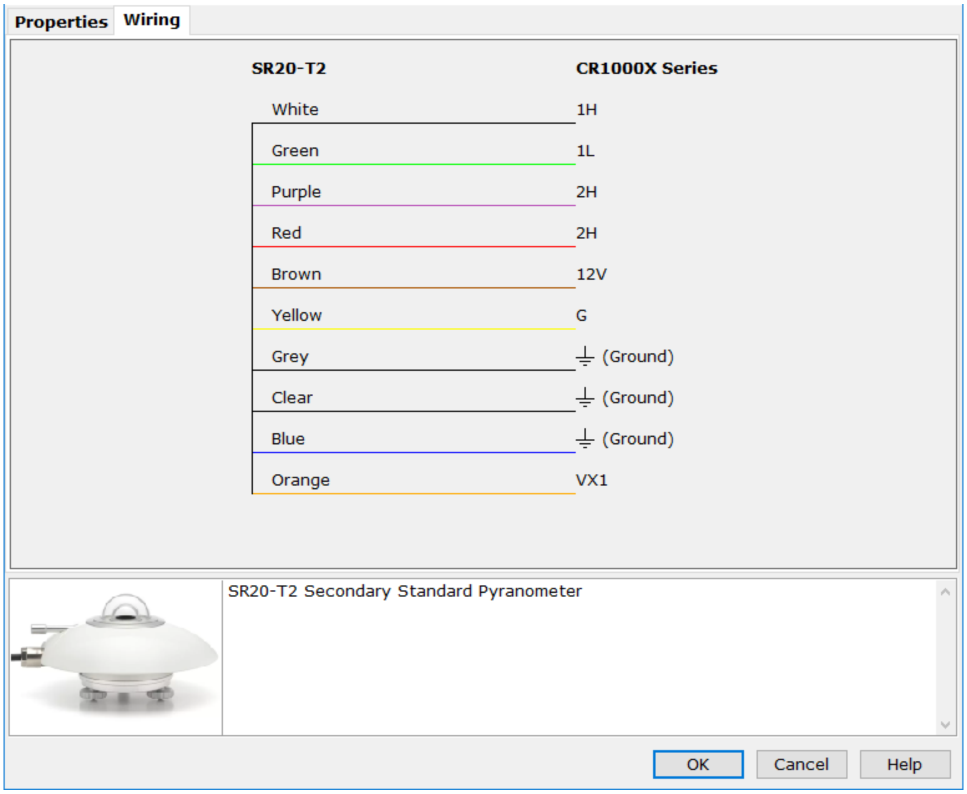
The following procedure also shows using Short Cut to program the sensor.

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 SR20 or locate the sensor in the **Sensors** > **Meteorological** > **Solar Radiation** folder. Double-click the **SR20-T2 ISO Secondary Standard Pyranometer**. Type the **Sensitivity** and temperature coefficient values listed on the calibration sheet. These values are unique for each sensor.

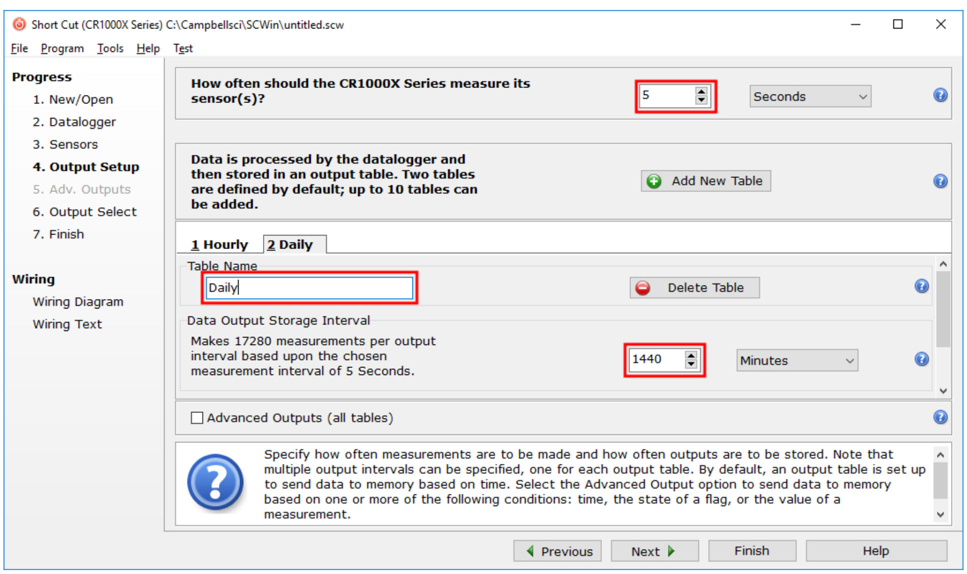


4. Click the **Wiring** tab to see how the sensor is to be wired to the data logger. Click **OK** after wiring the sensor.

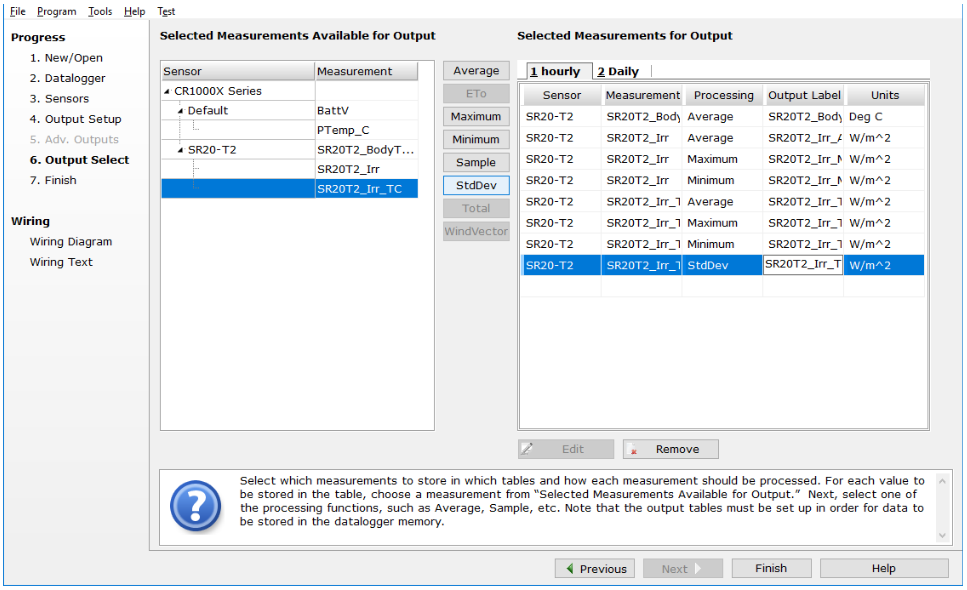


5. Repeat steps three and four for other sensors.

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



7. Select the measurement and its associated output option.



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. Siting

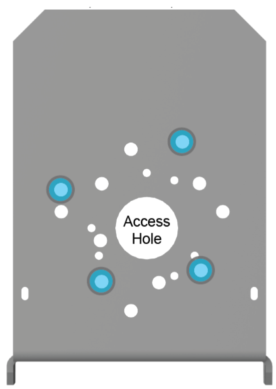
The solar radiation sensor is usually installed horizontally, but can also be installed at any angle including an inverted position. Site the sensor to allow easy access for maintenance while ideally avoiding any obstructions or reflections above the plane of the sensing element. It is important to mount 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.

4. Mounting procedure

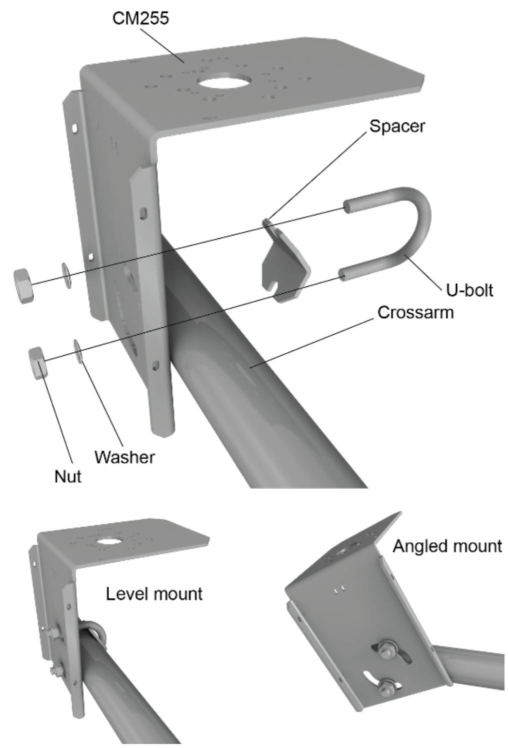
Required tools:

- Diopter
- Solar compass
- 8 mm (5/16-inch) open-end wrench for U-bolt nuts

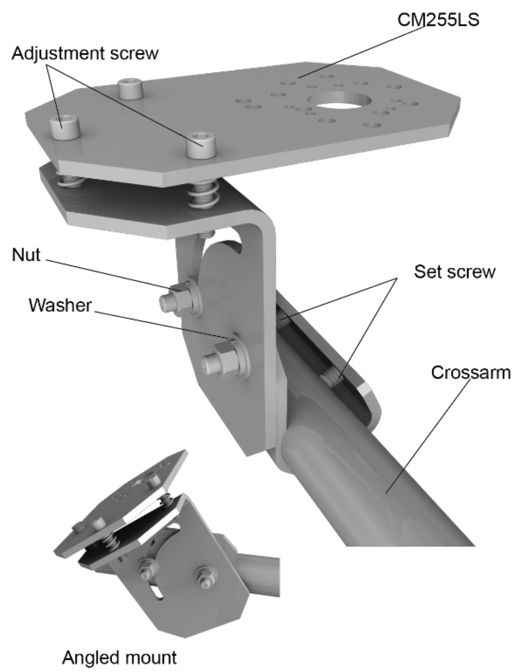
1. On a level surface, level the solar radiation sensor using the leveling feet on the sensor. Alternatively, remove the sensor leveling feet to allow it to be mounted directly to the mounting bracket.
2. Secure the solar radiation sensor to the mounting bracket. The blue dots in the following figure 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 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.

5. Wiring

Table 5-1 (p. 7) provides the 2-wire half bridge wiring and Table 5-2 (p. 8) provides the 4-wire half bridge wiring. FIGURE 5-1 (p. 10) provides the schematic for the 2-wire configuration of the integrated thermistor and FIGURE 5-2 (p. 10) provides the schematic for the 4-wire configuration of the integrated thermistor.

Table 5-1: Pin-out, wire color, function, and data logger connection for 2-wire half bridge

Wire color	Pin out		Function	Data logger connection	
	-PT	-PW		Differential	Single-ended
White	7	7	Pyranometer signal high	**U** configured for differential input[1], **DIFF H** (differential high, analog-voltage input)	**U** configured for single-ended analog input[1], **SE** (single-ended, analog-voltage input)
Green	5	9	Pyranometer signal reference	**U** configured for differential input[1], **DIFF L** (differential low, analog-voltage input)	⏚ (analog ground)
Brown	4	4	Heater (polarity does not matter, 1.5 W at 12 VDC)	Switched heater power: **SW**, **SW12**, **SW12V**, **SW** Battery (switched 12 V) Constant heater power: **12V**	Switched heater power: **SW**, **SW12**, **SW12V**, **SW** Battery (switched 12 V) Constant heater power: **12V**
Yellow	1	1	Heater ground	G	G
Red	2	2	Thermistor signal	**U** configured for single-ended analog input[1], **SE** (single-ended, analog-voltage input)	**U** configured for single-ended analog input[1], **SE** (single-ended, analog-voltage input)
Blue	6	6	Thermistor reference	⏚ (analog ground)	⏚ (analog ground)

Table 5-1: Pin-out, wire color, function, and data logger connection for 2-wire half bridge					
Wire color	Pin out		Function	Data logger connection	
	-PT	-PW		Differential	Single-ended
Orange	NC	NC	Thermistor voltage excitation	**U** configured for voltage excitation[1], **EX**, **VX** (voltage excitation)	**U** configured for voltage excitation[1], **EX**, **VX** (voltage excitation)
Purple	3	3	Thermistor signal	**U** configured for single-ended analog input[1], **SE** (single-ended, analog-voltage input)	**U** configured for single-ended analog input[1], **SE** (single-ended, analog-voltage input)
Gray	8	8	Thermistor reference	⏚ (analog ground)	⏚ (analog ground)
Black	9	5	Ground	G	G
Clear	NC	9	Shield	⏚ (analog ground)	⏚ (analog ground)

[1] U channels are automatically configured by the measurement instruction.

Table 5-2: Pin-out, wire color, function, and data logger connection for 4-wire half bridge					
Wire color	Pin out		Function	Data logger connection	
	-PT	-PW		Differential	Single-ended
White	7	7	Pyranometer Signal High	**U** configured for differential input[1], **DIFF H** (differential high, analog-voltage input)	**U** configured for single-ended analog input[1], **SE** (single-ended, analog-voltage input)
Green	5	9	Pyranometer Signal Reference	**U** configured for differential input[1], **DIFF L** (differential low, analog-voltage input)	⏚ (analog ground)
Brown	4	4	Heater (polarity does not matter, 1.5 W at 12 VDC)	Switched heater power: **SW**, **SW12**, **SW12V**, **SW Battery** (switched 12 V) Constant heater power: **12V**	Switched heater power: **SW**, **SW12**, **SW12V**, **SW Battery** (switched 12 V) Constant heater power: **12V**

Table 5-2: Pin-out, wire color, function, and data logger connection for 4-wire half bridge					
Wire color	Pin out		Function	Data logger connection	
	-PT	-PW		Differential	Single-ended
Yellow	1	1	Heater Ground	G	G
Blue	2	2	Thermistor Signal	**U** configured for differential input[1], **DIFF H** (differential high, analog-voltage input)	**U** configured for differential input[1], **DIFF H** (differential high, analog-voltage input)
Red	6	6	Thermistor Reference	**U** configured for differential input[1], **DIFF L** (differential low, analog-voltage input)	**U** configured for differential input[1], **DIFF L** (differential low, analog-voltage input)
Purple	NC	NC	Thermistor Signal	**U** configured for differential input[1], **DIFF H** (differential high, analog-voltage input)	**U** configured for differential input[1], **DIFF H** (differential high, analog-voltage input)
Orange	3	3	Thermistor Signal	**U** configured for differential input[1, 2], **DIFF L** (differential low, analog-voltage input)[2]	**U** configured for differential input[1, 2], **DIFF L** (differential low, analog-voltage input)[2]
Gray	8	8	Voltage Excitation	**U** configured for voltage excitation[1], **EX**, **VX** (voltage excitation)	**U** configured for voltage excitation[1], **EX**, **VX** (voltage excitation)
Black	9	5	Ground	G	G
Clear	NC	9	Shield	⏚ (analog ground)	⏚ (analog ground)

[1] U channels are automatically configured by the measurement instruction.

[2] Jumper to ground with a user-supplied wire.

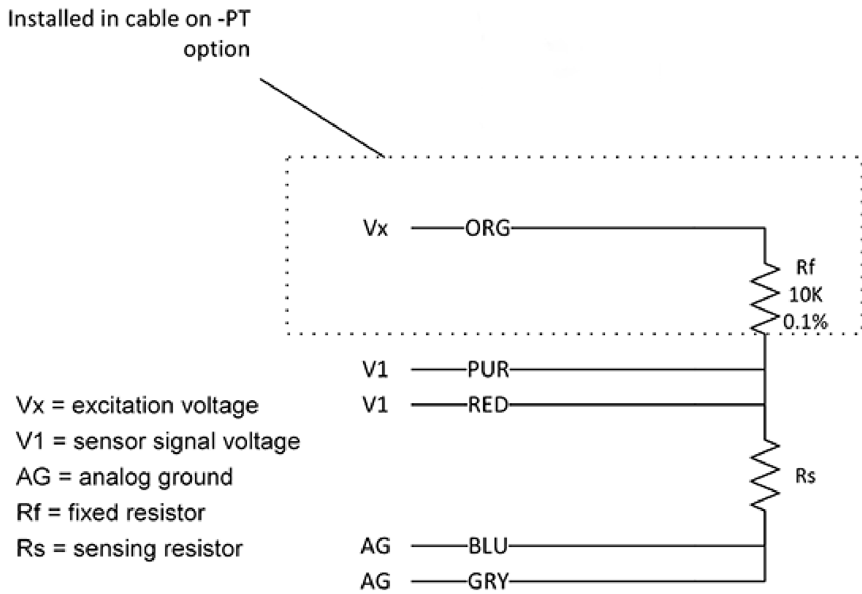


FIGURE 5-1. Schematic of the integrated thermistor (2-wire configuration)

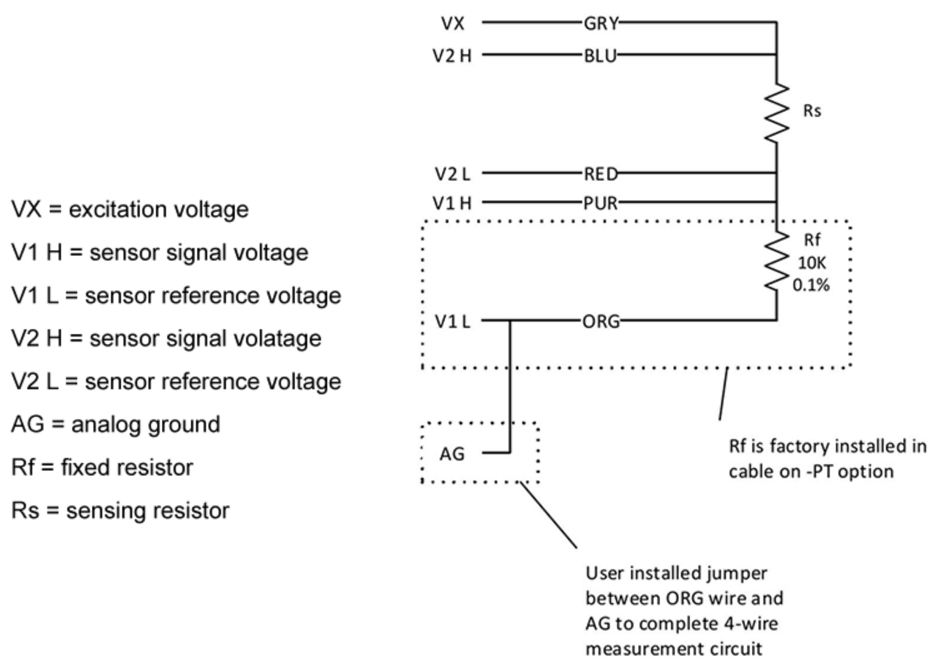


FIGURE 5-2. Schematic of the integrated thermistor (4-wire configuration)

6. Analog 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 W × m^{-2}) by the calibration factor (in µV / W × 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 6-1 (p. 11) provides the calculations required for the various units. The offset will normally be fixed at zero (see SR20-T2 example programs (p. 15)).

Table 6-1: Multipliers required for flux density and total fluxes

Units	Multiplier	Output processing
W × m^{-2}	M	Average
MJ × m^{-2}	M × t × 0.000001	Totalize
kJ × m^{-2}	M × t × 0.001	Totalize
cal × cm^{-2}	M × t × 0.0239 × 0.001	Totalize
cal × cm^{-2} × min^{-1}	M × 1.434 × 0.001	Average
W × hr × m^{-2}	M × t / 3600	Totalize
M = 1000/c, where c is the sensor output in µV / W × m^{-2}		
t = data logger program execution interval in seconds		

7. Integrated thermistor

The data logger program needs the resistance of the thermistor to calculate temperature. CRBasic instructions used are the `BrHalf()` (2-wire configuration) or `BrHalf4W` (4-wire configuration). The `BrHalf4W()` instruction returns a resistance measurement, but the `BrHalf()` instruction requires the following expression to convert the value to resistance:

Rs = Rf*(Vx/(1-Vx))

Where,

Rf = thermistor resistance in ohms (for example, for a 10 kohm thermistor, Rf is 10000)

Vx = value returned by the `BrHalf()` instruction

Both the 2-wire and 4-wire configurations use the Steinhart-Hart equation to convert resistance to temperature. The Steinhart-Hart equation for converting resistance to degree Celsius is as follows:

Temperature = 1/[A + B x LN(resistance) + C x (LN(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 pyranometer. A calibration certificate that lists these coefficients is shipped with each pyranometer. In CRBasic, the Steinhart-Hart equation is entered as a mathematical expression (SR20-T2 example programs (p. 15)).

8. Maintenance and troubleshooting

The SR20-T2 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 SR20-T2 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. SR20-T2 example programs

Table B-1: Wiring for example program

Wire color	CR1000X, 2-wire configuration	CR1000X, 4-wire configuration
White	1H	1H
Green	1L	1L
Brown	SW12-1	SW12-1
Yellow	G	G
Red	SE3	2L
Blue	⏚ (analog ground)	2H
Orange	VX1	1L[1]
Purple	SE3	1H
Gray	⏚ (analog ground)	VX1
Black	G	G
Clear	⏚ (analog ground)	⏚ (analog ground)

[1]Jumper to ground with a user-supplied wire.

CRBasic Example 1: CR1000X 2-wire configuration for measuring the SR20-T2

```
'CR1000X Series Data Logger
'Hukseflux SR20-T2 Pyranometer
'SR20 is a ISO 9060 Secondary Standard pyranometer
'T2 uses a 10k Ohm thermistor
SequentialMode
'Measurement function
'S(T) = So * (a*T^2 + b*T + c)
'S(T) = Sensitivity (10^-6 V/(W/m^2)) at instrument body temperature, T
'So = Sensitivity at 20 DegC
'a,b,c are temperature coefficients from 2nd order polynomial fit
'Calibration Constants for Irradiance and Temperature
```

CRBasic Example 1: CR1000X 2-wire configuration for measuring the SR20-T2

```
Const SR20T2_SENS_So = 16.12 'uV/W*m^-2 @ 20 DegC
Const SR20_A = -7.3905E-6 'Deg C^-2
Const SR20_B = -0.3711E-4 'Deg C^-1
Const SR20_C = 1.0037
'Resistor built into CSI cable (RES 0.1% 10K 1/8W 5PPM)
Const Rf = 10000
Public SR20T2_mV
Public SR20T2_IRR 'using SR20T2_SENS_So (sensitivity at 20 DegC)
Public SR20T2_IRR_TC 'using temperature characterization result S(T)
Public SR20T2_BodyTemp
Public SR20T2_SENS_TC
Dim Rs
Dim V1_Vx
'Thermistor Constants for Steinhart-Hart Linearization
'Constants for YSI 44031 type 10K thermistor
Const A = 1.0295*10^-3
Const B = 2.391*10^-4
Const C = 1.568*10^-7
Units SR20T2_IRR = W/m^2
Units SR20T2_IRR_TC = W/m^2
Units SR20T2_BodyTemp = DegC
Units SR20T2_SENS_TC = uV/(W/m^2)
DataTable (OneMin,1,-1)
  DataInterval (0,1,Min,10)
  Average (1,SR20T2_IRR,IEEE4,False)
  Average (1,SR20T2_IRR_TC,IEEE4,False)
  Maximum (1,SR20T2_IRR_TC,IEEE4,False,False)
  Minimum (1,SR20T2_IRR_TC,IEEE4,False,False)
  StdDev (1,SR20T2_IRR_TC,IEEE4,False)
  Average (1,SR20T2_BodyTemp,IEEE4,False)
EndTable
DataTable (SR20_T2_MetaData,1,-1)
  DataInterval (0,1,Hr,10)
  Average (1,SR20T2_SENS_TC,IEEE4,False)
  Maximum (1,SR20T2_SENS_TC,IEEE4,False,False)
  Minimum (1,SR20T2_SENS_TC,IEEE4,False,False)
  StdDev (1,SR20T2_SENS_TC,IEEE4,False)
EndTable
BeginProg
   Scan (1,Sec,0,0)
    VoltDiff(SR20T2_mV,1,mV200,1,True ,0,60,1.0,0)
    SR20T2_IRR = SR20T2_mV * (1000/SR20T2_SENS_So)
    BrHalf (V1_Vx,1,mV5000,3,Vx1,1,2500,True ,0,60,1.0,0)
    Rs = Rf*(V1_Vx/(1-V1_Vx))
    SR20T2_BodyTemp=(A+(B*(LN(Rs))+C*(LN(Rs))^3))^-1 - 273.15
    SR20T2_SENS_TC = SR20T2_SENS_So * (SR20_A*SR20T2_BodyTemp^2 + _
    SR20_B * SR20T2_BodyTemp + SR20_C)
```

CRBasic Example 1: CR1000X 2-wire configuration for measuring the SR20-T2

```
    SR20T2_IRR_TC = SR20T2_mV * (1000/SR20T2_SENS_TC)
    'SW12V HEATER CONTROL FUNCTION
    If TimeIsBetween (0,7,24, hr) Then
     SW12 (SW12_1,1,0)
   Else
     SW12 (SW12_1,0,0)
    EndIf
    CallTable (OneMin)
    CallTable (SR20_T2_MetaData)
  NextScan
EndProg
```

CRBasic Example 2: CR1000X 4-wire configuration for measuring the SR20-T2

```
'CR1000X Series Data Logger
'Hukseflux SR20-T2 Pyranometer
'SR20 is a ISO 9060 Secondary Standard pyranometer
'T2 uses a 10k Ohm thermistor
'4-wire temperature measurement example

SequentialMode

'Measurement function
'S(T) = So * (a*T^2 + b*T + c)
'S(T) = Sensitivity (10^-6 V/(W/m^2)) at instrument body temperature, T
'So = Sensitivity at 20 DegC
'a,b,c are temperature coefficients determined from second order polynomial
'fit

'Calibration Constants for Irradiance and Temperature (SN:4971)
Const SR20T2_SENS_So = 16.12 'uV/W*m^-2 @ 20 DegC
Const SR20_A = -7.3905E-6 'Deg C^-2
Const SR20_B = -0.3711E-4 'Deg C^-1
Const SR20_C = 1.0037

'Resistor built into CSI cable (RES 0.1% 10K 1/8W 5PPM)
Const Rf = 10000

Public SR20T2_mV
Public SR20T2_IRR 'using SR20T2_SENS_So (sensitivty at 20 DegC)
Public SR20T2_IRR_TC 'using temperature characterization result S(T)
Public SR20T2_BodyTemp
Public SR20T2_SENS_TC
Public Rs
```

CRBasic Example 2: CR1000X 4-wire configuration for measuring the SR20-T2

```
'Thermistor Constants for Steinhart-Hart Linearization
'Constants for YSI 44031 type 10K thermistor
Const A = 1.0295*10^-3
Const B = 2.391*10^-4
Const C = 1.568*10^-7

Units SR20T2_IRR = W/m^2
Units SR20T2_IRR_TC = W/m^2
Units SR20T2_BodyTemp = DegC
Units SR20T2_SENS_TC = uV/(W/m^2)

DataTable (OneMin,1,-1)
DataInterval (0,1,Min,10)
  Average (1,SR20T2_IRR,IEEE4,False)
  Average (1,SR20T2_IRR_TC,IEEE4,False)
  Maximum (1,SR20T2_IRR_TC,IEEE4,False,False)
  Minimum (1,SR20T2_IRR_TC,IEEE4,False,False)
  StdDev (1,SR20T2_IRR_TC,IEEE4,False)
  Average (1,SR20T2_BodyTemp,IEEE4,False)
EndTable

DataTable (SR20_T2_MetaData,1,-1)
  DataInterval (0,1,Hr,10)
  Average (1,SR20T2_SENS_TC,IEEE4,False)
  Maximum (1,SR20T2_SENS_TC,IEEE4,False,False)
  Minimum (1,SR20T2_SENS_TC,IEEE4,False,False)
  StdDev (1,SR20T2_SENS_TC,IEEE4,False)
EndTable

BeginProg

  Scan (1,Sec,0,0)

    VoltDiff (SR20T2_mV,1,mV200,1,True ,0,_60Hz,1.0,0)
    SR20T2_IRR = SR20T2_mV * (1000/SR20T2_SENS_So)

    BrHalf4W (Rs,1,mV5000,mV5000,2,Vx1,1,2500,True ,True ,0,60,Rf,0)

    SR20T2_BodyTemp=(A+(B*(LN(Rs))+C*(LN(Rs))^3))^-1 - 273.15
    SR20T2_SENS_TC = SR20T2_SENS_So * (SR20_A*SR20T2_BodyTemp^2 + _
    SR20_B*SR20T2_BodyTemp + SR20_C)
    SR20T2_IRR_TC = SR20T2_mV * (1000/SR20T2_SENS_TC)

    'SW12V heater control function
    If TimeIsBetween (0,7,24, hr) Then
      SW12 (SW12_1,1,0)
    Else
```

CRBasic Example 2: CR1000X 4-wire configuration for measuring the SR20-T2

```
      SW12 (SW12_1,0,0)
    EndIf

    CallTable (OneMin)
    CallTable (SR20_T2_MetaData)

  NextScan
EndProg
```

Limited warranty

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Refer to www.campbellsci.com/terms#warranty for more information.

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RMA#_____
815 West 1800 North
Logan, Utah 84321-1784

For all returns, the customer must fill out a "Statement of Product Cleanliness and Decontamination" form and comply with the requirements specified in it. The form is available from our website at www.campbellsci.com/repair. A completed form must be either emailed to repair@campbellsci.com or faxed to (435) 227-9106. Campbell Scientific is unable to process any returns until we receive this form. If the form is not received within three days of product receipt or is incomplete, the product will be returned to the customer at the customer's expense. Campbell Scientific reserves the right to refuse service on products that were exposed to contaminants that may cause health or safety concerns for our employees.

Safety

DANGER — MANY HAZARDS ARE ASSOCIATED WITH INSTALLING, USING, MAINTAINING, AND WORKING ON OR AROUND **TRIPODS, TOWERS, AND ANY ATTACHMENTS TO TRIPODS AND TOWERS SUCH AS SENSORS, CROSSARMS, ENCLOSURES, ANTENNAS, ETC.** FAILURE TO PROPERLY AND COMPLETELY ASSEMBLE, INSTALL, OPERATE, USE, AND MAINTAIN TRIPODS, TOWERS, AND ATTACHMENTS, AND FAILURE TO HEED WARNINGS, INCREASES THE RISK OF DEATH, ACCIDENT, SERIOUS INJURY, PROPERTY DAMAGE, AND PRODUCT FAILURE. TAKE ALL REASONABLE PRECAUTIONS TO AVOID THESE HAZARDS. CHECK WITH YOUR ORGANIZATION'S SAFETY COORDINATOR (OR POLICY) FOR PROCEDURES AND REQUIRED PROTECTIVE EQUIPMENT PRIOR TO PERFORMING ANY WORK.

Use tripods, towers, and attachments to tripods and towers only for purposes for which they are designed. Do not exceed design limits. Be familiar and comply with all instructions provided in product manuals. Manuals are available at www.campbellsci.com. You are responsible for conformance with governing codes and regulations, including safety regulations, and the integrity and location of structures or land to which towers, tripods, and any attachments are attached. Installation sites should be evaluated and approved by a qualified engineer. If questions or concerns arise regarding installation, use, or maintenance of tripods, towers, attachments, or electrical connections, consult with a licensed and qualified engineer or electrician.

General

- Protect from over-voltage.
- Protect electrical equipment from water.
- Protect from electrostatic discharge (ESD).
- Protect from lightning.
- Prior to performing site or installation work, obtain required approvals and permits. Comply with all governing structure-height regulations, 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, 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.

Internal Battery

- Be aware of fire, explosion, and severe-burn hazards.
- Misuse or improper installation of the internal lithium battery can cause severe injury.
- Do not recharge, disassemble, heat above 100 °C (212 °F), solder directly to the cell, incinerate, or expose contents to water. Dispose of spent batteries properly.

WHILE EVERY ATTEMPT IS MADE TO EMBODY THE HIGHEST DEGREE OF SAFETY IN ALL CAMPBELL SCIENTIFIC PRODUCTS, THE CUSTOMER ASSUMES ALL RISK FROM ANY INJURY RESULTING FROM IMPROPER INSTALLATION, USE, OR MAINTENANCE OF TRIPODS, TOWERS, OR ATTACHMENTS TO TRIPODS AND TOWERS SUCH AS SENSORS, CROSSARMS, ENCLOSURES, ANTENNAS, ETC.

CAMPBELL SCIENTIFIC
WHEN MEASUREMENTS MATTER

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
Website: www.campbellsci.com.au

Brazil

Location: São Paulo, SP Brazil
Phone: 11.3732.3399
Email: vendas@campbellsci.com.br
Website: www.campbellsci.com.br

Canada

Location: Edmonton, AB Canada
Phone: 780.454.2505
Email: dataloggers@campbellsci.ca
Website: www.campbellsci.ca

China

Location: Beijing, P. R. China
Phone: 86.10.6561.0080
Email: info@campbellsci.com.cn
Website: www.campbellsci.com.cn

Costa Rica

Location: San Pedro, Costa Rica
Phone: 506.2280.1564
Email: info@campbellsci.cc
Website: www.campbellsci.cc

France

Location: Vincennes, France
Phone: 0033.0.1.56.45.15.20
Email: info@campbellsci.fr
Website: www.campbellsci.fr

Germany

Location: Bremen, Germany
Phone: 49.0.421.460974.0
Email: info@campbellsci.de
Website: www.campbellsci.de

India

Location: New Delhi, DL India
Phone: 91.11.46500481.482
Email: info@campbellsci.in
Website: www.campbellsci.in

South Africa

Location: Stellenbosch, South Africa
Phone: 27.21.8809960
Email: sales@campbellsci.co.za
Website: www.campbellsci.co.za

Spain

Location: Barcelona, Spain
Phone: 34.93.2323938
Email: info@campbellsci.es
Website: www.campbellsci.es

Thailand

Location: Bangkok, Thailand
Phone: 66.2.719.3399
Email: info@campbellsci.asia
Website: www.campbellsci.asia

UK

Location: Shepshed, Loughborough, UK
Phone: 44.0.1509.601141
Email: sales@campbellsci.co.uk
Website: www.campbellsci.co.uk

USA

Location: Logan, UT USA
Phone: 435.227.9120
Email: info@campbellsci.com
Website: www.campbellsci.com